CANDIDATE CONSERVATION AGREEMENT WITH ASSURANCES FOR SIX SPECIES IN THE TRINITY RIVER BASIN

Texas Heelsplitter

Trinity Pigtoe

Texas Fawnsfoot

Louisiana Pigtoe

Western Chicken Turtle

Alligator Snapping Turtle

Developed cooperatively by the U.S. Fish and Wildlife Service – Southwest Region, Trinity River Authority, and partners included under Certificates of Inclusion:

North Texas Municipal Water District, Tarrant Regional Water District, City of Dallas, and City of Fort Worth

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Western Chicken Turtle
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Alligator Snapping Turtle
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Contents

List of Tables and Figures

TABLES

FIGURES

List of Acronyms

Acronym	Meaning
BMPs	Best Management Practices
CCAA	Candidate Conservation Agreement with Assurances
CI(s)	Certificate of Inclusion
Compact	Upper Trinity River Water Quality Compact
CPA(s)	Conservation Priority Areas
DFW	Dallas and Fort Worth Metropolitan Area
EPA	Environmental Protection Agency
ESA	Endangered Species Act
NTMWD	North Texas Municipal Water District
NRCS	Natural Resource Conservation Service
TCEQ	Texas Commission on Environmental Quality
TPDES	Texas Pollutant Discharge Elimination System
TPWD	Texas Parks and Wildlife Department
TRA	Trinity River Authority of Texas
TRWD	Tarrant Regional Water District
TWDB	Texas Water Development Board
USACE	US Army Corps of Engineers
USFWS	US Fish and Wildlife Service
USGS	US Geological Survey
WAM	Water Availability Model
WLA	Waste Load Allocation

Glossary of Terms

Term	Definition
Adaptive Management	The process of monitoring the implementation of Conservation Measures, then adjusting future Conservation Measures according to lessons learned and new information.
Applicant (and Permit Holder)	Trinity River Authority of Texas (TRA)
Avoidance and Minimization Measures	Measures that reduce the amount of (or completely avoids) incidental take of a Covered Species.
Candidate Conservation Agreement with Assurances	A voluntary agreement that provides regulatory assurances for non-federal landowners to conserve candidate species and other unlisted species likely to become candidates in the future.
Candidate Conservation Programs	Programs that bridge non-regulatory and regulatory approaches to species conservation.
Changed Circumstances	Defined by regulations at 50 CFR §17.3 as "changes in circumstances affecting a species or geographic area covered by a conservation plan or agreement that can reasonably be anticipated by plan or agreement developers and the USFWS and that can be planned for (e.g., the listing of new species, or a fire or other natural catastrophic event in areas prone to such events)."
Compact	Upper Trinity River Water Quality Compact - Association of the major wastewater dischargers in the Dallas and Fort Worth metro area.
Conservation Activities	Covered Parties' operations that include water quality monitoring, biological monitoring, riparian and instream data collection, and other activities, designed to monitor the health of the ecosystem.
Conservation Measures	Activities that collectively are designed to provide a net conservation benefit to the Covered Species.
Conservation Priority Areas	Portions of the Conservation Zones that are currently occupied by the Covered Species and/or contain suitable habitat, and where restoration and reintroduction efforts will be focused over the life of the CCAA.

Term	Definition
Conservation Strategy	The voluntary Conservation Measures and Avoidance and Minimization Measures described in this CCAA.
Conservation Zones	Areas within the basin delineated based on Covered Species of mussels occupancy, watershed characteristics, geography, and recovery potential.
Covered Area	The geographic area where the Covered Parties will implement this CCAA and where incidental take may be authorized when performing Covered Activities.
Covered Activities	An activity, when performed in accordance with this CCAA, that may result in authorized incidental take of the Covered Species.
Covered Parties	The entities covered by this CCAA by either signature or Certificate of Inclusion (CI). (*Signatory* – Trinity River Authority, *CIs* – City of Dallas, City of Fort Worth, North Texas Municipal Water District, and Tarrant Regional Water District).
Covered Species	Collectively, the set of six species whose conservation is the focus of this CCAA.
Gate Operation Procedures	Engineering documents describing reservoir gate operation procedures that operators are required to follow to ensure public safety.
Incidental Take Permit	This is a specific permit issued by the USFWS under Section 10(a) of the ESA to private parties that are conducting otherwise lawful activities, but not for the purpose of take, that might result in the taking of listed endangered or threatened species.
Permit	Section 10(a)(1)(A) Enhancement of Survival Permit
Permit Holder (and Applicant)	Trinity River Authority of Texas (TRA)
Suitable Habitat	Areas that have the elements of habitat required by a Covered Species.
Unforeseen Circumstances	Defined by regulations at 50 CFR §17.3 as "changes in circumstances affecting a species or geographic area covered by a conservation plan or agreement that could not reasonably have been anticipated by plan or agreement developers and the USFWS at the time of the conservation plan's or agreement's negotiation and development, and that result in a substantial and adverse change in the status of the Covered Species."
Zone	Conservation Zone

1 Introduction

1.1 Candidate Conservation Agreements with Assurances

This Candidate Conservation Agreement with Assurances (CCAA, agreement) for Six Species in the Trinity Basin is a voluntary conservation agreement between the U.S. Fish and Wildlife Service (USFWS) and the Trinity River Authority of Texas (TRA). Both the Upper Trinity River Water Quality Compact[1] (Compact) and the Tarrant Regional Water District (TRWD) have assisted in the development of this CCAA and intend to sign onto the agreement upon its completion. To develop a candidate conservation agreement with assurances, the USFWS works with its partners to identify threats to at-risk or candidate species (i.e., candidates for potential listing under the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C 1531 et seq.)) and designs Conservation Measures needed to address the threats, identifies landowners willing to implement those measures through conservation agreements and monitors the effectiveness of those measures utilizing Adaptive Management. In return, participating landowners who voluntarily sign a CCAA under a Certificate of Inclusion (CI) are given assurances that should a species covered by the agreement become listed under the ESA in the future, no additional conservation will be required beyond what is outlined in the agreement for Covered Activities that may result in take[2] of the listed species so long as the applicant is fulfilling the terms of the agreement. The goal of the agreement is to provide a net conservation benefit for candidate and at-risk species. In some cases, the conservation benefit may be sufficient to preclude the need for a species to become listed under the ESA in the future. If any of the 6 species (collectively Covered Species) within this CCAA do become listed, parties who have already entered into this CCAA with the USFWS can be covered under an issued Section 10(a)(1)(A) Enhancement of Survival Permit (Permit) and will not be required to implement additional Conservation Measures beyond those outlined in this CCAA. It is this regulatory certainty that appeals to many conservation partners and is one of the primary incentives for parties to enter into a CCAA. Once an agreement is in place, and if a Covered Species becomes listed, parties to the agreement are covered for incidental take if they comply with the terms of the CCAA, and operations may proceed as long as the terms of the CCAA continue to be met.

The Covered Species for this CCAA include four species of freshwater mussels, 1) Texas Fawnsfoot (*Truncilla macrodon*), 2) Texas Heelsplitter (*Potamilus amphichaenus*), 3) Trinity Pigtoe (*Fusconaia chunii*), and 4) Louisiana Pigtoe (*Pleurobema riddellii*); and two species of turtles, 1) Alligator Snapping Turtle (*Macrochelys temminckii*) and 2) Western Chicken Turtle (*Deirochelys reticularia miaria*). While the Conservation Measures outlined in this document are

[1] Members include Trinity River Authority, North Texas Municipal Water District, and the Cities of Dallas and Fort Worth.

[2] The term "take" as defined in Section 3 of the ESA means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.

designed to benefit these six species specifically, they should benefit a variety of aquatic species, including amphibians, fish, and macroinvertebrates.

1.2 Covered Parties and Certificates of Inclusion

The Upper Trinity River Water Quality Compact (Compact), a partnership consisting of North Texas Municipal Water District (NTMWD), TRA, City of Dallas, and the City of Fort Worth was formally organized in 1975 to facilitate cooperation among the large wastewater treatment plant (WWTP) operators in the basin in regulatory and planning matters; a collaborative partnership that continues today. The Compact has a long history of cooperation on water quality projects, such as the adoption of stream standards, nutrient modeling, instream water quality monitoring, ongoing funding of United States Geological Survey (USGS) gages, and emerging contaminant studies. One outcome of this collaboration is the Waste Load Allocation (WLA) study, the first of which was adopted in 1974. The WLA, described in detail in Section 6.2.1.1, is a modeling project that determines the Trinity River's assimilative capacity for constituents (i.e., the river's ability to absorb nutrient or biochemical oxygen demand loading without exceeding water quality standards), sets discharge limits, and then allocates that load out among the Compact members. These loadings are then codified in Texas Pollutant Discharge Elimination System (TPDES) permit limits issued to Compact members by the Texas Commission on Environmental Quality (TCEQ) with overview by the Environmental Protection Agency (EPA).

The Compact recently funded a freshwater mussel survey along the mainstem and Elm Fork Trinity River, specifically targeting two East Texas mussels, Texas Heelsplitter and Louisiana Pigtoe, that are species of concern and are among the species included in this CCAA. This study was designed to fill spatial data gaps in freshwater mussel sampling and attempt to better understand the population stressors in the Trinity River Basin (water quality vs. habitat). The results and accompanying report were submitted to the USFWS Arlington Ecological Services Field Office in 2019. The study suggested that habitat and the downcutting of the Trinity River bed since at least 1939 has resulted in permanently degraded habitat in and immediately below the Dallas Fort Worth Metropolitan Area (DFW) and that poor habitat may be more detrimental to freshwater mussels than water quality, though further research is needed.

Though not a formal member of the Compact, TRWD is a regional raw water supplier for the western portions of the DFW and has a long history of partnerships with the entities that make up the Compact. If issued, TRA will hold the Permit, and each member of the Compact and TRWD will participate and be provided take coverage and regulatory assurances under a CI. Together, these entities are the Covered Parties[3]. Each of the Covered Parties commit to this agreement, with the specific exclusion of all wastewater-related aspects for TRWD since they

[3] The term Covered Parties is used throughout this document to maintain consistency. However, when the term Covered Parties is used in reference to wastewater treatment topics, the term only applies to the members of the Compact (as described in Section 1.2) and does not include TRWD as they are the only participant in this agreement with no wastewater operations.

do not conduct any wastewater operations. Should one or more of the Covered Parties decide to withdraw from this CCAA, the term "Covered Parties" will automatically be amended to mean the parties continuing to abide by the CCAA.

1.3 Benefits of this Agreement

This agreement is designed to provide a net conservation benefit to the Covered Species. The Conservation Measures (Section 8) are specifically designed to reduce threats and increase the viability of these species while ongoing and future water supply development and wastewater treatment activities continue as needed to meet the demands of an increasing human population within the Trinity River Basin over the 10-year term of this CCAA. Although this agreement is targeted to specific species, it is anticipated that the Conservation Measures implemented as part of this agreement will also improve conditions for other aquatic-dependent species.

1.4 Purpose of this Agreement

The purpose of this CCAA is to protect and enhance ecological diversity and function in the Trinity River Basin while allowing for existing operations and future growth of the Covered Parties' operations in accordance with applicable laws, which are required to support a fast-growing population. To this end, this CCAA describes the net conservation benefits provided to the Covered Species, thereby addressing the Section 10 (ESA) permitting requirements relevant to these species for activities conducted within the Covered Parties' operational areas.

This CCAA has been designed to meet the following objectives:

1. Provide comprehensive, species-specific conservation in the Trinity River Basin.
2. Provide an ongoing, adaptively managed program that will monitor the status of the Covered Species for the 10-year CCAA term, which will provide baseline status information and long-term population monitoring.
3. Enhance and restore riparian and instream habitat to the benefit of the Covered Species and all native aquatic life.
4. Provide education and outreach opportunities that are designed to educate future generations on how to protect and improve water quality and habitat availability resulting in long-term benefits for all native aquatic species.
5. Allow Covered Parties' operations to continue uninterrupted should a Covered Species become listed under the ESA in the future.
6. Provide a roadmap and structure for when permitting of Covered Parties' activities will fall under the coverage of the Section 10 Permit (CCAA) or need additional Section 7 consultation under the ESA.
7. Provide clear expectations and regulatory predictability for the Covered Parties' operations and conservation efforts related to the Covered Species and associated natural communities within the Covered Area (Section 5 of CCAA) by identifying relevant conservation requirements for Covered Activities.

An important goal of this CCAA is to provide a framework for ESA compliance for Covered Species that may be impacted by Covered Activities within the Covered Area. Whether a Covered Activity occurs under Section 7 or 10 of the ESA, this CCAA will provide the framework for future ESA compliance. Federal projects (i.e., projects that are funded, approved, regulated, or carried out by a federal agency), which are subject to Section 7 of the ESA, are evaluated under a different method than those of non-federal projects, which are subject to Section 10 of the ESA. Non-federal projects must obtain a permit for take of listed species through the consultation process while federal agencies must consult with USFWS or National Marine Fisheries Service whenever their actions have the potential to affect a listed species. For example, the definition of "affect" differs slightly from that of "take" and which term applies depends on the species, the biology, the project, and its potential effects. In addition, compliance under Section 7 does not provide No Surprises assurances, instead, re-initiation of consultation may be necessary per 50 CFR Section 402.16. This CCAA is not intended to alter the obligation of a federal agency to consult with USFWS pursuant to Section 7 of the ESA. USFWS will conduct ESA consultations for Covered Activities in accordance with the established regulatory process and deadlines (50 CFR Section 402.14). Section 7 consultations are conducted on federal actions with the potential to affect ESA candidate, threatened or endangered species. Therefore, the Covered Species that are either candidates or listed as threatened or endangered need to be included in the consultation. Unless otherwise required by law or regulation, USFWS will not impose measures on applicants for take coverage under this CCAA in excess of those that have been or will be required by the permits issued should one of these Covered Species be listed. Before completing a Section 7 consultation for a Covered Activity in which USFWS proposes to require a measure that exceeds the requirements of this CCAA or associated permits, USFWS will meet with the Covered Party with jurisdiction over the affected project to discuss alternatives to the imposition of the measure that would meet the applicable legal or regulatory requirements.

This CCAA strikes a balance between natural resource conservation and the Covered Parties' important water supply, wastewater treatment, flood control, and reservoir operations. It also reflects the Covered Parties' operations which has potential negative effects on the Covered Species while balancing the benefits that the Covered Parties' operations provide. Due to historic reservoir construction and the highly altered hydrology of the basin today, wastewater and water supply delivery operations provide water to a system that would otherwise be dry during low flows; however, these operations can also negatively impact the Covered Species. This regimented system, which is designed to capture and store rainfall for beneficial consumptive uses, affords some measurable control to the Covered Parties within the Covered Area such that the Covered Parties have some legislative authority, even though they do not have full regulatory control of the water system in the basin.

2 Authority

Sections 2, 7, and 10 of the ESA, along with the Fish and Wildlife Coordination Act, allow USFWS and TRA to enter into this agreement. This agreement is prepared in accordance with the USFWS's 1999 Candidate Conservation Agreement with Assurances Final Policy (64 FR 32726) and 2016 revisions to the Candidate Conservation Agreement with Assurances Policy (81 FR 95164), which became effective on March 21, 2017 (82 FR 8540).

TRA was created in 1955 with House Bill 20 during the 54th Texas Legislature as a conservation and reclamation district under Article XVI, Section 59 of the Texas Constitution. As such, TRA is authorized to effectuate flood control and the conservation and use for all beneficial purposes of storm and floodwaters and unappropriated flow waters in the Trinity watershed. Although regulatory and enforcement authorities are designated to other state agencies, TRA has a long history as a regional coordinator for wastewater, water supply, and conservation activities throughout the basin and is a logical and capable entity to hold the permit associated with this agreement and oversee its implementation.

3 Covered Species

Relevant details on the status, distribution, life history and habitat requirements, and a summary of the primary threats for the Covered Species are provided below as well as the occupied area for the Covered Species (Figure 1).

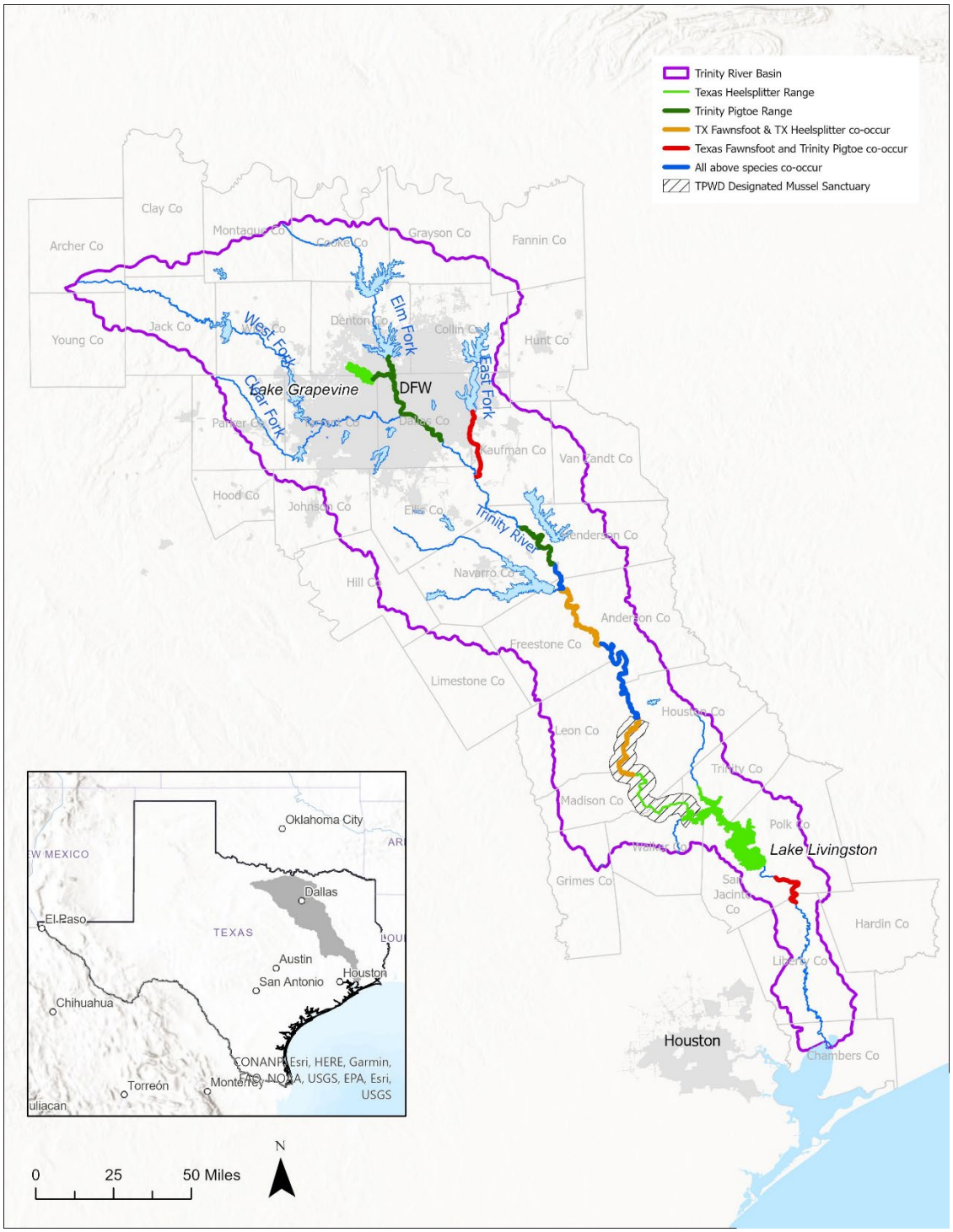


Figure 1. Areas in the Trinity River Basin currently occupied by the Trinity Pigtoe, Texas Heelsplitter, and Texas Fawnsfoot with a TPWD designated mussel sanctuary shown in the Middle Basin above Lake Livingston. Note: Currently, Louisiana Pigtoe is believed to be extirpated from the Trinity Basin; the Alligator Snapping Turtle and Western Chicken Turtle likely occur throughout the basin. Sources: Randklev et al. (2020) and USFWS Central Texas and East Texas Mussels Species Status Assessments.

3.1 Texas Fawnsfoot

The Field Guide to Texas Freshwater Mussels (Howells, 2014) describes the Texas Fawnsfoot as summarized below:

> A rare, elongate oval shaped mussel with adults reaching up to 60 mm in length. They have pseudocardinal (pseudo = false) teeth (two left, one right), 2 lateral teeth, and are generally unsculptured with an exterior color of dull green, tan, yellowish brown, or reddish-brown with broken rays. The nacre (inner shell layer) is white to bluish-white.

Until recently, the current range of the Texas Fawnsfoot was thought to be limited to the Brazos and Colorado river basins (Howells, 2014). Though they historically occurred in the Trinity River Basin, they were presumed extirpated (Howells et al., 1996). Recent genetic work on mussels previously classified as Fawnsfoot (*Truncilla donaciformis*) from the Middle and Lower East Fork of the Trinity River (Randklev, 2017) indicate that those mussels are actually Texas Fawnsfoot (Inoue et al., 2018). This 2019 range expansion for the Texas Fawnsfoot resulted in the Trinity River Basin (previously considered only as part of the USFWS' status review for East Texas Mussels) now also being affected by the status review for the Central Texas Mussels. In addition to the Texas Fawnsfoot, the Central Texas Mussels Species Status Assessment (SSA) includes five additional species of mussels (which are not thought to co-occur with the Eastern Texas mussels) currently under consideration by the USFWS for ESA protections.

The Texas Fawnsfoot is a rare species (Randklev et al., 2010; Burlakova et al., 2019) and little is known about its life history. In other river basins, Texas Fawnsfoot prefers deep bank habitats but they are also found in backwaters and on the upstream end of point bars (Randklev et al., 2014). Conversely, in the Trinity River Basin, Texas Fawnsfoot are primarily found in riffle habitats (Randklev et al, 2017). Texas Fawnsfoot are known to bury in up to 15-20 cm of sand, or in a mixture of sand and gravel, near the shore in riffles (Burlakova et al., 2019), making it difficult to locate using tactile sampling methods. The presumed host fish for this species is the Freshwater Drum (*Aplodinotus grunniens*)(Haag, 2012; Howells, 2014).

3.2 Texas Heelsplitter

The Field Guide to Texas Freshwater Mussels (Howells, 2014) describes the Texas Heelsplitter as follows:

> An elliptical shaped mussel with adults reaching up to 177 mm in length. They have two thin, compressed pseudocardinal teeth, two left and low beaks slightly above the hinge line. They lack sculpturing on the outside and are tan to chestnut brown or black. Nacre is white or bluish-white with purple or pink along the hinge line.

The Texas Heelsplitter prefers slow to moderately flowing habitats in deep pools with sand or mud substrate although recent research has suggested that they prefer bank habitats (Randklev et al., 2017). This species, which only occurs in Texas and is endemic to three East Texas river basins (Trinity, Neches, Sabine), is considered a riverine obligate species but is capable of surviving in backwater and reservoir habitats. Based on laboratory trials in Texas, the host fish for the Texas Heelsplitter is the freshwater drum (Bosman et al., 2015).

3.3 Trinity Pigtoe

The Mussels of Texas database (Randklev et al., 2020) describes the Trinity Pigtoe as follows:

> Shell structure is moderately thin to thick, inflated; outline subtriangular to subrhomboid; posterior ridge high, sharp or narrowly rounded, ends at a blunt point, may show a second or third ridge; sulcus present anterior to the posterior ridge; posterior slope steep and slightly concave with 2 wrinkle-like lines extending from the umbo to the margin. Shell color is reddish-brown, greenish-brown, or brown; may present green or brown rays; surface usually dull to subglossy. Shell is smooth with an inner nacre color that is usually white but can have salmon or rose highlights, some may show brassy blotches; iridescent posteriorly.

The Trinity Pigtoe was recently distinguished as genetically separate from Texas Pigtoe (*Fusconaia askewi*) and Triangle Pigtoe (*Fusconaia lananensis*), and has a distribution restricted to the Trinity Basin, specifically in the mainstem of the Trinity River near Dallas-Fort Worth downstream to just above Lake Livingston and adjacent tributaries (Inoue et al., 2018; Pieri et al., 2018). The Trinity Pigtoe is morphologically difficult to distinguish between other types of Pigtoe including the Wabash Pigtoe (*Fusconaia flava*), which is widely distributed throughout the Eastern United States and also occurs in the Trinity River Basin (Pieri et al., 2018). In the absence of genetic verification, problems with misidentification can lead to confusion about the status and distribution of the species (Howells, 2014; Inoue et al., 2018). The species is currently classified as threatened by the Texas Parks and Wildlife Department (TPWD) but is not currently under review by the USFWS for potential listing under the ESA.

Most habitat, host, and reproduction characteristics are similar to other Pigtoe species that occur in Texas. Habitat is thought to include streams and rivers, but the Trinity Pigtoe is not known to inhabit reservoirs. It can be found in nearshore habitats, such as banks and backwaters, but is most common in main channel habitats, such as riffles and runs. Preferred substrates include mud, sand, gravel, and cobble or a mix thereof in moderate to swift currents (Randklev et al., 2017). Trinity Pigtoe appears to be intolerant of flow alteration and poor water quality and is believed to have a maximum life expectancy of 45 years (Randklev et al., 2017). Host fish are unknown but likely include hosts of other Pigtoe species, such as Red Shiner (*Cyprinella lutrensis*), Blacktail Shiner (*Cyprinella venusta*), and Bullhead Minnow (*Pimephales vigilax*)(Bertram et al. 2017; Dudding et al., 2019); Spotfin Shiner (*Cyprinella spiloptera*), Silver Shiner (*Notropis photogenis*), and Creek Chub (*Semotilus atromaculatus*)(Randklev et al., 2020).

3.4 Louisiana Pigtoe

The Mussels of Texas database (Randklev et. al., 2020) describes the Louisiana Pigtoe as the following:

> A triangular shaped mussel with adult shell length over 62mm. The external shell does not have sculpturing and is brown to reddish brown in color, or black. Nacre is typically white and iridescent posteriorly. They can be found in small streams to large rivers in slow to moderate currents in substrates of clay, mud, sand, and gravel (Howells, 2014).

Mussels of Texas (Randklev et al., 2020) refers to the Blacktail Shiner as the host species for Louisiana Pigtoe while acknowledging that further study of possible host fishes is needed. Some past research has suggested other potential host fish may include Bullhead Minnow, Red Shiner, and others (Marshall, 2014). Currently, the range of the Louisiana Pigtoe extends across five states (Texas, Oklahoma, Arkansas, Louisiana, and Mississippi), but it is thought to be extirpated from the Trinity River Basin. According to Mussels of Texas (Randklev et al., 2020), the range in Texas is from the San Jacinto drainage east to the Sabine River (including the Neches River, Angelina River, and possibly Big Cypress Bayou). Other native mussel species (e.g., Pimpleback (*Cyclonaias pustulosa*); Texas Pigtoe (*Fusconaia askewi*); Trinity Pigtoe (*F. chunii*); and Wabash Pigtoe (*F. flava*) can easily be mistaken for Louisiana Pigtoe when identified by shell morphology alone; this has caused some confusion regarding its status. A recent survey suggested experienced malacologists had a 76% success rate accurately identifying the species in the Little River, Oklahoma when field identifications were compared with genetic analysis results (Inoue et al., 2018). The Louisiana Pigtoe has been categorized as state threatened by TPWD and is currently under review by the USFWS for potential protection under the ESA.

3.5 Alligator Snapping Turtle

The Alligator Snapping Turtle is striking in appearance, with a characteristic spiked shell and large, broad head. Adult males can reach 175 pounds or more with females weighing around 50 pounds. Although hatchling survival is low, the lifespan of adults can be over 100 years. They can be found on land but mainly inhabit aquatic environments, preferring the calm deep waters of ponds, oxbows, lakes, and large rivers. Upon reaching sexual maturity (approx. 15 years), females will emerge to lay their eggs along the shoreline or in upland areas up to 1 mile from water. This species is the only turtle that possesses a predatory worm-like mouth appendage, pink or drab in color, used to lure its prey. They are considered omnivores and will feed on small fish, insects, reptiles (including other turtles), and amphibians, (Hibbitts, T.D and Hibbitts, T. L., 2016). The current range of the Alligator Snapping Turtle extends across fourteen states in the southeastern U.S. including all the major river basins in East Texas. The Alligator Snapping Turtle likely occurs throughout the entire Trinity River Basin wherever suitable habitat is present.

The Alligator Snapping Turtle is one of the heaviest freshwater turtles in the world and the largest in North America (Carwardine, 2008). Though the species is most often associated with the Common Snapping Turtle, it is not closely related to it, as it is a different genus. The Alligator Snapping Turtle has long been prized as a food source, which led to population declines and the creation of laws limiting its capture. Poaching (i.e., illegal harvest) is considered a major threat and remains a cause for concern, as seen in the recent news of 27 Alligator Snapping Turtles that were returned to East Texas from Louisiana in August 2021. The released individuals were seized in 2016 by law enforcement during an attempt to illegally transport individuals from Texas to Louisiana where they likely would have been sold for human consumption (TPWD, 2021).

3.6 Western Chicken Turtle

Turtles of the United States and Canada (Ernst and Lovich, 2009) describes the Western Chicken Turtle as summarized below:

> The skin of the Western Chicken Turtle is olive to brown with yellow lines extending from the head across the neck, from the shoulder to the feet and vertically on the rump. The long narrow head comes to a point at the beak. The Western Chicken Turtle received its common name from its long head and neck, which tends to be as long as the [underside of the shell]. This species also exhibits sexual dimorphism with the female being larger than males. The egg-shaped carapace is rough textured and tends to be olive to brown in color. Adults primarily feed on plants, aquatic insects and crayfish.

The Western Chicken Turtle is a cryptic species and little is known about its behavior throughout the year. Western Chicken Turtles spend extended amounts of time estivating (a form of dormancy similar to hibernation) in upland areas (McKnight and Day, 2020), making standard survey methodologies less effective. Rivers and streams are not preferred habitat for this species, which tends to occupy lentic systems such as ephemeral wetlands, swamps, and ponds although oxbows and marginal wetland areas may be utilized to some extent (personal communication, Brandon Bowers, Texas A&M University).

The Western Chicken Turtle is considered rare and declining throughout its range although no range-wide population surveys have been conducted. Uncertainty regarding population status and perceived threats to habitat convinced the USFWS to consider ESA protections (Ryberg et al., 2017); the species is currently under review by the agency for potential listing. Threats to the species include habitat loss and commercial harvest to meet demand by the pet trade. The Western Chicken Turtle is a fairly mobile aquatic species, and in addition to basking on land, it frequently travels overland for a variety of activities including nesting twice per year, migration, estivation, and hibernation (Buhlmann, 1995). This cryptic species spends a considerable portion of the year buried underground in a state of estivation, making it difficult to survey. The current range of the Western Chicken Turtle includes portions of Texas, Oklahoma, Arkansas, Louisiana, Mississippi, and Missouri. In Texas, the Western Chicken Turtle's historical range

once comprised the entire eastern third of the state (Dixon, 2013); its current status is largely unknown.

4 Existing Conditions

4.1 Basin Overview and Background

At over 18,000 mi^2, the Trinity River Basin is the largest river basin in Texas that both begins and ends in Texas (Figure 2), providing water to over 50% of the population of Texas. The basin serves as a transition zone between the arid plains of West Texas and the wet piney woods of East Texas. It is unique relative to other basins in Texas in that it contains a very large, urbanized population (DFW) in the upper portions of the basin and, although not in-basin, is a major drinking water source for another large metropolitan area (Houston), near the bottom of the basin.

Water supply operations in the Trinity River Basin are complicated and nuanced due to the number of regional entities, major cities, and counties involved in the raw water supply chain and intra/inter-basin transfers, the importance of wastewater return flows, and a rapidly growing population. A major challenge is that there is not a single overarching entity that manages water supplies in the basin, which has led to an environment of regional cooperation among water managers over the last 70 years. This atmosphere of cooperation has led to drastic water quality improvements over the last half-century as described later in Sections 4.1.1, 4.1.2, and 4.1.3.

4.1.1 Complicated Operational Environment

As explained in detail later in the document, the Covered Parties are regulated entities[4], not regulators, and only represent one piece of the overall operational environment within the Trinity River Basin. This fact complicates conservation efforts because the Covered Parties have limited control over the chemistry of the water within the river.

From a water quality perspective, the Covered Parties discharge wastewater to the river system, but there also are inputs from other sources, such as agricultural and urban runoff, other municipal WWTPs, and flood releases from United States Army Corps of Engineers (USACE) reservoirs, which all combine into one “mixture” that is constantly changing over distance and time. Under low-flow conditions in effluent-dominated reaches, water chemistry is heavily dependent upon effluent quality (i.e., downstream of dischargers). However, under high-flow conditions, non-point runoff can dominate water quality. In both cases, the overall water chemistry results from the blending of multiple sources, each of varying quality and composition that varies temporarily and spatially. This fact makes teasing out the specific impacts of the Covered Parties’ operations extremely difficult, especially considering impacts to the species that can be both chronic and acute.

[4] Generally, the TCEQ issues TPDES (Section 1.2) permits and the USACE issues 404 Clean Water Act permits.

From a hydrologic perspective, the Covered Parties operate water supply reservoirs and flood management systems (Figure 2), but do not have any flood storage capacity. While the Covered Parties have some influence during normal and low flow periods, the USACE's eight major flood control reservoirs (Figure 2) are the driver during wet periods and the Covered Parties do not control their operations.

The Covered Parties' operations are only one piece of a larger, interconnected system and, as such, represent only a portion of the stressors on the Covered Species. The Conservation Measures put forth in this document are designed to provide a "net conservation benefit" to the Covered Species for those factors that the Covered Parties can influence, which is difficult to measure or quantify due to the cumulative effects of the entire system.

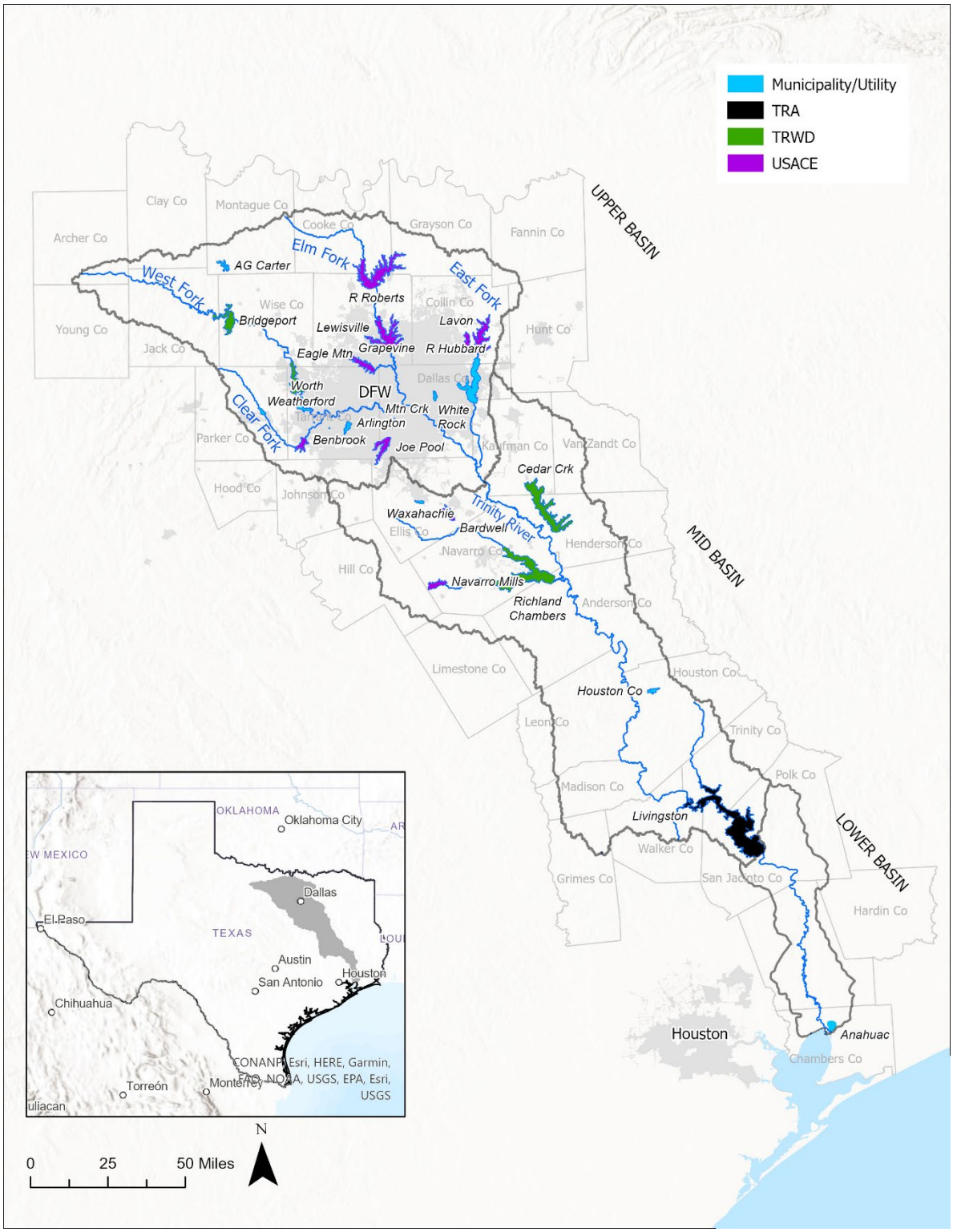


Figure 2. Map of the Trinity River Basin showing reservoir ownership in the Upper, Middle, and Lower Basins.

4.1.2 Historical Water Quality

Water quality has long been an issue in the Trinity River Basin. During A. W. Moore's reconnaissance of Texas in 1846, he described the Trinity river as a "narrow deep stinky affair scarcely worthy the name of river" (Moore, 1927). In the early 1900s, water quality problems intensified when two large slaughterhouses opened in Fort Worth. Their arrival, coupled with continued growth by the Cities of Dallas and Fort Worth, made the river dangerous to public health with numerous cases of typhoid fever and dead animals near the river in downtown Dallas. In the Texas State Department of Health's (1925) 1924-25 survey, the Trinity River below Dallas was described as follows:

> *The flow below Dallas for many miles does not impress one as being that of a river. A stench from its inky surface putrescent with the oxidizing process to which the shadows of overarching trees add Stygian blackness and the suggestion of some mythological river of death. With this burden of filth [sic] the purifying agencies of the stream are prostrated; it lodges against obstruction in the stream and rots, becoming hatcheries for mosquitoes and malaria. A thing of beauty is thus transformed into one of hideous danger.*

4.1.3 Success of Wastewater Treatment Plant Regionalization

In the 1930s, secondary treatment of wastewater began, but water quality continued to remain poor. Beginning in the 1970s, however, advances in wastewater treatment resulted in dramatic improvements. In 1971, implementation of the Upper Trinity River Basin Comprehensive Sewer Plan resulted in the "regionalization" of WWTPs. Regionalization resulted in the elimination of many small, independently operated municipal and industrial WWTPs and the adoption of larger, regional systems that were better able to treat effluent to much higher standards. The following year in 1972, Congress passed the Clean Water Act (CWA) which established the basic structure for wastewater discharge permitting and standards.

The Covered Parties' regionalization of wastewater service in the DFW area is the 'most significant driver for water quality improvements in the Trinity River Basin. Together, the Covered Parties spend over $397 million dollars[5] annually to operate 18 major[6] WWTPs, which as of December of 2022, are permitted to convert up to 978.4 million gallons per day (MGD) of raw sewage into high-quality effluent (see Section 6.2.1, Figure 15, and Table 6-1 for more detail). This discharged effluent provides aquatic habitat for organisms including the Covered Species and their host fish for the entirety of the 325 miles of the Trinity River from the DFW area to Lake Livingston. During periods of drought, this water provides approximately 500 cubic

[5] This number represents only those funds (fiscal year 2023 budgets) dedicated to operation of the treatment plants and does not include the significant other costs involved with the inspection, maintenance, and repair of the collection systems (pipelines).

[6] The US Environmental Protection Agency designates a "major" WWTP to be one that discharges greater than > 1 MGD and is required to report data to the Enforcement Compliance History Online (ECHO) database.

feet per second (cfs) of baseflow to a system that would *otherwise be dry, or extremely low*. However, during wet periods, this water is only a fractional component of the flow.

Water quality improvements in the Trinity River Basin are tied to technological advances that were possible because of the operation of the Covered Parties' regionalized WWTPs. Long-term water quality data has been collected at the TCEQ Surface Water Quality Monitoring (SWQM) site 10925 in Ellis and Kaufman Counties[7] for decades. A review of historical total ammonia nitrogen from this site, which can be harmful to aquatic organisms at some level, has fallen dramatically since 1985. Between 1972 and 1985, total ammonia nitrogen averaged 3.4 milligrams per liter (mg/L); from 1985 to present, average ammonia nitrogen levels have decreased 95% and now hold steady averaging 0.16 mg/L (Figure 3).

Simply, biochemical oxygen demand (BOD) is a measure of the amount of organic and inorganic material in the water. The Covered Parties' Regional WWTPs use an activated sludge treatment process for the major plants which is very efficient in the removal of BOD. A review of historical BOD data at SWQM site 10925 shows a dramatic decrease in average BOD since 1985. Between 1968 and 1985, BOD averaged 13.4 mg/L; since then, BOD has decreased by 81% to 2.5 mg/L (Figure 4). Overwhelmingly, these water quality improvements are due to the Covered Parties' efforts since the early 1970s to convert onsite septic systems and small, dysfunctional package plants to large, sophisticated Regional WWTPs.

[7] TCEQ Surface Water Quality Monitoring Station number 10925 is located at the Trinity River and State Highway 34 just below the confluence of the East Fork Trinity River. This has been used for decades to represent the water quality for the entire DFW area since it captures all of the urban runoff and effluent from all of the major WWTPs in the DFW area, including the Covered Parties' WWTPs.

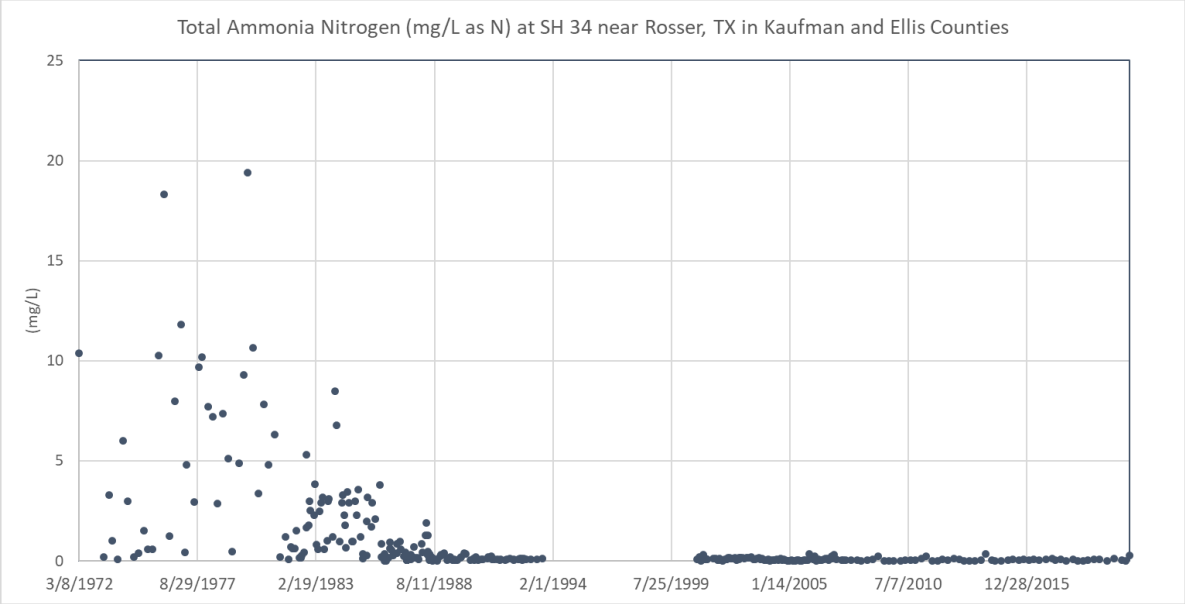


Figure 3. Graph showing decrease in total ammonia nitrogen (mg/L as N) at State Highway 34 near Rosser, Texas in Ellis and Kaufman Counties. Data source is based on surface grab samples from the TCEQ Surface Water Quality Database. Data was not collected between 1994 and 2000.

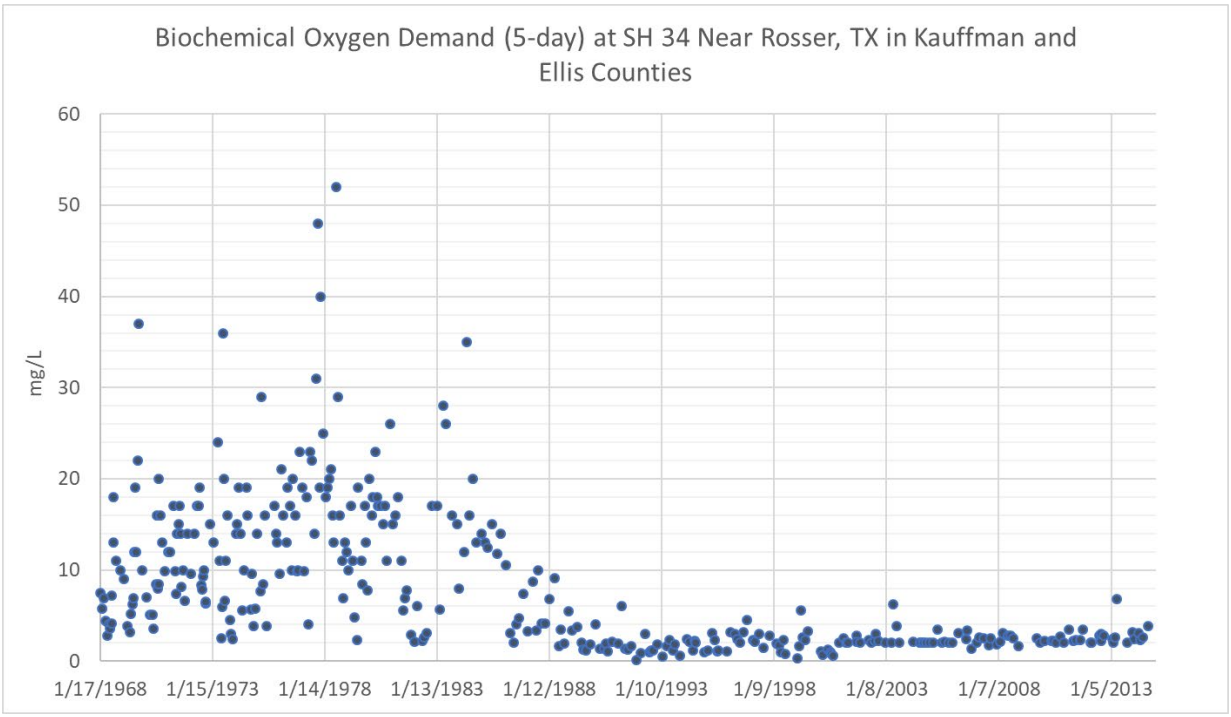


Figure 4. Graph showing decrease in biochemical oxygen demand (mg/L) at State Highway 34 near Rosser, Texas in Ellis and Kaufman Counties. Data source is based on surface grab samples from the USGS National Water Information System for gage number 08062500.

As ammonia and BOD have decreased, unsurprisingly, dissolved oxygen has shown a significant increase indicating improved water quality. Between 1968 and 1985, 39% of the USGS data collected show values of less than the TCEQ water quality screening level of 3.5 mg/L indicating degraded water quality. Since 1986, no values below 3.5 mg/L have been recorded (Figure 5).

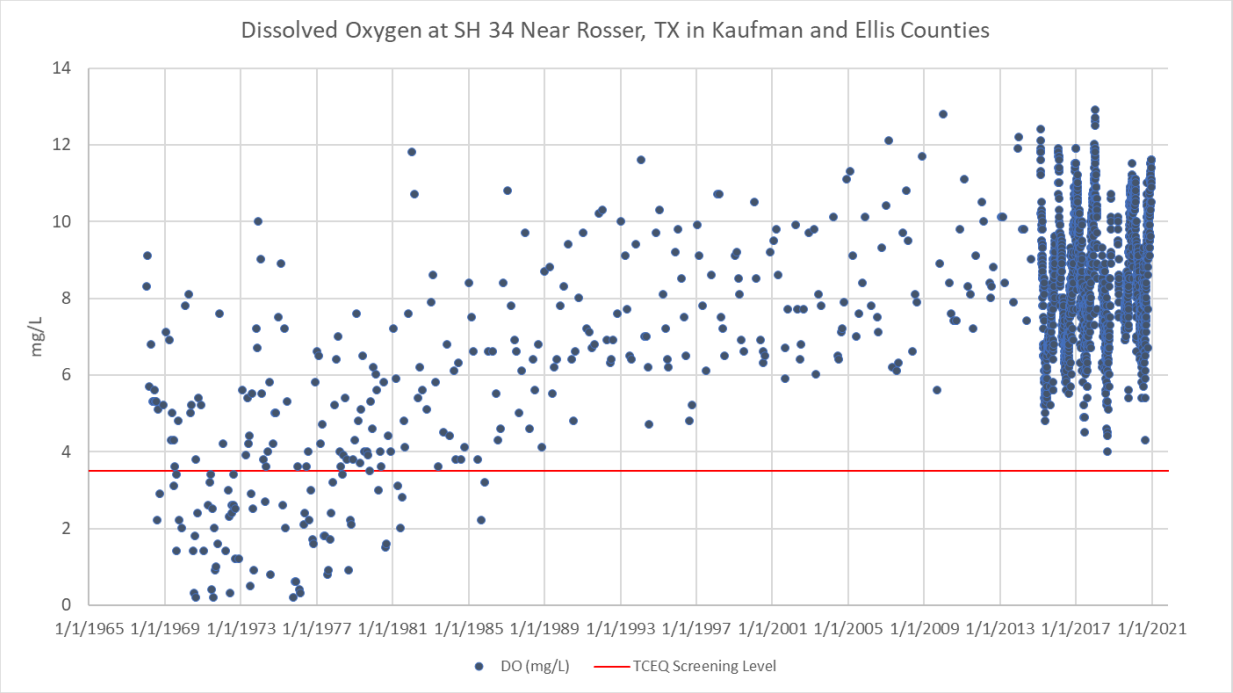


Figure 5. Graph showing a significant increase in dissolved oxygen (mg/L) at State Highway 34 near Rosser, Texas in Ellis and Kaufman Counties. Pre-2015 data is based on surface grab samples and post 2015 data is based on daily average near real-time data sonde readings from the USGS National Water Information System for gage number 08062500.

Before the 1980s, prior to regionalized WWTP operations and the technological advances in wastewater treatment processes put in place by the Covered Parties, regular fish kills occurred in the mainstem Trinity River. These fish kills were caused, in part, by the anoxic conditions created by under-treated wastewater, or "point sources". These fish kills no longer occur, and the Trinity River has seen a remarkable comeback of fish species. In 1974, prior to regionalized WWTP operations, only four species of fish were found in the Trinity River in and around the DFW area. That increased to 11 in 1987, 25 in 1995, and 38 in 2012 (TRA and TPWD, 2014; USGS, 1999). Additionally, intolerant species like the Dusky Darter (*Percina sciera*) and Bigscale Logperch (*Percina macrolepida*) are now regularly found in these reaches. Perkins and Bonner (2016) performed a detailed comparison of historical fish assemblage data to water quality and noted that point source pollution reductions caused an increase in species richness and guild composition between 1968 and 2008.

Due in part to the Covered Parties' regional wastewater operations, the water quality improvements discussed above are important in their own right, but it is also important to note that these improvements took place in the same timeframe (generally 1980 – present) that the

population in the DFW area increased 160% from 2.5 million people in 1980 to 6.5 million people in 2022[8]. The Texas Legislature recognizes the importance of regionalized WWTPs like the ones that the Covered Parties operate and requires TCEQ to consider regionalization during the review of new wastewater permits. Texas Water Code Section 26.081 provides Texas' regionalization policy for wastewater treatment and part (a) of that code states that:

> "The legislature finds and declares that it is necessary to the health, safety, and welfare of the people of this state to implement the state policy to encourage and promote the development and use of regional and area-wide waste collection, treatment, and disposal systems to serve the waste disposal needs of the citizens of the state and to prevent pollution and maintain and enhance the quality of the water in the state."

In 2008, the Trinity River, San Jacinto River, and Galveston Bay Stakeholder Committee and Expert Science Team (comprised of a diverse group of basin experts assembled to recommend environmental flow regimes to TCEQ) declared that the Trinity River system was a sound ecological environment. The water quality in the Upper Basin has improved to such a level that in 2020, the United States National Park Service recognized the Trinity River Paddling Trail as a National Recreation Trail.

4.1.4 Conservation Benefits of Regional Wastewater Treatment

As stated above, efficient, high-quality sewage treatment is essential for the Trinity River to meet the water quality standards set forth by the TCEQ in and below the DFW area, and regionalized WWTPs are the preferred option. It is important to understand what would happen if the Covered Parties were to stop regional WWTP operations.

First, wastewater would not stop flowing to the plants, as the Covered Parties have limited control as to what actually enters the plant[9]. While the Covered Parties have industrial pre-treatment programs,[10] WWTPs have no real options to stop wastewater and/or illicit discharges from reaching their plants[11] aside from closing the influent gates. If these gates were to be closed, it is important to note that the sewage does not stop flowing unless tens to hundreds of thousands of people immediately stop washing clothes, taking showers, washing vegetables, utilizing restroom facilities, etc. In short order, the closed gates would back the system up and cause sewage to backflow causing sanitary sewer overflows from manholes and backflow into

[8] https://www.macrotrends.net/cities/22966/dallas-fort-worth/population

[9] Except in rare cases, wastewater moves through the Covered Parties' pipelines in the DFW through gravity flow.

[10] Pre-treatment programs require some industrial dischargers to "pre-treat" their wastewater to an agreed upon limit prior to sending it through a wastewater pipeline and into the WWTP. These processes are regulated by through a permitting process by one of the Covered Parties, or customer municipality, and regular inspections.

[11] Illicit discharges can include actions like accidental of intended tapping of wastewater pipes from residences or businesses, discharge of an unapproved constituent or volume from industry, or removal of manhole covers and direct discharge into the pipeline. Identifying illicit discharges is a difficult process. Generally, if the Covered Parties suspect illicit discharges are taking place, sampling is done along the main interceptor pipeline to identify

homes causing immediate, detrimental environmental and human health impacts. The Conservation Measures designed to address these risks are discussed in Section 8.

Second, development would continue to occur and wastewater treatment would be implemented using small-scale treatment options, like package plants and septic systems, which have historically been poorly maintained over time and caused degraded water quality in densely populated areas. In the Greater Houston metro area, efforts are underway to convert small systems to centralized WWTPs, but that conversation is difficult for a variety of reasons, including the region's overall low elevation and minimal land slope make moving wastewater by gravity difficult. Several reports summarized in a white paper published by the Houston-Galveston Area Council (2009) suggested that in-stream water quality would be significantly improved if this region were able to convert to larger, more efficient WWTPs.

Third, the high-quality effluent discharged from the Covered Parties' WWTPs is a significant source of current and future water supplies, termed "reuse," for the Covered Species and downstream users. The Region C Water Planning Group (2020) identified conservation and reuse (to include effluent discharge from the Covered Parties' regional plants) as providing 31% of the water needed to meet the projected 2070 demand. Not only does reuse of the Covered Parties' discharges guarantee water remaining in the bed and banks of Trinity River mainstem (further discussed in Section 6.1), it prevents the need to fill this demand through other measures like new in-basin or out-of-basin reservoirs.

While regionalized WWTPs have been instrumental in restoring water quality in the Trinity River Basin, they also present a risk to the Covered Species. As discussed above, modern WWTPs are large, complex operations which rely on a variety of internal and external factors to function properly, and permit violations occur from time to time. Some of these factors include the following: 1) the quality of the wastewater received at the plant is not consistent, and operational decisions must be made during the treatment process; 2) activated sludge is a biological component, and many factors can affect microbial efficiency; 3) operations rely on a consistent supply chain for components like chlorine gas[12], fuel, and electricity; 4) unforeseen human error; 5) equipment failure; and 6) weather. Risk potential to the Covered Species from the Covered Parties' WWTP operations and the associated Conservation Measures are discussed in greater detail in Section 6.2.1 and Section 8.4, respectively.

4.1.5 Fish Consumption Bans and Advisories

The Texas Department of State Health Services (DSHS) is the state agency responsible for testing fish tissue across the state and issuing fish consumption bans and advisories[13] when appropriate to protect human health. The entire length of the Trinity River in the Covered Area

[12] Due to the risks of chlorine gas storage, WWTPs limit how much is stored onsite at one time.

[13] A fish consumption advisory limits the recommended amount of a selected fish species a person should consume (e.g., one meal per month) while a fish consumption ban recommends that a person does not eat any of that species from that designated part of a waterbody.

is covered under either a fish consumption advisory or a fish consumption ban due to elevated levels of polychlorinated biphenyls (PCBs) and dioxins in fish tissue.

PCBs are a class of 209 manmade chemicals that were manufactured from about 1929 to 1979 when they were banned. Because they were very stable, they were considered to be ideal for use in many products ranging from heat transfer fluids to carbonless copy paper. However, due to the same properties that made them stable, they are persistent in the environment and do not easily degrade. They can break down from more heavily chlorinated chemical compounds to less chlorinated chemical compounds over time. They are also fat soluble, which leads to bioaccumulation in animal tissues.

Dioxins are somewhat similar classes of chemicals. There are several hundred types of dioxins as well, but there are 17 dioxins that are considered the most toxic. Unlike PCBs, dioxins and furans are not intentionally produced, they are produced as byproduct contaminants of processes ranging from simple wood burning to production of various chemicals.

Legacy sources of PCBs in the Trinity River Basin are hard to pinpoint because PCBs are ubiquitous in the environment due to historical widespread use and accumulate in the sediment. While the tolerances of the Covered Species to PCBs and dioxins is unknown, it is important to recognize that these sediments provide the habitat that freshwater mussels inhabit. From the mid-1990s to the mid-2010s, TCEQ and other entities performed research and attempted to identify remediation options for PCBs and dioxins but were unable to identify any workable solutions other than the passage of time and entrainment by clean sediment.

5 Covered Area and Conservation Zone Descriptions

Because of its geographical, climatological, and political variability[14], the Trinity Basin has historically been categorized into three operationally different basins (Figure 2). For the purposes of this agreement, the Upper and Middle Basins have been further subdivided into Conservation Zones based on the status of the habitat and potential recovery opportunities and the Lower Basin as a whole is one conservation zone (Figure 6). The basins and Conservation Zones are listed below and discussed in detail throughout this section.

1. Upper Basin
    a. Conservation Zone A (Zone A),
    b. Conservation Zone B (Zone B),
2. Middle Basin
    a. Conservation Zone C (Zone C),
    b. Conservation Zone D Zone D), and
3. Lower Basin
    a. Conservation Zone E (Zone E).

In addition to the physical description of the basins and Conservation Zones, the locations where the Covered Species of freshwater mussels are known to occur or have been identified in the past are discussed below. For Alligator Snapping Turtle and Western Chicken Turtle, specific occupied habitats are difficult to locate since the species are cryptic, mobile, and data is sparse. The entire Trinity River Basin is considered part of these turtles' ranges, so for the purpose of this CCAA, it is assumed that these species may be located throughout the basin.

The Covered Area for this agreement includes all existing infrastructure and the operation of future infrastructure[15], owned property and easements, and facilities owned or operated by the Covered Parties within the Trinity River Basin as well as the downstream rivers and tributaries where activities by the Covered Parties may cause take of the Covered Species.

Within each Conservation Zone, the Covered Parties will work with USFWS and TPWD to identify potential Conservation Priority Areas (CPAs) in the first year of this agreement. Designated CPAs will primarily consist of areas that are currently occupied by at least one Covered Species with a reasonably high potential of either stabilizing the existing population by reducing threats or increasing the population size through various conservation actions, such as additional measures to protect water quality or habitat restoration. The Conservation Zones are described in detail below.

[14] Prominent political entities vary across the basin. Generally, major cities, regional entities, and the USACE are heavily influential in the Upper Basin, counties and regional entities in the Middle Basin, and the City of Houston, industry, and agriculture in the Lower Basin.

[15] Coverage for future infrastructure does not include the new construction which will be permitted outside of this agreement, but the operations of those facilities once constructed are covered so long as their operations fall under the Covered Activities covered in this CCAA.

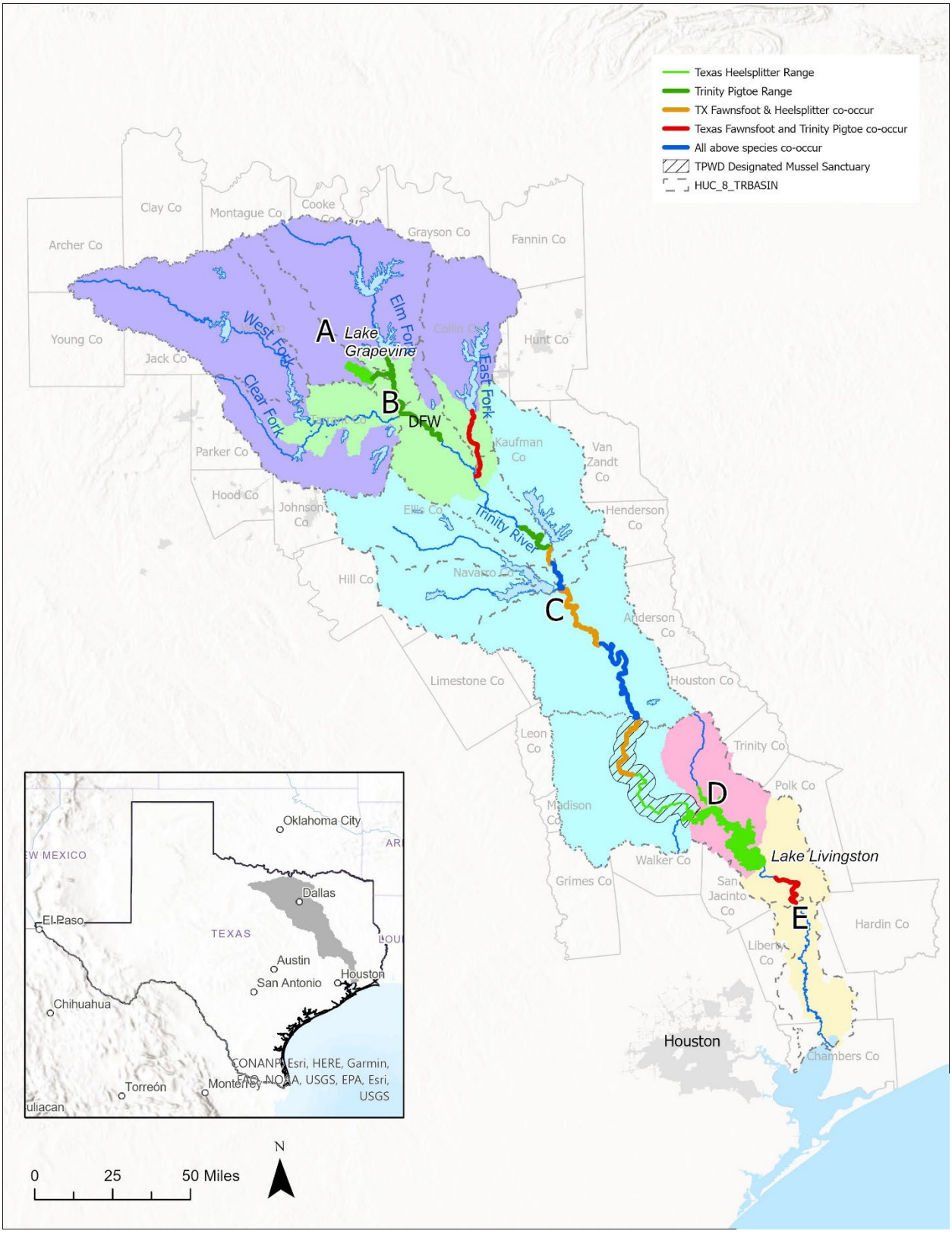


Figure 6. Map showing Conservation Zones A through E and habitat currently occupied by Covered Species of freshwater mussels (Louisiana Pigtoe is believed extirpated).

5.1 Upper Basin – Conservation Zones A and B

The Trinity River is comprised of four main tributaries that converge just below the DFW area. The Upper Basin's hydrology has been highly modified and urbanized since the 1800s. Each of these tributaries contain at least one major multipurpose reservoir, and the river has been straightened and leveed for flood control purposes in many places. The USACE operates seven flood control reservoirs in the Upper Basin. These flood control reservoirs are operated as a system, which is designed to impound water in the flood pool (the reservoir capacity above normal conservation pool designed to temporarily store and release floodwater) and release that water in a controlled manner to prevent downstream flooding. There are also water supply reservoirs in the Upper Basin that do not have flood storage capacity and are not authorized to impound flood water. These reservoirs are designed to impound water up to the top of the conservation pool to ensure that water supply is available during dry times. Because these reservoirs do not have flood storage, water is captured until the reservoir reaches conservation pool elevation, then the remainder of the flow is released through tainter gates downstream. Additionally, several of these reservoirs receive imported water from inside or outside of the Trinity River Basin to supplement their natural yield.

While flooding and flood releases drive the hydrology during wet seasons, wastewater return flows supplement baseflows year-round and provide the majority of the water in the river during times of drought or low precipitation. Most of the water use in the Upper Basin is municipal and not wholly consumptive, that is, generally 63% of the municipal and industrial water used in the Upper Basin is returned to the river through WWTPs (Espey Consultants, Inc., 2001). These wastewaters return flows keep baseflows artificially elevated at all times but provide the only means of flow connectivity during times of drought in the Upper and Middle Basins.

5.1.1 Conservation Zone A

Zone A (Figure 7) is defined as the controlled watersheds above the major reservoirs in the DFW area[16]. All of the water that leaves this zone passes through a major dam. Above the reservoirs, the flow in these tributaries is generally very low with intermittent baseflows in the summer months, supplemented with large runoff events during wet periods. The major USACE reservoirs in Zone A (Benbrook, Ray Roberts, Grapevine, Lewisville, and Lavon) were designed to serve water supply, flood control, and recreational needs. As such, extreme water level changes are common in these reservoirs and are by design. For example, Lake Grapevine, where two Texas Heelsplitters were detected in 2014 near the headwaters, fluctuated almost 40 feet in a 9-month period in 2015. Annual water level fluctuations of 10-15 feet are common (Figure 8).

[16] The boundary of Zone A is the controlled watersheds above the following reservoirs: Worth, Grapevine, Lewisville, Ray Hubbard, Mountain Creek, Joe Pool Lake, and Bridgeport.

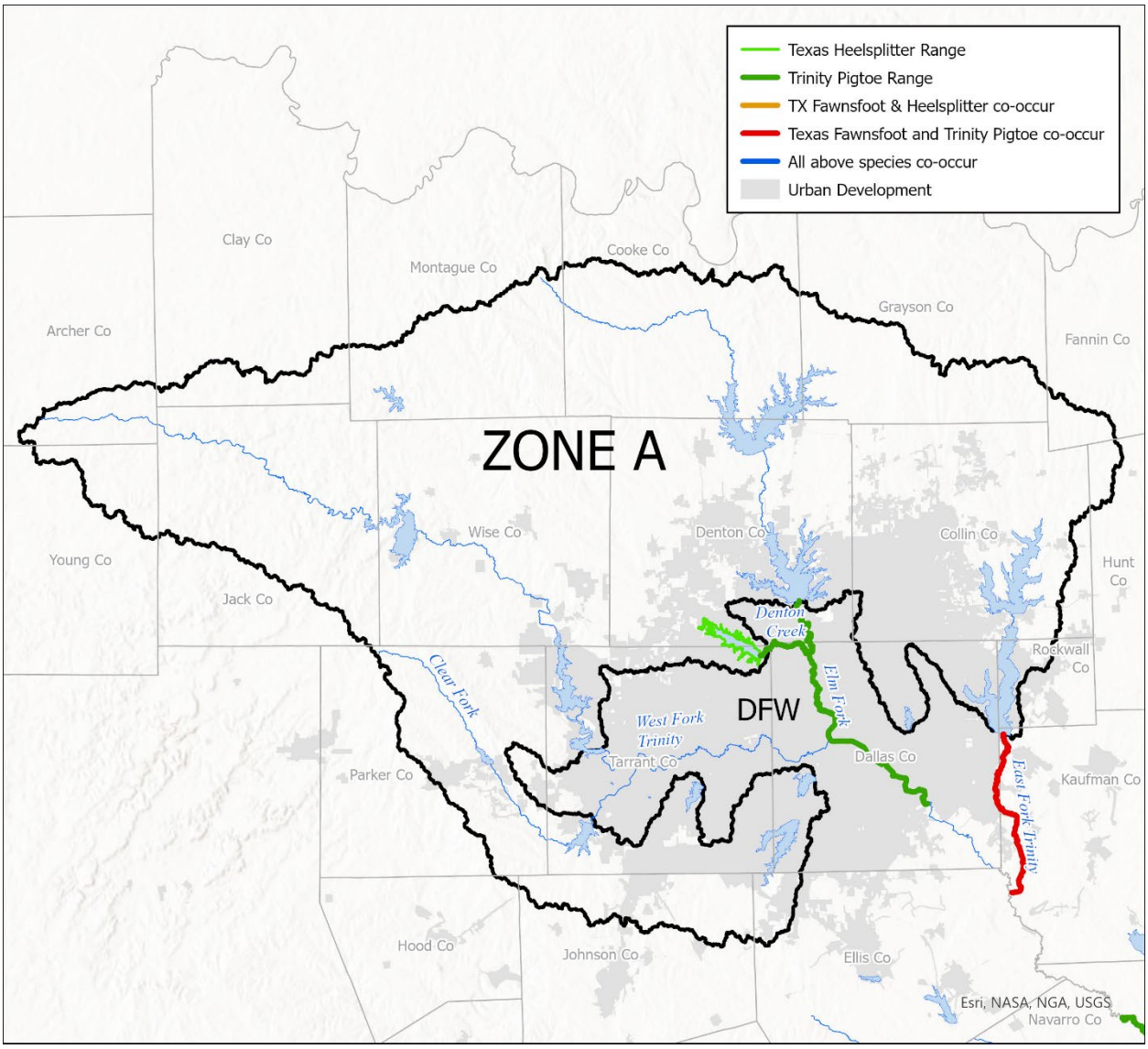


Figure 7. Map showing Conservation Zone A in the Upper Basin.

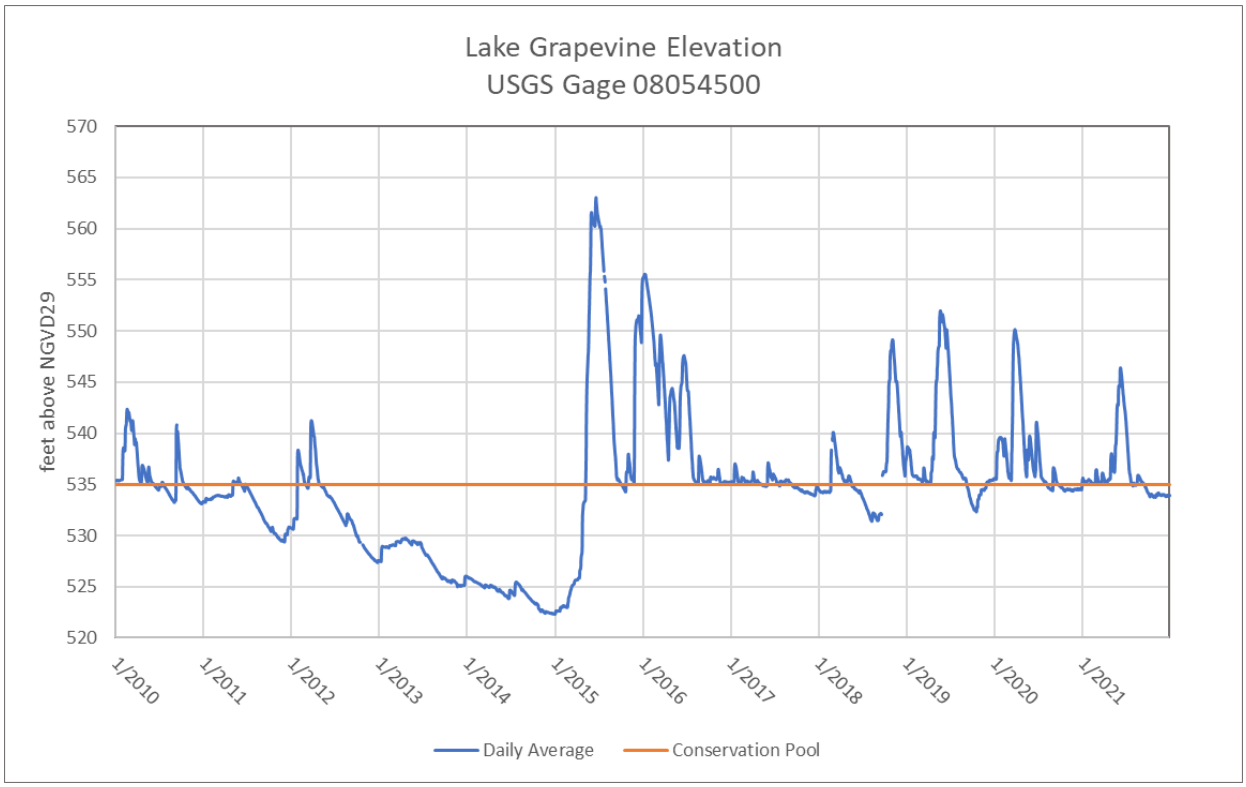


Figure 8. Daily average reservoir surface elevation on Lake Grapevine 2010 through 2021.

5.1.2 Conservation Zone B

Zone B is defined as highly urbanized with highly modified stream reaches and levees in the DFW area. This zone begins at the dams of the reservoirs mentioned in Zone A and ends downstream of the East Fork confluence at the USGS gage #08062500 Trinity River near Rosser, which is at the intersection of the Trinity River and State Highway 34 in Ellis and Kaufman Counties. The downstream boundary of this zone was chosen because it is below the confluence of the East Fork, captures all of the Covered Parties' WWTP effluent, and has long been used as a surrogate gage to represent the aggregation of the runoff from the DFW area. Much of the Trinity River in this zone is within flood control levees through much of Fort Worth and Dallas. Its hydrology is characterized by elevated baseflows from WWTPs (both from the Covered Parties and other municipalities return flows), water supply deliveries, USACE flood releases, and urban runoff. The Trinity Pigtoe is present on the Elm Fork and Mainstem Trinity River, and the Texas Fawnsfoot is known to occur on portions of the East Fork Trinity River (Figure 9).

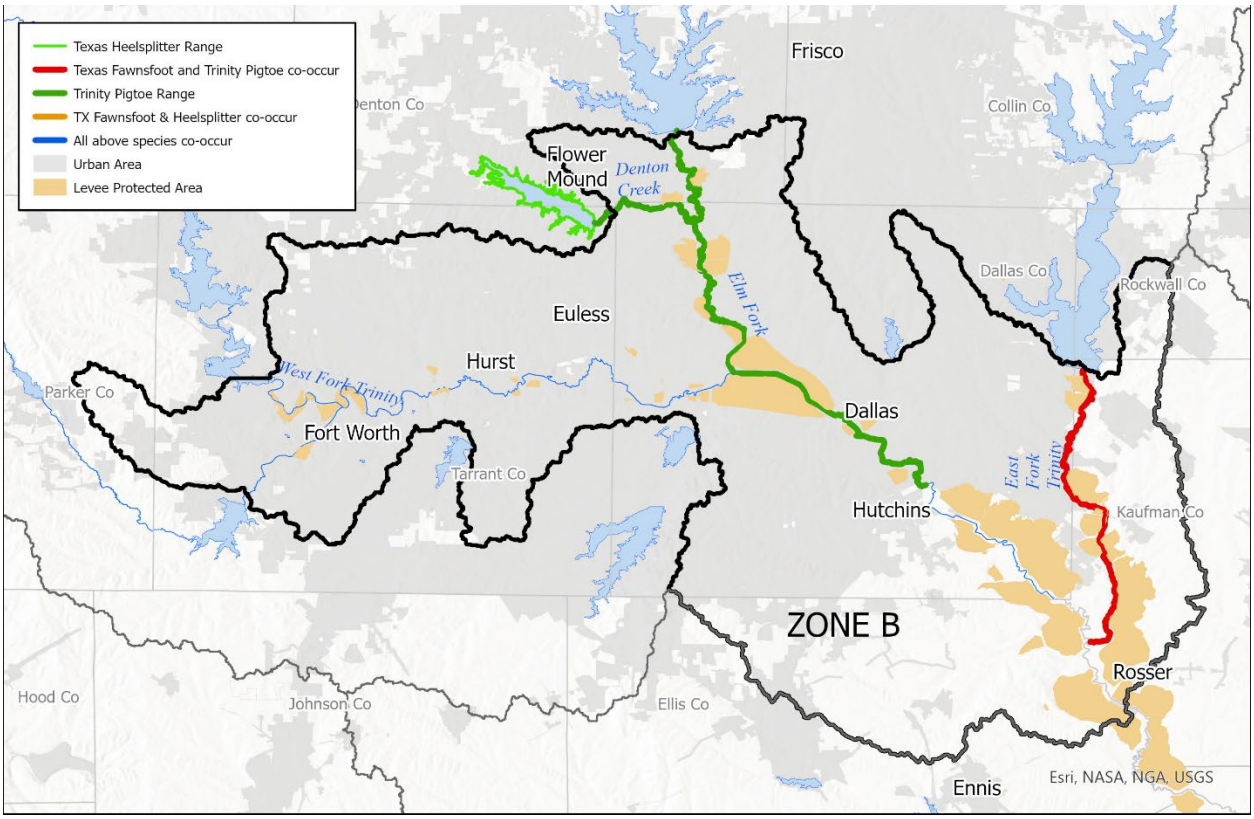


Figure 9. Map showing Conservation Zone B in the Upper Basin.

5.2 Middle Basin – Conservation Zones C and D

The Middle Basin begins below the DFW area downstream of the East Fork confluence at the USGS gage #08062500 Trinity River Near Rosser, which is at the intersection of the Trinity River and State Highway 34 in Ellis and Kaufman Counties, and ends at the Lake Livingston dam. This basin is rural and exhibits more "natural" conditions, but the hydrology and water quality are driven by the Upper Basin. Baseflows in the Middle Basin during times of drought are artificially elevated by wastewater return flows[17] . Flows can remain elevated for long periods of time due to USACE controlled flood storage releases. One example is the period between April 2015 and July 2016 when, except for a 50-day period in September and October of 2015, this reach did not go below 5,000 cfs and over half of that time was above 10,000 cfs (Figure 10).

The Middle Basin contains two relatively small USACE flood control reservoirs (Navarro Mills and Bardwell) and three major water supply reservoirs (Cedar Creek, Richland Chambers in the upper third of the Middle Basin and Lake Livingston at the bottommost portion). Richland Chambers and Cedar Creek provide an important water supply to the DFW area. Water from these two reservoirs is pumped from these reservoirs upstream through a series of pipelines to supplement the natural yields of Lakes Arlington, Benbrook, Eagle Mountain, and Worth.

[17] Summertime baseflows are regularly between 75 and 94% WWTP effluent (Plummer and Associates, 2021).

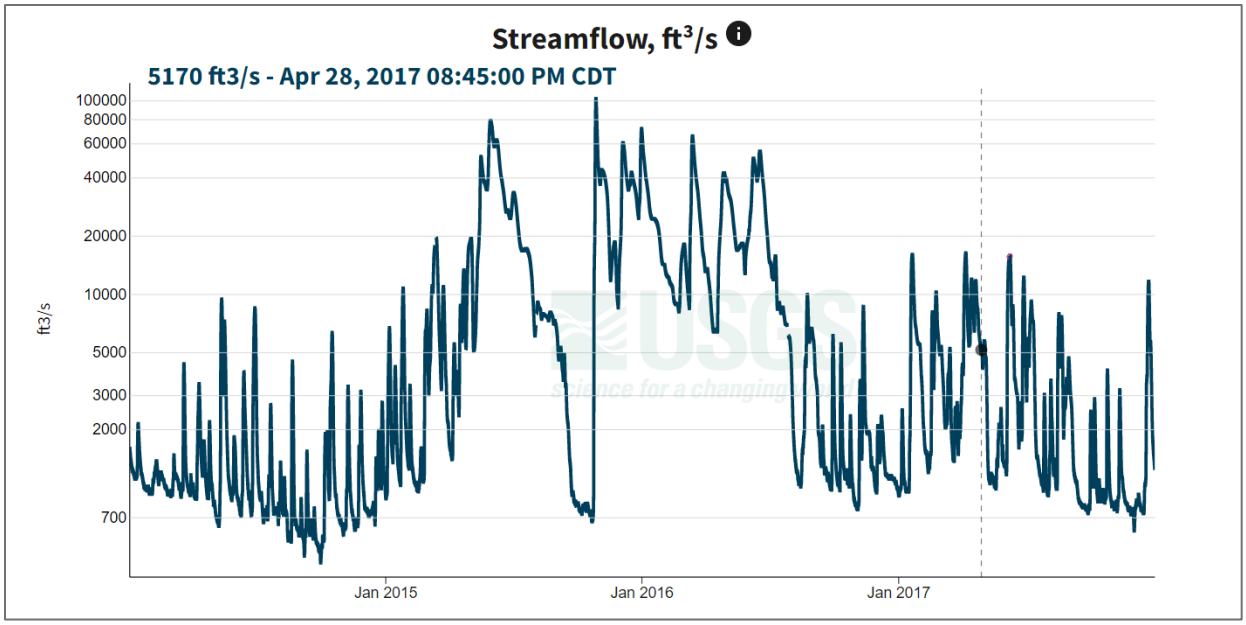


Figure 10. Hydrograph for USGS gage #08065000 Trinity River near Oakwood, TX showing long-term elevated flows based on USACE reservoir releases of captured flood waters upstream of the DFW area (Zone A).

5.2.1 Conservation Zone C

Zone C begins just below the East Fork confluence at the USGS gage #08062500 Trinity River Near Rosser, which is at the intersection of the Trinity River and State Highway 34 in Ellis and Kaufman Counties, and ends at the downstream boundary of the TPWD designated mussel sanctuary in the headwaters of Lake Livingston (Figure 11). This Zone exhibits more "natural" riverine conditions although it is highly modified hydrologically as described in Section 5.2 above. This zone is a mostly rural watershed where freshwater mussels are more common than in other zones (Randklev et al., 2017). Summertime baseflows are regularly between 75-80% WWTP effluent (Plummer and Associates, 2021). All of the covered species except for Louisiana Pigtoe[18] are known to occur in this reach. This zone has the highest mussel abundance of any zone in the Trinity River, and quality, occupied habitat is dispersed throughout the zone. A TPWD designated mussel sanctuary is located at the downstream end of this zone, where commercial harvest of mussels is prohibited.

[18] Assumed extirpated from the basin (Randklev et al., 2020).

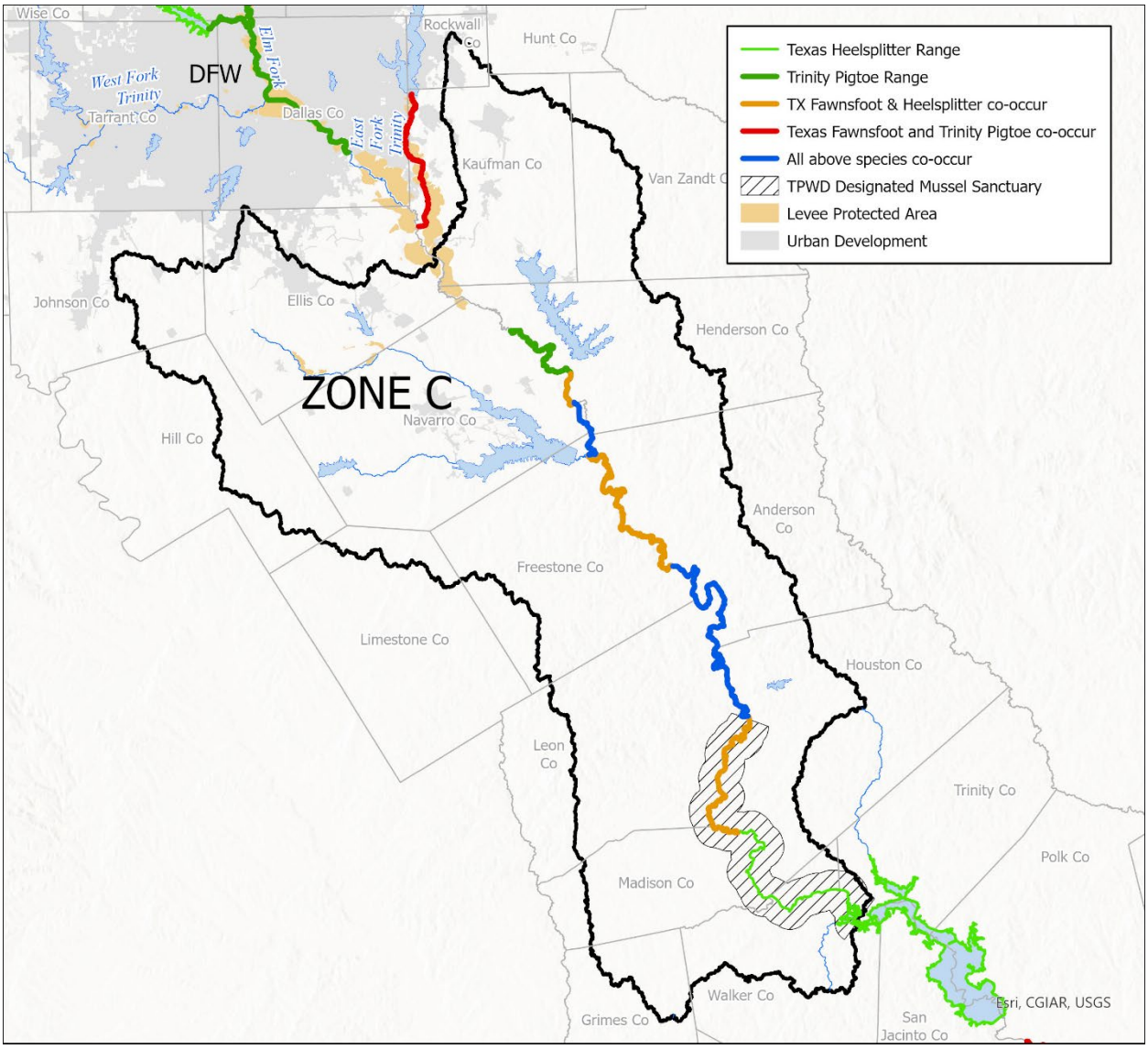


Figure 11. Map showing Conservation Zone C in the Middle Basin.

5.3 Conservation Zone D

Zone D is defined as Lake Livingston and the surrounding direct watersheds from the bottom of the TPWD freshwater mussel sanctuary to the Lake Livingston dam. This water supply and recreational reservoir is a major water supply for Houston but is not designed to capture flood waters. Lake Livingston regularly fluctuates 5 to 6 feet, as it draws down during periods of drought, refills during wet periods, and passes flood waters. The Texas heelsplitter has been documented in Lake Livingston.

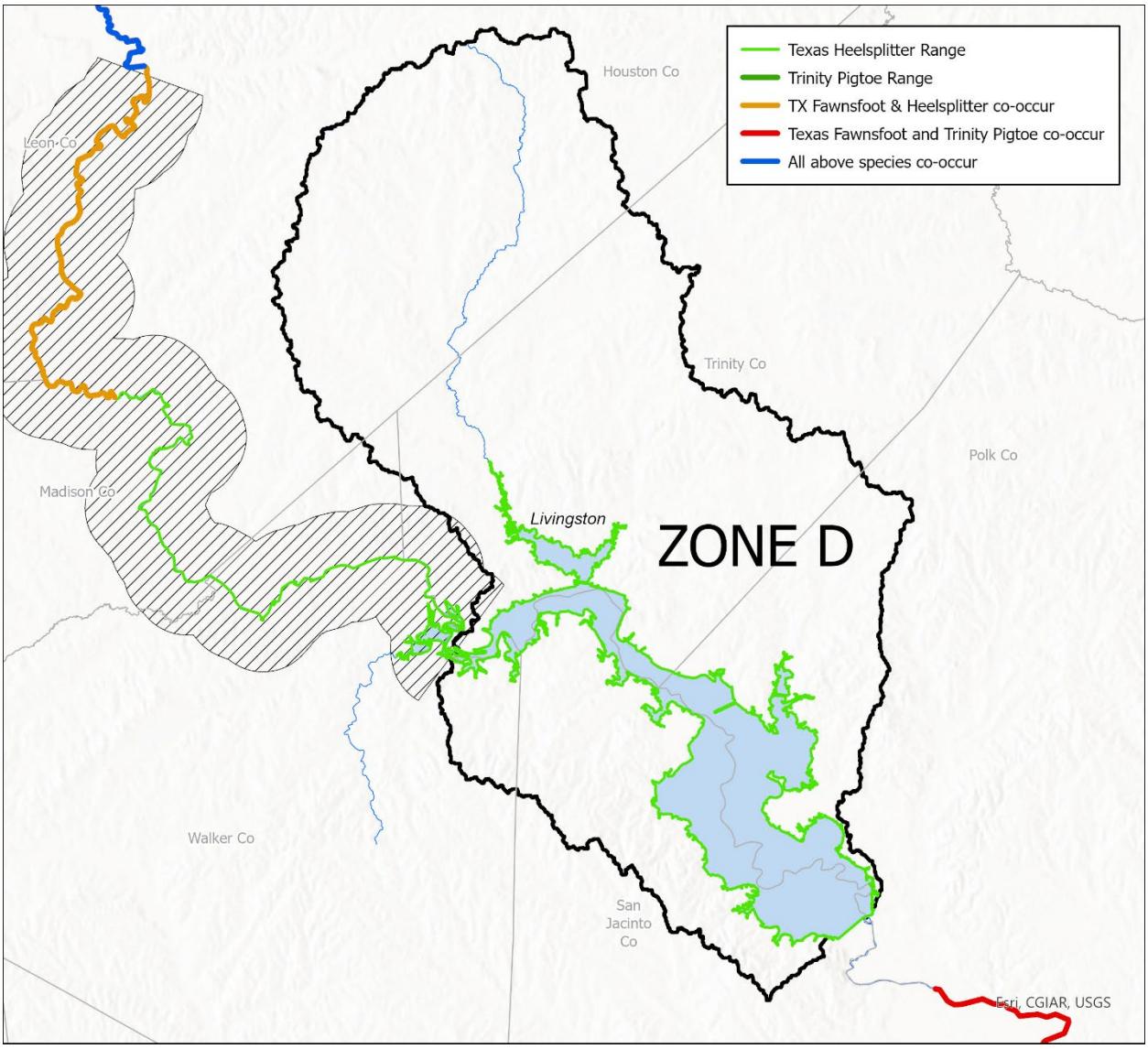


Figure 12. Map showing Conservation Zone D in the Middle Basin.

5.4 Lower Basin – Conservation Zone E

Below Lake Livingston, the hydrology of this rural portion of the basin is driven largely by reservoir releases for water supply delivered through the bed and banks, reservoir releases during high flows, and tropical storm systems. The Trinity River in the Lower Basin is characterized by wide, long meanders typical of a large coastal plain river system. Below Highway 90 near Liberty, Texas, the river becomes tidally influenced. Near the mouth of the river where the Trinity feeds Trinity Bay, is the Wallisville Saltwater barrier. This barrier is designed to be opened and narrowed in a manner that maintains constant positive flow in a downstream direction, which prevents saltwater intrusion upstream that would otherwise contaminate freshwater supplies.

5.4.1 Conservation Zone E

Zone E begins at the Lake Livingston dam and ends at Trinity Bay and is the most downstream Conservation Zone. Trinity Pigtoe and Texas Fawnsfoot are known to occur in the upper reaches of this Conservation Zone. Large, shifting sand bars and tall cut banks are common in this area. The low flows in Zone E are dominated by a constant 1,000-1,400 cfs water supply delivery from Lake Livingston at River Mile 116.5 to the Coastal Water Authority intake a River Mile at 30.5 and the Lower Neches Valley Authority Devers Canal intake at River Mile 24, and high flows consist of floodwater pass-throughs from Lake Livingston and local convective or cyclonic storm systems. Water supply deliveries from Lake Livingston to Houston are forecasted to increase over the term of this agreement, which would continue to ensure that there would be no dewatering and important riffle habitat would not fill with sediment but may increase erosion.

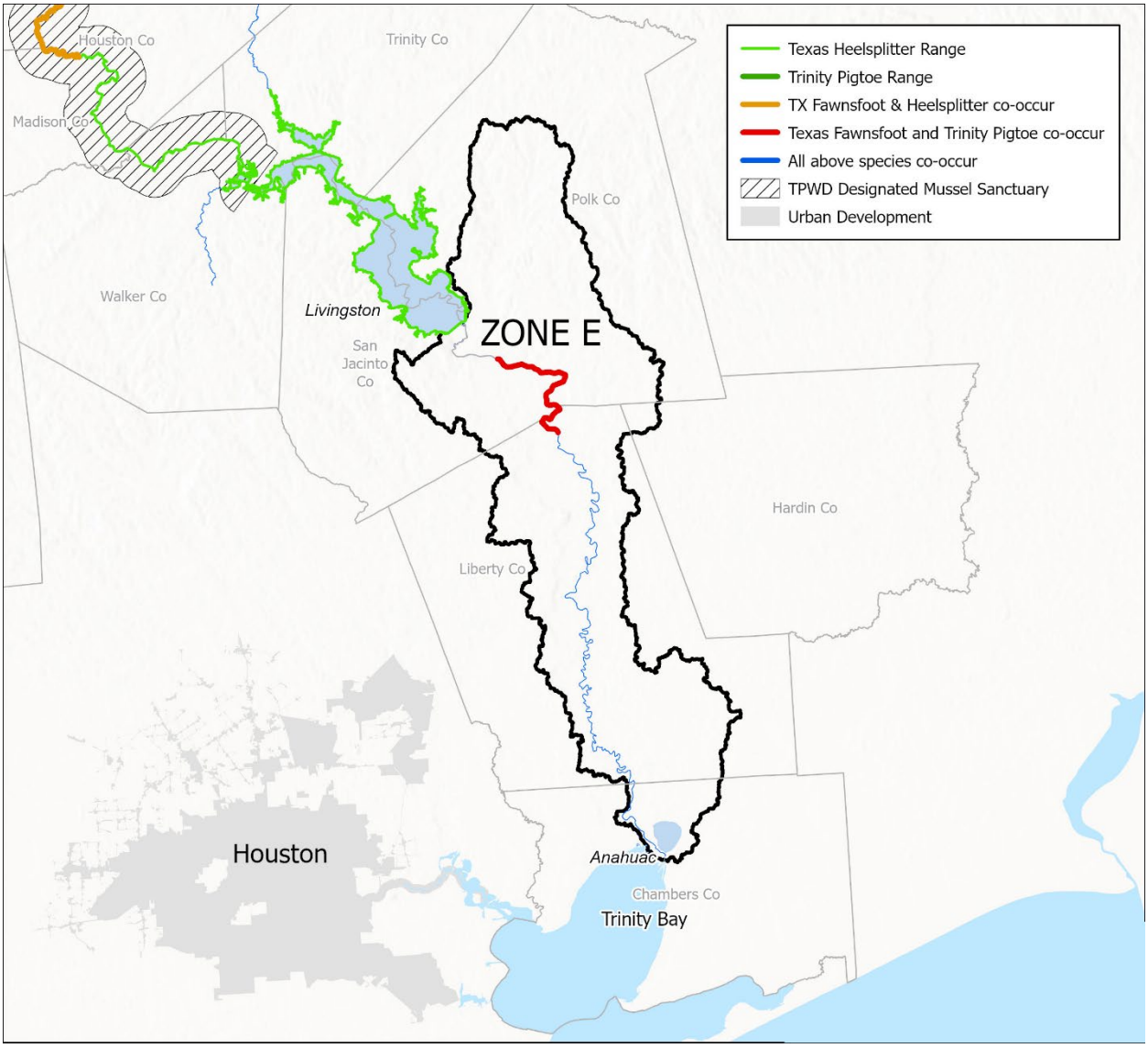


Figure 13. Map showing Conservation Zone E in the Lower Basin.

6 Threats

The USFWS has identified threats to the Covered Species as including: 1) altered hydrology, 2) degraded water quality, 3) modification, loss, or fragmentation of habitat, and (4) barriers to dispersal, which could be further exacerbated by the effects of a changing climate though are not likely measurable in the 10-year timeframe of this agreement. All of these threats can affect the Covered Species to varying degrees and are discussed in greater detail below. The Covered Parties have agreed to implement a Conservation Strategy (Section 7) designed to reduce or eliminate these threats within the Covered Area, thus providing a net conservation benefit to the Covered Species.

6.1 Altered Hydrology

While dewatering is not considered a threat in the Trinity Basin during the 10-year timeframe of this agreement (as discussed in Section 4), changes to water quantity and altered hydrology are considered ongoing threats for the Covered Species. The Trinity River Basin provides water for the DFW area in the upper part of the basin and the Houston metro area in the Lower Basin. Upstream infrastructure related to flood control and water supply reservoirs in combination with constant regional wastewater return flows from treatment plants that are further bolstered by inter and intra-basin water transfers into the Upper Basin, contracted bed and banks delivery of water, downstream senior water rights, and geography, ensure that under typical baseflow and dry weather/drought conditions *there is more water available than would be present under natural conditions* (Figure 14) (Land et al., 1998; Austin, 2006; TRA, 2017; Mangham, 2018; Clark and Mangham, 2019). These water supply and wastewater activities have resulted in baseflows that have steadily increased over the past century from less than 160 cfs to over 620 cfs (based on annual minimum 3-day mean discharge).

While TRA's water supply obligations and wastewater return flows help ensure base and low flows are sustained in the river, these same flows may also exceed conditions that mussels or other species can tolerate (e.g., water velocity and shear force), resulting in degraded habitat that may no longer be suitable for freshwater mussels or other Covered Species in the Upper Basin especially. While elevated baseflows could alter habitat, it is likely that other major operations that are outside of the Covered Parties' control have far greater influence on habitat quality. For example, the USACE operates six major flood control reservoirs and the Dallas Floodway in the Upper Basin and two flood control reservoirs in the Middle Basin. Most of these reservoirs have been in place since the 1950s and 1960s. These reservoirs capture and store excess water during periods of heavy rainfall, then release that water in a controlled manner after flood risks have subsided. The release schedule lowers the peak flows but extends the amount of time that the channel remains full. This altered hydrologic regime can cause increased erosion downstream of reservoirs due to the extended periods of higher than normal flow and reduced deposition of sediments that are captured upstream or entrained by the reservoirs. This altered hydrology is a threat to the Covered Species but is also considered a part of existing baseline conditions for the Trinity Basin.

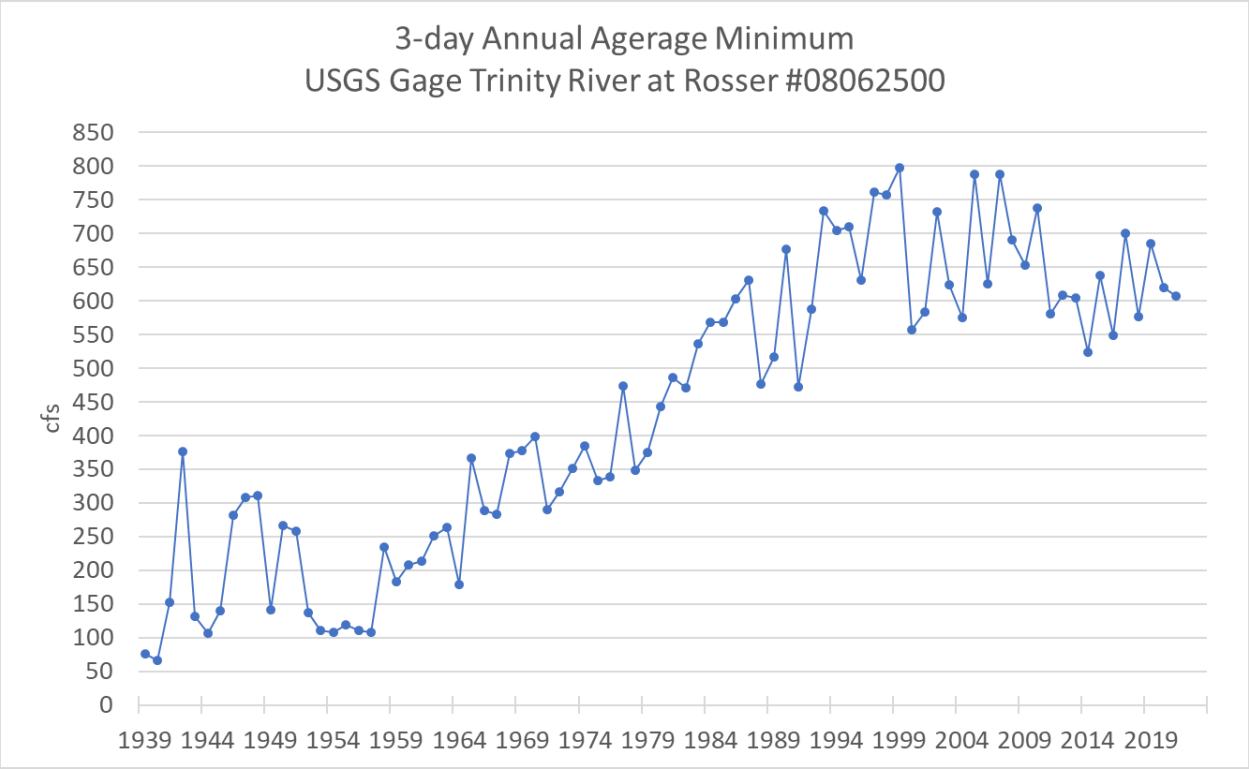


Figure 14. Indicators of Hydraulic Alteration analysis of 3-day minimum flows in the Trinity River at the USGS gage 08062500, Trinity River near Rosser, just below the DFW metro area, where baseflows have increased significantly over time.

6.2 Water Quality

While water quality improvements in the Upper Basin over the last 50 years are a success story (Section 4.1.2), the system as a whole has been significantly modified compared to pre-industrial conditions and remains heavily affected by a variety of ongoing anthropogenic activities that influence water quality. These activities include urbanization, changes to hydrology that influence water quality, agricultural practices, and a variety of point and non-point source pollution, including pollutants inherently present in effluent-dominated systems that can alter natural water quality conditions and influence survival, growth, and reproduction of the Covered Species (Chen et al., 2014). Excessive nutrients or other pollutants common to wastewater effluents can pose a threat to the Covered Species, though species-specific tolerance limits are largely unknown. Legacy contamination, such as PCBs, are also present in the river and may continue to negatively affect ecosystem health for decades.

6.2.1 Wastewater Treatment Facilities

Together, the Covered Parties operate 18 major WWTPs in the Upper Trinity River Watershed (Table 6-1 and Figure 15), which are currently permitted (as of December 2022) to discharge a

combined 978.4 MGD[19]. Of that total amount, 736 MGD is permitted to flow directly into the Trinity River or major tributary. The remainder of the discharged effluent flows into and through large reservoirs first, where it is diluted and becomes a fraction of the total volume. As previously discussed in Sections 4.1.2, 4.1.3, and 8.4, these WWTPs have been extremely important to the recovery of the water quality and fish communities that have taken place since the 1980s and prevent dewatering in the system during times of drought. While WWTPs provide significant benefits to the Covered Species, they also pose a water quality threat.

The threats posed by the Covered Parties' WWTPs are difficult to quantify for many reasons. For instance, 1) each WWTP processes is different, 2) influent characteristics are different, and 3) the receiving streams are different. In addition, from an effects standpoint, the tolerance limits for parameters like ammonia, temperature, and dissolved oxygen for the covered species are not known and are particularly difficult to determine because toxicity for many parameters varies with the ambient environmental conditions and the various freshwater mussel life stages, including host fish tolerances. For example, making a direct correlation between total ammonia and species health is difficult because each freshwater mussel species is unique, and both acute and chronic toxicity varies with, among other things, temperature and pH (Wang et al., 2007; Gates, Vaughn and Julian, 2015; Beggel et al., 2017).

It can be assumed that at some level WWTPs are a threat to the species because some literature has shown that mussel beds are lacking at some distance downstream of major WWTPs, though recent caged mussel studies in the San Antonio River Basin suggest that adult freshwater mussels can survive and grow in effluent dominated systems (Vaughn, 2020). As discussed in Section 4.1.4, WWTPs pose an inherent risk because treatment quality relies on a variety of controllable and uncontrollable factors:

1. The quality of the wastewater received at the plant is not consistent and operational decisions must be made during the treatment process;
2. Activated sludge is a biological component and many factors can affect microbial efficiency;
3. Operations rely on a consistent supply chain for components like chlorine gas[20], fuel, and electricity;
4. Unforeseen human error;
5. Equipment failure; and
6. Weather.

[19] WWTPs are regulated by the TCEQ's TPDES process described in Section 1.2. Generally, WWTPs do not discharge at the max permitted amount. According to Texas Administrative Code Rule §305.126, any sewage treatment plant facility in the state reaches 75% of the permitted average daily or annual average flow for 3 consecutive months, the permittee must initiate engineering and financial planning for expansion and/or upgrading of the wastewater treatment and/or collection facilities. By following these guidelines codified in law, the Covered Parties' WWTPs are able to accommodate the increasing flows before that treatment capacity is needed.

[20] Due to the risks of chlorine gas storage, WWTPs limit how much is stored onsite at one time.

Each WWTP will not be discussed in this CCAA, but the threats posed by the plants in aggregate will be discussed because each plant is one part of the combined effluent load that flows through the Trinity Basin to Lake Livingston.

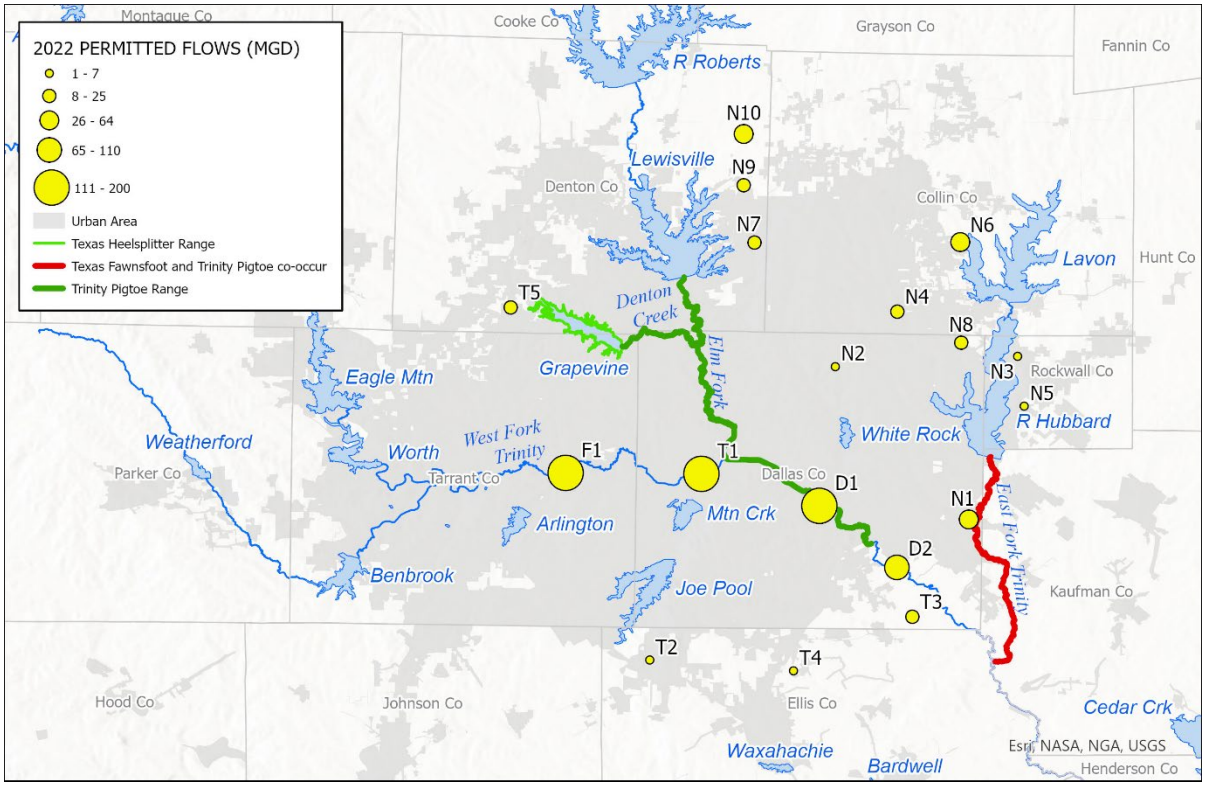


Figure 15. Map showing Covered Parties' WWTPs. Reference table below for additional WWTP information.

Table 6-1. This table shows the major (>1 MGD) WWTPs for the Covered Parties. The Map Label column corresponds to the map shown above.

EPA ID No	FACILITY NAME	PERMITTEE	COUNTY	2022 PERMITTED FLOWS (MGD)	MAP LABEL
TX0047830	Dallas Central	CITY OF DALLAS	DALLAS	200	D1
TX0047848	Dallas Southside	CITY OF DALLAS	DALLAS	110	D2
TX0047295	Village Creek	CITY OF FORT WORTH	TARRANT	166	F1
TX0047431	South Mesquite Creek	NTMWD	DALLAS	41	N1
TX0023931	Floyd Branch	NTMWD	DALLAS	4.75	N2
TX0022241	Squabble Creek	NTMWD	ROCKWALL	1.2	N3
TX0047911	Rowlett Creek	NTMWD	COLLIN	24	N4
TX0078565	Buffalo Creek	NTMWD	ROCKWALL	2.25	N5
TX0088633	Wilson Creek	NTMWD	COLLIN	64	N6
TX0103501	Stewart Creek West	NTMWD	DENTON	15	N7
TX0123561	Muddy Creek	NTMWD	DALLAS	20	N8
TX0123901	Panther Creek	NTMWD	DENTON	25	N9
TX0138584	Sister Grove	NTMWD (Online 2023)	COLLIN	64	N10
TX0022802	Central Regional	TRA	DALLAS	189	T1
TX0025011	Mountain Creek Regional	TRA	ELLIS	6.9	T2
TX0022811	Ten Mile Creek Regional	TRA	DALLAS	24	T3
TX0104345	Red Oak Creek Regional	TRA	ELLIS	6	T4
TX0104957	Denton Creek Regional	TRA	DENTON	15.3	T5

6.2.1.1 Waste Load Allocation Study

The WLA is the process that the Covered Parties use to calculate the Trinity River's assimilative capacity for constituents (i.e., the river's ability to absorb nutrients or biochemical oxygen demand loading without exceeding water quality standards), set discharge limits, and allocate that load out among the Compact members. These loadings are then codified in TPDES permit limits issued to the Covered Parties by TCEQ with overview by the EPA.

The WLA is updated[21], if needed, when the Compact's WWTPs discharge permits are modified to account for population growth and increases in wastewater discharges. The most recent WLA was completed in 2021 (Plummer Associates, Inc. 2021) using the EPA-approved modeling software QUAL2K and excerpts are included below:

> *Two models were set up: one for 2013 and one for 2017 and were set up to represent warm, effluent-dominated conditions in the Upper Trinity River. The*

[21] The original version of the WLA was completed in the 1970s and updated in 1986, 1998, 2011 and 2019-2021. There are no current plans to update the model.

goal is to derive a consistent set of algal growth and nutrient reaction rates that are representative of effluent-dominated conditions. The sequence by which water quality constituents in the model were calibrated is as follows, 1) flow, 2) temperature, 3) total suspended solids, and 4) nutrients (chlorophyll-a, total phosphorous, and total nitrogen). Once an acceptable set of model parameters was identified, that set of parameters was incorporated into a final nutrient model. The final nutrient model was used to simulate instream conditions for eight TP limit scenarios.

The model predicts that, within each discharge flow condition, none of the four TP effluent concentrations assessed produces a significant difference in the algal populations in the Upper Trinity River. The high turbidity of the river blocks a significant portion of the light needed for algae to grow. However, with less algal growth, less nutrients are assimilated; and the majority of the TP load discharged by Metroplex WWTPs is carried downstream and into the Middle Trinity River.

The model also predicts that if the major WWTPs are discharging at the full flow volumes authorized by their permits there are lower algal concentrations in the Upper Trinity River than when the major WWTPs are discharging at their 2017 flows. This is due to the lower retention time in the river produced by the higher permitted flows. With a lower retention time, less time is available for algal growth. An associated result is that a larger residual TP load enters the Middle Trinity River.

In summary, as WWTPs increase flows, loadings will increase, but model results show no change in algal growth due to the brown, turbid waters preventing the light penetration that is needed to support algal growth. Nutrients continue downstream and are assimilated in the Middle Trinity River and headwaters of Lake Livingston. Models do not exist downstream of the Trinidad gage, but a review of TCEQ Clean Rivers Program (CRP) data shows that chlorophyll-a averages remain constant (no trend) between the Trinidad gage, where the WLA model ends, and the headwaters of Lake Livingston, while average total phosphorous values slightly decrease (R^2=0.99) (Figure 16).

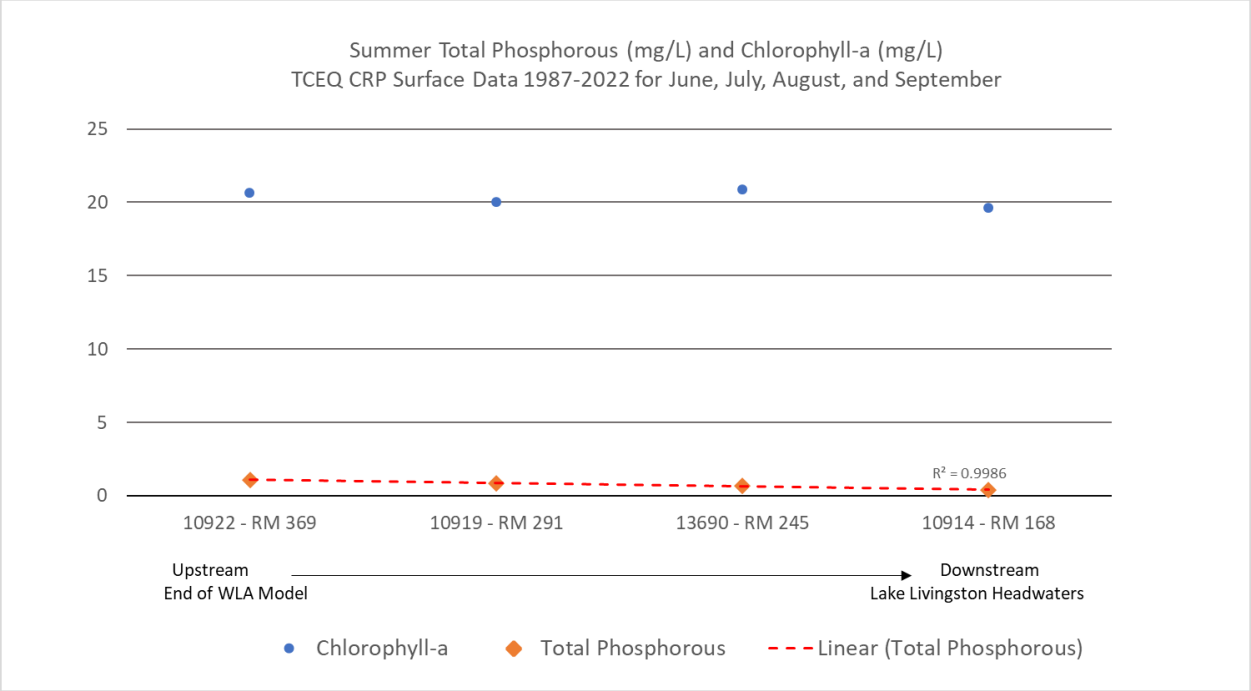


Figure 16. Graph showing average total phosphorous and chlorophyll-a at selected locations along the Trinity River between the Trinidad gage upstream and the headwaters of Lake Livingston.

6.2.2 Non-point Source

Pollutants from human activities and natural processes can be grouped into two categories based on their origin. Point source pollution is a discharge that can be traced back to a single point of origin, such as a pipe, drain, or outfall that is discharged directly into a waterway. Non-point source pollution cannot be traced back to a single point of origin and is therefore more challenging to manage. Non-point source pollutants are dispersed over the land (either through human activity or natural processes) and carried into waterways with runoff from storm events. Several factors may influence the types and amounts of pollutants that end up in a waterway, but they are primarily dependent on land use and land cover. Sources of pollutants stem from urban, rural, wildlife, and agriculture activities. Impairments from the bacterium *Escherichia coli* (*E.coli*) can stem from pet waste, livestock, wildlife, sanitary sewer overflows, and on-site septic facilities (OSSFs) failures. Nutrient concerns can stem from overirrigation, residential fertilization, pesticide application (that can suppress natural nitrogen cycles), and agricultural practices.

Sedimentation and flooding can also be considered a non-point source. Future growth, expansion, and development in a watershed can lead to increased impervious cover and decreased riparian buffers, and in turn, speed up runoff velocities and increase high peak flow that will increase erosion.

6.2.2.1 Urban Non-point Source

On-site septic facilities are used by residents for wastewater treatment. When not functioning properly, OSSFs can become sources of pollution for *E. coli*, nutrients, and solids, both in groundwater and surface water bodies. A variety of causes can be to blame for reduced performance or malfunctions, including improper use, design/installation, lack of maintenance, unsuitable soil types, age of the system, and proximity to other systems.

Feces from pets may also be a source of *E. coli* and nutrient loading to waterbodies via stormwater runoff. This may include dogs as well as cats that defecate outdoors, such as feral and barn cats. As with any non-point source, the severity of the contamination from an area is heavily influenced by the presence of impermeable soils and increasing amounts of impervious cover (e.g., buildings, parking lots) associated with ongoing development in the watershed.

Fertilizers used improperly are also of concern. Excessive nitrogen and phosphorus can enter the waterbody from improper disposal of yard clippings and excessive application of fertilizer, herbicide or pesticides on residential, commercial, industrial and agriculture lands. When fertilizers are applied overabundantly on residential properties, the excess is not utilized by the landscape and can cause eutrophication in water bodies if they run off during rain events or irrigation.

Floatables (e.g., plastics), litter accumulation, and illegal dumping can also be deemed a non-point pollutant source of *E. coli*, nutrients, and hazardous materials depending on the composition of the waste (e.g., household or construction waste; animal carcasses or hunting remains; or vehicle, furniture, and appliance disposal near or in water bodies). In addition, litter accumulation can also cause stream flow obstruction or alteration of the stream system, which would result in erosion of creek banks or impoundment of water.

6.2.2.2 Agricultural Non-point Source

Livestock that roam freely to graze can also be a contributor to non-point source *E. coli* loads, especially if they have direct access to waterbodies where they can defecate directly into or near a water body. However, poor land management practices can also affect the amount of manure *E. coli* that reaches waterbodies from upland areas by stormwater flows. If pastures are overgrazed, improperly tilled, or otherwise mismanaged for runoff potential, runoff will increase, which can deliver larger loads of *E. coli*, nutrients, and pesticides/herbicides to water bodies. In addition to *E. coli* and nutrient inputs from grazing livestock, production agriculture may also contribute other types of non-point source pollution to waterways, including nutrients from fertilizers, herbicides, and pesticides.

6.3 Degradation, Loss, and Fragmentation of Habitat

Natural and anthropogenic factors can lead to degradation, loss, or fragmentation of habitat for the Covered Species. For example, changes to water quantity or quality have the potential to degrade Covered Species habitat. Sedimentation from runoff and erosion can alter substrate conditions and lead to degradation of habitat and smothering or scouring riffle habitat while

inundation by reservoirs or desiccation during drought conditions can lead to loss of habitat. Fragmentation can occur as Covered Species populations become separated by dams, drought, or expanses of poor-quality habitat. Such fragmentation can restrict gene flow and result in genetic isolation of previously connected populations (BRA and USFWS, 2021).

Rivers and streams are a direct reflection of the hydrologic and geologic characteristics of their watershed, which directly affects each river's pattern, plan, and profile (Lane, 1954; Leopold et al., 1964; Brandt, 2000; Rosgen, 2006). According to Lane's Balance, if there is change or disturbance of the watershed that changes the flow or sediment regime, instream changes are inevitable. Changes within a watershed, such as residential development, deforestation, or other changes to land use or condition, can alter aquatic ecosystems and lead to degradation or loss of habitat for the Covered Species (Poole and Downing, 2004).

Alterations to landscapes within watersheds have significantly affected the Trinity River. The Upper Basin has experienced significant channel widening and downcutting of the channel bed due to elevated base flows, prolonged bankfull releases of stored flood waters, trapped sediment supply in upstream reservoirs, and increases in impervious surfaces (e.g., paved roads, concrete foundations, etc.). The Middle Basin is subjected to the same flow dynamics as the Upper Basin, though they are attenuated as the water moves downstream. In the Middle Basin, some agricultural practices like removal of riparian habitat, results in significant bank erosion and collapse, which can cover substrates preferred by mussels and suffocate native mussels. Erosion and sedimentation are considered a threat to the Covered Species in the Trinity River Basin.

Riparian area disturbance is a threat to the Covered Species throughout the Trinity River Basin. Among other benefits, healthy riparian zones can directly impact mussel populations by reducing nutrient loading, filtering particulates from runoff, reducing velocities during high flow events, and providing spawning habitat for host fish. There is a direct relationship between the quality of a river's riparian zone and the status of freshwater mussels and their habitat (Hastie et al., 2003; Poole and Downing, 2004). Riparian habitat can be affected by urban development and infrastructure projects as well as improper agriculture practices like plowing fields up to the streambank and allowing cattle direct access to streams. Uninhibited access of livestock to streams destroys the vegetation that protects the banks and degrades water quality.

6.4 Barriers to Dispersal

Dispersal of mussels is dependent on movement of host fish and serves several important functions such as connecting subpopulations within the occupied range of a species or allowing a species to move into formerly uninhabited areas (Strayer, 2008). Degradation and loss of habitat due to anthropogenic actions may lead to large sections of unsuitable mussel habitat, thus reducing dispersal success (Strayer, 2008). Dams can act as permanent barriers to host fish movement, and hydroelectric dams may impinge or entrain hosts and result in mortality (Watters, 1996; Newton et al., 2008; Rytwinski et al., 2017).

The underlying geology of the Middle Basin may affect host fish migration under certain circumstances, such as during low and base flow conditions. A portion of the Middle Trinity has marl outcrops which create small waterfalls and very shallow riffles during base and/or low flow conditions. Natural physical barriers, such as waterfalls associated with resistant geological formations, are thought to potentially restrict host fish movement and subsequently affect the structure of mussel communities although recent genetic diversity studies have produced conflicting evidence regarding gene flow among certain species of host fish and unionids (Kelly and Rhymer, 2005; Haponski et al., 2007; Szumowski et al., 2012). Evidence presented by Watters (1996) suggested that low head dams as small as 1 meter high are problematic for the distribution of host fish, particularly for benthic species, such as freshwater drum. Given the apparent similarity in structure and hydrological function, the geological outcrops along the Middle Trinity could present similar migratory obstacles. Also located in this reach are four river locks (Locks 2 through 5), which likely were constructed on similar geological formations. The existing locks, although continuously left open since construction in the early 1900s, may be contributing similarly in part as a migratory barrier. Low head dams are also in the Upper Basin for grade control in the Fort Worth Floodway and as part of existing and historical water supply intake structures.

6.5 Direct Mortality and Overutilization for Commercial, Recreational, Scientific, or Educational Purposes

6.5.1 Freshwater Mussels

Historically, the commercial harvesting of freshwater mussels for buttons and the pearl industry was common (Haag, 2012). In 2010, TRA staff encountered a commercial harvesting boat in the Middle Basin which was being used to harvest freshwater mussels. TPWD controls commercial freshwater mussel harvesting permits for Texas; as of 2022, there is a moratorium on the issuance of new permits. The Texas Department of Health and Human Services has issued a consumption ban on all freshwater mussel species in Texas, though harvesting up to 25 pounds of whole freshwater mussels per person, per day for recreational fishing bait is legal with a state fishing license[22]. The data for commercial and recreation harvesting of freshwater mussels are not available, but present-day numbers are not believed to be significant (Winemiller et al., 2010).

With the increase in freshwater mussel-related field work since 2012, scientific research itself could pose a threat to the Covered Species. Due to the difficulty in accessing much of the Trinity River, especially in the Middle Basin, many of the known mussel beds are near public access points. There is concern across the state that research projects could cause excessive stress on these more accessible animals and result in unintentional take of the covered mussel species. To mitigate this concern, the Freshwater Mussel Workgroup, chaired by the USFWS, meets

[22] 2021-2022 TPWD fishing regulations.

annually to coordinate research efforts. All research implemented as part of this CCAA will be coordinated with the above-mentioned workgroup.

6.5.2 Turtle Species

The commercial and recreational harvest of Alligator Snapping Turtles and Western Chicken Turtles is illegal in Texas. The exact number of Alligator Snapping Turtles and Western Chicken Turtles taken as recreational by-catch or during harvest for scientific purposes is unknown, but TPWD expects this to be minimal because a scientific collection permit and annual reporting is required (USFWS, 2021a). Harvest of Alligator Snapping Turtles as by-catch during recreational and commercial fishing, along with poaching and habitat loss, are believed to be the primary threats to the species (USFWS, 2021a). Estimates vary, but Alligator Snapping Turtles are believed to number in the thousands in the Trinity River Basin (USFWS, 2021a).

In the Gus Engeling Wildlife Management Area near the Trinity River in the Middle Basin, 221 Western Chicken Turtles were captured between February 4 to July 6, 2015 (Ryberg et al., 2017). Due to the difficulties in sampling these species, exact numbers of Western Chicken Turtle are not known. Habitat modeling suggests that significant habitat is available in the Trinity River Basin (Ryberg et al., 2017).

6.5.2.1 Habitat Loss and Fragmentation

Western Chicken Turtle is considered rare and declining, though no systematic population surveys have been completed. This species requires multiple, adjacent habitat types and, as such, populations are very difficult to quantify. According to Ryberg et al. (2017), Western Chicken Turtle habitat in Texas is currently threatened, and most likely will continue to be threatened by wetland loss and fragmentation caused by urbanization. Ryberg et al. (2017) surmise that there has been a significant loss of prime wetland habitat around the Greater Houston area between 2001 and 2011, but that the urbanization in and around the DFW area has not been as significant for the Western Chicken Turtle because less desirable habitat has been urbanized.

6.5.2.2 Poaching

In 2016, Texas Game Wardens and the USFWS Law Enforcement Office investigated an illegal, multistate Alligator Snapping Turtle poaching crime which resulted in several federal convictions. Alligator Snapping Turtles were illegally being taken from Texas and transported to Louisiana where they were sold primarily for human consumption. Though the full extent of illegal poaching operations is unknown, it is considered a major threat to the species. A variety of turtle species are collected legally and illegally in the U.S. as part of the pet trade. The level to which this activity is affecting Alligator Snapping Turtles or Western Chicken Turtles is unknown although anecdotal evidence suggests it is likely impacting these species on some level (USFWS, 2021a), and rare or at-risk species are often highly sought after.

6.5.2.3 Bycatch

Bycatch is the harvest of a non-target species incidental to fishing or recreational activities intended for other species. Alligator Snapping Turtles are drawn to the same bait that commercial and recreational anglers use on rod and reel, trot lines, nets, and handlines. Alligator Snapping Turtles can drown when they become entangled in lines or be killed by complications encountered when ingesting hooks or line (USFWS, 2021a; Enge et al., 2014). By-catch is believed to be a significant threat for this species (USFWS, 2021a).

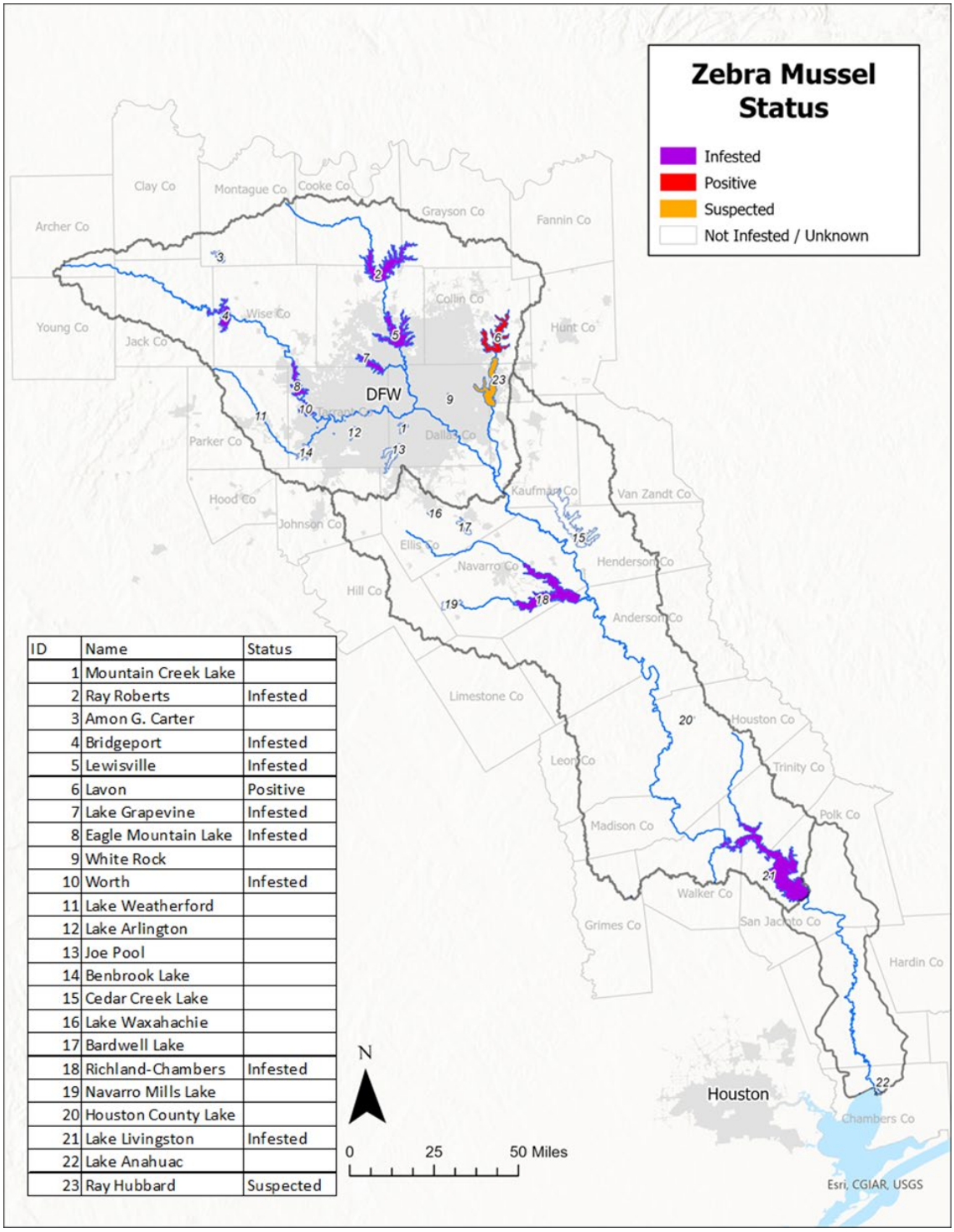
6.6 Climate Change

The Intergovernmental Panel on Climate Change (IPCC 2022) has identified rising sea levels, rising temperatures, and more frequent severe storms and droughts as threats from climate change. While the threats from climate change may have negative effects on the Covered Species, some of those threats may be mitigated due to the operational realities in the Covered Area. As mentioned in Section 4, extended drought is expected to have minimal effects on baseflows and temperature due to the Covered Parties' water supply operations. Because increased baseflows can mitigate the temperature effects from increasing air temperatures, within the 10-year timeframe of this agreement, water temperature is not expected to rise measurably.

According to the IPCC 2022 Report, sea level is expected to rise between 1.5 – 2 feet by 2050 in the Gulf of Mexico region. Assuming a linear trend over the 10-year term of this agreement, a 0.5 to 0.7-foot rise in sea level is not expected to impact the Covered Species due to the long distance from the known location of the lowermost Covered Species of freshwater mussel to the coast (Figure 13).

6.7 Invasive Species

Zebra mussels (*Dreissena polymorpha*), native to the Caspian and Black Sea, are small exotic freshwater mussels that were brought into the Great Lakes in cargo ship ballast water. The first zebra mussel infestation in Texas was found in Lake Texoma in 2009. Since then, zebra mussels have spread to many parts of Texas. According to TPWD, 10 of the major reservoirs in the Trinity River Basin have been designated as either suspected, positive, or infested for zebra mussels. Though some minor colonization may occur in rivers, zebra mussels have historically reached problematic densities in reservoirs. Zebra mussels compete with native mussels for food and resources. They use bissel threads to attach to virtually any solid surface, including other mussel species, preventing native mussels from filter feeding properly and ultimately leading to mortality (Nichols and Wolcox, 1997; Baker and Levinton, 2003). Zebra mussels are considered a threat to Texas Heelsplitter because both inhabit Lake Grapevine and Lake Livingston.



ID	Name	Status
1	Mountain Creek Lake	
2	Ray Roberts	Infested
3	Amon G. Carter	
4	Bridgeport	Infested
5	Lewisville	Infested
6	Lavon	Positive
7	Lake Grapevine	Infested
8	Eagle Mountain Lake	Infested
9	White Rock	
10	Worth	Infested
11	Lake Weatherford	
12	Lake Arlington	
13	Joe Pool	
14	Benbrook Lake	
15	Cedar Creek Lake	
16	Lake Waxahachie	
17	Bardwell Lake	
18	Richland-Chambers	Infested
19	Navarro Mills Lake	
20	Houston County Lake	
21	Lake Livingston	Infested
22	Lake Anahuac	
23	Ray Hubbard	Suspected

Figure 17. Status of zebra mussel infestation for reservoirs in the Trinity Basin.

7 Covered Activities

7.1 Conservation Activities

The Covered Parties all have ongoing Conservation Activities which include water quality monitoring, biological monitoring, riparian and instream data collection, and other activities which are designed to monitor the health of the ecosystem. These activities are an integral part of protecting the environment and provide information to federal, state, and local conservation managers. Although research activities may have short-term impacts, these efforts will continue and are designed to benefit the Covered Species in the long-term. When coupled with the additional conservation planned as part of this agreement, these combined efforts are expected to provide a net conservation benefit over the life of this CCAA that far exceeds any short-term impacts. Scientific research and methods that directly affect the Covered Species will be coordinated with the USFWS and TPWD.

7.2 Water Supply and Reservoir Operations

Supplying water to meet the needs of millions of residents of the Trinity River Basin is a complicated and difficult task. The State of Texas completes a State Water Plan every 5 years that describes current and future water demand and how it will be met. The State Water Plan is assembled by the Texas Water Development Board (TWDB) based on Regional Water Plans submitted by 16 Regional Water Planning Districts from across the state. During the timeframe of this 10-year Agreement, the TWDB expects the DFW and Houston areas to grow by approximately 8% combined. This future demand will increase the amount of water in the river due to increases in consumption for municipal use and corresponding increases in municipal wastewater return flows to the Upper Basin, as was described in Section 4.

This CCAA covers water supply operations including the current and future day-to-day tasks of reservoir gate operations, inspections, maintenance, repairs, cleaning, pumping operations, emergency repairs, contractually or permitted releases, permitted and future diversions, current and future water supply imports, and impoundment of water for water supply and flood control purposes. The Trinity Basin will require more water in the future to support a growing population, and nothing in this CCAA precludes the Covered Parties from seeking additional sources of water through the TCEQ permitting water rights appropriation process. These operations could cause take of the Covered Species as described in Sections 6.1, 6.2, 6.3, and 6.4.

Reservoirs in the basin are operated according to each reservoir's Gate Operations Procedures and specific design specifications[23]. These engineering documents guide day-to-day operations

[23] If hydropower is produced from a reservoir, then reservoir operations may have additional procedures and requirements put in place by the Federal Energy Regulatory Commission (FERC).

and maintenance and must be followed to ensure safe reservoir operations. The seven non-USACE reservoirs in the Trinity River Basin that are covered in this CCAA are listed in (Table 7-1). Reservoirs managed by the USACE are not included or covered by this CCAA.

Table 7-1. Lakes Owned and Operated by the Compact or TRWD

Lake	Owner/Operator	Dam Location	Use*	Zebra Mussel Status
Bridgeport	TRWD	Upper West Fork Trinity	F, WS, R	Infested
Eagle Mountain	TRWD	Upper West Fork Trinity	F, WS, R	Infested
Worth	Fort Worth	Upper West Fork Trinity	WS, R	Infested
Lake Ray Hubbard	Dallas	East Fork Trinity	WS, R, H	Suspect
Cedar Creek	TRWD	Cedar Creek	WS, R	N/A
Richland Chambers	TRWD	Richland and Chambers Creeks	WS, R	Infested
Livingston	TRA	Trinity River Mainstem	WS, R, H	Infested

* F – Flood Management, WS – Water Supply, R – Recreation, H - Hydropower

7.3 Levee, Dams, Bulkheads, Boat Dock, Boat Ramps, and Instream Structures

The Covered Parties are responsible for the routine repair and maintenance of instream infrastructure (e.g., intakes, outfalls, meters, pipelines, etc.), bulkheads, dams, boat docks, boat ramps, and levees. Examples of routine repair and maintenance activities include dredging, mowing, manual clearing of vegetation, stabilizing disturbed soils, installing temporary erosion control structures (including silt fencing, silt boxes, earthen berms, etc.), temporary fencing, temporary coffer dams, relocation of existing utilities, remediation, restoration of disturbed gradients to original contours, temporary placement of construction materials and structures, and mobilization and demobilization of equipment. *This agreement does not supersede any additional state or federal permitting requirements (e.g., Section 7 of ESA) that may be required for some of these activities.* These routine operations are designed to identify and prevent problems before they arise, thus protecting the environment, to include the Covered Species. When undertaking these activities, the Covered Parties will follow the Conservation Measures described in Section 8.10, Site-level Disturbances.

7.4 Wastewater Treatment[24]

The benefits of high-quality WWTPs, especially the Covered Parties' Regional WWTPs, have been discussed at length in Sections 4.1.2, 4.1.3, and 8.4. While WWTPs have been documented in scientific literature to show decreases in freshwater mussels for some length downstream, they are also the reason that water quality has rebounded substantially in the Trinity River above Lake Livingston since the 1980s (Section 4). From a hydrologic perspective, the Covered Parties' WWTPs operations, contracts, and agreements ensure that these systems are not

[24] This section excludes TRWD as they do not operate wastewater treatment plants.

dewatered during periods of drought. Section 6.1 describes the hydrology of the basin in detail. The routine operation of permitted water and WWTPs are covered by this agreement. Detailed descriptions of the Covered Parties' WWTPs have been outlined in Sections 4 and 6.2.1. Examples of these operations include routine plant and pipeline operations and maintenance and the discharge of treated effluent. Nothing in this agreement will prevent the Covered Parties from seeking to expand these operations through the appropriate permitting processes.

7.5 Pipelines

The Covered Parties own and operate hundreds of miles of pipelines to move treated water, raw water, and wastewater which are located primarily in Zones A, B, and C. Although these pipelines are extensive, there are less than 15 locations, with each footprint being <100 feet, where the pipelines cross the Trinity River or one of the major forks. Of those, only four cross within known occupied mussel habitat (two in Zone B and two in Zone C). Where they do, the Covered Parties commit to following the guidelines outlined in Section 8.10 Site-level Disturbances if there are any potential impacts to the habitat; however, routine inspections and maintenance activities would generally consist of cleaning of siphons, inspecting pumps, CCTV internal pipeline inspections and would not be expected to disturb habitat. For new construction, though not covered in this CCAA, the Covered Parties commit to routing pipelines to avoid river crossings and/or using boring techniques to prevent disturbance of the bed and banks whenever feasible. Pipeline operations, inspections, repairs, and maintenance activities are covered by this agreement. This agreement does not supersede any additional state or federal permitting requirements that may be required for some of these activities.

7.6 Invasive Aquatic Plant Control

Aquatic invasive plant species like Giant Salvinia (*Salvinia molesta*), Water Hyacinth (*Eichhornia crassipes*), and Hydrilla (*Hydrilla verticillate*) are serious threats to aquatic ecosystems. One effective measure to control these invasive plants is chemical treatment. These treatments are applied according to state and federal laws, permits, best management practices (BMPs), and manufacturers' recommendations. Chemical treatment of invasive plant species will be covered by this agreement. These operations are discussed further in Conservation Measures in Section 8.9.

7.7 Boat Dock and Pier Permitting

The Covered Parties issue permits for construction of boathouses and piers by individual homeowners and/or businesses on the reservoirs they own and operate through a General Permit from the USACE. These permits are designed to streamline the permitting process between the USACE, Covered Parties, and the property owners. Permitting of boat docks and piers will be covered by this agreement so long as the Covered Parties operate within the General Permit requirements set forth by the USACE, which included Section 7 consultation under the ESA when it was issued and every 5 years thereafter when the permit is renewed.

8 Conservation Measures

CCAAs are required to provide "net conservation benefit" to the Covered Species. Because the Covered Parties operate within but do not own, control, or regulate the Covered Area (described in detail in Section 4) and contribute to only a portion of the overall stressors to the Covered Species (Section 4), the Conservation Measures described in this section cannot address all of the threats to the Covered Species. *Due to the inherent nature and function of the Trinity River Basin, described in detail in Section 4, and the lifecycle of the Covered Species, Conservation Measures outlined in this Section should be considered cumulatively.* As such, they provide the required "net conservation benefit" to the Covered Species by addressing the threats that fall within the operational control of the Covered Parties. These Conservation Measures are described in detail in the remainder of this section and are summarized below in Table 8-1.

Table 8-1. Table summarizing the Conservation Measures.

Threat Category	Conservation Measure	Threats Addressed	Priority Zones
Altered Hydrology	Mainstem Environmental Flows Protections	Dewatering	All
Altered Hydrology	Stream Restoration Activities	Scour, streambank failures, and sedimentation	B, C, E
Altered Hydrology	USGS Flow and Water Quality Monitoring	Dewatering, scientific data gaps	All
Altered Hydrology	Hydraulic and Hydrologic Monitoring	Scientific data gaps	B, C
Water Quality	WWTP Effluent Discharge Limits	Toxicity	B, C
Water Quality	Caged mussel studies	Scientific data gaps	B, C
Water Quality	Long-term Monitoring for Mussels	Scientific data gaps and feedback for Adaptive Management	B, C, E
Water Quality	Modeling	Scientific data gaps	B, C
Water Quality	Instream Water Quality Monitoring	Toxicity, scientific data gaps, habitat degradation	B, C
Water Quality	Stream Restoration	Sediment Reduction	B, C, E
Degradation, Loss, Fragmentation of Habitat	Instream Flow Protections Avoid and Minimize Site-Disturbance of Occupied Habitat	Dewatering, temperature limits	B, C, D, E
Barriers to Dispersal	No construction of new permanent dams on Trinity River mainstem	Barriers to Dispersal	B, C, D, E

Threat Category	Conservation Measure	Threats Addressed	Priority Zones
Direct Mortality, Overutilization for Commercial, Recreational, Scientific, or Educational Purposes	Public Education and Outreach, Participate with Freshwater Mussel Group	Bycatch, poaching	All
Direct Mortality, Overutilization for Commercial, Recreational, Scientific, or Educational Purposes	Signage and Online Public Reporting Tool	Bycatch, poaching	All
Climate Change	Discharge of treated effluent	Dewatering, temperature limits	A, B, C
Invasive Species	Zebra Mussel Monitoring	Direct mortality, habitat degradation	All
Invasive Species	Invasive Aquatic Plant Eradication	Habitat degradation	A, B, C, D
ALL	Use Adaptive Management to implement voluntary Reasonable Risk Minimization Measures	Allows for new threats to be managed as they are identified by evolving science through implementation of additional conservation	All

Conservation measures implemented as part of this CCAA to benefit the Covered Species of mussels are based on recommendations from the Freshwater Mollusk Conservation Society's National Strategy for the Conservation of Native Freshwater Mollusks (2016) shown in Table 8-2 and detailed in the remainder of this Section.

Table 8-2. Issues and conservation goals identified in the Freshwater Mollusk Conservation Society's National Strategy for the Conservation of Native Freshwater Mollusks (2016).

Number	Issues	Goals
1	Increase knowledge of the distribution and taxonomy of mollusks at multiple scales over time and make that information available.	Understand the status and trends of mollusk populations to better manage and conserve.
2	Address the impacts of past, ongoing, and newly emerging stressors on mollusks and their habitats.	Minimize threats to mollusks and their habitats.

Number	Issues	Goals
3	Understand and conserve the quantity and quality of suitable habitat for mollusks over time.	Increase understanding of physical, chemical, and biological characteristics of habitat to support sustainable assemblages of mollusks.
4	Understand the ecology of mollusks at the individual, population, and community levels.	Increase fundamental knowledge of the biology of mollusks so managers can more effectively conserve them.
5	Restore abundant and diverse mollusk populations until they are self-sustaining.	Conserve and restore viable populations and communities of mollusks.
6	Identify the ecosystem services provided by mollusks and their habitats.	Improve science-based consideration of the social and economic values of mollusk communities and functioning aquatic systems.
7	Strengthen advocacy and build support for the conservation of mollusks and their habitats.	Increase information sharing and communication among citizens and decisi on-makers at multiple levels regarding conserving mollusk resources.
8	Educate and train the conservation community and future generations about the importance of mollusks to ensure conservation efforts continue into the future.	Provide a suite of training opportunities to the greater conservation community and inspire future generations to work on the conservation of mollusks.
9	Seek consistent, long-term funding to support mollusk conservation efforts.	Increase funding for mollusk conservation.
10	Coordinate a national strategy for the conservation of mollusk resources.	Increase coordination and information sharing among local, state, national, and international partners in conserving mollusk resources.

The Conservation Measures for Covered Species of turtles described in the CCAA are based on recommendations from resource managers, academic research, and USFWS and TPWD species experts, relying primarily on the use of BMPs[25] to reduce the threats.

[25] BMPs include avoiding, when possible, the removal of woody debris in the channel, typical construction BMPs like erosion and sediment barriers, habitat restoration, etc.

Due to the existing data gaps on basic life history, movement patterns, and areas occupied by the species, only limited, species-specific Conservation Measures that address direct impacts are proposed at this time. However, research is ongoing and future work is planned that may identify new Conservation Measures in the future. When more refined BMPs are developed and recommended by the scientific community, the Covered Parties will review and implement those BMPs during Covered Activities to the extent they are able to do so while also meeting the needs of their customers as long as the effort level fits within the existing framework of this CCAA.

The remainder of this section outlines the Conservation Measures the Covered Parties commit to completion or continuing for the timeframe of this CCAA.

8.1 Non-point Source Watershed Protection

Threats addressed: Altered Hydrology, Water Quality, Degradation, Loss, and Fragmentation of Habitat

As described in Section 4.1.1, the Covered Parties represent only a fraction of the threats to water quality in the basin because the water in the system is a mix of urban and agricultural non-point source runoff and WWTP effluent (discharges from the Covered Parties' WWTPs, other municipal WWTPs, small package plants, and local OSSFs). To benefit the Covered Species, both point and non-point sources of pollution need to be addressed (Section 6.2.2). The Covered Parties currently manage or participate as stakeholders in five large-scale watershed protection plans (WPPs), discussed later in this section, which are designed to reduce pollution through planning, public outreach, and on-the-ground projects. The Covered Parties are not required to create these programs but do so to help address water quality issues that improve the quality of water supplies and the environment, to include the Covered Species.

Some of the Covered Parties' WPPs are partially funded by the TCEQ Non-point Source Program, which is a federally funded program usually requiring a 40% local match under Clean Water Act Section 319(h) to reduce and prevent water pollution caused by runoff from *urban and other non-agricultural non-point sources*. Others are funded by an adjacent program within the Texas State Soil and Water Conservation Board (TSSWCB) which is a federally funded program designed to reduce and prevent water pollution caused by runoff from agricultural and silvicultural non-point sources. Other WPP efforts are funded entirely by the Covered Parties' internal funds.

Unlike WWTPs, non-point source pollution is challenging to manage since it cannot be traced back to a single point of origin. Pollutants are dispersed over the land (either through human activity or natural processes) and carried into waterways with runoff from storm events. Sources of pollutants may include excess agricultural or residential fertilizers; fluids from leaking vehicles; pet waste from yards or urban public areas; leaking septic facilities; or waste from wildlife, livestock, and feral hogs. Overall, water quality can be improved by reducing

sediment because excess and suspended sediment in waterbodies is known to harbor bacteria and nutrients, decrease die-off of bacteria, impact dissolved oxygen levels, alter flow regimes, and decrease water supply and flood control capacity. Future growth, expansion, and development can lead to decreased riparian buffers, and in turn, speed up runoff velocities that will increase erosion. Sedimentation in streams and lakes will increase and thus impact aquatic life, harbor bacteria, and potentially impact water supply capacity.

Because these programs are designed to be driven by local stakeholders in each specific subwatershed, the creation of new WPPs cannot be guaranteed. However, for the term of this CCAA, the Covered Parties commit to:

1. Continuing to administer the implement existing WPPs (described later in this section);
2. Actively seek opportunities to create new WPPs, or similar programs, within the basin; and
3. Design a watershed prioritization tool to delineate, rank, and prioritize the subwatersheds in Zone C (where enhancement potential is the highest) so that WPP efforts can be targeted to the subwatersheds that can provide the most benefit for the Covered Species.

TRA's WPPs

The Covered Parties participate and fund several large-scale WPPs in the Trinity River Basin. Specifically, the TRA has developed the Village Creek-Lake Arlington Watershed Protection Plan (VCLA WPP) and the Joe Pool Lake Watershed Protection Plan (JPL WPP). VCLA WPP was accepted by the EPA in 2019 and JPL WPP was accepted in 2022. The acceptance by EPA provides local planning partners with access to state and federal assistance programs that will encourage sustainable development as the watershed continues to urbanize as well as funding to implement strategies that mitigate non-point source pollution. In 2022, TRA received funding from the National Fish and Wildlife Foundation – Five Star and Urban Waters Restoration Grant Program to implement a trash reduction management strategy identified in the VCLA WPP. The implementation project focuses on reducing trash in the waterways of the City of Fort Worth and within the VCLA watershed. TRA has also been awarded Clean Water Act Section 319(h) funding to implement an OSSFs program within both Joe Pool Lake and Village Creek-Lake Arlington watersheds which will document the location of OSSFs and repair or replace up to 10 non-working OSSFs resulting in a direct benefit to aquatic species, to include the Covered Species. This project will begin in the fall of 2023.

NTMWD WPPs

North Texas Municipal Water District developed the Lavon Lake WPP in 2017 and has begun implementation of the plan in the watershed. NTMWD has implemented multiple management strategies that mitigate non-point source pollution in the Lavon Lake watershed. To date, NTMWD has funded a full–time Watershed Technician at the Collin County Soil and Water Conservation District that works with agriculture producers to develop and implement water

quality management plans on agricultural lands in the watershed, water quality monitoring, green stormwater installations, education and outreach workshops, tree plantings, and the purchase of a stream hydrology demonstration trailer. In 2020, the Natural Resource Conservation Service (NRCS) identified Lake Lavon watershed as a priority watershed to develop and implement projects geared towards reducing erosion and nutrients.

The NTMWD East Fork Water Reuse Project significantly mitigates non-point source pollution. The wetland acts as a large-scale recycling project, diverting treated wastewater flows from the East Fork of the Trinity River and filtering it naturally before it is returned to blend with other water supplies for future treatment and use. This reuse project not only actively cleans water, but it prevents the need to create other water supplies to fill basin needs.

Additionally, NTMWD recently completed the Bois d'Arc[26] Lake WPP. It was accepted by the EPA in 2022. While that WPP is outside of the Trinity River Basin, water from Bois d'Arc is pumped into the Trinity River Basin.

TRWD WPPs

Tarrant Regional Water District developed the Lake Worth Vision Plan in partnership with the City of Fort Worth in 2011. They also developed the Eagle Mountain Lake Watershed Protection Plan in 2016. Currently, the Cedar Creek Lake and Richland Chambers Reservoir WPPs are in development. TRWD and others assist local agencies, such as the Ellis-Prairies and Navarro County Soil and Water Conservation Districts, in helping agricultural producers implement conservation practices. These practices are designed to slow or capture runoff during storm events which directly reduces pollution in Zone C. Additionally, they fund education and outreach workshops.

8.2 Stream Restoration Activities

Stream and streambank restoration projects, riparian habitat protection and restoration, and upland BMPs[27] can improve both the quality and quantity of habitat available for the Covered Species by reducing the sediment and pollutant loadings and slowing runoff, thereby reducing shear stress which can decrease erosion. Because the Covered Parties *have no permitting or regulatory authority and only own an insignificant amount of property along the Trinity River*, the Covered Parties cannot commit to stream restoration. However, the Covered Parties have a long track record of partnership and cooperation with federal and state agencies, and they have successfully completed or are currently working on Clean Water Act Section 319(h) Watershed Protection Plans in Zones A, B, and C, which require intensive cooperation with the public and landowners. The Covered Parties commit to working with local stakeholders and state and

[26] Bois d'Arc is not in the Trinity basin, but water from that lake is pumped into Lake Lavon in Zone A to supplement water supplies.

[27] These BMPs include activities like restoration of riparian buffer zones, creation of bioswales, contour farming, methods to reduce over fertilization of fields, implementing no-till farming practices, etc.

federal agencies to identify locations, partners, funding opportunities, and project management for habitat restoration projects and the implementation of BMPs within the Covered Area.

8.3 Participate in the USACE Sustainable Rivers Project

Threats addressed: Altered Hydrology, Water Quality, Degradation, Loss, and Fragmentation of Habitat

The USACE Sustainable Rivers Program is designed to identify and implement environmental strategies at the USACE's water infrastructure projects that are designed to restore and protect ecosystems. This program is beginning at the USACE Fort Worth District in 2023, and the study will last several years. The Covered Parties agree to participate in the USACE stakeholder process and technical review to ensure that the Covered Species needs are considered during the USACE review of their operations. This multi-year effort could result in the modification of USACE reservoir operations in Zones A and C to, for example, provide flows, or modify existing flow rates and durations that maintain or improve habitat for the Covered Species.

As discussed in Section 7.2, the Covered Parties' reservoirs are not designed to have flood storage. They do have flood flowage easements to aid in operations but are not authorized to store flood waters. As such, the Covered Parties are unable to minimize the impacts of high flows through their reservoirs. The USACE is authorized to store flood waters and participation in the Sustainable Rivers Program could identify strategies and operational changes the USACE could make to reduce the threats to the Covered Species from high flows.

8.4 Regional and Large-scale Wastewater Treatment

Threats addressed: Altered Hydrology, Water Quality, Degradation, Loss, and Fragmentation of Habitat, Climate Change

As discussed in Section 4.1.3, large-scale Regional WWTPs in the DFW area have been instrumental in restoring water quality and fish assemblages to include the known or presumed host fish for the Covered Species in the Upper and Middle Trinity River.

Simply, most of the Covered Parties' major regional WWTPs use "activated sludge" as one part of the wastewater treatment process. This is a process whereby microorganisms are introduced to the wastewater under controlled conditions within a highly oxygenated holding tank. The microorganisms oxidize organic pollutants that produces a solid which is then removed. The healthier the microorganism community, the better the quality of the wastewater. To protect the treatment plants, the covered parties will continue to fund and implement industrial pre-treatment programs, described in Section 4, to ensure that industrial facilities are meeting their permit requirements, which helps the WWTP treatment process and ensure proper function of the facility. When needed, the Covered Parties will continue to investigate illicit discharges, discussed in Section 4, by deploying sampling equipment within the system and tracing potential sources of illicit discharges. If located, the Covered Parties will work with stakeholders to stop the illicit discharges.

Where appropriate, the Covered Parties will continue to support the regionalization of WWTPs through comments on new and renewing water quality permit applications to TCEQ and will work with local development permitting entities like cities and counties to encourage and or require new developments to tie into existing regional WWTPs when they are within an existing service area or facilitate new ones when feasible. As stated before, the Covered Parties will work with stakeholders and regulators to facilitate the regionalization of wastewater infrastructure whenever feasible.

WWTPs are regulated by the TCEQ's TPDES process described in Section 1.2. Generally, WWTPs do not discharge at the maximum permitted amount. According to Texas Administrative Code Rule §305.126, if any sewage treatment plant facility in the state reaches 75% of the permitted average daily or annual average flow for three consecutive months, the permittee must initiate engineering and financial planning for expansion and/or upgrading of the wastewater treatment and/or collection facilities. By following these guidelines codified in law, the Covered Parties' WWTPs can accommodate the increasing flows before that treatment capacity is needed.

The Covered Parties commit to continuing the WLA process (discussed in Section 4) for the mainstem Trinity River and to use modeling and other highly technical techniques to review and validate the discharge limits that are protective of the aquatic environment, including the Covered Species.

As described in detail in Section 4, it is impossible to discuss WWTP impacts to the Covered Species without also identifying the benefits of the Covered Parties' WWTPs to the protection of the aquatic environment, including the Covered Species. It is equally impossible to delineate the chronic impacts of WWTP effluent from the impacts of urban and agriculture runoff, non-Covered Parties' WWTPs, reservoir releases, and a litany of other sources that combine into an intertwined mixture which is constantly changing in makeup and over time. Additionally, at low flows these WWTPs provide water to a system that would be dry or extremely low. These increased flows may also help to mitigate the impacts of climate change. As a whole, the operation of the Covered Parties' WWTPs is a benefit to the Covered Species, and the Covered Parties commit to continuing these operations through the timeframe of this agreement.

8.5 Proactive Measures to Address Wastewater Overflows, Illicit Discharges into Treatment Plants, and Emergency Repairs

Threats addressed: Water Quality

The Covered Parties commit to continued proactive actions that protect the aquatic environment, including the Covered Species, by preventing negative impacts before they occur. These proactive measures include:

1. The continuation of the Capital Improvement Programs (CIP), or similar, for the timeframe of this agreement. CIPs are studies of major wastewater, raw water, or finished drinking water service areas to determine if and when the plants need to expand. These are multi-year efforts and involve watershed and sewer system modeling as well as population projections to ensure infrastructure is not overwhelmed and the plants continue to function as designed.
2. The continuation of industrial pre-treatment programs (described in Section 8.4).
3. Routine infrastructure inspections to ensure proper system function and reduce the chances of future pipeline breaks and identify small problems before they become big problems.
4. Perform emergency repairs as quickly as possible to minimize any negative effects from any infrastructure failure (leaking raw sewage pipe, raw water pump, etc.).

These proactive measures provide a direct benefit to the Covered Species.

8.6 Environmental Flows Protection

Threats addressed: Altered Hydrology, Water Quality, Degradation, Loss, and Fragmentation of Habitat, Barriers to Dispersal, Climate Change

As discussed in Section 6.1, dewatering is not considered a threat within the timeframe of this agreement (TRA, 2017) because of the increased baseflows from the Covered Parties' WWTPs and constant downstream water supply deliveries through the bed and banks of the Trinity River. Additionally, the artificially increased baseflows could help to minimize any climate change impacts. The Covered Parties will continue to support TCEQ's environmental flow requirements and continue environmental flow research. Texas Senate Bill (SB) 2 (2001) tasked TPWD, TCEQ, and TWDB jointly to "establish and continuously maintain an instream flow data collection and evaluation program … [and] conduct studies and analyses to determine appropriate methodologies for determining flow conditions in the state rivers and streams necessary to *support a sound ecological environment* (TWDB, 2021)." SB3 (2007) is an ongoing process designed to study instream and bay inflow requirements that are needed to *sustain a sound ecological environment, identify strategies to ensure this water is set aside for the environment, and balance the ecological and human needs for water* (TWDB, 2021). While the SB2 report is still in progress for the Trinity River Basin, the initial SB3 process was completed in 2010 with environmental baseflow standards adopted by TCEQ in 2011 and codified into the state's Water Availability Model (WAM).

A water right for a new appropriation of water or an amendment to an existing water right that increases the amount of water authorized to be stored, taken, or diverted issued after adoption of these standards must satisfy these flow values before a permit is issued and contain specific limitations on how and when water may be diverted. No further water supply projects may diminish in-stream flows below those deemed necessary to maintain a sound ecological environment. Currently, the Covered Parties serve in one position on the Basin and Bay Stakeholder Committee (BBASC) and two positions on the Basin and Bay Expert Science Team

(BBEST) and actively coordinate with the Texas Instream Flow Program[28] (TIFP) on in-stream environmental flow validation studies. The Covered Parties commit to ensuring that models and modeling results are provided to the BBASC and BBEST to inform the Adaptive Management phases of SB3. The Covered Parties will continue to support environmental flow requirements codified by the TCEQ[29] and incorporated into the WAM. The Covered Parties will also continue to work on environmental flow projects and research in conjunction with the BBASC and BBEST.

Additionally, as described in detail in Sections 4 and 8.4, the Covered Parties (*excluding TRWD which has no wastewater operations and NTMWD which has a separate Water Conservation Program to reduce water usage and increase flows in the basin*) commit to continuing the decades-old settlement agreement[30] that requires at least 30% of all in-basin wastewater return flows be allowed to flow downstream to Lake Livingston, thus keeping the channel wetted and protecting TRA and the City of Houston's water rights. Additionally, TRA commits to continuing the voluntary releases from Lake Livingston as described in (Section 8.7). These environmental flow efforts directly benefit the Covered Species by providing water to a system that would otherwise be dry during periods of low rainfall.

[28] The Texas Instream Flow Program is made up of the Texas Water Development Board, Texas Commission on Environmental Quality, and the Texas Parks and Wildlife Department and is designed to study environmental flows in a holistic manner.

[29] The Texas Commission on Environmental Quality is the entity in charge of water rights permitting in Texas.

[30] This agreement was made during a contested water rights permit application process to satisfy downstream water rights holders that their existing water rights would be protected.

Table 8-3. Table showing the seasonal SB3 Environmental Baseflow Standards (cfs) codified into the TCEQ WAM (TRA, 2017).

Gage 0804950	Gage 08049500	Gage 08049500	Gage 08049500	Gage 08057000	Gage 08057000	Gage 08057000	Gage 08057000	Gage 08065000	Gage 0806500	Gage 0806500	Gage 0806500	Gage 08066500	Gage 0806650	Gage 0806650	Gage 0806650
Zone B	Zone B	Zone B	Zone B	Zone B	Zone B	Zone B	Zone B	Zone C	Zone C	Zone C	Zone C	Zone E	Zone E	Zone E	Zone E
45	45	35	35	50	70	40	50	340	450	250	260	875	1150	1159	230
W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F	W	Sp	Su	F

W – Winter, Sp – Spring, Su – Summer, F - Fall

8.7 Instream Flow Protections in Zone E

Trinity River Authority, one of the Covered Parties, owns and operates Lake Livingston, a large multipurpose reservoir in the Middle Trinity River Basin. Trinity River Authority is committed to continuing an existing agreement with TPWD to release 250 cfs from Lake Livingston for environmental flows. Furthermore, TRA commits to providing an additional 500 cfs (7-day average) of flow between the Lake Livingston dam (River Mile 116.5) and the Coastal Water Authority canal (River Mile 30), which will ensure that the channel is wet during drought. If instream flows are negatively impacting a CPA occupied by a Covered Species, and those flows are determined to be outside the tolerance limits of the Covered Species, TRA will work with the USFWS, TPWD, and other partners to find solutions to reduce the threat, so long as those actions are not detrimental to the operations of the Covered Parties or their customers. Ensuring these flows is a direct benefit to the Covered Species.

8.8 USGS Flow and Water Quality Monitoring

The Covered Parties will continue to fund near real-time USGS stream gages throughout the Trinity River Basin. Currently, the Covered Parties sponsor all or part of more than 27 real-time stream discharge gages which provide valuable baseline flow data used extensively during mussel research projects (among other uses), investing over $500,000 annually to collect these data. In addition, at several of these stations the USGS collects automated, near real-time water quality measurements for parameters like total suspended solids, dissolved oxygen, pH, and specific conductance. The Covered Parties anticipate that this level of USGS gage support will continue through the term of this agreement, however, should a reduction in funding occur in the future, the Covered Parties, in consultation with USFWS and TPWD, commit to maintaining the gages that are determined to be important for continued monitoring of the health of the Covered Species.

Gages provide several benefits to the Covered Species by allowing monitoring and early detection of conditions that may be problematic to the Covered Species. For instance, flow data would alert the Covered Parties if areas within the system are at risk of dewatering. The gages also provide data to calibrate models and study trends in water quality and quantity through time, allowing researchers and water managers to better understand threats to the Covered Species and refine conservation strategies.

8.9 Eradication and Control Measures to Address Invasive Aquatic Plants

Invasive aquatic vegetation like Giant Salvinia, Hydrilla, and Water Hyacinth can cause water quality and habitat degradation by outgrowing and replacing native plants that provide food and habitat for the Covered Species of turtles and host fish for the Covered Species of mussels. The Covered Parties use a variety of methods, including the application of herbicides using TPWD protocols, to control and eradicate these invasive aquatic plants. The Covered Parties commit to continue funding eradication and control measures to address invasive aquatic plants in the Covered Parties' infested reservoirs during the timeframe of this agreement.

8.10 Site-level Disturbances

Site-level disturbances are those construction and maintenance activities that may have a direct detrimental effect on the covered species, examples include stream bed and bank excavation, pouring of new concrete, and runoff from construction activities. Where applicable, feasible, and consistent with other regulatory requirements, the Covered Parties will implement the Covered Activities in a manner that reduces or avoids impacts to the Covered Species by implementing the measures described below.

1. Prior to initiating any disturbance associated with a Covered Activity, mussel surveys and relocations will be conducted consistent with the latest USFWS and TPWD protocols and requirements by qualified/certified biologists.
2. Where possible, any Covered Activity requiring Clean Water Act Section 404 permitting, which requires consultation between USACE and the USFWS, will avoid occupied mussel beds in CPAs.
3. During any site-level disturbance activities, standard erosion and sediment control measures that are consistent with any state or local requirements and tailored to each site will be implemented, maintained, and regularly inspected to minimize the amount of sediment entering any watercourse within the Covered Area.
4. The area of new disturbance within a streambed will be minimized as much as feasible.
5. Vegetation clearing within riparian zones as part of a Covered Activity will be minimized as much as feasible.
6. Temporary coffer dams will be made of nontoxic materials.
7. Streambanks, vegetation, and streambeds and all temporary work areas will be restored after completing any construction that is a Covered Activity to pre-existing conditions or better.

8. If Covered Species of mussels are present in areas that will be disturbed, relocation of freshwater mussels will follow TPWD and USFWS protocols outlined in their Aquatic Resource Relocation Plan by qualified biologists and with prior notification to USFWS.

Natural Channel Design

Natural channel design is a field of engineering which incorporates natural stream characteristics into instream construction projects. For example, TRA recently completed a streambank stabilization project in Zone B on the Elm Fork Trinity which incorporated the use of underwater timber to provide habitat for fish, planted native vegetation to stabilize the bank, and sloped the bank to decrease shear stress. While new construction of water supply or wastewater infrastructure is outside of this agreement, the Covered Parties commit to incorporating natural channel design elements into construction projects permitted under a separate section 7 consultation of the ESA whenever feasible. These techniques are designed to protect infrastructure and minimize erosion while improving habitat for aquatic species, including the Covered Species.

8.11 Public Education and Outreach

The Covered Parties all currently participate in public outreach and education efforts throughout their respective jurisdictions. Each entity will work to increase public awareness of the Covered Species by adding species-specific information to existing conservation messaging, materials, and curriculum to be developed in the first year of the CCAA with input from TPWD and USFWS. Topics to be covered in the messaging will include: general awareness and life-cycle needs, ecosystem services, threats to persistence, poaching awareness, water quality, water conservation, and riparian restoration.

The TRA, NTMWD, and TRWD, three of the Covered Parties, recently started an Alligator Snapping Turtle signage project in consultation with TPWD at several reservoirs in the Trinity River Basin. This signage is designed to educate the public about the protected status of Alligator Snapping Turtles and includes a method of citizen-based science for reporting illegal activity or sightings of this imperiled turtle by submitting an image along with location information. The first 6 months of this project have proved successful, and the program is currently being expanded to other river access points and reservoirs. Additionally, a new crowd-sourced ArcGIS Online map reporting tool was developed and deployed on TRA's website[31]. The reports from this website are verified and shared with turtle researchers at the University of Houston Clear Lake and TPWD. This program will be further expanded within the basin and a minimum of 20 additional signs will be installed each year for the first 2 years of the CAA for a total of over 80 signs in the basin. The sites will be selected based on the public's ability to access the location (boat ramps and fishing piers) and the ability to gain permission for

[31] https://www.trinityra.org/basin_planning/turtles.php

installation. At the 3-year mark, the project will be assessed to determine success[32] and the project will either be continued, or funds will be allocated to other Conservation Measures.

These efforts are designed to provide a net conservation benefit to the Covered Species by increasing the understanding of where the species occurs, reducing threats posed by willful, negligent, or unintended actions that may harm the species, and increasing public awareness.

Figure 18. Alligator Snapping Turtle signage.

8.12 Reintroduction of Covered Species

Should the USFWS and TPWD authorize the reintroduction of the Covered Species of freshwater mussels in the Covered Area, TRA will work the appropriate agency to facilitate reintroduction efforts within CPAs. The Covered Parties commit to in-kind (labor and materials) support for these efforts. Should the USFWS and TPWD locate individuals of the Covered Species of turtles that were removed from the Trinity River Basin or that are available to be introduced to the basin to augment existing populations TRA will work the appropriate agency to facilitate reintroduction efforts.

[32] Success parameters will be determined in the first year of the CCAA in consultation with USFWS and TPWD.

The in-kind assistance may include, but is not limited to, mapping, field assistance, landowner coordination, site selection assistance, and bathymetric and topographic surveying. The Covered Parties have a long track record of providing high-quality data to TPWD, TCEQ, and the TWDB, which has been used in the past for very detailed hydraulic models which can calculate shear stress, velocities, water depths, and temperature.

These activities will support reintroduction efforts and provide a benefit to the species by giving USFWS and TPWD more informed site selection information which may lead to better long-term species recovery.

8.13 No New Permanent Dams on the Trinity River Mainstem

The Covered Parties commit to not building any new permanent dams on the Trinity River mainstem during the timeframe of this agreement.

8.14 Monitoring and Research

Threats addressed: All

The Monitoring and Research Conservation measures discussed below will be used to provide data and information to the research community, USFWS, and TPWD, which is a direct benefit to the Covered Species, to include informing potential reintroduction efforts. Additionally, the Covered Parties commit to using this data to inform a biennial review of the Covered Activities to determine if reasonable operational changes can be made to benefit the Covered Species. The USFWS Arlington Field Office, state species experts, and TPWD will be informed no less than 30 days prior to this meeting so that any relevant topics, comments, or new information can be incorporated into the meeting agenda.

The Covered Parties will provide a meeting summary report that will include a copy of the agenda, the discussion points, new data not previously submitted to the USFWS, and any relevant decisions used to inform these discussions will be provided to the USFWS Arlington office and state species experts no more than 30 days after the meeting. Any operational changes made will be at the sole discretion of the Covered Parties.

8.14.1 Instream Water Quality Monitoring

Protecting water quality for the benefit of people and the environment is viewed as a high priority and is a mutual goal of the Covered Parties and the USFWS. The Covered Parties all complete ambient water quality monitoring throughout their service area, but each also voluntarily participates in the Texas CRP, which has been administered in the Trinity River Basin by TRA under a grant from the TCEQ since 1991. The TRA CRP is responsible for maintaining an instream water quality sampling program throughout the basin through in-house stream sampling and data management for a network of partners that voluntarily submit their data to the program that is housed at the TCEQ. The benefit of the CRP program is that all data, regardless of the collection entity, is collected with standard methods and under a Quality Assurance Project Plan.

The TRA CRP is responsible for submitting quality assured data to the Statewide Surface Water Quality Monitoring Information System (SWQMIS), which is used to inform biannual statewide water quality assessments, discharge permitting, and scientific investigations of all types, to include ongoing studies for the Covered Species. Trinity River Authority's CRP has built an extensive network of over 250 monitoring stations, and since 1991, has been responsible for over 39,000 unique sampling events and 604,400 individual parameter results that have been added to the SWQMIS database. Additionally, TRA completes biological sampling events, 24-hour data sonde deployments (water quality probes), and targeted water quality special studies[33].

Grant funding for this program is provided by TCEQ on a 2-year rotating contract period and is in excess of $700,000. This program is very important to water quality permitting operations at TCEQ, and funding is expected to continue through the term of this agreement. This program is the primary source of instream data that is used to perform the biennial state-wide water quality stream assessment, or Integrated Report, and inform permitting decisions. As such, funding is expected to continue through the term of this agreement. Should TCEQ unexpectedly discontinue funding the CRP during the term of the agreement, the Covered Parties are committed to continuing water quality monitoring and reporting for the Trinity Basin to the mutual benefit of the Covered Parties and the Covered Species. Should this unexpectedly occur, it will not be possible for the Covered Parties to continue the program at the same basin-wide level. Therefore, the Covered Parties commit to funding water quality sampling efforts at or above the same level of effort as was in place when the funding was reduced, or eliminated, at the sites along the mainstem and major tributaries that have a direct effect on the Covered Species so that there will be no loss in data continuity.

The guaranteed continuation of this water quality monitoring project will benefit all the Covered Species by ensuring the continued collection of data that support a water quality trend assessment every 5 years, the results of which could help identify potential future threats to the Covered Species. If USFWS, TPWD, or the Covered Parties identify significant negative water quality trends within CPAs that are expected to cause harm to the Covered Species, and those threats are within the control of the Covered Parties or can be influenced by their actions, the Covered Parties will review their operations to determine if operational changes can be made to improve the water quality conditions. Should USFWS and TPWD determine that negative water quality trends in the reaches described above are not expected to improve and the animals may be better off being relocated to a less impacted area, the Covered Parties will assist USFWS and TPWD with the relocation efforts.

8.14.2 Caged mussel studies

Caged mussel studies are a form of in-situ biological monitoring where live hatchery-raised mussels are placed in cages at specific steam sites to assess whether ambient water quality

[33] A full review of TRA's CRP is outside the scope of this CCAA. Detailed information can be found at TRA's CRP program website.

conditions facilitate mussel growth and survival. This tool can be helpful in distinguishing if, and when, water quality or water quantity conditions in specific stream reaches may be limiting for mussels. This information can not only be used to determine if a site is appropriate to sustain a mussel population, or re-introduce a new population, but over time it can help increase our understanding of variables that may be impacting mussel viability. Caged mussel studies will be planned in coordination with stakeholders, USFWS, and TPWD, and will be completed at a minimum of two sites in Zone B and two sites in Zone C within the first 5 years of this agreement.

8.14.3 Long-term Monitoring for Mussels

Long-term monitoring for the Covered Species of mussels is an important feedback loop on the status and trends of mussel populations in the basin over time. Long-term monitoring at four sites within Zones B, C, and/or E will take place where the species are known to occur. Long-term monitoring will be closely coordinated with USFWS and TPWD using qualified biologists and approved methods designed to avoid harming sensitive populations.

This data will be used during the biennial review meetings discussed at the beginning of Section 8. Additionally, these efforts may inform any potential USFWS and TPWD future relocation efforts as well as help researchers understand population trends within the Trinity River Basin. Monitoring funded by the Covered Parties will be coordinated with other entities engaged in monitoring in the basin to reduce redundancy of effort, conserve funding, and minimize survey related stress to the mussels.

8.14.4 Water Quality Modeling

Water quality models can predict system responses based on flow, weather, local inputs, and upstream water quality boundary conditions. In turn, these models can be used to run future condition scenarios and better understand potential system responses.

Within the first 5 years, the Covered Parties will work with the USFWS, TPWD, and other stakeholders to create a water quality model or modify an existing model that can be used to better understand the expected water quality responses from up to three potential future flow conditions in all or portions of Conservation Zones B, C, and E[34]. This effort will include the collection of field data to calibrate and validate the water quality model. This data will be used during the biennial review meetings discussed at the beginning of Section 8, in the selection of future stream restoration sites and may be useful to the USFWS and TPWD for any recolonization efforts in the Trinity River Basin. The water quality model used in conjunction with information from the silo studies will help inform the understanding of freshwater mussel population tolerances, which will assist conservation managers throughout the state of Texas.

[34] TRA has recently competed a Water Quality model for temperature and dissolved oxygen in Zone C under contract for the Texas Water Development Board.

8.14.5 Hydraulic and Hydrologic Modeling

One of the questions surrounding the tolerance limits of mussels is shear stress. Shear stress is that force which is applied to the bed and banks of a river system. When shear and the sediment are in equilibrium, the channel is stable. When shear is too high, or too low, the river will degrade and dislodge mussels, or aggrade and potentially smother mussels, respectively. Hydrologic and hydraulic (H&H), water availability, overland runoff, habitat, and sediment transport modeling can be important components of environmental studies and help resource managers better understand the tolerance ranges for mussels. These models can also provide a tool that can help prioritize areas of the system for potential mussel recolonization efforts and future stream restoration efforts.

Within the first 4 years of the CCAA, the Covered Parties will work with the USFWS, TPWD, and other stakeholders to design a modeling project that can best address the current data gaps for shear tolerances for mussels in all or portions of Conservation Zones B and C. This data will be used during the biennial review meetings discussed at the beginning of Section 8, in the selection of future stream restoration sites and may be useful to the USFWS and TPWD for any recolonization efforts in the Trinity Basin.

8.14.6 Zebra Mussel Monitoring

Ten reservoirs in the Covered Area are impacted at some level by zebra mussels (Figure 17). The Covered Parties commit to continue funding zebra mussel monitoring programs throughout the Covered Area during the timeframe of this agreement at a level of effort of $40,000 per year. The Covered Parties currently contract with the USGS to monitor for larvae, eDNA, and adult zebra mussels at multiple reservoirs, stream sites, and transfer pipelines within the covered area. This monitoring is an early warning system for unimpacted sites and long-term monitoring for impacted sites; the data feeds into TPWD's Zebra Mussel Lake Status Assessment. Should USFWS and/or TPWD identify means and methods that could eradicate zebra mussels, the Covered Parties will provide in-kind (labor and materials) assistance.

Although zebra mussels have not been identified as a significant threat to the Covered Species, they are highly invasive and can quickly become established in waterbodies, particularly reservoirs, and may directly or indirectly threaten ecosystems that support the Covered Species in ways not fully understood at this time. Continued monitoring by the Covered Parties will improve the understanding of potential impacts from zebra mussels and other invasive species and help inform Adaptive Management over the life of the agreement.

9 Funding

<u>Continued Funding Commitments for Required Operations</u>

The Conservation Measures described in detail in Section 8 provide a net conservation benefit for the Covered Species. Annually, the Covered Parties spend:

1. *Hundreds of millions of dollars each year* to fund wastewater treatment facilities that take raw sewage and treat it to a point that it becomes habitat for aquatic species.
2. *$350,000* per year on water quality monitoring.

Continued Funding Commitments for Conservation Related Activities Over and Above Operational Requirements

The Conservation Measures described in detail in Section 8 provide a net conservation benefit for the Covered Species. Annually, the Covered Parties spend:

1. *Millions of dollars each year* to fund staff, equipment, and travel for participation in regional and statewide conservation programs, coordinate with federal and state entities on environmental flow research, and non-point source pollution prevention projects.
2. *$500,000 per year* on USGS stream gage flow and near-real-time water quality monitoring.
3. $40,000 per year on zebra mussel monitoring.
4. $20,000 per year on invasive aquatic plant eradication.

The Covered Parties commit to keeping this level of funding[35] throughout the term of this CCAA.

New Funding Commitments

Additionally, the Covered Parties commit to providing $750,000 in new funding for monitoring, research, public education programs, and non-point source and restoration projects to the benefit of the Covered Species during the term of this agreement. These funds will be used for materials, equipment, and contractors and *are exclusive of the significant internal costs to the Covered Parties (staffing, travel, field work, contract management, internal analysis, and reporting),* which will be funded through the Covered Parties' normal operational budgets.

As described in detail in Section 8, these activities will provide indirect benefits to the Covered Species by increasing the scientific understanding of the needs of the Covered Species within the Covered Area. It will also directly benefit the Covered Species by supporting non-point source projects and stream restoration efforts (Section 8.1), informing possible future reintroduction efforts as well as informing a biennial review of the Covered Parties' operations (Section 8.14) to determine if any operational changes to the Covered Parties' Covered Activities could be modified to benefit the Covered Species.

The breakdown of the new funding will be determined during the first year of the CCAA and reviewed annually as part of Adaptive Management. The initial CCAA Implementation Workplan and budget is provided as an example (Table 9-1).

[35] In the unlikely event that funding from TCEQ for the CRP is reduced, there will be no reduction in the sampling effort at locations determined important for the Covered Species along the mainstem and major tributaries.

Table 9-1. Table showing draft CCAA Implementation Workplan and associated budget.

Conservation Measure	Total Expected Cost (in dollars)	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8	Year 9	Year 10
Annual Report	In Kind	X	X	X	X	X	X	X	X	X	X
Biennial Operations Review and Report	In Kind	X	-	X	-	X	-	X	-	X	-
Identify/Review CPAs	In Kind	X	-	X	-	X	-	X	-	X	-
Public Education and Outreach	50,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000	5,000
Caged Mussel Studies	100,000	-	-	80,000	20,000	-	-	-	-	-	-
Long-term Monitoring of Mussels	250,000	-	50,000	-	50,000	-	50,000	-	50,000	-	50,000
Water Quality Modeling	50,000	-	20,000	20,000	10,000	-	-	-	-	-	-
Hydraulic and Hydrologic Modeling	70,000	-	-	50,000	20,000	-	-	-	-	-	-
Non-point Source & Restoration	230,000	-	40,000	-	30,000	-	20,000	20,000	30,000	70,000	20,000
Total Project Cost	**750,000**	**5,000**	**115,000**	**155,000**	**135,000**	**5,000**	**75,000**	**25,000**	**85,000**	**75,000**	**75,000**

10 Adaptive Management

Adaptive Management relies on an iterative cycle of monitoring, assessment, and decision making to clarify the relationships between the Conservation Measures being implemented, the response of habitat and, ultimately, the Covered Species themselves, as indicated by their general health and abundance. Ongoing and future scientific research may identify higher priority research needs than were described in Section 8.14. If the Covered Parties, with input from USFWS and TPWD, identify a higher priority and better use for monitoring and research funding, then they will work together to reallocate the resources allocated for that task to address these higher priorities. For example, if the USACE creates a hydraulic model that fulfills the research need identified in Section 8.14.5, then the resources for that task are no longer needed and can be reallocated to fund new monitoring and research priorities or supplement the Conservation Measures outlined in Section 8. No Adaptive Management strategy will result in a lower overall level of effort or funding or require the Covered Parties to provide increased funding or effort, though the Covered Parties may choose to do so.

The effectiveness of the Conservation Measures and monitoring methods will be reviewed on a biennial basis, as new science and technologies become available, or when results are available from each research task identified in Section 8.14. Likewise, new research and survey data as well as new information on threats to the Covered Species will aid in the evaluation of the Conservation Measures' effectiveness. As a result, modifications to the Conservation Measures, Covered Activities, or monitoring methods may be incorporated pursuant to Section 15.3 Modifications and Amendments of this document to further enhance the goals of this CCAA.

11 Changed and Unforeseen Circumstances

In the case of changed or unforeseen circumstances, assurances listed in this document apply to the Covered Parties when the CCAA is being properly implemented.

USFWS regulations define Changed Circumstances as, “changes in circumstances affecting a species or geographic area covered by a conservation plan that can reasonably be anticipated by plan developers and the [USFWS] and that can be planned for (e.g., the listing of new species, or a fire or other natural catastrophic event in areas prone to such events)” (50 CFR §17.3).

Unforeseen circumstances are “changes in circumstances affecting a species or geographic area covered by a conservation plan that could not reasonably have been anticipated by plan developers and the [USFWS] at the time of the conservation plan’s development, and that result in a substantial and adverse change in the status of the covered species.” (50 CFR §17.3)

11.1 Changed Circumstances

If additional Conservation or Avoidance and Minimization Measures are necessary to respond to Changed Circumstances and the measures needed are already set forth in this CCAA, the Covered Parties will implement the additional measures and remain eligible for the regulatory assurances provided in this agreement. If the additional Conservation or Avoidance and Minimization Measures necessary to respond to Changed Circumstances are not provided for in the CCAA, the USFWS will not require additional Conservation or Avoidance and Minimization Measures for the Covered Species. The Covered Parties may, however, at their own discretion voluntarily implement the additional measures.

The Covered Parties identify the following Changed Circumstances that may occur over the term of the CCAA and the responsive actions the Covered Parties will implement to address each Changed Circumstance. Changed Circumstances require written acknowledgement by TRA and USFWS to trigger the responses prescribed below.

11.1.1 New Listing or Critical Habitat Designation within the Covered Area

USFWS occasionally adds new species to the federal list of threatened and endangered species or designates new or revised areas of critical habitat associated with listed species. This Changed Circumstance will have occurred when USFWS publishes a Proposed Rule in the Federal Register that would create a new listed freshwater mussel or other aquatic species that occurs within the Covered Area or that creates or expands areas of critical habitat for Covered Species or such newly proposed species within the Covered Area. USFWS will notify TRA of the occurrence of this Changed Circumstance via the Federal Register.

Within 120 days, the Covered Parties will evaluate the Covered Activities within the Conservation Zones and its Conservation Measures or Avoidance and Minimization Measures to assess the Covered Parties’ potential impact on the newly proposed species or critical habitat designation and whether the existing Conservation Measures and Avoidance and Minimization

Measures and zones adequately address the new species. With this assessment, TRA will also notify USFWS if it intends to seek an amendment (following the process in Section 15) to address the new proposed species or new proposed critical habitat. USFWS may provide technical guidance to the Covered Parties as it considers whether an amendment is warranted. Regardless of this Changed Circumstance, TRA reserves the discretion to seek an amendment to add a Covered Species or add Conservation or Avoidance and Minimization Measures to the CCAA, Permit, and related documents that avoid the destruction or adverse modification of critical habitat. Any amendment will be focused solely on new Conservation Measures and Avoidance and Minimization measures or revisions to existing Conservation Measures and Avoidance and Minimization Measures to specifically address the new species or critical habitat and will not affect any other Conservation Measures or Avoidance and Minimization Measures or Conservation Zones that are not affected by the new species or critical habitat. For new critical habitat, TRA will seek amendments to update the zones to include such critical habitat.

11.1.2 Adding a Covered Species

TRA may seek to amend the CCAA, Permit, and related documents to add new species to the list of Covered Species either because of the Changed Circumstance or for other reasons. A notice from TRA to USFWS indicating the intent to seek such an amendment will trigger this Changed Circumstance. Under this Changed Circumstance, TRA, and USFWS agree to streamline the addition of new Covered Species by adopting, to the maximum extent practicable, the metrics for estimating take and basics of the Conservation Strategy already specified in the CCAA for species that use similar ecological niches.

11.1.3 Louisiana Pigtoe Re-discovered in the Trinity River Basin

The Louisiana Pigtoe is believed extirpated from the Trinity River Basin; however, should the species be re-discovered within the basin, individuals could be similarly affected by the Covered Activities. If this Changed Circumstance occurs, TRA will coordinate with USFWS to change the CCAA, Permit, and related documents using one or more of the processes in Section 15, as appropriate, to update the Conservation Zones and CPAs, adjust assessment of potential impacts, and clarify how Conservation Measures and Avoidance and Minimization Measures already in place address the needs of Louisiana Pigtoe because the Conservation Measures were designed to incorporate protections for this species.

Should the USFWS and TPWD decide that Louisiana Pigtoe should be reintroduced, TRA will provide in-kind (labor and materials) support for these efforts. The in-kind assistance may include, mapping, field assistance, landowner coordination, site selection assistance, and bathymetric and topographic surveying.

11.1.4 New Science on the Impacts of WWTP Effluent to the Covered Species

Municipal wastewater effluents are dynamic and complex mixtures that may contain a variety of constituents that are potentially harmful to aquatic organisms. The effects of effluents on fish, freshwater mussels, and other aquatic dependent biota are of interest to the USFWS and Covered Parties and is an area of focused research by academia, state, and federal researchers.

The information in this CCAA is based on the potential effects of municipal effluents to the Covered Species based on our current understanding and best available information. Over the 10-year agreement, new science may become available indicating impacts to Covered Species are likely occurring at levels not considered during the development of this CCAA. In fact, a component of this agreement includes a partnership between the Covered Parties and the USFWS to conduct caged mussel studies to better understand the potential impacts of municipal effluents on mussel growth and survival. As stated previously in the agreement, if new information comes to light that indicates a Covered Species is being impacted by a constituent found in wastewater effluents at levels not previously considered, whether that information is generated by studies covered by this agreement or by new information from the broader scientific community, the Covered Parties agree to work with the USFWS and other stakeholders to explore what, if any, actions within their control can be taken to reduce the newly identified threat. The Covered Parties agree to discuss the new science with USFWS, TPWD, and other interested stakeholders, and will consider adjusting operational procedures to benefit the Covered Species, to the extent they are able to do so while also meeting the requirements of their charter, contracts, permits, and customers.

11.1.5 Delisting of a Covered Species

USFWS may delist a listed Covered Species during the CCAA Term due to recovery, extinction, or error. This Changed Circumstance will have occurred when USFWS publishes a Final Rule in the Federal Register that delists a Covered Species.

In response to this Changed Circumstance, USFWS agrees that TRA may, in its discretion, request to amend the CCAA and related documents to remove the delisted species from the list of Covered Species and strike some or all the provisions of these documents that pertain to the delisted species. USFWS rationale for delisting, as published in the Final Rule, will determine the extent to which the Covered Parties may retire its obligations related to the delisted species through this Changed Circumstance:

1. In all delisting cases, TRA may, at its discretion, request to amend the CCAA, Permit, and related documents to remove obligations to address the delisted species for Covered Activities.
2. In the case of delisting due to recovery, where the Covered Parties previously completed Conservation Measures and Avoidance and Minimization Measures contributed to the delisting decision, the Covered Parties will not be relieved of any obligations under this CCAA related to those previously completed Conservation Measures and Avoidance and Minimization Measures actions without USFWS' expressed consent. This commitment applies only to Conservation Measures and Avoidance and Minimization Measures directly implemented by the Covered Parties.
3. In the case of delisting due to error or extinction, the USFWS will no longer require the Covered Parties to maintain any Conservation Measures or Avoidance and Minimization

Measures established specifically for the delisted species directly implemented by the Covered Parties.

The Covered Parties and USFWS agree that changes to the CCAA, Permit, and related documents that pertain to delisting of a listed Covered Species may be completed without additional public comment, NEPA analysis, or ESA analysis only if applicable to regulations and policy in place at the time.

In some cases, the Covered Parties may prefer to maintain the delisted species as a Covered Species or to continue to implement Conservation Measures and Avoidance and Minimization Measures to protect against future re-listing of the species. If the Covered Parties desire continued coverage of the delisted species, it will request a clarification from USFWS that updates the listing status of the delisted species.

11.1.6 Taxonomic Changes

The taxonomic classification of one or more of the Covered Species may change over the CCAA and Permit term. It is possible that new science will emerge that indicates one or more of the Covered Species is not a valid taxon or that it belongs to a different taxon. It is also possible that a currently unlisted species that is not a Covered Species will be synonymized with a Covered Species. Such taxonomic changes may alter the known range, distribution, or abundance of a Covered Species in ways that change the impact of the Covered Parties' Covered Activities under the CCAA and Permit.

Delisting of a listed Covered Species due to taxonomic changes, which would likely be categorized as a delisting due to error, are addressed in Section 11.1.5. This Changed Circumstance will have occurred if researchers publish new scientific information involving any Covered Species in a peer-reviewed, scientific journal that changes the taxonomic classification and USFWS formally accepts the taxonomic change in writing.

If this Changed Circumstance occurs, TRA will coordinate with USFWS to change the CCAA, Permit, and related documents using one or more of the processes in Section 15, as appropriate, to update the names of the Covered Species, adjust assessment of impacts necessary to conform to the new species designations, and clarify the extent to which Conservation Measures and Avoidance and Minimization Measures already in place address the updated taxonomy of the Covered Species. If the taxonomic change does not alter how take is authorized by the CCAA and Permit, then an amendment may not be necessary. If the taxonomic change expands the range of a Covered Species in ways not currently considered by the CCAA, TRA will coordinate with USFWS to determine if an amendment is necessary.

11.1.7 Unforeseen Catastrophic Event

Catastrophic events such as wildfires, hurricanes, floods, prolonged periods of drought, dam failure, toxicant or contaminant spill, wastewater treatment plant failure, or other similar events could temporarily (i.e., where the adverse effects would be expected to last for a period of no more than approximately 15 years) reduce or degrade suitable habitat for the Covered

Species within the Covered Area for this CCAA. Some of these acute and catastrophic events result from human error or mechanical failure; others occur naturally and are a normal or at least occasional occurrence.

If such an event occurs within the Covered Area, USFWS will hold the Covered Parties harmless for those impacts that are not a result of the Covered Parties' gross negligence. However, consistent with the Covered Parties' intent to provide a meaningful net conservation benefit to the Covered Species, TRA will coordinate with TPWD and USFWS and assist those agencies in taking reasonable and appropriate steps to reduce event-related harm to the Covered Species, including habitat and population restoration efforts to facilitate recovery of impacted populations.

11.1.8 Lack of Self-Sustaining Population within Suitable Habitat

It is possible that a self-sustaining population of the Covered Species within Zone B will no longer be capable of being self-sustaining within the timeframe of this agreement, and efforts to promote a self-sustaining population within portions of a CPA within Zone B could be unsuccessful. A large chemical spill, for example, could wipe out a population that cannot be re-established. If this occurs, TRA will coordinate with USFWS to change the CCAA, Permit, and related documents using one or more of the processes in Section 15, as appropriate, to reclassify the affected portions of a CPA. And if the threats that led to the demise of the population are resolved or can be resolved through feasible means then TRA will work with USFWS and TPWD to consider reintroduction into the same reach.

11.1.9 Environmental Flow Standards Substantially Revised or Abolished

TCEQ may substantially revise or abolish the environmental flow standards for the Trinity River Basin. In such case, TRA will coordinate with USFWS to evaluate whether such changes have the potential to adversely affect the Covered Species and whether revisions to the Conservation Measures and Avoidance and Minimization Measures are necessary and feasible.

11.1.10 Invasive Species Threaten Covered Species in Covered Area

It is possible that invasive species, such as the zebra mussel, could threaten the persistence of Covered Species in the Covered Area. In that case, the Covered Parties will work with USFWS and TPWD to conduct research or investigate potential removal and control efforts. Further, the Covered Parties will implement invasive species removal and control efforts that would not exceed $2,000 per year (in-kind and/or financial contribution). TRA will seek to cost share or secure matching grants if costs exceed the $2,000 per year spending cap for this Changed Circumstance. TPWD and USFWS may contribute funds or in-kind support for invasive species control efforts at their sole discretion at the time and depending on availability of funds and other resources.

11.1.11 Change in Covered Parties' Service Area

A change in a Covered Parties' service area will be determined to have occurred if, through legislative mandate, customer request, eminent domain, or other means, one or more of the

Covered Parties become responsible for a part of the basin for which they are currently not responsible. If a change in covered parties' service area occurs, the TRA will notify and work with the USFWS to complete an amendment to change the Covered Area, so long as the operations within the new area fit within the Covered Activities and Conservation and Avoidance and Minimization Measures can be implemented as described in this CCAA.

11.1.12 Change in Anticipated Grant Funding

Grant funding for the CRP is provided by TCEQ on a 2-year rotating contract period and is in excess of $700,000. This program is very important to water quality permitting operations at TCEQ and funding is expected to continue through the term of this agreement. Should TCEQ discontinue funding the CRP, the Covered Parties are committed to continuing water quality monitoring and reporting for the Trinity Basin to the mutual benefit of the Covered Parties and the Covered Species at a level of effort not less than $350,000 for each 2-year period.

If the grant funding is decreased or no longer available for either of these programs, TRA will notify USFWS of such reduction and provide its assessment of how such reductions will affect TRA's ability to implement certain Conservation Measures in this CCAA. TRA will work with USFWS to identify potential sources of alternative funding for these programs and to prioritize the activities under these programs that TRA is able to continue with available funds that provide a benefit to the Covered Species and ongoing Conservation Measures. TRA will work with USFWS to prioritize those sites that are most relevant to the Covered Species to ensure that data continues.

11.1.13 Significant Degradation in Water Quality in CPAs

If a significant degradation in water quality within a CPA occurs that was not anticipated or planned for as part of this CCAA, TRA will coordinate with USFWS to evaluate the extent to which degraded water quality may adversely affect the Covered Species and whether revisions to the Conservation Measures and Avoidance and Minimization Measures are necessary and feasible. If a significant degradation in water quality within a CPA is identified through water quality monitoring, applied research, or a hazardous spill notification, and the USFWS and TPWD determine that the relocation of one or more of the Covered Species would improve their chance of survival, TRA will provide manpower, equipment, and logistical support to USFWS and TPWD during these relocation efforts.

11.1.14 Environmental Flows Alteration

TCEQ may substantially revise or abolish the environmental flow standards for the Trinity River. In such case, TRA will coordinate with USFWS, TPWD, TCEQ, Trinity and San Jacinto BBASC, and the Trinity and San Jacinto BBEST, to evaluate whether such changes have the potential to adversely affect the Covered Species and whether revisions to the Conservation Measures and Avoidance and Minimization Measures are necessary and feasible.

11.1.15 Change in Covered Parties

Should one or more of the Covered Parties leave this CCAA, they will no longer have the Regulatory Assurances provided by this agreement. If this changed circumstance occurs, TRA will notify USFWS and meet with USFWS to modify the workplan. The Covered Parties may reduce the Conservation Measures by the percentage of the parties that leave the CCAA, or the other Covered Parties may, at their sole discretion, decide to maintain current levels of funding and effort.

11.2 Unforeseen Circumstances

There are no requirements for a CCAA permittee to respond to Unforeseen Circumstances of any kind. Responding to unforeseen circumstances is entirely voluntary. Additional Conservation Measures will not involve the commitment of additional resources on behalf of the Covered Parties beyond those described in the original CCAA without the consent of the Covered Parties.

The USFWS will demonstrate that unforeseen circumstances exist, using the best scientific and commercial data available. These findings must be clearly documented and based upon reliable technical information regarding the status and habitat requirements of the affected species. The USFWS may consider, but is not limited to, the following factors:

1. Size of the current range of the affected species;
2. Percentage of range adversely affected by Covered Activities;
3. Percentage of range conserved by the CCAA;
4. Ecological significance of that portion of the range affected by the CCAA;
5. Level of knowledge about the affected species and the degree of specificity of the species' conservation program under the CCAA; and
6. Whether failure to adopt additional Conservation Measures would appreciably reduce the likelihood of survival and recovery of the affected species in the wild.

After approval of the CCAA, the USFWS may not impose any new requirements or conditions on, or modify any existing requirements or conditions applicable to, the Covered Parties or successor, to compensate for changes in the conditions or circumstances of any species or ecosystem, natural community, or habitat covered by the CCAA except as stipulated in 50 CFR 17.22(d)(5) and 17.32(d)(5).

In the unlikely situation in which an unforeseen circumstance results in likely jeopardy to a species covered by this CCAA and Permit, the USFWS could revoke this CCAA and Permit as a last resort. However, the USFWS and its cooperators would first exercise all possible means to remedy the situation through other means (50 CFR § 17.22(d)(7)).

12 Effects and Incidental Take

As part of this agreement, a variety of voluntary measures will be implemented by the Covered Parties to reduce threats to Covered Species and benefit their conservation in the Trinity River

Basin. Population monitoring will be conducted to examine trends in the distribution and status of Covered Species through time to help gauge the success of conservation efforts. Activities covered by this agreement also include a variety of water and wastewater operations conducted by the Covered Parties. Both conservation and water/wastewater (excluding TRWD, which has no wastewater operations) activities could result in incidental take of the Covered Species. Take of Covered Species is considered incidental when it is not intentional but is caused by otherwise lawful activities. The USFWS will issue an ESA section 10(a)(1)(A) enhancement-of-survival permit to TRA providing incidental take coverage for the Covered Activities described in this CCAA, in the event one or more of the Covered Species is subsequently listed as threatened or endangered. Although incidental take could occur as a result of activities in this agreement, implementation of this CCAA and subsequent Conservation Measures will provide beneficial effects to the Covered Species that are expected to result in a net conservation benefit overall. Any take will be incidental to otherwise lawful activities described in this CCAA. Further, the Covered Parties do not expect that the Covered Activities and Conservation Measures will result in significant damage to habitats for the Covered Species based on current conditions and existing operations in the basin despite projected growth in the region.

Incidental take could occur as a result of Covered Activities conducted by the Covered Parties that involve operation and maintenance of its existing water and WWTPs, water supply and delivery infrastructure (including reservoirs), and from implementation of conservation, management, and monitoring programs designed to benefit the Covered Species. For example, the Covered Species may be inadvertently harmed by the downstream effects of 1) constituents in municipal wastewater effluents discharged to the Trinity River, 2) water releases from reservoirs or storage basins at flow rates that disturb mussel habitat (e.g., shear stress or erosion) or alter water quality (e.g., water temperatures too high or dissolved oxygen too low), 3) fluctuations in reservoir pool elevations, 4) treatment of invasive plants with aquatic-approved herbicides, or 5) movement of sediments transported downstream by operation and maintenance activities of reservoirs or other infrastructure. The Covered Species may also be inadvertently killed or injured during population surveys and other long-term monitoring activities, or habitat manipulations in the short-term. The extent to which these activities may impact Covered Species will depend on numerous site-specific factors that may change over time and will be difficult to detect or measure. Considered altogether, incidental take associated with the Covered Activities is not expected to be great enough to compromise the viability of populations of any of the Covered Species in the Trinity River Basin.

The Covered Species may naturally increase in population numbers and the extent of occupied areas following implementation of the Conservation Measures. If that were to occur, there may be an associated increase in the likelihood of injury or death of individuals as a result of ongoing water and wastewater management or conservation activities conducted by the Covered Parties. For example, Texas Heelsplitter, Trinity Pigtoe, or Texas Fawnsfoot may be inadvertently killed or injured during population surveys and other long-term monitoring

activities. Individuals of the Covered Species may experience reproductive failure or reduced growth rates associated with being handled during surveys or relocation events, or from environmental stress associated with changes in habitat conditions in the short term. Sub-adult life stages including glochidia and juveniles may be especially sensitive. Covered Species may be killed or injured due to infrastructure maintenance or upgrades associated with the Covered Parties' surface water supply and delivery, wastewater treatment, or catastrophic failure of these operations. Although considered unlikely, Texas Heelsplitter, Trinity Pigtoe, or Texas Fawnsfoot may also be killed or injured during routine water or wastewater management activities (e.g., delivering water from reservoirs managed by the Covered Parties to downstream customers via the bed and banks of the Trinity River).

The USFWS anticipates that incidental take of Covered Species will be difficult to detect for the following reasons: juveniles of the Covered Species (particularly mussels) have a small body size and finding dead or impaired glochidia or juvenile mussels is unlikely; losses may be masked by seasonal fluctuations in population size (and detectability) or by losses associated with actions or events outside of the Covered Parties' control (i.e., caused by other environmental stressors not attributable to the Covered Parties); losses may be sub-lethal with delayed onset of pathology and therefore difficult to measure or observe. Larger, more mature individuals will be easier to detect due to size, and in the case of Trinity Pigtoe and Texas Fawnsfoot, mussels occur in aggregations known as mussel beds that are easier to monitor over time. Although this agreement does not anticipate activities by the Covered Parties will result in large scale dewatering events leading to stranding of adult mussels, it is still possible that in combination with factors outside of the Covered Parties' control the death of mature individuals could be visibly detectable if entire riffles or bank habitats are persistently dewatered. The level of monitoring identified in this agreement would detect this level of take, especially because the Covered Parties will have knowledge of flow conditions in occupied stream reaches. Larger individuals are also more likely to be encountered during monitoring activities and take associated with such encounters is relatively easy to quantify, track, and report. Sub-adult life stages and sub-lethal effects are not likely to be detected. Nevertheless, TRA will notify USFWS as soon as possible in the event that they become aware of any take occurring or expected to occur resulting from Covered Activities or implementation of Conservation Measures.

The purpose of the agreement is to benefit the Covered Species while providing assurances to the Covered Parties, which includes reducing threats to facilitate expansion of occupied areas; therefore, USFWS expects that the conservation activities covered by the CCAA and permit will increase the amount and quality of suitable habitat. There may be minimal, short-term negative effects to habitat features associated with some of the Covered Activities, but generally the effects are expected to be beneficial and result in a net conservation benefit for the Covered Species over the 10-year term of the agreement (Section 4.1).

12.1 Level and Type of Take

Incidental take should be expressed in terms that are measurable and enforceable in the CCAA and in the Permit. The unit of take must be practicable, which means it can be monitored and the results of monitoring can be applied to Adaptive Management decisions. However, incidental take of the Covered Species will be difficult to definitively quantify for the following reasons: finding a dead or impaired specimen is unlikely; and losses may be masked by seasonal fluctuations in environmental conditions and/or numbers of each species, as well as mortality unrelated to Covered Activities. Therefore, it is not possible to provide precise numbers of Covered Species that will be harassed, harmed, or killed during implementation of this CCAA. In such instances where take is difficult to detect or otherwise quantify, take may be quantified in terms of some aspect of the species' habitat that may be diminished or removed by the action. In this section, estimates of take are provided for the Covered Species that may result from activities covered by this agreement. Negative effects to the species and their habitat associated with Covered Activities will be minimized or avoided to the extent possible, and the magnitude of those effects is expected to vary from year to year. Through implementation of the CCAA, temporary habitat disturbance is possible, but is expected to naturally recover with time. The following estimates of take are based on what is currently known about the potential impacts of Covered Activities and distribution and abundance of the Covered Species, including their life history traits, and their proximity to areas that could be impacted by the Covered Activities.

12.2 Take of Turtles

The Western Chicken Turtle is rare throughout its range, and only nine individuals have been documented in the Trinity River Basin (personal communication, Mandi Gordon, University of Houston). The Western Chicken Turtle utilizes habitat that is largely outside the operational areas managed as part of this agreement, namely ephemeral wetlands and other temporary waterbodies that are used seasonally for reproduction. When not engaged in breeding activity, the Western Chicken Turtle spends most of the year underground, estivating in upland areas. Nests are constructed in uplands also outside the operating area of the Covered Activities; therefore, no nests or eggs are expected to be impacted. Based on these species-specific factors, the potential for take of this species is believed to be highly unlikely; however, since the Western Chicken Turtle does occur in the basin, a minimal level of risk should be assumed no matter how unlikely. Therefore, take of one Western Chicken Turtle may occur due to Covered Activities during the 10-year life of the CCAA.

The Alligator Snapping Turtle is more common than the Western Chicken Turtle and is found in a variety of riverine and reservoir environments across its range, including East Texas. Relative to freshwater mussels, the Alligator Snapping Turtle is generally less vulnerable than freshwater mussels to disturbance or modification of habitats associated with the Covered Activities due to their motility and use of upland areas for nesting. Individuals would likely leave the immediate area when conservation or maintenance projects involve in-stream activity. The Alligator

Snapping Turtle occurs in higher numbers than the Western Chicken Turtle, but the vast majority of activities conducted by the Covered Parties will be in previously disturbed areas, thereby lowering the potential for impacts. Additionally, the Alligator Snapping Turtle prefers deeper water habitats available within the river system. Projects that require disturbance in new areas will likely have a small, quantifiable footprint (e.g., mussel surveys or riparian restoration). Therefore, potential take of Alligator Snapping Turtles would be rare and up to one Alligator Snapping Turtle per year may occur due to Covered Activities during the life of the CCAA.

12.3 Take of Mussels

In some cases, estimates of impacted stream miles or a percentage of the stream miles per Conservation Zone that may be affected by Covered Activities are used as a habitat surrogate measure to quantify estimates of take or identify when take has been exceeded. The causal link between using stream miles of riverine habitat as a surrogate (50 CFR 402.14(i)(1)(i)) to estimate potential take of individual mussels is a practical approach given that mussels spend the majority of their life cycle relatively immobile with most of their bodies buried in the sediment of the stream bed. Covered Activities include physical disturbance of stream beds as well as possible changes to water quality, water levels, and flow rates. Activities that disturb stream beds or alter water quality, water levels, and flow rates could injure or kill adult mussels, juveniles, or larval glochidia, or displace mussels or their host fish to unsuitable habitats (possibly disrupting reproduction). Low water levels could expose mussels to desiccation, heat stress, and predation; high water levels could dislodge mussels from sediments or contribute to sedimentation, erosion, or bank collapse (possibly suffocating mussels). Water quality degradation could result in direct mortality or sub-lethal effects, such as excessive valve closure, which can negatively affect mussel health and reproduction through increased energy costs and reduced feeding rates (Haney et al. 2019). Estimates of take based on impacts to habitat can inform possible levels of injury or death to individuals of the Covered Species due to Covered Activities and set targets that can be monitored and reported annually. The Covered Parties can monitor and document the river miles or percentage of stream miles in each zone affected by their actions (and possibly others) through a variety of measures including remote sensing and habitat monitoring. Additionally, dead shells and recently dead individuals may be detected during routine or contemporaneous monitoring visits and reported to the USFWS.

Freshwater mussels are sedentary filter feeding organisms that rely on suitable substrates and sufficient water quality and flows to meet their life history needs and those of their host fishes. The Trinity River Basin today is highly modified compared to conditions prior to the industrial revolution. On average, baseflows in Upper and Middle Basin are substantially higher due to municipal wastewater effluent return flows. Although wastewater flows comprise less than 1% of total flows (combination of effluent, rainfall, and stormwater) in the Upper and Middle Basins, when dry weather conditions persist, portions of the Upper and Middle Basin can become effluent dominated (approximately 75-95% wastewater). These effluent-dominated

conditions can occur in the winter or summer and may last for months between rain events. Wastewater effluents along with stormwater can scour the riverbed, dislodge mussels, and degrade water quality. However, it is important to note that reservoirs have altered the natural hydrology in the basin and without wastewater effluent in these reaches, the river would likely be dry or disconnected pools during drought conditions. Covered activities may impact both water quality and quantity, cause erosion and sedimentation, or modify substrates, all of which can affect mussel growth, survival, and reproduction.

The Louisiana Pigtoe is believed to be extirpated from the Trinity River Basin and is therefore unlikely to be affected by Covered Activities (i.e., no take is anticipated). However, should the species be re-discovered within the basin, individuals could be similarly affected by the Covered Activities. If Louisiana Pigtoe are once again found in the Trinity River Basin in the future, the potential for Covered Activities to impact the species will be reevaluated under the Changed Circumstances provision in this CCAA (Section 11.1.3) along with revised estimates of take. For the remaining mussels, estimates of take are based on a combination of basic life history traits, abundance, and the proximity of occupied areas to wastewater outflows, water supply (e.g., reservoirs), or other Covered Activities that could impact mussels. These activities and potential impacts to Covered Species were also viewed in the context of habitat conditions that are prevalent in the basin today, which in most cases have been shaped by these same activities for decades. To help quantify potential impacts, Covered Activities were placed into one of four categories, 1) conservation, 2) facilities maintenance, 3) water quality, and 4) hydrology (including reservoir and river impacts). While there is some overlap between these categories, such as wastewater effluent flows that can affect both water quality and flows (i.e., hydrology), they provide a reasonable approach to evaluate impacts systematically.

The majority of conservation related activity conducted as part of the CCAA, such as monitoring or relocation of Covered Species, will be carried out by researchers or contractors who possess their own 10(a)(1)(A) scientific collection permit; those activities are not covered by this CCAA and do not require estimates of take. The Covered Parties may, however, assist or engage directly in conservation work on occasion, but their involvement will impact less than 1% of areas currently occupied by the species over the life of the agreement, and any short-term impacts will result in long-term conservation benefits to the species. Similarly, the Covered Parties estimate that facilities maintenance activities will occur in less than 1% of the entire basin over the 10-year agreement, primarily in previously disturbed areas that are not occupied by the Covered Species. Both conservation and facilities maintenance projects will be easily quantifiable and reported annually based on river miles or acres impacted. There is a total of 595 river miles in Conservation Zones A to E that are occupied[36] by the Covered Species; therefore, up to 12 river miles (2% of 595) could be impacted by either conservation work or maintenance projects over the life of the agreement. Since 12 miles of impacted river

[36] Freshwater mussels require certain mesohabitat characteristics (riffle, run, pool, backwater, etc.), so it is important to note that occupied area does not suggest that the species occupies the entire area, but that the species could potentially occur if the specific mesohabitat is available at that particular location on the stream.

represents a very small portion of the basin, conservation work will benefit species in the long-term, facilities maintenance projects will primarily occur outside of areas occupied by the Covered Species, and projects will be spread out spatially and temporally over a 10-year period, take associated with conservation and facilities maintenance are expected to have little to no effect on the viability of populations of any of the Covered Species. Given these assumptions and stipulations regarding conservation and facilities maintenance, estimates of take for mussels will focus primarily on the remaining two categories, water quality and hydrology.

Based on mussel surveys conducted to date, the Trinity Pigtoe occupies a total of approximately 210 miles of the Trinity River in Conservation Zones A, B, C, and E. Mussel abundance can be used as a biological indicator of habitat condition (i.e., higher abundance generally equals higher quality habitat). Abundance data indicate the highest quality habitat for Trinity Pigtoe occurs along 30 miles of the Elm Fork located near downtown Dallas and Fort Worth (Zone B). The other occupied Zones have either low abundance (indicating poor habitat quality) or have so few individuals the species is believed functionally extirpated. Several scientific studies evaluated the impacts of municipal wastewater effluents on mussels, concluding that mussel growth and survival could be impacted up to 3.8 km (~2.5 miles) downstream of wastewater outfalls (Nobles and Zhang, 2015, Goudreau et al. 1993). To be conservative, the distance potentially impacted by effluents was doubled and the percent habitat occupied by the Covered Species within 5 miles of wastewater outfalls was calculated to estimate potential take related to degraded water quality (Note: areas within 5 miles of an outfall that overlapped with areas impacted by another outfall were not discounted (i.e., the full 5 miles was counted for both outfalls, not a lesser amount). Of the 210 miles occupied by the Trinity Pigtoe within the basin, about 32 miles fall within 5 miles of a wastewater outfall. Mussels within these 30 miles of impacted river could be adversely affected by wastewater discharges over the term of the CCAA, resulting in take of up to 14% of habitat occupied by the Trinity Pigtoe over 10 years. Only about 15 miles or 7% of areas impacted by wastewater are considered high quality habitat (located in the Elm Fork). Should future scientific studies indicate wastewater effluents can impact mussel health beyond 3.8 km during the 10-year agreement, USFWS and the Covered Parties will reevaluate the potential for take at that time under Changed Circumstances.

The Texas Fawnsfoot occupies a total of 181.5 miles in Conservation Zones B, C, and E of the Trinity Basin. Abundance is very low in all occupied areas (Randklev et al., 2017). Of the 181.5 occupied miles, approximately 10 miles fall within 5 miles of a WWTP capable of causing take, therefore up to 5.5% of habitat occupied by the Texas Fawnsfoot could be adversely affected by constituents in wastewater effluents.

The Texas Heelsplitter occupies a total of 203.5 miles in Conservation Zone C of the Trinity River Basin, and is historically known to two reservoirs in the basin, Lakes Grapevine (Zone A) and Livingston (Zone D). Abundance for this species is very low in all occupied areas (Randklev et al., 2017). Of the 203.5 occupied miles, none occur within 5 miles of a WWTP. In the last 22 years (since 2000), only 5 Texas Heelsplitters have been found in Lake Livingston and none have been

found in Lake Grapevine. Given the low abundance and lack of wastewater facilities near occupied habitat, water quality related impacts to this species associated with the Covered Activities are negligible.

Although high flows and shear stress can occur throughout the basin due to a combination of wastewater return flows and rainfall, estimates of take related to hydrology focused on reservoir related impacts below dams. The Covered Parties' own or operate seven reservoirs in the Trinity River Basin. Most of these lakes were constructed in the 1950s or 1960s with the most recent constructed in 1987 (Richland Chambers Reservoir). These impoundments have permanently altered the hydrology of the basin, holding back flows until reservoirs reach capacity and releasing water downstream once full pool elevation is achieved. The resulting changes to flow and water quality (e.g., lower or higher temperatures compared to ambient conditions) below dams subsequently influence habitat types and species diversity for some distance downstream. These impacts continue to occur for the life of the reservoir, and in the case of the Trinity River Basin, have been impacting mussel populations for decades. Reservoirs in the Trinity River Basin have been in place and affecting mussel abundance for a minimum of 35 years, and in most cases, longer. Therefore, the populations present today represent areas where mussels have either persisted despite changes to hydrology (e.g., Elm Fork), or they have long since perished and are unlikely to return. Based on the timing, magnitude, and severity of past changes to hydrology, it is unlikely that novel hydrology-related impacts will result in take of mussels beyond the areas affected by wastewater effluents, which are accounted for under the water quality category.

In summary, four categories of take associated with this CCAA were evaluated, 1) conservation, 2) facilities maintenance, 3) water quality, and 4) hydrology. Estimates of take were based on a combination of basic life history traits, abundance, and the proximity of occupied areas to wastewater outflows, water supply, or other Covered Activities that could impact the Covered Species. The potential impacts of Covered Activities were considered based on the best available scientific information and as they relate to current habitat conditions that exist in the basin today. Based on this review, in total, not more than 1 Western Chicken Turtle and 10 Alligator Snapping Turtles are expected to be harmed by Covered Activities cumulatively over 10 years. For mussels, out of a total of 595 river miles currently occupied by the 3 remaining mussels in the basin covered by the agreement, not more than 54 occupied river miles are expected to be harmed by Covered Activities cumulatively over 10 years. This impacted area represents less than 9% of the currently occupied habitat. Because incidental take of these species will be difficult to detect and monitor, the Covered Parties will track river miles impacted and notify the USFWS if they expect their activities to affect more than a total of 54 miles of occupied mussel habitat, cumulatively over the 10 years of this agreement. The Covered Parties will also notify the USFWS if they expect their activities will result in take of more than 1 Western Chicken Turtle or 10 Alligator Snapping Turtle, cumulatively over 10 years.

13 Regulatory Assurances

If approved, the USFWS will provide regulatory assurances to the Covered Parties, so long as the CCAA is fully implemented as agreed, and the USFWS will not require additional Conservation Measures nor impose additional land, water, or resource-use restrictions, beyond those stated and agreed to in this CCAA without consent of the Covered Parties. These assurances are made consistent with the USFWS Candidate Conservation Agreements with Assurances Policy (2016, 81 FR 95164) and will be authorized in an ESA Section 10(a)(1)(A) Enhancement of Survival Permit that becomes effective if any of the Covered Species is listed as threatened or endangered in the future. The Enhancement of Survival Permit will authorize the incidental take of the species for the Covered Parties under the permit, as long as their actions are fully in compliance with the CCAA, subject to the terms and conditions described in 50 CFR 17.22(d)(1) and 50 CFR 17.32(d)(1).

14 Reporting

The TRA will submit an Annual Report to the USFWS and TPWD by March 1 of each year for the term of this agreement. If the USFWS and/or TPWD wish to submit comments, they will be due back to TRA by April 1. TRA may incorporate or address these comments at its sole discretion (unless otherwise considered incomplete by USFWS) and deliver a final report to USFWS and TPWD by May 1. The Annual Report will include information related to the Covered Parties' Covered Activities for the previous calendar year. This report will include.

Topics covered in this report will include, but are not limited to:

1. Summary of the activities related to each of the Conservation Measures;
2. Results of any freshwater mussel surveys or relocations conducted on or behalf of the Covered Parties;
3. Summary of public outreach efforts;
4. Annual hydrologic review of each Conservation Zone;
5. Annual water quality data summary for each Conservation Zone; and
6. Summary of any mortality/injury (take) of Covered Species observed since the implementation of this CCAA.

15 Agreement Term, Responsibilities, Amendment, and Termination

15.1 Agreement Term

This CCAA will have a duration of 10 years from the date of signature. It can be renewed upon application by TRA provided the USFWS determines that it still provides net conservation benefit and still complies with applicable CCAA policy. Entities included under a CI will be subject to the same terms and responsibilities as in the CCAA.

Should any of the Covered Species become listed as threatened or endangered, the Permit will become effective and remain in effect through the expiration of the CCAA.

15.2 Responsibilities of Each Party

TRA shall be responsible for:

1. Funding, administering, and implementing this CCAA and the associated voluntary Conservation Measures outlined in Section 8;
2. Reporting as described in Section 14;
3. Keeping state and federal resource protection entities updated at least annually about research activities through meetings with the USFWS and Texas' Freshwater Mussel Workgroup;
4. Notifying the USFWS of any transfer of lands subject to a CCAA;
5. Giving the USFWS reasonable notice (generally at least 30 days) when TRA expects to incidentally take any listed species covered by the Permit. Such notice will provide the USFWS with an opportunity to relocate affected individuals of the species, if possible or appropriate.
6. In coordination with the USFWS, evaluating the results of monitoring data and Conservation Measures to assess if the actions of this CCAA are providing the desired net conservation benefit.

The USFWS shall be responsible for:

1. In coordination with the Covered Parties, evaluating the results of monitoring data and Conservation Measures to assess if the actions of this CCAA are providing the desired net conservation benefit;
2. Reviewing and providing comments for reports submitted by TRA along with any recommendations or suggested changes to conservation priorities to help inform Adaptive Management moving forward;
3. Issuing a Permit to TRA to allow for incidental take of the Covered Species in accordance with 50 CFR 17.22(d) or 17.32(d) and the terms of this CCAA should any of the Covered Species become listed as threatened or endangered in the future if the CCAA is properly and fully implemented. This permit would only authorize incidental take while conducting Covered Activities within the Covered Area.

15.3 Modifications and Amendments

Any party to this CCAA may propose amendments to the agreement by providing written notice to the other parties. This written notice will include a description of the proposed amendment, the justification for the amendment, and the expected results or outcomes. Once proposed, the other parties have 60 days to respond to the amendment request. Proposed amendments will become effective upon reaching mutual consent of the other parties along with written concurrence by all parties, and the CCAA document will be modified as appropriate, unless there is a change in potential effects to Covered Species.

In the event that an amendment results in 1) a different level of take than that associated with the original CCAA, 2) addition or removal of Covered Species, 3) an extreme unforeseen

circumstance, or 4) a change to the net conservation benefit such that the CCAA standard may not be met, the amendment process could include additional analysis by the USFWS, public notification in the Federal Register, and NEPA analysis.

15.4 Dispute Resolution

The Parties agree to work together in good faith to resolve any disputes, using dispute resolution procedures agreed upon by all parties.

15.5 Termination of CCAA, Suspension or Revocation of Permit

TRA may terminate the implementation of the CCAA's voluntary management actions at any time for any cause prior to the CCAA's expiration date, even if the expected benefits have not been realized. In such a case, if any of the Covered Species have been listed and an Enhancement of Survival Permit has been issued, TRA would be required to surrender the permit and thus relinquish all associated take assurances.

If issued, the USFWS may suspend or revoke the Enhancement of Survival Permit for cause in accordance with the laws and regulations in force at the time. Criteria for revocation are identified in 50 CFR 17.22 (d)(7) for species that are subsequently listed as endangered and 50 CFR 17.32 (d)(7) for species that are subsequently listed as threatened.

16 Authorized Signatures

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J. Kevin Ward

General Manager, Trinity River Authority of Texas

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Jeffery M Fleming

Deputy Regional Director, Region 2, U.S. Fish and Wildlife Service

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