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GEO-TECHNICAL REPORT
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MEG GEOTECHNICAL ENGINEERING REPORT

PROPOSED
MONAHANS SANDHILLS STATE PARK RENOVATIONS

MONAHANS, WARD COUNTY, TEXAS

Geotechnical Engineering • Construction Materials Engineering & Testing
Environmental • Consulting • Forensics

GEOTECHNICAL ENGINEERING REPORT
FOUNDATION RECOMMENDATIONS
PROPOSED MONAHANS SANDHILLS STATE PARK RENOVATIONS
MONAHANS, WARD COUNTY, TEXAS

Prepared For
David Negrete, AIA
Principal and Partner
Negrete & Kolar Architects LLP

MEG Report No. 04-20-29110

August 21, 2020

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Subject: **Geotechnical Engineering Report**
MEG Report No. 04-20-29110
Foundation Recommendations
Proposed Monahans Sandhills State Park Renovations
Monahans, Ward County, Texas

Dear Mr. Negrete (CLIENT):

Millennium Engineers Group, Inc. is pleased to submit the enclosed geotechnical engineering report that was prepared for the above subject project. This report addresses the procedures and findings of our geotechnical engineering study. Our recommendations should be incorporated into the design and construction documents for the proposed development.

We want to emphasize the importance that all our recommendations presented in this report and/or addendums to this report be followed. We look forward to continuing our involvement in the project by providing construction monitoring in accordance with the report recommendations and materials testing services during construction. We strongly recommend that we be a part of the preconstruction meeting to address any specific issues that are pertinent to this project.

Thank you for the opportunity to be of service to you in this phase of the project and we would like the opportunity to assist you in the upcoming phases of the project. If you have any questions, please contact our office at the address, telephone, fax or electronic address listed below.

Cordially,
Millennium Engineers Group, Inc.
TBPE Firm No. F-3913

Amos Emerson, EIT

Dr. Thang Pham, Ph.D., P.E.

STATE OF TEXAS
RAUL PALMA
65656
LICENSED
PROFESSIONAL ENGINEER

Raul Palma, P.E.
President

The seal appearing on this document was authorized by Raul Palma, P.E. 65656 on August 21, 2020. Alteration of a sealed document without proper notification to the responsible engineer is an offence under the Texas Engineering Practice Act

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APPENDIX

1.0 INTRODUCTION

Millennium Engineers Group, Inc. (MEG) has completed and is pleased to submit this document that presents our findings as a result of a geotechnical engineering study of this project to our client. The project site is located approximately 800 feet to the north west on State Highway and Interstate 20 Frontage Road Intersection Park Road 41 located near the Monahans State Park Visitor Section in Monahans, Ward County, Texas. The project location is shown on the Project Location Map, found in the Appendix section of this report. This report briefly describes the procedures utilized during this study and presents our findings along with our recommendation, for foundation design and construction considerations.

Our scope of services for the project was outlined in MEG proposal No. 04-20-112G, dated July 7, 2020 and approved by David Negrete, AIA on July 7, 2020.

2.0 PROJECT DESCRIPTION

It is our understanding that the proposed site will accommodate the construction of a new restroom facility along with a pavilion area. It is also our understanding that the proposed State Park development will consist of a one (1) story structure. The site construction for the proposed restroom facility is anticipated to be on concrete pier foundation and the proposed pavilion structure is anticipated to be on a spread footing provided expansive soil related movements will not impair the performance of the structure.

3.0 SCOPE AND LIMITATIONS OF STUDY

This engineering report has been prepared in accordance with accepted geotechnical engineering practices currently exercised by geotechnical engineers in this area. No warranty, expressed or implied, is made or intended. This report is intended for the exclusive use by the client and client's authorized project team for use in preparing design and construction documents for this project only. This report may only be reproduced in its entirety for inclusion in construction documents. This report in its entirety shall not be reproduced or used for any other purposes without the written consent of our firm. This report may not contain sufficient information for purposes of other parties or other uses and is not intended for use in determining construction means and methods.

The recommendations presented in this report are based on data obtained from the soil borings drilled at this site and our understanding of the project information provided to us by our client and other project team members, and the assumption that site grading will result in only minor changes in the existing topography. Subsurface soil conditions have been observed and interpreted at the boring locations only.

This report may not reflect the actual variations of the subsurface conditions across the subject site. It is important to understand that variations may occur due to real geologic conditions or previous uses of the site. The nature and extent of variations across the subject site may not become evident until specific design locations are identified and/or construction commences. The construction process itself may also alter subsurface

conditions. If variations appear evident at the time during the design phase and/or construction phase, we should be notified immediately to determine if our opinions, conclusions and recommendations need to be reevaluated. It may be necessary to perform additional field and laboratory tests and engineering analyses to establish the engineering impact of such variations. These services are additional and are not a part of our project scope.

The engineering report was conducted for the proposed project site described in this report. The conclusions and recommendations contained in this report are not valid for any other project sites. If the project information described in this report is incorrect, is altered, or if new information becomes available, we should be retained to review and modify our recommendations. These services are additional and are not a part of our project scope.

Our scope of services was limited to the proposed work described in this report, and did not address other items or areas. The scope of our geotechnical engineering study does not include environmental assessment of the air, soil, rock or water conditions on or adjacent to the site. No environmental opinions are presented in this report. If the client is concerned with environmental risk at this project site, the client should perform an environmental site assessment.

If final grade elevations are significantly different from existing grades at the time of our field activities (more than plus or minus one (1) foot), our office should be informed about these changes. If desired, we will reexamine our analyses and make supplemental recommendations.

4.0 FIELD EXPLORATION PROCEDURES

Subsurface conditions at the subject site were evaluated by two (2) 40-foot soil borings and one (1) 20-foot soil borings. The Borings were drilled at the locations shown on the Borings Location Map, found in the Appendix section of this report. This location is approximate and distances were measured using a measuring wheel, tape, angles, and/or pacing from existing references. The structural soil borings were drilled in general accordance with American Society of Testing Materials (ASTM) D 420 procedures.

As part of our sampling procedures, the samples were collected in general conformance with ASTM D 1586 procedures. Representative portions of the samples were sealed in containers to reduce moisture loss, identified, packaged, and transported to our laboratory for subsequent testing. In the laboratory, each sample was evaluated and visually classified by a member of our Geotechnical Engineering staff. The geotechnical engineering properties of the strata were evaluated by a series of laboratory tests. The results of the laboratory and field-testing are tabulated on the boring logs and Summary of Soil Sample Analyses which are found in the Attachments section of this report.

Standard penetration test results are noted on the boring logs as blows per 12 inches of penetration. Three 6 inch increments are performed for each standard penetration test. The sum of the blows for the final two 6 inch increments is considered the "standard

penetration resistance value" or "N-value." Where hard or very dense materials were encountered, the tests are terminated as follows: (1) when a total of 50 blows have been applied in any of the 6 inch increments, or (2) when a total of 100 blows have been applied, or (3) when there is no observed advance of the sampler in the application of 10 successive blows. The boring logs in the case of hard or very dense materials will be noted as follows: 50/3", where 50 is the number of blows applied in 3 inches of penetration, or 100/7½" where 100 is the number of blows applied in a total of 7 ½ inches of penetration, or 10/0", where 10 is the number of blows applied in 0 inches of penetration.

Samples will be retained in our laboratory for 30 days after submittal of this report. Other arrangements may be provided at the request of the Client.

5.0 GENERAL SITE CONDITIONS

5.1 Site Description

The project site is located approximately 800 feet to the north west on State Highway and Interstate 20 Frontage Road Intersection Park Road 41 located near the Monahans State Park Visitor Section in Monahans, Ward County, Texas. The project location is shown on the Project Location Map, found in the Appendix section of this report. At the time of our field operations, the subject site can be described as a developed tract of land. The general topography of the site is rolling hills consisting of sand with a visually estimated vertical relief of more than 5 feet. Surface drainage is visually estimated to be fair.

5.2 Site Geology

According to the Soil Survey of Ward County, Texas, published by the United States Department of Agriculture – Soil Conservation Service, the project site appears to be located within the Kermit soil association.

- The Kermit series consists of very deep, excessively drained soils formed in eolian sands. Kermit soils are on sandy plains with slopes of 0 to 12 percent. Mean annual precipitation is about 12 inches and mean annual temperature is about 63 degrees F. The corresponding soil symbol is KD, Kermit-Dune land association hummocky.

5.3 Subsurface Conditions

On the basis of our borings, three (3) generalized strata that possess similar physical and engineering characteristics can describe the subsurface stratigraphy at this site. Table 5.1 summarizes the approximate strata range in our boring logs. These were prepared by visual classification and were aided by laboratory analyses of selected soil samples. The lines designating the interfaces between strata on the boring logs represent approximate boundaries. Transitions between strata may be gradual details for each of the borings can be found on the boring logs in the appendix of this report.

Table 5.1. Approximate Subsurface Stratigraphy Depths.

Stratum	Range in Depth, ft[1]	Stratum Description[1]
I	0 – 10	SAND, tan, dry, very loose to medium dense
II	10 – 20	SAND, tan to white, dry, medium dense
III	20 – 40	SAND, tan to white, dry, very dense

Note 1: The stratum thickness and depths to strata interfaces are approximate. Our measurements are rounded off to the nearest foot increment and are referenced from ground surface at the time of our drilling activities. Subsurface conditions may vary between the boring locations.

5.4 Groundwater Conditions

The dry auger drilling technique was used to complete the soil borings in an attempt to observe the presence of subsurface water. During our drilling operations we did not encounter the groundwater table below natural ground elevation for short term conditions. Moisture content test did not exhibit high moisture content below natural ground elevation and were classified as relatively dry. It should be noted that the groundwater level measurements recorded are accurate only for the specific dates on which measurement were obtained and does not show fluctuations throughout the year.

Fluctuations in Groundwater levels are influenced by variations in rainfall and surface water run-off from season to season. The construction process itself may also cause variations in the groundwater level. If the subsurface water elevation is critical to the construction process the contractor should check the subsurface water conditions just prior to construction excavation activities.

Based on the findings in our borings and on our experience in this region, we believe that groundwater seepage may not be encountered during site earthwork activities. If groundwater seepage is encountered during site earthwork activities, it may be controlled using temporary earthen berms and/or conventional sump-and-pump dewatering methods.

6.0 ENGINEERING ANALYSIS AND RECOMMENDATIONS

6.1 General

The analysis and recommendations presented in this report are applicable specifically to the proposed foundation structure. The data gathered from both the field and laboratory testing programs on soil samples obtained from the borings was utilized to establish geotechnical engineering parameters to develop recommendations for the proposed structure. The foundation system(s) considered in this report to provide support for the proposed structure must meet two independent criteria. One of the criteria is that the movement below the foundation structure due to compression (consolidation) or expansion (swell) of the underlying soils must be within tolerable limits. This criterion is

addressed in the Soil Related Movements section of this report. The other criterion is that the dead and live loads must be distributed appropriately and the foundation structure designed with an acceptable factor of safety to minimize the potential for bearing capacity failure of the underlying soils.

Geotechnical and structural engineers in this general area consider soil movements or Potential Vertical Rise (PVR) of approximately one (1) inch or less to be within acceptable structural design tolerances for most structures but may be different depending on structure use and the desired performance of the foundation. Therefore, movements of the underlying soils are not eliminated and thus one should expect a slab foundation structure to exhibit differential vertical movements. However, structural engineers design slab foundations for the expected magnitude of soil movements without failure of the structure. More stringent soil movement criteria may be established but the owner should consider the exponential increase in cost required to design and construct a structure for such soil movements. Data obtained in this study indicate that the soils at this site have strength characteristics capable of supporting the foundation and structure if designed appropriately. Stratum I, II, and III are composed of SAND and they have no potential to exhibit volumetric changes (contraction and expansion). The potential for soil volumetric changes is dependent on variations in moisture contents of the underlying soils. Based on this data, this site is suitable for a slab foundation provided the subgrade is modified in accordance with the recommendations established in this report to reduce the potential for these soil volumetric changes.

6.2 Soil-Related Movements

The anticipated ground movements due to swelling of the underlying soils at this site were estimated for slab foundation construction using the Texas Department of Transportation (TxDOT) procedures of test method TEX-124-E for determining Potential Vertical Rise (PVR). A PVR value of less than one (1) inch was estimated for the stratigraphic conditions encountered in our subsurface borings. A surcharge of 1 pound per square inch for the concrete slab, an active zone of 15 feet, and dry subsurface moisture conditions were assumed in estimating the above PVR values.

The following methods are generally acceptable for use in modifying the subgrade to reduce the potential for soil movements, volumetric changes, and to provide a stable platform below the foundation structure.

Excavate expansive clay soils and replace with select fill.
Chemical injection of expansive clay soils.
A combination of methods 1 and 2.

The method to be used is dependent on specific site conditions. As of the date of this report the CLIENT/OWNER has not provided the proposed FFE. We recommend that the project civil engineer evaluate the proposed FFE with our recommendations to ensure that the subgrade modifications presented in the report are not diminished or compromised. Adding select fill is generally the most cost effective method for reducing the potential for soil related movements and to provide a stable platform. Therefore, we

only discuss this method in this report but we can provide details for the other methods if requested.

Based on the data obtained, the assumed FFE of natural ground elevation, information provided by our client and our analysis of the site, we recommend the following modification (Table 6.1. Subgrade Modifications) of the subgrade at this area to accomplished finish floor elevation of the subgrade at this site. This method will maintain the potential for soil related movements to an approximate PVR value of less than one (1) inch, which is generally desired for projects of this type.

Table 6.1.a Subgrade Modifications (Restroom Building)

Item	Description
1	See and adhere to the Site Preparation Recommendations section of this report.
2	Excavate existing soils to a depth of four (4) feet below natural ground elevation in accordance with the Site Preparation Recommendations section of this report.
3	Condition and compact twelve (12) inches of subgrade below excavated soils in accordance with the Site Preparation Recommendations section of this report.
4	Place **select fill,** (for a total of four (4) feet select fill) condition and compact up to the proposed FFE in accordance with the Select Fill Recommendations section of this report.

Table 6.1.b Subgrade Modifications (Pavilion Area)

Item	Description
1	See and adhere to the Site Preparation Recommendations section of this report.
2	Excavate existing soils to a depth of two (2) feet below footing bearing elevation in accordance with the Site Preparation Recommendations section of this report.
3	Condition and compact twelve (12) inches of subgrade below excavated soils in accordance with the Site Preparation Recommendations section of this report.
4	Place **select fill,** (for a total of two (2) feet select fill) condition and compact up to the proposed footing bearing elevation in accordance with the Select Fill Recommendations section of this report.

The PVR method of estimating expansive, soil-related movements is based on empirical correlations utilizing the measured plasticity indices and assuming typical seasonal fluctuations in moisture content. If desired, other methods of estimating expansive, soil-related movements are available, such as estimations based on swell tests and/or soil-suction analyses. However, the performance of these tests and the detailed analyses of expansive, soil-related movements were beyond the scope of the current study. It should also be noted that actual movements can exceed the calculated PVR values as a result of isolated changes in moisture content (such as leaks, landscape watering, etc.) or if water seeps into the soils to greater depths than the assumed active zone depth due to deep trenching and/or excavations.

6.3 Flatwork Recommendations

The ground exposed near the proposed Restroom Building should be sloped away for at least 10 feet beyond the perimeter. As part of the structure's maintenance program, the grading around the building should be inspected, adjusted and verified for accuracy and effective drainage. Flatworks will be subjected to post construction movement. Maximum grades shall be utilized to avoid ponding of water. Concrete sidewalks and driveways thicknesses and reinforcement shall be completed as shown on the plans as prepared by others.

Table 6.2. Subgrade Modifications (Flatwork)

Item	Description
1	See and adhere to the Site Preparation Recommendations section of this report.
2	Flatwork placed shall be bedded with at least six (6) inches of **select fill** condition and compact up to the proposed FFE in accordance with the Select Fill Recommendations section of this report. The subgrade shall be excavated and shaped to the lines and grades shown on the plans as prepared by others.

6.4 Conventional Spread Footing Foundation Design Criteria

We recommend the following soil bearing pressures, and dimensional criteria for the pavilion. These recommendations ensure proper utilization of soil bearing capacity of continuous beam sections in the spread footing foundation and reduce the potential of water migration from the outside to beneath the foundation. For structural considerations foundation may need to be greater and should be evaluated and designed by the structural engineer. Where concentrated load areas are present the grade beams or slab may be thickened and widened to serve as spread footings. Soil bearing pressures dimensional criteria are as follows:

Table 6.3. Bearing Criteria (Pavilion Area)

Spread Footings (square)	
Minimum depth below finished grade:	24 inches
Maximum depth below finished grade:	36 inches
Maximum width:	60 inches
Maximum allowable bearing pressure:	2,400 psf

The above-presented maximum allowable bearing pressures will provide a factor of safety of 3 with respect to the design soil strengths. For a foundation structure designed and constructed in accordance with the recommendations of this report, it is anticipated that total settlements will be in the order of one (1) inch or less. If lower anticipated total settlements are required for this project further mitigation may be required and MEG must be consulted for further recommendations.

Furthermore, the above design parameters are contingent upon the fill materials (if utilized) being selected and placed in accordance with the recommendations presented in the Select Fill Recommendations section of this report. Should select fill selection and placement differ from the recommendations presented herein, MEG should be informed of the deviations in order to reevaluate our recommendations and design criteria.

Excavations for spread footing foundations should be performed relatively clean and with an undisturbed bearing area. The bottom 6 inches of the excavation should be performed using a flat plate excavation bucket. The excavations should be neatly excavated. No foreign debris or undisturbed soil should be left in the footing bottom. Should there be any abundance of foreign debris or disturbed soil found, it may be necessary to re-assess the fill site of its bearing capacity suitability. If the bearing area is found to be disturbed, the bearing area will require preparation and compaction for the entire depth of the disturbance in accordance with the Site Preparation and/or the Select Fill sections of this report.

The bearing surface of the spread footings should be evaluated after excavation and immediately prior to concrete placement. We recommend that footing inspections be performed by a representative of MEG. The required inspections shall include inspecting for clean, dry (The moisture content should be within limits specified by the appropriate section in this report.) and undisturbed footing bottom, depth of footing, clearances from sides and size and spacing of reinforcing steel. Test results shall comply with the recommendations of this geotechnical report and shall be verified by an on-site representative of MEG.

Over excavation, if necessary, for compacted backfill placement below footings should extend laterally beyond all edges of the footings at least 8 inches per foot of over excavation depth below footing base elevation. The over excavation should then be backfilled up to the footing base elevation select fill placed in lifts of 8 inches or less in loose thickness and prepared and compacted in accordance with the Site Preparation

and/or the Select Fill sections of this report. Equipment should not be operated and materials should not be placed or stockpiled within a horizontal distance equal to the excavation depth from the edge of the excavation. Excavations should not be placed next to existing structures or buried utilities/structures closer than a horizontal distance equal to the excavation depth unless some form of protection for the facilities is provided.

Water should not be allowed to accumulate at the bottom of the foundation excavation. Proper barriers such as berms or swales should be placed to divert any surface runoff away from excavations. To reduce the potential for groundwater seepage into the excavations and to minimize disturbance to the bearing area, we recommend that steel and concrete be placed as soon as possible after the excavations are completed, properly prepared and cleaned. Excavations should not be left open overnight.

6.5 Soil Properties

Lateral loads on the retaining wall structure may be resisted by passive earth pressure developed against the embedded portion of the foundation and by frictional resistance between the bottom of the wall and the supporting subgrade soils. For footings bearing on the sandy soils, a frictional coefficient of 0.35 may be used to evaluate sliding resistance developed between the gabion wall and the subgrade soil.

Table 6.4. Soil Friction Coefficient

Structure	Soil Friction Coefficient
Retaining Wall Structure	0.35

6.6 Lateral Earth Pressures

Presented below are at-rest, active and passive earth pressure coefficients for various backfill types adjacent to below-grade walls or site retaining walls. At-rest earth pressures are recommended in cases where little wall yield is expected (such as structural below-grade walls). Active earth pressures may be utilized in cases where the walls can exhibit a certain degree of horizontal movements (such as cantilevered retaining walls).

Table 6.5. Lateral Earth Pressures

Backfill Type	Estimated Total Unit Weight (pcf)	Angle of Internal Friction Ø, deg	Active Condition		Passive Condition		At rest Condition	
			Earth Pressure Coefficient K_a	Equivalent Fluid Density (pcf)	Earth Pressure Coefficient K_p	Equivalent Fluid Density (pcf)	Earth Pressure Coefficient K_o	Equivalent Fluid Density (pcf)
Washed Gravel	135	33	0.29	40	3.39	460	0.45	60
Crushed Limestone	145	38	0.24	35	4.20	610	0.38	55
Clean Sand	120	30	0.33	40	3.00	360	0.50	60

The above values do not include a hydrostatic or ground-level surcharge component. To prevent hydrostatic pressure build-up, retaining walls should incorporate functional drainage (via free-draining aggregate or manufactured drainage mats) within the backfill zone. The effect of surcharge loads, where applicable, should be incorporated into wall pressure diagrams by adding a uniform horizontal pressure component equal to the applicable lateral earth pressure coefficient times the surcharge load, applied to the full height of the wall. The structure walls should be designed for hydrostatic pressures if drainage cannot be provided. Ports/weepholes for release of hydrostatic pressure need to be provided during construction. The ports/weepholes should be filled with filter cloth to reduce the loss of soil fines.

The compactive effort should be controlled during backfill operations adjacent to walls. Over compaction can produced lateral earth pressures in excess of at-rest magnitudes. Compaction levels adjacent to walls should be maintained between 95 and 100 percent of standard proctor (ASTM D 698) maximum dry density.

All retaining walls shall be provided with a subdrain system in order to minimize the potential for hydrostatic pressure buildup behind the proposed retaining walls. A wall drain system (consisting of freely-drained aggregate or manufactured drainage mat, along with outlet piping) is recommended for collection and removal of surface water percolation behind the walls. Proper control of surface water percolation will help to prevent buildup of higher wall pressures. In unpaved areas, the final 12 inches of backfill should preferably consist of clayey soils to help reduced percolation of subsurface water in to the backfill.

The lateral earth pressures recommended above for retaining wall assume that a permanent drainage system will be installed so that external water pressure will not be developed against the walls. If a drainage system is not provided, the walls should be designed to resist an external hydrostatic pressure due to water in addition to the lateral earth pressure. We do not recommend that retaining walls be designed allowing hydrostatic pressure to build up because other factors such as bearing capacity and shear strength of the soils may be significantly impacted and slope stability compromised. It is also important that behind the retaining wall there exist no barriers to the free flow of moisture into and through the wall drain system.

6.7 Soil Erosion Factors

The analysis of soil erosion factors is crucial and to be considered along degraded hill slopes. Having a better understanding of the erosion of the soil will help mitigate the natural interventions of the project site. Better erosion control methods by shaping will minimize soil movement and unnecessary reshaping. The soil erosion factors that are considered are as follows: the K Factor (Rock Free) indicates erodibility of the fine-earth fraction, the K Factor (Whole Soil) indicates erodibility of the whole soil, the T Factor indicated the maximum average annual rate of soil erosion by wind and/or water, the Wind Erodibility Group rating that are the most susceptible to wind erosion, and the Wind Erodibility Index is a value of tons per acre per year that identifies the soil's susceptibility to wind erosion. **The soils at this site are considered low erodible by sheet or rill water erosion. On the other hand, the Wind Erodibility Group rating of 1 indicates that they surface soils are very susceptible to wind erosion as presented in the Erosion Factor Maps that are found in the Appendix section of this report.**

7.0 PIER FOUNDATION RECOMMENDATIONS

7.1 Straight Sided Concrete Piers

Items influencing the type of foundation selected for the proposed Monahans Sandhills State Park include the design axial and lateral foundation loads, the presence of poorly graded sand. More specifically, the final pier dimensions, particularly to include the required length of pier, will be determined based on the foundation design loads, the depth of the active zone, the potential uplift force imposed by the soils within the active zone and the available side friction capacity and end bearing capacity allotted to the subsurface stratigraphy. Straight-sided piers bearing at a minimum elevation of 15 feet below natural ground may support vertical loads for the proposed structure**. The poorly graded sand at this site may require that the concrete piers to be placed with steel casing to prevent collapse of the shaft boring walls.** Based on our depth of exploration at an elevation of approximately 40 feet below natural ground and the type of structures, pier depths should not exceed a depth of 35 feet below natural ground. The allowable capacities are provided in an attachment in the Appendix section of this report, titled *Allowable Axial Capacity*. For straight sided piers, the contribution of the soils for the top 5 feet of soil embedment and for a length equal to at least 1 pier diameter from the bottom of the shaft should be neglected in the determination of friction capacity. The recommended design parameters include a factor of safety of 2 for skin friction and of 3 for end bearing. The minimum embedment depth was selected to locate the pier base within a specified desired bearing stratum. If the piers are subject to water action, scour may occur. If this is the case, the pier length should be referenced from the level of the maximum scour depth. Likewise, the LPILE analysis should neglect the contribution of soils down to the maximum scour depth.

7.2 Uplift Forces

Within the active zone the concrete piers may be subjected to potential uplift forces. Alternate drying and wetting conditions of the expansive soils surrounding the concrete pier create these uplift forces. The uplift force acting on the piers may be estimated by the following relationship:

Uplift force (tons) = 0.0 x shaft diameter (feet) (with subgrade modifications)

Other uplift forces due to other factors may need to be taken into consideration.

7.3 Allowable Uplift Resistance

The potential uplift forces that may be created by the swelling soils may be resisted by the dead load of the concrete pier plus the allowable uplift resistance provided by the friction between the soil and pier interface. The allowable uplift resistance are provided in an attachment in the Appendix section of this report, titled *Allowable Uplift Resistance*. These values have been estimated with a factor of safety of two (2). Design requirements for reinforcing and for pier penetration derived from compression or uplift loading for the structure is usually sufficient to overcome any effects of expansive soils. However, we recommend that the cross sectional area of the reinforcing steel should not be less than one (1) percent of the gross cross sectional area of the drilled pier shaft. The reinforcing steel should extend from the top to the bottom of the shaft to resist axial tension forces. The final reinforcing requirements should be determined by the project structural engineer.

7.4 Pier Lateral Criteria

Lateral pile analysis including capacity, maximum shear, and maximum bending moment should be evaluated by the project structural engineer using LPILE or similar software. In the following table, MEG presents geotechnical input parameters for the encountered soils. Please note that the depths to the top and bottom of each layer were interpreted using the data at the explored boring locations and layer boundaries as shown on the boring logs:

Table 7.1. Drilled Pier Geotechnical Input Parameters for LPILE Analysis

Depth	Material	Y_e	C_u	Φ	K	e_{50}
0 to 5	SAND	Neglect contribution				
5 to 10	SAND	115	-	29	K=25	-
10 to 20	SAND	120	-	31	K=90	-
20 to 35	SAND	125	-	37	K=225	-

Where: Y_e = Effective Soil Unit Weight, pcf
C_u = Undrained Soil Shear Strength, psf
Φ = Undrained angle of internal friction, degrees
e_{50} = 50% strain value
K = Modulus of subgrade reaction, pci
Ks= Modulus of subgrade reaction (static loading), pci
Kc= Modulus of subgrade reaction (cyclic loading), pci

7.5 Spacing for Concrete Piers

Concrete pier spacing should be at least three (3) shaft diameters from edge to edge to eliminate any reduction in load carrying capacity of the individual piers.

When utilizing a pier group and the pier spacing is less than three (3) times the pier diameter from edge to edge, the following reduction factors for bearing capacity and skink friction shall apply:

- The minimum recommended pier spacing shall be one and a half (1.5) times the pier diameter from edge to edge. The reduction factor for this spacing is 0.5.
- The reduction factor for pier spacing less than three (3) times the pier diameter but more than one and a half (1.5) times the pier diameter from edge to edge shall be linearly interpolated from the reduction factor values provided herein.

For straight-sided concrete piers, the total settlements based on the bearing pressures are estimated to generally be in the order of one (1) inch or less for properly designed and constructed drilled piers. At this site, the underlain soils exhibit low shear strengths and potential settlements can best be estimated when site grading, foundation dimensions and loads have been established. Most of the settlement beneath each individual pier should occur during the construction phase. Differential settlement between piers can be expected and should be in the order of 50 to 75 percent of the total pier settlement. For properly designed and constructed piers we estimate the differential settlement between adjacent piers to be in the order of three-fourths (¾) of an inch. A detailed estimate of settlement is outside the scope of this service report. The quality of construction will affect the settlement process of drilled piers more than the soil-structure interaction. Poor drilled pier construction could result in settlements significantly higher than what we have estimated in this report. Utilizing soil-bearing pressures higher than

the allowable values presented in this report can also produce significantly higher settlements at individual piers and differential settlement between adjacent piers.

7.6 IBC Site Classification and Seismic Design Coefficients

Section 1613 of the International Building Code (2012) requires that every structure be designed and constructed to resist the effects of earthquake motions, with the seismic design category to be determined in accordance with Minimum Design Loads for Buildings and Other Structures / ASCE 7. Site classification according to the ASCE 7 is based on the soil profile encountered to 100-foot depth. The stratigraphy at the site location was explored to a maximum of 40-foot depth as per Client scope of services for this study. Site classification is based on the available information from this study.

On the basis of the site class definitions included in ASCE 7, Table 20.3-1 and the encountered generalized stratigraphy, we characterize the site as Site Class D.

Seismic design coefficients were determined using the on-line software, OSHPD Seismic Design Maps accessed at (http://seismicmaps.org). Analyses were performed considering the 2012 International Building Code. Input included zip code 79756 and Site Class C. Seismic design parameters for the site are summarized in the following table:

Table 7.2. IBC Site Classification and Seismic Design Coefficients

Site Classification	F_a	F_v	S_s	S_1
D	1.6	2.4	0.167g	0.041g

Where:

F_a = Site coefficient
F_v = Site coefficient
S_s = Mapped spectral response acceleration for short periods
S_1 = Mapped spectral response acceleration for a 1-second period

7.7 Global Slope Stability Analysis

Global slope stability analysis was completed for the Monahan State Park Renovations proposed restroom facility that is anticipated to be on concrete pier foundation. The basis of this analysis is to determine the factor of safety such that the soil mass must be safe against slope failure on any surface across the slope. The global stability of the slope in this project was performed using Plaxis 2D software through the finite element method (FEM). Soil strength parameters used for the evaluation of the global stability were through the soil characteristics where correlations were made. In accordance with TxDOT 2020 Geotechnical Manual Section 2 for global stability of a slope, a minimum factor of safety of 1.3 is required for both the long-term drained condition and the short term undrained condition, for slope or walls that support abutment, buildings, critical utilities, or for other low tolerance failure, a minimum factor of safety of 1.5 is to be utilized. **The factor of safety for the slope was determined to be 2.7. Slope stability analysis**

figures representing the configuration of the project site slope, the total deformation, soil movement direction, and factor of safety for critical condition of a slope are found in the Appendix section of this report.

8.0 CONSIDERATIONS DURING CONSTRUCTION

8.1 Site Grading Recommendations

Site grading plans can result in changes in almost all aspects of foundation recommendations. We have prepared the foundation recommendations based on the existing ground surface; there is no surcharge addition for the stratigraphic conditions encountered at the time of our study. If site grading plans differ from existing grades by more than plus or minus 1 foot, we must be retained to review the site grading plans prior to bidding the project for construction. This will enable us to provide input for any changes in our original recommendations that may be required as a result of site grading operations or other considerations.

8.2 Site Drainage Recommendations

Drainage is one of the most important aspects to be addressed to ensure the successful performance of any foundation. Positive surface drainage should be implemented prior to, during and maintained after construction to prevent water ponding at or adjacent to the building facilities. It is recommended that the building and site design include rain gutters, downspouts and concrete gutters to channel runoff to paving or storm drains.

8.3 Site Preparation Recommendations

Building areas and all area to support select fill should be stripped of all vegetation and organic topsoil up to a minimum of 5 ft. beyond the building perimeters. After stripping, remove at least six (6) inches of on-site soil as measured from existing grade when excavation of existing subgrade is not recommended in other sections of this report. The excavated material, if free of organic and/or deleterious material, may be stockpiled for use in the non-structural areas of the site. Where excavation of the subgrade is recommended in this report, the bottom of the excavation will extend at least five (5) feet beyond the limits of the planned building perimeter including canopies and sidewalks. Exposed subgrades should be thoroughly proof rolled in order to locate and compact any weak, compressible and soft spots. Proof rolling shall be in accordance with TxDOT 2014 Specification Item 216. Proof rolling operations should be observed by the Geotechnical Engineer or his representative to document subgrade condition and preparation. Weak or soft areas identified during proof rolling or areas where large tree roots have been removed within the limits of excavation should be removed and replaced with a suitable, compacted select fill in accordance with the recommendations presented under the Select Fill Recommendations section of this report. Proof rolling operations and any excavation/backfill activities should be observed by **MEG** representatives to document subgrade preparation.

Prior to fill placement, the exposed subgrade shall be prepared based on what option is selected from the foundation and pavement recommendations. The exposed subgrade should be prepared, moisture-conditioned by scarifying to a minimum depth as recommended in the foundation and pavement recommendations and recompacting to a minimum 98 percent of the maximum dry density as determined in accordance with ASTM D 698, moisture-density relationship. The moisture content of the subgrade should be maintained within the range of minus two (-2) percentage points below optimum to plus two (+2) percentage points above the optimum moisture content until the fill is permanently covered. The soil should be properly compacted in accordance with these recommendations and tested by **MEG** personnel for compaction as specified.

8.4 Select Fill Recommendations

Materials used for select fill shall meet the following requirements:

1. Material shall conform to TxDOT 2014 Specification Item 247, Flexible Base; Type A, Grades 1 through 3.

Select fill shall be placed in loose lifts not to exceed 8 inches (6 inches compacted) and compacted to a minimum 98 percent of the maximum dry density as determined in accordance with ASTM D 1557. The moisture content of the fill shall be maintained within the range of minus two (-2) percentage points below optimum to plus two (+2) percentage points above the optimum moisture content until the fill is permanently covered. The select fill should be properly compacted in accordance with these recommendations and tested by **MEG** personnel for compaction as specified.

8.5 Drainage Rock Backfill Recommendations

Materials used for rock backfill shall meet the following requirements:

2. Material shall conform to TxDOT 2014 Specification Item 423, Retaining Walls Backfill; Type DS.

Backfill shall be placed in loose lifts not to exceed 10 inches (8 inches compacted) and compacted to a minimum 98 percent of the maximum dry density as determined in accordance with ASTM D 698. The moisture content of the fill shall be maintained within the range of minus two (-2) percentage points below optimum to plus two (+2) percentage points above the optimum moisture content until the fill is permanently covered. The select fill should be properly compacted in accordance with these recommendations and tested by **MEG** personnel for compaction as specified.

8.6 Site Fill Recommendations

Site fill shall be placed in loose lifts not to exceed 8 inches (6 inches compacted) and compacted to a minimum 95 percent of the maximum dry density as determined in accordance with ASTM D 698. The moisture content of the fill shall be maintained within the range of minus two (-2) percentage points below optimum to plus two (+2) percentage

points above the optimum moisture content until the fill is permanently covered. The site fill should be properly compacted in accordance with these recommendations and tested by **MEG** personnel for compaction as specified.

8.7 Back Fill Recommendations

Back fill shall be placed in loose lifts not to exceed 8 inches (6 inches compacted) and compacted to a minimum 98 percent of the maximum dry density as determined in accordance with ASTM D 698. The moisture content of the fill shall be maintained within the range of minus two (-2) percentage points below optimum to plus two (+2) percentage points above the optimum moisture content until the fill is permanently covered. The back fill should be properly compacted in accordance with these recommendations and tested by **MEG** personnel for compaction as specified.

8.8 Utility Considerations

Utilities that project through the slab-on-grade, slab-on-fill, floating floor slabs, or any other rigid unit should be designed with some degree of flexibility or with sleeves. Such features will help reduce the risk of damage to utility facilities from soil movements related to shrinkage and expansion.

8.9 Utility Trench Recommendations

Bedding and initial backfill are buried around utility lines to support and protect the utility. The secondary backfill above the initial backfill also helps protect and support the foundation and/or pavement above. To ensure that settlement is not excessive in this secondary backfill we recommend the following:

1) If possible, trench and install utilities prior to work such as lime treatment and/or compaction of subgrade or placement of other fills or bases.
2) Place, moisture condition and compact the secondary backfill in accordance with the pertinent project requirements. Within the footprint of a building pad the secondary backfill should meet the same compaction requirements for select fill. Within the footprint of a pavement structure the secondary backfill should meet the same compaction requirements for the subgrade. When compaction of the subgrade is not specified it should meet the same compaction level of the adjacent natural ground. An alternative to compaction of secondary backfill is the use of flowable fill where secondary backfill is to be placed. If properly designed, the flowable fill can be excavated easily at a later date if necessary. No compaction and no testing is required when properly designed flowable fill is used.

8.10 Excavation, Sloping and Benching Considerations

The soils encountered in the borings can easily be excavated using conventional earthwork equipment. No major hard soil and/or rock units were encountered in the borings through completion depth. In the case that excavations occur through granular

soil or submerged soils it will be necessary to either slope the excavation sidewalls or provide temporary bracing to control excavation wall instability.

The side slopes of excavations through the overburden soils should be made in such a manner to provide for their stability during construction. Pipe lines or other facilities which are constructed prior to or during the currently proposed construction and which require excavation should be protected from loss of end bearing or lateral support.

Temporary construction slopes and/or permanent embankment slopes should be protected from surface runoff water. Site grading should be designed to allow drainage at planned areas where erosion protection is provided instead of allowing surface water to flow down unprotected slopes.

Permanent slopes at the site should be as flat as practical to reduce creep and occurrence of shallow slides. The following slope angles are recommended as maximums. The presented angles refer to the total height of a slope. Site improvement should be maintained away from the top of the slope to reduce the possibility of damage due to creep or shallow slides.

Table 8-1. Slopes Angles Requirements

Height (ft.)	Horizontal to vertical
0 – 3	1:1
3 – 6	2:1
6 – 9	3:1
>9	4:1

The contractor or persons doing the trenching should adhere to the current Occupational Health and Safety Administration (OSHA) guidelines on trench excavation safety and protection measures. Other industry standards may be applicable. The collection of specific geotechnical data and development of a plan for trench safety, sloping, benching or various types of temporary shoring, is beyond the scope of this study.

Benching

Benches shall be excavated per Figure 9.1 into the existing slope to allow for proper compaction. Bench widths shall be a minimum of 5 feet in width. Proposed slopes shall be no greater than 1 unit vertical in 5 units horizontal (20% slope). Benches shall be spaced consecutively. Bench heights shall not exceed the lesser of one-half the bench width, or 10 feet. Placement of the soils shall be conditioned and compacted in accordance with the select fill recommendations of the report.

Keying

Benches shall have a key at the toe of the slope where the slope height exceeds 5 feet or the slope is greater than 1-unit vertical in 5 units horizontal (20% slope). The key shall be a minimum depth of 2 feet and a length not less than 10 feet.

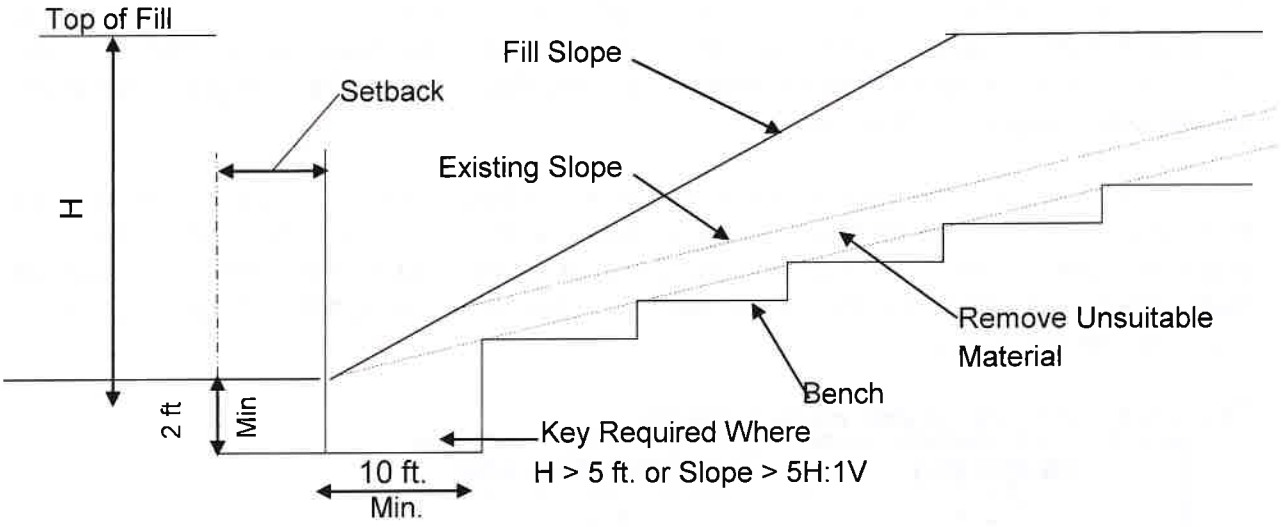


Figure 8.1 Benching Detail

Setbacks

General: Excavation and fill slopes shall be set back from the site boundary in accordance with this section. Setback dimensions shall be measured horizontally, and shall be perpendicular to the site boundary.

Top of excavation slope: The top of excavation slopes shall be set back from the site boundary not less than one-fifth the vertical height of the slope, but not less than 2 feet and need not to exceed 10 feet.

Toe of fill slope: The toe of fill slopes shall be set back from the site boundary not less than one-half the vertical height of the slope, but not less than 2 feet but need not exceed 20 feet.

8.11 Shallow Foundation Excavation Considerations

The Geotechnical Engineer or his representative prior to the placement of reinforcing steel and concrete should observe shallow foundation excavations. This is necessary to verify that the bearing soils at the bottom of the excavations are similar to those encountered during the subsurface soil exploration phase and that excessive loose materials and water are not present in the excavations. If soft pockets of soil are

encountered in the foundation excavations, they should be removed and replaced with a compacted non-expansive fill material or lean concrete up to the design foundation bearing elevation.

8.12 Pier Excavation Considerations

The following general considerations are important to ensure that the drilled piers are properly constructed. Pier excavations should be augured and constructed in a continuous process from beginning to end. Steel and concrete are to be placed in the pier excavation immediately after drilling and evaluation for proper bearing, embedment and cleanliness. Under no circumstances should a pier excavation remain open overnight. We recommend monitoring of installation by a representative of **MEG.**

We recommend that the foundation contractor verify the subsurface water level prior to beginning pier excavation. We recommend that he be prepared to control water intrusion and sloughing of soils into the pier excavation should these conditions occur. Typically the methods available to control these conditions are the casing method, slurry displacement method or a combination of the two. We recommend that the foundation contractor submit a plan for approval by the designer for the construction of concrete piers outlining and including proposed methods of excavation, preparations for dealing with ground water and sloughing, slurry methods and type (mineral or polymer), methods of cleaning excavation, methods for concrete placement and other procedures or materials important to the successful construction and performance of a drilled pier.

If water is encountered during the drilling operations in excess of 6 inches it should be pumped out prior to steel and concrete placement. If the water is left, a closed end tremie should be used to place the concrete completely to the bottom of the pier excavation in a controlled manner to properly displace the water. If water is not present, the concrete should be placed with a tremie if the free fall distance exceeds five (5) feet. The concrete should not be placed in a manner that causes the concrete to hit the excavated pier walls or reinforcing steel. Removal of casing should be done with extreme care and with proper supervision. Rapid removal of the casing can cause mixing of surrounding soil with the fresh concrete and/or develop a suction that will cause soil to intrude into the concrete pier and thus reduce its effective diameter and/or expose its reinforcement. An insufficient head of concrete in the casing during withdrawal could also cause the same conditions.

For this project we recommend that the concrete should be designed to achieve a minimum 28-day compressive strength of 3600 psi when placed at a seven (7) inch slump with a plus or minus one (1) inch tolerance. The concrete should be designed to meet the requirements of Texas Department of Transportation 2014 Standard Specification Item 421, Class C or SS concrete or American Concrete Institute (ACI) 318-11 – Building Code Requirements for Structural Concrete. If a high range water-reducing admixture is used to achieve the slump requirements, a span of slump retention should be thoroughly investigated for the concrete design to be used. Compatibility with other concrete admixtures should also be considered. We

recommend that a technical representative of the admixture supplier be consulted with the use of these admixtures.

The concrete pier design and construction should be performed as discussed in this report and as described in the publications entitled: ACI 336.1 – 98 Standard Specification for the Construction of Drilled Piers, ACI 336.3R-93 Suggested Design and Construction Procedures for Pier Foundations, Drilled Shafts: Construction Procedures and Design Methods by Michael W. O'Neill and Lymon C. Reese, Publication No. FHWA-IF-99-025, August 1999 and Texas Department of Transportation 2014 Standard Specification Item 416 for Dilled Shaft Foundations. Concrete pier construction should be carefully monitored to ensure that the construction activities comply with the project specifications. The following items in particular among others need to be considered during the concrete pier construction process.

1. Proper drilling rig with proper equipment (including augers, casing, slurry holding tanks with appurtenances);
2. Pier locations, vertical alignment, competent bearing;
3. Reinforcing steel cages tied to meet project specifications;
4. Proper scheduling and ordering of concrete;
5. Concrete properties and placement, steel placement;
6. Proper casing seal for subsurface water control, proper slurry properties and proper casing removal; and
7. Monitoring of installation by a representative of **MEG.**

8.13 Landscaping Considerations

Even though landscaping is a vital aesthetic component of any project, the owner, client and design team should be aware that placing trees or large bushes adjacent to any structure may distress the structure in the future. It is recommended that if any landscaping is to be placed adjacent to the structure in this project, it should be limited to small plants and shrubs. Trees and large bushes should be placed at a distance such that at their mature height, their canopy or "drip line" does not extend over the structures. The owner, client and design team should also be aware that if any watering is to be done in connection with the landscaping for this project it should be controlled, consistent and timely. Excessive or prolonged watering is not recommended. If watering is part of the landscaping plan, termination of watering for any extended period of time may also be detrimental to the structure. It is important that the moisture level in the subsurface soils remain constant so that shrinking and swelling of soils may be mitigated.

8.14 Perimeter Foundation Cap

We recommend that a cap of impervious fill be placed around the perimeter of the foundation to mitigate the intrusion of moisture into the soils surrounding the foundation. The top eighteen inches of fill around the foundation structure should be a low permeance clay cap to keep surface water away from the foundation. The low permeance clay cap should be sloped away from the foundation at a minimum slope of 2% and the surrounding areas should have positive drainage. The low permeance clay shall meet the USCS classification of CL and meeting the requirements in Tables 7.2 Gradation Requirements

and Table 7.3 Atterberg Limits Requirements. The low permeance clay shall be compacted to minimum of 95 percent of the maximum dry density as determined in accordance with ASTM D 698. The moisture content of the subgrade should be maintained within the range of optimum to four (4) percentage points above the optimum moisture. If plantings are intended, add 4 to 6 inches of loam on top of the clay cap.

Table 8.2. Gradation Requirements

Sieve Size	Percent Passing (by dry weight)
1/2 inch	100
No 4	70-100
No. 200	50 – 100

Table 8.3. Atterberg Limits Requirements

Test / ASTM	Requirement
Atterberg Limits D4318	LL ≤ 45 20 ≤ PI ≤ 30

9.0 PROJECT REVIEW AND QUALITY CONTROL

Each project site is unique and it is important that the appropriate design data, construction drawings, specifications, change orders and related documents be reviewed by the respective design and construction professionals participating in this project. The performance of foundations, construction building pads and/or parking areas for this project will depend on correct interpretation of our geotechnical engineering report and proper compliance of and adherence to our geotechnical recommendations and to the construction drawings and specifications.

It is important that **MEG** be provided the opportunity to review the final design and construction documents to check that our geotechnical recommendations are properly interpreted and incorporated in the design and construction documents. We cannot be responsible for misinterpretations of our geotechnical recommendations if we have not had the opportunity to review these documents. This review is an additional service and not part of our project scope.

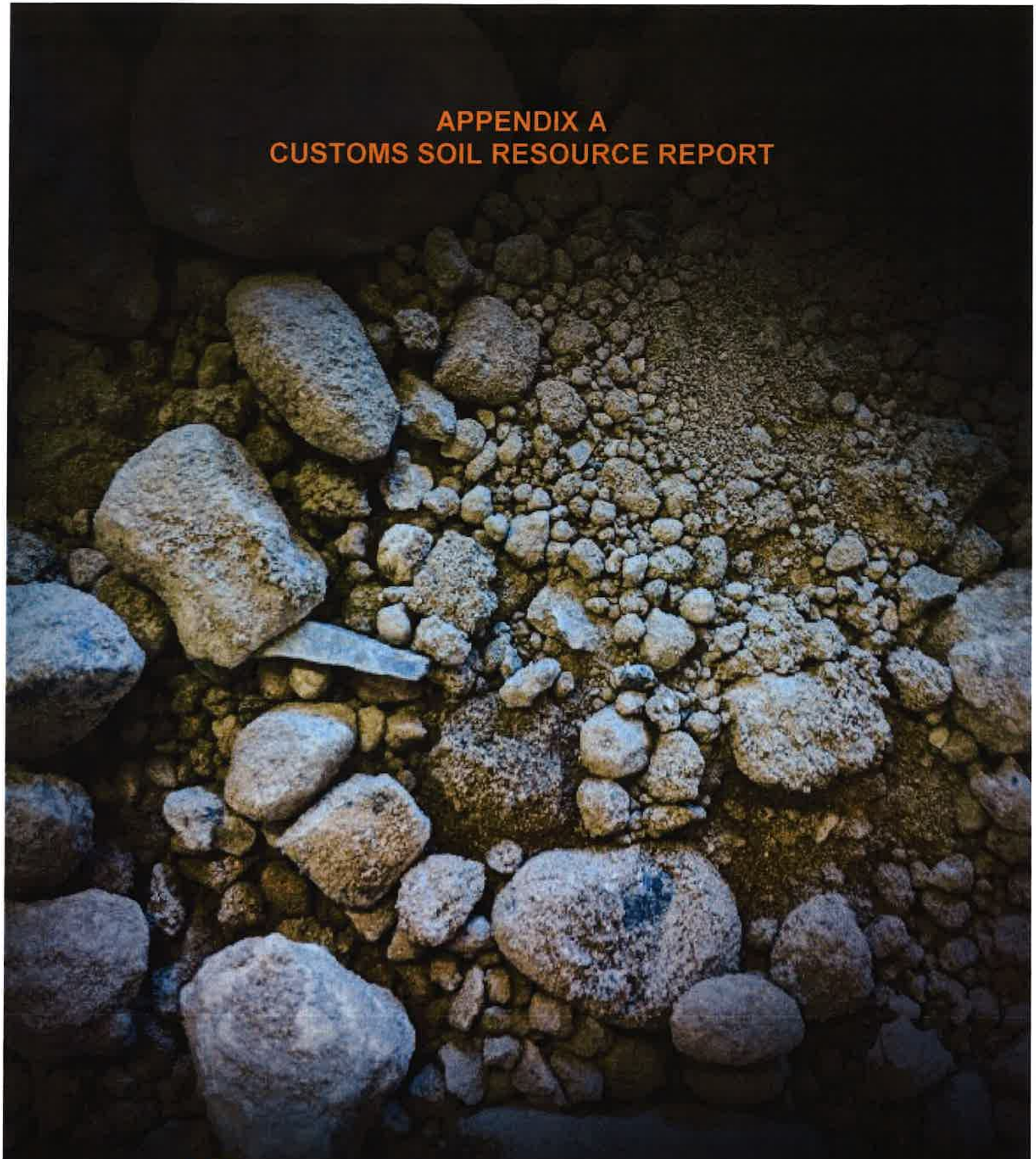
MEG should be retained to provide construction materials testing and observation services during all phases of the construction process of this project. As the Geotechnical Engineer of Record, it is important to let our technical personnel provide these services to make certain that our recommendations are interpreted properly and to ensure that actual field conditions are those described in our geotechnical report. Since our personnel are familiar with this project, **MEG**'s participation during the construction phase of this project would help mitigate any problems resulting from variations or anomalies in subsurface conditions, which are among the most prevalent on construction projects and

often lead to delays, changes, costs overruns, and disputes. If the client does not follow all of our recommendations presented in this report and/or addendums to this report, the client assumes the responsibility and liability of such actions and will hold our firm harmless and without responsibility and liability for client's actions.

A construction testing frequency plan and budget needs to be developed for the required construction materials engineering and testing services for this project. Before construction, we recommend that **MEG**, the project design team members and the project general contractor meet and jointly develop the testing plan and budget, as well as review the testing specifications as it pertains to this project. **A failure to implement a complete testing plan will negate the recommendations provided in this report.**

MEG looks forward to the opportunity to provide continued support on this project.

APPENDIX A
CUSTOMS SOIL RESOURCE REPORT



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1601 Rutherford Lane, Ste A100 ■ Austin, Texas 78754 ■ 956-702-8500

Soil Map—Ward County, Texas
(04-20-29110 proposed Monahans Sandhills State Park)

Map Scale: 1:861 if printed on A landscape (11" x 8.5") sheet.

N

Meters
0 10 20 40 60

Feet
0 40 80 160 240

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N 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 1:24,000.

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: Ward County, Texas
Survey Area Data: Version 19, Jun 11, 2020

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

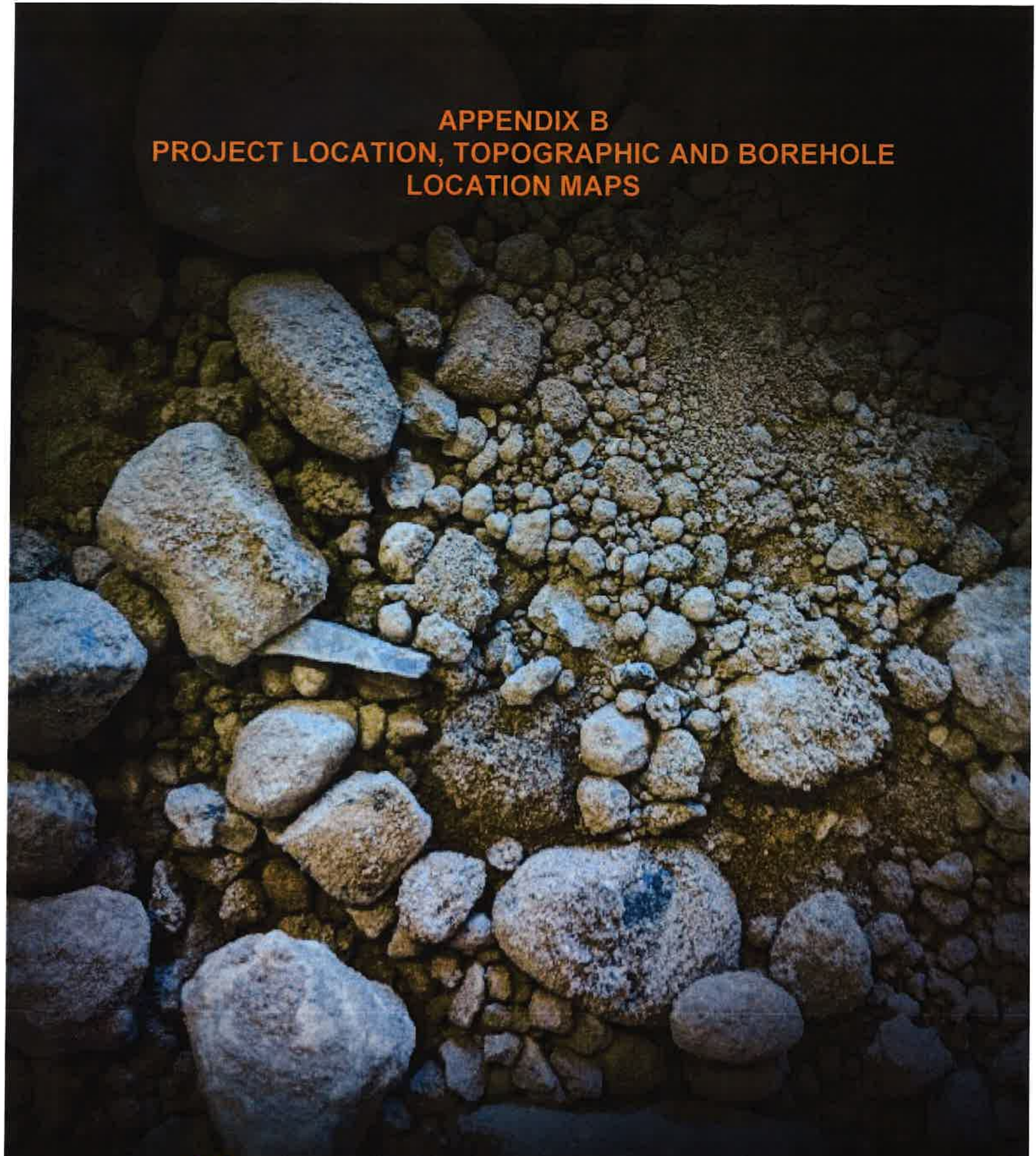
Date(s) aerial images were photographed: Oct 21, 2016—Sep 17, 2017

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
KD	Kermit-Dune land association, hummocky	1.3	100.0%
Totals for Area of Interest		**1.3**	**100.0%**

APPENDIX B
PROJECT LOCATION, TOPOGRAPHIC AND BOREHOLE LOCATION MAPS



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MEG PROJECT: 04-20-29110 / DATE: 8/19/2020 / APPROVED BY: A. PALMA / DRAWN BY: S. MARTINEZ

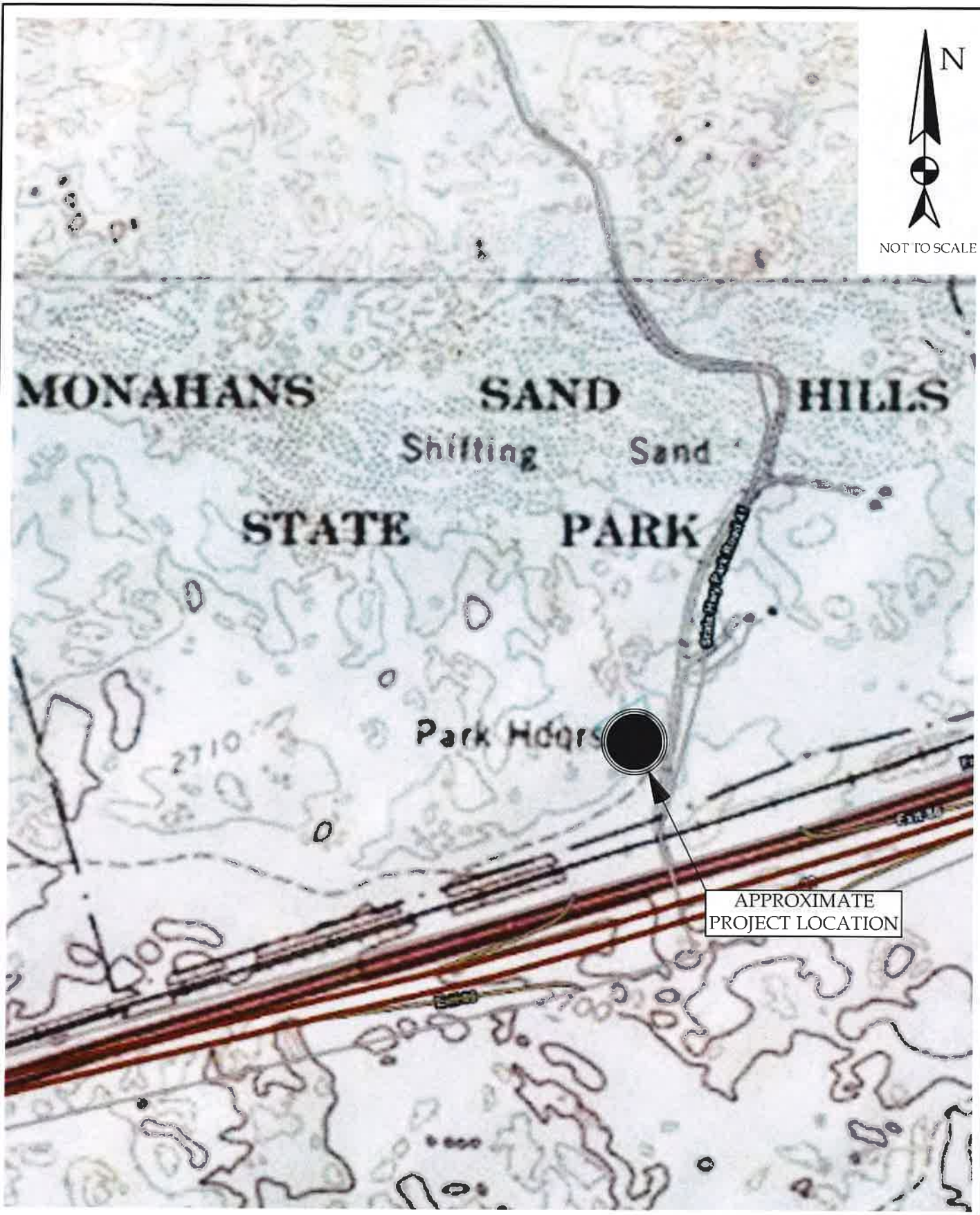
PROJECT SITE LOCATION MAP

PROPOSED
MONAHANS SANDHILLS STATE PARK
RENOVATIONS

MONAHANS, WARD COUNTY, TEXAS

MEG ENGINEERS
Millennium Engineers Group
Consultants - Geotechnical - Testing

MILLENNIUM ENGINEERS GROUP, INC.
1604 RUTHEFORD LANE
AUSTIN, TEXAS 78754
WWW.MEGENGINEERS.COM
TEL: 512-729-0400



PROJECT TOPOGRAPHY MAP

PROPOSED
MONAHANS SANDHILLS STATE
PARK RENOVATIONS

MONAHANS, WARD COUNTY, TEXAS

MILLENNIUM ENGINEERS GROUP, INC.
1604 RUTHEFORD LANE
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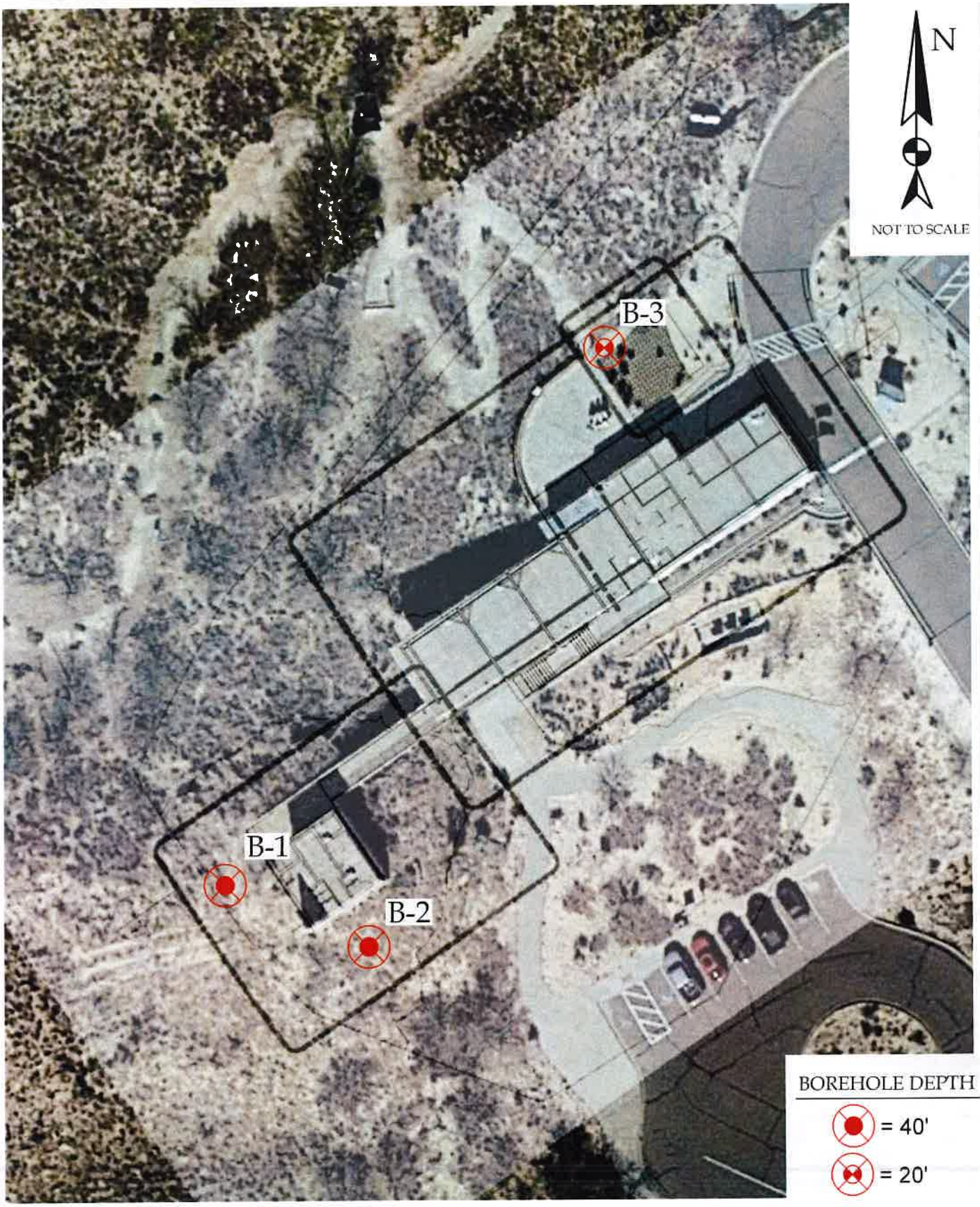
WWW.MEGENGINEERS.COM
TEL: 512-729-0400

MEG PROJECT: 04-20-29110 / DATE: 8/19/2020 / APPROVED BY: A. PALMA / DRAWN BY: S. MARTINEZ



MEG PROJECT: 04-20-2910 / DATE: 8/19/2020 / APPROVED BY: A. PALMA / DRAWN BY: S. MARTINEZ

PROJECT BOREHOLE LOCATION MAP

PROPOSED
MONAHANS SANDHILLS STATE PARK
RENOVATIONS

MONAHANS, WARD COUNTY, TEXAS

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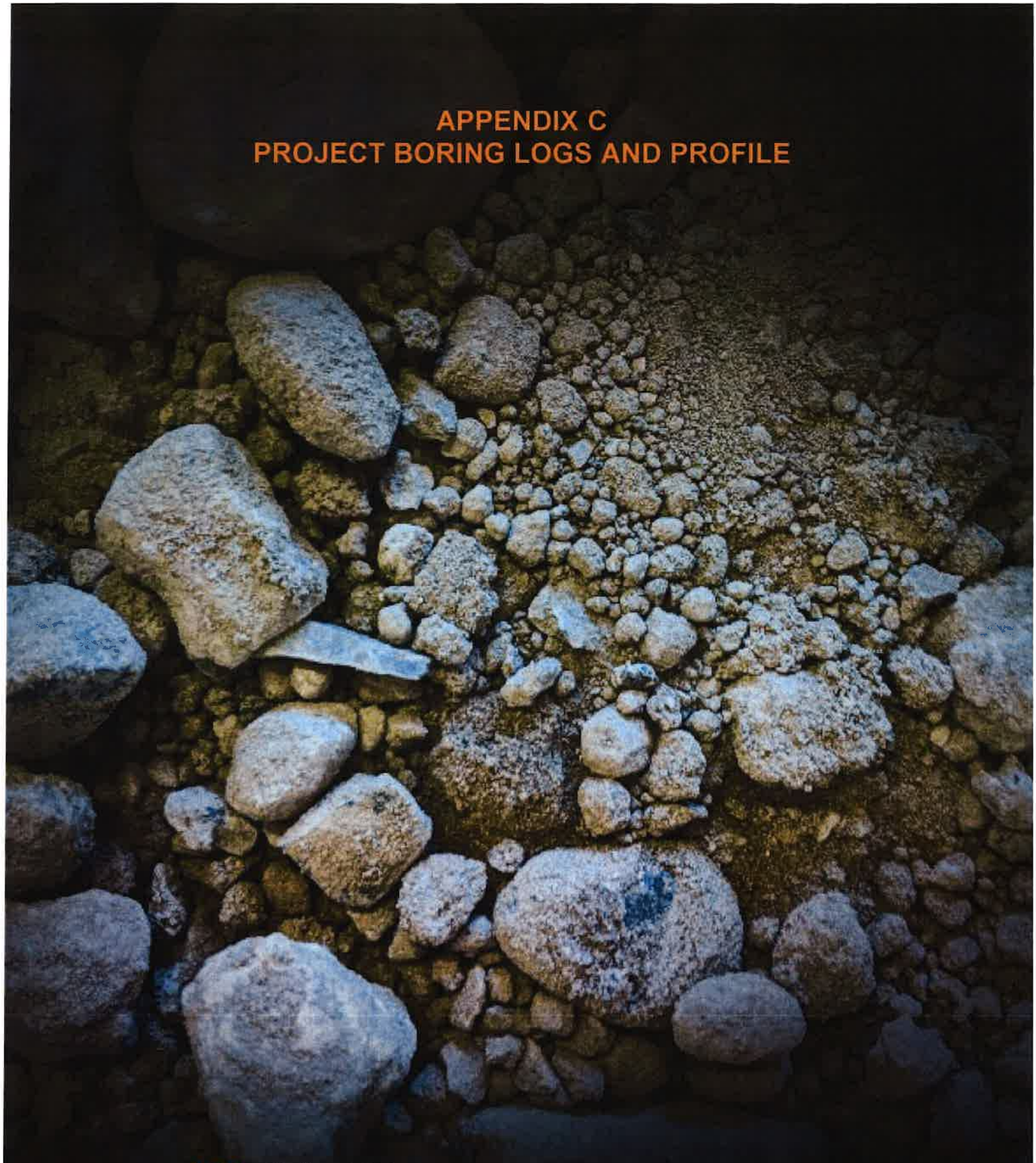
TEL: 512-729-0400

APPENDIX C
PROJECT BORING LOGS AND PROFILE



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Project: **Proposed Monahans Sandhills State Park**
Project Location: **Monahans, Ward County, Texas**
Project Number: **04-20-29110**

Log of Boring B-1
Sheet 1 of 1

Date(s) Drilled	Logged By **Juan Palma**	Checked By **Raul Palma**
Drilling Method **SFA**	Drill Bit Size/Type **4" soil bit**	Total Depth of Borehole **40 feet bgs**
Drill Rig Type	Drilling Contractor **Star Com. Tech**	Approximate Surface Elevation
Groundwater Level and Date Measured	Sampling Method(s) **SPT**	Hammer Data **140 lb., 30 in. drop, auto trip**
Borehole Backfill **Subgrade Cuttings**	Location **See Boring Location Map**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	LL, %	PI, %	Percent Fines	REMARKS AND OTHER TESTS
	0				SP		SAND, tan to white, dry,loose					
			1	4				0				
			2	8				0			3	
	5		3	5				1				
			4	9	SP		SAND, tan to white, dry, med. dense to dense	1				
			5	11				1			3	
	10											
			6	22				1				
	15											
			7	22				1				
	20											
			8	68				2			5	
	25											
			9	50				1				
	30											
			10	52				1			4	
	35											
			11	77				2				
	40						Bore Termination					
	45											

Project: **Proposed Monahans Sandhills State Park** Project Location: **Monahans, Ward County, Texas** Project Number: **04-20-29110**	Log of Boring B-2 **Sheet 1 of 1**

Date(s) Drilled	Logged By **Juan Palma**	Checked By **Raul Palma**
Drilling Method **SFA**	Drill Bit Size/Type **4" soil bit**	Total Depth of Borehole **40 feet bgs**
Drill Rig Type	Drilling Contractor **Star Com. Tech**	Approximate Surface Elevation
Groundwater Level and Date Measured	Sampling Method(s) **SPT**	Hammer Data **140 lb., 30 in. drop, auto trip**
Borehole Backfill **Subgrade Cuttings**	Location **See Boring Location Map**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	LL, %	PI, %	Percent Fines	REMARKS AND OTHER TESTS
	0				SP		SAND, tan to white, dry, very loose to very dense					
			1	2				0				
			2	6				0				
	5		3	8				0				
			4	12				0			3	
			5	13				0				
	10											
			6	27				2			6	
	15											
			7	23				1				
	20											
			8	65				2				
	25											
			9	45				2				
	30											
			10	39				1				
	35											
			11	63				2			26	
	40						Bore Termination					
	45											

Project: **Proposed Monahans Sandhills State Park**
Project Location: **Monahans, Ward County, Texas**
Project Number: **04-20-29110**

Log of Boring B-3
Sheet 1 of 1

Date(s) Drilled	Logged By **Juan Palma**	Checked By **Raul Palma**
Drilling Method **SFA**	Drill Bit Size/Type **4" soil bit**	Total Depth of Borehole **20 feet bgs**
Drill Rig Type	Drilling Contractor **Star Com. Tech**	Approximate Surface Elevation
Groundwater Level and Date Measured	Sampling Method(s) **SPT**	Hammer Data **140 lb., 30 in. drop, auto trip**
Borehole Backfill **Subgrade Cuttings**	Location **See Boring Location Map**	

Elevation (feet)	Depth (feet)	Sample Type	Sample Number	Sampling Resistance, blows/ft	Material Type	Graphic Log	MATERIAL DESCRIPTION	Water Content, %	LL, %	PI, %	Percent Fines	REMARKS AND OTHER TESTS
	0				SP		SAND, tan to white, dry, med. dense to very dense					
			1	10				1				
			2	11				0				
	5		3	14				2			3	
			4	12				3				
			5	9				1				
	10											
			6	16				3			7	
	15											
			7	21				1			4	
	20						Bore Termination					
	25											
	30											
	35											
	40											
	45											

Project: **Proposed Monahans Sandhills State Park**
Project Location: **Monahans, Ward County, Texas**
Project Number: **04-20-29110**

Key to Log of Boring
Sheet 1 of 1

1 Elevation (feet)	2 Depth (feet)	3 Sample Type	4 Sample Number	5 Sampling Resistance, blows/ft	6 Material Type	7 Graphic Log	8 MATERIAL DESCRIPTION	9 Water Content, %	10 LL, %	11 PI, %	12 Percent Fines	13 REMARKS AND OTHER TESTS

COLUMN DESCRIPTIONS

1 Elevation (feet): Elevation (MSL, feet).
2 Depth (feet): Depth in feet below the ground surface.
3 Sample Type: Type of soil sample collected at the depth interval shown.
4 Sample Number: Sample identification number.
5 Sampling Resistance, blows/ft: Number of blows to advance driven sampler one foot (or distance shown) beyond seating interval using the hammer identified on the boring log.
6 Material Type: Type of material encountered.
7 Graphic Log: Graphic depiction of the subsurface material encountered.
8 MATERIAL DESCRIPTION: Description of material encountered. May include consistency, moisture, color, and other descriptive text.
9 Water Content, %: Water content of the soil sample, expressed as percentage of dry weight of sample.
10 LL, %: Liquid Limit, expressed as a water content.
11 PI, %: Plasticity Index, expressed as a water content.
12 Percent Fines: The percent fines (soil passing the No. 200 Sieve) in the sample. WA indicates a Wash Sieve, SA indicates a Sieve Analysis.
13 REMARKS AND OTHER TESTS: Comments and observations regarding drilling or sampling made by driller or field personnel.

FIELD AND LABORATORY TEST ABBREVIATIONS

CHEM: Chemical tests to assess corrosivity
COMP: Compaction test
CONS: One-dimensional consolidation test
LL: Liquid Limit, percent
PI: Plasticity Index, percent
SA: Sieve analysis (percent passing No. 200 Sieve)
UC: Unconfined compressive strength test, Qu, in ksf
WA: Wash sieve (percent passing No. 200 Sieve)

MATERIAL GRAPHIC SYMBOLS

Poorly graded SAND (SP)

TYPICAL SAMPLER GRAPHIC SYMBOLS

Auger sampler
Bulk Sample
3-inch-OD California w/ brass rings
CME Sampler
Grab Sample
2.5-inch-OD Modified California w/ brass liners
Pitcher Sample
2-inch-OD unlined split spoon (SPT)
Shelby Tube (Thin-walled, fixed head)

OTHER GRAPHIC SYMBOLS

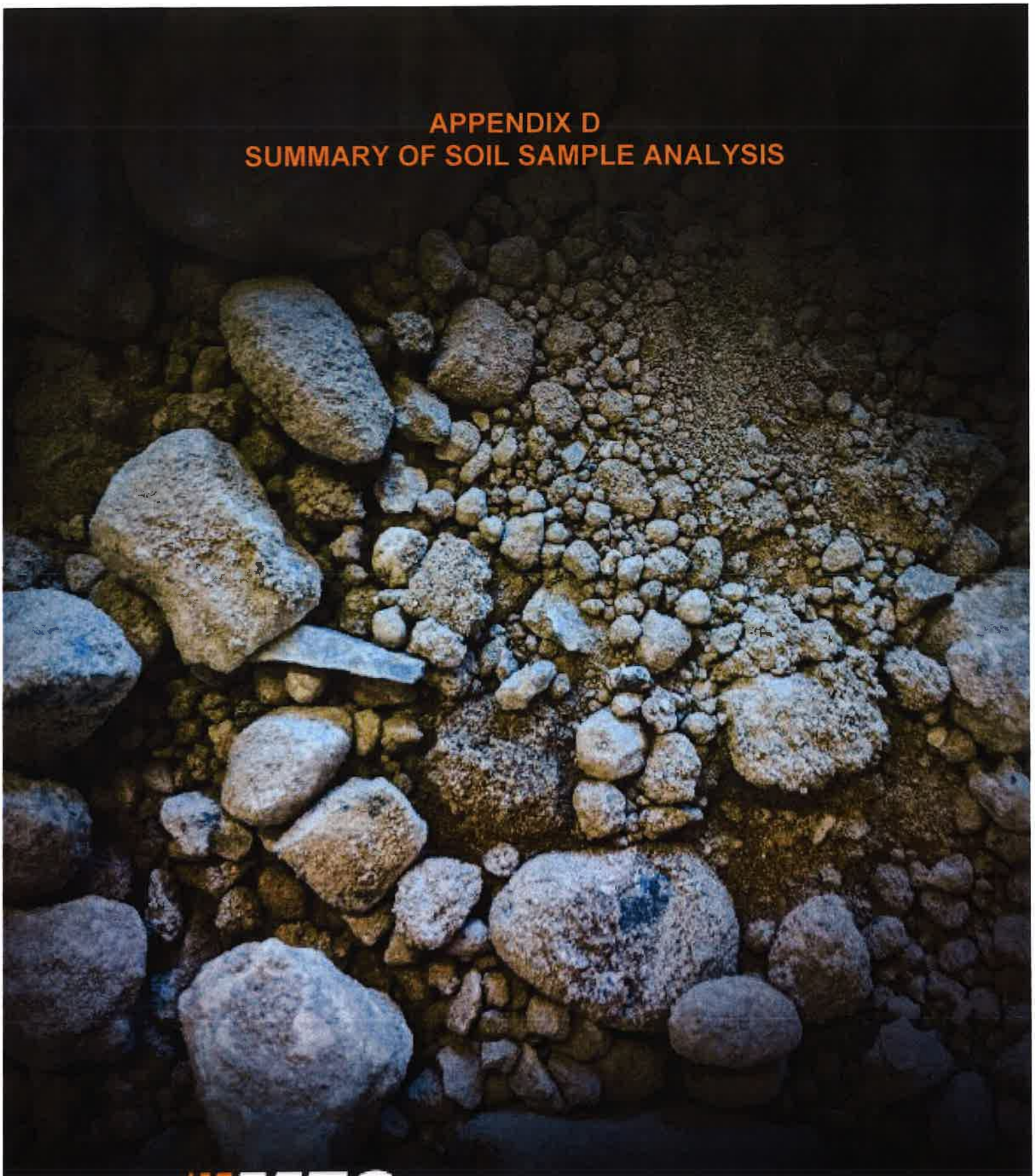
Water level (at time of drilling, ATD)
Water level (after waiting)
Minor change in material properties within a stratum
Inferred/gradational contact between strata
Queried contact between strata

GENERAL NOTES

1: Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2: Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.

Figure B-1

APPENDIX D
SUMMARY OF SOIL SAMPLE ANALYSIS



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Summary of Soil Sample Analyses

Project Name: Proposed Monahans Sandhills State Park

Boring No.	Sample Depth (ft)	Blows Per (ft)	Moisture Content	Liquid Limit	Plastic Limit	Plasticity Index	-200% Sieve	Shear Strength (tsf)	Dry Unit Weight (pcf)	USCS
B-1	.5 - 2	4	0							
	2.5 - 4	8	0				3			
	4.5 - 6	5	1							
	6.5 - 8	9	1							
	8.5 - 10	11	1				3			
	13.5 - 15	22	1							
	18.5 - 20	22	1							
	23.5 - 25	68	2				5			
	28.5 - 30	50	1							
	33.5 - 35	52	1				4			
	38.5 - 40	77	2							
B-2	.5 - 2	2	0							
	2.5 - 4	6	0							
	4.5 - 6	8	0							
	6.5 - 8	12	0				3			
	8.5 - 10	13	0							
	13.5 - 15	27	2				6			
	18.5 - 20	23	1							
	23.5 - 25	65	2							
	28.5 - 30	45	2							
	33.5 - 35	39	1							
	38.5 - 40	63	2				26			
B-3	.5 - 2	10	1							
	2.5 - 4	11	0							
	4.5 - 6	14	2				3			
	6.5 - 8	12	3							
	8.5 - 10	9	1							
	13.5 - 15	16	3				7			
	18.5 - 20	21	1				4			

APPENDIX E
SIEVE ANALYSIS DATA SHEET (ASTM D-2487)

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Sieve Analysis Data Sheet

ASTM D-2487

Project Name: Monahans Sandhills State Park **Tested By:** J. Uriostegui **Date:** 8/13/2020

Project No.: 04-20-29110

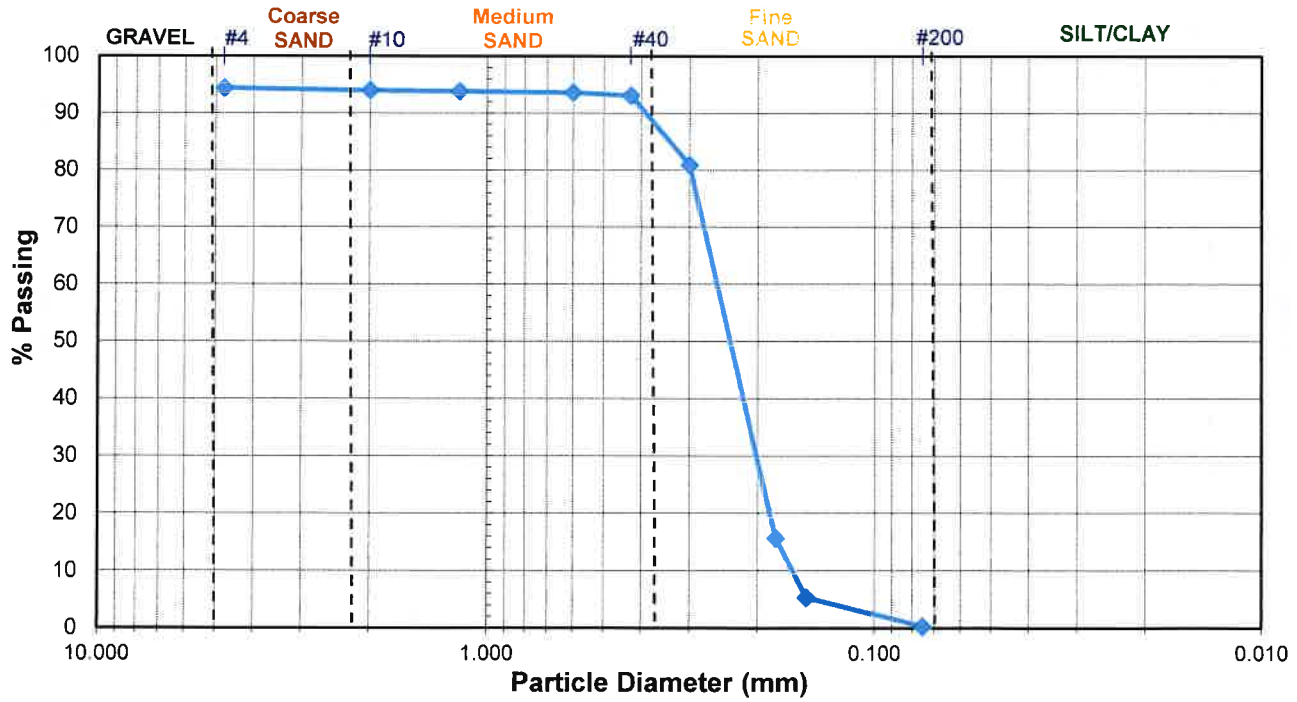
Location: Monahans, Ward County, Texas

Borehole No.: B-1 **Depth** 2.5 - 4

Weight of Container (g): 3736.6 **Weight of Container & Soil (g):** 3929.0

Weight of Dry Sample (g): 192.2

Sieve Number	Diameter (mm)	Mass of Empty Sieve (g)	Mass of Sieve & Soil (g)	Soil Retained (g)	Soil Retained (%)	Soil Passing (%)
4	4.750	513.6	524.5	10.9	5.7	94.3
10	2.000	680.5	681.3	0.8	0.4	93.9
16	1.180	427.7	428.1	0.4	0.2	93.7
30	0.600	399.3	399.7	0.4	0.2	93.5
40	0.425	269.3	270.2	0.9	0.5	93.1
50	0.300	256.6	280.1	23.5	12.2	80.8
80	0.180	245.3	370.4	125.1	65.1	15.8
100	0.150	235.2	255.1	19.9	10.4	5.4
200	0.075	218.6	228.5	9.9	5.1	0.2
Pan +	-200 washed	490.5	491.2	0.7	0.4	0.0
			TOTAL:	**192.4**	**100.1**	



Grain Size Distribution Curve Results:

% Gravel: 5.7 **D_{10}:** 0.163 **C_u:** 1.60

% Sand: 94.1 **D_{30}:** 0.206 **C_c:** 1.00

% Fines: 0.4 **D_{60}:** 0.262

Sieve Analysis Data Sheet

ASTM D-2487

Project Name: Monahans Sandhills State Park **Tested By:** J. Uriostegui **Date:** 8/13/2020

Project No.: 04-20-29110

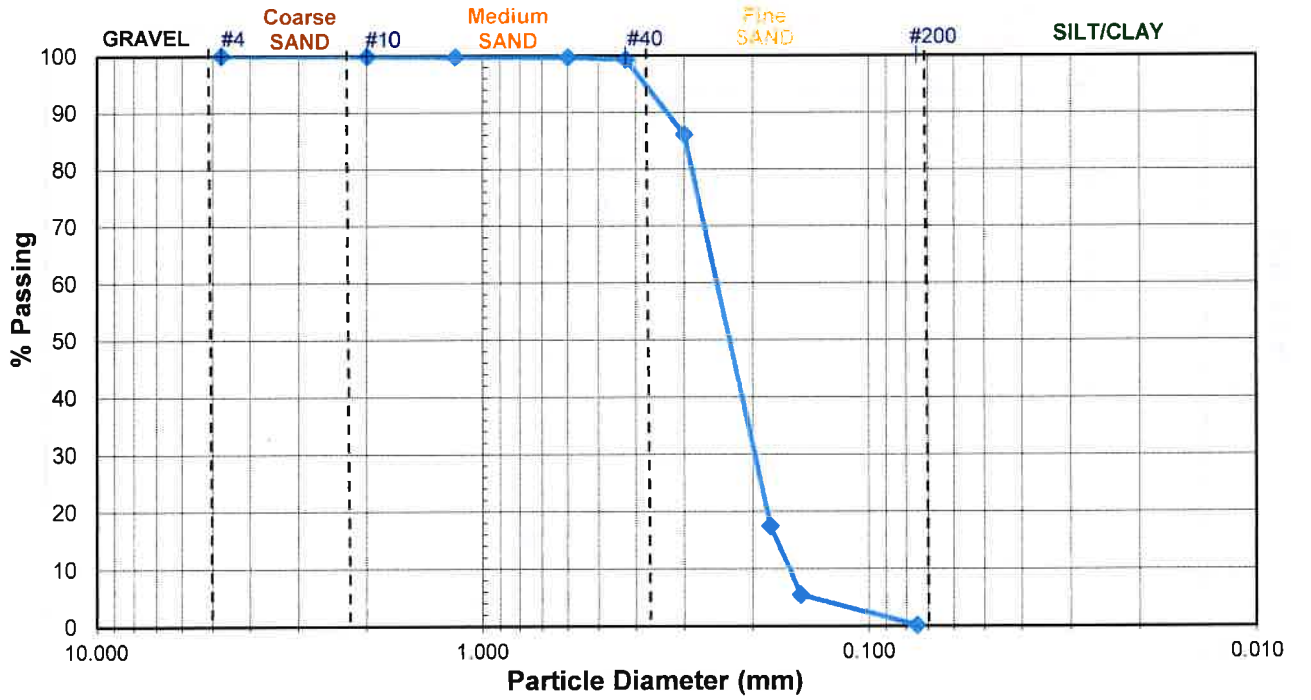
Location: Monahans, Ward County, Texas

Borehole No.: B-1 **Depth** 8.5 - 10

Weight of Container (g): 3736.6 **Weight of Container & Soil (g):** 3903.8

Weight of Dry Sample (g): 166.9

Sieve Number	Diameter (mm)	Mass of Empty Sieve (g)	Mass of Sieve & Soil (g)	Soil Retained (g)	Soil Retained (%)	Soil Passing (%)
4	4.750	513.6	513.6	0.0	0.0	100.0
10	2.000	680.5	680.8	0.3	0.2	99.8
16	1.180	427.7	427.9	0.2	0.1	99.7
30	0.600	399.3	399.5	0.2	0.1	99.6
40	0.425	269.3	270.0	0.7	0.4	99.2
50	0.300	256.6	278.6	22.0	13.2	86.0
80	0.180	245.3	359.7	114.4	68.5	17.5
100	0.150	235.2	255.2	20.0	12.0	5.5
200	0.075	218.6	227.6	9.0	5.4	0.1
Pan +	-200 washed	490.5	491.0	0.5	0.3	0.0
			TOTAL:	167.2	100.2	



Grain Size Distribution Curve Results:

% Gravel: 0.0 **D_{10}:** 0.161 **C_u:** 1.58

% Sand: 99.9 **D_{30}:** 0.202 **C_c:** 0.99

% Fines: 0.3 **D_{60}:** 0.254

Sieve Analysis Data Sheet

ASTM D-2487

Project Name: Monahans Sandhills State Park **Tested By:** J. Uriostegui **Date:** 8/13/2020

Project No.: 04-20-29110

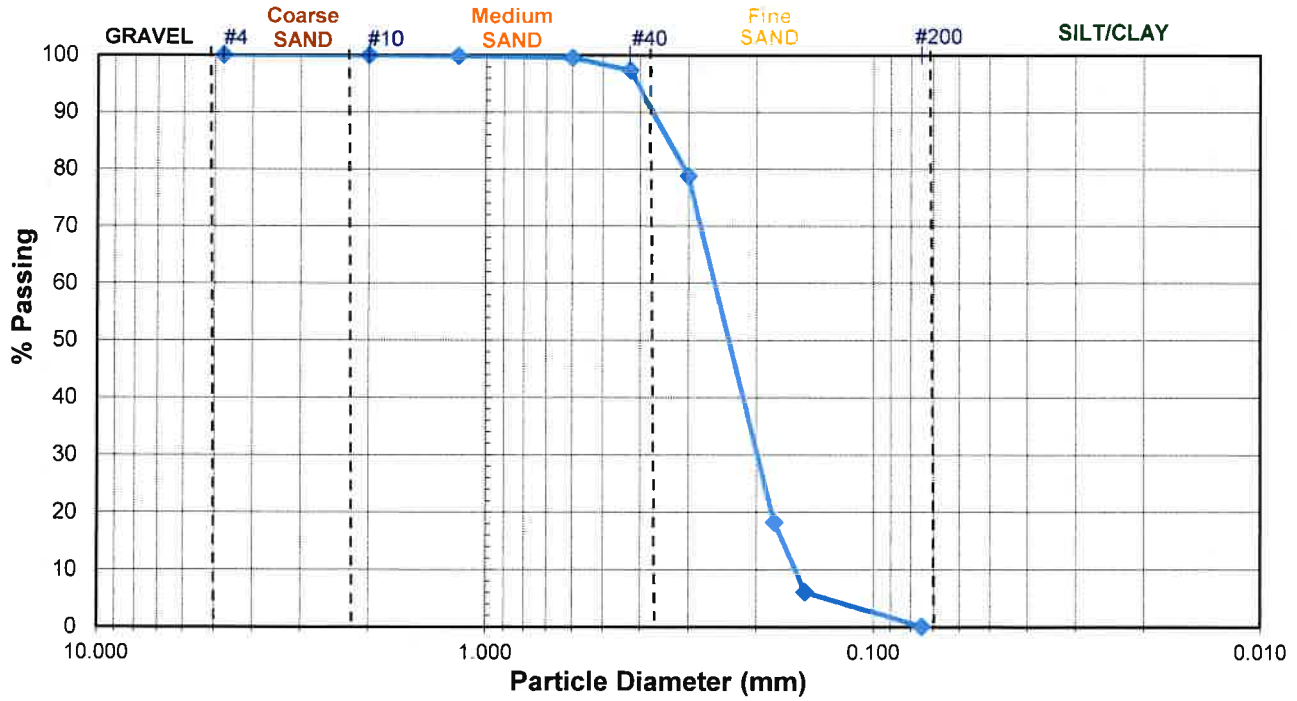
Location: Monahans, Ward County, Texas

Borehole No.: B-1 **Depth** 23.5 - 25

Weight of Container (g): 3736.6 **Weight of Container & Soil (g):** 3889.1

Weight of Dry Sample (g): 152.2

Sieve Number	Diameter (mm)	Mass of Empty Sieve (g)	Mass of Sieve & Soil (g)	Soil Retained (g)	Soil Retained (%)	Soil Passing (%)
4	4.750	513.6	513.6	0.0	0.0	100.0
10	2.000	680.5	680.6	0.1	0.1	99.9
16	1.180	427.7	427.8	0.1	0.1	99.8
30	0.600	399.3	399.8	0.5	0.3	99.5
40	0.425	269.3	272.6	3.3	2.2	97.3
50	0.300	256.6	284.8	28.2	18.5	78.8
80	0.180	245.3	337.4	92.1	60.5	18.3
100	0.150	235.2	253.6	18.4	12.1	6.2
200	0.075	218.6	227.9	9.3	6.1	0.1
Pan +	-200 washed	490.5	490.9	0.4	0.2	0.0
			TOTAL:	152.5	100.2	



Grain Size Distribution Curve Results:

% Gravel: 0.0 **D_{10}:** 0.159 **C_u:** 1.65

% Sand: 99.9 **D_{30}:** 0.203 **C_c:** 0.99

% Fines: 0.2 **D_{60}:** 0.263

Sieve Analysis Data Sheet

ASTM D-2487

Project Name: Monahans Sandhills State Park **Tested By:** J. Uriostegui **Date:** 8/13/2020

Project No.: 04-20-29110

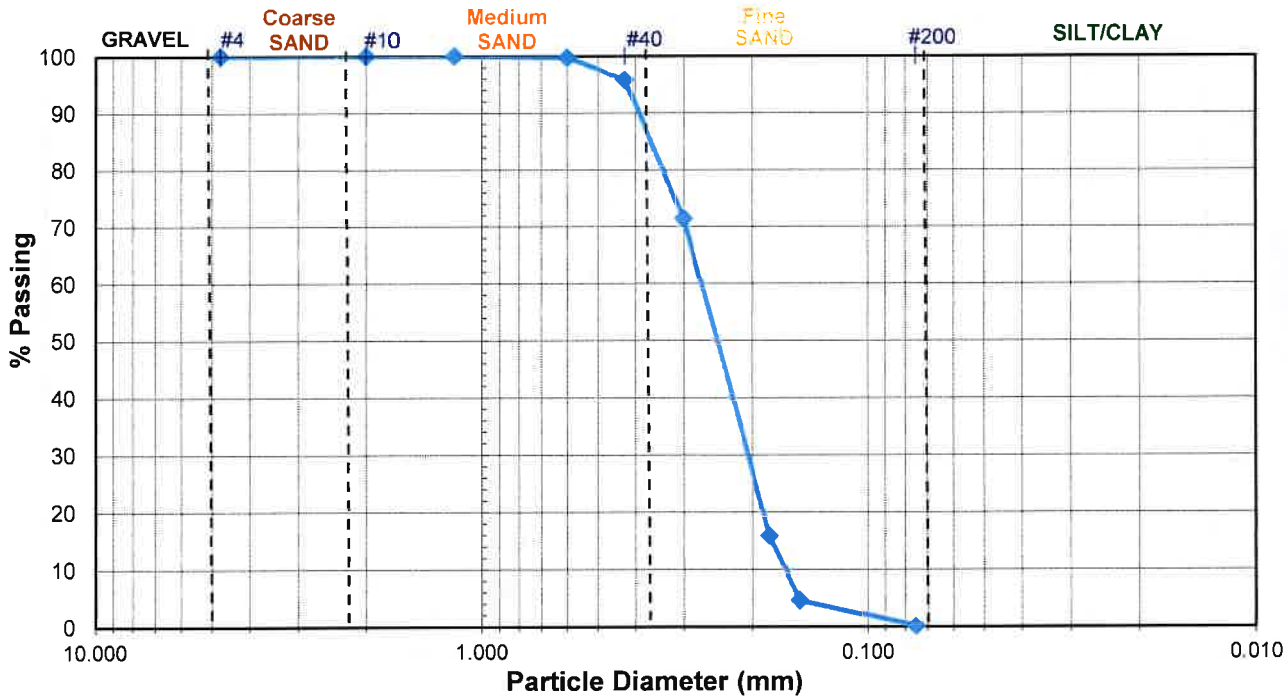
Location: Monahans, Ward County, Texas

Borehole No.: B-1 **Depth** 33.5 - 35

Weight of Container (g): 3736.6 **Weight of Container & Soil (g):** 3941.7

Weight of Dry Sample (g): 204.7

Sieve Number	Diameter (mm)	Mass of Empty Sieve (g)	Mass of Sieve & Soil (g)	Soil Retained (g)	Soil Retained (%)	Soil Passing (%)
4	4.750	513.6	513.6	0.0	0.0	100.0
10	2.000	680.5	680.5	0.0	0.0	100.0
16	1.180	427.7	427.7	0.0	0.0	100.0
30	0.600	399.3	399.9	0.6	0.3	99.7
40	0.425	269.3	277.3	8.0	3.9	95.8
50	0.300	256.6	306.7	50.1	24.5	71.4
80	0.180	245.3	358.7	113.4	55.4	15.9
100	0.150	235.2	258.1	22.9	11.2	4.7
200	0.075	218.6	228.0	9.4	4.6	0.2
Pan +	-200 washed	490.5	491.2	0.7	0.3	0.0
			TOTAL:	205.1	100.2	



Grain Size Distribution Curve Results:

% Gravel: 0.0 **D_{10}:** 0.164 **C_u:** 1.68

% Sand: 99.8 **D_{30}:** 0.210 **C_c:** 0.98

% Fines: 0.3 **D_{60}:** 0.275

Sieve Analysis Data Sheet

ASTM D-2487

Project Name: Monahans Sandhills State Park **Tested By:** J. Uriostegui **Date:** 8/13/2020

Project No.: 04-20-29110

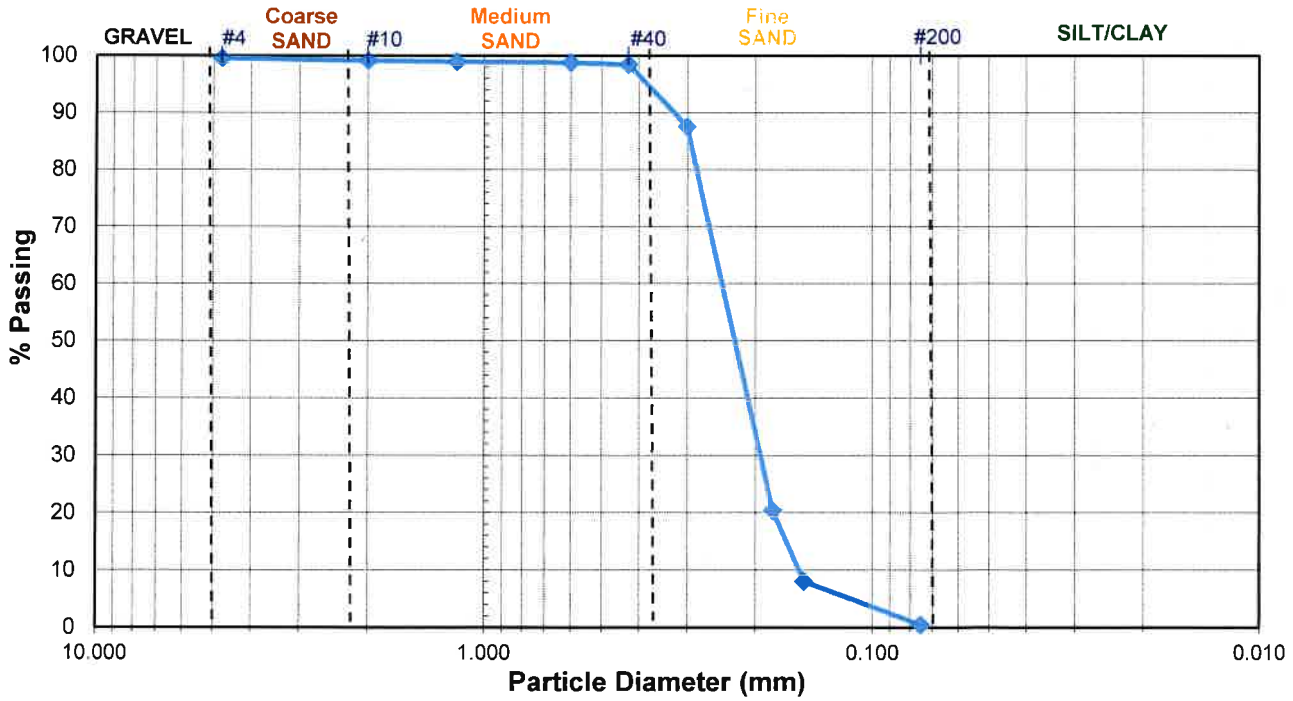
Location: Monahans, Ward County, Texas

Borehole No.: B-2 **Depth** 0.5 - 2

Weight of Container (g): 3736.6 **Weight of Container & Soil (g):** 3905.9

Weight of Dry Sample (g): 169.4

Sieve Number	Diameter (mm)	Mass of Empty Sieve (g)	Mass of Sieve & Soil (g)	Soil Retained (g)	Soil Retained (%)	Soil Passing (%)
4	4.750	513.6	514.5	0.9	0.5	99.5
10	2.000	680.5	681.2	0.7	0.4	99.0
16	1.180	427.7	428.0	0.3	0.2	98.9
30	0.600	399.3	399.6	0.3	0.2	98.7
40	0.425	269.3	269.9	0.6	0.3	98.4
50	0.300	256.6	275.1	18.5	10.9	87.5
80	0.180	245.3	358.9	113.6	67.1	20.4
100	0.150	235.2	256.2	21.0	12.4	8.0
200	0.075	218.6	231.5	12.9	7.6	0.4
Pan +	-200 washed	490.5	491.2	0.7	0.4	0.0
			TOTAL:	169.3	99.9	



Grain Size Distribution Curve Results:

% Gravel: 0.5 **D_{10}:** 0.155 **C_u:** 1.62

% Sand: 99.0 **D_{30}:** 0.197 **C_c:** 1.00

% Fines: 0.4 **D_{60}:** 0.251

Sieve Analysis Data Sheet

ASTM D-2487

Project Name: Monahans Sandhills State Park **Tested By:** J. Uriostegui **Date:** 8/13/2020

Project No.: 04-20-29110

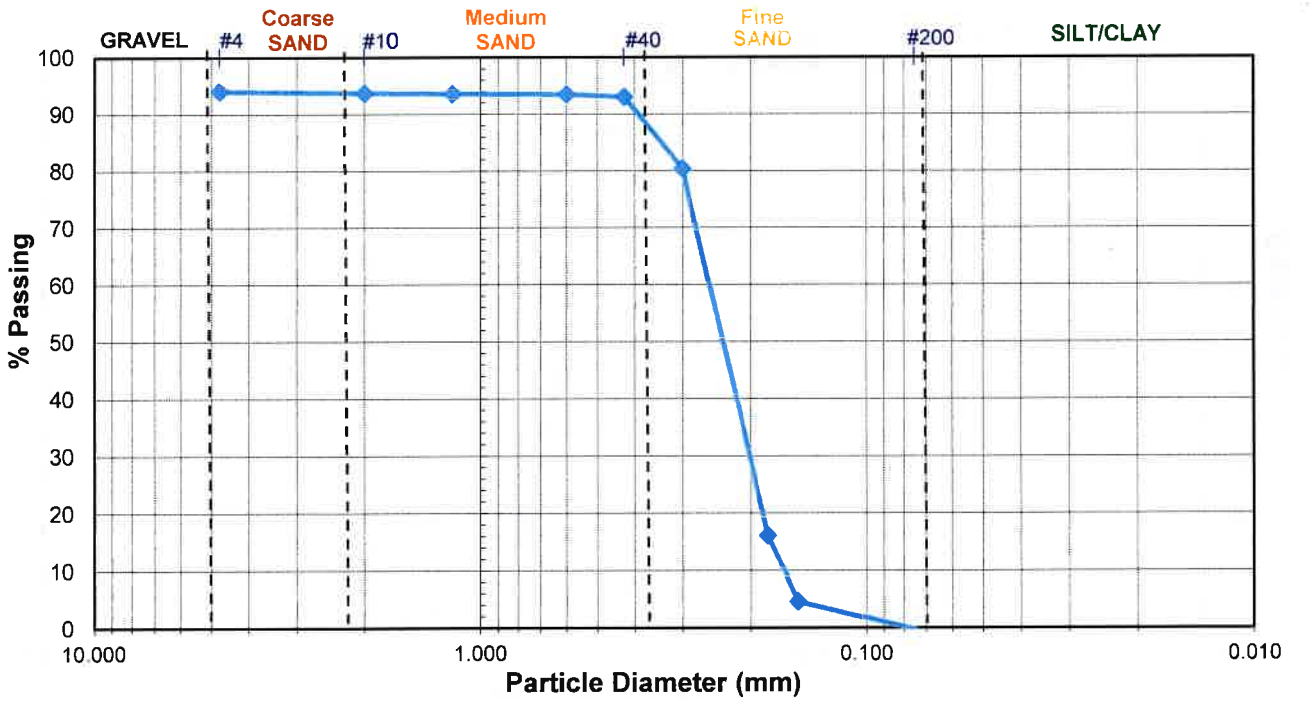
Location: Monahans, Ward County, Texas

Borehole No.: B-2 **Depth** 6.5 - 8

Weight of Container (g): 3736.6 **Weight of Container & Soil (g):** 3943.3

Weight of Dry Sample (g): 205.8

Sieve Number	Diameter (mm)	Mass of Empty Sieve (g)	Mass of Sieve & Soil (g)	Soil Retained (g)	Soil Retained (%)	Soil Passing (%)
4	4.750	513.6	526.0	12.4	6.0	94.0
10	2.000	680.5	681.2	0.7	0.3	93.6
16	1.180	427.7	427.9	0.2	0.1	93.5
30	0.600	399.3	399.6	0.3	0.1	93.4
40	0.425	269.3	270.2	0.9	0.4	93.0
50	0.300	256.6	282.6	26.0	12.7	80.3
80	0.180	245.3	377.3	132.0	64.1	16.2
100	0.150	235.2	259.0	23.8	11.5	4.6
200	0.075	218.6	228.7	10.1	4.9	-0.3
Pan +	-200 washed	490.5	490.8	0.3	0.2	0.0
			TOTAL:	206.7	100.4	



Grain Size Distribution Curve Results:

% Gravel: 6.0 **D_{10}:** 0.164 **C_u:** 1.60

% Sand: 94.3 **D_{30}:** 0.206 **C_c:** 0.99

% Fines: 0.2 **D_{60}:** 0.262

Sieve Analysis Data Sheet

ASTM D-2487

Project Name: Monahans Sandhills State Park **Tested By:** J. Uriostegui **Date:** 8/13/2020

Project No.: 04-20-29110

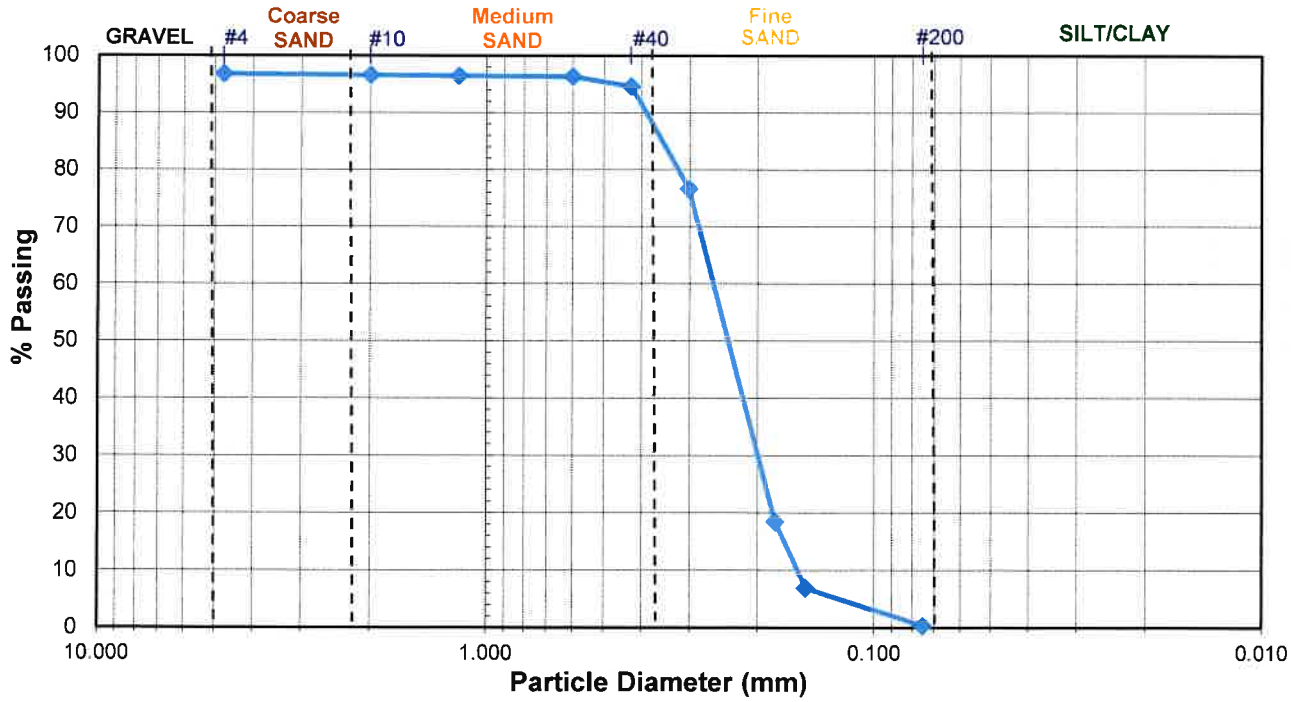
Location: Monahans, Ward County, Texas

Borehole No.: B-2 **Depth** 12.5 - 14

Weight of Container (g): 3736.6 **Weight of Container & Soil (g):** 3999.1

Weight of Dry Sample (g): 262.6

Sieve Number	Diameter (mm)	Mass of Empty Sieve (g)	Mass of Sieve & Soil (g)	Soil Retained (g)	Soil Retained (%)	Soil Passing (%)
4	4.750	513.6	522.2	8.6	3.3	96.7
10	2.000	680.5	681.1	0.6	0.2	96.5
16	1.180	427.7	428.0	0.3	0.1	96.4
30	0.600	399.3	399.6	0.3	0.1	96.3
40	0.425	269.3	273.8	4.5	1.7	94.6
50	0.300	256.6	304.2	47.6	18.1	76.4
80	0.180	245.3	397.6	152.3	58.0	18.4
100	0.150	235.2	265.3	30.1	11.4	7.0
200	0.075	218.6	236.0	17.4	6.6	0.4
Pan +	-200 washed	490.5	491.4	0.9	0.3	0.0
			TOTAL:	262.5	100.0	



Grain Size Distribution Curve Results:

% Gravel: 3.3 **D_{10}:** 0.158 **C_u:** 1.68

% Sand: 96.4 **D_{30}:** 0.204 **C_c:** 0.99

% Fines: 0.3 **D_{60}:** 0.266

Sieve Analysis Data Sheet

ASTM D-2487

Project Name: Monahans Sandhills State Park **Tested By:** J. Uriostegui **Date:** 8/13/2020

Project No.: 04-20-29110

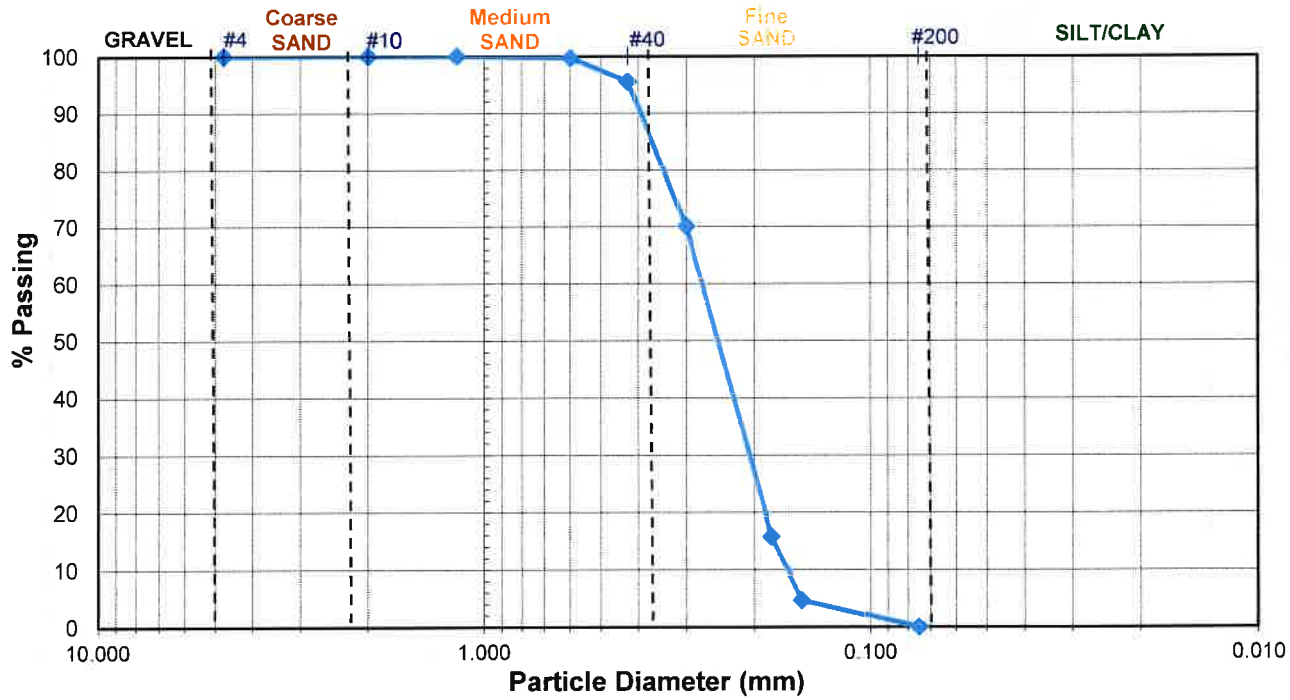
Location: Monahans, Ward County, Texas

Borehole No.: B-2 **Depth** 28.5 - 30

Weight of Container (g): 3736.6 **Weight of Container & Soil (g):** 3902.4

Weight of Dry Sample (g): 165.2

Sieve Number	Diameter (mm)	Mass of Empty Sieve (g)	Mass of Sieve & Soil (g)	Soil Retained (g)	Soil Retained (%)	Soil Passing (%)
4	4.750	513.6	513.6	0.0	0.0	100.0
10	2.000	680.5	680.5	0.0	0.0	100.0
16	1.180	427.7	427.7	0.0	0.0	100.0
30	0.600	399.3	399.8	0.5	0.3	99.7
40	0.425	269.3	276.2	6.9	4.2	95.5
50	0.300	256.6	298.7	42.1	25.5	70.1
80	0.180	245.3	334.8	89.5	54.2	15.9
100	0.150	235.2	253.5	18.3	11.1	4.8
200	0.075	218.6	226.5	7.9	4.8	0.0
Pan +	-200 washed	490.5	491.1	0.6	0.3	0.0
			TOTAL:	165.8	100.3	



Grain Size Distribution Curve Results:

% Gravel: 0.0 **D_{10}:** 0.164 **C_u:** 1.69

% Sand: 100.0 **D_{30}:** 0.211 **C_c:** 0.98

% Fines: 0.3 **D_{60}:** 0.278

Sieve Analysis Data Sheet

ASTM D-2487

Project Name: Monahans Sandhills State Park **Tested By:** J. Uriostegui **Date:** 8/13/2020

Project No.: 04-20-29110

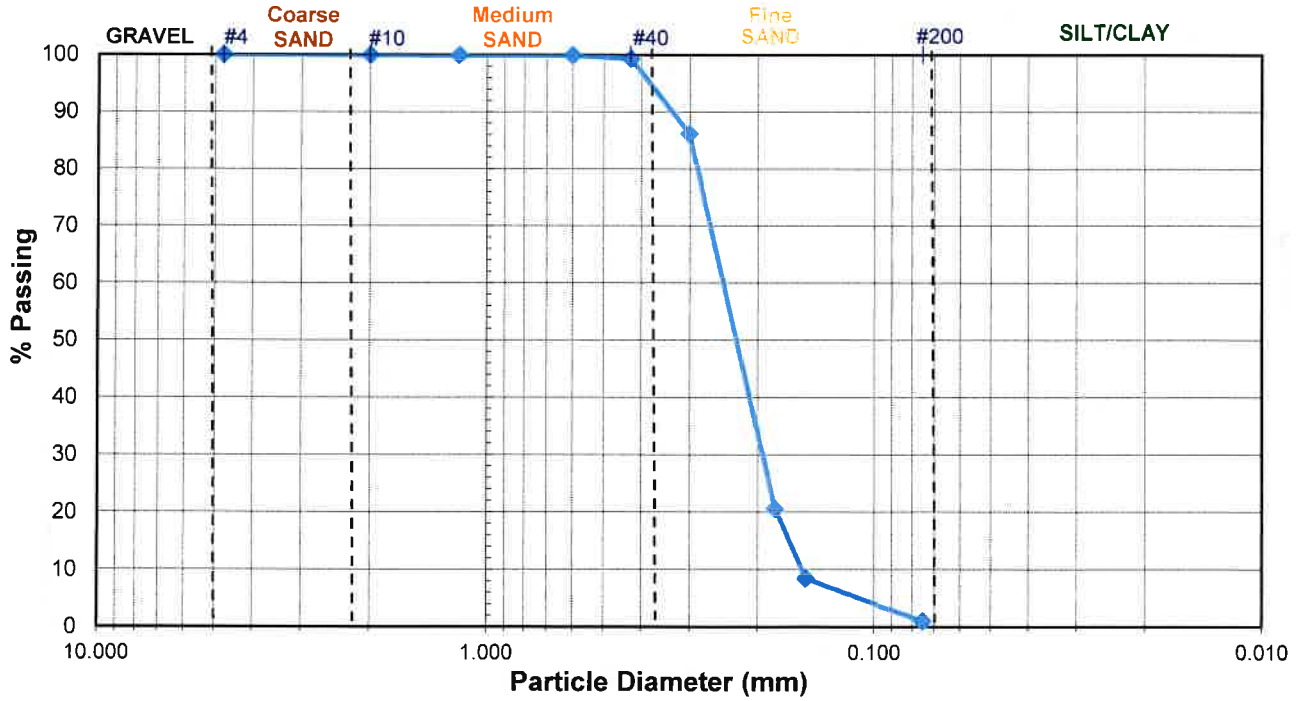
Location: Monahans, Ward County, Texas

Borehole No.: B-3 **Depth** 4.5 - 6

Weight of Container (g): 3736.6 **Weight of Container & Soil (g):** 3881.8

Weight of Dry Sample (g): 145.8

Sieve Number	Diameter (mm)	Mass of Empty Sieve (g)	Mass of Sieve & Soil (g)	Soil Retained (g)	Soil Retained (%)	Soil Passing (%)
4	4.750	513.6	513.6	0.0	0.0	100.0
10	2.000	680.5	680.6	0.1	0.1	99.9
16	1.180	427.7	427.8	0.1	0.0	99.9
30	0.600	399.3	399.3	0.0	0.0	99.9
40	0.425	269.3	270.2	0.9	0.6	99.3
50	0.300	256.6	275.9	19.3	13.3	86.0
80	0.180	245.3	340.7	95.4	65.4	20.6
100	0.150	235.2	252.9	17.7	12.1	8.4
200	0.075	218.6	229.6	11.0	7.5	0.9
Pan +	-200 washed	490.5	491.2	0.7	0.5	0.0
			TOTAL:	145.2	99.6	



Grain Size Distribution Curve Results:

% Gravel: 0.0 **D_{10}:** 0.154 **C_u:** 1.64

% Sand: 99.1 **D_{30}:** 0.197 **C_c:** 1.00

% Fines: 0.5 **D_{60}:** 0.252

Sieve Analysis Data Sheet

ASTM D-2487

Project Name: Monahans Sandhills State Park **Tested By:** J. Uriostegui **Date:** 8/13/2020

Project No.: 04-20-29110

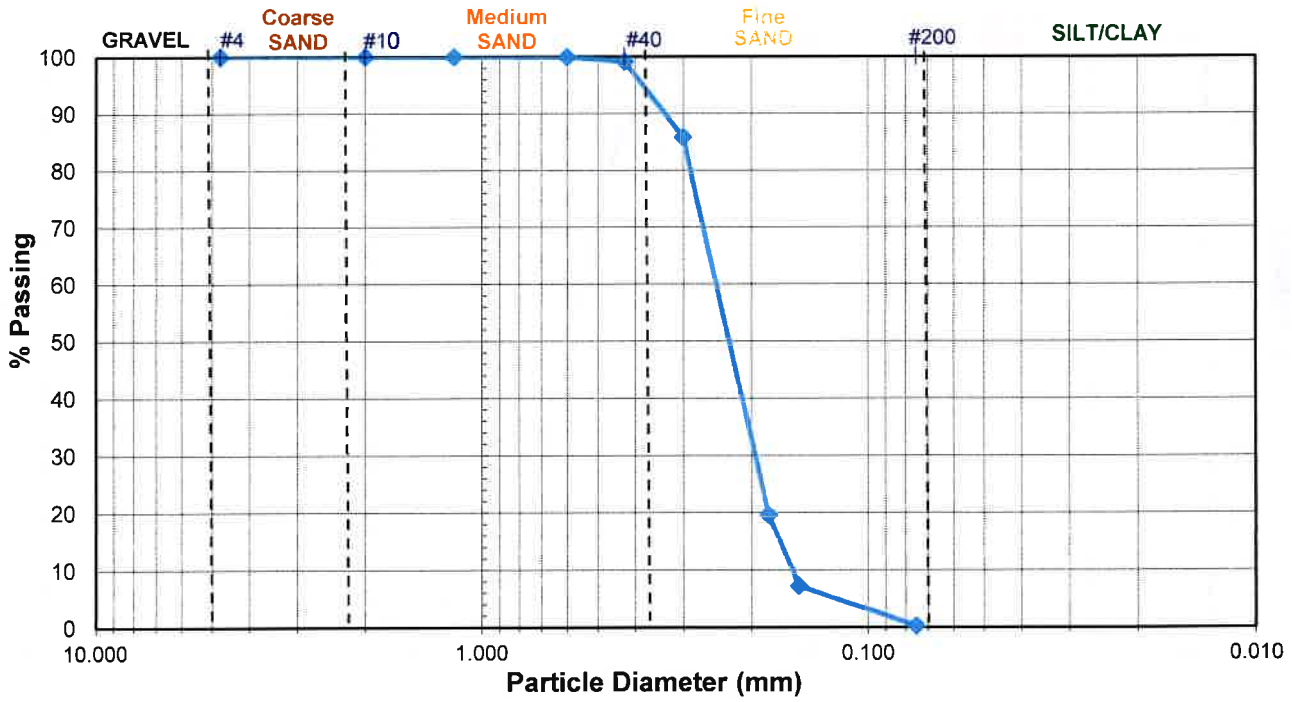
Location: Monahans, Ward County, Texas

Borehole No.: B-3 **Depth** 12.5 - 14

Weight of Container (g): 3736.6 **Weight of Container & Soil (g):** 3903.6

Weight of Dry Sample (g): 166.6

Sieve Number	Diameter (mm)	Mass of Empty Sieve (g)	Mass of Sieve & Soil (g)	Soil Retained (g)	Soil Retained (%)	Soil Passing (%)
4	4.750	513.6	513.6	0.0	0.0	100.0
10	2.000	680.5	680.6	0.1	0.0	100.0
16	1.180	427.7	427.8	0.1	0.0	99.9
30	0.600	399.3	399.4	0.1	0.0	99.9
40	0.425	269.3	270.7	1.4	0.9	99.1
50	0.300	256.6	278.7	22.1	13.3	85.8
80	0.180	245.3	355.5	110.2	66.2	19.6
100	0.150	235.2	255.8	20.6	12.4	7.3
200	0.075	218.6	230.3	11.7	7.0	0.2
Pan +	-200 washed	490.5	491.3	0.8	0.5	0.0
			TOTAL:	167.0	100.2	



Grain Size Distribution Curve Results:

% Gravel: 0.0 **D_{10}:** 0.157 **C_u:** 1.62

% Sand: 99.8 **D_{30}:** 0.199 **C_c:** 1.00

% Fines: 0.5 **D_{60}:** 0.253

Sieve Analysis Data Sheet

ASTM D-2487

Project Name: Monahans Sandhills State Park **Tested By:** J. Uriostegui **Date:** 8/13/2020

Project No.: 04-20-29110

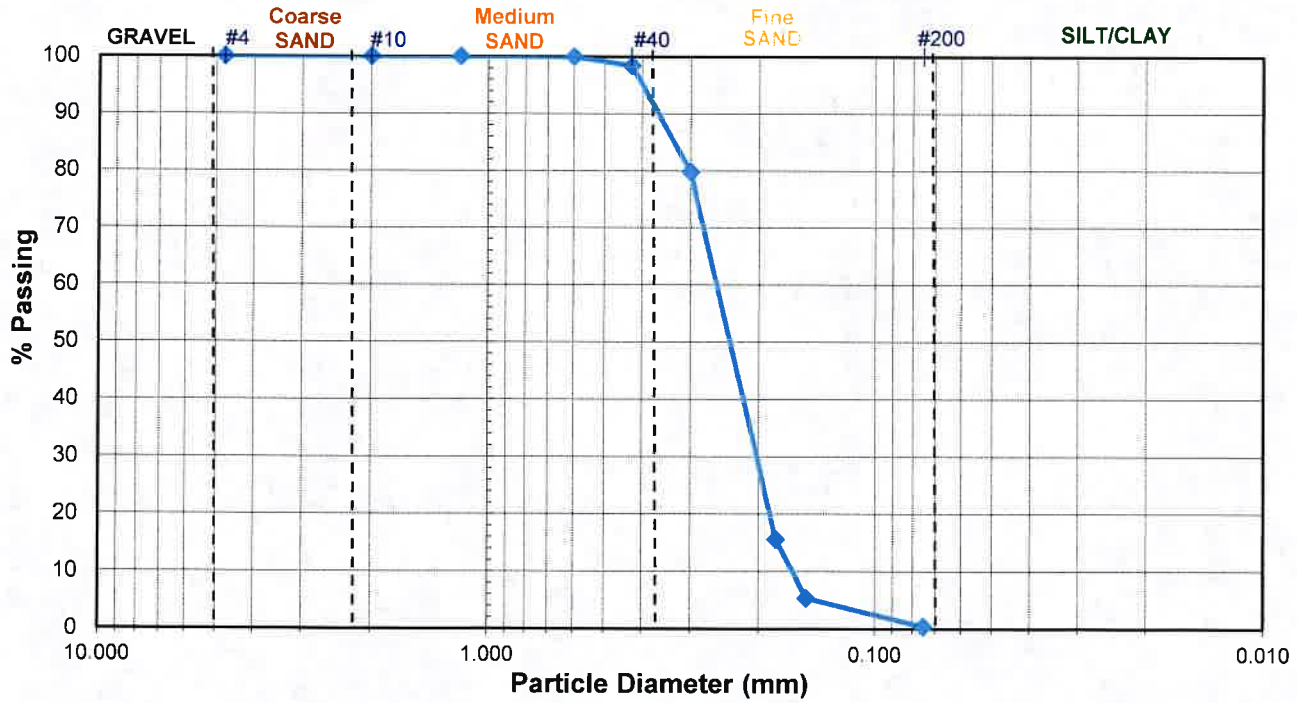
Location: Monahans, Ward County, Texas

Borehole No.: B-3 **Depth** 18.5 - 20

Weight of Container (g): 3736.6 **Weight of Container & Soil (g):** 3910.0

Weight of Dry Sample (g): 173.2

Sieve Number	Diameter (mm)	Mass of Empty Sieve (g)	Mass of Sieve & Soil (g)	Soil Retained (g)	Soil Retained (%)	Soil Passing (%)
4	4.750	513.6	513.6	0.0	0.0	100.0
10	2.000	680.5	680.5	0.0	0.0	100.0
16	1.180	427.7	427.7	0.0	0.0	100.0
30	0.600	399.3	399.4	0.1	0.1	99.9
40	0.425	269.3	272.0	2.7	1.6	98.4
50	0.300	256.6	288.8	32.2	18.6	79.7
80	0.180	245.3	356.5	111.2	64.2	15.6
100	0.150	235.2	252.9	17.7	10.2	5.3
200	0.075	218.6	227.2	8.6	4.9	0.4
Pan +	-200 washed	490.5	491.3	0.8	0.5	0.0
			TOTAL:	173.4	100.1	



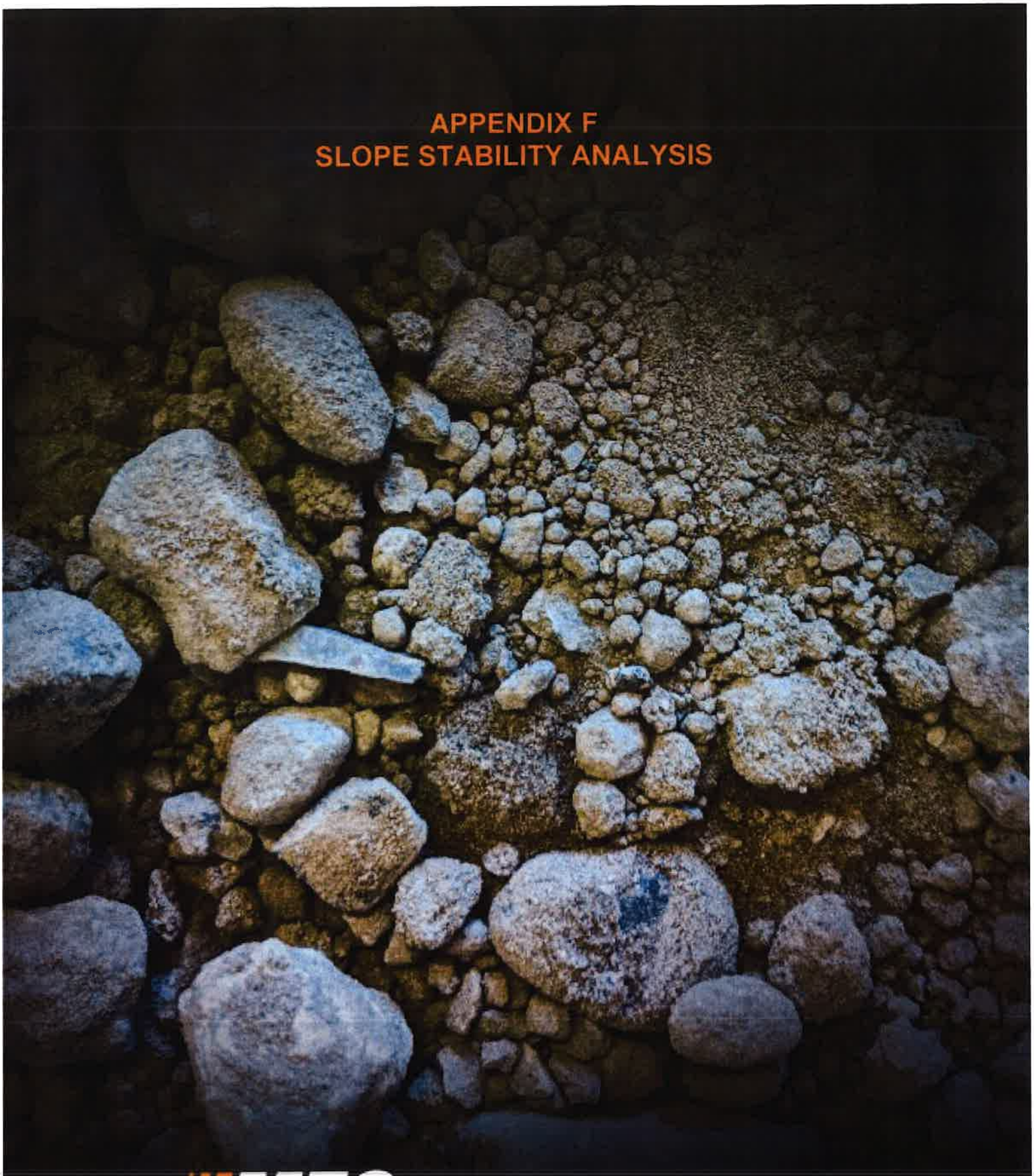
Grain Size Distribution Curve Results:

% Gravel: 0.0 **D_{10}:** 0.164 **C_u:** 1.61

% Sand: 99.6 **D_{30}:** 0.207 **C_c:** 0.99

% Fines: 0.5 **D_{60}:** 0.263

APPENDIX F
SLOPE STABILITY ANALYSIS



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Slope Stability Analysis

A finite element method was used for analyzing global stability of the slope in this project. The factor of safety of 2.7 was determined for the critical condition of the slope.

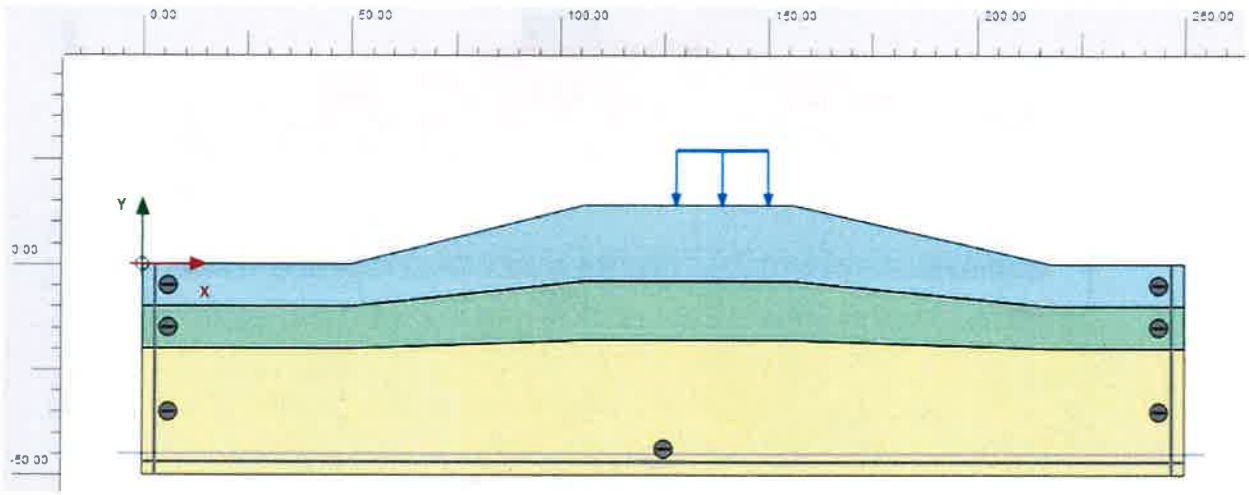


Figure 1: Configuration of the slope considering the restroom located on the top of the hill

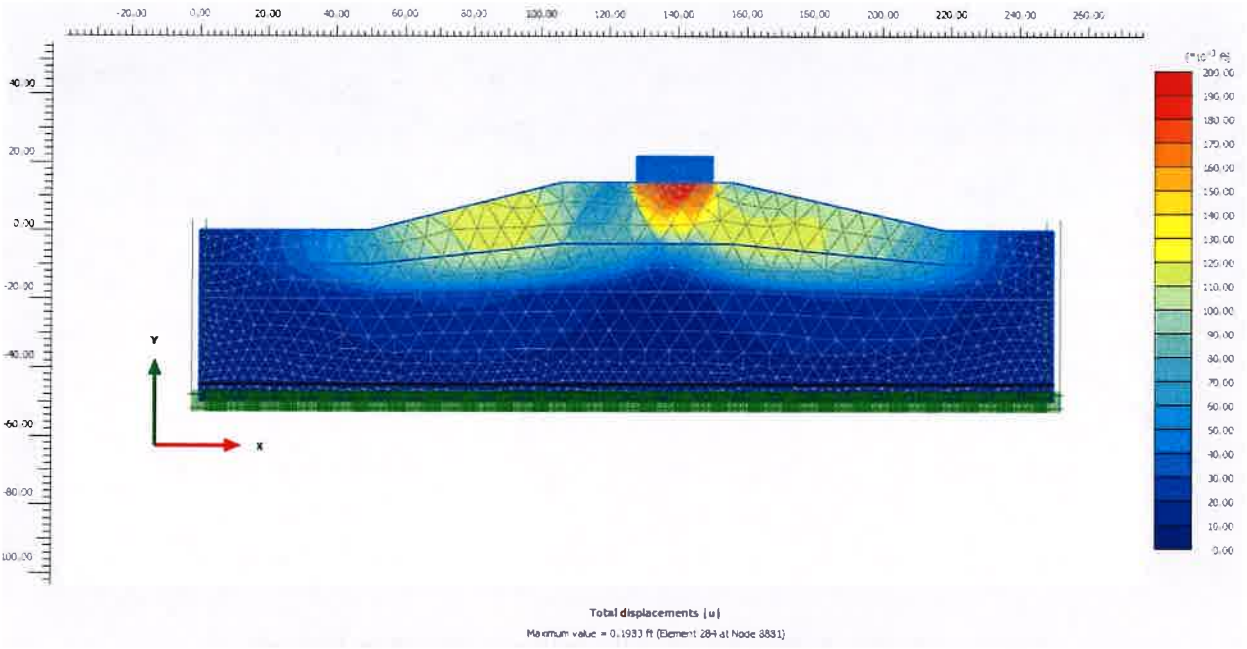


Figure 2: Total deformation

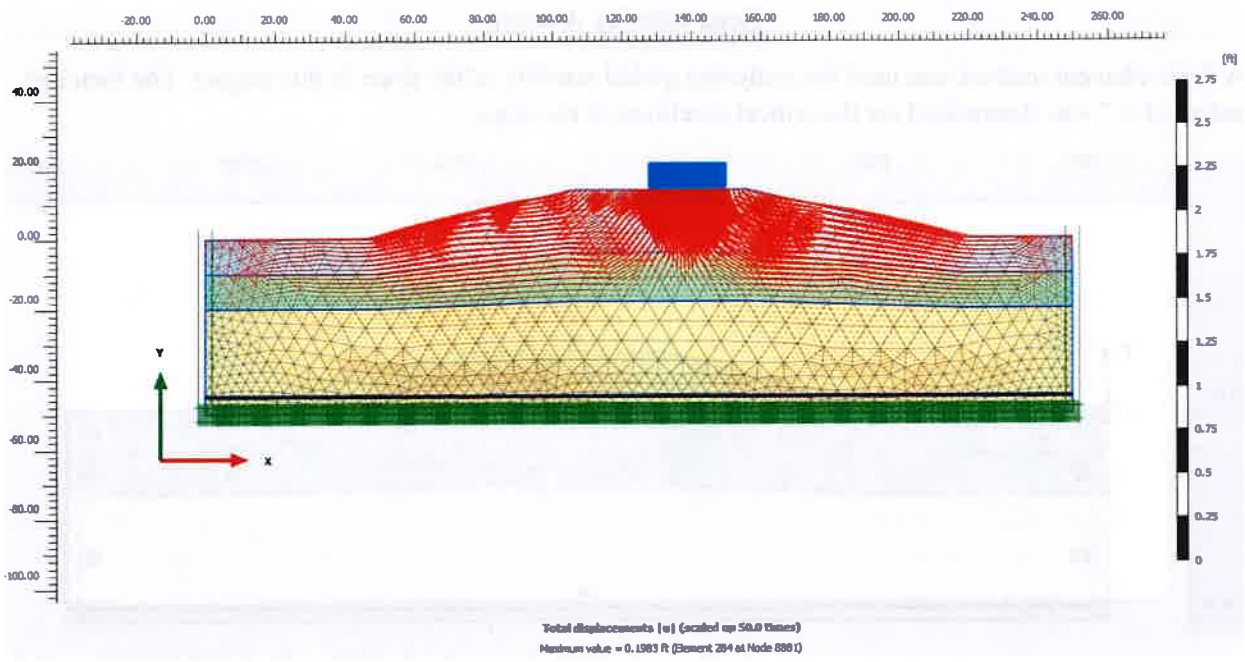


Figure 3: Soil movement direction

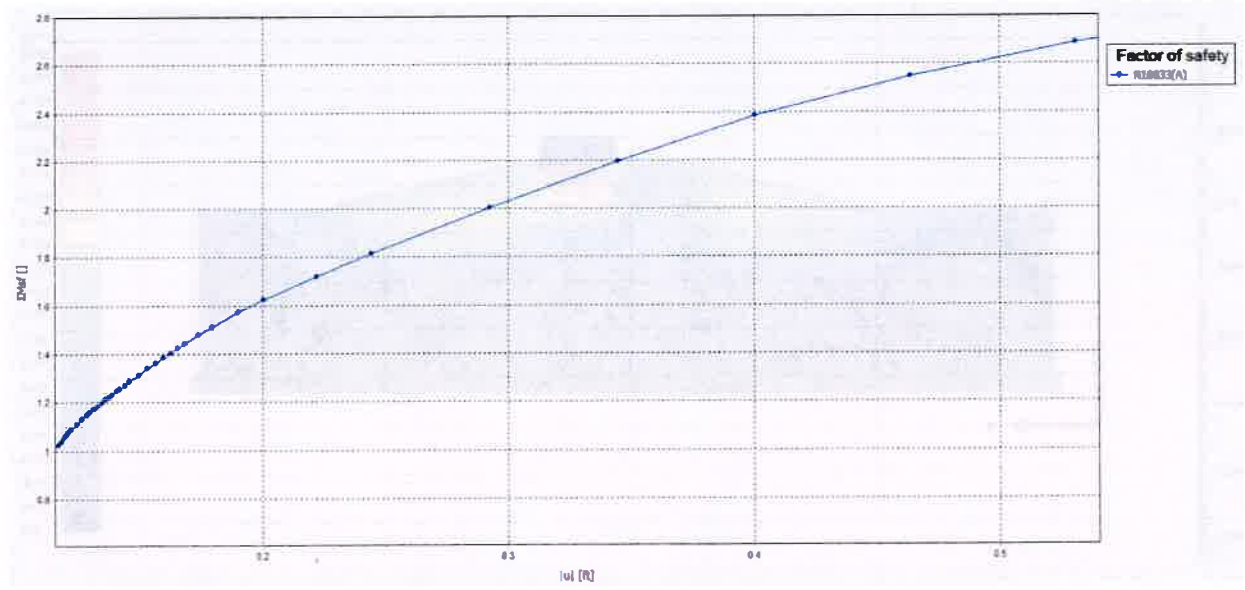
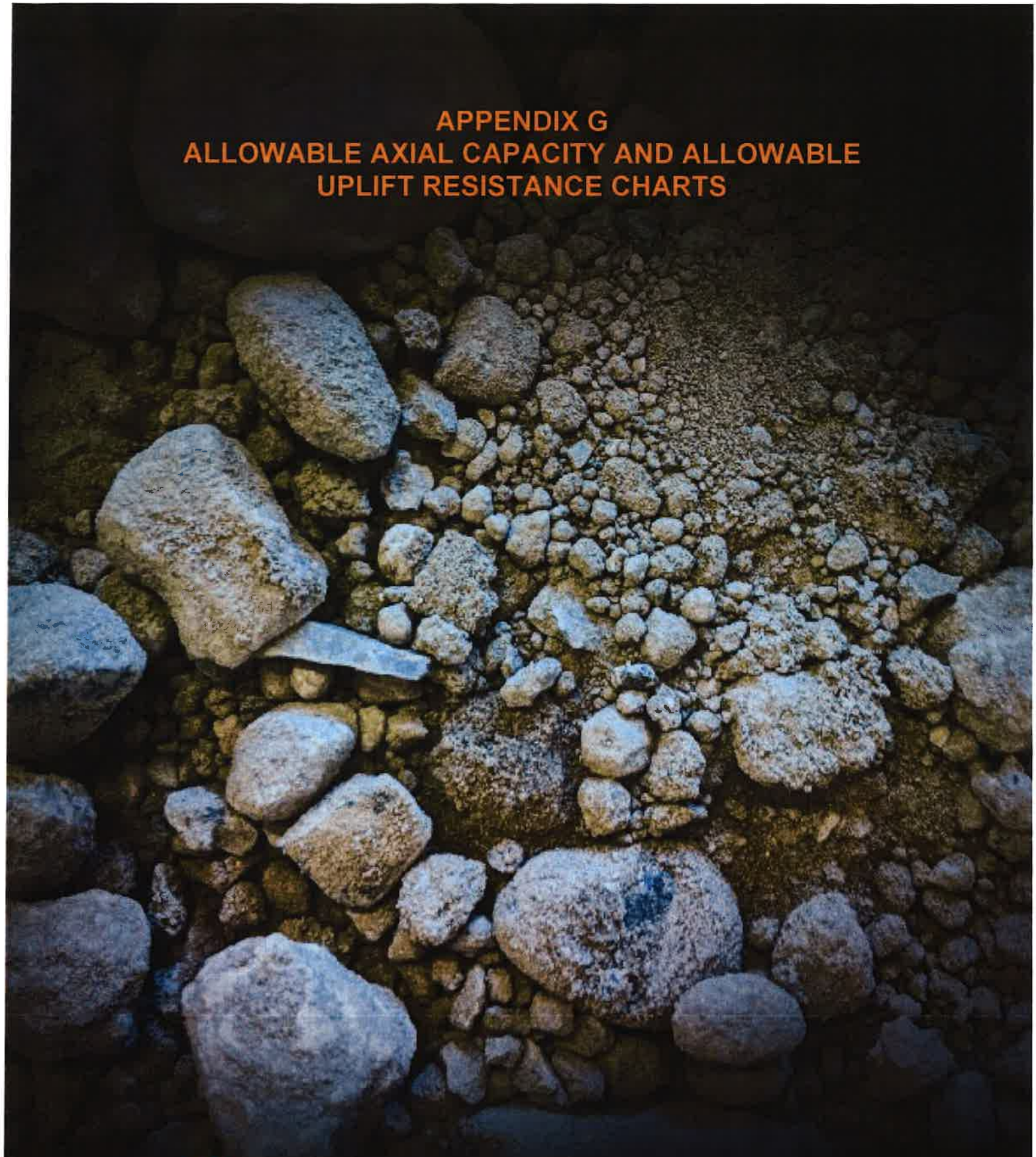


Figure 4: Factor of safety for critical condition of the slope is about 2.7

APPENDIX G
ALLOWABLE AXIAL CAPACITY AND ALLOWABLE UPLIFT RESISTANCE CHARTS



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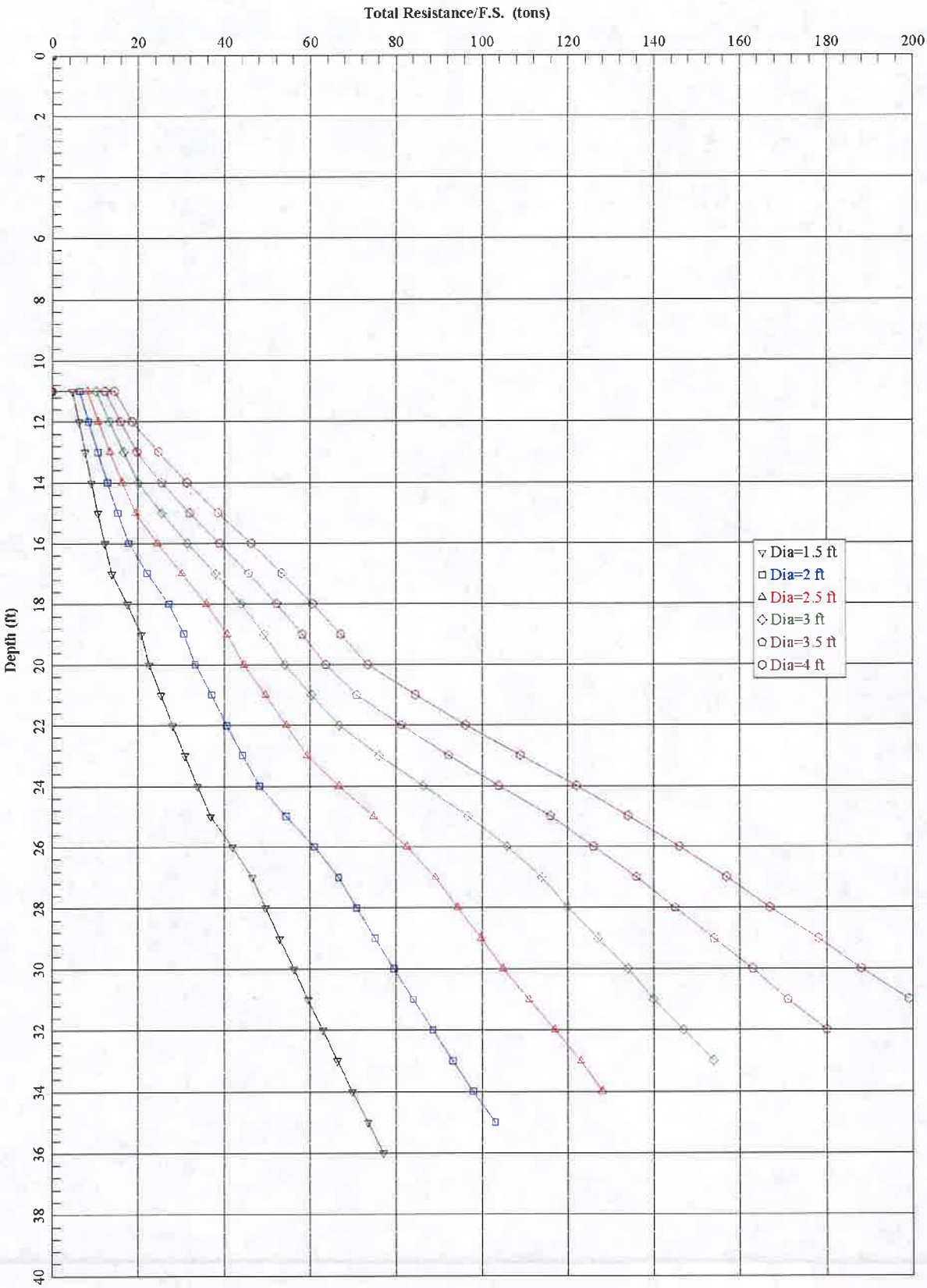
Geotechnical | Environmental | Testing

5840 N. Gumwood Avenue ■ Pharr, Texas 78577 ■ Tel: 956-702-8500 ■ Fax: 956-702-8140



ALLOWABLE AXIAL CAPACITY

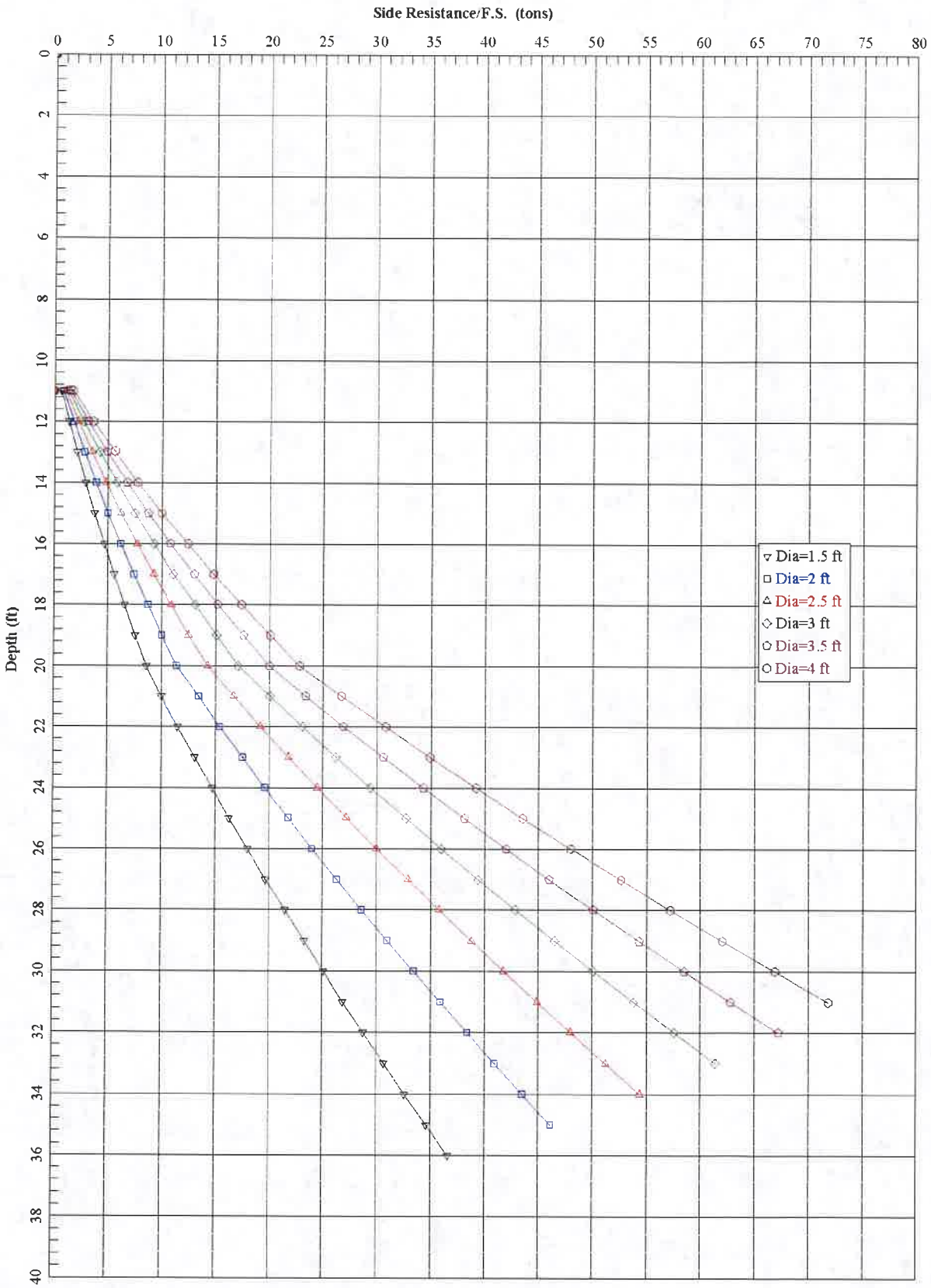
PROPOSED
MONAHANS SANDHILLS STATE PARK RENOVATIONS

MONAHANS, WARD COUNTY, TEXAS

MEG ENGINEERS
Millennium Engineers Group
Consultants - Geotechnical - Testing

MILLENNIUM ENGINEERS GROUP, INC.
1604 RUTHEFORD LANE
AUSTIN, TEXAS 78754
WWW.MEGENGINEERS.COM
TEL: 512-729-0400

MEG PROJECT: 04-20-2910 / DATE: 8/19/2020 / APPROVED BY: A. PALMA / DRAWN BY: S. MARTINEZ



ALLOWABLE UPLIFT RESISTANCE

PROPOSED
MONAHANS SANDHILLS STATE PARK RENOVATIONS

MONAHANS, WARD COUNTY, TEXAS

MILLENNIUM ENGINEERS GROUP, INC.
1604 RUTHEFORD LANE
AUSTIN, TEXAS 78754
WWW.MEGENGINEERS.COM
TEL: 512-729-0400

MEG PROJECT: 04-20-29110 / DATE: 8/19/2020 / APPROVED BY: A. PALMA / DRAWN BY: S. MARTINEZ

APPENDIX H
LABORATORY AND FIELD PROCEDURES

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Laboratory and Field Test Procedures

Soil Classification Per ASTM D2487-93:

This soil-testing standard was used for classifying soils according to the Unified Soil Classification System. The soil classifications of the earth materials encountered are as noted in the attached boring logs.

Soil Water Content Per ASTM D2216-92:

This test determines the water content of soil or rock expressed as a percentage of the solid mass of the soil. The test results are listed under **MC** in the attached boring logs.

Soil Liquid Limit Per ASTM D4318-93:

The soil Liquid Limit identifies the upper limit soil water content at which the soil changes from a moldable (plastic) physical state to a liquid state. The Liquid Limit water content is expressed as a percentage of the solid mass of the soil. The test results are listed under **LL** in the attached boring logs.

Soil Plastic Limit Per ASTM D4318-93:

The soil Plastic Limit identifies lower limit soil water content at which the soil changes from a moldable (plastic) physical state to a non-moldable (semi-solid) physical state. The Plastic Limit water content is expressed as a percentage of the solid mass of the soil. The test results are listed under **PL** in the attached boring logs.

Plasticity Index Per ASTM D4318-93:

This is the numeric difference between the Liquid Limit and Plastic Limit. This index also defines the range of water content over which the soil-water system acts as a moldable (plastic) material. Higher Plasticity Index (PI) values indicate that the soil has a greater ability to change in soil volume or shrink and swell with lower or higher water contents, respectively. The test results are listed under **PI** in the attached boring logs.

Standard Penetration Test (SPT) and Split Spoon Sampler (SS) per ASTM D 1586:

This is the standard test method for both the penetration test and split-barrel (spoon) sampling of soils. This sampling method is used for soils or rock too hard for sampling using Shelby Tubes. The method involves penetration of a split spoon sampler into the soil or rock through successive blows of a 140-pound hammer in a prescribed manner.

Blow Counts (N) per ASTM D 1586:

This is the number of blows required to drive a Split Spoon Sampler by means of a 140 pound hammer for a distance of 12 inches in accordance with the variables stated in the test procedures.

Shelby Tube (ST) per ASTM D 1587:

This procedure is for using a thin-walled metal tube to recover relatively undisturbed soil samples suitable for laboratory tests of physical properties.

Dry Density (DD) per ASTM D 2937:

This procedure is for the determination of in-place density of soil. The test results are measured in pounds per cubic foot, pcf.

Unconfined Compression Test (Uc) per ASTM D 2166:

This test method covers the determination of the unconfined compressive strength of cohesive soil in the undisturbed, remolded, or compacted condition, using strain-controlled application of the axial load.

Minus No. 200 Sieve per ASTM D 1140:

This test method covers determination of the amount of material finer than a Number 200 sieve by washing. The results are stated as a percent of the total dry weight of the sample.

Pocket Penetrometer (PP):

This test method is an accepted modification of ASTM D 1558 test method for establishing the moisture-penetration resistance relationships of fine-grained soils. The test results are measured in tons per square foot, tsf. The strength values provided by this method should be considered qualitatively.

Rock Quality Designation (RQD):

The measure of the quality of a rock mass defined by adding intact rock core pieces greater than four inches in length by the total length of core advance.

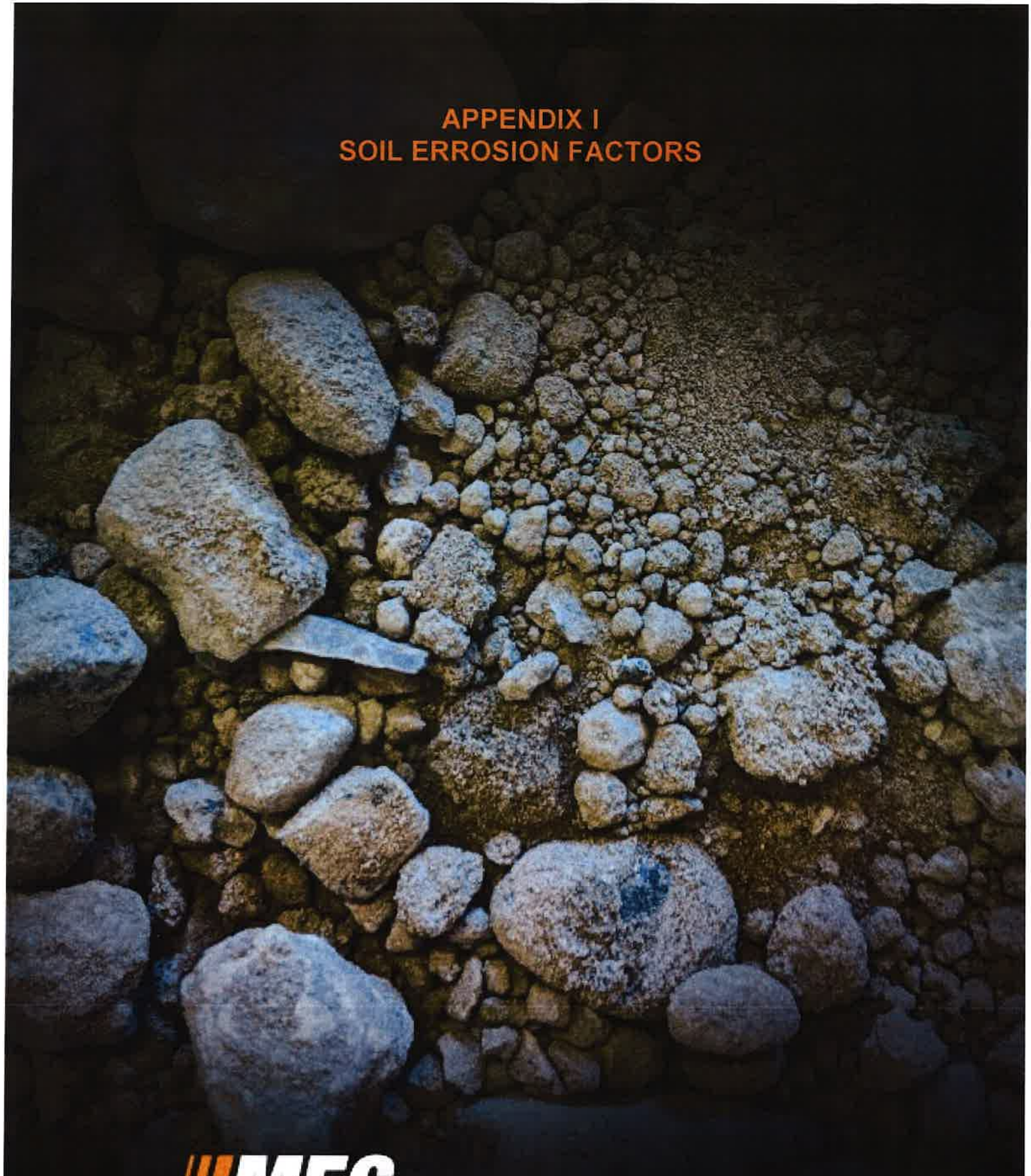
Recovery Ratio (REC):

The Recovery Ratio is equal to the total length of core recovered divided by the total length of core advance.

Boring Logs:

This is a summary of the above-described information at each boring location.

APPENDIX I
SOIL ERROSION FACTORS



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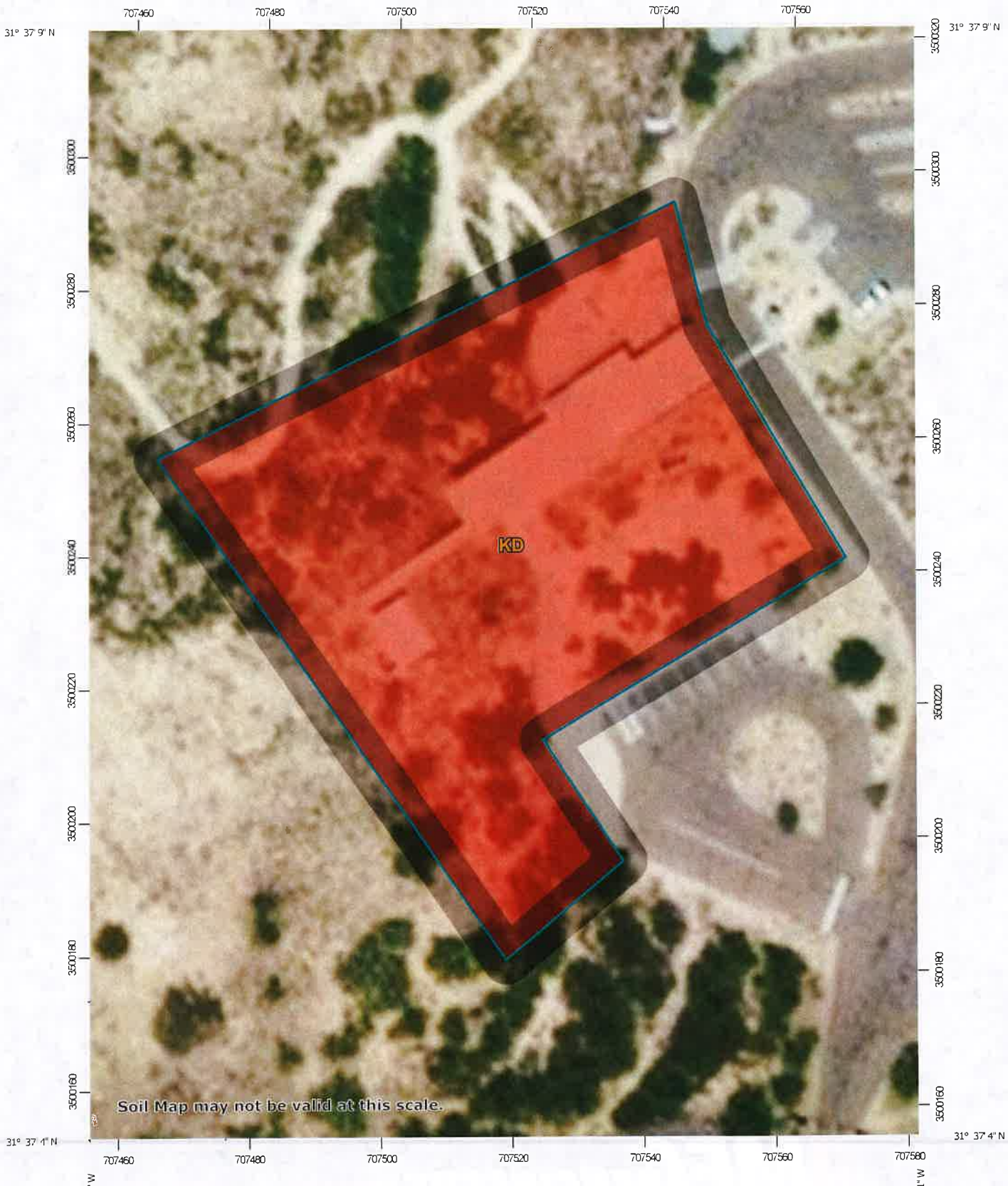
K Factor, Rock Free—Ward County, Texas
(04-20-29110 proposed Monahans Sandhills State Park)



Map Scale: 1:811 if printed on A portrait (8.5" x 11") sheet.

N

Meters
0 10 20 40 60

Feet
0 35 70 140 210

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

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

Soils
- Soil Survey Areas

Soil Rating Polygons
- .02
- .05
- .10
- .15
- .17
- .20
- .24
- .28
- .32
- .37
- .43
- .49
- .55
- .64
- Not rated or not available

Soil Rating Lines
- .02
- .05
- .10
- .15
- .17
- .20
- .24
- .28
- .32
- .37
- .43
- .49
- .55
- .64
- Not rated or not available

Soil Rating Points
- .02
- .05
- .10
- .15
- .17
- .20
- .24
- .28
- .32
- .37
- .43
- .49
- .55
- .64
- Not rated or not available

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 1:24,000.

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: Ward County, Texas
Survey Area Data: Version 19, Jun 11, 2020

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

Date(s) aerial images were photographed: Oct 21, 2016—Sep 17, 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.

K Factor, Rock Free

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
KD	Kermit-Dune land association, hummocky	.02	1.4	100.0%
Totals for Area of Interest			**1.4**	**100.0%**

Description

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kf (rock free)" indicates the erodibility of the fine-earth fraction, or the material less than 2 millimeters in size.

Rating Options

Aggregation Method: Dominant Component

Aggregation is the process by which a set of component attribute values is reduced to a single value that represents the map unit as a whole.

A map unit is typically composed of one or more "components". A component is either some type of soil or some nonsoil entity, e.g., rock outcrop. For the attribute being aggregated, the first step of the aggregation process is to derive one attribute value for each of a map unit's components. From this set of component attributes, the next step of the aggregation process derives a single value that represents the map unit as a whole. Once a single value for each map unit is derived, a thematic map for soil map units can be rendered. Aggregation must be done because, on any soil map, map units are delineated but components are not.

For each of a map unit's components, a corresponding percent composition is recorded. A percent composition of 60 indicates that the corresponding component typically makes up approximately 60% of the map unit. Percent composition is a critical factor in some, but not all, aggregation methods.

The aggregation method "Dominant Component" returns the attribute value associated with the component with the highest percent composition in the map unit. If more than one component shares the highest percent composition, the corresponding "tie-break" rule determines which value should be returned. The "tie-break" rule indicates whether the lower or higher attribute value should be returned in the case of a percent composition tie. The result returned by this aggregation method may or may not represent the dominant condition throughout the map unit.

Component Percent Cutoff: None Specified

Components whose percent composition is below the cutoff value will not be considered. If no cutoff value is specified, all components in the database will be considered. The data for some contrasting soils of minor extent may not be in the database, and therefore are not considered.

Tie-break Rule: Higher

The tie-break rule indicates which value should be selected from a set of multiple candidate values, or which value should be selected in the event of a percent composition tie.

Layer Options (Horizon Aggregation Method): All Layers (Weighted Average)

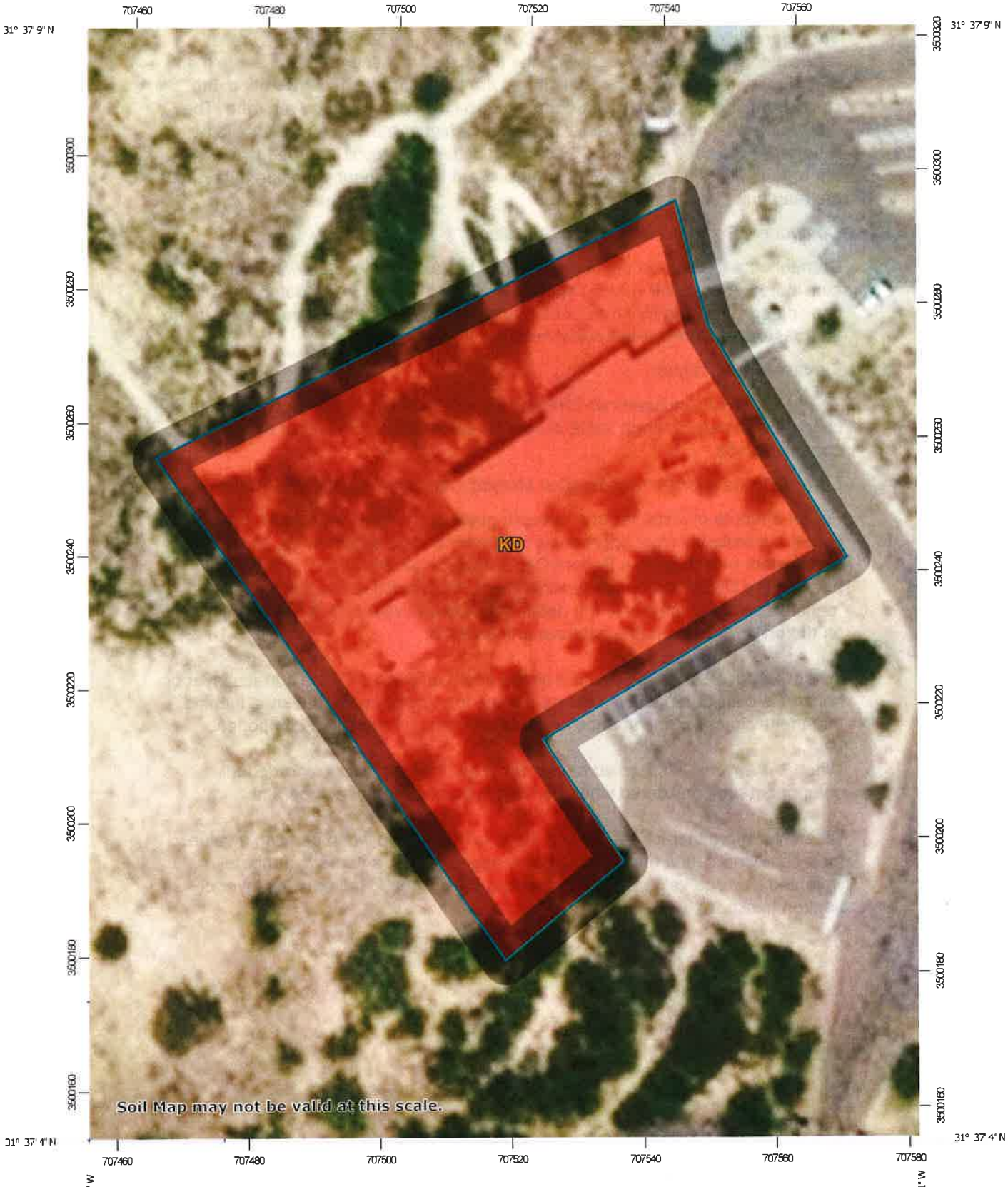
For an attribute of a soil horizon, a depth qualification must be specified. In most cases it is probably most appropriate to specify a fixed depth range, either in centimeters or inches. The Bottom Depth must be greater than the Top Depth, and the Top Depth can be greater than zero. The choice of "inches" or "centimeters" only applies to the depth of soil to be evaluated. It has no influence on the units of measure the data are presented in.

When "Surface Layer" is specified as the depth qualifier, only the surface layer or horizon is considered when deriving a value for a component, but keep in mind that the thickness of the surface layer varies from component to component.

When "All Layers" is specified as the depth qualifier, all layers recorded for a component are considered when deriving the value for that component.

Whenever more than one layer or horizon is considered when deriving a value for a component, and the attribute being aggregated is a numeric attribute, a weighted average value is returned, where the weighting factor is the layer or horizon thickness.

K Factor, Whole Soil—Ward County, Texas
(04-20-29110 proposed Monahans Sandhills State Park)



Map Scale: 1:811 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 10 20 40 60

Feet: 0 35 70 140 210

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

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

Soils
- Soil Survey Areas

Soil Rating Polygons
- .02
- .05
- .10
- .15
- .17
- .20
- .24
- .28
- .32
- .37
- .43
- .49
- .55
- .64
- Not rated or not available

Soil Rating Lines
- .02
- .05
- .10
- .15
- .17
- .20
- .24
- .28
- .32
- .37
- .43
- .49
- .55
- .64
- Not rated or not available

Soil Rating Points
- .02
- .05
- .10
- .15
- .17
- .20
- .24
- .28
- .32
- .37
- .43
- .49
- .55
- .64
- Not rated or not available

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 1:24,000.

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: Ward County, Texas
Survey Area Data: Version 19, Jun 11, 2020

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

Date(s) aerial images were photographed: Oct 21, 2016—Sep 17, 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.

K Factor, Whole Soil

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
KD	Kermit-Dune land association, hummocky	.02	1.4	100.0%
Totals for Area of Interest			**1.4**	**100.0%**

Description

Erosion factor K indicates the susceptibility of a soil to sheet and rill erosion by water. Factor K is one of six factors used in the Universal Soil Loss Equation (USLE) and the Revised Universal Soil Loss Equation (RUSLE) to predict the average annual rate of soil loss by sheet and rill erosion in tons per acre per year. The estimates are based primarily on percentage of silt, sand, and organic matter and on soil structure and saturated hydraulic conductivity (Ksat). Values of K range from 0.02 to 0.69. Other factors being equal, the higher the value, the more susceptible the soil is to sheet and rill erosion by water.

"Erosion factor Kw (whole soil)" indicates the erodibility of the whole soil. The estimates are modified by the presence of rock fragments.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

Layer Options (Horizon Aggregation Method): All Layers (Weighted Average)

T Factor—Ward County, Texas
(04-20-29110 proposed Monahans Sandhills State Park)

MAP LEGEND

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

Soils
- Soil Survey Areas

Soil Rating Polygons
- 1
- 2
- 3
- 4
- 5
- Not rated or not available

Soil Rating Lines
- 1
- 2
- 3
- 4
- 5
- Not rated or not available

Soil Rating Points
- 1
- 2
- 3
- 4
- 5
- Not rated or not available

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 1:24,000.

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: Ward County, Texas
Survey Area Data: Version 19, Jun 11, 2020

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

Date(s) aerial images were photographed: Oct 21, 2016—Sep 17, 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.

T Factor

Map unit symbol	Map unit name	Rating (tons per acre per year)	Acres in AOI	Percent of AOI
KD	Kermit-Dune land association, hummocky	5	1.4	100.0%
Totals for Area of Interest			**1.4**	**100.0%**

Description

The T factor is an estimate of the maximum average annual rate of soil erosion by wind and/or water that can occur without affecting crop productivity over a sustained period. The rate is in tons per acre per year.

Rating Options

Units of Measure: tons per acre per year

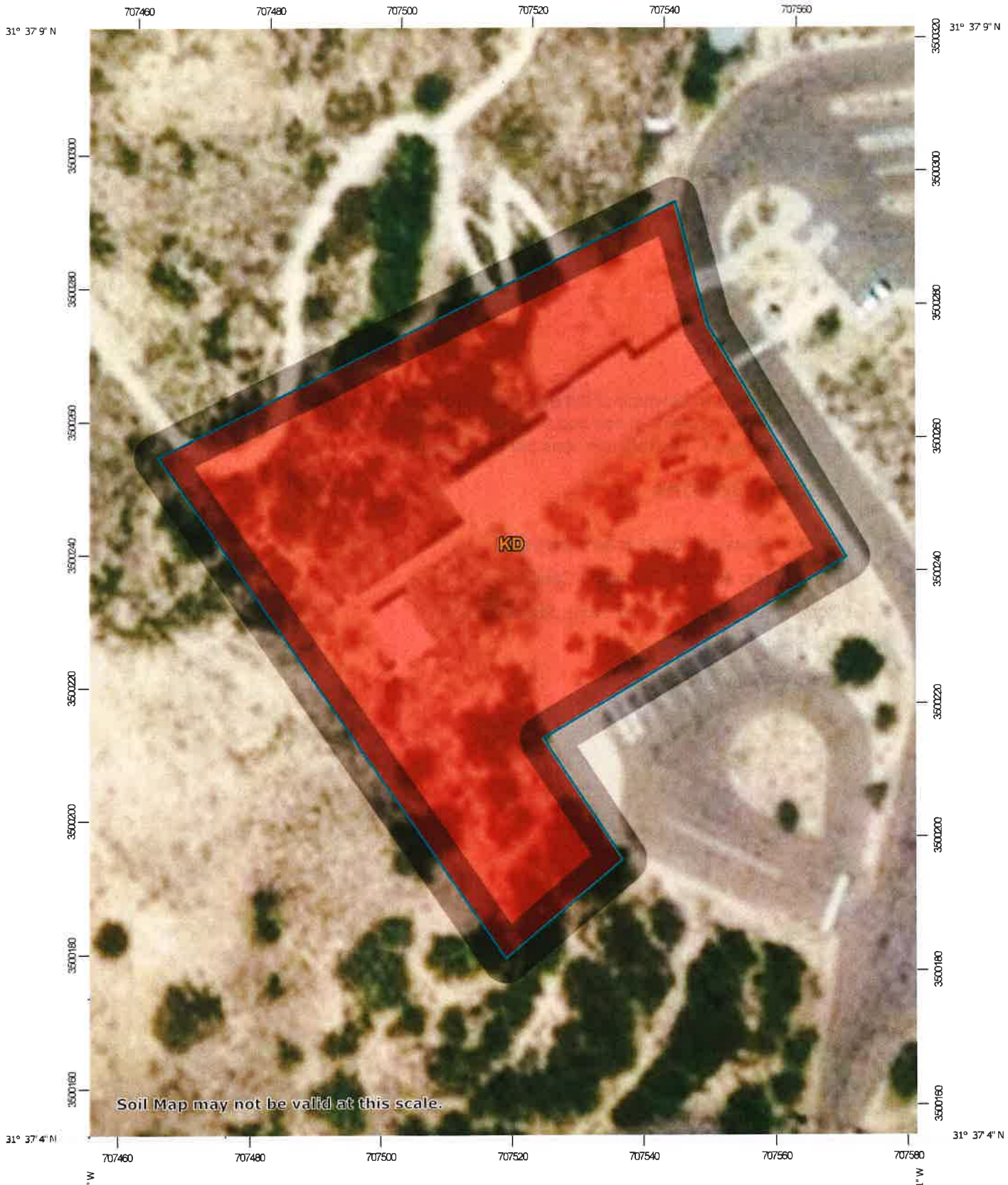
Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Interpret Nulls as Zero: No

Wind Erodibility Group—Ward County, Texas
(04-20-29110 proposed Monahans Sandhills State Park)



Map Scale: 1:811 if printed on A portrait (8.5" x 11") sheet.

N

Meters: 0 10 20 40 60

Feet: 0 35 70 140 210

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 13N WGS84

MAP LEGEND

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

Soils
- Soil Survey Areas

Soil Rating Polygons
- 1
- 2
- 3
- 4
- 4L
- 5
- 6
- 7
- 8
- Not rated or not available

Soil Rating Lines
- 1
- 2
- 3
- 4
- 4L
- 5
- 6
- 7
- 8
- Not rated or not available

Soil Rating Points
- 1
- 2
- 3
- 4
- 4L
- 5
- 6
- 7
- 8
- Not rated or not available

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 1:24,000.

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: Ward County, Texas
Survey Area Data: Version 19, Jun 11, 2020

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

Date(s) aerial images were photographed: Oct 21, 2016—Sep 17, 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.

Wind Erodibility Group

Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
KD	Kermit-Dune land association, hummocky	1	1.4	100.0%
Totals for Area of Interest			**1.4**	**100.0%**

Description

A wind erodibility group (WEG) consists of soils that have similar properties affecting their susceptibility to wind erosion in cultivated areas. The soils assigned to group 1 are the most susceptible to wind erosion, and those assigned to group 8 are the least susceptible.

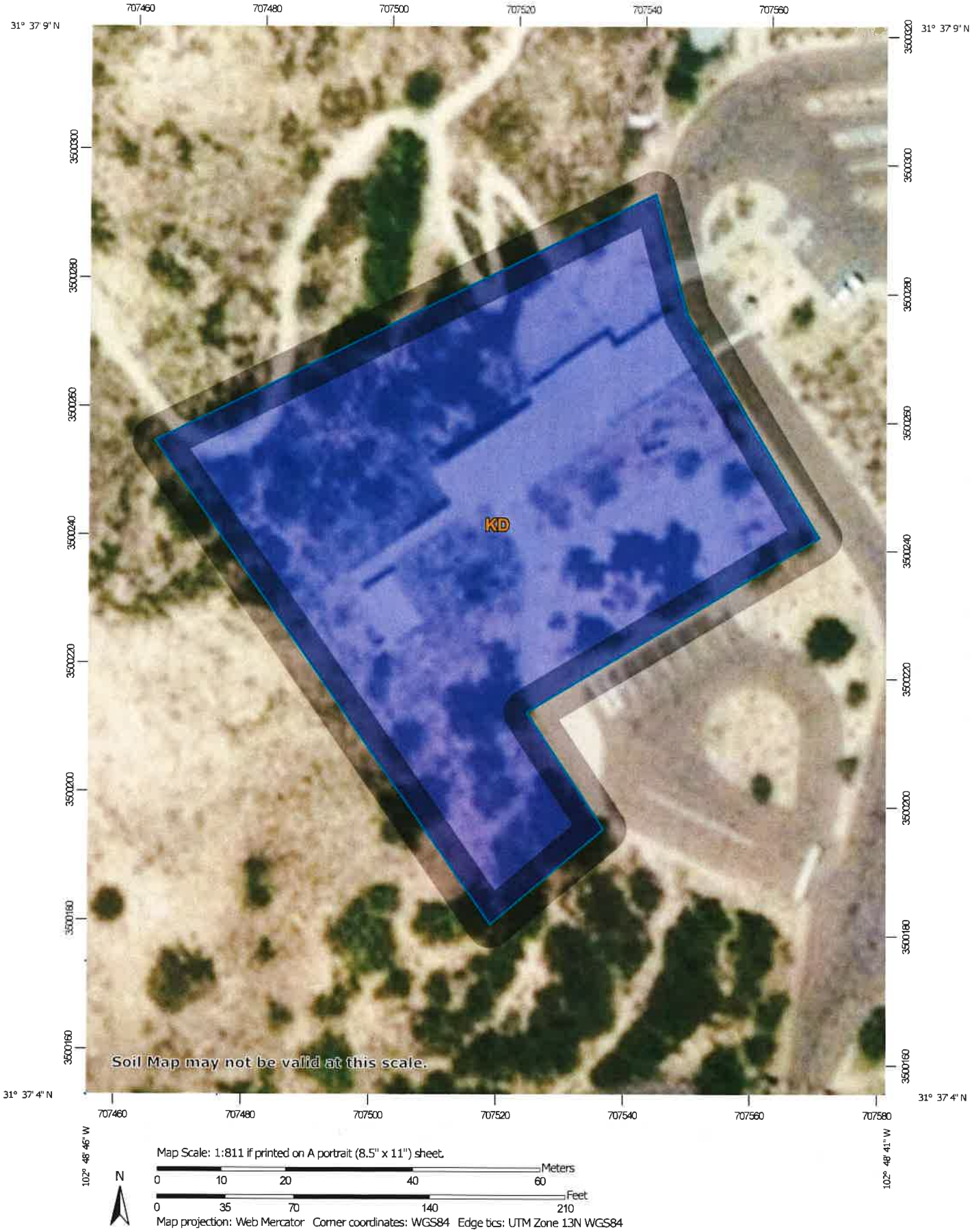
Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Lower

Wind Erodibility Index—Ward County, Texas
(04-20-29110 proposed Monahans Sandhills State Park)



MAP LEGEND

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

Soils
- Soil Survey Areas

Soil Rating Polygons
- 0
- 38
- 48
- 56
- 86
- 134
- 160
- 180
- 220
- 250
- 310
- Not rated or not available

Soil Rating Lines
- 0
- 38
- 48
- 56
- 86
- 134
- 160
- 180
- 220
- 250
- 310
- Not rated or not available

Soil Rating Points
- 0
- 38
- 48
- 56
- 86
- 134
- 160
- 180
- 220
- 250
- 310
- Not rated or not available

Water Features
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- Rails
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MAP INFORMATION

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

Soil Survey Area: Ward County, Texas
Survey Area Data: Version 19, Jun 11, 2020

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

Date(s) aerial images were photographed: Oct 21, 2016—Sep 17, 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.

Wind Erodibility Index

Map unit symbol	Map unit name	Rating (tons per acre per year)	Acres in AOI	Percent of AOI
KD	Kermit-Dune land association, hummocky	250	1.4	100.0%
Totals for Area of Interest			**1.4**	**100.0%**

Description

The wind erodibility index is a numerical value indicating the susceptibility of soil to wind erosion, or the tons per acre per year that can be expected to be lost to wind erosion. There is a close correlation between wind erosion and the texture of the surface layer, the size and durability of surface clods, rock fragments, organic matter, and a calcareous reaction. Soil moisture and frozen soil layers also influence wind erosion.

Rating Options

Units of Measure: tons per acre per year

Aggregation Method: Dominant Condition

Component Percent Cutoff: None Specified

Tie-break Rule: Higher

MEG OSSF REPORT

PROPOSED
MONAHANS STATE PARK OSSF

MONAHANS, WARD COUNTY, TEXAS

Geotechnical Engineering • Construction Materials Engineering & Testing
Environmental • Consulting • Forensics

ON-SITE SEWAGE FACILITES REPORT
MONAHANS STATE PARK OSSF
MONAHANS, WARD COUNTY, TEXAS

Prepared For
David Negrete, AIA
Principal and Partner
Negrete & Kolar Architects, LLP.

MEG Report No. 04-20-29108

September 2, 2020

TBPE FIRM NO. F-3913
1601 RUTHERFORD LANE, STE A100
AUSTIN, TEXAS 78754
TEL: 512-729-0400

September 2, 2020

David Negrete, AIA
Principal and Partner
NEGRETE & KOLAR ARCHITECTS LLP
11720 N. IH 35
Austin, Texas 78753
512.474.6526
dnegrete@nekoarch.com

Subject: **On-Site Sewage Facilities Report**
M.E.G. Report No. 04-20-29108
Monahans State Park OSSF
Monahans, Ward County, Texas

Dear Mr. Negrete:

Millennium Engineers Group, Inc. is pleased to submit the enclosed On-Site Sewage Facilities Report that was prepared for Monahans State Park located in Monahans, Ward County, Texas. This study addresses the findings of our On-Site sewage facilities. Our recommendations should be incorporated into the design and construction documents for the proposed development.

Thank you for the opportunity to be of service to you in this phase of the project and we would like the opportunity to assist you in the upcoming phases of the project. We look forward to continuing our involvement in the project by providing construction monitoring and materials testing services during construction.

If you have any questions, please contact our office at the address, telephone, fax or electronic address listed below.

Cordially,
Millennium Engineers Group, Inc.
TBPE Firm No. F-3913

Raul Palma, P.E.
President

Table of Contents

APPENDIX

Application Information:

Name: David Negrete, AIA
Address: 11720 N. IH 35
City/State/Zip Code: Austin, Texas 78753
Phone: (512) 474-6526

Site Evaluator Information:

Name: Raul Palma
Company: Millennium Engineers Group, Inc.
Address: 1601 Rutherford Lane
City/State/Zip Code: Austin, Texas 78754
Phone: 512-729-0400

Property Location Information:

Street/Road Address:
2500 East Interstate 20 Exit 86, Monahans, Texas
County: Ward
Unincorporated Area? Yes
Additional Information:

Schematic of Lot or Tract

Show:

- Compass, adjacent streets, property lines, property dimensions, locations of buildings, easements, swimming pools, water lines, and other surface improvements where known (drainage, patios, sidewalks).
- Locations of existing or proposed water wells within 150 feet of property.
- Indicate slope or provide contour lines from the structure to the farthest location of the proposed soil absorption or irrigation area.
- Location of soil borings or dug pits (show location with respect to a known reference point.).
- Location of natural, constructed, or proposed drainage ways, (streams, ponds, lakes, rivers, high tide of salt water bodies) water impoundment areas, cut or fill bank, sharp slopes and breaks.
- Note type of vegetation on lot.

For Site Drawing see "Attached Drawings".

Features of Site Area

Presence of 100 year flood zone. Flood zone designation: _	Yes: _	No: X
Presence of adjacent ponds, streams, water impoundments.	Yes: _	No: X
Existing or proposed water well in nearby area.	Yes: _	No: X
Organized sewage service available to lot or tract.	Yes: _	No: X

I certify that the findings of this report are based on my field observations and are accurate to the best of my ability.

Site Evaluator:
Name: Raul Palma, P.E. Signature: Raul Palma License No. 65656
(Circle One: RS, PE, DR, Installer II)

ON-SITE SEWERAGE FACILITY
SOIL EVALUATION REPORT INFORMATION

Date Soil Survey Performed: August 31, 2020
Site Location: Monahans State Park

County: Ward
Name of Site Evaluator: Raul Palma, P.E.

Proposed Excavation Depth: 5 feet
Registration Number: 65656

Requirements:

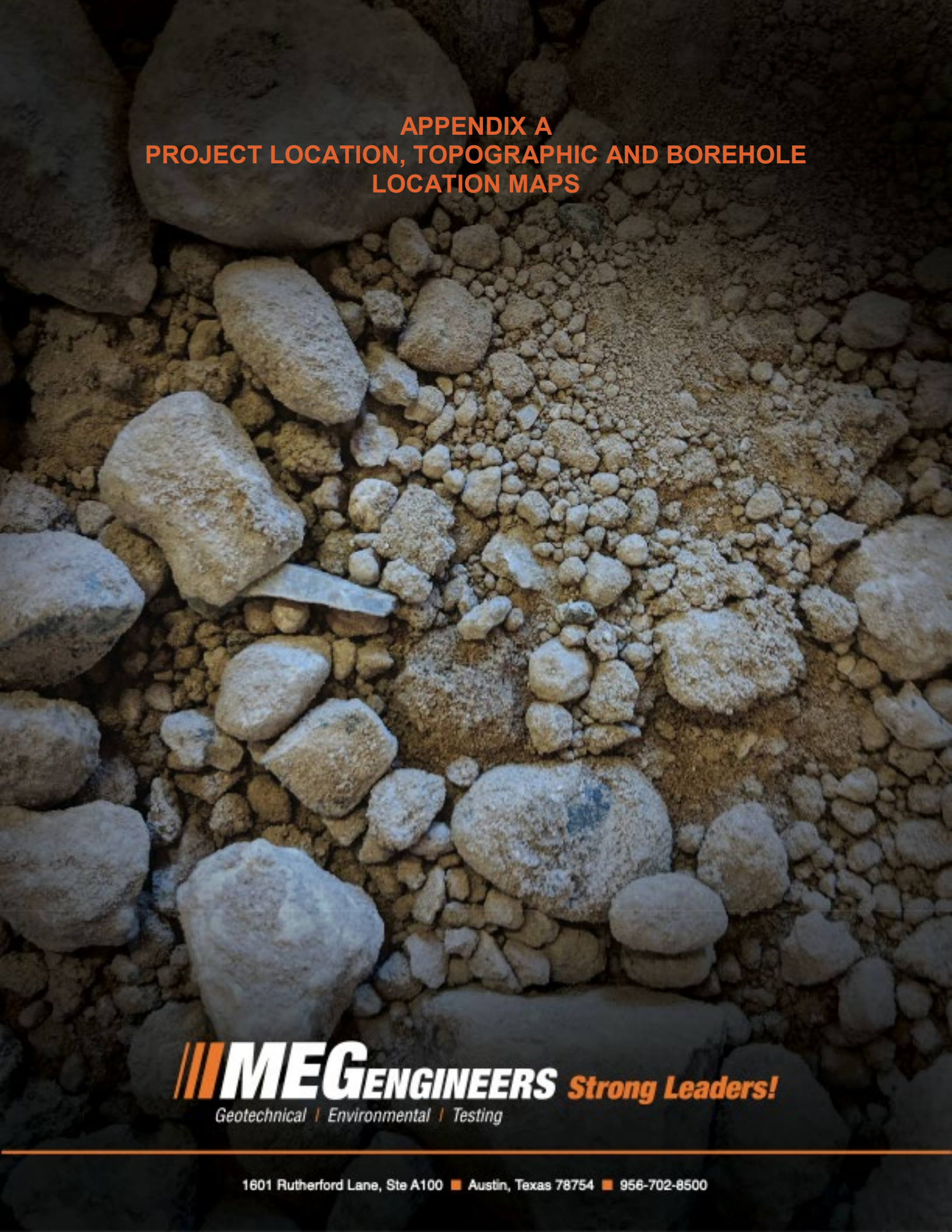
- At least two soil excavations must be performed on the site at opposite ends of the proposed disposal area. Locations of soil borings or dug pits must be shown on the site drawing.
- For subsurface disposal, soil evaluations must be performed to a depth of at least two feet below the proposed excavation depth. For surface disposal, the surface horizon must be evaluated.

Soil Boring Number (B-1)

Depth (Feet)	Classification	Soil Texture	Structure (for CL III-blocky, platy or massive)	Drainage (Mottless water table)	Restrictive Horizon	Observation
0	1b – Sand	Grittiness	Blocky	None	None	Brown color
1	1b – Sand	Grittiness	Blocky	None	None	Brown color
2	1b – Sand	Grittiness	Blocky	None	None	Brown color
3	1b – Sand	Grittiness	Blocky	None	None	Brown color
4	1b – Sand	Grittiness	Blocky	None	None	Brown color
5						

Soil Boring Number (B-2)

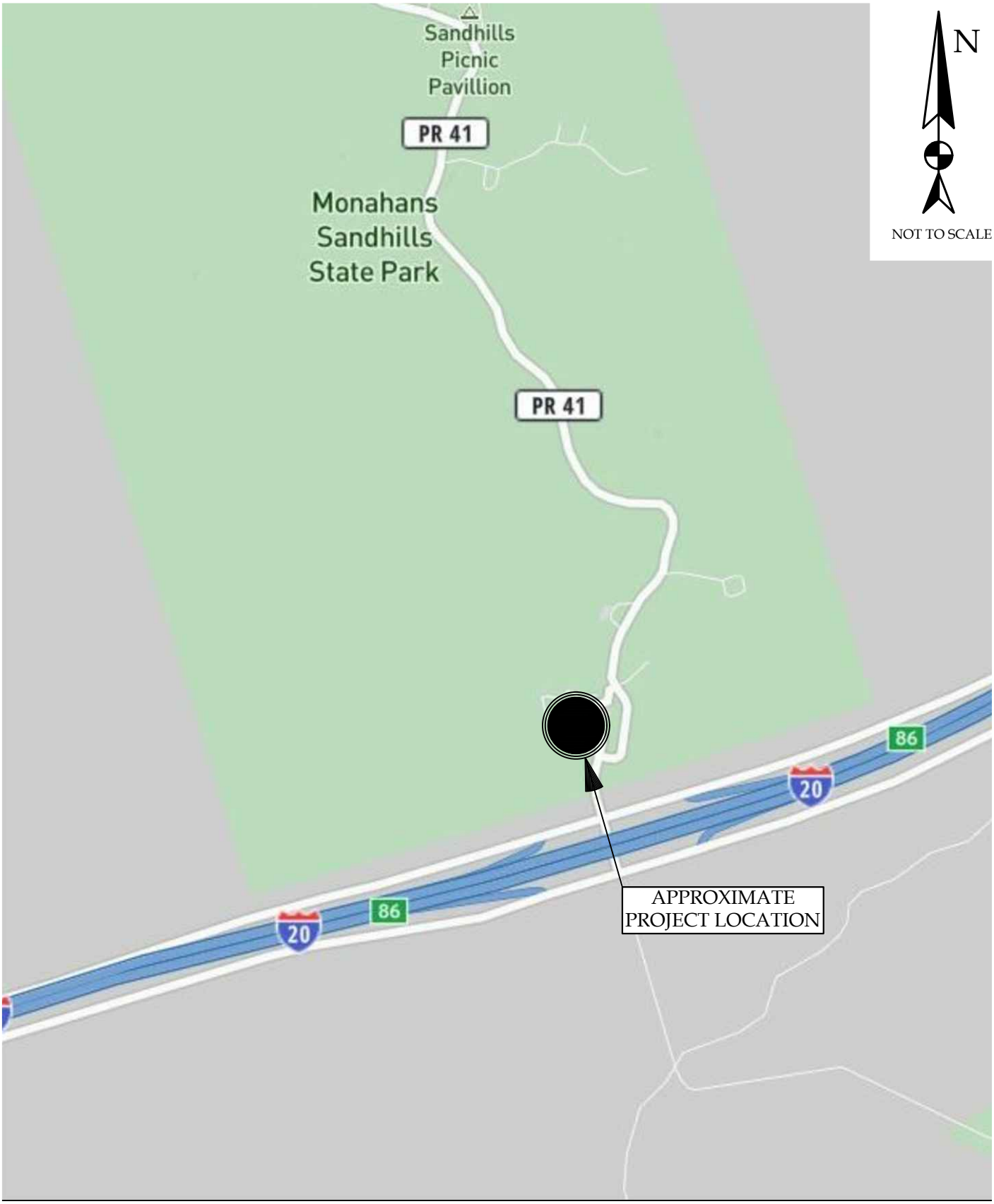
Depth (Feet)	Classification	Soil Texture	Structure (for CL III-blocky, platy or massive)	Drainage (Mottless water table)	Restrictive Horizon	Observation
0	1b – Sand	Grittiness	Blocky	None	None	Brown color
1	1b – Sand	Grittiness	Blocky	None	None	Brown color
2	1b – Sand	Grittiness	Blocky	None	None	Brown color
3	1b – Sand	Grittiness	Blocky	None	None	Brown color
4	1b – Sand	Grittiness	Blocky	None	None	Brown color
5						



APPENDIX A
PROJECT LOCATION, TOPOGRAPHIC AND BOREHOLE LOCATION MAPS

MEG ENGINEERS Strong Leaders!
Geotechnical | Environmental | Testing

1601 Rutherford Lane, Ste A100 ■ Austin, Texas 78754 ■ 956-702-8500



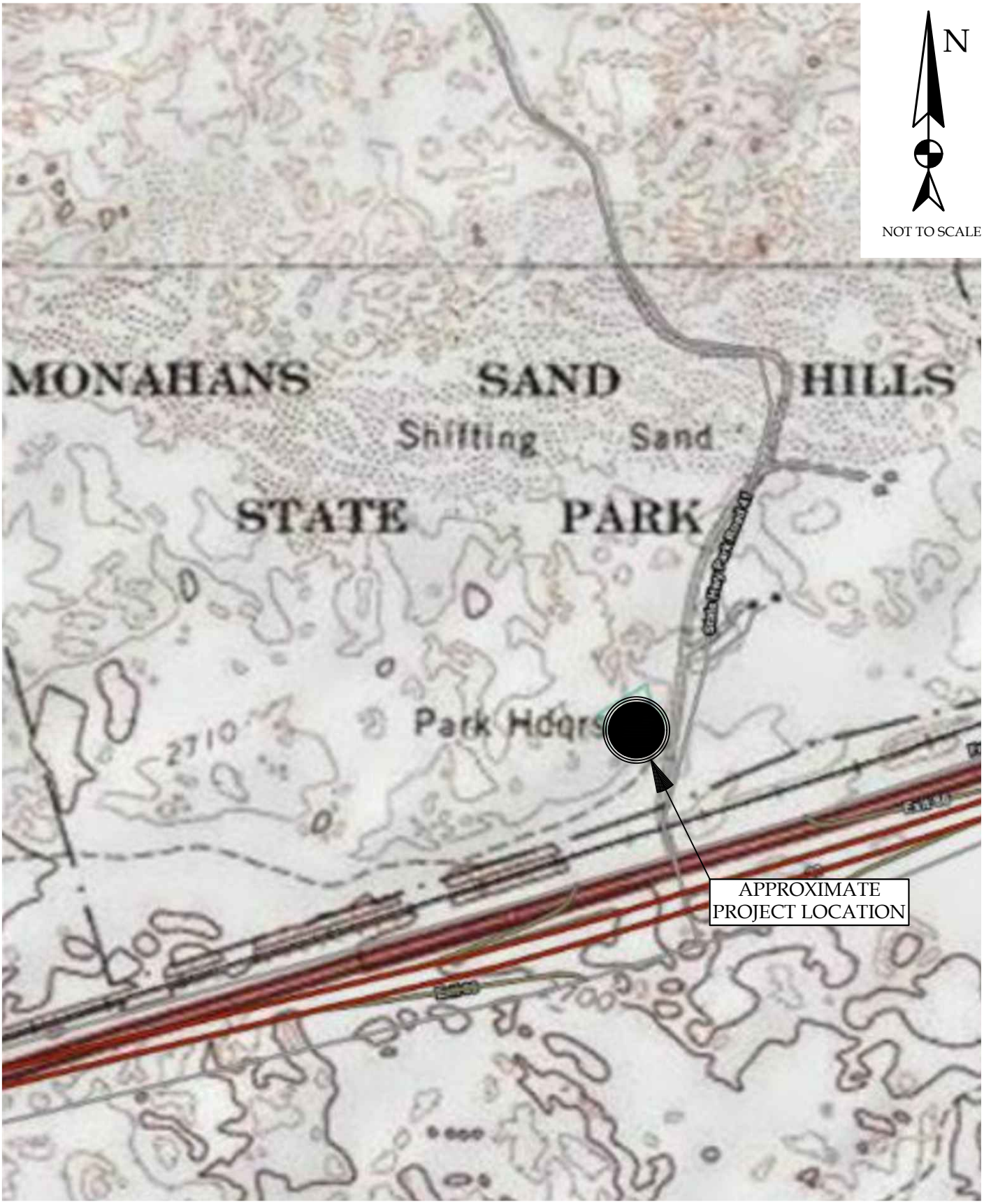
PROJECT SITE LOCATION MAP

PROPOSED
MONAHANS STATE PARK OSSF

MONAHANS, WARD COUNTY, TEXAS

MILLENNIUM ENGINEERS GROUP, INC.
1604 RUTHEFORD LANE
AUSTIN, TEXAS 78754
WWW.MEGENGINEERS.COM
TEL: 512-729-0400

MEG PROJECT: 04-20-29108 / DATE: 9/2/2020 / APPROVED BY: A. PALMA / DRAWN BY: S. MARTINEZ



PROJECT TOPOGRAPHY MAP

PROPOSED
MONAHANS STATE PARK OSSF

MONAHANS, WARD COUNTY, TEXAS

MILLENNIUM ENGINEERS GROUP, INC.
1604 RUTHEFORD LANE
AUSTIN, TEXAS 78754
WWW.MEGENGINEERS.COM
TEL: 512-729-0400

MEG PROJECT: 04-20-29108 / DATE: 9/2/2020 / APPROVED BY: A. PALMA / DRAWN BY: S. MARTINEZ

MEG PROJECT: 04-20-29108 / DATE: 9/2/2020 / APPROVED BY: A. PALMA / DRAWN BY: S. MARTINEZ

PROJECT BOREHOLE LOCATION MAP

PROPOSED
MONAHANS STATE PARK OSSF

MONAHANS, WARD COUNTY, TEXAS

Millennium Engineers Group
MEG ENGINEERS
Consultants - Geotechnical - Testing

MILLENNIUM ENGINEERS GROUP, INC.
1604 RUTHEFORD LANE
AUSTIN, TEXAS 78754
WWW.MEGENGINEERS.COM
TEL: 512-729-0400

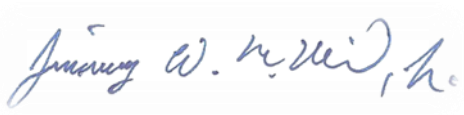
ABATEMENT SPECIFICATION FOR REMOVAL/REPAINTING OF COMPONENTS PREVIOUSLY PAINTED WITH LEAD BASED PAINT (COATINGS)

Sandhills State Park
Section House
2500 E. Interstate 20, Exit 86
Monahans, Texas, 79756

Prepared for:
Negrete & Kolar Architects LLP
11720 North IH 35
Austin, Texas, 79753

Prepared by:
Etech Environmental & Safety Solutions, Inc.
13000 W. County Road 100
Midland, Texas 79711

8 January 2021



Jimmy W. McNeil, Jr.
DSHS Lead Risk Assessor
Certification # 2070395
Expires 5/26/2022

ETECH
Environmental & Safety Solutions, Inc.

SECTION ONE: SCOPE OF WORK

1.0 Description of the Work

1.1 The work specified herein shall be the paint removal or paint stabilization or component replacement of approximately 12,500 square feet of Lead-based Paint from the Section House at the Sandhills State Park located approximately five miles east of Monahans, Texas. The lead-based paint is on all the painted surfaces of the structure including, but not limited to the siding, windows, doors and trim. The GPS coordinates for the Section House are 31.634833 N, 102.815132 W. The removal shall be performed in accordance with OSHA 1926.62 by a "competent" contractor employing properly trained personnel. A lead inspection was performed on the exterior of the Section House on August 25, 2020 and can be found in Section Ten of this specification.

1.2 Before submitting a bid for this work, it is highly recommended that the Bidder visit the site and familiarize themselves of existing conditions under which he will operate, and/or any conditions which could affect the work under this Contract. No allowance will be made to the Contractor for error or negligence on his part.

1.3 Discrepancies between conditions at the site and requirements of the contract documents shall be reported to the Architect, in writing, before any bids are opened. The Architect will issue necessary instructions to Bidders.

2.0 Project Schedule

2.1 The work schedule for this project has not yet been determined.

2.2 Completion time is to include all prep work, removal or paint stabilization or component replacement of specified Lead-based Paint, clean-up, final visual clearance, removal of containments or regulated areas, and vacating the work site.

2.3 For the purposes of this specification, a "workday" is defined as Monday through Friday, from 0800 to 1700.

3.0 Consultant

3.1 The consulting firm representing the owner for this project is E-Tech Environmental and Safety Solutions, Inc. Jimmy W. McNeil, Jr is the Project Designer. Email address for the consultant is wally@etechenv.com and cell number is 432-559-3566.

SECTION TWO: CONDITIONS & COORDINATION

1.0 General

1.1 The Owner, Architect, and Contractor shall coordinate with one another throughout the project to ensure that the project is completed to the Owner's satisfaction within the allotted timeframe and according to this specification and all applicable regulatory requirements.

2.0 Facilities

2.1 The Owner extends the use of his facility to the Contractor in the good faith that the contractor will use care and all precaution to prevent damage to the facility. The Owner is unaware of any existing damage to his facility. Before the Contractor begins work in the facility, the Contractor will inspect the area and furnish to the Consultant a list of any existing damage discovered. Damage discovered after work has begun will be assumed to have been caused by the Contractor.

2.2 The Contractor shall remain solely responsible for the safety of workers and sub-contractors and shall take all precautions regarding their safety.

2.3 The General Contractor shall provide water, electricity, and toilet facilities for the duration of the project.

2.4 The Contractor shall provide ground fault circuit interrupters (GFCIs), wiring, lighting switches, outlets, etc., and shall be in accordance with all Federal, State, and Local Underwriters Laboratories (UL) requirements. Installation shall be the responsibility of the Contractor.

2.5 The Contractor shall be responsible for any damages to the Owner's electrical system.

2.6 The Contractor shall comply with all local fire safety regulations, rules and standards.

2.7 The Contractor shall maintain adequate fire extinguishers (Class A, B, or C) ready for immediate use and distributed throughout the work area for the duration of the project. A minimum of one (1) such approved fire extinguisher must be available at the work area and others added at the rate of one (1) for every additional 100 linear feet of work area.

3.0 Personnel Qualifications

All personnel who will enter containment or regulated area or handle lead-based paint materials – loose or bagged shall:

a. Be trained in safe work practices and engineering controls for the removal of lead-based paint and possess a valid certificate of accreditation indicating completion of training or training refresher course within the past 12 months.
b. Possess proof of medical surveillance physical within the past 12 months.
c. Possess valid current (within the past 12 months) respirator fit tests for each specific respirator model which will be used on the project.

4.0 Responsibilities of the Air Monitoring Technician

4.1 The Lead Risk Assessor shall be hired by the Owner(s) and be independent of the Abatement Contractor on the job.

4.2 The Lead Risk Assessor shall be onsite periodically throughout the project.

4.3 The Lead Risk Assessor shall conduct visual inspections.

a. Prior to the start of removal activities to ensure that the regulated area is properly constructed or the containment is properly sealed and encloses all the lead-based paint to be removed,
b. Periodically throughout the removal work, to ensure that Contractor personnel are complying with all applicable regulations and this specification and that

there is no contamination of areas outside of regulated area or containment; and

c. After fine cleaning is completed to ensure that all specified lead-based paint has been removed from the work site.

4.4 The Lead Risk Assessor shall have the authority to stop work due to lack of cooperation by Contractor personnel, contamination of areas outside the work area, or any violations of the Specifications, or Federal, State and Local regulations.

a. Work stoppage shall continue until conditions have been corrected to the satisfaction of the Consultant or Architect.
b. Any standby time shall be at the expense of the Contractor.

4.5 The Lead Risk Assessor shall provide an Air Monitoring Technician (AMT) to be onsite throughout the project.

4.6 At the Lead Risk Assessor's discretion, he/she may act as the AMT if he has the appropriate training and license.

4.7 The AMT shall be responsible for collecting area and personal air samples.

5.0 Responsibilities of the Abatement Contractor

5.1 The Contractor shall provide labor, materials and equipment to complete the work as described in this specification, including but not limited to the following:

a. Work area preparation
b. Preparation of regulated area or containment
c. Removal, paint stabilization or component replacement of all specified lead-based paint containing materials
d. Cleaning of all surfaces inside of the regulated area or containment
e. Transportation and disposal of lead-based paint waste
f. Re-establishment of all building systems disrupted by the work
g. Repair or replacement of any existing finishes, construction, or other building components damaged during the work to the Owner's satisfaction.

5.2 All waste generated by the Contractor shall be disposed of as lead-contaminated waste at a licensed landfill.

5.3 The Contractor shall be responsible for ensuring that his Abatement Supervisor and all Abatement Workers are familiar with the Contractor's emergency response plan, fall protection plan, and respiratory protection plan.

5.4 The Contractor agrees to defend and hold harmless the Owner and the Lead Risk Assessor from any and all fines, levies or penalties including the cost to defend against penalties issued regulatory agencies as a result of actions or work procedures used by the Contractor or his sub-Contractors or any persons or organizations assisting or employed directly or indirectly by the Contractor.

5.5 The Contractor shall adhere to the following sequence of work:

a. Disabling Ventilation Systems, where necessary
b. Cleaning of Work Area
c. Construction of Critical Barriers
d. Construction of Containment
e. Construction of Decontamination Chamber/s
f. Removal of Lead-based Paint
g. Fine Cleaning
h. Visual Inspection
i. Encapsulation

j. Final Visual Clearance
k. Removal of Regulated Area or Containment
l. Disposal of Waste

6.0 Abatement Supervisor

6.1 The Contractor shall provide a “competent” Abatement Supervisor to be on site throughout the project. "Competent person" means one who is capable of identifying existing and predictable hazards in the surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

6.2 The Abatement Supervisor shall:

a. Be fluent in English and any languages spoken by the abatement workers on the project.

6.3 The Abatement Supervisor shall be responsible for:

a. Coordinating with the Owner, the Architect and the Consultant to complete the project within the allotted time and in compliance with all applicable Federal, State, and Local regulations and with this specification;
b. Maintaining a project logbook to include a detailed daily summary of the Contractor’s activities, regulated area or containment entry log with entry and exit times for each person who enters the regulated area or containment, and dates and times and pass/fail for all visual inspections;
c. Assuring that decontamination chambers are kept clean;
d. Surveying the regulated area and containment to ensure proper housekeeping, safety precautions, containment integrity, and clear paths of egress from the containment and regulated area, and
e. Ensuring all workers meet the qualifications listed in paragraph 3.0 above.

7.0 Progress Meetings

7.1 Progress meetings will be held when/if requested by the Owner and will be attended by representatives of Owner, the Architect, and the Contractor.

SECTION THREE: REGULATIONS

1.0 Applicable Standards and Guidelines

1.1 All work described in this specification shall be completed in strict accordance with all applicable Federal, State and Local regulations, standards and codes governing lead-based paint abatement including, but not limited to the following:

a. Code of Federal Regulations (CFR) Publications:
   1. 29 CFR 1926.62 Lead
   2. 29 CFR 1910.134 Respiratory Protection
   3. 29 CFR 1926 All Sections
   4. 29 CFR 1910 All Sections
   5. 40-CFR-61.145: Standards for Demolition and Renovation
   6. 40-CFR-260-265: Various EPA regulations implementing RCRA (Resource Conservation and Recovery Act). Waste disposal

b. American National Standards Institute (ANSI) Publications:
   1. Z9.2-79 Fundamental Governing the Design and Operation of Local Exhaust Systems
   2. Z88.2-80 Practices for Respiratory Protection

c. United States Environmental Protection Agency (EPA) – National Emissions Standards for Hazardous Air Pollutants (NESHAP).

SECTION FOUR: SUBMITTALS

1.0 Submittals - Before Work Begins

Prior to starting work on the project, the Contractor will submit to the Architect or his Project Manager the following:

1.1 Licenses and Certifications of the Abatement Contractor including:

a. Certificate of Insurance
b. Contractor's written Respiratory Protection Plan,
c. List of emergency contacts, and
d. List of any citations issued against the Contractor by EPA, OSHA, or TDSHS within the past 24 months, or if none, a signed letter from a representative of the Contractor stating that no notices of violation have been received.

1.2 Personnel Licenses and Certifications

a. Current contractor/supervisor training certificates for all personnel who will be on-site.
b. Current medical surveillance physicals for all personnel who will be on-site.
c. Current fit testing records indicating that all personnel who will be on-site have been fit tested for each respirator that they will be using during the project.

1.3 Safety Data Sheets for all products which will be used on the project as required by OSHA's hazard Communication Standard codified at 29CFR 1910.1200.

2.0 Submittals – During Work

During the project, the Contractor will submit to the Architect or his Project Manager the following:

2.1 Copy of waste manifest to be submitted as waste is removed from the project site.

3.0 Submittals – Post Work

Within one week of the end of work on the project, the Contractor will submit to the Architect or his Project Manager the following:

3.1 The Abatement Supervisor's Project Logbook as described in Section Two: Conditions & Coordination, Paragraph 6.3, item b.

SECTION FIVE: PERSONAL PROTECTIVE EQUIPMENT

1.0 Respiratory Protection

1.1 Respiratory protection shall be required for all individuals inside an active containment, performing lead-based paint removal activities inside a regulated area.

a. "Active containment" shall be defined as a regulated area or containment in which lead-based paint removal activities have begun and which has not yet achieved final visual clearance.

1.2 The following shall be the minimum respiratory protection for this project:

Activity	**Minimum Respiratory Protection**
Containment Prep	None Required
Small Lead-based Paint clean-up	½ face air purifying respirator w/ HEPA filtration
Gross Removal of Lead-based Paint	½ face air purifying respirator w/ HEPA filtration
Fine Cleaning of Regulated Area or Containment after Gross Removal	½ face air purifying respirator w/ HEPA filtration

1.3 All respiratory protection shall be MSHA/NIOSH approved in accordance with the provisions of 30 CFR Part 11.

a. The Contractor shall supply all workers, supervisors, and authorized visitors with personally issued, NIOSH and MSHA approved respirators of the type required for the work being performed.
b. The Contractor shall supply respirator filter replacements for each time workers enter regulated area or containment.
c. The Contractor shall ensure that all Contractor personnel have been fit tested for any respirator which they will use on the project within the past 12 months.
    1. Qualitative fit testing is acceptable only for negative pressure respirators.
    2. Quantitative fit testing is required for PAPR.
d. Workers shall perform the positive and negative air pressure fit test each time a respirator is donned.
e. No facial hair which comes between the skin and the sealing surface of the respirator shall be permitted.
f. Respiratory protection maintenance and decontamination procedures shall meet the following requirements:
    1. Respirators shall be inspected and decontaminated daily in accordance with OSHA 29 CFR 1910.134(b).
    2. HEPA filters for negative pressure respirators shall be changed after each shower.
    3. Workers shall wear respirators in the shower when going through decontamination procedures as stated in Part 56 of Title 12 section 9.2 (b).

2.0 Personal Protective Equipment

2.1 The Contractor shall provide to all workers, supervisors and authorized visitors and inspectors, protective disposable clothing consisting of full body coveralls and head covers.

a. All disposable protective clothing shall be discarded and disposed of as lead contaminated waste every time the wearer exits the work area to the outside area through the decontamination facilities.

2.2 The Contractor shall provide eye protection, hard hats and safety shoes as required by job conditions and safety regulations. Safety shoes and hard hats shall be approved in accordance with ANSI Z89.1 1969 and ANSI Z41.1 1967.

2.3 Reusable footwear, hard hats and eye protection shall be left in the "Contaminated Equipment Room" until the end of the lead-based paint removal work.

SECTION SIX: CONTAINMENTS

1.0 Containment Materials

1.1 All materials shall be of high quality and capable of performing under hot and humid conditions.

a. The Lead Risk Assessor shall have the authority to stop work in the case that he finds any of the containment materials to be of unacceptable quality until such time as adequate materials are available for the construction of containment.

1.2 The Contractor will provide the following materials for construction of containment:

a. 6-mil and 4-mil polyethylene sheeting,
b. Adhesive Tape (2" or 3" widths)
c. Spray Adhesive
d. Lead Warning Signs
e. Barricade Tape
f. Rags
g. HEPA filtered Vacuum
h. 2x4 lumber for the construction of temporary walls (if necessary)

2.0 Containment Preparation

2.1 Provide at least one (1) fire extinguisher for each 100 linear feet of containment area.

2.2 The Contractor will remove any movable items from the containment area.

2.3 The Contractor will establish a regulated area by hanging barricade tape and warning signs around the containment area in a wide enough radius to allow the public to encounter the signs/barricade tape and reroute to avoid the containment area.

2.4 The Contractor will deactivate any air conditioners, heating, or other powered ventilation into or out of the containment area.

2.5 The Contractor will clean the containment area using HEPA filtered vacuums and wet wiping.

2.6 When the area is clean, the Contractor will begin installing critical barriers of 6-mil polyethylene sheeting over all penetrations into the containment area including, doors, windows, vents, etc.

2.7 The Contractor will install at least one plexiglass window in containment to allow viewing of the work from the outside of containment by the Lead Risk Assessor and representatives of regulatory agencies.

a. At the request of the Lead Risk Assessor, the Contractor shall install additional windows as necessary to accommodate the Lead Risk Assessor's observation responsibilities.

3.0 Decontamination and Bagout Chambers

3.1 Install a three-stage personnel decontamination chamber (decon) on the containment. The decon will be the only rout of entry or egress from the interior of containment.

a. The decon will consist of three rooms: an equipment room (closest to containment), a shower (center), and a clean room.
b. Airlock flaps or curtains shall be installed at both sides of all three rooms of the decon.
c. The shower shall be stocked with soap and shall have running hot and cold water accessible to workers at all times.

3.2 The Contractor may elect to remove bags from the containment through the decon using the shower to decontaminate bags. In this case, the Contractor will adhere to the following waste decontamination sequence:

a. A worker in plain clothes stands in the clean room with an empty 6-mil poly bag.
b. Workers inside containment pass sealed bags of waste to a worker standing in the shower.
c. The worker in the shower washes the exterior of the waste bag, then passes it through the airlock flaps to the worker in the clean room and drops the cleaned bag into the empty bag, effectively double bagging it.
d. The worker in the clean room applies the required generator label to the bag and seals it, then hands the bag out to a worker on the outside of containment.
e. The worker outside of containment carries the bag to a lined, enclosed waste trailer or dumpster.

3.3 The Contractor also may elect to install a two stage bagout chamber as follows:

a. The bagout shall consist of two rooms, an inner room (closer to containment) and an outer room.
b. Air lock flaps or curtains shall divide the two rooms of the bagout and shall divide the inner room of the bagout from the containment and the outer room of the bagout from the area outside of containment.

3.4 Should the Contractor elect to construct a two-stage bagout, Contractor personnel will adhere to the following waste decontamination sequence:

a. A worker stands in the outer room of the bagout with an empty bag open and ready.
b. A worker in the inner room of the bagout washes off a sealed bag of waste using an airless sprayer, then passes the bag through the airlock flaps and drops it into the bag being held by the worker in the outer room of the bagout.
c. The worker in the outer room of the bagout applies the required generator label and seals the outer bag.
d. The worker in the outer room of the bagout may pass the bag out of the bagout through the airlock flaps to a worker outside of containment who takes the bag to the lined, enclosed waste trailer or dumpster, or
e. The worker in the outer room may stack double-bagged waste in the outer room of the bagout to be stored until Contractor personnel are ready to move bags to the lined, enclosed trailer or dumpster.
    1. To prevent contamination of the outer room of the bagout and trip hazards, Contractor personnel shall not allow the floor of the outer room of the bagout to become cluttered with bags.

SECTION SEVEN: ABATEMENT PROCEDURES

1.0 Abatement Materials

The Contractor shall provide all necessary tools and materials to accomplish the removal of the specified Lead-based paint including but not limited to:

1.1 Wetting agents/surfactant to increase the ability of water to penetrate Lead-based paint
1.2 Airless sprayer or pump sprayer
1.3 Handheld scrapers for detail cleaning
1.4 Wire brushes or other scrubbers for detail cleaning
1.5 Rags
1.6 Spray Bottles
1.7 Waste Containers, 6-mil polyethylene bags or sealable 55-gallon steel drums

2.0 Restrictions on Work Times

2.1 The Contractor shall work during the dates and times outlined in Section 1 of this specification only.

3.0 The Following Equipment and Work Practices are Prohibited.

3.1 Lead coatings shall not be disturbed by using open flame burning or torching.
3.2 Lead coatings shall not be disturbed by machine sanding or grinding without a high-efficiency particulate air (HEPA) local exhaust control.
3.3 Lead coatings shall not be disturbed by abrasive blasting or sandblasting without HEPA local exhaust control.
3.4 Lead coatings shall not be disturbed by using heat guns operating above 1100 degrees Fahrenheit or charring the paint.
3.5 Lead coatings shall not be disturbed by dry sanding or dry scraping, except dry scraping in conjunction with heat guns or within 1.0 ft. (0.30 m.) of electrical outlets, or when treating defective paint spots totaling no more than 2 sq. ft. (0.2 sq. m.) in any one interior room or space, or totaling no more than 20 sq. ft. (2.0 sq. m.) on exterior surfaces.
3.6 Lead coatings shall not be disturbed by paint stripping in a poorly ventilated space using a volatile stripper that is a hazardous substance in accordance with regulations of the Consumer Product Safety Commission at 16 CFR 1500.3, and/or a hazardous chemical in accordance with the Occupational Safety and Health Administration regulations at 29 CFR 1910.1200 or 1926.59, as applicable to the work.

4.0 Lead-based Paint Removal

4.1 Lead-based paint shall be wetted down thoroughly and as often as necessary to prevent the emission of paint or dust.
4.2 If the removal is conducted in a regulated area, removal shall be conducted where the worker can be upwind when possible.
4.3 Contractor personnel shall remove paint using hand-held scrapers or wire brushes.
   a. Contractor personnel shall work in teams of two where one worker removes the paint while the other worker containerizes the loose paint in 6-mil poly bags or 55-gallon drums.
   b. The method shall not allow for the accumulation of Lead-based Paint waste on the floor of the work area.
4.4 Removed Lead-based paint shall be disposed of in doubled 6-mil polyethylene bags or sealable 55-gallon steel drums.

a. Removed Lead-based Paint shall not be allowed to dry before it is containerized.

4.5 If the Contractor elects to use 6-mil poly bags for waste, then materials containing sharp edges shall be placed in small cardboard boxes or wrapped with cardboard prior to bagging to prevent tearing of the bags.

4.6 Waste bags and containers shall be properly labeled with lead warning labels and generator labels.

4.7 All disposable materials and equipment shall be packaged for disposal.

4.8 Other equipment shall be moved to the equipment room, decontaminated, bagged, and removed from the regulated area or containment.

4.9 All free water in contaminated areas shall be collected and added to Lead-based Paint waste and/or placed in plastic lined, leak proof containers, solidified or filtered appropriately in accordance with all applicable regulations.

5.0 Final Clean-Up of Work Area:

5.1 When all specified lead-containing materials have been removed, Contractor personnel shall remove all waste bags from the work area.

5.2 All surfaces in the containment shall be cleaned using HEPA vacuuming and wet wiping, using disposable rags.

a. Rags shall be disposed of as lead-containing waste and replaced regularly to avoid spreading contamination throughout the containment.

b. If the Contractor has elected to use sealable 55-gallon steel drums, then the drums shall be sprayed and wet-wiped.

5.3 After fine cleaning is finished, the Contractor shall request a visual clearance inspection from the Lead Risk Assessor or the Air Monitoring Technician on site. If the containment does not pass the visual clearance inspection, Contractor personnel shall re-clean the containment and call for another visual clearance inspection.

5.4 Because the application of encapsulant may cause issues with the adhesion of new paint, no lock-down encapsulation shall be permitted on this project.

5.5 When the containment has passed visual clearance inspection, Contractor personnel shall remove all equipment from the work area, remove all barrier tape and warning signs and shower out of containment.

SECTION EIGHT: INSPECTIONS & AIR MONITORING

1.0 Inspections

1.1 The Lead Risk Assessor on site shall inspect the regulated area or containment prior to the start of work inside the containment to ensure the following:

a. All critical barriers are in place, intact, and functioning as intended,
b. Containment is adequately sealed and under negative pressure of no less than -0.020 inches of water column,
c. The personnel decontamination chamber is in place, stocked, has running hot and cold water, and is functional, and
d. If the Contractor has elected to use a two-chamber bagout, that the bagout is constructed according to this specification.

1.2 During the work, the Lead Risk Assessor on site shall conduct periodic inspections – not less than twice per day - of the exterior of containment to ensure that the Contractor is working in compliance with all applicable Federal, State, and Local regulations and this specification.

1.3 The Lead Risk Assessor on site shall conduct visual clearance inspections to ensure that all specified Lead-based Paint has been removed.

2.0 Air Monitoring

2.1 The Lead Risk Assessor shall provide an Air Monitoring Technician to be on the project site.

2.2 The Air Monitoring Technician shall have the following qualifications:

a. Current EPA Air Monitoring Technician Training or Refresher
b. Medical Surveillance Physical
c. Current respirator fit test

2.3 The Air Monitoring Technician shall be responsible for collecting the following air samples:

a. Upwind and downwind samples if the lead-based paint removal is conducted in a regulated area.
b. Personal air samples on a minimum of ¼ of the Contractor's personnel inside containment.
    1. Personal samples shall be taken in sufficient numbers and time lengths as to allow for calculation of an 8-hour time weighted average exposure and a 30-minute excursion limit exposure.

2.4 The Air Monitoring Technician shall be responsible for shipping of all air samples to a NLLAP accredited lab for analysis.

a. All air samples shall be analyzed using the Flame Atomic Absorption Spectrophotometer (AAS) method and adhering to the Lab's written QA/QC plan.

3.0 Final Visual Clearance

3.1 Final visual clearance shall be conducted after all lead-based paint has been removed or stabilized.

SECTION NINE: LEAD-BASED PAINT HANDLING & DISPOSAL

1.0 Lead Containing Waste Requirements

1.1 The Contractor shall maintain compliance with the strictest set of regulations of U. S. EPA, OSHA's Hazard Communication Standard, Department of Transportation and other applicable standards. Note: Any penalties incurred for failure to comply with any of the above regulations, will be the sole responsibility of the Contractor and his Sub-Contractors. The Owner(s) claims no responsibility for fines imposed due to the negligence of the Contractor.

1.2 Keep lead contaminated waste (LCW) separate from any other waste.

1.3 Keep LCW in a secured, enclosed, and locked container which has been lined with 6-mil polyethylene sheeting.

1.4 Prior to transport the Contractor shall:

a. Ensure that LCW has been sufficiently wet down.
b. Ensure the integrity of the airtight seals on waste bags or drums.
c. Re-wet and re-package any damaged containers.
d. Ensure that the person transporting lead waste holds a valid permit issued pursuant to State of Texas regulations

1.5 Transport of LCW

a. Ensure that the LCW has been sufficiently wet down in a leak tight container.
b. Examine the integrity of the container's leak tight seal at a minimum of once per 24-hour period.
c. Re-wet and re-package any damaged containers.
d. Maintain at storage site an adequate supply of spare leak tight containers.
e. Maintain at storage site an adequate supply of amended water.
f. Keep LCW separate from any other waste.
g. Keep LCW in a secured, enclosed and locked container.

1.6 The Contractor or Sub-Contractor at the time of presenting for disposal of LCW shall comply with all applicable TCEQ, OSHA, EPA and DOT regulations issued pursuant to lead disposal.

1.7 For storage in the generation site the Contractor shall:

a. Ensure that all waste to be stored is double-bagged in 6-mil polyethylene bags or sealed in 55-gallon steel drums while wet,
b. Ensure that waste is stored in the outer room of the bagout chamber or in a room which has been lined with 6-mil polyethylene sheeting.
c. Keep LCW separate from any other waste.

1.8 LCW shall be stored on the generation site either in a poly-lined room or a lined, enclosed and locked trailer or dumpster until such time as it can be transported to an approved lead disposal landfill.

1.9 LCW Disposal:

a. The Contractor shall transport all sealed LCW to a landfill site approved by the Texas Commission on Environmental Quality (TCEQ).
b. Transportation shall be performed by a DOT licensed waste-hauler.
c. The Contractor shall be responsible for maintaining all sealed containers during the processing of bags (i.e. handling, loading, transporting, unloading).
d. At the completion of the project the Contractor shall provide a manifest duly executed by the Contractor, the transporter, and the disposal facility. The manifest shall be all-inclusive, describing the volume of materials, dates of

transport and date of disposal. A waste manifest shall be produced for each load.

e. The enclosed trailer or dumpster that is to receive lead material and other refuse from the contaminated area may be located adjacent to the exterior door as selected by the Contractor and approved by the Owner(s).
f. The trailer or dumpster is to be of the totally closeable type and is to be kept closed and locked to prevent vandalism.

SECTION TEN: LEAD-BASED PAINT SAMPLING REPORT

Lead Sampling Report

Presented To:

Millennium Engineers Group, Inc.
5804 N. Gumwood Ave.
Pharr, Texas, 78577

Project:

Sandhills State Park (Section House)
2500 E. I-20
Monahans, Texas, 79756

E-Tech Project 1280-12963-000

Inspection Date: 25 August 2020
Report Date: 28 August 2020

Table of Contents

Attachments

1.0 Executive Summary

E-Tech Environmental and Safety Solutions, Inc. was retained to perform lead paint inspection of the Section House located at the Sandhills State Park east of Monahans, Texas.

On 25 August 2020, Wally McNeil of E-Tech performed a visual inspection and collected bulk samples of suspect lead paint. A total of six (6) paint chip samples were taken for lead analysis.

The paint chip samples were submitted under chain of custody for standard turn around analysis to Accurate Analytical Testing in Romulus, Michigan. Accurate Analytical Testing laboratory is NELAC accredited for lead-based paint analysis. The analytical results indicate that four (4) of the samples contained greater than 5,000 parts per million of lead, the EPA threshold for lead in paint.

2.0 Lead-Based Paint Sampling Methodology

Each test location was identified numerically and plotted on a site drawing of the Section House. A two inch by two inch square was drawn at each sample location. The perimeter of the square was scored using a utility knife. After the square was scored, a chisel was used to scrape the paint from the test area into a zip-lock storage bag. The zip-lock bag was labeled and submitted with a chain of custody to Accurate Analytical Testing, a NELAC certified lab.

3.0 Conclusions

Four (4) of the paint chip samples were above the threshold of 5,000 ppm. The positive samples are identified as:

Sample Number	Approximate Location
L3	Exterior Siding
L4	Exterior Bunting
L5	Exterior Door
L6	Exterior Door Casing

4.0 Recommendations

Stabilize the areas that have been identified as lead containing prior to disturbance during planned renovations.

Hire a certified lead Renovation, Repair and Painting (RRP) contractor to stabilize or remove the lead from the identified areas.

Ensure that areas that are not disturbed, but that are identified to contain lead, are maintained in good condition, no cracked or peeling paint.

Do not dry sand or dry scrape lead containing identified areas.

Properly dispose of any lead contaminated materials that are removed.

5.0 Limitations

The field observations, measurements and research reported herein are considered sufficient in detail and scope to determine the asbestos content of the tested materials at the subject property on the date of the inspection. The assessment, conclusions and recommendations presented herein are based upon specifically limited data. They do not represent all conditions at the subject property. E-Tech warrants the findings and conclusions contained herein have been promulgated in accordance with generally accepted industrial hygiene methodology and only for the site described in this report.

6.0 Use by Third Parties

This report was prepared pursuant to the agreement between E-Tech and Millennium Engineers Group, Inc. The agreement relationship included an exchange of information about the subject property. Reliance or any use of this report by anyone other than the client, for whom it was prepared, is prohibited and therefore not foreseeable to E Tech.

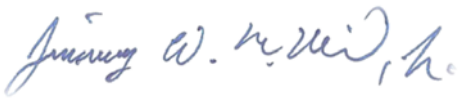
Reliance or use by any such third party without explicit authorization of the report does not make said third party a third party beneficiary to E-Tech's agreement with the client. Any such unauthorized reliance on or use of this report, including any of its information or conclusions, will be at third party's risk. For the same reasons, no warranties or representations, expressed or implied in this report, are made to any such third party.

7.0 Unidentifiable Conditions

This lead related environmental consulting report has been developed to provide the client with information regarding apparent conditions related to the subject property. Although E Tech believes that the findings and conclusions provided in this report are reasonable, the assessment is necessarily limited to the conditions observed and to the information available at the time of the inspection. Due to the nature of the work, there is a possibility conditions exist that could not be identified within the scope of the assessment or which were not apparent at the time it was conducted. It is also possible that the testing methods employed at the time of the report may later be superseded by other methods. E-Tech does not accept responsibility for changes in the state of the art.

We have employed state-of-the-art practices to perform this analysis of risk and identification, but this evaluation is limited in scope to the areas listed above. Our services consist of professional opinions and recommendations made in accordance with generally accepted engineering principles and practices.

Written by,



Jimmy W. McNeil, Jr.
Lead Risk Assessor
Certificate # 2070395
Expires: 5/26/2020

Attachments

Attachment 1 - Paint Chip Lab Results

Attachment 2 - Chain of Custody

Attachment 3 - Photographs

Attachment 4 - Copy of E-Tech License

Paint Chip Lab Results

ACCURATE ANALYTICAL TESTING LLC

30105 Beverly Road
Romulus, MI 48174
Ph: 734-629-8161; Fax: 734-629-8431

Certificate of Analysis: Lead In Paint by EPA SW-846 7420 and 3050B*

Client : E Tech Environmental
13000 W County Road 100
Odessa, TX 79765
Attn : Wally Mcneil **Email :** wally@etechenv.com
Phone : 432-559-3566 **Fax :**

AAT Project : 584545
Sampling Date : 08/25/2020
Date Received : 08/26/2020
Date Analyzed : 08/27/2020
Date Reported : 8/28/2020 4:00:00AM

Client Project : 12963

Project Location : 2500 W. I-20

Lab Sample ID	Client Code	Sample Description	PPM	Result Lead (% by weight)	Calculated R L (% by weight)
5646808	L1	EXT WINDOW CASING 4 SQ IN	539	0.0539	0.0007
5646809	L2	EXT WINDOW CASING 4 SQ IN	308	0.0308	0.0009
5646810	L3	EXT SIDING 4 SQ IN	39097	3.9097	0.0006
5646811	L4	EXT BUNTING 4 SQ IN	18220	1.8220	0.0006
5646812	L5	EXT DOOR 4 SQ IN	6898	0.6898	0.0006
5646813	L6	EXT DOOR CASING 4 SQ IN	8747	0.8747	0.0005

Analyst Signature

Tom Hamlin

RL= Reporting Limit * For true values assume (2) significant figures. The method and batch QC is acceptable unless otherwise stated. Current EPA/HUD Interim Standard for lead in paint samples is: 5000 PPM (parts per million) or ug/g which is equivalent to 0.5% by weight. AAT internal sop S203. The laboratory operates in accord with ISO 17025 guidelines and holds limited scopes of accreditation under AIHA-LAP and NY State DOH ELAP programs. These results are submitted pursuant to AAT LLC current terms and conditions of sale, including the company's standard warranty and limitation of liability provisions.Analytical results relate to the samples as received by the lab. AAT will not assume any liability or responsibility for the manner in which the results are used or interpreted. Reproduction of this document other than in its entirety is not permitted. All Quality control requirements for the samples this report contains have been met. AAT does not blank correct reported values. Sample data apply only to items analyzed. Samples are stored for 15 days following report date. *= Validated modified method
AIHA LAP- Lab ID #100986, NY State DOH ELAP -Lab ID #11864, State of Ohio- Lab ID # 10042

Date Printed: 08/28/2020 4:14AM AAT Project: 584545

ACCURATE ANALYTICAL TESTING LLC

30105 Beverly Road
Romulus, MI 48174
Ph: 734-629-8161; Fax: 734-629-8431

To : E Tech Environmental
13000 W County Road 100
Odessa, TX 79765

Attn : Wally Mcneil

Email : wally@etechenv.com
Phone : 432-559-3566

Project Location : 2500 W. I-20

AAT Project : 584545
Client Project : 12963
Date Reported : 8/28/2020 4:00:00AM

Sample	Client Code	Analysis Requested	Completed	Analyst
5646808	L1	Lead Paint	08/27/2020	Tom Hamlin
5646809	L2	Lead Paint	08/27/2020	Tom Hamlin
5646810	L3	Lead Paint	08/27/2020	Tom Hamlin
5646811	L4	Lead Paint	08/27/2020	Tom Hamlin
5646812	L5	Lead Paint	08/27/2020	Tom Hamlin
5646813	L6	Lead Paint	08/27/2020	Tom Hamlin

Reviewed By Quality Assurance Coordinator - Stephen Northcott

AIHA LAP- Lab ID #100986, NY State DOH ELAP -Lab ID #11864, State of Ohio- Lab ID # 10042

Chain of Custody

ACCURATE
ANALYTICAL TESTING LLC
12950 HAGGERTY ROAD
BELLEVILLE, MICHIGAN 48111
(734) 699-LABS (5227)
FAX: (734) 699-8407
www.accurate-test.com

SUBMITTING COMPANY
E-Tech Environmental
13000 W. CR 100
Odessa, Tx. 79765

PO #

CONTACT INFORMATION
Wally McNeil
Office 432-563-2200
Fax 432-563-2213
Cell 432-559-3566
Email : wally@etechenv.com

PROJECT NUMBER	12963	**SAMPLE DATE**	8/25/2020	**REQUESTED ANALYSIS**	**LEAD / PPM**
PROJECT ADDRESS	2500 E. I-20			**SINGLE WIPE DUST**	( )
SAMPLE START TIME	8:45	**SAMPLE END TIME**	9:30	**PAINT CHIP**	(X)

TURN AROUND TIME
SAME DAY ( ) 48 HOUR ( )
24 HOUR ( ) STD (X)

LAB ID	SAMPLE ID	ROOM	ROOM USAGE	S; T; F	AREA
5041608	L1	Extetior	**Window Casing**		**4 sq. inches**
09	L2	Extetior	**Window Casing**		**4 sq. inches**
10	L3	Extetior	**Siding**		**4 sq. inches**
11	L4	Extetior	**Bunting**		**4 sq. inches**
12	L5	Extetior	**Door**		**4 sq. inches**
13	L6	Extetior	**Door Casing**		**4 sq. inches**

CLIENT COMMENTS
FLAA

SAMPLE CONDITION

SEALS INTACT	Y	N
PRESERVATIVES	Y	N
CONTAINERS LABELED	Y	N

LAB REMARKS

LAB PROJECT NUMBER 2296 584545

SAMPLES RELINQUISHED BY	SAMPLES RECEIVED BY	TIME		
Wally McNeil		1600	AM	PM
			AM	PM
			AM	PM

8-26 9a

Attachment 3 - Photographs

Photo No: **1.**	
Direction Taken: West	
Description: Sign outside of the Section House.	

Photo No: **2.**	
Direction Taken: West	
Description: Front entrance or east side of the Section House.	

Photo No: **3.**	
Direction Taken: South	
Description: North side of the Section House.	

Photo No: **4.**	
Direction Taken: East	
Description: West side of the Section House.	

Photo No: **5.**	
Direction Taken: Northeast	
Description: South side of the Section House.	

Photo No: **6.**	
Direction Taken: North	
Description: Typical window and window casing for the Section House.	

Photo No: **7.**	
Direction Taken: North	
Description: Close-up of a window and window casing.	

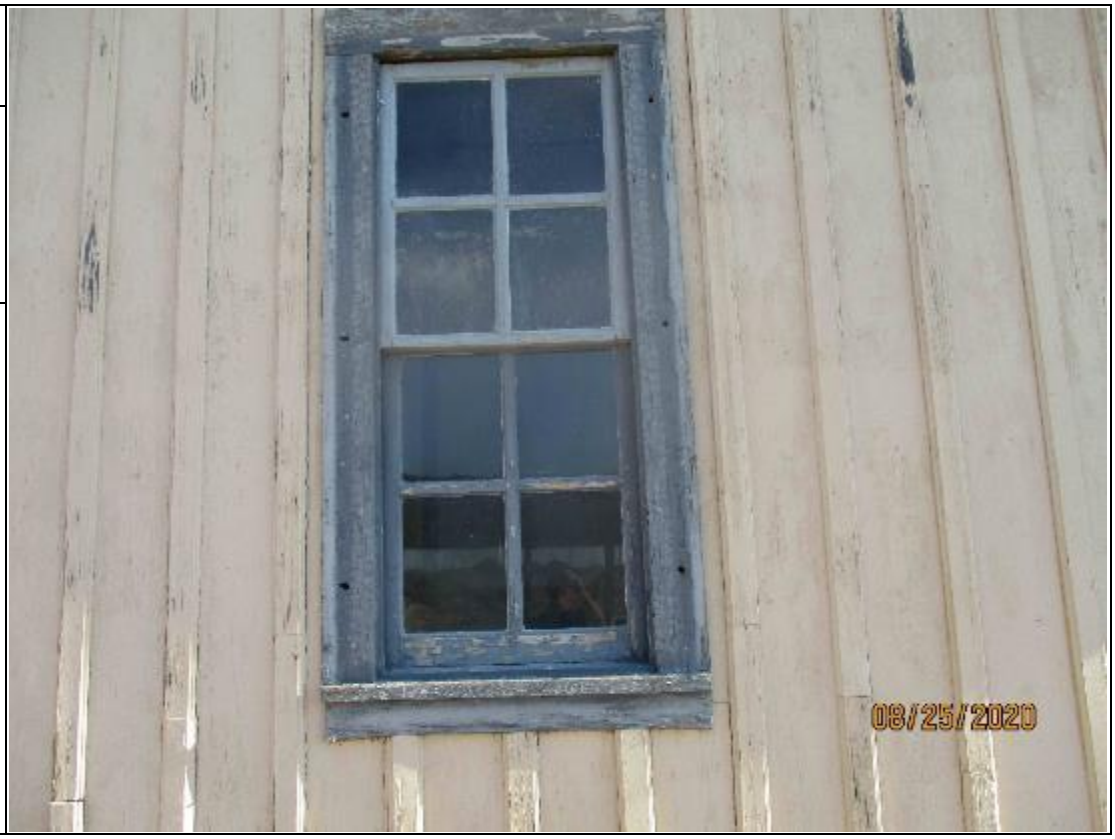
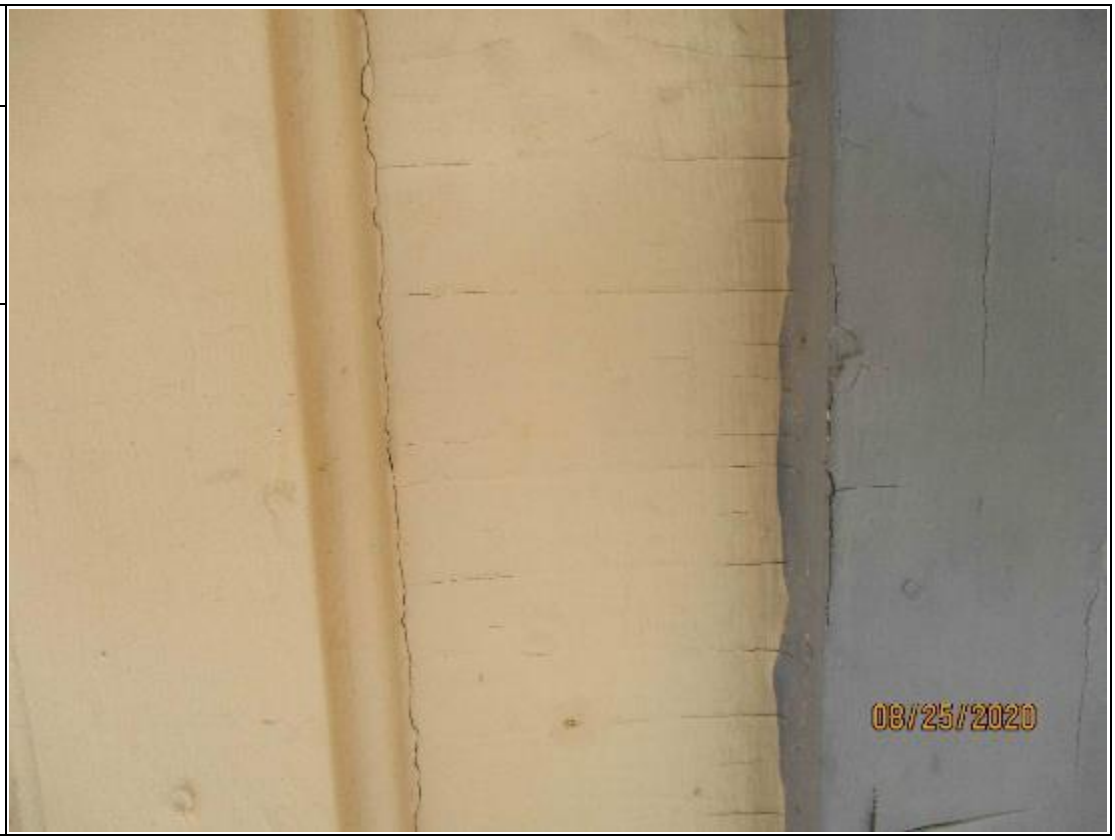
Photo No: **8.**	
Direction Taken: North	
Description: Typical window and window casing for the Section House.	

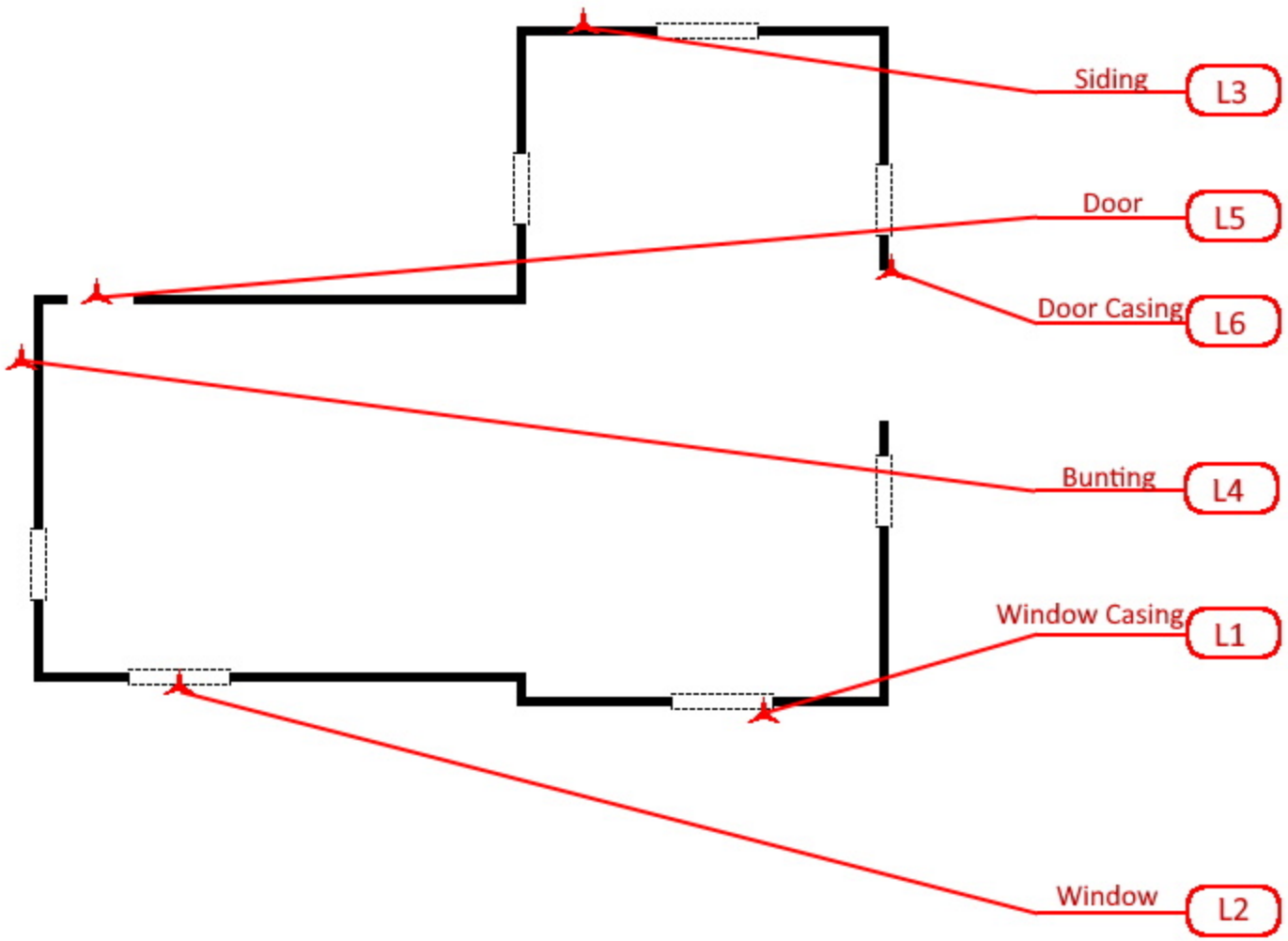
Photo No: **9.**	
Direction Taken: North	
Description: Close-up of the cracked paint on the window casing.	

Photo No: **10.**	
Direction Taken: Northwest	
Description: Siding and bunting on the east side of the Section House.	

Photo No: **11.**	
Direction Taken: West	
Description: Close-up of the cracked paint on the siding.	

Attachment 4 – Site Drawing

Monahans Sandhills State Park
Section House
Paint Chip Sample Locations



Component — Sample #

eTECH Environmental & Safety Solutions, Inc.

Attachment 5 - Copy of E-Tech License

Texas Department of State Health Services

BE IT KNOWN THAT

ETECH ENVIRONMENTAL & SAFETY SOLUTIONS, INC.

is certified to perform as a

Lead Firm

in the State of Texas and is hereby governed by the rights, privileges and responsibilities set forth in Texas Occupations Code, Chapter 1955 and Title 25, Texas Administrative Code, Chapter 295 relating to Texas Environmental Lead Reduction, as long as this license is not suspended or revoked.

Certification Number: 2110606

Expiration Date: 06/19/2022

John Hellerstedt, M.D.,
Commissioner of Health

Control Number: 7185

(Void After Expiration Date)

VOID IF ALTERED NON-TRANSFERABLE

SEE BACK

Texas Department of State Health Services

BE IT KNOWN THAT

JIMMY W MCNEIL JR

is certified to perform as a

Lead Risk Assessor

in the State of Texas and is hereby governed by the rights, privileges and responsibilities set forth in Texas Occupations Code, Chapter 1955 and Title 25, Texas Administrative Code, Chapter 295 relating to Texas Environmental Lead Reduction, as long as this license is not suspended or revoked.

Certification Number: 2070395

Expiration Date: 05/26/2022

John Hellerstedt, M.D.,
Commissioner of Health

Control Number: 7764

(Void After Expiration Date)

VOID IF ALTERED NON-TRANSFERABLE

SEE BACK

Environmental & Safety Solutions, Inc.

Mold Remediation Protocol

Monahans Sandhills State Park Visitor Center

Prepared For:
Millennium Engineers Group, Inc.
5804 N. Gumwood Avenue
Pharr, TX 78577

Issue Date: 9/3/2020

Prepared By:
Brandon Smitherman
Mold Assessment Consultant
eTech Environmental & Safety Solutions, Inc.
P.O. Box 62228 Midland, TX 79711

eTech Project #: 1280-13588-000

Table of Contents

1. Introduction

This protocol is for the remediation of mold and mold-contaminated materials at the Monahans Sandhills State Park Visitor Center located at 2500 E. I-20, Exit 86 near Monahans, Texas.

The remediation will be conducted by a licensed Mold Remediation Company employing at least one (1) licensed Mold Remediation Contractor (Contractor) and registered Mold Remediation Workers. The post remediation verification will be conducted by a licensed Mold Assessment Consultant (Consultant). Upon completion of the remediation and verification, The Mold Assessment Consultant and Mold Remediation Contractor will provide a completed Certificate of Mold Damage Remediation to the Property Owner and client.

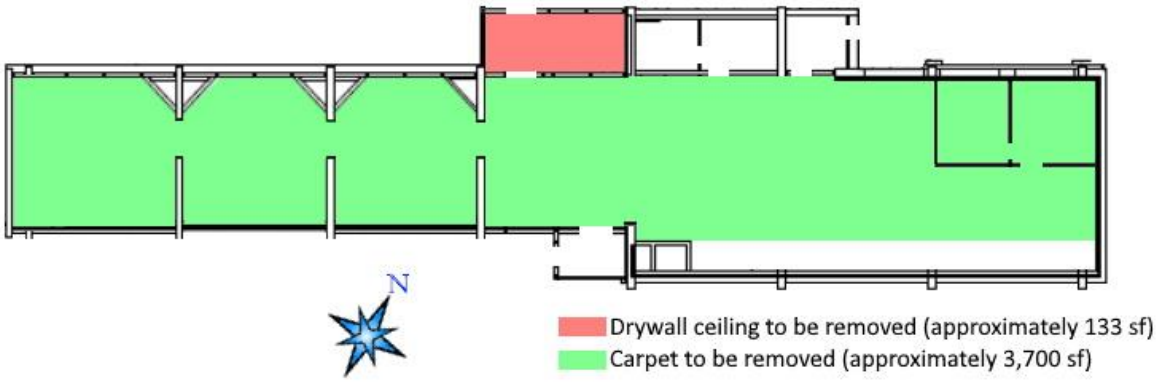
The remediation work will be performed in accordance with this protocol, Texas Occupations Code Chapter 1958, 16 Texas Administrative Code Chapter 78, and all other applicable Federal, State, and Local regulations.

2. Scope of Work

The scope of work will be as follows:

- Remove approximately 3,700 square feet of mold contaminated carpet
- Remove approximately 133 square feet of mold-contaminated ceiling drywall
- Thoroughly clean and disinfect underlying substrates and wood framework.

See the floor plan below showing the location of the materials to be removed.



3. Coordination

3.1. Contractor Responsibilities

3.1.1. Communicate and coordinate with the Client, Property Owner, and Consultant.

3.1.2. File the required Notification of Mold Remediation Activities with the Texas Department of Licensing & Regulation no less than five (5) calendar days prior to the start date of the remediation project and amend the notification if necessary, during the project to ensure that the department is notified of accurate Project Start and Stop Dates.

3.1.3. Prepare a remediation work plan specific to the project which fulfills all requirements of this protocol and provides specific instructions and/or standard operating procedures for the performance of the remediation project and provide the work plan to the client at least one day prior to the start date of the remediation.

3.1.4. Conduct the remediation in accordance with the work plan.

3.1.5. Ensure all Contractor staff use PPE as outlined in the protocol and/or work plan.

3.1.6. Immediately inform the Consultant in the even that conditions are encountered which

might cause a significant change in the scope of the project.

3.1.7. Comply with and accommodate the inspections by the Consultant including the post remediation assessment and periodic inspections during the remediation work.

3.1.8. Ensure that containment remains in place until the Consultant issues written notification that the project has achieved clearance.

3.1.9. Provide copies of before and after photographs of the remediation scene to the property owner within seven (7) calendar days after the project stop date.

3.1.10. Coordinate with the Consultant to provide a completed Certificate of Mold Damage Remediation to the property owner no more than ten (10) calendar days after the project stop date.

3.2. Consultant Responsibilities

3.2.1. Communicate and coordinate with Contractor, Client, and Property Owner.

3.2.2. Conduct at least one inspection during the active remediation work to ensure that the procedures outlined in the work plan and this protocol are being followed.

3.2.3. Provide timely recommendations to the Property Owner and Client if unexpected conditions are encountered during the remediation and provide directions on handling such situations to the Contractor.

3.2.4. Conduct post remediation assessment and clearance according to the criteria laid out in paragraph 8 of this protocol.

3.2.5. Issue a written passed clearance report to the client at the conclusion of the remediation to include:

- A description of relevant worksite observations,
- The type and location of measurements and samples collected,
- All data including temperature, humidity and material moisture readings,
- Results of analytical evaluation of the samples,
- Copies of all photographs taken by the Consultant, and
- A clear statement that the project has passed clearance.

4. Equipment & Materials

The Contractor will provide all necessary equipment and materials including but not limited to the following:

- Notice signs – minimum of 8” x 10” with black lettering on yellow background reading “NOTICE: Mold remediation in progress”
- 6-mil polyethylene sheeting
- Abatement-grade duct tape and spray adhesive
- HEPA filtered negative air machines
- Dehumidifiers – sufficient to maintain relative humidity inside containment to 50% (± 5%)
- HEPA vacuums
- Disinfectants/Biocides – Contractor may select type/s and brand/s based on his experience however his selection/s must be registered by the EPA for the intended use. The contractor will provide the Client and Property Owner with safety data sheets and proof of EPA registration for any such products used on this project. **The use of anti-microbial coatings or other long-lasting products will not be permitted on this project.**

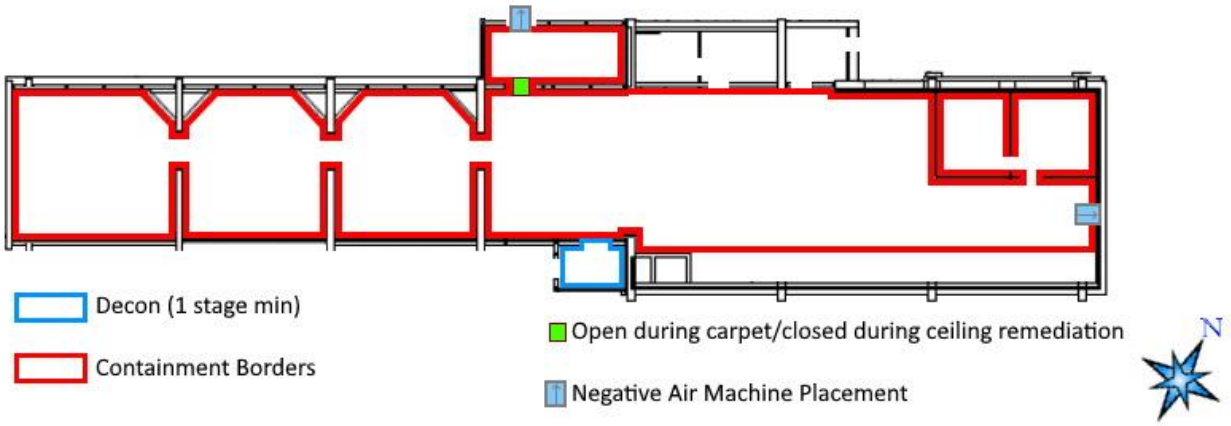
- All necessary tools
- Manometer capable of digitally recording negative pressure readings during all times of active remediation.

5. Containment

Only individuals licensed or registered under 16 TAC Chapter 78 will be allowed inside the Visitor Center building at any time between the start date and the stop date of the remediation.

5.1. Containment Delineation

There will be one (1) containment on this project. The containment will include the majority of the interior of the Visitor Center building. When the carpet remediation is completed and all cleaning and disinfecting in the main part of the building is finished, the active portion of the containment will be reduced to include only the northwest vestibule. See floor plans below showing the containment design.



5.2. Notice signs

Install notice signs reading “NOTICE: Mold remediation in progress” written in black lettering on a yellow background with a minimum size of 8” x 10” at all building entrances.

5.3. Critical Barriers

Prior to beginning any remediation activities, install critical barriers made of at least one layer of 6-mil polyethylene sheeting over all supply and return air vents. Seal critical barriers air-tight using spray glue and/or tape to prevent any airflow in or out of the HVAC duct system during remediation activities. Additional critical barriers will be installed over all windows and over any other openings as necessary to achieve and maintain negative pressure inside the Visitor Center building.

5.4. Surface Protection

Install walls of 6-mil poly as indicated on the floor plan above to prevent contamination of the walls. Coordinate with the Client to determine whether the lay-in ceiling tiles will be gone at the time of the remediation. If the lay-in ceiling is to be in place, consider inverted prep to prevent contamination of ceiling tiles. Install a layer of 6-mil poly over any additional surfaces such as floors, immovable objects, etc.

5.5. Negative Pressure & Recirculation

Install at least one (1) HEPA filtered negative air machines at each location indicated on the floor plan above. Additionally, negative air machines may be placed in the exterior doorway of the northeast vestibule if necessary to provide adequate negative pressure.

Use negative air machines in sufficient numbers to maintain negative pressure in the building of at least -0.02 inches of water column during all mold disturbance activities. Negative air machines will be in operation throughout all remediation activities and at the Contractor's discretion, may be powered down over night.

Duct the exhaust of all negative air machines outdoors during active remediation.

Connect a manometer capable of digitally recording negative pressure readings throughout the project. During the carpet remediation, the manometer's differential pressure hose may terminate anywhere inside the building. During the ceiling remediation, the differential pressure hose must terminate inside the northwest vestibule.

Upon completion of all remediation activities inside the containment, operate negative air machines inside containment in "recirculation mode" for at least twenty-four (24) hours prior to the Consultant's post remediation assessment. Recirculation will continue until such time as the Consultant provides written notice that the project has achieved clearance or until such time as the Consultant provides notice that the project has failed to achieve clearance.

If the project fails to achieve clearance, then the negative air machines will be re-installed and ducted outdoors throughout additional remediation activities. When the Contractor is finished re-cleaning, the negative air machines will be placed into "recirculation mode" for 24 hours prior to the next post remediation assessment.

5.6. Decontamination

Construct a decontamination chamber in the south vestibule as shown on the floor plan above. The decontamination chamber must consist of a minimum of one (1) chamber of sufficient size for workers to don and doff disposable coveralls and to house a waste bag for disposal of coveralls.

6. Personal Protective Equipment

6.1. Respiratory Protection

At the time of the mold assessment inspection, an asbestos inspection was also conducted at the Visitor Center. All materials tested negative for asbestos. A copy of the asbestos inspection should be kept on site during all demolition/renovation activities. Minimum respiratory protection for this project will be NIOSH certified N-95 dust masks. The Contractor may require increased respiratory protection at his discretion.

6.2. Other PPE

Tyvek or other brand of impermeable disposable coveralls will be required for entry into the containment. Provide steel-toed rubber boots, gloves, eye protection, and Hardhats.

7. Remediation Method

7.1. Order of Remediation

- 7.1.1. Remove carpet & Clean/disinfect substrates
- 7.1.2. Close the door between the southwest vestibule and the main building area
- 7.1.3. Remove the drywall ceiling in the southwest vestibule & clean/disinfect substrates

7.2. Mold-Contaminated Carpet

- 7.2.1. Remove the carpet beginning on the west end of the building and working west.
- 7.2.2. Cut the carpet into manageable strips
- 7.2.3. Lift strips of carpet off the slab as intact as possible
- 7.2.4. Roll carpet strips and move them to a dumpster or waste trailer.
- 7.2.5. If there is visible discoloration under the carpet, remove the carpet glue and thoroughly

clean and disinfect to at least two (2) feet beyond the discolored areas.

7.2.6. Conduct fine cleaning working from ceiling to walls to floors using wet wiping and/or HEPA vacuuming methods.

7.3. Mold-Contaminated Drywall Ceiling

7.3.1. Prevent the spread of contamination from the southwest vestibule into the main building by sealing the door between the southwest vestibule and the main building. This may be accomplished by lining the door with poly and closing the door or by installing a set of airlock flaps over the doorway.

7.3.2. Remove the ceiling drywall using caution to remove the largest pieces possible, causing minimal disturbance.

7.3.3. Bag or wrap the drywall in 6-mil poly and transport it to the dumpster.

7.3.4. Thoroughly clean/disinfect any discolored wood framing or other discolored substrate made visible by removing the drywall. Disinfect a minimum of two (2) feet beyond any discoloration.

7.3.5. Conduct fine cleaning, removing any dust or other particles starting at the ceiling, proceeding down the walls and finishing with the floor using wet wiping and/or HEPA vacuuming methods.

7.4. Recirculation

7.4.1. When all active remediation work is completed, the Contractor will leave the containment intact, open the door between the main building and the northwest vestibule, seal exterior doors, and place the HEPA filtered negative air machines into "recirculation mode" – placing the machines inside the containment to continuously recirculate and filter the air for twenty-four (24) hours prior to the post remediation assessment.

Recirculation will continue until the Consultant provides written notice that the project has achieved clearance or until the Consultant provides notice that the project has failed to achieve clearance.

If the project fails to achieve clearance, the Contractor will re-install the negative air machines as they were during the remediation, conduct re-cleaning and then operate the negative air machines in recirculation mode for 24 hours prior to the next post remediation assessment.

8. Post Remediation Assessment

The Consultant will conduct a post-remediation assessment no sooner than 24 hours after all remediation activity is completed in the containment. The Contractor will ensure that the containment is left in place until the Consultant provides written notice that the project has achieved clearance.

8.1. Clearance Criteria

8.1.1. Visual – The Consultant will visually inspect the areas inside of containment for visible mold growth and mold contamination. If the Consultant finds the containment free of visible mold contamination and wood rot, the assessment will continue to procedural testing.

8.1.2. Procedural – The consultant will collect the following:

- Temperature readings from central in each room of containment,

- Relative Humidity readings from central in each room of containment,
- Moisture content readings from each exposed substrate (this excludes materials which remain covered in poly), and
- Photos including wide angles of the interior of containment and close-ups of specific areas where mold contamination was visible during the initial assessment.

If the Consultant finds relative humidity no greater than 55% and moisture content of all materials within normal ranges for each material tested, then the assessment will proceed to the analytical testing.

8.1.3. Analytical – The consultant will collect no fewer than five (6) spore trap air samples throughout the building including at least one in each of the three display rooms on the west end of the building and at least one in the northwest vestibule. The consultant will also collect at least two spore trap air samples from outdoors; one (1) sample from north of the visitor center and one (1) sample from south of the visitor center. The samples will be sent to a laboratory under chain of custody and analyzed on 1-day turnaround.

8.1.4. Clearance Criteria – The project will be considered "cleared" after a post remediation assessment where:

- No visible mold is observed,
- No visible wood rot is observed,
- All relative humidity readings are no greater than 55%,
- All moisture content readings are within normal ranges,
- Analysis of spore traps indicates that samples collected indoors have lower total spore concentrations than those collected outdoors.

9. Reporting & CMDR

9.1. Passed Clearance Report

The Consultant will provide the Client with a written Passed Clearance Report or notice of failure to achieve clearance upon receipt of analytical results following a post remediation assessment.

9.2. Photos

Within seven (7) days of the project stop date, the Contractor will provide the Property Owner with copies of photos taken of the remediation scene before and after the remediation.

9.3. Certificate of Mold Damage Remediation

Within ten (10) days of the project stop date, the Contractor will provide the Property Owner with a completed Certificate of Mold Damage Remediation (CMDR). The CMDR must be completed by the Contractor and the Consultant; both Contractor and Consultant are responsible for coordinating to complete the CMDR in a timely fashion so that the Contractor can meet the 10-day deadline for submittal.