Water Resources Technical Memorandum

MoPac (State Loop 1) Intersections, Austin District

From North of Slaughter Lane to South of La Crosse Avenue
CSJ: 3136-01-015
Travis County, Texas
June 2015

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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1.0 WATER RESOURCES

This technical memorandum describes the water resources that could be affected by the proposed MoPac intersection improvements at Slaughter Lane and La Crosse Avenue, and the shared use path extending from Slaughter Lane to La Crosse Avenue, referred to herein as the MoPac Intersection Improvements (CSJ: 3136-01-015).

1.1 SURFACE WATER

1.1.1 Waters of the U.S. including Wetlands

Desktop data collected from United States Geological Survey (USGS) topographic maps (Signal Hill and Oak Hill quadrangles; 1996, 2002), USGS National Hydrography Dataset, and the United States Fish and Wildlife Service (USFWS) National Wetland Inventory (NWI) indicate five potential jurisdictional waters of the U.S. including wetlands (Slaughter Creek, Tributary 2 to Slaughter Creek, Tributary 3 to Slaughter Creek, Tributary 4 to Slaughter Creek and Tributary 1 to Danz Creek) located in the existing right-of-way (ROW) of the MoPac Intersection Improvements.

The topographic maps and NWI indicate a pond to be partially located within the existing ROW near the Alamo Drafthouse. Aerial photographs dating back to 1996 do not show the pond. Based on a field investigation conducted on February 13, 2014; the pond on the NWI was determined to be a detention pond and is completely outside of the existing ROW. It would not be impacted by the proposed project. Additionally, the unnamed tributary to the Kincheon Branch of Williamson Creek is depicted on the City of Austin creeks map as being located within the existing ROW after passing through a box culvert south of Davis Lane. That segment was not observed during field investigation and is therefore not analyzed further. **Figure 1** is a map of the potential waters of the U.S., including wetlands in the proposed project area and the watersheds crossed by the project.

Slaughter Creek crosses the existing ROW approximately 0.5 miles northeast of the intersection of MoPac South with La Crosse Avenue. The original construction of the MoPac South roadway in 1991 included the installation of two parallel bridges across Slaughter Creek. No work is required at the two bridges for the proposed project. No impacts are expected as a result of the proposed project at Slaughter Creek.

Tributary 4 to Slaughter Creek crosses the project ROW approximately 1,600 feet southwest of the intersection of MoPac South with La Crosse Avenue. This stream was routed through a subsurface concrete box culvert as part of previous construction activities within the MoPac South ROW. No additional impacts are expected as a result of the proposed project.

Tributary 2 to Slaughter Creek is located approximately 400 feet northeast of Slaughter Creek. This stream was routed through a subsurface concrete box culvert as part of previous construction activities within the MoPac South ROW. No additional impacts are expected as a result of the proposed project.

Tributary 3 to Slaughter Creek is located approximately 1,000 feet southwest of the intersection of MoPac South with Slaughter Lane. An earthen, natural portion of this stream exists in the median of the ROW. The remaining portions of the stream within the proposed project area have been routed through concrete culverts beneath the northbound and southbound lanes as part of previous roadway construction activities within the MoPac South ROW. Impacts to this tributary are expected as a result of the proposed project. Tributary 3 is shown as a blue line (see **Figure 1**) on USGS National Hydrography Dataset maps and appears to have been altered by original MoPac roadway construction in 1991. Currently it serves as road drainage, but appears to have been historically jurisdictional.

Tributary 1 to Danz Creek is located approximately 900 feet north of the intersection of MoPac South with South Bay Lane. This stream was routed through two subsurface concrete box culverts and cement lining as part of previous construction activities within the MoPac South ROW. No additional impacts are expected as a result of the proposed project. **Table 1** lists all potential jurisdictional features within the existing ROW and anticipated project impacts. Photos of these features are attached to this document in the **Appendix A**.

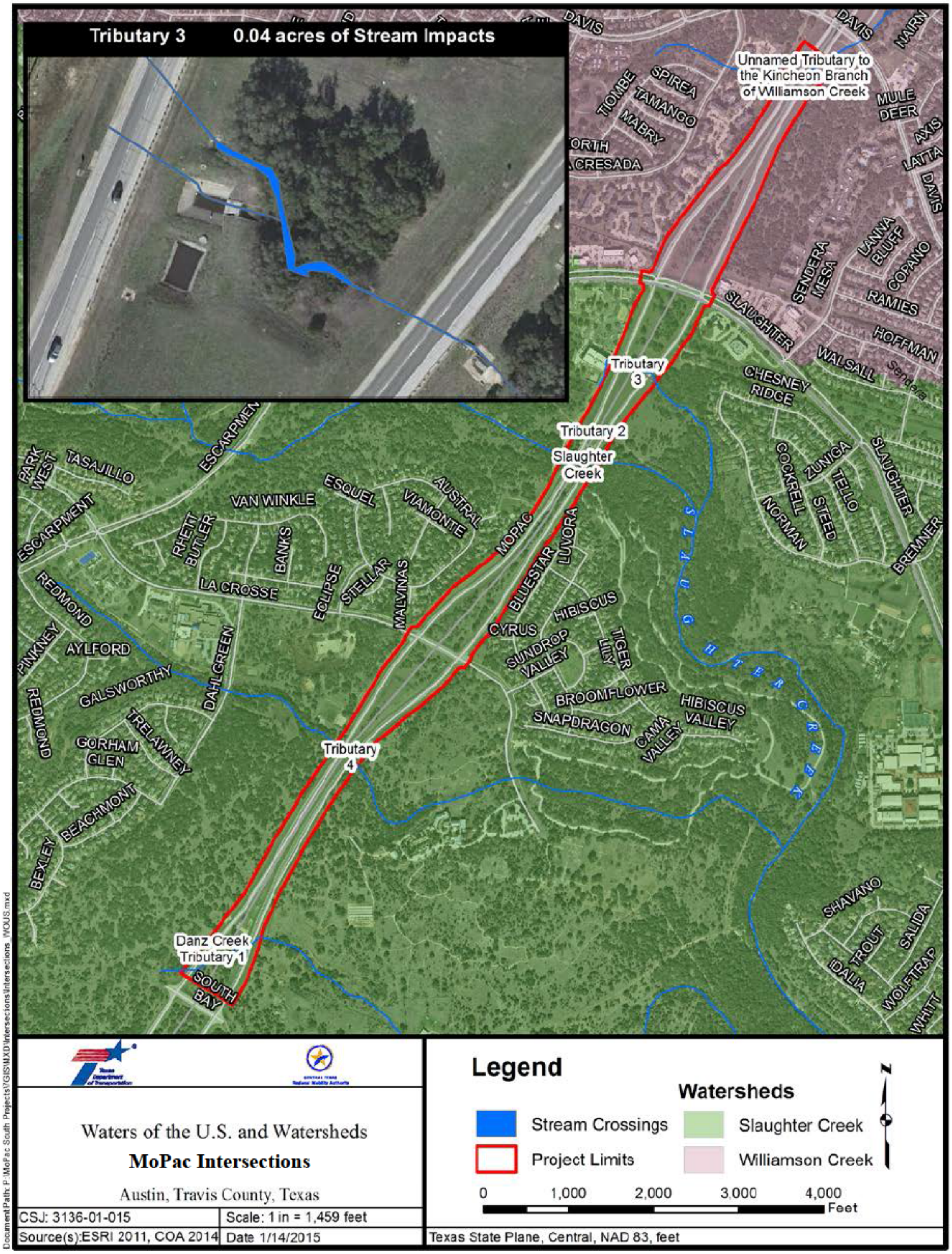

Figure 1: Waters of the U.S. and Watersheds

The MoPac Intersection Improvements are anticipated to impact approximately 0.04 acre of Tributary 3 to Slaughter Creek. It is assumed that the placement of temporary or permanent dredge/fill material into potentially jurisdictional waters of the U.S. including wetlands would be authorized under Nationwide Permit (NWP) 14 (Linear Transportation Projects) without a Pre-Construction Notification (PCN). Construction activities would comply with all general and regional conditions applicable to NWP 14. During the modification of the linear transportation facility, appropriate measures would be taken to maintain normal downstream flows and minimize flooding. A PCN for NWP 14 at Tributary 3 to Slaughter Creek would not be required because the 0.04 acre of impacts is under the 0.1-acre threshold.

Table 1: Summary of Delineated Potential Jurisdictional Features

Name of Water Body	Latitude/ Longitude	OHWM* (Average feet)	Existing ROW		Flow Direction	Potential Water of the U.S?	Potential Impacts	
			Stream (linear feet/acre)	Wetland (acre)			Streams (linear feet/acre)	Wetland (acre)
Slaughter Creek	30.1959/ -97.86933	26	468/0.23	None	SE	Yes	None	None
Tributary 4 to Slaughter Creek	30.18779/ -97.87684	5	356/0.03	None	SE	Yes	None	None
Tributary 2 to Slaughter Creek	30.19679/ -97.86874	4	439/0.03	None	SE	Yes	None	None
Tributary 3 to Slaughter Creek	30.19856/ -97.86758	4.5	430/0.04	None	SE	Yes	353/0.04	None
Tributary 1 to Danz Creek	30.1829/ -97.8803	3	426/0.03	None	SE	Yes	None	None
TOTAL POTENTIAL JURISDICTIONAL WATERS			1,693/0.34	0			353/0.04	0

*OHWM = Ordinary High Water Mark

Source: MoPac Intersection Improvements Study Team 2014.

The 2013 Memorandum of Understanding (MOU) between the Texas Department of Transportation (TxDOT) and the Texas Parks and Wildlife Division (TPWD) would not be triggered by waters of the U.S. because the project would not require a PCN or Individual Permit to be issued by the United States Army Corps of Engineers (USACE). Executive Order 11990 on wetlands does not apply because no wetlands would be impacted by the proposed project.

1.1.2 Navigable Waters

The proposed project would not involve work in or over a navigable water of the U.S.; therefore, Section 10 of the Rivers and Harbors Act does not apply.

1.1.3 Floodplains

Portions of the proposed project fall within a Federal Emergency Management Agency (FEMA) 100-year floodplain. This project drains into the Kincheon Branch of Williamson Creek and into the Danz Creek Tributary of Slaughter Creek. The hydraulic design for the proposed improvements will be in accordance with current TxDOT design policies. The facility would permit the conveyance of the 100-year flood, inundation of the roadway being acceptable, while minimizing damage to the facility, Williamson Creek and Slaughter Creek watershed or other property. The proposed project would not increase the base flood elevation to a level that would violate applicable floodplain regulations or ordinances. Coordination with the local Floodplain Administrator is required.

1.1.4 Surface Water Quality Regulations

The Texas Commission on Environmental Quality (TCEQ) *Permanent Rules Chapter 307, Texas Surface Water Quality Standards (TSWQS) Subsections 307.2 – 21 307.10*, effective June 30, 2010, presents surface water quality standards that apply to all surface waters in the State. These standards are designed to establish goals for water quality throughout the State and provide a basis from which TCEQ regulatory programs can establish reasonable methods to implement and attain these goals. In compliance with Section 303(d) of the Clean Water Act (CWA), the TCEQ identifies water bodies in the State that do not meet the TSWQS. The compilation of these water bodies reported in the Texas Integrated Report of Surface Water Quality, as required by the federal CWA Section 305(b) and 303(d); it is referred to as the 303(d) List. The major surface waters of the State are classified in the TSWQS as "segments" for the purposes of water quality management and designation of site-specific standards. The total maximum daily load (TMDL) represents the total amount of a substance that a water body can assimilate and still meet the TSWQS as adopted by the TCEQ for the particular water body. TCEQ designates water bodies that do not meet applicable water quality standards or are threatened for one or more designated use by one or more pollutant as Category 5. More specifically, Category 5a means that TMDLs have been developed for one of more parameter; Category 5b means that a review of the standards for one of more parameter needs to be conducted before a management strategy is selected, including the possible revision to the water quality standards; and Category 5c means that additional data needs to be collected/evaluated for one of more parameter before a management strategy is selected.

According to the 2012 Texas Integrated Report of Surface Water Quality, Segment 1427A of Slaughter Creek (from the confluence with Onion Creek to above US 290) is listed as Category 5a for having an impaired macrobenthic community (the organisms that live at the bottom of the water body). The proposed project crosses and, based on topography in the project area, likely drains to this segment of Slaughter Creek (TCEQ 2012). Because the project could affect an impaired assessment unit within five miles, coordination with TCEQ regarding Section 303(d) is required per the TxDOT/TCEQ MOU (43 TAC, Chapter 2, Subchapter I, Rule §2.305). TxDOT initiated coordination with TCEQ on May 15, 2015 and coordination was completed on June 12, 2015. As of April 2013, Slaughter Creek does not have a United States Environmental Protection Agency (EPA)-approved TMDL or a TCEQ-approved implementation plan (I-Plan) (TCEQ 2013). As such, the MoPac Intersections project and its associated activities would be implemented, operated and maintained using best management practices (BMPs) to control the discharge of pollutants from the project site.

The MoPac Intersections project must meet the requirements of Section 401 of the Clean Water Act, and the TCEQ Texas Pollution Discharge Elimination System (TPDES). All construction ites located in the state of Texas greater than one acre that discharge stormwater associated with construction activity to surface water are required to obtain a General Permit to Discharge (General Permit TXR150000) from the TCEQ (General Permit to Discharge under the Texas Pollutant Discharge Elimination System, TCEQ, effective March 5, 2013). It is anticipated that all discharges related to the proposed construction would be covered under the TPDES General

Permit. A Stormwater Pollution Prevention Plan (SW3P) will be developed prior to any construction activities in accordance with the guidelines set forth in the General Permit document. A Notice of Intent will be required. Appropriate BMPs will be in place during construction to protect water quality.

1.2 GROUNDWATER

The proposed project lies within the Edwards Aquifer recharge zone in the Barton Springs segment of the Edwards Aquifer (**Figure 2**). The Barton Springs segment of the Edwards Aquifer supplies water to between 50,000 and 60,000 persons, provides habitat for two endangered salamander species, discharges at the Barton Springs complex, and is one of the most studied karst aquifers areas in Texas (Barton Springs/Edwards Aquifer Conservation District [BSEACD] 2014). South of Williamson Creek, the Barton Springs segment of the Edwards Aquifer is designated as a sole-source aquifer, and several cities depend on it for their water (Federal Register 1988). As the proposed project is located over the Edwards Aquifer recharge zone, project actions would comply with TCEQ's Edwards Aquifer Rules, discussed further in **Section 1.2.4**.

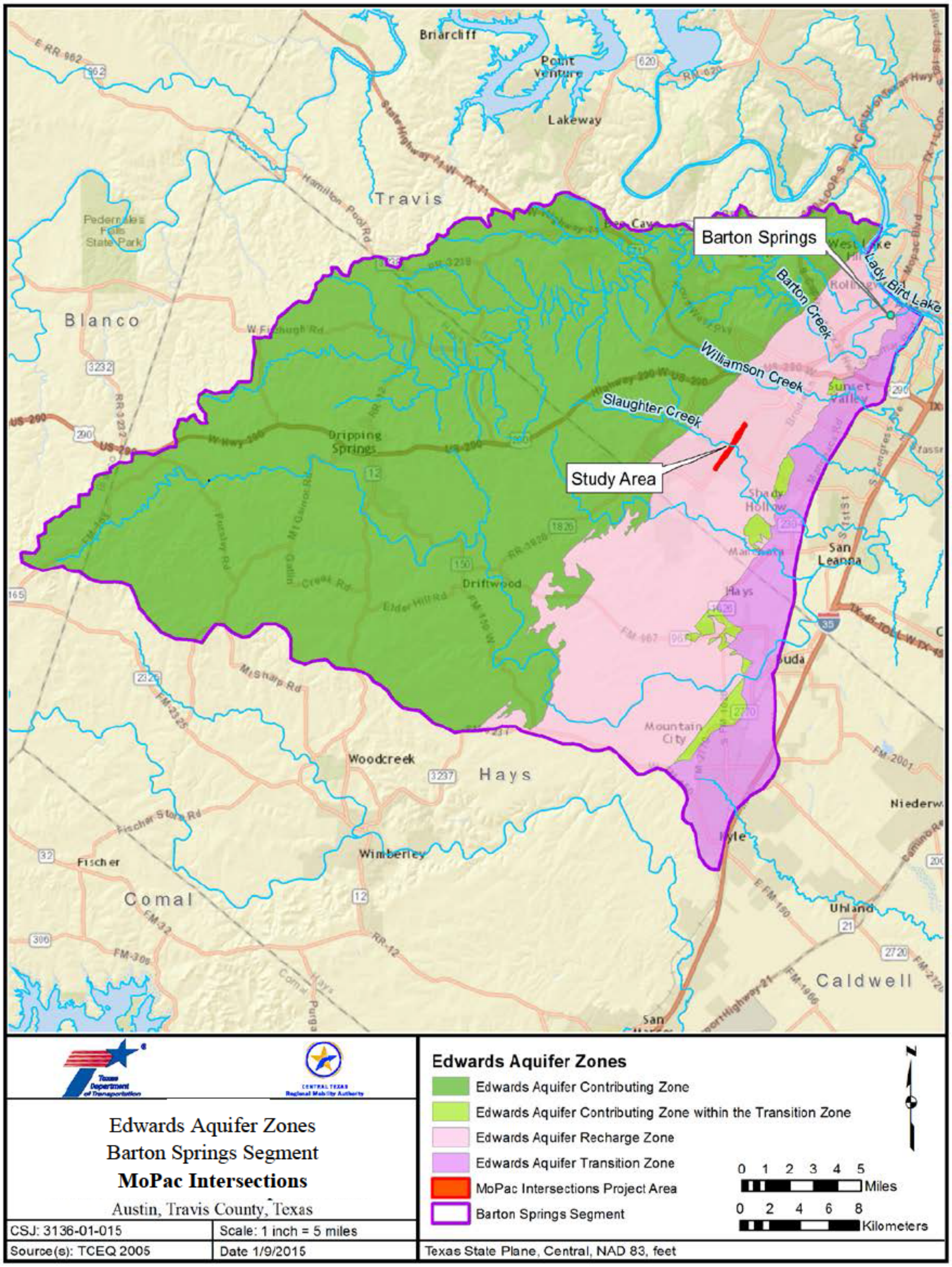

Figure 2: Edwards Aquifer Zones

The geological formations that comprise the Edwards Aquifer are from top to bottom the Georgetown, Person, and Kainer. In the recharge zone, these formations are exposed at the surface, allowing surface water to enter the aquifer with little to no filtration; therefore, the Edwards Aquifer is vulnerable to contamination. The contributing zone, to the west of the recharge zone, is composed of drainage areas and catchments of surface streams that flow onto the recharge zone. Much of the contributing zone lies over the older Glen Rose Limestone Formation, whose members include the geologic unit that separates the Edwards Aquifer from the Trinity Aquifer.

The Trinity Aquifer is composed of the Trinity Group geologic units including members of the Glen Rose Formation, which are exposed at the surface west of the project area. To the west of the project area in western Travis County and northern Hays County, the Edwards Aquifer is thin and the deeper Trinity Aquifer is more commonly used as a water supply. Within the project area, the Trinity Aquifer is located between 250 and 1,200 feet below the Edwards Aquifer (Wierman et al. 2010); therefore, impacts to the Trinity Aquifer are not anticipated, and it is not discussed further in this document.

The Edwards Aquifer is a karst aquifer formed by the dissolution of minerals within the bedrock by groundwater flow. Flow through the Edwards aquifer is highly anisotropic and heterogeneous, flowing through a network of anastomosing conduits that converge at the two major discharge points for the Barton Springs segment, Barton Springs, and Cold Springs. The majority of discharge occurs at a spring complex collectively known as Barton Springs, a smaller portion of discharge occurs at Cold Springs, and remainder of discharge is via groundwater pumping. Flow through the Barton Springs segment is rapid (miles/day) due to well-developed conduit networks that were formed by the dissolution of carbonate minerals within the bedrock by groundwater flow, discussed further in **Section 1.2.1**. The rock matrix and unsaturated zones store and slowly release water, which likely contributes significantly to baseflow in the Barton Springs segment, especially during drought conditions.

A recent study documented that most rainfall that falls on the Edwards Aquifer recharge zone is lost to evapotranspiration (ET) (Hauwert and Sharp 2014). The amount returned to the atmosphere through ET is a function of precipitation, but appears to average about 70 percent. About 5 percent of rainfall becomes surface runoff to creeks and upland recharge features, while only about 25 percent enters the aquifer through diffuse recharge (Slade 2014). Recharge into the Edwards Aquifer occurs primarily in losing streams, where surface water flows from the contributing zone flows over faults, fractures, and karst features that have been solutionally enlarged in the recharge zone (Sharp and Banner 1997). Periods of recharge are intermittent, as most streams in central Texas are ephemeral; however, the recharge capacity of surface water into the aquifer is extremely efficient due to the karstic nature of the system.

The majority of soil depths ranged from 0.5 to 3 feet; therefore, the filtration of diffuse recharge afforded by existing native soils is at best low. Recharge commonly occurs as point recharge into specific karst features, bypassing what little filtration a thin soil zone might afford. Flow systems within karst aquifers are formed by convergent flow paths that combine to form efficient flow networks. Rapid transport through integrated flow networks lead to lower residence times of water within the aquifer, minimizing the opportunity for reduction in contaminant concentrations. These efficient flow networks can cover large areas, allowing contaminants to travel long distances very quickly, endangering distant water supplies before problems are identified (Ford and Williams 2007). These are discussed in detail for the project area in **Section 1.2.1**.

1.2.1 Groundwater Flowpaths and Flow Rates

Numerous dye traces have been conducted on the in the Barton Springs segment of the Edwards Aquifer since 1996 to determine flowpaths and flow rates (Hauwert et. al. 2004, BSEACD 2006, Hauwert 2012, Hunt et al. 2013) (**Figure 3** through **Figure 7**). These tracing studies have shown that groundwater in the area generally flows from the southwest toward the northeast. This flow has been divided up into three basins, known as Cold Springs, Sunset Valley, and Manchaca (**Figure 3** and **Figure 7**). The Cold Springs Groundwater Basin discharges at Cold Springs on the Colorado River, while the other two basins feed the Barton Springs complex. The proposed project lies over the Sunset Valley and Manchaca basins; therefore, recharge in the proposed project area flows to the Barton Springs complex.

Groundwater flow through the Barton Springs segment of the Edwards Aquifer is though a well-developed conduit network, resulting in very rapid flow rates through the aquifer (miles/day). Dye introduced into Whirlpool Cave, just north of the proposed project area, arrived at Barton Springs, 6.8 miles northeast of the cave within three to four days. Following a 4.5 inch rain event on January 24, 2012, a sinkhole developed within a stormwater retention pond at the Arbor Trails retail complex, located on the west side of MoPac, north of the proposed project. The seven million gallons of stormwater in the pond drained into the aquifer. A subsequent dye trace from the sinkhole to Barton Springs, 6.2 miles southeast of the sinkhole showed a travel time of less than four days (Hunt et. al. 2013) (**Figure 7**) These rapid flow-through rates are typical of karst aquifers and contrast with other types of aquifers, where water may reside for long periods and be filtered by other matrices such as sand.

[redacted]

Maps and other location data for caves and karst features were removed to protect the sensitive nature of these features and the species that may be harmed by unintentional human disturbance. These data may be available upon request.

Figure 3: Summary of Dye Tracing 1996-2002
(Hauwert et al. 2004, used with permission)

[redacted]

Maps and other location data for caves and karst features were removed to protect the sensitive nature of these features and the species that may be harmed by unintentional human disturbance. These data may be available upon request.

[redacted]

Figure 4: Summary of 2007 Groundwater Traces
(Hauwert 2012, used with permission)

[redacted]

Maps and other location data for caves and karst features were removed to protect the sensitive nature of these features and the species that may be harmed by unintentional human disturbance. These data may be available upon request.

Figure 5: Summary of 2010 Dye Trace Results
(Hauwert, 2012, used with permission)

[redacted]

Maps and other location data for caves and karst features were removed to protect the sensitive nature of these features and the species that may be harmed by unintentional human disturbance. These data may be available upon request.

Figure 6: Summary of Dye Trace Results from 2005
(BSEACD 2006, used with permission)
Dashed lines are inferred flowpaths and triangles represent wells with dye recovery.

[redacted]

Maps and other location data for caves and karst features were removed to protect the sensitive nature of these features and the species that may be harmed by unintentional human disturbance. These data may be available upon request.

Figure 7: Summary of the 2012 Dye Trace from Arbor Trails Sinkhole
(Hunt et al. 2013, used with permission)

1.2.2 Karst Features

Background research identified the existence of six caves, two sinkholes, and one solution cavity within 500 feet of the proposed project. The current status of these features is not known; however, caves and sinkholes are conduits to the aquifer with high potential for recharge. Subsurface drainage basins have not been delineated for these features, but the possibility exists that drainage from the proposed project area may reach these features. Personal communication with City of Austin hydrogeologist Nico Hauwert (2014) indicates that surface drainage from the proposed project area may reach caves outside of the 500 foot buffer including Wildflower Cave, La Crosse Cave, and Windmill Flat Sink. Subsurface drainage basins for these caves have also not yet been delineated; however, Wildflower Cave has been successfully dye traced to Blowing Sink Cave, which is protected under the Balcones Canyonlands Conservation Plan (BCCP) for a species of concern, the ground beetle *(Rhadine austinica)*. This cave also contains aquatic salamanders recently given preliminary recognition as the endangered Barton Springs salamander *(Eurycea sosorum)* (Chippindale 2014). Delineations conducted by the City of Austin show a portion of the proposed project area to be within the subsurface drainage basin for Blowing Sink Cave.

Within the proposed project area, recharge is most likely to occur at karst features exposed in surface streams. The northern portion of the project area drains to Williamson Creek while the remainder of the project area drains to Slaughter Creek. One karst feature was identified within the right-of-way of the MoPac Intersections project area during karst feature surveys. This feature is a zone of enlarged fractures within the bed of Slaughter Creek. Slaughter Creek intersects the project area**.** As a result of the widespread nature of this feature and its location in a streambed within the recharge zone, this feature has a high recharge potential.

1.2.3 Groundwater Quality

The Barton Springs segment of the Edwards Aquifer has seen a substantial amount of development in recent decades. According to Herrington et al. (2010), the recharge and contributing zones have experienced a population increase of about 2.5 times during the period 1990 to 2010, from less than 60,000 individuals to more than 143,000. The precise amount of impervious cover created by this growth is not well known. Herrington et al. (2010) estimates that about 2,100 acres of structures were added in the recharge and contributing zones of the Barton Springs segment of the Edwards Aquifer based on property rolls; however, this value does not include driveways, sidewalks, or publicly owned transportation infrastructure. An estimate of the increase in total impervious cover from 1991 to 2008 in the Williamson Creek Watershed alone by Sung et al. (2013) indicated almost 1,400 acres of new impervious cover in this watershed alone.

Available scientific literature on water quality at Barton Springs was reviewed. Barton Springs was selected for several reasons. First, it is the known location of two endangered species, the Barton Springs Salamander (*Eurycea sosorum*) and the Austin Blind Salamander (*Eurycea waterlooensis*); therefore, any changes in water quality at this location have the potential to impact these listed species (for information on the salamanders and other threatened and endangered species in the proposed project area see the *Biological Studies Technical Memorandum*, which is available at the TxDOT-Austin District and Central Texas Regional Mobility Authority (Mobility Authority) offices as well as at www.MoPacSouth.com). Second, Barton Springs has also been a focal point for water quality monitoring in the Austin area. Finally, there is roughly a twenty-year record of water quality data collected at the springs for a wide variety of constituents, many of which are commonly observed in highway runoff.

A USGS three-year water quality study of Barton Springs showed persistent low concentrations of anthropogenic chemicals including atrazine from herbicides, chloroform from drinking water disinfection, and tetrachloroethene, a solvent widely used in dry cleaning and automotive businesses (Mahler et al. 2006). Storm events monitored at major recharging streams resulted in increased concentrations of calcium, sulfate, atrazine, simazine, chloroform, and tetrachloroethene reaching the springs one to two days after recharge. However, concentrations of volatile organic compounds, dissolved trace metals, and pesticides were well below the maximum contaminant levels for drinking water set by the EPA. While contaminant levels spike following storm events, most of the annual contaminate loads emerged from the springs under low flow conditions from water stored in the aquifer. Additionally, none of the anthropogenic chemicals detected in this study are typically present in roadway runoff.

A City of Austin analysis of water quality at Barton Springs showed statistically significant decreases in water quality over time that are potentially related to urbanization in the watershed

(Turner 2000). These included increases in specific conductance, sulfate, turbidity, and total organic carbon trends. Such an increase could be a result of withdrawing water from the aquifer via wells. The proposed project would not result in any withdrawals of groundwater. Some indications in this study pointed to an increase of nitrates, but not of suspended solids, or other common roadway contaminants.

The USGS examined the quality of sediment discharging from Barton Springs (Mahler 2003) and found only minor effects that could be contributed to urbanization. Elevated levels of metals in settled sediments at Barton Springs were attributed to natural geochemistry as opposed to anthropogenic sources. However, they found that concentrations of lead, zinc, and other contaminants in recharging surface streams were several times higher than sediment quality guidelines for the health of benthic biota. One possible reason for that could be storage of contaminated sediments in conduits within the aquifer.

The USGS conducted a study of nitrate concentrations in Barton Springs and its five principal recharging streams: Barton, Williamson, Slaughter, Bear, and Onion Creeks (Mahler et al. 2011). Nitrate levels in these waters during the period 2008 to 2010 were elevated compared to historic levels going back to 1990. The major sources of nitrates in groundwater are runoff from fertilizer use, septic systems, leaking sewer lines, and the dissolution of bedrock.

Impacts to water in cave streams resulting from road construction were documented by Richter (2009). Water sampling in Testudo Tube Cave before and after construction of the extension of Anderson Mill Road to Lime Kiln Road showed an increase in nickel (a trace element in asphalt), calcium, and nitrate/nitrite. While water quality remained good in the cave, continued water monitoring at the site was recommended in order to identify trends with the potential to affect cave fauna. Cave streams are also present in the proposed project area, notably within Blowing Sink Cave, but no water quality data has been published for them. Since the stream in Blowing Sink Cave is much closer to the proposed project than Barton Springs, and since it contains a probable population of the endangered Barton Springs salamander, water quality data for that site would be useful for evaluating past and future impacts.

Hazardous materials spills are a concern for groundwater quality at Barton Springs and within the contributing and recharge zones of the aquifer. Turner and O'Donnell (2004) determined that a gasoline spill affecting Barton Springs from a distance of three miles away could have catastrophic effects on salamander populations if it exceeded 1,650 gallons under normal flow conditions, or 360 gallons under low flow conditions. Hazardous material traps (HMTs) with a capacity of greater than 8,000 gallons are already in place in the proposed project area and would remain in place through the implementation of the proposed project.

Trends in water quality at Barton Springs were evaluated for the MoPac Intersections Environmental Study by Dr. Michael Barrett, P.E., P.G. Barton Springs data were analyzed for temporal trends for a selected list of constituents commonly observed in highway runoff, including solids, heavy metals, and nutrients. TSS was selected as the constituent to represent solids in spring discharge. Suspended solids and settled sediments are both factors cited by USFWS as listing considerations for the Austin blind salamander (USFWS 2013). However, no trend of increasing TSS through time is apparent in the City of Austin online data for Barton Springs. A graph of the observed TSS concentration for the period of record is presented in **Figure 8**. The slope of the regression line shown in this figure is negative, which would indicate that concentrations are actually declining. This improvement in water quality is statistically significant at a 95% confidence level.

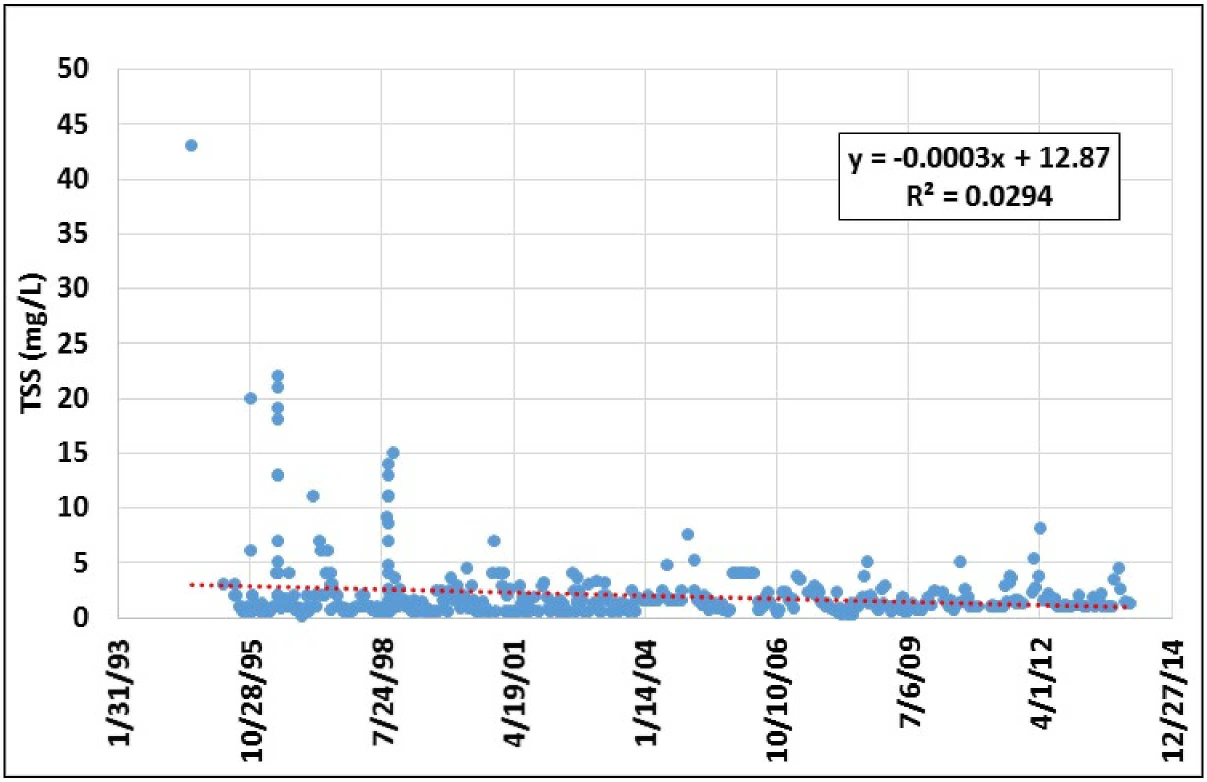

Figure 8: Total Suspended Solids (TSS) Concentrations Observed at Barton Springs (City of Austin 2014)

To evaluate the potential for increases in heavy metal concentrations at the springs, zinc was selected as a representative constituent. It is always found in highway runoff, with a primary source being the zinc used in tire manufacturing during the vulcanization process. Tires are typically 1 to 2 percent zinc. Another source of zinc in urban areas is galvanized metal, which is found in a number of applications including fences, guardrails, metal roofs, and sign posts. Zinc concentrations for the period of record are presented in **Figure 9**. Like TSS, this shows no trend of increasing concentration for zinc, and in fact the slope of the regression line is negative, indicating a gradual improvement in water quality. This apparent improvement is likely an artifact of lowered detection limits achieved for the newer data. It is important to note that no zinc concentrations above the laboratory quantification limit have been observed in over eight years, going back to 2006 and covering more than 40 individual samples. Similar results were found for copper, although those are not presented here.

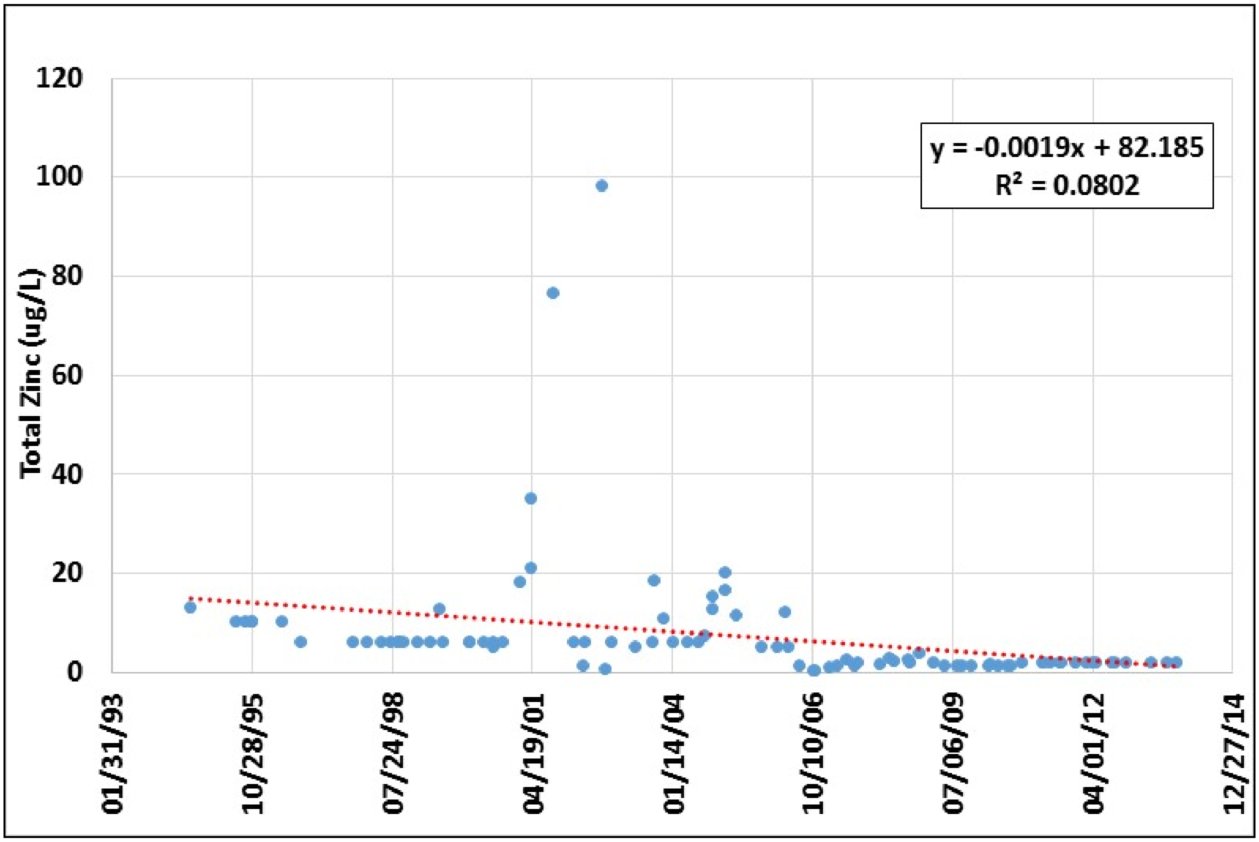

Figure 9: Total Zinc Concentrations Observed at Barton Springs
(City of Austin 2014)

Total phosphorus, nitrate and nitrite were selected to evaluate whether there are temporal trends in nutrient concentrations. The graphs for these two constituents are presented in **Figure 10** and **Figure 11**. Phosphorus shows no trend of increasing concentration at the springs, and the slope of the regression line is negative. However, this change through time is not statistically significant. Nitrate/nitrite shows an increasing concentration, with a significant slope at a 95 percent confidence level. One likely source of increasing nitrates at Barton Springs may be attributed to increases in the number of septic systems installed in the contributing and recharge zones of the Barton Springs segment of the Edwards Aquifer, especially from 1999 to 2010 in the Bear Creek Watershed, to the south of the proposed project area (Herrington et al. 2010). Nitrate is commonly observed in highway runoff with the primary source being the nitrate in rainfall itself. Recent monitoring of highway runoff from conventional asphalt pavement in the Austin area indicates that typical concentrations range from 0.16 to 0.26 mg/L (Eck et al. 2012), which is substantially lower than the concentration observed in Barton Springs discharge (about 1.5 mg/L). Consequently, the impact of additional highway runoff to aquifer recharge would be to counteract the existing trend of increasing concentrations.

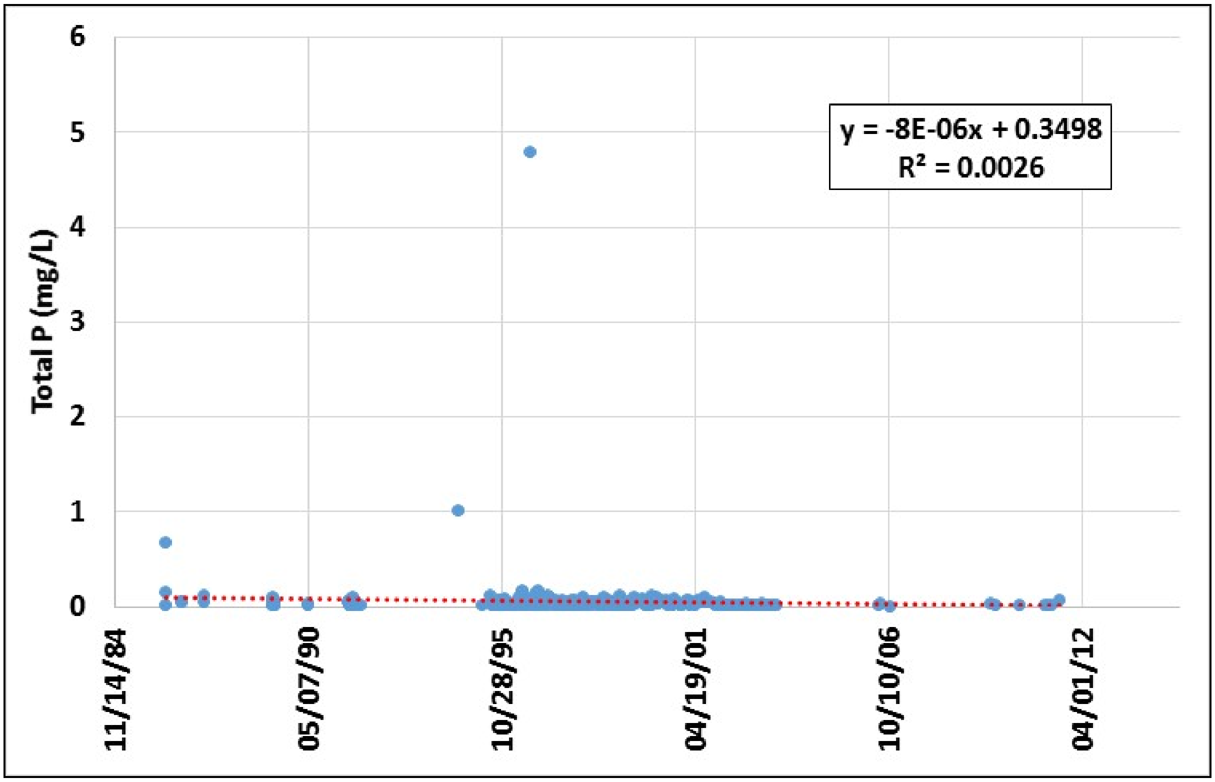

Figure 10: Total Phosphorus Concentrations Observed at Barton Springs
(City of Austin 2014)

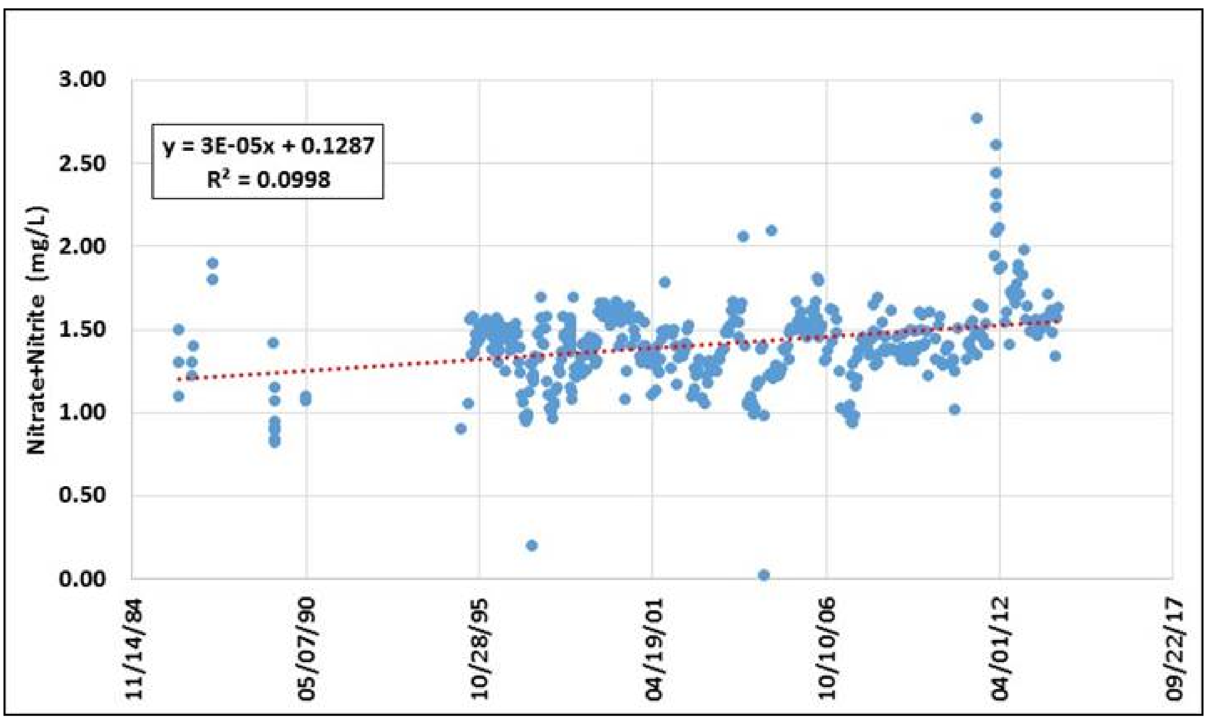

Figure 11: Nitrate/Nitrite Concentrations Observed at Barton Springs
(City of Austin 2014)

1.2.4 Groundwater Quality Regulations

To limit the impacts of land development on water quality, the City of Austin and the TCEQ have adopted requirements for the management of both construction and post-construction stormwater runoff in the recharge zone. The City of Austin requirements have been in place since 1992, while the TCEQ's Edwards Aquifer Protection Rules (30 Texas Administrative Code [TAC] Chapter 213) took effect in 1996, covering the recharge zone and transition zone, and were expanded in 1999 to include the contributing zone. TCEQ and City of Austin requirements prescribe a variety of practices for reducing project impacts on water quality. Water quality monitoring at Barton Springs over this same period of time shows no increases in roadway related contaminants and suspended solids, indicating that water quality regulations have been successful. Efforts by the City of Austin to acquire and manage water quality protection lands in the largely undeveloped southern section of the recharge zone, along with recharge enhancement programs carried out by the Barton Springs/Edwards Aquifer Conservation District may also have helped to mitigate negative effects on groundwater quality.

The proposed project is not subject to the City of Austin requirements, but is subject to TCEQ's Edwards Aquifer Rules, which require Edwards Aquifer Protection Plans (EAPP) to be submitted for all types of development where ground disturbance may have the potential to pollute the Edwards Aquifer and hydrologically connected surface streams (TCEQ 2005). The proposed project will require the completion and implementation of a TCEQ-approved Water Pollution Abatement Plan (WPAP). A WPAP is the type of EAPP that applies to roadway projects that includes temporary and permanent erosion, sedimentation, and water quality controls to reduce impacts to groundwater quality. Post construction runoff controls are required that remove a minimum of 80 percent of the incremental increase in the annual mass loading of total suspended solids (TSS) caused by the project. The WPAP must also include a geologic assessment detailing the current condition of the property and the presence of any sensitive karst features that may serve as a conduit for recharge into the aquifer, which has been completed for the MoPac Intersections Improvements. The WPAP would be developed during plans specifications and engineering (PS&E), submitted to the TCEQ and approved prior to starting construction.

South of Williamson Creek, the Barton Springs Segment is designated as a sole-source aquifer and several cities depend on it for their water. The EPA Sole Source Aquifer Program will review that WPAP to ensure the proposed project would not have adverse effects on the quality of groundwater underlying the project site.

1.2.5 Analysis of Potential Impacts to Groundwater

Groundwater concerns in the Edwards Aquifer can arise over impacts to either quantity or quality of water in the aquifer. Karst aquifers are particularly sensitive to pollution and siltation from runoff, with flow travelling rapidly through cave conduits to the water table. Groundwater quantity may be negatively impacted by the introduction of impervious cover in the form of roadways, parking lots, and buildings. This can limit the amount of direct and diffuse 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. On the other hand, an increase in impervious cover increases the frequency of flow in the creeks, where most of the recharge occurs. An analysis of the effect of land development on Barton Springs discharge was conducted by Barrett and Charbeneau (1996). They found that the greater number of runoff events during normally dry periods would result in little change in the minimum discharge rates.

The proposed improvements would result in minimal impacts to water quantity resulting from the placement of 7.7 acres of new impervious cover. All of the impervious cover would be placed within the existing ROW. Any impacts to water quantity are anticipated to be insignificant and discountable. The proposed improvements would also not require the withdrawal or use of groundwater. If the proposed improvements are not constructed, there would be no anticipated changes to water quantity in the project area.

If the proposed project were not built, the result would be no change in the quality of groundwater. The proposed improvements may negatively impact groundwater quality, primarily during the construction phase, due to increases in contaminants (e.g. TSS, from sediment) in stormwater runoff. If contaminants are mobilized by stormwater they could flow into Slaughter and Williamson creeks and enter the aquifer via faults, fractures, or other unidentified recharge features, or contaminants could also flow directly into caves or sinkholes whose drainage basins intersect the proposed project. One karst feature was identified within the ROW. This feature is a zone of enlarged fractures within the bed of Slaughter Creek with high recharge potential. The proposed project is also mapped within the subsurface drainage basin for Blowing Sink Cave; therefore, any changes in groundwater quality resulting from the project may impact the cave stream in Blowing Sink Cave. Water quality within the subsurface drainage basins for known caves and sinkholes and the fractured bedrock areas of Slaughter Creek should be treated as sensitive areas, especially during the construction phase. Temporary erosion and sedimentation controls should be used to protect these features.

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. When voids are encountered, 30 TAC 213.5(f)(2) rule requires that construction in the vicinity of the void cease. A geologist would evaluate the void and work with the design engineer, if necessary for structural concerns, to 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 in order to evaluate potential species habitat. If habitat for federally listed and endangered karst invertebrates or *Eurycea* salamanders is encountered, there may be an effect on those species (for information on the salamanders and other threatened and endangered species in the proposed project area see the *Biological Studies Technical Memorandum*, which is available at the TxDOT-Austin District and Mobility Authority offices and at www.MoPacSouth.com). Measures would be taken to ensure that there is project-wide awareness and education about the need to report void discoveries and implement protection measures.

The proposed improvements would incorporate a variety of approved practices for managing stormwater runoff during all phases of the project. During construction, TCEQ-approved measures to reduce erosion and maintain sediment on site would be implemented and documented in the SW3P. The erosion control measures could include minimizing the amount of disturbed land, locating potential sources of pollutants away from steep slopes, streams, and any other sensitive areas, stockpiling topsoil for re-vegetation, and stabilizing slopes with blankets or mulches as appropriate. Channels would be stabilized with geotextiles and check dams would be installed as needed to reduce runoff velocities and minimize erosion. Sediment control measures, such as silt fencing, would be installed along the project perimeter and at storm drain inlets. 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. Eight of nine existing water quality treatment facilities consisting of HMTs and vertical sand filter systems would remain in place during construction and future operation. One facility would be relocated and reconstructed as a result of the proposed project. The proposed project would incorporate other permanent TCEQ-approved treatment measures such as vegetated filter strips wherever possible due to their high runoff pollutant removal efficiency. Vegetated filter strips would be used in connection with existing water quality treatment facilities. Any existing HMTs or other structural water quality controls disturbed by the improvements will be repaired or replaced. The proposed improvements would also include four new clay-lined detention basins. These detention basins would mitigate any increase in downstream flooding risks associated with the changes to drainage patterns and increases in impervious cover. Soil amendments would be incorporated into stormwater treatment facilities as necessary to improve vegetation establishment, and to reduce the volume of runoff from the completed project. The proposed drainage and water quality treatment improvements would result in a net improvement in the amount of TSS removed from runoff leaving the project area. The proposed project water quality controls would be designed to meet all current regulatory requirements and ensure compliance with the 1990 Consent Decree and Partial Final Judgment for the original construction of MoPac, with the continued use of HMTs. The project is located over the Edwards Aquifer Recharge Zone and would comply with TCEQ’s Edwards Aquifer Rules.

The proposed project may result in an increased risk of aquifer contamination if there are increases in the number of vehicles carrying hazardous liquids within the project area. HMTs that are already in place along MoPac in the proposed project area are designed to mitigate this risk. These have a capacity of greater than 8,000 gallons and are designed to accommodate a catastrophic spill such as the full capacity of a gasoline tanker truck. Most existing HMTs are equipped with a siphoning device to remove stormwater runoff which may accumulate in the HMT during major rain events. While these could potentially be overwhelmed in the event such a spill occurred during a flood, the existence of these HMTs greatly reduces the probability of a spill reaching the aquifer.

2.0 CONCLUSIONS

2.1 SURFACE WATER IMPACTS

2.1.1 Waters of the U.S. including Wetlands

The proposed project would impact approximately 0.04 acres of potential waters of the U.S. (at Tributary 3 to Slaughter Creek). It is assumed that the placement of temporary or permanent dredge/fill material into potentially jurisdictional waters of the U.S. will be authorized under NWP 14 without a PCN.

2.1.2 Surface Water Quality

It is anticipated that all discharges related to the proposed construction will be covered under the TPDES General Permit. A SW3P will be developed prior to any construction activities in accordance with the guidelines set forth in the General Permit document. A Notice of Intent will be required.

According to the provisions of the TxDOT-TCEQ MOU, coordination with TCEQ is required if all or part of the project drains to an impaired assessment unit that is within five miles of the project and is in the same watershed as the project. The project area crosses and likely drains to an impaired assessment unit (Slaughter Creek) which is within five miles of the project and is in the same watershed as the project. TxDOT initiated coordination with TCEQ, in accordance with 43 TAC 2.23, on May 15, 2015. Coordination was completed on June 12, 2015. Slaughter Creek does not have an EPA-approved TMDL or a TCEQ-approved implementation plan.

In addition to coordination with TCEQ, the proposed improvements and its associated activities will be implemented, operated and maintained using both temporary and permanent BMPs to control the discharge of pollutants from the project site.

Temporary Water Pollution Control Measures: Water quality impacts will be minimized during construction of the proposed project through the implementation of a SW3P. These plans will include structural controls and practices that will be followed throughout the construction of the project to minimize water impacts. Guidance documents, such as TxDOT's *Storm Water Management Guidelines for Construction Activities*, provide a detailed discussion of construction BMPs and additional information on implementation of temporary storm water controls. The controls will include the following:

- Minimize the extent and the duration of disturbed areas. Plan the phases of construction to minimize exposure and use vegetation to stabilize disturbed areas as practicable.
- Apply erosion control practices to minimize the loss of sediment and keep the soil covered and in place as much as possible using temporary or permanent vegetation, erosion control blankets, or various mulch materials. Other practices include diversion structures to channel surface runoff from exposed soils and the use of slope drains where grades may be prone to erosion.
- Apply perimeter controls to minimize the discharge of sediment laden stormwater. This objective relates to using practices that effectively remove sediment from the runoff water and prevent its transport from the site. These controls include silt fences, diversion structures, swales, dikes, sediment traps, rock berms, and vegetative filters.
- Stabilize disturbed areas as quickly as possible after final grade has been attained. Permanent structures, temporary or permanent vegetation, mulch, stabilizing emulsions, or a combination of these measures should be employed as quickly as possible after the land is disturbed.
- Excavation will occur in a carefully considered sequence to avoid closed depressions that could concentrate drainage into accidentally discovered voids. Strict monitoring for void encounters will be maintained throughout the project, and protection measures to prevent surface flow into them will be installed immediately. Permanent protection, if applicable, will be designed to restore groundwater flow in severed conduits to the extent practicable.

Permanent Water Pollution Control Measures: Examples of stormwater pollution mitigation measures include detention ponds, wet ponds, sand filters, vegetative filter strips, and grassed swales. The primary mechanisms making these measures effective in removing pollutants from storm water are detention and filtration. The selection, design, and effectiveness of these measures are highly site dependent, but all have been shown to be effective in treating highway runoff. The type and location of appropriate permanent water pollution control measures will be determined during the final design of the proposed project. These measures will be designed for site-specific conditions.

2.2 GROUNDWATER IMPACTS

The MoPac Intersections project would result in minimal and discountable impacts to water quantity and possible, but negligible impacts to water quality. If the proposed project were not built, there would be no impacts to either water quality or water quantity.

Assessments of historical groundwater quality data and utilization of temporary and permanent stormwater treatment facilities and HMTs during and after construction indicate that this project may have possible, but negligible impacts on groundwater quality. This risk would be mitigated by the incorporation of permanent TCEQ-approved BMPs to protect water quality that are properly maintained throughout the life of the project. The highest risk for negative groundwater impacts is associated with the intersection of voids during excavation during construction. These impacts would be minimized and mitigated through project-wide awareness and contractor education about the need to report void discoveries and implement protection measures.

If voids or water flow are encountered, 30 TAC 213.5(f)(2) requires that construction in the vicinity of the void cease. A geologist will evaluate the void and work with the design engineer, if necessary for structural concerns, to develop a void mitigation plan. The void mitigation plan must be certified by a geologist, submitted to 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 will inspect the site as soon as possible to evaluate potential for species habitat. If habitat for federally-listed endangered species is encountered, there may be an effect on those species. Construction will cease and coordination with USFWS will occur.

The proposed project will require the completion and implementation of a TCEQ-approved WPAP which would authorize discharges over the Edwards Aquifer recharge zone from the project during and after construction.

The proposed project crosses a portion of the Barton Springs Segment of the Edwards Aquifer which is designated as a sole-source aquifer. As such, the EPA Sole Source Aquifer Program will review the TCEQ-approved WPAP to ensure the proposed project will not have adverse effects on the quality of groundwater underlying the project site.

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APPENDIX A – Photographs

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Photograph 1. View of Slaughter Creek. View is to the northeast from under northbound MoPac.

Photograph 2. View of Slaughter Creek. View is to the northwest from under the northbound MoPac.

Photograph 3. View of Tributary 3 of Slaughter Creek. View is to the northwest.

Photograph 4. View of Tributary 3 of Slaughter Creek. View is to the northwest.

Photograph 5. View of Tributary 4 of Slaughter Creek. View is to the west of the northbound MoPac.

Photograph 6. View of Tributary 1 of Danz Creek. View is to the east of the southbound MoPac lanes.

Photograph 7. View of median culvert for Tributary 1 of Danz Creek. View is to the west.

Photograph 8. View of Tributary 1 of Danz Creek. View is to the west of the northbound MoPac lanes.