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:

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March 16, 2017

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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

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

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

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.

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.

Appendix A: Notice of Activity over the Contributing Zone; and Request of Agreement

Texas Department of Transportation
P.O. DRAWER 15426 • AUSTIN, TEXAS 78761-5426 • (512) 832-7000

June 26, 2013

Texas Commission on Environmental Quality
Region 11
Edwards Program
12100 Park 35 Circle, Bldg. A, Rm. 179
Austin, Texas 78753

ATTN: Kevin Smith, P.E.

RE: Notice of Activity over the Contributing Zone; and Request of Agreement

Dear Kevin:

This notice of upcoming activity is within the vicinity just east of the US 290 and SH 71 split in Travis County. Specifically, an area as outlined in the attachment. Within the boundary shown, there are abandoned parking lots, building foundations and driveways. For years, the remnants of these structures have provided a hard flat surface that was useful for stockpiling road materials and storing TxDOT maintenance equipment.

Recently, TxDOT has received complaints about the appearance of this storage use area. TxDOT also confirms that illegal dumping occurs beyond these paved areas. The pavement fosters clandestine trespass by providing access to areas hidden from view. TxDOT has promised to clear the storage area, remove the pavement and concrete, and restrict unauthorized access. Before and during the process of obliterating and removing these materials, suitable temporary controls will be appropriately placed for the prevention of sediment loss. Then, after re-grading the exposed soil, the area will be seeded for vegetative cover.

The total area is just at the 5 acre threshold for Contributing Zone disturbance, (est. 220K s.f.). And since this activity is demolition and revegetation only, TxDOT is seeking Exemption status for the action.

This request for agreement also extends to the upcoming US 71 and US 290 construction in this same area. The full reconstruction project at the "Y" will not occur soon, but is imminent. TxDOT is seeking TCEQ acknowledgment that the 5 acres of impervious cover soon to be removed, can still be considered "existing conditions" of impervious cover when evaluating the TSS reduction in the forthcoming CZAP.

The department respectfully requests your balanced consideration of both the administration of the Edwards Rules as well as TxDOT's responsibility to provide this public service. The demolition needs to commence soon. A timely response would be greatly appreciated.

If any questions or further clarifications are needed, please contact either me, or Mr. Ben Engelhardt, the South Travis Area Engineer. His contact address: 9725 S. IH 35 Austin, TX. 78744 or, (512) 292-2401 or, ben.engelhardt@txdot.gov).

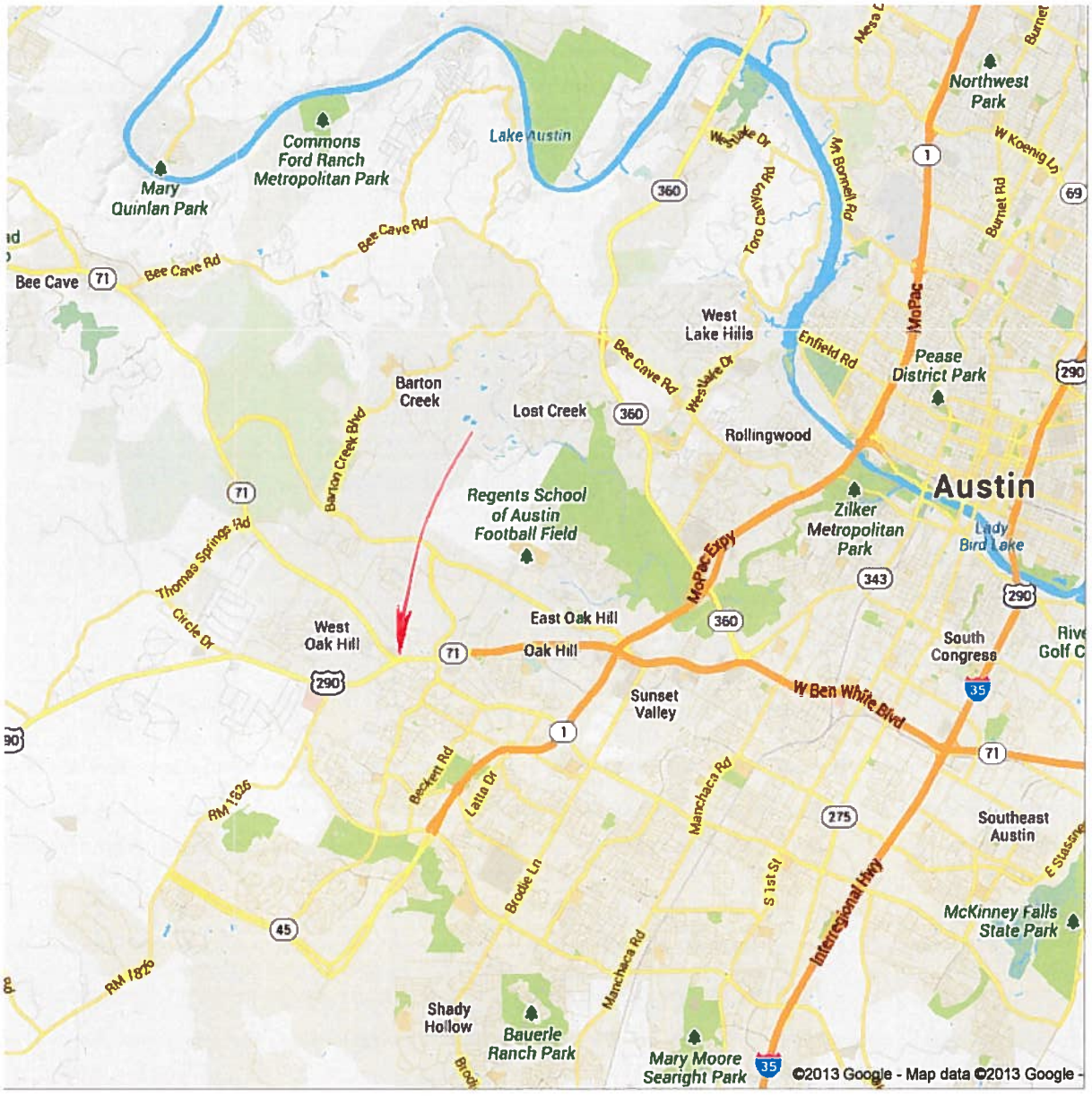
Sincerely,

J. Gary Lantrip, P.G., P.E.
Austin District, TxDOT

Attachment: location map and layout

Google

Location of;
US 290 @ SH 71 (the "Y")



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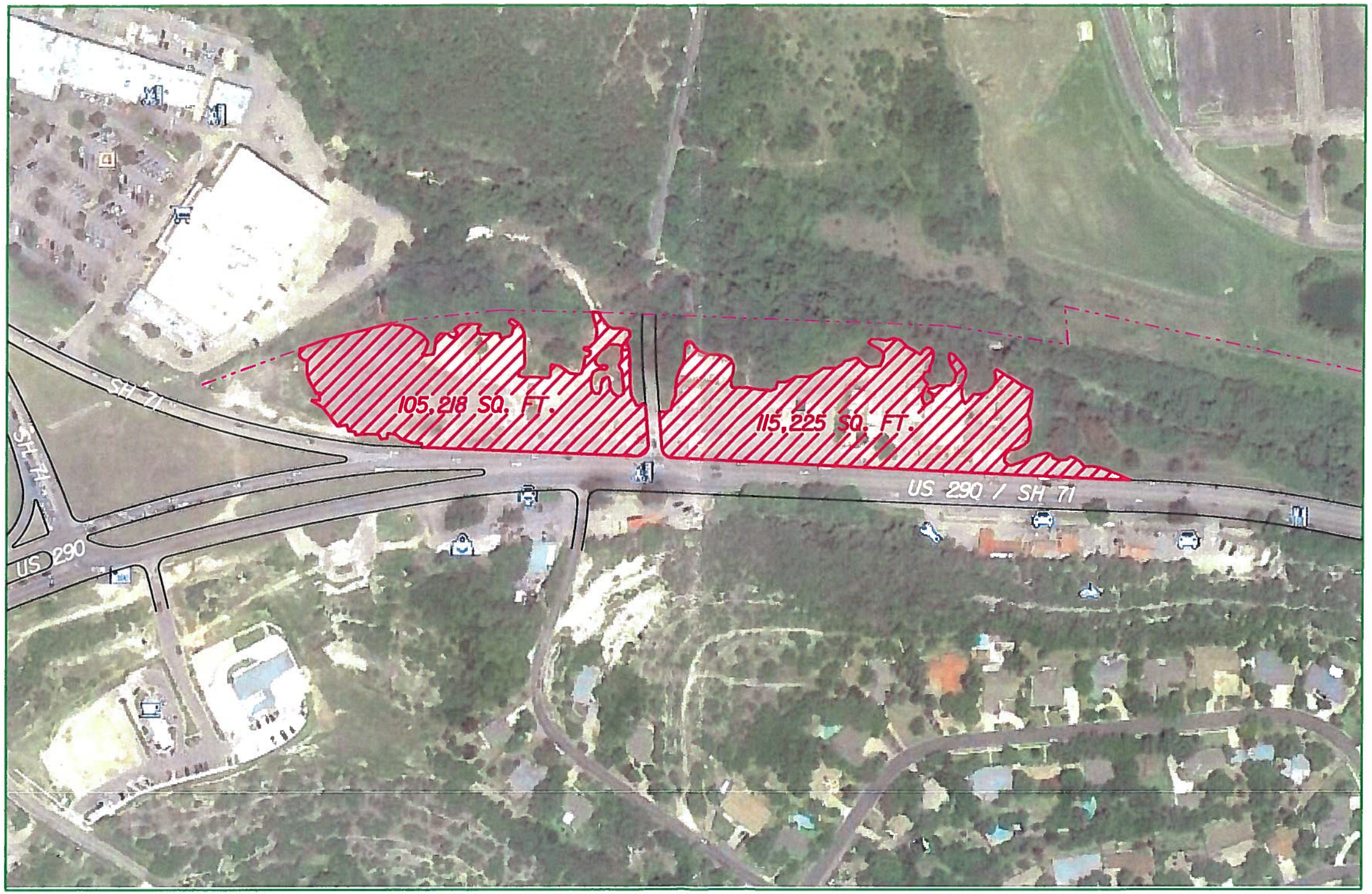
DATE: 02-May-13 07:14



105,218 SQ. FT.
115,225 SQ. FT.
220,443 SQ. FT.

5.06 ac.)

US 290

IMPERVIOUS COVER

SCALE : 1" = 200'

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SHEET 1 OF 1

FED. RD. DIV. NO.	FEDERAL AID PROJECT NO.		SHEET NO.
6			
STATE	STATE DIST. NO.	COUNTY	
TEXAS	14	TRAVIS	
CONT.	SECT.	JOB	HIGHWAY NO.
0113	08		US 290

Appendix B: EPA Sole Source Aquifer Map

WILLIAMSON CREEK

SH 71

FEMA ZONE AE

PROJECT LIMITS

SCENIC BROOK TRIBUTARY

US 290

EDWARDS AQUIFER II (AUSTIN AREA)
SOLE SOURCE AQUIFER
STREAMFLOW SOURCE ZONE

WHEELER BRANCH

EDWARDS AQUIFER CONTRIBUTING ZONE

EDWARDS AQUIFER RECHARGE ZONE

OAK HILL PARKWAY
EPA SOLE SOURCE AQUIFER ZONE EXHIBIT

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Appendix C: Existing Impervious Cover Exhibit

LEGEND

- PROJECT AREA
- EXIST R.O.W.
- PROP R.O.W.
- CONSTRUCTION ESMT
- EXIST E.O.P.
- EXIST IMPERVIOUS COVER
- EXIST PFC
- FEMA ZONE AE

Total Existing Impervious Cover (ac)	74.90
Total Existing PFC (ac)	18.49

OAK HILL PARKWAY
EXISTING IMPERVIOUS COVER
ALTERNATIVES A AND C

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Total Existing Impervious Cover (ac)	74.90
Total Existing PFC (ac)	18.49

OAK HILL PARKWAY
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ALTERNATIVES A AND C

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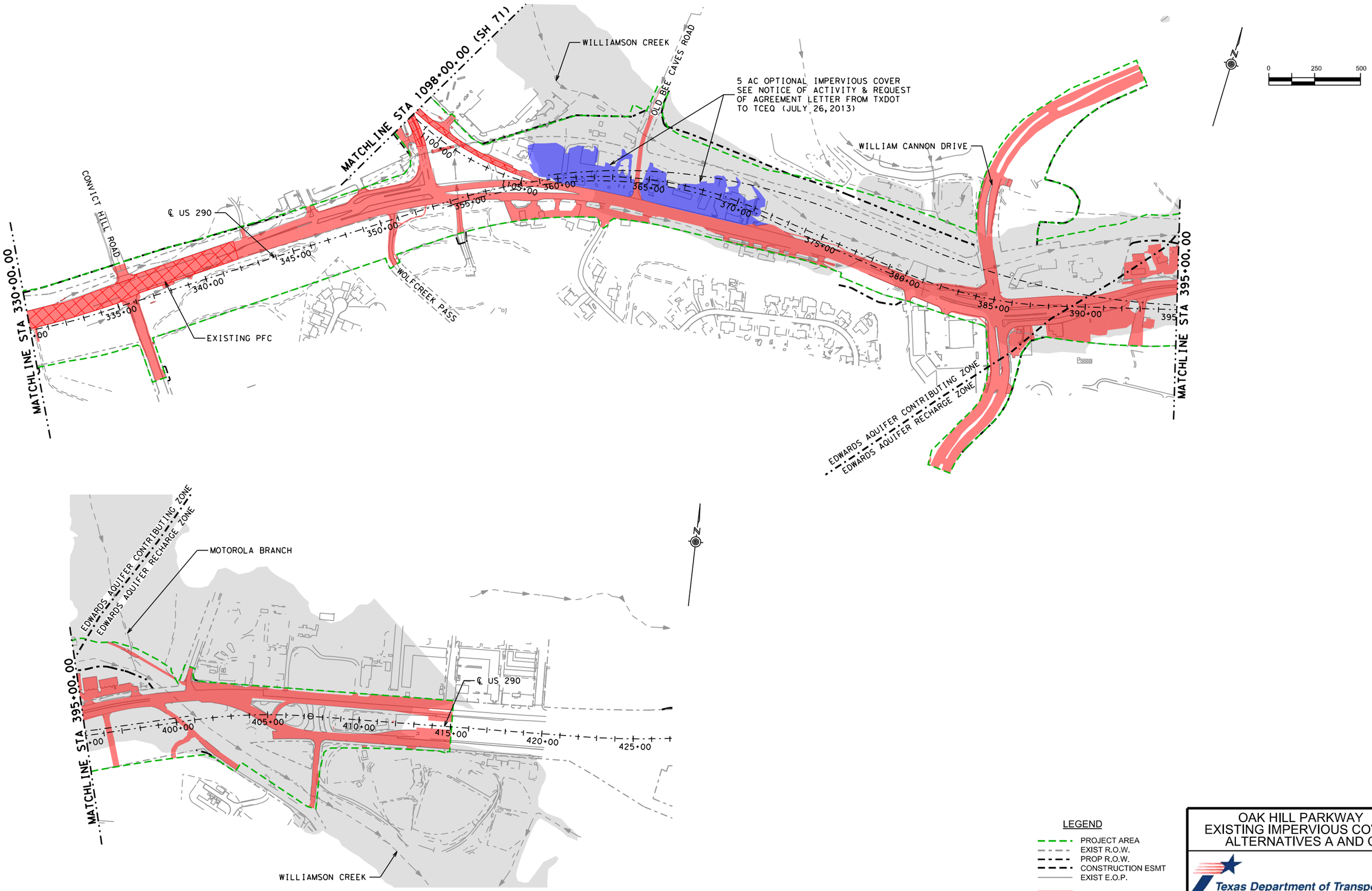

Total Existing Impervious Cover (ac)	74.90
Total Existing PFC (ac)	18.49

LEGEND

- PROJECT AREA
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OAK HILL PARKWAY
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ALTERNATIVES A AND C

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Appendix D: Proposed Impervious Cover - Alternative A

LEGEND

- PROJECT AREA
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- PROP R.O.W.
- CONSTRUCTION ESMT
- EXIST E.O.P.
- PROP E.O.P.
- PROP IMPERVIOUS COVER
- FEMA ZONE AE

Total Project Area (ac)	245.06
Total Proposed Impervious Cover Alt A (ac)	148.89

OAK HILL PARKWAY
PROPOSED IMPERVIOUS COVER
ALTERNATIVE A

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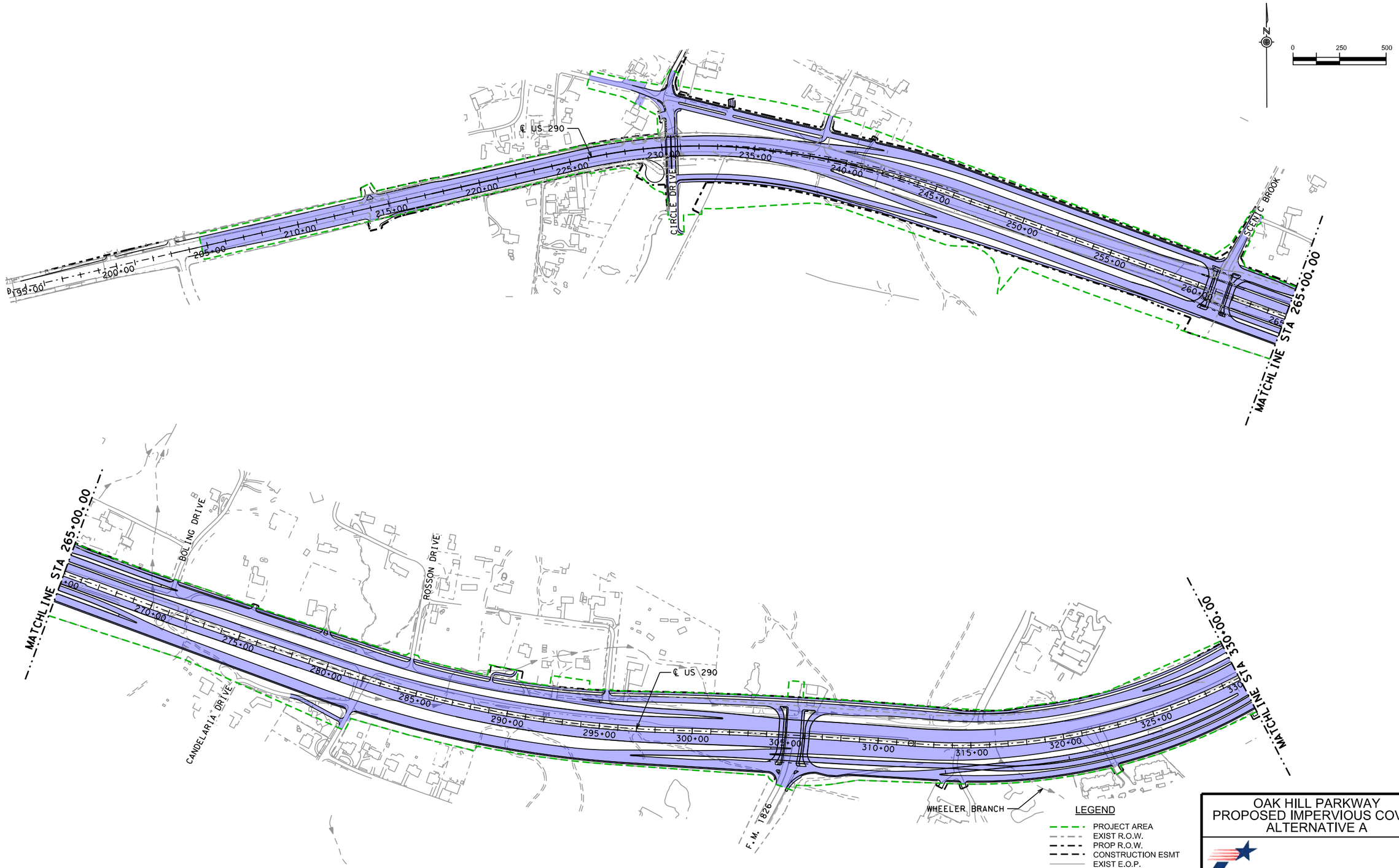

LEGEND

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- EXIST E.O.P.
- PROP E.O.P.
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- FEMA ZONE AE

Total Project Area (ac)	245.06
Total Proposed Impervious Cover Alt A (ac)	148.89

OAK HILL PARKWAY
PROPOSED IMPERVIOUS COVER
ALTERNATIVE A

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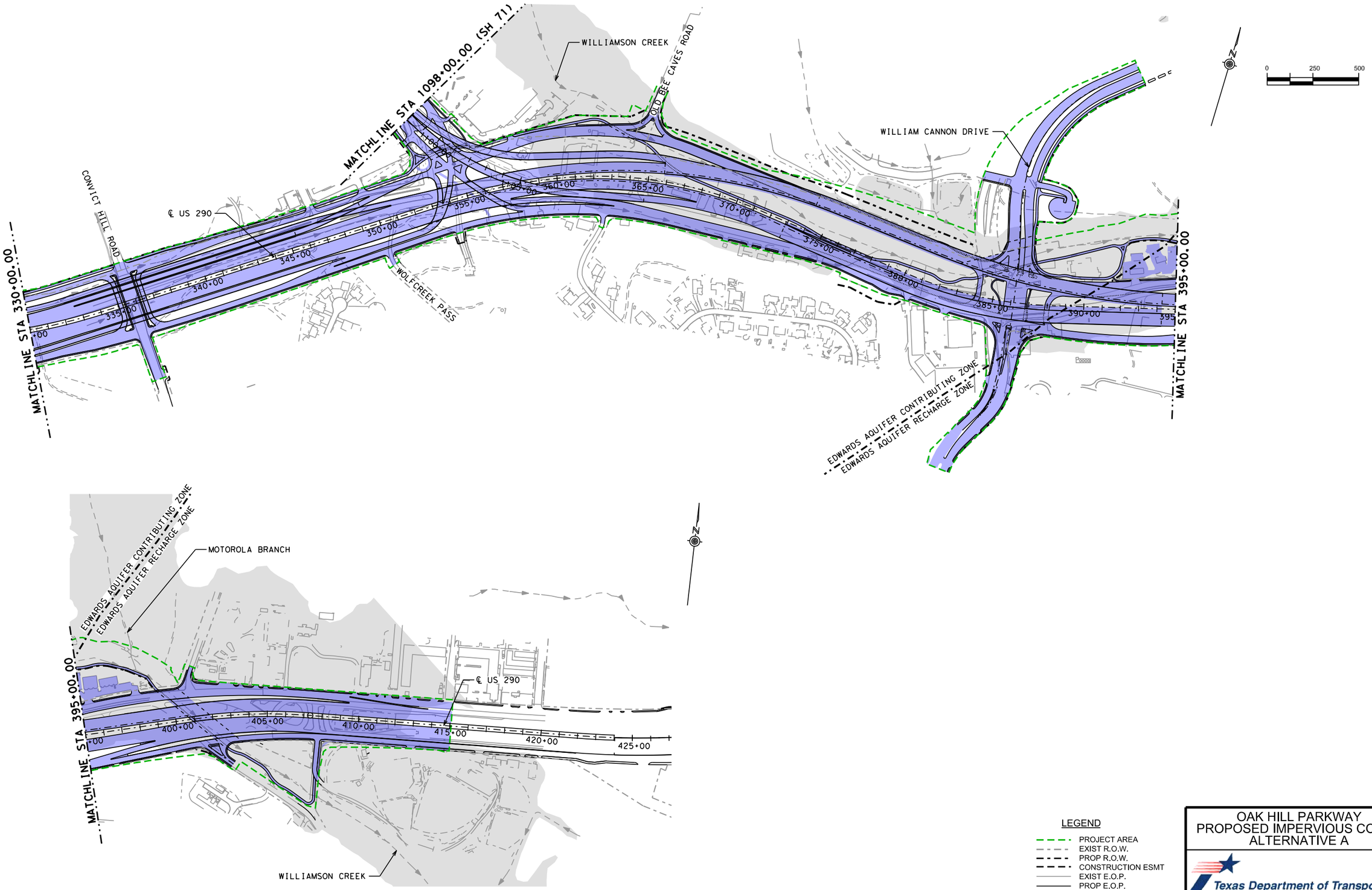

Total Project Area (ac)	245.06
Total Proposed Impervious Cover Alt A (ac)	148.89

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OAK HILL PARKWAY
PROPOSED IMPERVIOUS COVER
ALTERNATIVE A

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Appendix E: Proposed Impervious Cover - Alternative C

LEGEND

- PROJECT AREA
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- PROP R.O.W.
- CONSTRUCTION ESMT
- EXIST E.O.P.
- PROP E.O.P.
- PROP IMPERVIOUS COVER
- FEMA ZONE AE

Total Project Area (ac)	245.06
Total Proposed Impervious Cover Alt C (ac)	148.54

OAK HILL PARKWAY
PROPOSED IMPERVIOUS COVER
ALTERNATIVE C

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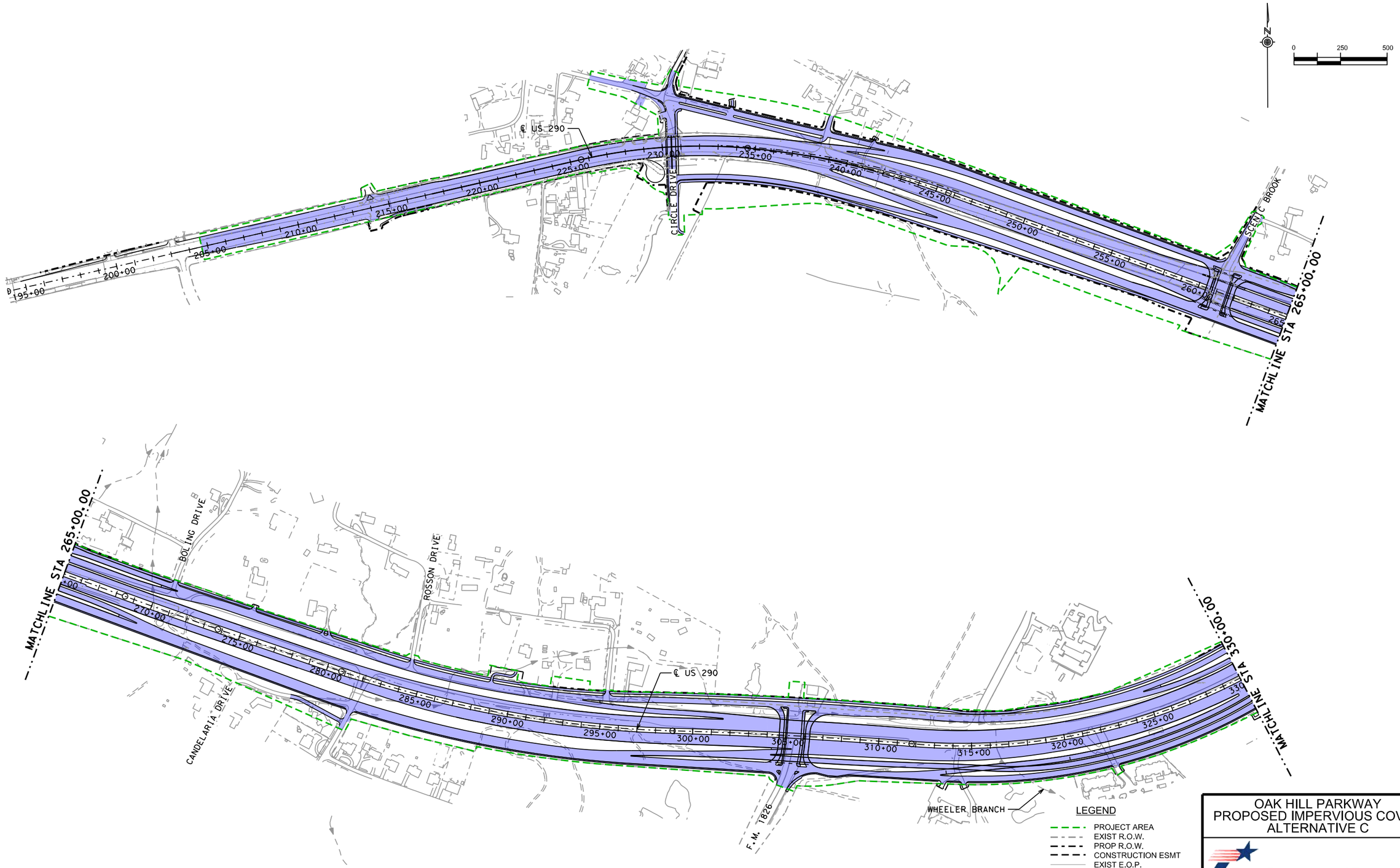

Total Project Area (ac)	245.06
Total Proposed Impervious Cover Alt C (ac)	148.54

LEGEND

- PROJECT AREA
- EXIST R.O.W.
- PROP R.O.W.
- CONSTRUCTION ESMT
- EXIST E.O.P.
- PROP E.O.P.
- PROP IMPERVIOUS COVER
- FEMA ZONE AE

OAK HILL PARKWAY
PROPOSED IMPERVIOUS COVER
ALTERNATIVE C

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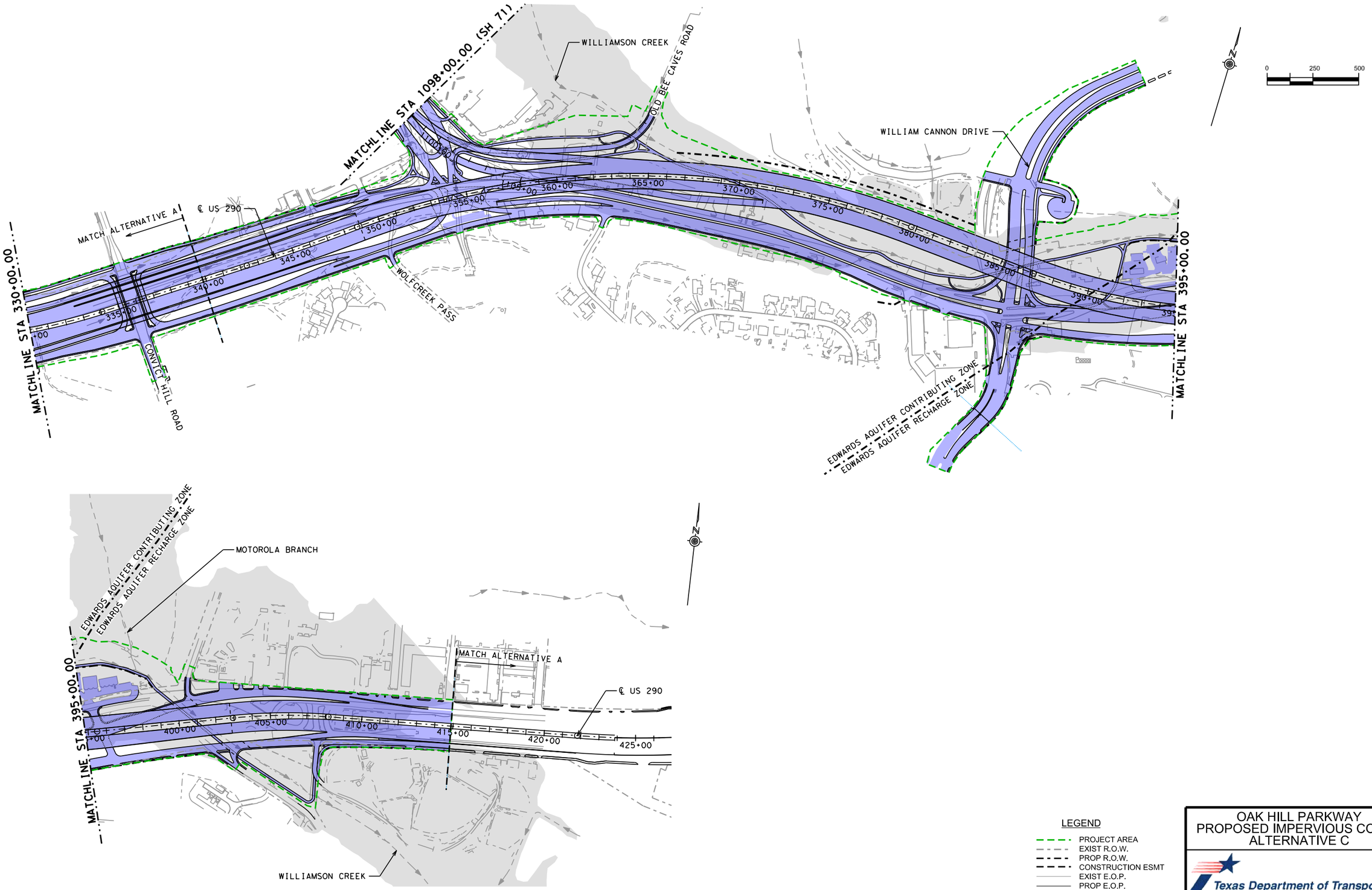

Total Project Area (ac)	245.06
Total Proposed Impervious Cover Alt C (ac)	148.54

LEGEND

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OAK HILL PARKWAY
PROPOSED IMPERVIOUS COVER
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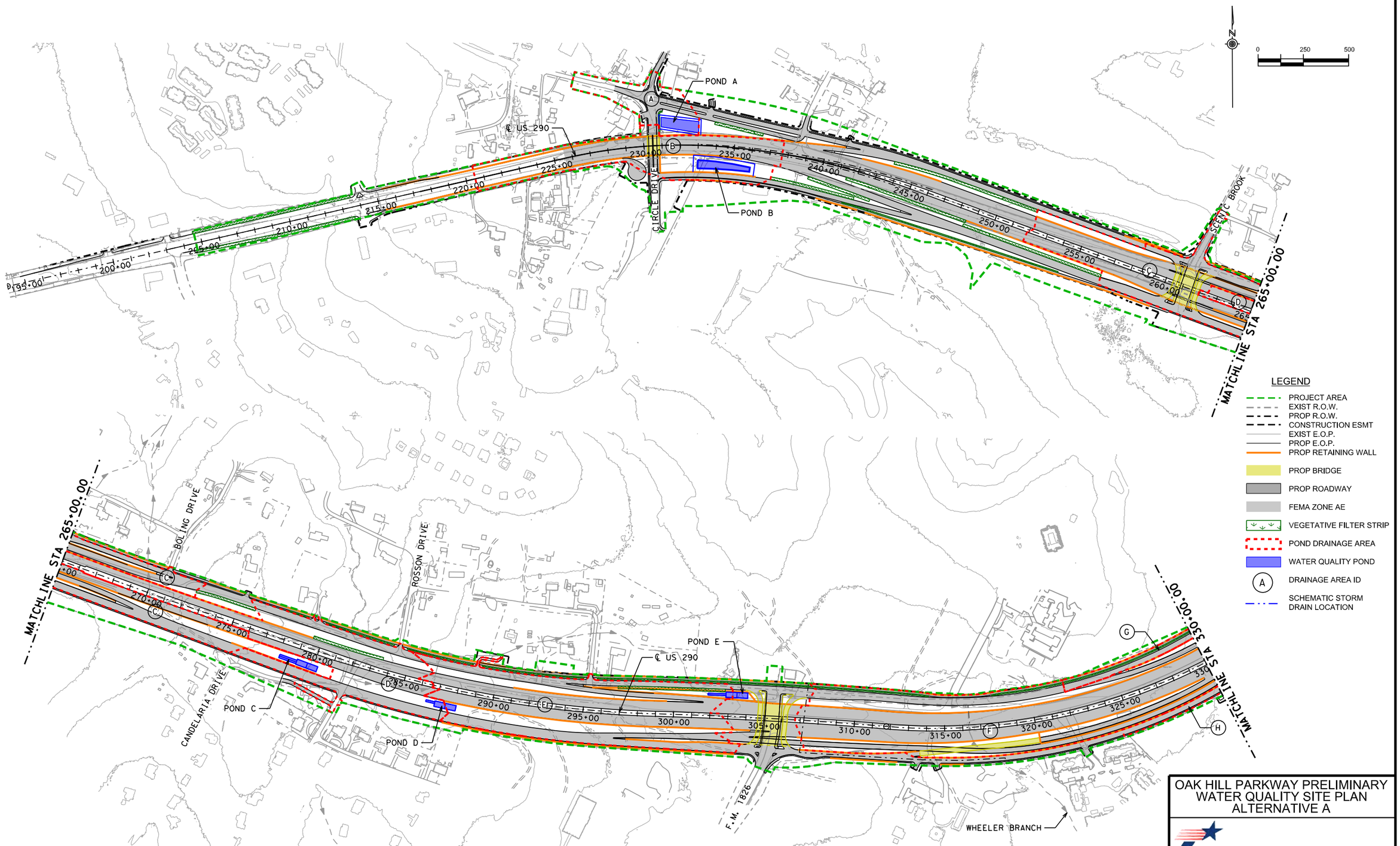
Appendix F: Preliminary Water Quality Site Plan – Alternative A



OAK HILL PARKWAY PRELIMINARY WATER QUALITY SITE PLAN ALTERNATIVE A

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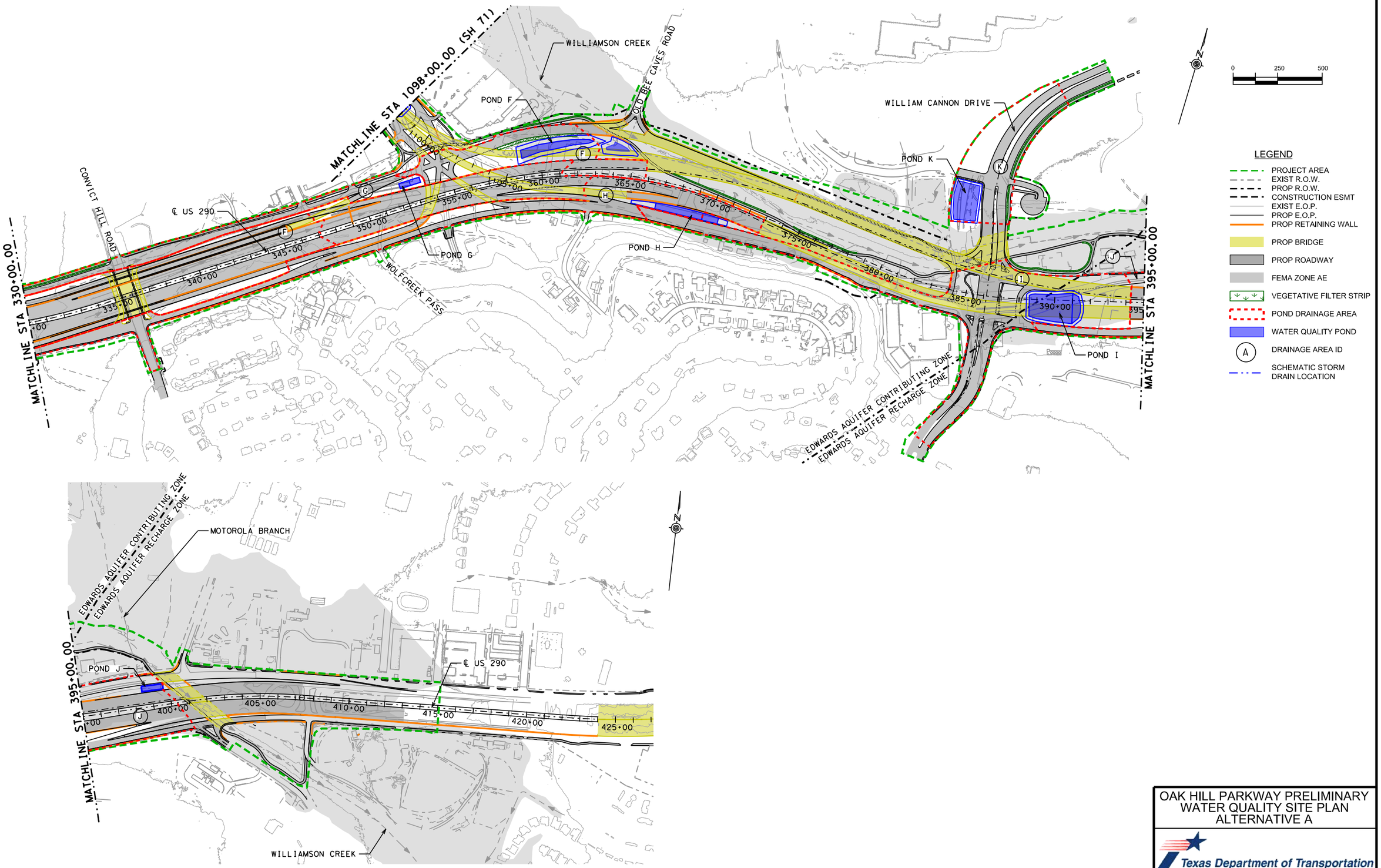

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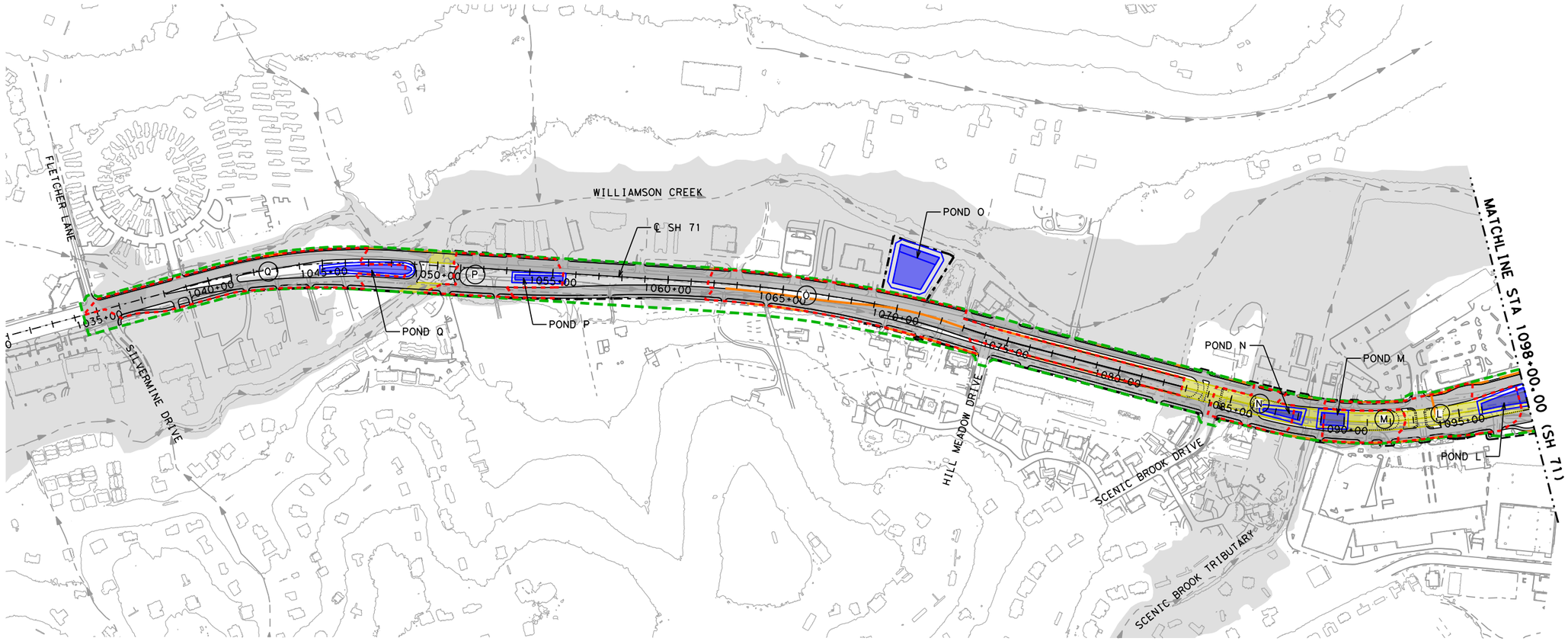

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- POND DRAINAGE AREA
- WATER QUALITY POND
- (A) DRAINAGE AREA ID
- SCHEMATIC STORM DRAIN LOCATION

OAK HILL PARKWAY PRELIMINARY WATER QUALITY SITE PLAN ALTERNATIVE A

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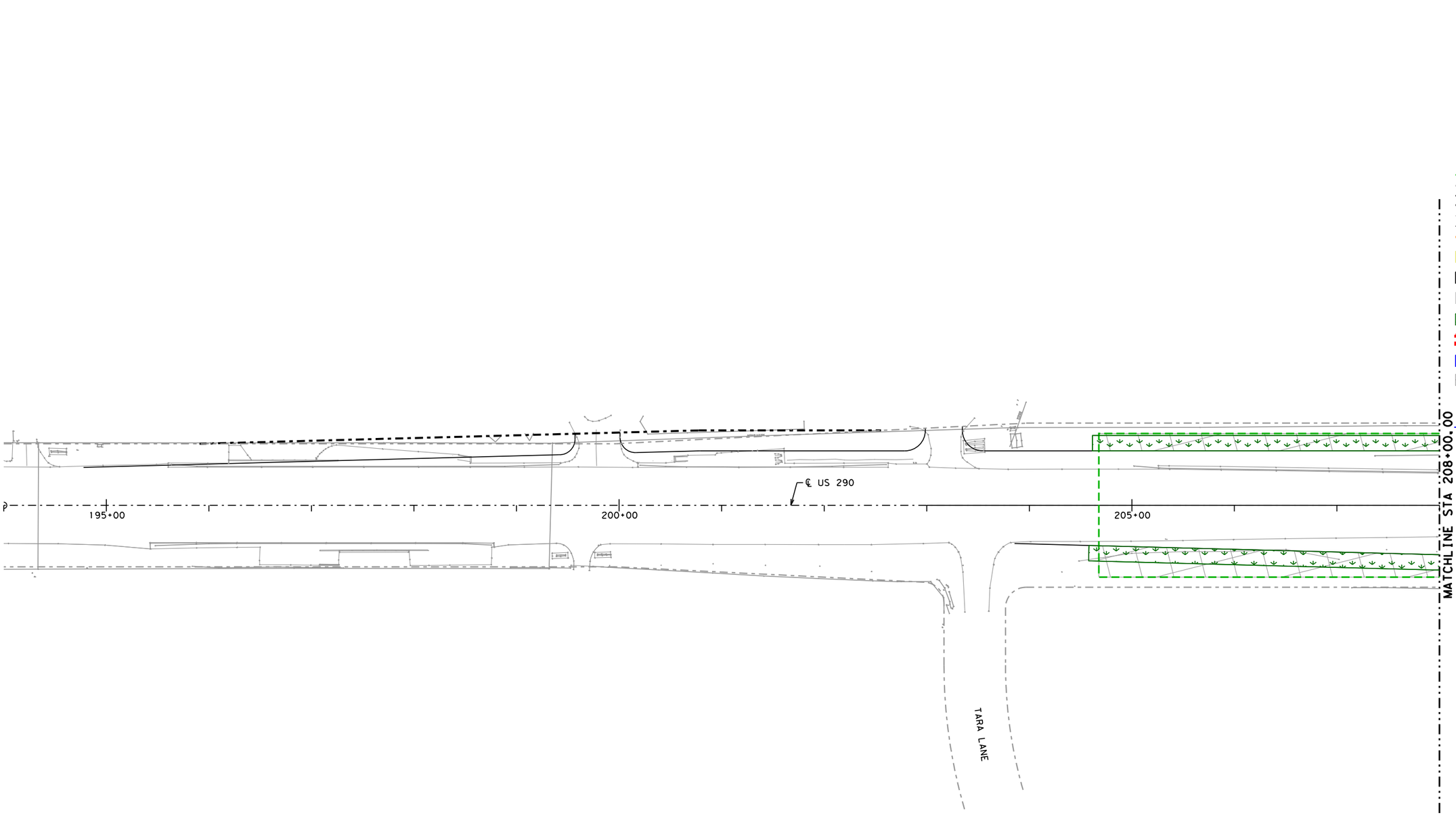

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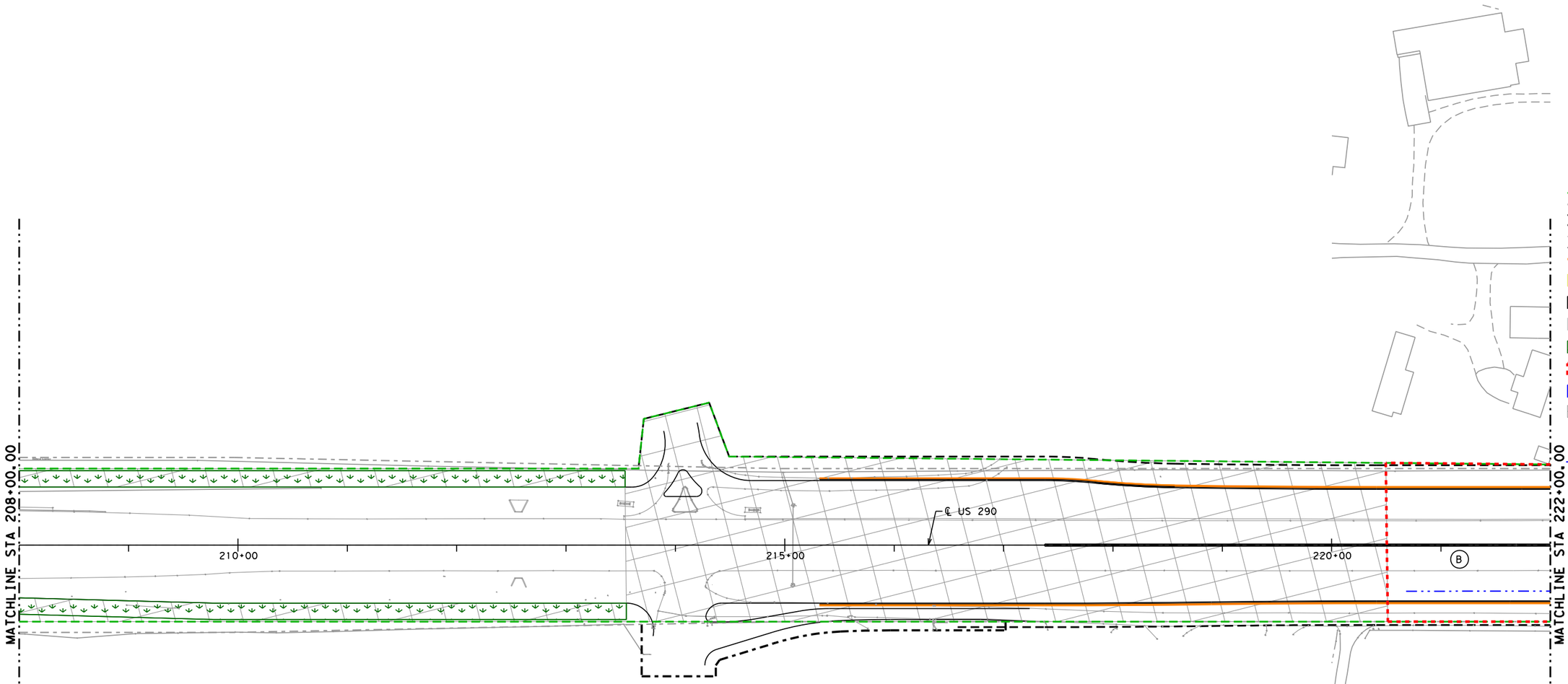

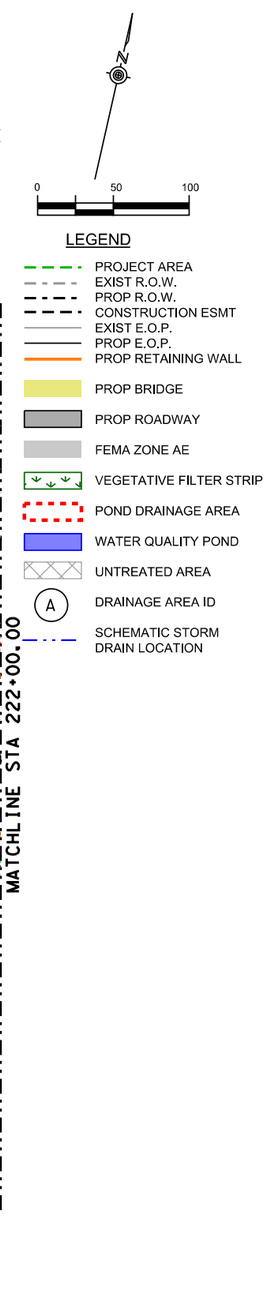

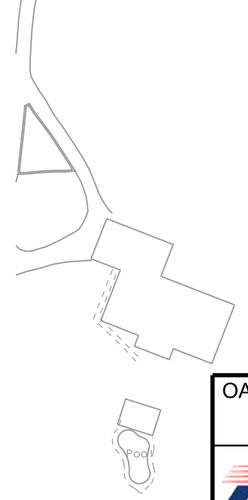

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CIRCLE DR

Gate

Butane Tank

A

B

SPLITTER BOX

POND A OUTFALL

POND A
BIORETENTION POND

POND B OUTFALL

SPLITTER BOX

POND B
EXTENDED DETENTION

℄ US 290

S VIEW RD

MATCHLINE STA 222+00.00

MATCHLINE STA 236+00.00

225+00

230+00

235+00

10+00

15+00

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N

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℄ US 290

℄ US 290 WB

℄ US 290 EB

240+00

240+00

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245+00

245+00

245+00

S 69° 36' 06.44" E

250

B

Gate

POND B OUTFALL

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LEGEND

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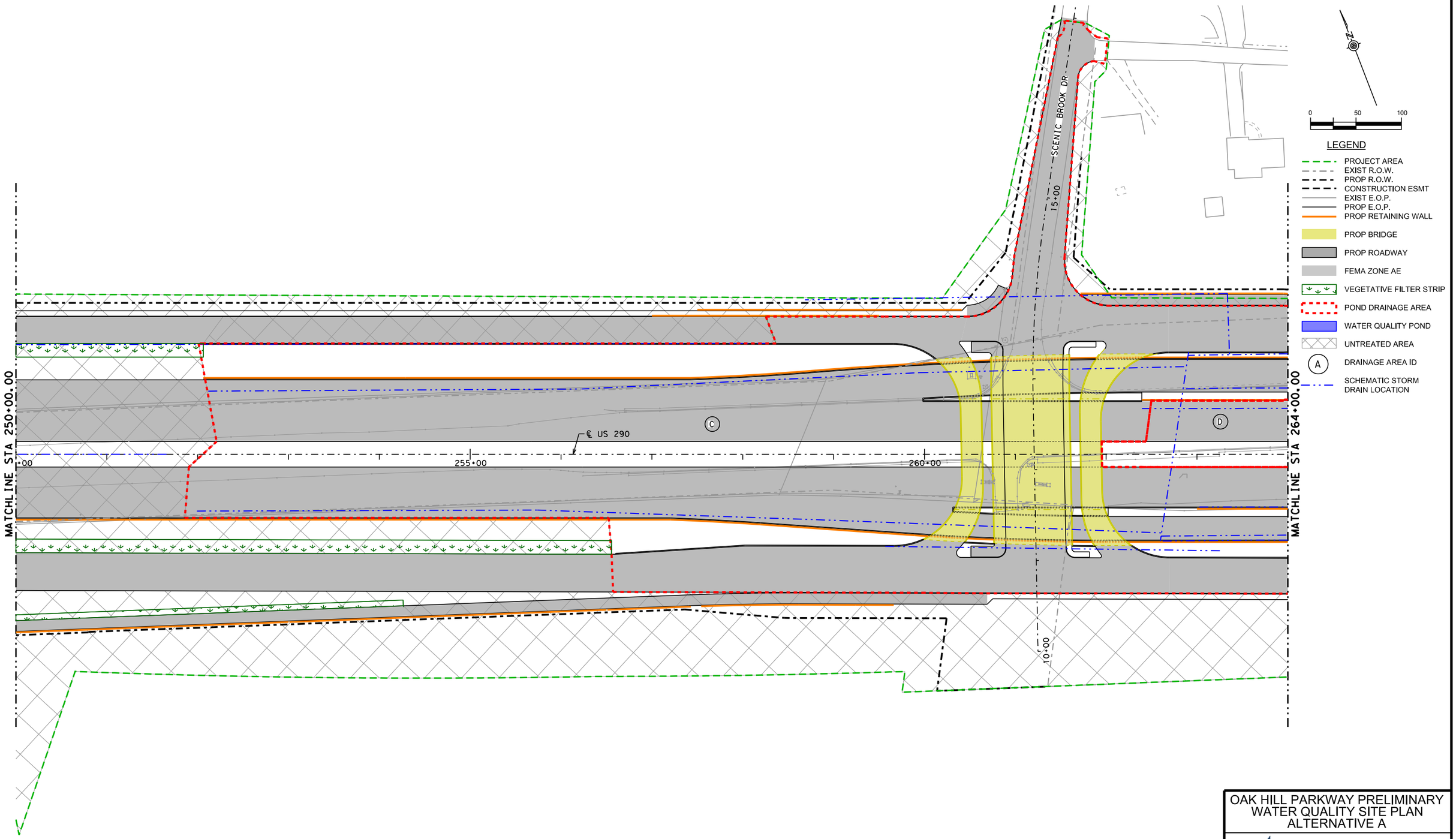

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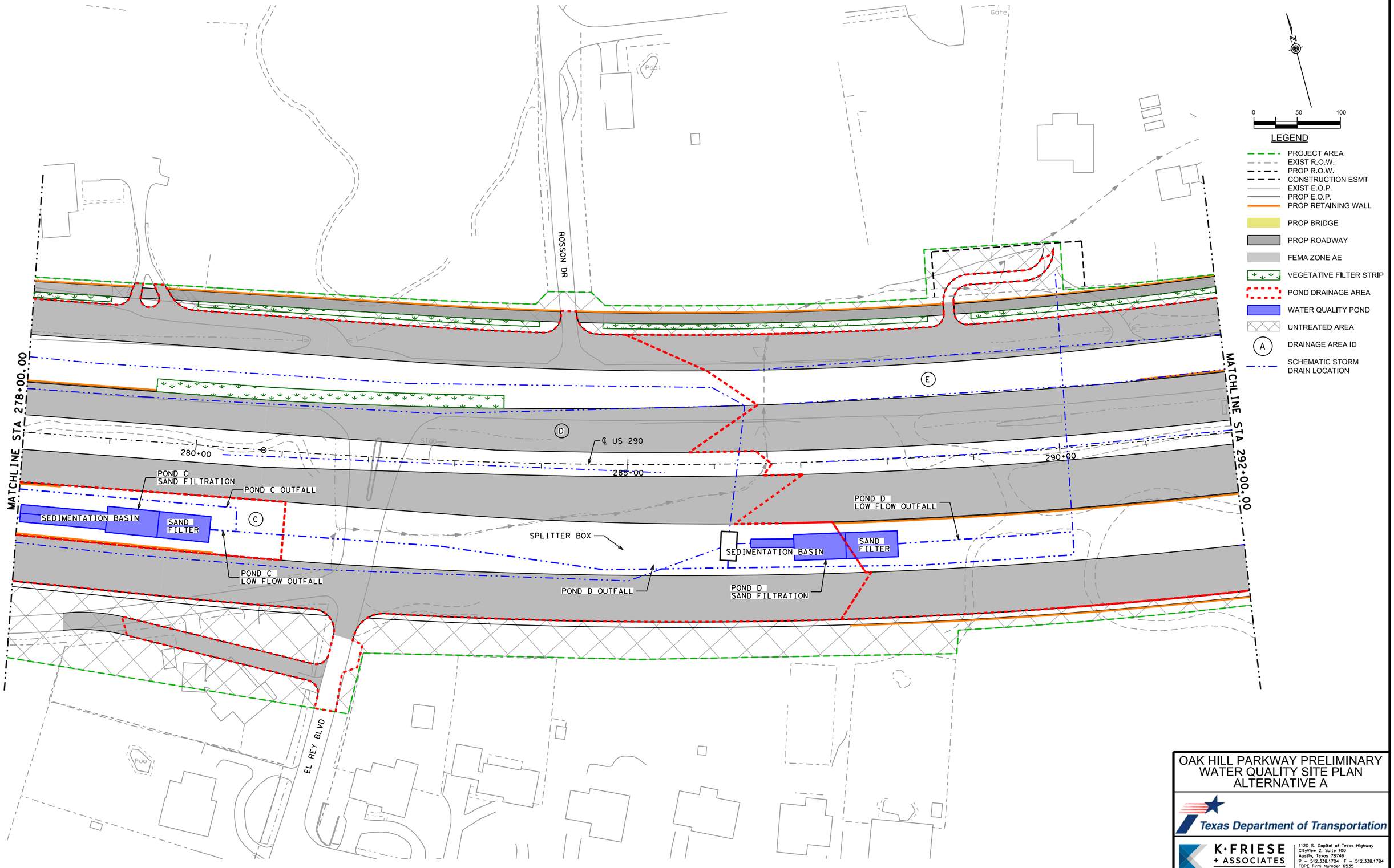

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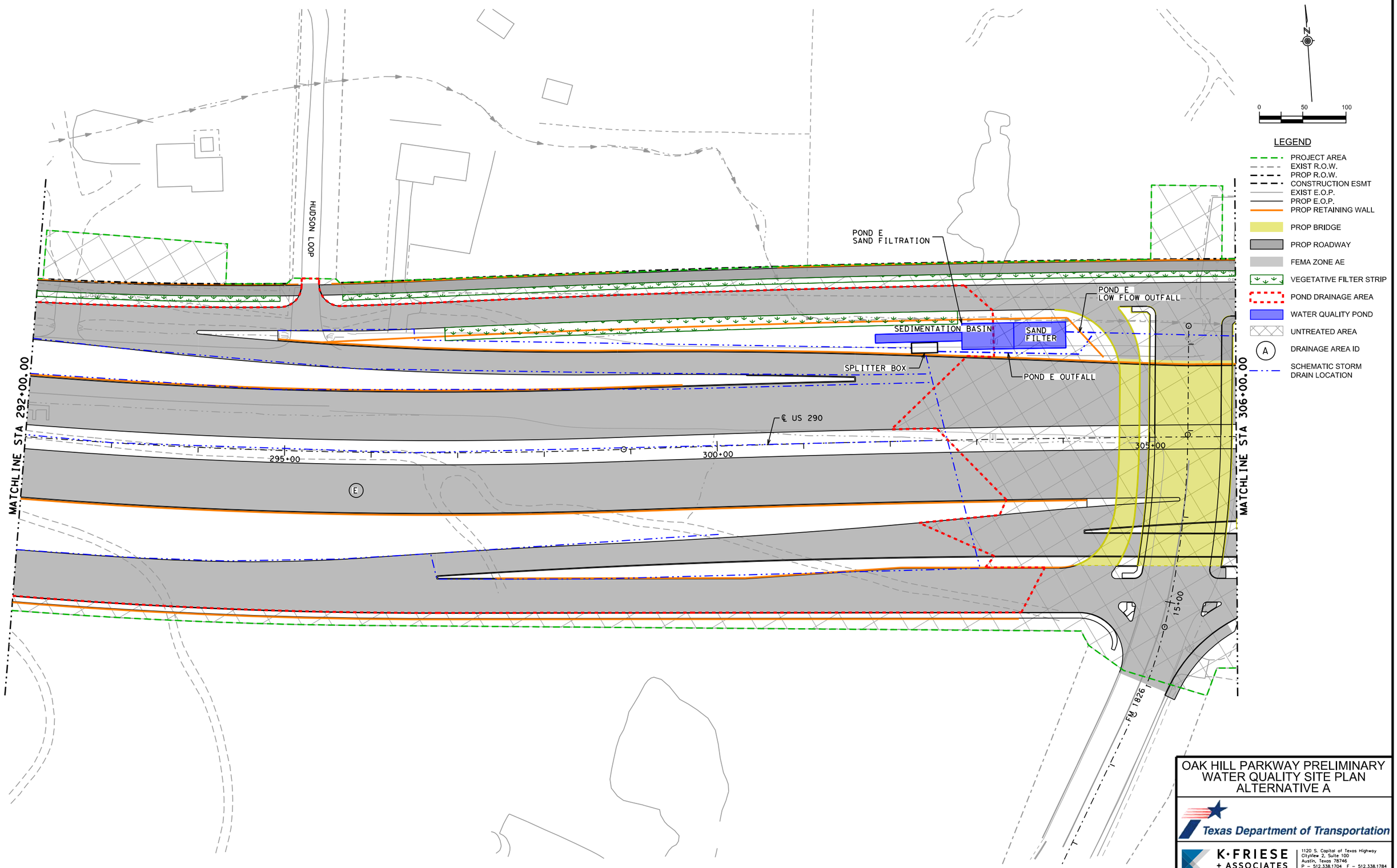

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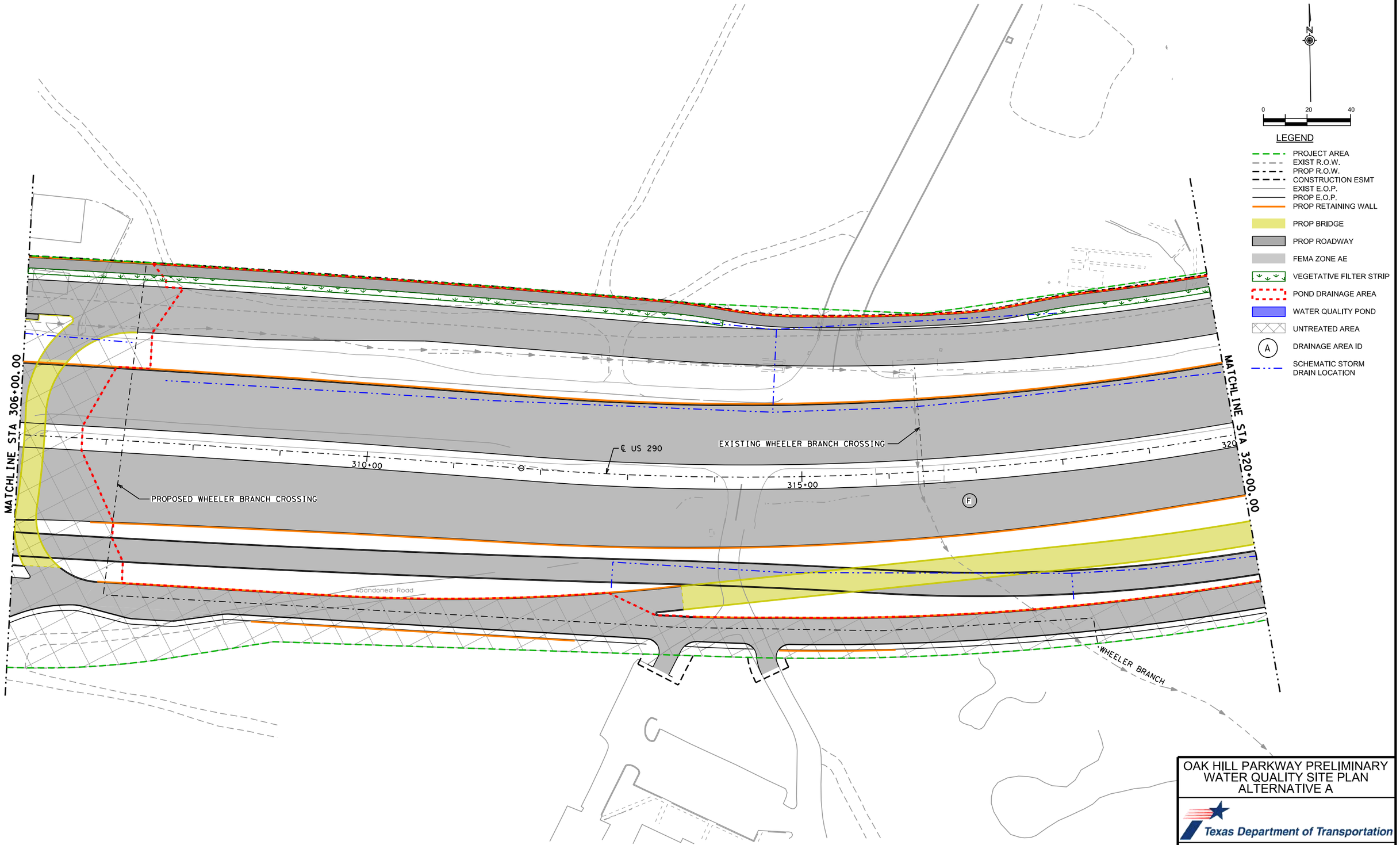

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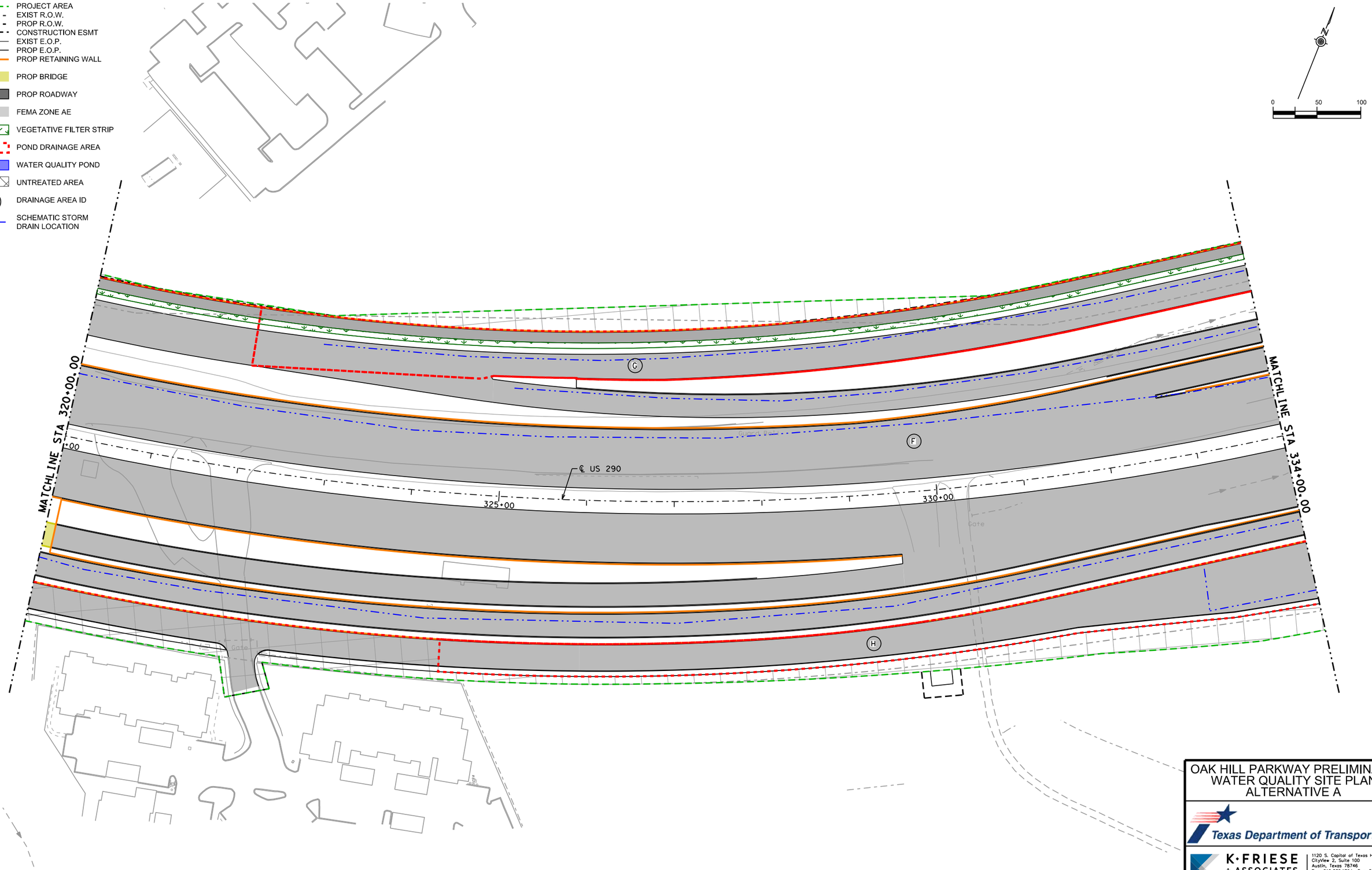

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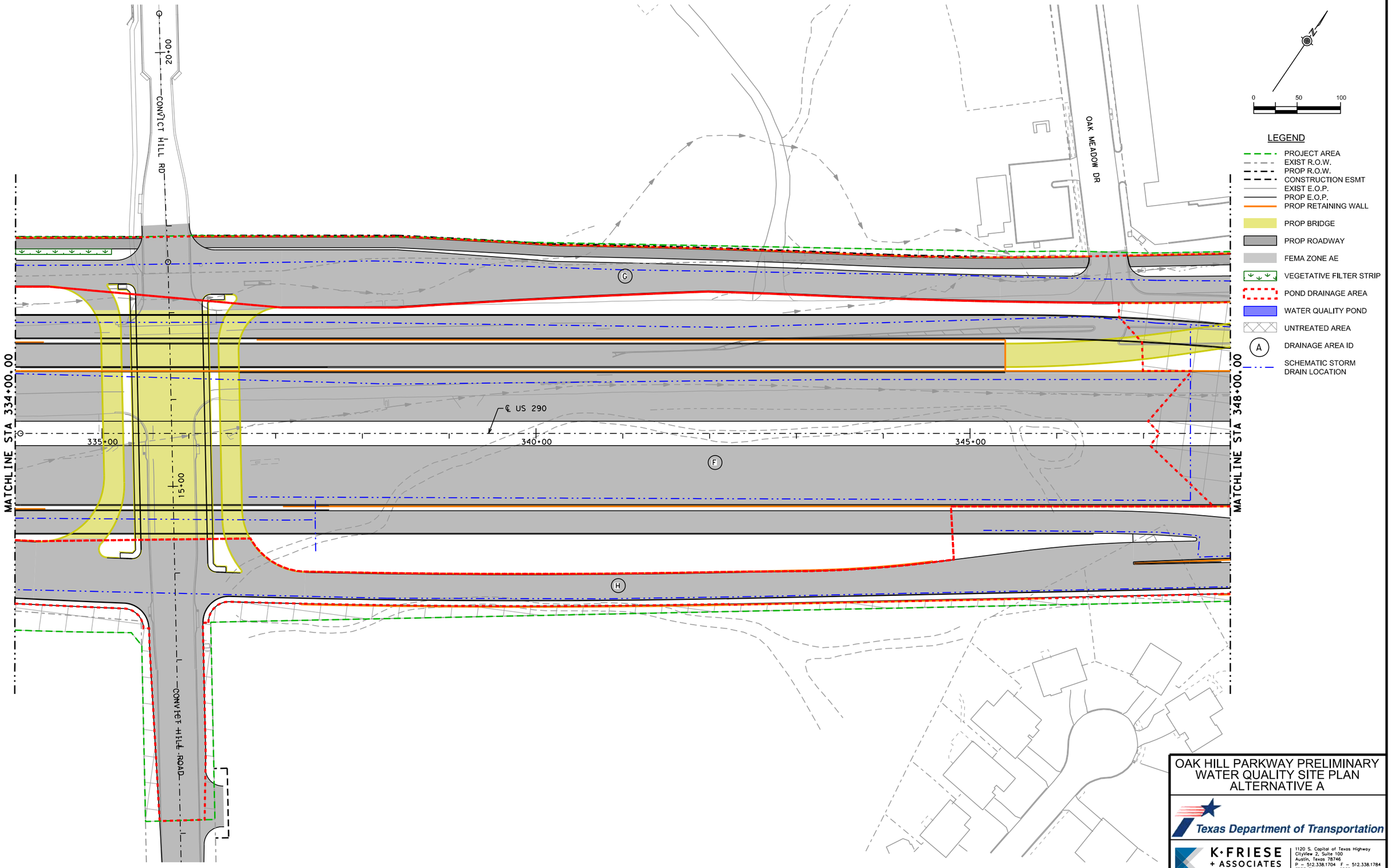

OAK HILL PARKWAY PRELIMINARY
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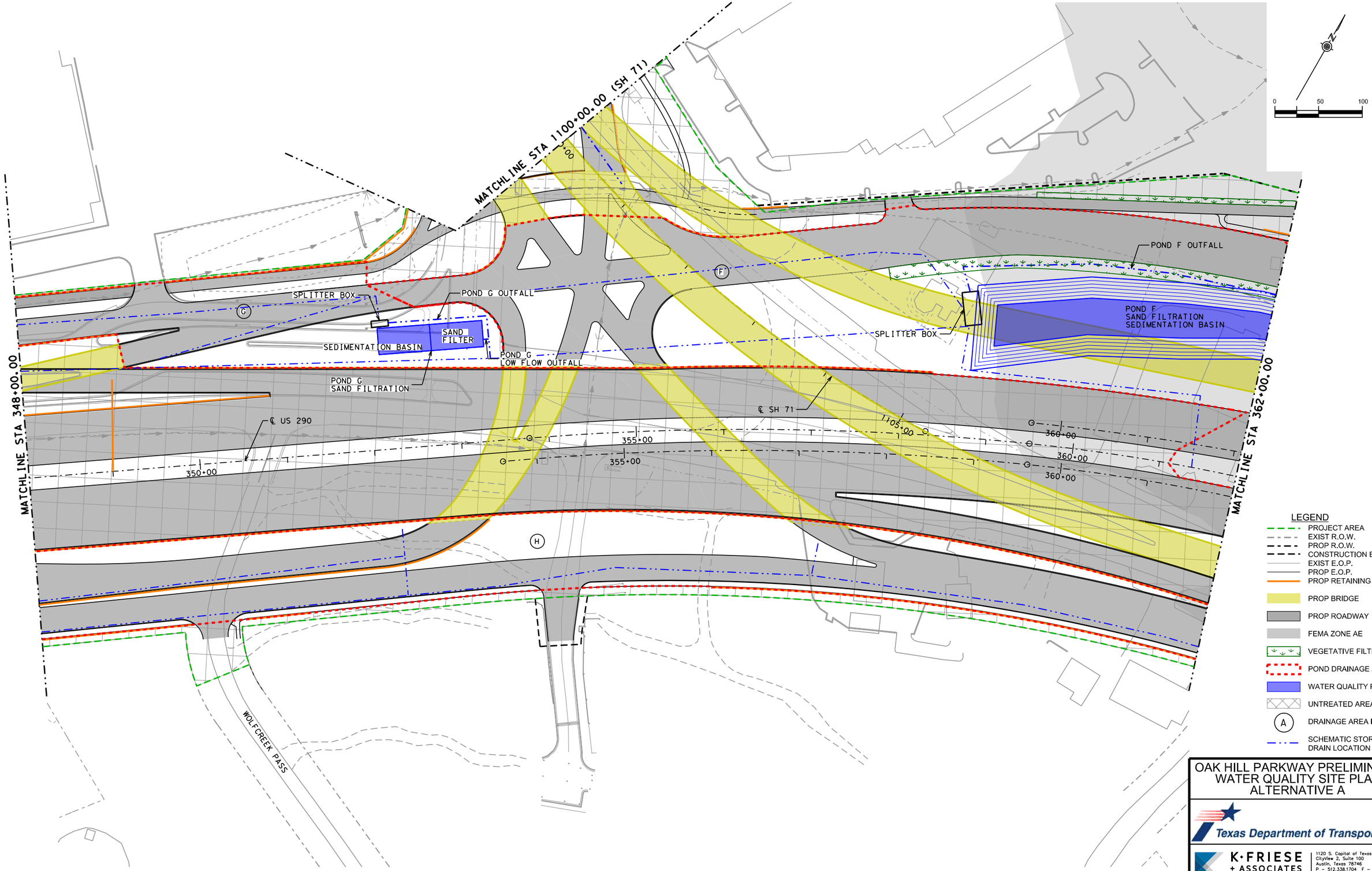

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OAK HILL PARKWAY PRELIMINARY WATER QUALITY SITE PLAN ALTERNATIVE A

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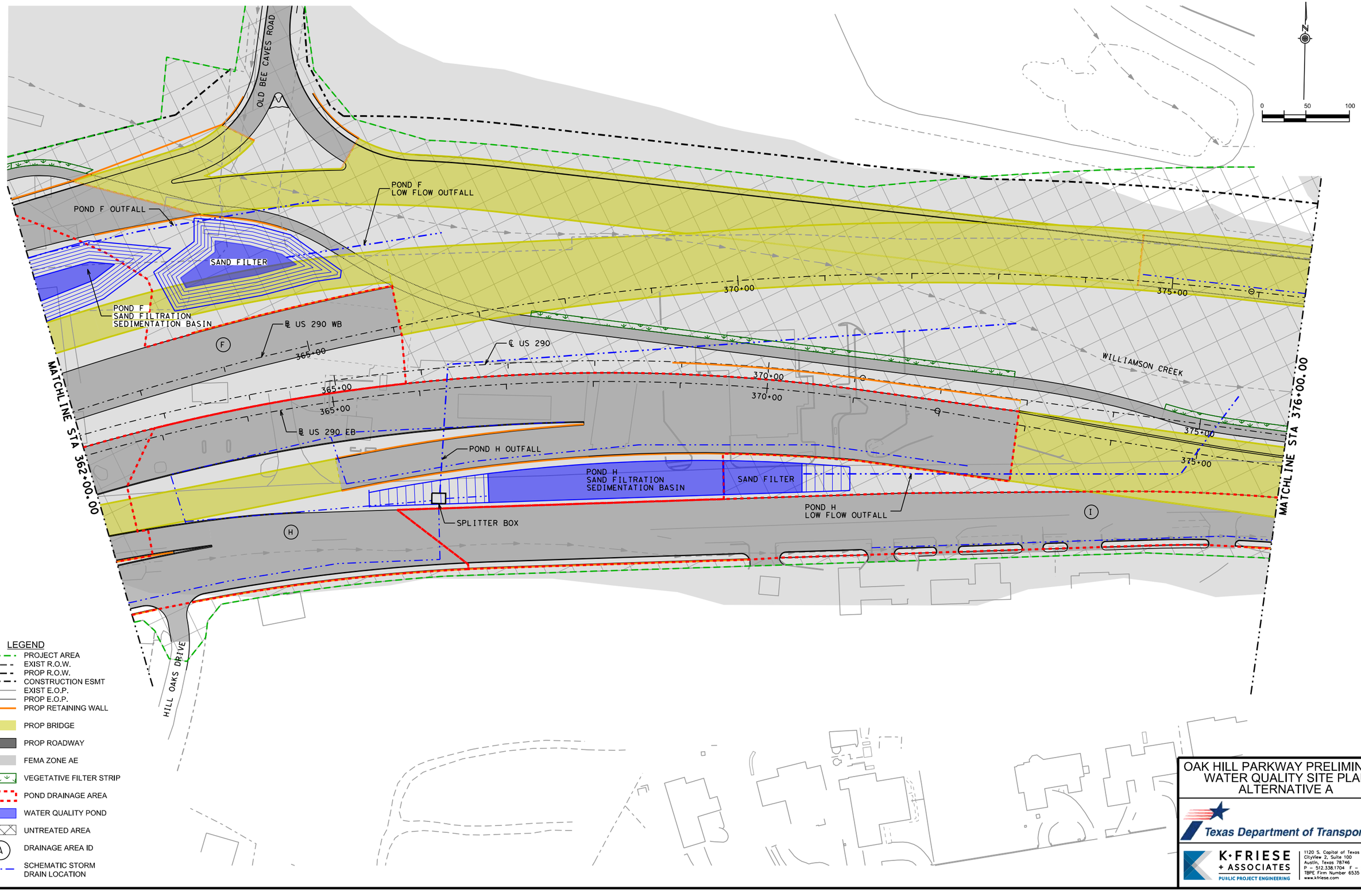

LEGEND

- PROJECT AREA
- EXIST R.O.W.
- PROP R.O.W.
- CONSTRUCTION ESMT
- EXIST E.O.P.
- PROP E.O.P.
- PROP RETAINING WALL
- PROP BRIDGE
- PROP ROADWAY
- FEMA ZONE AE
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- WATER QUALITY POND
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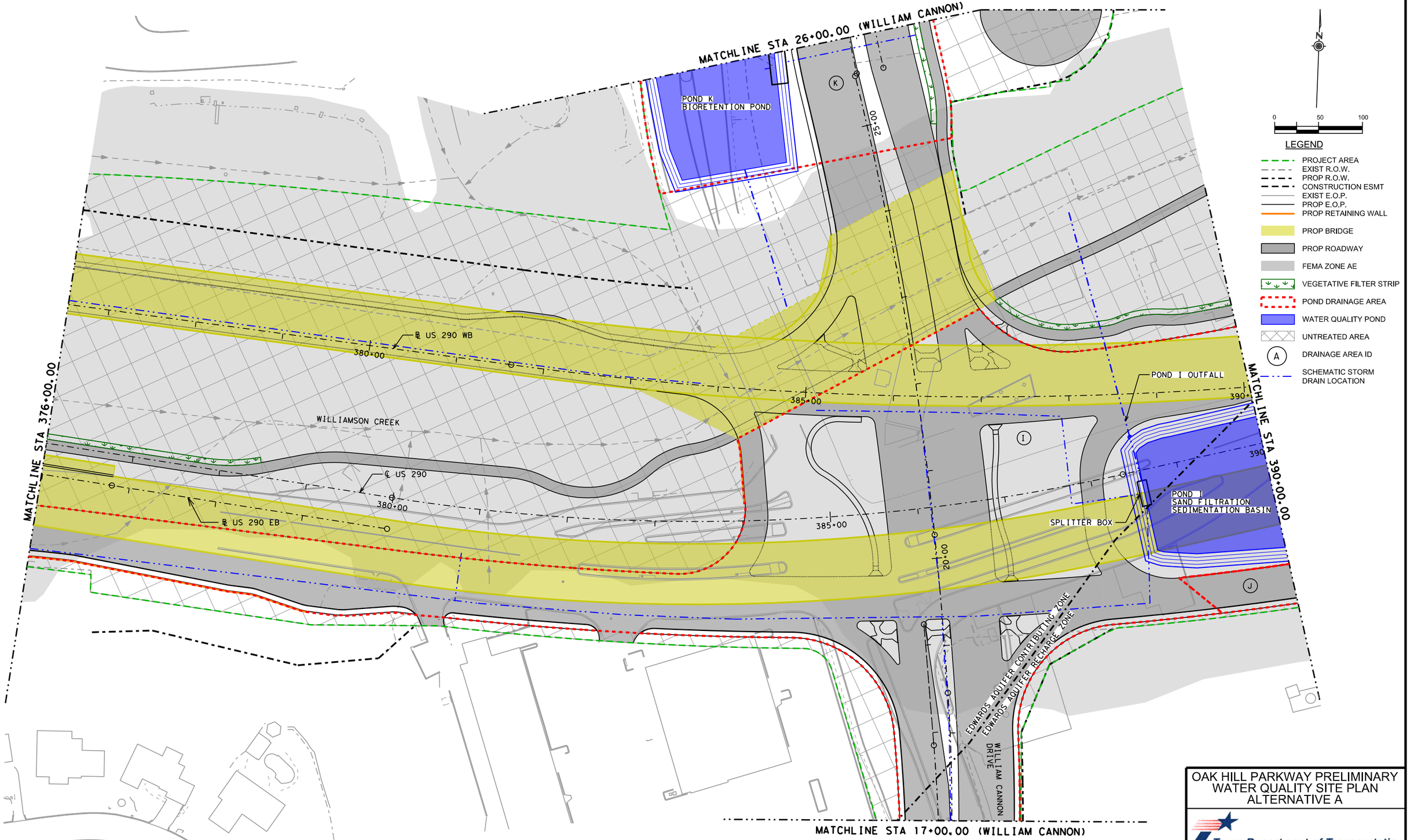

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EDWARDS AQUIFER CONTRIBUTING ZONE
EDWARDS AQUIFER RECHARGE ZONE

PATTON RANCH ROAD

POND J OUTFALL

POND J
EXTENDED DETENTION

℄ US 290 WB

℄ US 290

SAND
FILTER

POND I
LOW FLOW OUTFALL

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MCCARTY LANE

MATCHLINE STA 390+00.00

MATCHLINE STA 404+00.00

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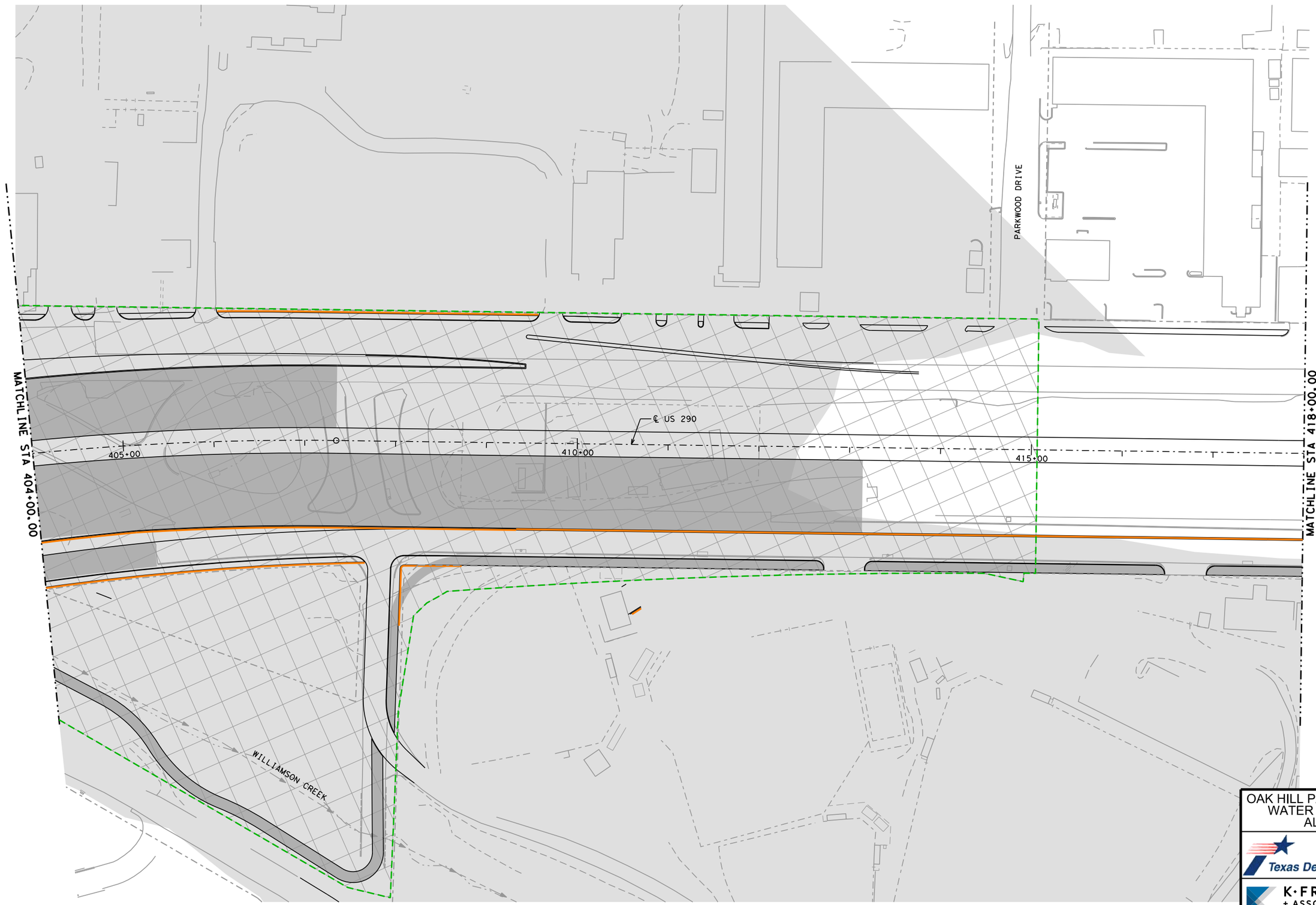

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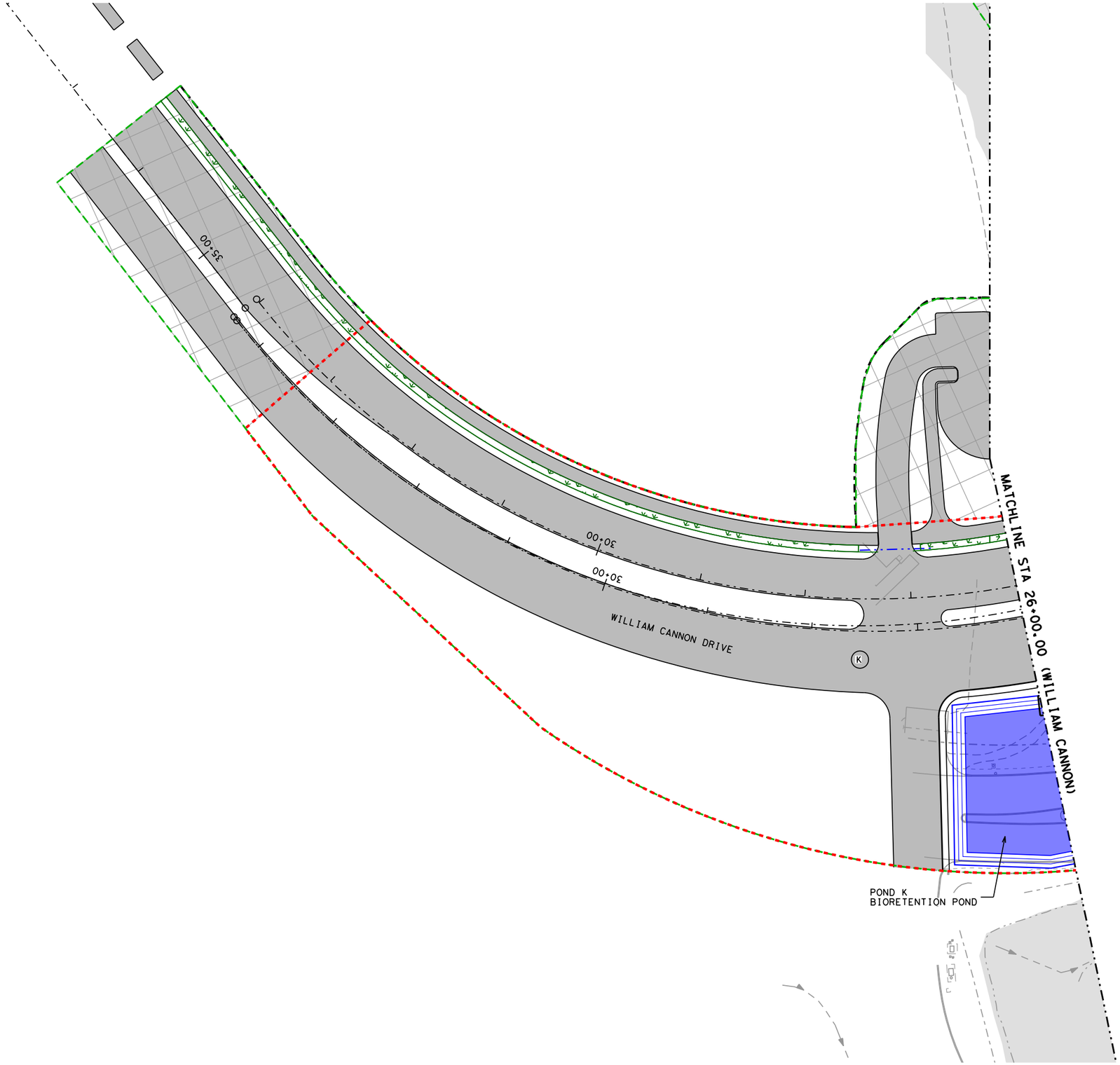

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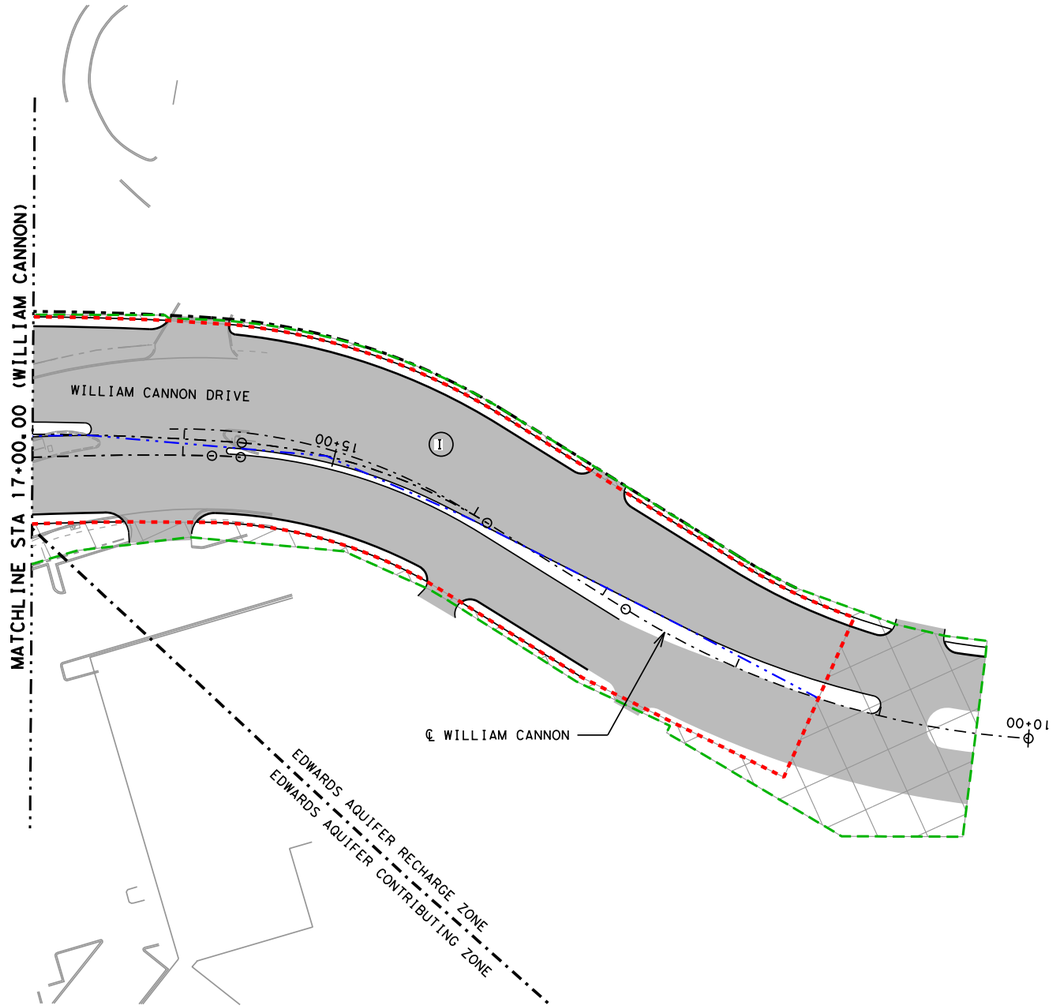

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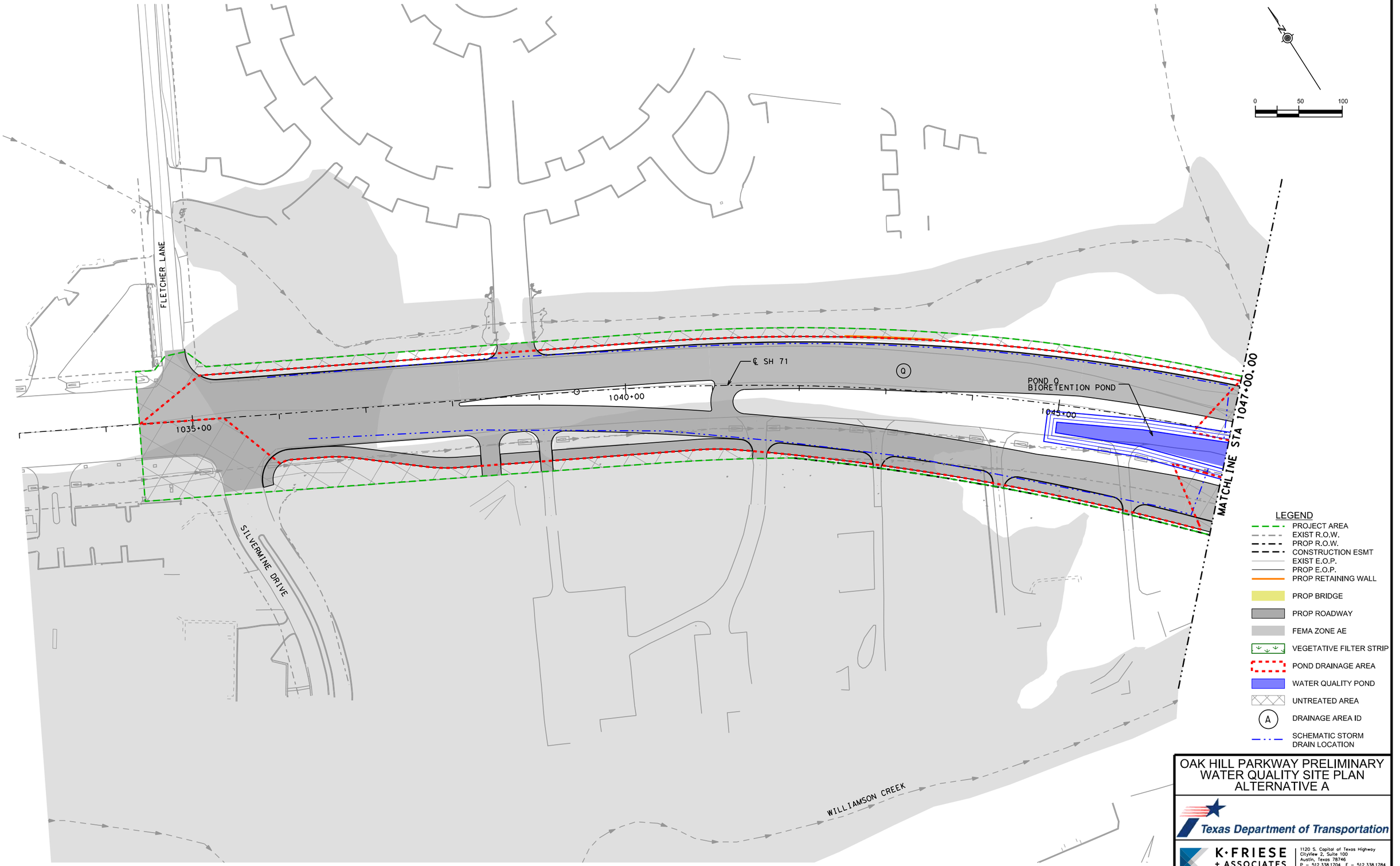

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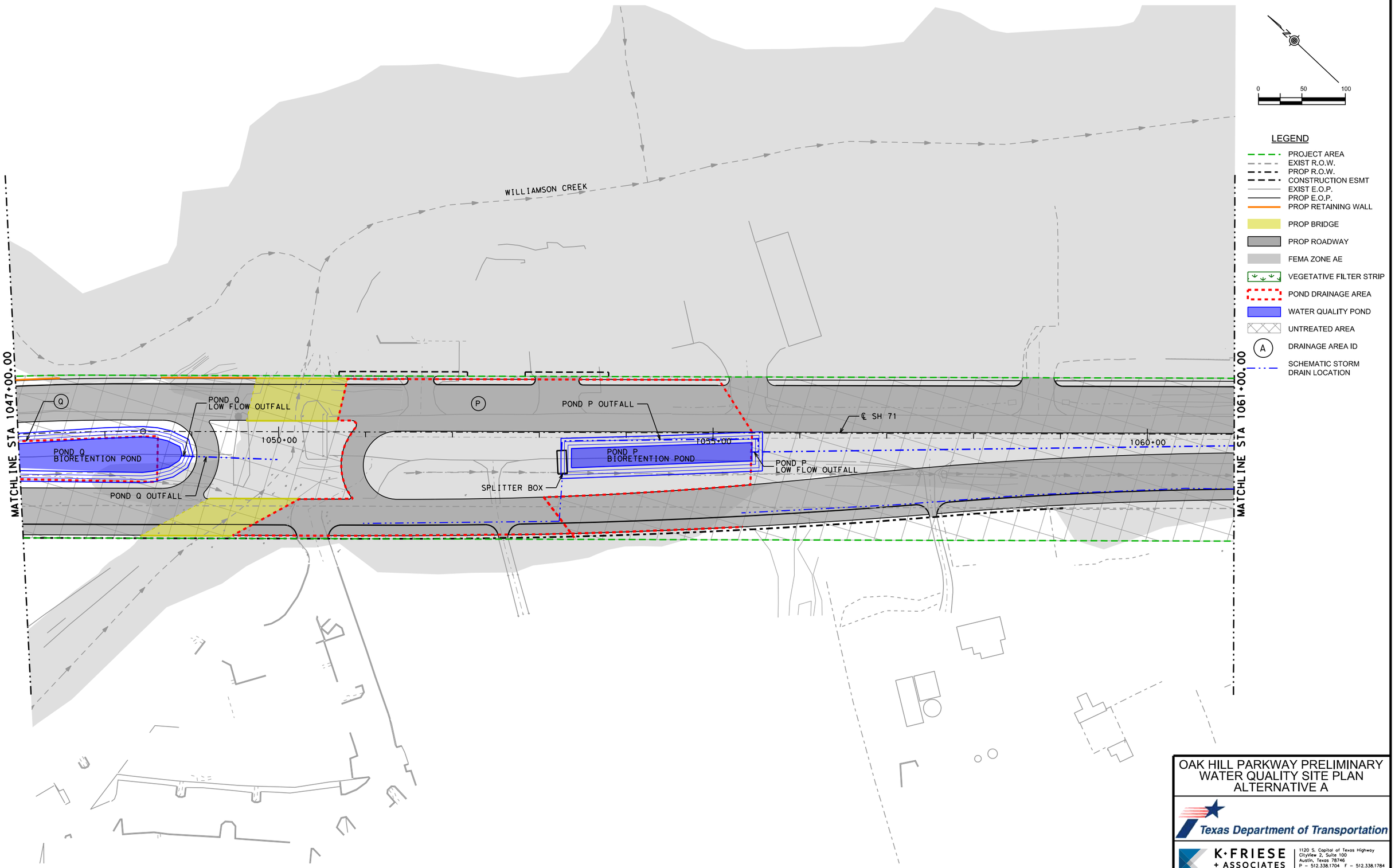

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LOW FLOW OUTFALL

SAND FILTER

POND O
SAND FILTRATION

SEDIMENTATION BASIN

POND O OUTFALL

SPLITTER BOX

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MATCHLINE STA 1061+00.00

MATCHLINE STA 1075+00.00

HILL MEADOW DRIVE

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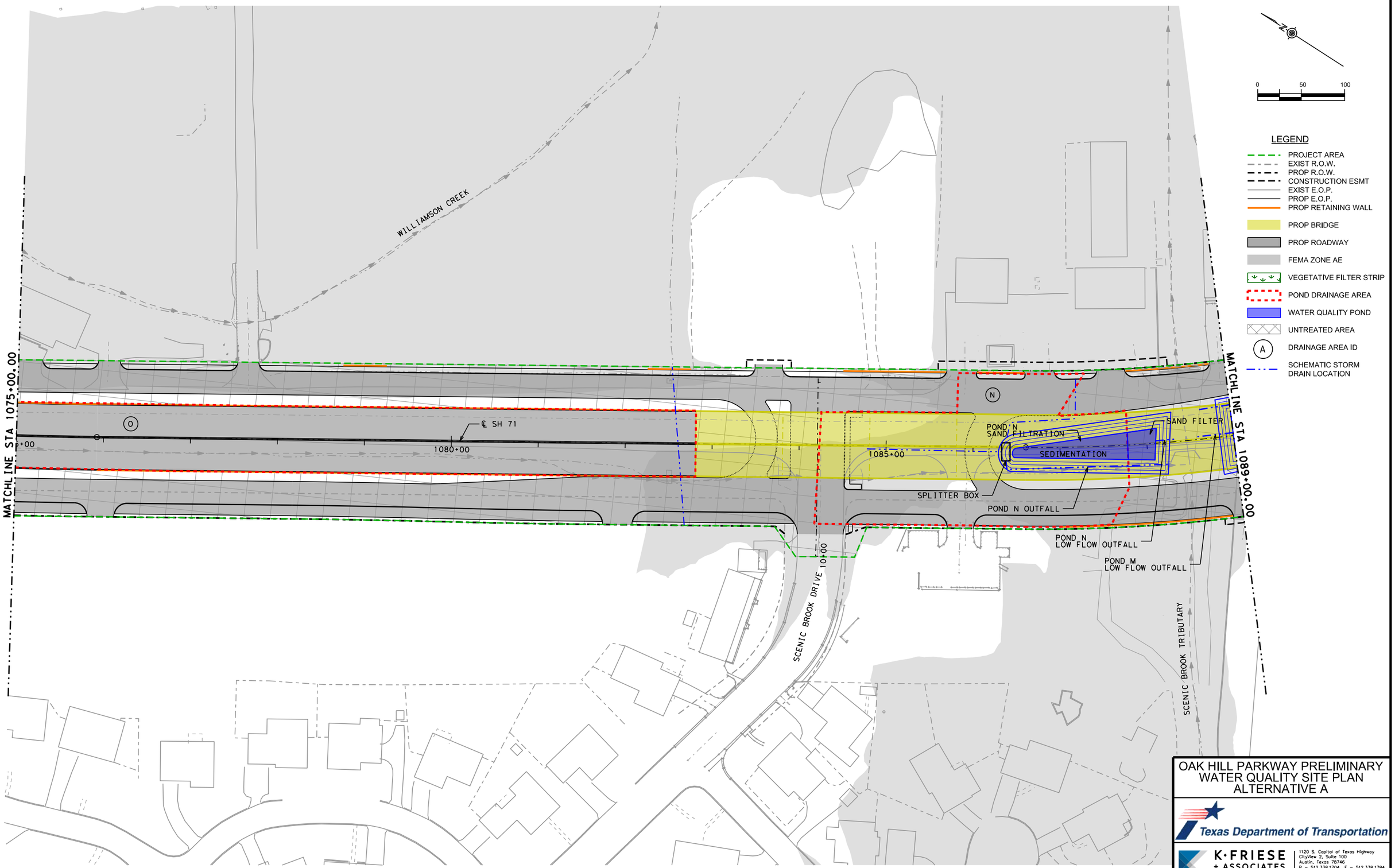

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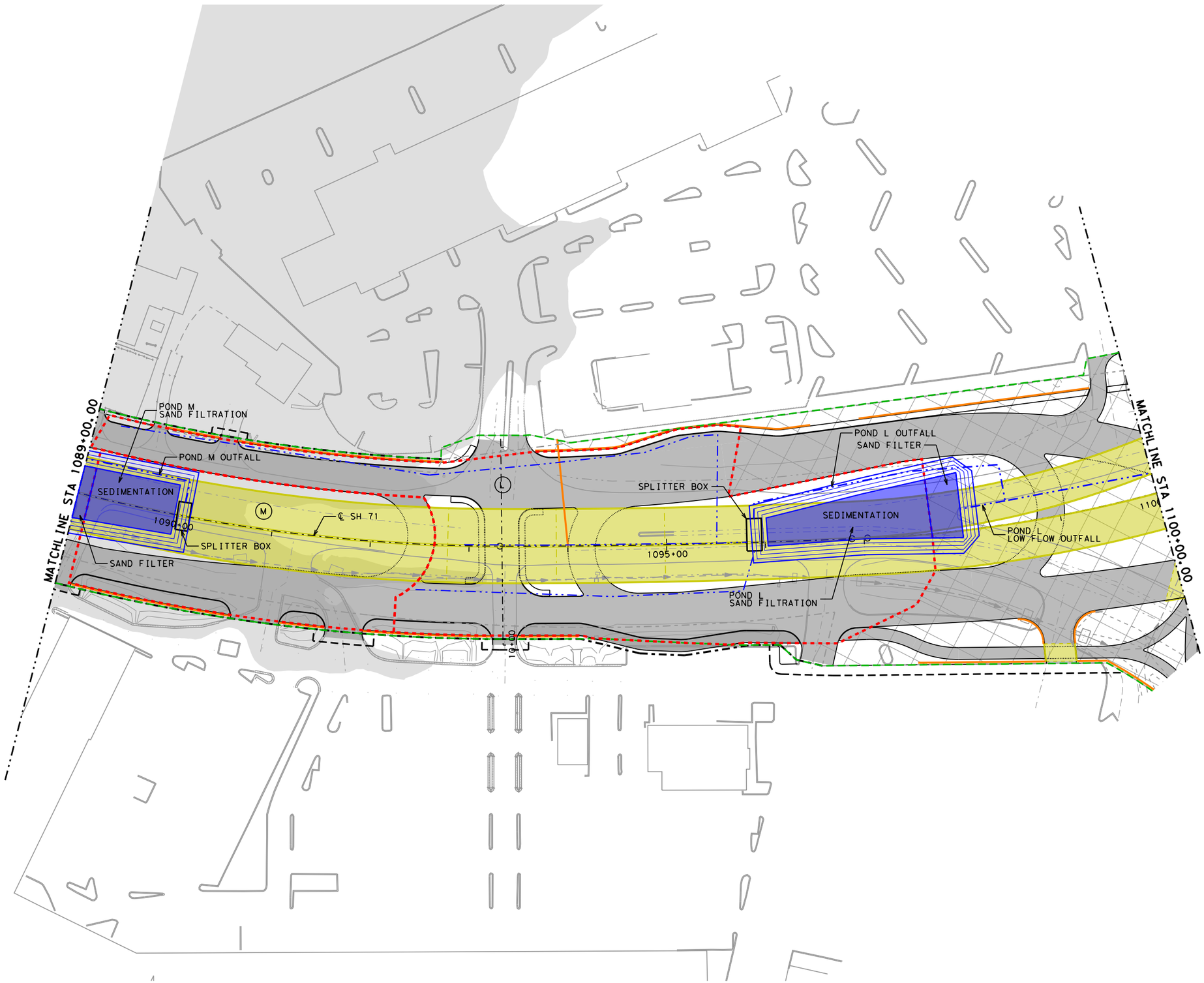

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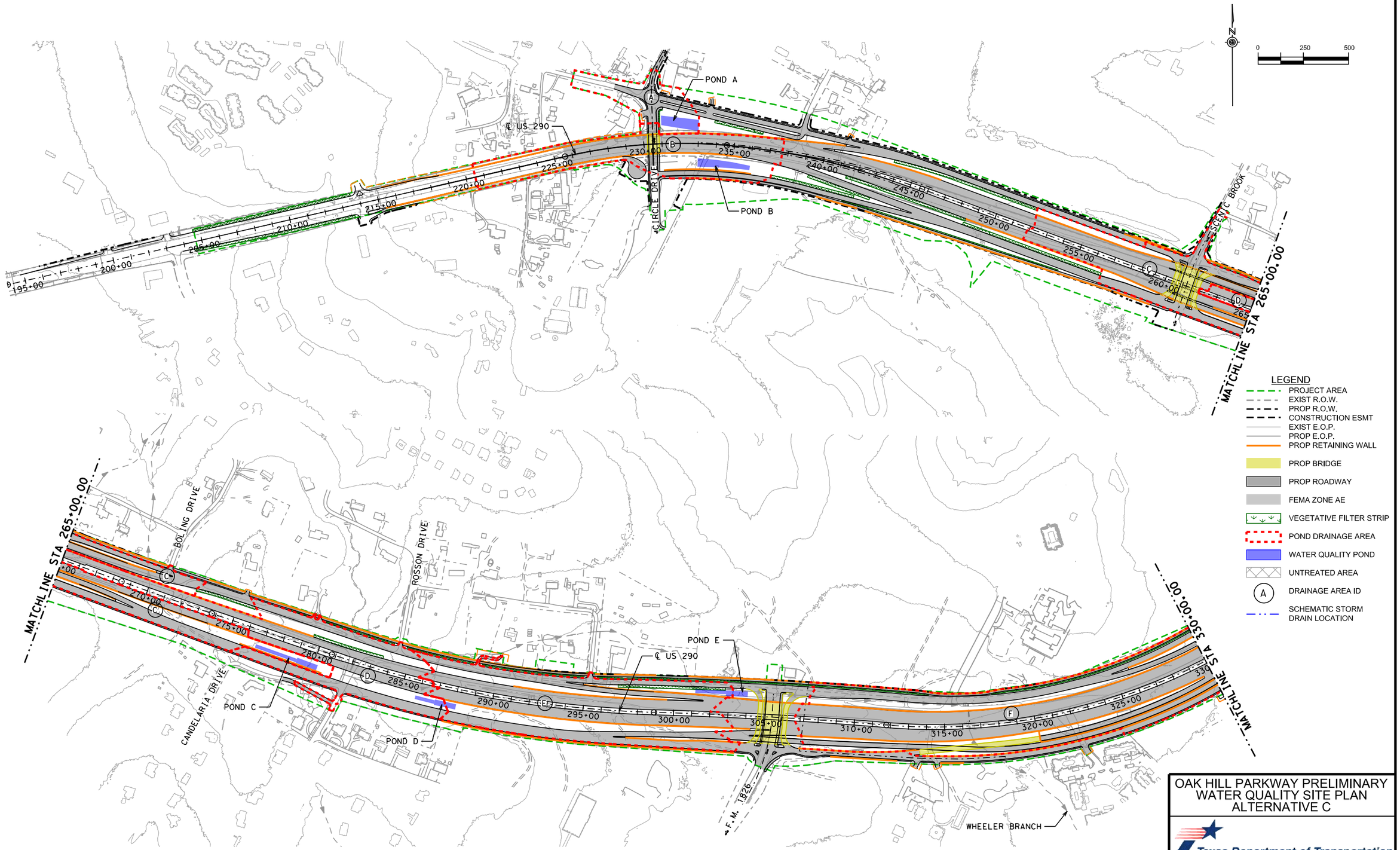
Appendix G: Preliminary Water Quality Site Plan – Alternative C



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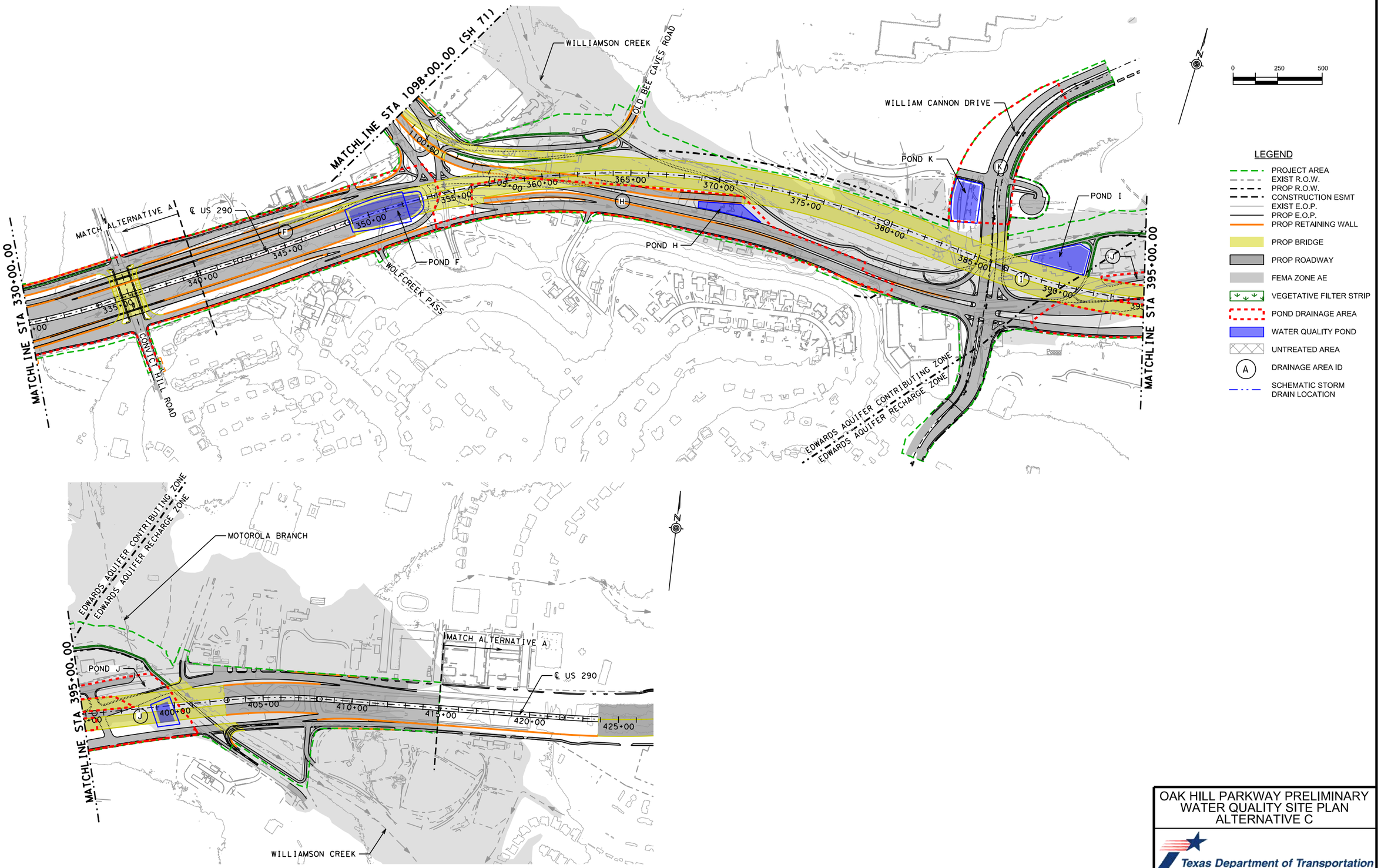

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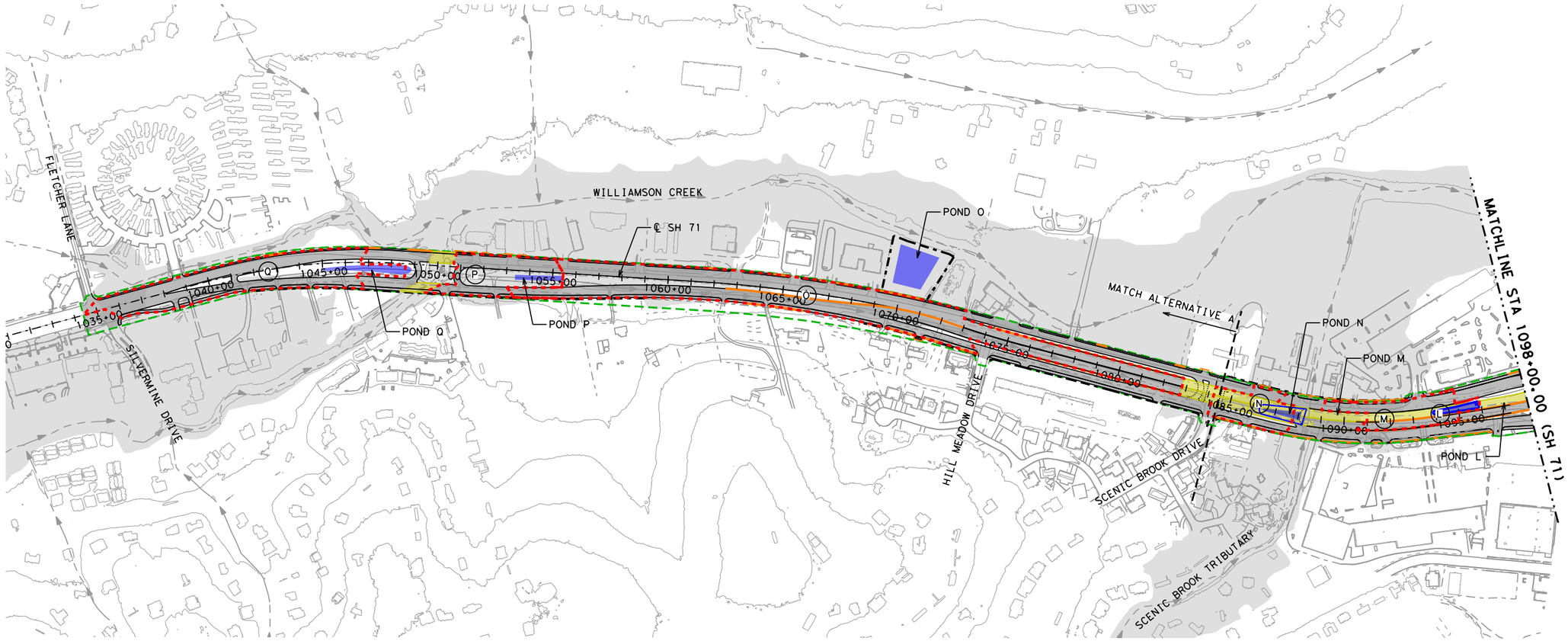

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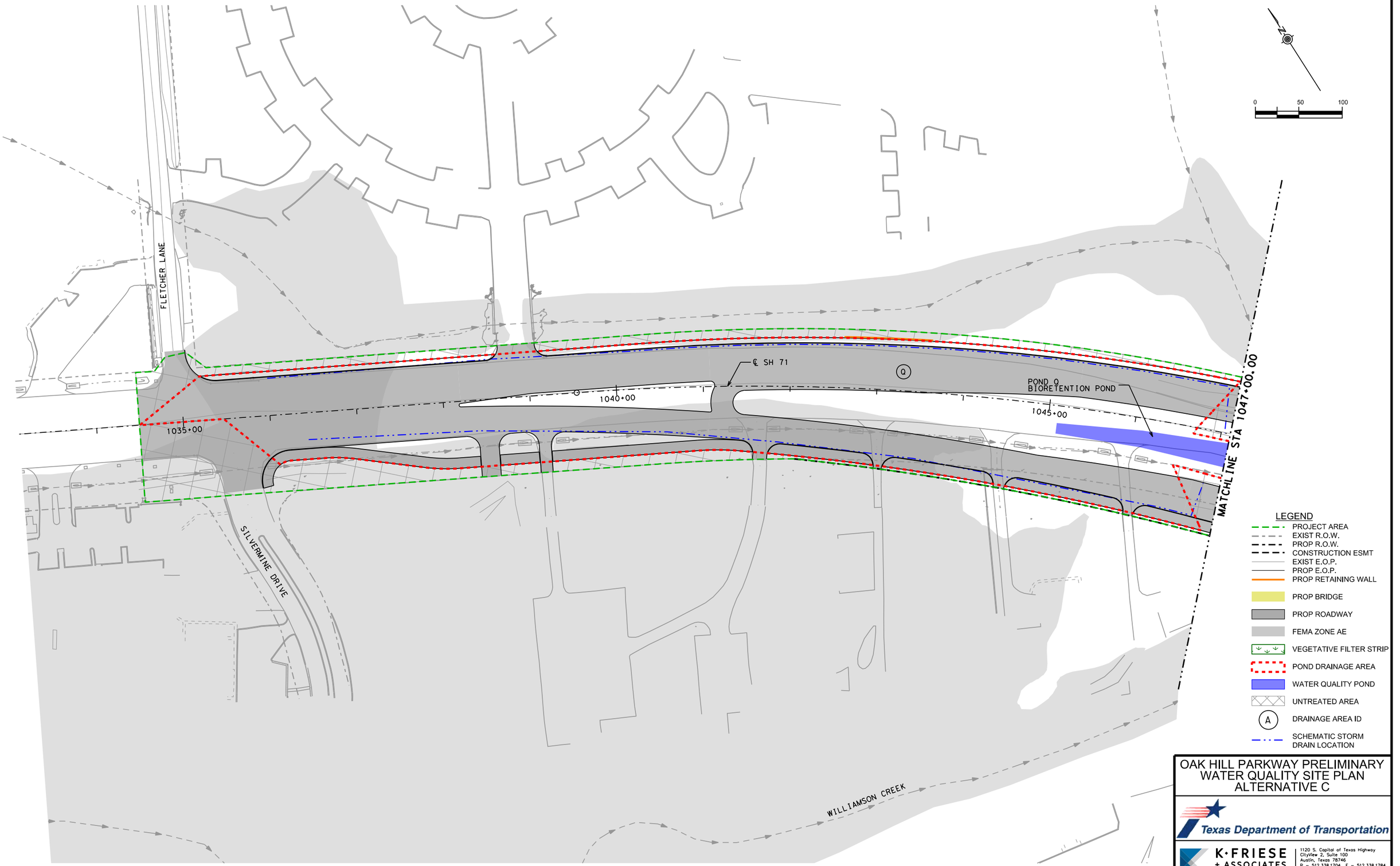

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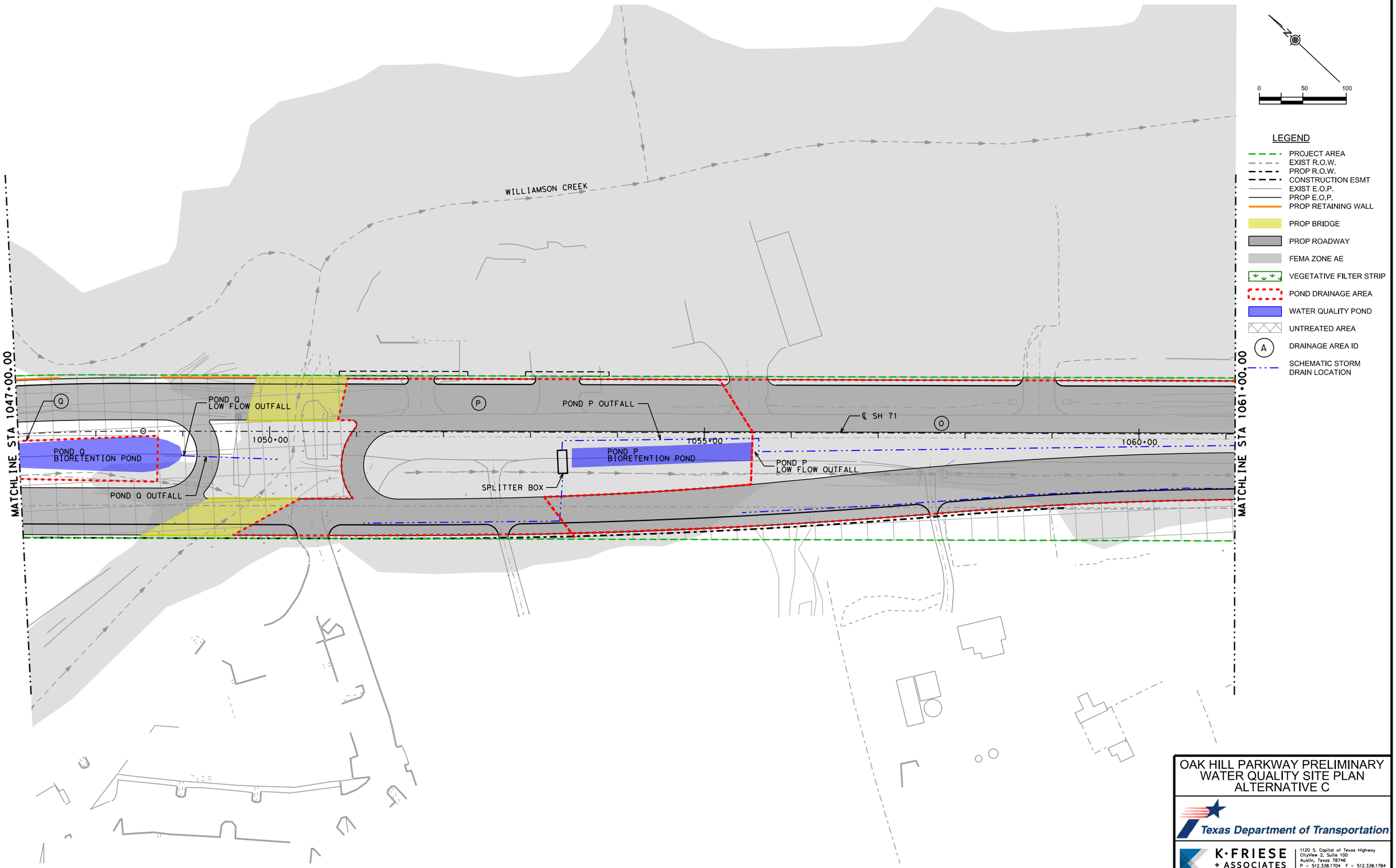

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SPLITTER BOX

℄ SH 71

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1065+00

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1075+

MATCHLINE STA 1061+00.00

MATCHLINE STA 1075+00.00

HILL MEADOW DRIVE

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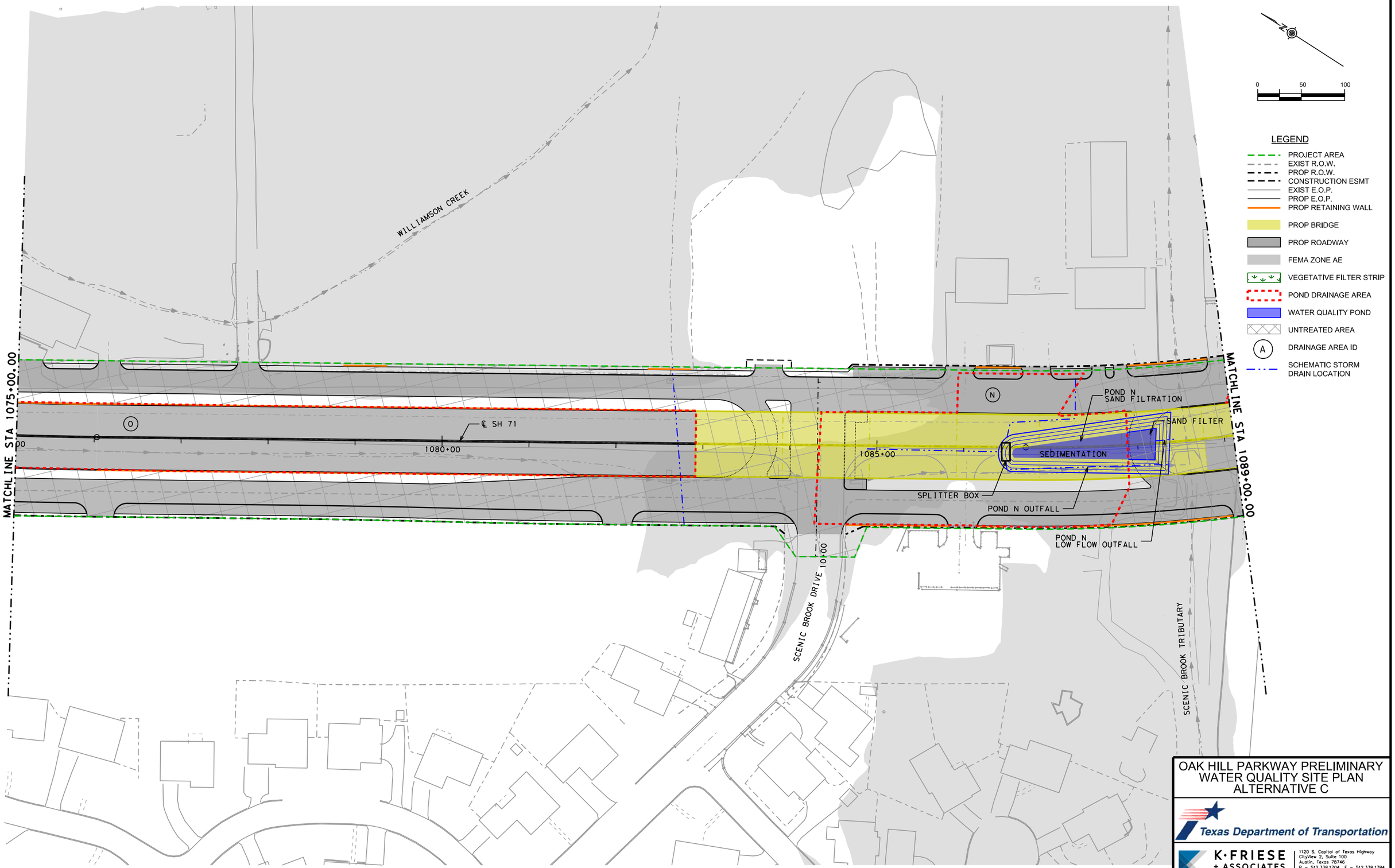

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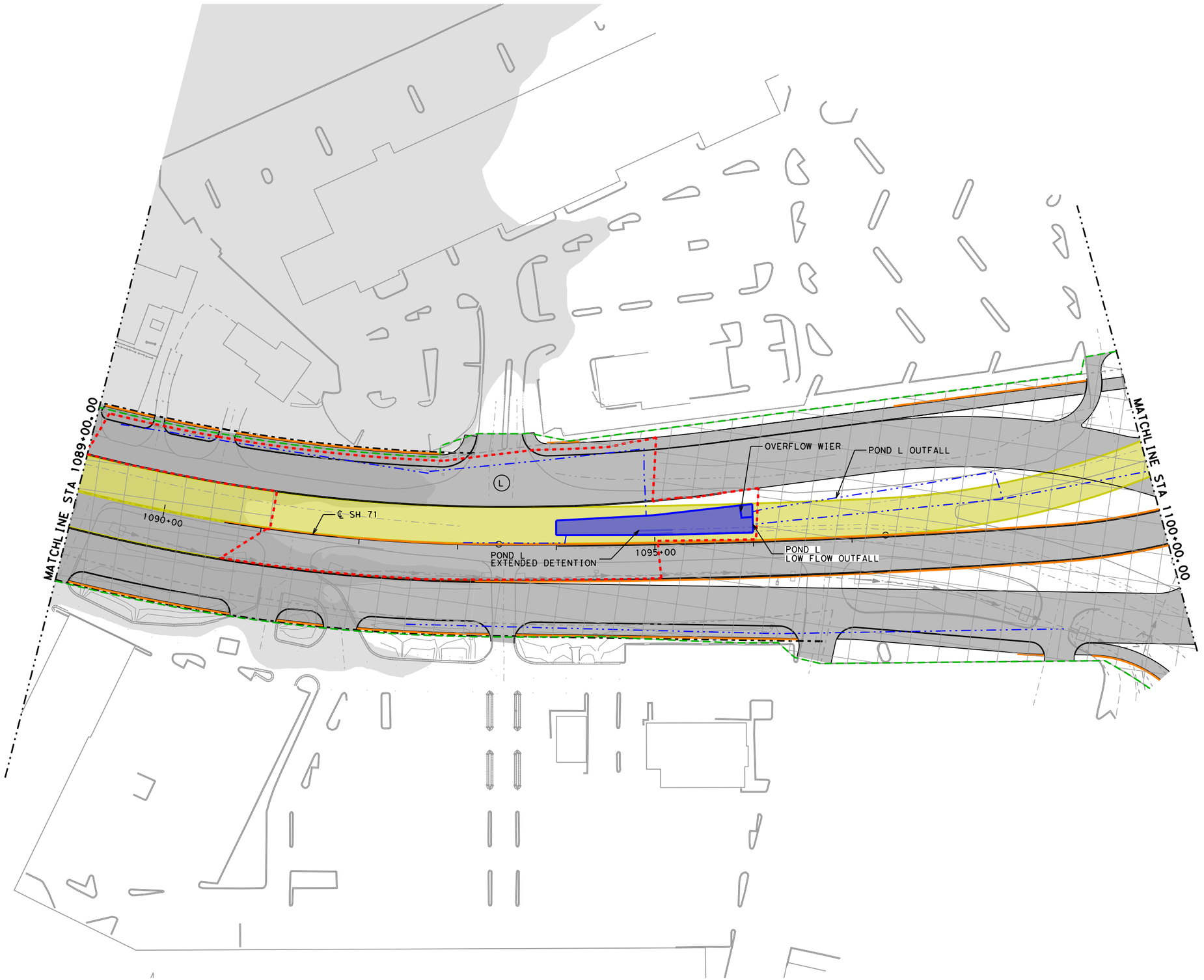

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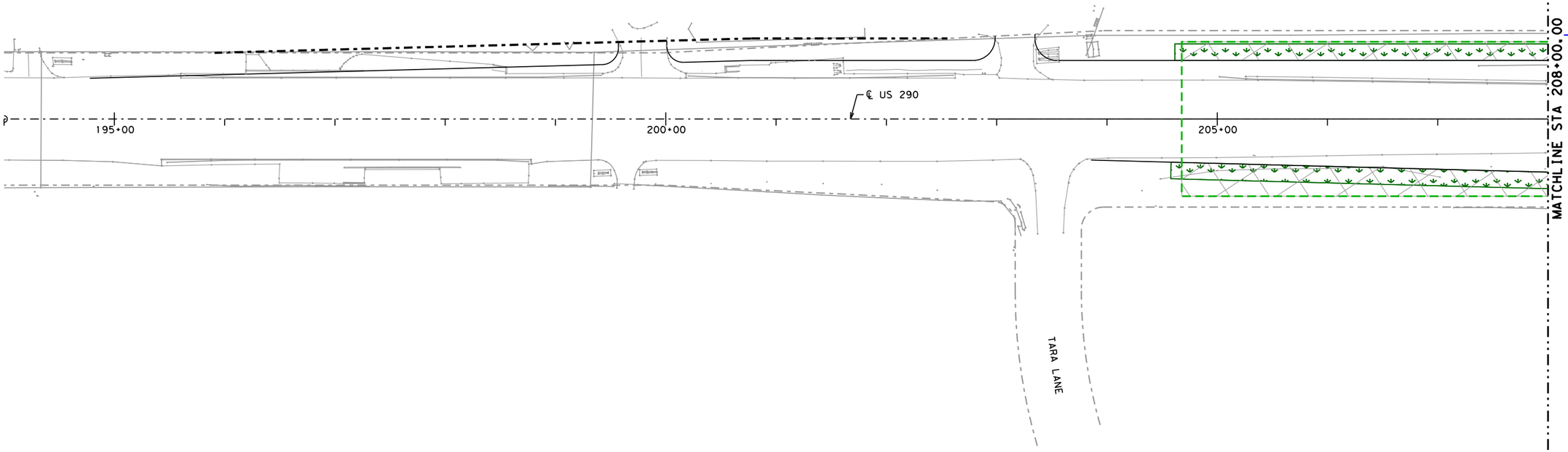

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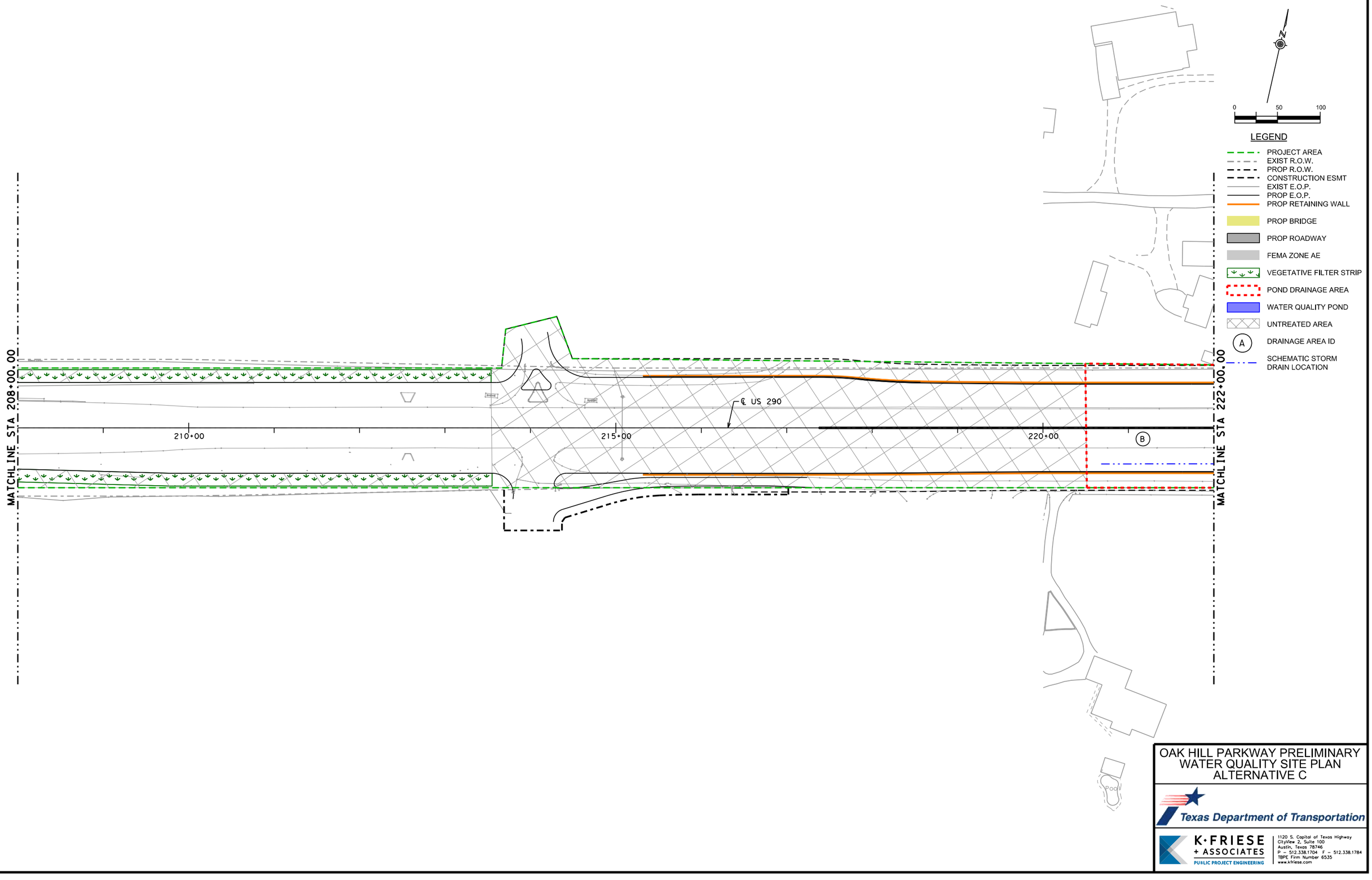

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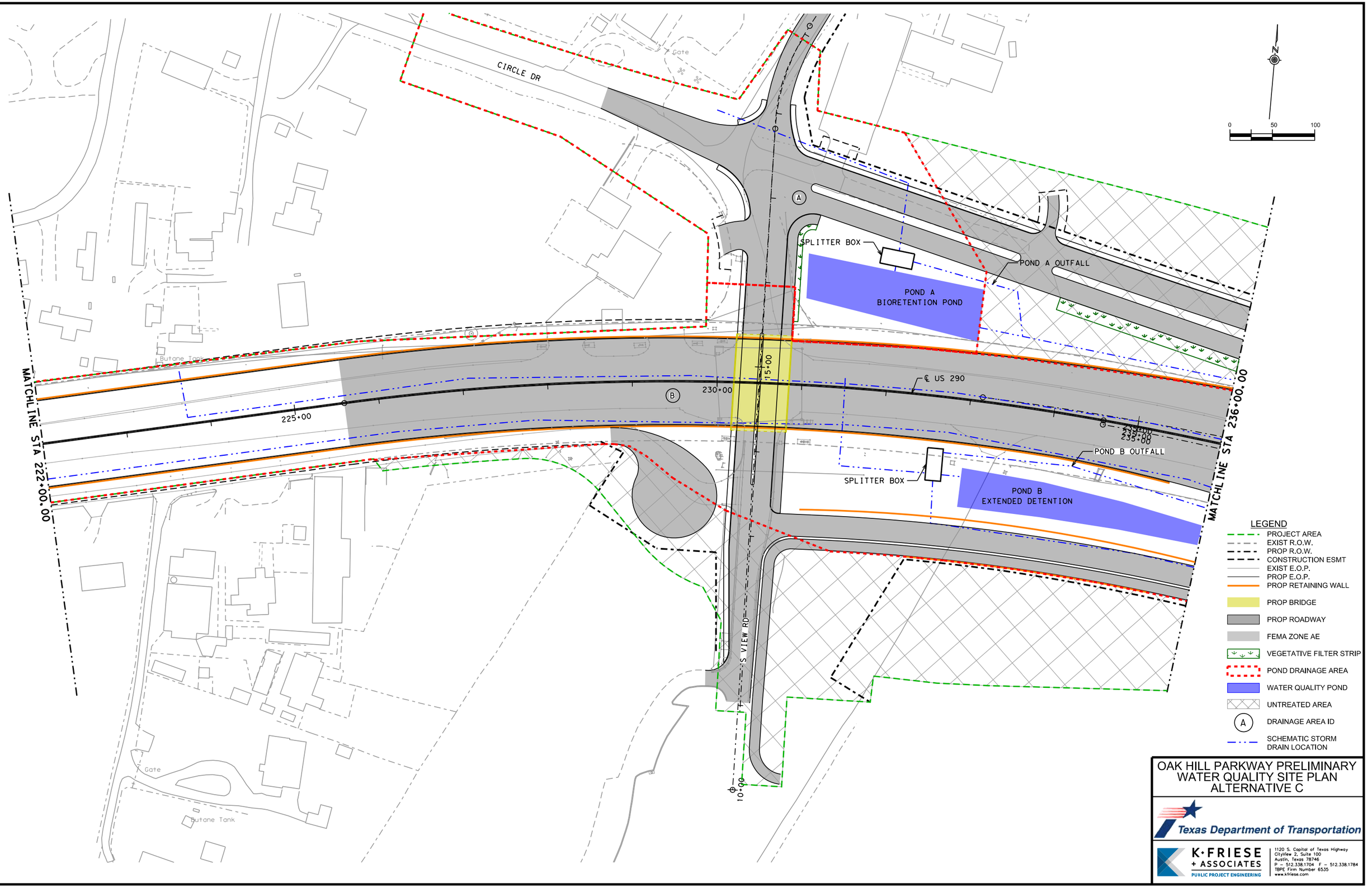

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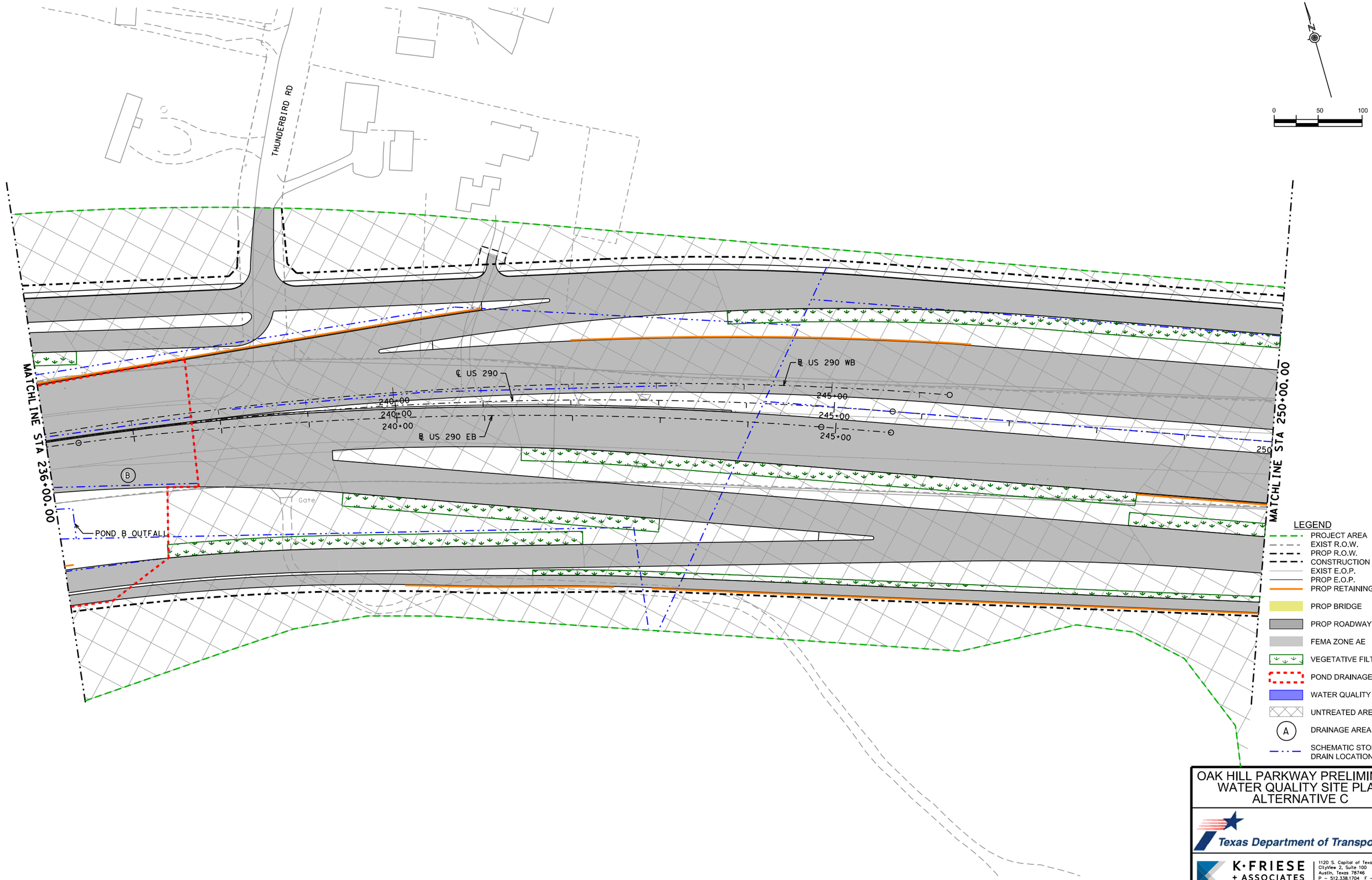

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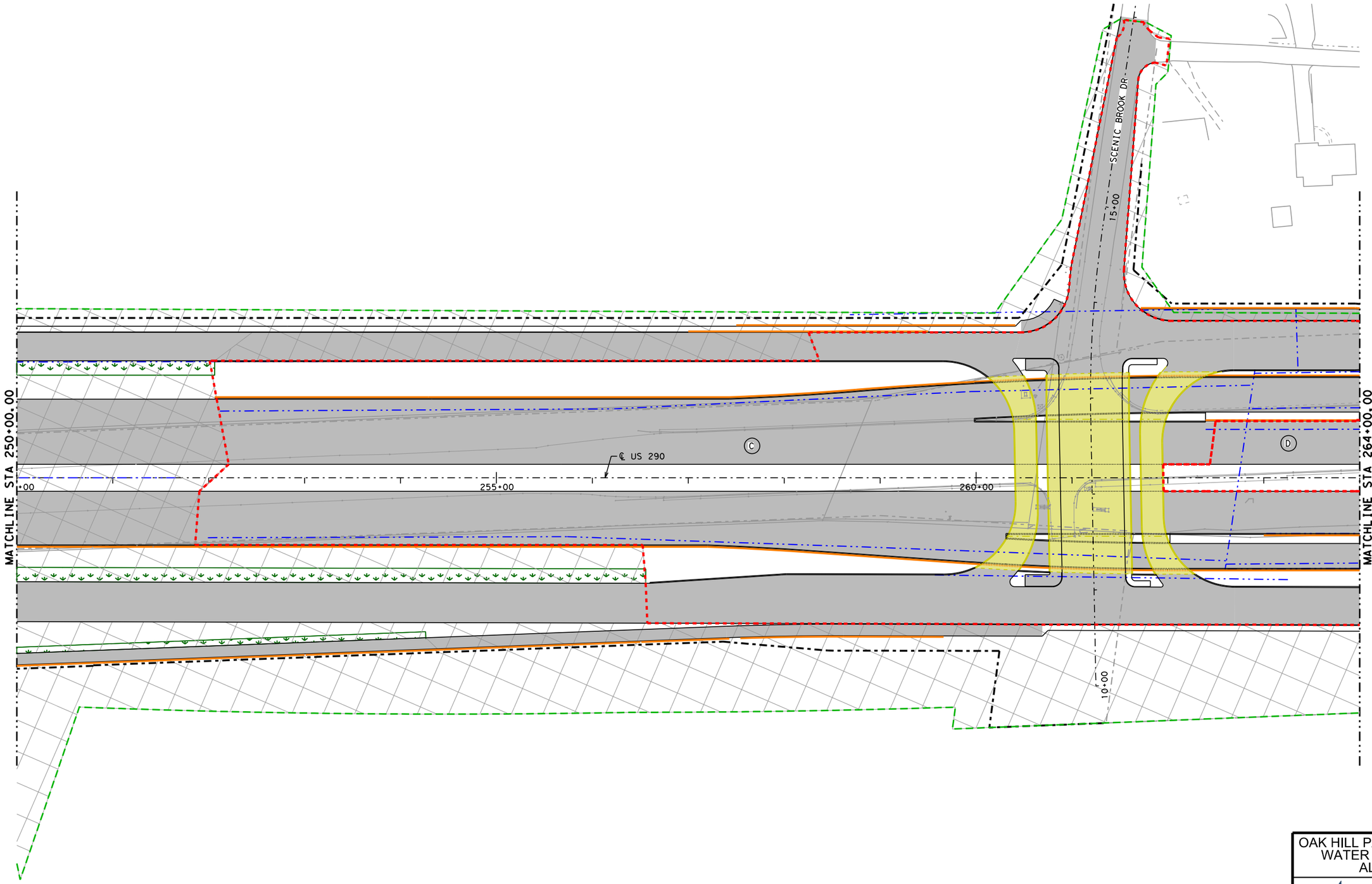

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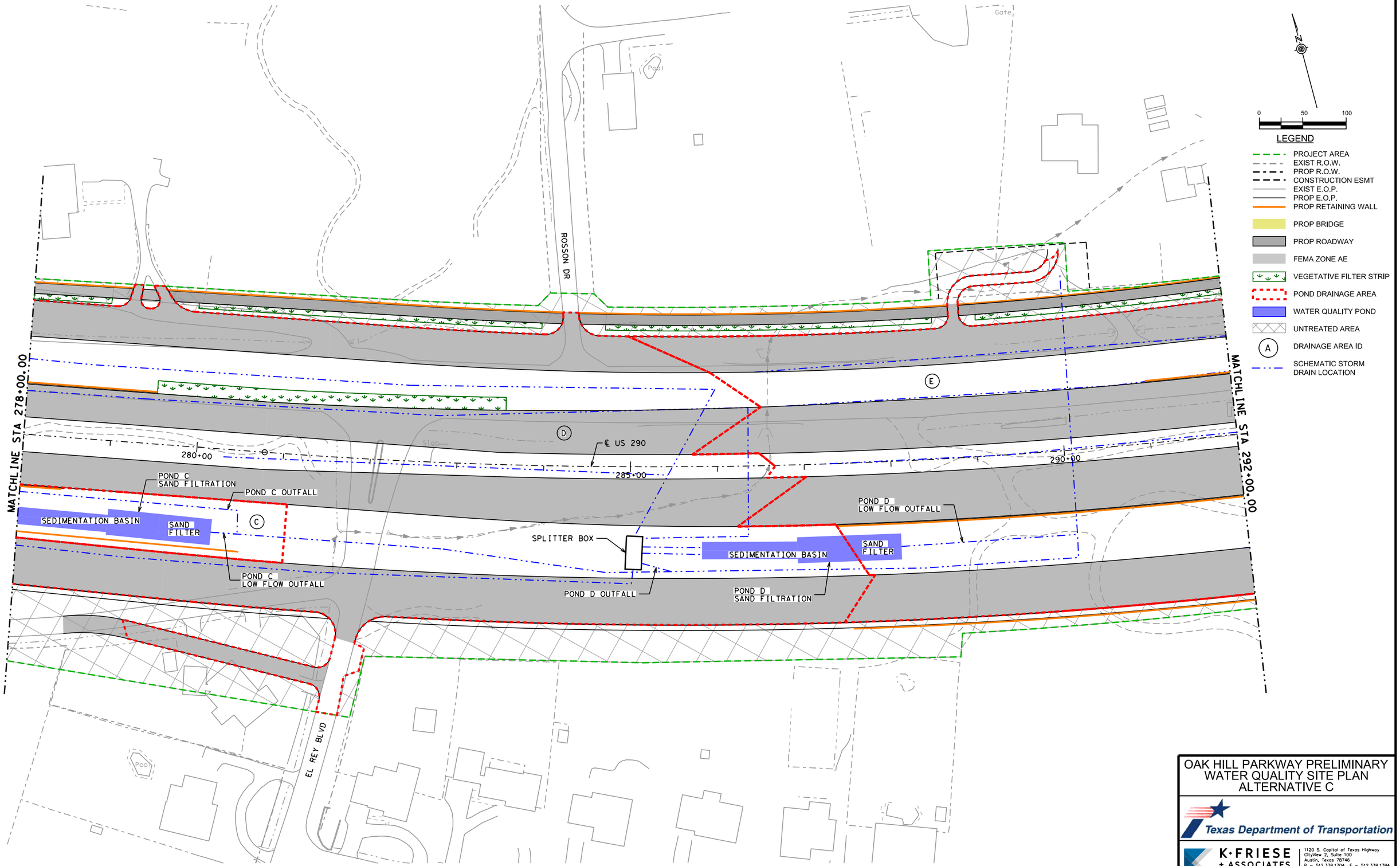

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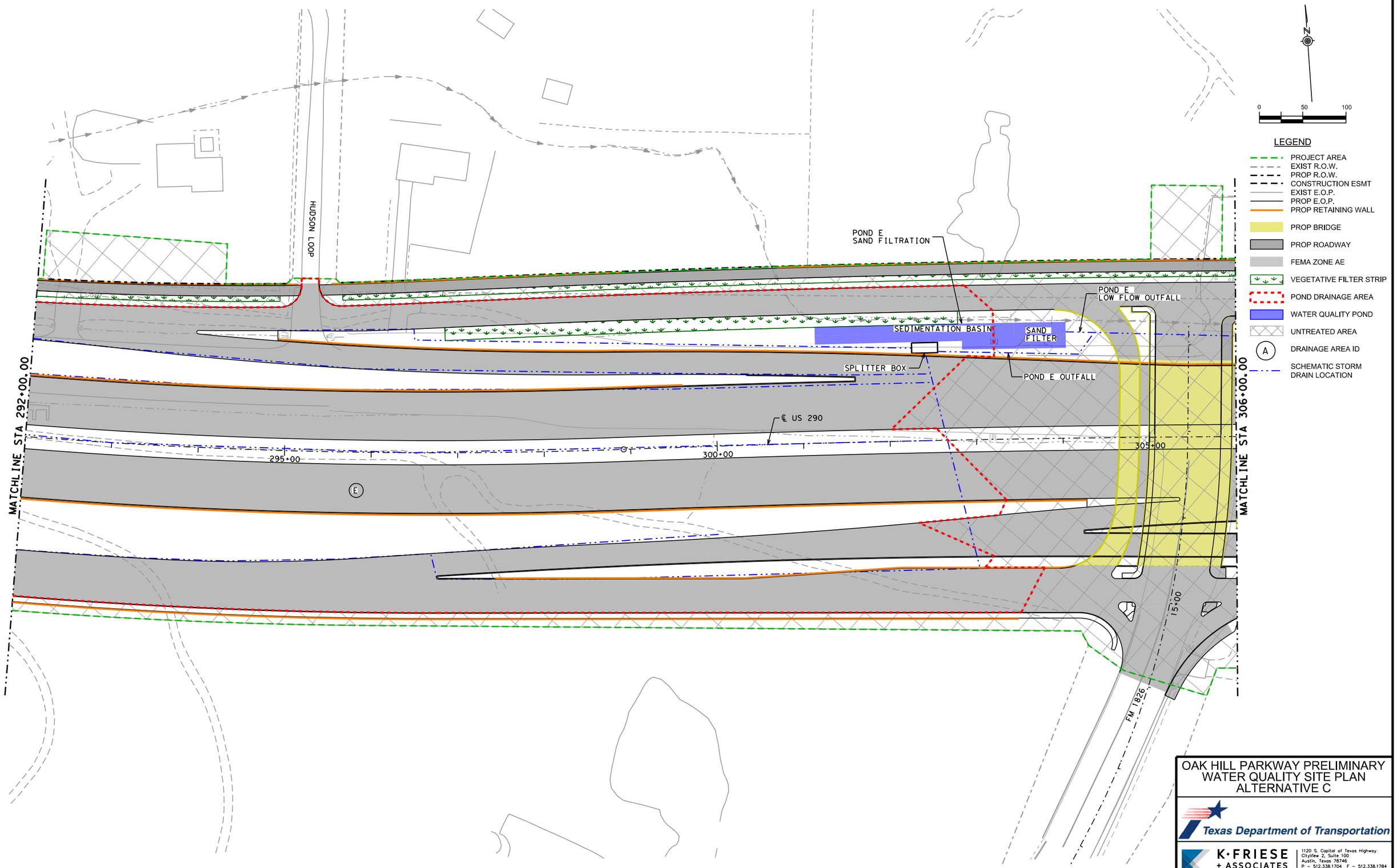

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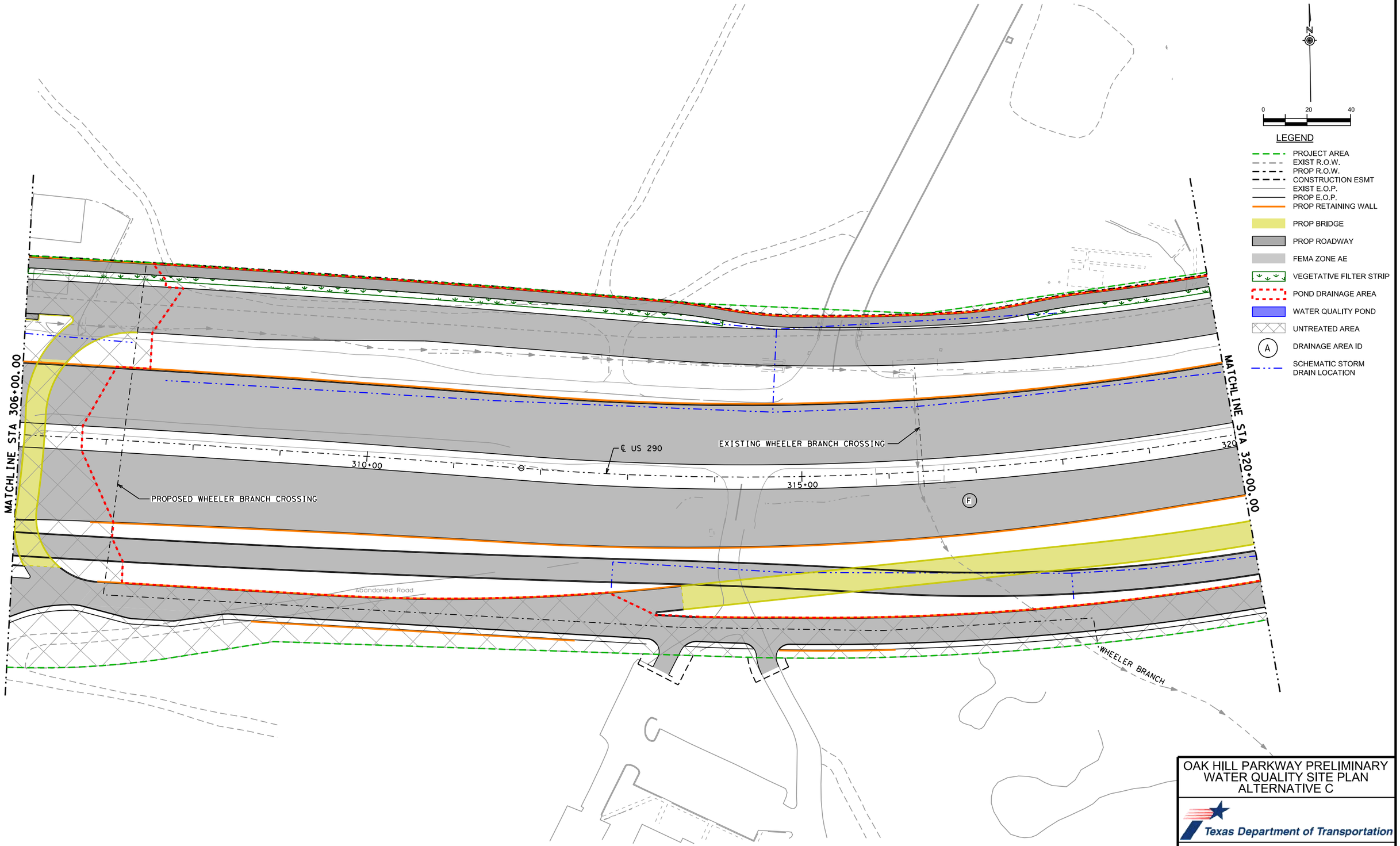

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LEGEND

- PROJECT AREA
- EXIST R.O.W.
- PROP R.O.W.
- CONSTRUCTION ESMT
- EXIST E.O.P.
- PROP E.O.P.
- PROP RETAINING WALL
- PROP BRIDGE
- PROP ROADWAY
- FEMA ZONE AE
- VEGETATIVE FILTER STRIP
- POND DRAINAGE AREA
- WATER QUALITY POND
- UNTREATED AREA
- (A) DRAINAGE AREA ID
- SCHEMATIC STORM DRAIN LOCATION

0 50 100

MATCHLINE STA 320+00.00

MATCHLINE STA 334+00.00

℄ US 290

325+00

330+00

(F)

Gate

Gate

Gate

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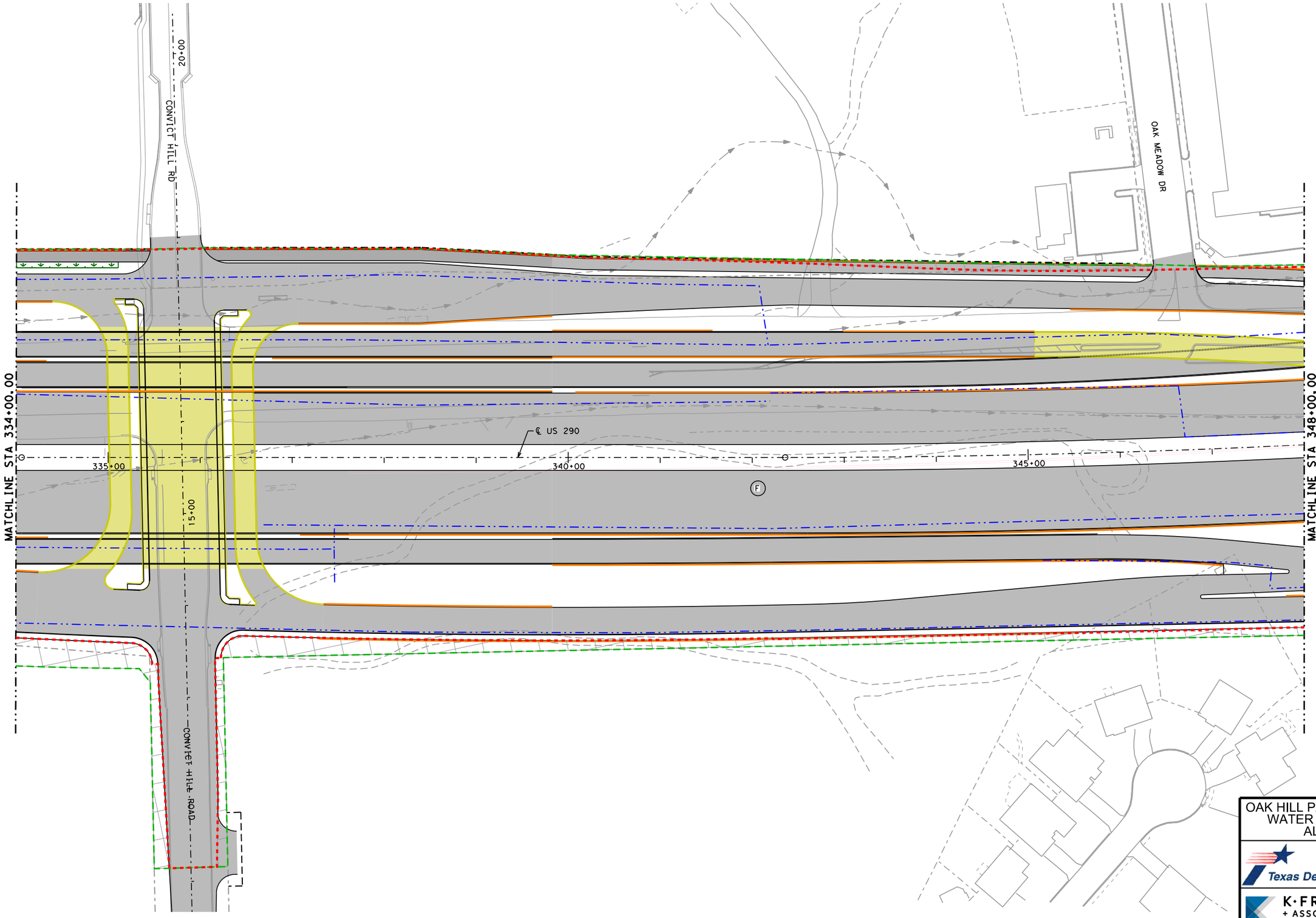

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MATCHLINE STA 1100+00.00 (SH 71)

MATCHLINE STA 348+00.00

MATCHLINE STA 362+00.00

POND F
SAND FILTRATION
SEDIMENTATION BASIN

SAND
FILTER

350+00

355+00

360+00

POND F
LOW FLOW OUTFALL

℄ SH 71

℄ US 290

SPLITTER BOX

POND F OUTFALL

H

WOLFCREEK PASS

0 50 100

LEGEND

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OLD BEE CAVES ROAD

MATCHLINE STA 362+00.00

MATCHLINE STA 376+00.00

℄ US 290

365+00

370+00

375+00

WILLIAMSON CREEK

POND H
SAND FILTRATION
SEDIMENTATION BASIN

SAND FILTER

POND H
LOW FLOW OUTFALL

POND H OUTFALL

SPLITTER BOX

H

HILL OAKS DRIVE

N

0 50 100

LEGEND

- PROJECT AREA
- EXIST R.O.W.
- PROP R.O.W.
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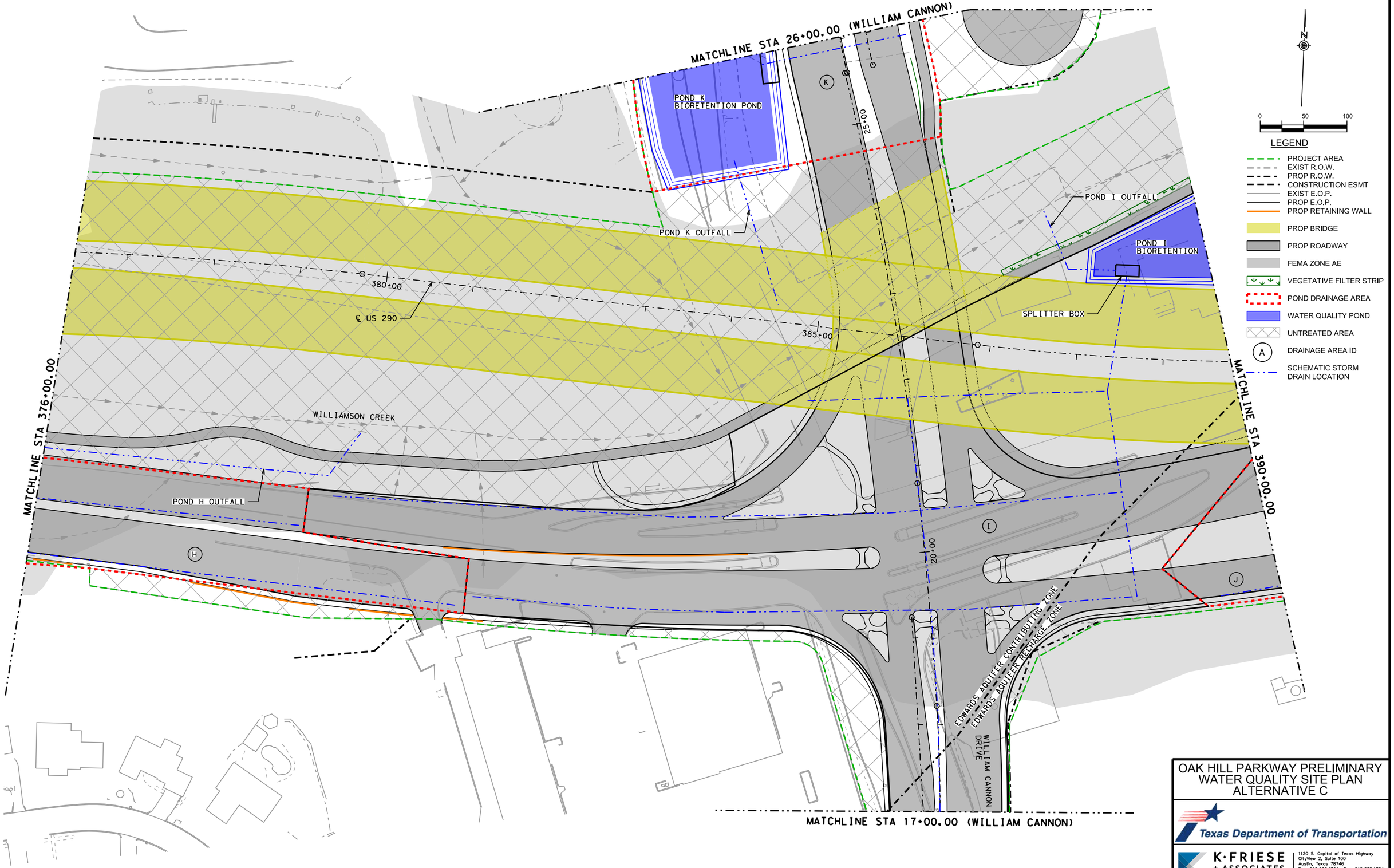

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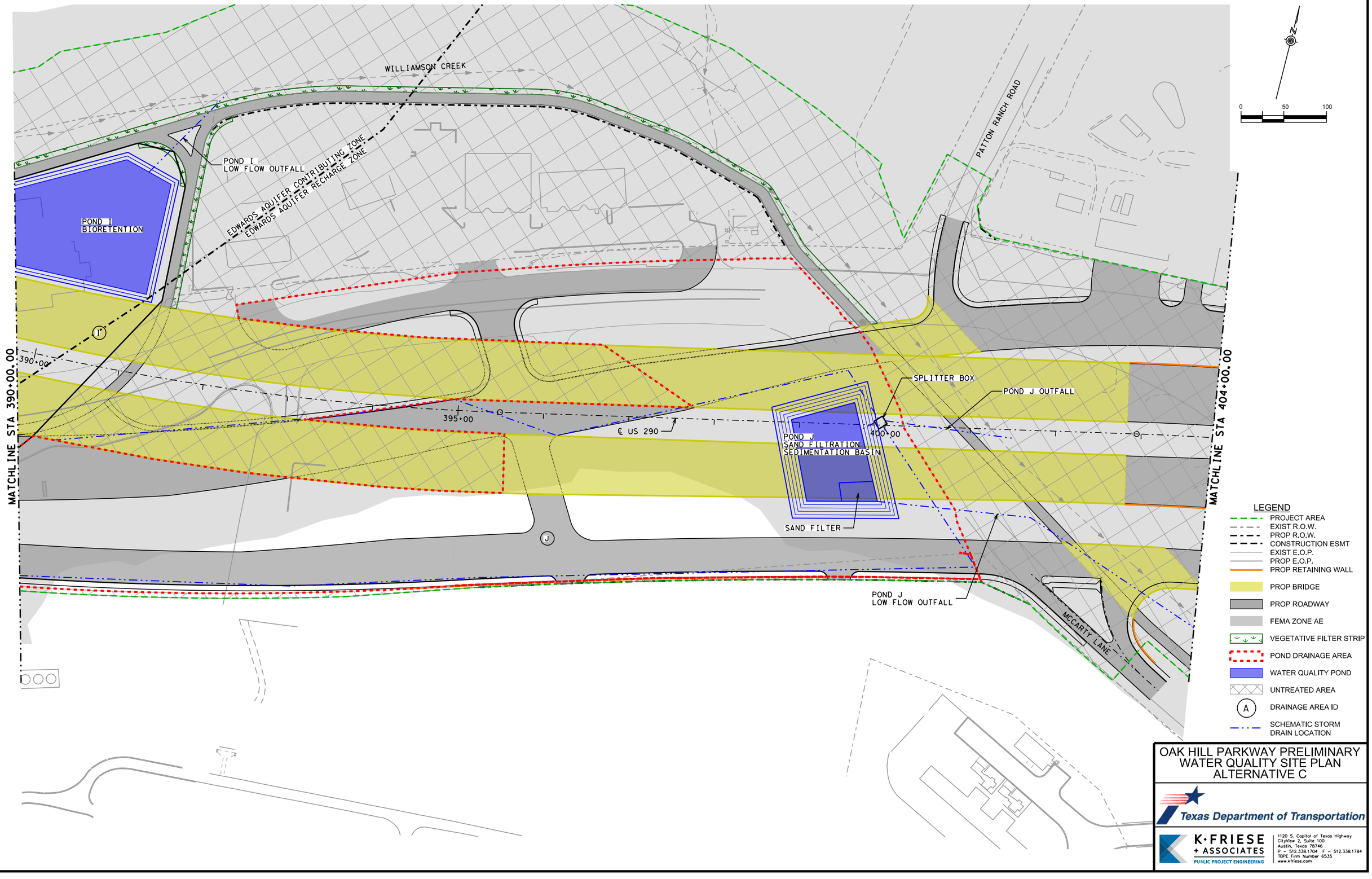

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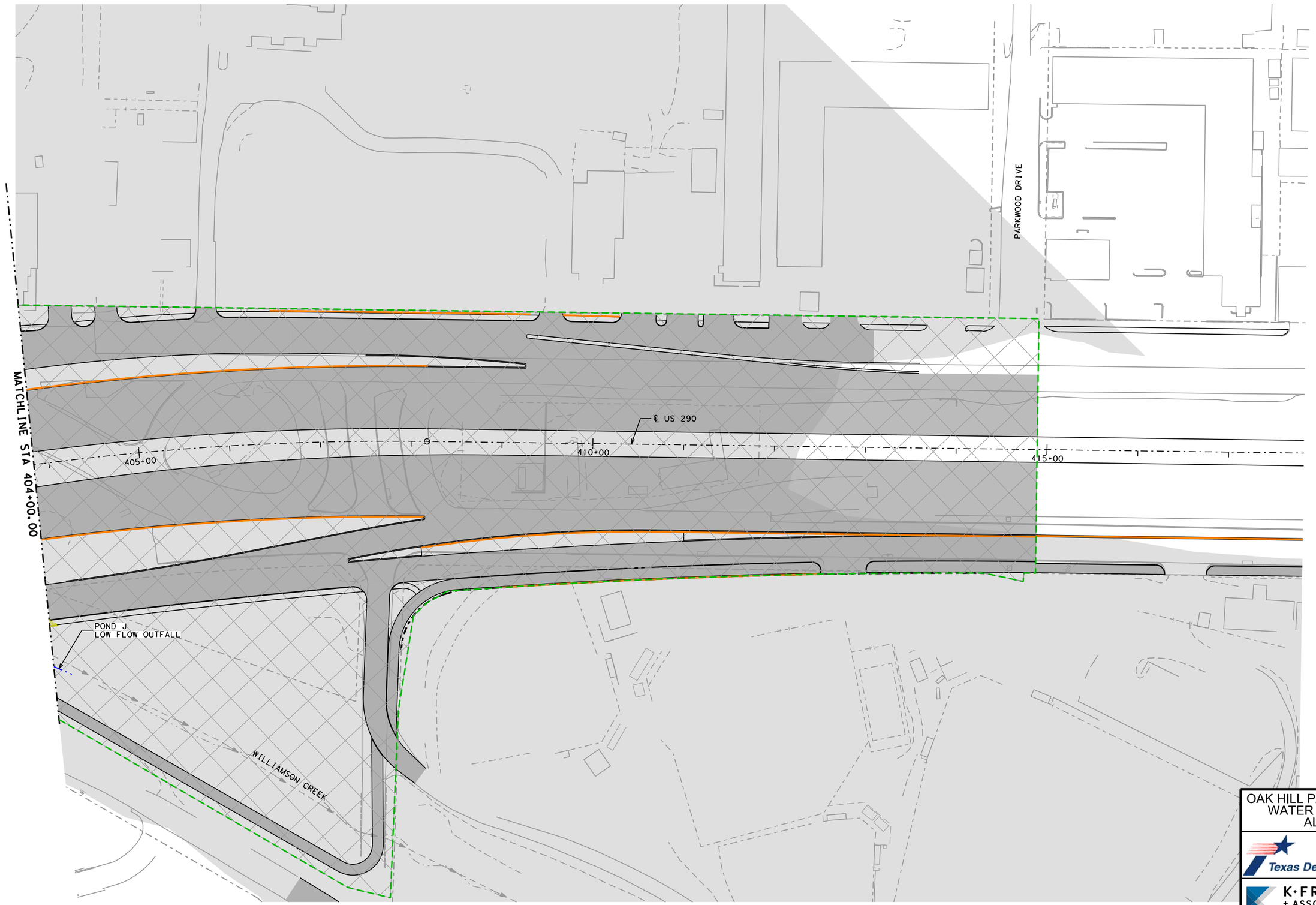

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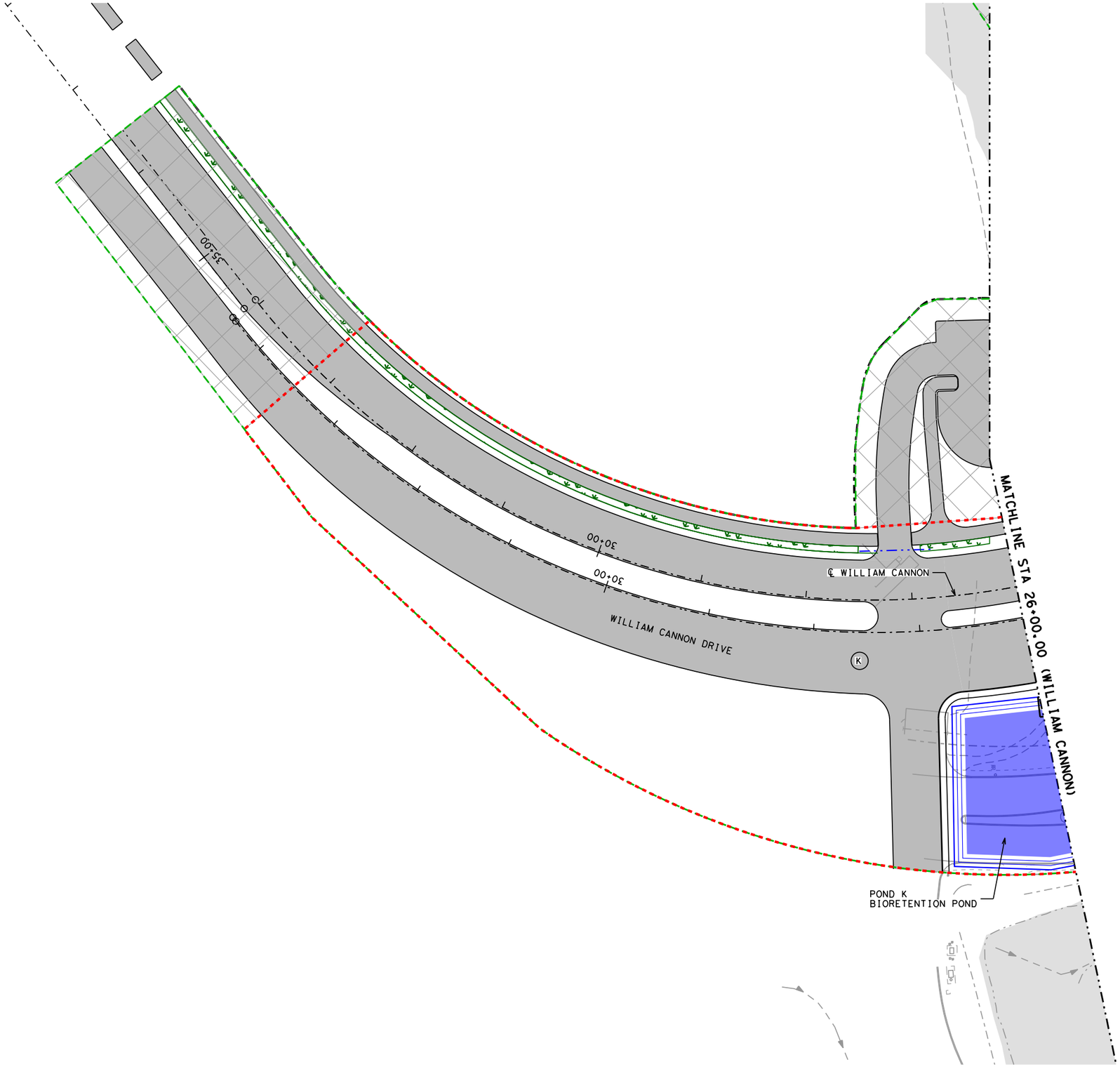

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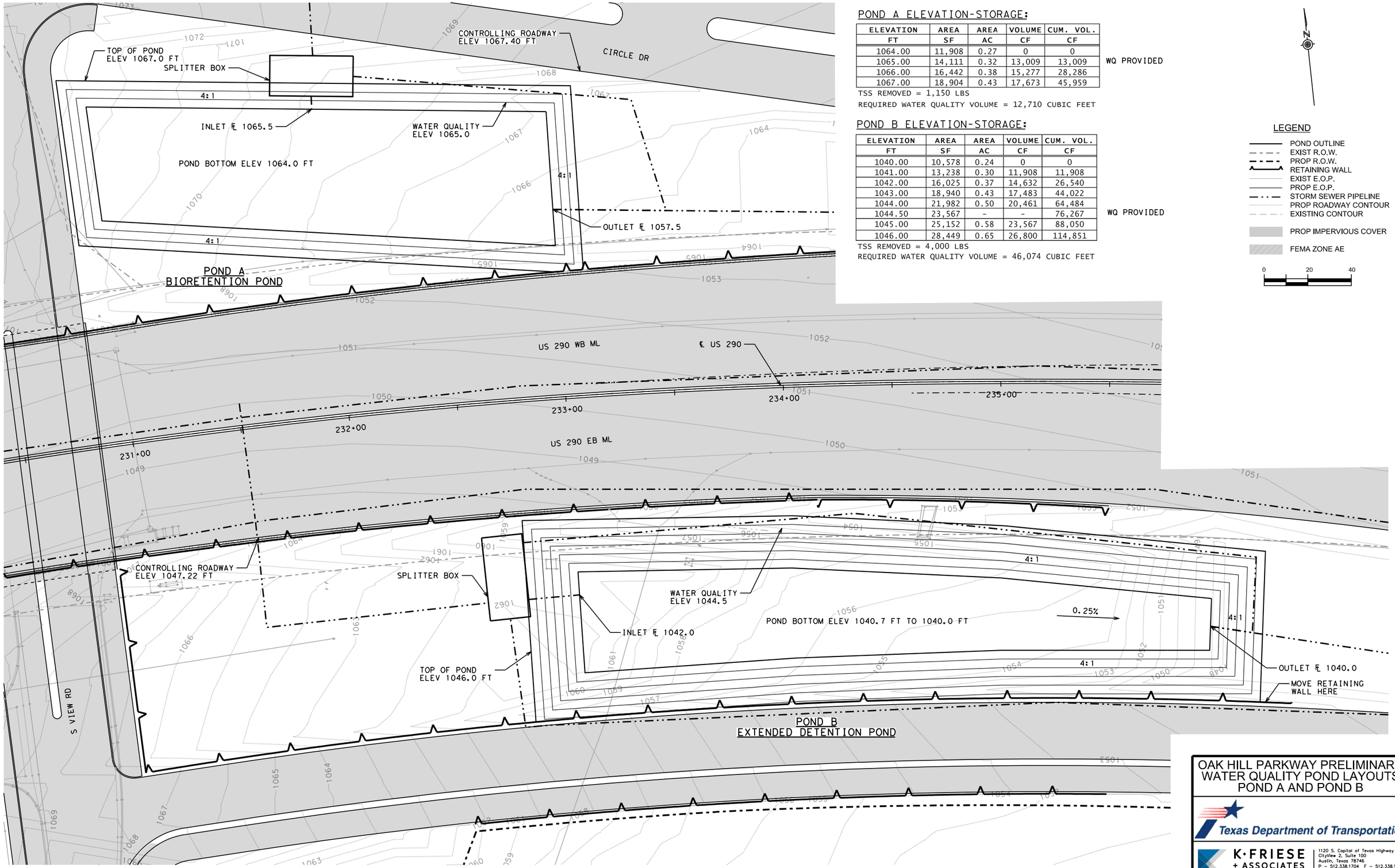
Appendix H: Preliminary Water Quality Pond Layouts – Alternative A



POND A ELEVATION-STORAGE:

ELEVATION FT	AREA SF	AREA AC	VOLUME CF	CUM. VOL. CF	
1064.00	11,908	0.27	0	0	
1065.00	14,111	0.32	13,009	13,009	WQ PROVIDED
1066.00	16,442	0.38	15,277	28,286	
1067.00	18,904	0.43	17,673	45,959	

TSS REMOVED = 1,150 LBS

REQUIRED WATER QUALITY VOLUME = 12,710 CUBIC FEET

POND B ELEVATION-STORAGE:

ELEVATION FT	AREA SF	AREA AC	VOLUME CF	CUM. VOL. CF	
1040.00	10,578	0.24	0	0	
1041.00	13,238	0.30	11,908	11,908	
1042.00	16,025	0.37	14,632	26,540	
1043.00	18,940	0.43	17,483	44,022	
1044.00	21,982	0.50	20,461	64,484	
1044.50	23,567	-	-	76,267	WQ PROVIDED
1045.00	25,152	0.58	23,567	88,050	
1046.00	28,449	0.65	26,800	114,851	

TSS REMOVED = 4,000 LBS

REQUIRED WATER QUALITY VOLUME = 46,074 CUBIC FEET

N

LEGEND

- POND OUTLINE
- EXIST R.O.W.
- PROP R.O.W.
- RETAINING WALL
- EXIST E.O.P.
- PROP E.O.P.
- STORM SEWER PIPELINE
- PROP ROADWAY CONTOUR
- EXISTING CONTOUR
- PROP IMPERVIOUS COVER
- FEMA ZONE AE

0 20 40

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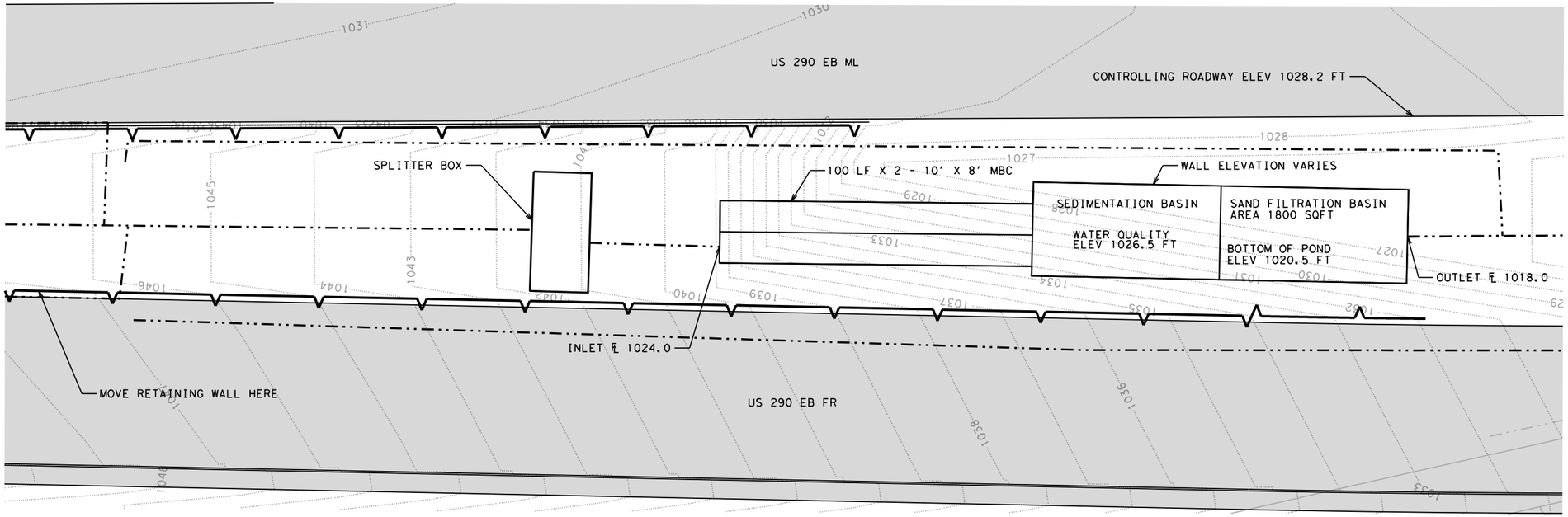
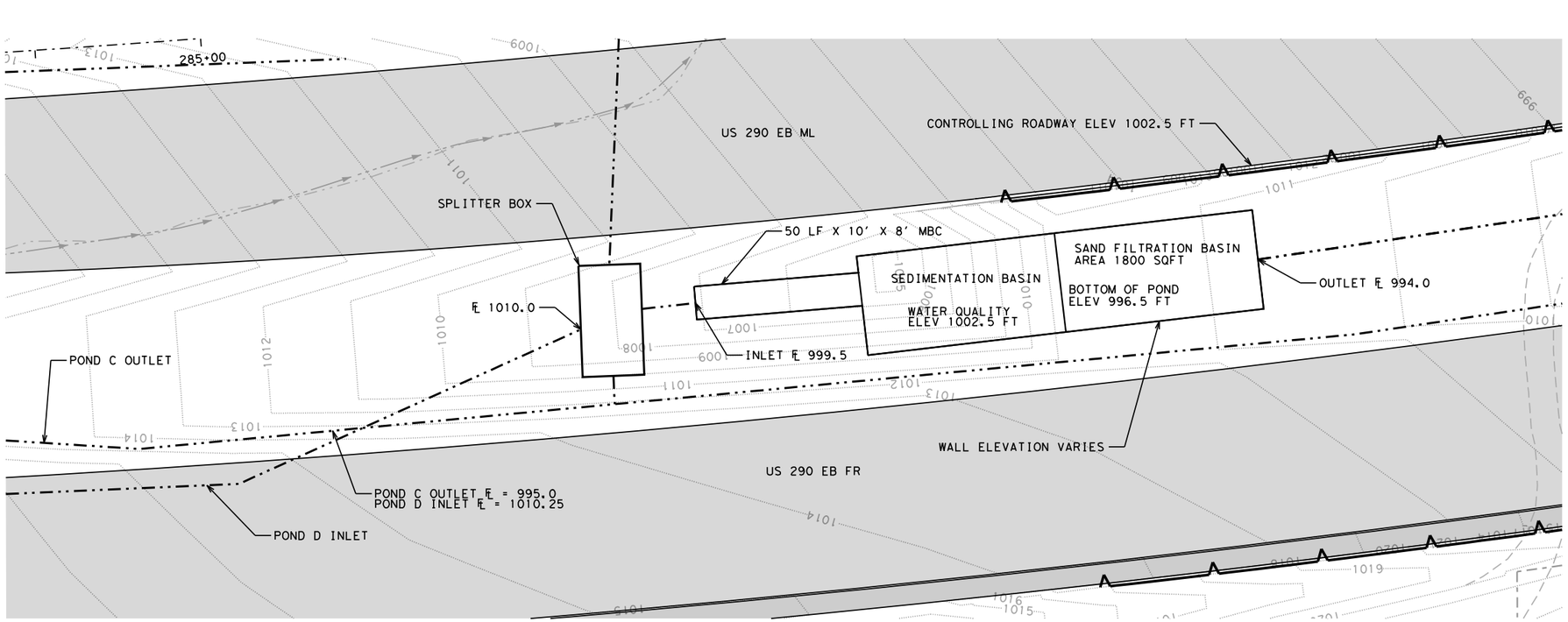


POND C
SAND FILTRATION POND



POND D
SAND FILTRATION POND

LEGEND

- POND OUTLINE
- EXIST R.O.W.
- PROP R.O.W.
- RETAINING WALL
- EXIST E.O.P.
- PROP E.O.P.
- STORM SEWER PIPELINE
- PROP ROADWAY CONTOUR
- EXISTING CONTOUR
- PROP IMPERVIOUS COVER
- FEMA ZONE AE

0 20 40

POND C ELEVATION-STORAGE:

SEDIMENTATION BASIN

ELEVATION FT	AREA SF	AREA AC	VOLUME CF	CUM. VOL. CF	
1020.50	3,800	0.09	0	0	
1021.50	3,800	0.09	3,800	3,800	
1022.50	3,800	0.09	3,800	7,600	
1023.50	3,800	0.09	3,800	11,400	
1024.50	3,800	0.09	3,800	15,200	
1025.50	3,800	0.09	3,800	19,000	
1026.50	3,800	0.09	3,800	22,800	WQ PROVIDED
1027.50	3,800	0.09	3,800	26,600	

TSS REMOVED = 6,501 LBS

REQUIRED WATER QUALITY VOLUME = 22,293 CUBIC FEET

POND D ELEVATION-STORAGE:

SEDIMENTATION BASIN

ELEVATION FT	AREA SF	AREA AC	VOLUME CF	CUM. VOL. CF	
996.50	2,300	0.05	0	0	
997.50	2,300	0.05	2,300	2,300	
998.50	2,300	0.05	2,300	4,600	
999.50	2,300	0.05	2,300	6,900	
1000.50	2,300	0.05	2,300	9,200	
1001.50	2,300	0.05	2,300	11,500	
1002.50	2,300	0.05	2,300	13,800	WQ PROVIDED
1003.50	2,300	0.05	2,300	16,100	

TSS REMOVED = 4,110 LBS

REQUIRED WATER QUALITY VOLUME = 13,683 CUBIC FEET

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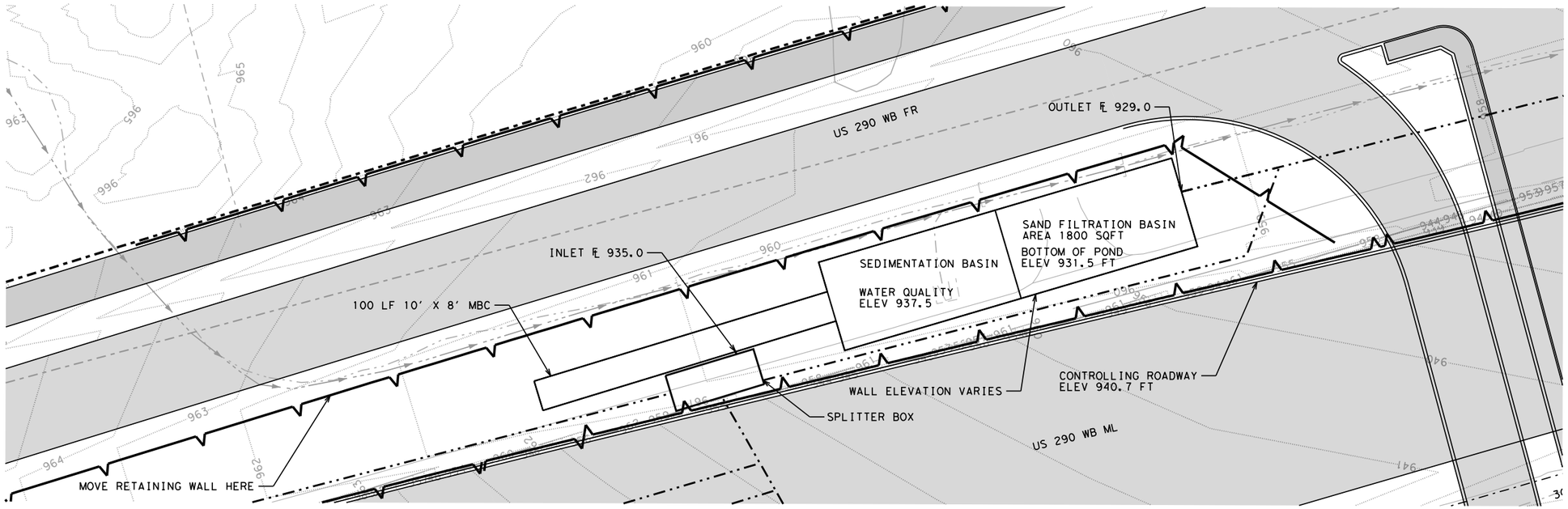
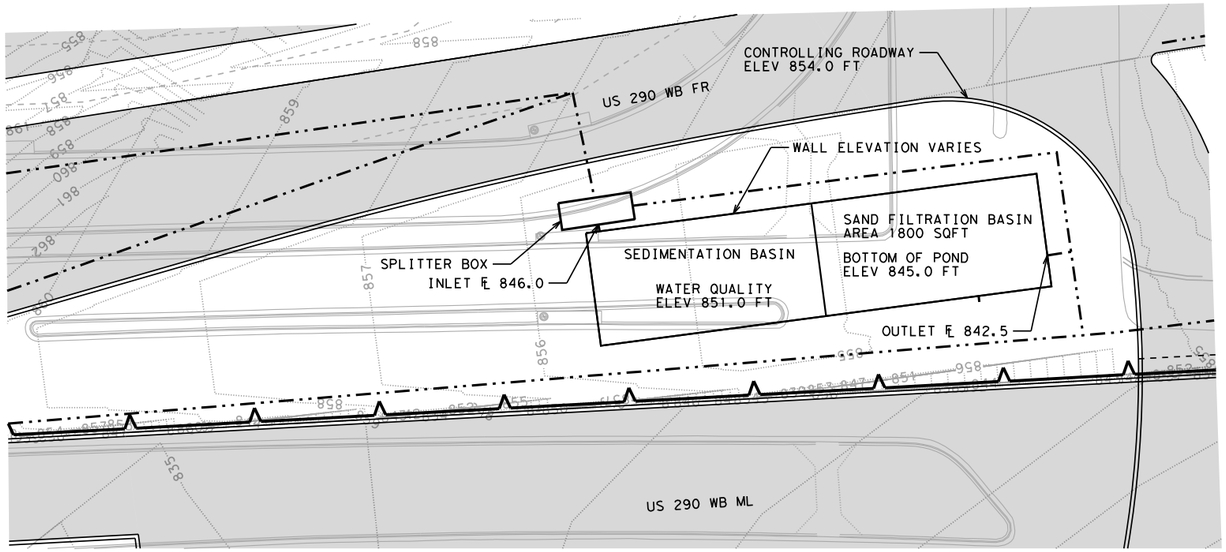


POND E
SAND FILTRATION POND



POND G
SAND FILTRATION POND

LEGEND

- POND OUTLINE
- EXIST R.O.W.
- PROP R.O.W.
- RETAINING WALL
- EXIST E.O.P.
- PROP E.O.P.
- STORM SEWER PIPELINE
- PROP ROADWAY CONTOUR
- EXISTING CONTOUR
- PROP IMPERVIOUS COVER
- FEMA ZONE AE

0 20 40

POND E ELEVATION-STORAGE:

SEDIMENTATION BASIN

ELEVATION FT	AREA SF	AREA AC	VOLUME CF	CUM. VOL. CF	
931.50	2,800	0.06	0	0	
932.50	2,800	0.06	2,800	2,800	
933.50	2,800	0.06	2,800	5,600	
934.50	2,800	0.06	2,800	8,400	
935.50	2,800	0.06	2,800	11,200	
936.50	2,800	0.06	2,800	14,000	
937.50	2,800	0.06	2,800	16,800	WQ PROVIDED
938.50	2,800	0.06	2,800	19,600	

TSS REMOVED = 5,339 LBS

REQUIRED WATER QUALITY VOLUME = 16,661 CUBIC FEET

POND G ELEVATION-STORAGE:

SEDIMENTATION BASIN

ELEVATION FT	AREA SF	AREA AC	VOLUME CF	CUM. VOL. CF	
845.00	1,800	0.04	0	0	
846.00	1,800	0.04	1,800	1,800	
847.00	1,800	0.04	1,800	3,600	
848.00	1,800	0.04	1,800	5,400	
849.00	1,800	0.04	1,800	7,200	
850.00	1,800	0.04	1,800	9,000	
851.00	1,800	0.04	1,800	10,800	WQ PROVIDED
852.00	1,800	0.04	1,800	12,600	

TSS REMOVED = 2,581 LBS

REQUIRED WATER QUALITY VOLUME = 10,725 CUBIC FEET

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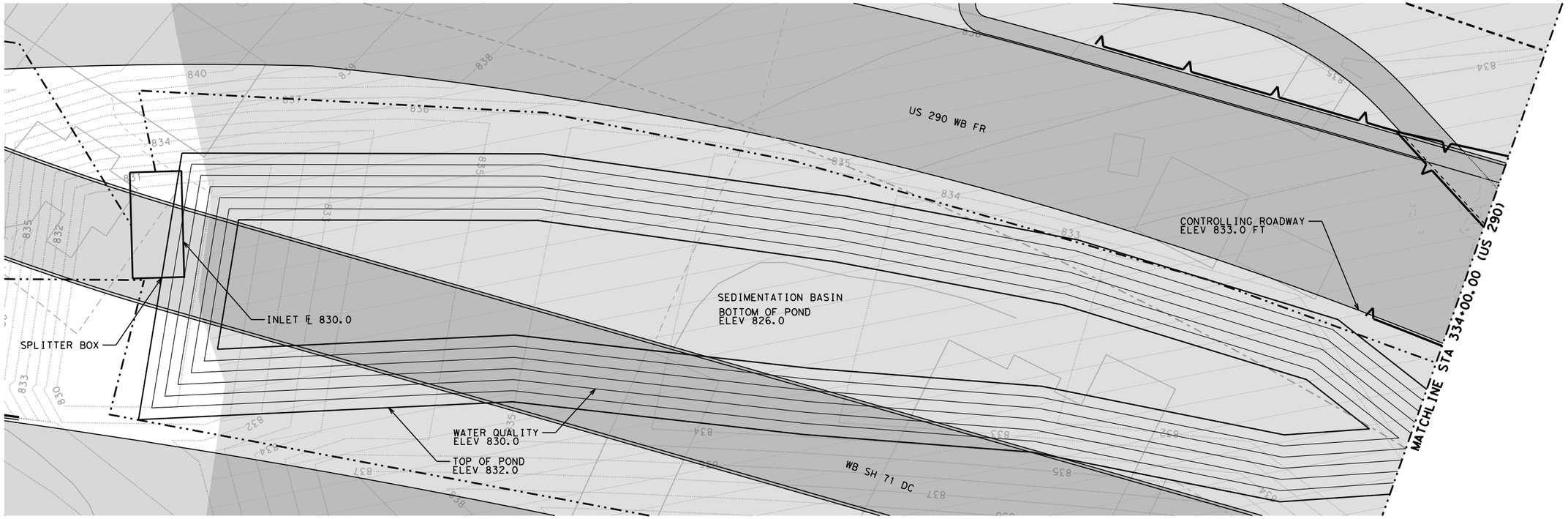
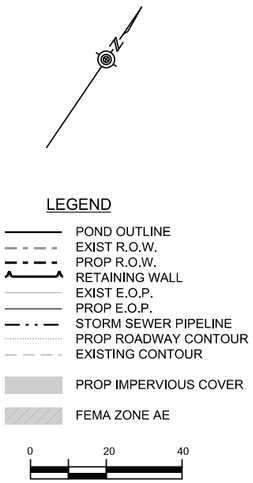
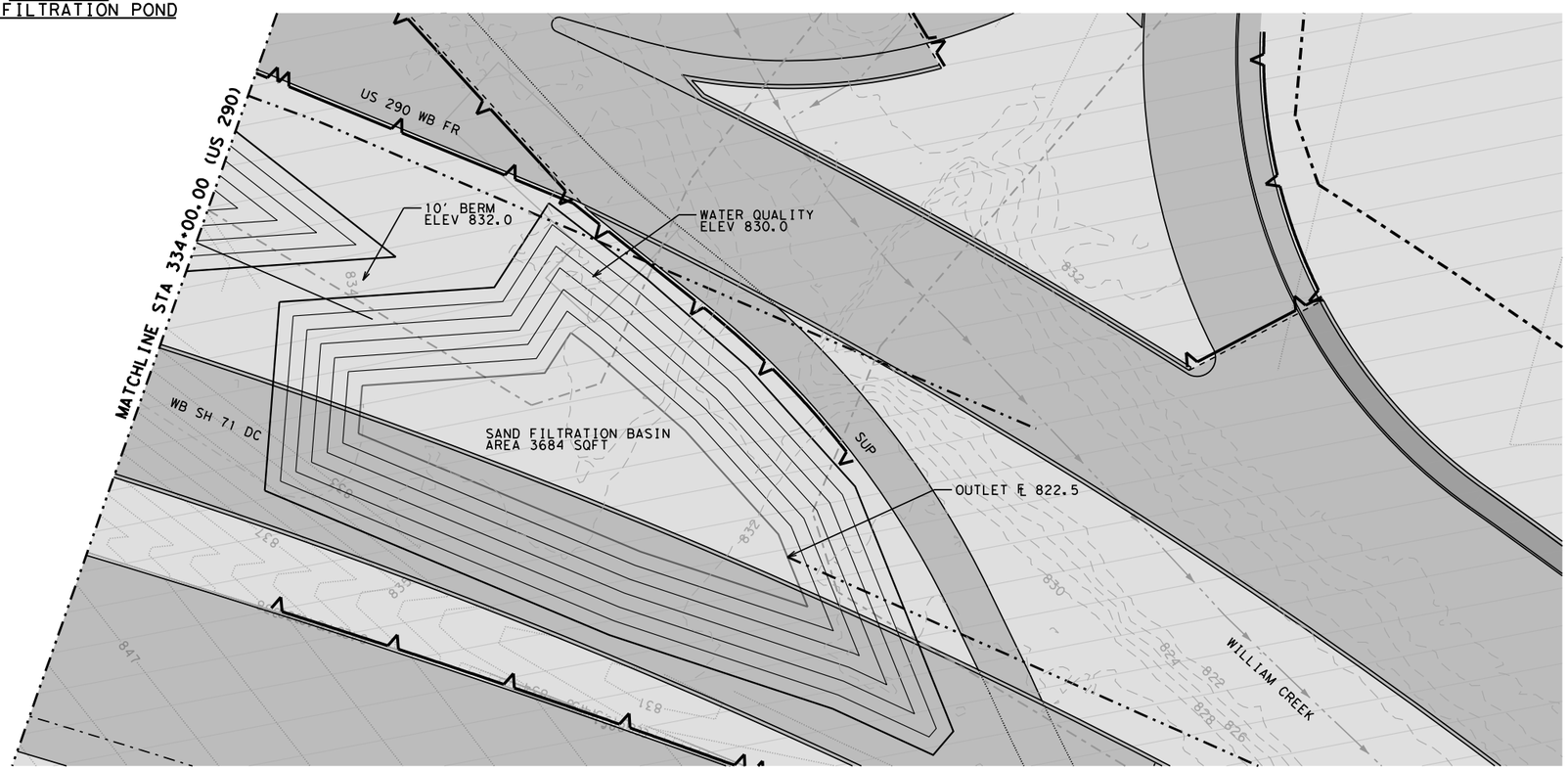




POND F(A)
SAND FILTRATION POND



POND F(A) ELEVATION-STORAGE:

SEDIMENTATION BASIN

ELEVATION FT	AREA SF	AREA AC	VOLUME CF	CUM. VOL. CF	
826.00	14,644	0.34	0	0	
827.00	18,273	0.42	16,458	16,458	
828.00	22,062	0.51	20,168	36,626	
829.00	26,013	0.60	24,038	60,664	
830.00	30,125	0.69	28,069	88,733	WQ PROVIDED
831.00	34,398	0.79	32,261	120,994	
832.00	38,831	0.89	36,614	157,608	

TSS REMOVED = 17,000 LBS

REQUIRED WATER QUALITY VOLUME = 88,605 CUBIC FEET

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POND F(A)

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- PROP E.O.P.
- STORM SEWER PIPELINE
- PROP ROADWAY CONTOUR
- EXISTING CONTOUR
- PROP IMPERVIOUS COVER
- FEMA ZONE AE

0 20 40

POND H(A) ELEVATION-STORAGE:

SEDIMENTATION BASIN

ELEVATION FT	AREA SF	AREA AC	VOLUME CF	CUM. VOL. CF	
823.50	10,613	0.24	0	0	
824.00	10,778	0.25	5,348	5,348	
825.00	11,101	0.25	10,939	16,287	
826.00	11,414	0.26	11,257	27,544	
827.00	11,717	0.27	11,565	39,110	
828.00	12,019	0.28	11,868	50,978	WQ PROVIDED
829.00	12,300	0.28	12,160	63,138	
830.00	12,581	0.29	12,440	75,578	

TSS REMOVED = 6,840 LBS

REQUIRED WATER QUALITY VOLUME = 46,290 CUBIC FEET

POND H(A)
SAND FILTRATION POND

OAK HILL PARKWAY PRELIMINARY
WATER QUALITY POND LAYOUT
POND H(A)

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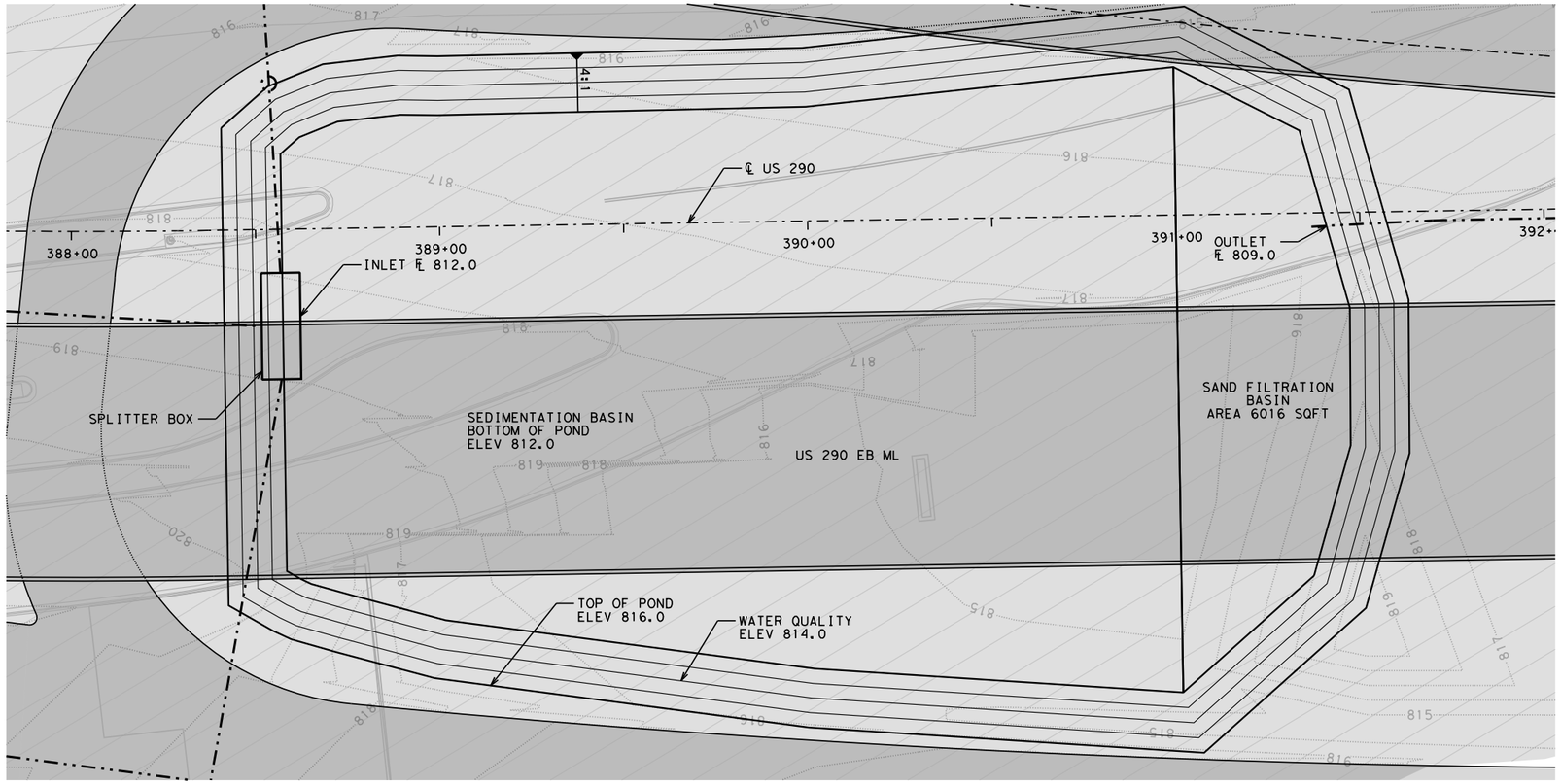
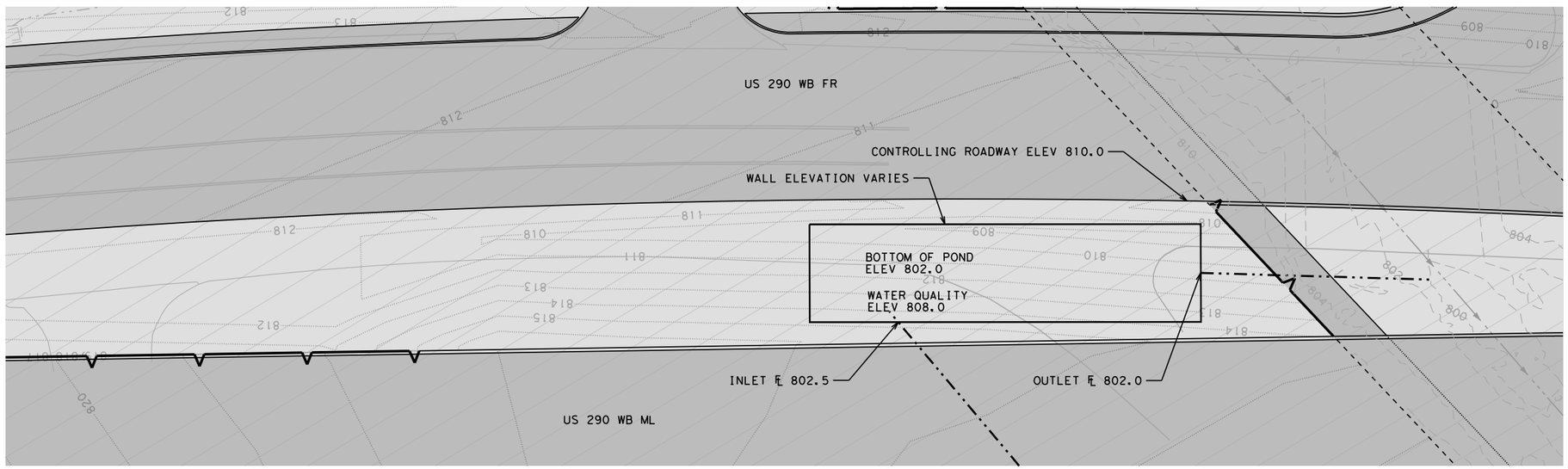
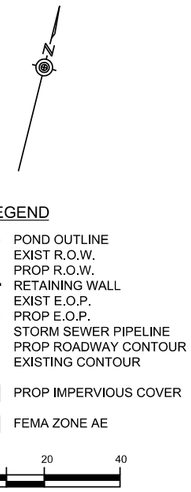


POND I(A)
SAND FILTRATION POND



POND J(A)
EXTENDED DETENTION POND



POND I(A) ELEVATION-STORAGE:
SEDIMENTATION BASIN

ELEVATION FT	AREA SF	AREA AC	VOLUME CF	CUM. VOL. CF	
812.00	36,173	0.83	0	0	
813.00	38,623	0.89	37,398	37,398	
814.00	41,126	0.94	39,874	77,272	WQ PROVIDED
815.00	43,682	1.00	42,404	119,676	
816.00	46,291	1.06	44,986	164,663	

TSS REMOVED = 9,400 LBS
REQUIRED WATER QUALITY VOLUME = 72,550 CUBIC FEET

POND J(A) ELEVATION-STORAGE:

ELEVATION FT	AREA SF	AREA AC	VOLUME CF	CUM. VOL. CF	
802.00	3,600	0.08	0	0	
803.00	3,600	0.08	3,600	3,600	
804.00	3,600	0.08	3,600	7,200	
805.00	3,600	0.08	3,600	10,800	
806.00	3,600	0.08	3,600	14,400	
807.00	3,600	0.08	3,600	18,000	
808.00	3,600	0.08	3,600	21,600	WQ PROVIDED
809.00	3,600	0.08	3,600	25,200	

TSS REMOVED = 3,004 LBS
REQUIRED WATER QUALITY VOLUME = 20,778 CUBIC FEET

OAK HILL PARKWAY PRELIMINARY WATER QUALITY POND LAYOUTS POND I(A) AND POND J(A)

Texas Department of Transportation

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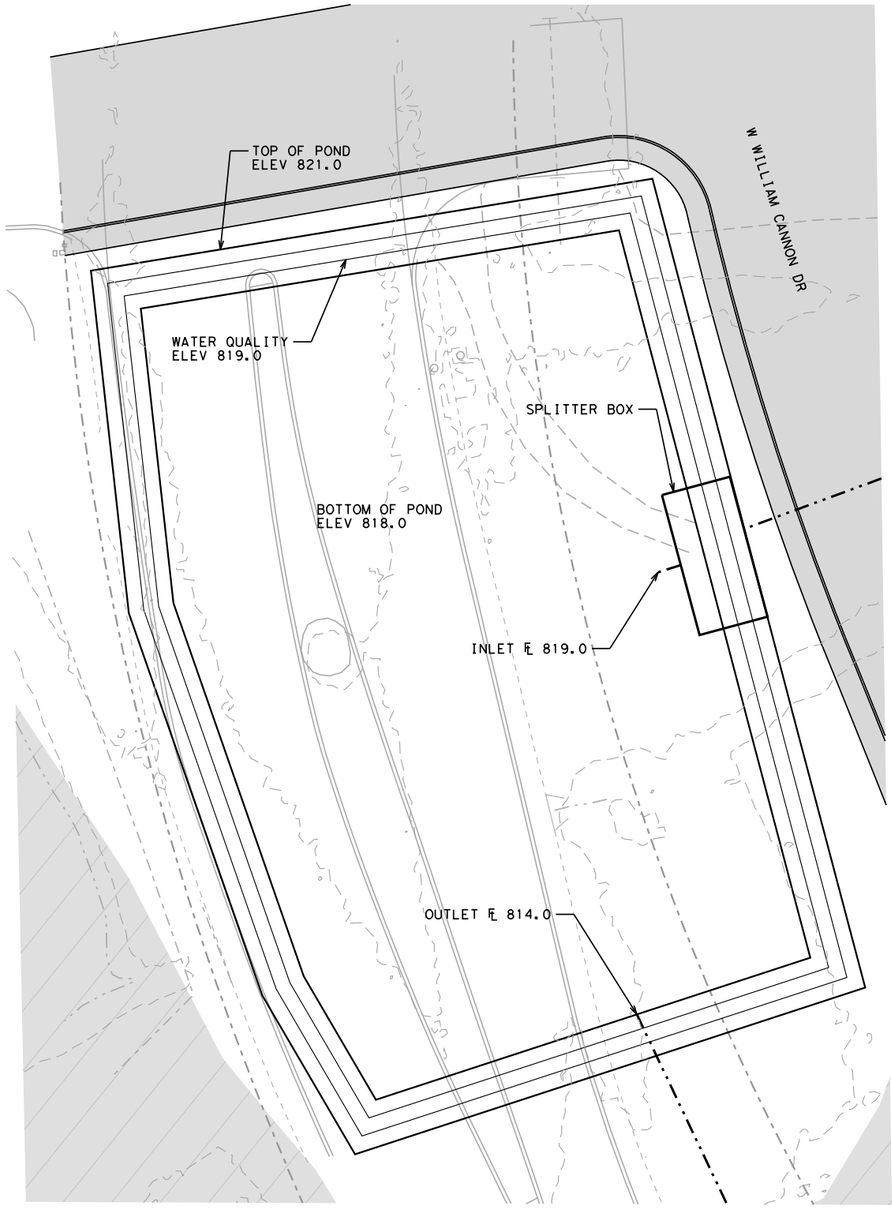


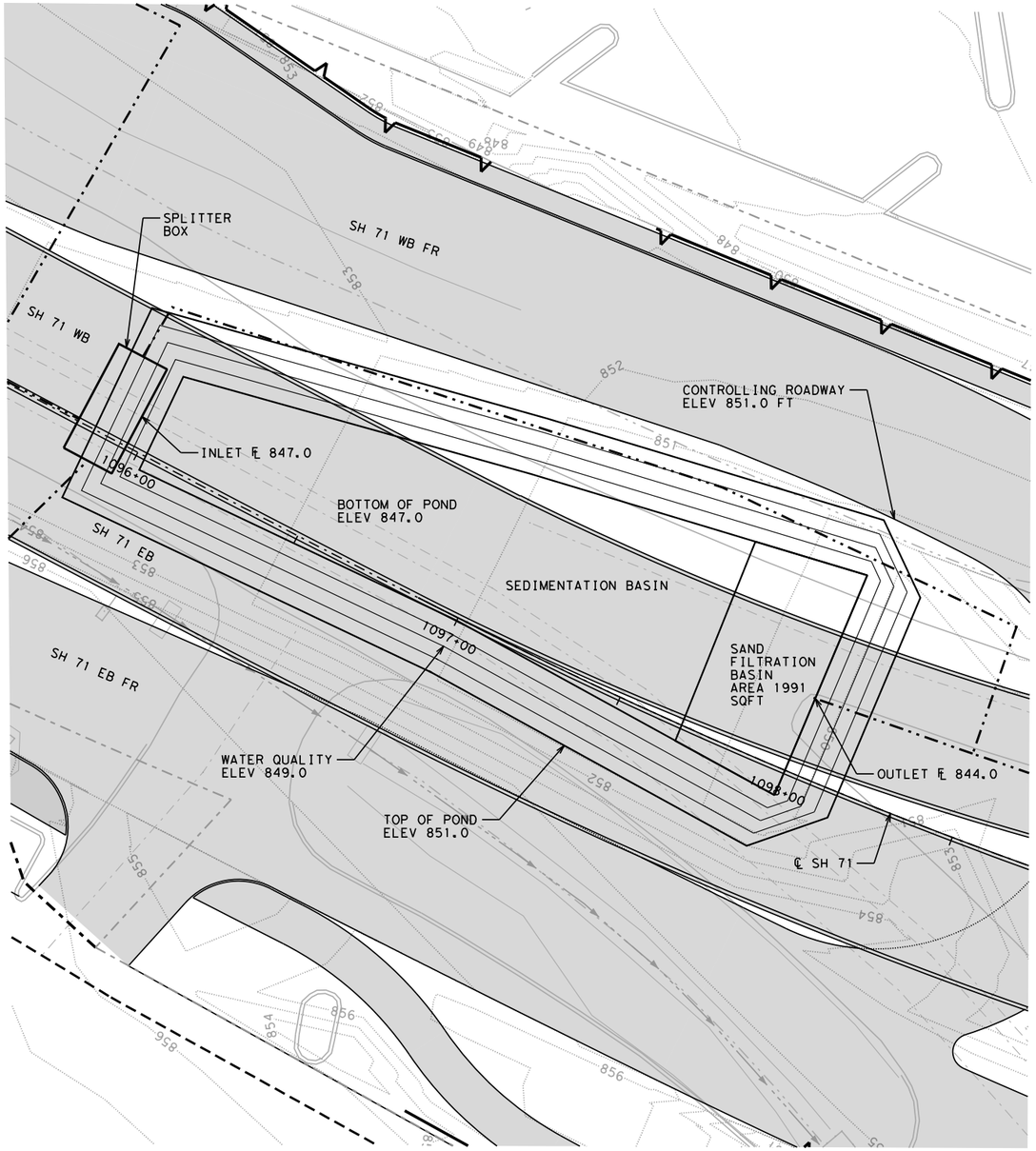
POND K
BIORETENTION POND

POND K ELEVATION-STORAGE:

ELEVATION FT	AREA SF	AREA AC	VOLUME CF	CUM. VOL. CF	
818.00	27,664	0.64	0	0	
819.00	30,395	0.70	29,030	29,030	WQ PROVIDED
820.00	33,248	0.76	31,821	60,851	
821.00	36,223	0.83	34,736	95,587	

TSS REMOVED = 2,400 LBS

REQUIRED WATER QUALITY VOLUME = 28,679 CUBIC FEET



POND L(A)
SAND FILTRATION POND

POND L(A) ELEVATION-STORAGE:

SEDIMENTATION BASIN

ELEVATION FT	AREA SF	AREA AC	VOLUME CF	CUM. VOL. CF	
847.00	7,134	0.16	0	0	
848.00	8,606	0.20	7,870	7,870	
849.00	10,140	0.23	9,373	17,243	WQ PROVIDED
850.00	11,736	0.27	10,938	28,180	
851.00	13,393	0.31	12,564	40,745	

TSS REMOVED = 2,015 LBS

REQUIRED WATER QUALITY VOLUME = 15,734 CUBIC FEET

N

LEGEND

- POND OUTLINE
- EXIST R.O.W.
- PROP R.O.W.
- RETAINING WALL
- EXIST E.O.P.
- PROP E.O.P.
- STORM SEWER PIPELINE
- PROP ROADWAY CONTOUR
- EXISTING CONTOUR
- PROP IMPERVIOUS COVER
- FEMA ZONE AE

0 20 40

OAK HILL PARKWAY PRELIMINARY
WATER QUALITY POND LAYOUTS
POND K AND POND L(A)

Texas Department of Transportation

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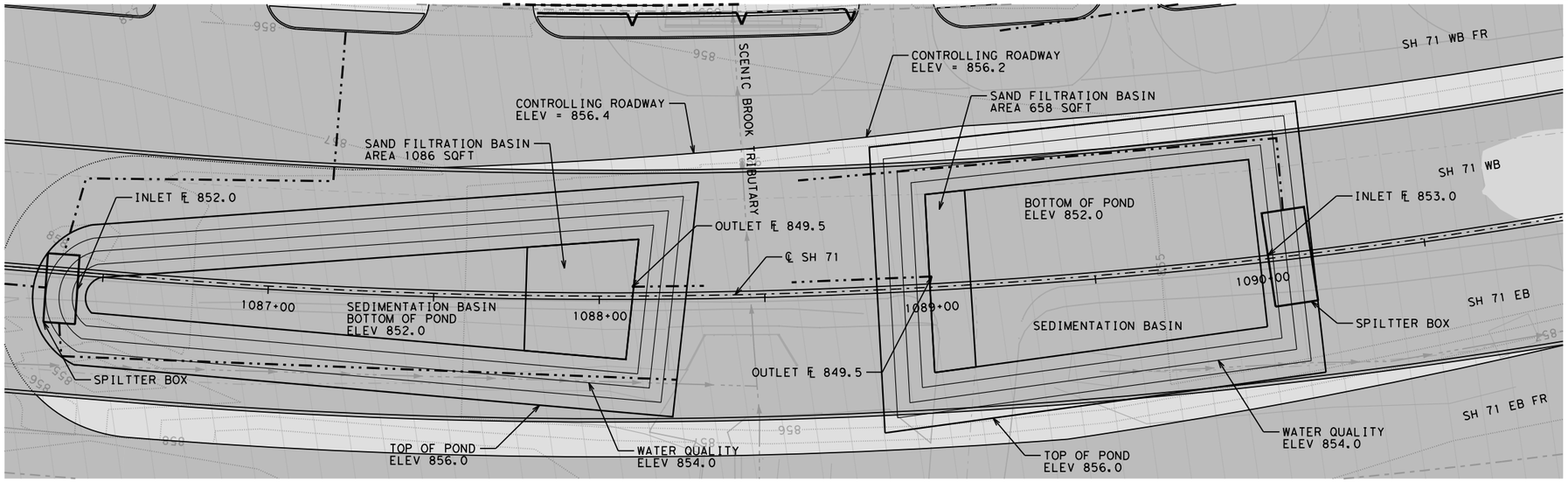
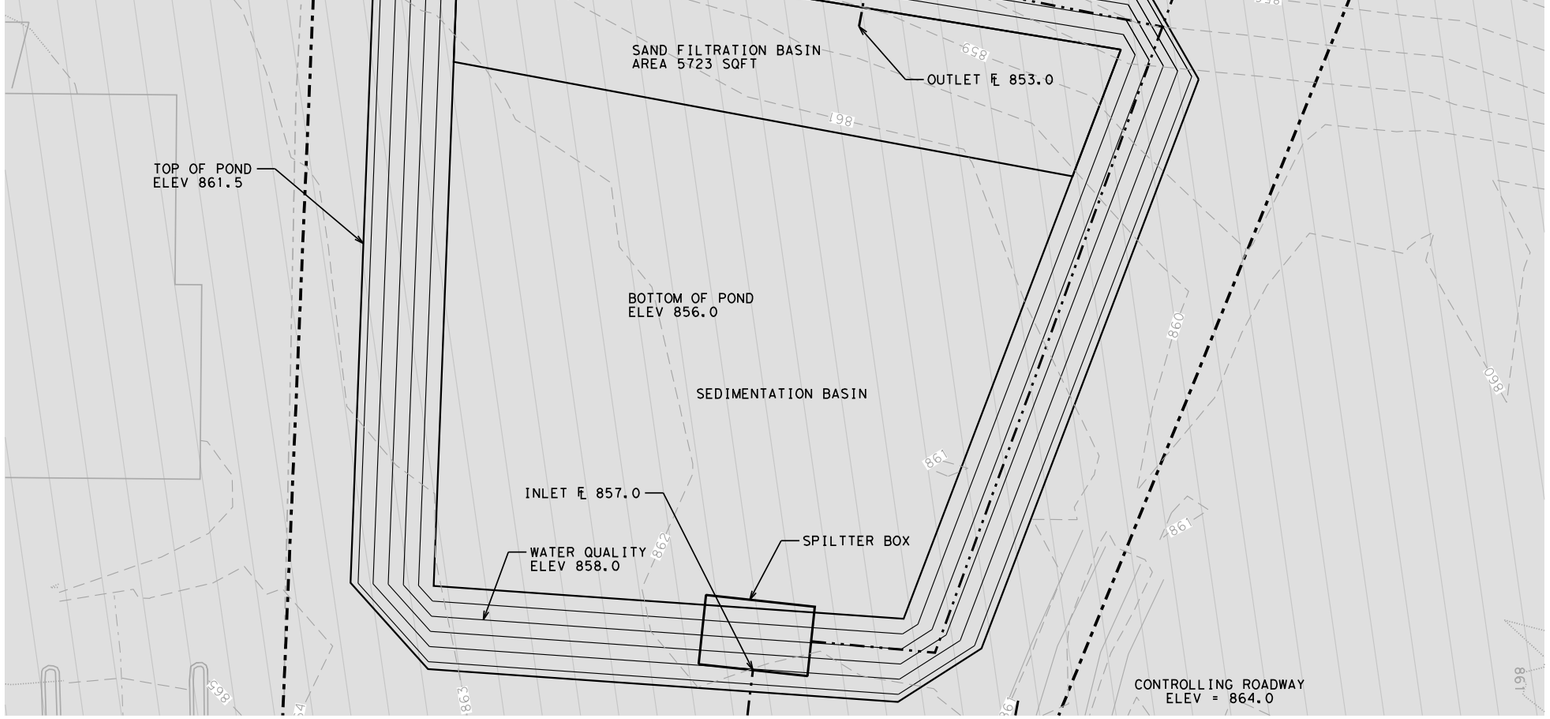


POND N
SAND FILTRATION POND

POND M
SAND FILTRATION POND



POND O
SAND FILTRATION POND

LEGEND

- POND OUTLINE
- EXIST R.O.W.
- PROP R.O.W.
- RETAINING WALL
- EXIST E.O.P.
- PROP E.O.P.
- STORM SEWER PIPELINE
- PROP ROADWAY CONTOUR
- EXISTING CONTOUR
- PROP IMPERVIOUS COVER
- FEMA ZONE AE

0 20 40

POND N ELEVATION STORAGE:

SEDIMENTATION BASIN

ELEVATION FT	AREA SF	AREA AC	VOLUME CF	CUM. VOL. CF	
852.00	2,746	0.06	0	0	
853.00	3,866	0.09	3,306	3,306	
854.00	5,037	0.12	4,452	7,758	WQ PROVIDED
855.00	6,258	0.14	5,647	13,405	
856.00	7,529	0.17	6,893	20,298	

TSS REMOVED = 990 LBS

REQUIRED WATER QUALITY VOLUME = 7,074 CUBIC FEET

POND M ELEVATION STORAGE:

SEDIMENTATION BASIN

ELEVATION FT	AREA SF	AREA AC	VOLUME CF	CUM. VOL. CF	
852.00	4,560	0.10	0	0	
853.00	5,495	0.13	5,027	5,027	
854.00	6,494	0.15	5,995	11,022	WQ PROVIDED
855.00	7,557	0.17	7,026	18,048	
856.00	8,683	0.20	8,120	26,168	

TSS REMOVED = 950 LBS

REQUIRED WATER QUALITY VOLUME = 10,563 CUBIC FEET

POND O ELEVATION STORAGE:

SEDIMENTATION BASIN

ELEVATION FT	AREA SF	AREA AC	VOLUME CF	CUM. VOL. CF	
856.00	18,826	0.43	0	0	
857.00	20,396	0.47	19,611	19,611	
858.00	22,002	0.51	21,199	40,810	WQ PROVIDED
859.00	23,645	0.54	22,824	63,633	
860.00	25,325	0.58	24,485	88,118	
861.00	27,041	0.62	26,183	114,301	
861.50	27,913	0.64	13,739	128,040	

TSS REMOVED = 4,500 LBS

REQUIRED WATER QUALITY VOLUME = 38,265 CUBIC FEET

OAK HILL PARKWAY PRELIMINARY WATER QUALITY POND LAYOUTS POND M, POND N AND POND O

Texas Department of Transportation

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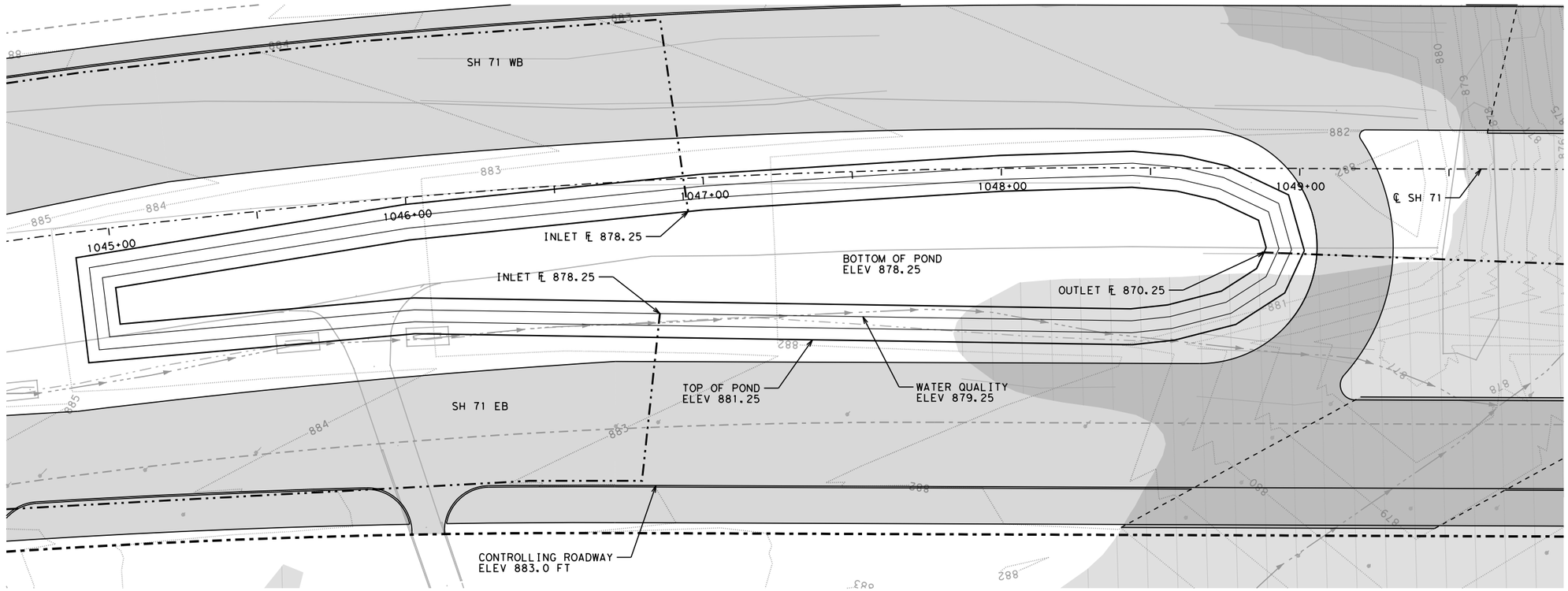
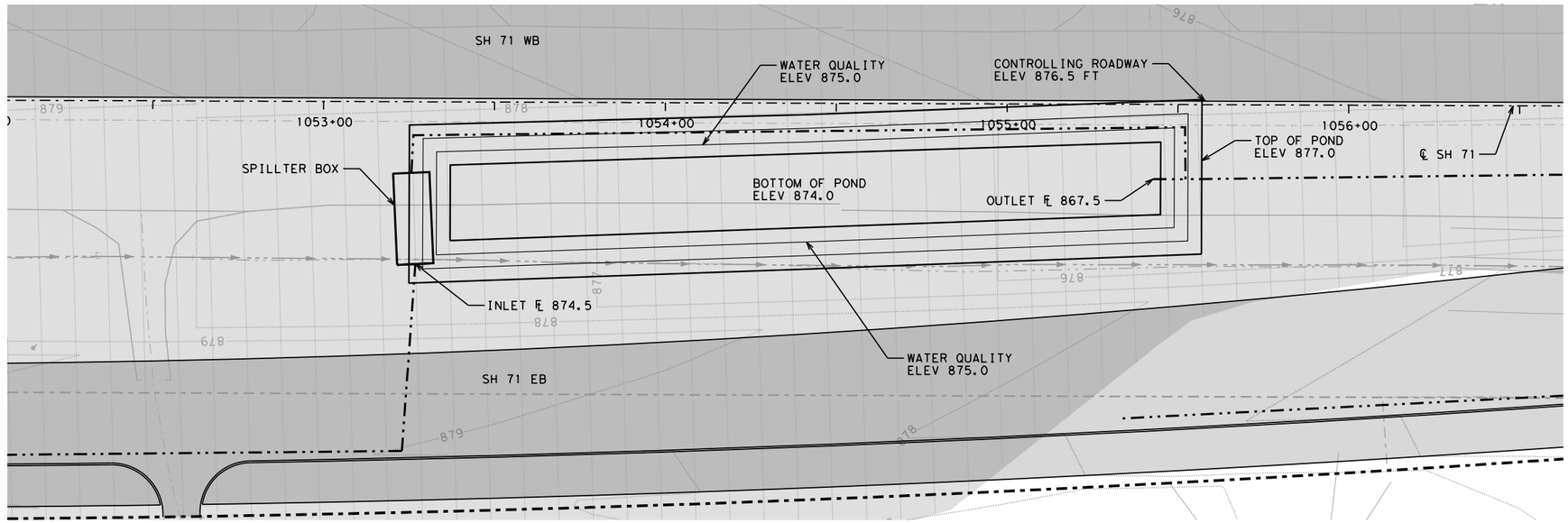


POND Q
BIORETENTION POND



POND P
BIORETENTION POND

LEGEND

- POND OUTLINE
- EXIST R.O.W.
- PROP R.O.W.
- RETAINING WALL
- EXIST E.O.P.
- PROP E.O.P.
- STORM SEWER PIPELINE
- PROP ROADWAY CONTOUR
- EXISTING CONTOUR
- PROP IMPERVIOUS COVER
- FEMA ZONE AE

0 20 40

POND Q ELEVATION-STORAGE:

ELEVATION FT	AREA SF	AREA AC	VOLUME CF	CUM. VOL. CF	
878.25	10,645	0.24	0	0	
879.25	13,904	0.32	12,275	12,275	WQ PROVIDED
880.25	17,279	0.40	15,592	27,866	
881.25	20,768	0.48	19,023	46,889	

TSS REMOVED = 2,250 LBS
REQUIRED WATER QUALITY VOLUME = 11,334 CUBIC FEET

POND P ELEVATION-STORAGE:

ELEVATION FT	AREA SF	AREA AC	VOLUME CF	CUM. VOL. CF	
874.00	4,461	0.10	0	0	
875.00	6,363	0.15	5,412	5,412	WQ PROVIDED
876.00	8,393	0.19	7,378	12,789	
877.00	10,551	0.24	9,472	22,261	

TSS REMOVED = 880 LBS
REQUIRED WATER QUALITY VOLUME = 5,118 CUBIC FEET

OAK HILL PARKWAY PRELIMINARY WATER QUALITY POND LAYOUTS POND P AND POND Q

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Appendix I: Preliminary Water Quality Pond Layouts – Alternative C

POND F(C) ELEVATION-STORAGE:

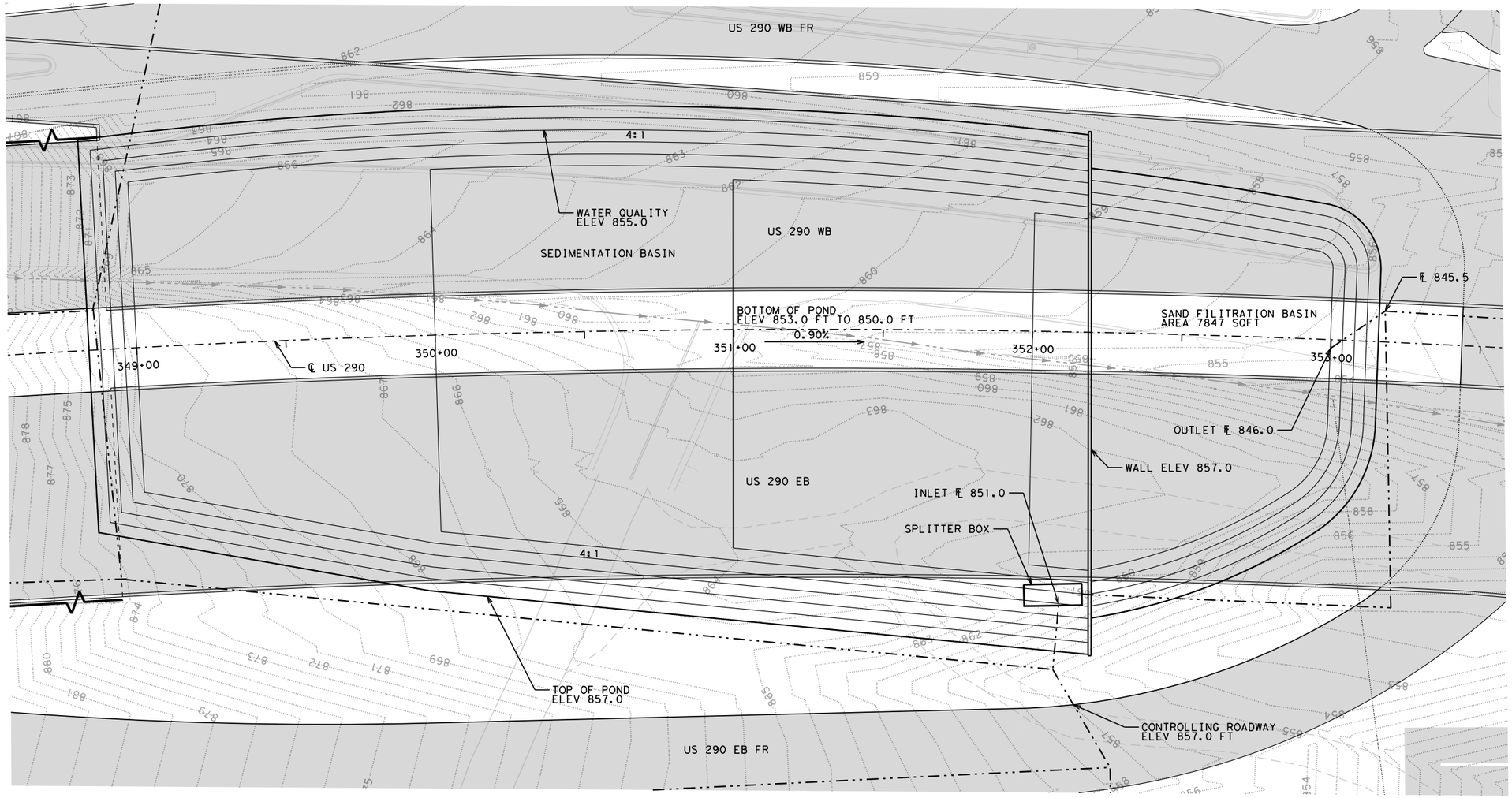
SEDIMENTATION BASIN

ELEVATION	AREA	AREA	VOLUME	CUM. VOL.
FT	SF	AC	CF	CF
850.00	2,234	0.05	0	0
851.00	14,914	0.34	8,574	8,574
852.00	28,500	0.65	21,707	30,281
853.00	41,996	0.96	35,248	65,529
854.00	45,005	1.03	43,501	109,029
855.00	48,075	1.10	46,540	155,569
856.00	51,203	1.18	49,639	205,208
857.00	54,393	1.25	52,798	258,006

WQ PROVIDED

TSS REMOVED = 26,000 LBS

REQUIRED WATER QUALITY VOLUME = 148,130 CUBIC FEET



POND F(C)
SAND FILTRATION POND

LEGEND

- POND OUTLINE
- EXIST R.O.W.
- PROP R.O.W.
- RETAINING WALL
- EXIST E.O.P.
- PROP E.O.P.
- STORM SEWER PIPELINE
- PROP ROADWAY CONTOUR
- EXISTING CONTOUR
- PROP IMPERVIOUS COVER
- FEMA ZONE AE

0 20 40

OAK HILL PARKWAY PRELIMINARY
WATER QUALITY POND LAYOUT
POND F(C)

Texas Department of Transportation

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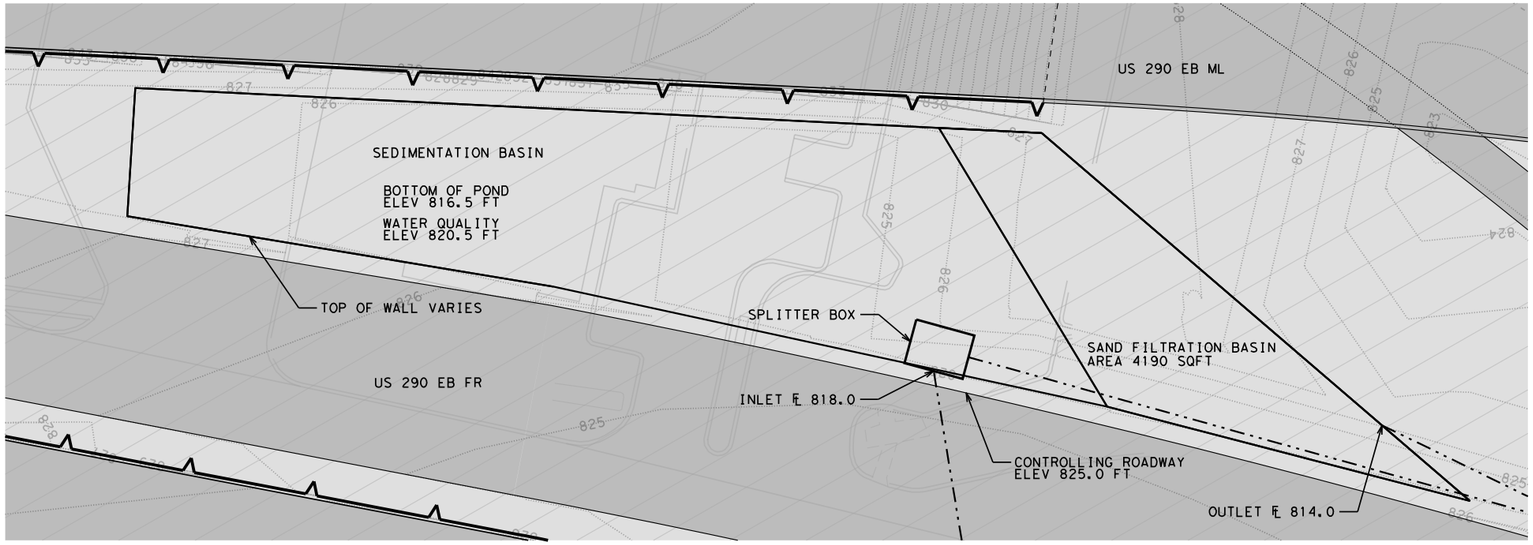
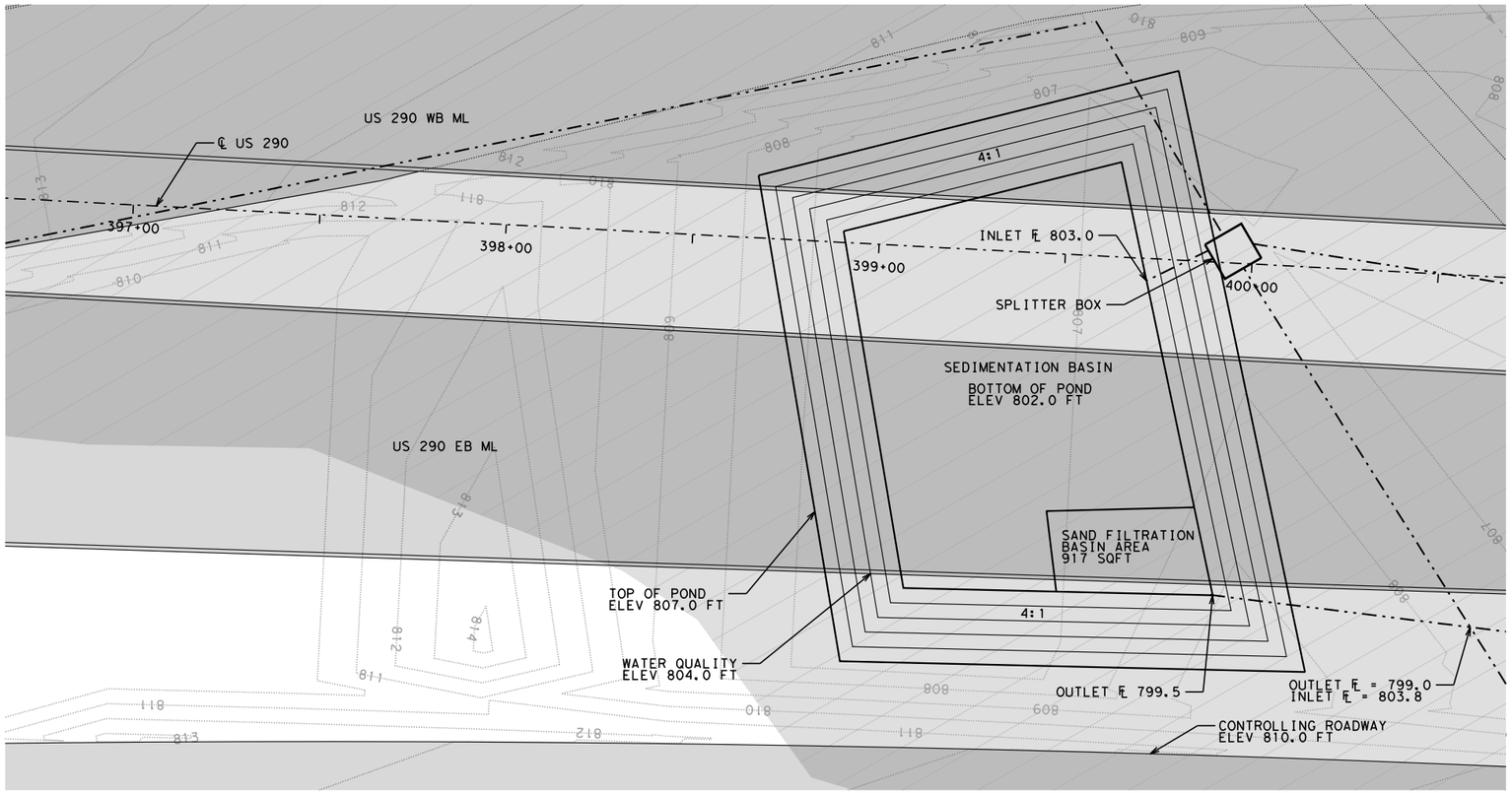
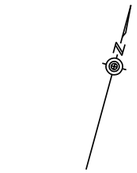


POND H(C)
SAND FILTRATION POND



POND J(C)
SAND FILTRATION POND



LEGEND

- POND OUTLINE
- EXIST R.O.W.
- PROP R.O.W.
- RETAINING WALL
- EXIST E.O.P.
- PROP E.O.P.
- STORM SEWER PIPELINE
- PROP ROADWAY CONTOUR
- EXISTING CONTOUR
- PROP IMPERVIOUS COVER
- FEMA ZONE AE

0 20 40

POND H(C) ELEVATION-STORAGE:

SEDIMENTATION BASIN

ELEVATION FT	AREA SF	AREA AC	VOLUME CF	CUM. VOL. CF	
816.50	11,490	0.26	0	0	
817.50	11,490	0.26	11,490	11,490	
818.50	11,490	0.26	11,490	22,980	
819.50	11,490	0.26	11,490	34,470	
820.50	11,490	0.26	11,490	45,960	WQ PROVIDED
821.50	11,490	0.26	11,490	57,450	
822.50	11,490	0.26	11,490	68,940	

TSS REMOVED = 6,750 LBS
REQUIRED WATER QUALITY VOLUME = 45,233 CUBIC FEET

POND J(C) ELEVATION-STORAGE:

SEDIMENTATION BASIN

ELEVATION FT	AREA SF	AREA AC	VOLUME CF	CUM. VOL. CF	
802.00	7,575	0.17	0	0	
803.00	8,860	0.20	8,218	8,218	
804.00	10,238	0.24	9,549	17,767	WQ PROVIDED
805.00	11,711	0.27	10,975	28,741	
806.00	13,279	0.30	12,495	41,236	
807.00	14,930	0.34	14,105	55,341	

TSS REMOVED = 3,200 LBS
REQUIRED WATER QUALITY VOLUME = 16,185 CUBIC FEET

OAK HILL PARKWAY PRELIMINARY WATER QUALITY POND LAYOUTS POND H(C) AND POND J(C)

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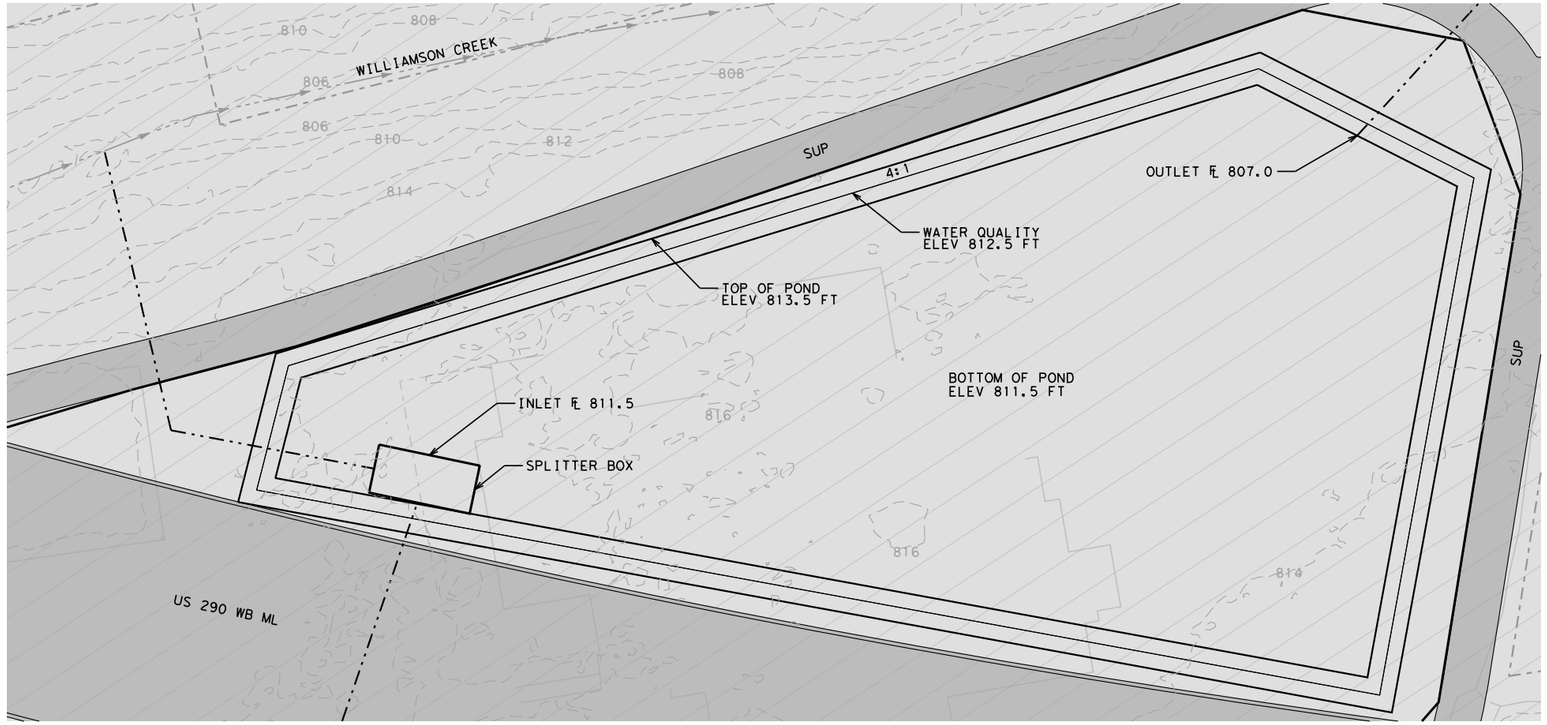
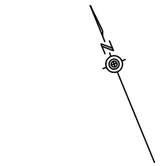


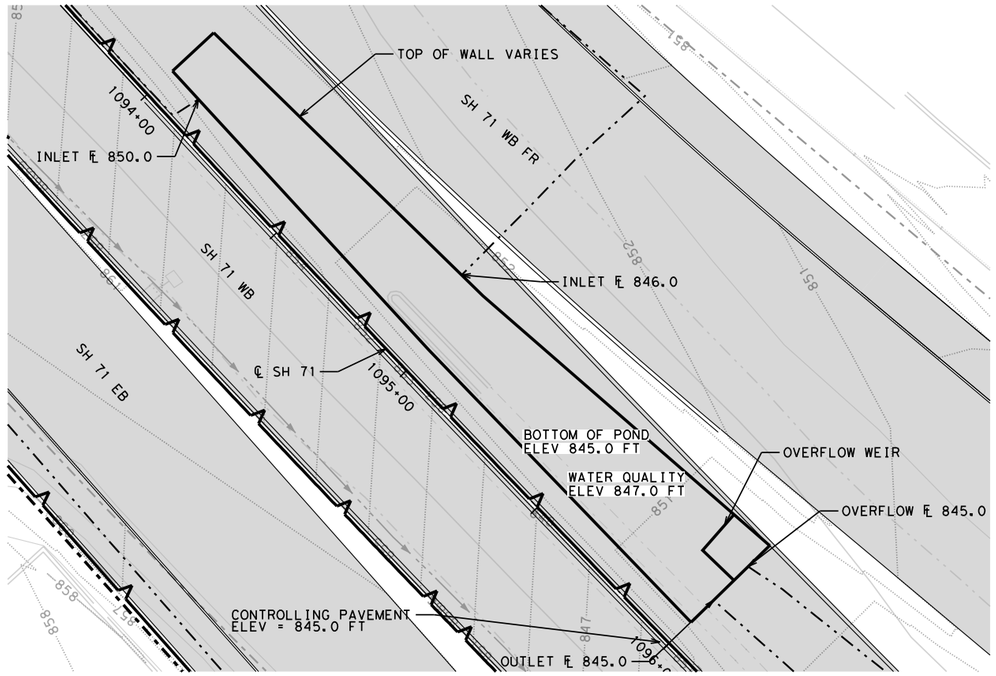


LEGEND

- POND OUTLINE
- EXIST R.O.W.
- PROP R.O.W.
- RETAINING WALL
- EXIST E.O.P.
- PROP E.O.P.
- STORM SEWER PIPELINE
- PROP ROADWAY CONTOUR
- EXISTING CONTOUR
- PROP IMPERVIOUS COVER
- FEMA ZONE AE

0 20 40

POND I(C)
BIORETENTION POND



POND L(C)
EXTENDED DETENTION POND

POND I(C) ELEVATION-STORAGE:

ELEVATION FT	AREA SF	AREA AC	VOLUME CF	CUM. VOL. CF	
811.50	28,600	0.66	0	0	
812.50	31,760	0.73	30,180	30,180	WQ PROVIDED
813.50	35,000	0.80	33,380	63,560	

TSS REMOVED = 5,700 LBS

REQUIRED WATER QUALITY VOLUME = 28,974 CUBIC FEET

POND L(C) ELEVATION-STORAGE:

ELEVATION FT	AREA SF	AREA AC	VOLUME CF	CUM. VOL. CF	
845.00	4,200	0.10	0	0	
846.00	4,200	0.10	4,200	4,200	
847.00	4,200	0.10	4,200	8,400	WQ PROVIDED
848.00	4,200	0.10	4,200	12,600	
849.00	4,200	0.10	4,200	16,800	

TSS REMOVED = 1,040 lbs

REQUIRED WATER QUALITY VOLUME = 8,022 CUBIC FEET

OAK HILL PARKWAY PRELIMINARY WATER QUALITY POND LAYOUTS POND I(C) AND POND L(C)

Texas Department of Transportation

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Appendix J: Water Quality Calculations Spreadsheet – Alternative A

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2014

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:
$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.89	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches
$L_{M\ TOTAL\ PROJECT}$ =	64405	lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 19

1.1. Treatment provided by Existing BMPs:

Existing treatment from SH 71 PFC= 8546
Existing treatment from US 290 PFC= 9883

1.2. Credit due to removed impervious cover:

Existing storage area load= -4405

1.3. Total Required Load Reduction:

$L_{M\ TOTAL\ PROJECT}$ = 78428

Total Load Removal Provided:

Treatment Area	Description	Load Removed
VFS RDWY	Vegetative filter strips along pavement edge	6505 lbs
VFS SUP	Vegetative filter strips along SUP and sidewalk edge	2421 lbs
Pond A	Pond along North Side of US 290 East of Circle Drive	1150 lbs
Pond B	Pond along South Side of US 290 East of Circle Drive	4000 lbs
Pond C	Pond along South Side of US 290 west of RM 1826	6501 lbs
Pond D	Pond along South Side of US 290 west of RM 18276	4110 lbs
Pond E	Pond along South Side of US 290 west of RM 1826	5339 lbs
Pond F	Pond along nouth Side of US 290 east of SH 71 (before creek)	17000 lbs
Pond G	Just West of the SH 71 and US 290 Interchange	2581 lbs
Pond H	Just East of the SH 71 and US 290 Interchange	6840 lbs
Pond I	Pond along US 290 median east of William Cannon	9400 lbs
Pond J	East of William Cannon before Williamson Creek	3004 lbs
Pond K	Pond along William Cannon (near Freescale)	2400 lbs
Pond L	SH 71 median near US 290 (HEB)	2015 lbs
Pond M	SH 71 median near Hill Meadow / Scenic Brook	950 lbs
Pond N	SH 71 median near Hill Meadow / Scenic Brook	990 lbs
Pond O	East side of SH 71 in purchased ROW	4500 lbs
Pond P	SH 71 median east of Williamson Creek	880 lbs
Pond Q	SH 71 median west of Williamson Creek	2250 lbs
	Total TSS Removed	**82837 lbs**

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2014

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.89	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches
$L_{M\ TOTAL\ PROJECT}$ =	78428	lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin):

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 =	0.00	
$L_{M\ THIS\ BASIN}$ =	-4405	lbs.

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2014

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.89	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches

$L_{M\ TOTAL\ PROJECT}$ = **78428** lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = **19**

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = 71 EX PFC

Total drainage basin/outfall area =	8.58	acres
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres
Post-development impervious area within drainage basin/outfall area =	8.58	acres
Post-development impervious fraction within drainage basin/outfall area =	1.00	
$L_{M\ THIS\ BASIN}$ =	7464	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Permeable Friction Course
Removal efficiency = 90 percent

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	8.58	acres
A_I =	8.58	acres
A_P =	0.00	acres
L_R =	8546	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 8546 lbs.

F = **1.00**

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2014

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.89	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches

$L_{M\ TOTAL\ PROJECT}$ = **78428** lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = **19**

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = 290 EX PFC

Total drainage basin/outfall area =	9.92	acres
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres
Post-development impervious area within drainage basin/outfall area =	9.92	acres
Post-development impervious fraction within drainage basin/outfall area =	1.00	
$L_{M\ THIS\ BASIN}$ =	8632	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Permeable Friction Course
Removal efficiency = 90 percent

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	9.92	acres
A_I =	9.92	acres
A_P =	0.00	acres
L_R =	9883	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 9883 lbs.

F = **1.00**

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2014

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.89	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches

$L_{M\ TOTAL\ PROJECT}$ = **78428** lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = **19**

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = VFS

Total drainage basin/outfall area =	6.91	acres
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres
Post-development impervious area within drainage basin/outfall area =	6.91	acres
Post-development impervious fraction within drainage basin/outfall area =	1.00	
$L_{M\ THIS\ BASIN}$ =	6016	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = **Vegetated Filter Strips**
Removal efficiency = 85 percent

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	6.91	acres
A_I =	6.91	acres
A_P =	0.00	acres
L_R =	6505	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 6505 lbs.

F = **1.00**

16. Vegetated Filter Strips Designed as Required in RG-348 Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips.
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%.

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348.

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2014

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.89	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches

$L_{M\ TOTAL\ PROJECT}$ = **78428** lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = **19**

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = **SUP/SW**

Total drainage basin/outfall area =	2.57	acres
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres
Post-development impervious area within drainage basin/outfall area =	2.57	acres
Post-development impervious fraction within drainage basin/outfall area =	1.00	
$L_{M\ THIS\ BASIN}$ =	2239	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = **Vegetated Filter Strips**
Removal efficiency = **85** percent

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	2.57	acres
A_I =	2.57	acres
A_P =	0.00	acres
L_R =	2421	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = **2421** lbs.

F = **1.00**

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2014

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.89	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches
$L_{M\ TOTAL\ PROJECT}$ =	78428	lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = Pond A

Total drainage basin/outfall area =	2.78	acres
Predevelopment impervious area within drainage basin/outfall area =	0.94	acres
Post-development impervious area within drainage basin/outfall area =	1.16	acres
Post-development impervious fraction within drainage basin/outfall area =	0.42	
$L_{M\ THIS\ BASIN}$ =	191	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Bioretention
Removal efficiency = 89 percent

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	2.78	acres
A_I =	1.16	acres
A_P =	1.62	acres
L_R =	1168	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ =	**1150**	lbs.
F =	**0.98**	

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	**3.33**	inches
Post Development Runoff Coefficient =	**0.32**	
On-site Water Quality Volume =	**10592**	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	**0.00**	acres
Off-site Impervious cover draining to BMP =	**0.00**	acres
Impervious fraction of off-site area =	**0**	
Off-site Runoff Coefficient =	**0.00**	
Off-site Water Quality Volume =	**0**	cubic feet
Storage for Sediment =	**2118**	
Total Capture Volume (required water quality volume(s) x 1.20) =	**12710**	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin =	**12710**	cubic feet

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2014

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.89	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches
$L_{M\ TOTAL\ PROJECT}$ =	78428	lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = Pond B

Total drainage basin/outfall area =	7.38	acres
Predevelopment impervious area within drainage basin/outfall area =	2.86	acres
Post-development impervious area within drainage basin/outfall area =	4.95	acres
Post-development impervious fraction within drainage basin/outfall area =	0.67	
$L_{M\ THIS\ BASIN}$ =	1819	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Extended Detention
Removal efficiency = 75 percent

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	7.38	acres
A_I =	4.95	acres
A_P =	2.43	acres
L_R =	4142	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = **4000** lbs.

F = **0.97**

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth = **3.00** inches
Post Development Runoff Coefficient = **0.48**
On-site Water Quality Volume = **38395** cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP = **0.00** acres
Off-site Impervious cover draining to BMP = **0.00** acres
Impervious fraction of off-site area = **0**
Off-site Runoff Coefficient = **0.00**
Off-site Water Quality Volume = **0** cubic feet

Storage for Sediment = **7679**
Total Capture Volume (required water quality volume(s) x 1.20) = **46074** cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = **46074** cubic feet

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2014

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.89	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches
$L_{M\ TOTAL\ PROJECT}$ =	78428	lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = Pond C

Total drainage basin/outfall area =	13.59	acres
Predevelopment impervious area within drainage basin/outfall area =	2.34	acres
Post-development impervious area within drainage basin/outfall area =	9.64	acres
Post-development impervious fraction within drainage basin/outfall area =	0.71	
$L_{M\ THIS\ BASIN}$ =	6354	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Sand Filter
Removal efficiency = 89 percent

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	13.59	acres
A_I =	9.64	acres
A_P =	3.95	acres
L_R =	9560	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 6501 lbs.

F = 0.68

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	0.73	inches
Post Development Runoff Coefficient =	0.52	
On-site Water Quality Volume =	18577	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site Impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	3715	
Total Capture Volume (required water quality volume(s) x 1.20) =	22293	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	**22293**	cubic feet		
Minimum filter basin area =	**1032**	square feet		**1800**
Maximum sedimentation basin area =	**9289**	square feet	**For minimum water depth of 2 feet**	
Minimum sedimentation basin area =	**2322**	square feet	**For maximum water depth of 8 feet**	

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	**22293**	cubic feet	
Minimum filter basin area =	**1858**	square feet	
Maximum sedimentation basin area =	**7431**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**464**	square feet	**For maximum water depth of 8 feet**

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2014

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Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:
$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.89	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches
$L_{M\ TOTAL\ PROJECT}$ =	78428	lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = Pond D

Total drainage basin/outfall area =	10.11	acres
Predevelopment impervious area within drainage basin/outfall area =	2.91	acres
Post-development impervious area within drainage basin/outfall area =	5.98	acres
Post-development impervious fraction within drainage basin/outfall area =	0.59	
$L_{M\ THIS\ BASIN}$ =	2669	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Sand Filter
Removal efficiency = 89 percent

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:
A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	10.11	acres
A_I =	5.98	acres
A_P =	4.12	acres
L_R =	5956	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 4110 lbs.

F = 0.69

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	0.75	inches
Post Development Runoff Coefficient =	0.41	
On-site Water Quality Volume =	11402	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site Impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	2280	
Total Capture Volume (required water quality volume(s) x 1.20) =	13683	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	**13683**	cubic feet	
Minimum filter basin area =	**633**	square feet	
Maximum sedimentation basin area =	**5701**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**1425**	square feet	**For maximum water depth of 8 feet**

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	**13683**	cubic feet	
Minimum filter basin area =	**1140**	square feet	
Maximum sedimentation basin area =	**4561**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**285**	square feet	**For maximum water depth of 8 feet**

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2014

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:
$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.89	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches
$L_{M\ TOTAL\ PROJECT}$ =	78428	lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = Pond E

Total drainage basin/outfall area =	13.28	acres
Predevelopment impervious area within drainage basin/outfall area =	3.07	acres
Post-development impervious area within drainage basin/outfall area =	8.53	acres
Post-development impervious fraction within drainage basin/outfall area =	0.64	
$L_{M\ THIS\ BASIN}$ =	4751	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Sand Filter
Removal efficiency = 89 percent

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:
A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	13.28	acres
A_I =	8.53	acres
A_P =	4.76	acres
L_R =	8475	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 5339 lbs.

F = 0.63

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	0.64	inches
Post Development Runoff Coefficient =	0.45	
On-site Water Quality Volume =	13884	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site Impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	2777	
Total Capture Volume (required water quality volume(s) x 1.20) =	16661	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	**16661**	cubic feet		
Minimum filter basin area =	**771**	square feet		**1800**
Maximum sedimentation basin area =	**6942**	square feet	**For minimum water depth of 2 feet**	
Minimum sedimentation basin area =	**1735**	square feet	**For maximum water depth of 8 feet**	

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	**16661**	cubic feet	
Minimum filter basin area =	**1388**	square feet	
Maximum sedimentation basin area =	**5554**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**347**	square feet	**For maximum water depth of 8 feet**

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2014

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:
$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.89	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches
$L_{M\ TOTAL\ PROJECT}$ =	78428	lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = Pond F

Total drainage basin/outfall area =	29.13	acres
Predevelopment impervious area within drainage basin/outfall area =	9.84	acres
Post-development impervious area within drainage basin/outfall area =	19.77	acres
Post-development impervious fraction within drainage basin/outfall area =	0.68	
$L_{M\ THIS\ BASIN}$ =	8641	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Sand Filter
Removal efficiency = 89 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:
A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	29.13	acres
A_I =	19.77	acres
A_P =	9.37	acres
L_R =	19622	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ =	**17000**	lbs.
F =	**0.87**	

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	**1.44**	inches
Post Development Runoff Coefficient =	**0.48**	
On-site Water Quality Volume =	**73837**	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	**0.00**	acres
Off-site Impervious cover draining to BMP =	**0.00**	acres
Impervious fraction of off-site area =	**0**	
Off-site Runoff Coefficient =	**0.00**	
Off-site Water Quality Volume =	**0**	cubic feet
Storage for Sediment =	**14767**	
Total Capture Volume (required water quality volume(s) x 1.20) =	**88605**	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	**88605**	cubic feet	
Minimum filter basin area =	**4102**	square feet	
Maximum sedimentation basin area =	**36919**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**9230**	square feet	**For maximum water depth of 8 feet**

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	**88605**	cubic feet	
Minimum filter basin area =	**7384**	square feet	
Maximum sedimentation basin area =	**29535**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**1846**	square feet	**For maximum water depth of 8 feet**

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2014

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.89	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches
$L_{M\ TOTAL\ PROJECT}$ =	78428	lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = Pond G

Total drainage basin/outfall area =	4.56	acres
Predevelopment impervious area within drainage basin/outfall area =	1.06	acres
Post-development impervious area within drainage basin/outfall area =	3.34	acres
Post-development impervious fraction within drainage basin/outfall area =	0.73	
$L_{M\ THIS\ BASIN}$ =	1983	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Sand Filter
Removal efficiency = 89 percent

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	4.56	acres
A_I =	3.34	acres
A_P =	1.22	acres
L_R =	3309	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 2581 lbs.

F = 0.78

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	1.00	inches
Post Development Runoff Coefficient =	0.54	
On-site Water Quality Volume =	8937	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site Impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	
Off-site Runoff Coefficient =	0.00	
Off-site Water Quality Volume =	0	cubic feet
Storage for Sediment =	1787	
Total Capture Volume (required water quality volume(s) x 1.20) =	10725	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	**10725**	cubic feet	
Minimum filter basin area =	**497**	square feet	
Maximum sedimentation basin area =	**4469**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**1117**	square feet	**For maximum water depth of 8 feet**

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	**10725**	cubic feet	
Minimum filter basin area =	**894**	square feet	
Maximum sedimentation basin area =	**3575**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**223**	square feet	**For maximum water depth of 8 feet**

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2014

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.89	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches

$L_{M\ TOTAL\ PROJECT}$ = **78428** lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = **19**

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = Pond H

Total drainage basin/outfall area =	9.44	acres
Predevelopment impervious area within drainage basin/outfall area =	2.38	acres
Post-development impervious area within drainage basin/outfall area =	7.56	acres
Post-development impervious fraction within drainage basin/outfall area =	0.80	
$L_{M\ THIS\ BASIN}$ =	4512	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Sand Filter
Removal efficiency = 89 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	9.44	acres
A_I =	7.56	acres
A_P =	1.88	acres
L_R =	7483	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = **6840** lbs.

F = **0.91**

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth = **1.80** inches
Post Development Runoff Coefficient = **0.63**
On-site Water Quality Volume = **38575** cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP = **0.00** acres
Off-site Impervious cover draining to BMP = **0.00** acres
Impervious fraction of off-site area = **0**
Off-site Runoff Coefficient = **0.00**
Off-site Water Quality Volume = **0** cubic feet

Storage for Sediment = **7715**
Total Capture Volume (required water quality volume(s) x 1.20) = **46290** cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin = **46290** cubic feet

Minimum filter basin area = **2143** square feet

Maximum sedimentation basin area = **19287** square feet **For minimum water depth of 2 feet**
Minimum sedimentation basin area = **4822** square feet **For maximum water depth of 8 feet**

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins = **46290** cubic feet

Minimum filter basin area = **3857** square feet

Maximum sedimentation basin area = **15430** square feet **For minimum water depth of 2 feet**
Minimum sedimentation basin area = **964** square feet **For maximum water depth of 8 feet**

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2014

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:
$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.89	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches
$L_{M\ TOTAL\ PROJECT}$ =	78428	lbs.

* The values entered in these fields should be for the total project area.

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = Pond I

Total drainage basin/outfall area =	12.30	acres
Predevelopment impervious area within drainage basin/outfall area =	8.50	acres
Post-development impervious area within drainage basin/outfall area =	10.47	acres
Post-development impervious fraction within drainage basin/outfall area =	0.85	
$L_{M\ THIS\ BASIN}$ =	1718	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Sand Filter
Removal efficiency = 89 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: L_R = (BMP efficiency) x P x (A_I x 34.6 + A_P x 0.54)

where:
A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	12.30	acres
A_I =	10.47	acres
A_P =	1.83	acres
L_R =	10344	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

0

Desired $L_{M\ THIS\ BASIN}$ = 9400 lbs.

F = 0.91

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	1.80	inches
Post Development Runoff Coefficient =	0.69	
On-site Water Quality Volume =	55863	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	**0.00**	acres
Off-site Impervious cover draining to BMP =	**0.00**	acres
Impervious fraction of off-site area =	**0**	
Off-site Runoff Coefficient =	**0.00**	
Off-site Water Quality Volume =	**0**	cubic feet
Storage for Sediment =	**11173**	
Total Capture Volume (required water quality volume(s) x 1.20) =	**67035**	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	**67035**	cubic feet	
Minimum filter basin area =	**3103**	square feet	
Maximum sedimentation basin area =	**27931**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**6983**	square feet	**For maximum water depth of 8 feet**

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	**67035**	cubic feet	
Minimum filter basin area =	**5586**	square feet	
Maximum sedimentation basin area =	**22345**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**1397**	square feet	**For maximum water depth of 8 feet**

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2014

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.89	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches
$L_{M\ TOTAL\ PROJECT}$ =	78428	lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = Pond J

Total drainage basin/outfall area =	5.51	acres
Predevelopment impervious area within drainage basin/outfall area =	1.56	acres
Post-development impervious area within drainage basin/outfall area =	4.04	acres
Post-development impervious fraction within drainage basin/outfall area =	0.73	
$L_{M\ THIS\ BASIN}$ =	2159	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Extended Detention
Removal efficiency = 75 percent

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	5.51	acres
A_I =	4.04	acres
A_P =	1.47	acres
L_R =	3376	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ =	**3004**	lbs.
F =	**0.89**	

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	**1.60**	inches
Post Development Runoff Coefficient =	**0.54**	
On-site Water Quality Volume =	**17315**	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	**0.00**	acres
Off-site Impervious cover draining to BMP =	**0.00**	acres
Impervious fraction of off-site area =	**0**	
Off-site Runoff Coefficient =	**0.00**	
Off-site Water Quality Volume =	**0**	cubic feet
Storage for Sediment =	**3463**	
Total Capture Volume (required water quality volume(s) x 1.20) =	**20778**	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin =	**20778**	cubic feet

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2014

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.89	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches
$L_{M\ TOTAL\ PROJECT}$ =	78428	lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = Pond K

Total drainage basin/outfall area =	5.56	acres
Predevelopment impervious area within drainage basin/outfall area =	1.89	acres
Post-development impervious area within drainage basin/outfall area =	2.42	acres
Post-development impervious fraction within drainage basin/outfall area =	0.43	
$L_{M\ THIS\ BASIN}$ =	453	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Bioretention
Removal efficiency = 89 percent

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	5.56	acres
A_I =	2.42	acres
A_P =	3.15	acres
L_R =	2428	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ =	**2400**	lbs.
F =	**0.99**	

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	**3.66**	inches
Post Development Runoff Coefficient =	**0.32**	
On-site Water Quality Volume =	**23899**	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	**0.00**	acres
Off-site Impervious cover draining to BMP =	**0.00**	acres
Impervious fraction of off-site area =	**0**	
Off-site Runoff Coefficient =	**0.00**	
Off-site Water Quality Volume =	**0**	cubic feet
Storage for Sediment =	**4780**	
Total Capture Volume (required water quality volume(s) x 1.20) =	**28679**	cubic feet

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin =	**28679**	cubic feet

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2014

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.89	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches
$L_{M\ TOTAL\ PROJECT}$ =	78428	lbs.

* The values entered in these fields should be for the total project area.

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = Pond L

Total drainage basin/outfall area =	2.41	acres
Predevelopment impervious area within drainage basin/outfall area =	1.15	acres
Post-development impervious area within drainage basin/outfall area =	2.21	acres
Post-development impervious fraction within drainage basin/outfall area =	0.92	
$L_{M\ THIS\ BASIN}$ =	927	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Sand Filter
Removal efficiency = 89 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	2.41	acres
A_I =	2.21	acres
A_P =	0.20	acres
L_R =	2183	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 2015 lbs.

F = 0.92

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	2.00	inches
Post Development Runoff Coefficient =	0.75	
On-site Water Quality Volume =	13112	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	**0.00**	acres
Off-site Impervious cover draining to BMP =	**0.00**	acres
Impervious fraction of off-site area =	**0**	
Off-site Runoff Coefficient =	**0.00**	
Off-site Water Quality Volume =	**0**	cubic feet
Storage for Sediment =	**2622**	
Total Capture Volume (required water quality volume(s) x 1.20) =	**15734**	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	**15734**	cubic feet	
Minimum filter basin area =	**728**	square feet	
Maximum sedimentation basin area =	**6556**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**1639**	square feet	**For maximum water depth of 8 feet**

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	**15734**	cubic feet	
Minimum filter basin area =	**1311**	square feet	
Maximum sedimentation basin area =	**5245**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**328**	square feet	**For maximum water depth of 8 feet**

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2014

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.89	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches
$L_{M\ TOTAL\ PROJECT}$ =	78428	lbs.

* The values entered in these fields should be for the total project area.

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = Pond M

Total drainage basin/outfall area =	1.08	acres
Predevelopment impervious area within drainage basin/outfall area =	0.60	acres
Post-development impervious area within drainage basin/outfall area =	0.99	acres
Post-development impervious fraction within drainage basin/outfall area =	0.91	
$L_{M\ THIS\ BASIN}$ =	340	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Sand Filter
Removal efficiency = 89 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	1.08	acres
A_I =	0.99	acres
A_P =	0.09	acres
L_R =	977	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 950 lbs.

F = 0.97

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	3.00	inches
Post Development Runoff Coefficient =	0.75	
On-site Water Quality Volume =	8803	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	**0.00**	acres
Off-site Impervious cover draining to BMP =	**0.00**	acres
Impervious fraction of off-site area =	**0**	
Off-site Runoff Coefficient =	**0.00**	
Off-site Water Quality Volume =	**0**	cubic feet
Storage for Sediment =	**1761**	
Total Capture Volume (required water quality volume(s) x 1.20) =	**10563**	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	**10563**	cubic feet	
Minimum filter basin area =	**489**	square feet	
Maximum sedimentation basin area =	**4401**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**1100**	square feet	**For maximum water depth of 8 feet**

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	**10563**	cubic feet	
Minimum filter basin area =	**880**	square feet	
Maximum sedimentation basin area =	**3521**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**220**	square feet	**For maximum water depth of 8 feet**

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2014

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.89	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches
$L_{M\ TOTAL\ PROJECT}$ =	78428	lbs.

* The values entered in these fields should be for the total project area.

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = Pond N

Total drainage basin/outfall area =	1.19	acres
Predevelopment impervious area within drainage basin/outfall area =	0.69	acres
Post-development impervious area within drainage basin/outfall area =	1.11	acres
Post-development impervious fraction within drainage basin/outfall area =	0.93	
$L_{M\ THIS\ BASIN}$ =	366	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Sand Filter
Removal efficiency = 89 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	1.19	acres
A_I =	1.11	acres
A_P =	0.08	acres
L_R =	1090	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 990 lbs.

F = 0.91

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	1.80	inches
Post Development Runoff Coefficient =	0.76	
On-site Water Quality Volume =	5895	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	**0.00**	acres
Off-site Impervious cover draining to BMP =	**0.00**	acres
Impervious fraction of off-site area =	**0**	
Off-site Runoff Coefficient =	**0.00**	
Off-site Water Quality Volume =	**0**	cubic feet
Storage for Sediment =	**1179**	
Total Capture Volume (required water quality volume(s) x 1.20) =	**7074**	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	**7074**	cubic feet	
Minimum filter basin area =	**327**	square feet	
Maximum sedimentation basin area =	**2947**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**737**	square feet	**For maximum water depth of 8 feet**

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	**7074**	cubic feet	
Minimum filter basin area =	**589**	square feet	
Maximum sedimentation basin area =	**2358**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**147**	square feet	**For maximum water depth of 8 feet**

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2014

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.89	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches
$L_{M\ TOTAL\ PROJECT}$ =	78428	lbs.

* The values entered in these fields should be for the total project area.

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = Pond O

Total drainage basin/outfall area =	5.52	acres
Predevelopment impervious area within drainage basin/outfall area =	3.70	acres
Post-development impervious area within drainage basin/outfall area =	4.89	acres
Post-development impervious fraction within drainage basin/outfall area =	0.89	
$L_{M\ THIS\ BASIN}$ =	1036	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Sand Filter
Removal efficiency = 89 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	5.52	acres
A_I =	4.89	acres
A_P =	0.63	acres
L_R =	4828	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 4500 lbs.

F = 0.93

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	2.20	inches
Post Development Runoff Coefficient =	0.72	
On-site Water Quality Volume =	31888	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	**0.00**	acres
Off-site Impervious cover draining to BMP =	**0.00**	acres
Impervious fraction of off-site area =	**0**	
Off-site Runoff Coefficient =	**0.00**	
Off-site Water Quality Volume =	**0**	cubic feet
Storage for Sediment =	**6378**	
Total Capture Volume (required water quality volume(s) x 1.20) =	**38265**	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	**38265**	cubic feet	
Minimum filter basin area =	**1772**	square feet	
Maximum sedimentation basin area =	**15944**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**3986**	square feet	**For maximum water depth of 8 feet**

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	**38265**	cubic feet	
Minimum filter basin area =	**3189**	square feet	
Maximum sedimentation basin area =	**12755**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**797**	square feet	**For maximum water depth of 8 feet**

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2014

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Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.89	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches
$L_{M\ TOTAL\ PROJECT}$ =	78428	lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = Pond P

Total drainage basin/outfall area =	1.73	acres
Predevelopment impervious area within drainage basin/outfall area =	0.94	acres
Post-development impervious area within drainage basin/outfall area =	0.99	acres
Post-development impervious fraction within drainage basin/outfall area =	0.57	
$L_{M\ THIS\ BASIN}$ =	42	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Bioretention
Removal efficiency = 89 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	1.73	acres
A_I =	0.99	acres
A_P =	0.74	acres
L_R =	983	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ =	**880**	lbs.
F =	**0.90**	

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	**1.70**	inches
Post Development Runoff Coefficient =	**0.40**	
On-site Water Quality Volume =	**4265**	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	**0.00**	acres
Off-site Impervious cover draining to BMP =	**0.00**	acres
Impervious fraction of off-site area =	**0**	
Off-site Runoff Coefficient =	**0.00**	
Off-site Water Quality Volume =	**0**	cubic feet
Storage for Sediment =	**853**	
Total Capture Volume (required water quality volume(s) x 1.20) =	**5118**	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin =	**5118**	cubic feet

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2014

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.89	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches
$L_{M\ TOTAL\ PROJECT}$ =	78428	lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = Pond Q

Total drainage basin/outfall area =	3.79	acres
Predevelopment impervious area within drainage basin/outfall area =	2.45	acres
Post-development impervious area within drainage basin/outfall area =	2.62	acres
Post-development impervious fraction within drainage basin/outfall area =	0.69	
$L_{M\ THIS\ BASIN}$ =	147	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Bioretention
Removal efficiency = 89 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	3.79	acres
A_I =	2.62	acres
A_P =	1.17	acres
L_R =	2602	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ =	**2250**	lbs.
F =	**0.86**	

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	**1.38**	inches
Post Development Runoff Coefficient =	**0.50**	
On-site Water Quality Volume =	**9445**	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	**0.00**	acres
Off-site Impervious cover draining to BMP =	**0.00**	acres
Impervious fraction of off-site area =	**0**	
Off-site Runoff Coefficient =	**0.00**	
Off-site Water Quality Volume =	**0**	cubic feet
Storage for Sediment =	**1889**	
Total Capture Volume (required water quality volume(s) x 1.20) =	**11334**	cubic feet

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin =	**11334**	cubic feet

Appendix K: Water Quality Calculations Spreadsheet – Alternative C

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2017

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:
$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan* =	148.54	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches

$L_{M\ TOTAL\ PROJECT\ BASE}$ = **64094** lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = **17**

1.1. Treatment provided by Existing BMPs:

Existing treatment from SH 71 PFC= **8546**
Existing treatment from US 290 PFC= **9883**

1.2. Credit due to removed impervious cover:

Existing storage area load= **-4405**

1.3. Total Required Load Reduction:

$L_{M\ TOTAL\ PROJECT}$ = **78117**

Total Load Removal Provided:

Project Designation	Description	Load Removed
VFS RDWY	Vegetative filter strips along pavement edge	5864 lbs
VFS SUP	Vegetative filter strips along SUP and sidewalk edge	2946 lbs
Pond A	Pond along North Side of US 290 East of Circle Drive	1150 lbs
Pond B	Pond along South Side of US 290 East of Circle Drive	4000 lbs
Pond C	Pond along South Side of US 290 west of RM 1826	6501 lbs
Pond D	Pond along South Side of US 290 west of RM 18276	4110 lbs
Pond E	Pond along South Side of US 290 west of RM 1826	5339 lbs
Pond F	Pond along nouth Side of US 290 east of SH 71 (before creek)	26000 lbs
Pond H	Just West of the SH 71 and US 290 Interchange	6750 lbs
Pond I	Pond along US 290 median east of William Cannon	5700 lbs
Pond J	East of William Cannon before Williamson Creek	3200 lbs
Pond K	Pond along William Cannon (near Freescale)	2000 lbs
Pond L	SH 71 median near US 290 (HEB)	1040 lbs
Pond N	SH 71 median near Hill Meadow / Scenic Brook	990 lbs
Pond O	East side of SH 71 in purchased ROW	4500 lbs
Pond P	SH 71 median east of Williamson Creek	880 lbs
Pond Q	SH 71 median west of Williamson Creek	2250 lbs
	Total TSS Removed=	**83220 lbs**

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2017

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.54	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches

$L_{M\ TOTAL\ PROJECT}$ = **78428** lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin):

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 =	0.00	
$L_{M\ THIS\ BASIN}$ =	-4405	lbs.

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2017

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.54	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches

$L_{M\ TOTAL\ PROJECT}$ = **78428** lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = 71 EX PFC

Total drainage basin/outfall area =	8.58	acres
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres
Post-development impervious area within drainage basin/outfall area =	8.58	acres
Post-development impervious fraction within drainage basin/outfall area =	1.00	
$L_{M\ THIS\ BASIN}$ =	7464	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = **Permeable Friction Course**
Removal efficiency = 90 percent

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	8.58	acres
A_I =	8.58	acres
A_P =	0.00	acres
L_R =	8546	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 8546 lbs.

F = **1.00**

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2017

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.54	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches

$L_{M\ TOTAL\ PROJECT}$ = **78428** lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = 290 EX PFC

Total drainage basin/outfall area =	9.92	acres
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres
Post-development impervious area within drainage basin/outfall area =	9.92	acres
Post-development impervious fraction within drainage basin/outfall area =	1.00	
$L_{M\ THIS\ BASIN}$ =	8632	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = **Permeable Friction Course**
Removal efficiency = 90 percent

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	9.92	acres
A_I =	9.92	acres
A_P =	0.00	acres
L_R =	9883	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 9883 lbs.

F = **1.00**

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2017

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan* =	74.90	acres
Total post-development impervious area within the limits of the plan =	148.54	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches

$L_{M\ TOTAL\ PROJECT}$ = **78117** lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = **17**

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = VFS

Total drainage basin/outfall area =	6.23	acres
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres
Post-development impervious area within drainage basin/outfall area =	6.23	acres
Post-development impervious fraction within drainage basin/outfall area =	1.00	
$L_{M\ THIS\ BASIN}$ =	5424	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Vegetated Filter Strips
Removal efficiency = 85 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	6.23	acres
A_I =	6.23	acres
A_P =	0.00	acres
L_R =	5864	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = **5864** lbs.

F = **1.00**

16. Vegetated Filter Strips Designed as Required in RG-348 Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips.
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%.

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348.

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2017

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
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Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan* =	74.90	acres
Total post-development impervious area within the limits of the plan =	148.54	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches

$L_{M\ TOTAL\ PROJECT}$ = **78117** lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = **17**

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = SUP/SW

Total drainage basin/outfall area =	3.13	acres
Predevelopment impervious area within drainage basin/outfall area =	0.00	acres
Post-development impervious area within drainage basin/outfall area =	3.13	acres
Post-development impervious fraction within drainage basin/outfall area =	1.00	
$L_{M\ THIS\ BASIN}$ =	2724	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Vegetated Filter Strips
Removal efficiency = 85 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	3.13	acres
A_I =	3.13	acres
A_P =	0.00	acres
L_R =	2946	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ =	**2946**	lbs.
F =	**1.00**	

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	**4.00**	inches
Post Development Runoff Coefficient =	**0.82**	
On-site Water Quality Volume =	**37098**	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	**0.00**	acres
Off-site Impervious cover draining to BMP =	**0.00**	acres
Impervious fraction of off-site area =	**0**	
Off-site Runoff Coefficient =	**0.00**	
Off-site Water Quality Volume =	**0**	cubic feet
Storage for Sediment =	**7420**	
Total Capture Volume (required water quality volume(s) x 1.20) =	**44518**	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

16. Vegetated Filter Strips Designed as Required in RG-348 Pages 3-55 to 3-57

There are no calculations required for determining the load or size of vegetative filter strips.
The 80% removal is provided when the contributing drainage area does not exceed 72 feet (direction of flow) and the sheet flow leaving the impervious cover is directed across 15 feet of engineered filter strips with maximum slope of 20% or across 50 feet of natural vegetation with a maximum slope of 10%. There can be a break in grade as long as no slope exceeds 20%.

If vegetative filter strips are proposed for an interim permanent BMP, they may be sized as described on Page 3-56 of RG-348.

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2017

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.54	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches

$L_{M\ TOTAL\ PROJECT}$ = **78428** lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = Pond A

Total drainage basin/outfall area =	2.78	acres
Predevelopment impervious area within drainage basin/outfall area =	0.94	acres
Post-development impervious area within drainage basin/outfall area =	1.16	acres
Post-development impervious fraction within drainage basin/outfall area =	0.42	
$L_{M\ THIS\ BASIN}$ =	191	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Bioretention
Removal efficiency = 89 percent

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	2.78	acres
A_I =	1.16	acres
A_P =	1.62	acres
L_R =	1168	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ =	**1150**	lbs.
F =	**0.98**	

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	**3.33**	inches
Post Development Runoff Coefficient =	**0.32**	
On-site Water Quality Volume =	**10592**	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	**0.00**	acres
Off-site Impervious cover draining to BMP =	**0.00**	acres
Impervious fraction of off-site area =	**0**	
Off-site Runoff Coefficient =	**0.00**	
Off-site Water Quality Volume =	**0**	cubic feet
Storage for Sediment =	**2118**	
Total Capture Volume (required water quality volume(s) x 1.20) =	**12710**	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin =	**12710**	cubic feet

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2017

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.54	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches

$L_{M\ TOTAL\ PROJECT}$ = **78428** lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = Pond B

Total drainage basin/outfall area =	7.38	acres
Predevelopment impervious area within drainage basin/outfall area =	2.86	acres
Post-development impervious area within drainage basin/outfall area =	4.95	acres
Post-development impervious fraction within drainage basin/outfall area =	0.67	
$L_{M\ THIS\ BASIN}$ =	1819	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Extended Detention
Removal efficiency = 75 percent

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	7.38	acres
A_I =	4.95	acres
A_P =	2.43	acres
L_R =	4142	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = **4000** lbs.

F = **0.97**

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth = **3.00** inches
Post Development Runoff Coefficient = **0.48**
On-site Water Quality Volume = **38395** cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP = **0.00** acres
Off-site Impervious cover draining to BMP = **0.00** acres
Impervious fraction of off-site area = **0**
Off-site Runoff Coefficient = **0.00**
Off-site Water Quality Volume = **0** cubic feet

Storage for Sediment = **7679**
Total Capture Volume (required water quality volume(s) x 1.20) = **46074** cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin = **46074** cubic feet

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2017

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:
$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.54	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches

$L_{M\ TOTAL\ PROJECT}$ = **78428** lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin)

Drainage Basin/Outfall Area No. = Pond C

Total drainage basin/outfall area =	13.59	acres
Predevelopment impervious area within drainage basin/outfall area =	2.34	acres
Post-development impervious area within drainage basin/outfall area =	9.64	acres
Post-development impervious fraction within drainage basin/outfall area =	0.71	
$L_{M\ THIS\ BASIN}$ =	6354	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Sand Filter
Removal efficiency = 89 percent

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:
A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	13.59	acres
A_I =	9.64	acres
A_P =	3.95	acres
L_R =	9560	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 6501 lbs.

F = **0.68**

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	0.73	inches
Post Development Runoff Coefficient =	0.52	
On-site Water Quality Volume =	18577	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	0.00	acres
Off-site Impervious cover draining to BMP =	0.00	acres
Impervious fraction of off-site area =	0	

Off-site Runoff Coefficient =	**0.00**	
Off-site Water Quality Volume =	**0**	cubic feet
Storage for Sediment =	**3715**	
Total Capture Volume (required water quality volume(s) x 1.20) =	**22293**	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	**22293**	cubic feet	
Minimum filter basin area =	**1032**	square feet	**1800**
Maximum sedimentation basin area =	**9289**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**2322**	square feet	**For maximum water depth of 8 feet**

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	**22293**	cubic feet	
Minimum filter basin area =	**1858**	square feet	
Maximum sedimentation basin area =	**7431**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**464**	square feet	**For maximum water depth of 8 feet**

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2017

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.54	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches

$L_{M\ TOTAL\ PROJECT}$ = **78428** lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin)

Drainage Basin/Outfall Area No. = Pond D

Total drainage basin/outfall area =	10.11	acres
Predevelopment impervious area within drainage basin/outfall area =	2.91	acres
Post-development impervious area within drainage basin/outfall area =	5.98	acres
Post-development impervious fraction within drainage basin/outfall area =	0.59	
$L_{M\ THIS\ BASIN}$ =	2669	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Sand Filter
Removal efficiency = 89 percent

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	10.11	acres
A_I =	5.98	acres
A_P =	4.12	acres
L_R =	5956	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 4110 lbs.

F = **0.69**

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	0.75	inches
Post Development Runoff Coefficient =	0.41	
On-site Water Quality Volume =	11402	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP = 0.00 acres

Off-site Impervious cover draining to BMP =	**0.00**	acres
Impervious fraction of off-site area =	**0**	
Off-site Runoff Coefficient =	**0.00**	
Off-site Water Quality Volume =	**0**	cubic feet
Storage for Sediment =	**2280**	
Total Capture Volume (required water quality volume(s) x 1.20) =	**13683**	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	**13683**	cubic feet	
Minimum filter basin area =	**633**	square feet	
Maximum sedimentation basin area =	**5701**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**1425**	square feet	**For maximum water depth of 8 feet**

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	**13683**	cubic feet	
Minimum filter basin area =	**1140**	square feet	
Maximum sedimentation basin area =	**4561**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**285**	square feet	**For maximum water depth of 8 feet**

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2017

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.54	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches

$L_{M\ TOTAL\ PROJECT}$ = **78428** lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin)

Drainage Basin/Outfall Area No. = Pond E

Total drainage basin/outfall area =	13.28	acres
Predevelopment impervious area within drainage basin/outfall area =	3.07	acres
Post-development impervious area within drainage basin/outfall area =	8.53	acres
Post-development impervious fraction within drainage basin/outfall area =	0.64	
$L_{M\ THIS\ BASIN}$ =	4751	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Sand Filter
Removal efficiency = 89 percent

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	13.28	acres
A_I =	8.53	acres
A_P =	4.76	acres
L_R =	8475	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 5339 lbs.

F = **0.63**

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	0.64	inches
Post Development Runoff Coefficient =	0.45	
On-site Water Quality Volume =	13884	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP = 0.00 acres

Off-site Impervious cover draining to BMP =	**0.00**	acres
Impervious fraction of off-site area =	**0**	
Off-site Runoff Coefficient =	**0.00**	
Off-site Water Quality Volume =	**0**	cubic feet
Storage for Sediment =	**2777**	
Total Capture Volume (required water quality volume(s) x 1.20) =	**16661**	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	**16661**	cubic feet	
Minimum filter basin area =	**771**	square feet	**1800**
Maximum sedimentation basin area =	**6942**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**1735**	square feet	**For maximum water depth of 8 feet**

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	**16661**	cubic feet	
Minimum filter basin area =	**1388**	square feet	
Maximum sedimentation basin area =	**5554**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**347**	square feet	**For maximum water depth of 8 feet**

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2017

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan* =	74.90	acres
Total post-development impervious area within the limits of the plan* =	148.54	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches
$L_{M\ TOTAL\ PROJECT}$ =	78117	lbs.

* **The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 17

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = Pond F

Total drainage basin/outfall area =	41.57	acres
Predevelopment impervious area within drainage basin/outfall area =	13.06	acres
Post-development impervious area within drainage basin/outfall area =	29.33	acres
Post-development impervious fraction within drainage basin/outfall area =	0.71	
$L_{M\ THIS\ BASIN}$ =	14163	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Sand Filter
Removal efficiency = 89 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	41.57	acres
A_I =	29.33	acres
A_P =	12.24	acres
L_R =	29090	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ =	**26000**	lbs.
F =	**0.89**	

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	**1.60**	inches
Post Development Runoff Coefficient =	**0.51**	
On-site Water Quality Volume =	**123442**	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	**0.00**	acres
Off-site Impervious cover draining to BMP =	**0.00**	acres
Impervious fraction of off-site area =	**0**	
Off-site Runoff Coefficient =	**0.00**	
Off-site Water Quality Volume =	**0**	cubic feet
Storage for Sediment =	**24688**	
Total Capture Volume (required water quality volume(s) x 1.20) =	**148130**	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	**148130**	cubic feet	
Minimum filter basin area =	**6858**	square feet	
Maximum sedimentation basin area =	**61721**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**15430**	square feet	**For maximum water depth of 8 feet**

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	**148130**	cubic feet	
Minimum filter basin area =	**12344**	square feet	
Maximum sedimentation basin area =	**49377**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**3086**	square feet	**For maximum water depth of 8 feet**

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2017

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan* =	74.90	acres
Total post-development impervious area within the limits of the plan* =	148.54	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches
$L_{M\ TOTAL\ PROJECT}$ =	78117	lbs.

* **The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 17

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = Pond H

Total drainage basin/outfall area =	9.63	acres
Predevelopment impervious area within drainage basin/outfall area =	5.14	acres
Post-development impervious area within drainage basin/outfall area =	7.53	acres
Post-development impervious fraction within drainage basin/outfall area =	0.78	
$L_{M\ THIS\ BASIN}$ =	2080	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Sand Filter
Removal efficiency = 89 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	9.63	acres
A_I =	7.53	acres
A_P =	2.10	acres
L_R =	7449	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ =	**6750**	lbs.
F =	**0.91**	

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	**1.80**	inches
Post Development Runoff Coefficient =	**0.60**	
On-site Water Quality Volume =	**37694**	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	**0.00**	acres
Off-site Impervious cover draining to BMP =	**0.00**	acres
Impervious fraction of off-site area =	**0**	
Off-site Runoff Coefficient =	**0.00**	
Off-site Water Quality Volume =	**0**	cubic feet
Storage for Sediment =	**7539**	
Total Capture Volume (required water quality volume(s) x 1.20) =	**45233**	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	**45233**	cubic feet	
Minimum filter basin area =	**2094**	square feet	
Maximum sedimentation basin area =	**18847**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**4712**	square feet	**For maximum water depth of 8 feet**

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	**45233**	cubic feet	
Minimum filter basin area =	**3769**	square feet	
Maximum sedimentation basin area =	**15078**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**942**	square feet	**For maximum water depth of 8 feet**

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2017

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan* =	74.90	acres
Total post-development impervious area within the limits of the plan =	148.54	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches

$L_{M\ TOTAL\ PROJECT}$ = **78117** lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 17

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = Pond I

Total drainage basin/outfall area =	9.53	acres
Predevelopment impervious area within drainage basin/outfall area =	5.72	acres
Post-development impervious area within drainage basin/outfall area =	6.85	acres
Post-development impervious fraction within drainage basin/outfall area =	0.72	
$L_{M\ THIS\ BASIN}$ =	986	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Bioretention
Removal efficiency = 89 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	9.53	acres
A_I =	6.85	acres
A_P =	2.68	acres
L_R =	6790	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ =	**5700**	lbs.
F =	**0.84**	

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	**1.26**	inches
Post Development Runoff Coefficient =	**0.52**	
On-site Water Quality Volume =	**22881**	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	**0.00**	acres
Off-site Impervious cover draining to BMP =	**0.00**	acres
Impervious fraction of off-site area =	**0**	
Off-site Runoff Coefficient =	**0.00**	
Off-site Water Quality Volume =	**0**	cubic feet
Storage for Sediment =	**4576**	
Total Capture Volume (required water quality volume(s) x 1.20) =	**27457**	cubic feet

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin =	**27457**	cubic feet

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2017

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan* =	74.90	acres
Total post-development impervious area within the limits of the plan* =	148.54	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches
$L_{M\ TOTAL\ PROJECT}$ =	78117	lbs.

* **The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 17

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = Pond J

Total drainage basin/outfall area =	6.31	acres
Predevelopment impervious area within drainage basin/outfall area =	2.51	acres
Post-development impervious area within drainage basin/outfall area =	3.68	acres
Post-development impervious fraction within drainage basin/outfall area =	0.58	
$L_{M\ THIS\ BASIN}$ =	1022	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Sand Filter
Removal efficiency = 89 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	6.31	acres
A_I =	3.68	acres
A_P =	2.63	acres
L_R =	3671	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ =	**3200**	lbs.
F =	**0.87**	

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	**1.44**	inches
Post Development Runoff Coefficient =	**0.41**	
On-site Water Quality Volume =	**13487**	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	**0.00**	acres
Off-site Impervious cover draining to BMP =	**0.00**	acres
Impervious fraction of off-site area =	**0**	
Off-site Runoff Coefficient =	**0.00**	
Off-site Water Quality Volume =	**0**	cubic feet
Storage for Sediment =	**2697**	
Total Capture Volume (required water quality volume(s) x 1.20) =	**16185**	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	**16185**	cubic feet	
Minimum filter basin area =	**749**	square feet	
Maximum sedimentation basin area =	**6744**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**1686**	square feet	**For maximum water depth of 8 feet**

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	**16185**	cubic feet	
Minimum filter basin area =	**1349**	square feet	
Maximum sedimentation basin area =	**5395**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**337**	square feet	**For maximum water depth of 8 feet**

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2017

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan* =	74.90	acres
Total post-development impervious area within the limits of the plan =	148.54	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches

$L_{M\ TOTAL\ PROJECT}$ = **78117** lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 17

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = Pond K

Total drainage basin/outfall area =	5.56	acres
Predevelopment impervious area within drainage basin/outfall area =	1.89	acres
Post-development impervious area within drainage basin/outfall area =	2.42	acres
Post-development impervious fraction within drainage basin/outfall area =	0.43	
$L_{M\ THIS\ BASIN}$ =	453	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Bioretention
Removal efficiency = 89 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	5.56	acres
A_I =	2.42	acres
A_P =	3.15	acres
L_R =	2428	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ =	**2000**	lbs.
F =	**0.82**	

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	**1.16**	inches
Post Development Runoff Coefficient =	**0.32**	
On-site Water Quality Volume =	**7575**	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	**0.00**	acres
Off-site Impervious cover draining to BMP =	**0.00**	acres
Impervious fraction of off-site area =	**0**	
Off-site Runoff Coefficient =	**0.00**	
Off-site Water Quality Volume =	**0**	cubic feet
Storage for Sediment =	**1515**	
Total Capture Volume (required water quality volume(s) x 1.20) =	**9090**	cubic feet

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin =	**9090**	cubic feet

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2017

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan* =	74.90	acres
Total post-development impervious area within the limits of the plan* =	148.54	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches
$L_{M\ TOTAL\ PROJECT}$ =	78117	lbs.

* **The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 17

2. Drainage Basin Parameters (This information should be provided for each basin):

Drainage Basin/Outfall Area No. = Pond L

Total drainage basin/outfall area =	1.45	acres
Predevelopment impervious area within drainage basin/outfall area =	0.98	acres
Post-development impervious area within drainage basin/outfall area =	1.41	acres
Post-development impervious fraction within drainage basin/outfall area =	0.97	
$L_{M\ THIS\ BASIN}$ =	371	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Extended Detention
Removal efficiency = 75 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	1.45	acres
A_I =	1.41	acres
A_P =	0.04	acres
L_R =	1171	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ =	**1040**	lbs.
F =	**0.89**	

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	**1.60**	inches
Post Development Runoff Coefficient =	**0.79**	
On-site Water Quality Volume =	**6685**	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	**0.00**	acres
Off-site Impervious cover draining to BMP =	**0.00**	acres
Impervious fraction of off-site area =	**0**	
Off-site Runoff Coefficient =	**0.00**	
Off-site Water Quality Volume =	**0**	cubic feet
Storage for Sediment =	**1337**	
Total Capture Volume (required water quality volume(s) x 1.20) =	**8022**	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

8. Extended Detention Basin System Designed as Required in RG-348 Pages 3-46 to 3-51

Required Water Quality Volume for extended detention basin =	**8022**	cubic feet

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2017

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.54	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches

$L_{M\ TOTAL\ PROJECT}$ = **78428** lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin)

Drainage Basin/Outfall Area No. = Pond N

Total drainage basin/outfall area =	1.19	acres
Predevelopment impervious area within drainage basin/outfall area =	0.69	acres
Post-development impervious area within drainage basin/outfall area =	1.11	acres
Post-development impervious fraction within drainage basin/outfall area =	0.93	
$L_{M\ THIS\ BASIN}$ =	366	lbs.

3. Indicate the proposed BMP Code for this basin

Proposed BMP = Sand Filter
Removal efficiency = 89 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	1.19	acres
A_I =	1.11	acres
A_P =	0.08	acres
L_R =	1090	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 990 lbs.

F = **0.91**

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	**1.80**	inches
Post Development Runoff Coefficient =	**0.76**	
On-site Water Quality Volume =	**5895**	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	**0.00**	acres
Off-site Impervious cover draining to BMP =	**0.00**	acres
Impervious fraction of off-site area =	**0**	
Off-site Runoff Coefficient =	**0.00**	
Off-site Water Quality Volume =	**0**	cubic feet
Storage for Sediment =	**1179**	
Total Capture Volume (required water quality volume(s) x 1.20) =	**7074**	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	**7074**	cubic feet	
Minimum filter basin area =	**327**	square feet	
Maximum sedimentation basin area =	**2947**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**737**	square feet	**For maximum water depth of 8 feet**

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	**7074**	cubic feet	
Minimum filter basin area =	**589**	square feet	
Maximum sedimentation basin area =	**2358**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**147**	square feet	**For maximum water depth of 8 feet**

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2017

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.54	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches

$L_{M\ TOTAL\ PROJECT}$ = **78428** lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin)

Drainage Basin/Outfall Area No. = Pond O

Total drainage basin/outfall area =	5.52	acres
Predevelopment impervious area within drainage basin/outfall area =	3.70	acres
Post-development impervious area within drainage basin/outfall area =	4.89	acres
Post-development impervious fraction within drainage basin/outfall area =	0.89	
$L_{M\ THIS\ BASIN}$ =	1036	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Sand Filter
Removal efficiency = 89 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	5.52	acres
A_I =	4.89	acres
A_P =	0.63	acres
L_R =	4828	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = 4500 lbs.

F = **0.93**

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth =	**2.20**	inches
Post Development Runoff Coefficient =	**0.72**	
On-site Water Quality Volume =	**31888**	cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP =	**0.00**	acres
Off-site Impervious cover draining to BMP =	**0.00**	acres
Impervious fraction of off-site area =	**0**	
Off-site Runoff Coefficient =	**0.00**	
Off-site Water Quality Volume =	**0**	cubic feet
Storage for Sediment =	**6378**	
Total Capture Volume (required water quality volume(s) x 1.20) =	**38265**	cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

9. Filter area for Sand Filters Designed as Required in RG-348 Pages 3-58 to 3-63

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	**38265**	cubic feet	
Minimum filter basin area =	**1772**	square feet	
Maximum sedimentation basin area =	**15944**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**3986**	square feet	**For maximum water depth of 8 feet**

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	**38265**	cubic feet	
Minimum filter basin area =	**3189**	square feet	
Maximum sedimentation basin area =	**12755**	square feet	**For minimum water depth of 2 feet**
Minimum sedimentation basin area =	**797**	square feet	**For maximum water depth of 8 feet**

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2017

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1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.54	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches

$L_{M\ TOTAL\ PROJECT}$ = **78428** lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin)

Drainage Basin/Outfall Area No. = Pond P

Total drainage basin/outfall area =	1.73	acres
Predevelopment impervious area within drainage basin/outfall area =	0.94	acres
Post-development impervious area within drainage basin/outfall area =	0.99	acres
Post-development impervious fraction within drainage basin/outfall area =	0.57	
$L_{M\ THIS\ BASIN}$ =	42	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Bioretention
Removal efficiency = 89 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	1.73	acres
A_I =	0.99	acres
A_P =	0.74	acres
L_R =	983	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = **880** lbs.

F = **0.90**

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth = **1.70** inches
Post Development Runoff Coefficient = **0.40**
On-site Water Quality Volume = **4265** cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP = **0.00** acres
Off-site Impervious cover draining to BMP = **0.00** acres
Impervious fraction of off-site area = **0**
Off-site Runoff Coefficient = **0.00**
Off-site Water Quality Volume = **0** cubic feet

Storage for Sediment = **853**
Total Capture Volume (required water quality volume(s) x 1.20) = **5118** cubic feet

The following sections are used to calculate the required water quality volume(s) for the selected BMP.
The values for BMP Types not selected in cell C45 will show NA.

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = **5118** cubic feet

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Project Name: 290 West Oak Hill
Date Prepared: 3/15/2017

Additional information is provided for cells with a red triangle in the upper right corner. Place the cursor over the cell.
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-348.
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will remove the equations used in the spreadsheet.

1. The Required Load Reduction for the total project: Calculations from RG-348 Pages 3-27 to 3-30

Page 3-29 Equation 3.3: $L_M = 27.2(A_N \times P)$

where:

$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resulting from the proposed development = 80% of increased load
A_N = Net increase in impervious area for the project
P = Average annual precipitation, inches

Site Data: Determine Required Load Removal Based on the Entire Project

County =	Travis	
Total project area included in plan * =	245.06	acres
Predevelopment impervious area within the limits of the plan * =	74.90	acres
Total post-development impervious area within the limits of the plan * =	148.54	acres
Total post-development impervious cover fraction * =	0.61	
P =	32	inches

$L_{M\ TOTAL\ PROJECT}$ = **78428** lbs.

*** The values entered in these fields should be for the total project area.**

Number of drainage basins / outfalls areas leaving the plan area = 19

2. Drainage Basin Parameters (This information should be provided for each basin)

Drainage Basin/Outfall Area No. = Pond Q

Total drainage basin/outfall area =	3.79	acres
Predevelopment impervious area within drainage basin/outfall area =	2.45	acres
Post-development impervious area within drainage basin/outfall area =	2.62	acres
Post-development impervious fraction within drainage basin/outfall area =	0.69	
$L_{M\ THIS\ BASIN}$ =	147	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = Bioretention
Removal efficiency = 89 percent

Aqualogic Cartridge Filter
Bioretention
Contech StormFilter
Constructed Wetland
Extended Detention
Grassy Swale
Retention / Irrigation
Sand Filter
Stormceptor
Vegetated Filter Strips
Vortechs
Wet Basin
Wet Vault

4. Calculate Maximum TSS Load Removed (L_R) for this Drainage Basin by the selected BMP Type.

RG-348 Page 3-33 Equation 3.7: $L_R = (\text{BMP efficiency}) \times P \times (A_I \times 34.6 + A_P \times 0.54)$

where:

A_C = Total On-Site drainage area in the BMP catchment area
A_I = Impervious area proposed in the BMP catchment area
A_P = Pervious area remaining in the BMP catchment area
L_R = TSS Load removed from this catchment area by the proposed BMP

A_C =	3.79	acres
A_I =	2.62	acres
A_P =	1.17	acres
L_R =	2602	lbs

5. Calculate Fraction of Annual Runoff to Treat the drainage basin / outfall area

Desired $L_{M\ THIS\ BASIN}$ = **2250** lbs.

F = **0.86**

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area. Calculations from RG-348

Rainfall Depth = **1.38** inches
Post Development Runoff Coefficient = **0.50**
On-site Water Quality Volume = **9445** cubic feet

Calculations from RG-348 Pages 3-36 to 3-37

Off-site area draining to BMP = **0.00** acres
Off-site Impervious cover draining to BMP = **0.00** acres
Impervious fraction of off-site area = **0**
Off-site Runoff Coefficient = **0.00**
Off-site Water Quality Volume = **0** cubic feet

Storage for Sediment = **1889**
Total Capture Volume (required water quality volume(s) x 1.20) = **11334** cubic feet

10. Bioretention System Designed as Required in RG-348 Pages 3-63 to 3-65

Required Water Quality Volume for Bioretention Basin = **11334** cubic feet