US Army Corps of Engineers ®
Fort Worth District

Public Notice

Applicant: Town of Flower Mound / Clay Riggs

Project No.: SWF-2019-00038

Date: April 9, 2024

Purpose

The purpose of this public notice is to inform you of a proposal for work in which you might be interested. It is also to solicit your comments and information to better enable us to make a reasonable decision on factors affecting the public interest. We hope you will participate in this process.

Regulatory Program

Since its early history, the U.S. Army Corps of Engineers has played an important role in the development of the nation's water resources. Originally, this involved construction of harbor fortifications and coastal defenses. Later duties included the improvement of waterways to provide avenues of commerce. An important part of our mission today is the protection of the nation's waterways through the administration of the U.S. Army Corps of Engineers Regulatory Program.

Section 10

The U.S. Army Corps of Engineers is directed by Congress under Section 10 of the Rivers and Harbors Act of 1899 (33 USC 403) to regulate *all work or structures in or affecting the course, condition or capacity of navigable waters of the United States*. The intent of this law is to protect the navigable capacity of waters important to interstate commerce.

Section 404

The U.S. Army Corps of Engineers is directed by Congress under Section 404 of the Clean Water Act (33 USC 1344) to regulate the *discharge of dredged and fill material into all waters of the United States, including wetlands*. The intent of the law is to protect the nation's waters from the indiscriminate discharge of material capable of causing pollution and to restore and maintain their chemical, physical and biological integrity.

Contact

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PUBLIC NOTICE

U.S. ARMY CORPS OF ENGINEERS, FORT WORTH DISTRICT

SUBJECT: Application for a Department of the Army Permit under Section 404 of the Clean Water Act (CWA) to discharge dredged or fill material into waters of the United States associated with the East Waketon Road Drainage Improvements Project located on property adjacent to and northeast of the intersection of Waketon Road and Long Prairie Road (FM 2499) in the Town of Flower Mound, Denton County, Texas.

APPLICANT: Town of Flower Mound
C/O Clay Riggs, Director of Public Works
2121 Cross Timbers Road
Flower Mound, Texas 75028

APPLICATION NUMBER: SWF-2019-00038

DATE ISSUED: April 8, 2024

LOCATION: The proposed East Waketon Road Drainage Improvements Project is located northeast of the intersection of Waketon Road and Long Prairie Road (FM 2499) in Denton County, Texas. The UTM coordinates are approximately 33.06025, -97.07346. The project is within the Lewisville West 7.5-minute USGS quadrangle map and the USGS Hydrologic Unit HUC 120301031003 (Timber Creek). See **Sheet 1-2 of 8**.

OTHER AGENCY AUTHORIZATIONS: State Water Quality Certification

PROJECT DESCRIPTION: The applicant proposes to excavate an approximately 1,500 LF stormwater channel to alleviate flooding. The channel would include a varying bottom width of up to 140', a bed slope of 0.7% on average 3-4 feet below existing grade, and 4:1 side slopes. A berm would also be placed along Waketon Road that will connect to the existing culvert headwalls, which would serve as a barrier and allow for containment of the 2-year flood event within the culvert. The project does not propose reclamation of the 100-year floodplain, but instead proposes to contain the 2-year flood events and smaller through the construction of a linear detention feature. No channel modification downstream of the Waketon Road culverts is proposed. NOTE: None of the following proposed impacts to waters of the United States have been confirmed or evaluated by the Corps. The proposed work would result in a loss of waters of the United States to include 1.99 acres of emergent wetland, 0.38 acres of forested wetland, 1.07 acres of on-channel ponds, and 0.1 acre of man-made channel with intermittent flow. **Sheets 3-5 of 8** show these proposed project components relative to aquatic features in the project area.

PURPOSE AND NEED: See Enclosure for the applicant's purpose and need. Note: USACE has not evaluated the purpose and need prepared by the applicant.

EXISTING CONDITIONS: The approximately 25-acre proposed project area contains an aquatic complex consisting of 8.40 acres of non-forested wetland, 0.40 acre of forested wetland, 1.51 acre of on-channel ponds, and 0.15 acre of man-made channel with intermittent flows. The site has been maintained as a pasture for several decades, and aerial photography over the last two decades shows a progression of the wetland footprint within the project area (**Sheets 7-8 of 8**).

The project area is located within the Eastern Cross Timbers ecoregion. Larger trees within project area include a few remnant post oaks and scattered cedar elm (*Ulmus crassifolia*) and American elm (*Ulmus americana*), Sugarberry (*Celtis laevigata*), and Honeylocust (*Gleditsia triacanthos*). Beaver activity has influenced the herbaceous communities on the site. A variety of prairie sedges (*Carex* spp.), spikerush (*Eleocharis* spp.), and smartweed (*Persicaria* spp.) represented wetland herbaceous communities that were seasonally inundated, along with seasonal buttercup (*Ranunculus hispidus*). Transitions to non-wetland communities were represented by giant ragweed (*Ambrosia trifida*) and perennial ryegrass (*Lolium perenne*) and seasonal false garlic (*Nothoscordum bivalve*).

ADVERSE IMPACTS OF THE PROPOSED PROJECT: The proposed project will result in the discharge of fill material through excavation, permanently impacting 2.37 acres of emergent and forested wetland and 1.07 acres of open water. Approximately 687 linear feet of a man-made drainage will be reconfigured by the proposed project.

ALTERNATIVES TO THE PROPOSED PROJECT (IF AVAILABLE): See Enclosure for the applicant's alternatives analysis. Note: USACE has not evaluated the alternatives analysis prepared by the applicant.

COMPENSATORY MITIGATION: To offset unavoidable adverse impacts to waters of the U.S., the applicant proposes to purchase credits from a USACE approved mitigation bank. Credits would be calculated using appropriate debit ratios as it relates to resource quality and service area. Note: USACE has not evaluated the mitigation plan prepared by the applicant.

PUBLIC INTEREST REVIEW FACTORS: This application will be reviewed in accordance with 33 CFR 320-332, the Regulatory Program of the U. S. Army Corps of Engineers (USACE), and other pertinent laws, regulations, and executive orders. Our evaluation will also follow the guidelines published by the U. S. Environmental Protection Agency pursuant to Section 404 (b)(1) of the CWA. The decision whether to issue a permit will be based on an evaluation of the probable impact, including cumulative impact, of the proposed activity on the public interest. That decision will reflect the national concerns for both protection and utilization of important resources. The benefits which reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. All factors which may be relevant to the proposal will be considered, including its cumulative effects. Among the factors addressed are conservation, economics, aesthetics, general environmental concerns, wetlands, historic properties, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shore erosion and accretion, recreation, water supply and conservation, water quality, energy needs,

safety, food and fiber production, mineral needs, considerations of property ownership, and, in general, the needs and welfare of the people.

The USACE is soliciting comments from the public; federal, state, and local agencies and officials; Indian Tribes; and other interested parties to consider and evaluate the impacts of this proposed activity. Any comments received will be considered by the USACE in determining whether to issue, issue with modifications, or conditions, or deny a permit for this proposal. To make this decision, comments are used to assess impacts on endangered species, historic properties, water quality, general environmental effects, and the other public interest factors listed above. Comments are used in the preparation of an Environmental Assessment and/or an Environmental Impact Statement pursuant to the National Environmental Policy Act. Comments are also used to determine the need for a public hearing and to determine the overall public interest of the proposed activity.

STATE WATER QUALITY CERTIFICATION: This proposed project will require review under Section 401 of the Clean Water Act (CWA). The Texas Commission on Environmental Quality (TCEQ) will review this application under Section 401 of the CWA in accordance with Title 30, Texas Administrative Code Section 279.1-13 to determine if the work would comply with State water quality standards. The applicant contacted TCEQ on April 5, 2024, to initiate the Section 401 CWA process by submitting a pre-filing meeting request. If you have comments or questions on this proposed project's State water quality certification process, please contact 401CERTS@tceq.texas.gov. You may also find information on the Section 401 process here: https://www.epa.gov/cwa-401/basic-information-cwa-section-401-certification.

ENDANGERED AND THREATENED SPECIES: The USACE has reviewed the U.S. Fish and Wildlife Service's latest published version of endangered and threatened species to determine if any may occur in the project area. The proposed project would be in a county where the whooping crane (*Grus americana*), piping plover (*Charadrius melodus*), and red knot (*Calidris canutus rufa*) are known to occur or may occur as migrants. The whooping crane is an endangered species, and the piping plover and red knot are threatened species. The tri-colored bat (*Perimyotis subflavus*) is proposed for listing as endangered. There are no designated critical habitats within the proposed project location. The Corps has not evaluated whether or not the proposed project would result in an effect on any of the aforementioned species.

NATIONAL REGISTER OF HISTORIC PLACES: The USACE will consider the impact of the proposed project on cultural resources listed, or eligible for listing, in the National Register of Historic Places (NRHP). Cultural resources include prehistoric and historic archeological sites, and areas or structures of cultural interest that occur in the permit area. The USACE, in consultation with the Texas Historical Commission, will determine if the proposed project would affect such resources.

FLOODPLAIN MANAGEMENT: The USACE is sending a copy of this public notice to the local floodplain administrator. In accordance with 44 CFR part 60 (Flood Plain Management Regulations Criteria for Land Management and Use), the floodplain administrators of participating communities are required to review all proposed development to determine if a floodplain development permit is required and maintain records of such review.

SOLICITATION OF COMMENTS: The public notice is being distributed to all known interested persons to assist in developing fact upon which a decision by the USACE may be based. For accuracy and completeness of the record, all data in support of or in opposition to the proposed work should be submitted in writing setting forth sufficient detail to furnish a clear understanding of the reasons for support or opposition.

PUBLIC HEARING: Prior to the close of the comment period any person may make a written request for a public hearing setting forth the particular reasons for the request. The District Engineer will determine whether the issues raised are substantial and should be considered in his permit decision. If a public hearing is warranted, all known interested persons will be notified of the time, date, and location.

CLOSE OF COMMENT PERIOD: All comments pertaining to this Public Notice must reach this office on or before May 9, 2024, which is the close of the comment period. Extensions of the comment period may be granted for valid reasons provided a written request is received by the limiting date. If no comments are received by that date, it will be considered that there are no objections. Comments should be submitted to U.S. Army Corps of Engineers, Fort Worth District, Regulatory Division, Permits Branch by emailing CESWF-Permits@usace.army.mil, and please reference the SWF Project Number in the email subject line. Requests for additional information may also be submitted electronically to Mrs. Julianna Kurpis by emailing julianna.k.kurpis@usace.army.mil. Telephone inquiries should be directed to 817-692-6139. Please note that names and addresses of those who submit comments in response to this public notice may be made publicly available.

DISTRICT ENGINEER
FORT WORTH DISTRICT
CORPS OF ENGINEERS

Enclosure, 48 pages
Exhibits, 8 pages

ATTACHMENT F:

ANALYSIS OF ALTERNATIVES PURSUANT TO SECTION 404(B)(1) OF THE CLEAN WATER ACT USACE SWF-2019-00038

For:

Waketon Road Drainage Improvements Project

Prepared for:

Town of Flower Mound
c/o Mr. Clay Riggs, PE, CFM
2121 Cross Timbers Road
Flower Mound, Texas, 75028

March 2024

AVO 35351

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1.0 INTRODUCTION

The Town of Flower Mound (Applicant) is seeking a Section 404 of the Clean Water Act (CWA) individual permit for fill in waters of the United States, including wetlands, associated with the proposed Waketon Road Drainage Improvements (Project) located northeast of the intersection of Waketon Road and FM 2499 in the Flower Mound, Texas. Please see **Figure F-1** and **Figure F-2** for the project location. The Project as proposed entails drainage improvements to alleviate local recurrent flooding issues near this location.

Section 404 of the CWA authorizes the U.S. Army Corps of Engineers (USACE) to issue permits for the placement of fill material into waters of the United States, including wetlands. Section 404(b)(1) Guidelines (40 CFR Part 230) promulgated by the U.S. Environmental Protection Agency (USEPA) are the substantive environmental criteria used by the USACE to evaluate Section 404 permit applications. Under these regulations, an alternatives practicability analysis is the primary tool used to determine whether a proposed fill activity can be authorized. Section 404(b)(1) Guidelines prohibit discharges of fill material into waters of the United States if a practicable alternative to the proposed discharge exists that would have less adverse impacts on the aquatic ecosystem (40 CFR Section 230.10(a)). An alternative is considered practicable if it is available and capable of being implemented after considering cost, existing technology, and logistics in light of the overall project purpose (40 CFR Section 230.3(q)). The Section 404(b)(1) Guidelines suggest a sequential approach to project planning that considers mitigation measures only after the project proponent shows that no practicable alternatives are available to achieve the overall project purpose with less impacts to aquatic resources. These guidelines and joint USEPA/USACE guidance implementing them[1] also indicate that the level of effort associated with the preparation of the alternatives analysis should be commensurate with the significance of the impact and/or discharge activity (40 CFR Section 230.10).

This document presents Applicant's analysis of the potential alternatives and demonstrates that the proposed project is the least environmentally damaging practicable alternative (LEDPA). This analysis of alternatives is patterned after regulatory guidance from the Fort Worth District, USACE.[2] The discussion that follows incorporates by reference several features that have been identified as waters of the United States. To avoid unnecessary duplication of material, please refer to the revised waters of the United States delineation dated March 2020, and addended March 2023 (**Attachment C**) for historical aerial photography, delineation data, and site photographs.

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[1] U.S. Army Corps of Engineers (USACE) and Environmental Protection Agency (USEPA). 1993. Memorandum: Appropriate Level of Analysis Required for Evaluating Compliance with the Section 404(b)(1) Guidelines Alternatives Requirements. Joint agency guidance issued on Aug. 23, 1993. *http://water.epa.gov/lawsregs/guidance/wetlands/flexible.cfm*.

[2] Regulatory Division, Fort Worth District, USACE. Preparing an Alternatives Analysis under Section 404 of the Clean Water Act (November 2014). *http://www.swf.usace.army.mil/Portals/47/docs/regulatory/Handouts/Preparing_An_Alternatives_%20Analysis.FINAL.pdf*

2.0 NEED AND PURPOSE

2.1 Need for the Project

The project is in the upper reaches of the watershed of an unnamed tributary of Timber Creek. The watershed encompasses approximately 870 acres consisting of a mixture of development and agricultural land. The Town of Flower Mound has observed flood waters from this tributary frequently overtop Waketon Road at locations between FM 2499 and Timber Way Drive to the east, resulting in road closure until flood water recedes. Events that led to Halff's engagement with the Town to study this area included events on the days April 13, 2015; November 17, 2015; and February 20, 2018. All were events 2-year events or less where Waketon Road needed to be closed. The 88-acre tract on the northeast corner of FM 2499 and Waketon Road which comprises the bulk of the area that was studied is currently a cattle pasture bisected by what remains of the tributary. As documented in the delineation of waters of the United States, historically, this was a non-descript channel consisting of a series of on-channel stock ponds. At the beginning of the study, this portion of the "tributary" lacked a defined channel. Changes in local drainage patterns and beaver activity has created an ecology of intermittent pockets of shallow water, deeper unvegetated open water ponds, and emergent wetland dominated by cattail.

The elevations of the tracts east of apartments at the southeast corner of FM 2499 and Waketon Road are at or slightly below the elevations of Waketon Road while the 88-acre tract and other lands further north is elevated slightly above Waketon Road. This general topographic setting combined with the expansive wetland complex has had a profound effect on the local drainage. Rather than flow beneath FM 2499 proceeding downstream to Waketon Road and the eventual defined channel, excess flow is directed south along the FM 2499 roadside drainage, and down and across Waketon Road under low intensity (1-year) storms. In addition to these flow patterns, the channel downstream of Waketon Road presents a backwater effect from downstream hydrology, backing water into the culverts and onto the 88-acre tract.

Photo 1 - Waketon Road flooding courtesy of Flower Mound PD

A hydraulic analysis was prepared utilizing the USACE River Analysis System (HEC-RAS program Version 5.0.3, September 2016) to analyze the peak water surface elevations along the unnamed tributary. The hydraulic model begins immediately above the confluence of Timber Creek (south of College Parkway), extending upstream to an existing detention pond west of FM 2499. The hydraulic model includes FM 2499, Waketon Road,

Townsend Drive, and the College Parkway culvert crossings. The model uses cross sections extracted from 2011 TNRIS LiDAR supplemented by data surveyed for structures and channel cross sections by Halff. The hydraulic model was used to determine the water surface elevations along the studied reach and at each culvert. The results of the study showed that 1-yr water surface elevations (WSEL) overtop the minimum top of road elevation of Waketon Road by half a foot. The 5-yr and 10-yr WSELs overtop the road by 1.5 feet and almost 2 feet respectively. Whereas flooding of nearby homes does not occur at these frequencies, flood waters proceed down and across Waketon Road, backing into residential side streets creating emergency and dad-to-day access issues, with the nearest accessible entrance to the subdivision located off College Parkway to the south. In addition to emergency access issues, overtopping of the road in flash events can be a hazard to students that regularly use Waketon Road as an alternative thoroughfare from the high school campus at Waketon Road and Morriss Road to the east.

FEMA, the National Weather Service, and numerous state and local organizations promote the Turn Around Don't Drown campaign. Different websites from these state and federal entities share flood safety information, and some FEMA sites provide specific sources that use rates of flow and depths to determine what can move a specific mass. Nonetheless, consistent themes communicated to the public include:

- Six inches of water will reach the bottom of most passenger cars causing loss of control and potential stalling.
- Six inches of moving water can cause someone existing their vehicle to slip and fall.
- A foot of water can float many vehicles.
- Two feet of moving water can carry away most vehicles, including SUV's and standard trucks.

The investment and planning by Applicant to date in the proposed Project is based on the need for providing flood mitigation to improve day-to-day and emergency access to nearby residences and improve the level of safety for local users (vehicular and pedestrian) during frequent and moderate rain events.

2.2 Overall Project Purpose

The overall purpose for the proposed project is a general statement from the Applicant's perspective of the fundamental nature of the project and reflects the Applicant's goals in undertaking the project. The project purpose is used throughout the alternatives analysis required by the Section 404(b)(1) Guidelines. The overall project purpose should not be defined in such a restrictive measure to unduly restrict or preclude other alternatives, nor should it be so broadly defined as to render the evaluation unreasonable and meaningless. Inclusion of a geographic limit within the purpose statement is normally justified but similarly should not unduly restrict the range of alternatives. Although the purpose entails a specific geographic target (i.e. narrow), floodplain mitigation measures still facilitate a broader scope with multiple physical

alternatives. Combined with several different location specific alternatives related to different levels of flood protection, a robust alternatives analysis is still facilitated. The Project's overall purpose is as follows:

To provide floodplain improvements aimed at mitigating flooding effects along Waketon Road and adjacent properties east of FM 2499.

3.0 PROJECT ALTERNATIVES

An alternatives analysis facilitates the applicant to view the project from a different perspective by examining practicable alternatives to the proposed discharge into the waters of the United States that have potentially less damaging consequences. For projects that are not water-dependent, the 404(b)(1) guidelines establish the rebuttable presumption that practicable alternatives that do not involve special aquatic sites are presumed to be available, unless clearly demonstrated otherwise" (40 CFR Section 230.10(a)(3). In making its permit decision, the Applicant must demonstrate and USACE must find that there are no available, practicable alternatives that would avoid the use of special aquatic sites. If no practicable avoidance alternative is found to be available and there is more than one practicable alternative with impacts to special aquatic sites, then the USACE may only approve the LEDPA. The guidelines also include the presumption that all practicable alternatives to the proposed discharge that do not involve a discharge into a special aquatic site (even though there may be impacts to streams or other water features) would have less adverse impact on the aquatic ecosystem, unless clearly demonstrated otherwise. The evaluation considers the No Action Alternative which includes an alternative that would involve no discharges into waters of the United States or permit denial. It also considers off-site locations and on-site alternatives, such as modifications to the site layout, design options, or other factors that could reduce the amount of impacts to waters of the United States.

A threshold consideration in this analysis is whether the Project is water-dependent. The Section 404(b)(1) Guidelines state that if an activity associated with the discharge proposed for a special aquatic site does not require access or proximity to, or siting within, a special aquatic site (e.g. wetlands) to fulfill its basic purpose, the activity is not water-dependent. As suggested in the purpose statement above, the Project proposes drainage improvements to mitigate flooding along Waketon Road and adjacent properties east. Whereas drainage improvements may imply water dependent actions, the act of flood mitigation is not necessarily so. In many instances, floodplain mitigation can be achieved in areas not subject to CWA jurisdiction. Similarly, acquisition of properties to minimize or reduce damages to personal property are also means of flood mitigation. Accordingly, as stated, the Project is not water-dependent.

3.1 Alternatives Screening Process

This section describes the alternatives screening process that was conducted to identify the project alternatives carried forward for evaluation. This evaluation includes an explanation of why some alternatives were eliminated from detailed study, because they were either clearly impracticable or unreasonable. The alternatives screening used a three-level screening process:

- Level 1 Screening: consideration of alternatives that excluded from detailed study;
- Level 2 Screening: consideration of studied alternatives that achieve the project purpose; and
- Level 3 Screening: consideration of alternatives and their effect on the aquatic environment.

Level 1 screening is to acknowledge what may sound like reasonable or practicable alternatives that were otherwise eliminated because a minimal level of study was able to conclude that these alternatives could not qualify as the LEDPA by either failing to address the purpose and need, would not be not practicable from a logistics or cost standpoint, or would have resulted in environmental impacts greater or comparable to further-studied alternatives. Level 2 and Level 3 screening criteria were carried forward for detailed evaluation to first demonstrate practicability through further analysis as it pertains to the project purpose and need and second, to evaluate impacts through further analysis, both of which are the basis for identifying the LEDPA.

3.1.1 Level 1 Screen: Alternatives Excluded from Detailed Study

Different levels of flood mitigation are available to address the Project need and purpose, levels which each influence the assessment of practicability and degree of impact to the environment. Analyses showed that FM 2499 is not overtopped by the 100-yr WSEL. It also shows that design to provide conveyance of the ultimate 100-yr flow condition would require extensive infrastructure improvements. This would include floodplain mitigation measures upstream and downstream of Waketon Road that would entail fill and excavation of all resources north of Waketon Road and a total reconfiguration of the channel geometry and riparian corridor downstream. This allows any alternatives that address a 100-year level of protection to be eliminated on lack of practicability and environmental impacts. Through eliminating 100-year protection alternatives, the early evaluation of alternatives focused on conveying intermediate ultimate flow conditions. Alternatives considered by Halff or recommended by the USACE are discussed in more detail below.

- **Townsend Drive and/or College Parkway Improvements**

  Proposed improvements to the culvert crossings further downstream at Townsend Drive and/or College Parkway were excluded from detailed study as a preliminary analysis concluded that any such measures would have little impact on the flooding at Waketon Road. Modification of these

crossings as a stand-alone alternative, or in any combination of other alternatives would not address the Project need or purpose, and they were eliminated as practicable alternatives.

- **Upstream Detention**

  This was not considered a viable option as remaining space northwest of the FM 2499 and Waketon Road is already occupied by a mix of detention features (i.e. wetlands) and remnant stock pond features, some of which have naturalized over the last two decades and would be considered waters of the United States given they have a direct surface connection to the features within the study area. By conservative estimate, such an alternative could result in the excavation or disturbance of double the acreage of proposed alternatives, consisting of a mixture of open water and forested and emergent wetlands. This could be eliminated as failing to be a less damaging alternative.

- **On-site Detention**

  A detention pond alternative was evaluated that would capture the flows to the channel downstream of Waketon Road, thereby reducing the tailwater and flooding at Waketon Road. The pond under this alternative was assumed to be located at the northeast corner of FM 2499 at Waketon Road to be most effective. The preliminary analysis showed that detention volume in excess of approximately 125 acre-feet would be required to sufficiently reduce the flows from an ultimate 10-yr storm event to an ultimate 2-yr storm event. The possible geometries (e.g.; 20 acres @ 6-ft depth; 10 acres @ 12-ft depth) and amount of excavation was considered impracticable, and could be eliminated as failing to be a less damaging alternative. Even smaller detention areas to address smaller events would still require excavation within the wetland complexes to optimize effectiveness and would have wetland impacts comparable to the proposed alternative.

- **On-site Detention (Non-wetland Areas)**

  The USACE requested evaluation of creating detention on portions of the site that did not include wetlands, or the possible expansion of wetlands. As shown in the hydraulic work maps, the limits of the modeled floodplain do not extend too far north of the limits of the existing wetlands. To create shallow detention features would ultimately require excavation of upland slopes so that excavated features could communicate with the target floodplain. Wetlands near the 100-year floodplain fringe would have no effect on the target event (not-practicable). To address the target flood event, wetland floor elevations would need to be around 595-596. As elevations begin to rise north of the wetlands and floodplain, any created wetland features would be 6-8 feet or more below the existing grades before any wetland design could be incorporated, with steep slopes transitioning to existing upland elevations. As noted above, there is insufficient space, and this alternative could be eliminated from a practicability standpoint.

- **Bridge Span**

  The USACE requested evaluation of raising the road and installing a bridge as an alternative to address the goals as stated in the purpose and need. This conceptual alternative would be defined as raising the road at its lowest point (near the existing culvert crossing) approximately 1-2 feet to achieve a desired level of flood protection. Currently, overtopping of Waketon Road in minor events includes flows across and down Waketon Road backing into the adjacent neighborhood via Timber Way Drive. Any bridge solution would require extending west of Timber Way Drive to allow elevation transitions which would present a logistical challenge of a T-intersection within a bridge. Timber Way would also have to be reconstructed to its intersection with Timber Park Drive so safely transition up to the new elevated intersection. Slope transitions from the re-purposed Timber Way would require the removal of at least one pedestrian trail that provides access to the neighborhood. To hold the southern edge of Waketon Road to eliminate impacts to existing infrastructure, any transitioning grades of the elevated roadbed would be to the north side of Waketon Road. A bridge would likely require some upstream work to reduce velocities and to prevent the upstream volume of water from overwhelming the downstream channel and floodplain conditions. Upstream and downstream excavation would be required to address floodplain mitigation associated with the elevated roadbed This conceptual footprint would still incur loss of waters by direct fill and excavation and result in impacts similar in scale to the recommended alternative.

3.1.2 Level 2 Screen: Studied Project Alternatives

The initial inquiry into build alternatives explores the availability and suitability, from a logistic standpoint, of alternative properties. These criteria are designed to exclude from further evaluation sites which would clearly not be practicable due to unavailability to Applicant or as a result of logistical challenges that do not advance the purpose or need for the Project. This coarse level of screening is undertaken first because it may eliminate the need to evaluate other information relative to the LEDPA such as the presence and/or function of water of the United States, or the presence/absence of threatened or endangered species. Six project alternatives that were evaluated in a basin-wide drainage study.

Preliminary drainage analyses included up to six project alternatives that would require activities in waters of the United States. Alternative 1 and Alternative 6 were initially proposed as viable alternatives to consider for design. Alternative 6 was provided as the cheapest alternative which also minimized the time of and road closures due to construction. Whereas the improvements would minimize the frequency of Waketon Road flooding during smaller events, the level of protection would not prevent overtopping under 2-year ultimate or larger storms. This latter deficiency of flood protection was deemed inconsistent with the purpose and need of the project, and Alternative 6 was no longer considered a practicable alternative. Alternative 1 was similar to Alternative 6 yet added downstream channel improvements to improve the level of flood mitigation. However, the additional level of cost and effort would still not protect Waketon Road from

inundation during the 10-yr ultimate storm even and was similarly deemed impracticable. Alternatives 2 through 5 were considered practicable relative to cost and logistics, consistent with the stated purpose and need, and carried forward for additional screening.

Details for each of the six alternatives are provided below. Evaluation of the remaining practicable alternatives are addressed in **Section 3.1.2**.

Alternative 1 (Figure F-3)

Alternative 1 includes an approximately 725-foot long variable height berm (up to 4 feet in height) along the north side of Waketon Road, increasing the culvert capacity at the Waketon Road crossing by adding four additional (10'x4') culverts, excavating approximately 720 linear feet (13,600 cubic yards) of the channel downstream of Waketon Road, and removing the brush and debris within the channel between Waketon Road and Townsend Drive. The proposed excavation consists of channel widening to add volume while maintaining the existing channel depth and slope. This alternative will contain the 2-yr and 5-yr ultimate storm event, but will allow roughly half a foot of water to pass over Waketon Road east of Townsend Drive under the 10-yr ultimate storm event.

Alternative 2 (Figure F-4)

Alternative 2 includes the same berm along Waketon Road. Culvert capacity at the Waketon Road crossing would be increased by replacing the existing four (10'x4') culverts with eight (10'x6') culverts, and excavating approximately 1,700 linear feet (33,600 cubic yards) of channel from Waketon Road to Townsend Drive. The channel improvements include a bottom width ranging between 15-300 feet depending on the boundaries of adjacent properties, side slopes at 4:1 and a bed slope of 0.4%. The proposed alternative will keep the WSELs under the 2-yr, 5-yr, and 10-yr ultimate storms from overtopping Waketon Road.

Alternative 3 (Figure F-5)

Alternative 3 includes eliminating the berm and excavating a large channel of approximately 1,500 linear feet from FM 2499 to Waketon Road, increasing the culvert capacity at the Waketon Road crossing by replacing the existing four (10'x4') culverts with six (10'x6') culverts, and excavating approximately 1,700 linear feet of channel downstream from Waketon Road to Townsend Drive. The proposed channel improvements north of Waketon Road include a varying bottom width (up to 200'), a bed slope of 0.7%, and 4:1 side slopes. The channel improvements downstream of Waketon include a bottom width of up to 300 feet depending on the boundaries of adjacent properties, side slopes at 4:1 and a bed slope of 0.4% percent. Approximately 95,000 cubic yards of excavation is proposed as a part of upstream and downstream channel improvements. The

proposed alternative will keep the WSELs under the 2-, 5-, and 10-year ultimate storms from overtopping Waketon Road.

Alternative 4 (Figure F-6)

Alternative 4 similarly includes excavating a channel of approximately 1,500 linear feet from FM 2499 to Waketon Road, increasing the culvert capacity at the Waketon Road crossing by replacing the existing four (10'x4') culverts with eight (10'x4') culverts, and excavating approximately 720 linear feet of channel downstream of Waketon Road. The proposed channel improvements north of Waketon Road include a varying bottom width of up to 100', a bed slope of 0.7%, and 4:1 side slopes. The proposed excavation consists of channel widening to add volume while maintain the existing channel depth and slope. The limits of the homeowner's parcels were taken into consideration when determining the proposed channel width (up to 150 ft). The proposed fill serves as a barrier to the flow from reaching Waketon Road and allows for onsite reuse of excavated soil thereby reducing offsite disposal costs. Under this alternative, the total excavated volume (26,000 cubic yards) approximately matches the proposed fill after accounting for compaction, so very minimal or no offsite disposal will be required. The proposed alternative will keep the WSELs under the 2-, 5-, and 10-year ultimate flows from overtopping Waketon Road.

Alternative 5 (Figure F-7)

Alternative 5 includes excavating a large channel of approximately 1,500 linear feet from FM 2499 to Waketon Road, placing fill in the area between the channel and Waketon Road for potential development (approx. 5.4 acres), increasing the culvert capacity at the Waketon Road crossing by replacing the existing four (10'x4') culverts with eight (10'x6') culverts, and excavating approximately 720 linear feet of channel downstream from Waketon Road to Townsend Drive. This is the only alternative amongst the five presented in the current report that was designed for 100-year ultimate flows along the tributary. The channel improvements north of Waketon Road will include a varying bottom width (up to 200'), a bed slope of 0.7%, and 4:1 side slopes. The channel improvements downstream of Waketon Road include a bottom width of up to 300 feet depending on the boundaries of adjacent properties, side slopes at 4:1 and a bed slope of 0.4%. The proposed fill serves as a barrier to the flow from reaching Waketon Road and allows for onsite reuse of excavated soil thereby reducing offsite disposal costs. The top of fill was assumed to be 1-foot above 100-yr WSEL to keep any potential future development outside the 100-yr floodplain. Approximately 70,000 cubic yards of excess soil from excavation would be available after placing the proposed fill and can be used for additional fill on site if required or disposed offsite. The proposed alternative will keep the WSELs under the 2-, 5-, 10-, and 100-yr ultimate storms from overtopping Waketon Road.

Alternative 6 (Figure F-8)

Alternative 6 includes the 725-foot long variable height berm (up to 4-ft in height) along Waketon Road, excavating approximately 720 linear feet (13,600 cubic yards) of the channel downstream of Waketon Road, and removing the brush and debris within the channel between Waketon Road and Townsend Drive. The proposed excavation consists of channel widening to add volume while maintain the existing channel depth and slope. In addition, this alternative will not excavate below the "Ordinary High Water Mark" (OHWM) which decreases the cost of mitigation. This alternative will contain the 1-yr ultimate storm event. The 1-yr storm event is approximately equal in magnitude to the 10-yr existing conditions discharge.

3.1.2 Level 3 Screening: Affected Environment

The remaining practicable alternatives were evaluated based upon their respective impacts to aquatic resources and the environment in general. Of the remaining alternatives, each has their subtle differences as described in **Section 3.1.2**, but the evaluation of the least damaging alternative focuses on two primary design components – channel excavation north of Waketon Road and channel improvements south of Waketon Road. The former impacts an on-channel emergent wetland/stock pond complex, and the latter impacts a natural reach of stream channel for which the surrounding residential development has allowed of in its layout.

Alternative	Excavated Channel (north)	Acres of Loss	Channel Improvements (south)	Acres of Loss
Alternative 2	None	--	Yes (1,700 feet) [2]	~0.3
Alternative 3	Yes (75-200 feet wide)[1]	~4.0 wetland 0.39 forested wetland ~1.0 open water	Yes (1,700 feet)	~0.3
Alternative 4	Yes (50-100 feet wide)	1.99 emergent wetland 0.38 forested wetland 1.07 open water	Yes (720 feet)	0.13
Alternative 5	Yes (75-200 feet wide)	~4.0 wetland 0.39 forested wetland ~1.0 open water	Yes (1,700 feet)	~0.3

Notes: 1. Approximate channel width
2. Approximate length along existing channel

Adopting a top-down approach, one may readily conclude that Alternative 3 and Alternative 5 fail the less damaging screen compared to Alternative 2. Channel impacts are the same, but Alternative 2 is less damaging alternative given that no excavated channel (and associated impacts) is proposed. Similarly, Alternative 3 and Alternative 5 fail the less damaging screen compared to Alternative 4. Although each

entail channel excavation, the general dimensions of the Alternative 4 excavated channel is on average less, and the channel improvements are a magnitude less. The remaining analysis rests with the comparison of Alternative 2 which has no excavated channel impacts yet impacts well over double the amount of stream channel downstream of Waketon Road compared to Alternative 4. In exchange of approximately 1,000 feet fewer impacts of stream and associated riparian corridor, Alternative 4 proposes approximately 3.4 acres of wetland, open water, and channel impacts, combined. The difference between Alternative 2 and Alternative 4 involve a comparison between "out-of-kind" or different resource types, thereby introducing more subjectivity into the analysis.

Additional Screening

As these alternatives were carried forward for further review with the Town of Flower Mound, it was determined that the Town would prefer a modified version of Alternative 4 which would retain the excavated channel north of Waketon Road, exclude the downstream channel modification, and include the small berm from Alternative 1 and Alternative 2 that would parallel the north side of Waketon Road. This modified version of Alternative 4 would still attain a serviceable level of flood reduction along Waketon Road and would reduce some of the constructability challenges (e.g. access; homeowner preferences) and cost (e.g. construction; mitigation) associated with channel modifications. This further reduction in impacts reduced the evaluation of the LEDPA to the following:

Alternative	Excavated Channel (north)	Acres of Loss	Channel Improvements (south)	Acres of Loss
Alternative 2	None	--	Yes (1,700 feet) [2]	~0.3
Alternative 4 (Modified)	Yes (50-100 feet wide)	1.99 emergent wetland 0.38 forested wetland 1.07 open water	None	--
Notes: 1. Approximate channel width 2. Approximate length along existing channel				

The final evaluation of a LEDPA comes to an evaluation of linear feet of stream impacts against the acreage of non-stream aquatic features. USACE guidance states that emphasis should be placed on impacts to the aquatic environment through acreage and functional unit loss of wetlands or other WOTUS that would be affected or eliminated by each alternative, but no distinction is provided when comparing loss of stream and non-stream type. Upon consideration of preliminary functional assessments, the emergent wetland complex is in a former grazing pasture, is relatively new to the landscape, and is still developing resulting in modest scores for an emergent wetland (TXRAM ~0.6). Stream TXRAM scores taken during the initial phases of the project reflected at channel that, although modified in part of its reach, reflected a natural channel environment that has been part of the landscape since the 1950s, which reflect some of the earliest record of aerial photography. TXRAM scores vary but score very highly for an urban stream (~0.7-0.8).

It is reasonable to conclude that Alternative 4 (Modified) is the LEDPA based on the following factors:

- If it can be defended that stream resources are considerably more challenging to mitigate or replace, it is not unreasonable to conclude a preference for avoiding a well-established stream corridor that rates moderate to high by approved functional assessments in lieu of impacting average quality emergent wetlands.
- The USACE nationwide permit general condition for mitigation recognizes that mitigation loss thresholds must be considered differently for streams, at a third of the total (0.03 acre) of non-stream resources (0.1 acre).
- The Texas Commission on Environmental Quality states in their letter to the USACE regarding water quality certification for the 2020 permit reissuance that "[a]ny proposed impacts greater than 1,500 linear feet of impacts in stream length will need to undergo an individual TCEQ 401 certification review, preferably in the context of a Section 404 individual permit." The TCEQ considers the loss of stream exceeding 1,500 feet to be comparable to 3 acres of wetlands.
- The USACE Fort Worth District does not have official regional conditions that prevents nationwide permit authorization for stream losses greater than 1,500 feet. The has mentioned in non-project-specific discussions that to use a nationwide permit for losses greater than 1,500 feet would not be guaranteed.
- Section 404 (b)(1) guidance supports that if another alternative has similar impacts to the aquatic ecosystem as the applicant's recommended, the USACE can conclude the applicant's proposal is the LEDPA.

4.0 ALTERNATIVES ANALYSIS

4.1 Proposed Project Impacts

The proposed project will impact waters of the United States associated with construction of the proposed alternative. The project will impact by fill and excavation 2.37 acres of emergent and forested wetland, and by excavation/fill 1.07 acres of open water. Excavated floodplain mitigation areas north of Waketon Road have been designed allow adjacent microtopography and larger depressions to continue to collect local surface runoff and larger flood waters, without draining back into the channel. Furthermore, the 5-year and 10-year flood limits within the field north of Waketon Road will still flood similar extents. No channel modification downstream of the Waketon Road culverts is proposed. This will allow channel forming flows to continue within the channel and minimize interruption of normal stream processes.

4.2 No Action Alternatives

The No Action Alternative must be retained for analysis to disclose to decision makers the environmental impacts that would arise without implementation of the preferred alternative. The No Action Alternative may represent alternatives that do not affect waters of the United States, permit denial, or choosing not to implement the project. As documented herein, off-channel detention was considered, but it is unlikely that an effective site without wetlands exists to accommodate the necessary size relative to the purpose and need. Under the No Action Alternative, current conditions with no flood mitigation would continue and flood conveyance capacity would remain unchanged. Under these conditions, excess flood flows would continue to overtop Waketon Road on a regular basis proximal to a developed residential/urban floodplain. Properties would not necessarily be flooded at these intermediate flood levels, yet there would remain a safety risk for a frequently used neighborhood street.

4.3 LEDPA

In identifying a project that impacts all waters of the United States as the LEDPA, one must demonstrate that any alternative that results in any minimization of impacts to the aquatic environment (i.e.; less damaging alternative) is not practicable. This demonstration must consider both off-site and on-site alternatives. The process began with a consideration of numerous alternatives on the site and downstream of the site. By considering a range of basic criteria necessary to accommodate the overall project purpose, alternatives were systematically eliminated based on the ability to serve the project need and purpose and then the potential to impact waters of the United States. No alternative that would result in further meaningful minimization of aquatic impacts was identified because they did not meet the project purpose. The No Build Alternative does not address the project need. The proposed alternative was deemed the LEDPA.

5.0 MITIGATION PLAN

Direct and indirect permanent impacts to aquatic resources will be compensated using a mitigation bank whose service area includes the project. Please refer to **Attachment J** for a description of mitigation, and how mitigation units were calculated.

ALTERNATIVES ANALYSIS FIGURES

N

0 2 4 8

SCALE IN MILES

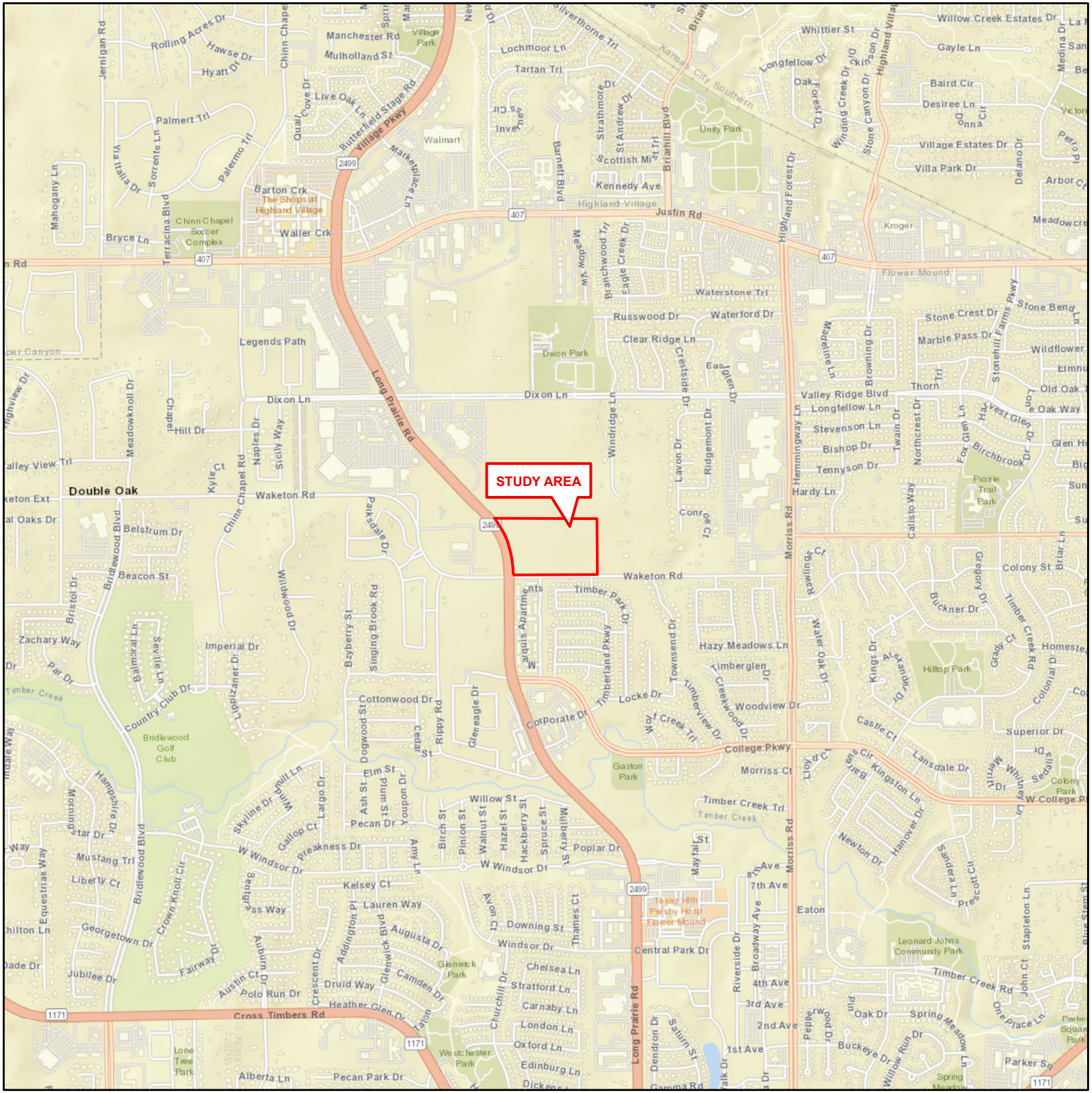
Legend

STUDY AREA

Notes:
1. Service Layer Credits: 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

WAKETON ROAD DRAINAGE IMPROVEMENTS PROJECT
PROJECT NO: SWF-2019-0038
DATE: 06/2022 AVO: 35351
LOCATION MAP
FIGURE F-1

HALFF



N

0 1,000 2,000 4,000

SCALE IN FEET

Legend

STUDY AREA

Notes:

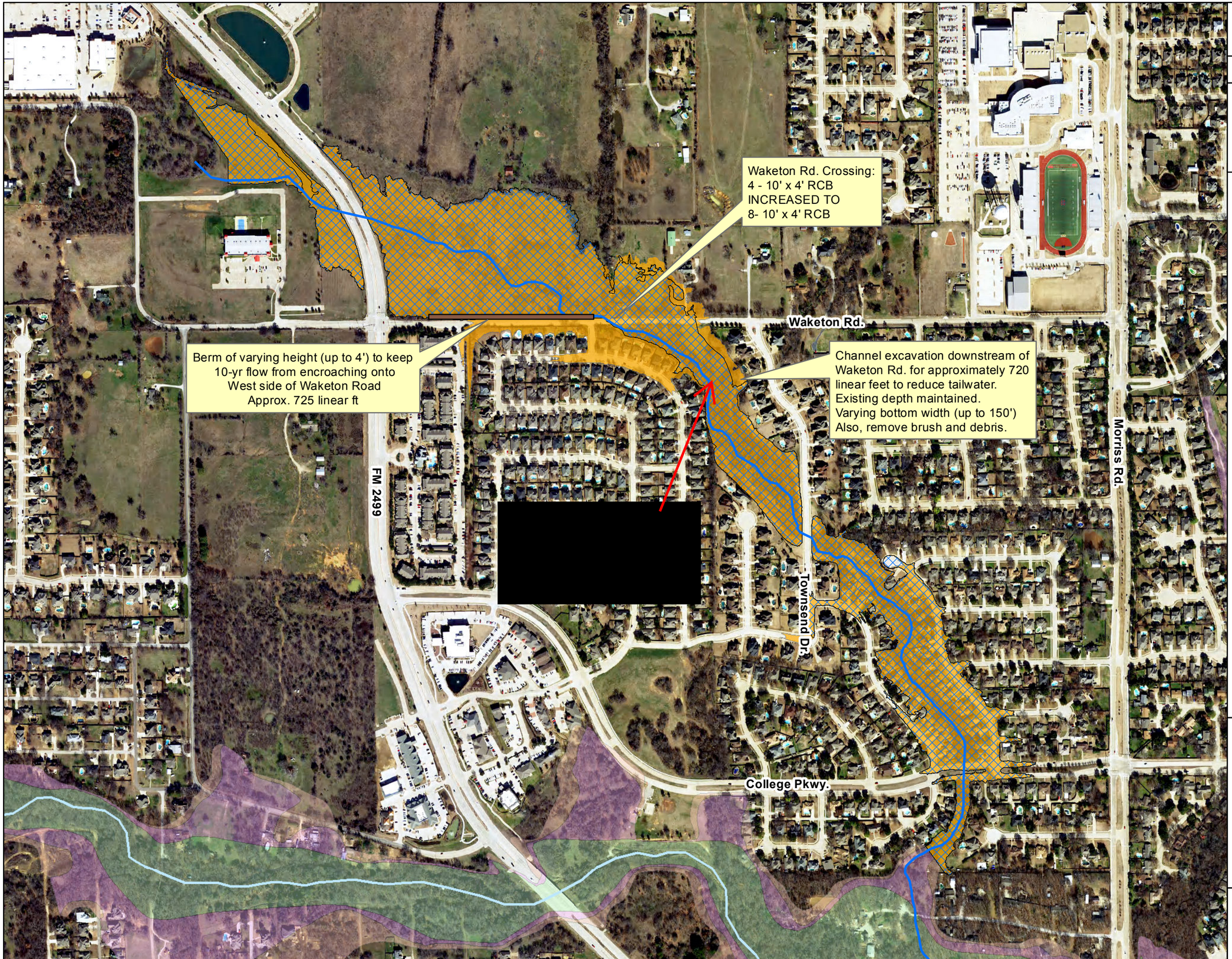
1. Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the

WAKETON ROAD DRAINAGE IMPROVEMENTS PROJECT
PROJECT NO: SWF-2019-0038
DATE: 06/2022 AVO: 35351
VICINITY MAP
FIGURE F-2

HALFF

Waketon Road at Timber Creek Trib. 16 Drainage Study

FIGURE F-3: Alternative #1



Legend

- Alternative #1 Stream Centerline
- Alternative #1 10-yr
- Existing Conditions 10-yr
- Timber Creek

Timber Creek

- 1 PCT ANNUAL CHANCE FLOOD
- FLOODWAY
- 0.2 PCT ANNUAL CHANCE FLOOD

Typical XS Legend

- Existing Ground
- Existing 10-yr WSEL
- Proposed Channel
- Proposed 10-yr WSEL

Note:

0 250 500 1,000 Feet

1 inch = 500 feet

HALFF

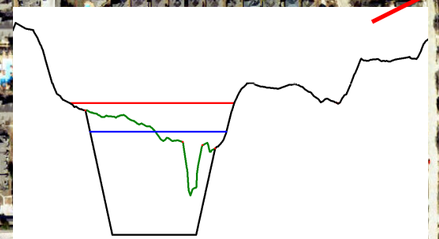
Waketon Road at Timber Creek Trib. 16 Drainage Study

FIGURE F-4: Alternative #2

Waketon Rd. Crossing:
4 - 10' x 4' RCB
INCREASED TO
8- 10' x 6' RCB

Channel excavation downstream of Waketon Rd. for approximately 1,700 linear feet to reduce tailwater.
Varying bottom width (15'-300')
4:1 side slopes
.4% bed slope

Berm of varying height (up to 4') to keep 10-yr flow from encroaching onto West side of Waketon Road
725 Linear ft



Waketon Rd.
Townsend Dr.
Morriss Rd.
FM 2499
College Pkwy.

Legend

- Alternative #2 Stream Centerline
- Alternative #2 10-yr
- Existing Conditions 10-yr
- Timber Creek

Timber Creek

- 1 PCT ANNUAL CHANCE FLOOD
- FLOODWAY
- 0.2 PCT ANNUAL CHANCE FLOOD

Typical XS Legend

- Existing Ground
- Existing 10-yr WSEL
- Proposed Channel
- Proposed 10-yr WSEL

Note:

N
W E
S

0 250 500 1,000 Feet

1 inch = 500 feet

HALFF

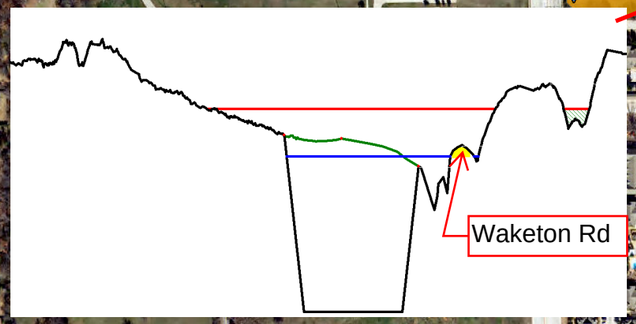
Waketon Road at Timber Creek Trib. 16 Drainage Study

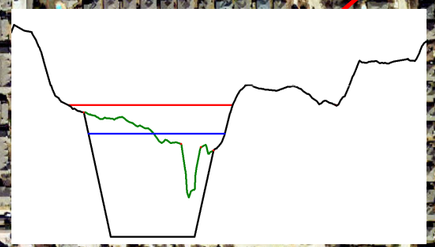
FIGURE F-5: Alternative #3

Channel excavation downstream of FM 2499 for approximately 1,500 linear feet.
Varying bottom width (75'-200')
4:1 side slopes
.7% bed slope

Waketon Rd. Crossing:
4 - 10' x 4' RCB
INCREASED TO
6- 10' x 6' RCB

Channel excavation downstream of Waketon Rd. for approximately 1,700 linear feet to reduce tailwater.
Varying bottom width (15'-300')
4:1 side slopes
.4% bed slope





Waketon Rd.
Morriss Rd.
Townsend Dr.
FM 2499
College Pkwy.

Legend

- Alternative #3 Stream Centerline
- Alternative #3 10-yr
- Existing Conditions 10-yr
- Timber Creek

Timber Creek

- 1 PCT ANNUAL CHANCE FLOOD
- FLOODWAY
- 0.2 PCT ANNUAL CHANCE FLOOD

Typical XS Legend

- Existing Ground
- Existing 10-yr WSEL
- Proposed Channel
- Proposed 10-yr WSEL

Note:

N
W E
S

0 250 500 1,000 Feet

1 inch = 500 feet

HALFF

Waketon Road at Timber Creek Trib. 16 Drainage Study

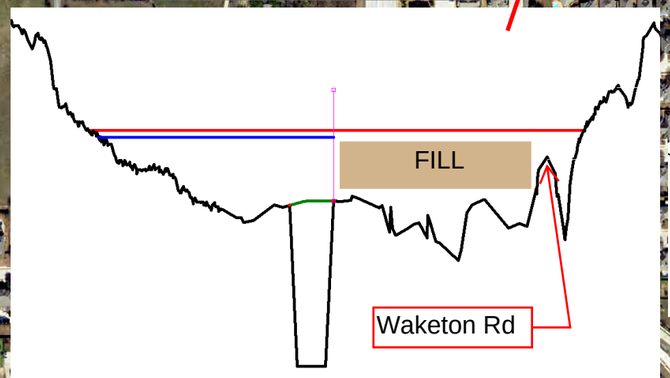
FIGURE F-6: Alternative #4

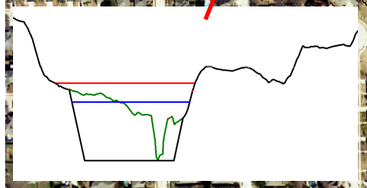
Channel excavation downstream of FM 2499 for approximately 1,500 linear feet.
Varying bottom width (50'-100')
4:1 side slopes
.7% bed slope

Waketon Rd. Crossing:
4 - 10' x 4' RCB
INCREASED TO
8- 10' x 4' RCB

Channel excavation downstream of Waketon Rd. for approximately 720 linear feet to reduce tailwater.
Existing depth maintained.
Varying bottom width (up to 150')
Also, remove brush and debris.

Fill from channel excavation to allow for development (8 ac.)





FM 2499

Waketon Rd.

Townsend Dr.

Morriss Rd.

College Pkwy.

Legend

- Alternative #4 Stream Centerline
- Alternative #4 10-yr
- Alternative #4 Fill
- Existing Conditions 10-yr
- Timber Creek

Timber Creek

- 1 PCT ANNUAL CHANCE FLOOD
- FLOODWAY
- 0.2 PCT ANNUAL CHANCE FLOOD

Typical XS Legend

- Existing Ground
- Existing 10-yr WSEL
- Proposed Channel
- Proposed 10-yr WSEL

Note:

N W E S

0 250 500 1,000 Feet

1 inch = 500 feet

HALFF

Waketon Road at Timber Creek Trib. 16 Drainage Study

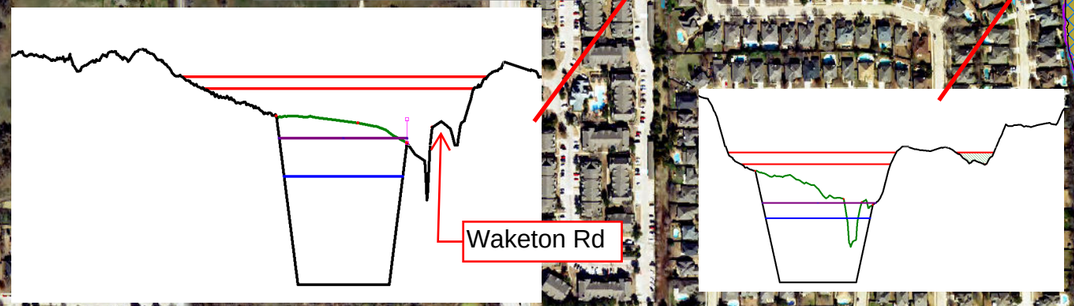
FIGURE F-7: Alternative #5

Channel excavation downstream of FM 2499 for approximately 1,500 linear feet.
Varying bottom width (75'-200')
4:1 side slopes
.7% bed slope

Waketon Rd. Crossing:
4 - 10' x 4' RCB
INCREASED TO
8- 10' x 6' RCB

Channel excavation downstream of Waketon Rd. for approximately 1,700 linear feet to reduce tailwater.
Varying bottom width (15'-300')
4:1 side slopes
.4% bed slope

Fill from channel excavation to allow for development (5.4 ac.)



FM 2499

Waketon Rd.

Townsend Dr.

Morriss Rd.

College Pkwy.

Legend

- Alternative #5 Stream Centerline
- Alternative #5 10-yr
- Alternative #5 100-yr
- Alternative #5 Fill
- Existing Conditions 10-yr
- Existing Conditions 100-yr
- Timber Creek

Timber Creek

- 1 PCT ANNUAL CHANCE FLOOD
- FLOODWAY
- 0.2 PCT ANNUAL CHANCE FLOOD

Typical XS Legend

- Existing Ground
- Existing 10-yr WSEL
- Existing 100-yr WSEL
- Proposed Channel
- Proposed 10-yr WSEL
- Proposed 100-yr WSEL

Note:

N W E S

0 250 500 1,000 Feet

1 inch = 500 feet

HALFF

Waketon Road at Timber Creek Trib. 16 Drainage Study

FIGURE F-8: Alternative #6

NO CHANGES to Waketon Rd. Crossing

Channel excavation downstream of Waketon Rd. for approximately 720 linear feet to reduce tailwater.
Existing depth maintained.
Varying bottom width (up to 150')
Also, remove brush and debris.

Berm of varying height (up to 4') to keep 1-yr flow from encroaching onto West side of Waketon Road
725 Linear ft

Waketon Rd.
FM 2499
Townsend Dr.
Morriss Rd.
College Pkwy.

Legend

- Tributary 16
- Alternative #6 1-yr
- Existing Conditions 1-yr
- Timber Creek

Timber Creek

- 1 PCT ANNUAL CHANCE FLOOD
- FLOODWAY
- 0.2 PCT ANNUAL CHANCE FLOOD

Typical XS Legend

- Existing Ground
- Existing 1-yr WSEL
- Proposed Channel
- Proposed 1-yr WSEL

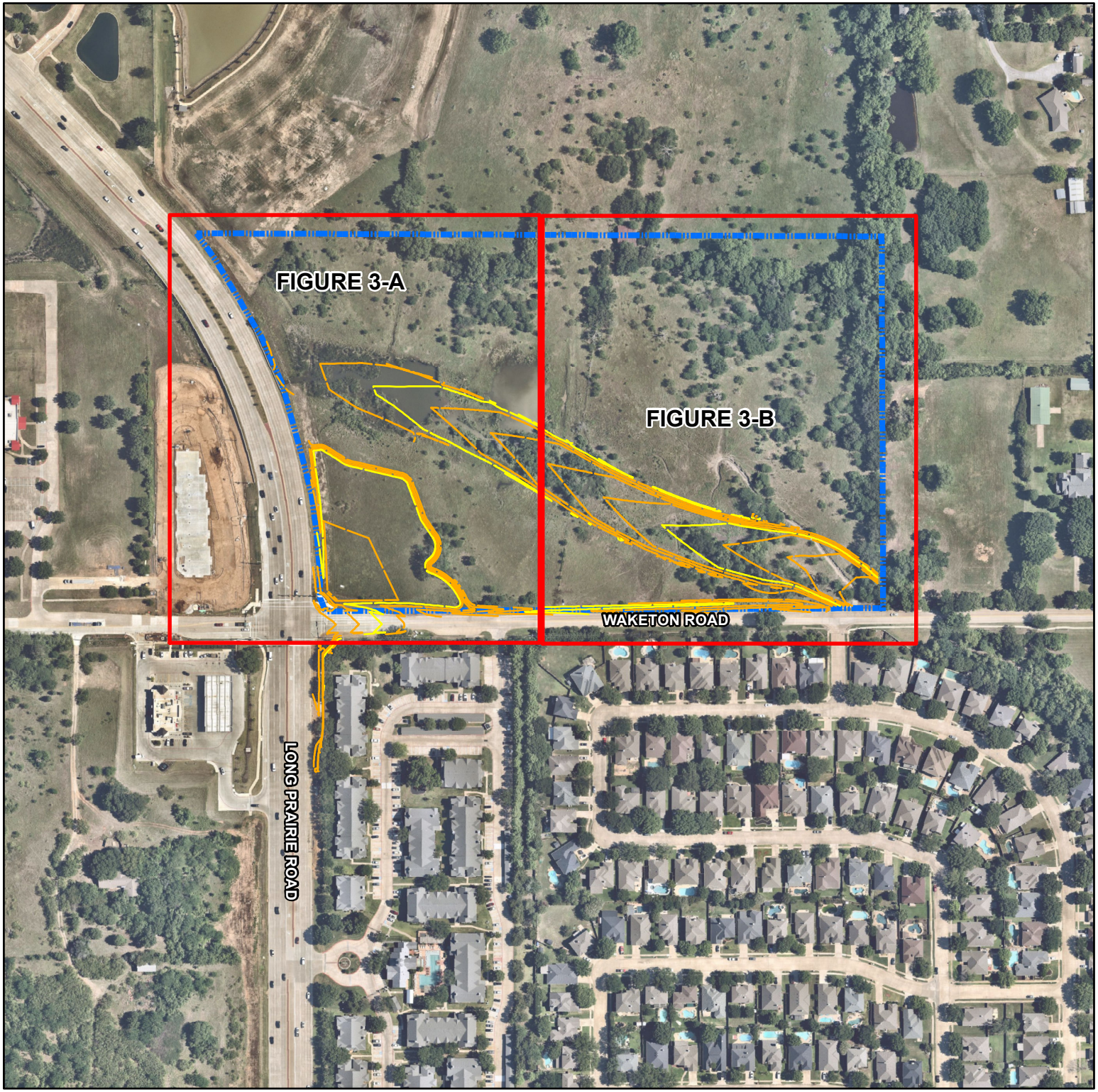
Note:

N W E S

0 250 500 1,000 Feet

1 inch = 500 feet

HALFF



N

0 150 300 600

SCALE IN FEET

LEGEND

- STUDY AREA
- FIGURE 3-A AND 3-B VIEW EXTENT
- PROPOSED MINOR CONTOUR
- PROPOSED MINOR CONTOUR

NOTES:
1. Service Layer Credits: NearMap, 2022
2.
3.
4.
5.

EAST WAKETON ROAD
DRAINAGE IMPROVEMENTS PROJECT

Project Number: #SWF-2019-00038

Date: 06/2022 AVO: 35351

PROJECT IMPACTS KEY MAP

FIGURE 3

HALFF

N

0 50 100 200

SCALE IN FEET

LEGEND

- STUDY AREA
- DRAINAGE DITCH
- EMERGENT WETLAND
- FORESTED WETLAND
- OPEN WATER
- IMPACTS TO AQUATIC FEATURES
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR

Design Data

- REUBCIRCED CONCRETE BOX CULVERT
- ROCK RIPRAP
- EXISTING REINCORCED CONCRETE BOX CULVERT
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR

NOTES:
1. Service Layer Credits: NearMap, 2022

EAST WAKETON ROAD
DRAINAGE IMPROVEMENTS PROJECT

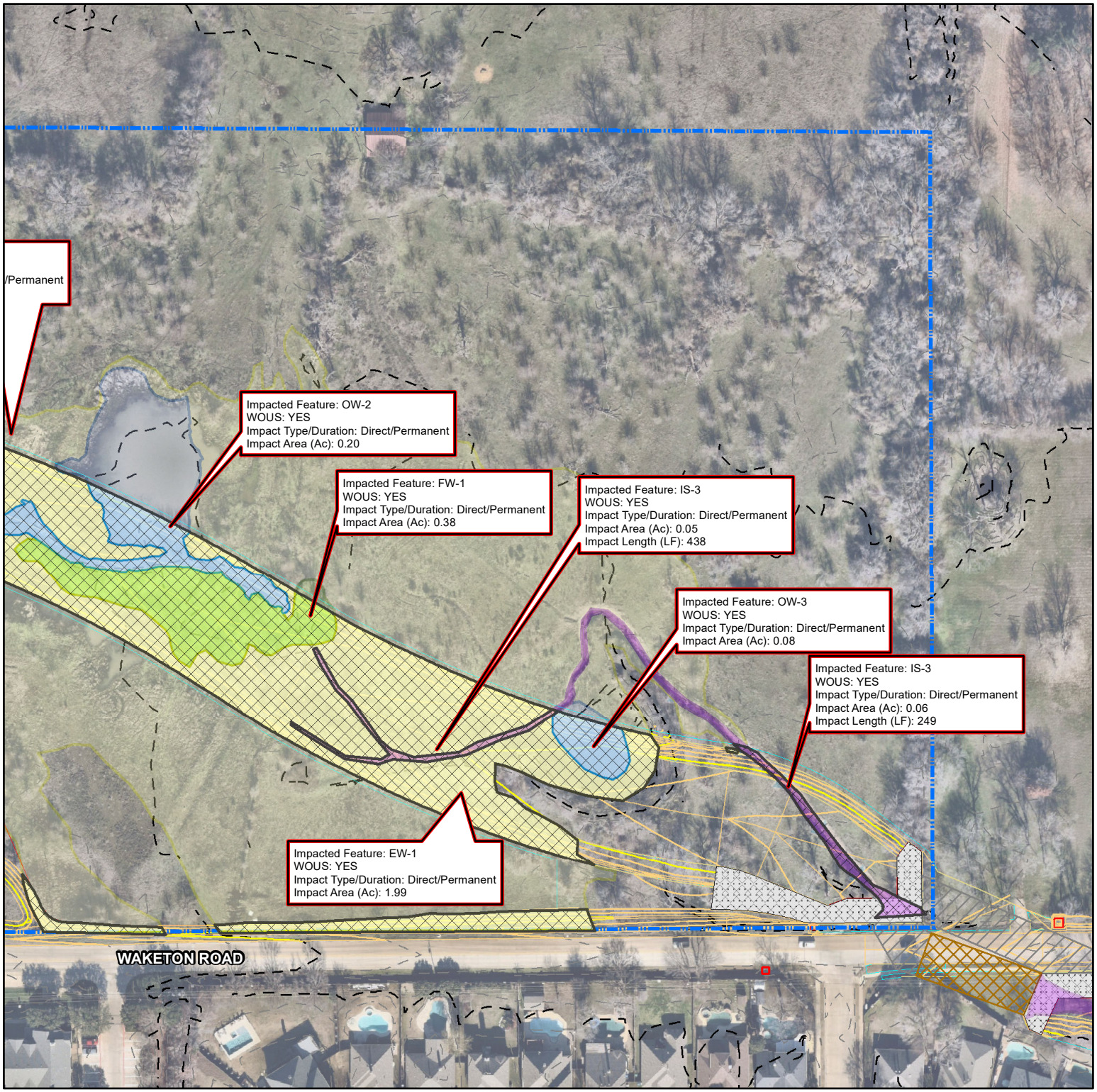
Project Number: #SWF-2019-00038

Date: 06/2022 AVO: 35351

PROJECT IMPACT MAP

FIGURE 3-A

HALFF



N

0 60 120 240

SCALE IN FEET

LEGEND

- STUDY AREA
- DRAINAGE DITCH
- EMERGENT WETLAND
- FORESTED WETLAND
- OPEN WATER
- INTERMITTENT STREAM
- IMPACTS TO AQUATIC FEATURES
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR

Design Data

- REINFORCED CONCRETE BOX CULVERT
- ROCK RIPRAP
- EXISTING REINFORCED CONCRETE BOX CULVERT
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR

NOTES:
1. Service Layer Credits: NearMap, 2024

EAST WAKETON ROAD
DRAINAGE IMPROVEMENTS PROJECT

Project Number: #SWF-2019-00038

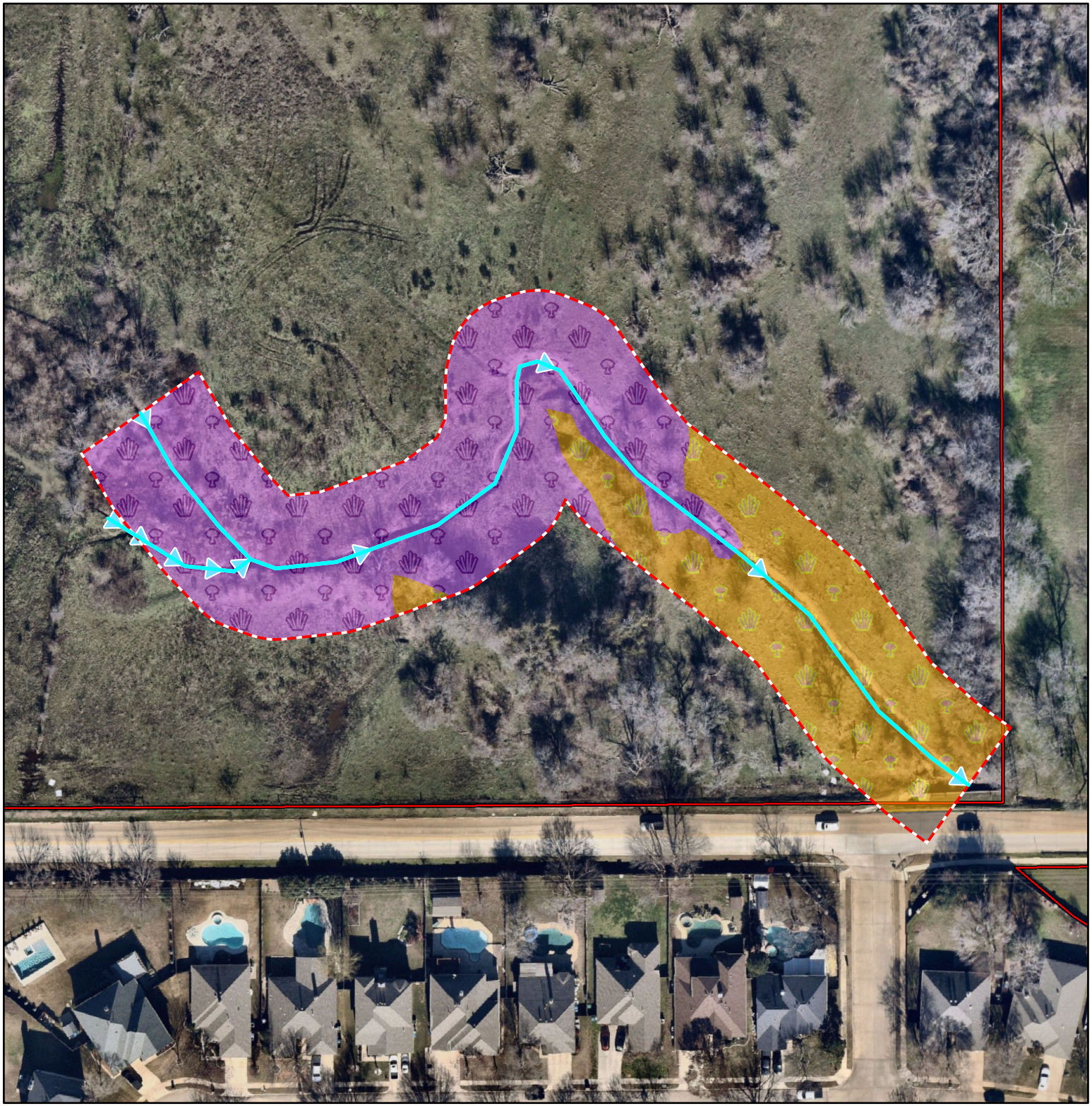
Date: 03/2024 AVO: 35351

PROJECT IMPACT MAP

FIGURE 3-B

HALFF

TXRAM SHEETS FOR LEDPA EVALUATION



N

0 50 100 200

Feet

Legend

- SAR-2 (IS-3) Centerline
- Buffer (52.5 ft)
- Study Area

Landscape Buffer Type

- Emergent Wetland (Native/Non-Native)
- Grassland Pasture (Native/Non-Native)
- Urban

Notes:
1. Service Layer Credits: Nearmap, 2024.
2.
3.
4.

Waketon Road Drainage Improvements Project
Project Number: SWF-2019-0038
Date: 02/2024 AVO: 35351
TXRAM Stream Buffer Assesment: SAR-2 (IS-3)
Figure SAR-2

halff

TXRAM STREAM DATA SHEET

Project/Site Name/No.: Waketon Road Project Type: ☒ Fill/Impact (☒ Linear ☐ Non-linear) ☐ Mitigation/Conservation

Stream ID/Name: IS-3 SAR No.: 2 Size (LF): 887 Date: 2/13/2024 Evaluator(s): M. Harpe

Stream Type: Intermittent Ecoregion: Cross Timber Delineation Performed: ☒ Previously ☐ Currently

8-Digit HUC: 12030103 Watershed Condition (developed, pasture, etc.): Developed Watershed Size: ~2000 sq. mi.

Aerial Photo Date and Source: January 2024, NearMap Site Photos: 2/12/2024 Representative: ☒ Yes ☐ No

Stressor(s): Significant impervious surface in surrounding area Are normal climatic/hydrologic conditions present? ☒ Yes ☐ No (If no, explain in Notes)

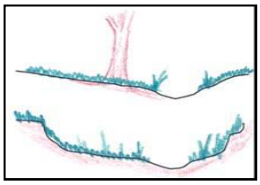
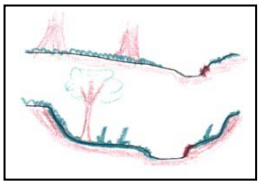
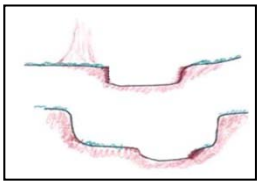
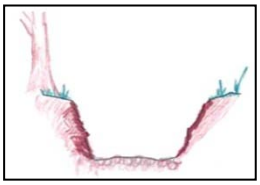
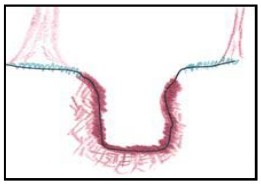
Stream Characteristics

Stream Width (Feet)		*Stream Height/Depth (Feet)*	
Avg. Bank to Bank:	6	Avg. Banks:	3
Avg. Waters Edge:	2	Avg. Water:	1
Avg. OHWM:	5	Avg. OHWM:	3

Notes: The southern reaches of this channel were excavated in 2020.

CHANNEL CONDITION

Floodplain Connectivity

				
Very little incision and access to the original floodplain or fully developed wide bankfull benches.	Slight incision and likely having regular (i.e., at least once a year) access to bankfull benches or newly developed floodplains along majority of the reach.	Moderate incision and presence of near vertical/ undercut banks; irregular (i.e., greater than 2 year return interval) access to floodplain or possible access to floodplain or bankfull benches at isolated areas.	Overwidened or incised channel and likely to widen further; majority of both banks near vertical/undercut; unlikely/rarely having access to floodplain or bankfull benches.	Deeply incised channel or channelized flow; severe incision with flow contained within the banks; majority of banks vertical/undercut.
5	4	3	2	1

Score: 1

Bank Condition

Left Bank Active Erosion: 80 % Right Bank Active Erosion: 80 % Average: 80

Bank Protection/Stabilization: ☐ Natural ☐ Artificial: _____

Score: 1

Sediment Deposition

☐ Less than 20% of the bottom covered by excessive sediment deposition; bars with established vegetation (5)

☐ 20–40% of the bottom covered by excessive sediment deposition; some established bars with indicators of recently deposited sediments (4)

☐ 40–60% of the bottom covered by excessive sediment deposition; moderate deposition on old bars and creating new bars; moderate sediment deposits at in-stream structures; OR obstructed view of the channel bottom and a lack of other depositional features (3)

☐ 60–80% of the bottom covered by excessive sediment deposition; newly created bars prevalent; heavy sediment deposits at in-stream structures (2)

☒ Greater than 80% of the bottom covered by excessive sediment deposition resulting in aggrading channel (1)

Score: 1

RIPARIAN BUFFER CONDITION

Riparian Buffer - See Table 22 to determine appropriate buffer distance. Confirm in office review.

Identify each buffer type and score according to canopy cover, vegetation community, and land use (see section 3.3.2.1.3).

Left Bank — Buffer Distance: 52.5

Buffer Type	*Canopy Cover*	*Vegetation Community*	*Land Use*	*Score*	*Percentage of Area*	*Subtotal*
1. Emergent Wetland	25	Mixed	Low	2	66.0	1.32
2. Grassland/Pasture	15	MIxed	Low	2	34.0	0.68
3.						
4.						
5.						

Score: 2

Right Bank

Buffer Type	*Canopy Cover*	*Vegetation Community*	*Land Use*	*Score*	*Percentage of Area*	*Subtotal*
1. Emergent Wetland	50	Mixed	Low	3	57.4	1.72
2. Grassland/Pasture	30	Mixed	Low	3	41.3	1.24
3. Urban	0	None	Intensive	0	1.3	0
4.						
5.						

Score: 2.96

IN-STREAM CONDITION

Substrate Composition (estimate percentages)

Boulder:	Gravel:	Fines (silt, clay, muck): 100	Artificial:
Cobble:	Sand:	Bedrock:	Other:

Score: 1

In-stream Habitat (check all habitat types that are present)

Habitat Type	*T1*	*T2*	*T3*	*T4*	*T5*	*T6*	*T7*	*T8*	*T9*	*T10*	*T11*	*T12*	*T13*
Undercut Banks													
Overhanging Vegetation													
Rootmats					✔	✔	✔	✔	✔				
Rootwads													
Woody/Leafy Debris													
Boulders/Cobbles													
Aquatic Macrophytes													
Riffle/Pool Sequence													
Artificial Habitat Enhancement													
Other													
Total No. Present	0	0	0	0	1	1	1	1	1				

Average: 0.5 **Score:** 1

HYDROLOGIC CONDITION

Flow Regime

- ☐ Noticeable surface flow present (4)
- ☐ Continual pool of water but lacking noticeable flow (3)
- ☒ Isolated pools and interstitial (subsurface) flow (2)
- ☐ Isolated pools and no evidence of surface or interstitial flow (1)
- ☐ Dry channel and no observable pools or interstitial flow (0)

Score: 2

Channel Flow Status

- ☐ Water covering greater than 75% of the channel bottom width; less than 25% of channel substrate is exposed (4)
- ☐ Water covering 50–75% of the channel bottom width; 25–50% of channel substrate is exposed (3)
- ☒ Water covering 25–50% of the channel bottom width; 50–75% of channel substrate is exposed (2)
- ☐ Water present but covering less than 25% of the channel bottom width; greater than 75% of channel substrate is exposed (1)
- ☐ No water present in the channel; 100% of channel substrate exposed (0)

Score: 2

TXRAM STREAM FINAL SCORING SHEET

Project/Site Name/No.: Waketon Road Project Type: ☒ Fill/Impact (☒ Linear ☐ Non-linear) ☐ Mitigation/Conservation

Stream ID/Name: IS-3 SAR No.: 2 Size (LF): 887 Date: 2/13/2024 Evaluator(s): M. Harpe

Stream Type: Intermittent Ecoregion: Cross Timber Delineation Performed: ☒ Previously ☐ Currently

8-Digit HUC: 12030103 Watershed Condition (developed, pasture, etc.): Development Watershed Size: ~2000 sq. mi.

Aerial Photo Date and Source: January 2024, NearMap Site Photos: 2/12/2024 Representative: ☒ Yes ☐ No

Stressor(s): Significant impervious surface in surrounding area Are normal climatic/hydrologic conditions present? ☒ Yes ☐ No (If no, explain in Notes)

Notes: _____

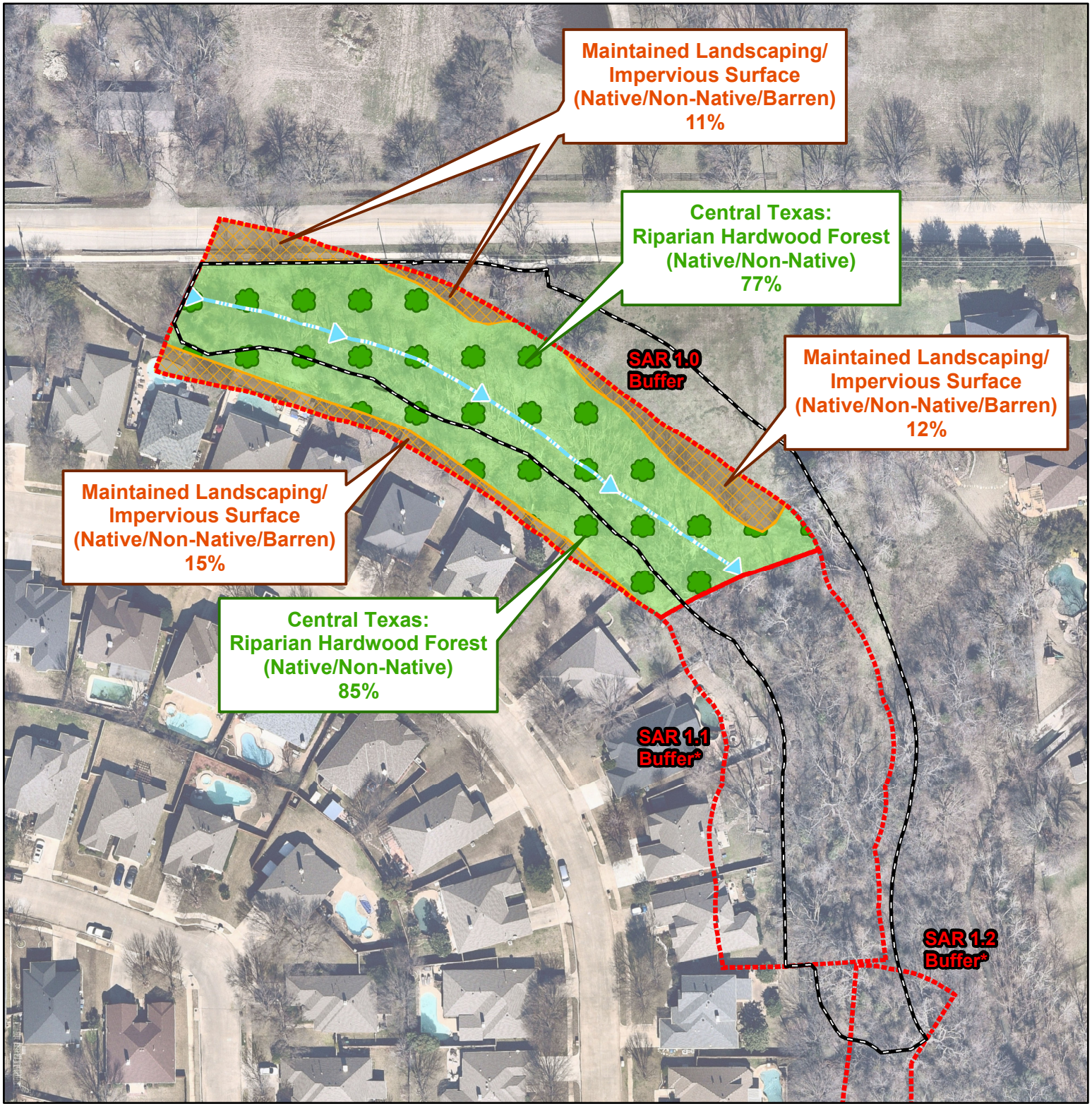
Stream Characteristics

Stream Width (Feet)		*Stream Height/Depth (Feet)*	
Avg. Bank to Bank:	6	Avg. Banks:	3
Avg. Waters Edge:	2	Avg. Water:	1
Avg. OHWM:	5	Avg. OHWM:	3

Scoring Table

Core Element	***Metric***	***Metric Score***	***Core Element Score Calculation***	***Core Element Score***
Channel condition	Floodplain connectivity	1	Sum of metric scores / 15 x 25	5
	Bank condition	1		
	Sediment deposition	1		
Riparian buffer condition	Riparian buffer (left bank)	2	Sum of bank scores / 10 x 25	12.4
	Riparian buffer (right bank)	2.96		
In-stream condition	Substrate composition	1	Sum of metric scores / 10 x 25	5
	In-stream habitat	1		
Hydrologic condition	Flow regime	2	Sum of metric scores / 8 x 25	12.5
	Channel flow status	2		
			Sum of core element scores = overall TXRAM stream score	34.9
Additional points for limited habitats = overall TXRAM stream score x 0.025 for each bank (right/left) if: L R ☐ ☐ Dominated by native trees greater than 24-inch diameter at breast height ☐ ☐ Dominated by hard mast (i.e., acorns and nuts) producing native species in the tree strata				
Sum of overall TXRAM stream score and additional points = **total overall TXRAM stream score**				

Representative Site Photograph:



N

0 50 100 200

Feet

Legend

- SAR-1.0 (IS-1.0)
- Buffer (60ft)
- Project Impact Limits

Landscape Buffer Type

- Central Texas: Riparian Hardwood Forest (Native/Non-Native)
- Maintained Landscaping/ Impervious Surface (Native/Non-Native/Barren)

Notes:
1. Service Layer Credits: Nearmap, 2020.
2. *SAR 1.1 and 1.2 buffers shown for reference.
3.

Waketon Road Drainage Improvements Project
Project Number: SWF-2019-0038
Date: 04/2020 AVO: 35351
TXRAM Stream Buffer Assesment: SAR-1.0 (IS-1.0)
Figure SAR-1.0

HALFF

TXRAM STREAM DATA SHEET

Project/Site Name/No.: Waketon Road Project Type: ☒ Fill/Impact (☒ Linear ☐ Non-linear) ☒ Mitigation/Conservation

Stream ID/Name: IS-1.0 SAR No.: 1.0 Size (LF): 466 Date: 3/27/2020 Evaluator(s): J. Jordan

Stream Type: Intermittent Ecoregion: Cross Timbers Delineation Performed: ☐ Previously ☒ Currently

8-Digit HUC: 12030103 Watershed Condition (developed, pasture, etc.): Developed Watershed Size: ~2000 sq. mi.

Aerial Photo Date and Source: February 2020, Nearmap Site Photos: See photosheet. Representative: ☐ Yes ☒ No

Stressor(s): Significant impervious surface in surrounding areas. Are normal climatic/hydrologic conditions present? ☒ Yes ☐ No (If no, explain in Notes)

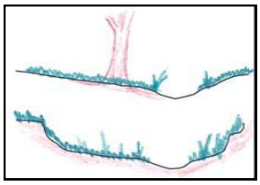
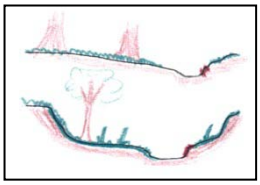
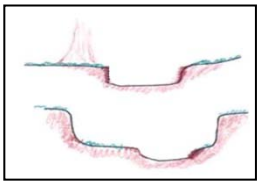
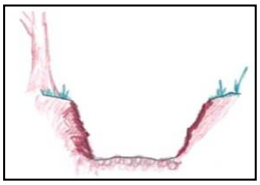
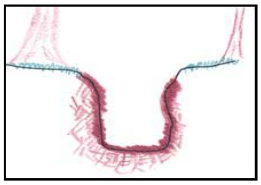
Stream Characteristics

Stream Width (Feet)		*Stream Height/Depth (Feet)*	
Avg. Bank to Bank:	11	Avg. Banks:	1
Avg. Waters Edge:	10	Avg. Water:	0.5
Avg. OHWM:	11	Avg. OHWM:	0.5

Notes: Concrete-lined channel with occasional sparsely vegetated sediment bars. SAR 1.0 is representative of the observed intermittent stream feature for the duration of the concrete-lined channel. SAR 1.1 begins at the point of transition between concrete-lined channel, and natural bed and bank. Surrounding land use was determined to be moderate due to utility easements existing proximal to the stream feature and relatively small distance between residential areas adjacent the riparian corridor. Buffer size was slightly increased to accurately depict riparian zone condition.

CHANNEL CONDITION

Floodplain Connectivity

				
Very little incision and access to the original floodplain or fully developed wide bankfull benches.	Slight incision and likely having regular (i.e., at least once a year) access to bankfull benches or newly developed floodplains along majority of the reach.	Moderate incision and presence of near vertical/ undercut banks; irregular (i.e., greater than 2 year return interval) access to floodplain or possible access to floodplain or bankfull benches at isolated areas.	Overwidened or incised channel and likely to widen further; majority of both banks near vertical/undercut; unlikely/rarely having access to floodplain or bankfull benches.	Deeply incised channel or channelized flow; severe incision with flow contained within the banks; majority of banks vertical/undercut.
5	4	3	2	1

Score: 3

Bank Condition

Left Bank Active Erosion: 0 % Right Bank Active Erosion: 0 % Average: 0

Bank Protection/Stabilization: ☐ Natural ☒ Artificial: Conrete-lined channel.

Score: 0

Sediment Deposition

☐ Less than 20% of the bottom covered by excessive sediment deposition; bars with established vegetation (5)

☒ 20–40% of the bottom covered by excessive sediment deposition; some established bars with indicators of recently deposited sediments (4)

☐ 40–60% of the bottom covered by excessive sediment deposition; moderate deposition on old bars and creating new bars; moderate sediment deposits at in-stream structures; OR obstructed view of the channel bottom and a lack of other depositional features (3)

☐ 60–80% of the bottom covered by excessive sediment deposition; newly created bars prevalent; heavy sediment deposits at in-stream structures (2)

☐ Greater than 80% of the bottom covered by excessive sediment deposition resulting in aggrading channel (1)

Score: 4

RIPARIAN BUFFER CONDITION

Riparian Buffer - See Table 22 to determine appropriate buffer distance. Confirm in office review.

Identify each buffer type and score according to canopy cover, vegetation community, and land use (see section 3.3.2.1.3).

Left Bank — Buffer Distance: 60'

Buffer Type	*Canopy Cover*	*Vegetation Community*	*Land Use*	*Score*	*Percentage of Area*	*Subtotal*
1. Central Texas: Riparian Hardwood Forest (Native/Non-Native)	75	Mix	Moderate	3	77	3
2. Maintained Landscaping/Impervious Surface	10	Mix	Intensive	0	23	0
3.						
4.						
5.						

Score: 3

Right Bank

Buffer Type	*Canopy Cover*	*Vegetation Community*	*Land Use*	*Score*	*Percentage of Area*	*Subtotal*
1. Central Texas: Riparian Hardwood Forest (Native/Non-Native)	70	Mix	Moderate	3	85	3
2. Maintained Landscaping/Impervious Surface	5	Mix	Intensive	0	15	0
3.						
4.						
5.						

Score: 3

IN-STREAM CONDITION

Substrate Composition (estimate percentages)

Boulder:	Gravel:	Fines (silt, clay, muck):	Artificial: Concrete-lined
Cobble:	Sand:	Bedrock:	Other:

Score: 0

In-stream Habitat (check all habitat types that are present)

Habitat Type	*T1*	*T2*	*T3*	*T4*	*T5*	*T6*	*T7*	*T8*	*T9*	*T10*	*T11*	*T12*	*T13*
Undercut Banks													
Overhanging Vegetation													
Rootmats													
Rootwads													
Woody/Leafy Debris													
Boulders/Cobbles													
Aquatic Macrophytes													
Riffle/Pool Sequence													
Artificial Habitat Enhancement													
Other													
Total No. Present	0	0	0	0									

Average: 0 **Score:** 0

HYDROLOGIC CONDITION

Flow Regime

- ☒ Noticeable surface flow present (4)
- ☐ Continual pool of water but lacking noticeable flow (3)
- ☐ Isolated pools and interstitial (subsurface) flow (2)
- ☐ Isolated pools and no evidence of surface or interstitial flow (1)
- ☐ Dry channel and no observable pools or interstitial flow (0)

Score: 4

Channel Flow Status

- ☐ Water covering greater than 75% of the channel bottom width; less than 25% of channel substrate is exposed (4)
- ☒ Water covering 50–75% of the channel bottom width; 25–50% of channel substrate is exposed (3)
- ☐ Water covering 25–50% of the channel bottom width; 50–75% of channel substrate is exposed (2)
- ☐ Water present but covering less than 25% of the channel bottom width; greater than 75% of channel substrate is exposed (1)
- ☐ No water present in the channel; 100% of channel substrate exposed (0)

Score: 3

TXRAM STREAM FINAL SCORING SHEET

Project/Site Name/No.: Waketon Road Project Type: ☒ Fill/Impact (☒ Linear ☐ Non-linear) ☐ Mitigation/Conservation

Stream ID/Name: IS-1.0 SAR No.: 1.0 Size (LF): 466 Date: 3/27/2020 Evaluator(s): J. Jordan

Stream Type: Intermittent Ecoregion: Cross Timbers Delineation Performed: ☐ Previously ☒ Currently

8-Digit HUC: 12030103 Watershed Condition (developed, pasture, etc.): Developed Watershed Size: ~2000 sq. mi.

Aerial Photo Date and Source: February 2020, Nearmap Site Photos: See photosheet. Representative: ☐ Yes ☒ No

Stressor(s): Significant impervious surface in surrounding areas. Are normal climatic/hydrologic conditions present? ☒ Yes ☐ No (If no, explain in Notes)

Notes: See datasheet for notes.

Stream Characteristics

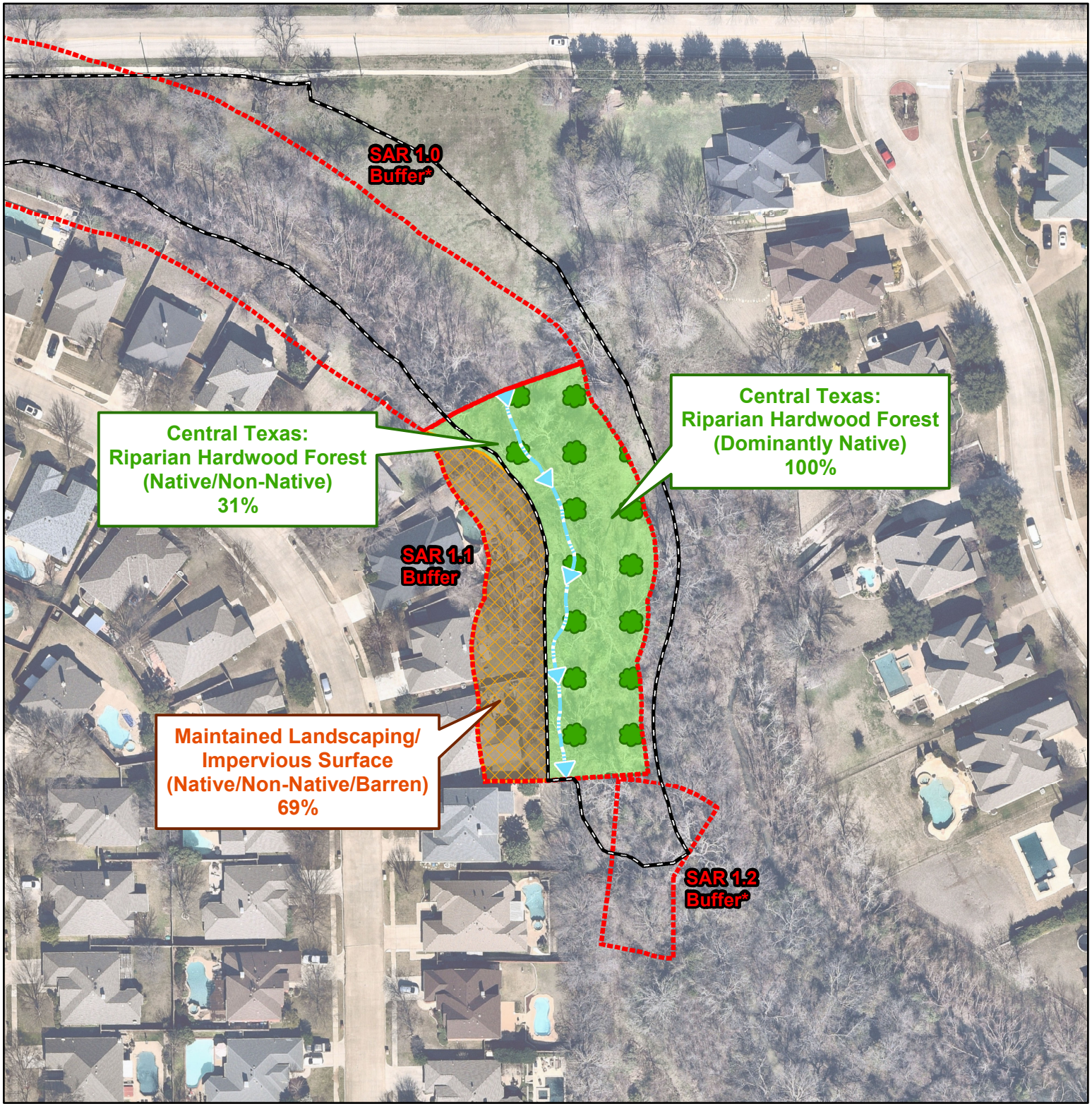
Stream Width (Feet)		*Stream Height/Depth (Feet)*	
Avg. Bank to Bank:	11	Avg. Banks:	1
Avg. Waters Edge:	10	Avg. Water:	0.5
Avg. OHWM:	11	Avg. OHWM:	0.5

Scoring Table

Core Element	***Metric***	***Metric Score***	***Core Element Score Calculation***	***Core Element Score***
Channel condition	Floodplain connectivity	3	Sum of metric scores / 15 x 25	11.7
	Bank condition	0		
	Sediment deposition	4		
Riparian buffer condition	Riparian buffer (left bank)	3	Sum of bank scores / 10 x 25	15
	Riparian buffer (right bank)	3		
In-stream condition	Substrate composition	0	Sum of metric scores / 10 x 25	0
	In-stream habitat	0		
Hydrologic condition	Flow regime	4	Sum of metric scores / 8 x 25	21.9
	Channel flow status	3		
			Sum of core element scores = overall TXRAM stream score	48.6
Additional points for limited habitats = overall TXRAM stream score x 0.025 for each bank (right/left) if: L R ☐ ☐ Dominated by native trees greater than 24-inch diameter at breast height ☒ ☐ Dominated by hard mast (i.e., acorns and nuts) producing native species in the tree strata				1.13
			Sum of overall TXRAM stream score and additional points = **total overall TXRAM stream score**	49.73

Representative Site Photograph:

Representative photo of IS-1.0 (SAR-1.0). The area circled in red shows the exposed concrete-lined bed of this reach of stream.



N

0 50 100 200

Feet

Legend

- SAR-1.1 (IS-1.1)
- Buffer (60ft)
- Project Impact Limits

Landscape Buffer Type

- Central Texas: Riparian Hardwood Forest (Native/Non-Native)
- Maintained Landscaping/ Impervious Surface (Native/Non-Native/Barren)

Notes:
1. Service Layer Credits: Nearmap, 2020.
2. *SAR 1.0 and 1.2 buffers shown for reference.
3.

Waketon Road Drainage Improvements Project
Project Number: SWF-2019-0038
Date: 04/2020 AVO: 35351
TXRAM Stream Buffer Assesment: SAR-1.1 (IS-1.1)
Figure SAR-1.1

HALFF

TXRAM STREAM DATA SHEET

Project/Site Name/No.: Waketon Road Project Type: ☒ Fill/Impact (☒ Linear ☐ Non-linear) ☐ Mitigation/Conservation

Stream ID/Name: IS-1.1 SAR No.: 1.1 Size (LF): 305 Date: 3/27/2020 Evaluator(s): J. Jordan

Stream Type: Intermittent Ecoregion: Cross Timbers Delineation Performed: ☐ Previously ☒ Currently

8-Digit HUC: 12030103 Watershed Condition (developed, pasture, etc.): Developed Watershed Size: ~2000 sq. mi.

Aerial Photo Date and Source: February 2020, Nearmap Site Photos: See photosheet. Representative: ☐ Yes ☒ No

Stressor(s): Significant impervious surface in surrounding areas. Are normal climatic/hydrologic conditions present? ☒ Yes ☐ No (If no, explain in Notes)

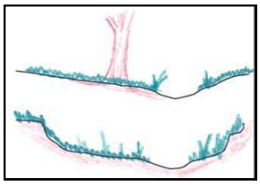
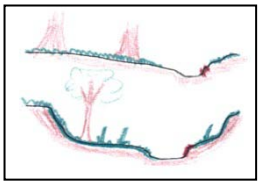
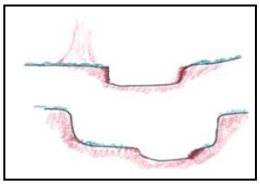
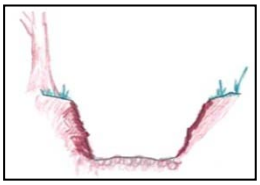
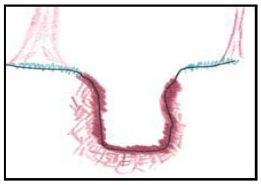
Stream Characteristics

Stream Width (Feet)		*Stream Height/Depth (Feet)*	
Avg. Bank to Bank:	15	Avg. Banks:	5
Avg. Waters Edge:	10	Avg. Water:	2
Avg. OHWM:	12	Avg. OHWM:	3

Notes: SAR 1.1 begins at the point of transition between concrete-lined channel, and natural bed and bank. SAR 1.1 has natural bed and bank. Buffer size was slightly increased to accurately depict riparian zone condition.

CHANNEL CONDITION

Floodplain Connectivity

				
Very little incision and access to the original floodplain or fully developed wide bankfull benches.	Slight incision and likely having regular (i.e., at least once a year) access to bankfull benches or newly developed floodplains along majority of the reach.	Moderate incision and presence of near vertical/ undercut banks; irregular (i.e., greater than 2 year return interval) access to floodplain or possible access to floodplain or bankfull benches at isolated areas.	Overwidened or incised channel and likely to widen further; majority of both banks near vertical/undercut; unlikely/rarely having access to floodplain or bankfull benches.	Deeply incised channel or channelized flow; severe incision with flow contained within the banks; majority of banks vertical/undercut.
5	4	3	2	1

Score: 3

Bank Condition

Left Bank Active Erosion: 70 % Right Bank Active Erosion: 70 % Average: 70

Bank Protection/Stabilization: ☒ Natural ☐ Artificial: _____

Score: 1

Sediment Deposition

☐ Less than 20% of the bottom covered by excessive sediment deposition; bars with established vegetation (5)

☒ 20–40% of the bottom covered by excessive sediment deposition; some established bars with indicators of recently deposited sediments (4)

☐ 40–60% of the bottom covered by excessive sediment deposition; moderate deposition on old bars and creating new bars; moderate sediment deposits at in-stream structures; OR obstructed view of the channel bottom and a lack of other depositional features (3)

☐ 60–80% of the bottom covered by excessive sediment deposition; newly created bars prevalent; heavy sediment deposits at in-stream structures (2)

☐ Greater than 80% of the bottom covered by excessive sediment deposition resulting in aggrading channel (1)

Score: 4

RIPARIAN BUFFER CONDITION

Riparian Buffer - See Table 22 to determine appropriate buffer distance. Confirm in office review.

Identify each buffer type and score according to canopy cover, vegetation community, and land use (see section 3.3.2.1.3).

Left Bank — Buffer Distance: 60'

Buffer Type	*Canopy Cover*	*Vegetation Community*	*Land Use*	*Score*	*Percentage of Area*	*Subtotal*
1. Central Texas: Riparian Hardwood Forest (Dominantly Native)	90	Native	Low	5	100	5
2.						
3.						
4.						
5.						

Score: 5

Right Bank

Buffer Type	*Canopy Cover*	*Vegetation Community*	*Land Use*	*Score*	*Percentage of Area*	*Subtotal*
1. Central Texas: Riparian Hardwood Forest (Native/Non-Native)	70	Mix	High	3	31	3
2. Maintained Landscaping/Impervious Surface (Native/Non-Native/Barren)	70	Mix	Intense	0	69	0
3.						
4.						
5.						

Score: 3

IN-STREAM CONDITION

Substrate Composition (estimate percentages)

Boulder:	Gravel: 60	Fines (silt, clay, muck): 20	Artificial:
Cobble:	Sand: 20	Bedrock:	Other:

Score: 4

In-stream Habitat (check all habitat types that are present)

Habitat Type	*T1*	*T2*	*T3*	*T4*	*T5*	*T6*	*T7*	*T8*	*T9*	*T10*	*T11*	*T12*	*T13*
Undercut Banks	✔	✔	✔										
Overhanging Vegetation													
Rootmats													
Rootwads	✔	✔	✔										
Woody/Leafy Debris	✔	✔	✔										
Boulders/Cobbles													
Aquatic Macrophytes													
Riffle/Pool Sequence	✔	✔											
Artificial Habitat Enhancement													
Other													
Total No. Present	4	4	3										

Average: 3.7 **Score:** 4.0

HYDROLOGIC CONDITION

Flow Regime

- ☒ Noticeable surface flow present (4)
- ☐ Continual pool of water but lacking noticeable flow (3)
- ☐ Isolated pools and interstitial (subsurface) flow (2)
- ☐ Isolated pools and no evidence of surface or interstitial flow (1)
- ☐ Dry channel and no observable pools or interstitial flow (0)

Score: 4

Channel Flow Status

- ☒ Water covering greater than 75% of the channel bottom width; less than 25% of channel substrate is exposed (4)
- ☐ Water covering 50–75% of the channel bottom width; 25–50% of channel substrate is exposed (3)
- ☐ Water covering 25–50% of the channel bottom width; 50–75% of channel substrate is exposed (2)
- ☐ Water present but covering less than 25% of the channel bottom width; greater than 75% of channel substrate is exposed (1)
- ☐ No water present in the channel; 100% of channel substrate exposed (0)

Score: 4

Version 1.0 - Final Draft

TXRAM STREAM FINAL SCORING SHEET

Project/Site Name/No.: Waketon Road Project Type: ☒ Fill/Impact (☒ Linear ☐ Non-linear) ☐ Mitigation/Conservation

Stream ID/Name: IS-1.1 SAR No.: 1.1 Size (LF): 305 Date: 3/27/2020 Evaluator(s): J. Jordan

Stream Type: Intermittent Ecoregion: Cross Timbers Delineation Performed: ☐ Previously ☒ Currently

8-Digit HUC: 12030103 Watershed Condition (developed, pasture, etc.): Developed Watershed Size: ~2000 sq. mi.

Aerial Photo Date and Source: February 2020, Nearmap Site Photos: See photosheet. Representative: ☐ Yes ☒ No

Stressor(s): Significant impervious surface in surrounding areas. Are normal climatic/hydrologic conditions present? ☒ Yes ☐ No (If no, explain in Notes)

Notes: _____

Stream Characteristics

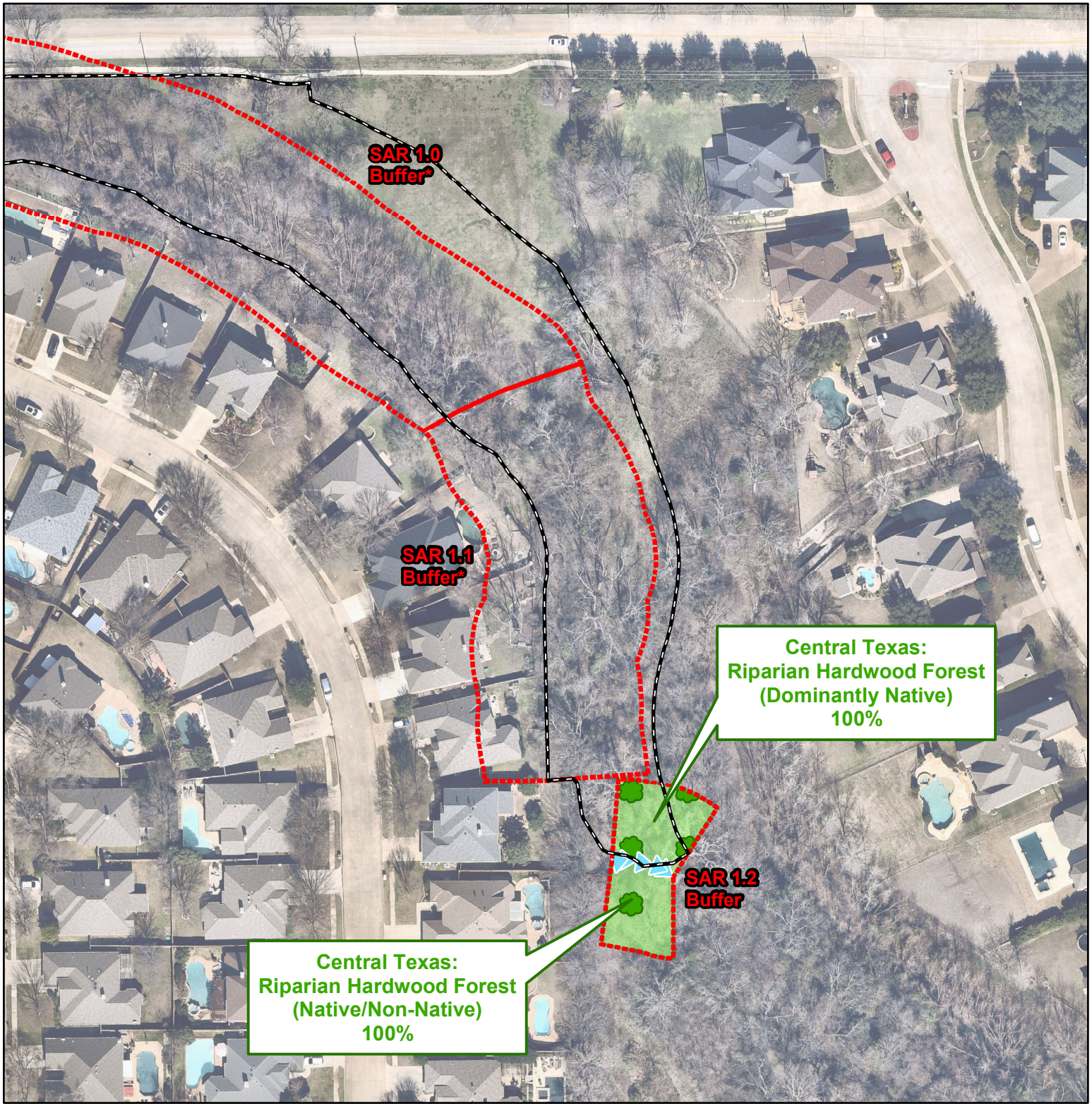
Stream Width (Feet)		*Stream Height/Depth (Feet)*	
Avg. Bank to Bank:	15	Avg. Banks:	5
Avg. Waters Edge:	10	Avg. Water:	2
Avg. OHWM:	12	Avg. OHWM:	3

Scoring Table

Core Element	***Metric***	***Metric Score***	***Core Element Score Calculation***	***Core Element Score***
Channel condition	Floodplain connectivity	3	Sum of metric scores / 15 x 25	13.3
	Bank condition	1		
	Sediment deposition	4		
Riparian buffer condition	Riparian buffer (left bank)	5	Sum of bank scores / 10 x 25	20
	Riparian buffer (right bank)	3		
In-stream condition	Substrate composition	4	Sum of metric scores / 10 x 25	20
	In-stream habitat	4		
Hydrologic condition	Flow regime	4	Sum of metric scores / 8 x 25	25
	Channel flow status	4		
			Sum of core element scores = overall TXRAM stream score	78.3
Additional points for limited habitats = overall TXRAM stream score x 0.025 for each bank (right/left) if: L R ☒ ☐ Dominated by native trees greater than 24-inch diameter at breast height ☐ ☐ Dominated by hard mast (i.e., acorns and nuts) producing native species in the tree strata				1.9
			Sum of overall TXRAM stream score and additional points = **total overall TXRAM stream score**	80.2

Representative Site Photograph:

Representative photo of IS-1.1 (SAR-1.1).



N

0 50 100 200

Feet

Legend

- SAR-1.2 (IS-1.1)
- Buffer (60ft)
- Project Impact Limits

Landscape Buffer Type

- Central Texas: Riparian Hardwood Forest (Native/Non-Native)

Notes:
1. Service Layer Credits: Nearmap, 2020.
2. *SAR 1.0 and 1.1 buffers shown for reference.
3.

Waketon Road Drainage Improvements Project
Project Number: SWF-2019-0038
Date: 04/2020 AVO: 35351
TXRAM Stream Buffer Assesment: SAR-1.2 (IS-1.1)
Figure SAR-1.2

HALFF

TXRAM STREAM DATA SHEET

Project/Site Name/No.: Waketon Road Project Type: ☒ Fill/Impact (☐ Linear ☐ Non-linear) ☐ Mitigation/Conservation

Stream ID/Name: IS-1.1 SAR No.: 1.2 Size (LF): 134 Date: 3/27/2020 Evaluator(s): J. Jordan

Stream Type: Intermittent Ecoregion: Cross Timbers Delineation Performed: ☐ Previously ☒ Currently

8-Digit HUC: 12030103 Watershed Condition (developed, pasture, etc.): Developed Watershed Size: ~2000 sq. mi.

Aerial Photo Date and Source: February 2020, Nearmap Site Photos: See photosheet. Representative: ☐ Yes ☒ No

Stressor(s): Significant impervious surface in surrounding areas Are normal climatic/hydrologic conditions present? ☒ Yes ☐ No (If no, explain in Notes)

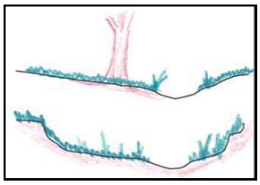
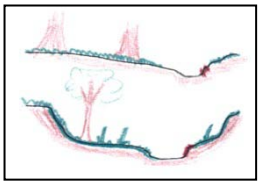
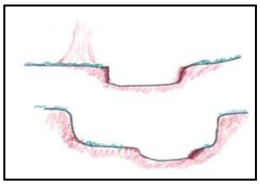
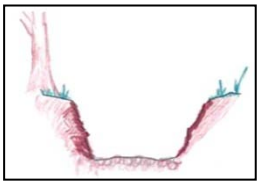
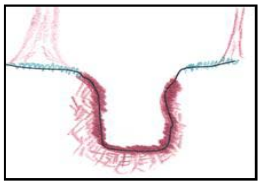
Stream Characteristics

Stream Width (Feet)		*Stream Height/Depth (Feet)*	
Avg. Bank to Bank:	25	Avg. Banks:	6
Avg. Waters Edge:	18	Avg. Water:	3
Avg. OHWM:	20	Avg. OHWM:	4

Notes:

CHANNEL CONDITION

Floodplain Connectivity

				
Very little incision and access to the original floodplain or fully developed wide bankfull benches.	Slight incision and likely having regular (i.e., at least once a year) access to bankfull benches or newly developed floodplains along majority of the reach.	Moderate incision and presence of near vertical/ undercut banks; irregular (i.e., greater than 2 year return interval) access to floodplain or possible access to floodplain or bankfull benches at isolated areas.	Overwidened or incised channel and likely to widen further; majority of both banks near vertical/undercut; unlikely/rarely having access to floodplain or bankfull benches.	Deeply incised channel or channelized flow; severe incision with flow contained within the banks; majority of banks vertical/undercut.
5	4	3	2	1

Score: 3

Bank Condition

Left Bank Active Erosion: 70 % Right Bank Active Erosion: 70 % Average: 70

Bank Protection/Stabilization: ☒ Natural ☐ Artificial: _____

Score: 1

Sediment Deposition

☐ Less than 20% of the bottom covered by excessive sediment deposition; bars with established vegetation (5)

☒ 20–40% of the bottom covered by excessive sediment deposition; some established bars with indicators of recently deposited sediments (4)

☐ 40–60% of the bottom covered by excessive sediment deposition; moderate deposition on old bars and creating new bars; moderate sediment deposits at in-stream structures; OR obstructed view of the channel bottom and a lack of other depositional features (3)

☐ 60–80% of the bottom covered by excessive sediment deposition; newly created bars prevalent; heavy sediment deposits at in-stream structures (2)

☐ Greater than 80% of the bottom covered by excessive sediment deposition resulting in aggrading channel (1)

Score: 4

RIPARIAN BUFFER CONDITION

Riparian Buffer - See Table 22 to determine appropriate buffer distance. Confirm in office review.

Identify each buffer type and score according to canopy cover, vegetation community, and land use (see section 3.3.2.1.3).

Left Bank — Buffer Distance: 60'

Buffer Type	*Canopy Cover*	*Vegetation Community*	*Land Use*	*Score*	*Percentage of Area*	*Subtotal*
1. Central Texas: Riparian Hardwood Forest (Dominantly Native)	90	Native	Low	5	100	5
2.						
3.						
4.						
5.						

Score: 5

Right Bank

Buffer Type	*Canopy Cover*	*Vegetation Community*	*Land Use*	*Score*	*Percentage of Area*	*Subtotal*
1. Central Texas: Riparian Hardwood Forest (Native/Non-Native)	70	Mix	Moderate	3	100	3
2.						
3.						
4.						
5.						

Score: 3

IN-STREAM CONDITION

Substrate Composition (estimate percentages)

Boulder:	Gravel: 60	Fines (silt, clay, muck): 20	Artificial:
Cobble:	Sand: 20	Bedrock:	Other:

Score: 4

In-stream Habitat (check all habitat types that are present)

Habitat Type	*T1*	*T2*	*T3*	*T4*	*T5*	*T6*	*T7*	*T8*	*T9*	*T10*	*T11*	*T12*	*T13*
Undercut Banks	✔												
Overhanging Vegetation													
Rootmats													
Rootwads	✔												
Woody/Leafy Debris	✔												
Boulders/Cobbles													
Aquatic Macrophytes													
Riffle/Pool Sequence													
Artificial Habitat Enhancement													
Other													
Total No. Present	3												

Average: 3.0 **Score:** 3.0

HYDROLOGIC CONDITION

Flow Regime

- ☒ Noticeable surface flow present (4)
- ☐ Continual pool of water but lacking noticeable flow (3)
- ☐ Isolated pools and interstitial (subsurface) flow (2)
- ☐ Isolated pools and no evidence of surface or interstitial flow (1)
- ☐ Dry channel and no observable pools or interstitial flow (0)

Score: 4

Channel Flow Status

- ☒ Water covering greater than 75% of the channel bottom width; less than 25% of channel substrate is exposed (4)
- ☐ Water covering 50–75% of the channel bottom width; 25–50% of channel substrate is exposed (3)
- ☐ Water covering 25–50% of the channel bottom width; 50–75% of channel substrate is exposed (2)
- ☐ Water present but covering less than 25% of the channel bottom width; greater than 75% of channel substrate is exposed (1)
- ☐ No water present in the channel; 100% of channel substrate exposed (0)

Score: 4

TXRAM STREAM FINAL SCORING SHEET

Project/Site Name/No.: Waketon Road Project Type: ☒ Fill/Impact (☒ Linear ☐ Non-linear) ☐ Mitigation/Conservation

Stream ID/Name: IS-1.1 SAR No.: 1.2 Size (LF): 134 Date: 3/27/2020 Evaluator(s): J. Jordan

Stream Type: Intermittent Ecoregion: Cross Timbers Delineation Performed: ☐ Previously ☒ Currently

8-Digit HUC: 12030103 Watershed Condition (developed, pasture, etc.): Developed Watershed Size: ~2000 sq. mi.

Aerial Photo Date and Source: February 2020, Nearmap Site Photos: See photosheet. Representative: ☐ Yes ☒ No

Stressor(s): Significant impervious surface in surrounding areas. Are normal climatic/hydrologic conditions present? ☒ Yes ☐ No (If no, explain in Notes)

Notes: _____

Stream Characteristics

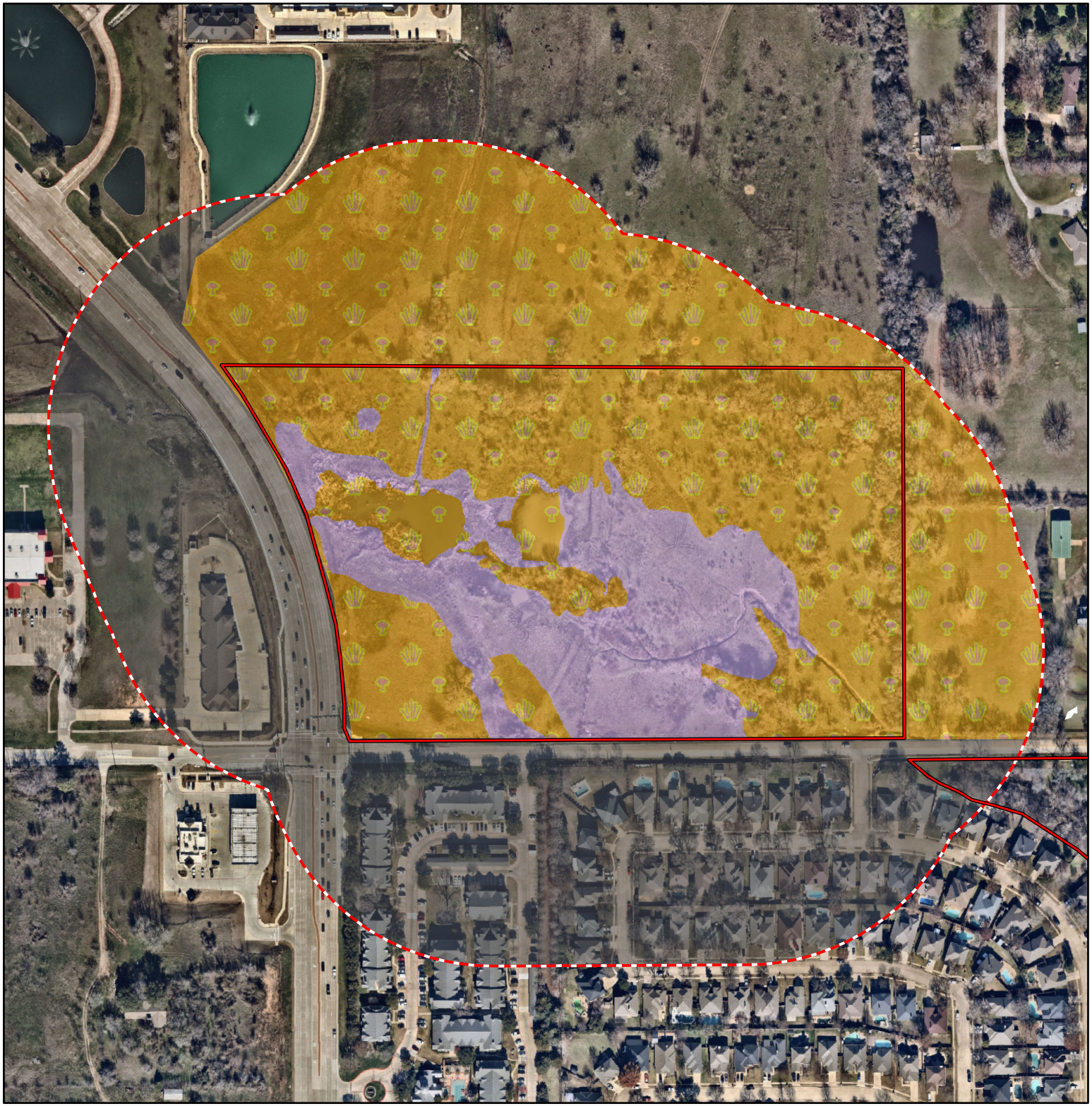
Stream Width (Feet)		*Stream Height/Depth (Feet)*	
Avg. Bank to Bank:	25	Avg. Banks:	6
Avg. Waters Edge:	18	Avg. Water:	3
Avg. OHWM:	20	Avg. OHWM:	4

Scoring Table

Core Element	***Metric***	***Metric Score***	***Core Element Score Calculation***	***Core Element Score***
Channel condition	Floodplain connectivity	3	Sum of metric scores / 15 x 25	13.3
	Bank condition	1		
	Sediment deposition	4		
Riparian buffer condition	Riparian buffer (left bank)	5	Sum of bank scores / 10 x 25	20
	Riparian buffer (right bank)	3		
In-stream condition	Substrate composition	4	Sum of metric scores / 10 x 25	17.5
	In-stream habitat	3		
Hydrologic condition	Flow regime	4	Sum of metric scores / 8 x 25	25
	Channel flow status	4		
			Sum of core element scores = overall TXRAM stream score	75.8
Additional points for limited habitats = overall TXRAM stream score x 0.025 for each bank (right/left) if: L R ☒ ☐ Dominated by native trees greater than 24-inch diameter at breast height ☒ ☐ Dominated by hard mast (i.e., acorns and nuts) producing native species in the tree strata				1.9
			Sum of overall TXRAM stream score and additional points = **total overall TXRAM stream score**	76.1

Representative Site Photograph:

Representative photo of IS-1.1 (SAR 1.2).



N

0 150 300 600

Feet

Legend

- Buffer (500 ft)
- Study Area
- Emergent Wetland Limits (EW-1, EW-2)

Landscape Buffer Type

- Grassland Pasture (Native/Non-Native)
- Urban

Notes:
1. Service Layer Credits: Nearmap, 2024.
2.
3.
4.

Waketon Road Drainage Improvements Project
Project Number: SWF-2019-0038
Date: 02/2024 AVO: 35351
TXRAM Wetland Buffer Assesment: WAA-1 (EW-1, EW-2)
Figure WAA-1

halff

TXRAM WETLAND DATA SHEET

Project/Site Name/No.: Waketon Road Project Type: ☒ Fill/Impact (☒ Linear ☐ Non-linear) ☐ Mitigation/Conservation

Wetland ID/Name: EW-1, EW-2 WAA No.: 1 Size: 8.4 acres Date: 2/15/2023 Evaluator(s): M. Harpe

Wetland Type: Riverine Ecoregion: Cross Timbers Delineation Performed: ☒ Previously ☐ Currently

Aerial Photo Date and Source: January 2024, NearMap Site Photos: 3/26/2020 Representative: ☒ Yes ☐ No

Notes:

LANDSCAPE

Connectivity – Confirm in office review. See figures in section 2.3.1.1 for examples.

Notes on any barriers or alterations that prevent connectivity: Urban Development

Aquatic resources within 1,000 feet of WAA to which wetland connects (including number for other considerations): 12 **Score:** 4

Buffer – Evaluate to 500 feet from WAA boundary. Confirm in office review. See figures in section 2.3.1.2 for examples.

Buffer Type/Description	*Score (See Narratives)*	*Percentage*	*Subtotal*
1. Grassland Pasture	2	54.5	1.09
2. Urban	0	45.5	0
3.			
4.			
5.			

Score: 1.09

HYDROLOGY

Water Source – Degree of natural or unnatural/artificial influence. Confirm in office review for watershed.

Natural: ☐ Precipitation ☐ Groundwater ☐ Overbank flow/stream discharge ☒ Overland flow ☒ Beaver activity ☐ Other: _____

Unnatural/Manipulated: ☒ Impoundment ☐ Outfall ☐ Irrigation/pumping ☒ Other artificial influence or control: Culvert, roadside ditch

Watershed: ☐ Development ☐ Irrigated agriculture ☐ Wastewater treatment plant ☐ Impoundment ☐ Other: _____

Degree of artificial influence/control: ☐ Complete ☒ High ☐ Low ☐ None

Wetland created/restored/enhanced: ☐ Sustainable/replicates natural ☐ Controlled **Score:** 3

Hydroperiod – Variability and recent alteration of the duration, frequency, and magnitude of inundation/saturation.

Evaluate the hydroperiod including natural variation: Wet prairie for most of the year.

Direct evidence of alteration: Natural: ☐ Log-jam ☐ Channel migration ☒ Other: Beaver activity

Human: ☐ Diversions ☒ Ditches ☐ Levees ☒ Impoundments ☐ Other: _____

Riverine only: ☐ Recent channel in-stability/dis-equilibrium (☐ Degradation or ☐ Aggradation)

Indirect evidence of alteration: ☐ Wetland plant stress: _____ ☐ Plant morphology: _____

☐ Upland species encroachment: _____ ☐ Plant Community: _____ ☐ Soil: _____

Change/Alteration of hydroperiod: ☐ None ☐ Due to natural events ☐ Human influences (☐ Slight or ☐ High)

Degree hydroperiod of wetland created/restored/enhanced replicates natural patterns: _____

Lacustrine fringe on human impoundment: ☐ High variability ☐ Low variability ☐ Recent changes to hydroperiod **Score:** 4

Hydrologic Flow – Movement of water to or from surrounding area and openness to water moving through the WAA.

Flow: ☒ Inlets: 1 ☐ Outlets: _____ ☒ Signs of water movement to or from WAA: Impoundments

Restrictions: ☐ Levee ☐ Berm/dam ☐ Diversion ☒ Other: Beaver acitivity

High flowthrough: ☐ Floodplain ☐ Drift deposits ☐ Drainage patterns ☐ Sediment deposits ☐ Other: _____

Low flowthrough: ☐ High landscape position ☐ Stagnant water ☐ Closed contours ☐ Other: _____ **Score:** 2

SOILS

Organic Matter – Use data and indicators from wetland determination data form(s) based on applicable regional supplement.

☐ High (organic soil or indicator A1, A2, A3)

☐ Moderate (indicator A9, S1, F1 in AW or A9, S1, S2, F1 in GP or A6, A7, A9, S7, F13 in AGCP)

☐ Low (indicated by thin organic or organic-mineral layer) ☒ None observable in surface layer as described herein **Score:** 1

Sedimentation – Deposition of excess sediment due to human actions. Confirm in office review for landscape.

Landscape with stress that could lead to excess sedimentation? ☐ Yes ☒ No Landscape position: ☐ High ☒ Low

Magnitude of recent runoff/flooding events: ☐ High ☒ Low Percent of WAA with excess sediment deposition: 0

☐ Sand deposits: _____% of area, _____ average thickness ☐ Silt/Clay deposits: _____% of area, _____ average thickness

Lacustrine fringe only: ☐ Upper end of impoundment ☐ Degrades wetland ☐ Contributes to wetland processes **Score:** 4

Soil Modification – Physical changes by human activities. Confirm in office review for past.

Type (Check those applicable and circle R for recent or P for past): ☒ Farming (R)/P ☐ Logging R/P ☐ Mining R/P ☐ Filling R/P

☐ Grading R/P ☐ Dredging R/P ☐ Off-road vehicles R/P ☐ Other R/P: _____

Percent of WAA with recent soil modification: _____% Degree of modification: ☐ High ☐ Low

Indicators of past modification: ☐ High bulk density ☐ Low organic matter ☐ Lack of soil structure ☐ Lack of horizons ☐ Hardpan

☐ Dramatic change in texture/color ☐ Heterogeneous mixture ☐ Other: _____

Indicators of recovery: ☐ Organic matter ☐ Structure ☐ Horizons ☐ Mottling ☐ Hydric soil ☐ Other: _____

Percent of WAA with past modification: 15 % Recovery: ☐ Complete ☒ High ☐ Moderate ☐ Low ☐ None **Score:** 3

PHYSICAL STRUCTURE

Topographic Complexity – See figures in section 2.3.4.1. Record % micro-topography and % WAA for each elevation gradient.

Elevation gradients (EG): 2 Evidence: ☒ Plant assemblages ☒ Level of saturation/inundation ☐ Path of water flow ☐ Slope

Micro-topography: 25 % of WAA (By EG: _____)

Types: ☒ Depressions ☐ Pools ☐ Burrows ☐ Swales ☐ Wind-thrown tree holes ☐ Mounds ☐ Gilgai ☐ Islands

☐ Variable shorelines ☐ Partially buried debris ☐ Debris jams ☐ Plant hummocks/roots ☐ Other:_____ **Score:** 3

Edge Complexity – Confirm in office review. See figure in section 2.3.4.2 to evaluate wetland-to-upland boundary.

Variability: ☐ High ☐ Moderate ☐ Low ☐ None Edge (feet) to Area (square feet) ratio: 0.02 **Score:** 3

Physical Habitat Richness – See definitions and table in section 2.3.4.3 for habitat types applicable to each wetland type.

Label of habitat types qualifying as present in WAA: Thick herbaceous cover, submerged vegetation, vegetated island, un-vegetated pools, secondary channel Total: 5 **Score:** 2

BIOTIC STRUCTURE

Plant Strata – Use applicable wetland delineation regional supplement and data from determination data form(s).

Number of plant strata: ☐ ≥ 4 ☐ 3 ☒ 2 ☐ 1 ☐ 0 **Score:** 2

Species Richness – Use data from determination data form(s) to count species with 5% or more relative cover in a stratum.

Number of species across all strata and determination data forms (not counting a species more than once): 9 **Score:** 4

Non-Native/Invasive Infestation – Use data from determination data form(s). See tables in section 2.3.5.3 for examples.

Average total relative cover of non-native/invasive species across all strata and determination data forms: 27 % **Score:** 1

Interspersion – Confirm in office review. Use figure in section 2.3.5.4 to determine the degree of interspersion of plant zones.

Degree of horizontal/plan view interspersion: ☐ High ☒ Moderate ☐ Low ☐ None **Score:** 3

Strata Overlap – Use strata defined in plant strata metric using applicable regional supplement. See figures in section 2.3.5.5.

High overlap (≥ 3 strata overlapping): _____% of WAA Moderate overlap (2 strata overlapping): _____% of WAA

Herbaceous species/dense litter overlap (only in portion where there are no other strata overlapping): 24 % of WAA

Total percentage of WAA with some form of overlap (if more than one present): _____% of WAA **Score:** 1

Herbaceous Cover – Estimate for entire WAA.

Total cover of emergent and submergent plants: ☒ > 75% ☐ 51–75% ☐ 26–50% ☐ ≤ 25% **Score:** 4

Vegetation Alterations – Unnatural (human-caused) stressors. Confirm in office review for past.

Type (Check those applicable and circle R for recent or P for past): ☐ Disking R/P ☐ Mowing/shredding R/P ☐ Logging R/P

☐ Cutting R/P ☒ Trampling R(P) ☐ Herbicide treatment R/P ☐ Herbivory R/P ☐ Disease R/P ☐ Chemical spill R/P

☐ Pollution R/P ☐ Feral hog rooting R/P ☐ Woody debris removal R/P ☐ Other R/P: _____

Percent of WAA with recent vegetation alteration: 5 % Severity of alteration: ☐ High ☒ Low

Percent of WAA with past vegetation alteration: _____% Degree of recovery: ☐ Complete ☐ High ☐ Moderate ☐ Low

☐ Alteration to improve wetland (degree of natural community recovery):_____ **Score:** 3

TXRAM WETLAND FINAL SCORING SHEET

Project/Site Name/No.: Waketon Road Project Type: ☒ Fill/Impact (☒ Linear ☐ Non-linear) ☐ Mitigation/Conservation

Wetland ID/Name: EW-1, EW-2 WAA No.: 1 Size: 8.4 acres Date: 2/15/2024 Evaluator(s): M. Harpe

Wetland Type: Riverine Ecoregion: Cross Timbers Delineation Performed: ☒ Previously ☐ Currently

Aerial Photo Date and Source: January 2024, NearMap Site Photos: 3/26/2020 Representative: ☒ Yes ☐ No

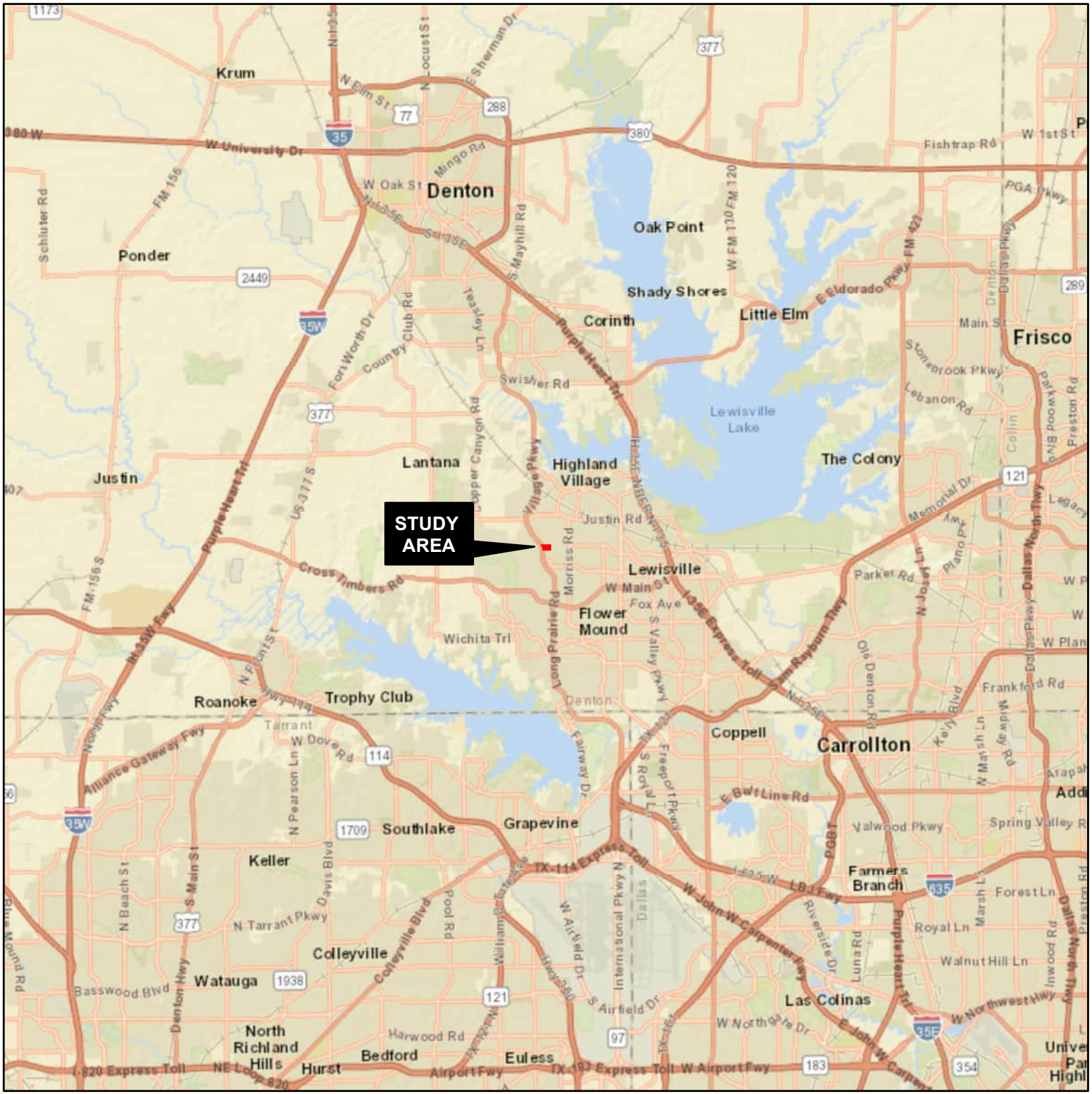
Notes: _____

Core Element	*Metric*	*Metric Score*	*Core Element Score Calculation*	*Core Element Score*
Landscape	Connectivity	4	Sum of metric scores / 8 x 20	12.7
	Buffer	1.09		
Hydrology	Water source	3	Sum of metric scores / 12 x 20	15
	Hydroperiod	4		
	Hydrologic flow	2		
Soils	Organic matter	1	Sum of metric scores / 12 x 20	13.3
	Sedimentation	4		
	Soil modification	3		
Physical Structure	Topographic complexity	3	Sum of metric scores / 12 x 20	13.3
	Edge complexity	3		
	Physical habitat richness	2		
Biotic Structure	Plant strata	2	Sum of metric scores / 28 x 20	12.9
	Species richness	4		
	Non-native/invasive infestation	1		
	Interspersion	3		
	Strata overlap	1		
	Herbaceous cover	4		
	Vegetation alterations	3		

Sum of core element scores = overall TXRAM wetland score	67.2
Additional points for unique resources = overall TXRAM wetland score x 0.10 if: ☐ Area of Caddo Lake designated a "Wetland of International Importance" under the Ramsar Convention ☐ Bald cypress – water tupelo swamp ☐ Pitcher plant bog ☐ Spring	
Additional points for limited habitats = overall TXRAM wetland score x 0.05 if: ☐ Dominated by native trees greater than 24-inch diameter at breast height ☐ Dominated by hard mast (i.e., acorns and nuts) producing native species in the tree strata	
Sum of overall TXRAM wetland score and additional points = **total overall TXRAM wetland score**	

Representative Site Photograph:

View among the transition of the wetland complex (EW-1) to an open water (OW-3) feature within the complex. View facing southeast of the DP-4 location.



0 2 4 8

SCALE IN MILES

Legend

STUDY AREA

Notes:

1. Service Layer Credits: 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

WAKETON ROAD DRAINAGE IMPROVEMENTS PROJECT

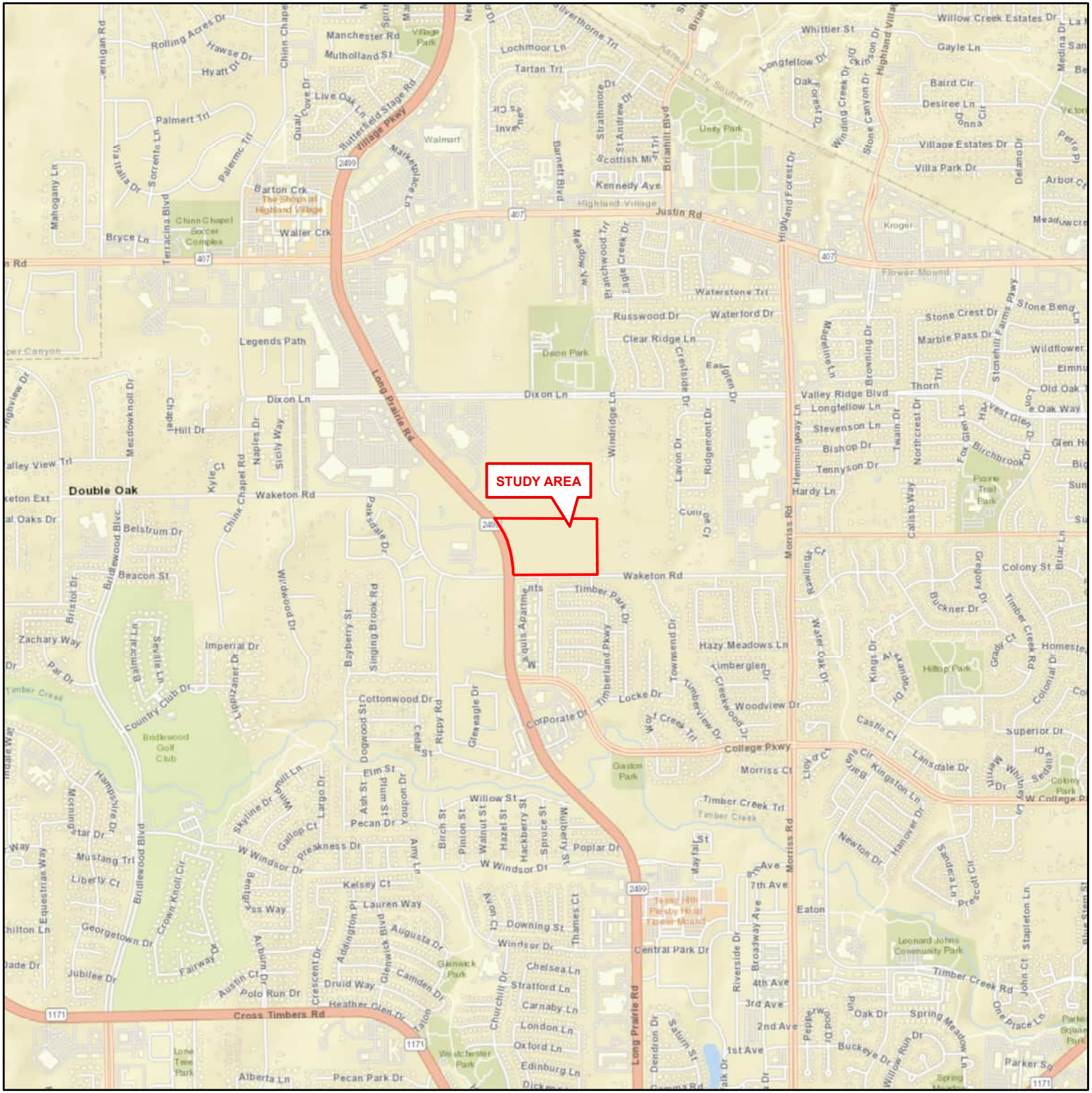
PROJECT NO: SWF-2019-0038

DATE: 06/2022 AVO: 35351

LOCATION MAP

SHEET 1 OF 8

HALFF



N

0 1,000 2,000 4,000

ld SCALE IN FEET

Legend

STUDY AREA

Notes:
1. Service Layer Credits: 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

WAKETON ROAD DRAINAGE IMPROVEMENTS PROJECT
PROJECT NO: SWF-2019-0038
DATE: 06/2022 AVO: 35351
VICINITY MAP
SHEET 2 OF 8

HALFF

N

0 150 300 600

SCALE IN FEET

LEGEND

- STUDY AREA
- SHEET 4 AND 5 VIEW EXTENTS
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR

NOTES:
1. Service Layer Credits: NearMap, 2022
2.
3.
4.
5.

EAST WAKETON ROAD
DRAINAGE IMPROVEMENTS PROJECT

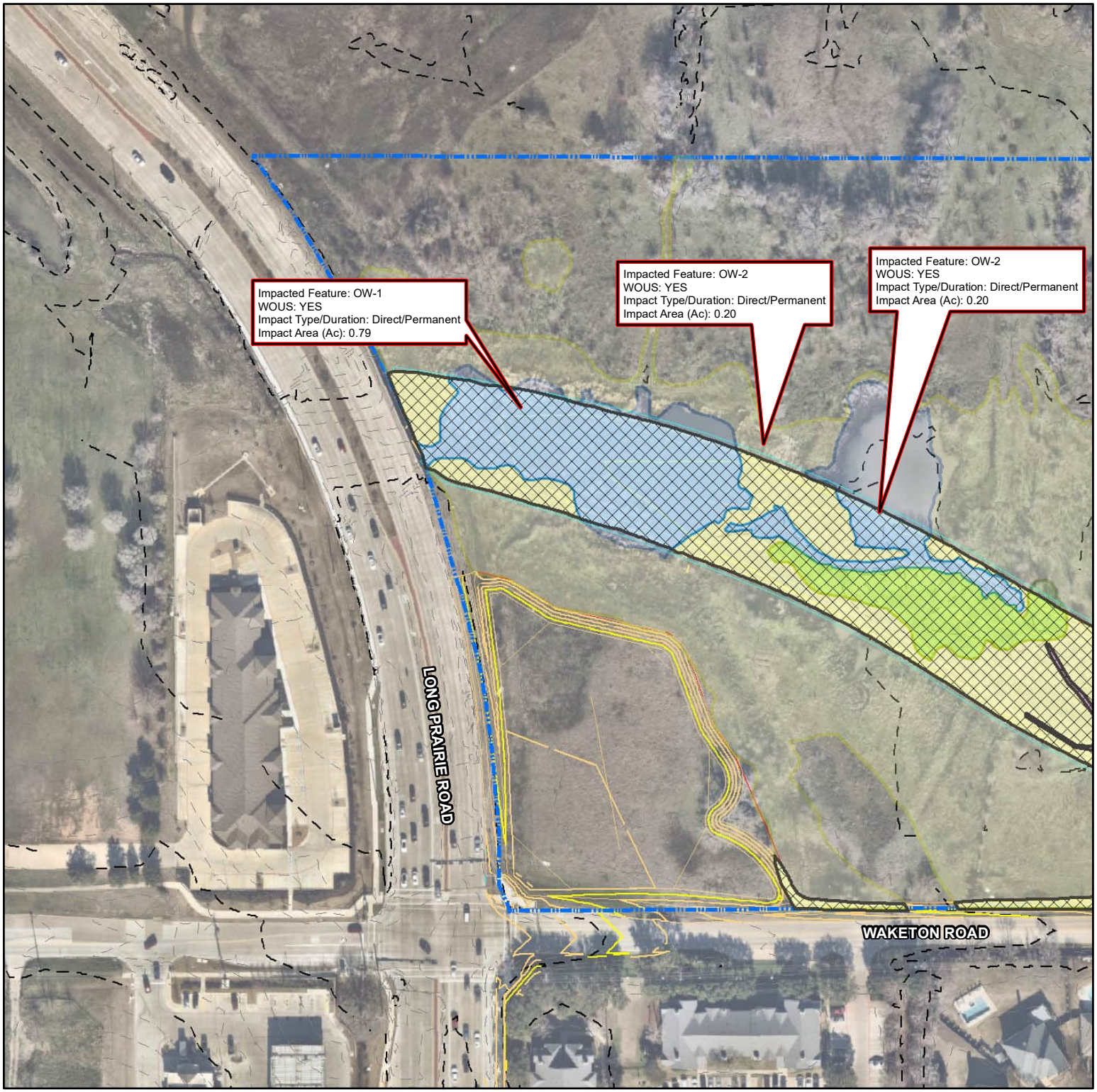
Project Number: #SWF-2019-00038

Date: 06/2022 AVO: 35351

PROJECT IMPACTS KEY MAP

SHEET 3 OF 8

HALFF



N

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SCALE IN FEET

LEGEND

- STUDY AREA
- DRAINAGE DITCH
- EMERGENT WETLAND
- FORESTED WETLAND
- OPEN WATER
- INTERMITTENT STREAM
- IMPACTS TO AQUATIC FEATURES
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR

Design Data

- REINFORCED CONCRETE BOX CULVERT
- ROCK RIPRAP
- EXISTING REINFORCED CONCRETE BOX CULVERT
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR

NOTES:
1. Service Layer Credits: NearMap, 2024

EAST WAKETON ROAD
DRAINAGE IMPROVEMENTS PROJECT

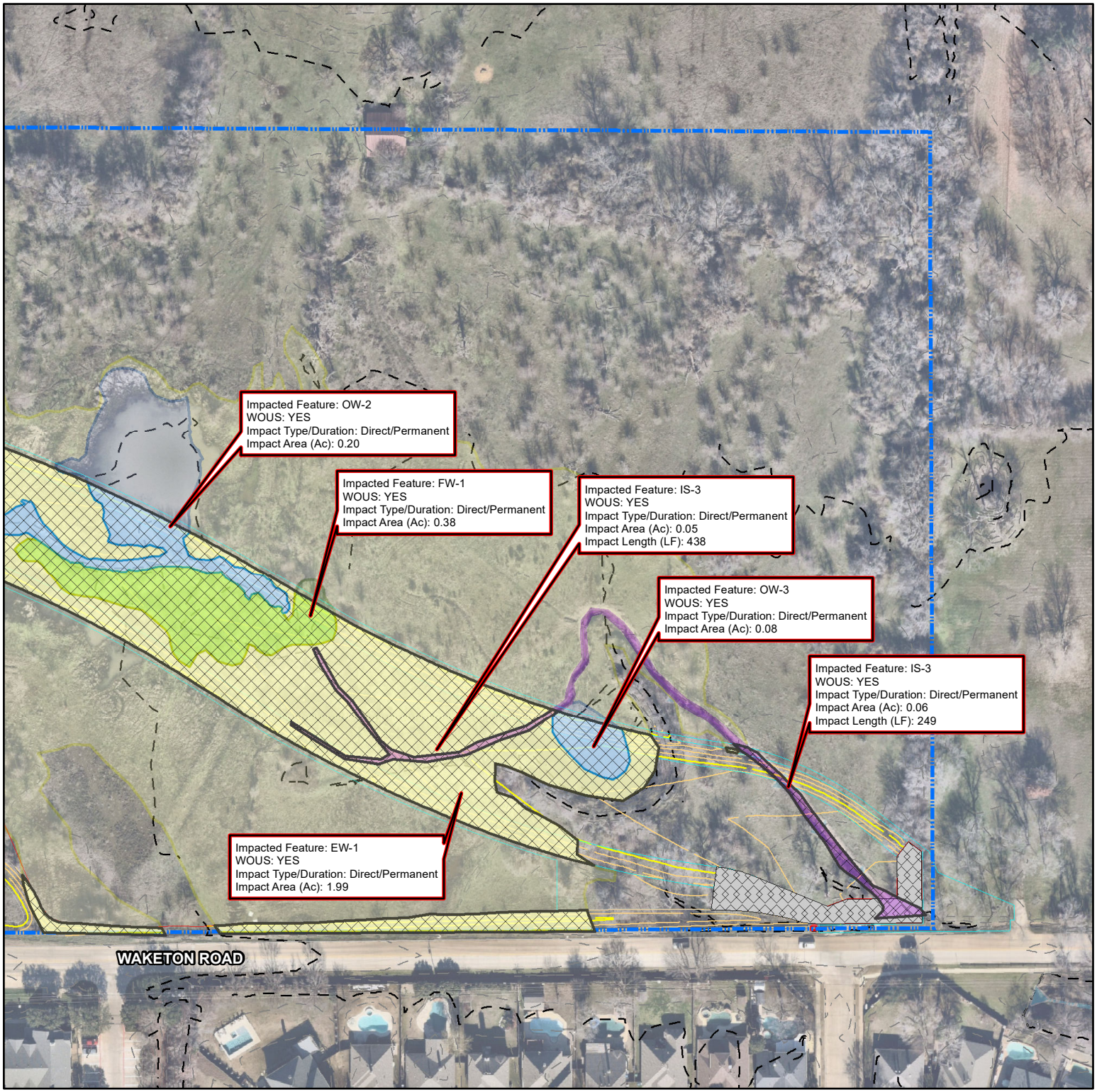
Project Number: #SWF-2019-00038

Date: 03/2024 AVO: 35351

PROJECT IMPACT MAP

SHEET 4 OF 8

HALFF



N

0 60 120 240

SCALE IN FEET

LEGEND

- STUDY AREA
- DRAINAGE DITCH
- EMERGENT WETLAND
- FORESTED WETLAND
- OPEN WATER
- INTERMITTENT STREAM
- IMPACTS TO AQUATIC FEATURES
- EXISTING MAJOR CONTOUR
- EXISTING MINOR CONTOUR

Design Data

- ROCK RIPRAP
- PROPOSED MAJOR CONTOUR
- PROPOSED MINOR CONTOUR

NOTES:
1. Service Layer Credits: NearMap, 2024

EAST WAKETON ROAD
DRAINAGE IMPROVEMENTS PROJECT

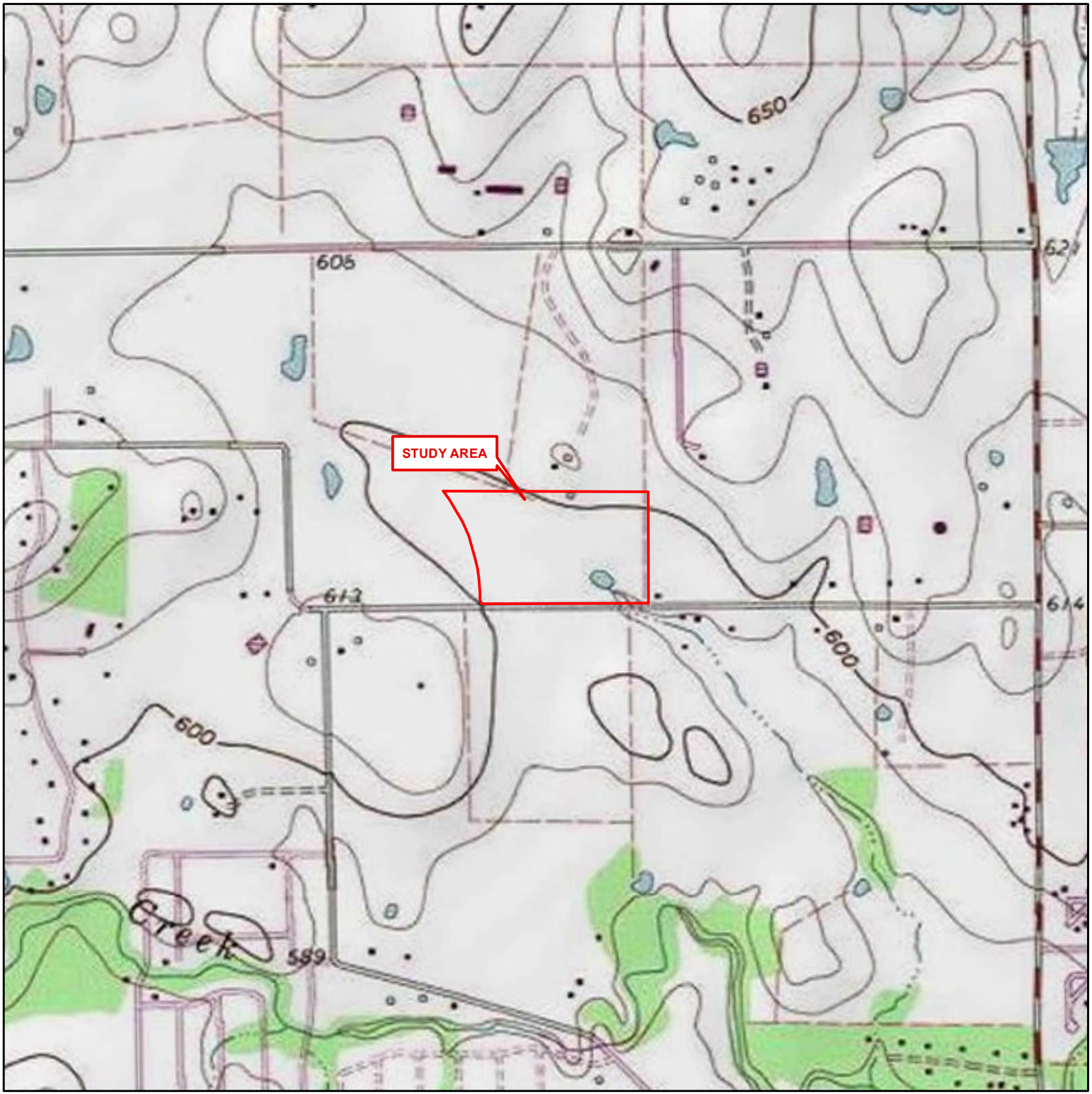
Project Number: #SWF-2019-00038

Date: 03/2024 AVO: 35351

PROJECT IMPACT MAP

SHEET 5 OF 8

HALFF



N

0 500 1,000 2,000

SCALE IN FEET

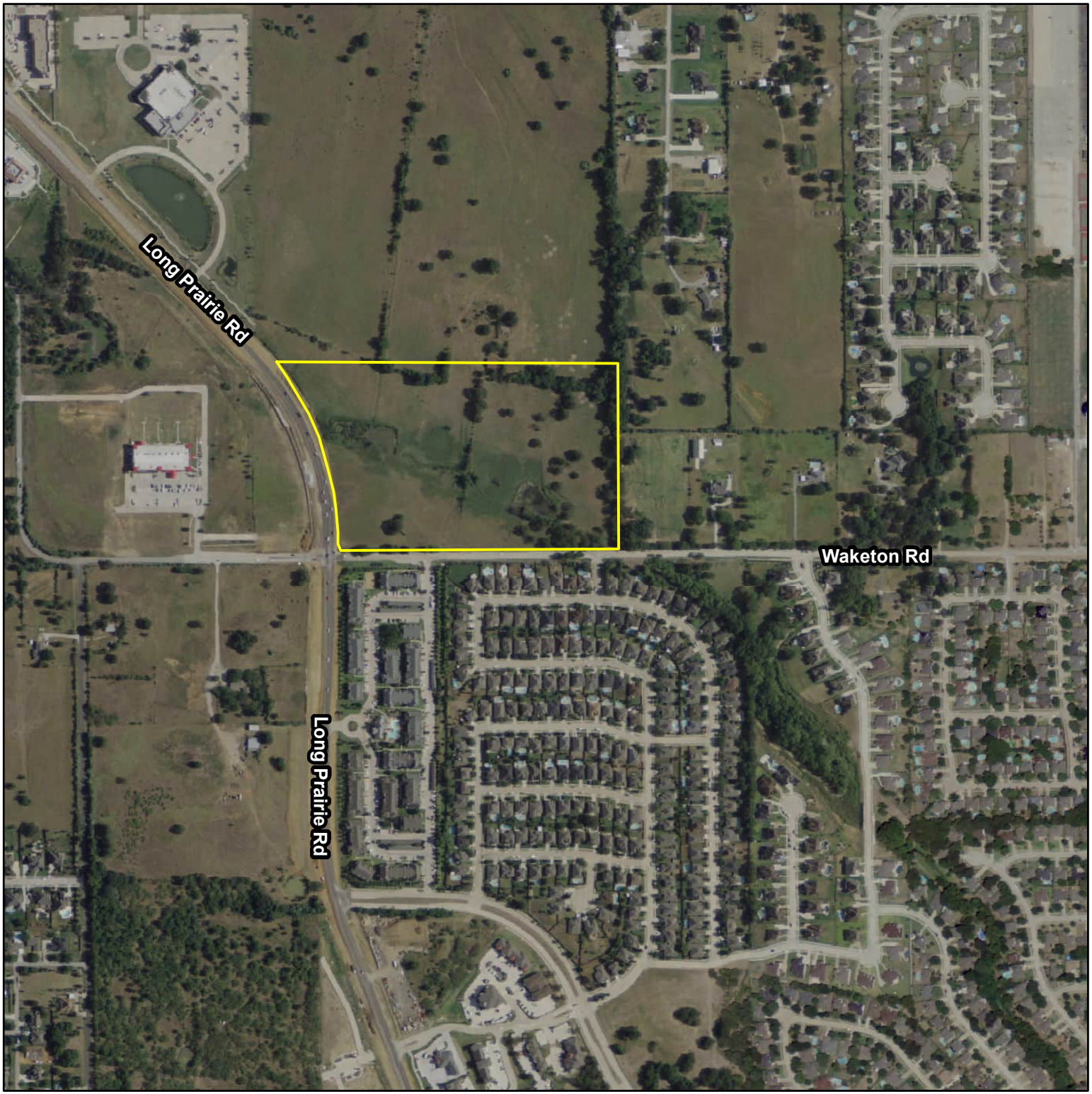
Legend

STUDY AREA

Notes:
1. Service Layer Credits: Copyright:© 2013 National Geographic Society, i-cubed
2.
3.
4.

WAKETON ROAD DRAINAGE IMPROVEMENTS PROJECT
PROJECT NO: SWF-2019-0038
DATE: 06/2022 AVO: 35351
USGS TOPOGRAPHIC MAP
SHEET 6 OF 8

HALFF



N

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SCALE IN FEET

Legend

STUDY AREA

Notes:
1. Service Layer Credits: USDA, 2008.
2.
3.
4.
5.

WAKETON ROAD DRAINAGE IMPROVEMENTS PROJECT
PROJECT NO: SWF-2019-0038
DATE: 03/2020 AVO: 35351
2008 AERIAL IMAGERY
SHEET 7 OF 8

HALFF

N

0 300 600 1,200

SCALE IN FEET

Legend

STUDY AREA

Notes:
1. Service Layer Credits: NearMap, 2020.
2. Aerial imagery collected on March 6, 2019
3.
4.

WAKETON ROAD DRAINAGE IMPROVEMENTS PROJECT
PROJECT NO: SWF-2019-0038
DATE: 03/2020 AVO: 35351
2019 AERIAL IMAGERY
SHEET 8 OF 8

HALFF