Oak Hill Parkway
Water Resources
Technical Report

U.S. Highway 290 (US 290) / State Highway (SH)
71 West from State Loop 1 (Mopac) to
Ranch-to-Market (RM) 1826 and SH 71 to
Silvermine Drive

Travis County, Texas

CSJ # 0113-08-060 and 0700-03-077

June 2017

The environmental review, consultation, and other actions required by applicable Federal environmental laws for this project are being, or have been, carried-out by TxDOT pursuant to 23 U.S.C. 327 and a Memorandum of Understanding dated December 16, 2014, and executed by FHWA and TxDOT.

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1. INTRODUCTION AND PURPOSE

The Texas Department of Transportation (TxDOT) and the Central Texas Regional Mobility Authority are considering mobility improvements to U.S. Highway 290 (US 290)/State Highway (SH) 71 West through Oak Hill (the Oak Hill Parkway). The project corridor extends along US 290 from State Loop 1 (Loop 1 or Mopac) to Farm-to-Market Road (FM) 1826 for a distance of approximately 6.15 miles with a transition to the west. The project also includes the interchange on SH 71 from US 290 to Silvermine Drive, a distance of approximately 1.31 miles. The proposed project corridor is within the City of Austin (COA), Travis County, Texas, and includes the proposed location of two stormwater detention ponds: the first along SH 71 north of Covered Bridge Drive and the second between SH 71 and Old Bee Caves Road across from Sunset Ridge. The existing bridge over Williamson Creek and several culverts and/or drainage structures would be replaced or rehabilitated to accommodate the additional roadway width and new alignment. The existing right-of-way ranges from 90 to 260 feet wide and the proposed right-of-way would range from approximately 150 to 600 feet wide.

Steady population growth in the Austin metropolitan area has increased congestion within the Oak Hill Parkway corridor, which has been the cause of unreliable traffic operations, travel time delays, and poor level of service along the roadway, as well as delayed emergency response and transit times. Congestion also affects connectivity of the corridor to other Austin metropolitan area roadways and areas west and south of the project area. The proposed Oak Hill Parkway project's purpose is to improve mobility and operational efficiency, facilitate long-term congestion management in the corridor, and improve safety and emergency response and transit times.

The proposed improvements were originally considered in a Final Environmental Impact Statement (FEIS) covering improvements to SH 71/US 290 from FM 1826 to FM 973. A Record of Decision (ROD) was issued by the Federal Highway Administration (FHWA) on August 22, 1988. The mid-section of the original project limits, between Joe Tanner Lane and Riverside Drive, has been constructed. Since the issuance of the ROD, changes in adjacent land use, state and federal listing of the Barton Springs salamander and Austin Blind salamander as endangered, changes in funding mechanisms, and public input have resulted in changes and a new proposed design concept. The original FEIS has been reevaluated four times due to numerous design modifications and changes in funding mechanisms. TxDOT published a notice in the Federal Register in October of 2012 announcing their intent to prepare a new EIS for the Oak Hill Parkway project.

The purpose of this technical report is to identify and describe all water resources located within the proposed project area in order to assist in avoidance of impacts and minimization of project effects. Conclusions contained in this report are the opinion of the professionals conducting the study and are subject to confirmation by the appropriate regulatory agencies. In addition, this report covers regulatory issues related to water resources that are relevant to the requirements for an Environmental Impact Statement for a TxDOT Project.

1.1 Existing Facility

Currently, the US 290/SH 71 facility consists of a six-lane urban freeway section with 2 to 4-lane frontage roads from Mopac to just west of Old Fredericksburg Road. Direct connector ramps connect US 290/SH 71 to the Mopac main lanes. Between Old Fredericksburg Road and Joe Tanner Lane, US 290/SH 71 transitions from a freeway/frontage road facility to a four- and five-lane urban highway; this urban highway section continues to just east of the SH 71 junction. Between SH 71 and FM 1826, the existing US 290 roadway consists of four 11-foot travel lanes with intermittent 14-foot center turn lanes and shoulders ranging from 2 to 4 feet in width. The existing SH 71 accommodates four 12-foot travel lanes, two 8-foot shoulders, and a 14-foot continuous center turn lane.

Dual left-turn and right-turn lanes exist on US 290 at Convict Hill Road, the Austin Community College Driveway, the Speedy Stop, Oak Hill United Methodist Church, and FM 1826. Innovative improvements called continuous flow intersections (CFI) were constructed on US 290 at William Cannon and SH 71, as well as a median U-turn at Joe Tanner Lane. The CFI was constructed in one direction at SH 71 and in two directions at William Cannon.

1.2 Project Information

The project corridor extends along US 290 from Mopac to FM 1826 for a distance of approximately 6.15 miles with a transition to the west. The project also includes the interchange on SH 71 from US 290 to Silvermine Drive, a distance of approximately 1.31 miles. Two proposed detention pond locations adjacent to SH 71 are also included in the project area. (see **Figure 1**). The project is located in Travis County, Texas and is shown on the USGS 7.5’ quadrangle maps for Bee Cave, Oak Hill, and Signal Hill, Texas (see **Figure 2**).

1.3 Build Alternatives

Two design alternatives (*Alternative A* & *Alternative C*) will be advanced through schematic development and environmental analysis as the potential build options for the Oak Hill Parkway project. The *No Build Alternative* will also be carried forward. For purposes of this report, the physical area covered by the combined build alternative alignments is considered the project area since there are only slight modifications between the overall alignments of the build alternatives. The project area includes the location of two stormwater detention ponds: the first along SH 71 north of Covered Bridge Drive and the second between SH 71 and Old Bee Caves Road across from Sunset Ridge. New right-of-way and easements would be required for both design alternatives. See **Figures 1** and **2** in **Attachment A.**

1.3.1 Alternative A

Alternative A is a conventional controlled-access highway with frontage roads. New construction on roadway improvements would begin just east of Joe Tanner Lane where the existing main lanes transition to an urban highway. With *Alternative A*, the main lanes would be elevated over William Cannon Drive and the westbound main lanes and frontage road would be located north of Williamson Creek. The main lanes would be depressed under SH 71 and direct connectors would be provided connecting eastbound SH 71 with US 290 and westbound US 290 to SH 71. Main lanes would vary from four lanes in each direction near William Cannon Drive to a two-lane transition near the western project extent. Grade-separated intersections would be constructed at Convict Hill Road, FM 1826, Scenic Brook Drive, and Circle Drive (S. View Road). Main lanes would generally be 12 feet wide with 10-foot shoulders. Texas turnarounds, which allow vehicles traveling on a frontage road to U-turn onto the opposite frontage road, would be constructed on US 290 frontage roads at Scenic Brook Drive, FM 1826, Convict Hill Drive, and William Cannon Drive.

Along SH 71, the direct connector ramps would extend past Scenic Brook Drive where the main lanes would transition to a five-lane (three lanes northbound, two lanes southbound) rural highway with Texas turnarounds. Bicycle and pedestrian facilities would be provided via a shared-use path along the entire project length.

Alternative A would require the acquisition of approximately 74.58 acres of new right-of-way, which would include acreages for the two stormwater detention ponds. Approximately 4.08 acres of temporary construction easements and 0.21 acres of shared-use path are outside the right-of-way are currently proposed for this alternative.

1.3.2 Alternative C

Alternative C is a controlled-access highway with frontage roads. New construction on roadway improvements would begin just east of Joe Tanner Lane where the existing main lanes transition to an urban highway. With *Alternative C*, the US 290 main lanes would be elevated over William Cannon Drive with eastbound and westbound main lanes located north of Williamson Creek. The frontage roads would be along the existing highway. The main lanes would remain elevated over the intersection with SH 71. West of SH 71, *Alternatives A* and *C* share the same design and grade-separated intersections would be constructed at Convict Hill Road, FM 1826, Scenic Brook Drive, and Circle Drive (S. View Road). Direct connectors would allow drivers to access westbound SH 71 and eastbound US 290. US 290 would consist of two to four 12-foot lanes with 10-foot shoulders in each direction. Texas turnarounds would be constructed on US 290 frontage roads at Scenic Brook Drive, FM 1826, and Convict Hill Drive.

Along SH 71, the direct connector ramps would extend past Scenic Brook Drive where the main lanes would transition to a five-lane (three lanes northbound, two lanes southbound) rural highway with Texas turnarounds. Bicycle and pedestrian facilities would be provided via a shared-use path along the entire project length.

Alternative C would require the acquisition of approximately 75.19 acres of new right-of-way, which would include acreages for the two stormwater detention ponds. Approximately 4.12 acres of temporary construction easements and 0.21 acres of shared-use path outside of the right-of-way are currently proposed for this alternative.

1.3.3 No Build Alternative

Consistent with the requirements of the National Environmental Policy Act (NEPA) and FHWA guidelines, this analysis considers an alternative that assesses environmental effects if the proposed project were not built. This alternative, called the *No Build Alternative*, includes the routine maintenance improvements of the existing roads in the project area and the currently programmed, committed, and funded roadway projects. While the *No Build Alternative* does not meet the project needs, it provides a baseline condition to compare and measure the effects of both build alternatives.

2. GENERAL DESCRIPTION OF THE OAK HILL PARKWAY PROJECT AREA

2.1 Natural Setting

The proposed project is located in the Edwards Plateau Natural Region of Texas (Gould, 1960). The Edwards Plateau is an uplifted ecological region of Central Texas characterized by thin top soils and rolling hills of sandstone, limestone, and shales. Elevations within this region range from 100 feet to 3,000 feet above mean sea level and the topography is dissected by several river systems, which create a well-drained landscape. Historically a grassland savannah, the Edwards Plateau once supported a diverse assemblage of grasses and forbs with a juniper-oak woodland overstory.

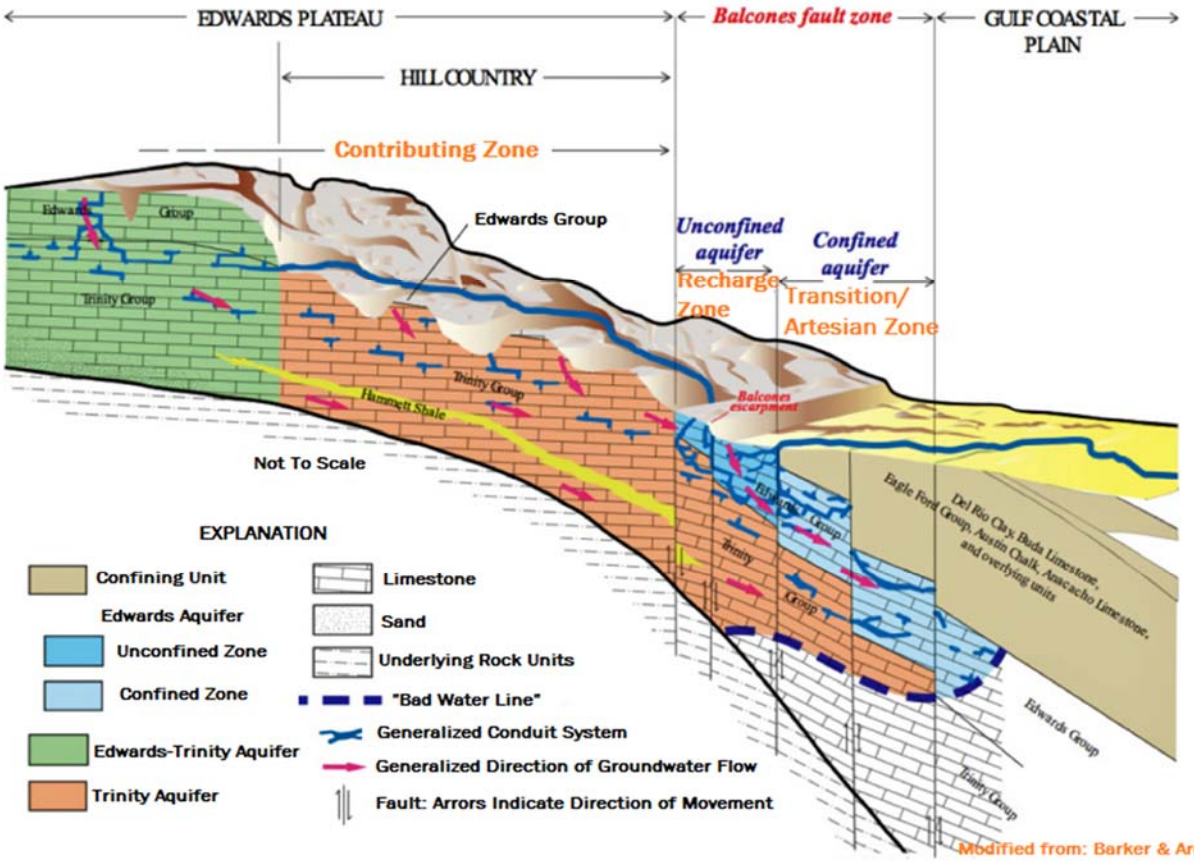
The proposed project area is located in a primarily urban area. Both commercial and residential structures exist adjacent to the project area (**Attachment B**, **Photos 1 – 2**). Several parcels adjacent to the US 290 and SH 71 roadways are vacant, vegetated lots, which contain disturbed oak-juniper and native-invasive woodland vegetation (**Photos 3 - 5**). Undeveloped land is fragmented throughout the project area. The proposed detention pond locations are a mixture of native and introduced vegetation surrounded by residential and commercial land. The proposed pond site located west of SH 71 is currently being used for livestock grazing (**Photo 6**), and the proposed pond site adjacent to Old Bee Caves Road is currently undeveloped vegetated land.

2.2 Geology

The geology of the project area is a typical representation of karst topography (eroded limestone) in Central Texas. Two bedrock formations underlie the project area (**Figure 3**). West of the Mount Bonnell Fault lies the Upper Glen Rose Limestone formation which forms the stair-step topography that characterizes the Texas Hill Country region (TNRIS, 2007; Ward, 2006). East of the fault lies the Fredericksburg Group of the Edwards Formation. The Edwards Formation consists almost entirely of limestone, with minor chert lenses or horizons, and weathers mainly by dissolution. The Edwards Formation is known for its cavernous limestone which tends to fracture, creating sinkholes and caves that become avenues for recharge and dissolution (Small et al., 1996). At the intersection between these two formations lies the Mount Bonnell fault. The surface expression of this fault is known as the Balcones Escarpment and demarcates the line at which the eastern edge of the Texas Hill Country transitions into the western boundary of the Texas Coastal Plain. Along Williamson Creek the geology is less certain due to the alluvial deposits that mostly contain stream-laid sand and gravel (USGS, 2015). Over time, these deposits have undergone calichification and have created a bedrock-type surface with varying thickness; the areas of such deposits are mapped as alluvium. The eastern project terminus overlies high gravel deposits, which are commonly exposed to the surface; the gravel deposits may be overlaid by a silty-clay top layer with a lower coarse unit that is known to yield water (TNRIS, 2007). Several exposed rocky outcrops and roadway cuts are present within the project area and display the karstic limestone that is representative of the Central Texas formations (**Photos 7 – 9**).

2.3 Aquifers

The geologic framework of Central Texas creates the foundation for an underground layer of water-bearing permeable rock known as an aquifer. The project area is situated over two aquifers: the Trinity Aquifer and the Edwards Aquifer (**Illustration 1**). Aquifers are generally recharged by direct precipitation on the land surface, but a number of factors including topography, streamflow characteristics, soils, geology, faulting, land-use, and distribution of precipitation will impact the amount of water that is recharged into or discharged from the aquifer (Ryder, 1996). Karst landscapes have unique hydrogeology that results in aquifers that are highly productive but extremely vulnerable to contamination (Mahler and Massei, 2007). Most of the recharge in karst regions occurs as point recharge into solution cavities or karst features. These features often form a network of subterranean flowpaths that allow for rapid transportation through the aquifer. Rapid transportation typically results in short residence times and little to no filtration, which minimizes the opportunity for sediment, pathogens, and chemicals to settle out, degrade, or become inert (Mahler et al., 2011). As depicted in **Illustration 1**, the Edwards and Trinity Aquifers are interconnected and groundwater flow paths trend towards the Balcones Escarpment (fault zone).



Modified from: Barker & Ardis (1996)

Illustration 1. Edwards and Trinity Aquifer Positions.

2.3.1 Trinity Aquifer

The Trinity Aquifer is a major aquifer which extends across much of the central and northeastern parts of Texas. This aquifer occurs in early Cretaceous-age rock formations of the Trinity Group in a band extending through the central part of the state (Barker & Ardis, 1996; TWDB, 2016a). This area includes all or parts of 61 counties, from the Red River in North Texas to the Hill Country of south-central Texas. One of the most extensive and highly used groundwater resources in Texas, the Trinity Aquifer is primarily used for municipalities, irrigation, livestock, and other domestic purposes (TWDB, 2016a). This aquifer has recently recorded significant declines in its water levels ranging from 350 to more than 1,000 feet; the declines are attributed primarily to municipal pumping (TWDB, 2016a).

This aquifer is divided into three hydrologic units: Upper Trinity, Middle Trinity, and Lower Trinity. The Upper and Middle Trinity units are recharged by rainwater and influent streams where surface exposure occurs (Wong et al., 2014). The Trinity Aquifer recharges slowly, with only 4-5 percent of precipitation recharging to the aquifer (Eckhardt, 2016). Additionally, the Trinity Aquifer contributes a significant amount of water as recharge to the Edwards Aquifer each year (Eckhardt, 2016). This recharge can occur where the geologic layers of the two aquifers are juxtaposed by faults, or by upwelling from the Trinity Aquifer into the Edwards

Aquifer. There is evidence that hydraulic connections between the Edwards and the Trinity Aquifers are significant; these connections may necessitate changes to the use and management of the Trinity Aquifer as urbanization and policy changes impact the amount of groundwater extracted from the Edwards Aquifer in Central Texas (Wong et al., 2014).

2.3.2 Edwards Aquifer

The Edwards Aquifer is a major aquifer located in the south-central part of the state and crosses eight Texas counties: Williamson, Travis, Hays, Comal, Bexar, Medina, Uvalde, and Kinney. The Edwards Aquifer is primarily composed of partially dissolved limestone in thicknesses ranging from 200 to 600 feet and is highly permeable, having sinkholes, caves, surface faults, and fractures. As a result, water levels and spring flows within the Edwards Aquifer respond quickly to rainfall, drought, and pumping. This aquifer provides water for municipal, industrial, and agricultural uses, and sustains a number of rare and endangered species. The Edwards Aquifer is comprised of three segments: Northern Segment, Barton Springs Segment, and San Antonio Segment; the Oak Hill Parkway project crosses the Barton Springs Segment of the aquifer.

The Edwards Aquifer includes three primary zones: the Contributing Zone, the Recharge Zone, and the Transition/Artesian Zone. These zones are depicted on **Illustration 1;** summary descriptions provided below are from Eckhardt (2016).

- The Contributing Zone. Water from the Contributing Zone flows over relatively impermeable limestones until they reach the Recharge Zone. The Contributing Zone is located on the Edwards Plateau and “catches” water from rainfall events in streams that flow into the Recharge Zone. The Contributing Zone within the Edwards Plateau generally occurs in the Texas Hill Country. This zone is about 5,400 square miles, with elevations ranging between 1,000 and 2,300 feet above sea level. Rainfall averages about 30 inches per year in this zone, and water runs off into streams or infiltrates into the water table.

- The Recharge Zone. The Recharge Zone is an area where highly fractured and faulted Edwards limestones outcrop at the land surface allowing large quantities of water to flow into the aquifer. The aquifer in the Recharge Zone is unconfined and has a water table that rises and falls in response to rainfall. Water works its way down by gravity into the transition/artesian zone. The Recharge Zone is about 1,250 square miles and is located along the Balcones Fault. About 75-80 percent of the recharge occurs when streams and rivers cross the porous formation and go underground. The remaining recharge amount is the result of precipitation.

- The Transition/Artesian Zone. The Transition/Artesian Zone includes a thin strip of land south and southeast of the Recharge Zone from San Antonio to Austin.

> Limestones that overlie the Edwards Aquifer in this area are faulted and fractured and have caves and sinkholes that allow surface water entry into the aquifer.

The Oak Hill Parkway project area includes portions of the Contributing and Recharge Zones over the Edwards Aquifer. Of the total project area, approximately 64 percent lies within the Contributing Zone and 36 percent is located in the Recharge Zone. Studies have shown that streams originating in the Contributing Zone provide the majority of recharge to the Barton Springs Segment of the aquifer through stream losses in the Recharge Zone (Slade et al., 1986; Wong et al., 2014). The movement of groundwater in the aquifer is from the higher elevation (southwestern areas) toward major discharge areas in the northeast, with flow controlled primarily by barrier faults that disrupt the continuity of the permeable Edwards strata (Eckhardt, 2016) (see **Illustration 1**). The Barton Springs Segment primarily discharges at Barton Springs, Cold Springs, and (to a lesser degree) small springs and seeps along Barton Creek and the Colorado River (Small et al., 1996; Hauwert et al., 2004; Slade, 2014; Hauwert, 2016). Water levels of the Edwards Aquifer and associated flows of Barton Springs and other natural discharge points are affected by the rate of water entering the aquifer (recharge through caves and sinks) and the rate of water exiting the aquifer (discharge through springs or seeps). Decreased spring discharge and/or degradation of water quality, including human contamination, can negatively affect the health of the aquifer and the species that are dependent on it, such as the Barton Springs and Austin blind salamanders, two federally listed endangered species that require adequate minimum flows at Barton Springs for survival.

Within the project area, the demarcation between the Recharge Zone and Contributing Zone occurs at a point approximately 800 feet east of the intersection of US 290 and William Cannon Drive along the Mount Bonnell Fault. The Recharge Zone occurs east of the fault, and the Contributing Zone occurs west of the fault where the Trinity Aquifer groups are exposed.

A Geologic Assessment was conducted for the portion of the project area occurring over the Edwards Aquifer Recharge Zone (Rahe, 2009; HDR, 2016). In all, eight potential recharge features were identified in 2009 but only six features were found during an updated survey conducted in 2016 (**Figure 4**). These features included one fault, one closed depression, two zones displaying fractures, three solution cavities, and one feature described as a natural bedrock feature. Each was characterized using the methodology presented in the guidelines for geologic assessments on the Edwards Aquifer Recharge Zone (TCEQ, 2004). The two features not identified in 2016 (one solution cavity and one non-karst closed depression) and all six of the features described in 2016 were evaluated as sensitive (i.e., they have the potential to provide aquifer recharge pathways).

2.4 Soils

Information regarding soils within the project corridor was obtained from the U.S. Department of Agriculture (USDA) Natural Resources Conservation Service (NRCS) Soil Surveys for Travis

County (NRCS, 2016a). Soils from two associations underlie the project site. The eastern portion of the project area consists of soils from the Speck-Tarrant association, which are characterized by shallow, stony, loamy soils and very shallow, stony, clayey soils overlying limestone. The western portion of the project area consists of soils from the Brackett association. Brackett soils are characterized by their shallow, gravelly, calcareous, loamy textures and are overlie interbedded limestone and marl. According to NRCS data, 12 soil types are located in the project area and have a range of slopes and infiltration characteristics (NRCS, 2016b). No soils are listed as hydric or containing hydric inclusions. A list of soils occurring within the project area included as **Table 1** and shown on **Figure 5**.

Table 1: Soils within the Oak Hill Parkway Right-of-Way

Soil Type Code	Mapped Soil Types	Hydric (Yes/No)
BID	Bracket-Rock outcrop complex, 1 to 12 percent slopes	No
BoF	Brackett-Rock outcrop-Real complex, 8 to 30 percent slopes	No
CrA	Crawford clay, 0 to 1 percent slopes	No
CrB	Crawford clay, 1 to 3 percent slopes	No
DeB	Denton silty clay, 1 to 3 percent slopes*	No
GP	Pits, gravel, 1 to 90 percent slopes	No
Md	Mixed alluvial land, 0 to 1 percent slopes, frequently flooded	No
PuC	Purves silty clay, 1 to 5 percent slopes	No
SaB	San Saba clay, 1 to 2 percent slopes	No
SsC	Speck stony clay loam, 1 to 5 percent slopes	No
TcA	Tarrant and Speck soils, 0 to 2 percent slopes	No
VoD	Volente silty clay loam, 1 to 8 percent slopes	No

Source: NRCS, 2016a

2.5 Hydrology

The proposed project is located within the Colorado River Basin (TCEQ Basin #14), within the Austin-Travis Lakes HU8 watershed (12090205). The watersheds for Slaughter, Williamson, and Barton Creeks cross the proposed project area. Within the project area, US 290 is crossed by Wheeler Branch, Williamson Creek, Devil's Pen Creek, and five unnamed tributaries to Williamson Creek. SH 71 is crossed by Scenic Brook Tributary, one unnamed tributary to Williamson Creek, and the main branch of Williamson Creek. Williamson Creek is listed by the U.S. Geologic Survey (USGS) and National Hydrography Dataset as a perennial stream but was noted to be dry within the project area during several of the field visits and is assumed to be intermittent. All tributaries in the project area are listed as intermittent or ephemeral. The project area intersects the Federal Emergency Management Agency (FEMA) designated 100-

year floodplains associated with Devil's Pen Creek and several locations of Williamson Creek and its tributaries. No tributaries or floodplains associated with Barton Creek are crossed by the project area. These resources are show on **Figure 6**.

2.6 Vegetation

Based on site visits conducted in January, May, and June 2016 by qualified biologists, it was determined that much of vegetation within the existing right-of-way consists of maintained grasses and forbs. Although a mixture of native hardwoods, Ashe juniper (*Juniperus ashei)*, and introduced tree species persist as an overstory component adjacent to the roadways in Oak Hill, the majority of vegetation within the current transportation right-of-way fits the description of "Urban Low Intensity" habitat. Several fragmented patches of unmaintained native vegetation are located within the proposed right-of-way along US 290 and SH 71, west of Williamson Creek. Typical vegetation within these areas consists of an Ashe juniper, sugarberry (*Celtis laevigata*), chinaberry (*Melia azedarach*), American sycamore (*Platanus occidentalis*), black walnut (*Juglans nigra*), Texas mountain laurel (*Sophora secundiflora*), and plateau live oak (*Quercus fusiformis*) overstory with a mixed shrub and grass understory of evergreen sumac (*Rhus sempervirens*), Texas persimmon (*Diospyros texana*), Texas pricklypear (*Opuntia engelmannii)*, saw greenbriar (*Smilax bona-nox*), elbowbush (*Forestiera pubescens*), little bluestem (*Schizachyrium scoparium* var*. frequens*), mustang grape (*Vitis mustangensis*), silver bluestem (*Bothriochloa laguroides*), purple horsemint (*Mondarda citriodora*), and scattered honey mesquite (*Prosopis glandulosa*).

Table 2 summarizes vegetation within the Oak Hill Parkway corridor according to the Ecological Mapping System of Texas (EMST) Observed Vegetation types and presents the corresponding habitat types described in the Memorandum of Understanding (MOU) between TxDOT and the Texas Parks and Wildlife Department (TPWD). EMST Observed Vegetation types are shown on **Figure 7** (MoRAP, 2015). Additional information pertaining to vegetation within the project area can be found in the *Biological Resources Technical Report* (provided under separate cover).

Table 2: Observed Vegetation Types within the Oak Hill Parkway Project Area

Observed Vegetation Type	Corresponding MOU Type
Urban Low Intensity	Urban
Edwards Plateau: Ashe Juniper Motte and Woodland	Edwards Plateau Savannah, Woodland, and Shrubland
Edwards Plateau Deciduous Oak/ Evergreen Mottle Woodland	
Edwards Plateau: Savanna Grassland	
Edwards Plateau: Floodplain Ashe Juniper Shrubland	Floodplain

Observed Vegetation Type	Corresponding MOU Type
Edwards Plateau: Riparian Hardwood Forest	Riparian
Native Invasive: Mesquite Shrubland	Disturbed Prairie

Source: MoRAP, 2015

3. SPECIFIC AREAS OF ENVIRONMENTAL CONCERN

3.1 Jurisdictional Waters of the U.S. Including Wetlands

Investigations to identify the general types of wetlands and other potential waters of the U.S. that occur in the Oak Hill Parkway project corridor included a review of background information such as aerial photography, topographic maps, soil maps, United States Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) maps, and FEMA floodplain maps. The primary goal of the preliminary wetland delineation conducted on July 20 and 21, 2015, was to verify the presence of wetland areas.

Within the project area, US 290 is crossed by one tributary to Slaughter Creek (Devil's Pen Creek), five unnamed tributaries to Williamson Creek, Wheeler Branch, and Williamson Creek. SH 71 is crossed by Scenic Brook Tributary and one other unnamed tributary to Williamson Creek, and the main branch of Williamson Creek. The areas proposed for both of the detention ponds include tributaries to Williamson Creek. Williamson Creek is an intermittent stream within the project area; it flows to the southeast into Onion Creek and on to the Colorado River. The main branch of Slaughter Creek is a perennial water; it flows southeast into Onion Creek and on to the Colorado River. It's confluence with Onion Creek is located approximately seven miles upstream of the Williamson Creek confluence. Tributaries to Williamson Creek and Slaughter Creek would be considered potentially jurisdictional waters of the U.S. due to their direct hydrologic connection to a traditional navigable water. Because all of the streams in the project area are tributaries to Williamson Creek or Slaughter Creek they would also be considered potentially jurisdictional. In addition to the streams, one emergent wetland was identified within the project area. This wetland is associated with a stream crossing in the project area. Additional information regarding impacts to these resources is provided in Section 3.1.

3.2 Rivers and Harbors Act

No navigable waters regulated under Sections 9 and 10 of the Rivers and Harbors Act lie within the project area.

3.3 Floodplains

A floodplain is a low-lying area adjacent to a river or stream that is subject to flooding. FEMA publishes Flood Insurance Rate Maps (FIRMs) that delineate the base floodplain elevations and floodways for the major rivers and streams. The FIRMs were consulted to identify floodplains within the project area. The regulatory floodway indicates the corridor of effective flow area within the floodplain where, if the base flood encroaches equally on both banks in terms of flow conveyance, the base flood elevation is increased no more than one foot. The 100-year floodplain includes areas that would be inundated by a flood event that has a one percent chance of being equaled or exceeded in any given year.

The project is located in Travis County, which is a participant in the National Flood Insurance Program. According to the FEMA FIRM Community Panel Numbers 48453C0560H and 48453C0580H the project intersects the FEMA-designated 100-year floodplains associated with Williamson Creek and Devil's Pen Creek (see **Figure 6**). Approximately 71.77 acres of floodplain associated with Williamson Creek and 1.30 acres of Devil's Pen Creek floodplain are mapped within the project area.

3.4 Water Quality

The Oak Hill Parkway corridor crosses an area which is known to contribute to Edwards Aquifer recharge via surface and groundwater conduits. Without proper controls, project runoff could impact aquatic resources across a larger geography, given the regional nature of aquifer recharge. Surface water and groundwater quality are interrelated due to the recharge characteristics of the aquifer.

Water quality and quantity is influenced by several factors, including climate, soils, geology, and topography. For instance, in Central Texas high intensity rainfalls tend to lead to pulses of stormwater runoff due to the abundance of clayey soils, which favor overland flow (sheet flow) over infiltration, especially in high volume rain events where soil saturation is quickly reached or where the ground surface is highly impervious (Hillel, 1982). This sheet flow quickly concentrates in creeks and may send a pulse of water directly into aquifer recharge features in the stream bed (Hunt et al., 2004). Sheet flow may also enter into upland recharge features (Cowan and Hauwert, 2013). As is the case with most aquifers dominated by karst geology, pulses of water move through underground conduits and emerge again as surface water at nearby springs and seeps. This movement can happen quite rapidly, especially at times of high flow (Hunt et al., 2004). Rapid transport to and through the aquifer provides little opportunity for landscape elements to influence water quality, and poor water quality at the recharge site can be quickly expressed as poor water quality at springs downgradient. In contrast, during low intensity rain events, infiltration may be the dominant mode of water movement with little to no sheet flow generated. This can be especially prevalent when soils are dry and contracted, which is when cracks and other pore spaces may open—allowing for more infiltration and less runoff (Cowan and Hauwert, 2013). Soil infiltration often allows for natural water filtration, which could result in improved water quality over time, especially during low evaporation periods that allow groundwater to recharge into the aquifer over longer time periods. The current statuses of surface and groundwater within the Oak Hill Parkway project area are described in detail below.

3.4.1 Surface Water

The Oak Hill Parkway project area is located within the Colorado River basin and crosses the drainage area of three watersheds (**Figure 6**). The portion of the project area occurring west of the intersection of US 290 and Mowinkle Drive is within the Slaughter Creek Watershed. The portion of the project between Mowinkle Drive and Patton Ranch Road lies within the Williamson Creek Watershed, and the portion of the project area east of this intersection lies within the Barton Creek Watershed. Within the project area US 290 is crossed by five unnamed tributaries to Williamson Creek, Devil's Pen Creek, Wheeler Branch, and the main branch Williamson Creek; SH 71 is crossed by Scenic Brook Tributary, one other unnamed tributary to Williamson Creek, and the main branch of Williamson Creek.

The COA Water Utility Department provides drinking water from the Colorado River and groundwater supplied from the aquifer. Contaminants in the source water may include microbes, inorganic and organic substances, pesticides and herbicides, and radioactive materials (COA, 2012). The COA Department of Watershed Protection, the Lower Colorado River Authority (LCRA), the Texas Commission on Environmental Quality (TCEQ), and USGS, among others, monitor water quality in locations surrounding the project area. The data collected by these entities is reported in the LCRA Water Quality Index, the TCEQ Integrated Report for Surface Water Quality, and the COA Environmental Integrity Index, and is compiled for independent research projects. A surface water quality monitoring site (Site 13653) occurs within the project area at the Williamson Creek/US 290 crossing. The parameters measured at this site would account for runoff in the Williamson Creek watershed, located north and west of the project area. The next closest monitoring site is located at the intersection of Slaughter Creek and FM 1826 (Site 12186), approximately 2 miles downstream of the project area. Water quality parameters that have the potential to impact sensitive species and drinking water quality include dissolved oxygen, conductivity, total suspended solids (TSS), and point and non-point source contaminants (USDOI, 2013).

The COA Watershed Protection Department samples water quality parameters in 50 watersheds within the COA's planning area to compile an Environmental Integrity Index (EII). The EII is a comprehensive biological, chemical, and physical inventory of data and is representative of current water quality in the project area. Each watershed is given an individual parameter score and assigned an overall EII score for long-term trend analysis. Data are collected for dissolved oxygen, pH, conductivity, ammonia, nitrate, ortho-phosphates, TSS, turbidity, E. coli, benthic macroinvertebrates, and diatoms. The scores are ranked "Very Bad", "Bad", "Poor", "Marginal", "Fair", "Good", "Very Good", and "Excellent".

The Williamson Creek watershed has a total catchment area of 30 square miles, of which 8 square miles are located within the Recharge Zone of the Edwards Aquifer. The majority of the project area is contained within the Williamson Creek watershed boundary. Onion Creek is the receiving water for this stream and is located approximately 18.75 miles downstream from the origination of Williamson Creek. Based on 2013 data presented in the COA EII Summary Factsheet for Williamson Creek:

Impervious cover accounts for approximately 34.1 percent of the land use in the Williamson Creek watershed.

- The overall EII score for the Williamson Creek watershed was 70 (Good). Williamson Creek ranked better than 27 other watersheds in Austin.
- The water chemistry EII score for the Williamson Creek watershed was 64 (Good), which is above average as ranked by the COA.
- The sediment quality EII score for this watershed was 83 (Very Good). Polycyclic Aromatic Hydrocarbons (PAH) are low, herbicides/pesticides are low, and metals are low.
- The aquatic life EII score for the Williamson Creek watershed was 72 (Good). The benthic macroinvertebrate community is fair; the diatom community is very good.

The Slaughter Creek watershed has a total catchment area of 30.7 square miles, of which 10.7 square miles are located within the Recharge Zone (COA, 2014). Slaughter Creek is approximately 18 miles in length; Onion Creek is the receiving water for this stream. Based on 2014 data presented in the COA EII Summary Factsheet for Slaughter Creek:

- Impervious cover accounts for approximately 19.4 percent of the land use in the Slaughter Creek watershed.
- The overall EII score for the Slaughter Creek watershed was 77 (Very Good). Slaughter Creek ranked better than 39 other watersheds in Austin.
- The water chemistry EII score for the Slaughter Creek watershed was 71 (Good), which is above average as ranked by the COA.
- The sediment quality EII score for this watershed was 75 (Very Good). PAHs are low, herbicides/pesticides are low, and metals are low.
- The aquatic life EII score for Slaughter Creek watershed was 83 (Very Good). The benthic macroinvertebrate community is very good; the diatom community is very good.

The largest of the watersheds that is crossed by the project area is the Barton Creek watershed, which has a total catchment area of 108.7 square miles, of which 7.8 square miles are located within the Recharge Zone of the Edwards Aquifer (COA, 2013). Town Lake (the Colorado River) is the receiving water for this stream. Barton Creek is approximately 49.5 miles in length. Based on 2013 data presented in the COA EII Summary Factsheet for the Barton Creek watershed:

- Impervious cover accounts for approximately 8 percent of the land use in this watershed.
- The overall EII score for the Barton Creek watershed was 79 (Very Good). Barton Creek ranked better than 42 other watersheds in Austin.
- The water chemistry EII score for the Barton Creek watershed was 70 (Good), which is above average as ranked by the COA.
- The sediment quality EII score for this watershed was 75 (Very Good). PAHs are low, and metals are low.
- The aquatic life EII score for Barton Creek watershed was 86 (Very Good). The benthic macroinvertebrate community is very good; the diatom community is very good.

Section 303(d) of the Clean Water Act

Under the TCEQ Chapter 307 rules, all surface waters of the state are classified as unique “segments” in the *Texas Surface Water Quality Standards* (TSWQS). The TSWQS establish goals for surface water quality throughout the state and identify the criteria for determining a waterbody’s appropriate use (e.g. aquatic life, public water supply, or recreation) or level of impairment based on water quality criteria. For the purposes of monitoring water quality, the TCEQ has divided the major water bodies within the Colorado River Basin into 34 discrete segments. Williamson Creek, an unclassified water body, has been designated by TCEQ as Segment 1427B. This water body drains in a southeastern direction into Onion Creek (Segment 1427), which intersects with the Colorado River below Town Lake (Segment 1428-02), and eventually drains into the Gulf of Mexico. Devil’s Pen Creek is an ephemeral waterway at the western end of the project area and it does not have a segment ID; however, it drains southward into Slaughter Creek (Segment 1427A), which terminates at its confluence with Onion Creek.

The Williamson Creek segments were listed in the 2014 *Texas Integrated Report of Surface Water Quality* as meeting all applicable water quality standards (TCEQ, 2015a). Two segments of Onion Creek located upstream of the Williamson Creek confluence were listed as impaired in 2014 by TCEQ but will not be impacted by the proposed project. According to the 2014 *Texas Water Quality Inventory, Water Body Assessments by Basin* (TCEQ, 2015b) report, Williamson Creek includes designated uses for aquatic life use and general use, while Onion Creek includes aquatic life use, recreation use, general use, fish consumption use, and public water supply use. Williamson Creek and Onion Creek were listed as including no water quality concerns and were considered to be fully supporting of their designated uses. Onion Creek does not have a US Environmental Protection Agency (EPA)-approved Total Maximum Daily Load (TMDL) or TCEQ-approved implementation plan.

Devil's Pen Creek is an ephemeral creek at the western end of the project intersecting US 290; it is a tributary to Slaughter Creek, which is located 0.2 mile south of the project area. Slaughter Creek has been listed since 2002 for an impaired macrobenthic community from the confluence with Onion Creek to above US 290. Slaughter Creek includes designated uses for aquatic life, recreation, and general use (TCEQ, 2015b). As of November 2015, Slaughter Creek does not have a US EPA-approved TMDL standard or a TCEQ-approved implementation plan established to address these issues. The TCEQ 2014 303(d) list was utilized in this assessment. See **Figure 8**.

Texas Pollutant Discharge Elimination System

The project would include five or more acres of earth disturbance; therefore, TxDOT would comply with TCEQ's Texas Pollutant Discharge Elimination System (TPDES) Construction General Permit (CGP). A Storm Water Pollution Prevention Plan (SW3P) would be implemented, and a construction site notice would be posted on the construction site. A NOI would be required.

In order to meet minimum control measures, set by the TCEQ, any project with construction on a TxDOT system within a municipal separate storm sewer system (MS4) area needs to have a Notice of Intent (NOI) submitted to the proper authority receiving a discharge. The project area is within the Phase I MS4 area that serves the COA, TxDOT Austin District, and Travis County. All MS4 operators that may receive a discharge would be notified. As an MS4 operator, TxDOT may have additional requirements for construction and post-construction BMPs, these would be described in the TxDOT Stormwater Management Plan.

3.4.2 Groundwater

The Oak Hill Parkway project area crosses both the Edwards and the Trinity Aquifer, and water leaving the project could contribute to the Barton Springs segment of the Edwards Aquifer by stream recharge or percolation. The Barton Springs segment extends from the groundwater divide north of Kyle, in Hays County, northward to the Colorado River, in Travis County; its primary discharge point is Barton Springs (BSEACD, 2010; Smith et al., 2005) (**Figure 9**).

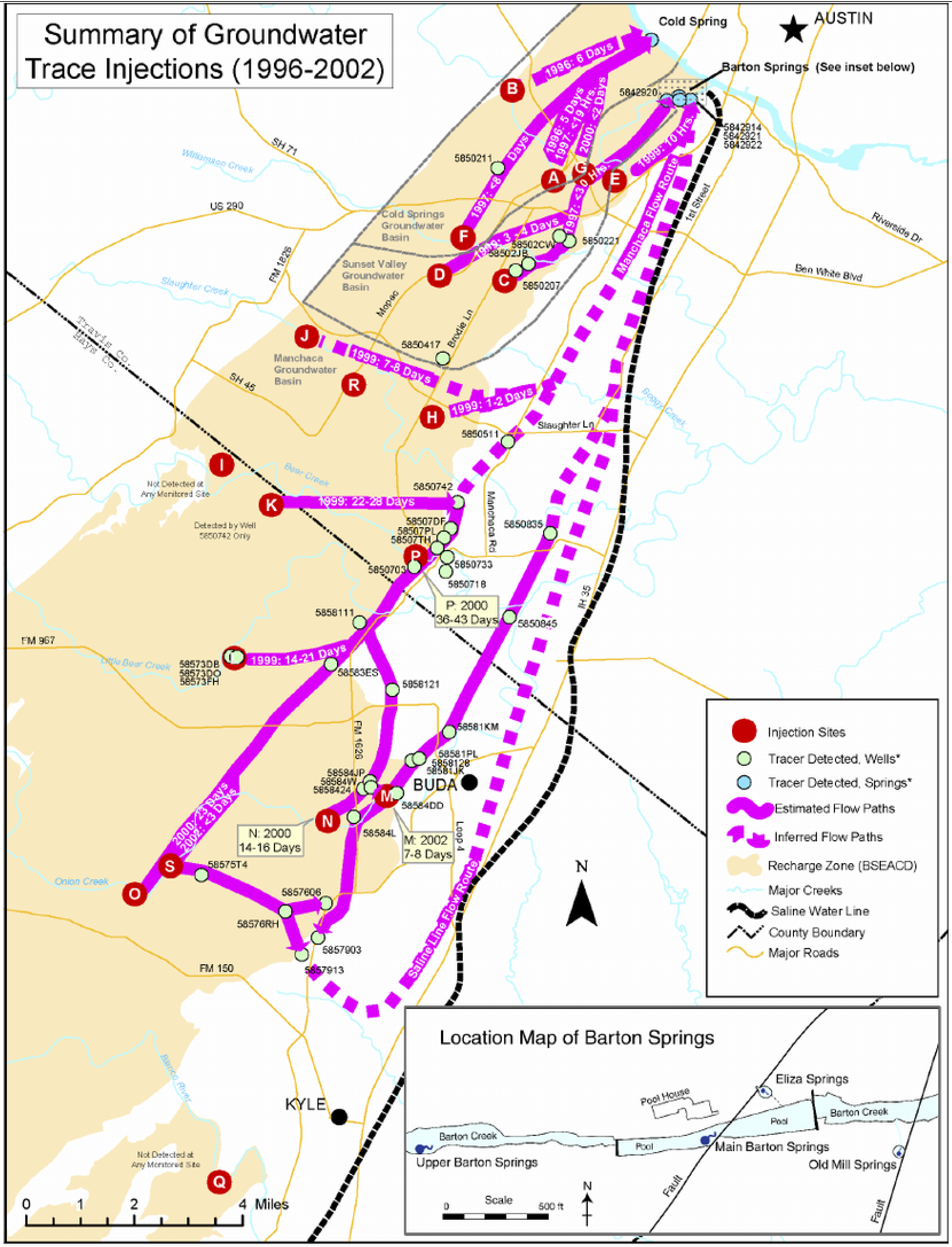
Both freshwater and saline zones can be found in the Edwards Aquifer. The freshwater portion is divided into three TCEQ regulated zones: Contributing, Recharge, and Transition Zones. The project area includes portions of the Recharge and Contributing Zones as described in **Section 2.3** above. Within the project area, the Contributing Zone is located approximately 800 feet west of the intersection of US 290 and William Cannon Drive and the Recharge Zone is located to the east of this point (see **Figure 3**). Approximately 36 percent (140.09 acres) of the total project area occurs within the Recharge Zone, and 64 percent (255.55 acres) lies within the Contributing Zone of the Edwards Aquifer. Runoff recharges to the Edwards Aquifer over the Recharge Zone (Garner and Young, 1976; Smith et al, 2005, 2013). Groundwater flow follows a southwest to northeast trending fault associated with the Balcones Fault Zone that extends from Hays County northward into Travis County and roughly parallels Interstate Highway 35 (I-35).

The project area is located in a semi-arid environment with average annual rainfall of about 33 inches (National Weather Service, 2006). Evaporation removes much of this water prior to recharging the aquifer, and the remaining water that originated as precipitation is divided between runoff and recharge to the aquifer (Slade et al., 1986). Water in stream channels may percolate through the stream substrate or flow through macropores associated with karst features, faults, and joints and recharge to the underlying aquifer (Slade et al., 1986). Recharge in upland areas may occur at caves, sinkholes, faults, fractures, and other permeable features that allow water to percolate downward and enter the aquifer (USDA, 1974; TCEQ, 2008). Groundwater discharge from the Edwards Aquifer is primarily through springs or pumped wells. According to well data within the project area, groundwater depth is variable throughout the Oak Hill Parkway corridor. Well data suggests that the aquifer depth ranges from approximately 35 to 265 feet below the ground surface throughout the project area (see **Table 3**) (TWDB, 2016b).

The Barton Springs segment of the Edwards Aquifer is approximately 155 square miles (BSEACD, 2003). Three groundwater basins have been delineated within this segment: Cold Springs, Sunset Valley, and the Manchaca groundwater basins (**Figure 9**). A portion of the project area is located within the Cold Springs groundwater basin. Several studies have been performed in the Barton Springs segment of the Edwards Aquifer to identify flow paths and rates of flow through the aquifer from these different basins. In general, dye trace studies have concluded that most groundwater within this segment discharges at Barton Springs, located approximately 4.3 miles northeast of the eastern terminus of the project area (BSEACD, 2010; Smith et al., 2005). However, some studies indicate that approximately 12 square miles of the aquifer discharges to Cold Springs (Hauwert et al., 2004: Figure 1, which is included here as **Illustration 2**; Hauwert, 2015), while others suggest that the Cold Springs discharge from this area occurs only during high flow events (Slade, 2014). Hauwert et al. (2004) reported that two sites on Williamson Creek located downstream closer to the confluence with Onion Creek transmitted dye to Barton Springs instead of to the Cold Springs Complex (**Illustration 2**). These studies document that within the Recharge Zone, Cold Springs is hydraulically linked to surface water recharge from the upper portions of Williamson Creek

(Hauwert et al., 2004; Hauwert, 2015), but lower reaches of this creek are also connected to flow paths discharging at Barton Springs. It is likely that the discharge from both Cold Springs and Barton Springs is highly correlated with groundwater levels; to date, all dye trace studies for the Barton Springs segment represent point injections into recharge features and none have studied stream reaches or varying flow conditions at Barton Springs (Slade, 2014).

The Edwards Aquifer is one of the most permeable and productive limestone aquifers in the United States (EAA, 2016). The aquifer is especially susceptible to contamination due to its karst topography, which facilitates rapid transmittal of potential contaminants over long distances once in the limestone aquifer (Small et al., 1996). Approximately 85 percent of recharge to the Edwards Aquifer comes from six streams located within the Recharge Zone (Slade et al., 1986). Of these, Williamson Creek, its tributaries, and Devil's Pen Creek (a tributary to Slaughter Creek) occur within the Oak Hill Parkway project area. Recharge from the eastern portions of the project area have been associated with the Cold Springs flow route through the aquifer, which has been shown to supply water to Cold Springs and other unidentified springs on the Colorado River as depicted on Illustration 2 (Hauwert et al, 2004; Hauwert, 2015). Flow paths from downstream of the project area are located within the Sunset Valley groundwater basin and have mapped flow paths that lead to the Upper Barton and Parthenia (Main) Springs but not Eliza or Old Mill Springs (Hauwert et al., 2004). Dye trace studies have shown that potential pollutants in the upper portions of Williamson Creek can reach Cold Springs (through groundwater paths) in about eight days and can reach Barton Springs from the lower reaches in as little as 30 hours under high flow conditions (Hauwert et al., 2004; Hauwert, 2015). Because groundwater moves through highly permeable fractures and voids, the aquifer has little ability to filter potential contaminants. This characteristic makes the Edwards Aquifer's water quality highly dependent on the quality of surface water flowing over the Recharge Zone.



Sources: BSEACD, TCEQ, TXDoT
Created by Jason West (BSEACD)

* Monitored wells and springs with no detections are not shown.
** All travel times are to the Springs (Cold Spring and Barton Springs).

Illustration 2. Mapped Flow Paths, Groundwater Basins, and Spring Locations

Source: Included with permission from Hauwert et al., 2004: Figure 1. Flow Systems of the Edwards Aquifer Barton Springs Segment Interpreted from Tracing and Associated Field Studies.

3.4.3 Groundwater Quality

The Barton Springs segment and contributing watersheds are experiencing rapid population growth which has resulted in development and increased urbanization across southwestern Travis County. According to the COA EII in 2015, from 2003 to 2013 the contributing watersheds that are relevant to the Oak Hill Parkway project have experienced estimated increases in impervious cover of approximately 90.5 percent (Williamson Creek), 110 percent (Barton Creek), and 115 percent (Slaughter Creek). Sung et al. (2013) estimated that almost 1,400 acres of new impervious cover had been added to the Williamson Creek watershed from 1991 to 2008. Urbanization and the associated increase of impervious cover can increase stormwater runoff, which leads to the degradation of water quality by increasing anthropogenic sources of contaminants entering surface streams and groundwater conduits.

The water quality of the Barton Springs segment and its associated watersheds has been widely studied since the 1980s and was sampled for constituents, such as nitrates, as early as the 1930s (Turner, 2009; Herrington, 2003; Mahler et al., 2006; Mahler et al., 2011a; Mahler et al., 2011b). Barton Springs has been the focal point for much of this research since it is an iconic Austin recreation spot, it provides part of the COA municipal water supply, and it supports habitat for two federally listed salamanders (Slade et al., 1996; Mahler et al., 2011b). In addition, the Barton Springs segment is designated as a Sole Source Aquifer by the EPA, providing drinking water for approximately 60,000 people; its main discharge site is the Barton Springs Complex (Hauwert et al, 2004; COA 2013). For these reasons, there is interest in long-term monitoring efforts to document water quality conditions in order to measure the effects of urbanization over time.

Most of these studies measure a suite of water quality constituents such as: dissolved oxygen, conductivity, pH, nitrogen, phosphorus, TSS, turbidity, and bacteria levels. Several studies have focused specifically on urban runoff constituents like atrazine (herbicides), chloroform (drinking water purification substance), and heavy metals such as zinc (Mahler et al., 2011b, COA 2014). Vehicle tires are the primary sources of zinc, which can be a significant component of highway runoff (Councell, et al., 2004). A recent report by Barrett (2016) evaluated the results of over 20 years of water quality data, including roadway runoff constituents (TSS & zinc), at Barton Springs. Barrett's report also examined the effectiveness of typical BMPs that are frequently used to treat stormwater runoff under COA regulations and the TCEQ Edwards Aquifer Rules. He concluded that these BMPs are successful at removing pollutants from highway runoff, and he cited the findings of historical water quality data collected by the COA and the USGS at Barton Springs. Of particular importance to highway runoff are TSS, zinc, and copper, all of which have been stable or decreasing over the last 20 years despite the increased urbanization over the Barton Springs Zone (Barrett, 2016). Several water quality constituents (nitrate, dissolved oxygen, sulfate, calcium, strontium, etc.) studied in Barrett's report were found to have worsened over the same period (Herrington and Heirs, 2010;

Barrett, 2016). The increase in these constituents is explained in detail by Barrett (2016). Briefly, the increase in nitrates is likely associated with an increase in septic or wastewater systems throughout the Barton Springs Zone (Mahler et al. 2011a). The increases in many of the other constituents can be explained as the result of their natural occurrences in the aquifer and by the increased water supply demands, which can cause saline water from the eastern boundary of the Edwards Aquifer to move west and increase its discharge at Barton Springs (Mahler et al., 2006). This saline water line (also known as the "bad water line") is well documented as the cause of increases in the concentrations of sulfate, fluoride, sodium, chloride, strontium, and other minerals, and it can discharge at Barton Springs under certain conditions (Barrett, 2016). Based on Barrett's analysis, none of the water quality data analyzed for Barton Springs indicated any degradation due to stormwater runoff or an increase in impervious cover.

Barrett's (2016) report also focused on the effectiveness of various BMPs for stormwater runoff within the Barton Springs Zone. He concluded that, based on the water quality analysis of the constituents that are typically found in stormwater or highway runoff, the TCEQ and COA BMP standards are effective at preventing degradation to water quality by matching or improving on background water quality parameters (Barrett, 2016).

3.4.4 Groundwater Quantity

The Texas Water Development Board's (TWDB) recognizes 9 major aquifers and 21 minor aquifers that are a critical source of water for Texas, providing approximately 62% of the 13. 7 million acre-feet of water used across the state in 2014 (TWDB, 2016c). The change in groundwater quantity over time is reflected through water-level changes that are measured at well sites across the state. Groundwater levels in all the major and minor aquifers of Texas have declined since 1900 and have ranged from less than 50 feet to more than 1,00 feet (TWDB, 2016c). The Trinity aquifer, surrounding the Dallas and Waco areas, have witnessed the greatest water-level declines; whereas, the Edwards aquifer has declined steadily overtime but has episodically reversed this trend during major storm events when recharge exceeds discharge (TWDB, 2016c).

The Edwards and Trinity are considered tributary aquifers, which means they contribute to surface water flow through groundwater discharge. Groundwater from these aquifers primarily discharges at springs and seeps, and is removed via pumping at groundwater wells. The Texas Water Development Board's (TWDB) Groundwater Database lists 11 water wells within 500 feet of the Oak Hill Parkway project area (see **Figure 6**). **Table 3** shows the well numbers, well types, and recorded water depth for the listed wells. Although this well data represents a single measurement in time, it provides a reference point for the recorded water levels closest to the project area.

Table 3: Water Wells within 500 feet of the Project Area

Well Number	Aquifer	Primary Use	Water Depth (feet)	Date of Sample	Well Type
5841903	Trinity	Domestic	130	1969	Withdrawal of Water
5849310	Trinity	Unused	195	1962	Withdrawal of Water
5849316	Trinity	Domestic	240	1980	Withdrawal of Water
5849323	Unassigned	Unknown	N/A	N/A	Withdrawal of Water
5850103	Edwards	Domestic	35	1947	Withdrawal of Water
5850104	Edwards	Unused	219	1946	Withdrawal of Water
5850105	Edwards	Unused	145	1978	Withdrawal of Water
5850115	Trinity	Domestic	142	1970	Withdrawal of Water
5850123	Edwards	Public Supply	157	2003	Withdrawal of Water
5850129	Trinity	Irrigation	265	2004	Withdrawal of Water
5850130	Trinity	Irrigation	265	2004	Withdrawal of Water

Source: TWDB, 2016b

Table 4 provides a summary of the two closest, long-term USGS maintained water monitoring wells to the project area. Well #5850301 is an Edwards Aquifer well located approximately three miles downstream of the project area adjacent to Williamson Creek and well # 5850120 is a Trinity Aquifer well located behind the HEB grocery store at the US 290/SH 71 intersection.

Table 4: Long Term Water Level Monitoring Well Data

	Edwards Well (#5850301)		Trinity Well (#5850120)	
Sample Date	Daily High Water Level (feet below land surface)	Change overtime (feet)	Daily High Water Level (feet below land surface)	Change overtime (feet)
05/30/2017	113.54	--	339.70	--
05/29/2017	113.40	-0.14	340.00	0.30
05/28/2017	113.29	-0.25	341.10	1.40

	Edwards Well (#5850301)		Trinity Well (#5850120)	
Sample Date	Daily High Water Level (feet below land surface)	Change overtime (feet)	Daily High Water Level (feet below land surface)	Change overtime (feet)
05/23/2017	113.08	-.046	347.40	7.70
04/30/2017	112.25	-1.29	323.20	-16.50
02/28/2017	113.89	0.35	322.70	-17.00
11/30/2016	1110.31	-3.23	336.80	-2.90
05/30/2016	117.30	3.76	319.90	-19.80
Oldest Date*	161.75	48.21	255.79	-83.91

Source: TWDB, 2017
Note: *Oldest date of sampling for Edwards well was 03/13/2003 and for the Trinity well was 11/04/1991.

The amount of water stored in the aquifers is dependent on the relationship between climatic conditions and anthropogenic factors, such a well pumping and urbanization. In addition, the location of the well (unconfined versus confined zones) will influence the water levels and how much they may vary over time. Although some wells respond quickly to recharge events, most wells show a combination of slow (matrix) and fast (conduit) flow (BSEACD, 2010). A study by Barrett and Charbeneau (1996) investigated the effects of urban development on aquifer recharge and spring discharge. They found that although development reduced the amount of recharge to the aquifer during periods of direct runoff, the increase in impervious cover also resulted in more recharge during dry periods through concentrated flow routes, so that the average spring discharge remained unchanged (Barrett and Charbeneau, 1996).

Springflow discharging from Barton Springs is often used to evaluate the overall water levels of the Barton Springs segment of the Edwards Aquifer, and is closely monitored by a number of agencies. The long-term average springflow at Barton Springs is 53 cubic feet per second (cfs) (Scanlon et al., 2001; Hauwert et al., 2004). Fluctuations in water level in the Barton Springs segment of the Edwards Aquifer represent changes in storage due to hydrologic stresses (Hunt and Smith, 2006). These fluctuations are due to a combination of seasonal and long-term (months to years) climatic changes that influence recharge via precipitation and anthropogenic changes in recharge and discharge rates (Hunt and Smith, 2006; Mahler et al., 2006). Water levels are generally lowest during extended periods of drought (Brune and Duffin, 1983), as was observed during the severe drought conditions in 2011. During this period, the Austin area received only 33 percent of its average annual precipitation total, and diminished streamflow led to reduced recharge, lowering water levels in the aquifer and decreasing springflow at Barton Springs to Critical Stage Drought levels (Hunt et al., 2012a).

Recharge and discharge rates to the aquifer are influenced by a variety of anthropogenic factors. Pumpage removes water from the aquifer and can decrease discharge rates at springs, while recharge may be decreased by (1) increasing pumpage capturing groundwater upstream of contributing streams, (2) increasing temperatures and evapotranspiration rates, thereby reducing recharge, and (3) land-use practices that increase rates of evapotranspiration (Hunt et al. 2012b). In 1983, Brune and Duffin found that groundwater discharge (the sum of springflow and groundwater pumpage) was approximately equal to average annual recharge. However, more recent studies performed by the BSEACD have demonstrated the need for a reduction in pumpage from the Barton Springs segment of the Edwards Aquifer during periods of extreme drought to protect water wells from going dry and to maintain the quantity and quality of flow at Barton Springs (Smith and Hunt, 2004). Smith and Hunt (2004) used groundwater models to predict that, with projected pumping and a recurrence of drought-of-record conditions, springflow at Barton Springs would be greatly diminished or stopped. Additionally, under these conditions, as many as 19 percent of all water supply wells in the District could be negatively impacted and the potential for saline water to flow into the freshwater aquifer would increase (Smith and Hunt, 2004).

The contribution of recent recharge to spring discharge has been the subject of numerous recent studies. Mahler et al. (2006) reported that recharge water contributed from 0 to 55 percent of spring discharge during non-stormflow conditions, while Mahler et al. (2011b) found that stream recharge contributed about 80 percent of Barton Springs discharge during a wetter-than-normal period. Groundwater flow rates are correlated to springflow rates, and vary under differing climatic conditions (BSEACD, 2003).

A review of historical precipitation and hydrological data from Central Texas suggests that a change to a wetter climate has occurred since the 1960s (Hunt et al., 2012b). This shift has correlated to an increase in streamflows and springflows at Barton Creek during the past 60 years, indicating increased water within the Edwards Aquifer over this time period (Hunt et al., 2012b). At the same time, base flow, which is the portion of stream flow that is not runoff and results from deep subsurface flow and delayed shallow subsurface flow, has decreased and variation in flow rates has increased. This balance has resulted in relatively little change to total discharge at Barton Springs over time (Hunt et al., 2012b). Moreover, base flow declines are directly related to increased pumping from the aquifer and pumping from the Barton Springs segment has increased dramatically in recent years, from less than 2,000 acre-feet per year in 1970 to approximately 5,700 acre-feet per year in the mid-2000s (Brune and Duffin, 1983; Hunt et al., 2012b). The Trinity Aquifer does not seem to have the same response to the increased precipitation as the Edwards, which is reflected in the declining groundwater levels despite the wetter climate (Hunt et al., 2012b). Future water use is difficult to project because of unpredictable weather conditions and the potential for alternative water supply scenarios. However, it is projected that water levels within the aquifers may decline in response to intensification of future pumpage and potential future drought conditions associated with a changing climate (Scanlon et al., 2001).

3.5 Executive Order 11990, Wetlands

Executive Order 11990 Protection of Wetlands (issued in 1977) requires federal agencies to minimize the destruction or modification of wetlands. One wetland was identified within the project area; therefore, Executive Order 11990 would apply and project design would minimize impacts to wetlands as practicable.

3.6 Texas Coastal Management Program

The project is located in Travis County, outside of the Texas Coastal Management Program Boundary; therefore, a consistency determination would not be required.

3.7 Trinity River Corridor Development Certificate

The project is located outside the Trinity River Corridor Development Regulatory zone. A Corridor Development Certificate would not be required.

3.8 Edwards Aquifer Recharge and Contributing Zones

A variety of regulations are in place to protect the quality of groundwater in the Barton Springs segment of the Edwards Aquifer. The TCEQ has in place the Edwards Aquifer Protection Program which provides guidelines on complying with the Edwards Aquifer Rules, as well as Optional Enhanced Measures that may be adopted to further protect water quality (TCEQ, 2013), including wells and springs fed by the aquifer and water resources to the aquifer, and upland areas draining directly to it and surface streams. Any project located within the Recharge Zone would require the submittal of a Water Pollution Abatement Plan (WPAP) to the TCEQ. The project is located within the Edwards Aquifer Recharge Zone and Edwards Aquifer Contributing Zones as discussed in previous sections; therefore, it would require the preparation of an WPAP in compliance with the Edwards Aquifer Rules (TCEQ, 2013). According to the TxDOT-TCEQ 2013 MOU, construction of either build alternative would require coordination with the TCEQ due to its location over the Edwards Aquifer and due to the project's NEPA classification as an EIS.

3.9 International Boundary and Water Commission

The project is located outside of the jurisdiction of the International Boundary and Water Commission; therefore, coordination would not be required.

3.10 Other Applicable Regulations—the Endangered Species Act

Due to the location of the Oak Hill Parkway project area on the Recharge Zone and the location of the project's eastern terminus (Mopac) approximately 4.3 miles southwest of the Barton Springs Complex, the project has the potential to indirectly affect the habitat of two federally listed species through negative impacts to water quality. The Endangered Species Act (ESA) prohibits the "take" of listed species such as the Barton Springs salamander (*Eurycea sosorum*) and Austin blind salamander (*Eurycea waterlooensis*). Any federal action that "May Affect" a federally listed species requires consultation under Section 7 of the ESA. Any action that would result in the take of a listed species would require coverage under Section 9 of the ESA.

The Barton Springs and Austin Blind salamanders are indicator species for the overall health and water quality at Barton Springs and are sensitive to environmental changes. The largest and most stable populations of Barton Springs Salamanders are within Parthenia and Eliza Springs. The Austin Blind Salamander has been found in three of the four springs in the Barton Springs Complex but has never been observed at Upper Barton Springs. In 2015, a single Barton Springs Salamander was identified from a sampling well on FM 1626, approximately 9.5 miles south of the Barton Springs Complex (TXNDD, 2016). This recent observation confirms that the habitat for this species is not limited to the Barton Springs Complex.

Because both listed salamander species are neotenic and complete their lifecycle in the water, they are highly dependent on the water quality and quantity of the Barton Springs segment of the Edwards Aquifer, which feeds Barton Springs. Total organic carbon and specific conductance levels as well as dissolved pollutants such as total petroleum hydrocarbons, heavy metals, pesticides/herbicides, and excessive nutrients have been shown to have a detrimental effect on salamanders (USFWS, 2005). Dissolved oxygen is also critical to salamander survival; however, levels that could be harmful to the salamander are not known (USFWS, 2005). In addition, TSS and pollutants adhering to sediments may concentrate over time as sediments are deposited and sediment loads increase. Furthermore, sediments and associated increases in turbidity can impact the ecosystem and thereby impact the salamanders (USFWS, 2005).

There have been documented instances when water quality has negatively impacted Barton Springs salamanders in the past (USFWS, 1997; USFWS, 2005) but, to date, there have been no studies linking stormwater runoff from highway construction or operation over the Recharge Zone to a specific effect on the Barton Springs or Austin Blind salamanders. Studies have shown that impervious cover within a watershed should generally not exceed 15 percent in order to prevent damage to the watershed and associated aquatic ecosystems (Center for Watershed Protection, 2003). For highly sensitive watersheds, an impervious cover percentage of no greater than 10 percent has been recommended to prevent damage to sensitive stream ecosystems (USFWS, 2005). The Williamson Creek watershed was estimated to have approximately 34.1 percent impervious cover in 2013, which was an increase of over 90 percent since 2003 (COA, 2013). However, a recent report by Barrett (2016) summarized the findings of water quality parameters typically associated with stormwater runoff at Barton Springs and found that common highway-generated constituents (e.g., TSS and zinc) have been stable or decreasing over the last 20 years despite the increase of impervious surface in the Barton Springs Zone.

Coordination with the USFWS may be required once project design has been finalized to ensure that water quality protection measures adequately protect federally listed species. For additional life history information and a discussion of project effects on these species, see the *Biological Resources Technical Report* provided under separate cover.

4. POTENTIAL PROJECT IMPACTS

4.1 Wetlands and Waters of the U.S.

In accordance with the Clean Water Act (CWA [33 U.S.C. 1251 et. Seq]), Section 404, the Code of Federal Regulations (CFR) defines jurisdictional waters as all waters that are currently used, were used in the past, or may be susceptible to use in interstate or foreign commerce, including their tributaries and adjacent wetlands (40 CFR 230.3). This includes streams exhibiting an Ordinary High Water Mark (OHWM), their adjacent wetlands, and other water bodies exhibiting a “significant nexus” with these waters (i.e., exerting a substantial effect on the chemical, physical, and biological integrity of those waters).

Section 404 of the CWA also defines jurisdictional wetlands as “areas inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.” Wetlands generally include swamps, marshes, bogs, and similar areas. The U.S. Army Corps of Engineers (USACE) regulates the fill of waters of the U.S., including wetlands, and has established methodology for the delineation of wetlands. The USACE methodology utilizes vegetation, soils, and hydrologic characteristics of a site in the delineation of wetlands.

Investigations to identify the general types of wetlands and other potential waters of the U.S. that occur in the Oak Hill Parkway project corridor included a review of background information such as aerial photography, topographic maps, soil maps, USFWS NWI maps, and FEMA floodplain maps. Field reconnaissance was conducted to preliminarily verify the presence of jurisdictional areas on July 20 and 21, 2015. The acreage of each potentially jurisdictional water body within the project area, as well as the acreage of potential impacts from each alternative, are shown in **Table 5** below. Field delineation was restricted to areas where right-of-entry was granted; detention pond locations were not included in this assessment due to lack of right-of-entry (**Figure 10**). Field data sheets are included in **Attachment C** for resources that could be accessed.

Table 5 – Potential Impacts to Water Bodies Within the Project Area

Aquatic Resource ID	Description	OHWM (in feet)	Acreage within Alt. A	Acreage within Alt. C
W-1	Headwaters of Tributary to Scenic Brook Tributary	undet.	0.03	0.03
S-1	Unnamed Tributary to Williamson Creek	3	0.01	0.01
S-2	Unnamed Tributary to Williamson Creek	2	0.04	0.04
S-3	Ephemeral Stream Wheeler Branch	10	0.45	0.45
S-4	Ephemeral Scenic Brook Tributary to Williamson Creek	20	0.08	0.85
S-5	Perennial Stream Headwaters of Williamson Creek at SH 71 bridge	5	0.03	0.03
S-6	Williamson Creek	25	2.27	2.17
S-7	Unnamed Tributary to Williamson Creek	5	0.18	0.18
S-8	Unnamed Tributary to Williamson Creek	4	0.02	0.02
S-9	Devil's Pen Creek*	undet.	undet.	undet.
DS-1	Unnamed Tributary to Williamson Creek*	undet.	undet.	undet.
DS-2	Unnamed Tributary to Williamson Creek*	undet.	undet.	undet.
P-1	Detention Pond*	n/a	n/a	0.06
P-2	Detention Pond*	n/a	n/a	0.61
DP-1	Stock Pond*	n/a	0.33	0.33
Total			**3.44**	**4.78**

*ROE was not granted for these areas; estimates were calculated from desktop analysis

One emergent wetland (W-1) was identified within the proposed project area during the wetland delineation on the south side of US 290 near Boling Drive (**Photo 10**). This wetland appears to be on the headwaters of Scenic Brook Tributary and is a potentially jurisdictional wetland. It appears to have been dug from uplands on the headwaters to contain stormwater or to store water for use during road maintenance. It has a weir and pump on the end of the wetland nearest the road and included a cut into the stream to allow for overflow into the stream, which creates a jurisdictional connection. During the delineation this wetland did not have any standing water but had developed into an emergent wetland.

S-1 is a small ephemeral stream with a 3-foot-wide OHWM. S-1 begins near the existing northern right-of-way on SH 290 and flows north into Scenic Brook Tributary (S-4), a tributary to Williamson Creek that parallels Scenic Brook Drive. Due to its connection to another Scenic

Brook Tributary (S-4), S-1 is considered a jurisdictional water (**Photo 11**). S-2 begins at El Ray Boulevard and parallels US 290 for about 450 feet before turning north to cross under the existing roadway and flow into Wheeler Branch (S-3) (**Photo 12**). S-3 is a portion of Wheeler Branch south of US 290 with a 10-foot-wide OHWM (**Photo 13** and **14**). S-4 is a portion of Scenic Brook Tributary which drains to Williamson Creek; it crosses SH 71 through large concrete culverts. Outside of the culverts Scenic Brook Tributary (S-4) has a 20-foot-wide OHWM within the project area (**Photo 15**). S-5 is the headwaters of Williamson Creek, although the main branch of the creek was mapped as S-6 during the delineation. The headwaters of the creek have an OHWM of 5-feet within the project area (**Photo 16** and **17**). Williamson Creek (S-6) is an intermittent stream with a 25-foot-wide OHWM within the project area; it flows to the southeast along US 290/SH 71 into Onion Creek and on to the Colorado River. Williamson Creek would be considered a potentially jurisdictional water of the U.S. due to its direct hydrologic connection to a traditional navigable water (**Photo 18** to **23**). S-7 is an ephemeral stream with an OHWM of 5-feet; it originates south of the project then flows under US 290/SH 71 and into Williamson Creek (**Photo 24**). S-8 is a short ephemeral stream with an OHWM of 4-feet; it originates south of the project then flows under US 290/SH 71 into Williamson Creek (**Photo 25**). Devil's Pen Creek (S-9) is a small ephemeral stream with an OHWM of 3-feet that is conveyed under US 290 through a concrete box culvert; this waterway is a tributary to Slaughter Creek and would be considered a potentially jurisdictional water (**Photo 26**). DS-1 and DS-2 correspond to the proposed upstream detention ponds. The proposed size for DS-1 is 9.42 acres at full capacity and for DS-2 it is approximately 8.88 acres at full capacity. Both DS-1 and DS-2 are located along unnamed tributaries to the headwaters of Williamson Creek. Both of these tributaries would be considered potentially jurisdictional. DP-1 is a stock pond located within the northwestern SH 71 detention pond proposed right-of-way. P-1 and P-2 are detention ponds owned and maintained by the NXP Semiconductors (formerly Freescale) property located northwest of the William Cannon/US 290/SH 71 intersection. These ponds are isolated and do not appear to have a surface connection to Williamson Creek. OHWMs and field verification of impacts were only obtained for parcels with right-of-entry granted at the time of survey (**Figure 10**). Once an alternative is selected and right-of-way purchased, additional field verification will be required to document impacts associated with waters of the U.S.

Impacts to W-1 and the other nine delineated potentially jurisdictional streams would be similar under either build alternative, although within the limits of *Alternative C* there are an additional 1.34 acres of water resource compared to *Alternative A*. The impacts to these waters would occur from extending existing culverts, placing fill for concrete aprons and/or rock rip rap at bridges, and placing temporary fills during construction. Exact fill types and amounts will be determined once design is finalized and, if necessary, would be permitted with a nationwide permit from USACE. Mitigation for these impacts would also be determined, if necessary, and calculated based on amount and type of impact to each jurisdictional water.

No Build Alternative

Under the *No Build Alternative*, no project-related direct impacts to waters of the U.S. or other water resources would occur. Existing impacts to water resources would continue, such as pollution from stormwater runoff and impacts from maintenance activities within the project area.

4.2 Surface Water Impacts

Roadways have the potential to impact water quality and quantity during both their construction phase and their operation and maintenance phases. The water quality impacts arise primarily, though not wholly, from the effects that roadways can have on stormwater runoff. Whereas, water quantity impacts may arise for the addition of new impervious cover or through the alteration of existing vegetation.

4.2.1 Construction Phase

During the construction phase, site preparation activities such as grading, excavating, trenching, boring, and clearing vegetation result in loosened topsoil. In addition to this disturbance of native soil, it is often necessary to bring new material onto the site to be used, for example, in building up roadbeds. Construction sites, therefore, may create extensive areas of loose material that are susceptible to erosion. Although these exposed areas are temporary, they may be highly erodible until final revegetation of the right-of-way has occurred. Erosive forces associated with stormwater come both from rain that falls directly onto the project area and from overland flow that originates up-gradient and crosses the project site. Once eroded, soil will be transported down-gradient and deposited. This deposition, also known as sedimentation, may occur on a variety of locations, such as on another upland site, in a water body, or in an aquifer recharge feature (such as a cave or sink). Dye trace studies have shown that potential pollutants in Williamson Creek can reach Barton Springs (through groundwater paths) in as little as 30 hours under high flow conditions (Hauwert et al., 2004; Hauwert, 2015).

The erosion and sedimentation of soil and other particles from construction sites can have direct negative impacts on water quality. When introduced into aquatic environments, both the particles and any pollutants adhering to them can impact the basic functions of aquatic species. Under excessive sedimentation essential habitat and aquatic plants may also be directly shaded by particles suspended in the water column or be covered completely. Sediment may be indirectly associated with other impacts as well, such as by acting as a vector for pollutants or contributing to the degradation of a variety of water quality indicators. Sediment may become contaminated with hydrophobic pollutants such as pesticide residues and heavy metals, which adsorb onto certain soil particles. This contaminated sediment, when deposited, may act as a reservoir of toxic compounds and contribute to bio-concentration of toxins in aquatic plants and animals (Barrett et al, 1995b). Oil and grease residues and dissolved nutrients may be associated with sediment particles as well. The use of heavy machinery, along with the fluids, fuels, and lubricants necessary for its operation, combined with the effects of frictional wear on metal parts, increases the likelihood of soil contamination by oil, grease, and metals on construction sites. By-products from fuel combustion that become temporarily suspended in the air may also contaminate soil through atmospheric deposition during rain events. Because of the direct and indirect impacts associated with solids entrained in a waterbody, the TSS in a sample of water is measured as an important indicator of water quality. TSS is the fraction of total solids present in a water sample that are not dissolved but are smaller than 2 micrometers in size. TSS reduction is often a goal in pollution mitigation because the time required for a particle to settle increases as the size of the particle decreases. A 3-micrometer silt particle will take 20.1 hours to settle 1 meter through water while a 1.5-micrometer particle will take 79 hours to settle the same distance (TXDOT, 2013). Therefore, while the total solids in a sediment-laden water body may be primarily comprised of larger particles, measures that reduce TSS will have beneficial impacts on levels of other solids as well.

Construction-phase contamination would be prevented by adherence to environmental commitments such as temporary BMPs outlined in the SW3P and Water Pollution and Abatement Plan. While TSS is a principal concern during both construction and operation of roadways, the BMPs that are proposed as part of this proposed project would address other roadway-associated pollutants as well, such as heavy metals, nutrients, and hydrocarbons.

No Build Alternative

There would be no construction phase impacts to surface water as a result of the *No Build Alternative.*

4.2.2 Operation Phase

Similar to construction impacts, potential impacts to surface water quality associated with the operational phase of roadways include two broad, interrelated divisions: impacts from altered hydrology and impacts from roadway-associated pollution. Hydrological changes result mainly from the increase in impervious surfaces, the alteration of natural flow patterns, and the concentration of stormwater flow. Similar to the effects of highly compacted soils, impervious surfaces decrease infiltration rates directly by preventing access to covered areas and indirectly by increasing stormflow velocity, which can lead to increased erosion and its associated impacts. Impervious surfaces associated with roadways include the road surface itself as well as curbs, concrete swales, some types of detention ponds, and other stormwater management infrastructure. Current project design indicates that approximately 74.0 and 73.6 acres of impervious cover would be added as a result of *Alternative A* and *Alternative C*, respectively.

The proposed project includes two upstream detention ponds (with a total area of 18.30 acres) and up to 17 water quality ponds to mitigate for the increased impervious cover throughout the project area. These permanent ponds would be designed to improve the quality of stormwater runoff as well as the flow characteristics (e.g., rate, velocity) of discharged stormwater, which would decrease flood potential and reduce channel scouring downstream. It is anticipated that due to the upstream detention ponds and the US 290 bridge improvements at Old Bee Cave Road, William Cannon Drive, and US 290 there would be a reduction in 10-year flood levels (0.5 feet) in Williamson Creek that would slightly reduce overland flow into the Barton Creek watershed (H&H Resources, 2017). This improvement would reduce the amount of roadway contaminants potentially reaching the Barton Creek watershed and indirectly, the Barton Springs complex, during storm events.

Roadway-associated pollution may be generated through highway maintenance, accidental spills, and vehicle use. Routine maintenance activities introduce pollutants such as pesticides, paint, and herbicides to the roadside environment. Accidental spills that range from small leaks, to loss of fluids during crashes, to tanker truck spills can introduce pollutants as well. Vehicle use also generates a number of pollutants. The processes that control the build-up of these pollutants and the processes that control their removal from the roadway have been well studied in an effort to address highway-associated pollution loads in receiving waters.

The processes that generate pollutants associated with vehicle use include frictional wear, leaks and spills, and fuel combustion. Frictional wear works at the point of contact between tires and the road surface causing both to lose particles to the roadside environment. Certain automotive parts such as brakes and clutches are intentionally designed to use frictional forces for their proper function. These parts are continually worn down and their constituent materials fall from vehicles to the roadway. Other metal parts wear similarly even though they are not designed to rely on frictional forces, and these are often lubricated in an effort to reduce friction and wear. The metal particles that result from this wear, along with the oil and grease used for lubrication, also fall from vehicles to the roadway. Additionally, vehicles may pick up pollutants such as dirt or other residues and carry them to the roadway where they may be deposited.

In a general sense, the pollution load that reaches a waterbody from a roadway is determined by the factors that contribute to its build-up on the roadway and the factors that contribute to its removal from the roadway, the latter also contributing to its transport to water bodies. Since the use of vehicles is a source of roadway pollutants, studies have investigated the effects of several vehicle use variables such as average daily traffic (ADT) and the number of vehicles that pass a certain point during a storm. The antecedent dry period (ADP) or time since the last rain event, is also studied for its effects on pollutant loading. ADT combined with ADP gives an indication of the sum number of vehicles that have used a roadway since the last rain event. Because of complicated interactions between pollutant removal factors, these pollutant build-up factors do not result in a linear increase in pollutant load that is simply the result of the sum of cars since the last rain event (Kim et al., 2006).

Stormwater runoff is an important consideration for pollutant removal, but it is not the only contributing process. Roadside turbulence generated by natural wind patterns or from passing vehicles has a scrubbing effect on the road surface (Barrett et al., 1995a). Particles are blown from the surface of the road and deposited in areas adjacent to the traffic lanes. Other substances may be removed from the roadway by volatilization, oxidation, or other chemical degradation. Through processes like these, pollution loading tends to reach an equilibrium between rain events with dry period processes removing a portion of the pollutant load as it is being deposited (Li and Barrett, 2008). Pollutant loading to the roadway has been theorized to vary with rainfall intensity as well (Li and Barrett, 2008b). This is partly due to the washing action that road spray has on vehicles. In times when pavement is wet enough for tires to produce spray but not wet enough to generate substantial runoff, pollutants may be washed from vehicles and left on the road to be removed by dry period processes and the next sufficient rain event.

Rain events and their resultant stormwater runoff are well studied with respect to variations in constituent pollutant concentrations. Much attention has been given to pollutant concentrations in the initial volume of runoff from a storm, i.e. the first flush. This volume of water has been targeted for capture and treatment in an effort to remove the majority of the pollution load associated with any one runoff event. However, the influence of the first flush has been found to vary with various factors, including percent impervious cover in the contributing watershed and the constituent of interest (Schuler, 2000). Furthermore, a considerable amount of pollution can be carried by runoff generated throughout a storm event, and the entirety of the load washed off may surpass that of the first flush (Barrett et al. 1995). This phenomenon is influenced by other pollutant removal factors such as rainfall intensity, rainfall volume, and runoff volume. For example, low-intensity rainfalls may not produce sufficient runoff to pick up and wash away certain pollutants on the roadway (Barrett et al 1995a). Alternately, low-intensity rain followed by increasing intensity may mobilize the majority of pollutants during or around the peak intensity. Pollutant concentrations measured during the peak of a storm may still be relatively low, but this may be because high water volume dilutes the concentrations. Nonetheless, a relatively large pollutant load may be entrained in the runoff.

Surface water quantity impacts may occur in association with construction and operation activities as well. Changes in vegetation coverage, addition of impervious cover, soil compaction, and soil roughness (a measure of how easily water will flow over the ground) all change infiltration rates and flow dynamics. A decrease in soil roughness and an increase in soil compaction are common on construction sites where heavy machinery travels over the same areas repeatedly. Increased soil compaction leads to decreased infiltration and, therefore, increased volumes of stormwater runoff. Increases in flow volume and velocity lead to increased flow energy which, in turn, increases water's ability to carry larger sediment loads and to scour stream channels, which further increases the overall sediment load in streams if not mitigated for appropriately within the project area.

Post-construction TSS levels in treated stormwater are anticipated to exceed the total TCEQ required removal by approximately 4,409 pounds under *Alternative A* and approximately 5,103 pounds under *Alternative C* (KFA, 2017). Both build alternatives would utilize a combination of upstream stormwater detention ponds, extended detention, vegetative filter strips, bioretention, and san filter systems to meet and exceed the TSS removal required by the TCEQ.

In addition to stormwater runoff, Hazardous materials spills are also a concern for surface water quality as they may enter features associated with the contributing and recharge zones of the aquifer. A Hazardous Materials Trap (HMT) would be included as a permanent BMP under either build alternative to mitigate impacts associated with accidental spills within the Oak Hill Parkway corridor.

No Build Alternative

Under the *No Build Alternative* stormwater runoff would continue to flow into adjacent streams and recharge features, while vehicular traffic on the roadway would continue to increase. Temporary changes to water quality as a result of the construction phase of the project would not occur. However, an important change to the existing conditions under either build alternative would be the inclusion of required TCEQ BMPs to control the quality, quantity, and velocity of water (including roadway runoff) entering streams and recharge features with flow paths to Barton Springs. The existing US 290/SH 71 roadway infrastructure within the project area lacks a HMT and stormwater detention ponds, which are designed to mitigate the impacts from stormwater runoff associated with transportation corridors.

Additionally, under the *No Build Alternative* there would be no reduction in flood levels in Williamson Creek and the overland flow into the Barton Creek watershed would continue at current levels.

4.3 Groundwater Quality Impacts

Potential impacts on water quality related to roadway construction and operation can quickly translate to the aquifer and springflow environments. If contaminants such as heavy metals, oil, nutrients, or pesticides are mobilized by stormwater they could flow into Williamson Creek or downstream to Slaughter Creek via tributaries and enter the aquifer through faults, fractures, or other unidentified recharge features. Although the proposed project area does not occur within the mapped subsurface drainage basin for any caves, several sensitive recharge features were noted during the GA in the vicinity of Williamson Creek. Without appropriate BMP use, sediment-laden water may enter recharge features via overland flow or the stream bed and could bring contaminants into aquifer and spring outflow environments. Studies have shown that water in the aquifer may move at rates between 2.3 and 7.4 miles per day (Hunt, et al., 2004), and increased storm flow in creeks in the Recharge Zone has been shown to result in predictable changes in water quality parameters in Barton Springs after a short temporal lag (Hunt, et al., 2013).

The greatest possibility for groundwater impacts during the construction phase of the proposed project could occur if voids connected to the aquifer or containing groundwater are intersected during the down cutting of bedrock below the current grade or other excavation activities, such as bridge piers. Preliminary design indicates that *Alternative A* would require the placement of approximately 167 columns and *Alternative C* would require the placement of approximately 152 columns within the Recharge Zone. Columns would reach depths between 19 and 33 feet, which would be shallower than the all the recorded wells near the project area.

Additionally, previously unknown caves and recharge features may be impacted by construction activities. Trenching and boring may create, uncover, or enlarge openings, changing the hydrology and atmospheric conditions of the feature. New or enlarged openings may allow for runoff to enter aquifer conduits with little to no opportunity for pollution attenuation from natural methods such as soil percolation. Changes in exposure to the open air may also lead to changes in humidity, light, and nutrient flow within the feature, which could negatively impact any cave-dependent species living there. The accidental discovery of recharge features or other underground voids may require them to be partially or completely plugged, which could lead to their removal from the recharge matrix. If voids are encountered during construction, 30 TAC 213.5(f)(2) rule requires that activities near the void cease until a geologist could evaluate the void and develop a void mitigation plan. The void mitigation plan must be certified by the geologist, submitted to the TCEQ, and approved prior to the implementation of mitigation, and before continuing construction in the vicinity of the void. In addition, a section 10(A)(1)(a) permitted scientist should inspect the site as soon as possible to evaluate potential species habitat.

The proposed improvements would incorporate a variety of approved practices for managing stormwater runoff during all phases of the project in order to attenuate the potential impacts to groundwater. During construction, TCEQ-approved measures to reduce erosion and maintain sediment on site would be implemented and documented in the SW3P, as discussed in Section 5 below. These measures should be effective in most conditions; however, there is a possibility that they could be overwhelmed during major rain events. Management of post-construction runoff for the proposed project would also be accomplished with permanent

TCEQ-approved measures that would capture and treat the first flush. Generally, the most contaminated stormwater runoff occurs during the first flush of runoff generated during a storm event, which mobilizes particles and contaminants that have accumulated on impervious surfaces since the previous rainfall event. The proposed drainage and water quality treatment improvements would result in a net improvement in the amount of TSS and associated roadway contaminants removed from runoff leaving the project area. It is anticipated that the proposed Oak Hill Parkway project would result in negligible impacts to water quality. The risk would be mitigated by the incorporation of permanent TCEQ-approved BMPs that are properly maintained throughout the life of the project.

No Build Alternative

Under the *No Build Alternative* stormwater runoff would continue to enter into groundwater conduits through adjacent streams and recharge features, while vehicular traffic on the roadway would continue to increase. Existing water quality controls within the project area include permeable friction course pavement, which removes approximately 18,428 pounds of TSS. Under the *No Build Alternative* no impacts to groundwater quality resulting from construction would occur and stormwater runoff from the existing roadway would continue with limited treatment.

4.4 Impacts to Groundwater Quantity

Due to the aquifer's high permeability, water levels and spring flows responds quickly to rainfall, drought, and extraction (pumping). These dynamic systems can decline rapidly in response to drought conditions but will also rebound quickly with increased precipitation (TWDB, 2016c). Groundwater quantity may be negatively impacted by the introduction of impervious cover such as roadways, parking lots, and buildings. These surfaces can limit the amount of aquifer recharge, particularly with large scale urbanization. Increased runoff due to impervious cover can divert stormwater sheet flow to discrete channels and eventually to surface streams, thus focusing surface water flow to creeks and rivers, and speeding the departure of surface flow from recharge zones. Alteration of natural vegetation regimes can also reduce recharge by speeding up runoff. An increase in impervious cover could also increase the frequency of flow in creeks and stream beds, where most of the recharge occurs. Sediment-laden stream water may also plug recharge features with sediment, closing off potentially important paths of aquifer recharge. In a scenario where stormwater flow is increased, infiltration is decreased, and recharge features are plugged, water levels in the Edwards Aquifer could be reduced. Low flows in Barton Springs have been associated with increased specific conductance (Mahler, et al., 2006) and decreased dissolved oxygen levels (Turner, 2009), both of which negatively affect spring-dependent biota.

Additionally, although there are no known caves or large recharge features within the Oak Hill Project area, encroachment of impervious roadway cover on the drainage basins associated with unknown caves or recharge features could result in a decrease in water volume, resulting in potential drying of the cave environment and impacts to sensitive karst invertebrates or aquifer-dependent species utilizing those areas.

The proposed project would result in minimal impacts to water quantity resulting from the placement of 74.0 acres and 73.6 acres of new impervious cover in an already urbanized area, for *Alternative A* and *Alternative C* respectively. The permanent BMPs would be designed to control the velocity of flow and quality of stormwater runoff leaving the project area in order to minimize any potential impacts to the recharge of groundwater over the Edwards Aquifer. The proposed improvements would not require the withdrawal or use of groundwater. Therefore, the proposed project would result in minimal and discountable impacts to water quantity.

<u>No Build Alternative</u>

Under the *No Build Alternative*, no project related impacts to water quantity would occur.

4.5 Impacts to Floodplains

There are 71.77 acres of FEMA-mapped floodplains within the project area. Areas mapped as Zone A or AE are subject to inundation by the 1-percent-annual-chance flood event. *Alternative A* includes 69.42 acres and *Alternative C* includes 69.66 acres of Williamson Creek that may be impacted. Therefore, *Alternative C* would cross an additional 0.24 acres of floodplains compared to *Alternative A*. Both alternatives include 1.3 acres of floodplain at Devil's Pen Creek.

In addition to the impacts discussed above, the existing concrete bridges at Old Bee Cave Road, William Cannon Drive, and US 290 will be removed and rebuilt under either build alternative. It is anticipated that approximately 563, 1,597, and 996 cubic yards (CY) of concrete would be removed from the 25-year floodplain at these locations. The new crossings would include construction of bridges utilizing 10-foot by 10-foot concrete columns, totaling 222 CY. The net result of the bridge removal/reconstruction would be an approximately 2,933 CY reduction of concrete within the 25-year floodplain of Williamson Creek. When coupled with the proposed upstream detention ponds, the bridge crossing improvements are anticipated to have a positive effect on downstream flooding. For flood events below a 10-year flood, there would be no overland flow outside the banks of Williamson Creek and for flood events of a 10-year flood or higher, overflow from the Williamson Creek to Barton Creek watershed would occur. However, under either build alternative flood levels at the overflow point will be reduced by approximately 0.5 feet from the existing conditions (Eric Friedrich, H&H Resources, 2017).

Impacts to floodplains in the project area would be minimized by using BMPs during both construction and operation of the proposed project. Over five acres of earth would be disturbed as a result of either build alternative, which would require preparation of a SW3P for the project. Stormwater runoff would be addressed through compliance with the TPDES and Edwards Aquifer Protection Program. It is anticipated that bridge support structures (e.g., piers, abutments) and culverts could be designed to avoid causing an increase in the base flood elevation that would violate applicable floodplain regulations. Coordination with the local floodplain administer would be required.

No Build Alternative

Under the *No Build Alternative*, no project-related direct impacts to floodplains would occur.

4.6 Impacts to Sensitive Aquatic Resources, Including Salamanders

Potential impacts to aquatic resources associated with the construction and operational phases of roadways include impacts from altered hydrology and impacts from roadway-associated pollution. Pollutants can enter the aquatic environment via untreated stormwater runoff or spills, and the addition of impervious cover can affect the volume and quality of runoff leaving the project area. Based on the project's location over the Recharge Zone of the Edwards Aquifer and the known aquifer flow paths to Barton Springs from the impacted watersheds, this project may have indirect effects on the Barton Springs and Austin Blind salamanders. The project would strictly adhere to the TCEQ standards for BMPs over the Edwards Aquifer and would commit to removing 80% of the incremental increase in TSS that results from the project's additions of impervious cover in the Edwards Aquifer Recharge Zone. Additionally, the project would apply the TCEQ *Optional Enhanced Measures for the Protection of Water Quality in the Edwards Aquifer (Revised) – Appendix A to RG-348* as practicable within the Recharge Zone (TCEQ, 2007).

No Build Alternative

Under the *No Build Alternative* stormwater runoff would continue to flow into adjacent streams and recharge features, while vehicular traffic on the roadway would continue to increase. No project-related direct or indirect effects to salamanders would occur.

5. ENVIRONMENTAL COMMITMENTS

To mitigate for the increase of impervious cover within the project area and to ensure protection of downstream resources (including salamanders), BMPs would be applied to reduce the intensity of stormwater runoff and amount of roadway pollutants entering Williamson and Slaughter Creeks. In 2007, the TCEQ published a set of voluntary Optional Enhanced Measures (OEMs) as an appendix to their guidance document, *Complying with the*

Edwards Aquifer Rules: Technical Guidance on Best Management Practices (TCEQ, 2007). These measures provide a suite of options that can be used to enhance water quality by committing to construction, post-construction, and maintenance phase BMPs. According to the TCEQ's *Optional Enhanced Measures for the Protection of Water Quality in the Edwards Aquifer Report (Revised) – Appendix A to RG-348* (TCEQ, 2005; TCEQ, 2007), projects that adopt the OEM would not result in the take of a listed species through water quality impacts. Although this guidance explicitly mentions the Barton Springs salamander and does not address the Austin Blind salamander, the life history and habitat of the Austin Blind salamander are quite similar to the Barton Springs salamander and it is assumed that the OEMs would be effective for this species as well.

TSS is often used as an indicator of water quality because it includes both large and small sediment particles. Most BMPs designed to improve water quality focus on TSS removal in stormwater runoff. The proposed Oak Hill Parkway project would strictly adhere to the TCEQ standards for BMPs over the Edwards Aquifer and would commit to removing 80% of the incremental increase in TSS that results from the project's additions of impervious cover in the Edwards Aquifer Recharge Zone. Where practicable, the project would adopt the OEMs to ensure the protection of water quality. The design and TSS removal metrics are included in **Appendix A**, *Preliminary Water Quality Analysis and Design Report* (KFA, 2016). The following BMPs have been recommended as permanent water quality protection measures for the Oak Hill Parkway project:

Permanent BMPs

- Bioretention Ponds – Bioretention ponds are stormwater storage facilities that passively collect stormwater and thus delay the conveyance of water downstream. The ponds also filter the stormwater, typically using sand or vegetative media. Multiple (more than 10) bioretention ponds utilizing a classic sand filter system with biofiltration will be incorporated throughout undeveloped portions of the project right-of-way. Ponds will be a mixture of vegetated and non-vegetated systems depending on location (e.g., non-vegetated under roadway overpass). Pond depths will vary but are expected to be approximately two to three feet deep.

- Vegetative Filter Strips (VFS) – A VFS is a section of land located adjacent to the roadway shoulder or median that has moderate slopes designed to accept runoff as overland sheet flow. Pollutant removal is achieved through velocity reduction, filtration by vegetation, and infiltration. Optimal performance of a VFS relies on maintaining a dense mix of erosion-resistant vegetation. VFS will be utilized along pavement edges, within the medians as practicable, and along the shared-use path of the Oak Hill Parkway project.

- Hazardous Materials Trap (HMT) – A HMT is a detention pond that captures and contains liquid hazardous material spills or stormwater runoff. In instances of hazardous materials spills, the pond would hold the material until it could be safely collected and removed. For stormwater quality, the pond is designed to operate in an open-close cycle to allow particulates to settle prior to releasing the less turbid water. HMTs are being considered at the Williamson Creek crossings within the project area.

The following BMPs may be applied to the Oak Hill Parkway project to minimize downstream impacts to water quality and sensitive aquatic resources as practicable throughout the construction and operation phases of the project:

General BMPs

- Erosion Control - The project will incorporate temporary erosion control structures to minimize erosion. Erosion control measures, such as silt fences, temporary seeding, rock checks, and erosion control blankets, will be incorporated as a first step in construction and will be maintained throughout active construction activities. In addition, permanent stormwater quality BMPs, such as stormwater ponds, wetlands, or detention basins, may be required for projects that require coverage under the TPDES General Permit.

- Sediment Control - The SW3P will describe the temporary and permanent structural and vegetative measures to be used for soil stabilization, runoff control, and sediment control for each stage of the project from initial land clearing and grubbing to project close-out. The SW3P will include a description of structural practices to divert flows from exposed soils, store flows, or otherwise limit runoff and the discharge of pollutants from exposed areas of the site to the degree attainable.

- Roadside Drainage - Where feasible, vegetated swales would be used to assist with filtering sediment and other pollutants from stormwater before it reaches streams and adjacent wetlands.

- Revegetation - All temporarily disturbed areas created by construction activities would be revegetated following TxDOT specifications. Permanent revegetation will occur after sections are completed and will consist of a variety of grasses and forbs, including legumes, wildflowers, and cereals. The species used shall be suitable to the area and should not compete with permanently planted grasses. To temporarily stabilize unprotected earth, mulch consisting of hay, straw, wood fiber, or other suitable material will be placed evenly after applying the seed mix.

- Equipment Service/Maintenance - The SW3P and TxDOT Environmental Permits, Issues, and Commitments (EPIC) form may require that any areas used for servicing or performing maintenance on construction equipment will be located away from streams, wetlands, and ponds and outside the 100-year floodplain. The contractor will submit a proposed plan designating staging areas, and this plan will be reviewed and approved by the engineer prior to construction. Materials that may leach pollutants will be stored under cover and out of the weather. Fuel tanks located on-site will have double containment systems and any fuels or other spills must be cleaned up immediately. Concrete or other material wash outs will be located in designated areas away from aquatic resources. All construction equipment will be maintained in proper mechanical condition so fuel, oil, and other pollutants do not get into water bodies during construction activities.

Wetland/Stream Protection

- Establish and/or maintain buffers around known or discovered recharge features.
- Locate, design, construct, and maintain stream crossings to provide maximum erosion protection.
- Maintain existing road ditches, culverts, and turnouts to ensure proper drainage and minimize the potential for the development of ruts and mud holes and other erosion-related problems.
- Stabilize, seed, and mulch eroded roadsides and new road cuts with native grasses and legumes, where feasible, in a timely manner to minimize impacts to water bodies.
- Implement erosion and sediment controls where appropriate. Maintain protective vegetative covers over all compatible areas, especially on steep slopes. Where necessary, gravel, fabrics, mulch, riprap, or other materials that are environmentally safe and compatible with the location may be used, as appropriate, for erosion control in problem areas.
- Water quality protection BMPs will have multiple levels of oversight to ensure their continued proper function. In addition to contractor inspectors who are responsible for daily monitoring of BMPs, TxDOT inspectors will conduct weekly inspections and will submit compliance reports to the Project Engineer. Additional oversight will be provided by the TxDOT Project Manager (who will be on site each day) and staff from the District Environmental Quality Office, including the District Environmental Quality Coordinator.

Roadway Construction

- Permeable Friction Course (PFC Overlay) – PFC is a porous asphalt applied over conventional asphalt to the underlying pavement that drains to the edge of pavement. The porous surface also reduces splash, which reduces the washing of pollutants from the undersides of vehicles. During its operational life, PFC reduces pollutant concentrations along the roadway and provides filtration of contaminants. PFC is not currently proposed as a BMP on the Oak Hill Parkway project.

Bridge Construction and Geotechnical Drilling Protection

- A specific karst void discovery protocol would be developed for the project for all excavation phases.
- Monitor drill shafts for voids and leave steel casings in place if water is encountered during drilling activities.

- Backfill annular spaces outside of cased excavations with washed pea gravel covered with a layer of bentonite chips and Portland cement from land surface to a depth of three feet.

- Install concrete surface caps at the above-ground base of each bridge column.

- Provide bridge deck drains that will capture bridge deck runoff and direct it to sedimentation basins, if feasible.

Sensitive Feature Protection

- Sensitive features would be protected, where applicable, by buffers and temporary BMPs. Permanent protections would include stormwater treatment via water quality ponds and structural and vegetative BMPs in other areas. The quality and quantity of recharge reaching sensitive features would be preserved to the greatest extent practicable.

6. CONCLUSIONS

Surface and groundwater resources associated with the Oak Hill Parkway may be impacted as a result of the proposed project. Placement of the roadway could encroach on the surface or subsurface drainage areas of unknown adjacent caves/sensitive recharge features, altering the hydrologic regime in those features. Additionally, any features that are uncovered during construction operations would be closed in accordance with TCEQ regulations.

Proposed water quality protection measures and BMPs to be utilized under either build alternative would remove at least 80% of the incremental increase in TSS that results from the project's addition of impervious cover in the Edwards Aquifer Recharge Zone, in compliance with the TCEQ's Edwards Aquifer Rules. In addition, the proposed water control facilities for both alternatives are anticipated to exceed the total TSS removal required by TCEQ. The potential for pollutants in stormwater runoff from the construction site and completed roadway to enter the aquifer and the potential for changes in recharge rates to the aquifer resulting from increases in impervious cover would be minor. Impacts would be minimized by the use of robust BMPs during roadway construction and operation. These BMPs (outlined in the *Oak Hill Parkway (US 290/ SH 71) Preliminary Water Quality Analysis and Design Report,* attached as **Appendix A**) include multiple levels of water quality treatment measures, water quality ponds, vegetative filter strips, and a hazmat trap at Williamson Creek. During construction, project activities would be guided by an Environmental Compliance Management Plan (ECMP) which would include protocols designed to avoid environmental impacts. Stormwater runoff would also be treated by BMPs over the Recharge and Contributing Zone.

Impacts to surface waters in the project area would also be minimized using BMPs during both construction and operation of the proposed project. Over five acres of earth would be disturbed as a result of either build alternative, requiring preparation and implementation of a SW3P for the project. Stormwater runoff would be addressed through compliance with the TPDES and Edwards Aquifer Protection Plan. Any impacts to jurisdictional waters would comply with Section 404 of the CWA and would be permitted accordingly using a Nationwide Permit 14 with or without a Preconstruction Notification.

No Build Alternative

Under the *No Build Alternative*, no project related impacts to waters of the U.S., floodplains, surface water, or groundwater would occur. Water quality in the Oak Hill area would be expected to decline due to the increase in vehicle use and the limited stormwater treatment facilities available along the existing US 290/SH 71 corridor.

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Attachment A – Figures

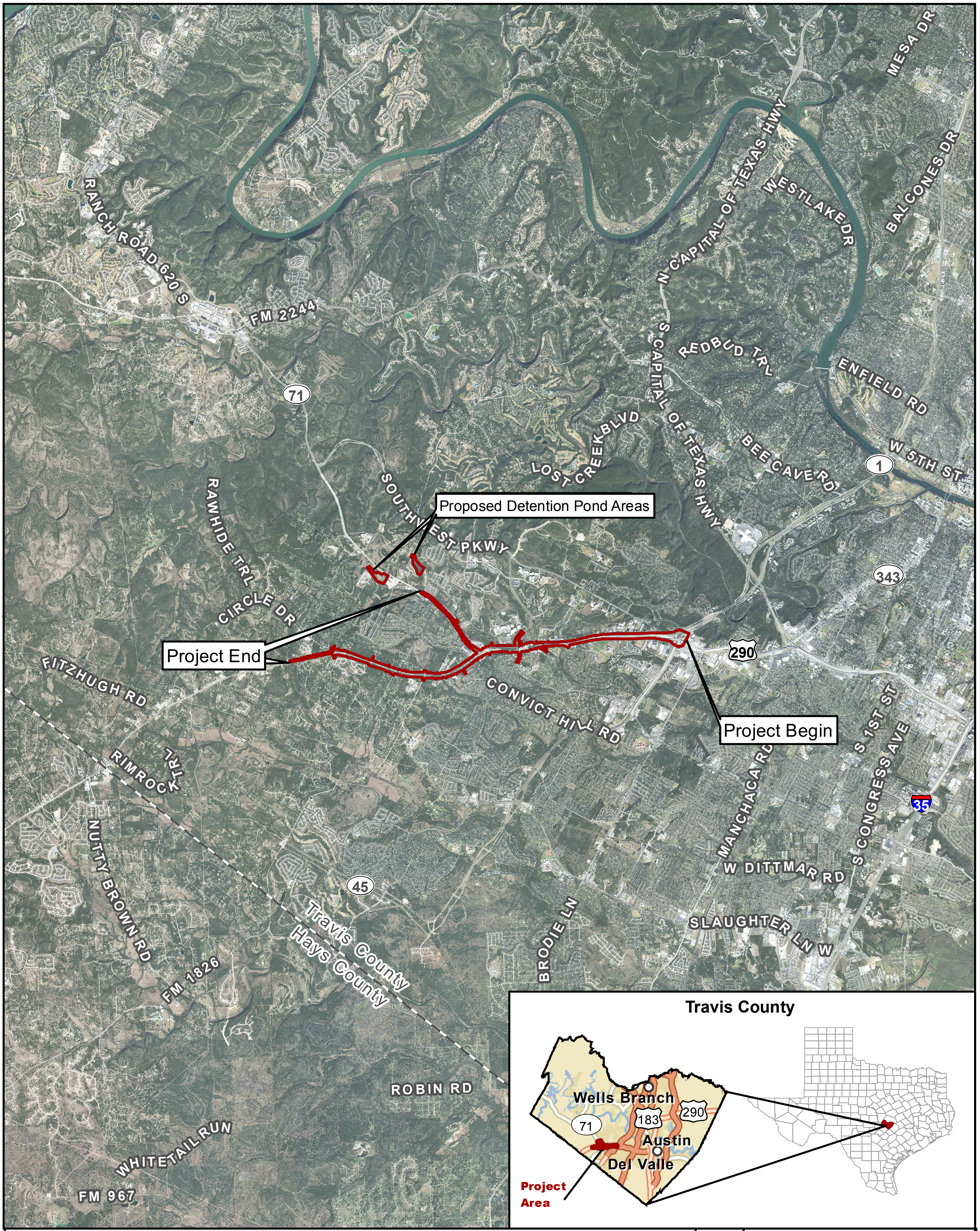

Figure 1. Project Location (Aerial Base)

Oak Hill Parkway: US 290W from Mopac/Loop1 to west of Circle Drive and SH 71 from US 290W to Silvermine Drive

▭ Project Location

0 2 Miles
0 3 Kilometers

Basemap Source: TNRIS (2015)

Prepared for: TxDOT
CSJ: 0013-08-060 and 0700-03-077

1 in = 2 miles
Scale1:126,720
Date: 6/6/2017

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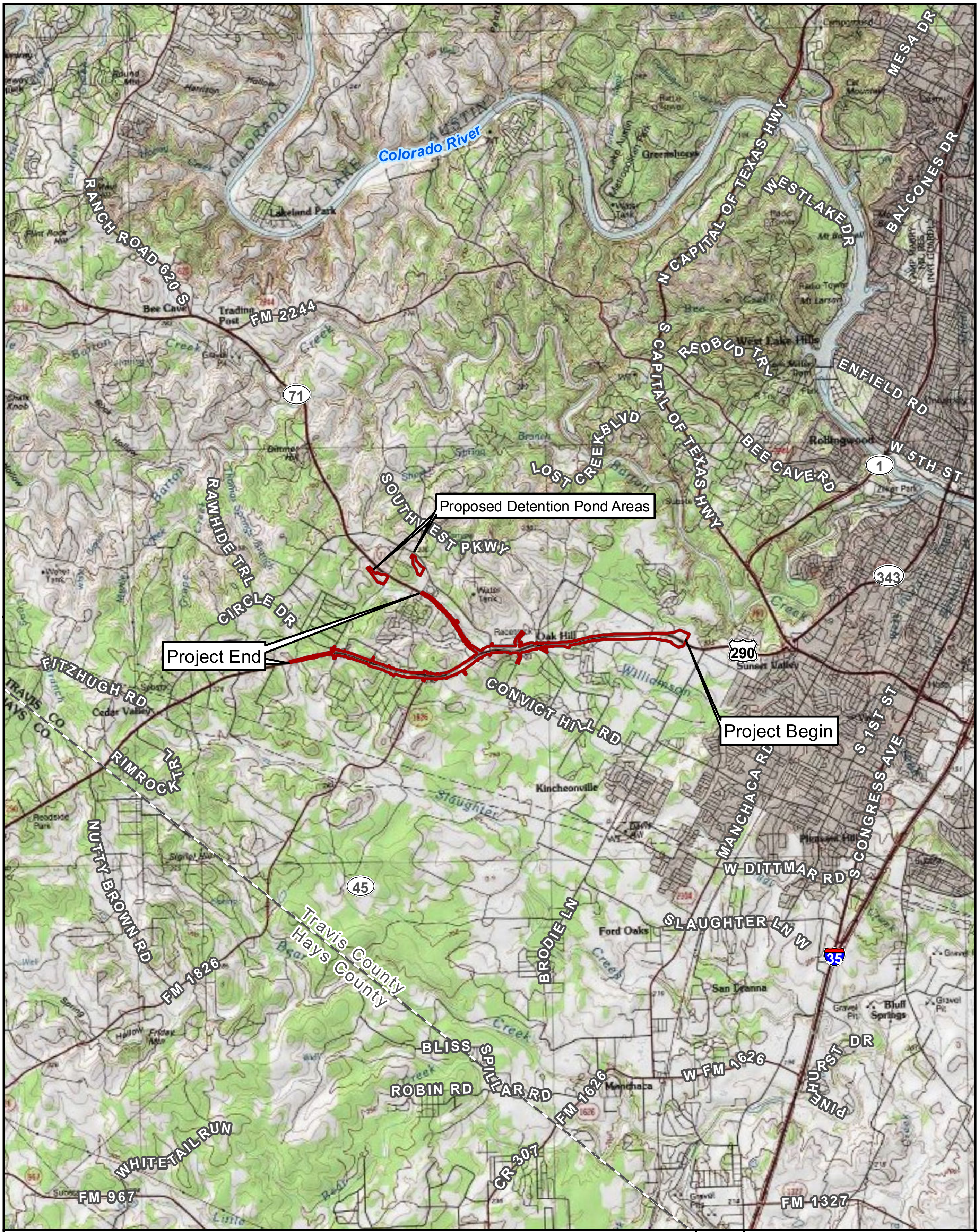

Figure 2. **Project Location (Topographic Base)**

Project Location

Oak Hill Parkway: US 290W from Mopac/Loop1 to west of Circle Drive and SH 71 from US 290W to Silvermine Drive

Topographic Source: USGS Austin, Texas
30' x 60' Quadrangle (1985)

0 2 Miles
0 3 Kilometers

Prepared for: TxDOT
1 in = 2 miles
Scale1:126,720
CSJ: 0013-08-060 and 0700-03-077
Date: 6/6/2017

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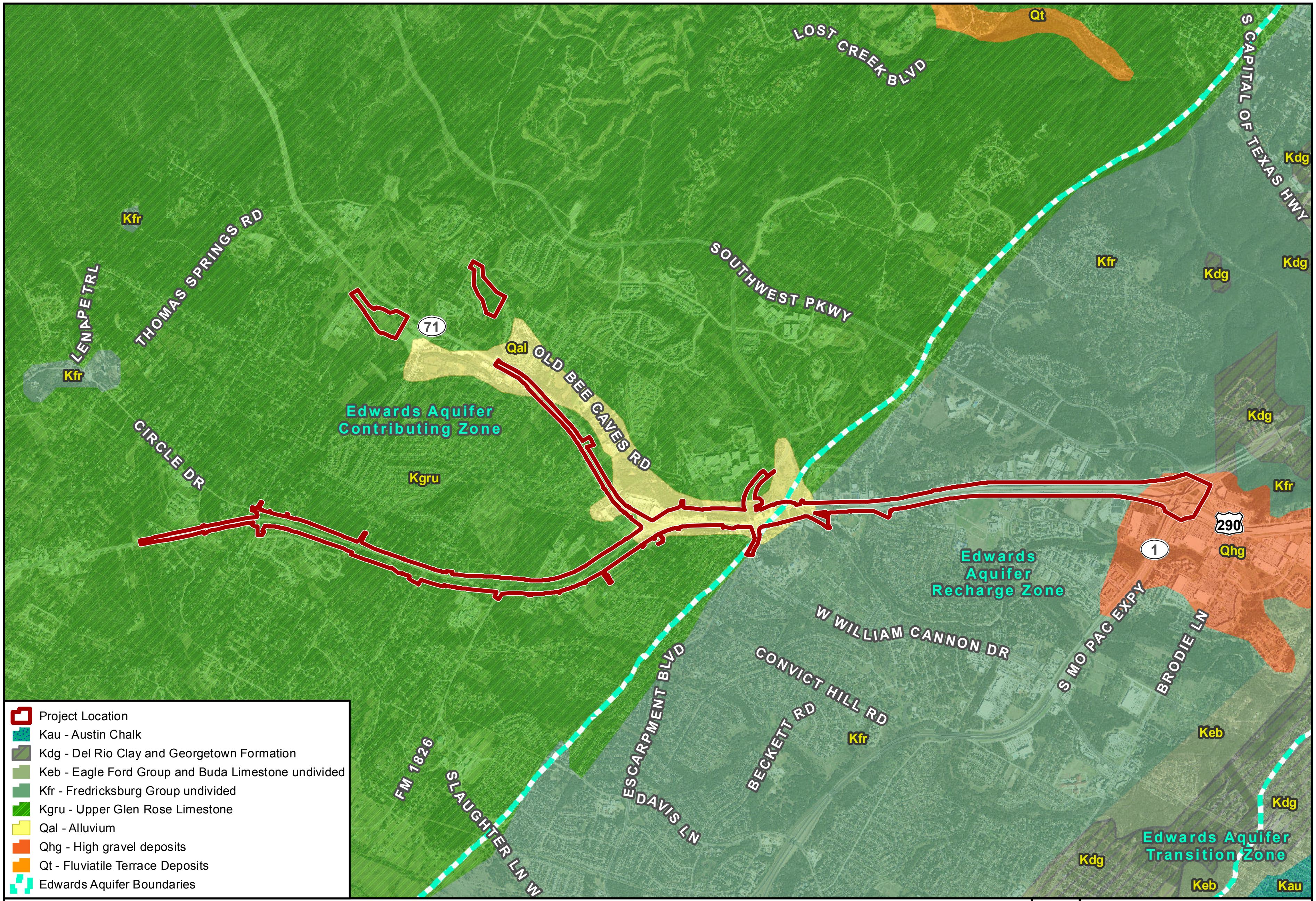

Figure 3. Project Area Geology

Oak Hill Parkway: US 290W from Mopac/Loop 1 to west of Circle Drive and SH 71 from US 290W to Silvermine Drive

Data Sources: Geologic Database of Texas (2007)/
Geologic Atlas of Texas Austin Sheet (1981), TCEQ (2005)
Aerial Source: TNRIS (2015)

N

0 — 0.75 Mile
0 — 1 Kilometer

Prepared for: TxDOT
1 in = 0.75 mile
Scale: 1:47,520
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Date: 12/5/2016

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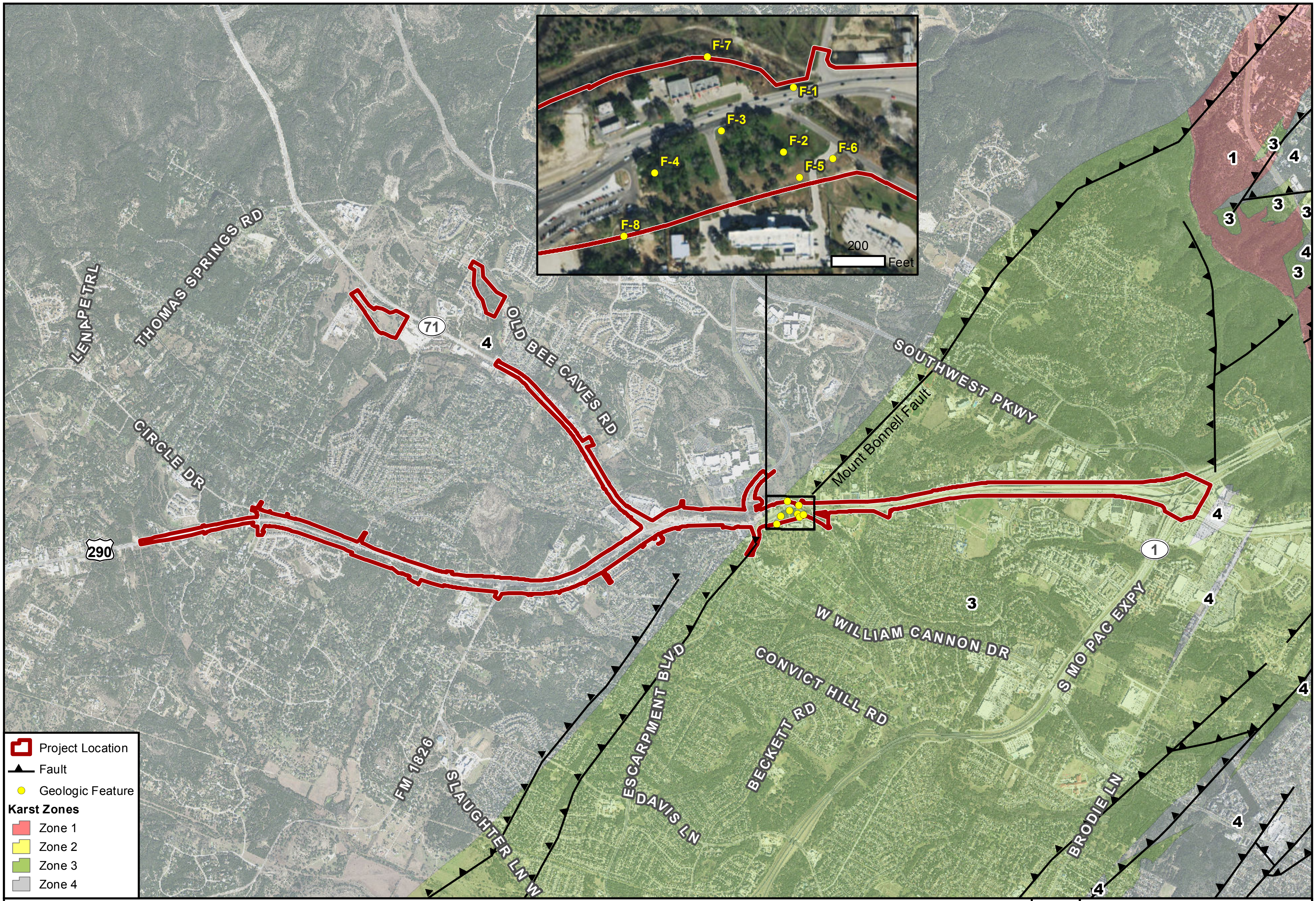

Figure 4. Geologic Features and Karst Zones

Oak Hill Parkway: US 290W from Mopac/Loop 1 to west of Circle Drive and SH 71 from US 290W to Silvermine Drive

Data Sources: Geologic Database of Texas (2007),
Veni (2007), CMH2H (2009)
Aerial Source: TNRIS (2015)
Inset Aerial Source: ESRI (2015)

Prepared for: TxDOT	1 in = 0.75 mile
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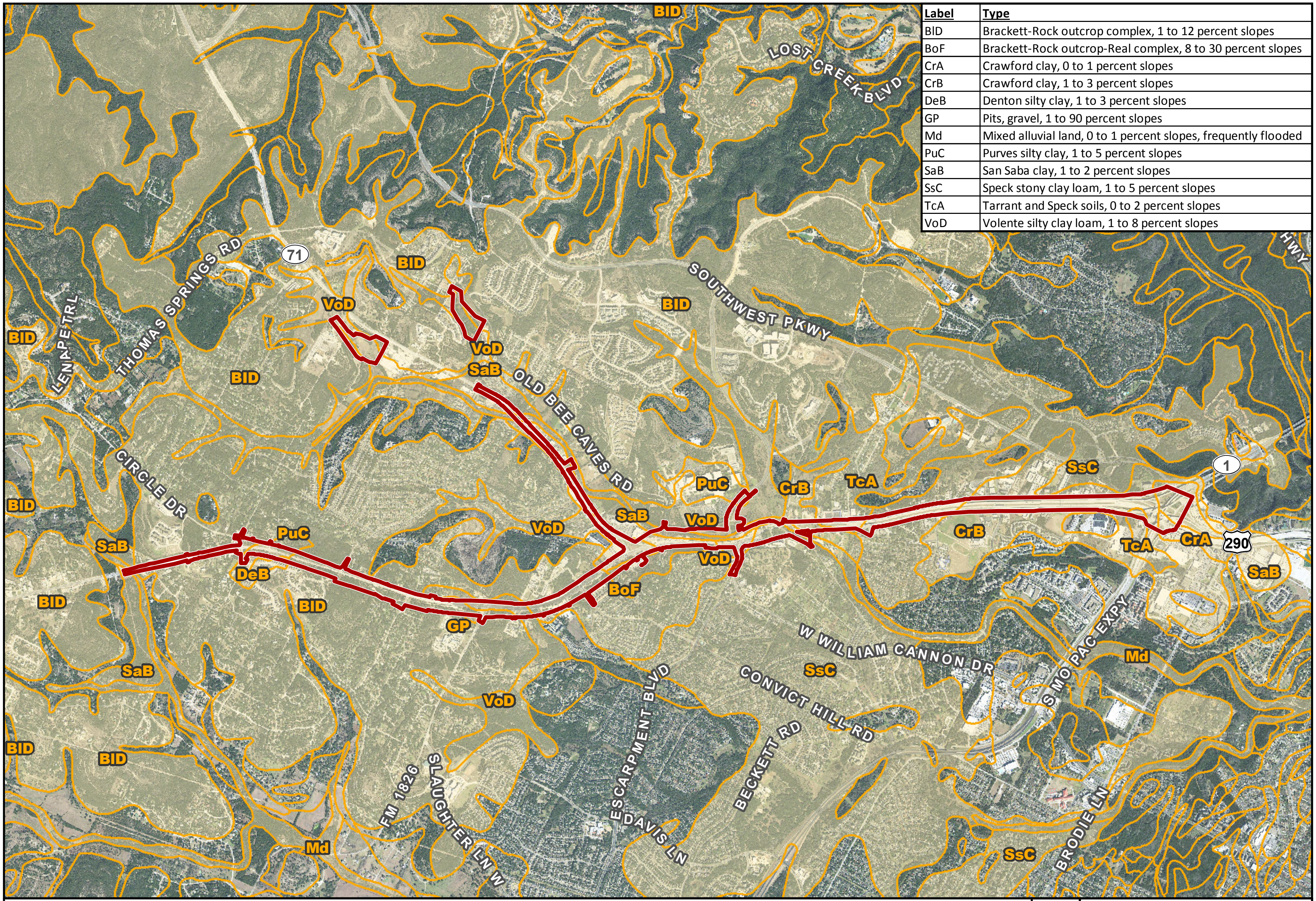

Label	Type
BID	Brackett-Rock outcrop complex, 1 to 12 percent slopes
BoF	Brackett-Rock outcrop-Real complex, 8 to 30 percent slopes
CrA	Crawford clay, 0 to 1 percent slopes
CrB	Crawford clay, 1 to 3 percent slopes
DeB	Denton silty clay, 1 to 3 percent slopes
GP	Pits, gravel, 1 to 90 percent slopes
Md	Mixed alluvial land, 0 to 1 percent slopes, frequently flooded
PuC	Purves silty clay, 1 to 5 percent slopes
SaB	San Saba clay, 1 to 2 percent slopes
SsC	Speck stony clay loam, 1 to 5 percent slopes
TcA	Tarrant and Speck soils, 0 to 2 percent slopes
VoD	Volente silty clay loam, 1 to 8 percent slopes

Figure 5. Project Area Soils

Oak Hill Parkway: US 290W from Mopac/Loop 1 to west of Circle Drive and SH 71 from US 290W to Silvermine Drive

🟥 Project Location
Soils

Data Source: NRCS (2016)
Aerial Source: TNRIS (2015)

Prepared for: TxDOT
CSJ: 0013-08-060 and 0700-03-077
1 in = 0.75 mile
Scale: 1:47,520
Date: 12/15/2016

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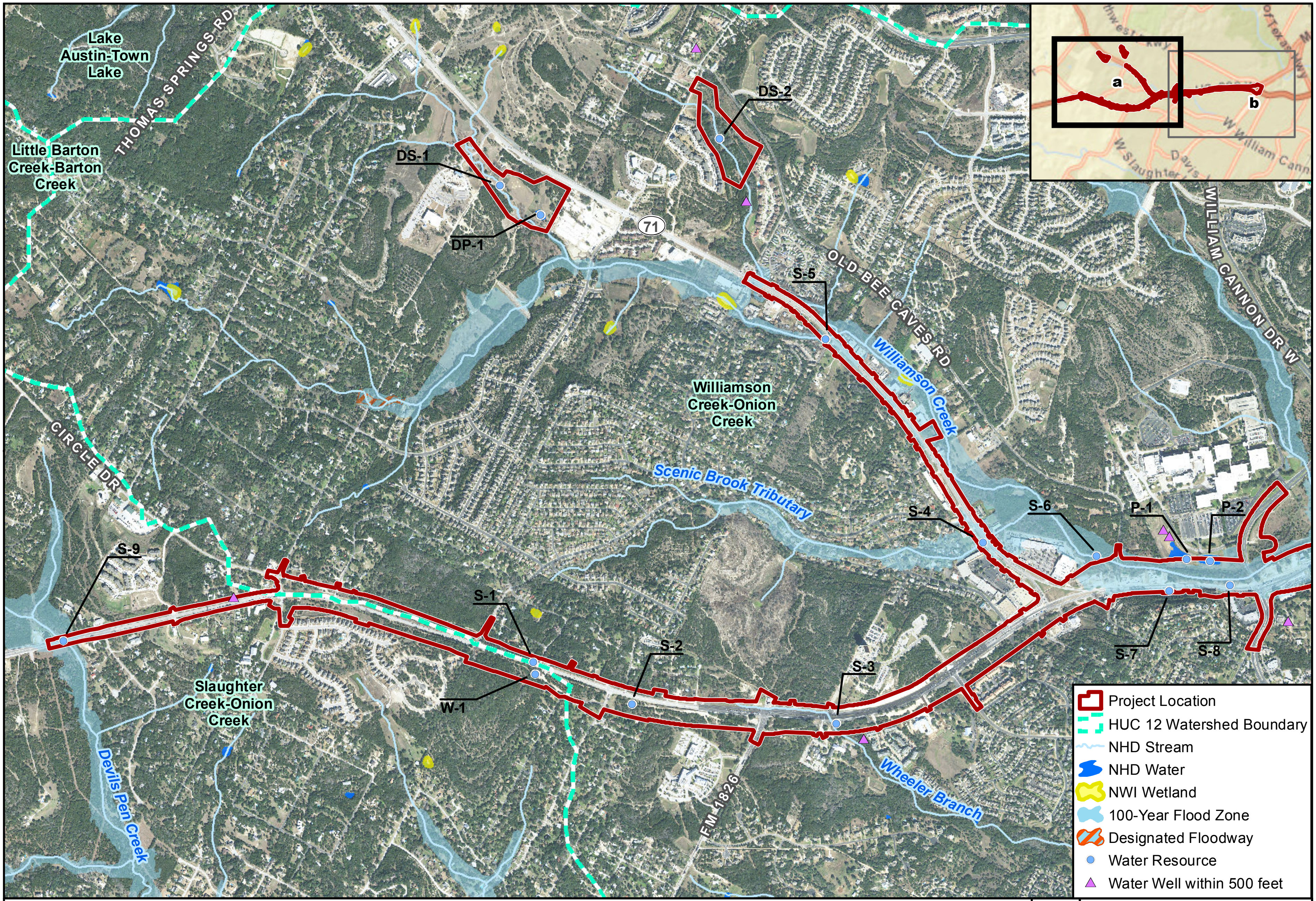


Figure 6a. Water Resources

Oak Hill Parkway: US 290W from Mopac/Loop 1 to west
of Circle Drive and SH 71 from US 290W to Silvermine Drive

Data Sources: NHD (2014), NWI (2014),
FEMA NFHL (2014), TWDB (2016), HDR (03/2016)
Aerial Source: TNRIS (2015)

N

0 2,000 Feet
0 600 Meters

Prepared for: TxDOT	1 in = 2,000 feet
	Scale: 1:24,000
CSJ: 0013-08-060 and 0700-03-077	Date: 6/8/2017

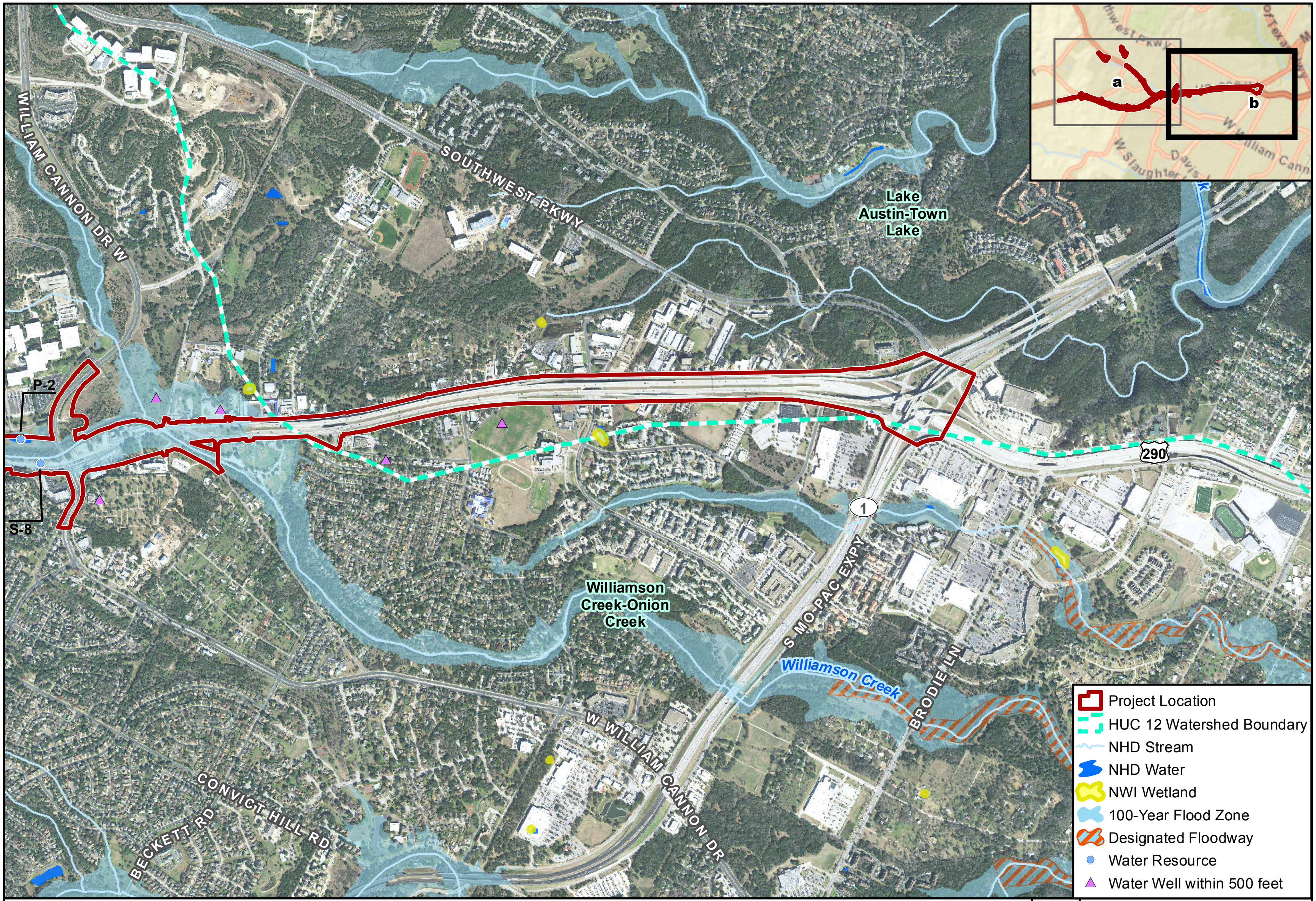


Figure 6b. Water Resources

Oak Hill Parkway: US 290W from Mopac/Loop 1 to west of Circle Drive and SH 71 from US 290W to Silvermine Drive

Data Sources: NHD (2014), NWI (2014), FEMA NFHL (2014), TWDB (2016), HDR (03/2016)
Aerial Source: TNRIS (2015)

0 2,000 Feet
0 600 Meters

Prepared for: TxDOT	1 in = 2,000 feet
	Scale: 1:24,000
CSJ: 0013-08-060 and 0700-03-077	Date: 6/8/2017

G:\Projects\TXDOT\US290\Water_Figure 6_Water Resources_20170608.mxd

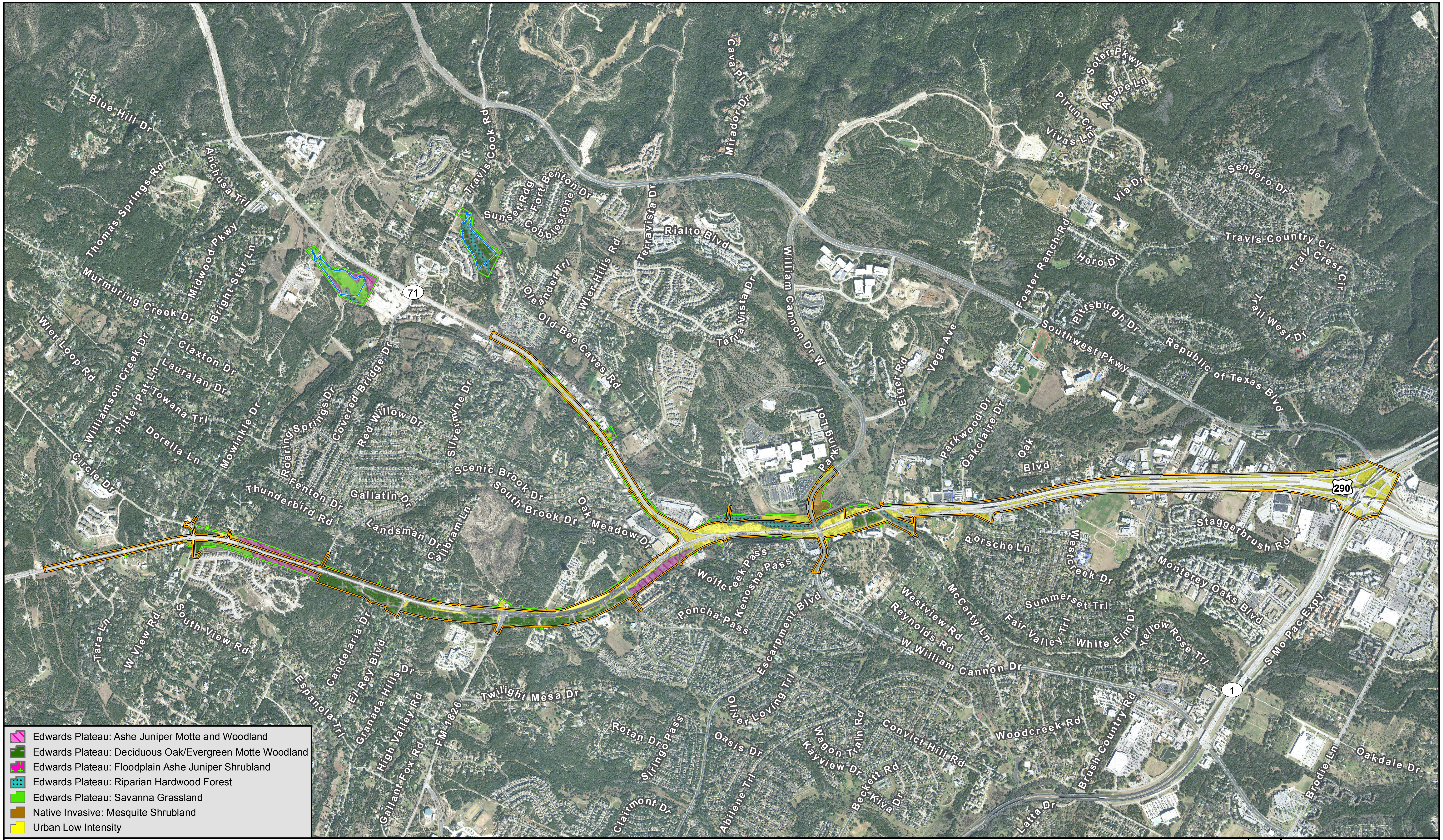


Figure 7. Observed Vegetation Types

Oak Hill Parkway: US 290W from Mopac/Loop 1 to west of Circle Drive and SH 71 from US 290W to Silvermine Drive

- 🟫 Existing Right-of-Way
- 🟩 Proposed Right-of-Way, Easements, & Shared-Use Path
- 🟦 Proposed Detention Pond

Data Source: CMEC (2016)
Aerial Source: TNRIS (2015)

0 2,125 Feet
0 700 Meters

Prepared for: TxDOT	1 in = 2,125 feet
	Scale: 1:25,500
CSJ: 0013-08-060 and 0700-03-077	Date: 6/8/2017

G:\Projects\TXDOT\US290\Water_Figure 7_ObservedVeg_20170608.mxd

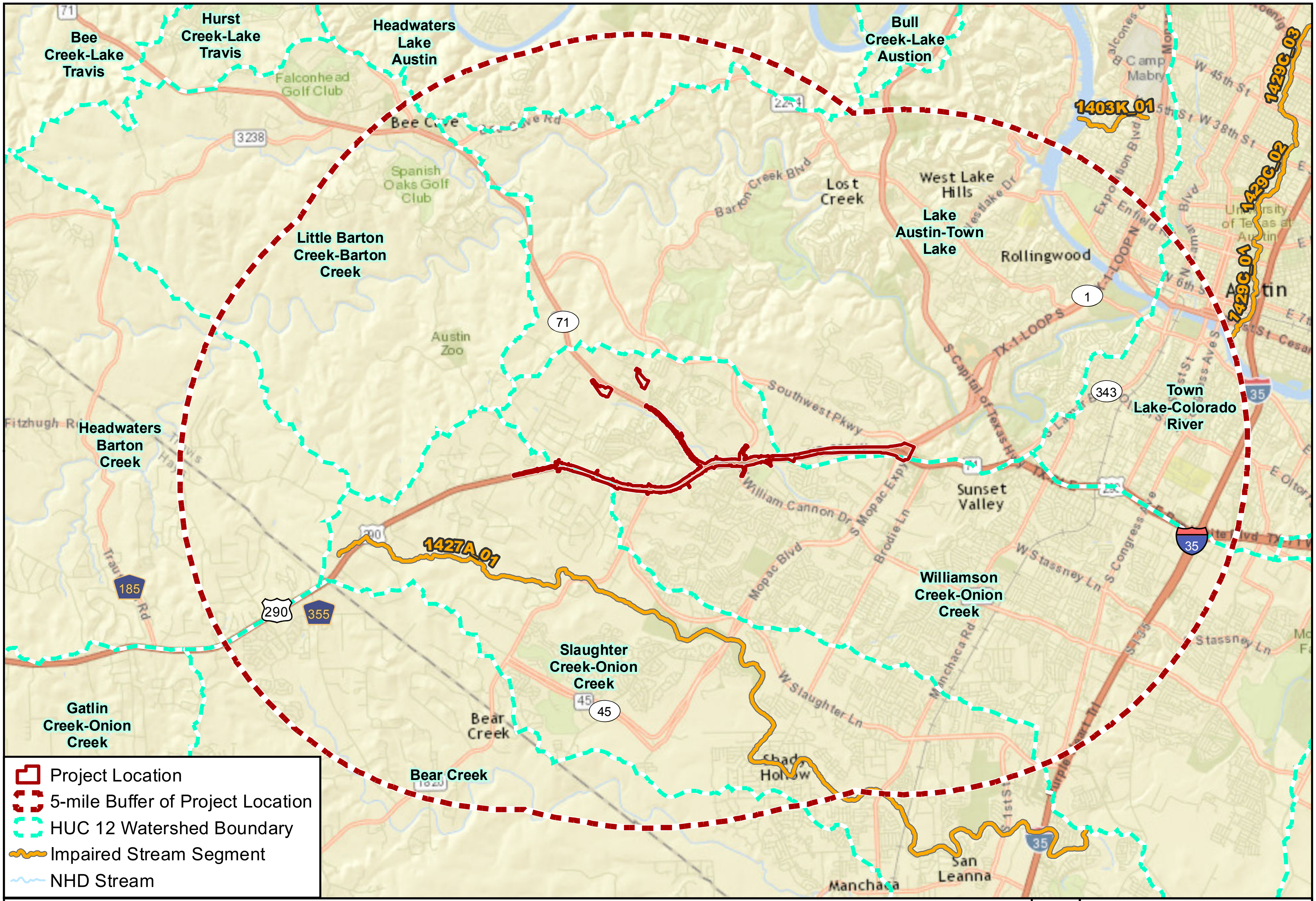


Figure 8. Impaired Stream Segments

Oak Hill Parkway: US 290W from Mopac/Loop1 to west of Circle Drive and SH 71 from US 290W to Silvermine Drive

Data Sources: TCEQ (2016), NHD (2014)
Basemap Source: ESRI (2017)

Prepared for: TxDOT	1 in = 2 miles
	Scale1:126,720
CSJ: 0013-08-060 and 0700-03-077	Date: 6/9/2017

G:\Projects\TXDOT\US290\Water_Figure 8_Impaired Stream Segments_20170608.mxd

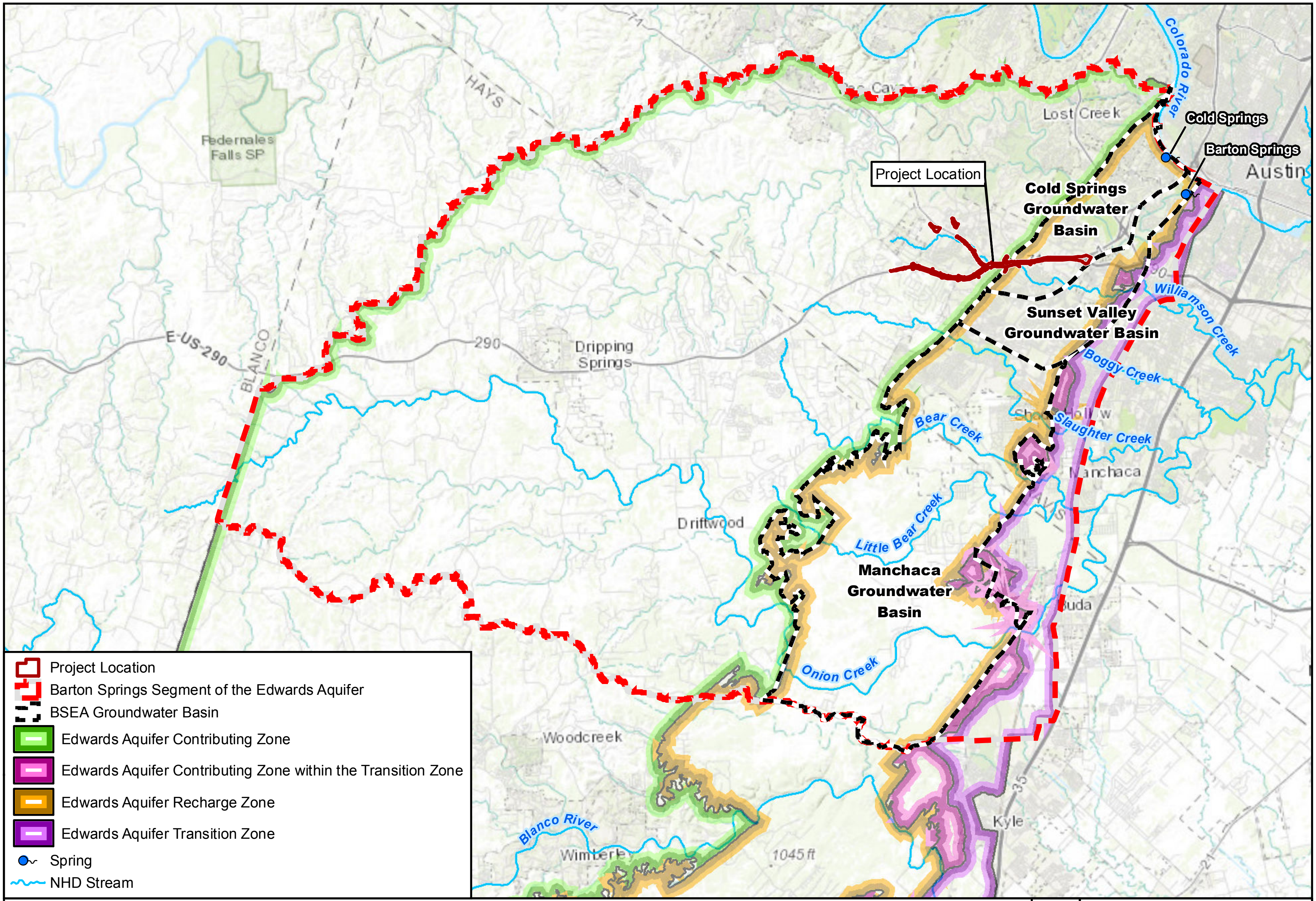


Figure 9. Groundwater Basins within the Barton Springs Segment of the Edwards Aquifer

Oak Hill Parkway: US 290W from Mopac/Loop1 to west of Circle Drive and SH 71 from US 290W to Silvermine Drive

Data Sources: TCEQ (2005), Hauwert, et al. (2004), COA (2016)
Basemap Source: ESRI (2017)

0 4 Miles
0 6 Kilometers

Prepared for: TxDOT
CSJ: 0013-08-060 and 0700-03-077
1 in = 4 miles
Scale1:253,440
Date: 6/9/2017

G:\Projects\TXDOT\US290\Water_Figure 9_BSEA_20170608.mxd

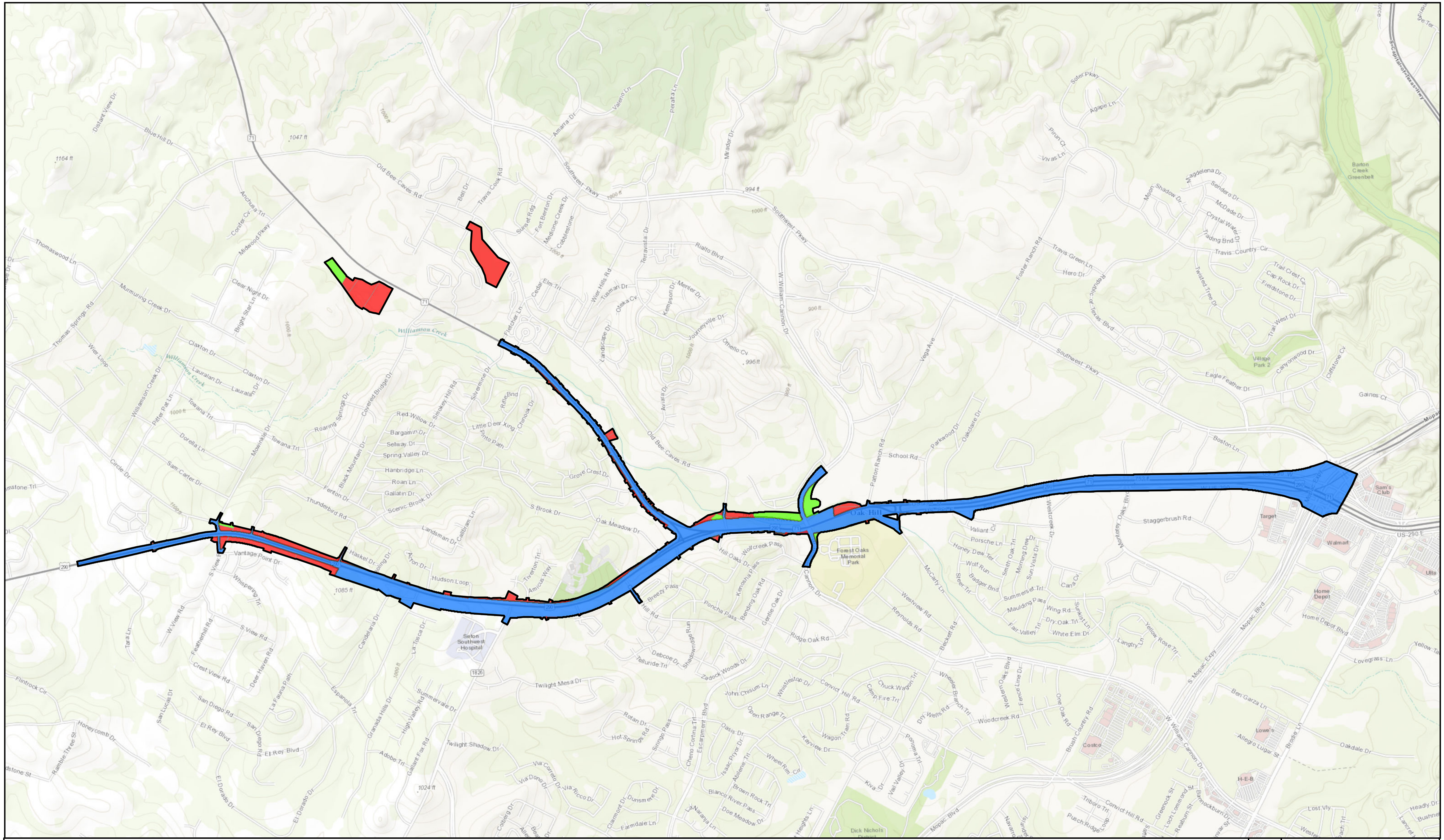


Figure 10. Right-of-Entry

Oak Hill Parkway: US 290W from Mopac/Loop 1 to west of Circle Drive and SH 71 from US 290W to Silvermine Drive

☐ Project Location
🟦 Existing Right-of-Way
🟥 Proposed ROW/Easement: Right-of-Entry Denied/No Response
🟩 Proposed ROW/Easement: Right-of-Entry Granted

0 2,250 Feet
0 750 Meters

Prepared for: TxDOT	1 in = 2,250 feet
	Scale: 1:27,000
CSJ: 0013-08-060 and 0700-03-077	Date: 6/9/2017

Data Sources: TCAD (2016), TxDOT (2016)
Basemap Source: ESRI (2017)

G:\Projects\TXDOT\US290\Water_Figure 10_Right-of-Entry_20170608.mxd

Attachment B – Project Area Photographs

Photograph 1: Commercial land use along SH 71 south of Williamson Creek crossing; facing south.

Photograph 2: Urban land use and commercial properties along US 290; facing east.

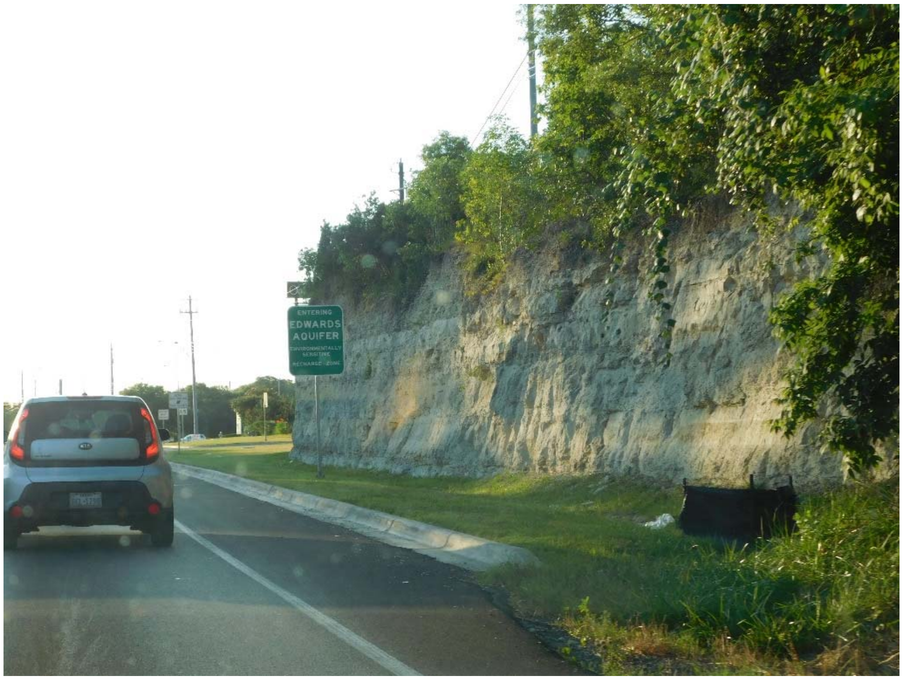
Photograph 3: Edwards Plateau: Savannah Grassland with juniper overstory along US 290 (foreground) and residential development in background; facing southeast.

Photograph 4: Oak-juniper woodland and native-invasive vegetation along US 290; facing west.

Photograph 5: Edwards Plateau: Deciduous Oak/Evergreen Motte and Woodland vegetation type along US 290; facing north.

Photograph 6: Looking north across potential detention pond location, west of SH 71; facing north.

Photograph 7: Limestone outcrop along US 290; facing west.



Photograph 8: Urban Low Intensity vegetation and limestone cliff at the start of Recharge Zone along US290/SH71 at William Cannon; facing east.

Photograph 9: Roadway cut in front of the Austin Community College Pinnacle Campus; facing northeast.

Photograph 10: Wetland (W-1) within the project area; facing south.

Photograph 11: S-1

Photograph 12: S-2

Photograph 13: S-3 south of 290.

Photograph 14: S-3 north of US 290

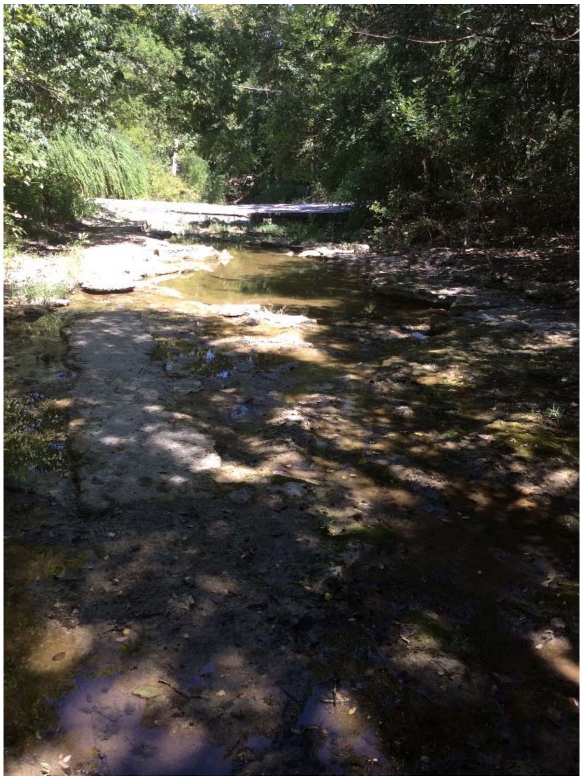
Photograph 15: (S-4) Scenic Brook Tributary looking north from south of SH 71

Photograph 16: S-5 under SH 71 looking west

Photograph 17: S-5 looking east

Photograph 18: Williamson Creek (S-6) main branch north of US 290/SH 71 behind development; facing north.

Photograph 19: Along Williamson Creek (S-6) north of US 290/SH 71; facing east.



Photograph 20: Williamson Creek (S-6) west of the low water crossing at Old Bee Caves Road; facing east.

Photograph 21: Williamson Creek (S-6) upstream of US 290/SH 71 crossing; facing south.

Photograph 22: Downstream of US 290/SH 71 crossing of Williamson Creek (S-6); facing south.

Photograph 23: Williamson Creek (S-6) at William Cannon Road crossing; facing east.

Photograph 24: Unnamed tributary to Williamson Creek (S-7) south of US 290/SH 71; facing east.

Photograph 25: Unnamed tributary to Williamson Creek (S-8) north of US 290/SH 71; facing south.

Photograph 26: Devil's Pen Creek (S-9) at the US 290 crossing at the western project terminus; facing north.

Attachment C - Wetland and Stream Field Data Sheets

WETLAND DETERMINATION DATA FORM – Great Plains Region

Project/Site: 290/71 Oakhill Parkway City/County: Travis Sampling Date: 7/20/2015

Applicant/Owner: TxDOT State: Tx Sampling Point: W-1

Investigator(s): C. Magers, S. Moren Section, Township, Range: N/A

Landform (hillslope, terrace, etc.): - Local relief (concave, convex, none): concave Slope (%): 5

Subregion (LRR): I (Southwest Plateaus) Lat: 30.231008 Long: -97.899092 Datum: NAD 83

Soil Map Unit Name: Brackett-Rock outcrop complex, 1 to 12 percent slopes NWI classification: n/a

Are climatic / hydrologic conditions on the site typical for this time of year? Yes ✔ No ☐ (If no, explain in Remarks.)

Are Vegetation ☐, Soil ☐, or Hydrology ☐ significantly disturbed? Are "Normal Circumstances" present? Yes ✔ No ☐

Are Vegetation ☐, Soil ☐, or Hydrology ☐ naturally problematic? (If needed, explain any answers in Remarks.)

SUMMARY OF FINDINGS – Attach site map showing sampling point locations, transects, important features, etc.

Hydrophytic Vegetation Present? Yes ✔ No ☐

Hydric Soil Present? Yes ☐ No ✔

Wetland Hydrology Present? Yes ✔ No ☐

Is the Sampled Area within a Wetland? **Yes** ✔ **No** ☐

Remarks:

Appears to be a dry pond that was dug in uplands during construction of roadway with a cut into an existing stream.

VEGETATION – Use scientific names of plants.

	Absolute % Cover	Dominant Species?	Indicator Status
Tree Stratum (Plot size: 30')			
1. none			
2.			
3.			
4.			
	- = Total Cover		
Sapling/Shrub Stratum (Plot size: 15')			
1. Baccharis halimifolia	5	yes	FAC
2. Salix nigra	5	yes	FACW
3. Sapium sebiferum	5	yes	FAC
4. Juniperus ashei	5	yes	NI
5. Melia azedarach	5	yes	FACU
	25 = Total Cover		
Herb Stratum (Plot size: 5')			
1. Polygonum hydropiperoides	30	yes	OBL
2. Muhlenbergia reverchonii	15	no	FAC
3. Typha latifolia	5	no	OBL
4. Yucca rupicola	5	no	NI
5.			
6.			
7.			
8.			
9.			
10.			
	55 = Total Cover		
Woody Vine Stratum (Plot size: 30')			
1. Lonicera japonica	20	yes	FACU
2.			
	20 = Total Cover		

% Bare Ground in Herb Stratum 45

Dominance Test worksheet:

Number of Dominant Species That Are OBL, FACW, or FAC (excluding FAC−): 4 (A)

Total Number of Dominant Species Across All Strata: 7 (B)

Percent of Dominant Species That Are OBL, FACW, or FAC: 57% (A/B)

Prevalence Index worksheet:

Total % Cover of:		Multiply by:	
OBL species		x 1 =	
FACW species		x 2 =	
FAC species		x 3 =	
FACU species		x 4 =	
UPL species		x 5 =	
Column Totals:	(A)		(B)

Prevalence Index = B/A =

Hydrophytic Vegetation Indicators:

- ☐ 1 - Rapid Test for Hydrophytic Vegetation
- ☑ 2 - Dominance Test is >50%
- ☐ 3 - Prevalence Index is ≤3.0[1]
- ☐ 4 - Morphological Adaptations[1] (Provide supporting data in Remarks or on a separate sheet)
- ☐ Problematic Hydrophytic Vegetation[1] (Explain)

[1] Indicators of hydric soil and wetland hydrology must be present, unless disturbed or problematic.

Hydrophytic Vegetation Present? **Yes** ✔ **No** ☐

Remarks:

SOIL

Sampling Point: W-1

Profile Description: (Describe to the depth needed to document the indicator or confirm the absence of indicators.)

Depth (inches)	Matrix		Redox Features				Texture	Remarks
	Color (moist)	%	Color (moist)	%	Type[1]	Loc[2]		
0-2	10 YR 6/2						gravel	

[1]Type: C=Concentration, D=Depletion, RM=Reduced Matrix, CS=Covered or Coated Sand Grains. [2]Location: PL=Pore Lining, M=Matrix.

Hydric Soil Indicators: (Applicable to all LRRs, unless otherwise noted.)

☐ Histosol (A1)
☐ Histic Epipedon (A2)
☐ Black Histic (A3)
☐ Hydrogen Sulfide (A4)
☐ Stratified Layers (A5) (**LRR F**)
☐ 1 cm Muck (A9) (**LRR F, G, H**)
☐ Depleted Below Dark Surface (A11)
☐ Thick Dark Surface (A12)
☐ Sandy Mucky Mineral (S1)
☐ 2.5 cm Mucky Peat or Peat (S2) (**LRR G, H**)
☐ 5 cm Mucky Peat or Peat (S3) (**LRR F**)
☐ Sandy Gleyed Matrix (S4)
☐ Sandy Redox (S5)
☐ Stripped Matrix (S6)
☐ Loamy Mucky Mineral (F1)
☐ Loamy Gleyed Matrix (F2)
☐ Depleted Matrix (F3)
☐ Redox Dark Surface (F6)
☐ Depleted Dark Surface (F7)
☐ Redox Depressions (F8)
☐ High Plains Depressions (F16)
(**MLRA 72 & 73 of LRR H**)

Indicators for Problematic Hydric Soils[3]:

☐ 1 cm Muck (A9) (**LRR I, J**)
☐ Coast Prairie Redox (A16) (**LRR F, G, H**)
☐ Dark Surface (S7) (**LRR G**)
☐ High Plains Depressions (F16)
(**LRR H outside of MLRA 72 & 73**)
☐ Reduced Vertic (F18)
☐ Red Parent Material (TF2)
☐ Very Shallow Dark Surface (TF12)
☐ Other (Explain in Remarks)

[3]Indicators of hydrophytic vegetation and wetland hydrology must be present, unless disturbed or problematic.

Restrictive Layer (if present):

Type: gravel

Depth (inches): 2

Hydric Soil Present? Yes ☐ No ☑

Remarks:

Soil appears to be greatly affected by adjacent roadway. Gravel was found at surface level and restricted digging below 2 inches.

HYDROLOGY

Wetland Hydrology Indicators:

Primary Indicators (minimum of one required; check all that apply)

☐ Surface Water (A1)
☐ High Water Table (A2)
☐ Saturation (A3)
☑ Water Marks (B1)
☑ Sediment Deposits (B2)
☐ Drift Deposits (B3)
☑ Algal Mat or Crust (B4)
☐ Iron Deposits (B5)
☐ Inundation Visible on Aerial Imagery (B7)
☐ Water-Stained Leaves (B9)
☐ Salt Crust (B11)
☐ Aquatic Invertebrates (B13)
☐ Hydrogen Sulfide Odor (C1)
☐ Dry-Season Water Table (C2)
☐ Oxidized Rhizospheres on Living Roots (C3)
(**where not tilled**)
☐ Presence of Reduced Iron (C4)
☐ Thin Muck Surface (C7)
☐ Other (Explain in Remarks)

Secondary Indicators (minimum of two required)

☐ Surface Soil Cracks (B6)
☑ Sparsely Vegetated Concave Surface (B8)
☐ Drainage Patterns (B10)
☐ Oxidized Rhizospheres on Living Roots (C3)
(**where tilled**)
☐ Crayfish Burrows (C8)
☐ Saturation Visible on Aerial Imagery (C9)
☐ Geomorphic Position (D2)
☐ FAC-Neutral Test (D5)
☐ Frost-Heave Hummocks (D7) (**LRR F**)

Field Observations:

Surface Water Present? Yes ☐ No ☑ Depth (inches):
Water Table Present? Yes ☐ No ☑ Depth (inches):
Saturation Present? (includes capillary fringe) Yes ☐ No ☑ Depth (inches):

Wetland Hydrology Present? Yes ☑ No ☐

Describe Recorded Data (stream gauge, monitoring well, aerial photos, previous inspections), if available:

Google Earth aerial photograph

Remarks:

STREAM DATA SHEET

Stream #: S-1 | **Date:** 7/20/15

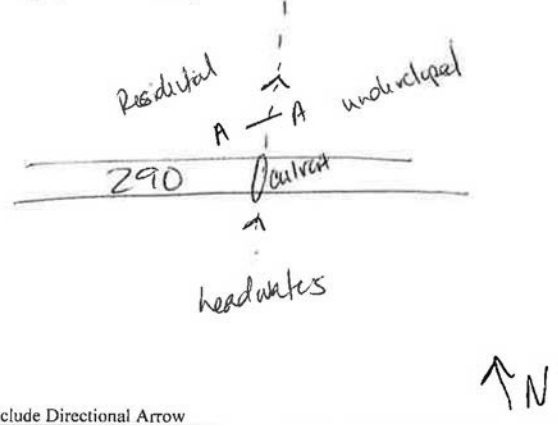
Project Name: Oak Hill Parkway	Project No.: 173570
County/State: Travis, Texas	Surveyors: Christine Magers, Sara Moren
Stream Name: Unk. Tributary near Boling Rd.	GPS Unit #: IPad 2

Stream Characteristics

Stream Width:	*Stream Height/Depth:*
Bank to Bank = 3’	Avg. Banks = 1’
Waters Edge =n/a	Avg. Water = n/a
OHWM = 3’	OHWM =1’

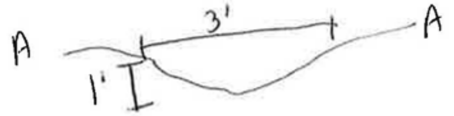
Stream Flow:	☐Perennial	☐Intermittent	☒ Ephemeral
Erosion:	☐Heavy	☐Moderate	☒ Slight
Flow Regime:	☒ Upstream Development	☐Dense Regrowth	☐Heavy Downcutting

Drawing (Plan View)



Please Include Directional Arrow

Drawing (Cross-Section)



Facing Downstream for Cross-Section

Substrate Description

☐Bedrock	☐Boulder	☐Cobble	☐Gravel	☐Sand	☐Silt/Clay	☐Organic	☐Concrete

☐Other (Describe):

Aquatic Habitat (Instream) Description

☐Undercut Banks	☐Logs/Brush	☐Aquatic Veg.	☐Sand Bar	☐Mud Bar
☐Overhanging Veg.	☐Gravel Riffles	☐Deep Pools	☐Oxbows	☐Shallows

Species (Description): Privet, johnsongrass

Riparian Zone Description

☐Forest	☐Scrub/Shrub	☒ Old-Field/[✓ ROW]	☐Pasture	☐Row Crop
☐Wetland	☐Paved	☒ Residential	☐Park	☐Other

Species (Description): Privet, sugarberry, johnsongrass, doveweed.

Width:	Age Class:	Existing Species Composition Sufficient for Maintenance and Recovery:	☐Y	☐N

Notes: 2 photos taken on the south side. 3 photos of culverts.

STREAM DATA SHEET

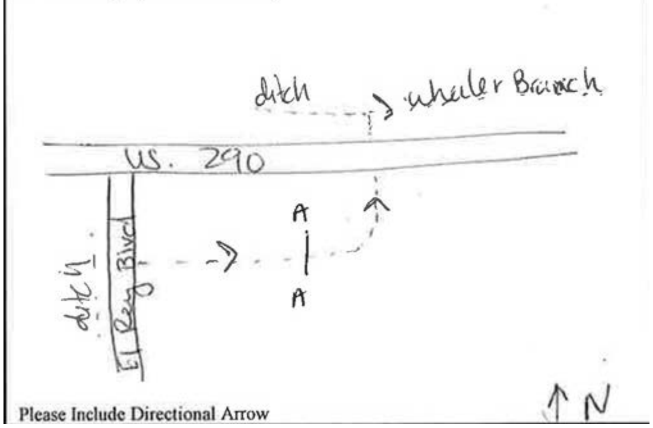
Stream #: S-2	**Date:** 7/20/15

Project Name: Oak Hill Parkway	Project No.: 173570
County/State: Travis, Texas	Surveyors: Christine Magers, Sara Moren
Stream Name: Unk. Tributary	GPS Unit #: IPad 2

Stream Characteristics	
Stream Width:	*Stream Height/Depth:*
Bank to Bank = 10’	Avg. Banks = 3’
Waters Edge =n/a	Avg. Water = n/a
OHWM = 2’	OHWM =1’

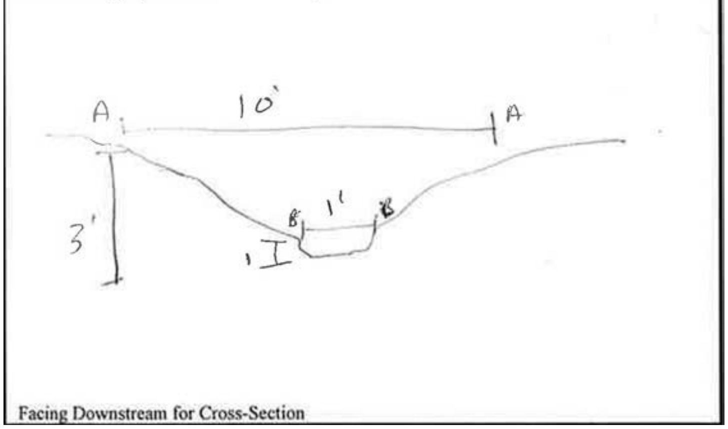
Stream Flow:	☐Perennial	☐Intermittent	☒ Ephemeral
Erosion:	☐Heavy	☐Moderate	☒ Slight
Flow Regime:	☒ Upstream Development	☐Dense Regrowth	☐Heavy Downcutting

Drawing (Plan View)



Please Include Directional Arrow

Drawing (Cross-Section)



Facing Downstream for Cross-Section

Substrate Description

☒ Bedrock	☐Boulder	☐Cobble	☒ Gravel	☐Sand	☐Silt/Clay	☐Organic	☐Concrete

☐Other (Describe):

Aquatic Habitat (Instream) Description

☐Undercut Banks	☐Logs/Brush	☐Aquatic Veg.	☐Sand Bar	☐Mud Bar
☒ Overhanging Veg.	☐Gravel Riffles	☐Deep Pools	☐Oxbows	☐Shallows

Species (Description): Ragweed, bluestem

Riparian Zone Description

☐Forest	☐Scrub/Shrub	☒ Old-Field/[✓ ROW]	☐Pasture	☐Row Crop
☐Wetland	☐Paved	☒ Residential	☐Park	☐Other

Species (Description): Ragweed, bluestem, cocklebur, hackberry/cedar and sumac on banks.

Width: 10+	Age Class: 10+	Existing Species Composition Sufficient for Maintenance and Recovery:	☒ Y	☐N

Notes: Headwaters at El Rey are just a ditch.

STREAM DATA SHEET

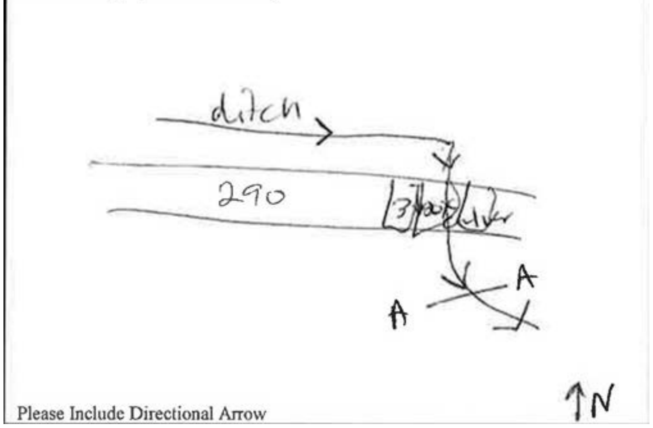
Stream #: S-3 | **Date:** 7/20/15

Project Name: Oak Hill Parkway	Project No.: 173570
County/State: Travis, Texas	Surveyors: Christine Magers, Sara Moren
Stream Name: Unk. Tributary	GPS Unit #: IPad 2

Stream Characteristics	
Stream Width:	*Stream Height/Depth:*
Bank to Bank = 25’	Avg. Banks = 2’
Waters Edge =n/a	Avg. Water = n/a
OHWM = 10’	OHWM =1’

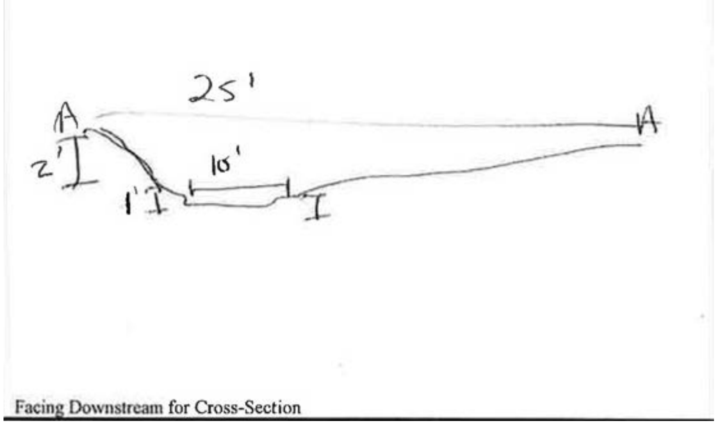
Stream Flow:	☐Perennial	☐Intermittent	☒ Ephemeral
Erosion:	☐Heavy	☐Moderate	☒ Slight
Flow Regime:	☒ Upstream Development	☐Dense Regrowth	☐Heavy Downcutting

Drawing (Plan View)



Please Include Directional Arrow

Drawing (Cross-Section)



Facing Downstream for Cross-Section

Substrate Description

☒ Bedrock	☒ Boulder	☐Cobble	☐Gravel	☐Sand	☐Silt/Clay	☐Organic	☐Concrete

☐Other (Describe):

Aquatic Habitat (Instream) Description

☐Undercut Banks	☐Logs/Brush	☐Aquatic Veg.	☐Sand Bar	☐Mud Bar
☒ Overhanging Veg.	☐Gravel Riffles	☐Deep Pools	☐Oxbows	☐Shallows

Species (Description): Yaupon, privet, live oak, algae crust in stream.

Riparian Zone Description

☐Forest	☐Scrub/Shrub	☒ Old-Field/[✓ ROW]	☐Pasture	☐Row Crop
☐Wetland	☐Paved	☐ Residential	☐Park	☐Other

Species (Description): Cedar, privet, yaupon, yard daisy.

Width: 25+	Age Class: 10+	Existing Species Composition Sufficient for Maintenance and Recovery:	☐ Y	☒ N

Notes: Wide shallow stream bed to bedrock, debris, wrack lines in stream. Barn swallows in culverts.

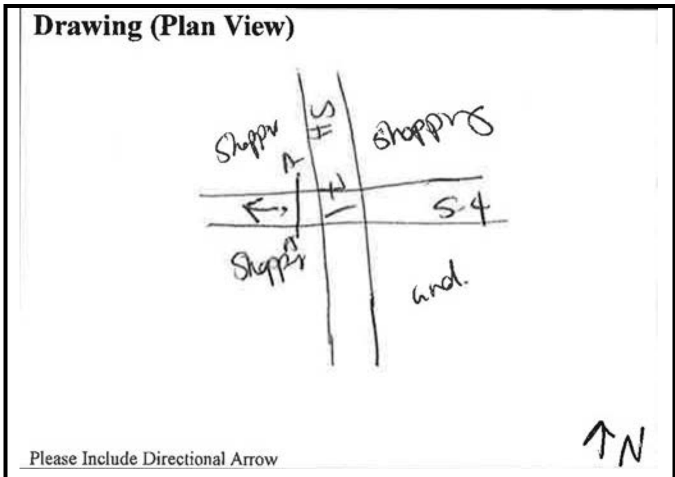
STREAM DATA SHEET

Stream #: S-4	**Date:** 7/20/15

Project Name: Oak Hill Parkway	Project No.: 173570
County/State: Travis, Texas	Surveyors: Christine Magers, Sara Moren
Stream Name: Unk. Tributary	GPS Unit #: IPad 2

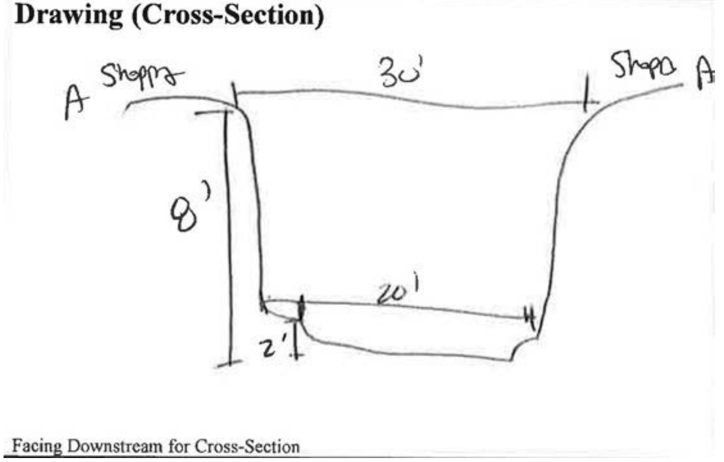
Stream Characteristics	
Stream Width:	*Stream Height/Depth:*
Bank to Bank = 30’	Avg. Banks = 8’
Waters Edge =n/a	Avg. Water = n/a
OHWM = 20’	OHWM =2’

Stream Flow:	☐Perennial	☐Intermittent	☒ Ephemeral
Erosion:	☐Heavy	☐Moderate	☒ Slight
Flow Regime:	☒ Upstream Development	☐Dense Regrowth	☐Heavy Downcutting



Drawing (Plan View)

Please Include Directional Arrow



Drawing (Cross-Section)

Facing Downstream for Cross-Section

Substrate Description

☒ Bedrock	☐ Boulder	☒ Cobble	☐Gravel	☐Sand	☐Silt/Clay	☐Organic	☐Concrete

☐Other (Describe):

Aquatic Habitat (Instream) Description

☐Undercut Banks	☒ Logs/Brush	☐Aquatic Veg.	☐Sand Bar	☐Mud Bar
☐ Overhanging Veg.	☐Gravel Riffles	☐Deep Pools	☐Oxbows	☐Shallows

Species (Description): Cocklebur, ragweed

Riparian Zone Description

☐Forest	☐Scrub/Shrub	☒ Old-Field/ROW	☐Pasture	☐Row Crop
☐Wetland	☐Paved	☐ Residential	☐Park	☒ Other - Commercial

Species (Description): Hackberry, cedar elm, sumac, red bud, vitis.

Width: 30’	Age Class: 50+	Existing Species Composition Sufficient for Maintenance and Recovery:	☐ Y	☒ N

Notes: 4 – 4x4 box culverts under 71. Tributary to Williamson Creek.

STREAM DATA SHEET

Stream #: S-5

Date: 7/20/15

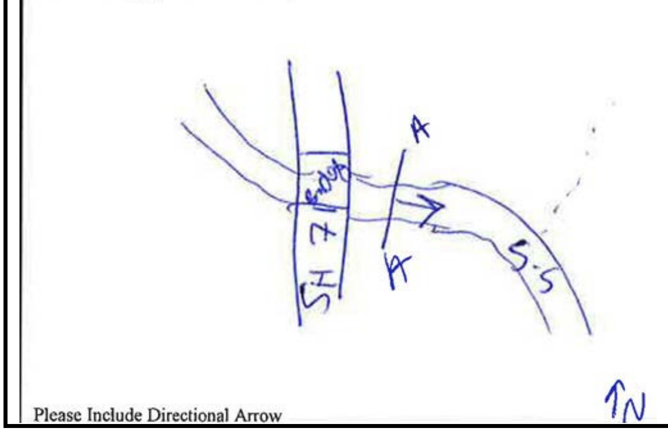
Project Name: Oak Hill Parkway	Project No.: 173570
County/State: Travis, Texas	Surveyors: Christine Magers, Sara Moren
Stream Name: Williamson Creek	GPS Unit #: IPad 2

Stream Characteristics

Stream Width:	*Stream Height/Depth:*
Bank to Bank = 50’	Avg. Banks = 15’
Waters Edge =3’	Avg. Water = 1’
OHWM = 5’’	OHWM =2’

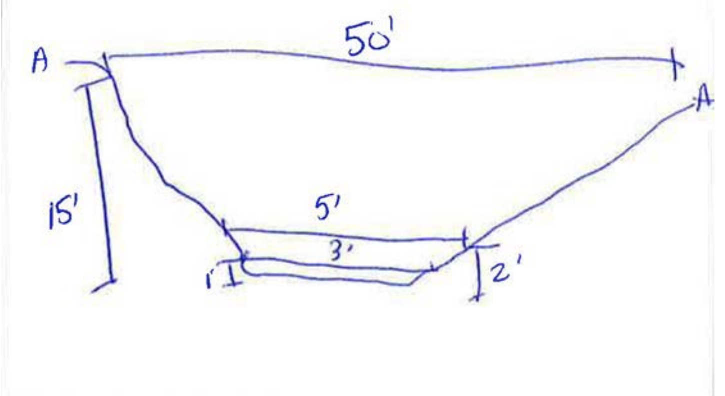
Stream Flow:	☒ Perennial	☐ Intermittent	☐ Ephemeral
Erosion:	☐ Heavy	☒ Moderate	☐ Slight
Flow Regime:	☐ Upstream Development	☐ Dense Regrowth	☒ Heavy Downcutting

Drawing (Plan View)



Please Include Directional Arrow

Drawing (Cross-Section)



Facing Downstream for Cross-Section

Substrate Description

☐ Bedrock	☐ Boulder	☒ Cobble	☒ Gravel	☐ Sand	☐ Silt/Clay	☐ Organic	☐ Concrete

☐ Other (Describe):

Aquatic Habitat (Instream) Description

☐ Undercut Banks	☒ Logs/Brush	☐ Aquatic Veg.	☐ Sand Bar	☐ Mud Bar
☒ Overhanging Veg.	☐ Gravel Riffles	☐ Deep Pools	☐ Oxbows	☐ Shallows

Species (Description): Poison ivy, green ash, sycamore, American elm.

Riparian Zone Description

☐ Forest	☐ Scrub/Shrub	☒ Old-Field/[✓ ROW]	☐ Pasture	☐ Row Crop
☐ Wetland	☐ Paved	☐ Residential	☐ Park	☒ Other - Commercial

Species (Description): Same species.

Width: 50+	Age Class: 50+	Existing Species Composition Sufficient for Maintenance and Recovery:	☐ Y	☒ N

Notes: Crayfish, minnows, steep banks.

STREAM DATA SHEET

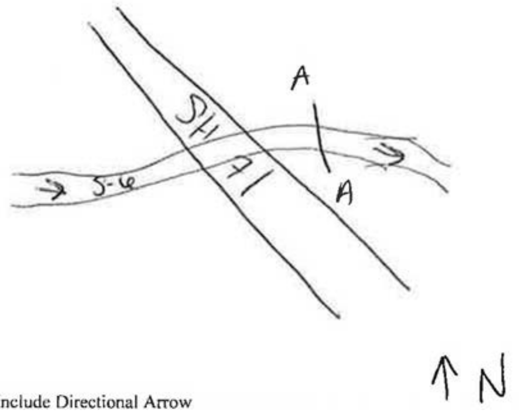
Stream #: S-6 @ SH71 Crossing	**Date:** 7/20/15

Project Name: Oak Hill Parkway	Project No.: 173570
County/State: Travis, Texas	Surveyors: Christine Magers, Sara Moren
Stream Name: Williamson Creek	GPS Unit #: IPad 2

Stream Characteristics	
Stream Width:	*Stream Height/Depth:*
Bank to Bank = 50’	Avg. Banks = 10’
Waters Edge =15’	Avg. Water = 1’
OHWM = 20’’	OHWM =3’

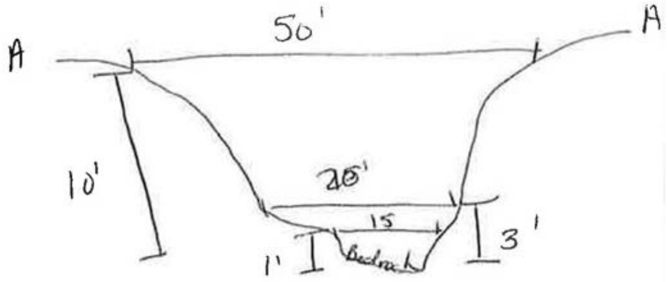
Stream Flow:	☒ Perennial	☐ Intermittent	☐ Ephemeral
Erosion:	☐ Heavy	☐ Moderate	☒ Slight
Flow Regime:	☐ Upstream Development	☐ Dense Regrowth	☐ Heavy Downcutting

Drawing (Plan View)



Please Include Directional Arrow

Drawing (Cross-Section)



Facing Downstream for Cross-Section

Substrate Description

☒ Bedrock	☐ Boulder	☐ Cobble	☐ Gravel	☐ Sand	☐ Silt/Clay	☐ Organic	☐ Concrete

☐ Other (Describe):

Aquatic Habitat (Instream) Description

☐ Undercut Banks	☒ Logs/Brush	☐ Aquatic Veg.	☐ Sand Bar	☐ Mud Bar
☒ Overhanging Veg.	☐ Gravel Riffles	☐ Deep Pools	☐ Oxbows	☐ Shallows

Species (Description): Live oak, privet, American elm.

Riparian Zone Description

☐ Forest	☐ Scrub/Shrub	☒ Old-Field/[✓ ROW]	☐ Pasture	☐ Row Crop
☐ Wetland	☐ Paved	☒ Residential	☐ Park	☐ Other

Species (Description): Live oak, privet, sycamore, mulberry, American elm on banks.

Width: 50’	Age Class: 50+	Existing Species Composition Sufficient for Maintenance and Recovery:	☐ Y	☒ N

Notes: Retaining wall may be historic 2 – pictures. Sunfish, minnows and frogs in stream. Bank protection – right bank retaining wall.

STREAM DATA SHEET

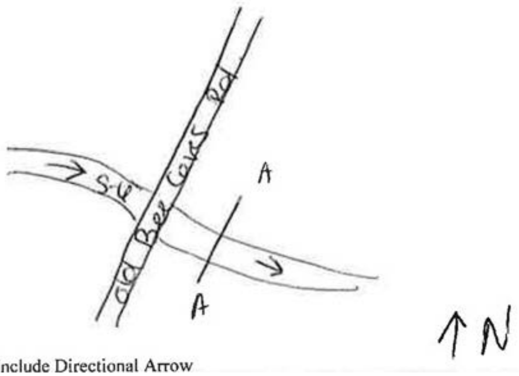
Stream #: S-6 @ Old Bee Caves Road	**Date:** 7/21/15

Project Name: Oak Hill Parkway	Project No.: 173570
County/State: Travis, Texas	Surveyors: Christine Magers, Sara Moren
Stream Name: Williamson Creek	GPS Unit #: IPad 2

Stream Characteristics	
Stream Width:	*Stream Height/Depth:*
Bank to Bank = 50’	Avg. Banks = 15’
Waters Edge =n/a	Avg. Water =n/a
OHWM = 25’’	OHWM =3’

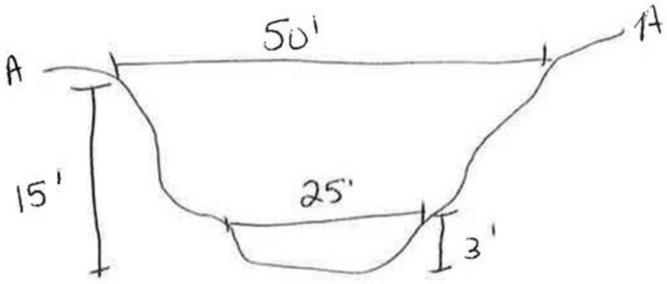
Stream Flow:	☐ Perennial	☒ Intermittent	☐ Ephemeral
Erosion:	☐ Heavy	☐ Moderate	☒ Slight
Flow Regime:	☐ Upstream Development	☐ Dense Regrowth	☐ Heavy Downcutting

Drawing (Plan View)



Please Include Directional Arrow

Drawing (Cross-Section)



Facing Downstream for Cross-Section

Substrate Description

☒ Bedrock	☒ Boulder	☒ Cobble	☒ Gravel	☐ Sand	☐ Silt/Clay	☐ Organic	☐ Concrete

☐ Other (Describe):

Aquatic Habitat (Instream) Description

☐ Undercut Banks	☐ Logs/Brush	☐ Aquatic Veg.	☐ Sand Bar	☐ Mud Bar
☒ Overhanging Veg.	☐ Gravel Riffles	☐ Deep Pools	☐ Oxbows	☐ Shallows

Species (Description): Mulberry, sycamore, willow

Riparian Zone Description

☐ Forest	☐ Scrub/Shrub	☒ Old-Field/ROW	☐ Pasture	☐ Row Crop
☐ Wetland	☐ Paved	☐ Residential	☐ Park	☐ Other

Species (Description): Sycamore, willow, mulberry, hackberry, ragweed, American elm.

Width: 50+	Age Class: 50+	Existing Species Composition Sufficient for Maintenance and Recovery:	☐ Y	☒ N

Notes: Wider with no water – other portions have flowing or pools of water. Taken at 290 bridge by Patton Ranch Road.

STREAM DATA SHEET

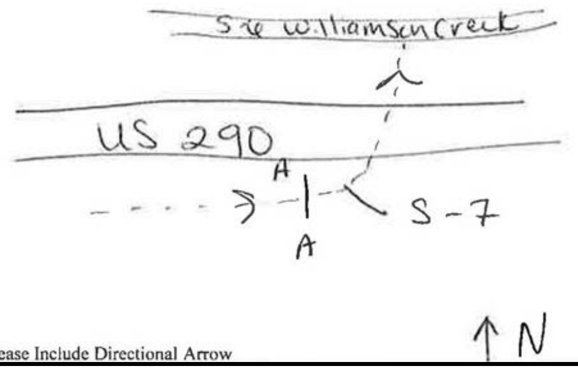
Stream #: S-7	**Date:** 7/20/15

Project Name: Oak Hill Parkway	Project No.: 173570
County/State: Travis, Texas	Surveyors: Christine Magers, Sara Moren
Stream Name: Unk. tributary	GPS Unit #: IPad 2

Stream Characteristics	
Stream Width:	*Stream Height/Depth:*
Bank to Bank = 20’	Avg. Banks = 6’
Waters Edge =n/a	Avg. Water =n/a
OHWM = 5’’	OHWM =1’

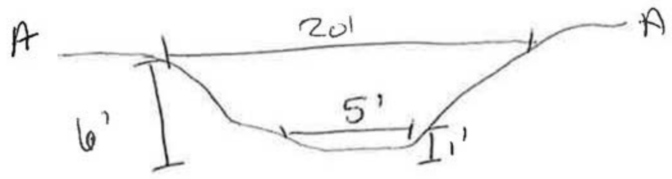
Stream Flow:	☐ Perennial	☐ Intermittent	☒ Ephemeral
Erosion:	☐ Heavy	☒ Moderate	☐ Slight
Flow Regime:	☐ Upstream Development	☐ Dense Regrowth	☐ Heavy Downcutting

Drawing (Plan View)



Please Include Directional Arrow

Drawing (Cross-Section)



Facing Downstream for Cross-Section

Substrate Description

☐ Bedrock	☐ Boulder	☒ Cobble	☐ Gravel	☐ Sand	☒ Silt/Clay	☐ Organic	☐ Concrete

☐ Other (Describe):

Aquatic Habitat (Instream) Description

☐ Undercut Banks	☒ Logs/Brush	☐ Aquatic Veg.	☐ Sand Bar	☐ Mud Bar
☒ Overhanging Veg.	☐ Gravel Riffles	☐ Deep Pools	☐ Oxbows	☐ Shallows

Species (Description): Rootmats also present.

Riparian Zone Description

☐ Forest	☐ Scrub/Shrub	☒ Old-Field/ROW	☐ Pasture	☐ Row Crop
☐ Wetland	☐ Paved	☐ Residential	☐ Park	☐ Other

Species (Description): Green ash, red bud, Virginia creeper, yaupon, smilax, pecan, hackberry, vitis, ragweed – all on banks no instream vegetation.

Width: 50’	Age Class: 50+	Existing Species Composition Sufficient for Maintenance and Recovery:	☐ Y	☒ N

Notes: Stressors – Road/development

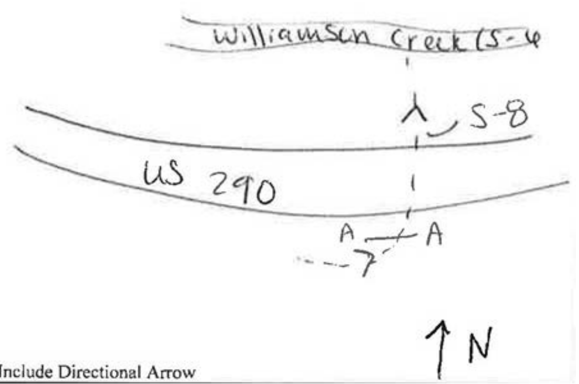
STREAM DATA SHEET

Stream #: S-8	**Date:** 7/20/15

Project Name: Oak Hill Parkway	Project No.: 173570
County/State: Travis, Texas	Surveyors: Christine Magers, Sara Moren
Stream Name: Williamson Creek tributary	GPS Unit #: IPad 2

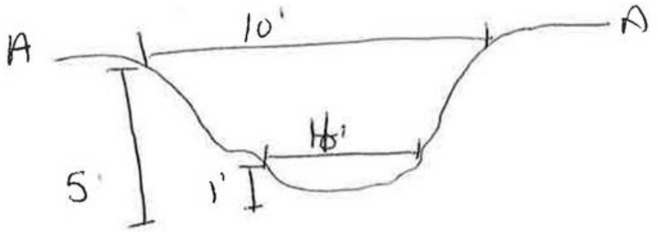
Stream Characteristics			
Stream Width:		*Stream Height/Depth:*	
Bank to Bank = 10’		Avg. Banks = 5’	
Waters Edge =n/a		Avg. Water =n/a	
OHWM = 4’’		OHWM =1’	
Stream Flow:	☐Perennial	☐ Intermittent	☒ Ephemeral
Erosion:	☐Heavy	☐Moderate	☒ Slight
Flow Regime:	☐ Upstream Development	☐Dense Regrowth	☐Heavy Downcutting

Drawing (Plan View)



Please Include Directional Arrow

Drawing (Cross-Section)



Facing Downstream for Cross-Section

Substrate Description

☐ Bedrock	☐ Boulder	☐ Cobble	☐ Gravel	☐Sand	☒ Silt/Clay	☐Organic	☐Concrete

☐Other (Describe):

Aquatic Habitat (Instream) Description

☐Undercut Banks	☒ Logs/Brush	☐Aquatic Veg.	☐Sand Bar	☐Mud Bar
☐ Overhanging Veg.	☐Gravel Riffles	☐Deep Pools	☐Oxbows	☐Shallows

Species (Description): Artificial habitat enhancement. Dry channel and no observable pools or interstitial flow.

Riparian Zone Description

☐Forest	☐Scrub/Shrub	☒ Old-Field/[✓ ROW]	☐Pasture	☐Row Crop
☐Wetland	☐Paved	☐ Residential	☐Park	☐ Other

Species (Description): Green ash, pecan, hackberry, sycamore overhanging.

Width:	Age Class:	Existing Species Composition Sufficient for Maintenance and Recovery:	☐ Y	☒ N

Notes: Stressors – ROW – 290.

This report was written on behalf of the Texas Department of Transportation by

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Appendix A – Preliminary Water Quality Analysis and Design

Note: Only the text of this report is provided in this appendix. Full report is available for review at TxDOT and Mobility Authority offices.

Oak Hill Parkway (US 290 / SH 71)

CSJ 0113-08-060
CSJ 0700-03-077

Preliminary Water Quality Analysis and Design

Prepared For:

Texas Department of Transportation (TxDOT)
Austin District

Prepared by:

K FRIESE
+ ASSOCIATES
PUBLIC PROJECT ENGINEERING

K Friese & Associates, Inc.
1120 S Capital of Texas Highway
CityView II, Suite 100
Austin, Texas 78746
Firm No: F-6535

March 16, 2017

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Appendices

1.0 Introduction

1.1 Project Description

The Oak Hill Parkway project consists of roadway improvements along US 290 and SH 71 from East of Tara Lane to East of Williamson Creek along US 290 and from Silvermine Drive to the US 290 interchange along SH 71. They include main lane and frontage road construction along US 290, SH 71 and the William Cannon and US 290 / SH 71 interchanges.

There are two proposed alternatives for the Oak Hill Parkway Improvements, Alternative A and Alternative C. The difference between Alternatives A and C is the alignment and grade separation at the US 290 / SH 71 Interchange and the intersection with William Cannon. The remainder of the improvements are the same between Alternatives A and C.

K Friese & Associates, Inc. has prepared a preliminary water quality analysis and design to assist with the schematic development and environmental process. This study estimates the current pollutant load removal achieved by the existing water quality control facilities, summarizes the requirements for pollutant load removal for the proposed project, and recommends required improvements to ensure compliance with current water quality regulations.

2.0 Design Criteria

2.1 Water Quality Regulations

Most of the project (including SH 71) is located within the Edwards Aquifer Contributing Zone. The US 290 improvements east of William Cannon Drive are located in the Recharge Zone. The project is therefore subject to the Texas Commission on Environmental Quality (TCEQ) Edwards Aquifer Protection Program (EAPP) regulations. In addition, the project must meet the requirements of the TCEQ Texas Pollution Discharge Elimination System (TPDES), and United States Army Corps of Engineers (USACE) Section 401 of the Clean Water Act.

2.1.1 TCEQ Edwards Aquifer Protection Program (EAPP) Recharge Zone

The Edwards Aquifer Recharge Zone provides water to numerous communities within the greater Austin area, and also provides a habitat for the endangered Barton Springs Salamander. The project is located partially within the Contributing Zone and Recharge Zone and will require a TCEQ Water Pollution Abatement Plan (WPAP).

Chapter 213, of the Texas Administrative Code (TAC) states that, “BMPs and measures must be implemented to control the discharge of pollution from regulated activities after the completion of construction. These practices and measures must be designed, constructed, operated, and maintained to insure that 80% of the incremental increase in the annual mass loading of total suspended solids from the site caused by the regulated activity is removed. These quantities must be calculated in accordance with technical guidance prepared or accepted by the executive director.”[1] The TCEQ has developed a

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[1] Texas Administrative Code, Title 30, Part 1, Chapter 213, Subchapter A,(4),(D),(ii),(I).

technical guidance manual, *Complying with the Edwards Aquifer Rules – Technical Guidance on Best Management Practices, RG-348* (RG-348)[2], to ensure that new construction activities provide stormwater mitigation measures compliant with the Edwards Aquifer rules and regulations outlined in chapter 213 of the TAC. This document describes in detail the selection and design of permanent, structural and non-structural Best Management Practices (BMPs) to provide treatment for 80% of the incremental increase in Total Suspended Solid (TSS) caused by the construction of impervious cover on the Oak Hill Parkway project.

Along with the RG-348 guidance manual, TCEQ provides a spreadsheet[3] to assist in calculating the required TSS load removal for a proposed project and to calculate the required sizing of a proposed permanent BMP based on a desired pollutant load removal. This spreadsheet was developed for the purpose of assisting a project through the TCEQ application review process.

2.1.2 Permanent Water Quality Best Management Practices (TCEQ EAPP)

Permanent BMPs are implemented to reduce pollution of surface water or stormwater that originates on site or upstream from the site and flows across the project site. Chapter 3 of the TCEQ RG-348 document provides technical guidance to designers on how to adequately select and size BMPs to meet the pollutant reduction requirements for stormwater runoff defined in the Edwards Aquifer Rules[4].

RG-348 describes in detail 10 permanent BMPs that are appropriate for the Edwards Aquifer Region, along with maintenance guidelines necessary to ensure the long-term performance of the controls function as designed. For a description of additional BMP's approved since 2005, refer to the Addendum Sheet Complying with the Edwards Aquifer Rules – Technical Guidance on Best Management Practices RG-348 (Revised July 2005), July 5, 2012 shows a summary of the potential permanent structural BMPs to be used in the Edwards Aquifer Region. Not all BMPs provided in the Addendum Sheet (July 2012) are listed in **Table 2-1.**

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http://texreg.sos.state.tx.us/public/readtac$ext.TacPage?sl=T&app=9&p_dir=F&p_rloc=103547&p_tloc=14809&p_ploc=1&pg=2&p_tac=&ti=30&pt=1&ch=213&rl=5

[2] Complying with the Edwards Aquifer Rules – Technical Guidance on Best Management Practices (RG-348). Texas Commission on Environmental Quality, Revised July 2005, http://www.tceq.texas.gov/publications/rg/rg-348/rg-348.html; see also: Addendum Sheet Complying with the Edwards Aquifer Rules – Technical Guidance on Best Management Practices RG-348 (Revised July 2005), July 5, 2012.

[3] Calculation Spreadsheet: TSS Removal. Texas Commission on Environmental Quality, Revised April 20, 2009. http://www.tceq.texas.gov/field/eapp/spreadsheet.html

[4] Edwards Aquifer Rules. Texas Commission on Environmental Quality, Revised March 31, 2011. http://www.tceq.state.tx.us/rules/indxpdf.html/#213

Table 2-1: Summary of TCEQ Approved Permanent BMPs

Permanent Structural BMP	Drainage Area Limit		Maintenance Requirements	TSS Removal Efficiency
	Small (<10 AC)	Large (>10 AC)		
Retention/Irrigation		X	High	100%
Extended Detention Basin		X	Low to Medium	75%
Grassy Swales	X		Low to Medium	70%
Vegetative Filter Strips (VFS)	X		Low	85%
Sand Filter Systems	X		Medium	89%
AquaLogic Cartridge System	X		High	95%
Wet Basins		X	Medium to High	93%
Bioretention	X		Medium to High	89%
Permeable Friction Course*	X		Medium	90%

*See the Addendum Sheet (July 2012)

2.1.3 TPDES Stormwater General Permit

All construction sites located in the state of Texas greater than 1 Acre that discharge stormwater associated with construction activity to surface water are required to obtain a Construction General Permit to Discharge (Construction General Permit TXR150000) under the Texas Pollutant Discharge Elimination System (TPDES) permit from the TCEQ[5]. It is anticipated that all discharges related to the proposed construction of Oak Hill Parkway will be covered under the TPDES Construction General Permit, provided that a Stormwater Pollution Prevention Plan (SW3P) is developed prior to any construction activities in accordance with the guidelines set forth in the General Permit document. The contents of the SW3P will be included in the TCEQ WPAP. A Notice of Intent (NOI) would be required.

2.1.4 Temporary Stormwater Protections

During the construction of the Project, the contractor shall follow the TCEQ WPAP guidelines for protecting overall water quality and sensitive features of the Edwards Aquifer Recharge Zone found in the project area. Temporary protections will be described detail in the Temporary Stormwater Section (TCEQ-0602) of the WPAP, including:

- Spill Response Actions
- Potential Sources of Contamination
- Sequence of Major Activities
- Temporary Best Management Practices and Measures
- Request to Temporarily Seal a Feature, if sealing a feature
- Structural Practices
- Drainage Area Map
- Temporary Sediment Pond(s) Plans and Calculations
- Inspection and Maintenance for BMPs
- Schedule of Interim and Permanent Soil Stabilization Practices

A complete list of temporary protections can be found within the TCEQ-0602 section of

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[5] General Permit to Discharge under the Texas Pollutant Discharge Elimination System. Texas Commission on Environmental Quality, Effective March 5, 2013. http://www.tceq.texas.gov/assets/public/permitting/stormwater/TXR150000_CGP.pdf

the WPAP. [6]

The project construction plans will require the following TCEQ Water Pollution Abatement Plan General Construction Notes[7]:

1. A written notice of construction must be submitted to the TCEQ regional office at least 48 hours prior to the start of any regulated activities. This notice must include:
    - the name of the approved project;
    - the activity start date; and
    - the contact information of the prime contractor.

2. All contractors conducting regulated activities associated with this project must be provided with complete copies of the approved Water Pollution Abatement Plan (WPAP) and the TCEQ letter indicating the specific conditions of its approval. During the course of these regulated activities, the contractors are required to keep on-site copies of the approved plan and approval letter.

3. If any sensitive feature(s) (caves, solution cavity, sink hole, etc.) is discovered during construction, all regulated activities near the sensitive feature must be suspended immediately. The appropriate TCEQ regional office must be immediately notified of any sensitive features encountered during construction. Construction activities may not be resumed until the TCEQ has reviewed and approved the appropriate protective measures in order to protect any sensitive feature and the Edwards Aquifer from potentially adverse impacts to water quality.

4. No temporary or permanent hazardous substance storage tank shall be installed within 150 feet of a water supply source, distribution system, well, or sensitive feature.

5. Prior to beginning any construction activity, all temporary erosion and sedimentation (E&S) control measures must be properly installed and maintained in accordance with the approved plans and manufacturers specifications. If inspections indicate a control has been used inappropriately, or incorrectly, the applicant must replace or modify the control for site situations. These controls must remain in place until the disturbed areas have been permanently stabilized.

6. Any sediment that escapes the construction site must be collected and properly disposed of before the next rain event to ensure it is not washed into surface streams, sensitive features, etc.

7. Sediment must be removed from the sediment traps or sedimentation basins not later than when it occupies 50% of the basin’s design capacity.

8. Litter, construction debris, and construction chemicals exposed to stormwater shall be prevented from being discharged offsite.

9. All spoils (excavated material) generated from the project site must be stored on-site with proper E&S controls. For storage or disposal of spoils at another site on the Edwards Aquifer Recharge Zone, the owner of the site must receive approval of a water

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[6] http://www.tceq.state.tx.us/assets/public/compliance/field_ops/eapp/F-0602_temporary_stormwater.pdf

[7] Texas Commission on Environmental Quality Water Pollution Abatement Plan General Construction Notes. Texas Commission on Environmental Quality, Revised July 15, 2015. http://www.tceq.state.tx.us/assets/public/compliance/field_ops/eapp/F-0592_WPAP_const_notes.pdf

pollution abatement plan for the placement of fill material or mass grading prior to the placement of spoils at the other site.

10. If portions of the site will have a temporary or permanent cease in construction activity lasting longer than 14 days, soil stabilization in those areas shall be initiated as soon as possible prior to the 14th day of inactivity. If activity will resume prior to the 21st day, stabilization measures are not required. If drought conditions or inclement weather prevent action by the 14th day, stabilization measures shall be initiated as soon as possible.

11. The following records shall be maintained and made available to the TCEQ upon request:
    - the dates when major grading activities occur;
    - the dates when construction activities temporarily or permanently cease on a portion of the site; and
    - the dates when stabilization measures are initiated.

12. The holder of any approved Edward Aquifer protection plan must notify the appropriate regional office in writing and obtain approval from the executive director prior to initiating any of the following:

    A. any physical or operational modification of any water pollution abatement structure(s), including but not limited to ponds, dams, berms, sewage treatment plants, and diversionary structures;

    B. any change in the nature or character of the regulated activity from that which was originally approved or a change which would significantly impact the ability of the plan to prevent pollution of the Edwards Aquifer;

    C. any development of land previously identified as undeveloped in the original water pollution abatement plan.

Austin Regional Office 12100 Park 35 Circle, Building A Austin, Texas 78753-1808 Phone (512) 339-2929 Fax (512) 339-3795	San Antonio Regional Office 14250 Judson Road San Antonio, Texas 78233-4480 Phone (210) 490-3096 Fax (210) 545-4329

2.1.5 Section 401 Water Quality Certification for USACE Section 404 Permits

Section 404 of the Clean Water Act requires a permit to be issued by the U.S. Army Corps of Engineers to regulate the discharge of dredged or fill material into any streams, lakes, rivers, wetlands or any other waterways classified as Waters of the United States (WOTUS). It has not been determined if any of the drainageways crossing the project are considered WOTUS, but the proposed activities cross Williamson Creek along both US 290 and SH 71 as well as Wheeler Branch along US 290. Once WOTUS limits have been determined, the applicability of a Section 404 permit will need to be evaluated.

2.1.6 EPA Sole Source Aquifer Program

The Environmental Protection Agency (EPA) Soul Source Aquifer (SSA) Program defines a SSA as an aquifer that, “supplies at least 50 percent of the drinking water for its service area” and/or “there are no reasonable available drinking water sources should the aquifer become contaminated”[8]. At the western end of the project along US 290 near Circle drive, the project limits enter the Edwards Aquifer II (Austin Area) Sole Source Aquifer – Streamflow Source Zone. See **Appendix B** for a map of the SSA zone as related to the proposed project limits. Any project that is located within the SSA zone and will receive federal funding must be submitted to the EPA regional office for review upon design completion.

3.0 Existing Conditions

Existing impervious cover was delineated using project topographic survey and aerial imagery. In the area just east of the US 290 and SH 71 intersection, abandoned parking lots and building foundations were used by TxDOT for stockpiling and storing road materials and equipment. In a letter dated June 26, 2013, TxDOT notified the TCEQ of their removal of impervious cover in this area and requested that the TCEQ acknowledge this impervious cover as existing in the Oak Hill Parkway project. The letter and corresponding exhibit are located in **Appendix A.** The area is approximately five acres and is shown in the existing impervious cover exhibit in **Appendix C.** The water quality benefit from counting this storage area as existing impervious cover on the Oak Hill Parkway project is illustrated in the TCEQ calculation in **Table 3-1.**

Table 3-1: TCEQ Calculation of Storage Area Water Quality Benefit

Drainage Basin/Outfall Area No. =	EX Storage Area
Total drainage basin/outfall area =	5.06 acres
Predevelopment impervious area within drainage basin/outfall area =	5.06 acres
Post-development impervious area within drainage basin/outfall area =	0.00 acres
Post-development impervious fraction within drainage basin/outfall area =	0
$L_{M\ THIS\ BASIN}$ =	-4405 lbs.

3.1 Existing Water Quality Controls

Existing water quality controls were determined from existing WPAP’s and Contributing Zone Plans (CZP) prepared for previous projects along US 290 and SH 71. Of the three WPAP/CZP’s found within the project corridor, two utilized Permeable Friction Course (PFC) overlay as the permanent water quality control. The third project which included the intersection improvements at William Cannon and the SH 71 / US 290 interchange, removed existing impervious cover within the ROW in the northeast corner of the William Cannon intersection. The removal of this impervious cover offset the addition of impervious cover due to roadway widening, so no additional water quality treatment was required.

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[8] EPA Overview of the Drinking Water Sole Source Aquifer Program. https://www.epa.gov/dwssa/overview-drinking-water-sole-source-aquifer-program#What_Is_SSA

In addition to existing water quality controls associated with the roadways, there is an existing Retention / Irrigation pond within the limits of the proposed ROW. The pond is west of the William Cannon intersection and treats runoff from the NXP Semiconductor facility. Impacts to those existing private facilities must be considered as part of the ROW acquisition process, with mitigation for lost water quality treatment being possibly included in ponds constructed as part of the roadway project, for example Pond K, adjacent to William Cannon Drive.

Existing permits and Water Quality Control Facilities associated with TxDOT roadway projects have been summarized in **Table 3-2** and are illustrated in **Appendix C.**

3.2 Existing Analysis Approach

This report utilizes the TCEQ RG-348 formulae and methodology to determine the TSS removed by the existing systems. Treated areas and existing impervious cover areas were delineated for each BMP based on limits defined within the permit documents and aerial imagery. The appropriate removal efficiency was applied for each BMP (see **Table 2-1**). For this application, L_R, the maximum load available for removal in the TCEQ spreadsheet, reflects the best approximation for the current TSS removal based on RG-348 and the Addendum Sheet (July 2012).

3.3 Existing Results

The existing TSS removal results are shown in **Table 3-2.** The total TSS removed value of 18,428 lbs is the computed annual TSS removal amount for the entire project area under current conditions.

Table 3-2: Summary of Existing Water Quality Controls

TCEQ Permit Number	Project Description	Station	Treatment Type	TSS Removed (lbs)
11-13050801	SH 71 left turn lanes	1050+50 - 1100+00 [1] (SH 71)	Permeable Friction Course	8546
11-12101101	US 290 from William Cannon to Convict Hill	N/A	None	0
11-12051501	US 290 from FM 1826 to Convict Hill	296+00 - 342+00 (US 290)	Permeable Friction Course	9883
			Total:	**18,428**

[1] TCEQ Permit extended between station limits 1050+50 to 1084+70. However the PFC limits were extended to Station 1100+00 during construction.

4.0 Proposed Conditions

Proposed impervious cover was delineated using design files provided by Rodriguez Transportation Group (RTG). Proposed impervious cover maps were created for both Alternative A and Alternative C and can be found in **Appendix D** and **Appendix E** respectively.

4.1 Proposed Impacts

The proposed Oak Hill Parkway will cause the overall drainage patterns for the project site to change from existing conditions as the vertical alignment high and low points will shift to accommodate grade separations for main lanes, ramps, and frontage roads. There are two alternatives proposed for the Oak Hill Parkway project, Alternative A and Alternative C. The differences between the two alternatives occur between STA 340+00 to STA 415+00 (US 290) and STA 1084+50 to STA 1105+00 (SH 71). This area encompasses the US 290 / SH 71 interchange, the William Cannon intersection and the US 290 Williamson Creek crossing. Water quality controls were preliminarily designed for both alternatives. In both alternatives, the existing PFC will be removed with the roadway realignment and reconstruction.

The existing Retention Irrigation pond for the NXP facility discussed in **Section 3.1** will not be affected in Alternative A. However, Alternative C has a proposed bridge spanning approximately half of the water quality pond. In final design, efforts should be made to minimize impacts to this existing Retention Irrigation pond or additional mitigation in this area may be provided to return the pond to its designed volume.

4.2 Proposed Design Approach

The TCEQ spreadsheet calculates the required removal (L_M) in compliance with the TAC and technical guidance, as 80% of the TSS load generated by the incremental increase in impervious cover. For a typical TCEQ WPAP application which does not include an area previously approved, the pre-project conditions reflect the existing impervious cover at the time of application, this area is shown in **Table 4-1** and **Table 4-2**. For the Oak Hill Parkway project, the post-project conditions reflect the proposed area of impervious cover based on the preliminary roadway schematic. For the purposes of water quality analysis, impervious cover was delineated on all roadway, driveway and sidewalk surfaces composed of concrete or asphalt pavement. Water quality pond areas were not counted as impervious cover. Proposed impervious cover was delineated for both Alternative A and Alternative C. **Table 4-1** and **Table 4-2** summarize the total TSS removal required for Alternative A and C respectively of the proposed project based simply upon the TCEQ EAPP regulations.

Table 4-1: Proposed TSS Removal Required - Alternative A

Total Project Area (AC)	245.1
Pre-Project Impervious Area (AC)	74.9
Post-Project Impervious Area (AC)	148.9
TSS Removal Required for Project Area (lbs.)	64,405

Table 4-2: Proposed TSS Removal Required - Alternative C

Total Project Area (AC)	245.1
Pre-Project Impervious Area (AC)	74.9
Post-Project Impervious Area (AC)	148.5
TSS Removal Required for Project Area (lbs.)	64,094

Recognizing that the existing PFC along US 290 and SH 71 is currently providing 18,428 lbs of TSS removal, the Project proposes to provide additional treatment. Furthermore, the Project proposes to request a water quality credit of 4,405 lbs provided from the removal of impervious cover in the TxDOT storage area.

4.3 Proposed Water Quality Controls

Due to their high removal efficiency and relatively low cost, VFS are utilized wherever possible along the new mainlanes, frontage roads, ramps and sidewalks by providing flat side slopes adjacent to the new pavement edges. VFS along the sidewalks and shared use path utilized the sizing provided in **Table 4-3**, where the filter strip width is approximately one-half the path width.

Table 4-3: Filter Strip Sizing for Shared Use Paths

Shared Path Width (ft)	Engineered VFS Width (ft)
4	2.10
6	3.10
8	4.20
10	5.20
12	6.30
14	7.30

In addition to VFS, three types of water quality ponds were utilized at various locations along the corridor including, Bioretention, Sand Filter Systems and Extended Detention Basins. Due to the high removal efficiency and aesthetic appeal, Bioretention ponds were designed wherever feasible. Limitations to Bioretention ponds include;

- Only one foot of allowable ponding depth – ponds require large surface area.
- Need to be in direct sunlight to remain vegetated – cannot be placed under bridges.
- Media depth and underdrain pipe slopes require significant amount of fall from bottom of pond to outfall.

When Bioretention was not feasible, a Sand Filter System was evaluated. Sand Filters can be placed under bridges and have allowable ponding depths between two and eight feet. Therefore, the location and treatment volume of the Sand Filter System is more flexible than that of the Bioretention pond, making it a more appropriate BMP for corridors with limited open space within the ROW. However, like Bioretention ponds, Sand Filter Systems require a significant amount of hydraulic head with media depth and underdrain pipe slopes. All proposed Sand Filter Systems were designed as full sedimentation and filtration.

In cases where neither a Bioretention pond nor a Sand Filter System were feasible, an Extended Detention Basin was designed. The geometry and hydraulic head required with and Extended Detention Basin is more flexible than the Sand Filter System or Bioretention pond and can be designed within tight elevation and geometric constraints.

4.3.1 Alternative A

A total of 17 water quality ponds are proposed for Alternative A in addition to VFS adjacent to the roadway, sidewalk, and shared use path where practicable. All proposed water quality control facilities for Alternative A are summarized in **Table 4-4** and can be seen in the preliminary water quality site plans located in **Appendix F.** Preliminary Pond layouts can be found in **Appendix H.**

Table 4-4: Summary of Proposed Water Quality Control Facilities - Alternative A

Project Designation	Station	Roadway	Treatment Type	TSS Removed (lbs)
VFS RDWY	Varies	Varies	Vegetative Filter Strip	6505
VFS SUP	Varies	Varies	Vegetative Filter Strip	2421
Pond A	232+00 LT	US 290	Bioretention	1150
Pond B	234+00 RT	US 290	Extended Detention	4000
Pond C	279+00 RT	US 290	Sand Filter System	6501
Pond D	287+00 RT	US 290	Sand Filter System	4110
Pond E	303+00 LT	US 290	Sand Filter System	5339
Pond F	362+00 LT	US 290	Sand Filter System	17000
Pond G	353+00 LT	US 290	Sand Filter System	2581
Pond H	369+00 RT	US 290	Sand Filter System	6840
Pond I	390+00 Median	US 290	Sand Filter System	9400
Pond J	399+00 LT	US 290	Extended Detention	3004
Pond K	25+00 LT	Wm Cannon	Bioretention	2400
Pond L	1097+00 Median	SH 71	Sand Filter System	2015
Pond M	1089+50 Median	SH 71	Sand Filter System	950
Pond N	1087+00 Median	SH 71	Sand Filter System	990
Pond O	1070+00 LT	SH 71	Sand Filter System	4500
Pond P	1055+00 Median	SH 71	Bioretention	880
Pond Q	1047+00 Median	SH 71	Bioretention	2250
			Total :	**82,837**

4.3.2 Alternative C

A total of 15 water quality ponds are proposed for Alternative C in addition to VFS adjacent to the roadway, sidewalk and shared use path where practicable. The project designations for ponds in Alternative C are the same as those in Alternative A. Ponds G and M were removed from Alternative C due to conflicts with roadway elements. Ponds F, H, I, J, and L have been altered from Alternative A by changing treatment type, volume, or moving the pond location. The remainder of the ponds are unchanged from Alternative A. All proposed water quality control facilities for Alternative C are summarized in **Table 4-5** and can be seen in the preliminary water quality site plans located in **Appendix G.** Preliminary pond layouts can be found in **Appendix I**.

Table 4-5: Summary of Proposed Water Quality Control Facilities - Alternative C

Project Designation	Station	Roadway	Treatment Type	TSS Removed (lbs)
VFS RDWY	Varies	Varies	Vegetative Filter Strip	5864
VFS SUP	Varies	Varies	Vegetative Filter Strip	2946
Pond A	232+00 LT	US 290	Bioretention	1150
Pond B	234+00 RT	US 290	Extended Detention	4000
Pond C	279+00 RT	US 290	Sand Filter System	6501
Pond D	287+00 RT	US 290	Sand Filter System	4110
Pond E	303+00 LT	US 290	Sand Filter System	5339
Pond F	350+00 Median	US 290	Sand Filter System	26000
Pond H	371+00 RT	US 290	Sand Filter System	6750
Pond I	390+00 LT	US 290	Bioretention	5700
Pond J	399+00 Median	US 290	Sand Filter System	3200
Pond K	25+00 LT	Wm Cannon	Bioretention	2000
Pond L	1097+00 Median	SH 71	Extended Detention	1040
Pond N	1087+00 Median	SH 71	Sand Filter System	990
Pond O	1070+00 LT	SH 71	Sand Filter System	4500
Pond P	1055+00 Median	SH 71	Bioretention	880
Pond Q	1047+00 Median	SH 71	Bioretention	2250
			Total :	**83,220**

4.4 Proposed Results

4.4.1 Alternative A

Table 4-4 summarizes the TSS removal amount for each of the proposed permanent Water Quality BMPs for Alternative A. The total TSS removed value of **82,837 lbs** is the TSS removal amount for the entire project area under proposed conditions. TCEQ water quality calculations for entire project area and each BMP can be found in **Appendix J.**

The additional TSS removal required under the TCEQ regulations for this project is **18,428 lbs,** the existing conditions TSS removal. The water quality credit for this project is 4,405 lbs for the removal of impervious cover. With the BMPs proposed, the anticipated TSS removal exceeds the total required removal, see **Table 4-6**.

Table 4-6: Proposed TSS Removal Summary – Alternative A

TSS Removal Required for Project Area (lbs.)	64,405
Existing Conditions TSS Removal (lbs.)	18,428
TSS Credit for Storage Area (lbs.)	-4,405
Total Required TSS Removal (lbs.)	78,428
Proposed Conditions TSS Removal (lbs.)	82,837
Proposed - Required TSS Removal (lbs.) (Overtreatment)	4,409

4.4.2 Alternative C

Table 4-5 summarizes the TSS removal amount for each of the proposed permanent Water Quality BMPs for Alternative C. The total TSS removed value of **83,220 lbs** is the TSS removal amount for the entire project area under proposed conditions. TCEQ water quality calculations for entire project area and each BMP can be found in **Appendix K.**

The additional TSS removal required under the TCEQ regulations for this project is **18,428 lbs,** the existing conditions TSS removal. The water quality credit for this project is 4,405 lbs for the removal of impervious cover. With the BMPs proposed, the anticipated TSS removal exceeds the total required removal, see **Table 4-7**.

Table 4-7: Proposed TSS Removal Summary - Alternative C

TSS Removal Required for Project Area (lbs.)	64,094
Existing Conditions TSS Removal (lbs.)	18,428
TSS Credit for Storage Area (lbs.)	-4,405
Total Required TSS Removal (lbs.)	78,117
Proposed Conditions TSS Removal (lbs.)	83,220
Proposed - Required TSS Removal (lbs.) (Overtreatment)	5,103

5.0 Conclusion & Recommendations

The proposed water quality controls for the Project have been designed to meet all TCEQ EAPP requirements. Any sensitive features encountered during construction will be addressed in conformance to chapter 213.5 of the TAC. It is recommended that a combination of VFS, Bioretention ponds, Sand Filter Systems, and Extended Detention Basins be designed as the permanent water quality controls for the Oak Hill Parkway project. By providing a combination of the aforementioned BMPs, the project will be able to meet the TSS removal required by the TCEQ.