April 24, 2023

Mr. Kevin Smith, P.E.
Texas Commission on Environmental Quality
P.O. Box 13087
Austin, TX 78711-3087

Re: Water Pollution Abatement Plan Modification Submittal
Loop 1604 Segment 4 Project
Loop 1604 from Stone Oak Parkway to 1.09 mile East of Redland Road
Bexar County, Texas
CSJ: 2452-02-130, 2452-03-113

Dear Mr. Smith:

This letter accompanies TxDOT's Water Pollution Abatement Plan Modification submittal for the referenced project. I have divided the submittal into the following PDF files:

- Loop 1604 Segment 4 WPAP Volume 1 of 6 (Modification Form)
- Loop 1604 Segment 4 WPAP Volume 2 of 6 (Roadway Application and other forms)
- Loop 1604 Segment 4 WPAP Volume 3 of 6 (Geologic Assessment)
- Loop 1604 Segment 4 WPAP Volume 4 of 6 (construction plans)
- Loop 1604 Segment 4 WPAP Volume 5 of 6 (construction plans, continued)
- Loop 1604 Segment 4 WPAP Volume 6 of 6 (construction plans, continued)

There are a few unusual features in this section I want to give you a briefing on.

Feature S7C – You wont find this in Zara's Geological Assessment (no fault of the geologist). This exists only as a storm drain inlet that was constructed by Alamo RMA (ARMA) circa 2012. TCEQs approval letter to ARMA referred to this as an engineered drain. It carries runoff to a cave that, as of 2012, is located beneath highway exit ramp pavement. The engineered drain is not in conflict with our Segment 4 construction project, and it will be protected during construction and retained. I included a detail of what ARMA reported the feature to look like in our construction plans (Sheet 982) to help inform future generations of its existence.

Feature 1604-101 – This is a former cave at the base of a roadcut. ARMA sealed it circa 2012 and it appears today as a big concrete patch. Our project will require excavating this roadcut further back slightly which could reopen whatever is behind the concrete patch. We have a detail to seal it back up if any void is encountered (Sheet 981)

If you have any questions, please contact me at (210) 615-5838 or at john.bryant@txdot.gov.

Sincerely,

John Bryant, P.G.
Environmental Specialist, San Antonio District

Modification of a Previously Approved Plan

Texas Commission on Environmental Quality

for Regulated Activities on the Edwards Aquifer Recharge Zone and Transition Zone and Relating to 30 TAC 213.4(j), Effective June 1, 1999

To ensure that the application is administratively complete, confirm that all fields in the form are complete, verify that all requested information is provided, consistently reference the same site and contact person in all forms in the application, and ensure forms are signed by the appropriate party.

Note: Including all the information requested in the form and attachments contributes to more streamlined technical reviews.

Signature

To the best of my knowledge, the responses to this form accurately reflect all information requested concerning the proposed regulated activities and methods to protect the Edwards Aquifer. This request for a **Modification of a Previously Approved Plan** is hereby submitted for TCEQ review and executive director approval. The request was prepared by:

Print Name of Customer/Agent: John Bryant, TxDOT

Date: 4/14/2023

Signature of Customer/Agent:

DocuSigned by:
John Bryant
07AB486D73884A8...

Project Information

1. Current Regulated Entity Name: LP1604 from Stone Oak Pkwy to 1.09 miles east of Redland Rd
   Original Regulated Entity Name: limits of prior WPAPs vary
   Regulated Entity Number(s) (RN): not available
   Edwards Aquifer Protection Program ID Number(s):
   13-10090210, 13-10090211, 13-000320, 13-000654

   ☒ The applicant has not changed and the Customer Number (CN) is: 600803456
   ☒ The applicant or Regulated Entity has changed. A new Core Data Form has been provided.

2. ☒ **Attachment A: Original Approval Letter and Approved Modification Letters**. A copy of the original approval letter and copies of any modification approval letters are attached.

3. A modification of a previously approved plan is requested for (check all that apply):
   - ☒ 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;
   - ☒ 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;
   - ☐ Development of land previously identified as undeveloped in the original water pollution abatement plan;
   - ☐ Physical modification of the approved organized sewage collection system;
   - ☐ Physical modification of the approved underground storage tank system;
   - ☐ Physical modification of the approved aboveground storage tank system.

4. ☒ Summary of Proposed Modifications (select plan type being modified). If the approved plan has been modified more than once, copy the appropriate table below, as necessary, and complete the information for each additional modification.

WPAP Modification Summary	*Approved Project*	*Proposed Modification*
Acres	30.13-411.7*	233.45
Type of Development	Road	Road
Number of Residential Lots	0	0
Impervious Cover (acres)	15.4-176.7*	183.38
Impervious Cover (%	43.1-69.8%*	78.6%
Permanent BMPs	*	STU
Other	*see attached page for details	

SCS Modification Summary	*Approved Project*	*Proposed Modification*
Linear Feet	0	0
Pipe Diameter	0	0
Other	0	0

AST Modification Summary	***Approved Project***	***Proposed Modification***
Number of ASTs	0	0
Volume of ASTs	0	0
Other	0	0

UST Modification Summary	***Approved Project***	***Proposed Modification***
Number of USTs	0	0
Volume of USTs	0	0
Other	0	0

5. ☒ **Attachment B: Narrative of Proposed Modification**. A detailed narrative description of the nature of the proposed modification is attached. It discusses what was approved, including any previous modifications, and how this proposed modification will change the approved plan.

6. ☒ **Attachment C: Current Site Plan of the Approved Project**. A current site plan showing the existing site development (i.e., current site layout) at the time this application for modification is attached. A site plan detailing the changes proposed in the submitted modification is required elsewhere.
   - ☒ The approved construction has not commenced. The original approval letter and any subsequent modification approval letters are included as Attachment A to document that the approval has not expired.
   - ☐ The approved construction has commenced and has been completed. Attachment C illustrates that the site was constructed as approved.
   - ☐ The approved construction has commenced and has been completed. Attachment C illustrates that the site was **not** constructed as approved.
   - ☐ The approved construction has commenced and has **not** been completed. Attachment C illustrates that, thus far, the site was constructed as approved.
   - ☐ The approved construction has commenced and has **not** been completed. Attachment C illustrates that, thus far, the site was **not** constructed as approved.

7. ☐ The acreage of the approved plan has increased. A Geologic Assessment has been provided for the new acreage.
   ☐ Acreage has not been added to or removed from the approved plan.

8. ☒ Submit one (1) original and one (1) copy of the application, plus additional copies as needed for each affected incorporated city, groundwater conservation district, and county in which the project will be located. The TCEQ will distribute the additional copies to these jurisdictions. The copies must be submitted to the appropriate regional office.

DETAILS OF PREVIOUSLY APPROVED PROJECTS[1]

Details of Previously Approved Projects						
	LP 1604 from 0.3 miles east of US 281 to Mud Creek	US 281 and LP 1604 from Bitters Rd to Redland Rd along 1604 and Bitters Rd to 1604 along 281	US 281 and LP 1604 from Bitters Rd to Redland Rd along 1604 and Bitters Rd to 1604 along 281	US 281 from LP 1604 to 0.8 miles north of Stone Oak Pkwy	LP 1604 from Redland Rd to Bulverde	Modification
	TWC Approved 06/15/1992	TCEQ Approved 12/07/2010	TQEC Approved 12/22/2011	TQEC Approved 04/07/2017	TQEC Approved 06/06/2018	
EAPP ID No	None	13-10090210	13-10090211	13-000320	13-000654	N/a
CSJ No	2452-03-070	0253-04-139	0253-04-139	0253-04-146	2452-03-118	2452-02-130
Acres of Development	30.13	411.7	411.7	253.1	84.1	233.45
Type of Development	Road	Road	Road	Road	Road	Road
Number of Residential Lots	0	0	0	0	0	0
Impervious Cover (acres)	12.98	15.4	15.4	176.7	48.95	183.38
Impervious Cover (%)	43.1%	64.5%	64.5%	69.8%	58.0%	78.6%
Permanent BMPs	Sedimentation Pond	VFS, Grassy Swale, Aqualogic	VFS, Grassy Swale, Aqualogic	STU, VFS, Detention, Grassy Swale	VFS, Grassy Swale, Aqualogic	STU

[1]This additional detail is provided based on Item 4 of TCEQ Form 0590.
N/a – this information was not available.

ATTACHMENT A – ORIGINAL APPROVAL LETTERS

1. LP 1604 from 0.3 miles east of US 281 to Mud Creek, TWC Approved 6/15/1992
2. US 281 and LP 1604 from Bitters Rd to Redland Rd along 1604 and Bitters Rd to 1604 along 281, TCEQ Approved WPAP 12/7/2010
3. US 281 and LP 1604 from Bitters Rd to Redland Rd along 1604 and Bitters Rd to 1604 along 281, TCEQ Approved WPAP 12/22/2011
4. US 281 from LP 1604 to 0.8 miles north of Stone Oak Pkwy, TCEQ Approved 4/7/2017
5. LP 1604 from Redland Rd to Bulverde, TCEQ Approved 6/6/2018

J. Brown
S. Hewitt

RECEIVED
DISTRICT 15
92 JUN 17 AM 10:57

TEXAS WATER COMMISSION

PROTECTING TEXANS' HEALTH AND SAFETY BY PREVENTING AND REDUCING POLLUTION

cc to Mayer

June 15, 1992

2452-3-70

Kenneth C. Bohuslav, P.E. (D8-E)
Engineer of Environmental Studies
Texas Department of Transportation
125 E. 11th Street
Austin, Texas 78701-2483

Re: Environmental Assessment, Bexar County: Texas Department of Transportation (TxDOT) Construction of Permanent Erosion and Sedimentation Control Structures at Loop 1604 from 0.3 Mile East of U.S. 281 to Mud Creek

Dear Mr. Bohuslav:

The proposed project provides for the construction of a permanent sedimentation pond and hazardous materials basin for Loop 1604 at Mud Creek in Bexar County, Texas. The plans for this project was received by the Texas Water Commission (TWC) on May 18, 1992. Pursuant to the Memorandum of Understanding between our agencies the following comments are offered:

Standard Comments:

1) Stormwater runoff from this proposed construction will flow directly into Mud Creek which discharges into Salado Creek which is segment number 1910 of the San Antonio River Basin. This segment is designated for contact recreation, high quality aquatic habitat, public water supply, and for aquifer protection. The water quality of wetlands and waters in the State shall be maintained in accordance with all applicable provisions of the Texas Surface Water Quality Standards including the General, Narrative and Numerical Criteria.

   Elevated levels of fecal coliform occur approximately half the time. A portion of this segment does not meet swimmable criteria due to the elevated fecal coliform levels.

2) Temporary erosion and sedimentation control structures should be in place prior to initiation of construction and should be maintained during construction. Any area disturbed should be restored upon completion of construction to minimize potential water quality impacts. Discharges from the site, including stormwater, shall not cause substantial and persistent changes from ambient conditions of turbidity or color. Silt fences, rock berms, and other appropriate methods should be used to minimize the discharge of suspended particulates.

3) The District 8 Office of the TWC may monitor stormwater discharges from the site to evaluate the adequacy of the temporary erosion and sedimentation control measures.

4) The TxDOT and the Contractor shall employ measures to control spills of fuels, lubricants, or any other materials used in construction to prevent them from entering waters in the State. All spills shall be promptly reported to the TWC at 1(800)633-9363.

5) All sanitary wastes shall be retained on-site and disposed of in accordance with all TWC rules.

6) Materials resulting from the destruction of existing roads and structures shall be removed from any waters in the State or areas adjacent to waters in the State and shall be properly disposed of in accordance with all TWC rules.

7) All areas utilized for spoil disposal shall be designated on the plans and shall be protected from run-on and run-off. The placement of any material in a watercourse or wetlands shall be avoided and shall be placed there only with the approval of the TWC and when no other reasonable alternative is available. If work within a watercourse or wetland is unavoidable, heavy equipment shall be placed on mats, if necessary, to protect the substrate from gouging and rutting.

8) Contaminated runoff from any storage area, or which occurred as a result of a spill shall not be allowed to enter waters in the State. Non-contaminated stormwater from the construction area shall be controlled to prevent the discharge of debris from the site.

9) Upon completion of earthwork operations all temporary fills shall be removed from watercourses, wetlands, and areas disturbed during construction shall be seeded, rip-rapped, or given some other type of protection to minimize subsequent soil erosion. Any fill material shall be clean and of such composition that it will not adversely effect the biological, chemical or physical properties of any waters in the State.

10) Disturbance to vegetation will be limited to only what is absolutely necessary, and the limits of construction activity shall be clearly identified on the construction plans. After construction, all disturbed areas will be revegetated to approximate the pre-disturbance native plant assemblage.

11) Where control of weeds, insects and other undesirable species is deemed necessary by the TxDOT or Contractor, control methods which are nontoxic to aquatic life or human health

shall be employed when the activity is located in, or in close proximity to, waters in the State.

12) Disposal sites shall be located outside of the vicinity of public water supply intakes, where possible, otherwise the operator of the water supply system shall be notified at least 72 hours prior to discharge.

13) Concentrations of taste and odor producing substances shall not interfere with the production of potable water by reasonable water treatment methods, impart unpalatable flavor to food fish including shellfish, result in offensive odors arising from the water, or otherwise interfere with reasonable use of the water in the State.

14) Surface water shall be essentially free of floating debris and suspended solids that are conducive to producing adverse responses in aquatic organisms or putrescible sludge deposits or sediment layers which adversely affect benthic biota or any other designated uses. Surface water shall be essentially free of settleable solids conducive to changes in flow characteristics of stream channels or the untimely filling of reservoirs, lakes and bays.

15) The work of the TxDOT shall be conducted such that surface waters are maintained in an aesthetically attractive condition, foaming or frothing of a persistent nature is avoided. Surface waters shall be maintained so that oil, grease, or related residue will not produce a visible film of oil or globules of grease on the surface or coat the banks or bottom of any watercourses.

16) The TxDOT shall not engage in any activity which will cause waters in the State to be toxic to man, aquatic or terrestrial life.

17) Any discharge of wastewater which would constitute a new source of pollution or an increased source of pollution from any industrial, public, or private project or development shall be required to provide a level of wastewater treatment consistent with the provisions of the Texas Water Code and the Clean Water Act. Additionally, the TxDOT is placed on notice that stormwater detention and/or treatment facilities may be required now, or at a later date, to meet requirements of State and/or Federal law.

18) These comments shall not be deemed as fulfilling the TxDOT's responsibility to obtain additional authorization or approval from other local, state or federal regulatory agencies having

authority to preserve and protect resources within the area where the work will occur.

Additional Comments:

19) Any construction activity which will result in the disturbance of five acres or more will require an NPDES Storm Water Permit. TxDOT projects should have to comply with the General Permit Requirements. These requirements should be finalized and adopted by the EPA within the next few months. In general, upon adoption of the General Permitting Requirements, for any project under construction the contractor will be responsible for notifying the EPA prior to October 1, 1992. For all projects initiated after October 1, 1992 the contractor will be responsible for notifying the EPA at least 48 hours prior to initiation of construction.

20) After the permanent facilities have been in place and operating for at least a six month period the TxDOT shall provide an inspection report which verifies that the 24-hour drawdown time is being achieved, inflows are not short-circuiting the system, scour and erosion are not taking place within or downstream of the basins, structural integrity of the system is being maintained, debris and litter is being removed, and adequate grass cover exists.

21) The TxDOT shall clarify who will be responsible for closing the shut-off valve located in the berm between the hazardous materials basin and the sedimentation pond, and for diverting stormwater around the basins in the event that a spill or discharge occurs. Proper training and instructions shall be provided to the responsible parties.

The City of San Antonio conducted a review of the proposed plans and expressed a concern that the hazardous materials trap be constructed of rip-rap rather than using a clay liner. In response to this concern the TxDOT provided additional information to the TWC dated June 12, 1992. Since this is not a typical curb and gutter installation the TWC agrees and supports the recommendation of the TxDOT; however, the TWC agrees that any spill of hazardous materials may involve a costly clean-up that may need to conform to strict RCRA regulations. The TWC appreciates the efforts by the City of San Antonio to provide timely and appropriate comments on these plans.

If you have any questions or require additional information, please contact me at (512) 463-7790 in Austin.

Sincerely,

Hank B. Smith, P.E.
Watershed Management Division

cc: Rebecca Cedillo, Director, City of San Antonio, Department of Planning
Russell L. Masters, Edwards Underground Water District
John C. Kight, P.E., District Design Engineer, Texas Department of Transportation
District 8 Office, Texas Water Commission

COPY

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

December 7, 2010

Mr. Dale Stein, P.E.
Alamo Regional Mobility Authority
1222 North Main Avenue, Suite 1000
San Antonio, Texas 78212

Re: Edwards Aquifer, Bexar County
NAME OF PROJECT: US Highway 281 and Loop 1604 Interchange, from Bitters Road to Redland Road along Loop 1604 and from Bitters Road to Loop 1604 along US 281, San Antonio, Texas
Request for Approval of a Water Pollution Abatement Plan (WPAP)
30 Texas Administrative Code (TAC) Chapter 213 Subchapter A Edwards Aquifer
Edwards Aquifer Protection Program ID No. 13-10090210

Dear Mr. Stein:

The Texas Commission on Environmental Quality (TCEQ) has completed its review of the WPAP application for the referenced project submitted to the Austin Regional Office by Jacobs Engineering Group, Inc. on behalf of Alamo Regional Mobility Authority on September 2, 2010. Final review of the WPAP submittal was completed after additional material was received on October 8, November 8 and November 29, 2010. As presented to the TCEQ, the Temporary and Permanent Best Management Practices (BMPs) and construction plans were prepared by a Texas licensed professional engineer to be in general compliance with the requirements of 30 TAC Chapter 213. These planning materials were sealed, signed, and dated by a Texas licensed professional engineer. Therefore, based on the engineer's concurrence of compliance, the planning materials for construction of the proposed project and pollution abatement measures are hereby approved subject to applicable state rules and the conditions in this letter. The applicant or a person affected may file with the chief clerk a motion for reconsideration of the executive director's final action on this WPAP. A motion for reconsideration must be filed no later than 23 days after the date of this approval letter. *This approval expires two (2) years from the date of this letter unless, prior to the expiration date, more than 10% of the construction has commenced on the project or an extension of time has been requested.*

BACKGROUND

A related project within the same right-of-way (ROW), Edwards Aquifer Protection Program ID No. 13-05090110, *Loop 1604 Toll Starter System*, has expired, as substantial construction has not commenced.

PROJECT DESCRIPTION

The proposed roadway project consists of new construction of four (4) direct connectors (flyover sections to connect traffic flows between Loop 1604 and US 281 Hwy.), removal and reconstruction of entrance and exit ramps, widening of auxiliary lanes, pavement overlay, and bridge widening. The project extends from Bitters Road to Redland Road along Loop 1604 and from Bitters Road to Loop 1604 along US 281. Construction will occur within a right-of-way (ROW) area of approximately 411.7 acres. The ultimate impervious cover will be increased to approximately 265.5 acres (64.5%) from 250.1 acres*.

*All grade separated direct connector areas were counted as additional impervious cover for the calculation of TSS loading, but not used in the impervious cover determination.

The project is within the Recharge Zone and a smaller section within the Transition Zone along US 281 at Hill Country Village and approves:

- Adding 4 direct connectors to connect traffic flows between Loop 1604 and US 281 Hwy., and necessary drainage improvements,
- Installing 3 AquaLogic systems near outfalls of 3 direct connects,
- Installing vegetated filter strips alongside selected lengths of the roadway (as outlined in Exhibit 2 of the plan documents),
- Improving ramps near Mudd Creek, and Stone Oak Parkway,
- Widening selected lanes and bridges (as outlined in Exhibits 1&2),
- Re-stabilizing the ROW after construction.

In addition to the described activities, temporary erosion and sedimentation controls will be installed prior to commencing site disturbance and the disturbed areas will begin to be re-stabilized within 21 days upon completion of construction in sub-areas, and at the finish of construction. Activities will be controlled by the addition of silt fencing, concrete washouts, stabilized exits, dewatering pits, erosion control logs, rock bedding, storm inlet protections, curb and gutter, and storm sewers. In addition, Stormwater Pollution Prevention Plan (SW3P) coverage will apply. No wastewater will be generated by this roadway project.

PERMANENT POLLUTION ABATEMENT MEASURES

The selected BMPs for this project are filtering with vegetative filter strips (VFS) and grassy swales (GS) along Loop 1604 and installing three (3) AquaLogic systems at the outfalls of certain connectors. The AquaLogic devices will also serve as hazardous material traps (HMT). In addition, protection for 10 of 12 identified sensitive features will be provided with additional Best Management Practices (BMPs).

Treatment design calculations were sealed by Erin Sobotik, P.E., to demonstrate the total treatment load removal to exceed the required 21,813 lbs. increase caused by the project by removal of 46,989 lbs. in those watershed areas traversed by the roadway. Control measures have been shown to comply with the guidance in the TCEQ manual (RG-348).

Drainage culverts will direct and divert off-site runoff around and underneath the project. The approved measures meet the required 80 percent removal of the increased load in total suspended solids caused by the project.

GEOLOGY

According to the geologic assessment included with the application, there are 12 sensitive karst related features. The project area is located in the midst of the Balcones Escarpment where faults generally trend northeast to southwest. The most predominate member of the Edwards Group appears to be the Person formation. It is noted that more than 85% of the natural surface has been re-graded or landscaped within the project boundaries. 10 of the 12 sensitive features were caves, and all the caves were exposed in the road cuts. Certain caves are present at the base of the road cuts where the road cut meets the shoulder. Debris was observed to have flowed into several of the cave openings indicating that the features receive rapid infiltration over a short period of time during heavy or numerous rain events. Some of the caves were located above where the shoulder intersects the road cut. The horizontal and vertical extents varied, as did the presence of absence of flowstone and speleothems. The project area has been studied more than on this occasion. The project drains into Panther Springs Creek, Lorence Creek, Elm Creek and Mudd Creek. Many nearby projects were in different stages of construction, and outfall in the same watersheds.

Plan protections as outline in the Feature designations and protections Table center around maintenance of flow and prevention of pollution to the sensitive features identified. As a consequence, 10 of the 12 sensitive features are being given permanent BMP protection. Two features will have to be sealed at the opening as result of retaining wall construction.

Feature designations and protections	
S10	-protected by setback
S6BN	-flow maintained by native permeable fill
S5BS	-flow maintained by native permeable fill
S6AS	-flow maintained by native permeable fill
S5EN	-flow maintained by native permeable fill
S5FN	-flow maintained by native permeable fill
S7AS	-wall seal at opening
S7BS	-wall seal at opening
S7CN	-flow maintained by engineered drain
S4AS	-flow maintained by native permeable fill
S5GN	-flow maintained by native permeable fill
S6CS	-flow maintained by native permeable fill

SPECIAL CONDITIONS

I. Since this is a roadway construction project, deed recordation of this approval letter is not required.

II. A staging area was not proposed for this project. If the contractor desires a staging area, information indicating the proposed location and placement of appropriate temporary erosion and sedimentation controls must be submitted to the TCEQ for review and approved prior to its installation.

III. All sediment and/or media removed from the water quality basins during maintenance activities shall be properly disposed of according to 30 TAC 330 or 30 TAC 335, as applicable.

IV. Recover and dispose of all slurries and waste water in accordance with good engineering practices. No discharges are allowed within or in close proximity to streams or other bodies of water.

STANDARD CONDITIONS

1. Pursuant to Chapter 7 Subchapter C of the Texas Water Code, any violations of the requirements in 30 TAC Chapter 213 may result in administrative penalties.

2. In addition to the rules of the Commission, the applicant may also be required to comply with state and local ordinances and regulations providing for the protection of water quality.

Prior to Commencement of Construction:

3. All contractors conducting regulated activities at the referenced project location shall be provided a copy of this notice of approval. At least one complete copy of the approved WPAP and this notice of approval shall be maintained at the project location until all regulated activities are completed.

4. Modification to the activities described in the referenced WPAP application following the date of approval may require the submittal of a plan to modify this approval, including the payment of appropriate fees and all information necessary for its review and approval prior to initiating construction of the modifications.

5. The applicant must provide written notification of intent to commence construction, replacement, or rehabilitation of the referenced project. Notification must be submitted to the Austin Regional Office no later than 48 hours prior to commencement of the regulated activity. Written notification must include the date on which the regulated activity will commence, the name of the approved plan and program ID number for the regulated activity, and the name of the prime contractor with the name and telephone number of the contact person. The executive director will use the notification to determine if the approved plan is eligible for an extension.

6. Temporary erosion and sedimentation (E&S) controls, i.e., silt fences, rock berms, stabilized construction entrances, or other controls described in the approved WPAP, must be installed prior to construction and maintained during construction. Temporary E&S controls may be removed when vegetation is established and the construction area is stabilized. The TCEQ may monitor stormwater discharges from the site to evaluate the adequacy of temporary E&S control measures. Additional controls may be necessary if excessive solids are being discharged from the site.

7. All borings with depths greater than or equal to 20 feet must be plugged with non-shrink grout from the bottom of the hole to within three (3) feet of the surface. The remainder of the hole must be backfilled with cuttings from the boring. All borings less than 20 feet must be backfilled with cuttings from the boring. All borings must be backfilled or plugged within four (4) days of completion of the drilling operation. Voids may be filled with gravel.

During Construction:

8. During the course of regulated activities related to this project, the applicant or agent shall comply with all applicable provisions of 30 TAC Chapter 213, Edwards Aquifer. The applicant shall remain responsible for the provisions and conditions of this approval until such responsibility is legally transferred to another person or entity.

9. This approval does not authorize the installation of temporary aboveground storage tanks on this project. If the contractor desires to install a temporary aboveground storage tank for use during construction, an application to modify this approval must be submitted and approved prior to installation. The application must include information related to tank location and spill containment.

10. If any sensitive feature (caves, solution cavities, sink holes, etc.) is discovered during construction, all regulated activities near the feature must be suspended immediately. The applicant or his agent must immediately notify the San Antonio Regional Office of the discovery of the feature. Regulated activities near the feature may not proceed until the executive director has reviewed and approved the methods proposed to protect the feature and the aquifer from potentially adverse impacts to water quality. The plan must be sealed, signed, and dated by a Texas licensed professional engineer.

11. If sediment escapes the construction site, the sediment must be removed at a frequency sufficient to minimize offsite impacts to water quality (e.g., fugitive sediment in street being washed into surface streams or sensitive features by the next rain). Sediment must be removed from sediment traps or sedimentation ponds not later than when design capacity has been reduced by 50 percent. Litter, construction debris, and construction chemicals shall be prevented from becoming stormwater discharge pollutants.

12. Intentional discharges of sediment laden water are not allowed. If dewatering becomes necessary, the discharge will be filtered through appropriately selected best management practices. These may include vegetated filter strips, sediment traps, rock berms, silt fence rings, etc.

13. No water well exists on site. All water wells, including injection, dewatering, and monitoring wells must be in compliance with the requirements of the Texas Department of Licensing and Regulation under Title 16 TAC Chapter 76 (relating to Water Well Drillers and Pump Installers) and all other locally applicable rules, as appropriate

14. The following records shall be maintained and made available to the executive director 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.

15. Stabilization measures shall be initiated as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased, and construction activities will not resume within 21 days. When the initiation of stabilization measures by the 14th day is precluded by weather conditions, stabilization measures shall be initiated as soon as practicable.

After Completion of Construction:

16. A Texas licensed professional engineer must certify in writing that the permanent BMPs or measures were constructed as designed. The certification letter must be submitted to the Austin Regional Office within 30 days of site completion.

17. The applicant or agent shall be responsible for maintaining the permanent BMPs after construction until such time as the maintenance obligation is either assumed in writing by another entity having ownership or control of the property or the ownership of the property is transferred to the entity. The regulated entity shall then be responsible for maintenance until another entity assumes such obligations in writing or ownership is transferred. A copy of the transfer of responsibility must be filed with the executive director through Austin Regional Office within 30 days of the transfer. A copy of the transfer form (TCEQ-10263) is enclosed.

18. Upon legal transfer of this property, the new owner(s) is required to comply with all terms of the approved Edwards Aquifer protection plan. If the new owner intends to commence any new regulated activity on the site, a new Edwards Aquifer protection plan that specifically addresses the new activity must be submitted to the executive director. Approval of the plan for the new regulated activity by the executive director is required prior to commencement of the new regulated activity.

19. An Edwards Aquifer protection plan approval or extension will expire and no extension will be granted if more than 50 percent of the total construction has not been completed within ten years from the initial approval of a plan. A new Edwards Aquifer protection plan must be submitted to the Austin Regional Office with the appropriate fees for review and approval by the executive director prior to commencing any additional regulated activities.

20. At project locations where construction is initiated and abandoned, or not completed, the site shall be returned to a condition such that the aquifer is protected from potential contamination.

If you require additional information, please contact Mr. Kevin Lee Smith, P.E. of the Edwards Aquifer Protection Program with the Austin Regional Office at (512) 339-2929.

Sincerely,

Carolyn Runyon for

Mark R. Vickery, P.G.
Executive Director
Texas Commission on Environmental Quality

MRV/kls

Enclosure: Change in Responsibility for Maintenance of Permanent BMPs, TCEQ-10263

cc: Ms. Lynn Bumguardner, Water Section Manager, San Antonio Regional Office
Ms. Erin Sobotik, P.E., Jacobs Engineering Group, Inc.
Mr. Scott Halty, San Antonio Water System, San Antonio, Texas
Mr. Karl Dreher, General Manager, Edwards Aquifer Authority, San Antonio, Texas
Ms. Renee Green, P.E., Bexar County Public Works, San Antonio, Texas
The Honorable Bob Sartor, Mayor, Town of Hollywood Park, Texas
The Honorable Kirk Francis, Mayor, Hill Country Village, Texas
Mr. Andrew Hawkins, Save Our Springs Alliance, Austin Texas
Mr. Richard De La Cruz, P.E., San Antonio District, Texas Department of Transportation
TCEQ Central Records, Building F, MC 212

Change in Responsibility for Maintenance on Permanent Best Management Practices and Measures

The applicant is no longer responsible for maintaining the permanent best management practice (BMP) and other measures. The project information and the new entity responsible for maintenance is listed below.

Customer: ______________________________

Regulated Entity Name: ______________________________

Site Address: ______________________________

City, Texas, Zip: ______________________________

County: ______________________________

Approval Letter Date: ______________________________

BMPs for the project: ______________________________

New Responsible Party: ______________________________

Name of contact: ______________________________

Mailing Address: ______________________________

City, State: ______________________ Zip: __________

Telephone: ______________________ FAX: __________

______________________________ ______________

Signature of New Responsible Party Date

I acknowledge and understand that I am assuming full responsibility for maintaining all permanent best management practices and measures approved by the TCEQ for the site, until another entity assumes such obligations in writing or ownership is transferred.

If you have questions on how to fill out this form or about the Edwards Aquifer protection program, please contact us at 210/490-3096 for projects located in the San Antonio Region or 512/339-2929 for projects located in the Austin Region.

Individuals are entitled to request and review their personal information that the agency gathers on its forms. They may also have any errors in their information corrected. To review such information, contact us at 512/239-3282.

Bryan W. Shaw, Ph.D., *Chairman*
Buddy Garcia, *Commissioner*
Carlos Rubinstein, *Commissioner*
Mark R. Vickery, P.G., *Executive Director*

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

December 22, 2011

Mr. Dale Stein, P.E.
Alamo Regional Mobility Authority
1222 North Main Avenue, Suite 1000
San Antonio, Texas 78212

Re: Edwards Aquifer, Bexar County
NAME OF PROJECT: US Highway 281 and Loop 1604 Interchange, from Bitters Road to Redland Road along Loop 1604 and from Bitters Road to Loop 1604 along US 281, San Antonio, Texas
Request for Approval of a Water Pollution Abatement Plan (WPAP)
30 Texas Administrative Code (TAC) Chapter 213 Subchapter A Edwards Aquifer
Edwards Aquifer Protection Program ID No. 13-10090211

Dear Mr. Stein:

The Texas Commission on Environmental Quality (TCEQ) has completed its review of the WPAP application for the referenced project submitted to the Austin Regional Office by Jacobs Engineering Group, Inc. on behalf of Alamo Regional Mobility Authority on November 18, 2011. As presented to the TCEQ, the Temporary and Permanent Best Management Practices (BMPs) and construction plans were prepared by a Texas licensed professional engineer to be in general compliance with the requirements of 30 TAC Chapter 213. These planning materials were sealed, signed, and dated by a Texas licensed professional engineer. Therefore, based on the engineer's concurrence of compliance, the planning materials for construction of the proposed project and pollution abatement measures are hereby approved subject to applicable state rules and the conditions in this letter. The applicant or a person affected may file with the chief clerk a motion for reconsideration of the executive director's final action on this WPAP. A motion for reconsideration must be filed no later than 23 days after the date of this approval letter. *This approval expires two (2) years from the date of this letter unless, prior to the expiration date, more than 10% of the construction has commenced on the project or an extension of time has been requested.*

BACKGROUND

This project modifies the prior approval obtained in EAPP 13-10090210 by updating the permanent and temporary BMPs, updating the drainage areas to better fit the planned construction, updating the storm water pollution prevention plan (SWPPP) and providing a new set of calculations to verify treatment and loading removal. A modification is necessary because water pollution abatement structures are being physically modified, both sizing and numbers.

PROJECT DESCRIPTION

The proposed roadway project consists of new construction of four (4) direct connectors (flyover sections to connect traffic flows between Loop 1604 and US 281 Hwy.), removal and reconstruction of entrance and exit ramps, widening of auxiliary lanes, pavement overlay, and bridge widening. The project extends from Bitters Road to Redland Road along Loop 1604 and from Bitters Road to Loop 1604 along US 281. Construction will occur within a right-of-way (ROW) area of approximately 411.7 acres. The ultimate impervious cover will be increased to approximately 265.5 acres (64.5%) from 250.1 acres*.

*All grade separated direct connector areas were counted as additional impervious cover for the calculation of TSS loading, but not used in the impervious cover determination. There is no difference from the previous approval.

The project is within the Recharge Zone and a smaller section within the Transition Zone along US 281 at Hill Country Village and approves:

- Adding 4 direct connectors to connect traffic flows between Loop 1604 and US 281 Hwy., and necessary drainage improvements,
- Installing 2 AquaLogic systems near outfalls of 2 direct connects (previously 3),
- Installing vegetated filter strips alongside selected lengths of the roadway (as outlined in Exhibit 2 of the new plan documents),
- Improving ramps near Mudd Creek, and Stone Oak Parkway,
- Widening selected lanes and bridges (as outlined in Exhibits 1&2),
- Re-stabilizing the ROW after construction.

In addition to the described activities, temporary erosion and sedimentation controls will be installed prior to commencing site disturbance and the disturbed areas will begin to be re-stabilized within 21 days upon completion of construction in sub-areas, and at the finish of construction. Activities will be controlled by the addition of silt fencing, concrete washouts, stabilized exits, dewatering pits, erosion control logs, rock bedding, storm inlet protections, curb and gutter, and storm sewers. In addition, SWPPP coverage will apply. No wastewater will be generated by this roadway project.

PERMANENT POLLUTION ABATEMENT MEASURES

The selected BMPs for this project are filtering with vegetative filter strips (VFS) and grassy swales (GS) along Loop 1604 and installing two (2) AquaLogic systems at the outfalls of certain connectors. The AquaLogic devices will also serve as hazardous material traps (HMT). In addition, protection for 10 of 12 identified sensitive features will be provided with additional Best Management Practices (BMPs).

Treatment design calculations were sealed by Erin Sobotik, P.E., to demonstrate the total treatment load removal to exceed the required 19,414 lbs. increase caused by the project by removal of 26,460 lbs. in those watershed areas traversed by the roadway. Control measures have been shown to comply with the guidance in the TCEQ manual (RG-348).

Drainage culverts will direct and divert off-site runoff around and underneath the project. The approved measures meet the required 80 percent removal of the increased load in total suspended solids caused by the project.

GEOLOGY

According to the geologic assessment included with the application, there are 12 sensitive karst related features. The project area is located in the midst of the Balcones Escarpment where faults generally trend northeast to southwest. The most predominate member of the Edwards Group appears to be the Person formation. It is noted that more than 85% of the natural surface has been re-graded or landscaped within the project boundaries. 10 of the 12 sensitive features were caves, and all the caves were exposed in the road cuts. Certain caves are present at the base of the road cuts where the road cut meets the shoulder. Debris was observed to have flowed into several of the cave openings indicating that the features receive rapid infiltration over a short period of time during heavy or numerous rain events. Some of the caves were located above where the shoulder intersects the road cut. The horizontal and vertical extents varied, as did the presence of absence of flowstone and speleothems. The project area has been studied more than on this occasion. The project drains into Panther Springs Creek, Lorence Creek, Elm Creek and Mudd Creek. Many nearby projects were in different stages of construction, and outfall in the same watersheds.

Plan protections as outline in the Feature designations and protections Table center around maintenance of flow and prevention of pollution to the sensitive features identified. As a consequence, 10 of the 12 sensitive features are being given permanent BMP protection. Two features will have to be sealed at the opening as result of retaining wall construction.

Feature designations and protections	
S10	-protected by setback
S6BN	-flow maintained by native permeable fill
S5BS	-flow maintained by native permeable fill
S6AS	-flow maintained by native permeable fill
S5EN	-flow maintained by native permeable fill
S5FN	-flow maintained by native permeable fill
S7AS	-wall seal at opening
S7BS	-wall seal at opening
S7CN	-flow maintained by engineered drain
S4AS	-flow maintained by native permeable fill
S5GN	-flow maintained by native permeable fill
S6CS	-flow maintained by native permeable fill

SPECIAL CONDITIONS

I. Since this is a roadway construction project, deed recordation of this approval letter is not required.

II. A staging area was not proposed for this project. If the contractor desires a staging area, information indicating the proposed location and placement of appropriate temporary erosion and sedimentation controls must be submitted to the TCEQ for review and approved prior to its installation.

III. All sediment and/or media removed from the water quality basins during maintenance activities shall be properly disposed of according to 30 TAC 330 or 30 TAC 335, as applicable.

IV. Recover and dispose of all slurries and waste water in accordance with good engineering practices. No discharges are allowed within or in close proximity to streams or other bodies of water.

STANDARD CONDITIONS

1. Pursuant to Chapter 7 Subchapter C of the Texas Water Code, any violations of the requirements in 30 TAC Chapter 213 may result in administrative penalties.

2. In addition to the rules of the Commission, the applicant may also be required to comply with state and local ordinances and regulations providing for the protection of water quality.

Prior to Commencement of Construction:

3. All contractors conducting regulated activities at the referenced project location shall be provided a copy of this notice of approval. At least one complete copy of the approved WPAP and this notice of approval shall be maintained at the project location until all regulated activities are completed.

4. Modification to the activities described in the referenced WPAP application following the date of approval may require the submittal of a plan to modify this approval, including the payment of appropriate fees and all information necessary for its review and approval prior to initiating construction of the modifications.

5. The applicant must provide written notification of intent to commence construction, replacement, or rehabilitation of the referenced project. Notification must be submitted to the Austin Regional Office no later than 48 hours prior to commencement of the regulated activity. Written notification must include the date on which the regulated activity will commence, the name of the approved plan and program ID number for the regulated activity, and the name of the prime contractor with the name and telephone number of the contact person. The executive director will use the notification to determine if the approved plan is eligible for an extension.

6. Temporary erosion and sedimentation (E&S) controls, i.e., silt fences, rock berms, stabilized construction entrances, or other controls described in the approved WPAP, must be installed prior to construction and maintained during construction. Temporary E&S controls may be removed when vegetation is established and the construction area is stabilized. The TCEQ may monitor stormwater discharges from the site to evaluate the adequacy of temporary E&S control measures. Additional controls may be necessary if excessive solids are being discharged from the site.

7. All borings with depths greater than or equal to 20 feet must be plugged with non-shrink grout from the bottom of the hole to within three (3) feet of the surface. The remainder of the hole must be backfilled with cuttings from the boring. All borings less than 20 feet must be backfilled with cuttings from the boring. All borings must be backfilled or plugged within four (4) days of completion of the drilling operation. Voids may be filled with gravel.

<u>During Construction</u>:

8. During the course of regulated activities related to this project, the applicant or agent shall comply with all applicable provisions of 30 TAC Chapter 213, Edwards Aquifer. The applicant shall remain responsible for the provisions and conditions of this approval until such responsibility is legally transferred to another person or entity.

9. This approval does not authorize the installation of temporary aboveground storage tanks on this project. If the contractor desires to install a temporary aboveground storage tank for use during construction, an application to modify this approval must be submitted and approved prior to installation. The application must include information related to tank location and spill containment.

10. If any sensitive feature (caves, solution cavities, sink holes, etc.) is discovered during construction, all regulated activities near the feature must be suspended immediately. The applicant or his agent must immediately notify the San Antonio Regional Office of the discovery of the feature. Regulated activities near the feature may not proceed until the executive director has reviewed and approved the methods proposed to protect the feature and the aquifer from potentially adverse impacts to water quality. The plan must be sealed, signed, and dated by a Texas licensed professional engineer.

11. If sediment escapes the construction site, the sediment must be removed at a frequency sufficient to minimize offsite impacts to water quality (e.g., fugitive sediment in street being washed into surface streams or sensitive features by the next rain). Sediment must be removed from sediment traps or sedimentation ponds not later than when design capacity has been reduced by 50 percent. Litter, construction debris, and construction chemicals shall be prevented from becoming stormwater discharge pollutants.

12. Intentional discharges of sediment laden water are not allowed. If dewatering becomes necessary, the discharge will be filtered through appropriately selected best management practices. These may include vegetated filter strips, sediment traps, rock berms, silt fence rings, etc.

13. No water well exists on site. All water wells, including injection, dewatering, and monitoring wells must be in compliance with the requirements of the Texas Department of Licensing and Regulation under Title 16 TAC Chapter 76 (relating to Water Well Drillers and Pump Installers) and all other locally applicable rules, as appropriate

14. The following records shall be maintained and made available to the executive director 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.

15. Stabilization measures shall be initiated as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased, and construction activities will not resume within 21 days. When the initiation of stabilization measures by the 14th day is precluded by weather conditions, stabilization measures shall be initiated as soon as practicable.

After Completion of Construction:

16. A Texas licensed professional engineer must certify in writing that the permanent BMPs or measures were constructed as designed. The certification letter must be submitted to the Austin Regional Office within 30 days of site completion.

17. The applicant or agent shall be responsible for maintaining the permanent BMPs after construction until such time as the maintenance obligation is either assumed in writing by another entity having ownership or control of the property or the ownership of the property is transferred to the entity. The regulated entity shall then be responsible for maintenance until another entity assumes such obligations in writing or ownership is transferred. A copy of the transfer of responsibility must be filed with the executive director through Austin Regional Office within 30 days of the transfer. A copy of the transfer form (TCEQ-10263) is enclosed.

18. Upon legal transfer of this property, the new owner(s) is required to comply with all terms of the approved Edwards Aquifer protection plan. If the new owner intends to commence any new regulated activity on the site, a new Edwards Aquifer protection plan that specifically addresses the new activity must be submitted to the executive director. Approval of the plan for the new regulated activity by the executive director is required prior to commencement of the new regulated activity.

19. An Edwards Aquifer protection plan approval or extension will expire and no extension will be granted if more than 50 percent of the total construction has not been completed within ten years from the initial approval of a plan. A new Edwards Aquifer protection plan must be submitted to the Austin Regional Office with the appropriate fees for review and approval by the executive director prior to commencing any additional regulated activities.

20. At project locations where construction is initiated and abandoned, or not completed, the site shall be returned to a condition such that the aquifer is protected from potential contamination.

If you require additional information, please contact Mr. Kevin Lee Smith, P.E. of the Edwards Aquifer Protection Program with the Austin Regional Office at (512) 339-2929.

Sincerely,

Mark R. Vickery, P.G.
Executive Director
Texas Commission on Environmental Quality

MRV/kls

Enclosure: Change in Responsibility for Maintenance of Permanent BMPs, TCEQ-10263

cc: Ms. Lynn Bumguardner, Water Section Manager, San Antonio Regional Office
Ms. Erin Sobotik, P.E., Jacobs Engineering Group, Inc.
Mr. Scott Halty, San Antonio Water System, San Antonio, Texas
Mr. Karl Dreher, General Manager, Edwards Aquifer Authority, San Antonio, Texas
Ms. Renee Green, P.E., Bexar County Public Works, San Antonio, Texas
The Honorable Bob Sartor, Mayor, Town of Hollywood Park, Texas
The Honorable Kirk Francis, Mayor, Hill Country Village, Texas
Mr. Barrlynn West, P.G., San Antonio District, Texas Department of Transportation
TCEQ Central Records, Building F, MC 212

Change in Responsibility for Maintenance on Permanent Best Management Practices and Measures

The applicant is no longer responsible for maintaining the permanent best management practice (BMP) and other measures. The project information and the new entity responsible for maintenance is listed below.

Customer: ______________________________

Regulated Entity Name: ______________________________

Site Address: ______________________________

City, Texas, Zip: ______________________________

County: ______________________________

Approval Letter Date: ______________________________

BMPs for the project: ______________________________

New Responsible Party: ______________________________

Name of contact: ______________________________

Mailing Address: ______________________________

City, State: ______________________ Zip: ____________

Telephone: ____________________ FAX: ____________________

______________________________ ____________

Signature of New Responsible Party Date

I acknowledge and understand that I am assuming full responsibility for maintaining all permanent best management practices and measures approved by the TCEQ for the site, until another entity assumes such obligations in writing or ownership is transferred.

If you have questions on how to fill out this form or about the Edwards Aquifer protection program, please contact us at 210/490-3096 for projects located in the San Antonio Region or 512/339-2929 for projects located in the Austin Region.

Individuals are entitled to request and review their personal information that the agency gathers on its forms. They may also have any errors in their information corrected. To review such information, contact us at 512/239-3282.

TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

May 2, 2017

Mr. Mario Jorge, P.E.
San Antonio District
Texas Department of Transportation
4615 NW Loop 410
San Antonio, Texas 78229

Re: Edwards Aquifer, Bexar County
US 281 N Loop 1604 to Stone Oak Pkwy; Loop 1604 to Marshall Road, San Antonio, Texas
Request for Approval of a Water Pollution Abatement Plan (WPAP)
30 Texas Administrative Code (TAC) Chapter 213
Edwards Aquifer Protection Program ID No. 13000320; RN109458919

Dear Mr. Jorge:

The Texas Commission on Environmental Quality (TCEQ) has completed its review of the WPAP application for the referenced project submitted to the Austin Regional Office by K Friese & Associates, Inc. on behalf of Texas Department of Transportation on December 28, 2016. Final review of the WPAP submittal was completed after additional material was received on March 10 and April 13, 2017. As presented to the TCEQ, the Temporary and Permanent Best Management Practices (BMPs) and construction plans were prepared by a Texas licensed professional engineer to be in general compliance with the requirements of 30 TAC Chapter 213. These planning materials were sealed, signed, and dated by a Texas licensed professional engineer. Therefore, based on the engineer's concurrence of compliance, the planning materials for construction of the proposed project and pollution abatement measures are hereby approved subject to applicable state rules and the conditions in this letter. The applicant or a person affected may file with the chief clerk a motion for reconsideration of the executive director's final action on this WPAP. A motion for reconsideration must be filed no later than 23 days after the date of this approval letter. *This approval expires two (2) years from the date of this letter unless, prior to the expiration date, more than 10% of the construction has commenced on the project or an extension of time has been requested.*

BACKGROUND

The right-of-way for the project was acquired circa 2000 and before. The corridor is largely developed and has been used as US 281 for decades. Utilities within the corridor are maintained by San Antonio Water System (SAWS).

The previous WPAP (EAPP ID 13-09120710) is to be superseded by this approval; it had designated vegetated filter strips (VFS) for treatment, to be replaced by the construction of newer BMPs within parts of the right of way (ROW). Overlap will also occur with WPAP (EAPP ID 13-10090210) for those portions contained within Loop 1604. One existing BMP, a VFS at the westbound frontage road of Loop 1604 will be removed. Except for this one change, the overall previous approval remains in place.

PROJECT DESCRIPTION

The proposed roadway construction will add approximately 4.0 miles of new six lane freeway with HOV lanes, direct connection improvements at Loop 1604, a bridge over Mud Creek, overpasses at intersections, new two lane (three-lane in places) frontage roads and sidewalks between Loop 1604 and Marshall Road, along with additional appurtenances. The additional roadway will be within a ROW corridor of 253.1 acres. Total impervious cover within the ROW will be 176.7 acres (69.8 percent).

The project is entirely within the Recharge Zone and approves:

- Demolition of existing highway between Stations 330 and 497, before reconstruction of new lanes,
- Reconstructing 6 lanes of US 281 containing a new bridge over Mud Creek,
- Constructing overpasses for the freeway at Redland Road, Encino Rio, Evans Road, and Stone Oak Parkway, including additional turn lanes.
- Adding four northern direct connect ramps at Loop 1604, and an elevated "T" ramp to connect the HOV lanes directly to a new offsite park & ride facility,
- Installing structural and non-structural BMPs,
- Utilizing engineered filter strips (VFS), stormwater treatment units (STU) and extended detention basins (ED), to treat runoff, with ED serving as hazardous materials traps,
- Re-stabilizing the ROW after construction.

In addition to the described activities, temporary erosion and sedimentation controls will be installed prior to commencing site disturbance and maintained during construction. No wastewater will be generated by this roadway project.

PERMANENT POLLUTION ABATEMENT MEASURES

To prevent the pollution of stormwater runoff originating on-site or upgradient of the site and potentially flowing across and off the site after construction, stormwater treatment units (Jellyfish), engineered filter strips (VFS), and extended detention basins (ED), designed using the TCEQ technical guidance document, Complying with the Edwards Aquifer Rules: Technical Guidance on Best Management Practices (2005), will be constructed in summary as follows:

- The thirteen (13) EDs are individually designed according to local drainage characteristics with outlet valves to assist in hazardous materials abatement.
- The eleven (11) STUs consist of the Jellyfish design with either 3 or 4 filter elements, with at least a 40 inch cartridge length, as sized and profiled on Sheet 1192 and tied to stormsewer.
- Four (4) grassy swales and twelve VFS will also treat designated parts of the project.

-Use the WPAP quality plans dated 11/10/2016 and water quality calculations dated 04/07/2017 for details.

The approved measures meet the required 80 percent removal of the increased load in total suspended solids caused by the project. Treatment design calculations were sealed by Danielle Skidmore, P.E., on April 7, 2017 to demonstrate the total treatment load removal to exceed the required 64,759 lbs. increase caused by the project by 4,933 lbs. in those watershed areas traversed by the roadway project.

TxDOT will maintain the BMPs and owns the ROW.

GEOLOGY

According to the geologic assessment included with the application, there are 20 sensitive karst related features within 50 feet of the ROW. The project area is located in the midst of the Balcones Escarpment where faults generally trend northeast to southwest. The most predominate member of the Edwards Group appears to be the Person Formation. It is noted that more than 85% of the natural surface has been re-graded or landscaped within the project boundaries. Certain caves are present at the base of the road cuts where the road cut meets the shoulder, or just above the grade. The project drains into West Elm Creek and Mud Creek. Many nearby projects were in different stages of construction, and outfall in the same watersheds. The Austin Regional Office site assessment conducted on January 18, and February 23, 2017 verified the site to be generally as described in the application.

Plan protections center around maintenance of flow and prevention of pollution to the sensitive features identified. As a consequence, twelve (12) sensitive features are being given permanent BMP protection. Eight (8) features are proposed to be sealed or removed at the opening as result of no alternative to realign the construction. Other water wells and non-sensitive features were also identified.

The protections and setbacks described in the following table.

Feature ID No.	Name	Protection Description*
281-088 281-089 281-091	Zombie Cave Complex	Approximately 20 feet setback from the features.
281-075	Solution cavity	Approximately 9 feet setback from the feature.
281-070 281-071 281-072 281-073	Cool Cave & Stafford Cave Complex	Approximately 20 feet setback from the features.
281-083 281-085 281-086	Dripstone Cave Complex	Approximately 20 feet setback from the features.
281-080	Power Pole Hole Cave	Stone gate, and approximately 23 feet setback from the feature.

*For greater detail, see Water Quality Site Plan sheets.

SPECIAL CONDITIONS

I. Since this is a roadway construction project, deed recordation of this approval letter is not required.

II. All construction activities, including staging, stockpiling, parking lots, and traffic shall be conducted inside the established ROW, and outside the 100-year floodplain, except in the case where proper BMPs are being installed or maintained, and approved prior to its installation.

STANDARD CONDITIONS

1. Pursuant to Chapter 7 Subchapter C of the Texas Water Code, any violations of the requirements in 30 TAC Chapter 213 may result in administrative penalties.

2. In addition to the rules of the Commission, the applicant may also be required to comply with state and local ordinances and regulations providing for the protection of water quality.

Prior to Commencement of Construction:

3. All contractors conducting regulated activities at the referenced project location shall be provided a copy of this notice of approval. At least one complete copy of the approved WPAP and this notice of approval shall be maintained at the project location until all regulated activities are completed.

4. Modification to the activities described in the referenced WPAP application following the date of approval may require the submittal of a plan to modify this approval, including the payment of appropriate fees and all information necessary for its review and approval prior to initiating construction of the modifications.

5. The applicant must provide written notification of intent to commence construction, replacement, or rehabilitation of the referenced project. Notification must be submitted to the Austin Regional Office no later than 48 hours prior to commencement of the regulated activity. Written notification must include the date on which the regulated activity will commence, the name of the approved plan and program ID number for the regulated activity, and the name of the prime contractor with the name and telephone number of the contact person. The executive director will use the notification to determine if the approved plan is eligible for an extension.

6. Temporary erosion and sedimentation (E&S) controls, i.e., silt fences, rock berms, stabilized construction entrances, or other controls described in the approved WPAP, must be installed prior to construction and maintained during construction. Temporary E&S controls may be removed when vegetation is established and the construction area is stabilized. The TCEQ may monitor stormwater discharges from the site to evaluate the adequacy of temporary E&S control measures. Additional controls may be necessary if excessive solids are being discharged from the site.

7. All borings with depths greater than or equal to 20 feet must be plugged with non-shrink grout from the bottom of the hole to within three (3) feet of the surface. The remainder of the hole must be backfilled with cuttings from the boring. All borings less than 20 feet must be backfilled with cuttings from the boring. All borings must be backfilled or plugged within four (4) days of completion of the drilling operation. Voids may be filled with gravel.

During Construction:

8. During the course of regulated activities related to this project, the applicant or agent shall comply with all applicable provisions of 30 TAC Chapter 213, Edwards Aquifer. The applicant shall remain responsible for the provisions and conditions of this approval until such responsibility is legally transferred to another person or entity.

9. If any sensitive feature (caves, solution cavities, sink holes, etc.) is discovered during construction, all regulated activities near the feature must be suspended immediately. The applicant or his agent must immediately notify the Austin Regional Office of the discovery of the feature. Regulated activities near the feature may not proceed until the executive director has reviewed and approved the methods proposed to protect the feature and the aquifer from potentially adverse impacts to water quality. The plan must be sealed, signed, and dated by a Texas licensed professional engineer.

10. One well exists on site. All water wells, including injection, dewatering, and monitoring wells must be in compliance with the requirements of the Texas Department of Licensing and Regulation under Title 16 TAC Chapter 76 (relating to Water Well Drillers and Pump Installers) and all other locally applicable rules, as appropriate.

11. If sediment escapes the construction site, the sediment must be removed at a frequency sufficient to minimize offsite impacts to water quality (e.g., fugitive sediment in street being washed into surface streams or sensitive features by the next rain). Sediment must be removed from sediment traps or sedimentation ponds not later than when design capacity has been reduced by 50 percent. Litter, construction debris, and construction chemicals shall be prevented from becoming stormwater discharge pollutants.

12. Intentional discharges of sediment laden water are not allowed. If dewatering becomes necessary, the discharge will be filtered through appropriately selected best management practices. These may include vegetated filter strips, sediment traps, rock berms, silt fence rings, etc.

13. The following records shall be maintained and made available to the executive director 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.

14. Stabilization measures shall be initiated as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased, and construction activities will not resume within 21 days. When the initiation of stabilization measures by the 14th day is precluded by weather conditions, stabilization measures shall be initiated as soon as practicable.

After Completion of Construction:

15. A Texas licensed professional engineer must certify in writing that the permanent BMPs or measures were constructed as designed. The certification letter must be submitted to the Austin Regional Office within 30 days of site completion.

16. The applicant shall be responsible for maintaining the permanent BMPs after construction until such time as the maintenance obligation is either assumed in writing by another entity having ownership or control of the property (such as without limitation, an owner's association, a new property owner or lessee, a district, or municipality) or the ownership of the property is transferred to the entity. The regulated entity shall then be responsible for maintenance until another entity assumes such obligations in writing or ownership is transferred.

17. Upon legal transfer of this property, the new owner(s) is required to comply with all terms of the approved Edwards Aquifer protection plan. If the new owner intends to commence any new regulated activity on the site, a new Edwards Aquifer protection plan that specifically addresses the new activity must be submitted to the executive director. Approval of the plan for the new regulated activity by the executive director is required prior to commencement of the new regulated activity.

18. An Edwards Aquifer protection plan approval or extension will expire and no extension will be granted if more than 50 percent of the total construction has not been completed within ten years from the initial approval of a plan. A new Edwards Aquifer protection plan must be submitted to the Austin Regional Office with the appropriate fees for review and approval by the executive director prior to commencing any additional regulated activities.

This action is taken under authority delegated by the Executive Director of the Texas Commission on Environmental Quality. If you have any questions or require additional information, please contact Mr. Kevin Lee Smith, P.E., of the Edwards Aquifer Protection Program of the Austin Regional Office at (512) 339-2929.

Sincerely,

Shawn Stewart
Austin Water Section Manager
CSS/kls

cc: Ms. Lynn Bumguardner, Water Section Manager, San Antonio Regional Office
Ms. Danielle Skidmore, P.E., K Friese & Associates, Inc., Austin
Mr. Scott Halty, San Antonio Water System, San Antonio
Ms. Renee Green, P.E., Bexar County Public Works, San Antonio
Mr. Roland Ruiz, General Manager, Edwards Aquifer Authority, San Antonio
Mr. Ricardo Flores, P.G., TxDOT San Antonio District, San Antonio
Mr. George Wissmann, Trinity Glen Rose Conservation District, San Antonio

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TEXAS COMMISSION ON ENVIRONMENTAL QUALITY

Protecting Texas by Reducing and Preventing Pollution

June 6, 2018

Mr. Eddie Reyes, P.E., Area Engineer
San Antonio District
Texas Department of Transportation
9320 SE Loop 410
San Antonio, Texas 78223

Re: Edwards Aquifer, Bexar County
Loop 1604 at Bulverde Road; San Antonio, Texas
Request for Approval of a Water Pollution Abatement Plan (WPAP)
30 Texas Administrative Code (TAC) Chapter 213 Edwards Aquifer
Edwards Aquifer Protection Program ID No. 13000654; RN104209911

Dear Mr. Reyes:

The Texas Commission on Environmental Quality (TCEQ) has completed its review of the WPAP application for the referenced project submitted to the Austin Regional Office by the Texas Department of Transportation on March 29, 2018. Final review of the WPAP submittal was completed after additional material was received on May 26, 2018. As presented to the TCEQ, the Temporary and Permanent Best Management Practices (BMPs) and construction plans were prepared by a Texas licensed professional engineer to be in general compliance with the requirements of 30 TAC Chapter 213. These planning materials were sealed, signed, and dated by a Texas licensed professional engineer. Therefore, based on the engineer's concurrence of compliance, the planning materials for construction of the proposed project and pollution abatement measures are hereby approved subject to applicable state rules and the conditions in this letter. The applicant or a person affected may file with the chief clerk a motion for reconsideration of the executive director's final action on this Water Pollution Abatement Plan. A motion for reconsideration must be filed no later than 23 days after the date of this approval letter. *This approval expires two (2) years from the date of this letter unless, prior to the expiration date, more than 10% of the construction has commenced on the project or an extension of time has been requested.*

PROJECT DESCRIPTION

The proposed expansion to the current roadway design consists of reversing ramps between Redland Road and Bulverde Road and adding two frontage road turnarounds at Bulverde Road. One exit ramp will be removed. The project ROW is approximately 84.1 acres within the Elm Creek watershed. The project extends from Redland Road to Bulverde Road along Loop 1604.

The project traverses the Recharge Zone and approves:

- Removing and relocating existing ramps onto Loop 1604,
- Adding frontage road turnaround lanes at Bulverde Road,
- Utilizing vegetated filter strips (VFS) to treat runoff,
- Re-stabilizing the ROW after construction.

In addition to the described activities, temporary erosion and sedimentation controls will be installed prior to commencing site disturbance and maintained during construction. No wastewater will be generated by this roadway project.

PERMANENT POLLUTION ABATEMENT MEASURES

The selected BMP for this project is the Bulverde Road turnarounds receiving VFS as shown on the erosion control sheets. Cross-sections confirm the VFS widths. The approved measures meet the required 80 percent removal of the increased load in total suspended solids caused by the project. Design calculations were sealed by Erik Scott, P.E., on March 15, 2018 to demonstrate the total treatment load removal is sufficient in the affected watershed areas from the projected 3.72 acres of new impervious cover.

GEOLOGY

According to the geologic assessment included with the application, there are no wells nor sensitive karst related features. The leached and Collapsed member of the Person Formation of the Edwards Group outcrop on site. The project drains into the Elm Creek watershed. The site slopes from west and east to the culvert at Elm Creek. The survey area is highly altered by previous Loop 1604 construction. The TCEQ site assessment of April 9, 2018 confirms this general description.

SPECIAL CONDITIONS

I. Since this is a roadway construction project, deed recordation of this approval letter is not required.

II. A staging area was not proposed for this project. If the contractor desires a staging area, information indicating the proposed location and placement of appropriate temporary erosion and sedimentation controls must be submitted to the TCEQ for review and approved prior to its installation.

STANDARD CONDITIONS

1. Pursuant to Chapter 7 Subchapter C of the Texas Water Code, any violations of the requirements in 30 TAC Chapter 213 may result in administrative penalties.

Prior to Commencement of Construction:

2. All contractors conducting regulated activities at the referenced project location shall be provided a copy of this notice of approval. At least one complete copy of the approved WPAP and this notice of approval shall be maintained at the project location until all regulated activities are completed.

3. Modification to the activities described in the referenced WPAP application following the date of approval may require the submittal of a plan to modify this approval, including the payment of appropriate fees and all information necessary for its review and approval prior to initiating construction of the modifications.

4. The applicant must provide written notification of intent to commence construction, replacement, or rehabilitation of the referenced project. Notification must be submitted to the Austin Regional Office no later than 48 hours prior to commencement of the regulated activity. Written notification must include the date on which the regulated activity will commence, the name of the approved plan and program ID number for the regulated activity, and the name of the prime contractor with the name and telephone number of the contact person. The executive director will use the notification to determine if the approved plan is eligible for an extension.

5. Temporary erosion and sedimentation (E&S) controls, i.e., silt fences, rock berms, stabilized construction entrances, or other controls described in the approved WPAP, must be installed prior to construction and maintained during construction. Temporary E&S controls may be removed when vegetation is established and the construction area is stabilized. The TCEQ may monitor stormwater discharges from the site to evaluate the adequacy of temporary E&S control measures. Additional controls may be necessary if excessive solids are being discharged from the site.

6. All borings with depths greater than or equal to 20 feet must be plugged with non-shrink grout from the bottom of the hole to within three (3) feet of the surface. The remainder of the hole must be backfilled with cuttings from the boring. All borings less than 20 feet must be backfilled with cuttings from the boring. All borings must be backfilled or plugged within four (4) days of completion of the drilling operation. Voids may be filled with gravel.

<u>During Construction</u>:

7. During the course of regulated activities related to this project, the applicant or agent shall comply with all applicable provisions of 30 TAC Chapter 213, Edwards Aquifer. The applicant shall remain responsible for the provisions and conditions of this approval until such responsibility is legally transferred to another person or entity.

8. This approval does not authorize the installation of temporary aboveground storage tanks on this project. If the contractor desires to install a temporary aboveground storage tank for use during construction, an application to modify this approval must be submitted and approved prior to installation. The application must include information related to tank location and spill containment.

9. If any sensitive feature (caves, solution cavities, sink holes, etc.) is discovered during construction, all regulated activities near the feature must be suspended immediately. The applicant or his agent must immediately notify the Austin Regional Office of the discovery of the feature. Regulated activities near the feature may not proceed until the executive director has reviewed and approved the methods proposed to protect the feature and the aquifer from potentially adverse impacts to water quality. The plan must be sealed, signed, and dated by a Texas licensed professional engineer.

10. No evidence of wells exist. All water wells, including injection, dewatering, and monitoring wells must be in compliance with the requirements of the Texas Department of Licensing and Regulation under Title 16 TAC Chapter 76 (relating to Water Well Drillers and Pump Installers) and all other locally applicable rules, as appropriate.

COPY

11. If sediment escapes the construction site, the sediment must be removed at a frequency sufficient to minimize offsite impacts to water quality (e.g., fugitive sediment in street being washed into surface streams or sensitive features by the next rain). Sediment must be removed from sediment traps or sedimentation ponds not later than when design capacity has been reduced by 50 percent. Litter, construction debris, and construction chemicals shall be prevented from becoming stormwater discharge pollutants.

12. Intentional discharges of sediment laden water are not allowed. If dewatering becomes necessary, the discharge will be filtered through appropriately selected best management practices. These may include vegetated filter strips, sediment traps, rock berms, silt fence rings, etc.

13. The following records shall be maintained and made available to the executive director 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.

14. Stabilization measures shall be initiated as soon as practicable in portions of the site where construction activities have temporarily or permanently ceased, and construction activities will not resume within 21 days. When the initiation of stabilization measures by the 14th day is precluded by weather conditions, stabilization measures shall be initiated as soon as practicable.

After Completion of Construction:

15. A Texas licensed professional engineer must certify in writing that the permanent BMPs or measures were constructed as designed. The certification letter must be submitted to the Austin Regional Office within 30 days of site completion.

16. The applicant shall be responsible for maintaining the permanent BMPs after construction until such time as the maintenance obligation is either assumed in writing by another entity having ownership or control of the property (such as without limitation, an owner's association, a new property owner or lessee, a district, or municipality) or the ownership of the property is transferred to the entity. The regulated entity shall then be responsible for maintenance until another entity assumes such obligations in writing or ownership is transferred.

17. Upon legal transfer of this property, the new owner(s) is required to comply with all terms of the approved Edwards Aquifer protection plan. If the new owner intends to commence any new regulated activity on the site, a new Edwards Aquifer protection plan that specifically addresses the new activity must be submitted to the executive director. Approval of the plan for the new regulated activity by the executive director is required prior to commencement of the new regulated activity.

18. An Edwards Aquifer protection plan approval or extension will expire and no extension will be granted if more than 50 percent of the total construction has not been completed within ten years from the initial approval of a plan. A new Edwards Aquifer protection plan must be submitted to the Austin Regional Office for review and approval by the executive director prior to commencing any additional regulated activities.

19. At project locations where construction is initiated and abandoned, or not completed, the site shall be returned to a condition such that the aquifer is protected from potential contamination.

This action is taken under authority delegated by the Executive Director of the Texas Commission on Environmental Quality. If you have any questions or require additional information, please contact Mr. Kevin Lee Smith, P.E. of the Edwards Aquifer Protection Program of the Austin Regional Office at 512-339-2929.

Sincerely,

Robert Sadlier, Water Section Team Leader
Austin Region Office
Texas Commission on Environmental Quality

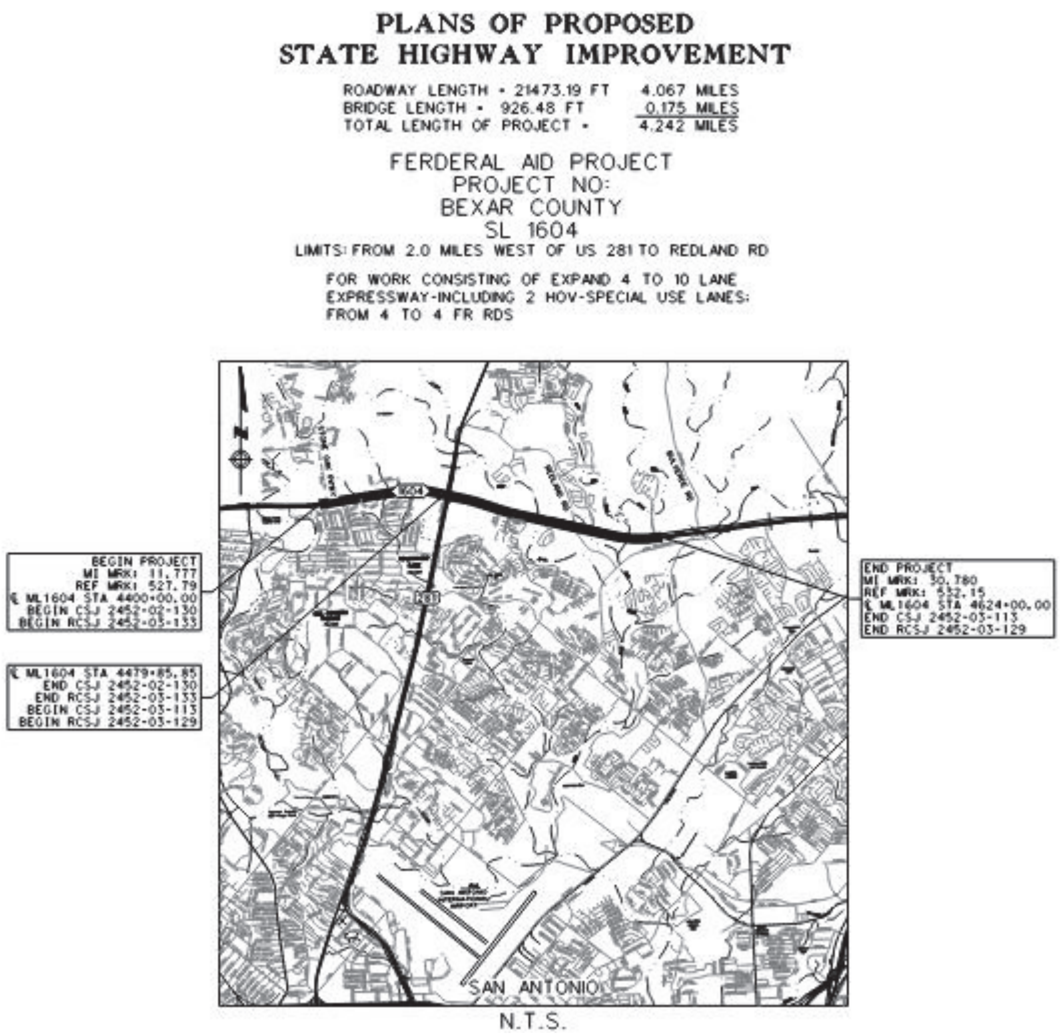
RCS/kls

cc: Ms. Renee Green, P.E., Bexar County Public Works
Ms. Lynn Bumgaurdner, Water Section Manager, San Antonio Regional Office
Mr. Ricardo Flores, San Antonio District, Texas Department of Transportation
Mr. Scott Halty, San Antonio Water System
Mr. George Wissmann, General Manager, Trinity Glen Rose Conservation District
Mr. Roland Ruiz, General Manager, Edwards Aquifer Authority

ATTACHMENT B – NARRATIVE OF PROPOSED MODIFICATIONS

The Loop 1604 Segment 4 project extends from Stone Oak Parkway to 1.09 miles east of Redland Road (see image below). TxDOT proposes to expand Loop 1604 from an eight-lane expressway to an eighteen-lane expressway by adding two general purpose lanes and one high-occupancy vehicle (HOV) lane to the mainlanes in each direction. The layout of auxiliary lanes, and entrance and exit ramps and frontage roads would be reconfigured.

Most existing BMPs within the project limits will be displaced. This project will include mitigation for all displaced BMPs and proposed impervious cover created by the project. There are 5 sensitive features in the survey area that will not be impacted by the project. There are 2 sensitive features (Loop-012 and Loop-205) located outside of the ROW on private property; there will be no work in those drainage easements.



END OF ATTACHMENT B

ATTACHMENT C – CURRENT SITE PLAN OF APPROVED PROJECT

The current site layout is shown superimposed (faded back) on the plan and profile layouts in the Construction Plans.

END ATTACHMENT C

LP 1604: From Stone Oak Parkway to 1.09 miles East of Redland Road
CSJ #2452-02-130 and #2452-03-113

City of San Antonio, Texas

Bexar County, Texas

WATER POLLUTION ABATEMENT PLAN

Prepared for:

Texas Department of Transportation

Prepared by:

LJA Engineering, Inc.

LJA Engineering, Inc.
7500 Rialto Blvd, Building II Suite 100
Austin, Texas 78735

STATE OF TEXAS
ZACHARY B. RYAN
106276
LICENSED
PROFESSIONAL ENGINEER

01/25/2023

Texas Commission on Environmental Quality
Edwards Aquifer Application Cover Page

Our Review of Your Application

The Edwards Aquifer Program staff conducts an administrative and technical review of all applications. The turnaround time for administrative review can be up to 30 days as outlined in 30 TAC 213.4(e). Generally administrative completeness is determined during the intake meeting or within a few days of receipt. The turnaround time for technical review of an administratively complete Edwards Aquifer application is 90 days as outlined in 30 TAC 213.4(e). Please know that the review and approval time is directly impacted by the quality and completeness of the initial application that is received. In order to conduct a timely review, it is imperative that the information provided in an Edwards Aquifer application include final plans, be accurate, complete, and in compliance with 30 TAC 213.

Administrative Review

1. Edwards Aquifer applications must be deemed administratively complete before a technical review can begin. To be considered administratively complete, the application must contain completed forms and attachments, provide the requested information, and meet all the site plan requirements. The submitted application and plan sheets should be final plans. Please submit one full-size set of plan sheets with the original application, and half-size sets with the additional copies.

   To ensure that all applicable documents are included in the application, the program has developed tools to guide you and web pages to provide all forms, checklists, and guidance. Please visit the below website for assistance: http://www.tceq.texas.gov/field/eapp.

2. This Edwards Aquifer Application Cover Page form (certified by the applicant or agent) must be included in the application and brought to the administrative review meeting.

3. Administrative reviews are scheduled with program staff who will conduct the review. Applicants or their authorized agent should call the appropriate regional office, according to the county in which the project is located, to schedule a review. The average meeting time is one hour.

4. In the meeting, the application is examined for administrative completeness. Deficiencies will be noted by staff and emailed or faxed to the applicant and authorized agent at the end of the meeting, or shortly after. Administrative deficiencies will cause the application to be deemed incomplete and returned.

   An appointment should be made to resubmit the application. The application is re-examined to ensure all deficiencies are resolved. The application will only be deemed administratively complete when all administrative deficiencies are addressed.

5. If an application is received by mail, courier service, or otherwise submitted without a review meeting, the administrative review will be conducted within 30 days. The applicant and agent will be contacted with the results of the administrative review. If the application is found to be administratively incomplete, it can be retrieved from the regional office or returned by regular mail. If returned by mail, the regional office may require arrangements for return shipping.

6. If the geologic assessment was completed before October 1, 2004, and the site contains “possibly sensitive” features, the assessment must be updated in accordance with the *Instructions to Geologists* (TCEQ-0585 Instructions).

Technical Review

1. When an application is deemed administratively complete, the technical review period begins. The regional office will distribute copies of the application to the identified affected city, county, and groundwater conservation district whose jurisdiction includes the subject site. These entities and the public have 30 days to provide comments on the application to the regional office. All comments received are reviewed by TCEQ.
2. A site assessment is usually conducted as part of the technical review, to evaluate the geologic assessment and observe existing site conditions. The site must be accessible to our staff. The site boundaries should be clearly marked, features identified in the geologic assessment should be flagged, roadways marked, and the alignment of the Sewage Collection System and manholes should be staked at the time the application is submitted. If the site is not marked the application may be returned.
3. We evaluate the application for technical completeness and contact the applicant and agent via Notice of Deficiency (NOD) to request additional information and identify technical deficiencies. There are two deficiency response periods available to the applicant. There are 14 days to resolve deficiencies noted in the first NOD. If a second NOD is issued, there is an additional 14 days to resolve deficiencies. If the response to the second notice is not received, is incomplete or inadequate, or provides new information that is incomplete or inadequate, the application must be withdrawn or will be denied. Please note that because the technical review is underway, whether the application is withdrawn or denied **the application fee will be forfeited**.
4. The program has 90 calendar days to complete the technical review of the application. If the application is technically adequate, such that it complies with the Edwards Aquifer rules, and is protective of the Edwards Aquifer during and after construction, an approval letter will be issued. Construction or other regulated activity may not begin until an approval is issued.

Mid-Review Modifications

It is important to have final site plans prior to beginning the permitting process with TCEQ to avoid delays.

Occasionally, circumstances arise where you may have significant design and/or site plan changes after your Edwards Aquifer application has been deemed administratively complete by TCEQ. This is considered a "Mid-Review Modification." Mid-Review Modifications may require redistribution of an application that includes the proposed modifications for public comment.

If you are proposing a Mid-Review Modification, two options are available:

- If the technical review has begun your application can be denied/withdrawn, your fees will be forfeited, and the plan will have to be resubmitted.
- TCEQ can continue the technical review of the application as it was submitted, and a modification application can be submitted at a later time.

If the application is denied/withdrawn, the resubmitted application will be subject to the administrative and technical review processes and will be treated as a new application. The application will be redistributed to the affected jurisdictions.

Please contact the regional office if you have questions. If your project is located in Williamson, Travis, or Hays County, contact TCEQ's Austin Regional Office at 512-339-2929. If your project is in Comal, Bexar, Medina, Uvalde, or Kinney County, contact TCEQ's San Antonio Regional Office at 210-490-3096

Please fill out all required fields below and submit with your application.

1. Regulated Entity Name: IH-10 at Loop 1604					**2. Regulated Entity No.:**				
3. Customer Name: Texas Department of Transportation					**4. Customer No.:**				
5. Project Type: (Please circle/check	New		Modification		Extension		Exception		
6. Plan Type: (Please circle/check	WPAP	CZP	SCS	UST	AST	EXP	EXT	Technical Clarification	Optional Enhanced Measures
7. Land Use: (Please circle/check	Residential		Non-residential			**8. Site (acres):**		233.45	
9. Application Fee:			**10. Permanent BMP(s):**				VFS and Water Quality STUs		
11. SCS (Linear Ft.):			**12. AST/UST (No. Tanks):**						
13. County:	Bexar		**14. Watershed:**				Leon Creek		

Application Distribution

Instructions: Use the table below to determine the number of applications required. One original and one copy of the application, plus additional copies (as needed) for each affected incorporated city, county, and groundwater conservation district are required. Linear projects or large projects, which cross into multiple jurisdictions, can require additional copies. Refer to the "Texas Groundwater Conservation Districts within the EAPP Boundaries" map found at:

http://www.tceq.texas.gov/assets/public/compliance/field_ops/eapp/EAPP%20GWCD%20map.pdf

For more detailed boundaries, please contact the conservation district directly.

Austin Region			
County:	**Hays**	**Travis**	**Williamson**
Original (1 req.)	__	__	__
Region (1 req.)	__	__	__
County(ies)	__	__	__
Groundwater Conservation District(s)	__Edwards Aquifer Authority __Barton Springs/ Edwards Aquifer __Hays Trinity __Plum Creek	__Barton Springs/ Edwards Aquifer	NA
City(ies) Jurisdiction	__Austin __Buda __Dripping Springs __Kyle __Mountain City __San Marcos __Wimberley __Woodcreek	__Austin __Bee Cave __Pflugerville __Rollingwood __Round Rock __Sunset Valley __West Lake Hills	__Austin __Cedar Park __Florence __Georgetown __Jerrell __Leander __Liberty Hill __Pflugerville __Round Rock

San Antonio Region					
County:	**Bexar**	**Comal**	**Kinney**	**Medina**	**Uvalde**
Original (1 req.)	_X_	__	__	__	__
Region (1 req.)	_X_	__	__	__	__
County(ies)	_X_	__	__	__	__
Groundwater Conservation District(s)	_X_ Edwards Aquifer Authority _X_Trinity-Glen Rose	__Edwards Aquifer Authority	__Kinney	__EAA __Medina	__EAA __Uvalde
City(ies) Jurisdiction	__Castle Hills __Fair Oaks Ranch __Helotes __Hill Country Village __Hollywood Park _X_San Antonio (SAWS) __Shavano Park	__Bulverde __Fair Oaks Ranch __Garden Ridge __New Braunfels __Schertz	NA	__San Antonio ETJ (SAWS)	NA

I certify that to the best of my knowledge, that the application is complete and accurate. This application is hereby submitted to TCEQ for administrative review and technical review.

Zachary Ryan

Print Name of Customer/Authorized Agent

01/25/2023

Signature of Customer/Authorized Agent Date

FOR TCEQ INTERNAL USE ONLY			
Date(s)Reviewed:		Date Administratively Complete:	
Received From:		Correct Number of Copies:	
Received By:		Distribution Date:	
EAPP File Number:		Complex:	
Admin. Review(s) (No.):		No. AR Rounds:	
Delinquent Fees (Y/N):		Review Time Spent:	
Lat./Long. Verified:		SOS Customer Verification:	
Agent Authorization Complete/Notarized (Y/N):		Fee Check:	Payable to TCEQ (Y/N):
Core Data Form Complete (Y/N):			Signed (Y/N):
Core Data Form Incomplete Nos.:			Less than 90 days old (Y/N):

Edwards Aquifer Protection Program Roadway Checklist

-Edwards Aquifer Application Cover Page (TCEQ-20705)

Edwards Aquifer Protection Program Roadway Application (TCEQ-20872)

Attachment A - Road Map
Attachment B - USGS Quadrangle
Attachment C - Project Description
Attachment D - Factors Affecting Surface Water Quality
Attachment E - BMPs for Upgradient (Offsite) Stormwater
Attachment F - BMPs for On-site Stormwater
Attachment G - Construction Plans
Attachment H - Inspection, Maintenance, Repair and Retrofit Plan
Attachment I - Pilot-Scale Field Testing Plan
Attachment J - Measures for Minimizing Surface Stream Contamination
Attachment K - Volume and Character of Stormwater

-Geologic Assessment Form (TCEQ-0585)

- *Required for site over the Recharge zone*

Attachment A - Geologic Assessment Table (TCEQ-0585-Table)
Attachment B - Stratigraphic Column
Attachment C - Site Geology
Attachment D - Site Geologic Map(s)

-Temporary Stormwater Section (TCEQ-0602)

- *Review Item 37 on Roadway Application for applicability*

Attachment A - Spill Response Actions
Attachment B - Potential Sources of Contamination
Attachment C - Sequence of Major Activities
Attachment D - Temporary Best Management Practices and Measures
Attachment E - Request to Temporarily Seal a Feature (if requested)
Attachment F - Structural Practices
Attachment G - Drainage Area Map
Attachment H - Temporary Sediment Pond(s) Plans and Calculations
Attachment I - Inspection and Maintenance for BMPs

-Agent Authorization Form (TCEQ-0599)

- ***Only if application is submitted by an authorized agent***

-Application Fee Form (TCEQ-0574)

- ***Do <u>not</u> submit for TxDOT roadways***

-Core Data Form (TCEQ-10400)

-Modification of a Previously Approved Plan Form (TCEQ-0590)

Edwards Aquifer Protection Program Roadway Application

Texas Commission on Environmental Quality

This application is intended only for projects which a major roadway is designed for construction, such as State highways, County roads, and City thoroughfares.

Designed for Regulated Activities on the Contributing Zone to the Edwards Aquifer in relation to 30 TAC §213.24, Regulated Activities on the Edwards Aquifer Recharge Zone, in relation to 30 TAC §213.5(b), Effective June 1, 1999.

To ensure that the application is administratively complete, confirm that all fields in the form are complete, verify that all requested information is provided, consistently reference the same site, and contact person in all forms in the application, and ensure forms are signed by the appropriate party.

Note: Including all the information requested in the form and attachments contributes to more streamlined technical reviews.

Signature

To the best of my knowledge, the responses to this form accurately reflect all information requested concerning the proposed regulated activities and methods to protect the Edwards Aquifer.

The application was prepared by:

Print Name of Customer/Agent: Zachary Ryan

Date:

Signature of Customer/Agent:

____

Project Information

1. Regulated Entity (Project) Name: LP1604 from Stone Oak Parkway to 1.09 miles east of Redland Rd
2. County: Bexar
3. Stream Basin(s): Lorence Creek, Mud Creek, Elm Creek
4. Groundwater Conservation District (if applicable): Edwards Aquifer Authority and Trinity Glen Rose Groundwater Conservation District (TGRGCD)
5. Customer (Applicant):
   Contact Person: Gina Gallegos, P.E.
   Entity: Texas Department of Transportation
   Mailing Address: 4615 NW Loop 410
   City, State: San Antonio, Texas Zip: 78229-0928
   Telephone: (210)-615-5801
   Email Address: gina.gallegos@txdot.gov

6. Agent (Representative):

   Contact Person: Zachary B. Ryan, P.E.
   Entity: LJA Engineering
   Mailing Address: 7500 Rialto Boulevard, Building II, Suite 100
   City, State: Austin, Texas Zip: 78735
   Telephone: (512)-439-4700
   Email Address: zryan@lja.com

7. Landowner of R.O.W. (Right of Way)
   Person or entity responsible for maintenance of water quality Best Management Practices (BMPs), if not applicant.

   Contact Person: _____
   Entity: _____
   Mailing Address: _____
   City, State: _____ Zip: _____
   Telephone: _____
   Email Address: _____

8. ☒ **The TCEQ must be able to inspect the project site, or the application will be returned**. Sufficient survey marking is provided on the project to allow TCEQ regional staff to locate the boundaries and alignment of any regulated activities and the geologic or manmade features noted in the Geologic Assessment.

   ☐ Survey marking will be completed by this date: _____

9. ☒ **Attachment A - Road Map**. A road map showing directions to, and the location of the project site is attached. The map clearly shows the boundary of the project site.

10. ☒ **Attachment B - USGS Quadrangle**. A copy of the official 7 ½ minute USGS Quadrangle Map (Scale: 1" = 2000') is attached. The map(s) clearly show:

    ☒ Project site boundaries
    ☒ USGS Quadrangle Name(s)
    ☒ All drainage paths from site to surface waters

11. ☒ **This project extends into (Check all that apply):**

    ☒ Recharge Zone (RZ)
    ☐ Contributing Zone (CZ)
    ☐ Transition Zone (TZ)
    ☐ Contributing Zone within Transition Zone (CZ/TZ)
    ☐ Zone not regulated by EAP

12. ☒ **Attachment C - Project Description**. A detailed narrative description of the proposed project is attached. The project description is consistent throughout the application and contains, at a minimum, the following details:

    ☒ Complete site area [Acres]
    ☒ Offsite upgradient stormwater areas to be captured
    ☒ Impervious area [Acres]
    ☒ Permanent BMP(s)
    ☒ Proposed site use

☒ Existing roadway (paved and/or unpaved)
☐ Structures to be demolished [Include demo phase]
☐ Major interim phases

13. Existing project site conditions are noted below:

☒ Existing paved and/or unpaved roads
☐ Undeveloped (Cleared)
☐ Undeveloped (Undisturbed/Not cleared)
☐ Existing commercial site
☐ Existing industrial site
☐ Existing residential site
☐ Other: ______

14. ☒ **Attachment D - Factors Affecting Surface Water Quality**. A detailed description of all factors that could affect surface water quality is attached.

15. ☒ Only inert materials as defined by 30 TAC §330.3 will be used as fill material.

16. Type of pavement or road surface to be used:

☒ Concrete
☒ Asphaltic concrete pavement
☐ Permeable Friction Course (PFC)
☐ Other: ______

17. Right of Way (R.O.W.) and Pavement Area:

R.O.W. for project: 233.45 (ac.)
Length: 22,400 ft.
Width: varies from 304 ft. to 480 ft.
Impervious cover (IC): 183.38 (ac.)
Total of Pavement area 183.38 (ac.) ÷ R.O.W. area 233.45 (ac.) x 100 = 78.55% IC.
☒ CAD program was used to determine areas.
☒ Number of travel lanes: proposed: 18, existing: 8
☒ Typical widths of lanes: 12 (ft.)
☒ Are intersections also being improved? (Y/N) Y

Site Plan Requirements

Items 18 - 28 must be included on the Site Plan.

18. ☒ The Site Plan must have a minimum scale of 1" = 400'.
Site Plan Scale: 1" = 100'

19. 100-year floodplain boundaries:

☒ Some part(s) of the project site is located within the 100-year floodplain. The floodplain is shown and labeled. The 100-year floodplain boundaries are based on the following specific (including date of material) source(s): Federal Emergency Management Agency (FEMA).
☐ No part of the project site is located within the 100-year floodplain.

20. ☒ A layout of the development with existing and finished contours at appropriate, but not greater than ten-foot contour intervals is shown. Sensitive features, lots, wells, buildings, roads, culverts, etc. are shown on the site plan.

21. ☒ A figure (map) indicating all paths of drainage from the site to surface waters.

    ☒ Name all stream crossings: Lorence Creek, Mud Creek, Elm Creek
    ☐ Drainage patterns and approximate slopes.
    ☐ There will be no discharge to surface waters.

22. ☒ Distinguish between areas of soil disturbance and areas which will not be disturbed.

23. ☒ Show locations of major structural and nonstructural controls. These are the temporary and permanent best management practices. Include the following:

    ☒ Show design and location of any hazardous materials traps.
    ☐ Show design at outfalls of major control structures and conveyances.
    ☒ A description of the BMPs and measures that prevent pollutants from entering surface streams.

24. Show locations of staging areas or project specific locations (PSL). Are they:

    ☐ Onsite, within project R.O.W.
    ☐ Offsite.
    ☒ Not yet determined. (Requires future authorization)

25. ☒ Show locations where soil stabilization practices are expected to occur.

26. ☒ Show surface waters (including wetlands).

27. Temporary aboveground storage tank (AST) facilities:

    ☐ Temporary AST facilities will be located on this site. Show on site plan.
    ☒ Temporary AST facilities will not be located on this site.

28. ☒ Plan(s) also include:

    ☒ Sidewalks
    ☒ Related turn lanes
    ☒ Demolition plans
    ☐ Shared-use paths
    ☐ Off-site improvements and staging areas
    ☒ Utility relocations
    ☐ Other improved areas: ___________________________

Permanent Best Management Practices (BMPs)

Description of practices and measures that will be used after construction is completed.

29. ☒ Permanent BMPs and measures have been designed, and will be constructed, operated, and maintained to ensure that 80% of the incremental increase in the annual mass loading of total suspended solids (TSS) from the site caused by the regulated activity is removed. These quantities have been calculated in accordance with technical guidance accepted by the executive director.

    ☒ The TCEQ Technical Guidance Manual (TGM) was used to design permanent BMPs and measures for this site.
    ☐ A technical guidance other than the TCEQ TGM was used to design permanent BMPs and measures for this site. The complete citation for the technical guidance that was used:

30. ☒ **Attachment E - BMPs for Upgradient (Offsite) Stormwater.**

☒ A description of the BMPs and measures that will be used to prevent pollution of surface water, groundwater, or stormwater that originates upgradient from the site and flows across the site is attached.
☐ No surface water, groundwater or stormwater originates upgradient from the site and flows across the site, and an explanation is attached.
☐ Permanent BMPs or measures are not required to prevent pollution of surface water, groundwater, or stormwater that originates upgradient from the site and flows across the site, and an explanation is attached.

31. ☒ **Attachment F - BMPs for On-site Stormwater**.

☒ A description of the BMPs and measures that will be used to prevent pollution of surface water or groundwater that originates on-site or flows off the site, including pollution caused by contaminated stormwater runoff from the site is attached.
☐ Permanent BMPs or measures are not required to prevent pollution of surface water or groundwater that originates on-site or flows off the site, including pollution caused by contaminated stormwater runoff, and an explanation is attached.

32. ☒ **Attachment G - Construction Plans**. Construction plans and design calculations for the proposed permanent BMPs and measures have been prepared by or under the direct supervision of a Texas Licensed Professional Engineer, and are signed, sealed, and dated. Construction plans for the proposed permanent BMPs and measures are attached and include all proposed structural plans and specifications, and appropriate details.

☒ Major bridge cross-sections, and roadway plan and profiles

☒ BMP plans and details

☒ Erosion control

☒ SW3P

☒ Design calculations

☒ TCEQ Construction Notes

☒ EPIC, as necessary

33. ☒ **Attachment H - Inspection, Maintenance, Repair and Retrofit Plan**. A site and BMP specific plan for the inspection, maintenance, repair, and, if necessary, retrofit of the permanent BMPs and measures is attached. The plan fulfills all the following:

☒ Prepared and certified by the engineer designing the permanent BMPs and measures.
☒ Signed by the owner or responsible party.
☒ Outlines specific procedures for documenting inspections, maintenance, repairs, and, if necessary, retrofit.
☒ Contains a discussion of recordkeeping procedures.

34. ☐ **Attachment I - Pilot-Scale Field Testing Plan.** Pilot studies for BMPs that are not recognized by the Executive Director require prior approval from the TCEQ. A plan for pilot-scale field testing is attached.

☒ N/A

35. ☒ **Attachment J - Measures for Minimizing Surface Stream Contamination.** A description of the measures that will be used to avoid or minimize surface stream contamination and changes in the way in which water enters a stream as a result of the construction and development is attached. The measures address increased stream flashing, the creation of stronger flows, and in-stream effects caused by the regulated activity which increase erosion or may result in water quality degradation.

☒ Include permanent spill measures used to contain hydrocarbons or hazardous substances by way of traps, or response contingencies.

36. The applicant is responsible for maintaining the permanent BMPs after construction until such time as the maintenance obligation is either assumed in writing by another entity.

    If the applicant intends to transfer responsibility, check the box below.

    ☒ Yes

    A copy of the transfer of responsibility must be filed with the executive director at the appropriate regional office within 30 days.

Stormwater to be generated by the Proposed Project

Description of practices and measures that will be used during construction.

37. ☒ The site description, controls, maintenance, and inspection requirements for the Storm Water Pollution Prevention Plan (SWPPP or SW3P) developed under the Texas Pollutant Discharge Elimination System (TPDES) general permits for stormwater discharges have been submitted to fulfill paragraphs 30 TAC §213.24(1-5) & §213.5(b) of the technical report.

    ☐ The Temporary Stormwater Section (TCEQ-0602) is included with the application.
    ☒ The SWPPP (SW3P) will serve as the Temporary Stormwater Section (TCEQ-0602).

38. ☒ **Attachment K - Volume and Character of Stormwater**. A detailed description of the volume (quantity) and character (quality) of the stormwater runoff expected to occur from the proposed project is attached. The estimates of stormwater runoff quality and quantity are based on area and type of impervious cover.

    ☒ Include the pre-construction runoff coefficient.
    ☒ Include the post-construction runoff coefficient.

Administrative Information

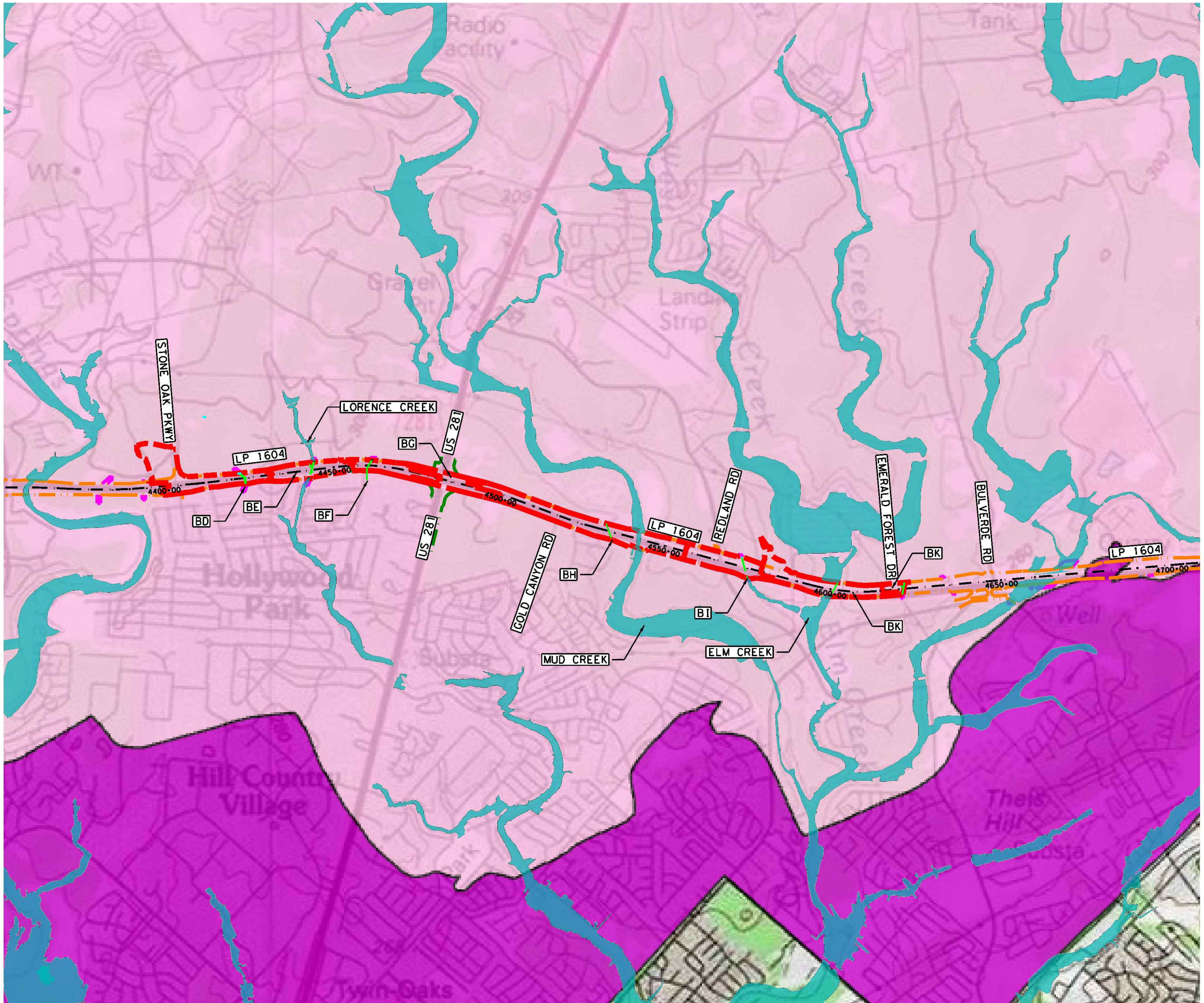
39. ☒ Submit one (1) original and one (1) copy of the application, plus one electronic copy as needed, for each affected incorporated city, groundwater conservation district, and county in which the project will be located. The TCEQ is required to distribute the additional copies to these jurisdictions.

40. The fee for the plan(s) is based on:

    ☐ The total R.O.W. (as in Item 17).

    ☒ TxDOT roadway project.

EDWARDS AQUIFER PROTECTION PROGRAM ROADWAY APPLICATION – TCEQ-20872
ATTACHMENT A – ROAD MAP



N

LEGEND

- RECHARGE ZONE
- TRANSITION ZONE
- CONTRIBUTING ZONE
- 100-YEAR FLOODPLAIN
- WPAP PROJECT AREA
- STREETS
- UTILITY EASEMENT
- EXISTING ROW

0' 750' 1500' 3000'

SCALE: 1"=3000'

NOTES:

TCEQ MAP OF EDWARDS AQUIFER WITH USGS NATIONAL MAP BASELAYER.

REV. NO.	DATE	DESCRIPTION	BY

LJA Engineering, Inc.
FRN - F-1386

Texas Department of Transportation

LP 1604

ROAD MAP

SHEET 1 OF 1

FED.RD. DIV.NO.	STATE	PROJECT NO.			HIGHWAY NO.
6	TEXAS				LP1604
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	2452	08	130	

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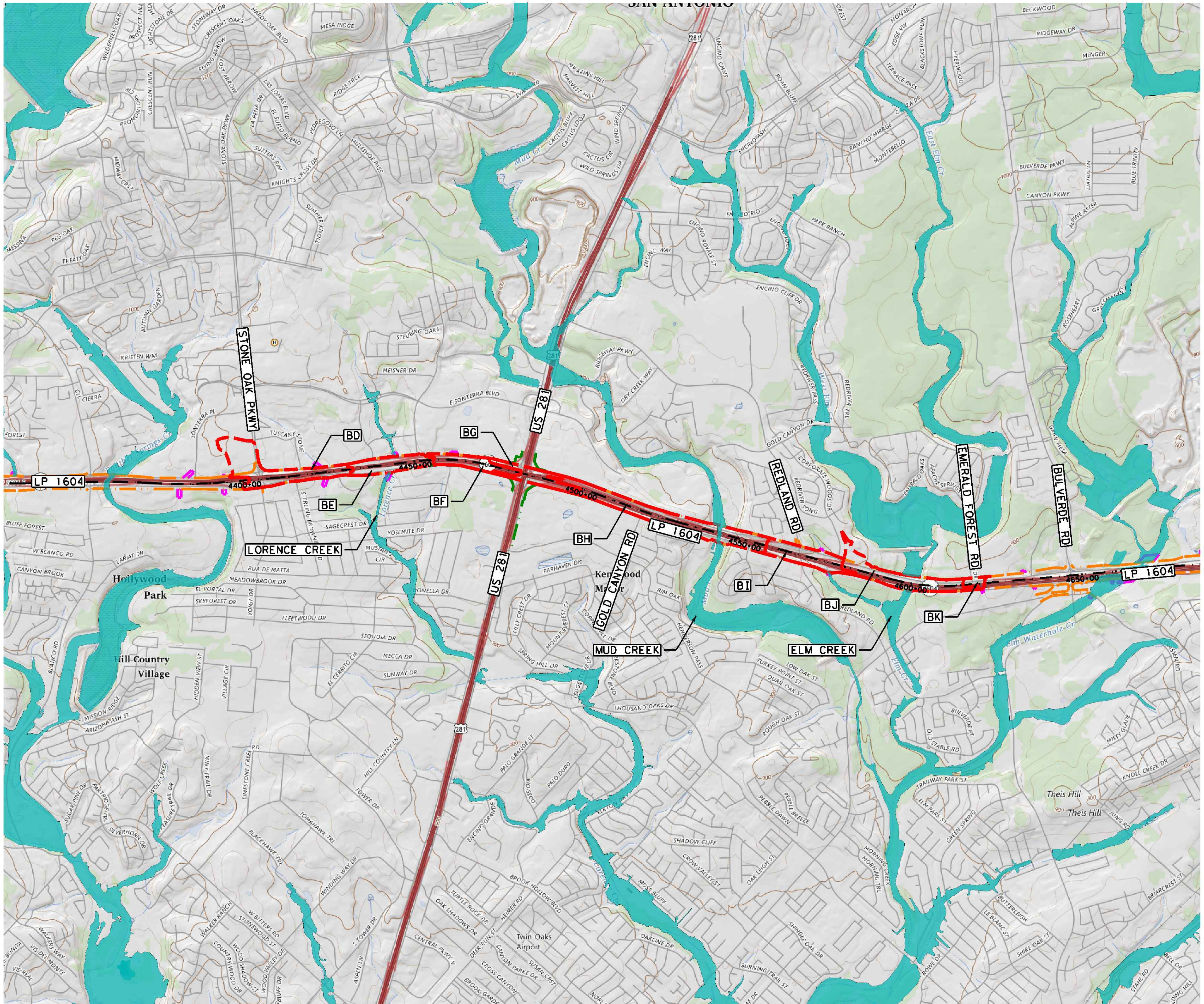
EDWARDS AQUIFER PROTECTION PROGRAM ROADWAY APPLICATION – TCEQ-20872
ATTACHMENT B – USGS QUADRANGLE MAP



N

LEGEND

	100-YEAR FLOODPLAIN
	WPAP PROJECT AREA
	STREETS
	UTILITY EASEMENT
	EXISTING ROW

0' 750' 1500' 3000'

SCALE: 1"=3000'

NOTES:

USGS MAP OF HELOTES (29098-E6) AND CAMP BULLIS (29098-F5) QUADRANGLES.

REV. NO.	DATE	DESCRIPTION	BY

LJA Engineering, Inc.
FRN - F-1386

Texas Department of Transportation

LP 1604

USGS MAP

SHEET 1 OF 1

FED.RD. DIV.NO.	STATE	PROJECT NO.	HIGHWAY NO.
6	TEXAS		LP1604

STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	2452	08	130	

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EDWARDS AQUIFER PROTECTION PROGRAM ROADWAY APPLICATION - TCEQ-20872
ATTACHMENT C – PROJECT DESCRIPTION

Introduction

This project is one segment of a multi-phase expansion of Loop 1604 from SH 16 to IH 35 (Image 1).

1. Segment 1 extends from SH 16 to IH 10. Letting April 2021
2. Segment 2 consists of the IH 10 – Loop 1604 interchange reconfiguration including the addition of direct connector bridges. Letting Nov 2021
3. Segment 3 extends from IH 10 to Stone Oak Parkway and includes intersection improvements at FM 2696 (Blanco Road). Letting June 2021
4. Segment 4 extends from Stone Oak Parkway to Redland Road. Letting 2024
5. Segment 5 extends from Redland Road to IH 35. Letting 2025

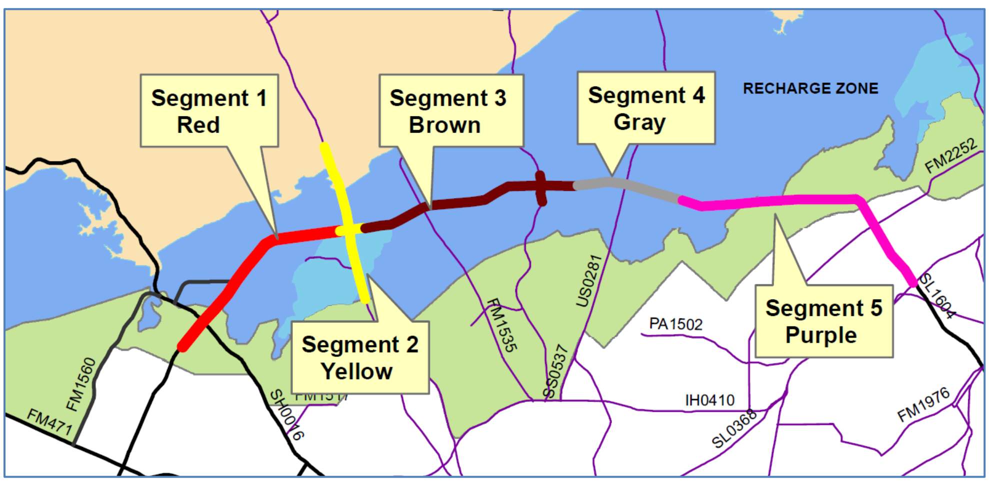

Image 1 - Loop 1604 Expansion Segments

This WPAP was prepared to permit Segment 4 under 30 TAC 213.

Segment 4 Corridor History

The majority of Segment 4 was converted from a non-freeway facility to a freeway facility in 1992. Further improvements were made since including the addition of direct connectors, cross street bridges, roadway widening, and drainage improvements.

Segment 4 Project Description

The Loop 1604 Segment 4 project extends from Stone Oak Parkway to 1.09 miles east of Redland Road. TxDOT proposes to expand Loop 1604 from an eight-lane expressway to an eighteen-lane expressway by adding two general purpose lanes and one high-occupancy vehicle (HOV) lane to the mainlanes in each direction (Image 2). The layout of auxiliary lanes, and entrance and exit ramps and frontage roads would be reconfigured. The Segment 4 project will tie into the Segment 3 and 5 projects at the Western and Eastern interfaces respectively.

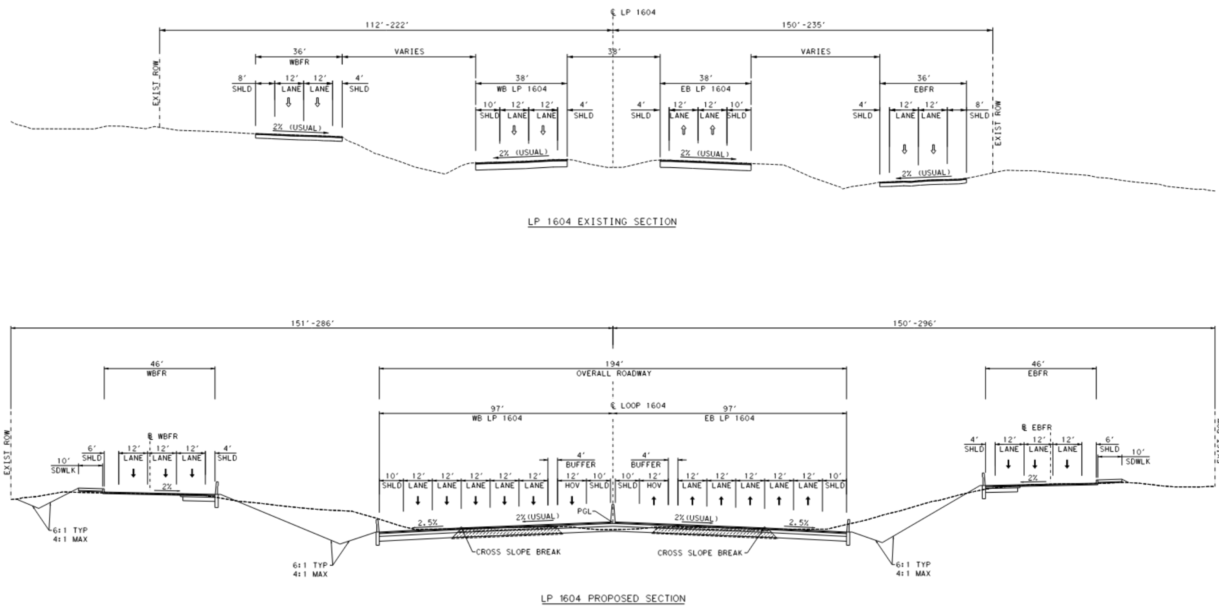

Image 2 - General Project Concept

The project would include pavement, retaining walls, bridge widening, culverts, storm sewers, illumination, traffic signals and management systems, utility adjustments, signs, sidewalks, and other highway features.

The project would be constructed within the existing right of way. TxDOT has some drainage easements on private property in this segment which were inspected to identify sensitive areas. This information is disclosed in these studies; however, the work within the easement at the upstream end of Culvert BE consists of adding an 18” gabion mattress for scour protection only. No impervious cover is being added and no grading is to occur within these easements.

<u>Segment 4 Impervious Cover and Permanent BMPs</u>

Segment 4 is located in the Edwards Aquifer Recharge Zone. Therefore, the project design accounts for new impervious cover and removal of existing BMPs and treats the runoff as required in the Recharge Zone.

Segment 4 would add 32.93 acres of impervious cover (IC) within project limits; increasing the IC from 150.45 acres to 183.38 acres. To account for this increase alone, the project is required to remove at least 26,870 lbs of TSS per year (i.e., Lm =26,870).

There are existing BMPs within the project limits including vegetative filter strips, grassy swales, water quality ponds, and an AquaLogic. Most existing features will be removed due to the roadway widening. The two large existing BMPS, Mud Creek water quality pond and the BF-AQ AquaLogic, are to remain and are documented in this application. Specific details for the existing BMPs to remain and to be removed are outlined in Attachment F.

The previous WPAPs within this segment are:

1. WPAP 13-10090211 (CSJ 0253-04-139)
2. WPAP 13-000320 (CSJ 0253-04-146)
3. WPAP Number Unavailable (CSJ 2452-03-070)
4. WPAP 13-000654 (CSJ 2452-03-118)

The project would add Stormwater Treatment Units (STU; specifically, Jellyfish Filters) to remove TSS from runoff. The STUs would have valves in the outlet pipes that could be closed manually in the event of a hazardous material spill. The WPAP for each segment will include a spill response plan (SRP) which will be consolidated into one comprehensive SRP plan upon completion of the overall expansion project.

Segment 4 Sensitive Features

There are 5 sensitive features in the survey area that will not be impacted by the project. There are 2 sensitive features (Loop-012 and Loop-205) located outside of the ROW on private property in existing drainage easements; there will be no work in those drainage easements. See Table 1 for more detailed information.

Feature ID/Type	Temporary and Permanent Impacts to Sensitive Features
LOOP-012	Swallet and fractured bedrock (page 222 in geologic assessment) This sensitive feature will be avoided and remain in its current state. This feature is located outside of the ROW in a drainage easement where no work will take place for this project.
LOOP-205	Swallet and fractured bedrock (page 269 in geologic assessment) This sensitive feature will be avoided and remain in its current state. This feature is located outside of the ROW in a drainage easement where no work will take place for this project.
LOOP-009	Solution cavity (page 218 in geologic assessment) This sensitive feature is unavoidable and would be partially removed and the remainder of the feature will be closed. This feature is located in a roadcut which will be reduced by pavement widening, thus removing part of the feature although some may remain. It will be protected by temporary BMPs until it is removed and closed. See the karst closure detail illustrating construction in the vicinity of this feature.

LOOP-009 (continued)	Because of its topographic setting, runoff from the existing facility does drain toward this feature. It will be located under the proposed ramp widening for the proposed facility. As a result, a portion of the feature will be closed.
1604-F101	Tally Ho Cave (page 94 in geologic assessment) This sensitive feature is in the roadcut south of the eastbound mainlanes of Loop 1604 west of Gold Canyon Road and will remain so. The cave was sealed pursuant to EAPP ID 13-10090211 on December 22, 2011. The now grouted entrance is 39.4 ft wide and 2 ft high. If this feature is reopened by construction activities, there is potential for rapid recharge to the subsurface. If this feature is reopened, please see the provided detail for reseal operations.
S-7-C	Karst (not included in geologic assessment, found in as-built plans CSJ 0253-04-139, etc.) This feature is an engineered drain to an underground cave designed by ARMA. The only surface expression of the feature is a grate inlet with a 3" diameter pipe inlet below the grate. Refer to Attachment F in this report for the as-built ARMA cave protection detail illustrating construction in the vicinity of this feature. This feature is also documented in the construction plans karst closure detail sheet 982. Contractor is to protect and preserve this drain inlet feature.

Table 1 - Temporary and Permanent Impacts to Sensitive Features

The locations of the sensitive features and their closure plans are shown on the WPAP Site Plan Exhibits, and the Closure Plan Cross Sections located in the construction plans.

END PROJECT DESCRIPTION

EDWARDS AQUIFER PROTECTION PROGRAM ROADWAY APPLICATION
TCEQ-20872
ATTACHMENT D – FACTORS AFFECTING WATER QUALITY

I. Major Soil Disturbing Activities Include:

1. Install erosion and sediment control BMPs down-slope of work area and initiate inspection and maintenance activities.
2. Begin phased construction with interim stabilization practices. Adjust erosion and sedimentation controls during construction to meet requirements and changing conditions and as directed/approved by the TxDOT construction representative.
3. Major soil disturbing activities may include but are not limited to: right-of-way preparation, drill shafts, cut and/or fill, paving operations, final grading and placement of topsoil and the following:
    - Clearing and Grubbing
    - Placement of road base
    - Extensive ditch and roadway grading
    - Construction of retaining walls
    - Upgrading or replacing culverts or bridges
    - Storm Sewer Construction
    - Utility Relocation and new construction
    - Temporary Detour Roads

II. Potential sources of contamination associated with the construction phase of this project that could affect storm water quality are listed as follows:

- Runoff and erosion of sediment and pollutants from exposed soil due to site preparation, including grading, excavation, trenching, drilling, boring and clearing vegetation.
- Oil and Grease from runoff pollutants associated with paving.
- Construction sewage leaks from sanitary facilities including portable bathrooms and wastewater storage tanks for field office sanitary facilities.
- Asphalt emulsion from the parking lots and streets just after repair is complete.
- Gasoline, engine coolant, transmission fluid, etc. from leaks or spills associated with vehicle use on site.
- Sediment and high pH runoff caused by concrete mixer washout.
- Construction product staging, storage, waste and litter.
- Fertilizer and pesticide used for landscaping.
- Building materials such as paints and sealants leaked or spilled on site.
- TSS runoff loads from roadways.

III. Potential sources of contamination associated with the operation phase of this project that could affect storm water quality are listed as follows:

- Surface water runoff from roadway pavement.
- TSS runoff loads from roadways.
- Runoff from fuel or hazardous material spills.
- Potential sewage spills.

EDWARDS AQUIFER PROTECTION PROGRAM ROADWAY APPLICATION – TCEQ-20872
ATTACHMENT E – BMPs FOR UPGRADIENT STORMWATER

Permanent Best Management Practices (BMPs) for upgradient stormwater are not needed for this project. All cross-drainage structures are to remain in place will be extended to accommodate proposed roadway modifications. Where necessary, culverts will be enlarged to accommodate increased flows. No offsite runoff will flow across the project site or the proposed roadway improvements. Runoff from the offsite areas will be collected by a combination or roadside ditches and storm sewers to be discharged to Lorence Creek, Mud Creek, and Elm Creek.

EDWARDS AQUIFER PROTECTION PROGRAM ROADWAY APPLICATION – TCEQ-20872
ATTACHMENT F – BMPs FOR ON-SITE STORMWATER

The proposed site development is required to remove at least 80% of the increase in total suspended solids (TSS) caused by the net increase in impervious cover. To accomplish this, on-site stormwater will be treated by stormwater treatment units (STU) installed in multiple locations on storm sewers within the limits of the project in addition to existing BMPs. Due to limited space, STUs could not be installed in every outfall area. To achieve the required 80% removal of TSS project-wide, other outfall areas were overtreated.

In most outfall areas in this segment, existing vegetative filter strips (VFS) and grassy swales are to be removed for the proposed roadway design. The existing structures that are to remain include an Aqualogic and sedimentation pond. Therefore, stormwater treatment units are proposed to treat the remaining amount of TSS or to fully provide treatment to the outfall area. Off-line stormwater treatment units are proposed along the project. The off-line stormwater treatment units will be contained in subgrade manholes. They will collect storm sewer flow in a splitter manhole which will divert the first flush of runoff into the treatment unit. Treated water will then return to the storm sewer system before discharge. The specific treatment units utilize the Jellyfish Filter System which is detailed in Section 3.2.22 of the Edwards Aquifer Technical Guidance Manual, July 2005.

Eight off-line stormwater treatment units were included in the calculations of this WPAP. The TSS removal provided by these BMPs was determined and adjusted according to their drainage area considering the pre- and post-development impervious cover based on as-builts corresponding to those BMPs. The impervious cover area flowing to existing BMPs to remain was considered part of the overall treatment area required for the project.

One Aqualogic basin and one sedimentation pond were included in the calculations of this WPAP. The TSS removal provided by the Aqualogic was determined according to its volume and drainage area considering the proposed impervious cover. As-built plans for this BMP are included in this attachment. The TSS removal provided by the sedimentation pond was determined according to its volume and drainage area considering the impervious cover present at its time of construction. WPAP calculations are not available for this pond; however, the as-builts for this pond are included in this attachment

Permanent BMPs have been sized according to the Edwards Aquifer TSS Removal Calculations Spreadsheet. Total TSS load increase calculations are included below in this Attachment.

TSS REMOVAL CALCULATION

TEMPLATE SHEETS

01/25/2023

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Additional information is provided for cells with a red triangle in the upper right corn
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will r

1. The Required Load Reduction for the total project: Calculations from RG-348

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

where:
$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resul
A_N = Net increase in impervious a
P = Average annual precipitation

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

County =	**Bexar**	
Total project area included in plan * =	**233.45**	acres
Predevelopment impervious area within the limits of the plan * =	**150.45**	acres
Total post-development impervious area within the limits of the plan* =	**183.38**	acres
Total post-development impervious cover fraction * =	**0.79**	
P =	**30**	inches
$L_{M\ TOTAL\ PROJECT}$ =	**26870**	lbs.

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

Number of drainage basins / outfalls areas leaving the plan area = **8**

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

Drainage Basin/Outfall Area No. = BD

Total drainage basin/outfall area =	**48.99**	acres
Predevelopment impervious area within drainage basin/outfall area =	**38.00**	acres
Post-development impervious area within drainage basin/outfall area =	**40.31**	acres
Post-development impervious fraction within drainage basin/outfall area =	**0.82**	
$L_{M\ THIS\ BASIN}$ =	**1881**	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = **Wet Vault**
Removal efficiency = **86** 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 = (BMP efficiency) x P x (A_I x 3

where:

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

A_C =	0.00	acres
A_I =	0.00	acres
A_P =	0.00	acres
L_R =	0	lbs

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

Desired $L_{M\ THIS\ BASIN}$ =	0	lbs.
F =	#DIV/0!	

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area.

Rainfall Depth =	#DIV/0!	inches
Post Development Runoff Coefficient =	#DIV/0!	
On-site Water Quality Volume =	#DIV/0!	cubic feet

Calculations from RG-348

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 =	#DIV/0!	cubic feet

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Additional information is provided for cells with a red triangle in the upper right corn
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will r

1. The Required Load Reduction for the total project: Calculations from RG-348

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

where: $L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resul
A_N = Net increase in impervious a
P = Average annual precipitation

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

County =	**Bexar**	
Total project area included in plan * =	**233.45**	acres
Predevelopment impervious area within the limits of the plan * =	**150.45**	acres
Total post-development impervious area within the limits of the plan* =	**183.38**	acres
Total post-development impervious cover fraction * =	**0.79**	
P =	**30**	inches
$L_{M\ TOTAL\ PROJECT}$ =	**26870**	lbs.

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

Number of drainage basins / outfalls areas leaving the plan area = **8**

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

Drainage Basin/Outfall Area No. = BE

Total drainage basin/outfall area =	**22.31**	acres
Predevelopment impervious area within drainage basin/outfall area =	**13.87**	acres
Post-development impervious area within drainage basin/outfall area =	**18.67**	acres
Post-development impervious fraction within drainage basin/outfall area =	**0.84**	
$L_{M\ THIS\ BASIN}$ =	**3916**	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP =	**Wet Vault**	
Removal efficiency =	**86**	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 = (BMP efficiency) x P x (A_I x 3

where:

A_C = Total On-Site drainage area

A_I = Impervious area proposed in

A_P = Pervious area remaining in tl

L_R = TSS Load removed from this

A_C =	**1.36**	acres
A_I =	**1.36**	acres
A_P =	**0.00**	acres
L_R =	**1214**	lbs

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

Desired $L_{M\ THIS\ BASIN}$ =	**0**	lbs.
F =	**0.00**	

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area.

Rainfall Depth =	**#N/A**	inches
Post Development Runoff Coefficient =	**0.82**	
On-site Water Quality Volume =	**#N/A**	cubic feet

Calculations from RG-348

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 =	**#N/A**	cubic feet

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

Additional information is provided for cells with a red triangle in the upper right corn
Text shown in blue indicate location of instructions in the Technical Guidance Manual - RG-
Characters shown in red are data entry fields.
Characters shown in black (Bold) are calculated fields. Changes to these fields will r

1. The Required Load Reduction for the total project: Calculations from RG-348

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

where:
$L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resul
A_N = Net increase in impervious a
P = Average annual precipitation

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

County =	**Bexar**	
Total project area included in plan * =	**233.45**	acres
Predevelopment impervious area within the limits of the plan * =	**150.45**	acres
Total post-development impervious area within the limits of the plan* =	**183.38**	acres
Total post-development impervious cover fraction * =	**0.79**	
P =	**30**	inches
$L_{M\ TOTAL\ PROJECT}$ =	**26870**	lbs.

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

Number of drainage basins / outfalls areas leaving the plan area = **8**

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

Drainage Basin/Outfall Area No. = BF

Total drainage basin/outfall area =	**17.64**	acres
Predevelopment impervious area within drainage basin/outfall area =	**13.77**	acres
Post-development impervious area within drainage basin/outfall area =	**16.39**	acres
Post-development impervious fraction within drainage basin/outfall area =	**0.93**	
$L_{M\ THIS\ BASIN}$ =	**2140**	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = **Aqualogic Cartridge Filter**
Removal efficiency = **95** 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 = (BMP efficiency) x P x (A_I x 3

where:

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

A_C =	**7.32**	acres
A_I =	**6.43**	acres
A_P =	**0.89**	acres
L_R =	**6358**	lbs

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

Desired $L_{M\ THIS\ BASIN}$ =	**2500**	lbs.
F =	**0.39**	

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area.

Rainfall Depth =	**0.28**	inches
Post Development Runoff Coefficient =	**0.72**	
On-site Water Quality Volume =	**5321**	cubic feet

Calculations from RG-348

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 =	**1064**	
Total Capture Volume (required water quality volume(s) x 1.20) =	**6385**	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.

7. Retention/Irrigation System — Designed as Required in RG

Required Water Quality Volume for retention basin =	**NA**	cubic feet

Irrigation Area Calculations:

Soil infiltration/permeability rate =	**0.1**	in/hr
Irrigation area =	**NA**	square feet
	NA	acres

8. Extended Detention Basin System — Designed as Required in RG

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

9. Filter area for Sand Filters — Designed as Required in RG

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	**NA**	cubic feet
Minimum filter basin area =	**NA**	square feet
Maximum sedimentation basin area =	**NA**	square feet
Minimum sedimentation basin area =	**NA**	square feet

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	**NA**	cubic feet
Minimum filter basin area =	**NA**	square feet
Maximum sedimentation basin area =	**NA**	square feet
Minimum sedimentation basin area =	**NA**	square feet

10. Bioretention System — Designed as Required in RG

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

11. Wet Basins — Designed as Required in RG

Required capacity of Permanent Pool =	**NA**	cubic feet
Required capacity at WQV Elevation =	**NA**	cubic feet

12. Constructed Wetlands Designed as Required in RG

Required Water Quality Volume for Constructed Wetlands = **NA** cubic feet

13. AquaLogic™ Cartridge System Designed as Required in RG

**** 2005 Technical Guidance Manual (RG-348) does not exempt the required 20% increase with mainten**

Required Sedimentation chamber capacity =	**6385**	cubic feet
Filter canisters (FCs) to treat WQV =	**14.69**	cartridges
Filter basin area (RIA_F) =	**29.39**	square feet

14. Stormwater Management StormFilter® by CONTECH

Required Water Quality Volume for Contech StormFilter System = **NA** cubic feet

THE SIZING REQUIREMENTS FOR THE FOLLOWING BMPs / LOAD REMOVALS ARE BASED UPON FL

15. Grassy Swales Designed as Required in RG

Design parameters for the swale:

Drainage Area to be Treated by the Swale = A =	1.00	acres
Impervious Cover in Drainage Area =	0.50	acres
Rainfall intensity = i =	1.1	in/hr
Swale Slope =	0.02	ft/ft
Side Slope (z) =	5	
Design Water Depth = y =	0.33	ft
Weighted Runoff Coefficient = C =	0.54	

A_{CS} = cross-sectional area of flow in Swale =	1.17	sf
P_W = Wetted Perimeter =	5.27	feet
R_H = hydraulic radius of flow cross-section = A_{CS}/P_W =	0.22	feet
n = Manning's roughness coefficient =	0.2	

15A. Using the Method Described in the RG-348

Manning's Equation: $$Q = \frac{1.49}{n} A_{CS} R_H^{2/3} S^{0.5}$$

$$b = \frac{0.134 \times Q}{} - zy = \quad 1.90 \text{ feet}$$

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

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1. The Required Load Reduction for the total project: Calculations from RG-348

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

where: $L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resul
A_N = Net increase in impervious a
P = Average annual precipitation

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

County =	**Bexar**	
Total project area included in plan * =	**233.45**	acres
Predevelopment impervious area within the limits of the plan * =	**150.45**	acres
Total post-development impervious area within the limits of the plan* =	**183.38**	acres
Total post-development impervious cover fraction * =	**0.79**	
P =	**30**	inches
$L_{M\ TOTAL\ PROJECT}$ =	**26870**	lbs.

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

Number of drainage basins / outfalls areas leaving the plan area = **8**

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

Drainage Basin/Outfall Area No. = BG

Total drainage basin/outfall area =	**18.18**	acres
Predevelopment impervious area within drainage basin/outfall area =	**14.23**	acres
Post-development impervious area within drainage basin/outfall area =	**16.88**	acres
Post-development impervious fraction within drainage basin/outfall area =	**0.93**	
$L_{M\ THIS\ BASIN}$ =	**2158**	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP =	**Wet Vault**	
Removal efficiency =	**86**	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 = (BMP efficiency) x P x (A_I x 3

where:

A_C = Total On-Site drainage area

A_I = Impervious area proposed in

A_P = Pervious area remaining in th

L_R = TSS Load removed from this

A_C =	**1.57**	acres
A_I =	**1.57**	acres
A_P =	**0.00**	acres
L_R =	**1402**	lbs

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

Desired $L_{M\ THIS\ BASIN}$ =	**0**	lbs.
F =	**0.00**	

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area.

Rainfall Depth =	**#N/A**	inches
Post Development Runoff Coefficient =	**0.82**	
On-site Water Quality Volume =	**#N/A**	cubic feet

Calculations from RG-348

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 =	**#N/A**	cubic feet

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

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1. The Required Load Reduction for the total project: Calculations from RG-348

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

where: $L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resul
A_N = Net increase in impervious a
P = Average annual precipitation

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

County =	**Bexar**	
Total project area included in plan * =	**233.45**	acres
Predevelopment impervious area within the limits of the plan * =	**150.45**	acres
Total post-development impervious area within the limits of the plan* =	**183.38**	acres
Total post-development impervious cover fraction * =	**0.79**	
P =	**30**	inches
$L_{M\ TOTAL\ PROJECT}$ =	**26870**	lbs.

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

Number of drainage basins / outfalls areas leaving the plan area = **8**

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

Drainage Basin/Outfall Area No. =	**BH**	
Total drainage basin/outfall area =	**58.67**	acres
Predevelopment impervious area within drainage basin/outfall area =	**35.94**	acres
Post-development impervious area within drainage basin/outfall area =	**41.41**	acres
Post-development impervious fraction within drainage basin/outfall area =	**0.71**	
$L_{M\ THIS\ BASIN}$ =	**4468**	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 = (BMP efficiency) x P x (A_I x 3

where:

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

A_C =	**30.13**	acres
A_I =	**12.98**	acres
A_P =	**17.15**	acres
L_R =	**10314**	lbs

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

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.

Rainfall Depth =	**1.80**	inches
Post Development Runoff Coefficient =	**0.32**	
On-site Water Quality Volume =	**63356**	cubic feet

Calculations from RG-348

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 =	**12671**	
Total Capture Volume (required water quality volume(s) x 1.20) =	**76027**	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.

7. Retention/Irrigation System — Designed as Required in RG

Required Water Quality Volume for retention basin =	**NA**	cubic feet

Irrigation Area Calculations:

Soil infiltration/permeability rate =	**0.1**	in/hr
Irrigation area =	**NA**	square feet
	NA	acres

8. Extended Detention Basin System — Designed as Required in RG

Required Water Quality Volume for extended detention basin =	**76027**	cubic feet

9. Filter area for Sand Filters — Designed as Required in RG

9A. Full Sedimentation and Filtration System

Water Quality Volume for sedimentation basin =	**NA**	cubic feet
Minimum filter basin area =	**NA**	square feet
Maximum sedimentation basin area =	**NA**	square feet
Minimum sedimentation basin area =	**NA**	square feet

9B. Partial Sedimentation and Filtration System

Water Quality Volume for combined basins =	**NA**	cubic feet
Minimum filter basin area =	**NA**	square feet
Maximum sedimentation basin area =	**NA**	square feet
Minimum sedimentation basin area =	**NA**	square feet

10. Bioretention System — Designed as Required in RG

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

11. Wet Basins — Designed as Required in RG

Required capacity of Permanent Pool =	**NA**	cubic feet
Required capacity at WQV Elevation =	**NA**	cubic feet

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

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1. The Required Load Reduction for the total project: Calculations from RG-348

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

where: $L_{M\ TOTAL\ PROJECT}$ = Required TSS removal resul
A_N = Net increase in impervious a
P = Average annual precipitation

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

County =	**Bexar**	
Total project area included in plan * =	**233.45**	acres
Predevelopment impervious area within the limits of the plan * =	**150.45**	acres
Total post-development impervious area within the limits of the plan* =	**183.38**	acres
Total post-development impervious cover fraction * =	**0.79**	
P =	**30**	inches
$L_{M\ TOTAL\ PROJECT}$ =	**26870**	lbs.

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

Number of drainage basins / outfalls areas leaving the plan area = **8**

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

Drainage Basin/Outfall Area No. = BI

Total drainage basin/outfall area =	**26.76**	acres
Predevelopment impervious area within drainage basin/outfall area =	**12.01**	acres
Post-development impervious area within drainage basin/outfall area =	**18.46**	acres
Post-development impervious fraction within drainage basin/outfall area =	**0.69**	
$L_{M\ THIS\ BASIN}$ =	**5266**	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP =	**Wet Basin**	
Removal efficiency =	**93**	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 = (BMP efficiency) x P x (A_I x 3

where:

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

A_C =	**0.00**	acres
A_I =	**0.00**	acres
A_P =	**0.00**	acres
L_R =	**0**	lbs

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

Desired $L_{M\ THIS\ BASIN}$ =	**0**	lbs.
F =	**#DIV/0!**	

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area.

Rainfall Depth =	**#DIV/0!**	inches
Post Development Runoff Coefficient =	**#DIV/0!**	
On-site Water Quality Volume =	**#DIV/0!**	cubic feet

Calculations from RG-348

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 =	**#DIV/0!**	cubic feet

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

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where:

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A_N = Net increase in impervious a
P = Average annual precipitation

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

County =	**Bexar**	
Total project area included in plan * =	**233.45**	acres
Predevelopment impervious area within the limits of the plan * =	**150.45**	acres
Total post-development impervious area within the limits of the plan* =	**183.38**	acres
Total post-development impervious cover fraction * =	**0.79**	
P =	**30**	inches
$L_{M\ TOTAL\ PROJECT}$ =	**26870**	lbs.

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

Number of drainage basins / outfalls areas leaving the plan area = **8**

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

Drainage Basin/Outfall Area No. = BJ

Total drainage basin/outfall area =	**36.81**	acres
Predevelopment impervious area within drainage basin/outfall area =	**20.82**	acres
Post-development impervious area within drainage basin/outfall area =	**28.45**	acres
Post-development impervious fraction within drainage basin/outfall area =	**0.77**	
$L_{M\ THIS\ BASIN}$ =	**6226**	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP = **Wet Vault**
Removal efficiency = **86** 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 = (BMP efficiency) x P x (A_I x 3

where:

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

A_C =	0.00	acres
A_I =	0.00	acres
A_P =	0.00	acres
L_R =	0	lbs

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

Desired $L_{M\ THIS\ BASIN}$ =	0	lbs.
F =	#DIV/0!	

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area.

Rainfall Depth =	#DIV/0!	inches
Post Development Runoff Coefficient =	#DIV/0!	
On-site Water Quality Volume =	#DIV/0!	cubic feet

Calculations from RG-348

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 =	#DIV/0!	cubic feet

Texas Commission on Environmental Quality

TSS Removal Calculations 04-20-2009

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A_N = Net increase in impervious a
P = Average annual precipitation

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

County =	**Bexar**	
Total project area included in plan * =	**233.45**	acres
Predevelopment impervious area within the limits of the plan * =	**150.45**	acres
Total post-development impervious area within the limits of the plan* =	**183.38**	acres
Total post-development impervious cover fraction * =	**0.79**	
P =	**30**	inches
$L_{M\ TOTAL\ PROJECT}$ =	**26870**	lbs.

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

Number of drainage basins / outfalls areas leaving the plan area = **8**

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

Drainage Basin/Outfall Area No. = BK

Total drainage basin/outfall area =	**4.08**	acres
Predevelopment impervious area within drainage basin/outfall area =	**1.86**	acres
Post-development impervious area within drainage basin/outfall area =	**2.69**	acres
Post-development impervious fraction within drainage basin/outfall area =	**0.66**	
$L_{M\ THIS\ BASIN}$ =	**681**	lbs.

3. Indicate the proposed BMP Code for this basin.

Proposed BMP =	**Wet Vault**	
Removal efficiency =	**86**	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 = (BMP efficiency) x P x (A_I x 3

where:

A_C = Total On-Site drainage area

A_I = Impervious area proposed in

A_P = Pervious area remaining in tl

L_R = TSS Load removed from this

A_C =		acres
A_I =		acres
A_P =	**0.00**	acres
L_R =	**0**	lbs

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

Desired $L_{M\ THIS\ BASIN}$ =		lbs.
F =	**#DIV/0!**	

6. Calculate Capture Volume required by the BMP Type for this drainage basin / outfall area.

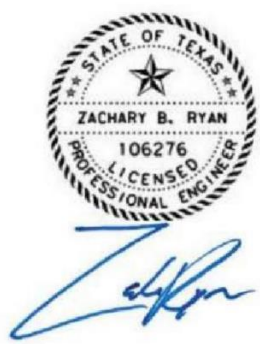
Rainfall Depth =	**#DIV/0!**	inches
Post Development Runoff Coefficient =	**#DIV/0!**	
On-site Water Quality Volume =	**#DIV/0!**	cubic feet

Calculations from RG-348

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 =	**#DIV/0!**	cubic feet

TSS REMOVAL CALCULATIONS:

Total Project Summary



01/25/2023

The proposed roadway improvement along the project area of Segment 4 requires the removal of existing BMPs in outfall areas BD, BE, BF, BG, BH, BI, and BJ. To properly compensate for the removal of these existing BMPs, the TSS removed by each was found in the as-built plans and counted toward the amount of TSS removal required for this project. For example, in outfall area BD, there is one vegetative filter strip and three grassy swales in the existing condition which will be removed for the proposed condition. The as-builts state that the total TSS removed by these features totals to 2,118 lbs. Therefore, the required TSS removal for the BD outfall area must increase by that amount on top of the amount calculated based on increase in impervious cover. The existing sedimentation pond at Mud Creek is a special case. The TSS removed by this BMP was not listed by the available as-built plans, see the Water Quality Pond Summary for more information. Table 1 summarizes TSS removed by existing BMPs that are to be removed by Segment 4. See Table 2 for a project wide TSS removal summary.

TABLE 1: TSS REMOVED BY EXISTING BMPs								
OUTFALLS	AS-BUILT CSJ	EXIST FEATURES	APPROXIMATE STARTING STATION (CL LP1604)	TYPE OF EXISTING BMP	STATUS	TSS REMOVED BY		
						BMPs TO REMAIN	BMPs REMOVED	BMPs REMOVED (TOTAL)
						LBS	LBS	LBS
BD	0253-04-139	BB-3	409+00	VFS	remove		556	2,118
		AA-2(AB)	411+30	GS	remove		310	
		DD(AB)	425+70	GS	remove		717	
		DD2A	429+00	GS	remove		535	
BE	0253-04-139	FF-1(AC)	430+50	GS	remove		632	3,341
		EE-1(AC)	432+00	GS	remove		528	
		EE-2(AC)	432+00	GS	remove		551	
		FF-2(AC)	432+10	GS	remove		891	
		GG-2(AC)	450+00	GS	remove		739	
BF	0253-04-139	LL-1(AE)	453+00	GS	remove		411	1,755
		LL-60	460+00	AQUALOGIC	KEEP	2,500		
		LL-2(AE)	460+35	GS	remove		504	
		LL-2A(AE)	467+00	VFS	remove		239	
		LL-24(AE)	469+00	VFS	remove		363	
		LL-23(AE)	470+20	VFS	remove		238	
BG	0253-04-139	MM-120(AG)	490+15	VFS	remove		584	1,555
	0253-04-146	RG	4477+00	GS	remove		446	
		MMX	4493+00	VFS	remove		525	
BH	0253-04-139	MM-117(AG)	494+25	GS	remove		1,013	6,309
		MM-211	515+00	GS	remove		721	
		NN-210(AG)	515+00	GS	remove		219	
		OO-201(AG	521+50	VFS	remove		229	
		OO-200(AG)	523+00	GS	remove		729	
		MM-POND1	523+85	GS	remove		426	
		PP-100(AG)	527+50	GS	remove		567	
		MM-POND2	529+00	POND	remove		426	
		PP-201(AG)	530+80	GS	remove		249	
		QQ-200(AG)	535+00	GS	remove		797	
	0253-04-146	MME1	4495+00	POND	remove		488	
		MMV	4498+90	VFS	remove		445	
	2452-03-70	WQ POND	at Mud Creek	POND	KEEP	9,400		
BI	2452-03-118	RG-348	4568+00	VFS	remove		1,399	2,089
		RG-348	4568+00	VFS	remove			
		RG-348	4568+00	VFS	remove			
		RG-348	4568+00	VFS	remove			
	0253-04-139	RR-VFS1(AH)	558+5	VFS	remove		690	
BJ	2452-03-118	RG-348	4583+00	VFS	remove		1,637	1,637
		RG-348	4583+00	VFS	remove			

Table 1 - TSS Removed by Existing BMPs

TABLE 2: PROJECT TSS REMOVAL SUMMARY								
OUTFALLS	TOTAL AREA	EXISTING IMPERVIOUS	PROPOSED IMPERVIOUS	REQUIRED TSS REMOVAL FOR ADDED PAVEMENT, LM	ACTUAL TSS REMOVAL BY EXIST BMP TO REMAIN	REQUIRED TSS REMOVAL FOR BMP REMOVED	ACTUAL TSS REMOVAL REQUIRED	ACTUAL TSS REMOVAL (BMP)
	AC	AC	AC	LBS	LBS	LBS	LBS	LBS
BD	48.99	38.00	40.31	1881	0	2118	3999	14289
BE	22.31	13.87	18.67	3916	0	3341	7257	8293
BF	17.64	13.77	16.39	2140	2500	1755	1395	0
BG	18.18	14.23	16.88	2158	0	1555	3713	0
BH	58.67	35.94	41.41	4468	9400	6309	1377	0
BI	26.76	12.01	18.46	5266	0	2089	7355	6855
BJ	36.81	20.82	28.45	6226	0	1637	7863	9319
BK	4.08	1.86	2.69	681	0	0	681	0
TOTAL	**233.45**	**150.50**	**183.26**	**26,736**	**11,900**	**18,804**	**33,640**	**38,757**

Table 2 - Project TSS Removal Summary

TSS REMOVAL CALCULATIONS:

Stormwater Treatment Unit Summary

01/25/2023

TABLE 3: SUMMARY OF TSS REMOVED BY PROPOSED STUs													
STU	TOTAL AREA	IMPERVIOUS AREA	PERVIOUS AREA	EFFECTIVE AREA	F	INTENSITY	Q	LR	JELLYFISH MODEL	STU DIAMETER	# OF HI-FLOW CARTRIDGES	# OF DRAINDOWN CARTRIDGES	TREATMENT FLOWRATE
	AC	AC	AC	AC		IN/HR	CFS	LBS		FT			CVS
BD-1	23.62	20.25	3.37	18.32	0.61	0.2	3.66	11,054.41	JF10-19-4	10	19	4	3.74
BD-2	6.30	4.23	2.07	3.87	0.85	0.85	3.29	3,234.19	JF10-17-4	10	17	4	3.39
OUTFALL BD TOTAL								11,054.41					
BE-1	7.43	5.44	1.99	4.96	0.83	0.75	3.72	4,053.64	JF10-19-4	10	19	4	3.74
BE-2	1.30	1.29	0.00	1.16	0.85	0.85	0.99	978.88	JF6-6-1	6	6	1	1.16
BE-3	5.03	4.29	0.74	3.88	0.85	0.85	3.30	3,260.91	JF10-17-4	10	17	4	3.39
OUTFALL BE TOTAL								8,293.43					
BI-1	5.86	4.23	1.63	3.86	0.85	0.85	3.28	3,231.91	JF10-17-4	10	17	4	3.39
BI-2	6.48	4.87	1.62	4.43	0.83	0.75	3.32	3,623.32	JF10-17-4	10	17	4	3.39
OUTFALL BI TOTAL								6,855.23					
BJ-1	22.17	17.32	4.85	15.74	0.60	0.18	2.83	9,319.37	JF10-14-4	10	14	4	2.85
OUTFALL BJ TOTAL								9,319.37					
8	<- TOTAL NUMBER OF STUs						TOTAL:	35,522.44					

Table 3 - Summary of TSS Removed by Proposed STUs

TSS REMOVAL CALCULATIONS:

Water Quality Pond Summary

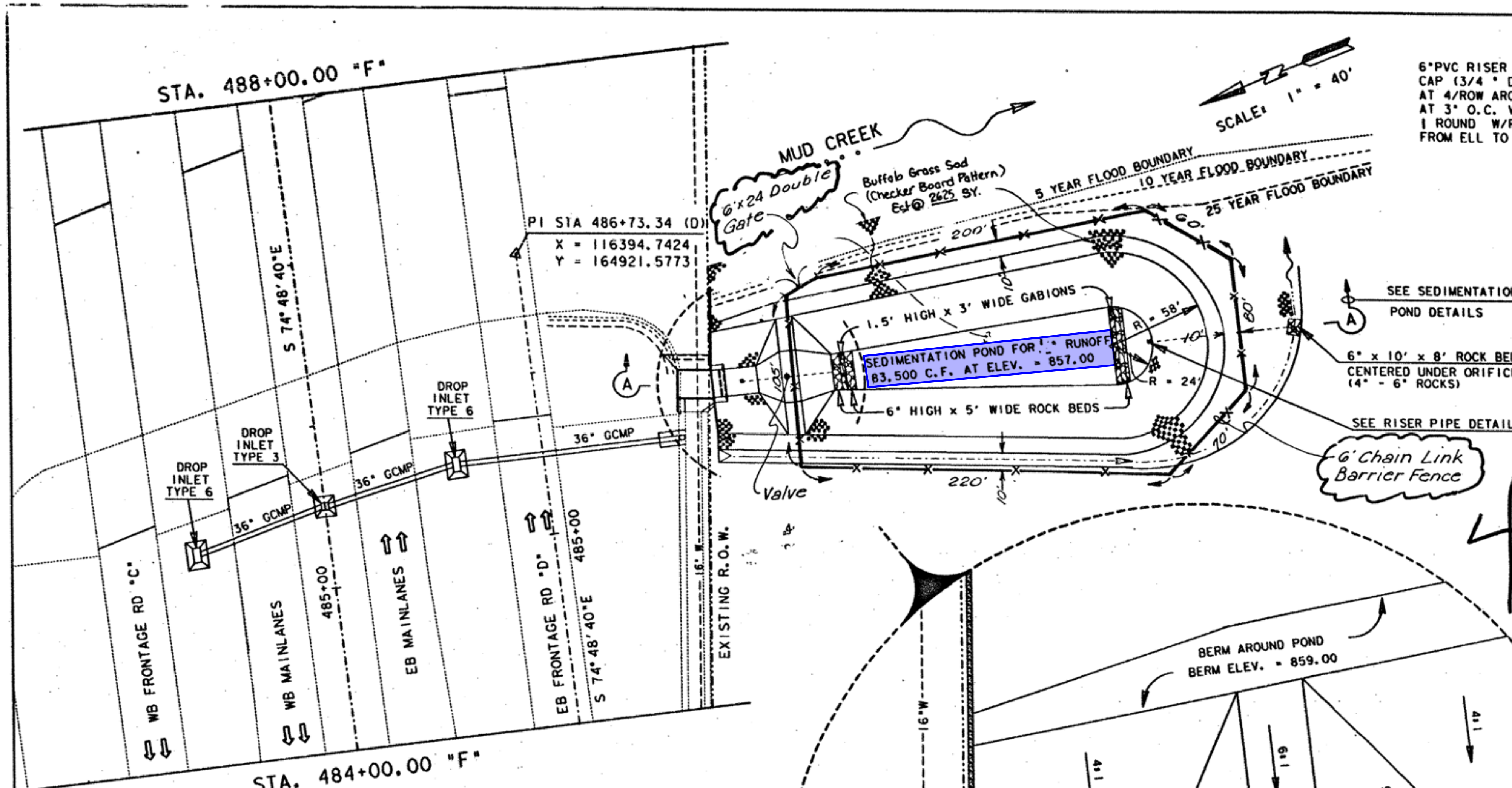
01/25/2023

To determine the TSS removed by the existing water quality pond located in a drainage easement on Segment 4 at Mud Creek, it was necessary to recreate the existing impervious cover as it was when the pond was constructed in approximately 1992. These shapes were obtained from the 1995 Google Earth imagery of the area which is the closest year with useable aerial data. The drainage area for the pond was drawn using the layout of existing storm sewer and ditch flow lines from the as-builts. In the interest of making a conservative estimate for the amount of TSS that this pond can remove, the area of 1995 impervious cover was used as the amount of impervious area proposed in the BMP catchment area (A_I). The provided as-builts indicated a storage capacity of **83,500 ft^3**. The maximum TSS load that can be removed from the drainage area of this pond was calculated using the L_R formula with the efficiency of extended detention. From the maximum L_R, a desired TSS to be removed was assigned such that the required capture volume of water is less than the storage capacity of the pond. Table 4 below shows the results of the calculations confirming that the required volume of water to remove the desired TSS is less than the storage capacity of the pond.

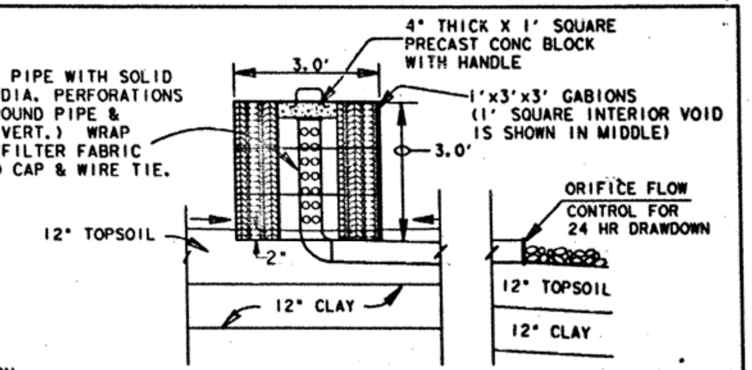
TABLE 4: EXISTING MUD CREEK WATER QUALITY POND SUMMARY							
OUTFALL	WQ POND DRAINAGE AREA	EXISTING IMPERVIOUS COVER AT TIME OF CONSTRUCTION	PROPOSED IMPERVIOUS COVER	MAXIMUM TSS LOAD REMOVED (LR) FOR DRAINAGE AREA	DESIRED TSS LOAD REMOVAL (LM)	STORAGE CAPACITY OF POND	REQUIRED CAPTURE VOLUME OF WATER REQUIRED TO REMOVE DESIRED TSS LOAD REMOVAL
	AC	AC	AC	LBS	LBS	CU FT	CU FT
BH	30.13	12.98	22.61	10,314	9,400	83,500	76,027

Table 4 - Existing Mud Creek Water Quality Pond Summary

AS-BUILT PLAN SHEET MUD CREEK POND
CSJ 2452-03-070



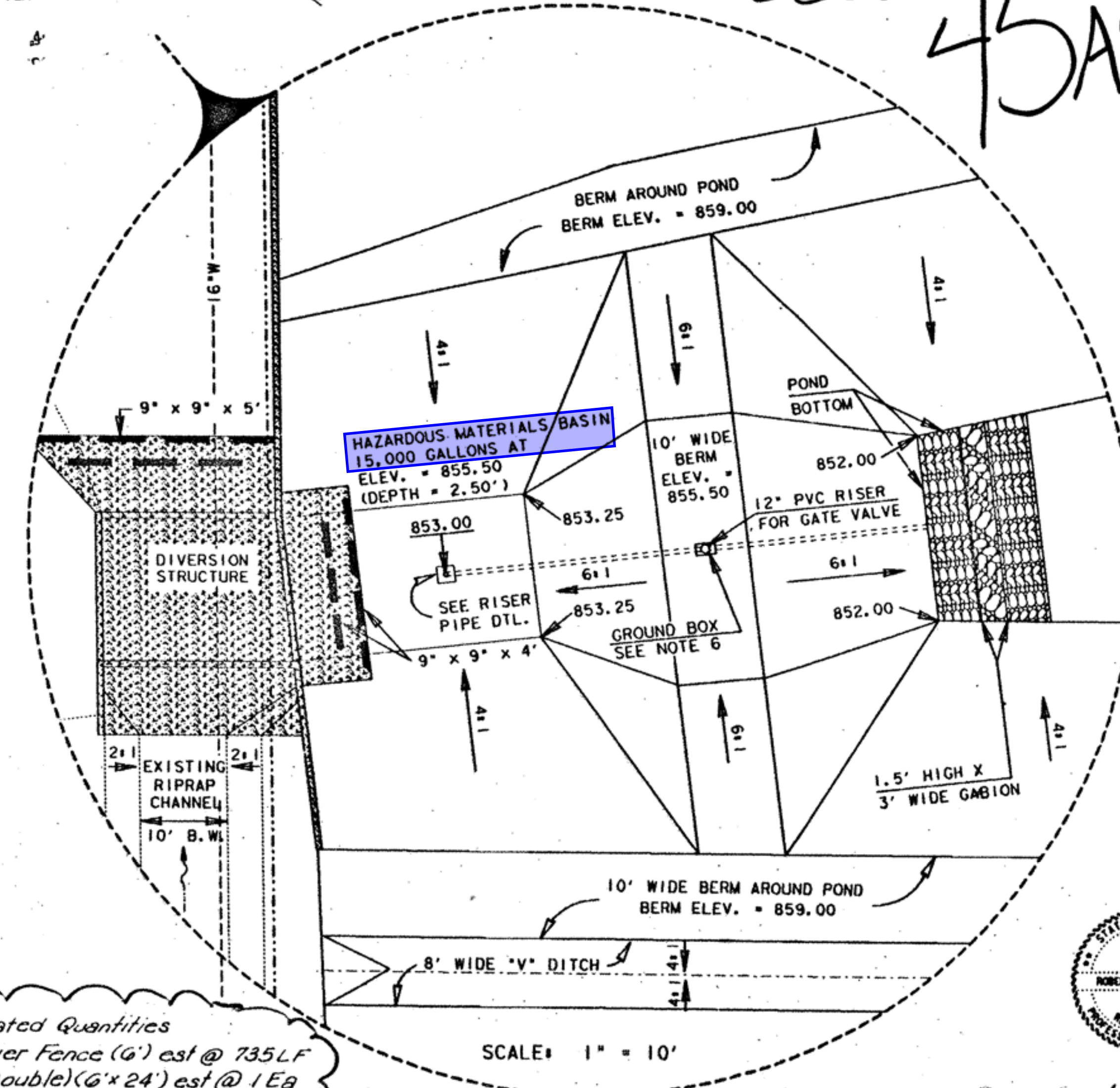
6"PVC RISER PIPE WITH SOLID CAP (3/4" DIA. PERFORATIONS AT 4/ROW AROUND PIPE & AT 3" O.C. VERT.) WRAP 1 ROUND W/FILTER FABRIC FROM ELL TO CAP & WIRE TIE.



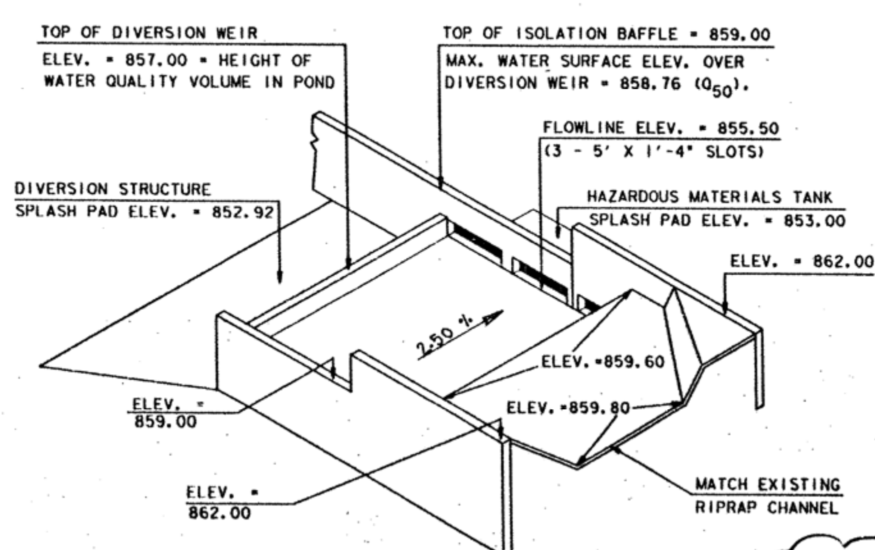
RISER PIPE DETAIL

NO SCALE

45A2



SCALE: 1" = 10'



DIVERSION STRUCTURE

NO SCALE

F.C. No. 15 Estimated Quantities
Chain Link Barrier Fence (6') est @ 735 LF
Vehicle Gate (Double)(6'x 24') est @ 1 Ea

GENERAL NOTES:

1. ALL PVC SHALL BE SCH 40 GRADE. JOINTS SHALL BE CLEAN AND GLUED AIR TIGHT. 12" PVC RISER CASING SHALL BE SLOTTED TO FIT OVER VALVE ASSEMBLY AND EXTEND TO 6" BELOW THE TOP OF THE 10' WIDE BERM AT ELEV 855.50. THE GATE VALVE, ELLS, VALVE HANDLE EXTENSION, DRILLED ORIFICE PLATES, 12" PVC RISER WITH GROUND BOX, PERFORATED 6" PVC RISER WRAPPED WITH FILTER FABRIC, AND ANY OTHER PLUMBING APPURTANCES NECESSARY TO COMPLETE THE WORK SHALL BE SUBSIDIARY TO THE 6" PVC PIPE, ITEM 582.

2. RIPRAP SHALL BE CLASS "A" WITH A THICKNESS OF 5" PER ITEM 432. REINFORCEMENT SHALL BE 6" X 6" X #6 WELDED WIRE FABRIC.

3. THE HAZARDOUS MATERIALS BASIN AND SEDIMENTATION POND SHALL HAVE 12" OF CLAY LINER UNDER 12" OF TOPSOIL AND SHALL BE SODDED WITH BUFFALO GRASS IN A CHECKER BOARD PATTERN. SOLID SOD AND A SOIL RETENTION BLANKET SHALL BE PLACED ON THE 10' WIDE BERM AT 855.50 AND ON THE 6:1 AND TRANSITION SLOPES SURROUNDING THE BERM (SEE SHT. 45B). THE SOIL RETENTION BLANKET SHALL BE ENKAMAT (TYPE 7010) AS MANUFACTURED BY AKZO INDUSTRIAL SYSTEMS CO. OR AN OR AN APPROVED EQUAL.

4. CLAY SHALL MEET THE FOLLOWING SPECIFICATIONS:

PROPERTY	TEST METHOD	UNIT	SPECIFICATION
PERMEABILITY	TEX-123-E	Cm/Sec	1×10^{-8}
PLASTICITY INDEX	TEX-106-E	%	NOT < 15
LIQUID LIMIT	TEX-104-E	%	NOT < 30
PARTICLES PASSING 200 SIEVE	TEX-110-E (PART II)	%	NOT < 30
COMPACTION	AS DIRECTED BY THE ENGINEER		

THE CLAY SHALL BE PAID FOR UNDER ITEM 1147 EMBANKMENT (TYPE C) (ORDINARY COMPACTION).

5. SEE SHEET 45B FOR QUANTITIES.

6. THE GROUND BOX SHALL MEET THE FOLLOWING REQUIREMENTS:

THE PRECAST CONCRETE GROUND BOX SHALL BE CONSTRUCTED OF REINFORCED CONCRETE WITH A MINIMUM WALL THICKNESS OF 1". THE COVER SHALL BE STEEL, HOT DIPPED GALVANIZED, AND SHALL HAVE "VALVE" IMPRINT.

MINIMUM INSIDE DIMENSIONS (WXLXH) SHALL BE 16" X 29" X 11". BOTTOM EDGE OF BOX SHALL BE FOOTED (2 1/2" FLANGE).

STATE OF TEXAS
ROBERT D. AUSTIN
67596
REGISTERED PROFESSIONAL ENGINEER

DIVERSION STRUCTURE,
HAZARDOUS MATERIALS BASIN,
& SEDIMENTATION POND

CHANGE ORDER NO. 3 Sht 1 of 2

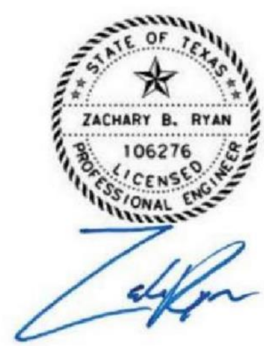
Robert D. Austin, P.E. 4-30-92
ROBERT D. AUSTIN DATE

FED. RD. DIV. NO.	FEDERAL AID PROJECT NO.			SHEET NO.
6	CRP 91(39)M			45A(6)
STATE	STATE DIST. NO.	COUNTY		
TEXAS	15	BEXAR		
CONT.	SECT.	JOB	HIGHWAY NO.	
2452	03	070	LP 1604	

1604GCSP.DGN

TSS REMOVAL CALCULATIONS:

AquaLogic Summary



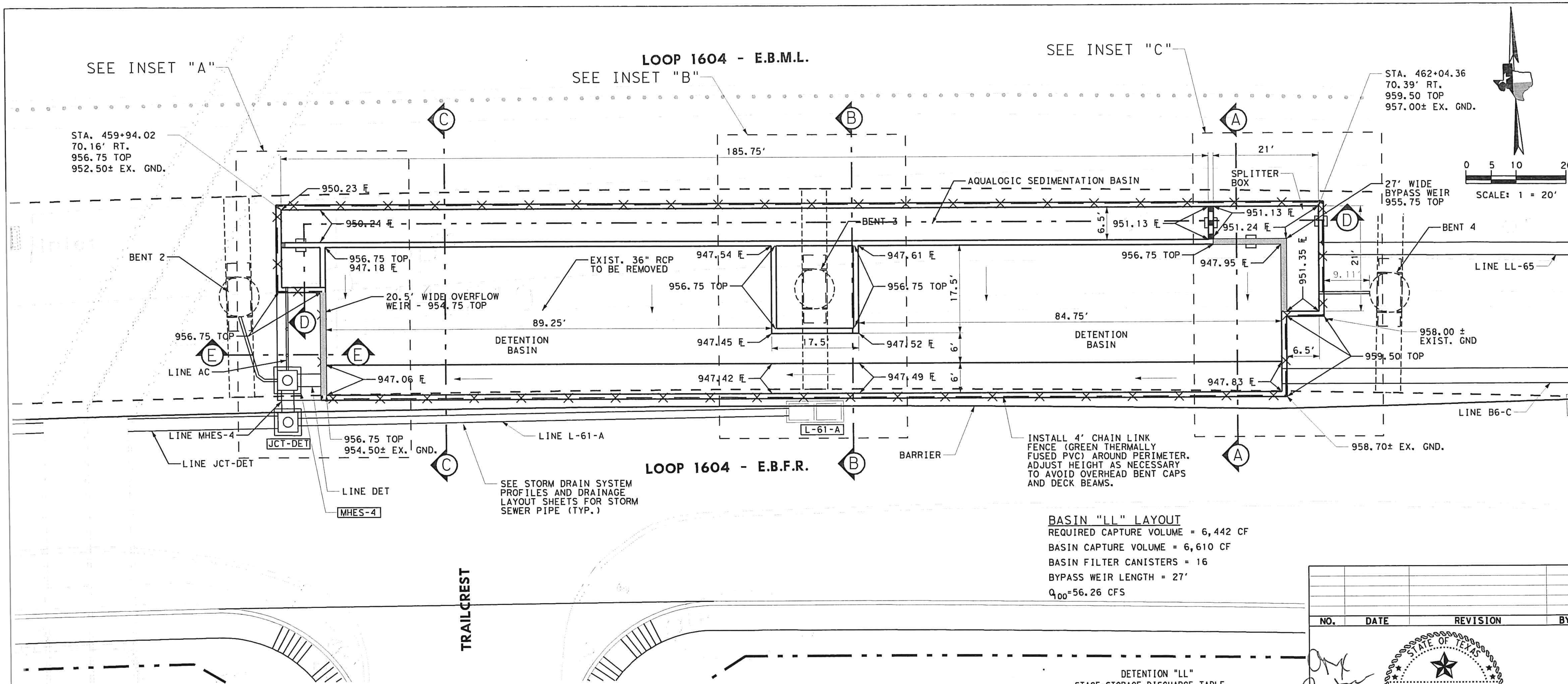
01/25/2023

The TSS removal provided by the existing AquaLogic in Segment 4 is clearly shown in the provided CSJ 0253-04-139 as-built plans. The provided as-builts indicated a storage capacity of **6610 ft3** for the AquaLogic basin. The same method used for the Mud Creek water quality pond was applied here. The maximum TSS load that can be removed from the drainage area was calculated using the LR formula with the efficiency of an AquaLogic. From the maximum L_R, a desired TSS to be removed was assigned such that the required capture volume of water is less than the storage capacity of the basin. The number of required filter cartridges was considered in addition to the required basin capacity. Table 4 below shows the results of the calculations confirming that the required volume of water to remove the desired TSS is less than the storage capacity of the pond.

TABLE 5: EXISTING AQUALOGIC SUMMARY									
OUTFALL	AQUALOGIC DRAINAGE AREA	EXISTING IMPERVIOUS COVER	PROPOSED IMPERVIOUS COVER	MAXIMUM TSS LOAD REMOVED (LR) FOR DRAINAGE AREA	DESIRED TSS LOAD REMOVAL (LM)	STORAGE CAPACITY OF BASIN	REQUIRED BASIN CAPACITY REQUIRED TO REMOVE DESIRED TSS LOAD REMOVAL	EXIST # FILTERS	# FILTERS REQUIRED FOR DESIRED TSS
	AC	AC	AC	LBS	LBS	CU FT	CU FT		
BF-AQ	7.32	5.86	6.61	6,358	2,500	6,610	6,385	15	15

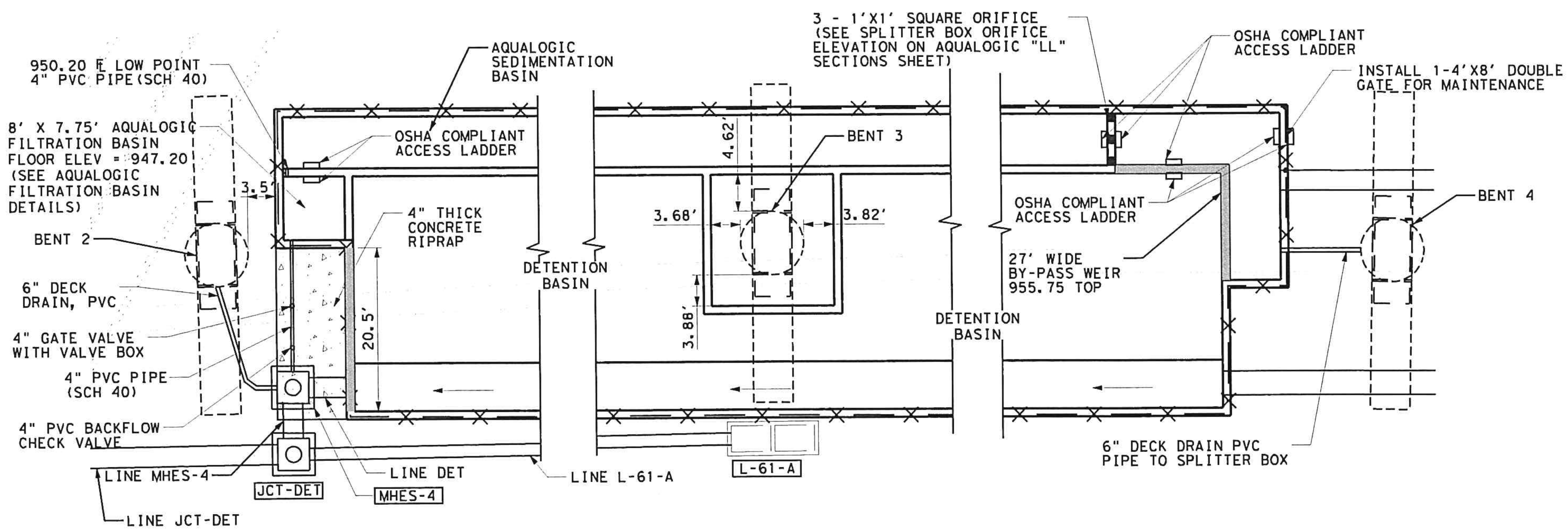
Table 5 - Existing AquaLogic Summary

AS-BUILT PLAN SHEET AQUALOGIC
CSJ 0253-04-139



BASIN "LL" LAYOUT

REQUIRED CAPTURE VOLUME = 6,442 CF
BASIN CAPTURE VOLUME = 6,610 CF
BASIN FILTER CANISTERS = 16
BYPASS WEIR LENGTH = 27'
Q_{100}=56.26 CFS



INSET "A" INSET "B" INSET "C"

DETENTION "LL"
STAGE-STORAGE-DISCHARGE TABLE

STAGE	STORAGE		DISCHARGE
MSL	CF	AC-FT	CFS
947.18	0	0.00	2.64
947.95	1373	0.03	8.11
948	1640	0.04	8.44
949	6989	0.16	12.05
950	12338	0.28	14.74
951	17687	0.41	17.04
952	23036	0.53	19.09
953	28385	0.65	20.98
954	33734	0.77	22.92
955	39083	0.90	24.86
955.75	43095	0.99	26.31

AQUALOGIC "LL" STAGE-STORAGE TABLE

STAGE	STORAGE	
MSL	CF	AC-FT
950.2	0	0
951.35	769	0.02
952	1632	0.04
953	2959	0.07
954	4287	0.10
955	5614	0.13
955.75	6610	0.15

SEE AQUALOGIC "LL"
SECTIONS AND ELEVATIONS
ON SHEET 712F

NO.	DATE	REVISION	BY

STATE OF TEXAS
ALEX ZERTUCHE
92080
LICENSED
PROFESSIONAL ENGINEER

Alex Zertuche
11/18/11

WILLIAMS BROTHERS CONSTRUCTION CO., INC.

JACOBS
JACOBS ENGINEERING GROUP INC. FIRM #2966

ALAMO RMA
Alamo Regional Mobility Authority
"Moving people faster"

US 281 LP 1604 INTERCHANGE

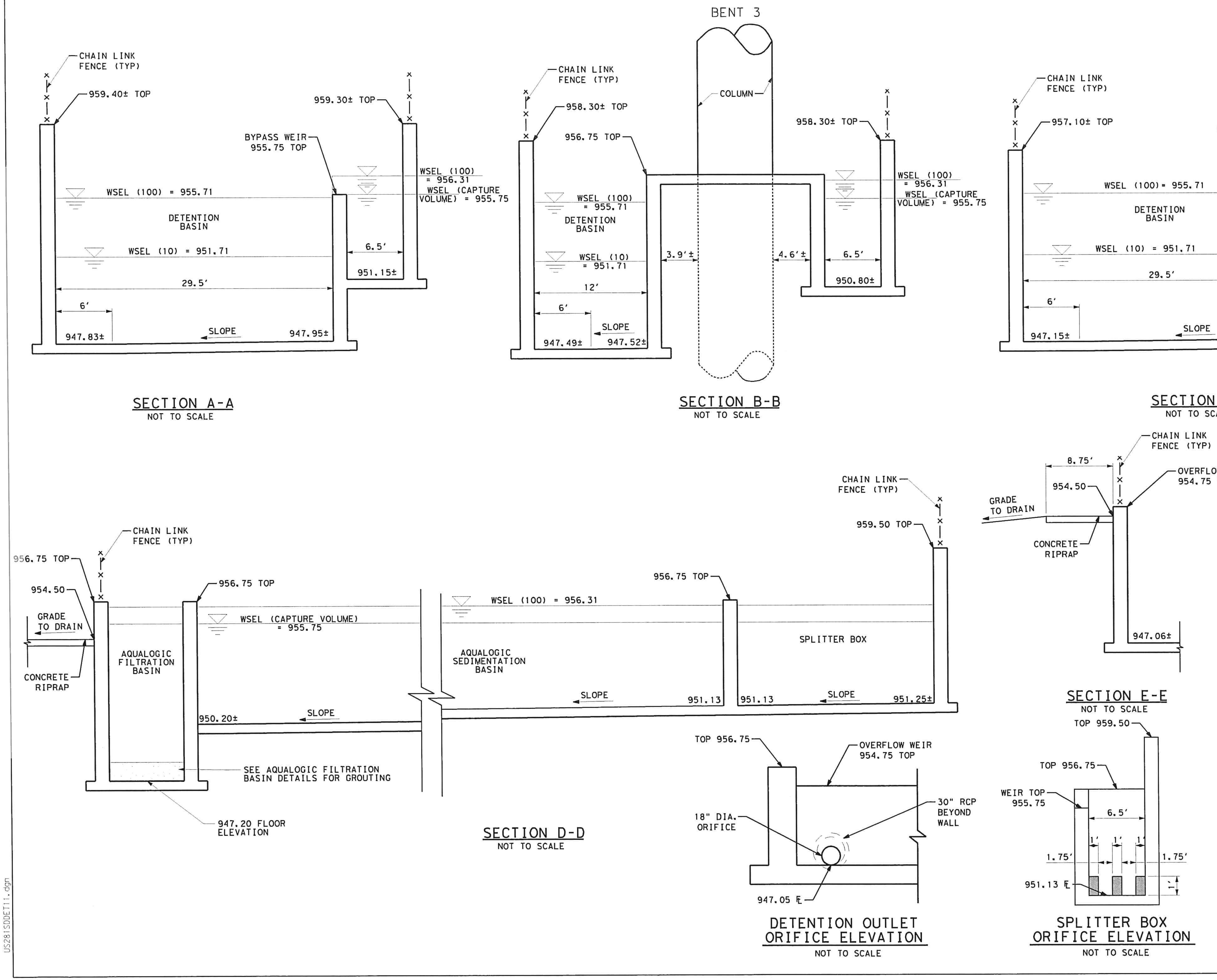
AQUALOGIC "LL" LAYOUT

SHEET 1 OF 5

FED. RD. DIV. NO.	STATE	FEDERAL AID PROJECT NO.			INTERIM PACKAGE	
6	TEXAS	STP 2009(653)ES				
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	HIGHWAY NO.	FINAL PACKAGE
SAT	BEXAR	0253	04	139, ETC	US 281/LP 1604	712E

9:07:58 AM
11/18/2011
US281SDDET10.dgn

AS-BUILT PLAN SHEET AQUALOGIC
CSJ 0253-04-139



NOTES:

WSEL(100) = 955.71 ELEVATION IN DETENTION BASIN ASSUMES 30" RCP OUTFALL PIPE IS CLOGGED, AND OVERFLOW WIER IS ONLY OUTLET.

REFER TO AQUALOGIC WALL DETAILS SHEET FOR FOOTING DIMENSIONS.

STATE OF TEXAS
ALEX ZERTUCHE
92080
LICENSED PROFESSIONAL ENGINEER
11/18/11

JACOBS
JACOBS ENGINEERING GROUP INC. FIRM #2966

ALAMO RMA
Alamo Regional Mobility Authority "Moving people faster"

US 281 LP 1604 INTERCHANGE

AQUALOGIC "LL" SECTIONS

SHEET 2 OF 5

FED. RD. DIV. NO.	STATE	FEDERAL AID PROJECT NO.			INTERIM PACKAGE	
6	TEXAS	STP 2009(653)ES				
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	HIGHWAY NO.	FINAL PACKAGE
SAT	BEXAR	0253	04	139, ETC	US 281/ LP 1604	712F

11/18/2011 US281SDDET11.dgn 9:08:35 AM

WPAP SITE PLAN SHEETS

DIST	PROJECT NO.		SHEET NO.
15			1
STATE	DIST	COUNTY	
TEXAS	SAT	BEXAR	
CONT	SECT	JOB	HIGHWAY
2452	02	130, ETC	SL 1604, ETC

INDEX OF SHEETS

SEE SHEETS 2 THRU 8 FOR INDEX OF SHEETS

STATE OF TEXAS
DEPARTMENT OF TRANSPORTATION

PLANS OF PROPOSED
STATE HIGHWAY IMPROVEMENT

ROADWAY LENGTH = 21473.19 FT 4.067 MILES
BRIDGE LENGTH = 926.48 FT 0.175 MILES
TOTAL LENGTH OF PROJECT = 4.242 MILES

FERDERAL AID PROJECT
PROJECT NO:
BEXAR COUNTY
SL 1604
LIMITS: FROM 2.0 MILES WEST OF US 281 TO REDLAND RD

FOR WORK CONSISTING OF EXPAND 4 TO 10 LANE EXPRESSWAY-INCLUDING 2 HOV-SPECIAL USE LANES; FROM 4 TO 4 FR RDS

CCSJ 2452-02-130
SL 1604
DESIGN SPEED
MAINLANES = 60 mph
FRONTAGE ROADS = 45 mph
RAMP = 35 mph
DIRECT CONNECTORS = 45 mph
CROSS STREETS = 45/30 mph
AREA OF DISTURBED SOIL = 66 AC.
ADT:
168,750 = (2025)
235,300 = (2045)
FUNCTIONAL CLASS = URBAN FREEWAY

REGISTERED ACCESSIBILITY SPECIALIST (RAS) INSPECTION REQUIRED
TDLR NO.
ACCESSIBILITY STANDARDS = PROWAG

FINAL PLANS

LETTING DATE: ______
DATE CONTRACTOR BEGAN WORK: ______
DATE WORK WAS ACCEPTED: ______
DATE WORK WAS COMPLETED: ______
FINAL CONTRACT COST: $ ______
CONTRACTOR: ______

FINAL PLANS STATEMENT:

THE CONSTRUCTION WORK WAS PERFORMED IN ACCORDANCE WITH THE PLANS:

______ P.E. ______
AREA ENGINEER DATE

TEXAS DEPARTMENT OF TRANSPORTATION

LJA Engineering, Inc.
FRN - F-1386

BEGIN PROJECT
MI MRK: 11.777
REF MRK: 527.79
℄ ML1604 STA 4400+00.00
BEGIN CSJ 2452-02-130
BEGIN RCSJ 2452-03-133

℄ ML1604 STA 4479+85.85
END CSJ 2452-02-130
END RCSJ 2452-03-133
BEGIN CSJ 2452-03-113
BEGIN RCSJ 2452-03-129

N.T.S.

END PROJECT
MI MRK: 30.780
REF MRK: 532.15
℄ ML1604 STA 4624+00.00
END CSJ 2452-03-113
END RCSJ 2452-03-129

ATTACHMENT NO. 01-22 TO SPECIAL AGREEMENT FOR CONSTRUCTION, MAINTENANCE, AND OPERATIONS OF HIGHWAY LIGHTING SYSTEMS WITHIN A MUNICIPALITY, DATED JUNE 24, 2014. THE CITY-STATE CONSTRUCTION, MAINTENANCE AND OPERATION RESPONSIBILITIES SHALL BE AS HERETOFORE AGREED TO, ACCEPTED, AND SPECIFIED IN THE AGREEMENT TO WHICH THESE PLANS ARE MADE A PART.

CONCURRENCE

CITY OF SAN ANTONIO

RECOMMENDED FOR LETTING:

PLAN REVIEW

RECOMMENDED FOR LETTING:

TRANSPORTATION ENGINEER

RECOMMENDED FOR LETTING:

DIRECTOR OF TRANSPORTATION, PLANNING AND DEVELOPMENT

APPROVED FOR LETTING:

DISTRICT ENGINEER

EXCEPTIONS: N/A
EQUATION: STA 4412+82.55 = STA 4412+82.88 LP 1604
RR X-ING'S: N/A

COUNTY BEXAR PROJ. NO. ______
HWY. NO. LP1604 LETTING DATE ______
DATE ACCEPTED ______

SPECIFICATIONS ADOPTED BY THE TEXAS DEPARTMENT OF TRANSPORTATION, NOVEMBER 1, 2014 AND SPECIFICATION ITEMS LISTED AND DATED AS FOLLOWS, SHALL GOVERN ON THIS PROJECT: REQUIRED CONTRACT PROVISIONS FOR ALL FEDERAL-AID CONSTRUCTION CONTRACTS (FORM FHWA 1273, JULY 5 2022)

Texas Commission on Environmental Quality
Water Pollution Abatement Plan
General Construction Notes

Edwards Aquifer Protection Program Construction Notes – Legal Disclaimer

The following/listed "construction notes" are intended to be advisory in nature only and do not constitute an approval or conditional approval by the Executive Director (ED), nor do they constitute a comprehensive listing of rules or conditions to be followed during construction. Further actions may be required to achieve compliance with TCEQ regulations found in Title 30, Texas Administrative Code (TAC), Chapters 213 and 217, as well as local ordinances and regulations providing for the protection of water quality. Additionally, nothing contained in the following/listed "construction notes" restricts the powers of the ED, the commission or any other governmental entity to prevent, correct, or curtail activities that result or may result in pollution of the Edwards Aquifer or hydrologically connected surface waters. The holder of any Edwards Aquifer Protection Plan containing "construction notes" is still responsible for compliance with Title 30, TAC, Chapters 213 or any other applicable TCEQ regulation, as well as all conditions of an Edwards Aquifer Protection Plan through all phases of plan implementation. Failure to comply with any condition of the ED's approval, whether or not in contradiction of any "construction notes," is a violation of TCEQ regulations and any violation is subject to administrative rules, orders, and penalties as provided under Title 30, TAC § 213.10 (relating to Enforcement). Such violations may also be subject to civil penalties and injunction. The following/listed "construction notes" in no way represent an approved exception by the ED to any part of Title 30 TAC, Chapters 213 and 217, or any other TCEQ applicable regulation

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

THESE GENERAL CONSTRUCTION NOTES MUST BE INCLUDED ON THE CONSTRUCTION PLANS PROVIDED TO THE CONTRACTOR AND ALL SUBCONTRACTORS.

STATE OF TEXAS
ZACHARY B. RYAN
106276
LICENSED
PROFESSIONAL ENGINEER
2/9/2023

REV. NO.	DATE	DESCRIPTION	BY

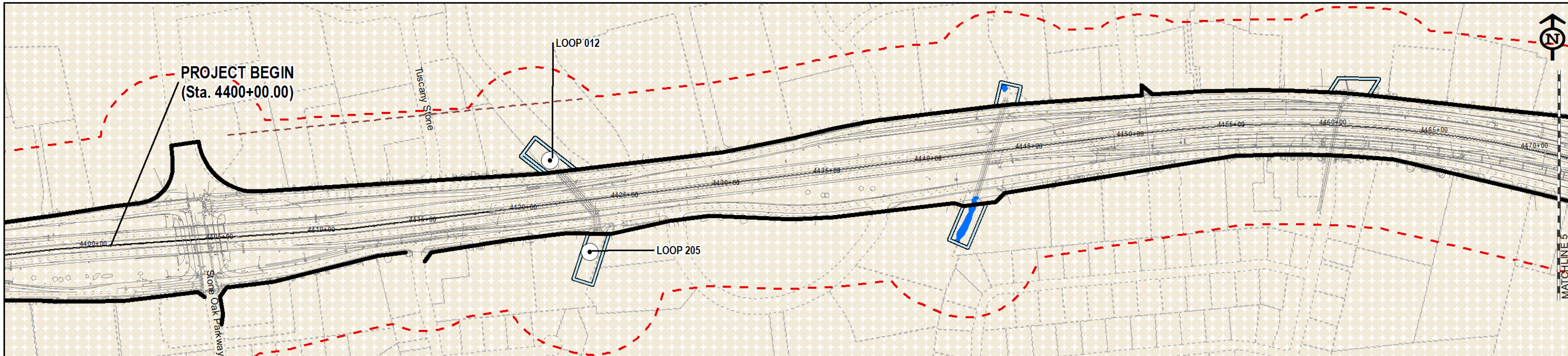
LJA Engineering, Inc.
FRN - F-1386

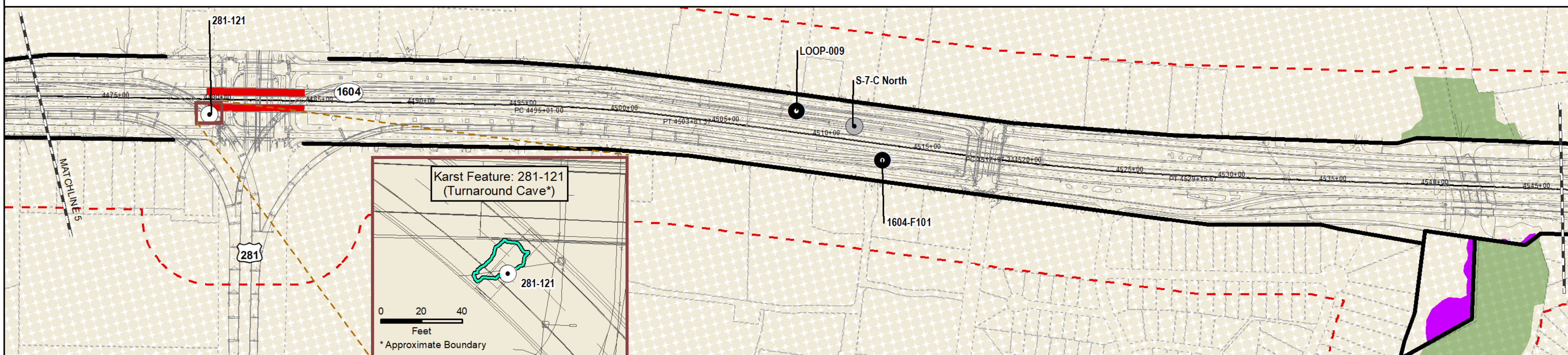
Texas Department of Transportation
©2023

LP 1604
TCEQ
GENERAL NOTES

SHEET 1 OF 1

FED. RD. DIV. NO.	STATE	PROJECT NO.			HIGHWAY NO.
6	TEXAS	SEE TITLE SHEET			LP1604
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	0072	08	130	2652





Surveyed Feature Sensitivity

- Potential Habitat and Not Sensitive (USFWS)
- Potential Habitat and Sensitive Feature (TCEQ)
- Sensitive Feature - Not Considered Potential Habitat - Above 40 (TCEQ)
- Lead Based Paint Containing Bridge (TxDOT)
- Golden-cheeked Warbler Habitat
- Approved GCW Impact Area
- Ordinary High Water Mark (OHWM)
- Existing Right-of-way
- Easement
- Action Area
- Existing Sanitary Sewer
- Proposed Sanitary Sewer
- Asbestos Containing Materials Bridge
- Edwards Acquifer Recharge Zone (RZ)

NOTE:
Feature 281-121 is a cave encountered by drilled shaft on CSJ: 0253-04-146. The cave was filled with flowable fill per TCEQ approved mitigation plan.

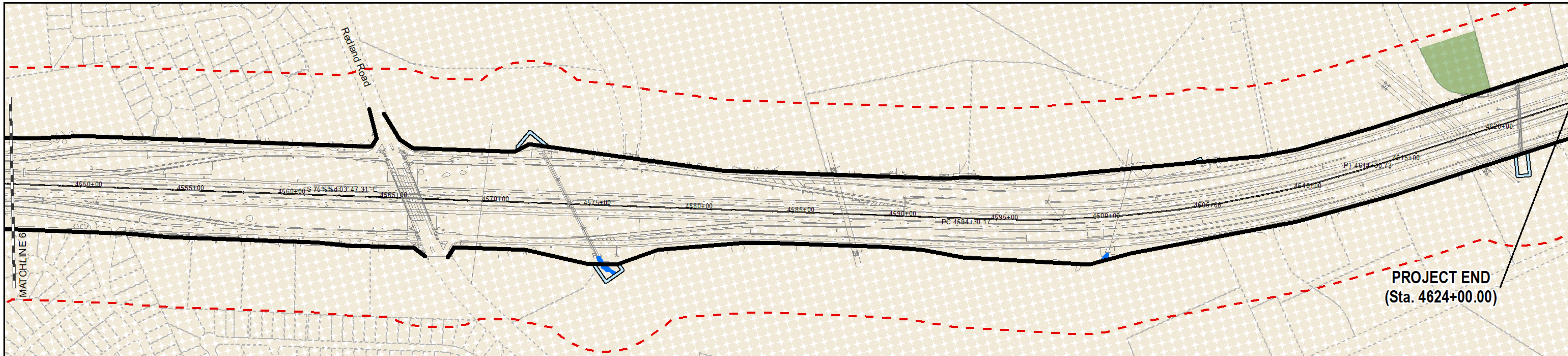
LJA ENGINEERING
FRN - F-1386

Texas Department of Transportation®

LP 1604
Environmental Features

0 250 500
Feet
Scale 1" = 500'

CSJ: 2451-02-083
SEGMENT 4
SHEET 1 OF 2



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- Proposed Sanitary Sewer
- Asbestos Containing Materials Bridge
- Edwards Acquifer Recharge Zone (RZ)

LJA ENGINEERING
FRN - F-1386

Texas Department of Transportation®

LP 1604
Environmental Features

0 250 500
Feet
Scale 1" = 500'

CSJ: 2451-02-083
SEGMENT 4
SHEET 2 OF 2

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I. STORMWATER POLLUTION PREVENTION-CLEAN WATER ACT SECTION 402

Texas Pollutant Discharge Elimination System (TPDES) TXR 150000: Stormwater Discharge Permit or Construction General Permit (CGP) required for projects with 1 or more acres distrubed soil. Projects with any disturbed soil must protect for erosion and sedimentation in accordance with Item 506.

☐ No Action Required ☒ Required Action

Action No.

1. Prevent stormwater pollution by controlling erosion and sedimentation in accordance with TPDES Permit TXR 150000.
2. Comply with the Storm Water Pollution Prevention Plan (SW3P) and revise when necessary to control pollution or required by the Engineer.
3. Post Construction Site Notice (CSN) with SW3P information on or near the site, accessible to the public and Texas Commission on Environmental Quality (TCEQ), Environmental Protection Agency (EPA) or other inspectors.
4. When Contractor project specific locations (PSL's) increase disturbed soil area to 5 acres or more, Contractor shall submit Notice of Intent (NOI) to TCEQ and the Engineer.
5. NOI required: Yes ☒ No ☐

Note: If amount of soil disturbance changes, permit requirements may change.

II. WORK IN OR NEAR STREAMS, WATERBODIES AND WETLANDS CLEAN WATER ACT SECTIONS 401 AND 404

US Army Corps of Engineers (USACE) Permit required for filling, dredging, excavating or other work in any potential USACE jurisdictional water, such as, rivers, creeks, streams, or wetlands.

The Contractor shall adhere to all of the terms and conditions associated with the following permit(s):

☐ No Permit Required

☒ Nationwide Permit (NWP) 14 - Pre-construction Notice (PCN) not Required

☐ Nationwide Permit 14 - PCN Required

☐ Individual 404 Permit Required

☐ Other Nationwide Permit Required: NWP* ______

Required Actions: List waters of the US permit applies to, location in project and check Best Management Practices (BMPs) planned to control erosion, sedimentation and post-project total suspended solids (TSS).

1. BE (Lorence Creek)(Crossing 21)
2. BH (Mud Creek)(Crossing 22)
3. BI (UT to Elm Creek)(Crossing 23)
4. BJ (Elm Creek)(Crossing 24)

401 Best Management Practices: (Not applicable if no USACE permit)

Erosion	Sedimentation	Post-Construction TSS
☒ Temporary Vegetation	☒ Silt Fence	☐ Vegetative Filter Strips
☒ Blankets/Matting	☒ Rock Berm	☐ Retention/Irrigation Systems
☐ Mulch	☐ Triangular Filter Dike	☐ Extended Detention Basin
☒ Sodding	☐ Sand Bag Berm	☐ Constructed Wetlands
☐ Interceptor Swale	☐ Straw Bale Dike	☐ Wet Basin
☐ Diversion Dike	☐ Brush Berms	☐ Erosion Control Compost
☐ Erosion Control Compost	☐ Erosion Control Compost	☐ Mulch Filter Berm and Socks
☒ Mulch Filter Berm and Socks	☒ Mulch Filter Berm and Socks	☐ Compost Filter Berm and Socks
☒ Compost Filter Berm and Socks	☒ Compost Filter Berm and Socks	☒ Vegetation Lined Ditches
	☐ Stone Outlet Sediment Traps	☐ Sand Filter Systems
	☐ Sediment Basins	☐ Sedimentation Chambers
		☐ Grassy Swales

III. CULTURAL RESOURCES

Refer to TxDOT Standard Specifications in the event historical issues or archeological artifacts are found during construction. Upon discovery of archeological artifacts (bones, burnt rock, flint, pottery, etc.) cease work in the immediate area and contact the Engineer immediately.

☒ No Action Required ☐ Required Action

Action No.

1.

2.

3.

4.

IV. VEGETATION RESOURCES

Preserve native vegetation to the extent practical. Contractor must adhere to Construction Specification Requirements Specs 162,164, 192, 193, 506, 730, 751, 752 in order to comply with requirements for invasive species, beneficial landscaping, and tree/brush removal commitments.

☐ No Action Required ☒ Required Action

Action No.

1. Numerous restrictions apply to tree removal activities. See Migratory Bird requirements and Areas of Environmental Concern Table on EPIC Page 3.
2.
3.
4.

V. FEDERAL LISTED, PROPOSED THREATENED, ENDANGERED SPECIES, CRITICAL HABITAT, STATE LISTED SPECIES, CANDIDATE SPECIES AND MIGRATORY BIRDS.

☐ No Action Required ☒ Required Action

Comply with all EPICs located in Section 8 of the EA and all conditions listed in the BO issued for this project.

Action No.

1. MIGRATORY BIRD NESTS: Schedule construction activities as needed to meet the following requirements:

A. Do not remove or destroy any active migratory bird nests (nests containing eggs and/or flightless birds) at any time of year. If there are any active nests, they shall not be removed until the nests become inactive.

B. On/in structures, if there are any active nests, they shall not be removed until all nests become inactive. After inactive nests are removed and/or before nest activity begins, deterrent materials may be applied to the structures to prevent future nest building.

2. See Item 5 in General Notes.

3. TPWD Amphibian BMPs
- Amphibians present may include Cascade Caverns Salamander, Comal Blind Salamander, Strecker's Chorus Frog, Texas Salamander, Woodhouse's Toad.
- Contractors will be advised of potential occurrence in the project area, and to avoid harming the species if encountered.
- When work is in water or will permanently impact a water feature and potential habitat exists for the target species complete the following:
- Minimize impacts to wetland, temporary and permanent open water features,including depressions, and riverine habitats.
- Maintain hydrologic regime and connections between wetlands and other aquatic features.
- Use barrier fencing to direct animal movements away from construction activities and areas of potential wildlife-vehicle collisions in construction areas directly adjacent, or that may directly impact, potential habitat for the target species.
- Use erosion control blankets or mats that contain no netting, or only contain loosely woven natural fiber netting is preferred. Plastic netting should be avoided to the extent practicable.

TPWD Amphibian BMPs (Continued)
- Project specific locations (PSLs) proposed within state-owned ROW should be located in uplands away from aquatic features.
- When work is directly adjacent to the water, minimize impacts to shoreline basking sites (e.g., downed trees, sand bars, exposed bedrock) and overwinter sites (e.g., brush and debris piles, crayfish burrows) where feasible.
- Avoid or minimize disturbing or removing downed trees, rotting stumps, and leaf litter, which may be refugia for terrestrial amphibians, where feasible.

4. TPWD Terrestrial Reptile BMPs
- Reptiles present may include Texas Garter Snake and Tamaulipan Spot-tailed Earless Lizard
- Contractors will be advised of potential occurrence in the project area, and to avoid harming the species if encountered.
- Inform contractors that if reptiles are found on the project site allow species to safely leave the project area.
- For open trenches and excavated pits, install escape ramps at an angle of less than 45 degrees (1:1) in areas left uncovered. Visually inspect excavation areas for trapped wildlife prior to backfilling.
- Avoid or minimize disturbing or removing downed trees, rotting stumps, and leaf litter where feasible.
- Due to increased activity (mating) of reptiles during the spring, construction activities like clearing or grading should attempt to be scheduled outside of the spring (April-May) season. Also, timing conducting ground-disturbing activities before October, when reptiles become less active and may be using burrows in the project area, is also encouraged.

5. TPWD Bird BMPs
- Prior to construction, perform daytime surveys for nests, including under bridges and in culverts, to determine they are not active before removal. Nests that are active should not be disturbed.
- Do not disturb, destroy, or remove active nests, including ground-nesting birds, during the nesting season. Nesting season is recognized at the TxDOT San Antonio District as: From February 15th to October 1st.
- Avoid the removal of unoccupied, inactive nests, as practicable.
- Prevent the establishment of active nests during the nesting season on TxDOT owned and operated facilities and structures proposed for replacement or repair.
- Do not collect, capture, relocate, or transport birds, eggs, young, or active nests without a permit.

6. TPWD Bat BMPs
- Bats present may include: Big Brown Bat, Cave Myotis, Eastern Red Bat, Hoary Bat, Mexican Free-Tailed Bat, Tricolored Bat.
- Active bat colonies were identified at a large atypical arch culvert (anticipated to remain) and a retaining wall cap within an on-ramp of Loop 1604 (may require removal) near UPRR bridges, FM 2252 and Lookout Road. TPWD recommends that any work at either location be performed outside of the young rearing period between May to October to avoid impacts to bats, particularly when young bats are non-volant.

- If bats are present or recent signs of occupation (i.e., piles of guano, distinct musky odor, or staining and rub marks at potential entry points) are observed, take appropriate measures to ensure that bats are not harmed, such as implementing non-lethal exclusion activities or timing or phasing of construction. Exclusion devices can be installed by a qualified individual between September 1 and March 31. Exclusion devices should be used for a minimum of seven days when minimum nighttime temperatures are above 50°F and minimum daytime temperatures are above 70°F. Prior to exclusion, ensure that alternate roosting habitat is available in the immediate area. If no suitable roosting habitat is available, installation of alternate roosts is recommended to replace the loss of an occupied roost.

- In all instances, avoid harm or death to bats. Bats should only be handled as a last resort and after communication with TPWD.

STATE OF TEXAS
HUMBERTO CONTRERAS
99213
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PROFESSIONAL ENGINEER

3/6/2023

Humberto Contreras

Texas Department of Transportation
San Antonio District Standard

ENVIRONMENTAL PERMITS, ISSUES AND COMMITMENTS

EPIC

FILE: epic 2015-10-09 SAT.dgn	DN: TxDOT	CK: TxDOT	DW: BW	CK: GAC
©TxDOT OCTOBER 2015	CONT	SECT	JOB	HIGHWAY
REVISIONS	2452	02	130, ETC	LP1604
	DIST		COUNTY	SHEET NO.
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7. TPWD BMPs for Plains Spotted Skunk, Western Hog-nosed Snake, Western Spotted Skunk
- Contractor is advised of potential occurrence in the project area, and to avoid harming the species if encountered, and to avoid unnecessary impacts to dens.

If any of the listed species are observed, cease work in the immediate area, do not disturb species or habitat and contact the Engineer immediately. The work may not remove active nests from bridges and other structures during nesting season of the birds associated with the nests. If caves or sinkholes are discovered, cease work in the immediated area, and contact the Engineer immediately.

VI. HAZARDOUS MATERIALS OR CONTAMINATION ISSUES

General (applies to all projects):

Comply with the Hazard Communication Act (the Act) for personnel who will be working with hazardous materials by conducting safety meetings prior to beginning construction and making workers aware of potential hazards in the workplace. Ensure that all workers are provided with personal protective equipment appropiate for any hazardous materials used.

Obtain and keep on-site Material Safety Data Sheets (MSDS) for all hazardous products used on the project, which may include, but are not limited to the following categories: Paints, acids, solvents, asphalt products, chemical additives, fuels and concrete curing compounds or additives. Provide protected storage, off bare ground and covered, for products which may be hazardous. Maintain product labelling as required by the Act.

Maintain an adequate supply of on-site spill response materials, as indicated in the MSDS. In the event of a spill, take actions to mitigate the spill as indicated in the MSDS, in accordance with safe work practices, and contact the District Spill Coordinator immediately. The Contractor shall be responsible for the proper containment and cleanup of all product spills.

Contact the Engineer if any of the follwing are detected:

- Dead or distressed vegetation (not identified as normal)
- Trash piles, drums, canister, barrels, etc.
- Undesirable smells or odors
- Evidence of leaching or seepage of substances

Hazardous Materials or Contamination Issues Specific to this Project:

☐ No Action Required ☒ Required Action

Action No.

1. CONTRACTOR WASTE AND MATERIALS MANAGEMENT PLAN (CWMP)

- The project area includes the Edwards Aquifer Recharge Zone, and the construction directly overlies the water table of the regional drinking water supply aquifer. The groundwater can carry pollutants over 1 mile per day to water wells. Numerous water wells are located near the project. The aquifer is vulnerable to spills of chemicals and sanitary waste.
- Contractor will prepare and implement a CWMP to prevent, avoid, minimize, and clean up any spills associated with materials, waste and equipment that the Contractor brings onto the project area or generates within the project area with an emphasis on chemicals and sanitary wastes.
- CWMP will address measures to prevent spills of chemicals associated with construction materials, waste and equipment and to prevent damage to all sanitary sewer facilities including sanitary sewer lines, manholes, lift stations and power supply, force mains, valves, and related appurtenances. Maintain labelling and protection all sanitary waste facilities in the ROW. CWMP will list chemicals which will be brought onto State ROW by Contractor with relevant health and safety data and protection measures for each. CWMP will include measures to respond to spills.
- CWMP will identify on-site personnel responsible for daily implementation and enforcement, including contact information.
- Contractor to provide CWMP training to all on-site personnel once every 365 days and invite TxDOT personnel (five business days notice) to each training event. Contractor is to maintain copies of training records on-site and provide records upon request.
- TxDOT will not permit storage of any quantity of hazardous materials, such as a one- quart container of oil, in state ROW in the Edwards Aquifer Contributing, Recharge and Transition Zones during construction. TxDOT's expectation of the contractor is that no containers of non-potable liquids other than non-potable clean water, would be left outside the confines of a vehicle unattended.
- The contractor must immediately report spills including sanitary sewer discharge to TxDOT and to the following:

EPA National Response Center (800) 424-8802
State Emergency Response Commission (800) 832-8224
TCEQ Regional Office (210) 490-3096
Edwards Aquifer Authority (210) 222-2204
San Antonio Water System (210) 704-7297

Does the project involve the demolition of a span bridge?

☒ Yes ☐ No (No further action required)

If "Yes", a pre- demolition notification must be submitted to the Texas Department of State Health Services. The contractor shall contact TxDOT's Project Engineer 25 calendar days prior to the demolition of the bridges(s) on the project to assist with the notification.

VII. OTHER ENVIRONMENTAL ISSUES

(includes regional issues such as Edwards Aquifer District, etc.)

☐ No Action Required ☒ Required Action

Action No.

1. NOTE TO CONTRACTOR

Please be advised that the project is located within a known area of Karstic Limestone and the Karst features may be impacted throughout construction for the entire project limits.

2. TRAINING REQUIREMENTS

1) Karst Training
- TxDOT will provide karst training to the Contractor following the preconstruction meeting and will provide additional training events at locations provided by Contractor and approved by TxDOT. Request training 5 business days in advance.
- Contractor is to ensure all on-site personnel involved with soil disturbance (excavation, grading, trenching, drilling, etc) including subcontractors attend karst training once every 365 days.
- No soil disturbance may occur in the presence of personnel lacking documentation of karst training requirements.
- Contractor is to maintain copies of training records on-site and provide records upon request.

2) Contractor Waste and Materials Management (CWMP) Training
- Contractor will provide CWMP training to all on-site personnel once every 365 days and invite TxDOT personnel (five business days) to each training event.
- Contractor is to ensure all personnel including subcontractors attend CWMP training once per calendar year.
- Contractor is to maintain copies of training records on-site and provide records upon request.

3. KARST FEATURE STOP WORK REQUIREMENTS

- If karst features (i.e., caves, solution cavities, voids, holes, openings in rock, etc) are discovered, immediately stop work within 50 feet of the opening except as necessary to protect the feature. Notify TxDOT within 12 hours.
- Cover opening with wood or plastic to protect feature from ambient air temperature and humidity. Add insulation if temperatures exceed 100°F.
- Add sandbags or berms to prevent runoff from entering the opening. Place fence or barricades around feature for public safety.
- Do not drive equipment when scientists are inside feature.
- TxDOT will provide scientists to evaluate the feature and will provide direction to the contractor regarding the disposition of feature and notice when work may resume. The duration of the stop work requirement is indefinite depending upon findings and resource agency coordination.
- Features may require management under the Endangered Species Act and Edwards Aquifer Rules under the jurisdiction of the USFWS and TCEQ, respectively.
- TxDOT must notify TCEQ within 24 hours after a professional geologist determines a feature is classified as "sensitive" and TxDOT must obtain TCEQ approval of a feature disposition plan.
- Features determined potential habitat under USFWS requirements may require frequent visits (presence-absence surveys) to inspect for listed species. Features which are too small or unsafe to enter may require baiting every 2-3 days for approximately 2-3 weeks. Features which can be safely entered may require entry every 2-3 days for approximately 4-5 weeks. Results of surveys may affect feature disposition plans.

4. PROJECT SPECIFIC LOCATIONS (PSLs)

On-ROW PSLs
- The Contractor may not locate any PSLs such as offices and storage yards on TxDOT ROW within 300 feet of any known listed species location or potential Golden Cheeked Warbler (GCW) habitat. See Environmental Features sheets.
- TxDOT is required to submit information regarding on-ROW PSLs to TCEQ's Edwards Aquifer Program for review and approval before installation. TCEQ sensitive features and floodplain should be avoided to facilitate TCEQ approval. TCEQ sensitive features are shown on the Environmental Features sheets in the construction plans.
- Locations of listed species and TCEQ sensitive features are subject to change with time. New karst features may be discovered.

Off-ROW PSLs
- The Contractor is responsible for compliance on PSLs located outside the ROW.
- The Contractor is required to provide information to TxDOT on Contractor PSLs located outside the TxDOT ROW.
- TxDOT is required to submit information regarding off-ROW PSLs to TCEQ5's Edwards Aquifer Program for approval before installation.
- USFWS requires TxDOT to provide information to contractor to facilitate contractor compliance with the Endangered Species Act (ESA).
- Potential Golden-cheeked Warbler (GCW) habitat within 300 feet of the project area is shown on the Environmental Features layouts in the construction plans. Potential GCW habitat may be located beyond the areas shown in layouts.

Off-ROW PSLs (Continued)
- Potential karst invertebrate habitat is located in the project area and surrounding portions of Bexar County. Karst Zone 1 includes areas that are known to contain listed species. Karst Zone 2 includes areas that probably contain listed species.
- Information on compliance with issues such as Karst Invertebrate Endangered Species and the Edwards Aquifer is available on USFWS and TCEQ websites. https://www.fws.gov/southwest/es/AustinTexas/ESA_Sp_KarstInverts.html#Karst_zones

5. TPWD Water Quality BMPs
- Minimize the use of equipment in streams and riparian areas during construction. When possible, equipment access should be from banks, bridge decks, or barges.
- When temporary stream crossings are unavoidable, remove stream crossings once they are no longer needed and stabilize banks and soils around the crossing.

6. See EPIC sheet 3 of 3 for table summarizing areas of environmental concern.

7. Asbestos-Containing Material and Lead-Containing Paint Inspection Reports are available for each bridge to be modified by the project. Concentration of lead were identified in the paint on the bridges shown in the Areas of Environmental Concern Table.
The contractor is responsible to identify locations on the bridges that will require torch cutting, grinding, sawing, etc. Once the locations are identified, the contractor shall notify the project engineer.
TxDOT will be responsible for contracting a specialty contractor to spot abate these locations by stripping the paint in accordance with TxDOT 2014 Standard Specification 6.10 and TxDOT Bridge Division Special Provision SP 006-30 and SP 006-31 prior to dismantling the bridge.
The contract shall only torch cut, grind, or saw steel elements at locations where the lead containing paint has been stripped back to expose uncoated steel.
The contractor will be responsible for recycling the portions of the bridge that contain lead containing paint in accordance with all applicable state and federal guidelines including item 6.10 - Removal & Disposal of Painted Steel (2014 Standard Specifications).
Contractor shall develop a containment plan for lead paint waste to be submitted to TxDOT for review and approval. This applies to any activity that may generate lead paint waste such as surface preparation, washing, pressure washing, etc.

8. Special Requirements For Features Found In Joint-Bid Sanitary Sewer Excavations. TxDOT is responsible for notifying TCEQ and SAWS if any sensitive features are encountered in joint-bid sanitary sewer excavations.
TxDOT is also responsible for endangered species habitat assessments and species surveys, as needed. In the event that endangered or presumed endangered species are found, TxDOT and SAWS shall work cooperatively to develop a plan that is compliant with the project's Endangered Species Act requirements and TCEQ requirements.
SAWS is responsible for preparing and obtaining TCEQ approval of sensitive feature closure plans for features found in joint bid sanitary sewer excavations. TxDOT will implement the TCEQ approved closure plan.

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3/6/2023

Texas Department of Transportation
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ENVIRONMENTAL PERMITS, ISSUES AND COMMITMENTS

EPIC

FILE: epic 2015-10-09 SAT.dgn	DN: TxDOT	CK: TxDOT	DW: BW	CK: GAG
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REVISIONS	2452	02	130, ETC	LP1604
	DIST		COUNTY	SHEET NO.
	SAT		BEXAR	

AREAS OF ENVIRONMENTAL CONCERN

Feature Name and description	Location	Access	Instructions
Potential Golden-cheeked Warbler (GCW) Habitat	Patches throughout project area. See Environmental Features Sheet 1 of 2.	Limited	Access permitted to remove trees from GCW habitat impact areas shown on Environmental Features sheets. Trees may be removed after August 31 and before March 1.
Trees within 300 feet of potential GCW Habitat	Trees subject to criteria throughout project area.	Limited	Distance between trees and GCW habitat to be measured by contractor. Trees within 300 feet of habitat areas may be removed after August 31 and before March 1.
Edwards Aquifer Recharge Zone, Contributing Zone and Transition Zone	Patches throughout project area. See Environmental Features Sheets.	Limited	Comply with the TCEQ-approved Water Pollution Abatement Plan (WPAP) and conditions in the TCEQ authorization letter. Maintain copies of WPAP and letter on-site. Ground disturbing activities may not commence until the TCEQ has approved the WPAP. Comply with SAWS TCEQ-approved SCS Plan and conditions in the TCEQ authorization letter. Maintain copies of SCS Plan and letter on-site. TxDOT will not permit storage of any quantity of hazardous materials, such as a one- quart container of oil, in state ROW in the CZ, RZ, or TZ during construction. TxDOT*s expectation of the contractor is that no containers of non-potable liquids other than non-potable clean water, would be left outside the confines of a vehicle unattended.
LOOP-012 TCEQ Sensitive Features	Upstream Easement - Lorence Creek Tributary WPAP Site Plan Sheet 3 OF 23		Feature is upstream of soil disturbance.
LOOP-205 TCEQ Sensitive Features	Downstream Easement - Lorence Creek Tributary WPAP Site Plan Sheet 3 OF 23		Maintain temporary erosion control in ROW upstream of feature. Feature to be protected and preserved.
LOOP-009 TCEQ Sensitive Features	Between WBML and WBFR West of Gold Canyon Dr. WPAP Site Plan Sheet 12 OF 23		Protect feature until it is removed.
S-7-C NORTH TCEQ Sensitive Features Engineered drain to an underground cave designed by ARMA. The only surface expression of the feature is a grate inlet with a 3 in. diameter PVC pipe inlet below the grate. Refer to karst closure feature closure sheet 982 for an illustration of the feature relative to the previously closed cave.	Between WBML and existing exit ramp located just West of Gold Canyon Dr. WPAP Site Plan Sheet 12 OF 23	Limited	Contractor is to protect and preserve this drain inlet feature.
1604-F101 TCEQ Sensitive Features	In ROW Along EBFR West of Gold Canyon Dr. WPAP Site Plan Sheet 12 OF 23		Feature was previously sealed with TCEQ approval. Excavation may reopen it; and if so, it would be resealed. Refer to karst closure detail sheet.
Ordinary high-water marks (OHWM). Stream boundaries where US Army Corps of Engineers may have jurisdiction	Various locations in ROW and easements See Environmental Features sheets	Limited	Access permitted if NWP 14 terms and conditions satisfied without requiring preconstruction notification. Minimize placement of dredge and fill including drill shaft cuttings in OHWM.
TxDOT channel and drainage easements	Various	None	Numerous issues in easements. Consult with TxDOT Environmental Specialist for any easement access. TxDOT must survey for Seymeria texana in easements to confirm presence or absence prior to disturbance.
US 281 Underpass Widening at LP 1604 WBML	15-015-0-0253-04-105	Unrestricted	(430 ppm lead paint)
US 281 Underpass Widening at LP 1604 EBML	15-015-0-0253-04-251	Unrestricted	(1030 ppm lead paint)

3/10/2023

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ENVIRONMENTAL PERMITS, ISSUES AND COMMITMENTS

EPIC

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REVISIONS	2452	02	130, ETC	LP1604
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LEGEND

- OUTFALL AREA
- BMP DRAINAGE AREA
- VEGETATIVE FILTER STRIP (VFS) AREA
- VEGETATIVE FILTER STRIP
- EXISTING VFS
- FLOW DIRECTION
- XX-XX BMP AREA ID
- SENSITIVE FEATURE
- DITCH FLOWLINE
- SURFACE WATERS

NOTES:

1. FOR DRAINAGE PATTERNS AND APPROXIMATE SLOPES, SEE DRAINAGE AREA MAPS.
2. FOR AREAS OF SOIL DISTURBANCE AND LOCATIONS OF STABILIZATION SEE SW3P LOCATED UNDER THE CONSTRUCTION PLANS (ATTACHMENT G).
3. ANY INCIDENTAL WORK OUTSIDE OF WPAP PROJECT AREA IS LIMITED TO MODIFICATIONS OF ROADWAY SIGNAGE.

STATE OF TEXAS
ZACHARY B. RYAN
106276
LICENSED
PROFESSIONAL ENGINEER

2/9/2023

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SCALE: 1"=100'

REV. NO.	DATE	DESCRIPTION	BY

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FRN - F-1386

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LP 1604
WPAP
SITE PLAN
BEGIN TO 4405+00

SHEET 1 OF 23

FED. RD. DIV. NO.	STATE	PROJECT NO.			HIGHWAY NO.
6	TEXAS	SEE TITLE SHEET			LP1604
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
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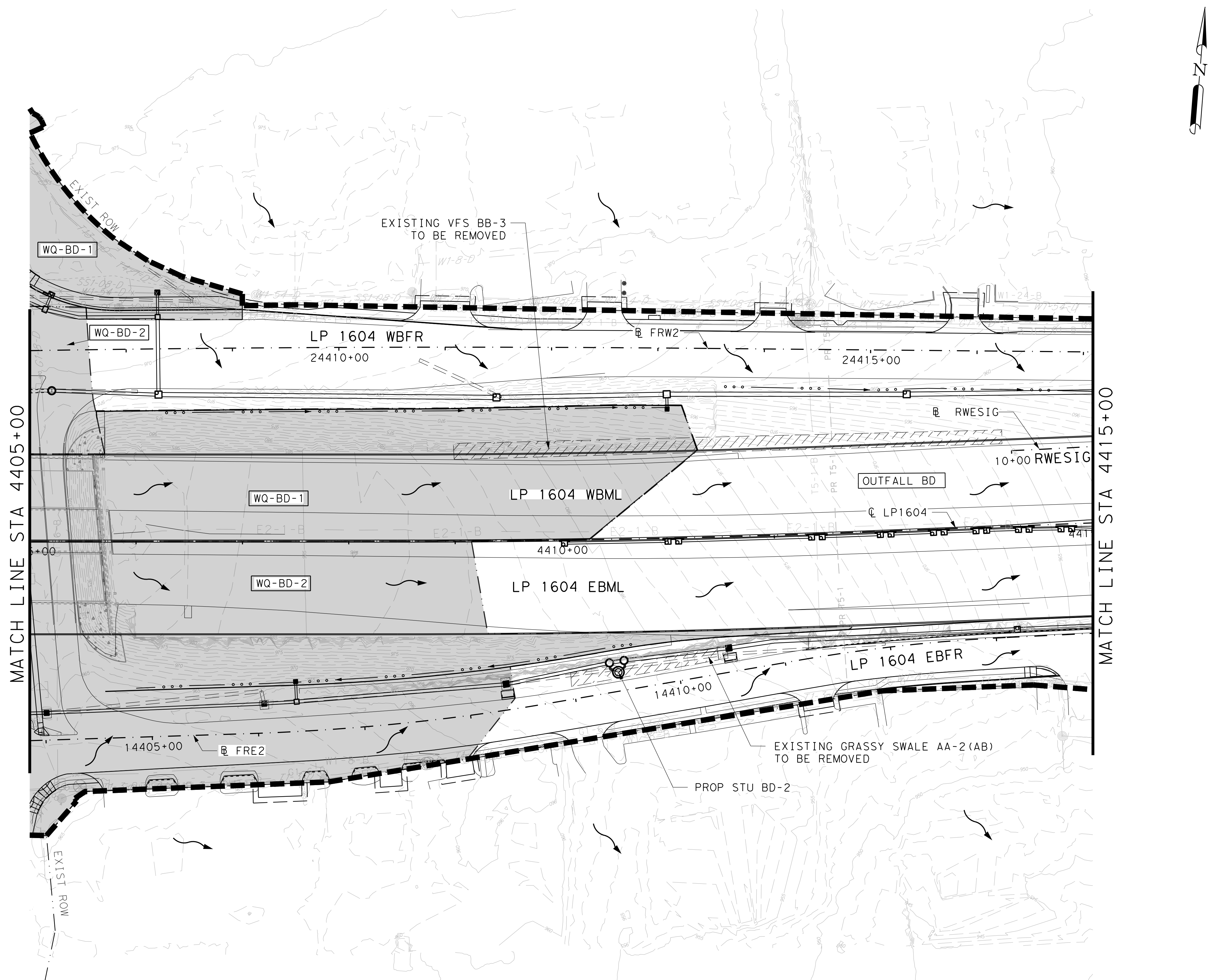

LEGEND

- OUTFALL AREA
- BMP DRAINAGE AREA
- VEGETATIVE FILTER STRIP (VFS) AREA
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STATE OF TEXAS
ZACHARY B. RYAN
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PROFESSIONAL ENGINEER

2/9/2023

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SCALE: 1"=100'

REV. NO.	DATE	DESCRIPTION	BY

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LP 1604
WPAP
SITE PLAN
4405+00 TO 4415+00

SHEET 2 OF 23

FED. RD. DIV. NO.	STATE	PROJECT NO.		HIGHWAY NO.
6	TEXAS	SEE TITLE SHEET		LP1604
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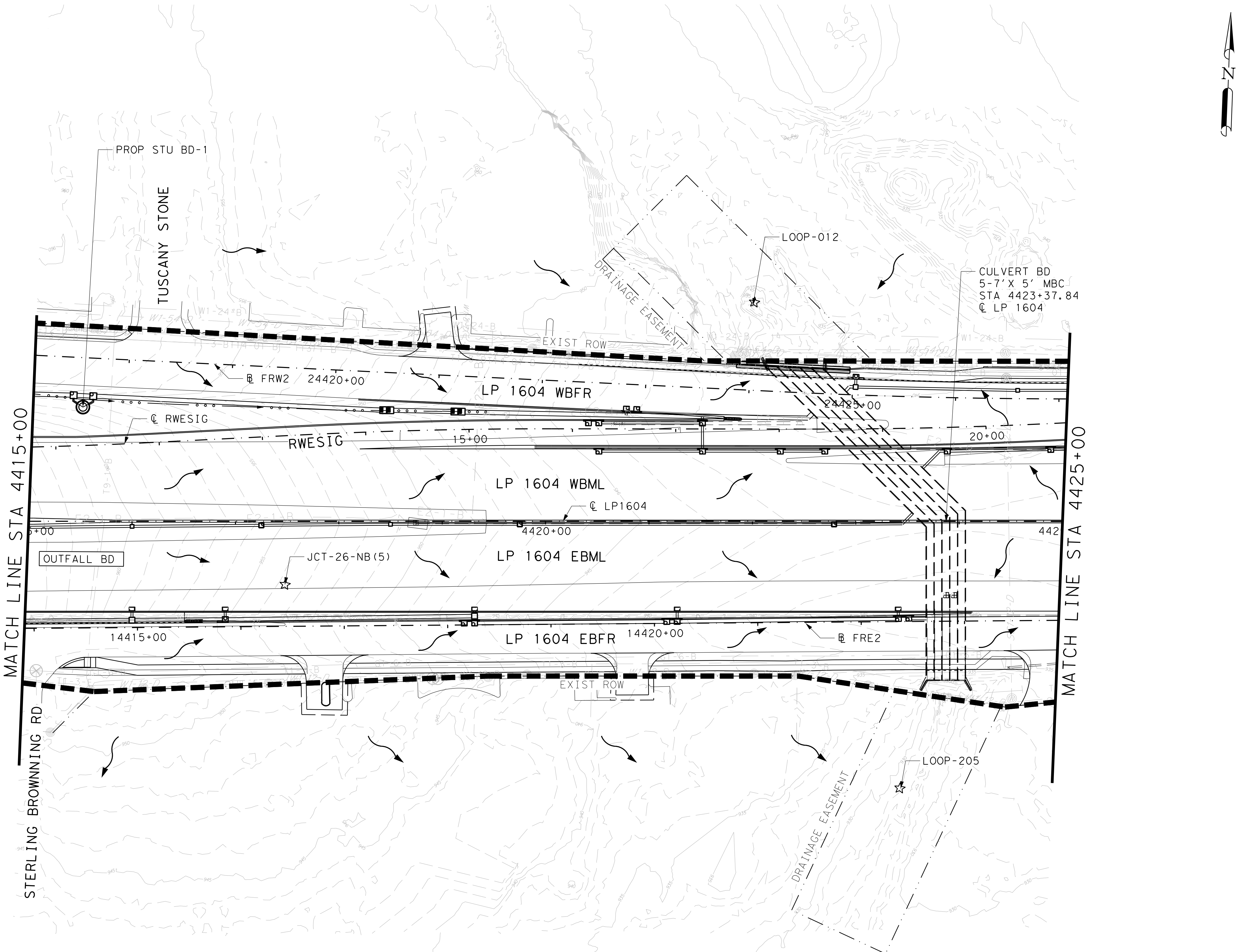

LEGEND

- OUTFALL AREA
- BMP DRAINAGE AREA
- VEGETATIVE FILTER STRIP (VFS) AREA
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2. FOR AREAS OF SOIL DISTURBANCE AND LOCATIONS OF STABILIZATION SEE SW3P LOCATED UNDER THE CONSTRUCTION PLANS (ATTACHMENT G).
3. ANY INCIDENTAL WORK OUTSIDE OF WPAP PROJECT AREA IS LIMITED TO MODIFICATIONS OF ROADWAY SIGNAGE.

STATE OF TEXAS
ZACHARY B. RYAN
106276
LICENSED
PROFESSIONAL ENGINEER

2/9/2023

0' 25' 50' 100'
SCALE: 1"=100'

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SITE PLAN
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SHEET 3 OF 23

FED. RD. DIV. NO.	STATE	PROJECT NO.			HIGHWAY NO.
6	TEXAS	SEE TITLE SHEET			LP1604
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	2452	02	130	2655

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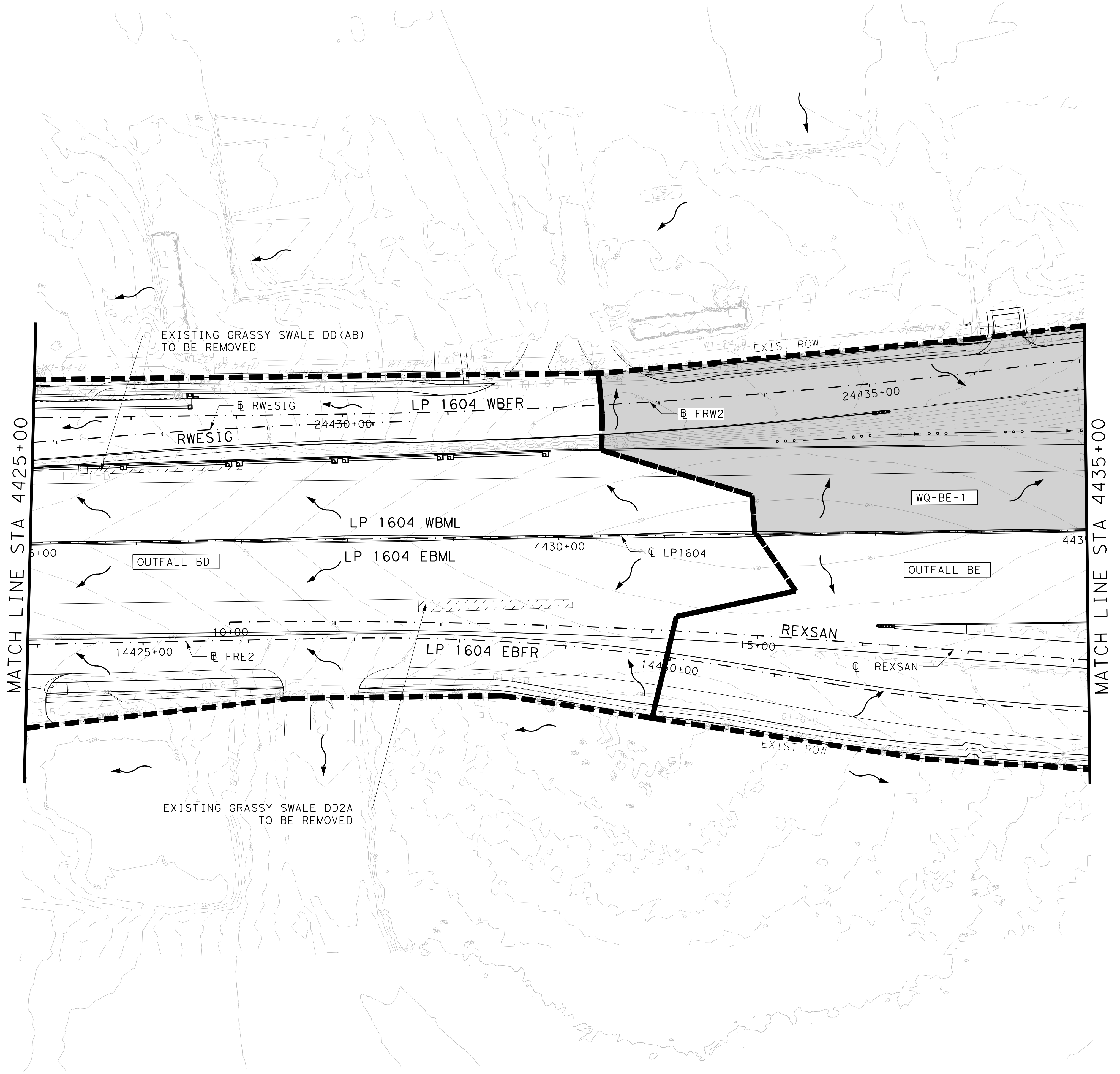

LEGEND

- OUTFALL AREA
- BMP DRAINAGE AREA
- VEGETATIVE FILTER STRIP (VFS) AREA
- VEGETATIVE FILTER STRIP
- EXISTING VFS
- FLOW DIRECTION
- XX-XX BMP AREA ID
- ☆ SENSITIVE FEATURE
- DITCH FLOWLINE
- SURFACE WATERS

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SHEET 4 OF 23

FED. RD. DIV. NO.	STATE	PROJECT NO.			HIGHWAY NO.
6	TEXAS	SEE TITLE SHEET			LP1604
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	2452	02	130	2656

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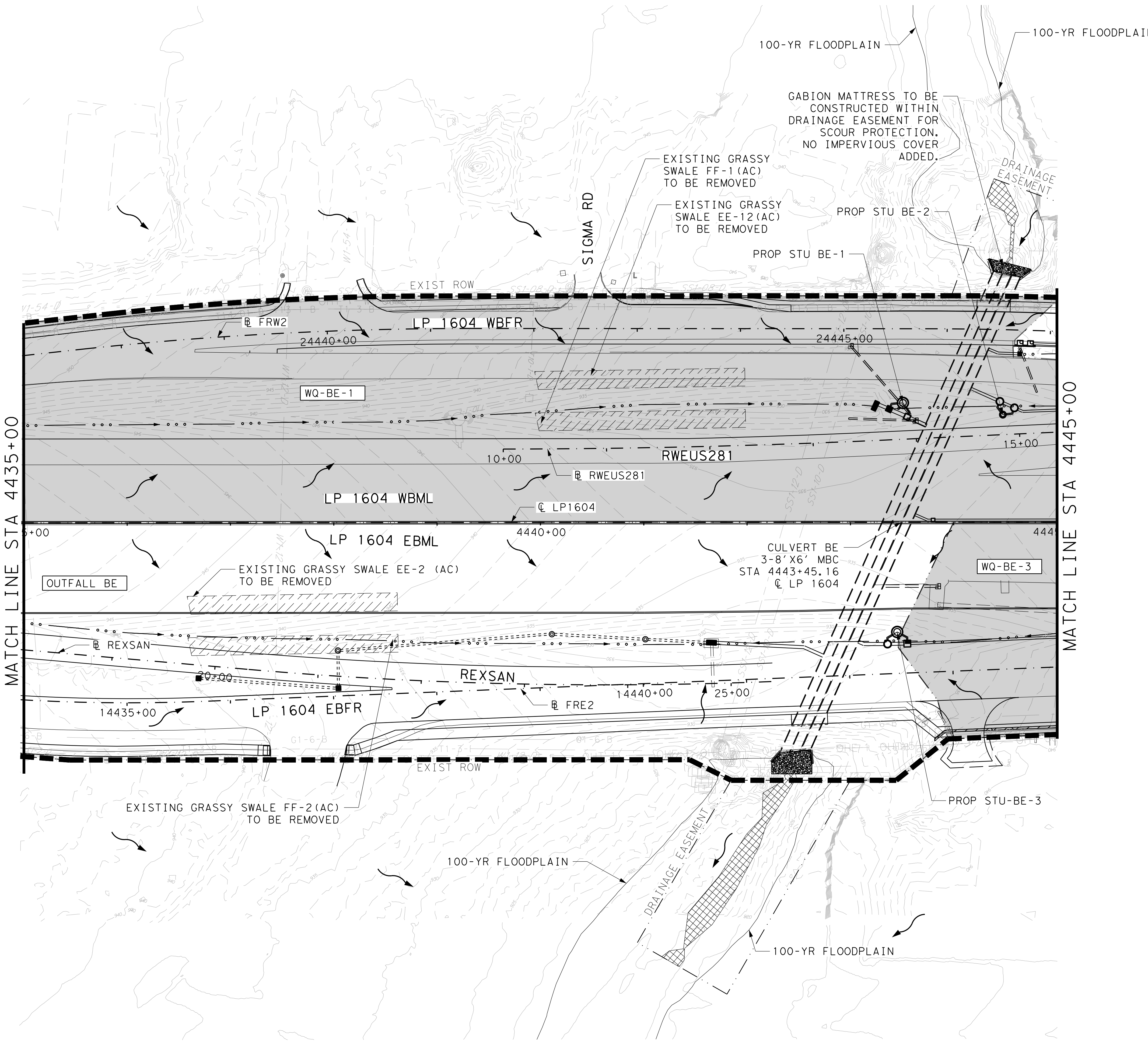

LEGEND

- OUTFALL AREA
- BMP DRAINAGE AREA
- VEGETATIVE FILTER STRIP (VFS) AREA
- VEGETATIVE FILTER STRIP
- EXISTING VFS
- FLOW DIRECTION
- XX-XX BMP AREA ID
- SENSITIVE FEATURE
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SHEET 5 OF 23

FED. RD. DIV. NO.	STATE	PROJECT NO.			HIGHWAY NO.
6	TEXAS	SEE TITLE SHEET			LP1604
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	2452	02	130	2657

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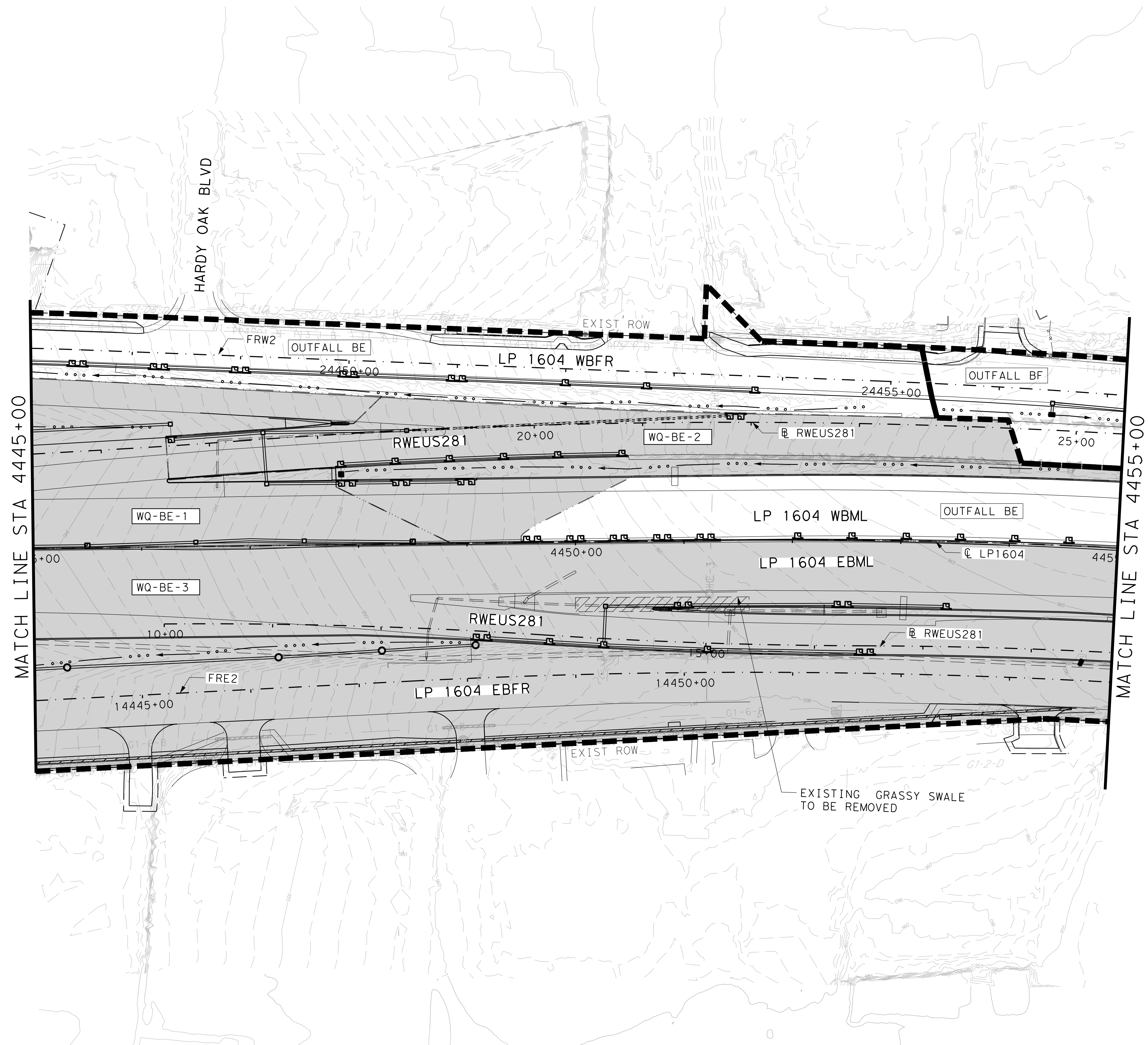

LEGEND

- OUTFALL AREA
- BMP DRAINAGE AREA
- VEGETATIVE FILTER STRIP (VFS) AREA
- VEGETATIVE FILTER STRIP
- EXISTING VFS
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SHEET 6 OF 23

FED. RD. DIV. NO.	STATE	PROJECT NO.			HIGHWAY NO.
6	TEXAS	SEE TITLE SHEET			LP1604
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	2452	02	130	2658

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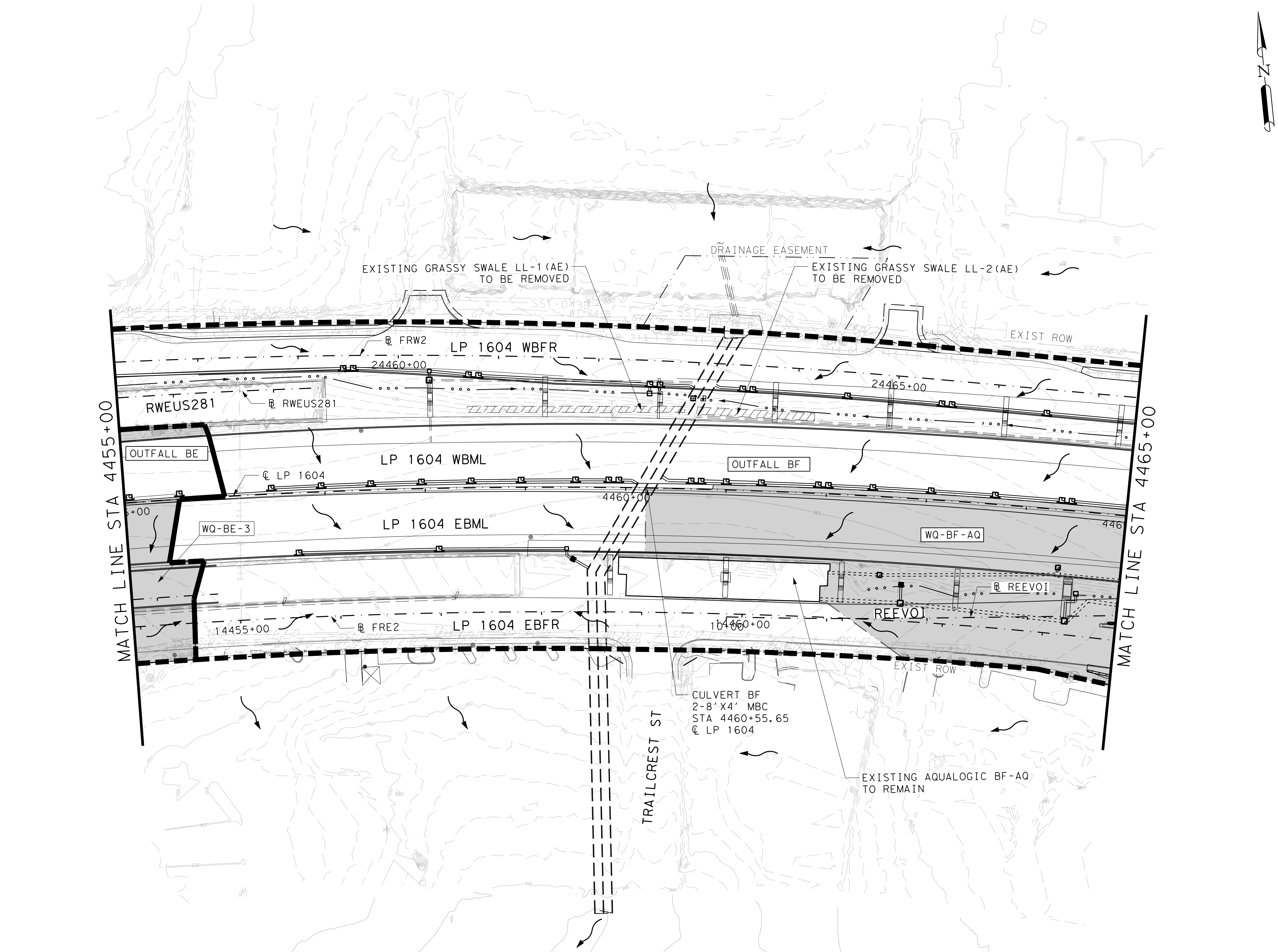

LEGEND

- OUTFALL AREA
- BMP DRAINAGE AREA
- VEGETATIVE FILTER STRIP (VFS) AREA
- VEGETATIVE FILTER STRIP
- EXISTING VFS
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SHEET 7 OF 23

FED. RD. DIV. NO.	STATE	PROJECT NO.			HIGHWAY NO.
6	TEXAS	SEE TITLE SHEET			LP1604
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	2452	02	130	2659

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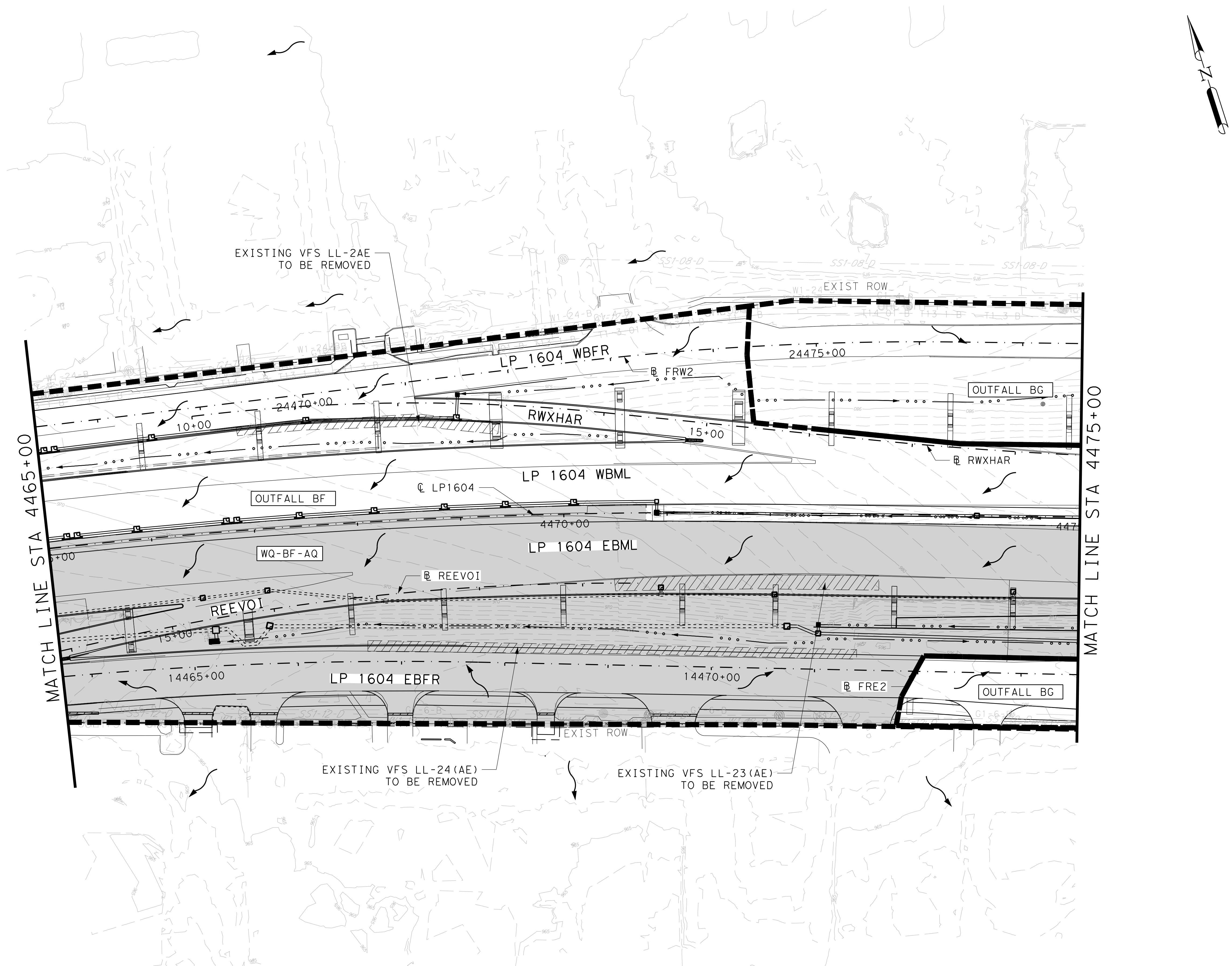

NOTE: DIRECT CONNECTOR COLUMNS SHOWN BUT DECK AND RAIL ARE NOT SHOWN FOR CLARITY.

LEGEND

- OUTFALL AREA
- BMP DRAINAGE AREA
- VEGETATIVE FILTER STRIP (VFS) AREA
- VEGETATIVE FILTER STRIP
- EXISTING VFS
- FLOW DIRECTION
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SHEET 8 OF 23

FED. RD. DIV. NO.	STATE	PROJECT NO.			HIGHWAY NO.
6	TEXAS	SEE TITLE SHEET			LP1604
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	2452	02	130	2660

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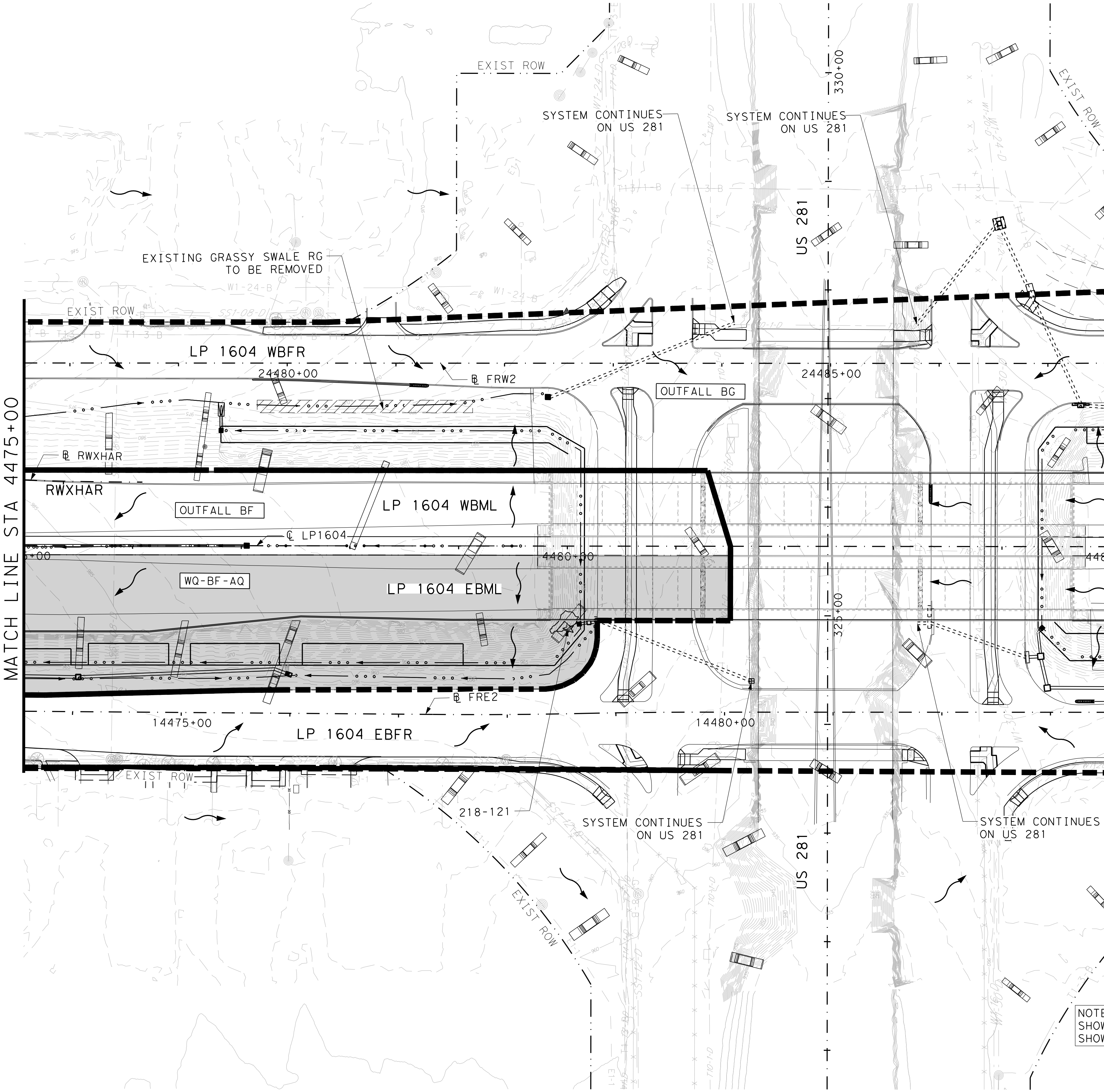

NOTE: DIRECT CONNECTOR COLUMNS SHOWN BUT DECK AND RAIL ARE NOT SHOWN FOR CLARITY.

LEGEND

- OUTFALL AREA
- BMP DRAINAGE AREA
- VEGETATIVE FILTER STRIP (VFS) AREA
- VEGETATIVE FILTER STRIP
- EXISTING VFS
- FLOW DIRECTION
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SHEET 9 OF 23

FED. RD. DIV. NO.	STATE	PROJECT NO.			HIGHWAY NO.
6	TEXAS	SEE TITLE SHEET			LP1604
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	2452	02	130	2661

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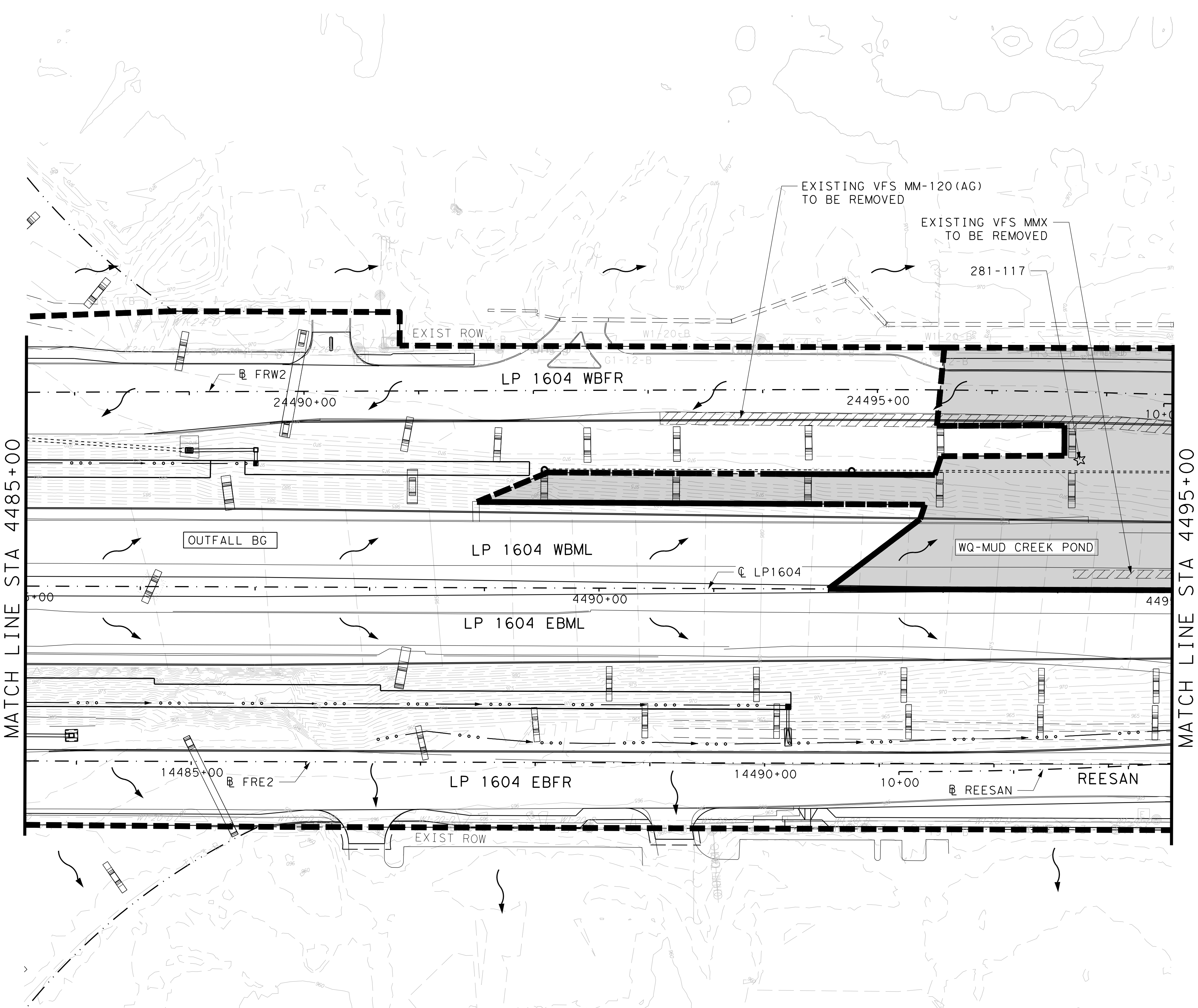

NOTE: DIRECT CONNECTOR COLUMNS SHOWN BUT DECK AND RAIL ARE NOT SHOWN FOR CLARITY.

LEGEND

- OUTFALL AREA
- BMP DRAINAGE AREA
- VEGETATIVE FILTER STRIP (VFS) AREA
- VEGETATIVE FILTER STRIP
- EXISTING VFS
- FLOW DIRECTION
- XX-XX BMP AREA ID
- SENSITIVE FEATURE
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SHEET 10 OF 23

FED. RD. DIV. NO.	STATE	PROJECT NO.			HIGHWAY NO.
6	TEXAS	SEE TITLE SHEET			LP1604
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	2452	02	130	2662

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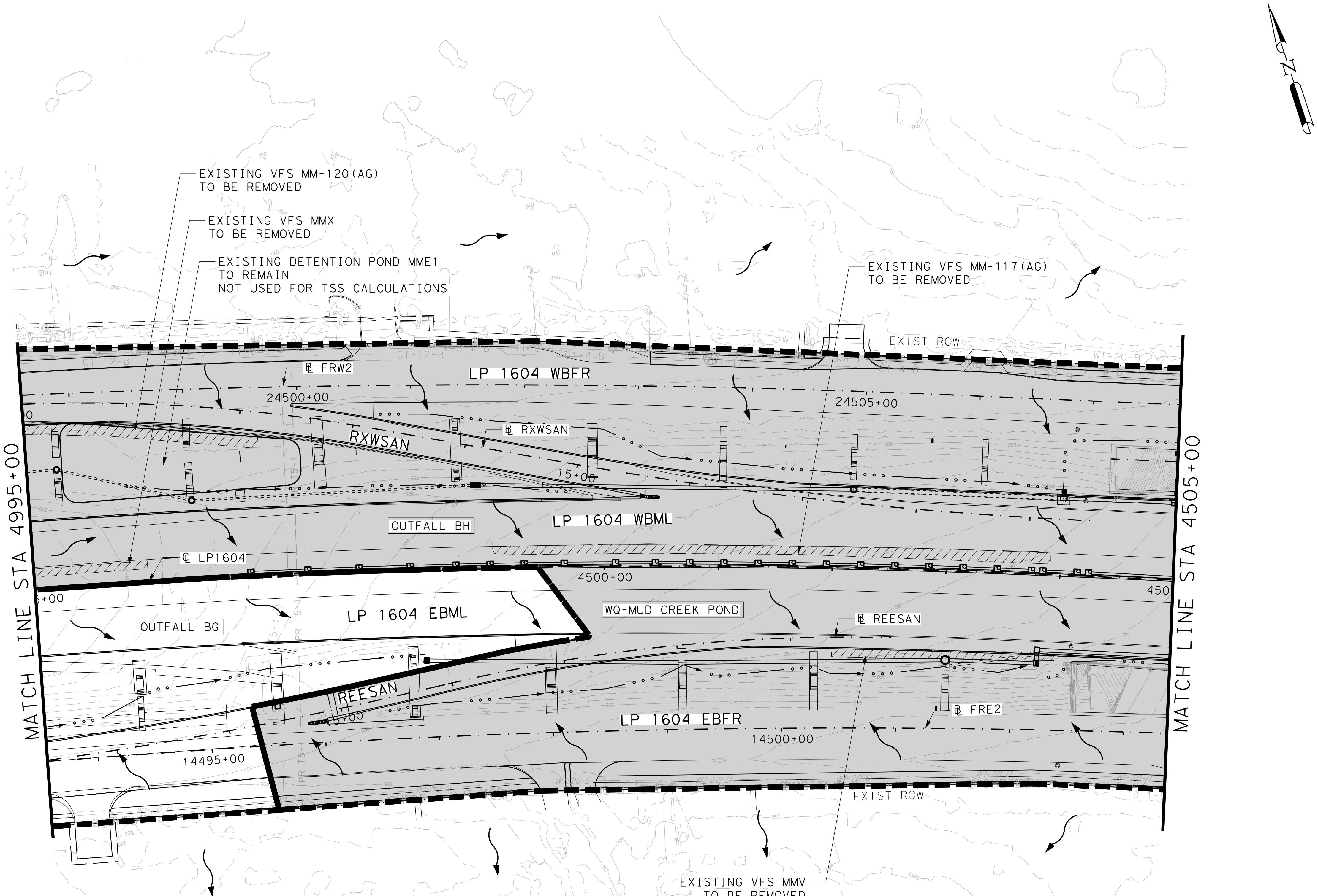

LEGEND

- OUTFALL AREA
- BMP DRAINAGE AREA
- VEGETATIVE FILTER STRIP (VFS) AREA
- VEGETATIVE FILTER STRIP
- EXISTING VFS
- FLOW DIRECTION
- XX-XX BMP AREA ID
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SHEET 11 OF 23

FED. RD. DIV. NO.	STATE	PROJECT NO.			HIGHWAY NO.
6	TEXAS	SEE TITLE SHEET			LP1604
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	2452	02	130	2663

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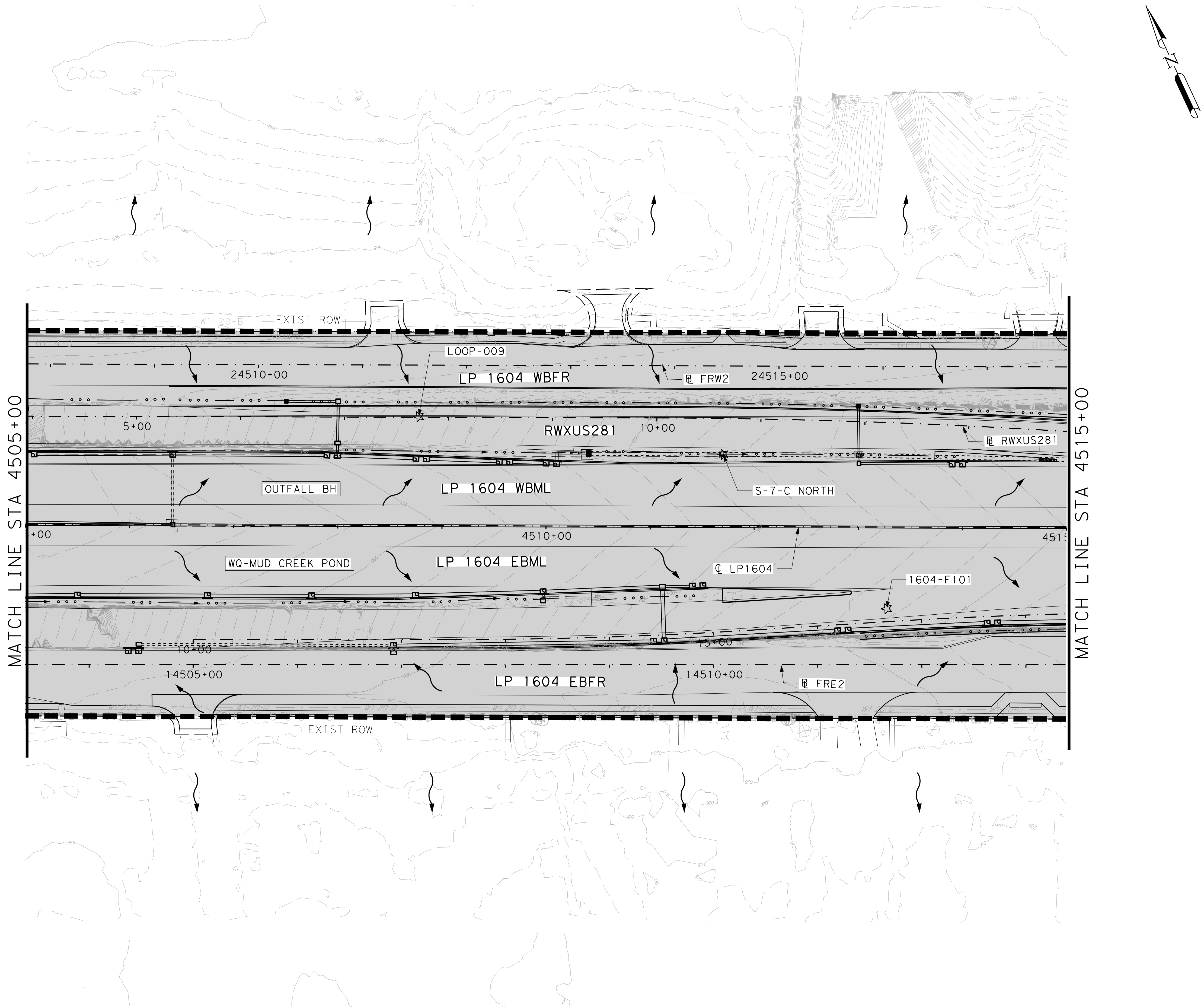

LEGEND

- OUTFALL AREA
- BMP DRAINAGE AREA
- VEGETATIVE FILTER STRIP (VFS) AREA
- VEGETATIVE FILTER STRIP
- EXISTING VFS
- FLOW DIRECTION
- XX-XX BMP AREA ID
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SHEET 12 OF 23

FED. RD. DIV. NO.	STATE	PROJECT NO.		HIGHWAY NO.
6	TEXAS	SEE TITLE SHEET		LP1604
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	2452	02	130	2664

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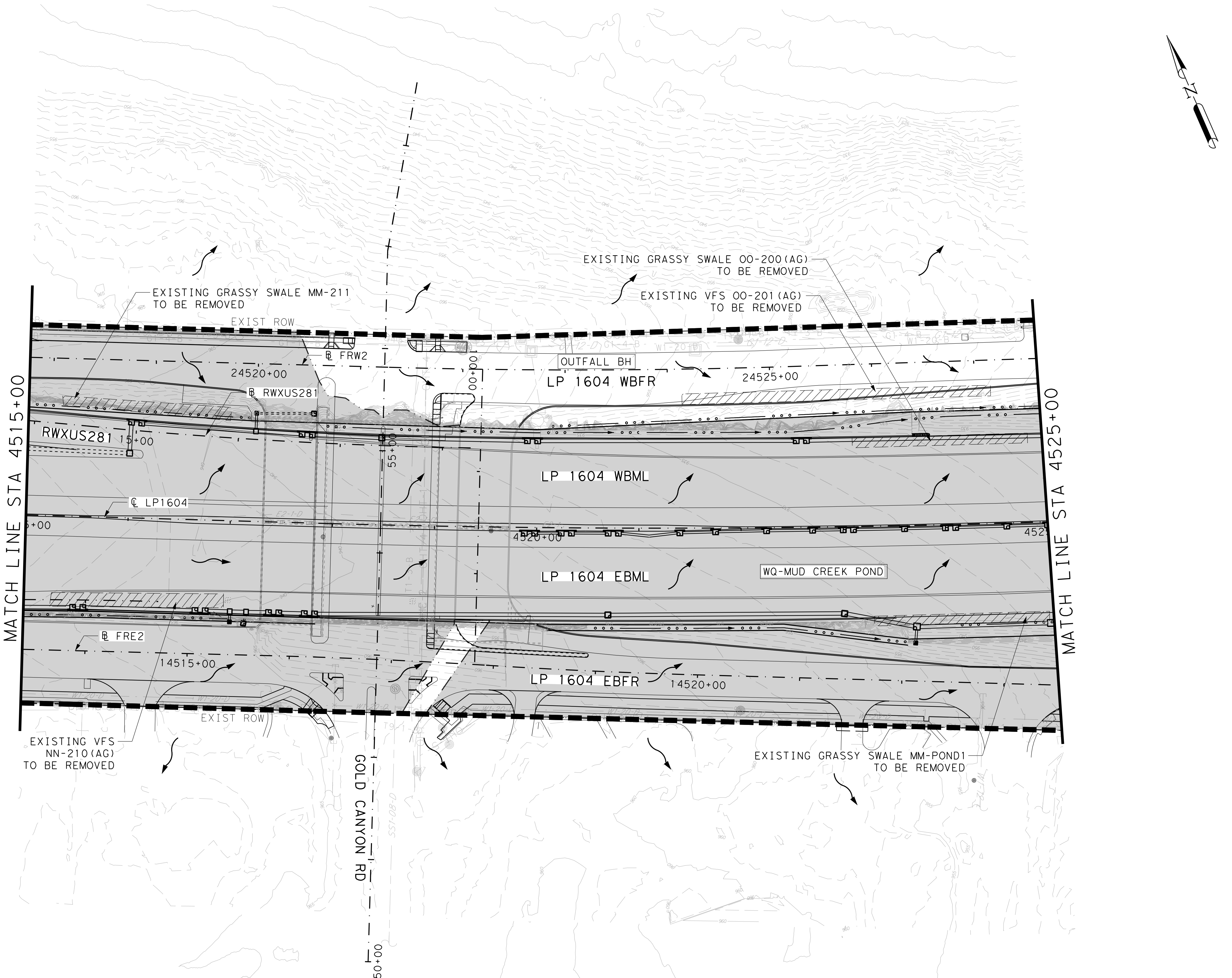

LEGEND

	OUTFALL AREA
	BMP DRAINAGE AREA
	VEGETATIVE FILTER STRIP (VFS) AREA
	VEGETATIVE FILTER STRIP
	EXISTING VFS
	FLOW DIRECTION
XX-XX	BMP AREA ID
☆	SENSITIVE FEATURE
	DITCH FLOWLINE
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SHEET 13 OF 23

FED. RD. DIV. NO.	STATE	PROJECT NO.		HIGHWAY NO.
6	TEXAS	SEE TITLE SHEET		LP1604
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	2452	02	130	2665

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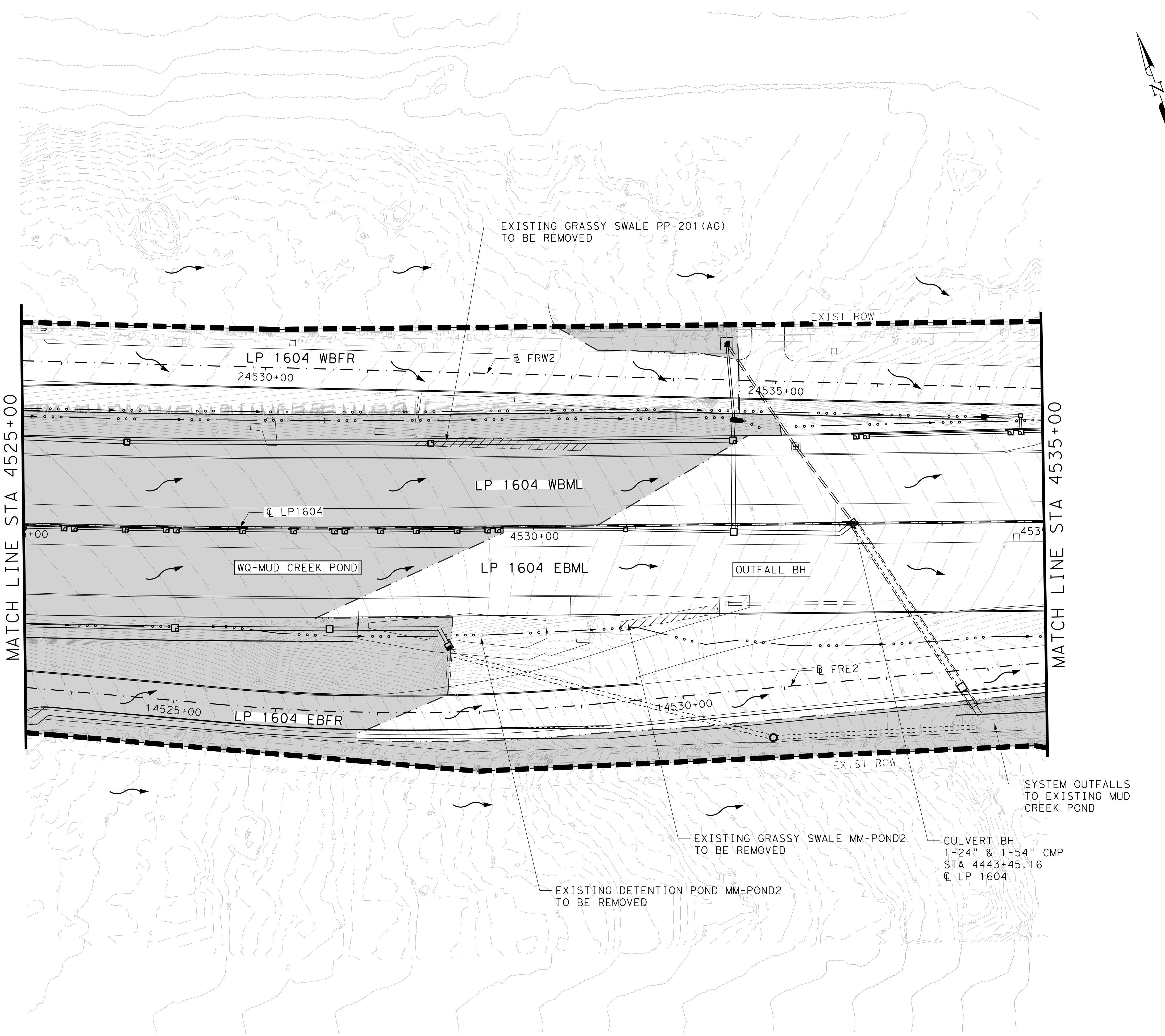

LEGEND

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- BMP DRAINAGE AREA
- VEGETATIVE FILTER STRIP (VFS) AREA
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SHEET 14 OF 23

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6	TEXAS	SEE TITLE SHEET		LP1604
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	2452	02	130	2666

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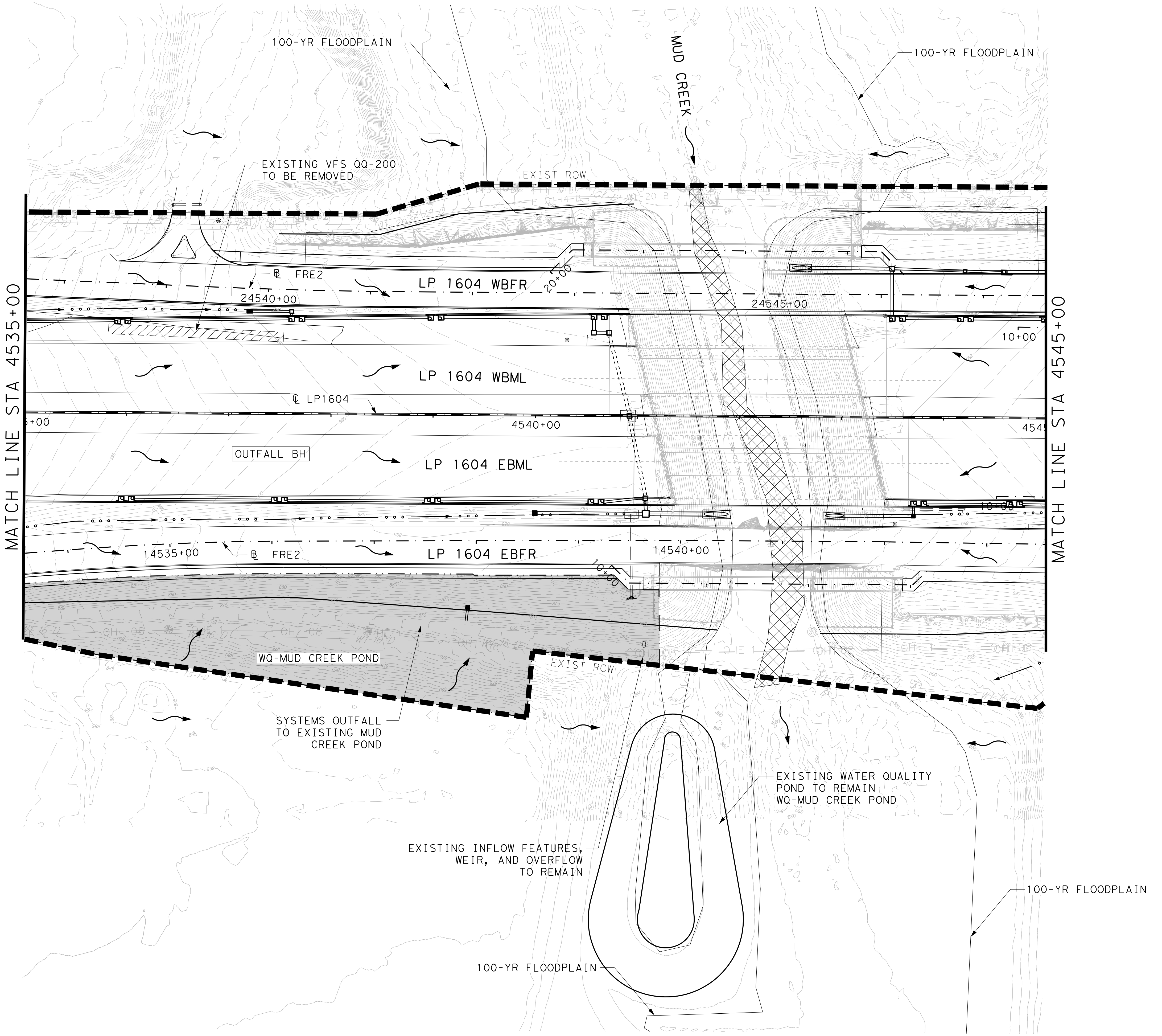

LEGEND

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SHEET 15 OF 23

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6	TEXAS	SEE TITLE SHEET		LP1604
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	2452	02	130	2667

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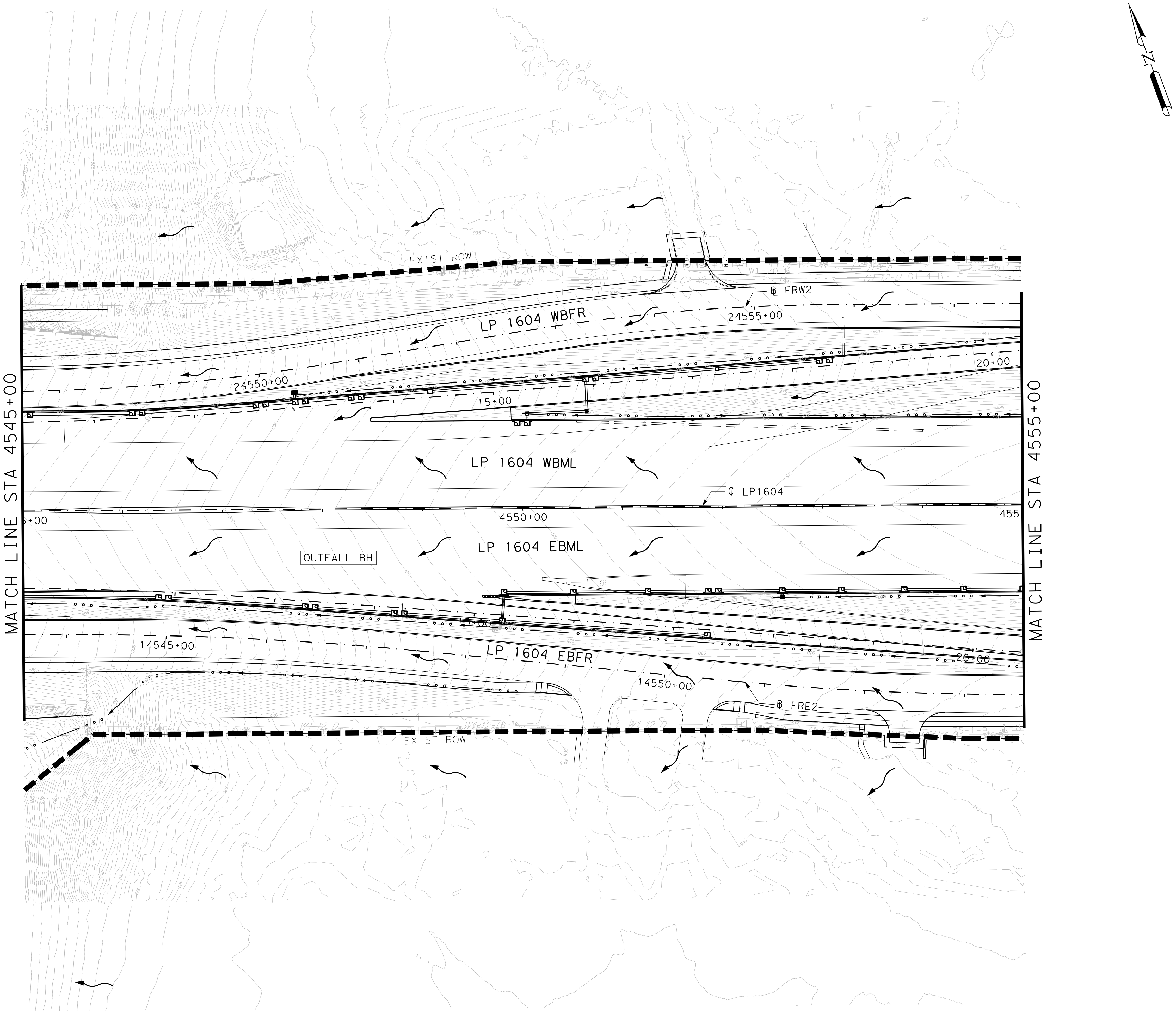

LEGEND

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SCALE: 1"=100'

REV. NO.	DATE	DESCRIPTION	BY

LJA Engineering, Inc.
FRN - F-1386

Texas Department of Transportation
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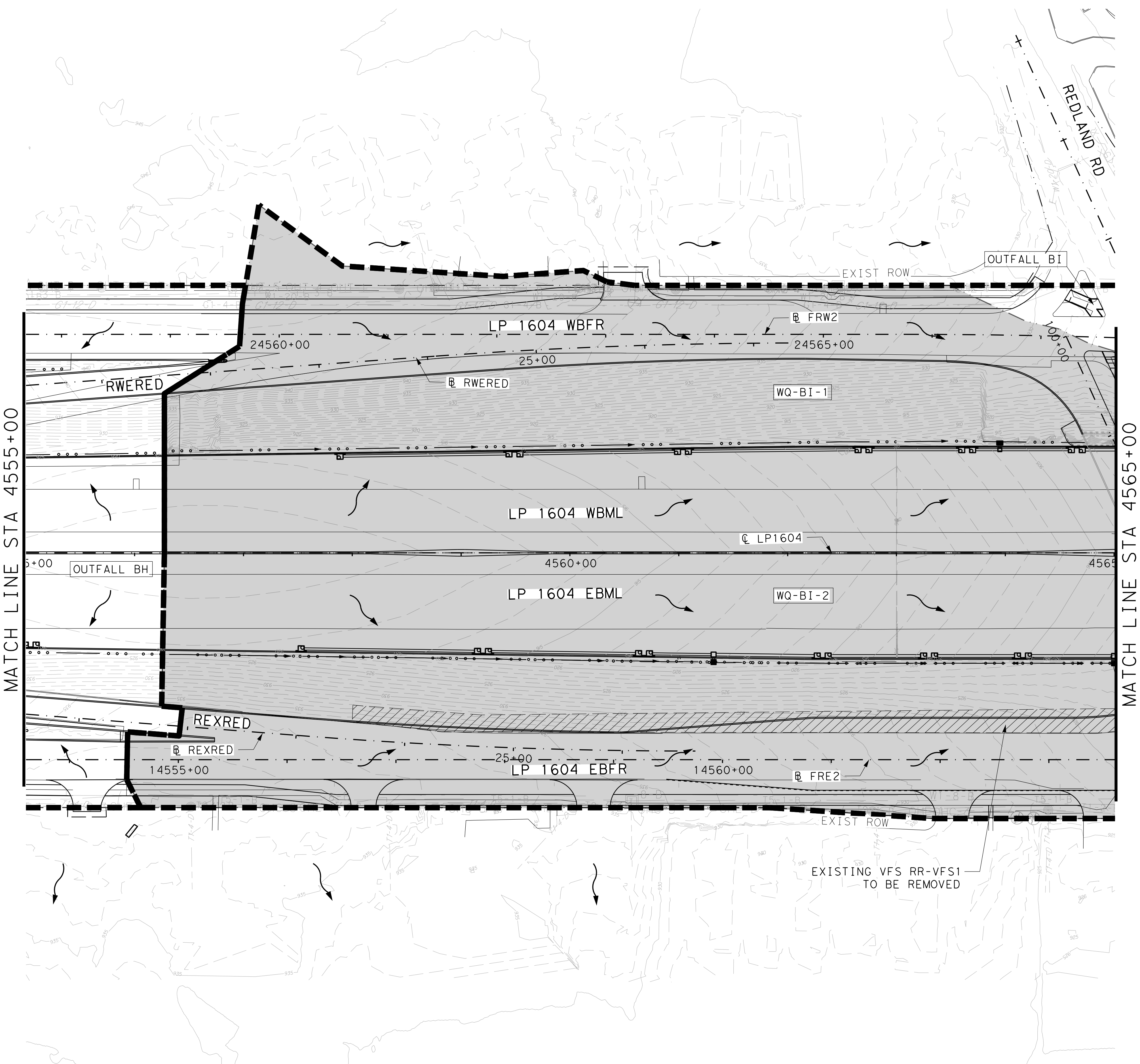
LP 1604
WPAP
SITE PLAN
4545+00 TO 4555+00

FED. RD. DIV. NO.	STATE	PROJECT NO.		HIGHWAY NO.
6	TEXAS	SEE TITLE SHEET		LP1604
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	2452	02	130	2668



LEGEND

- OUTFALL AREA
- BMP DRAINAGE AREA
- VEGETATIVE FILTER STRIP (VFS) AREA
- VEGETATIVE FILTER STRIP
- EXISTING VFS
- FLOW DIRECTION
- XX-XX BMP AREA ID
- ☆ SENSITIVE FEATURE
- DITCH FLOWLINE
- SURFACE WATERS

NOTES:

1. FOR DRAINAGE PATTERNS AND APPROXIMATE SLOPES, SEE DRAINAGE AREA MAPS.
2. FOR AREAS OF SOIL DISTURBANCE AND LOCATIONS OF STABILIZATION SEE SW3P LOCATED UNDER THE CONSTRUCTION PLANS (ATTACHMENT G).
3. ANY INCIDENTAL WORK OUTSIDE OF WPAP PROJECT AREA IS LIMITED TO MODIFICATIONS OF ROADWAY SIGNAGE.

STATE OF TEXAS
ZACHARY B. RYAN
106276
LICENSED
PROFESSIONAL ENGINEER

2/9/2023

0' 25' 50' 100'
SCALE: 1"=100'

REV. NO.	DATE	DESCRIPTION	BY

LJA Engineering, Inc.
FRN - F-1386

Texas Department of Transportation
©2023

LP 1604
WPAP
SITE PLAN
4555+00 TO 4565+00

SHEET 17 OF 23

FED. RD. DIV. NO.	STATE	PROJECT NO.			HIGHWAY NO.
6	TEXAS	SEE TITLE SHEET			LP1604
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	2452	02	130	2669

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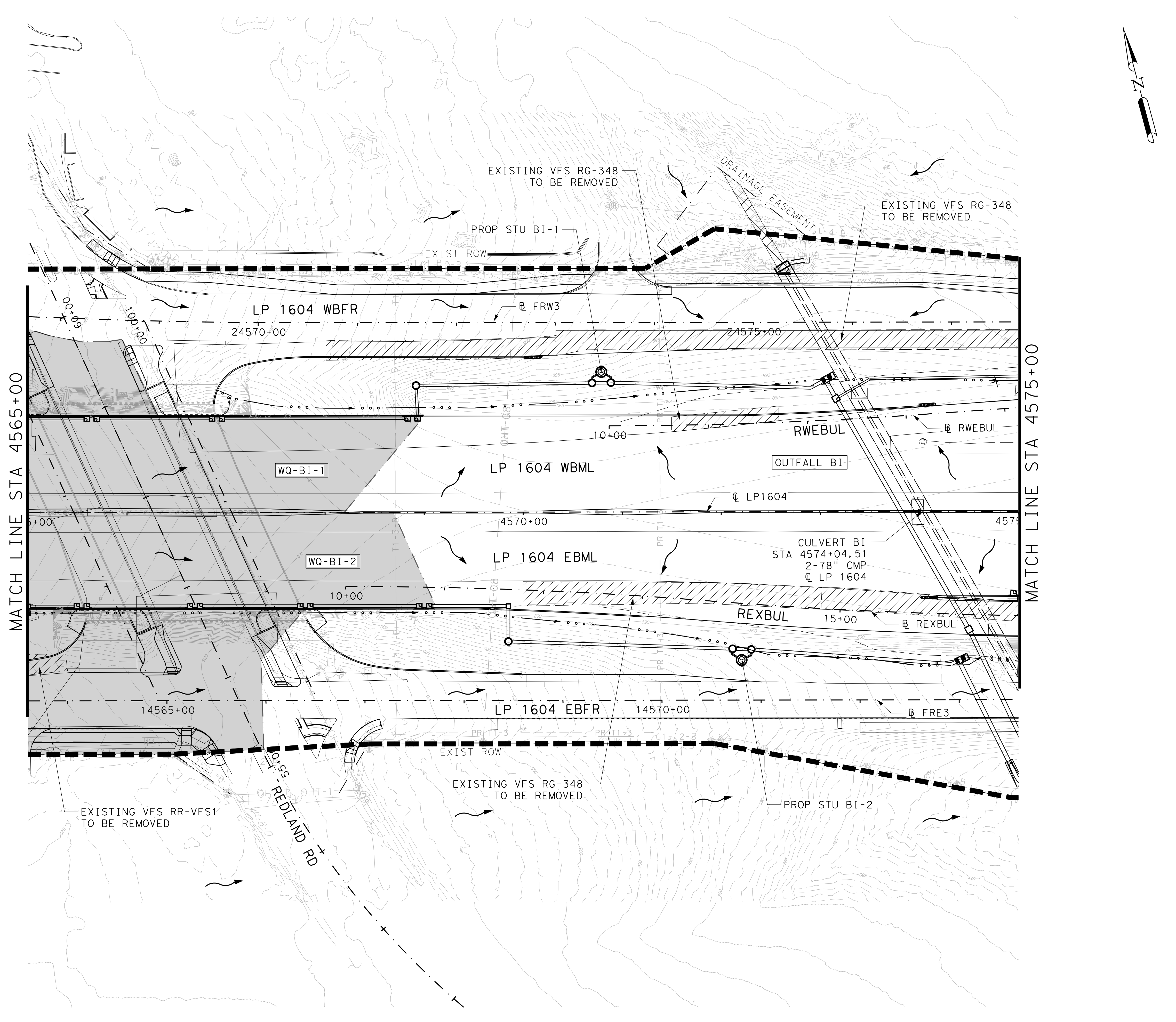

LEGEND

- OUTFALL AREA
- BMP DRAINAGE AREA
- VEGETATIVE FILTER STRIP (VFS) AREA
- VEGETATIVE FILTER STRIP
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STATE OF TEXAS
ZACHARY B. RYAN
106276
LICENSED
PROFESSIONAL ENGINEER

2/9/2023

0' 25' 50' 100'
SCALE: 1"=100'

REV. NO.	DATE	DESCRIPTION	BY

LJA Engineering, Inc.
FRN - F-1386

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©2023

LP 1604
WPAP
SITE PLAN
4565+00 TO 4575+00

SHEET 18 OF 23

FED. RD. DIV. NO.	STATE	PROJECT NO.			HIGHWAY NO.
6	TEXAS	SEE TITLE SHEET			LP1604
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	2452	02	130	2670

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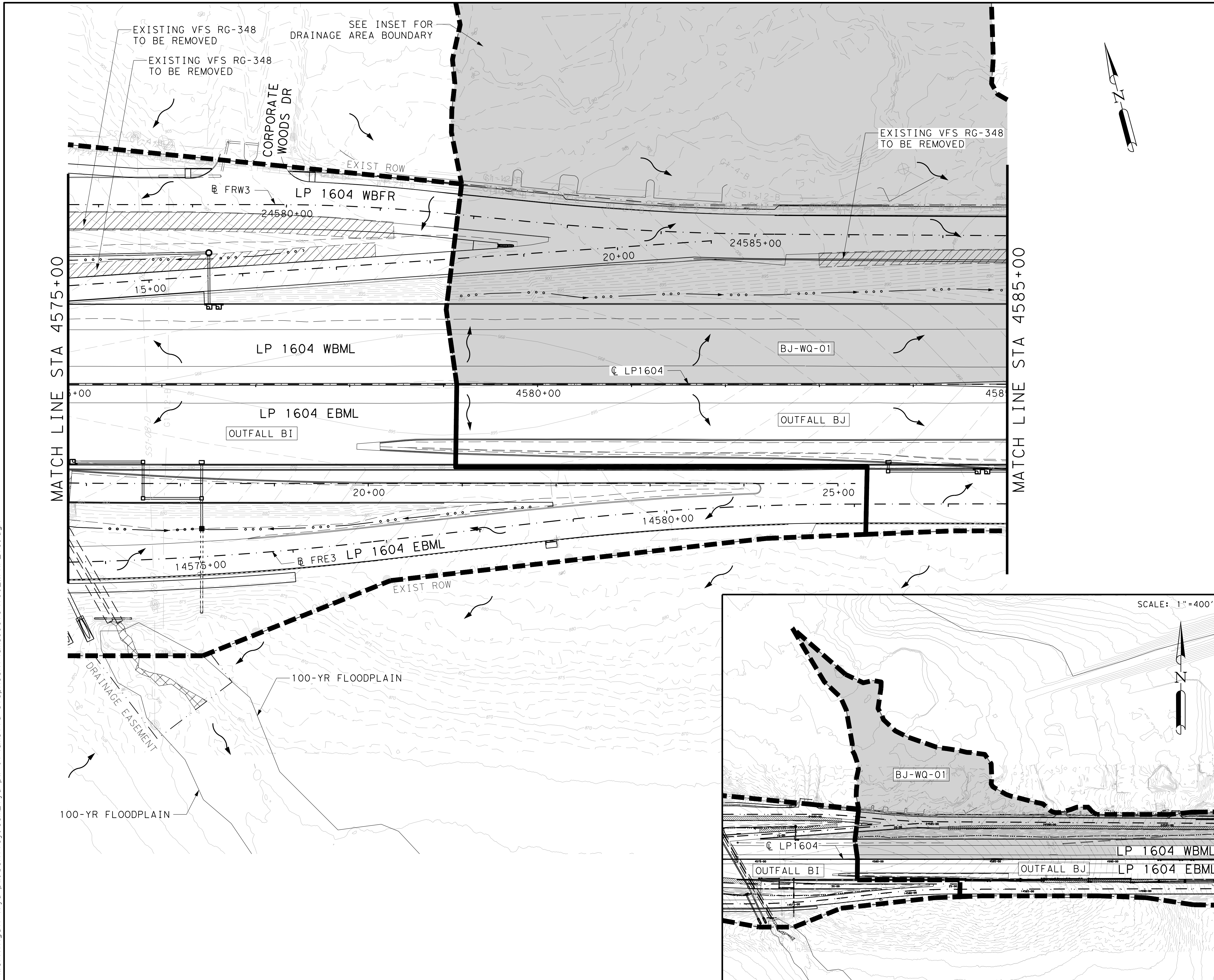

LEGEND

- OUTFALL AREA
- BMP DRAINAGE AREA
- VEGETATIVE FILTER STRIP (VFS) AREA
- VEGETATIVE FILTER STRIP
- EXISTING VFS
- FLOW DIRECTION
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STATE OF TEXAS
ZACHARY B. RYAN
106276
LICENSED
PROFESSIONAL ENGINEER

2/9/2023

0' 25' 50' 100'
SCALE: 1"=100'

REV. NO.	DATE	DESCRIPTION	BY

LJA Engineering, Inc.
FRN - F-1386

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LP 1604
WPAP
SITE PLAN
4575+00 TO 4585+00

SHEET 19 OF 23

FED. RD. DIV. NO.	STATE	PROJECT NO.		HIGHWAY NO.
6	TEXAS	SEE TITLE SHEET		LP1604
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	2452	02	130	2671

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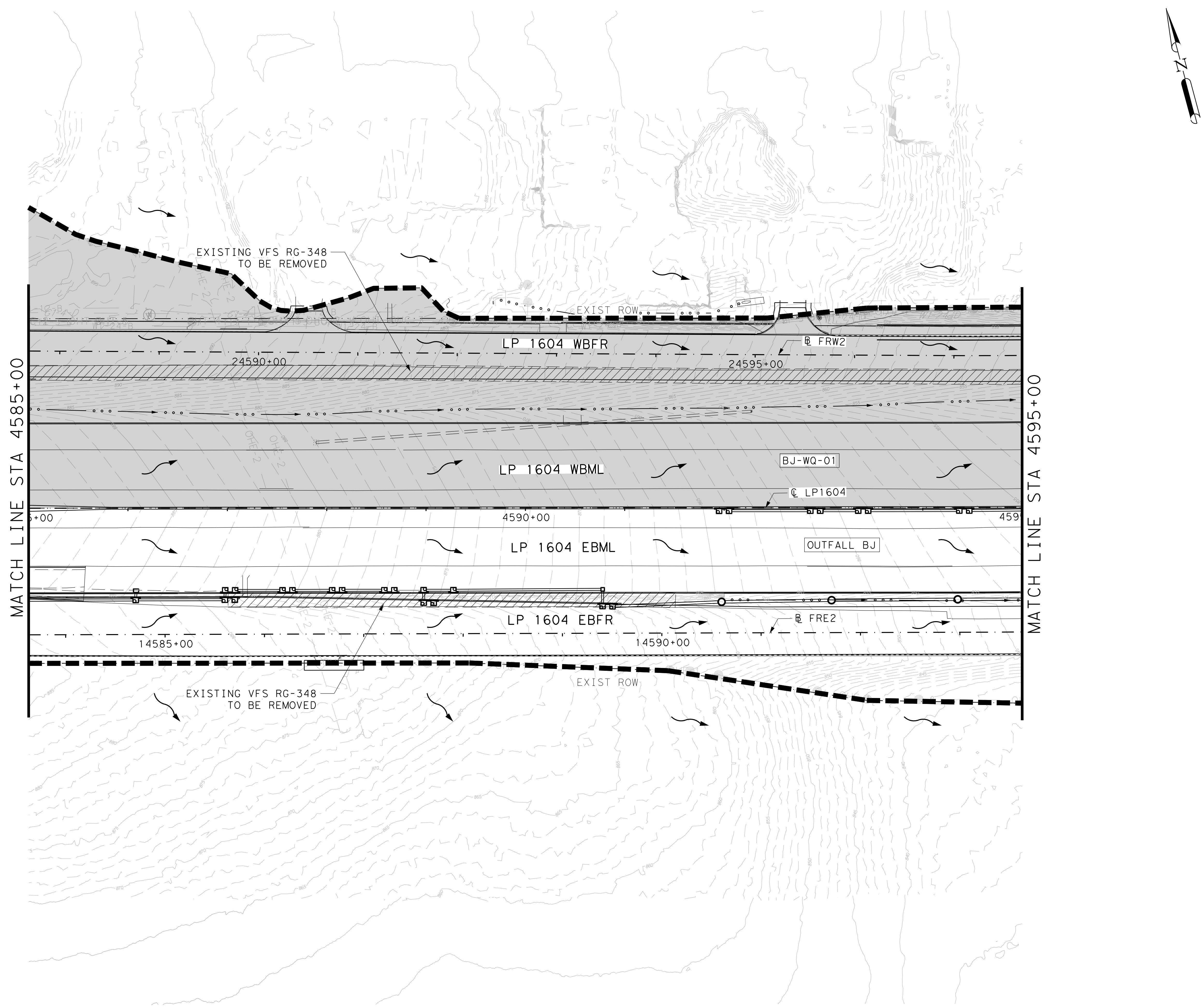

LEGEND

- OUTFALL AREA
- BMP DRAINAGE AREA
- VEGETATIVE FILTER STRIP (VFS) AREA
- VEGETATIVE FILTER STRIP
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STATE OF TEXAS
ZACHARY B. RYAN
106276
LICENSED
PROFESSIONAL ENGINEER

2/9/2023

0' 25' 50' 100'
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REV. NO.	DATE	DESCRIPTION	BY

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FRN - F-1386

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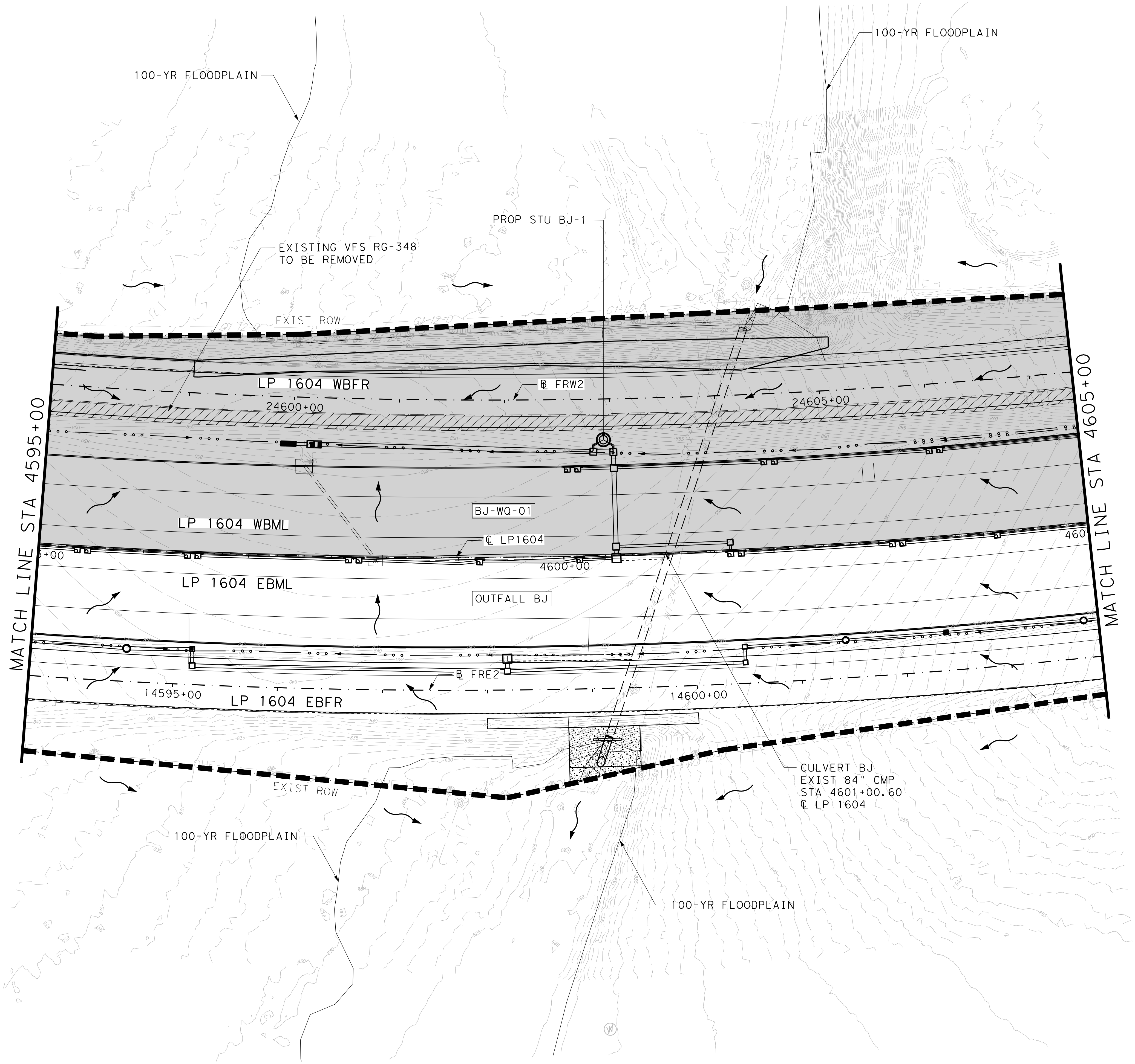
©2023

LP 1604
WPAP
SITE PLAN
4585+00 TO 4595+00

SHEET 20 OF 23

FED. RD. DIV. NO.	STATE	PROJECT NO.		HIGHWAY NO.
6	TEXAS	SEE TITLE SHEET		LP1604
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	2452	02	130	2672



LEGEND

- OUTFALL AREA
- BMP DRAINAGE AREA
- VEGETATIVE FILTER STRIP (VFS) AREA
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STATE OF TEXAS
ZACHARY B. RYAN
106276
LICENSED
PROFESSIONAL ENGINEER

2/9/2023

0' 25' 50' 100'
SCALE: 1"=100'

REV. NO.	DATE	DESCRIPTION	BY

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FRN - F-1386

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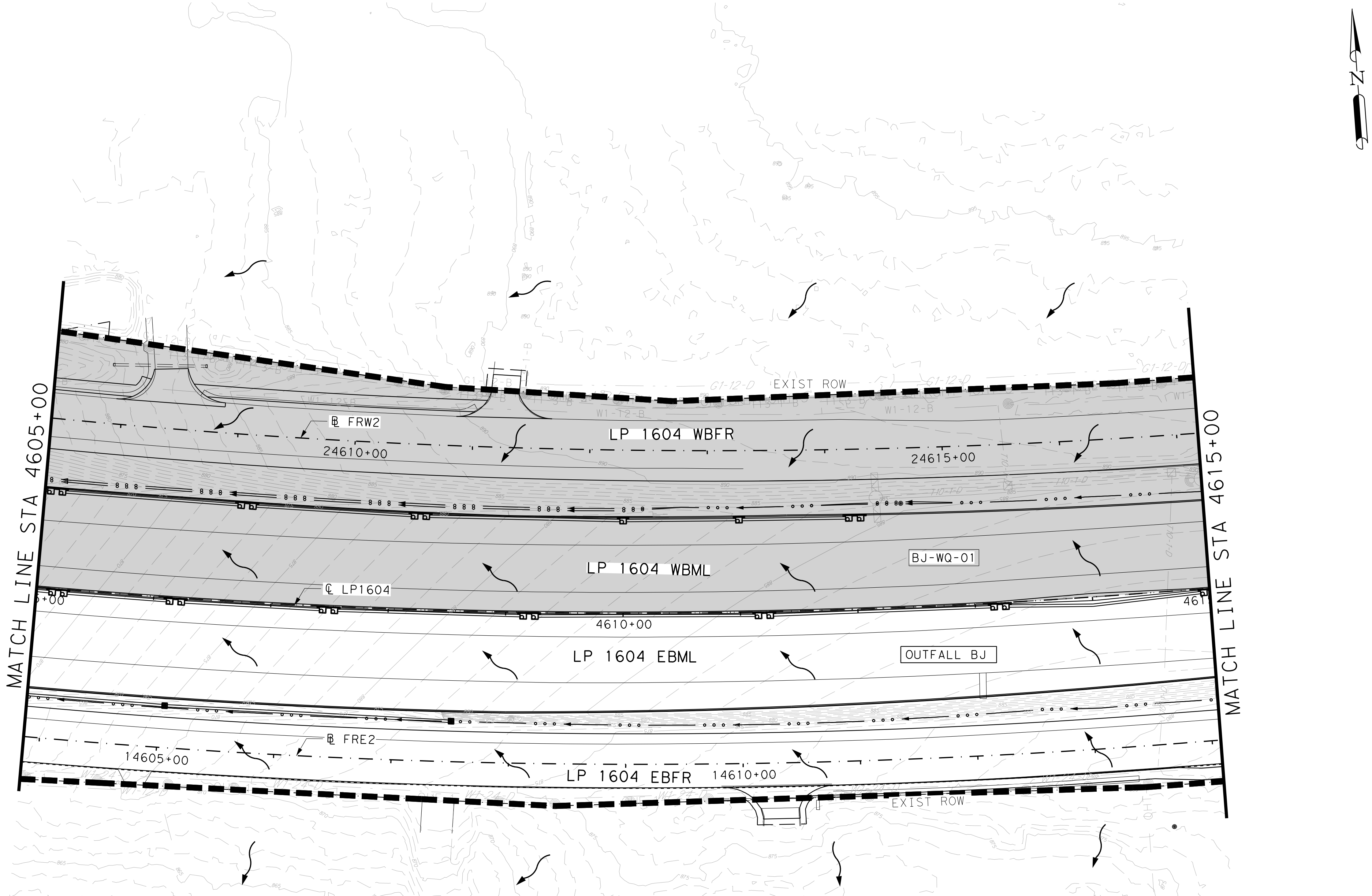
LP 1604
WPAP
SITE PLAN
4595+00 TO 4605+00

SHEET 21 OF 23

FED. RD. DIV. NO.	STATE	PROJECT NO.			HIGHWAY NO.
6	TEXAS	SEE TITLE SHEET			LP1604
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	2452	02	130	2673



LEGEND

- OUTFALL AREA
- BMP DRAINAGE AREA
- VEGETATIVE FILTER STRIP (VFS) AREA
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STATE OF TEXAS
ZACHARY B. RYAN
106276
LICENSED
PROFESSIONAL ENGINEER

2/9/2023

0' 25' 50' 100'
SCALE: 1"=100'

REV. NO.	DATE	DESCRIPTION	BY

LJA Engineering, Inc.
FRN - F-1386

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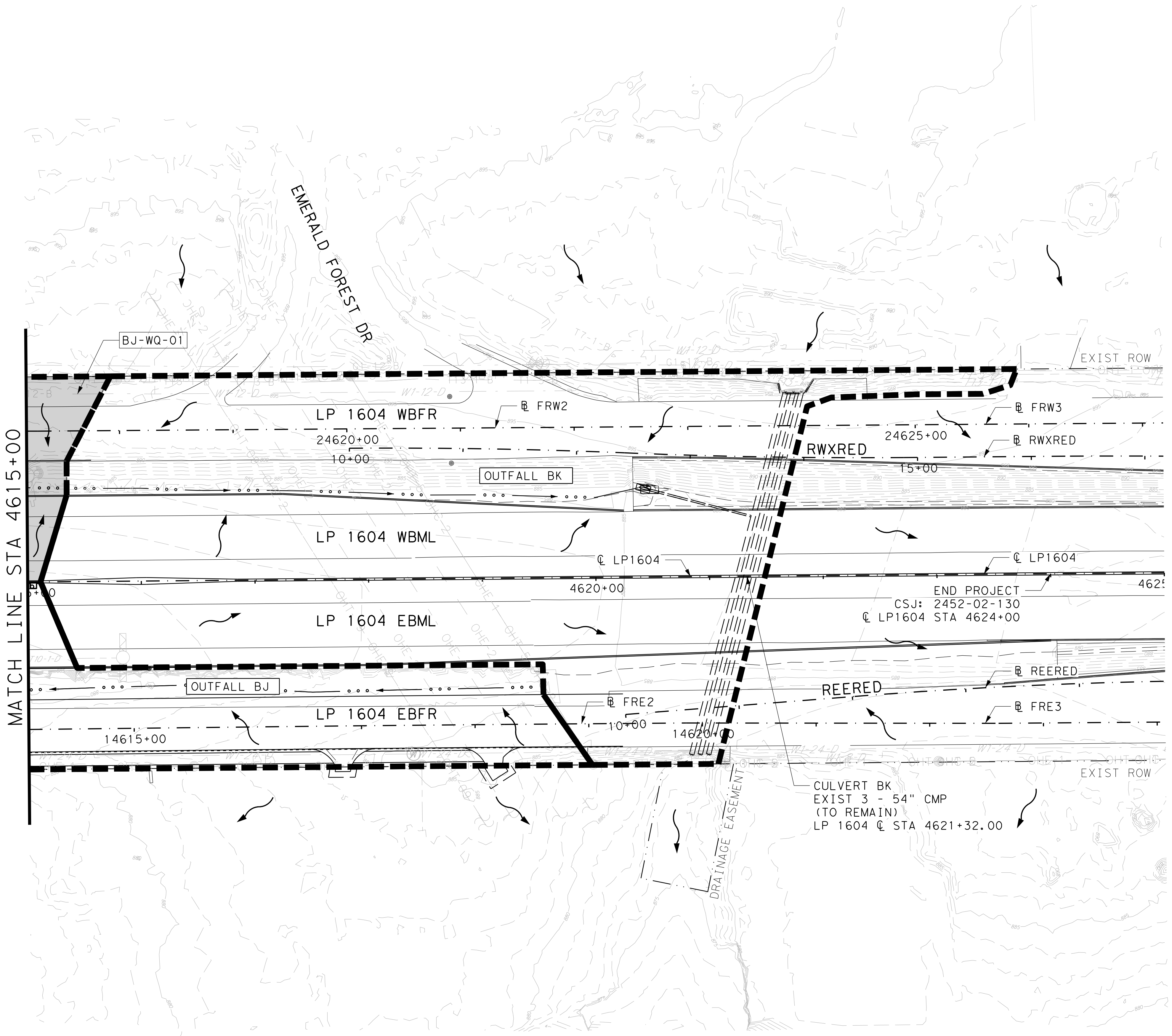
LP 1604
WPAP
SITE PLAN
4605+00 TO 4615+00

SHEET 22 OF 23

FED. RD. DIV. NO.	STATE	PROJECT NO.		HIGHWAY NO.
6	TEXAS	SEE TITLE SHEET		LP1604
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	2452	02	130	2674



LEGEND

- OUTFALL AREA
- BMP DRAINAGE AREA
- VEGETATIVE FILTER STRIP (VFS) AREA
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STATE OF TEXAS
ZACHARY B. RYAN
106276
LICENSED
PROFESSIONAL ENGINEER

2/9/2023

0' 25' 50' 100'
SCALE: 1"=100'

REV. NO.	DATE	DESCRIPTION	BY

LJA Engineering, Inc.
FRN - F-1386

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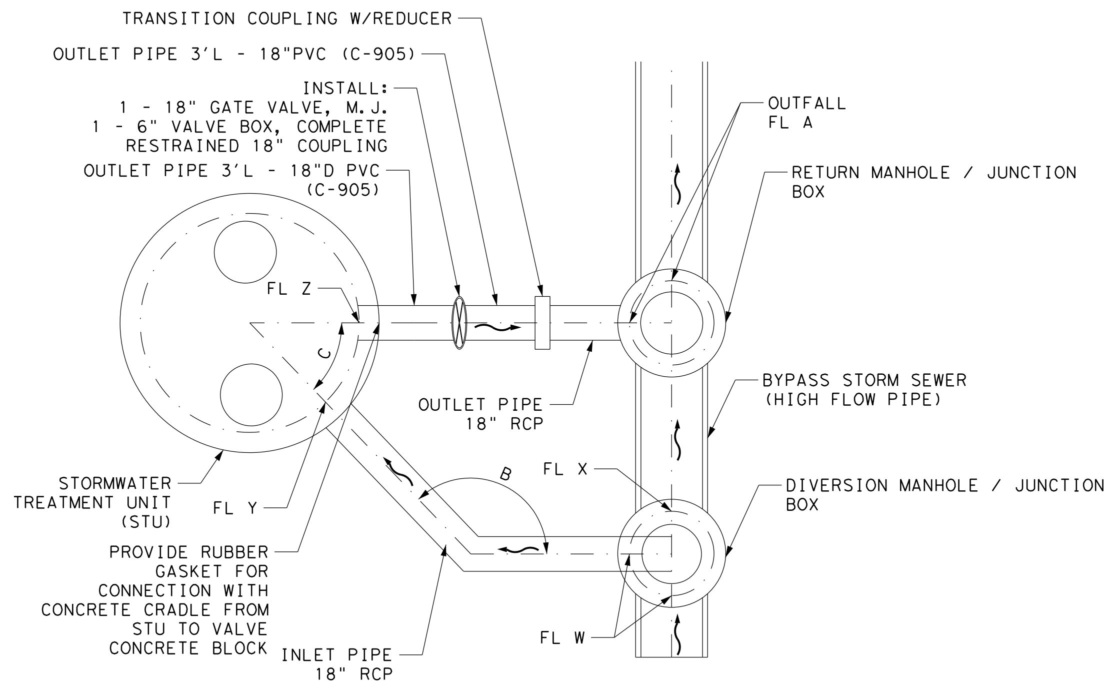
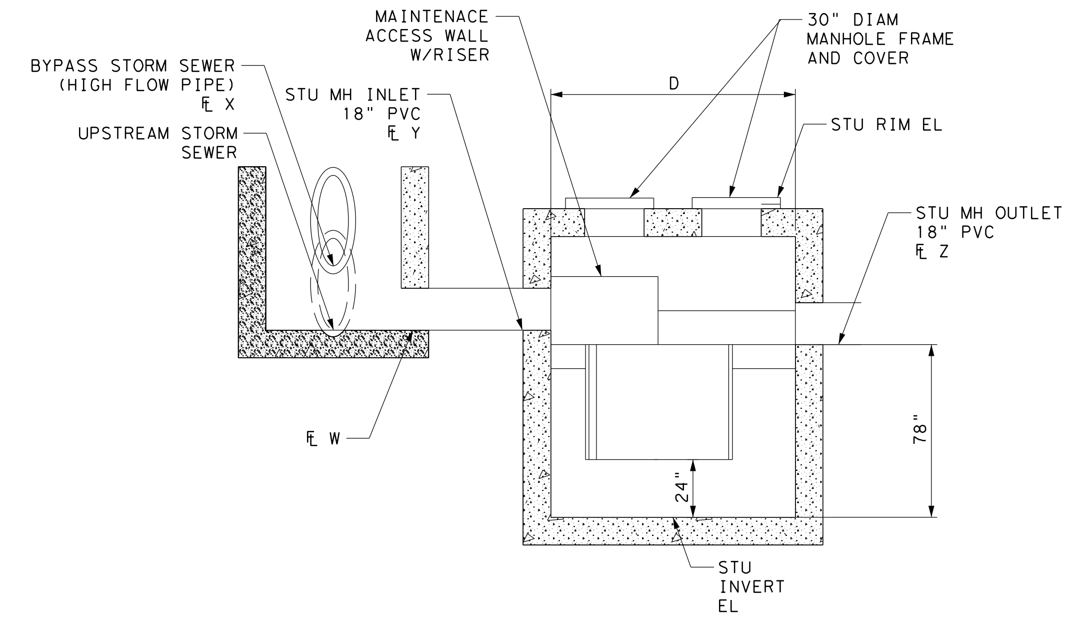
LP 1604
WPAP
SITE PLAN
4615+00 TO END

SHEET 23 OF 23

FED. RD. DIV. NO.	STATE	PROJECT NO.		HIGHWAY NO.
6	TEXAS	SEE TITLE SHEET		LP1604
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	2452	02	130	2675

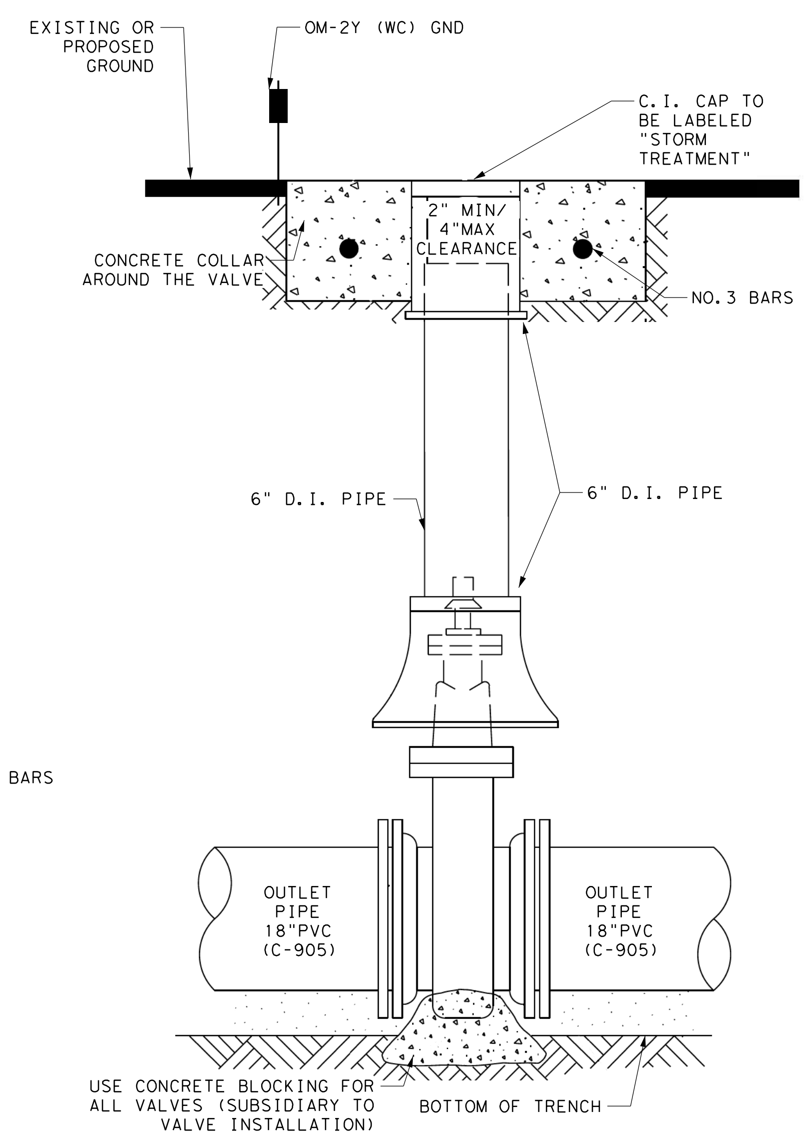


STORMWATER TREATMENT UNIT (STU) PLAN VIEW
CONFIGURATION 1

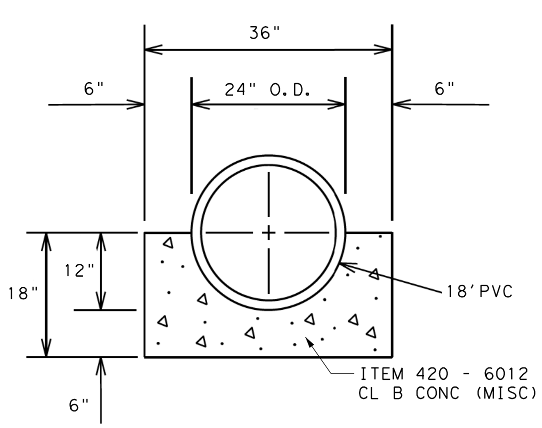


STORMWATER TREATMENT UNIT (STU) PROFILE VIEW

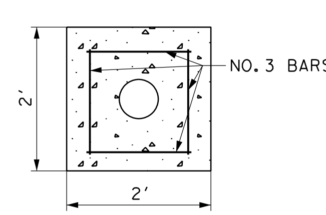
BMP	BD-1	BD-2	BE-1	BE-2	BE-3	BI-1	BI-2	BJ-1
REQUIRED TREATMENT FLOW RATE	3.66	3.29	3.72	0.99	3.30	3.28	3.32	2.83
PROVIDED TREATMENT FLOW RATE	3.74	3.39	3.74	1.16	3.39	3.39	3.39	2.85
TREATMENT AREA (AC)	23.62	6.30	7.43	1.30	5.03	5.86	6.48	22.17
IMPERVIOUS COVER (AC)	20.25	4.23	5.44	1.29	4.29	4.23	4.87	17.32
STU DIAMETER (FT)	10	10	10	6	10	10	10	10
# OF HI-FLOW CARTRIDGES	19	17	19	6	17	17	17	14
# OF DRAINDOWN CARTRIDGES	4	4	4	1	4	4	4	4
CARTRIDGE LENGTH (IN)	54	54	54	54	54	54	54	54
FL W	947.37	950.21	923.77	924.57	922.21	884.27	877.15	837.79
FL X	949.37	952.21	925.77	926.57	924.21	886.27	879.15	839.79
FL Y	947.12	949.96	923.52	924.32	921.96	884.02	876.90	837.54
FL Z	946.62	949.46	923.02	923.82	921.46	883.52	876.40	837.04
FL A	945.37	949.21	922.77	922.57	920.21	882.27	875.15	835.79
B (DEG)	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0
C (DEG)	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0
D (DEG)	120.0	120.0	120.0	120.0	120.0	120.0	120.0	120.0
CONFIG.	OFFLINE	OFFLINE	OFFLINE	OFFLINE	OFFLINE	OFFLINE	OFFLINE	OFFLINE
STU RIM EL	956.43	956.61	932.56	934.75	930.45	893.71	889.34	853.03
STU INVERT EL	940.12	942.96	916.52	917.32	914.96	877.02	869.90	830.54
18" RCP (FT)	10	6	12	12	12	12	12	12
18" PVC (FT)	6	6	6	6	6	6	6	6



STU VALVE DETAIL N.T.S.



CONCRETE CRADLE DETAIL N.T.S.



CONCRETE COLLAR TOP VIEW N.T.S.

STATE OF TEXAS
ZACHARY B. RYAN
106276
LICENSED PROFESSIONAL ENGINEER
2/14/2023

0' 25' 50' 100'
SCALE: 1"=100'

REV. NO.	DATE	DESCRIPTION	BY

LJA Engineering, Inc.
FRN - F-1386

Texas Department of Transportation
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LP 1604
WATER QUALITY DETAILS

SHEET 1 OF 1

FED.RD. DIV.NO.	STATE	PROJECT NO.	HIGHWAY NO.
6	TEXAS	SEE TITLE SHEET	LP1604

STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	2452	02	130	1665

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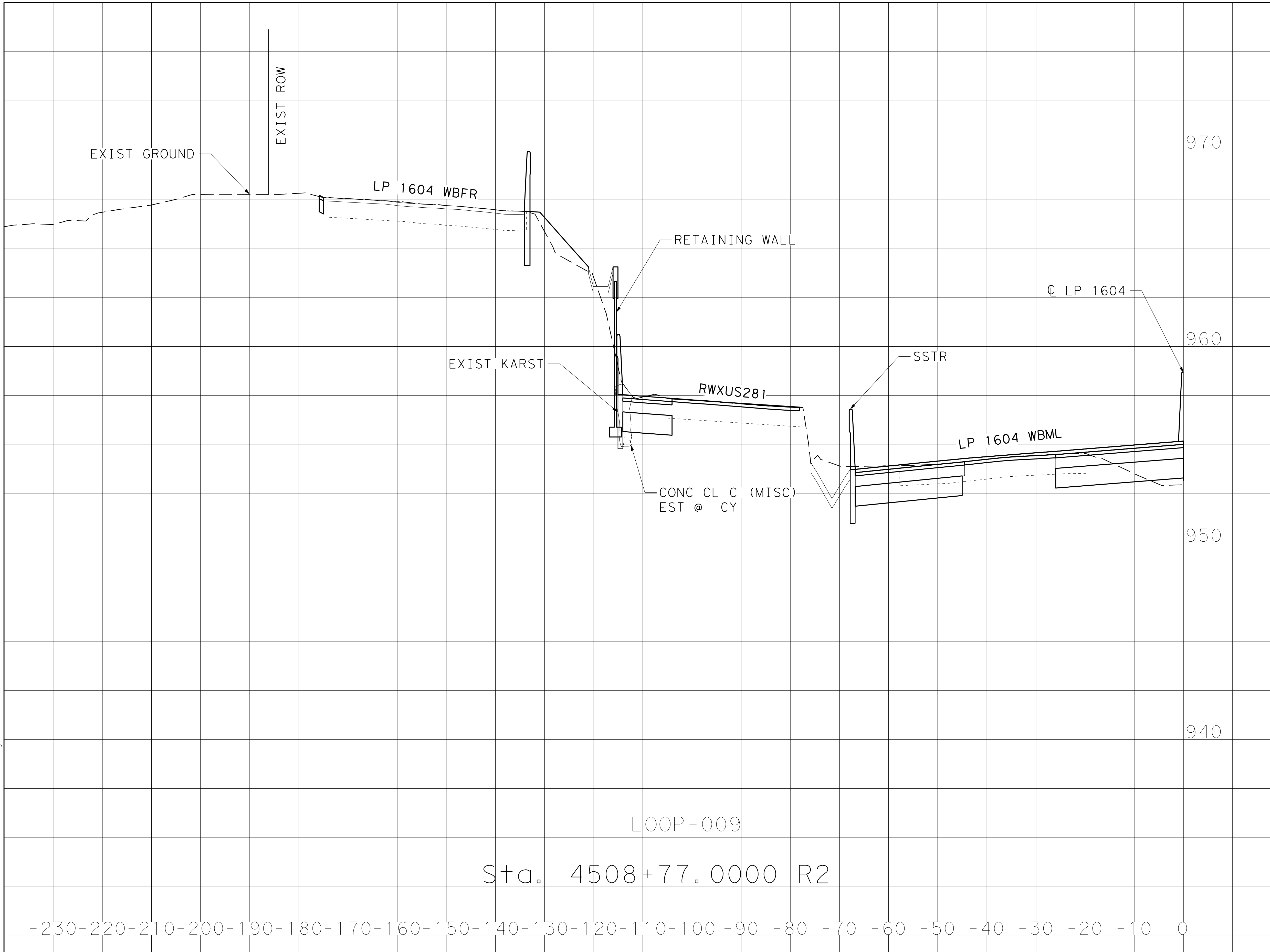
SENSITIVE FEATURES CLOSURE PLAN
CROSS SECTIONS



DESIGN

R. MATTHEW ESTES, P.E. 3/21/2023 DATE

REVIEW AND APPROVAL

JAMES A. LUTZ, P.E. 3/21/2023 DATE

0' 5' 10' 20'

SCALE: 1"=20' - HORZ
1"=5' - VERT

REV. NO.	DATE	DESCRIPTION	BY

PAPE-DAWSON ENGINEERS

SAN ANTONIO | AUSTIN | HOUSTON | FORT WORTH | DALLAS
2000 NW LOOP 410 | SAN ANTONIO, TX 78213 | 210.375.9000
TBPE FIRM REGISTRATION #470 | TBPLS FIRM REGISTRATION #10028800

LJA Engineering, Inc.
FRN - F-1386

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LP 1604
KARST CLOSURE
DETAIL

SHEET 1 OF 3

FED. RD. DIV. NO.	STATE	PROJECT NO.			HIGHWAY NO.
6	TEXAS				LP1604
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	2452	02	130, ETC	980

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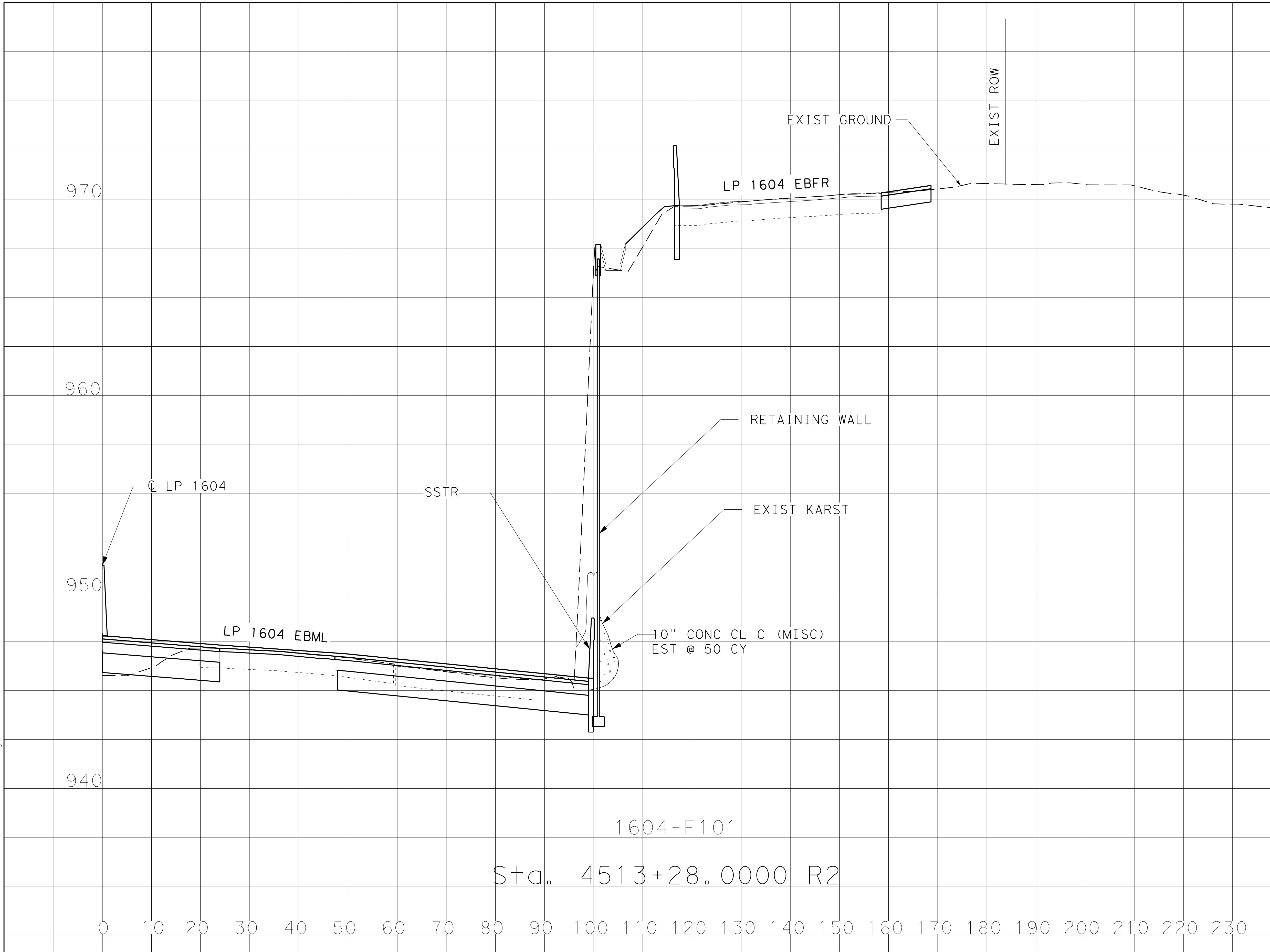

DESIGN

STATE OF TEXAS
R. MATTHEW ESTES
101558
LICENSED
PROFESSIONAL ENGINEER

R. MATTHEW ESTES, P.E. 3/21/2023
DATE

REVIEW AND APPROVAL

STATE OF TEXAS
JAMES A. LUTZ
84722
LICENSED
PROFESSIONAL ENGINEER

JAMES A. LUTZ, P.E. 3/21/2023
DATE

0' 5' 10' 20'

SCALE: 1"=20' - HORZ
1"=5' - VERT

REV. NO.	DATE	DESCRIPTION	BY

PAPE-DAWSON ENGINEERS

SAN ANTONIO | AUSTIN | HOUSTON | FORT WORTH | DALLAS
2000 NW LOOP 410 | SAN ANTONIO, TX 78213 | 210.375.9000
TBPE FIRM REGISTRATION #470 | TBPLS FIRM REGISTRATION #10028800

LJA Engineering, Inc.
FRN - F-1386

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LP 1604
KARST CLOSURE
DETAIL

SHEET 2 OF 3

FED. RD. DIV. NO.	STATE	PROJECT NO.			HIGHWAY NO.
6	TEXAS				LP1604
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	2452	02	130, ETC	981

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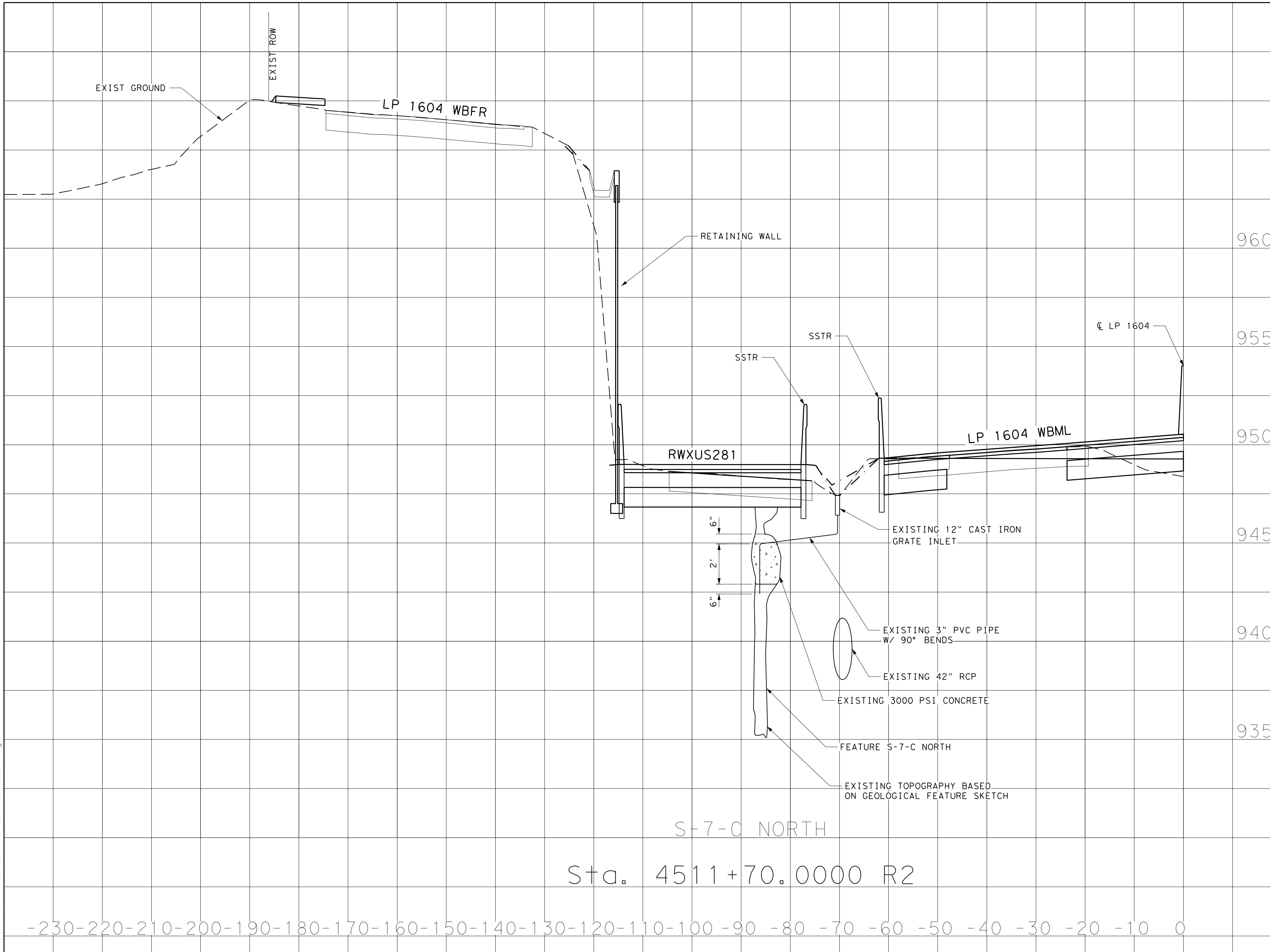


NOTES:

1. THIS SHEET PROVIDED FOR CONTRACTOR INFORMATION ONLY. CONTRACTOR TO PROTECT EXISTING KARST FEATURE AND RECHARGE SYSTEM DURING GRADING OPERATIONS. DO NOT DISTURB EXISTING GRATE INLET OR ALLOW INLET TO BECOME BLOCKED DURING CONSTRUCTION.

INTERIM REVIEW

DOCUMENT INCOMPLETE. NOT INTENDED FOR PERMIT, BIDDING OR CONSTRUCTION.
ENGINEER: JAMES A. LUTZ
P.E. SERIAL NO: 84722
DATE: 3/21/2023

0' 5' 10' 20'
SCALE: 1"=20' - HORZ
1"=5' - VERT

REV. NO.	DATE	DESCRIPTION	BY

PAPE-DAWSON ENGINEERS

SAN ANTONIO | AUSTIN | HOUSTON | FORT WORTH | DALLAS
2000 NW LOOP 410 | SAN ANTONIO, TX 78213 | 210.375.9000
TBPE FIRM REGISTRATION #470 | TBPLS FIRM REGISTRATION #10028800

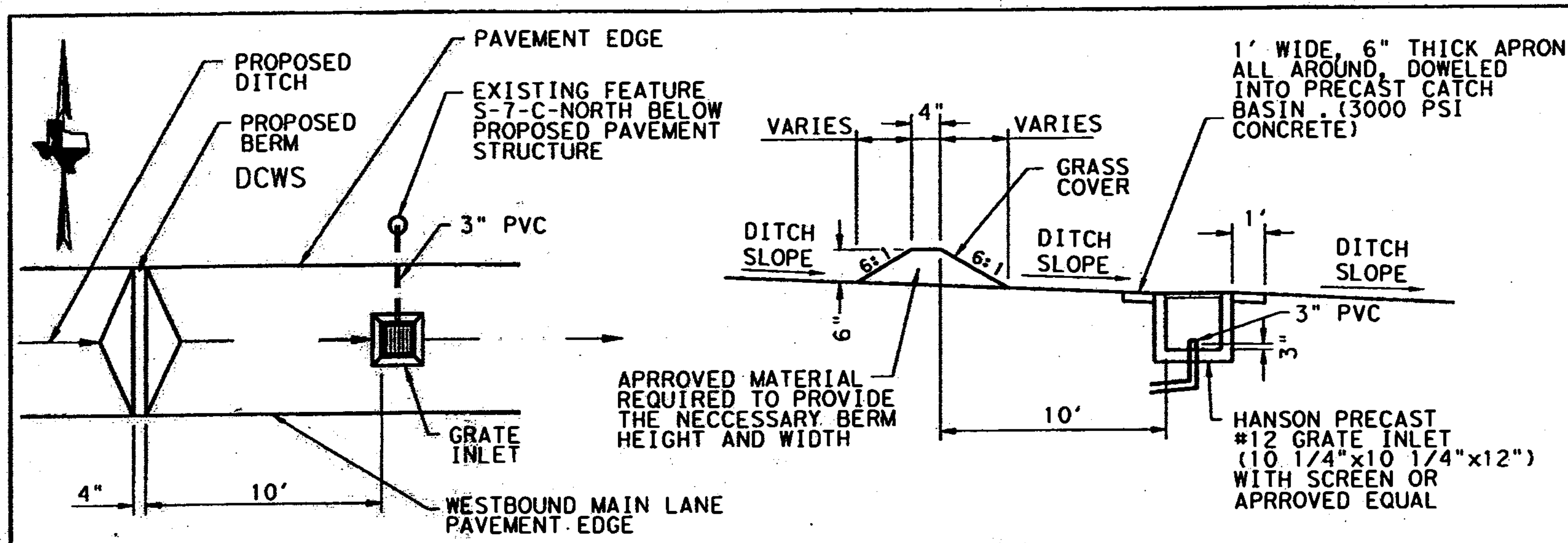
LJA Engineering, Inc.
FRN - F-1386

Texas Department of Transportation

LP 1604
KARST CLOSURE
DETAIL

SHEET 3 OF 3

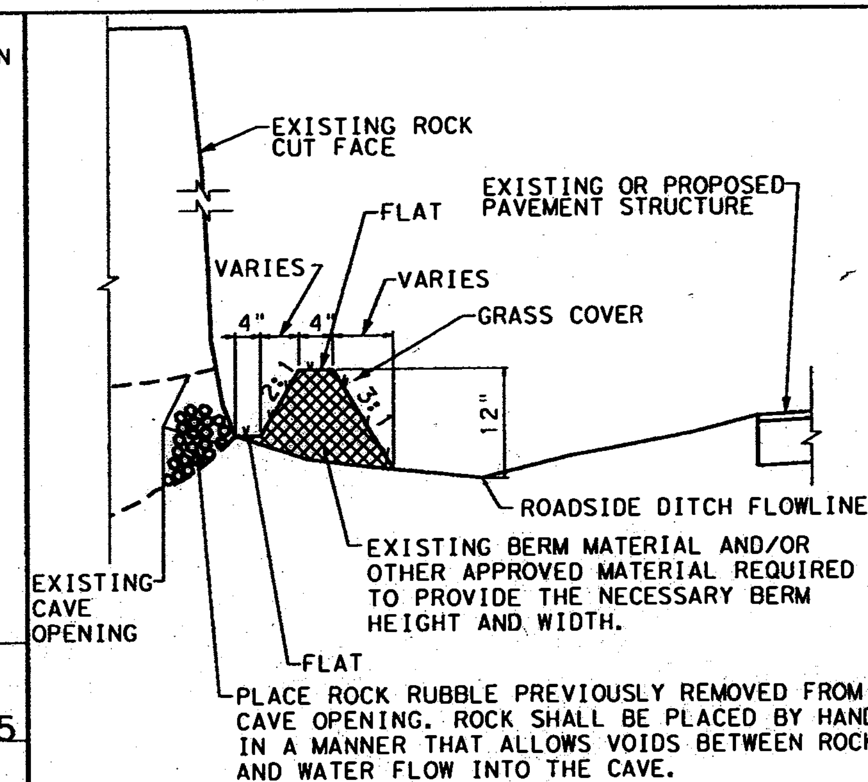
FED. RD. DIV. NO.	STATE	PROJECT NO.			HIGHWAY NO.
6	TEXAS	STP 2021(616)MM			LP1604
STATE DISTRICT	COUNTY	CONTROL NO.	SECTION NO.	JOB NO.	SHEET NO.
SAT	BEXAR	2452	02	128, ETC	982



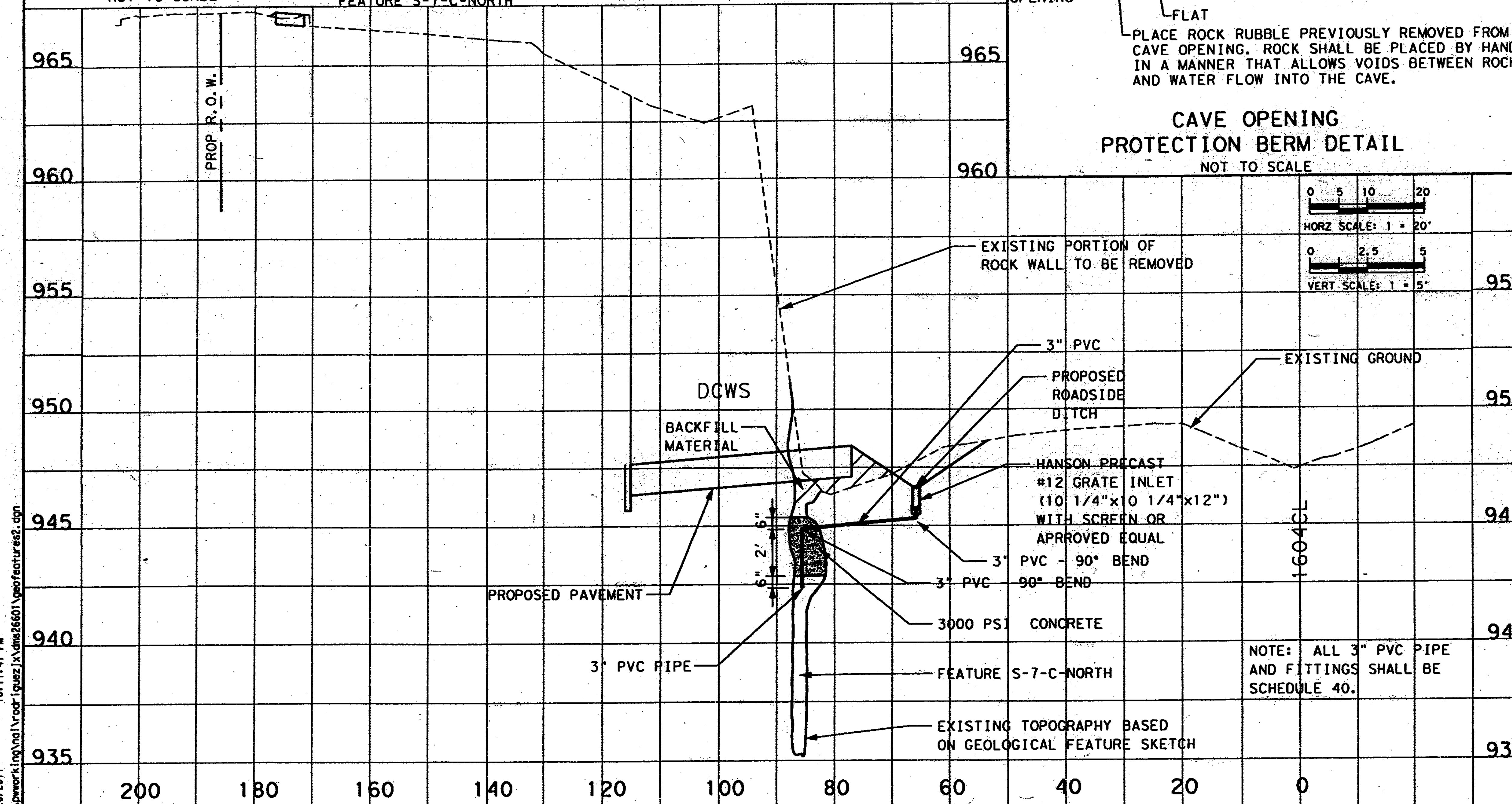
PLAN
NOT TO SCALE

NOTE: THIS DETAIL IS SPECIFIC TO FEATURE S-7-C-NORTH

PROFILE
NOT TO SCALE



CAVE OPENING PROTECTION BERM DETAIL
NOT TO SCALE



FEATURE S-7-C-NORTH DETAIL

AS-BUILTS

ALAMO RMA
RFC#: SWPPP
DATE: Mar 01, 2011

STATE OF TEXAS
ALEX ZERTUCHE
92080
LICENSED PROFESSIONAL ENGINEER
2/21/11

JACOBS
JACOBS ENGINEERING GROUP INC. FIRM #2966

ALAMO RMA
Alamo Regional Mobility Authority "Moving people faster"

US 281 LP 1604 INTERCHANGE

CAVE PROTECTION DETAILS

2162
SHEET 50 OF 50

FED. RD. DIV. NO.	STATE	FEDERAL AID PROJECT No.	HIGHWAY No.	INTERIM PACKAGE
6	TEXAS	STP 2009(653)ES	US 281/LP 1604	SWSP
STATE DISTRICT	COUNTY	CONTROL No. / SECTION No.	JOB No.	FINAL PACKAGE
SAT	BEXAR	0253 / 04	139, ETC	2167

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EDWARDS AQUIFER PROTECTION PROGRAM ROADWAY APPLICATION – TCEQ-20872
ATTACHMENT G – CONSTRUCTION PLANS

EDWARDS AQUIFER PROTECTION PROGRAM ROADWAY APPLICATION - TCEQ-20872
ATTACHMENT H – INSPECTION, MAINTENANCE, REPAIR AND RETROFIT

PROJECT NAME: LP 1604 from Stone Oak Parkway to Redland Road – Segment 4
CITY, STATE, ZIP: San Antonio, Texas 78258
CSJ: 2452-02-130

BMP maintenance operations should be performed on a regular basis as outlined below and as required to ensure that the BMPs and measures are constructed and functioning as designed. Operations must also be performed as required to maintain site aesthetics, vegetation, BMP access, and debris removal. After a Texas licensed professional engineer has certified that the permanent BMPs and measures were constructed as designed and submitted certification to the TCEQ regional office, the maintenance schedule as outlined below will commence.

General:

1. Records and diaries will be kept for maintenance activities listed and performed by TxDOT and contractors. All records must be retained for a period of not less than five (5) years.
2. Maintenance and contracted personnel may oversee minor repairs. Major repairs or retrofits must be overseen by TxDOT.
3. Roadways and roadsides will be reviewed regularly, usually weekly, by maintenance forces. BMPs will be inspected after rainfall events greater than four inches to ensure no damage to grass cover, accumulation of litter, or erosion has occurred. Areas of concern will be noted, and any necessary maintenance scheduled.
4. Right-of-way areas, including areas of vegetative filter strips (VFS), grassy swales, and earthen water quality and detention ponds, will be mowed by contract. Cutting height is a maximum of eighteen inches. Mowing will be delayed during times when preferred vegetation is seeding to allow for natural propagation to continue.
5. Fertilizer, herbicide and pesticide best practices may be found in the attached Integrated Pest Management (IPM) plan.

Stormwater Treatment Unit:

1. Post-construction inspection is required prior to putting the unit into service.
2. It is recommended that stormwater treatment units be inspected on a quarterly basis for the first year of operation. The rate at which each system collects pollutants will often depend more on-site activities than the size or type of unit. For example, watershed construction activities, or heavy winter sanding will cause sediments to accumulate at a more rapid rate.
3. After the first year, maintenance personnel will have a better understanding of the operational characteristics of the unit and subsequent inspections can be reduced if warranted. At a minimum, maintenance should be performed twice annually during project BMP inspections

when feasible. At least one of the inspections should occur following a rainfall event to observe system operations.

4. In the event of an oil, fuel, or other chemical spill, an inspection is required.
5. All exposed site areas should be stabilized to minimize sediment loads in unit and runoff from non-stabilized construction areas should be routed around the unit and treated separately.
6. With each inspection, any damage to the structural elements of the system (pipes, concrete drainage structures, filters, cartridges, etc.) must be identified and repaired immediately. Cracks, voids and undermining should be patched/filled to prevent growth in cracks and joints that can cause structural damage. Repair or replace any components that are inoperative.
7. Maintenance should be conducted by professional vacuum cleaning service providers with experience in confined space entry procedures and the maintenance of underground tanks, sewers, or catch basins.
    a. Every 12 months, filter cartridges should be tested for adequate flow rate and cleaned, recommissioned, or replaced as necessary.
    b. A manual backflush must be performed on one of the draindown cartridges using the unit's backflush pipe. If time required to drain 14 gallons exceeds 15 seconds, it is recommended to perform a manual backflush on each cartridge. If draindown time exceeds 15 seconds after manual backflush, then cartridge must be replaced.
8. Filters/Cartridge should be replaced once every three years, if inspection of the removed filters/cartridges indicates that their life expectancy exceeds three years, a modified maintenance plan should be provided to TCEQ specifying the new replacement schedule. Filters/Cartridges may initially require annual replacement due to sediment load from construction activities. Cartridge replacement also may be required in the event of a chemical or hazardous material spill or due to excessive sediment loading from site erosion or extreme storms.
9. Check and verify that the BMP facility site(s) are secure at least once per month. Any site found to be insecure should be made secure immediately.
10. Standing water within vaults may become a location of mosquito breeding. The facility should be evaluated at least twice a year to determine if mosquito control is needed.

Maintenance Contact

The Maintenance Supervisor or Maintenance Contracts Engineer may be contacted for questions or concerns that pertain to the maintenance of this facility after it is completed and operating. The current maintenance supervisor and/or contracts engineer is named below and may be contacted at the following location:

Responsible Party for Maintenance:

Name: Henry Jay Fojtik, P.E.
Title: Maintenance Contracts Engineer
Email: Henry.Fojtik@txdot.gov
Phone: 210-615-5939

Signature of Responsible Party: ______ P.E. ______

INTEGRATED PEST MANAGEMENT PLAN

Project components will require pest monitoring and include vegetative filter strips, extended detention ponds and roadside ditches/grassy swales. Potential pests are weeds, woody plant weeds, Red Imported Fire Ants, Crazy Tawny Ants, mosquitoes, Oak Wilk, and burrowing animals. The approach consists of three principles:

1. **Correctly identifying pests and documentation:** Ensure that all pests are properly identified so that appropriate action can be taken, and beneficial organisms are not eliminated. Follow the applicable inspection schedule. Record monitoring results and inspection findings and recommend additional response measures if necessary. All pest management response measures must be documented with dates, inspection results, and extent of action taken. Routinely monitor:
    a. Pest Populations
    b. Areas sensitive to infestation
    c. Efficacy of measures currently or previously taken

    Note that this IPM should be updated as necessary in response to monitoring results and changing site conditions.
2. **Prevention:** Follow species-specific prevention guidelines and measures as outlined in this IPM and the projects Inspection, Maintenance, Repair and Retrofit Plan.
3. **Action Thresholds:** Additional action must be taken once pest population presence has become a nuisance, economic threat, or health threat.

General Pest Management Guidelines

- Application of fertilizers and pesticides should be avoided within 25 feet of open waterways or within any feature buffer zone.
- Source sites of topsoil and fill must be surveyed for the presence of pest species. Survey results are to be submitted to the responsible maintenance personnel for review and approval before any soil or fill is transported to the project site. Species that may be transported in fill include Crazy Tawny Ants, Red Imported Fire Ants and weeds.
- The known or suspected presence of invasive or non-native species must be reported as soon as possible.
- Application of fertilizers, herbicides and pesticides should be avoided unless the population presence becomes a nuisance, economic threat or health threat.

Species specific pest management guidelines are as follows:

- Weeds:
    - Preventative measures are the most effective at weed management and should be implemented on a consistent basis. A well-maintained turf and erosion control will ensure no bare soil and subsequent weed propagation. Removing weeds may expose

solid which must be reseeded using a native seed mix. Mowing at strategic times of the year before weeds have flowered is necessary to inhibit the spread of seeds. A 4 to 6 inch mulch layer is encouraged as it blocks sunlight and air, however, bark mulch is prohibited because it can flood and be washed out by runoff. No mulch should be placed in or on BMPs. Regular and consistent solid cultivating at 2 to 3 week intervals during the growing season should be done via hand removal. Cultivating is effective at preventing the spread of weeds. The method requires weed taproots to be cut, thus killing the plants. Cultivating machines are prohibited.

  - Additional action may be necessary if preventative measures are not effective at curbing weed populations. Increased efforts should be made toward cultivating, mulching and reseeding

- Woody Plant Weeds:
  - Colonization of these plants can affect the integrity of water quality basin liners and interfere with other project components. The following species are included in this weed categorization: Ash, Chinaberry, Chinese Tallow, Cottonwood, Giant Cane, Mulberry, Poison Ivy, Rough-leaf Dogwood and Willow.
  - Prevention can be accomplished by removing young plants by hand, with sharp shovels, or grubbing tools. Exposed soils must be compacted as necessary and reseeded. Any removals done within water quality basins must be conducted in accordance to the project maintenance plans.
  - Manual removal of larger woody plant weeds can be accomplished with the use of a tree/weed wrench. Any necessary re-grading or fill is contingent upon the approval of TxDOT.
- Mosquitos
  - Mosquitoes can be prevented by eliminating areas of long-standing water. Standing water shall not be present 96 hours after the water quality basins have drained. If standing water becomes a problem, first ensure pond maintenance requirements laid out in the project Inspection, Maintenance, Repair and Retrofit Plan have been met. If it is determined regrading or other alterations to the pond structure are necessary to correct standing water, it shall be contingent upon the approval of TxDOT.
  - The use of a product with the active ingredient Bacillus Thuringiensis Israelianis is an acceptable temporary measure for mosquito larvae treatment. Introduction of predatory insects may also be used as a temporary measure for mosquito management.
- Red Imported Fire Ants and Crazy Tawny Ants
  - Survey of offsite fill and topsoil is effective at preventing ant infestations. See the General Pest Management Guidelines for information.
  - Biologic control such as insect pheromones or introduction of predatory insects may be used as temporary measures for ant control. Also, natural grade Diatomaceous earth can be effectively used to kill ants. Diatomaceous Earth kills ants through direct physical contact, so should be directly applied to the ant mounts. Wear protective masks and void inhalation when applying

- Oak Wilt
    - Oak wilt is a fungus which affects oak trees. When trees are cut or pruned, either intentionally or unintentionally, wound dressing or painting wounds with latex paint can help prevent the spread of Oak Wilt. Pruning in the months of February, March, April, May and June should be avoided as much as possible. Before pruning any oak trees or between pruning two different trees, tools must be disinfected. Approved disinfectants include Lysol, Listerine, Pine Sol, 70% solutions of isopropyl alcohol or denatured methyl alcohol, or 10% bleach solution (note that bleach may accelerate rusting). Wood from infected oaks which have died should be burned or buried. Any burning or oak removal must be approved by the maintenance point-of-contact at TxDOT.
- Wildlife and burrowing animals
    - Wildlife activities, especially burrowing or digging, within a pond can affect the integrity of the liner or outlet structures. Holes in ponds should be identified and documented as soon as possible to prevent structural damage. Possible mitigation may be fencing, trapping, or other exclusionary methods to restrict animal access. No coil spring, foot, body, or other lethal or maiming traps are allowed.

Unprecedented pest problems not mentioned in this IPM:
The TxDOT will develop pest species control strategies as needed to assist in meeting the project environmental goals and commitments as well as applicable regulations.

J. Brown
S. Hewitt

TEXAS WATER COMMISSION

PROTECTING TEXANS' HEALTH AND SAFETY BY PREVENTING AND REDUCING POLLUTION

cc to Mager

June 15, 1992

2452-3-70

Kenneth C. Bohuslav, P.E. (D8-E)
Engineer of Environmental Studies
Texas Department of Transportation
125 E. 11th Street
Austin, Texas 78701-2483

Re: Environmental Assessment, Bexar County: Texas Department of Transportation (TxDOT) Construction of Permanent Erosion and Sedimentation Control Structures at Loop 1604 from 0.3 Mile East of U.S. 281 to Mud Creek

Dear Mr. Bohuslav:

The proposed project provides for the construction of a permanent sedimentation pond and hazardous materials basin for Loop 1604 at Mud Creek in Bexar County, Texas. The plans for this project was received by the Texas Water Commission (TWC) on May 18, 1992. Pursuant to the Memorandum of Understanding between our agencies the following comments are offered:

Standard Comments:

1) Stormwater runoff from this proposed construction will flow directly into Mud Creek which discharges into Salado Creek which is segment number 1910 of the San Antonio River Basin. This segment is designated for contact recreation, high quality aquatic habitat, public water supply, and for aquifer protection. The water quality of wetlands and waters in the State shall be maintained in accordance with all applicable provisions of the Texas Surface Water Quality Standards including the General, Narrative and Numerical Criteria.

   Elevated levels of fecal coliform occur approximately half the time. A portion of this segment does not meet swimmable criteria due to the elevated fecal coliform levels.

2) Temporary erosion and sedimentation control structures should be in place prior to initiation of construction and should be maintained during construction. Any area disturbed should be restored upon completion of construction to minimize potential water quality impacts. Discharges from the site, including stormwater, shall not cause substantial and persistent changes from ambient conditions of turbidity or color. Silt fences, rock berms, and other appropriate methods should be used to minimize the discharge of suspended particulates.

3) The District 8 Office of the TWC may monitor stormwater discharges from the site to evaluate the adequacy of the temporary erosion and sedimentation control measures.

4) The TxDOT and the Contractor shall employ measures to control spills of fuels, lubricants, or any other materials used in construction to prevent them from entering waters in the State. All spills shall be promptly reported to the TWC at 1(800)633-9363.

5) All sanitary wastes shall be retained on-site and disposed of in accordance with all TWC rules.

6) Materials resulting from the destruction of existing roads and structures shall be removed from any waters in the State or areas adjacent to waters in the State and shall be properly disposed of in accordance with all TWC rules.

7) All areas utilized for spoil disposal shall be designated on the plans and shall be protected from run-on and run-off. The placement of any material in a watercourse or wetlands shall be avoided and shall be placed there only with the approval of the TWC and when no other reasonable alternative is available. If work within a watercourse or wetland is unavoidable, heavy equipment shall be placed on mats, if necessary, to protect the substrate from gouging and rutting.

8) Contaminated runoff from any storage area, or which occurred as a result of a spill shall not be allowed to enter waters in the State. Non-contaminated stormwater from the construction area shall be controlled to prevent the discharge of debris from the site.

9) Upon completion of earthwork operations all temporary fills shall be removed from watercourses, wetlands, and areas disturbed during construction shall be seeded, rip-rapped, or given some other type of protection to minimize subsequent soil erosion. Any fill material shall be clean and of such composition that it will not adversely effect the biological, chemical or physical properties of any waters in the State.

10) Disturbance to vegetation will be limited to only what is absolutely necessary, and the limits of construction activity shall be clearly identified on the construction plans. After construction, all disturbed areas will be revegetated to approximate the pre-disturbance native plant assemblage.

11) Where control of weeds, insects and other undesirable species is deemed necessary by the TxDOT or Contractor, control methods which are nontoxic to aquatic life or human health

shall be employed when the activity is located in, or in close proximity to, waters in the State.

12) Disposal sites shall be located outside of the vicinity of public water supply intakes, where possible, otherwise the operator of the water supply system shall be notified at least 72 hours prior to discharge.

13) Concentrations of taste and odor producing substances shall not interfere with the production of potable water by reasonable water treatment methods, impart unpalatable flavor to food fish including shellfish, result in offensive odors arising from the water, or otherwise interfere with reasonable use of the water in the State.

14) Surface water shall be essentially free of floating debris and suspended solids that are conducive to producing adverse responses in aquatic organisms or putrescible sludge deposits or sediment layers which adversely affect benthic biota or any other designated uses. Surface water shall be essentially free of settleable solids conducive to changes in flow characteristics of stream channels or the untimely filling of reservoirs, lakes and bays.

15) The work of the TxDOT shall be conducted such that surface waters are maintained in an aesthetically attractive condition, foaming or frothing of a persistent nature is avoided. Surface waters shall be maintained so that oil, grease, or related residue will not produce a visible film of oil or globules of grease on the surface or coat the banks or bottom of any watercourses.

16) The TxDOT shall not engage in any activity which will cause waters in the State to be toxic to man, aquatic or terrestrial life.

17) Any discharge of wastewater which would constitute a new source of pollution or an increased source of pollution from any industrial, public, or private project or development shall be required to provide a level of wastewater treatment consistent with the provisions of the Texas Water Code and the Clean Water Act. Additionally, the TxDOT is placed on notice that stormwater detention and/or treatment facilities may be required now, or at a later date, to meet requirements of State and/or Federal law.

18) These comments shall not be deemed as fulfilling the TxDOT's responsibility to obtain additional authorization or approval from other local, state or federal regulatory agencies having

authority to preserve and protect resources within the area where the work will occur.

Additional Comments:

19) Any construction activity which will result in the disturbance of five acres or more will require an NPDES Storm Water Permit. TxDOT projects should have to comply with the General Permit Requirements. These requirements should be finalized and adopted by the EPA within the next few months. In general, upon adoption of the General Permitting Requirements, for any project under construction the contractor will be responsible for notifying the EPA prior to October 1, 1992. For all projects initiated after October 1, 1992 the contractor will be responsible for notifying the EPA at least 48 hours prior to initiation of construction.

20) After the permanent facilities have been in place and operating for at least a six month period the TxDOT shall provide an inspection report which verifies that the 24-hour drawdown time is being achieved, inflows are not short-circuiting the system, scour and erosion are not taking place within or downstream of the basins, structural integrity of the system is being maintained, debris and litter is being removed, and adequate grass cover exists.

21) The TxDOT shall clarify who will be responsible for closing the shut-off valve located in the berm between the hazardous materials basin and the sedimentation pond, and for diverting stormwater around the basins in the event that a spill or discharge occurs. Proper training and instructions shall be provided to the responsible parties.

The City of San Antonio conducted a review of the proposed plans and expressed a concern that the hazardous materials trap be constructed of rip-rap rather than using a clay liner. In response to this concern the TxDOT provided additional information to the TWC dated June 12, 1992. Since this is not a typical curb and gutter installation the TWC agrees and supports the recommendation of the TxDOT; however, the TWC agrees that any spill of hazardous materials may involve a costly clean-up that may need to conform to strict RCRA regulations. The TWC appreciates the efforts by the City of San Antonio to provide timely and appropriate comments on these plans.

If you have any questions or require additional information, please contact me at (512) 463-7790 in Austin.

Sincerely,

Hank B. Smith, P.E.
Watershed Management Division

cc: Rebecca Cedillo, Director, City of San Antonio, Department of Planning
Russell L. Masters, Edwards Underground Water District
John C. Kight, P.E., District Design Engineer, Texas Department of Transportation
District 8 Office, Texas Water Commission

WATER POLLUTION ABATEMENT FACILITIES
FORMAL MAINTENANCE PLAN

COUNTY:	BEXAR
PROJECT:	LOOP 1604
LIMITS:	FROM 0.3 MILE EAST OF US 281 EAST TO MUD CREEK
ROADWAY LENGTH:	5055 FT. = 0.957 MILE
PROJECT NO:	CRP 91(39)M
CONTROL NO:	2452-03-070

OIL AND HAZARDOUS SUBSTANCE SPILLS

AUTHORITY

Section 26.127 of the TEXAS WATER CODE establishes the Texas Water Commission (TWC) as the principal authority on matters relating to the quality of water in the State. In addition, the TEXAS HAZARDOUS SUBSTANCE SPILL PREVENTION AND CONTROL ACT (Chapter 26, Subchapter G, TEXAS WATER CODE) stipulates that it is the policy of this State to prevent the spill or discharge of hazardous substances into the waters in the State and to cause the removal of any spills and discharges without undue delay. **The TWC shall be the State's lead contact agency in spill response, shall conduct spill response for the State, and shall administer the provisions of the Act.** The Act also authorizes the executive director of the TWC to act independently if no federal on-scene coordinator is present or no action is being taken by an agency of the federal government in response to a spill, discharge of oil or a hazardous substance. The executive director's response may include actions to abate and remove the spill.

As established under the, TEXAS HAZARDOUS SUBSTANCE SPILL PREVENTION AND CONTROL ACT, the Texas Department of Transportation (TxDOT) is charged with certain responsibilities relating to the cleanup of oil and hazardous substances discharged or spilled within the territorial limits of the State. In carrying out these responsibilities, the TxDOT Safety and Maintenance Operations Division, the affected Districts and appropriate Austin Divisions will cooperate with and work with the TWC, the Department of Public Safety, the Environmental Protection Agency (EPA), the Governor, the United States Coast Guard and all other appropriate federal and state agencies in implementing the requirements of this Act.

NOTIFICATION REQUIREMENTS

Upon discovery of any spill of a harmful quantity of oil, hazardous substances or other substances or a release or threatened release, the responsible person must immediately make a telephone report to the TWC. This notification may be made by calling the **Texas Emergency Response Center (TERC) at 512/463-7727.**

Once the TERC has been contacted, the TWC office will initiate coordination with the appropriate State and federal agencies, depending on the nature of the incident and the location being from 0.3 miles east of US 281 east to Mud Creek. This includes the TxDOT.

RECOMMENDED INITIAL RESPONSE ACTIONS BY THE TxDOT

The following measures should be considered as general guidelines and may not apply for all circumstances:

1. Notify DPS. Their communications network will assure the appropriate officials are informed.

2. Refer to the GUIDEBOOK FOR HAZARDOUS MATERIALS (DOT Publication 5800.5) which may assist in determining what has been spilled and help in making appropriate decisions.

3. Department personnel at the scene should restrict access to the area until relieved by DPS or other responsible officials. Stop or detour traffic until safe passage can be assured.

4. Attempt to segregate and detain for further examination those persons who have had possible contact with toxic materials. Obtain the names and addresses of those involved. Remove injured persons from the area affected by the incident using as little personal contact as possible and hold them at a safe point for transfer to medical facilities.

5. Department personnel may participate in containment, cleanup or neutralization of material that has been determined to be non-hazardous to their health and/or safety, then only when proper approval is obtained according to the interagency cooperative contract between the TWC and TxDOT. This determination can be made by the TWC or Department of Health.

OIL AND HAZARDOUS SUBSTANCE SPILL RESPONSIBILITIES

The TEXAS HAZARDOUS SUBSTANCE SPILL PREVENTION AND CONTROL ACT holds the person responsible for the activity, from which a spill occurs (the responsible person), responsible for the containment and cleanup of the spill.

When the responsible person cannot be identified or when the responsible person is not adequately carrying out containment and cleanup operations, these operations may become the responsibility of the EPA. In the event EPA fails to act to authorize containment and cleanup operations, the TWC may authorize such operations under the TEXAS SPILL RESPONSE FUND which may be utilized to finance a State-sponsored cleanup.

The TWC and the TxDOT maintain an interagency cooperation contract whereby personnel, equipment and materials in possession or under control of the TxDOT may be diverted and utilized for a State-sponsored discharge or spill cleanup when appropriate approval is given by the department directors in accordance with the terms of the interagency cooperation contract. The TWC will utilize private contractors when specialized personnel and equipment are required. Costs resulting from State-sponsored cleanup activities may be reimbursed from the TEXAS SPILL RESPONSE FUND.

DEFINITIONS

DISCHARGE OR SPILL An act or omission by which oil, hazardous substances or other substances in harmful quantities are spilled, leaked, pumped, poured, emitted, entered, or dumped onto or into the waters in this State or by which those substances are deposited where, unless controlled or removed, they may drain, seep, run, or otherwise enter water in this State.

RESPONSIBLE PERSON * The owner, operator, or demise charterer of a vessel from which a spill or discharge emanates;
* The owner or operator of a facility from which a spill or discharge emanates;
or
* Any other person who causes, suffers, allows or permits a spill or discharge.

HARMFUL QUANTITY Any quantity of a hazardous substance discharge or spill which is determined to be harmful to the environment, or public health or welfare or may reasonably be anticipated to present an imminent and substantial danger to the public health or welfare by the administrator of the EPA. Any quantity or concentration of a hazardous substance or other substance that is toxic, corrosive, ignitable, reactive, oxygen demanding, or that exhibits another factor or factors which the executive director of the TWC or his designee determines is causing or may cause pollution or harm to the environment, or the public health or welfare.

HAZARDOUS SUBSTANCE Any substance designated as such by the EPA.

HAZARDOUS WASTE Any solid waste identified or listed as a hazardous waste by the EPA.

OIL Oil of any kind or in any form, including but not limited to petroleum, fuel oil, sludge, oil refuse, and oil mixed with wastes other than dredged spoil.

OTHER SUBSTANCE Any substance, which may be useful or valuable and therefore not ordinarily considered to be a waste, but that will cause pollution if discharged into water in the State. This does not include substances associated with the exploration, development and production of oil and gas or geothermal resources.

ROUTINE MAINTENANCE OF WATER POLLUTION ABATEMENT FACILITIES

HAZARDOUS MATERIALS BASIN AND SEDIMENTATION POND Mowing shall be conducted as necessary to control the invasion of weeds or undesirable woody plants. If healthy stands of native and/or desirable vegetation are established, mowing may not be necessary.

Inspection should be conducted periodically, particularly after heavy rainfall which produces significant runoff to determine if the pond is functioning as designed, specifically:

* 24 hour drawdown times are being achieved;
* inflows are not short-circuiting the system;
* scour and erosion are not taking place, within or downstream of the pond;
* structural integrity of the system is maintained, eg. walls, piping, appurtenances are not failing;
* debris and litter are to be removed as may be required.

VEGETATED SLOPES AND GRASS-LINED CHANNELS Periodic inspections shall be conducted to insure adequate cover exists. The intent is to maintain a stand of grass to promote filtration of solids and reduce erosion.

Mowing and litter-pickup shall be conducted in accordance with the TxDOT policy and funded levels of service.

Applications of approved herbicides will be applied in accordance with the TxDOT policies to control undesirable plant species and weeds.

NON-ROUTINE MAINTENANCE OF WATER POLLUTION ABATEMENT FACILITIES

HAZARDOUS MATERIALS BASIN AND SEDIMENTATION POND Inlet and outlet structures shall be repaired or replaced equal to the original condition as may be required.

Sediment removal shall be conducted when accumulation within the pond reduces the actual storage to below the design volume. The height of sediment shall not exceed 12 inches above elevation 850.6 (or the 1 foot mark on the pond guage).

If a spill or discharge should occur and seepage of the substance is directed towards or enters the hazardous materials basin, the shut-off valve located in the berm between the hazardous materials basin and the sedimentation pond shall be closed so as to contain the substance within the hazardous materials basin.

Should an oil or hazardous substance spill occur and the hazardous materials basin and the sedimentation pond become contaminated, material shall be removed and disposed of in an approved manner. The hazardous materials basin and the sedimentation pond shall be restored equal to the original condition by the responsible person.

During the clean-up and restoration time when the hazardous materials basin and the sedimentation pond become nonfunctional, the diversion slots in the inlet structure shall be covered in an appropriate manner so that runoff does not enter the hazardous materials basin and the sedimentation pond.

The maintenance plan for water pollution abatement facilities shall be posted in the appropriate maintenance section.

PERMANENT WATER POLLUTION ABATEMENT MEASURES
MAINTENANCE PROCEDURES

This document has been prepared to provide a description and schedule for the performance of maintenance on permanent pollution abatement measures. The project specific water pollution abatement plan should be reviewed to determine what permanent pollution abatement measures are incorporated into a project.

It should also be noted that the timing and procedures presented herein are general guidelines. Adjustments to the timing and procedures may have to be made depending on project specific characteristics as well as weather related conditions.

I understand that I am responsible for maintenance of the Permanent Water Pollution Abatement Measures included in this project until such time as the maintenance obligation is either assumed in writing by another entity having ownership or control of the property or ownership is transferred.

I, have read and understand the requirements of the attached Maintenance Procedures.

The following maintenance section will be responsible for maintaining the permanent BMP's:

Bexar Maintenance Office
Lawrence Coyle
9230 S.E. Loop 410
San Antonio, TX 78223
210-633-1402

P.E.
Signature

11/29/10
Date

MAINTENANCE PROCEDURES FOR PERMANENT POLLUTION ABATEMENT MEASURES

These maintenance guidelines were prepared at the request of the Texas Commission on Environmental Quality (TCEQ) with regard to their approval of an Edwards Aquifer Protection Plan for the above referenced project. These guidelines apply to the portions of the project limits that are subject to the Edwards Aquifer Rules.

Pest Management: Any vegetated areas that have noxious vegetation, insects, or other pests will be remedied with the minimum amount of selective pesticide necessary to control the pest. All chemicals are EPA labeled, registered, and approved. Personnel licensed and/or trained according to Texas Department of Agriculture (TDA) laws and regulations will apply pesticides. Records are kept for each application in accordance with TDA laws and regulations.

Seasonal mowing and vegetation management: Right-of-Way areas, which include the areas of vegetative filter strips, grassy swales and sensitive feature protection berms will be mowed by contract. The cutting height is usually 5-7 inches for all areas.

Inspection Cycles: Maintenance forces will review roadways, roadsides and sensitive feature protection berms on a regular basis, most of which are visited within a weekly cycle. Drainage ditches, structures and sensitive feature protection berms are inspected after large storms with consideration for any damage to grass cover, litter accumulation, or erosion. The sensitive feature protection drain (for Feature S-7-C-North) located approximately 20 feet North of Loop 1604 westbound mainlanes and approximately 650 feet West of the Gold Canyon overpass will be inspected quarterly to check that the grate, the screen and the 3" drain pipe are not clogged and draining properly, and that the sediment accumulation at the bottom of the inlet is less than 2 inches. Any problem areas are duly noted particularly if there is an absence of vegetation, any accumulation of brush, debris or litter, and/or any areas of significant erosion. These items will then be scheduled for repair on a priority basis.

Debris and litter removal: Litter, debris and brush accumulation is assessed not only for aesthetic reasons but also for the tendency to clog drainage paths or impede the intended flow of a structure's hydraulic design. Areas are cleaned periodically by state forces or by outside contractor. Areas documented as trouble spots are scheduled on a priority basis.

Sediment removal: During inspections, if sediment has accumulated to a depth that hinders original design characteristics it will be removed. For sediment accumulation in the Gold Canyon feature protection drain identified above in the Inspection Cycles, the grate, the screen and the 3" drain pipe will be unclogged, and the sediment accumulation will be removed from the bottom of the inlet. Excessive sedimentation, or a significant load of silt, does not normally occur in filter strip areas, grassy swale areas, or in permanent pond structures after project completion, but it may occur from other drainage areas or construction underway beyond State right-of-way.

Computer Controlled Cartridge Filter System:

A. Site Inspection and Cleaning: Inspect each treatment system within 4 calendar days of any continuous rainfall accumulating 1/4 in. or greater in the rain gauge at each treatment system location, but not longer than 30 calendar days from the last inspection. Rotate (flip) filter cartridges as deemed necessary (approximately half of the filter is dirty/clogged) at the time of the site inspection. Rotate filters immediately upon discovery of need to rotate. Rotation of filters subsidiary to site inspection and not paid for directly. Visually inspect the following components.

1. **Basins and Inlets.** Insure the basins, inlets and bypass is not clogged.
2. **Bladder Valve.** Check for proper operation in both "auto" and "manual" mode.
3. **Filter Canisters.** Clean dirty or clogged filter canisters.
4. **Filter Cartridges.** Inspect the cartridge, cartridge screen wrapping and clean dirty or clogged cartridge and cartridge screen wrapping.
5. **Equipment and Controls.** Visually inspect and verify that equipment and controls function properly and that the battery is adequately charged to keep the system operable.
6. **Outfall.** Inspect outfall, and verify that storm water is leaving the filter by gravity.
7. **Site Cleaning.** Inspect entire site and remove trash. (See item B for trash, debris and sediment removal cleaning cycle.)
8. **Wet Well/Sump Pump.** Inspect wet well and sump pump to verify proper discharge of stormwater.
9. **Underdrain Piping.** Clean underdrain piping thru clean-out access ports to insure unimpeded discharge of filtered stormwater.
10. **Security Fence.** Verify the site fence is intact and all gates are closed and locked.

B. Trash, Debris and Sediment Removal. Remove all trash, debris, and sediment from the sedimentation and filtration basins, inlets, and all other locations in the treatment system. Removal must be within 10 calendar days of any continuous rainfall accumulating 1/4 in. or greater in the rain gauge at each treatment system location, but not longer than 30 calendar days from the last removal. Sediment shall be removed at 2 inches of accumulation. Dispose of debris, trash, and sediment in accordance with all local, state, and federal regulations.

C. Replacing Filter Cartridges. Replace used cartridges with new cartridges in accordance with the frequency recommended by the manufacturer.

D. Replace Bladder Valve. Replace the bladder of a treatment system location as deemed necessary (the bladder will not hold air during a manual cycle) during a site inspection. Replace the bladder within 48 hours of discovery of need to replace.

E. Replace Battery. Replace the battery of a treatment system location as deemed necessary (the battery will not activate the system during a manual cycle) during a site inspection. Replace the battery within 48 hours of discovery of need to replace.

EDWARDS AQUIFER PROTECTION PROGRAM ROADWAY APPLICATION - TCEQ-20872
ATTACHMENT J – MEASURES FOR MINIMIZING SURFACE STREAM CONTAMINATION

During construction, temporary BMPs outlined in the Storm Water Pollution Prevention Plan (SW3P), located in the Construction Plans, will be utilized to treat any on-site runoff prior to entering any surface streams. After construction, proposed Stormwater Treatment Units will be in place to meet the 80% TSS removal requirements. After construction, the project limits will be revegetated to prevent pollution of surface streams.

As a permanent measure for hazardous materials spills, hazardous material traps are in sensitive recharge areas and where the highway crosses stream channels. The following spill response plan must be followed in the case of a spill.

TxDOT Spill Response Plan
Loop 1604 Segment 4
From Stone Oak Parkway to 1.09 miles east of Redland Road

TxDOT's Spill Response Procedures are shown in Image 1, below.

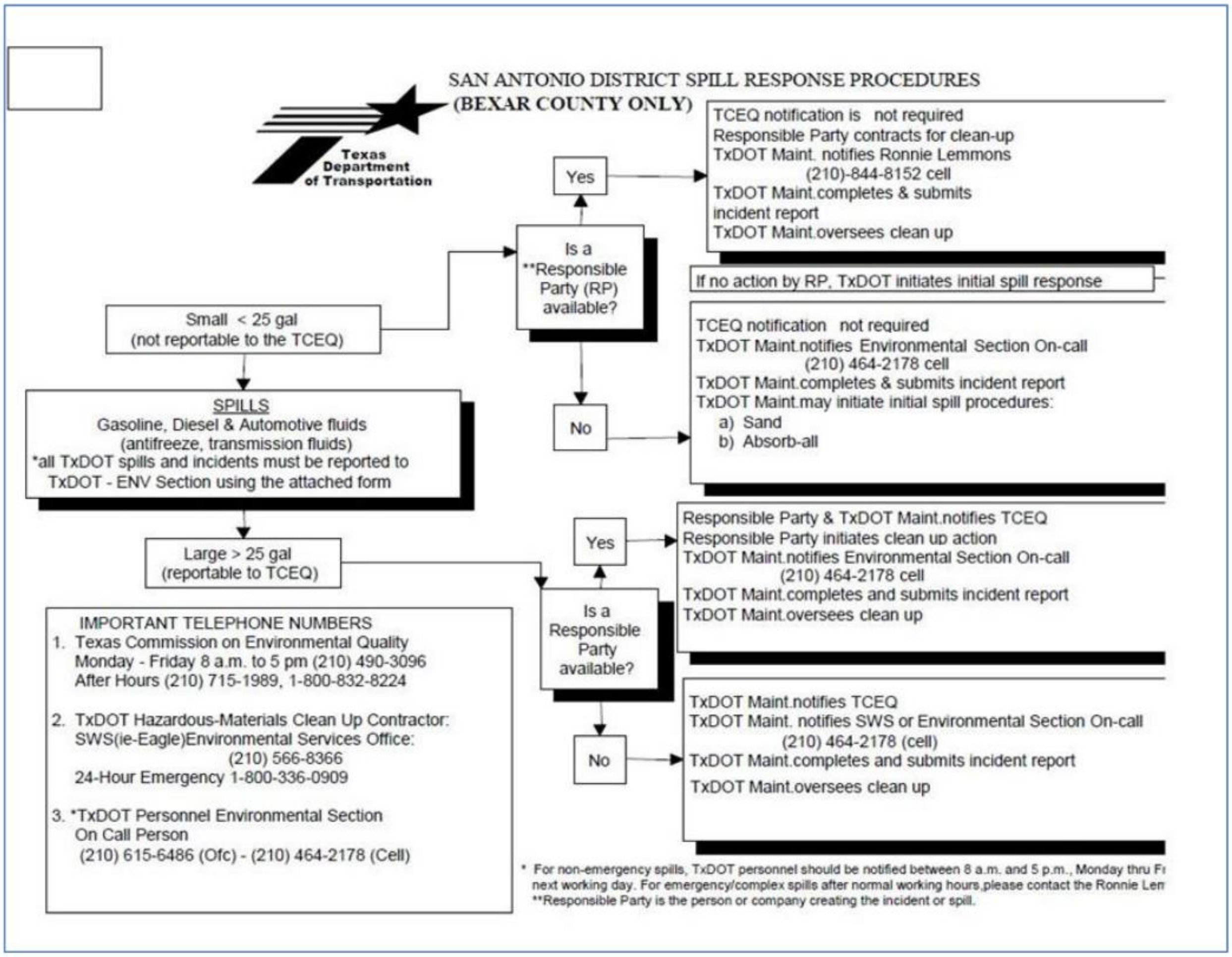

Image 1 - TxDOT Spill Response Procedures

There is existing and proposed infrastructure which may facilitate control of a spill.

1. EXISTING WATER QUALITY POND AT MUD CREEK

There is an existing diversion structure, hazardous materials basin, and sedimentation pond to remain on Loop 1604 in a drainage easement. This structure was built in 1992 by CSJ 2452-03-070 and is identified on the WPAP Site Plans. This pond was constructed with a 15,000 gallon hazardous materials basin, gate valve and 12 inches of clay liner beneath both the hazardous materials basin and sedimentation pond to facilitate spill control.

Image 2 - Mud Creek Pond

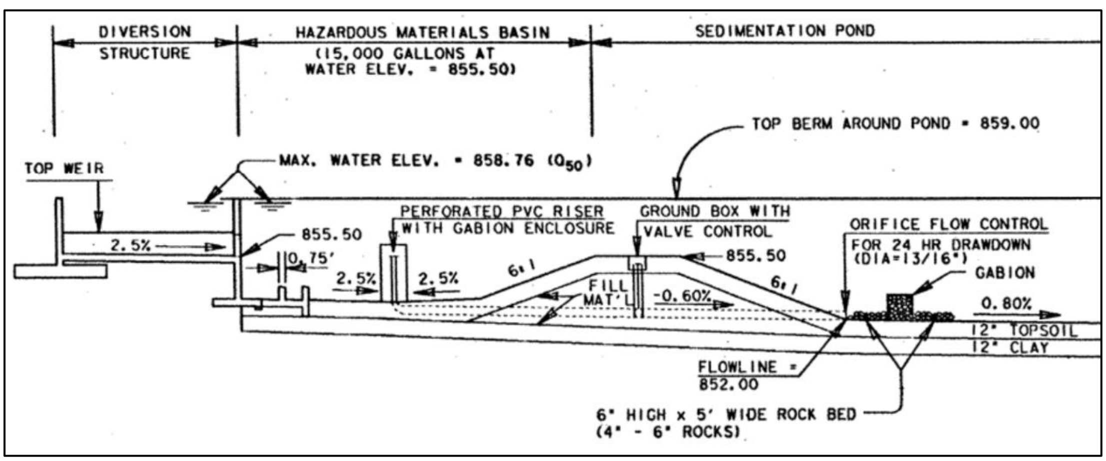

Image 3 - HMT Berm from as-built plans (CSJ 2452-03-070), outlet control valve shown.

2. PROPOSED STU OUTFALL VALVES

Some of the Stormwater Treatment Units will not outfall to existing HMTs and their outlet pipes will contain valves as shown in Image 4. The STUs and valves are shown on the WPAP Site Plans.

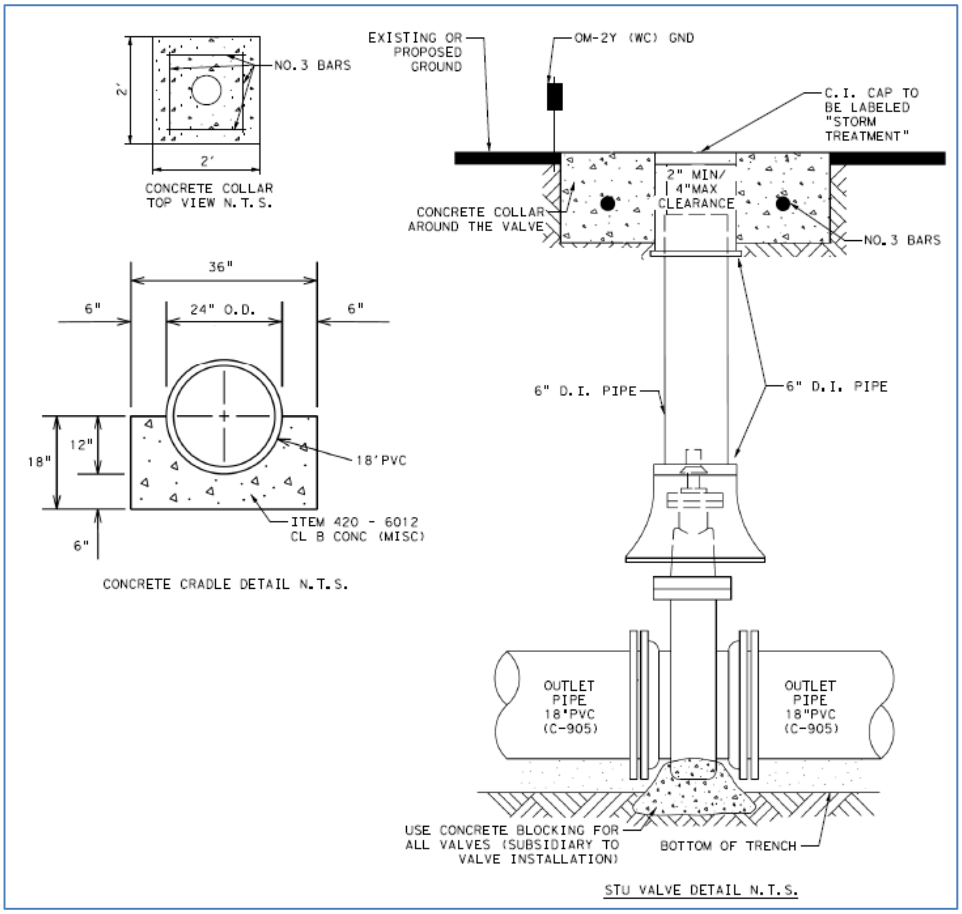

Image 4 - STU Valves

EDWARDS AQUIFER PROTECTION PROGRAM ROADWAY APPLICATION - TCEQ-20872
ATTACHMENT K – VOLUME AND CHARACTER OF STORMWATER

The post construction peak project runoff for the LP 1604 Segment 4 project will be increased, when compared to the pre-construction peak runoff. The post-construction composite runoff C factor will increase from 0.76 to 0.83 due to the proposed pavement increasing the impervious area within the project right of way. The runoff C factors were calculated using the existing and proposed impervious cover areas within the right of way of the total area of Segment 4. Stormwater runoff calculations for exterior and interior drainage areas were calculated using NRCS and Rational Method depending on the size of the area and the values obtained are shown in Attachment G, Construction Plans: Drainage Details. Area delineations are shown for Existing and Proposed conditions and include onsite areas only, they are included in Table 1 below.

TABLE 1: DRAINAGE AREA SUMMARY			
OUTFALLS	TOTAL AREA	EXISTING IMPERVIOUS	PROPOSED IMPERVIOUS
	AC	AC	AC
BD	48.991	38	40.305
BE	22.31	13.87	18.67
BF	17.64	13.77	16.39
BG	18.18	14.23	16.88
BH	58.67	35.94	41.41
BI	26.76	12.01	18.46
BJ	36.81	20.82	28.45
BK	4.08	1.86	2.69
TOTAL	**233.45**	**150.50**	**183.26**

Table 1 - Drainage Area Summary

The character of stormwater is expected to change from pre- to post-construction, as the area surrounding and including the project is still developing. Potential sources of contamination will be from sediment, debris, and chemicals generated on site by activities related to grading, paving, storm sewer and culvert construction and utility relocations. These potential contaminants are explained in more detail in Attachment D above. Runoff from the proposed project will be conveyed through storm sewer and/or roadside ditches to culverts leaving the site. Permanent BMPs including detention ponds and Stormwater Treatment Units, will ensure the required TSS load removal. All disturbed areas will be re-vegetated or stabilized at the completion of the project; therefore, no significant degradation of stormwater quality is anticipated because of the project.

An impact analysis was also performed for the overall hydrologic and hydraulic impacts of the project, that includes onsite and offsite flows.

GEOLOGIC ASSESSMENT – TCEQ-0585

The Geologic Assessment report provided to LJA Engineering contains the investigation performed along the entire LP 1604 project, which is delimited between SH 16 (Bandera Rd) and Interstate Highway 35. The same Geologic Assessment report will be attached for all the WPAPs that will be submitted, but a table like the one shown below will be provided to emphasize the sensitive features pertaining to the corresponding segment of the project. The table below shows the sensitive features found between the limits of LP 1604 Segment 4.

Feature ID	Latitude	Longitude	Feature Type
LOOP-012*	29.60986	-98.48728	Swallow Hole
LOOP-205*	29.60862	-98.48667	Swallow Hole
LOOP-009	29.60735	-98.46035	Solution Cavity
1604-F101	29.60621	-98.45929	Cave
S-7-C NORTH**	29.60695	-98.45951	Karst

*Features Loop-012 and Loop-205 are located outside the ROW on private property. There would be no work in these drainage easements, and they are not considered part of the project.

**Feature S-7-C North was not reported in the Geological Assessment, it is known from as-built documents.

Agent Authorization Form
For Required Signature
Edwards Aquifer Protection Program
Relating to 30 TAC Chapter 213
Effective June 1, 1999

I Clayton Ripps, P.E. ,
Print Name

Director of Transportation Planning and Development ,
Title - Owner/President/Other

of Texas Department of Transportation – San Antonio District ,
Corporation/Partnership/Entity Name

have authorized Zachary B. Ryan, P.E.
Print Name of Agent/Engineer

of LJA Engineering
Print Name of Firm

to represent and act on the behalf of the above named Corporation, Partnership, or Entity for the purpose of preparing and submitting this plan application to the Texas Commission on Environmental Quality (TCEQ) for the review and approval consideration of regulated activities.

I also understand that:

1. The applicant is responsible for compliance with 30 Texas Administrative Code Chapter 213 and any condition of the TCEQ's approval letter. The TCEQ is authorized to assess administrative penalties of up to $10,000 per day per violation.

2. For those submitting an application who are not the property owner, but who have the right to control and possess the property, additional authorization is required from the owner.

3. Application fees are due and payable at the time the application is submitted. The application fee must be sent to the TCEQ cashier or to the appropriate regional office. The application will not be considered until the correct fee is received by the commission.

4. A notarized copy of the Agent Authorization Form must be provided for the person preparing the application, and this form must accompany the completed application.

5. No person shall commence any regulated activity on the Edwards Aquifer Recharge Zone, Contributing Zone or Transition Zone until the appropriate application for the activity has been filed with and approved by the Executive Director.

SIGNATURE PAGE:

Clayton Patrick Ripps
Signed on 2020/09/17 14:20:31 -8:00

Applicant's Signature

09/17/2020
Date

THE STATE OF Texas §

County of Harris §

BEFORE ME, the undersigned authority, on this day personally appeared Clayton Patrick Ripps known to me to be the person whose name is subscribed to the foregoing instrument, and acknowledged to me that (s)he executed same for the purpose and consideration therein expressed.

GIVEN under my hand and seal of office on this ____ day of 09/17/2020, ____.

Angela Rachel Bricout
Commission # 10808833
Notary Public
STATE OF TEXAS
My Comm Exp. Nov 12, 2023
NOTARY PUBLIC STATE OF TEXAS
Notary Stamp 2020/09/17 14:20:31 PST 7A7382ED64BB

Rachel Bricout
Signed on 2020/09/17 14:20:31 -8:00

NOTARY PUBLIC

Rachel Bricout
Typed or Printed Name of Notary

MY COMMISSION EXPIRES: 11/12/2023

CORE

TCEQ Core Data Form

TCEQ Use Only

For detailed instructions regarding completion of this form, please read the Core Data Form Instructions or call 512-239-5175.

SECTION I: General Information

1. Reason for Submission *(If other is checked please describe in space provided.)*

☒ New Permit, Registration or Authorization (*Core Data Form should be submitted with the program application.)*

☐ Renewal *(Core Data Form should be submitted with the renewal form)* ☐ Other

2. Customer Reference Number *(if issued)*	Follow this link to search for CN or RN numbers in Central Registry**	3. Regulated Entity Reference Number *(if issued)*
CN 600803456		RN

SECTION II: Customer Information

4. General Customer Information | **5. Effective Date for Customer Information Updates** (mm/dd/yyyy)

☐ New Customer ☐ Update to Customer Information ☐ Change in Regulated Entity Ownership
☐ Change in Legal Name (Verifiable with the Texas Secretary of State or Texas Comptroller of Public Accounts)

The Customer Name submitted here may be updated automatically based on what is current and active with the Texas Secretary of State (SOS) or Texas Comptroller of Public Accounts (CPA).

6. Customer Legal Name *(If an individual, print last name first: eg: Doe, John)* — *If new Customer, enter previous Customer below:*

Texas Department of Transportation, San Antonio District

7. TX SOS/CPA Filing Number	8. TX State Tax ID (11 digits)	9. Federal Tax ID (9 digits)	10. DUNS Number *(if applicable)*

11. Type of Customer: ☐ Corporation ☐ Individual Partnership: ☐ General ☐ Limited

Government: ☐ City ☐ County ☐ Federal ☒ State ☐ Other ☐ Sole Proprietorship ☐ Other:

12. Number of Employees
☐ 0-20 ☐ 21-100 ☐ 101-250 ☐ 251-500 ☐ 501 and higher

13. Independently Owned and Operated?
☐ Yes ☐ No

14. Customer Role (Proposed or Actual) – *as it relates to the Regulated Entity listed on this form. Please check one of the following*

☐ Owner ☐ Operator ☒ Owner & Operator
☐ Occupational Licensee ☐ Responsible Party ☐ Voluntary Cleanup Applicant ☐ Other:

15. Mailing Address:
4615 NW Loop 410

City	San Antonio	State	TX	ZIP	782229	ZIP + 4	0928

16. Country Mailing Information *(if outside USA)*	17. E-Mail Address *(if applicable)*
	Clayton.Ripps@txdot.gov

18. Telephone Number	19. Extension or Code	20. Fax Number *(if applicable)*
(210) 615-5810		(210) 615-6015

SECTION III: Regulated Entity Information

21. General Regulated Entity Information *(If 'New Regulated Entity" is selected below this form should be accompanied by a permit application)*

☒ New Regulated Entity ☐ Update to Regulated Entity Name ☐ Update to Regulated Entity Information

The Regulated Entity Name submitted may be updated in order to meet TCEQ Agency Data Standards (removal of organizational endings such as Inc, LP, or LLC).

22. Regulated Entity Name *(Enter name of the site where the regulated action is taking place.)*

LP 1604 From Stone Oak Parkway to Redland Road

23. Street Address of the Regulated Entity: *(No PO Boxes)*							
	City		State		ZIP		ZIP + 4
24. County							

Enter Physical Location Description if no street address is provided.

25. Description to Physical Location:	Project site begins at LP 1604 and Stone Oak Parkway and extends east along the existing 1604 corridor to 1.09 miles east of Redland Road.

26. Nearest City	State	Nearest ZIP Code
San Antonio	TX	78259

27. Latitude (N) In Decimal:	29.6070	28. Longitude (W) In Decimal:	-98.4548

Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
29	36	25.20	-98	27	17.28

29. Primary SIC Code (4 digits)	30. Secondary SIC Code (4 digits)	31. Primary NAICS Code (5 or 6 digits)	32. Secondary NAICS Code (5 or 6 digits)

33. What is the Primary Business of this entity? *(Do not repeat the SIC or NAICS description.)*

Texas Department of Transporation

34. Mailing Address:	4615 NW Loop 410						
	City	San Antonio	State	TX	ZIP	78229	ZIP + 4 928
35. E-Mail Address:	Jonathan.Bean.txdot.gov						

36. Telephone Number	37. Extension or Code	38. Fax Number *(if applicable)*
(210) 615-5801		(210) 615-6015

39. TCEQ Programs and ID Numbers Check all Programs and write in the permits/registration numbers that will be affected by the updates submitted on this form. See the Core Data Form instructions for additional guidance.

☐ Dam Safety	☐ Districts	☐ Edwards Aquifer	☐ Emissions Inventory Air	☐ Industrial Hazardous Waste
☐ Municipal Solid Waste	☐ New Source Review Air	☐ OSSF	☐ Petroleum Storage Tank	☐ PWS
☐ Sludge	☐ Storm Water	☐ Title V Air	☐ Tires	☐ Used Oil
☐ Voluntary Cleanup	☐ Waste Water	☐ Wastewater Agriculture	☐ Water Rights	☐ Other:

SECTION IV: Preparer Information

40. Name:	Zachary Ryan	41. Title:	Vice President

42. Telephone Number	43. Ext./Code	44. Fax Number	45. E-Mail Address
(512) 439-4760		( ) -	zryan@lja.com

SECTION V: Authorized Signature

46. By my signature below, I certify, to the best of my knowledge, that the information provided in this form is true and complete, and that I have signature authority to submit this form on behalf of the entity specified in Section II, Field 6 and/or as required for the updates to the ID numbers identified in field 39.

Company:	LJA Engineering	**Job Title:**	Vice President
Name *(In Print)*:	Zachary Ryan	**Phone:**	(512) 439- **4760**
Signature:		**Date:**	01.25.2023

Geologic Assessment

Loop 1604 from SH 16 to I-35, Bexar County, Texas
CSJs: 2452-02-083, 2452-03-087, 2452-03-113

Prepared by: Zara Environmental LLC and JACOBS
Date: 05 March 2020

Geologist Certification

Loop 1604 from SH 16 to I-35, Bexar County, Texas
CSJs: 2452-02-083, 2452-03-087, 2452-03-113

Prepared for: Texas Department of Transportation
Prepared by: Zara Environmental LLC
Date: March 5, 2020

In accordance with the Texas Board of Professional Geologists rules at 22 Texas Administrative Code, Part 39, Chapter 851, Subchapter C, §851.156, this report is signed and sealed on the title page to assure the user that the work has been performed by or directly supervised by the following professional geoscientists who take full responsibility for this work.

The computer-generated seals appearing on this document were authorized by Aubri Jenson, P.G. 11007, and Jeff Watson, P.G. 12995.

Aubri A. Jenson, Texas Professional Geoscientist No. 11007
Jeffery Watson, Texas Professional Geoscientist No. 12995
Zara Environmental LLC, Geoscience Firm No. 50365

Geologic Assessment

Texas Commission on Environmental Quality

For Regulated Activities on The Edwards Aquifer Recharge/transition Zones and Relating to 30 TAC §213.5(b)(3), Effective June 1, 1999

To ensure that the application is administratively complete, confirm that all fields in the form are complete, verify that all requested information is provided, consistently reference the same site and contact person in all forms in the application, and ensure forms are signed by the appropriate party.

Note: Including all the information requested in the form and attachments contributes to more streamlined technical reviews.

Signature

To the best of my knowledge, the responses to this form accurately reflect all information requested concerning the proposed regulated activities and methods to protect the Edwards Aquifer. My signature certifies that I am qualified as a geologist as defined by 30 TAC Chapter 213.

Print Name of Geologist: Aubri Jenson, P.G.; Jeffery Watson, P.G.

Telephone: 512-291-4555

Fax: 866-908-9137

Date: March 5, 2020

Representing: Zara Environmental LLC/ TBPG No. 50365

Signature of Geologist:

Aubri Jenson   Jeffry Wat

Regulated Entity Name: Loop 1604 from SH 16 to I-35, Bexar County, Texas

Project Information

1. Date(s) Geologic Assessment was performed: 10 July 2019 – 30 September 2019
2. Type of Project

☒ WPAP ☐ AST

☐ SCS ☐ UST

3. Location of Project:

☒Recharge Zone ☒Contributing Zone within the Transition Zone

☒Transition Zone

4. ☒ **Attachment A - Geologic Assessment Table**. Completed Geologic Assessment Table (Form TCEQ-0585-Table) is attached.

5. ☒ Soil cover on the project site is summarized in the table below and uses the SCS Hydrologic Soil Groups* (Urban Hydrology for Small Watersheds, Technical Release No. 55, Appendix A, Soil Conservation Service, 1986). If there is more than one soil type on the project site, show each soil type on the site Geologic Map or a separate soils map.

Table 1 - Soil Units, Infiltration Characteristics and Thickness

Soil Name	Group*	Thickness (feet)
Austin silty clay, 1 to 3 percent slopes (AuB)	D	1.83-3.25
Austin silty clay, 2 to 5 percent slopes, moderately eroded (AuC)	D	1.83-3.25
Whitewright-Austin complex, 1 to 5 percent slopes (BsC)	D	1.67
Anhalt clay, 0 to 2 percent slopes (Ca)	D	1.67-3.33
Crawford, stony and Bexar soils, 0 to 5 percent slopes (Cb)	D	1.75-3.75
Heiden clay, 1 to 3 percent slopes (HnB)	D	3.33-5.42
Houston Black clay, 1 to 3 percent slopes (HsB)	D	6.67+
Houston Black gravelly clay, 3 to 5 percent slopes (HuC)	D	6.67+
Krum clay, 1 to 5 percent slopes (Kr)	C	6.67+
Lewisville silty clay, 0 to 1 percent slopes (LvA)	C	6.67+
Lewisville silty clay, 1 to 3 percent slopes (LvB)	B	6.67+
Patrick soils, 1 to 3 percent slopes, rarely flooded (PaB)	B	6.67+

** Soil Group Definitions (Abbreviated)*
A. Soils having a high infiltration rate when thoroughly wetted.
B. Soils having a moderate infiltration rate when thoroughly wetted.
C. Soils having a slow infiltration rate when thoroughly wetted.
D. Soils having a very slow infiltration rate when thoroughly wetted.

ATTACHMENT A

Soil Name	Group*	Thickness (feet)
Pits and Quarries, 1 to 90 percent slopes (Pt)	D	6.67+
Eckrant cobbly clay, 1 to 8 percent slopes (TaB)	D	0.33-1.67
Eckrant very cobbly clay, 5 to 15 percent slopes (TaC)	D	0.83-1.67
Eckrant-Rock outcrop association, 8 to 30 percent slopes (TaD)	D	0.33-1.67
Eddy gravelly clay loam, 1 to 8 percent slopes (Tb)	D	0.25-1.25
Tinn clay, 0 to 1 percent slopes, occasionally flooded (Tc)	D	6.67+
Tinn and Frio soils, 0 to 1 percent slopes, frequently flooded (Tf)	D	6.67+

6. ☒ **Attachment B – Stratigraphic Column**. A stratigraphic column showing formations, members, and thicknesses is attached. The outcropping unit, if present, should be at the top of the stratigraphic column. Otherwise, the uppermost unit should be at the top of the stratigraphic column.

7. ☒ **Attachment C – Site Geology**. A narrative description of the site-specific geology including any features identified in the Geologic Assessment Table, a discussion of the potential for fluid movement to the Edwards Aquifer, stratigraphy, structure(s), and karst characteristics is attached.

8. ☒ **Attachment D – Site Geologic Map(s)**. The Site Geologic Map must be the same scale as the applicant's Site Plan. The minimum scale is 1”: 400'

Applicant's Site Plan Scale: 1" = 100'
Site Geologic Map Scale: 1" = 100'
Site Soils Map Scale (if more than 1 soil type): 1" = 6,500'

9. Method of collecting positional data:

☒ Global Positioning System (GPS) technology.
☒ Other method(s). Please describe method of data collection: Faults derived from Geologic Atlas of Texas Data, some features from previous field work in survey area

10. ☒ The project site and boundaries are clearly shown and labeled on the Site Geologic Map.

11. ☒ Surface geologic units are shown and labeled on the Site Geologic Map.

12. ☒ Geologic or manmade features were discovered on the project site during the field investigation. They are shown and labeled on the Site Geologic Map and are described in the attached Geologic Assessment Table.

☐ Geologic or manmade features were not discovered on the project site during the field investigation.

13. ☒ The Recharge Zone boundary is shown and labeled, if appropriate.

14. All known wells (test holes, water, oil, unplugged, capped and/or abandoned, etc.): If applicable, the information must agree with Item No. 20 of the WPAP Application Section.

☒ There are 5 (#) wells present on the project site and the locations are shown and labeled. (Check all of the following that apply.)
☒ The wells are not in use and have been properly abandoned.
☐ The wells are not in use and will be properly abandoned.
☒ The wells are in use and comply with 16 TAC Chapter 76.
☐ There are no wells or test holes of any kind known to exist on the project site.

Administrative Information

15. ☒ Submit one (1) original and one (1) copy of the application, plus additional copies as needed for each affected incorporated city, groundwater conservation district, and county in which the project will be located. The TCEQ will distribute the additional copies to these jurisdictions. The copies must be submitted to the appropriate regional office.

ATTACHMENT A

GEOLOGIC ASSESSMENT TABLE			PROJECT NAME:			*Loop 1604 from SH 16 to I-35, Bexar County, Texas*														
LOCATION			FEATURE CHARACTERISTICS												EVALUATION			PHYSICAL SETTING		
1A	1B *	1C*	2A	2B	3	4			5	5A	6	7	8A	8B	9	10		11		12
FEATURE ID	LATITUDE	LONGITUDE	FEATURE TYPE	POINTS	FORMATION	DIMENSIONS (FEET)			TREND (DEGREES)	DOM	DENSITY (NO/FT)	APERTURE (FEET)	INFILL	RELATIVE INFILTRATION RATE	TOTAL	SENSITIVITY		CATCHMENT AREA (ACRES)		TOPOGRAPHY
						X	Y	Z		10						<40	≥40	<1.6	≥1.6	
1604-002	29.60177	-98.39429	CD	5	Kbu	6.6	26.4	0.3	-	0	-	-	O,V,F	5	10	X		X		Hillside
1604-801	29.6088	-98.52064	Z	30	Kplc	20	6	2.5	55	10	0.2	1.5	N,C	5	45		X	X		Roadcut
1604-D05	29.60843	-98.51149	SC	20	Kplc	1.6	2.3	0.65	-	0	-	-	N	5	25	X		X		Roadcut
1604-D06	29.6084	-98.50948	SC	20	Kplc	0.65	2.9	0.98	-	0	-	-	N	5	25	X		X		Roadcut
1604-D07	29.60843	-98.50932	SC	20	Kplc	1.6	4.9	1	-	0	-	-	N,F	5	25	X		X		Roadcut
1604-D08	29.60842	-98.50792	SC	20	Kplc	1.6	1.6	0.98	-	0	-	-	C,F	5	25	X		X		Roadcut
1604-D09	29.60838	-98.50818	SC	20	Kplc	1.9	3.9	1.6	-	0	-	-	C, F	5	25	X		X		Roadcut
1604-D10	29.60897	-98.50897	SC	20	Kplc	1	1	1.4	-	0	-	-	N,C	5	25	X		X		Roadcut
1604-D11	29.60887	-98.51001	SC	20	Kplc	2.3	3.9	0.82	-	0	-	-	C, F	5	25	X		X		Roadcut
1604-D13	29.60882	-98.51234	SC	20	Kplc	9.8	0.7	3.3	-	0	-	-	N,C,F	5	25	X		X		Roadcut
1604-D15	29.60802	-98.52374	SF	20	Kpcm	0.3	1	2.9	90, 100	0	-	-	N	5	25	X		X		Roadcut

* DATUM: NAD 83

2A	TYPE	2B POINTS
C	Cave	30
SC	Solution cavity	20
SF	Solution-enlarged fracture(s)	20
F	Fault	20
O	Other natural bedrock features	5
MB	Manmade feature in bedrock	30
SW	Swallow hole	30
SH	Sinkhole	20
CD	Non-karst closed depression	5
Z	Zone, clustered or aligned features	30

	8A INFILLING
N	None, exposed bedrock
C	Coarse - cobbles, breakdown, sand, gravel
O	Loose or soft mud or soil, organics, leaves, sticks, dark colors
F	Fines, compacted clay-rich sediment, soil profile, gray or red colors
V	Vegetation. Give details in narrative description
FS	Flowstone, cements, cave deposits
X	Other materials

12 TOPOGRAPHY

Cliff, Hilltop, Hillside, Drainage, Floodplain, Streambed

I have read, I understood, and I have followed the Texas Commission on Environmental Quality's Instructions to Geologists. The information presented here complies with that document and is a true representation of the conditions observed in the field. My signature certifies that I am qualified as a geologist as defined by 30 TAC Chapter 213.

STATE OF TEXAS
Aubri A. Jenson
GEOLOGY
11007
LICENSED
PROFESSIONAL GEOSCIENTIST

STATE OF TEXAS
JEFFERY A. WATSON
GEOLOGY
2995
LICENSED
PROFESSIONAL GEOSCIENTIST

Date 05 March 2020

Sheet ____1___ of ___17___

TCEQ-0585-Table (Rev. 10-01-04)

ATTACHMENT A

GEOLOGIC ASSESSMENT TABLE			PROJECT NAME:			*Loop 1604 from SH 16 to I-35, Bexar County, Texas*															
LOCATION			FEATURE CHARACTERISTICS												EVALUATION			PHYSICAL SETTING			
1A	1B *	1C*	2A	2B	3	4			5	5A	6	7	8A	8B	9	10		11		12
FEATURE ID	LATITUDE	LONGITUDE	FEATURE TYPE	POINTS	FORMATION	DIMENSIONS (FEET)			TREND (DEGREES)	DOM	DENSITY (NO/FT)	APERTURE (FEET)	INFILL	RELATIVE INFILTRATION RATE	TOTAL	SENSITIVITY		CATCHMENT AREA (ACRES)		TOPOGRAPHY
						X	Y	Z		10						<40	≥40	<1.6	≥1.6	
1604-D16	29.60747	-98.52552	SC	20	Kplc	0.8	3.1	1	5	0			N,F	5	25	X		X		Roadcut
1604-D17	29.60528	-98.53048	SC	20	Kplc	2.4	2.4	0.8	-	0	-	-	O	20	40		X		X	Roadcut
1604-D19	29.60875	-98.52154	SC	20	Kplc	16.4	8.2	0.5	-	0			N,C	5	25	X		X		Roadcut
1604-D20	29.60630	-98.45881	SC	20	Kplc	8.2	1.6	6.5	-	0	-	-	F,C	5	25	X		X		Roadcut
1604-E04	29.60888	-98.5136	SC	20	Kplc	2.6	4.6	1.3	-	0	-	-	C, F	5	25	X		X		Roadcut
1604-E05	29.6088	-98.52048	SC	20	Kplc	0.7	0.8	3	-	0	-	-	C,N,X	5	25	X		X		Roadcut
1604-E09	29.60241	-98.37166	C	30	Kau	6.0	72.2	49.2	-	0	-	-	C,F,FS	35	65		X		X	Hillside
1604-F057	29.60152	-98.53901	O	5	Kpcm	11.5	11.5	4.9	100, 120	0	-	-	N	20	25	X			X	Streambed
1604-F061	29.60513	-98.52975	C	30	Kplc	13.1	3.3	9.8	-	0	-	-	C,F	35	65		X	X		Roadcut
1604-F063	29.60781	-98.52605	SC	20	Kplc	3.3	8.2	3.3	105	0	-	-	N,O,F,X	20	40		X	X		Roadcut
1604-F064	29.60802	-98.52538	SC	20	Kpcm	10	5	3.75	-	0	-	-	C,F,V	5	25	X		X		Roadcut

* DATUM: NAD 83

2A	TYPE	2B POINTS
C	Cave	30
SC	Solution cavity	20
SF	Solution-enlarged fracture(s)	20
F	Fault	20
O	Other natural bedrock features	5
MB	Manmade feature in bedrock	30
SW	Swallow hole	30
SH	Sinkhole	20
CD	Non-karst closed depression	5
Z	Zone, clustered or aligned features	30

8A INFILLING	
N	None, exposed bedrock
C	Coarse - cobbles, breakdown, sand, gravel
O	Loose or soft mud or soil, organics, leaves, sticks, dark colors
F	Fines, compacted clay-rich sediment, soil profile, gray or red colors
V	Vegetation. Give details in narrative description
FS	Flowstone, cements, cave deposits
X	Other materials

12 TOPOGRAPHY

Cliff, Hilltop, Hillside, Drainage, Floodplain, Streambed

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Date 05 March 2020

Sheet 2 of 17

TCEQ-0585-Table (Rev. 10-01-04)

ATTACHMENT A

GEOLOGIC ASSESSMENT TABLE			PROJECT NAME:			*Loop 1604 from SH 16 to I-35, Bexar County, Texas*														
LOCATION			**FEATURE CHARACTERISTICS**												**EVALUATION**			**PHYSICAL SETTING**		
1A	1B *	1C*	2A	2B	3	4			5	5A	6	7	8A	8B	9	10		11		12
FEATURE ID	LATITUDE	LONGITUDE	FEATURE TYPE	POINTS	FORMATION	DIMENSIONS (FEET)			TREND (DEGREES)	DOM	DENSITY (NO/FT)	APERTURE (FEET)	INFILL	RELATIVE INFILTRATION RATE	TOTAL	SENSITIVITY		CATCHMENT AREA (ACRES)		TOPOGRAPHY
						X	Y	Z		10						<40	≥40	<1.6	≥1.6	
1604-F066	29.60837	-98.52443	SC	20	Kpcm	1.5	0.6	5	-	0	-	-	C,N	5	25	X		X		Roadcut
1604-F069	29.60857	-98.52377	SC	20	Kpcm	13	12	1.6	-	0	-	-	C	5	25	X		X		Roadcut
1604-F070	29.60827	-98.52233	Z	30	Kplc	50	2.5	14	-	0	-	-	O,C,V	5	35	X		X		Roadcut
1604-F071	29.60878	-98.52184	SC	20	Kplc	8.2	3.3	1	-	0	-	-	N,O,C,FS	20	40		X	X		Roadcut
1604-F072	29.60833	-98.52133	C	30	Kplc	39	4.9	32.8	-	0	-	-	N,FS	5	35	X		X		Roadcut
1604-F073	29.60826	-98.52067	SC	20	Kplc	16.4	10.5	3	90	0	-	-	N,C,FS	35	55		X	X		Roadcut
1604-F074	29.60832	-98.52026	SC	20	Kplc	2.6	8.2	2.6	-	0	-	-	C,FS,N	5	25	X		X		Roadcut
1604-F076	29.60885	-98.51199	SC	20	Kplc	0.7	1.6	0.5	50	10	-	-	N,O,F,C	5	35	X		X		Roadcut
1604-F077	29.60885	-98.51321	C	30	Kplc	6.2	16.4	13	-	0	-	-	N,O,C,FS	35	65		X	X		Roadcut
1604-F078	29.6083	-98.51319	SC	20	Kplc	3.9	2.4	4.9	-	0	-	-	C	35	55		X		X	Roadcut
1604-F079	29.6088	-98.51282	SC	20	Kplc	3.9	2.4	4.9	-	0	-	-	N	5	25	X			X	Roadcut

* DATUM: NAD 83

2A	TYPE	2B POINTS
C	Cave	30
SC	Solution cavity	20
SF	Solution-enlarged fracture(s)	20
F	Fault	20
O	Other natural bedrock features	5
MB	Manmade feature in bedrock	30
SW	Swallow hole	30
SH	Sinkhole	20
CD	Non-karst closed depression	5
Z	Zone, clustered or aligned features	30

	8A INFILLING
N	None, exposed bedrock
C	Coarse - cobbles, breakdown, sand, gravel
O	Loose or soft mud or soil, organics, leaves, sticks, dark colors
F	Fines, compacted clay-rich sediment, soil profile, gray or red colors
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Date 5 March 2020

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TCEQ-0585-Table (Rev. 10-01-04)

ATTACHMENT A

GEOLOGIC ASSESSMENT TABLE			PROJECT NAME:			*Loop 1604 from SH 16 to I-35, Bexar County, Texas*														
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1A	1B *	1C*	2A	2B	3	4			5	5A	6	7	8A	8B	9	10		11		12
FEATURE ID	LATITUDE	LONGITUDE	FEATURE TYPE	POINTS	FORMATION	DIMENSIONS (FEET)			TREND (DEGREES)	DOM	DENSITY (NO/FT)	APERTURE (FEET)	INFILL	RELATIVE INFILTRATION RATE	TOTAL	SENSITIVITY		CATCHMENT AREA (ACRES)		TOPOGRAPHY
						X	Y	Z		10						<40	≥40	<1.6	≥1.6	
1604-F083	29.60841	-98.51119	SC	20	Kplc	1.6	1.6	2.3	-	0	-	-	C	20	40		X	X		Roadcut
1604-F084	29.60839	-98.51077	SC	20	Kplc	4.9	1	9.8	-	0	-	-	N,C	5	25	X		X		Roadcut
1604-F085	29.60847	-98.50945	SC	20	Kplc	2.3	3.6	3.9	-	0	-	-	N,C,O	20	40		X	X		Roadcut
1604-F101	29.60621	-98.45929	C	30	Kplc	39.4	16.4	6.6	45	10	-	-	X	5	45		X	X		Roadcut
1604-FZ3	29.60883	-98.5102	SC	20	Kplc	1	1	9.8	-	0	-	-	C,O	5	25	X		X		Roadcut
1604-FZ4	29.60838	-98.51343	SC	20	Kplc	1.5	0.8	3.6	-	0	-	-	F,O	5	25	X		X		Roadcut
1604-FZ6	29.60798	-98.52578	Z	30	Kpcm	2	1.75	3.2	140	0	-	-	C,FS,N	5	35	X		X		Roadcut
1604-FZ7	29.608061	-98.525249	SC	20	Kpcm	5.7	6.6	1.6	-	0	-	-	C,O	20	40		X	X		Roadcut
1604-FZ8	29.60379	-98.53302	SC	20	Kplc	10	1	5.3	-	0	-	-	C,F,N	5	25	X		X		Roadcut
1604-K41	29.60595	-98.45623	SC	20	Kplc	2	1.1	1.3	-	0	-	-	F	5	25	X		X		Roadcut
1604-L02	29.600834	-98.561419	SC	20	Kkd	6.6	0.7	0.2	-	0	-	-	O	5	25	X		X		Roadcut

* DATUM: NAD 83

2A	TYPE	2B POINTS
C	Cave	30
SC	Solution cavity	20
SF	Solution-enlarged fracture(s)	20
F	Fault	20
O	Other natural bedrock features	5
MB	Manmade feature in bedrock	30
SW	Swallow hole	30
SH	Sinkhole	20
CD	Non-karst closed depression	5
Z	Zone, clustered or aligned features	30

8A INFILLING	
N	None, exposed bedrock
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O	Loose or soft mud or soil, organics, leaves, sticks, dark colors
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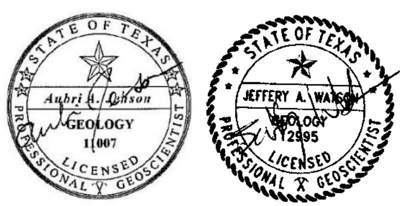

Date 05 March 2020

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TCEQ-0585-Table (Rev. 10-01-04)

ATTACHMENT A

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LOCATION			FEATURE CHARACTERISTICS												EVALUATION			PHYSICAL SETTING		
1A	1B *	1C*	2A	2B	3	4			5	5A	6	7	8A	8B	9	10		11		12
FEATURE ID	LATITUDE	LONGITUDE	FEATURE TYPE	POINTS	FORMATION	DIMENSIONS (FEET)			TREND (DEGREES)	DOM	DENSITY (NO/FT)	APERTURE (FEET)	INFILL	RELATIVE INFILTRATION RATE	TOTAL	SENSITIVITY		CATCHMENT AREA (ACRES)		TOPOGRAPHY
						X	Y	Z		10						<40	≥40	<1.6	≥1.6	
1604-L11	29.60301	-98.53477	SC	20	Kpcm	9	3	2.5	-	0	-	-	N,FS,C	5	25	X		X		Roadcut
1604-L12	29.603117	-98.53463	SC	20	Kpcm	6.6	0.7	4.6	33	10	-	-	N,C,O,X	20	50		X	X		Roadcut
1604-L13	29.60334	-98.53395	SC	20	Kplc	0.3	0.3	3.7	124	0	0.1	0.32	C,F,N	5	25	X		X		Roadcut
1604-L13a	29.60334	-98.53395	SC	20	Kplc	0.7	0.5	2.6	-	0	-	-	C,F	5	25	X		X		Roadcut
1604-L16	29.60276	-98.53431	SC	20	Kplc	3	2.6	11	17	0	-	-	C,F	5	25	X		X		Roadcut
1604-M21	29.60257	-98.53965	C	30	Kpcm	6.5	9.8	0.98	-	0	-	-	C,F,X	20	50		X		X	Floodplain
1604-M22	29.60224	-98.53955	SC	20	Kpcm	2.5	3.3	0.66	-	0	-	-	C,X	5	25	X			X	Floodplain
1604-Q48	29.59031	-98.6041	SC	20	Kplc	4.9	6.6	2.5	-	0	-	-	N,C	5	25	X			X	Floodplain
1604-R03	29.59075	-98.60438	C	30	Kplc	2.9	4.9	7.9	-	0	-	-	C,O,F	5	35	X			X	Floodplain
1604-R04	29.59078	-98.60455	SC	20	Kplc	9.8	5.9	5.9	-	0	-	-	C,O,F	5	25	X			X	Floodplain
1604-R05	29.59072	-98.60454	SC	20	Kplc	5.9	6.6	3.0	-	0	-	-	N	5	25	X		X		Roadcut

* DATUM: NAD 83

2A	TYPE	2B POINTS
C	Cave	30
SC	Solution cavity	20
SF	Solution-enlarged fracture(s)	20
F	Fault	20
O	Other natural bedrock features	5
MB	Manmade feature in bedrock	30
SW	Swallow hole	30
SH	Sinkhole	20
CD	Non-karst closed depression	5
Z	Zone, clustered or aligned features	30

	8A INFILLING
N	None, exposed bedrock
C	Coarse - cobbles, breakdown, sand, gravel
O	Loose or soft mud or soil, organics, leaves, sticks, dark colors
F	Fines, compacted clay-rich sediment, soil profile, gray or red colors
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Date 5 March 2020

Sheet 5 of 17

TCEQ-0585-Table (Rev. 10-01-04)

ATTACHMENT A

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1A	1B *	1C*	2A	2B	3	4			5	5A	6	7	8A	8B	9	10		11		12
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						X	Y	Z		10						<40	≥40	<1.6	≥1.6	
1604-R06	29.5907	-98.60484	Z	30	Kplc	5.9	40.0	3.0	-	0	10	-	C,F	5	35	X		X		Roadcut
1604-T01	29.60563	-98.45509	SC	20	Kplc	3.3	1.0	4.9	-	0	-	-	N,C,F,V	5	25	X		X		Roadcut
1604-T02	29.6058	-98.45574	SH	20	Kplc	5	9	3	-	0	-	-	N,C,F,V	5	25	X		X		Roadcut
1604-T04	29.607994	-98.525234	SH	20	Kpcm	4	3	13	-	0	-	-	N,C	5	25	X		X		Roadcut
1604-T05	29.603564	-98.534041	F	20	Kpcm	1420	NA	NA	50	10	-	-	Und.	5	35	X			X	Roadcut
1604-T06	29.602691	-98.534679	SH	20	Kplc	10	10	NA	-	0	-	-	N,C,F,V	5	25	X		X		Roadcut
1604-T07	29.602761	-98.534457	F	20	Kplc	36	15	NA	-	0	-	-	N	5	25	X		X		Roadcut
1604-T08	29.602843	-98.53414	Z	30	Kplc	24	15	NA	32	0	-	0.1	N,C,F,V	5	35	X		X		Roadcut
1604-T09	29.602991	-98.533825	SH	20	Kplc	9.8	3.3	13.1	-	0	-	-	F	5	25	X		X		Roadcut
1604-T11	29.605028	-98.530001	SH	20	Kplc	6.6	3.3	11.5	-	0	-	-	N,C,V,F	5	25	X		X		Roadcut
1604-T12	29.60737	-98.5257	Z	30	Kplc	18	2.5	14	-	0	-	-	SF,V, O	5	35	X		X		Roadcut

* DATUM: NAD 83

2A	TYPE	2B POINTS
C	Cave	30
SC	Solution cavity	20
SF	Solution-enlarged fracture(s)	20
F	Fault	20
O	Other natural bedrock features	5
MB	Manmade feature in bedrock	30
SW	Swallow hole	30
SH	Sinkhole	20
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Z	Zone, clustered or aligned features	30

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TCEQ-0585-Table (Rev. 10-01-04)

STATE OF TEXAS Aubri A. Jackson GEOLOGY 11007 LICENSED PROFESSIONAL GEOSCIENTIST

STATE OF TEXAS JEFFERY A. WATSON GEOLOGY 12995 LICENSED PROFESSIONAL GEOSCIENTIST

ATTACHMENT A

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LOCATION			FEATURE CHARACTERISTICS												EVALUATION			PHYSICAL SETTING			
1A	1B *	1C*	2A	2B	3	4			5	5A	6	7	8A	8B	9	10		11		12
FEATURE ID	LATITUDE	LONGITUDE	FEATURE TYPE	POINTS	FORMATION	DIMENSIONS (FEET)			TREND (DEGREES)	DOM	DENSITY (NO/FT)	APERTURE (FEET)	INFILL	RELATIVE INFILTRATION RATE	TOTAL	SENSITIVITY		CATCHMENT AREA (ACRES)		TOPOGRAPHY
						X	Y	Z		10						<40	≥40	<1.6	≥1.6	
1604-T17	29.60259	-98.381286	F	20	Kau/Kpg	756	NA	NA	47	10	-	-	Und.	5	35	X			X	Hillside
1604-T18	29.602495	-98.385698	F	20	Kbu/Kau	1760	NA	NA	60, 80	10	-	-	Und.	5	35	X			X	Hillside
1604-T22	29.6009	-98.4189	F	20	Kplc/Kpcm	793	NA	NA	45	10	-	-	Und.	5	35	X			X	Hillside
1604-T25	29.598957	-98.563387	F	20	Kkd/Ku	223	NA	NA	67	0	-	-	Und.	5	25	X			X	Hillside
1604-T27	29.592182	-98.587653	F	20	Ked/Kef/K	902	NA	NA	65	10	-	-	Und.	5	35	X			X	Hillside
1604-T34	29.546374	-98.674039	F	20	Kbu/Kau	466	NA	NA	102	0	-	-	Und.	5	25	X			X	Hillside
1604-W05	29.60857	-98.52336	Z,SC	30	Kpcm	3	2	5	-	0	-	-	N,V,C	5	35	X		X		Roadcut
1604-W08	29.60319	-98.53317	Z,SC	30	Kplc	10	3	7	-	0	-	-	N,F	5	35	X		X		Roadcut
F056	29.60293	-98.53897	Z	30	Kpcm	20	50	1	89,45	10	0.2	1	N,O,V,F,C	20	60		X		X	Floodplain
G01	29.592528	-98.597487	CD	5	Kplc	0.9	0.7	3	-	0	-	-	C,O	30	35	X		X		Hillside
G04	29.615031	-98.606639	Z	30	Kgru	9.8	3.3	1.6	-	0	-	-	C,O,F	5	35	X		X		Roadcut

* DATUM: NAD 83

2A	TYPE	2B POINTS
C	Cave	30
SC	Solution cavity	20
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TCEQ-0585-Table (Rev. 10-01-04)

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FEATURE ID	LATITUDE	LONGITUDE	FEATURE TYPE	POINTS	FORMATION	DIMENSIONS (FEET)			TREND (DEGREES)	DOM	DENSITY (NO/FT)	APERTURE (FEET)	INFILL	RELATIVE INFILTRATION RATE	TOTAL	SENSITIVITY		CATCHMENT AREA (ACRES)		TOPOGRAPHY
						X	Y	Z		10						<40	≥40	<1.6	≥1.6	
HB-007	29.60474	-98.53141	Z	30	Kplc	7	0.5	0.5	135	0	-	-	N,C,F,V,	5	35	X		X		Roadcut
HB-008	29.604	-98.53268	SC	20	Kplc	12	2.5	8	-	0	-	-	N,C	5	25	X		X		Roadcut
HB-009	29.603984	-98.532747	SC	20	Kplc	8	1.5	3.8	-	0	-	-	N,C,V	5	25	X		X		Roadcut
HB-010	29.603927	-98.532797	SC	20	Kplc	1	1.8	1	-	0	-	-	N,F	5	25	X		X		Roadcut
HB-012	29.603786	-98.533114	SC	20	Kplc	12	3.5	15	-	0	-	-	N,F	5	25	X		X		Roadcut
HB-013	29.603666	-98.533329	Z	30	Kplc	6	2	3.5	-	0	-	-	N,C,F,V	5	35	X		X		Roadcut
HB-014	29.603568	-98.533484	Z	30	Kplc	15	4	12	-	0	-	-	N,C,F,V	5	35	X		X		Roadcut
HB-016	29.603285	-98.534174	Z	30	Kpcm	5	1.5	3	-	0	-	-	N,F	5	35	X		X		Roadcut
HB-017	29.603008	-98.535008	SH	30	Kpcm	20	4	15	-	0	-	-	N,C,F,V	5	35	X		X		Roadcut
HB-018	29.602889	-98.535435	SC	20	Kpcm	5	2	2	-	0	-	-	N,C,F	5	25	X		X		Roadcut
HB-019	29.602838	-98.535533	SC	20	Kpcm	2.5	1.5	6	-	0	-	-	N,C,F	5	25	X		X		Roadcut

* DATUM: NAD 83

2A	TYPE	2B POINTS
C	Cave	30
SC	Solution cavity	20
SF	Solution-enlarged fracture(s)	20
F	Fault	20
O	Other natural bedrock features	5
MB	Manmade feature in bedrock	30
SW	Swallow hole	30
SH	Sinkhole	20
CD	Non-karst closed depression	5
Z	Zone, clustered or aligned features	30

	8A INFILLING
N	None, exposed bedrock
C	Coarse - cobbles, breakdown, sand, gravel
O	Loose or soft mud or soil, organics, leaves, sticks, dark colors
F	Fines, compacted clay-rich sediment, soil profile, gray or red colors
V	Vegetation. Give details in narrative description
FS	Flowstone, cements, cave deposits
X	Other materials

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Sheet ____8___ of ___17___

TCEQ-0585-Table (Rev. 10-01-04)

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ATTACHMENT A

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LOCATION			FEATURE CHARACTERISTICS												EVALUATION			PHYSICAL SETTING		
1A	1B *	1C*	2A	2B	3	4			5	5A	6	7	8A	8B	9	10		11		12
FEATURE ID	LATITUDE	LONGITUDE	FEATURE TYPE	POINTS	FORMATION	DIMENSIONS (FEET)			TREND (DEGREES)	DOM	DENSITY (NO/FT)	APERTURE (FEET)	INFILL	RELATIVE INFILTRATION RATE	TOTAL	SENSITIVITY		CATCHMENT AREA (ACRES)		TOPOGRAPHY
						X	Y	Z		10						<40	≥40	<1.6	≥1.6	
HB-020	29.602808	-98.535746	SC	20	Kpcm	2.5	2.5	4	-	0	-	-	N,C,F	5	25	X		X		Roadcut
HB-021	29.60273	-98.53604	Z	30	Kpcm	5	2.5	1.5	-	0	-	-	N,C,F,V	5	35	X		X		Roadcut
HB-022	29.602666	-98.536343	SH	30	Kpcm	12	3	12	-	0	-	-	N,C,F,V,FS	5	35	X		X		Roadcut
HB-023	29.60881	-98.520777	SC	20	Kplc	1	1.3	0.5	-	0	-	-	N,C,F	5	25	X		X		Roadcut
HB-024	29.608286	-98.524493	SH	30	Kpcm	6	3	12	-	0	-	-	N,C,F,V	5	35	X		X		Roadcut
HB-025	29.602464	-98.535399	SH	30	Kpcm	25	10	10	-	0	-	-	N,F,V	5	35	X		X		Roadcut
HB-026	29.60262	-98.535	SC	20	Kpcm	0.3	2	1.5	0	0	-	-	N,F	5	25	X		X		Roadcut
HB-027	29.602728	-98.534434	SC	20	Kplc	15	5	12	-	0	-	-	N,F,C,V	5	25	X		X		Roadcut
HB-029	29.603333	-98.532906	SC	20	Kplc	6	3	1.3	-	0	-	-	N,C	5	25	X		X		Roadcut
HB-030	29.603773	-98.532104	SC	20	Kplc	8	3.6	0.75	-	0	-	-	N,C	5	25	X		X		Roadcut
HB-031	29.607491	-98.525383	SH	30	Kplc	7	3.5	9.5	-	0	-	-	N,C,F,V	5	35	X		X		Roadcut

* DATUM: NAD 83

2A	TYPE	2B POINTS
C	Cave	30
SC	Solution cavity	20
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HB-032	29.60764	-98.52505	Z	30	Kplc	15	4	4	-	0	-	-	N,C,F,V	5	35	X		X		Roadcut
HB-033	29.60792	-98.524091	Z	30	Kpcm	20	3	5	-	0	-	-	N,C,F,V	5	35	X		X		Roadcut
HB-034	29.60812	-98.52329	SC	20	Kpcm	1	2.5	0.3	-	0	-	-	N,C,F	5	25	X		X		Roadcut
HB-035	29.60812	-98.5232	SC	20	Kpcm	20	4	2	-	0	-	-	N,C,F	5	25	X		X		Roadcut
HB-036	29.608192	-98.522795	Z	30	Kpcm	15	2	4	-	0	0.5	0.5	N,C,F,V	5	35	X		X		Roadcut
HB-037	29.608235	-98.522576	SC	20	Kpcm	70	2	3	-	0	-	-	N,C,F,V	5	25	X		X		Roadcut
HB-038	29.608329	-98.52111	SC	20	Kplc	1	2.2	1	-	0	-	-	N,C	5	25	X		X		Roadcut
LOOP-001	29.60124	-98.40352	O	5	Ku	13.1	9.8	4.9	165	10	0.5	0.13	N,C	20	35	X			X	Drainage
LOOP-002	29.60341	-98.53891	O	5	Kpcm	4.9	32.8	0	75, 175	10	0.5	0.06	N	20	35	X			X	Streambed
LOOP-003	29.56273	-98.65813	Z	5	Kpcm	6.5	82	0	0, 80	10	0.75	0.08	N	5	20	X			X	Streambed
LOOP-006	29.60151	-98.39114	O	5	Kbu	10	50	0	-	0	-	-	N, C, O	20	25	X			X	Streambed

* DATUM: NAD 83

2A	TYPE	2B POINTS
C	Cave	30
SC	Solution cavity	20
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Aubri Jenson
Jeffery Watson

Date 05 March 2020

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TCEQ-0585-Table (Rev. 10-01-04)

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LOCATION			FEATURE CHARACTERISTICS												EVALUATION			PHYSICAL SETTING		
1A	1B *	1C*	2A	2B	3	4			5	5A	6	7	8A	8B	9	10		11		12
FEATURE ID	LATITUDE	LONGITUDE	FEATURE TYPE	POINTS	FORMATION	DIMENSIONS (FEET)			TREND (DEGREES)	DOM	DENSITY (NO/FT)	APERTURE (FEET)	INFILL	RELATIVE INFILTRATION RATE	TOTAL	SENSITIVITY		CATCHMENT AREA (ACRES)		TOPOGRAPHY
						X	Y	Z		10						<40	≥40	<1.6	≥1.6	
LOOP-007	29.60203	-98.39027	O	5	Kbu	1.6	9.8	0	29	0	0.75	0.06	N,O,V	5	10	X		X		Drainage
LOOP-008	29.60178	-98.40454	MB	30	Ku	0.4	0.4	unk	-	0	-	-	N, F	5	35	X		X		Hilltop
LOOP-009	29.60735	-98.46035	SC	20	Kplc	2.6	3.2	3.6	-	0	-	-	C	20	40		X	X		Roadcut
LOOP-010	29.60731	-98.46007	SC	20	Kplc	4.9	4.5	3.9	-	0	-	-	F, FS	5	25	X		X		Roadcut
LOOP-012	29.60986	-98.48728	SW	30	Kplc	13.1	70	3.2	40, 120	10	-	0.1	N,C,O,V	35	75		X		X	Streambed
LOOP-013	29.61021	-98.48101	O	5	Kplc	3.2	19.7	0	50, 120	10	0.75	<0.01	N	5	20	X		X		Hillside
LOOP-014	29.60921	-98.51984	O	5	Kplc	6.6	19.7	-	70, 135	0	0.5	0.03	N, C, O	20	25	X			X	Streambed
LOOP-015	29.60717	-98.52825	O	5	Kplc	6.5	19.6	0	60, 170	10	0.75	0.06	N, V, C	20	35	X			X	Streambed
LOOP-016	29.60781	-98.51811	O	5	Kplc	13.1	19.6	0	50, 116	10	0.75	0.06	N, V, C	20	35	X			X	Streambed
LOOP-017	29.6077	-98.51674	O	5	Kplc	9.8	65.6	0	53, 88	10	0.25	0.1	N, C, O	20	35	X			X	Streambed
LOOP-101	29.59939	-98.59896	CD	5	Kkd	26.2	16.4	4.9	-	0	-	-	C,O,V	5	10	X			X	Floodplain

* DATUM: NAD 83

2A	TYPE	2B POINTS
C	Cave	30
SC	Solution cavity	20
SF	Solution-enlarged fracture(s)	20
F	Fault	20
O	Other natural bedrock features	5
MB	Manmade feature in bedrock	30
SW	Swallow hole	30
SH	Sinkhole	20
CD	Non-karst closed depression	5
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8A INFILLING	
N	None, exposed bedrock
C	Coarse - cobbles, breakdown, sand, gravel
O	Loose or soft mud or soil, organics, leaves, sticks, dark colors
F	Fines, compacted clay-rich sediment, soil profile, gray or red colors
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STATE OF TEXAS
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ATTACHMENT A

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LOCATION			**FEATURE CHARACTERISTICS**												**EVALUATION**			**PHYSICAL SETTING**		
1A	1B *	1C*	2A	2B	3	4			5	5A	6	7	8A	8B	9	10		11		12
FEATURE ID	LATITUDE	LONGITUDE	FEATURE TYPE	POINTS	FORMATION	DIMENSIONS (FEET)			TREND (DEGREES)	DOM	DENSITY (NO/FT)	APERTURE (FEET)	INFILL	RELATIVE INFILTRATION RATE	TOTAL	SENSITIVITY		CATCHMENT AREA (ACRES)		TOPOGRAPHY
						X	Y	Z		10						<40	≥40	<1.6	≥1.6	
LOOP-102	29.60107	-98.6012	C	30	Kkd	11.5	24.6	1.6	-	0	-	-	F	20	50		X		X	Floodplain
LOOP-103	29.60119	-98.60129	SC	20	Kkd	1.3	4.9	1.3	-	0	-	-	F	5	25	X			X	Floodplain
LOOP-104	29.57426	-98.59406	O	5	Kbu	3.3	unk	0.1	-	0	-	-	O,V	5	10	X		X		Hillside
LOOP-105	29.61315	-98.60548	SC	20	Ked	1.3	4.1	1.3	-	0	-	-	N,C	5	25	X		X		Roadcut
LOOP-106	29.60169	-98.39597	O	5	Kdr	9.8	19.7	-	50, 120	10	0.25	0.06	O	20	35	X			X	Streambed
LOOP-107	29.60716	-98.45952	SC	20	Kplc	0.5	4.9	0.7	-	0	-	-	N	5	25	X		X		Roadcut
LOOP-108	29.60579	-98.456	SF	20	Kplc	3.3	1.6	9.8	155	0	-	-	N,C,FS	5	25	X		X		Roadcut
LOOP-109	29.60573	-98.45537	SF	20	Kplc	3.3	1.6	9.8	160	0	-	-	N,C,FS	5	25	X		X		Roadcut
LOOP-110	29.60557	-98.45665	SC	20	Kplc	1.6	1.6	2.3	50	10	-	-	N,C,FS	5	35	X		X		Roadcut
LOOP-111	29.6061	-98.45826	SC	20	Kplc	1	1	3.3	23	0	-	-	N,C, V	5	25	X		X		Roadcut
LOOP-112	29.60624	-98.45866	SC	20	Kplc	1	1	0.7	-	0	-	-	N,C,FS	5	25	X		X		Roadcut

* DATUM: NAD 83

2A	TYPE	2B POINTS
C	Cave	30
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						X	Y	Z		10						<40	≥40	<1.6	≥1.6	
LOOP-113	29.60793	-98.50007	O	5	Kplc	6.6	13.1	-	20	10	-	-	N,C,O	20	35	X			X	Streambed
LOOP-114	29.60793	-98.50007	O	5	Kplc	8.2	19.7	-	40, 120	10	0.5	0.03	N, C, V	20	35	X			X	Drainage
LOOP-116	29.60893	-98.48083	O	5	Kplc	4.9	13.1	-	5, 65	10	-	-	N,O,C	20	35	X			X	Streambed
LOOP-201	29.55824	-98.66204	MB	30	Ked	0.3	0.3	3.2	-	0	-	-	O	5	35	X		X		Hillside
LOOP-202	29.57593	-98.64722	SC	20	Kg	1.6	0.7	0.3	-	0	-	-	O,C,F	20	40		X		X	Streambed
LOOP-204	29.60776	-98.49603	SF	20	Kplc	5	8	0.4	84, 31	10	1	0.5	N,O,C	5	35	X			X	Drainage
LOOP-205	29.60862	-98.48667	SW	30	Kplc	10	125	0	10, 110	0	0.5	0.01	O,V,C,	35	65		X		X	Streambed
LOOP-207	29.60118	-98.60151	SC,SF	20	Kkd	2.5	6	1	41	10	0.2	-	O,C,F	20	50		X		X	Streambed
LOOP-208	29.61892	-98.60857	O	5	Kgru	20	50	0	105	0	0.2	0.25	N,O,C,	5	10	X			X	Drainage
LOOP-209	29.58197	-98.64213	SF	20	Kpcm	8	30	0	56	10	0.1	0.3	N,V,C,	5	35	X			X	Streambed
LOOP-211	29.57528	-98.64575	SF,MB	30	Kpcm	0.5	8	0	160	0	-	-	N,O,	5	35	X			X	Streambed

* DATUM: NAD 83

2A	TYPE	2B POINTS
C	Cave	30
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1A	1B *	1C*	2A	2B	3	4			5	5A	6	7	8A	8B	9	10		11		12
FEATURE ID	LATITUDE	LONGITUDE	FEATURE TYPE	POINTS	FORMATION	DIMENSIONS (FEET)			TREND (DEGREES)	DOM	DENSITY (NO/FT)	APERTURE (FEET)	INFILL	RELATIVE INFILTRATION RATE	TOTAL	SENSITIVITY		CATCHMENT AREA (ACRES)		TOPOGRAPHY
						X	Y	Z		10						<40	≥40	<1.6	≥1.6	
LOOP-212	29.57942	-98.64146	O	5	Kpcm	8	30	0	56	10	0.3	0.02	N, FS, F	5	20	X			X	Drainage
LOOP-213	29.5863	-98.62984	SC,SF	20	Kpcm	3	3	0.2	-	0	0.1	0.3	N,O,V	35	55		X		X	Streambed
LOOP-214	29.60146	-98.53899	SC,SF	20	Kpcm	30	180	2	45, 110	10	0.1	1	N,O,F,C	35	65		X		X	Streambed
LOOP-215	29.60105	-98.60126	SC	20	Kkd	4	2.6	6	192, 230	10	-	-	N,F,C	5	35	X		X		Floodplain
LOOP-216	29.60887	-98.51072	F	20	Kplc	14.7	3.3	9.8	50	10	0.06	-	F,FS	5	35	X		X		Roadcut
LOOP-217	29.60841	-98.512	SC	20	Kplc	0.2	0.3	2.5	-	0	-	-	O,C,F	20	40		X	X		Roadcut
LOOP-F01	29.559599	-98.661385	F	20	Kpcm/Ku	331	NA	NA	114	0	-	-	Und.	5	25	X			X	Streambed
LOOP-F02	29.575675	-98.646597	F	20	Kg/Ku/Kpc	1438	NA	NA	60`	10	-	-	Und.	5	35	X			X	Streambed
LOOP-F03	29.587233	-98.629183	F	20	Kpcm/Kkd	984	NA	NA	27, 45	10	-	-	Und.	5	35	X			X	Streambed
LOOP-F04	29.589475	-98.610333	F	20	Kkd/Kplc	856	NA	NA	51	10	-	-	Und.	5	35	X			X	Hillside
LOOP-F05	29.589679	-98.60443	F	20	Kpcm/Ku	30	NA	NA	38	10	-	-	Und.	5	35	X			X	Hillside

* DATUM: NAD 83

2A	TYPE	2B POINTS
C	Cave	30
SC	Solution cavity	20
SF	Solution-enlarged fracture(s)	20
F	Fault	20
O	Other natural bedrock features	5
MB	Manmade feature in bedrock	30
SW	Swallow hole	30
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N	None, exposed bedrock
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F	Fines, compacted clay-rich sediment, soil profile, gray or red colors
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Date 05 March 2020

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ATTACHMENT A

GEOLOGIC ASSESSMENT TABLE — PROJECT NAME: *Loop 1604 from SH 16 to I-35, Bexar County, Texas*

LOCATION			FEATURE CHARACTERISTICS												EVALUATION			PHYSICAL SETTING		
1A	1B *	1C*	2A	2B	3	4			5	5A	6	7	8A	8B	9	10		11		12
FEATURE ID	LATITUDE	LONGITUDE	FEATURE TYPE	POINTS	FORMATION	DIMENSIONS (FEET)			TREND (DEGREES)	DOM	DENSITY (NO/FT)	APERTURE (FEET)	INFILL	RELATIVE INFILTRATION RATE	TOTAL	SENSITIVITY		CATCHMENT AREA (ACRES)		TOPOGRAPHY
						X	Y	Z		10						<40	≥40	<1.6	≥1.6	
LOOP-F06	29.591004	-98.598577	F	20	Kplc/Ku	3485	NA	NA	77	0	-	-	Und.	5	25	X			X	Hillside
LOOP-F07	29.593213	-98.598822	F	20	Kkd/Kplc	463	NA	NA	81	0	-	-	Und.	5	25	X			X	Streambed
LOOP-F08	29.595094	-98.599059	F	20	Kkd/Kkd	465	NA	NA	65	10	-	-	Und.	5	35	X			X	Hillside
LOOP-F09	29.606506	-98.602081	F	20	Ked/Kgru/	532	NA	NA	56	10	-	-	Und.	5	35	X			X	Hillside
LOOP-F10	29.61394	-98.605119	F	20	Kgru/Ked	505	NA	NA	65	10	-	-	Und.	5	35	X			X	Hillside
LOOP-F11	29.620576	-98.608295	F	20	Kgru/Kgru	336	NA	NA	50	10	-	-	Und.	5	35	X			X	Hillside
LOOP-F12	29.572953	-98.593951	F	20	Kbu/Kdr	452	NA	NA	90	0	-	-	Und.	5	25	X			X	Hillside
LOOP-F13	29.593451	-98.578692	F	20	Ked/Kbu	722	NA	NA	93	0	-	-	Und.	5	25	X			X	Hillside
LOOP-F14	29.596911	-98.569275	F	20	Kkd/Kpcm	2900	NA	NA	68	0	-	-	Und.	5	25	X			X	Hillside
LOOP-F15	29.599962	-98.560677	F	20	Kkd/Ku	211	NA	NA	67	0	-	-	Und.	5	25	X			X	Hillside
LOOP-F16	29.601244	-98.553286	F	20	Kkd/Ku	3002	NA	NA	89	0	-	-	Und.	5	25	X			X	Hillside

* DATUM: NAD 83

2A	TYPE	2B POINTS
C	Cave	30
SC	Solution cavity	20
SF	Solution-enlarged fracture(s)	20
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Aubri Jonson

Jeffery Watson

Date 05 March 2020

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ATTACHMENT A

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						X	Y	Z		10						<40	≥40	<1.6	≥1.6	
LOOP-F17	29.601945	-98.544771	F	20	Kpcm/Ku	1174	NA	NA	66	0	-	-	Und.	5	25	X			X	Hillside
LOOP-F18	29.602294	-98.538944	F	20	Kpcm/Kpc	962	NA	NA	4	0	-	-	Und.	5	25	X			X	Hillside
LOOP-F19	29.608568	-98.515969	F	20	Kplc/Kplc	987	NA	NA	29, 38	10	-	-	Und.	5	35	X			X	Hillside
LOOP-F20	29.608562	-98.50737	F	20	Kplc/Kprd/	964	NA	NA	67	0	-	-	Und.	5	25	X			X	Hillside
LOOP-F21	29.608526	-98.500335	F	20	Kplc/Kkd	807	NA	NA	36, 54	10	-	-	Und.	5	35	X			X	Hillside
LOOP-F22	29.608584	-98.495084	F	20	Kplc/Kplc	430	NA	NA	15	0	-	-	Und.	5	25	X			X	Hillside
LOOP-F23	29.604515	-98.451411	F	20	Kkg/Kprd	565	NA	NA	45	10	-	-	Und.	5	35	X			X	Hillside
LOOP-F24	29.602221	-98.44166	F	20	Kplc/Kplc	573	NA	NA	36	10	-	-	Und.	5	35	X			X	Hillside
LOOP-F25	29.601639	-98.439464	F	20	Kplc/Kplc	833	NA	NA	70	0	-	-	Und.	5	25	X			X	Hillside
LOOP-F26	29.601134	-98.406959	F	20	Ked/Kdr	166	NA	NA	51	10	-	-	Und.	5	35	X			X	Hillside
LOOP-F27	29.602897	-98.363634	F	20	Kau/Kau	500	NA	NA	10	0	-	-	Und.	5	25	X			X	Hillside

* DATUM: NAD 83

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Date 05 March 2020

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TCEQ-0585-Table (Rev. 10-01-04)

ATTACHMENT A

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						X	Y	Z		10						<40	≥40	<1.6	≥1.6	
LOOP-F28	29.602201	-98.360257	F	20	Kau/Kef	182	NA	NA	127	0	-	-	Und.	5	25	X			X	Hillside
LOOP-F29	29.600393	-98.357834	F	20	Kpg/Kau	547	NA	NA	57	10	-	-	Und.	5	35	X			X	Hillside
LOOP-F30	29.603385	-98.533936	F	20	Kplc/Kpcm	1452	NA	NA	50	10	-	-	Und.	5	35	X			X	Hillside
LOOP-W01	29.60277	-98.38879	MB	20	Kbu	1	1	<285	-	0	-	-	O	35	55		X		X	Hillside
North Wall C(33)	29.60666	-98.4582	SC	20	Kplc	1.3	1.0	9.8	-	0	-	-	FS, F	5	25	X		X		Roadcut

* DATUM: NAD 83

2A	TYPE	2B POINTS
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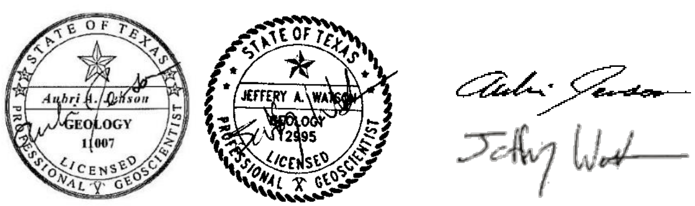
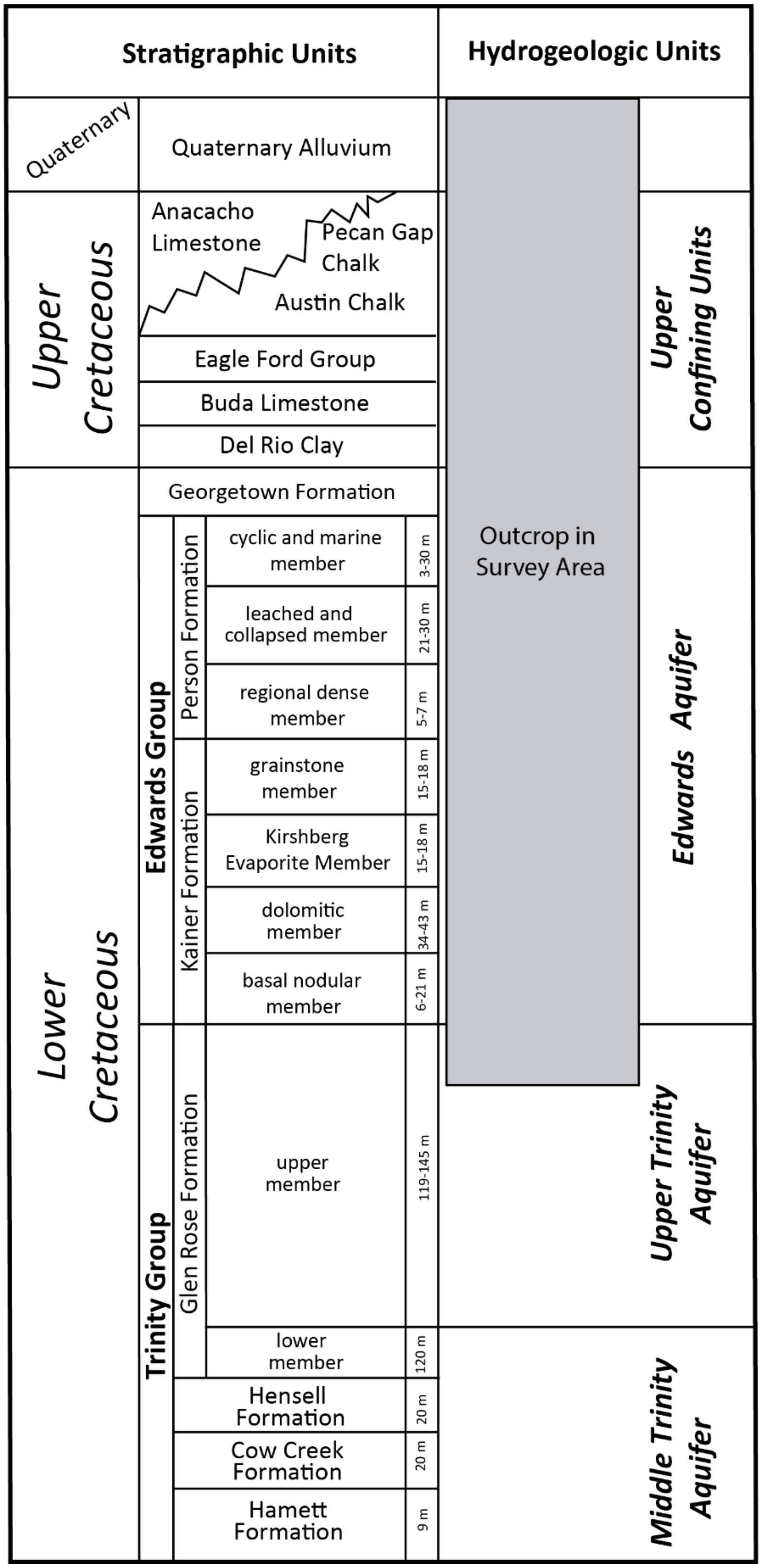
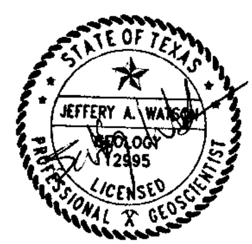


ATTACHMENT B





This stratigraphic column shows the regional geologic units and indicates the zones of rocks that outcrop in the survey area. Adapted from Lindgren et al. (2004).

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Introduction

The Texas Department of Transportation (TxDOT) is planning roadway improvements to Loop 1604 from State Highway 16 to Interstate 35 (Project). The Project is within the Texas Commission of Environmental Quality (TCEQ) Edwards Aquifer Recharge Zone, Transition Zone, and Contributing Zone within the Transition Zone. Figure 1 shows the Project location. The proposed Project meets the TCEQ's requirements for regulation under the Edwards Rules at Title 30 Texas Administrative Code (TAC) Chapter 213.5. A Geologic Assessment (GA) was conducted within the survey area, defined as the Loop 1604 right of way (ROW) and drainage easements inside all Edwards Aquifer zones extending from east of Green Mountain Road to Braun Road during fieldwork conducted from July 10, 2019 through September 30, 2019.

ATTACHMENT C

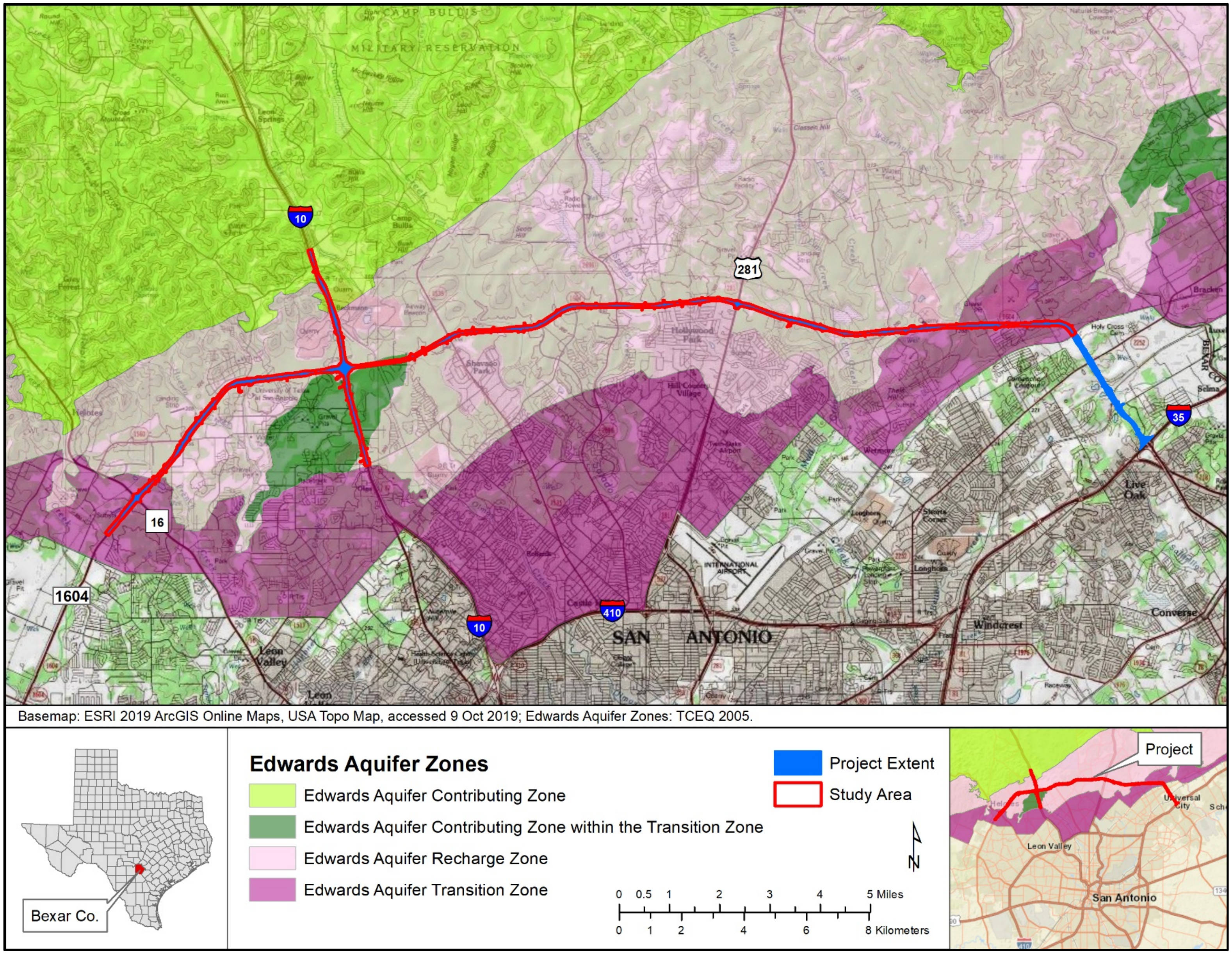

Figure 1. The Loop 1604 from SH 16 to I-35, Bexar County, Texas Project and survey areas.

ATTACHMENT C

Methods

Background Data Collection

Surface geologic maps from the Geologic Atlas of Texas (GAT; 2010) and Blome et al. (2005) were reviewed. The preferred map was Blome et al. (2005) that included surface geology over the Edwards Aquifer at 1:24,000 scale. In instances where features were located outside of the mapped area, the GAT (2010) was referenced instead at the same scale. Floodplain maps produced by the Federal Emergency Management Agency (FEMA) were also reviewed. Soil descriptions were compiled from the Web Soil Survey of the U.S. Department of Agriculture (USDA) (2019). Water well information was obtained from the Texas Water Development Board (TWDB) database and from TCEQ records. Geoscientists also consulted an unpublished draft GA (Unpublished 2010) prepared for a larger Loop 1604 survey area, which included the current Project area. This unpublished GA included an exhaustive search of cave locations from the Texas Speleological Survey (TSS) and previous GAs performed within or nearby the previous Loop 1604 survey area.

Feature descriptions from three recently conducted GAs were incorporated into this report (TxDOT 2017; TxDOT 2018a; TxDOT 2018b). The study area for these GAs covered the 1604 ROW in the vicinity of Northwest Military Highway, Bitters Road, Huebner Road, Redland Road, and Bulverde Road. These portions of the ROW were not resurveyed for this GA report. Data on previously known features were drawn from multiple surveys dating back to 2010 (see TxDOT (2020)-Appendix A). When previously known features were relocated, they were reevaluated based on current survey protocols. Some previously known features were not relocated, typically due to being destroyed or covered by construction.

Field Survey

Karst survey methods followed protocols outlined in TCEQ Instructions to Geologists for Geologic Assessments (TCEQ 2004) and the U.S. Fish and Wildlife Service (USFWS) Section 10(a)(1)(A) Scientific Permit Requirements for conducting excavations of features that may contain habitat suitable for endangered karst invertebrate species (USFWS 2015). Walking ground surveys, as defined by Veni and Reddell (2002), Barrett (2005), and TCEQ (2004) were conducted throughout the survey area and reconnaissance excavations were conducted at all potential karst features. Positions of all features were documented using Global Positioning System (GPS) technology (WGS-84 datum) and checked with field maps based on digital orthoimagery. All identified features were inspected by a licensed professional geoscientist and evaluated for potential impact to Edwards Aquifer recharge. This was completed by ranking the recharge sensitivity of each feature using the point scheme defined by TCEQ (2004). Fieldwork for the karst survey was overseen by Texas licensed professional geoscientists Aubri Jenson (TX#11007) and Jeff Watson (TX#12995).

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Results

Background Data

Soils

Nineteen soil types were mapped within the survey area by the USDA. A soils map is included as Figure 2. A brief description of each soil type is below:

Austin silty clay, 1 to 3 percent slopes (AuB)

This soil forms on ridges and consists of residuum weathered from chalk. A typical soil profile contains silty clay between 22 to 39 inches (in) deep. This soil has the capacity to transmit water at low to moderately high rates (0.00 to 0.20 inches per hour [in/hr]) through its most limiting layer, placing it in Hydrologic Soil Group D (USDA 2019). This soil makes up approximately 1.2 percent of the survey area.

Austin silty clay, 2 to 5 percent slopes, moderately eroded (AuC).

This soil forms on ridges and consists of residuum weathered from chalk. A typical soil profile contains silty clay between 22 and 39 in deep. This soil has the capacity to transmit water at low to moderately high rates (0.00 to 0.20 in/hr) through its most limiting layer, placing it in Hydrologic Soil Group D (USDA 2019). This soil makes up approximately 0.4 percent of the survey area.

Whitewright-Austin complex, 1 to 5 percent slopes (BsC).

This soil forms on ridges and consists of residuum weathered from the Austin chalk formation. A typical soil profile contains clay loam and silty clay. The depth of the Whitewright soil measures 10 to 20 in and the depth of the Austin soil measures 24 to 43 in deep. The Whitewright soil has the capacity to transmit water at moderately low to high rates (0.06 to 1.98 in/hr) through its most limiting layer, placing it in Hydrologic Soil Group D (USDA 2019). The Austin soil has the capacity to transmit water at moderately low to moderately high rates (0.06 to 0.57 in/hr) through its most limiting layer, placing it in Hydrologic Soil Group C (USDA 2019). This soil makes up approximately 0.4 percent of the survey area.

Anhalt clay, 0 to 2 percent slopes (Ca).

This soil forms on hillslopes and consists of clayey residuum weathered from limestone. A typical soil profile contains clay between 20 and 40 in deep. This soil has the capacity to transmit water at very low to moderately low rates (0.00 to 0.06 in/hr) through its most limiting layer, placing it in Hydrologic Soil Group D (USDA 2019). This soil makes up approximately 2.8 percent of the survey area.

ATTACHMENT C

Crawford, stony and Bexar soils, 0 to 5 percent slopes (Cb).
This soil forms on hillslopes and consists of residuum weathered from limestone. A typical soil profile contains stony clay between 21 and 45 in deep. This soil has the capacity to transmit water at very low to moderately low rates (0.00 to 0.06 in/hr) through its most limiting layer, placing it in Hydrologic Soil Group D (USDA 2017). This soil is the only soil type mapped in the Bitters Road survey area and makes up approximately 51.8 percent of the Huebner Road survey area.

Heiden clay, 1 to 3 percent slopes (HnB).
This soil forms on ridges and consists of clayey residuum weathered from mudstone. A typical soil profile contains clay between 40 and 65 in deep. This soil has the capacity to transmit water at very low to moderately low rates (0.00 to 0.06 in/hr) through its most limiting layer, placing it in Hydrologic Soil Group D (USDA 2019). This soil makes up approximately 1.7 percent of the survey area.

Houston Black clay, 1 to 3 percent slopes (HsB).
This soil forms on ridges and consists of clayey residuum weathered from calcareous mudstone. A typical soil profile contains clay more than 80 in deep. This soil has the capacity to transmit water at very low to moderately low rates (0.00 to 0.06 in/hr) through its most limiting layer, placing it in Hydrologic Soil Group D (USDA 2019). This soil makes up approximately 0.9 percent of the survey area.

Houston Black gravelly clay, 3 to 5 percent slopes (HuC).
This soil forms on ridges and consists of clayey residuum weathered from calcareous mudstone. A typical soil profile contains gravelly clay and clay more than 80 in deep. This soil has the capacity to transmit water at very low to moderately low rates (0.00 to 0.06 in/hr) through its most limiting layer, placing it in Hydrologic Soil Group D (USDA 2019). This soil makes up approximately 0.04 percent of the survey area.

Krum clay, 1 to 5 percent slopes (Kr).
This soil forms on stream terraces and consists of alluvium derived from limestone. A typical soil profile contains clay more than 80 in deep. This soil has the capacity to transmit water at moderately high rates (0.06 to 0.20 in/hr) through its most limiting layer, placing it in Hydrologic Soil Group C (USDA 2019). This soil makes up approximately 0.8 percent of the survey area.

Lewisville silty clay, 0 to 1 percent slopes (LvA).
This soil forms on stream terraces and consists of calcareous clayey alluvium derived from mudstone. A typical soil profile contains silty clay more than 80 in deep. This soil has the capacity to transmit water at moderately low to moderately high rates (0.06 to 0.20 in/hr)

through its most limiting layer, placing it in Hydrologic Soil Group C (USDA 2019). This soil makes up approximately 1.0 percent of the survey area.

Lewisville silty clay, 1 to 3 percent slopes (LvB).
This soil forms on stream terraces and consists of calcareous clayey alluvium derived from mudstone. A typical soil profile contains silty clay more than 80 in deep. This soil has the capacity to transmit water at moderately low to moderately high rates (0.06 to 0.20 in/hr) through its most limiting layer, placing it in Hydrologic Soil Group B (USDA 2019). This soil makes up approximately 7.0 percent of the survey area.

Patrick soils, 1 to 3 percent slopes, rarely flooded (PaB).
This soil forms on paleoterraces and consists of calcareous clayey and/or sandy alluvium of quaternary age derived from mixed sources. A typical soil profile contains clay loam and very gravelly sand more than 80 in deep. This soil has the capacity to transmit water at moderately high to high rates (0.57 to 1.98 in/hr) through its most limiting layer, placing it in Hydrologic Soil Group B (USDA 2019). This soil makes up approximately 3.6 percent of the survey area.

Pits and Quarries 1 to 90 percent slopes (Pt).
This includes all pits and quarries in the survey area. Pits and Quarries are not assigned to a Hydrologic Soil Group. This classification makes up 1.0 percent of the survey area.

Eckrant cobbly clay, 1 to 8 percent slopes (TaB).
This soil forms on ridges and consists of residuum weathered from limestone. A typical soil profile contains cobbly clay between 4 and 20 in deep. This soil has the capacity to transmit water at moderately low to moderately high rates (0.06 to 0.57 in/hr) through its most limiting layer, placing it in Hydrologic Soil Group D (USDA 2019). This soil is makes up approximately 20.1 percent of the survey area.

Eckrant very cobbly clay, 5 to 15 percent slopes (TaC).
This soil forms on ridges and consists of residuum weathered from limestone. A typical soil profile consists of cobbly clay between 10 and 20 in deep. This soil has the capacity to transmit water at moderately low to moderately high rates (0.06 to 0.57 in/hr) through its most limiting layer, placing it in Hydrologic Soil Group D (USDA 2019). This soil makes up approximately 2.9 percent of the survey area.

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Eckrant- Rock outcrop association, 8 to 30 percent slopes (TaD).

This soil forms on ridges and consists of residuum weathered from limestone. A typical soil profile consists of cobbly clay between 10 and 20 in deep. This soil has the capacity to transmit water at moderately low to moderately high rates (0.06 to 0.57 in/hr) through its most limiting layer, placing it in Hydrologic Soil Group D (USDA 2019). This soil makes up approximately 0.6 percent of the survey area.

Eddy gravelly clay loam, 1 to 8 percent slopes (Tb).

This soil forms on ridges and consists of residuum weathered from the Austin chalk formation. A typical soil profile consists of gravelly clay loam between 3 and 15 in deep. This soil has the capacity to transmit water at moderately low to high rates (0.06 to 1.98 in/hr) through its most limiting layer, placing it in Hydrologic Soil Group D (USDA 2019). This soil makes up approximately 1.9 percent of the survey area.

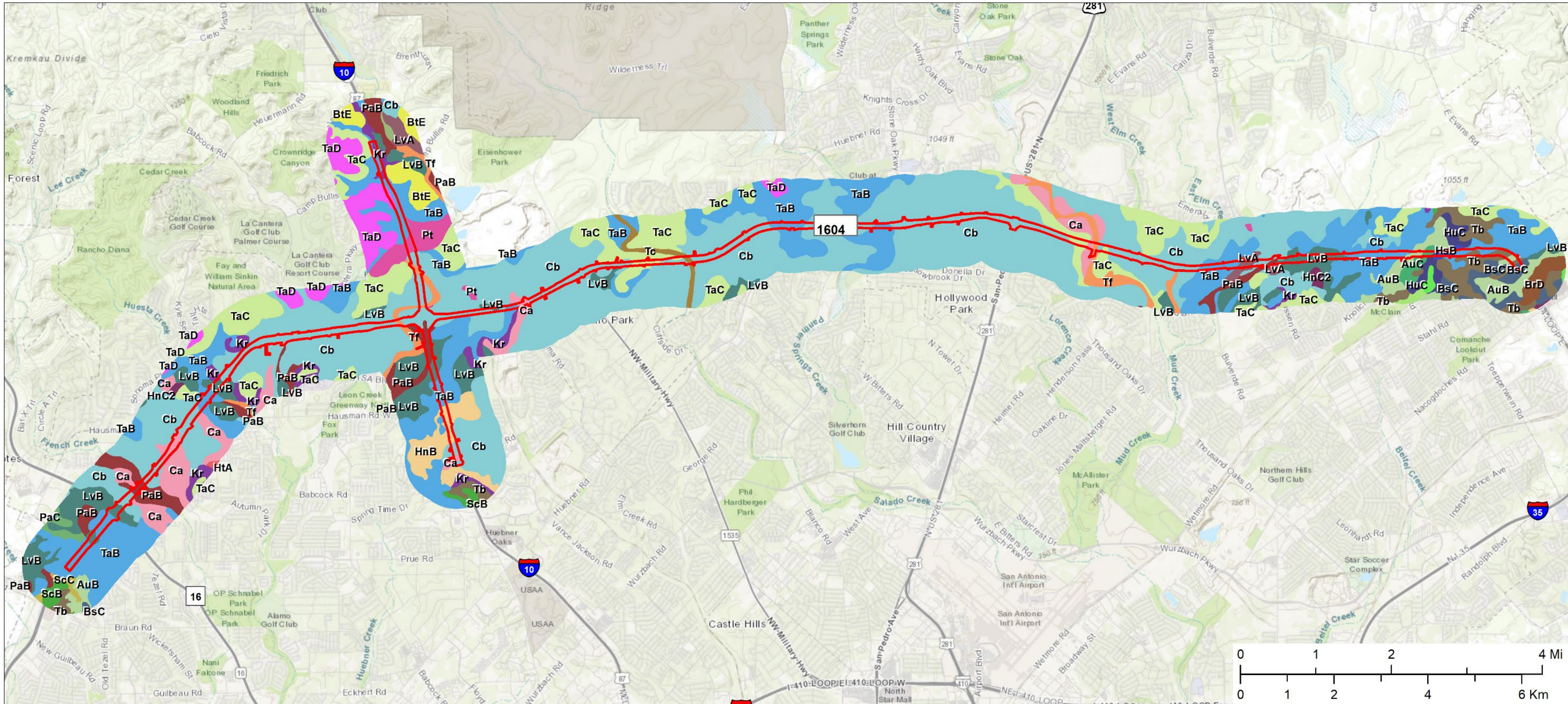
Tinn clay, 0 to 1 percent slopes, occasionally flooded (Tc).

This soil forms in flood plains and consists of calcareous clayey alluvium. A typical soil profile contains clay more than 80 in deep. This soil has the capacity to transmit water at very low to moderately low rates (0.00 to 0.06 in/hr) through its most limiting layer, placing it in Hydrologic Soil Group D (USDA 2019). This soil makes up approximately 0.4 percent of the survey area.

Tinn and Frio soils, 0 to 1 percent slopes, frequently flooded (Tf).

This soil forms in flood plains and consists of clayey alluvium of Holocene age derived from mixed sources. A typical soil profile contains clay and silty clay loam more than 80 in deep. The Tinn soil has the capacity to transmit water at very low to moderately low rates (0.00 to 0.06 in/hr) through its most limiting layer, placing it in Hydrologic Soil Group D (USDA 2019). The Frio soil has the capacity to transmit water at moderately high rates (0.20 to 0.57 in/hr) through its most limiting layer, placing it in Hydrologic Soil Group C (USDA 2019). This soil makes up approximately 1.5 percent of the survey area.

ATTACHMENT C



Basemap: ESRI 2019c. ESRI's World Topographic Map; Soils: USDA Web Soil Survey, accessed 9 Oct 2019.

Soil Type

- **AuB - Austin silty clay, 1 to 3 % slopes**
- **AuC - Austin silty clay, 2 to 5 % slopes**
- BrD - Brackett gravelly clay loam, 3 to 12 % slopes
- **BsC - Whitewright Austin complex, 1 to 5 % so;pes**
- BtE - Brackett-Eckrant association, 20 to 60 % slopes
- **Ca - Anhalt clay, 0 to 2 % slopes**
- **Cb - Crawford, stony and Bexar soils, 0 to 5 % sopes**
- **HnB - Heiden clay, 1 to 3 % slopes**
- HnC2 - Heiden clay, 3 to 5 % slopes
- HoD3 - Heiden-Ferris complex, 5 to 10 % slopes
- **HsB - Houston Black clay, 1 to 3 % slopes**
- HsC - Houston Black clay, 3 to5 % slopes
- HtA - Branyon clay, 0 to 1 % slopes
- HuB - Houston Black gravelly clay, 1 to 3 % slopes
- **HuC - Houston Balck gravelly clay, 3 to 5 % slopes**
- **Kr - Krum clay 1 to 5 % slopes**
- **LvA - Lewisville silty clay, 0 to 1 % slopes**
- **LvB - Lewisville silty clay, 1 to 3 % slopes**
- **PaB - Patrick soils, 1 to 3 % slopes, rarely flooded**
- PaC - Patrick soils, 3 to 5 % slopes, rarely flooded
- **Pt - Pits and Quarries, 1 to 90 % slopes**
- ScB - Stephen silty clay, 1 to 4 % slopes
- ScC - Stephen silty clay, 3 to5 % slopes
- **TaB - Eckrant cobbly clay, 1 to 8 % slopes**
- **TaC - Eckrant very cobbly clay, 5 to 15 % slopes**
- **TaD - Eckrant-Rock outcrop asociation, 8 to 30 % slopes**
- **Tb - Eddy gravelly clay loam, 1 to 8 % slopes**
- **Tc - Tinn clay, 0 to 1 % slopes, occasionally flooded**
- **Tf - Tinn and Frio soils, 0 to 1 % slopes, frequently flooded**
- VaB - Suney loam, 1 to 3 % slopes

Note: Soils types in BOLD occur within the Survey Area

Survey Area

N

1 inch = 6,500 feet

Figure 2. Soils map of the Loop 1604 from SH 16 to I-35, Bexar County, Texas survey area.

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Regional Geology and Structure

The geologic formations occurring within the region are comprised mostly of Cretaceous age-rocks with some overlaying Quaternary alluvium along surface drainages. The limestone bedrock developed from the accumulation of thick sequences of marine sediments deposited in a lagoon environment on the San Marcos Platform protected by a barrier reef during the Cretaceous about 100 million years ago (Rose 1972). The Cretaceous strata dip to the southeast at about 10 to 15 feet (ft) per mile (mi) toward the Gulf of Mexico. Soils have formed on top of these limestones as a result of erosion off the Balcones Escarpment and Edwards Plateau and re-deposition of sediment downstream. Soils are relatively thin and gravelly, and therefore provide minimal retention of infiltrating surface water.

The survey area is in the southeastern portion of the Edwards Plateau Physiographic Province of central Texas, along the Balcones Fault Zone (BFZ). The BFZ is a 5-30 mi-wide zone of *en echelon*, mostly northeast-southwest striking normal faults with downward displacement toward the Gulf of Mexico. BFZ faulting occurred in the Miocene as a result of tectonic uplift of the Edwards Plateau. Subsequently, these faults provided pathways for surface water to percolate into the limestone, allowing for extensive karstic diagenesis and development of cavernous porosity typical of the Edwards Aquifer (Ferrill 2008). This karstic development can now be observed in many places where Edwards Group units outcrop on the surface. Total displacement across the BFZ can be greater than 1,000 ft, and regionally juxtaposes older units of the Trinity group to the west against younger units of the Edwards group to the east along the southeast margin of the Balcones Escarpment. The BFZ also forms the Balcones Escarpment, a highly eroded region bordering the Edwards Plateau on its southern and eastern boundaries (Maclay 1995). The region is typified by higher elevations to the north and west, generally sloping in a southeastern direction. Canyons and drainage basins were formed by surface streams within the San Antonio River Basin, including tributaries of Cibolo Creek that drain the Project area.

Regional Stratigraphy

The strata in this region consist of a thick sequence of Cretaceous carbonate deposits. From youngest to oldest, these include the Pecan Gap Chalk, Austin Chalk, Eagle Ford, Buda Limestone, Del Rio Clay, Georgetown, Edwards Group, and the Glen Rose Formation. The Edwards Aquifer extends from the Lower Cretaceous Georgetown Formation through the Edwards Group, which is subdivided into the Person and Kainer formations. Below these, the Glen Rose Formation occurs in a zone of exchange with the Trinity aquifer. The overlying layers above the Georgetown Formation are of Upper Cretaceous age and are generally considered confining units due to higher densities and some laterally extensive clay layers. A stratigraphic column showing the regional geology is included as Attachment B, before the Site Geology Narrative (Attachment C).

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Cretaceous Stratigraphic Units:

The Pecan Gap Chalk has a thickness 100-400 ft, thinning to the west (Barnes 1982). It is composed of chalk and chalky marl, and forms moderately deep soil when weathered. West of Eastern Medina County it is included with the Austin Chalk (Barnes 1982).

The Austin Chalk is about 210 ft thick in Bexar County. The Austin Chalk is not currently recognized as a minor aquifer in Texas. However, near San Antonio and to the west through Medina, Uvalde, Kinney, and Val Verde counties, the Austin Chalk can be karstified with cavern development. Some wells tap the Austin Chalk, especially west of San Antonio. The Austin Chalk hosts significant springs that produce Edwards Aquifer water, such as San Antonio and San Pedro Springs.

The Eagle Ford Group consists of undifferentiated flags of shale and interbedded layers of hard argillaceous limestone. Outcrops are approximately 30 ft thick. The Buda Limestone is a hard, dense, fine-grained, buff, or light gray limestone with small, calcite-filled fractures. The Buda is distinctly nodular with a conchoidal fracture and has been described as porcelaneous with little primary porosity or permeability. The Del Rio Clay is a blue, sticky clay in the subsurface, which weathers in outcrop to greenish-yellow brown clay with pyrite and gypsum. The Del Rio Clay ranges from about 40 to 50 ft thick and often has large accumulations of rams-horn index fossil (*Ilymatogyra arietina*).

Maclay and Small (1976) divided the Edwards Aquifer into eight hydrogeologic units (Units I through VIII), which are based on aquifer and lithologic properties. The Georgetown Formation (Unit I) can be up to about 20 ft thick in Bexar County and unconformably overlies the Person Formation. The Georgetown Formation can be identified by the presence of the index fossil brachiopod *Waconella wacoensis*. The Georgetown Formation is a shaley, relatively impervious yellow limestone that is not known to yield water and sometimes can be considered part of the upper confining unit to the Edwards Aquifer.

The Person and Kainer formations comprise the Edwards Group (Rose 1972). The Person Formation is about 185 ft thick in northern Bexar County. The composition of the Person Formation ranges from crystalline limestone to grainstone to mudstone and is comprised of three informal hydrogeologic units: the cyclic and marine members, undivided; the leached and collapsed members, undivided; and the regional dense member.

The cyclic and marine members (Unit II) are composed of mudstone to fossiliferous packstone and are approximately 85 ft thick but can be somewhat variable in thickness because of the erosional unconformity between the Person and Georgetown formations. The cyclic member is an alternating tidal flat deposit with small collapsed breccias, and the marine member is a cross-bedded biosparite to biomicrite with chert nodules.

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The leached and collapsed members (Unit III) are a sequence of interbedded mudstone and grainstone intervals that form one of the more porous and permeable subdivisions of the Edwards Aquifer. The leached member is a dense, bioturbated micrite and the collapsed member is composed of several 1- to 5-ft thick zones of collapsed stromatilitic limestone (Rose 1972). Average thickness of the leached and collapsed members is approximately 80 ft in northern Bexar County and is characterized by two highly churned, iron stained beds separated by a more massive light-colored limestone. Horizontal caverns with relatively large rooms develop in this unit.

The bottom unit of the Person Formation is the regional dense member (Unit IV), which has a relatively consistent thickness of 20 ft. The regional dense member consists of argillaceous mudstone and is easily identified in the outcrop and on a variety of geophysical logs. Most of the fractures that penetrate the regional dense member do not appear to be solution enlarged. Caves that breach the regional dense member are typically vertical shafts with horizontal caverns developed above or below the regional dense member. The regional dense member can function as a confining unit between the upper and lower portions of the Edwards Aquifer between the Kainer and the Person formations. However, caves, faults, and fractures may greatly reduce the vertical confining ability of the regional dense member (Small and Lambert, 1998). The regional dense member is probably not an effective barrier to lateral flow at faults because of the relatively thin 20-foot section. The flow of water tends to circumvent the regional dense member because its low permeability.

The Kainer Formation has a total thickness of about 285 ft. The lithology of the Kainer Formation ranges from mudstone to miliolid grainstone to crystalline limestone. The Kainer Formation is subdivided into four informal members that include the grainstone, Kirschberg Evaporate, dolomitic and basal nodular members.

The grainstone member (Unit V) is the uppermost unit of the Kainer Formation and is approximately 55-ft thick. It consists of thick sequences of dense, tightly cemented, miliolid grainstone. Primary matrix porosity, as measured on geophysical logs, is some of the lowest in the Edwards Aquifer. Secondary fracture porosity accounts form the bulk of effective porosity in this aquifer unit.

The Kirschberg Evaporite Member (Unit VI) underlies the grainstone member and is about 60 ft in thickness. This hydrogeologic unit consists of crystalline limestone interbedded with mudstone containing chert lenses. Collapsed features are common. The porosity has been described as boxwork (Maclay and Small 1976) because of the configuration of the voids and the secondary neospar and travertine deposits. The boxwork porosity does not seem to be prevalent throughout the entire thickness or extent but occurs sporadically within more massive limestone. Dissolution of evaporite minerals, such as gypsum and anhydrite, and the existence of contorted beds in the Kirschberg Evaporite Member results in extensive secondary porosity, which creates one of the most permeable subdivisions in the Edwards Aquifer.

The dolomitic member (Unit VII) is a dense, crystalline limestone with interbedded grainstone and burrowed mudstone with some chert beds. The dolomitic member has a total thickness of about 110 ft and is characterized by massive thick beds. Effective porosity and probable pathways of water in this unit are restricted to solution enlarged bedding planes, joints, fractures and faults.

The basal nodular member (Unit VIII) is the lowermost unit of the Edwards Group and is about 50 to 60 ft of tan, marly, nodular limestone. In the subsurface, the basal nodular member has negligible porosity and permeability (Maclay and Small 1984) and can function as part of the lower confining unit. However, in outcrop the basal nodular member often displays extensive karstification, which has generated secondary porosity in the form of large lateral caves.

The Upper Glen Rose Formation was the only Trinity Group unit outcropping in the survey area. It is composed of alternating resistant and recessive beds of limestone, dolomite, and marl which form the stair-step topography characteristic of much of the Edwards Plateau (Barnes 1982). The Upper Glen Rose has relatively low permeability and is considered the basal confining unit of the Edwards Aquifer (Maclay 1984).

Site Geology

Site geology was consistent with GAT (2010) and Blome (2005) and shown in Figure 3, and Attachment D – Site Geologic Maps. The survey area included the ROW and easements along the north and south sides of Loop 1604 from I-35 to SH 16. The survey area also included a segment of I-10 ROW extending from approximately 2 mi south to 2.5 mi north of the intersection with Loop 1604. Land within and surrounding the survey area was developed for commercial and residential use, and therefore contained a large amount of fill and pavement cover. Bedrock was observable in roadcuts and some drainages where it was generally consistent with formations of the Edwards Limestone over most of the project area. There were also surface outcrops of Cretaceous strata younger than the Edwards Limestone (Kpc, Kau, Kbu, and Kdr) present in the project area. The only Trinity Aquifer strata in the project area was a surface outcrop of Upper Glen Rose along the I-10 ROW north of Loop 1604. Mapped faults cross the project site with northeast-southwest trends ranging from 45^{o} to 65^{o}. Evidence of these faults was most apparent in roadcuts where they crossed the project area and was manifested as highly fractured/contorted or steeply dipping beds. Displacement of beds along individual fault planes was sometimes observable in these roadcuts. A more detailed summary of surface geology covering the project area from east to west is presented below.

Loop 1604 ROW and easements from I-35 to 0.5 mi east of Bulverde Road:
This segment of the survey area consists of Upper Cretaceous strata younger than the Edwards Group outcrop. Units include the Pecan Gap Chalk (Kpg), Austin Chalk (Kau), Buda Limestone (Kbu), and Del Rio Clay (Kdr).

Loop 1604 ROW and easements from 0.5 mi east of Bulverde Road to I-10:
This segment of the survey area consists mostly of the cyclic and marine (Kpcm), and leached and collapsed (Kplc) members of the Person Formation, and some outcrops of the regional dense member (Kprd) of the Person Formation and the grainstone member of the Kainer Formation exposed in low-lying creek beds and minor upthrown fault blocks. A surface outcrop of the dolomitic member of the Kainer Formation is present along the survey area where the Loop 1604 ROW briefly crosses a major fault near the intersection of NW Military Hwy and Loop 1604.

I-10 ROW and easements north of Loop 1604:
This segment of the survey area is on the upthrown side of a major mapped fault. Surface outcrop is mostly the dolomitic member of the Kainer Formation with some outcrop of the Upper Glen Rose member (Kgru) of the Glen Rose Formation present toward the northern boundary of the project area.

I-10 ROW and easements south of Loop 1604:
This segment of the survey area consists of Quaternary alluvial deposits and Upper Cretaceous strata younger than the Edwards, including the Buda Limestone (Kbu) and the Del Rio Clay (Kdr), with some surface outcrop of the Cyclic and Marine (Kpcm) member of the Person Formation present toward the southern boundary of the survey area.

Loop 1604 ROW and easements from I-10 to 0.5 mi east of SH 16:
This segment of the survey area consists mostly of the cyclic and marine and leached and collapsed members of the Person Formation. The dolomitic member of the Kainer Formation outcrops where the survey area crosses a fault just west of the intersection of Valero Way and Loop 1604. A small outcrop of Georgetown Formation is on the surface along the survey area near the intersection of Kyle Seale Parkway and Loop 1604.

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Loop 1604 ROW and easements from 0.5 mi east of SH 16 to western boundary of survey area:

This segment of the survey area consists of Upper Cretaceous strata younger than the Edwards Limestone, including the Austin Chalk (Kau), Buda Limestone (Kbu), and Del Rio Clay (Kdr) Formations.

ATTACHMENT C

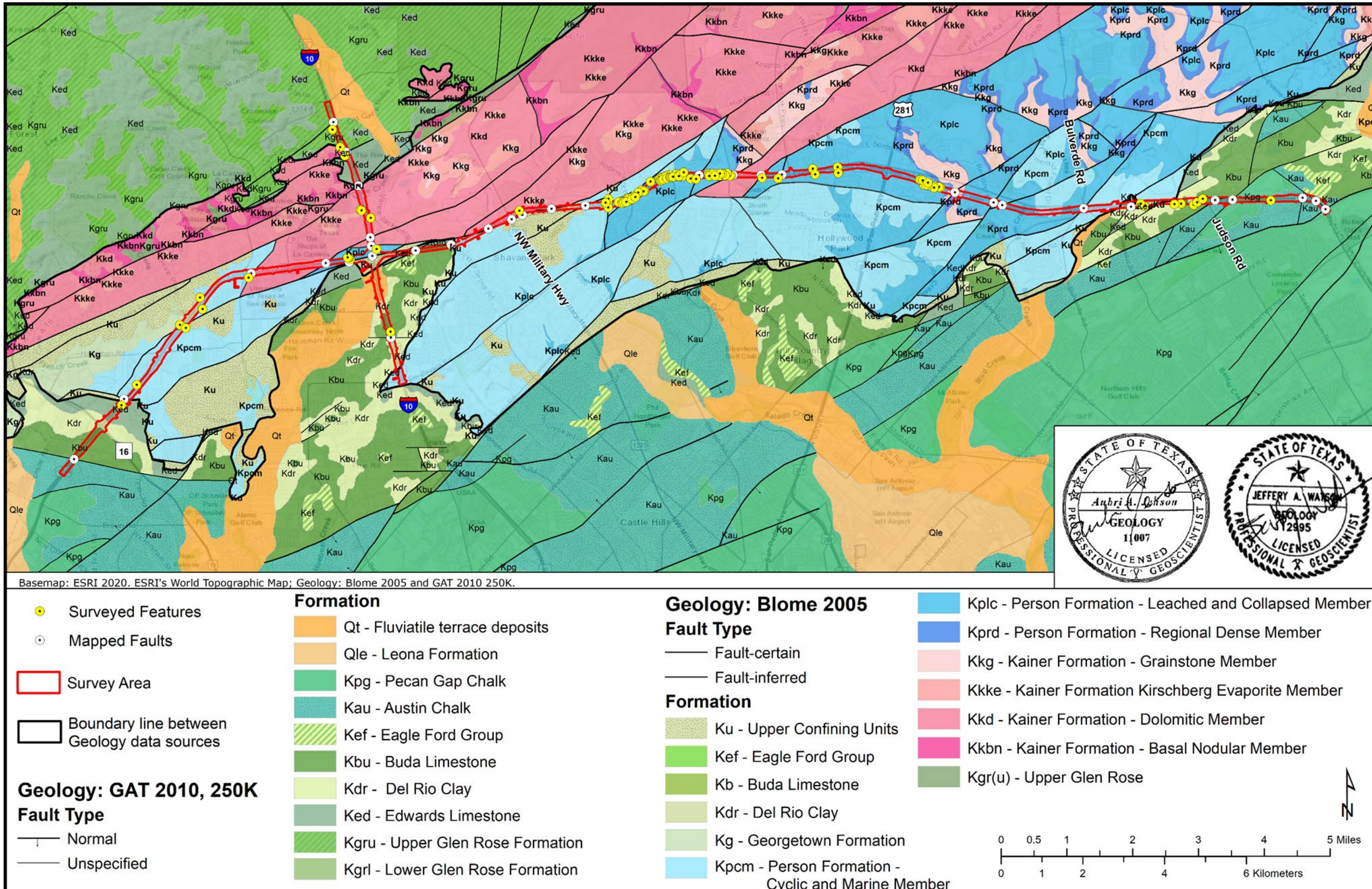

Figure 3. Geology of the Loop 1604 from SH 16 to I-35, Bexar County, Texas survey area.

ATTACHMENT C

Water Wells

Two wells were reported within the GA survey area in TWDB database records but only one of these wells was successfully located during field surveys. The well that was found in the field was located near Judson Road (State Well Number 6829305). According to the TWDB database records, this well was owned by the Edwards Underground Water District (now the Edwards Aquifer Authority) and was in use as a monitoring well from 1992 through 2002. It was reportedly completed in the Edwards Aquifer, but as there was no original drilling log in the TWDB database, the depth is unknown. This well was assigned feature ID LOOP-W01 for this report. The other well (State Well Number 6829211) was assumed to be abandoned but that was not confirmed as a plugging report was not found in TWDB records. According to TWDB records, this well was an industrial well located in the ROW on the west bank of Elm Creek and owned by Allen Keller. It was drilled in 1986 and completed in the Edwards Aquifer at a depth of 260 ft. Given that the well could not be located in the field, it is possible that the well head has been covered or destroyed by roadway construction activity.

In addition to the above wells reported in the TWDB database, three uncapped boreholes were encountered in the field that did not have associated TWDB database entries. These included feature LOOP-008, an un-capped borehole with a drill stem sticking out of it; LOOP-201, an uncapped geotechnical borehole; and feature LOOP-211, an uncapped borehole infilled with sediment and next to a solution-enlarged fracture. Refer to the feature description section of this report for details on these boreholes.

Floodplains

The FEMA flood maps for the survey areas were numbers 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective September 29, 2010 and 48091C0480F effective September 2, 2009. Portions of the survey area were within flood hazard zones with 1% annual chance flood hazard. Flood hazard zones are shown in Attachment D.

ATTACHMENT C

Description of Features

Results of the surface karst feature survey are presented in the TCEQ Geologic Assessment Table (Attachment A) and discussed below. All features were ranked according to TCEQ standards and reported in TCEQ-0585-Geologic Assessment Table (Attachment A) and mapped in Attachment D. For clarification, note that solution-enlarged bedding planes are a type of solution cavity (TCEQ 2004).

Feature 1604-002; Non-karst Closed Depression

This feature was located in the ROW south of the eastbound mainlanes of Loop 1604 and west of Judson Road (Figure 4- Figure 7; Attachment D page 113). The feature was a non-karst closed depression that measured 26.4 ft long by 6.6 ft wide and 0.3 ft deep, and contained a soil drain approximately 0.75 ft in diameter and 0.3 ft deep. This feature contained compact soil, vegetation and clay. The soil drain was observed to have a compact clay floor. It had a catchment area of less than 1.6 acres (ac). Temporary ponding of surface water was indicated by flat-lying dead grass in the depression. There was a low potential for this feature to rapidly transmit water to the subsurface due to a compact clay floor and the absence of downward trending voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 4. Overview of feature 1604-002.

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Figure 5. Close-up of soil drain in feature 1604-002.

Figure 6. Overview of the location of feature 1604-002.

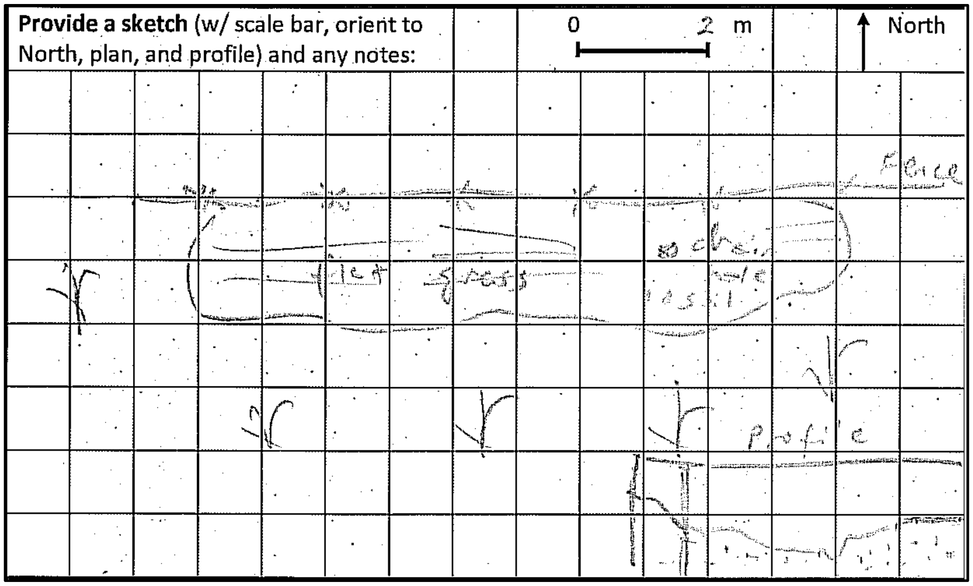

Figure 7. Field sketch of feature 1604-002.

Feature 1604-801; Zone of Solution-enlarged Fractures

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and east of Huebner Road (Figure 8 - Figure 10; Attachment D page 83). The feature was a zone of three solution-enlarged fractures within an area 20 ft wide by 6 ft long by 2.5 ft high. The largest opening was 1.5 ft wide by 2 ft high and extended 6 ft into the roadcut. The fractures had a trend of 55 degrees (55^{o}), which is consistent with trends along the Balcones Fault Zone. The feature contained exposed bedrock and breakdown. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface as it was exposed above the base of the roadcut; however, due to it being a zone of features developed along fractures that align with the dominant trend of faults and fractures in the region, this feature was determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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Figure 8. Overview of feature 1604-801.

Figure 9. The largest of three solution-enlarged fractures in the zone feature 1604-801.

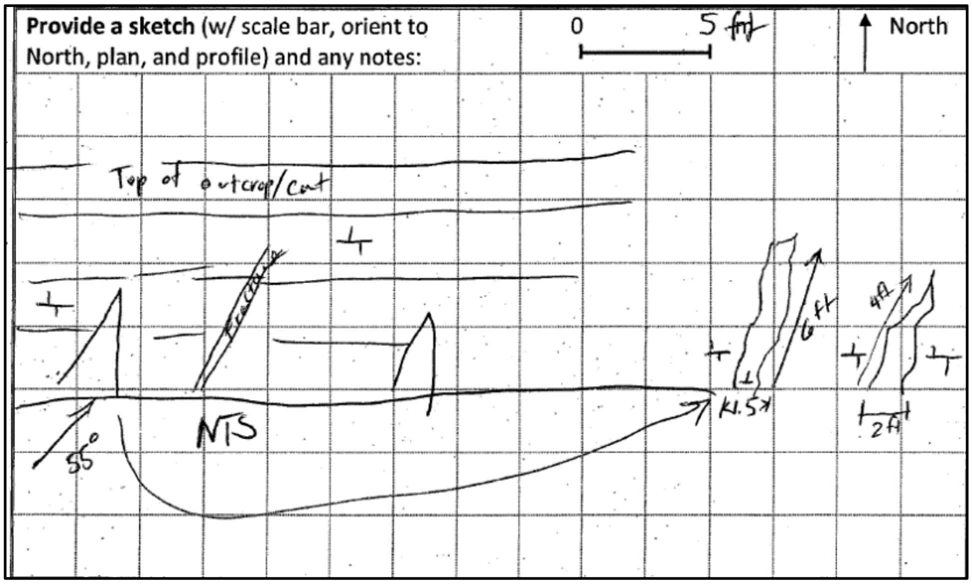

Figure 10. Field sketch of feature 1604-801.

Feature 1604-D05; Solution Cavity

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Blanco Road (Figure 11 - Figure 14; Attachment D page 85). The feature was a solution cavity that measured 1.6 ft wide by 2.3 ft long and 0.65 ft deep. This feature consisted of only bedrock. It had a catchment area of less than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface as it was approximately 6 ft above the base of the roadcut and lacked downward trending voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).


Figure 11. Overview of feature 1604-D05.

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Figure 12. Interior of feature 1604-D05.

Figure 13. Overview of location of feature 1604-D05.

ATTACHMENT C

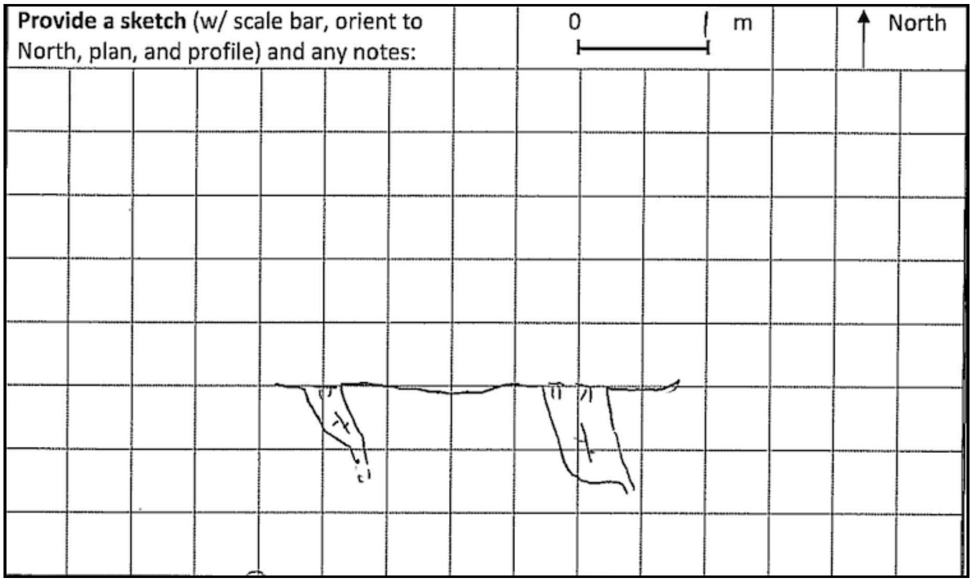

Figure 14. Field sketch of feature 1604-D05.

Feature 1604-D06; Solution Cavity

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Blanco Road (Figure 15 - Figure 18; Attachment D page 85). The feature is a solution cavity that measured 0.65 ft wide by 2.9 ft long and 0.98 ft deep. This feature consisted only of exposed bedrock. It had a catchment area of less than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface as it was exposed above the base of the roadcut and lacked downward trending voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).


Figure 15. Overview of feature 1604-D06.

ATTACHMENT C

Figure 16. Entrance of feature 1604-D06.

Figure 17. Interior of feature 1604-D06.

ATTACHMENT C

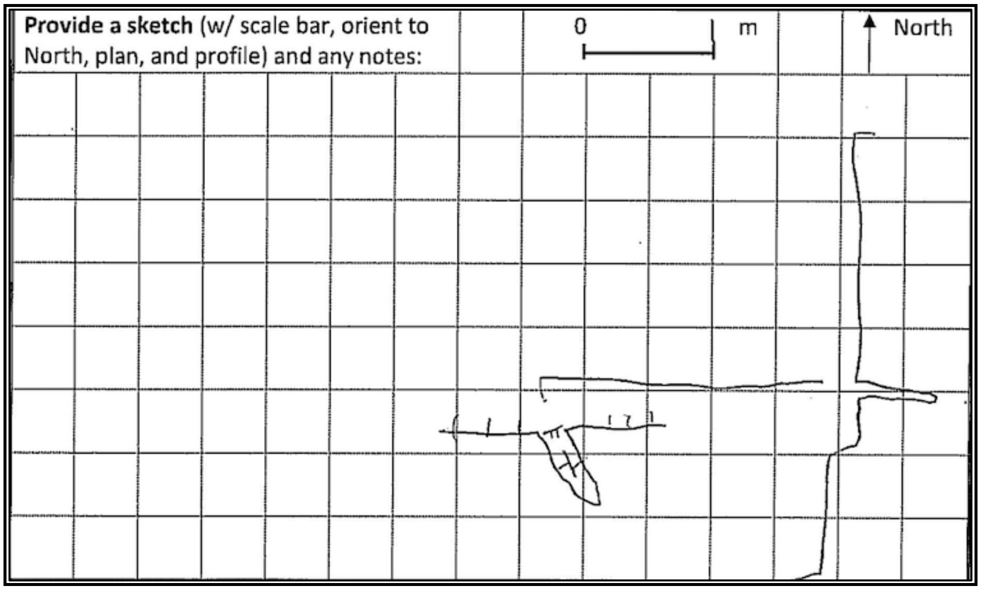

Figure 18. Field sketch of feature 1604-D06.

Feature 1604-D07; Solution Cavity

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Blanco Road (Figure 19 - Figure 21; Attachment D page 85). The feature was a solution cavity that measured 1.6 ft wide by 4.9 ft long and 1.0 ft deep. A downward trending void was visible continuing into bedrock. This feature was infilled with red clay. It had a catchment area of less than 1.6 ac. Even though the feature contained downward trending voids, it was determined that there was a low potential for this feature to rapidly transmit water to the subsurface because it is approximately 3 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 19. Overview of feature 1604-D07.

Figure 20. Interior of feature 1604-D07.

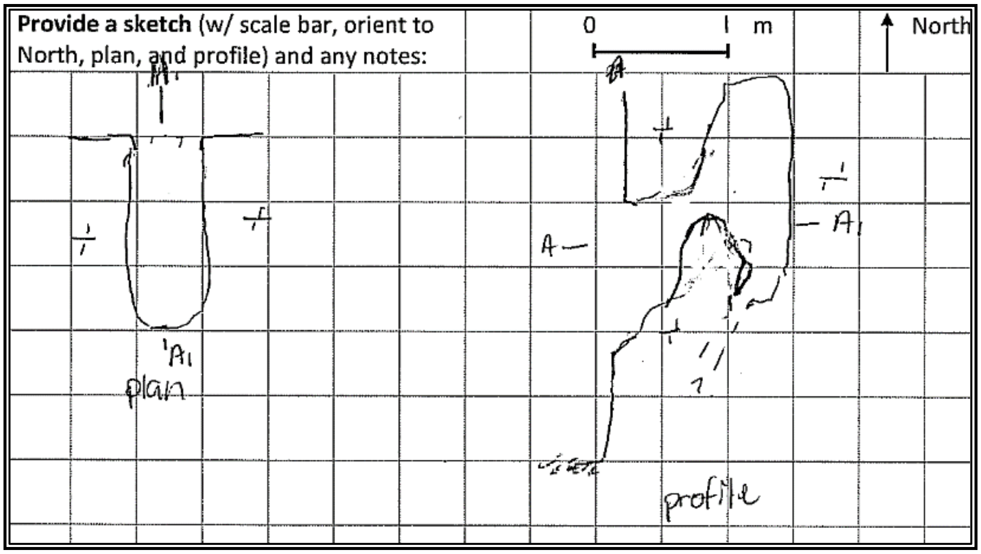

Figure 21. Field sketch of feature 1604-D07.

Feature 1604-D08; Solution Cavity

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and east of Blanco Road (Figure 22 - Figure 25; Attachment D page 85). The feature was a solution cavity that measured 1.6 ft wide by 1.6 ft long and 0.98 ft deep. This feature was filled with compact soil and cobbles. It had a catchment area of less than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface as it was approximately 3 ft above the base of the roadcut and lacked downward trending voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 22. Overview of feature 1604-D08.

ATTACHMENT C

Figure 23. Interior of feature 1604-D08.

Figure 24. Overview of location of feature 1604-D08.

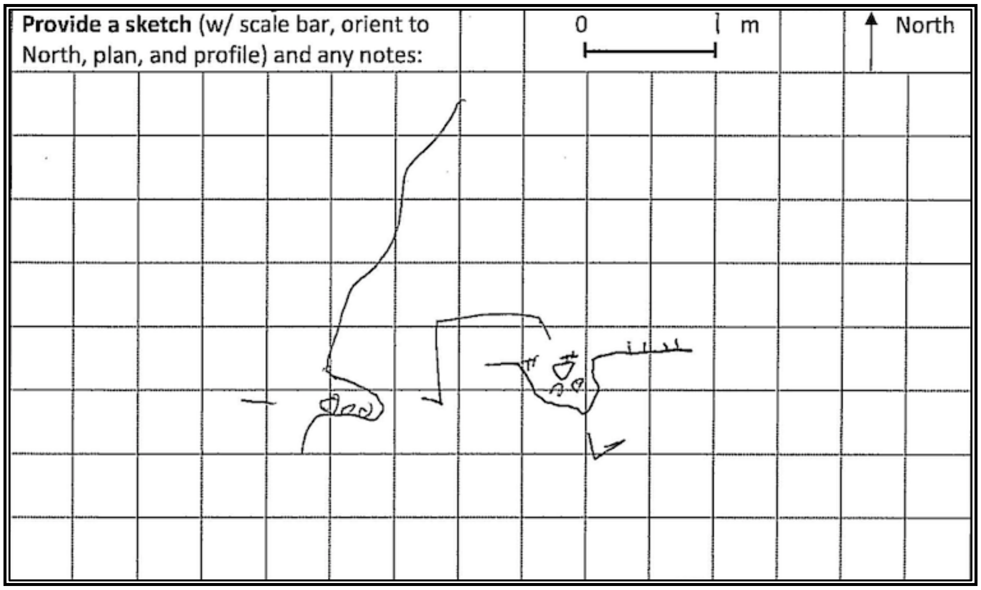

Figure 25. Field sketch of feature 1604-D08.

Feature 1604-D09; Solution Cavity

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and west of Blanco Road (Figure 26 - Figure 29; Attachment D page 85). The feature was a solution cavity that measured 1.9 ft wide by 3.9 ft long and 1.6 ft deep. This feature was filled with fine loose soil and cobbles. It had a catchment area of less than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface as it was exposed above the base of the roadcut and lacked downward trending voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 26. Overview of feature 1604-D09.

ATTACHMENT C

Figure 27. Exterior of feature 1604-D09.

Figure 28. Interior of feature 1604-D09.

ATTACHMENT C

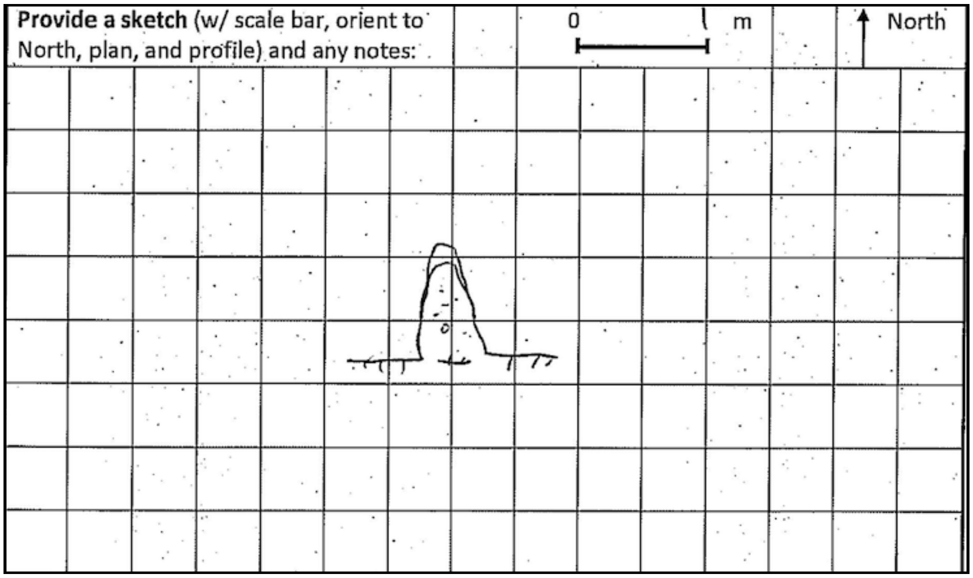

Figure 29. Field sketch of feature 1604-D09.

Feature 1604-D10; Solution Cavity

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Blanco Road (Figure 30 - Figure 35; Attachment D page 85). The feature was a solution cavity that measured 1.0 ft wide by 1.0 ft long and 1.4 ft deep. This feature contained bedrock and gravel. It appeared to be remnant of a larger feature that was bisected by blasting. The catchment area was less than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface as it was exposed above the base of the roadcut and lacked downward trending voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).


Figure 30. Overview of feature 1604-D10.

ATTACHMENT C

Figure 31. Upper hole of feature 1604-D10.

Figure 32. Interior of upper hole of feature 1604-D10.

ATTACHMENT C

Figure 33. Lower hole of feature 1604-D10.

Figure 34. Interior of lower hole of feature 1604-D10.

ATTACHMENT C

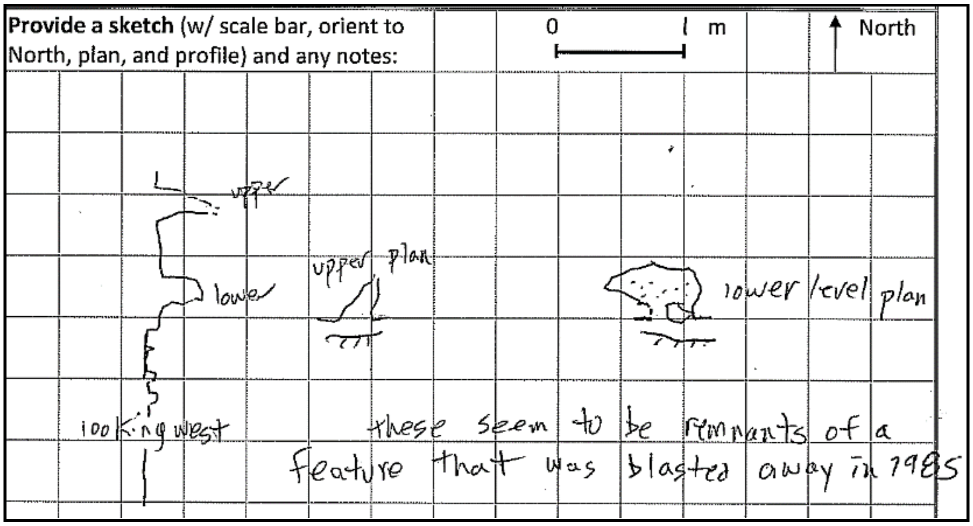

Figure 35. Field sketch of feature 1604-D10.

Feature 1604-D11; Solution Cavity

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and west of Blanco Road (Figure 36 - Figure 39; Attachment D page 85). The feature was a solution cavity that measured 2.3 ft wide by 3.9 ft long and 0.82 ft deep. This feature was infilled with gravel and compact red clay. It had a catchment area of less than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface as it was approximately 4 ft above the base of the roadcut and lacked downward trending voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 36. Overview of feature 1604-D11.

ATTACHMENT C

Figure 37. Entrance of feature 1604-D11.

Figure 38. Interior of feature 1604-D11.

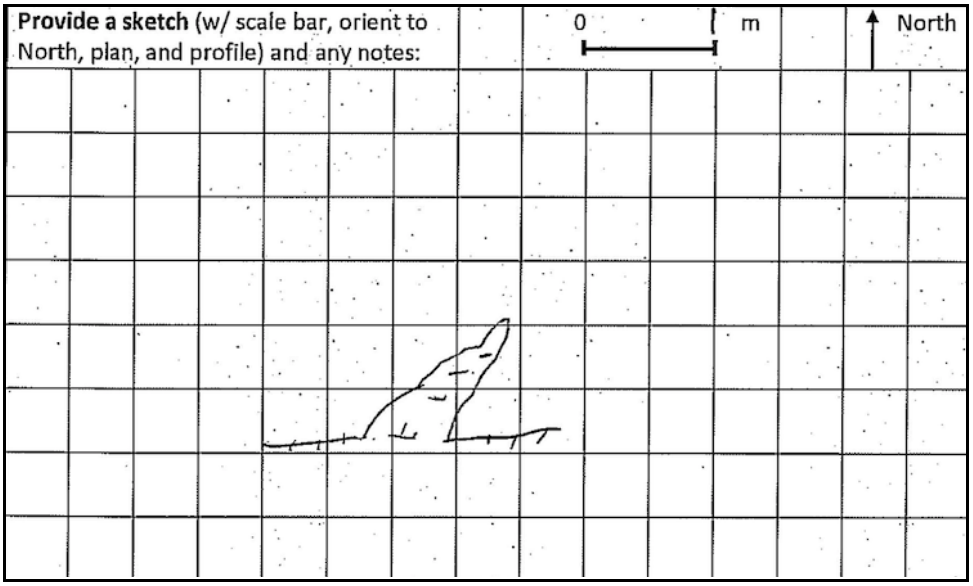

Figure 39. Field sketch of feature 1604-D11.

Feature 1604-D13; Solution Cavity (Solution-enlarged Bedding Plane)

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and west of Blanco Road (Figure 40 - Figure 43; Attachment D page 84-85). The feature was a solution-enlarged bedding plane that measured 9.8 ft wide by 0.7 ft high and 3.3 ft long. This feature was infilled with gravel and compact red clay. It had a catchment area of less than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface as it was approximately 3 ft above the base of the roadcut and lacked downward trending voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 40. Overview of feature 1604-D13.

ATTACHMENT C

Figure 41. Entrance of feature 1604-D13.

Figure 42. Interior of feature 1604-D13.

ATTACHMENT C

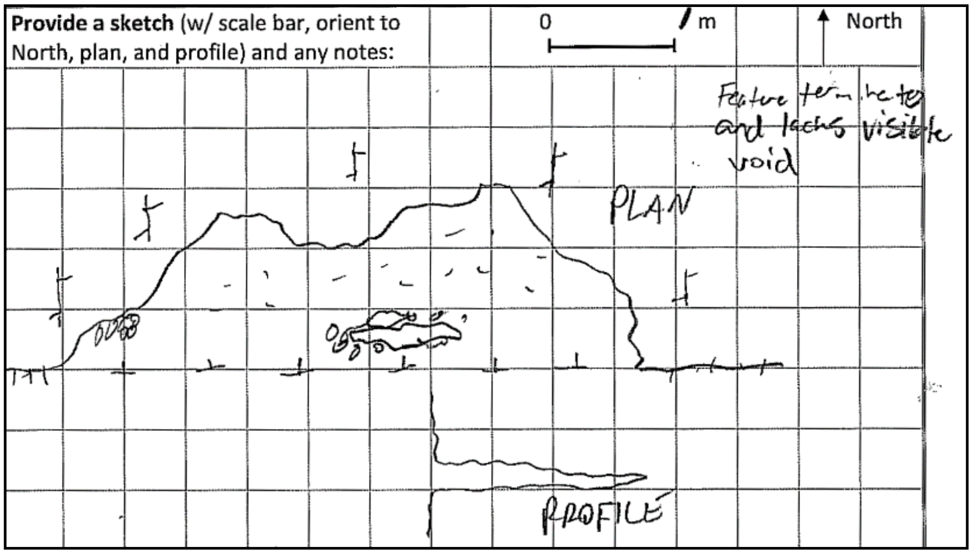

Figure 43. Field sketch of feature 1604-D13.

Feature 1604-D15; Solution-enlarged Fracture

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Huebner Road (Figure 44 - Figure 46; Attachment D page 82). It was originally evaluated in 2010, again in 2016, and for a third time on 15 August 2019. This feature consisted of a solution-enlarged fracture and a bisected vug. with the bisected vug measured approximately 0.5 ft wide, 0.75 ft tall, and 0.3 ft deep. The vug had no mesocaverns extending from it. The solution-enlarged fracture measured 0.3 ft wide, 1.0 ft tall and extended 2.9 ft into the roadcut with a trend of 90 to 100°. The feature contained bedrock, loose rocks, and dark brown soil. Past evaluations noted that some void space can be seen continuing off from the feature, but during the 2019 evaluation the space was entirely filled with a young possum. It had a catchments area of less than 1.6 ac. It was determined that there is a low potential for this feature to rapidly transmit water to the subsurface due its location above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 44. Overview of feature 1604-D15.

Figure 45. Interior of feature 1604-D15.

ATTACHMENT C

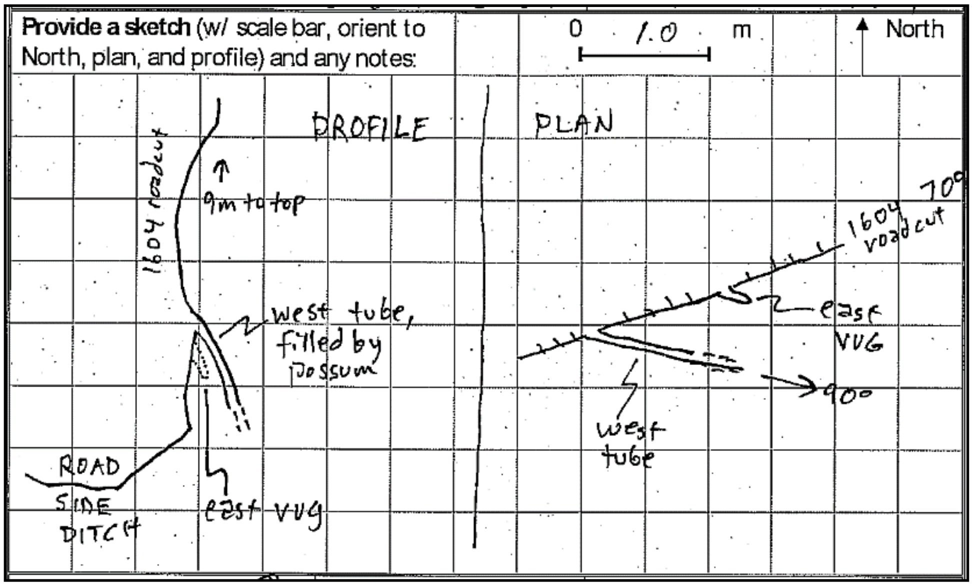

Figure 46. Field sketch of feature 1604-D15.

Feature 1604-D16; Solution Cavity

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Huebner Road (Figure 47 - Figure 49; Attachment D page 81-82). The feature was a solution cavity that was 0.8 ft wide by 3.1 ft long by 1 ft high. It was guided by a fracture with a trend of 5°. This feature contained brown clayey soils and exposed bedrock. It had a catchment area of less than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface as it was approximately 3 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).


Figure 47. Overview of feature 1604-D16.

ATTACHMENT C

Figure 48. Interior of feature 1604-D16.

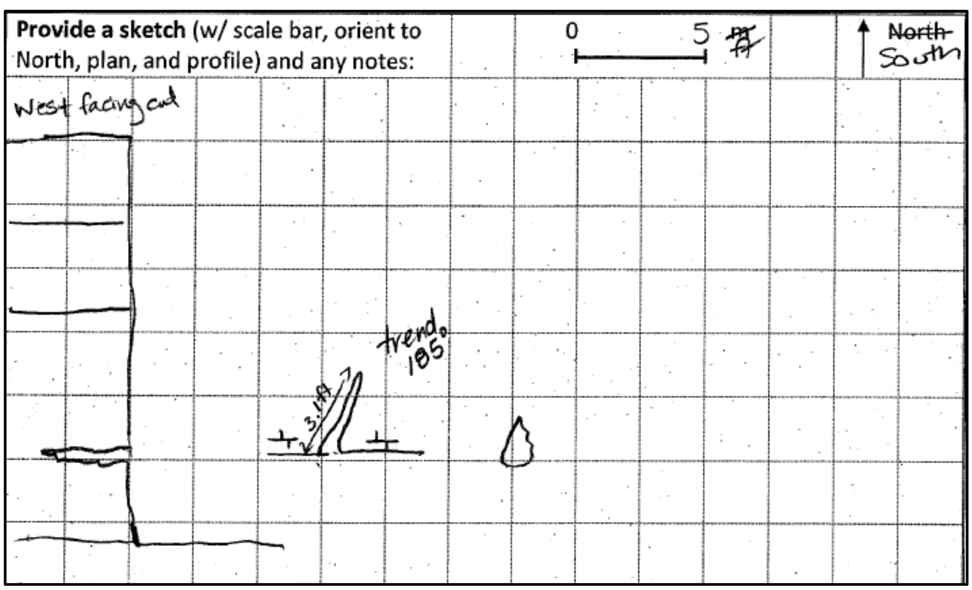

Figure 49. Field sketch of feature 1604-D16.

ATTACHMENT C

Feature 1604-D17; Solution Cavity

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and west of Huebner Road (Figure 50 - Figure 52; Attachment D page 80). The feature was a solution cavity that measured 2.4 ft long by 2.4 ft wide and 0.8 ft deep. This feature contained loose organic soil and leaf-litter. It had a catchment area of greater than 1.6 ac. It was determined that there was a moderate potential for this feature to rapidly transmit water to the subsurface due to presence of downward trending voids and relatively large catchment area. This feature was determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 50. Overview of feature 1604-D17.

ATTACHMENT C

Figure 51. Close-up of feature 1604-D17.

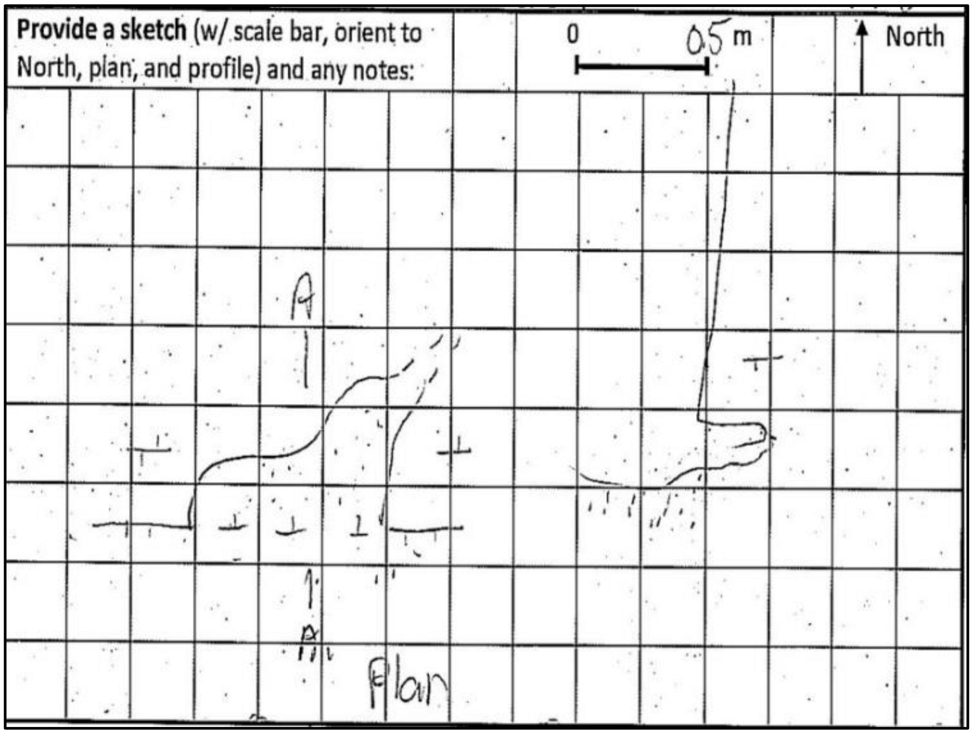

Figure 52. Field sketch of feature 1604-D17.

ATTACHMENT C

Feature 1604-D19; Solution-enlarged Bedding Plane

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and east of Huebner Road (Figure 53 - Figure 54; Attachment D page 82-83). The feature was a solution-enlarged bedding plane 16.4 ft wide by 8.2 ft long by 0.5 ft high. The feature contained bedrock and breakdown. It had a catchment area of less than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface as it was 4 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 53. Overview of feature 1604-D19.

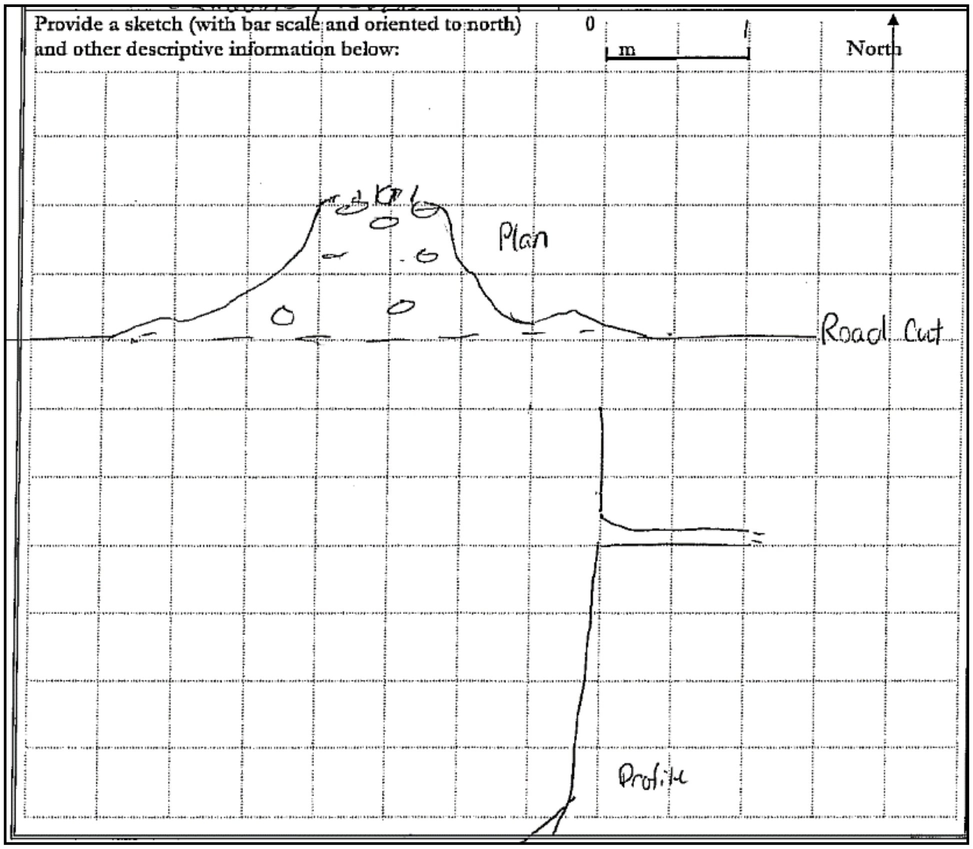

Figure 54. Field sketch of feature 1604-D19.

Feature 1604-D20; Solution Cavity

This feature was located south of the eastbound mainlanes of Loop 1604 and east of Highway 281 (Figure 55– Figure 57; Attachment D page 97). The feature was a solution cavity that measured 8.2 ft wide by 1.6 ft long and 6.5 ft deep. This feature contained compact sediment and bedrock. It had a catchment area of less than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface as it was above the base of the roadcut and did not appear to extend into the bedrock beyond what was exposed. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 55. Overview of feature 1604-D20.

Figure 56. Close-up of feature 1604-D20.

ATTACHMENT C

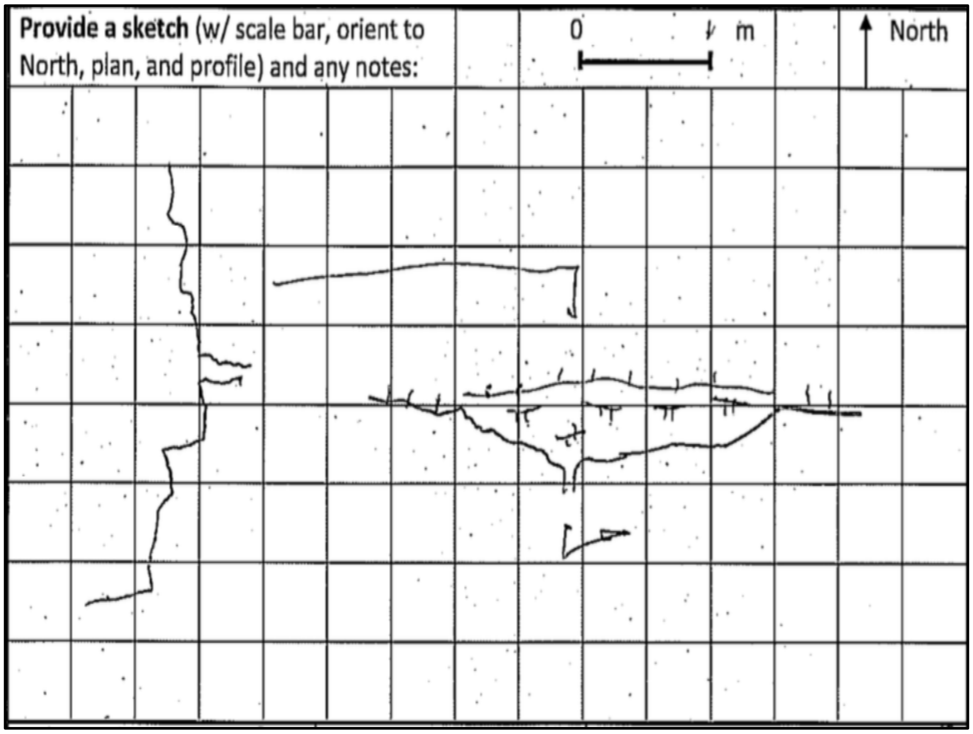

Figure 57. Field sketch of feature 1604-D20.

Feature 1604-E04; Solution Cavity

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and east of Bitters Road (Figure 58 - Figure 62; Attachment D page 84). The feature was excavated on July 10-11, 2019 using a total 7 man-hours to remove 2 cubic feet (ft^3) of material. No continuing mesocaverns or downward trending voids were found during excavation. The excavated feature was a solution cavity that measured 2.6 ft wide by 1.3 ft high and extended 4.6 ft into bedrock. This feature contained loose rocks and compact sediment. It had a catchment area of less than 1.6 ac. It was determined that there is a low potential for this feature to rapidly transmit water to the subsurface as it was slightly above the base of the roadcut and lacked downward trending voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 58. Overview of feature 1604-E04.

Figure 59. Entrance of feature 1604-E04.

Figure 60. Interior of feature 1604-E04.

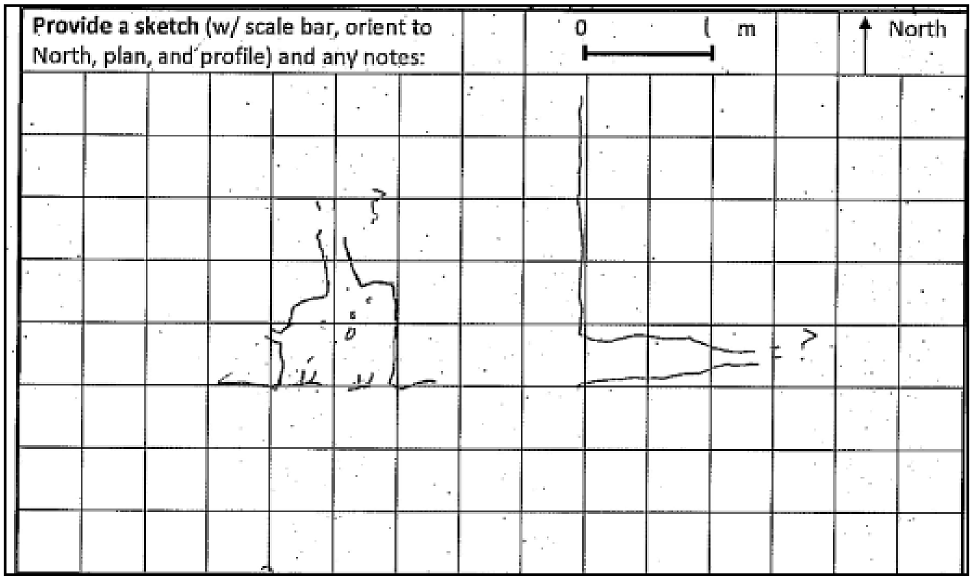

Figure 61. Field sketch of feature 1604-E04.

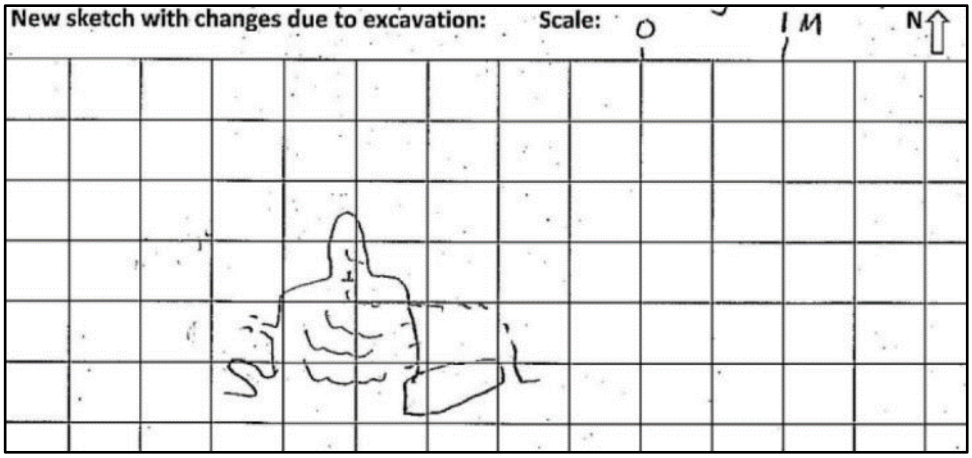

Figure 62. Plan sketch of feature 1604-E04 after excavation.

Feature 1604-E05; Solution Cavity

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and east of Huebner Road (Figure 63- Figure 65; Attachment D page 83). The feature was a solution cavity that measured 0.7 ft wide by 0.8 ft long by 3 ft high. This feature contained breakdown, flowstone, and exposed bedrock. The feature was excavated in 2010 and a definitive terminus was found with no mesocavernous voids. It had a catchment area of less than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface as it was above the base of the roadcut and lacked mesocavernous voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 63. Overview of feature 1604-E05.

ATTACHMENT C

Figure 64. Interior of feature 1604-E05.

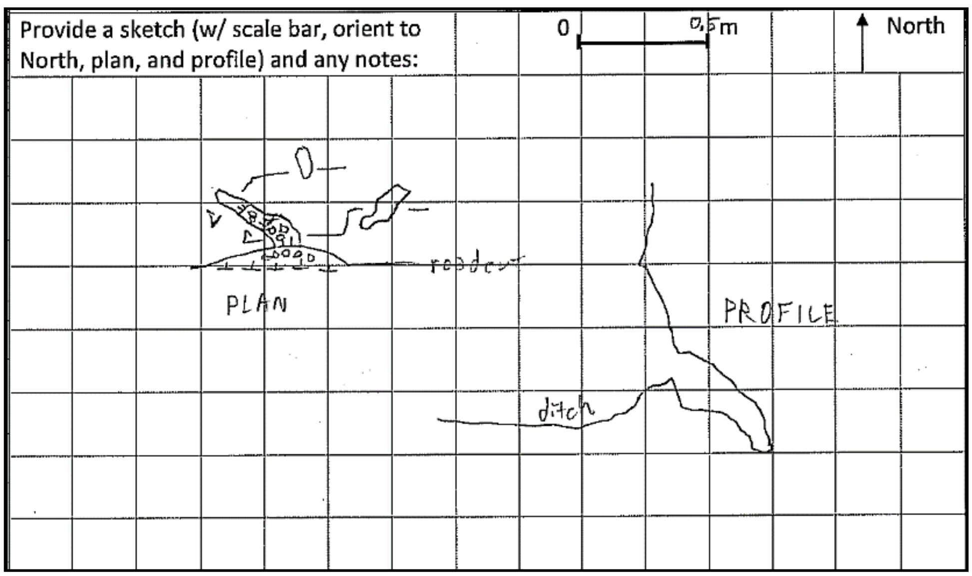

Figure 65. Field sketch of feature 1604-E05. Note that the feature comes to a definitive end.

ATTACHMENT C

Feature 1604-E09 (Green Mountain Road Cave); Cave

This feature was located south of the eastbound mainlanes of Loop 1604 and west of Green Mountain Road (Figure 66 - Figure 70; Attachment D page 117). The feature was a cave with a maximum length of 72.2 and maximum depth of 49.2 ft. It was identified in the TSS database as Green Mountain Road Cave. The gated entrance covered a narrow vertical drop that continued into two lower rooms with an average width of about 6 ft. This feature contained bedrock, breakdown, clay, and flowstone. The feature was excavated between July 7 and August 1, 2019 utilizing a total of 48 person-hours to remove 134 ft^3 of material. The lower passages narrowed and became humanly impassible; however, voids could be seen extending into the bedrock. It has a catchment area of greater than 1.6 ac. It was determined that there was a high potential for this feature to rapidly transmit water to the subsurface as it contained mesocavernous voids. This feature was determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 66. Entrance of feature 1604-E09.

ATTACHMENT C

Figure 67. View below the entrance of feature 1604-E09.

Figure 68. View of passage in feature 1604-E09.

ATTACHMENT C

Figure 69. View of terminus of feature 1604-E09.

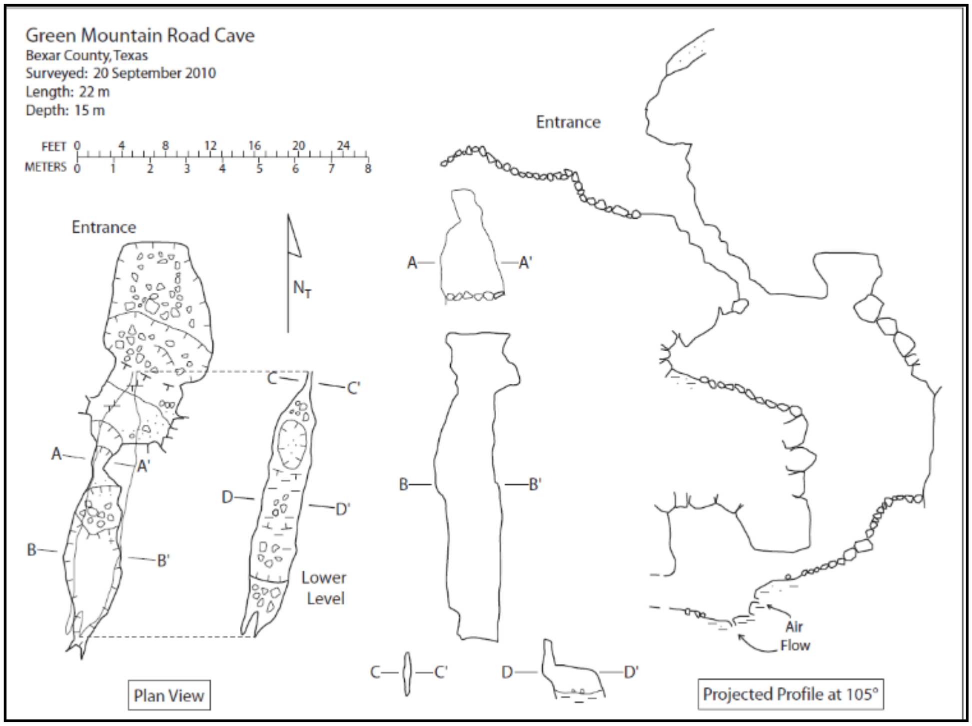

Figure 70. Map of 1604-E09, Green Mountain Road Cave.

ATTACHMENT C

Feature 1604-F057; Other (Solution Scour)

This feature was located south of the eastbound mainlanes of Loop 1604 and west of Bitters Road (Figure 71 - Figure 73; Attachment D page 78). The feature was a solution scour that measured 11.5 ft long by 11.5 ft wide and 4.9 ft deep. This feature consisted of exposed bedrock in a streambed. Two sets of fractures were present with trends of 100° and 120°. It had a catchment area of greater than 1.6 ac. It was determined that there was a moderate potential for this feature to rapidly transmit water to the subsurface due to the size of the catchment area. However, there were no obvious drains extending into the subsurface. Therefore, this feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 71. Overview of feature 1604-F057.

ATTACHMENT C

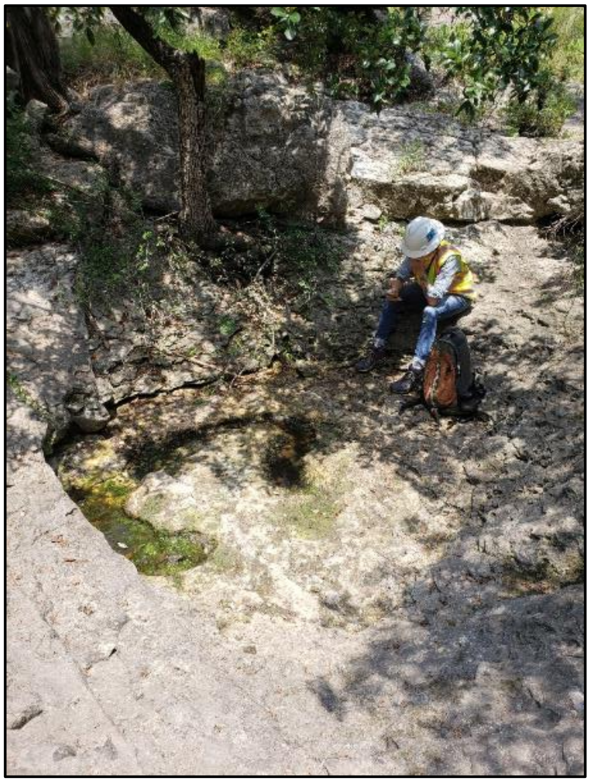

Figure 72. Close-up of feature 1604-F057.

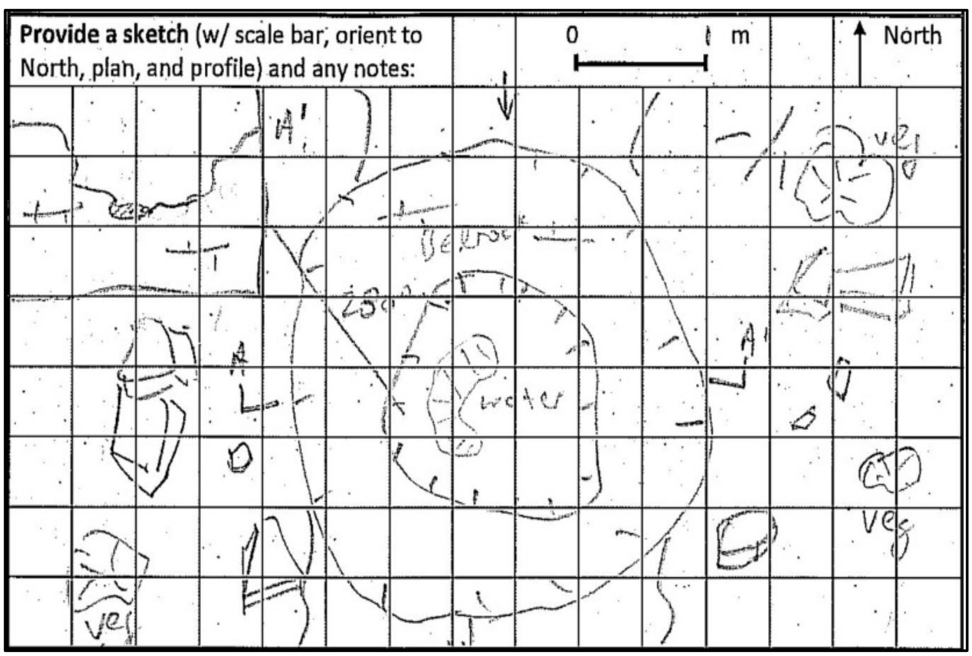

Figure 73. Field sketch of feature 1604-F057.

ATTACHMENT C

Feature 1604-F061 (Scottish Beard Cave); Cave

This feature was located south of the eastbound mainlanes of Loop 1604 and east of W. Bitters Road (Figure 74 - Figure 79; Attachment D page 80). The feature was a cave that measured 13.1 ft wide by 3.3 ft high at the entrance and extended 9.8 ft into bedrock. On June 20, 2019, rocks covering the entrance were removed. It was identified in the TSS database as Scottish Beard Cave. This feature contained loose rocks and red clay with a loose depth of 1 cm. The cave terminated in a mesocavern with a compact clay floor. It had a catchment area of greater than 1.6 ac. It was determined that there was a high potential for this feature to rapidly transmit water to the subsurface as it was situated along the base of the roadcut. This feature was determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 74. Overview of feature 1604-F061, Scottish Beard Cave, prior to excavation.

ATTACHMENT C

Figure 75. Entrance of feature 1604-F061, Scottish Beard Cave.

Figure 76. View of passage in feature 1604-F061, Scottish Beard Cave.

ATTACHMENT C

Figure 77. View of terminus of feature 1604-F061, Scottish Beard Cave.

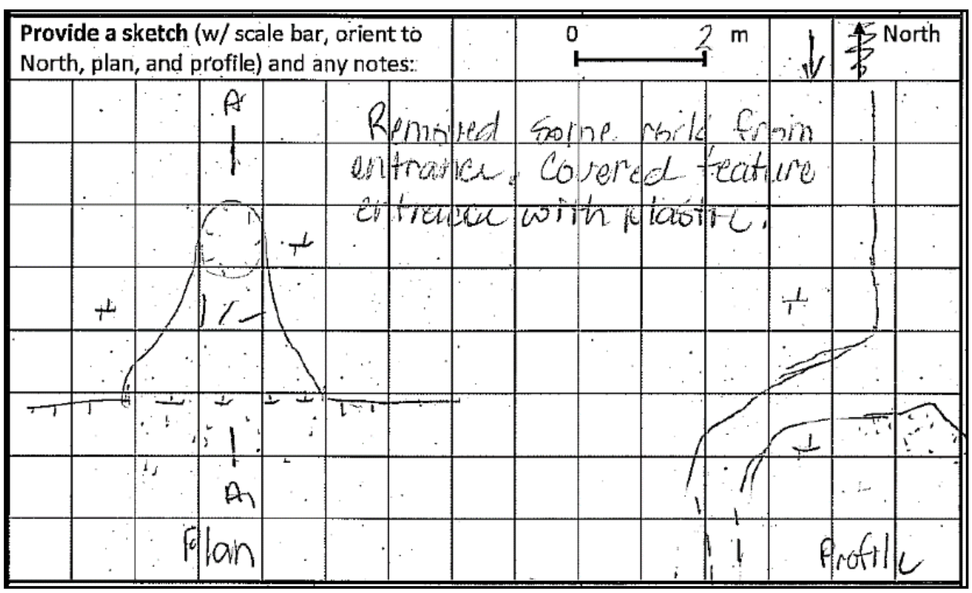

Figure 78. Field sketch of feature 1604-F061, Scottish Beard Cave.

ATTACHMENT C

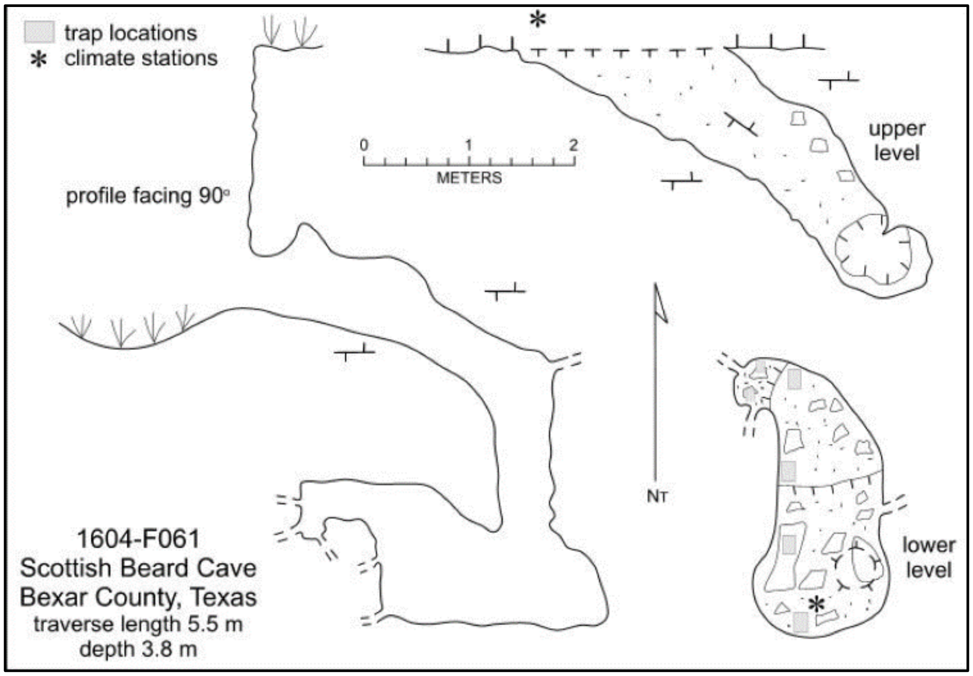

Figure 79. Cave map of feature 1604-F061, Scottish Beard Cave.

Feature 1604-F063; Solution Cavity

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and west of Huebner Road (Figure 80 - Figure 83; Attachment D page 81-82). The feature was a solution cavity that measured 3.3 ft wide by 8.2 ft long by 3.3 ft high. The feature contained bedrock, compact grey soil, leaf litter, and trash. The void continued into the roadcut at trend of a 105° and ended in a mesocavern (Figure 83). The feature had a catchment area of less than 1.6 ac. It was determined that there was a moderate potential for this feature to rapidly transmit water to the subsurface due its location at the base of the roadcut and the mesocavernous extension. This feature was determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 80. Overview of feature 1604-F063.

Figure 81. Interior of feature 1604-F063.

ATTACHMENT C

Figure 82. Terminus of feature 1604-F063.

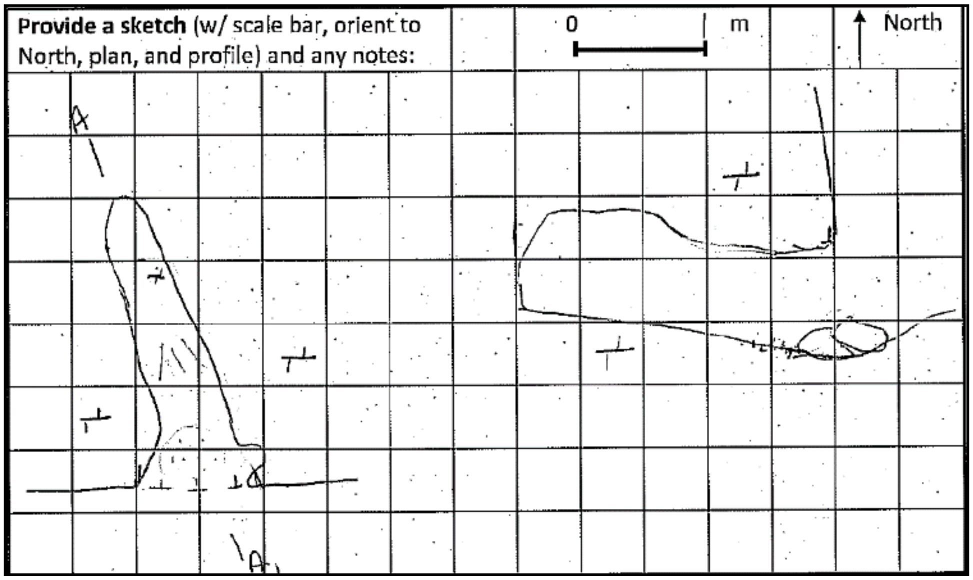

Figure 83. Field sketch of feature 1604-F063.

Feature 1604-F064; Solution Cavity

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and west of Huebner Road (Figure 84 - Figure 85; Attachment D page 81-82). The feature was a solution cavity that measured 10 ft wide by 5 ft long by 3.75 ft tall. It contained loose cobbles, breakdown, red clay soil, and vegetation. The feature had a catchment area of less than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface due its location above the base of the roadcut and the lack of mesocavernous extensions. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 84. Overview of feature 1604-F064.

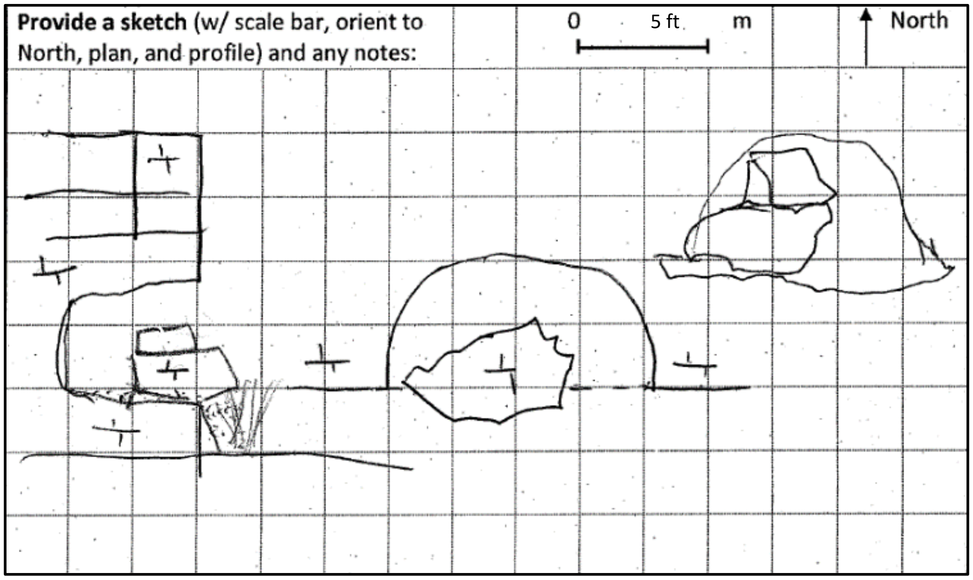

Figure 85. Field sketch of feature 1604-F064.

ATTACHMENT C

Feature 1604-F066; Solution Cavity (Solution-enlarged Bedding Plane)

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and west of Huebner Road (Figure 86 - Figure 87; Attachment D page 82). The feature was a solution-enlarged bedding plane that measured 1.5 ft wide by 0.6 ft high and extend 5 ft into bedrock. It narrowed as it extended into the roadcut and continued as a very low bedding plane. This feature contained loose rocks and bedrock. It had a catchment area of less than 1.6 ac. While the feature was laterally extensive, it was determined that there was a low potential for this feature to rapidly transmit water to the subsurface as it was situated approximately 6 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 86. Overview of feature 1604-F066.

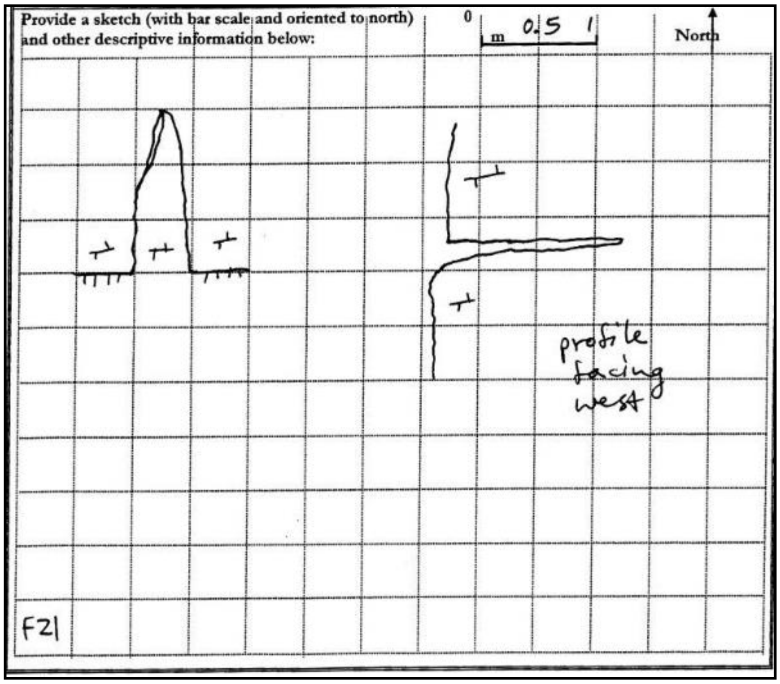

Figure 87. Field sketch of feature 1604-F066.

Feature 1604-F069; Solution Cavity (Solution-enlarged Bedding Plane)

This feature was located in the roadcut north of the westbound mainlanes of Loop 1604 and west of Huebner Road (Figure 88 - Figure 90; Attachment D page 82). The feature was a solution-enlarged bedding plane that measured 13 ft wide by 12 ft long by 1.6 ft high. It narrowed as it extends into the roadcut and continued as a very low bedding plane. This feature contained loose rocks. It had a catchment area of less than 1.6 ac. While it was laterally extensive, it was determined that there was a low potential for this feature to rapidly transmit water to the subsurface as it was situated approximately 6 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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Figure 88. Overview of feature 1604-F069.

Figure 89. Interior of feature 1604-F069.

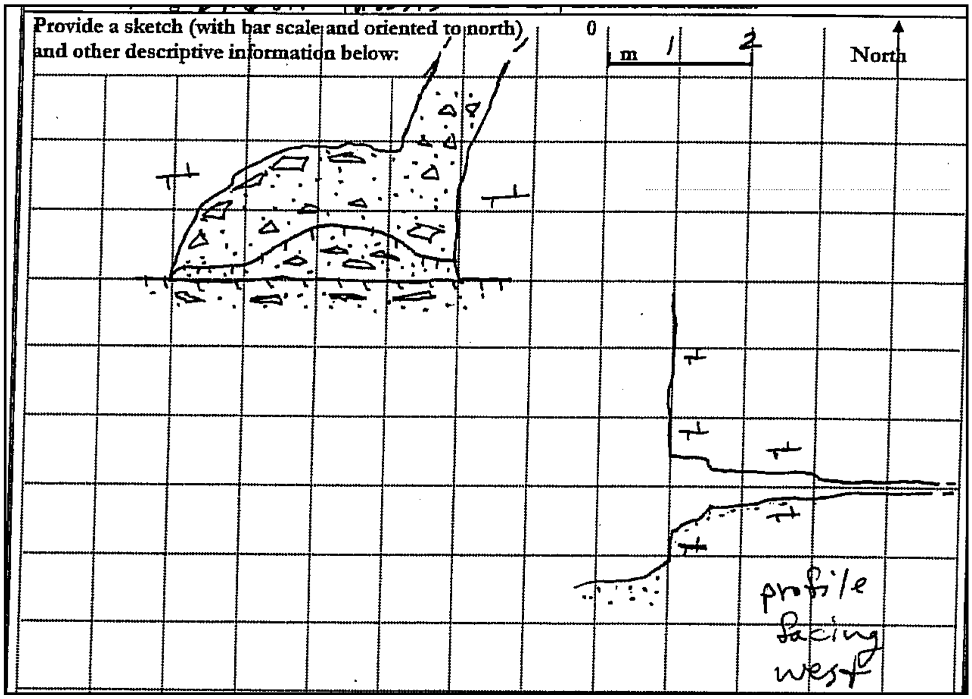

Figure 90. Field sketch of feature 1604-F069.

Feature 1604-F070; Zone with Solution Cavity and Solution-enlarged Fractures

This zone of features was located in the roadcut south of the eastbound mainlanes of Loop 1604 and east of Huebner Road (Figure 91 -Figure 95; Attachment D page 82). The feature was originally described as a single solution-enlarged fracture located at the base of the roadcut that was 1.6 ft wide by 3.3 ft high and 2.3 ft long. In addition to the solution-enlarged fracture, a solution-enlarged bedding plane and bisected solution cavity were also described immediately above the solution-enlarged fracture. The zone containing all three features measured 50 ft wide by 2.5 ft long by 14 ft high. These features were infilled with loose soils, rocks, bedrock, and vegetation. Flowstone was also observed in the originally described solution-enlarged fracture. The features had a catchment area of less than 1.6 ac. While the zone of features was laterally extensive, the lowest feature was approximately 3.5 ft above the base of the roadcut; therefore, it was determined that there was a low potential for this feature to rapidly transmit water to the subsurface. This zone of features was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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Figure 91. Overview of feature 1604-F070.

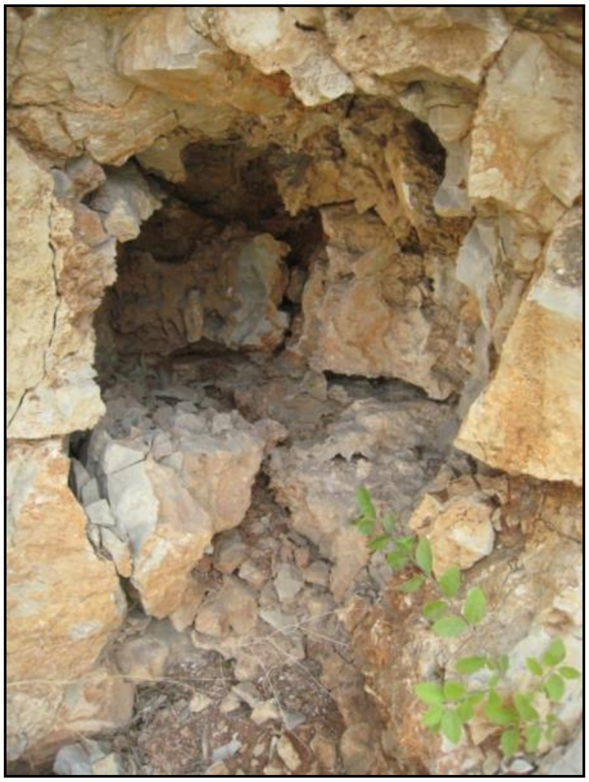

Figure 92. Interior of feature 1604-F70.

ATTACHMENT C

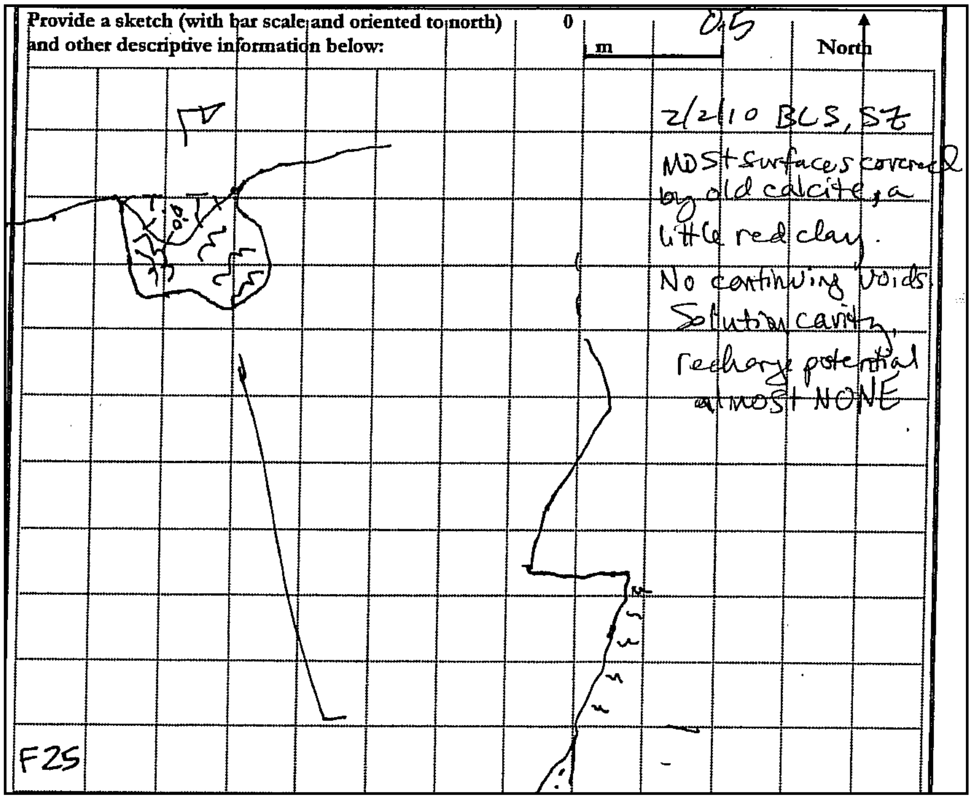

Figure 93. Field sketch of feature 1604-F070.

Figure 94. Overview of solution-enlarged bedding plane and bisected solution cavity added to the feature 1604-F070 description.

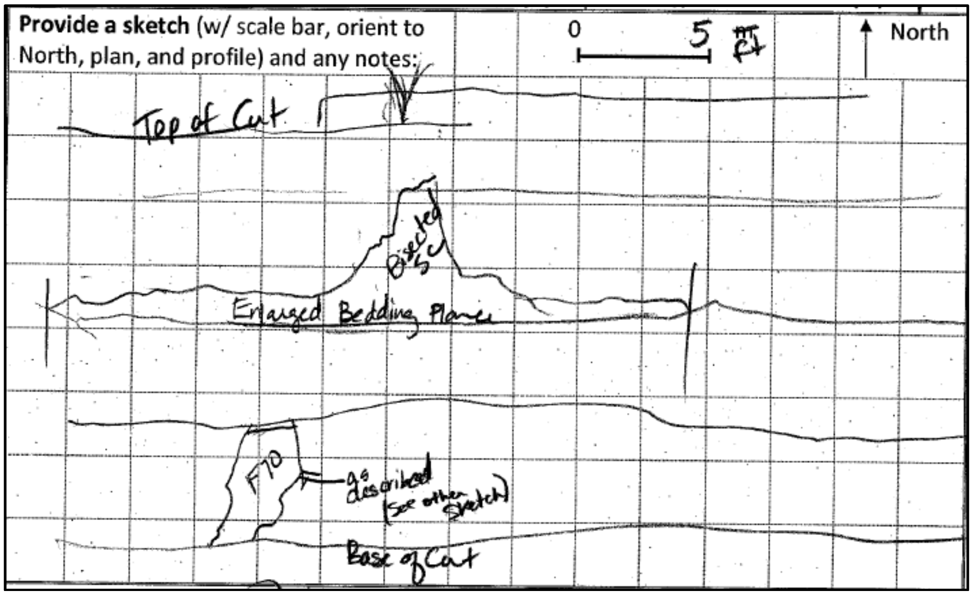

Figure 95. Additional field sketch of feature 1604-F070.

Feature 1604-F071; Solution Cavity (Solution-enlarged Bedding Plane)

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and east of Huebner Road (Figure 96 - Figure 98; Attachment D page 82). The feature was a solution-enlarged bedding plane that measured 8.2 ft wide by 3.3 ft long by 1.0 ft high. It narrowed to 3.3 ft wide and continued into the rock face as a very narrow bedding plane. This feature contained loose, modern soils likely introduced by landscaping activities, coarse cobbles, flowstone, and bedrock. It had a catchment area of less than 1.6 ac. As the feature was located at and slightly below the base of the roadcut and is laterally extensive, it was determined that there was a moderate potential for this feature to rapidly transmit water to the subsurface. This feature was determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 96. Overview of feature 1604-F071.

Figure 97. Interior of feature 1604-F071.

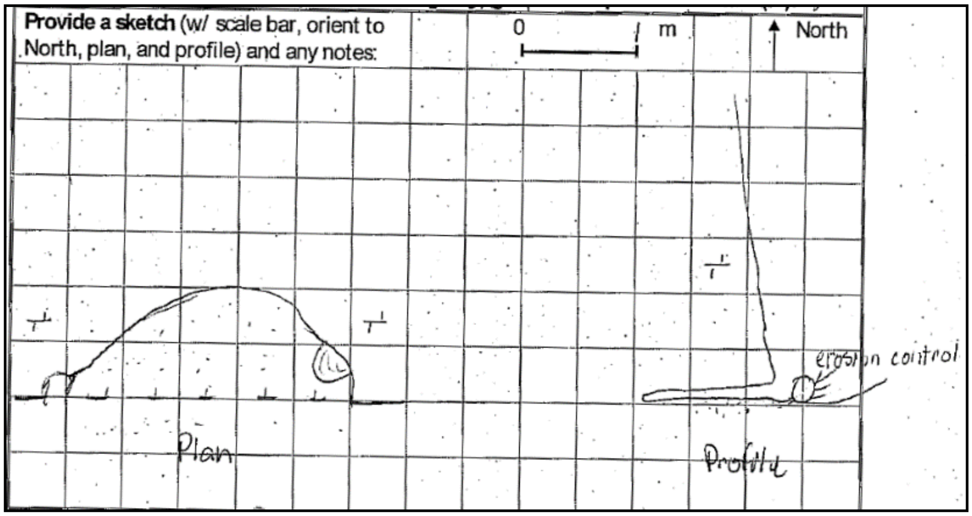

Figure 98. Field sketch of feature 1604-F071.

Feature 1604-F072 (Air Filter Cave); Cave

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and east of Huebner Road (Figure 99 - Figure 103; Attachment D page 82-83). This feature was a cave that was previously recorded in TSS records as 1604 Cave, but also known as Air Filter Cave. Air Filter cave had an entrance that is 39 ft wide, 4.9 ft high at its entrance, and extended 32.8 ft into the roadcut. The cave was developed along a low bedding plane passage that was barely enterable, without excavation. (Figure 101). The floor was partially covered with flowstone and there were numerous stalactites. Airflow was detected in the cave. Excavation was conducted in September and October 2009, utilizing 29 person hours of effort and removed 15 ft^3 of material. Excavation primarily involved chiseling flowstone from the floor to allow easier access to the back of the cave. The back of the cave dropped down slightly but there were no voids extending off of it. Airflow detected at the entrance was later determined to be a result of air circulating from the wide mouth of the cave, and not coming from within the cave. It had a catchment area of less than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface as the feature was located 9 ft above the base of the roadcut and no mesocavernous extensions were observed. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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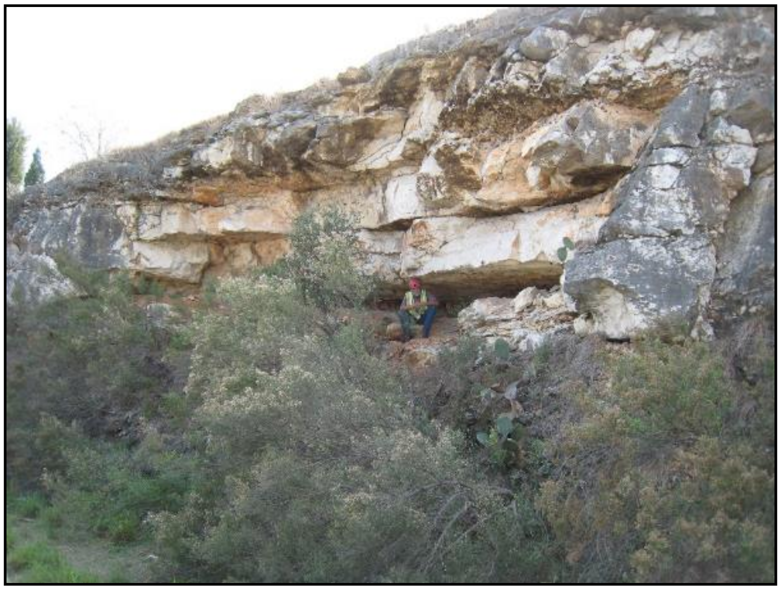

Figure 99. Overview of feature 1604-F072, Air Filter Cave.

Figure 100. Entrance of feature 1604-F072, Air Filter Cave.

ATTACHMENT C

Figure 101. Interior of feature 1604-F072, Air Filter Cave.

Figure 102. Interior of feature 1604-F072, Air Filter Cave, after lowering of floor by excavation.

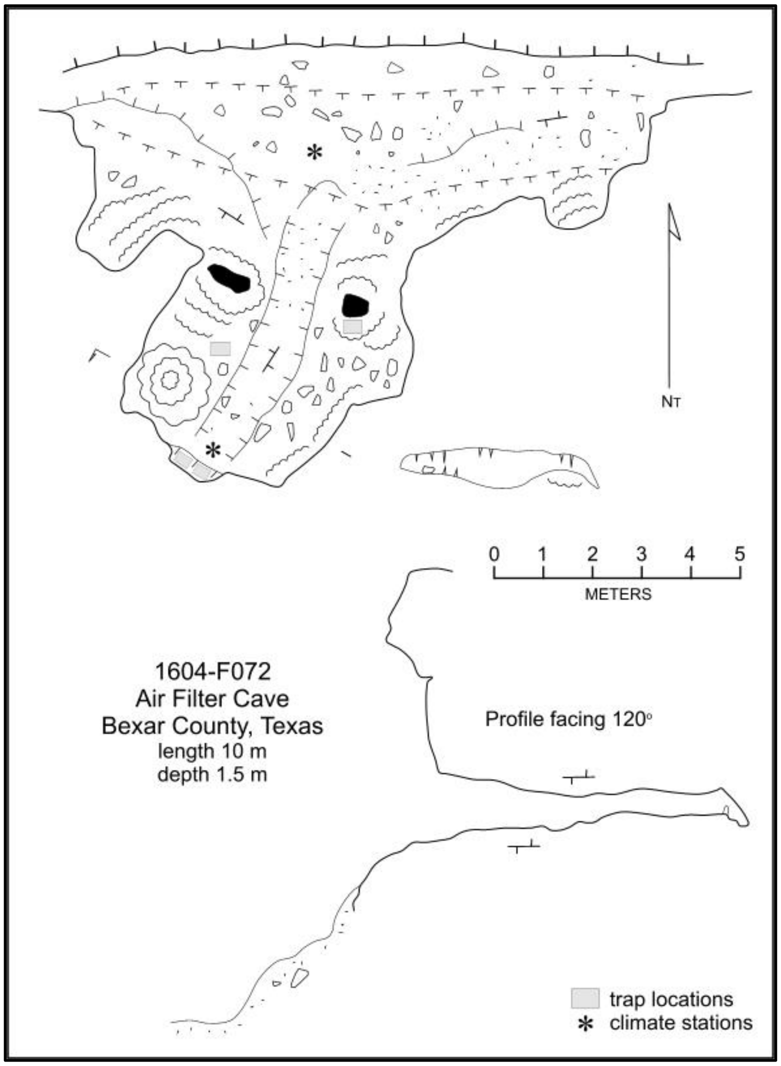

Figure 103. Map of feature 1604-F072, Air Filter Cave.

Feature 1604-F073; Solution Cavity (Solution-enlarged Bedding Plane)

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and east of Huebner Road (Figure 104 - Figure 108; Attachment D page 83). The feature was a solution-enlarged bedding plane that appeared to be developed along a fracture trending 90° with a dip of 35° south. Prior to excavation, the feature was 16.4 ft wide by 9.8 ft long by 2.3 ft high. Excavation to remove a large block at the entrance occurred in October 2009 utilizing 39.5 person hours of labor and resulted in the removal of 33 ft^3 of material from the feature. The feature was enlarged to a length of 10.5 ft with an average width of 5.6 ft and a height of 3 ft. This feature was infilled with speleothems, bedrock, and loose rocks and the entrance to the feature was obscured by large rocks. It had a catchment area of less than 1.6 ac. It was determined that there was a high potential for this feature to rapidly transmit water to the subsurface as the feature was located at and slightly below the base of the roadcut and had mesocavernous extensions. This feature was determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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Figure 104. Overview of feature 1604-F073.

Figure 105. Entrance of feature 1604-F073.

ATTACHMENT C

Figure 106. Interior of feature 1604-F073 prior to excavation in 2009.

Figure 107. Interior of feature 1604-F073, showing natural passage with speleothems.

ATTACHMENT C

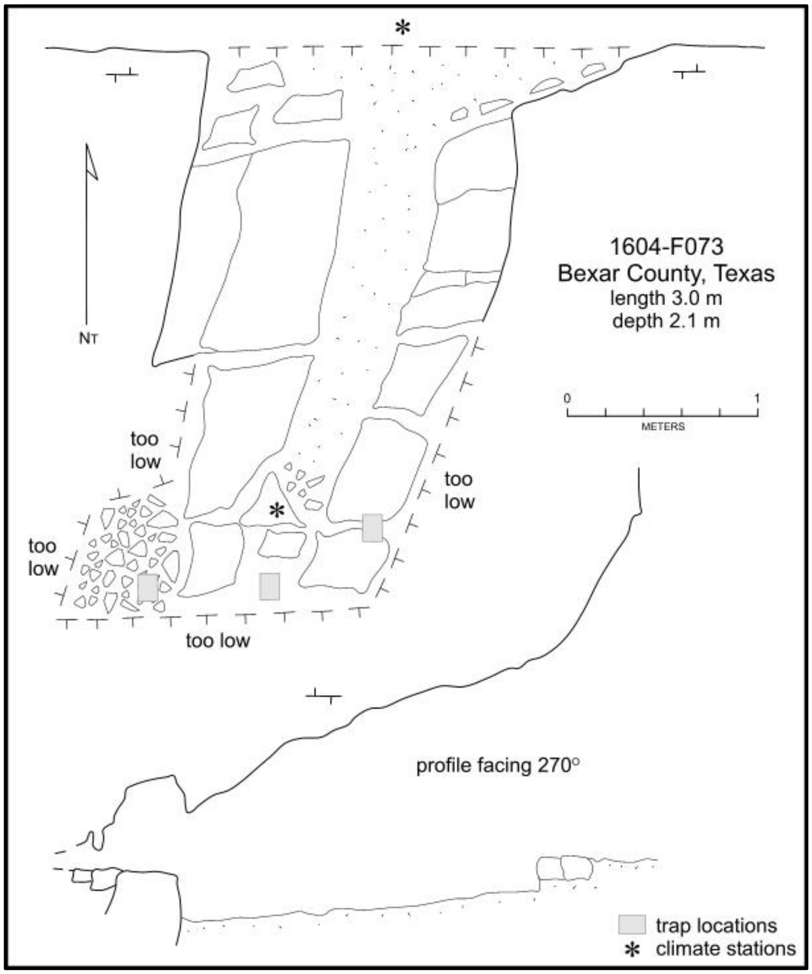

Figure 108. Map of feature 1604-F073.

Feature 1604-F074; Solution Cavity

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and east of Huebner Road (Figure 109 - Figure 111; Attachment D page 83). The feature was a solution cavity that measured 2.6 ft wide by 8.2 ft long and is 2.6 ft high. This feature contained dry flowstone and exposed bedrock and was infilled with loose rocks. It had a catchment area of less than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface as the feature was located approximately 2 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 109. Overview of feature 1604-F074.

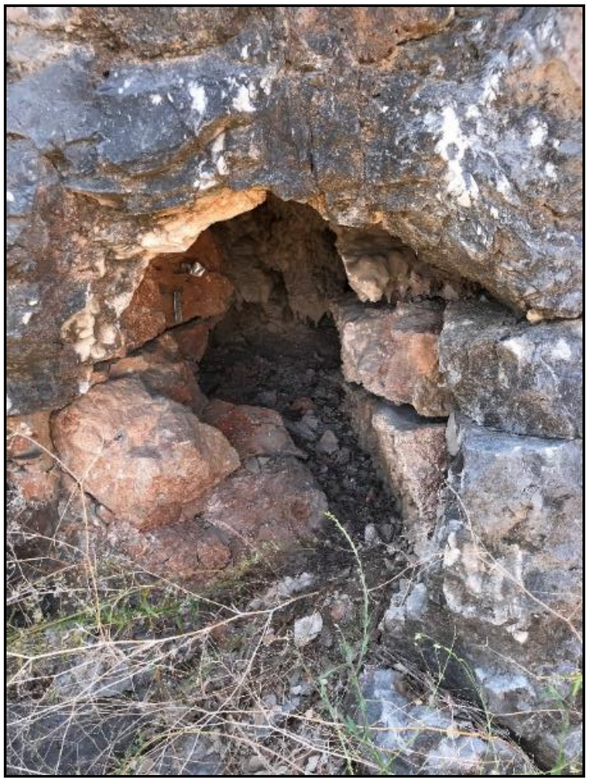

Figure 110. Interior of feature 1604-F074.

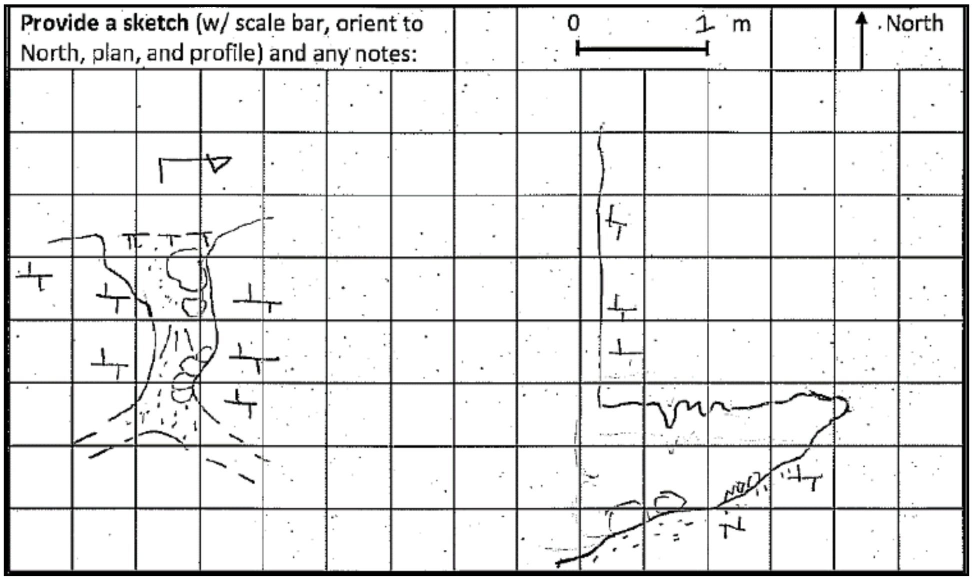

Figure 111. Field sketch of feature 1604-F074.

Feature 1604-F076; Solution Cavity

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and west of Blanco Road (Figure 112 - Figure 115; Attachment D page 85). The feature was a solution cavity that measured 0.7 ft wide by 0.5 ft high and extends 1.6 ft into bedrock. The feature was guided by a fracture with a trend of 50^{o}, which is consistent with regional trends associated with the Balcones Fault Zone. This feature contained bedrock and was infilled with loose rocks, organic soil, and leaf litter. It had a catchment area of less than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface as the feature was small and filled with compact soil. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 112. Overview of feature 1604-F076.

Figure 113. Entrance of feature 1604-F076.

Figure 114. Interior of feature 1604-F076.

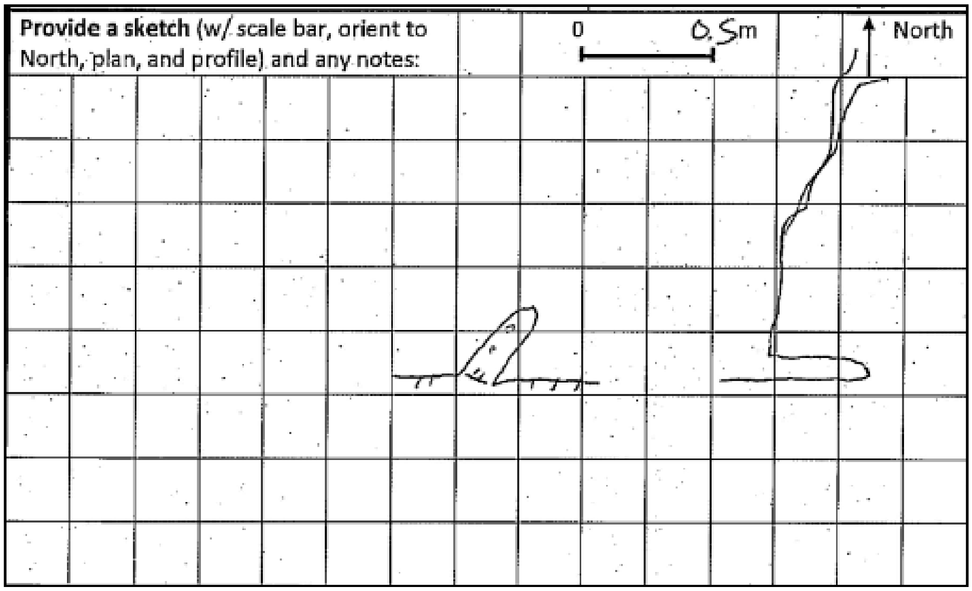

Figure 115. Field sketch of feature 1604-F076.

Feature 1604-F077 (Hubcap Cave); Cave

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Huebner Road (Figure 116 - Figure 120; Attachment D page 84). The feature is a cave that measured 6.2 ft wide, 16.4 ft long, and 13 ft deep. The cave was identified as Hubcap Cave in the TSS database. This feature contained bedrock, flowstone, loose rocks, and leaf litter. The feature was excavated on March 22, 2019 to remove 16 ft^3 of loose rocks. It had a catchment area of less than 1.6 ac. It was determined that there was a high potential for this feature to rapidly transmit water to the subsurface as it was situated at and below the base of the roadcut and contained mesocaverns. This feature was determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 116. Overview of feature 1604-F077.

Figure 117. Entrance of feature 1604-F077.

ATTACHMENT C

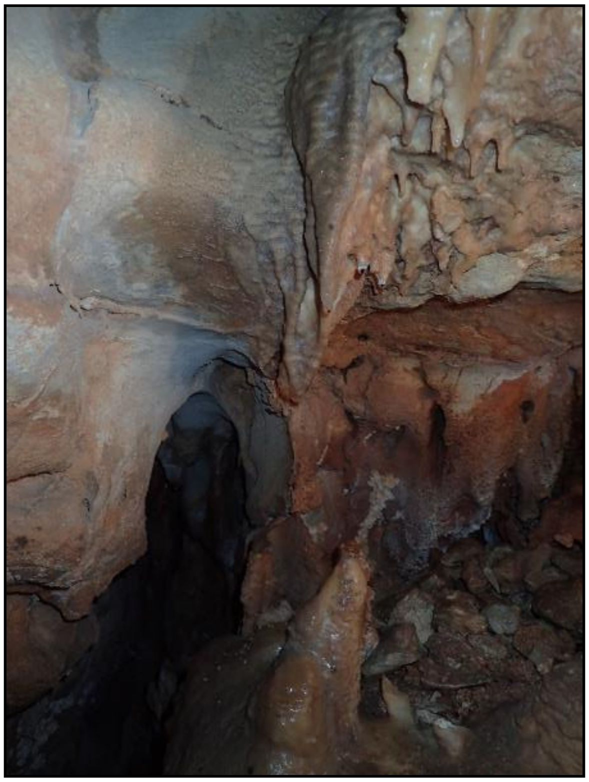

Figure 118. Interior of feature 1604-F077, showing a mesocavern.

Figure 119. Close-up of formations in feature 1604-F077.

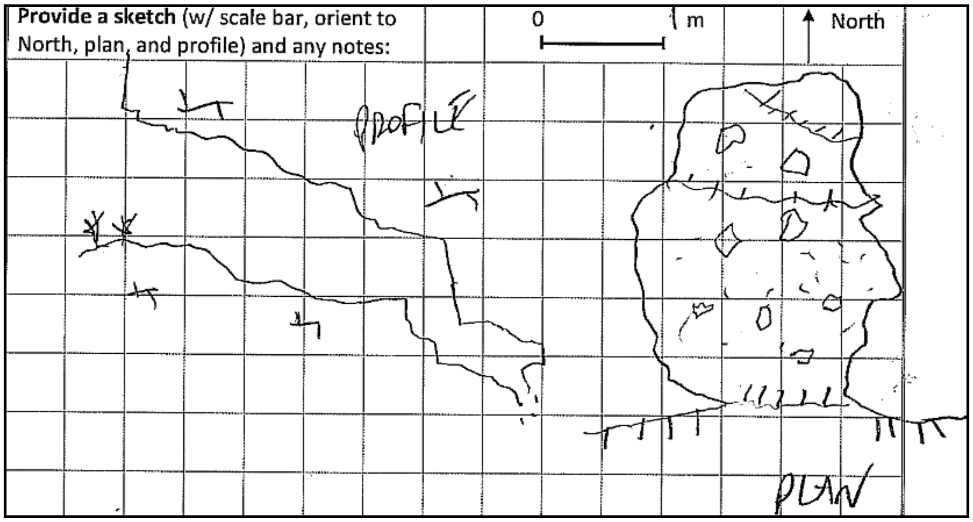

Figure 120. Field sketch of feature 1604-F077.

Feature 1604-F078; Solution Cavity

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Blanco Road (Figure 121 - Figure 124; Attachment D page 84). The feature was a solution cavity that measured 3.9 ft wide by 2.4 ft long and 4.9 ft deep. This feature was filled with loose rocks. It had a catchment area of greater than 1.6 ac. It was determined that there was a high potential for this feature to rapidly transmit water to the subsurface due to the presence of downward trending voids and its low elevation relative to the roadway and high likelihood of receiving channelized recharge. This feature was determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 121. Overview of feature 1604-F078.

ATTACHMENT C

Figure 122. Entrance of feature 1604-F078.

Figure 123. Interior of feature 1604-F078.

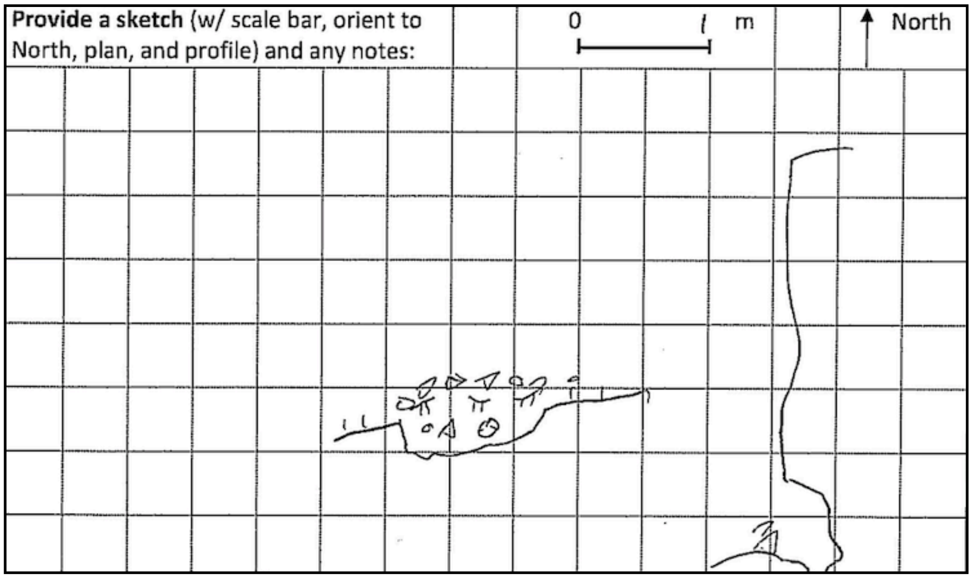

Figure 124. Field sketch of feature 1604-F078.

Feature 1604-F079; Solution Cavity

This feature was located in the roadcut north of the westbound mainlanes of Loop 1604 and west of Blanco Road (Figure 125 - Figure 128; Attachment D page 84). The feature was a solution cavity that measured 3.9 ft wide by 2.4 ft long and 4.9 ft deep. This feature consisted of only bedrock. It had a catchment area of greater than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface due to the absence of downward trending voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 125. Overview of feature 1604-F079.

ATTACHMENT C

Figure 126. Entrance of feature 1604-F079.

Figure 127. Interior of feature 1604-F079.

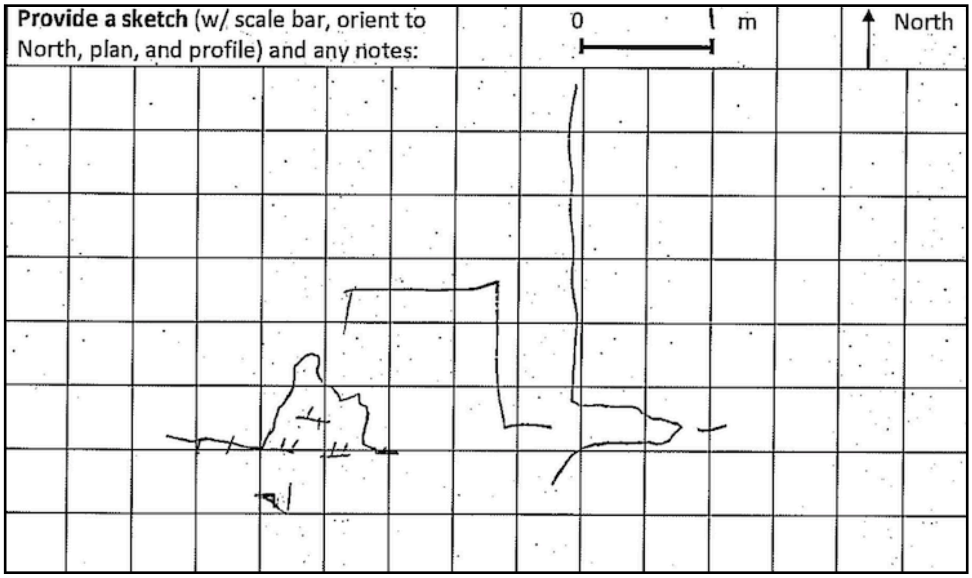

Figure 128. Field sketch of feature 1604-F079.

Feature 1604-F083; Solution Cavity

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Blanco Road (Figure 129 - Figure 132; Attachment D page 85). The feature was a solution cavity that measured 1.6 ft wide by 1.6 ft high and 2.3 ft deep. This feature was filled with loose rocks. It had a catchment area of less than 1.6 ac. It was determined that there was a moderate potential for this feature to rapidly transmit water to the subsurface as it was located along the base of the roadcut and may extend deeper into bedrock beyond what was observable from the surface. This feature was determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 129. Overview of feature 1604-F083.

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Figure 130. Entrance of feature 1604-F083.

Figure 131. Interior of feature 1604-F083.

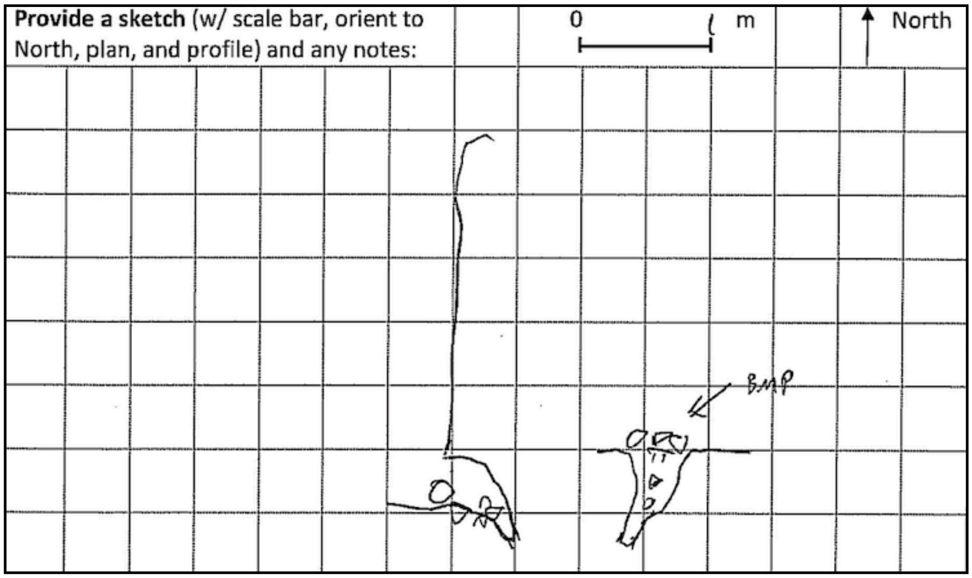

Figure 132. Field sketch of feature 1604-F083.

Feature 1604-F084; Solution Cavity (Solution-enlarged Bedding Plane)

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Blanco Road (Figure 133 - Figure 135; Attachment D page 85). The feature was a solution-enlarged bedding plane that measured 4.9 ft wide by 1 ft high at the entrance and extended 9.8 ft into bedrock. This feature contained bedrock and loose rocks. It had a catchment area of less than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface as it was situated 6 ft above the base of the roadcut and lacked downward trending voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).


Figure 133. Overview of feature 1604-F084.

ATTACHMENT C

Figure 134. Interior of feature 1604-F084,

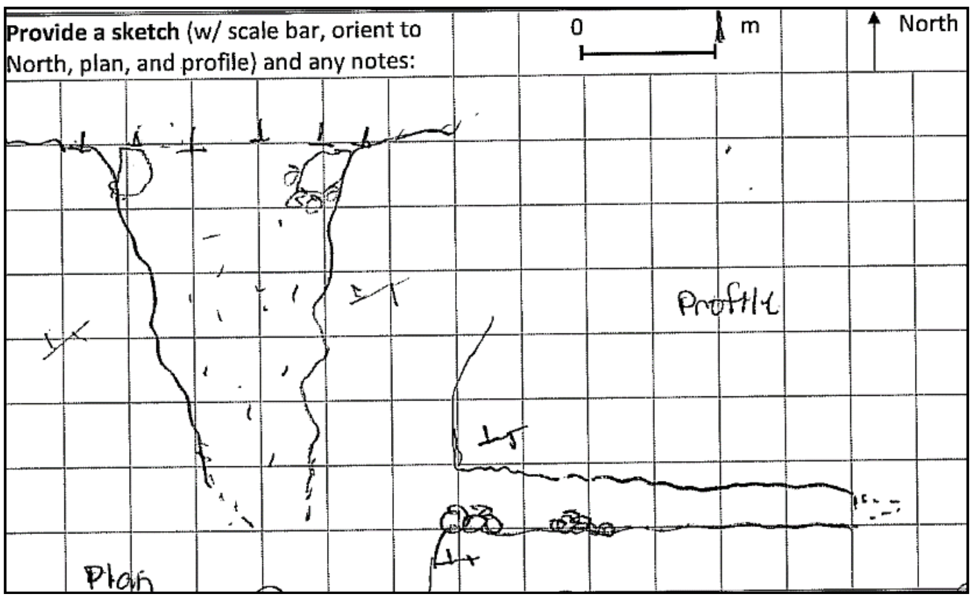

Figure 135. Field sketch of feature 1604-F084.

Feature 1604-F085; Solution Cavity

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Blanco Road (Figure 136 - Figure 138; Attachment D page 85). The feature was a solution cavity that measures 2.3 ft wide by 3.6 ft high and 3.9 ft deep. This feature contained bedrock, organic soil, and loose rocks. It had a catchment area of less than 1.6 ac. It was determined that there was a moderate potential for this feature to rapidly transmit water to the subsurface as it was situated along the base of the roadcut and could potentially extend deeper into bedrock than is observable from the surface. This feature was determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

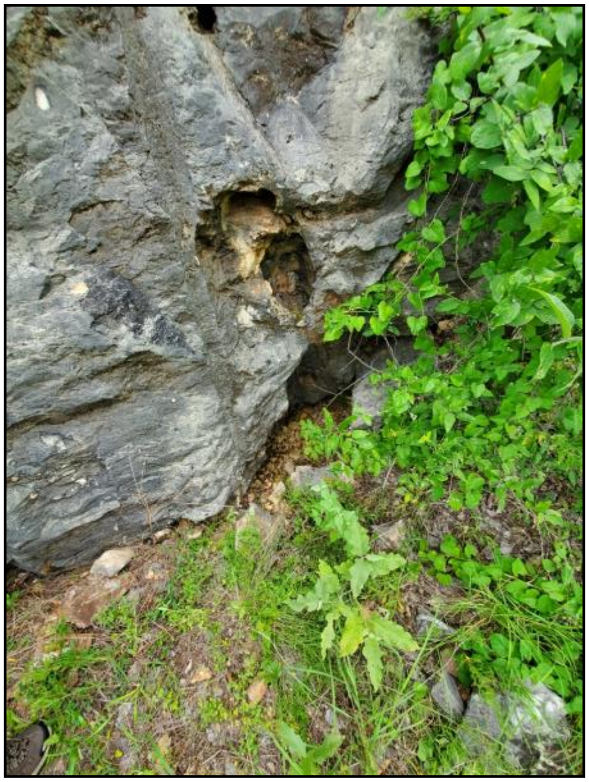

Figure 136. Overview of feature 1604-F085.

Figure 137. Interior of feature 1604-F085.

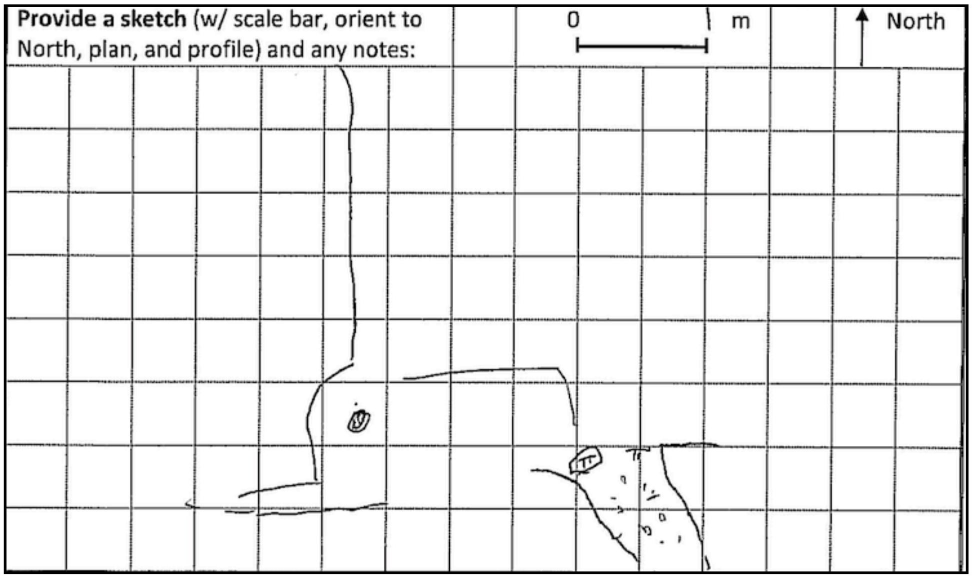

Figure 138. Field sketch of feature 1604-F085.

Feature 1604-F101 (Tally Ho Cave); Cave

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Gold Canyon Road (Figure 139 - Figure 142; Attachment D page 97). The feature was a cave identified in the TSS database as Tally Ho Cave. This cave was found on 15 July 2009 and evaluated in October 2009 (TxDOT 2015). The cave was sealed by the Alamo Regional Mobility Authority, who identified the feature as S-7-B-South, pursuant to EAPP ID 13-10090211 approved by the TCEQ on December 22, 2011 (Bryant 2020). This feature was comprised of four vertically aligned holes developed in an enlarged fracture with a trend of 45°. The lowest entrance, near ground level, was initially 7.2 ft wide and extended 5.2 ft into the face of the roadcut. The total vertical extent of this feature was 16.4 ft. The lower part of the feature was excavated using 15.8 person hours of effort, with 80.7 ft^3 of material removed from the feature making it 16.4 ft long and 6.6 ft deep. After an initial drop-off at the entrance, there was a step-up at a narrow spot that opened to a room measuring 4.9 ft by 2 m 6.6 ft with some small holes that extended up into the ceiling. The grouted entrance observed in 2019 was 39.4 ft wide by 2 ft high. The feature had a catchment area of less than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface as the entrance was grouted shut. However, it was determined that there could be potential for rapid recharge to the subsurface if the feature is reopened by construction activities. This feature was determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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Figure 139. Overview of feature 1604-F101 (Tally Ho Cave) in 2009, after excavation.

ATTACHMENT C

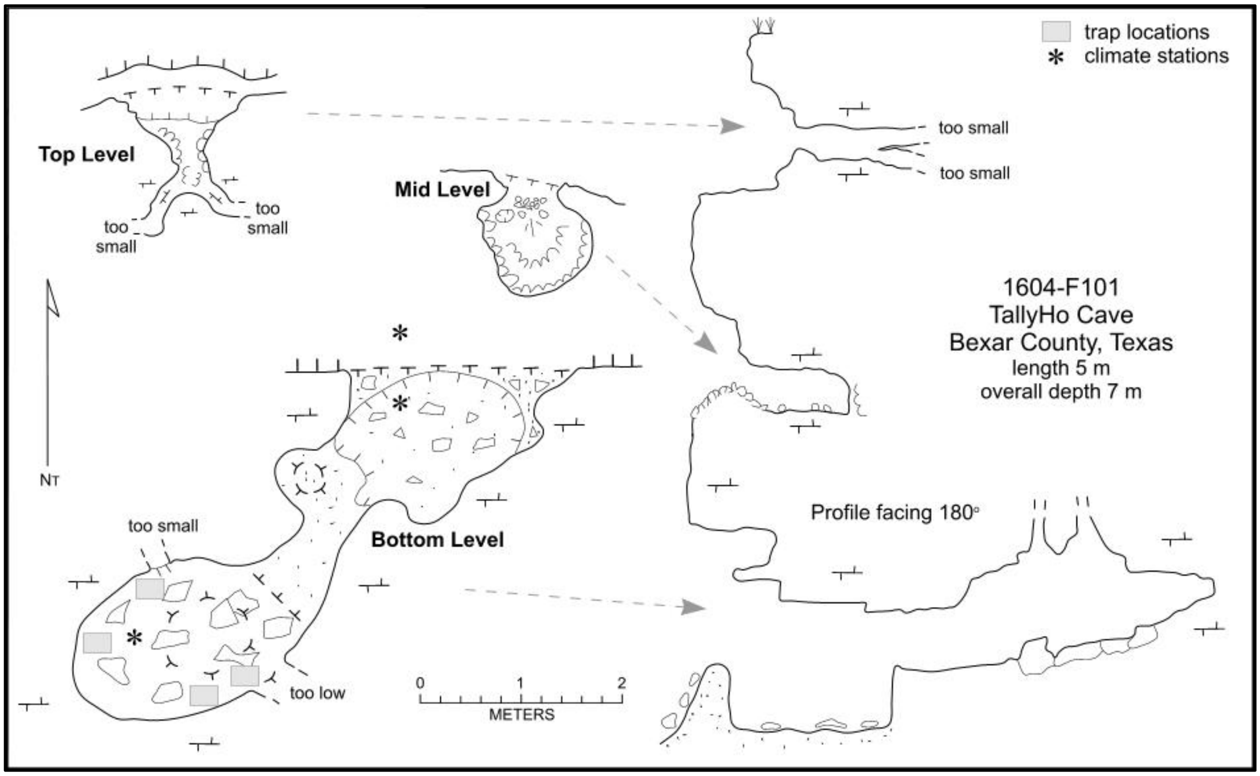

Figure 140. Map of feature 1604-F101 (Tally Ho Cave) prior to it being mined away.

Figure 141. Overview of feature 1604-F101 in 2019.

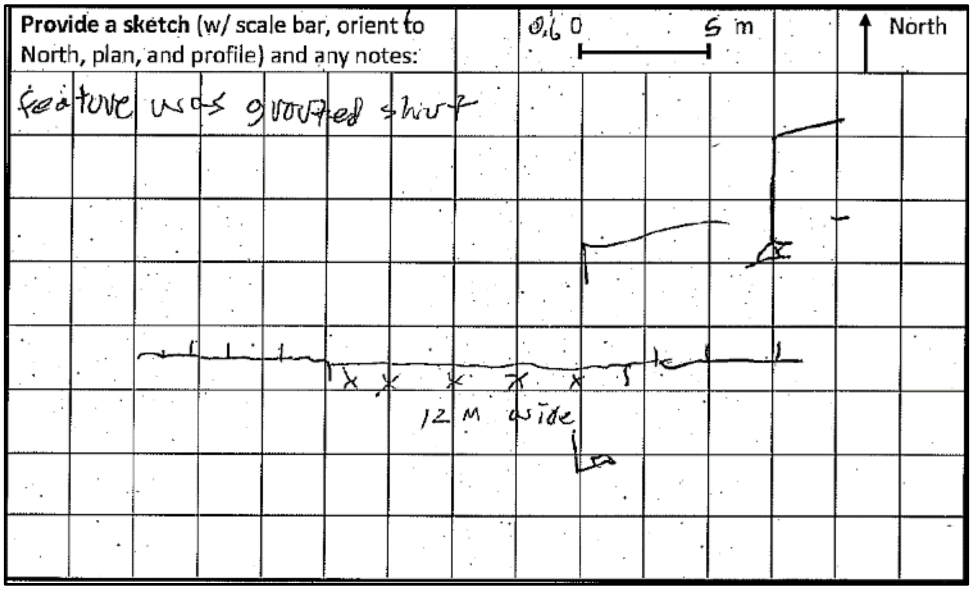

Figure 142. Field sketch of feature 1604-F101 in 2019.

Feature 1604-FZ3; Solution Cavity (Solution-enlarged Bedding Plane)

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and west of Blanco Road (Figure 143 - Figure 146 ; Attachment D page 85). The feature was a solution-enlarged bedding plane that measured 1 ft wide by 1 ft high and extended 9.8 ft into bedrock. It had a catchment area of less than 1.6 ac. It was determined that there was a low potential for this feature to transmit water to the subsurface due its location above the base of the roadcut and lack of downward trending voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 143. Overview of feature 1604-FZ3.

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Figure 144. Entrance of feature 1604-FZ3.


Figure 145. Interior of 1604-FZ3.

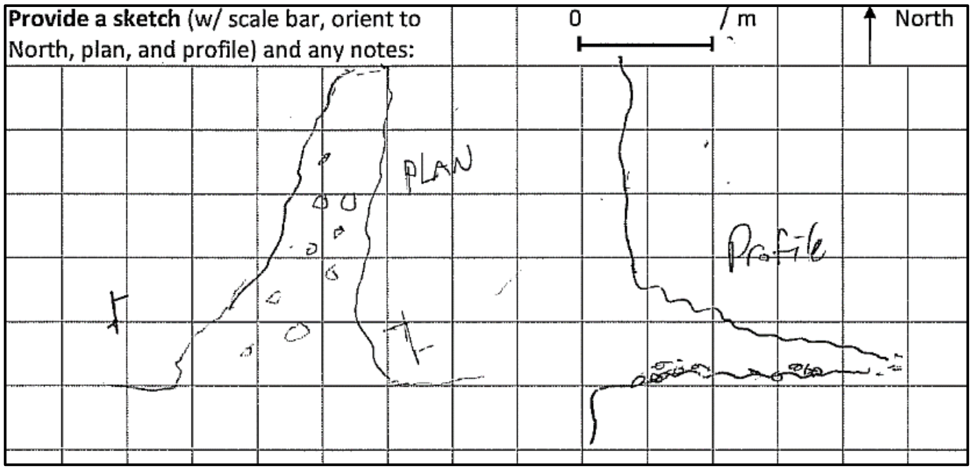

Figure 146. Field sketch of feature 1604-FZ3.

Feature 1604-FZ4; Solution Cavity

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Blanco Road (Figure 147 - Figure 150; Attachment D page 84). The feature was a solution cavity that measured 1.5 ft wide by 0.8 ft high and extended 3.6 ft into bedrock. This feature contained fine organic soil and leaf litter. It had a catchment area of less than 1.6 ac. It was determined that there was a low potential for this feature to transmit water to the subsurface due its location above the base of the roadcut and lack of downward trending voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).


Figure 147. Overview of feature 1604-FZ4.

ATTACHMENT C

Figure 148. Entrance of feature 1604-FZ4.

Figure 149. Interior of 1604-FZ4.

ATTACHMENT C

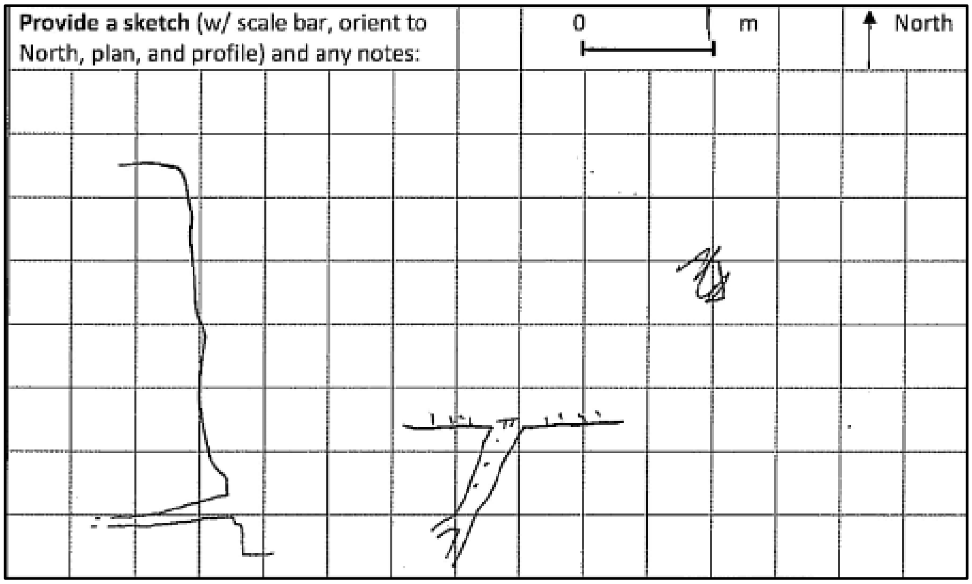

Figure 150. Field sketch of feature 1604-FZ4.

Feature 1604-FZ6; Zone with Solution-enlarged Fracture and Solution Cavity

This feature was a zone with two features located in a roadcut north of the westbound mainlanes of Loop 1604 and west of Huebner Road (Figure 151 - Figure 154; Attachment D page 81-82). The largest feature in the zone was a solution-enlarged fracture located 1.6 ft above the base of the roadcut. It was 2 ft wide by 1.75 ft high and extended 3.2 ft into bedrock. This feature contained loose rocks, fine sediment, and bedrock. A smaller solution cavity was also present at the base of the cut that was 0.6 ft in diameter and extended 0.75 ft into bedrock. The features both trended at approximately 140º into the roadcut and contained mesocavernous voids that extended into the roadcut along that trend. The feature had a catchment area of less than 1.6 ac. It was determined that there was a low potential for the larger of these features to rapidly transmit water to the subsurface due its location above the base of the roadcut. The smaller feature was located at the base of the cut, but it was approximately 2 ft above the base of the adjacent vegetated ditch. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

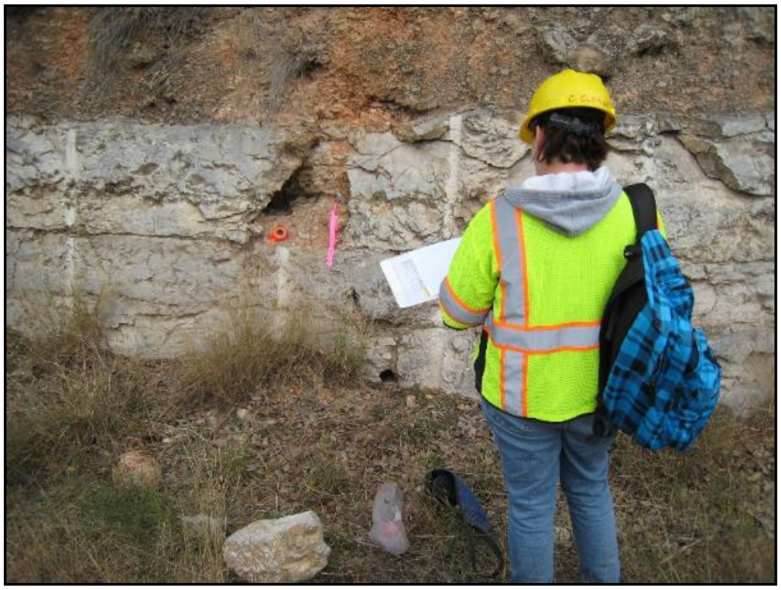

Figure 151. Overview of feature 1604-FZ6.

Figure 152. Close-up of the larger solution-enlarged fracture of feature 1604-FZ6.

ATTACHMENT C

Figure 153. Close-up of the smaller solution cavity of feature 1604-FZ6.

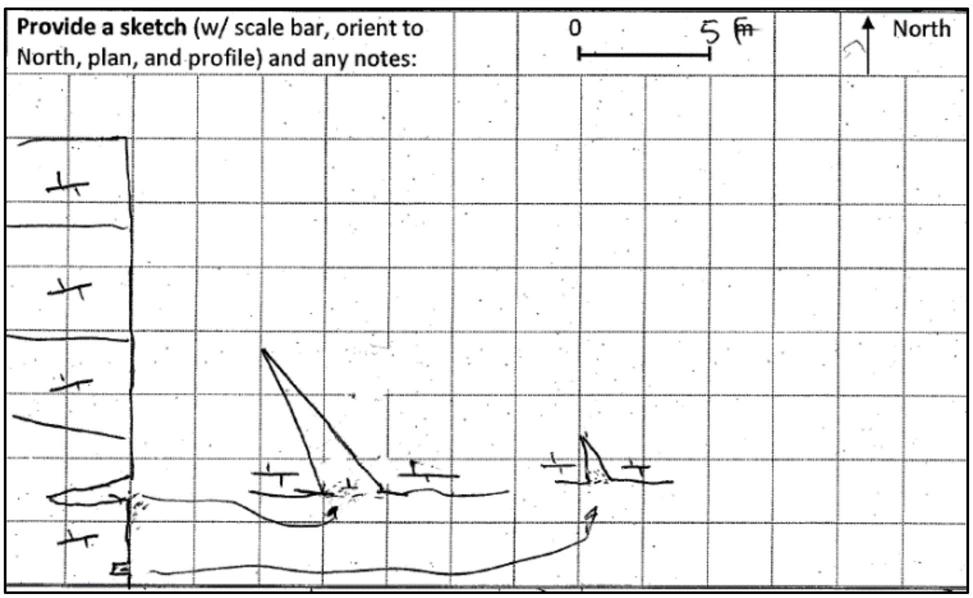

Figure 154. Field sketch of feature 1604-FZ6.

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Feature 1604-FZ7; Solution Cavity

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and west of Huebner Road (Figure 155 - Figure 159; Attachment D page 81-82). The feature was a solution cavity that measured 5.7 ft wide by 1.6 ft high and extended 6.6 ft into bedrock. The feature was originally evaluated in 2009 and again in 2017. Excavation in 2017 resulted in the removal of 43 ft^3 of material that appeared to be road base. Excavation revealed a compact clay floor and a mesocavernous drain with a terminus in bedrock. This feature contained loose rocks, red clay, and leaf litter. A berm has been placed at the entrance to redirect surface runoff around the void. It had a catchment area of less than 1.6 ac. It was determined that there was a moderate potential for this feature to rapidly transmit water to the subsurface due its location at and below the base of the roadcut and mesocavernous drain. This feature was determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 155. Overview of feature 1604-FZ7.

ATTACHMENT C

Figure 156. Entrance of feature 1604-FZ7.

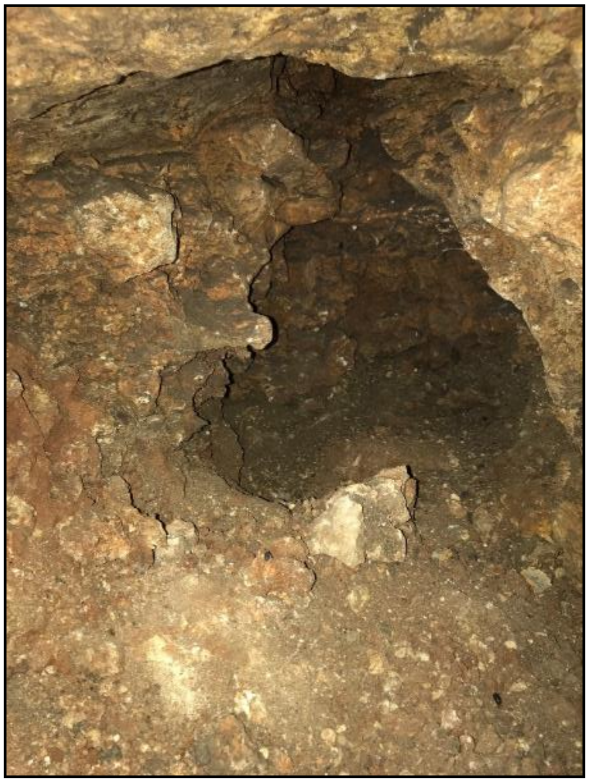

Figure 157. Interior of feature 1604-FZ7.

ATTACHMENT C

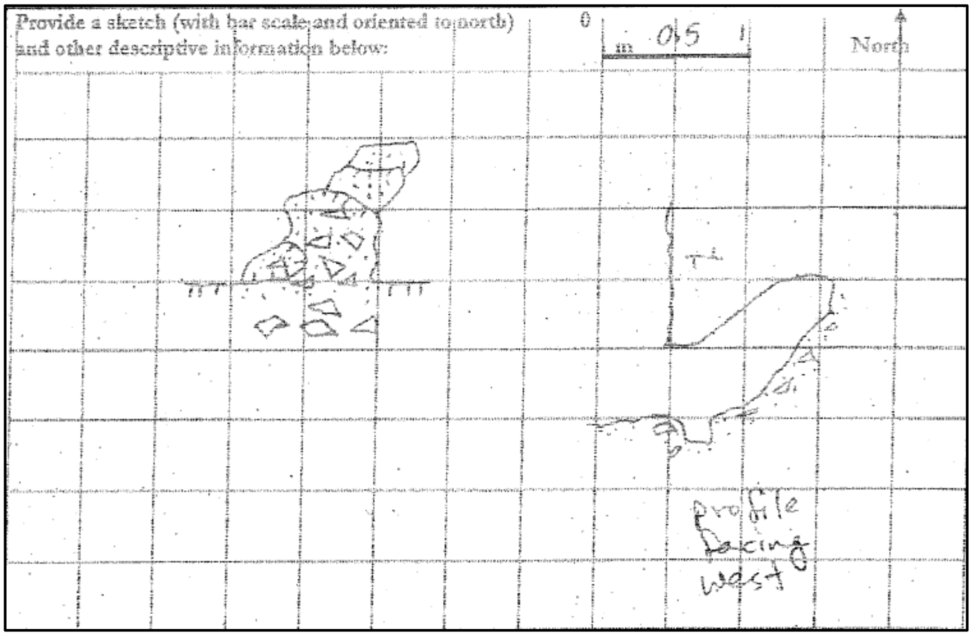

Figure 158. Field sketch of feature 1604-FZ7 prior to excavation.

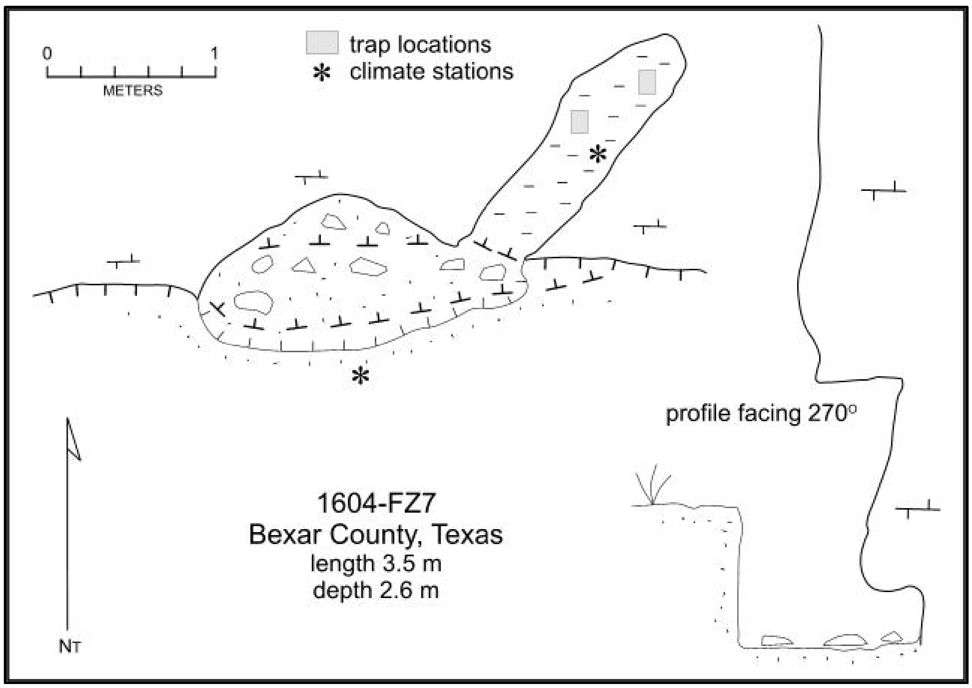

Figure 159. Map feature 1604-FZ7 after excavation.

Feature 1604-FZ8; Solution Cavity (Solution-enlarged Bedding Plane)

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and east of Bitters Road (Figure 160 - Figure 162; Attachment D page 79). The feature was an enlarged bedding plane that measured 10 ft wide by 1 ft high and extended 5.3 ft into bedrock. It continued as a low bedding plane opening and no larger voids were visible. The feature was originally evaluated in 2009 and again in 2017. This feature was filled with lose cobbles, fine sediment and bedrock. It had a catchment area of less than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface as it was situated 1.6 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 160. Overview of feature 1604-FZ8.

ATTACHMENT C

Figure 161. Interior of feature 1604-FZ8.

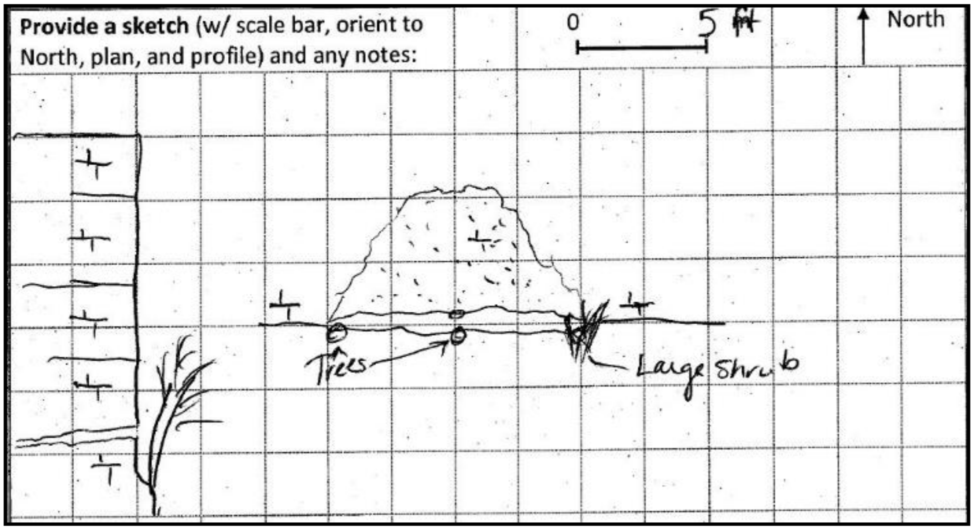

Figure 162. Field sketch of feature 1604-FZ8.

Feature 1604-K41; Solution Cavity

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and east of Gold Canyon Road (Figure 163 - Figure 165; Attachment D page 98). The feature was a solution cavity that measured 2 ft wide by 1.1 ft high and 1.3 ft deep. This feature contained fine sediment. It had a catchment area of less than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface due to its small size and sediment fill. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 163. Overview of feature 1604-K41.

Figure 164. Close-up of feature 1604-K41.

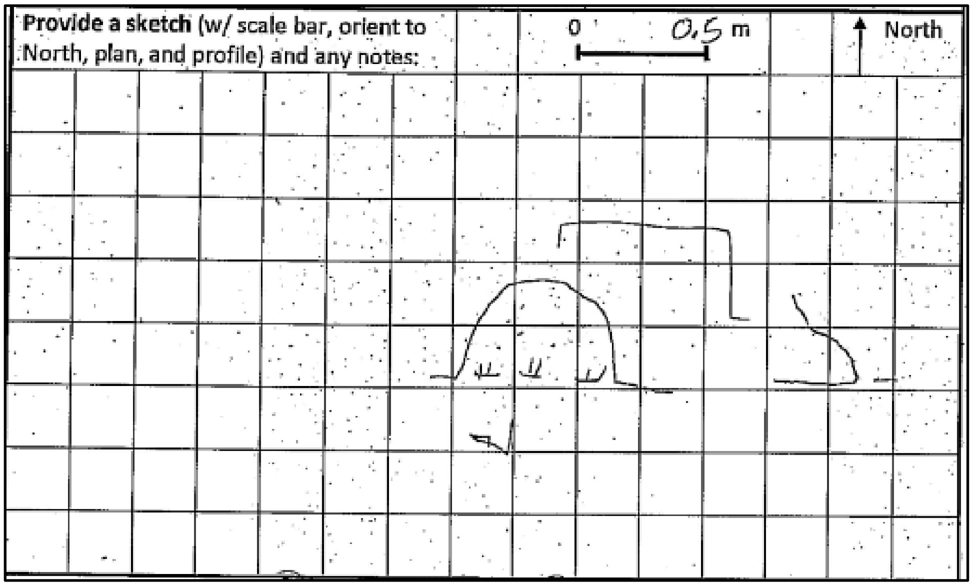

Figure 165. Field sketch of feature 1604-K41.

Feature 1604-L02; Solution Cavity (Solution-enlarged Bedding Plane)

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and east of NW Military Hwy (Figure 166 - Figure 168; Attachment D page 71). The feature was a solution-enlarged bedding plane that measured 6.6 ft wide by 0.2 ft high and extended 0.7 ft into bedrock. This feature contained organic soil and leaf litter. It had a catchment area of less than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface due to its position above the base of the roadcut and a lack of downward trending voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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Figure 166. Overview of feature 1604-L02.

Figure 167. Close-up of feature 1604-L02.

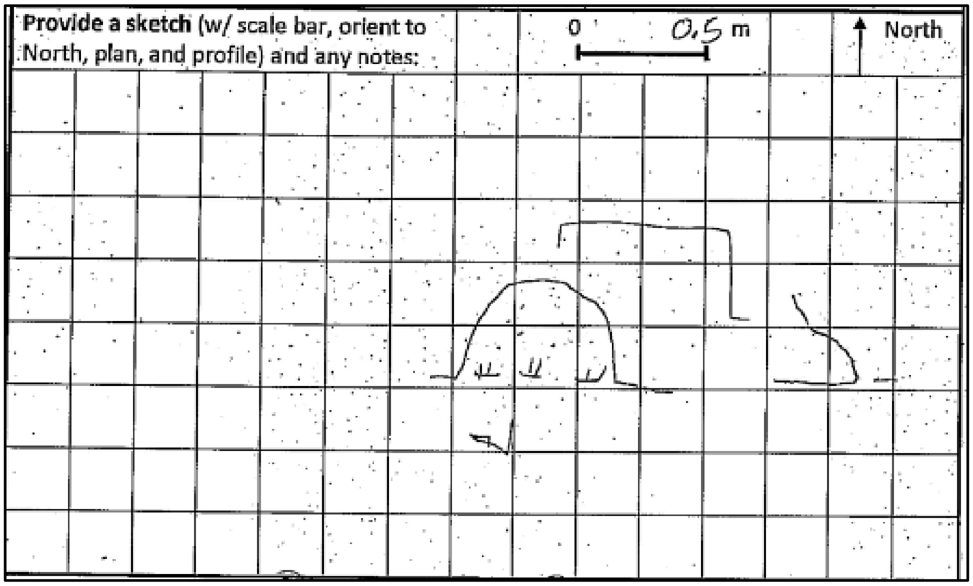

Figure 168. Field sketch of feature 1604-L02.

Feature 1604-L11; Solution Cavity (Solution-enlarged Bedding Plane)

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and west of Bitters Road (Figure 169 - Figure 171; Attachment D page 79). The feature was a solution-enlarged bedding plane that measured 9 ft wide by 3 ft high and extends 2.5 ft into bedrock. The feature was first evaluated in 2009 and again in 2017. This feature contained exposed bedrock, flowstone, and coarse breakdown. It had a catchment area of less than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface as the feature was situated approximately 5 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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Figure 169. Overview of feature 1604-L11.

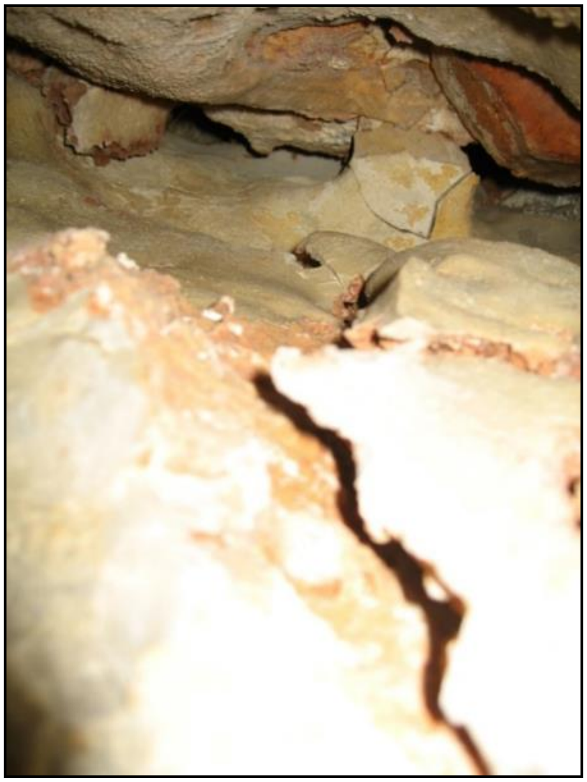

Figure 170. Interior of feature 1604-L11.

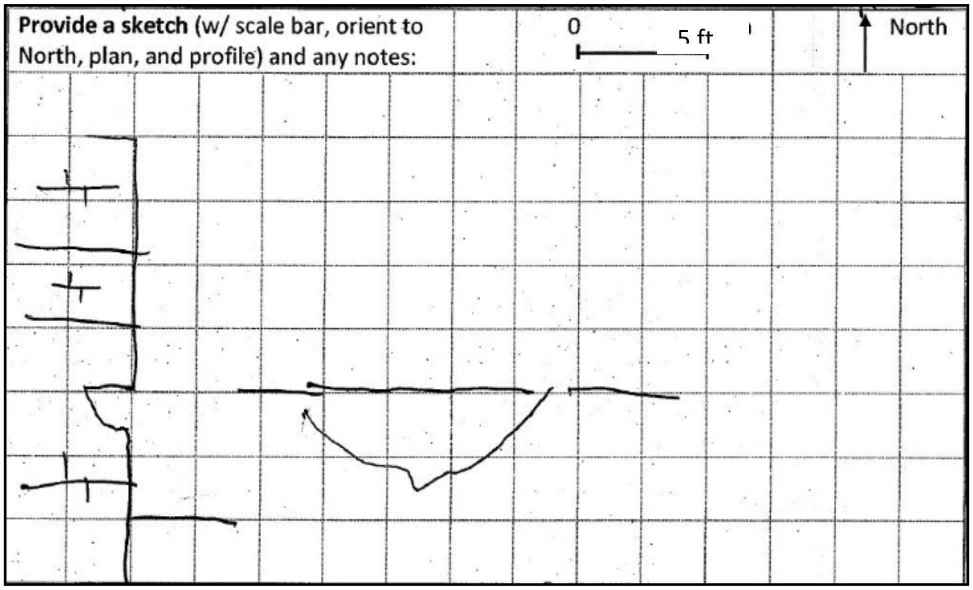

Figure 171. Field sketch of feature 1604-L11.

Feature 1604-L12; Solution Cavity (Solution-enlarged Bedding Plane)

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and west of Bitters Road (Figure 172 - Figure 176; Attachment D page 79). The feature was a solution-enlarged bedding plane that measures 6.6 ft wide by 0.7 ft high and extended 4.6 ft deep into bedrock at a trend of 33°. This feature was originally evaluated and excavated in 2010. In August 2010, 0.6 person hours were spent removing 0.7 ft^3 of material using hand tools. A distinct terminus was reached 5.6 ft from the entrance with a mesocavernous void leading off from the ceiling at the northeast extent of the feature. The feature was re-evaluated on 5 August 2019. At the time of this reevaluation, the feature contained exposed bedrock, modern soils and rocks, and organic debris such as bird feathers and leaf litter. Additionally, tire fragments appeared to have washed into the void. It had a catchment area of less than 1.6 ac. It was determined that there was a moderate potential for this feature to rapidly transmit water to the subsurface. Despite the single mesocavern being at a higher elevation than the base of the roadcut, field conditions indicated that water has previously entered the feature. A sediment log has been placed in front of the void to redirect surface runoff around the feature. This feature was determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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Figure 172. Overview of feature 1604-L12.

Figure 173. Interior of feature 1604-L12 after excavation.

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Figure 174. Interior of feature 1604-L12.

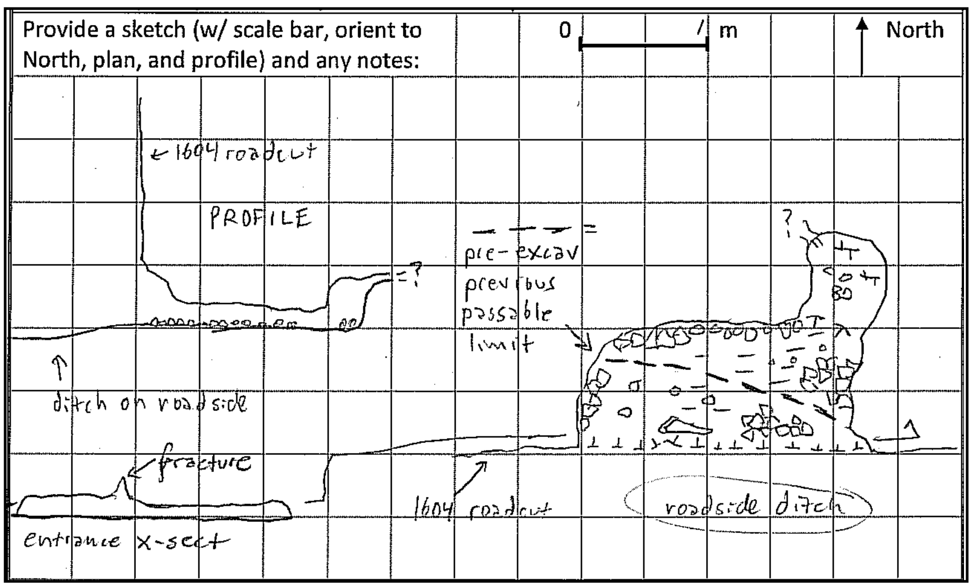

Figure 175. Pre and post excavation field sketch of feature 1604-L12 in 2010.

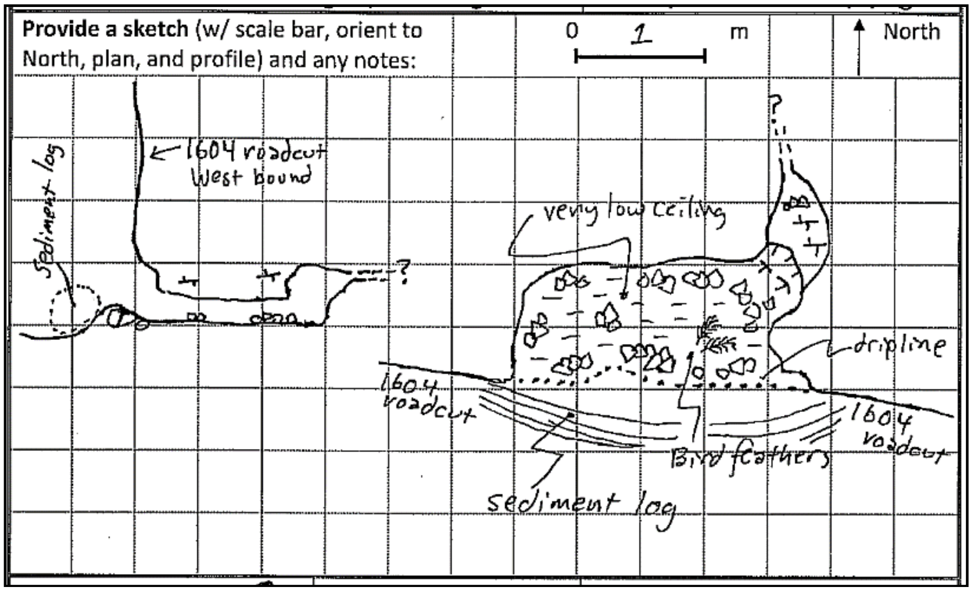

Figure 176. Field sketch of feature 1604-L12.

Feature 1604-L13 and 13a; Solution Cavities

These features were located in a roadcut north of the westbound mainlanes of Loop 1604 and immediately west of Bitters Road (Figure 177 - Figure 181; Attachment D page 79). The features consisted of two vertically aligned solution cavities. Feature 13 measured 0.3 ft wide by 0.3 ft high and extended 3.7 ft into bedrock guided by a fracture with a trend of 124º. Feature 13a measured 0.7 ft wide by 0.5 ft high and extended 2.6 ft into bedrock. The lower feature 1604-L13 contained silt, pebbles, and exposed bedrock and had a very small void leading out of sight at the back. The upper feature 1604-L13a contained rocks and red clay, had no mesocaverns. Both features had a catchment area of less than 1.6 ac. It was determined that there was a low potential for these features to rapidly transmit water to the subsurface as they were situated well above the base of roadcut. These features were not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 177. Overview of feature 1604-L13 (lower) and 1604-L13a (upper).

Figure 178. Close up of feature 1604-L13.

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Figure 179. Interior of feature 1604-L13.

Figure 180. Close up of feature 1604-L13a.

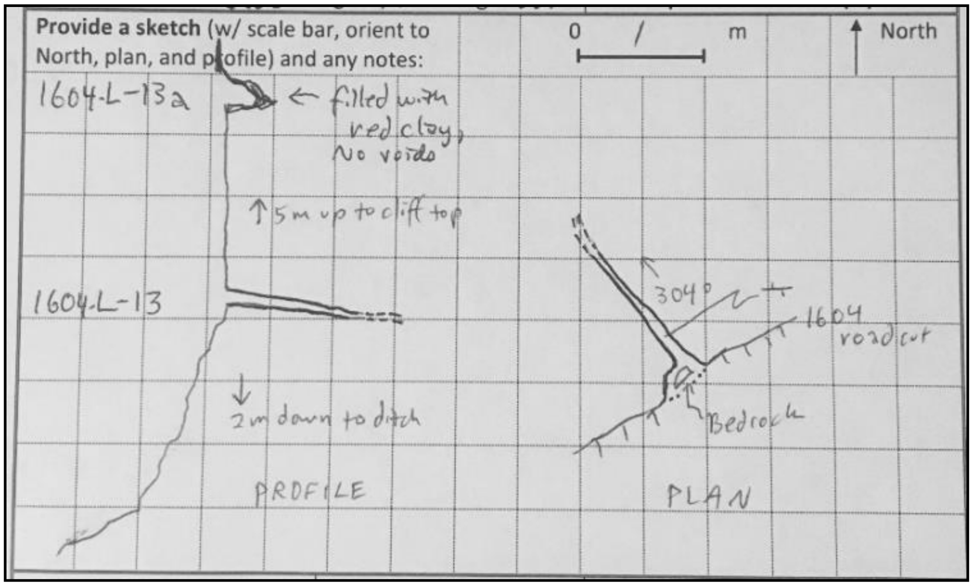

Figure 181. Field sketch of feature 1604-L13 and 13b.

Feature 1604-L16 (12A Cave); Solution Cavity (Solution-enlarged Bedding Plane)

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Bitters Road (Figure 182- Figure 185; Attachment D page 79). The feature was an enlarged bedding plane that measured 3.0 ft wide by 2.6 ft high and extended 11 ft into bedrock at a trend of 17°. This feature was in the TSS database as “12A Cave” even though it did not meet the length requirements of a cave (15.5 ft) previously established by the TSS. It was originally evaluated in 2009 and revisited for this project on 5 August 2019. This feature contained breakdown, gravel, flowstone, and red-tan silty clay with a loose depth of 3 cm. Excavation revealed a compact clay-filled terminus with no significant mesocavernous extensions. It had a catchment area less than 1.6 ac. Despite its location at the base of the roadcut, it was determined that there was a low potential for this feature to transmit water into the subsurface due to the compact clay fill and lack of downward trending voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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Figure 182. Overview of feature 1604-L16.

Figure 183. Interior of feature 1604-L16. Scale bar points north.

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Figure 184. Interior of feature 1604-L16. Scale bar points north, and flowstone can be seen on the left side of the passage.

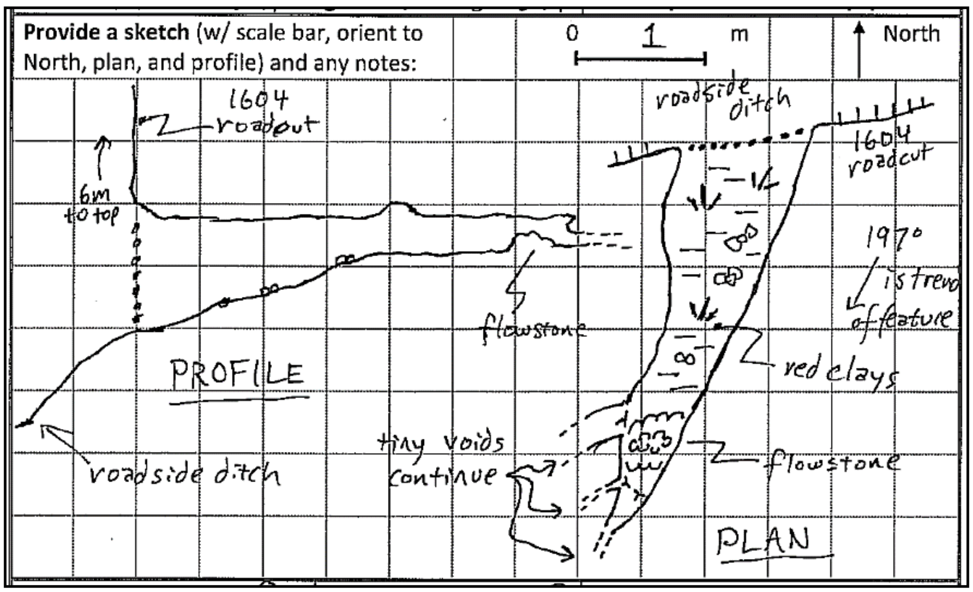

Figure 185. Field sketch of feature 1604-L16.

Feature 1604-M21 (Hans Grotto); Cave

This feature was located in Salado Creek under the west bound access road of Loop 1604 and west of Bitters Road (Figure 186 - Figure 189; Attachment D page 77-78). The feature was a cave that measured 6.5 ft wide by 0.98 ft high at the entrance and extended 9.8 ft into bedrock. This feature was filled with loose rocks, concrete, and compact silt. It had a catchment area of greater than 1.6 ac. It was determined that there was a moderate potential for this feature to rapidly transmit water to the subsurface due its location adjacent to a creek channel. This feature was determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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Figure 186. Overview of feature 1604-M21 (Hans Grotto).

Figure 187. Entrance of feature 1604-M21 (Hans Grotto).

ATTACHMENT C

Figure 188. Interior of feature 1604-M21 (Hans Grotto).

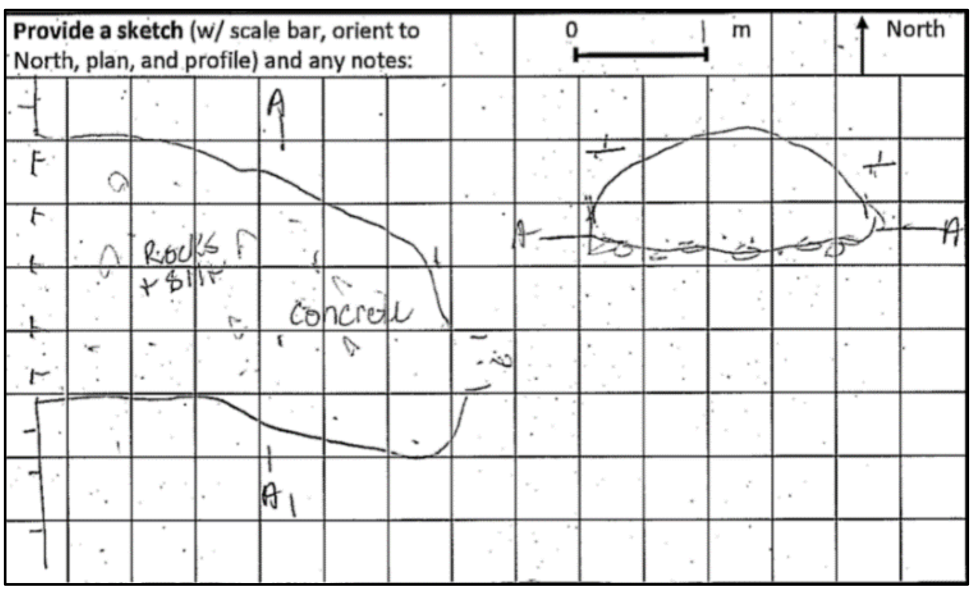

Figure 189. Field sketch of feature 1604-M21 (Hans Grotto).

ATTACHMENT C

Feature 1604-M22; Solution Cavity (Paleospring)

This feature was located in a modified streambed under the westbound mainlanes of Loop 1604 and west of Bitters Road (Figure 190 - Figure 192; Attachment D page 77-78). The feature was solution cavity that functioned as a paleospring that measures 0.66 ft wide by 3.3 ft long and 2.5 ft deep. This feature contained loose rocks and trash. It had a catchment area of less than 1.6 ac. The feature has potentially received recharge during high floods. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface due to the absence of downward trending voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 190. Overview of feature 1604-M22.

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Figure 191. Interior of feature 1604-M22.

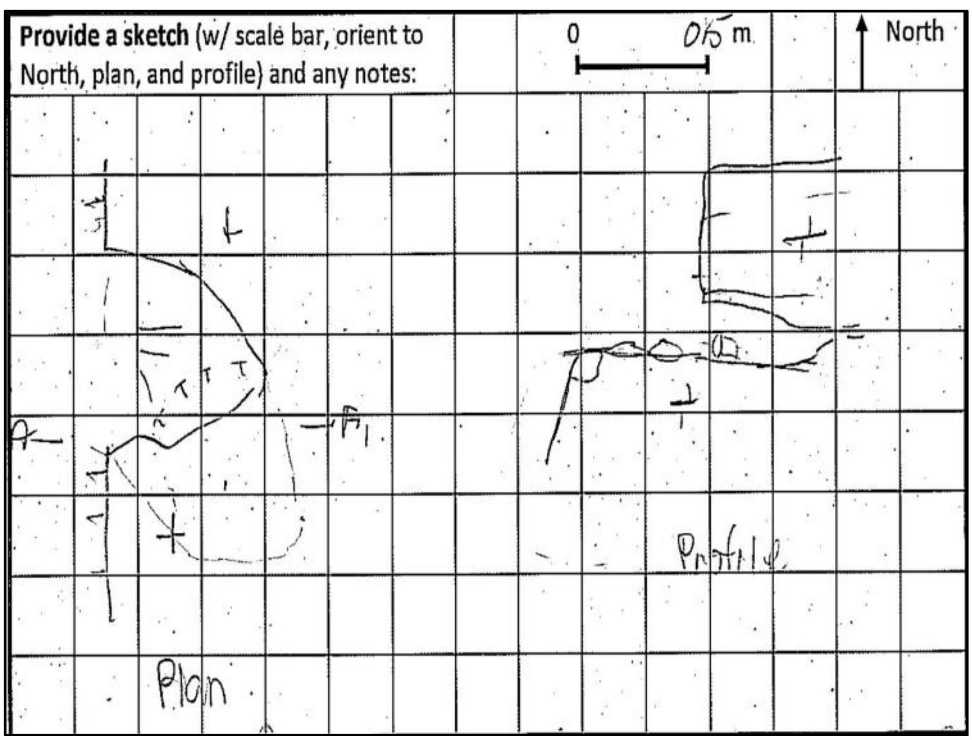

Figure 192. Field sketch of feature 1604-M22.

ATTACHMENT C

Feature 1604-Q48; Solution cavity

This feature was located high in the western sloping bank of Leon Creek under the westbound mainlanes of Loop 1604 and west of I-10 (Figure 193 - Figure 195; Attachment D page 61). The feature was a solution cavity developed along a bedding plane. It measured 4.9 ft wide by 2.5 ft high and extended 6.6 ft into bedrock. This feature contained bedrock, loose rocks, and fine, compact soil. It had a catchment area of less than 1.6 ac. It is possible that this feature has received recharge during high floods as it was situated in the side slope of Leon Creek. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface due to the absence of downward trending voids and a compact soil floor. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 193. Entrance of feature 1604-Q48.

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Figure 194. Interior of feature 1604-Q48.

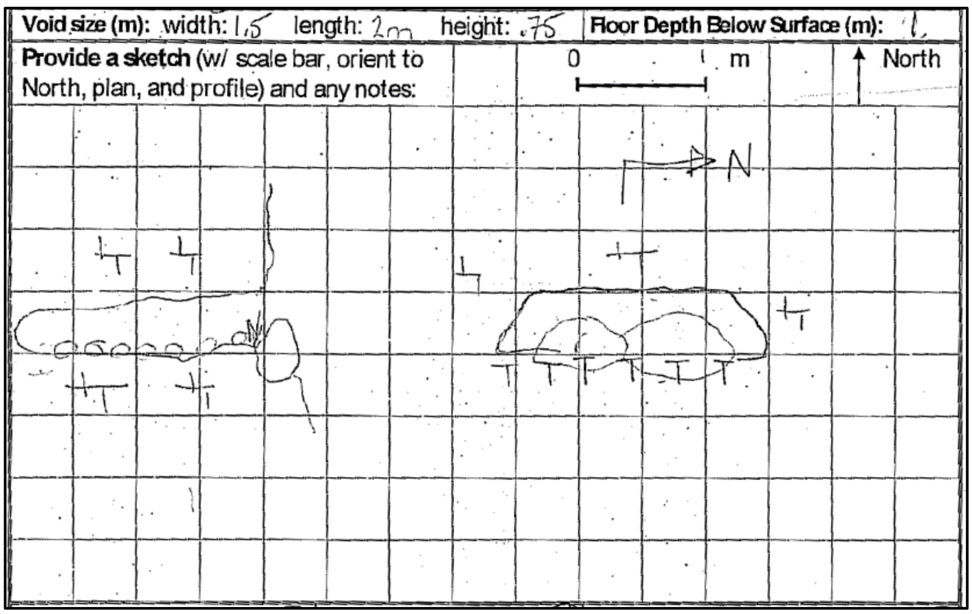

Figure 195. Field sketch of feature 1604-Q48.

ATTACHMENT C

Feature 1604-R03; Cave

This feature was located north of the westbound lanes of Loop 1604 and west of I-10 (Figure 196 - Figure 198; Attachment D page 61). The feature was a cave that measured 2.9 ft wide by 4.9 ft high between two vertically aligned entrances and extends a maximum of 7.9 ft into bedrock. It was situated approximately 6 ft below the ground surface on a slope of the western bank along Leon Creek. This feature contained rocks, leaf-litter and compact silt and had a floor depth of 9.8 ft below the surface. Dry mud-cracks were observed at the entrance of the feature, indicating that water ponds and slowly infiltrates. It had a catchment area of less than 1.6 ac due to its location approximately 20 ft above the streambed. It was determined that there is a low potential for this feature to rapidly transmit water to the subsurface due to sediment fill and the absence of downward trending voids, as well as its high position relative to the streambed. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 196. Overview of feature 1604-R03.

ATTACHMENT C

Figure 197. Interior of feature 1604-R03.

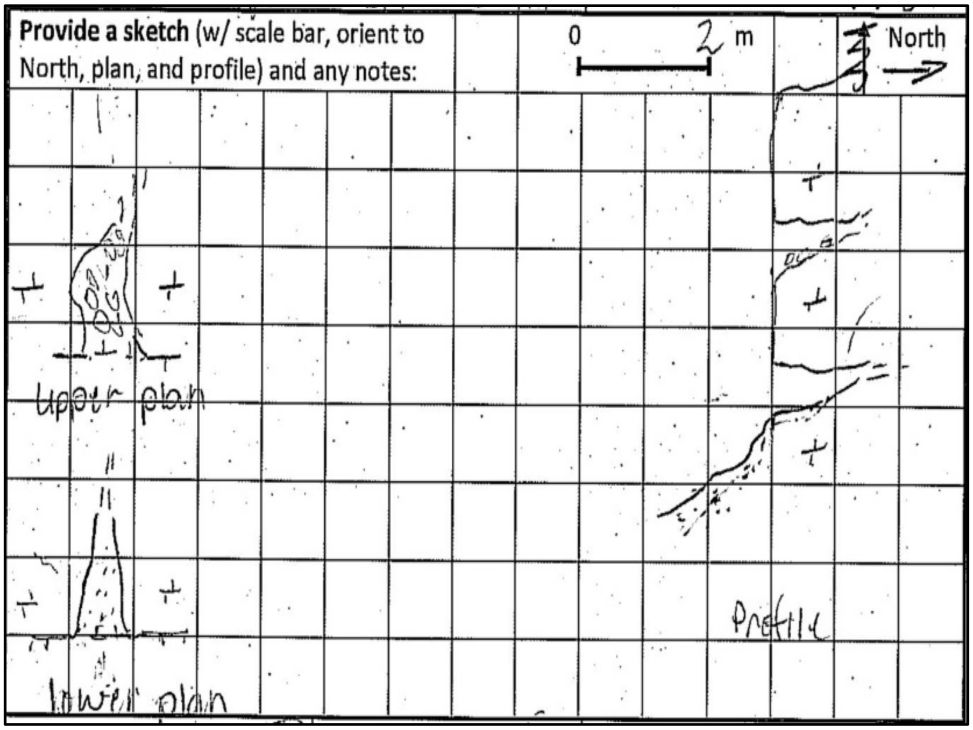

Figure 198. Field sketch of feature 1604-R03.

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Feature 1604-R04; Solution Cavity (Solution-enlarged bedding plane)

This feature was located north of the westbound lanes of Loop 1604 and west of I-10 (Figure 199 - Figure 201; Attachment D page 61). The feature was a solution-enlarged bedding plane that measured 9.8 ft wide by 5.9 ft high at the entrance and extended 5.9 ft into bedrock. This feature contained rocks, leaf-litter and compact sediment. It was situated approximately 6 ft below the ground surface on a slope of the western bank along Leon Creek. It had a catchment area of less than 1.6 ac due to its location approximately 20 ft above the streambed. It was determined that there is a low potential for this feature to rapidly transmit water to the subsurface due to its relatively high position above the streambed. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 199. Overview of feature 1604-R04.

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Figure 200. Interior of feature 1604-R04.

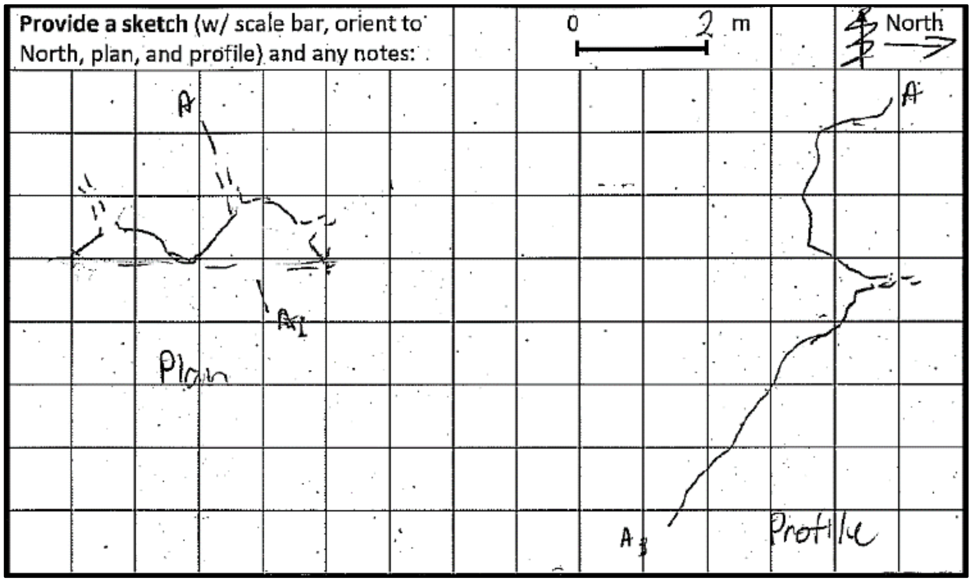

Figure 201. Field sketch of feature 1604-R04.

Feature 1604-R05; Solution Cavity (Solution-enlarged bedding plane)

This feature was located north of the westbound lanes of Loop 1604 and west of I-10 (Figure 202 - Figure 204; Attachment D page 61). The feature was a solution-enlarged bedding plane that measured 5.9 ft wide by 3 ft high at the entrance and extended 6.6 ft into bedrock. This feature contained only bedrock. It was situated approximately 5 ft below ground surface on a slope of the western bank along Leon Creek. It had catchment area of less than 1.6 ac due to its location approximately 20 ft above the streambed. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface due to its relatively high position above the streambed. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 202. Overview of feature 1604-R05.

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Figure 203. Interior of feature 1604-R05.

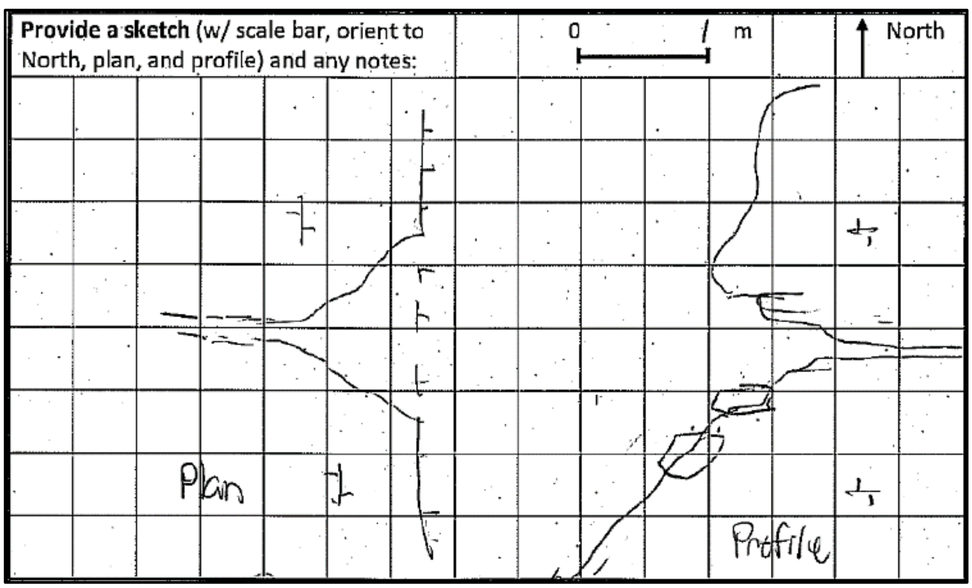

Figure 204. Field sketch of feature 1604-R05.

Feature 1604-R06; Zone of Solution Cavities

This feature was located in a roadcut of the westbound lanes of Loop 1604 and west of I-10 (Figure 205 - Figure 207; Attachment D page 61). The feature was a zone of four solution cavities within an area 40 ft wide by 5.9 ft high and extending a maximum of 3 ft into bedrock. The feature contained bedrock and compact sediment. It was situated in a streambed with a catchment area greater than 1.6 ac. It was determined that there is a low potential for this feature to rapidly transmit water to the subsurface due to its location above the base of the streambed. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 205. Overview of feature 1604-R06.

Figure 206. Interior of feature 1604-R06.

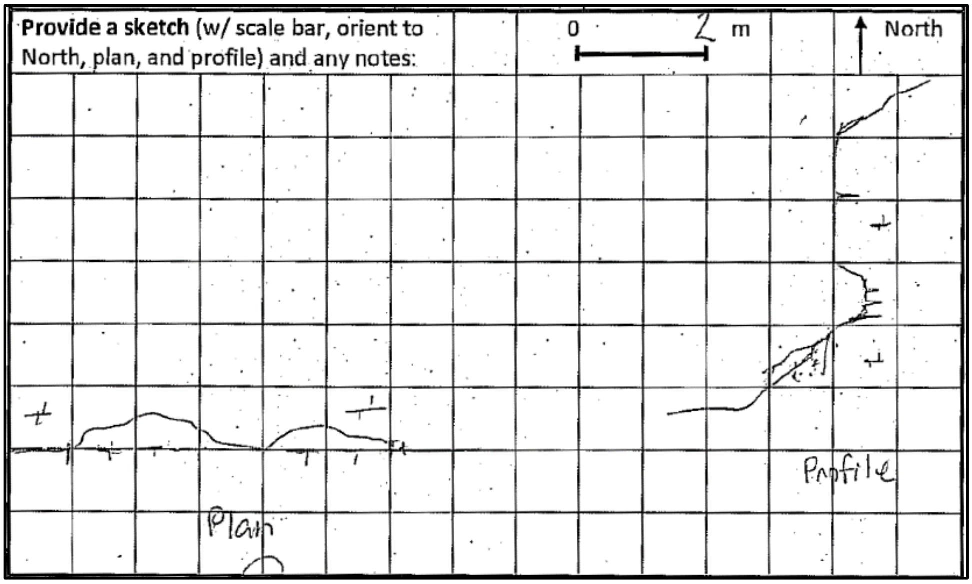

Figure 207. Field sketch of feature 1604-R06.

Feature 1604-T01; Solution Cavity

This feature was in a roadcut north of the westbound mainlanes of Loop 1604 and west of Gold Canyon Road. The feature was a solution cavity 3.3 ft wide by 4.9 ft high that extended 1 ft into the cut (Figure 208 - Figure 210; Attachment D page 98). This feature contained bedrock, loose rocks, vegetation, and compact clay. It had a catchment area of less than 1.6 ac. It was determined that there is a low potential for this feature to rapidly transmit water to the subsurface due to clay fill and a lack of downward trending voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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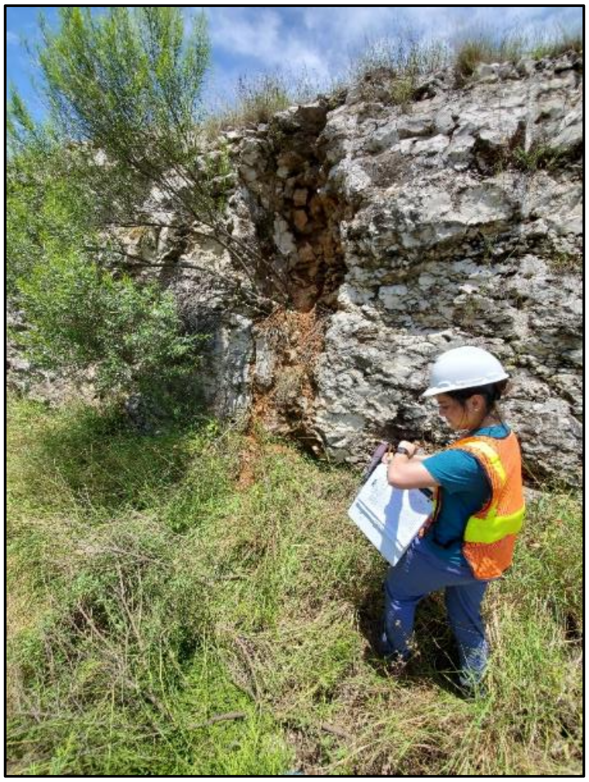

Figure 208. Overview of feature 1604-T01.

Figure 209. Close-up of feature 1604-T01.

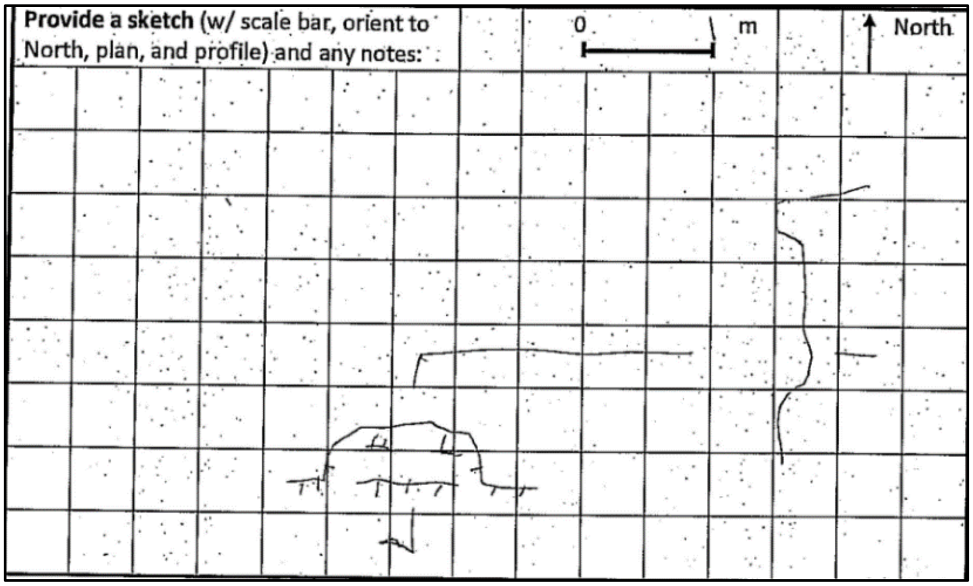

Figure 210. Field sketch of feature 1604-T01.

Feature 1604-T02; Sinkhole

This feature was in a roadcut north of the westbound mainlanes of Loop 1604 and east of U.S. 281 North. The feature was a sinkhole that was bisected by construction and did not appear to continue beyond what was exposed along the cut face. It was approximately 5 ft wide by 9 ft high and extended 3 ft into the cut (Figure 211 - Figure 213; Attachment D page 98). This feature contained bedrock and compact red clay. It had a catchment area of less than 1.6 ac. It was determined that there is a low potential for this feature to rapidly transmit water to the subsurface due to clay fill and a lack of downward trending voids. This feature was not determined to be sensitive according to Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 211. Overview of feature 1604-T02.

Figure 212. Close-up of feature 1604-T02.

ATTACHMENT C

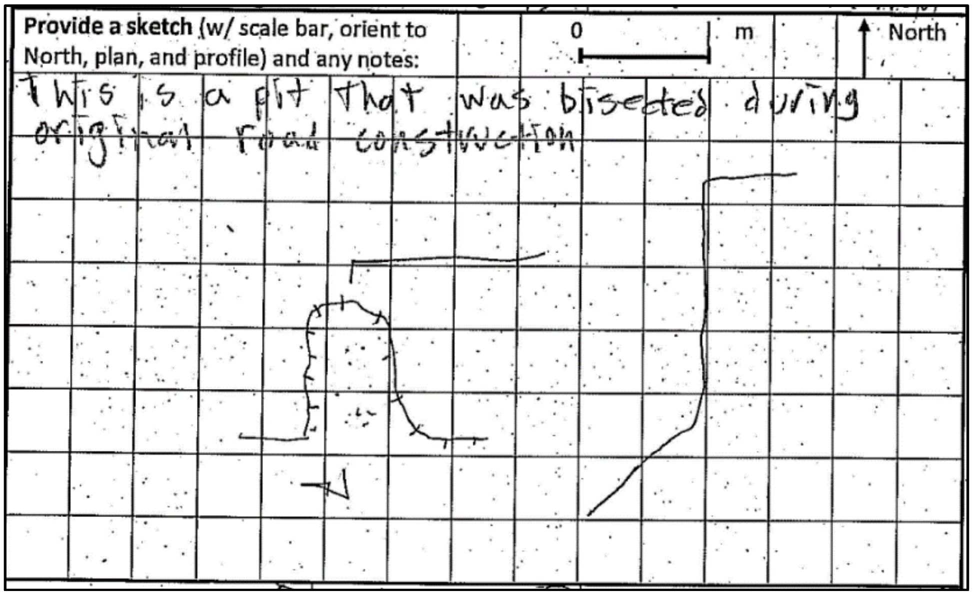

Figure 213. Field sketch of feature 1604-T02.

Feature 1604-T04; Sinkhole

This feature was located north of the westbound mainlanes of Loop 1604 and west of Huebner Road. The feature was a sinkhole that was bisected during construction. It measured 4 ft wide by 3 ft long by 13 ft high (Figure 214 - Figure 215; Attachment D page 81-82). The feature was exposed from about 3 ft from the top of the cut and continues to about 2 ft above the base of the roadcut. The feature contained loose rocks, and bedrock. It had a catchment area of less than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface as the feature was 2 ft above the base of the roadcut and did not appear to have mesocavernous voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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Figure 214. Overview of feature 1604-T04.

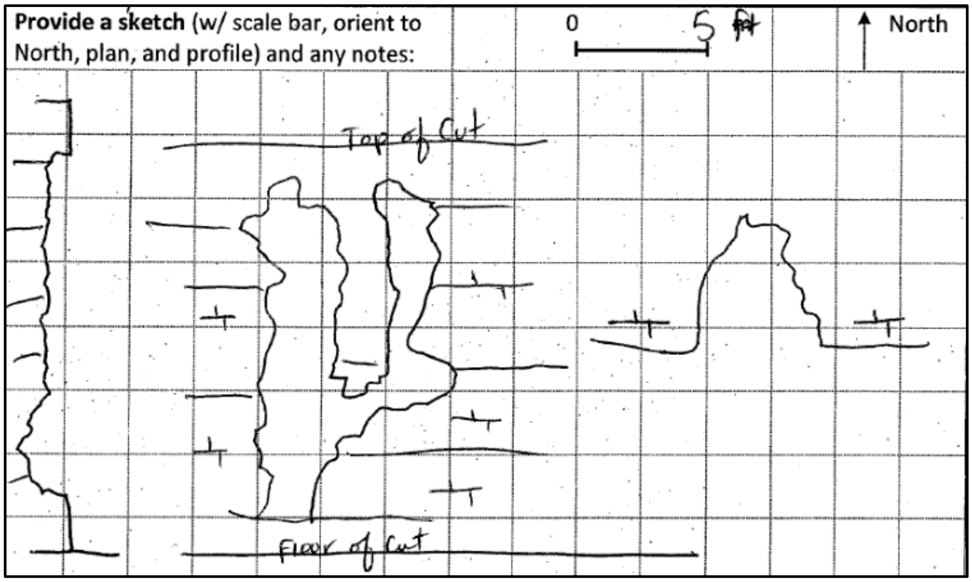

Figure 215. Field sketch of feature 1604-T04.

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Feature 1604-T05; Fault

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and west of Bitters Road (Figure 216 - Figure 217; Attachment D page 79). The feature was a fault that was exposed by road construction. The observed fault was located in close proximity to a fault mapped by Blome et al. (2005) (Feature LOOP-F30). The fault zone was 60 ft wide and extended the entire height of the 15 ft tall roadcut. The feature's length could not be measured, as there was no aperture. It contained only bedrock. It had a catchment area of greater than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface as no opening or solution-enlarged features were observed. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 216. Overview of feature 1604-T05. The dashed line shows the approximate location of fault.

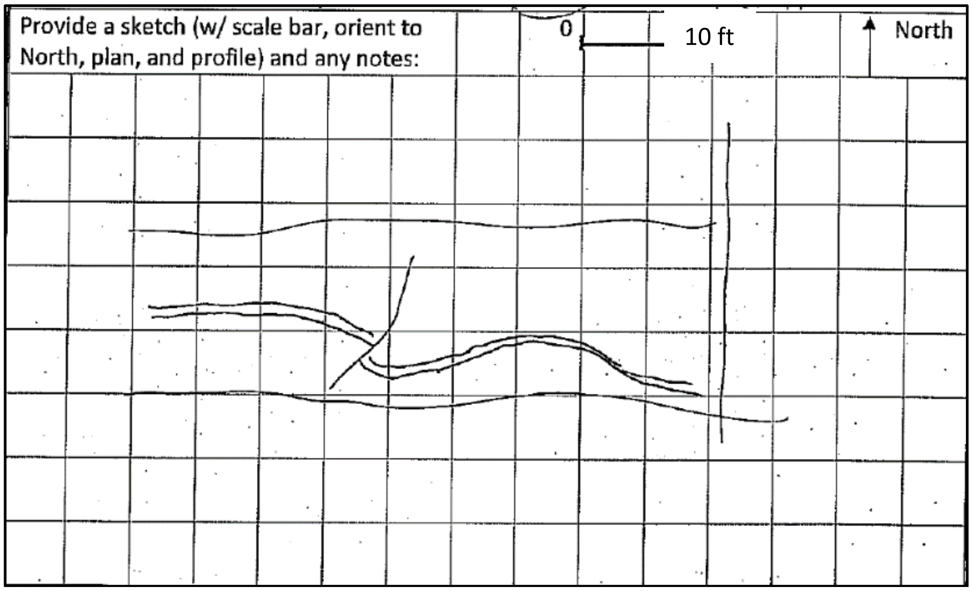

Figure 217. Field sketch of feature 1604-T05.

Feature 1604-T06; Sinkhole

This feature was in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Bitters Road (Figure 218 - Figure 219; Attachment D page 79). The feature was a 10 ft diameter sinkhole that was bisected by road construction. It extended from the top of the roadcut downward for approximately 10 ft, stopping approximately 5 ft above the base of the cut. This feature contained loose rocks, red clay, vegetation, and bedrock. It had a catchment area of less than 1.6 ac. It was determined that there is a low potential for this feature to rapidly transmit water to the subsurface as it was situated above the base of the roadcut and did no voids appear to extend into the cut beyond what is exposed. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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Figure 218. Overview of feature 1604-T06.

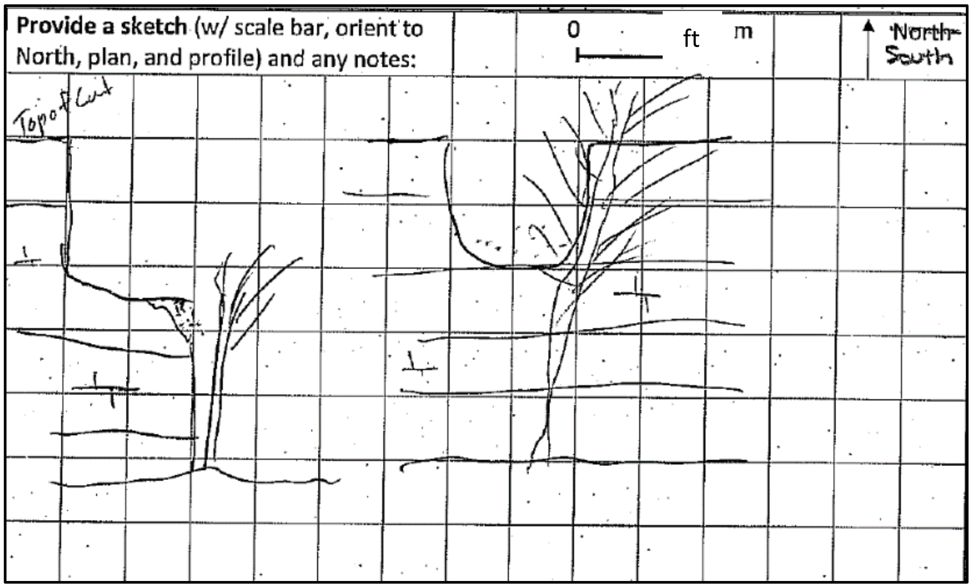

Figure 219. Field sketch of feature 1604-T06.

Feature 1604-T07; Fault

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Bitters Road (Figure 220 - Figure 221; Attachment D page 79). The feature was a fault that was exposed by the 1604 roadcut. The observed fault was located in close proximity to a fault mapped by Blome et al. (2005) (Feature LOOP-F30). The fault zone was 36 ft wide and extends the entire height of the 15 ft tall roadcut. The feature's length could not be measured, as there was no aperture. It contained only bedrock. It had a catchment area of greater than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface as no opening or solution-enlarged fractures were observed. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 220. Overview of feature 1604-T07. The dashed line shows the approximate location of the fault.

ATTACHMENT C

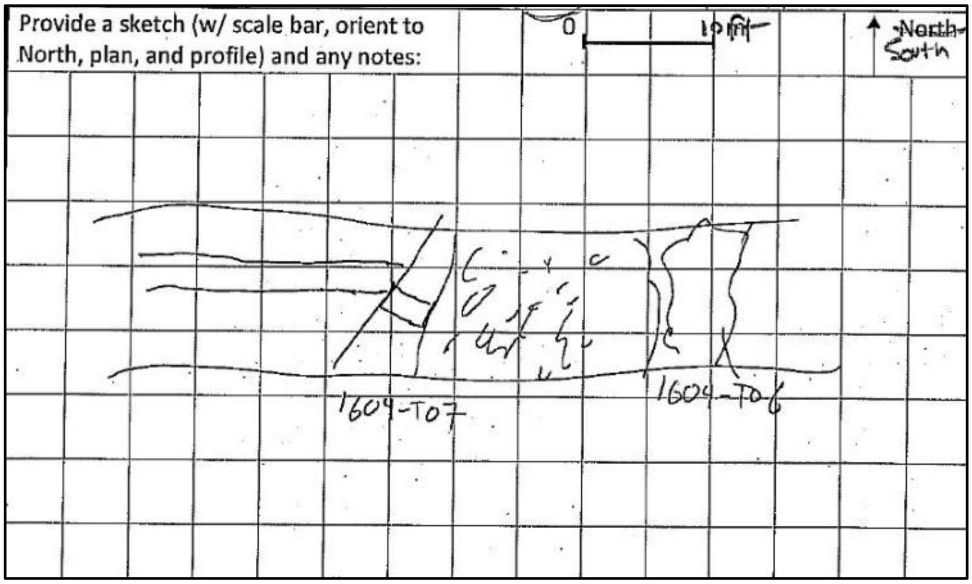

Figure 221. Field sketch of feature 1604-T07.

Feature 1604-T08; Zone of Solution-enlarged Fractures

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Bitters Road (Figure 222 - Figure 223; Attachment D page 79). The feature was a zone of solution-enlarged fractures that was intersected by road construction. It was exposed for a width of 24 ft across its entire 15 ft height. The fracture trend is 32^{o} and the maximum aperture is 0.1 ft. This feature contained fine tans soils, loose rocks, vegetation, and bedrock. It had a catchment area of less than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface due to the small apertures and infilling with fine, compact soils. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 222. Overview of feature 1604-T08.

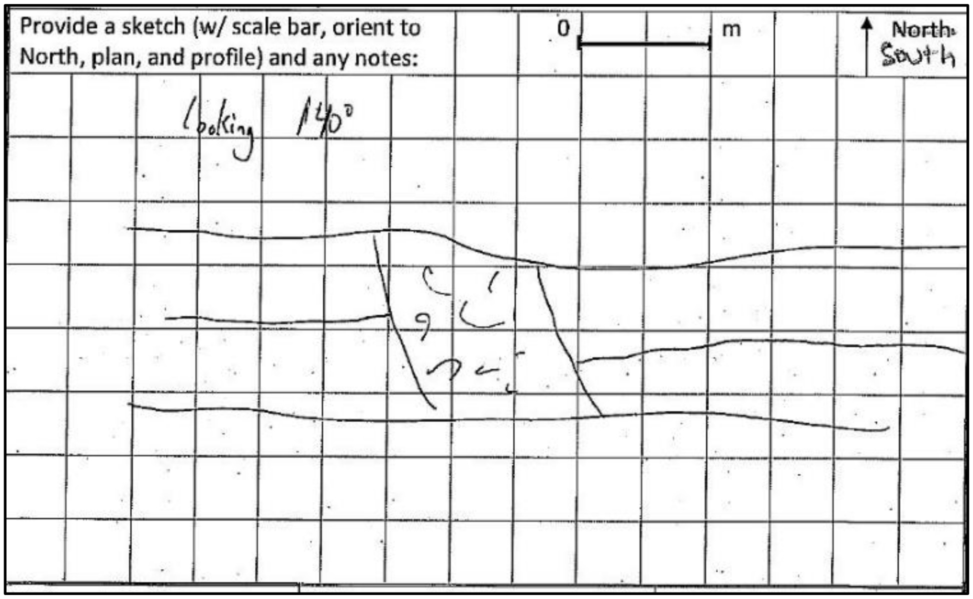

Figure 223. Field sketch of feature 1604-T08.

Feature 1604-T09; Sinkhole

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Bitters Road (Figure 224 - Figure 225; Attachment D page 79). The feature was a sinkhole that was bisected by road construction. It measured 9.8 ft wide by 13.1 ft high and 3.3 ft long. This feature contained fine, compact, reddish tan soils, and bedrock. It had a catchment area of less than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface as it was filled with fine, compacted soils and did not appear to extend beyond what was exposed in the cut face. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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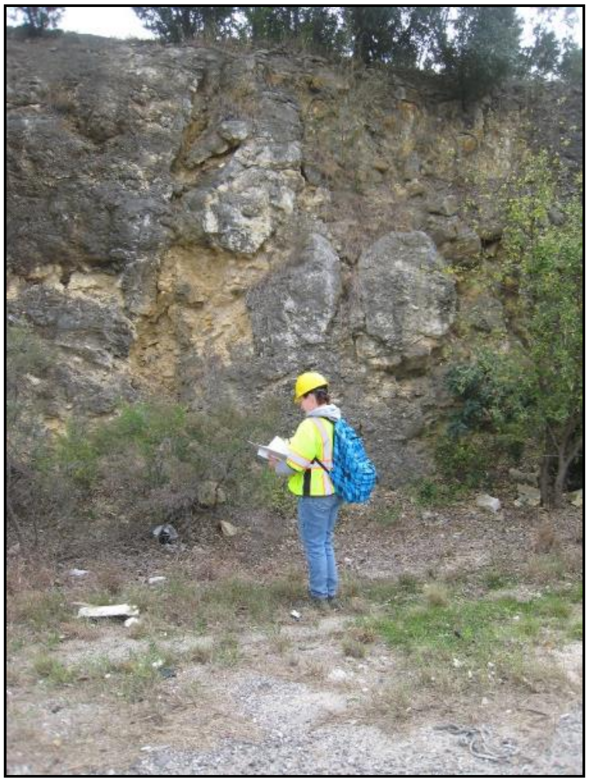

Figure 224. Overview of feature 1604-T09.

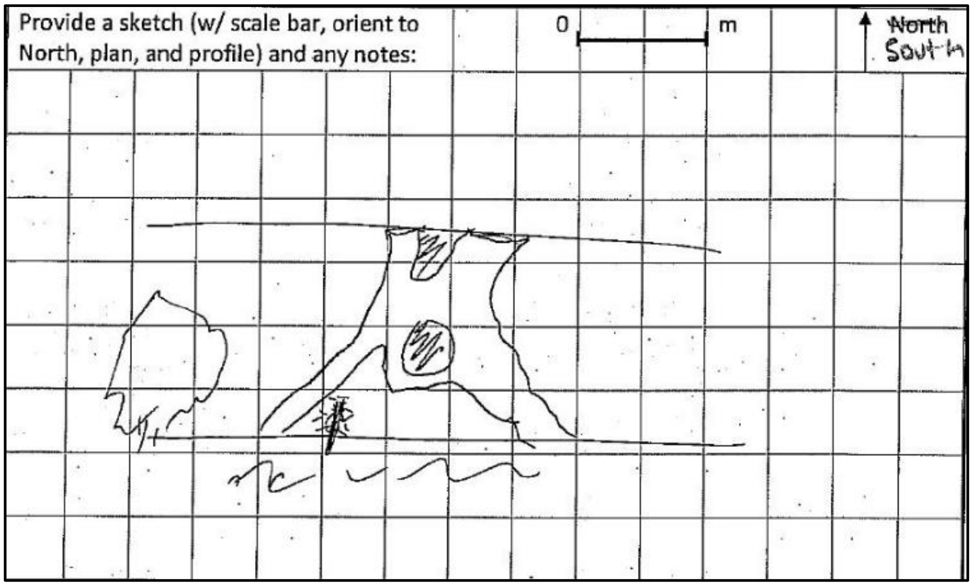

Figure 225. Field sketch of feature 1604-T09.

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Feature 1604-T11; Sinkhole

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and east of Bitters Road (Figure 226 - Figure 227; Attachment D page 80). The feature was a sinkhole that was bisected by road construction. It measured approximately 6.6 ft wide by 11.5 ft high and 3.3 ft long. This feature contained loose rocks, red clay, grassy vegetation, and bedrock. It had a catchment area of less than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface as it was filled with compact clay and did not appear to extend beyond what is exposed in the cut face. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 226. Overview of feature 1604-T11.

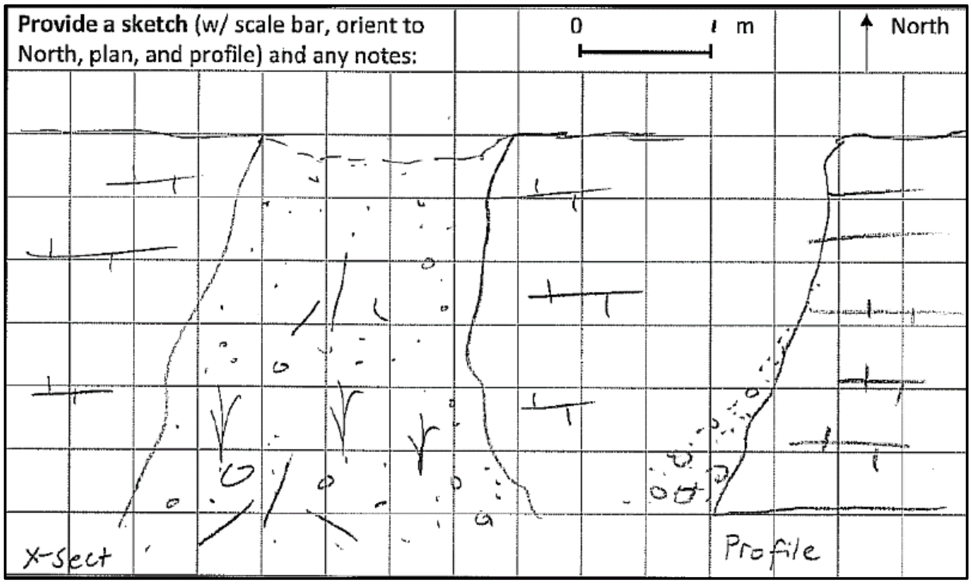

Figure 227. Field sketch of feature 1604-T11.

Feature 1604-T12; Zone with Sinkhole and Solution-enlarged Bedding Plane

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Huebner Road (Figure 228 - Figure 229; Attachment D page 81-82). The feature was a zone that included a sinkhole bisected by the roadcut and a solution-enlarged bedding plane. The sinkhole was 5 ft wide by 5 ft long by 14 ft high. It was developed laterally along a solution-enlarged bedding plane and may have continued into the subsurface. This feature contained flowstone, vegetation, and coarse sediment. A second solution-enlarged bedding plane was located 6 ft east of the sinkhole that was 13 ft wide by 2.5 ft long by 3 ft high. The bedding plane contained bedrock, red clay soils, and vegetation. The zone had a catchment area of less than 1.6 ac. It was determined that there was a low potential for this feature to rapidly transmit water to the subsurface as it did not appear to continue beyond what was exposed in the rock face. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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Figure 228. Overview of feature 1604-T12. The sinkhole is on the left and the solution-enlarged bedding plane on the right.

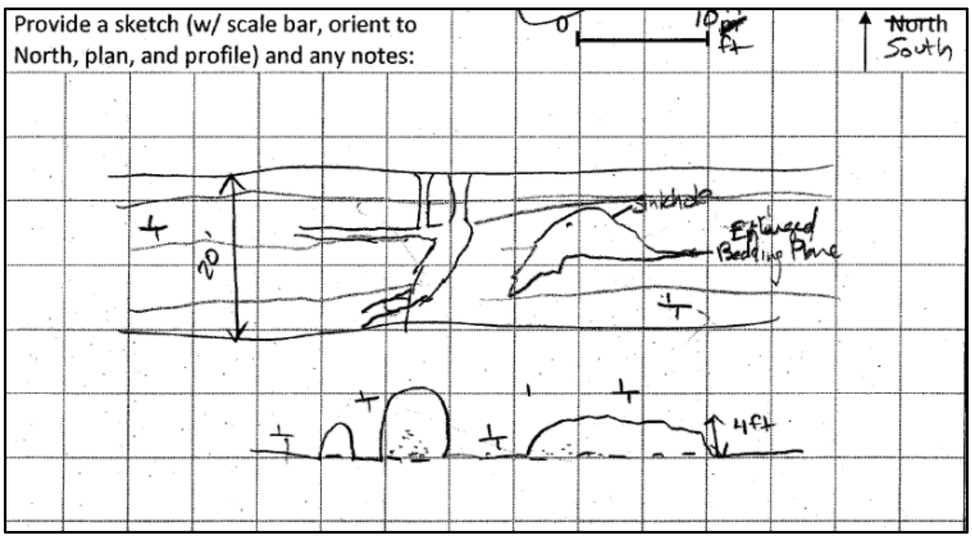

Figure 229. Field sketch of feature 1604-T12.

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Feature 1604-W05; Zone with Solution Cavity and Solution-enlarged Bedding Plane

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 immediately west of Huebner Road (Figure 230 - Figure 231; Attachment D page 82). The feature was a zone containing a solution cavity that was bisected in the roadcut, extending upward from a solution-enlarged bedding plane. The solution cavity was 5 ft wide by 3 ft long by 5 ft high. The solution-enlarged bedding plane continued an additional 7 ft west of the edge of the solution cavity and is 1 ft wide by 1 ft high. This feature contained loose rocks, vegetation, and bedrock. It had a catchment area of less than 1.6 ac. The feature was located 3.5 ft above the base of the roadcut and appeared to function as a discharge point (seep) based on the presence of ferns and other similar vegetation, there was a low potential for this feature to rapidly transmit water to the subsurface. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 230. Overview of feature 1604-W05.

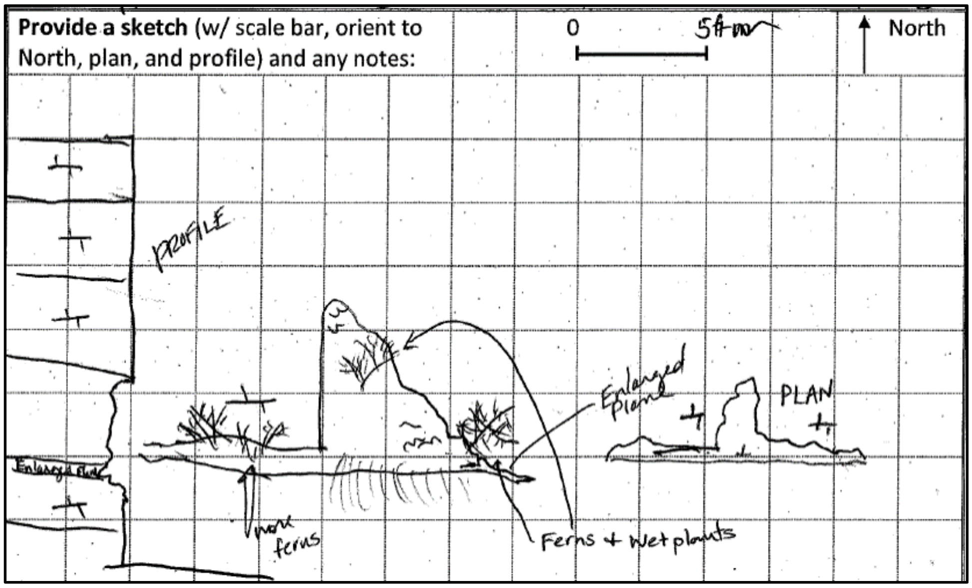

Figure 231. Field sketch of feature 1604-W05.

Feature 1604-W08; Zone with Solution-enlarged Fractures

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 east of Bitters Road (Figure 232 - Figure 233; Attachment D page 79). The feature was a zone that contained four solution-enlarged fractures over an area 10 ft wide and 7 ft tall. The fractures had a maximum length of 3 ft and aperture of 0.5 ft and a bearing of 180°. The fractures had no infill except exposed bedrock. There was also a collapsed area filled with breakdown and fine, red-tan soils adjacent to the fractures. The zone had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface, as the fractures were 2 to 3 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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Figure 232. Overview of feature 1604-W08.

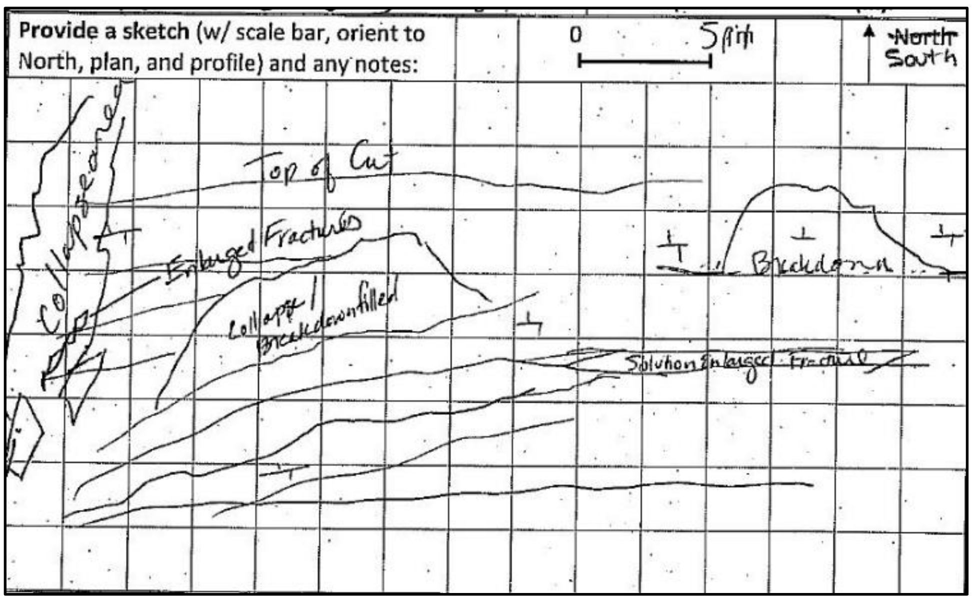

Figure 233. Field sketch of feature 1604-W08.

Feature F056; Zone of Solution-enlarged Fractures

This feature was located north of the westbound mainlanes of Loop 1604 and west of Rogers Ranch Road (Figure 234 - Figure 236; Attachment D page 77). The feature was a zone of solution-enlarged fractures 50 ft long by 20 ft wide and 1 ft deep. The southern end of the feature terminated in a possible fault scarp approximately 8 ft high with a trend of 89º. Two sets of fractures were present with trends of 89° and 45°, consistent with trends of the Balcones Fault Zone. Fracture density was 0.2 per linear ft and the maximum aperture is 1 ft. This feature consisted of bedrock, soil, leaf litter, vegetation, and gravel. It had a catchment area of greater than 1.6 ac. There was a moderate potential for this feature to rapidly transmit water to the subsurface due to the size of the catchment area and presence of fractures that may continue deeper into the bedrock. This feature was determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

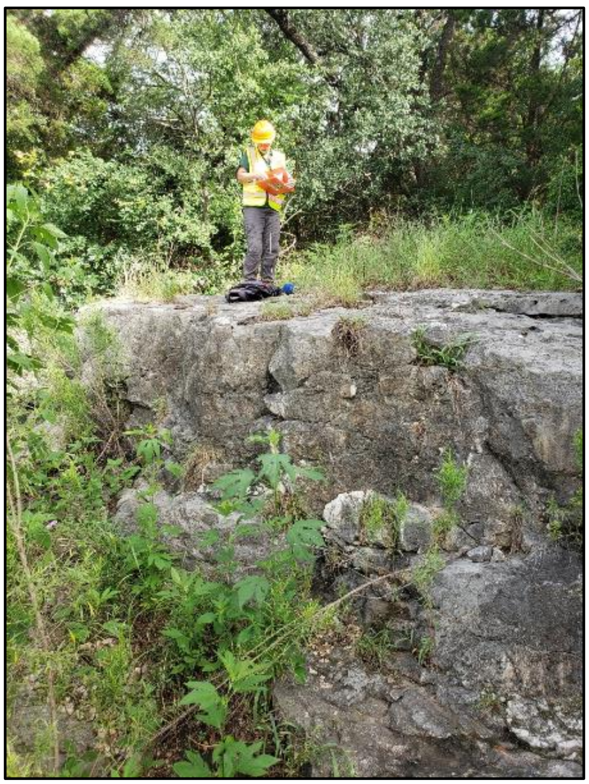

Figure 234. Overview of feature 1604-F056.

ATTACHMENT C

Figure 235. Close-up of feature 1604-F056.

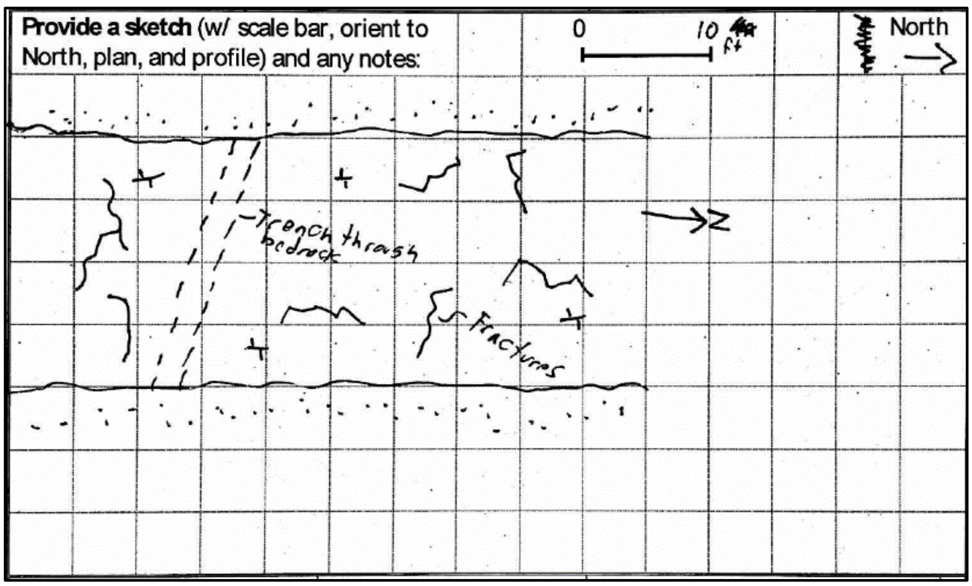

Figure 236. Field sketch of feature 1604-F056.

Feature G01; Non-karst Closed Depression

This feature was located in an embankment along the northeast exit lane of the I-10 Loop 1604 interchange (Figure 237 - Figure 239; Attachment D page 16). The feature was a non-karst closed depression that measured 1.5 ft wide by 2.5 ft long by 2 ft deep. The floor consisted of modern soil, leaf-litter, tree roots, and cobbles. It had a catchment area of less than 1.6 ac. It was determined that this feature had a low potential to rapidly transmit water into the subsurface as it was not located in bedrock and did not have any apparent drains. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 237. Overview of feature G01.

Figure 238. Close-up of feature G01.

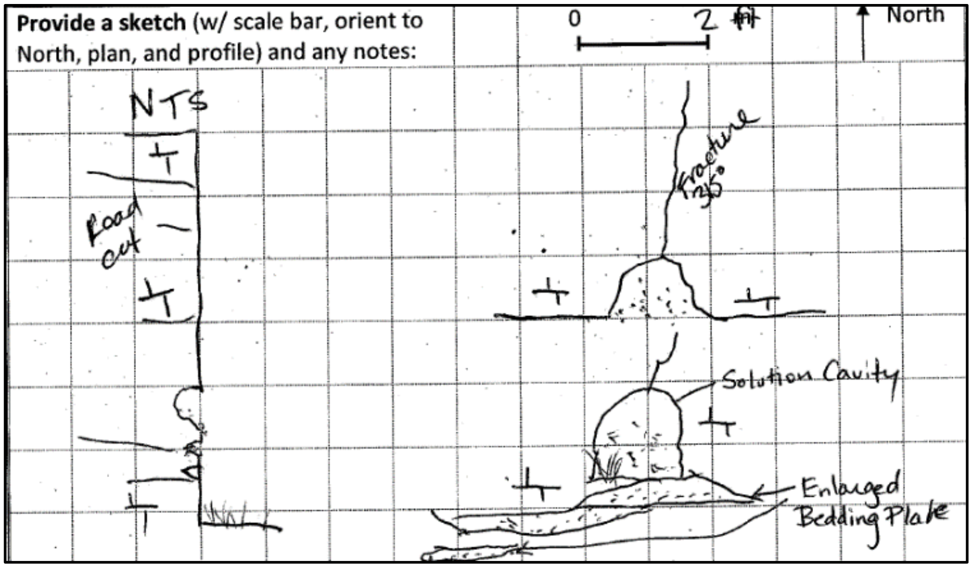

Figure 239. Field sketch of feature G01.

Feature G04; Zone of Solution Cavities

This feature was located in a roadcut west of the southbound lanes of I-10 and north of La Cantera Parkway (Figure 240 - Figure 243; Attachment D page 5-6). The feature was a zone consisting of two solution cavities that measured 9.8 ft wide and 1.6 ft in height and extended by 3.3 ft into the roadcut. The floor of the solution cavities consisted of modern soil, leaf-litter, and fine sediment. It had a catchment area of less than 1.6 ac. It was determined that this feature had a low potential to rapidly transmit water into the subsurface as the solution cavities were located at a higher elevation than the road. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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Figure 240. Overview of feature G04.

Figure 241. Close-up of feature G04.

Figure 242. Close-up of feature G04.

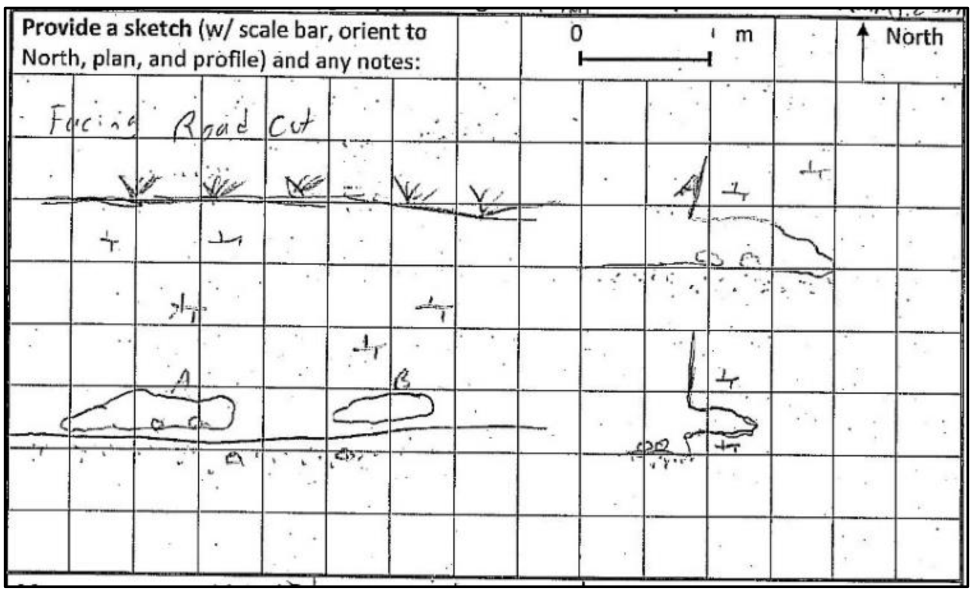

Figure 243. Field sketch of feature G04.

Feature HB-007; Zone with Solution Cavity and Solution-enlarged Bedding Plane

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 east of Bitters Road (Figure 244 - Figure 245; Attachment D page 80). The feature was a zone that included a solution cavity 1.5 ft wide by 2 ft long by 2.5 ft high above a solution-enlarged bedding plane that was 7 ft wide by 0.5 ft long by 0.5 ft high. A second solution-enlarged bedding plane that is 1.5 ft wide by 0.3 ft long by 0.3 ft high was below and west. The solution cavity was developed along a fracture trending 315^{o}. This feature contained fine red-soil, cobbles, vegetation, roadside debris, and bedrock. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface, as this zone was located 1.5 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

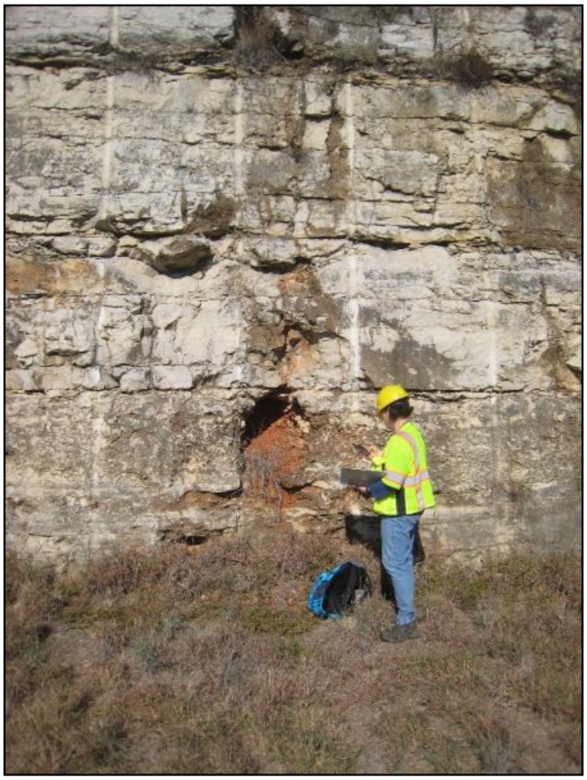

Figure 244. Overview of feature HB-007.

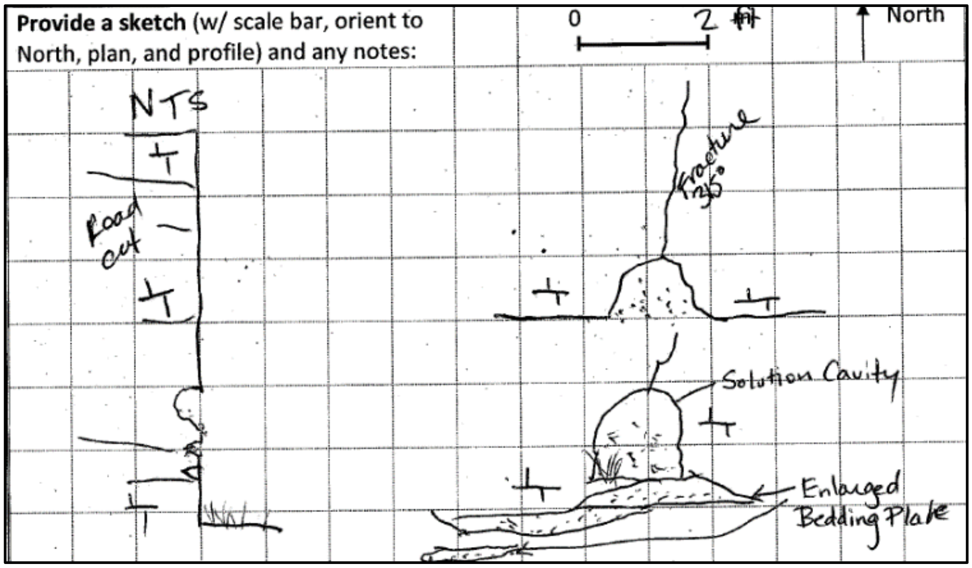

Figure 245. Field sketch of feature HB-007.

Feature HB-008; Solution Cavity (Solution-enlarged Bedding Plane)

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and east of Bitters Road (Figure 246 - Figure 247; Attachment D page 79). The feature was a collapsed solution-enlarged bedding plane that measured 12 ft wide by 2.5 ft long by 8 ft high. This feature contained loose rocks and bedrock. The collapsed materials accumulated below the feature along the base of the roadcut. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface as it was positioned approximately 3.5 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 246. Overview of feature HB-008.

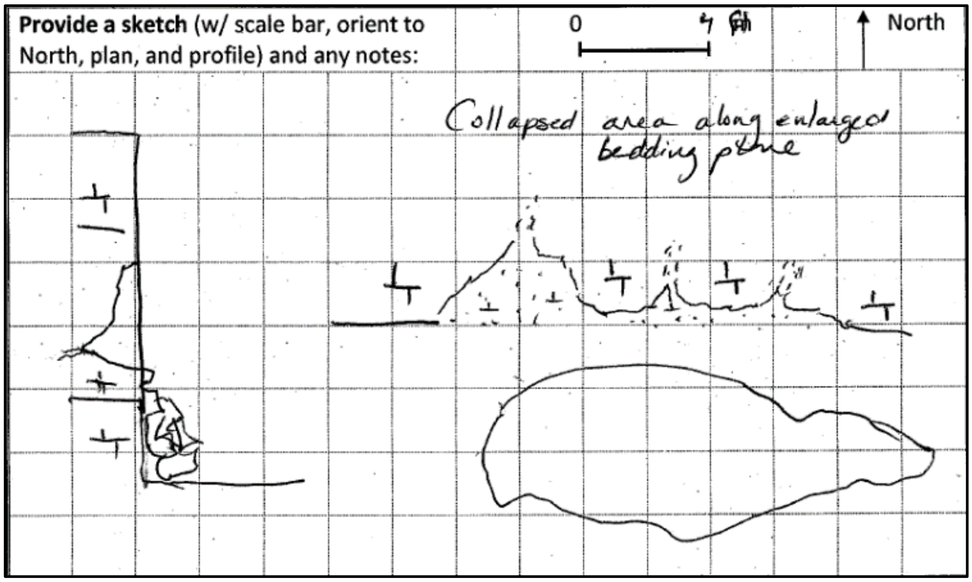

Figure 247. Field sketch of feature HB-008.

Feature HB-009; Solution Cavity (Solution-enlarged Bedding Plane)

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and east of Bitters Road (Figure 248 - Figure 249; Attachment D page 79). The feature was a collapsed solution-enlarged bedding plane that measured 8 ft wide by 1.5 ft long by 3.8 ft tall. This feature contained cobbles, vegetation, and bedrock. The collapsed materials accumulated below the feature along the base of the roadcut. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface, as it was positioned 2.5 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 248. Overview of feature HB-009.

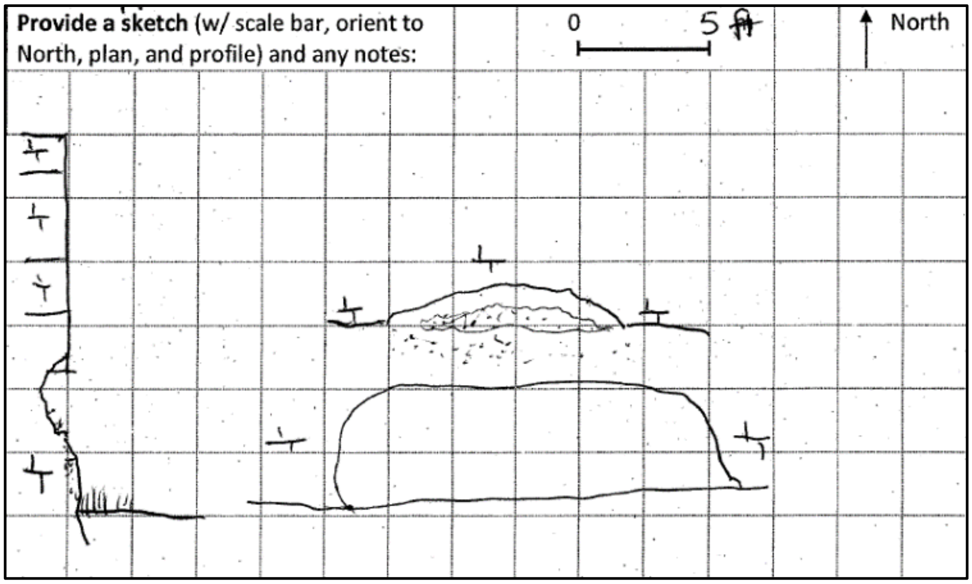

Figure 249. Field sketch of feature HB-009.

Feature HB-010; Solution Cavity

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and east of Bitters Road (Figure 250 - Figure 251; Attachment D page 79). The feature was a solution cavity that measured 1 ft wide by 1.8 ft long by 1 ft high. This feature contained fine red-tan soils and bedrock. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface due to its location 3 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 250. Field sketch of feature HB-010.

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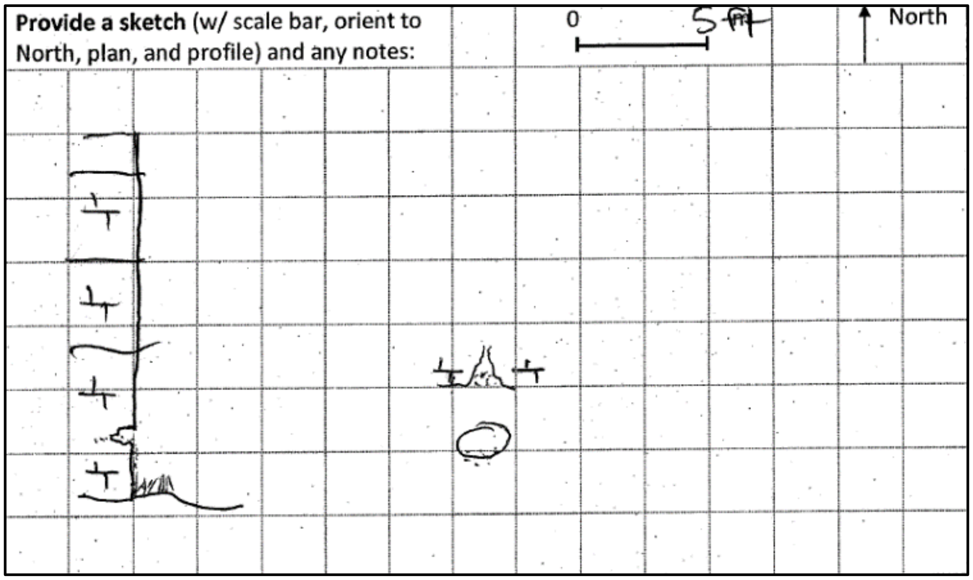

Figure 251. Field sketch of feature HB-010.

Feature HB-012; Solution Cavity (Solution-enlarged Bedding Plane)

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and east of Bitters Road (Figure 252 - Figure 253; Attachment D page 79). The feature was a solution-enlarged bedding plane bisected by the roadcut that measured 12 ft wide by 3.5 ft long by 15 ft high. This feature contained red-brown fine soils and bedrock. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface, as the feature was located well above the base of the roadcut and did not appear to extend beyond what was exposed in the rock face. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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Figure 252. Overview of feature HB-012.

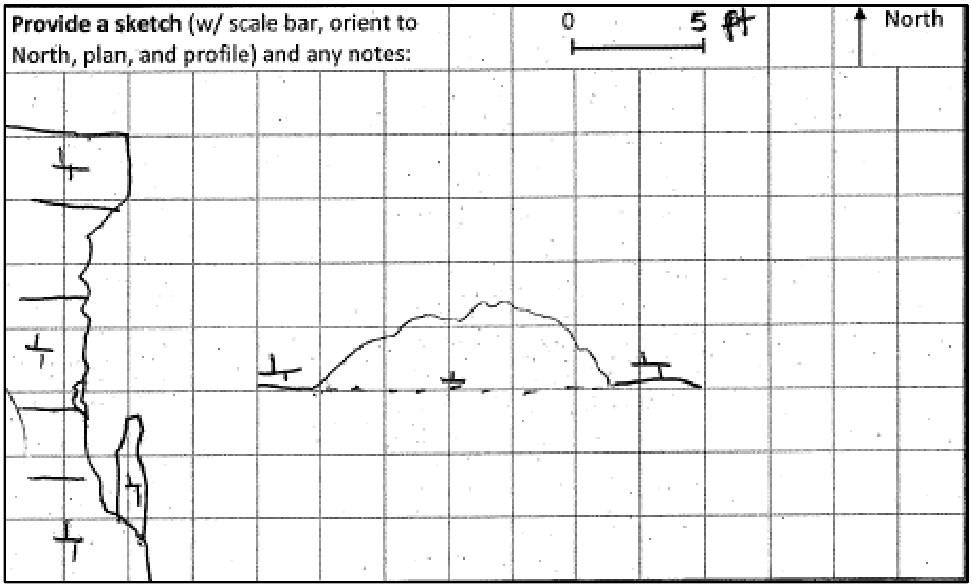

Figure 253. Field sketch of feature HB-012.

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Feature HB-013; Zone with Solution Cavity and Solution-enlarged Bedding Plane

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and east of Bitters Road (Figure 254 - Figure 255; Attachment D page 79). The feature was a zone containing a solution cavity that was 2 ft wide by 2 ft long by 3.5 ft high and a solution-enlarged bedding plane that was 4 ft wide by 2 ft long by 1 ft high. This feature contained red fine soils, cobbles, vegetation, and bedrock. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface, as the feature was located 2.5 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 254. Overview of feature HB-013.

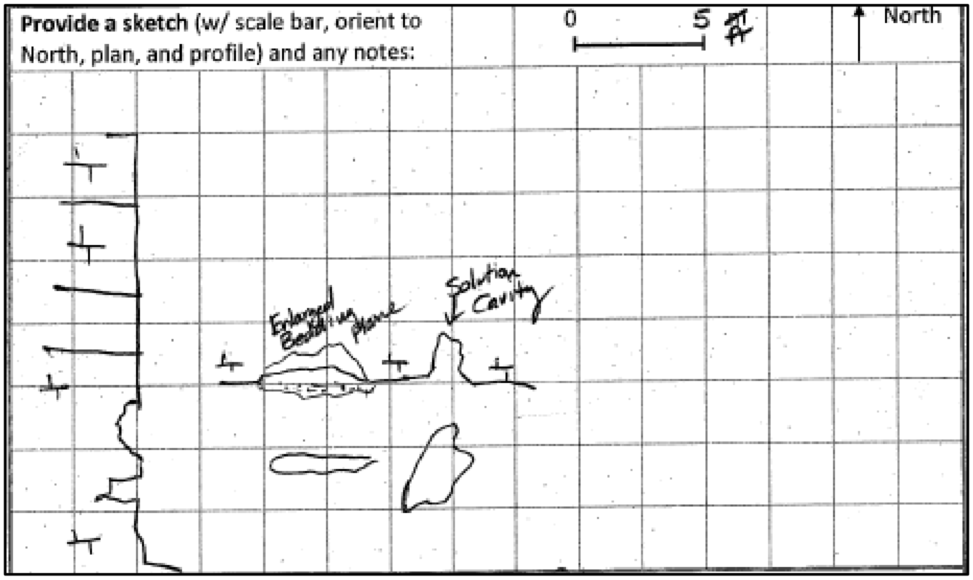

Figure 255. Field sketch of feature HB-013.

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Feature HB-014; Zone with Sinkhole and Solution-enlarged Bedding Plane

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and east of Bitters Road (Figure 256 - Figure 259; Attachment D page 79). The feature was originally described as 1604-W07, a zone of karst features; however, due to the distance from the original GPS point, the feature was re-described as HB-014. The feature was a zone containing a bisected collapsed sinkhole and a solution-enlarged bedding plane. The zone containing the features was 15 ft wide by 4 ft long by 12 high. Both features appeared to have collapsed downward after the roadcut based on the materials accumulated below the features. The features were infilled with coarse soils, loose rocks, vegetation, and bedrock. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface due to the location of the features 1 ft to 3 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 256. Overview of feature HB-014.

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Figure 257. Overview of the sinkhole portion of HB-014.

Figure 258. Overview of the solution-enlarged bedding plane portion of feature HB-014.

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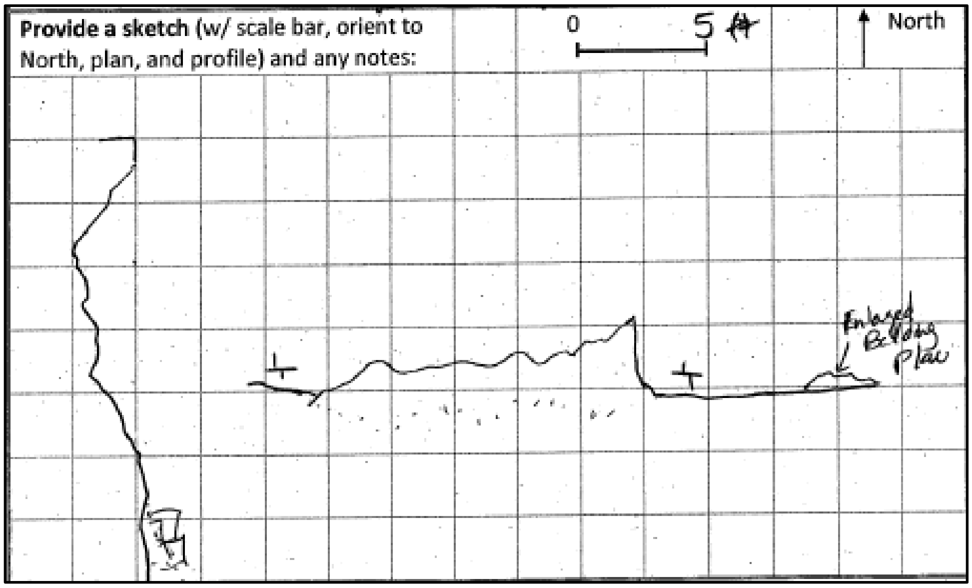

Figure 259. Field sketch of feature HB-014.

Feature HB-016; Zone with Solution Cavities

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and west of Bitters Road (Figure 260 - Figure 261; Attachment D page 79). The feature was a zone containing two solution cavities. The larger cavity measured 5 ft wide by 1.5 ft long by 3 ft high, and the smaller cavity was approximately 2.5 ft wide by 2 ft long by 0.5 ft high. The solution cavities were filled with fine red clay and bedrock. They had a catchment area of less than 1.6 ac. There was a low potential for these solution cavities to rapidly transmit water to the subsurface due to compact clay fill and a lack of mesocavernous voids. This zone was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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Figure 260. Overview of feature HB-016.

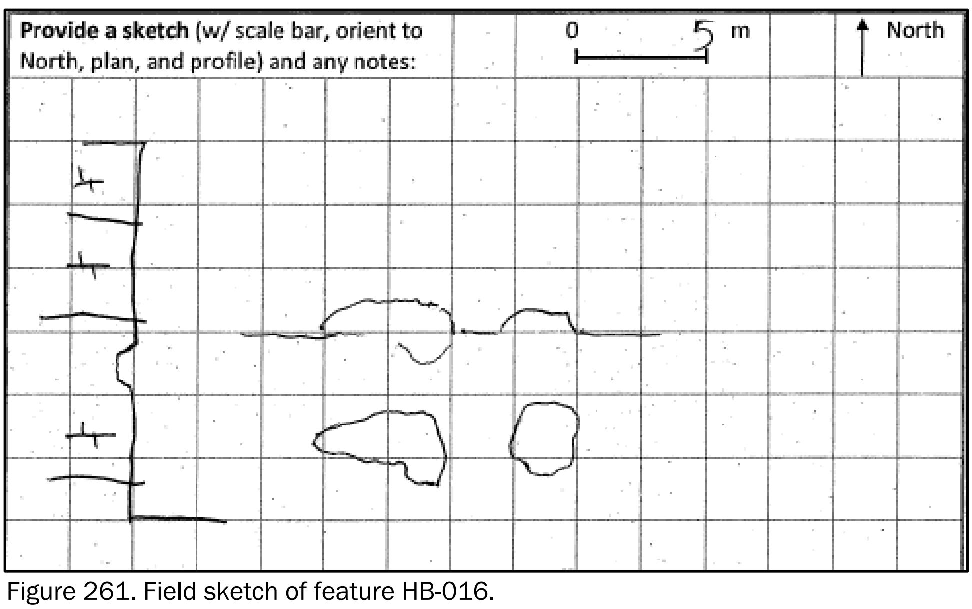

Figure 261. Field sketch of feature HB-016.

Feature HB-017; Sinkhole

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and west of Bitters Road (Figure 262 - Figure 263; Attachment D page 79). The feature was a bisected sinkhole that measured 20 ft wide by 4 ft long by 15 ft high. This feature contained red-tan fine soils, cobbles, vegetation, and bedrock. Materials from collapse had accumulated on a talus slope at the base of the roadcut. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface as the feature was filled with compact fine soils and no mesocavernous voids were observed. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 262. Overview of feature HB-017.

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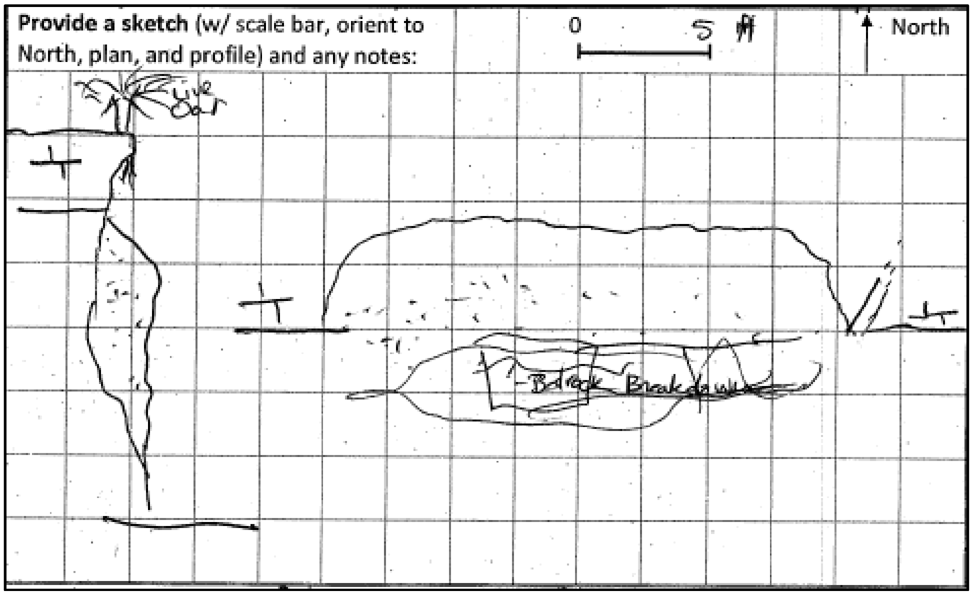

Figure 263. Field sketch of feature HB-017.

Feature HB-018; Solution Cavity (Solution-enlarged Bedding Plane)

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and west of Bitters Road (Figure 264 - Figure 265; Attachment D page 77, 79). The feature was a solution-enlarged bedding plane that measured 5 ft wide by 2 ft long by 2 ft tall. This feature contained fine red soils, cobbles, and bedrock. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface, as it was located 8 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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Figure 264. Overview of feature HB-018.

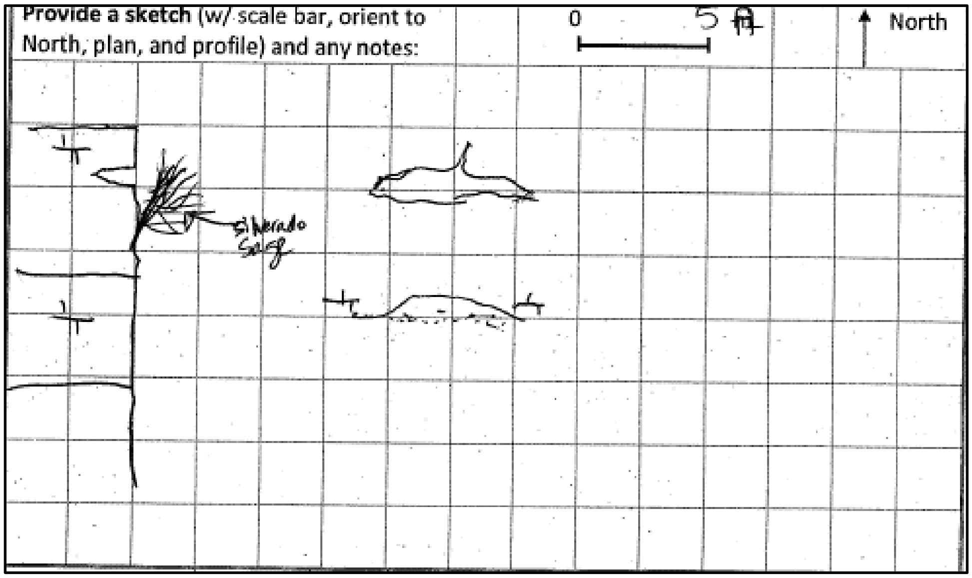

Figure 265. Field sketch of feature HB-018.

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Feature HB-019; Solution Cavity

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and west of Bitters Road (Figure 266 - Figure 268; Attachment D page 77, 79). The feature was a solution cavity that measured 2.5 ft wide by 1.5 ft long by 6 ft high. This feature contained fine red soils, cobbles, and bedrock. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface due to its location 2.5 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 266. Overview of feature HB-019.

ATTACHMENT C

Figure 267. Close up of feature HB-019.

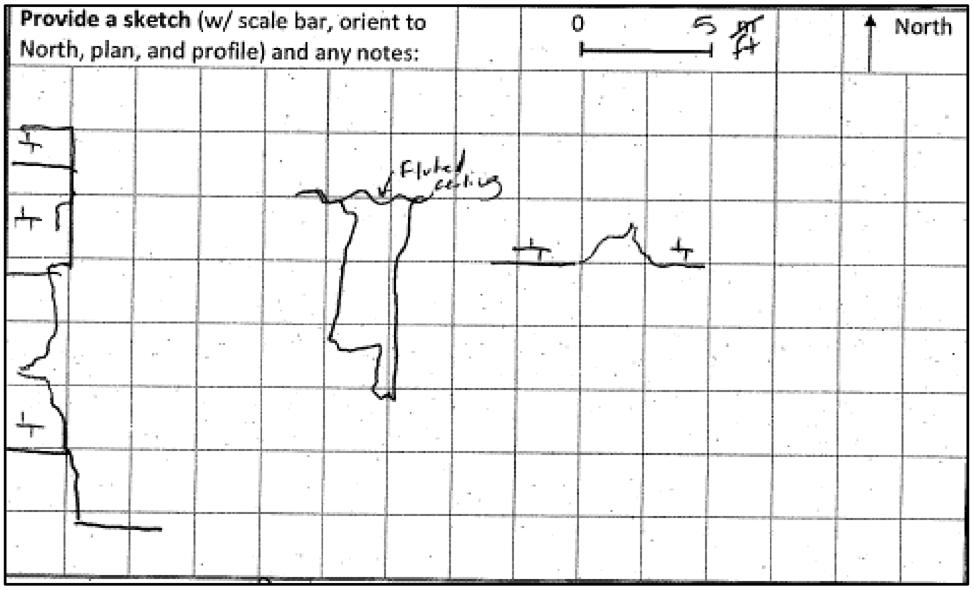

Figure 268. Field sketch of feature HB-019.

Feature HB-020; Solution Cavity

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and west of Bitters Road (Figure 269 - Figure 270; Attachment D page 77). The feature was a solution cavity that measured 2.5 ft wide by 2.5 ft long by 4 ft high. This feature contained fine to coarse red soils, loose rocks, and bedrock. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface due to its location 4.5 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

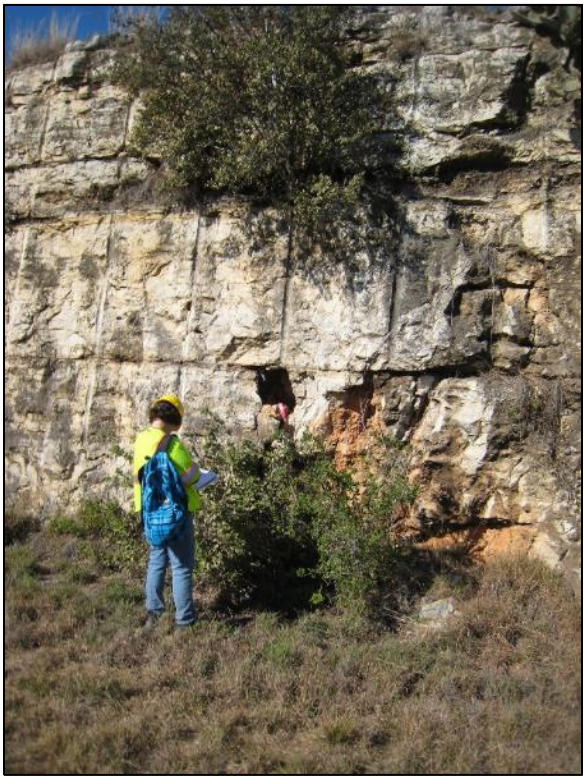

Figure 269. Overview of feature HB-020.

ATTACHMENT C

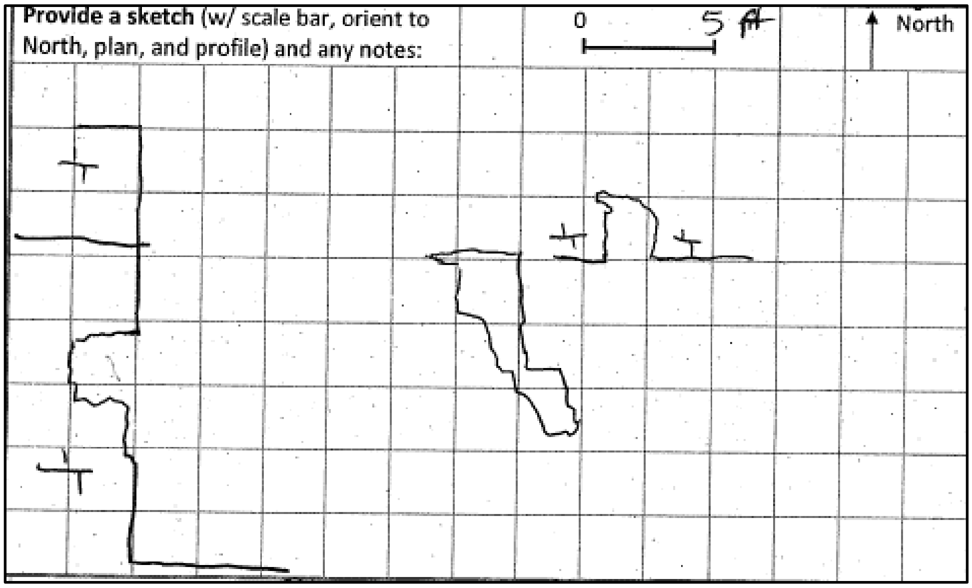

Figure 270. Field sketch of feature HB-020.

Feature HB-021; Zone with Solution Cavity and Solution-enlarged Bedding Plane

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and west of Bitters Road (Figure 271 - Figure 273; Attachment D page 77). The feature was a zone containing a solution cavity and a solution-enlarged bedding plane. The zone was 5 ft wide by 2.5 ft long by 1.5 high with the largest void aperture at 1.5 ft. These features contained coarse to fine red soils, cobbles, vegetation, and bedrock. The zone had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface due to the location of these features 1.5 ft to 4 ft above the base of the roadcut. This zone was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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Figure 271. Overview of feature HB-021.

Figure 272. Close up the solution cavity portion of feature HB-021.

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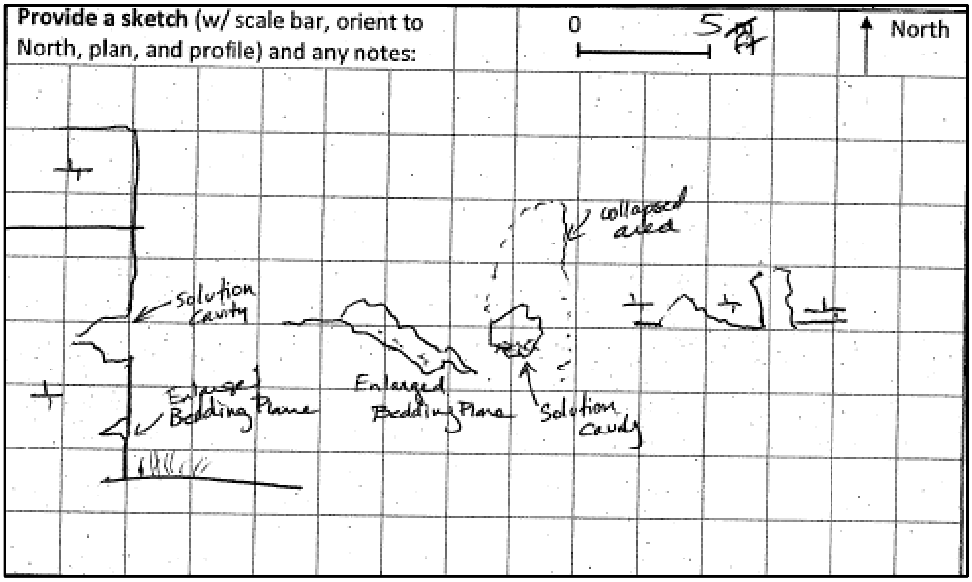

Figure 273. Field sketch of feature HB-021.

Feature HB-022; Sinkhole

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and west of Bitters Road (Figure 274 - Figure 275; Attachment D page 77-78). The feature was a collapsed, bisected sinkhole that measured 12 ft wide by 3 ft long by 12 ft high. This feature contained coarse to fine red soils, cobbles, flowstone on the interior wall, vegetation, and bedrock. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface as the feature did not appear to continue into the roadcut and was protected from inflow by several feet of accumulated collapsed debris at the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 274. Overview of feature HB-022.

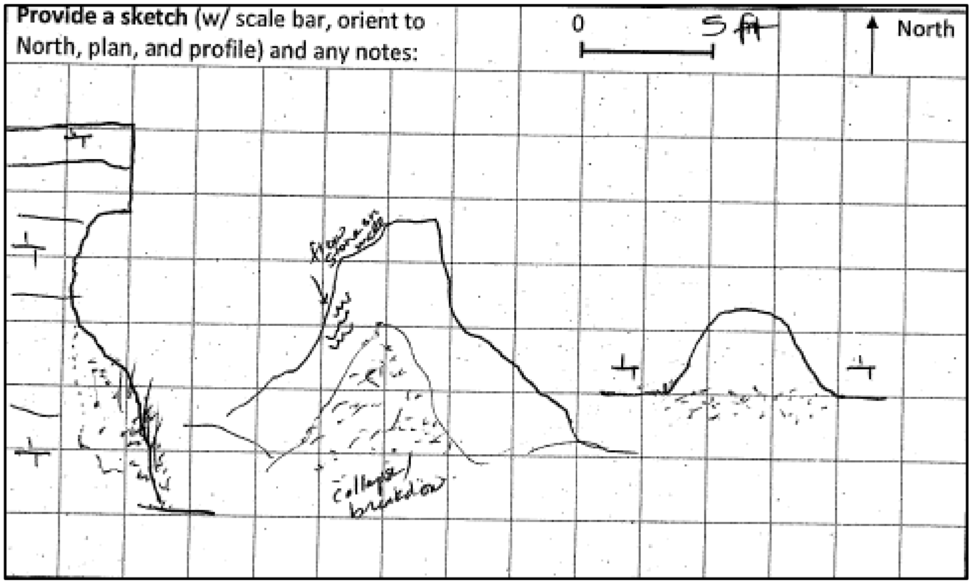

Figure 275. Field sketch of feature HB-022.

Feature HB-023; Solution Cavity

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and east of Huebner Road (Figure 276 - Figure 278; Attachment D page 83). The feature was a solution cavity that measured 1 ft wide by 1.3 ft long by 0.5 ft high and contained breakdown, fine soil, and exposed bedrock. The feature was located 1.5 ft above the base of the roadcut and appeared to have a mesocavernous extension into the roadcut. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface due its location above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 276. Overview of feature HB-023.

Figure 277. Interior of feature HB-023.

ATTACHMENT C

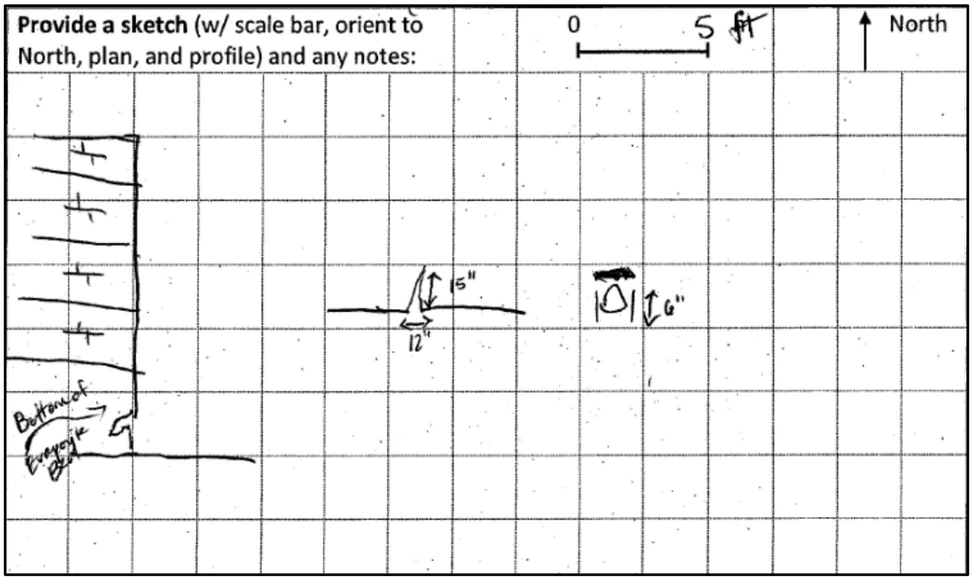

Figure 278. Field sketch of feature HB-023.

Feature HB-024; Sinkhole

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and west of Huebner Road (Figure 279 - Figure 280; Attachment D page 82). The feature was a bisected sinkhole that measured 6 ft wide by 3 ft long by 12 ft high. This feature contained breakdown, fine red clay, cobbles, vegetation, and exposed bedrock. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface due its location 7 ft above the base of the roadcut and a lack of mesocavernous voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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Figure 279. Overview of feature HB-024.

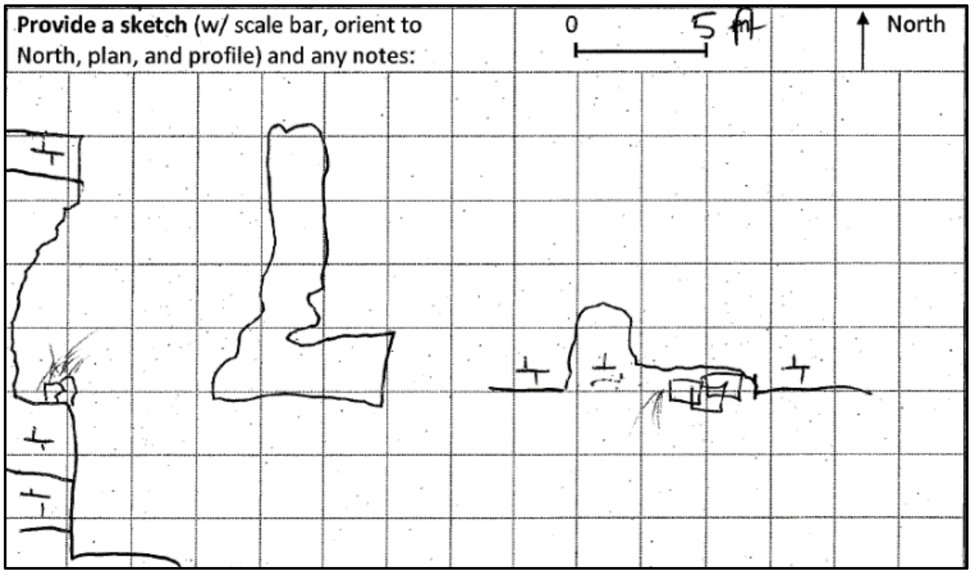

Figure 280. Field sketch of feature HB-024.

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Feature HB-025; Sinkhole

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Bitters Road (Figure 281 - Figure 282; Attachment D page 78-79). The feature was a collapsed sinkhole that had been bisected by the roadcut. It measured 25 ft wide by 10 ft long by 10 ft high. This feature contained coarse to fine tan soils, vegetation, and bedrock. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface as the feature did not appear to continue into the roadcut and was protected from inflow by several feet of accumulated collapsed debris at the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 281. Overview of feature HB-025.

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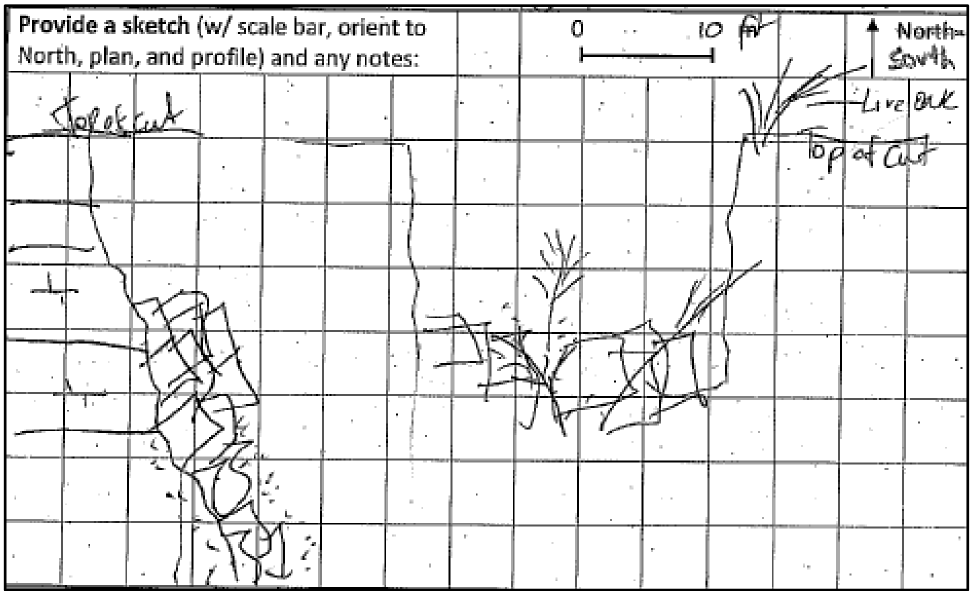

Figure 282. Field sketch of feature HB-025.

Feature HB-026; Solution Cavity

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Bitters Road (Figure 283 - Figure 285; Attachment D page 79). The feature was a solution cavity that measured 0.3 ft wide by 2 ft long by 1.5 ft high and had trends into the roadcut at 180º. This feature contained fine red soils and bedrock. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface due to its location 4 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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Figure 283. Overview of feature HB-026.

Figure 284. Interior of feature HB-026.

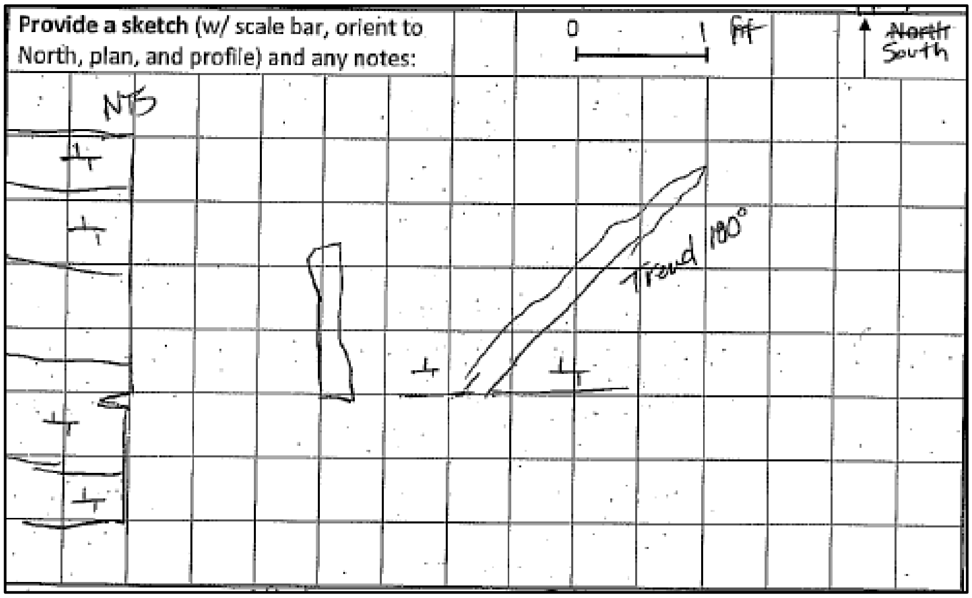

Figure 285. Field sketch of feature HB-026.

Feature HB-027; Solution Cavity

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Bitters Road (Figure 286 - Figure 288; Attachment D page 79). The feature was a solution cavity developed along a solution-enlarged bedding plane that measured 15 ft wide by 5 ft long by 12 ft high. This feature contained coarse to fine red-tan soils, cobbles, vegetation, and bedrock. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface due to its location 3 ft above the base of the roadcut and lack of mesocavernous extensions into the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 286. Overview of feature HB-027.

Figure 287. Interior of feature HB-027.

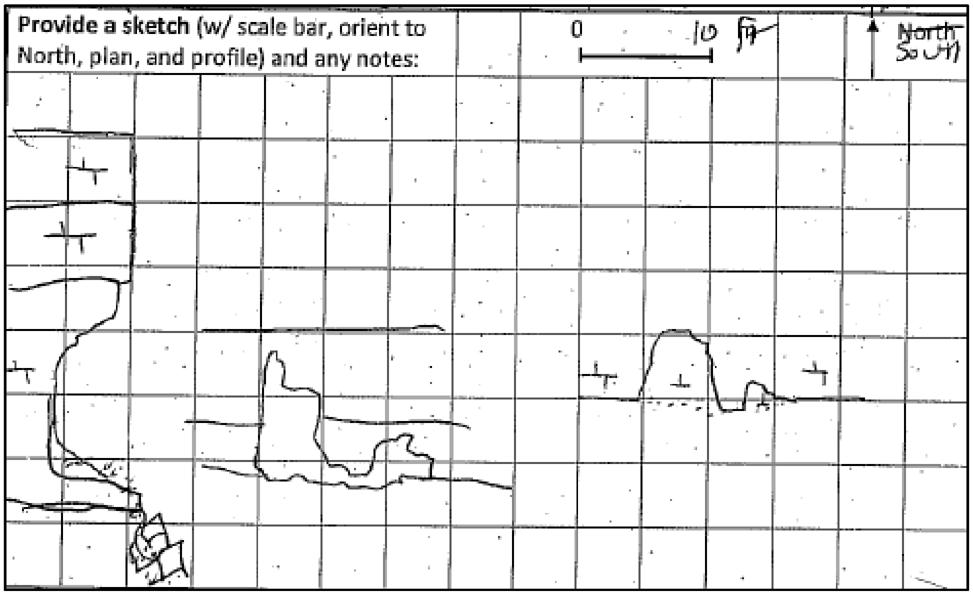

Figure 288. Field sketch of feature HB-027.

Feature HB-029; Solution Cavity (Solution-enlarged Bedding Plane)

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and east of Bitters Road (Figure 289 - Figure 290; Attachment D page 79). The feature was a solution-enlarged bedding plane that measured 6 ft wide by 3 ft long by 1.3 ft tall. This feature contained cobbles and bedrock. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface, as it was located 5 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 289. Overview of feature HB-029.

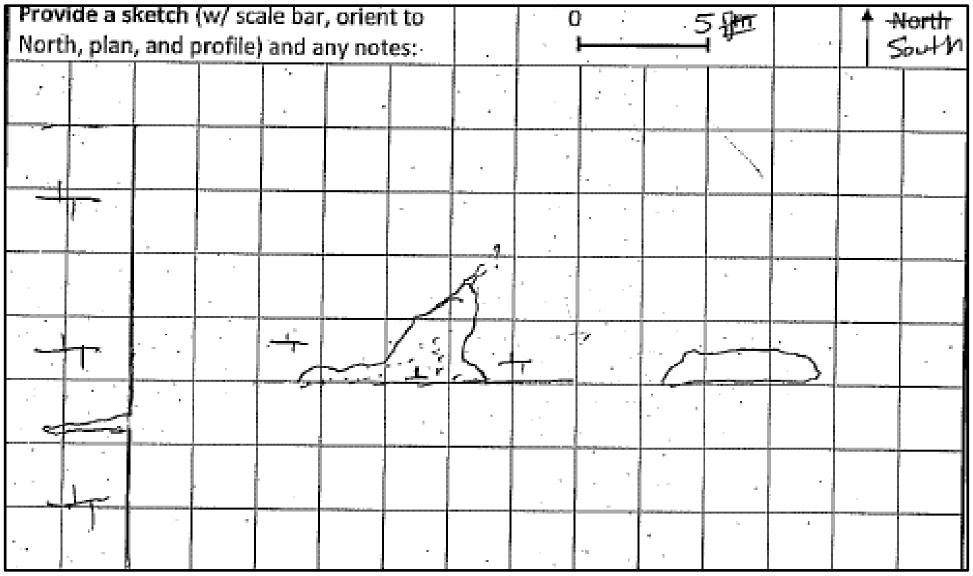

Figure 290. Field sketch of feature HB-029.

Feature HB-030; Solution Cavity (Solution-enlarged Bedding Plane)

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and east of Bitters Road. The feature was a solution-enlarged bedding plane that measured 8 ft wide by 3.6 ft long by 0.75 ft tall (Figure 291 - Figure 292; Attachment D page 79). This feature contained only exposed bedrock. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface, as it was located 5.5 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 291. Overview of feature HB-030.

ATTACHMENT C

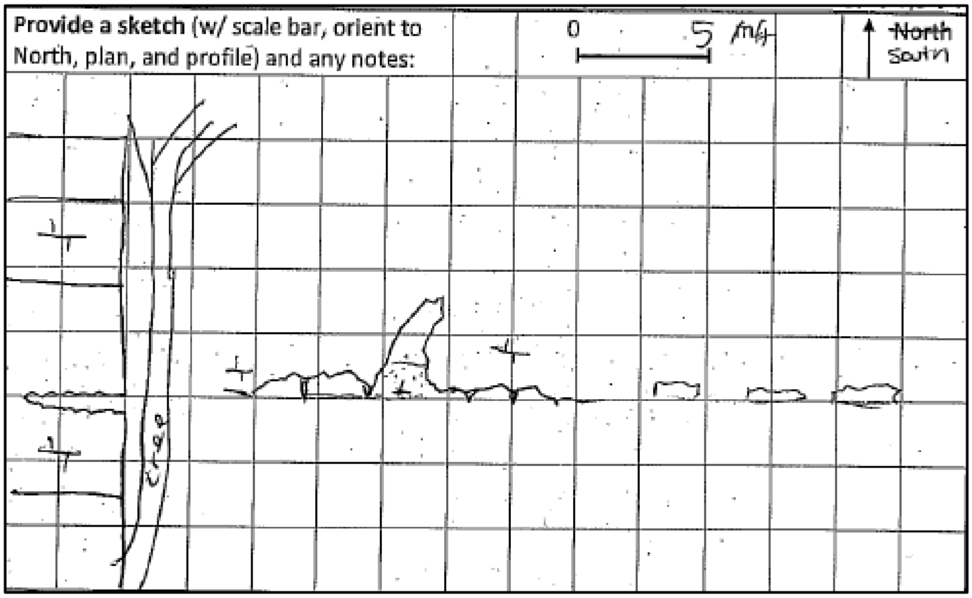

Figure 292. Field sketch of feature HB-030.

Feature HB-031; Sinkhole

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Huebner Road (Figure 293 - Figure 295; Attachment D page 81-82). The feature was a bisected sinkhole that measured 7 ft wide by 3.5 ft long by 9.5 ft high. This feature contained breakdown, fine red clay, cobbles, vegetation, and exposed bedrock. The feature appeared to be developed laterally along a bedding plane, but no downward trending voids were visible. It has a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface due its location 2.5 ft above the base of the roadcut and lack of mesocavernous voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

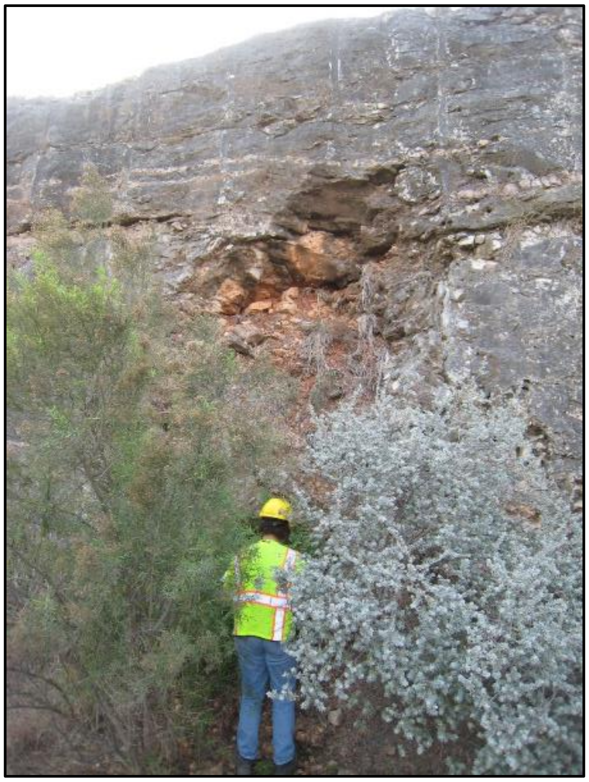

Figure 293. Overview of feature HB-031.

Figure 294. Infill and interior of feature HB-031.

ATTACHMENT C

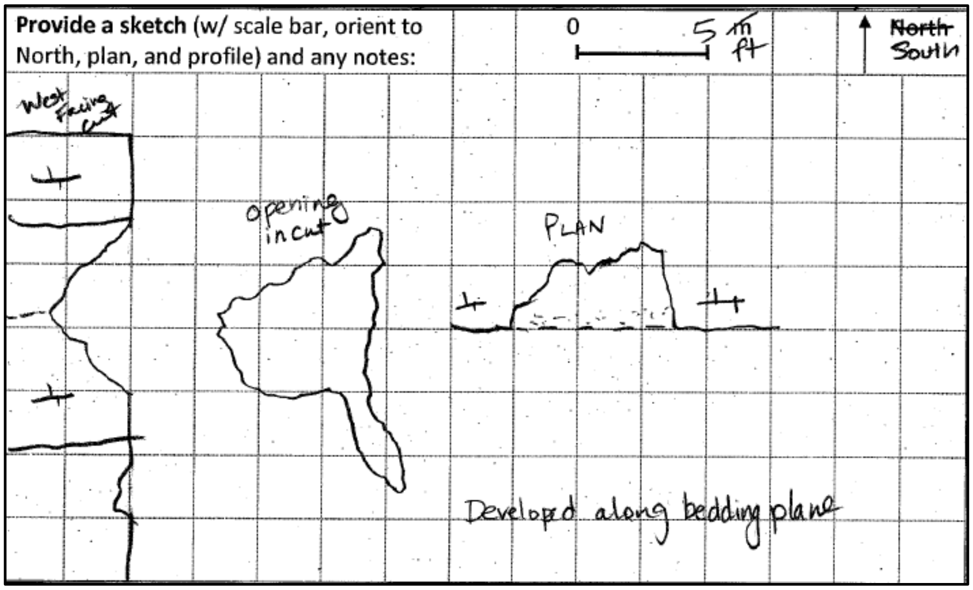

Figure 295. Field sketch of feature HB-031.

Feature HB-032; Zone of Solution Cavities

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Huebner Road (Figure 296 - Figure 297; Attachment D page 81-82). The feature was a zone containing two solution cavities bisected by the roadcut. The larger feature measured 5 ft wide by 4 ft long by 4 ft high, and the smaller is approximately 2 ft wide by 2 ft long by 4 ft high. The features contained, fine red-brown clay, cobbles, vegetation, and exposed bedrock. The feature appeared to be developed laterally along a bedding plane, but no downward trending voids were visible. There was a low potential for this feature to rapidly transmit water to the subsurface due its location 7.5 ft above the base of the roadcut and lack of mesocavernous voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 296. Overview of feature HB-032.

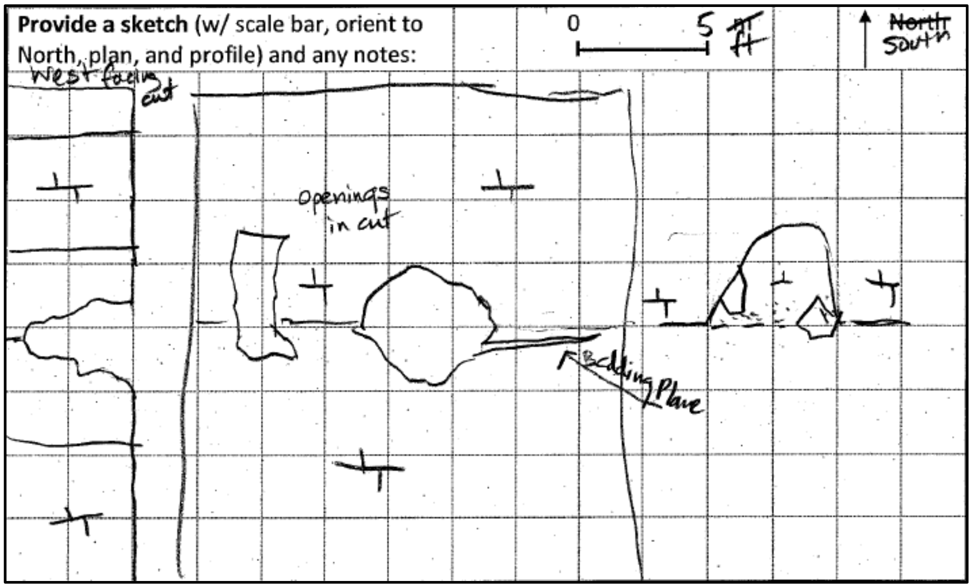

Figure 297. Field sketch of feature HB-032.

Feature HB-033; Zone of Solution Cavities

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Huebner Road (Figure 298 - Figure 299; Attachment D page 82). The feature was a zone containing two bisected solution cavities that were connected along a solution-enlarged bedding plane 20 ft wide by 3 ft long by 5 ft high. The features contained, fine red-brown clay, cobbles, vegetation, and exposed bedrock. There was a low potential for this feature to rapidly transmit water to the subsurface due its location 6.5 ft above the base of the roadcut and lack of mesocavernous voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 298. Overview of feature HB-033.

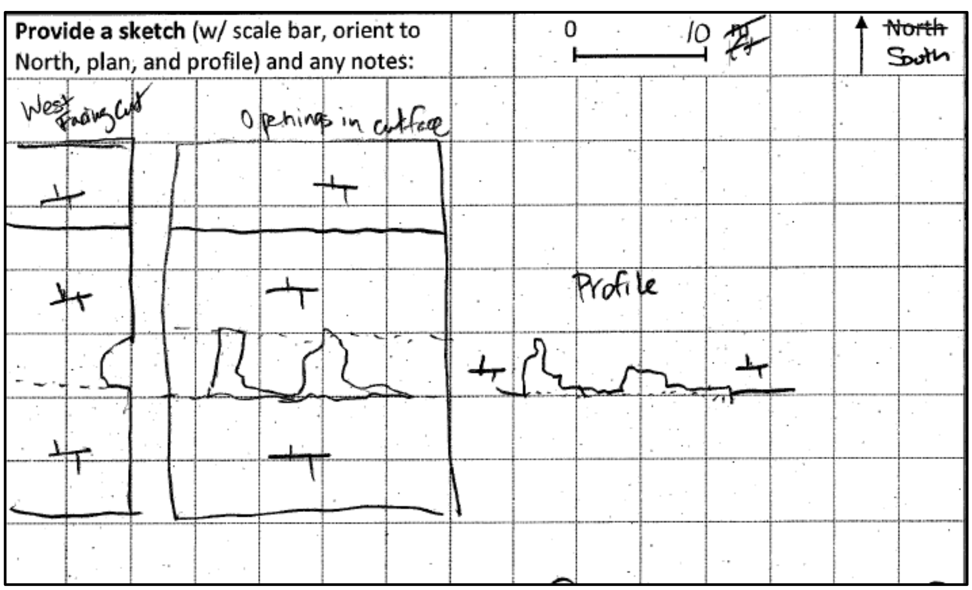

Figure 299. Field sketch of feature HB-033.

Feature HB-034; Solution Cavity (Solution-enlarged Bedding Plane)

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Huebner Road (Figure 300 - Figure 302; Attachment D page 82). The feature was in the area originally described as feature 1604-W06, a zone of karst features; however, it was located with enough distance from other features to re-describe it as a distinct feature. The feature was a solution-enlarged bedding plane that measured 1 ft wide by 2.5 ft long by 0.3 ft high. It narrowed as it extended into the roadcut and appeared to terminate in bedrock. This feature was filled with fine brown soil, loose rocks, and bedrock. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface due to its small size and compact soil fill. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 300. Overview of feature HB-034.

ATTACHMENT C

Figure 301. Interior of feature HB-034.

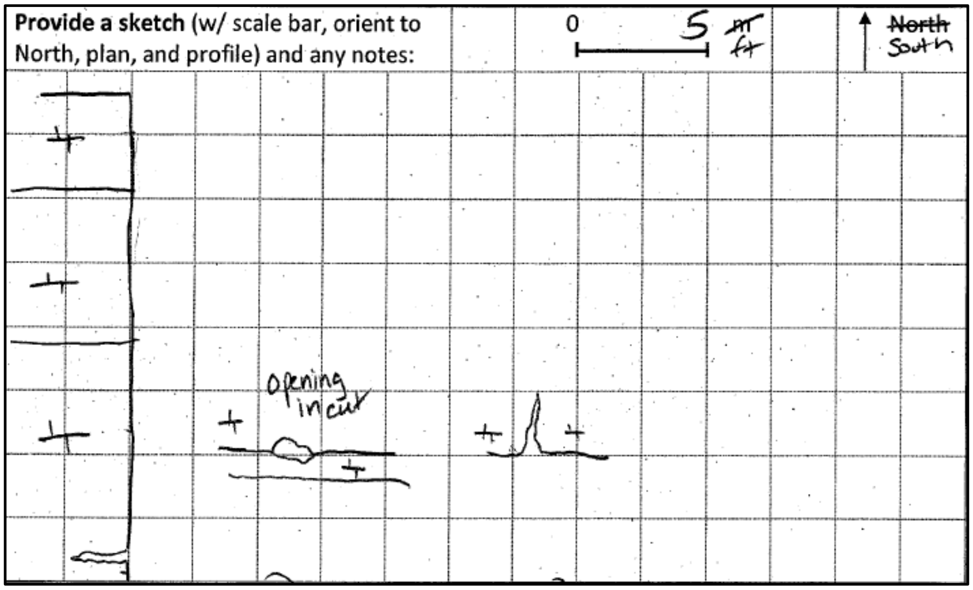

Figure 302. Field sketch of feature HB-034.

ATTACHMENT C

Feature HB-035; Solution-enlarged Bedding Plane

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Huebner Road (Figure 303 - Figure 304; Attachment D page 82). This feature was in the area originally described as feature 1604-W06, a zone of karst features; however, it was located with enough distance from other features to re-describe it as a distinct feature. The feature was a solution-enlarged bedding plane that measured 20 ft wide by 4 ft long by 2 ft high. It narrowed as it extended into the roadcut and appeared to terminate in bedrock. This feature was infilled with fine red-tan soil, loose rocks, and bedrock. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface due to its location 5.5 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 303. Overview of feature HB-035.

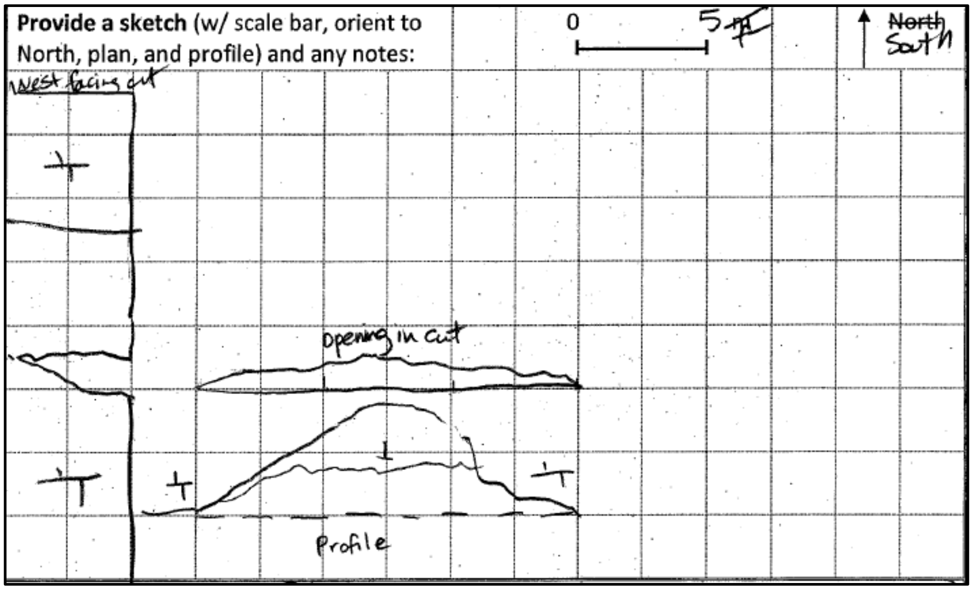

Figure 304. Field sketch of feature HB-035.

Feature HB-036; Zone with Solution-enlarged Bedding Plane and Solution Cavities

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and immediately east of the Huebner Road overpass (Figure 305 - Figure 307; Attachment D page 82). The feature was a zone containing a bisected solution-enlarged bedding plane that was 15 ft wide by 2 ft long by 4 ft high, and approximately eight solution cavities extending from it. The largest solution cavity had an aperture of 0.5 ft in diameter. This feature contained fine red-brown soil, cobbles, vegetation, and bedrock. It had a catchment area of less than 1.6 ac. As the feature was located 4 to 7 ft above the base of the roadcut and appeared to function as a discharge feature (seep) based on the presence of ferns and other similar vegetation (Figure 306), there was a low potential for this feature to rapidly transmit water to the subsurface. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 305. Overview of feature HB-036. Note the concrete apron of the Huebner Road bridge on the right side of the photo.

Figure 306. Close-up of feature HB-036 showing ferns growing from feature.

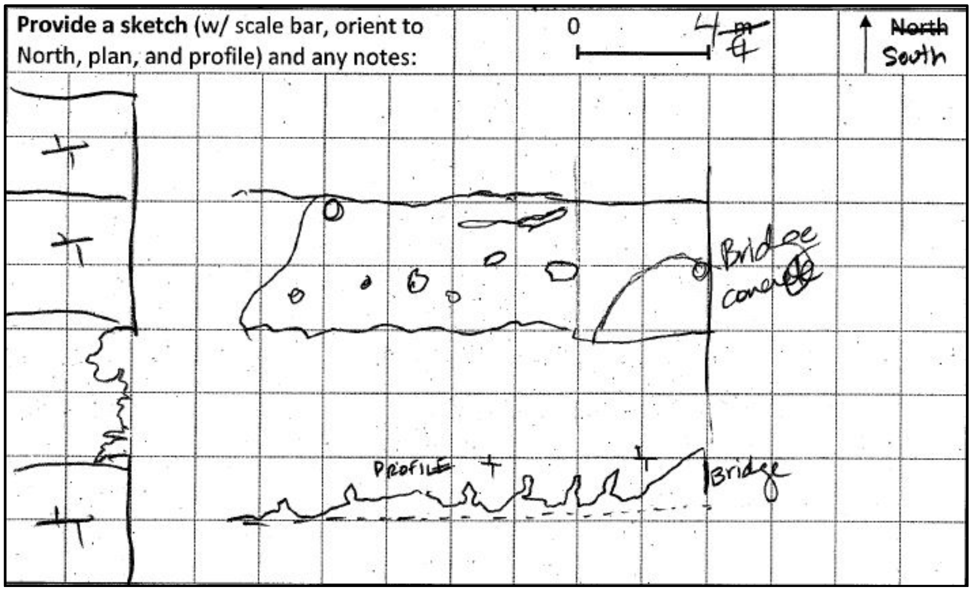

Figure 307. Field sketch of feature HB-036.

Feature HB-037; Solution Cavity (Solution-enlarged Bedding Plane)

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and east of Huebner Road (Figure 308 - Figure 309; Attachment D page 82). The feature was a solution-enlarged bedding plane that measured 70 ft wide by 2 ft long by 3 ft high. The feature contained fine red clay soil, rocky breakdown, vegetation, and exposed bedrock. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface due its location 6 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).


Figure 308. Overview of feature HB-037.

ATTACHMENT C

Provide a sketch (w/ scale bar, orient to North, plan, and profile) and any notes:

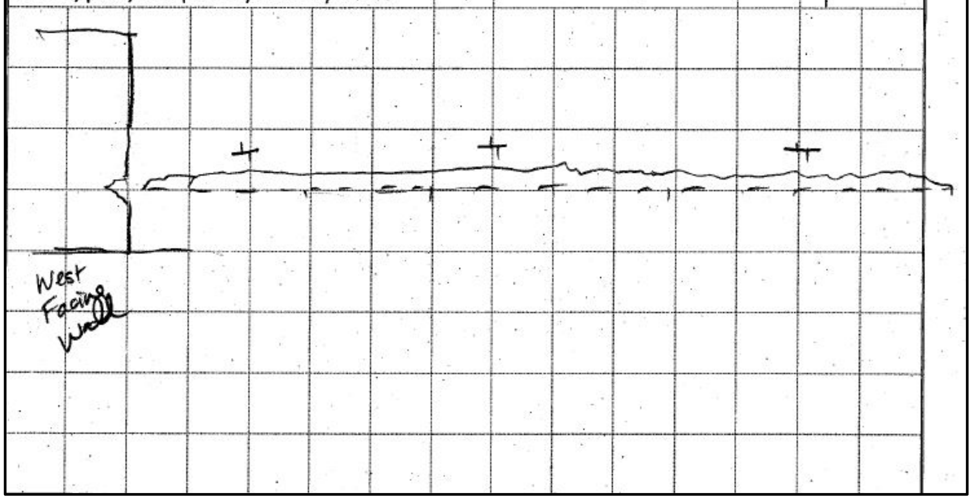

Figure 309. Field sketch of feature HB-037.

Feature HB-038; Solution Cavity

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and east of Huebner Road (Figure 310 - Figure 312; Attachment D page 83). The feature was a solution cavity that measured 1 ft wide by 2.2 ft long and is 1 ft high. This feature contained loose rocks and exposed bedrock. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface due to its location 6 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 310. Overview of feature HB-038.

Figure 311. Interior of feature HB-038.

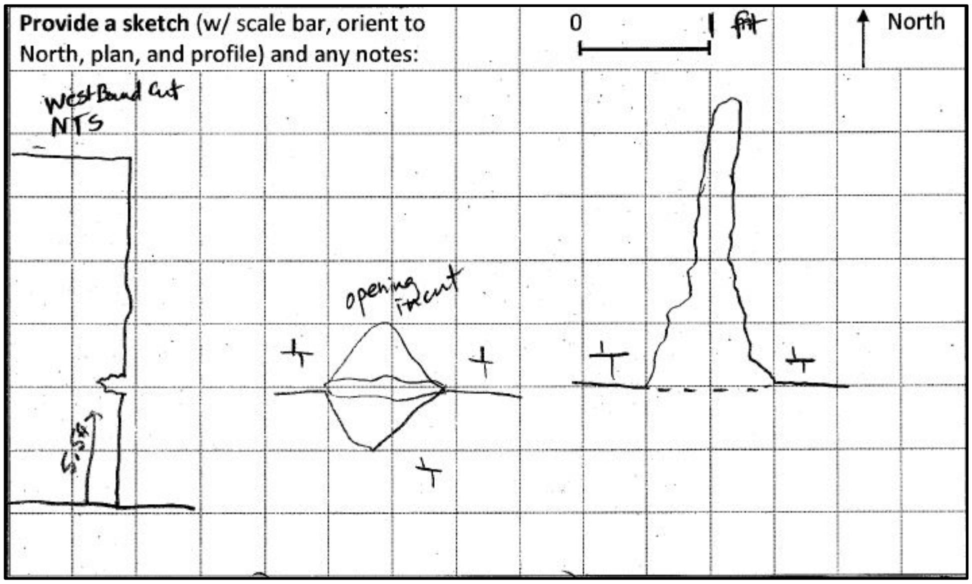

Figure 312. Field sketch of feature HB-038.

Feature LOOP-001; Other (Fractured Bedrock)

This feature was located in the ROW south of the eastbound mainlanes of Loop 1604 and east of O'Connor Road (Figure 314 - Figure 316; Attachment D page 111). This area of fractured bedrock measured 13.1 ft wide by 9.8 ft long and 4.9 ft high. The floor depth of the bedrock was 4.9 ft below the surrounding ground surface. Two sets of fractures were present with apertures of 0.03 to 0.13 ft and trends of 3° and 93°. The feature was guided by a fracture with a trend of 165°, likely associated with jointing along the Balcones Fault Zone. This feature contained exposed bedrock and gravel to boulder sized rocks. It was situated in a manmade drainage that had a catchment area greater than 1.6 ac. There was a moderate potential for this feature to rapidly transmit water to the subsurface as the fractures lacked soil infill and may have continued deeper below the surface. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).


Figure 313. Overview of feature LOOP-001.


Figure 314. Close-up of feature LOOP-001.

ATTACHMENT C

Figure 315. View to the north from feature LOOP-001.

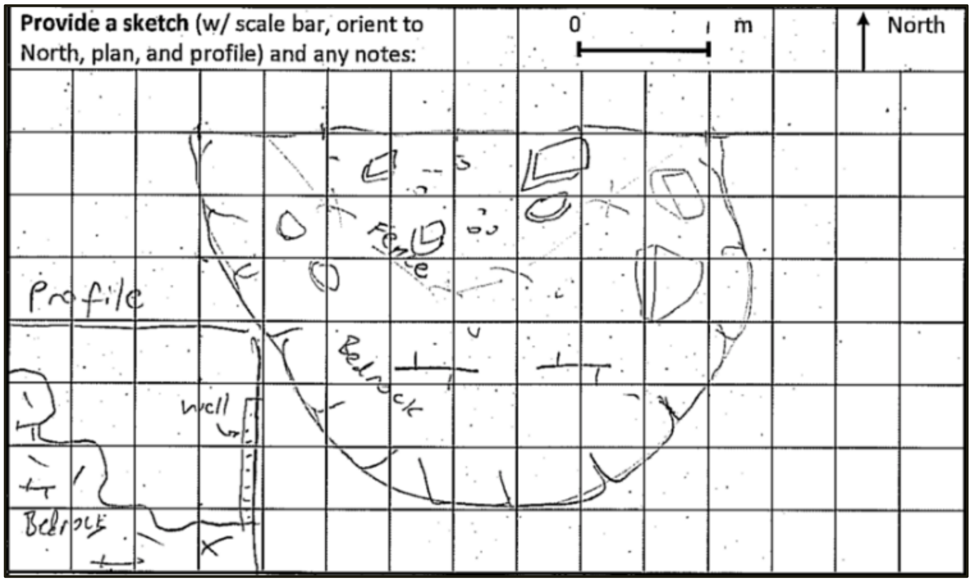

Figure 316. Field sketch of feature LOOP—001.

Feature LOOP-002; Other (Fractured Bedrock)

This feature was located in an easement north of the westbound mainlanes of Loop 1604 and west of Bitters Road at the entrance of the Villas Apartments (Figure 317 - Figure 320; Attachment D page 77). This area of fractured bedrock measured 4.9 ft wide by 32.8 ft long. Two sets of fractures were present with apertures of 0.01 to 0.06 ft and trends of 75^{o} and 175^{o}. This feature contained exposed bedrock that was partially covered with modern soil and leaf litter. It was situated in a manmade drainage with a catchment area greater than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface due to compact soil filled in the fractures, but it was determined that there was a moderate infiltration potential due to the large catchment area. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 317. Overview of feature LOOP-002.

Figure 318. Close-up of feature LOOP-002.

Figure 319. View to the south from feature LOOP-002.

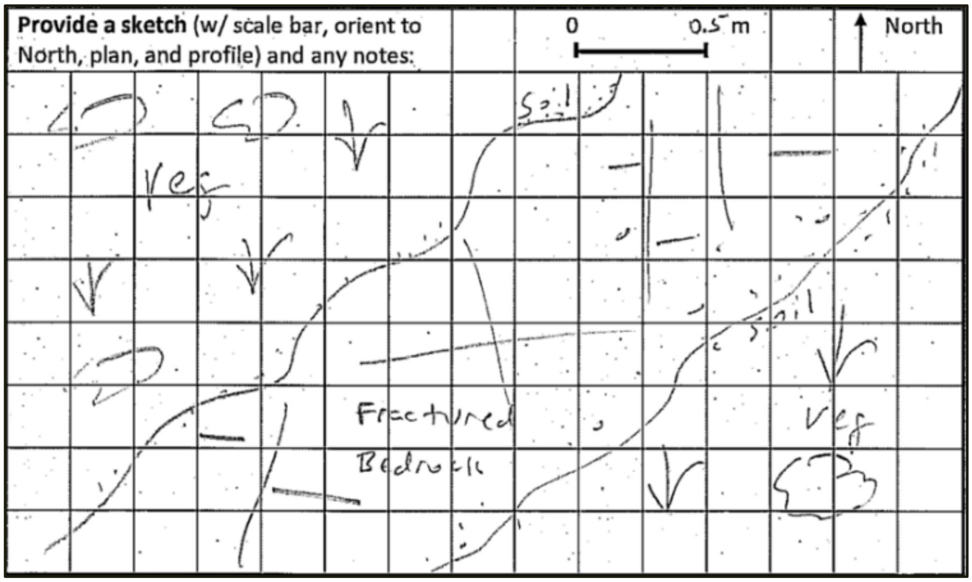

Figure 320. Field sketch of feature LOOP-002.

Feature LOOP-003; Other (Zone of Fractures)

This feature was located in an easement north of the westbound mainlanes of Loop 1604 and east of Bandera Road (Figure 321 - Figure 324; Attachment D page 40-41). This zone of fractured bedrock measured 6.5 ft wide by 82 ft long. Two sets of fractures were present with apertures of 0.08 ft and trends of 0º and 80°. Fracture density was 0.75 per linear foot. This feature contains exposed bedrock and compact soil. It was situated in a streambed with a catchment area greater than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface as the fractures were filled with compact soil. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

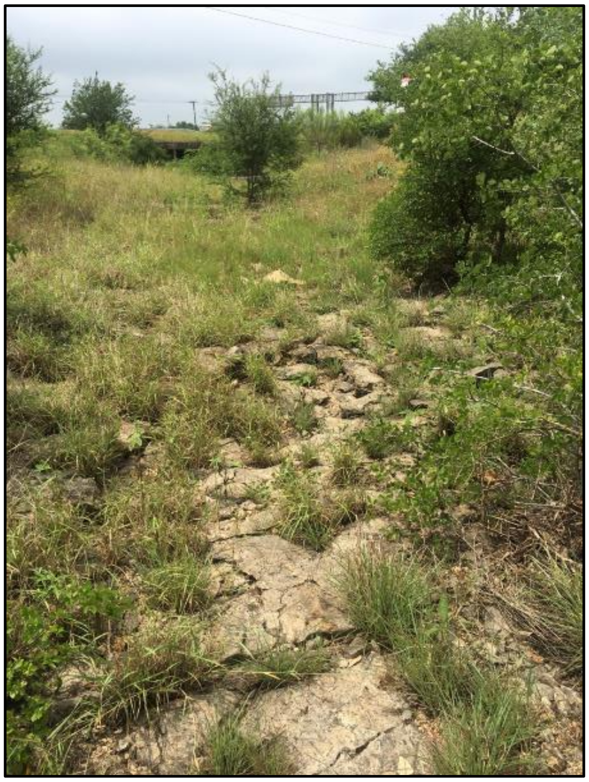

Figure 321. Overview of feature LOOP-003.

Figure 322. Close-up of feature LOOP-003.

Figure 323. Close-up of feature LOOP-003.

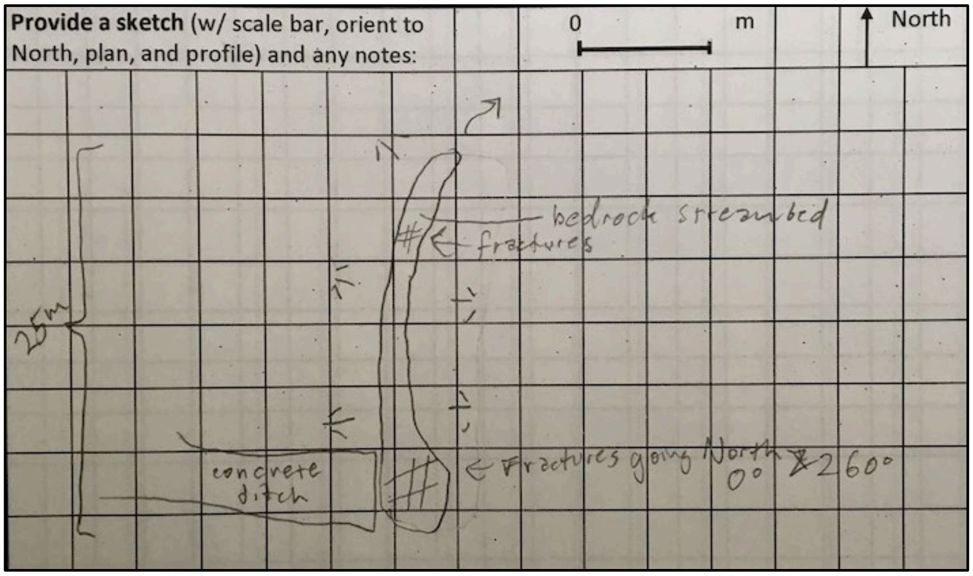

Figure 324. Field sketch of feature LOOP-003.

Feature LOOP-006; Other (Vuggy Bedrock)

This feature was located in an easement south of the eastbound mainlanes of Loop 1604 and west of Judson Road (Figure 325 - Figure 327; Attachment D page 113). The feature was an area of vuggy bedrock that measured 10 ft wide and 50 ft long. This feature contained exposed bedrock partially covered with organic soils, leaf litter, and gravel. It was situated in a streambed that had a catchment area of greater than 1.6 ac. There was a moderate potential for this feature to rapidly transmit water to the subsurface due to its size and catchment area. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 325. Overview of feature LOOP-006.

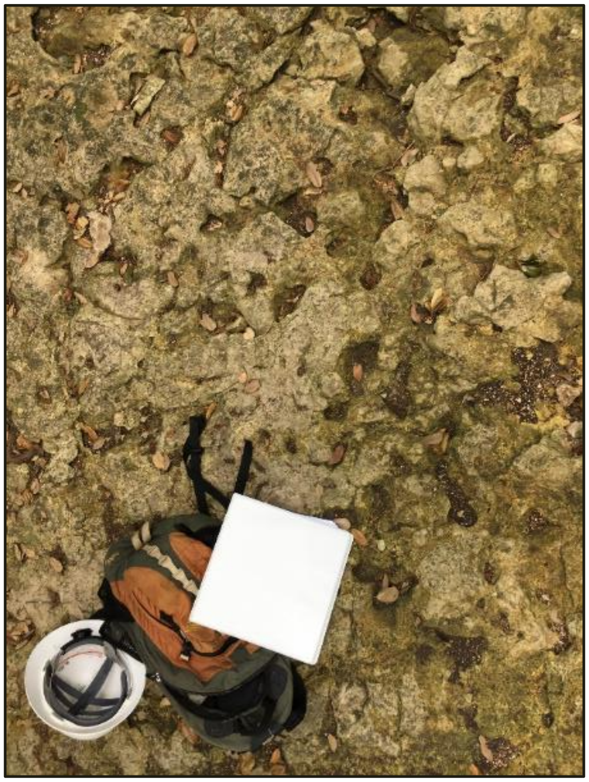

Figure 326. Close-up of feature LOOP-006.

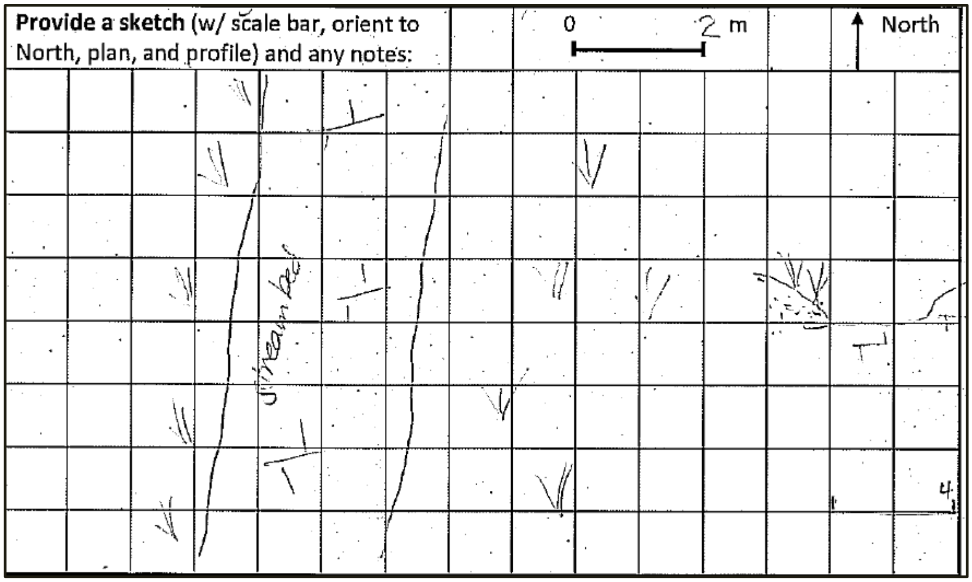

Figure 327. Field sketch of feature LOOP-006.

Feature LOOP-007; Other (Fractured Bedrock)

This feature was located in an easement south of the eastbound mainlanes of Loop 1604 and west of Judson Road (Figure 328 - Figure 330; Attachment D page 113). The feature was an area of fractured bedrock that measured 1.6 ft wide by 9.8 ft long. Fractures of 0.03 to 0.06 ft aperture were present with a trend of 29°. This feature was composed of exposed bedrock partially covered with organic soil and vegetation. The rock inside of the drainage was exposed and washed out by stormwater runoff. Recon excavation revealed open cavities that continued in multiple directions. The feature had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface due to its small size and lack of significant downward-trending voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 328. Overview of feature LOOP-007.

Figure 329. Close-up of feature LOOP-007.

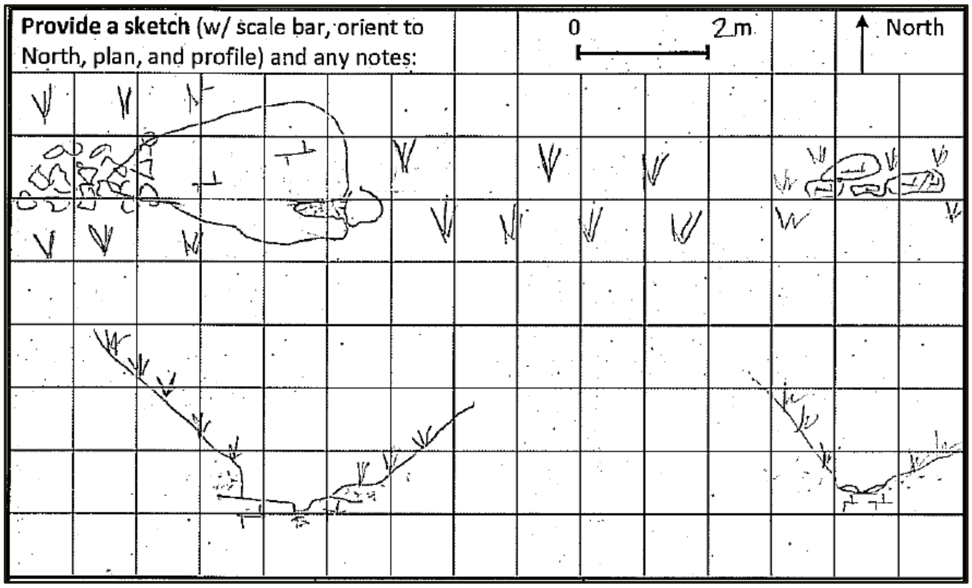

Figure 330. Field sketch of feature LOOP-007.

Feature LOOP-008; Man-made Feature in Bedrock (Borehole)

This feature was located in the median between the mainlanes of Loop 1604 and east of O'Connor Road (Figure 331 - Figure 333; Attachment D page 110-111). The feature was an uncovered borehole 0.4 ft in diameter and with an unknown depth. This feature contained compact soil and a 2.5 in drill stem that protruded approximately 1.5 ft out of the hole and possibly extended into bedrock. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface as it was situated on a hilltop. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 331. Overview of feature LOOP-008.

ATTACHMENT C

Figure 332. Close-up of feature LOOP-008.

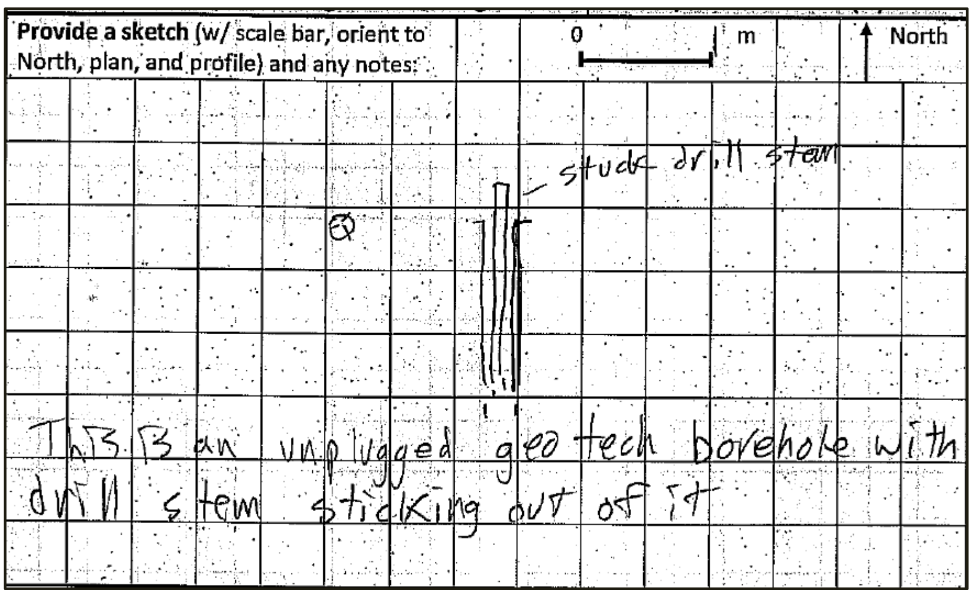

Figure 333. Field sketch of feature LOOP-008.

ATTACHMENT C

Feature LOOP-009; Solution Cavity

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and east of Highway 281 (Figure 334 - Figure 336; Attachment D page 97). This feature was a solution cavity that measured 2.6 ft wide, 3.2 ft high, and 3.6 ft deep. It had a floor depth of 6.5 ft below the surface. This feature contained rocks, cobbles, and bedrock. In June 2019, 2.25 person hours were spent removing 56 ft^3 of material using hand tools. Excavation revealed mesocavernous voids trending downward into bedrock. It had a catchment area of less than 1.6 ac. There was a moderate potential for this feature to rapidly transmit water to the subsurface as it contained downward trending voids. This feature was determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 334. Overview of feature LOOP-009.

ATTACHMENT C

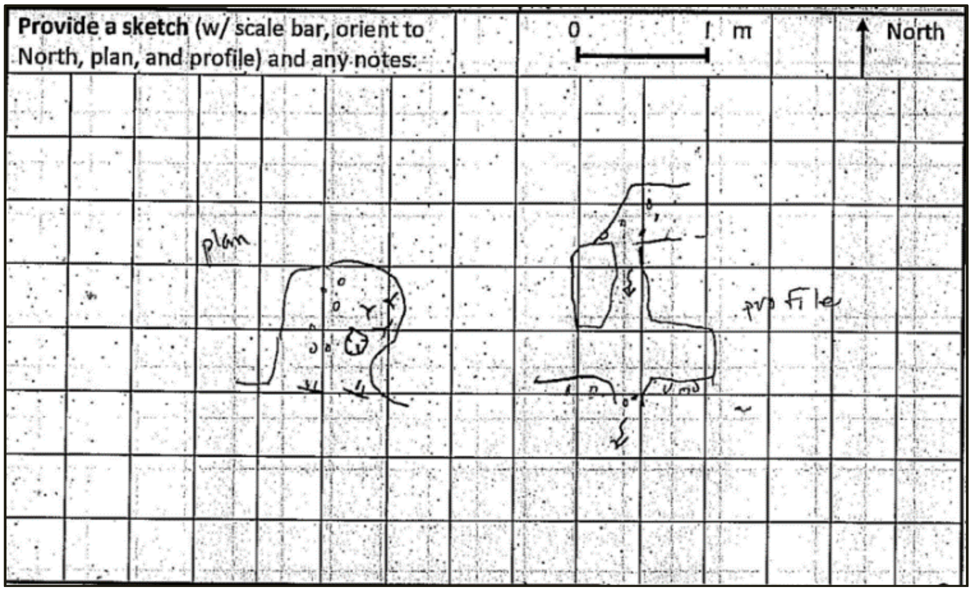

Figure 335. Pre-excavation field sketch of feature LOOP-009.

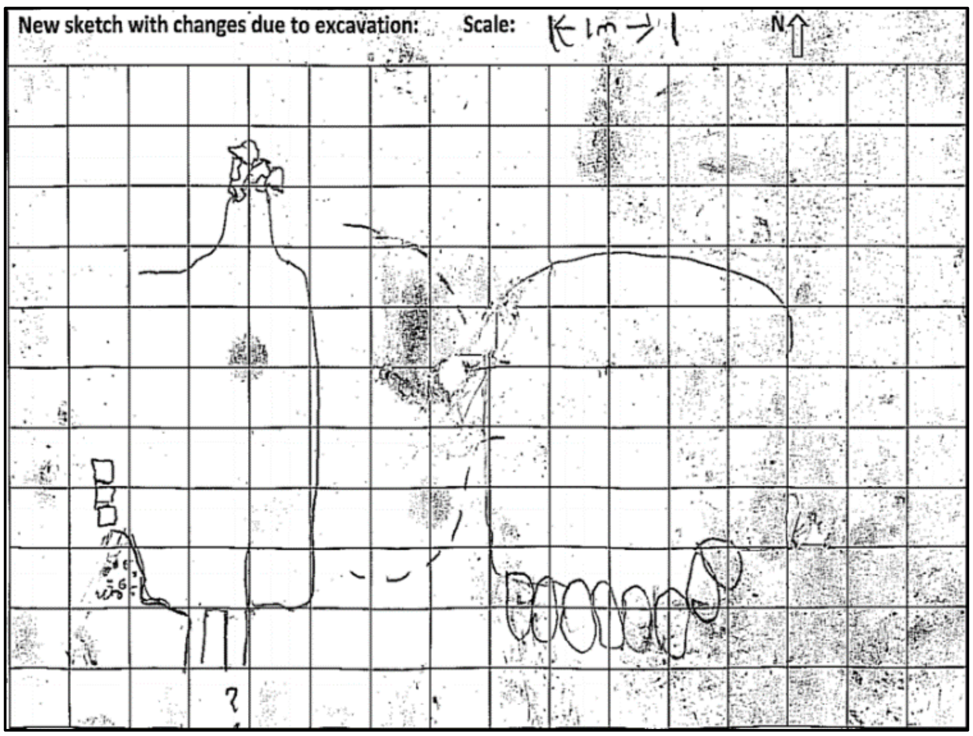

Figure 336. Post-excavation field sketch of feature LOOP-009.

ATTACHMENT C

Feature LOOP-010; Solution Cavity

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and east of Highway 281 (Figure 337 - Figure 340; Attachment D page 97). The feature was a solution cavity that measured 4.9 ft wide, 4.5 ft long, and 3.9 ft in height. The solution cavity was bisected by the roadcut and extended 7.8 ft below the surface. This feature contained fine, compact, reddish sediment and some calcite. A void extending 1.3 ft into the feature was discovered after recon excavation was performed. In June 2019, 1.5 person hours were spent removing 0.25 ft^3 of material using hand tools. A distinct terminus was reached when the back wall of the feature was visible. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface as it was above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 337. Overview of feature LOOP-010.

Figure 338. Material excavated from feature LOOP-010.

Figure 339. Interior of feature LOOP-010 after excavation, revealing flowstone.

ATTACHMENT C

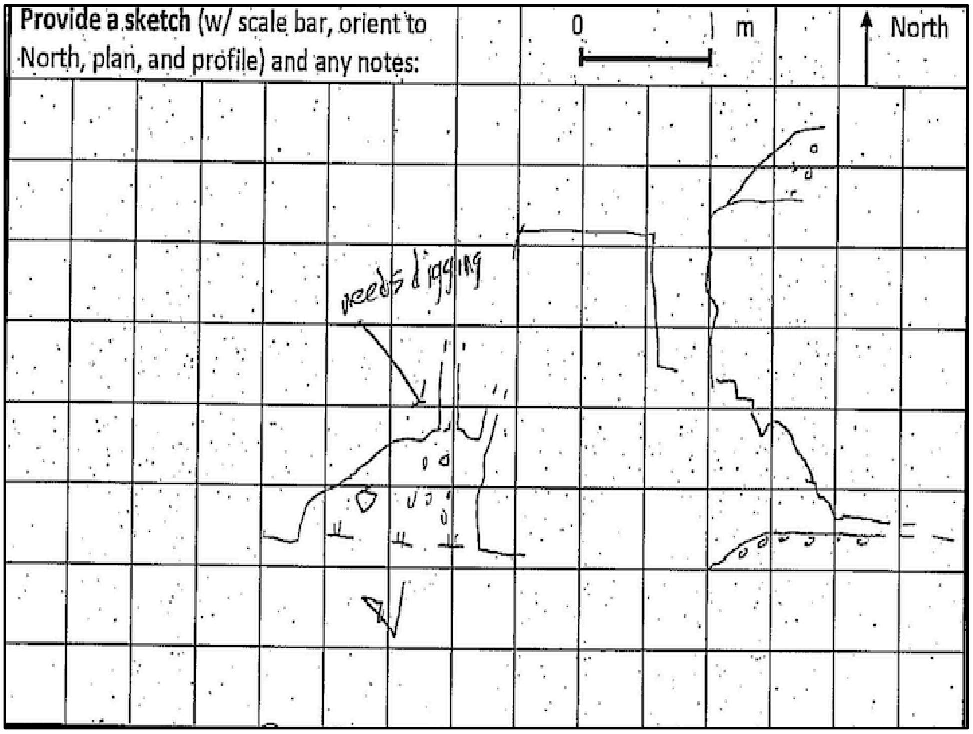

Figure 340. Pre-excavation field sketch of feature LOOP-010.

Feature LOOP-012; Swallet & Fractured Bedrock

This feature was located in an easement north of the westbound mainlanes of Loop 1604 and east of Tuscany Stone (Figure 341 - Figure 345; Attachment D page 90). This feature measured 13.1 ft wide by 70 ft long and 3.2 ft deep. Two sets of fractures were present with trends of 120° and 40°, consistent with regional trends along the Balcones Fault Zone. These fractures had a maximum aperture of 0.1 ft. This feature consisted of exposed bedrock and flowing water. On 25 June 2019, flowing water was observed sinking into the ground that indicated a buried swallet. It had a catchment area greater than 1.6 ac. There was a high potential for this feature to rapidly transmit water to the subsurface due to the size of the catchment area and directly observed flow loss into fractured bedrock in the streambed. This feature was determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 341. Overview of feature LOOP-012 downstream portion.

Figure 342. Close-up of feature LOOP-012 downstream portion.

ATTACHMENT C

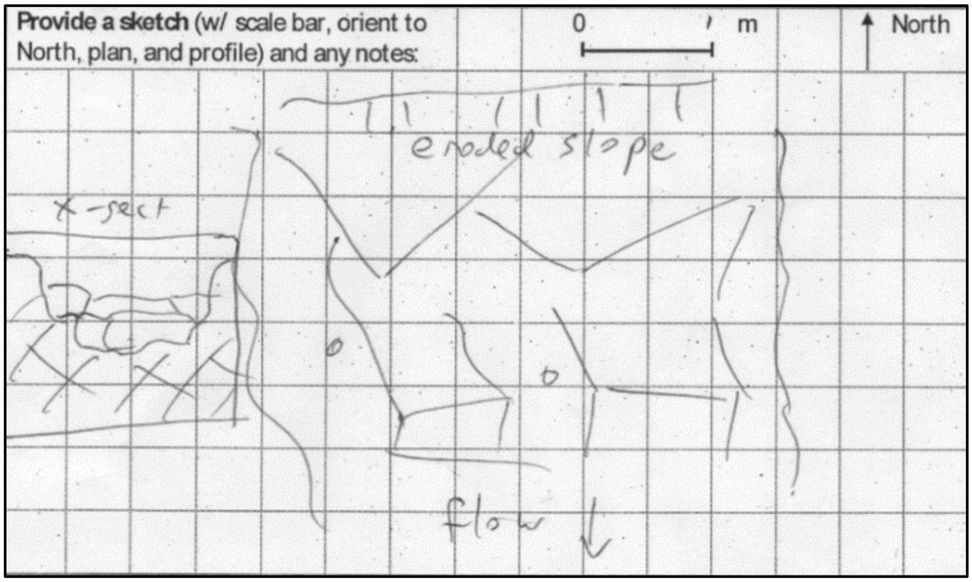

Figure 343. Field sketch of feature LOOP-012 downstream portion.

Figure 344. Overview of feature LOOP-012 upstream portion.

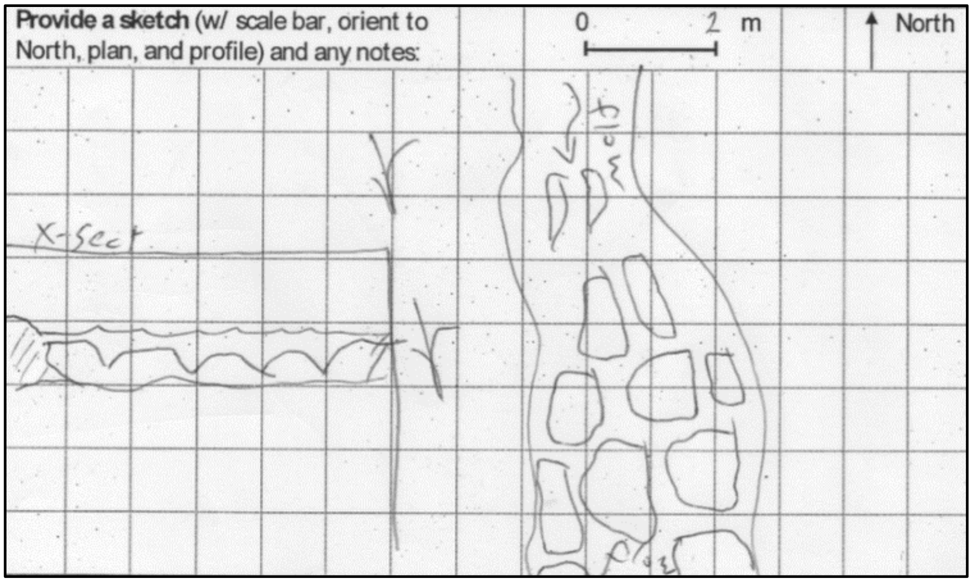

Figure 345. Field sketch of feature LOOP-012 upstream portion.

Feature LOOP-013; Other (Fractured Bedrock)

This feature was located in the median between the westbound access road and mainlanes of Loop 1604 and west of highway 281 (Figure 346 - Figure 348; Attachment D page 91). This feature measured 3.2 ft wide by 19.6 ft long. Two sets of fractures were present in the bedrock with apertures of <0.01 ft and trends of 50° and 120°. This feature consisted only of exposed bedrock. It had a catchment area less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface as the fractures had a small aperture and the feature was situated on a hillside. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 346. Overview of feature LOOP-013.

Figure 347. Close-up of feature LOOP-013.

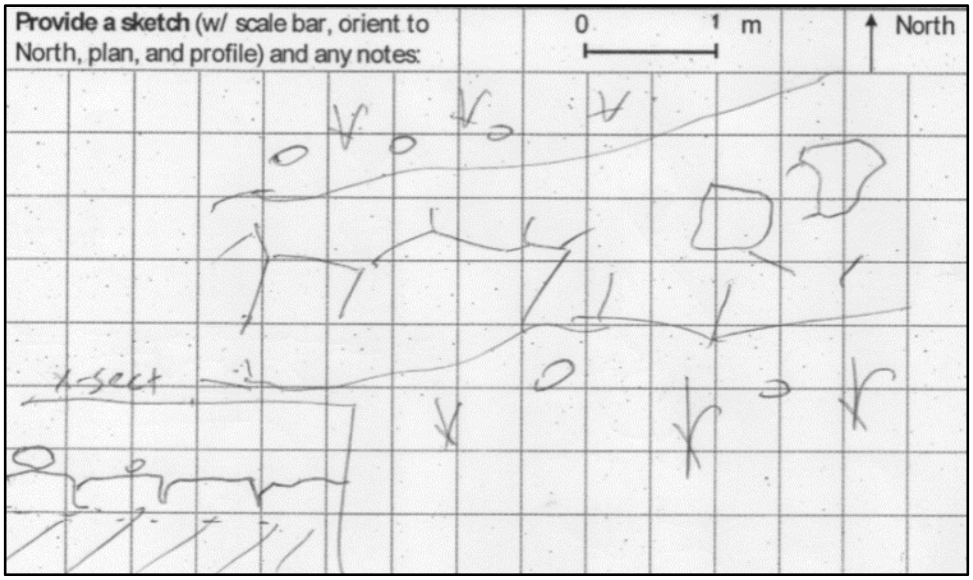

Figure 348. Field sketch of feature LOOP-013.

Feature LOOP-014; Other (Fractured Bedrock)

This feature was located in an easement north of the westbound mainlanes of Loop 1604 and east of Huebner Road (Figure 349 - Figure 351; Attachment D page 83). The feature was an area of fractured bedrock that measured 6.6 ft wide and 19.7 ft long. Two sets of fractures were present with apertures of 0.03 ft and trends of 70° and 135°. This feature consisted of exposed bedrock that was partially covered by gravel and organic soil. It was situated in a streambed that had a catchment area greater than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface as the fractures were thin and filled with compact soil. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 349. Overview of feature LOOP-014.

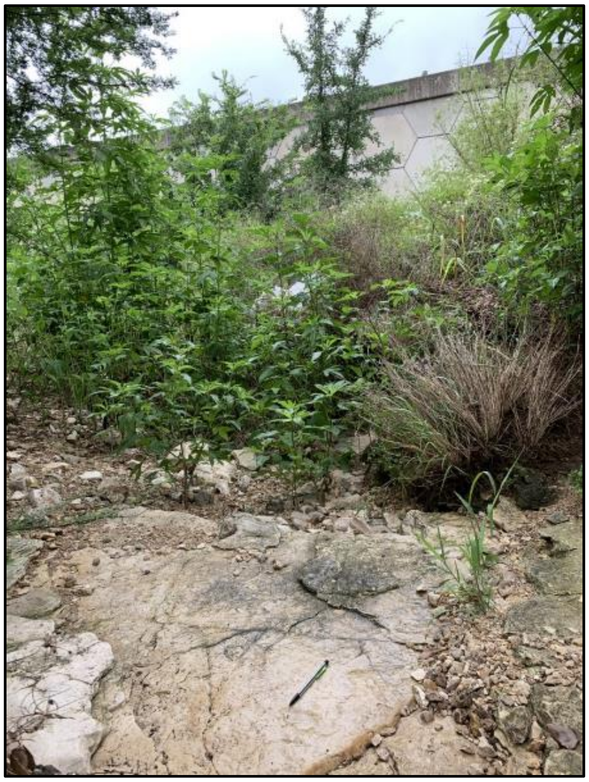

Figure 350. Close-up of feature LOOP-014.

ATTACHMENT C

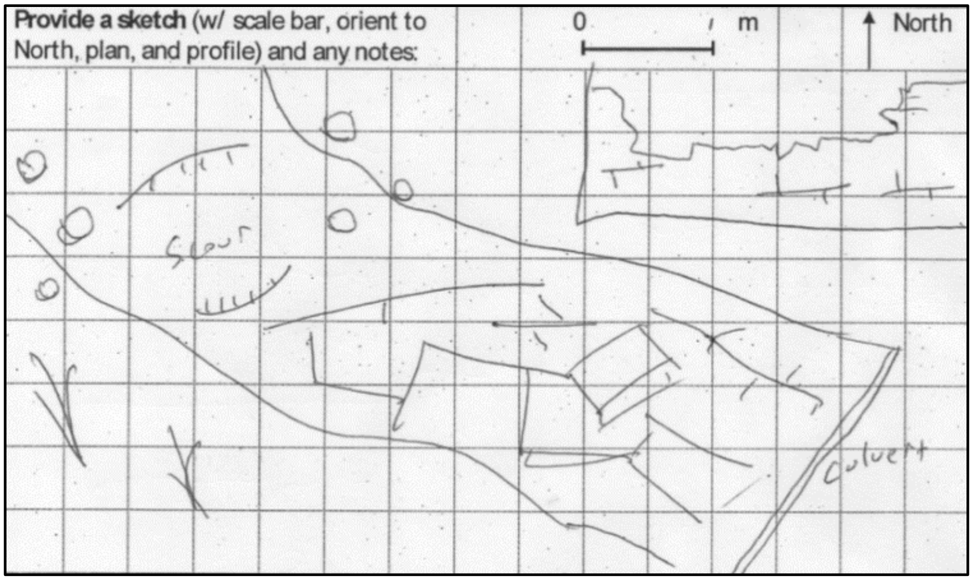

Figure 351. Field sketch of feature LOOP-014.

Feature LOOP-015; Other (Fractured Bedrock)

This feature was located in an easement north of the westbound mainlanes of Loop 1604 and east of Blanco Springs (Figure 352 - Figure 354; Attachment D page 81). The feature was an area of fractured bedrock that measured 6.5 ft wide by 19.6 ft long. This feature consisted of exposed bedrock partially covered by gravel and vegetation. Two sets of fractures were present with apertures of 0.06 ft and trends of 60° and 170°. It was situated in a streambed with a catchment area greater than 1.6 ac. Despite the large catchment area, there was only a moderate potential for this feature to rapidly transmit water to the subsurface as the fractures were compact and filled with sediment. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 352. Overview of feature LOOP-015.

Figure 353. Close-up of feature LOOP-015.

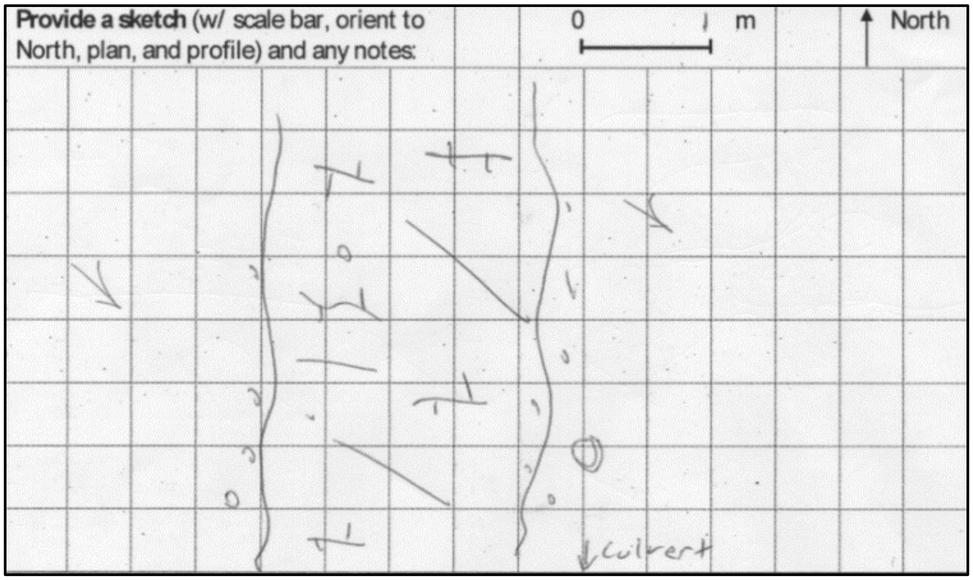

Figure 354. Field sketch of feature LOOP-015.

Feature LOOP-016; Other (Fractured Bedrock)

This feature was located in an easement south of the eastbound mainlanes of Loop 1604 and east of Huebner Road on the western side of Texas Leather Interiors (Figure 355 - Figure 357; Attachment D page 83). The feature was an area of fractured bedrock that measured 13.1 ft wide by 19.6 ft long. This feature consisted of exposed bedrock partially covered by gravel and vegetation. Two sets of fractures were present with apertures of 0.03 to 0.06 ft and trends of 50° and 116°. It was situated in a streambed that had a catchment area greater than 1.6 ac. Despite the large catchment area, there was only a moderate potential for this feature to rapidly transmit water to the subsurface as the fractures were compact and filled with sediment. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 355. Overview of feature LOOP-016.

Figure 356. Overview of location of feature LOOP-016.

ATTACHMENT C

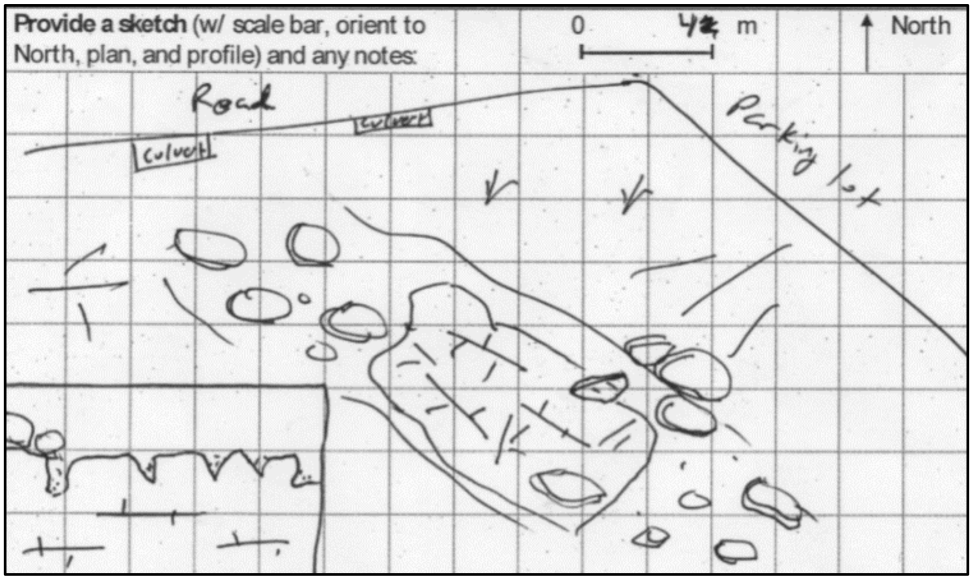

Figure 357. Field sketch of feature LOOP-016.

Feature LOOP-017; Other (Fractured Bedrock)

This feature was located in an easement south of the eastbound mainlanes of Loop 1604 and east of Huebner Road on the eastern side of Texas Leather Interiors (Figure 358 - Figure 360; Attachment D page 83-84). The feature was an area of fractured bedrock that measured 9.8 ft wide by 65.6 ft long. This feature consisted of exposed bedrock partially covered by soil and gravel- to boulder- size rocks. Two sets of fractures were present with a maximum aperture of 0.1 ft and trends of 53° and 88°. It was situated in a streambed that had a catchment area greater than 1.6 ac. Despite the large catchment area, there was only a moderate potential for this feature to rapidly transmit water to the subsurface as the fractures were compact and filled with sediment. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 358. Overview of feature LOOP-017.

Figure 359. Close-up of feature LOOP-017.

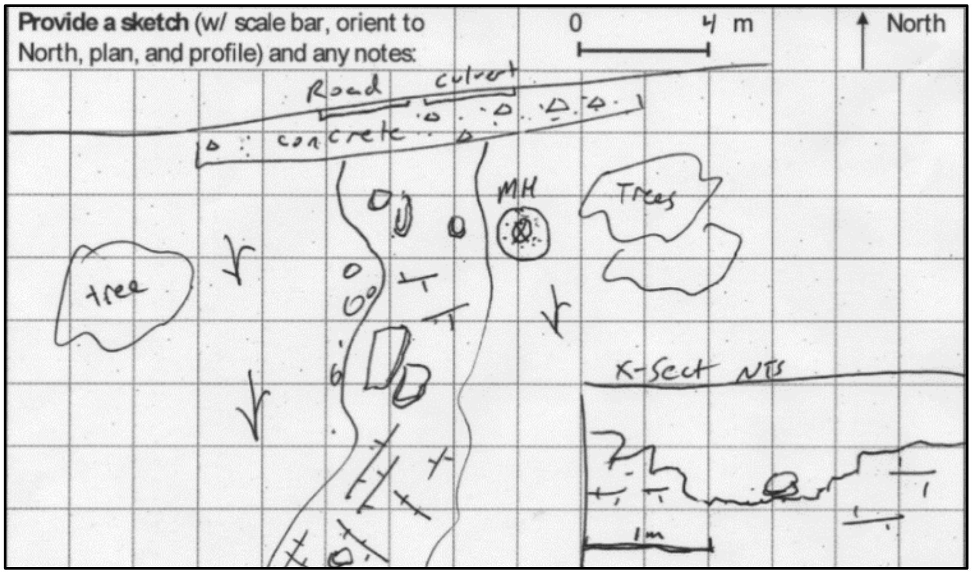

Figure 360. Field sketch of feature LOOP-017.

Feature LOOP-101; Non-Karst Closed Depression

This feature was located in an easement east of the northbound mainlanes of I-10 and north of Loop 1604 (Figure 361 - Figure 363; Attachment D page 13). The feature was a non-karst closed depression that measured 26.2 ft wide by 16.4 ft long and 4.9 ft high. This feature contained rocks, cobbles, loose soft soil, leaf litter, and vegetation. It had a catchment area of greater than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface as it was situated on a hillside and no downward trending voids were found. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).


Figure 361. Overview of feature LOOP-101.

Figure 362. Close-up of feature LOOP-101.

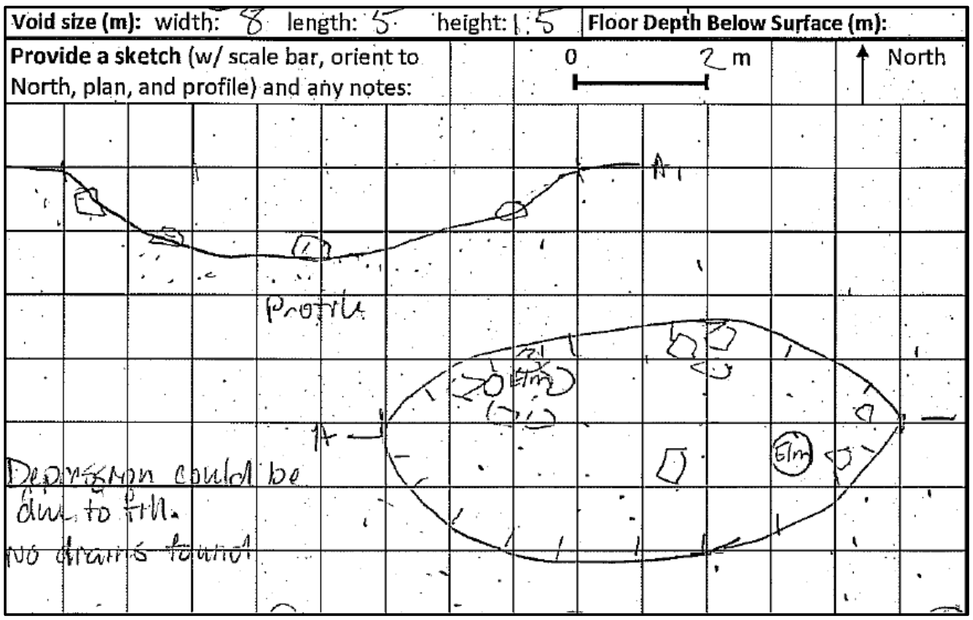

Figure 363. Field sketch of feature LOOP-101.

Feature LOOP-102 (Fiesta Cave); Cave (Paleospring)

This feature was located in an easement west of the southbound mainlanes of I-10 and north of Loop 1604 (Figure 364 - Figure 366; Attachment D page 12). The feature was a paleospring that measured 13.1 ft wide by 9.8 ft long and 1.6 ft high. The floor was 13.1 ft below the ground surface. This feature contained rocks, cobbles, and fine, tan clayey sediment with a loose depth of 2 cm. The feature was identified as Fiesta Cave in the TSS database. The entrance was exposed in a rock face above a streambed that had a catchment area greater than 1.6 ac. Although this paleospring was dry at the time of evaluation, it could act as a recharge point during flood conditions. It was determined that there was a moderate potential for this feature to rapidly transmit water to the subsurface. This feature was determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 364. Overview of feature LOOP-102.

Figure 365. Interior of feature LOOP-102.

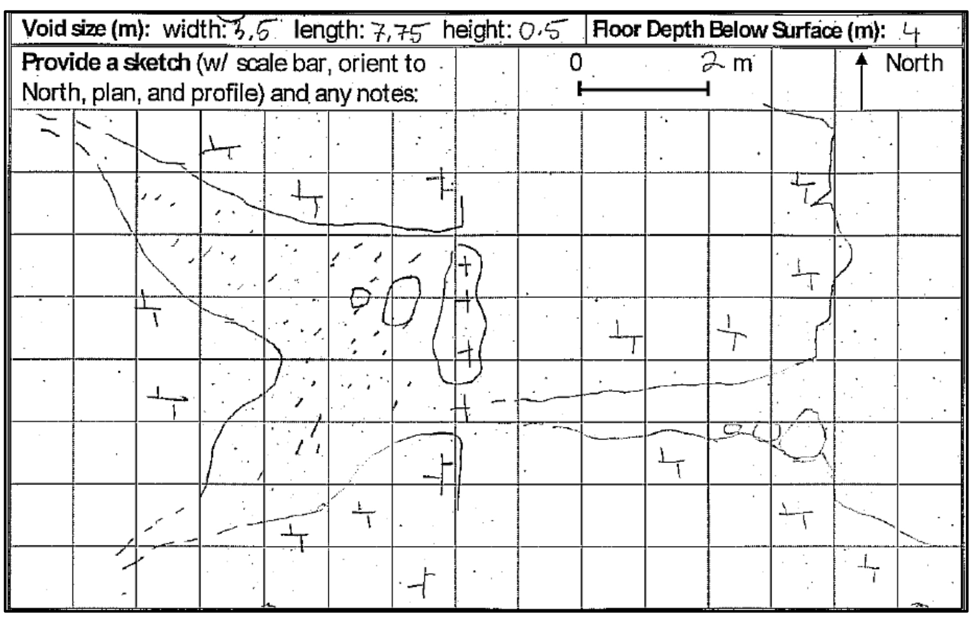

Figure 366. Field sketch of feature LOOP-102.

ATTACHMENT C

Feature LOOP-103; Solution Cavity

This feature was located in an easement west of the southbound mainlanes of I-10 and north of Loop 1604 (Figure 367 - Figure 369; Attachment D page 12). The feature was a solution cavity that measures 1.3 ft wide by 4.9 ft long and 1.3 ft high. The floor was 13.1 ft below the ground surface. This feature contained fine, tan, clayey sediment with a loose depth of 3 cm. It was exposed in a rock face above a streambed that had a catchment area greater than 1.6 ac. Although this feature was dry at the time of evaluation, it had the potential to act as a recharge feature during flood conditions. There was a low potential for this feature to rapidly transmit water to the subsurface due to a lack of downward trending voids and a clay floor. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 367. Overview of feature LOOP-103.

ATTACHMENT C

Figure 368. Interior of feature LOOP-103.

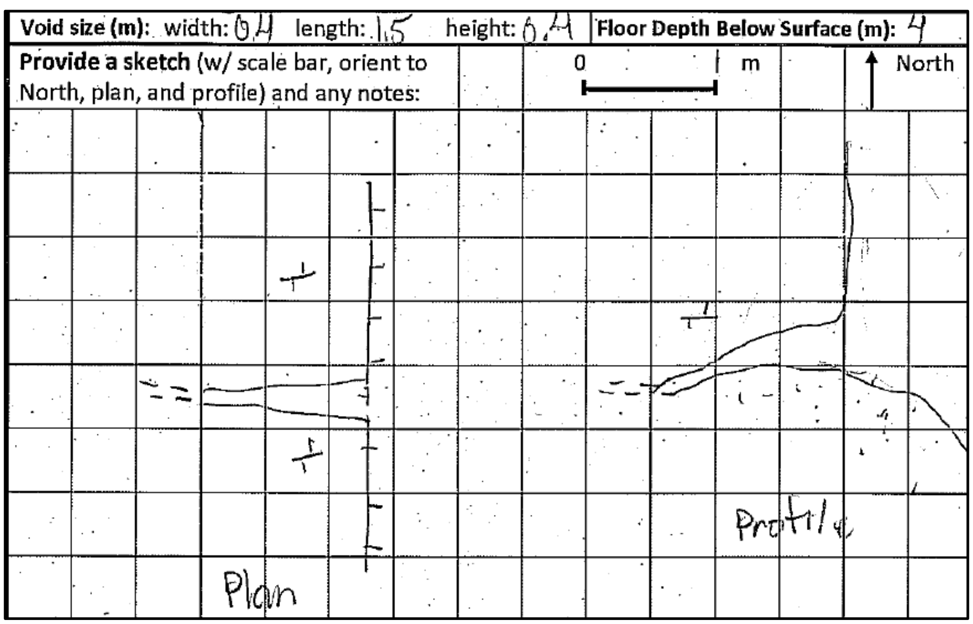

Figure 369. Field sketch of feature LOOP-103.

ATTACHMENT C

Feature LOOP-104; Other (Seep)

This feature was located in the ROW east of the northbound mainlanes of I-10 and south of Loop 1604 (Figure 370 - Figure 372; Attachment D page 25). The feature was a seep approximately 3 ft wide and 0.02 ft high with an unknown length extending underneath concrete. This feature contained soft loose soil and vegetation. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water into the subsurface due to its limited exposed extent. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 370. Overview of feature LOOP-104.

Figure 371. Close-up of feature LOOP-104.

ATTACHMENT C

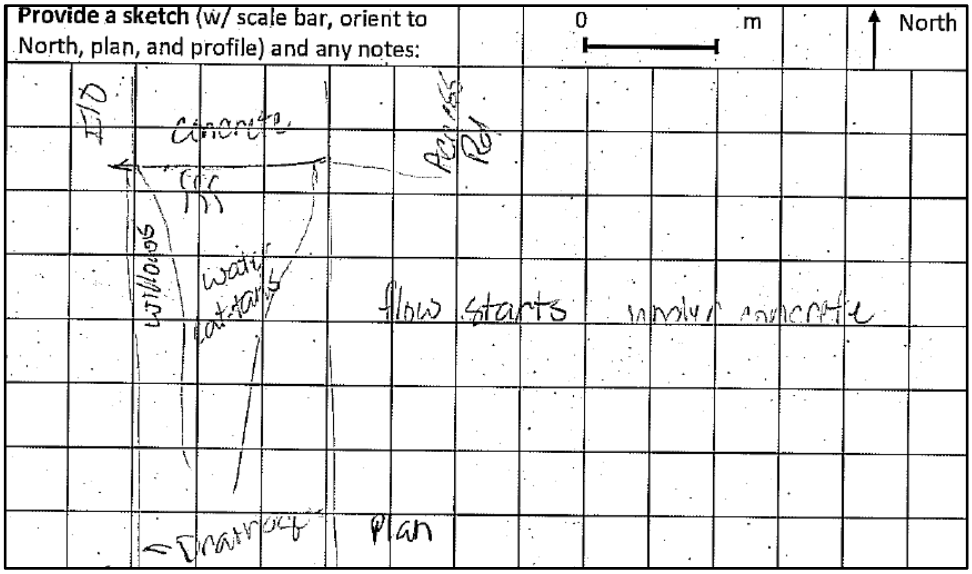

Figure 372. Field sketch of feature LOOP-104.

Feature LOOP-105; Solution Cavity

This feature was located in a roadcut west of the southbound mainlanes of I-10 and north of Loop 1604 (Figure 373 - Figure 376; Attachment D page 6-7). The feature was a solution cavity that measured 1.3 ft wide by 4.1 ft long and 1.3 ft high. The floor was approximately 16.4 ft below the surface. This feature contained bedrock and gravel. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface as it was above the base of the roadcut and did not extend into the bedrock beyond what was exposed. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 373. Overview of feature LOOP-105.

Figure 374. Close-up of feature LOOP-105.

ATTACHMENT C

Figure 375. View to the north from feature LOOP-105.

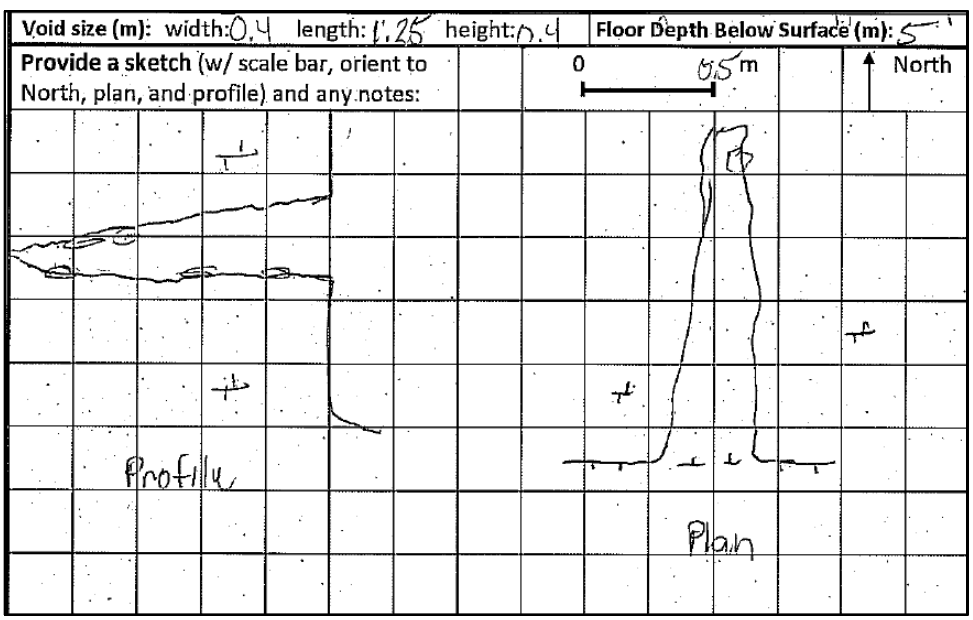

Figure 376. Field sketch of feature LOOP-105.

Feature LOOP-106; Other (Fractured Bedrock)

This feature was located in an easement between O'Connor and Judson Road on the south side of the Loop 1604 frontage road (Figure 377 - Figure 379; Attachment D page 112). The feature was an area of fractured bedrock that measured approximately 9.8 ft wide by 19.7 ft long. This feature contained exposed bedrock that is partially covered with modern soils and leaf litter. Two sets of fractures were present with apertures of 0.06 ft and trends of 50° and 120°, consistent with regional trends in the Balcones Fault Zone. The feature was situated in a streambed that had a catchment area greater than 1.6 ac. Despite the potentially large catchment area, there was only a moderate potential for this feature to rapidly transmit water to the subsurface due to the limited area of bedrock exposure and sediment fill in the fractures. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 377. Overview of feature LOOP-106.

ATTACHMENT C

Figure 378. Close-up of feature LOOP-106.

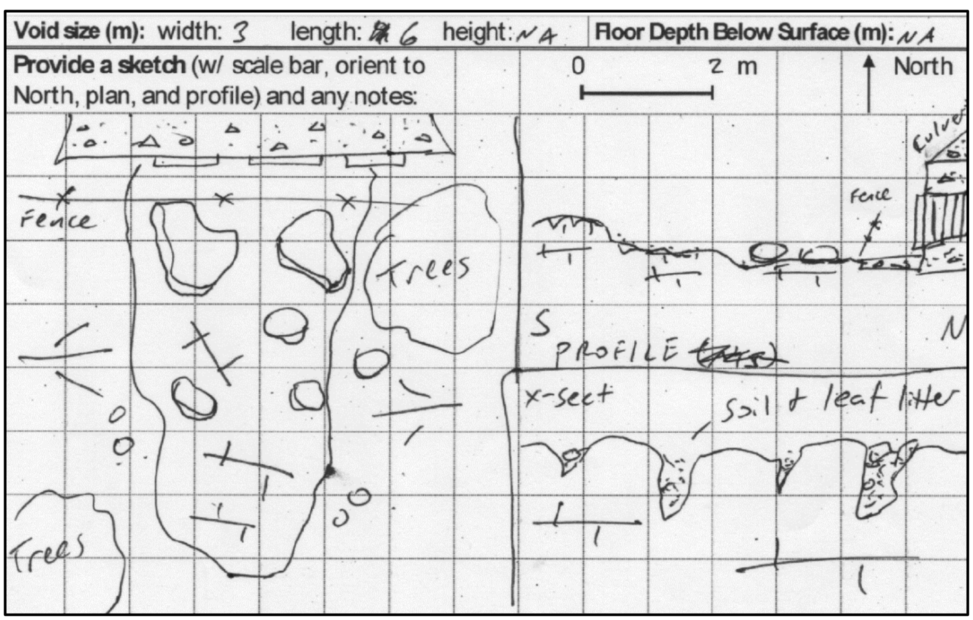

Figure 379. Field sketch of feature LOOP-106.

ATTACHMENT C

Feature LOOP-107; Solution Cavity (Solution-enlarged Bedding Plane)

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and east of U.S. 281 North (Figure 380 - Figure 382; Attachment D page 97). The feature was a solution cavity that measured 0.5 ft wide by 4.9 ft long by 0.7 ft tall. The feature was a continuous void formed along a bedding plane that had been bisected by the roadcut to reveal two entrances. This feature contained exposed bedrock and some calcite. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface, as it was situated 3 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 380. Overview of feature LOOP-107.

Figure 381. Close-up of feature LOOP-107.

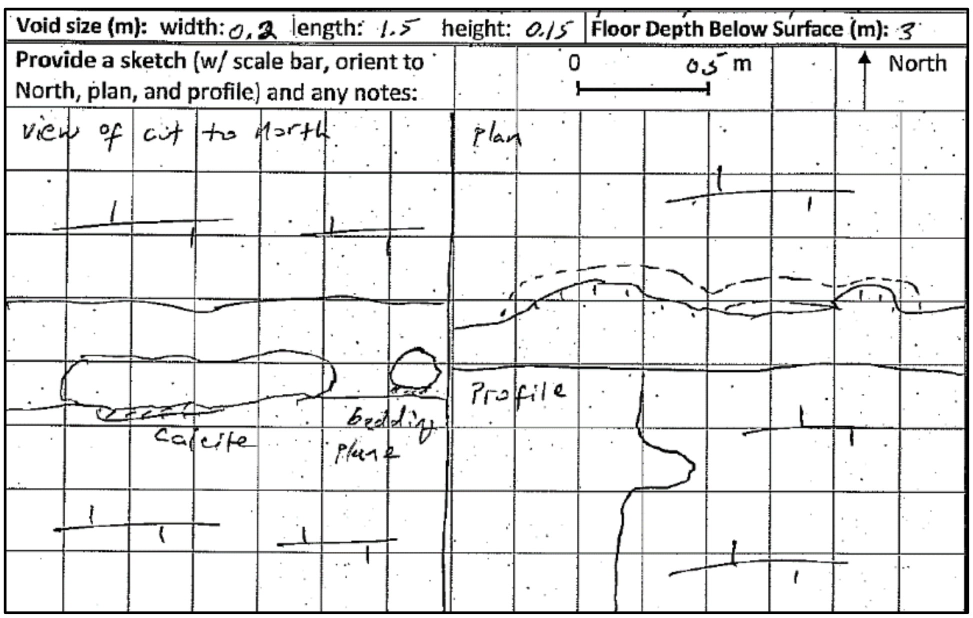

Figure 382. Field sketch of feature LOOP-107.

Feature LOOP-108; Solution-enlarged Fracture

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and east of Gold Canyon (Figure 383 - Figure 385; Attachment D page 98). The feature was a solution-enlarged fracture that measured 3.3 ft wide by 1.6 ft long by 9.8 ft tall. The fracture had a trend of 155°. This feature contained exposed bedrock, cobble-sized rocks, and calcite. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface as it was situated 3 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 383. Overview of feature LOOP-108.

Figure 384. Close-up of feature LOOP-108.

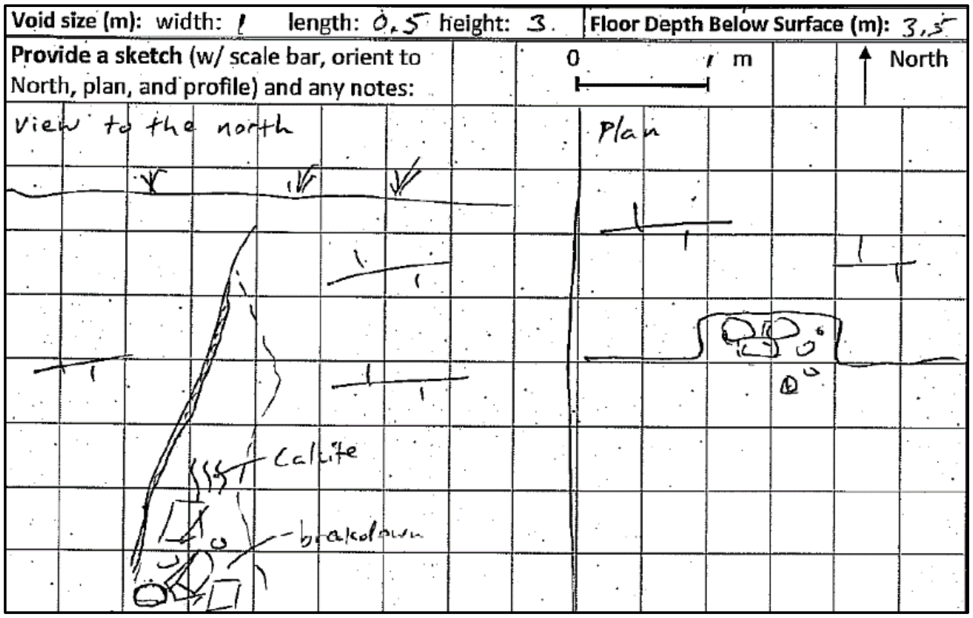

Figure 385. Field sketch of feature LOOP-108.

Feature LOOP-109; Solution-enlarged Fracture

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and east of Gold Canyon (Figure 386 - Figure 388; Attachment D page 98). The feature was a solution-enlarged fracture that measured 3.3 ft wide by 1.6 ft long by 9.8 ft tall. The fracture had a trend of 160°. This feature contained exposed bedrock, cobble-sized rocks, and calcite. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface as it was situated 3 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).


Figure 386. Overview of feature LOOP-109.

ATTACHMENT C

Figure 387. Close-up of feature LOOP-109.

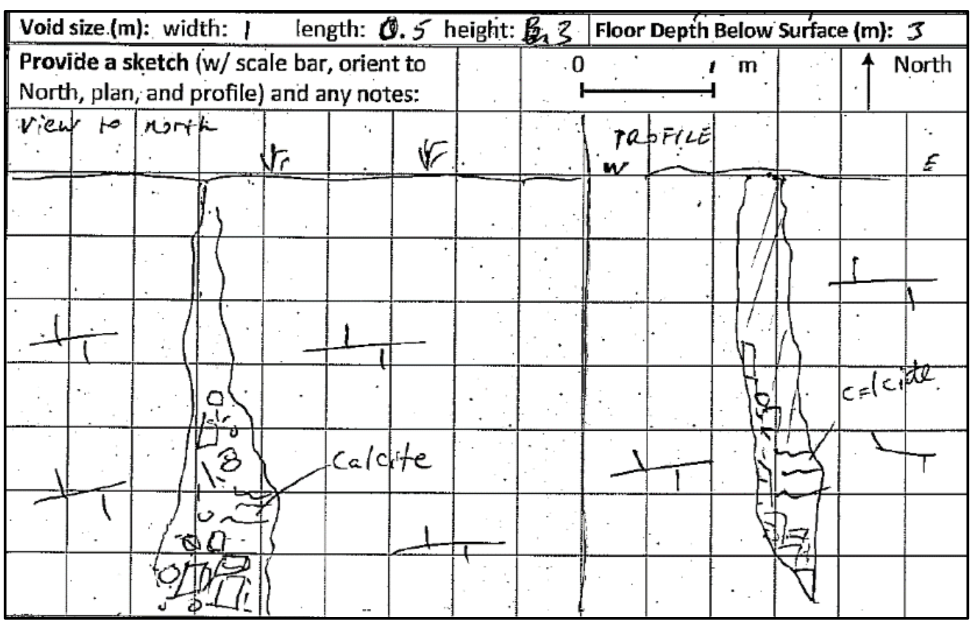

Figure 388. Field sketch of feature LOOP-109.

ATTACHMENT C

Feature LOOP-110; Solution Cavity

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and east of Gold Canyon (Figure 389 - Figure 391; Attachment D page 98). The feature was a solution cavity that measured 1.6 ft wide by 1.6 ft long by 2.3 ft tall. The solution cavity was formed along a fracture with a trend of 50°. This feature contained exposed bedrock, gravel, and calcite. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface as it was situated 4 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

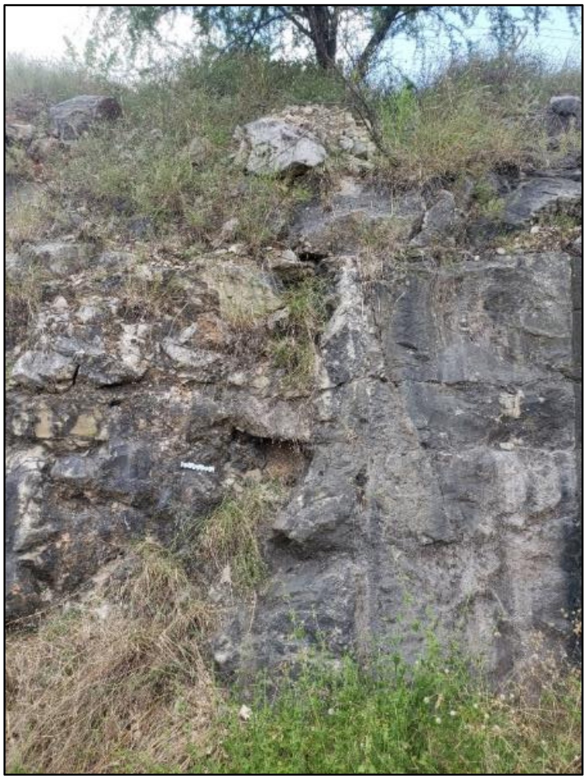

Figure 389. Overview of feature LOOP-110.

Figure 390. Close-up of feature LOOP-110.

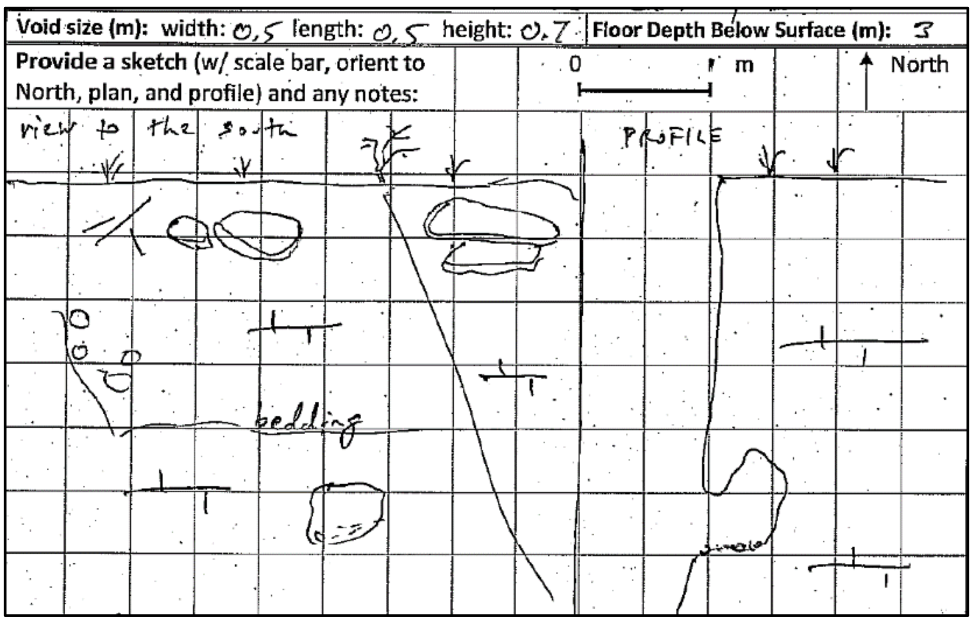

Figure 391. Field sketch of feature LOOP-110.

Feature LOOP-111; Solution Cavity

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Gold Canyon (Figure 392 - Figure 394; Attachment D page 97). The feature was a solution cavity that measured 1.0 ft wide by 1.0 ft long by 3.3 ft tall. The solution cavity was formed along a fracture with a trend of 23º. This feature contained exposed bedrock with orange staining, gravel, and some grass. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface as it was located 2 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 392. Overview of feature LOOP-111.

Figure 393. Close-up of feature LOOP-111.

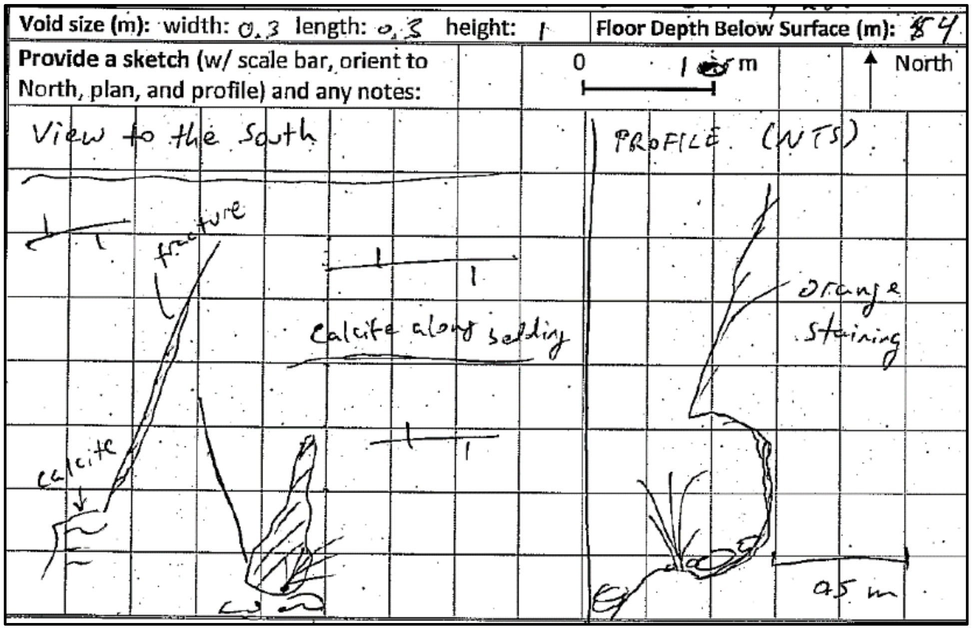

Figure 394. Field sketch of feature LOOP-111.

Feature LOOP-112; Solution Cavity

This feature was located in a roadcut south of the eastbound mainlanes of Loop 1604 and west of Gold Canyon (Figure 395 - Figure 397; Attachment D page 97). The feature was a solution cavity that measured 1.0 ft wide by 1.0 ft long by 0.7 ft tall. This feature contained exposed bedrock with orange staining, calcite surfaces, and gravel-sized rocks. It had a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface as it was located 9 ft above the base of the roadcut. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

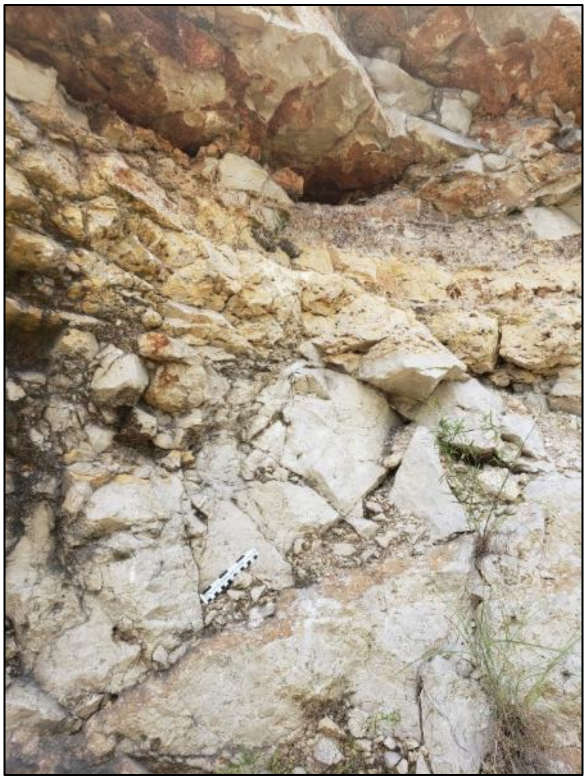

Figure 395. Overview of feature LOOP-112.

Figure 396. Close-up of feature LOOP-112.

ATTACHMENT C

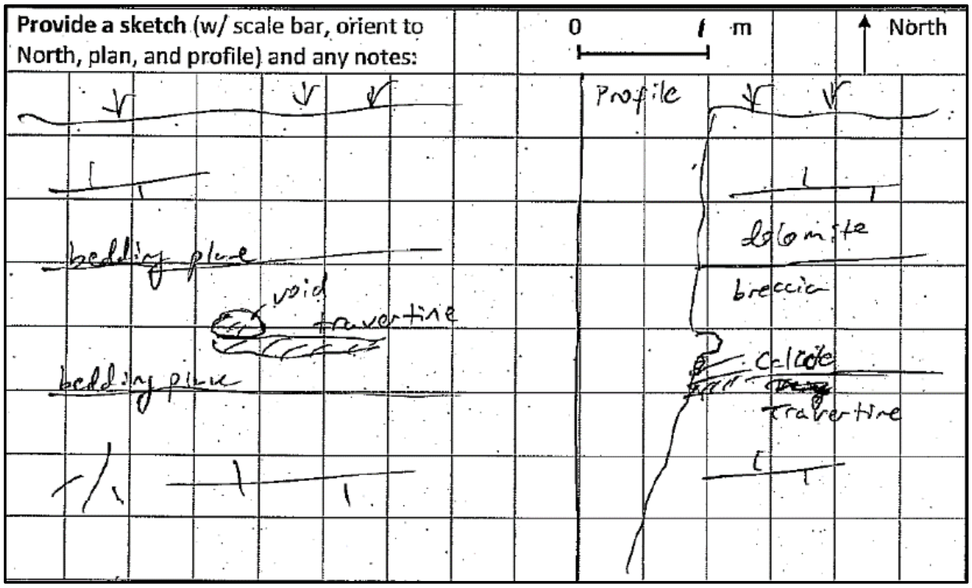

Figure 397. Field sketch of feature LOOP-112.

Feature LOOP-113; Other (Exposed Bedrock/High-angle Bedding)

This feature was located in an easement between Blanco Road and Voight Drive on the south side of the Loop 1604 frontage road (Figure 398 - Figure 400; Attachment D page 87). The feature was an area of exposed bedrock with high-angle bedding that measured 6.6 ft wide by 13.1 ft long. This feature contained bedrock, gravel, and leaf litter. Bedding was on a trend of 20º and dips 60º NW. The high-angle bedding was likely associated with the Balcones Fault Zone. The feature was within a natural streambed that had a catchment area greater than 1.6 ac. Despite the large catchment area, there was only a moderate potential for this feature to rapidly transmit water to the subsurface due to compact soil between the bedding planes. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 398. Overview of feature LOOP-113.

Figure 399. Close-up of feature LOOP-113.

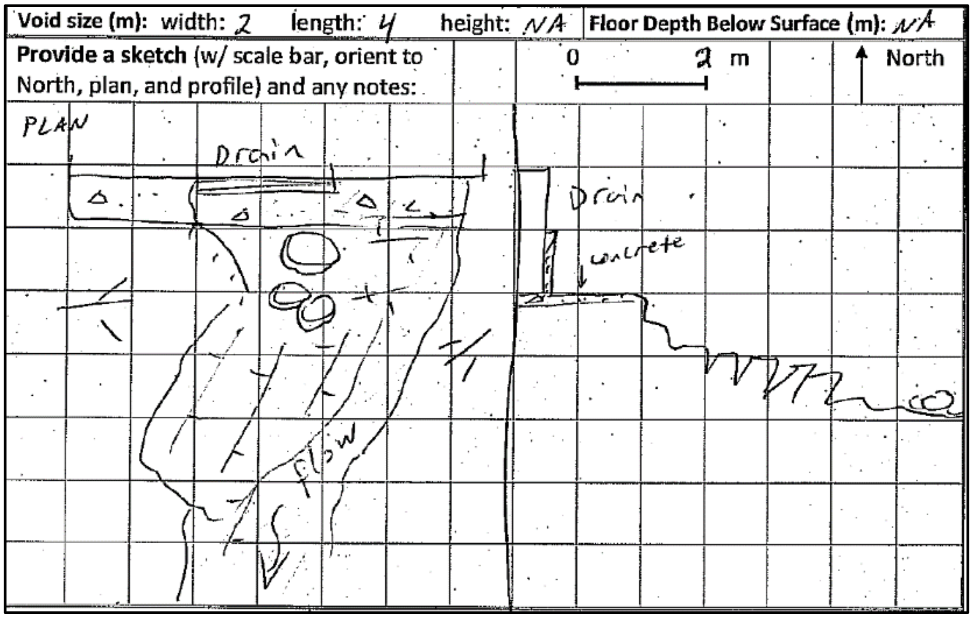

Figure 400. Field sketch of feature LOOP-113.

Feature LOOP-114; Fractured Bedrock

This feature was located in an easement to the west of Voight Drive on the south side of the Loop 1604 frontage road (Figure 401 - Figure 403; Attachment D page 87). The feature was an area of fractured bedrock 8.2 ft wide by 19.7 ft long. This feature contained exposed bedrock that was partially covered with gravel and vegetation. Two sets of fractures were present with trends of 35 to 40^{o} and 120 to 135^{o}. Fracture density was 2 per linear ft with a maximum aperture of 0.04 ft. The feature was within a manmade drainage with a catchment area greater than 1.6 ac. Despite the large catchment area there was only a moderate potential for this feature to rapidly transmit water to the subsurface due to the limited extent of exposure and the thin width of the fractures. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 401. Overview of feature LOOP-114.

Figure 402. Close-up of feature LOOP-114.

ATTACHMENT C

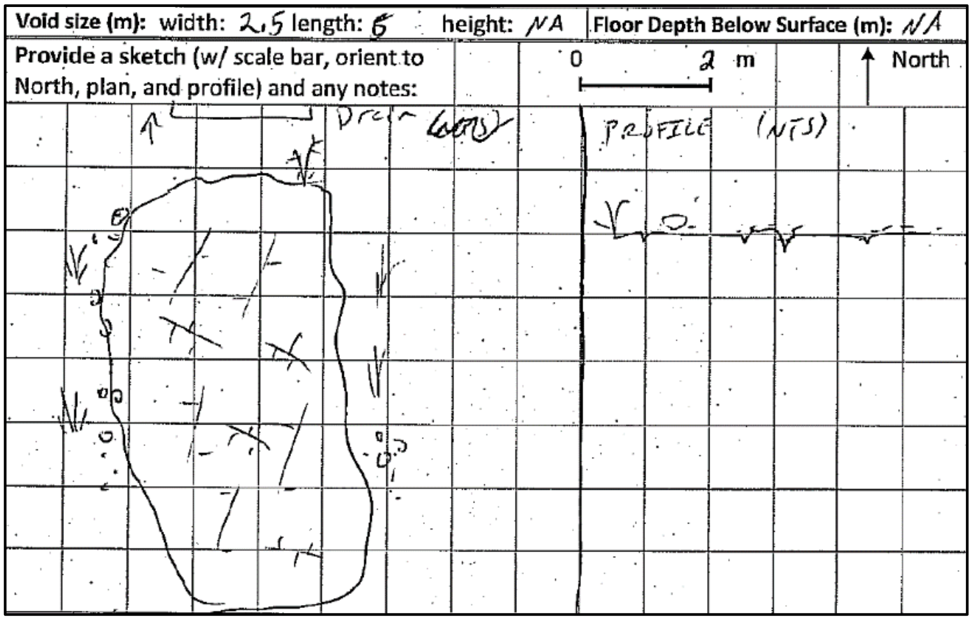

Figure 403. Field sketch of feature LOOP-116.

Feature LOOP-116; Fractured & Vuggy Bedrock

This feature was located in an easement to the east of Afton Oaks Drive on the south side of the Loop 1604 frontage road (Figure 404 - Figure 406; Attachment D page 91). This feature was an area of vuggy bedrock 4.9 ft wide by 13.1 ft long. This feature contained exposed bedrock that was partially covered by soil and gravel. Two sets of fractures were present with trends of 5° and 65°. The feature was within a streambed with a catchment area greater than 1.6 ac. Despite the large catchment area, there was only a moderate potential for this feature to rapidly transmit water to the subsurface due to the relatively low permeability of the bedrock. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 404. Overview of feature LOOP-116.

Figure 405. Close-up of feature LOOP-116.

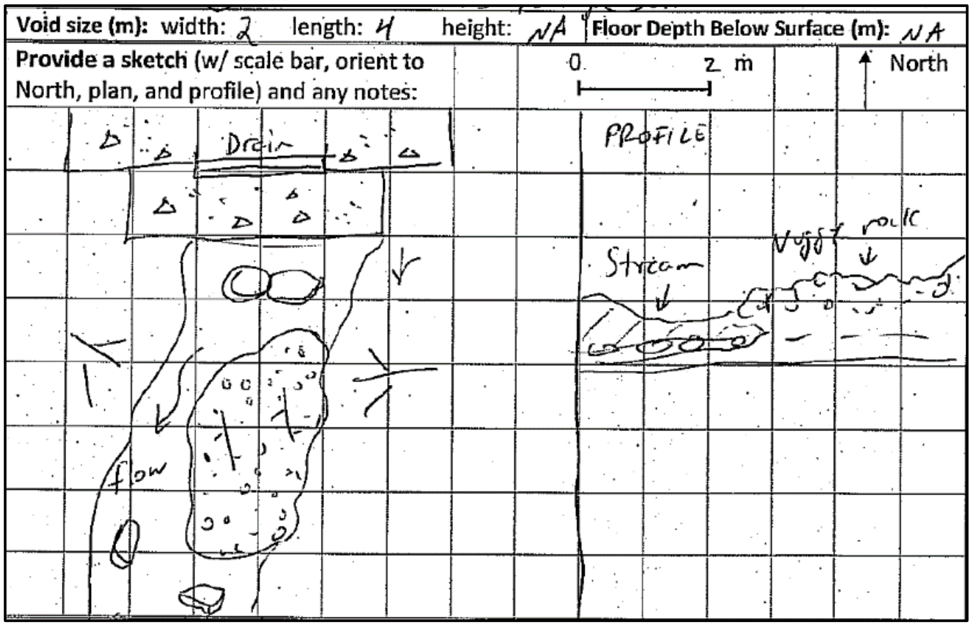

Figure 406. Field sketch of feature LOOP-116.

Feature LOOP-201; Manmade Feature in Bedrock

This feature was located in the median between the westbound and eastbound mainlanes of Loop 1604 east of Bandera Road (Figure 407 - Figure 410; Attachment D page 38). This feature was an uncapped geotechnical borehole that measured 0.3 ft wide by 0.3 ft long and 3.2 ft deep. This feature contained compact mud and black sediment. It was situated on a hillside with a catchment area of less than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface as it was filled with compact sediment and there were no downward trending voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 407. Overview of feature LOOP-201.

Figure 408. Interior of feature LOOP-201.

Figure 409. Overview of location of feature LOOP-201.

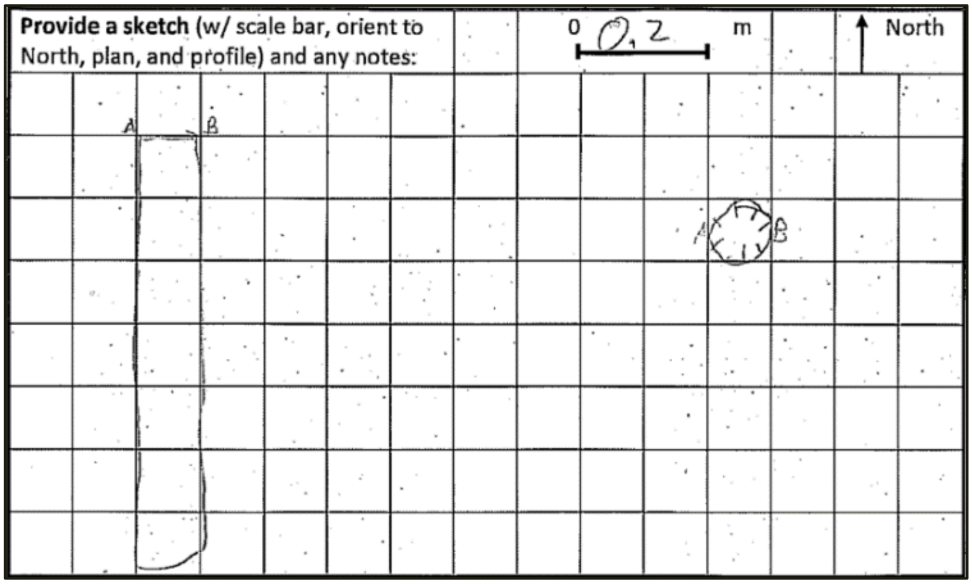

Figure 410. Field sketch of feature LOOP-201.

Feature LOOP-202; Solution Cavity

This feature was located under the bridge on westbound access road of Loop 1604 southwest of Kyle Seale Parkway (Figure 411 - Figure 414; Attachment D page 47). This feature was a solution cavity that measured 1.6 ft long by 0.7 ft wide and 1.0 ft deep. This feature contained rocks, cobbles, fine loose sediment, and leaf litter. It had a catchment area greater than 1.6 ac. In June 2019, 0.5 person hours were spent removing 0.3 ft^3 of material using hand tools. A distinct terminus was reached at the end of excavation. There was a moderate potential for this feature to rapidly transmit water to the subsurface as it appeared to continue into the subsurface. This feature was determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

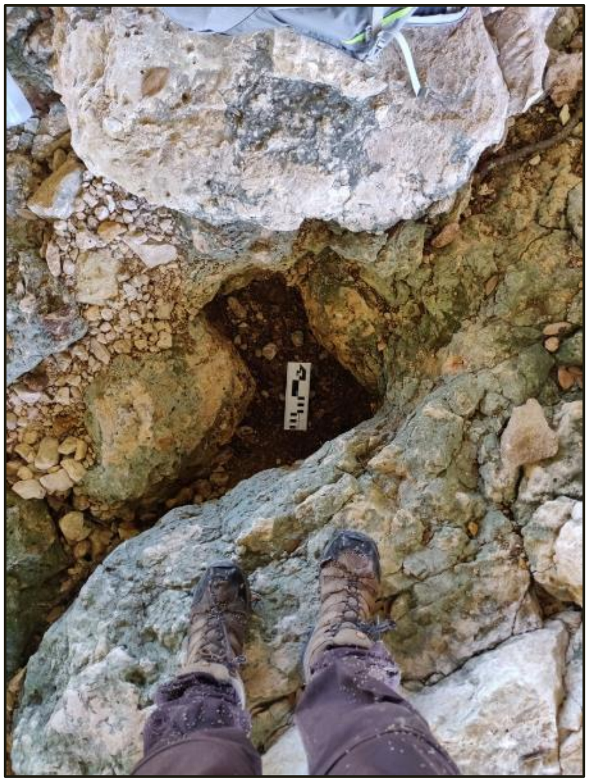

Figure 411. Overview of feature LOOP-202.

Figure 412. Overview of location of feature LOOP-202.

ATTACHMENT C

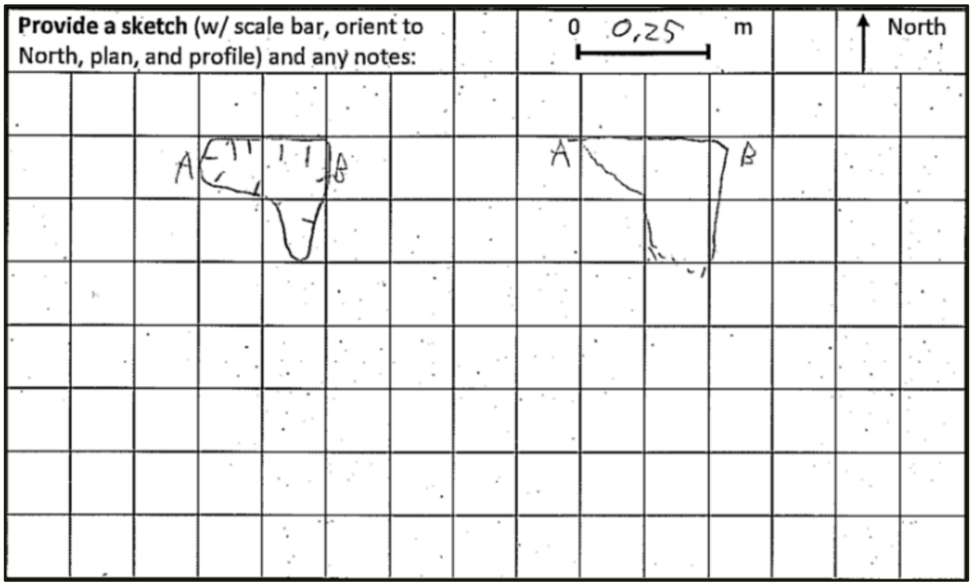

Figure 413. Pre-excavation field sketch of feature LOOP-202.

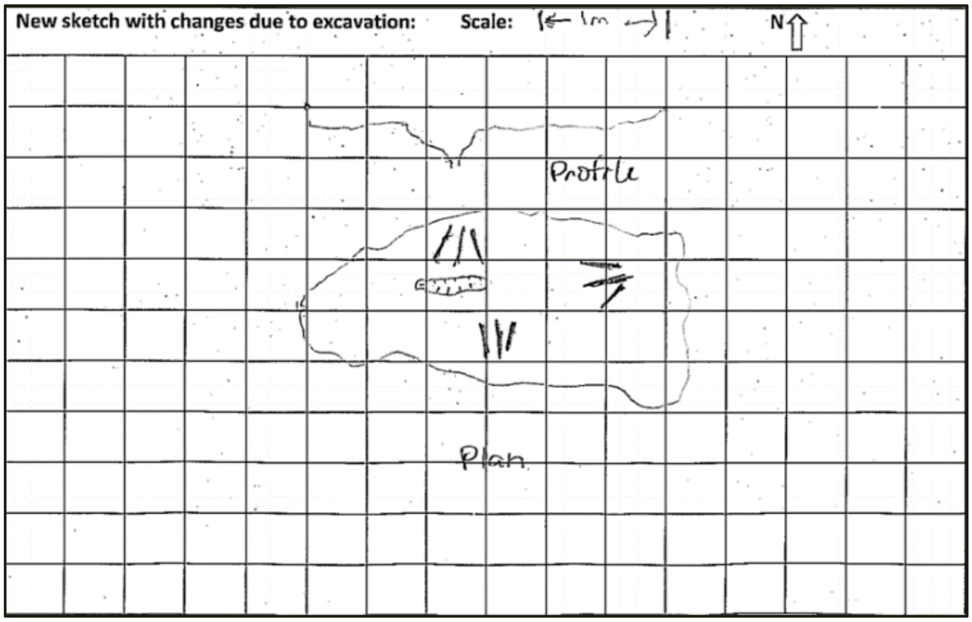

Figure 414. Post-excavation field sketch of feature LOOP-202.

ATTACHMENT C

Feature LOOP-204; Solution-enlarged Fracture

This feature was located in an easement south of the eastbound mainlanes of Loop 1604 west of Stone Oak Parkway (Figure 415 - Figure 417; Attachment D page 88). This feature was a solution-enlarged fracture that measured 5 ft wide by 8 ft long and 0.4 ft deep. This feature contained exposed bedrock, gravel, compact soil, and calcite. Two sets of fractures were present in the bedrock with trends of 84° and 31° that could be associated with the Balcones Fault Zone. The fractures had a density of 1 per linear foot and a max aperture of 0.5 ft. The feature was situated in a manmade drainage with a catchment area greater than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface as the fractures are filled with compact sediment and vegetation. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 415. Overview of feature LOOP-204.

ATTACHMENT C

Figure 416. Close-up of feature LOOP-204.

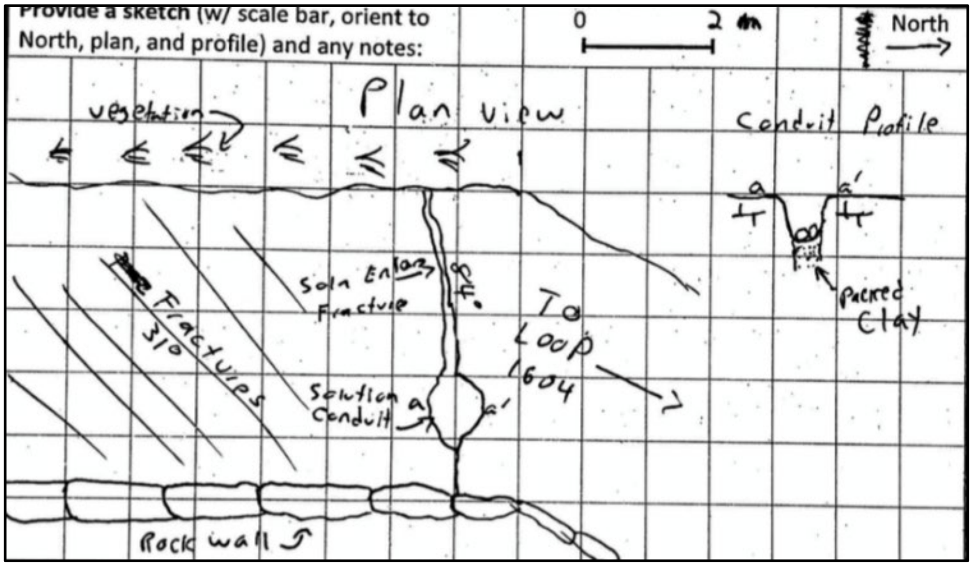

Figure 417. Field sketch of feature LOOP-204.

Feature LOOP-205; Swallet and Fractured Bedrock

This feature was located in an easement south of the eastbound mainlanes of Loop 1604 and east of Voigt Drive (Figure 418 -Figure 421; Attachment D page 90). The feature was an area of fractured bedrock that measured 10 ft wide by 125 ft long. This feature contained exposed bedrock partially covered by leaf-litter, vegetation, and cobble- sized rocks. Two sets of fractures were present in the bedrock with trends of 10° and 110°. The fractures had a density of 0.5 per linear foot and a max aperture of 0.01 ft. This feature was situated in a streambed that had a catchment area greater than 1.6 ac. There was a high potential for this feature to rapidly transmit water to the subsurface due to fractured and vuggy bedrock along the streambed. Stream flow was observed sinking into the ground on 16 July 2019 (approximately 0.25 cubic-feet/second [cfs]) that indicated a buried swallet. This feature was determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 418. Overview of feature LOOP-205.

ATTACHMENT C

Figure 419. View upstream of feature LOOP-205.

Figure 420. Close-up of fractured bedrock along the streambed of feature LOOP-205.

Figure 421. Close-up of fractures within the streambed of feature LOOP-205.

Feature LOOP-207; Solution Cavity/Solution-enlarged Fracture

This feature was located in an easement west of the southbound lanes of I-10 and north of Loop 1604 (Figure 422 - Figure 424; Attachment D page 12). This feature was a solution cavity that measured 2.5 ft wide by 6 ft long and 1 ft deep. The solution cavity was guided by a fracture with a trend of 41°. Additional fractures were present with a density of 0.2 per linear foot and trend of 41°. The solution cavity was exposed at the base of a rock face and has a floor depth of 31 ft below the surface. This feature was filled with loose soils, leaf litter, cobbles, and fine sediment 1 ft deep. It was situated in a streambed with a catchment area greater than 1.6 ac. There was a moderate potential for this feature to rapidly transmit water to the subsurface due to its position in the streambed and the orientation of the fracture that was consistent with regional trend of the Balcones Fault Zone. This feature was determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

Figure 422. Overview of feature LOOP-207.

Figure 423. Close-up of feature LOOP-207.

ATTACHMENT C

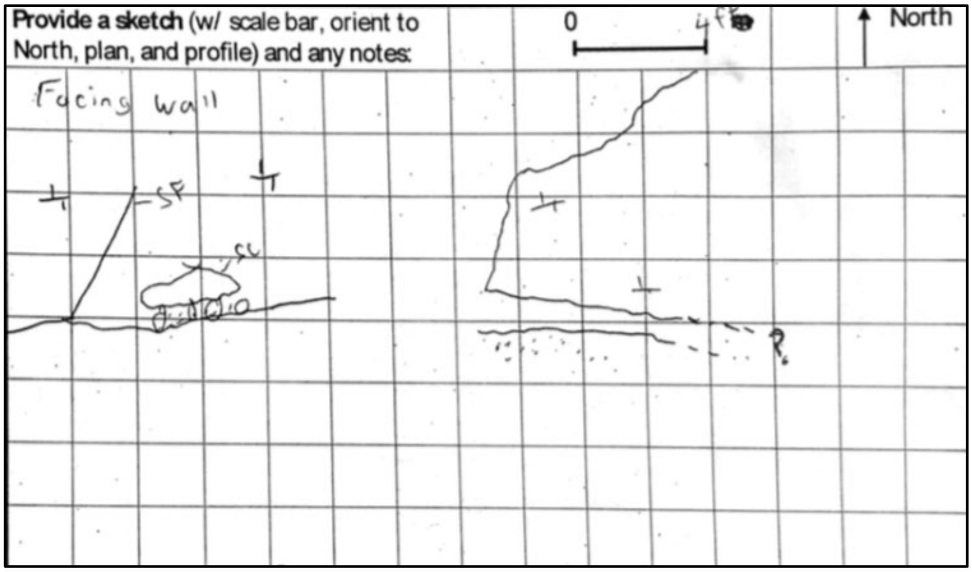

Figure 424. Field sketch of feature LOOP-207.

Feature LOOP-208; Other (Fractured Bedrock)

This feature was located in an easement west of the southbound mainlanes of I-10 and south of Camp Bullis Road (Figure 425 - Figure 427; Attachment D page 4). The feature was an area of fractured bedrock that measured 20 ft wide by 50 ft long. The fractures had a trend of 105°, a density of 0.2 per linear foot, and a max aperture of 0.25 ft. This feature consisted of exposed bedrock partially covered with fine compact soils and gravel. It was situated in a manmade drainage that had a catchment area greater than 1.6 ac. Despite the large catchment area, there was a low potential for this feature to rapidly transmit water to the subsurface due to the compactness of the fractures and the absence of downward trending voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

ATTACHMENT C

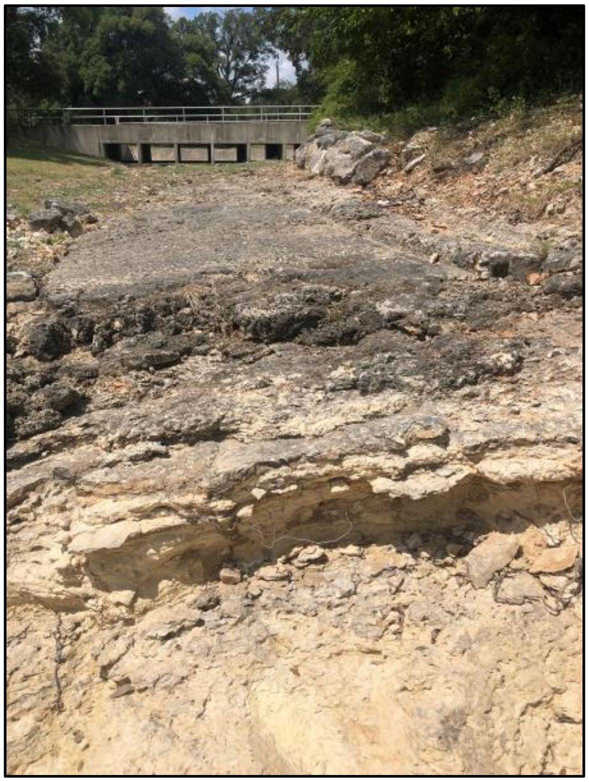

Figure 425. Overview of feature LOOP-208.

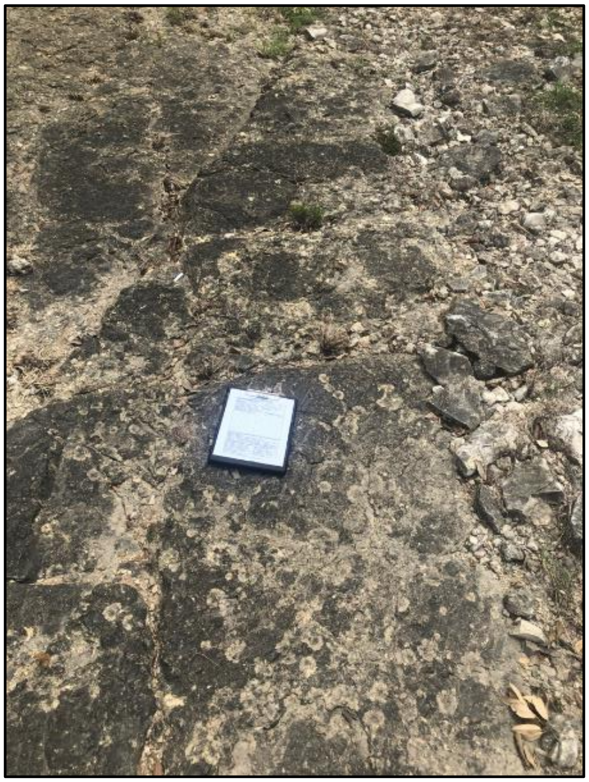

Figure 426. Close-up of feature LOOP-208.

ATTACHMENT C

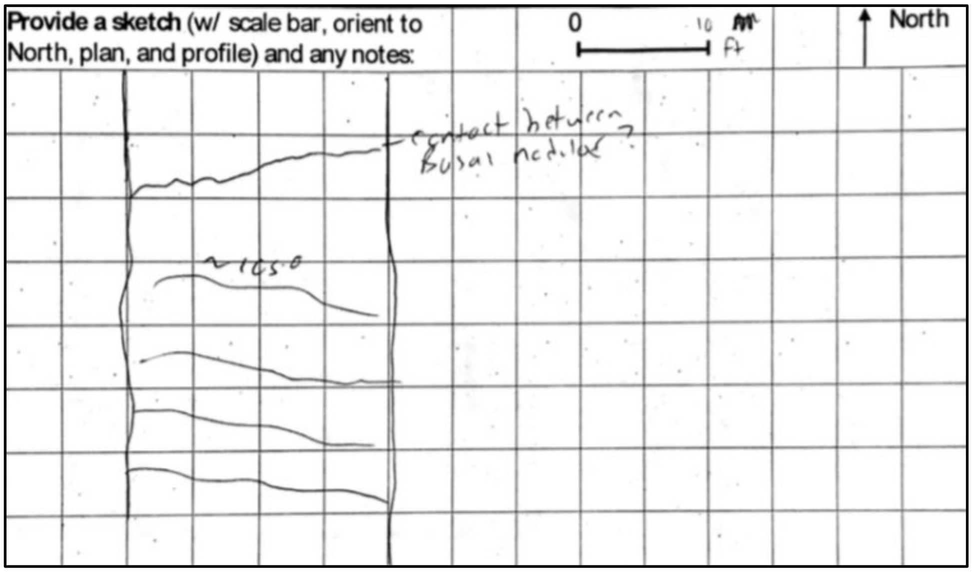

Figure 427. Field sketch of feature LOOP-208.

Feature LOOP-209; Solution-enlarged Fracture

This feature was located in an easement north of the westbound mainlanes of Loop 1604 and northeast of Kyle Seale Parkway (Figure 428 - Figure 430; Attachment D page 50). The feature was an area of fractured bedrock that measures 8 ft wide by 30 ft long. Fractures were present with a density of 0.1 per linear foot and a maximum aperture is 0.3 ft. The fractures had a trend of 56^{o}, consistent with regional trends of the Balcones Fault Zone. This feature contained exposed bedrock partially covered with fine compact soil, gravel, and vegetation. The feature was situated in a streambed that had a catchment area greater than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface due to compact soil fill in the fractures and the absence of downward trending voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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Figure 428. Overview of feature LOOP-209.

Figure 429. Close-up of feature LOOP-209.

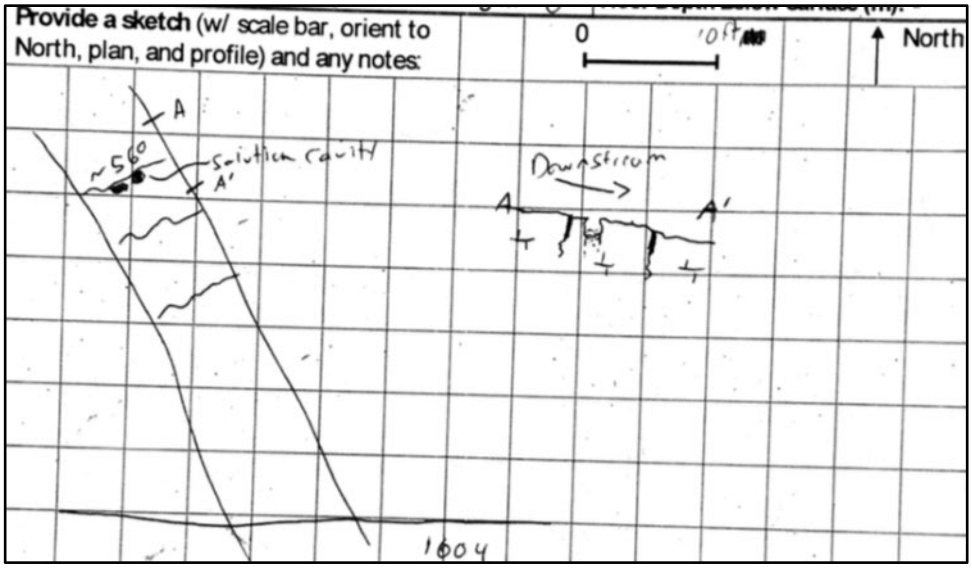

Figure 430. Field sketch of feature LOOP-209.

Feature LOOP-211; Solution-enlarged Fracture/Manmade Feature (Borehole)

This feature was located in an easement south of the eastbound mainlanes of Loop 1604 and west of Kyle Seale Parkway (Figure 431 - Figure 435; Attachment D page 46). The feature was a solution-enlarged fracture adjacent to an uncapped borehole of unknown depth infilled with compact sediment. The fracture measured 0.5 ft wide by 8 ft long. This feature was filled with compact soils, calcite, and bedrock. The fracture had a trend of 160°. The feature was situated in a streambed that had a catchment area of greater than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface due to compact soil fill and the absence of downward trending voids. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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Figure 431. Overview of feature LOOP-211.

Figure 432. Close-up of feature LOOP-211.

Figure 433. Borehole adjacent to feature LOOP-211.

Figure 434. Overview of location of feature LOOP-211.

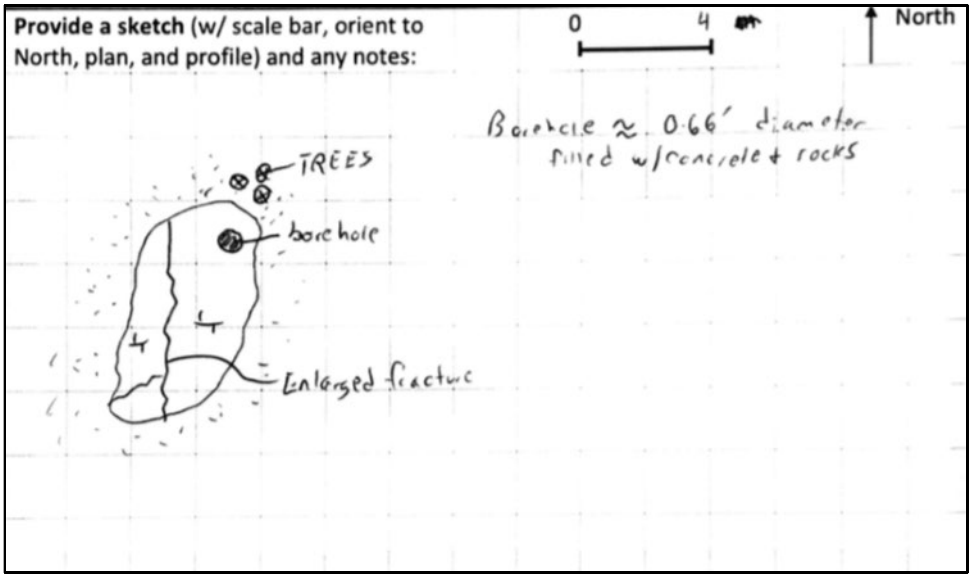

Figure 435. Field sketch of feature LOOP-211.

Feature LOOP-212; Other (Fractured Bedrock)

This feature was located in an easement south of the eastbound mainlanes of Loop 1604 and east of Kyle Seale Parkway (Figure 436 - Figure 438; Attachment D page 49). The feature was an area of fractured bedrock that measured 8 ft wide by 30 ft long. Fractures were present with a density of 0.3 per linear ft and a maximum aperture of 0.02 ft. The fractures had a trend of 56^{o}, consistent with regional trend of the Balcones Fault Zone. This feature contained exposed bedrock, organic soils, and calcite. The feature was situated in a manmade drainage that had a catchment area greater than 1.6 ac. There was a low potential for this feature to rapidly transmit water to the subsurface due to soil and mineral fill of the fractures. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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Figure 436. Overview of feature LOOP-212.

Figure 437. Close-up of feature LOOP-212

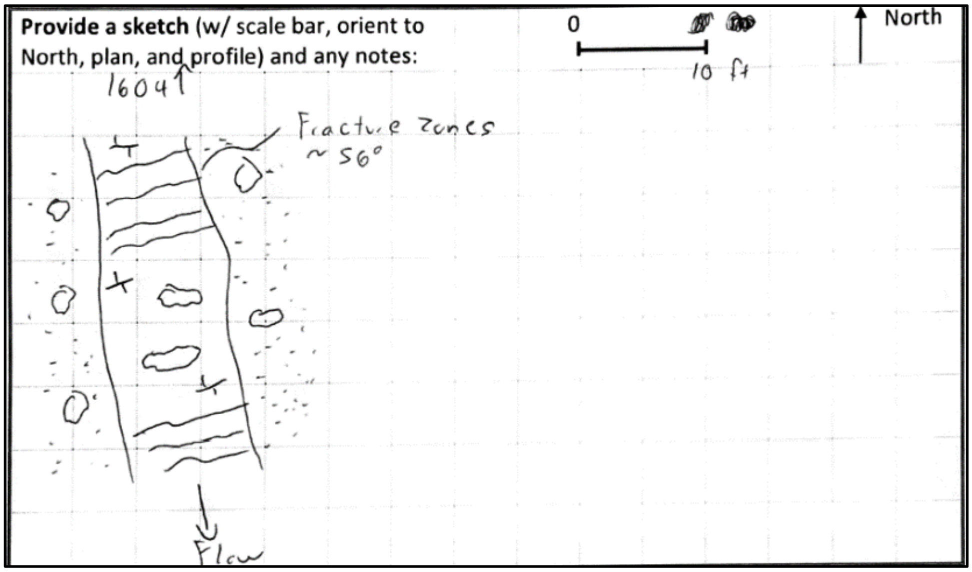

Figure 438. Field sketch of feature LOOP-212.

Feature LOOP-213; Solution Cavity/Solution-enlarged Fracture

This feature was located south of the eastbound mainlanes of Loop 1604 and east of Babcock Road (Figure 439 - Figure 441; Attachment D page 53, 55, 56). The feature was a solution-enlarged fracture that measured 3 ft wide by 3 ft long and 0.2 ft deep. This feature had a floor depth of 6 ft below the surface. This feature was filled with loose soils, leaf litter, vegetation, and bedrock. Solution cavities were exposed in the cliff with a density of 0.1 per linear foot and a maximum aperture of 0.3 ft. The feature was situated in the bank of a streambed with a catchment area greater than 1.6 ac. There was a high potential for this feature to rapidly transmit water to the subsurface due to the presence of downward trending voids. This feature was determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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Figure 439. Overview of feature LOOP-213.

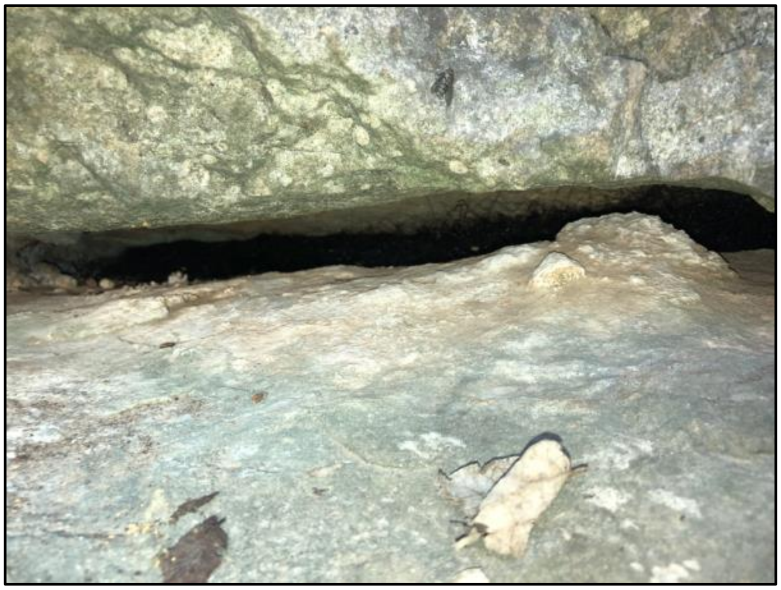
Figure 440. Interior of feature LOOP-213.

ATTACHMENT C

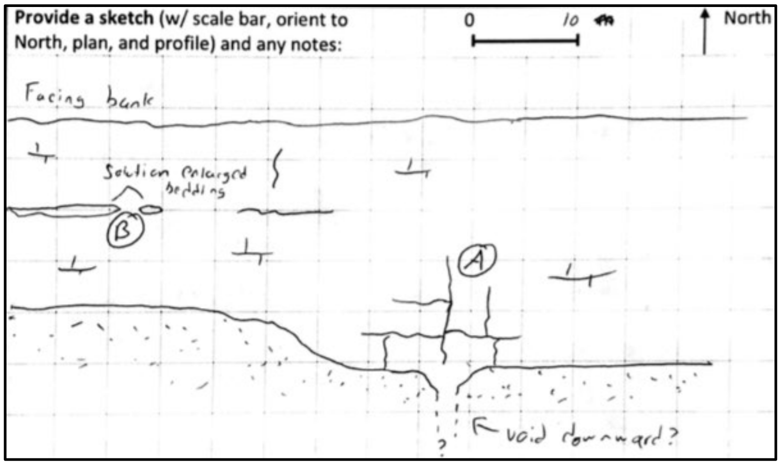

Figure 441. Field sketch of feature LOOP-213.

Feature LOOP-214; Solution Cavity/Solution-enlarged Fracture

This feature was located south of the eastbound mainlanes of Loop 1604 and west of West Bitters Road (Figure 442 - Figure 446; Attachment D page 78). This feature was a zone of solution-enlarged fractures and solution cavities that measured 30 ft wide by 180 ft long and 2 ft deep. Fractures were present with a density of 0.1 per linear foot and a maximum aperture of 1 ft. The fractures occurred in two sets with trends of 45^{o} and 110^{o} that are likely associated with the Balcones Fault Zone. This feature consisted of exposed bedrock that was partially covered by gravel, soil, leaf litter, and calcite. The feature was situated in a streambed with a catchment area greater than 1.6 ac. There was a high potential for this feature to rapidly transmit water to the subsurface due to the presence of downward trending voids. This feature was determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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Figure 442. Overview of feature LOOP-214.

Figure 443. Fracture in bedrock of feature LOOP-214.

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Figure 444. Solution cavities in bedrock of feature LOOP-214.

Figure 445. Solution-enlarged fracture in bedrock of feature LOOP-214.

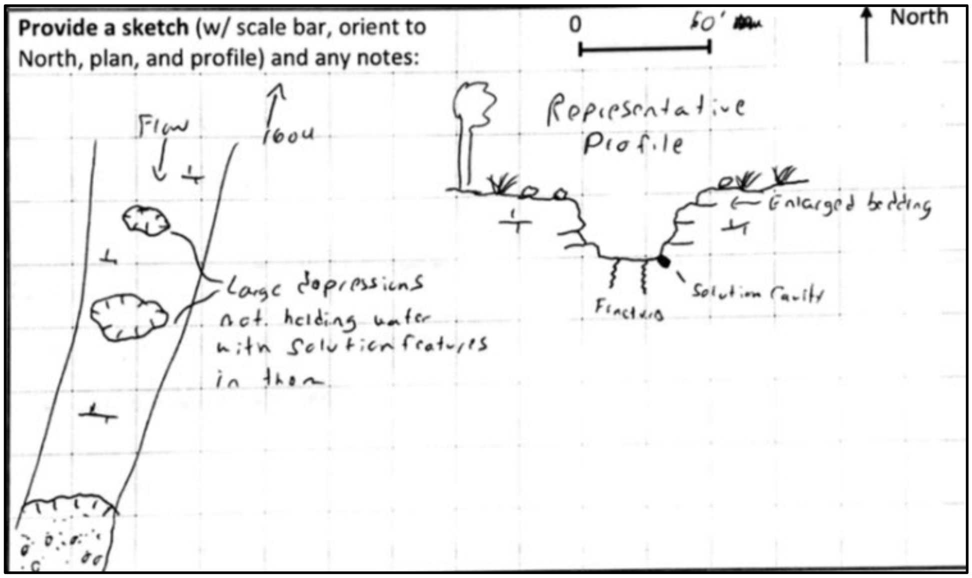

Figure 446. Field sketch of feature LOOP-215.

Feature LOOP-215; Solution Cavity/Solution-enlarged Fracture

This feature was located in an easement west of the southbound lanes of I-10 and south of La Cantera Road (Figure 447 - Figure 450; Attachment D page 12). The feature was a solution-enlarged fracture that measured 4 ft wide by 2.6 ft high and 6 ft deep. This feature had a floor depth of 9.8 ft below the ground surface and the entrance was 13 ft above the streambed of Leon Creek. The floor consisted of loose soils, rocks, and bedrock, and had mesocavernous voids that extended both laterally and vertically into the bedrock from the back of the feature. No excavation is warranted because all of the voids were in solid bedrock. The catchment area was less than 1.6 ac due to its position in a rock face above the streambed. Although it was situated within a floodplain, it was determined that there was a low potential for this feature to rapidly transmit water to the subsurface due to its elevation above the streambed. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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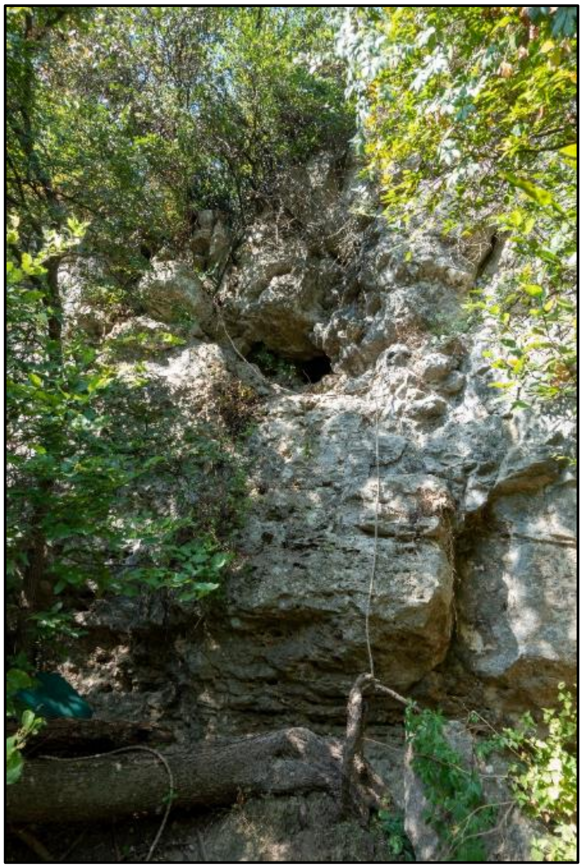

Figure 447. Overview of feature LOOP-215.

Figure 448. Entrance of feature LOOP-215.

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Figure 449. Interior of feature LOOP-215.

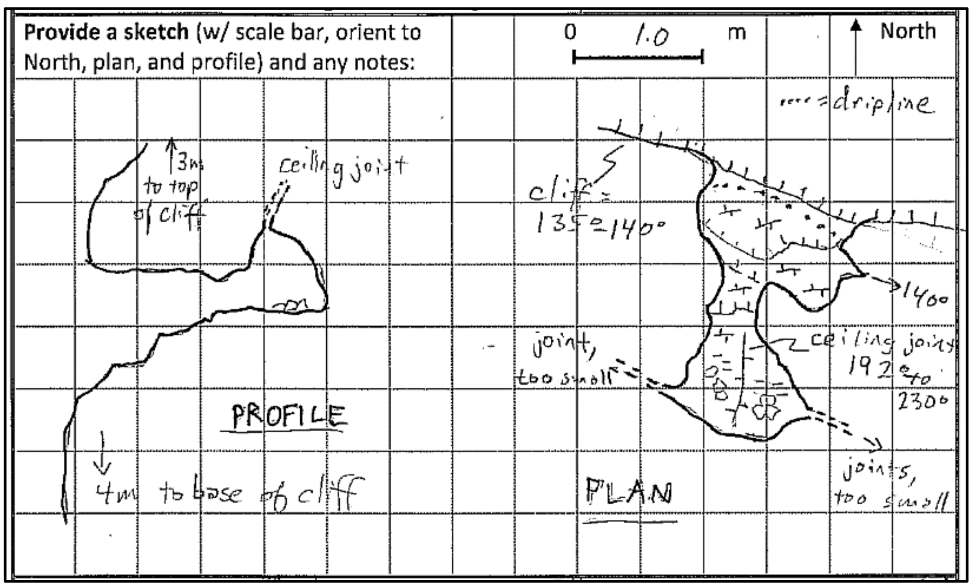

Figure 450. Field sketch of feature LOOP-215.

Feature LOOP-216; Fault

This feature was located in a roadcut north of the westbound lanes of Loop 1604 and west of Blanco Road (Figure 451 - Figure 453; Attachment D page 85). It was a fault that measured 14.7 ft wide, 9.8 ft high, and extended 3.3 ft into the roadcut. The floor consisted of red clay, calcite cement, and flowstone. It had a catchment area of less than 1.6 ac. The feature had a trend of 50, which was consistent with dominant regional trend of mapped BFZ faults in the area. It was determined that the feature had a low potential to rapidly transmit water to the subsurface as it was located above the elevation of the road. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

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Figure 451. Overview of feature LOOP-216.

Figure 452. Close-up of feature LOOP-216.

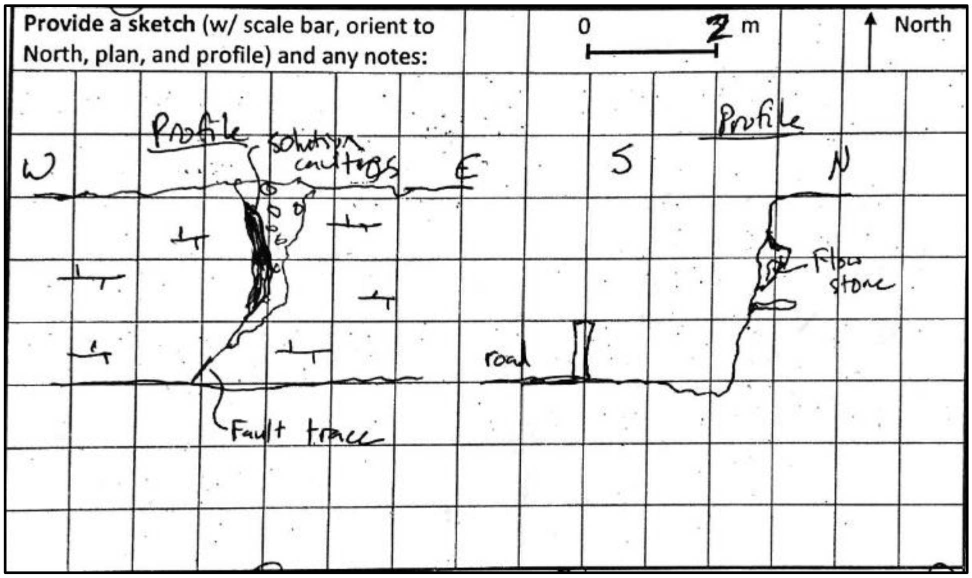

Figure 453. Field sketch of feature LOOP-216.

Feature LOOP-217; Solution Cavity

This feature was located at the base of a roadcut south of the eastbound lanes of 1604 and west of Blanco Road (Figure 454 - Figure 457; Attachment D page 85). It was a solution cavity measuring 0.2 ft wide, 2.5 ft deep, and extended 0.3 ft into the roadcut. The feature was infilled with leaf litter, cobbles, and modern soil. It had a catchment area of less than 1.6 ac. A downhole camera survey was performed on September 30, 2019 and it was determined that the feature had a distinct terminus with no apparent mesocaverns extending into the subsurface. It was determined that the feature had a moderate potential to rapidly transmit water to the subsurface as it was at a lower elevation than the road and there was evidence of recent flow into the feature. This feature was determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 454. Overview of feature LOOP-217.

Figure 455. Entrance of feature LOOP-217.

Figure 456. Interior of feature LOOP-217 taken with downhole camera.

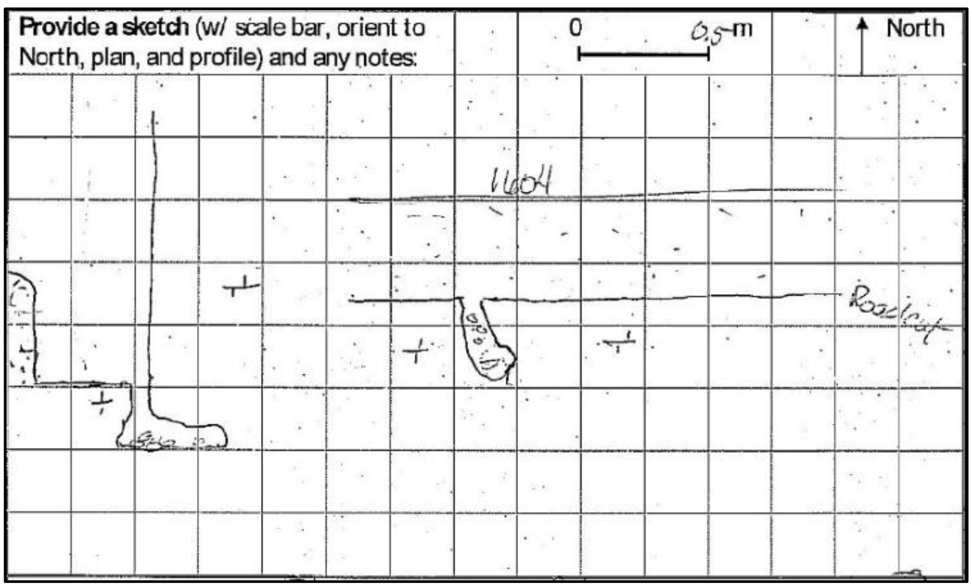

Figure 457. Field sketch of feature LOOP-217.

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Feature LOOP-W01; Manmade Feature (Well)

This feature was a water well located on a hillside in the ROW north of the westbound mainlanes of 1604 and west of Judson Road (Figure 458 - Figure 460; Attachment D page 114). The well was in use as a monitoring well by the Edwards Aquifer Authority and known as the Judson Well. The well had a steel plate cover 1 in in diameter and was set in a 3-ft diameter concrete pad. The feature was identified as State Well No. 6829305 by the TWDB database and has been monitored for groundwater level since 1992. According to the TWDB water well report the well had a 6 in steel casing. As no drilling log was found in the TWDB database, the depth and many other construction details of the well are unknown. The deepest water level was recorded on August 5, 1996 at -285.42 ft below ground surface. The well had a catchment area of greater than 1.6 ac. Although the well appeared to be properly capped on the surface, it was assigned a high infiltration rating because it could provide a direct connection to the aquifer if the surface cap is disturbed during construction activities. This feature was determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 458. Overview of feature LOOP-W01.

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Figure 459. Close up view of feature LOOP-W01

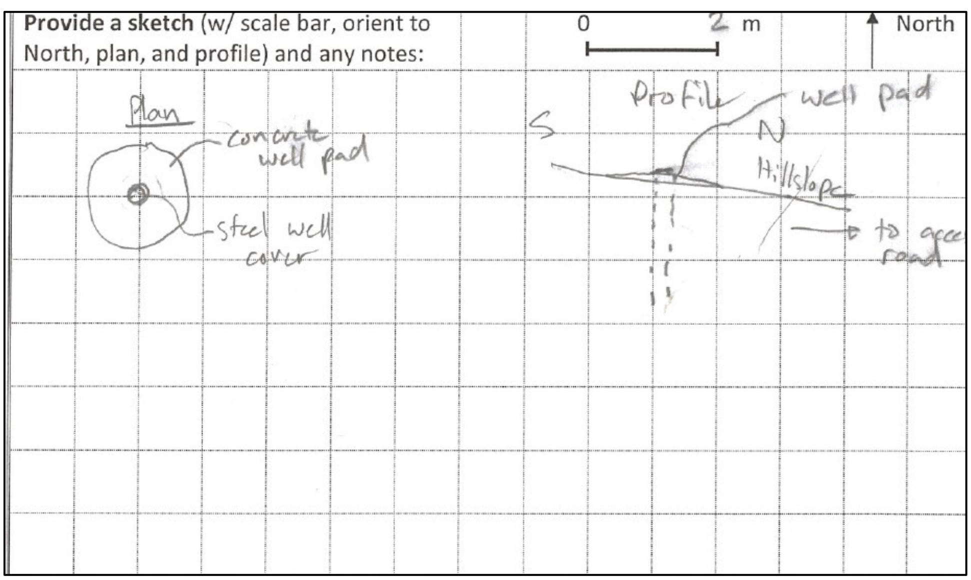

Figure 460. Field sketch of feature LOOP-W01

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North Wall C (33); Solution Cavity

This feature was located in a roadcut north of the westbound mainlanes of Loop 1604 and west of Gold Canyon Road (Figure 461 - Figure 463; Attachment D page 97). This feature was a solution cavity that had been bisected during road construction. It measured 1.3 ft wide by 9.8 ft high and extended 1 ft into the bedrock with a floor depth of 13 ft below the top of the roadcut. The walls of the feature were covered with flowstone, and the ground at the base of the feature consisted of compact red clay and vegetation. There was a low potential for this feature to rapidly transmit water to the subsurface due to the presence of compact red clay at the base of the feature and as it did not appear to extend beyond what was exposed. This feature was not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Figure 461. Overview of feature North Wall C (33).

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Figure 462. Interior of feature North Wall C (33).

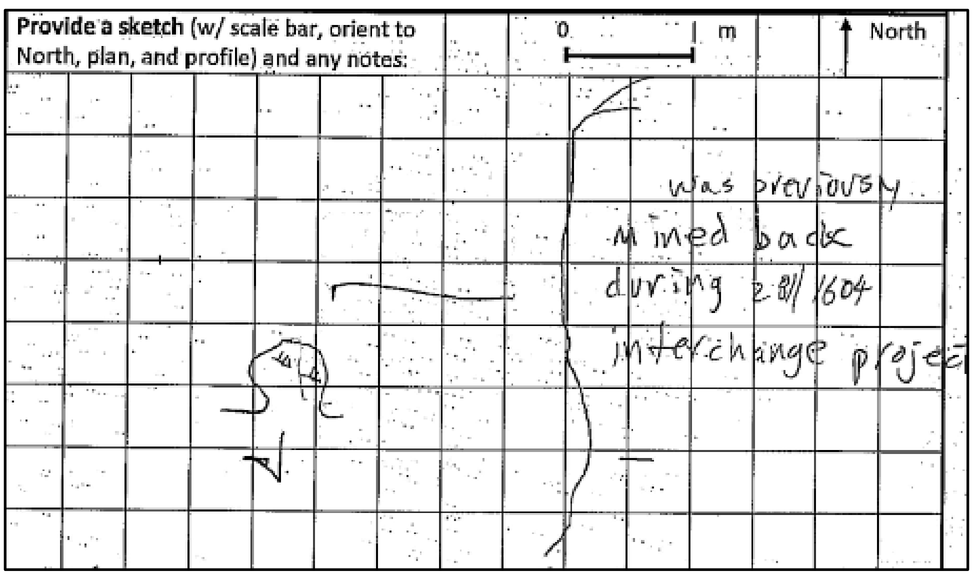

Figure 463. Field sketch of feature North Wall C (33).

Features 1604- T17, 1604-T18, 1604-T22, 1604-T25, 1604-T27, 1604-T34; and Features LOOP-F01 through LOOP-F30: Mapped Faults

These features were mapped faults from GAT 250K (2010) and Blome et al., (2005) that intersected the survey area. The 1604-T features were faults which could be correlated to features documented in a 2015 Karst Technical Report (TxDOT 2015). The approximate midpoint of each fault mapped within the survey area was marked as the feature location. Fault trends were measured in Adobe Illustrator using the measure tool on north-oriented screenshots of the features imported from ESRI ArcGIS. Approximate fault trace length across the survey area was measured using the ESRI ArcGIS measurement tool. Because two different datasets were used to generate these features, formation nomenclature reported in the GA table may differ depending on the dataset used. Blome et al. (2005) combines all Upper Cretaceous units into "Ku" (Undifferentiated upper Cretaceous) and subdivides the Edwards Group into the informal hydrogeologic units of the Kainer and Person Formations. The GAT (2010) dataset combines all Edwards Group sub-units into "Ked" (Edwards Limestone) and differentiates between upper Cretaceous formations (from youngest to oldest: Kpg, Kau, Kef, Kbu and Kdr).

Locations of these features are shown on the Site Geologic Maps (Attachment D). Because no surface expression of the mapped faults was observed, infilling materials could not be determined. Infiltration rates for the faults were assumed to be low as it was covered by imported fill, pavement, and vegetation. It was determined that there was a low potential for these covered faults to transmit water rapidly to the subsurface. However, the presence of faults at a given location generally increases the opportunities for recharge into the Edwards Aquifer (Clark 1998). Excavation of roads, imported fill, and vegetation covering these mapped faults during construction activities may reveal karst features which previously could not be seen on the ground. These features were not determined to be sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)).

Discussion

The overall potential for rapid infiltration of runoff into the subsurface within the survey area is moderate, as there are 26 features rated as sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)). Most of the sensitive features are located along SL 1604 in the base of roadcuts and receive runoff from the highway and ROW. Many of the remaining sensitive features are in streambeds within easements for SL 1604. All the features located in the roadcuts were exposed during construction and likely had no natural surface drainage area. The drainage areas for many of these features is formed by manmade structures such as roadcuts, swales and the edge of the highway or other engineered structures. A list of features rated as sensitive according to the Edwards Aquifer Rules (30 TAC §213.5(b)(3)) is included in Table 1.

ATTACHMENT C

Table 1. Features rated as sensitive in the Loop 1604 survey area.

Feature Name	Feature Type	Survey Area Location	Attachment D Page Number
1604-801	Zone of Solution Enlarged Fractures	Loop 1604 east of Huebner Road	83
1604-D17	Solution Cavity	Loop 1604 west of Huebner Road	80
1604-E09	Cave	Loop 1604 west of Green Mountain Road	117
1604-F061	Cave	Loop 1604 and east of W. Bitters Road	80
1604-F063	Solution Cavity	Loop 1604 west of Huebner Road	81-82
1604-F071	Solution Cavity	Loop 1604 east of Huebner Road	82
1604-F073	Solution Cavity	Loop 1604 east of Huebner Road	83
1604-F077	Cave	Loop 1604 west of Huebner Road	84
1604-F078	Solution Cavity	Loop 1604 west of Blanco Road	84
1604-F083	Solution Cavity	Loop 1604 west of Blanco Road	85
1604-F085	Solution Cavity	Loop 1604 west of Blanco Road	85
1604-F101	Cave	Loop 1604 west of Gold Canyon Road	97
1604-FZ7	Solution Cavity	Loop 1604 west of Huebner Road	81-82
1604-L12	Solution Cavity	Loop 1604 west of Bitters Road	79
1604-M21	Cave	Loop 1604 west of Bitters Road	77-78
F056	Zone of Solution Enlarged Fractures	Loop 1604 west of Rogers Ranch Road	77
LOOP-009	Solution Cavity	Loop 1604 east of US 281	97
LOOP-012	Swallet	Loop 1604 east of Tuscany Stone	90
LOOP-102	Cave	I-10 north of Loop 1604	12
LOOP-202	Solution Cavity	Loop 1604 southwest of Kyle Seale Parkway	47
LOOP-205	Solution Fracture	Loop 1604 east of Voigt Drive	90
LOOP-207	Solution Cavity and Solution Fractures	I-10 north of Loop 1604	12
LOOP-213	Solution Cavity and Solution Fractures	Loop 1604 east of Babcock Road	53, 55, 56
LOOP-214	Solution Cavity and Solution Fractures	Loop 1604 west of W. Bitters Road	78
LOOP-217	Solution Cavity	Loop 1604 west of Blanco Road	85
LOOP-W01	Historic Monitoring Well	Loop 1604 west of Judson Road	114

Temporary best management practices (BMPs) should be implemented during construction to minimize the potential for the mobilization of disturbed soils and untreated runoff from entering sensitive karst features and/or creeks that receive runoff from the Project. Care should be taken when excavating near identified features and near mapped faults as these areas may have an increased risk of intersecting voids.

ATTACHMENT C

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ATTACHMENT D

Site Geologic Maps

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

ZARA ENVIRONMENTAL LLC

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Manchaca, Texas 78652
www.zaraenvironmental.com

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Survey Area

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Boundary line between Geology data sources

Geology: GAT 2010, 250K

Fault Type

- Normal
- Unspecified

Formation

- Qle - Leona Formation
- Qt - Fluviatile terrace deposits
- Kpg - Pecan Gap Chalk
- Kau - Austin Chalk
- Kef - Eagle Ford Group
- Kbu - Buda Limestone
- Kdr - Del Rio Clay
- Ked - Edwards Limestone
- Kgru - Upper Glen Rose Formation
- Kgrl - Lower Glen Rose Formation

Geology: Blome 2005

Fault Type

- Fault-certain
- Fault-inferred

Formation

- Ku - Upper Confining Units
- Kef - Eagle Ford Group
- Kb - Buda Limestone
- Kdr - Del Rio Clay
- Kg - Georgetown Formation
- Kpcm - Person Formation - Cyclic and Marine Member
- Kplc - Person Formation - Leached and Collapsed Member
- Kprd - Person Formation - Regional Dense Member
- Kkg - Kainer Formation - Grainstone Member
- Kkke - Kainer Formation Kirschberg Evaporite Member
- Kkd - Kainer Formation - Dolomitic Member
- Kkbn - Kainer Formation - Basal Nodular Member
- Kgr(u) - Upper Glen Rose

Edwards Aquifer Zones

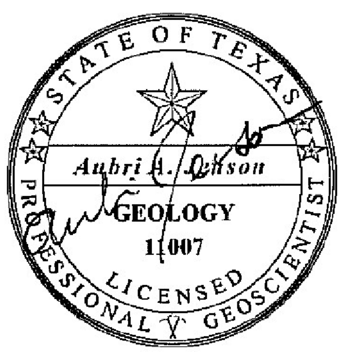
- Contributing Zone
- Contributing withing Transition Zone
- Recharge Zone
- Transition Zone

N

1 inch = 100 feet

0 50 100 200 300 Feet

0 50 100 Meters



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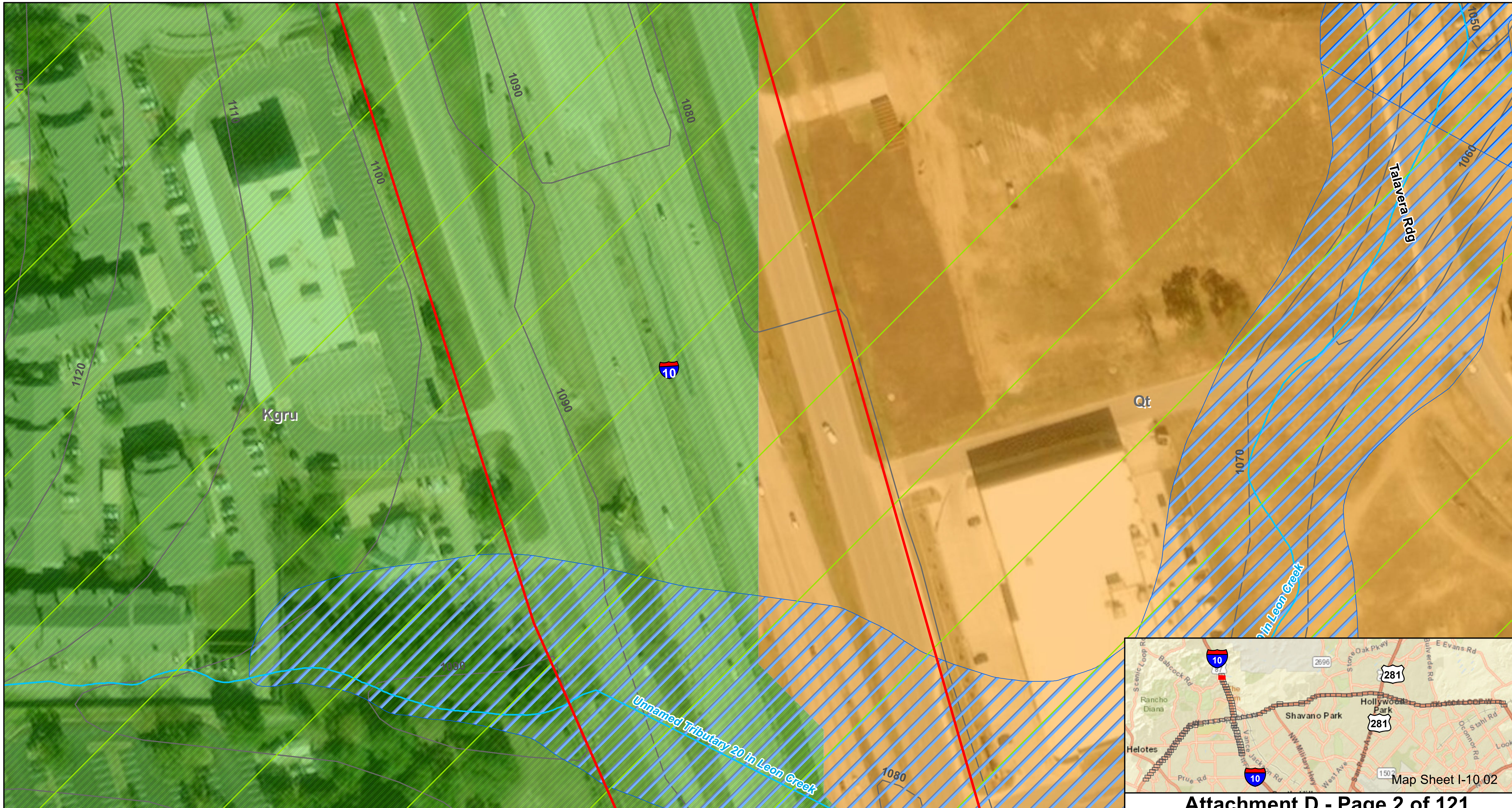

Attachment D - Page 2 of 121

Survey Area

GA Features
- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours
Streams (FEMA)
FEMA 100-yr flood zone

Boundary line between Geology data sources

Geology: GAT 2010, 250K

Fault Type
- Normal
- Unspecified

Formation
- Qle - Leona Formation
- Qt - Fluviatile terrace deposits
- Kpg - Pecan Gap Chalk
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- Kgru - Upper Glen Rose Formation
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Geology: Blome 2005

Fault Type
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Formation
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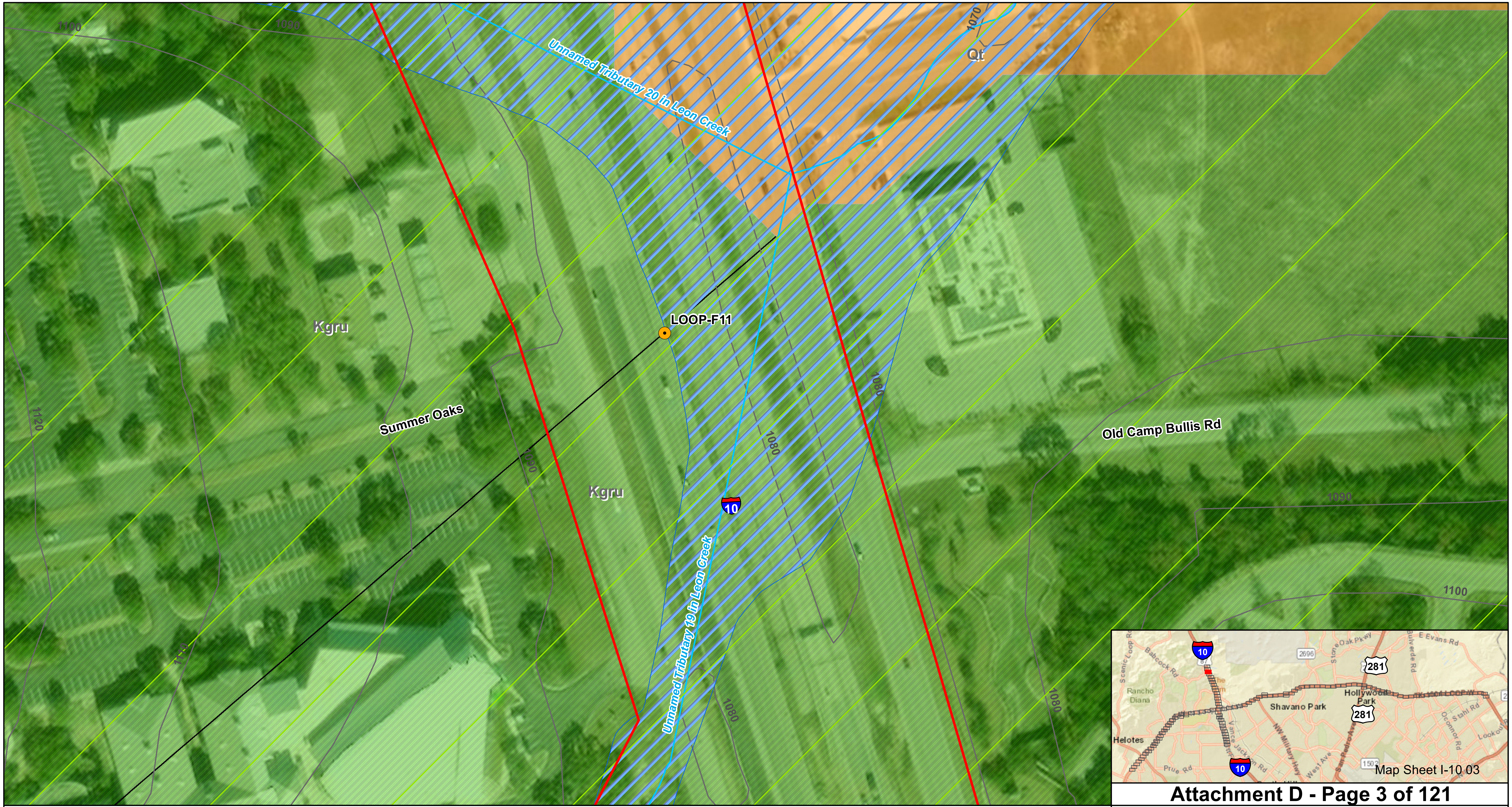

Attachment D - Page 3 of 121

Survey Area

GA Features
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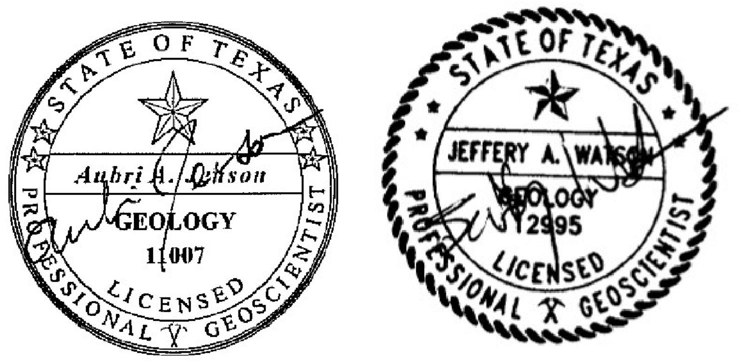

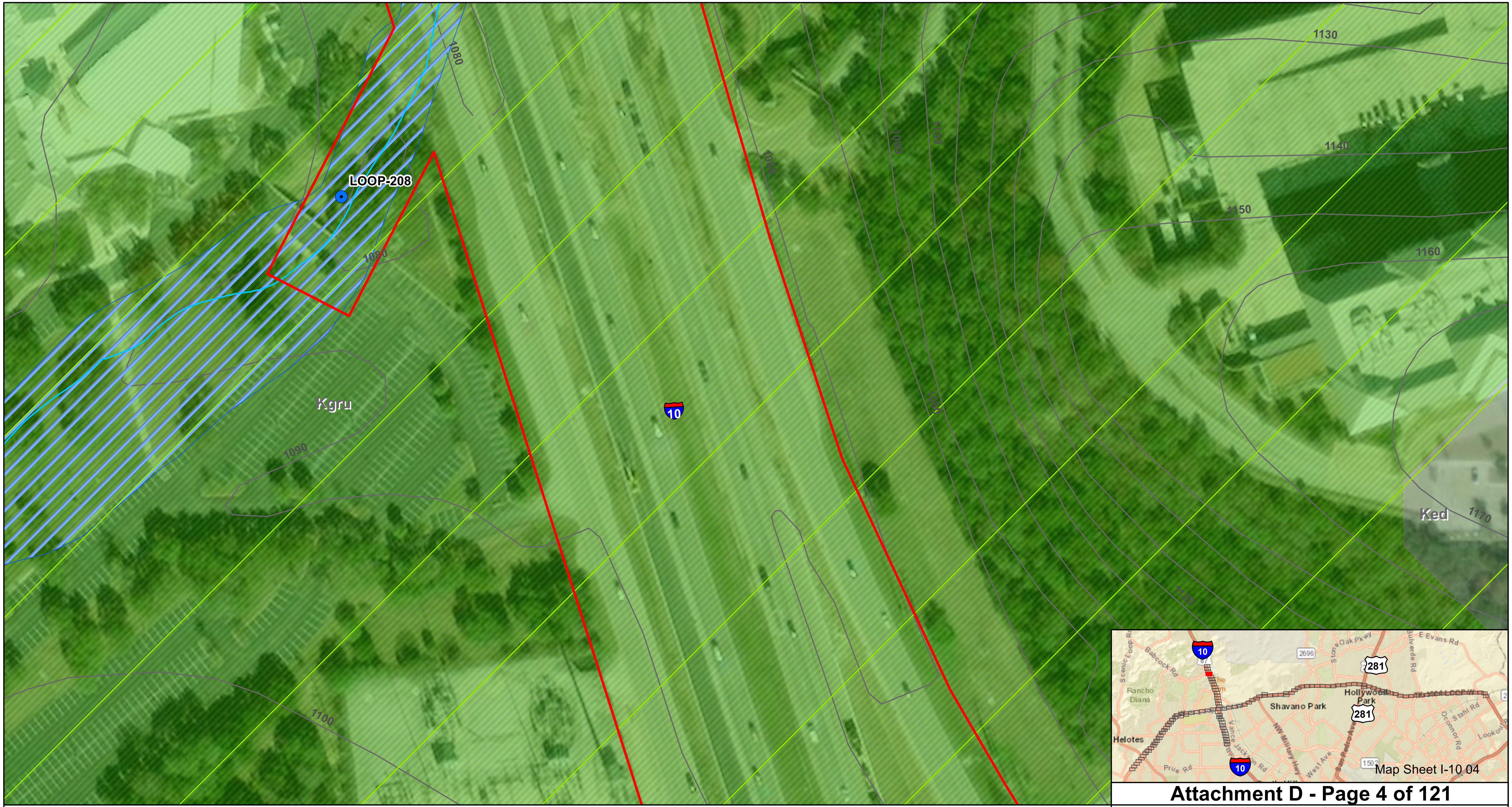

Attachment D - Page 4 of 121

Survey Area

GA Features
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Geology: Blome 2005

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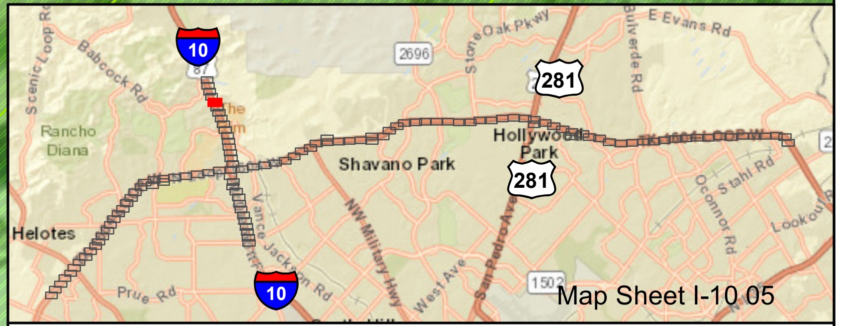

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Survey Area

GA Features
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- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours
Streams (FEMA)
FEMA 100-yr flood zone

Boundary line between Geology data sources

Geology: GAT 2010, 250K

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Geology: Blome 2005

Fault Type
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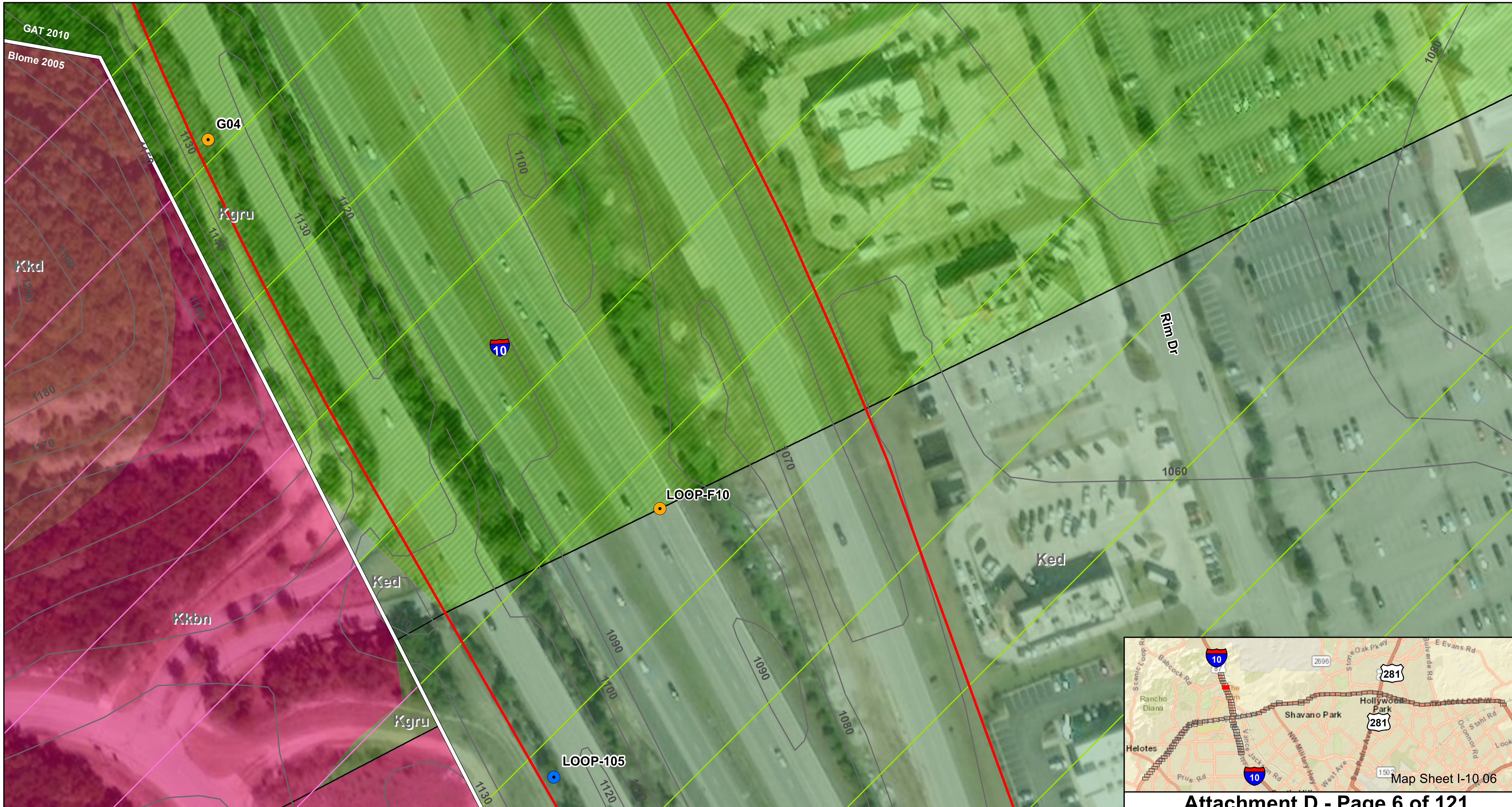

Attachment D - Page 6 of 121

Survey Area

Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

Normal

Unspecified

Formation

- Qle - Leona Formation
- Qt - Fluviatile terrace deposits
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Geology: Blome 2005

Fault Type

Fault-certain

Fault-inferred

Formation

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Edwards Aquifer Zones

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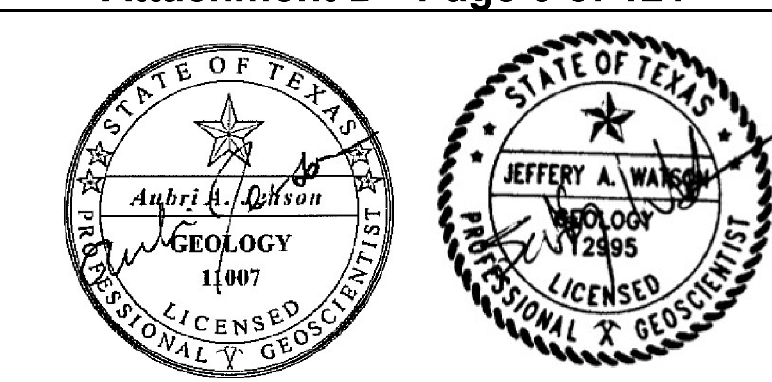

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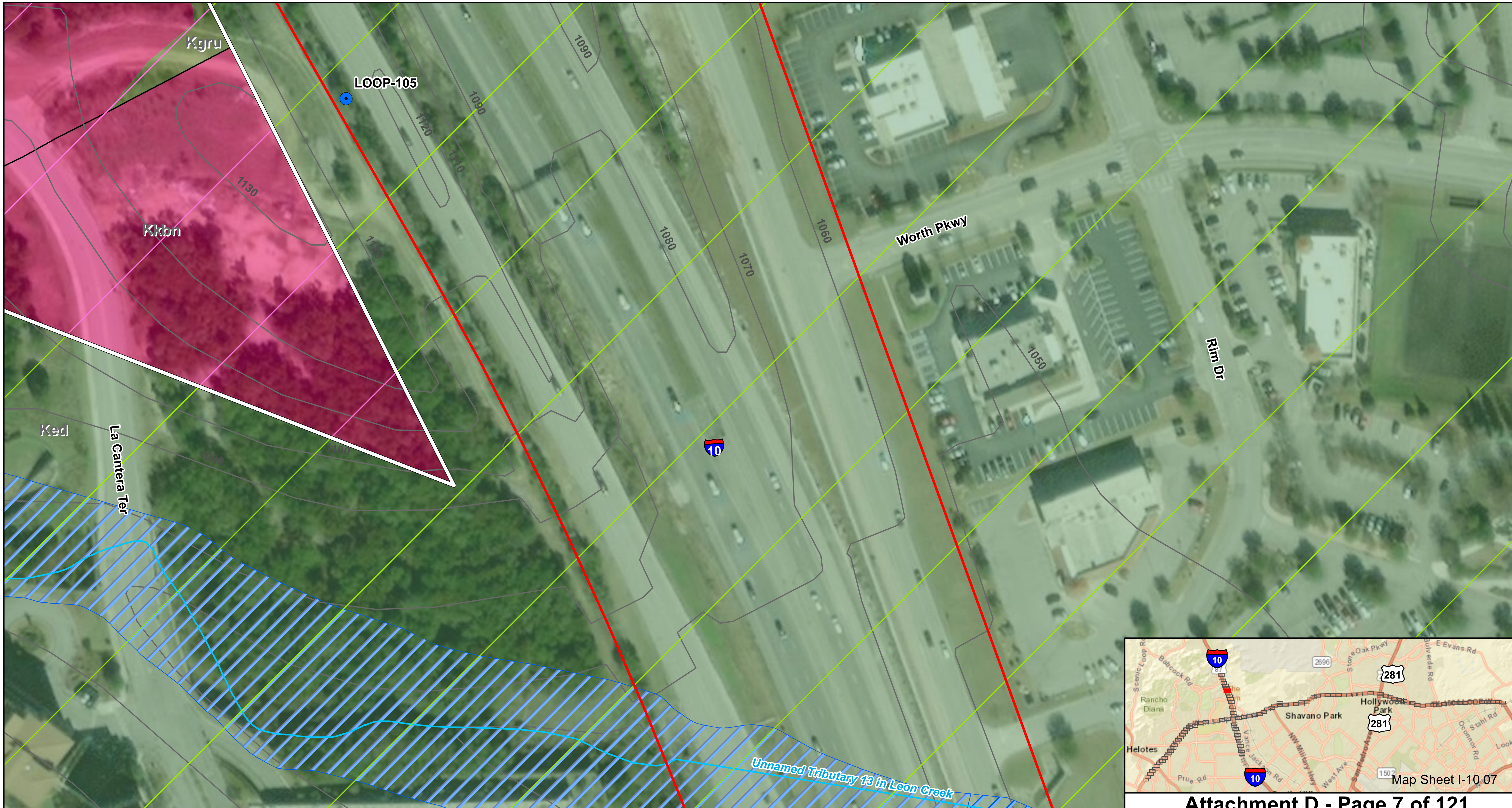

Attachment D - Page 7 of 121

Survey Area

Boundary line between Geology data sources

GA Features
- Non-Sensitive: <35 Rating
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- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours
Streams (FEMA)
FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type
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Formation
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Geology: Blome 2005

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Edwards Aquifer Zones
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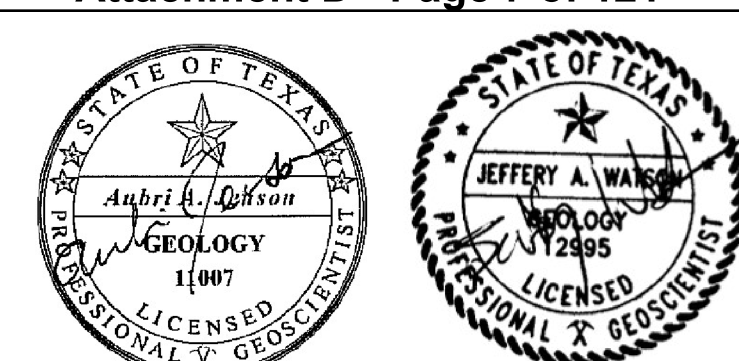

Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.

Attachment D - Page 8 of 121

- Survey Area
- Boundary line between Geology data sources

GA Features

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- Sensitive: >40 Rating
- TWDB Wells
- StratMap 10-ft elevation contours
- Streams (FEMA)
- FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

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Edwards Aquifer Zones

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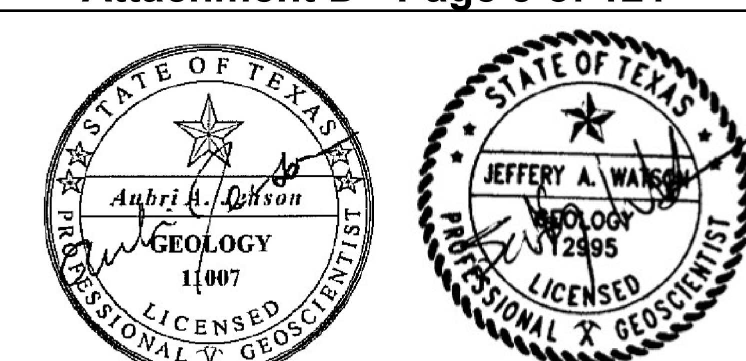

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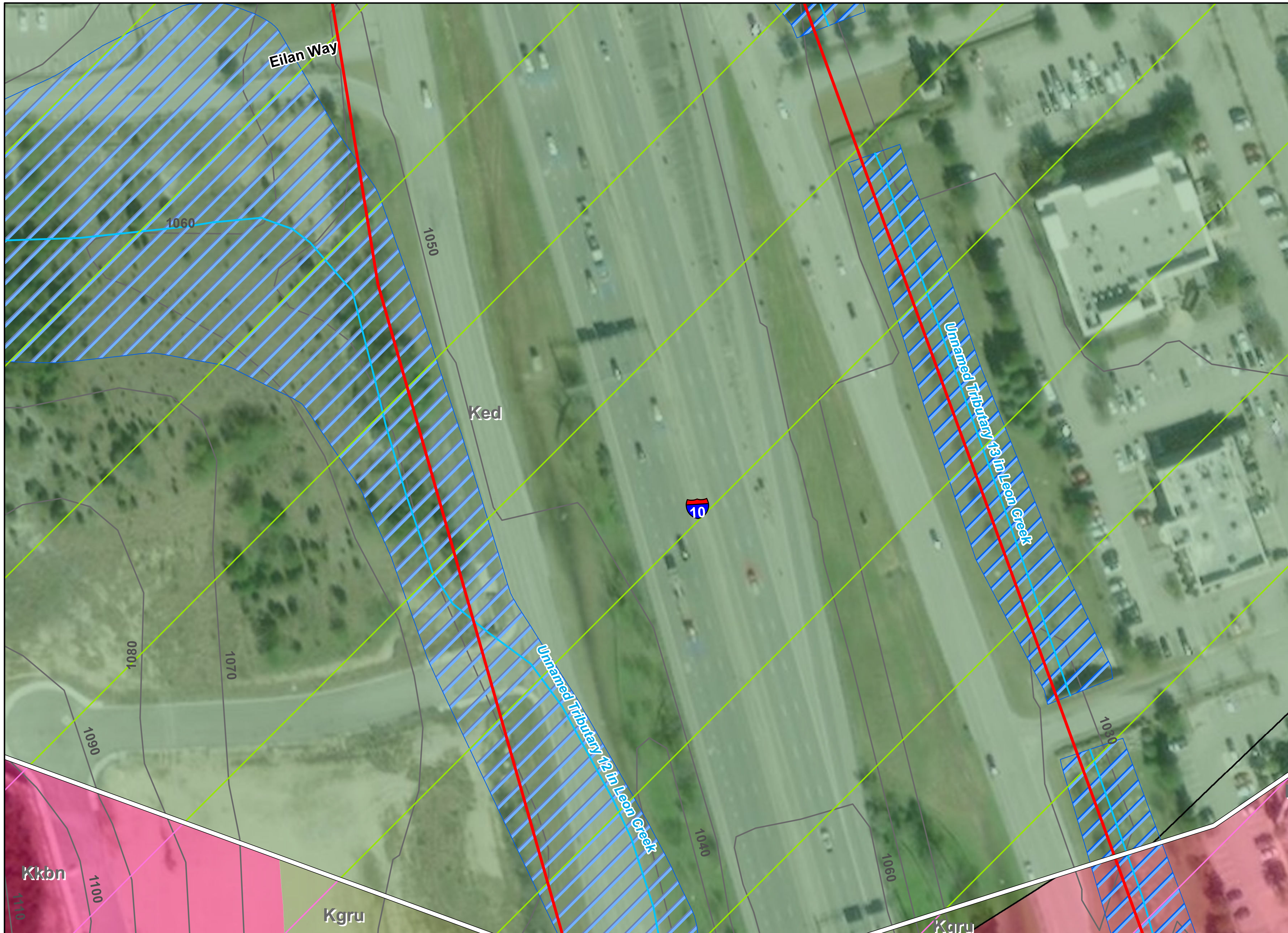

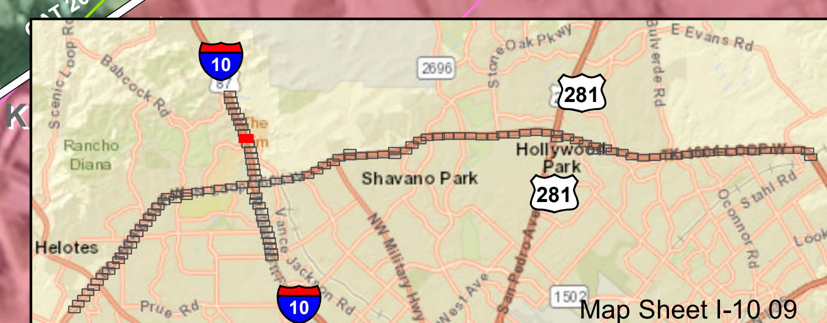

Survey Area

Boundary line between Geology data sources

GA Features

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StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

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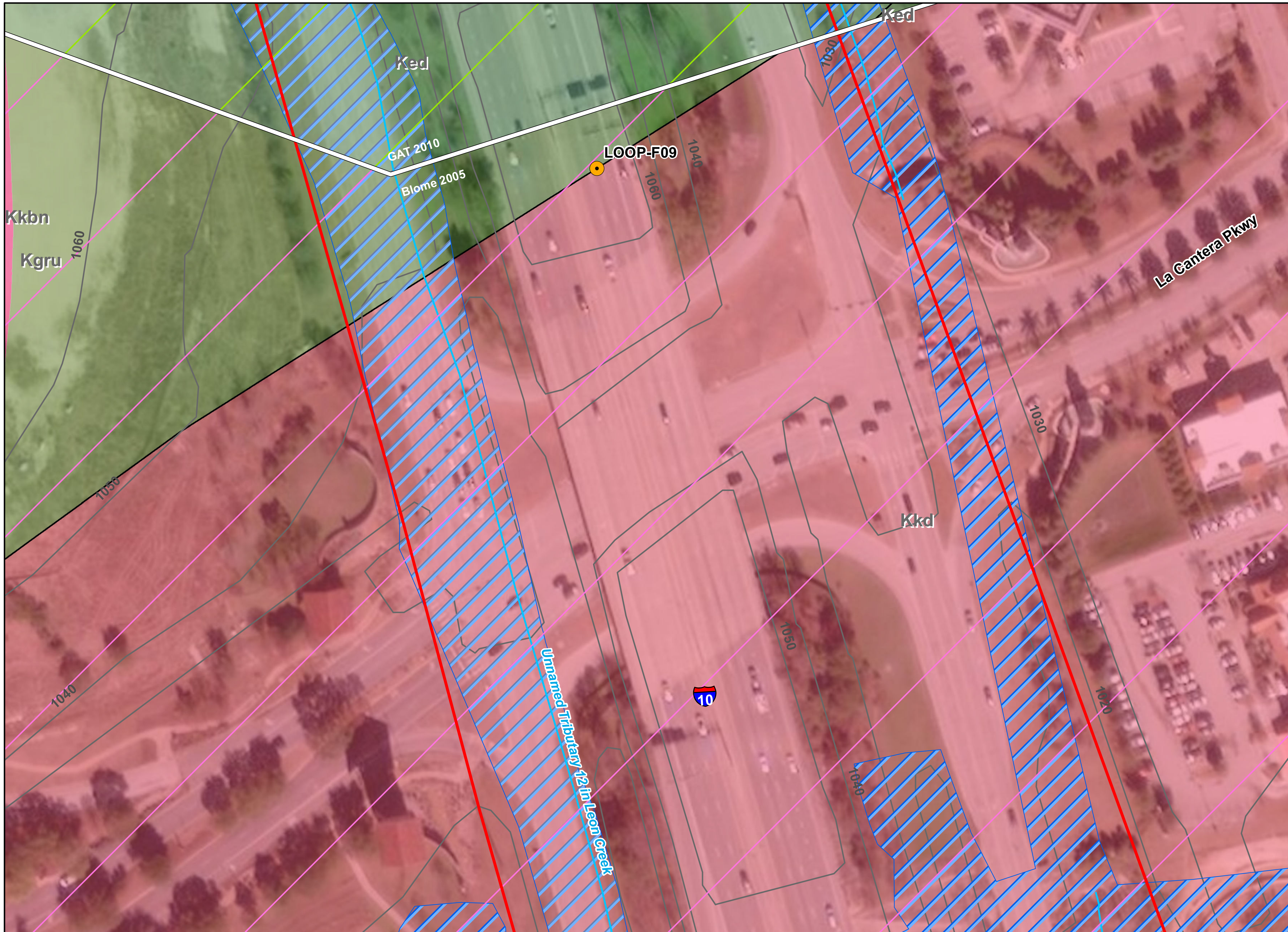

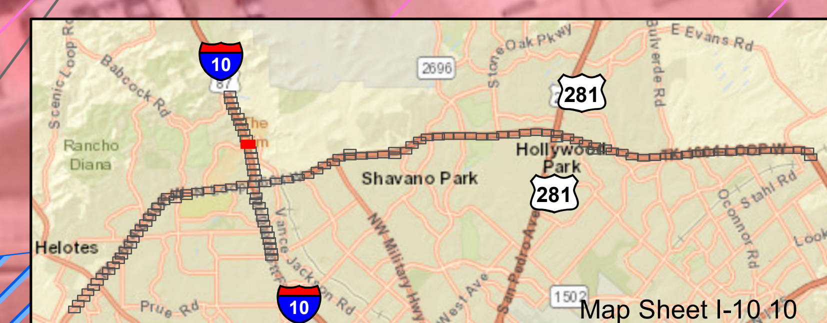

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Survey Area

Boundary line between Geology data sources

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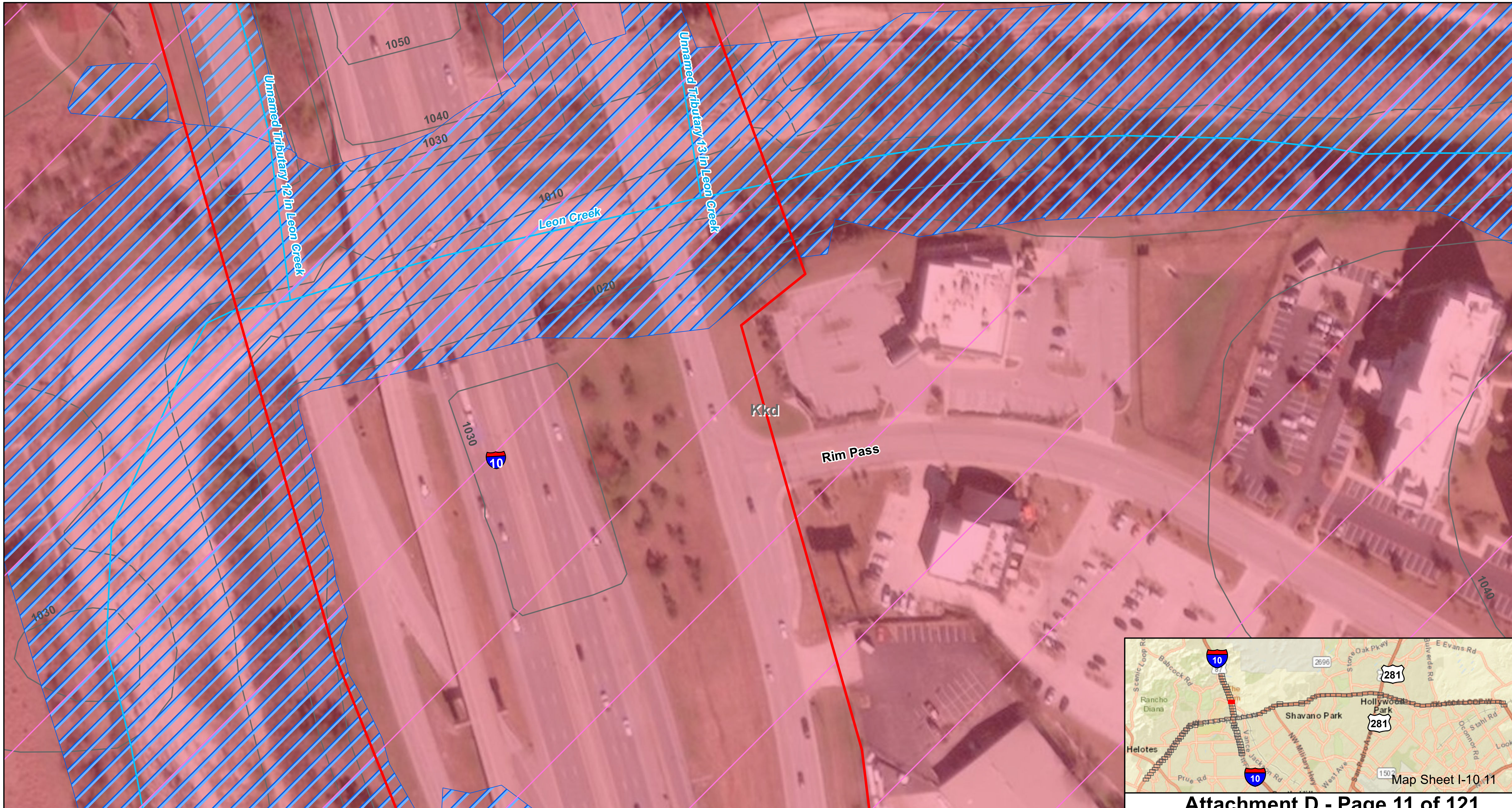

Attachment D - Page 11 of 121

Survey Area

Boundary line between Geology data sources

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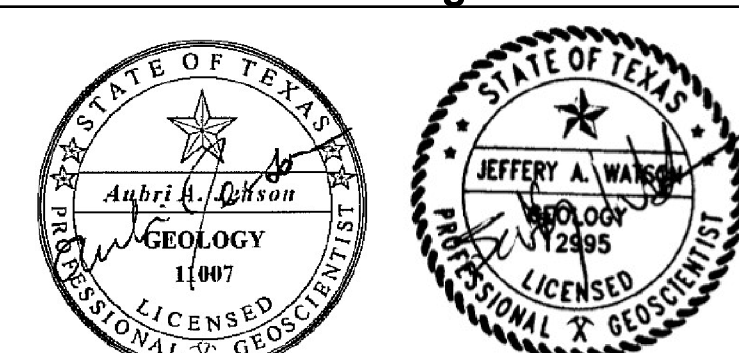
- Recharge Zone
- Transition Zone

N

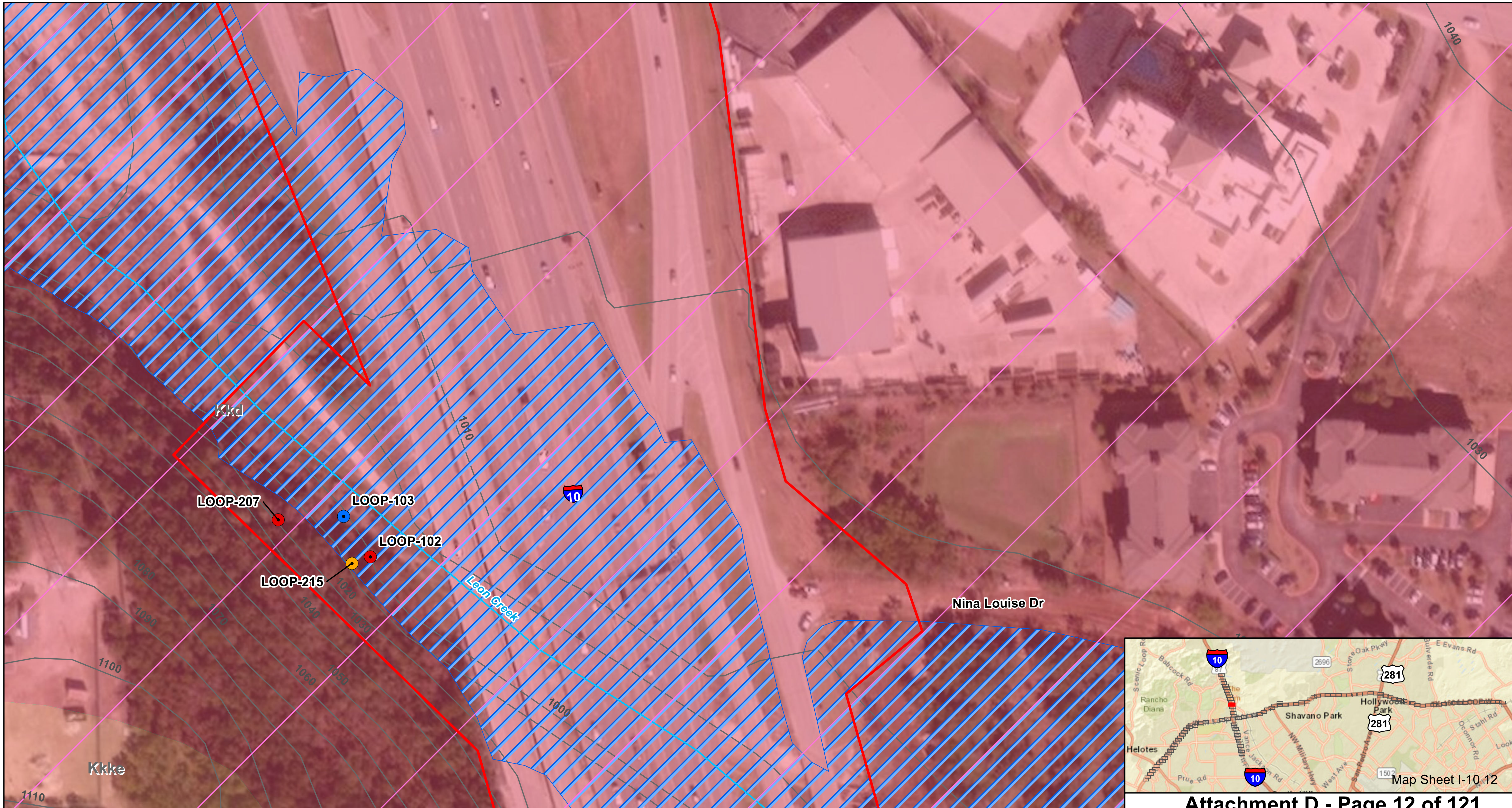
1 inch = 100 feet

0 50 100 200 300 Feet

0 50 100 Meters



Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.



Attachment D - Page 12 of 121

Survey Area

Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

Normal

Unspecified

Formation

Qle - Leona Formation

Qt - Fluviatile terrace deposits

Kpg - Pecan Gap Chalk

Kau - Austin Chalk

Kef - Eagle Ford Group

Kbu - Buda Limestone

Kdr - Del Rio Clay

Ked - Edwards Limestone

Kgru - Upper Glen Rose Formation

Kgrl - Lower Glen Rose Formation

Geology: Blome 2005

Fault Type

Fault-certain

Fault-inferred

Formation

Ku - Upper Confining Units

Kef - Eagle Ford Group

Kb - Buda Limestone

Kdr - Del Rio Clay

Kg - Georgetown Formation

Kpcm - Person Formation - Cyclic and Marine Member

Kplc - Person Formation - Leached and Collapsed Member

Kprd - Person Formation - Regional Dense Member

Kkg - Kainer Formation - Grainstone Member

Kkke - Kainer Formation Kirschberg Evaporite Member

Kkd - Kainer Formation - Dolomitic Member

Kkbn - Kainer Formation - Basal Nodular Member

Kgr(u) - Upper Glen Rose

Edwards Aquifer Zones

Contributing Zone

Contributing withing Transition Zone

Recharge Zone

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Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.

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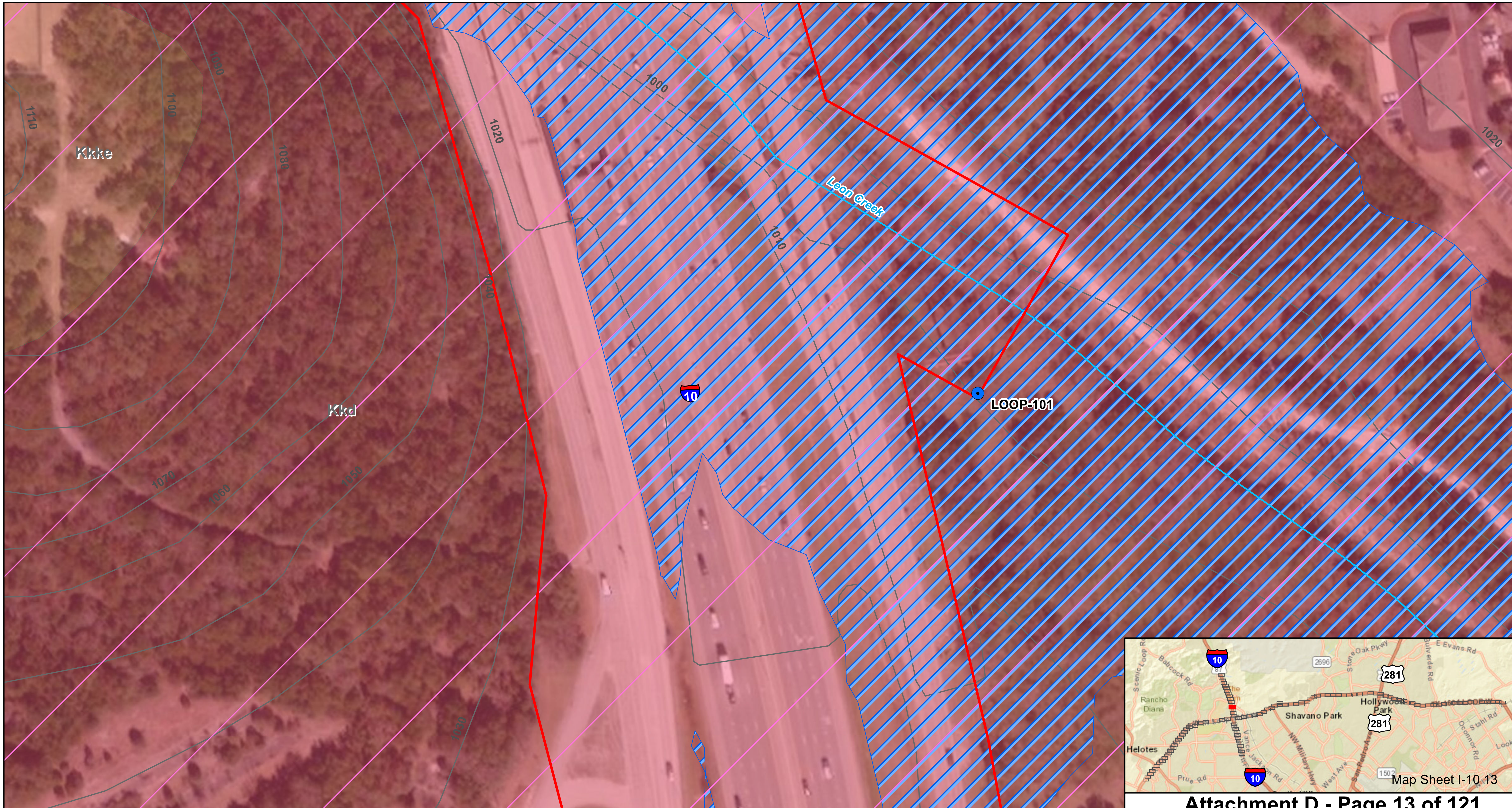

Attachment D - Page 13 of 121

Survey Area

Boundary line between Geology data sources

GA Features
- Non-Sensitive: <35 Rating
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- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours
Streams (FEMA)
FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type
- Normal
- Unspecified

Formation
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Geology: Blome 2005

Fault Type
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- Fault-inferred

Formation
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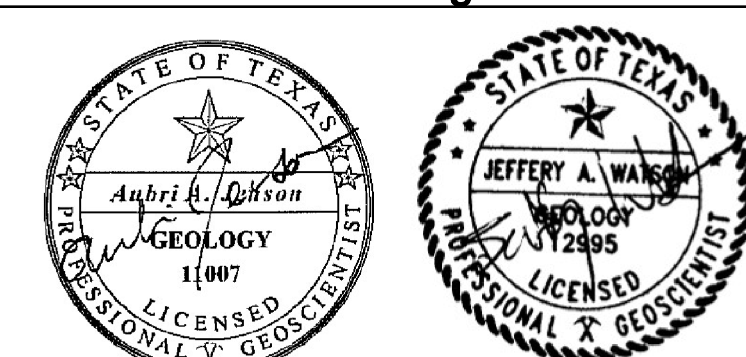

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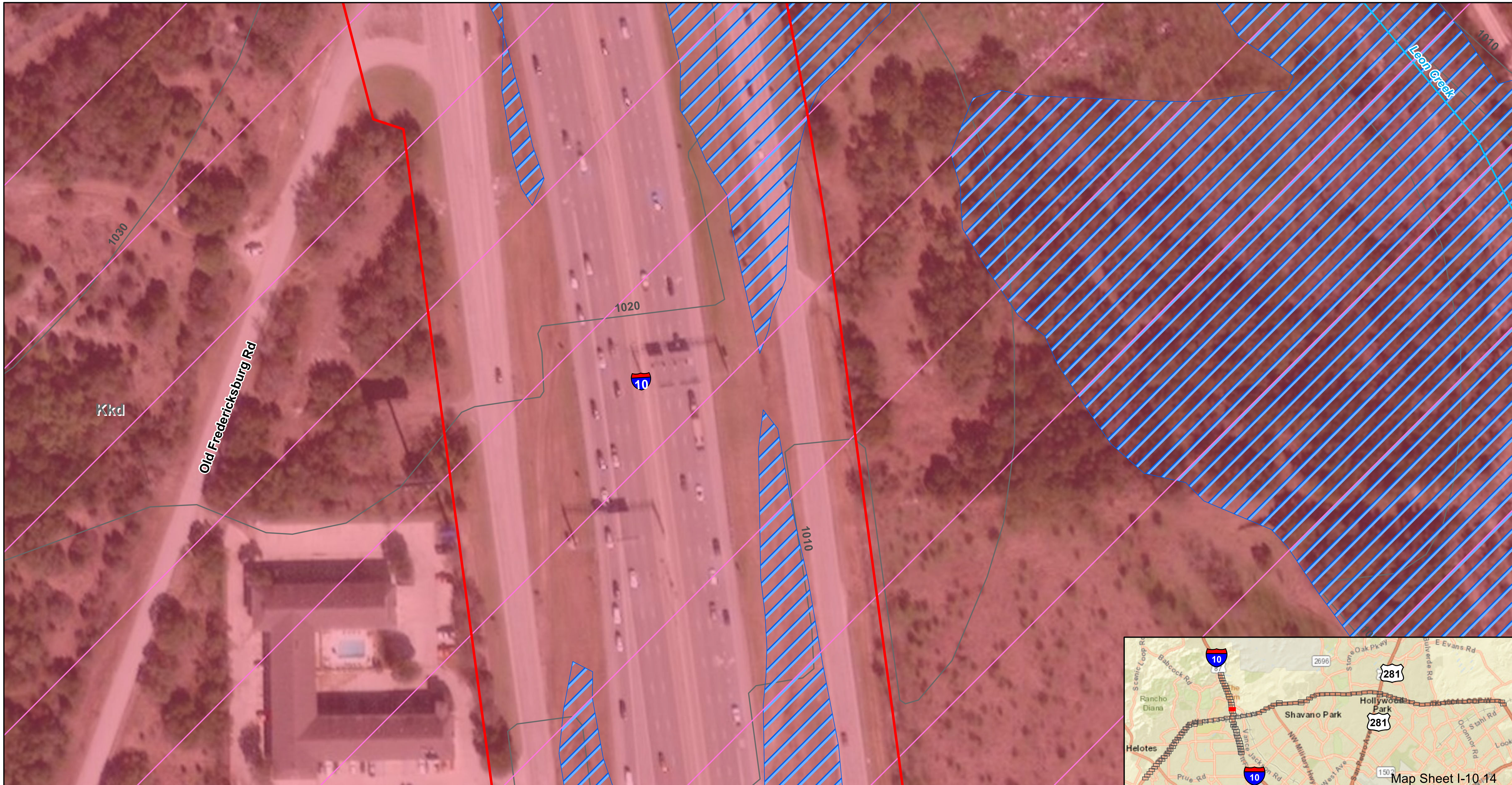

Attachment D - Page 14 of 121

Survey Area

Boundary line between Geology data sources

GA Features

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- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

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Unspecified

Formation

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Kdr - Del Rio Clay

Ked - Edwards Limestone

Kgru - Upper Glen Rose Formation

Kgrl - Lower Glen Rose Formation

Geology: Blome 2005

Fault Type

Fault-certain

Fault-inferred

Formation

Ku - Upper Confining Units

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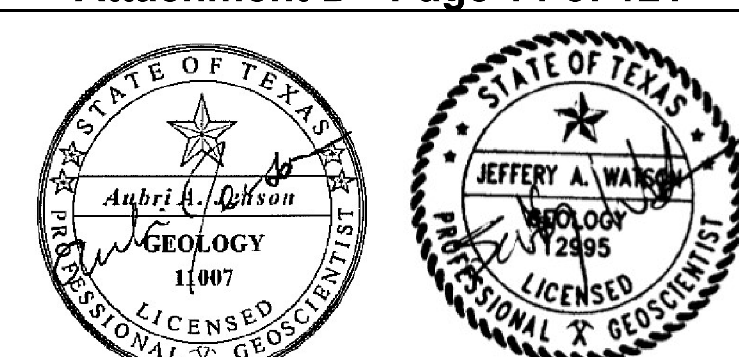
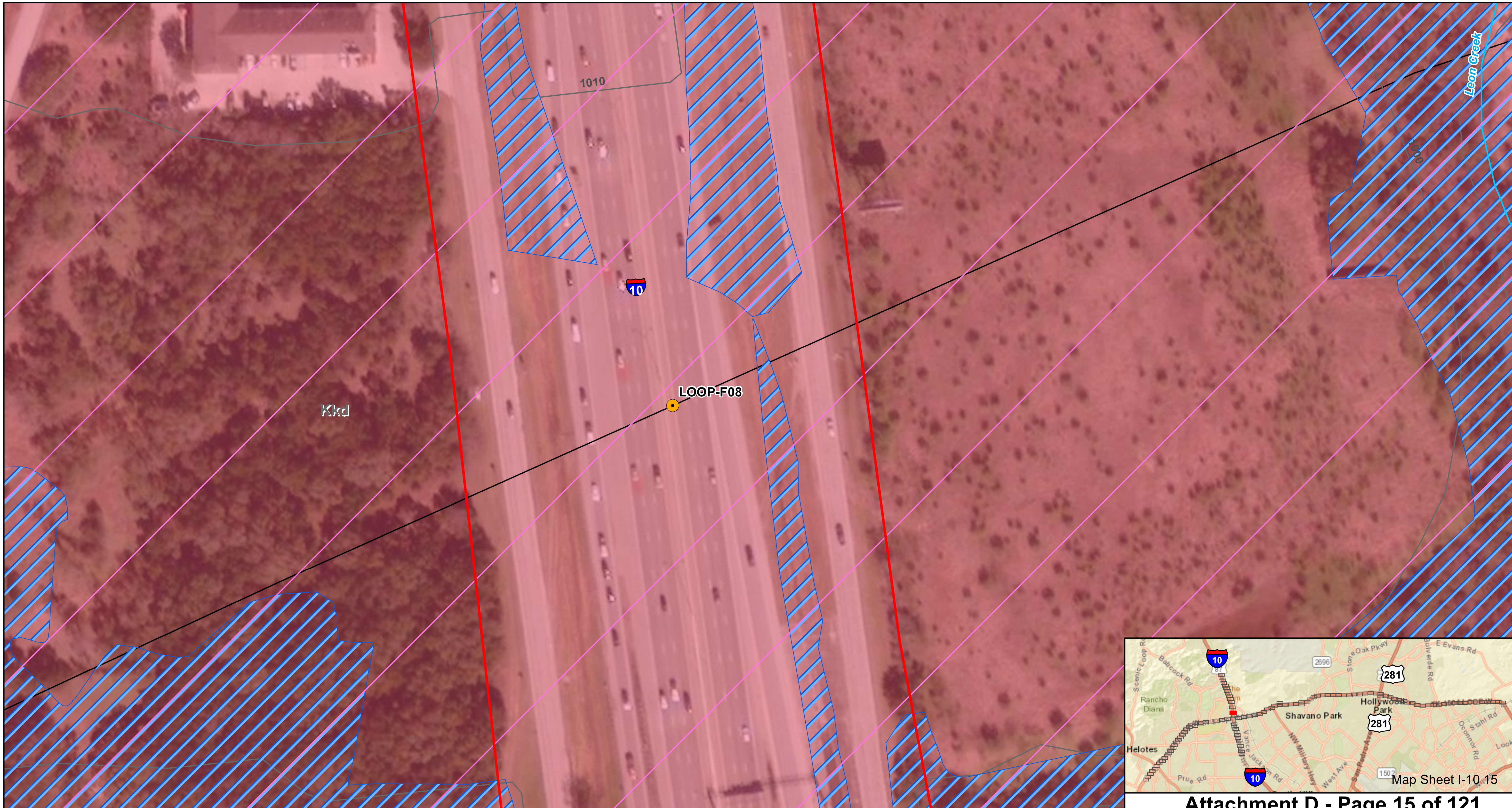


Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.



Attachment D - Page 15 of 121

Survey Area

Boundary line between Geology data sources

GA Features
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- TWDB Wells

StratMap 10-ft elevation contours
Streams (FEMA)
FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type
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Formation
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- Kgrl - Lower Glen Rose Formation

Geology: Blome 2005

Fault Type
- Fault-certain
- Fault-inferred

Formation
- Ku - Upper Confining Units
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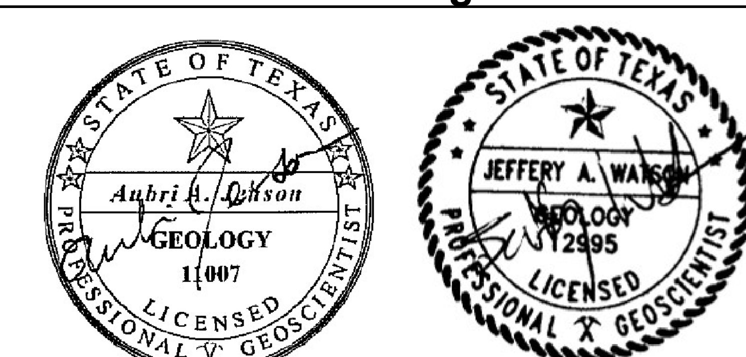
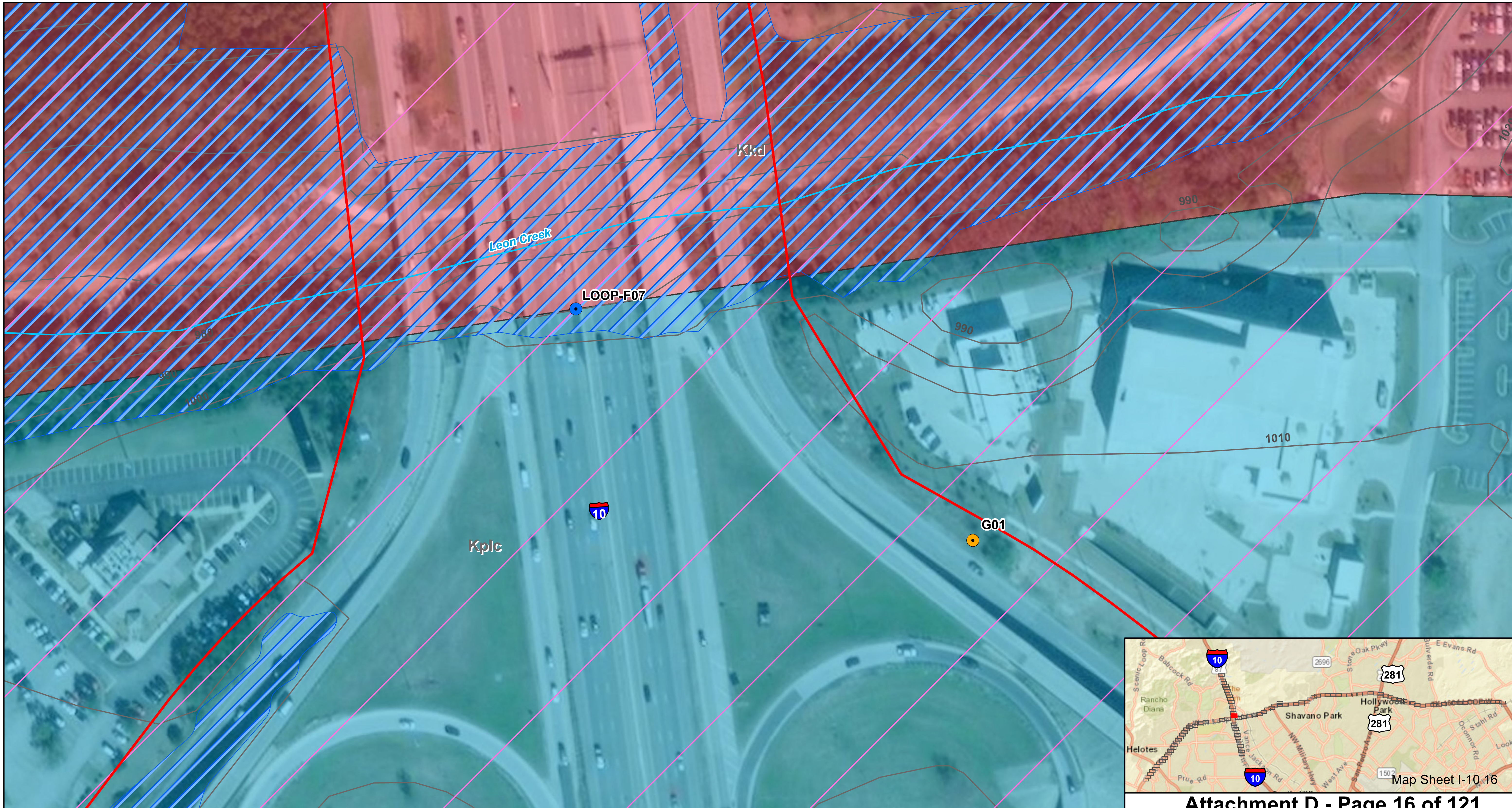


Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.



Survey Area

Boundary line between Geology data sources

GA Features

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- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

Normal

Unspecified

Formation

Qle - Leona Formation

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Fault Type

Fault-certain

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Edwards Aquifer Zones

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Transition Zone

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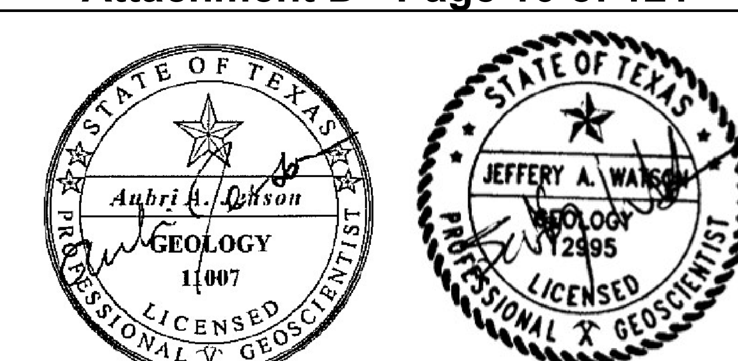

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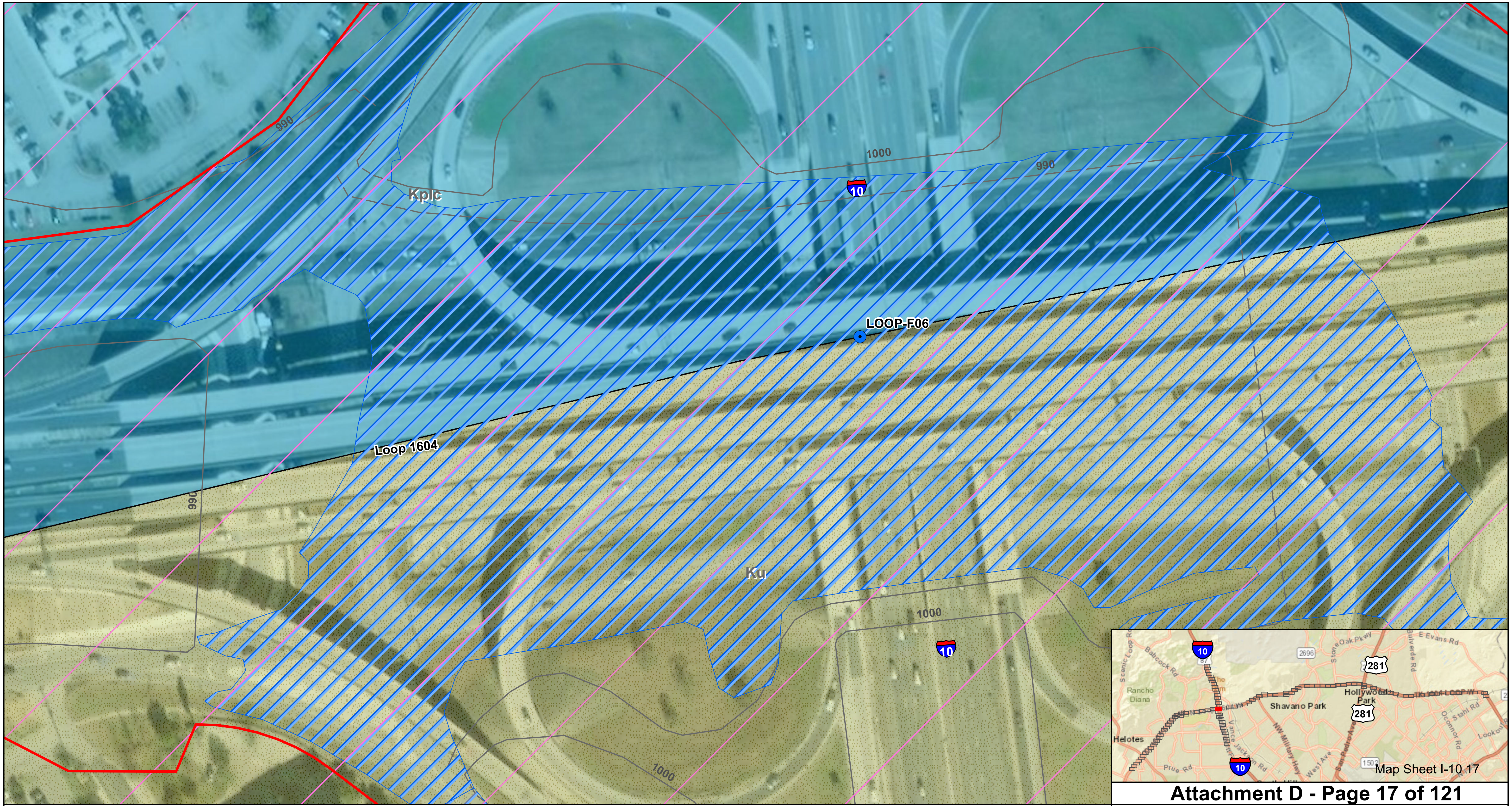

Attachment D - Page 17 of 121

Survey Area

Boundary line between Geology data sources

GA Features
- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours
Streams (FEMA)
FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type
- Normal
- Unspecified

Formation
- Qle - Leona Formation
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- Kef - Eagle Ford Group
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Geology: Blome 2005

Fault Type
- Fault-certain
- Fault-inferred

Formation
- Ku - Upper Confining Units
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Edwards Aquifer Zones
- Contributing Zone
- Contributing withing Transition Zone
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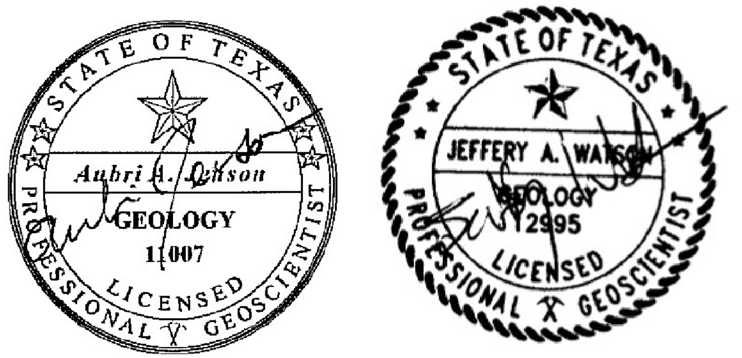
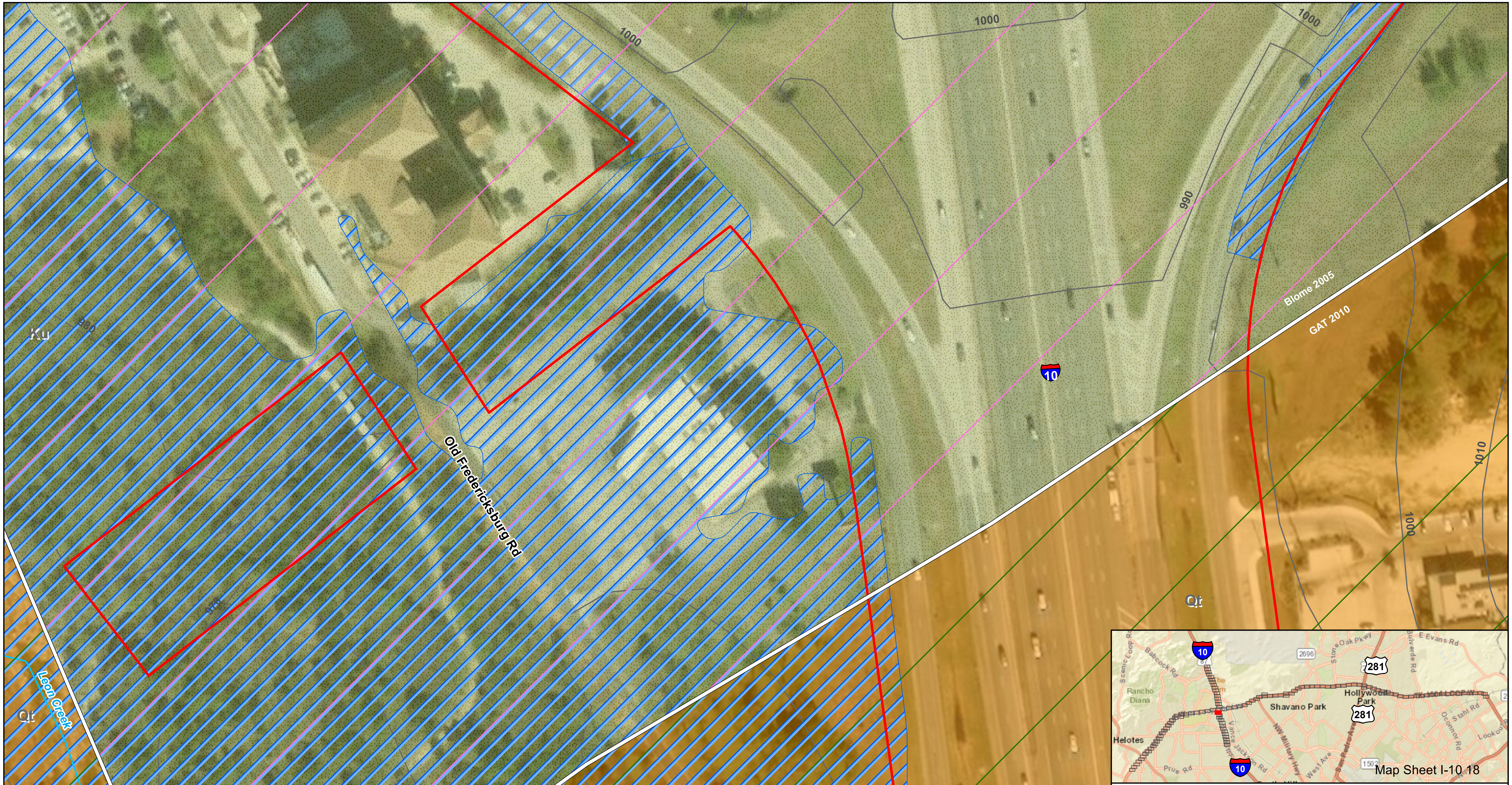


Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.



Attachment D - Page 18 of 121

Survey Area

Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

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- Unspecified

Formation

- Qle - Leona Formation
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Geology: Blome 2005

Fault Type

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Formation

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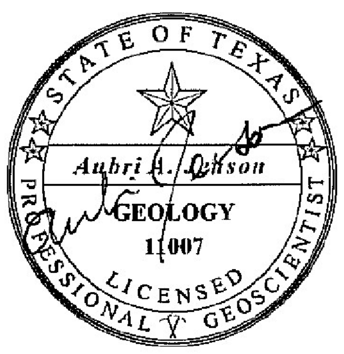

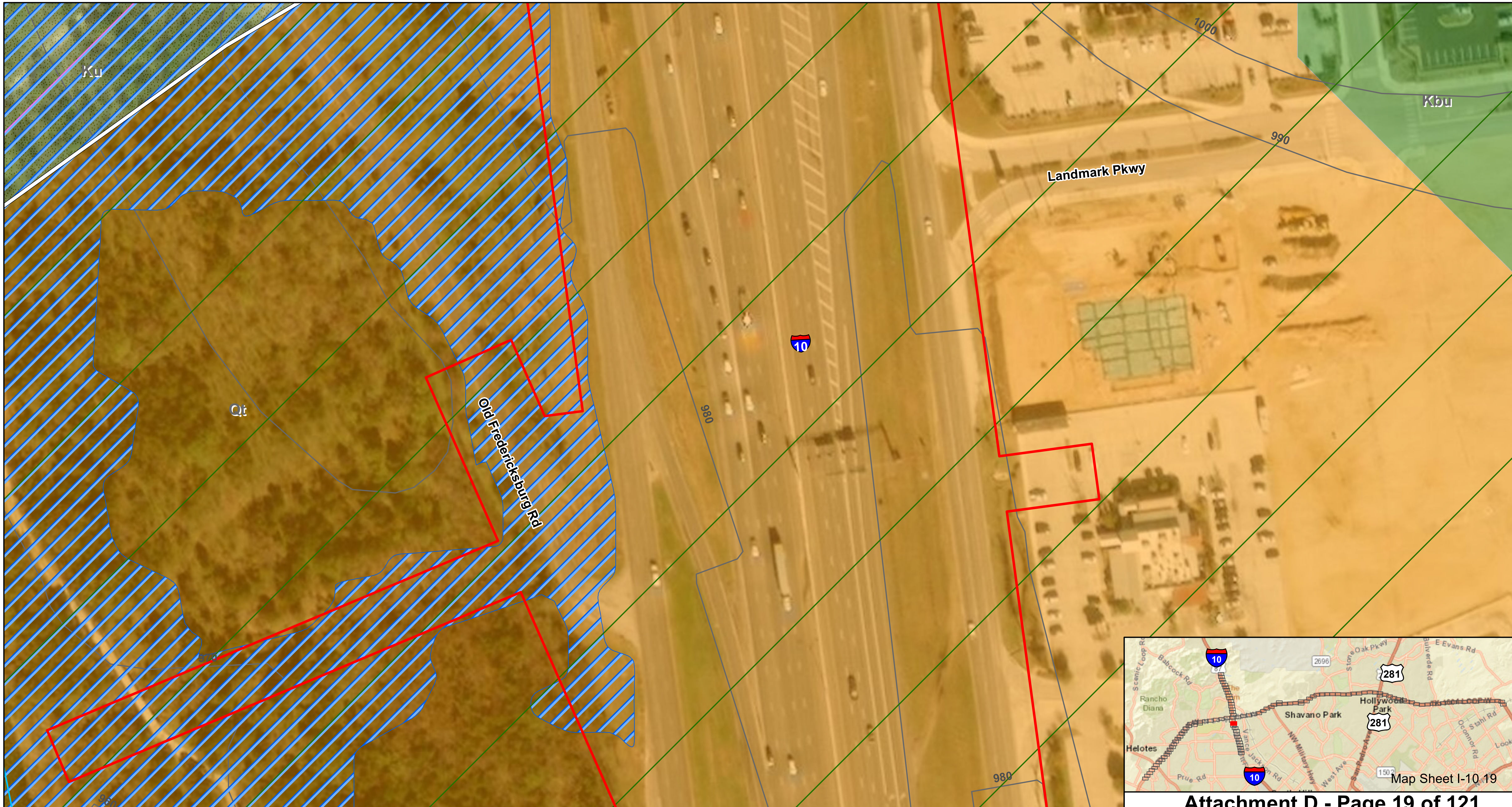

Survey Area

Boundary line between Geology data sources

GA Features

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StratMap 10-ft elevation contours

Streams (FEMA)

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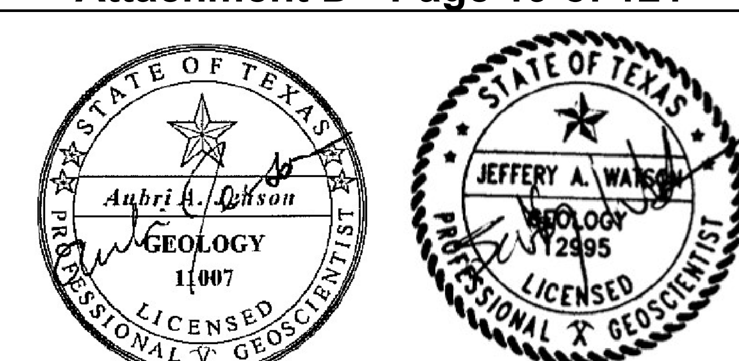

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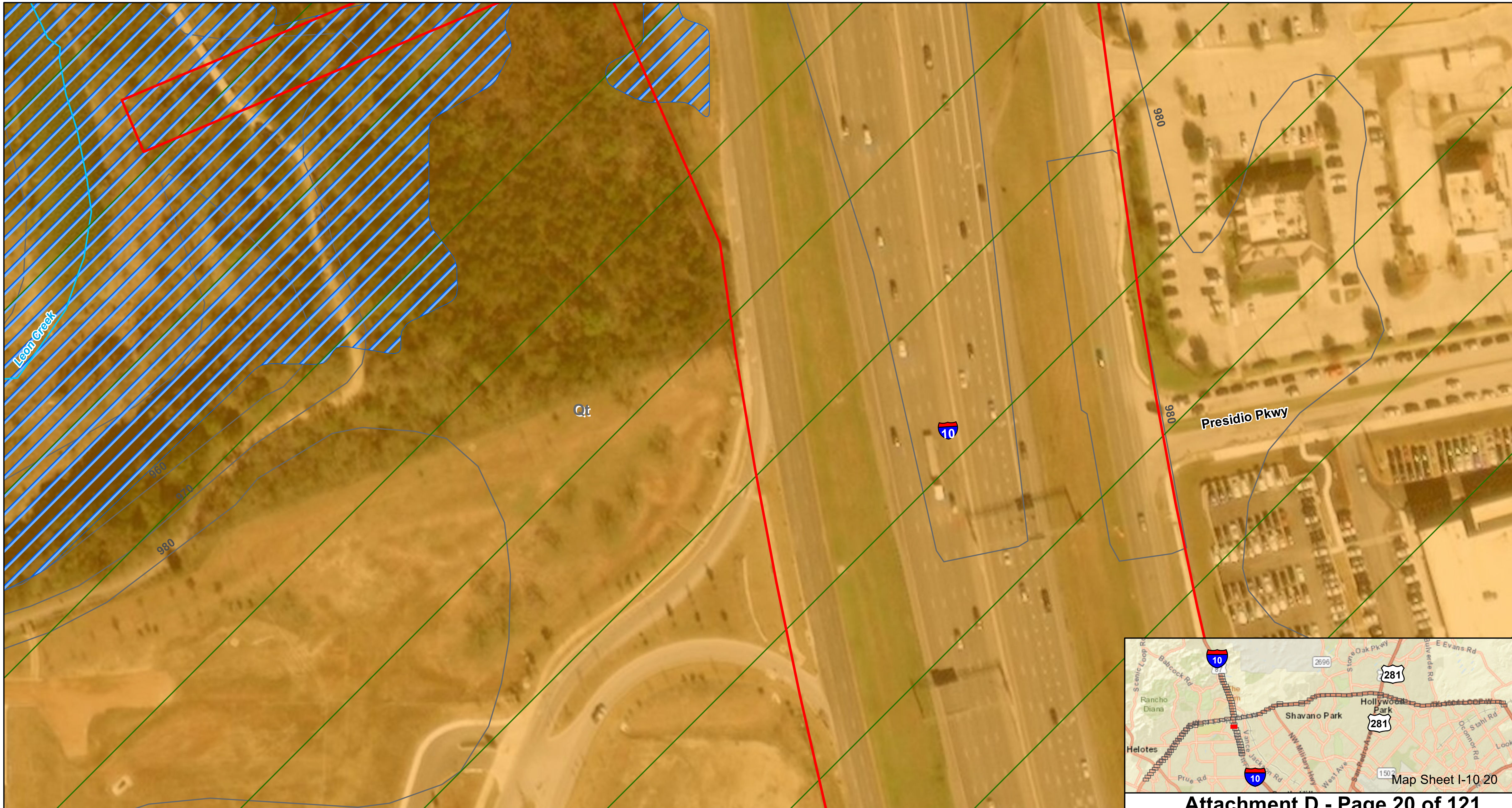

Attachment D - Page 20 of 121

Survey Area

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours
Streams (FEMA)
FEMA 100-yr flood zone

Boundary line between Geology data sources

Geology: GAT 2010, 250K

Fault Type

Normal
Unspecified

Formation

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Geology: Blome 2005

Fault Type

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Fault-inferred

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Edwards Aquifer Zones

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Contributing withing Transition Zone
Recharge Zone
Transition Zone

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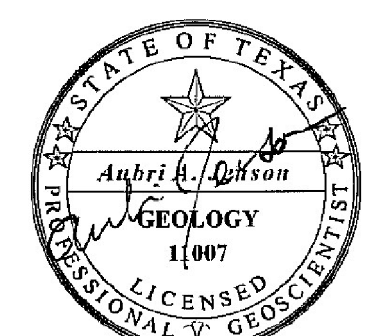

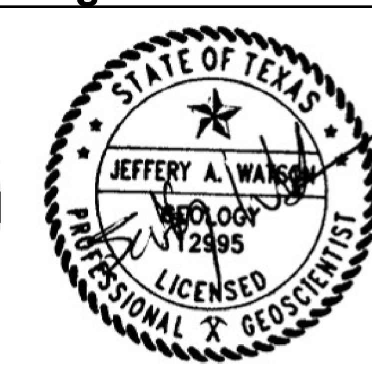

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Attachment D - Page 21 of 121

Survey Area

Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
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- Sensitive: >40 Rating
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StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

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Formation

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Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.

Attachment D - Page 22 of 121

Survey Area

Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

- Normal
- Unspecified

Formation

- Qle - Leona Formation
- Qt - Fluviatile terrace deposits
- Kpg - Pecan Gap Chalk
- Kau - Austin Chalk
- Kef - Eagle Ford Group
- Kbu - Buda Limestone
- Kdr - Del Rio Clay
- Ked - Edwards Limestone
- Kgru - Upper Glen Rose Formation
- Kgrl - Lower Glen Rose Formation

Geology: Blome 2005

Fault Type

- Fault-certain
- Fault-inferred

Formation

- Ku - Upper Confining Units
- Kef - Eagle Ford Group
- Kb - Buda Limestone
- Kdr - Del Rio Clay
- Kg - Georgetown Formation
- Kpcm - Person Formation - Cyclic and Marine Member
- Kplc - Person Formation - Leached and Collapsed Member
- Kprd - Person Formation - Regional Dense Member
- Kkg - Kainer Formation - Grainstone Member
- Kkke - Kainer Formation Kirschberg Evaporite Member
- Kkd - Kainer Formation - Dolomitic Member
- Kkbn - Kainer Formation - Basal Nodular Member
- Kgr(u) - Upper Glen Rose

Edwards Aquifer Zones

- Contributing Zone
- Contributing withing Transition Zone
- Recharge Zone
- Transition Zone

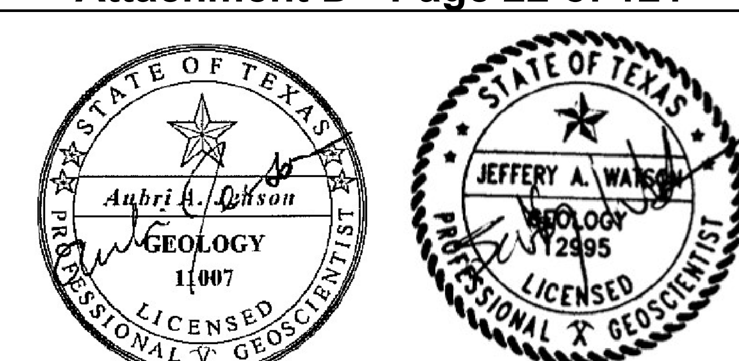
N

1 inch = 100 feet

0 50 100 200 300 Feet

0 50 100 Meters

Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.



Survey Area

Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

Normal

Unspecified

Formation

- Qle - Leona Formation
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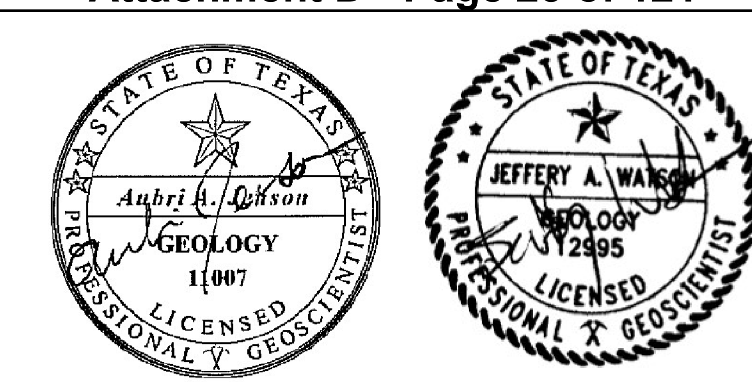

Survey Area

Boundary line between Geology data sources

GA Features

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- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

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Formation

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Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.

Survey Area

GA Features

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- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Boundary line between Geology data sources

Geology: GAT 2010, 250K

Fault Type

- Normal
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Formation

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Geology: Blome 2005

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Attachment D - Page 26 of 121

- Survey Area
- Boundary line between Geology data sources

GA Features
- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells
- StratMap 10-ft elevation contours
- Streams (FEMA)
- FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type
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Geology: Blome 2005

Fault Type
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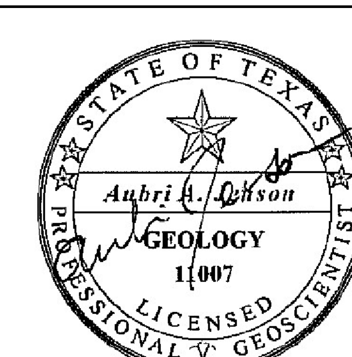

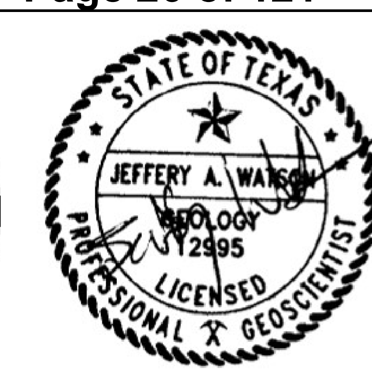

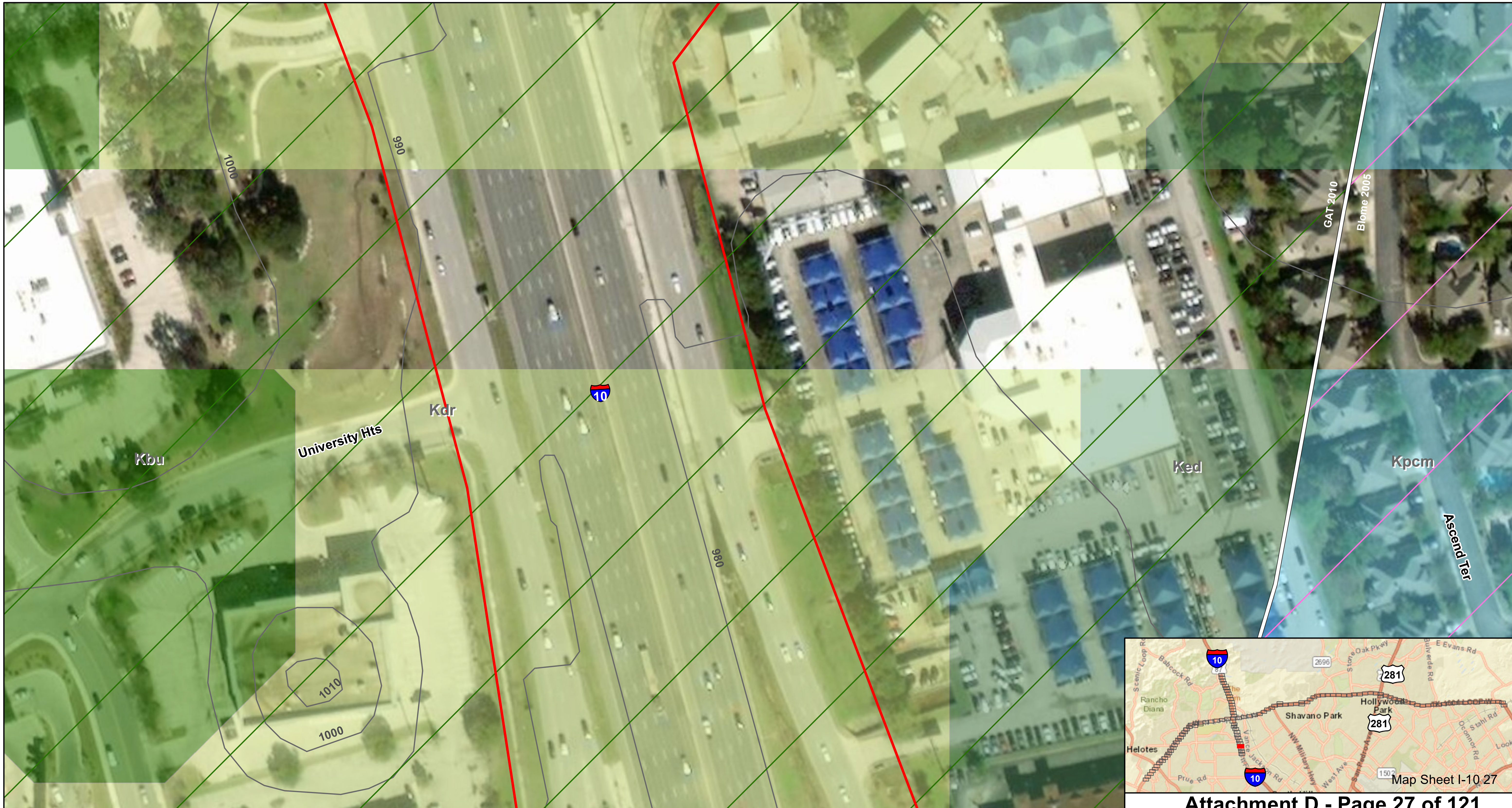

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Survey Area

Boundary line between Geology data sources

GA Features
- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours
Streams (FEMA)
FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type
- Normal
- Unspecified

Formation
- Qle - Leona Formation
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Geology: Blome 2005

Fault Type
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Edwards Aquifer Zones
- Contributing Zone
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Attachment D - Page 28 of 121

Survey Area

Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

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Formation

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Edwards Aquifer Zones

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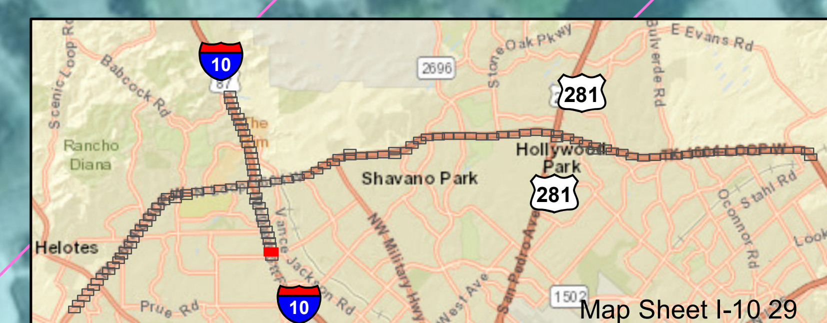

Attachment D - Page 29 of 121

Survey Area

Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

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Edwards Aquifer Zones

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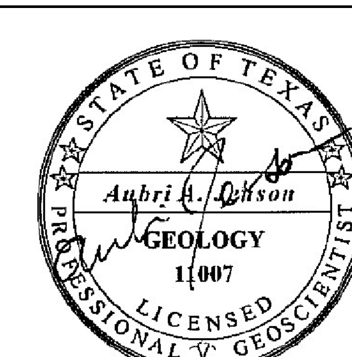

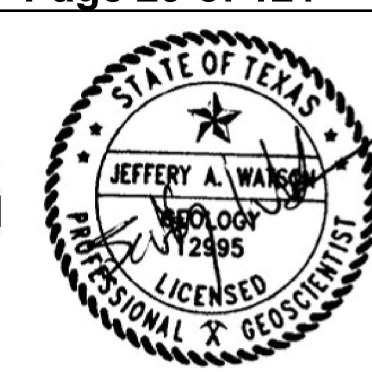

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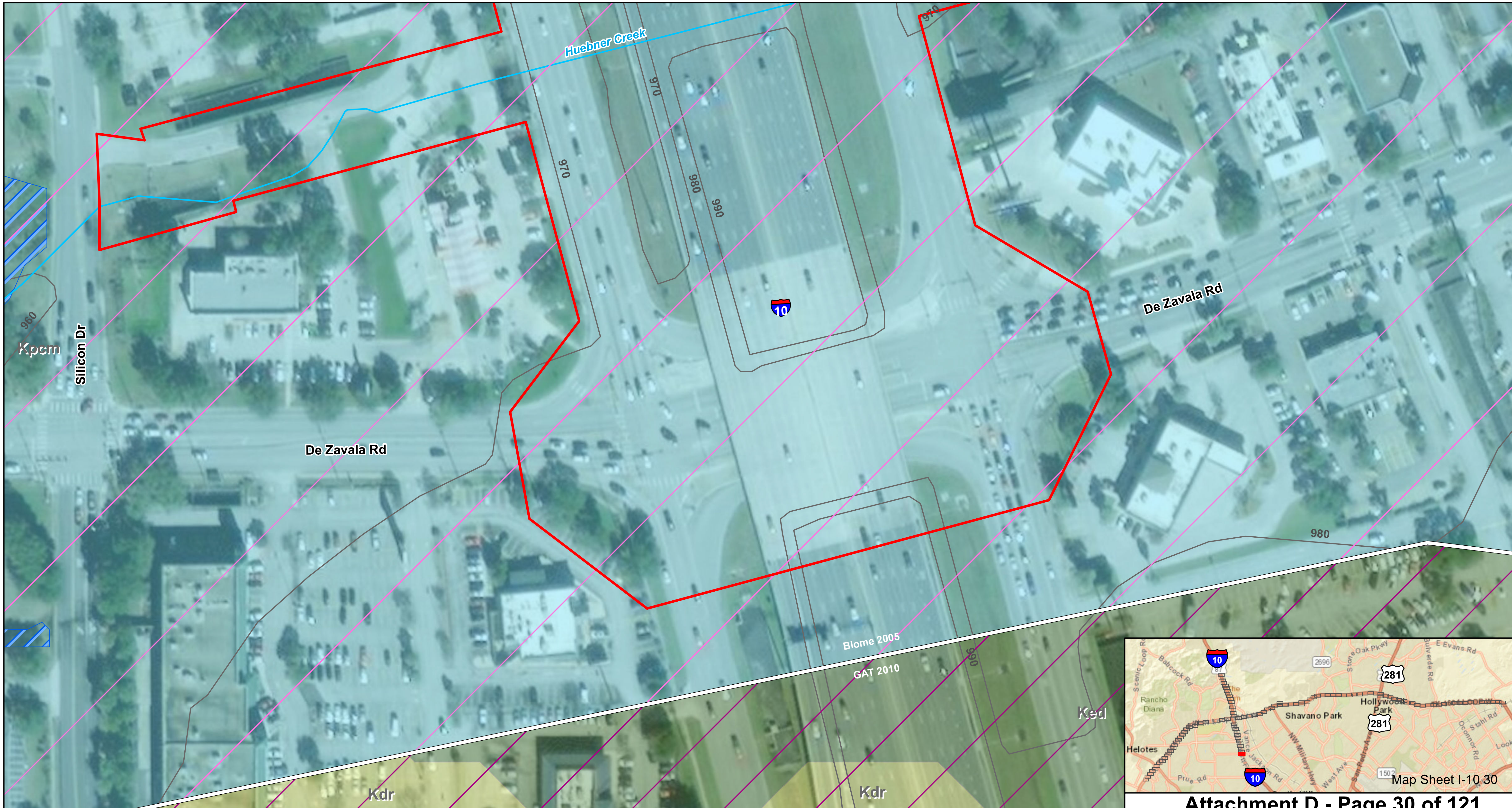

Attachment D - Page 30 of 121

Survey Area

GA Features

- Non-Sensitive: <35 Rating
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- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Boundary line between Geology data sources

Geology: GAT 2010, 250K

Fault Type

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Formation

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Geology: Blome 2005

Fault Type

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Edwards Aquifer Zones

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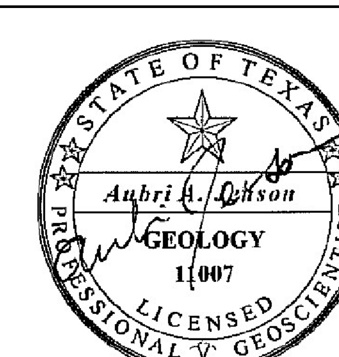

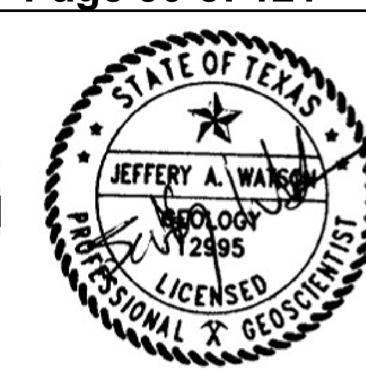

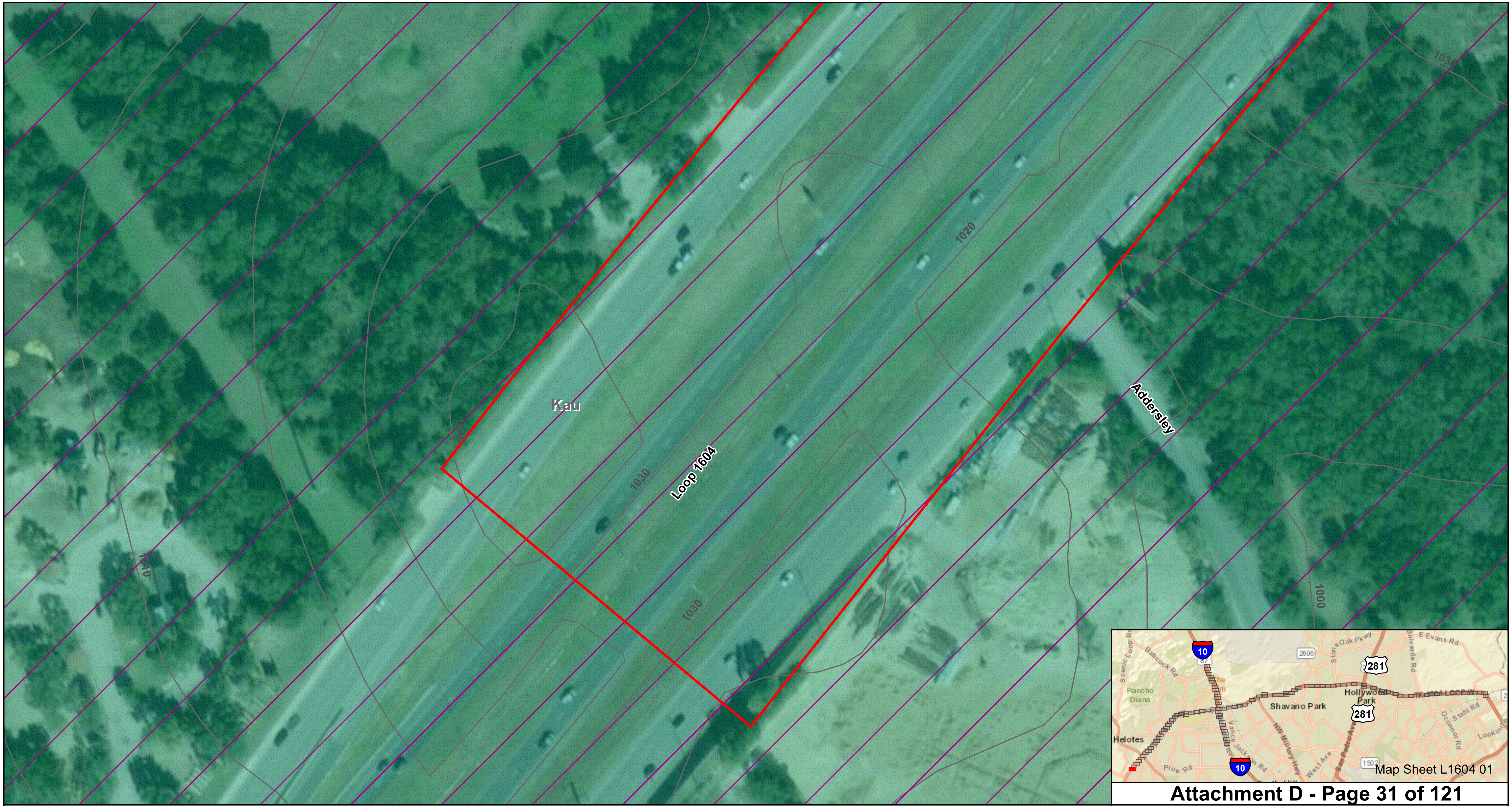

Attachment D - Page 31 of 121

Survey Area

Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

- StratMap 10-ft elevation contours
- Streams (FEMA)
- FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

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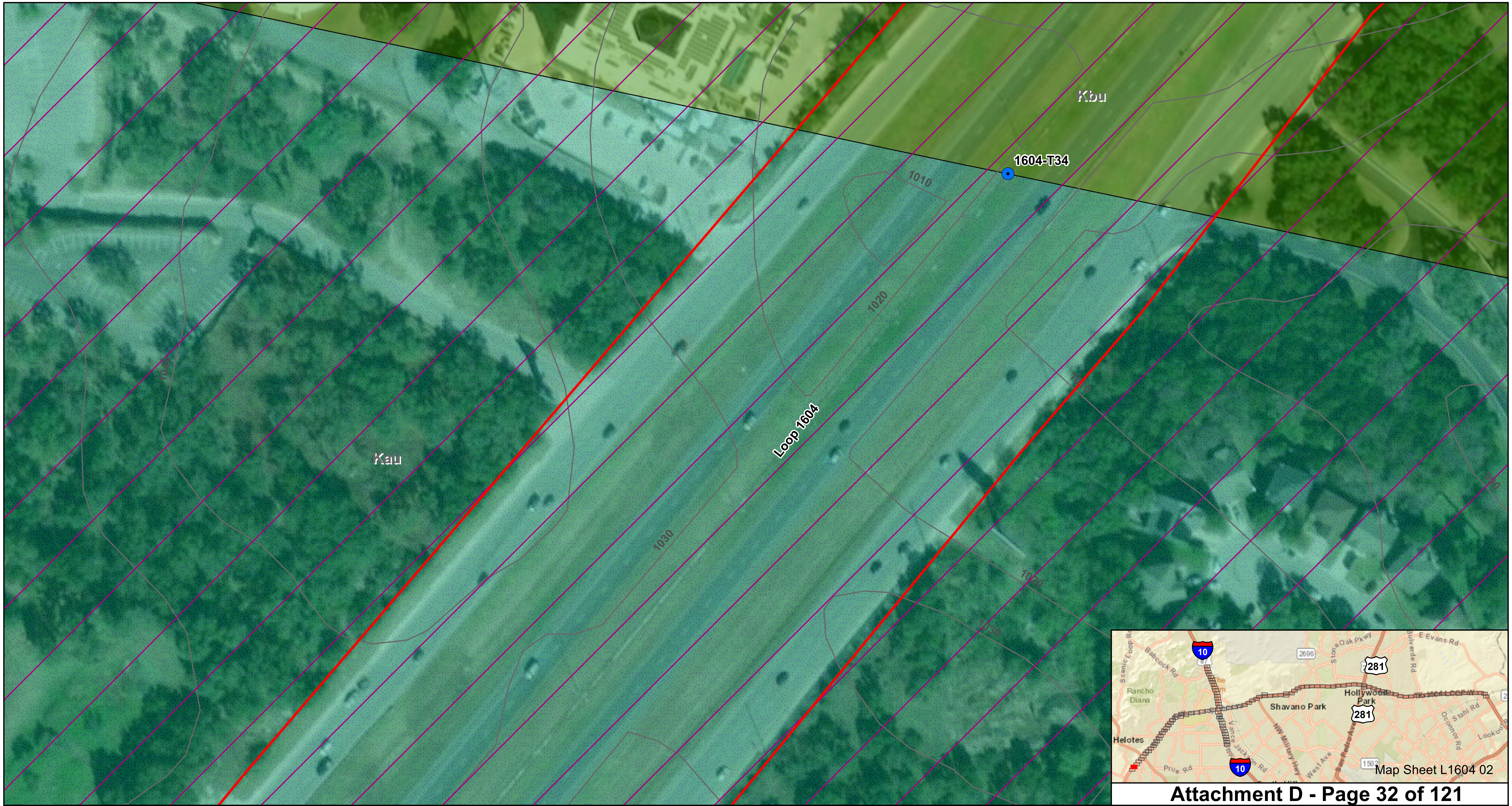

Attachment D - Page 32 of 121

Survey Area

GA Features
- Non-Sensitive: <35 Rating
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- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours
Streams (FEMA)
FEMA 100-yr flood zone

Boundary line between Geology data sources

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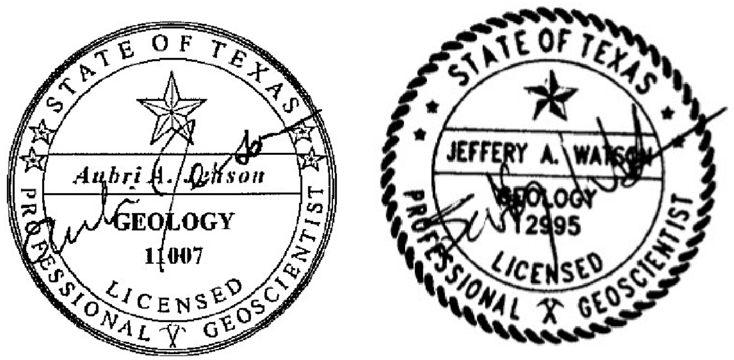


Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.

Survey Area

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Boundary line between Geology data sources

Geology: GAT 2010, 250K

Fault Type

- Normal
- Unspecified

Formation

- Qle - Leona Formation
- Qt - Fluviatile terrace deposits
- Kpg - Pecan Gap Chalk
- Kau - Austin Chalk
- Kef - Eagle Ford Group
- Kbu - Buda Limestone
- Kdr - Del Rio Clay
- Ked - Edwards Limestone
- Kgru - Upper Glen Rose Formation
- Kgrl - Lower Glen Rose Formation

Geology: Blome 2005

Fault Type

- Fault-certain
- Fault-inferred

Formation

- Ku - Upper Confining Units
- Kef - Eagle Ford Group
- Kb - Buda Limestone
- Kdr - Del Rio Clay
- Kg - Georgetown Formation
- Kpcm - Person Formation - Cyclic and Marine Member
- Kplc - Person Formation - Leached and Collapsed Member
- Kprd - Person Formation - Regional Dense Member
- Kkg - Kainer Formation - Grainstone Member
- Kkke - Kainer Formation Kirschberg Evaporite Member
- Kkd - Kainer Formation - Dolomitic Member
- Kkbn - Kainer Formation - Basal Nodular Member
- Kgr(u) - Upper Glen Rose

Edwards Aquifer Zones

- Contributing Zone
- Contributing withing Transition Zone
- Recharge Zone
- Transition Zone

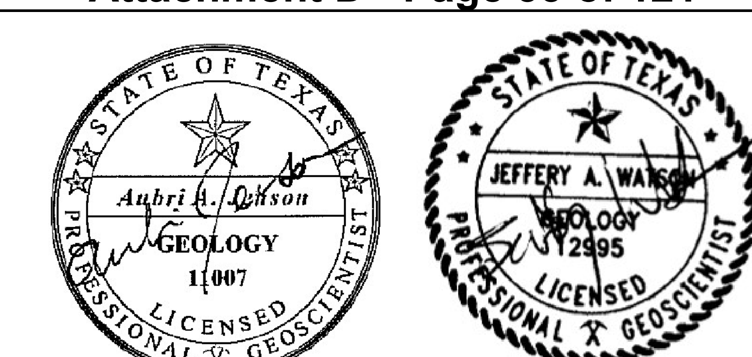
N

1 inch = 100 feet

0 50 100 200 300 Feet

0 50 100 Meters

Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.



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Survey Area

Boundary line between Geology data sources

GA Features
- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours
Streams (FEMA)
FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type
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- Unspecified

Formation
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Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.

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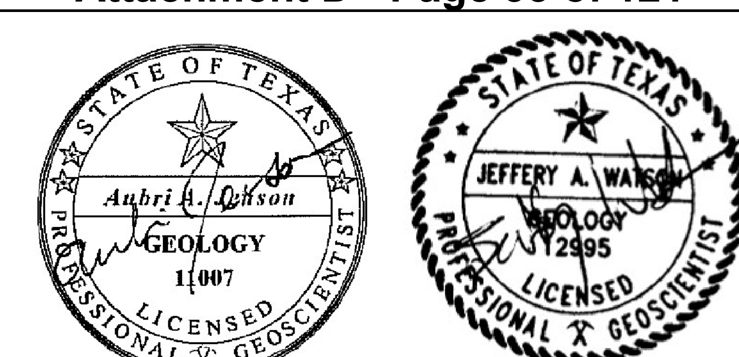

Survey Area

Boundary line between Geology data sources

GA Features
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- Sensitive: >40 Rating
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StratMap 10-ft elevation contours
Streams (FEMA)
FEMA 100-yr flood zone

Geology: GAT 2010, 250K

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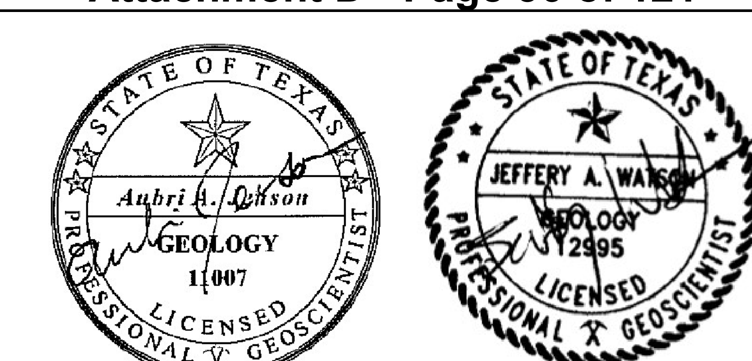

Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.

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Survey Area

Boundary line between Geology data sources

GA Features

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- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

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Formation

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Geology: Blome 2005

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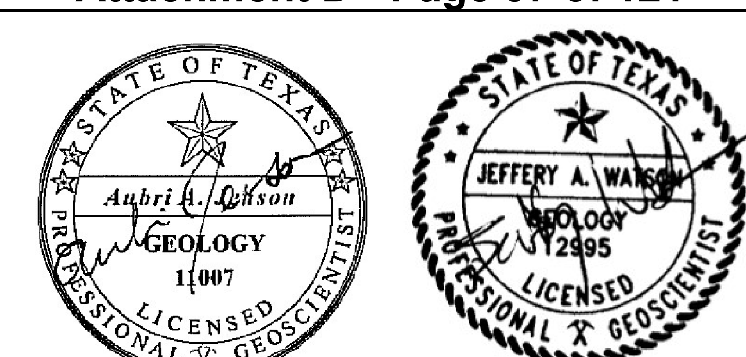

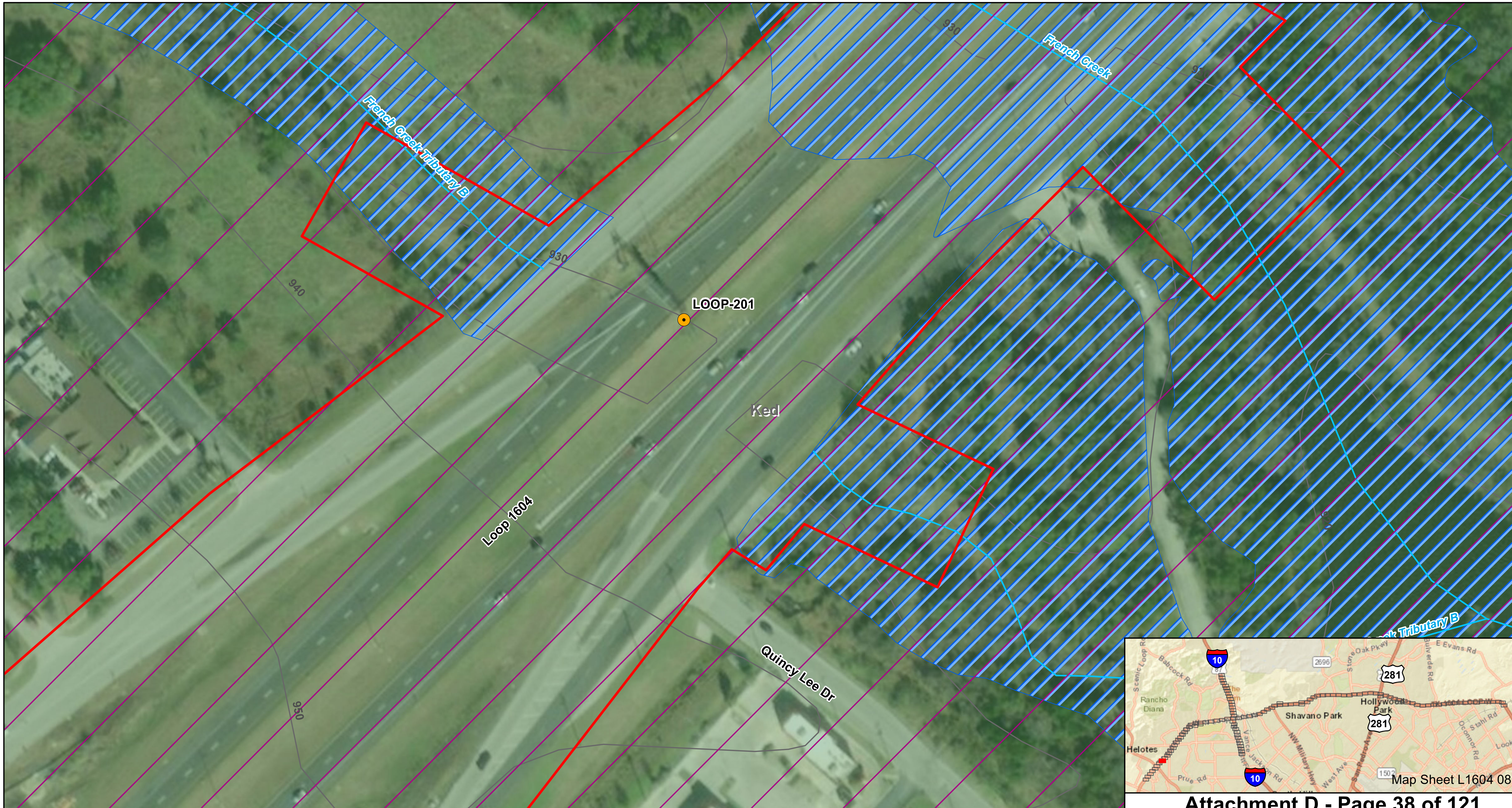

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Survey Area

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Boundary line between Geology data sources

Geology: GAT 2010, 250K

Fault Type

Normal

Unspecified

Formation

Qle - Leona Formation

Qt - Fluviatile terrace deposits

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Kef - Eagle Ford Group

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Kdr - Del Rio Clay

Ked - Edwards Limestone

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Kgrl - Lower Glen Rose Formation

Geology: Blome 2005

Fault Type

Fault-certain

Fault-inferred

Formation

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Edwards Aquifer Zones

Contributing Zone

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Recharge Zone

Transition Zone

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Attachment D - Page 39 of 121

Survey Area

GA Features
- Non-Sensitive: <35 Rating
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StratMap 10-ft elevation contours
Streams (FEMA)
FEMA 100-yr flood zone

Boundary line between Geology data sources

Geology: GAT 2010, 250K

Fault Type
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Edwards Aquifer Zones
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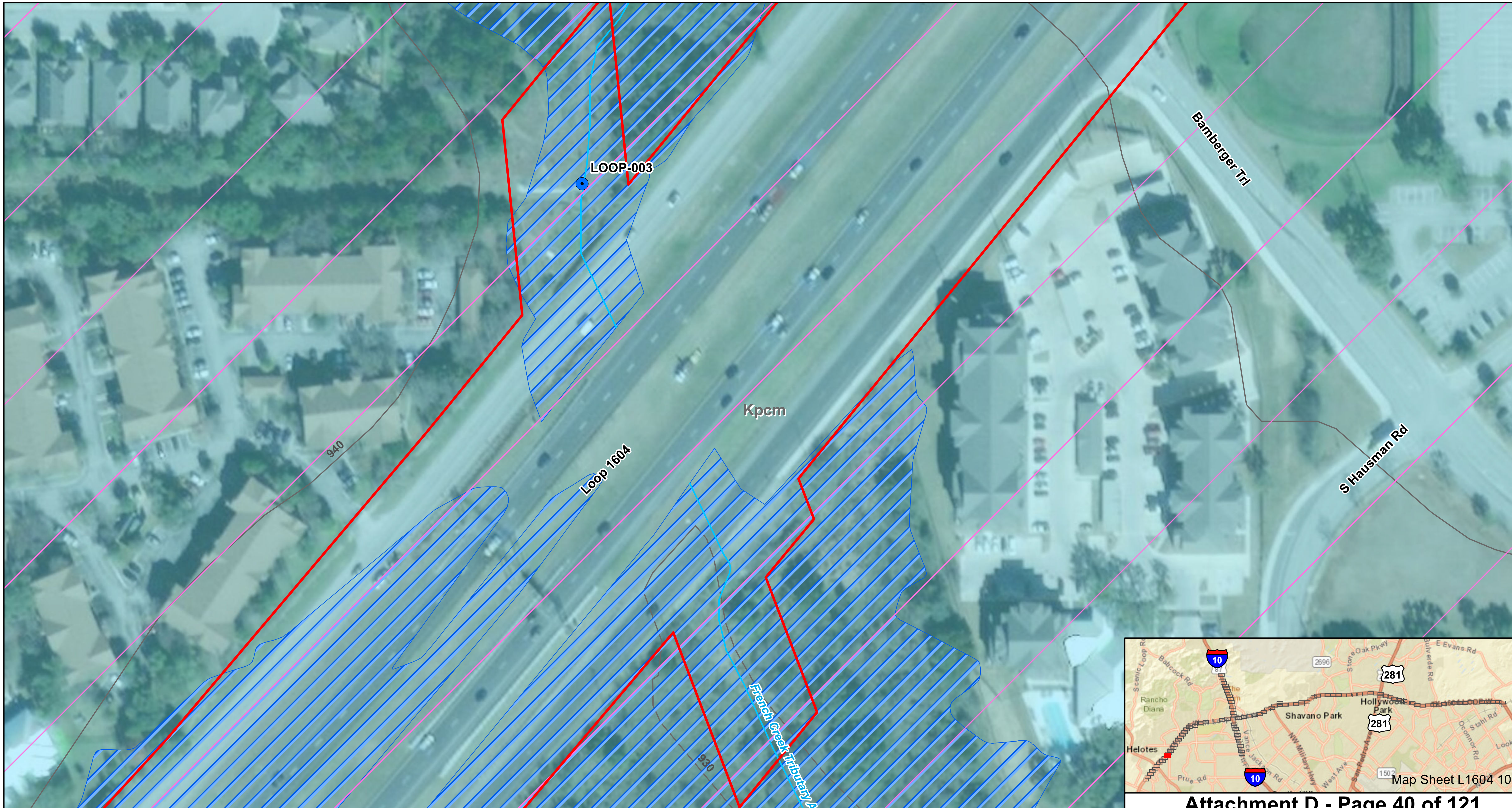

Attachment D - Page 40 of 121

Survey Area

Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

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Formation

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Geology: Blome 2005

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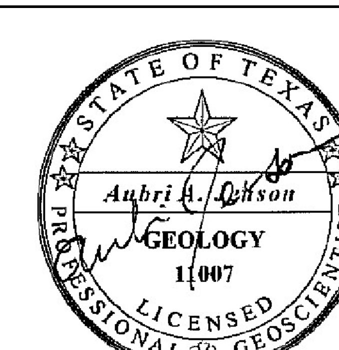
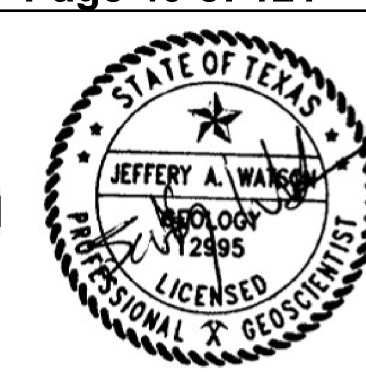
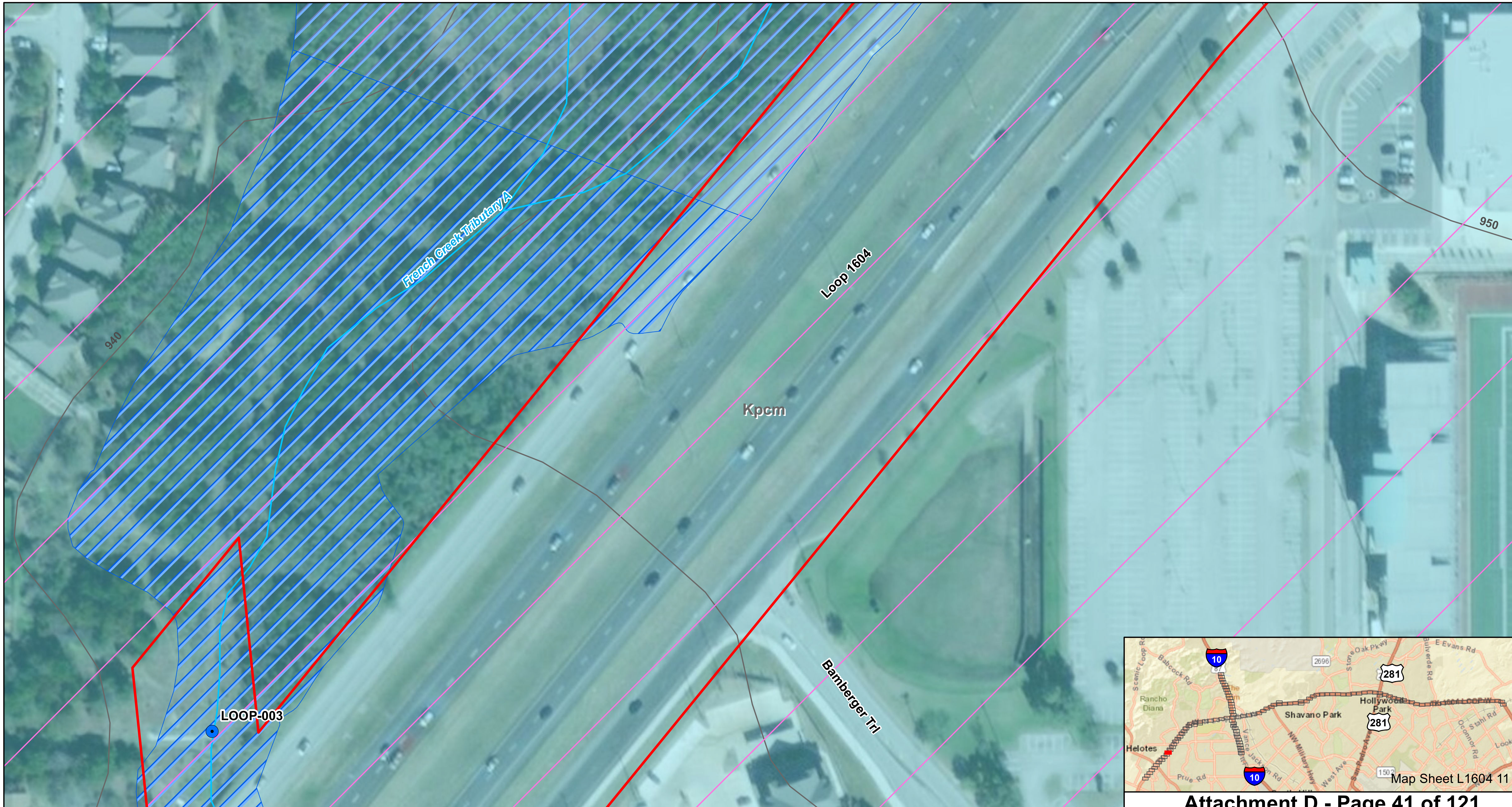




Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.



Attachment D - Page 41 of 121

Survey Area

Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

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Formation

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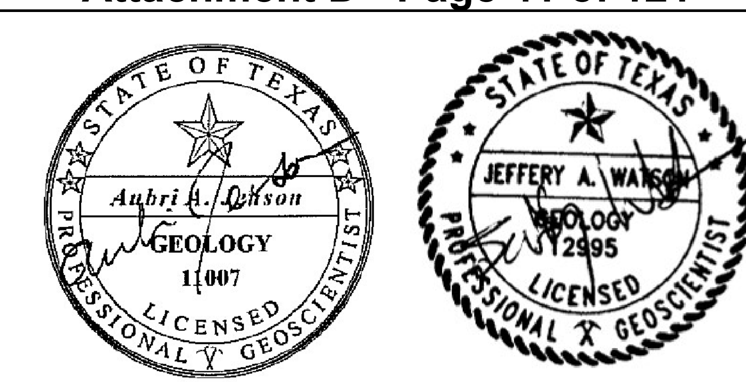

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- Survey Area
- Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
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- Sensitive: >40 Rating
- TWDB Wells
- StratMap 10-ft elevation contours
- Streams (FEMA)
- FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

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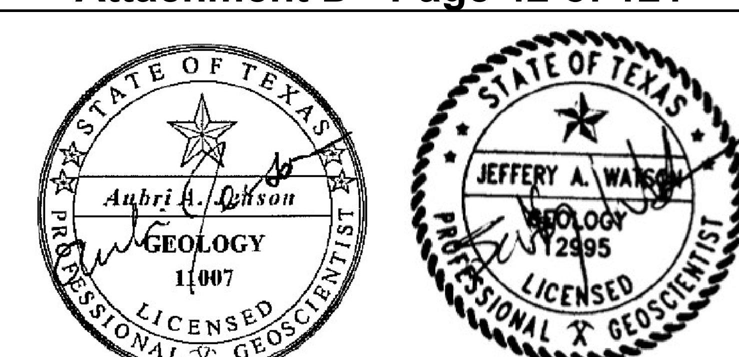

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Attachment D - Page 43 of 121

Survey Area

GA Features

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- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Boundary line between Geology data sources

Geology: GAT 2010, 250K

Fault Type

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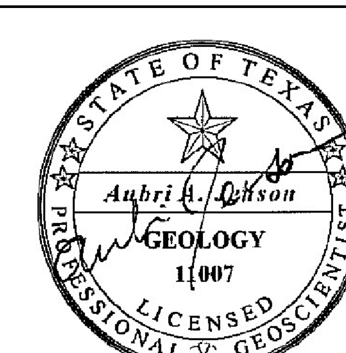
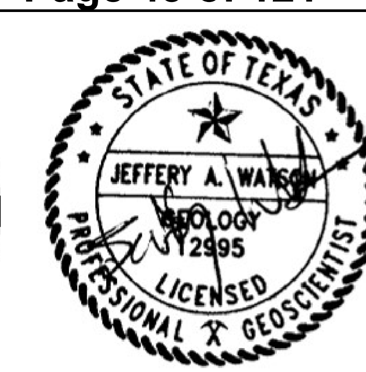
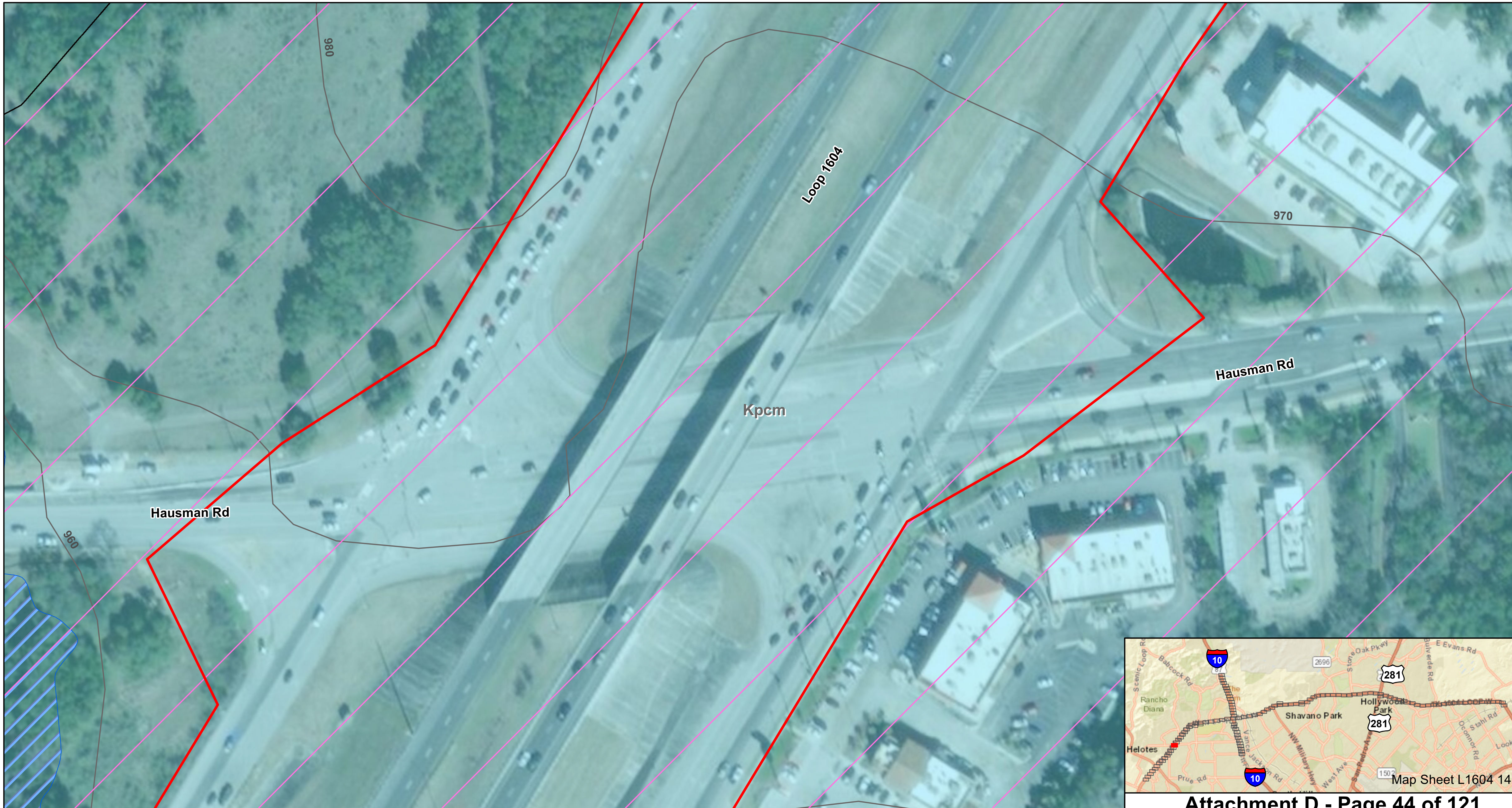
0 50 100 Meters





Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.



Attachment D - Page 44 of 121

Survey Area

Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

- Normal
- Unspecified

Formation

- Qle - Leona Formation
- Qt - Fluviatile terrace deposits
- Kpg - Pecan Gap Chalk
- Kau - Austin Chalk
- Kef - Eagle Ford Group
- Kbu - Buda Limestone
- Kdr - Del Rio Clay
- Ked - Edwards Limestone
- Kgru - Upper Glen Rose Formation
- Kgrl - Lower Glen Rose Formation

Geology: Blome 2005

Fault Type

- Fault-certain
- Fault-inferred

Formation

- Ku - Upper Confining Units
- Kef - Eagle Ford Group
- Kb - Buda Limestone
- Kdr - Del Rio Clay
- Kg - Georgetown Formation
- Kpcm - Person Formation - Cyclic and Marine Member
- Kplc - Person Formation - Leached and Collapsed Member
- Kprd - Person Formation - Regional Dense Member
- Kkg - Kainer Formation - Grainstone Member
- Kkke - Kainer Formation Kirschberg Evaporite Member
- Kkd - Kainer Formation - Dolomitic Member
- Kkbn - Kainer Formation - Basal Nodular Member
- Kgr(u) - Upper Glen Rose

Edwards Aquifer Zones

- Contributing Zone
- Contributing withing Transition Zone
- Recharge Zone
- Transition Zone

N

1 inch = 100 feet

0 50 100 200 300 Feet

0 50 100 Meters

Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.

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State of Texas
Jeffery A. Watson
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Licensed
Professional Geoscientist

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Survey Area

Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

Normal

Unspecified

Formation

Qle - Leona Formation

Qt - Fluviatile terrace deposits

Kpg - Pecan Gap Chalk

Kau - Austin Chalk

Kef - Eagle Ford Group

Kbu - Buda Limestone

Kdr - Del Rio Clay

Ked - Edwards Limestone

Kgru - Upper Glen Rose Formation

Kgrl - Lower Glen Rose Formation

Geology: Blome 2005

Fault Type

Fault-certain

Fault-inferred

Formation

Ku - Upper Confining Units

Kef - Eagle Ford Group

Kb - Buda Limestone

Kdr - Del Rio Clay

Kg - Georgetown Formation

Kpcm - Person Formation - Cyclic and Marine Member

Kplc - Person Formation - Leached and Collapsed Member

Kprd - Person Formation - Regional Dense Member

Kkg - Kainer Formation - Grainstone Member

Kkke - Kainer Formation Kirschberg Evaporite Member

Kkd - Kainer Formation - Dolomitic Member

Kkbn - Kainer Formation - Basal Nodular Member

Kgr(u) - Upper Glen Rose

Edwards Aquifer Zones

Contributing Zone

Contributing withing Transition Zone

Recharge Zone

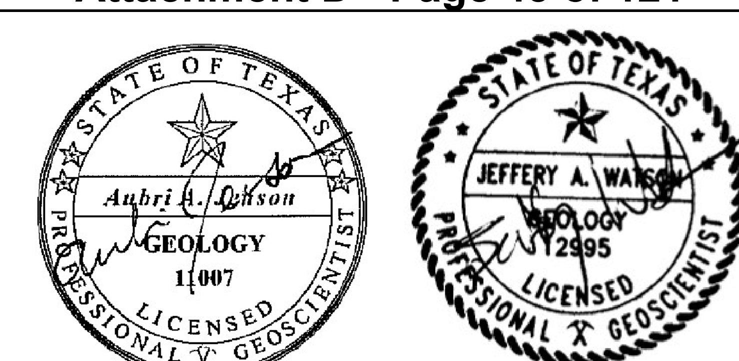
Transition Zone

N

1 inch = 100 feet

0 50 100 200 300 Feet

0 50 100 Meters



Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.

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Survey Area

Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

- Normal
- Unspecified

Formation

- Qle - Leona Formation
- Qt - Fluviatile terrace deposits
- Kpg - Pecan Gap Chalk
- Kau - Austin Chalk
- Kef - Eagle Ford Group
- Kbu - Buda Limestone
- Kdr - Del Rio Clay
- Ked - Edwards Limestone
- Kgru - Upper Glen Rose Formation
- Kgrl - Lower Glen Rose Formation

Geology: Blome 2005

Fault Type

- Fault-certain
- Fault-inferred

Formation

- Ku - Upper Confining Units
- Kef - Eagle Ford Group
- Kb - Buda Limestone
- Kdr - Del Rio Clay
- Kg - Georgetown Formation
- Kpcm - Person Formation - Cyclic and Marine Member
- Kplc - Person Formation - Leached and Collapsed Member
- Kprd - Person Formation - Regional Dense Member
- Kkg - Kainer Formation - Grainstone Member
- Kkke - Kainer Formation Kirschberg Evaporite Member
- Kkd - Kainer Formation - Dolomitic Member
- Kkbn - Kainer Formation - Basal Nodular Member
- Kgr(u) - Upper Glen Rose

Edwards Aquifer Zones

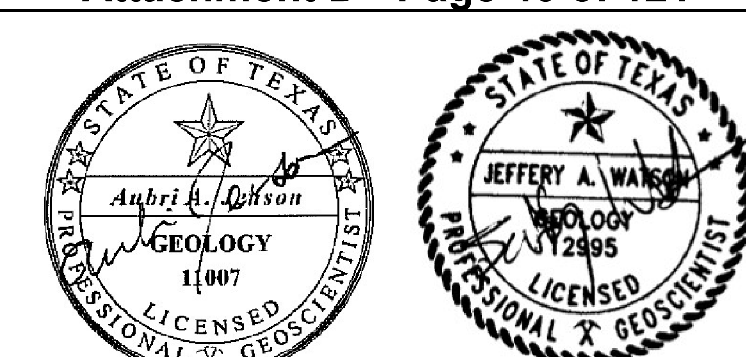
- Contributing Zone
- Contributing withing Transition Zone
- Recharge Zone
- Transition Zone

N

1 inch = 100 feet

0 50 100 200 300 Feet

0 50 100 Meters



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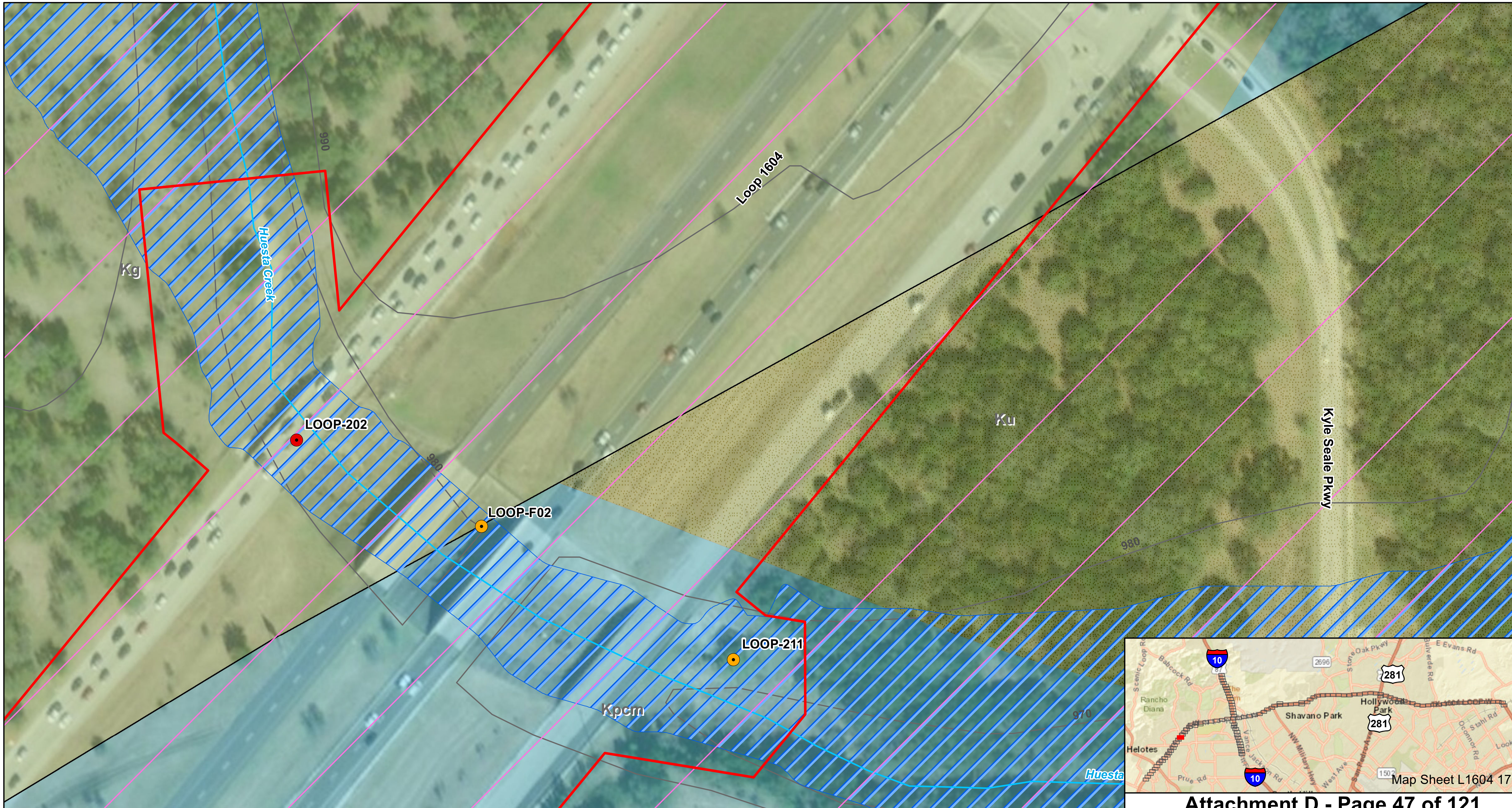

Attachment D - Page 47 of 121

Survey Area

Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

- Normal
- Unspecified

Formation

- Qle - Leona Formation
- Qt - Fluviatile terrace deposits
- Kpg - Pecan Gap Chalk
- Kau - Austin Chalk
- Kef - Eagle Ford Group
- Kbu - Buda Limestone
- Kdr - Del Rio Clay
- Ked - Edwards Limestone
- Kgru - Upper Glen Rose Formation
- Kgrl - Lower Glen Rose Formation

Geology: Blome 2005

Fault Type

- Fault-certain
- Fault-inferred

Formation

- Ku - Upper Confining Units
- Kef - Eagle Ford Group
- Kb - Buda Limestone
- Kdr - Del Rio Clay
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- Kpcm - Person Formation - Cyclic and Marine Member
- Kplc - Person Formation - Leached and Collapsed Member
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- Kkg - Kainer Formation - Grainstone Member
- Kkke - Kainer Formation Kirschberg Evaporite Member
- Kkd - Kainer Formation - Dolomitic Member
- Kkbn - Kainer Formation - Basal Nodular Member
- Kgr(u) - Upper Glen Rose

Edwards Aquifer Zones

- Contributing Zone
- Contributing withing Transition Zone
- Recharge Zone
- Transition Zone

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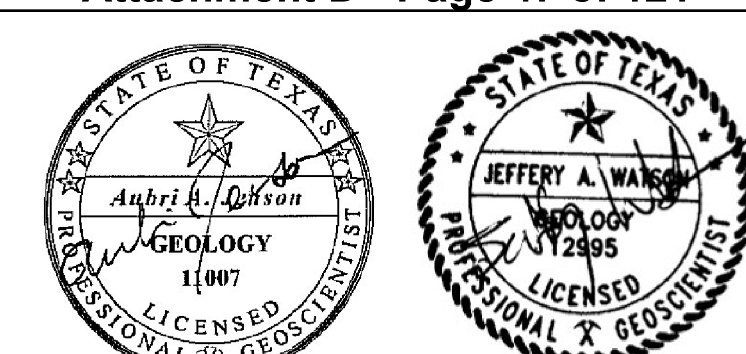
1 inch = 100 feet

0 50 100 200 300 Feet

0 50 100 Meters

Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.



Attachment D - Page 48 of 121

Survey Area

Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

- Normal
- Unspecified

Formation

- Qle - Leona Formation
- Qt - Fluviatile terrace deposits
- Kpg - Pecan Gap Chalk
- Kau - Austin Chalk
- Kef - Eagle Ford Group
- Kbu - Buda Limestone
- Kdr - Del Rio Clay
- Ked - Edwards Limestone
- Kgru - Upper Glen Rose Formation
- Kgrl - Lower Glen Rose Formation

Geology: Blome 2005

Fault Type

- Fault-certain
- Fault-inferred

Formation

- Ku - Upper Confining Units
- Kef - Eagle Ford Group
- Kb - Buda Limestone
- Kdr - Del Rio Clay
- Kg - Georgetown Formation
- Kpcm - Person Formation - Cyclic and Marine Member
- Kplc - Person Formation - Leached and Collapsed Member
- Kprd - Person Formation - Regional Dense Member
- Kkg - Kainer Formation - Grainstone Member
- Kkke - Kainer Formation Kirschberg Evaporite Member
- Kkd - Kainer Formation - Dolomitic Member
- Kkbn - Kainer Formation - Basal Nodular Member
- Kgr(u) - Upper Glen Rose

Edwards Aquifer Zones

- Contributing Zone
- Contributing withing Transition Zone
- Recharge Zone
- Transition Zone

N

1 inch = 100 feet

0 50 100 200 300 Feet

0 50 100 Meters

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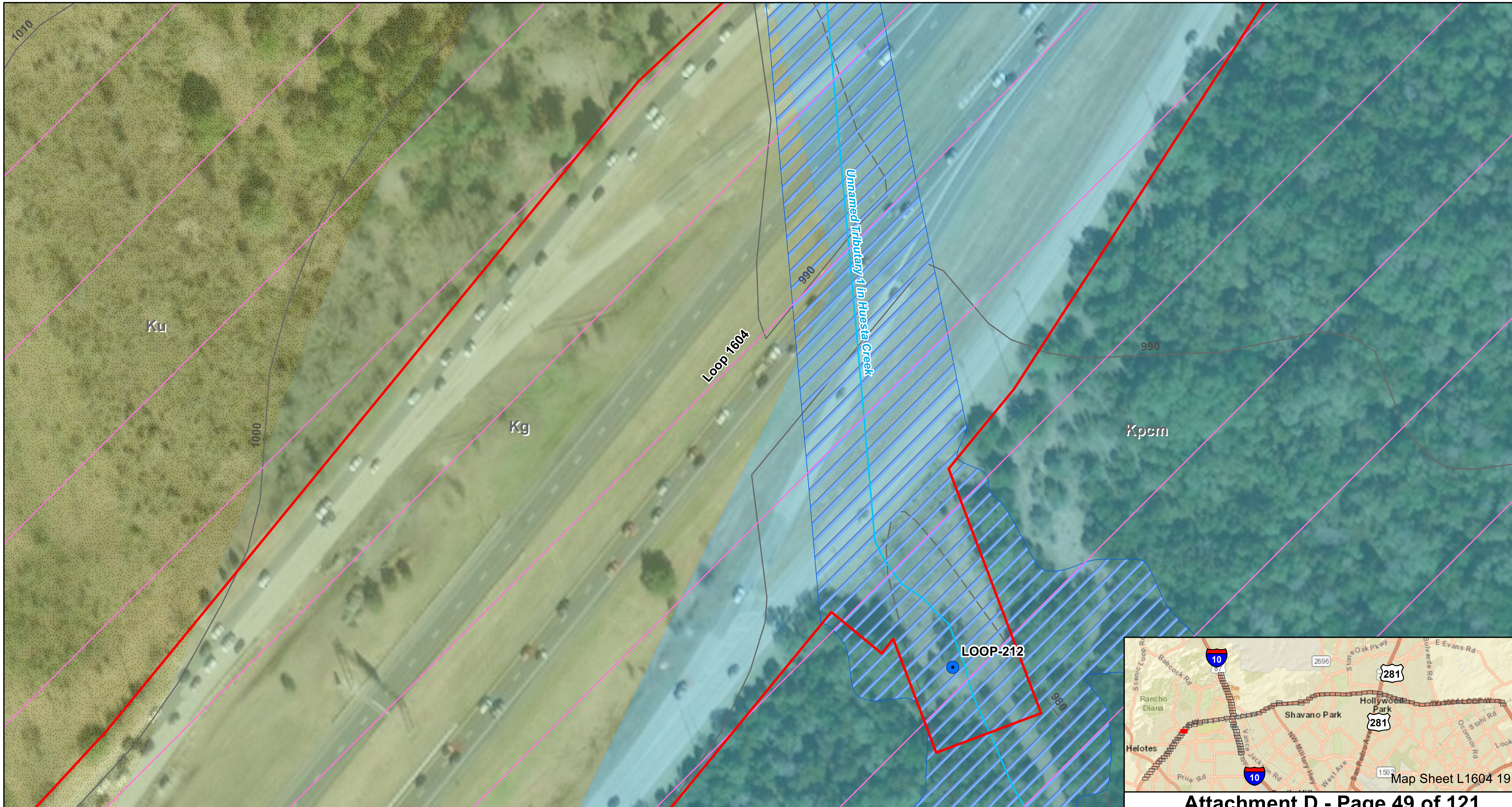
Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.



Survey Area

Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

- Normal
- Unspecified

Formation

- Qle - Leona Formation
- Qt - Fluviatile terrace deposits
- Kpg - Pecan Gap Chalk
- Kau - Austin Chalk
- Kef - Eagle Ford Group
- Kbu - Buda Limestone
- Kdr - Del Rio Clay
- Ked - Edwards Limestone
- Kgru - Upper Glen Rose Formation
- Kgrl - Lower Glen Rose Formation

Geology: Blome 2005

Fault Type

- Fault-certain
- Fault-inferred

Formation

- Ku - Upper Confining Units
- Kef - Eagle Ford Group
- Kb - Buda Limestone
- Kdr - Del Rio Clay
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- Kkke - Kainer Formation Kirschberg Evaporite Member
- Kkd - Kainer Formation - Dolomitic Member
- Kkbn - Kainer Formation - Basal Nodular Member
- Kgr(u) - Upper Glen Rose

Edwards Aquifer Zones

- Contributing Zone
- Contributing withing Transition Zone
- Recharge Zone
- Transition Zone

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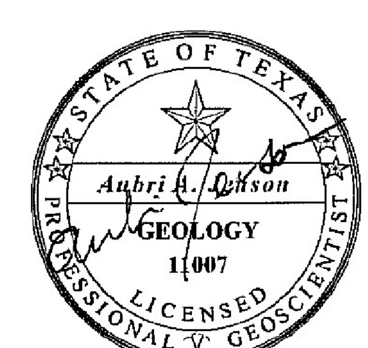
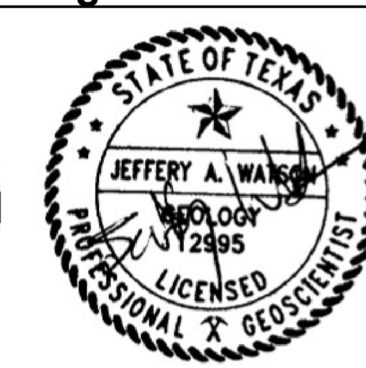
0 50 100 Meters





Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.

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Survey Area

GA Features
- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours
Streams (FEMA)
FEMA 100-yr flood zone

Boundary line between Geology data sources

Geology: GAT 2010, 250K
Fault Type
- Normal
- Unspecified

Formation
- Qle - Leona Formation
- Qt - Fluviatile terrace deposits
- Kpg - Pecan Gap Chalk
- Kau - Austin Chalk
- Kef - Eagle Ford Group
- Kbu - Buda Limestone
- Kdr - Del Rio Clay
- Ked - Edwards Limestone
- Kgru - Upper Glen Rose Formation
- Kgrl - Lower Glen Rose Formation

Geology: Blome 2005
Fault Type
- Fault-certain
- Fault-inferred

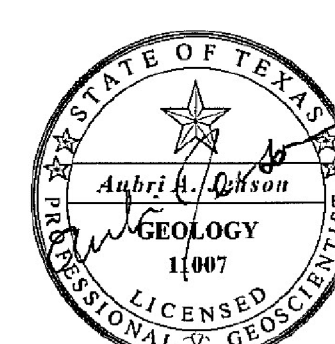
Formation
- Ku - Upper Confining Units
- Kef - Eagle Ford Group
- Kb - Buda Limestone
- Kdr - Del Rio Clay
- Kg - Georgetown Formation
- Kpcm - Person Formation - Cyclic and Marine Member
- Kplc - Person Formation - Leached and Collapsed Member
- Kprd - Person Formation - Regional Dense Member
- Kkg - Kainer Formation - Grainstone Member
- Kkke - Kainer Formation Kirschberg Evaporite Member
- Kkd - Kainer Formation - Dolomitic Member
- Kkbn - Kainer Formation - Basal Nodular Member
- Kgr(u) - Upper Glen Rose

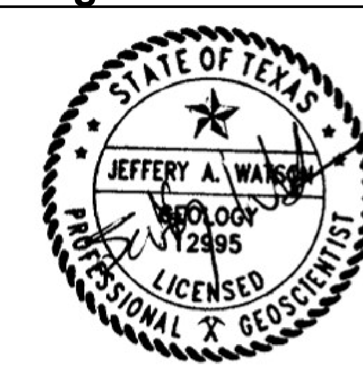
Edwards Aquifer Zones
- Contributing Zone
- Contributing withing Transition Zone
- Recharge Zone
- Transition Zone

N

1 inch = 100 feet

0 50 100 200 300 Feet
0 50 100 Meters





Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.

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Survey Area

Boundary line between Geology data sources

GA Features
- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours
Streams (FEMA)
FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type
- Normal
- Unspecified

Formation
- Qle - Leona Formation
- Qt - Fluviatile terrace deposits
- Kpg - Pecan Gap Chalk
- Kau - Austin Chalk
- Kef - Eagle Ford Group
- Kbu - Buda Limestone
- Kdr - Del Rio Clay
- Ked - Edwards Limestone
- Kgru - Upper Glen Rose Formation
- Kgrl - Lower Glen Rose Formation

Geology: Blome 2005

Fault Type
- Fault-certain
- Fault-inferred

Formation
- Ku - Upper Confining Units
- Kef - Eagle Ford Group
- Kb - Buda Limestone
- Kdr - Del Rio Clay
- Kg - Georgetown Formation
- Kpcm - Person Formation - Cyclic and Marine Member
- Kplc - Person Formation - Leached and Collapsed Member
- Kprd - Person Formation - Regional Dense Member
- Kkg - Kainer Formation - Grainstone Member
- Kkke - Kainer Formation Kirschberg Evaporite Member
- Kkd - Kainer Formation - Dolomitic Member
- Kkbn - Kainer Formation - Basal Nodular Member
- Kgr(u) - Upper Glen Rose

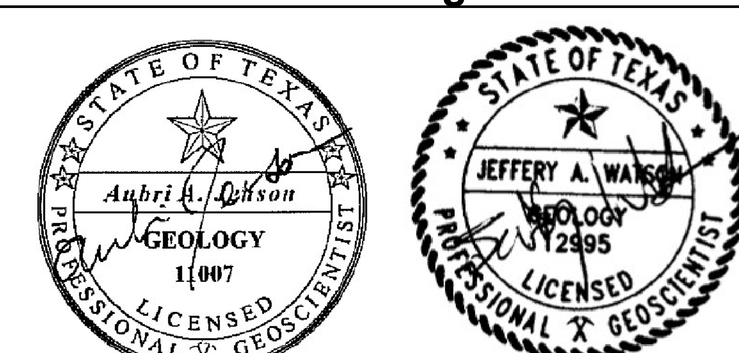
Edwards Aquifer Zones
- Contributing Zone
- Contributing withing Transition Zone
- Recharge Zone
- Transition Zone

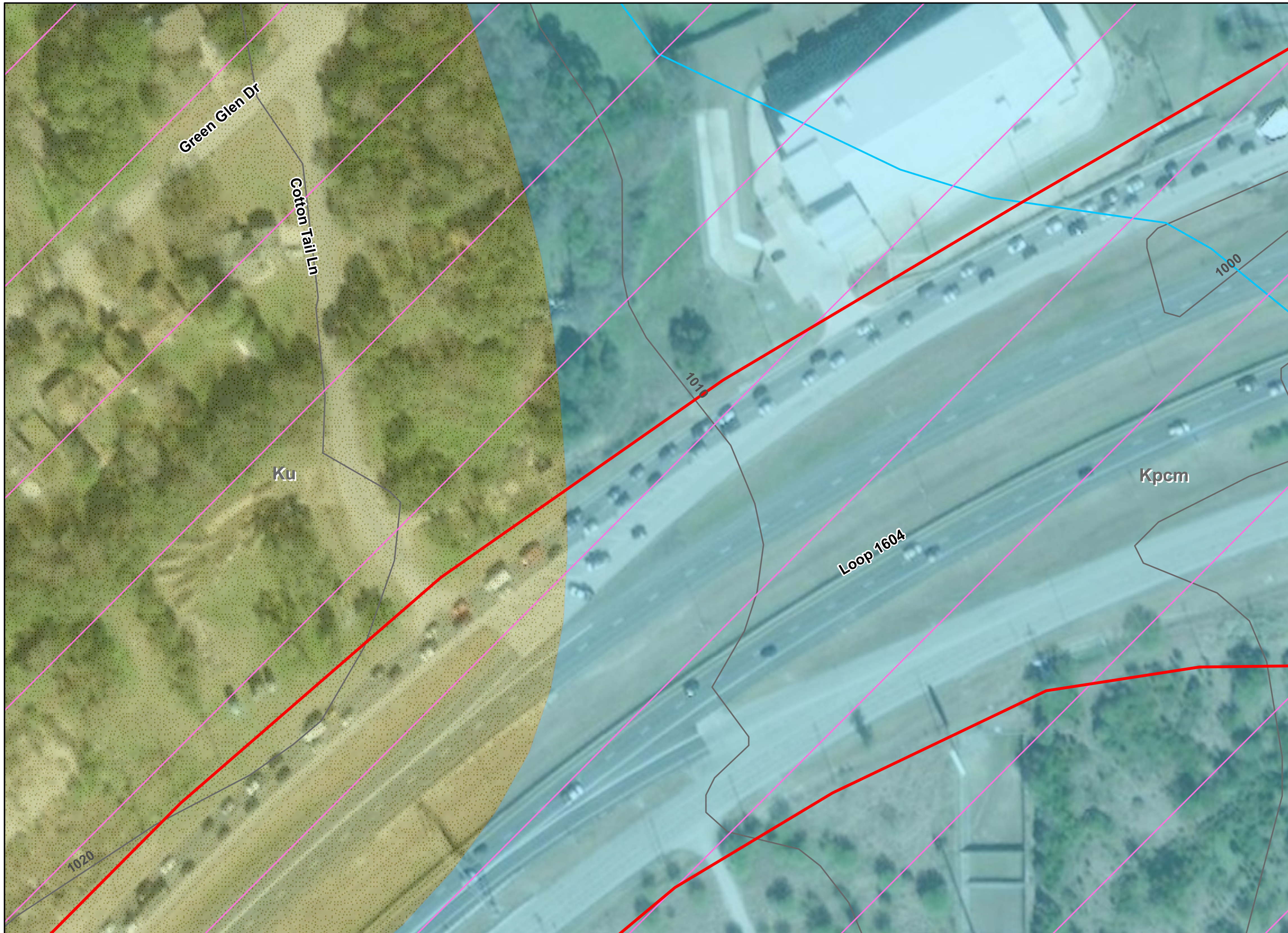
N

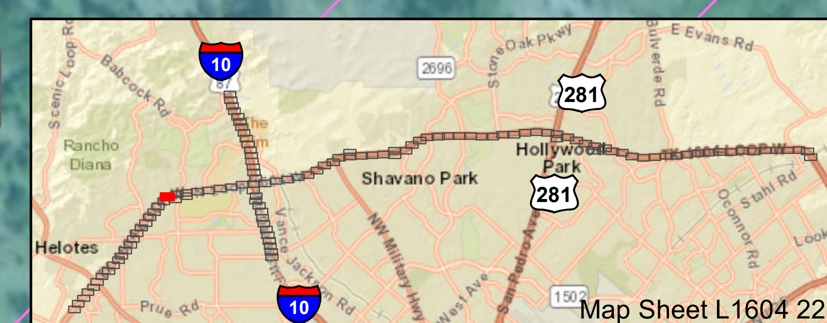
1 inch = 100 feet

0 50 100 200 300 Feet
0 50 100 Meters

Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.







Attachment D - Page 52 of 121

Survey Area	Boundary line between Geology data sources	Kef - Eagle Ford Group	**Formation**	Kkd - Kainer Formation - Dolomitic Member
GA Features	**Geology: GAT 2010, 250K**	Kbu - Buda Limestone	Ku - Upper Confining Units	Kkbn - Kainer Formation - Basal Nodular Member
Non-Sensitive: <35 Rating	**Fault Type**	Kdr - Del Rio Clay	Kef - Eagle Ford Group	Kgr(u) - Upper Glen Rose
Non-Senstive: >35 Rating	Normal	Ked - Edwards Limestone	Kb - Buda Limestone	**Edwards Aquifer Zones**
Sensitive: >40 Rating	Unspecified	Kgru - Upper Glen Rose Formation	Kdr - Del Rio Clay	Contributing Zone
TWDB Wells	**Formation**	Kgrl - Lower Glen Rose Formation	Kg - Georgetown Formation	Contributing withing Transition Zone
StratMap 10-ft elevation contours	Qle - Leona Formation	**Geology: Blome 2005**	Kpcm - Person Formation - Cyclic and Marine Member	Recharge Zone
Streams (FEMA)	Qt - Fluviatile terrace deposits	**Fault Type**	Kplc - Person Formation - Leached and Collapsed Member	Transition Zone
FEMA 100-yr flood zone	Kpg - Pecan Gap Chalk	Fault-certain	Kprd - Person Formation - Regional Dense Member	
	Kau - Austin Chalk	Fault-inferred	Kkg - Kainer Formation - Grainstone Member	
			Kkke - Kainer Formation Kirschberg Evaporite Member	

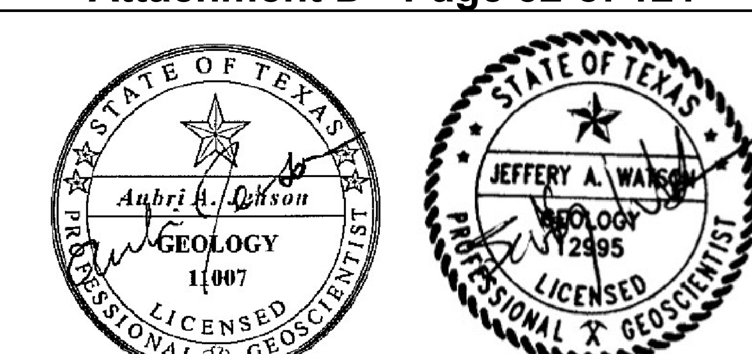
N

1 inch = 100 feet

0 50 100 200 300 Feet

0 50 100 Meters

Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.



Attachment D - Page 53 of 121

Survey Area

GA Features
- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours
Streams (FEMA)
FEMA 100-yr flood zone

Boundary line between Geology data sources

Geology: GAT 2010, 250K
Fault Type
- Normal
- Unspecified

Formation
- Qle - Leona Formation
- Qt - Fluviatile terrace deposits
- Kpg - Pecan Gap Chalk
- Kau - Austin Chalk
- Kef - Eagle Ford Group
- Kbu - Buda Limestone
- Kdr - Del Rio Clay
- Ked - Edwards Limestone
- Kgru - Upper Glen Rose Formation
- Kgrl - Lower Glen Rose Formation

Geology: Blome 2005
Fault Type
- Fault-certain
- Fault-inferred

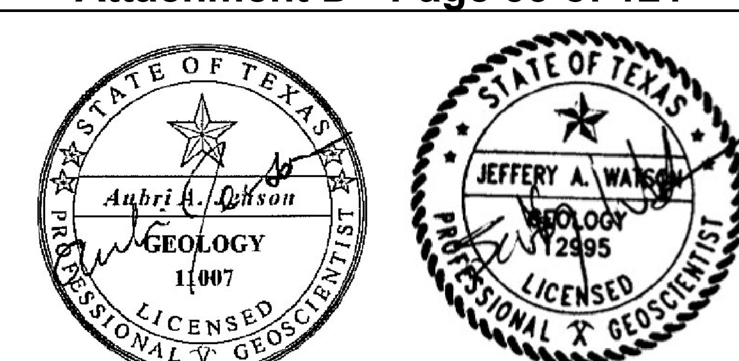
Formation
- Ku - Upper Confining Units
- Kef - Eagle Ford Group
- Kb - Buda Limestone
- Kdr - Del Rio Clay
- Kg - Georgetown Formation
- Kpcm - Person Formation - Cyclic and Marine Member
- Kplc - Person Formation - Leached and Collapsed Member
- Kprd - Person Formation - Regional Dense Member
- Kkg - Kainer Formation - Grainstone Member
- Kkke - Kainer Formation Kirschberg Evaporite Member
- Kkd - Kainer Formation - Dolomitic Member
- Kkbn - Kainer Formation - Basal Nodular Member
- Kgr(u) - Upper Glen Rose

Edwards Aquifer Zones
- Contributing Zone
- Contributing withing Transition Zone
- Recharge Zone
- Transition Zone

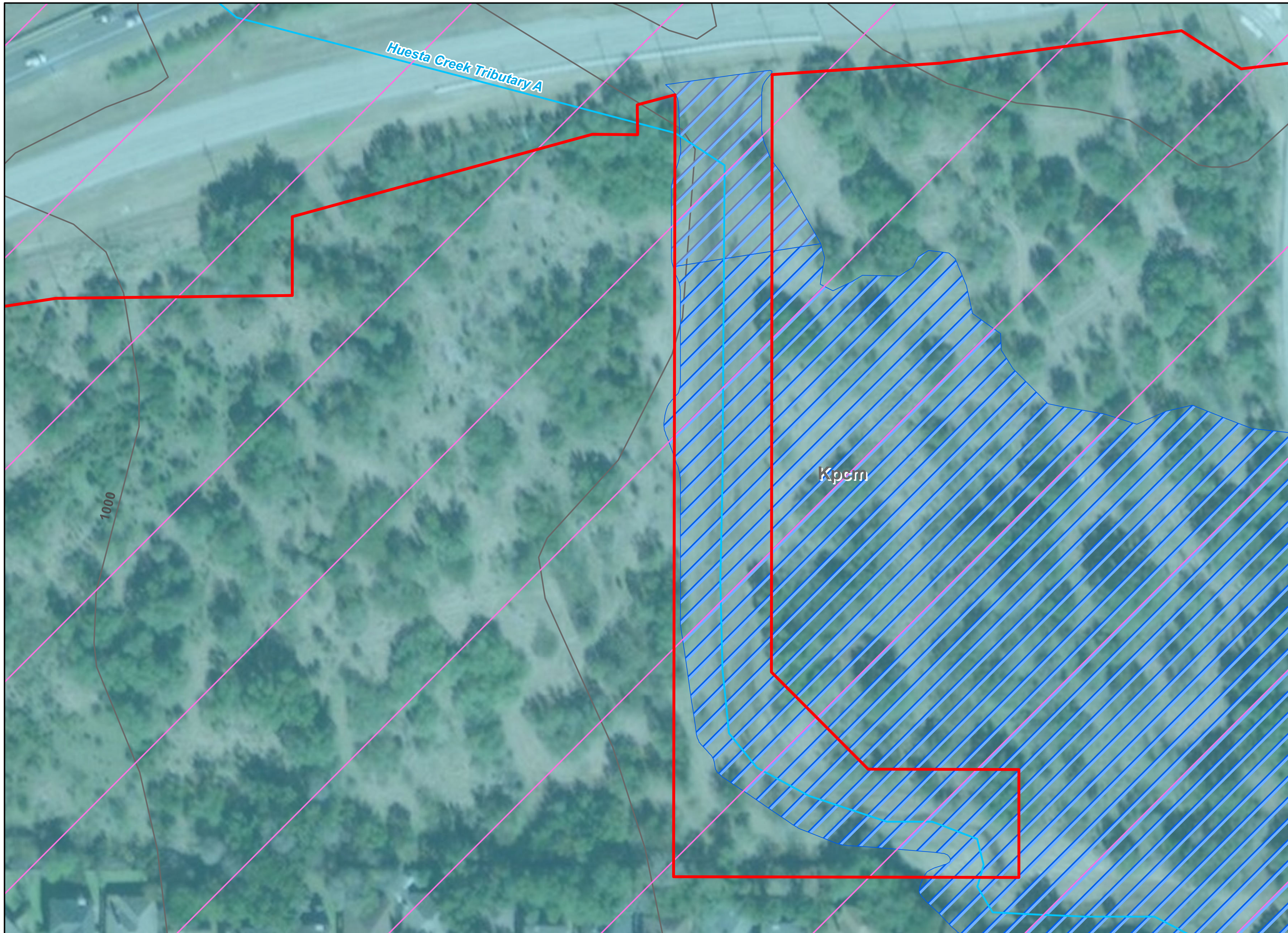
N

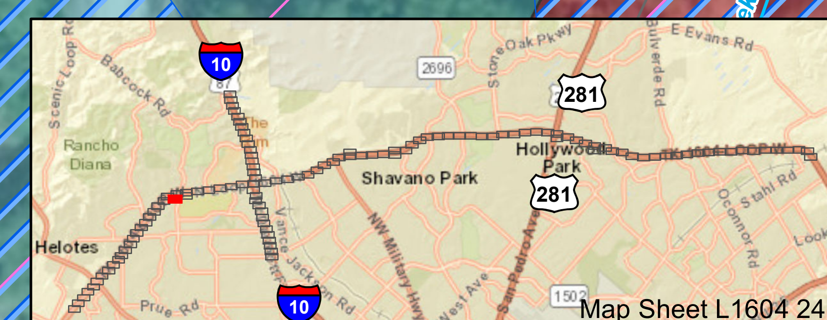
1 inch = 100 feet

0 50 100 200 300 Feet
0 50 100 Meters



Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.





Attachment D - Page 54 of 121

Survey Area

Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

Normal

Unspecified

Formation

Qle - Leona Formation

Qt - Fluviatile terrace deposits

Kpg - Pecan Gap Chalk

Kau - Austin Chalk

Kef - Eagle Ford Group

Kbu - Buda Limestone

Kdr - Del Rio Clay

Ked - Edwards Limestone

Kgru - Upper Glen Rose Formation

Kgrl - Lower Glen Rose Formation

Geology: Blome 2005

Fault Type

Fault-certain

Fault-inferred

Formation

Ku - Upper Confining Units

Kef - Eagle Ford Group

Kb - Buda Limestone

Kdr - Del Rio Clay

Kg - Georgetown Formation

Kpcm - Person Formation - Cyclic and Marine Member

Kplc - Person Formation - Leached and Collapsed Member

Kprd - Person Formation - Regional Dense Member

Kkg - Kainer Formation - Grainstone Member

Kkke - Kainer Formation Kirschberg Evaporite Member

Kkd - Kainer Formation - Dolomitic Member

Kkbn - Kainer Formation - Basal Nodular Member

Kgr(u) - Upper Glen Rose

Edwards Aquifer Zones

Contributing Zone

Contributing withing Transition Zone

Recharge Zone

Transition Zone

N

1 inch = 100 feet

0 50 100 200 300 Feet

0 50 100 Meters

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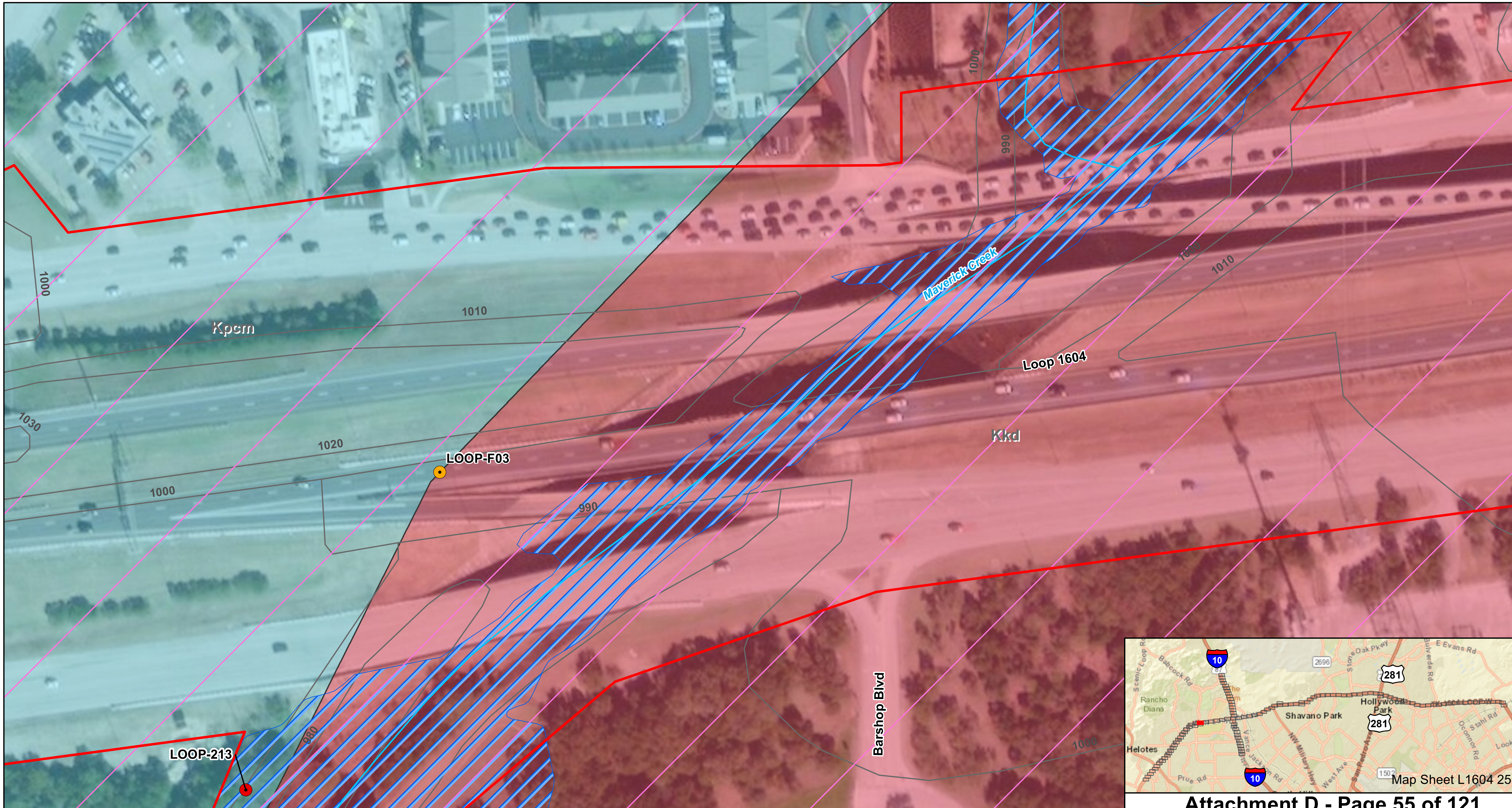

Attachment D - Page 55 of 121

Survey Area

Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

- Normal
- Unspecified

Formation

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Geology: Blome 2005

Fault Type

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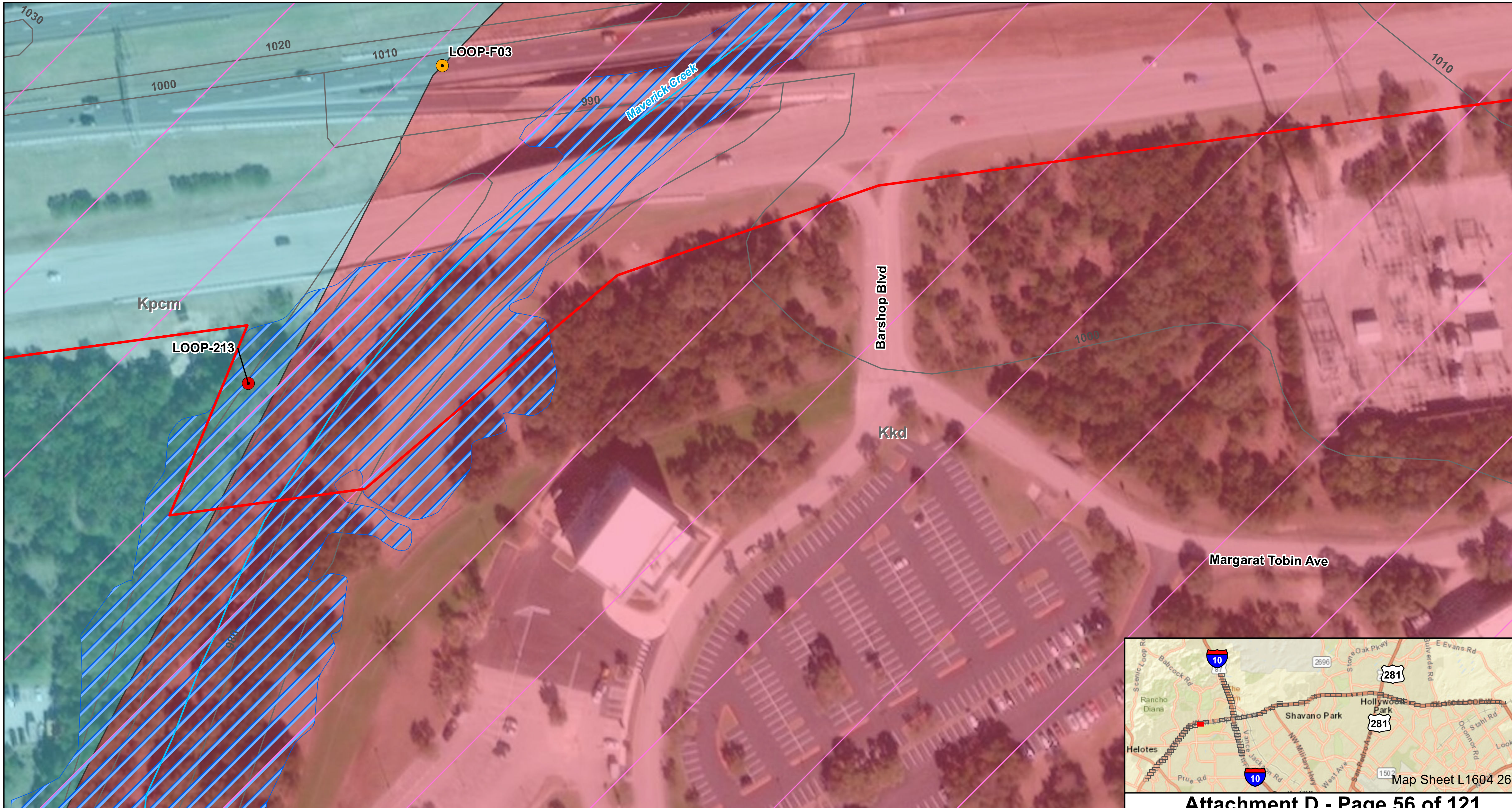

Attachment D - Page 56 of 121

Survey Area

Boundary line between Geology data sources

GA Features

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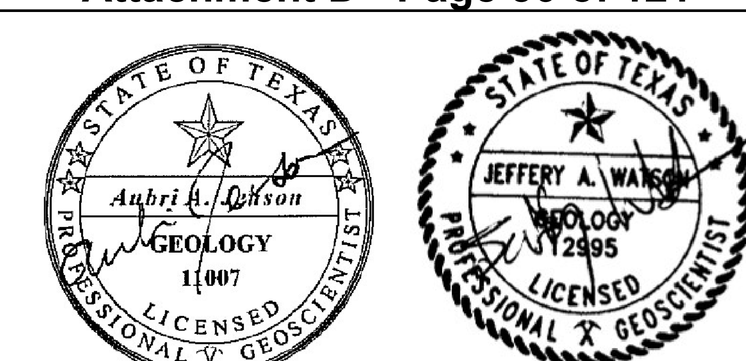

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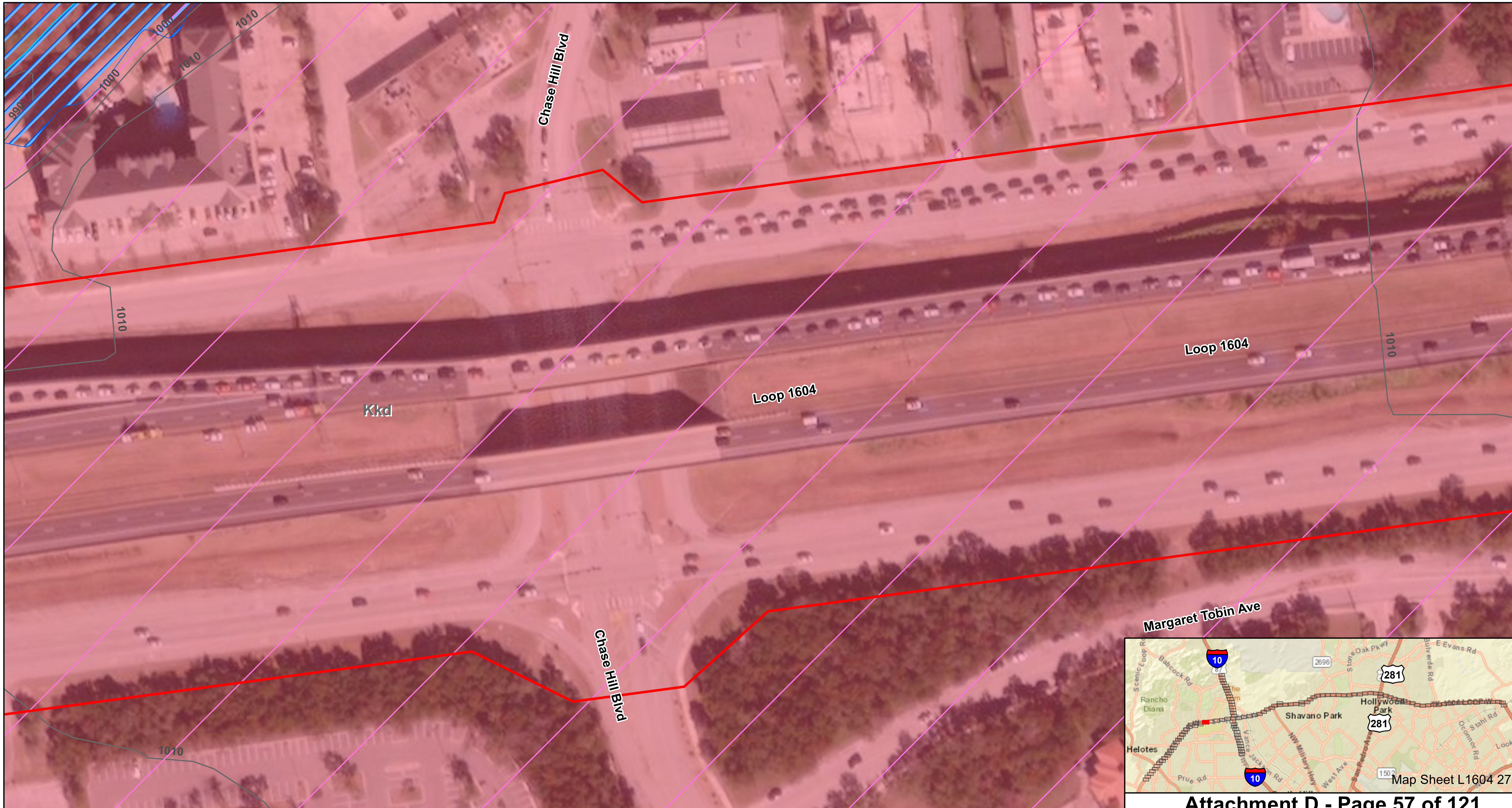

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FEMA 100-yr flood zone

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Geology: Blome 2005

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Fault-inferred

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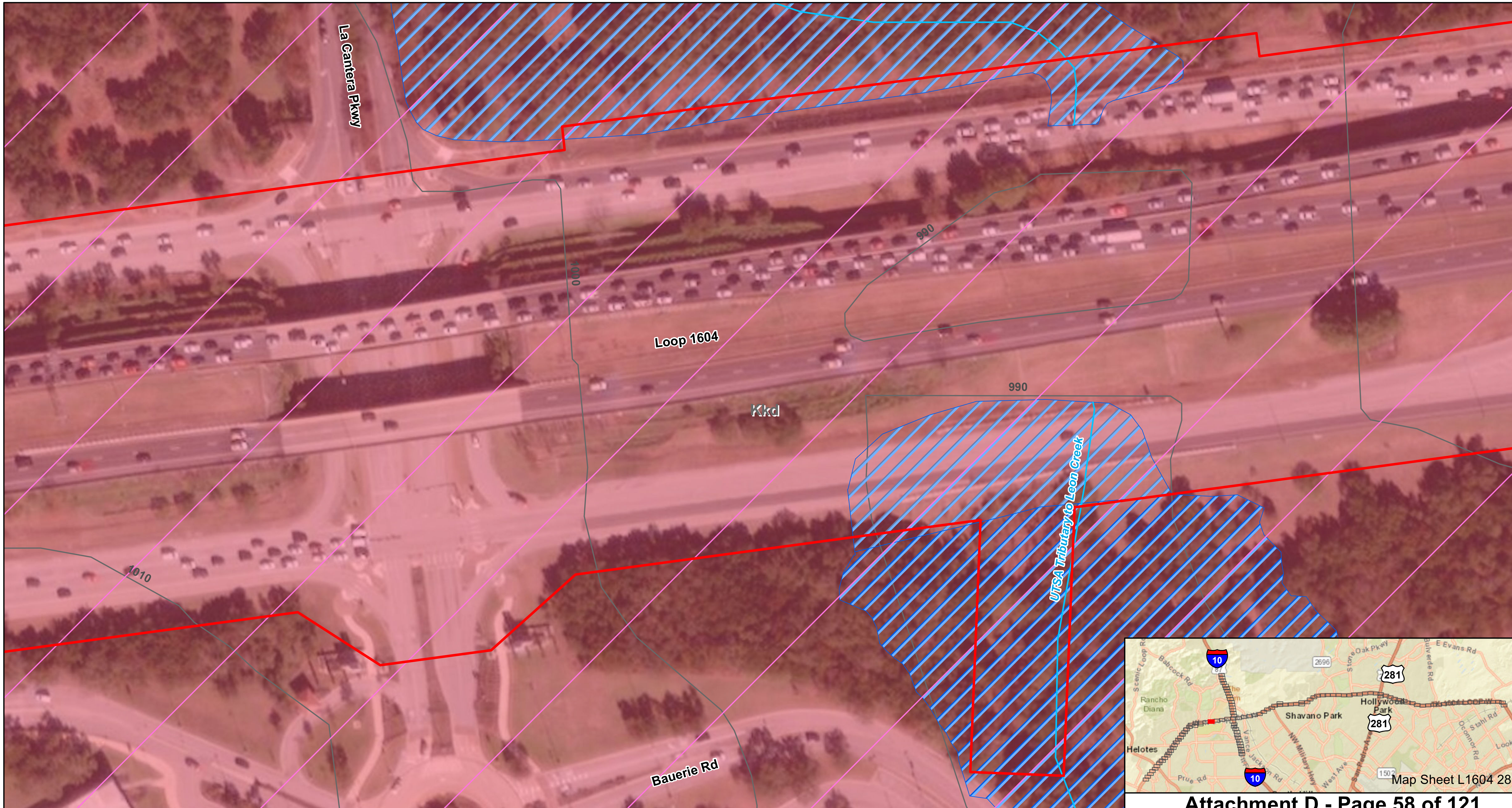

Attachment D - Page 58 of 121

Survey Area

Boundary line between Geology data sources

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Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

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Geology: Blome 2005

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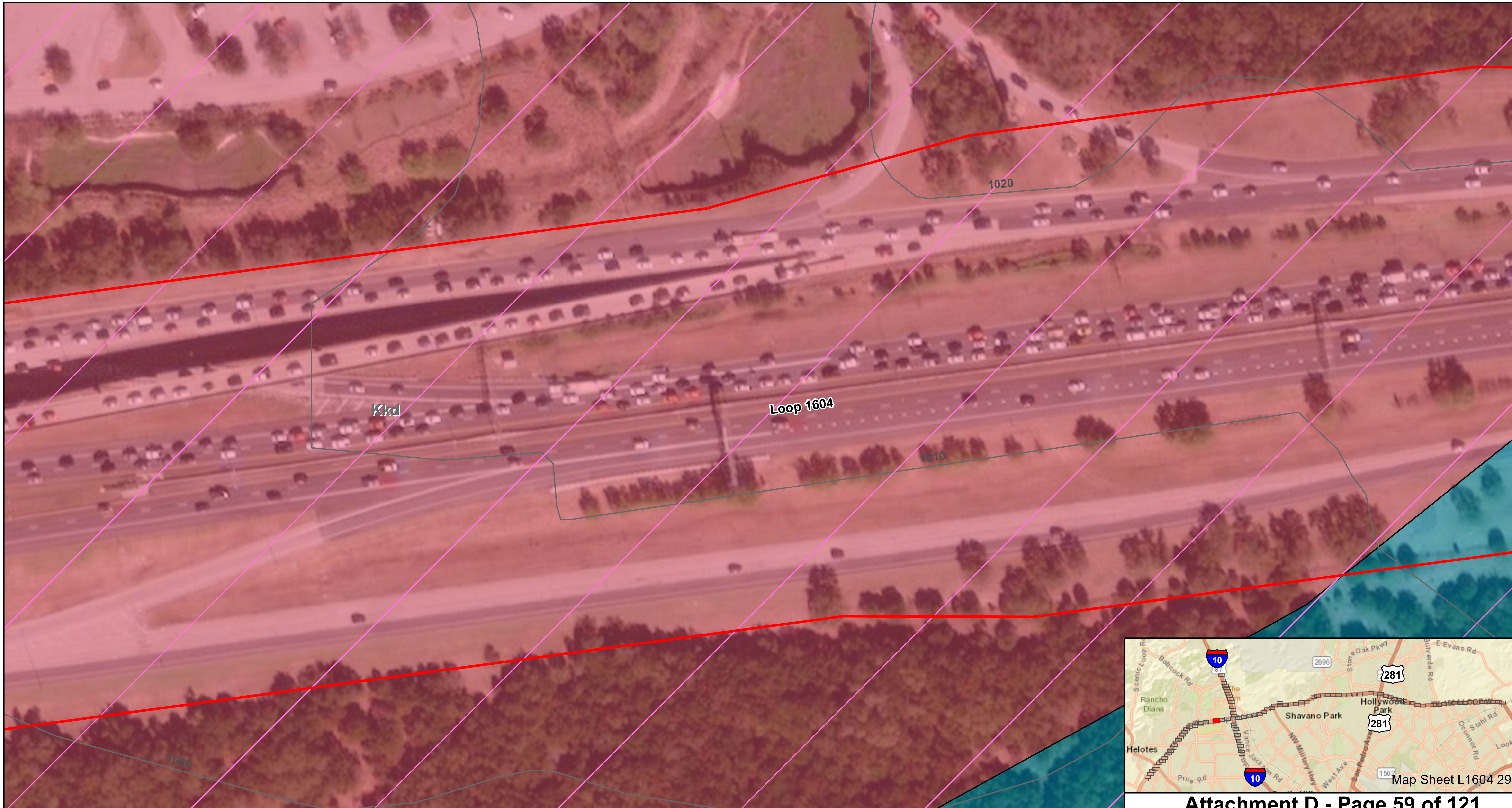

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Survey Area

GA Features

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- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Boundary line between Geology data sources

Geology: GAT 2010, 250K

Fault Type

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Edwards Aquifer Zones

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Contributing withing Transition Zone

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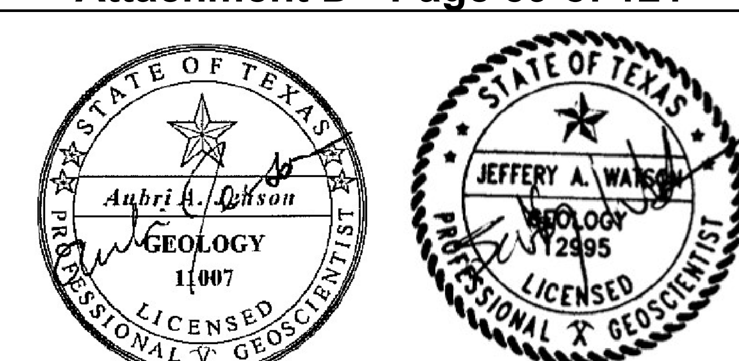

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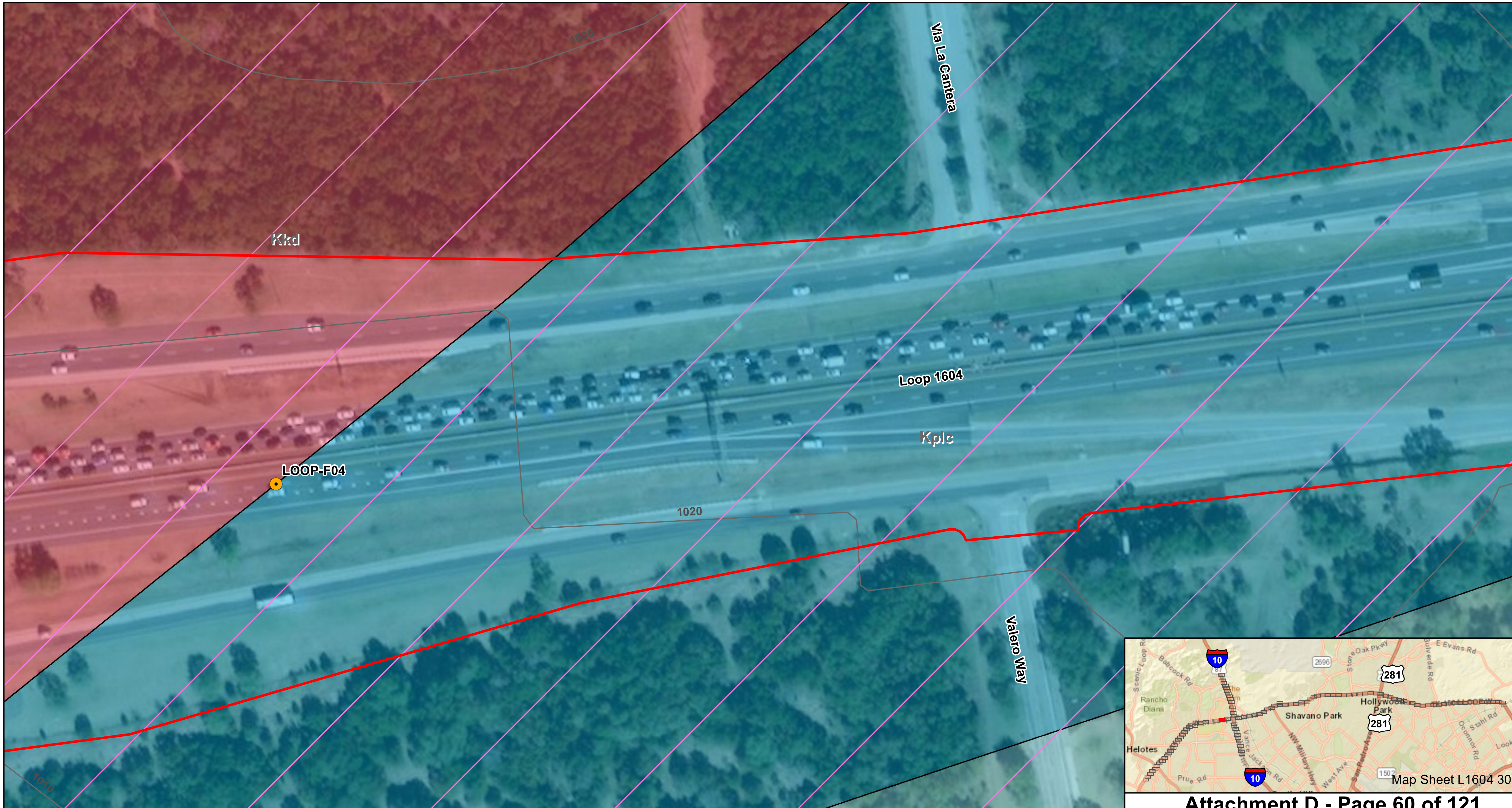

Attachment D - Page 60 of 121

Survey Area

GA Features
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StratMap 10-ft elevation contours
Streams (FEMA)
FEMA 100-yr flood zone

Boundary line between Geology data sources

Geology: GAT 2010, 250K

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Geology: Blome 2005

Fault Type
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Edwards Aquifer Zones
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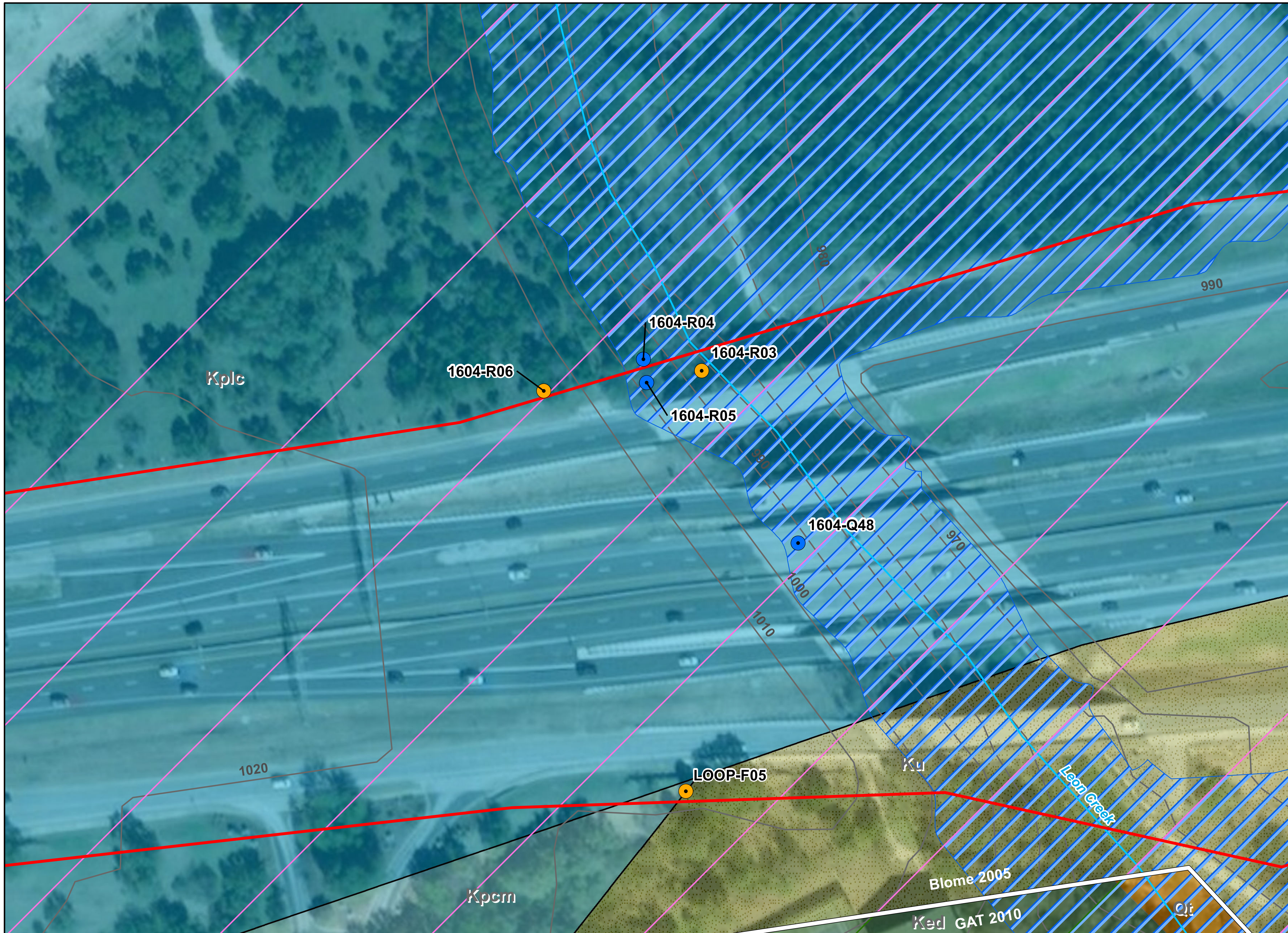

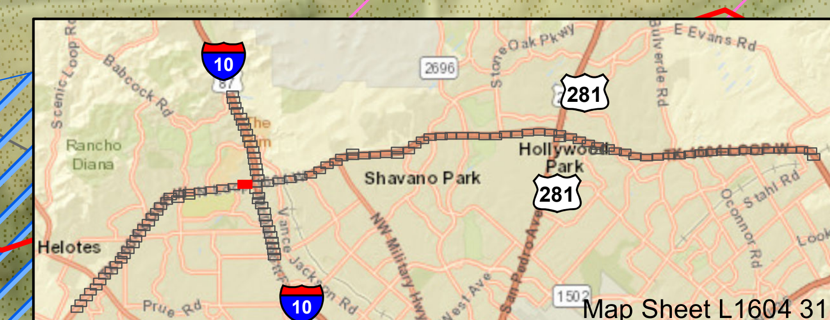

Attachment D - Page 61 of 121

Survey Area

Boundary line between Geology data sources

GA Features

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StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

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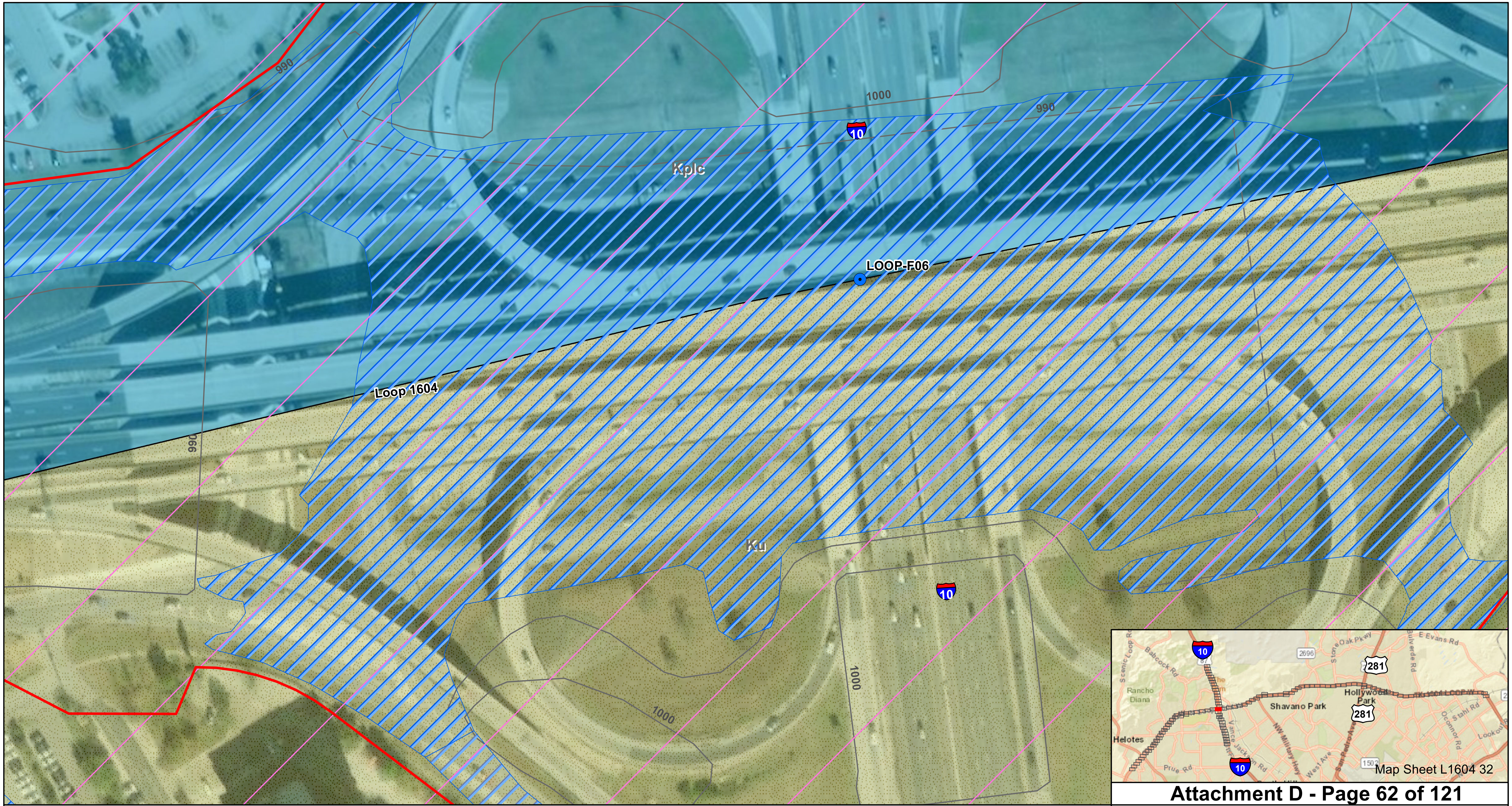

Attachment D - Page 62 of 121

Survey Area

GA Features
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StratMap 10-ft elevation contours
Streams (FEMA)
FEMA 100-yr flood zone

Boundary line between Geology data sources

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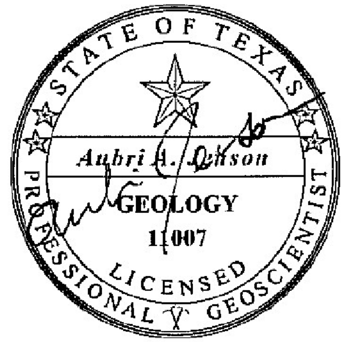

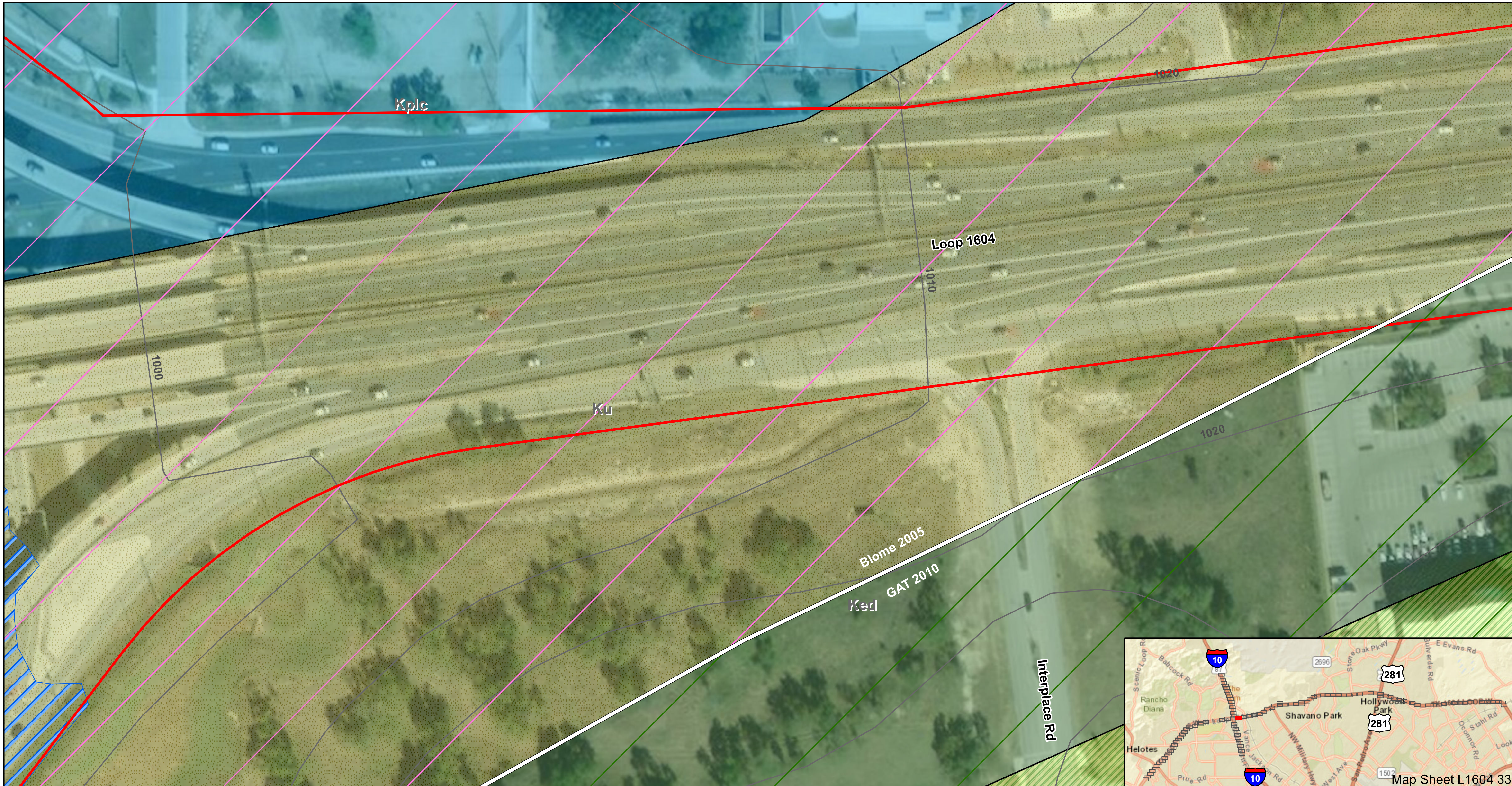

Attachment D - Page 63 of 121

Survey Area

Boundary line between Geology data sources

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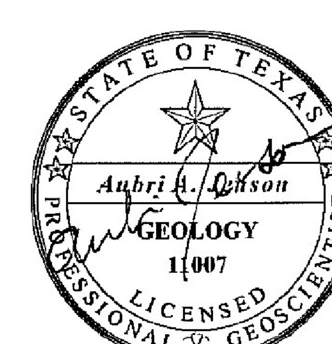

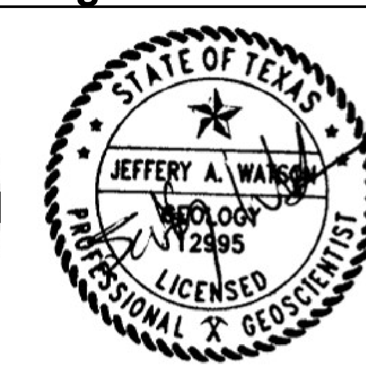

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Survey Area

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Streams (FEMA)
FEMA 100-yr flood zone

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- Kkd - Kainer Formation - Dolomitic Member
- Kkbn - Kainer Formation - Basal Nodular Member
- Kgr(u) - Upper Glen Rose

Edwards Aquifer Zones

- Contributing Zone
- Contributing withing Transition Zone
- Recharge Zone
- Transition Zone

N

1 inch = 100 feet

0 50 100 200 300 Feet

0 50 100 Meters

STATE OF TEXAS
Aubri A. Jackson
GEOLOGY
11007
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STATE OF TEXAS
JEFFERY A. WATSON
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2995
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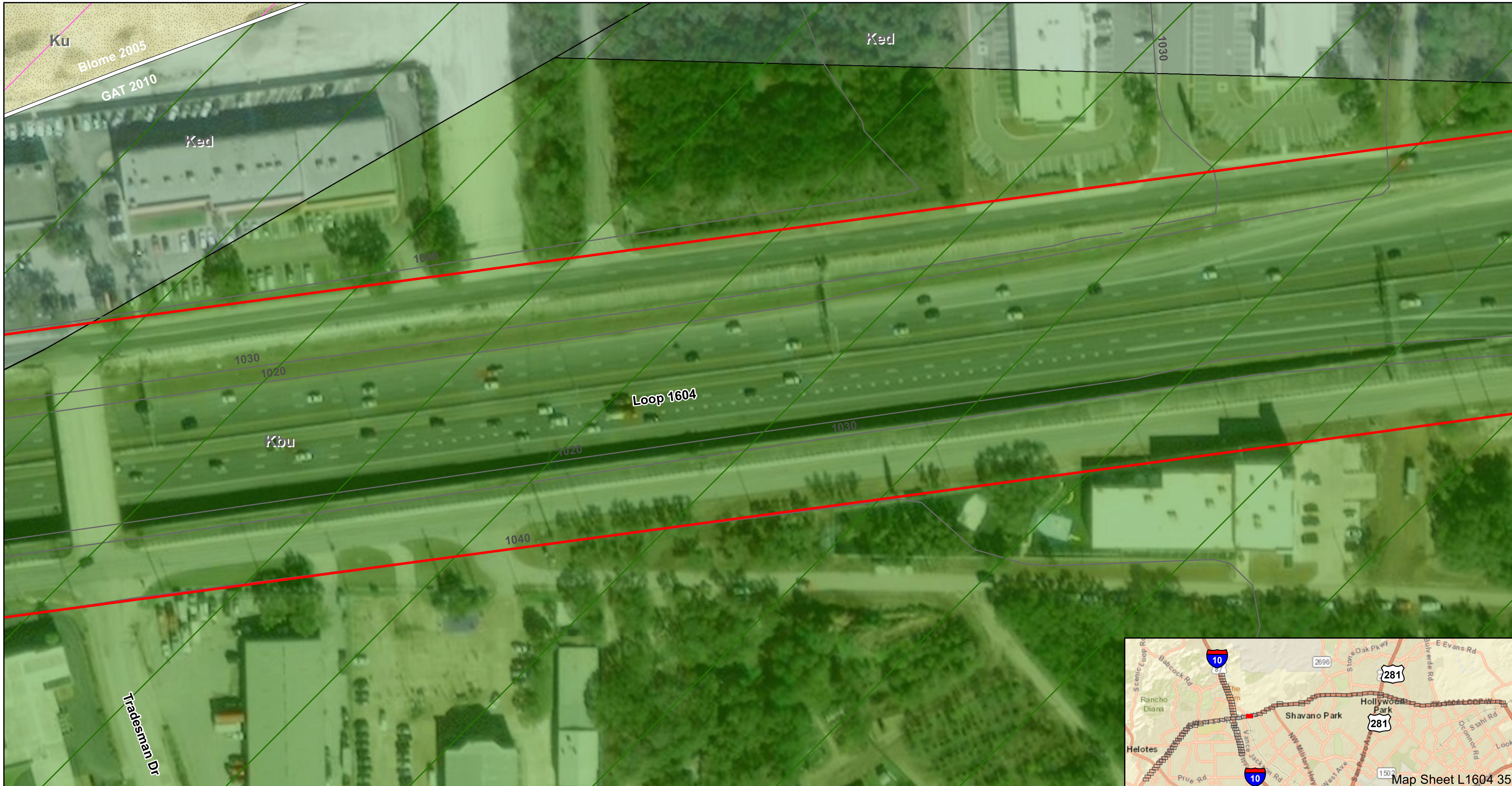
PROFESSIONAL GEOSCIENTIST

Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.



Attachment D - Page 65 of 121

Survey Area

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours
Streams (FEMA)
FEMA 100-yr flood zone

Boundary line between Geology data sources

Geology: GAT 2010, 250K

Fault Type

Normal
Unspecified

Formation

Qle - Leona Formation
Qt - Fluviatile terrace deposits
Kpg - Pecan Gap Chalk
Kau - Austin Chalk
Kef - Eagle Ford Group
Kbu - Buda Limestone
Kdr - Del Rio Clay
Ked - Edwards Limestone
Kgru - Upper Glen Rose Formation
Kgrl - Lower Glen Rose Formation

Geology: Blome 2005

Fault Type

Fault-certain
Fault-inferred

Formation

Ku - Upper Confining Units
Kef - Eagle Ford Group
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Kdr - Del Rio Clay
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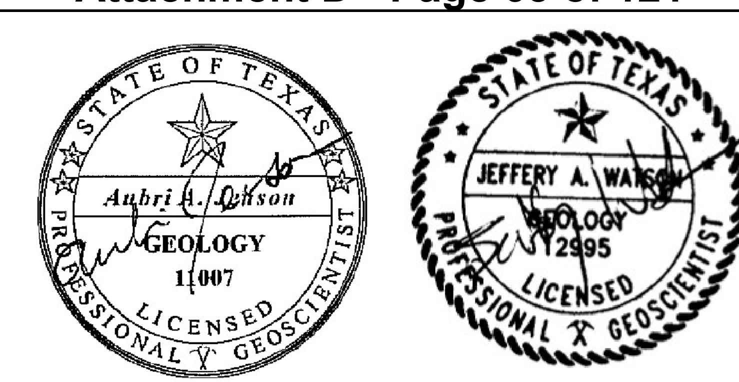

Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.

Attachment D - Page 66 of 121

Survey Area

GA Features

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- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Boundary line between Geology data sources

Geology: GAT 2010, 250K

Fault Type

- Normal
- Unspecified

Formation

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Geology: Blome 2005

Fault Type

- Fault-certain
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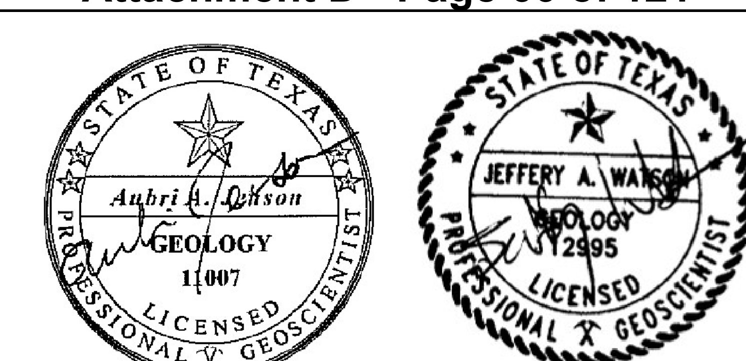

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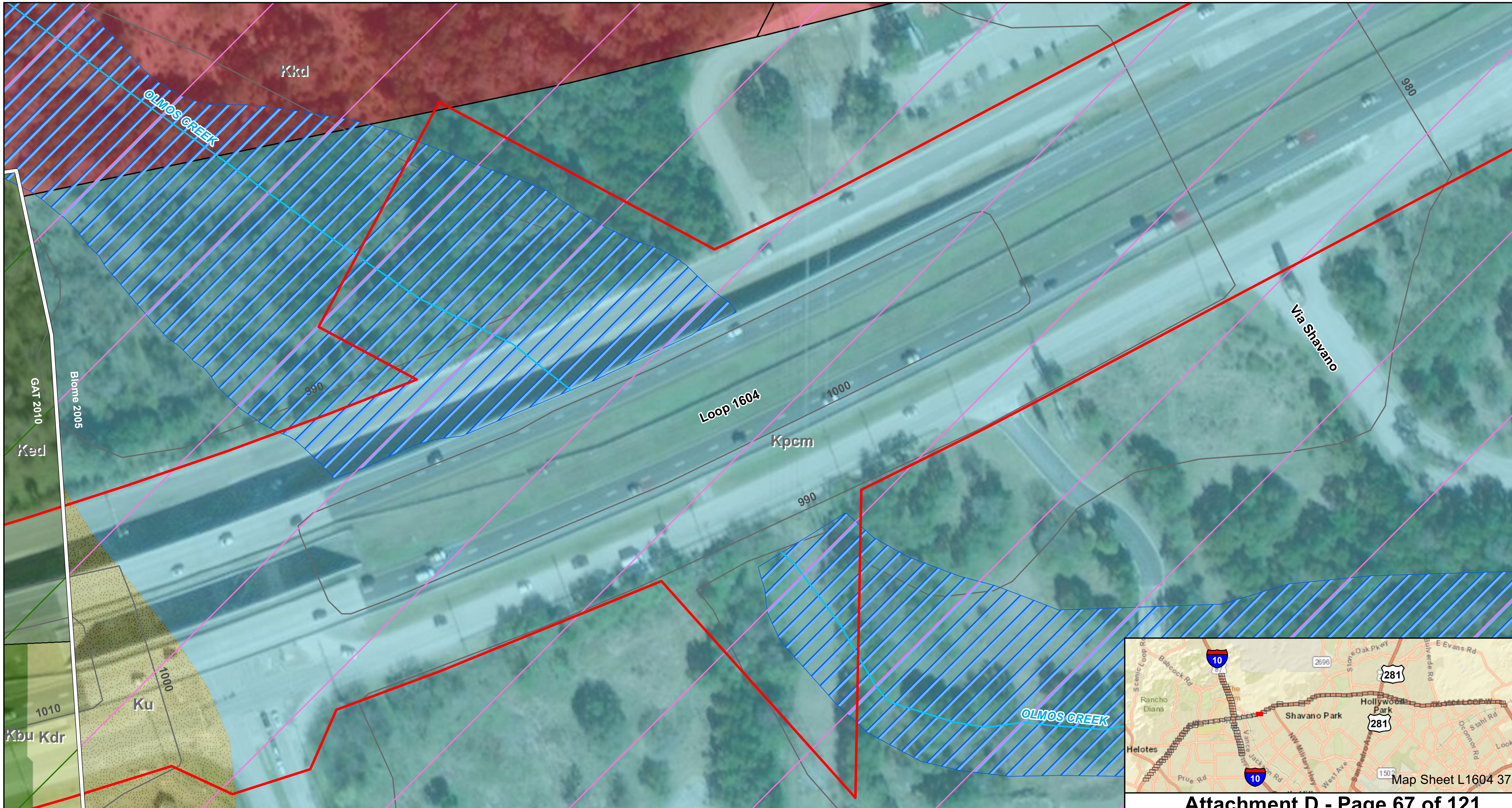

Attachment D - Page 67 of 121

Survey Area

GA Features

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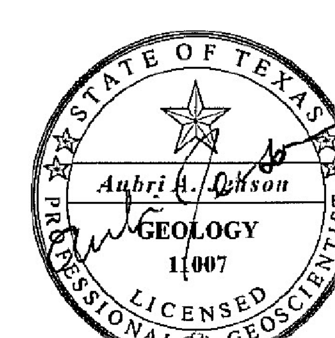

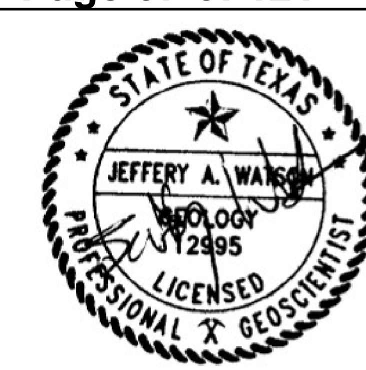

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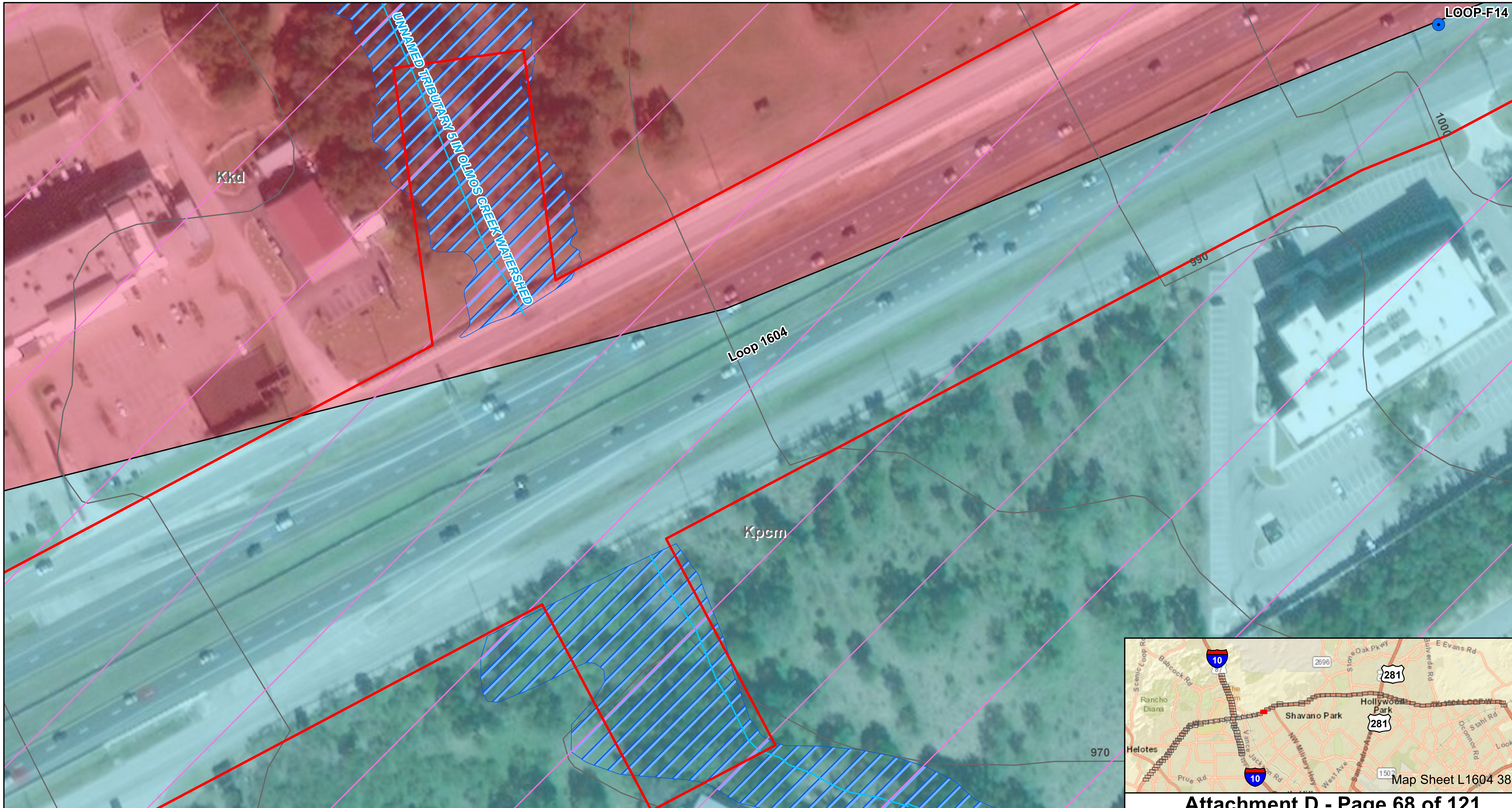

Survey Area

Boundary line between Geology data sources

GA Features

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StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

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Geology: Blome 2005

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Fault-certain

Fault-inferred

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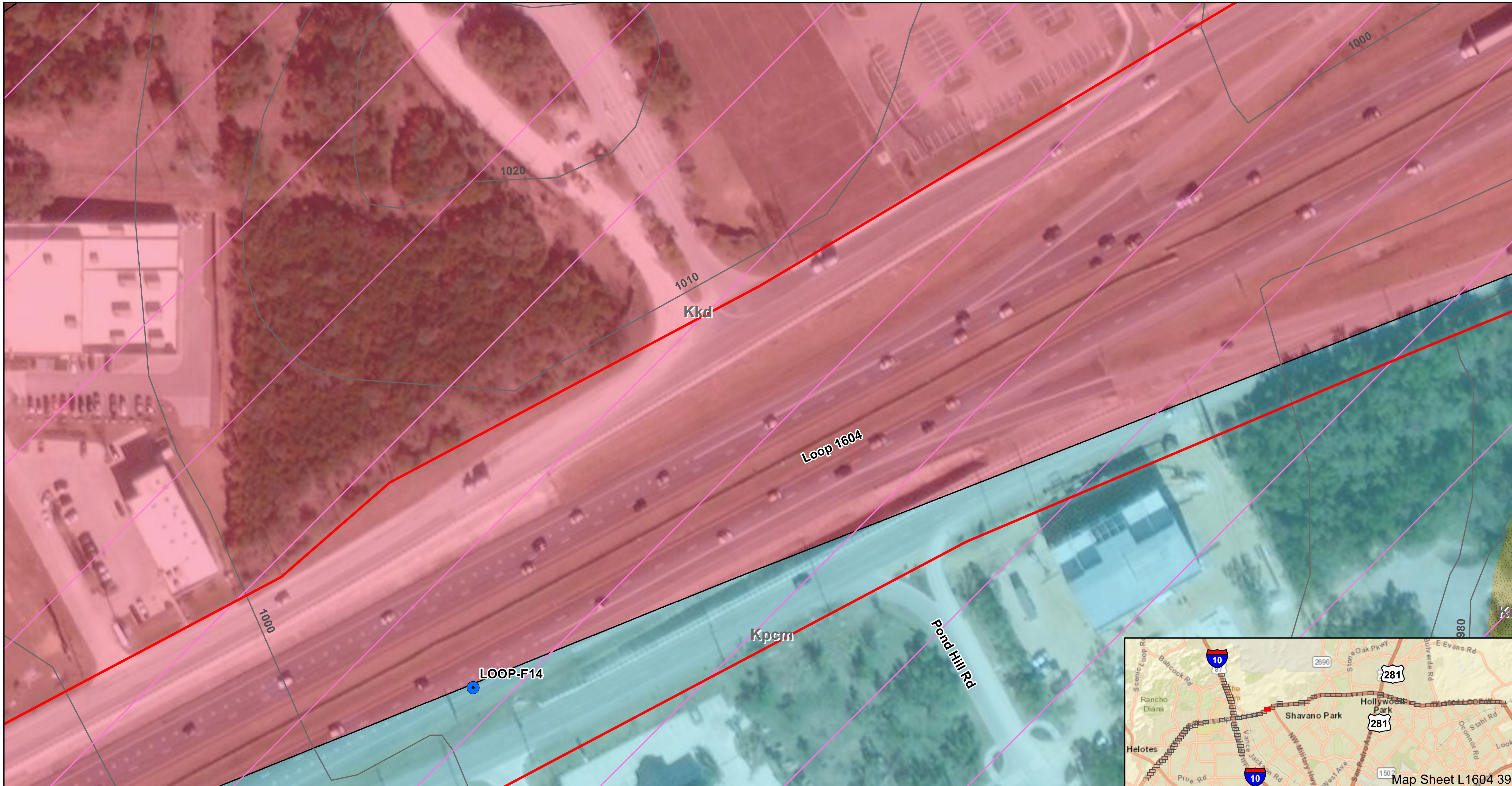
Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.



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Survey Area

Boundary line between Geology data sources

GA Features
- Non-Sensitive: <35 Rating
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- TWDB Wells

StratMap 10-ft elevation contours
Streams (FEMA)
FEMA 100-yr flood zone

Geology: GAT 2010, 250K

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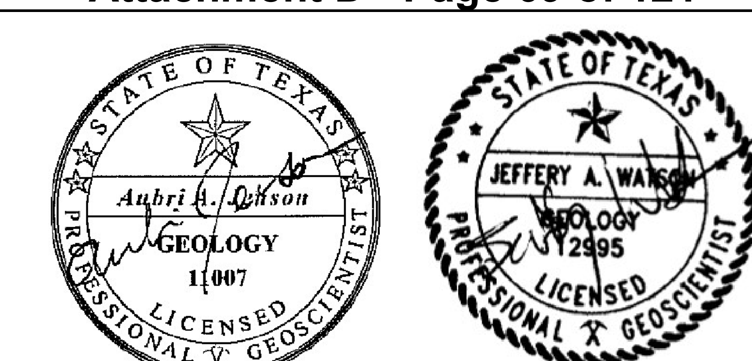

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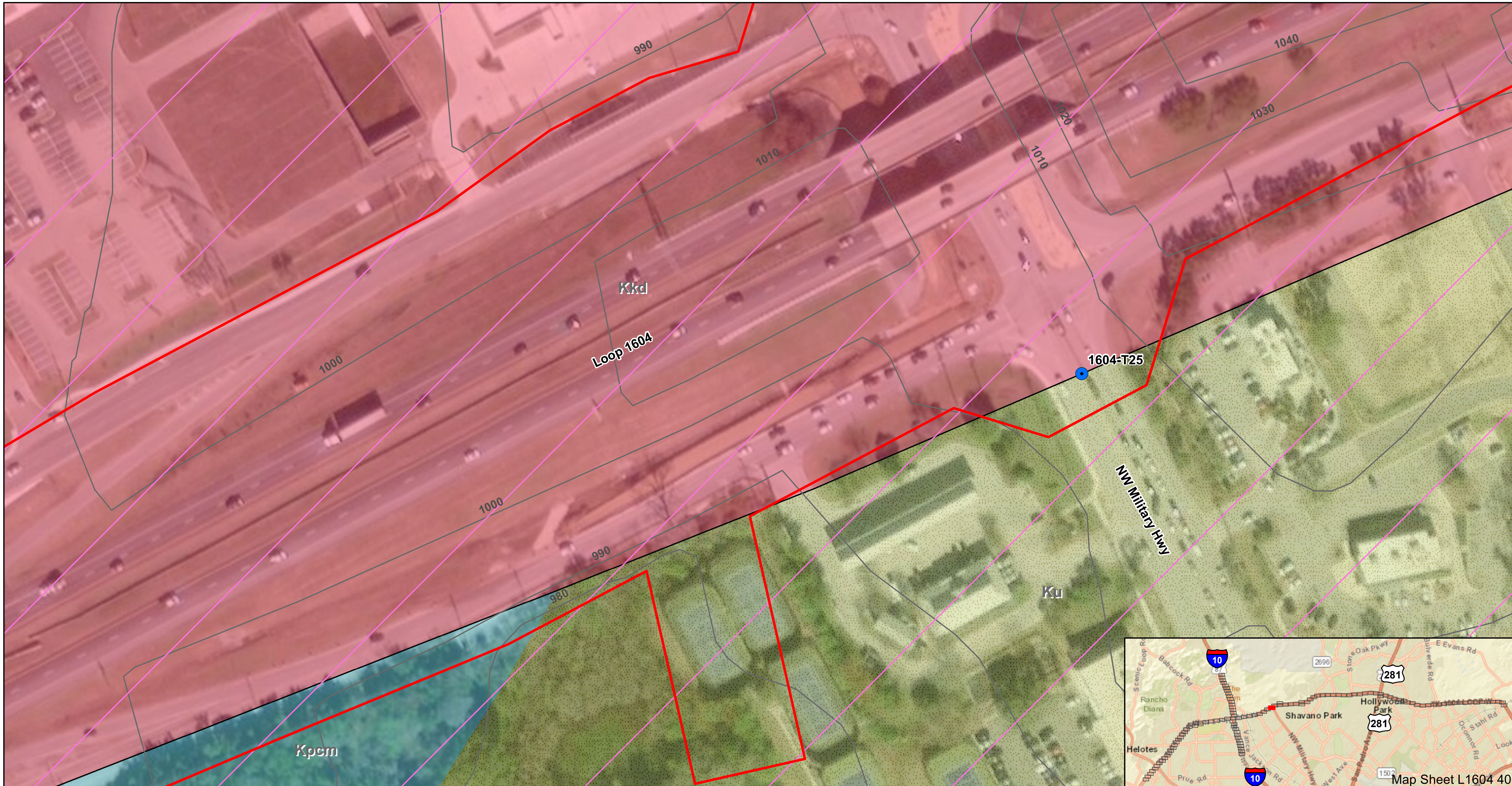

Attachment D - Page 70 of 121

Survey Area

Boundary line between Geology data sources

GA Features

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StratMap 10-ft elevation contours

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FEMA 100-yr flood zone

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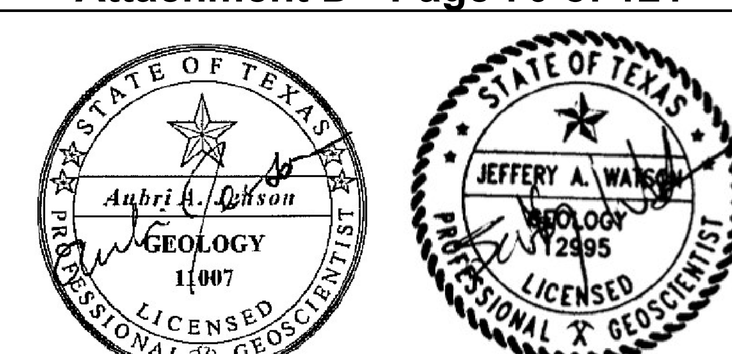

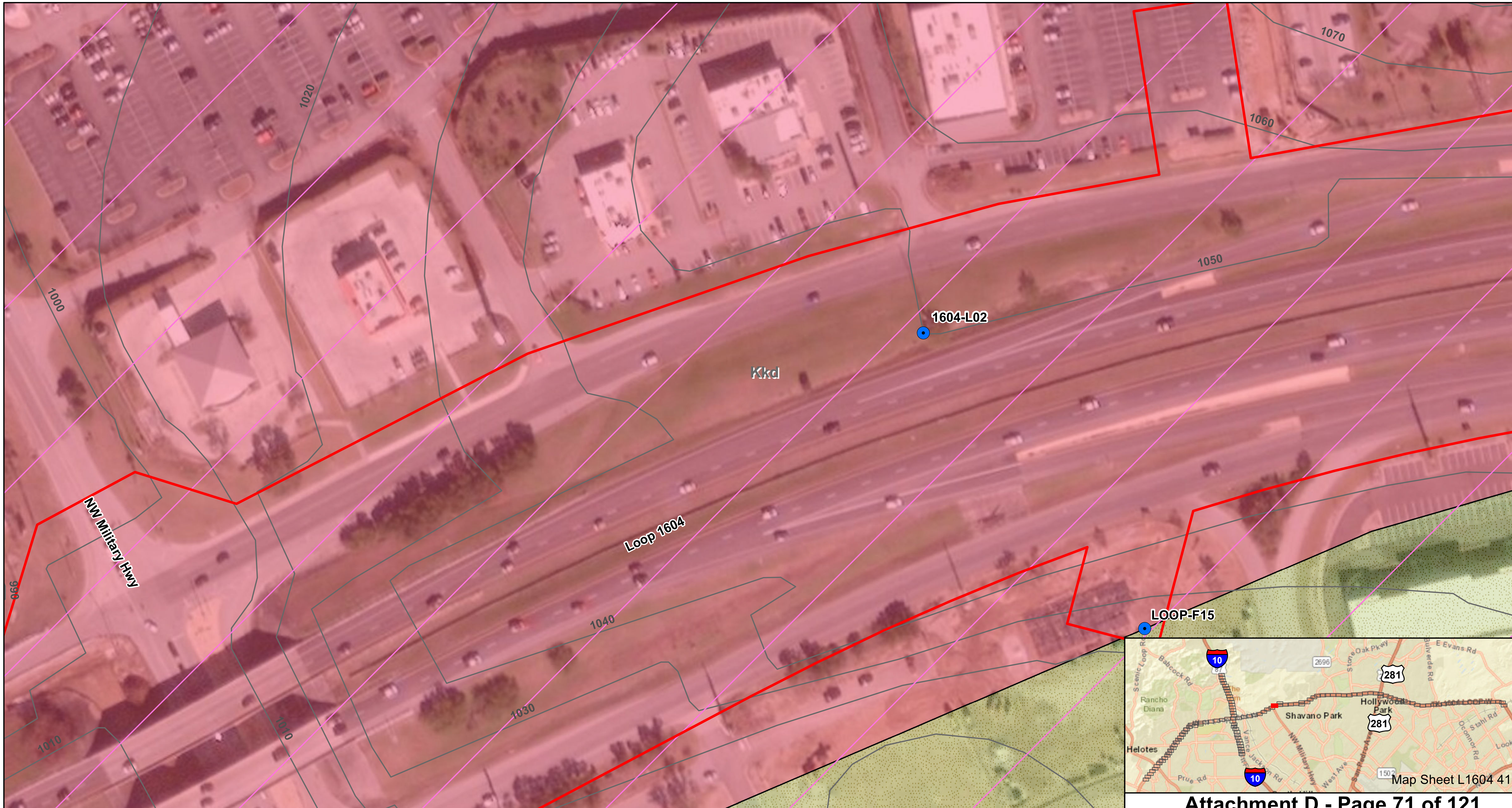

Survey Area

Boundary line between Geology data sources

GA Features

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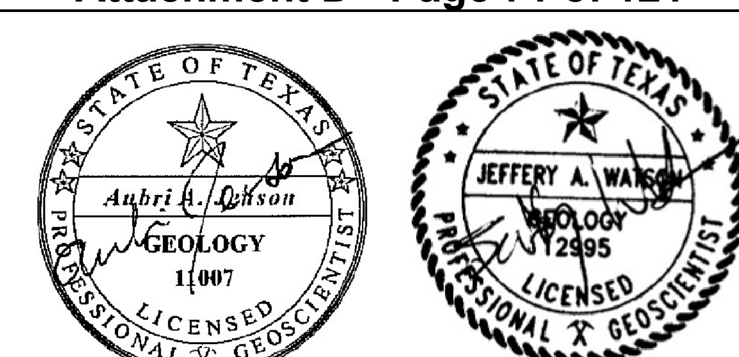

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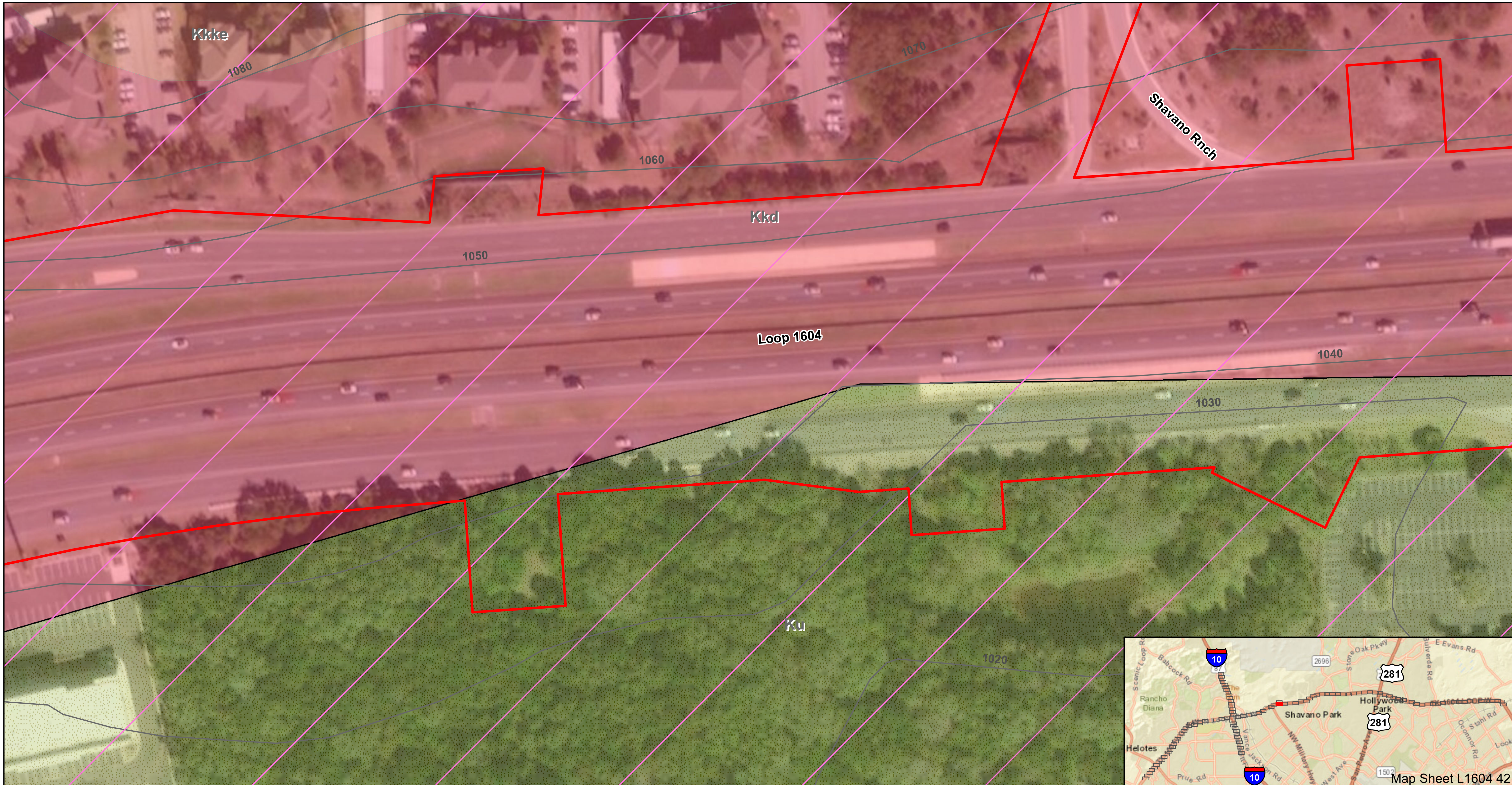

Survey Area

Boundary line between Geology data sources

GA Features
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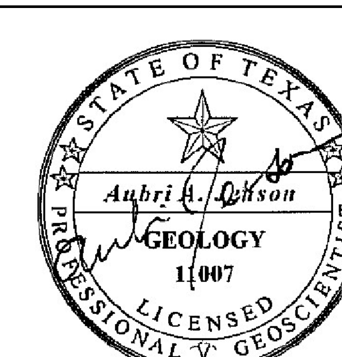

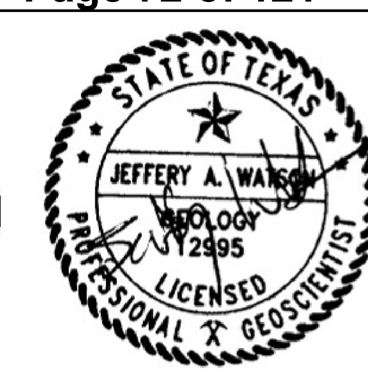

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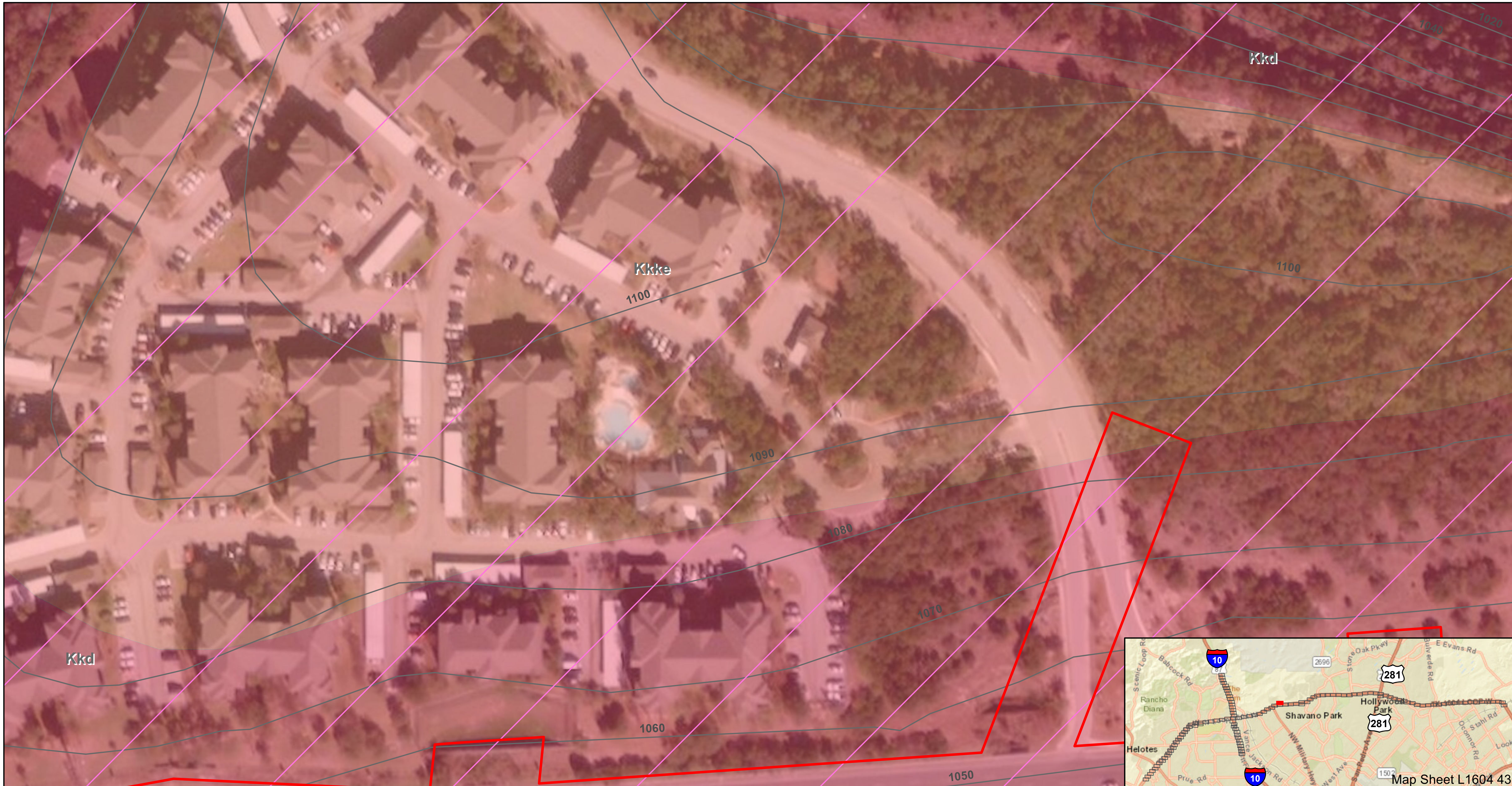

Attachment D - Page 73 of 121

Survey Area

GA Features
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StratMap 10-ft elevation contours
Streams (FEMA)
FEMA 100-yr flood zone

Boundary line between Geology data sources

Geology: GAT 2010, 250K

Fault Type
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Geology: Blome 2005

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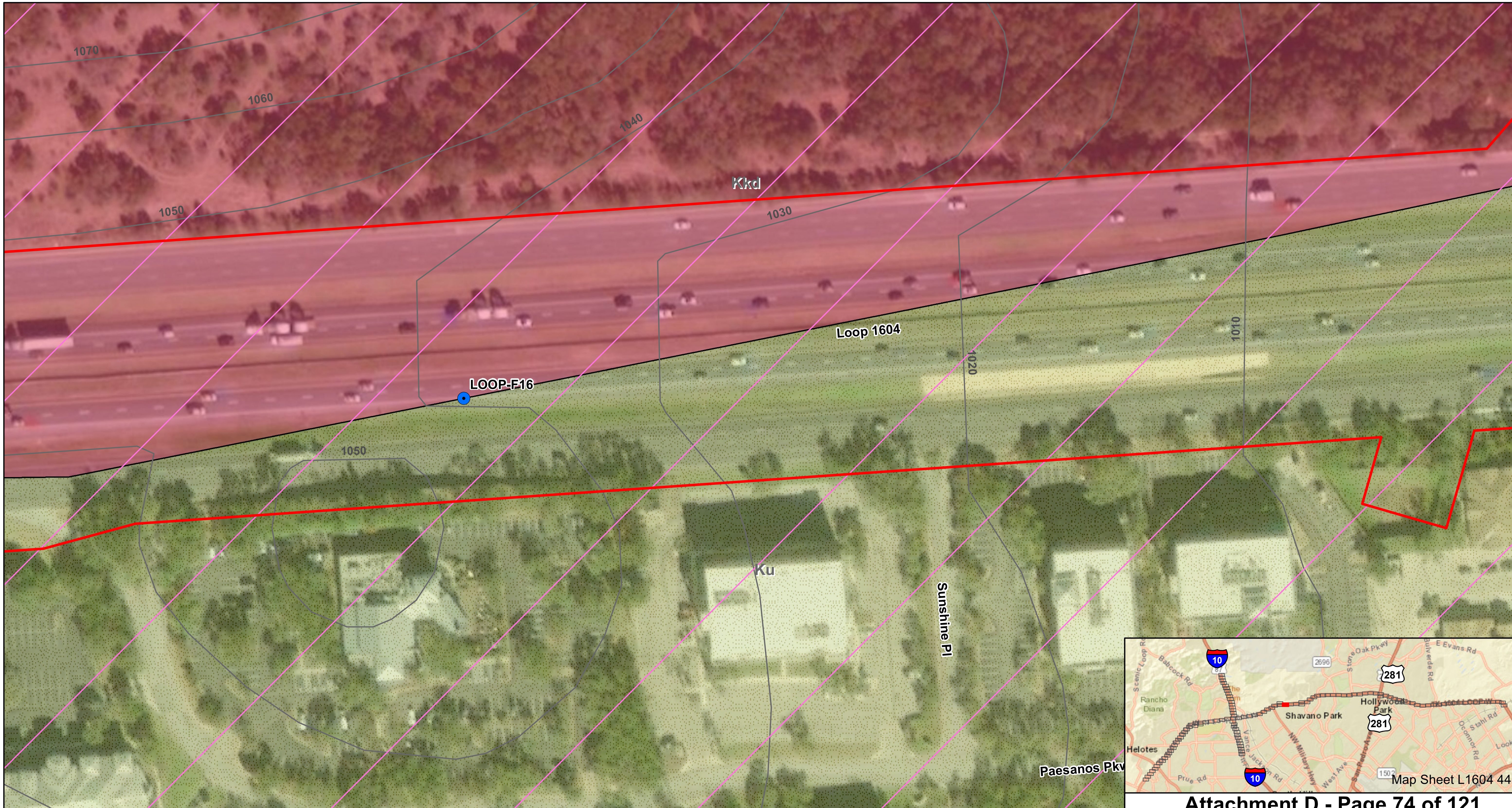

Survey Area

Boundary line between Geology data sources

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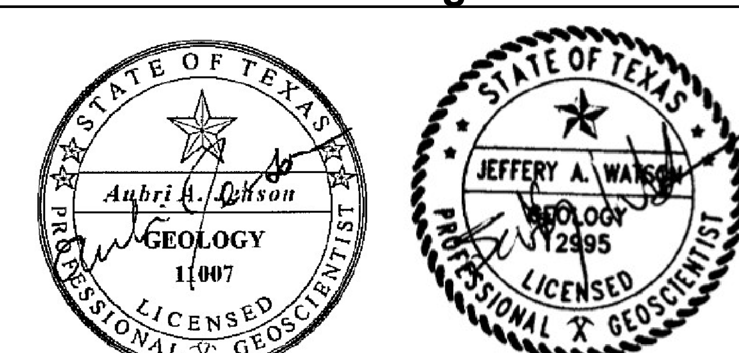
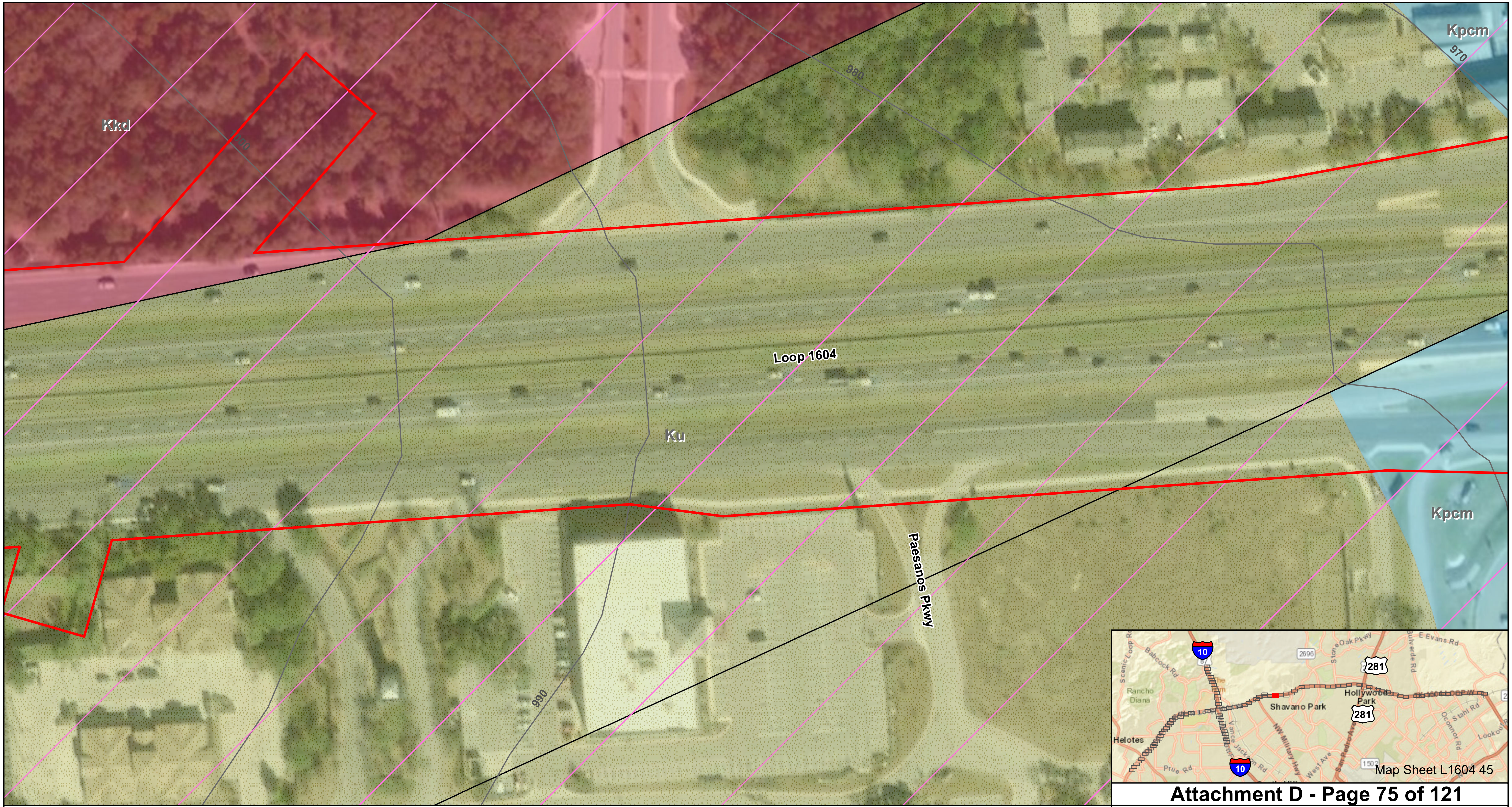


Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.



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Survey Area

GA Features
- Non-Sensitive: <35 Rating
- Non-Sensitive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours
Streams (FEMA)
FEMA 100-yr flood zone

Boundary line between Geology data sources

Geology: GAT 2010, 250K

Fault Type
- Normal
- Unspecified

Formation
- Qle - Leona Formation
- Qt - Fluviatile terrace deposits
- Kpg - Pecan Gap Chalk
- Kau - Austin Chalk
- Kef - Eagle Ford Group
- Kbu - Buda Limestone
- Kdr - Del Rio Clay
- Ked - Edwards Limestone
- Kgru - Upper Glen Rose Formation
- Kgrl - Lower Glen Rose Formation

Geology: Blome 2005

Fault Type
- Fault-certain
- Fault-inferred

Formation
- Ku - Upper Confining Units
- Kef - Eagle Ford Group
- Kb - Buda Limestone
- Kdr - Del Rio Clay
- Kg - Georgetown Formation
- Kpcm - Person Formation - Cyclic and Marine Member
- Kplc - Person Formation - Leached and Collapsed Member
- Kprd - Person Formation - Regional Dense Member
- Kkg - Kainer Formation - Grainstone Member
- Kkke - Kainer Formation Kirschberg Evaporite Member
- Kkd - Kainer Formation - Dolomitic Member
- Kkbn - Kainer Formation - Basal Nodular Member
- Kgr(u) - Upper Glen Rose

Edwards Aquifer Zones
- Contributing Zone
- Contributing withing Transition Zone
- Recharge Zone
- Transition Zone

N

1 inch = 100 feet

0 50 100 200 300 Feet

0 50 100 Meters

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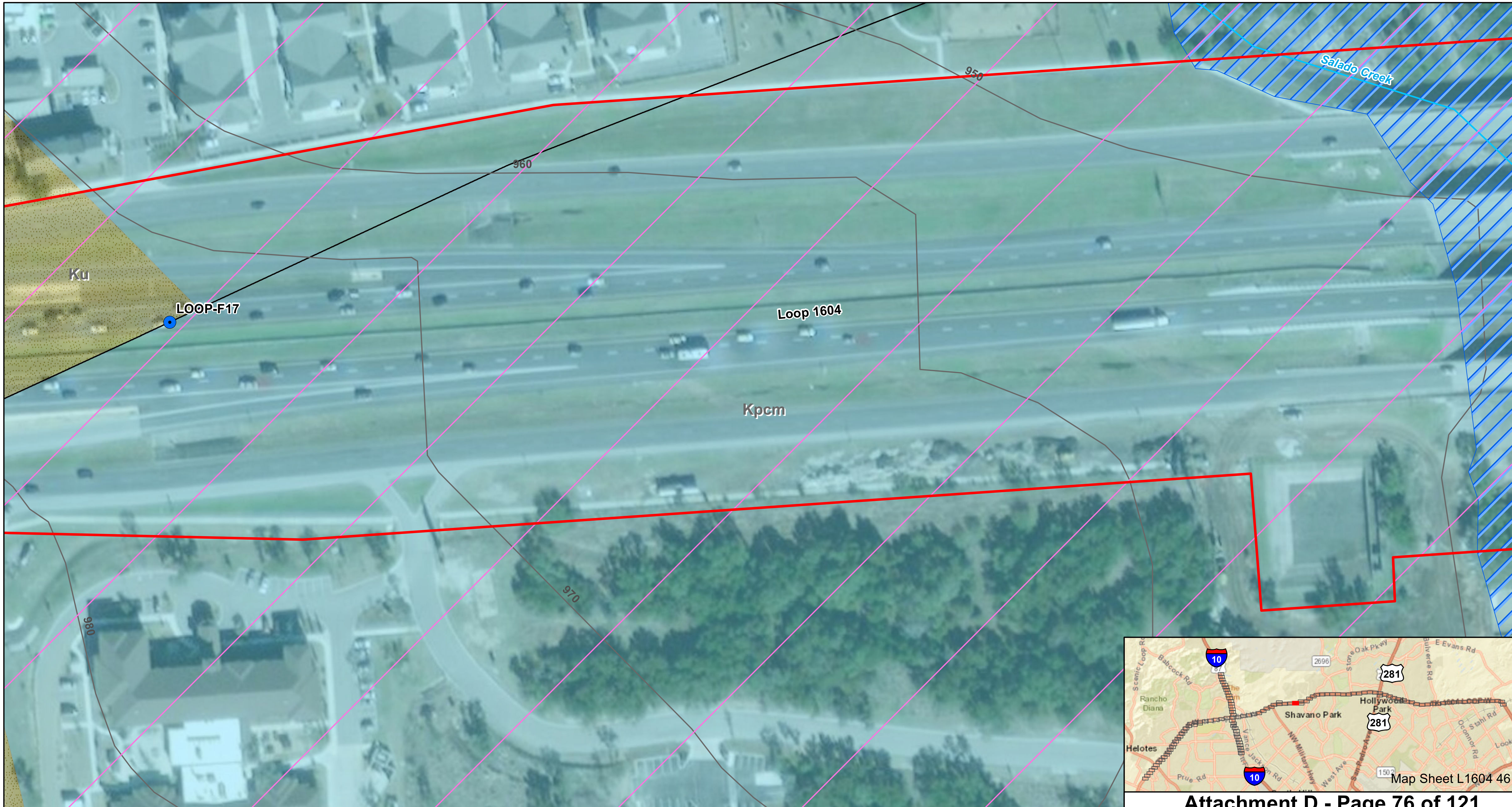
Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.



Survey Area

Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

- Normal
- Unspecified

Formation

- Qle - Leona Formation
- Qt - Fluviatile terrace deposits
- Kpg - Pecan Gap Chalk
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Geology: Blome 2005

Fault Type

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- Fault-inferred

Formation

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Edwards Aquifer Zones

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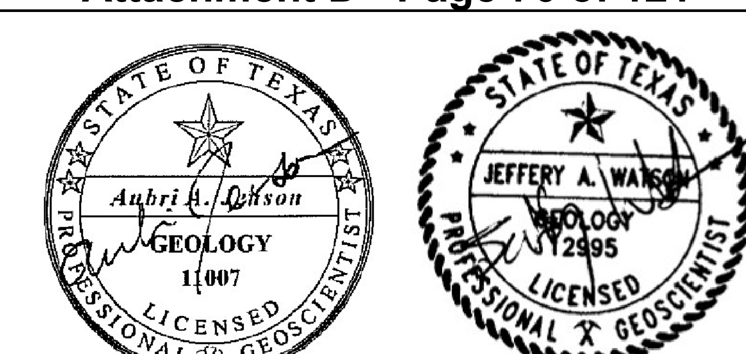

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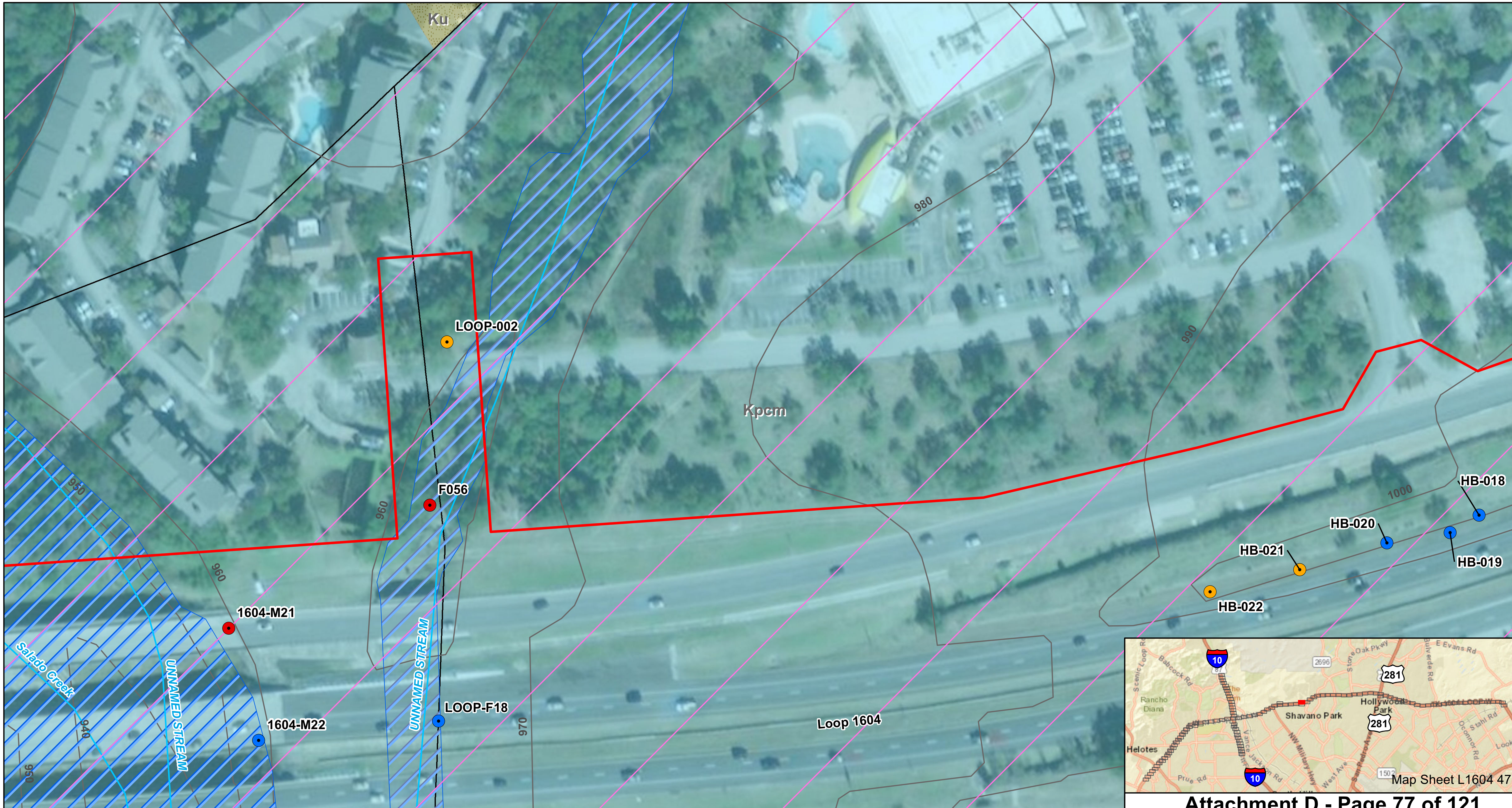

Survey Area

Boundary line between Geology data sources

GA Features

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- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

Normal

Unspecified

Formation

Qle - Leona Formation

Qt - Fluviatile terrace deposits

Kpg - Pecan Gap Chalk

Kau - Austin Chalk

Kef - Eagle Ford Group

Kbu - Buda Limestone

Kdr - Del Rio Clay

Ked - Edwards Limestone

Kgru - Upper Glen Rose Formation

Kgrl - Lower Glen Rose Formation

Geology: Blome 2005

Fault Type

Fault-certain

Fault-inferred

Formation

Ku - Upper Confining Units

Kef - Eagle Ford Group

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Edwards Aquifer Zones

Contributing Zone

Contributing withing Transition Zone

Recharge Zone

Transition Zone

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Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.

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Survey Area

Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

- Normal
- Unspecified

Formation

- Qle - Leona Formation
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Geology: Blome 2005

Fault Type

- Fault-certain
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Formation

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Edwards Aquifer Zones

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- Contributing withing Transition Zone
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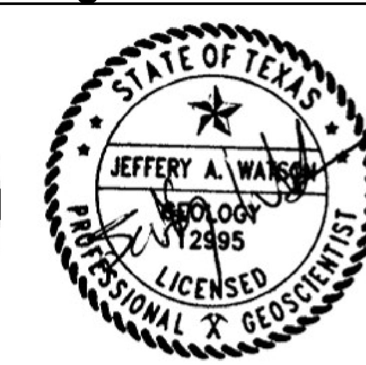
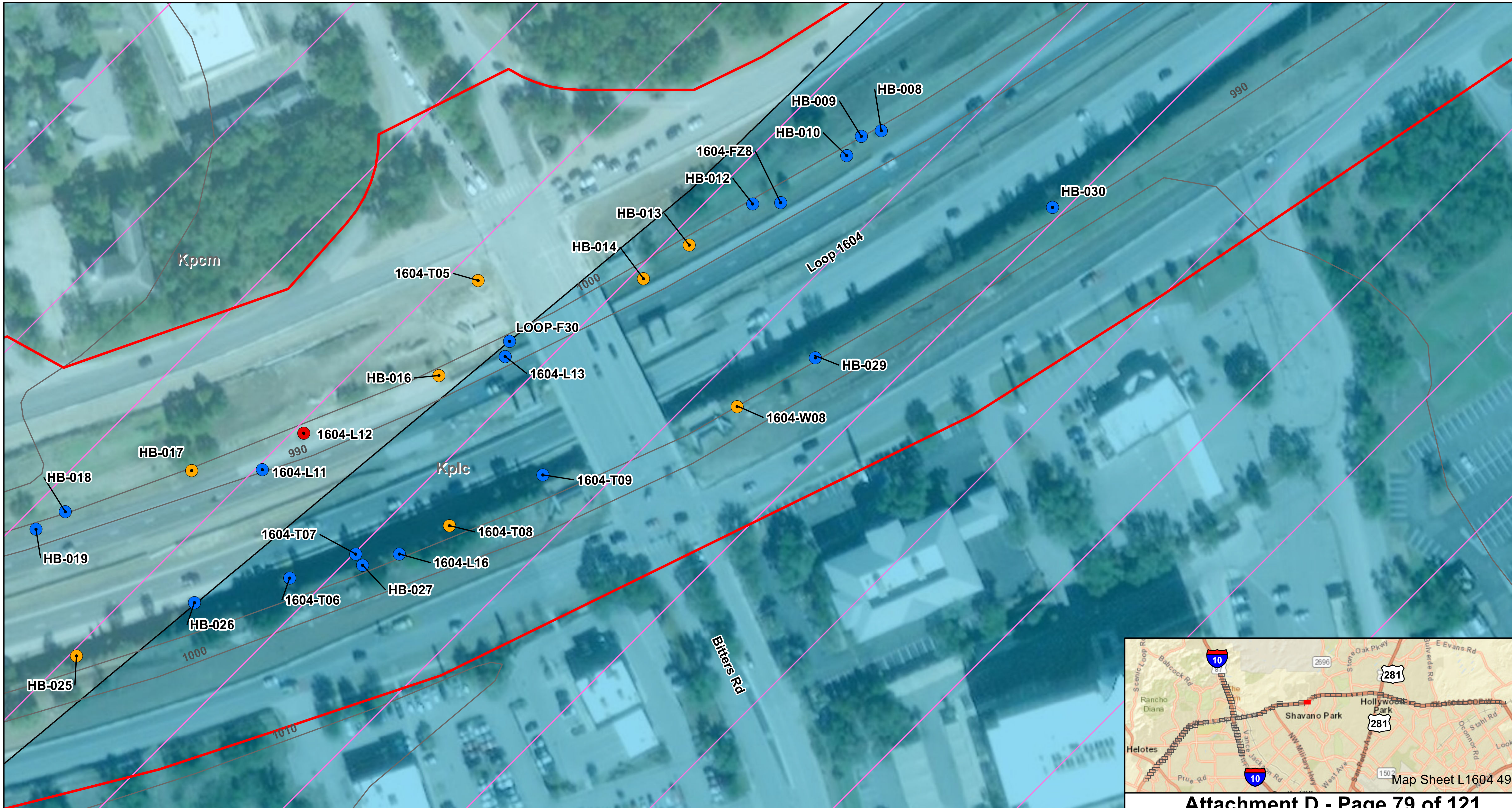


Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.



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Survey Area

GA Features
- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells
- StratMap 10-ft elevation contours
- Streams (FEMA)
- FEMA 100-yr flood zone

Boundary line between Geology data sources

Geology: GAT 2010, 250K

Fault Type
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Formation
- Qle - Leona Formation
- Qt - Fluviatile terrace deposits
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Geology: Blome 2005

Fault Type
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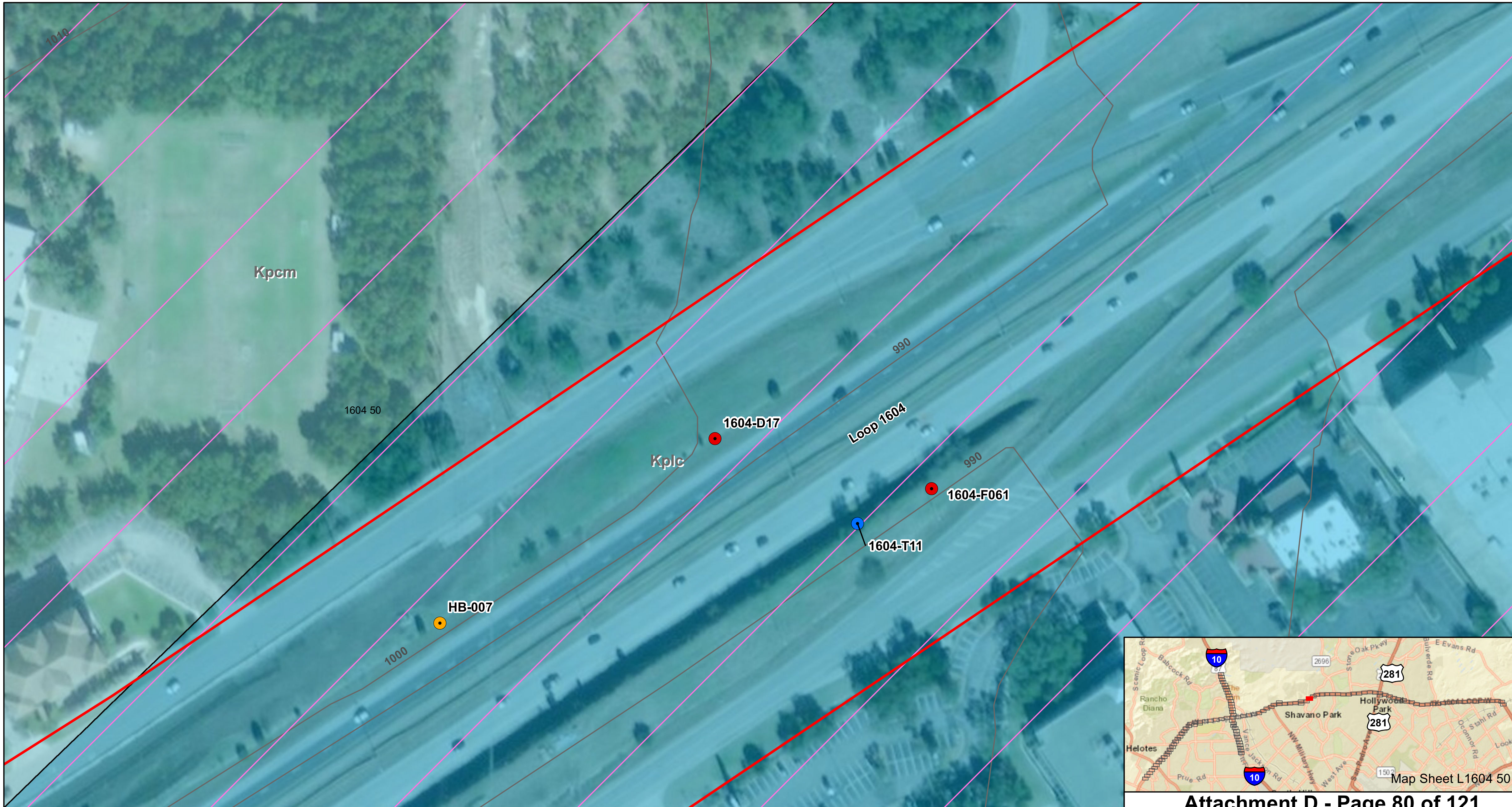

Attachment D - Page 80 of 121

Survey Area

Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

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Formation

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Geology: Blome 2005

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Edwards Aquifer Zones

- Contributing Zone
- Contributing withing Transition Zone
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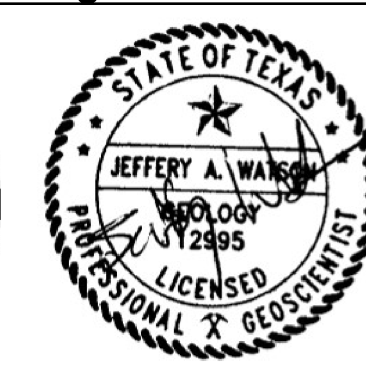

Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.

Survey Area

Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

- Normal
- Unspecified

Formation

- Qle - Leona Formation
- Qt - Fluviatile terrace deposits
- Kpg - Pecan Gap Chalk
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Geology: Blome 2005

Fault Type

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Formation

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Edwards Aquifer Zones

- Contributing Zone
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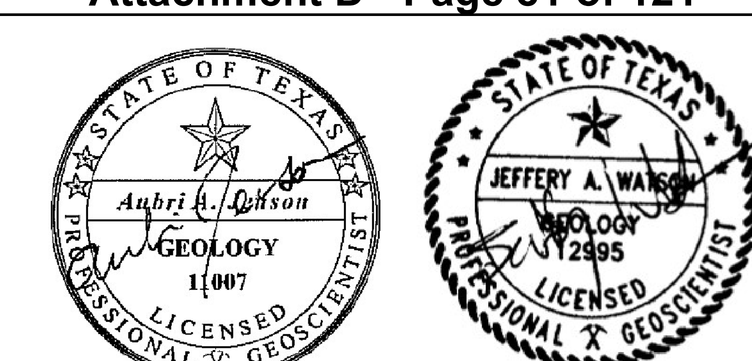
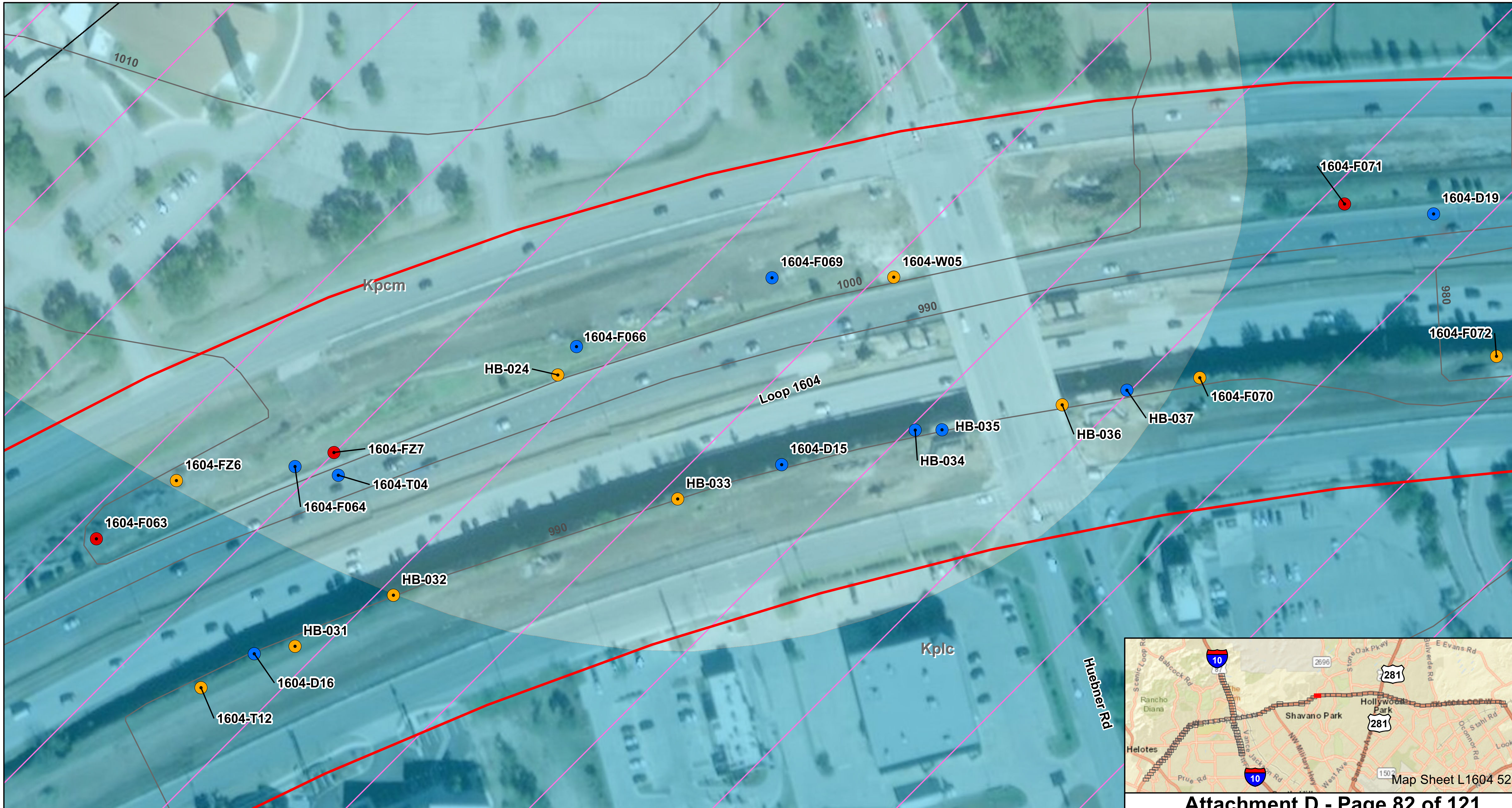
0 50 100 Meters



Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.



Attachment D - Page 82 of 121

Survey Area

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours
Streams (FEMA)
FEMA 100-yr flood zone

Boundary line between Geology data sources

Geology: GAT 2010, 250K

Fault Type

- Normal
- Unspecified

Formation

- Qle - Leona Formation
- Qt - Fluviatile terrace deposits
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Geology: Blome 2005

Fault Type

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Edwards Aquifer Zones

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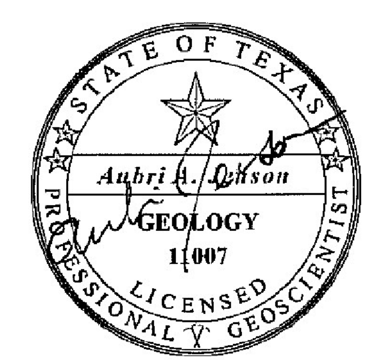
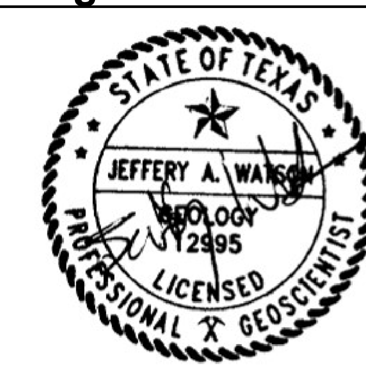
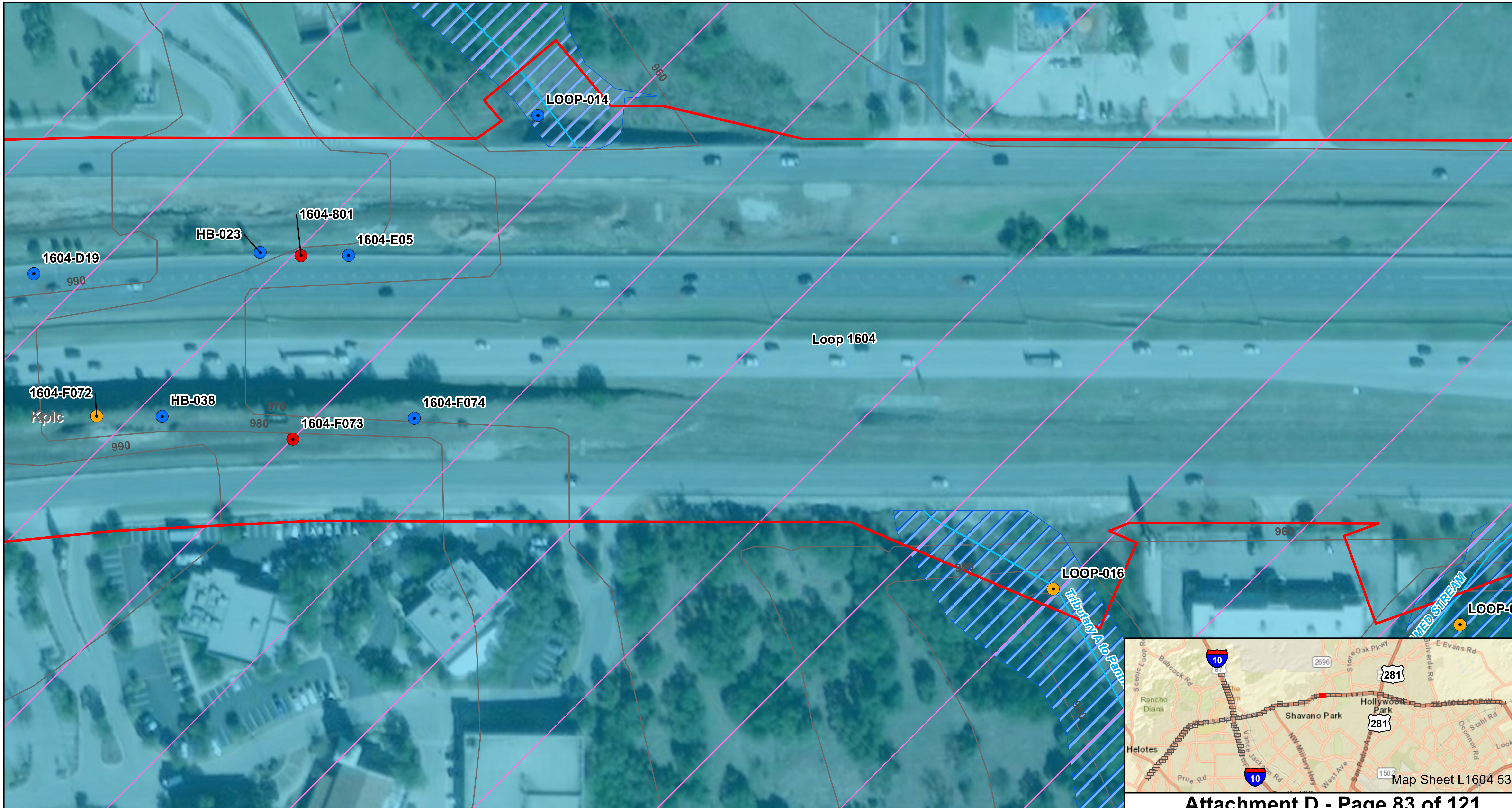
Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.







Attachment D - Page 83 of 121

Survey Area

Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

- Normal
- Unspecified

Formation

- Qle - Leona Formation
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Geology: Blome 2005

Fault Type

- Fault-certain
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Edwards Aquifer Zones

- Contributing Zone
- Contributing withing Transition Zone
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- Transition Zone

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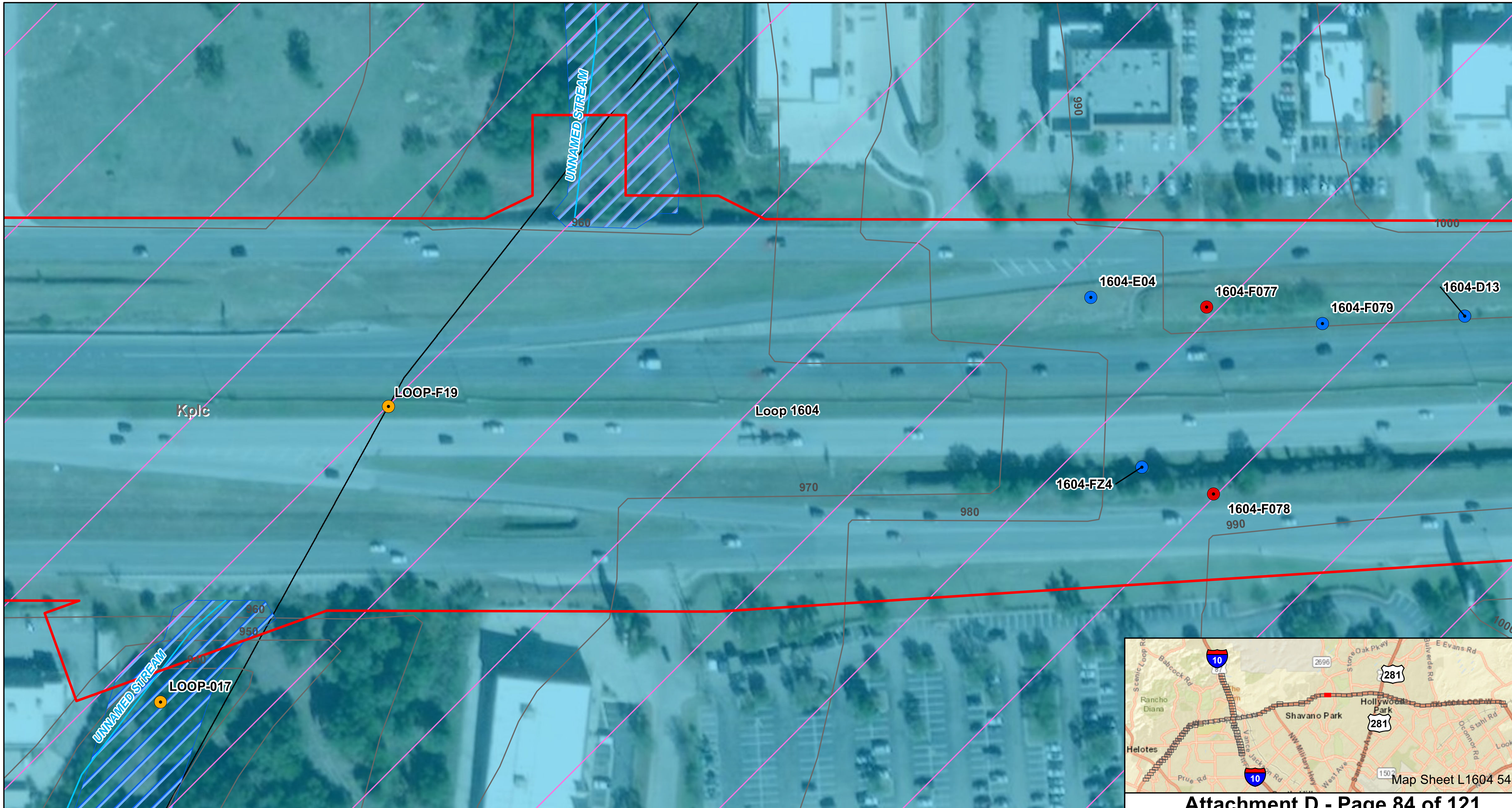

Attachment D - Page 84 of 121

Survey Area

Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
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- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

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Edwards Aquifer Zones

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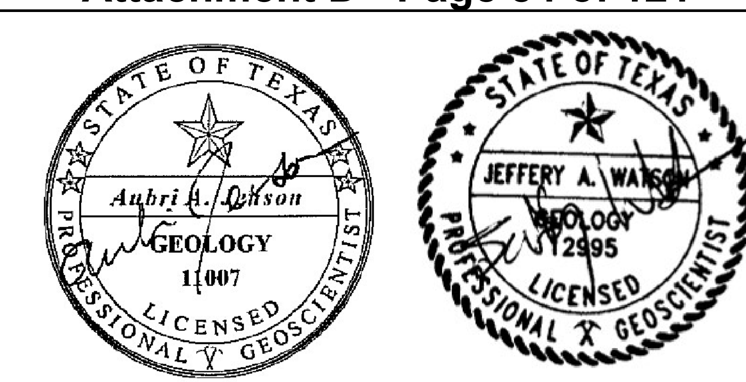
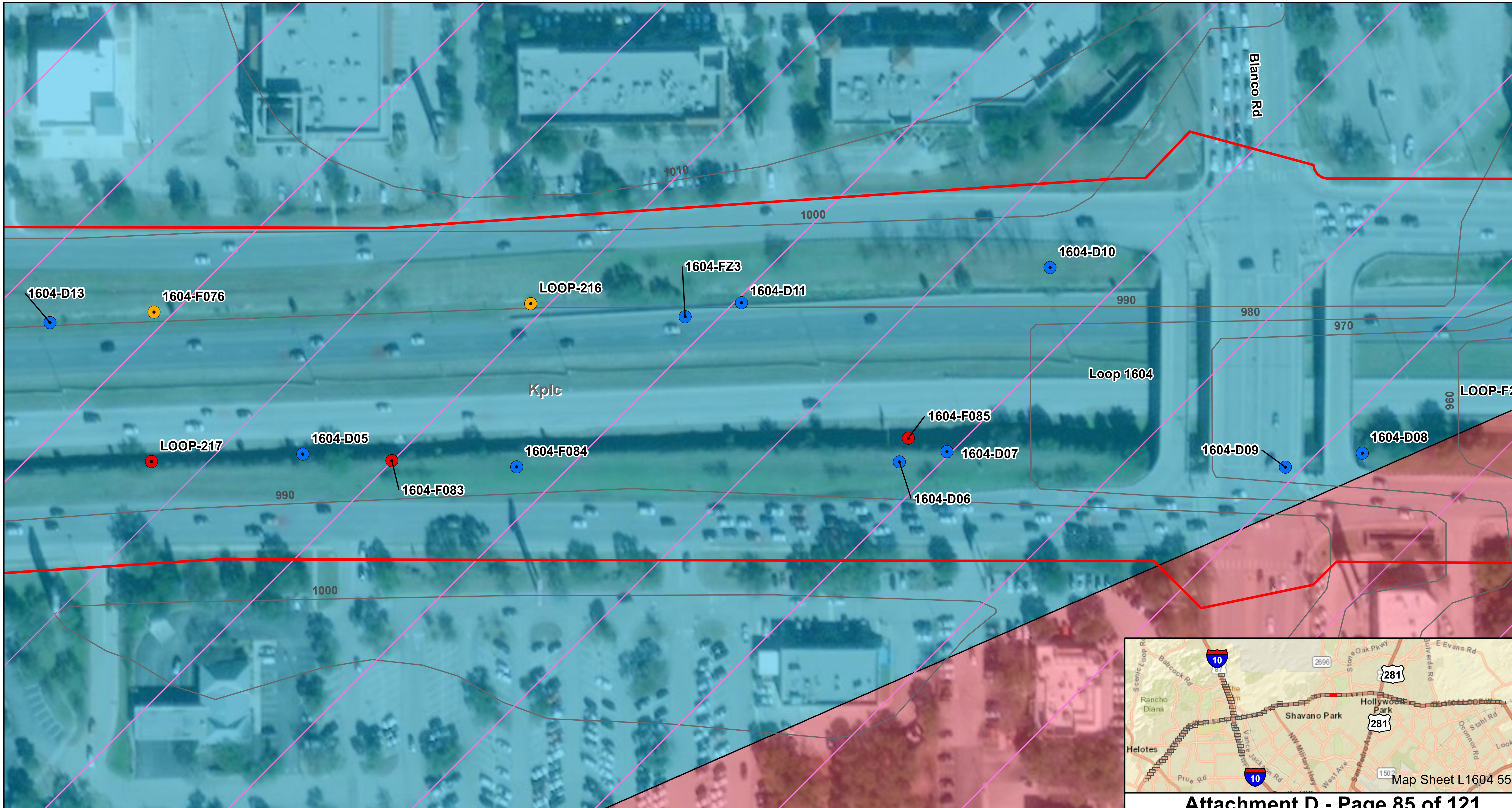


Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.



Attachment D - Page 85 of 121

Survey Area

GA Features
- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours
Streams (FEMA)
FEMA 100-yr flood zone

Boundary line between Geology data sources

Geology: GAT 2010, 250K

Fault Type
- Normal
- Unspecified

Formation
- Qle - Leona Formation
- Qt - Fluviatile terrace deposits
- Kpg - Pecan Gap Chalk
- Kau - Austin Chalk
- Kef - Eagle Ford Group
- Kbu - Buda Limestone
- Kdr - Del Rio Clay
- Ked - Edwards Limestone
- Kgru - Upper Glen Rose Formation
- Kgrl - Lower Glen Rose Formation

Geology: Blome 2005

Fault Type
- Fault-certain
- Fault-inferred

Formation
- Ku - Upper Confining Units
- Kef - Eagle Ford Group
- Kb - Buda Limestone
- Kdr - Del Rio Clay
- Kg - Georgetown Formation
- Kpcm - Person Formation - Cyclic and Marine Member
- Kplc - Person Formation - Leached and Collapsed Member
- Kprd - Person Formation - Regional Dense Member
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- Kkke - Kainer Formation Kirschberg Evaporite Member
- Kkd - Kainer Formation - Dolomitic Member
- Kkbn - Kainer Formation - Basal Nodular Member
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Edwards Aquifer Zones
- Contributing Zone
- Contributing withing Transition Zone
- Recharge Zone
- Transition Zone

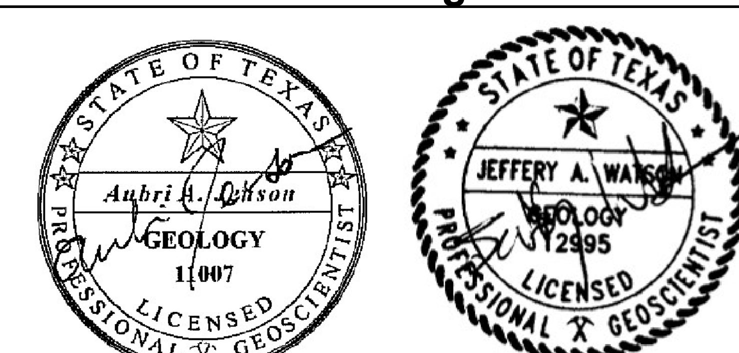
N

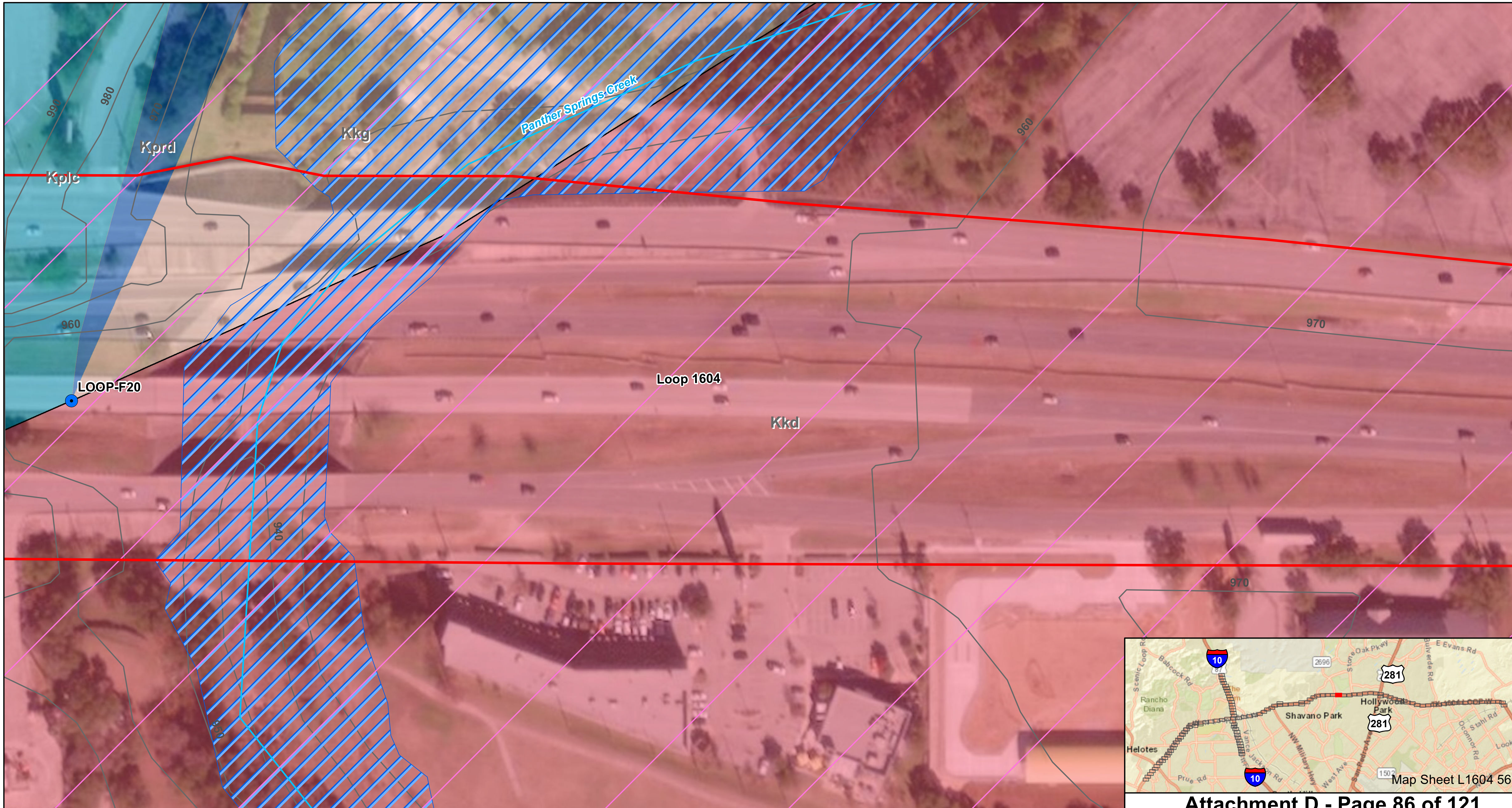
1 inch = 100 feet

0 50 100 200 300 Feet

0 50 100 Meters

Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.





Survey Area

Boundary line between Geology data sources

GA Features
- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours
Streams (FEMA)
FEMA 100-yr flood zone

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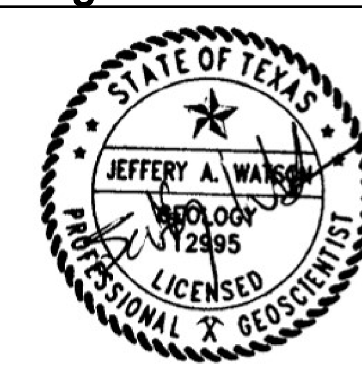

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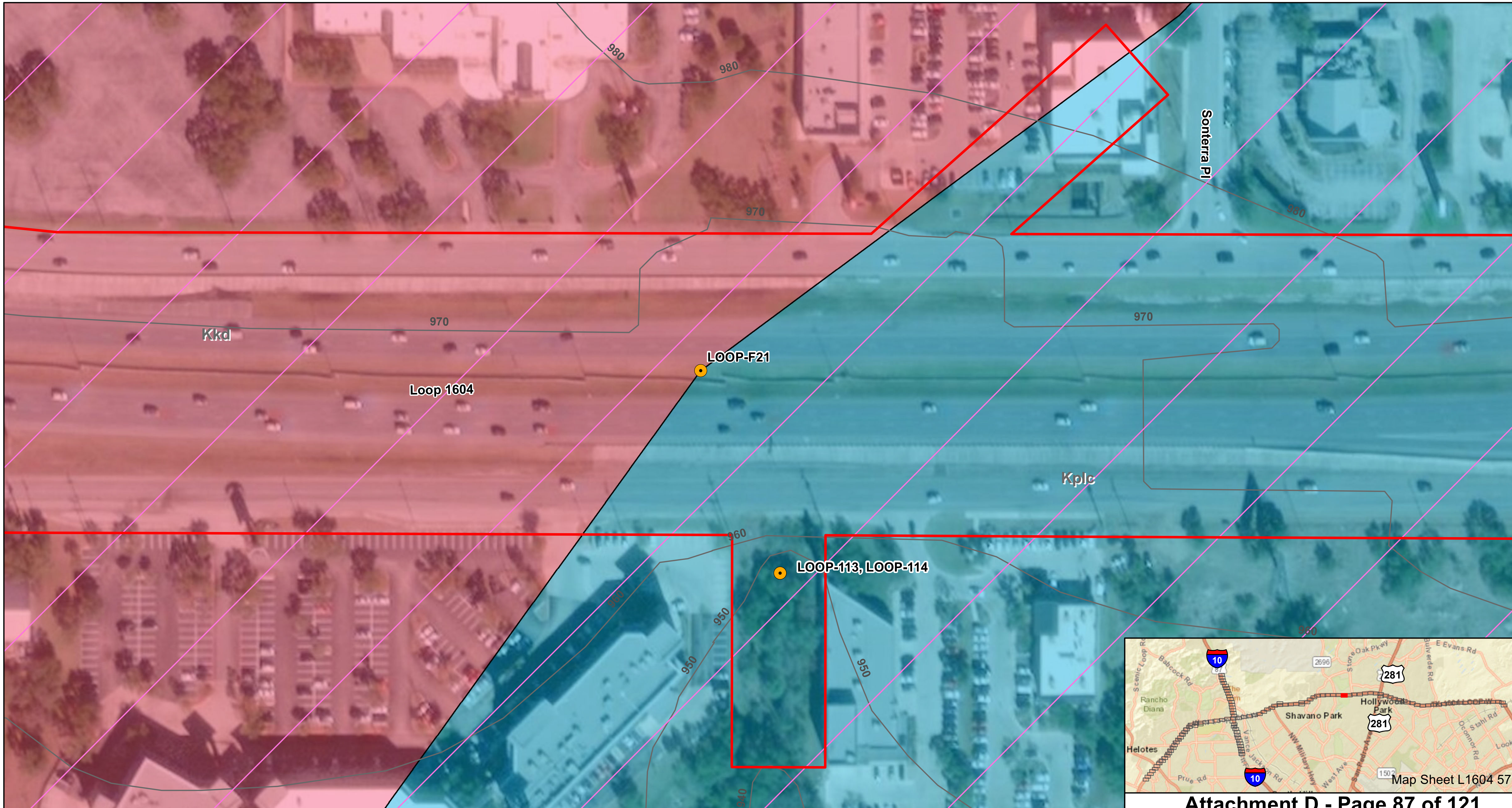

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Survey Area
Boundary line between Geology data sources

GA Features
- Non-Sensitive: <35 Rating
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Streams (FEMA)
FEMA 100-yr flood zone

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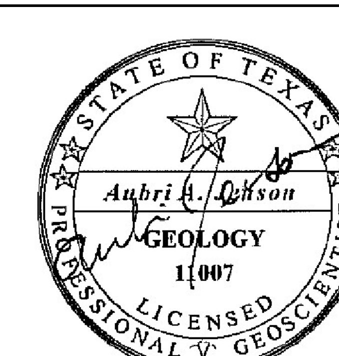

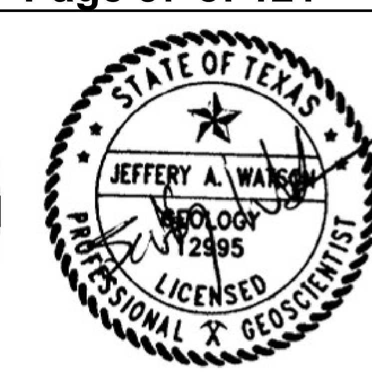

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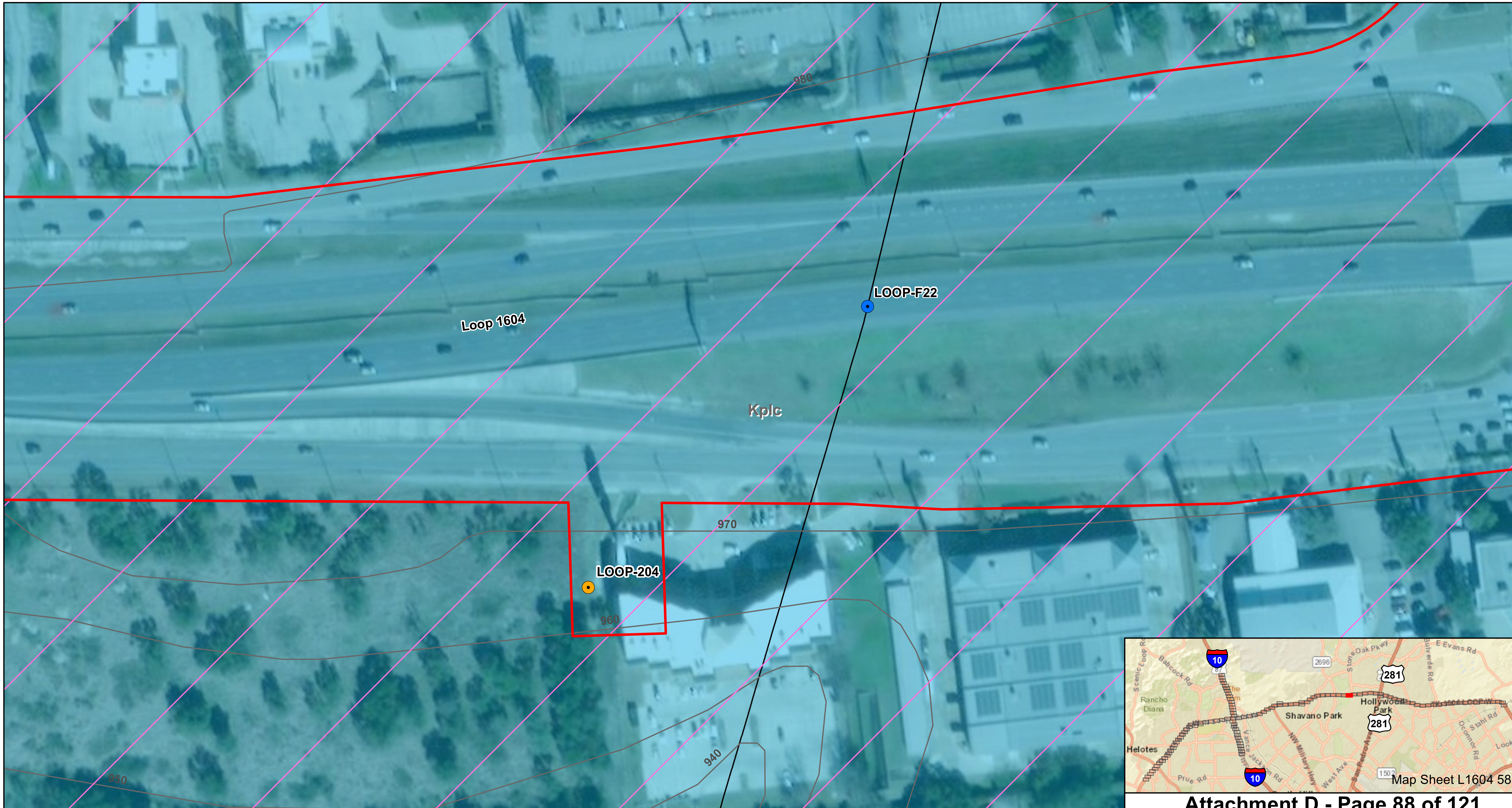

Attachment D - Page 88 of 121

Survey Area

GA Features
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- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours
Streams (FEMA)
FEMA 100-yr flood zone

Boundary line between Geology data sources

Geology: GAT 2010, 250K

Fault Type
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Formation
- Qle - Leona Formation
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Geology: Blome 2005

Fault Type
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- Fault-inferred

Formation
- Ku - Upper Confining Units
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- Contributing withing Transition Zone
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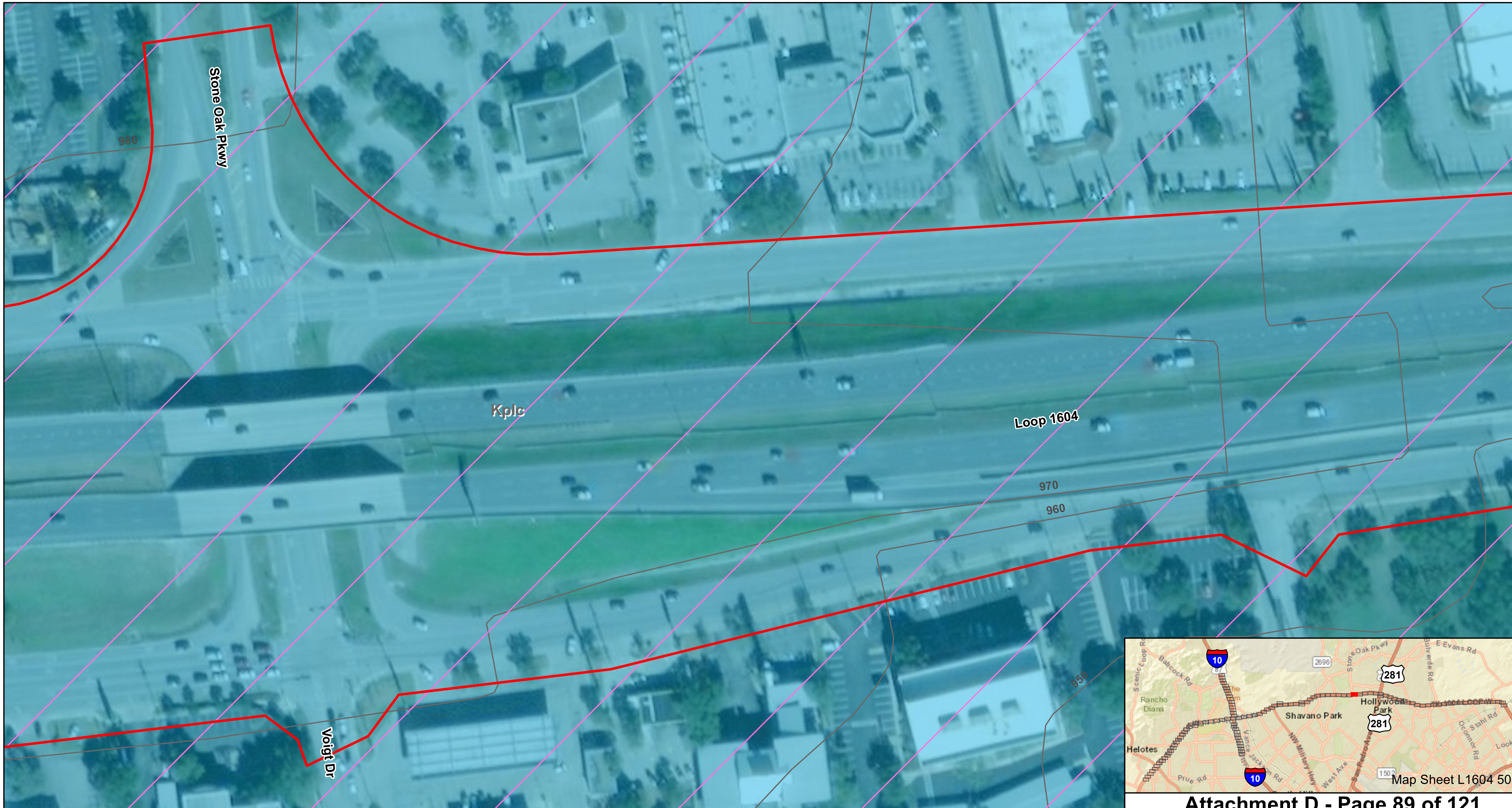

Survey Area

Boundary line between Geology data sources

GA Features

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- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

Normal

Unspecified

Formation

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Geology: Blome 2005

Fault Type

Fault-certain

Fault-inferred

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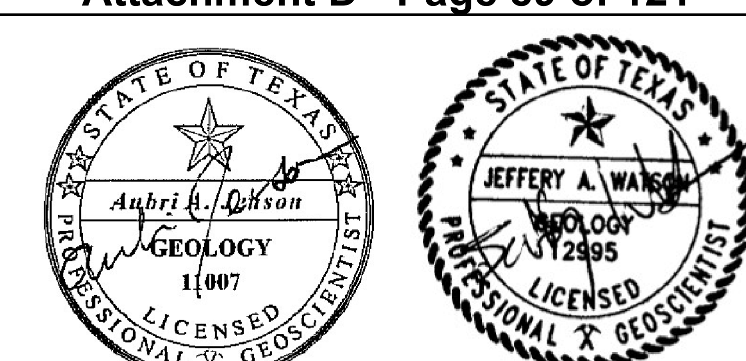

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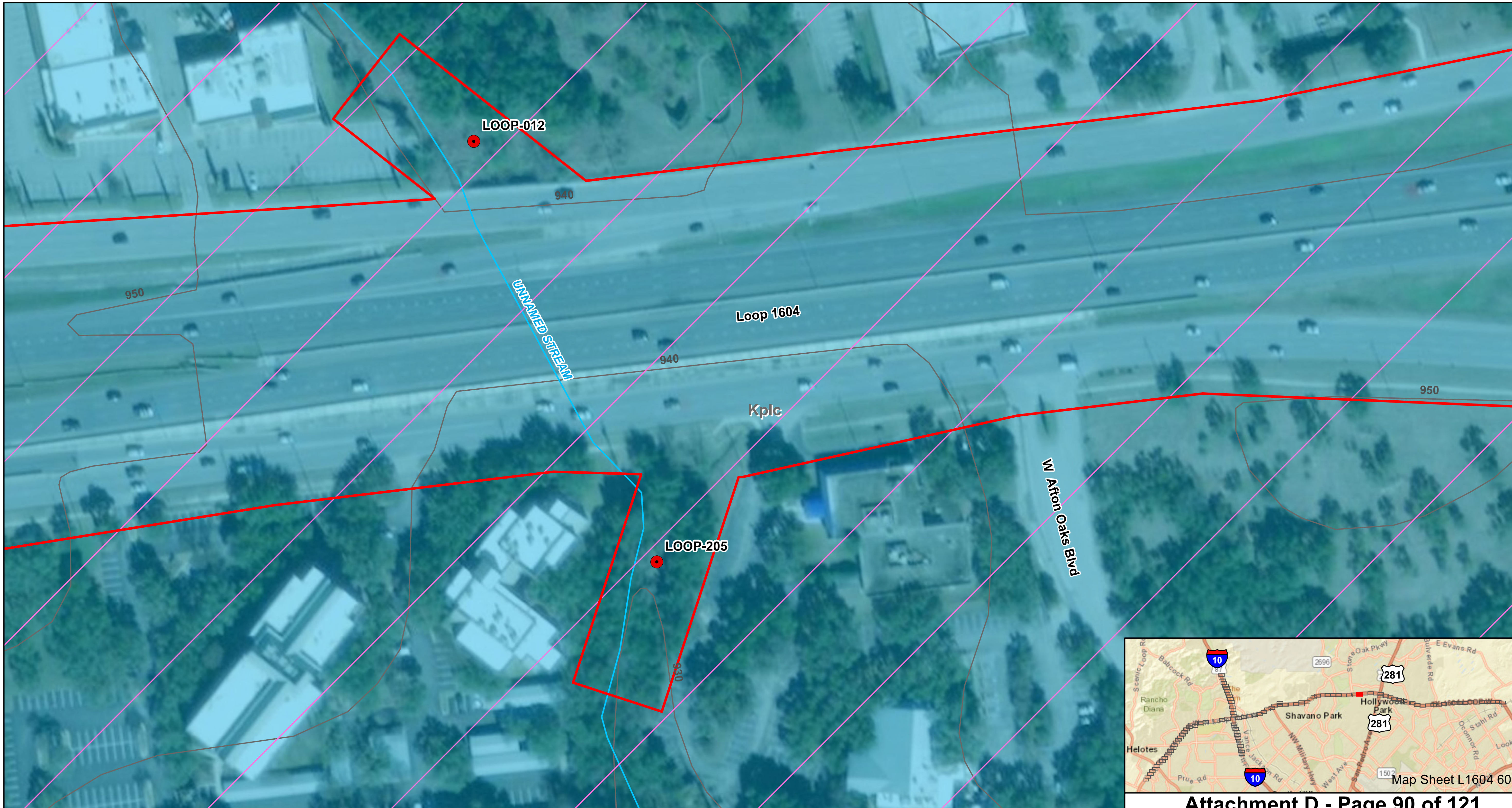

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Survey Area

GA Features

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- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Boundary line between Geology data sources

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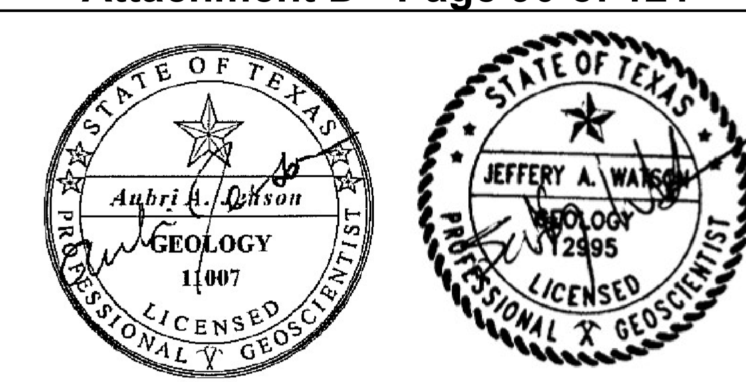

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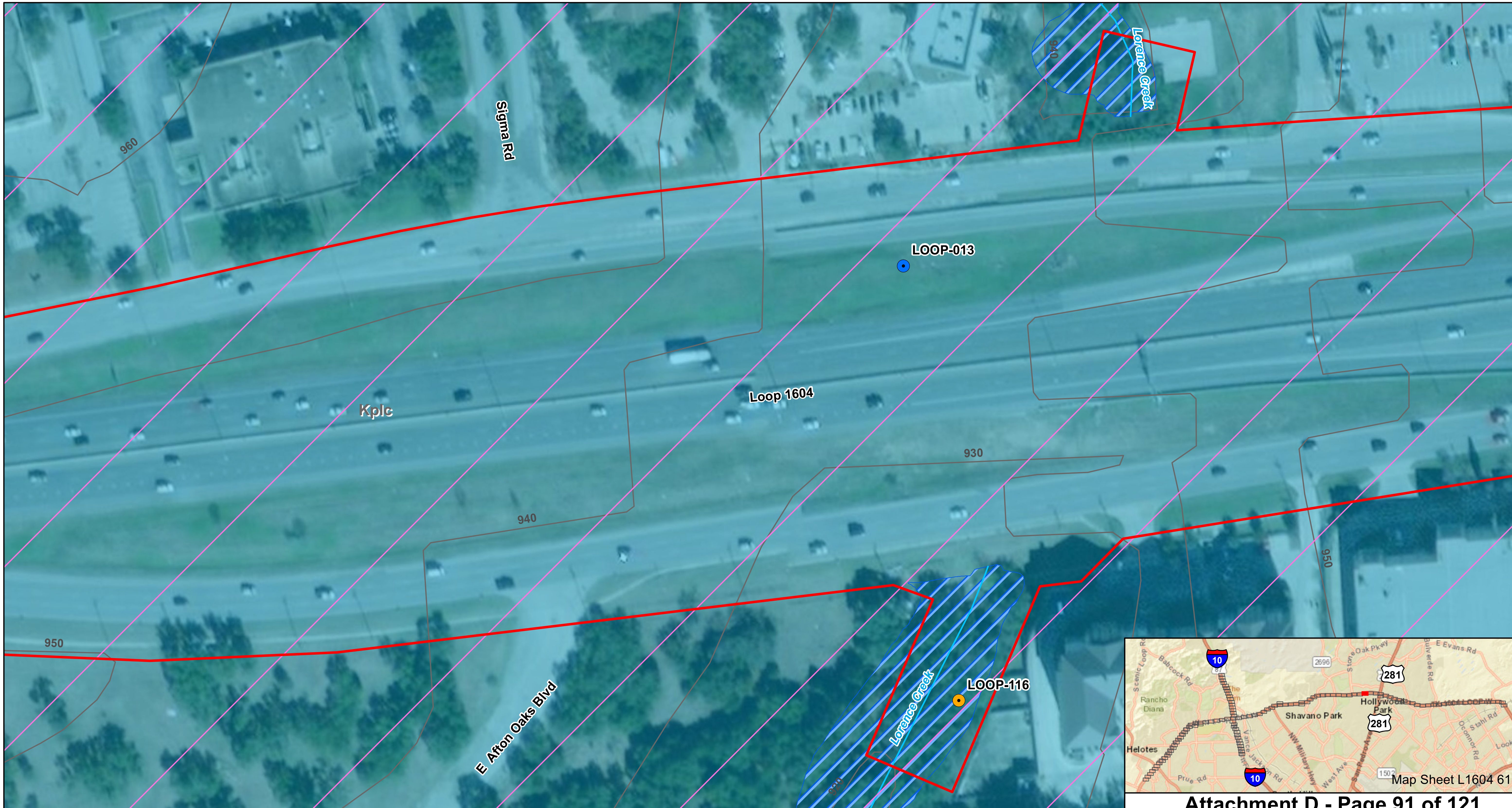

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Survey Area

Boundary line between Geology data sources

GA Features

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StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

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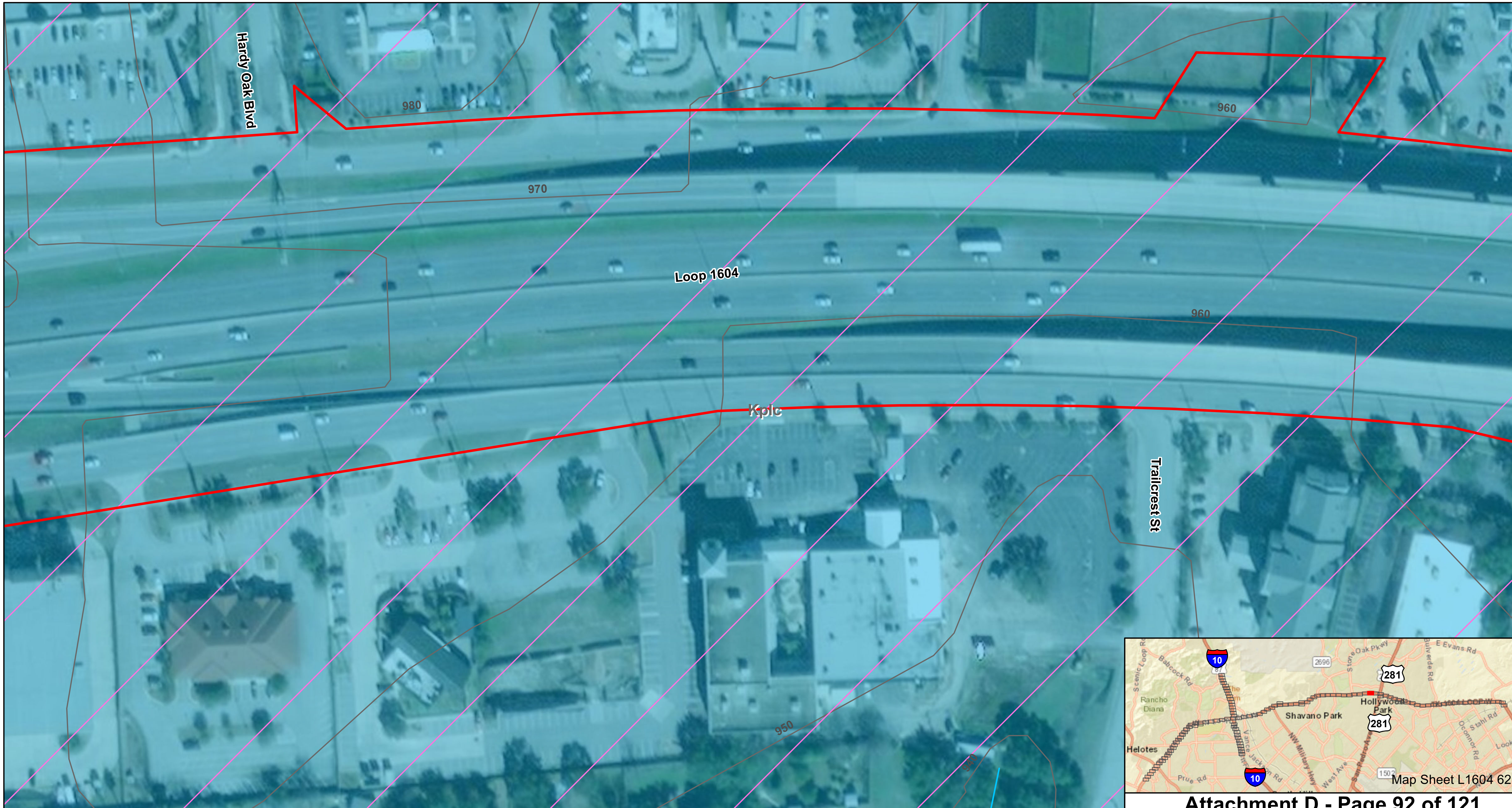

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Survey Area

Boundary line between Geology data sources

GA Features

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StratMap 10-ft elevation contours

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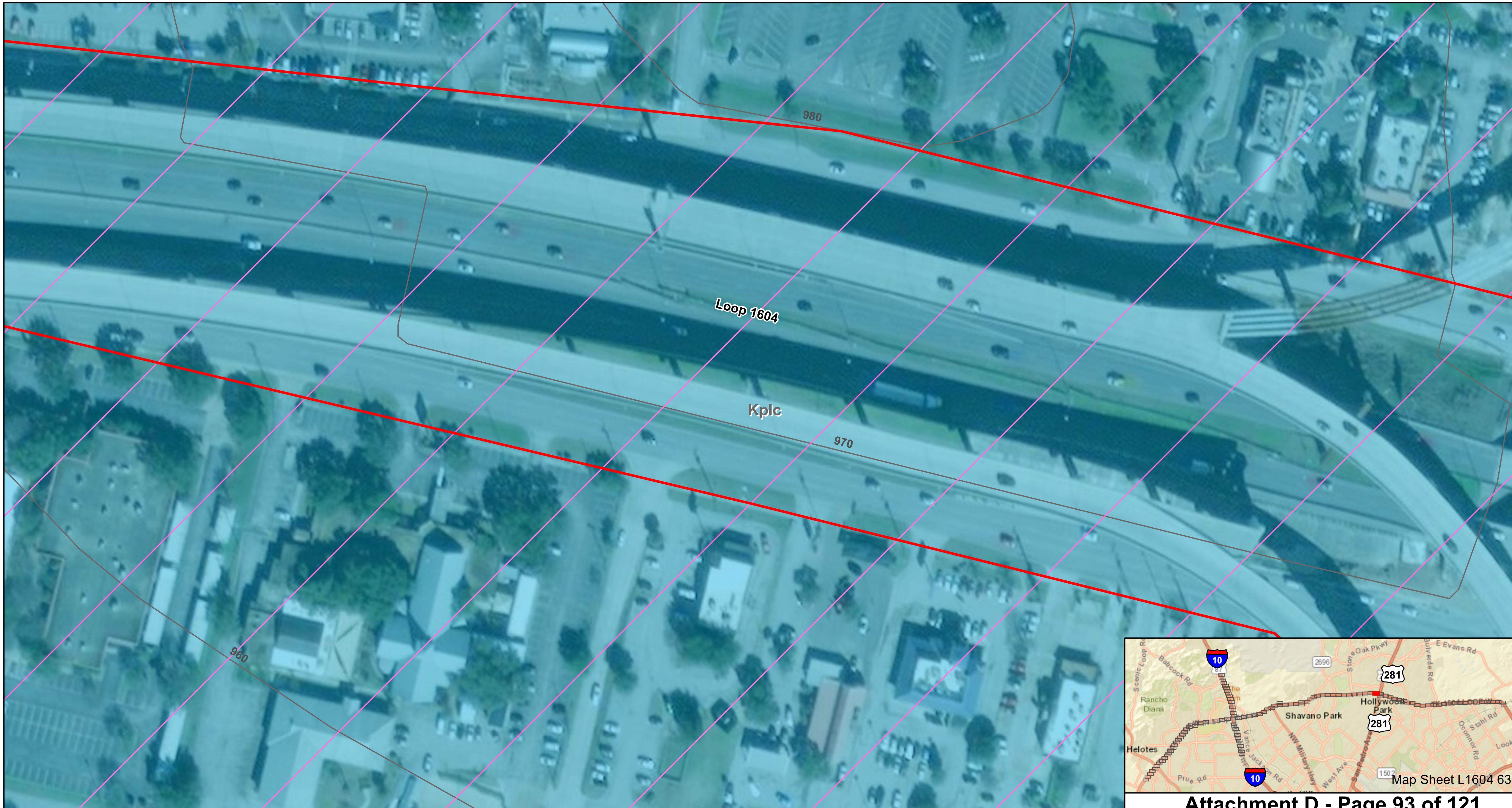

Attachment D - Page 93 of 121

Survey Area

Boundary line between Geology data sources

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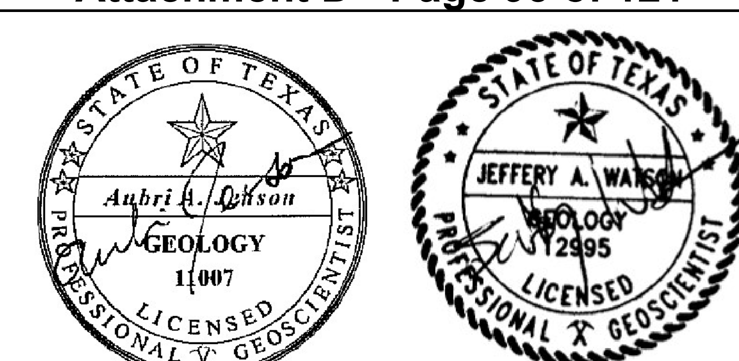

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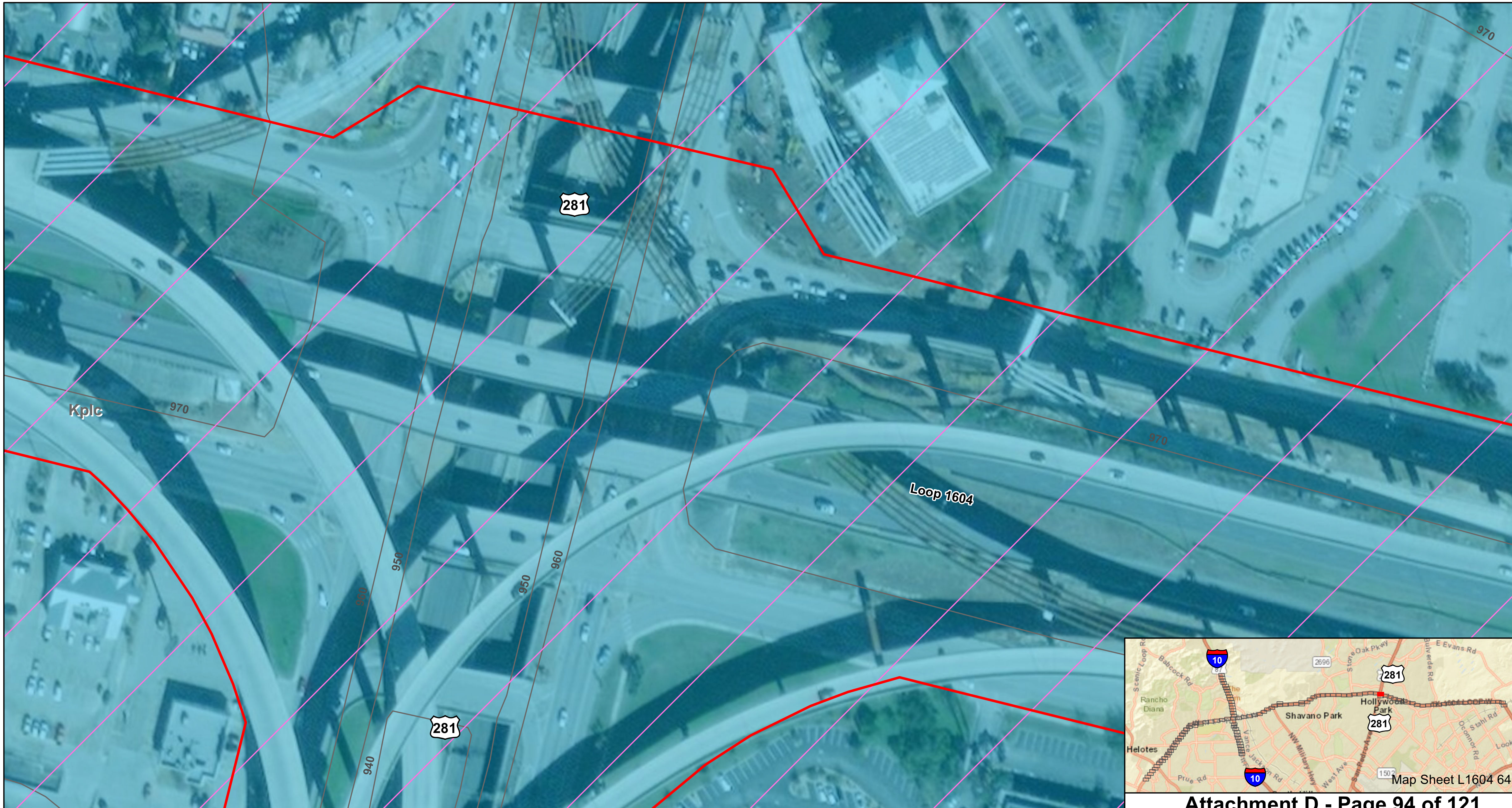

Attachment D - Page 94 of 121

Survey Area

GA Features
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- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours
Streams (FEMA)
FEMA 100-yr flood zone

Boundary line between Geology data sources

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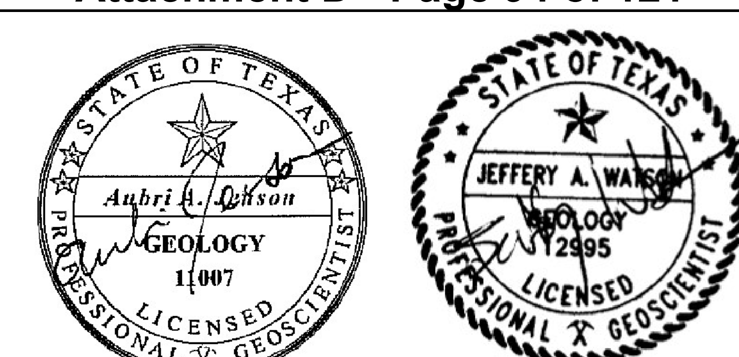

Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.

Survey Area

Boundary line between Geology data sources

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StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

Normal

Unspecified

Formation

Qle - Leona Formation

Qt - Fluviatile terrace deposits

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Kkke - Kainer Formation Kirschberg Evaporite Member

Kkd - Kainer Formation - Dolomitic Member

Kkbn - Kainer Formation - Basal Nodular Member

Kgr(u) - Upper Glen Rose

Edwards Aquifer Zones

Contributing Zone

Contributing withing Transition Zone

Recharge Zone

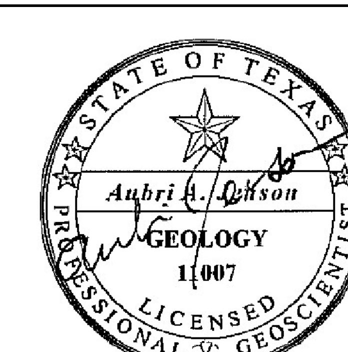
Transition Zone

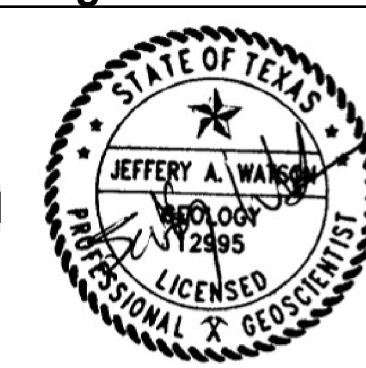
N

1 inch = 100 feet

0 50 100 200 300 Feet

0 50 100 Meters





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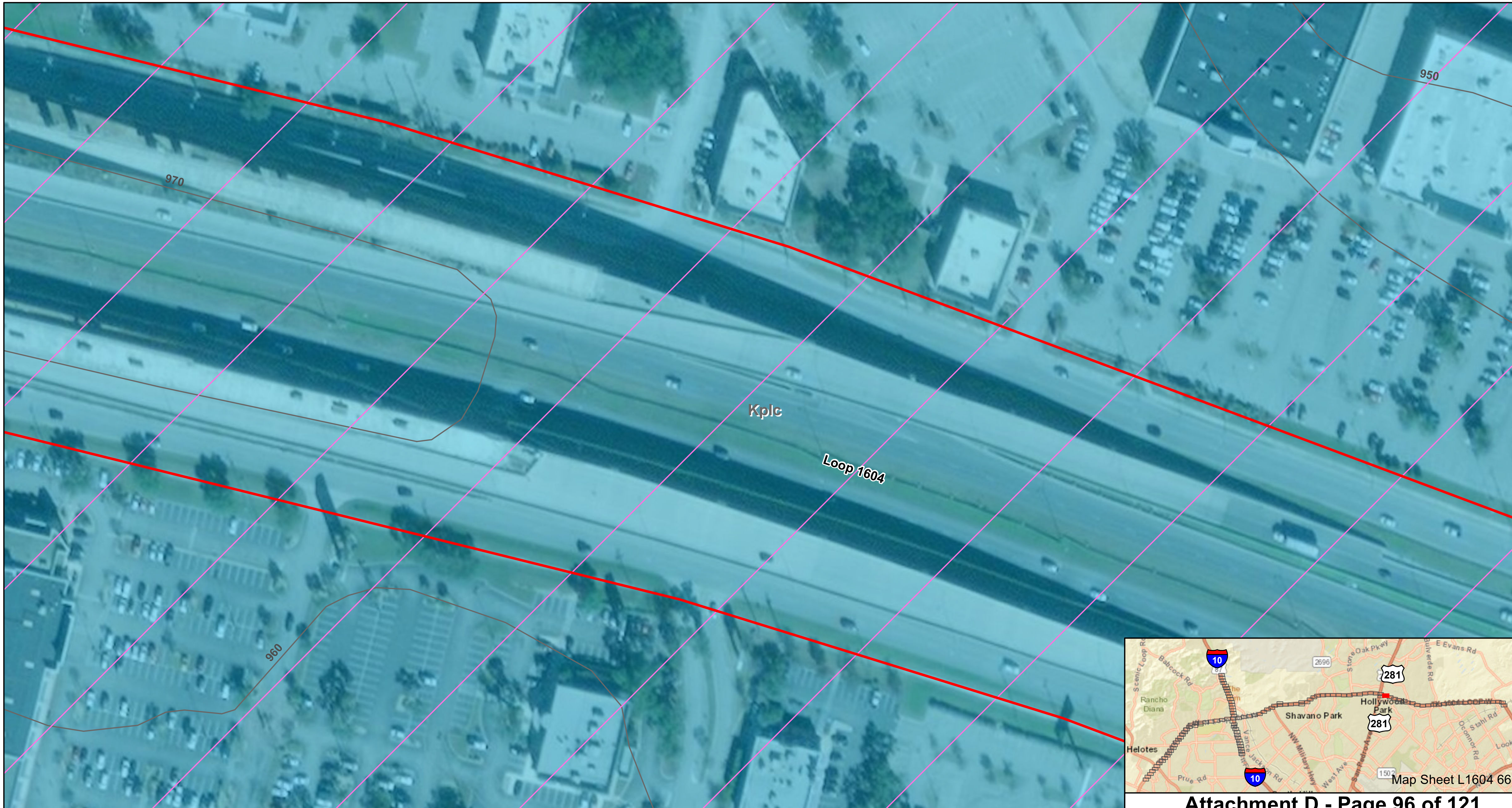

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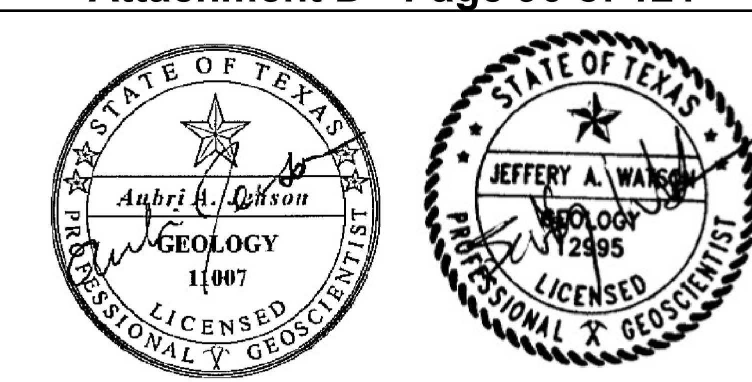
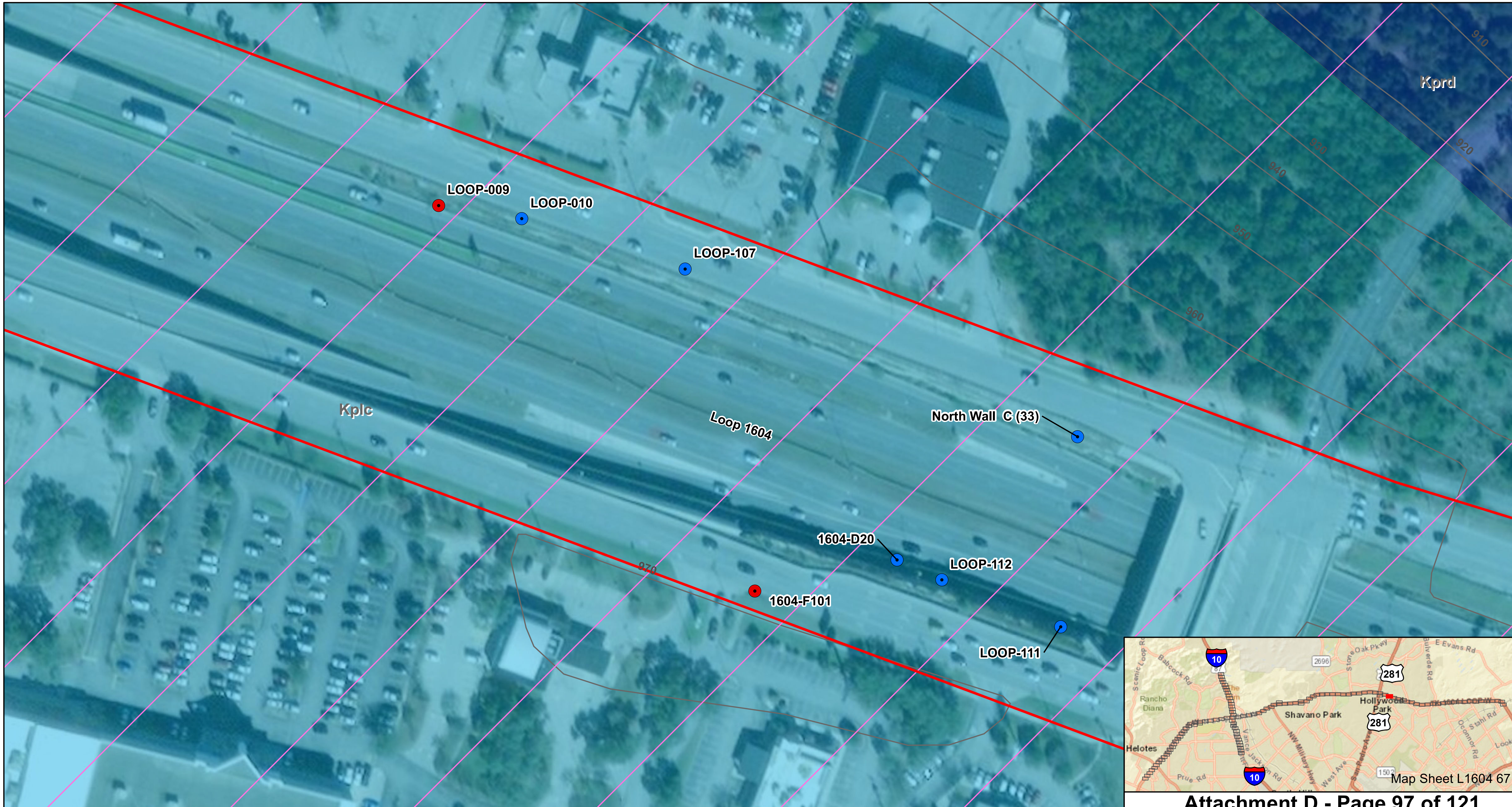
Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.





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Survey Area

Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

Normal

Unspecified

Formation

- Qle - Leona Formation
- Qt - Fluviatile terrace deposits
- Kpg - Pecan Gap Chalk
- Kau - Austin Chalk
- Kef - Eagle Ford Group
- Kbu - Buda Limestone
- Kdr - Del Rio Clay
- Ked - Edwards Limestone
- Kgru - Upper Glen Rose Formation
- Kgrl - Lower Glen Rose Formation

Geology: Blome 2005

Fault Type

Fault-certain

Fault-inferred

Formation

- Ku - Upper Confining Units
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Edwards Aquifer Zones

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- Contributing withing Transition Zone
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- Transition Zone

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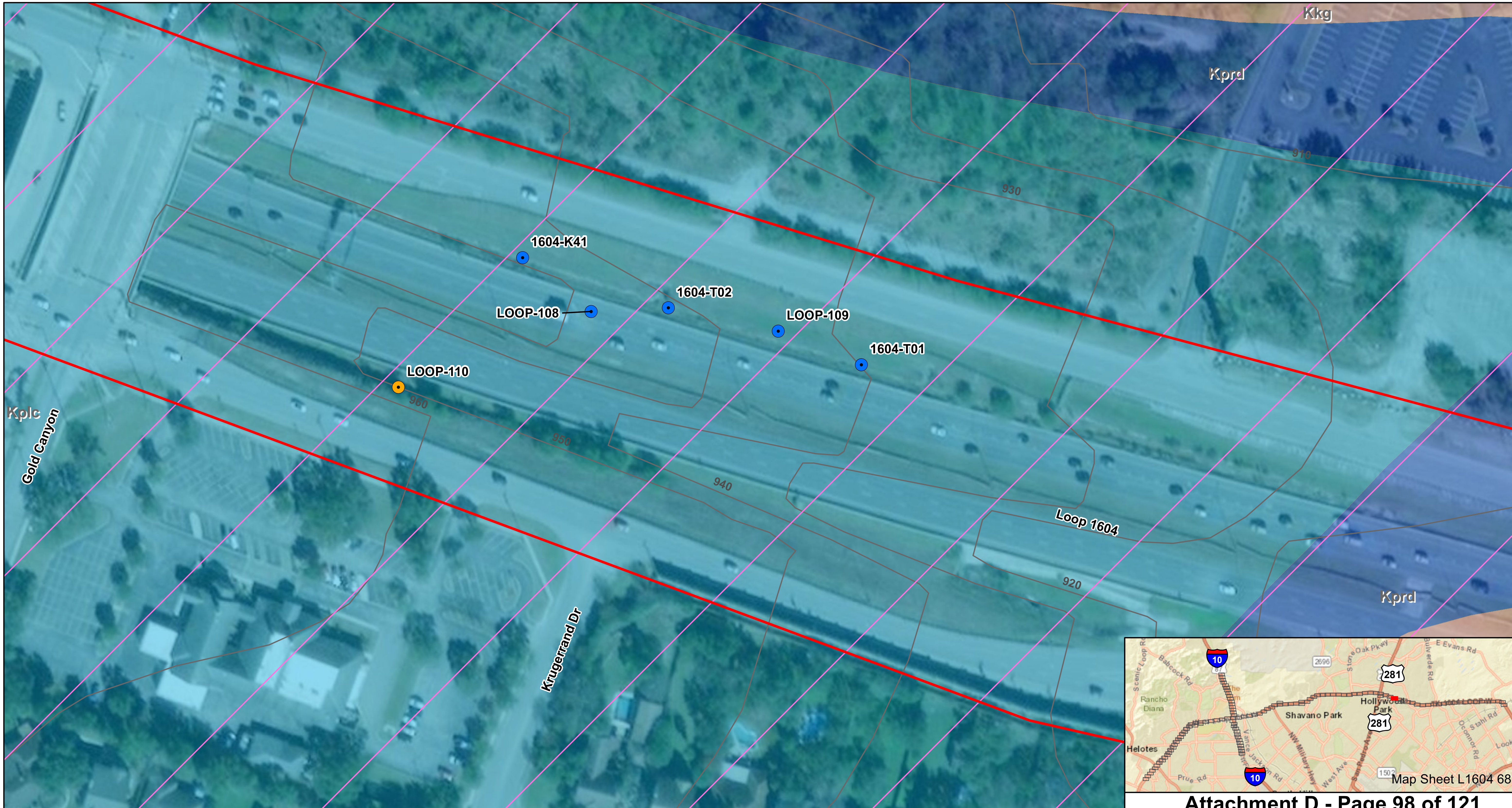
STATE OF TEXAS
Aubri A. Olson
GEOLOGY
11007
LICENSED
PROFESSIONAL GEOSCIENTIST

STATE OF TEXAS
JEFFERY A. WATSON
GEOLOGY
12995
LICENSED
PROFESSIONAL GEOSCIENTIST

Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.



Attachment D - Page 98 of 121

Survey Area

Boundary line between Geology data sources

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- TWDB Wells

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FEMA 100-yr flood zone

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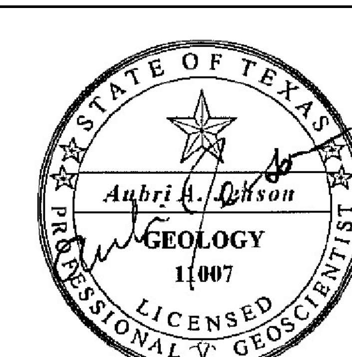

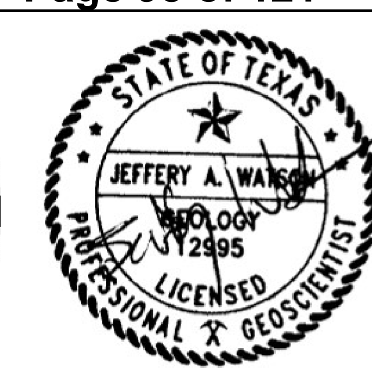

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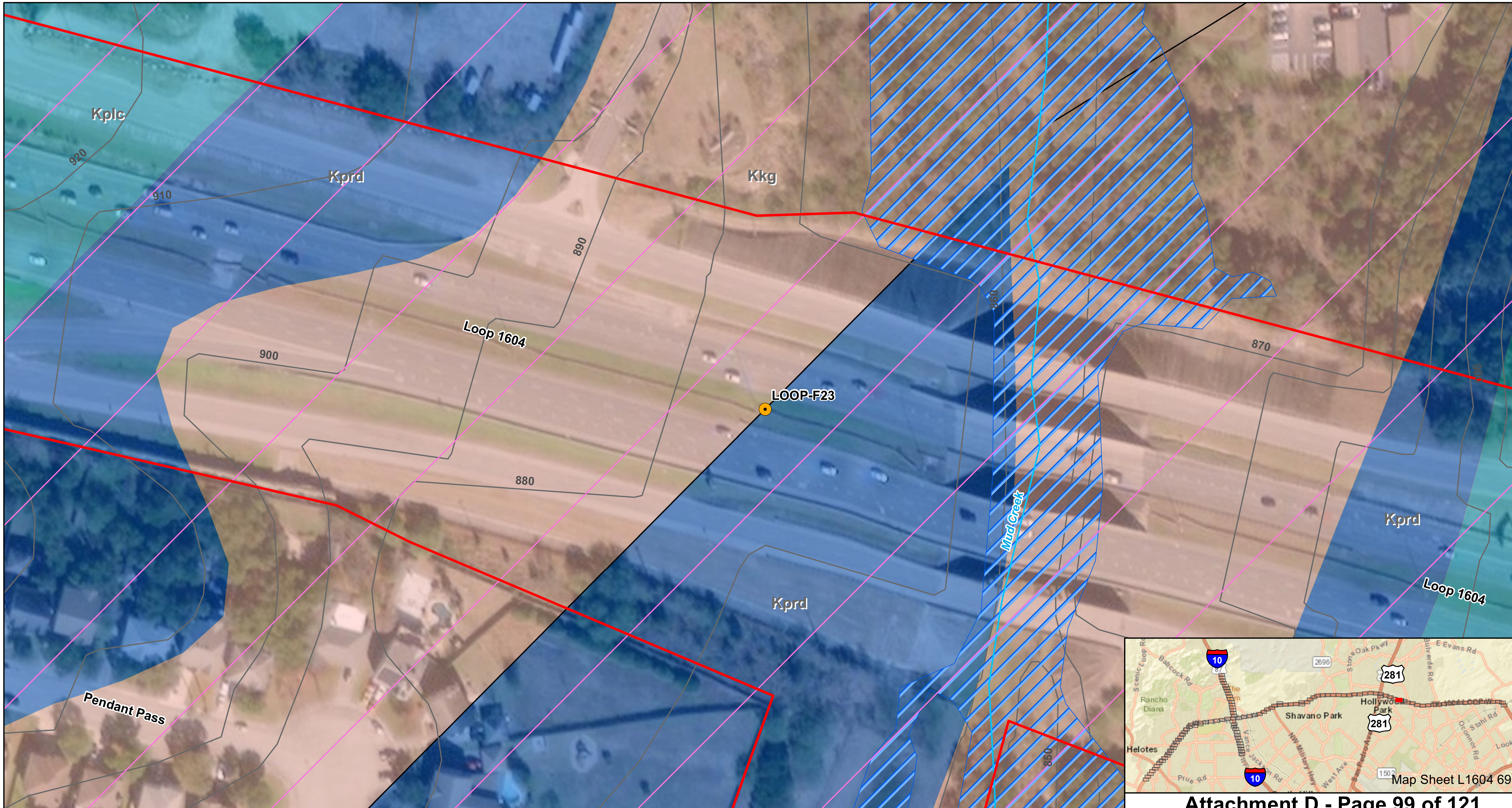

Attachment D - Page 99 of 121

Survey Area

Boundary line between Geology data sources

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FEMA 100-yr flood zone

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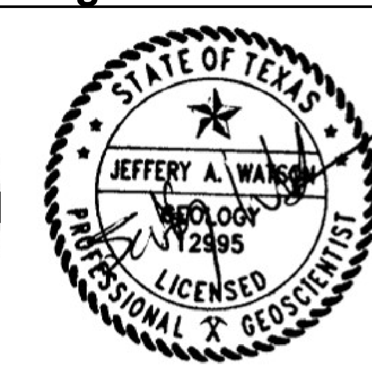

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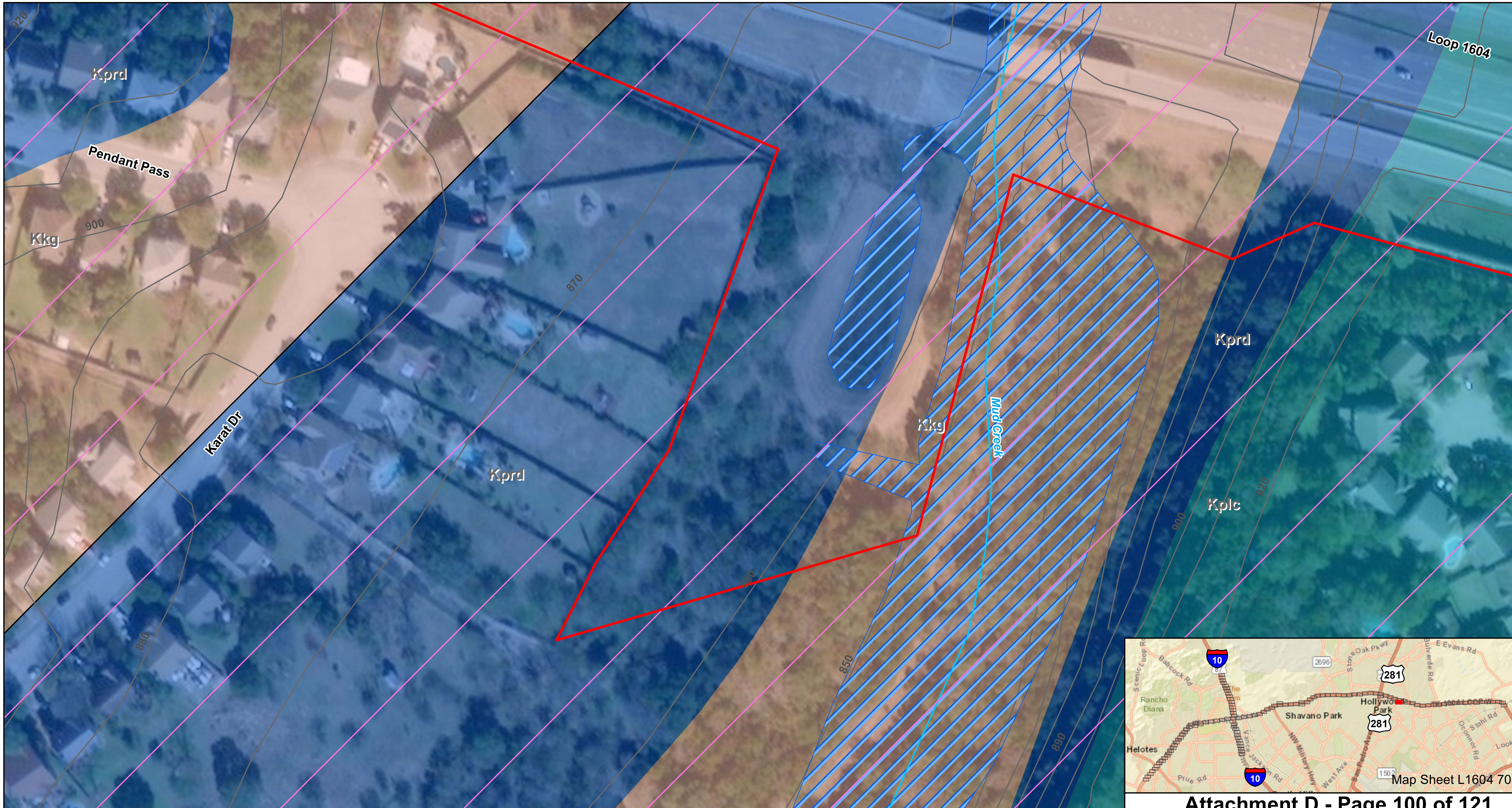

Attachment D - Page 100 of 121

Survey Area

Boundary line between Geology data sources

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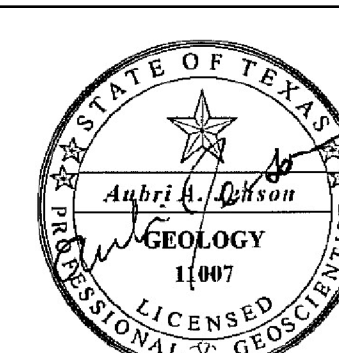

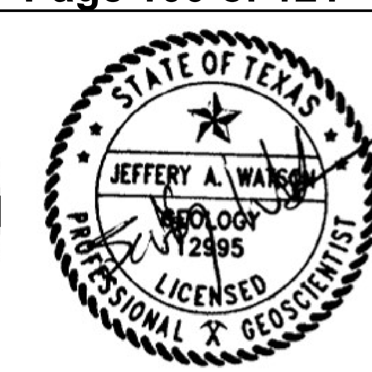

Attachment D - Page 101 of 121

Survey Area

GA Features

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- Non-Senstive: >35 Rating
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StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Boundary line between Geology data sources

Geology: GAT 2010, 250K

Fault Type

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Unspecified

Formation

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Geology: Blome 2005

Fault Type

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Fault-inferred

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Edwards Aquifer Zones

Contributing Zone

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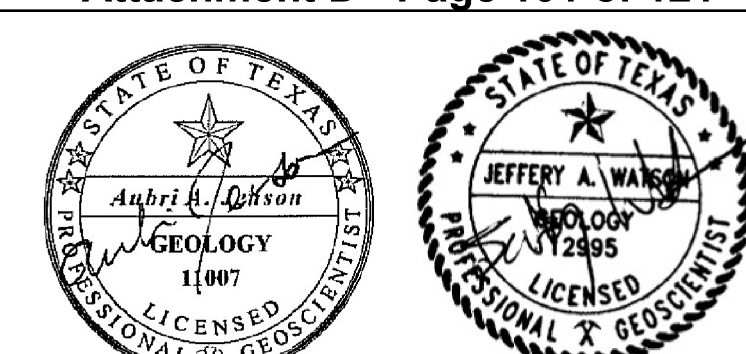
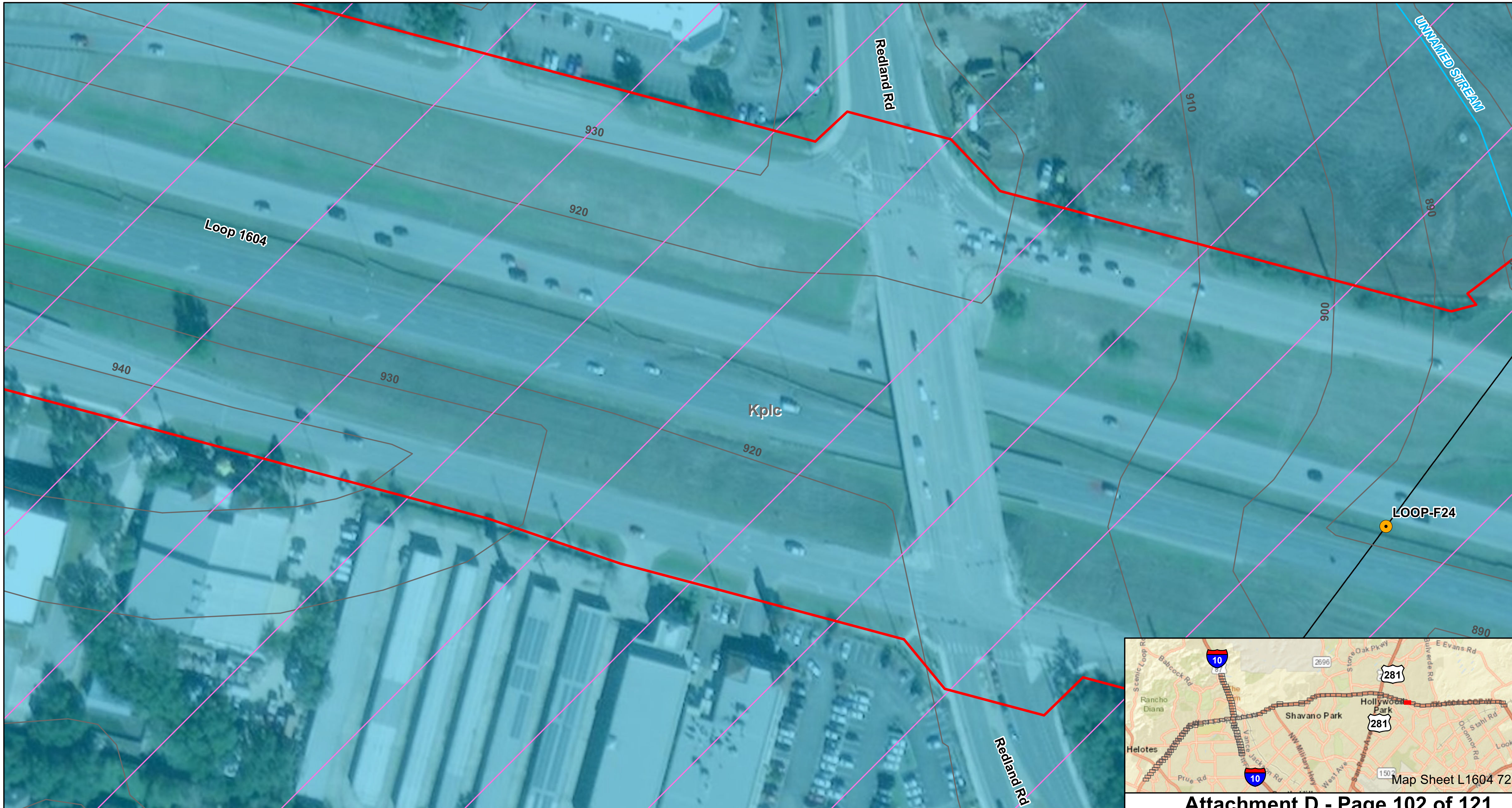


Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.



Survey Area

Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
- Non-Sensitve: >35 Rating
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StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

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Geology: Blome 2005

Fault Type

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Formation

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Edwards Aquifer Zones

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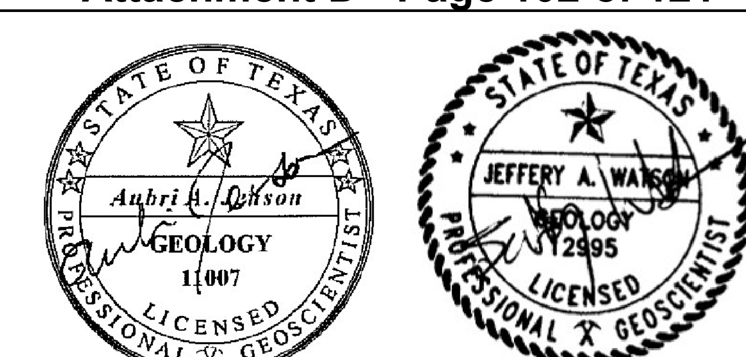

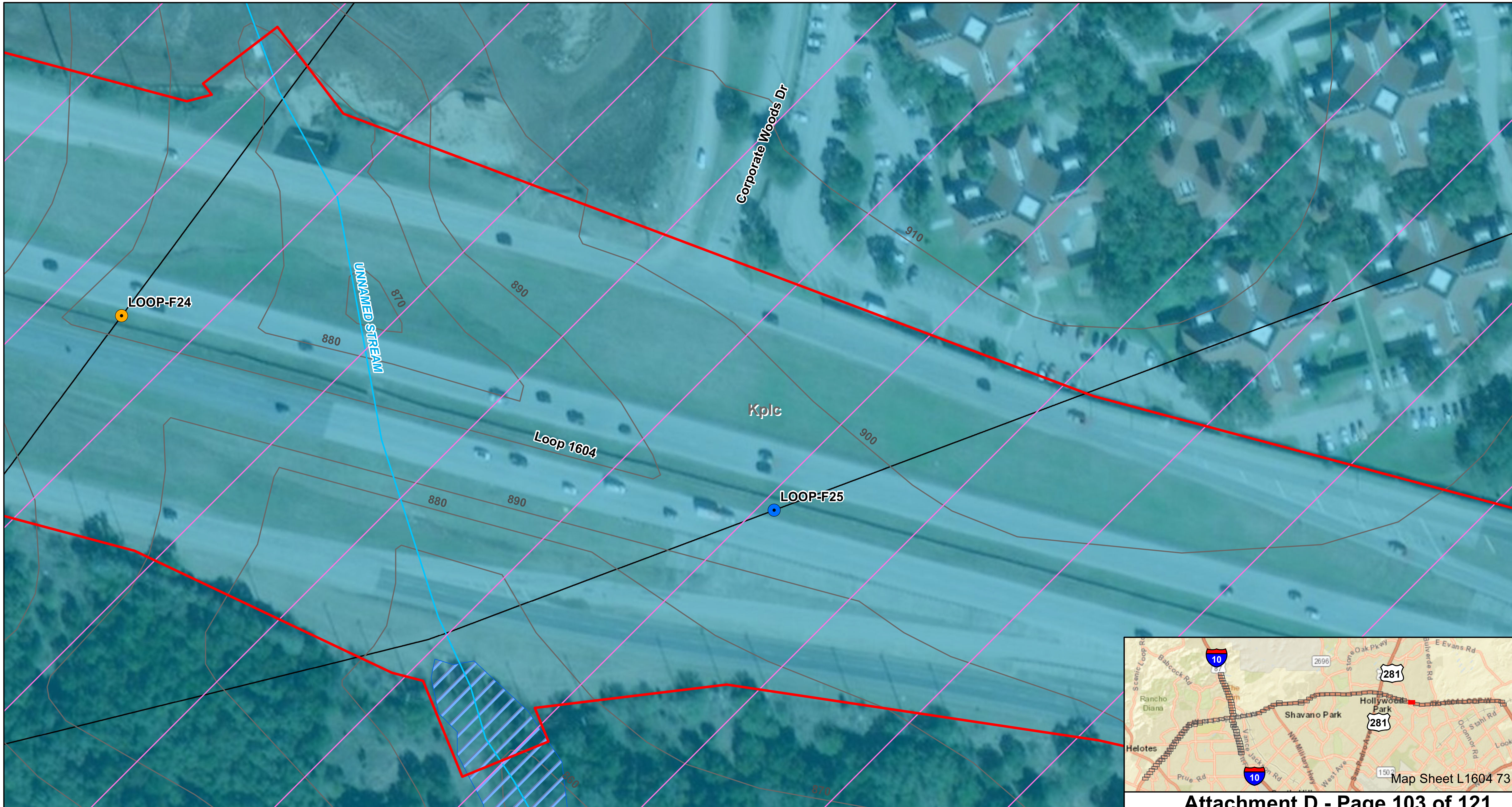

Attachment D - Page 103 of 121

Survey Area

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
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- TWDB Wells

StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Boundary line between Geology data sources

Geology: GAT 2010, 250K

Fault Type

Normal

Unspecified

Formation

Qle - Leona Formation

Qt - Fluviatile terrace deposits

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Geology: Blome 2005

Fault Type

Fault-certain

Fault-inferred

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Ku - Upper Confining Units

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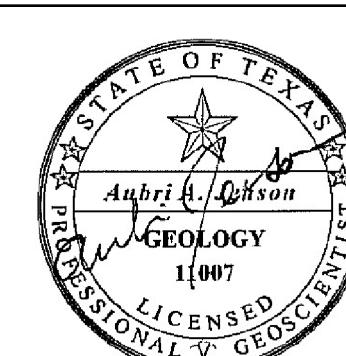

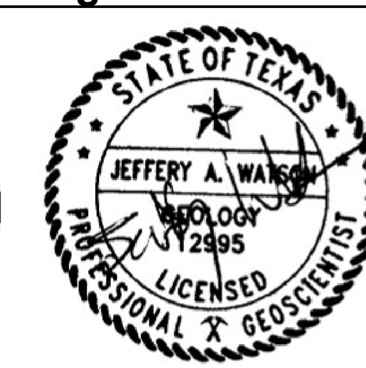

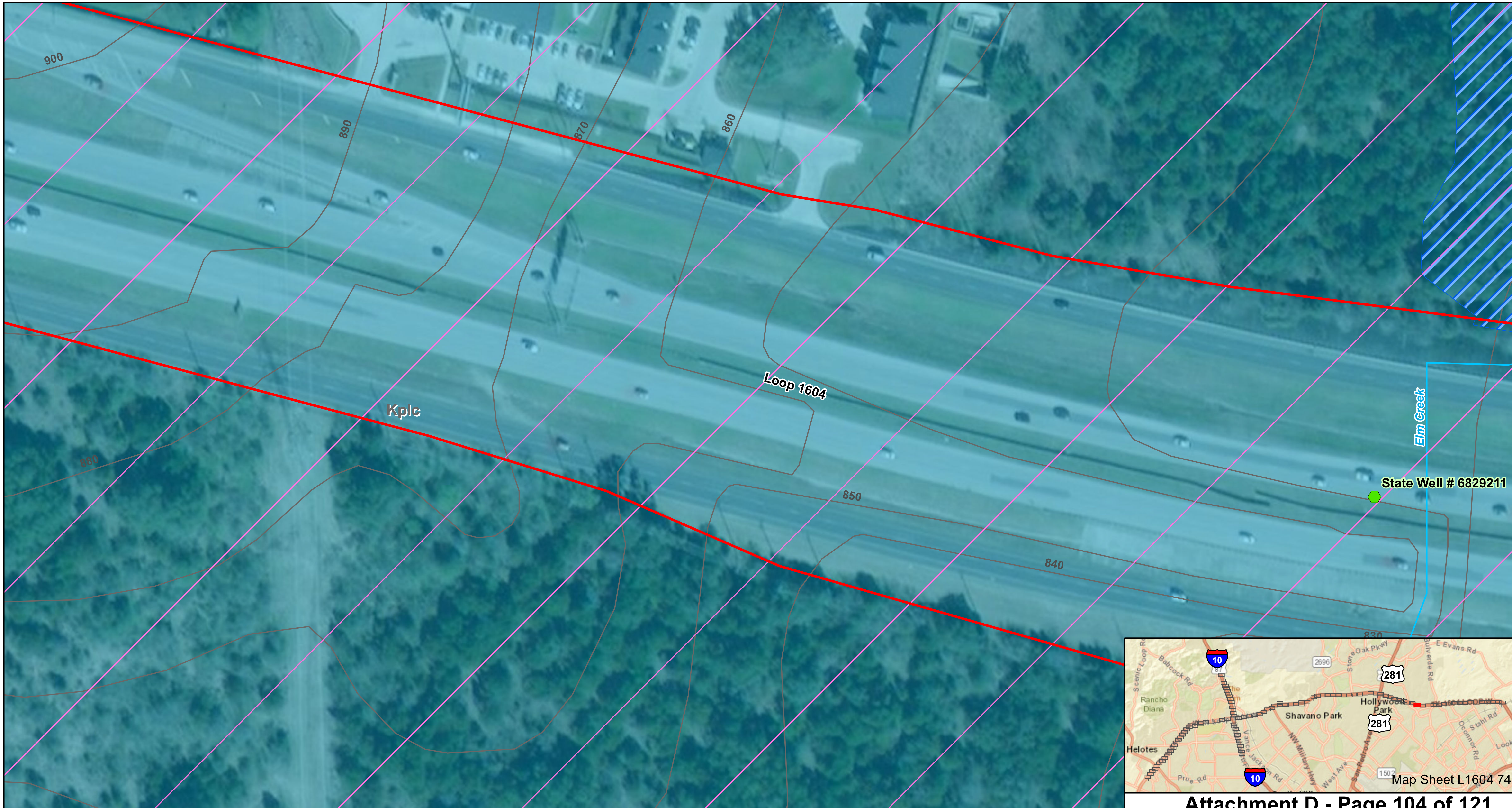

Attachment D - Page 104 of 121

Survey Area

Boundary line between Geology data sources

GA Features
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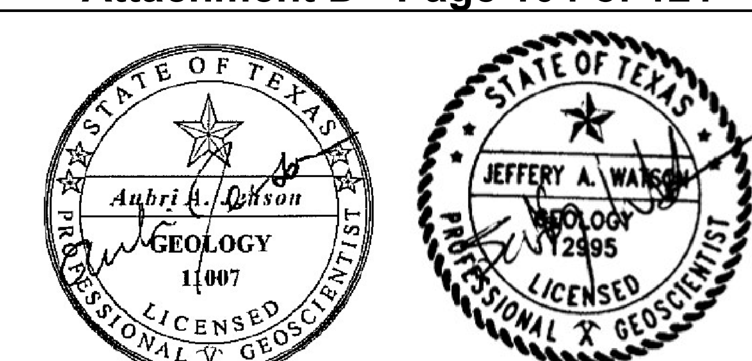

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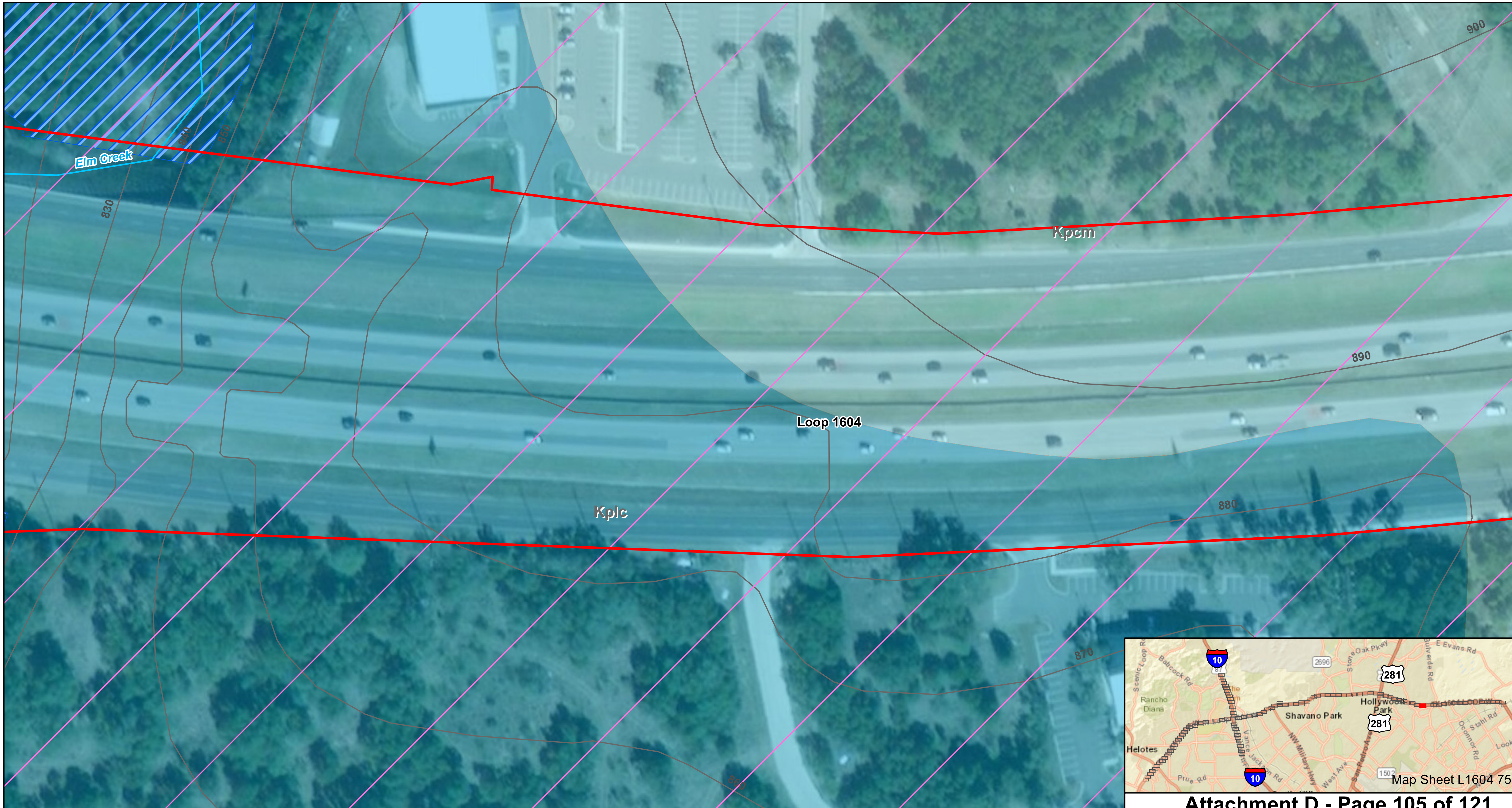

Attachment D - Page 105 of 121

Survey Area

Boundary line between Geology data sources

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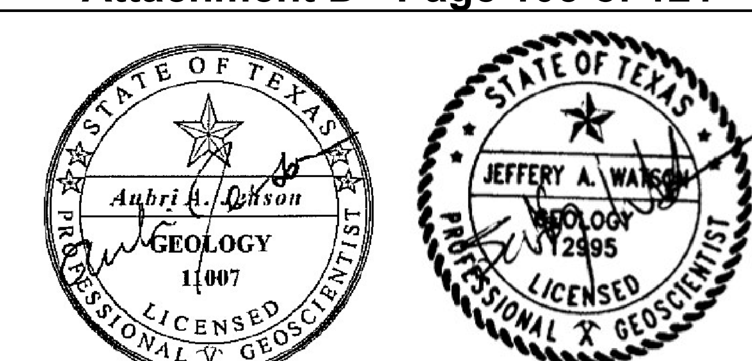

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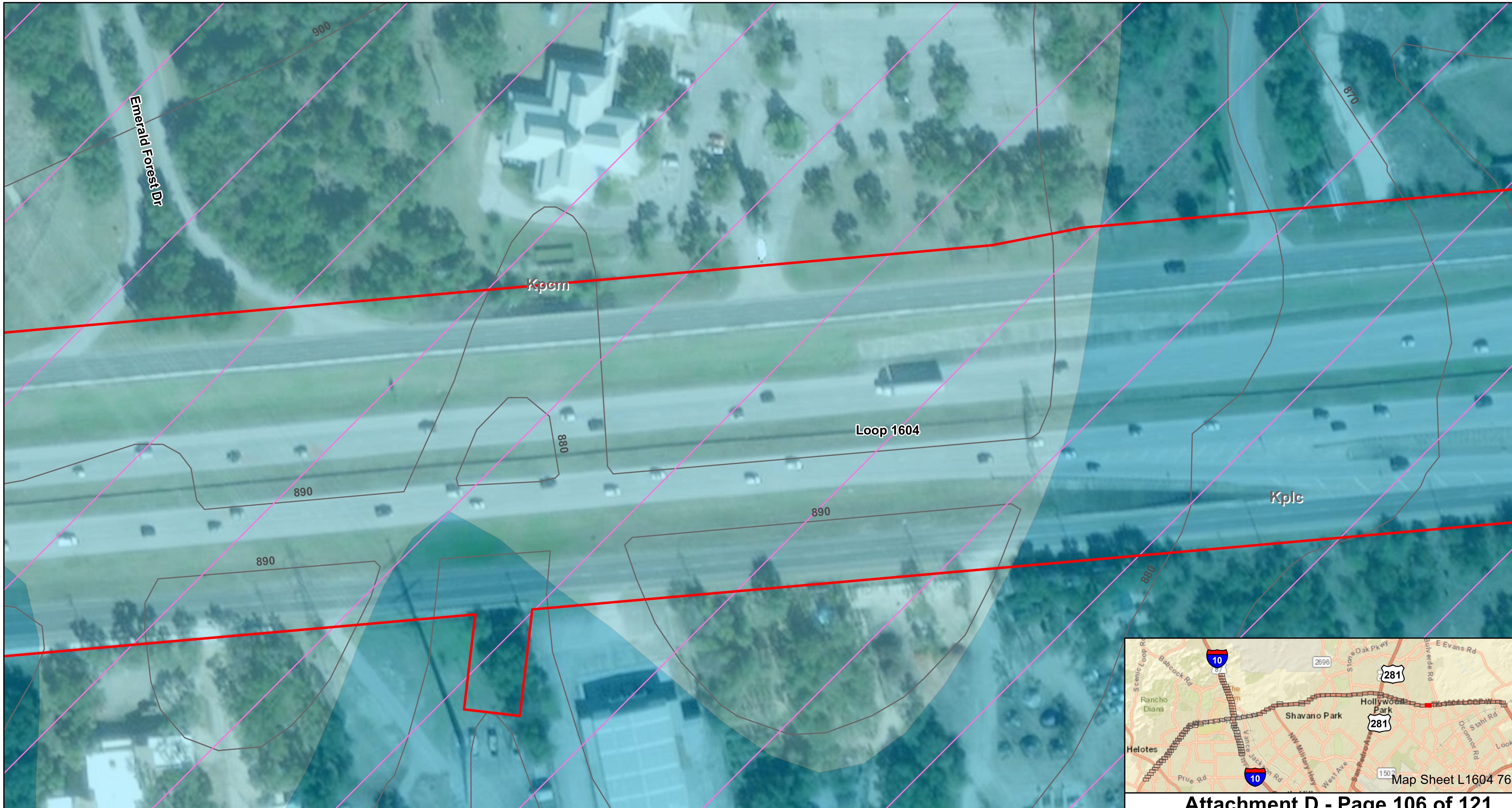

Attachment D - Page 106 of 121

- Survey Area
- Boundary line between Geology data sources

GA Features

- Non-Sensitive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
- TWDB Wells
- StratMap 10-ft elevation contours
- Streams (FEMA)
- FEMA 100-yr flood zone

Geology: GAT 2010, 250K

Fault Type

- Normal
- Unspecified

Formation

- Qle - Leona Formation
- Qt - Fluviatile terrace deposits
- Kpg - Pecan Gap Chalk
- Kau - Austin Chalk
- Kef - Eagle Ford Group
- Kbu - Buda Limestone
- Kdr - Del Rio Clay
- Ked - Edwards Limestone
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Geology: Blome 2005

Fault Type

- Fault-certain
- Fault-inferred

Formation

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Edwards Aquifer Zones

- Contributing Zone
- Contributing withing Transition Zone
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N

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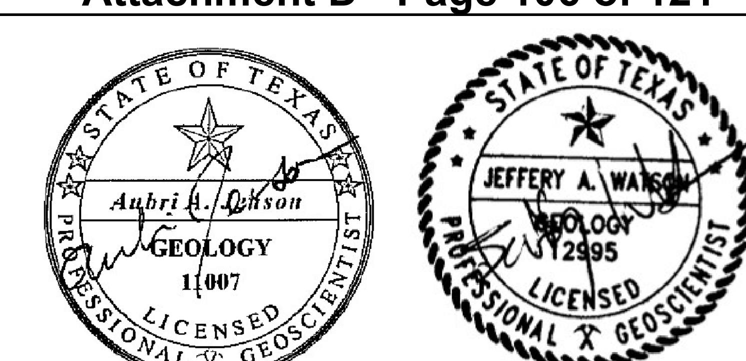
0 50 100 200 300 Feet

0 50 100 Meters



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Survey Area

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FEMA 100-yr flood zone

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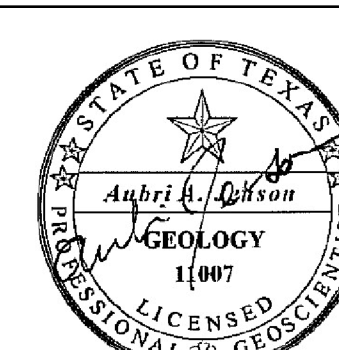

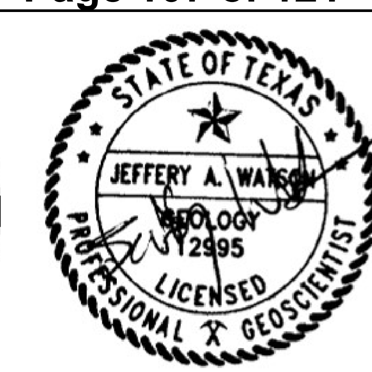

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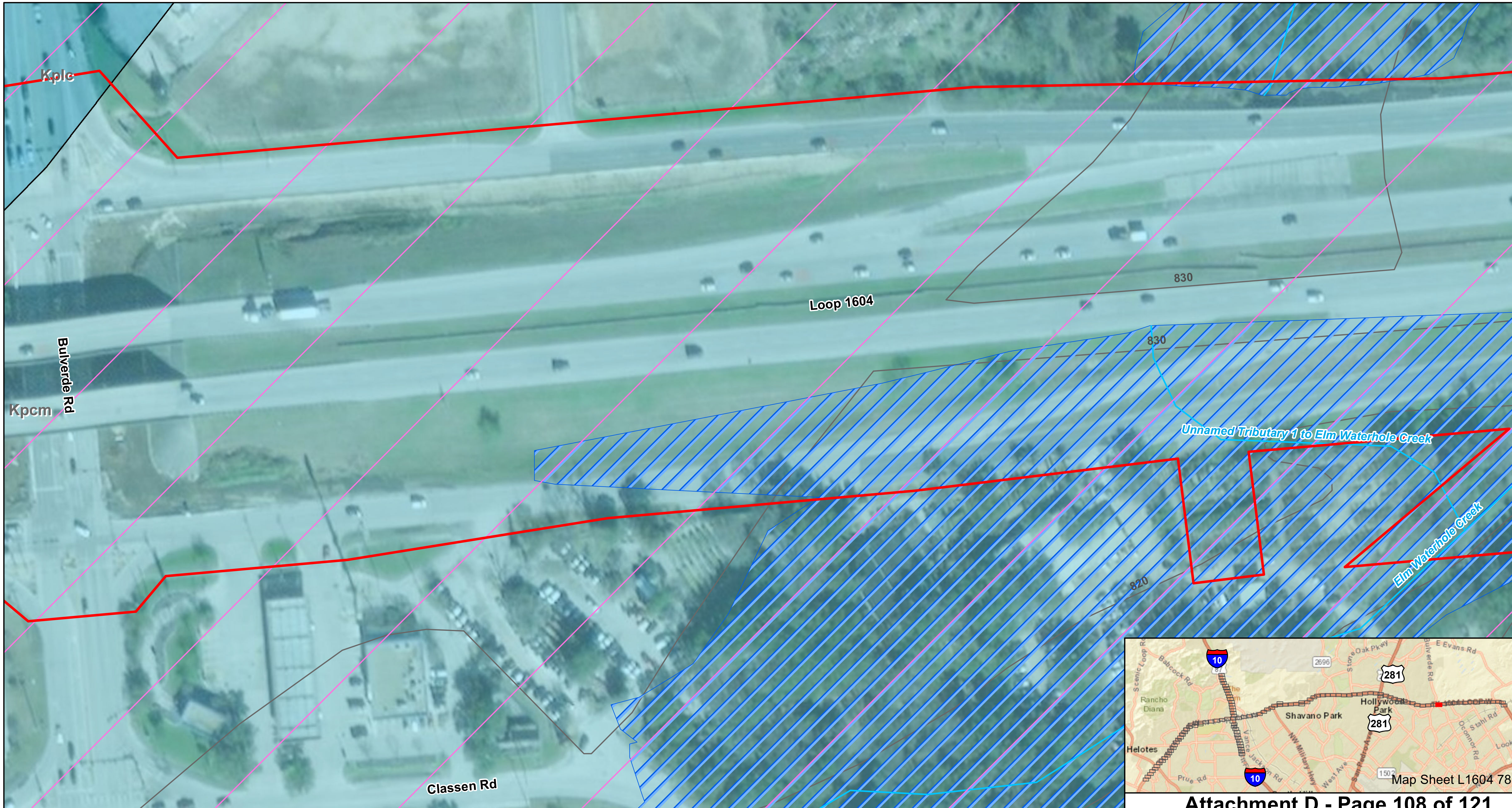

Survey Area

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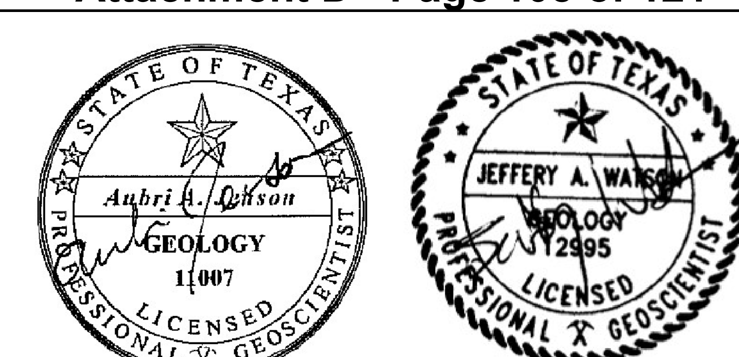

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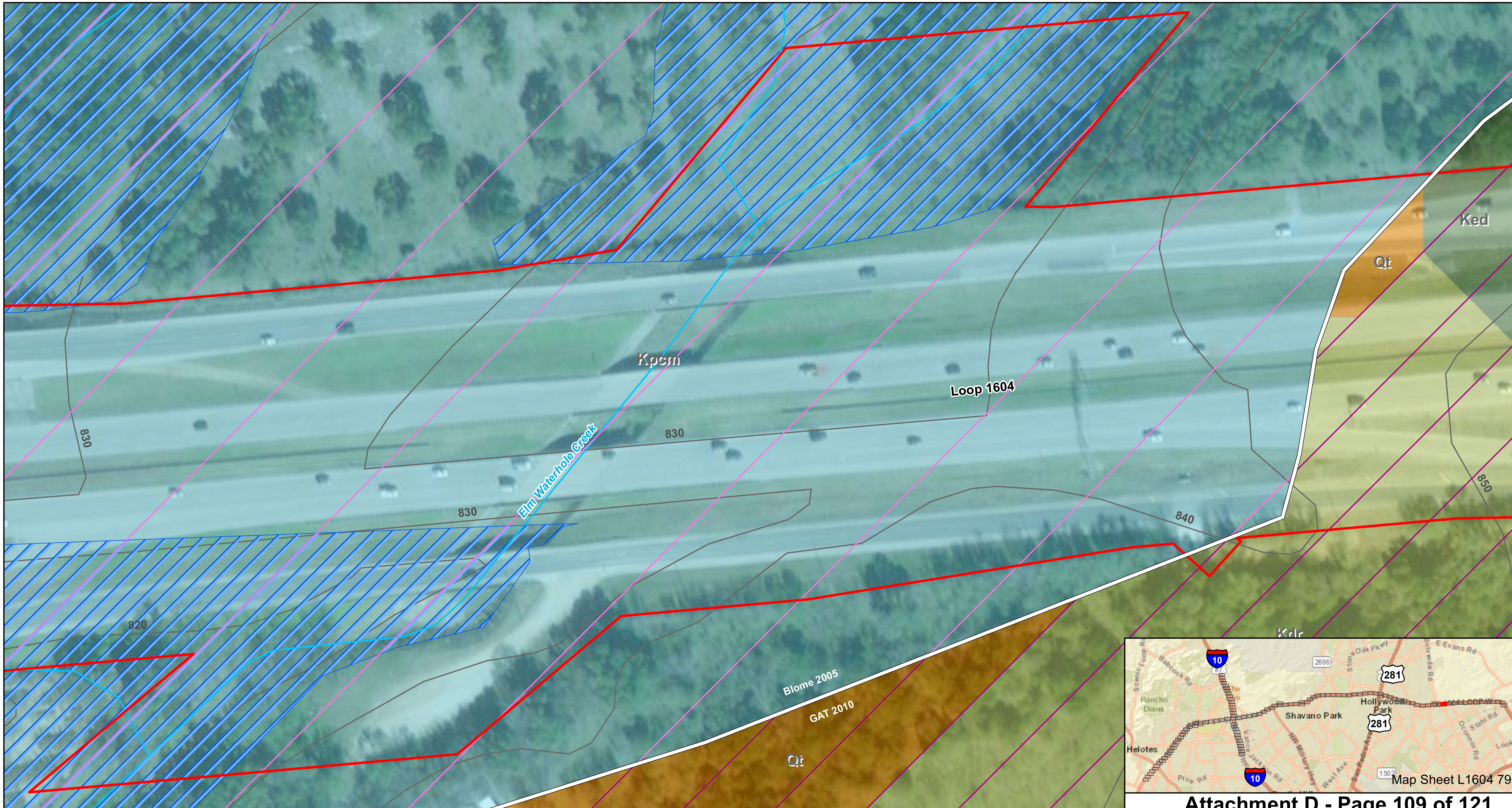

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Survey Area

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Survey Area

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StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

Boundary line between Geology data sources

Geology: GAT 2010, 250K

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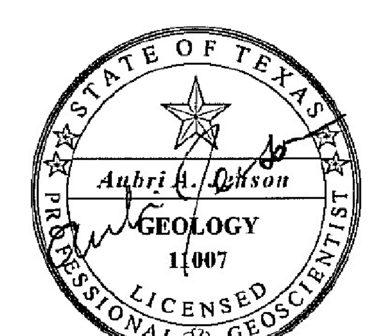

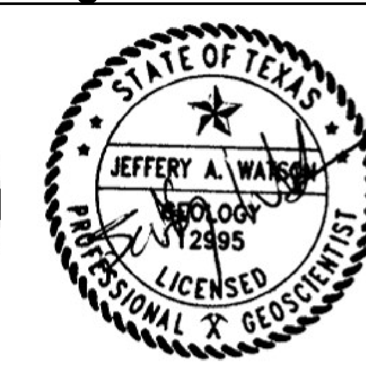

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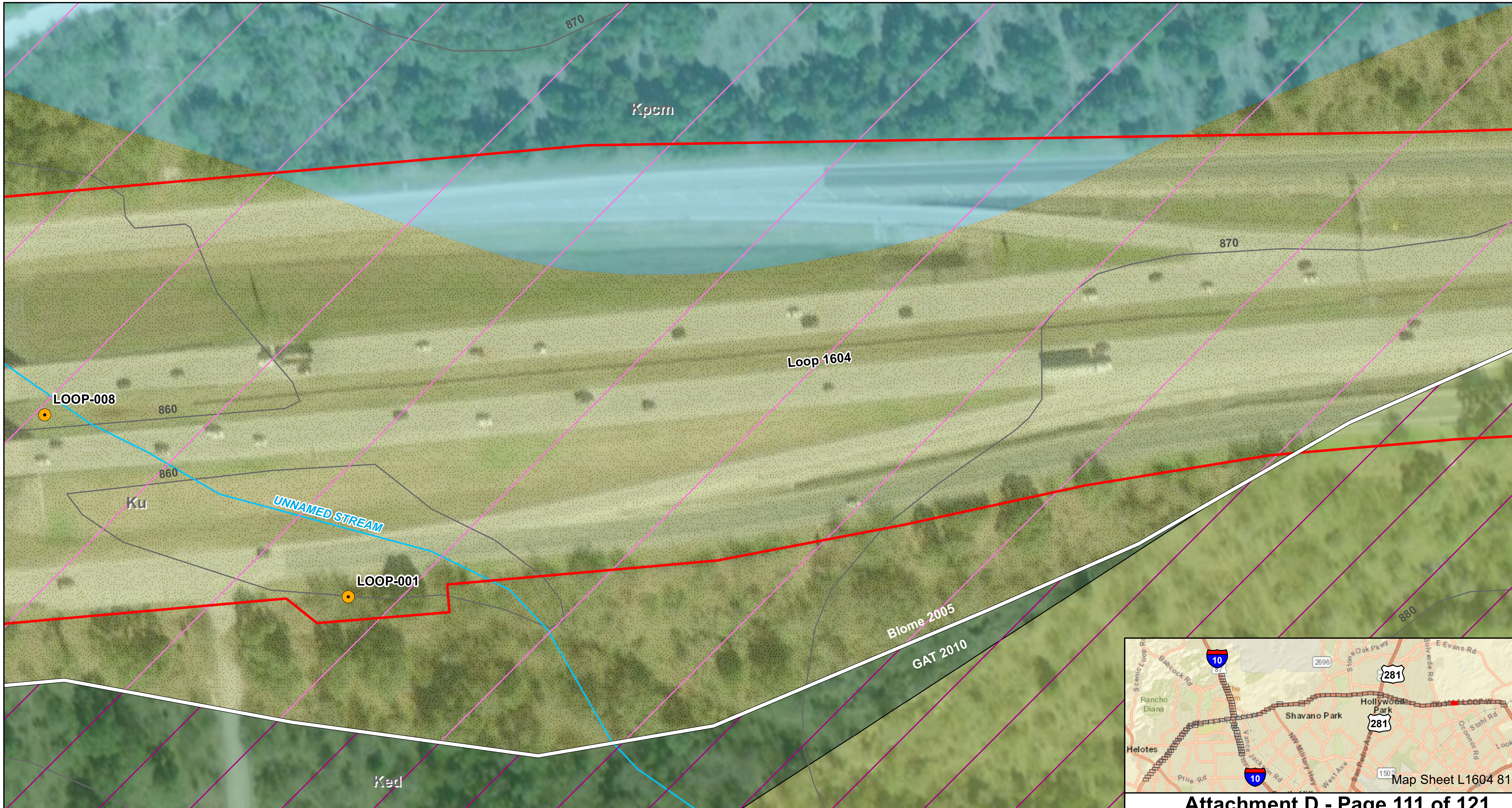

Attachment D - Page 111 of 121

- Survey Area
- Boundary line between Geology data sources

GA Features

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Geology: GAT 2010, 250K

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Edwards Aquifer Zones

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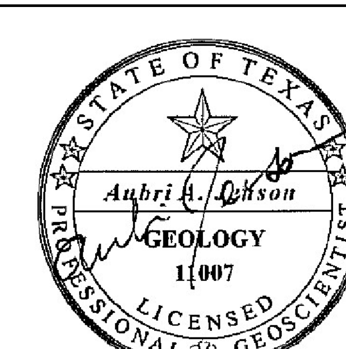

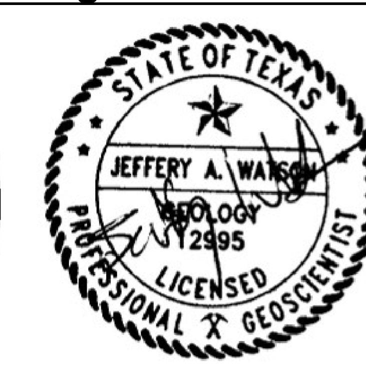

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Survey Area

Boundary line between Geology data sources

GA Features

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StratMap 10-ft elevation contours

Streams (FEMA)

FEMA 100-yr flood zone

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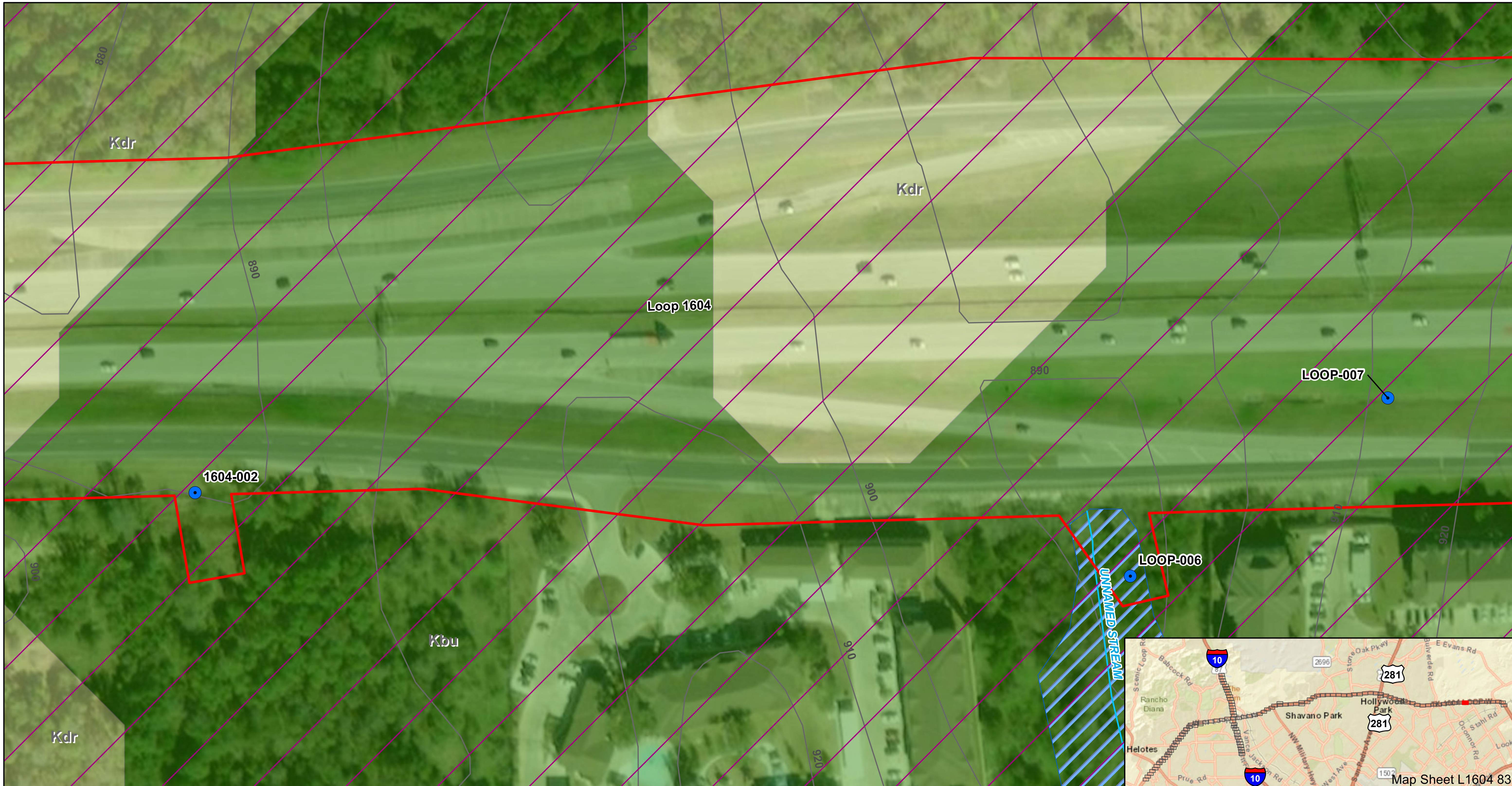

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Survey Area

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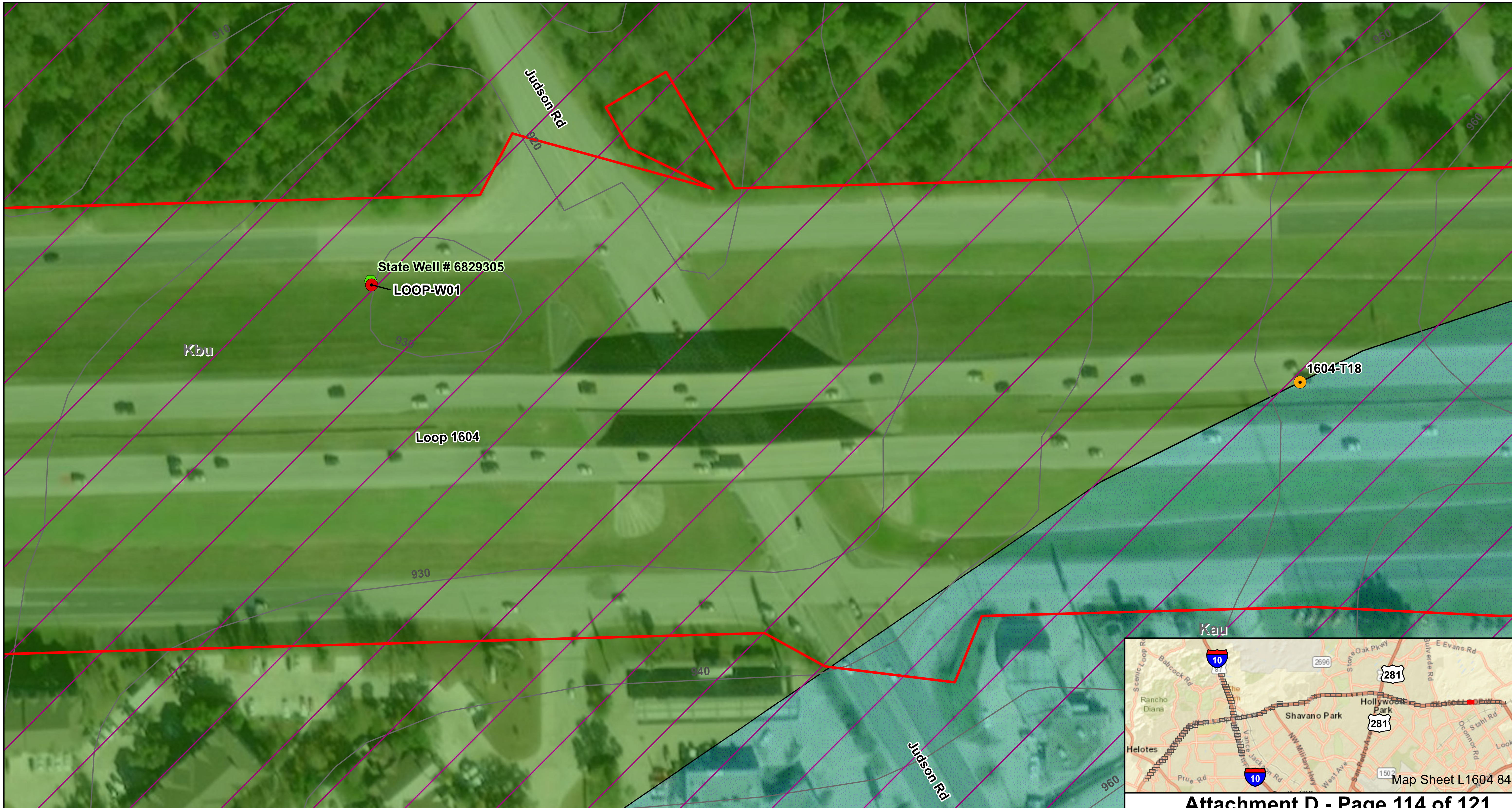

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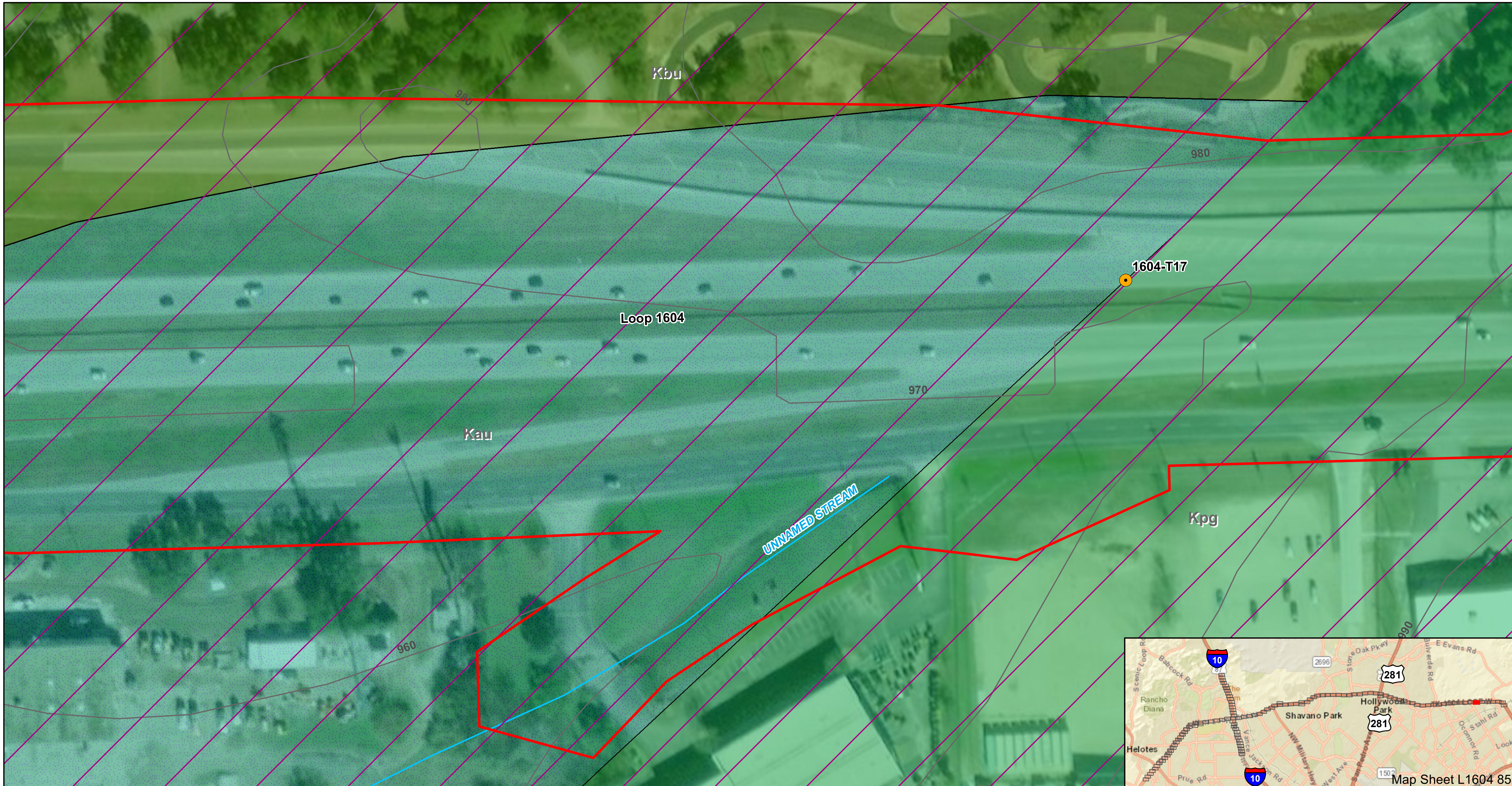

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Survey Area

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StratMap 10-ft elevation contours
Streams (FEMA)
FEMA 100-yr flood zone

Geology: GAT 2010, 250K
Fault Type
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Formation
- Qle - Leona Formation
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Geology: Blome 2005
Fault Type
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Edwards Aquifer Zones
- Contributing Zone
- Contributing withing Transition Zone
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- Transition Zone

N

1 inch = 100 feet

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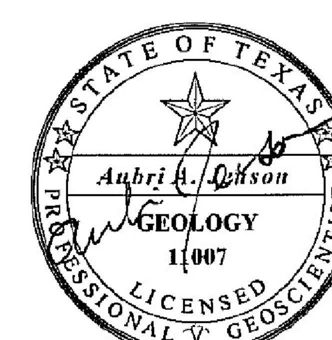
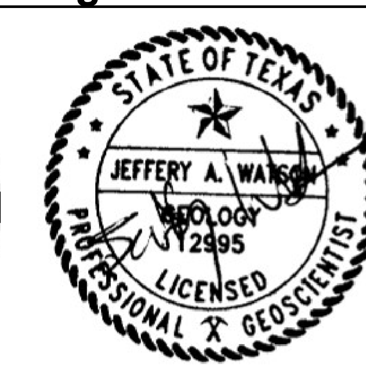
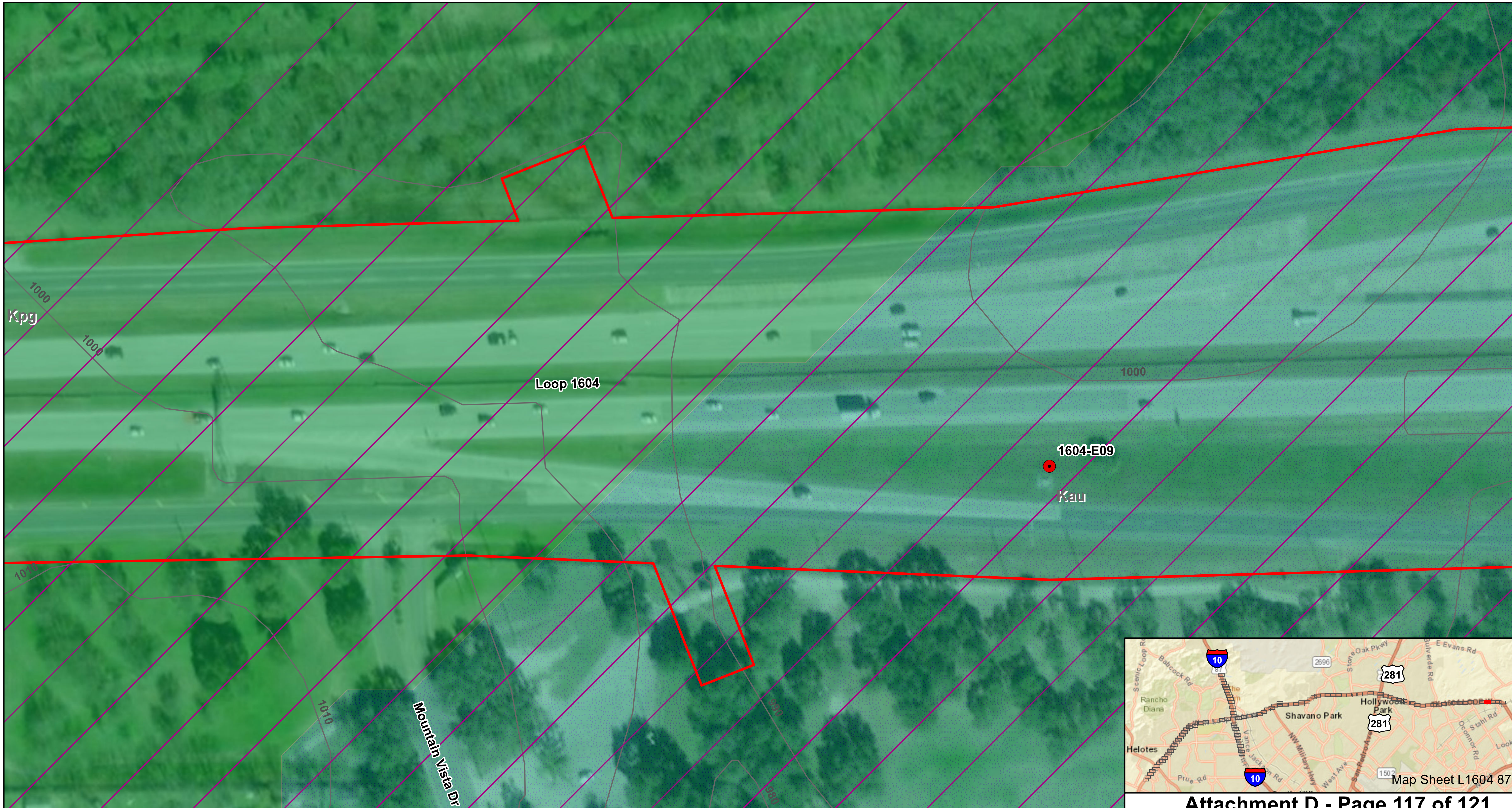
0 50 100 Meters





Basemap: ESRI 2019. Geology: GAT 2010 250K and Blome 2005; FEMA Flood Zones and Streams: FEMA Plan IDs 48029C0220G, 48029C0210G, 48029C0230G, 48029C0235G, 48029C0255G, 48029C0260G, 48029C0280F effective 29 Sept 2010 and 48029C0480F effective 2 Sept 2009; Elevation contours: StratMap 10ft contours, accessed October 2019.



Attachment D - Page 117 of 121

Survey Area

Boundary line between Geology data sources

GA Features
- Non-Senstive: <35 Rating
- Non-Senstive: >35 Rating
- Sensitive: >40 Rating
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STATE OF TEXAS
JEFFERY A. WATSON
GEOLOGY
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Attachment D - Page 118 of 121

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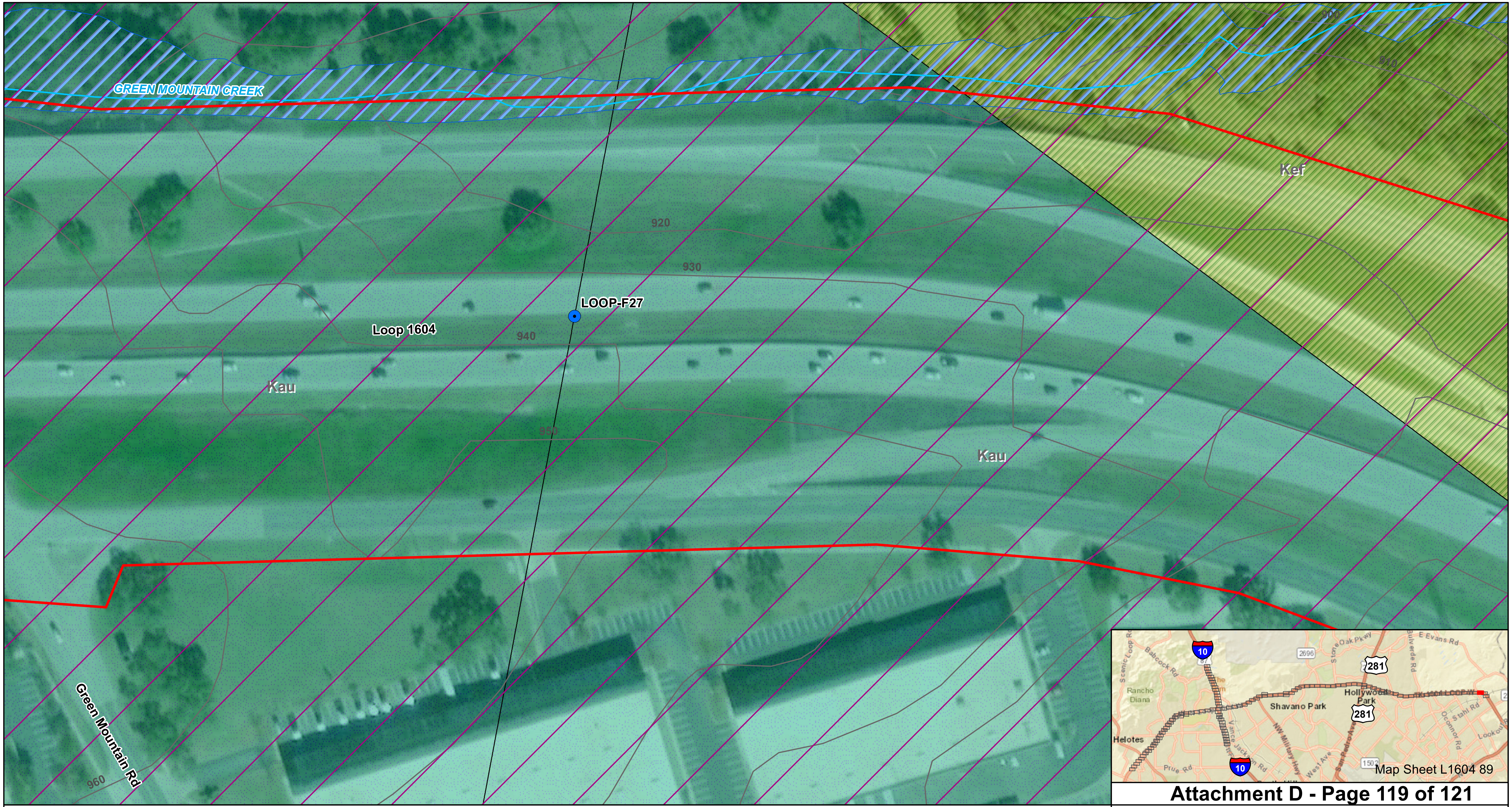

Map Sheet L1604 89

Attachment D - Page 119 of 121

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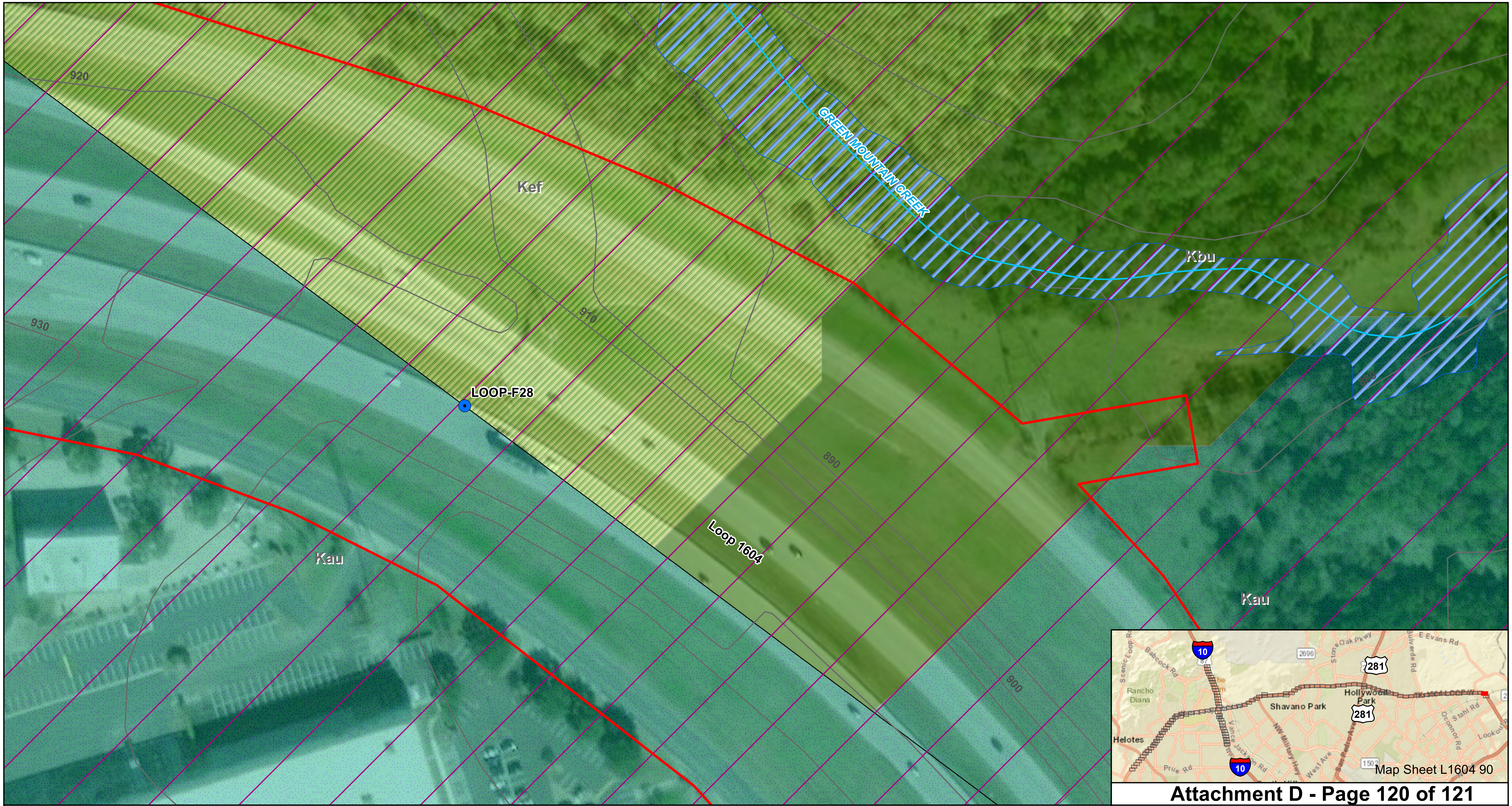

Attachment D - Page 120 of 121

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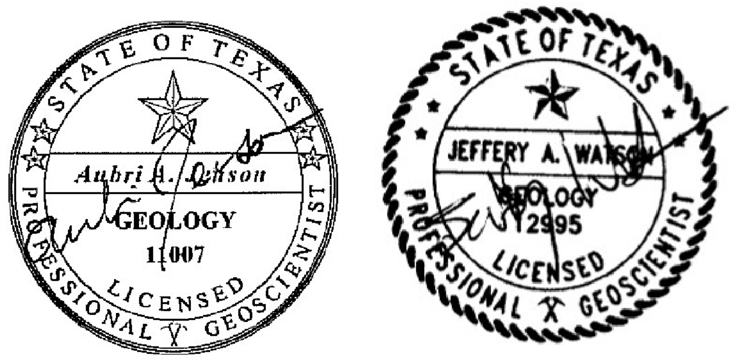

Attachment D - Page 121 of 121

Survey Area

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Agent Authorization Form
For Required Signature
Edwards Aquifer Protection Program
Relating to 30 TAC Chapter 213
Effective June 1, 1999

I Clayton Ripps, P.E.,
Print Name

Director of Transportation Planning and Development,
Title - Owner/President/Other

of Texas Department of Transportation – San Antonio District,
Corporation/Partnership/Entity Name

have authorized Zachary B. Ryan, P.E.
Print Name of Agent/Engineer

of LJA Engineering
Print Name of Firm

to represent and act on the behalf of the above named Corporation, Partnership, or Entity for the purpose of preparing and submitting this plan application to the Texas Commission on Environmental Quality (TCEQ) for the review and approval consideration of regulated activities.

I also understand that:

1. The applicant is responsible for compliance with 30 Texas Administrative Code Chapter 213 and any condition of the TCEQ's approval letter. The TCEQ is authorized to assess administrative penalties of up to $10,000 per day per violation.

2. For those submitting an application who are not the property owner, but who have the right to control and possess the property, additional authorization is required from the owner.

3. Application fees are due and payable at the time the application is submitted. The application fee must be sent to the TCEQ cashier or to the appropriate regional office. The application will not be considered until the correct fee is received by the commission.

4. A notarized copy of the Agent Authorization Form must be provided for the person preparing the application, and this form must accompany the completed application.

5. No person shall commence any regulated activity on the Edwards Aquifer Recharge Zone, Contributing Zone or Transition Zone until the appropriate application for the activity has been filed with and approved by the Executive Director.

SIGNATURE PAGE:

Clayton Patrick Ripps
Signed on 2020/09/17 14:20:31 -8:00

Applicant's Signature

09/17/2020
Date

THE STATE OF Texas §

County of Harris §

BEFORE ME, the undersigned authority, on this day personally appeared Clayton Patrick Ripps known to me to be the person whose name is subscribed to the foregoing instrument, and acknowledged to me that (s)he executed same for the purpose and consideration therein expressed.

GIVEN under my hand and seal of office on this ____ day of 09/17/2020, _____.

NOTARY PUBLIC STATE OF TEXAS

Angela Rachel Bricout
Commission # 10808833
Notary Public
STATE OF TEXAS
My Comm Exp. Nov 12, 2023
Notary Stamp 2020/09/17 14:20:31 PST 7A7382ED64BB

Rachel Bricout
Signed on 2020/09/17 14:20:31 -8:00

NOTARY PUBLIC

Rachel Bricout
Typed or Printed Name of Notary

MY COMMISSION EXPIRES: 11/12/2023

TCEQ Use Only

TCEQ Core Data Form

For detailed instructions regarding completion of this form, please read the Core Data Form Instructions or call 512-239-5175.

SECTION I: General Information

1. Reason for Submission *(If other is checked please describe in space provided.)*

☒ New Permit, Registration or Authorization (*Core Data Form should be submitted with the program application.)*

☐ Renewal *(Core Data Form should be submitted with the renewal form)* ☐ Other

2. Customer Reference Number *(if issued)*	Follow this link to search for CN or RN numbers in Central Registry**	**3. Regulated Entity Reference Number *(if issued)***
CN 600803456		RN

SECTION II: Customer Information

4. General Customer Information | **5. Effective Date for Customer Information Updates** (mm/dd/yyyy)

☐ New Customer ☐ Update to Customer Information ☐ Change in Regulated Entity Ownership
☐ Change in Legal Name (Verifiable with the Texas Secretary of State or Texas Comptroller of Public Accounts)

The Customer Name submitted here may be updated automatically based on what is current and active with the Texas Secretary of State (SOS) or Texas Comptroller of Public Accounts (CPA).

6. Customer Legal Name *(If an individual, print last name first: eg: Doe, John)* — *If new Customer, enter previous Customer below:*

Texas Department of Transportation, San Antonio District

7. TX SOS/CPA Filing Number	**8. TX State Tax ID** (11 digits)	**9. Federal Tax ID** (9 digits)	**10. DUNS Number** *(if applicable)*

11. Type of Customer: ☐ Corporation ☐ Individual Partnership: ☐ General ☐ Limited

Government: ☐ City ☐ County ☐ Federal ☒ State ☐ Other ☐ Sole Proprietorship ☐ Other:

12. Number of Employees
☐ 0-20 ☐ 21-100 ☐ 101-250 ☐ 251-500 ☐ 501 and higher

13. Independently Owned and Operated?
☐ **Yes** ☐ **No**

14. Customer Role (Proposed or Actual) – *as it relates to the Regulated Entity listed on this form. Please check one of the following*

☐ Owner ☐ Operator ☒ Owner & Operator
☐ Occupational Licensee ☐ Responsible Party ☐ Voluntary Cleanup Applicant ☐ Other:

15. Mailing Address:							
	4615 NW Loop 410						
	City	San Antonio	**State**	TX	**ZIP**	782229	**ZIP + 4** 0928

16. Country Mailing Information *(if outside USA)*	**17. E-Mail Address** *(if applicable)*
	Clayton.Ripps@txdot.gov

18. Telephone Number	**19. Extension or Code**	**20. Fax Number** *(if applicable)*
(210) 615-5810		(210) 615-6015

SECTION III: Regulated Entity Information

21. General Regulated Entity Information *(If 'New Regulated Entity" is selected below this form should be accompanied by a permit application)*

☒ New Regulated Entity ☐ Update to Regulated Entity Name ☐ Update to Regulated Entity Information

The Regulated Entity Name submitted may be updated in order to meet TCEQ Agency Data Standards (removal of organizational endings such as Inc, LP, or LLC).

22. Regulated Entity Name *(Enter name of the site where the regulated action is taking place.)*

LP 1604 From Stone Oak Parkway to Redland Road

23. Street Address of the Regulated Entity: *(No PO Boxes)*							
	City		**State**		**ZIP**		**ZIP + 4**
24. County							

Enter Physical Location Description if no street address is provided.

25. Description to Physical Location:	Project site begins at LP 1604 and Stone Oak Parkway and extends east along the existing 1604 corridor to 1.09 miles east of Redland Road.

26. Nearest City	**State**	**Nearest ZIP Code**
San Antonio	TX	78259

27. Latitude (N) In Decimal:	29.608956		**28. Longitude (W) In Decimal:**	98.482275	
Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
29	36	35.24	98	28	56.19

29. Primary SIC Code (4 digits)	**30. Secondary SIC Code** (4 digits)	**31. Primary NAICS Code** (5 or 6 digits)	**32. Secondary NAICS Code** (5 or 6 digits)
2373		23731	

33. What is the Primary Business of this entity? *(Do not repeat the SIC or NAICS description.)*

Texas Department of Transporation

34. Mailing Address:	4615 NW Loop 410						
	City	San Antonio	**State**	TX	**ZIP**	78229	**ZIP + 4** 928
35. E-Mail Address:	Jonathan.Bean.txdot.gov						

36. Telephone Number	**37. Extension or Code**	**38. Fax Number** *(if applicable)*
(210) 615-5801		(210) 615-6015

39. TCEQ Programs and ID Numbers Check all Programs and write in the permits/registration numbers that will be affected by the updates submitted on this form. See the Core Data Form instructions for additional guidance.

☐ Dam Safety	☐ Districts	☒ Edwards Aquifer	☐ Emissions Inventory Air	☐ Industrial Hazardous Waste
☐ Municipal Solid Waste	☐ New Source Review Air	☐ OSSF	☐ Petroleum Storage Tank	☐ PWS
☐ Sludge	☐ Storm Water	☐ Title V Air	☐ Tires	☐ Used Oil
☐ Voluntary Cleanup	☐ Waste Water	☐ Wastewater Agriculture	☐ Water Rights	☐ Other:

SECTION IV: Preparer Information

40. Name:	Zachary Ryan	**41. Title:**	Vice President
42. Telephone Number	**43. Ext./Code**	**44. Fax Number**	**45. E-Mail Address**
(512) 439-4760		( ) -	zryan@lja.com

SECTION V: Authorized Signature

46. By my signature below, I certify, to the best of my knowledge, that the information provided in this form is true and complete, and that I have signature authority to submit this form on behalf of the entity specified in Section II, Field 6 and/or as required for the updates to the ID numbers identified in field 39.

Company:	LJA Engineering	**Job Title:**	Vice President
Name *(In Print)*:	Zachary Ryan	**Phone:**	(512) 439- **4760**
Signature:		**Date:**	04-26-2023