SUPPLEMENTAL WATERSHED PLAN NO. VIII & ENVIRONMENTAL ASSESSMENT

FOR THE REHABILITATION OF FLOODWATER RETARDING STRUCTURE NO. 29 OF THE UPPER BRUSHY CREEK WATERSHED

Prepared by:

U.S. Department of Agriculture

Natural Resources Conservation Service

In Cooperation With:

Lower Brushy Creek Water Control and Improvement District

January, 2025

Draft
Supplemental Watershed Plan No. VIII and Environmental Assessment
for the
Rehabilitation of Floodwater Retarding Structure No. 29
of the
Upper Brushy Creek Watershed
Williamson County, Texas

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

In Cooperation With:
Lower Brushy Creek Water Control and Improvement District

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. 29 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 two residential structures, one private road, three county roads, one commercial railroad, and State Highway 95 downstream of Upper Brushy Creek Floodwater Retarding Structure (FRS) No. 29 cause the dam to be classified as a high-hazard structure. In its current state, Upper Brushy Creek FRS No. 29 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 purpose of the proposed rehabilitation of Upper Brushy Creek FRS No. 29 is to address flooding problems and to comply with current performance and safety standards. Rehabilitation of the dam will require installing a 54-inch-diameter principal spillway pipe with an intake riser and an impact basin at the outlet. The embankment will be extended to block the earthen auxiliary spillway, while raising the top of dam an average of 2 feet. An additional 3-cycle labyrinth spillway with a width of 90 feet at elevation of 572.8 feet will be added. Project installation cost is estimated to be $11,342,600 of which $7,975,500 will be paid from the Small Watershed Rehabilitation funds and $3,367,100 from local funds.

Comments and Inquiries

The U.S. Department of Agriculture (USDA) and the Natural Resources Conservation Service (NRCS) has completed this Draft 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 Draft 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.

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Upper Brushy Creek
Supplemental Watershed Plan Agreement No. VIII

between the

Lower Brushy Creek Water Control and Improvement District (WCID)
(Referred to herein as Sponsors)

and the

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

Whereas, the original Watershed Plan Agreement for the Upper Brushy Creek Watershed, State of Texas, executed by the Sponsors named therein and NRCS, became effective on the 21th day of June 1956; and

Whereas, a Supplemental Watershed Plan Agreement No. I for the Upper Brushy Creek Watershed, State of Texas, executed by the Sponsors named therein and NRCS, became effective on the 13th day of September 1957; and

Whereas, a Supplemental Watershed Plan Agreement No. II for the Upper Brushy Creek Watershed, State of Texas, executed by the Sponsors named therein and NRCS, became effective on the 23rd day of May 1961; and

Whereas, a Supplemental Watershed Plan Agreement No. III for the Upper Brushy 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 Upper Brushy Creek Watershed, State of Texas, executed by the Sponsors named therein and NRCS, became effective on the 5th day of September 1979; and

Whereas, a Supplemental Watershed Plan Agreement No. V for the Upper Brushy Creek Watershed, State of Texas, executed by the Sponsors named therein and NRCS, became effective on the 29th day of July 2004; and

Whereas, a Supplemental Watershed Plan Agreement No. VI for the Upper Brushy Creek Watershed, State of Texas, executed by the Sponsors named therein and NRCS, became effective on the 29th day of July 2015; and

Whereas, in order to carry out the watershed work plan for said watershed, it has become necessary to modify said Watershed Work Plan Agreement; and
Whereas, in order to extend the watershed plan for said Floodwater Retarding Structure (FRS) No. 29 beyond its current evaluated life, it has become necessary to modify said watershed agreement; and

Whereas, application has heretofore been made to the Secretary of Agriculture by the Sponsors for assistance in preparing a plan for works of improvement for the Upper Brushy 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, has been assigned by the Secretary of Agriculture to NRCS; and

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

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

3. **Real property.** The sponsors will acquire such real property as will be needed in connection with the works of improvement. The amounts and percentages of the real property acquisition costs to be borne by the Sponsors and NRCS are as shown in the Cost-share table in item 5 hereof. For areas upstream of the dam, the STC shall inform the SLO that water may reach an elevation equal to or greater than the top of the dam. The SLO should be encouraged to acquire land rights upstream of the dam for the entire area below the elevation of the maximum water surface during passage of the probable maximum flood (PMF) event. As a minimum, land rights must be acquired to an elevation no lower than the maximum water surface elevation during passage of the 100-year, 24-hour storm through the dam or the minimum elevation determined to be appropriate and approved in the watershed plan, whichever is higher." Circular 390-21-1, Attachment B, 504.3C.(1)(ii). The sponsors will only obtain land rights up to the 100-year elevation. The sponsor and landowners acknowledge and accept the potential risks and liability associated with not acquiring land rights and with allowing future construction to occur at elevations lower than the proposed top of dam elevation for the proposed alternative.

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

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

5. **Cost-share for Watershed Work Plan.** The following table shows cost-share percentages and amounts for Watershed Work Plan implementation.

Works of Improvement	NRCS	Sponsor	Total
Cost Sharable Items			
Rehabilitation of Dam (Construction Costs)	$6,002,400	$2,965,700	$8,968,100
Relocation, Replacement in-kind	$0	$0	$0
Relocation, Required Decent, Safe, Sanitary	$0	$0	$0
Sponsors Planning Costs	NA	$0	$0
Sponsors Engineering Costs	NA	$0	$0
Sponsors Project Administration	NA	$0	$0
Land Right Acquisition Cost	NA	$266,400	$266,400
Subtotal: Cost-Share Costs	$6,002,400	$ 3,232,100	$9,234,500
Cost Share Percentages a/	65.0%	35.0%	100%
Non Cost-Sharable Items			
NRCS Engineering & Project Administration	$1,973,100	NA	$1,973,100
Natural Resources Rights	NA	$0	$0
Federal, State and Local Permits	NA	$135,000	$135,000
Relocation, Beyond required decent, safe, sanitary	NA	$0	$0
Subtotal: Non Cost-Share Costs	$1,973,100	$135,000	$2,108,100

a/ Maximum NRCS cost-share is 65% of Cost-Sharable items not to exceed 100% of construction cost (including replacement-in-kin; Required Decent, Safe, Sanitary; and flood proofing of downstream properties).
b/ If actual non-cost-sharable item expenditures vary from these figures, the responsible party will bear the change.

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

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

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

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

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

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

A. The project sponsoring organizations signatory to this agreement certify as follows:
(1) Any facility to be utilized in the performance of this proposed agreement is (____), is not (X) listed on the Environmental Protection Agency List of Violating Facilities.

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

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

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

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

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

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

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

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

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

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

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

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

(5) The term "facility" means any building, plant, installation, structure, mine, vessel, or other floating craft, location or site of operations, owned, leased, or supervised by a sponsor, to be utilized in the performance of an agreement or subagreement. Where a location or site of operations contains or includes more than one building, plant, installation, or structure, the entire location will be deemed

to be a facility except where the Director, Office of Federal Activities, Environmental Protection Agency, determines that independent facilities are collocated in one geographical area.

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

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

    Nonprofit Organizations, Hospitals, Institutions of Higher Learning: OMB Circular Nos. A-110, A-122, A-129, and A-133; and 7 CFR Parts 3015, 3017, 3018, 3019, 3021 and 3052.
22. **Examination of Records.** The sponsors must give the NRCS or the Comptroller General, through any authorized representative, access to and the right to examine all records, books, papers, or documents related to this agreement, and retain all records related to this agreement for a period of three years after completion of the terms of this agreement in accordance with the applicable OMB Circular.

23. **Signatures.**

Lower Brushy Creek Water Control and Improvement District

The signing of this plan was authorized by a resolution of the government body of the Lower Brushy Creek Water Control and Improvement District governing body and adopted at an official meeting held on

_____, 2024 at Taylor, Texas.

By:

_____ Date: _____

Edmond S Komandosky
President

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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LIST OF TABLES

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
Plan-EA	Plan Environmental Assessment
PMP	Probable Maximum Precipitation
PMF	Probable Maximum Flood
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	Tribal 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

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

Supplemental Watershed Plan No. VIII - Environmental Assessment for the Rehabilitation of Floodwater Retarding Structure No. 29 of the Upper Brushy Creek Watershed Williamson County, Texas Texas 31st 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. 29 is authorized under Public Law 83-566 (as amended), and as further amended by Section 313 of Public Law 106-472.

Sponsors:

- Lower Brushy Creek Water Control and Improvement District

Proposed Action (Preferred Alternative)

- Upgrade Upper Brushy Creek FRS No. 29 to meet current safety and performance standards for a high-hazard potential dam.

Purpose and Need for Action

- The National Environmental Policy Act (NEPA) purpose and need tis to remedy structural deficiency of FRS No. 29. The Proposed Action (Preferred Alternative) is needed to address dam safety hazard classification concerns by implementing rehabilitation repairs or decommissioning.

- FRS No. 29 was originally designed as a low hazard potential dam for the purpose of flood prevention and is currently performing as intended. However, due to downstream development since the dam construction, it has been reclassified as a high hazard potential dam and currently does not meet dam safety criteria as required by the NRCS or Texas Commission on Environmental Quality (TCEQ) to prevent embankment overtopping during a Probable Maximum Precipitation (PMP) event as required for a high hazard potential dam. The water in the reservoir would flow over the top of the embankment during the resulting Probable Maximum Flood (PMF) and could cause it to erode and collapse. FRS No. 29 is categorized as having high potential to fail due to deficient hydrologic capacity.

- There is a potential for loss of life from a catastrophic dam failure of the FRS due to potential significant flooding impacts to habitable structures and infrastructure located downstream of the FRS.

Description of the Proposed Action (Preferred Alternative)

The Proposed Action (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 installing a 54-inch-diameter principal spillway pipe with an intake riser and an impact basin at the outlet. The embankment will be extended to block the earthen auxiliary spillway, while raising the top of dam elevation an average of 2 feet. An additional 3-cycle labyrinth spillway with a width of 90 feet at elevation 572.8 feet will be added.

Resource Information

- Williamson County has a subtropical climate, with mild winters and warm and muggy summers. Average annual rainfall is approximately 37 inches. Normal temperatures range from an average daily high of 95°F in July to an average daily low of 39°F in January (NOAA, 2023).
- The Eight Digit Hydrologic Unit Number (HUC) for the San Gabriel Subbasin which contains the drainage area of Upper Brushy Creek FRS No. 29 is 12070205.
- Upper Brushy Creek No. 29 is located at Latitude 30.5250° and Longitude -97.4294° (decimal degree).
- The project area for Upper Brushy Creek No. 29, comprised of the contributing watershed and inundation extents, totals 2,022 acres.
- Land uses within the project area for Upper Brushy Creek No. 29 are: 74 acres grassland, 3 acres forest, 138 acres pasture, 556 acres developed, 662 acres cropland, 28 acres shrubland, 2 acres of wetlands.
- Land ownership within the project area for Upper Brushy Creek No. 29 is 100% Private.
- The population of the project area for Upper Brushy Creek No. 29 is approximately 56. Demographic population estimates of the area reflect a minority (all races except non-Hispanic white) population of approximately 34 percent. The per capita income for the area is approximately $36,346.
- Relevant Resource Concerns identified during the scoping process.

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

Alternative Plans Considered for Upper Brushy Creek 29: the following four alternatives were considered and evaluated in detail. The opinion of probable construction cost for all alternatives are presented in appendix E.

- **Alternative #1 – No Federal Action/Future Without Federal Investment:** The local sponsor, public, and project stakeholders are opposed to a dam decommissioning and do not have funds to rehabilitate the dam without Federal investment. 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 no change to the current high risk to life and property. The annual probability of the dam overtopping, assuming average hydrologic conditions, is approximately 0.106%. This probability was estimated using the methodology described in 390-303-NI released in December 2022.

- **Alternative #2 – Decommission FRS No. 29:** Alternative #2 utilizes Federal 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 363 acres to 409 acres. Regulatory base flood elevations (BFEs) do not exist for the downstream area. Downstream easements and property within the expanded 100-year floodplain would be acquired from 44 residences to maintain flood protection measures.

- **Alternative #3 – Rehabilitate FRS No. 29:** Alternative #3 consists of decommissioning the existing earthen auxiliary spillway, building a two-stage structural spillway with a total width of 180 feet, a high-stage crest at an elevation of 573.3 feet, a low-stage crest elevation of 571.8 feet, and raising the top of the dam by 0.5 feet to an elevation of 576.4 feet. The labyrinth spillway consists of a 6-cycle, 180 feet wide with a center line length of approximately 900 feet. The low stage consists of a 80 feet long notch to handle the more frequent storm events. The existing principal spillway will be replaced with a new 30-inch diameter pipe with intake riser and impact basin. The 100-year inundation area downstream would be increased from 363 acres to 364 acres. Regulatory BFEs do not exist for the downstream area. All disturbed areas will be re-vegetated using adapted and/or native species.

- **Alternative #4 – Rehabilitate FRS No. 29:** Alternative #4 consists of replacing the existing principal spillway with a standard intake riser with a 54-inch diameter pipe and an impact basin at the outlet end. Additionally, a new labyrinth spillway will be constructed with a crest elevation at 572.8 feet and will have a width of 90 feet and will consist of a 3-cycle and a center line length of approximately 435 feet to safely route the design storm event. The top of dam will be raised by 2.0 feet to an elevation of 577.9 feet. The 100-year inundation area downstream would be increased from 363 acres to 366 acres. Regulatory BFEs do not exist for the downstream area. All disturbed areas will be re-vegetated using adapted and/or native species. This is the Proposed Action (Preferred Alternative).

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 Upper Brushy Creek 29.

Table S-1: Project Costs Upper Brushy Creek FRS No. 29, Alt. 4

Installation Cost	**Estimated Costs**		
	PL 83-566	Sponsors	Total
Construction	$6,002,400	$2,965,700	$8,968,100
Engineering	$896,900	$0	$896,900
Land Acquisition / Easements	$0	$266,400	$266,400
Required Permits	$0	$135,000	$135,000
Project Administration	$1,076,200	$0	$1,076,200
Total Costs	**$7,975,500**	**$3,367,100**	**$11,342,600**
Annual O&M (non-Fed)	$0	$11,900	$11,900

Project Benefits

Project benefits are derived from assuring the continued performance of FRS No. 29 by meeting current safety and performance standards. Benefits are based on continued flood damage reductions to the downstream area. The total average annual benefit for the Proposed Action (Preferred Alternative) is $8,600 including:

- Flood Damage Reduction
    - Structures -$820

  - Cropland and Pastureland -$110
  - Erosion and Sedimentation -$10
  - Roads and Bridges $9,490
- Number of Direct beneficiaries: Onsite – 19 (Population at Risk), Offsite – N/A
- Description of Other beneficial Physical Effects:
  - Reduces the threat to loss of life to approximately 19 people.
  - Reduces the threat of loss of access to residents and emergency services for 2 residential structures, 6 outbuildings, in addition to three County Roads (CR 405, CR 406, and CR 497), and State Highway 95 within the project area.
  - If the dam is removed, at least 1 residence and 2 outbuildings would have increased flooding, and 6 out of 9 downstream crossings would be impacted by the 100-year flood event.
  - 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: 0.02
- Total Benefits: $8,600
- Net Beneficial Effects: -$337,400

Funding Schedule

- Funding Schedule (budget year + 1):
  - Federal Funds (budget year): $896,900
  - Federal Funds (year after budget year): $7,078,600
  - Non-Federal Funds (budget year): $3,367,100
  - Non-Federal Funds (year after budget year): $11,900 annually
- Period of Analysis – 102 years
- Project Life – 100 years

Table S-2: Environmental Effects/Impacts of the Proposed Action (Preferred Alternatives) – Ecosystem Services

Resource	Impact
Air Quality	Temporary increase in particulate matter on site during construction.
Land Use Changes	Land use will not change; however, local sponsors are required to prevent future development below the new crest elevation of the structural spillway.
Floodplains	Current regulatory floodplain will be increased downstream of the dam by 3 acres (0.83%).
Forest Resources	None present. There are minimal trees present along the shorelines of the reservoir. The reservoir is surrounded by agricultural/farmland.
Wetlands	There are emergent fringe wetlands present along the shorelines of the reservoir upstream of the dam that may be temporarily impacted during construction. There are no wetlands present immediately downstream of the dam.
Water Quality	Turbidity in the reservoir and sediment loading downstream will increase temporarily during construction. Rehabilitation of the dam spillway

	will require a cofferdam which will temporarily 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 continue.
Wildlife Habitat	Wildlife habitat would be temporarily impacted during construction. The majority of the area immediately upstream and downstream of the dam is used as pasture for livestock or farmland for crop production. Disturbed areas would be revegetated with native plant species once construction is complete. Revegetation and invasive species management will be consistent with TPWD guidance (Appendix A).
Prime Farmland	There are no Prime Farmlands within the maximum extent of possible ground disturbance. Additionally, there are no Prime Farmlands upstream of the dam that would be impacted by the change in flood pool from the proposed action (Preferred Alternative). There are approximately 24 acres of prime farmland (if irrigated) within the 100-year inundation area downstream of the dam.
Cultural Resources	NRCS consulted with the SHPO and determined that no historic properties are present or will be affected by the project. Consultation was initiated with the six identified federally recognized Tribal Nations with ancestral interests in the project area. SHPO and THPO coordination documentation will be included in Appendix A.
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 (Table L). The Project has a "No Effect" determination for relevant federally listed species with the potential to occur within the project area. Coordination documents from USFWS and TPWD are included in Appendix A.
Mitigation	None.

Major Conclusions

All the alternatives which meet have monetized costs greater than monetized benefits. Alternative 4 would meet the NRCS and State criteria by replacing the existing principal spillway with a standard intake riser and a 54-inch diameter pipe; adding an new labyrinth structural spillway with a crest at an elevation of

572.8 feet and a width of 90 feet, and extending the dam at the right abutment to block the existing auxiliary spillway. Additionally, the top of dam elevation has to be raised on average 2 ft.

The current degree of downstream flood protection will not decrease for events less than or equal to the 100-year storm event. No permanent change to the normal operating level of 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 the Upper Brushy Creek FRS No. 29.

Issues to be Resolved

- A new Operation and Maintenance (O&M) Agreement will be developed with Lower Brushy Creek WCID for FRS No. 29 for the 100-year program life of the structure. 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 reviewing and updating 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__

1. CHANGES REQUIRING PREPARATION OF A SUPPLEMENT

This supplement addresses the rehabilitation of Upper Brushy Creek Watershed FRS No. 29. The dam was originally designed as a Class A, or low hazard potential, structures to provide flood control and is currently classified as a high hazard potential dam 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 performance and safety standards.

When the Upper Brushy Creek Watershed was planned in 1956, 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 Upper Brushy Creek Watershed was primarily agricultural when the original planning was completed. In the last 20 years, the population growth of Williamson County, which contains Upper Brushy Creek FRS No. 29, has grown from 249,967 in 2000 to an estimated 609,017 in 2020 (Bureau of Census), an increase of 244 percent. Section 5.7 contains additional demographic information for the project area. Since the construction of the original dam, 8 new structures have been constructed downstream of the dam, 2 of which are residential, 6 of which are outbuildings Additionally 6 roads could also be impacted, which are 4 County Roads, 1 State Highway, and 1 private road.

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 Upper Brushy 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 Upper Brushy Creek Watershed FRS No. 29 rehabilitation project to determine the requisite level of NEPA documentation to support the Proposed Action. Based upon the results of this analysis, an EA was required.

2. PURPOSE AND NEED FOR ACTION

This supplemental Watershed Plan was prepared, and an Environmental Assessment was performed, to evaluate alternatives to bring Upper Brushy Creek FRS No. 29 into compliance with current performance and safety standards and to maintain its original purpose (flood prevention). Upper Brushy Creek FRS No. 29 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. 29 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 Upper Brushy Creek FRS No. 29 per the 390-NWPM, part 500, Subpart A, Section 500.4B are Flood Prevention (Flood Damage Reduction).

Upper Creek Watershed FRS No. 29 was originally designed as a Class A, or low hazard potential structure, to provide flood control. However, the structure has been reclassified as a high hazard potential dam. The dam does not meet the TCEQ criteria for a high hazard potential 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 dam design and safety standards and reduce risk to life and property that could result from a potential dam failure, in addition to maintaining the original purpose of the dam (flood prevention). The dam is located upstream of CR 405, CR 406, CR 497, Highway 95, a railroad and one private road all of which would be impacted in the event of a breach of FRS No. 29. There are also 2 residences and 6 outbuildings that would be impacted in the event of a breach. 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. FRS No. 29 captures the runoff from 1,530 acres, or 0.80% of the total watershed (191,360 acres). The 2015 Dam Assessment Report performed by Freese and Nichols Inc. (FNI) indicates that portions of CR 405, CR 497, CR 406, Highway 95, and one residential structure are at risk from a catastrophic breach. Based on the findings of this assessment, NRCS and TCEQ update the hazard classification from low to high hazard. 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 2 residential structures, 6 outbuildings, CR 405, CR 497, CR 406, Highway 95, and one railroad crossing.

Currently, Upper Brushy Creek FRS No. 29 is functioning as originally planned and providing downstream flood damage prevention (original purpose of the dam). 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 downstream of the dam.
- 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.

2.1 Watershed Problems

The Sponsors were aware of the problems with Upper Brushy Creek FRS No. 29 no later than 2015 when FNI produced their Dam Assessment Report, confirming the inadequacies of the dam. NRCS criteria states that the dam, in its current condition, must be capable of passing the principal spillway hydrograph (PSH) without engaging the auxiliary spillway. The 2015 assessment report evaluated that the principal spillway of the dam does not have sufficient capacity to convey the PSH 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 increased.

Sponsor Concerns: The 2015 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 1.6 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 understand that the dam in its current configuration provides flood protection benefits to the downstream area for frequent storm events, and that it also poses a hazard in failing to meet current dam safety criteria. Frequency storm analysis indicates that the dam has an approximately 0.106% annual probability of overtopping. This probability was estimated using the methodology described in 390-303-NI released in December 2022.

Erosion and Sedimentation: Upon the completion of the most recent bathymetric surveys in 2023, Upper Brushy Creek FRS No. 29 has reached 51 years of its planned 100-year design life. According to the as-built plans, the dam was originally constructed with 200 acre-feet of submerged sediment storage, and 40 acre-feet of aerated sediment storage. The latest bathymetric surveys performed in 2023 indicate that the reservoir has 184.7 acre-feet of remaining submerged sediment storage, with an estimated 15.3 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 submerged sedimentation rate from observed data of 0.755 acre-feet per year, there is over 100 years of remaining life before the submerged sediment storage is filled. Assuming that the aerated sedimentation rate is equal to 20% of the submerged sedimentation rate, then there is 7.7 acre-feet of aerated sediment present above the reservoir pool and there is still 32.3 acre-feet of aerated sediment storage remaining, which means there is over 100 years of remaining life before the aerated sediment storage is considered to be filled.

Local Concerns: The Upper Brushy Creek Watershed dams were planned and constructed in the 1950s and 1970s to enhance agricultural land use by mitigating flood damages as well as reducing sediment damages. The possibility of decommissioning Upper Brushy Creek FRS No. 29 was mentioned at the first public meeting in March 2023 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 several structures are present downstream. The 100-year inundation area, shown as Zone A on Federal Emergency Management Agency (FEMA) flood maps, would be increased from 363 to 409 acres. If the dam were to be removed, 1 residence and 2 barns/outbuildings would have increased flooding in the 100-year flood event, and 6 out of 9 crossings included in the project area will experience increased damage in the 100-year flood event. Furthermore, the Soil and Water Conservation District mentioned that it would prefer to maintain the existing dam aesthetics while considering the selected alternative. For the past 51 years, the dam has performed as designed and constructed.

2.2 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 proposed top of dam elevation.

3. 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, plants, 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 February 14, 2023. This meeting served as a project kickoff meeting in which the project scope, personnel, and schedule were reviewed and discussed.

On March 29, 2023, the first public meeting was held at the Taylor Public Library in Taylor, Williamson County. The public was informed about the development of a Supplemental Watershed Plan (SWP) for Upper Brushy Creek FRS No. 29. The methodology and scope of the SWP and EA was explained along with the timeline.

In April 2023, and June 16, 2023, 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. On March 12, 2025 a second public meeting was held at the Taylor Public Library in Taylor, Williamson County. The public was informed about the results the Supplemental Watershed Plan (SWP) for Upper Brushy Creek FRS No. 29. The findings of the SWP and EA were explained along with the Proposed Action (Preferred Alternative) and next steps required to finalize the project. 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 Upper Brushy Creek Watershed FRS No. 29

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 bank 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 no Prime Farmlands within the maximum extent of possible ground disturbance or

			upstream of the dam. There are prime farmlands (if irrigated) downstream of the dam.
WATER			
Surface Water Quality	X		Battleground Creek is not included in the 2022 Texas Integrated Report of Surface Water Quality for impaired waterbodies.
Groundwater Quality		X	The project would not affect the Trinity or Edwards-Trinity aquifers.
Floodplain Management	X		The 100-year inundation area would be enlarged from 363 acres to 409 acres if the dam were decommissioned. Present and future downstream development would be affected by increased flood profiles. Floodwater from a 100-year storm event without the dam would overtop multiple roads. If the dam were rehabilitated, future development below the new top of dam crest elevation would be prohibited.
Waters of the U.S./Wetlands (Clean Water Act- 401 and 404)	X		There are wetlands present upstream of the dam that may be temporarily impacted during construction. These wetlands would likely be considered jurisdictional and regulated by the USACE under Section 404 of the Clean Water Act. There are no wetlands present immediately downstream of the dam.
Water Quality (Clean Water Act – 303(d)/305(b))	X		Impacts to downstream water quality within Battleground Creek will be minimized during construction with BMPs.
Coastal Zone Management Act		X	The project area is not located in or near a designated Coastal Zone Management Area.
National Wild and Scenic Rivers Act		X	The project area is not located in or near designated wild or scenic rivers.
AIR			
Air Quality	X		The Project may cause a temporary increase in particulate matter and other emissions.
Clean Air Act (Criteria Pollutants)		X	Although there would be increased air emissions during construction,

			Williamson County is within attainment.
Clean Air Act (Regional Visibility Degradation)		X	Williamson County is not within a designated Class 1 area.
ANIMALS			
Coral Reefs		X	None present in the project area.
Threatened and Endangered Species	X		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 (Table L). The Project has a "No Effect" determination for relevant federally listed species within Williamson County. Coordination documents from USFWS and TPWD are included in Appendix A.
Fish and Wildlife Resources	X		Potential for fish and wildlife habitat improvements.
Essential Fish Habitat		X	There are no designated Essential Fish Habitat 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		Invasive species management would be consistent with TPWD recommendations (Appendix A).
Migratory Birds/Bald Eagles/Golden Eagles	X		Five migratory bird species have the potential to occur within the project area. No Bald or Golden Eagle nests were found during the project site visit. Additionally, no recorded nests are documented within the project area. There is no proposed tree clearing associated with the alternatives.
PLANTS			
Threatened and Endangered Species		X	No threatened or endangered plant species were documented within the project area during the site visit. The Consistency Letters from USFWS are included in Appendix A, and the TPWD response will be included once received.

Invasive Plant Species	X		Invasive plant species were documented within the project area during the site visit. Invasive species management will be consistent with TPWD guidance (Appendix A).
Ecologically Critical Areas		X	There are no ecologically critical areas in the vicinity of the project area.
Forest Resources		X	There are no forest resources present within the project area.
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, the alternatives will be assessed for potential effects.
Historic Properties		X	NRCS consulted with the SHPO and determined that no historic properties are present or will be affected by the project. Consultation was initiated with the six identified federally recognized Tribal Nations with ancestral interests in the project area on January 9, 2024. SHPO and THPO coordination documentation will be included in Appendix A.
Land Use		X	Land use will not change; however, local sponsors are required to prevent future development below the new crest elevation of the structural spillway.
Local and Regional Economy	X		Temporary benefit to local economy during construction.
Natural Areas		X	No impact to natural areas.
National Parks, Monuments, and Historical Sites		X	No impacts to national parks, monuments, or historical sites.
Portable Water Supply/Regional Water Management Plans		X	This site is not used for water supply.
Public Health and Safety	X		Rehabilitation is needed because the dam does not meet current safety standards because downstream development has caused its reclassification to High hazard.

Recreation	X		The reservoir provides incidental recreation to private residents with homes around the lake and to their guests.
Scenic Beauty and Parklands		X	No designated scenic beauty or parklands within the project area.
Scientific Resources		X	An assessment of potential adverse effects on areas listed in or eligible for listing in the National Register of Historic Places, or that may result in loss of destruction of significant scientific, cultural, or historical resources was completed this for project. No scientific resources were identified by either the SHPO or THPO.
Social/Cultural Issues	X		Concerns about flooding if the dam were decommissioned.

4. AFFECTED ENVIRONMENT

4.1 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-efficiency 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 #4 in a manner that allows the alternatives' effects to be better understood. The following summarizes the existing environmental conditions.

4.2 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. 29 is authorized under Public Law 83-566 (as amended), and as further amended by Section 313 of Public Law 106-472.

Description of Existing Dam

Upper Brushy Creek FRS No. 29 was originally designed and constructed in 1972 as a low-hazard (class A) potential dam. A low-hazard potential classification is given to dams which do not pose a threat to loss of life. Upper Brushy Creek FRS No. 29 was constructed as a zoned earth fill embankment with one vegetated auxiliary spillway located at the right abutment and a principal spillway consisting of an inlet tower with a 24-inch concrete outlet pipe that discharges into an unlined plunge basin. A site visit was performed in February 2023. The embankment was found to be in good condition with good vegetative cover.

The effective top of dam elevation is 575.9 feet per the as-built plans. The upstream slope of the embankment was constructed to a 2.5 horizontal:1 vertical slope (2.5H:1V), and the downstream slope was constructed to a 2.5H:1V slope. There is a 40-foot-wide berm on the upstream slope and a 14-foot-wide berm on the downstream slope located at elevation 549.0 feet. The auxiliary spillway has a 150-foot-wide bottom width, and the crest elevation is 571.6 feet. The principal spillway inlet structure is a 2-foot by 4-foot (interior dimensions) by 15-foot-tall tower with a crest elevation of 560.7 feet with a notch at an elevation of 560.2 feet. Metal grating covers the top of the inlet tower. There is a 12-inch sluice gate located at the bottom of the tower with an invert elevation of 546.2 feet to facilitate lowering the permanent water level for repairs and maintenance. The principal spillway outlet pipe consists of 230 feet of 24-inch diameter prestressed, concrete lined, steel cylinder pipe connected to the downstream side of the inlet tower.

A bathymetric survey was performed in February 2023. The final results of the survey indicate a volume at normal pool (560.2 feet) of 184.7 acre-feet, approximately an 8% decrease compared to the as-built plans which indicate a normal pool volume of 200 acre-feet.

Table B: Upper Brushy Creek 29 Existing Structural Data

Item	Unit	FRS No. 29
Surface Area (Principal Spillway Crest)	Acres	34.6
Elevation, Top of Dam (effective)	Feet	575.9
Length of Dam	Feet	2,340
Principal Spillway	Type	Drop Inlet
Elevation, Principal Spillway Crest	Feet	560.2
Pipe Diameter, Principal Spillway	inches	24
Principal Spillway Discharge at AS Crest	cfs	58.4
Auxiliary Spillway	Type	Earth Channel
Elevation, Auxiliary Spillway	Feet	572.1
Bottom Width, Auxiliary Spillway	Feet	150
Surface Area (Auxiliary Spillway Crest)	Acres	112.4
Sediment Reserve Below Riser	Acre-feet	184.7
Flood Storage	Acre-feet	835.6
Total Storage at Auxiliary Spillway Crest	Acre-feet	1,020

4.3 Physical Features and Location

Project Location

The Upper Brushy Creek Floodwater Retarding Structure (FRS) No. 29 watershed covers 1,530 acres (2.39 square miles) in Williamson County, Texas. The site is located approximately 3.8 miles south of Taylor, Texas and is situated about 1.3 miles east of County Road 973 on Battleground Creek, a tributary to Brushy Creek. The approximate latitude and longitude coordinates of Upper Brushy Creek FRS No. 29 are 30.5249°N and 97.4297°W. The watershed is located within the San Gabriel Subbasin as delineated by the United States Geological Survey (USGS), Hydrologic Unit Number (HUC) 12070205 (USGS, 2023b).

Topography

The project area lies within the southern extent of the Northern Blackland Prairie ecoregion of Texas. The topography within and surrounding the watershed is comprised of gently rolling hills dominated by ranches, lakes, riparian areas, and pastures. The watershed elevation ranges between 550 and 620 feet above the mean sea level.

Soils

The primary soil units underlying the Upper Brushy Creek FRS Site No. 29 watershed were identified using the NRCS web soil survey (NRCS, 2023b). The major soil groups in the watershed include Burleson clay, 0 to 1 percent slopes, 594 acres (38.7%) with more than 80 inches to restrictive layer and water table; Branyon clay, 1 to 3 percent slopes, 327 acres (21.3%) with more than 80 inches to restrictive later and water table; Ferris-Heiden complex, 5 to 15 percent slopes, moderately eroded, 218 acres (14.2%) with 39 to 59 inches to densic bedrock and more than 80 inches to water table; Queeny-Sunev complex, 5 to 15 percent slopes, 148 acres (9.7%) with 4 to 20 inches to petrocalcic and more than 80 inches to water table; and Lewisville Altoga complex, 2 to 5 percent slopes, 140 acres (9.1%) with more than 80 inches to restrictive layer and water table. Other smaller soil map units make up the remainder of the acreage in the watershed. Additionally, there are 959 acres of Prime Farmland within the watershed protected under the

Farmland Protection Policy Act (FPPA). 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 watershed is located within the Northern Blackland Prairie ecoregion which spans roughly 300 miles from the Red River in North Texas to San Antonio in the south. The watershed lies within the southern portion of the ecoregion where the Ozan Formation makes up the majority of the bedrock. High gravel deposits and alluvium features can be found within the watershed (USGS, 2023a).

Climate

The climate of the Northern Blackland Prairie ecoregion ranges from subhumid subtropical in the south to subhumid warm temperate. Seasonally, the winters are described as mild and summers as hot. For Williamson County, January and July are generally the coolest and warmest months with average temperatures of 39°F and 95°F, respectively. Annual rainfall is 30 to 40 inches (NOAA, 2023).

4.4 Water

Water from the Upper Brushy Creek FRS No. 29 reservoir flows downstream into Battleground Creek, which converges with Brushy Creek approximately 2 miles east of the Upper Brushy Site 31. Battleground Creek and Brushy Creek are part of the San Gabriel Subbasin within the Lower Brazos Watershed.

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). 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 CWA. These assessments are published in an integrated report which is titled the "2022 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, 2022).

The 2022 Texas Integrated Report of Surface Water Quality for the Clean Water Act Sections 305(b) and 303(d) was released in July 2022 and summarizes the water quality conditions in Texas over a two-year period, January 1, 2021, through December 31, 2022. Battleground Creek was not a waterbody included in the report. Battleground Creek is a tributary to Brushy Creek which has been listed as impaired since 2006 at two localities (stream segment 1244_01 and 1244_03). Bacteria in water (recreational use) is the impairment described. These two segments are downstream of the project area.

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 Upper Brushy Creek FRS No. 29 watershed contains a variety of aquatic resources, including lakes, ponds, wetlands, intermittent and perennial streams, as well as riparian areas. It is NRCS policy to protect and promote wetland functions and values. Wetlands are defined by NRCS as areas, natural or artificial, that have hydric soil, hydrophytic vegetation, and indicators of wetland hydrology (NRCS, 2023a). 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. 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.

WOTUS, including wetlands, within the watershed were first identified by reviewing the U.S. Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) mapper. There are a total of 45 acres of WOTUS within the watershed that includes 3 acres of freshwater emergent wetlands, 8 acres of riverine habitat, 4 acres of freshwater ponds, and 30 acres of lake. Additionally, the watershed includes approximately 5.07 miles (26,769 linear feet) of streams and tributaries (Appendix C).

Following the desktop review, WOTUS, including wetlands, immediately adjacent to, upstream, and downstream of the dam were delineated during a field survey performed on March 1, 2023. The ordinary high-water mark of the reservoir and Battleground Creek immediately upstream and downstream of the dam were delineated using sub-meter accuracy GPS units. Additionally, freshwater emergent wetlands located along the fringe of the reservoir shorelines were delineated based on wetland hydrologic indicators, hydric soil indicators, and wetland plant communities. Wetlands were observed along the two upstream stream reaches of the reservoir. Dominant plant species observed in the wetlands included Common spikerush (*Eleocharis palustris)*, Floating primrose (*Ludwigia peploides),* and Coontail *(Cerstophyllum demersum)*. 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. Williamson 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 floodplain of Battleground Creek, a tributary of the Brushy Creek, is managed by Williamson County, and Williamson 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 flood is also referred to as the base flood or 100-year flood. FEMA FIRM Panels 48491C0545F (effective on 12/20/2019) indicates the project is located within Zone A and indicates that no BFEs or flood depths

are available for the area because hydraulic analyses have not been performed (FEMA, 2001; FEMA, 2023). Potential permitting requirements for floodplain management that may be required based upon the alternative carried forward for impacts analysis are outlined in the Environmental Consequences section.

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, 2023). 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.

4.5 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 (PM10 and PM2.5), and ozone (O3). The EPA categorizes individual regions or counties into two levels of compliance with the NAAQS for criteria pollutants: attainment and nonattainment. Attainment areas are those that meet the NAAQS; nonattainment areas are those that exceed the NAAQS and must develop and implement a plan to meet the NAAQS.

General Conformity Rule (Criteria Pollutants)

Established under the CAA, the General Conformity Rule (40 CFR Part 51, subpart 54) ensures 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 projects located in nonattainment areas. A General Conformity Determination would not be required because Williamson County is within attainment.

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. Williamson County is not within a designated Class 1 area and would not be bound to the Regional Haze rule.

4.6 Vegetation and Wildlife

Vegetation Communities and Habitat

The Upper Brushy Creek FRS No. 29 watershed lies within the Northern Blackland Prairie Ecoregion, named for deep, fertile black soils that characterize the area. The soils of this ecoregion are uniformly dark-colored alkaline clays interspersed with gray acidic sandy loams. Elevation ranges from 300 to 800 feet above sea level across the Blackland Prairie. Historically the region was characterized as a dominant tallgrass prairie. This ecoregion is known for its fertile dark clay soils, some of the richest soils in the world and subsequently the region is almost entirely agricultural. Today 99% of the fertile soil is devoted to cropland and other agricultural enterprises (TPWD, 2023). A few of the dominant tree species include Pecan

(*Carya illinoinensis*), Black Walnut (*Juglans nigra*), American Sycamore (*Platanus occidentalis*), Eastern Cottonwood (*Populus deltoides*), and Burr Oak (*Quercus macrocarpa*). Big Bluestem (*Andropogon gerardii*), Side-oats Grama (*Bouteloua curtipendula*), Canada Wild Rye (*Elymus candensis*), Indiangrass (*Sorghastrum nutans*), and Little Bluestem (*Schizachyrium scoparium*) are among the grasses found throughout the region.

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, 2019). The NLCD identified a total of 14 landcover classes across the watershed of the project area.

Land Cover Type	Drainage Area of Brushy Creek FRS No.29 (acres)	Percentage of Total Watershed Area	Breach Inundation Zone (acres)	Percentage of Total
Range	25	2%	40	10%
Forest	72	5%	38	9%
Developed Land	554	36%	10	2%
Water	29	2%	94	23%
Pasture	850	55%	232	56%
Total	1530	100%	414	100%

in the Land Use section lists the vegetation cover types in order of prevalence in the project area. Appendix C depicts the spatial distribution of vegetation communities throughout the watershed.

Riparian Areas

Riparian areas are present along Battleground Creek upstream and downstream of the dam as well as along the shorelines of the reservoir. NRCS policy requires integration of riparian area management into all plans and alternatives (GM 190, Park 411). Although Federal Law does not specially regulate riparian areas, portions of riparian areas, such as wetlands and other WOTUS, may be subject to Federal regulations. The riparian areas around the perimeter of the reservoir are primarily dominated by Giant Ragweed (*Ambrosia trifida*). Tree species including Green Ash (*Fraxinus pennsylvanica*), Chinese Tallow (*Triadica sebifera*), Black Willow (*Salix nigra*), Sugar Hackberry (*Celtis laevigata*), and Cedar Elm (*Ulmus crassifolia*) are present, as well as shrub and herbaceous species including Common Reed (*Phragmites australis*) California Bulrush (*Schoenoplectus californicus*), Wild Garlic (*Allium vineale*), Smartweed (*Persicaria spp*.), Giant Ragweed (*Ambrosia trifida*), Cocklebur (*Xanthium stumarium*), Crowpoison (*Nothoscordum bivalve*). Herbaceous wetland fringe along the upstream portions of the reservoir are dominated by Common Spikerush (*Eleocharis palustris*) and Floating Primrose-willow (*Ludwigia peploides*).

Invasive Species

Invasive species are those of both plant and animals that have been introduced, either intentionally or accidentally, into areas outside of their natural environments. Invasive species have the potential to grow and spread rapidly, which may result in economic and environmental damage, or harm to human health (Texas Invasives, 2023). Executive Order 13112 directs Federal agencies to "prevent the introduction of invasive species, provide for their control, and to minimize the economic, ecological and human health impacts that invasive species cause."

Two invasive plant species, King Ranch Bluestem (*Bothriochloa ischaemum)* and Little Bur-clover (*Medicago minima),* and one invasive animal species, Asian clams (*Corbicula fluminea),* were observed at Upper Brushy Creek FRS No. 29. According to Texas Invasives (2023), local level management strategies

for King Ranch Bluestem include timely mowing, prescribed fires, and herbicide application. Installation of screens over the intake pipes to man-made lakes may prevent Asian clam larvae from entering new waterways (Texas Invasives, 2023).

Additionally, TPWD recommends reducing the amount of vegetation proposed for clearing if possible and minimize the clearing of native vegetation, particularly mature native trees, riparian vegetation, and shrubs to the greatest extent practicable; replacement/restoration of the native vegetation along disturbed areas 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 A).

Federally Protected Threatened and Endangered Species

Section 7(a) of the Endangered Species Act (ESA) requires the NRCS, in consultation with the U.S. Fish and Wildlife Service (USFWS) and/or National Oceanographic and Atmospheric Administration (NOAA), National Marine Fisheries Service (NMFS), to advance the purposes of the ESA by implementing programs for the conservation of endangered and threatened species, and to ensure that NRCS actions and activities does not jeopardize the continued existence of threatened and endangered species or results in the destruction or adverse modification of the species' critical habitat.

In accordance with Section 12 of PL 566 (as amended) requires the NRCS to notify (USFWS) to make surveys and investigations and prepare a report, as they deem appropriate, with recommendations concerning the conservation and development of wildlife resources and participate, under arrangements satisfactory to the NRCS, in the preparation of a plan for works of improvement that is acceptable to the local organization and the NRCS.

Table C, which was generated from the USFWS Information for Planning and Consultation (IPaC) website (USFWS, 2024a), provides a list of federally listed species which have been identified as potentially occurring within the project area in Williamson 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, one clam species, one mammal species, three species of insects, and two arachnid species. Information such as life history, habitat requirements, and potential project effects are listed below.

Table C: Federally Protected Species Potentially Occurring within the Project Area in Williamson County, Texas.

Common Name	Scientific Name	Federal Status[1]	Federally Designated Critical Habitat within the project area
Birds			
Golden-cheeked Warbler	*Setophaga chrysoparia*	E	No
Piping Plover	*Charadrius melodus*	T	No
Red Knot	*Calidris canutus rufa*	T	No
Whooping Crane	*Grus americana*	E	No
Mussels			
Balcones Spike	*Fusconaia iheringi*	E	No
Mammals			
Tricolored Bat	*Perimyotis subflavus*	PT	No
Insects			
Coffin Cave Mold Beetle	*Batrisodes texanus*	E	No
Monarch Butterfly	*Danaus plexippus*	C	No

Common Name	Scientific Name	Federal Status[1]	Federally Designated Critical Habitat within the project area
Tooth Cave Ground Beetle	*Rhadine persephone*	E	No
Arachnids			
Bone Cave Harvestman	*Texella reyesi*	E	No
Tooth Cave Spider	*Tayshaneta myopica*	E	No

T = threatened; E = endangered; PT = proposed threatened; C = candidate
[1]according to USFWS, 2023b.

Golden-cheeked Warbler

The Golden-cheeked Warbler (*Setophaga chrysoparia*) is federally listed as endangered and resides in habitats consisting mainly of dense, mature Ashe Juniper (*Juniperus ashei*) mixed with various oak species. This woodland habitat grows on limestone hills, canyons, and adjacent canyons. Habitat suitable for the Golden-cheeked Warbler was not observed within the project area. eBird (2024) data shows the nearest sighting of the species is over 12 miles away from the project area. TPWD (2024a) data show no observations of Golden-cheeked Warbler near the project area. No effect to the species is expected to result from the proposed project.

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 (2024) data shows the nearest sighting is over 10 miles away from the project area. Habitat suitable for the Piping Plover was not observed within the project area. TPWD (2024a) data show no observations of Piping Plover near the project area. No effect to the species is expected to result from the proposed project.

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, 2024c). 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 Williamson County (TPWD, 2024a). eBird (2024) data shows the nearest sighting to be over 25 miles away from the project area. No effect to the species is expected to result from the proposed project.

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, 2007a). 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 located within the designated migration corridor for the Whooping Crane. Their proposed habitat includes coastal marshes, estuaries, inland marshes, lakes, and ponds. For feeding, they forage in brackish bays, marshes, and salt flats. Suitable habitat such as fallow cropland, pastures, and wetlands were

observed within the project area. eBird (2024) data shows 21 observations approximately 3 miles from the project site near Granger Lake. Most of the observations are flyovers as Whopping Cranes migrate to wintering habitat. No effect to the species is expected to result from the proposed project.

Balcones Spike

Balcones Spike (*Fusconaia iheringi)* is a medium sized mussel with yellow-green, brown, or black elongated shell and occasionally some green rays. False Spike are found in larger creeks with sand, cobble or gravel bottoms and slow to moderate flows. False Spikes are not known to tolerate impoundments or deep water. The species is found within the Guadalupe River in Gonzales, DeWitt, and Victoria Counties (USFWS, 2021). The likelihood of the mussel species occurring within the project area is very rare. No effect to the species is expected to result from the proposed project.

Tricolored Bat

The tricolored bat (*Perimyotis subflavus)* is one of the smallest bats native to North America. The once common species is wide ranging across the eastern and central United States and portions of southern Canada, Mexico and Central America. During the winter, tricolored bats are found in caves and mines, although in the southern United States, where caves are sparse, tricolored bats are often found roosting in roadway-associated culverts. During the spring, summer and fall, tricolored bats are found in forested habitats where they roost in trees, primarily among leaves (USFWS, 2024c). On September 13, 2022, the USFWS announced a proposal to list the tricolored bat as endangered under the ESA. The project area is located within the Texas: Year-round Active Range (Zone 2) for tricolored bats. However, the project area is surrounded by maintained pasture/lawn with minimal tree cover (except immediately along the reservoir shorelines). The project would not impact roost trees as part of construction and no effect to the species is expected to result from the proposed project.

Coffin Cave Mold Beetle

The Coffin Cave Mold Beetle (*Batrisodes texanus)* is a karst troglobite (i.e., a species adapted to subterranean habitats and must complete their life-cycle underground) found exclusively in Williamson County. These species are adapted to the humid microhabitats of the dark zone of caves (e.g., under rocks). Morphologically, the coffin cave mold beetle exhibit troglomorphic traits such as absent or reduced eyes, elongated antennas, legs, and sensory setae (USFWS, 2018). Habitat destruction, degradation and fragmentation due to urban development is the most influential stressor to the Coffin Cave Mold Beetle's viability. As of 2018, there are 24 documented caves with records of Coffin Cave mold beetles in Williamson County. In accordance with USFWS (2018) report, confirmed distribution of Coffin Cave mold beetles occur west of interstate 35. However, the project is not located within a known karst zone (USFWS, 2007). No effect to the species is expected to result from the proposed project.

Tooth Cave ground Beetle

The Tooth Cave Ground Beetle (*Rhadine persephone*) is a karst troglobite endemic to central Texas. Little is known about specific habitat requirements for the Tooth Cave Ground Beetle but it is most likely very similar to other endangered karst species of Travis and Williamson counties; karst forming rock, stable temperatures with high humidity, suitable foraging and sheltering substrate, and native plants in and around the karst feature to support a healthy surface community (Berkhouse, 2005). The project is not located within a known karst zone (USFW, 2007b). No effect to the species is expected to result from the proposed project.

Bone Cave Harvestman and Tooth Cave Spider

The Bone Cave Harvestman (*Texella reyesi)* is a karst troglobite endemic to central Texas. These species prefer the cooler, damp spots of caves where they prey on tiny invertebrates. Generally, they can be found under large rocks and on occasion walking on moist floors (Glenn, 2006). The Tooth Cave Spider (*Tayshaneta myopica)* is a karst troglobitic endemic to central Texas. The species are small with long legs

relative to the size of their body. The project is not located within a known karst zone (USFW, 2007b). No effect to the species is expected to result from the proposed project.

Monarch Butterfly

Adult Monarch Butterflies (*Danaus plexippus)* 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 (USFWS, 2024d). 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 was not found within the project area where construction activities will occur. No effect to the species is expected to result from the proposed project.

State Protected Endangered and Threatened Species

TPWD 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 Williamson County identifies the following flora and fauna with the potential to occur within the county.

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

Common Name	Scientific Name	State Protection Status[1]	Habitat within the Project Area
Amphibians			
Barton Spring Salamander	*Eurycea sosorum*	E	No
Jollyville Plateau Salamander	*Eurycea tonkawae*	T	No
Salado Springs Salamander	*Eurycea chisholmensis*	T	No
Georgetown Salamander	*Eurycea naufragia*	T	No
Birds			
White-faced Ibis	*Plegadis chihi*	T	Yes
Wood Stork	*Mycteria americana*	T	Yes
Swallow-tailed Kite	*Elanoides forficatus*	T	No
Black Rail	*Laterallus jamaicenis*	T	No
Whopping Crane	*Grus americana*	E	No
Piping Plover	*Charadrius melodus*	T	No
(Rufa) Red Knot	*Calidris canutus rufa*	T	No
Golden-cheeked Warbler	*Setophaga chrysoparia*	E	No
Reptile			
Texas Horned Lizard	*Phrynosoma cornutum*	T	No
Mollusks			
Brazos Heelsplitter	*Potamilus streckersoni*	T	No
False Spike	*Fusconaia mitchelli*	T	No
Texas Fawnsfoot	*Truncilla macrodon*	T	No

T = Threatened; E = Endangered

[1]According to TPWD, 2024a, 2024b

Of the sixteen state listed species with the potential to be found in Williamson County, White-face Ibis and Wood Stork have the highest chance of occurring within the project area. White-faced Ibis and Wood Storks

are found near perennial waterbodies, swamps, marsh, 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 A.

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),* Chimney Swift (*Chatura pelagica),* Lesser Yellowlegs (*Tringa flavipes),* Little Blue Heron (*Egretta caerulea),* and Red-headed Woodpecker (*Melanerpes erythrocephalus)* as migratory birds with the potential to occur within the project area. Chimney Swift, Lesser Yellowlegs, Little Blue Heron, and Red-headed Woodpeckers are considered Birds of Conservation Concern (BCCs), which are species designated by the USFWS as 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. Little Blue Herons can be found on quiet waters such as tidal flats, estuaries, streams, swamps and flooded fields. Chimney Swift will occasionally roost in the open but prefer an enclosed area such as an air shaft, abandon building or chimney. Red-headed Woodpeckers live in open forests with clear understory near wetlands.

Bald and Golden Eagle Protection Act

In addition to the MBTA, 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 March 2023. There are no listed Bald or Golden Eagle nests within 2 miles of the project area (TPWD, 2023a). Additionally, there were no nests observed during the site visit on March 1, 2023. 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

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 Upper Brushy Creek FRS No. 29 watershed is located inland and does not include saltwater tributaries or marine fisheries. Therefore, there is no potential EFH 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). Williamson 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.

4.7 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) and federally recognized Tribal Nations with ancestral interests in the project area, 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. The following Federally Recognized Tribes were consulted with: Apache Tribe of Oklahoma, Comanche Nation of Oklahoma, Coushatta Tribe of Louisiana, Delaware Nation of Oklahoma, Tonkawa Tribe of Indians of Oklahoma, and Wichita and Affiliated Tribes of Oklahoma.

Section 106 of the National Historic Preservation Act

The National Historic Preservation Act (NHPA) of 1966, and a specific section of the NHPA, Section 106, requires that Federal agencies take into account the impacts of their undertakings on historic properties. The term undertaking means a project, activity, or program funded in whole or in part under the direct or indirect jurisdiction of a Federal agency, including those (a) carried out by or on behalf of the agency; (b) carried out with Federal financial assistance; or (c) requiring a Federal permit, license, or approval. The SHPO, in addition to appropriate tribes and local officials, are included as parties that have consultative roles in the Section 106 process. In Texas, the SHPO is the Executive Director of the Texas Historic Commission (THC).

The Area of Potential Effect (APE) means the geographic area or areas within which an undertaking may directly or indirectly cause alterations in the character or use of historic properties, if any such properties exist. The APE generally encompasses areas where construction activities will cause ground disturbance and is defined in three dimensions, including the project limits, width, acreage, and depth of impacts. Additionally, the APE encompasses the viewshed from any identified historic resource to the proposed undertaking (using the maximum possible extent of ground disturbance). The viewshed includes the visible area in the line of sight of the project and excludes areas obstructed by terrain or other features.

The APE for Upper Brushy Creek FRS No. 29 totals approximately 16.5 acres and includes the dam embankment, intake riser, impact basin at the outlet, and auxiliary spillway. A cultural resources desktop review was performed in October 2023. The desktop review included a search of archeological records available on the THC's Texas Archeological Site Atlas to determine if any previously recorded archeological sites or historic properties listed in the NRHP, State Antiquities Landmarks, and Recorded Texas Historic Landmarks are located within 1-kilometer of the APE. Additionally, historic and aerial topographic maps were evaluated to determine changing land use over time. The records review revealed two previously recorded archeological surveys (Atlas No. 8500015623 and 8500004706) completed in 2009 and 1979, respectively, and one previously recorded site (Trinomial 41WM256) recorded in 1973 located within the normal pool elevation of the reservoir.

Upper Brushy Creek FRS No. 29 was constructed in 1972, and therefore, is old enough for National Register consideration due to the structure being older than at least 50 years in age. NRCS-TX coordinated with the THC recommending that UBC-29 is Not Eligible for listing in the NRHP as the dam is a typical utilitarian structure that does not exhibit distinctive architectural or engineering significance. Additionally, NRCS-TX coordinated with six Federally recognized Tribal Nations (see Distribution List) with ancestral interests in the project area.

The THC concurred that no historic properties are present and therefore none would be affected by the project. Additionally, the THC concurred that no archeological sites would be affected by the project. Coordination documentation is provided in Appendix A.

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.

Per the National Park Service's National Historic Landmarks Program website, there are no National Historic Landmarks listed in Williamson County, Texas (NPS, 2023). 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 Upper Brushy Creek FRS No. 29 watershed is 1,530 acres (2.39 square miles). The dominant land use within the watershed is agriculture/pasture. 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 2019 landcover dataset. Appendix C shows the land use map of the watershed.

Table E: Dominant Land Use in Upper Brushy Creek FRS. No. 29 Watershed

Land Cover Type	Drainage Area of Brushy Creek FRS No.29 (acres)	Percentage of Total Watershed Area	Breach Inundation Zone (acres)	Percentage of Total
Range	25	2%	40	10%
Forest	72	5%	38	9%
Developed Land	554	36%	10	2%
Water	29	2%	94	23%
Pasture	850	55%	232	56%
Total	1530	100%	414	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 Upper Brushy Creek FRS No. 29 during the construction period, there are no designated State or National Nature and Scenic Area Preserves or river segments located within the project area. 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 and upper breach inundation zone of Upper Brushy Creek FRS No. 29 lies within Census Tract 208.08 with the lower inundation zone in Census Tract 209 in Williamson County, Texas. The 2017-2021 American Community Survey (ACS) 5-Year Data Profiles provide demographic, economic, and

population data from the U.S. Census Bureau. Table F includes the data that were downloaded for Census Tract 208.08, Census Tract 209, and Williamson County. These data were compared to the state and national level.

Table F: Demographics and Socioeconomics of Williamson County and Census Tract 208.8

Socioeconomic Category	Census Tract 208.08	Census Tract 209	Williamson County	State of Texas	United States
POPULATION	1,738	5,057	643,026	30,029,572	329,725,481
White	62.9%	79.4%	66.1%	77.4%	68.2%
Black/African American	10.2%	1.7%	6.0%	13.4%	12.6%
American Indian	0.0%	1.3%	0.4%	0.5%	0.8%
Asian	0.0%	1.3%	7.5%	5.0%	5.7%
Native Hawaiian	0.0%	0.0%	0.1%	0.1%	0.2%
Other Race	11.7%	2.5%	3.6%	7.0%	5.6%
AGE					
Median Age	38.1	44.1	36.7	35.0	38.4
18 years old or older	79.8%	59.2%	74.6%	74.2%	77.5%
65 years old or older	18.8%	18.3%	12.2%	12.5%	16.0%
EDUCATION					
Population 25 years or over	1,274	3,665	346,522	17,815,359	225,152,317
Some college, no degree	25.9%	23.7%	21.7%	21.8%	20.0%
Associate's degree	6.8%	5.4%	8.8%	7.0%	8.7%
Bachelor's degree	19.9%	19.7%	29.1%	19.1%	20.6%
Graduate or professional degree	7.2%	9.8%	15.7%	10.1%	13.1%
EMPLOYMENT/UNEMPLOYMENT, CLASS OF WORKER, AND COMMUTER STATUS					
Population 16 years and over	1,420	4,015	529,375	23,471,441	264,087,642
In Labor Force	849	2,549	71.0%	65.0%	63.1%
Employed	828	2,425	68.9%	62.1%	59.6%
Unemployed	21	124	2.1%	2.9%	3.5%
Unemployment Rate	n/r	4.9%	2.9%	4.4%	5.5%
Occupation Sectors of Local Economy					
Management, business, science, and arts occupations	40.5%	40.3%	52.4%	40.6%	40.3%
Service occupations	11.1%	14.8%	11.4%	15.7%	17.0%
Sales and office occupations	24.2%	19.5%	22.3%	20.9%	20.9%
Natural resources, construction, and maintenance occupations	9.7%	15.3%	6.4%	10.1%	8.7%
Production, transportation, and material moving occupations	14.6%	10.1%	7.4%	12.7%	13.1%
INCOME					
Median household income (dollars)	$67,548	$86,510	$96,073	$67,321	$69,021
Median family income (dollars)	$71,736	$103,750	$112,236	$80,498	$85.028
Per capita income (dollars)	$31,844	$35,000	$42,959	$34,255	$37,638
POVERTY					

Socioeconomic Category	Census Tract 208.08	Census Tract 209	Williamson County	State of Texas	United States
Population living below the poverty level	17%	7.3%	6.3%	14.1%	11.6%
HOUSING					
Housing Units – Occupied	92.5%	89.2%	95.2%	90.5%	88.8%
Owner Occupied	79.1%	83.1%	71.2%	64.8%	64.6%
Renter Occupied	20.9%	17.3%	28.8%	35.2%	35.4%

n/r = not reported

Recreation

Upper Brushy Creek FRS No. 29 provides incidental recreation to private residents with homes around the lake and to their guests. There is no public access to the lake.

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. An environmental justice and civil rights analysis was conducted for the breach inundation zone and associated nearby areas downstream of Upper Brushy Creek FRS No. 29 (
Figure 1 and Table G). 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. Due to the sparsely populated nature of the breach inundation zone, and to protect sensitive information about those populations, a 0.3-mile buffer was applied in order to generate a report.

The statistics displayed in Table G address 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 G: Indicators and Groups from EPA's Environmental Justice Tool

Selected Variables	Value	State		USA	
		Avg.	%tile	Avg.	%tile
Pollution and Sources					
Particulate Matter (µg/m^3)	9.11	9.11	38	8.08	76
Ozone (ppb)	60.6	64.6	17	61.6	46
Diesel Particulate Matter (µg/m^3)	0.0982	0.218	16	0.261	15
Air Toxics Cancer Risk* (lifetime risk per million)	20	28	1	25	5
Air Toxics Respiratory HI*	0.2	0.3	1	0.31	4
Toxic Releases to Air	8.4	12,000	13	4,600	8
Traffic Proximity (daily traffic count/distance to road)	14	150	15	210	20
Lead Paint (% Pre-1960 Housing)	0.19	0.17	69	0.3	47
Superfund Proximity (site count/km distance)	0.018	0.085	24	0.13	14

Selected Variables	Value	State		USA	
		Avg.	%tile	Avg.	%tile
RMP Facility Proximity (facility count/km distance)	0.14	0.63	24	0.43	42
Hazardous Waste Proximity (facility count/km distance)	0.12	0.75	26	1.9	24
Underground Storage Tanks (count/km^2)	0.12	2.3	19	3.9	29
Wastewater Discharge (toxicity-weighted concentration/m distance)	0.041	0.91	84	22	77
Socioeconomic Indicators					
Demographic Index[1]	30%	46%	29	35%	50
Supplemental Demographic Index[2]	12%	17%	35	14%	44
People of Color Population	36%	58%	29	39%	55
Low Income Population	23%	34%	37	31%	43
Unemployment Rate	4%	5%	55	6%	53
Limited English Speaking	2%	8%	47	5%	63
Population with Less Than High School Education	9%	16%	43	12%	55
Population under Age 5	6%	6%	49	6%	57
Population over Age 64	18%	14%	72	17%	61
Low Life Expectancy	15%	20%	7	20%	12

[1] *Average of low income and people of color populations.*

[2] *The supplemental demographic index averages percent low income, percent persons with disabilities, percent limited English speaking, percent less than high school education, and low life expectancy. The supplemental demographic index is then combined with a single environmental indicator, to display areas with the highest intersection between these socioeconomic factors and the environmental indicator.*

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

4.8 Status of Operation and Maintenance

The Lower Brushy Creek Water Control and Improvement District is currently responsible for the operation and maintenance of FRS No. 29. 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 12-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.

4.9 Reservoir Storage

Specialty Devices, Inc. (SDI) performed a bathymetric survey of the reservoir with acoustic survey equipment on February 17, 2023. The results of this survey were combined with available LiDAR topography data to update the elevation-storage curve for FRS No. 29. This data indicates that the reservoir volume at normal pool is approximately 184.7 acre-feet.

Based on the results of the bathymetric survey, the reservoir has lost approximately 15.3 acre-feet of storage below normal pool. Assuming that this is driven solely by sedimentation, a revised annual sedimentation rate of 0.301 acre-feet can be estimated. This revised sedimentation rate predicts that the Proposed Action (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, 560.2 feet, which allows for 184.7 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 Upper Brushy Creek FRS No. 29.

4.10 Breach Analysis and Hazard Classification

Upper Brushy Creek FRS No. 29 does not meet current dam design and safety requirements. The dam was originally constructed in 1972 as a low-hazard potential 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 and economic damage concerning at-risk infrastructure located in the downstream dam breach inundation area.

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, there would be impacts to 2 residences and 6 outbuildings, as well as impacts to sections of County Road 405 (AADT of 74), County Road 406 (AADT of 162), County Road 497 (AADT of 80), and State Highway 95 (AADT of 7,558).

Although FRS No. 29 is presently sound, there is always a risk of failure. The most likely cause of FRS No. 29 is failing 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 36,400 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, Breach Inundation Map and Appendix D, Investigation and Analysis – Hydrology.

4.11 Evaluation of Potential Failure Modes

Both NRCS and the TCEQ Dam Safety Program, recognize that Upper Brushy Creek FRS No. 29 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. 29 was designed with a 50-year sediment storage life. The bathymetric survey indicates that while some sediment has accumulated, FRS No. 29 has sufficient storage capacity remaining for more than 100 years. Given the planned changes to the undeveloped upstream land use, future sediment rates are expected to decrease compared to the rate computed for this plan. However, due to the possibility that the upstream development takes more than 20 years (approximate timeline provided by the city officials), and to maintain a conservative approach, the sediment yield rate that was computed based on the bathymetric data gathered for this study were used for the analysis of existing conditions and for the development of alternatives. Given this information, it can be concluded that sedimentation presents a low potential mode of failure for FRS No. 29.

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. 29 currently has a capacity of 1,020 acre-feet of detention storage (at crest of auxiliary spillway) and 3.8 feet of freeboard (to top of dam elevation). Current NRCS criteria require FRS No. 29 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. 29 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. 29 shows no visible signs of seepage along the downstream toe of the dam. The embankment has generally been kept in good conditions free of trees and brushy vegetation. Therefore, in the near future, seepage presents a low potential mode of failure for FRS No. 29.

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 Department of Agriculture's Technical Release 210-60, , FRS No. 29 is located in an area where the peak ground acceleration (PGA) is estimated as 0.0606g for 0.5 percent probability of exceedance in 50 years (equivalent to a 10,000-year return period). 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. 29.

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. 29 does not have a slope failure, thus, a slope failure presents a low potential mode of failure for FRS No. 29.

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. 29 should continue to be monitored annually and after significant storm events.

4.12 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.

Two residences, six outbuildings, as well as motorists on County Road 405, County Road 406, County Road 497, and Texas Highway 95 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 the number of people at risk due to a breach of FRS No. 29 would be 19. Table H shows the effects of a breach of FRS No. 29 on downstream properties and crossings (Figures 2 to 5).

Table H: Effects of Breach of FRS No. 29 to Downstream Properties and Crossings

Downstream Properties/Crossings	Depth Above First Floor Elevation (ft)	Depth Over Crossing (ft)	Daily Traffic Count (AADT)	Maximum Velocity (ft/s)
1 residences	>1	-	-	-
1 residence	<1	-	-	-
2 barns/outbuildings	>1	-	-	-
3 barns/outbuildings	<1	-	-	-
County Road 405	-	7.6	74	11.2
County Road 406	-	6.5	162	8.1
County Road 497	-	6.8	80	4.6
Texas Highway 95	-	3.4	7,558	5.1

Figure 2 County Road 405 would be inundated by about 7.6 feet of floodwaters during a breach of Upper Brushy Creek FRS No. 29

Figure 3 County Road 406 would be inundated by about 6.5 feet of floodwaters during a breach of Upper Brushy Creek FRS No. 29

Figure 4 N State Highway 95 would be inundated by about 3.4 feet of floodwaters during a breach of Upper Brushy Creek FRS No. 29

Figure 5 County Road 497 would be inundated by about 6.8 feet of floodwaters during a breach of Upper Brushy Creek FRS No. 25

5. 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.

5.1 Formulation process

Formulation of the proposed alternatives for Upper Brushy Creek 29 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 102-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.

Lower Brushy Creek Water Control and Improvement 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. Lower Brushy Creek Water Control and Improvement 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. Existing conditions were analyzed., and it was determined that 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. In the case of Upper Brushy 29, the local sponsor, the public, and relevant stakeholders oppose the decommissioning of the dam. Additionally, the local sponsor has indicated that the dam is not likely to be rehabilitated in the absence of Federal funds. Hence, the “Future Without Federal Investment” alternative for FRS 29 is a true no-action scenario where the dam continues to operate in its existing conditions and the dam would be expected to fail at some point in the future. The probability of failure was estimated using the guidance describe in NI_390_303 – Part 303 Clarification and Instructions for the No-Action Alternative in Supplemental Watershed Rehabilitation Plans released in December 2022.

Appendix C (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. The estimated annual probability of failure is equal to 0.106%.

Failure of the dam could result in significant damage and risk to loss of life. The Lower Brushy Creek Water Control and Improvement 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.

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 the two rehabilitation alternatives that were developed, Alternative No. 4 was selected. The alternative was chosen because it was seen as maximizing public benefits, relative to public costs.

5.2 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 I and Table J.

Table I: Alternatives Development Matrix for Upper Brushy Creek FRS No. 29

Alternative ID	Principal Spillway	Auxiliary Spillway		Dam Raise (ft)
	Conduit Diam. (in.)	Total Width (ft)	Crest Elev. (ft)	
1A	30	150	574.3	4.6
1B		200		4.0
1C		250		3.6
1D		300		3.4
1E		400		2.7
2A	36	150	573.8	4..2
2B		200		3.7
2C		250		3.2
2D		300		2.9
2E		400		2.3
3A	42	150	573.4	4.0
3B		200		3.4
3C		250		2.9
3D		300		2.5
3E		400		2.0

Alternative ID	Principal Spillway	Auxiliary Spillway		Dam Raise (ft)
	Conduit Diam. (in.)	Total Width (ft)	Crest Elev. (ft)	
4A	48	150	573.1	3.7
4B		200		3.1
4C		250		2.6
4D		300		2.3
4E		400		1.7
5A	54	150	572.8	3.5
5B		200		2.9
5C		250		2.4
5D		300		2.0
5E		400		1.5

Table J: Alternatives Development Matrix for Upper Brushy Creek FRS No. 29

Alternative ID	Principal Spillway	Auxiliary Spillway		Structural Spillway		Dam Raise (ft)
	Conduit Diam. (in.)	Total Width (ft)	Crest Elev. (ft)	Total Width (ft)	Crest Elev. (ft)	
A	30	150	574.3	N/A		4.6
B		250				3.6
C		400				2.7
D		N/A		2,000	574.3	1.4
E	54	N/A		750	572.8	0
F				190		0
G		150	572.8			0
H	30	N/A		180	571.8 & 573.3	0.4
I	54	N/A		90	610.3	2.0

Alternatives to breach and rehabilitate the dam to comply with State criteria were evaluated. However, the local sponsor opposed these alternatives because they do not have the funds to cover such projects, thus making State alternatives not feasible. The sponsor is pursuing this supplemental watershed plan because the State of Texas, through the Texas State Soil and Water Conservation Board (TSSWCB), matches 100% of the funds provided by the NRCS for projects that meet federal regulations. Based on preliminary analysis, a dam rehabilitation is estimated at approximately $4,000,000. State criteria is also less robust than Federal criteria, requiring the dam to be able to safely route the 75% probable maximum flood instead of requiring the dam to pass the freeboard hydrograph event. Rehabilitating the dam only to State criteria would mean that there would be residual risk of failure of the dam due to overtopping. Additionally, a rehabilitation to State criteria carries the risk associated with the integrity and stability of the existing auxiliary spillway.

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. A total of 8 structures would have to be bought out in addition to buying partial plots located within the breach inundation area from 40 owners. The total cost of this alternative is $3,345,600. 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 (CR 405, CR 406, CR 497, and US Hwy 95). Beyond the political implications and the lack of funding available to implement the alternative, the sponsor opposes this alternative because the dam would still pose a risk to commuters on the downstream roads. Hence, this alternative was eliminated.

An alternative which lowered the normal pool elevation such that the sediment storage would be limited to 100 years of storage was also evaluated but was deemed to have additional benefits that were negligible. From this evaluation it was determined that the normal pool could be lowered 3.9 ft which implies a reduction of 0.5 ft in the potential dam raise. The cost saving associated with the lower dam raise is eliminated by the additional environmental permitting and potential mitigation that would be required if the normal pool were to be lowered. Moreover, the public, landowners, and local sponsors are also all opposed to the modification of the normal pool elevation. Hence, this alternative was rejected.

5.3 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 annual probability of failure is equal to 0.106%.

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 27,400 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 32 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 3,200 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 363 acres to 409 acres due to the absence of flood attenuation, potential present and future downstream development would be affected by the increased flood profiles. Floodwaters from a 100-year storm event without the dam would overtop County Road 405 by 1.2 feet, County Road 406 by 3.3 feet, County Road 497 by 3.2 feet, Highway 95 by 2.5 feet, and a private road by 8.4 feet. Several crossings would not be overtopped above the deck but are predicted to experience damage according to the methodology used in the economic analysis. One house and two barns/outbuildings, along with partial plots from 44 different landowners who have land within the enlarged 100-year inundation area downstream of the dam, would be acquired to maintain flood protection. Upstream, there are 3 residences, 6 barns/outbuildings, that are below the existing top of dam elevation, along with a portion of County Road 404, of which 1 residence and 4 barns/outbuildings are flooded to some extent during the 100-year event. With the removal of the dam, these structures would no longer be subject to flooding from water retained by the dam.

The estimated cost to implement this alternative is $5,547,541.

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). The existing earthen auxiliary spillway will be blocked. However, a new structural labyrinth spillway will be added. The new 6-cycle spillway will be 180 feet wide, with a total weir length of approximately 900 feet. The structural spillway will have two stages at elevation 571.8 feet and 573.3 feet to safely route the FBH without overtopping the dam while increasing the downstream 100-year floodplain by 1 acre. The top of the dam will be raised an average of 0.5 feet and the downstream slope flattened from 2.5:1 to 3:1 using fill material from the surrounding area. The dam will be lengthened by approximately 500 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. For existing conditions, the top of dam flood pool is approximately 142 acres, and upstream impacts include 10 structures: 3 residences, 6 barns/outbuildings, and County Road 404. While the top of dam flood pool for this alternative is approximately 146 acres, no additional structures would be impacted, but the flooding for already impacted structures would be worsened. However, the existing 100-year flood pool is approximately 122 acres and impacts 1 residence and 4 barns/outbuildings, while this alternative's 100-year flood pool is only 120 acres and impacts only 1 residence and 3 barns/outbuildings. Furthermore, as seen by the peak water surface elevations in Table D-5 in Appendix D, for all frequency events from the 2 year to the 1,000 year event, upstream flooding will be decreased.

The estimated cost to implement this alternative is $17,196,900 and a conceptual figure representing this alternative is included in Appendix C.

Alternative No. 4 – Dam Rehabilitation

This alternative consists of replacing the existing principal spillway with a standard intake riser with a 54-inch diameter pipe. The existing principal spillway needs to be replaced in order to meet requirements of the Principal Spillway Hydrograph (PSH). The embankment will extend through the existing earthen auxiliary spillway preventing any discharge through this structure; thus, a single-stage structural labyrinth spillway will be constructed. The structural spillway will be placed in the main embankment along the

existing principal spillway alignment with a stilling basin on the downstream end. The structural spillway will have a total width of 90 feet, with a crest elevation of 572.8 feet. The top of the dam will be raised 2 feet while the downstream slope is flattened from 2.5:1 to 3:1 using fill material from the surrounding area. The dam will be lengthened by approximately 600 feet. The downstream 100-year floodplain will be increased by 3 acres. The upstream 100-year flood pool will be decreased by approximately 6 acres. 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. For existing conditions, the top of dam flood pool is approximately 142 acres, and upstream impacts include 10 structures: 3 residences, 6 barns/outbuildings, and County Road 404. While the top of dam flood pool for this alternative is approximately 164 acres, no additional structures would be impacted, but the flooding for already impacted structures would be worsened. However, the existing 100-year flood pool is approximately 122 acres and impacts 1 residence and 4 barns/outbuildings, while this alternative's 100-year flood pool is only 116 acres and impacts only 1 residence and 1 barn/outbuilding. Furthermore, as seen by the peak water surface elevations in Table D-5 in Appendix D, for all frequency events from the 2 year to the 1,000 year event, upstream flooding will be decreased.

The estimated cost to implement this alternative is $11,342,600 and a conceptual figure representing this alternative is included in Appendix C. This alternative is the Proposed Action (Preferred Alternative).

5.4 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. 4. A summary of the alternative plans is included in Table K and Table L. 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. Pursuant to 2014 NWPM 502.2, Alternative 1 is not designated the NEE alternative because human life is at risk in the event of a catastrophic failure of the existing dam which does not meet current safety and performance standards; and Alternative 1 will not meet said standards.

Table K: Summary and Comparison of Alternative Plans for Upper Brushy Creek FRS No. 29

Resource Concerns	Alternative 1 (Future without Federal Investment)	Alternative 2 (Decommissioning)	Alternative 3 (Rehabilitation)	Alternative 4 (Rehabilitation) (Recommended)
Installation Cost				
NRCS Contribution	$0	$3,632,400	$12,144,400	$7,975,500
SLO Contribution	$0	$1,915,100	$5,052,500	$3,367,100
Total	$0	$5,547,500	$17,196,900	$11,342,600
NED Account				
Avg Annual Cost	$0	$163,400	$506,500	$334,100
Installation	$0	$5,547,500	$17,196,900	$11,342,600
O, M, & R	$11,900	$2,500	$11,900	$11,900
Total	$11,900	$165,900	$518,400	$345,900
Annual Benefits	$0	-$51,400	$2,100	$8,600
Annual Costs	$11,900	$165,900	$518,400	$345,900
Annual Net Benefits	-$11,900	-$217,300	-$516,300	-$337,400
Annual Remaining Flood Damage	$61,400	$112,800	$59,300	$52,800
EQ Account[2]				
Air Quality	There will be 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 and wildlife habitat will be maintained in its current state, sediment pool remains the same, the structure will continue to	Converts approximately 32 acres of sediment pool to riparian area. Stream channel reconnected through the sediment pool and area returns to pre-dam conditions. Riparian vegetation established along the stream channel.	Fish and wildlife habitat will be maintained, sediment pool remains the same, the structure will continue to capture sediment and attenuate floodwater.	

Resource Concerns	**Alternative 1 (Future without Federal Investment)**	**Alternative 2 (Decommissioning)**	**Alternative 3 (Rehabilitation)**	**Alternative 4 (Rehabilitation) (Recommended)**
	capture sediment and attenuate floodwater.			
Prime Farmland (FPPA)	There will be no change in flood protection for downstream prime farmland.	Approximately 24 acres of downstream prime farmland (if irrigated) will lose flood protection currently provided by the dam.	There will be no change in flood protection for downstream prime farmland.	
Riparian Area	There will be no change to riparian areas.	The total riparian area will be increased when the dam is decommissioned, and the stream channel is reconnected through the sediment pool. Riparian vegetation established along the stream channel post construction.	There will be no change to riparian areas.	
Water Bodies (Including Waters of the U.S.)	The Sediment pool is retained. No change in the size of the sediment pool. No Federal authorization required.	Converts approximately 32 acres of sediment pool to approximately 3,200 linear feet of stream channel/riparian area. Likely authorized under NWP 27, *Aquatic Habitat Restoration*.	The Sediment pool is retained. Likely authorized under NWP 3, *Maintenance*, or NWP 43, *Stormwater Management Facilities*.	
Wetlands	No change to wetlands within the project area.	Conversion of wetland types. Re-establish riparian areas along 3,200 linear feet of stream channel with fringe emergent wetlands.	Minor temporary impact to upstream fringe wetlands during construction. Wetlands would return to pre-existing conditions following construction.	
Wildlife Community (Incl. Migratory Birds)	No impacts to local wildlife community.	Decrease of approximately 32 acres of open water habitat following decommissioning; increases in riparian area vegetation as stream channel is restored to pre-dam conditions.	Temporary impacts and disturbance during construction. Maintenance of open water habitat and attenuates flows in downstream stream channel.	
Water Quality	No change to water quality within the sediment pool or downstream stream Chanel.	Efforts would be made to stabilize existing sediment and to prevent head cutting following decommissioning of the dam. SWP3 in effect during construction.	Minor temporary impacts during construction (increases in turbidity, sediment, etc.). SWP3 in effect during construction.	
Sedimentation and Erosion	No change to sediment pool.	Minor erosion during and after construction. Loss of sediment pool and increases in sedimentation downstream.	Minor erosion during construction. Sediment pool has sufficient storage for evaluated 100-year life.	
RED Account[3]				
Land Values	Land values and inundation area will not change from current condition.	Negative impact to downstream properties not currently in floodplain due to induced flood damages from decommissioning. Positive effect for upstream properties that would be no longer be subject to flooding from water retained by the dam.	Negative impact to downstream properties because 100-year inundation	Negative impact to downstream properties because 100-year inundation area increased by 3 acres.

Resource Concerns	Alternative 1 (Future without Federal Investment)	Alternative 2 (Decommissioning)	Alternative 3 (Rehabilitation)	Alternative 4 (Rehabilitation) (Recommended)
			area increased by 1 acre.	
OSE Account[4]				
Public Health & Safety	Threat to loss of life will continue to exist with no action to existing dam structure. The estimated annual probability of failure is equal to 0.106%.	Eliminate threat to loss of life and property from breach, but will increase the floodplain by32 acres.	Flood protection maintained with minimal change to existing conditions for affected population. Increase in flood pool and downstream breach inundation zones.	
Flood Damages	Flood protection maintained with minimal change to existing conditions for affected population, until dam failure, an event with a 0.106% annual probability, and a 10% probability over the course of 100 years.	Relief of approximately 32 acres of floodwater retarding pool from the floodplain. Additional downstream properties and roadways would be impacted during a 100-year storm event without the dam in place.	Negative impact to downstream properties because 100-year inundation area increased by 1 acre.	Negative impact to downstream properties because 100-year inundation area increased by 3 acres.
Environmental Justice	Affected populations and properties downstream will continue to be at risk of a dam breach.	Loss of flood protection for affected populations below the dam regardless of economic status. Positive effect for upstream properties that would be no longer be subject to flooding from water retained by the dam.	Flood protection maintained with minimal change to existing conditions for affected population.	
Floodplain Management	Level of flood protection will be maintained, until dam failure, an event with a 0.106% annual probability, and a 10% probability over the course of 100 years.	Downstream floodplain is identified as Zone A (without base flood elevations). CLOMR may be required from FEMA post-construction to revise effective FIRMs to show changes to the floodplains and/or flood elevations.	Flood protection maintained with minimal change to existing conditions for affected population. Future construction of inhabitable dwellings upstream from the dam below the elevation of top of dam will be prohibited.	

[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

[5] – Dollar amounts were rounded to the nearest hundred

All alternatives evaluated as a 2.75% discount rate

All plans evaluated over 100 years

Current 2023 price levels except current normalized (2023, WRC) used for crop and pasture

Table L: Project Alternatives and Associated Ecosystem Services for Upper Brushy Creek FRS No. 29

Resource Concerns	**Alternative 1 (Future without Federal Investment)**	**Alternative 2 (Decommissioning)**	**Alternative 3 (Rehabilitation)**	**Alternative 4 (Rehabilitation) (Recommended) (NEE)**
Alternatives				
Locally Preferred				X
Environmentally Preferable		X		
Brief Description of Major Project Features	The dam will continue to operate on its existing configuration with regular maintenance provided by the local sponsor until failure.	Excavate breach in embankment and reconnect stream channel through sediment pool. Establish riparian vegetation along swale.	Replace principal spillway. Decommission the auxiliary spillway. Build two stage labyrinth spillway. Raise the top of dam and flatten the downstream slope.	Replace the principal spillway. Decommission the auxiliary spillway. Build a single stage labyrinth spillway. Raise the top of dam and flatten the downstream slope.
Provisioning Services				
Food	Protects 45 acres of downstream cropland, however higher chance for non-compliant dam failure.	Loss of flood protection for 57 acres of downstream cropland.	Protects 45 acres of downstream cropland.	Protects 46 acres of downstream cropland.
Water	No Effect, the reservoir is not a water supply.	No Effect, the reservoir is not a water supply.	No Effect, the reservoir is not a water supply.	No Effect, the reservoir is not a water supply.
Regulating Services				
Flood and Disease Control	Project remains non-compliant with dam safety standards for high hazard potential dams, posing additional risk to downstream lives and property.	Action would achieve compliance through the loss of a functional dam structure.	Action will result in compliance with dam safety standards for high hazard potential dams.	Action will result in compliance with dam safety standards for high hazard potential dams.
Supporting Services				

Resource Concerns	**Alternative 1 (Future without Federal Investment)**	**Alternative 2 (Decommissioning)**	**Alternative 3 (Rehabilitation)**	**Alternative 4 (Rehabilitation) (Recommended) (NEE)**
Primary Production	Non-compliant high hazard potential dam - risk to cropland. Maintain perennial hydrology that supports algae, cyanobacteria, and aquatic macrophytes.	Loss of downstream cropland protection and perennial hydrology that supports algae, cyanobacteria, and aquatic macrophytes.	Compliant high hazard dam with cropland protection. Maintain perennial hydrology that supports algae, cyanobacteria, and aquatic macrophytes.	Compliant high hazard dam with cropland protection. Maintain perennial hydrology that supports algae, cyanobacteria, and aquatic macrophytes.
Cultural Services				
Recreational Experiences	Existing recreational areas preserved.	Loss of lake-based recreational opportunities.	Existing recreational areas preserved.	Existing recreational areas preserved.
Aesthetic Viewsheds	Preserves existing aesthetic views, however dam would remain non-compliant.	Aesthetic view altered through the loss of open water lake.	Preserves existing aesthetic views.	Preserves existing aesthetic views.

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

[5] – Dollar amounts were rounded to the nearest hundred

All alternatives evaluated as a 2.75% discount rate

All plans evaluated over 100 years

Current 2023 price levels except current normalized (2023, WRC) used for crop and pasture

Table M. Consideration of PR&G Guiding Principles for Upper Brushy Creek FRS No. 29

PR&G GUIDING PRINCIPLES	Alternative 1 (Future without Federal Investment)	Alternative 2 (Decommissioning)	Alternative 3 (Rehabilitation) (NEE/NED)	Alternative 4 (Rehabilitation) (Recommended)
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
Sustainable Economic Development	No effect	Complies with sustainable use and management of water resources through return to natural conditions. Increase flood damages by $57,100 annually.	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 363 acres to 409 acres (an increase of 12.7%), and will increase water depth for 3 structures	The 100-year inundation area downstream would increase from 363 acres to 364 acres (an increase of 0.3%)	The 100-year inundation area downstream would increase from 363 acres to 366 acres (an increase of 0.8%)
Public Safety	Threat to loss of life from breach	Eliminate threat to loss of life and property from breach but will increase the floodplain by 12.7%.	Flood protection slightly decreased for downstream communities. Increase of 0.3% in the floodplain downstream of the dam	Flood protection slightly decreased for downstream communities. Increase of 0.8% in the floodplain downstream of the dam
Environmental Justice	Affected populations downstream will continue to be at risk of a dam breach	Loss of flood protection for affected populations below the dam regardless of economic status	Flood protection decreased with increase of 0.3% in the floodplain downstream of the dam	Flood protection decreased with increase of 0.8% in the floodplain downstream of the dam
Watershed Approach	Maintain current ecological function of Battleground Creek	Decommissioning of dam could improve ecological function of Battleground Creek	Maintain current ecological function of Battleground Creek	Maintain current ecological function of Battleground Creek

6. ENVIRONMENTAL CONSEQUENCES

Four alternative plans were considered and evaluated in detail, including the No Federal Action/Future without Federal Investment Alternative (Alternative No 1. - FWOFI), a Dam Decommissioning Alternative (Alternative No 2.), and two Dam Rehabilitation Alternatives (Alternatives No. 3 and 4). 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
- Essential Fish Habitat
- Coral Reefs
- Clean Air Act – General Conformity Rule and Regional Haze Regulations
- Bald and Golden Eagle Protection Act
- National Historic Landmarks Program
- Scenic Beauty and Visual Resources

6.1 Special Environmental Concerns

Soils

Existing Conditions: There are no Prime Farmlands located within the maximum extent of potential disturbance of Upper Brushy Creek FRS No. 29 that would potentially be impacted by construction activities. Additionally, there are no Prime Farmlands upstream of the dam that would be impacted by the change in flood pool from the proposed alternative. There are approximately 24 acres of prime farmland (if irrigated) within the 100-year inundation area downstream of the dam.

Alternative No. 1 - No Federal Action/Future without Federal Investment: There would be no long-term adverse effects to soils or downstream prime farmlands. 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 27,400 cubic yards of excavated materials will be placed in the sediment and detention pool areas and all exposed areas would be vegetated as needed for erosion control. 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. Approximately 24 acres of downstream prime farmland will lose flood protection currently provided by the dam.

Alternatives No. 3, 4 - Dam Rehabilitation Alternatives: The Dam Rehabilitation Alternatives would require borrow material from surrounding upland areas to raise the top of dam and auxiliary spillway. The acreage that will be disturbed will be determined during the design process. After construction is complete, disturbed areas will be revegetated with native or adapted plant species. Approximately 24 acres of downstream prime farmland will continue to receive flood protection currently provided by the dam.

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 soil. The impacts would be incremental to other regional effects occurring because of increased residential and commercial developments, and ongoing agricultural land uses. Soil effects in the long term as a result of the project would be considered minor.

Water

Clean Water Act

Sections 303(d) and 305(b)

Existing Conditions: The 2022 Texas Integrated Report of Surface Water Quality for the Clean Water Act Sections 305(b) and 303(d) was released in July 2022. Battleground Creek is not included in the report. Battleground Creek is a tributary to Brushy Creek which has been listed as impaired since 2006 at two localities (stream segment 1244_01 and 1244_03). Bacteria in water (recreational use) is the impairment described. These two segments are downstream of 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 releases 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 releases related to breaching of the dam. However, 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 - 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 during construction. 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 Battleground 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 shoreline of the Upper Brushy Creek FRS No. 29 reservoir pool was visually surveyed by FNI environmental scientists for wetlands on March 1, 2023. In addition to the reservoir, there are freshwater emergent wetlands along the fringe of the reservoir shorelines located upstream of the dam. These would likely be considered jurisdictional WOTUS under Section 404 of the CWA and regulated by the USACE.

Alternative No 1. - No Federal Action/ Future without Federal Investment: There would be no effects to WOTUS, including wetlands; therefore, no Section 404 CWA permit would be required. The risk of a dam breach would persist. In the event of a dam breach, downstream conditions and natural resources would be

impacted. Additionally, 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 - 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 under Section 401 of the CWA. Any impacts to upstream wetlands and the reservoir would be temporary and minor. The rehabilitation activities would likely be authorized under a Section 404 CWA General Permit, including either Nationwide Permit 3, *Maintenance*, or NWP 43, *Stormwater Management Facilities*. A Pre-Construction Notification to the USACE may be required.

Cumulative Impacts: Water levels within the reservoir would be permanently lowered with the No Federal Action/ Future without Federal Investment, only in the event of a dam failure, 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 floodplain of Battleground Creek, a tributary of the Brushy Creek, is managed by Williamson County, and Williamson County participates in the National Flood Insurance Program administered by FEMA.

Alternative No. 1 - No Federal Action/ Future without Federal Investment: 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 annual probability of failure is equal to 0.106%.

Alternative No. 2 - Dam Decommissioning: Alternative No. 2 utilizes federal 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 346 acres to 409 acres and potential present and future downstream development would be affected by the increased flood profiles. Floodwaters from a 100-year storm event without the dam would overtop County Road 405, County Road 406, County Road 497, Highway 95, as well as a private road. Several crossings would also experience flood damage during the 100-year storm event. One house and two barns/outbuildings, along with partial plots from 44 different landowners who have land within the enlarged 100-year inundation area downstream of the dam, would be acquired to maintain flood protection. Upstream, there are 3 residences, 6 barns/outbuildings, that are below the existing top of dam elevation, along with a portion of County Road 404, of which 1 residence and 4 barns/outbuildings are flooded to some extent during the 100-year event. With the removal of the dam, these structures would no longer be subject to flooding from water retained by the dam. 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 - Dam Rehabilitation: Rehabilitation activities will increase the 100-year floodplain downstream of the dam within the project area by approximately 1 acre, from 363 acres to 364 acres for Alternative No. 3, and 3 acres, from 363 acres to 366 acres for Alternative No. 4. 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. Future construction of inhabitable dwellings upstream from the dam below the elevation of the new, raised, top of dam will be, prohibited.

Alternative No. 3 expands the flood pool to 146 acres with no new structures affected but worsens flooding for already impacted structures. The current 100-year flood pool is 122 acres affecting 1 residence and 4 barns/outbuildings, whereas Alternative No. 3 reduces it to 120 acres, impacting 1 residence and 3 barns/outbuildings. Upstream flooding decreases for all events from the 2-year to the 1,000-year event.

Alternative No. 4 increases the flood pool to 164 acres without impacting additional structures but worsens flooding for those already affected. The existing 100-year flood pool covers 122 acres, impacting 1 residence and 4 barns/outbuildings, whereas Alternative No. 4 reduces this to 116 acres, affecting only 1 residence and 1 barn/outbuilding.

Cumulative Impacts: The No Federal Action/Future without Federal Investment Alternative, in the event of a dam failure, and the Dam Decommissioning and Rehabilitation Alternatives would have long-term impacts on the floodplain and flooding severity and frequencies downstream of the reservoir. Alternatives No. 3 and 4 reduce upstream flooding for all events from the 2-year to the 1,000-year event.

Air

Existing Conditions: According to the TCEQ, Williamson County is categorized as attainment for all NAAQS. 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. Williamson County would continue to be in attainment status for all NAAQS.

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 are anticipated to be temporary and localized.

Alternative No. 3, 4 – 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. 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 are 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. 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 that primarily consist of grasses, trees and shrubs including Bermuda grass (*Cynodon dactylon*), Bahia grass (*Paspalum notatum*),Green Ash (*Fraxinus pennsylvanica),* Cedar Elm (*Ulmus crassifolia)*,), Cocklebur (*Xanthium strumarium*) and California Bulrush (*Schoenoplectus californicus*). The majority of the project area is maintained as pasture/grazing areas for livestock.

Alternative No. 1 – No Federal Action/Future without Federal Investment: There would be no effects to riparian areas. The dam would continue to exist in its current state. In the event of a dam breach, riparian 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.

Alternative No. 3, 4 - 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 Williamson County. No critical habitat has been designated near the Upper Brushy Creek No. 29 Project Area. A copy of the TPWD and USFWS concurrence letters can be found in Appendix A.

Invasive Plant Species

During the field site visit on March 1, 2023, King Ranch bluestem *(Bothriochloa ischaemum)* and Little Bur-clover (*Medicago minima*), and one invasive animal species, Asian clams (*Corbicula fluminea)*, were 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. Installation of screens over the intake pipes to man-made lakes may prevent Asian clam larvae from entering new waterways (Texas Invasives, 2023). Additionally, disturbed areas will be vegetated with non-invasive species.

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 Williamson County (**Table N**).

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 N 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 N: Potential Impacts to Wildlife Communities from No Action, Dam Decommissioning, and Dam Rehabilitation Alternatives for Upper Brushy Creek FRS No. 29

Wildlife Community	Timeframe	Impact Type	Impact Description[1]	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 temporarily 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

Wildlife Community	Timeframe	Impact Type	Impact Description[1]	BMP or Measures to Comply with Applicable Laws
				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.

Wildlife Community	Timeframe	Impact Type	Impact Description[1]	BMP or Measures to Comply with Applicable Laws
				Ensure that borrow material imported to the construction area is not infested with plant species. Ensure seed sources for revegetation are weed-free.

[1] *Under the FWOFI, there would be no immediate impacts to wildlife; however, the overtopping risk and chance of dam failure associated with the dam not passing the state and Federal requirements would remain. If the dam were to fail, there would be impacts to wildlife from the immediate loss of the reservoir and disturbance along the creek and downstream riparian areas.*

State Protected Threatened and Endangered Species

Of the sixteen state listed species with the potential to be found in Williamson County, White-face Ibis and Wood Stork have the highest chance of occurring 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 A.

Human Environment

Local and Regional Economy

Existing Conditions: The Upper Brushy Creek FRS No. 29 project area is surrounded by rural residential development. The dam and reservoir are located on private property. The reservoir provides incidental recreation to private residents with homes around the lake and to their guests.

Alternative No. 1 - No Federal Action/Future without Federal Investment: There would be no beneficial or adverse 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. The 100-year inundation area downstream would increase from 346 acres to 409 acres and potential present and future downstream development would be affected by the increased flood profiles. Floodwaters from a 100-year storm event without the dam would overtop County Road 405, County Road 406, County Road 497, Highway 95, as well as a private road. Several crossings would also experience flood damage during the 100-year storm event. One house and two barns/outbuildings, along with partial plots from 44 different landowners who have land within the enlarged 100-year inundation area downstream of the dam, would be acquired to maintain flood protection. Upstream, there are 3 residences, 6 barns/outbuildings, that are below the existing top of dam elevation, along with a portion of County Road 404, of which 1 residence and 4 barns/outbuildings are flooded to some extent during the 100-year event. With the removal of the dam, these structures would no longer be subject to flooding from water retained by the dam.

Alternative No. 3, 4 - Dam Rehabilitation: There would likely be a temporary positive effect on the local economy during construction and rehabilitation of the dam. Alternative No. 3 expands the flood pool to 146 acres with no new structures affected but worsens flooding for already impacted structures. The current 100-year flood pool is 122 acres affecting 1 residence and 4 barns/outbuildings, whereas Alternative No. 3

reduces it to 120 acres, impacting 1 residence and 3 barns/outbuildings. Upstream flooding decreases for all events from the 2-year to the 1,000-year event.

Alternative No. 4 increases the flood pool to 164 acres without impacting additional structures but worsens flooding for those already affected. The existing 100-year flood pool covers 122 acres, impacting 1 residence and 4 barns/outbuildings, whereas Alternative No. 4 reduces this to 116 acres, affecting only 1 residence and 1 barn/outbuilding.

Cumulative Impacts: Rehabilitation of the dam would likely result in a temporary positive effect on the local economy during construction. Cumulative effects to the regional and local economy may result from future construction associated with continued flood protection and increased development within the watershed.

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 impacts to County Road 405, Country Road 406, County Road 497, a private road, state Highway 95, a commercial railroad, and two residential structures. The Population at Risk is estimated to be 19 based on the number of impacted residential structures and the overtopping of County Road 405, County Road 406, N State Highway 95, a Rail Road, County Road 497, and a Private Road by the dam breach.

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: Dam decommissioning would result in an increased threat of loss of life and property from flood risk to the downstream community, though there would no longer be a risk of catastrophic dam breach. Floodwaters from a 100-year storm event without the dam would overtop County Road 405, County Road 406, County Road 497, Highway 95, as well as a private road. Several crossings would also experience flood damage during the 100-year storm event. One house and two barns/outbuildings, along with partial plots from 44 different landowners who have land within the enlarged 100-year inundation area downstream of the dam, would be acquired to maintain flood protection. Upstream, there are 3 residences, 6 barns/outbuildings, that are below the existing top of dam elevation, along with a portion of County Road 404, of which 1 residence and 4 barns/outbuildings are flooded to some extent during the 100-year event. With the removal of the dam, these structures would no longer be subject to flooding from water retained by the dam. A CLOMR may be required from FEMA post-construction to revise effective FIRMs and show changes to the floodplains and/or flood elevations.

Alternative No. 3, 4 - 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. Rehabilitation activities will increase the 100-year floodplain downstream of the dam within the project area by approximately 1 acre, from 363 acres to 364 acres for Alternative No. 3, and 3 acres, from 363 acres to 366 acres for Alternative No. 4.

Additionally, Alternative No. 3 expands the flood pool to 146 acres with no new structures affected but worsens flooding for already impacted structures. The current 100-year flood pool is 122 acres affecting 1 residence and 4 barns/outbuildings, whereas Alternative No. 3 reduces it to 120 acres, impacting 1 residence and 3 barns/outbuildings. Upstream flooding decreases for all events from the 2-year to the 1,000-year event.

Alternative No. 4 increases the flood pool to 164 acres without impacting additional structures but worsens flooding for those already affected. The existing 100-year flood pool covers 122 acres, impacting 1 residence and 4 barns/outbuildings, whereas Alternative No. 4 reduces this to 116 acres, affecting only 1 residence and 1 barn/outbuilding.

Cumulative Impacts: Rehabilitation of the dam is needed because the dam does not meet current dam safety and performance criteria. There are 2 residences, 6 outbuildings, 3 County Roads (405, 406, and 497), State Highway 95, and one railroad all located within the breach inundation area. These structures, as well as the downstream communities, would continue to receive flood protection from the dam.

Cultural and Historic Resources

Existing Conditions: Upper Brushy Creek FRS No. 29 is located within the APE of the proposed actions. The dam was built in 1972, and therefore, meets the age requirement to be eligible for National Register consideration due to its age (50+ years old). NRCS-TX coordinated with the THC with a No Effect to historic properties determination being sought as the dam is a typical, utilitarian example of its type and does not represent distinctive architectural or engineering merit. Therefore, NRCS-TX recommended that UBC-29 is Not Eligible for listing in the NRHP. Additionally, NRCS-TX coordinated with six Federally recognized Tribal Nations with ancestral interests in the project area. The following Federally Recognized Tribes were consulted with: Apache Tribe of Oklahoma, Comanche Nation of Oklahoma, Coushatta Tribe of Louisiana, Delaware Nation of Oklahoma, Tonkawa Tribe of Indians of Oklahoma, and Wichita and Affiliated Tribes of Oklahoma.

Alternative No. 1 - No Federal Action/Future without Federal Investment: There will be no impact to cultural or historical resources. Current dam and reservoir conditions would continue; however, threat of a dam breach/failure would remain. The THC provided concurrence that no historic properties are present and therefore none would be affected by the project. Additionally, the THC provided concurrence that no archeological sites would be affected by the project.

Alternative No. 2 - Dam Decommissioning: Dam decommissioning would result in the loss of flood protection capabilities. The THC provided concurrence that no historic properties are present and therefore none would be affected by the project. Additionally, the THC provided concurrence that no archeological sites would be affected by the project.

Alternative No. 3, 4 – Dam Rehabilitation: The THC provided concurrence that no historic properties are present and therefore none would be affected by the project. Additionally, the THC provided concurrence that no archeological sites would be affected by the project.

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 rural residential communities. The existing dam and auxiliary spillway are vegetated with grassland plant species. 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: The land use is expected to remain the same. Local sponsors are required to prevent future development below the crest elevation of the structural spillway. The dam would continue to exist in its current state. Recreational opportunities for

the private landowners, and public recreational opportunities, 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: Dam Decommissioning would result in the dam being breached, and the reservoir no longer holding water. Land use is expected to change as incidental recreation currently provided to private residents with homes around the lake and to their guests would be diminished.

Alternative No. 3, 4 – 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 temporarily lowering of water levels in the reservoir to facilitate construction. Land use will not change; however, local sponsors are required to prevent future development below the new crest elevation of the structural spillway. The reservoir provides incidental recreation to private residents with homes around the lake and to their guests, which 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 and recreational opportunities are expected to remain the same due to private access to the reservoir; additionally, local sponsors are required to prevent future development below the new crest elevation of the structural spillway. Increased residential and commercial development in the surrounding areas outside of the project should have no effect on the private use of the reservoir.

Environmental Justice

Existing Conditions: There is an estimated population of 37 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, 2023).The project area is not located within an EPA IRA disadvantaged community. Further, the project area is not located in a community that is disadvantaged according to the Justice40 Initiative criteria (EPA, 2023).

Alternative No. 1 - No Federal Action/Future without Federal Investment: The project area is not located within an EPA IRA disadvantaged community. Further, the project area is not located in a community that is disadvantaged according to the Justice40 Initiative criteria (EPA, 2023). There would be no immediate change in flood protection for downstream communities; however, affected populations and properties downstream regardless of socioeconomic status would continue to be at risk of a dam breach.

Alternative No. 2 - Dam Decommissioning: 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 Upper Brushy Creek FRS No. 29 to capture flood waters during extreme precipitation events. The 100-year inundation area downstream would increase from 346 acres to 409 acres and potential present and future downstream development would be affected by the increased flood profiles. Floodwaters from a 100-year storm event without the dam would overtop County Road 405, County Road 406, County Road 497, Highway 95, as well as a private road. Several crossings would also experience flood damage during the 100-year storm event. One house and two barns/outbuildings, along with partial plots from 44 different landowners who have land within the enlarged 100-year inundation area downstream of the dam, would be acquired to maintain flood protection. Upstream, there are 3 residences, 6 barns/outbuildings, that are below the existing top of dam elevation, along with a portion of County Road 404, of which 1 residence and 4 barns/outbuildings are flooded to some extent during the 100-year event. With the removal of the dam, these structures would no longer be subject to flooding from water retained by the dam.

Alternative No. 3, 4 - Dam Rehabilitation: The project area is not located within an EPA IRA disadvantaged community. Further, the project area is not located in a community that is disadvantaged according to the Justice40 Initiative criteria (EPA, 2023). Alternative No. 3 expands the flood pool to 146 acres with no new

structures affected but worsens flooding for already impacted structures. The current 100-year flood pool is 122 acres affecting 1 residence and 4 barns/outbuildings, whereas Alternative No. 3 reduces it to 120 acres, impacting 1 residence and 3 barns/outbuildings. Upstream flooding decreases for all events from the 2-year to the 1,000-year event. Alternative No. 4 increases the flood pool to 164 acres without impacting additional structures but worsens flooding for those already affected. The existing 100-year flood pool covers 122 acres, impacting 1 residence and 4 barns/outbuildings, whereas Alternative No. 4 reduces this to 116 acres, affecting only 1 residence and 1 barn/outbuilding.

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 until failure. 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 the useful life of the project will be extended by an additional 100 years following construction. 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.

7. CONSULTATION AND PUBLIC PARTICIPATION

The lead sponsoring organization is the Lower Brushy Water Control and Improvement District. The local, state and Federal support for the rehabilitation of the Upper Brushy Creek FRS No. 29 has been strong. Thus, multiple meetings were held throughout the project with representatives of the Lower Brushy WCID, 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 February 14, 2023. 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 Lower Brushy WCID, NRCS, and TSSWCB.

On March 29, 2023, a public meeting was held in the Taylor Public Library to explain the Watershed Rehabilitation Program and to discuss resource problems, issues, and concerns of local residents associated with the FRS No. 29 project area. Invitations to participate in the public meeting were made to potentially affected landowners and interested parties around and below FRS No. 29 and reservoir area. A presentation and handout materials were utilized to provide information to the group. Potential alternative solutions to bring Upper Brushy Creek FRS No. 29 into compliance with current dam safety criteria were presented at the initial meeting.

Additional meetings were held with sponsor and NRCS on June 15, 2023 and June 16, 2023. 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 held in the Taylor Public Library on January XX, 2025, 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. 29.

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 the importance of Tribes' interest in places of cultural or religious significance on ancestral lands, including those on private lands. Tribal coordination was initiated January 9, 2024 in accordance with the NHPA and other related authorities and will be completed by NRCS-TX. Additionally, NRCS-TX coordinated with the THC for effects to archeological and above-ground historic resources potentially affected by the project. The THC provided concurrence that no historic properties are present and therefore none would be affected by the project. Additionally, the THC provided concurrence that no archeological sites would be affected by the project.

8. PROPOSED ACTION (PREFERRED ALTERNATIVE)

Alternative No. 4 is the Proposed Action (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. 29 will be extended for 100 years. The modification will consist of installing a 54-inch diameter principal spillway pipe with an intake riser. The embankment will extend through the existing earthen auxiliary spillway preventing any discharge through this structure. A new structural labyrinth spillway will be added, with a length of 90 feet and a crest elevation of 572.8 feet. The top of the dam will be raised an average of 2 feet, and the downstream slope flattened from 2.5:1 to 3:1. The dam will be lengthened by approximately 435 feet. The estimated cost to implement this alternative is $11,342,600.

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 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 review and update the existing 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.

8.1 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 19 people, based on PAR calculations developed in this study using a HEC-RAS 2D model.
- Reduces the threat of loss of access and loss of emergency services to 2 residences, 6 outbuildings, 3 County Roads, 1 State highway, and 1 railroad.
- 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.
- Reduces the likelihood of dam failure.

The Proposed Action (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 and 4 effectively reduce the risk of dam failure by overtopping and minimizes the change to the level of flood prevention downstream compared to existing conditions. Between the two alternatives that rehabilitate the dam, – Alternative No. 4 has the highest NEE net benefits, and hence, the highest benefit-cost ratio.

8.2 Summary and Purpose

The selected plan consists of structural modifications to FRS No. 29 as follows:

- Replace existing principal spillway pipe and install a 54-inch diameter principal spillway pipe with an intake riser and an impact basin
- Extend the embankment through the existing earthen auxiliary spillway to prevent discharge through this structure.
- Build a new 3-cycle labyrinth structural spillway with a crest at an elevation of 572.8 feet and a width of 90 feet;
- Raise top of dam 2 feet;
- Flatten downstream embankment slope from 2.5:1 to 3:1;

After the implementation of these planned works of improvement, Upper Brushy Creek FRS No. 29 will meet all current NRCS and TCEQ dam safety performance standards.

8.3 Easements and Land rights

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 auxiliary spillway will change for implementation of the Proposed Action (Preferred 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 and landowners acknowledge the risk and liability associated with this decision, as the probability for one or more exceedances of a 1-percent annual chance (100-year recurrence) events over the course of the life of the dam (100 years) is 63%. The 100-year elevation is below the elevation of land rights already owned by the local sponsor; therefore, new land rights do not need to be obtained in the upstream area. Some property acquisition is also required to develop the Proposed Action (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, though NRCS does recommend obtaining land rights up to the proposed top of dam elevation, it does not require it. Two, the purchase of these land rights increases sponsor expenses as the item is not cost shareable. Three, there are currently two habitable structures (S1 and S4) below the existing top of dam elevation and one additional habitable structure (S3) is located the below the proposed. However, the proposed configuration reduces the frequency and duration of flooding at S1 and S4 for all the return period (2-yr through 1000 yr) analyzed in this study. Moreover, S3 is located 1.4 feet below the proposed top of dam thus, the flooding of this structure is expected to occur only during extreme event with a return period close to the FBH. Because of this, no significant risk is considered to be incurred in the proposed conditions. Additionally, the local sponsors will enact a land use ordinance that prevents future development below the proposed top of dam elevation.

8.4 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. 29. No extraordinary circumstances or significant impacts will result from actions of the Proposed Action (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 Proposed Action (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 Proposed Action (Preferred Alternative).

8.5 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. 29 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. 29 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 Proposed Action (Preferred Alternative) involves increasing the principal spillway pipe diameter, and thus the peak discharge from the spillway during a flood event. The structural spillway will be engaged above the 100-year peak event. While the existing auxiliary spillway engages in the 50-year event, the selected Proposed Action (Preferred Alternative) was sized to engage at the 100-year event as to minimize the peak 100-year discharge as well as reduce the frequency of the flooding of the upstream structures. Likewise, the modeled inundation area for the 100-year event for the Proposed Action (Preferred Alternative) is 0.8% larger than the modeled existing conditions inundation area due to an increased discharge volume during this event as a result of a more efficient spillway design. Thus, a FEMA Letter of Map Revision (LOMR) is required as a result of the rehabilitation. Zone A is mapped downstream of the dam.

The proposed project may involve de-watering of the sediment pool for construction activities. An Aquatic Resource Relocation Plan (ARRP) may be required prior to construction to evaluate the presence/absence of freshwater mussel and fish species within the project area and immediately adjacent areas, and to relocate them outside of any impacted areas. Coordination with TPWD is recommended during final design to determine whether an ARRP would be necessary. ARRPs are required from TPWD for construction or maintenance projects when dewatering and the diversion of water are anticipated to potentially strand aquatic organisms (e.g., cofferdam, open trenching, etc.). The ARRP describes how stranding would be avoided by collecting and transporting aquatic organisms to another location. A permit to introduce fish, shellfish or plants would be required by TPWD to relocate fish, freshwater mussels, and other organisms away from the site from which they are collected.

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. NRCS-TX coordinated with the THC for effects to archeological and above-ground historic resources potentially affected by the project. The THC provided concurrence that no historic properties are present and therefore none would be affected by the project. Additionally, the THC provided concurrence that no archeological sites would be affected by the project.

8.6 Costs and Cost-Sharing

Cost sharing between Public Law (PL) 83-566 Funds and other sources is shown in Table S-1, Table K, and Table 2. The estimated Proposed Action (Preferred Alternative) costs are $11,342,600. The estimated construction costs for program measures total $8,968,100. The sponsors' estimated cost of construction is $2,965,700, and the estimated cost of construction eligible for PL 83-566 funding is $6,002,400.

Construction costs for program measures are direct costs for installation. Construction includes such items as the construction of a labyrinth spillway, raising the dam, filling in the existing auxiliary spillway, replacing the principal spillway, staging of rehabilitation materials, labor and material costs, and seeding of disturbed areas with native species.

Engineering services include the direct cost of engineers and other technicians for surveys, investigations, designs, and preparation of plans and specification for program measures and the preparation of operation and maintenance plans. Estimated costs eligible for PL 83-566 funding is $896,900. Sponsor Engineering costs are estimated to be $0 and the cost to obtain permits for the works of improvement is estimated to be $135,000 for the project.

Project administration costs include the cost of contract administration, review of engineering plans prepared by others, contract administrators, and inspection services during construction. The total estimated cost of the project administration is $1,076,200. The sponsors estimated cost of project administration is $0, and the estimated cost of project administration eligible for PL 83-566 funding is $1,076,200.

Land rights costs are direct and related costs for the right to install, operate, and maintain works of improvement and are borne entirely by the sponsors. The purchase of land rights from the existing property owners is expected to cost $266,400.

8.7 Installation and Financing

The installation of the project will be financed jointly by the SLO and the NRCS. NRCS will use funds appropriated for this purpose. Additionally, the SLO 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 2024 fiscal year and construction funding will be requested for fiscal year 2025. The SLO has the power of eminent domain to secure the real property rights. The duration of construction is approximately 24 months.

NRCS will aid the Sponsors with the Upper Brushy Creek FRS No. 29 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 new Operation and Maintenance Agreement with the Sponsors that establishes new 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 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.
- Prepare a floodplain management plan designed to reduce the impacts of future flood events in the project area.
- Enforce the County's floodplain management to restrict future development below the new top of dam elevation.
- Review and update the existing 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 SLO or the NRCS.

8.8 Operation, Maintenance, and Replacement

Operation and Maintenance Agreement

The project will be operated and maintained by the Sponsors. Once FRS No. 29 is rehabilitated, the SLO will have the primary responsibilities for maintenance of FRS No. 29. A new Operation and Maintenance (O&M) Agreement will be developed with the Sponsors for FRS No. 29 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 $11,900 per year.

Emergency Action Plan

The Sponsors will provide leadership in reviewing and updating the Emergency Action Plan (EAP) prior to the commencement of construction and will review and update the EAP annually with local emergency response officials.

8.9 Economic and Structural Tables

Table 1: Estimated Installation Cost FRS No. 29

Table 2: Estimated Cost Distribution – Water Resource Project Measures FRS No. 29

Table 3: Structural Data – Dams with Planned Storage Capacity FRS No. 29

Table 4: Estimated Average Annual NEE Cost FRS No. 29

Table 5: Estimated Average Annual Flood Damage Reduction Benefits FRS No. 29

Table 6: Comparison of NEE Benefits and Costs FRS No. 29

Table 1: Estimated Installation Cost FRS No. 29

Upper Brushy Creek Watershed, Texas

(Dollars) [1,2]

		Number			Estimated Costs		
Works of Improvement	**Units**	**Federal Land**	**Non-Federal Land**	**Total**	**Public Law 83-566 Funds**	**Other Funds**	**Total**
Rehabilitation of FRS No. 29	N/A	N/A	N/A	N/A	$7,975,500	$3,100,700	$11,076,200
Land Acquisition	Acres	0	4	4	$0	$266,400	$266,400
Total Project	**Acres**	**0**	**4**	**4**	**$7,975,500**	**$3,367,100**	**$11,342,600**

[1] Price base: December, 2023

[2] All the numbers presented in this table were rounded to the nearest hundred.

Table 2: Estimated Cost Distribution – Water Resource Project Measures FRS No. 29

Upper Brushy Creek Watershed, Texas

(Dollars) [1]

Total Installation Cost	Installation Cost - Public Law 83-566						Total Installation Cost
	Construction	**Engineering**	**Real Property**	**Relocation Payments**	**Project Admin.**	**Total Federal Cost**	
Rehabilitation of dam	$6,002,400	$896,900	$0	$0	$1,076,200	$7,975,500	$11,342,600
	Installation Cost - Other funds						
	Construction	**Engineering**	**Real Property**	**Required Permits**	**Project Admin.**	**Total Non-Federal Cost**	
	$2,965,700	$0	$266,400	$135,000	$0	$ 3,367,100	

[1] Price base: December, 2023

[2] All the numbers presented in this table were rounded to the nearest hundred.

Table 3: Structural Data – Dams with Planned Storage Capacity FRS No. 29
Upper Brushy Creek Watershed, Texas

Item	Unit	FRS No. 29
Class of structure		High
Seismic zone (PGA)	g	0.0606
Uncontrolled drainage area	mi^2	2.39
Controlled drainage area	mi^2	0
Total drainage area	mi^2	2.39
Runoff curve number (1-day) (AMC avg.)		89
Time of Concentration (T_c)	hr	2.1
Elevation top of dam	ft	577.9
Elevation crest of auxiliary spillway	ft	572.8
Elevation crest high stage inlet	ft	560.7
Elevation crest low stage inlet	ft	560.2
Auxiliary spillway type		Structural, Labyrinth
Auxiliary spillway bottom width (perpendicular to the flow)	ft	90
Auxiliary spillway length (parallel to the flow)	ft	70
Auxiliary spillway exit slope	percent	33.3
Weir length	ft	435
Cycles	No.	3
Capacity	ft^3/s	8,901
Maximum height of dam	ft	44
Volume of fill	yd^3	28,900
Total Capacity	acre ft	1,106
Sediment submerged	acre ft	205
Sediment aerated	acre ft	22.7
Floodwater retarding	acre ft	901
Surface area		
Sediment pool	acres	34.6
Floodwater retarding pool	acres	115.4
Principal spillway design		
Rainfall volume (1-day)	in	11.4
Rainfall volume (10-day)	in	16.2
Runoff volume (10-day)	in	12.8
Capacity of low stage (max)	ft^3/s	N/A
Capacity of high stage (max)	ft^3/s	388
Type of conduit		RCP
Diameter	in	54

Frequency operation-auxiliary spillway	Percent chance	1
Auxiliary spillway hydrograph		
Rainfall volume	in	14.4
Runoff volume	in	13.0
Storm duration	hr	6
Velocity of flow (V_c)	ft/s	10.7
Maximum reservoir water surface elevation	ft	574.2
Freeboard hydrograph		
Rainfall volume	in	31.0
Runoff volume	in	29.5
Storm duration	hr	6
Maximum reservoir water surface elevation	ft	577.9
Capacity equivalents		
Sediment volume	in	1.6
Floodwater retarding volume	in	7.1

Table 4: Estimated Average Annual NEE Cost FRS No. 29

Upper Brushy Creek Watershed, Texas

(Dollars) [1]

	Project Outlays		
Evaluation Unit	**Amortization of Installation Cost [2]**	**Operation, Maintenance and Replacement Cost**	**Total**
FRS No. 29	$334,100	$11,900	$345,900
Grand Total	**$334,100**	**$11,900**	**$345,900**

[1] Price base: December, 2023
[2] Amortized over 100 years at a discount rate of 2.75 percent.
[2] All the numbers presented in this table were rounded to the nearest hundred.

Table 5: Estimated Average Annual Flood Damage Reduction Benefits FRS No. 29

Upper Brushy Creek Watershed, Texas

(Dollars) [1, 2, 3, 5]

Damage Category	Estimated Average Annual Damages Without the Project[4]	Estimated Average Annual Damages With the Project	Estimated Average Annual Damage Reduction Benefits
Structures	$4,130	$4,950	- $820
Crops	$1,770	$1,870	- $110
Pastureland	$180	$190	- $10
Roads and Bridges	$55,130	$45,630	$9,490
Erosion and Sedimentation	$150	$150	$0
Total	**$61,360**	**$52,800**	**$8,560**

[1] Price base: December, 2023
[2] Damages and benefits will accrue from floods of greater magnitude than the 1,000-year frequency event, but these were not evaluated.
[3] Values have been rounded to the nearest ten.
[4] Based on average annual damages of the No Action Alternative which includes a potential dam breach
[5]All damages and benefits listed are Agricultural-related due to the population of the area, and the table is presented as is for simplicity.

Table 6: Comparison of NEE Benefits and Costs FRS No. 29

Upper Brushy 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. 29	$8,560	$0	$8,560	$345,900	1.0 : 0.02	-$337,400

[1] Price base: December, 2023
[2] From Table 5
[3] From Table 4
[4] Values have been rounded to the nearest ten.

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- Technical Release 210-60, Earth Dams and Reservoirs

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Jacob Adkins, P.E.	Water Resources Engineer 5 years	B.S. Civil Engineering	N/A	
Aaron Brewer, P.G.	Senior Geologist 6 years	B.S. Geology	5 years	
Aaron Petty	Environmental Scientist 8 years	M.S. Environmental Science B.S. Biology	5 years	
Tam Tran	Environmental Scientist 7 years	B.S. Ecology, Evolution & Behavior	5 years	
Kelsey Calvez	Environmental Scientist 7 years	B.S. Environmental Geoscience	1 year	
Heath Myers	GIS Analyst 8 years	B.S. Spatial Science	3 years	
Brian King, RPA	Lead GIS Analyst 12 years	B.S. Archaeology M. S. Geographical Information Systems	10 years	
Texas State Soil and Water Conservation Board Staff				
Steve Bednarz, P.E.	Program Administrator/Engineer, 8 years	B.S. Agricultural Engineering	38 years	
Allen Nash, P.E.	Engineer II, 2 years	B.S. Environmental Engineering	12 years	
Natural Resources Conservation Service Staff				

Name	**Present Title and Years in Current Position**	**Education**	**Previous Experience**	**Other**
Mark Northcut	Natural Resource Manager, 5 years	B.S. Agriculture Engineering	31 years	
David Buland	Economist, 4 years	B.A. Economics M.A. Economics	38 years	
David Sullivan	Civil Engineer, 4 years	B. S. Civil Engineering	12 years	
Michael Jugle	Geologist, 5 years	B.S. Geology	N/A	
Angela Moody	Archeologist, 4 years	B.A. in Anthropology M.A. in Museum Sciences	15 years	
Rocky Ingram	Soil Conservationist, 6 years	B.S. Agriculture Education	12 years	
Dawson Lilly	Wildlife Biologist, 1 year	B.S. Wildlife Management, Minor in Biology M.S. Wildlife Science	10 years	

10. DISTRIBUTION LIST

Comments were requested on the 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)
- Lower Brushy Creek Water Control and Improvement District.
- Texas Historical Commission
- State Historic Preservation Office
- Federally Recognized Tribes for Consultation:
    - Apache Tribe of Oklahoma
    - Comanche Nation of Oklahoma
    - Coushatta Tribe of Louisiana
    - Delaware Nation of Oklahoma
    - Tonkawa Tribe of Indians of Oklahoma
    - Wichita and Affiliated Tribes of Oklahoma

11. INDEX

12. APPENDICES

APPENDIX A: COMMENTS AND RESPONSES

APPENDIX B: PROJECT MAP

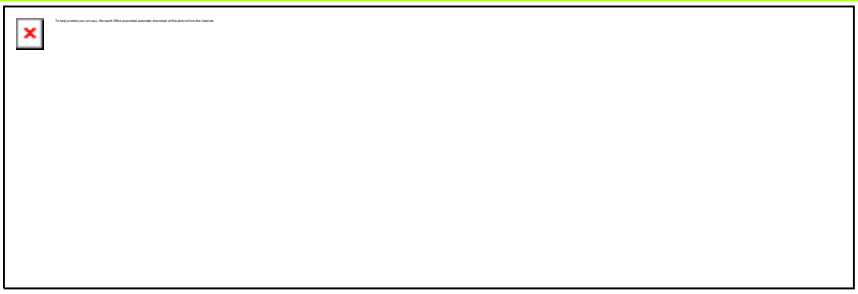
APPENDIX C: SUPPORT MAPS

APPENDIX D: INVESTIGATIONS AND ANALYSES REPORT

APPENDIX E: OTHER SUPPORTING INFORMATION

Appendix A - Comments and Responses

From: noreply@thc.state.tx.us <noreply@thc.state.tx.us>
Sent: Monday, February 12, 2024 8:33 AM
To: Moody, Angela - FPAC-NRCS, TX <Angela.Moody@usda.gov>; reviews@thc.state.tx.us
Subject: [External Email]Rehabilitation of Upper Brushy Creek FRS 29



Re: Project Review under Section 106 of the National Historic Preservation Act
THC Tracking #202405115
Date: 02/12/2024
Rehabilitation of Upper Brushy Creek FRS 29
1150 CR 405
Taylor,TX 76574

Description: Upper Brushy Creek FRS 29 was constructed in 1974 by the SCS as a single-purpose earthen dam (flood prevention) structure and requires rehabilitation to bring it up to code.

Dear Angela Moody:
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.

The review staff, led by Amy Borgens, Rebecca Shelton and 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 Edward G. Lengel, Ph.D
State Historic Preservation Officer

Please do not respond to this email.

violate the law and subject the violator to civil or criminal penalties. If you believe you have received this message in error, please notify the sender and delete the email immediately.

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Austin Ecological Services Field Office
1505 Ferguson Lane
Austin, TX 78754-4501
Phone: (512) 937-7371

In Reply Refer To: November 03, 2023
Project Code: 2024-0012548
Project Name: NRCS Upper Brushy Creek No. 29 Dam Rehabilitation Project

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, that may occur within the boundary of your proposed project and/or may be affected by 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.*).

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.

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 sections 7(a)(1) and 7(a)(2) of the Act and its implementing regulations (50 CFR 402 *et seq.*), Federal agencies are required to utilize their authorities to carry out programs for the conservation of threatened and endangered species and to determine whether projects may affect threatened and endangered species and/or designated critical habitat.

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 projects 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.

If a Federal agency determines, based on the Biological Assessment or biological evaluation, that listed species and/or designated critical habitat may be affected by the proposed project, the agency is required to consult with the Service pursuant to 50 CFR 402. In addition, the Service recommends that candidate species, proposed species and proposed critical habitat be addressed within the consultation. 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: https://www.fws.gov/sites/default/files/documents/endangered-species-consultation-handbook.pdf

Migratory Birds: In addition to responsibilities to protect threatened and endangered species under the Endangered Species Act (ESA), there are additional responsibilities under the Migratory Bird Treaty Act (MBTA) and the Bald and Golden Eagle Protection Act (BGEPA) to protect native birds from project-related impacts. Any activity, intentional or unintentional, resulting in take of migratory birds, including eagles, is prohibited unless otherwise permitted by the U.S. Fish and Wildlife Service (50 C.F.R. Sec. 10.12 and 16 U.S.C. Sec. 668(a)). For more information regarding these Acts see https://www.fws.gov/program/migratory-bird-permit/what-we-do.

The MBTA has no provision for allowing take of migratory birds that may be unintentionally killed or injured by otherwise lawful activities. It is the responsibility of the project proponent to comply with these Acts by identifying potential impacts to migratory birds and eagles within applicable NEPA documents (when there is a federal nexus) or a Bird/Eagle Conservation Plan (when there is no federal nexus). Proponents should implement conservation measures to avoid or minimize the production of project-related stressors or minimize the exposure of birds and their resources to the project-related stressors. For more information on avian stressors and recommended conservation measures see https://www.fws.gov/library/collections/threats-birds.

In addition to MBTA and BGEPA, Executive Order 13186: *Responsibilities of Federal Agencies to Protect Migratory Birds*, obligates all Federal agencies that engage in or authorize activities that might affect migratory birds, to minimize those effects and encourage conservation measures that will improve bird populations. Executive Order 13186 provides for the protection of both migratory birds and migratory bird habitat. For information regarding the implementation of Executive Order 13186, please visit https://www.fws.gov/partner/council-conservation-migratory-birds.

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 Code 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

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:

Austin Ecological Services Field Office
1505 Ferguson Lane
Austin, TX 78754-4501
(512) 937-7371

PROJECT SUMMARY

Project Code: 2024-0012548
Project Name: NRCS Upper Brushy Creek No. 29 Dam Rehabilitation Project
Project Type: Dam - Maintenance/Modification
Project Description: The NRCS, local sponsors, and stakeholders are identifying alternatives to rehabilitate or decommission the floodwater retarding structure to comply with current NRCS and TCEQ dam safety standards.

Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@30.5297992,-97.43672963561264,14z

Counties: Williamson County, Texas

ENDANGERED SPECIES ACT SPECIES

There is a total of 11 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.

---

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.

MAMMALS

NAME	STATUS
Tricolored Bat *Perimyotis subflavus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/10515	Proposed Endangered

BIRDS

NAME	STATUS
Golden-cheeked Warbler *Setophaga chrysoparia* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/33	Endangered
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. Your location does not overlap the critical habitat. This species only needs to be considered under the following conditions: ▪ Wind Energy Projects Species profile: https://ecos.fws.gov/ecp/species/6039	Threatened
Rufa Red Knot *Calidris canutus rufa* There is **proposed** critical habitat for this species. 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. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/758	Endangered

CLAMS

NAME	STATUS
False Spike *Fusconaia mitchelli* There is **proposed** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/3963	Proposed Endangered

INSECTS

NAME	STATUS
Coffin Cave Mold Beetle *Batrisodes texanus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/6234	Endangered
Monarch Butterfly *Danaus plexippus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	Candidate
Tooth Cave Ground Beetle *Rhadine persephone* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/5625	Endangered

ARACHNIDS

NAME	STATUS
Bone Cave Harvestman *Texella reyesi*	Endangered
No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/5306	
Tooth Cave Spider *Tayshaneta myopica*	Endangered
No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/2360	

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

IPAC USER CONTACT INFORMATION

Agency: Natural Resources Conservation Service
Name: Kelsey Calvez
Address: 10431 Morado Circle
City: Austin
State: TX
Zip: 78759
Email kelsey.calvez@freese.com
Phone: 5126173165

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Austin Ecological Services Field Office
1505 Ferguson Lane
Austin, TX 78754-4501
Phone: (512) 937-7371

In Reply Refer To: 11/08/2024 13:43:32 UTC
Project Code: 2025-0016923
Project Name: NRCS Upper Brushy Creek No. 29 Dam Rehabilitation Project

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, that may occur within the boundary of your proposed project and/or may be affected by 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.*).

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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 Code in the header of this letter with any request for consultation or correspondence about your project that you submit to our office.

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This species list is provided by:

Austin Ecological Services Field Office
1505 Ferguson Lane
Austin, TX 78754-4501
(512) 937-7371

PROJECT SUMMARY

Project Code: 2025-0016923
Project Name: NRCS Upper Brushy Creek No. 29 Dam Rehabilitation Project
Project Type: Dam - Maintenance/Modification
Project Description: Supplemental watershed plan and environmental assessment for the rehabilitation of NRCS Upper Brushy Creek No. 29 Dam Rehabilitation Project.
Project Location:

The approximate location of the project can be viewed in Google Maps: https://www.google.com/maps/@30.5251752,-97.42908491902611,14z

Counties: Williamson County, Texas

ENDANGERED SPECIES ACT SPECIES

There is a total of 11 threatened, endangered, or candidate species on this species list.

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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.

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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.

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NAME	STATUS
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BIRDS

NAME	STATUS
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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. Your location does not overlap the critical habitat. This species only needs to be considered under the following conditions: ▪ Wind Energy Projects Species profile: https://ecos.fws.gov/ecp/species/6039	Threatened
Rufa Red Knot *Calidris canutus rufa* There is **proposed** critical habitat for this species. Your location does not overlap the critical habitat. 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. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/758	Endangered

CLAMS

NAME	STATUS
Balcones Spike *Fusconaia iheringi* Population: There is **final** critical habitat for this species. Your location does not overlap the critical habitat. Species profile: https://ecos.fws.gov/ecp/species/10909	Endangered

INSECTS

NAME	STATUS
Coffin Cave Mold Beetle *Batrisodes texanus* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/6234	Endangered
Monarch Butterfly *Danaus plexippus*	Candidate

NAME	STATUS
No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/9743	
Tooth Cave Ground Beetle *Rhadine persephone* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/5625	Endangered

ARACHNIDS

NAME	STATUS
Bone Cave Harvestman *Texella reyesi* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/5306	Endangered
Tooth Cave Spider *Tayshaneta myopica* No critical habitat has been designated for this species. Species profile: https://ecos.fws.gov/ecp/species/2360	Endangered

CRITICAL HABITATS

THERE ARE NO CRITICAL HABITATS WITHIN YOUR PROJECT AREA UNDER THIS OFFICE'S JURISDICTION.

YOU ARE STILL REQUIRED TO DETERMINE IF YOUR PROJECT(S) MAY HAVE EFFECTS ON ALL ABOVE LISTED SPECIES.

IPAC USER CONTACT INFORMATION

Agency: Private Entity
Name: Kelsey Calvez
Address: 10431 Morado Circle
City: Austin
State: TX
Zip: 78759
Email kelsey.calvez@freese.com
Phone: 5126173165

LEAD AGENCY CONTACT INFORMATION

Lead Agency: Natural Resources Conservation Service

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Lee M. Bass
Chairman-Emeritus
Fort Worth

T. Dan Friedkin
Chairman-Emeritus
Houston

David Yoskowitz, Ph.D.
Executive Director

December 8, 2023

Ms. Kelsey Calvez
Freese and Nichols, Inc.
10431 Morado Circle
Bldg. 5, Suite 300
Austin, TX 78759

RE: Upper Brushy Creek No. 29 NRCS Dam Rehabilitation Project, Williamson County, Texas

Dear Ms. Calvez:

Texas Parks and Wildlife Department (TPWD) has received the request for review of the proposed project referenced above. TPWD staff has reviewed the information provided and offers the following information and recommendations concerning this project. For tracking purposes, please refer to TPWD project number 51680 in any return correspondence regarding this project.

Project Description

Upgrade Upper Brushy Creek FRS No. 29 to meet current safety and performance standards for a high hazard potential dam.

General Construction Recommendations

TPWD would like to provide the following general construction recommendations to assist in project planning.

Recommendation: TPWD recommends implementing Beneficial Management Practices (BMPs) to prevent erosion and sedimentation into the waters and wetlands within the project area. Erosion and sediment control measures include temporary or permanent seeding (with native plants), mulching, earth dikes, silt fences, sediment traps, and sediment basins. Examples of post-construction BMPs include vegetation systems (biofilters) such as grass filter strips and vegetated swales as well as retention basins capable of treating any additional runoff. Erosion controls and sediment runoff control measures should be installed prior to construction and maintained until disturbed areas are permanently revegetated using site-specific native vegetation. Measures should be properly installed to effectively minimize the amount of sediment and other debris entering the waterway.

Natural buffers contiguous to any wetlands or aquatic systems should remain undisturbed to preserve wildlife cover, food sources, and travel corridors. During construction, trucks and equipment should use existing bridge or culvert structures to cross creeks, and equipment staging areas should be located in previously disturbed areas outside of riparian corridors. Destruction

December 8, 2023

Ms. Kelsey Calvez
Freese and Nichols, Inc.
10431 Morado Circle
Bldg. 5, Suite 300
Austin, TX 78759

RE: Upper Brushy Creek No. 29 NRCS Dam Rehabilitation Project, Williamson County, Texas

Dear Ms. Calvez:

Texas Parks and Wildlife Department (TPWD) has received the request for review of the proposed project referenced above. TPWD staff has reviewed the information provided and offers the following information and recommendations concerning this project. For tracking purposes, please refer to TPWD project number 51680 in any return correspondence regarding this project.

Project Description

Upgrade Upper Brushy Creek FRS No. 29 to meet current safety and performance standards for a high hazard potential dam.

General Construction Recommendations

TPWD would like to provide the following general construction recommendations to assist in project planning.

Recommendation: TPWD recommends implementing Beneficial Management Practices (BMPs) to prevent erosion and sedimentation into the waters and wetlands within the project area. Erosion and sediment control measures include temporary or permanent seeding (with native plants), mulching, earth dikes, silt fences, sediment traps, and sediment basins. Examples of post-construction BMPs include vegetation systems (biofilters) such as grass filter strips and vegetated swales as well as retention basins capable of treating any additional runoff. Erosion controls and sediment runoff control measures should be installed prior to construction and maintained until disturbed areas are permanently revegetated using site-specific native vegetation. Measures should be properly installed to effectively minimize the amount of sediment and other debris entering the waterway.

Natural buffers contiguous to any wetlands or aquatic systems should remain undisturbed to preserve wildlife cover, food sources, and travel corridors. During construction, trucks and equipment should use existing bridge or culvert structures to cross creeks, and equipment staging areas should be located in previously disturbed areas outside of riparian corridors. Destruction

of inert microhabitats in waterways such as snags, brush piles, fallen logs, creek banks, pools, and gravel stream bottoms should also be avoided, as these provide habitat for a variety of fish and wildlife species and their food sources.

If trenching or other excavation is involved in construction, TPWD recommends that contractors keep trenching and excavation and backfilling crews close together to minimize the number of trenches or excavation areas left open at any given time during construction. TPWD recommends that any open trenches or excavation areas be covered overnight and inspected every morning to ensure no wildlife species have been trapped. Trenches left open for more than two daylight hours should be inspected for the presence of trapped wildlife prior to backfilling. If trenches and excavation areas cannot be backfilled the day of initial excavation, then escape ramps should be installed at least every 90 meters (approximately 295 feet). Escape ramps can be short lateral trenches or wooden planks sloping to the surface at an angle less than 45 degrees (1:1).

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 microplastics should be avoided.

TPWD recommends the judicious use and placement of sediment control fence to exclude wildlife from the construction area. In many cases sediment control fence placement for the purposes of controlling erosion and protecting water quality can be modified minimally to also provide the benefit of excluding wildlife access to active construction areas. The exclusion fence should be buried at least six inches and be at least 24 inches high. The exclusion fence should be maintained during active construction and only be removed after the construction is completed. Construction personnel should be encouraged to examine the inside of the exclusion area daily to determine if any wildlife species have been trapped inside the active construction area and provide safe egress opportunities prior to initiation of daily construction activities.

During construction of the proposed project, TPWD recommends observing slow (25 miles per hour, or less) speed limits within the project area. Reduced speed limits would allow personnel to see wildlife in the vehicle path and avoid wildlife injury or death.

Impacts to Vegetation/Wildlife Habitat

The information provided states that "Disturbed areas would be revegetated with native plant species once construction is complete."

> **Recommendation:** TPWD recommends that the removal of native vegetation during construction be minimized to the extent feasible. Unavoidable removal of vegetation should be mitigated by revegetating disturbed areas with site specific plant species where feasible. The replacement of native plants will help control erosion, provide habitat for wildlife, and provide native species an opportunity to compete with undesirable, non-native, invasive plant species.

Monarch and Pollinator Conservation

In December 2020, the U.S. Fish and Wildlife Service (USFWS) determined that Endangered Species Act (ESA) listing for the monarch butterfly (*Danaus plexippus*) was warranted; however, listing was precluded by higher priority listing actions. Currently, the monarch butterfly is a candidate for listing and the USFWS will review the species status annually until a proposal for listing is developed.

There is widespread concern regarding the decline of monarch butterflies and other native insect pollinator species due to reductions in native floral resources. To support pollinators and migrating monarchs, TPWD encourages the establishment of native wildflower habitats on private and public lands. By acting as refugia for pollinators in otherwise inhospitable landscapes, this habitat can contribute to the maintenance of healthy ecosystems and provide ecological services such as crop pollination.

> **Recommendation:** To contribute to pollinator conservation efforts, TPWD encourages the project proponent to revegetate impacted areas with vegetation that provides habitat for monarch butterflies and other pollinator species. Species appropriate for the project area can be found by accessing the Lady Bird Johnson Wildflower Center Native Plants Database, working with TPWD biologists to develop an appropriate list of species, or utilizing resources found at the Monarch Watch website or the Xerces Society's Guidelines website.

Federal Laws

Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) prohibits taking, attempting to take, capturing, killing, selling, purchasing, possessing, transporting, and importing of migratory birds, their eggs, parts, or nests, except when specifically authorized by the Department of the Interior. This protection applies to most native bird species, including ground nesting species. The USFWS Migratory Bird Office can be

contacted at (505) 248-7882 for more information on potential impacts to migratory birds.

Recommendation: TPWD recommends any vegetation clearing be scheduled outside of the general bird nesting season of March 15th to September 15th. If clearing vegetation during the migratory bird nesting season is unavoidable, TPWD recommends surveying the area proposed for disturbance to ensure that no nests with eggs or young will be disturbed by construction. Nest surveys should be conducted not more than five days prior to clearing activities to maximize detection of active nests. TPWD generally recommends a 100-foot radius buffer of vegetation remain around active nests until the eggs have hatched and the young have fledged; however, the size of the buffer zone depends on various factors and can be coordinated with the local or regional USFWS office. Raptor nesting occurs late winter through early spring; TPWD recommends construction activities be excluded from a minimum zone of 100 meters (approximately 328 feet) surrounding any raptor nest during the period of February 1st through July 15th. The USFWS can be contacted at the number listed above for further information.

State Laws

Parks and Wildlife Code – Chapter 64, Birds

Parks and Wildlife Code (PWC) Section 64.002, regarding protection of nongame birds, provides that no person may catch, kill, injure, pursue, or possess a bird that is not a game bird. PWC Section 64.003, regarding destroying nests or eggs, provides that, no person may destroy or take the nests, eggs, or young and any wild game bird, wild bird, or wild fowl.

Recommendation: Please review the *Migratory Bird Treaty Act* section above for recommendations as they are also applicable for Chapter 64 of the PWC compliance.

Parks and Wildlife Code, Section 68.015 – State listed Species

PWC Section 68.015 regulates state listed threatened and endangered animal species. The capture, trap, take, or killing of state listed threatened and endangered animal species is unlawful unless expressly authorized under a permit issued by USFWS or TPWD. A copy of TPWD *Protection of State Listed Species Guidelines*, which includes a list of penalties for take can be found on the TPWD website. State listed species may only be handled by persons with the appropriate authorization obtained through the TPWD Wildlife Permits Program. For more information on this authorization, please contact the Wildlife Permits Office at (512) 389-4647.

Species of Greatest Conservation Need

In addition to state and federally protected species, TPWD tracks species considered to be Species of Greatest Conservation Need (SGCN) that, due to limited distributions or declining populations, face threat of extirpation or extinction but currently lack the legal protections given to threatened or endangered species. Special landscape features, natural plant communities, and SGCN are rare resources for which TPWD actively promotes conservation, and TPWD considers it important to minimize impacts to such resources to reduce the likelihood of endangerment and preclude the need to list SGCN as threatened or endangered in the future. These species and communities are tracked in the Texas Natural Diversity Database (TXNDD). The most current and accurate TXNDD data can be requested from the TXNDD website.

TPWD notes that there are no TXNDD observations of SGCN, natural communities, or special features located in the proposed project area.

> **Recommendation:** TPWD recommends reviewing the Rare, Threatened, and Endangered Species of Texas online application for Williamson County, as rare and protected species could be present in the project area, depending upon habitat availability.

Determining the actual presence of a species in an area depends on many variables including daily and seasonal activity cycles, environmental activity cues, preferred habitat, transiency, and population density (both wildlife and human). The absence of a species can only be established with repeated negative observations and consideration of all factors contributing to the lack of detectable presence.

> **Recommendation:** TPWD recommends providing information prior to construction to educate personnel of the potential occurrence of rare and protected species within the project area, and the relevant rules and regulations that protect plants, fish, and wildlife. If encountered during construction, measures should be taken to avoid impacting wildlife.

TPWD strives to respond to requests for project review within a 45-day comment period. Responses may be delayed due to workload and lack of staff. Failure to meet the 45-day review timeframe does not constitute a concurrence from TPWD that the proposed project will not adversely impact fish and wildlife resources. Please contact me at (806) 761-4930 ext. 4936 or Richard.Hanson@tpwd.texas.gov if you have any questions.

Sincerely,

Rick Hanson

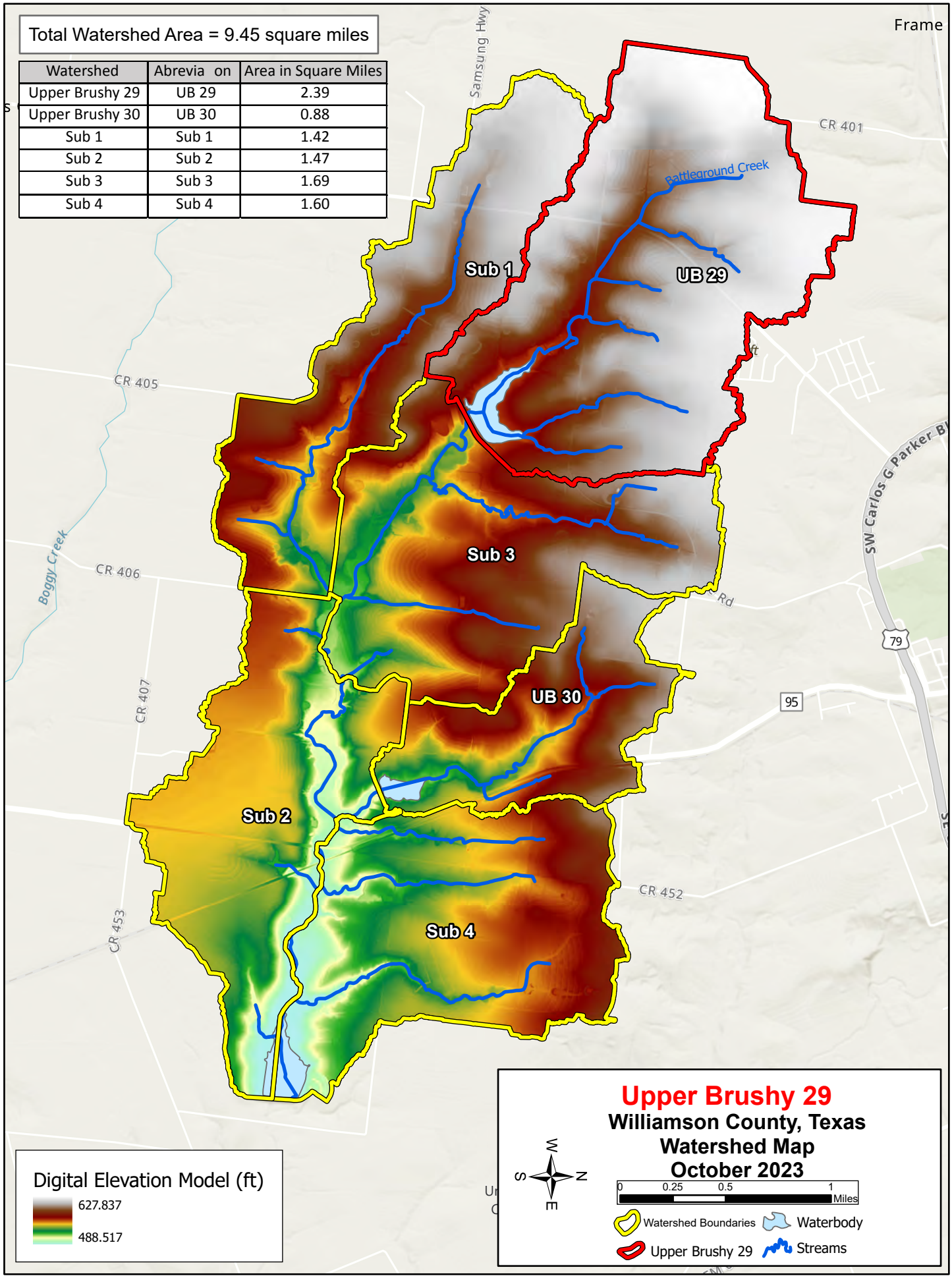
Rick Hanson
Ecological & Environmental Planning Program
Wildlife Division

RH:51680

Appendix B - Watershed Project Map

Total Watershed Area = 9.45 square miles

Watershed	Abrevia on	Area in Square Miles
Upper Brushy 29	UB 29	2.39
Upper Brushy 30	UB 30	0.88
Sub 1	Sub 1	1.42
Sub 2	Sub 2	1.47
Sub 3	Sub 3	1.69
Sub 4	Sub 4	1.60



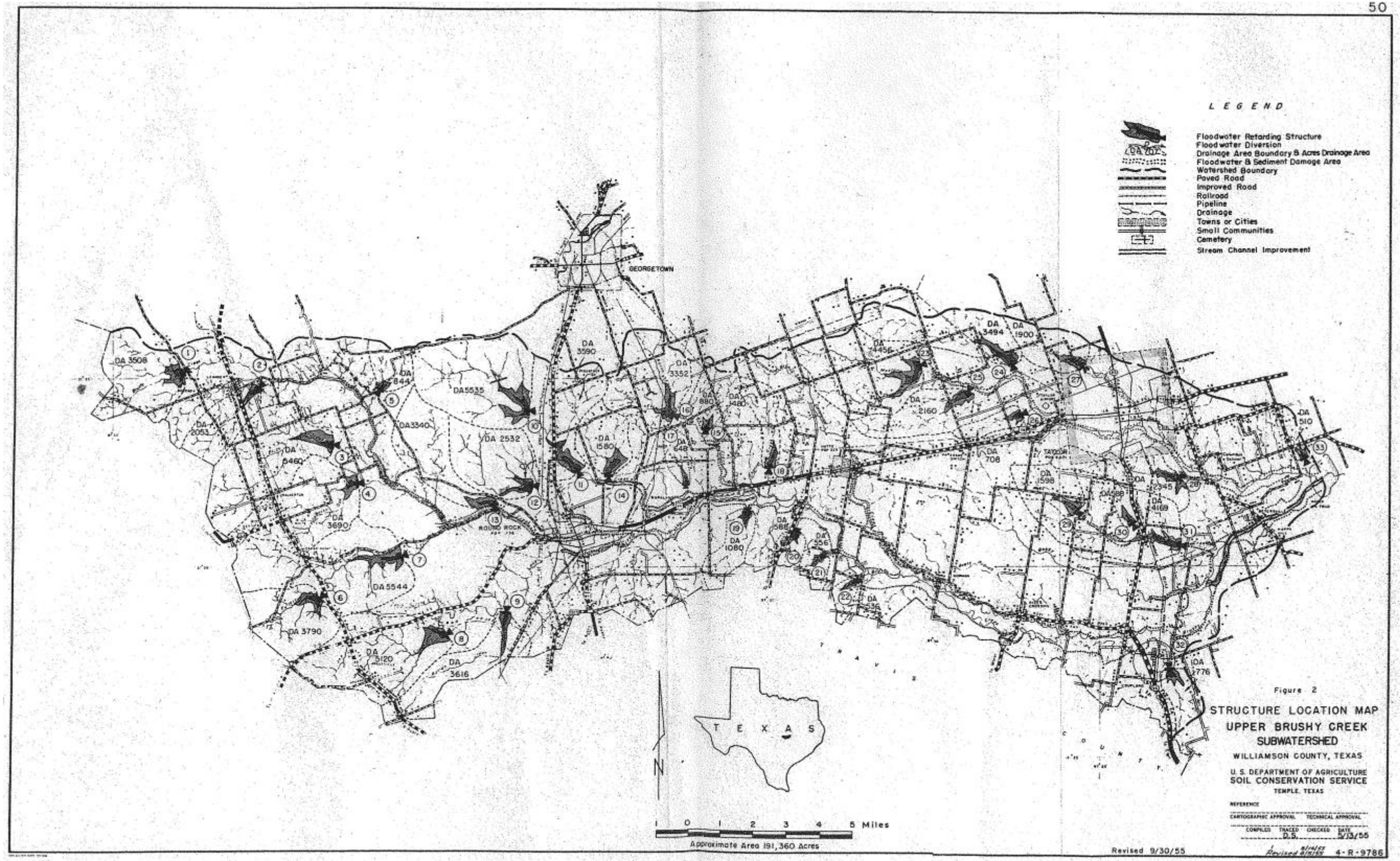


Figure 2

STRUCTURE LOCATION MAP
UPPER BRUSHY CREEK SUBWATERSHED
WILLIAMSON COUNTY, TEXAS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
TEMPLE, TEXAS

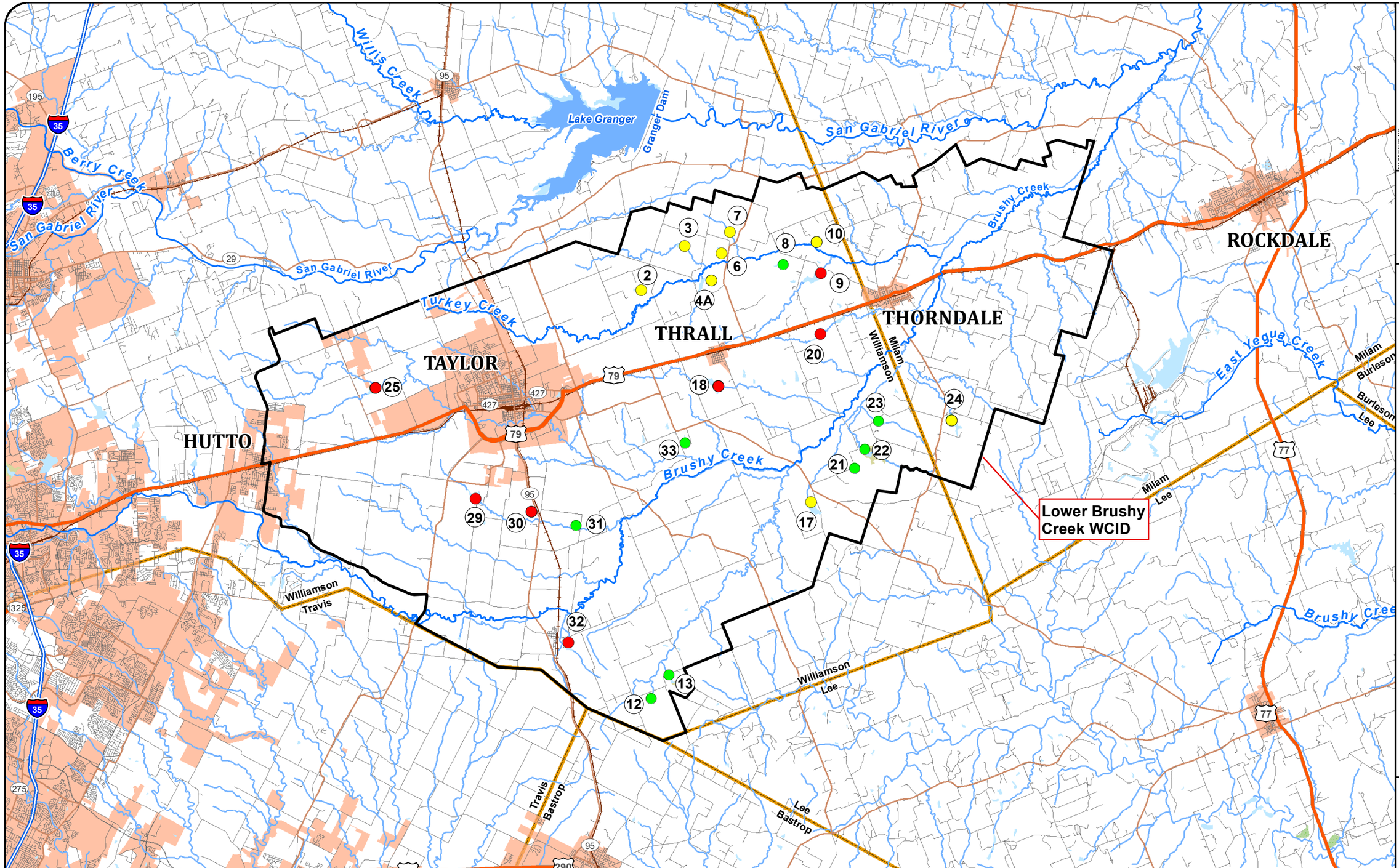
REFERENCE

CARTOGRAPHIC APPROVAL	TECHNICAL APPROVAL

COMPILED	TRACED	CHECKED	DATE
	D.S.		9/13/55

Revised 9/30/55

Revised 8/4/65 8/19/65 4-R-9786



Hazard Status
- High
- Significant
- Low

- LBC Main
- Streets (Local)
- City Limits

- Stream River
- Lake Granger
- Counties

0 3 Miles

N

LOWER BRUSHY CREEK WATER CONTROL AND IMPROVEMENT DISTRICT

Programming Study

District Map

FIGURE 2.2

FREESE AND NICHOLS, INC.
10814 JOLLYVILLE ROAD
BUILDING 4, SUITE 100
AUSTIN, TX 78759
PHONE: 512.617.3100

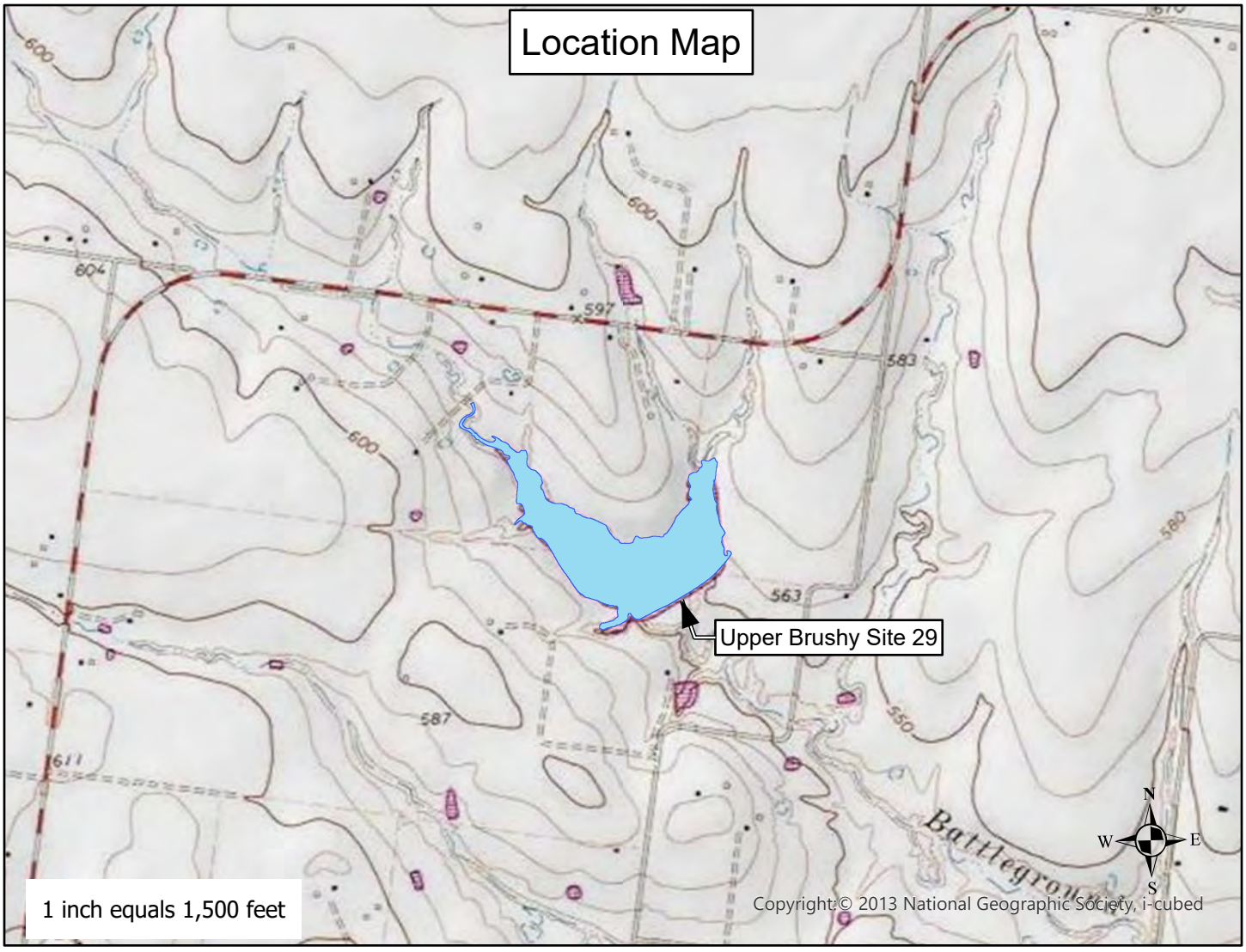
FN PROJECT NO.	OF117050
DATE CREATED	Date: 12/7/2017
DATUM & COORDINATE SYSTEM	NAD83 State Plane (feet) Texan Central
FILE NAME	Document Name: District_Map_Fig2_2_20171207
PREPARED BY	BCK

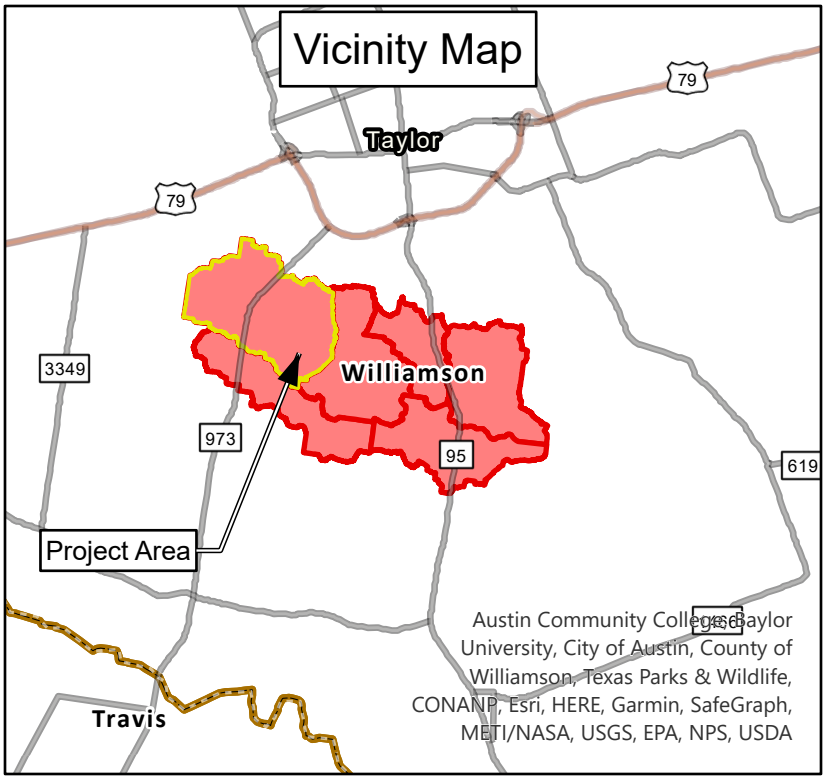
Date Saved: 12/7/2017 3:00:27 PM

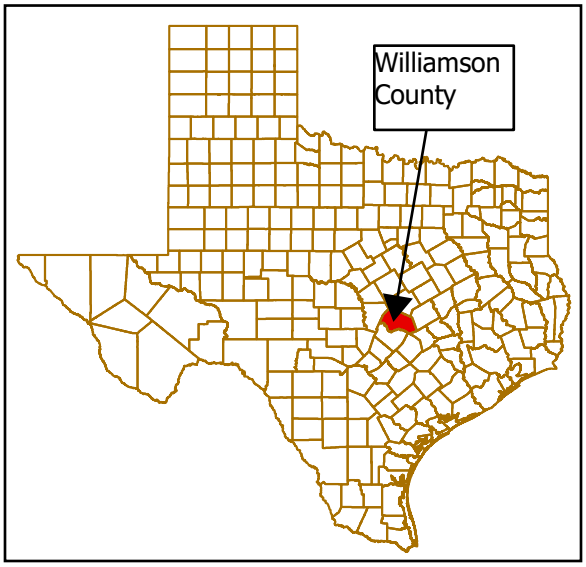
Document Path: H:\BrushyCreek\LBC_WCID_20171207\District_Map_Fig2_2_20171207.mxd

Appendix C - Support Maps

C-1: Location Vicinity Map, Upper Brushy Creek 29







Upper Brushy Site 29

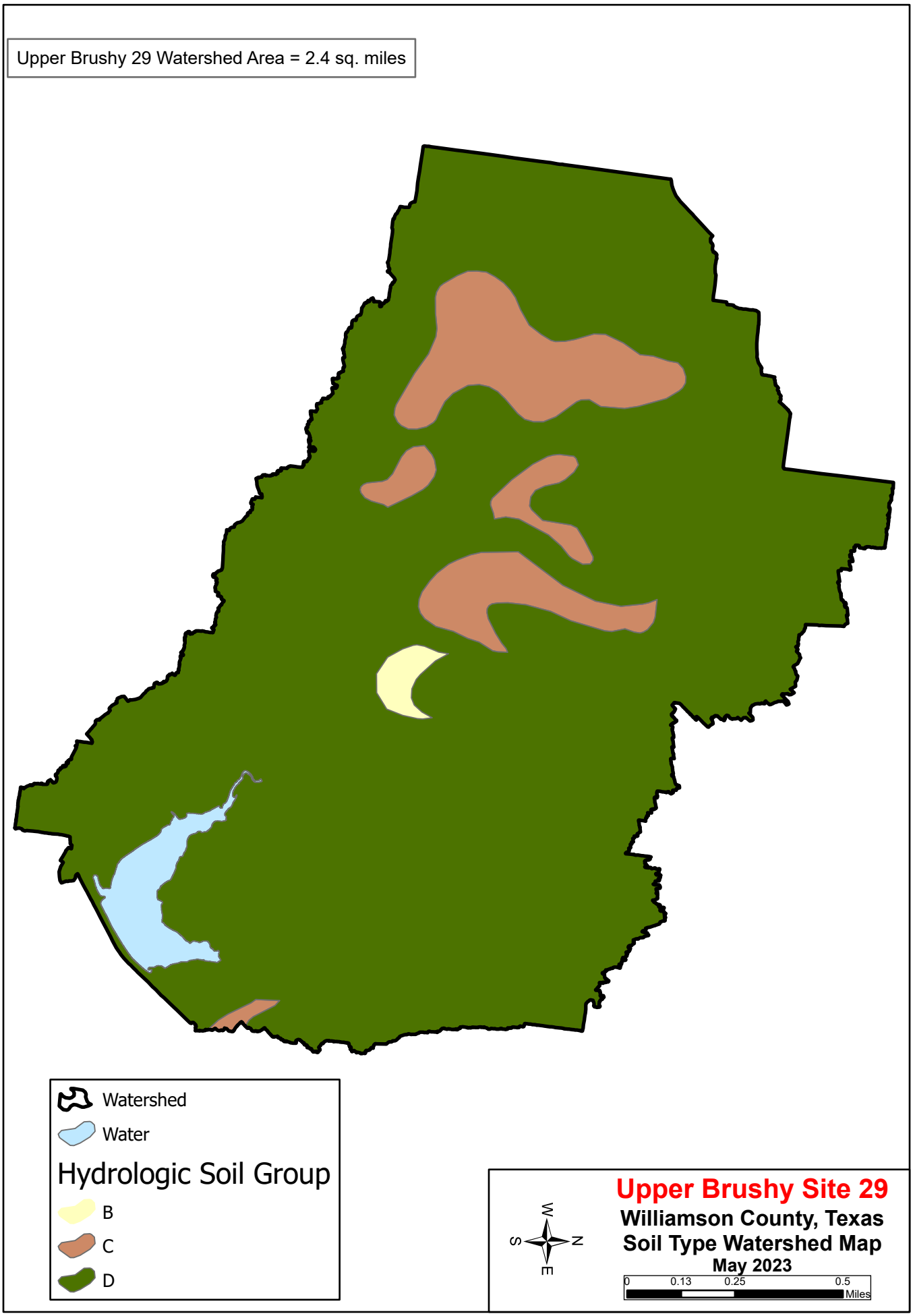
Williamson County, Texas

October 2023

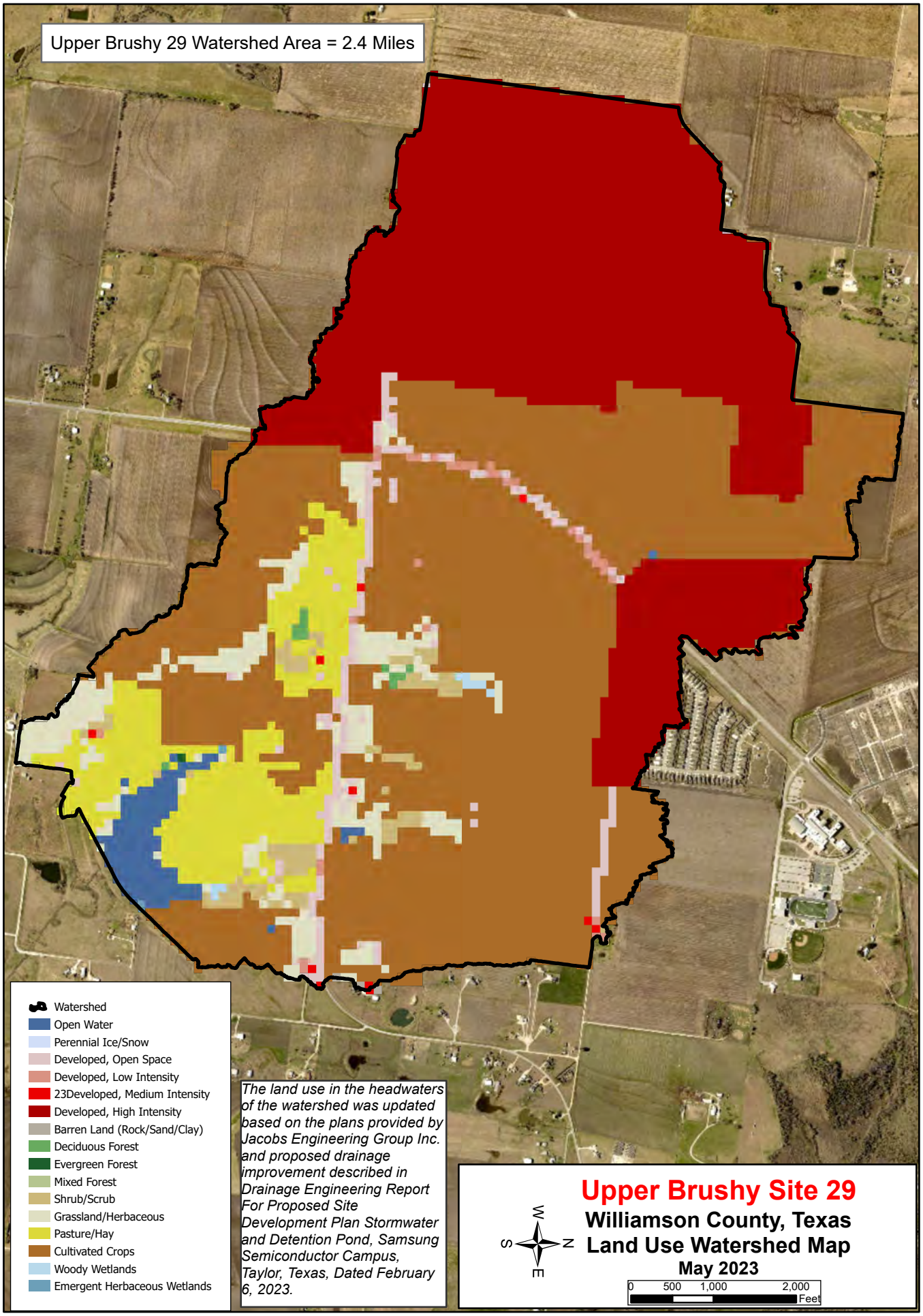
USDA United States Department of Agriculture

C-2: Watershed Map, Upper Brushy Creek 29

C-3: Soil Type Map, Upper Brushy Creek 29



C-4: Land Use Map, Upper Brushy Creek 29



C-5: Upstream Area Map, Upper Brushy Creek 29

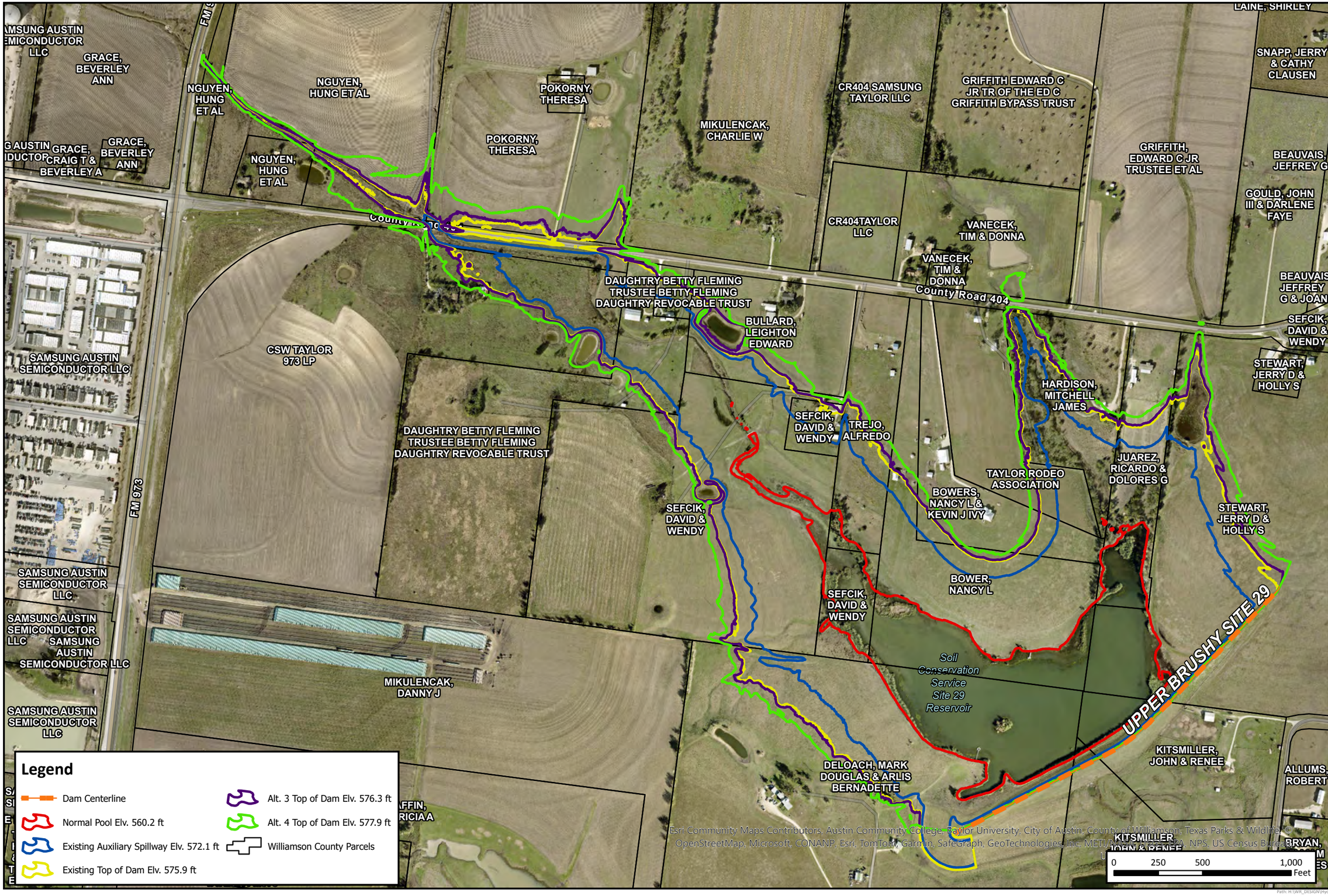


FIGURE C-5

FN JOB NO	TSW23171
FILE	UB29_Workmap
DATE	11/11/2024
SCALE	
DRAFTED	08231

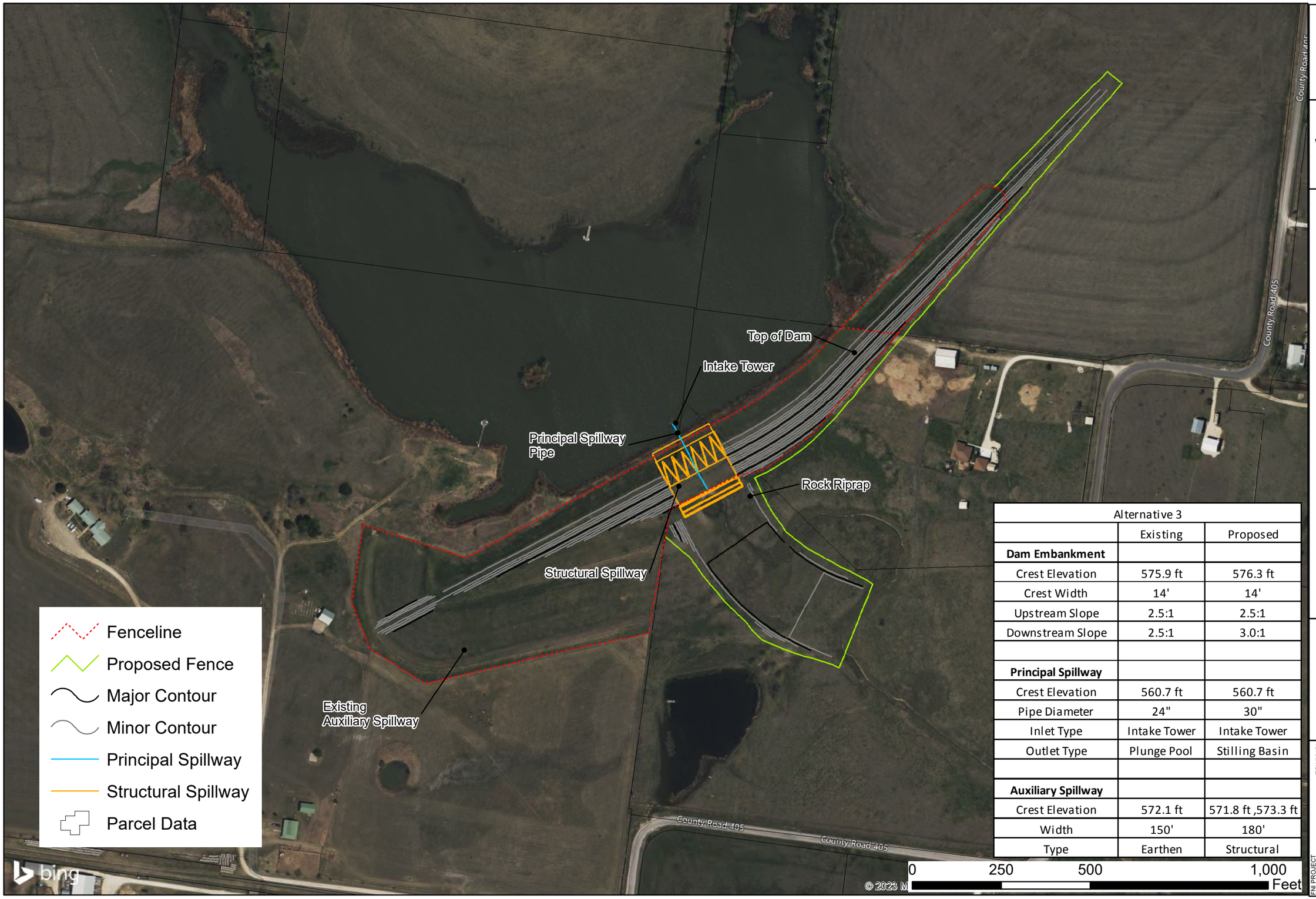
Upstream Area Map

Upper Brushy Creek 29

FREESE NICHOLS
801 Cherry Street, Suite 2800
Fort Worth, TX 76102
(P) 817-735-7300 (F) 817-735-7491

Path: H:\WR_DESIGN\Hydrology\UB29_Workmap\UB29_Workmap.aprx

C-6: Alternative 3 - Plan View, Upper Brushy Creek 29



Alternative 3		
	Existing	Proposed
Dam Embankment		
Crest Elevation	575.9 ft	576.3 ft
Crest Width	14'	14'
Upstream Slope	2.5:1	2.5:1
Downstream Slope	2.5:1	3.0:1
Principal Spillway		
Crest Elevation	560.7 ft	560.7 ft
Pipe Diameter	24"	30"
Inlet Type	Intake Tower	Intake Tower
Outlet Type	Plunge Pool	Stilling Basin
Auxiliary Spillway		
Crest Elevation	572.1 ft	571.8 ft ,573.3 ft
Width	150'	180'
Type	Earthen	Structural

FIGURE C-6

N W E S

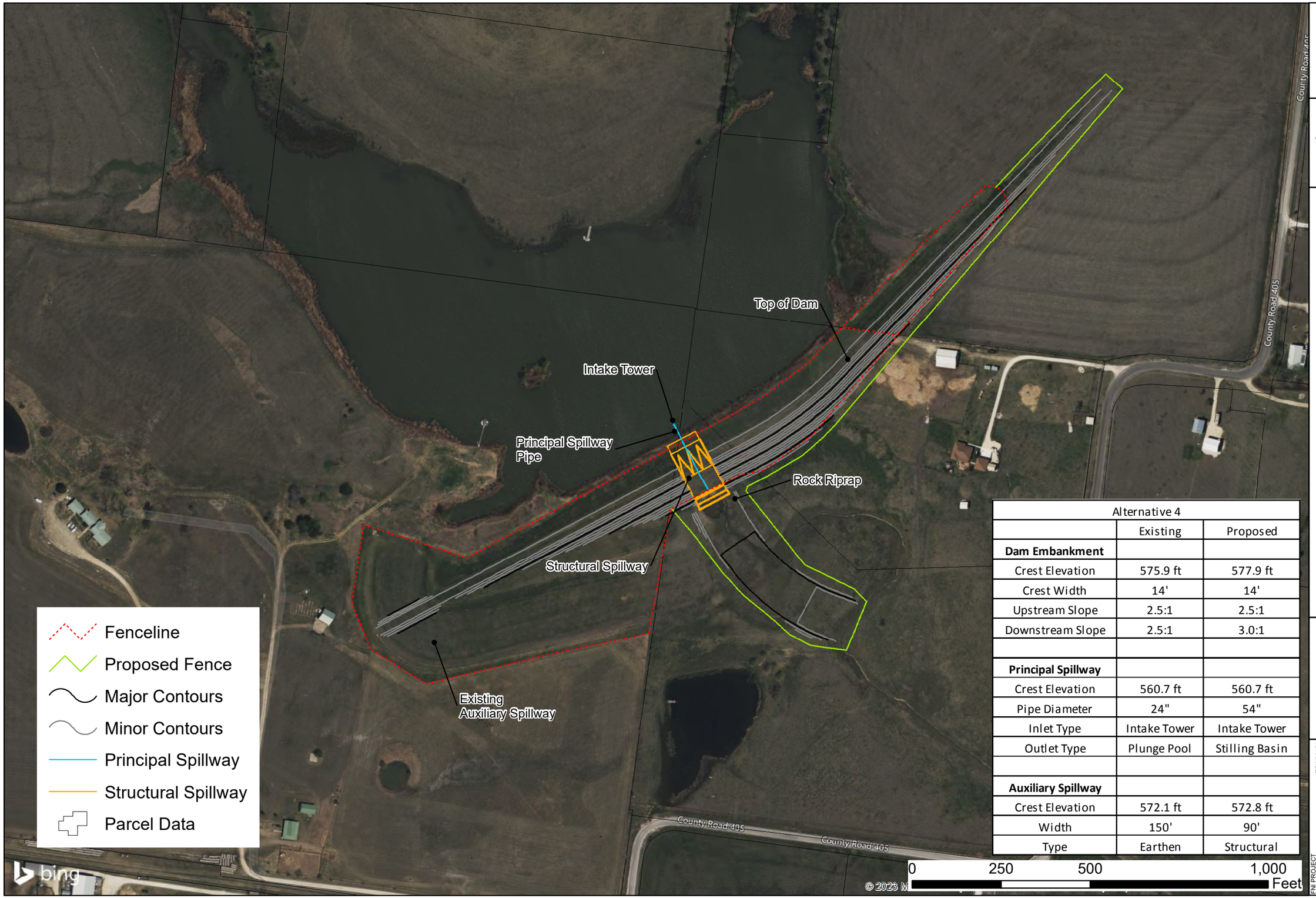
UPPER BRUSHY 29 ALTERNATIVE 3

SUPPLEMENTAL WATERSHED PLAN

FREESE NICHOLS
12770 Merit Drive
Suite 900
Dallas, TX 75251

FNI PROJECT TSW23171
FILE H:\WR_DESIGN\Figures\WC21\pdtream\Area
DATUM & COORDINATE SYSTEM NAD 1983 StatePlane Texas Central FIPS 4203 Feet
DATE October 2023
PREPARED BY BET

C-7: Alternative 4 - Plan View, Upper Brushy Creek 29



Alternative 4		
	Existing	Proposed
Dam Embankment		
Crest Elevation	575.9 ft	577.9 ft
Crest Width	14'	14'
Upstream Slope	2.5:1	2.5:1
Downstream Slope	2.5:1	3.0:1
Principal Spillway		
Crest Elevation	560.7 ft	560.7 ft
Pipe Diameter	24"	54"
Inlet Type	Intake Tower	Intake Tower
Outlet Type	Plunge Pool	Stilling Basin
Auxiliary Spillway		
Crest Elevation	572.1 ft	572.8 ft
Width	150'	90'
Type	Earthen	Structural

FIGURE C-7

N W E S

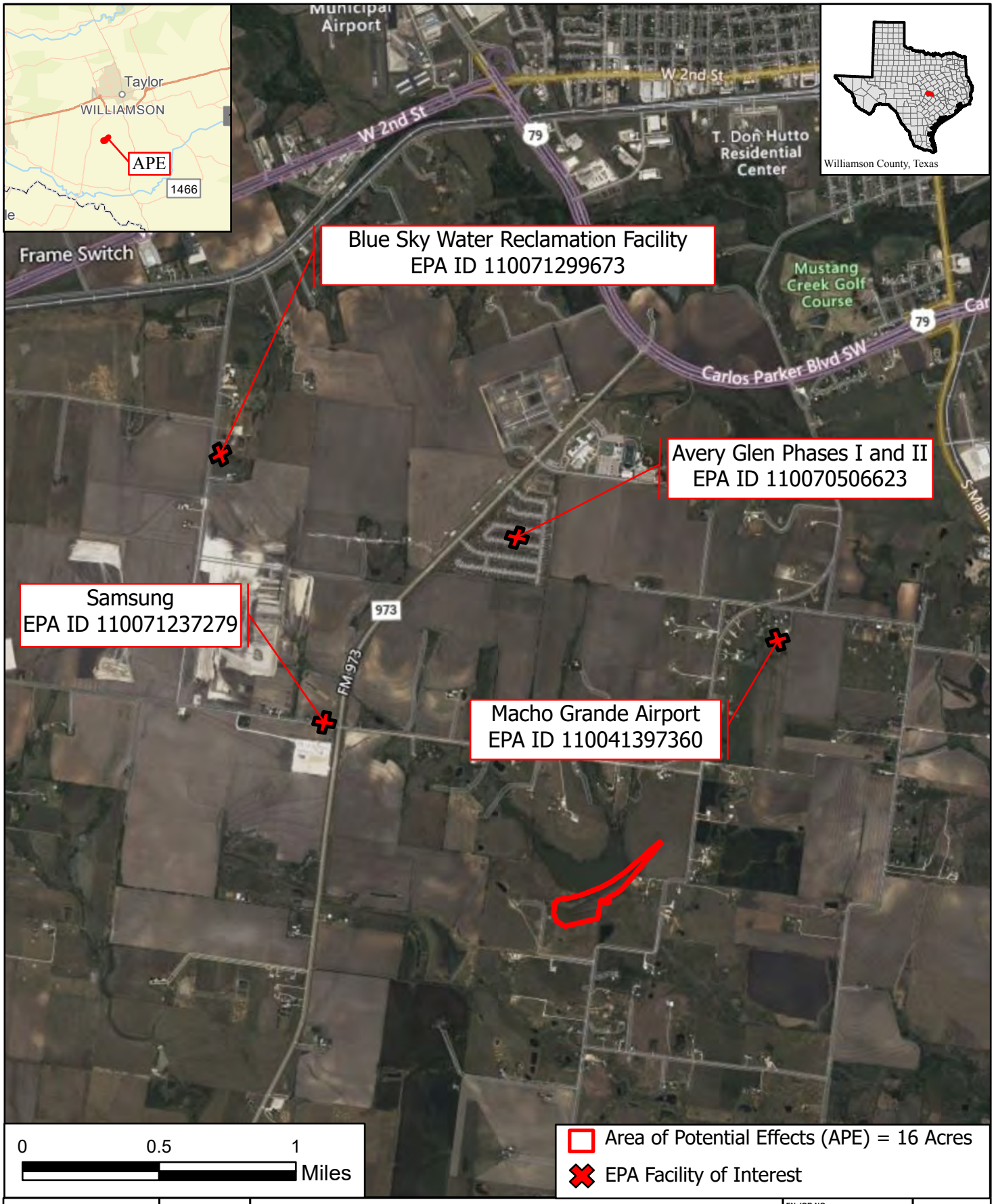
UPPER BRUSHY 29 ALTERNATIVE 4

SUPPLEMENTAL WATERSHED PLAN

FREESE NICHOLS
12770 Merit Drive
Suite 900
Dallas, TX 75251

FNI PROJECT TSW23171
FILE H:\WR_DESIGN\Figures\WC2\UpBrushyArea
DATUM & COORDINATE SYSTEM NAD 1983 StatePlane Texas Central FIPS 4203 Feet
DATE October 2023
PREPARED BY BET

C-8: Hazardous Materials Map, Upper Brushy Creek 29



FREESE AND NICHOLS, INC
10431 Morado Circle, Suite 300
Austin, TX 78759
512-617-3188

Texas State Soil and Water Conservation Board

Upper Brushy Creek Site No. 29

Hazardous Material Map

FN JOB NO	TSW23171
FILE NAME	Tech_Memo_Pro.mxd
DATE	5/4/2023
DESIGNED	02588
DRAFTED	02588

C-8 FIGURE

Path: H:\ENVIRONMENTAL\Final_Exhibits\Tech\Tech_Memo_Pro.aprx

C-9: Area of Potential Effect, Upper Brushy Creek 29

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Austin, TX 78759
512-617-3188

TX STATE SOIL & WATER CONSERVATION

SWP EA - Upper Brushy 29

Aerial Map

FN JOB NO	TSW23171
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DATE	3/23/2023
DESIGNED	HHM
DRAFTED	HHM

C-9 FIGURE

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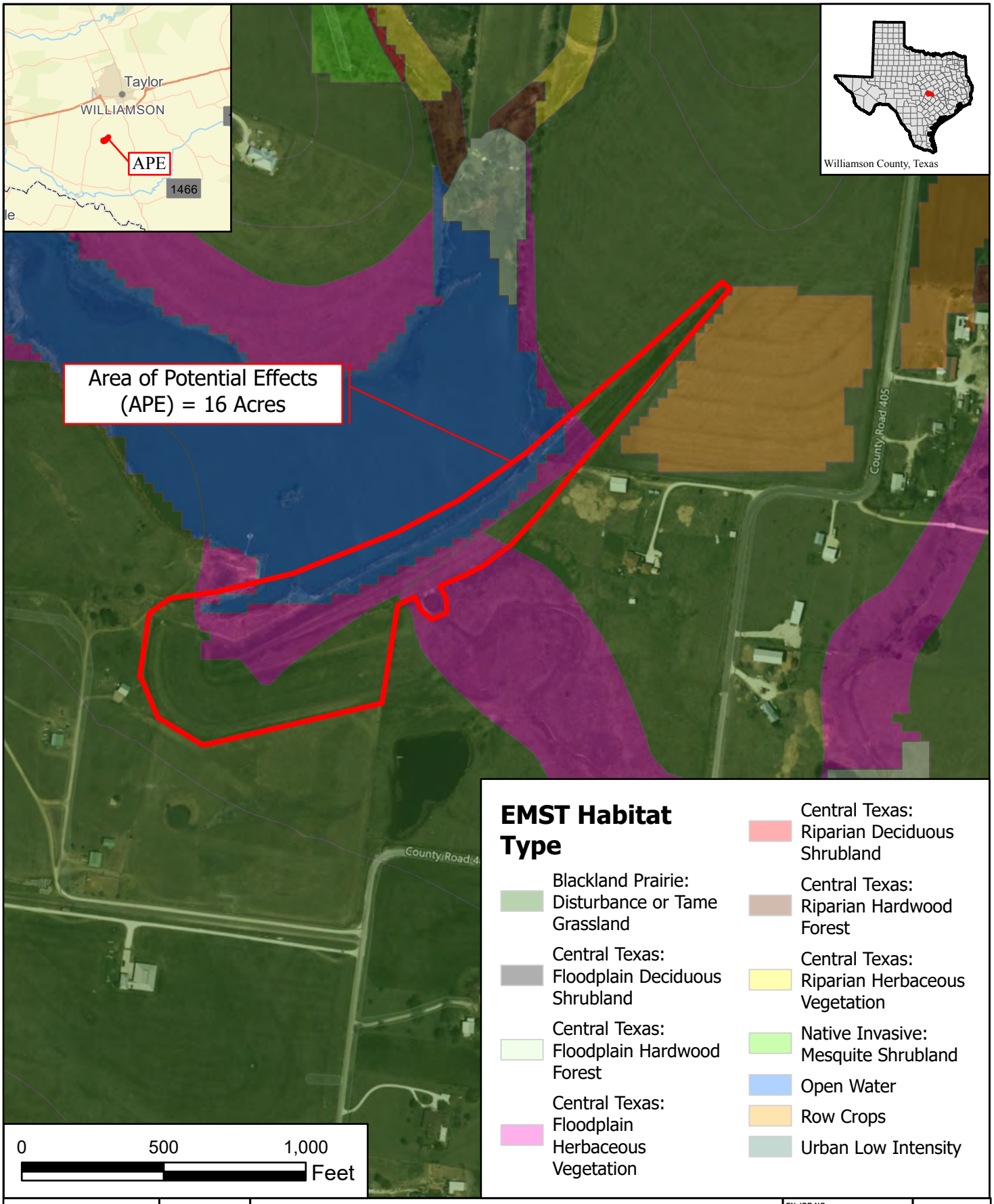
NAD 1983 StatePlane Texas Central FIPS 4203 Feet

C-10: EMST Habitat Map, Upper Brushy Creek 29



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Austin, TX 78759
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N W E S

Texas State Soil and Water Conservation Board

Upper Brushy Creek Site No. 29

EMST Habitat Map

FN JOB NO	TSW23171
FILE NAME	Tech_Memo_Pro.mxd
DATE	5/4/2023
DESIGNED	02588
DRAFTED	02588

C-10

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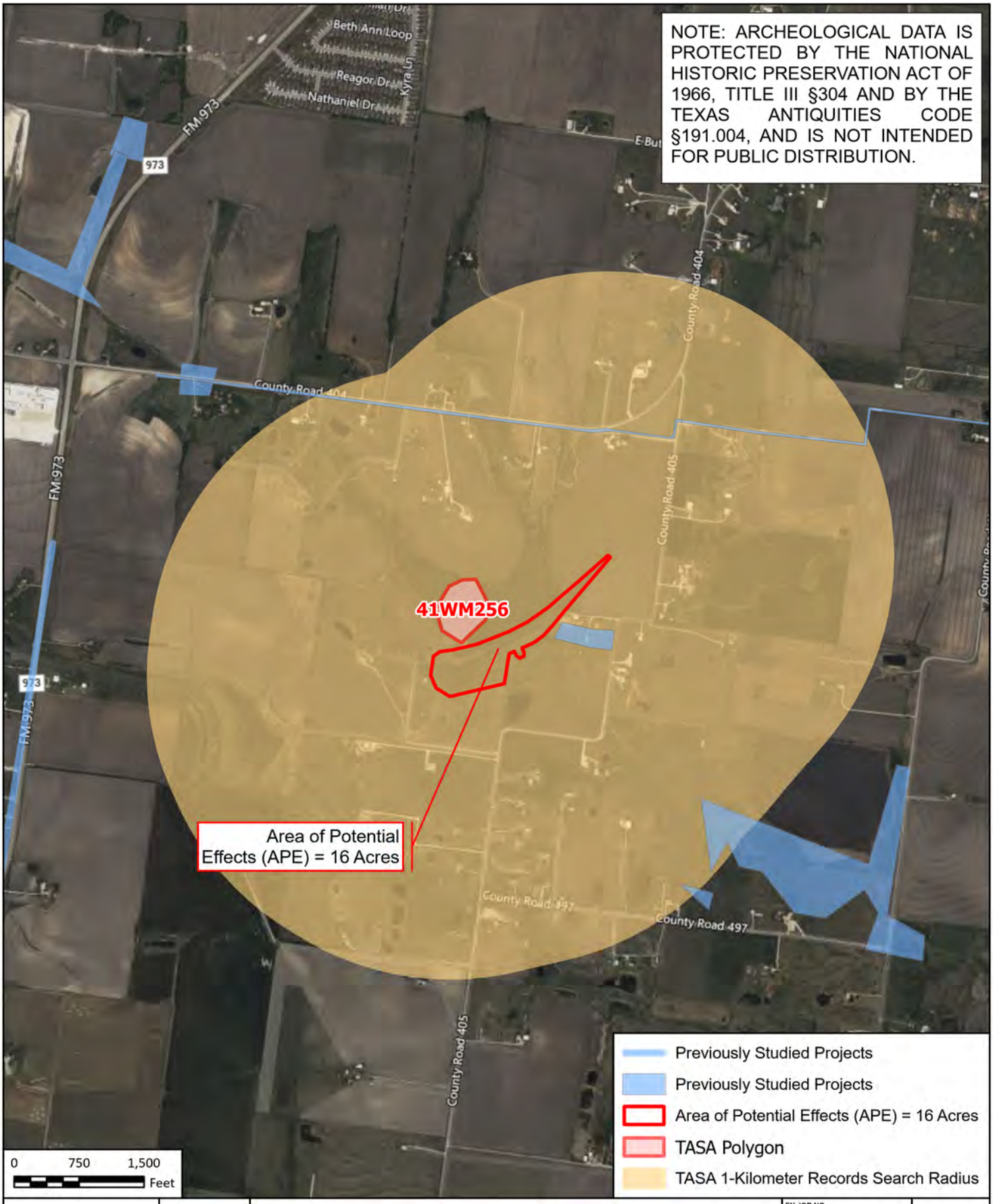
C-11: TASA Atlas Review Map, Upper Brushy Creek 29



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Austin, TX 78759
512-617-3188

TX STATE SOIL & WATER CONSERVATION

SWP EA - Upper Brushy 29

TASA Map

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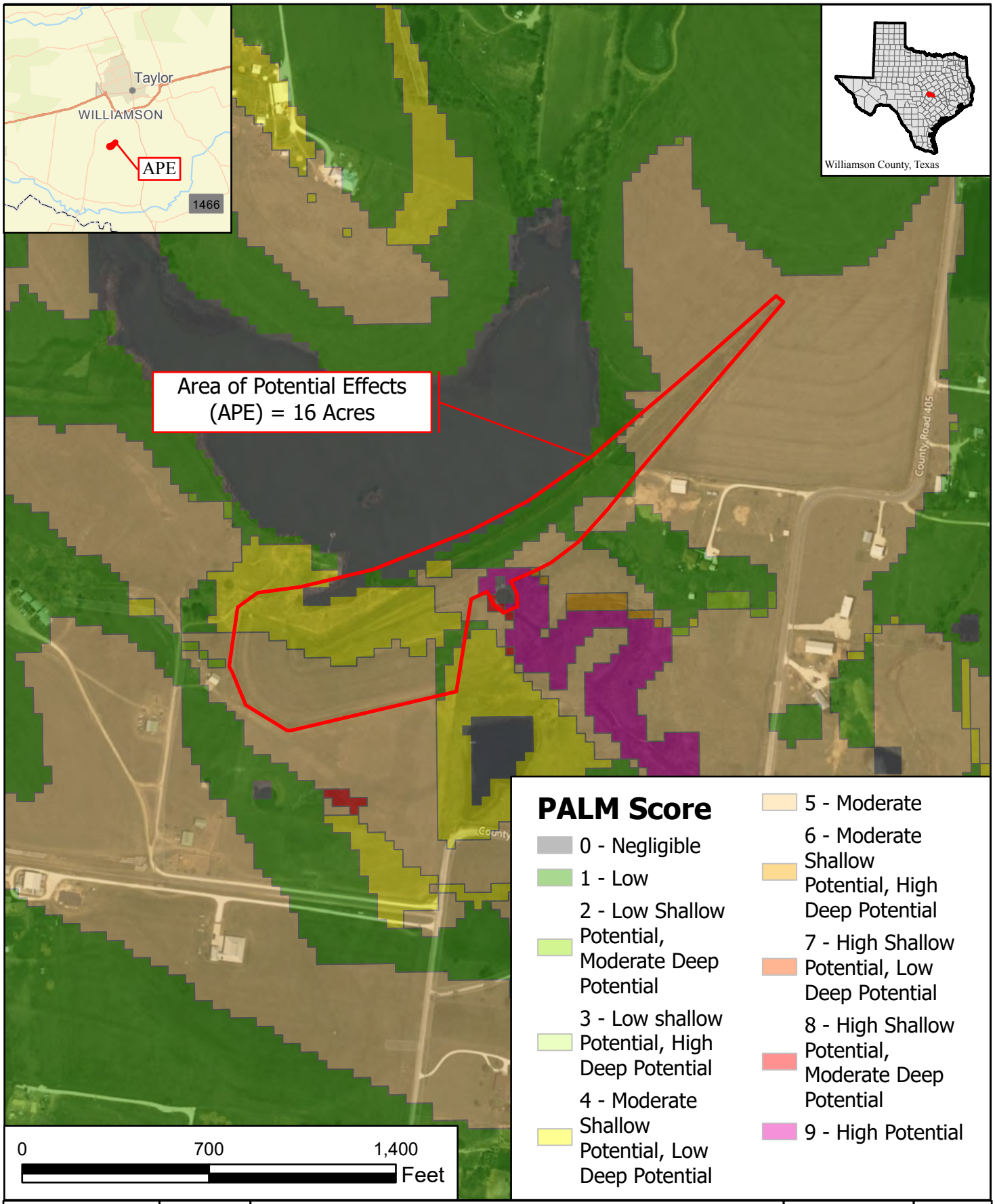
FILE NAME	THC_Memo_Pro.mxd
DATE	3/23/2023
DESIGNED	HHM
DRAFTED	HHM

C-11

Path: H:\ENVIRONMENTAL\Final_Exhibits\THC\THC_Memo_Pro.aprx

NAD 1983 StatePlane Texas Central FIPS 4203 Feet

C-12: Potential Archaeological Liability Map, Upper Brushy Creek 29



FREESE AND NICHOLS, INC
10431 Morado Circle, Suite 300
Austin, TX 78759
512-617-3188

Texas State Soil and Water Conservation Board

Upper Brushy Creek Site No. 29

Potential Archeological Liability Maps (PALMs)

FN JOB NO	TSW23171
FILE NAME	Tech_Memo_Pro.mxd
DATE	5/4/2023
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DRAFTED	02588

C-12

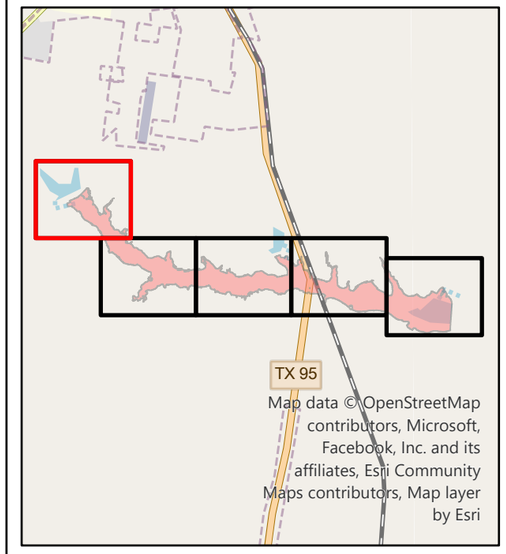
Path: H:\ENVIRONMENTAL\Final_Exhibits\Tech\Tech_Memo_Pro.aprx

C-13: Breach Inundation Map, Upper Brushy Creek 29

UPPER BRUSHY 29
DAM FAILURE MAPPING

Panel 1 of 5

PANEL LOCATOR



LEGEND

- Dam Centerline

Inpacted Strucutes

- Non-Habitable Structure
- Habitable Structure
- Top of Dam Breach Inundation

Breach flood hydrograph was computed using NRCS TR-60 methodology.

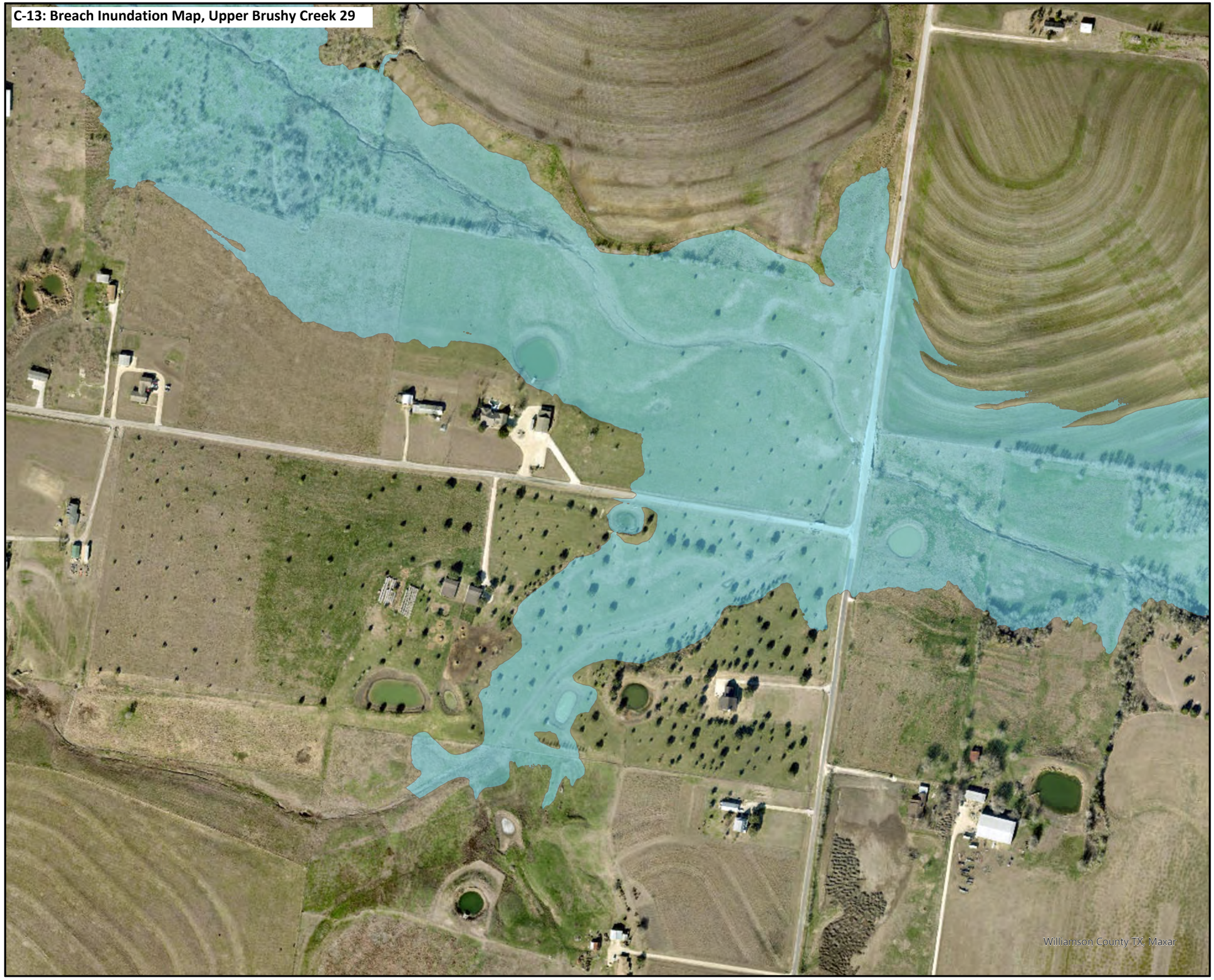
The methods used to develop inundation zones and flood wave arrival times are approximate and should only be used as guidance for establishing evacuation zones. Actual areas inundated will depend on actual failure and pre-failure hydrologic conditions and may differ significantly from information shown on maps.

N

0 0.03 0.05 0.1 Miles

0 150 300 600 Feet

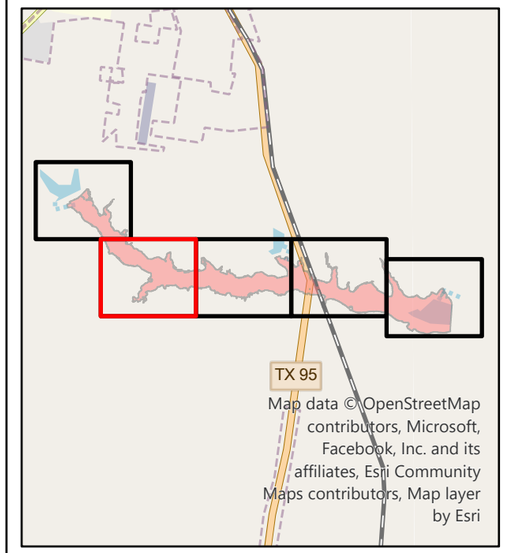
C-13: Breach Inundation Map, Upper Brushy Creek 29



UPPER BRUSHY 29
DAM FAILURE MAPPING

Panel 2 of 5

PANEL LOCATOR



LEGEND

- Dam Centerline

Inpacted Strucutes

- Non-Habitable Structure
- Habitable Structure
- Top of Dam Breach Inundation

Breach flood hydrograph was computed using NRCS TR-60 methodology.

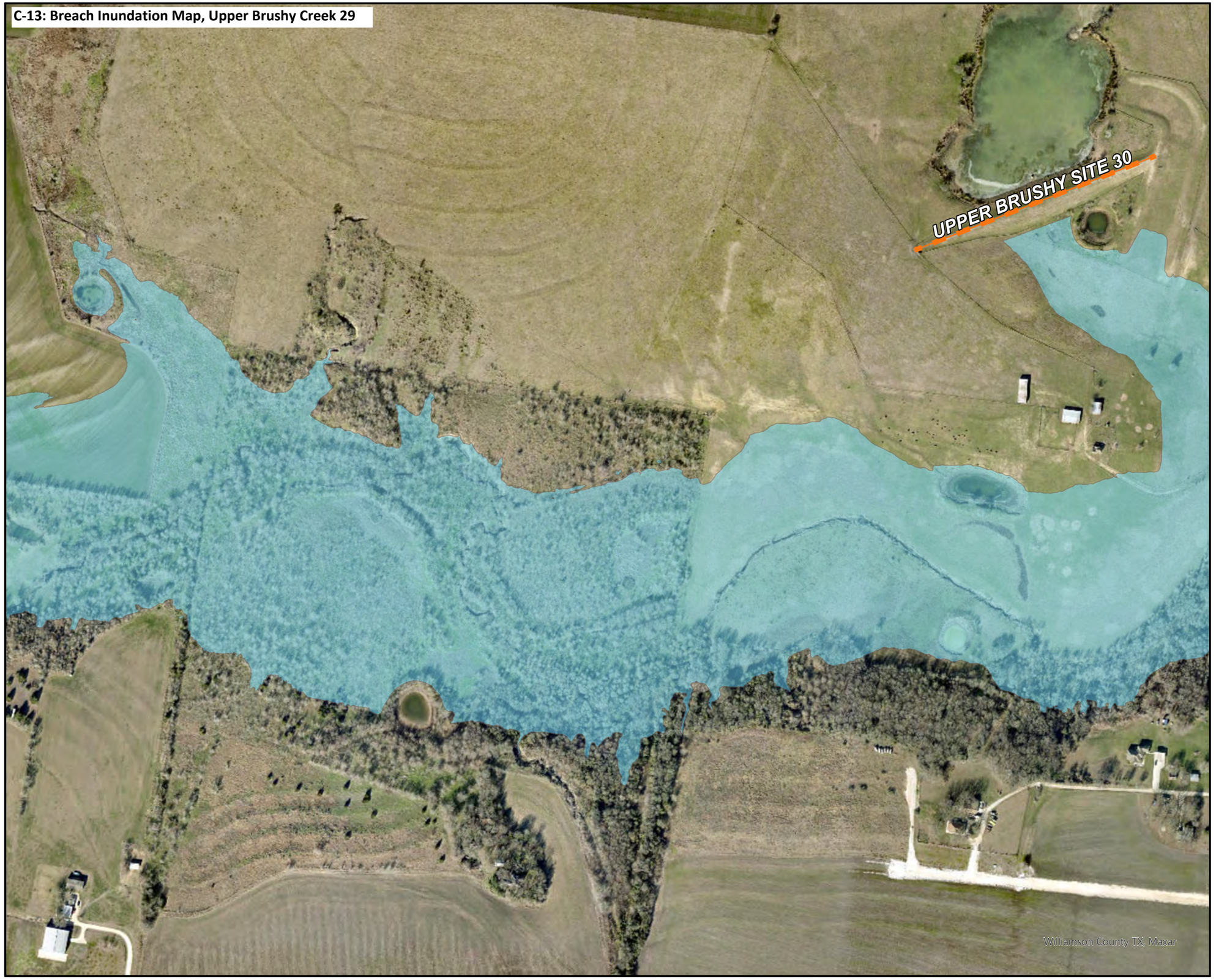
The methods used to develop inundation zones and flood wave arrival times are approximate and should only be used as guidance for establishing evacuation zones. Actual areas inundated will depend on actual failure and pre-failure hydrologic conditions and may differ significantly from information shown on maps.

N

0 0.03 0.05 0.1 Miles

0 150 300 600 Feet

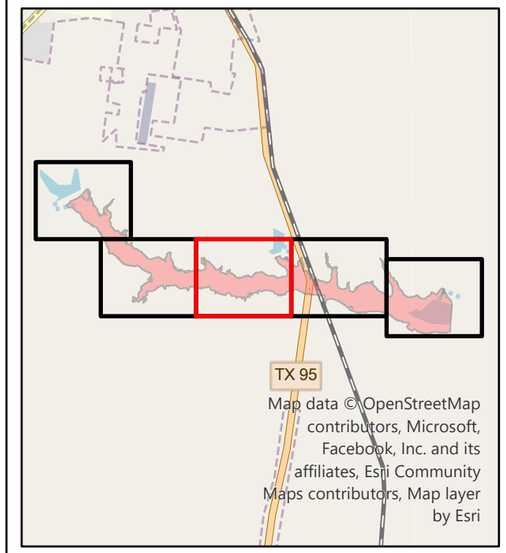
C-13: Breach Inundation Map, Upper Brushy Creek 29



UPPER BRUSHY 29
DAM FAILURE MAPPING

Panel 3 of 5

PANEL LOCATOR



LEGEND

- Dam Centerline

Inpacted Strucutes

- Non-Habitable Structure
- Habitable Structure
- Top of Dam Breach Inundation

Breach flood hydrograph was computed using NRCS TR-60 methodology.

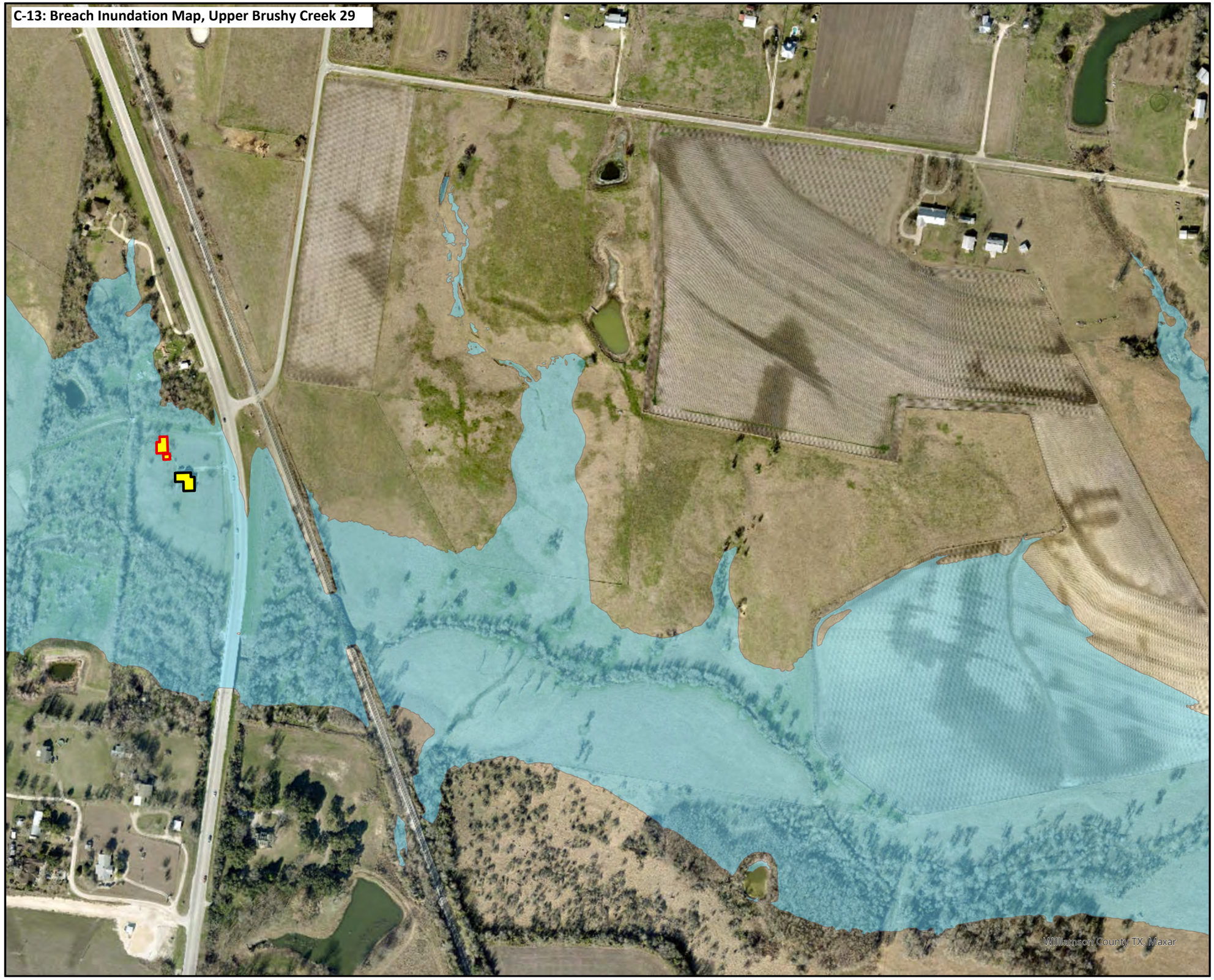
The methods used to develop inundation zones and flood wave arrival times are approximate and should only be used as guidance for establishing evacuation zones. Actual areas inundated will depend on actual failure and pre-failure hydrologic conditions and may differ significantly from information shown on maps.

N

0 0.03 0.05 0.1 Miles

0 150 300 600 Feet

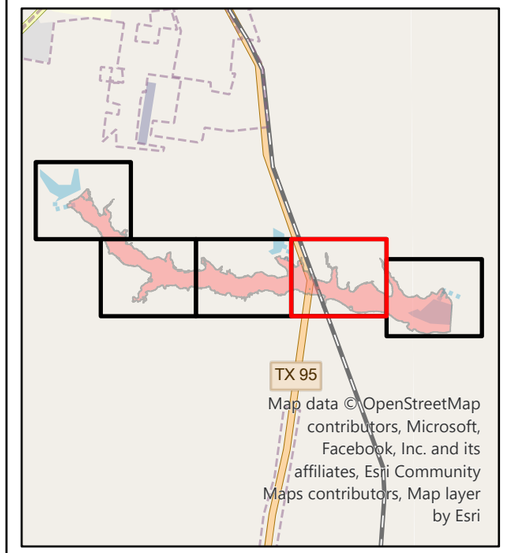
C-13: Breach Inundation Map, Upper Brushy Creek 29



UPPER BRUSHY 29
DAM FAILURE MAPPING

Panel 4 of 5

PANEL LOCATOR



LEGEND

- Dam Centerline

Inpacted Strucutes

- Non-Habitable Structure
- Habitable Structure
- Top of Dam Breach Inundation

Breach flood hydrograph was computed using NRCS TR-60 methodology.

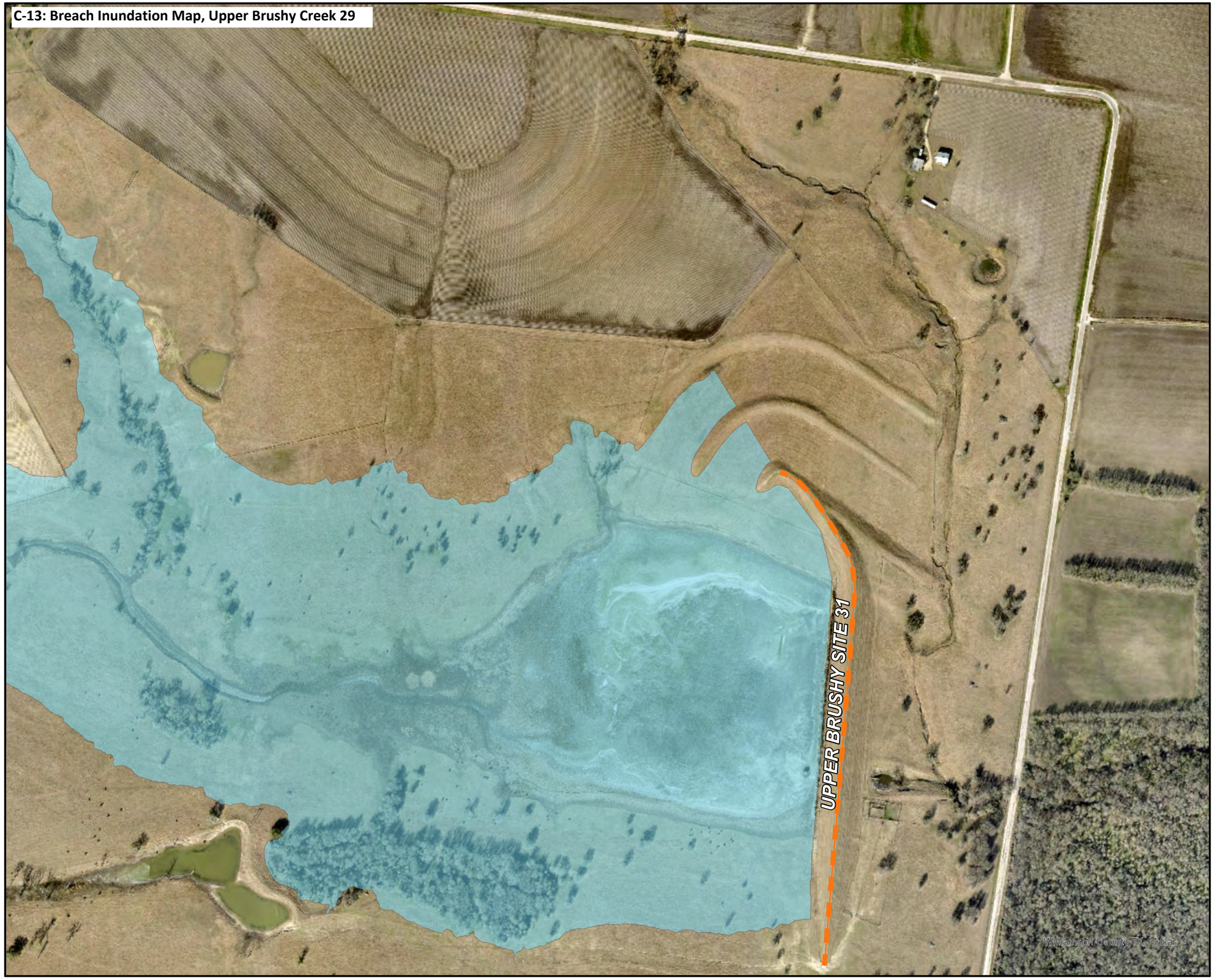
The methods used to develop inundation zones and flood wave arrival times are approximate and should only be used as guidance for establishing evacuation zones. Actual areas inundated will depend on actual failure and pre-failure hydrologic conditions and may differ significantly from information shown on maps.

N

0 0.03 0.05 0.1 Miles

0 150 300 600 Feet

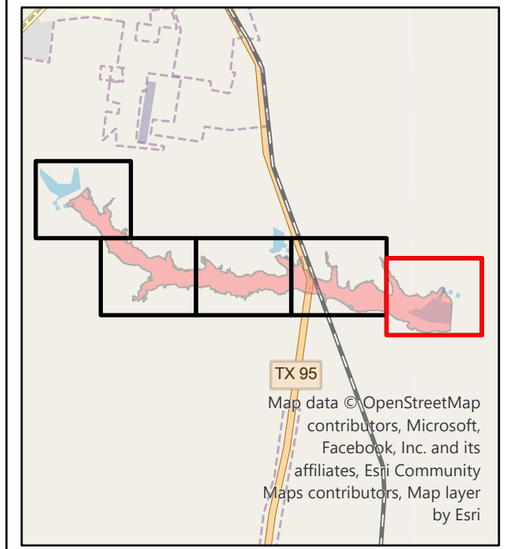
C-13: Breach Inundation Map, Upper Brushy Creek 29



UPPER BRUSHY 29
DAM FAILURE MAPPING

Panel 5 of 5

PANEL LOCATOR



LEGEND

- Dam Centerline

Inpacted Strucutes

- Non-Habitable Structure
- Habitable Structure
- Top of Dam Breach Inundation

Breach flood hydrograph was computed using NRCS TR-60 methodology.

The methods used to develop inundation zones and flood wave arrival times are approximate and should only be used as guidance for establishing evacuation zones. Actual areas inundated will depend on actual failure and pre-failure hydrologic conditions and may differ significantly from information shown on maps.

N

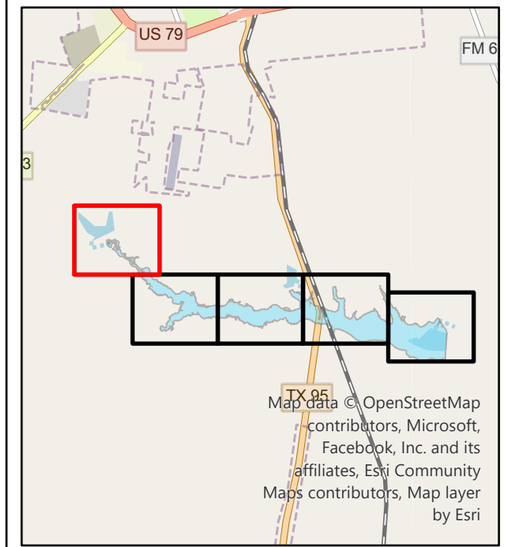
0 0.03 0.05 0.1 Miles

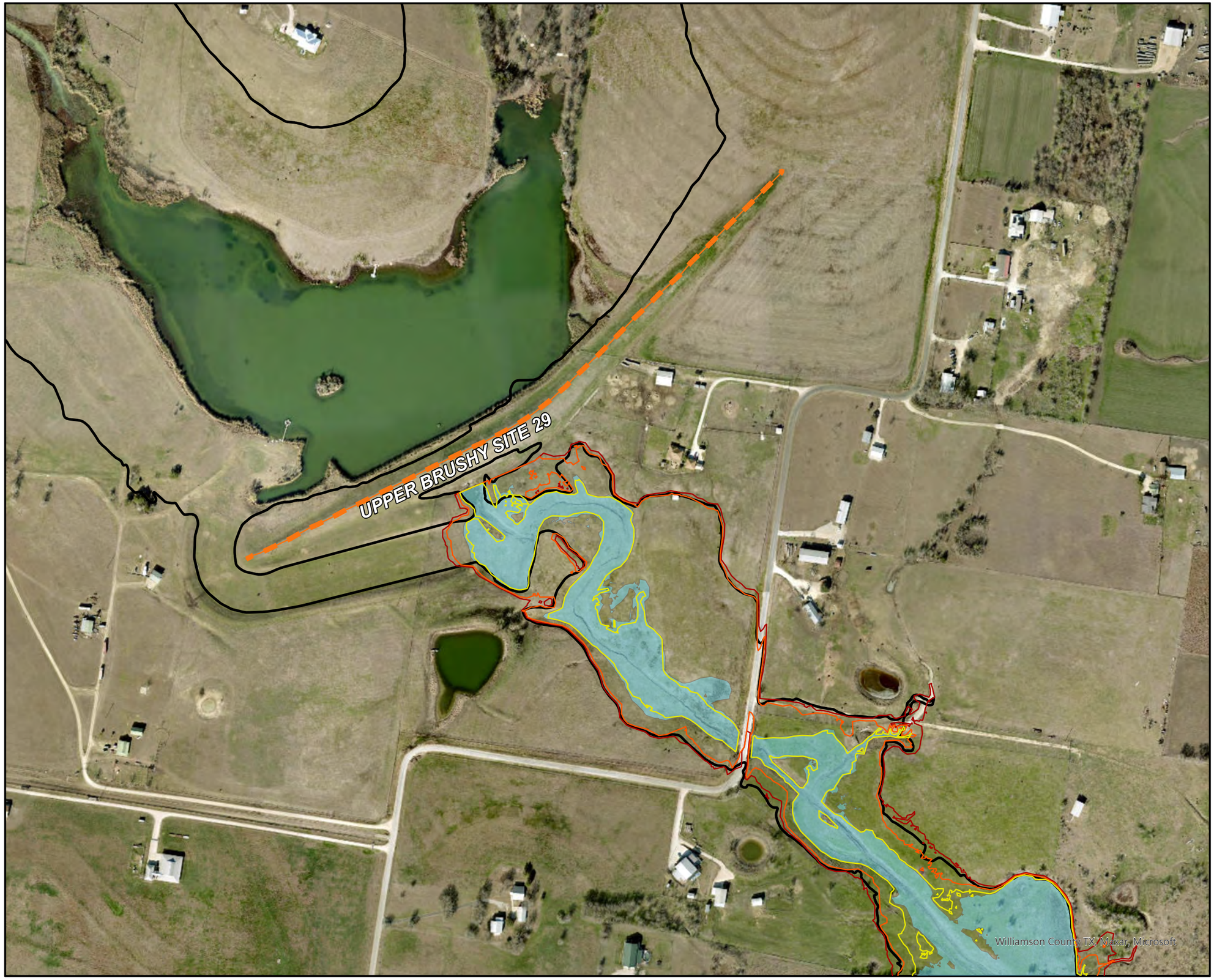
0 150 300 600 Feet

UPPER BRUSHY 29 FREQUENCY MAPPING

Panel 1 of 5

PANEL LOCATOR





LEGEND

- Dam Centerline
- Impacted Structures
- Decom. 100 Year Inundation
- Preferred Alt. 500 Year Inundation
- Preferred Alt. 100 Year Inundation
- Existing 100 Year Floodplain
- Regulatory FEMA Zone A Inundation

The methods used to develop inundation zones and flood wave arrival times are approximate and should only be used as guidance for establishing evacuation zones. Actual areas inundated will depend on actual failure and pre-failure hydrologic conditions and may differ significantly from information shown on maps.

N

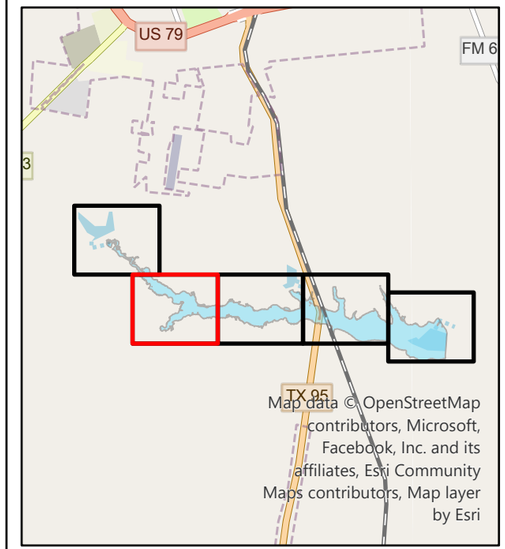
0 0.03 0.05 0.1 Miles

0 150 300 600 Feet

UPPER BRUSHY 29
FREQUENCY MAPPING

Panel 2 of 5

PANEL LOCATOR



Williamson County TX, Maxar

LEGEND

- Dam Centerline
- Impacted Structures
- Decom. 100 Year Inundation
- Preferred Alt. 500 Year Inundation
- Preferred Alt. 100 Year Inundation
- Existing 100 Year Floodplain
- Regulatory FEMA Zone A Inundation

The methods used to develop inundation zones and flood wave arrival times are approximate and should only be used as guidance for establishing evacuation zones. Actual areas inundated will depend on actual failure and pre-failure hydrologic conditions and may differ significantly from information shown on maps.

N

0 0.03 0.05 0.1 Miles

0 150 300 600 Feet

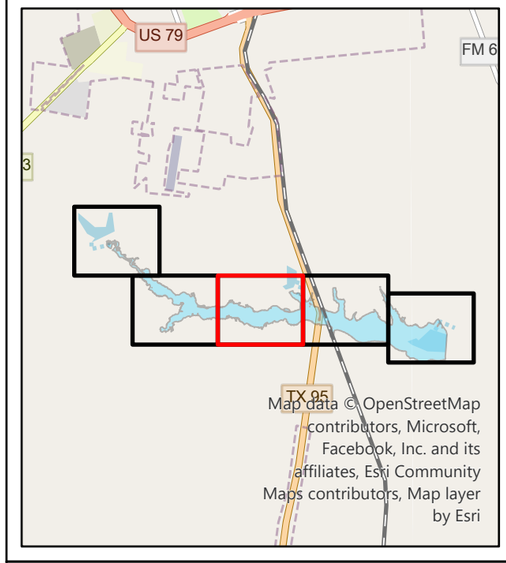
UPPER BRUSHY 29
FREQUENCY MAPPING

Panel 3 of 5

UPPER BRUSHY SITE 30

Williamson County TX, Maxar

PANEL LOCATOR



LEGEND

- Dam Centerline
- Impacted Structures
- Decom. 100 Year Inundation
- Preferred Alt. 500 Year Inundation
- Preferred Alt. 100 Year Inundation
- Existing 100 Year Floodplain
- Regulatory FEMA Zone A Inundation

The methods used to develop inundation zones and flood wave arrival times are approximate and should only be used as guidance for establishing evacuation zones. Actual areas inundated will depend on actual failure and pre-failure hydrologic conditions and may differ significantly from information shown on maps.

N

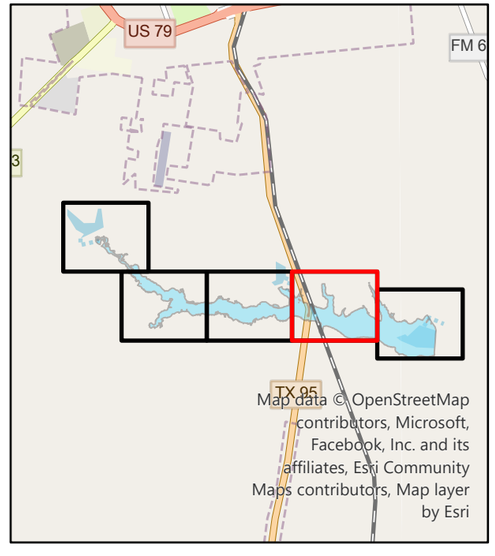
0 0.03 0.05 0.1 Miles

0 150 300 600 Feet

UPPER BRUSHY 29
FREQUENCY MAPPING

Panel 4 of 5

PANEL LOCATOR



LEGEND

- Dam Centerline
- Impacted Structures
- Decom. 100 Year Inundation
- Preferred Alt. 500 Year Inundation
- Preferred Alt. 100 Year Inundation
- Existing 100 Year Floodplain
- Regulatory FEMA Zone A Inundation

The methods used to develop inundation zones and flood wave arrival times are approximate and should only be used as guidance for establishing evacuation zones. Actual areas inundated will depend on actual failure and pre-failure hydrologic conditions and may differ significantly from information shown on maps.

N

0 0.03 0.05 0.1 Miles

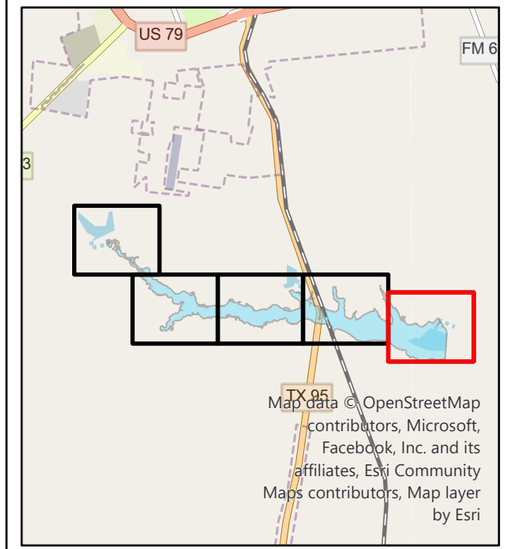
0 150 300 600 Feet

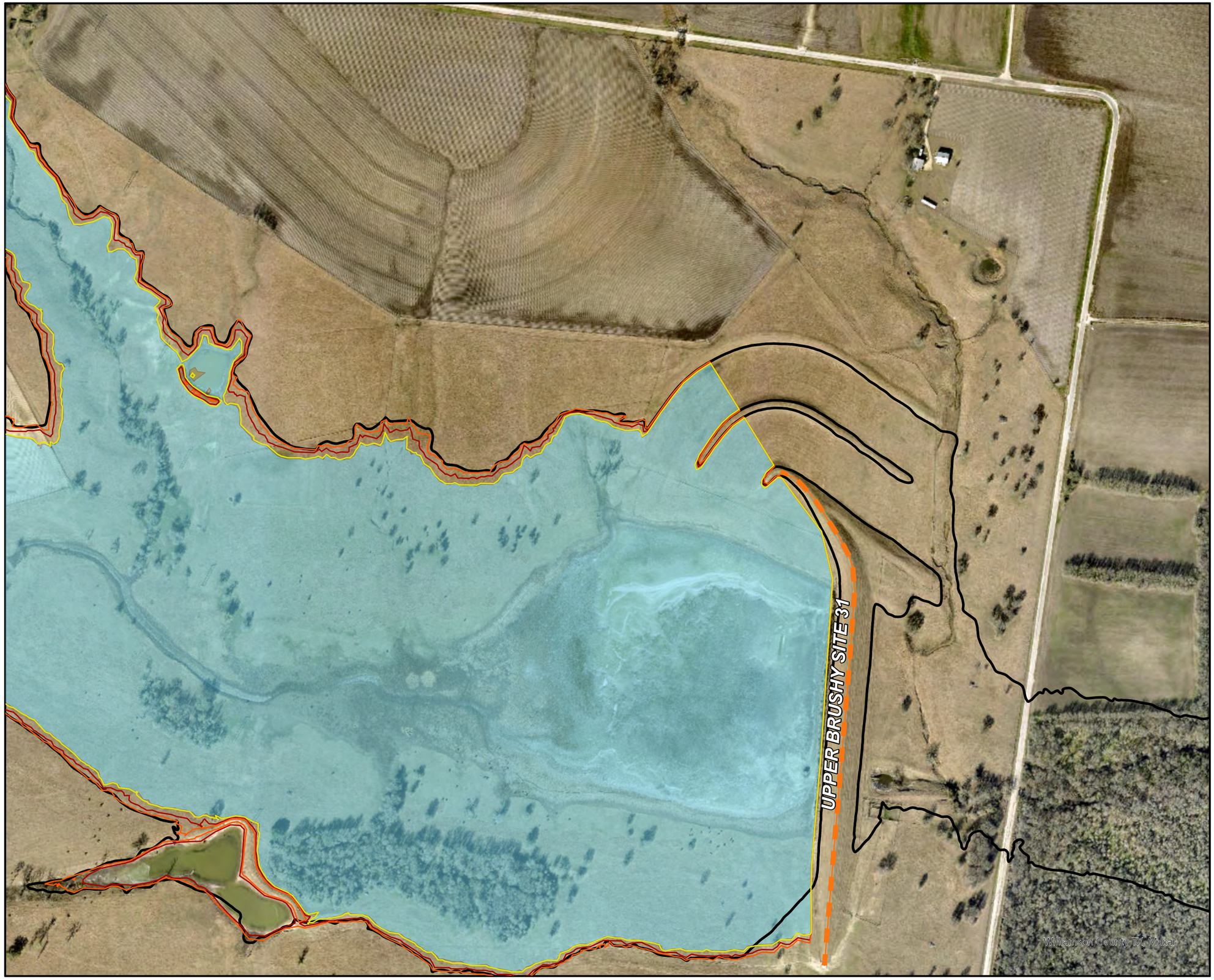
Williamson County TX, Maxar

UPPER BRUSHY 29
FREQUENCY MAPPING

Panel 5 of 5

PANEL LOCATOR





LEGEND

- Dam Centerline
- Impacted Structures
- Decom. 100 Year Inundation
- Preferred Alt. 500 Year Inundation
- Preferred Alt. 100 Year Inundation
- Existing 100 Year Floodplain
- Regulatory FEMA Zone A Inundation

The methods used to develop inundation zones and flood wave arrival times are approximate and should only be used as guidance for establishing evacuation zones. Actual areas inundated will depend on actual failure and pre-failure hydrologic conditions and may differ significantly from information shown on maps.

N

0 0.03 0.05 0.1 Miles

0 150 300 600 Feet

Appendix D - Investigations and Analyses Report

Appendix D

Investigations and Analyses Report Upper Brushy Creek 29

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 Upper Brushy Creek 29 watershed.

- 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 2-year to 1,000-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.
- Development of structural service spillway rating curve.
- 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. 29
Hazard classification	n/a	High
Location	decimal degrees	Latitude: 30.5250° Longitude: -97.4294°
Contributing drainage area	sq. mi	2.39
Runoff curve number (1-day) (AMC avg.)	n/a	89
Time of Concentration (T_c)	hr	2.1
Principal Spillway Design		
Rainfall volume (1-day)	in	11.40
Rainfall volume (10-day)	in	16.20
Runoff volume (10-day)	in	12.78
Auxiliary Spillway and Freeboard Design		
6-hour Stability Rainfall	in	14.37
6-hour Runoff Volume	in	12.99
24-hour Stability Rainfall	in	19.98
24-hour Runoff Volume	in	18.57
Freeboard Rainfall Design		
6-hour Freeboard Rainfall	in	30.96
6-hour Runoff Volume	in	29.52
24-hour Stability Rainfall	in	44.38
24-hour Runoff Volume	in	42.93

Hydraulic Adequacy

Upper Brushy Creek Site 29 dam is classified by TCEQ as an intermediate size dam based on a maximum storage at top of dam of 1,767 acre-feet and height of 42 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.

The hydraulic adequacy of the dam was assessed based on both NRCS and TCEQ criteria using SITES and HEC-HMS, respectively. The model developed in HEC-HMS was used to compute the frequency storms and the Probable Maximum Flood (PMF). The model consists of the contributing area to FRS No. 29 and the reservoir. Runoff losses were calculated using the NRCS Curve Number Method. Curve numbers were calculated for each sub-basin within the project area 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 for passing 75% of the PMF, 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. 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 75% of the PMF overtops the dam by 1.22 feet. Therefore, the dam does not currently meet the 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.

Table D-2 Frequency Event Results for FRS No. 29, Existing Conditions

Flood Recurrences	Peak WSE (ft)	Peak Inflow (cfs)	Peak Outflow (cfs)
2-YR	566.1	1,514	52
5-YR	568.1	2,069	54
10-YR	569.7	2,554	56
25-YR	571.8	3,255	58
50-YR	572.9	3,821	163
100-YR	573.6	4,426	557
200-YR	574.3	5,102	1,218
500-YR	575.2	6,069	2,161
1,000-YR	576.0	6,866	3,092

*Existing Top of Dam is 575.9

Based on t the guidance provided by NRCS in title 390, Part 303 -*Clarification and Instructions for the No-Action alternative in Supplemental Watershed Rehabilitation Plans*, the annual probability of failure was interpolated from Table D-2. This interpolation is used to estimate and annual probability of failure equal to 0.106%. This probability was used to calculate the benefit cost analysis.

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 1.6 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 75% of the PMF analysis (described above). The 6-hour FBH is the critical storm event, and it overtops the existing top of dam by 3.3 feet; therefore, the NRCS requirements governed the required top of dam used in the plan.

Table D- 3 TCEQ PMP and 75% PMF Results for FRS No. 29, Existing Conditions

Duration (hr)	Precipitation (in)	Peak Water Surface Elevation (feet)
1	15.2	574.8
2	21.5	576.7
3	23.3	576.9
6	29.0	576.6
12	34.6	577.1
24	41.6	577.0
48	46.2	575.8
72	46.3	575.0
*Existing Top of Dam elevation located at 575.9 ft		

Table D- 4 NRCS FBH Results for FRS No. 29, Existing Conditions

Duration (hr)	Peak Elevation (feet)
6 hour - FBH	579.2
24 hour - FBH	578.7
*Existing Top of Dam elevation located at 575.9 ft	

Table D- 5 Frequency Event Results for FRS No. 29, All Conditions

Frequency Event Recurrence	Peak Water Surface Elevation, Existing (ft)	Peak Water Surface Elevation, Alt 3 (feet)	Peak Water Surface Elevation, Alt 4 (feet)
2 year	566.1	565.8	565.8
5 year	568.1	567.6	566.3
10 year	569.7	569.2	567.7
25 year	571.8	571.3	569.7
50 year	572.9	572.5	571.1
100 year	573.6	573.3	572.7
200 year	574.3	573.8	573.5
500 year	575.2	574.3	574.2
1000 year	576.0	574.6	574.7

Alternative 2 is not included since the dam will not be in place

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. 29 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 event was simulated to occur at the peak water surface elevation in the reservoir (top of dam). The Hydrologic Breach hydrograph is shown in Figure D-1 below. The peak breach discharge was determined to be 36,400 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.

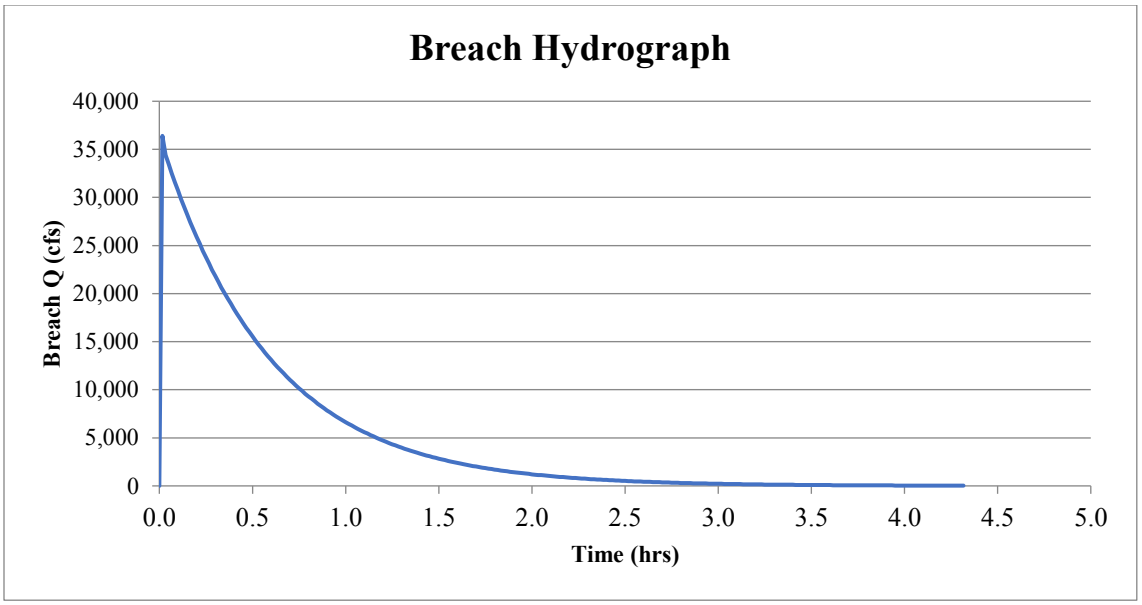


Figure D-1 TR-60 Breach Hydrograph for FRS No. 29

Based on the updated dam breach modeling, County Road 405, County Road 406, N State Highway 95, a Railroad, County Road 497, and a Private Road can all be impacted by the breach. Also, 2 residential structure and 6 barn/out-buildings could be impacted by breach inundation wave. The breach inundation map showing the location of the habitable structures is included in Appendix C. The Population at Risk (PAR) is estimated to be 19 based on the number of impacted residential structures and the overtopping of County Road 405, County Road 406, N State Highway 95, County Road 497, and a Private Road by the dam breach (PAR analysis submitted as Appendix E).

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. Two distinct materials were encountered in the auxiliary spillway area, Figure D-2, and pertinent parameters for each material are presented in Table D-7.

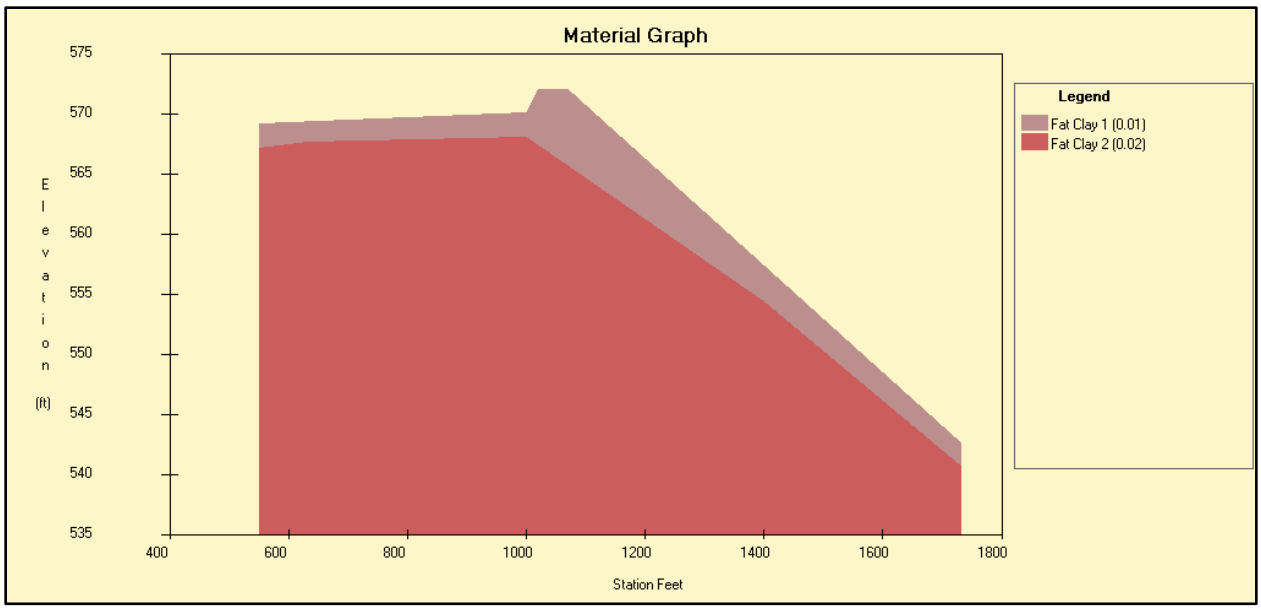


Figure D-2 Existing Auxiliary Spillway Soil Profile

Existing Conditions

For the preferred alternative, the auxiliary spillway has a 4.46% exit slope. The SDH runs result in an exit velocity of 10.57 ft/s. The overall stability of the auxiliary spillway design was found to be unacceptable for both soil and vegetal stress factors. The allowable soil stress is 0.156 psf, while the effective soil stress from the SITES output is 0.184 psf. The allowable vegetal stress is 7.5 psf, and the effective vegetal stress is 3.35 psf (calculated as the total stress from the SITES output minus the soil effective stress). The integrity analysis also indicated that the auxiliary spillway breaches during the 24-hour FBH.

Preferred Alternative

For the preferred alternative, the earthen auxiliary spillway will be blocked and replaced with a structural labyrinth spillway. The stability and integrity of the structural spillway were not analyzed in SITES since the spillway will be designed to withstand the hydraulic load, therefore, a soil stress analysis and vegetal stress analysis are not applicable.

Structural Service Spillway

The preferred alternative (Alt. #4) includes a structural spillway. The proposed structure is a single stage labyrinth spillway designed to be engaged for events larger than the 50-year, 24-hour flood (crest located at 572.8 ft). The labyrinth spillway rating curve was developed according to Crookston & Tullis [3]. The service spillway is a 3-cycle labyrinth weir and a channel width of 90 feet. The total centerline length of the labyrinth walls is approximately 436-feet. The labyrinth weir discharges 8,901 cfs at a water surface elevation of 577.9 feet, which is equal to the proposed top of dam elevation. The final spillway rating curve is presented Figure D-3.

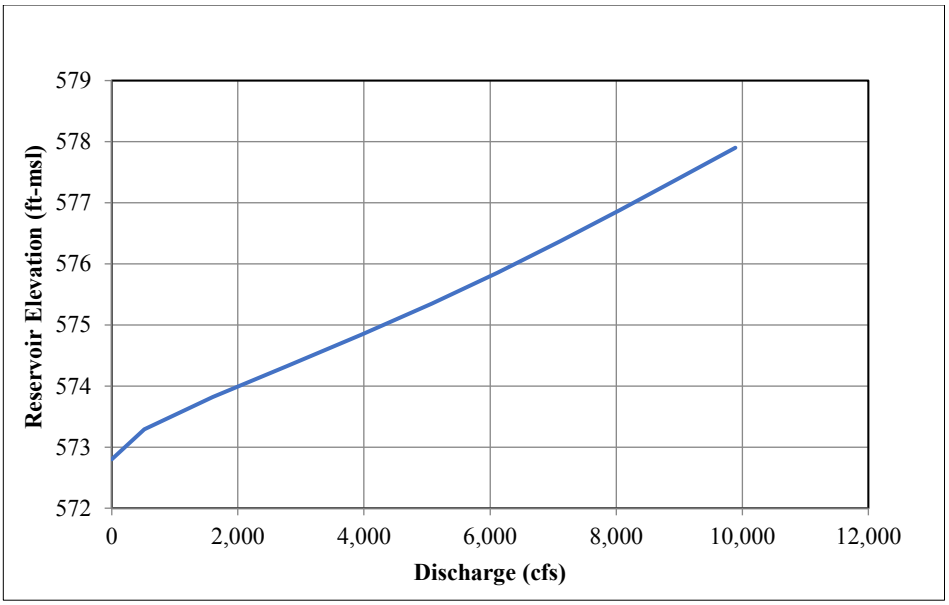


Figure D-3 Alternative 4 – Structural spillway rating curve

Geotechnical Investigation Report

Subsurface Exploration and Laboratory Testing

Geotechnical exploration activities have been conducted at Site 29 associated with the rehabilitation planning for the site. Results of the activities are discussed in the sections below.

Field exploration included five (5) geotechnical borings drilled in March 2023. 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 below in Table 1, and the boring locations are shown on the attached Boring Location Map (see Appendix E).

Table D-6 Upper Brushy Creek Site 29 Boring Schedule

Boring	Location	Boring Depth (ft below ground surface)
01	Center line of Dam	60
02	Center line of Dam	60
201	Existing Eastern Spillway	25
202	Existing Eastern Spillway	25
203	Existing Eastern Spillway	25

The drilling was performed from March 6 to 8, 2023, using a CME-75 truck-mounted drilling rig for the embankment borings and CME-75 truck-mounted drilling rig. Borings were drilled by Austin Geologic and Mr. Zach Ready, with Geoscience Consultants International, LLC, supervised the drilling and logged the borings.

Hollow-stem and continuous flight augers were used to advance 00 and 200 series borings, respectively. Observations of groundwater were made during and after 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 (according to 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.

At selected locations, samples were collected by driving a split-spoon sampler in conjunction with the Standard Penetration Test (SPT). This technique involves driving the spoon sampler a distance into the soil using a free-falling hammer (according to ASTM D1586). The results of the penetration test are reported on the boring logs at the corresponding depth. Materials recovered from the split spoon sampler are then placed in a plastic bag to reduce moisture loss and protect the sample.

Laboratory testing was performed on collected samples by Beyond Engineering and Testing, LLC. 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 dispersion, and unconfined compression tests. The results of these tests are presented on the boring logs in Appendix E.

Boring logs were prepared from 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. Soil type/classification, color and consistency/apparent density recorded on the logs follows the guidelines in NEH Part 628, Chapter 52.

Groundwater was only encountered in Boring 01-23 at a depth of 51 feet at the time of drilling. Seepage and groundwater were not encountered within the other borings during drilling and after completion of drilling. The groundwater level at the subject site is anticipated to fluctuate seasonally depending on the amount of rainfall, prevailing weather conditions, subsurface drainage characteristics, and reservoir pool level. 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.

Summary of Subsurface Stratigraphy

Embankment Centerline of Dam

Based on borings 01-23 and 02-23, drilled along the centerline of the dam, the dam embankment is interpreted as engineered fill overlying alluvium and consolidated Marlbrook Marl formation material weathered to varying degrees. The subsurface can be generally described as follows:

- Embankment Fill: The embankment fill is interpreted as consisting of stiff to hard, moist, dark brown fat clay (CH) with varying content of sand. Groundwater was observed in Boring 01-23 at a depth of 51 feet at time of drilling. Crumb tests were performed in two samples taken from the embankment fill and they were both classified as non-dispersive.

- Alluvial Deposits (Qal): Alluvial deposits generally consisting of dark gray, yellow-brown, very stiff fat clay (CH) were encountered in the borings below the embankment fill. Depth of alluvium was encountered approximately 28 to 33 feet below the crest elevation.

- Foundation/Bedrock Formation (Ko): Residual Marlbrook Marl consisting of very stiff to hard, yellow-brown and light gray fat clay (CH) was encountered below the alluvial deposits. The fat clay (CH) was noted as calcareous, with fractures and calcite infilling. Underlying the residual consolidated clay, at a depth ranging from approximately 48.5 to 53.5 feet below the crest of the embankment, was very soft, calcareous, gray marl.

Existing Auxiliary Spillway

Borings 201-23, 202-23, and 203-23 were drilled within the footprint of the existing auxiliary spillway. Based on these borings. the existing auxiliary spillway is interpreted as predominately fat clay (CH). The subsurface can be generally described as follows:

- Alluvial Deposits (Qal): Alluvial deposits consisting of dark brown, stiff fat clay (CH) were encountered in the upper 2 feet of the auxiliary spillway borings. Crumb tests were performed in three samples taken from the alluvium in the auxiliary spillway and they were classified as non-dispersive.
- Foundation Formation: Residual Marlbrook Marl consisting of stiff to hard, yellow-brown and light gray fat clay (CH) was encountered below the alluvial deposits. The fat clay (CH) was noted as calcareous, with fractures and calcite infilling. Marl was not encountered in any of the auxiliary spillway borings.

STES Parameter Development

Based on the field investigation, the proposed subsurface profile of the existing auxiliary spillway is approximately 2 feet of alluvial/residual fat clay (CH), overlying 23 to 25 feet of highly weathered Marlbrook Marl fat clay (CH). Rock was not encountered in the auxiliary spillway borings and was excluded from the proposed stratigraphy. The overburden soils are estimated to meet common excavation criteria in NRCS Construction Specification 21, Excavation.

Headcut erodibility index (Kh) values were developed for the auxiliary spillway at Site 29 based on site-specific information from Borings 201-23 through 203-23. Table 2 summarizes the headcut erodibility index values. Associated calculations and assumptions were made with the development of the headcut erodibility index values are included in Appendix E.

Table D-7 Summary of Headcut Erodibility Index Determination (Kh)

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)
Fat Clay (CH) [1]	0.05	1	0.25	1	0.01
Fat Clay (CH) [2]	0.09	1	0.22	1	0.02
[1] Alluvium/Residual Ozan					
[2] Highly Weathered Marlbrook Marl					

Economics

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 along Battleground Creek up to Upper Brushy Site Creek 31. 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-8. 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-8 Description of Proposed Plans

Plan Name	Description
Future Without Federal Investment (Alternative 1)	No federal funds expended on project. The local sponsor, public, and project stakeholders are 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 expected to fail at some time in the future considering an estimated annual probability of failure of 0.106%
Decommission (Alternative 2)	Remove the storage function of the dam and reconnect, restore, and stabilize the stream and floodplain functions.
Alternative 3	Install a new 30-inch principal spillway, raise the top of dam 0.4 feet to an elevation of 576.3 feet, and extend the embankment to block the existing earthen auxiliary spillway. Additionally, a new structural labyrinth spillway with width of 180 feet with two engagement elevations at 571.8 and 573.3 feet.
Alternative 4	Install a new 54-inch principal spillway, raise the top of dam 2 feet to an elevation of 577.9 feet, and extend the embankment to block the existing earthen auxiliary spillway. Additionally install a new single stage labyrinth structural auxiliary spillway at elevation 572.8 feet and width of 90 feet.

Structure Damages

The maximum water depths and flow velocities were imported into ArcGIS Pro 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

Three structures were identified within the project area and categorized using aerial photography, street level imagery, and data from the Williamson County appraisal district. The project area was determined using the existing 100-year floodplain and the decommissioning alternatives 100-year floodplain, and defined the project area to be where the difference between the two water surface elevations was a foot or more. One of these structures is a residential house, and two are barns or various outbuildings. The floor elevations of the structures were assigned based on the 2017 LiDAR data that was obtained through the TNRIS StratMap website (TNRIS, 2017).

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- 4 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 value for barns/outbuildings was computed as 30% of the structure value. The damages to contents were computed based on unique depth-damage curves for each structure, refer to Figure D- 5.

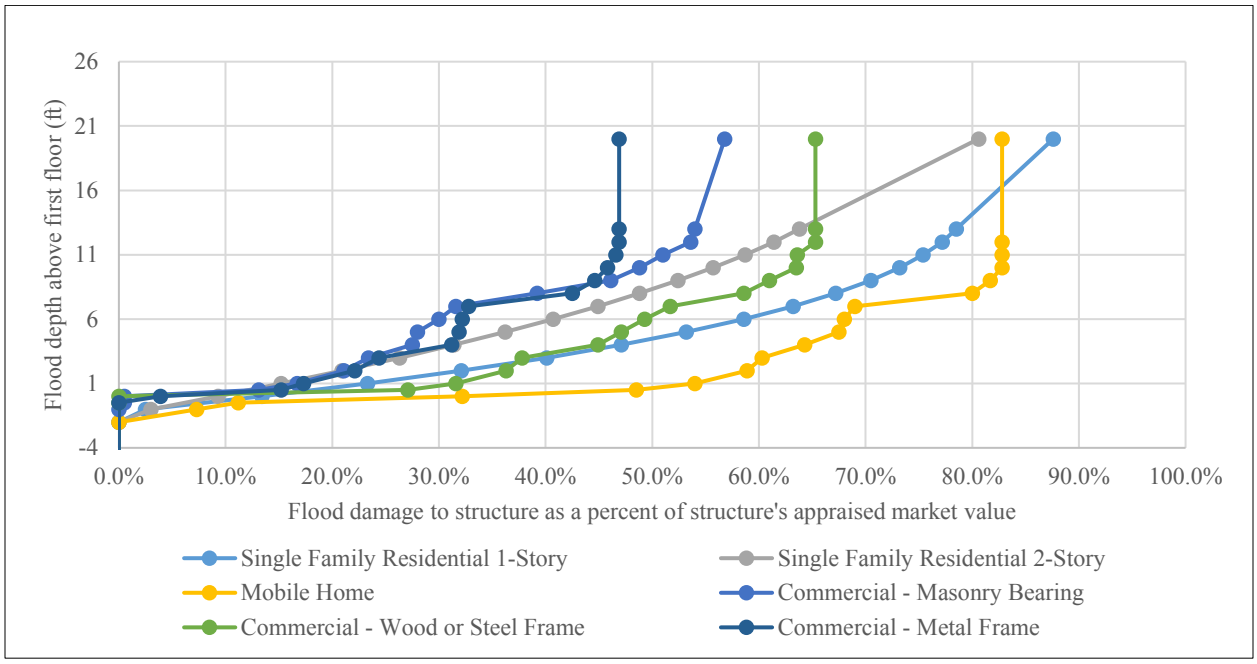


Figure D- 4 Structure Depth-Damage Curves

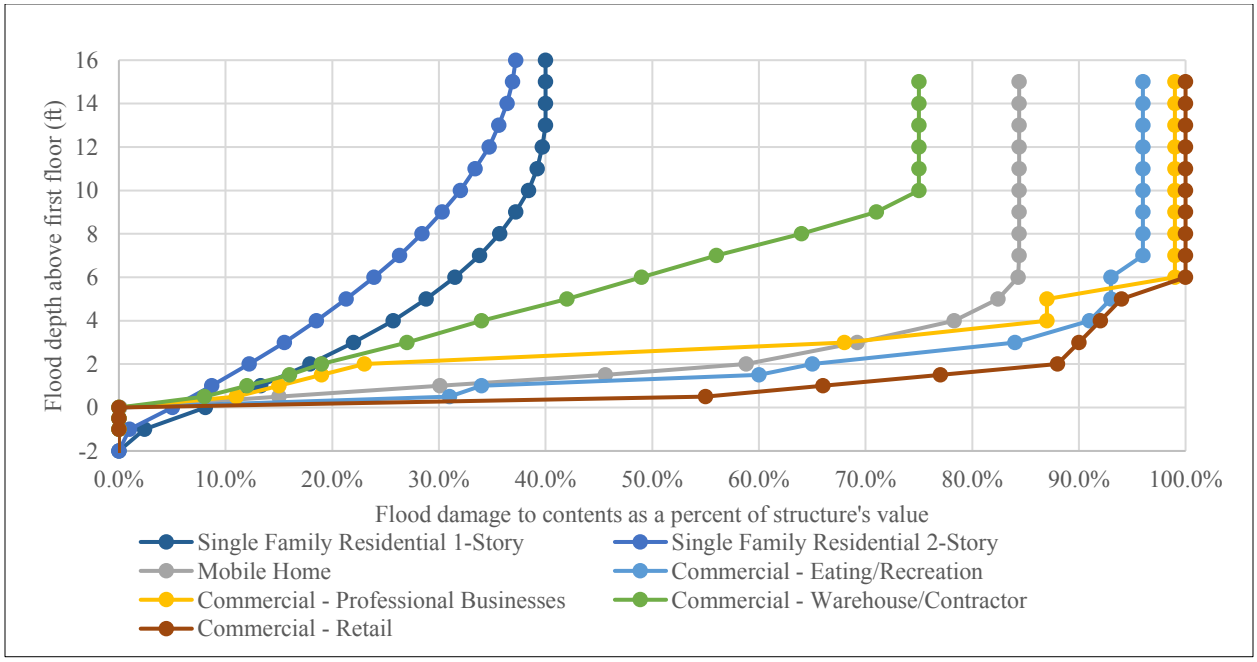


Figure D- 5 Contents Depth-Damage Curves

Structure Inventory

Data from the Williamson County appraisal district was used to determine the 2023 market value of affected structures. The structures inventory is shown in Table D-9.

Table D-9 Impacted Properties Within Project Area

Structure Number	Appraised Value of Structure	Estimated Finished Floor Elevation	Occupancy Type
A	$12,209	560.70	Warehouse/Commercial
B	$15,000	508.71	Warehouse/Commercial
C	$307,229	508.07	Single Family Residence, 2 story
D	$184,064	557.04	Single Family Residence, 1 story
E	$44,061	556.40	Warehouse/Commercial
F	$750	555.77	Warehouse/Commercial
G	$750	555.61	Warehouse/Commercial
H	$10,127	508.80	Warehouse/Commercial

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- 4, 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 integral of this curve is the annual damage to the structures for each alternative, shown in shown in Table D-10 and Table D-11.

Table D-10 Expected Frequency Storm Damages to Structures

Frequency Event	Alt. 1 (Existing)	Alt. 2 (No Dam)	Alt. 3	Alt. 4
2-year	$0	$0	$0	$0
5-year	$0	$13,443	$0	$0
10-year	$4,134	$44,121	$4,626	$6,557
25-year	$23,860	$91,741	$24,994	$44,578
50-year	$53,078	$121,007	$54,890	$61,184
100-year	$90,305	$159,381	$92,655	$98,598
200-year	$129,996	$198,280	$134,476	$137,122
500-year	$179,494	$240,352	$192,274	$183,254
1000-year	$524,892	$268,273	$229,161	$219,123

Table D-11 Expected Annual Damages to structures (Summary)

Alt 1 (Existing)	Alt 2 (No Dam)	Alt. 3	Alt. 4
$3,855	$14,266	$3,875	$4,974

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

Crops prices and yields have significant variability, thus, FNI utilized the normalized values calculated by the Economic Research Service (ERS) to smooth out the effects of shortrun seasonal or cyclical variation, for key agricultural inputs and outputs. However, some of the crops located in the study area are not included in the study done by the ERS.

The NASS publishes yields and prices for various crops by state and year. Hence, NRCS-TX recommended using the five-year (2018 -2022) average prices for all the crops that are not included int the ERS data. The crop prices were adjusted to real 2023 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-12 shows the development of the damageable values for the crops in the project area.

Table D-12 Development of Damageable Values for Crops

	Corn	Cotton	Rice	Sorghum	Winter Wheat	Oats	Hay (non alf.)	Pecans	Soybeans
Planting Starts	1-Mar	22-Mar	17-Mar	1-Mar	4-Sep	7-Sep	23-Feb	1-Mar	24-Mar
Harvesting Starts	18-Jul	10-Aug	29-June	25-Jun	25-May	13-May	1-May	1-Sep	18-Aug
Harvesting Ends	8-Nov	11-Jan	20-Sep	6-Dec	12-Jul	4-Jul	30-Sep	1-Dec	7-Nov
Seasonal Damage Factor	0.35	0.40	0.26	0.38	0.43	0.41	0.30	0.38	0.31
Inundation Damage Factor (≤ 1ft)	0.26	0.17	0.33	0.33	0.33	0.32	0.20	0.10	0.33
Inundation Damage Factor (1-3 ft)	0.35	0.41	0.50	0.50	0.50	0.50	0.23	0.20	0.50
Inundation Damage Factor (≥ 3 ft)	0.47	0.54	0.63	0.63	0.63	0.63	0.36	0.30	0.63
2023 Normalized Unit Price	4.5	0.7	0.1272	4.00	9.1	4.04	138.38	1.75	8.81
2018 Yield (unit/acre)	64	626	7970	34	49	50	2	300	32
2019 Yield (unit/acre)	101	590	7350	53	48	50	2	335	28
2020 Yield (unit/acre)	88	434	8150	58	48	45	2	370	34
2021 Yield (unit/acre)	98	1142	6860	67	49	45	2	325	38
2022 Yield (unit/acre)	52	588	6510	48	35	55	2	250	20
2018 Areal Unit Value (2023 dollars)	$285.75	$438.20	$1,013.78	$134.40	$448.54	$202.00	$228.33	$525.00	$277.52
2019 Areal Unit Value (2023 dollars)	$452.70	$413.00	$934.92	$213.60	$433.16	$202.00	$249.08	$586.25	$246.68
2020 Areal Unit Value (2023 dollars)	$394.65	$411.60	$1,036.68	$232.80	$434.07	$181.80	$256.00	$647.50	$299.54
2021 Areal Unit Value (2023 dollars)	$441.90	$799.40	$872.59	$267.60	$445.90	$181.80	$256.00	$568.75	$334.78
2022 Areal Unit Value (2023 dollars)	$234.90	$303.80	$828.07	$190.00	$317.59	$222.20	$207.57	$437.50	$176.20
Average 2023 Areal Unit Value (2023 dollars)	$361.98	$473.20	$973.21	$207.68	$416.05	$197.96	$239.40	$553.00	$266.94
Damageable Value per Acre (≤ 1ft)	$32.49	$35.51	$79.23	$26.29	$58.49	$26.12	$14.43	$20.83	$27.51
Damageable Value per Acre (1-3 ft)	$43.74	$78.40	$120.04	$39.83	$88.62	$40.81	$16.59	$41.66	$41.69
Damageable Value per Acre (≥ 3 ft)	$58.73	$103.26	$151.25	$50.18	$111.67	$51.42	$25.97	$62.50	$52.53

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-13.

Table D-13 Expected annual damages to crops

	Alt 1 (Existing)	Alt 2 (No Dam)	Alt. 3	Alt. 4
Annual Damages	$1,766	$2,154	$1,787	$1,874

Pasture Damages

NASS publishes county-wide average pasture cash rental rates each year (USDA 2023). 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-14 and Table D-15 present the development of pastureland damageable values in the project area and the expected annual damages for each alternative, respectively.

Table D-14 Development of pastureland damageable values

Damage factor (≤ 2 feet depth)	0.14
Damage factor (> 2 feet depth)	0.23
2019 Cash Rental Rate for Pasture	$13.00
2020 Cash Rental Rate for Pasture	$12.50
2021 Cash Rental Rate for Pasture	$13.00
2022 Cash Rental Rate for Pasture	$13.50
2023 Cash Rental Rate for Pasture	$15.50
Adjusted Cash Rental Rate (2023 dollars)	$14.70
Damageable Value per Acre (≤ 2ft)	$1.99
Damageable Value per Acre (> 2 ft)	$3.34

Table D-15 Expected Annual Damages to Pastureland

	Alt 1 (Existing)	Alt 2 (No Dam)	Alt. 3	Alt. 4
Annual Damages	$183	$235	$185	$191

Bridge and Culvert Damages

There are fifteen bridges and twelve culverts in the project area. The Texas Department of Transportation (TxDOT) publishes average unit costs for bridge and culvert projects. This data was last published in 2020 for railroads, and 2022 for all other structures, so these costs were adjusted to 2023 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 2023 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. 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.

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- 16 and Table D-17 summarizes the results obtained for the bridges and culverts analyzed in the project area.

Table D- 16 Expected Frequency Storm Damages to Bridges and Culverts

Frequency Event	Alt 1 (Existing)	Alt 2 (No Dam)	Alt. 3	Alt. 4
2-year	$26,883	$78,669	$27,752	$27,753
5-year	$45,861	$104,794	$46,493	$48,820
10-year	$65,999	$136,511	$66,528	$69,171
25-year	$77,741	$159,264	$78,213	$82,105
50-year	$635,316	$766,610	$595,725	$352,296
100-year	$1,043,613	$1,697,060	$1,008,041	$763,639
200-year	$1,680,899	$2,697,278	$1,731,822	$1,459,606
500-year	$2,730,577	$3,933,995	$2,974,624	$2,555,634
1,000-year	$7,980,608	$4,814,452	$3,930,112	$3,483,114

Table D-17 Expected Annual Damages to Bridge and Culverts (Summary)

Category	Alt 1 (Existing)	Alt 2 (No Dam)	Alt. 3	Alt. 4
Bridges	$30,435	$39,879	$28,332	$20,714
Culvert	$24,691	$55,463	$24,918	$24,918
Total	**$55,126**	**$95,342**	**$53,250**	**$45,632**

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 Upper Brushy 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 Upper Brushy 29 do not appear to be noticeably modified based on aerial imagery and historical USGS topographic maps. The upstream watershed contributing to Upper Brushy 29 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 1000-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 Upper Brushy 29 based on contribution to the total Upper Brushy Creek Watershed and adjusting the prices to 2023 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 2024 discount rate is 2.75 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-18 summarizes the flood damage reduction benefits of each alternative, Table D-19 summarizes the costs of each alternative, and Table D-20 presents the benefit-cost analysis for each alternative. Of the two structural rehabilitation options, Alternative 4 had the greatest benefit-cost ratio.

Table D-18 Flood damages and Damage Reduction Benefits

Damage Category	*Expected Annual Damages*				*Damage Reduction Benefits*		
	Alt 1 (Existing)	**Alt 2 (No Dam)**	**Alt. 3**	**Alt. 4**	**Alt 2 (No Dam)**	**Alt. 3**	**Alt. 4**
Structures	$4,127	$14,266	$3,875	$4,947	($10,139)	$252	($820)
Crops	$1,766	$2,154	$1,787	$1,874	($388)	($21)	($108)
Pastureland	$183	$235	$185	$191	($51)	($2)	($8)
Roads and Bridges	$55,126	$95,342	$53,250	$45,632	($40,216)	$1,876	$9,494
Erosion and Sedimentation	$153	$784	$153	$153	($632)	$0	$0
Total	**$61,355**	**$112,781**	**$59,250**	**$52,798**	**($51,426)**	**$2,105**	**$8,558**

Table D-19 Project Costs

Cost Category	Alt 1 (Existing)	Alt 2 (No Dam)	Alt. 3	Alt. 4
Capital Costs	$0	$5,547,541	$17,196,900	$11,342,600
O&M	$11,850	$2,500	$11,850	$11,850
Discount Rate	- -	2.75%	2.75%	2.75%
Project Lifespan (years)	100	100	100	100
Total Annual Costs	**$11,850**	**$165,898**	**$518,371**	**$345,937**

Table D-20 Benefit-Cost Calculations

	Alt 2 (No Dam)	Alt. 3	Alt. 4
Flood Damage Reduction Benefits[1]	($51,426)	$2,105	$8,558
Total Benefits	($51,426)	$2,105	$8,558
Annual Costs[2]	$165,898	$518,371	$345,937
Benefit-Cost Ratio[3]	1.0 : -0.31	1.0 : 0.0	1.0 : 0.02
Net NED Benefits	**($217,324)**	**($516,266)**	**($337,379)**

[1]From Table D-18

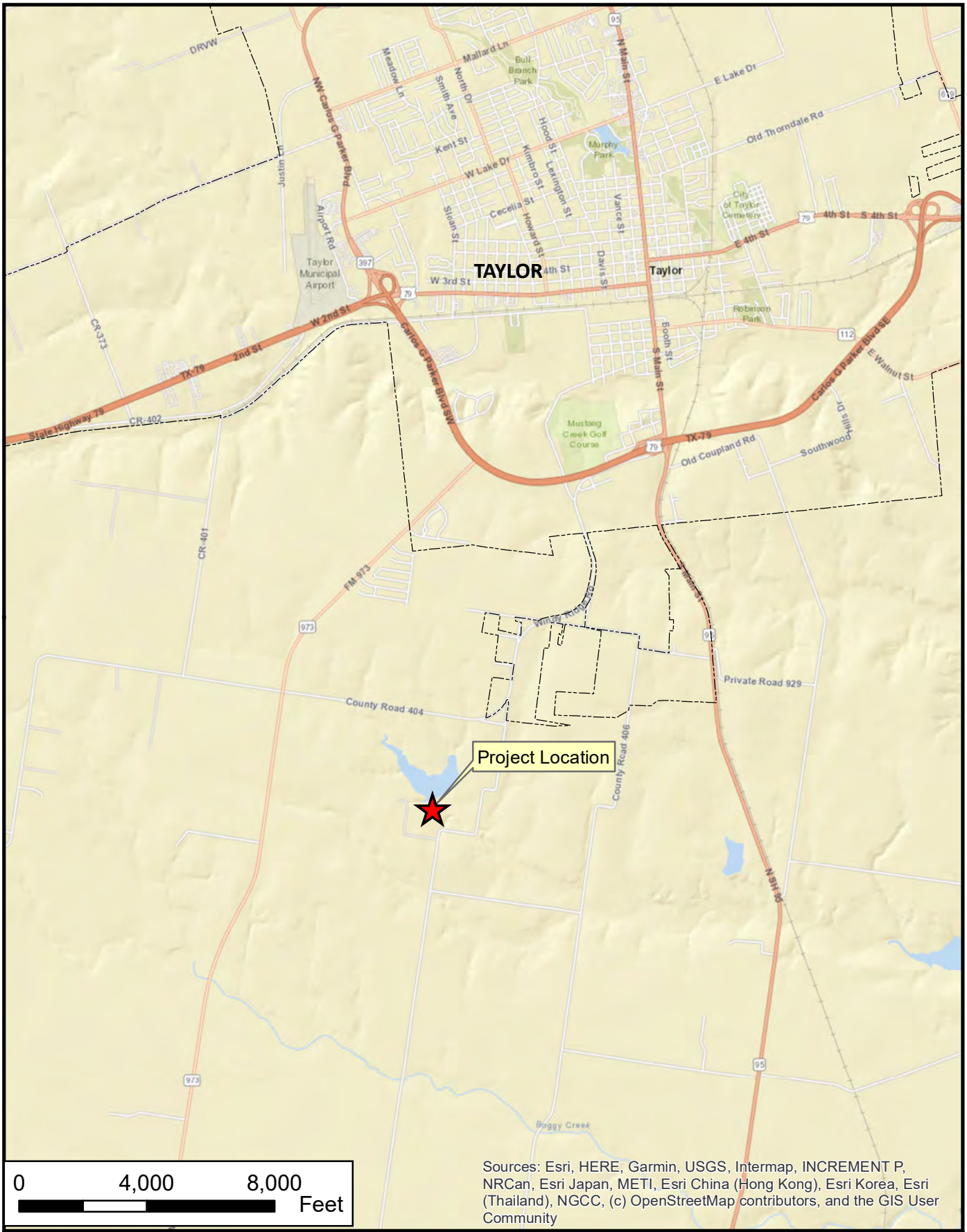
[2]From Table D-19

[3]Alternative 2 and 3 incurs costs but generate negative benefits, hence the negative benefit to cost ratio

Appendix E – Other Supporting Information

Attachment E-1: Geotechnical Information

Upper Brushy Creek 29 Location Map



0 4,000 8,000 Feet

Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

FREESE AND NICHOLS
801 Cherry St. Suite 2800
Fort Worth, TX 76102-6800
Phone - (817) 735 - 7300

N W E S

Upper Brushy 29
Texas State and Water Conservation Board

Vicinity Map

FN JOB NO	TSW23171
FILE	UB29_VIC
DATE	2/28/2023
SCALE	1:50,000
DESIGNED	H. Saez
DRAFTED	Z. Crossley

1
FIGURE

Attachment E-2: Geotechnical Information

Upper Brushy Creek 29 Boring Location Map

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801 Cherry St. Suite 2800
Fort Worth, TX 76102-6800
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N
W E
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Upper Brushy 29
Texas State Soil and Water Conservation Board

Boring Location Map

FN JOB NO	TSW23171
FILE	UB29_BLM
DATE	2/28/2023
SCALE	1:5,500
DESIGNED	H. Saez
DRAFTED	Z. Crossley

2
FIGURE

Attachment E-3: Geotechnical Information

Upper Brushy Creek 29 Boring Logs

LOG OF BORING NO. B-01-23

Project Description: Upper Brushy 29
Project Location: Hutto, Texas
Date Drilling Started: 3/7/2023
Logged By: Z. Ready
Rig Type: CME 75
Latitude: 30.524485
Drilling Co.: Austin Geologic
Hammer Type: Automatic
Longitude: -97.430668
Project No.: TSW23171
Phase No.: ****
Date Drilling Completed: 3/7/2023
Drill Method: HSA
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)	69			(CH) FAT CLAY, dark brown, hard, moist, calcareous (Fill)									
							1/ (CH) FAT CLAY, light brown, hard, moist, calcareous, some silt, trace fossil fragments (Fill)									
	U-2		4.5+ (P)	79												
5	U-3		3.5 (P)	52			4/ (CH) FAT CLAY with SAND, dark brown, very stiff, moist, calcareous, trace fine gravel, trace calcareous partings, trace sandy partings and gravel partings (Fill)	29	93	82	66	25	41	2.4	7.5	
	U-4		3.75 (P)	71												
	U-5		4.5+ (P)	73			8/ (CH) FAT CLAY, olive-brown, hard, moist, calcareous, some silt, trace gravel (Fill)									
10																
	SPT-6	4-5-8 (13)					13.5/ (CH) FAT CLAY, dark brown, stiff, moist, calcareous, trace coarse sand and trace 1-inch gravel (FIll)	27		89	74	21	53			
15																
	SPT-7	3-5-7 (12)					-coloring to olive-brown at 18.5 feet									
20																
	SPT-8	3-5-7 (12)						29		94	74	22	52			
25							-coloring to dark brown at 24.8 feet									
	SPT-9	5-7-9 (16)					-trace 1.5-inch limestone angular gravel at 28.5 feet									
30																

GROUND WATER OBSERVATIONS

MEASUREMENT	▽ At Time Of Drilling	▼ At End of Drilling	▼ After Drilling
DATE			
DEPTH (ft.bgs.)	51		
NOTES			None

Remarks:
0-60 feet - hollow stem auger. Boring backfilled with cement-bentonite grout upon completion.

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. B-01-23

Project Description: Upper Brushy 29
Project Location: Hutto, Texas
Date Drilling Started: 3/7/2023
Logged By: Z. Ready
Rig Type: CME 75
Latitude: 30.524485
Drilling Co.: Austin Geologic
Hammer Type: Automatic
Longitude: -97.430668
Project No.: TSW23171
Phase No.: ****
Date Drilling Completed: 3/7/2023
Drill Method: HSA
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
							(CH) FAT CLAY, dark brown, stiff, moist, calcareous, trace coarse sand and trace 1-inch gravel (Flll) *(continued)*									
35	U-10		2.75 (P)	96			(CH) FAT CLAY with SAND, blue-green and yellow-brown, very stiff, moist, calcareous, with 1.5-inch gravel, rounded (Alluvium) 33/	28	96	82	72	22	50	2.3	9.3	
	U-11		3.75 (P)	53												
40							-multi-layered coloring, mixed and mottled from 38 to 40 feet									
45	SPT-12	5-7-9 (16)					(CH) FAT CLAY, yellow-brown and light gray, very stiff, moist, calcareous, some silt, trace healed fractures, with calcite infilling, highly weathered (Residual Marlbrook Marl) 43.5/									
50	SPT-13	7-9-10 (19)					-wet, trace fossil fragments (bivalves) at 48.5 feet ▽	25		98	78	23	55			
55	SPT-14	10-18-25 (43)					MARL, gray to dark gray, weathered, soft rock, calcareous 53.5/									
60	SPT-15	12-17-21 (38)					Total boring depth 60.0 ft.	21		99	70	23	47			

GROUND WATER OBSERVATIONS

MEASUREMENT	▽ At Time Of Drilling	▼ At End of Drilling	▼ After Drilling
DATE			
DEPTH (ft.bgs.)	51		
NOTES			None

Remarks:
0-60 feet - hollow stem auger. Boring backfilled with cement-bentonite grout upon completion.

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. B-02-23

Project Description: Upper Brushy 29
Project Location: Hutto, Texas
Date Drilling Started: 3/8/2023
Logged By: Z. Ready
Rig Type: CME 75
Latitude: 30.525089
Drilling Co.: Austin Geologic
Hammer Type: Automatic
Longitude: -97.429379
Project No.: TSW23171
Phase No.: ****
Date Drilling Completed: 3/8/2023
Drill Method: HSA
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)	88			(CH) FAT CLAY, dark brown, hard, moist, calcareous (Fill) 0.8/									
	U-2		N/A	75			(CH) FAT CLAY, light brown, very stiff to hard, dry, calcareous, with some silt, trace gravel (Fill)									
5	U-3		4.5+ (P)	92			(CH) FAT CLAY, dark brown, very stiff to hard, moist, calcareous, trace gravel 1.5-inch, trace calcareous particles, trace sand and silt partings 4/									
	U-4		4.5+ (P)	69			-olive-brown mottling from 6 to 8 feet	27	95	93	75	21	54	2.3	10.1	
	U-5		4.5+ (P)	96			(CH) FAT CLAY, yellow-brown and light brown, very stiff to hard, moist, calcareous, trace fine gravel (Fill) 9.2/									
10																
	U-6		4.5+ (P)	73												
15																
	U-7		4.5+ (P)	60			-trace 2-inch gravel at 18 feet	24	105	89	64	20	44	3	9.8	
20																
	U-8		4.5+ (P)	67			-coloring dark brown and olive-brown at 23 feet									
25																
	U-9		4.0 (P)	67			(CH) FAT CLAY, dark gray, stiff to hard, moist, calcareous, with fine grained sand, trace fine gravel, trace sandy partings and seams (Alluvium) 28/	26	96	91	76	21	55	1.8	7	
30																

GROUND WATER OBSERVATIONS

MEASUREMENT	▽ At Time Of Drilling	▼ At End of Drilling	▼ After Drilling
DATE			
DEPTH (ft.bgs.)			
NOTES	None		None

Remarks:
0-60 feet - hollow stem augers. Boring backfilled with cement bentonite grout upon completion.

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. B-02-23

Project Description: Upper Brushy 29
Project Location: Hutto, Texas
Date Drilling Started: 3/8/2023
Logged By: Z. Ready
Rig Type: CME 75
Latitude: 30.525089
Drilling Co.: Austin Geologic
Hammer Type: Automatic
Longitude: -97.429379
Project No.: TSW23171
Phase No.: ****
Date Drilling Completed: 3/8/2023
Drill Method: HSA
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
35	U-10		4.5+ (P)	65			(CH) FAT CLAY, dark gray, stiff to hard, moist, calcareous, with fine grained sand, trace fine gravel, trace sandy partings and seams (Alluvium) *(continued)* -blocky structure at 34 feet									
40	U-11		4.25 (P)	88			(CH) SANDY FAT CLAY, yellow-brown, very stiff to hard, dry, calcareous, slightly fissile fractured with calcite infilling on fracture planes, highly weathered (Residual Marlbrook Marl) 38/	24	98	72	75	20	55	2	3.2	
45	U-12		N/A	96			-with dark gray 8-inch marl layers at 44 feet									
50	SPT-13	10-14-18 (32)					MARL, gray to light gray, slightly weathered, soft rock, fissile, calcareous, trace fossils (bivalve), trace iron staining (Marlbrook Marl) 48.5/									
55	SPT-14	10-16-21 (37)						24		100	75	22	53			
60	SPT-15	12-19-27 (46)					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	None		None

Remarks:
0-60 feet - hollow stem augers. Boring backfilled with cement bentonite grout upon completion.

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. B-201-23

Project Description: Upper Brushy 29
Project Location: Hutto, Texas
Date Drilling Started: 3/6/2023
Logged By: Z. Ready
Rig Type: CME 75
Latitude: 30.523867
Drilling Co.: Austin Geologic
Hammer Type: Automatic
Longitude: -97.433028
Project No.: TSW23171
Phase No.: ****
Date Drilling Completed: 3/6/2023
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
	U-1		1.5 (P)	88			(CH) FAT CLAY with SAND, dark brown, medium stiff to stiff, moist, calcareous, trace gravel and calcareous nodules (Alluvium)	29	89	76	66	20	46	0.7	4.7	
	U-2		4.5+ (P)	79			2/ (CH) FAT CLAY, olive-brown and yellow-brown, stiff to hard, dry, blocky, fractured, calcareous, some iron staining, highly weathered (Residual Marlbrook Marl)									
5	U-3		4.5+ (P)	88				24	98	99	73	20	53	1.1	3.6	
	U-4		4.5+ (P)	81												
	U-5		4.5+ (P)	88			-trace calcite crystalline seams and partings, trace fossil fragments (bivalve), trace fine roots in fractures below 8 feet									
10																
	U-6		4.5+ (P)	96				29	95	99	72	22	50	2.2	3.1	
15																
	U-7		4.5+ (P)	96			-trace large bivalve >3 inches at 19 feet									
20																
	SPT-8	7-8-11 (19)														
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	None		None

Remarks:
0-25 feet - continuous flight augers. Boring backfilled with cement bentonite grout upon completion.

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. B-202-23

Project Description: Upper Brushy 29
Project Location: Hutto, Texas
Date Drilling Started: 3/6/2023
Logged By: Z. Ready
Rig Type: CME 75
Latitude: 30.523342
Drilling Co.: Austin Geologic
Hammer Type: Automatic
Longitude: -97.432862
Project No.: TSW23171
Phase No.: ****
Date Drilling Completed: 3/6/2023
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
	U-1		1.5 (P)	67			(CH) FAT CLAY, dark brown, stiff, moist, calcareous, trace gravel (Alluvium)									
	U-2		4.5+ (P)	100			(CH) FAT CLAY, yellow-brown and olive-brown, stiff to hard, dry, calcareous, slightly fissile, trace silty partings, highly weathered (Residual Marlbrook Marl) 1.8/	26	94	98	97	27	70	1.9	7.1	
5	U-3		4.5+ (P)	96												
	U-4		4.0 (P)	100				26	90	98	89	23	66	1.3	10.4	
	U-5		4.25 (P)	100												
10																
	U-6		3.5 (P)	92			(CH) FAT CLAY, olive-brown and yellow-brown, very stiff, dry, slightly fissile, tightly fractured with carbon staining, with silt, highly weathered (Residual Marlbrook Marl) 13/	30	87	100	88	23	65	1.3	9.6	
15																
	SPT-7	6-9-11 (20)														
20							-trace dark gray shaly seams and layers below 23 feet									
	SPT-8	7-10-13 (23)														
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	None		None

Remarks:
0-25 feet - continuous flight augers. Boring backfilled with cement bentonite grout upon completion.

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. B-203-23

Project Description: Upper Brushy 29
Project Location: Hutto, Texas
Date Drilling Started: 3/6/2023
Logged By: Z. Ready
Rig Type: CME 75
Latitude: 30.523415
Drilling Co.: Austin Geologic
Hammer Type: Automatic
Longitude: -97.431875
Project No.: TSW23171
Phase No.: ****
Date Drilling Completed: 3/6/2023
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
	U-1		2.5 (P)	33			(CH) FAT CLAY, dark brown, stiff to very stiff, moist, calcareous, trace gravel (Alluvium)	29	87	91	70	21	49	1.1	3.1	
	U-2		4.5+ (P)	100			(CH) FAT CLAY, light brown to olive-brown, stiff to hard, dry, blocky, calcareous, highly weathered (Residual Marlbrook Marl) 2/									
5	U-3		4.5+ (P)	58			-yellow-brown, iron stained silty partings from 4 to 10 feet									
	U-4		4.5+ (P)	100												
	U-5		4.5+ (P)	100												
10																
	U-6		4.5+ (P)	83				31	93	100	84	24	60	1.2	2.9	
15																
	SPT-7	4-6-7 (13)					(CH) FAT CLAY, yellow-brown and light brown, stiff, moist, calcareous, slightly fissile, some silt, trace fossils, trace gypsum partings, highly weathered (Residual Marlbrook Marl) 18.5/									
20																
	SPT-8	5-7-10 (17)						25		99	83	21	62			
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	None		None

Remarks:
0-25 feet - continuous flight augers. Boring backfilled with cement bentonite grout upon completion.

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.

Attachment E-4: Geotechnical Information

Upper Brushy Creek 29 Laboratory Test Results

SUMMARY OF LABORATORY RESULTS

PROJECT NAME Upper Brushy 29 **PROJECT NUMBER** TSW23171 **PROJECT PHASE** ****

PROJECT LOCATION Hutto, Texas **TESTING PERFOMED BY:** Beyond Engineering

Borehole	Depth, ft	Water Content, %	Unit Dry Weight lb/ft^3	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index	Unconfined Compressive Strength, tsf	Strain at Failure, %
B-01-23	4.0	28.8	93.2	82	66	25	41	2.4	7.5
B-01-23	13.5	26.8		89	74	21	53		
B-01-23	23.5	28.9		94	74	22	52		
B-01-23	33.0	27.5	96.2	82	72	22	50	2.3	9.3
B-01-23	48.5	24.6		98	78	23	55		
B-01-23	58.5	21.4		99	70	23	47		
B-02-23	6.0	27.4	95.3	93	75	21	54	2.3	10.1
B-02-23	18.0	23.6	104.7	89	64	20	44	3	9.8
B-02-23	28.0	26.1	95.8	91	76	21	55	1.8	7
B-02-23	38.0	24.1	98.3	72	75	20	55	2	3.2
B-02-23	53.5	23.6		100	75	22	53		
B-201-23	0.0	29.4	89.2	76	66	20	46	0.7	4.7
B-201-23	4.0	24.2	98.1	99	73	20	53	1.1	3.6
B-201-23	13.0	29.2	94.5	99	72	22	50	2.2	3.1
B-202-23	2.0	25.7	93.6	98	97	27	70	1.9	7.1
B-202-23	6.0	26.1	90.2	98	89	23	66	1.3	10.4
B-202-23	13.0	30.1	87.0	100	88	23	65	1.3	9.6
B-203-23	0.0	28.7	86.7	91	70	21	49	1.1	3.1
B-203-23	13.0	30.6	92.9	100	84	24	60	1.2	2.9
B-203-23	23.5	24.7		99	83	21	62		

Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)

Beyond Project No.: LT2303018
Testing Method: ASTM D6572
Method A
Test Dates: 3/20/2023

Determining Dispersive Characteristics of Clayey Soils by the Crumb Test

Sample	Time	Temp °C	Grade	Overall Dispersive Classification
B-01-23 at 4 ft (U-3)	2 minutes	17.5	1	Non-dispersive
	1 hour	17.7	1	
	6 hours	18.1	1	

*Samples tested at as-received moisture content in distilled water

2 minutes

1 hour

6 hours

Te-An Wang, 03/22/23
Quality Review/Date

Tested by: J.Z.

Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)

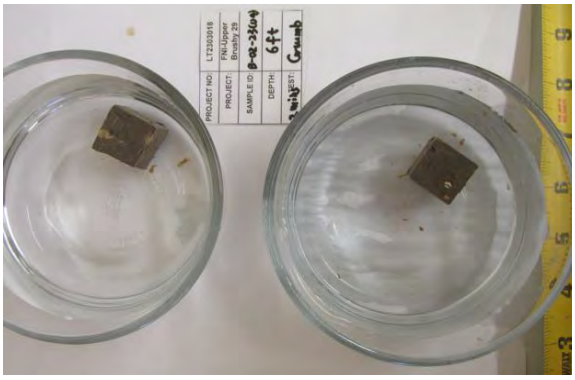
Beyond Project No.: LT2303018
Testing Method: ASTM D6572
Method A
Test Dates: 3/20/2023

Determining Dispersive Characteristics of Clayey Soils by the Crumb Test

Sample	Time	Temp °C	Grade	Overall Dispersive Classification
B-02-23 at 6 ft (U-4)	2 minutes	17.4	1	Non-dispersive
	1 hour	17.5	1	
	6 hours	17.7	1	

*Samples tested at as-received moisture content in distilled water

2 minutes



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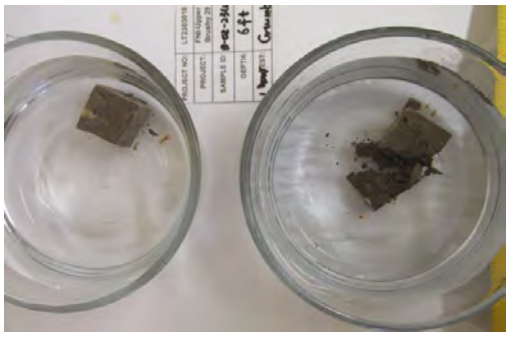

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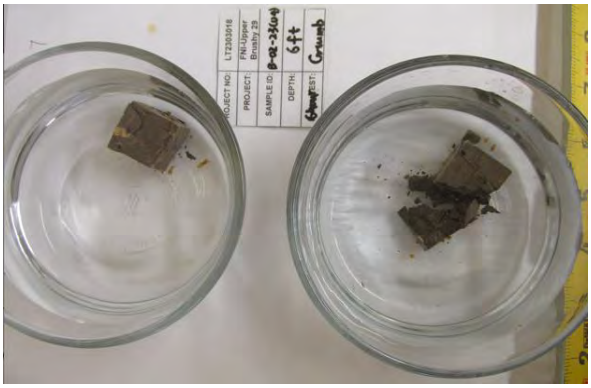


Te-An Wang, 03/22/23
Quality Review/Date
Tested by: J.Z.

Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)

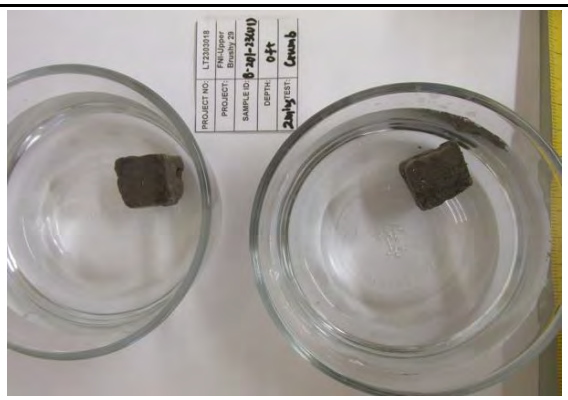
Beyond Project No.: LT2303018
Testing Method: ASTM D6572
Method A
Test Dates: 3/20/2023

Determining Dispersive Characteristics of Clayey Soils by the Crumb Test

Sample	Time	Temp °C	Grade	Overall Dispersive Classification
B-201-23 at 0 ft (U-1)	2 minutes	17.3	1	Non-dispersive
	1 hour	17.3	1	
	6 hours	17.4	1	

*Samples tested at as-received moisture content in distilled water

2 minutes



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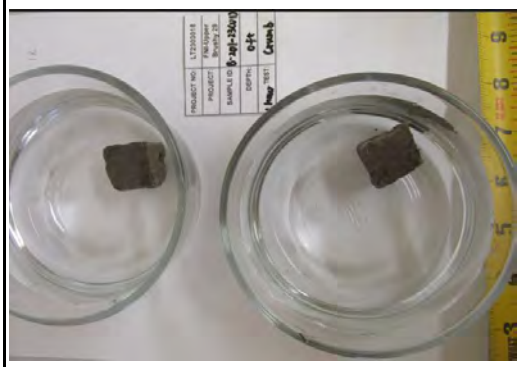

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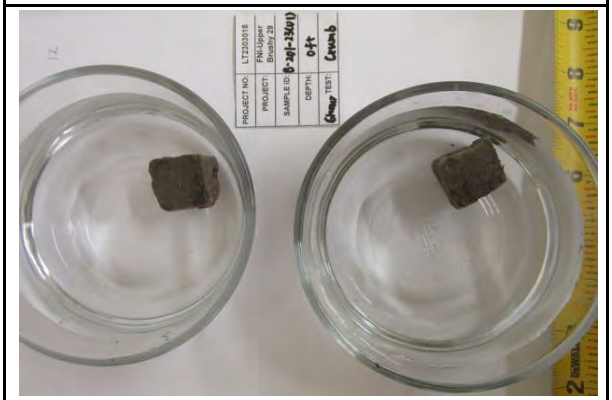

Te-An Wang, 03/22/23
Quality Review/Date
Tested by: J.Z.

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3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)

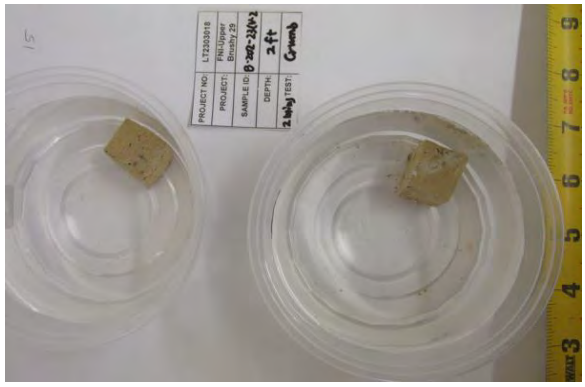
Beyond Project No.: LT2303018
Testing Method: ASTM D6572
Method A
Test Dates: 3/20/2023

Determining Dispersive Characteristics of Clayey Soils by the Crumb Test

Sample	Time	Temp °C	Grade	Overall Dispersive Classification
B-202-23 at 2 ft (U-2)	2 minutes	16.6	1	Non-dispersive
	1 hour	17.1	1	
	6 hours	17.2	1	

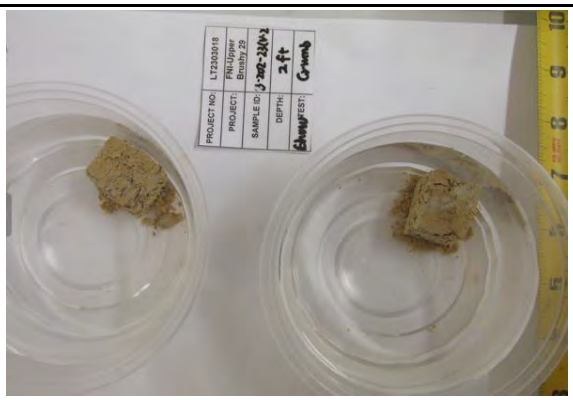
*Samples tested at as-received moisture content in distilled water

2 minutes



1 hour

6 hours



Te-An Wang, 03/22/23
Quality Review/Date
Tested by: J.Z.

Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
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(512) 358-6048

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)

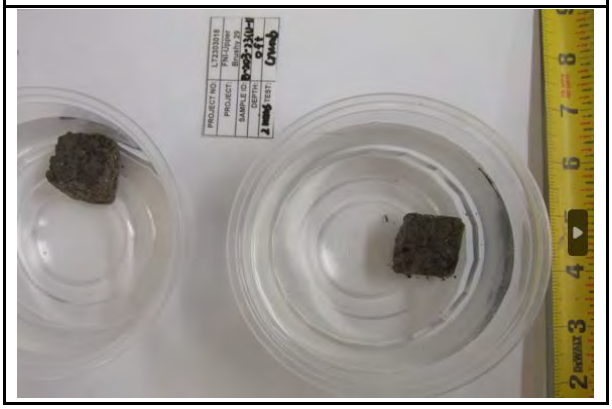
Beyond Project No.: LT2303018
Testing Method: ASTM D6572
Method A
Test Dates: 3/20/2023

Determining Dispersive Characteristics of Clayey Soils by the Crumb Test

Sample	Time	Temp °C	Grade	Overall Dispersive Classification
B-203-23 at 0 ft (U-1)	2 minutes	16.7	1	Non-dispersive
	1 hour	16.9	1	
	6 hours	17.2	1	

*Samples tested at as-received moisture content in distilled water

2 minutes



1 hour

6 hours

Te-An Wang, 03/22/23
Quality Review/Date

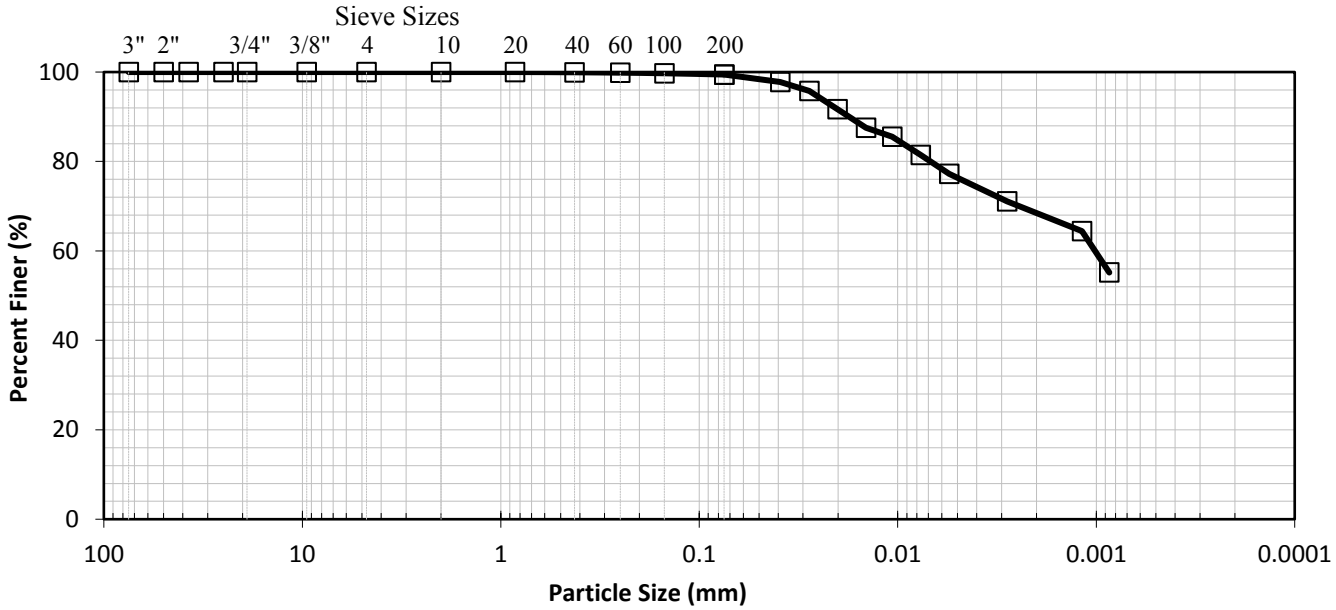
Tested by: J.Z.

Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Particle Size Analysis for Soils

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29 (PN: TSW23171)
Sample: B-201-23 at 4 ft

Beyond Project No.: LT2303018
Test Method: ASTM D6913 & ASTM D7928
Test Date: 3/15/2023



Sieve Analysis	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.0 mm)	100.0
No. 20 (850 mm)	100.0
No. 40 (425 mm)	99.9
No. 60 (250 mm)	99.9
No. 100 (150 mm)	99.7
No. 200 (75 mm)	99.4

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.039 mm	98
0.028 mm	96
0.020 mm	92
0.014 mm	88
0.011 mm	86
0.0077 mm	81
0.0055 mm	77
0.0028 mm	71
0.0012 mm	64
0.0009 mm	55

Note: S.G. assumed to be 2.70, sample was prepared air-dried.

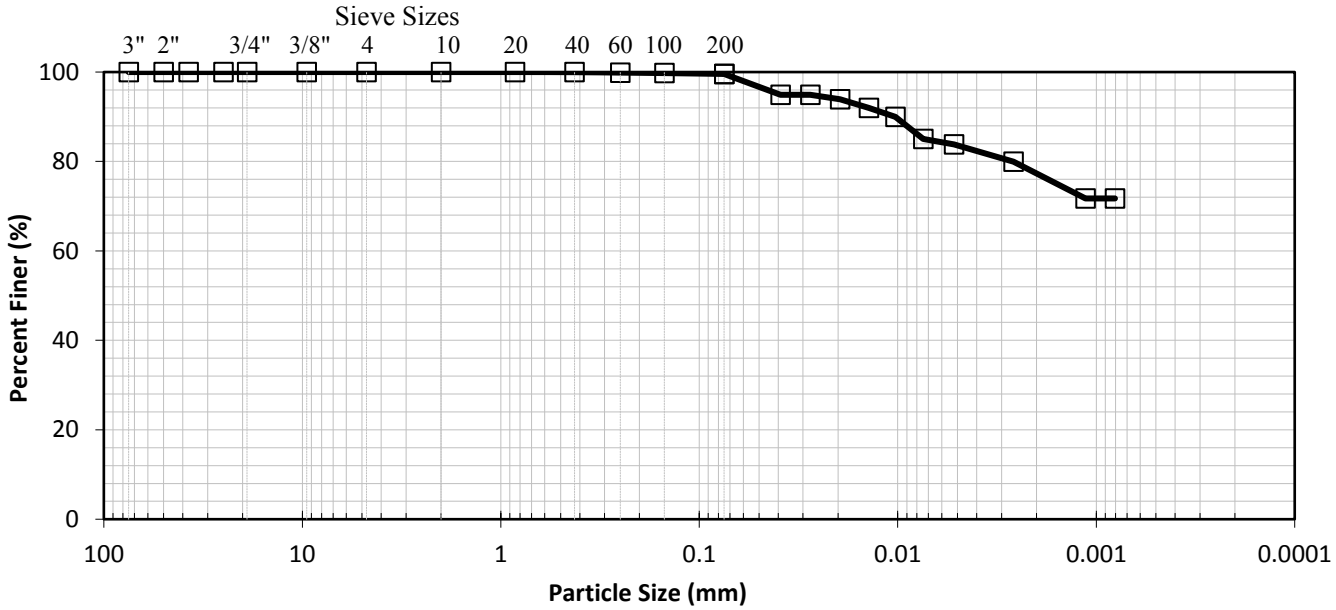
Te-An Wang, EIT, 03/24/23
Quality Review/Date
Tested by: J.Z.

Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Particle Size Analysis for Soils

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29 (PN: TSW23171)
Sample: B-202-23 at 13 ft

Beyond Project No.: LT2303018
Test Method: ASTM D6913 & ASTM D7928
Test Date: 3/15/2023



Sieve Analysis	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	100.0
No. 10 (2.0 mm)	100.0
No. 20 (850 mm)	100.0
No. 40 (425 mm)	100.0
No. 60 (250 mm)	99.9
No. 100 (150 mm)	99.8
No. 200 (75 mm)	99.6

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.039 mm	95
0.028 mm	95
0.020 mm	94
0.014 mm	92
0.010 mm	90
0.0074 mm	85
0.0052 mm	84
0.0026 mm	80
0.0011 mm	72
0.0008 mm	72

Note: S.G. assumed to be 2.70, sample was prepared air-dried.

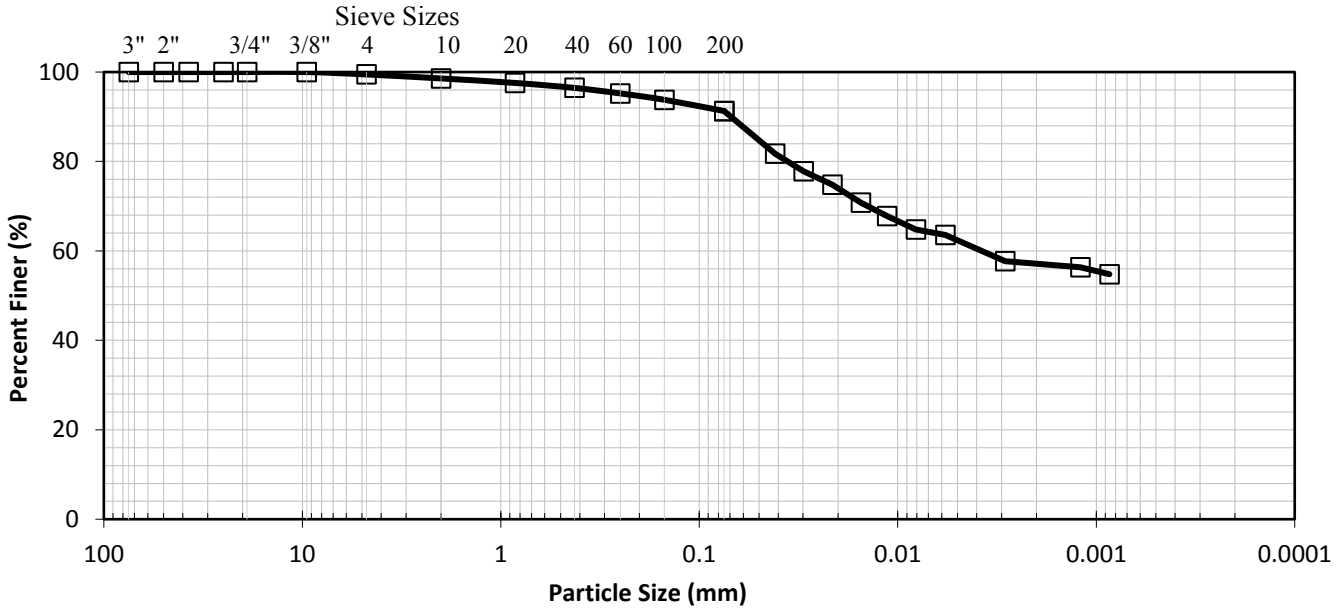
Te-An Wang, EIT, 03/24/23
Quality Review/Date
Tested by: J.Z.

Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Particle Size Analysis for Soils

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29 (PN: TSW23171)
Sample: B-203-23 at 0 ft

Beyond Project No.: LT2303018
Test Method: ASTM D6913 & ASTM D7928
Test Date: 3/15/2023



Sieve Analysis	
Sieve Size	Percent Passing (%)
3 in.	100.0
2 in.	100.0
1.5 in.	100.0
1 in.	100.0
3/4 in.	100.0
3/8 in.	100.0
No. 4 (4.75 mm)	99.5
No. 10 (2.0 mm)	98.6
No. 20 (850 mm)	97.6
No. 40 (425 mm)	96.5
No. 60 (250 mm)	95.2
No. 100 (150 mm)	93.8
No. 200 (75 mm)	91.3

Hydrometer Analysis	
Particle Size	Percent Passing (%)
0.041 mm	82
0.030 mm	78
0.021 mm	75
0.015 mm	71
0.011 mm	68
0.0081 mm	65
0.0057 mm	64
0.0029 mm	58
0.0012 mm	56
0.0009 mm	55

Note: S.G. assumed to be 2.70, sample was prepared air-dried.

Te-An Wang, EIT, 03/24/23
Quality Review/Date
Tested by: J.Z.

Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
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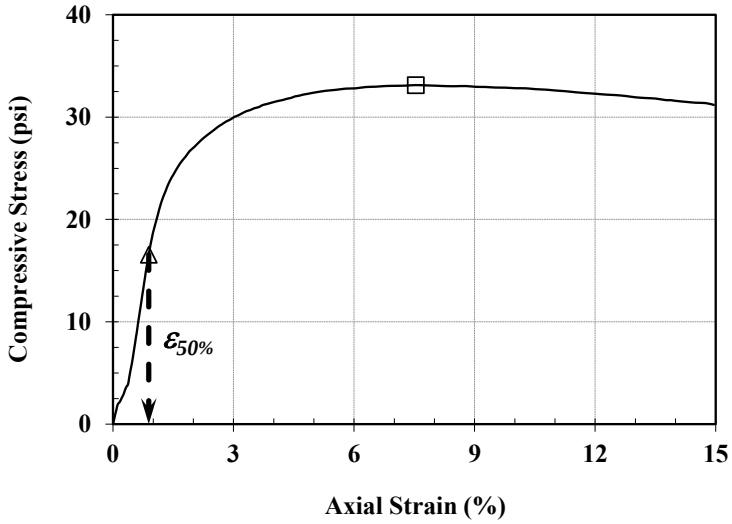
Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29 (PN: TSW23171)
Sample I.D.: B-01-23 at 4 ft

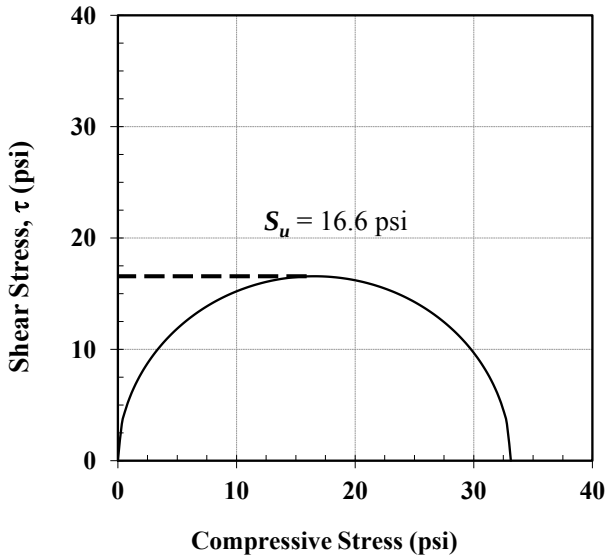
Project No.: LT2303018
Test Method: ASTM D2166

Type of Specimen: Shelby Tube
Strain Rate: 1.0 %/min
Test Date: 3/14/2023



Initial Specimen Conditions		
Avg. Diameter (in)	D_o	2.73
Avg. Height (in)	H_o	5.73
Water Content (%)	w_o	28.8
Total Unit Weight (pcf)	g_{total}	120.1
Dry Unit Weight (pcf)	g_{dry}	93.2
Saturation (%)	S_r	96.2
Void Ratio	e_o	0.81
Specific Gravity (Assumed)	G_s	2.70

Mohr Circles for Peak Stress at Failure



Stresses at Failure	
Compressive Strength, q_u (tsf)	2.4
Axial Strain at Failure (%)	7.5
Axial Strain at 50 % of q_u (%)	0.9
Total Stresses at Failure	
Major Principal Stress, s_1 (psi)	33.1
Minor Principal Stress, s_3 (psi)	0
Undrained Shear Strength, S_u (tsf)	1.19

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

Te-An Wang, EIT, 03/20/23
Quality Review/Date
Specimen prepared & tested by: A.B.

Beyond Engineering & Testing, LLC
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(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)
Specimen: B-01-23 at 4 ft

Project No.: LT2303018
Test Method: ASTM D2166
Test Date: 03/14/23

Failure Mode: Diagonal Failure Plane (Transition)

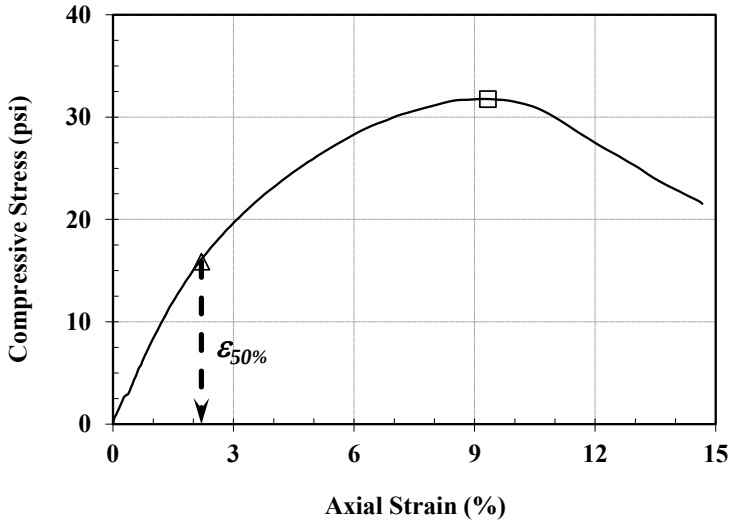
Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)
Sample I.D.: B-01-23 at 33 ft

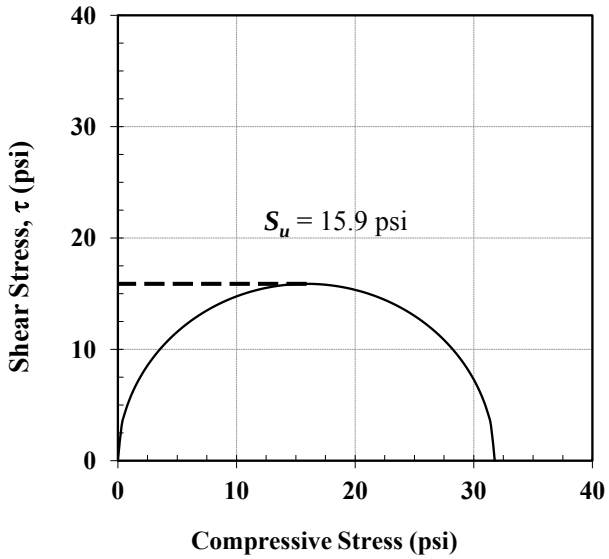
Project No.: LT2303018
Test Method: ASTM D2166

Type of Specimen: Shelby Tube
Strain Rate: 1.0 %/min
Test Date: 3/14/2023



Initial Specimen Conditions		
Avg. Diameter (in)	D_o	2.75
Avg. Height (in)	H_o	5.66
Water Content (%)	w_o	27.5
Total Unit Weight (pcf)	g_{total}	122.6
Dry Unit Weight (pcf)	g_{dry}	96.2
Saturation (%)	S_r	98.7
Void Ratio	e_o	0.75
Specific Gravity (Assumed)	G_s	2.70

Mohr Circles for Peak Stress at Failure



Stresses at Failure	
Compressive Strength, q_u (tsf)	2.3
Axial Strain at Failure (%)	9.3
Axial Strain at 50 % of q_u (%)	2.2
Total Stresses at Failure	
Major Principal Stress, s_1 (psi)	31.8
Minor Principal Stress, s_3 (psi)	0
Undrained Shear Strength, S_u (tsf)	1.14

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

Te-An Wang, EIT, 03/22/23
Quality Review/Date
Specimen prepared & tested by: A.B.

Beyond Engineering & Testing, LLC
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Round Rock, TX 78664
(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)
Specimen: B-01-23 at 33 ft

Project No.: LT2303018
Test Method: ASTM D2166
Test Date: 03/14/23

Failure Mode: Brittle Failure

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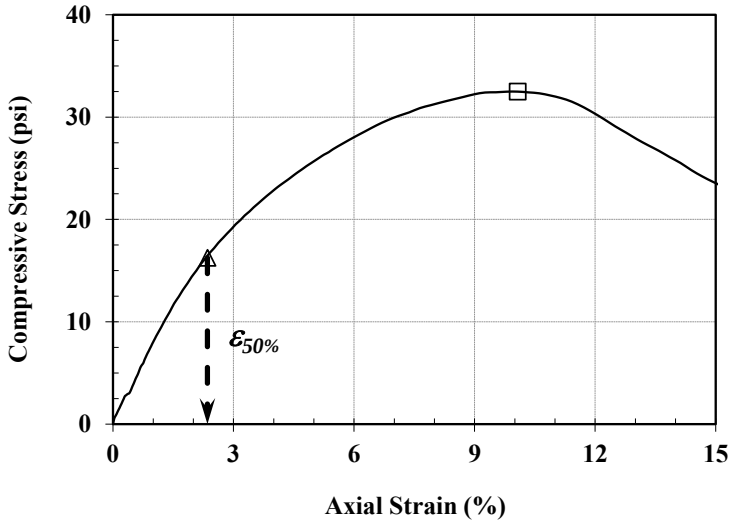
Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)
Sample I.D.: B-02-23 at 6 ft

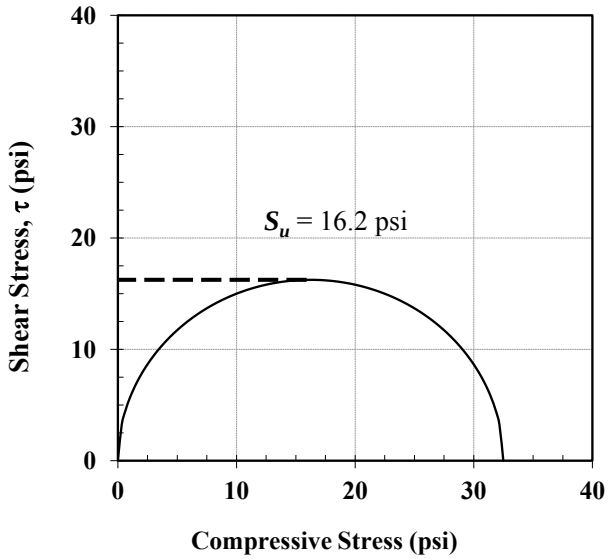
Project No.: LT2303018
Test Method: ASTM D2166

Type of Specimen: Shelby Tube
Strain Rate: 1.1 %/min
Test Date: 3/14/2023



Initial Specimen Conditions		
Avg. Diameter (in)	D_o	2.71
Avg. Height (in)	H_o	5.24
Water Content (%)	w_o	27.4
Total Unit Weight (pcf)	g_{total}	121.4
Dry Unit Weight (pcf)	g_{dry}	95.3
Saturation (%)	S_r	96.2
Void Ratio	e_o	0.77
Specific Gravity (Assumed)	G_s	2.70

Mohr Circles for Peak Stress at Failure



Stresses at Failure	
Compressive Strength, q_u (tsf)	2.3
Axial Strain at Failure (%)	10.1
Axial Strain at 50 % of q_u (%)	2.4
Total Stresses at Failure	
Major Principal Stress, s_1 (psi)	32.5
Minor Principal Stress, s_3 (psi)	0
Undrained Shear Strength, S_u (tsf)	1.17

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

Te-An Wang, EIT, 03/22/23
Quality Review/Date
Specimen prepared & tested by: A.B.

Beyond Engineering & Testing, LLC
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(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)
Specimen: B-02-23 at 6 ft

Project No.: LT2303018
Test Method: ASTM D2166
Test Date: 03/14/23

Failure Mode: Single Inclined Failure Plane

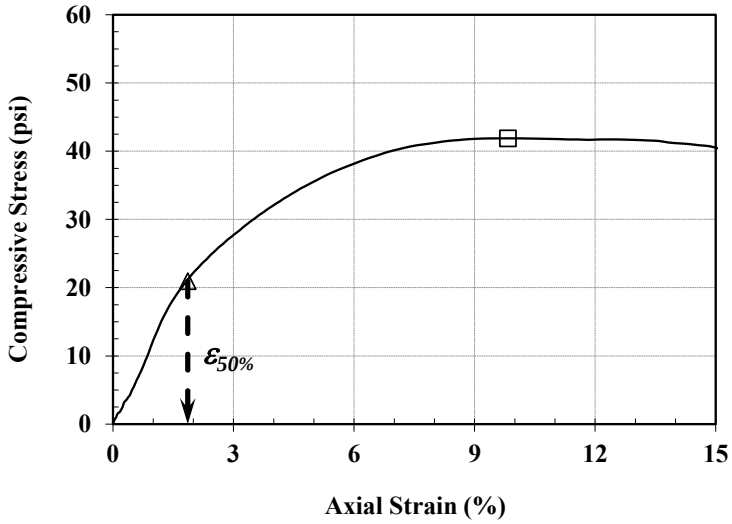
Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)
Sample I.D.: B-02-23 at 18 ft

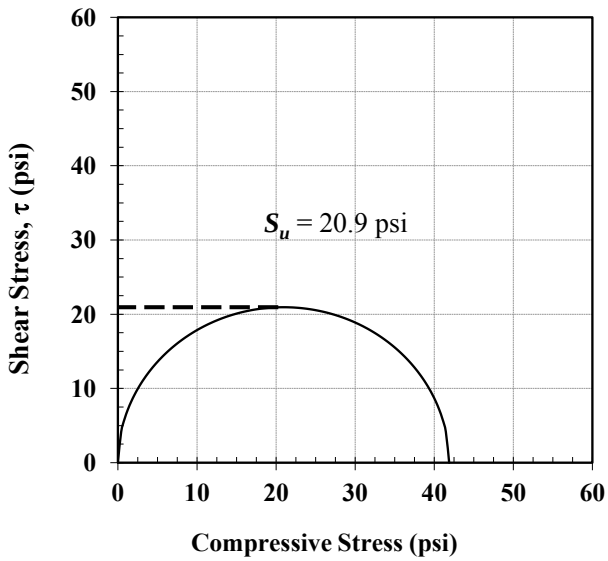
Project No.: LT2303018
Test Method: ASTM D2166

Type of Specimen: Shelby Tube
Strain Rate: 1.0 %/min
Test Date: 3/14/2023



Initial Specimen Conditions		
Avg. Diameter (in)	D_o	2.72
Avg. Height (in)	H_o	5.69
Water Content (%)	w_o	23.6
Total Unit Weight (pcf)	g_{total}	129.4
Dry Unit Weight (pcf)	g_{dry}	104.7
Saturation (%)	S_r	100.0
Void Ratio	e_o	0.61
Specific Gravity (Assumed)	G_s	2.70

Mohr Circles for Peak Stress at Failure



Stresses at Failure	
Compressive Strength, q_u (tsf)	3.0
Axial Strain at Failure (%)	9.8
Axial Strain at 50 % of q_u (%)	1.9
Total Stresses at Failure	
Major Principal Stress, s_1 (psi)	41.9
Minor Principal Stress, s_3 (psi)	0
Undrained Shear Strength, S_u (tsf)	1.51

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

Te-An Wang, EIT, 03/22/23
Quality Review/Date
Specimen prepared & tested by: A.B.

Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)
Specimen: B-02-23 at 18 ft

Project No.: LT2303018
Test Method: ASTM D2166
Test Date: 03/14/23

Failure Mode: Diagonal Failure Plane (Transition)

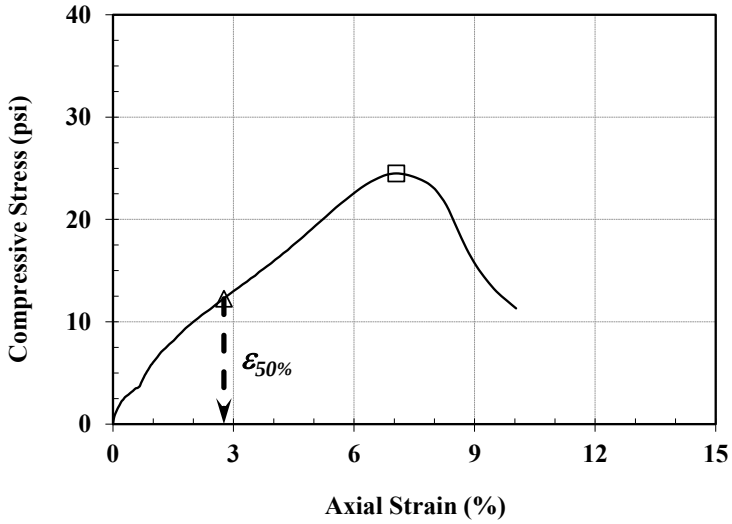
Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)
Sample I.D.: B-02-23 at 28 ft

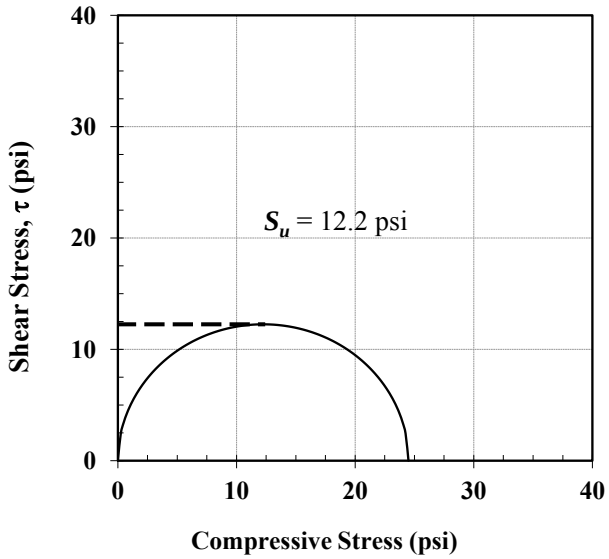
Project No.: LT2303018
Test Method: ASTM D2166

Type of Specimen: Shelby Tube
Strain Rate: 1.0 %/min
Test Date: 3/14/2023



Initial Specimen Conditions		
Avg. Diameter (in)	D_o	2.70
Avg. Height (in)	H_o	5.50
Water Content (%)	w_o	26.1
Total Unit Weight (pcf)	g_{total}	120.8
Dry Unit Weight (pcf)	g_{dry}	95.8
Saturation (%)	S_r	92.9
Void Ratio	e_o	0.76
Specific Gravity (Assumed)	G_s	2.70

Mohr Circles for Peak Stress at Failure



Stresses at Failure	
Compressive Strength, q_u (tsf)	1.8
Axial Strain at Failure (%)	7.0
Axial Strain at 50 % of q_u (%)	2.8
Total Stresses at Failure	
Major Principal Stress, s_1 (psi)	24.5
Minor Principal Stress, s_3 (psi)	0
Undrained Shear Strength, S_u (tsf)	0.88

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

Te-An Wang, EIT, 03/22/23
Quality Review/Date
Specimen prepared & tested by: A.B.

Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)
Specimen: B-02-23 at 28 ft

Project No.: LT2303018
Test Method: ASTM D2166
Test Date: 03/14/23

Failure Mode: Brittle Failure

Beyond Engineering & Testing, LLC
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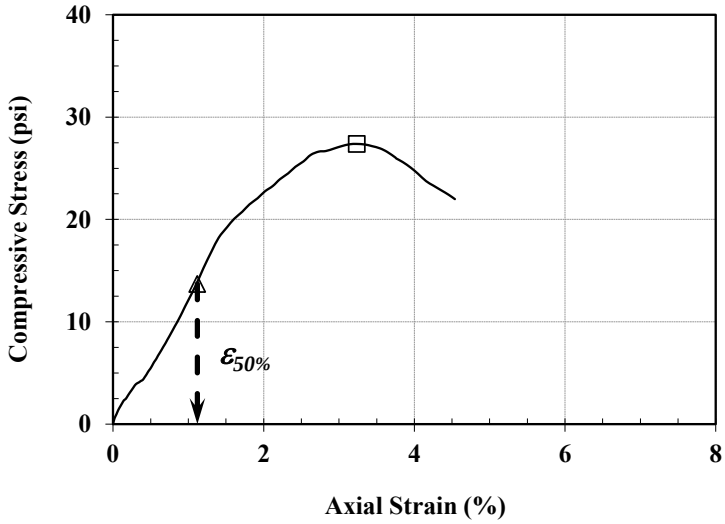
(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)
Sample I.D.: B-02-23 at 38 ft

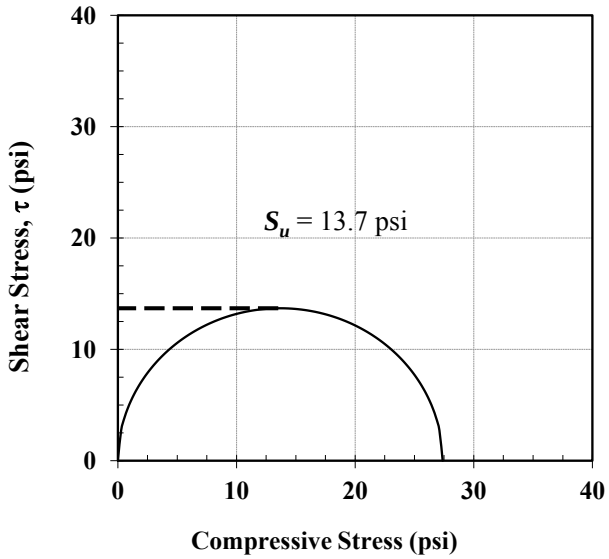
Project No.: LT2303018
Test Method: ASTM D2166

Type of Specimen: Shelby Tube
Strain Rate: 1.0 %/min
Test Date: 3/14/2023



Initial Specimen Conditions		
Avg. Diameter (in)	D_o	2.73
Avg. Height (in)	H_o	5.68
Water Content (%)	w_o	24.1
Total Unit Weight (pcf)	g_{total}	122.0
Dry Unit Weight (pcf)	g_{dry}	98.3
Saturation (%)	S_r	91.1
Void Ratio	e_o	0.72
Specific Gravity (Assumed)	G_s	2.70

Mohr Circles for Peak Stress at Failure



Stresses at Failure	
Compressive Strength, q_u (tsf)	2.0
Axial Strain at Failure (%)	3.2
Axial Strain at 50 % of q_u (%)	1.1
Total Stresses at Failure	
Major Principal Stress, s_1 (psi)	27.4
Minor Principal Stress, s_3 (psi)	0
Undrained Shear Strength, S_u (tsf)	0.99

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

Te-An Wang, EIT, 03/22/23
Quality Review/Date
Specimen prepared & tested by: A.B.

Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
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(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)
Specimen: B-02-23 at 38 ft

Project No.: LT2303018
Test Method: ASTM D2166
Test Date: 03/14/23

Failure Mode: Single Inclined Failure Plane

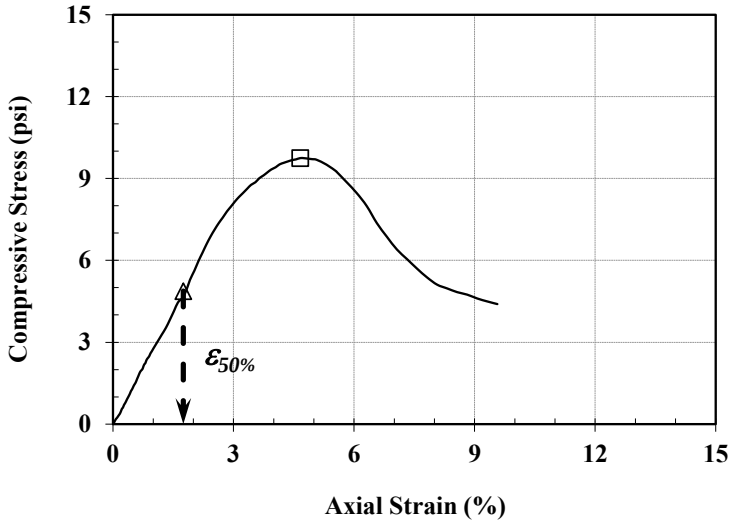
Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)
Sample I.D.: B-201-23 at 0 ft

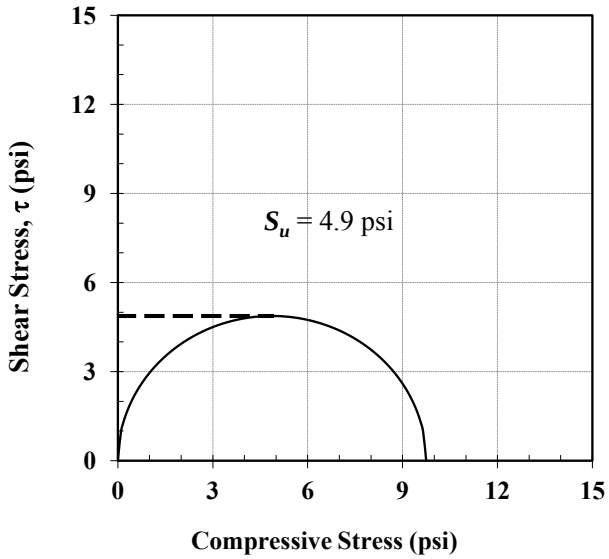
Project No.: LT2303018
Test Method: ASTM D2166

Type of Specimen: Shelby Tube
Strain Rate: 1.0 %/min
Test Date: 3/15/2023



Initial Specimen Conditions		
Avg. Diameter (in)	D_o	2.73
Avg. Height (in)	H_o	5.69
Water Content (%)	w_o	29.4
Total Unit Weight (pcf)	g_{total}	115.4
Dry Unit Weight (pcf)	g_{dry}	89.2
Saturation (%)	S_r	89.1
Void Ratio	e_o	0.89
Specific Gravity (Assumed)	G_s	2.70

Mohr Circles for Peak Stress at Failure



Stresses at Failure	
Compressive Strength, q_u (tsf)	0.7
Axial Strain at Failure (%)	4.7
Axial Strain at 50 % of q_u (%)	1.8
Total Stresses at Failure	
Major Principal Stress, s_1 (psi)	9.7
Minor Principal Stress, s_3 (psi)	0
Undrained Shear Strength, S_u (tsf)	0.35

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

Te-An Wang, EIT, 03/17/23
Quality Review/Date
Specimen prepared & tested by: A.B.

Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)
Specimen: B-201-23 at 0 ft

Project No.: LT2303018
Test Method: ASTM D2166
Test Date: 03/15/23

Failure Mode: Brittle Failure

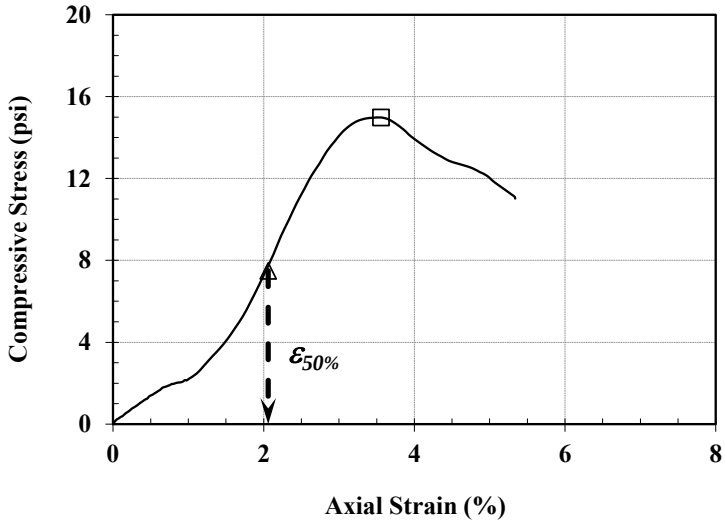
Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)
Sample I.D.: B-201-23 at 4 ft

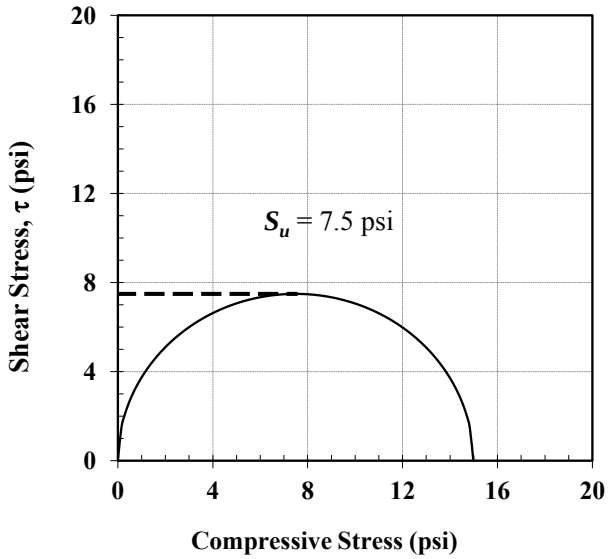
Project No.: LT2303018
Test Method: ASTM D2166

Type of Specimen: Shelby Tube
Strain Rate: 1.0 %/min
Test Date: 3/15/2023



Initial Specimen Conditions		
Avg. Diameter (in)	D_o	2.74
Avg. Height (in)	H_o	5.68
Water Content (%)	w_o	24.2
Total Unit Weight (pcf)	g_{total}	121.9
Dry Unit Weight (pcf)	g_{dry}	98.1
Saturation (%)	S_r	91.1
Void Ratio	e_o	0.72
Specific Gravity (Assumed)	G_s	2.70

Mohr Circles for Peak Stress at Failure



Stresses at Failure	
Compressive Strength, q_u (tsf)	1.1
Axial Strain at Failure (%)	3.6
Axial Strain at 50 % of q_u (%)	2.1
Total Stresses at Failure	
Major Principal Stress, s_1 (psi)	15.0
Minor Principal Stress, s_3 (psi)	0
Undrained Shear Strength, S_u (tsf)	0.54

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

Te-An Wang, EIT, 03/17/23
Quality Review/Date
Specimen prepared & tested by: A.B.

Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)
Specimen: B-201-23 at 4 ft

Project No.: LT2303018
Test Method: ASTM D2166
Test Date: 03/15/23

Failure Mode: Single Inclined Failure Plane

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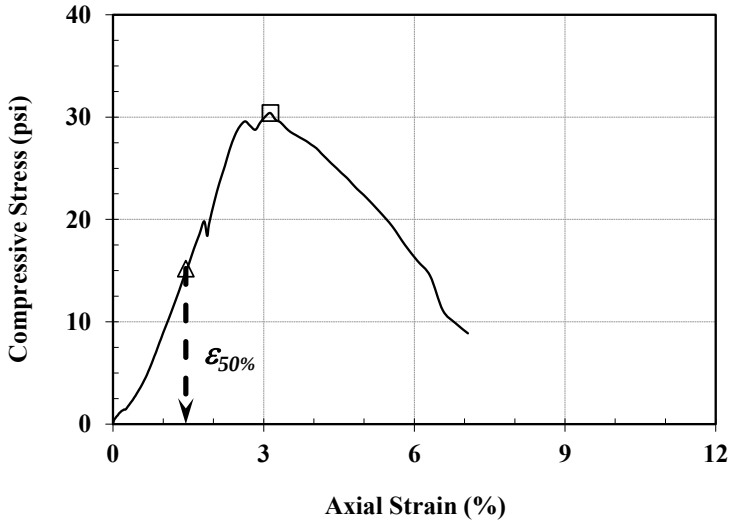
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)
Sample I.D.: B-201-23 at 13 ft

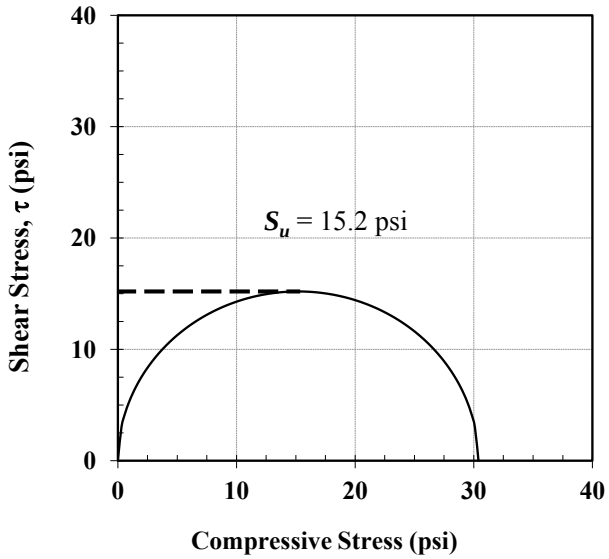
Project No.: LT2303018
Test Method: ASTM D2166

Type of Specimen: Shelby Tube
Strain Rate: 1.0 %/min
Test Date: 3/15/2023



Initial Specimen Conditions		
Avg. Diameter (in)	D_o	2.76
Avg. Height (in)	H_o	5.61
Water Content (%)	w_o	29.2
Total Unit Weight (pcf)	g_{total}	122.0
Dry Unit Weight (pcf)	g_{dry}	94.5
Saturation (%)	S_r	100.0
Void Ratio	e_o	0.78
Specific Gravity (Assumed)	G_s	2.70

Mohr Circles for Peak Stress at Failure



Stresses at Failure	
Compressive Strength, q_u (tsf)	2.2
Axial Strain at Failure (%)	3.1
Axial Strain at 50 % of q_u (%)	1.5
Total Stresses at Failure	
Major Principal Stress, s_1 (psi)	30.4
Minor Principal Stress, s_3 (psi)	0
Undrained Shear Strength, S_u (tsf)	1.09

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

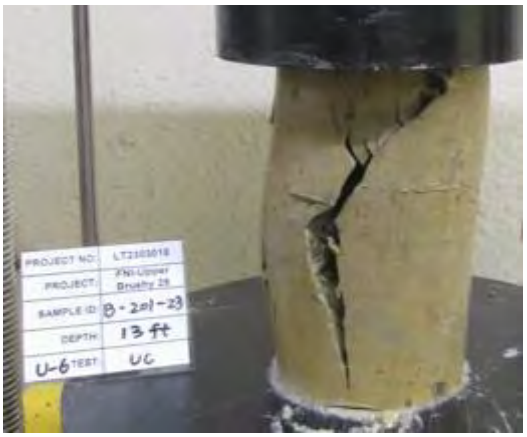
Te-An Wang, EIT, 03/17/23
Quality Review/Date
Specimen prepared & tested by: A.B.

Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)
Specimen: B-201-23 at 13 ft

Project No.: LT2303018
Test Method: ASTM D2166
Test Date: 03/15/23



Failure Mode: Brittle Failure

Beyond Engineering & Testing, LLC
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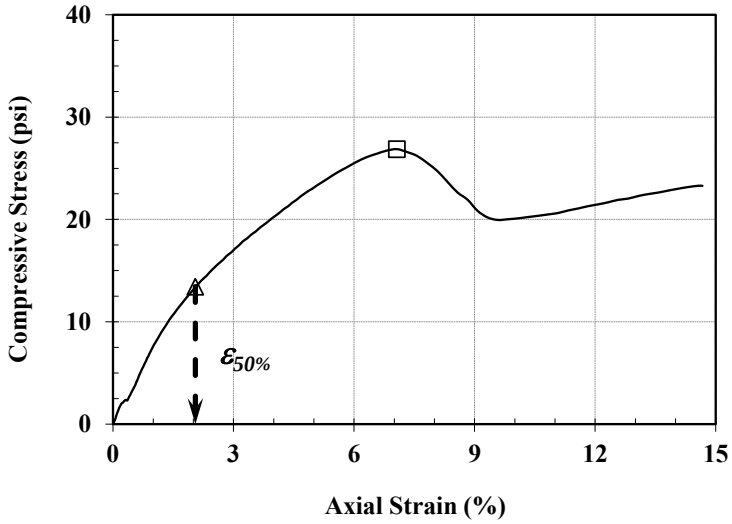
Round Rock, TX 78664
(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)
Sample I.D.: B-202-23 at 2 ft

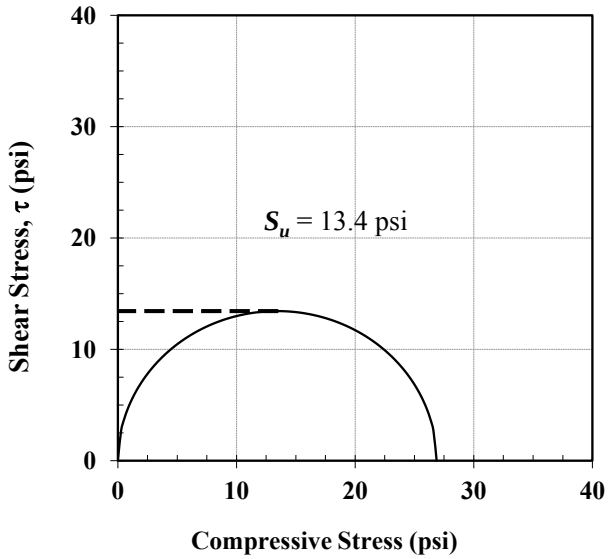
Project No.: LT2303018
Test Method: ASTM D2166

Type of Specimen: Shelby Tube
Strain Rate: 1.0 %/min
Test Date: 3/15/2023



Initial Specimen Conditions		
Avg. Diameter (in)	D_o	2.64
Avg. Height (in)	H_o	5.67
Water Content (%)	w_o	25.7
Total Unit Weight (pcf)	g_{total}	117.6
Dry Unit Weight (pcf)	g_{dry}	93.6
Saturation (%)	S_r	86.5
Void Ratio	e_o	0.80
Specific Gravity (Assumed)	G_s	2.70

Mohr Circles for Peak Stress at Failure



Stresses at Failure	
Compressive Strength, q_u (tsf)	1.9
Axial Strain at Failure (%)	7.1
Axial Strain at 50 % of q_u (%)	2.1
Total Stresses at Failure	
Major Principal Stress, s_1 (psi)	26.9
Minor Principal Stress, s_3 (psi)	0
Undrained Shear Strength, S_u (tsf)	0.97

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

Te-An Wang, EIT, 03/22/23
Quality Review/Date
Specimen prepared & tested by: A.B.

Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)
Specimen: B-202-23 at 2 ft

Project No.: LT2303018
Test Method: ASTM D2166
Test Date: 03/15/23

Failure Mode: Single Inclined Failure Plane

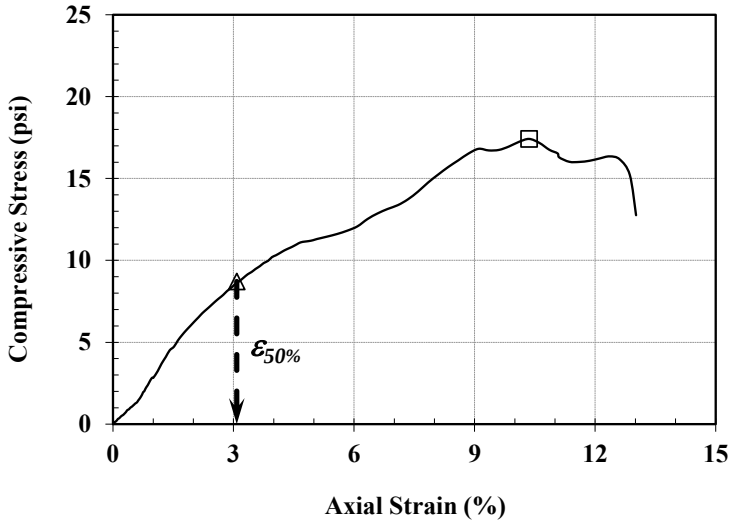
Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)
Sample I.D.: B-202-23 at 6 ft

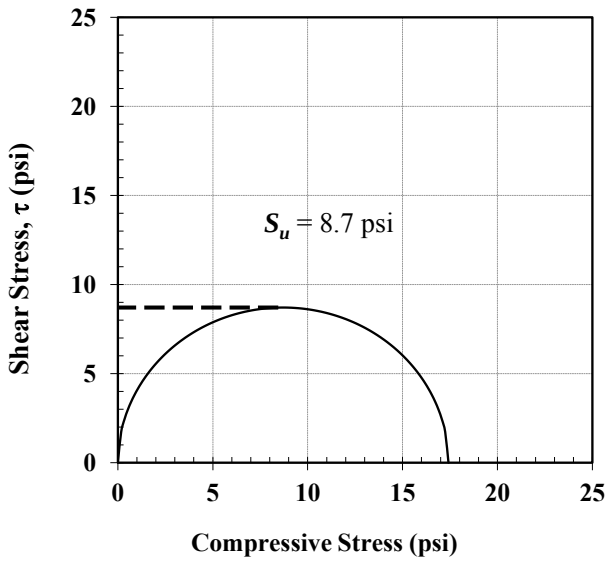
Project No.: LT2303018
Test Method: ASTM D2166

Type of Specimen: Shelby Tube
Strain Rate: 1.0 %/min
Test Date: 3/15/2023



Initial Specimen Conditions		
Avg. Diameter (in)	D_o	2.67
Avg. Height (in)	H_o	5.44
Water Content (%)	w_o	26.1
Total Unit Weight (pcf)	g_{total}	113.8
Dry Unit Weight (pcf)	g_{dry}	90.2
Saturation (%)	S_r	81.1
Void Ratio	e_o	0.87
Specific Gravity (Assumed)	G_s	2.70

Mohr Circles for Peak Stress at Failure



Stresses at Failure	
Compressive Strength, q_u (tsf)	1.3
Axial Strain at Failure (%)	10.4
Axial Strain at 50 % of q_u (%)	3.1
Total Stresses at Failure	
Major Principal Stress, s_1 (psi)	17.4
Minor Principal Stress, s_3 (psi)	0
Undrained Shear Strength, S_u (tsf)	0.63

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

Te-An Wang, EIT, 03/17/23
Quality Review/Date
Specimen prepared & tested by: A.B.

Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)
Specimen: B-202-23 at 6 ft

Project No.: LT2303018
Test Method: ASTM D2166
Test Date: 03/15/23

Failure Mode: Brittle Failure

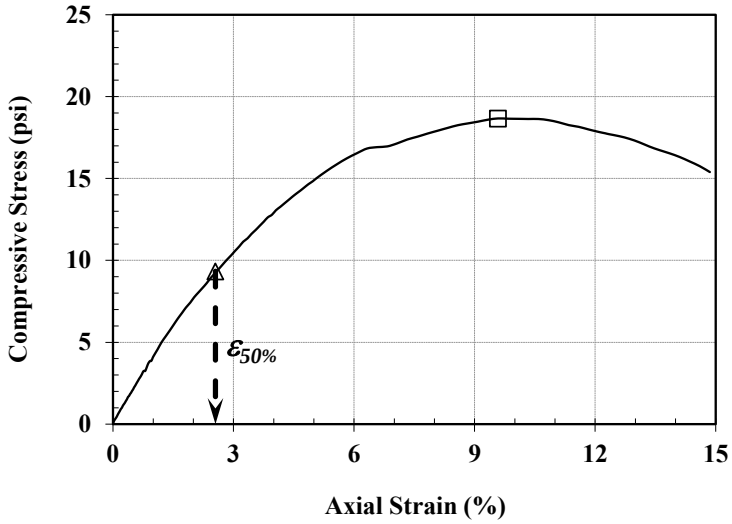
Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)
Sample I.D.: B-202-23 at 13 ft

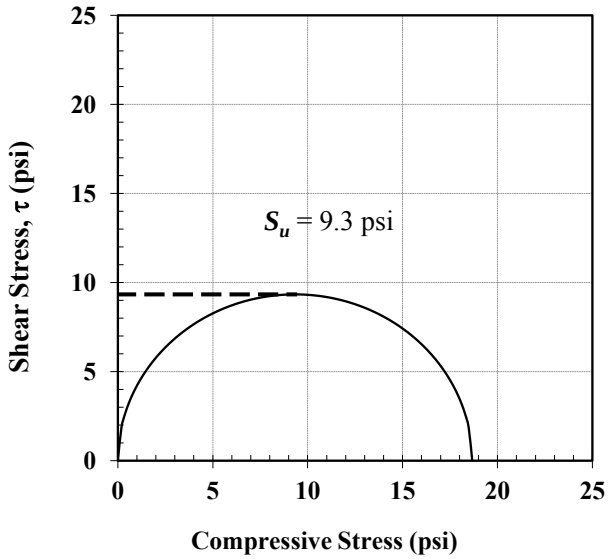
Project No.: LT2303018
Test Method: ASTM D2166

Type of Specimen: Shelby Tube
Strain Rate: 1.0 %/min
Test Date: 3/15/2023



Initial Specimen Conditions		
Avg. Diameter (in)	D_o	2.65
Avg. Height (in)	H_o	5.41
Water Content (%)	w_o	30.1
Total Unit Weight (pcf)	g_{total}	113.2
Dry Unit Weight (pcf)	g_{dry}	87.0
Saturation (%)	S_r	86.7
Void Ratio	e_o	0.94
Specific Gravity (Assumed)	G_s	2.70

Mohr Circles for Peak Stress at Failure



Stresses at Failure	
Compressive Strength, q_u (tsf)	1.3
Axial Strain at Failure (%)	9.6
Axial Strain at 50 % of q_u (%)	2.6
Total Stresses at Failure	
Major Principal Stress, s_1 (psi)	18.7
Minor Principal Stress, s_3 (psi)	0
Undrained Shear Strength, S_u (tsf)	0.67

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

Te-An Wang, EIT, 03/17/23
Quality Review/Date
Specimen prepared & tested by: A.B.

Beyond Engineering & Testing, LLC
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Round Rock, TX 78664
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Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)
Specimen: B-202-23 at 13 ft

Project No.: LT2303018
Test Method: ASTM D2166
Test Date: 03/15/23

Failure Mode: Brittle Failure

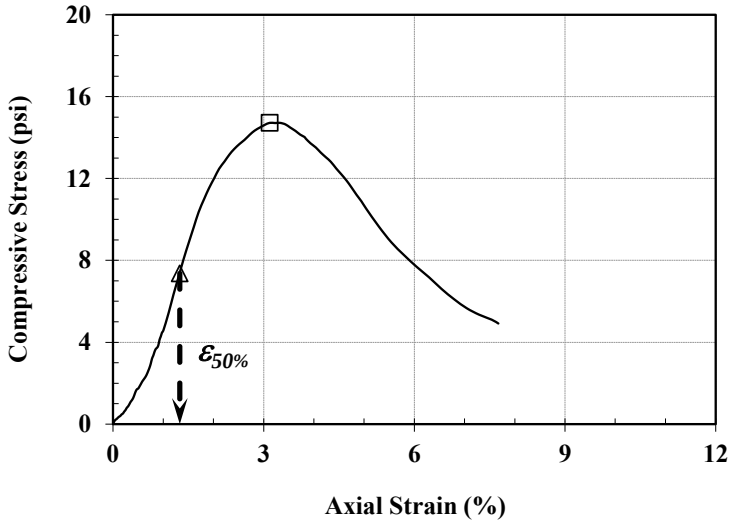
Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)
Sample I.D.: B-203-23 at 0 ft

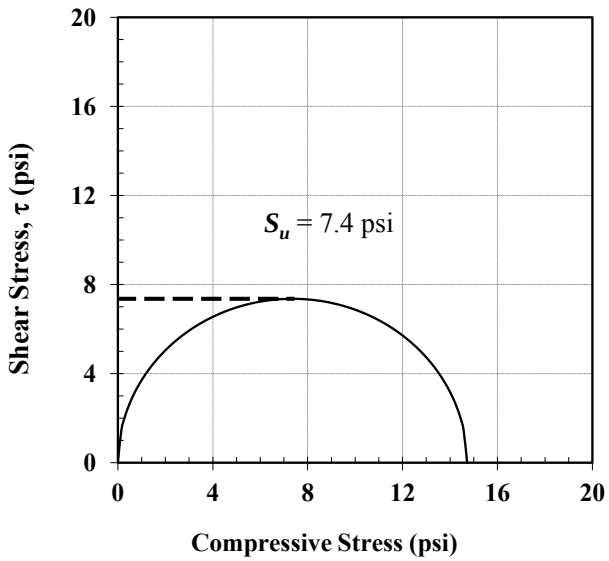
Project No.: LT2303018
Test Method: ASTM D2166

Type of Specimen: Shelby Tube
Strain Rate: 1.0 %/min
Test Date: 3/15/2023



Initial Specimen Conditions		
Avg. Diameter (in)	D_o	2.61
Avg. Height (in)	H_o	5.39
Water Content (%)	w_o	28.7
Total Unit Weight (pcf)	g_{total}	111.6
Dry Unit Weight (pcf)	g_{dry}	86.7
Saturation (%)	S_r	82.1
Void Ratio	e_o	0.94
Specific Gravity (Assumed)	G_s	2.70

Mohr Circles for Peak Stress at Failure



Stresses at Failure	
Compressive Strength, q_u (tsf)	1.1
Axial Strain at Failure (%)	3.1
Axial Strain at 50 % of q_u (%)	1.3
Total Stresses at Failure	
Major Principal Stress, s_1 (psi)	14.7
Minor Principal Stress, s_3 (psi)	0
Undrained Shear Strength, S_u (tsf)	0.53

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

Te-An Wang, EIT, 03/22/23
Quality Review/Date
Specimen prepared & tested by: A.B.

Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)
Specimen: B-203-23 at 0 ft

Project No.: LT2303018
Test Method: ASTM D2166
Test Date: 03/15/23

Failure Mode: Diagonal Failure Plane (Transition)

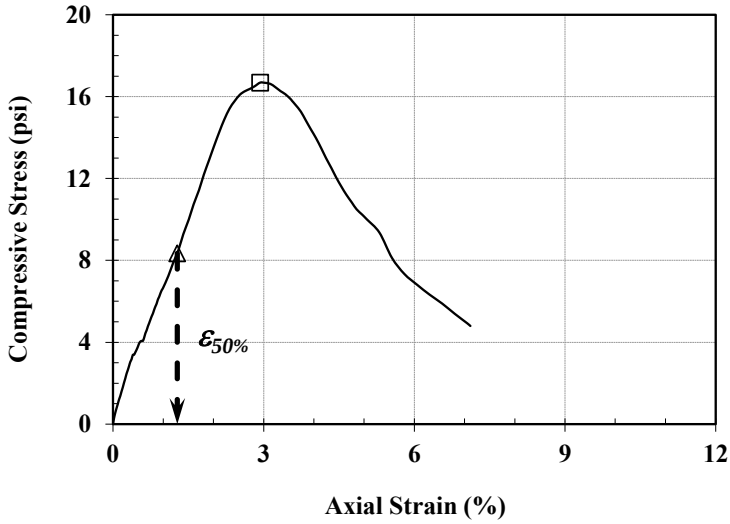
Beyond Engineering & Testing, LLC
3801 Doris Lane, Suite B
Round Rock, TX 78664
(512) 358-6048

Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)
Sample I.D.: B-203-23 at 13 ft

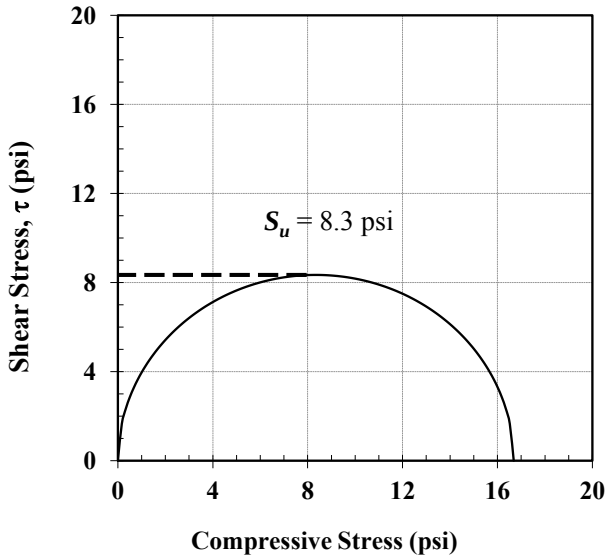
Project No.: LT2303018
Test Method: ASTM D2166

Type of Specimen: Shelby Tube
Strain Rate: 1.0 %/min
Test Date: 3/15/2023



Initial Specimen Conditions		
Avg. Diameter (in)	D_o	2.74
Avg. Height (in)	H_o	5.70
Water Content (%)	w_o	30.6
Total Unit Weight (pcf)	g_{total}	121.3
Dry Unit Weight (pcf)	g_{dry}	92.9
Saturation (%)	S_r	100.0
Void Ratio	e_o	0.81
Specific Gravity (Assumed)	G_s	2.70

Mohr Circles for Peak Stress at Failure



Stresses at Failure	
Compressive Strength, q_u (tsf)	1.2
Axial Strain at Failure (%)	2.9
Axial Strain at 50 % of q_u (%)	1.3
Total Stresses at Failure	
Major Principal Stress, s_1 (psi)	16.7
Minor Principal Stress, s_3 (psi)	0
Undrained Shear Strength, S_u (tsf)	0.60

Note: Failure was determined at the maximum deviator stress or deviator stress at 15 % axial strain, whenever is obtained first.

Te-An Wang, EIT, 03/22/23
Quality Review/Date
Specimen prepared & tested by: A.B.

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Unconfined Compression Test Report

Client: Freese & Nichols, Inc.
Project: Upper Brushy 29
(PN: TSW23171)
Specimen: B-203-23 at 13 ft

Project No.: LT2303018
Test Method: ASTM D2166
Test Date: 03/15/23

Failure Mode: Single Inclined Failure Plane

Attachment E-5: Headcut Erodibility Index Calculation Information

Upper Brushy Creek 29

Rev.	Author	Author Initials	Reviewer	Reviewer Initials	Date
0	Holly Saez	HS	Sean Kim	SK	04/20/2023

1.0 PURPOSE

Upper Brushy Creek Watershed SCS Site No. 29 (Upper Brushy 29) is a flood control structure located in Williamson 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 Upper Brushy 25.

2.0 REFERENCES

1) Field Procedures Guide for the Headcut Erodibility Index (NRCS, Part 628, Chapter 52, 1997)
2) Boring Logs (FNI, 2022) – Borings 201 through 203
3) Upper Brushy Creek Watershed Project As-Builts (December, 1974)

3.0 GEOTECHNICAL INVESTIGATION

3.1 Field Investigation

Provided within the Field Investigation Plan and Plan of Operations, written by FNI, three (3) geotechnical boreholes (201 through 203) were proposed through the existing auxiliary spillway and two (2) geotechnical boreholes (01 and 02) were propose through the existing embankment crest. The FNI borings were drilled in March 2023 to depths of 25 feet within the existing auxiliary spillway footprint and 60 feet through the existing embankment crest. All borings generally encountered expansive fat clay (CH). The developed K_h values were based on the information gathered from laboratory testing performed on geotechnical borings drilled through the existing auxiliary spillway at Upper Brushy 29.

3.2 Laboratory Results

Laboratory testing for the 2023 FNI field investigations included moisture content and unit dry weight, Atterberg limits, percent passing No. 200 sieve, particle size gradation, hydrometer, crumb dispersion, and unconfined compressive strength testing on the clays to be used to develop K_h values. Field and laboratory data required for the headcut erodibility calculation was based on the 2023 FNI investigations.

3.3 Stratigraphy

Soils within the existing auxiliary spillway were composed of fat clays (CH). The fat clays (CH) were generally residual to highly weathered soils of the Marlbrook Marl formation and were characterized as olive-brown to yellow-brown, stiff to very stiff with calcareous deposits and iron oxide stains. Laboratory testing was not available for all samples collected for the auxiliary spillway borings. Therefore, averages were developed from assigned laboratory results.

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[1] (%)	UCS (tsf)
1	Fat Clay (CH) [2]	68	48	54	0.9
2	Fat Clay (CH) [3]	84	61	73	1.5

[1] Limited hydrometer testing was performed on collected samples. An average CF was estimated from results that were available.
[2] Alluvium/Residual Marlbrook Marl
[3] Highly Weathered Marlbrook Marl

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:

$$K_h = M_s * K_b * K_d * J_s$$

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 clays possessing an unconfined compressive strength (UCS), the M_s is approximated using the formula found in Table 52-3 of the NRCS guidelines. When UCS values are not present, consistency can be utilized by field identification.

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.

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, $\Phi'_r = 234.73\ (LL)^{-0.6655}$

4.4 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.

5.0 Summary

A summary of the SITES parameters developed by FNI are provided in Table 2. The excel calculation for the headcut erodibility index value (K_h) for the fat clay (CH) materials are included as an attachment.

Table 2: Summary of SITES Input Parameters for Upper Brushy 25

Layer	Description	PI [1] (%)	Dry Density[1] (pcf)	Clay Fraction [1] (%)	Representative Diameter [2] (in)	Percent Passing No. 200 Sieve [1]	Head Cut Index (K_h)
1	Fat Clay (CH)[3]	48	88	57	0.0019	84	0.01
2	Fat Clay (CH)[4]	61	93	73	0.00011	99	0.02

[1] Laboratory data for all clay samples within the auxiliary spillway were not available. Samples collected and tested are assumed to be representative of the material encountered.

[2] Limited sieve gradation results were available for the sampled clay material. The representative diameter for the soil materials were averaged based on available D75 values.

[3] Alluvium/Residual Marlbrook Marl

[4] Highly Weathered Marlbrook Marl

The proposed subsurface profile of the existing auxiliary spillway is presented in Figure 1. It is assumed that approximately the top 2 feet of the existing auxiliary spillway consists of the alluvial/residual fat clay (CH), overlying approximately 23-to-25 feet of highly weathered Marlbrook Marl fat clay (CH).

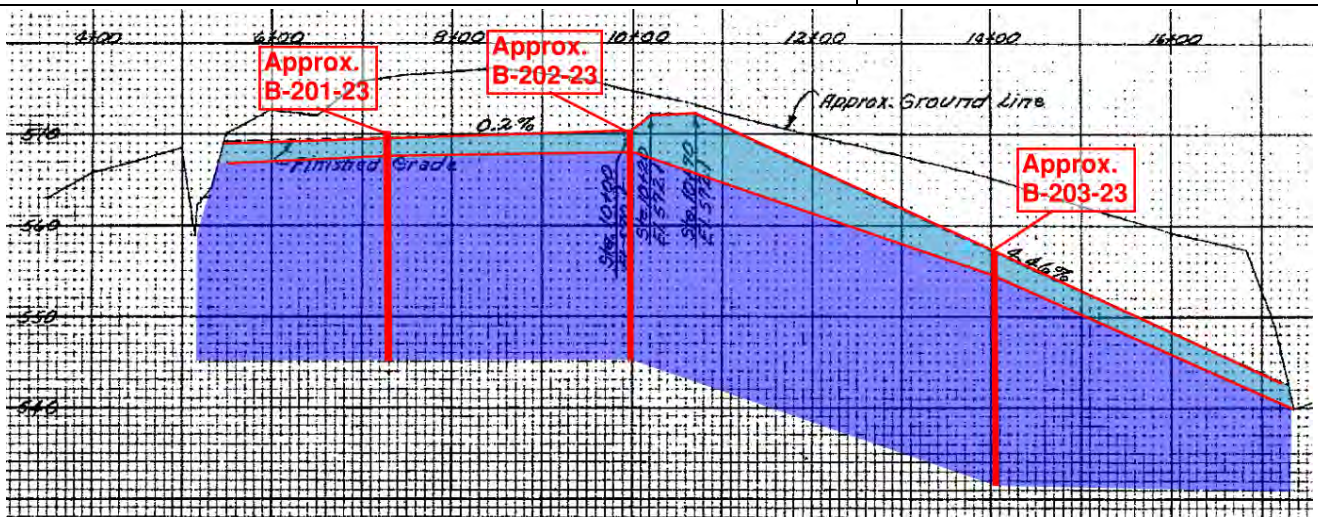

Figure 1. Generalized Stratigraphy of Auxiliary Spillway Profile

ATTACHMENTS

Boring	Depth			Material	USCS	Formation	MC (%)	DUW (pcf)	Hand Pen. (tsf)	LL	PI	% Passing No. 4	% Passing 0.002 mm (Clay Fraction)	% Passing No. 200	D75 (mm)	D75 (in)	q_u (tsf)	q_u (MPa)	SPT	SPT Min. per 52-3	SPT Max. per 52-3	Ms Min. per 52-3	Ms Max. 52-3	M_s	K_b	ϕ_r	K_d	J_s	K_h
B-201-23	0	-	2	FAT CLAY	CH	Alluvium/Residual	29.4	89.2	1.5	66	46	100.0	50	76	0.075	0.002953	0.7	0.0672	--	--	--	--	--	0.04	1	14.4	0.26	1	0.01
B-201-23	4	-	6	FAT CLAY	CH	Marlbrook	24.2	98.1	4.5+	73	53	100.0	68	99	0.004	0.000157	1.1	0.1056	--	--	--	--	--	0.07	1	13.5	0.24	1	0.02
B-201-23	13	-	15	FAT CLAY	CH	Marlbrook	29.2	94.5	4.5+	72	50	100.0	73	99	0.00285	0.000112	2.2	0.2112	--	--	--	--	--	0.14	1	13.6	0.24	1	0.03
B-202-23	2	-	4	FAT CLAY	CH	Marlbrook	25.7	93.6	4.5+	97	70	100.0	73	98	0.00285	0.000112	1.9	0.1824	--	--	--	--	--	0.12	1	11.2	0.20	1	0.02
B-202-23	6	-	8	FAT CLAY	CH	Marlbrook	26.1	90.2	4.0+	89	66	100.0	73	98	0.00285	0.000117	1.3	0.1248	--	--	--	--	--	0.08	1	11.8	0.21	1	0.02
B-202-23	13	-	15	FAT CLAY	CH	Marlbrook	30.1	87	3.5	88	65	100.0	77	100	0.0017	6.69E-05	1.3	0.1248	--	--	--	--	--	0.08	1	11.9	0.21	1	0.02
B-203-23	0	-	2	FAT CLAY	CH	Alluvium/Residual	28.7	86.7	2.5	70	49	100.0	57	91	0.021	0.000827	1.1	0.1056	--	--	--	--	--	0.07	1	13.9	0.25	1	0.02
B-203-23	13	-	15	FAT CLAY	CH	Marlbrook	30.6	92.9	4.5+	84	60	100.0	73	100	0.00285	0.000112	1.2	0.1152	--	--	--	--	--	0.07	1	12.3	0.22	1	0.02
B-203-23	23.5	-	25	FAT CLAY	CH	Marlbrook	24.7	92.7	--	83	62	100.0	73	99	0.00285	0.000112	1.5	0.144	--	--	--	--	--	0.09	1	12.4	0.22	1	0.02

Notes

1) Cells filled with Green are **assumed** values

2) K_b = 1 based on 628.5203 (b), (2) for *"Cohesive soils and coarse detritus, gravels, and boulders"*

3) Ms is determined based on Unconfined Compressive Strength data ad interpretation per **Table 52-3**

4) K_d is developed based on either Equation **[52-7]**, **[52-8]**, or **[52-9]** depending on clay fraction percentage

5) Based on section 628.5203 (d) for Relative Ground Structure Number, *"...soil material is considered intact (without structure), in which case J_s = 1."*

	Material	USCS	Formation	MC (%)	DUW (pcf)	qu (hand penetrometer - tsf)	LL	PI	% Passing #4	% Passing 0.002 mm (Clay Fraction)	% Passing No. 200	D75 (mm)	D75 (in)	q_u (tsf)	q_u (MPa)	SPT	SPT Min. per 52-2	SPT Max. per 52-2	Ms Min. per 52-2	Ms Max. 52-2	M_s	K_b	ϕ_r	K_d	J_s	K_h
Average "Input" Parameters w/ Raw Data, EXCLUDES assumptions where applicable	FAT CLAY	CH	Alluvium/Residual	29.1	88.0	2.0	68.0	47.5	100.0	57.0	83.5	0.021	0.000827	0.9	0.0864	--	--	--	--	--	0.05	1	14.2	0.252	1	0.01
	FAT CLAY	CH	Highly Weathered Marlbrook	27.2	92.7	4.5+	83.7	60.9	100.0	72.5	99.0	0.003	0.000112	1.5	0.144						0.09	1	12.3	0.219	1	0.02
Average Kh INCLUDING assumptions	FAT CLAY	CH	Alluvium/Residual	29.1	88.0	2.0	68.0	47.5	100.0	53.5	83.5	0.048	0.00189	0.9	0.1	--	--	--	--	--	0.05	1	14.2	0.252	1	0.01
	FAT CLAY	CH	Highly Weathered Marlbrook	27.2	92.7	3.5	83.7	60.9	100.0	72.5	99.0	0.003	0.00011	1.5	0.1						0.09	1	12.3	0.219	1	0.02

Attachment E-6: TR-60 Breach Caculations

Upper Brushy Creek 29

TR-60 Breach Calculations
Hydrologic Breach (Location A)

Watershed Name	UPPER BRUSHY 29	Date	10-Aug-23
Site No.	29	Prepared By:	TNM

Elevations			
Top of Dam	575.9 Ft msl	Top Width	14 Ft
Breach Hydrograph	575.9 Ft msl	Upstream Slope Above Berm	2.5 :1
Wave Berm	560.7 Ft msl	Upstream Slope Below Berm	2.5 :1
Average Valley Floor	534.0 Ft msl	Downstream Slope Above Berm	2.5 :1
Stability Berm	549.0 Ft msl	Downstream Slope Below Berm	2.5 :1
Length of Dam at Breach Elev	2342 Ft	Wave Berm Width	40 Ft
Volume of Breach	1767 Ac Ft	Stability Berm Width	14 Ft

Breach Discharge Computations

Volume of Breach (Vs)	1,767	Ac Ft
Height Of Breach (Hw)	42	Ft
Cross-Section Area at Breach (A)	6,254	FT^2
$T = 65(H^{0.35})/0.416$	578	
If L > T,		
$Br = (Vs * Hw)/A$	12	
$Qmax = 1{,}100\ (Br)^{1.35}$	30,930	CFS
If L < T,		
$Qmax = 0.416\ (L)(Hw^{1.5})$	264,242	CFS
Qmax NOT GREATER THAN		
$Qmax = 65(HW^{1.85})$	65,164	CFS
Qmax NOT LESS THAN		
$Qmax = 3.2(Hw^{5/2})$	36,365	CFS
Breach Qmax for Hazard Classification =	**36,400**	**CFS** ←

TR-60 Breach Calculations
Hydrologic Breach (Location B)

Watershed Name	UPPER BRUSHY 29	Date	10-Aug-23
Site No.	29	Prepared By:	TNM

Elevations			
Top of Dam	575.9 Ft msl	Top Width	14 Ft
Breach Hydrograph	575.9 Ft msl	Upstream Slope Above Berm	2.5 :1
Wave Berm	560.7 Ft msl	Upstream Slope Below Berm	2.5 :1
Average Valley Floor	558.0 Ft msl	Downstream Slope Above Berm	2.5 :1
Stability Berm	549.0 Ft msl	Downstream Slope Below Berm	2.5 :1
Length of Dam at Breach Elev	2342 Ft	Wave Berm Width	40 Ft
Volume of Breach	136 Ac Ft	Stability Berm Width	14 Ft

Breach Discharge Computations

Volume of Breach (Vs)	136	Ac Ft
Height Of Breach (Hw)	18	Ft
Cross-Section Area at Breach (A)	1,034	FT^2
$T = 65(H^{0.35})/0.416$	429	
If L > T,		
$Br = (Vs * Hw)/A$	2	
$Qmax = 1{,}100\ (Br)^{1.35}$	3,496	CFS
If L < T,		
$Qmax = 0.416\ (L)(Hw^{1.5})$	73,784	CFS
Qmax NOT GREATER THAN		
$Qmax = 65(HW^{1.85})$	13,511	CFS
Qmax NOT LESS THAN		
$Qmax = 3.2(Hw^{5/2})$	4,338	CFS
Breach Qmax for Hazard Classification =	**4,300**	**CFS** ←

TR-60 Breach Calculations
Static Breach (Location A)

Watershed Name	UPPER BRUSHY 29	Date	10-Aug-23
Site No.	29	Prepared By:	TNM

Elevations			
Top of Dam	575.9 Ft msl	Top Width	14 Ft
Breach Hydrograph	572.1 Ft msl	Upstream Slope Above Berm	2.5 :1
Wave Berm	560.7 Ft msl	Upstream Slope Below Berm	2.5 :1
Average Valley Floor	534.0 Ft msl	Downstream Slope Above Berm	2.5 :1
Stability Berm	549.0 Ft msl	Downstream Slope Below Berm	2.5 :1
Length of Dam at Breach Elev	2021 Ft	Wave Berm Width	40 Ft
Volume of Breach	997 Ac Ft	Stability Berm Width	14 Ft

Breach Discharge Computations

Volume of Breach (Vs)	997	Ac Ft
Height Of Breach (Hw)	38	Ft
Cross-Section Area at Breach (A)	6,254	FT^2
$T = 65(H^{0.35})/0.416$	559	
If L > T,		
$Br = (Vs * Hw)/A$	6	
$Qmax = 1{,}100\ (Br)^{1.35}$	12,563	CFS
If L < T,		
$Qmax = 0.416\ (L)(Hw^{1.5})$	197,718	CFS
Qmax NOT GREATER THAN		
$Qmax = 65(HW^{1.85})$	54,654	CFS
Qmax NOT LESS THAN		
$Qmax = 3.2(Hw^{5/2})$	28,672	CFS

Breach Qmax for Hazard Classification = 28,700 CFS

TR-60 Breach Calculations
Seismic Breach (Location A)

Watershed Name	UPPER BRUSHY 29	Date	10-Aug-23
Site No.	29	Prepared By:	TNM

Elevations			
Top of Dam	575.9 Ft msl	Top Width	14 Ft
Breach Hydrograph	560.7 Ft msl	Upstream Slope Above Berm	2.5 :1
Wave Berm	560.7 Ft msl	Upstream Slope Below Berm	2.5 :1
Average Valley Floor	534.0 Ft msl	Downstream Slope Above Berm	2.5 :1
Stability Berm	549.0 Ft msl	Downstream Slope Below Berm	2.5 :1
Length of Dam at Breach Elev	1310 Ft	Wave Berm Width	40 Ft
Volume of Breach	217 Ac Ft	Stability Berm Width	14 Ft

Breach Discharge Computations

Volume of Breach (Vs)	217	Ac Ft
Height Of Breach (Hw)	27	Ft
Cross-Section Area at Breach (A)	6,254	FT^2
$T = 65(H^{0.35})/0.416$	493	
If L > T,		
$Br = (Vs * Hw)/A$	1	
$Qmax = 1{,}100\ (Br)^{1.35}$	992	CFS
If L < T,		
$Qmax = 0.416\ (L)(Hw^{1.5})$	75,185	CFS
Qmax NOT GREATER THAN		
$Qmax = 65(HW^{1.85})$	28,311	CFS
Qmax NOT LESS THAN		
$Qmax = 3.2(Hw^{5/2})$	11,788	CFS

Breach Qmax for Hazard Classification = 11,800 CFS

Attachment E-7: Opinion of Probable Construction Cost

Upper Brushy Creek 29

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OPINION OF PROBABLE CONSTRUCTION COSTS

SITE NUMBER	Upper Brushy 29	ALTERNATIVE	Alt No. 2 - Federally Sponsored Breach
CLIENT	National Resources Conservation Service - Texas	DATE	7/14/2023

ESTIMATOR	CHECKED BY	FNI PROJECT NO.
Bethany Trammell	Bryce Todd	TSW22726

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Mobilization & Demobilization	1	LS	$140,200.00	$ 140,200.00
2	Construction Survey	1	LS	$ 40,100.00	$ 40,100.00
3	Quality Control	1	LS	$ 100,200.00	$ 100,200.00
4	Care of Water	1	LS	$ 100,200.00	$ 100,200.00
5	Pollution Control	1	LS	$ 40,100.00	$ 40,100.00
6	Excavation - Embankment	27400	CY	$ 15.00	$ 411,000.00
7	Rock Riprap - Breach	1260	CY	$ 100.00	$ 126,000.00
8	Gravel Bedding	630	CY	$ 100.00	$ 63,000.00
9	Removal of Concrete Structures	1	LS	$ 20,000.00	$ 20,000.00
10	Excavation - Pilot Channel	47500	CY	$ 15.00	$ 712,500.00
11	Reservoir Restoration	28	AC	$ 20,000.00	$ 560,000.00
12	Remapping of FEMA Floodplain	1	LS	$ 110,000.00	$ 110,000.00
	Construction - Subtotal				$ 2,423,300.00
	Construction - Contingency	30%			$ 727,000.00
	Construction - Total				**$ 3,150,300.00**
	Engineering (% of Construction)	10%			**$ 315,100.00**
	Project Administration (% of Construction)	12%			**$ 378,100.00**
	Downstream Land acquisition				**$ 1,780,140.80**

PROJECT TOTAL (Construction + Engineering + Administration) $5,623,641

AACE Class 4 Range:	-30%	$3,936,549
	50%	$8,435,461

NOTES:

1 Excavate through the embankment for controlled breach. Assume on-site spoil disposal.
2 Excavation has bottom width of 100 feet, with side slopes of 5H:1V. Excavation takes place near maximum section of embankment.
3 Stabilize the remaining embankment structure with rock riprap through the breach section.
4 Remove the concrete structures associated with the principal spillway.
5 Excavate pilot channel through reservoir to restore original channel. Assume on-site disposal.
6 Channel has bottom width of 20 feet with 2H:1V side slopes. Channel depth = 10 feet.
7 Restore/revegetateupstream reservoir area. Total restoration area = 28 acres.
8 Restoration will consist of vegetation plantings of trees, shrubs, and native grasses.
9 Land acquisition includes obtaining downstream easements/property from 44 land owners.
10 Multiple plantings assumed to achieve full survival rate. Assume drip irrigation system required for tree plantings.
11 Costs listed do not include damages or replacement costs to downstream roads, bridgest, or culverts.
12 Re-map the FEMA 100-yr flood plain in the areas affected downstream of the dam.

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OPINION OF PROBABLE CONSTRUCTION COSTS

SITE NUMBER	Upper Brushy 29	ALTERNATIVE	Alt. 3 - Dam Raise, Labyrinth Spwy, Aux Spwy
CLIENT	National Resources Conservation Service - Texas	DATE	7/6/2023

ESTIMATOR	CHECKED BY	FNI PROJECT NO.
Bethany Trammell	Bryce Todd	TSW23171

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Mobilization & Demobilization	1	LS	$ 549,800.00	$ 549,800.00
2	Construction Survey	1	LS	$ 157,100.00	$ 157,100.00
3	Quality Control	1	LS	$ 392,700.00	$ 392,700.00
4	Care of Water	1	LS	$ 785,400.00	$ 785,400.00
5	Pollution Control	1	LS	$ 157,100.00	$ 157,100.00
6	Miscellaneous Work Items	1	LS	$ 785,400.00	$ 785,400.00
7	Select Compacted Fill - Embankment	8100	CY	$ 15.00	$ 121,500.00
8	Topsoil & Seeding - Embankment	4	AC	$ 20,000.00	$ 80,000.00
9	Flexible Base - Embankment	950	CY	$ 75.00	$ 71,250.00
10	Clearing & Grubbing - Embankment	4	AC	$ 8,000.00	$ 32,000.00
11	Structural Concrete Spillway	5380	CY	$ 1,200.00	$ 6,456,000.00
12	Rock Riprap - Auxiliary Spillway	1000	CY	$ 100.00	$ 100,000.00
13	Excavation - Principal Spillway	4,800	CY	$ 15.00	$ 72,000.00
14	Select Compacted Fill - Principal Spillway	4800	CY	$ 15.00	$ 72,000.00
15	30" I.D. Reinforced Concrete Pipe	210	LF	$ 600.00	$ 126,000.00
16	Unreinforced Concrete - Pipe Cradle	60	CY	$ 800.00	$ 48,000.00
17	Reinforced Concrete - Traditional Inlet	20	CY	$ 1,800.00	$ 36,000.00
18	Excavation - Auxiliary Spillway	28300	CY	$ 15.00	$ 424,500.00
19	Topsoil & Seeding - Auxiliary Spillway	3	AC	$ 20,000.00	$ 60,000.00
20	Clearing & Grubbing - Auxiliary Spillway	3	AC	$ 8,000.00	$ 24,000.00
21	Remapping of FEMA Floodplain	1	LS	$ 110,000.00	$ 110,000.00
22	Removal of Concrete Structures	1	LS	$ 20,000.00	$ 20,000.00
	Construction - Subtotal				$ 10,680,800.00
	Construction - Contingency	30%			$ 3,204,300.00
	Construction - Total				**$ 13,885,100.00**
	Engineering (% of Construction)	10%			**$ 1,388,600.00**
	Project Administration (% of Construction)	12%			**$ 1,666,300.00**
	Land Acquisition	4.73	AC		**$ 359,300.00**

PROJECT TOTAL (Construction + Engineering + Administration + Easements) $17,299,300

AACE Class 4 Range:	-30%	$12,109,510
	50%	$25,948,950

NOTES:

1. Raise crest of dam with compacted fill (Crest El. = 576.3 feet, Upstream Slope = 2.5H:1V, Downstream Slope = 3H:1V, Crest Width = 14 feet).
2. Construct new principal spillway conduit using cut and cover method (Pipe Diameter = 30").
3. Construct new labyrinth structural spillway. (width =180', apron length = 72.57', 6 cycles, wall width 2.5', spillway crest = 571.8 ft (low stage), 573.3 ft (high stage) - msl).
4. Construct rock riprap erosion protection downstream of labyrinth spillway (Riprap Thickness = 30 inches).
5. Construct 9-inch thick flexible base roadway surface on crest of dam.
6. Construct new traditional inlet structure for principal spillway of reinforced concrete (Crest El. = 560.7 feet-msl).
7. Existing easement limits were not available for this site at the time of this estimate. It was assumed that the existing fenceline matches the easement

FREESE AND NICHOLS

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OPINION OF PROBABLE CONSTRUCTION COSTS

SITE NUMBER	Upper Brushy 29	ALTERNATIVE	Alt. 4 - Dam Raise and Labyrinth Spwy
CLIENT	National Resources Conservation Service - Texas	DATE	10/17/2024

ESTIMATOR	CHECKED BY	FNI PROJECT NO.
Tessa Mortensen		TSW23171

ITEM	DESCRIPTION	QUANTITY	UNIT	UNIT PRICE	TOTAL
1	Mobilization & Demobilization	1	LS	$ 362,800.00	$ 362,800.00
2	Construction Survey	1	LS	$ 103,700.00	$ 103,700.00
3	Quality Control	1	LS	$ 259,200.00	$ 259,200.00
4	Care of Water	1	LS	$ 518,300.00	$ 518,300.00
5	Pollution Control	1	LS	$ 103,700.00	$ 103,700.00
6	Miscellaneous Work Items	1	LS	$ 518,300.00	$ 518,300.00
7	Select Compacted Fill - Embankment	28900	CY	$ 15.00	$ 433,500.00
8	Topsoil & Seeding - Embankment	5	AC	$ 20,000.00	$ 100,000.00
9	Flexible Base - Embankment	1050	CY	$ 75.00	$ 78,750.00
10	Clearing & Grubbing - Embankment	5	AC	$ 8,000.00	$ 40,000.00
11	Structural Concrete Spillway	2930	CY	$ 1,200.00	$ 3,516,000.00
12	Excavation - Auxiliary Spillway	17200	CY	$ 15.00	$ 258,000.00
13	Rock Riprap - Auxiliary Spillway	600	CY	$ 100.00	$ 60,000.00
14	Excavation - Principal Spillway	5400	CY	$ 15.00	$ 81,000.00
15	Select Compacted Fill - Principal Spillway	5400	CY	$ 15.00	$ 81,000.00
16	54" I.D. Reinforced Concrete Pipe	210	LF	$ 1,080.00	$ 226,800.00
17	Unreinforced Concrete - Pipe Cradle	120	CY	$ 800.00	$ 96,000.00
18	Reinforced Concrete - Traditional Inlet	45	CY	$ 1,800.00	$ 81,000.00
19	Remapping of FEMA Floodplain	1	LS	$ 110,000.00	$ 110,000.00
20	Removal of Concrete Structures	1	LS	$ 20,000.00	$ 20,000.00
	Construction - Subtotal				$ 7,048,100.00
	Construction - Contingency	30%			$ 2,114,500.00
	Construction - Total				**$ 9,162,600.00**
	Engineering (% of Construction)	10%			**$ 916,300.00**
	Project Administration (% of Construction)	12%			**$ 1,099,600.00**
	Land Acquisition	4.05	AC		**$ 266,400.00**

PROJECT TOTAL (Construction + Engineering + Administration + Easements) $11,444,900

AACE Class 4 Range:	-30%	$8,011,430
	50%	$17,167,350

NOTES:

1. Raise crest of dam with compacted fill (Crest El. = 577.9 feet, Upstream Slope = 2.5H:1V, Downstream Slope = 3H:1V, Crest Width = 14 feet).
2. Construct new principal spillway conduit using cut and cover method (Pipe Diameter = 54").
3. Construct new labyrinth structural spillway. (width = 90', apron length = 70', 3 cycles, wall width 2.5', spillway crest = 572.8 ft msl)
4. Construct rock riprap erosion protection downstream of labyrinth spillway (Riprap Thickness = 30 inches).
5. Construct 9-inch thick flexible base roadway surface on crest of dam.
6. Construct new traditional inlet structure for principal spillway of reinforced concrete (Crest El. = 560.7 feet-msl).
7. Existing easement limits were not available for this site at the time of this estimate. It was assumed that the existing fenceline matches the easement

Attachment E-8: Survey Data for Structures Located Upstream of

Upper Brushy Creek 29

R = RESIDENTIAL
NR = NON RESIDENTIAL

UPPER BRUSHY CREEK 29

N.T.S.