GEOTECHNICAL ENGINEERING STUDY
KOHLERS CROSSING
HAYS COUNTY, TEXAS

Prepared For:
HDR, INC.
Round Rock, Texas

Prepared by:
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Report No. 190583.00-GT-Geo – Revision 1
December 22, 2020

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December 22, 2020
Project No. 190583.00

Lee Frieberg, P.E.
Project Manager
HDR, Inc.
710 Hesters Crossing, Suite 150
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Subject: **Geotechnical Engineering Study**
Kohlers Crossing
Kyle, Texas

Dear Mr. Frieberg:

This report presents the results of our geotechnical study performed for the above referenced project in Kyle, Texas. This study was performed in general accordance with the agreement dated November 13, 2019.

Our engineering analyses as well as the results of the field exploration and laboratory testing are included in this report. Our firm is interested in providing the professional materials testing that will be required during the construction phase of the project.

We appreciate the opportunity to be of assistance on this project. Please feel free to contact us if you have any questions or if we can be of further service.

Sincerely,

PAVETEX ENGINEERING, LLC
TBPE Firm Registration No. 961

DENNIS J. TURNER
97276
DEC 22, 2020

Jimmy Baldwin.
Project Manager

Dennis Turner, P.E.
Senior Geotechnical Engineer

Copies Submitted: 1 (via email)

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GEOTECHNICAL ENGINEERING STUDY
KOHLER’S CROSSING
KYLE, TEXAS

1 INTRODUCTION

1.1 PROJECT AND SITE DESCRIPTION

This report presents the results of our geotechnical study for the Kohler’s Crossing roadway improvements in Kyle, Texas. The site is located along County Road 171 between County Road 1626 and Kyle Crossing in Kyle, Texas and is shown in the Vicinity Map in Figure 1 of Appendix A.

Based on the request for geotechnical services from HDR, Inc., dated June 20, 2019, we understand that the project consists of bridge, wall and roadway borings for design considerations for roadway improvements. At the time of our exploration, the site was developed and had an existing four lane divided roadway with an asphaltic concrete surface between curb and gutter. The area under investigation spans approximately from roadway station 115+00 to station 136+00. If there are differences in location or design features as we understand them, or if the locations or design features change, we should be authorized to review the changes, and, if necessary, to modify our conclusions and recommendations.

1.2 PURPOSE AND SCOPE OF WORK

The purpose of our study was to prepare a Geotechnical Engineering Study Report for the Engineer of Record to develop plans for the site infrastructure.

2 FIELD EXPLORATION

The subsurface conditions at the project site were explored by drilling 12 geotechnical borings. The boring locations were selected and marked in the field by PAVETEX representatives based on the exhibit provided by HDR and can be found in Appendix A.

Borings B1 through B4 were located within the proposed bridge structure and drilled to a depth of 50 feet below existing grade. Borings C1 through C4 were drilled for the proposed retaining walls to a depth of 25 feet below the existing grade. Roadway borings D1 through D4 were selected adjacent to the existing roadway to minimize the impact on the traveling public and were drilled to a depth of 15 feet below existing grade. The Bore Location Exhibit and the Logs of Borings are provided in Appendix A of this report. All general bore locations were marked with global positioning system coordinates (GPS) and can be found on the bore logs.

Disturbed samples of non-cohesive soils, and/or hard cohesive materials were collected by driving a split-spoon sampler in conjunction with the Standard Penetration Test (SPT). This technique involves driving the split-spoon sampler a distance into the soil using a free-falling hammer in general accordance with ASTM D 1586 with the exception of using the hammer outlined in the Texas Department of Transportation (TxDOT) Texas Cone Penetration test procedure designated Tex-132-E. During the test, the logger records the number of blows required to drive the split-spoon sampler over three successive 6-inch increments. The first 6 inches is the “seating drive,” while the number of blows required to drive the sampler the last two 6-inch increments is the “penetration” in blows per foot. Where resistance was high, the number of inches of penetration for 50 blows of the hammer is recorded. When less than 6 inches of penetration is obtained, the test is terminated regardless of the drive increment. Materials recovered from the split-spoon sampler are then placed in a plastic bag to protect the sample and to reduce moisture loss. The results of the SPT test are summarized in Table 2.1.

Table 2.1 – Standard Penetration Test Summary

Standard Penetration Test Data				
Bore	Depth (ft)	1st 6 (in)	2nd 6 (in)	3rd 6 (in)
B1	2 – 3.5	12	20	30
	6 – 7.5	27	50/1	
B2	2 – 3.5	6	11	15
	6 – 7.5	29	49	6
	13.5 - 15	5	6	11
B4	6 – 7.5	15	14	12
C1	2 – 3.5	25	50/1	
C3	6 – 7.5	19	21	24
C4	6 – 7.5	18	20	22
D1	2 – 3.5	7	11	18
D3	6 – 7.5	10	27	49
D4	6 – 7.5	50/2		

In addition, Texas Cone Penetration (TCP) testing was completed using a 24 inch free fall with a 170 pound hammer to drive a hardened steel conical driving point into the soil or rock in general accordance with TxDOT Tex-132-E. The first 6 inches or twelve blows, whichever is achieved first, is the “seating drive,” while the number of blows required to drive the cone the last two 6 inch increments are the penetration blows that are recorded for a blows per foot measure. TCP tests were completed at 5 foot intervals and strata changes to the designated depths. Rock cores were taken as necessary and the Rock Quality Designation (RQD) and rate of recovery were calculated and can be found in the bore logs. The boreholes were backfilled with bentonite pellets upon completion of drilling.

Field boring logs were prepared by an experienced technician as part of the drilling operations. The boring logs include visual classifications of the materials encountered during drilling and the driller's interpretation of the subsurface conditions between samples. The final boring logs included in this report represent our interpretation of the field logs and include modifications based on observations and testing of the samples in the laboratory. Soil strata boundaries shown on the boring logs are approximate. The stratification boundaries shown on the boring logs represent the approximate locations of the changes in the soil and rock types; in-situ, the transition between material types may be gradual and indistinct.

The boring locations should be considered accurate only to the degree implied by the method used in its determination. If a greater degree of accuracy is required or desired, then a licensed land surveyor should be retained to record the coordinates and elevations of the borings.

3 LABORATORY TESTING

Laboratory testing was performed on selected samples collected from the borings. Samples were examined at our laboratory by the project staff engineer. Classification tests performed for this study included liquid and plastic limits, collectively termed the Atterberg Limits, and sieve analyses. These tests were helpful in the evaluation of the engineering properties of the underlying soils. Results of these tests are presented in the WinCORE Drill Logs in Appendix A. The sieve analysis results are presented on the boring logs as the percent retained. A select number of recovered rock cores were also tested in compression. All tests were performed in accordance with the applicable Texas Department of Transportation or ASTM methods. Table 3.1 summarizes the number and type of tests performed for this study.

Table 3.1 - Laboratory Testing Summary

Test	Quantity	Procedure
Moisture Content	18	Tex-103-E
Atterberg Limits	33	Tex-104-, 105-, 106-E
Sieve Analysis	23	Tex-110-E
Compressive Strength (Rock Cores)	8	ASTM D7012

4 SUBSURFACE CONDITIONS

4.1 GEOLOGY

Atlas maps published by the Bureau of Economic Geology at the University of Texas at Austin indicate that the site may be located within the upper Cretaceous Formation, more specifically the Austin Chalk. Surficial geology maps indicate a Silty Clay Decomposition Residuum which is defined as material derived by in place chemical weathering of clastic rock with no appreciable subsequent lateral transport.

4.2 SUBSURFACE CONDITIONS

Specific types and depths of subsurface strata encountered in the borings are shown on the boring logs. Generally, the rock encountered at the termination depth in the borings were hard limestone. Refer to the WinCORE Drill Logs in Appendix A for more detailed subsurface descriptions. Note that demarcation lines between the strata are interpretive of the field conditions, and that actual strata transitions in the field may be gradual.

Stratum I Beginning from the west side of the investigated section and moving east Stratum 1 extends from the existing surface to approximately 4 feet and drops to a depth of 20 feet through the center, bores B1 and B2, and comes back to a depth of approximately 8 feet on the east end. The details on the depth for each location can be found in the bore logs located in Appendix A. Stratum I appears to be alluvial deposits of brown sandy fat clay with layers of brown to tan sandy lean clay and brown to tan clayey sands with some occasional gravel. Based on the Texas Cone Penetrometer the material ranged from stiff to very soft. The plasticity index (PI) ranged from 13 to 51 for the materials. Moisture contents for this layer ranges from 7 to 20 percent.

Stratum II Limestone that is white to tan in color with clay and sand seams. Clay and sand seams clear out at lower depths with hardness ranging from hard to very hard through the depth of the bores based on the Texas Cone penetrometer that ranged from 100 blows per inch to no movement in 100 blows. Rock Quality Designation (RQD) values were generally between 16 and 60, with an apparent outlier of 5 in Boring B-4 at a depth of approximately 30 feet. Rock Recovery (RR) values were typically between

90 and 100 percent below 15 feet. Limestone has a gray tint at lower depths and is very hard with the occasional shale layer.

4.3 GROUNDWATER CONDITIONS

The borings were advanced with an air rotary drilling rig. These methods allow relatively accurate groundwater observations to be made while drilling. Groundwater was not encountered during drilling. These boreholes were observed to be dry during and upon completion of drilling.

In the hill country terrain, it is common for groundwater to be present, sometimes in large quantities, along fractures and joints within rock formations and also along the interface between the overburden soil and weathered rock and underlying hard unweathered rock. It is not possible to accurately predict the magnitude of subsurface water fluctuations that might occur based upon short-term observations. The occurrence and variation of groundwater can vary due to many factors. These factors include seasonal changes, site topography, surface runoff, the layering and permeability of subsurface strata; water levels in waterways, utilities, and other factors not evident at the time of this study. One such factor for consideration is a creek running north to south, just east of the project limits. This would indicate potential water flow from west to east across the underlying hard layer of rock with the potential for saturated conditions in the subgrade layers through the area. The possibility of groundwater and its fluctuation should be considered when developing this project.

5 FINDINGS, CONCLUSIONS AND DESIGN RECOMMENDATIONS

5.1 PAVEMENT RECOMENDATIONS

Recommendations were based on a change in vertical alignment that would require total reconstruction. Average daily traffic (ADT) counts were not provided for the current roadway and current counts were not readily available. Assumptions on traffic are based on traffic counts for similar roadways in the vicinity with traffic surveys on file, which are presented in Appendix B.

5.1.1 PAVEMENT SUBGRADES

With the exception of the embankment between MSE walls, the subgrade materials at this site are anticipated to consist of sandy fat clay or clayey sand. These subgrade soils will be subject to loss of support with the moisture increases that can occur beneath paving. Pavement subgrades should be graded to prevent ponding and infiltration of excessive moisture on or adjacent to the pavement subgrade surface.

Potential Vertical Rise (PVR) should be considered when assessing the existing subgrades for potential roadbeds. The PVR calculations for the materials through the area under consideration have been calculated and are presented in Appendix B for the bore locations with sufficient laboratory data. Our estimated PVR values starting from a average to dry in-situ condition are on the order of 0.5 to 1.4 inches for the portions of the site that will not receive embankment/MSE wall fill.

5.1.2 PAVEMENT SECTIONS

Based on our understanding of the existing traffic levels, the proposed project may require heavy-duty pavements with both rigid and flexible pavement systems under consideration. The Texas Department of Transportation Pavement Manual and the approved design methods described below were used to develop the following pavement sections.

The pavement thickness calculations for flexible pavements were performed using the Texas Department of Transportation (TxDOT) FPS 21 v1.5 parameters with a check of the pavement section using the Texas Triaxial Design method as well as a Mechanistic Check. Rigid pavements were evaluated using AASHTO 1993 Design Procedure. The details used to calculate the pavement recommendations are shown in Table 5.1.2.1 that were developed based on traffic data on similar roads in the area with current traffic counts. When appropriate, the item listed in the parenthesis at the end of each item refers to the source of the value.

Table 5.1.2.1 – Pavement Design Parameters

Design Parameter	Value	
	Rigid	Flexible
Design Life	30 Years	20 Years
Reliability	95% (TxDOT Pavement Manual)	95% (TxDOT Pavement Manual)
28 Day Concrete Strength (M_r)	620 psi (TxDOT Class P 4,000 psi Comp. Str)	NA
28 Day Concrete Elastic Modulus	5,000,000 psi (TxDOT Pavement Manual)	NA
Effective Modulus of Subgrade Reaction	300 psi/in. (TxDOT Pavement Manual)	NA
Subgrade Elastic Modulus	NA	8.0 ksi (TTC of 4.55)
Initial Serviceability	4.5	4.5
Terminal Serviceability	2.5	2.5
Drainage Coefficient	1.16 (TxDOT Pavement Manual)	NA
Load Transfer Coefficient	2.9 (TxDOT Pavement Manual)	NA
Overall Standard Deviation	0.39 (TxDOT Pavement Manual)	NA
Base Modulus	NA	120 ksi (Cement Treated Base) 70 ksi (Flexible Base)

Based on the assumed traffic data, the following types of pavement and corresponding ESALs (Table 5.1.2.2) are considered for our pavement recommendations of the proposed roadway.

Table 5.1.2.2 – Pavement Design Loading

Location	ESAL$^{(1)}$
Main Lanes	5,500,000 (Flexible) or 10,300,000 (Rigid)$^{(2)}$

(1) Assumed Equivalent Single Axle Load

(2) Rigid Estimated ESALs based on information in Appendix B for 30-year analysis period. Flexible ESALs estimated for a 20-year analysis period.

Recommended pavement thickness values for both rigid (Jointed/CPCD concrete) and flexible (asphaltic) pavement systems are provided in Table 5.1.2.3. The recommended rigid and flexible sections for each pavement type are considered to meet the requirements of the individual programs with respect to pavement design parameters and loading data as presented in Table 5.1.2.1 and 5.1.2.2 respectively. Rigid pavement layout, jointing design and steel specifications should be in accordance with TxDOT Standard Sheet CPCD-14.

Table 5.1.2.3 - Recommended Pavement Thickness

Pavement Type	Flexible Section
Concrete/Rigid	9.5 in. Portland Cement Concrete 1 in. Asphalt Bond Breaker 6 in. Cement Treated Base or 4 in. of HMA
Hot-Mix Asphalt/Flexible with Cement Treated Base	2 in. Asphalt Surface Concrete 5 in. Asphalt Base Course 6 in. Cement Treated Base
Hot-Mix Asphalt/Flexible with Flexible Base	2 in. Asphalt Surface Concrete 5 in. Asphalt Base Course 12 in. Flexible Base

If traffic data indicates ESALs different than that what we have assumed in Table 5.1.2.2, we should be authorized to review the traffic data and, if necessary, to modify our pavement recommendations. The recommended pavement sections are intended to provide an adequate thickness of structural materials, such that wheel loads are distributed over a larger area. The pavement may be adequate from a structural standpoint, yet still experience cracking and deformation due to soil movements below the section. Therefore, moisture changes in the subgrade should be mitigated. The pavement and adjacent areas should be well drained. Proper and regular maintenance should be performed on cracks in the pavement surface to prevent water passing through to the base or sub-base material. Even with these precautions, some movements and cracking may still occur, which will require periodic maintenance.

5.1.3 PAVEMENT MATERIAL SPECIFICATIONS

Material specifications for the recommended pavement sections are provided below.

Portland Cement Concrete - TxDOT Item 360 (Texas Department of Transportation Standard Specifications for Construction and Maintenance of Highways, Streets, and Bridges, 2014 Edition), with a minimum flexural strength of 620 psi at 28 days. As a general guide, the air entrainment should vary from 4 to 6 percent.

Steel Bar Reinforcement – meeting TxDOT Item 440 as detailed on TxDOT Standard Sheet CPCD-14 for layout and specific bar size and type.

Hot Mix Asphaltic Concrete Surface Course - TxDOT Item 340, Type D

Hot Mix Asphaltic Concrete Base Course - TxDOT Item 340, Type B

Cement Treated Base – TXDOT Item 276 Class L with crushed stone base (TxDOT item 247 Gr 1-2) with strengths between 300 – 600 psi. Strengths above 600 psi will require microcracking of the layer prior to placing subsequent courses.

Crushed Rock Base Material (Crushed Stone Base)- TxDOT Item 247, Flexible Base Material, Type D, Grade 1-2

5.2 BRIDGE FOUNDATION RECOMMENDATIONS

Based on our observations, the TCP data and depth to an appropriate bearing strata, it is recommended that the concrete abutment and interior bents be supported by single or multiple drilled straight-sided shafts to receive a significant end bearing contribution from the encountered limestone in Stratum II. Based on Figures 5-3 and 5-4 in the 2020 TxDOT Geotechnical Manual, we recommend the drilled shafts be designed using an allowable skin friction of 3.0 tsf and allowable end bearing capacity of 30 tsf. We recommend disregarding the skin friction contribution in the soils above the Stratum II limestone.

Table 5.2.1 below presents the anticipated elevation to encounter Stratum II materials based on estimated ground surface elevations at the time of exploration. We recommend consideration for a contingency budget in the event that the actual elevations/depths to encounter Stratum II vary between our boring locations and drilled shaft locations. We recommend a minimum embedment into Stratum II of 2 shaft diameters to develop the design capacities presented above. All drilled shaft construction should be in accordance with TxDOT Item 416, including inspection and observations that Stratum II materials were encountered.

Table 5.2.1 – Anticipated Elevation To Encounter Stratum II Materials

Approximate Bent Location (WB/EB)	Reference Boring	Approximate Elevation to Stratum II
315+00 / 215+00	B-1	730 ft
316+10 / 216+10	B-1	730 ft
317+40 / 217+40	B-2	715 ft
318+45 / 218+45	B-2	715 ft
319+30 / 219+30	B-2	710 ft
320+25 / 220+25	B-3	705 ft
321+50 / 221+50	B-3	705 ft
322+75 / 222+75	B-4	705 ft
324+00 / 224+00	B-4	705 ft

5.3 RETAINING WALL RECOMMENDATIONS

We understand that Mechanically Stabilized Earth (MSE) walls have been selected for the proposed construction.

There are multiple earth forces that must be considered when designing MSE retaining walls such as sliding, bearing capacity, overturning and global stability. There are additional considerations for the internal stability of the MSE retaining wall design that are generally addressed by the wall designer. The MSE retaining wall analysis was performed in general accordance with the 2020 TxDOT Geotechnical Manual and an internal TxDOT Memo dated January 14, 2013 on New and Revised Retaining Wall Standard Drawings

5.3.1 FOUNDATION SOIL STRENGTH

The shear strength of the soil beneath the wall was estimated based on the Texas Cone Penetrometer, the hand penetrometer measurements performed on site, our experience with similar soils, and TxDOT Guidance from the 2020 TxDOT Geotechnical Manual and an internal TxDOT Memo dated January 14, 2013 on New and Revised Retaining Wall Standard Drawings. The critical design case for foundation soil properties is from Boring B-3, with an estimated undrained shear strength of 2,000 psf in Stratum I for bearing capacity analysis and corresponding design friction angle of 26 degrees per the TxDOT Memo for all other analyses.

5.3.2 EXTERNAL WALL STABILITY CRITERIA

MSE retaining walls require stability evaluation for sliding, overturning, eccentricity, and bearing pressure. Foundation base sliding is a critical mode of failure with this wall system. It is highly recommended that walls not be placed directly on material with a plasticity index of 45 or greater. The following table, Table 5.3.3.1, present the recommended minimum safety factors for sliding, overturning, and bearing pressure.

Table 5.3.3.1 MSE Wall Design Parameters

Stability Condition	Minimum Required Factor of Safety
Sliding	1.5
Overturning	2.0
Bearing Pressure	2.0

5.3.3 GLOBAL WALL STABILITY ANALYSIS

The required minimum factor of safety for retaining wall global stability established by the Texas Department of Transportation is 1.5. The factors of safety represent the calculated resisting forces and moments divided by the driving forces and moments of the various surfaces analyzed for potential failure. These forces and moments are based on the estimated unit weights and shear strengths of the materials in the slope profile. Graphical output from the software program Slope/W is presented in the Appendix.

5.3.4 MSE RETAINING WALL BACKFILL

The mechanically stabilized earth retaining wall system requires detailed design with regards to the configuration of the internal reinforcement within the backfill. This design should be completed by the subcontracted wall designer. Construction of the MSE wall should be in accordance with TxDOT Item 423. Type AS backfill as outlined in this specification may be utilized. Based on information provided by HDR, we do not anticipate the walls to be inundated. The MSE wall backfill properties are provided in Table 5.3.4.1. Leveling pads for MSE retaining walls should be constructed a minimum of 2 feet below the lowest adjacent grade. Consideration should be made for future removal of material for pavement rehabilitation. MSE retaining walls should be designed in accordance with TxDOT Standard Drawing No. RW (MSE). The stabilized mass width shown on the standard drawing should be considered a minimum value. This does not relieve the contractor of his responsibility to check the reinforcing strip length required to ensure a stable wall.

Table 5.3.4.1 MSE Wall Reinforced Volume

Parameter	Property
Material Type	TxDOT Item 423 Ty AS
Unit Weight	125 or 105 pcf
Cohesion	0
Friction Angle	34

Embankment fill retained by the MSE retaining walls is should Ty C fill in accordance with TxDOT Item 132 and should meet the following requirements as shown in Table 5.3.4.2 below.

Table 5.3.4.2 MSE Wall Retained Volume Properties

Parameter	Property
Material Type	TxDOT Item 423 Ty AS, BS, or CS, or Select Fill per Section 6.4
Unit Weight	125
Cohesion	0
Friction Angle	30

5.3.5 CALCULATED FACTORS OF SAFETY

Table 5.3.5.1 below presents the calculated factors of safety for Sliding, Overturning, Bearing Capacity, and Global Stability for given wall heights and reinforcement lengths.

Table 5.3.5.1 Calculated Factors of Safety

Wall Height (ft)	Reinforcement Length (ft)	Sliding	Overturning	Bearing Capacity	Global Stability
10	8 (0.80H)	1.7	3.60	5.3	1.82
12	10 (0.83H)	1.8	4.17	4.7	1.88
15	11 (0.73H)	1.7	3.46	3.6	1.61
17	13 (0.76H)	1.7	3.31	3.2	1.59
20	16 (0.80H)	1.8	3.89	2.9	1.54
22	17 (0.77H)	1.9	4.22	2.7	1.54
25	19 (0.76H)	2.0	4.65	2.5	1.53

6 GENERAL CONSTRUCTION PROCEDURES AND RECOMENDATIONS

6.1 EXCAVATION

Temporary construction slopes should utilize excavation protection systems or be sloped back at an appropriate angle as required by OSHA. Soil types should be identified by the contractors “competent person” as defined by OSHA at the time of excavation. Excavations deeper than 20 feet will need to be engineered on a case-by-case basis according to OSHA standards.

6.2 PREVENTATIVE PAVEMENT MAINTENANCE

Preventative pavement maintenance should be planned because of the presence of active nature of clayey soils at this site. Differential soil movements can occur that can cause pavement cracking and opening of joints. Water entering joints can reduce the service life of the pavement. Preventative maintenance should be provided for through and on-going pavement management program to enhance future pavement performance. Preventative maintenance activities are intended to slow the rate of pavement deterioration and to preserve the pavement investment.

Preventative maintenance consists of both localized maintenance (e.g. crack and joint sealing and patching) and global maintenance (e.g. surface sealing). Preventative maintenance is usually the first priority when implementing a planned pavement maintenance program and provides the highest return on investment for pavements. Also, thicker pavement sections could be used to reduce the required maintenance and extend the service life of the pavement. Signs should be placed at the entrances of the parking area to limit heavy trucks being on the automobile pavements. Prior to implementing any maintenance, additional engineering observation is recommended to determine the type and extent of preventative maintenance.

6.3 SITE PREPARATION AND PROOFROLLING

All existing surface vegetation, organic topsoil, gravel surface, loose materials, loose fill, and/or any debris or deleterious matter should be removed. Existing pavement structure can be salvaged and stockpiled for use dependent on material properties. Reclaimed materials shall meet the specifications of the intended item. Following excavation, the exposed soil should be proof rolled to expose any weak, soft, wet, or otherwise unsuitable soils. The exposed subgrade should be proof rolled under the observation of qualified personnel in accordance with TxDOT Item 216.

Following proof rolling, all exposed surfaces should then be scarified to a depth of 8 inches, watered and recompacted in accordance with TxDOT Items 204 and 210. Re-compacted material should meet the requirements detailed in Table 2 of TxDOT Item 132 using the maximum dry density and optimum moisture established with TxDOT test method Tex-114-E. The site may then be filled to grade using on-site soils, borrow materials or select fill meeting the requirements presented below, that are free from deleterious matter and contain no particles larger than 4 inches.

Fill materials should be placed in six (6) to eight (8)-inch loose lifts in accordance with Table 2 of Item 132 using the maximum dry density and optimum moisture established with TxDOT test method Tex-114-E. Field density tests should be taken at the rate that meets the minimum testing frequency as detailed in the applicable TxDOT Guide Schedule of Sampling and Testing. For areas where hand tamping is required, the testing frequency should be increased to approximately one test, per lift, per 100 linear feet of area.

Utility backfill up to a depth of 10 feet below grade should be compacted to the same requirements as outline above.

6.4 SELECT FILL CRITERIA

Onsite materials may be used as select fill provided they meet the criteria below. The select fill material should be very sandy lean clay to clayey sand with a Plasticity Index (PI) between 8 and 20, maximum particle size of 3 inches and contain between 30 and 70 percent fines (passing the No. 200 Sieve). Select fill materials should be placed in six (6) to eight (8)-inch loose lifts in accordance with Table 2 of TxDOT Item 132 using the maximum dry density and optimum moisture established with TxDOT test method Tex-114-E. The first lift of select fill should be placed wet of optimum to prevent drying the underlying subgrade. Positive drainage should be provided away from structures to prevent the ponding of water in the select fill, during and following construction. Care must be taken that backfill against structures are properly compacted as outlined above.

If Flexible Base materials (crushed limestone) is used as an alternative to Select Fill, it should follow TxDOT Item 247, Type A, Grade 1-2, or 3. The material should be placed in 6-inch lifts and compacted to meet the requirements of Table 2 of TxDOT Item 132 using the maximum dry density and optimum moisture established with TxDOT test method Tex-114-E.

7 LIMITATIONS

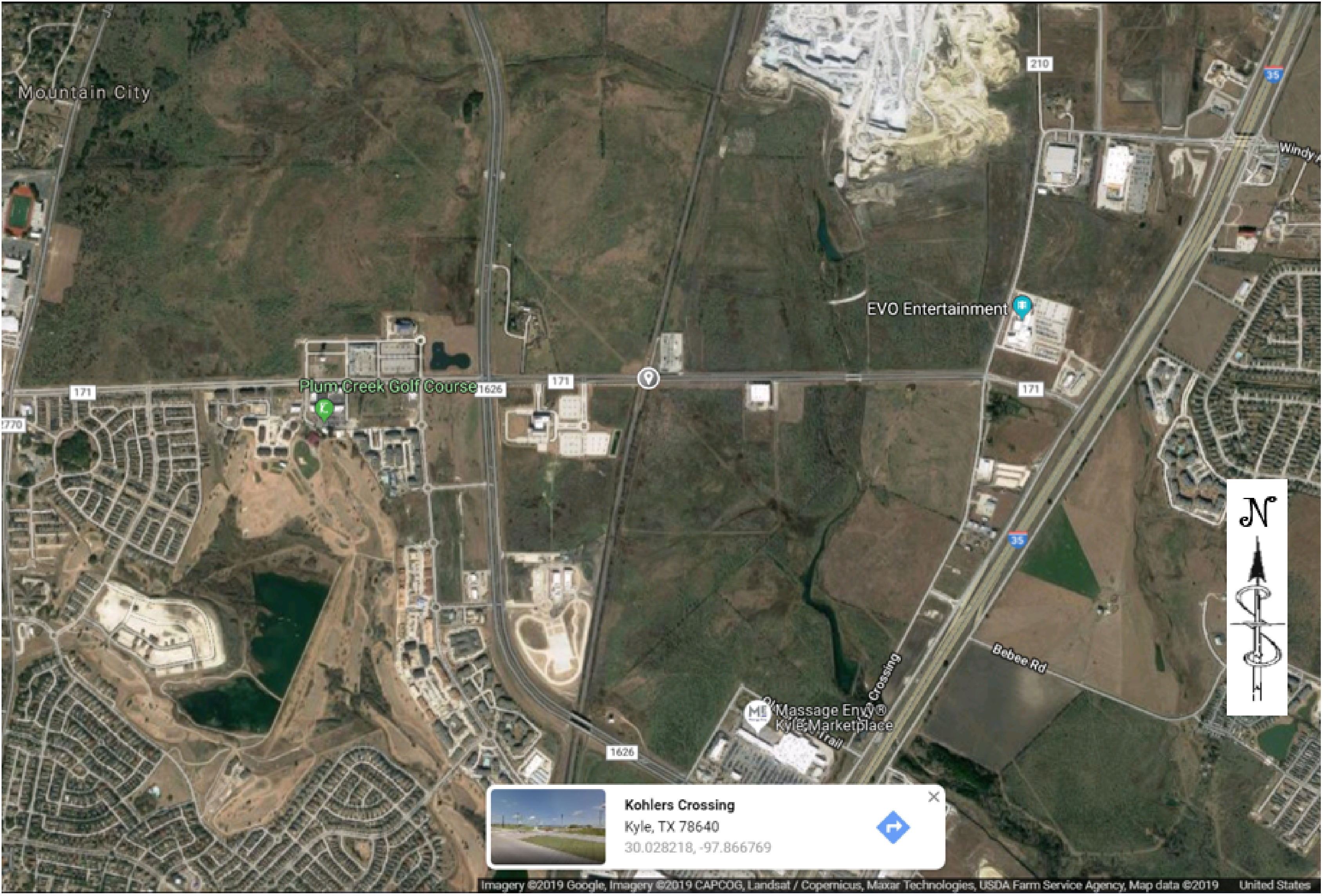
In preparation of this report, we have strived to perform our services in a manner consistent with that level of care and skill ordinarily exercised by other members of our profession currently practicing in the same locality under similar conditions and at the time the services are provided. The results, conclusions, opinions and recommendations provided in this report are directed at, and intended to be utilized within, the scope of work contained in the proposal and agreement executed by PAVETEX and the client. These are based on a limited number of observations and data. It is possible that conditions could vary between or beyond the data evaluated. PAVETEX makes no other representation, guarantee or warranty, express or implied, regarding the services, communication (oral or written), report, opinion, or instrument of service provided.

This report may be used only by the client and the registered design professional in responsible charge and only for the purposes stated for this specific engagement within a reasonable time from its issuance, but in no event later than two (2) years from the date of the report.

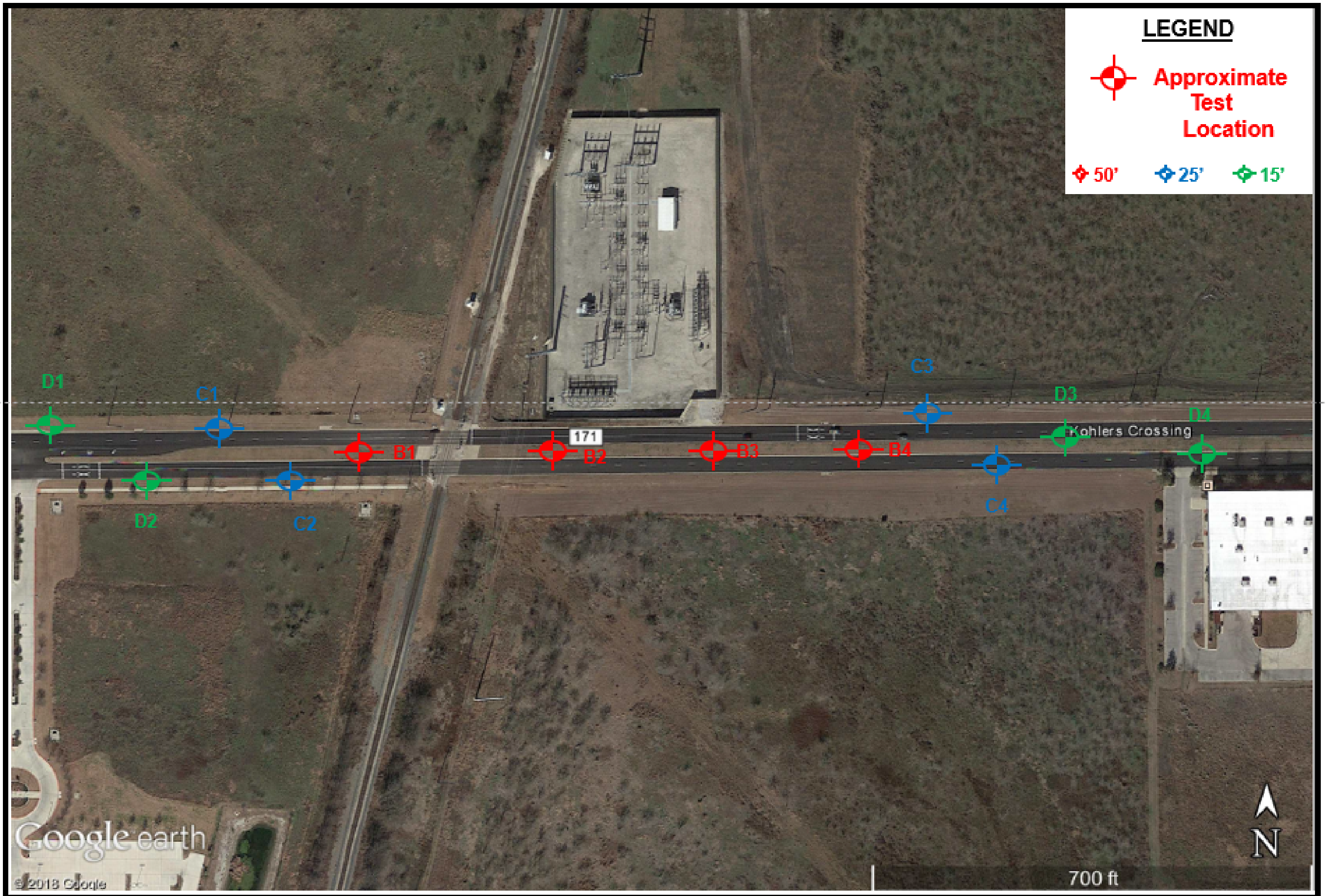
The scope of services was limited to the borings completed at the site. It should be recognized that definition and evaluation of subsurface conditions are difficult. Since some variation was found in subsurface conditions at the specific boring locations for this study, all readers should be aware that a greater variation could occur between the boring locations. Statements in the report as to subsurface variations across the site are intended only as estimations from the data obtained at specific boring locations.

The scope of services did not include environmental assessments or evaluations regarding the presence or absence of wetlands or hazardous substances in the soil, surface water, or groundwater at this site.

APPENDIX A



SCALE: NTS CHECKED BY: DT PLOTTED BY: JB DATE: 2019 – 8 -- 27	PAVETEX	**Vicinity Map** Kohler's Crossing Hays County, Texas	**FIGURE** **1**



SCALE:	NTS
CHECKED BY:	DT
PLOTTED BY:	JB
DATE:	2019 – 8 - 27

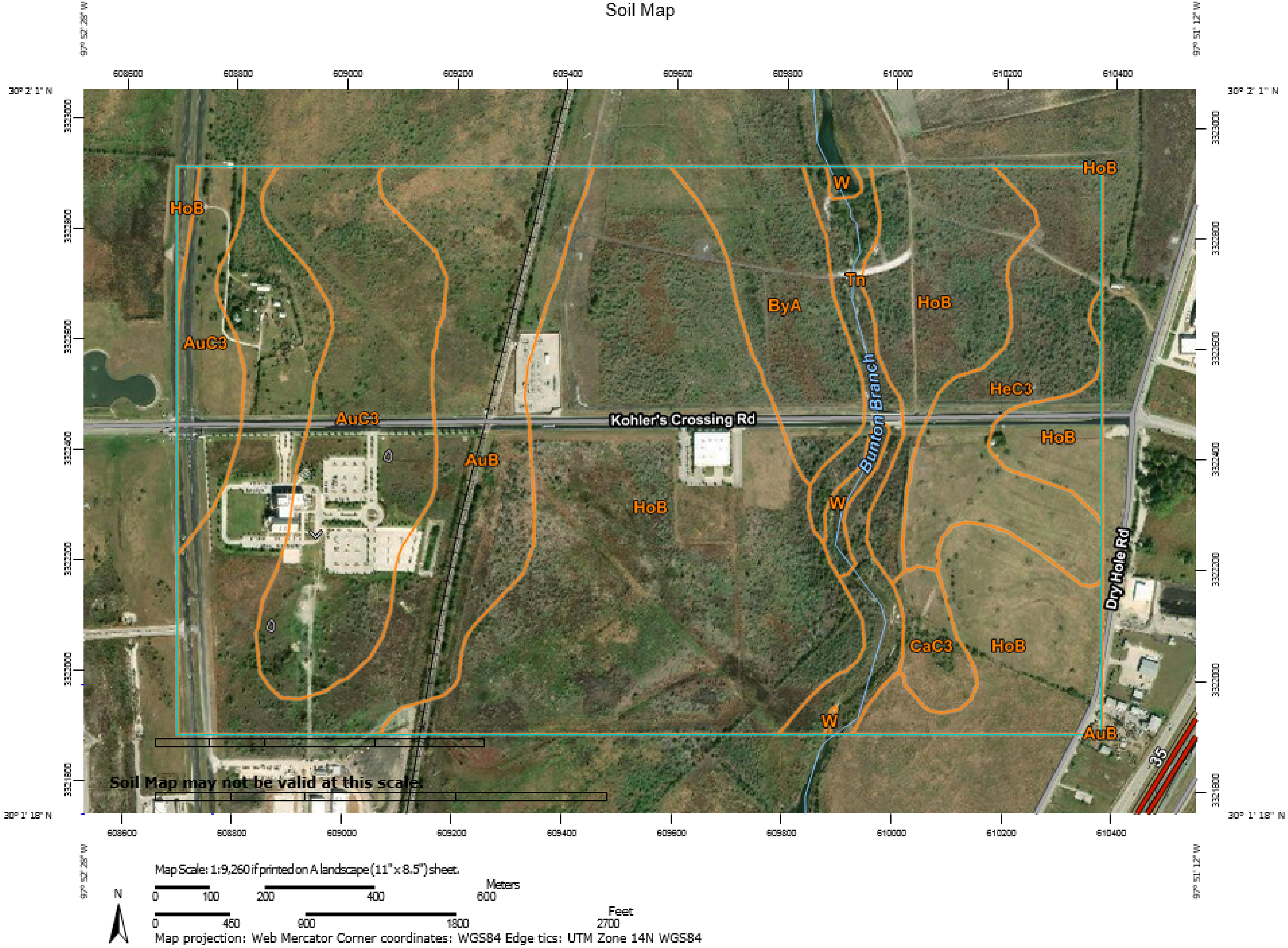
PAVETEX

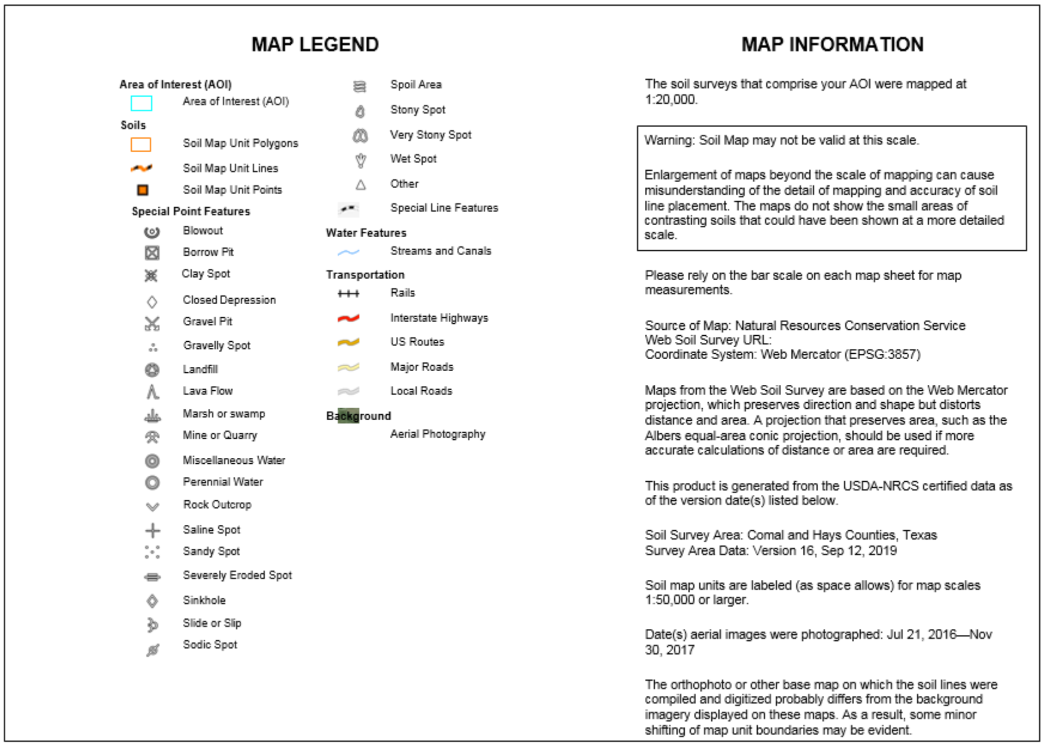
PLAN OF TEST LOCATIONS

Kohler's Crossing
Geotechnical Investigation
Hays County, Texas

FIGURE
2

Soil Map


97° 52' 28" W
97° 51' 12" W
30° 2' 1" N
30° 1' 18" N
608600
608800
609000
609200
609400
609600
609800
610000
610200
610400
3323000
3322800
3322600
3322400
3322200
3322000
3321800
HoB
W
Tn
ByA
HoB
HeC3
HoB
AuC3
AuC3
AuB
HoB
W
CaC3
HoB
W
AuB
Kohler's Crossing Rd
Bunton Branch
Dry Hole Rd
35
Soil Map may not be valid at this scale.
Map Scale: 1:9,260 if printed on A landscape (11" x 8.5") sheet.
Meters
0
100
200
400
600
Feet
0
450
900
1800
2700
N
Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 14N WGS84



MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils
- Soil Map Unit Polygons
- Soil Map Unit Lines
- Soil Map Unit Points

Special Point Features
- Blowout
- Borrow Pit
- Clay Spot
- Closed Depression
- Gravel Pit
- Gravelly Spot
- Landfill
- Lava Flow
- Marsh or swamp
- Mine or Quarry
- Miscellaneous Water
- Perennial Water
- Rock Outcrop
- Saline Spot
- Sandy Spot
- Severely Eroded Spot
- Sinkhole
- Slide or Slip
- Sodic Spot
- Spoil Area
- Stony Spot
- Very Stony Spot
- Wet Spot
- Other
- Special Line Features

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:20,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL:
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

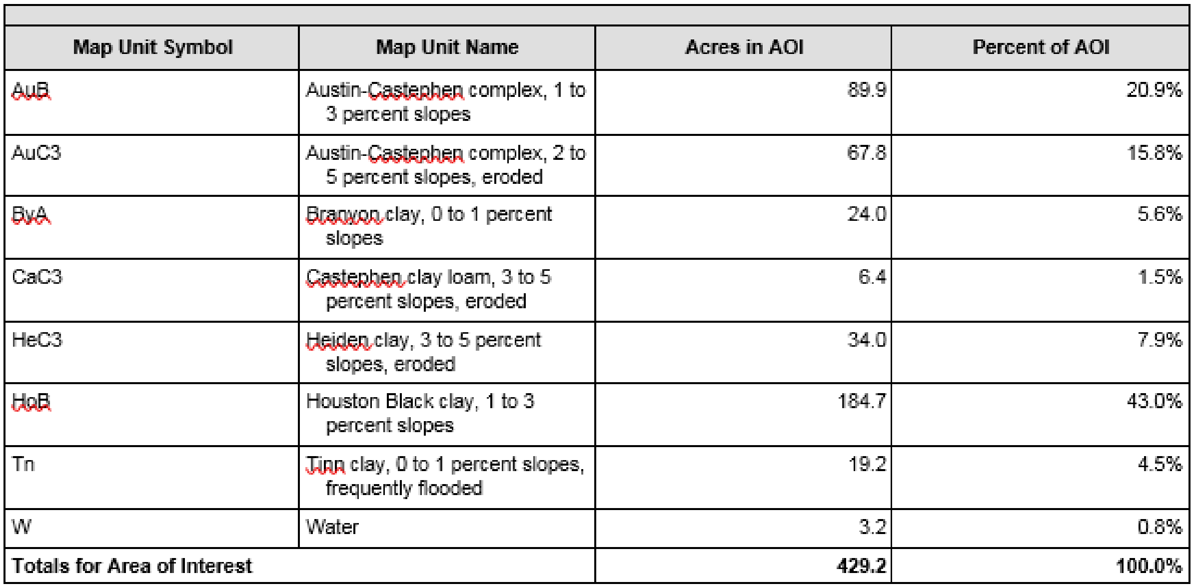
Soil Survey Area: Comal and Hays Counties, Texas
Survey Area Data: Version 16, Sep 12, 2019

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Jul 21, 2016—Nov 30, 2017

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Map Unit Legend



Map Unit Symbol	Map Unit Name	Acres in AOI	Percent of AOI
AuB	Austin-Castephen complex, 1 to 3 percent slopes	89.9	20.9%
AuC3	Austin-Castephen complex, 2 to 5 percent slopes, eroded	67.8	15.8%
BvA	Branyon clay, 0 to 1 percent slopes	24.0	5.6%
CaC3	Castephen clay loam, 3 to 5 percent slopes, eroded	6.4	1.5%
HeC3	Heiden clay, 3 to 5 percent slopes, eroded	34.0	7.9%
HoB	Houston Black clay, 1 to 3 percent slopes	184.7	43.0%
Tn	Tinn clay, 0 to 1 percent slopes, frequently flooded	19.2	4.5%
W	Water	3.2	0.8%
Totals for Area of Interest		**429.2**	**100.0%**

DRILLING LOG

WinCore
Version 3.3

County	Hays	Hole	B1	District	Austin
Highway	171 - Kohler's Crossing	Structure	Bridge and MSE Walls	Date	12/14/19
CSJ		Station	NP	Grnd. Elev.	0.00 ft
		Offset	NP	GW Elev.	N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			CLAY, drk brn with sand (SC)				50	34		PP - 4.5 tsf
-2.		16 (6) 11 (6)	SAND, brn/tan clayey (SC)				36	22		
-3.5		20 (6) 30 (6)	SAND, tan/White sand like lmst							
5										
							27	13		Started Coring w/water
-7.5		50 (0.25) 50 (1)	LIMESTONE, tan with sand and clay seams, very hard							RQD=0, RR-14.6%
10										RQD=46, RR-100%
-15. 15		50 (0.25) 50 (0)								RQD=60, RR-100%
			LIMESTONE, tan/grey with few sand and clay seams, very hard							
-20. 20		50 (0.25) 50 (0.25)								RQD=53.5, RR-100%
			LIMESTONE, drk tan to drk tan/gray with clay seams, very hard							
-25. 25		50 (0.25) 50 (0.25)								RQD=60, RR-100%
			LIMESTONE, drk to lt gray with clay seams, very hard							
30		50 (0.25) 50 (0)								RQD=60, RR-100%
-35. 35		50 (0) 50 (0)								RQD=54, RR-100%
			LIMESTONE, drk to lt gray, very hard							
40		50 (0) 50 (0)								RQD=60, RR-100%
-45. 45		50 (0.5) 50 (0.25)								RQD=55, RR-100%
			LIMESTONE, lt gray with some shale, very hard							
-50. 50		50 (0) 50 (0)								
55										
60										

Remarks: GPS + 30.0283 - 97.8672 No Water encountered at time of sampling

The ground water elevation was not determined during the course of this boring.

Driler: Arturo **Logger: Arturo** **Organization: Austin Geo-Logic**

DRILLING LOG

WinCore
Version 3.3

County	Hays	Hole	B2	District	Austin
Highway	171 - Kohler's Crossing	Structure	Bridge, Wall and Roadway	Date	12/12/19
CSJ		Station	NP	Grnd. Elev.	0.00 ft
		Offset	NP	GW Elev.	N/A

Elev. (ft)		LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test Lateral Press. (psi)	Triaxial Test Deviator Stress (psi)	Properties MC	Properties LL	Properties PI	Properties Wet Den. (pcf)	Additional Remarks
				SAND, drk brn clayey (SC)			11.3	56	36		#4-14.6, #200-53.1 PP=4.5 tsf
-2.			26 (6) 29 (6)	SAND, drk brn clayey with gravel, stiff (SC)			12.2	58	40		#4-17.1, #200-54.0
	5										
-6.				GRAVEL, drk brn clayey with sand			6.0	60	42		#4-40.8, #200-81.5
-7.5			17 (6) 19 (6)	CLAY, drk yellow/gray marly, soft (CH)							
	10										
-15.	15		10 (6) 11 (6)				19.8	63	47		#4-0.0, #200-17.0
				CLAY, drk yellow/orange marly, soft (CH)							
-20.	20		50 (1) 50 (1)					68	54		#4-0.0, #200-4.7 RQD=33, RR-100%
				LIMESTONE, soft							
-25.	25		50 (0.25) 50 (0.25)		0	4773					RQD=37.5, RR-96%
				LIMESTONE, soft to med hard with sand seams							
-30.	30		50 (0.25) 50 (0.25)								RQD=18, RR-93%
				LIMESTONE, med to hard with sand seams							
-35.	35		50 (0.25) 50 (0)								RQD=38, RR-93%
				LIMESTONE, drk-lt gray to drk gray, very hard							
-40.	40		50 (0.25) 50 (0)								RQD=45, RR-85%
				LIMESTONE, drk gray, very hard							
-45.	45		50 (0) 50 (0)								RQD=53, RR-80%
				LIMESTONE, drk gray with shells and some shale, very hard							
-50.	50		50 (0) 50 (0)								
	55										
	60										

Remarks: GPS 30.0282 -97.8664 No Water encountered at time of sampling

The ground water elevation was not determined during the course of this boring.

Driller: Arturo

Logger: Arturo

Organization: Austin Geo-Logic

C:\Program Files (x86)\TxDOT\WinCore\Kohler's Crossing Hays County.CLG

DRILLING LOG

1 of 1

WinCore
Version 3.3

County Hays
Highway 171 - Kohler's Crossing
CSJ

Hole B3
Structure Bridge, Wall and Roadway
Station NP
Offset NP

District Austin
Date 14/14/19
Grnd. Elev. 0.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
-2.			CLAY, drk brn with sand (CH)			22.7	57	39		#4-2.6, #200-15.8 PP=4.5 tsf
-4.		6 (6) 6 (6)	CLAY, drk brn sandy (CH)			10.6	53	36		#4-13.7, #200-46.9 PP=4.5 tsf
5			CLAY, drk to lt brn/tan with sand, soft (CH)			13.4	44	29		#4-4.9, #200-23.7 PP=4.5 tsf
-8.		5 (6) 4 (6)	CLAY, drk to lt tan/gray fatty moist, very soft (CH)			19.2	62	46		#4-0.1, #200-2.2 PP=4.5 tsf
10										
-15. 15		3 (6) 4 (6)	CLAY, drk to lt tan/wht dry with sand, very soft (CH)			14.9	53	39		#4-2.0, #200-18.5 PP=3.0 tsf
-20. 20		50 (1) 50 (1)	LIMESTONE, drk to lt tan/wht with sand seams, hard							RQD=11, RR-100%
25		50 (0.25) 50 (0.5)								RQD=10.5, RR-100%
-30. 30		50 (0.5) 50 (0.25)	LIMESTONE, tan to gray hard							RQD=45, RR-95%
-35. 35		50 (0.25) 50 (0)	LIMESTONE, gray hard to to gray very hard with shale	0	6092					RQD=60, RR-100%
-40. 40		50 (0.25) 50 (0)	LIMESTONE, drk to lt gray very hard							RQD=60, RR-100%
-45. 45		50 (0) 50 (0)	LIMESTONE, drk gray, ery hard							RQD=60, RR-100%
-50. 50		50 (0) 50 (0)								
55										
60										

Remarks: GPS + 30.0278 -97.8629 No Water encountered at time of sampling

The ground water elevation was not determined during the course of this boring.

Driller: Arturo

Logger: Arturo

Organization: Austin Geo-Logic

C:\Program Files (x86)\TxDOT\WinCore\Kohler's Crossing Hays County.CLG

DRILLING LOG

WinCore
Version 3.3

County Hays
Highway 171 - Kohler's Crossing
CSJ

Hole B4
Structure Bridge, Wall and Roadway
Station NP
Offset NP

District Austin
Date 12/12/19
Grnd. Elev. 0.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test Lateral Press. (psi)	Triaxial Test Deviator Stress (psi)	Properties MC	Properties LL	Properties PI	Properties Wet Den. (pcf)	Additional Remarks
			CLAY, drk brn sandy (CH)			24.3	54	36		#4-0.5, #200-47.5 PP=3.0 tsf
-2.			CLAY, drk to lt brn dry with sand (CH)			8.21				#4-0.8, #200-15.2 PP=4.5 tsf
-4. 5		20 (6) 26 (6)	CLAY, drk to lt tan/wht sandy, stiff (CL)				26	14		#4-1.4, #200-42.1
-7.5		50 (0.25) 50 (0.025)	LIMESTONE, tan to wht soft sand seams							
10										RQD=11, RR-78%
-15. 15		50 (0.25) 50 (0)								RQD=21, RR-83%
			LIMESTONE, lt tan/wht with clay and sand seams, hard							
-20. 20		50 (0.25) 50 (0.25)		0	2203					RQD=28 , RR-99%
			LIMESTONE, tan/wht to gray clay and sand layers, very hard							
-25. 25		50 (0.25) 50 (0)								RQD=28.5, RR-78%
			LIMESTONE, tan/wht to gray with clay and sand seams very hard							
-30. 30		50 (0.25) 50 (0)								RQD=5, RR-95%
			LIMESTONE, drk-lt gray/wht with clay seams							
-35. 35		50 (0.25) 50 (0)								RQD=52, RR-100
			LIMESTONE, dark - lt gray/white clay seams very hard							
-40. 40		50 (0.25) 50 (0.25)								RQD=60, RR-100%
			LIMESTONE, dark - lt gray some shale seams, hard							
-45. 45		50 (0.25) 50 (0.25)		0	2445					RQD=60, RR-100%
			LIMESTONE, dark - lt gray very hard							
-50. 50		50 (0) 50 (0)								
55										
60										

Remarks: GPS + 30.282, -97.8251 No Water encountered at time of sampling

The ground water elevation was not determined during the course of this boring.

Driller: Arturo Logger: Arturo Organization: Austin Geo-Logic

C:\Program Files (x86)\TxDOT\WinCore\Kohler's Crossing Hays County.CLG

DRILLING LOG

WinCore
Version 3.3

County	Hays	Hole	C1	District	Austin
Highway	171 - Kohler's Crossing	Structure	Bridge and MSE Walls	Date	12/17/19
CSJ		Station	NP	Grnd. Elev.	0.00 ft
		Offset	NP	GW Elev.	N/A

Elev. (ft)		LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test Lateral Press. (psi)	Triaxial Test Deviator Stress (psi)	Properties MC	Properties LL	Properties PI	Properties Wet Den. (pcf)	Additional Remarks
				SAND, drk - lt brn/tan clayey with gravel (SC)			17.7	46	29		#4-26.9, #200-68.7 PP=4.5 tsf
-2.				SAND, drk - lt tan/wht clayey with gravel (SC)			7.9	41	26		#4-28.0, #200-88.0
-4.			50 (2) 50 (1)								
	5			LIMESTONE, drk to lt tan/wht with layers of clay and sandy loam, soft							RQD=0, RR-33%
-10.	10		50 (1) 50 (0.5)		0	3014					RQD=49.5, RR-92%
				LIMESTONE, drk to lt tan/wht with sand layers and clay seams, hard							
-15.	15		50 (0.5) 50 (0.25)								RQD=60, RR-93%
				LIMESTONE, drk tan to lt gray, hard							
-20.	20		50 (0.25) 50 (0)								RQD=50.5, RR-84%
				LIMESTONE, drk to lt grey, very hard							
-25.	25		50 (0) 50 (0)								
	30										

Remarks: GPS +30.0283 N, -97.8683 W No Water encountered at time of sampling

The ground water elevation was not determined during the course of this boring.

Driler: Arturo Logger: Arturo Organization: Austin Geo-Logic

C:\Program Files (x86)\TxDOT\WinCore\Kohler's Crossing Hays County.CLG

DRILLING LOG

1 of 1

WinCore
Version 3.3

County	Hays	Hole	C2	District	Austin
Highway	171 - Kohler's Crossing	Structure	Bridge and MSE Walls	Date	12/14/19
CSJ		Station	NP	Grnd. Elev.	0.00 ft
		Offset	NP	GW Elev.	N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test Lateral Press. (psi)	Deviator Stress (psi)	Properties MC	LL	PI	Wet Den. (pcf)	Additional Remarks
			CLAY, drk brown (CH)				64	41		PP=4.5 tsf
-2.			CLAY, drk brn/tan fatty (CH)				60	41		PP=4.5 tsf
-4.		50 (2) 50 (1)	LIMESTONE, drk to lt tan with clay and sand seams, soft							RQD=34, RR-100%
5										
-10. 10		50 (1) 50 (0.75)	LIMESTONE, drk tan to lt gray, hard							RQD=60, RR-100%
-15. 15		50 (1) 50 (0.25)	LIMESTONE, lt gray, hard							RQD=60, RR-100%
-20. 20		50 (0.25) 50 (0)	LIMESTONE, drk gray with shale layers, very hard							RQD=52, RR-52%
-25. 25		50 (0.25) 50 (0)								
30										

Remarks: GPS +30.028, -97.8651 No Water encountered at time of sampling.

The ground water elevation was not determined during the course of this boring.

Driller: Arturo

Logger: Arturo

Organization: Austin, Geo-Logic

C:\Program Files (x86)\TxDOT\WinCore\Kohler's Crossing Hays County.CLG

DRILLING LOG

1 of 1

WinCore
Version 3.3

County	Hays	Hole	C3	District	Austin
Highway	171 - Kohler's Crossing	Structure	Bridge and MSE Walls	Date	12/14/19
CSJ		Station	NP	Grnd. Elev.	0.00 ft
		Offset	NP	GW Elev.	N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			CLAY, drk brn moist with cal. (CH)				75	51		PP=3.0
-2.		50 (1.5) 50 (1)	CLAY, drk to lt brn/tan with weathered lmst (CH)				60	40		PP=4.5 tsf
-4. 5			SAND, drk to lt tan/wht clayey with gravel, very dense			7.7	23	7		#4-30.5, #200-69.3
-7.5		50 (0.5) 50 (0.25)	LIMESTONE, drk to lt tan/wht, soft with sand seams	0	3039					RQD=16, RR100% RQD=10, RR-95%
-10. 10		50 (0.25) 50 (0.25)	LIMESTONE, drk to lt tan/wht with sand and clay layers	0	2938					RQD=51, RR-97%
-15. 15		50 (0.25) 50 (0)	LIMESTONE, drk tan soft to lt gray, hard							RQD=54, RR-97%
-20. 20		50 (0) 50 (0)	LIMESTONE, drk to lt gray with embedded shale, very hard							
-25. 25										
30										

Remarks: GPS +30.028, -97.8651 No Water encountered at the time of sampling

The ground water elevation was not determined during the course of this boring.

Driler: Arturo

Logger: Arturo

Organization: Austin, Geo-Logic

C:\Program Files (x86)\TxDOT\WinCore\Kohler's Crossing Hays County.CLG

DRILLING LOG

WinCore
Version 3.3

County	Hays	Hole	C4	District	Austin
Highway	171 - Kohler's Crossing	Structure	Bridge and MSE Walls	Date	12/16/19
CSJ		Station	NP	Grnd. Elev.	0.00 ft
		Offset	NP	GW Elev.	N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test Lateral Press. (psi)	Triaxial Test Deviator Stress (psi)	Properties MC	Properties LL	Properties PI	Properties Wet Den. (pcf)	Additional Remarks
			CLAY, drk to lt brn fatty (CH)				62	43		PP=4.0 tsf
-2.		24 (6) 26 (6)	CLAY, drk to lt brn with gravel (CH)				66	45		PP=4.5 tsf
-4. 5			SAND, drk to lt tan/wht clayey, stiff (SC)				31	17		
-7.5		50 (0.25) 50 (0.25)	LIMESTONE, tan soft							RQD=20, RR-100%
-10. 10		50 (0.25) 50 (0)	LIMESTONE, tan with clay layers							RQD=13.5, RR-80%
-15. 15		50 (0) 50 (0)	LIMESTONE, lt tan to gray, very hard							RQD=60, RR-100%
-20. 20		50 (0) 50 (0)	LIMESTONE, drk to lt gray to dark gray, very hard							RQD=52, RR-92%
-25. 25										
30										

Remarks: GPS +30.0281, -97.8662 No Water encountered at the time of sampling

The ground water elevation was not determined during the course of this boring.

Driller: Arturo

Logger: Arturo

Organization: Austin Geo-Logic

DRILLING LOG

WinCore
Version 3.3

County	Hays	Hole	D1	District	Austin
Highway	171 - Kohler's Crossing	Structure	Bridge and MSE Walls	Date	12/17/19
CSJ		Station	NP	Grnd. Elev.	0.00 ft
		Offset	NP	GW Elev.	N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test Lateral Press. (psi)	Triaxial Test Deviator Stress (psi)	Properties MC	Properties LL	Properties PI	Properties Wet Den. (pcf)	Additional Remarks
			CLAY, drk brn dry sandy (CH)			20.6	62	40		#4-14.6, #200-39.7 PP=4.5 tsf
-2.			GRAVEL, tan sandy, clayey			10.1	38	20		#4-41.3, #200-72.2
-3.5		50 (0.5) 50 (0.25)	LIMESTONE, tan with sand seams, hard							
5										RQD=20.5, RR-100%
-10. 10		50 (0.25) 50 (0.25)	LIMESTONE, tan to gray with sand seams and clay layers, hard							RQD=53.5, RR-95%
-15. 15		50 (0) 50 (0)								

Remarks: GPS +30.0281, -97.8688 60 ft offset to the S.E. due to conflict. Taken in center median. No Water encountered at the time of sampling.

The ground water elevation was not determined during the course of this boring.

Driller: Aturo

Logger: Arturo

Organization: Austin Geo-Logic

C:\Program Files (x86)\TxDOT\WinCore\Kohler's Crossing Hays County.CLG

DRILLING LOG

WinCore
Version 3.3

County Hays
Highway 171 - Kohler's Crossing
CSJ

Hole D2
Structure Bridge and MSE Walls
Station NP
Offset NP

District Austin
Date NP
Grnd. Elev. 0.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			SAND, dark brown clayey, gravelly (SC)							
						12.3	42	25		#4-32.4, #200-68.4 PP=4.5 tsf
-2.			GRAVEL, dark to lt brown/tan clayey, sandy							
						10.5	55	36		#4-56.4, #200-81.8 PP=4.5 tsf
-4.		50 (1) 50 (0.5)	LIMESTONE, dark to lt tan/wht, hard							
5										RQD=29, RR-100%
-10. 10		50 (0.25) 50 (0.25)	LIMESTONE, dark to lt tan/gray, hard							RQD=58, RR-100%
-15. 15		50 (0.25) 50 (0)								

Remarks: GPS +30.0287, -97.8686 No Water uncountered at time of sampling

The ground water elevation was not determined during the course of this boring.

Driler: Arturo **Logger: Arturo** **Organization: Austin Geo-Logic**

DRILLING LOG

WinCore
Version 3.3

County Hays
Highway 171 - Kohler's Crossing
CSJ

Hole D3
Structure Bridge and MSE Walls
Station NP
Offset NP

District Austin
Date 12/12/19
Grnd. Elev. 0.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test		Properties				Additional Remarks
				Lateral Press. (psi)	Deviator Stress (psi)	MC	LL	PI	Wet Den. (pcf)	
			CLAY, dark brown to lt brown with sand (CH)							
							67	47		#4-0.9, #200-21.9 PP=4.5 tsf
										PP=4.5 tsf
-4.		29 (6) 37 (6)								
			SAND, lt tan/wht clayey, stiff (SC)							
5										
							27	13		
-7.5										RQD=14.5, RR-100%
			LIMESTONE, tan with clay and sand seams, hard							
		50 (1) 50 (0.5)								
-10. 10			LIMESTONE, tan to wht with clay and sand seams							RQD=21, RR-93%
-15. 15		50 (0.25) 50 (0.25)								

Remarks: GPS +30.0280 - 97.8639

The ground water elevation was not determined during the course of this boring.

Driller: Arturo

Logger: Arturo

Organization: Austin Geo-Logic

C:\Program Files (x86)\TxDOT\WinCore\Kohler's Crossing Hays County.CLG

1 of 1

DRILLING LOG

WinCore
Version 3.3

County Hays
Highway 171 - Kohler's Crossing
CSJ

Hole D4
Structure Bridge and MSE Walls
Station NP
Offset NP

District Austin
Date 12/13/19
Grnd. Elev. 0.00 ft
GW Elev. N/A

Elev. (ft)	LOG	Texas Cone Penetrometer	Strata Description	Triaxial Test Lateral Press. (psi)	Triaxial Test Deviator Stress (psi)	Properties MC	Properties LL	Properties PI	Properties Wet Den. (pcf)	Additional Remarks
			CLAY, drk to lt brn/tan/wht with sand (CH)							
							48	35		#4-8.4, #200-27.1 PP=4.5 tsf
-2.			CLAY, drk to lt brn/tan/wht gravelly (CH)							
							67	49		#4-20.4, #200-37.2 PP=4.5 tsf
-4.		22 (6) 24 (6)	CLAY, drk to lt brn/tan/wht gravelly, stiff (CH)							
5										
-7.5		50 (1.5) 50 (1)	LIMESTONE, drk to lt tan/wht with sand seams, hard	0	2497					RQD=12, RR-67%
-10. 10			LIMESTONE, drk to lt tan/wht with sand and clay layers, hard							RQD=0, RR-80%
-15. 15		50 (2) 50 (1)								

Remarks: GPS +30.0282 -97.8630

The ground water elevation was not determined during the course of this boring.

Driller: Arturo

Logger: Arturo

Organization: Austin Geo-Logic

C:\Program Files (x86)\TxDOT\WinCore\Kohler's Crossing Hays County.CLG

APPENDIX B

POTENTIAL VERTICAL RISE (PVR)
TEX-124-E

Refresh Workbook

File Version: 03/09/15 10:25:48

SAMPLE ID:	KOHLER'S CROSSING BORINGS	SAMPLED DATE:	12/14/19
TEST NUMBER:	B4	LETTING DATE:	
SAMPLE STATUS:	COMPLETE	CONTROLLING CSJ:	
COUNTY:	HAYS	SPEC YEAR:	2014
SAMPLED BY:	AUSTIN GEOLOGIC	SPEC ITEM:	
SAMPLE LOCATION:	171 SITE B4	SPECIAL PROVISION:	
MATERIAL CODE:		GRADE:	
MATERIAL NAME:			
PRODUCER:			
AREA ENGINEER:		PROJECT MANAGER:	
COURSE\LIFT:	STATION:	DIST. FROM CL:	

Boring Number:	B4	Ground Elevation (z):	NP	Longitude (x):	30.282	Latitude (y):	-97.8251

PVR Data BH

Depth to Bottom of Layer [ft]	Average Load [psi]	Liquid Limit (LL)	Dry 0.2LL+9	Wet 0.47LL+2	Percent Moisture	Dry Avg Wet	Percent -No.40	Plasticity Index (PI)	Percent Volume Swell	Percent Free Swell	PVR [in] Top of Layer	PVR [in] Bottom of Layer	Differential Swell [in]	Modified -No.40 Factor	Modified Density Factor	PVR in Layers [in]	Total PVR [in]
0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**0.97**
4.0	2.0	54	19.8	27.4	24.3	Avg	90.0	36	7.7	10.8	**0.00**	**0.84**	0.84	0.90	1.00	0.76	**0.21**
7.5	5.8	26	14.2	14.2	10.3	Dry	88.6	14	2.8	5.6	**0.36**	**0.60**	0.24	0.89	1.00	0.21	**0.00**
	3.8		9.0	2.0		Dry			0.0	0.0	**0.60**	**0.60**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**0.60**	**0.60**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**0.60**	**0.60**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**0.60**	**0.60**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**0.60**	**0.60**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**0.60**	**0.60**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**0.60**	**0.60**	0.00	0.00	1.00	0.00	**0.00**
	0.0		9.0	2.0		Dry			0.0	0.0	**0.60**	**0.60**	0.00	0.00	1.00	0.00	**0.00**

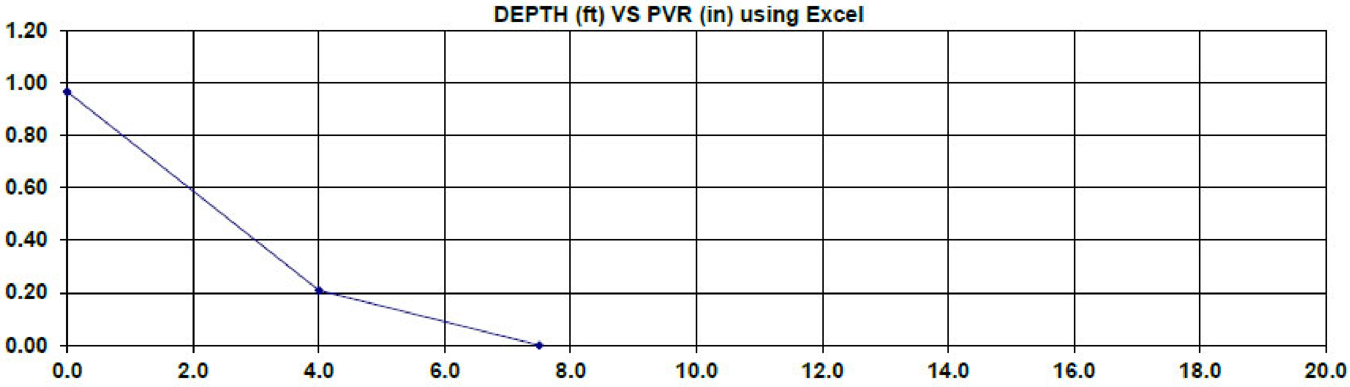
Fields are chart inputs

Fields are final answers per layer

Final Total PVR for the borehole

Note: PVR calculations are based on future pavement grade being the same as present grade. Bold numbers are interpolated and extrapolated values.

DEPTH (ft) VS PVR (in) using Excel



Remarks:

Test Method:	Tested By:		Tested Date:
TX124			
Test Stamp Code:	Omit Test:	Completed Date:	Reviewed By:

Locked By: TxDOT: District: Area:

Authorized By: Authorized Date:

POTENTIAL VERTICAL RISE (PVR)
TEX-124-E

Refresh Workbook

File Version: 03/09/15 10:25:48

SAMPLE ID:	KOHLER'S CROSSING BORINGS	SAMPLED DATE:	12/14/19
TEST NUMBER:	C1	LETTING DATE:	
SAMPLE STATUS:	COMPLETE	CONTROLLING CSJ:	
COUNTY:	HAYS	SPEC YEAR:	2014
SAMPLED BY:	AUSTIN GEOLOGIC	SPEC ITEM:	
SAMPLE LOCATION:	171 SITE C1	SPECIAL PROVISION:	
MATERIAL CODE:		GRADE:	
MATERIAL NAME:			
PRODUCER:			
AREA ENGINEER:		PROJECT MANAGER:	
COURSE\LIFT:	STATION:	DIST. FROM CL:	

Boring Number:	C1	Ground Elevation (z):	NP	Longitude (x):	30.282	Latitude (y):	-97.8251

PVR Data BH

Depth to Bottom of Layer [ft]	Average Load [psi]	Liquid Limit (LL)	Dry 0.2LL+9	Wet 0.47LL+2	Percent Moisture	Dry Avg Wet	Percent -No.40	Plasticity Index (PI)	Percent Volume Swell	Percent Free Swell	PVR [in] Top of Layer	PVR [in] Bottom of Layer	Differential Swell [in]	Modified -No.40 Factor	Modified Density Factor	PVR in Layers [in]	Total PVR [in]
0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.51
2.0	1.0	46	18.2	23.6	17.7	Dry	58.9	29	7.7	10.8	0.00	0.46	0.46	0.59	1.00	0.27	0.24
4.0	3.0	41	17.2	21.3	7.9	Dry	38.8	26	6.7	9.8	0.43	1.05	0.63	0.39	1.00	0.24	0.00
	2.0		9.0	2.0		Dry			0.0	0.0	1.05	1.05	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	1.05	1.05	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	1.05	1.05	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	1.05	1.05	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	1.05	1.05	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	1.05	1.05	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	1.05	1.05	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	1.05	1.05	0.00	0.00	1.00	0.00	0.00

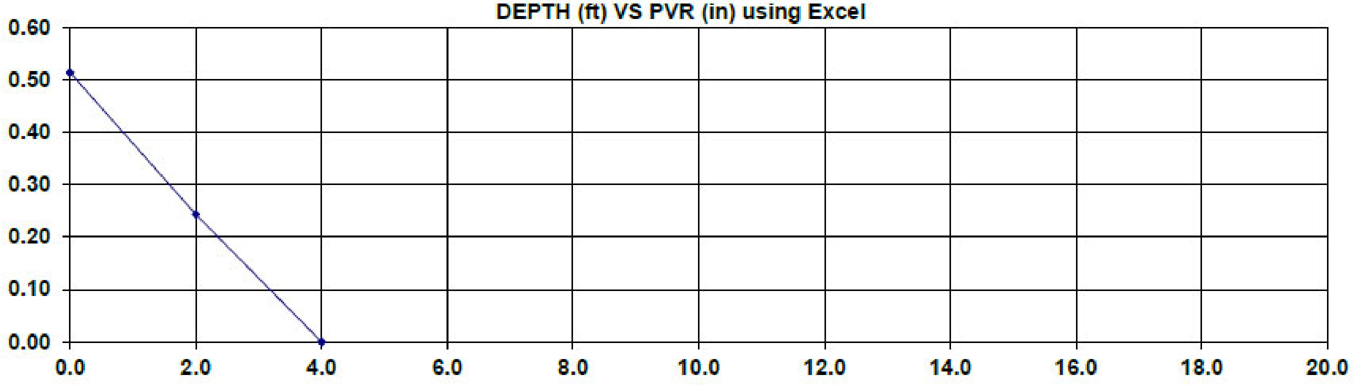
Fields are chart inputs

Fields are final answers per layer

Final Total PVR for the borehole

Note: PVR calculations are based on future pavement grade being the same as present grade. Bold numbers are interpolated and extrapolated values.

DEPTH (ft) VS PVR (in) using Excel



Remarks:

Test Method:	Tested By:		Tested Date:	
TX124				
Test Stamp Code:	Omit Test:	Completed Date:	Reviewed By:	
Locked By:	TxDOT:	District:	Area:	
Authorized By:		Authorized Date:		

POTENTIAL VERTICAL RISE (PVR)
TEX-124-E

Refresh Workbook

File Version: 03/09/15 10:25:48

SAMPLE ID:	KOHLER'S CROSSING BORINGS	SAMPLED DATE:	12/14/19
TEST NUMBER:	D1	LETTING DATE:	
SAMPLE STATUS:	COMPLETE	CONTROLLING CSJ:	
COUNTY:	HAYS	SPEC YEAR:	2014
SAMPLED BY:	AUSTIN GEOLOGIC	SPEC ITEM:	
SAMPLE LOCATION:	171 SITE	SPECIAL PROVISION:	
MATERIAL CODE:		GRADE:	
MATERIAL NAME:			
PRODUCER:			
AREA ENGINEER:		PROJECT MANAGER:	
COURSE\LIFT:		STATION:	
		DIST. FROM CL:	

Boring Number:	D1	Ground Elevation (z):	NP	Longitude (x):	30.0281	Latitude (y):	-97.8688

PVR Data BH

Depth to Bottom of Layer [ft]	Average Load [psi]	Liquid Limit (LL)	Dry 0.2LL+9	Wet 0.47LL+2	Percent Moisture	Dry Avg Wet	Percent -No.40	Plasticity Index (PI)	Percent Volume Swell	Percent Free Swell	PVR [in] Top of Layer	PVR [in] Bottom of Layer	Differential Swell [in]	Modified -No.40 Factor	Modified Density Factor	PVR in Layers [in]	Total PVR [in]
0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.56
2.0	1.0	62	21.4	31.1	20.6	Dry	77.2	40	11.3	14.6	0.00	0.59	0.59	0.77	1.00	0.46	0.10
3.5	2.8	38	16.6	19.9	10.1	Dry	40.0	20	4.8	7.7	0.32	0.57	0.25	0.40	1.00	0.10	0.00
	1.8		9.0	2.0		Dry			0.0	0.0	0.57	0.57	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	0.57	0.57	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	0.57	0.57	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	0.57	0.57	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	0.57	0.57	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	0.57	0.57	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	0.57	0.57	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	0.57	0.57	0.00	0.00	1.00	0.00	0.00

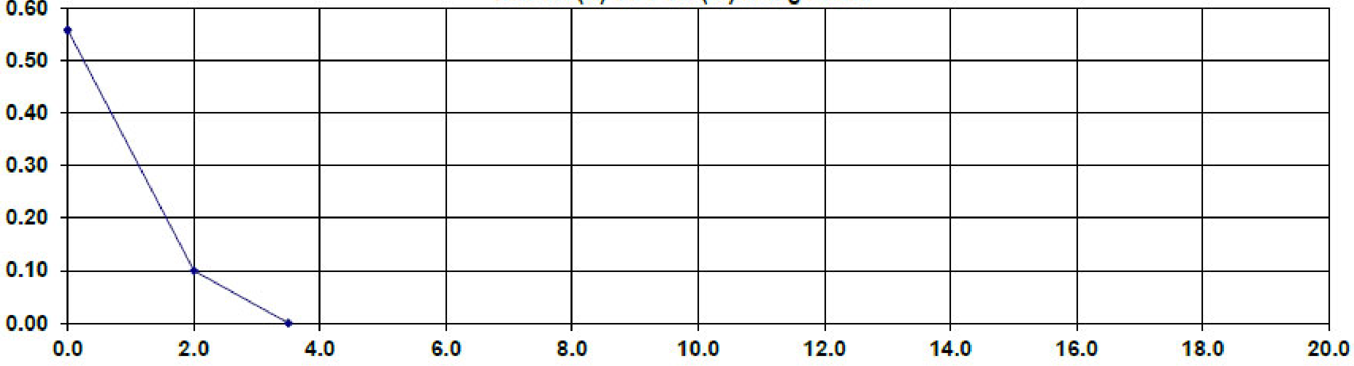
Fields are chart Inputs

Fields are final answers per layer

Final Total PVR for the borehole

Note: PVR calculations are based on future pavement grade being the same as present grade. Bold numbers are interpolated and extrapolated values.

DEPTH (ft) VS PVR (in) using Excel



Remarks:

Test Method: TX124

Tested By:

Tested Date:

Test Stamp Code:

Omit Test:

Completed Date:

Reviewed By:

Locked By:

TxDOT:

District:

Area:

Authorized By:

Authorized Date:

POTENTIAL VERTICAL RISE (PVR)
TEX-124-E

Refresh Workbook

File Version: 03/09/15 10:25:48

SAMPLE ID:	KOHLER'S CROSSING BORINGS	SAMPLED DATE:	12/14/19
TEST NUMBER:	D2	LETTING DATE:	
SAMPLE STATUS:	COMPLETE	CONTROLLING CSJ:	
COUNTY:	HAYS	SPEC YEAR:	2014
SAMPLED BY:	AUSTIN GEOLOGIC	SPEC ITEM:	
SAMPLE LOCATION:	171 SITE	SPECIAL PROVISION:	
MATERIAL CODE:		GRADE:	
MATERIAL NAME:			
PRODUCER:			
AREA ENGINEER:		PROJECT MANAGER:	
COURSE\LIFT:	STATION:	DIST. FROM CL:	

Boring Number:	D2	Ground Elevation (z):	NP	Longitude (x):	30.0281	Latitude (y):	-97.8688

PVR Data BH

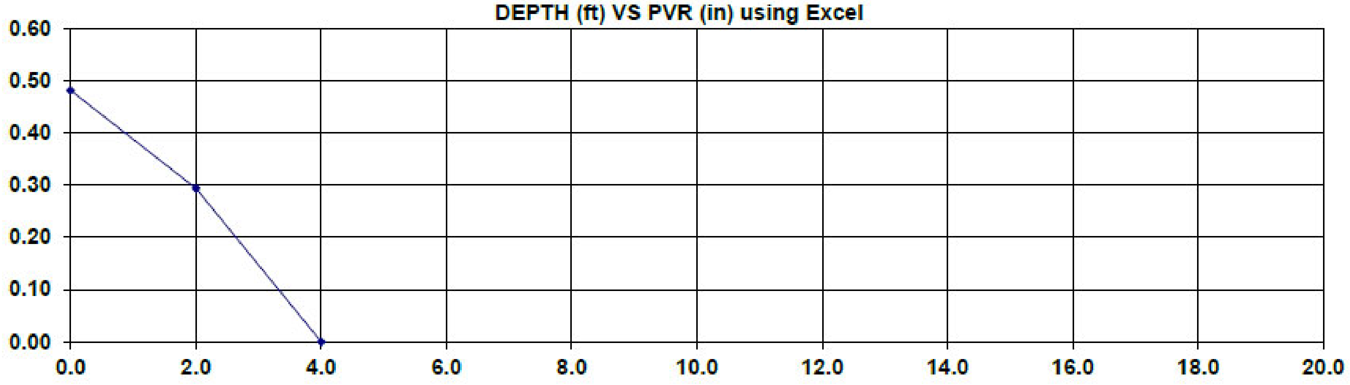
Depth to Bottom of Layer [ft]	Average Load [psi]	Liquid Limit (LL)	Dry 0.2LL+9	Wet 0.47LL+2	Percent Moisture	Dry Avg Wet	Percent -No.40	Plasticity Index (PI)	Percent Volume Swell	Percent Free Swell	PVR [in] Top of Layer	PVR [in] Bottom of Layer	Differential Swell [in]	Modified -No.40 Factor	Modified Density Factor	PVR in Layers [in]	Total PVR [in]
0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.48
2.0	1.0	42	17.4	21.7	12.3	Dry	50.3	25	6.4	9.4	0.00	0.37	0.37	0.50	1.00	0.19	0.29
4.0	3.0	55	20.0	27.9	10.5	Dry	35.3	36	10.0	13.2	0.53	1.36	0.83	0.35	1.00	0.29	0.00
	2.0		9.0	2.0		Dry			0.0	0.0	1.36	1.36	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	1.36	1.36	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	1.36	1.36	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	1.36	1.36	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	1.36	1.36	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	1.36	1.36	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	1.36	1.36	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	1.36	1.36	0.00	0.00	1.00	0.00	0.00

Fields are chart inputs

Fields are final answers per layer

Final Total PVR for the borehole

Note: PVR calculations are based on future pavement grade being the same as present grade. Bold numbers are interpolated and extrapolated values.


DEPTH (ft) VS PVR (in) using Excel

Remarks:

Test Method: TX124

Tested By:

Tested Date:

Test Stamp Code:

Omit Test:

Completed Date:

Reviewed By:

Locked By:

TxDOT:

District:

Area:

Authorized By:

Authorized Date:

POTENTIAL VERTICAL RISE (PVR)
TEX-124-E

Refresh Workbook

File Version: 03/09/15 10:25:48

SAMPLE ID:	KOHLER'S CROSSING BORINGS	SAMPLED DATE:	12/14/19
TEST NUMBER:	D4	LETTING DATE:	
SAMPLE STATUS:	COMPLETE	CONTROLLING CSJ:	
COUNTY:	HAYS	SPEC YEAR:	2014
SAMPLED BY:	AUSTIN GEOLOGIC	SPEC ITEM:	
SAMPLE LOCATION:	171 SITE	SPECIAL PROVISION:	
MATERIAL CODE:		GRADE:	
MATERIAL NAME:			
PRODUCER:			
AREA ENGINEER:		PROJECT MANAGER:	

COURSE\LIFT:		STATION:		DIST. FROM CL:	

Boring Number:	D4	Ground Elevation (z):	NP	Longitude (x):	30.282	Latitude (y):	-97.863

PVR Data BH

Depth to Bottom of Layer [ft]	Average Load [psi]	Liquid Limit (LL)	Dry 0.2LL+9	Wet 0.47LL+2	Percent Moisture	Dry Avg Wet	Percent -No.40	Plasticity Index (PI)	Percent Volume Swell	Percent Free Swell	PVR [in] Top of Layer	PVR [in] Bottom of Layer	Differential Swell [in]	Modified -No.40 Factor	Modified Density Factor	PVR in Layers [in]	Total PVR [in]
0.0	0.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.40
2.0	1.0	48	18.6	24.6	20.5	Avg	60.0	35	7.4	10.5	0.00	0.46	0.46	0.60	1.00	0.28	1.12
7.5	4.8	67	22.4	33.5	20.5	Dry	65.0	49	14.2	17.8	0.71	2.44	1.73	0.65	1.00	1.12	0.00
	3.8		9.0	2.0		Dry			0.0	0.0	2.44	2.44	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	2.44	2.44	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	2.44	2.44	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	2.44	2.44	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	2.44	2.44	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	2.44	2.44	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	2.44	2.44	0.00	0.00	1.00	0.00	0.00
	0.0		9.0	2.0		Dry			0.0	0.0	2.44	2.44	0.00	0.00	1.00	0.00	0.00

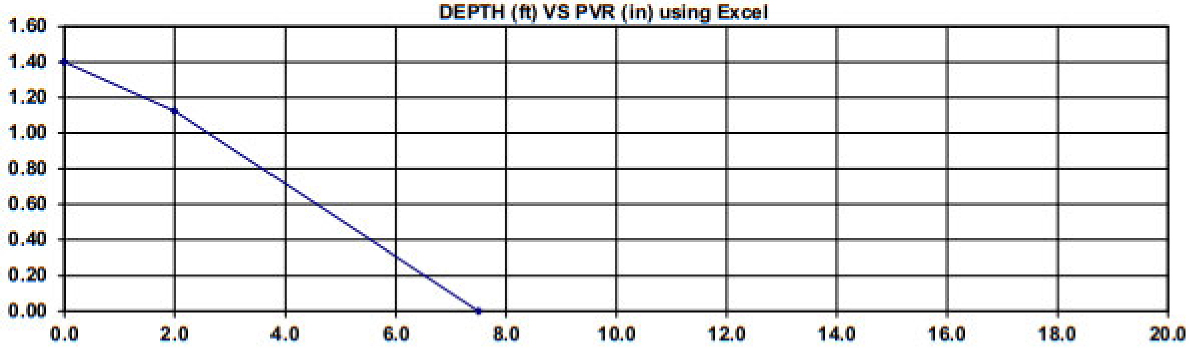
Fields are chart inputs

Fields are final answers per layer

Final Total PVR for the borehole

Note: PVR calculations are based on future pavement grade being the same as present grade. Bold numbers are interpolated and extrapolated values.

DEPTH (ft) VS PVR (in) using Excel



Remarks:

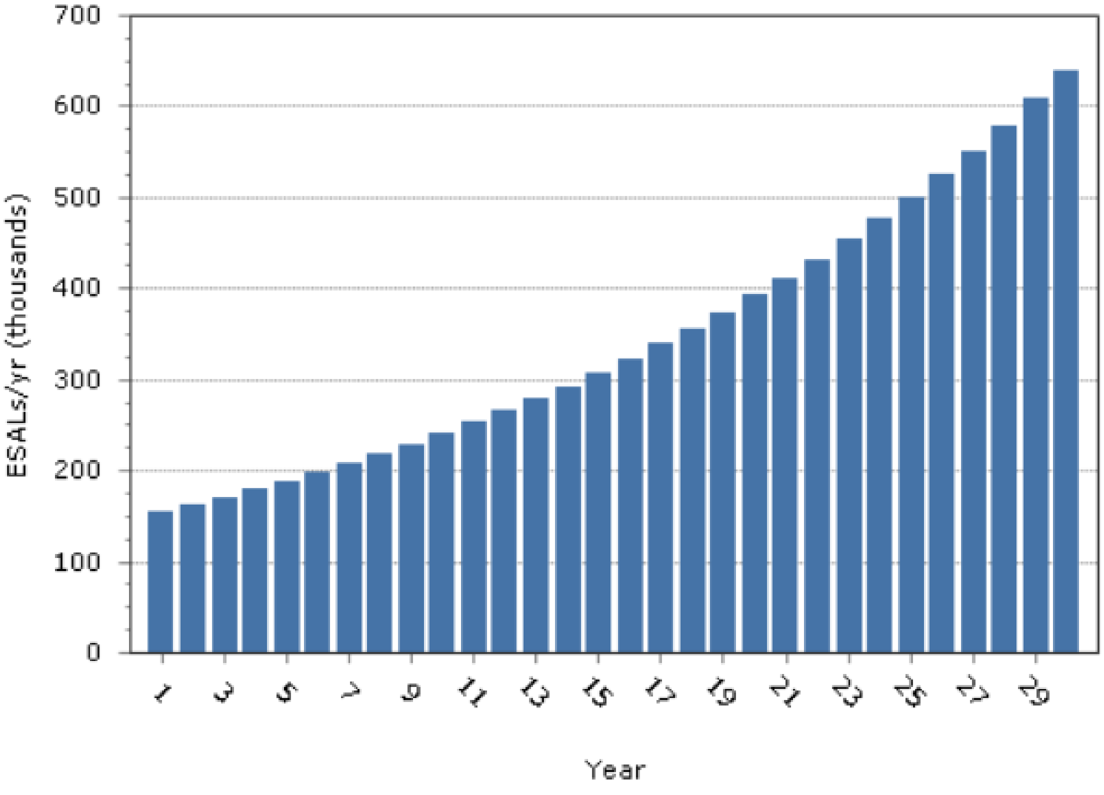
Test Method:		Tested By:		Tested Date:	
TX124					
Test Stamp Code:		Omit Test:	Completed Date:	Reviewed By:	
Locked By:	TxDOT:	District:	Area:		
Authorized By:			Authorized Date:		

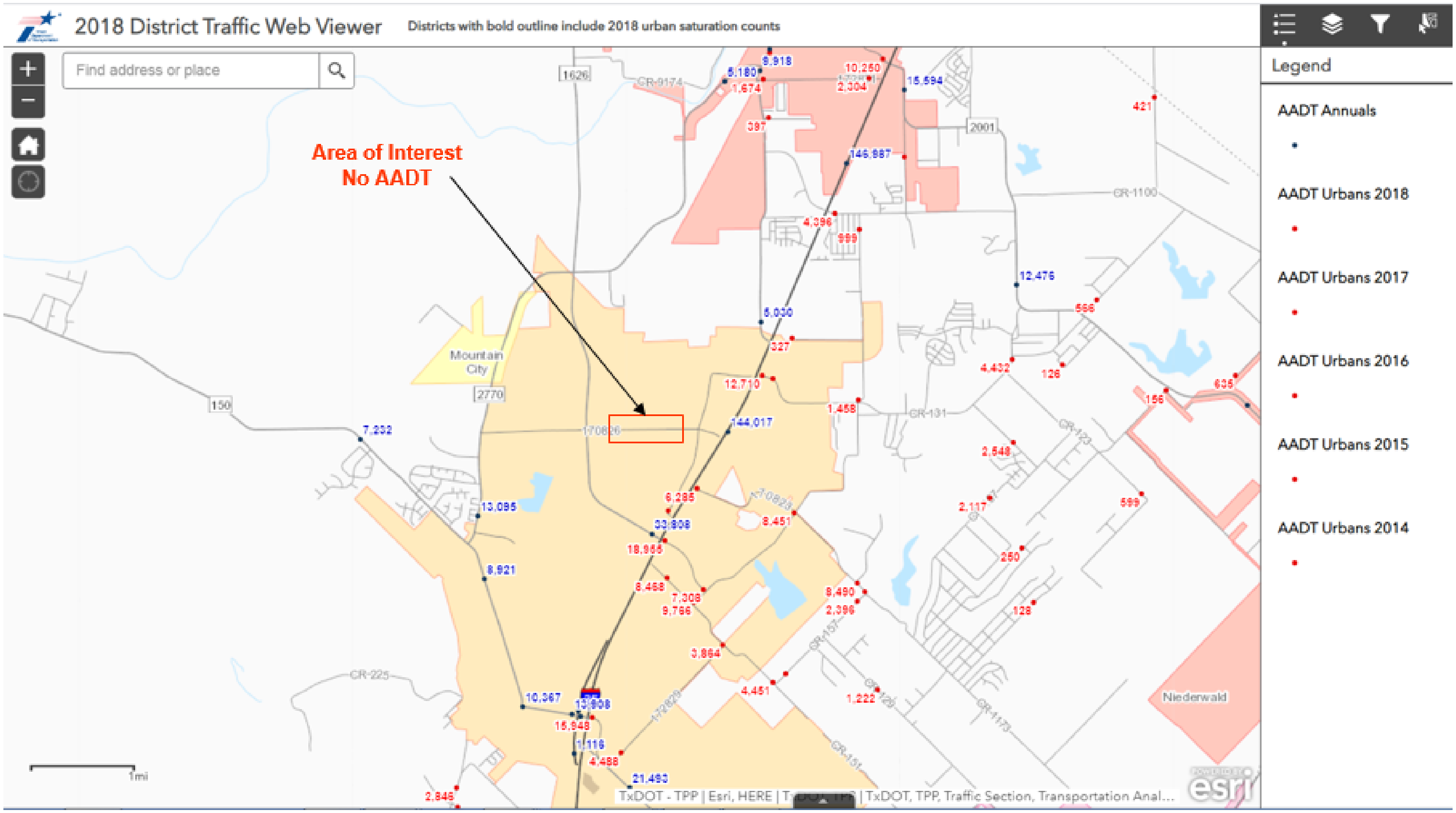
RIGID ESAL Calculation Data

Number Of years to project Data	30
Two Way Average Daily Traffic (ADT)	5000
Directional Distrubution Factor (%)	50 %
Design Lane Distribution Factor (%)	90 %
Growth Rate (%)	5 %
Percent Trucks (%)	10 %
Truck Factors (ESALs/Truck)	1.7

ESAL Calculation

Total ESALs:	10,306,326





2018 District Traffic Web Viewer

Districts with bold outline include 2018 urban saturation counts

Find address or place

Legend

AADT Annuals ●

AADT Urbans 2018 ●

AADT Urbans 2017 ●

AADT Urbans 2016 ●

AADT Urbans 2015 ●

AADT Urbans 2014 ●

TxDOT - TPP | Esri, HERE | TxDOT, TPP | TxDOT, TPP, Traffic Section, Transportation Anal...

SCALE:	NTS
CHECKED BY:	DT
PLOTTED BY:	JB
DATE:	2020 – 6 - 5

PAVETEX

Annual Average Daily Traffic

Kholer's Crossing
Hays County, Texas
No Data Available

FIGURE
3

Texas Department of Transportation

```
--------------------------------------------------------------------------------
```

TEXAS DEPARTMENT OF TRANSPORTATION

F P S21-1.5 *FLEXIBLE PAVEMENT SYSTEM* *Release:12-12-2018*

```
--------------------------------------------------------------------------------

              PAVEMENT DESIGN TYPE # 7 -- USER DEFINED PAVEMENT

PROB   DIST.-14   COUNTY-106   CONT.  SECT.  JOB     HIGHWAY       DATE     PAGE

Kyl     Austin       HAYS       NA      2     NA     K Cross    12/15/2020  1
--------------------------------------------------------------------------------
                        COMMENTS ABOUT THIS PROBLEM





--------------------------------------------------------------------------------
```

BASIC DESIGN CRITERIA

```
  LENGTH OF THE ANALYSIS PERIOD (YEARS)                                    20.0
  MINIMUM TIME TO FIRST OVERLAY (YEARS)                                    10.0
  MINIMUM TIME BETWEEN OVERLAYS (YEARS)                                     5.0
  DESIGN CONFIDENCE LEVEL ( 95.0%)                                           C
  SERVICEABILITY INDEX OF THE INITIAL STRUCTURE                             4.5
  FINAL SERVICEABILITY INDEX P2                                             2.5
  SERVICEABILITY INDEX P1 AFTER AN OVERLAY                                  4.2
  DISTRICT TEMPERATURE CONSTANT                                            31.0
  SUBGRADE ELASTIC MODULUS by COUNTY (ksi)                                  8.00
  INTEREST RATE OR TIME VALUE OF MONEY (PERCENT)                            7.0
```

PROGRAM CONTROLS AND CONSTRAINTS

```
  NUMBER OF SUMMARY OUTPUT PAGES DESIRED ( 8 DESIGNS/PAGE)                 3
  MAX FUNDS AVAILABLE PER SQ.YD. FOR INITIAL DESIGN (DOLLARS)              99.00
  MAXIMUM ALLOWED THICKNESS OF INITIAL CONSTRUCTION (INCHES)               25.0
  ACCUMULATED MAX DEPTH OF ALL OVERLAYS (INCHES) (EXCLUDING LEVEL-UP)       2.0
```

TRAFFIC DATA

```
  ADT AT BEGINNING OF ANALYSIS PERIOD (VEHICLES/DAY)                    5000.
  ADT AT END OF TWENTY YEARS (VEHICLES/DAY)                            13268.
  ONE-DIRECTION 20YEAR 18 kip ESAL (millions)                           5.500
  AVERAGE APPROACH SPEED TO THE OVERLAY ZONE(MPH)                          55.0
  AVERAGE SPEED THROUGH OVERLAY ZONE (OVERLAY DIRECTION)(MPH)              55.0
  AVERAGE SPEED THROUGH OVERLAY ZONE (NON-OVERLAY DIRECTION) (MPH)         55.0
  PROPORTION OF ADT ARRIVING EACH HOUR OF CONSTRUCTION (PERCENT)           20.0
  PERCENT TRUCKS IN ADT                                                    10.0
--------------------------------------------------------------------------------
```

Texas Department of Transportation

TEXAS DEPARTMENT OF TRANSPORTATION

F P S21-1.5 *FLEXIBLE PAVEMENT SYSTEM* *Release:12-12-2018*

PAVEMENT DESIGN TYPE # 7 -- USER DEFINED PAVEMENT

```
PROB   DIST.-14   COUNTY-106   CONT.  SECT.  JOB     HIGHWAY       DATE    PAGE

Kyl     Austin       HAYS       NA      2     NA     K Cross    12/15/2020  2
```

```
                           INPUT DATA CONTINUED
```

CONSTRUCTION AND MAINTENANCE DATA

```
  MINIMUM OVERLAY THICKNESS (INCHES)                                     0.5
  OVERLAY CONSTRUCTION TIME (HOURS/DAY)                                  8.0
  ASPHALTIC CONCRETE COMPACTED DENSITY (TONS/C.Y.)                       1.90
  ASPHALTIC CONCRETE PRODUCTION RATE (TONS/HOUR)                       200.0
  WIDTH OF EACH LANE (FEET)                                             12.0
  FIRST YEAR COST OF ROUTINE MAINTENANCE (DOLLARS/LANE-MILE)             0.00
  ANNUAL INCREMENTAL INCREASE IN MAINTENANCE COST (DOLLARS/LANE-MILE)    0.00
1     ***WARNING***
        AS INPUT,THE PRODUCT OF HPDAND PROP IS GREATER/          THAN 100.0 PERCENT -- PROGRAM CONTINUES
```

DETOUR DESIGN FOR OVERLAYS

```
  TRAFFIC MODEL USED DURING OVERLAYING                                   2
  TOTAL NUMBER OF LANES OF THE FACILITY                                  2
  NUMBER OF OPEN LANES IN RESTRICTED ZONE (OVERLAY DIRECTION)            0
  NUMBER OF OPEN LANES  IN RESTRICTED ZONE (NON-OVERLAY DIRECTION)       1
  DISTANCE TRAFFIC IS SLOWED (OVERLAY DIRECTION) (MILES)                 0.60
  DISTANCE TRAFFIC IS SLOWED (NON-OVERLAY DIRECTION) (MILES)             0.60
  DETOUR DISTANCE AROUND THE OVERLAY ZONE (MILES)                        0.00
```

PAVING MATERIALS INFORMATION

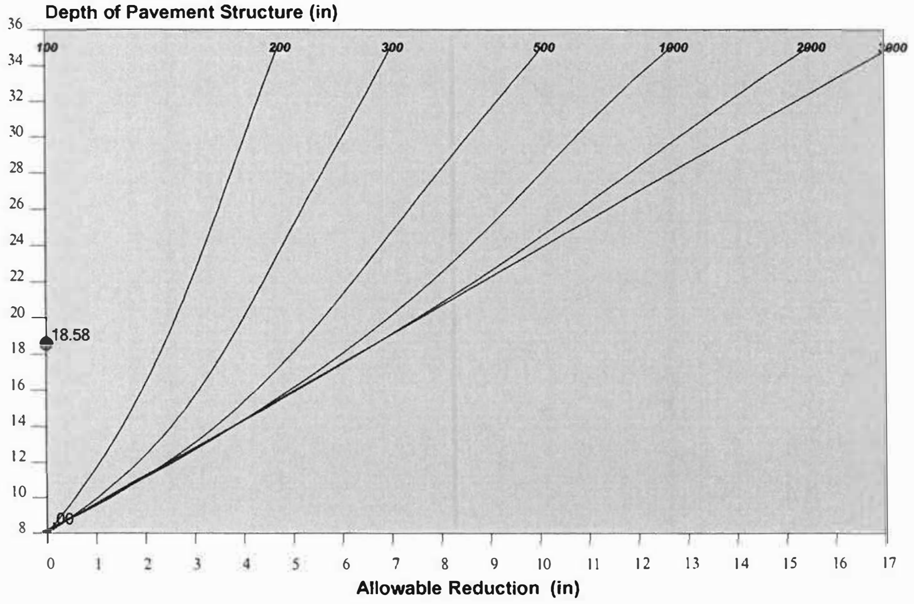
```
             MATERIALS       COST     E    POISSON   MIN.    MAX. SALVAGE
LAYER CODE       NAME       PER CY MODULUS  RATIO   DEPTH   DEPTH   PCT.
  1    B  DENSE-GRADED HMA T150.00  650000.   0.35    2.00    2.00   30.00
  2    C  DENSE-GRADED HMA T150.00  650000.   0.35    5.00    5.00   90.00
  3    M  FLEXIBLE BASE      54.00   70000.   0.35   12.00   12.00   75.00
  4    T  SUBGRADE            2.00    8000.   0.40  200.00  200.00   90.00
```

TEXAS DEPARTMENT OF TRANSPORTATION

F P S21-1.5 *FLEXIBLE PAVEMENT SYSTEM* *Release:12-12-2018*

```
--------------------------------------------------------------------------------

              PAVEMENT DESIGN TYPE # 7 -- USER DEFINED PAVEMENT

PROB   DIST.-14   COUNTY-106   CONT.  SECT.  JOB     HIGHWAY       DATE     PAGE

Kyl     Austin        HAYS       NA      2     NA     K Cross    12/15/2020  3
--------------------------------------------------------------------------------


     C. LEVEL C       SUMMARY OF THE BEST DESIGN STRATEGIES
                        IN ORDER OF INCREASING TOTAL COST
                         1
--------------------------------------------------------------------------------
MATERIAL ARRANGEMENT   BCM
INIT. CONST. COST     47.17
OVERLAY CONST. COST    0.00
USER COST              0.00
ROUTINE MAINT. COST    0.00
SALVAGE VALUE         -8.98
--------------------------------------------------------------------------------
TOTAL COST            38.19
--------------------------------------------------------------------------------
NUMBER OF LAYERS        3
--------------------------------------------------------------------------------
LAYER DEPTH (INCHES)
     D(1)              2.00
     D(2)              5.00
     D(3)             12.00
--------------------------------------------------------------------------------
NO.OF PERF.PERIODS      1
--------------------------------------------------------------------------------
PERF. TIME (YEARS)
     T(1)              20.
--------------------------------------------------------------------------------
OVERLAY POLICY(INCH)
(INCLUDING LEVEL-UP)
--------------------------------------------------------------------------------


        THE TOTAL NUMBER OF FEASIBLE DESIGNS CONSIDERED WAS         1
```

	Thickness (inches)	Modulus (ksi)	Poisson's Ratio	Material Name
SUPERPAVE Surface	2.00	650.00	0.35	SUPERPAVE Surface
DENSE-GRADED HMA Thick	5.00	650.00	0.35	DENSE-GRADED HMA Thick
FLEXIBLE BASE	12.00	70.00	0.35	FLEXIBLE BASE
SUBGRADE	200.00	8.00	0.40	SUBGRADE
Bed Rock		800.00	0.15	Bed Rock



Thickness Reduction Chart for Stabilized Layers

INPUT PARAMETERS:

The Heaviest Wheel Loads Daily (ATHWLD)	12000.0 (lb)
Percentage of TandemAxles	50.0 (%)
Modified Cohesionmeter Value	100.0
Design Wheel Load	15600.0 (lb)
Subgrade Texas Triaxial Class Number (TTC)	4.55

User Input TTC based on historical TEX-117-E

RESULT:

Triaxial Thickness Required	18.6 (in)
The FPS Design Thickness	19.0 (in)
Allowable Thickness Reduction	0.0 (in)
Modified Triaxial Thickness	18.6 (in)

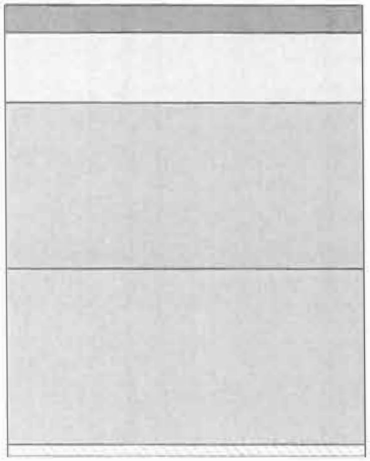
TRIAXIAL CHECK CONCLUSION:

The Design OK !

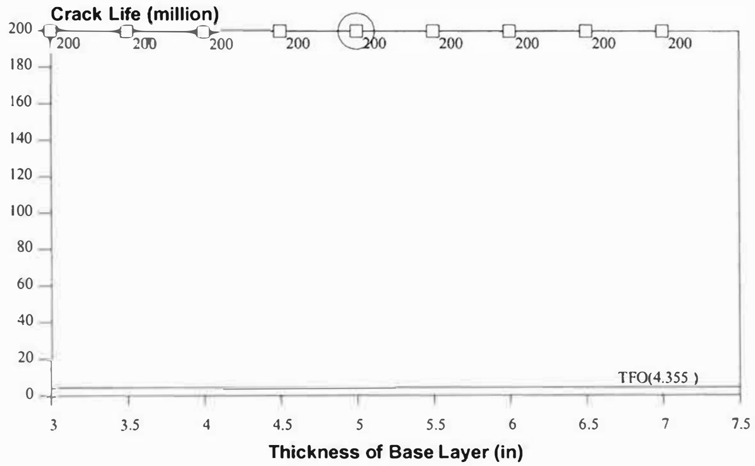
FPS 21 Triaxial Design Check Output (FPS21-1.5Release:12-12-2018)

Highway	171	Problem	Kyl
C-S-J	NA - 2 - NA	Date	12/15/2020
District	Austin	County	HAYS

Design Type:User Defined Pavement Design



Thickness (inches)	Modulus (ksi)	Poisson's Ratio	Material Name
2.00	650.00	0.35	SUPERPAVE Surface
5.00	650.00	0.35	DENSE-GRADED HMA Thick
12.00	70.00	0.35	FLEXIBLE BASE
200.00	8.00	0.40	SUBGRADE



Fatigue Crack Model:

$$N_f = f_1 (\varepsilon_t)^{-f_2} (E_1)^{-f_3}$$

f_1 =7.96E-02

f_2 = 3.291

f_3 = .854

Rutting Model:

$$N_d = f_4 (\varepsilon_v)^{-f_5}$$

f_4 =1.37E-09

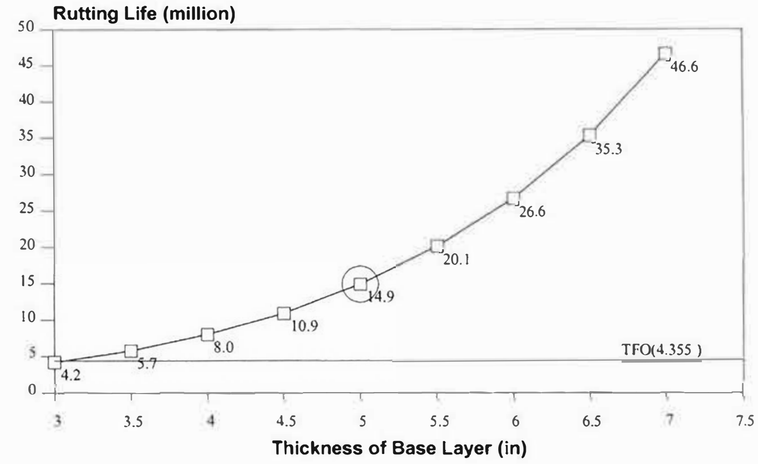
f_5 = 4.477

TFO(Traffic to 1st Overlay): 4.36 (million)

Crack Life: 200.00 (million) $\varepsilon_\tau =$ -4.62 (με)

Rut Life: 14.86 (million) $\varepsilon_v =$ -262.00 (με)

Traffic to 1st Overlay is calculated by analysis period: 20years and 18 kips:5.50millions.
Also the start ADT:5000.0 and ending ADT:13268.0



Mechanistic Check Conclusion:

The design is OK !

FPS 21 Mechanistic Design Check Output (FPS21-1.5Release:12-12-2018)			
Highway	171	Problem	Kyl
C-S-J	NA - 2 - NA	Date	12/15/2020
District	Austin	County	HAYS
Design Type:User Defined Pavement Design			

Texas Department of Transportation

TEXAS DEPARTMENT OF TRANSPORTATION

F P S21-1.5 *FLEXIBLE PAVEMENT SYSTEM* *Release:12-12-2018*

```
PAVEMENT DESIGN TYPE # 7 -- USER DEFINED PAVEMENT

PROB   DIST.-14   COUNTY-106   CONT.  SECT.  JOB     HIGHWAY       DATE     PAGE

Kyl     Austin       HAYS       NA      2     NA     K Cross    12/15/2020  1
--------------------------------------------------------------------------------
                        COMMENTS ABOUT THIS PROBLEM
```

BASIC DESIGN CRITERIA

```
LENGTH OF THE ANALYSIS PERIOD (YEARS)                                     20.0
MINIMUM TIME TO FIRST OVERLAY (YEARS)                                     10.0
MINIMUM TIME BETWEEN OVERLAYS (YEARS)                                      5.0
DESIGN CONFIDENCE LEVEL ( 95.0%)                                            C
SERVICEABILITY INDEX OF THE INITIAL STRUCTURE                              4.5
FINAL SERVICEABILITY INDEX P2                                              2.5
SERVICEABILITY INDEX P1 AFTER AN OVERLAY                                   4.2
DISTRICT TEMPERATURE CONSTANT                                             31.0
SUBGRADE ELASTIC MODULUS by COUNTY (ksi)                                   8.00
INTEREST RATE OR TIME VALUE OF MONEY (PERCENT)                             7.0
```

PROGRAM CONTROLS AND CONSTRAINTS

```
NUMBER OF SUMMARY OUTPUT PAGES DESIRED ( 8 DESIGNS/PAGE)                  3
MAX FUNDS AVAILABLE PER SQ.YD. FOR INITIAL DESIGN (DOLLARS)              99.00
MAXIMUM ALLOWED THICKNESS OF INITIAL CONSTRUCTION (INCHES)               25.0
ACCUMULATED MAX DEPTH OF ALL OVERLAYS (INCHES) (EXCLUDING LEVEL-UP)       2.0
```

TRAFFIC DATA

```
ADT AT BEGINNING OF ANALYSIS PERIOD (VEHICLES/DAY)                      5000.
ADT AT END OF TWENTY YEARS (VEHICLES/DAY)                              13268.
ONE-DIRECTION 20YEAR 18 kip ESAL (millions)                             5.500
AVERAGE APPROACH SPEED TO THE OVERLAY ZONE(MPH)                           55.0
AVERAGE SPEED THROUGH OVERLAY ZONE (OVERLAY DIRECTION)(MPH)               55.0
AVERAGE SPEED THROUGH OVERLAY ZONE (NON-OVERLAY DIRECTION) (MPH)          55.0
PROPORTION OF ADT ARRIVING EACH HOUR OF CONSTRUCTION (PERCENT)            20.0
PERCENT TRUCKS IN ADT                                                     10.0
--------------------------------------------------------------------------------
```

PAVEMENT DESIGN TYPE # 7 -- USER DEFINED PAVEMENT

```
PROB   DIST.-14   COUNTY-106   CONT.  SECT.  JOB     HIGHWAY       DATE    PAGE

Kyl     Austin        HAYS       NA      2     NA     K Cross    12/15/2020  2
```

```
                         INPUT DATA CONTINUED
```

CONSTRUCTION AND MAINTENANCE DATA

```
   MINIMUM OVERLAY THICKNESS (INCHES)                                    0.5
   OVERLAY CONSTRUCTION TIME (HOURS/DAY)                                 8.0
   ASPHALTIC CONCRETE COMPACTED DENSITY (TONS/C.Y.)                      1.90
   ASPHALTIC CONCRETE PRODUCTION RATE (TONS/HOUR)                      200.0
   WIDTH OF EACH LANE (FEET)                                            12.0
   FIRST YEAR COST OF ROUTINE MAINTENANCE (DOLLARS/LANE-MILE)            0.00
   ANNUAL INCREMENTAL INCREASE IN MAINTENANCE COST (DOLLARS/LANE-MILE)   0.00
1     ***WARNING***
         AS INPUT,THE PRODUCT OF HPDAND PROP IS GREATER/         THAN 100.0 PERCENT -- PROGRAM CONTINUES
```

DETOUR DESIGN FOR OVERLAYS

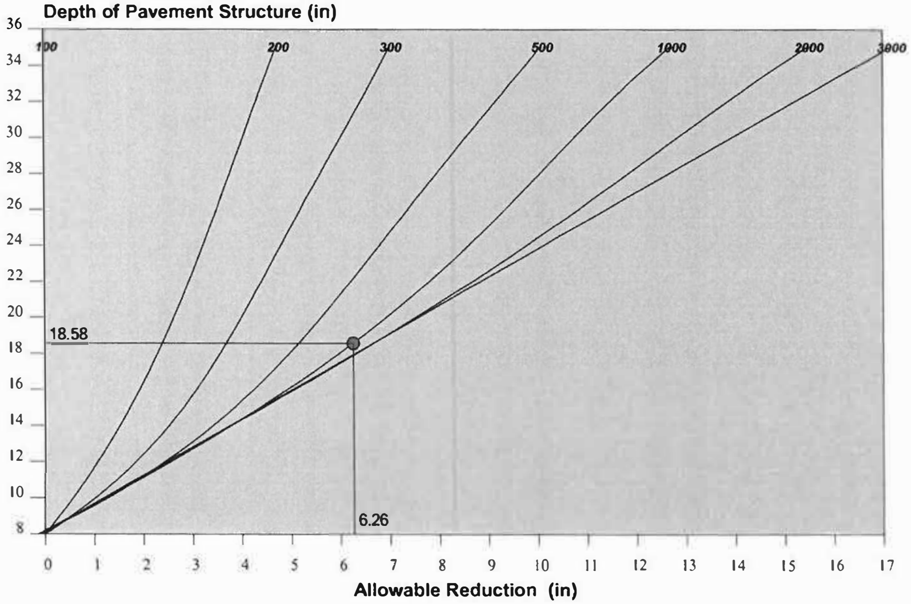
```
   TRAFFIC MODEL USED DURING OVERLAYING                                 2
   TOTAL NUMBER OF LANES OF THE FACILITY                                2
   NUMBER OF OPEN LANES IN RESTRICTED ZONE (OVERLAY DIRECTION)          0
   NUMBER OF OPEN LANES  IN RESTRICTED ZONE (NON-OVERLAY DIRECTION)     1
   DISTANCE TRAFFIC IS SLOWED (OVERLAY DIRECTION) (MILES)               0.60
   DISTANCE TRAFFIC IS SLOWED (NON-OVERLAY DIRECTION) (MILES)           0.60
   DETOUR DISTANCE AROUND THE OVERLAY ZONE (MILES)                      0.00
```

PAVING MATERIALS INFORMATION

```
              MATERIALS       COST     E    POISSON   MIN.    MAX. SALVAGE
LAYER CODE       NAME        PER CY MODULUS  RATIO   DEPTH   DEPTH   PCT.
  1    B  DENSE-GRADED HMA T150.00  650000.   0.35    2.00    2.00   30.00
  2    C  DENSE-GRADED HMA T150.00  650000.   0.35    5.00    5.00   90.00
  3    P  CEMENT STABILIZED  65.00  120000.   0.25    6.00    6.00   70.00
  4    T  SUBGRADE            2.00    8000.   0.40  200.00  200.00   90.00
```

```
--------------------------------------------------------------------------------

              PAVEMENT DESIGN TYPE # 7 -- USER DEFINED PAVEMENT

PROB   DIST.-14   COUNTY-106   CONT.  SECT.  JOB     HIGHWAY       DATE     PAGE

Kyl     Austin        HAYS       NA      2     NA     K Cross    12/15/2020  3
--------------------------------------------------------------------------------


     C. LEVEL C       SUMMARY OF THE BEST DESIGN STRATEGIES
                        IN ORDER OF INCREASING TOTAL COST
                          1
--------------------------------------------------------------------------------
MATERIAL ARRANGEMENT   BCP
INIT. CONST. COST     40.00
OVERLAY CONST. COST    1.73
USER COST            462.12
ROUTINE MAINT. COST    0.00
SALVAGE VALUE         -7.77
--------------------------------------------------------------------------------
TOTAL COST           496.07
--------------------------------------------------------------------------------
NUMBER OF LAYERS        3
--------------------------------------------------------------------------------
LAYER DEPTH (INCHES)
     D(1)             2.00
     D(2)             5.00
     D(3)             6.00
--------------------------------------------------------------------------------
NO.OF PERF.PERIODS      2
--------------------------------------------------------------------------------
PERF. TIME (YEARS)
     T(1)             19.
     T(2)             30.
--------------------------------------------------------------------------------
OVERLAY POLICY(INCH)
(INCLUDING LEVEL-UP)
     O(1)             1.5
--------------------------------------------------------------------------------


        THE TOTAL NUMBER OF FEASIBLE DESIGNS CONSIDERED WAS         1




--------------------------------------------------------------------------------
```

	Thickness (inches)	*Modulus (ksi)*	*Poisson's Ratio*	*Material Name*
DENSE-GRADED HMA Thin	2.00	650.00	0.35	DENSE-GRADED HMA Thin
DENSE-GRADED HMA Thick	5.00	650.00	0.35	DENSE-GRADED HMA Thick
CEMENT STABILIZED BASE	6.00	120.00	0.25	CEMENT STABILIZED BASE
SUBGRADE	200.00	8.00	0.40	SUBGRADE
Bed Rock		800.00	0.15	Bed Rock



Thickness Reduction Chart for Stabilized Layers

INPUT PARAMETERS:

The Heaviest Wheel Loads Daily (ATHWLD)	12000.0 (lb)
Percentage of TandemAxles	50.0 (%)
Modified Cohesionmeter Value	1000.0
Design Wheel Load	15600.0 (lb)
Subgrade Texas Triaxial Class Number (TTC)	4.55

User Input TTC based on historical TEX-117-E

RESULT:

Triaxial Thickness Required	18.6 (in)
The FPS Design Thickness	13.0 (in)
Allowable Thickness Reduction	6.3 (in)
Modified Triaxial Thickness	12.3 (in)

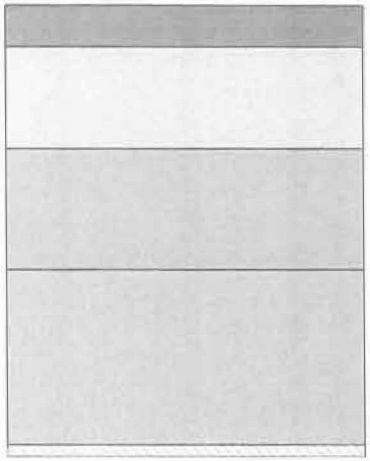
TRIAXIAL CHECK CONCLUSION:

The Design OK !

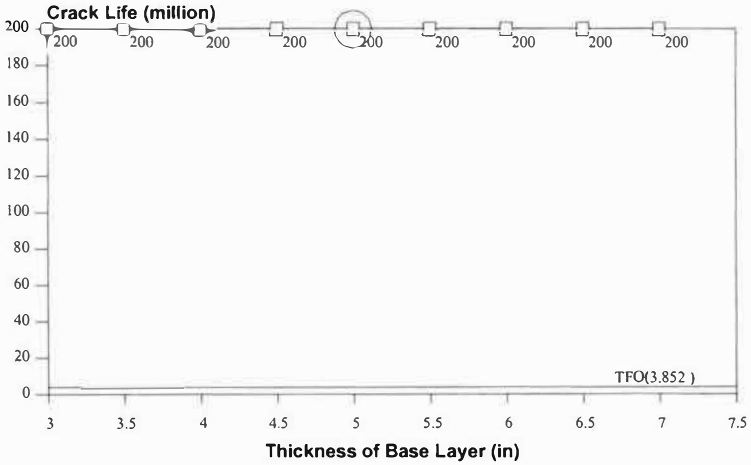
FPS 21 Triaxial Design Check Output **(FPS21-1.5Release:12-12-2018)**

Highway	171	Problem	Kyl
C-S-J	NA - 2 - NA	Date	12/15/2020
District	Austin	County	HAYS

Design Type:User Defined Pavement Design



Thickness (inches)	Modulus (ksi)	Poisson's Ratio	Material Name
2.00	650.00	0.35	DENSE-GRADED HMA Thin
5.00	650.00	0.35	DENSE-GRADED HMA Thick
6.00	120.00	0.25	CEMENT STABILIZED BASE
200.00	8.00	0.40	SUBGRADE



Fatigue Crack Model:

$$N_f = f_1(\varepsilon_t)^{-f_2}(E_1)^{-f_3}$$

f_1 =7.96E-02

f_2 = 3.291

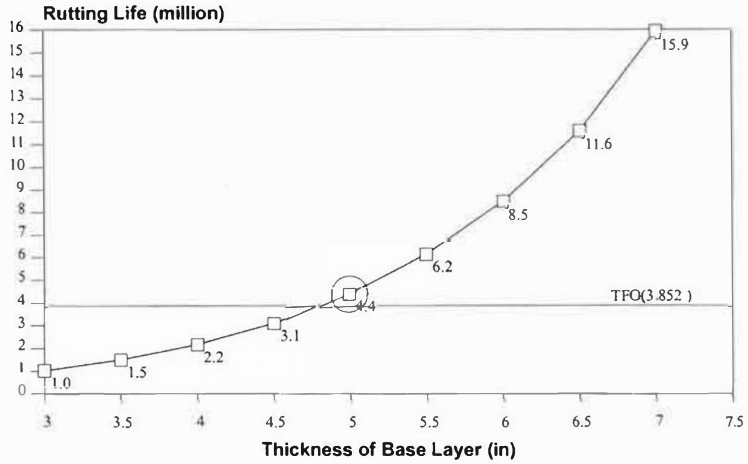
f_3 = .854

Rutting Model:

$$N_d = f_4(\varepsilon_v)^{-f_5}$$

f_4 =1.37E-09

f_5 = 4.477



TFO(Traffic to 1st Overlay): 3.85 (million)

Crack Life: 200.00 (million) $\varepsilon_\tau =$ -7.81 ($\mu\varepsilon$)

Rut Life: 4.39 (million) $\varepsilon_v =$ -344.00 ($\mu\varepsilon$)

Traffic to 1st Overlay is calculated by analysis period: 20years and 18 kips:5.50millions.
Also the start ADT:5000.0 and ending ADT:13268.0

Mechanistic Check Conclusion:

The design is OK !

FPS 21 Mechanistic Design Check Output (FPS21-1.5Release:12-12-2018)

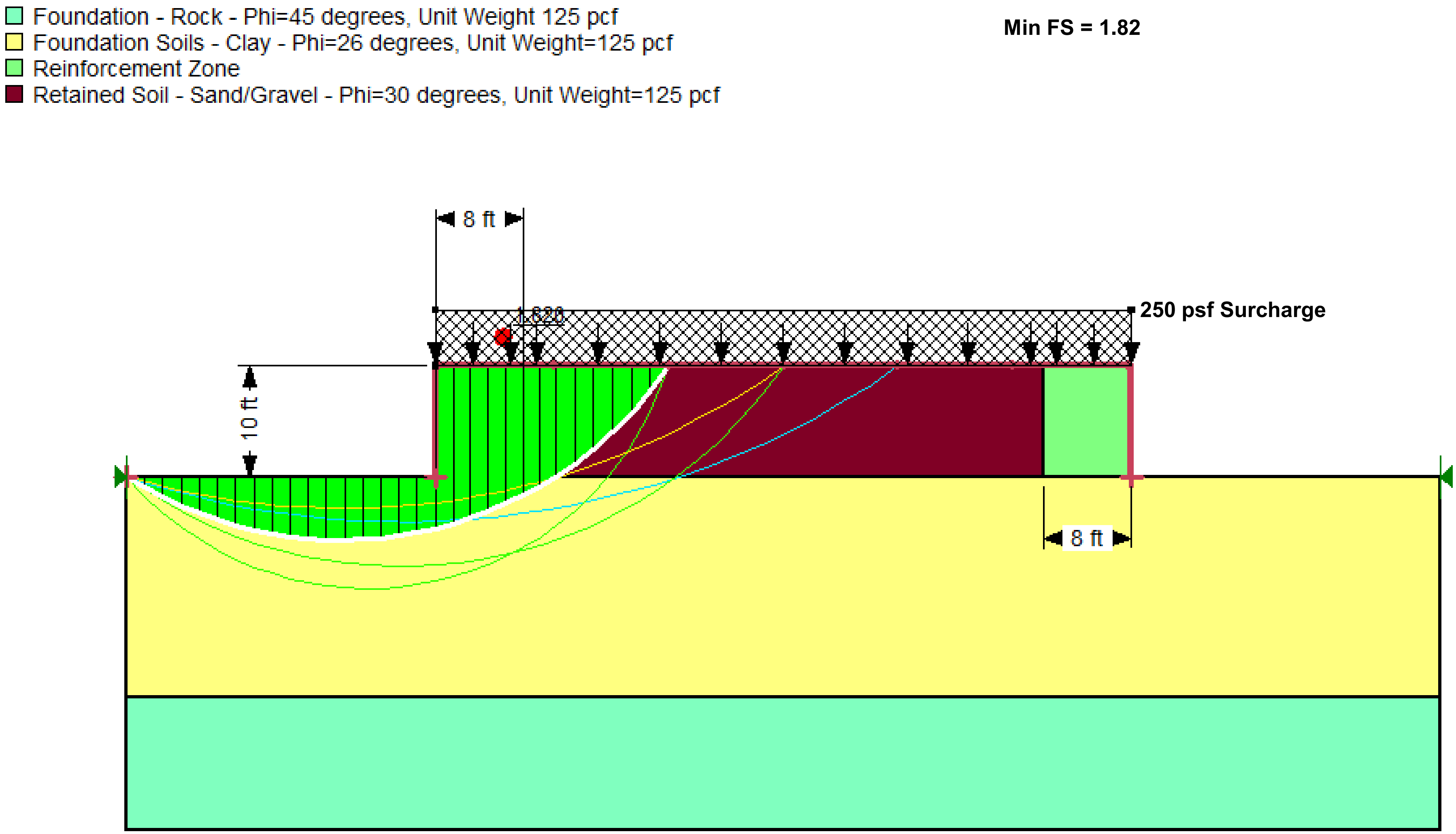
Highway	171	Problem	Kyl
C-S-J	NA - 2 - NA	Date	12/15/2020
District	Austin	County	HAYS

Design Type:User Defined Pavement Design

1993 AASHTO Guide for Design of Pavement Structures
Rigid Pavement Design Equation

		Option 1		Option 2	
Initial Serviceability	p_o	4.5		4.5	
Terminal Serviceability	p_t	2.5		2.5	
28-Day PCC Flexural Strength	S'_c	620	psi	620	psi
28-Day PCC Elastic Modulus	E_c	5,000,000	psi	5,000,000	psi
Reliability	R	95%		95%	
Standard Deviation	s_o	0.39		0.39	
Drainage Coefficient	C_d	1.16		1.16	
Modulus of Support Reaction	k	300		300	
Load Transfer Coefficient	J	2.9		2.9	
Thickness	D	9.50	in.	9.00	in.
Cumulative 18-kip ESALs to Failure	W_{18}	**10,532,323**	ESALs	**7,586,145**	ESALs

W18 Ratio (Option 2 /Option 1): 72.0%



SCALE: NTS

CHECKED BY: DT

PLOTTED BY: AA

DATE: 2020-10-02

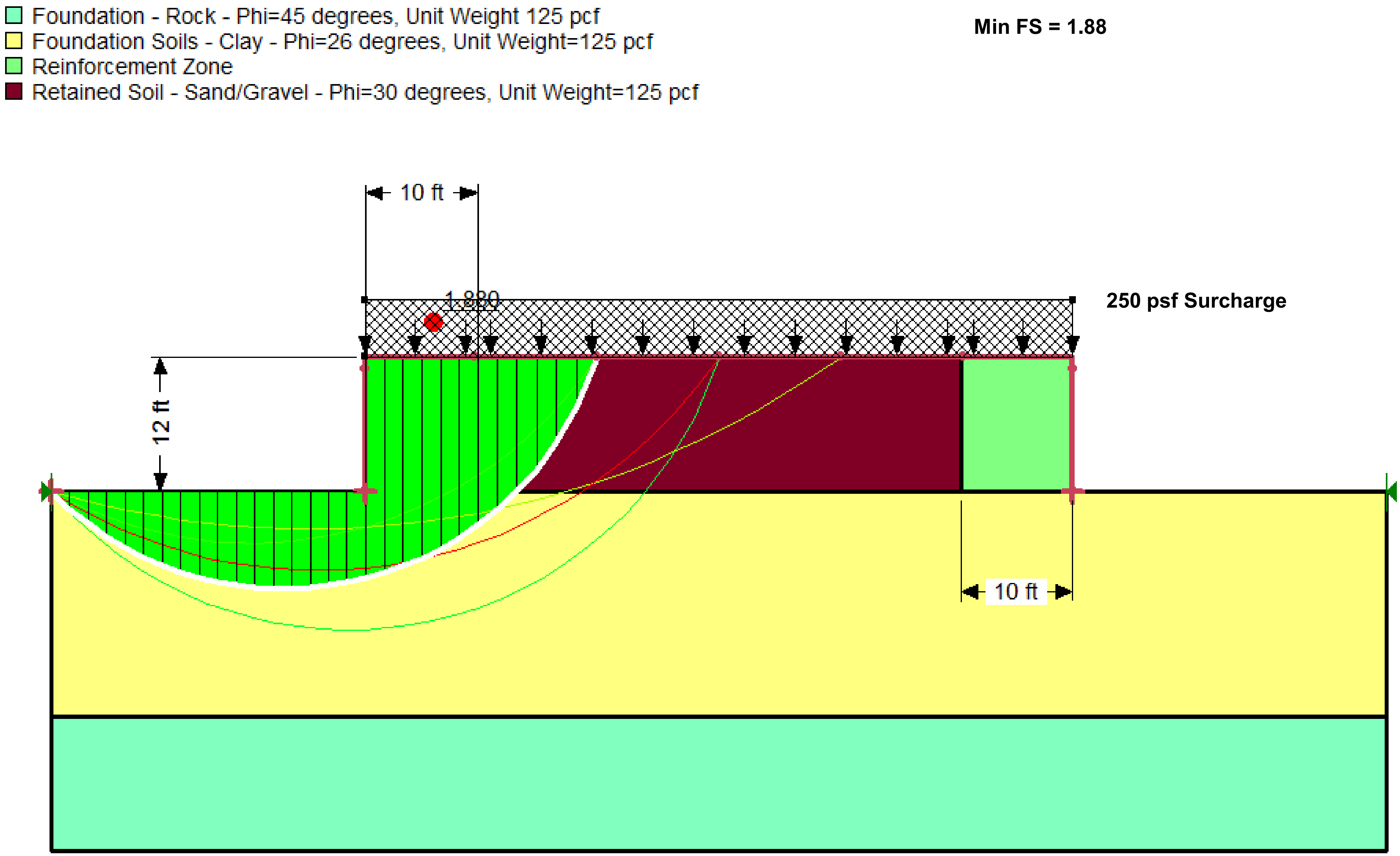
PAVETEX

Global Stability Analysis (H=10 ft)

Kohler's Crossing
Hays County, Texas

FIGURE B-1

Dripping Springs\Results\Clients\HDR\Kohlers Crossing



SCALE: NTS

CHECKED BY: DT

PLOTTED BY: AA

DATE: 2020-10-02

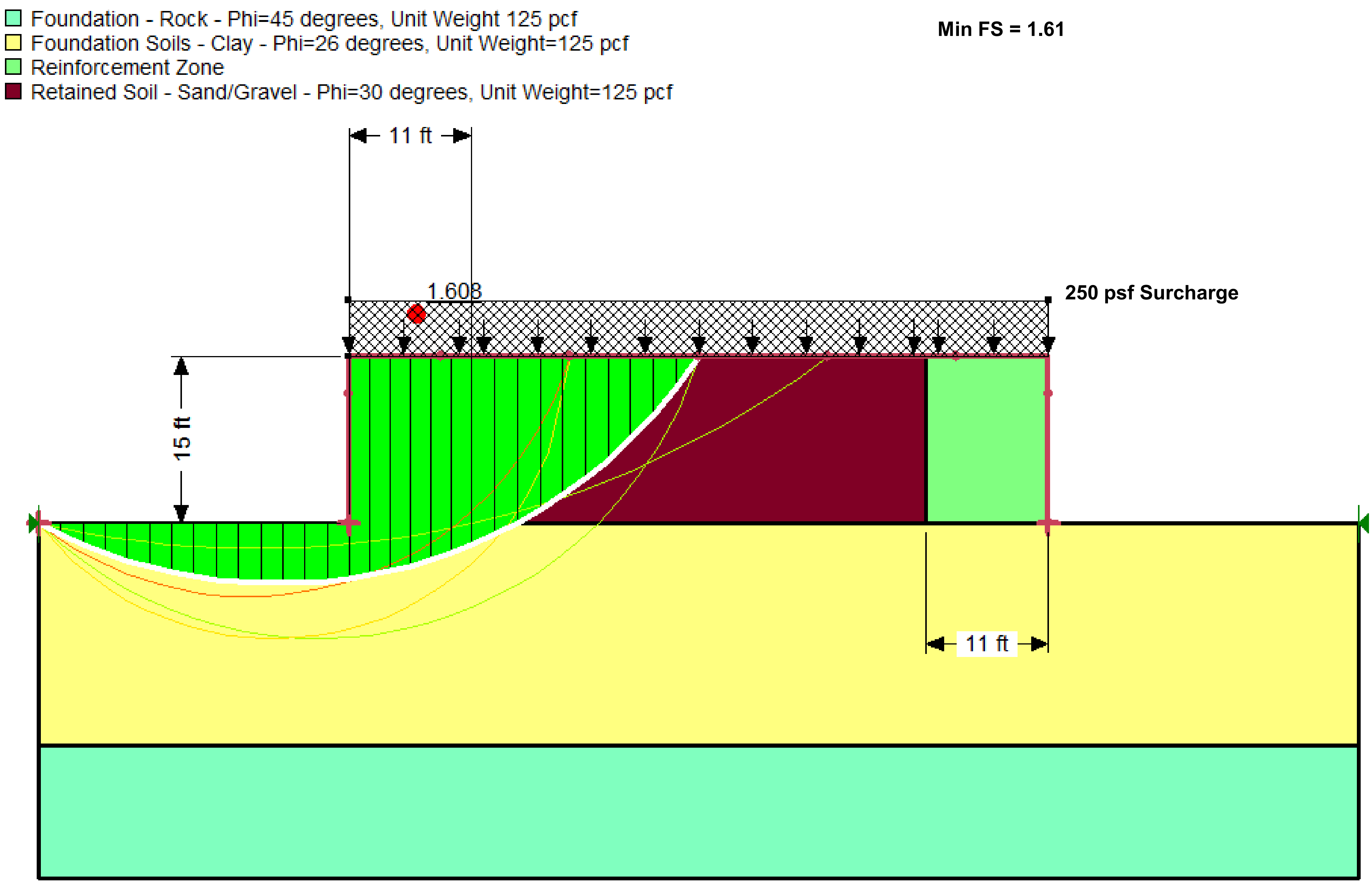
PAVETEX

Global Stability Analysis (H=12 ft)

Kohler's Crossing
Hays County, Texas

FIGURE
B-2

Dripping Springs\Results\Clients\HDR\Kohlers Crossing



SCALE: NTS

CHECKED BY: DT

PLOTTED BY: AA

DATE: 2020-10-02

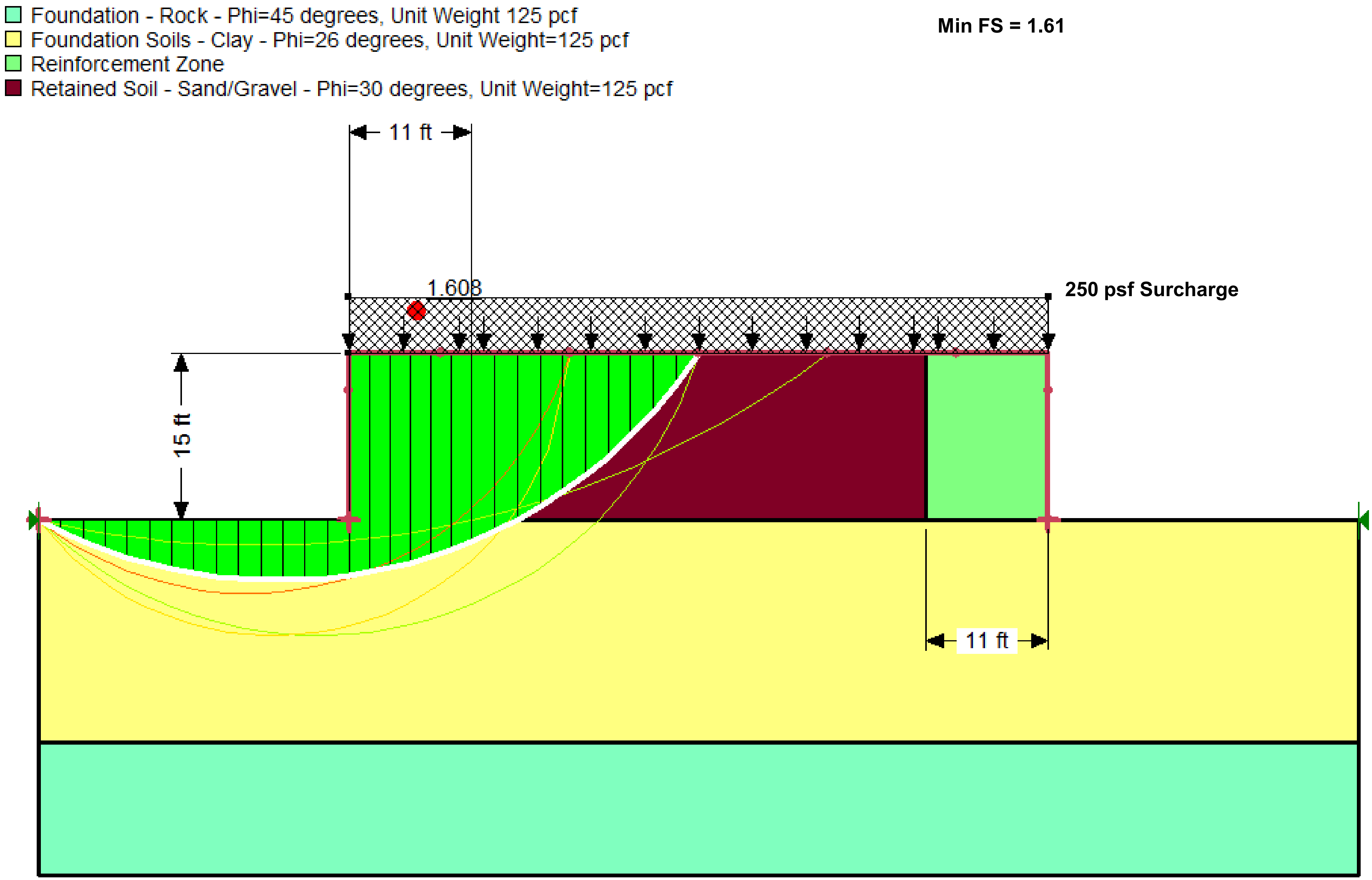
PAVETEX

Global Stability Analysis (H=15 ft)

Kohler's Crossing
Hays County, Texas

FIGURE
B-3

Dripping Springs\Results\Clients\HDR\Kohlers Crossing



SCALE: NTS

CHECKED BY: DT

PLOTTED BY: AA

DATE: 2020-10-02

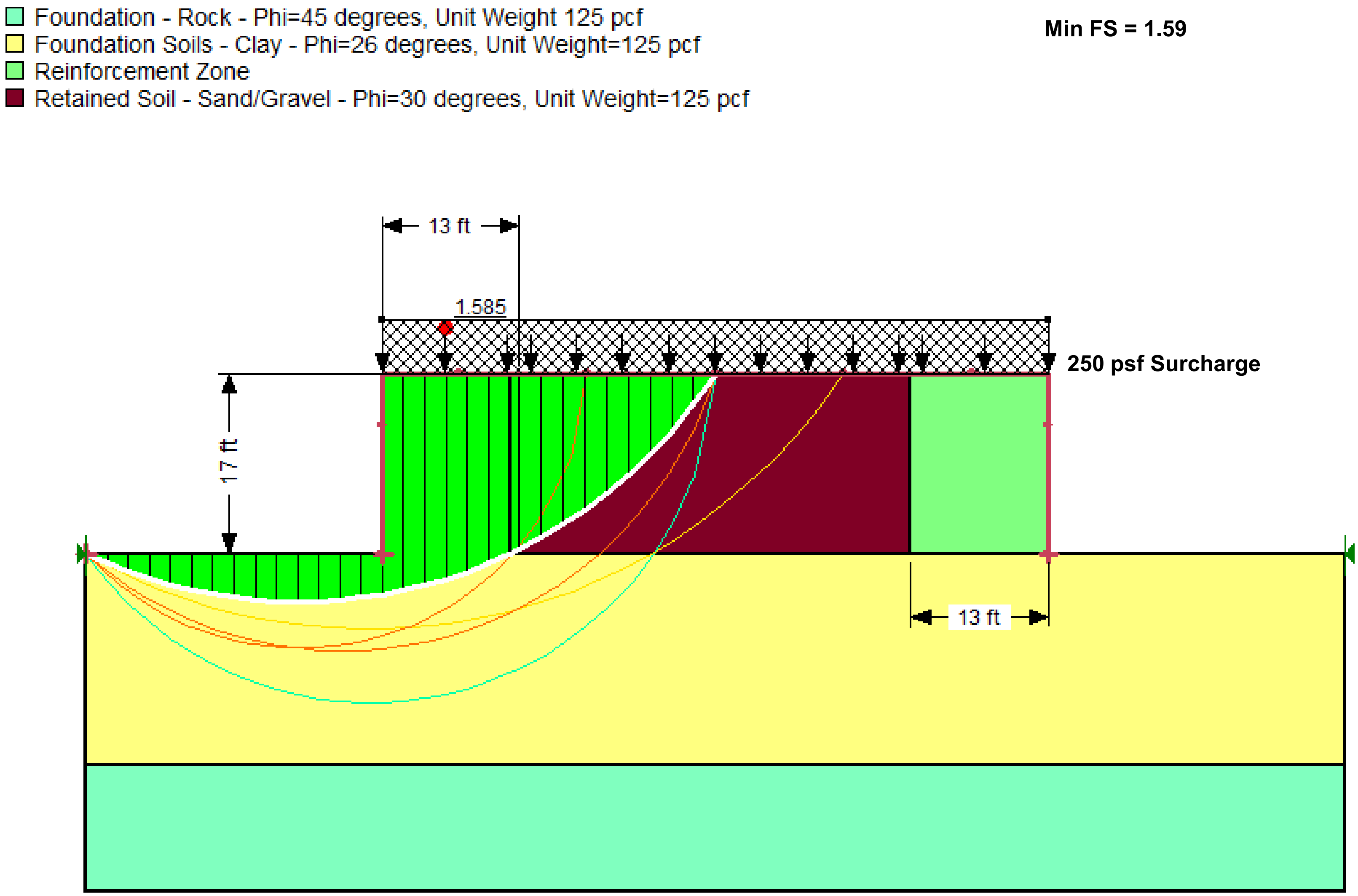
PAVETEX

Global Stability Analysis (H=15 ft)

Kohler's Crossing
Hays County, Texas

FIGURE B-3

Dripping Springs\Results\Clients\HDR\Kohlers Crossing



SCALE: NTS

CHECKED BY: DT

PLOTTED BY: AA

DATE: 2020-10-02

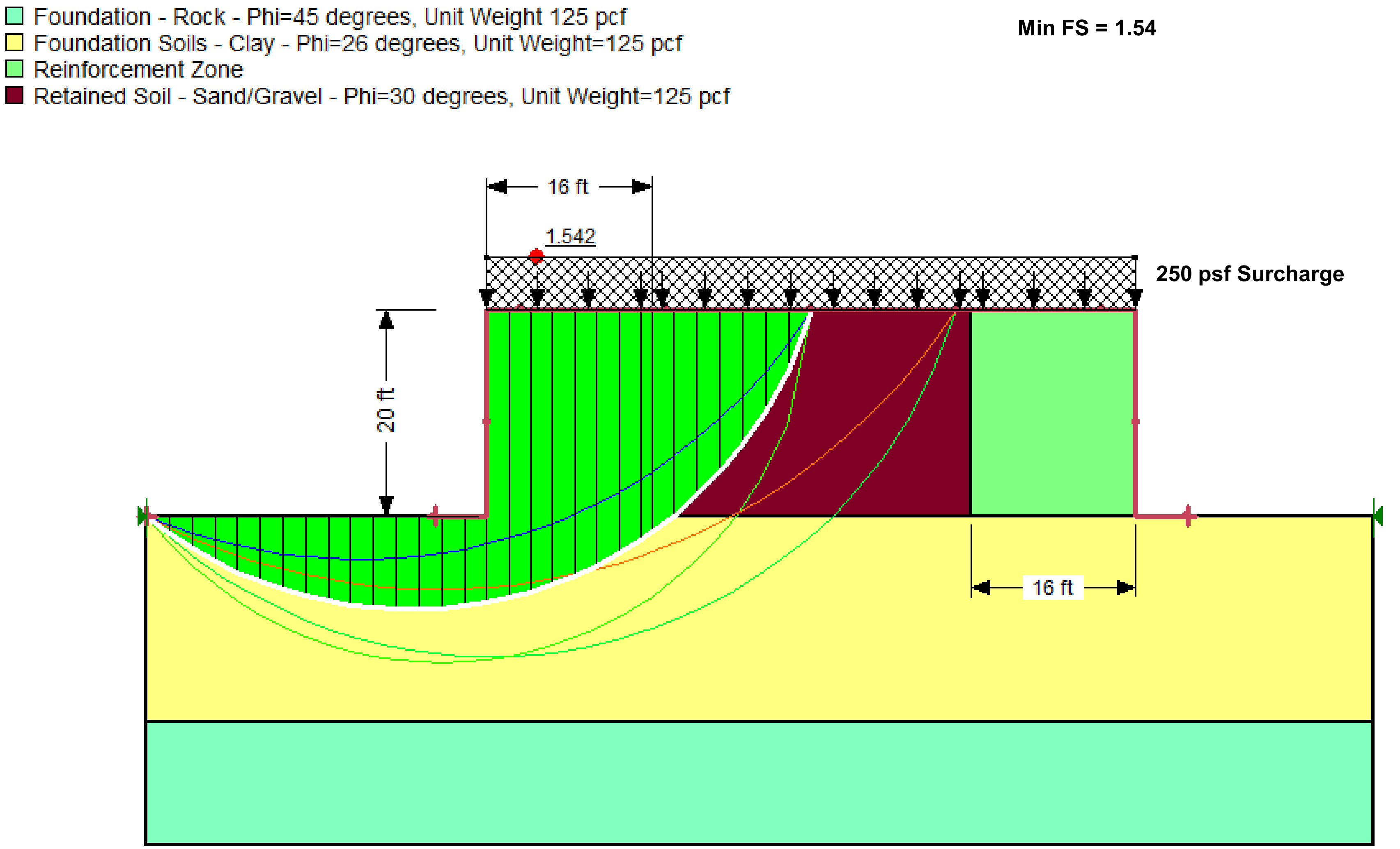
PAVETEX

Global Stability Analysis (H=17 ft)

Kohler's Crossing
Hays County, Texas

FIGURE
B-4

Dripping Springs\Results\Clients\HDR\Kohlers Crossing



SCALE:	NTS
CHECKED BY:	DT
PLOTTED BY:	AA
DATE:	2020-10-02

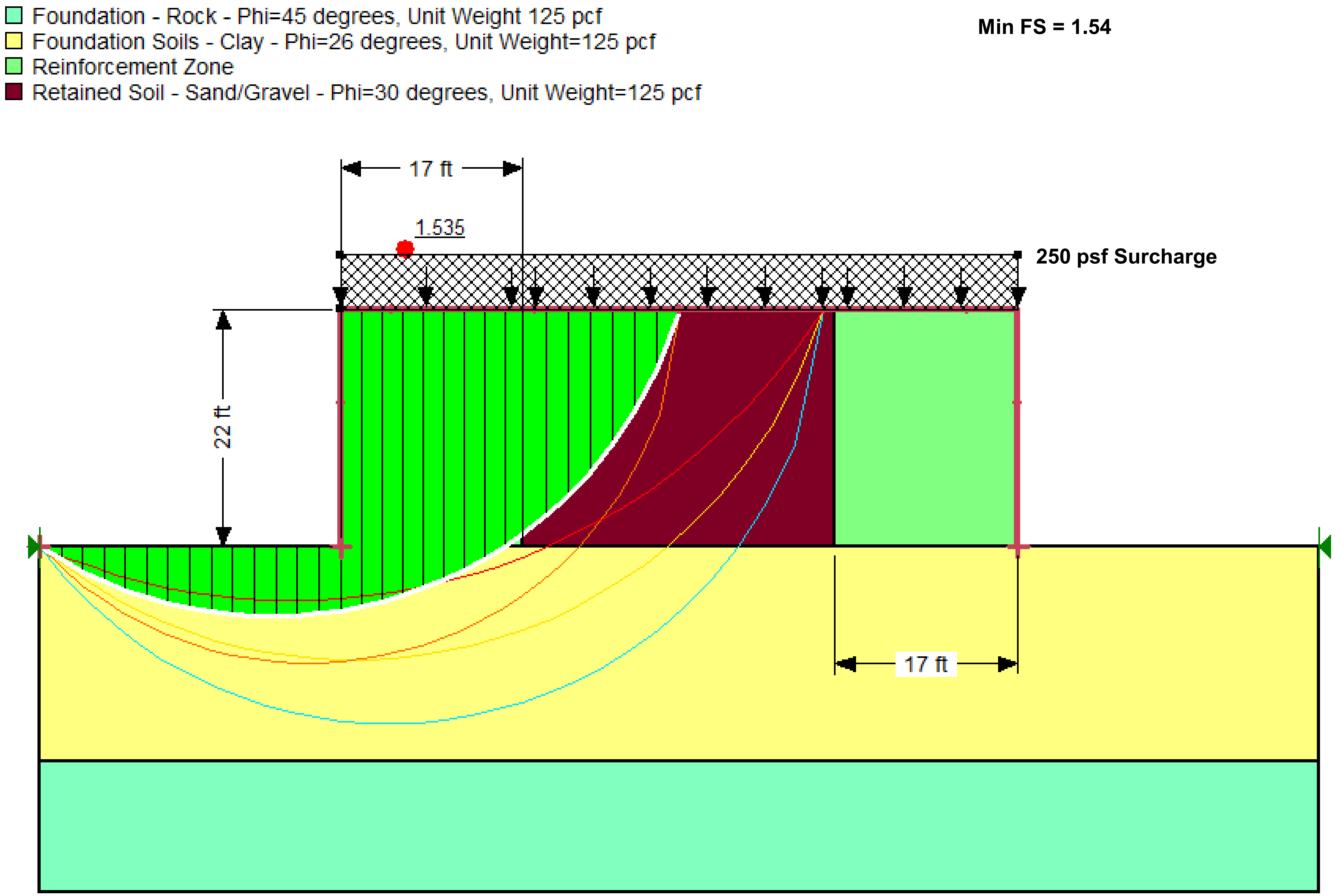
PAVETEX

Global Stability Analysis (H=20 ft)

Kohler's Crossing
Hays County, Texas

FIGURE
B-5

Dripping Springs\Results\Clients\HDR\Kohlers Crossing



SCALE: NTS

CHECKED BY: DT

PLOTTED BY: AA

DATE: 2020-10-02

PAVETEX

Global Stability Analysis (H=22 ft)

Kohler's Crossing
Hays County, Texas

FIGURE
B-6

Dripping Springs\Results\Clients\HDR\Kohlers Crossing