

October 24, 2022
Job No. 19-070

Garver, LLC
4701 Northshore Drive
North Little Rock, Arkansas 72118

Attn: Mr. John Ruddell, P.E., S.E.
Vice President, Bridge Design Manager

**GEOTECHNICAL INVESTIGATION
ARDOT JOB 070513 I-30 STR. & APPRS. (HWY. 51) (S)
CLARK COUNTY, ARKANSAS**

INTRODUCTION

This report provides the final results of the geotechnical investigation performed for Bridge #3873, ARDOT Job 070513 I-30 Str. & Apprs. (Hwy. 51) (S) in Clark County, Arkansas. This geotechnical investigation was authorized on behalf of Garver, LLC by the subconsultant agreement of May 14, 2019. Notice to proceed was received on December 30, 2020. Results of this study have been provided to Garver throughout the course of this study. An interim report was submitted on April 30, 2021 and additional submittals with revised pile capacity, MSE wall bearing and global stability, and driveability were submitted in January to September 2022.

We understand that the Hwy. 51 Bridge over I-30 will be a continuous plate girder unit with three (3) bents, two (2) spans, and a total bridge length of about 202 feet. We understand that plans are to support the foundation loads on steel pile foundations. The replacement bridge end embankments will utilize MSE walls at bridge abutments and simple slopes at embankment sides. A preliminary bridge layout is provided in Appendix A. The project will also include new approach roads at each bridge end.

The purposes of this geotechnical study were to explore subsurface conditions at the replacement bridge location and to develop recommendations to guide design and construction of foundations, MSE walls, and earthwork. These purposes have been achieved by a multi-phased study that has included the following.

- ◆ Drilling sample borings to evaluate subsurface conditions and obtain soil samples for laboratory testing.

- ◆ Performing laboratory tests to evaluate pertinent engineering properties of the foundation and subgrade strata.
- ◆ Analyzing field and laboratory data to develop recommendations for foundation design, embankment configurations, and construction considerations.

The results of the subsurface exploration program and laboratory test results are included in the attachments. Recommendations for design and construction are discussed in subsequent report sections.

SUBSURFACE EXPLORATION

Subsurface conditions at the replacement bridge location were investigated by drilling three (3) sample borings to depths of 100 ft below existing grades in the structure areas (Borings S1, S2, and S3), six (6) sample borings to depths of 20 ft in or near the plan wall alignments, (Borings W1 to W6) and two (2) sample borings to depths of 15 ft in the plan approach road alignments (Borings P1 and P2). The project location is shown on Plate 1. The approximate locations of the borings are shown on Plate 2. Logs of the borings, presenting descriptions of the subsurface strata encountered and results of the field and laboratory tests, are included as Plates 3 through 19. The approximate centerline station and offset of the boring locations are noted on the logs. In addition, the approximate ground surface elevation, as inferred from the topographic information provided by the Engineer, is also shown on the logs. It must be recognized that the elevations shown are approximate and actual elevations may vary. A key to the terms and symbols used on the boring logs is presented as Plate 20. A generalized subsurface profile in the bridge alignment is provided as Plate 21.

The sample borings were drilled with a track-mounted CME-850X rotary-drilling rig using a combination of dry-auger and rotary-wash drilling methods. Samples were obtained at approximately 2-ft intervals using a 2-in.-diameter split-barrel sampler driven into the strata by blows of a 140-lb automatic hammer dropped 30 inches, in accordance with Standard Penetration Test (SPT) procedures. The number of blows required to drive the standard split-barrel sampler each 6 in. of an 18-in. total drive, or a portion thereof, is shown on the boring logs in the "Blows Per Ft" column.

All samples were removed from samplers in the field. Samples were then visually classified by the geotechnical technician. Representative samples were placed in appropriate containers to prevent moisture loss and/or disturbance during transfer to our laboratory for further examination and testing.

The borings were advanced using dry-auger procedures to the extent possible to facilitate evaluation of shallow groundwater conditions. Observations regarding groundwater are noted in the lower-right portion of each log and are discussed in subsequent sections of this report. All boreholes were backfilled after obtaining final water level readings.

LABORATORY TESTING

To evaluate pertinent soil properties, laboratory tests consisting of liquid and plastic limit measurements and natural water content determinations were performed. A total of 69 natural water content determinations were performed to develop information on *in-situ* soil water content. Water content results are plotted on the boring log forms in accordance with the scale and symbols shown in the legend located in the upper-right corner of the logs.

To verify field classification and to evaluate soil plasticity, 27 liquid and plastic limit (Atterberg limits) determinations and 38 sieve analyses were performed on selected representative samples. The Atterberg limits are plotted on the logs as pluses inter-connected with a dashed line using the water content scale or are denoted as “non-plastic.” The percentage of soil passing through the No. 200 Sieve is noted in the “- No. 200 %” column on the appropriate log forms. Classification test results, along with soil classification by the Unified Soil Classification System and AASHTO Classification System and grain size distribution curves, are presented in Appendix B.

GENERAL SITE and SUBSURFACE CONDITIONS

Site Conditions

The project location is in the southwestern portion of Clark County where Hwy. 51 crosses over Interstate 30, about 7 miles south of Okolona town center. The area surrounding the existing bridge location is mostly undeveloped woodlands with a gravel surfaced staging area to the southeast. The subject alignment crosses over I-30, which is a four-lane divided interstate roadway with a wide median. Surface drainage of the interstate is facilitated by swales on each side of the roadway.

The existing bridge is a two-lane roadway with the bridge ends and approaches on earthen embankments. The abutment embankments have simple slopes. The bridge deck is visibly in poor condition. The alignment of the new bridge is northeast of the existing bridge. The surrounding terrain is mostly flat with poor to fair surface drainage.

Site Geology

Geologically, the project locale is in the mapped exposure of Quaternary Terrace Deposits. The Terrace deposits are flood-plain deposits comprising terraces of gravel, sand, silt and clay and mixtures of any or all of these clastic materials. The overall thickness of the terrace deposits varies and individual horizontal and vertical distributions of soil units are highly variable. The terrace deposits overly the late Cretaceous Period Nacatoch Sand. The Nacatoch Sand is comprised of cross-bedded fine quartz sand; hard fossiliferous sandy limestone; coarse, highly glauconitic sand fine-grained clayey sand, and bedded clay and marl. Thin-bedded clay with interbedded fine sand is common near the top of the formation. The formation varies in thickness from 150 to 400 ft and the base is unconformable. Bedrock (Paleozoic rocks) in the site vicinity is reported to be in excess of 1400 ft deep.

Seismic Conditions

Based on the average soil conditions revealed by the borings drilled for this study, the site geology, and our experience in the area, a Seismic Site Class C (very dense soil and soft rock profile) is considered fitting for the Hwy. 51 bridge over I-30 location with respect to the criteria of the AASHTO LRFD Bridge Design Specifications Seventh Edition 2014¹. Given the location and AASHTO code-based values, the 1.0-sec period spectral acceleration coefficient for Site Class C (S_1) is 0.057 and the 1.0-sec period spectral acceleration coefficient (S_{D1}) value for Site Class C is 0.097. Utilizing these parameters, Table 3.10.6-1² indicates that a Seismic Performance Zone 1 is fitting for the Hwy. 51 bridge over I-30 site. In reference to the 2011 edition of the AASHTO Guide Specifications, the Peak Ground Acceleration (PGA) having a 7 percent chance of exceedance in 75 years (or mean return period of approximately 1000 years) is predicted to be 0.079 for a Seismic Site Class C for the bridge location. Based on the results of the borings and the anticipated Seismic Performance Zone 1, the liquefaction potential is considered low for the granular and cohesive soils encountered in the borings.

Subsurface Conditions

Subsurface conditions revealed by the borings performed for the replacement bridge can be summarized into the following general stratigraphy.

Stratum I: The existing embankment fill is comprised of variable brown, dark brown, reddish brown, tan, reddish tan, and gray soft to stiff fine sandy clay and

¹ AASHTO LRFD Bridge Design Specifications, 7th Edition; AASHTO; 2014.

² AASHTO LRFD Bridge Design Specification, AASHTO; 2012

very loose to medium dense silty, clayey fine sand and fine sandy silt to 2 to 6 ft below existing grades. The fill contains silt pockets, fine gravel, occasional organics, and ferrous nodules. These soils typically classify as A-4 by the AASHTO classification system (AASHTO M 145), which correlates with poor to fair subgrade support for pavement structures. The embankment fill exhibits variable compaction with high to moderate compressibility. Fill content and compaction is likely to vary within the embankment.

Stratum II: The natural upper soil units at the replacement bridge location are composed of red, reddish brown, gray, reddish tan, and yellowish tan firm to very stiff fine sandy, silty clay and medium dense to dense silty, clayey fine sand and fine sandy silt extending to variable depths of 4 to 18 ft (approximately El 221 to El 228). The silty, clayey soils have low to moderate plasticity, low to moderate shear strength/relative density, and moderate to low compressibility. In general, shear strength increases and compressibility decreases with depth.

Stratum III: Medium dense to very dense gray, light gray, reddish brown, tan, and reddish tan fine to coarse sand, occasionally silty, and sandy fine to coarse gravel are below the Stratum II soils and extend to approximately El 211 to El 216. The variable granular units exhibit medium to high relative density and low compressibility.

Stratum IV: Underlying Stratum III to in excess of the exploration depths of the borings is dense to very dense gray, dark gray and bluish gray weakly cemented calcareous silty fine sand. The silty fine sand contains calcareous nodules, shell fragments, and occasional clay layers and sandstone fragments. The silty fine sand exhibits high relative density and low compressibility.

To aid in visualizing subsurface conditions in the replacement bridge alignment, a generalized subsurface profile is provided as Plate 21. It should be recognized that the stratigraphy illustrated by the profile has been inferred between discrete boring locations. In view of the natural variations in stratigraphy and conditions, variations from the stratigraphy illustrated by the profile should be anticipated. Additionally, the natural transition between strata is generally gradual, and the stratigraphy described in the sections above may vary.

Groundwater Conditions

Shallow groundwater was locally encountered at 9.7- to 28.3-ft depth in January and February 2021. Groundwater levels will vary, depending on seasonal precipitation, surface runoff and infiltration, and water levels in nearby drainage features.

ANALYSES and RECOMMENDATIONS

Bridge Foundation Design

Foundations for the replacement bridge must satisfy two (2) basic and independent design criteria: a) foundations must have an acceptable factor of safety against bearing failure under maximum design loads, and b) foundation movement due to consolidation or swelling of the underlying strata should not exceed tolerable limits for the structures. Construction factors, such as installation of foundations, excavation procedures, and surface and groundwater conditions must also be considered.

In light of the results of the borings performed for this study and the anticipated moderate bridge foundation loads, we recommend that foundation loads of the replacement bridge be supported on piling. Given the medium to high relative density of the granular soil units (Strata III and IV), we recommend that piles extend to these units with relatively high bearing capacity and low compressibility. Recommendations for piling foundations are discussed in the following paragraphs.

Pile Foundations

We recommend the bridge foundation loads be supported on a deep foundation system comprised of piles. The planned use of HP 14x73 steel piles is considered suitable. Nominal single pile capacity curves for these piles are provided in Appendix C. Nominal axial pile capacities have been developed using static pile capacity formulae, the results of the borings, and the plan pile cap bottom elevations shown on the preliminary bridge layout drawing. We have recommended that the piles at bridge ends (Bents 1 and 3) be prebored to the cemented sand strata, with a prebore depth of 33 to 35 ft below the plan abutment cap elevation and about 12 to 14 ft below the plan MSE wall subgrade elevation. We understand that the MSE walls and embankments will be constructed after pile installation. In the event that piles are driven to practical refusal in the cemented sand, the pile capacity may be based on the structural capacity of the section providing embedment is sufficient to satisfy structural requirements. Practical pile refusal is recommended for pile penetration of 0.5 in. or less for the final 10 blows of driving.

The nominal axial capacities are based on single, isolated foundations. Piles spaced closer than three (3) pile widths may develop lower individual capacity due to group effects. The potential for group capacity reductions should be evaluated for pile spacing closer than three (3) widths.

Based on AASHTO LRFD geotechnical design procedures, an effective resistance factor (ϕ_{stat}) of 0.45 is recommended for evaluation of factored compression capacity. For evaluation of

factored uplift capacities, a resistance factor (ϕ_{up}) of 0.35 is recommended. These resistance factors are based on Strength Limit States. For Extreme Event Limit States, such as earthquake loading and collision, resistance factors of 1.0 and 0.8 are recommended for evaluating compression and uplift capacities, respectively. Post-construction settlement of piles installed to the recommended factored capacities should be less than 1.0 inch.

Based on the results of the borings and the anticipated preboring, downdrag loads on piles are expected to be minor. The surface and near-surface soils vary from stiff to very stiff sandy, silty clay to medium dense to dense silty, clayey fine sand and sandy, fine to coarse gravel. Preboring has been recommended to achieve the necessary pile penetration at the end bents. We anticipate that prebores on the order of 10 to 12 ft below the MSE wall subgrade will be required at the end bents.

Battered piles can be utilized to resist lateral loads. The axial capacity of battered piles may be taken as equivalent to that of a vertical pile with the same tip elevation and embedment. Special driving equipment is typically required where pile batter exceeds about 1-horizontal to 4-vertical.

Lateral Load Analysis Parameters

We understand that lateral load analyses of deep foundations may be performed by the Engineer. Recommended parameters for use in lateral load analyses are summarized in Appendix D. The values provided in Appendix D have been selected based on published correlation with classification and engineering properties and static loading conditions. Group action should be considered where pile spacing in the direction of loading is less than six (6) pile widths. In this case, the subgrade modulus value (k) should be reduced based on the ratio of spacing to pile width.

Mechanically Stabilized Earth (MSE) Walls

Mechanically stabilized earth (MSE) walls are planned at each bridge end. Wall heights on the order of 20 to 24 ft are anticipated. Specific design of MSE retaining walls will be performed by Others on behalf of the Contractor. All final wall design should be reviewed by the Engineer or Department. Recommendations for wall bearing and global stability are discussed in the following report sections.

Wall Bearing. The natural subgrade and foundation soils in the wall alignment generally consist of medium dense to very dense silty fine sand, loose clayey fine sand, or very stiff fine sandy clay. These soils exhibit low to high relative density, moderate shear strength, and moderate to low compressibility. A summary of recommendations related to wall bearing and sliding resistance is provided in Appendix E.

Some undercut will be required for MSE wall bearing. The anticipated depths of undercut along Bents 1 and 3 are summarized in Appendix E. The suitability of the wall bearing strata must be field verified by the Engineer or Department at the time of construction. Where undercuts are warranted, these should extend at least 10 ft outside the reinforced zone to the extent possible. At the wall ends (longitudinally), the undercut should extend beyond the reinforced zone a minimum distance determined by a 1-horizontal to 2-vertical (1H:2V) projection from the edge of the reinforced zone to the undercut bottom. Where existing structures limit the undercut extent, the undercut limits should be field verified and adjusted as needed.

As noted in Appendix E, recommended backfill for undercuts will vary with the height of the wall. We recommend that undercut backfill consist of selected material (ARDOT Standard Specifications Section 302, SM-1), crushed stone aggregate base (ARDOT Standard Specifications Section 302, Class 7), or an approved alternate. Clean granular backfill should be fully enveloped in a suitable geotextile filter fabric complying with ARDOT Standard Specifications Subsection 625.02, Type 2. A resistance factor (ϕ_b) of 0.65 is recommended for evaluation of factored bearing. A resistance factor (ϕ_τ) of 1.0 is recommended for evaluation of sliding resistance.

Subgrade and foundation preparation at the wall locations and under all embankments must include stripping all organics and thorough proof-rolling. Subgrade and foundation preparation should extend at least 5 ft in front of walls and outside reinforced zones. The MSE wall leveling pads and reinforced zones should bear as recommended above and at a minimum depth of 2 ft below lowest adjacent grade. A minimum wall embedment of 2 ft is recommended.

Where seepage into undercuts is apparent or positive drainage cannot be assured, Select Granular Backfill should be fully encapsulated in a filter fabric geotextile complying with ARDOT Standard Specifications Subsection 625.02, Type 2.

Global Stability - MSE Walls at Bridge Abutments. Analyses were performed to verify global stability of the MSE walls and side slopes at both the north and south bridge ends for the Hwy. 51 over I-30 Bridge. Wall heights on the order of 23 ft were evaluated for stability. The embankment side slopes are planned with 3-horizontal to 1-vertical (3H:1V) configurations.

To evaluate suitability of the plan configurations, slope stability analyses have been performed. A 250 lbs per sq ft uniform surcharge from vehicles was included for the purposes of stability analyses. Stability analyses were performed using the computer program SLOPE/W 2020³

³ Slope/W 2020; GEO-SLOPE International; 2020.

and a Bishop analysis. For the embankment slopes, three (3) general loading conditions were evaluated, i.e., End of Construction, Long Term, and Seismic Conditions. For analysis of the seismic condition, a horizontal seismic acceleration coefficient (k_h) of one-half the peak acceleration (A_s) was used, a value of 0.04.

For the purposes of the stability analyses, unclassified embankment as per Standard Specifications for Highway Construction, 2014 Edition, Subsection 210.06 was assumed for embankment fill. Accordingly, an undrained shear strength value of 1500 lbs per sq ft has been assumed for the embankment fill. Depending on the specific borrow utilized for embankments, verification of stability could be warranted.

The results of the stability analyses performed for the walls are provided in Appendix F. These results indicate acceptable stability for all conditions analyzed.

Subgrade Support

In light of the results of the borings drilled at the bridge ends and the approach road alignments (i.e., Borings S1, S3, P1, and P2), the on-site subgrade soils are expected to be variable and include fine sandy silt, silty fine sand, clayey fine sand, and fine sandy clay fill. The AASHTO classification of the subgrade soils is predominantly A-4 with subordinate amounts of A-6 soils. Based on correlation with SPT N-values and soil classification, fair to poor subgrade support is expected. Locally available borrow for use as embankment fill is expected to have similar properties.

We recommend that any soils classifying as A-7-6 and soils with a plasticity index (PI) in excess of 18, if encountered during the work, be excluded from use within 12 in. of the plan subgrade elevation of the approach roads. The top 12 in. of subgrade soils should have a maximum plasticity index (PI) of 18. Areas of unstable or otherwise unsuitable subgrade should be improved by undercut and replacement or treatment with additives approved by the Engineer. The results of the borings indicate that localized undercuts on the order of 2 ft, more or less, may be required.

Based on the results of the borings and Standard Penetration Tests and correlation with the AASHTO classification of the anticipated subgrade soils, subgrade support for a properly-prepared subgrade is expected to be fair. The following parameters are recommended for use in pavement design.

- Resilient Modulus (M_R): 2735 lbs per sq in.
- R value: 8.4

Subgrade preparation must include thorough proof-rolling after any cut and prior to placing fill. Areas which exhibit pumping or instability or are otherwise unsuitable should be improved by undercut or stabilization. Undercut or improvement depths on the order of 2 ft below existing grades, more or less, should be anticipated in approach road alignments.

Site Grading and Subgrade Preparation

Site grading and site preparation in the bridge alignment should include necessary clearing and grubbing of trees and underbrush and stripping the organic-containing surface soils in work areas. Where fill depths in excess of 3 ft are planned, stumps may be left after close cutting trees to grade, as per ARDOT criteria. Otherwise, tree stumps must be completely excavated and stumpholes properly backfilled.

The depth of stripping will be variable, with deeper stripping depths in wooded areas, and less stripping required in the predominant open areas. In general, the stripping depth is estimated to be about 6 to 9 in. in cleared areas but may be 18 to 24 in. or more in the localized wooded areas and areas with thick underbrush. The zone of organic surface soils should be completely stripped in the embankment footprint areas and at least 5 ft beyond the projected embankment toe to the extent possible.

Following required clearing and grubbing and stripping, and prior to fill placement or otherwise continuing with subgrade preparation, the extent of weak and unsuitable soils should be determined. Thorough proof-rolling should be performed to verify subgrade stability. Proof-rolling should be performed with a loaded tandem-wheel dump truck or similar equipment. Unstable soils exhibiting a tendency to rut and/or pump should be undercut and replaced with suitable fill. Care should be taken that undercuts, stump holes, and other excavations or low areas resulting from subgrade preparation are properly backfilled with compacted fill. Based on the results of the borings, localized undercutting could be required to develop subgrade stability. Potential undercut depths are estimated to be on the order of 2 to 4 ft, more or less. Deeper undercuts could be required for ground improvement in the footprints of MSE reinforced zones.

In areas of deep fills, the potential exists for use of thick initial lifts ("bridging"), as per ARDOT criteria. Bridge lifts will be subject to some consolidation. Settlement of a primarily granular fill suitable for use in bridging would be expected to be relatively rapid and long-term post-construction settlement would not be expected to be a significant concern. Where clayey soils are placed in thick lifts, long term settlement will be more significant. Consequently, we recommend that the use of "bridging" techniques be limited to granular borrow soils, i.e., sand or

gravel. Where fill amounts are limited to less than about 3 ft, bridging will be less effective and the potential for undercut or stabilization will increase. Use of bridging techniques and fill lift thickness must be specifically approved by the Engineer or Department.

Subgrade preparation and mass undercuts should extend at least 5 ft beyond the embankment toes to the extent possible. Subgrade preparation in roadway areas should extend at least 3 ft outside pavement shoulder edges to the extent possible. Where existing drainage features will be backfilled, these should be completely mucked out and all loose and/or organic soils removed prior to fill placement.

With the exception of reinforced zones of MSE walls and MSE wall undercuts, fill and backfill for embankment construction may consist of unclassified borrow free of organics and other deleterious materials as per Standard Specifications for Highway Construction, 2014 Edition, Subsection 210.06. Granular soils must be protected from erosion with a minimum 18-in.-thick armor of clayey soil. The on-site silty clay and sandy clay are typically suitable for this use.

Subgrade preparation should comply with Standard Specifications for Highway Construction, 2014 Edition, Section 212. Embankments should be constructed in accordance with Standard Specifications for Highway Construction, 2014 Edition, Section 210. Fill and backfill should be placed in nominal 6- to 10-in.-thick loose lifts. All fill and backfill must be placed in horizontal lifts. Where fill is placed against existing slopes, short vertical cuts should be “notched” in the existing slope face to facilitate bonding of horizontal fill lifts. The in-place density and water content should be determined for each lift and should be tested to verify compliance with the specified density and water content prior to placement of subsequent lifts.

CONSTRUCTION CONSIDERATIONS

Groundwater and Seepage Control

Positive surface drainage should be established at the start of the work, be maintained during construction and following completion of the work to prevent surface water ponding and subsequent saturation of subgrade soils. Density and water content of all earthwork should be maintained until the retaining walls, embankments, and bridge work is completed.

Subgrade soils that become saturated by ponding water or runoff should be excavated to undisturbed soil. The embankment subgrade should be evaluated by the Engineer during subgrade preparation.

Groundwater was locally encountered at 9.7 to 28.3-ft depth in January and February 2021. This is considered perched water and true groundwater levels are expected to be considerably deeper. Nevertheless, shallow perched groundwater could be locally encountered in the near-surface soils. The volume of groundwater produced can be highly variable depending on the condition of the soils in the immediate vicinity of the excavation. In addition, seasonal surface seeps or springs could develop.

Seepage into excavations and cuts can typically be controlled by ditching or sump-and-pump methods. If seepage into excavations becomes a problem, backfill should consist of select granular backfill (AASHTO M43, No. 57 stone), stone backfill (Standard Specifications for Highway Construction, 2014 Edition, Section 207), or approved alternates extending up to an elevation above the inflow of seepage. In areas of seepage infiltration, the granular fill should be encapsulated with a filter fabric complying with Standard Specifications for Highway Construction, 2014 Edition, Subsection 625.02, Type 2 and vented to positive discharge. Where surface seeps or springs are encountered during site grading, we recommend the seepage be directed via French drains or blanket drains to positive discharge at daylight or to storm drainage lines.

Piling

Piles should be installed in compliance with ARDOT Standard Specifications for Highway Construction, 2014 Edition, Section 805. Preboring for 10 to 12 ft could be warranted to set off pile driving.

To evaluate required hammer energy for driving equipment, driveability analyses were performed. For these analyses, wave equation analysis of piles (WEAP) and the computer program GRLWEAP 2014⁴ were used. In the driveability analyses, the steel piles were assumed to be driven from plan MSE wall subgrade elevation or existing grade. The results of these analyses have been submitted under separate cover.

Based on static pile capacity calculations and the results of the driveability analyses, we recommend a hammer system capable of delivering at least 28,000 ft-kips per blow for driving the steel piles. A specific review and analysis of the pile-hammer system proposed by the Contractor should be performed by the Engineer or Department prior to hammer acceptance and start of pile installation.

⁴ GRLWEAP 2014; Pile Dynamics, Inc.

The density of the granular foundation soils increases with depth. As a result, difficult driving could be experienced at depth. Use of a higher energy hammer could be warranted. Installing piles using a vibratory hammer or jetting could also be required. Use of vibrating or jetting for pile installation should be approved by the Engineer or Department. If piles are installed by jetting, the geotechnical capacity of piles should be re-evaluated if these values are utilized in design. Where piles are advanced by approved vibrating or jetting, we recommend that the final 5 ft of penetration, or driving to refusal, be achieved with an impact hammer. We recommend that steel piles be fitted with rock points.

Safe bearing capacity of production piles should be determined by Standard Specifications for Highway Construction, 2014 Edition, Section 805.09, Method B. Driving records should be available for review by the Engineer during pile installation. Piles should be carefully examined prior to driving and piles with structural defects should be rejected. Any splices in steel piles should develop the full cross-sectional capacity of un-spliced piles.

Pile installation should be monitored by qualified personnel to maintain specific and complete driving records and to observe pile installation procedures. Blow counts on steel piles should be limited to about 20 blows per inch. We recommend that practical pile refusal be defined as a penetration of 0.5 in. or less for the final 10 blows.

CLOSURE

The Engineer or Department or a designated representative thereof should monitor site preparation, grading work and foundation construction. Subsurface conditions significantly at variance with those encountered in the borings should be brought to the attention of the Geotechnical Engineer. The conclusions and recommendations of this report should then be reviewed in light of the new information.

The following illustrations are attached and complete this final report.

| | |
|---------------------|---|
| Plate 1 | Site Vicinity |
| Plate 2 | Plan of Borings |
| Plates 3 through 19 | Boring Logs |
| Plate 20 | Key to Terms and Symbols |
| Appendix 21 | Generalized Subsurface Profile |
| Appendix A | Preliminary Bridge Layout |
| Appendix B | Classification Test Results |
| Appendix C | Nominal Pile Capacity Curves |
| Appendix D | Lateral Load Analyses Parameters |
| Appendix E | Summary of MSE Wall Bearing Recommendations |
| Appendix F | Stability Analyses Results |

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We appreciate the opportunity to be of service to you on this project. Should you have any questions regarding this report, or if we may be of additional assistance, please call on us.

Sincerely,

**GRUBBS, HOSKYN,
BARTON & WYATT, INC.**

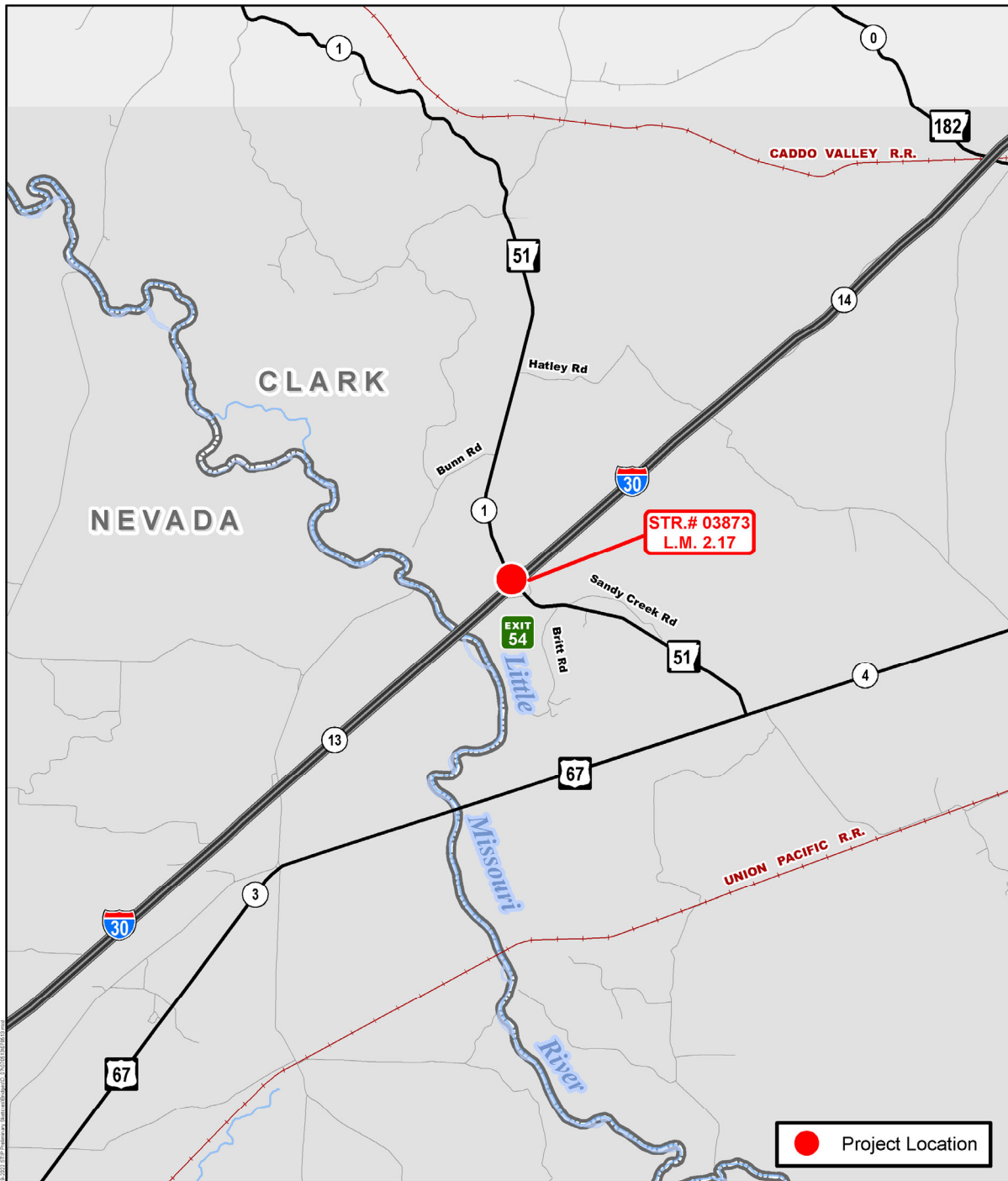
Velletta Scott
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Attn: Mr. Dustin Tackett, P.E. (1-email)



Job 070513

I-30 Str. & Apprs. (Hwy. 51) (S)

Hwy. 51, Sec. 1

Clark County

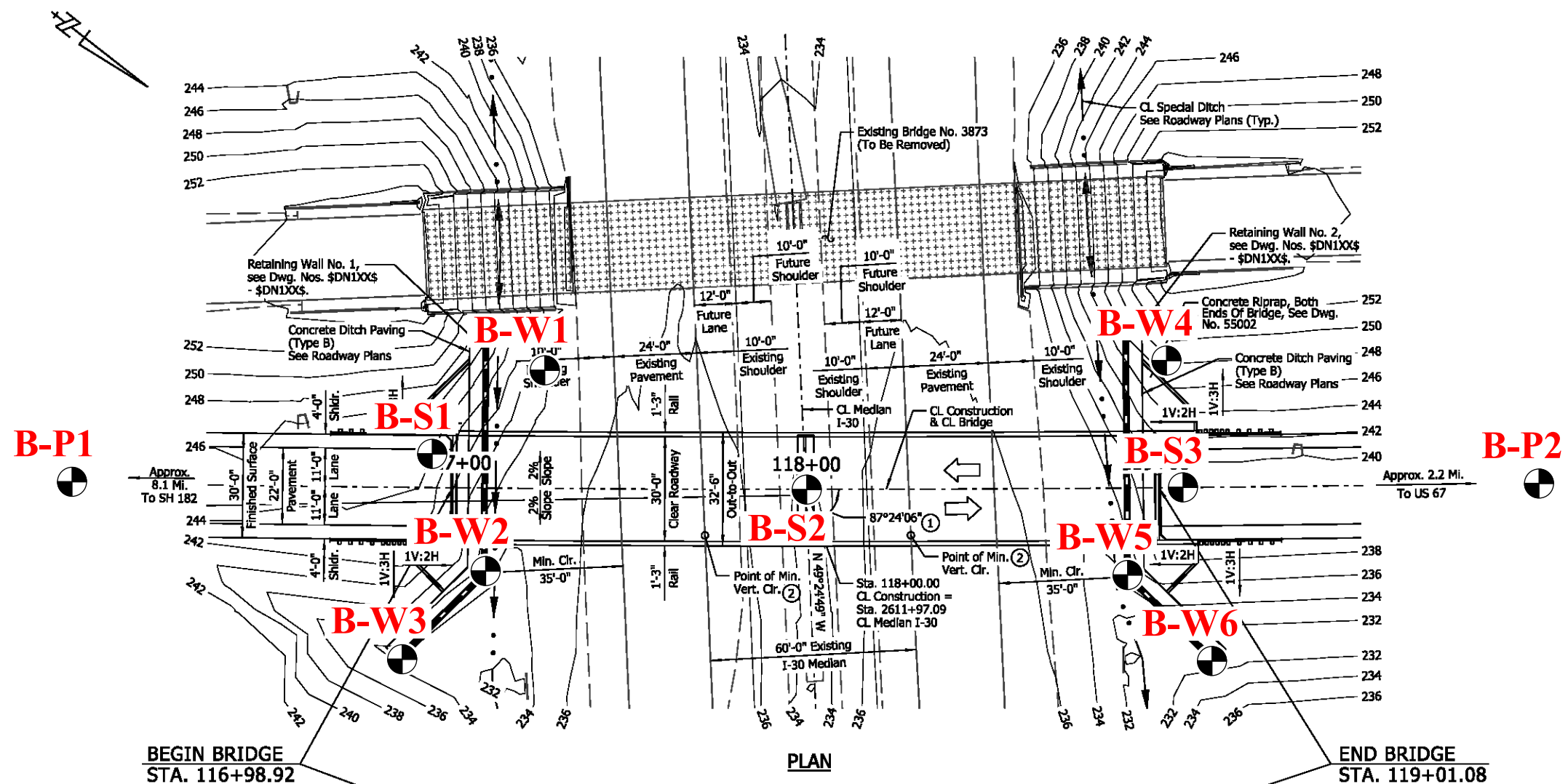


**Grubbs, Hoskyn,
Barton & Wyatt, INC.**
CONSULTING ENGINEERS

SITE VICINITY MAP
070513 – Hwy 51 over I-30
Clark County, Arkansas

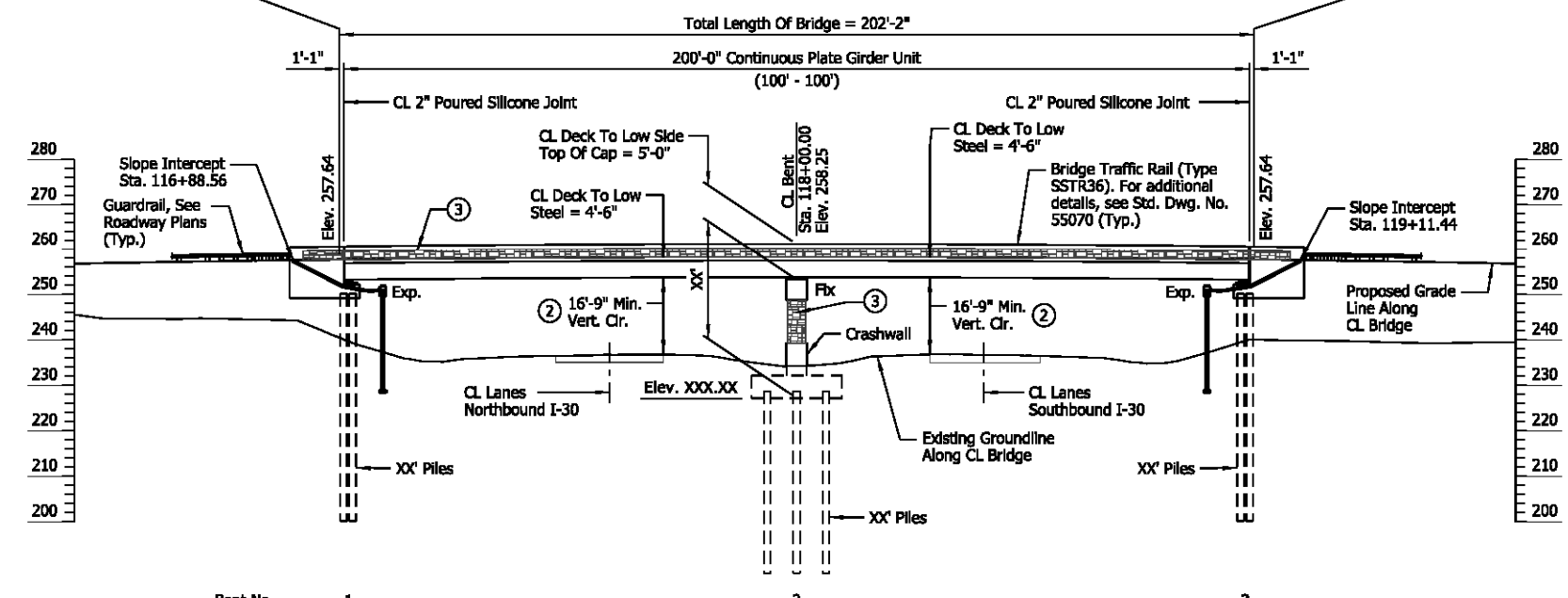
Job No. 19-070

Plate 1



BEGIN BRIDGE STA. 116+98.92

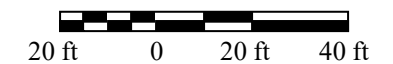
END BRIDGE STA. 119+01.08



FOR R/W DATA, SEE
ROADWAY PLANS

ELEVATION

NOTES:
Use Type I Special Approach Gutters at each end
of bridge. See Dwg. No. \$DNOXX\$.








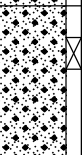



**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

LOG OF BORING NO. S1

070513 - Hwy 51 over I-30
Clark County, Arkansas

TYPE: HSA to 20 ft/Wash

LOCATION: Approx Sta 116+95, 10 ft Lt

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT | | | | - No. 200 % | | | | |
|----------------------------|---|---------|---|--------------|-------------------------|-----------------------|-----------------------|-----------|---------------|-------------|----------------------|-----|-----|----|
| | | | | | | 0.2 | 0.4 | 0.6 | 0.8 | | 1.0 | 1.2 | 1.4 | |
| | | | | | | PLASTIC LIMIT + | WATER CONTENT ● | | | | LIQUID LIMIT + | | | |
| | | | SURF. EL: 244± | | | 10 | 20 | 30 | 40 | 50 | 60 | 70 | | |
| 5 |  | X | Firm to stiff reddish brown, tan and gray fine sandy clay w/silt pockets and ferrous stains (fill) | 10 | | ● | | | | | | | 59 | |
| | | | 10 | | ● | + | | | | | | | | |
| | | | Stiff red, gray and reddish tan silty clay, sandy | 13 | | ● | | | | | | | | 77 |
| | | | | 20 | | ● | - - - - - | + | | | | | | |
| 22 | | ● | | | | | | | | | | | | |
| 10 |  | X | - very stiff, gray with red below 13 ft | 30 | | ● | | | | | | | | |
| 15 | | | | | | | | | | | | | | |
| 20 |  | X | Medium dense light gray fine to medium sand | 26 | | ● | | | | | | | 4 | |
| 25 |  | X | Dense to very dense tan and reddish tan fine to coarse sand, slightly silty w/fine gravel | 50/6" | | | | | | | | | 9 | |
| | | | | | | | | | | | | | | |
| 30 |  | X | Very stiff dark brownish gray clay w/fine sand pockets | 50/10" | | ● | + | - - - - - | + | | | | 17 | |
| | | | Dense to very dense dark gray silty fine sand, calcareous and weakly cemented | | | | | | | | | | | |
| 35 |  | X | | 50/11" | | | | | -NON-PLASTIC- | | | | 48 | |
| | | | | | | | | | | | | | | |
| 40 |  | X | Dense to very dense gray silty fine sand, calcareous, cemented w/occasional fine gravel-sized sandstone nodules | 25/0" | | | | | | | | | | |
| | | | | | | 25/0" | | | | | | | | |
| COMPLETION DEPTH: 100.0 ft | | | | | | | | | | | | | | |
| DATE: 1-29-21 | | | | | | | | | | | | | | |
| DEPTH TO WATER | | | | | | | | | | | | | | |
| IN BORING: Dry to 20 ft | | | | | | | | | | | | | | |
| DATE: 1/29/2021 | | | | | | | | | | | | | | |

LGBNEW 19-070.GPJ 4-7-21



**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

LOG OF BORING NO. S1

070513 - Hwy 51 over I-30
Clark County, Arkansas

TYPE: HSA to 20 ft/Wash

LOCATION: Approx Sta 116+95, 10 ft Lt

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL (continued) | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT | | | | | | | - No. 200 % |
|-----------|--------|---------|---|--------------|-------------------------|--|-----|-----|---------------|-----|-----|-----|-------------|
| | | | | | | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 | 1.2 | 1.4 | |
| | | | | | | <div> <div>PLASTIC LIMIT</div> <div>WATER CONTENT</div> <div>LIQUID LIMIT</div> </div> | | | | | | | |
| | | | | | | 10 | 20 | 30 | 40 | 50 | 60 | 70 | |
| 50 | | | | 25/0" | | | | | | | | | |
| 55 | | | Dense to very dense bluish gray silty fine sand, calcareous, weakly cemented w/occasional calcareous nodules and inclusions | 50/3" | | | | | | | | | |
| 60 | | | | 50/4" | | | | | -NON-PLASTIC- | | | | 23 |
| 65 | | | | 50/6" | | | | | | | | | |
| 70 | | | | 50/4" | | | | | | | | | |
| 75 | | | | 50/4" | | | | | | | | | |
| 80 | | | | 50/4" | | | | | | | | | |
| 85 | | | | 50/6" | | | | | | | | | |
| | | | | 50/4" | | | | | | | | | |

COMPLETION DEPTH: 100.0 ft
DATE: 1-29-21

DEPTH TO WATER
IN BORING: Dry to 20 ft

DATE: 1/29/2021



**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

LOG OF BORING NO. S1

070513 - Hwy 51 over I-30
Clark County, Arkansas

TYPE: HSA to 20 ft/Wash

LOCATION: Approx Sta 116+95, 10 ft Lt

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL (continued) | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT | | | - No. 200 % | | | | |
|-----------|--------|---------|--|--------------|-------------------------|---------------------|-----|-----|-------------|--------------------|-----|-----|-------------------|
| | | | | | | 0.2 | 0.4 | 0.6 | | 0.8 | 1.0 | 1.2 | 1.4 |
| | | | | | | PLASTIC LIMIT + | | | | WATER CONTENT ● | | | LIQUID LIMIT + |
| | | | | | | 10 | 20 | 30 | 40 | 50 | 60 | 70 | |
| 95 | | | | 50/4" | | | | | | | | | |
| 100 | | | | 50/3" | | | | | | | | | |
| 105 | | | | | | | | | | | | | |
| 110 | | | | | | | | | | | | | |
| 115 | | | | | | | | | | | | | |
| 120 | | | | | | | | | | | | | |
| 125 | | | | | | | | | | | | | |
| 130 | | | | | | | | | | | | | |

COMPLETION DEPTH: 100.0 ft
DATE: 1-29-21

DEPTH TO WATER
IN BORING: Dry to 20 ft

DATE: 1/29/2021



**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

LOG OF BORING NO. S2

070513 - Hwy 51 over I-30
Clark County, Arkansas

TYPE: HSA to 30 ft/Wash

LOCATION: Approx Sta 118+00, CL

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT | | | | | | | - No. 200 % |
|-----------|--------|---------|---|--------------|-------------------------|---------------------|-----|-----|--------------------|-----|-----|-------------------|-------------|
| | | | | | | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 | 1.2 | 1.4 | |
| | | | SURF. EL: 234± | | | PLASTIC LIMIT + | | | WATER CONTENT ● | | | LIQUID LIMIT + | |
| | | | | | | 10 | 20 | 30 | 40 | 50 | 60 | 70 | |
| 5 | | | Medium dense yellowish tan, reddish brown and gray clayey fine sand, silty | 17 | | | ● | | | | | | 32 |
| | | | | 20 | | | ● | + | | | | | |
| | | | | 18 | | | ● | | | | | | |
| | | | Medium dense yellowish tan, reddish brown and gray silty fine sand | 21 | | | ● | | | | | | 13 |
| | | | | | | | | | -NON-PLASTIC- | | | | |
| 10 | | | Dense reddish brown sandy fine to coarse gravel | 32 | | | ● | | | | | | 4 |
| | | | | | | | | | | | | | |
| 15 | | | Dense gray and tan fine sand, slightly silty w/ferrous stains and cemented silt nodules | 32 | | | | | | | | | 9 |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| 20 | | | | 44 | | | | | | | | | |
| | | | | | | | | | | | | | |
| 25 | | | Very stiff dark gray clay | 50/6" | | | + | | ● | | + | | |
| | | | Dense to very dense gray silty fine sand, calcareous, cemented w/shell fragments | | | | | | | | | | |
| | | | | 25/0" | | | | | | | | | |
| 30 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| 35 | | | | 25/0" | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| 40 | | | | 25/0" | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | 25/0" | | | | | | | | | |

COMPLETION DEPTH: 100.0 ft
DATE: 3-10-21

DEPTH TO WATER
IN BORING: 9.7 ft

DATE: 3/10/2021



**Grubbs, Hoskyn,
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Consulting Engineers

LOG OF BORING NO. S2

070513 - Hwy 51 over I-30
Clark County, Arkansas

TYPE: HSA to 30 ft/Wash

LOCATION: Approx Sta 118+00, CL

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL (continued) | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT | | | | | | | - No. 200 % |
|---|--------|---------|--|--------------|-------------------------|--|-----|-----|-----|-----|-----|-----|-------------|
| | | | | | | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 | 1.2 | 1.4 | |
| | | | | | | <div> <div>PLASTIC LIMIT</div> <div>WATER CONTENT</div> <div>LIQUID LIMIT</div> </div> | | | | | | | |
| | | | | | | 10 | 20 | 30 | 40 | 50 | 60 | 70 | |
| 50 | | | Dense to very dense bluish gray silty fine sand, calcareous, weakly cemented w/calcareous nodules and occasional shell fragments | 50/5" | | | | | | | | | 19 |
| 55 | | | | 50/4" | | | | | | | | | |
| 60 | | | | 50/6" | | | | | | | | | |
| 65 | | | | 50/4" | | | | | | | | | |
| 70 | | | | 50/4" | | | | | | | | | |
| 75 | | | | 25/0" | | | | | | | | | |
| 80 | | | | 50/2" | | | | | | | | | |
| 85 | | | | 50/3" | | | | | | | | | |
| | | | - bluish gray with green below 88 ft (glaucousitic sand) | 50/6" | | | | | | | | | |
| COMPLETION DEPTH: 100.0 ft DATE: 3-10-21 | | | | | | | | | | | | | |
| DEPTH TO WATER IN BORING: 9.7 ft | | | | | | | | | | | | | |
| DATE: 3/10/2021 | | | | | | | | | | | | | |

LGBNEW 19-070.GPJ 4-7-21



**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

LOG OF BORING NO. S2

070513 - Hwy 51 over I-30
Clark County, Arkansas

TYPE: HSA to 30 ft/Wash

LOCATION: Approx Sta 118+00, CL

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL (continued) | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT | | | - No. 200 % | | | | | |
|-----------|--------|---------|--|--------------|-------------------------|---------------------|-----|-----|-------------|---------------|-----|-----|--------------|--|
| | | | | | | 0.2 | 0.4 | 0.6 | | 0.8 | 1.0 | 1.2 | 1.4 | |
| | | | | | | PLASTIC LIMIT | | | | WATER CONTENT | | | LIQUID LIMIT | |
| | | | | | | 10 | 20 | 30 | 40 | 50 | 60 | 70 | | |
| 95 | | | | 50/6" | | | | | | | | | | |
| 100 | | | | 50/7" | | | | | | | | | | |
| 105 | | | | | | | | | | | | | | |
| 110 | | | | | | | | | | | | | | |
| 115 | | | | | | | | | | | | | | |
| 120 | | | | | | | | | | | | | | |
| 125 | | | | | | | | | | | | | | |
| 130 | | | | | | | | | | | | | | |

COMPLETION DEPTH: 100.0 ft
 DATE: 3-10-21

DEPTH TO WATER
 IN BORING: 9.7 ft

DATE: 3/10/2021



**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

LOG OF BORING NO. S3

070513 - Hwy 51 over I-30
Clark County, Arkansas

TYPE: HSA to 30 ft/Wash

LOCATION: Approx Sta 119+10, CL

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT | | | | | | | - No. 200 % |
|----------------------------|--------|---------|--|--------------|-------------------------|---------------------|-----|-----|-----|-----|-----|-----|-------------|
| | | | | | | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 | 1.2 | 1.4 | |
| | | | SURF. EL: 239± | | | | | | | | | | |
| | | | Medium dense brown, reddish brown and gray clayey fine sand w/trace fine gravel and ferrous nodules (fill) | 12 | | | + | | | | | | 43 |
| | | | Medium dense red, gray and reddish tan clayey fine sand | 13 | | | + | | | | | | 49 |
| 5 | | | | 16 | | | | | | | | | |
| | | | | 19 | | | | | | | | | |
| 10 | | | | 18 | | | | | | | | | |
| | | | | | | | | | | | | | |
| 15 | | | Dense to very dense tan and gray clayey fine to coarse sand w/a little fine chert gravel | 58 | | | | | | | | | 16 |
| | | | | | | | | | | | | | |
| 20 | | | Dense tan sandy fine to coarse gravel, slightly silty | 35 | | | | | | | | | 7 |
| | | | | | | | | | | | | | |
| 25 | | | Dense bluish gray silty fine sand, calcareous and weakly cemented | 31 | | | | | | | | | 29 |
| | | | | 41 | | | | | | | | | |
| 30 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| 35 | | | Dense to very dense light gray silty fine sand, calcareous and cemented w/occasional fine gravel-sized sandstone nodules | 25/0" | | | | | | | | | |
| | | | | 25/0" | | | | | | | | | |
| 40 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | Dense bluish gray silty fine sand, calcareous and weakly cemented | 48 | | | | | | | | | |
| COMPLETION DEPTH: 100.0 ft | | | | | | | | | | | | | |
| DATE: 2-4-21 | | | | | | | | | | | | | |
| DEPTH TO WATER | | | | | | | | | | | | | |
| IN BORING: 28.3 ft | | | | | | | | | | | | | |
| DATE: 2/4/2021 | | | | | | | | | | | | | |

LGBNEW 19-070.GPJ 4-7-21



**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

LOG OF BORING NO. S3

070513 - Hwy 51 over I-30
Clark County, Arkansas

TYPE: HSA to 30 ft/Wash

LOCATION: Approx Sta 119+10, CL

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL (continued) | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT | | | | | | | | - No. 200 % |
|----------------------------|--------|---------|--|--------------|-------------------------|--|-----------------------|----|---------------|----|----|----|----------------------|-------------|
| | | | | | | <div><div></div><div>0.20.40.60.81.01.21.4</div></div> | | | | | | | | |
| | | | | | | PLASTIC LIMIT + | WATER CONTENT ● | | | | | | LIQUID LIMIT + | |
| | | | | | | 10 | 20 | 30 | 40 | 50 | 60 | 70 | | |
| | | | with occasional calcareous nodules | | | | | | | | | | | |
| | | | - dense to very dense below 48 ft | | | | | | | | | | | |
| 50 | | | | 50/10" | | | | | -NON-PLASTIC- | | | | 42 | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 55 | | | | 50/8" | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 60 | | | | 50/5" | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 65 | | | | 50/3" | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 70 | | | | 50/3" | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 75 | | | | 50/4" | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 80 | | | | 50/6" | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 85 | | | - bluish gray with green with shell fragments below 83 ft (glauconitic sand) | 50/6" | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | 50/7" | | | | | | | | | | |
| COMPLETION DEPTH: 100.0 ft | | | | | | | | | | | | | | |
| DATE: 2-4-21 | | | | | | | | | | | | | | |
| DEPTH TO WATER | | | | | | | | | | | | | | |
| IN BORING: 28.3 ft | | | | | | | | | | | | | | |
| DATE: 2/4/2021 | | | | | | | | | | | | | | |

LGBNEW 19-070.GPJ 4-7-21






**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

LOG OF BORING NO. S3

070513 - Hwy 51 over I-30
Clark County, Arkansas

TYPE: HSA to 30 ft/Wash

LOCATION: Approx Sta 119+10, CL

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL (continued) | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT | | | | | | | | - No. 200 % |
|--|---|--|--|--------------------------------------|-------------------------|--|-----------------------|----------------|----|----|----------------------|----|--|-------------|
| | | | | | | <div><div></div><div>0.20.40.60.81.01.21.4</div></div> | | | | | | | | |
| | | | | | | PLASTIC LIMIT + | WATER CONTENT ● | | | | LIQUID LIMIT + | | | |
| | | | | | | 10 | 20 | 30 | 40 | 50 | 60 | 70 | | |
| 95 |  |   | - with shells below 98 ft | 50/6" | | | | | | | | | | |
| 100 | | | | 50/4" | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 105 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 110 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 115 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 120 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 125 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 130 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| COMPLETION DEPTH: 100.0 ft DATE: 2-4-21 | | | | DEPTH TO WATER IN BORING: 28.3 ft | | | | DATE: 2/4/2021 | | | | | | |

LGBNEW 19-070.GPJ 4-7-21



**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

LOG OF BORING NO. W1

070513 - Hwy 51 over I-30
Clark County, Arkansas

TYPE: Auger

LOCATION: Appro Sta 117+25, 35 ft Lt

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT | | | | | | | - No. 200 % | |
|---------------------------------|--------|---------|---|--------------|-------------------------|--|------------------|----|---------------|----|----|-----------------|-------------|--|
| | | | | | | <div><div></div><div>0.20.40.60.81.01.21.4</div></div> | | | | | | | | |
| | | | | | | PLASTIC LIMIT | WATER CONTENT | | | | | LIQUID LIMIT | | |
| | | | SURF. EL: 236± | | | + | | | | | | | | |
| | | | | | | 10 | 20 | 30 | 40 | 50 | 60 | 70 | | |
| | | | Loose reddish tan, red and gray fine sandy silt | 5 | | | ● | | | | | | | |
| | | | Dense light gray w/red fine sandy silt | 39 | | | ● | | | | | | | |
| 5 | | | - medium dense below 4 ft | 26 | | | ● | | -NON-PLASTIC- | | | | 71 | |
| | | | | 26 | | ● | | | | | | | | |
| | | | Dense to very dense light tan w/reddish tan silty fine sand w/some fine chert gravel | 50/8" | | ● | | | | | | | 21 | |
| 10 | | | | | | | | | | | | | | |
| | | | Dense to very dense light tan and reddish tan sandy fine chert gravel, slightly silty | 50/6" | | ● | | | -NON-PLASTIC- | | | | 6 | |
| 15 | | | | | | | | | | | | | | |
| | | | | 50/4" | | | | | | | | | | |
| 20 | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| | | | | | | | | | | | | | | |
| 25 | | | | | | | | | | | | | | |
| COMPLETION DEPTH: 20.0 ft | | | | | | | | | | | | | | |
| DATE: 2-3-21 | | | | | | | | | | | | | | |
| DEPTH TO WATER IN BORING: 14 ft | | | | | | | | | | | | | | |
| DATE: 2/3/2021 | | | | | | | | | | | | | | |



**Grubbs, Hoskyn,
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Consulting Engineers

LOG OF BORING NO. W2

070513 - Hwy 51 over I-30
Clark County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 117+10, 25 ft Rt

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT | | | | | | | - No. 200 % |
|---------------------------|--------|---------|---|--------------------------------------|-------------------------|--|-----------------------|----------------|----|----|----------------------|----|-------------|
| | | | | | | <div><div></div><div>0.20.40.60.81.01.21.4</div></div> | | | | | | | |
| | | | | | | PLASTIC LIMIT + | WATER CONTENT ● | | | | LIQUID LIMIT + | | |
| | | | SURF. EL: 235± | | | 10 | 20 | 30 | 40 | 50 | 60 | 70 | |
| | | | Soft dark brown fine sandy clay w/a little fine to coarse gravel and occasional rootlets (fill) | 6 | | | ● | | | | | | |
| | | | Stiff reddish tan, gray and red silty clay, sandy | 18 | | | ● | --- | + | | | | 79 |
| 5 | | | Medium dense light tan w/reddish tan and red silty fine sand | 24 | | | ● | -NON-PLASTIC- | | | | | 50 |
| | | | | 29 | | | ● | | | | | | 30 |
| 10 | | | Dense tan and reddish tan sandy fine to coarse chert gravel, slightly silty | 49 | | ● | | | | | | | |
| 15 | | | Dense to very dense tan silty fine to coarse sand w/some fine to coarse gravel | 50/10" | | ● | | | | | | | |
| 20 | | | - dense below 18 ft | 46 | | ● | | | | | | | |
| 25 | | | | | | | | | | | | | |
| COMPLETION DEPTH: 20.0 ft | | | | DEPTH TO WATER IN BORING: 13.8 ft | | | | DATE: 2/3/2021 | | | | | |
| DATE: 2-3-21 | | | | | | | | | | | | | |

LGBNEW 19-070.GPJ 4-7-21



**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

LOG OF BORING NO. W3

070513 - Hwy 51 over I-30
Clark County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 116+85, 50 ft Rt

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT | | | | | | | - No. 200 % |
|-----------|--------|---------|--|--------------|-------------------------|---------------------|------------------|----|----|----|----|-----------------|-------------|
| | | | | | | | | | | | | | |
| | | | | | | PLASTIC LIMIT | WATER CONTENT | | | | | LIQUID LIMIT | |
| | | | SURF. EL: 234± | | | + | | ○ | | | | + | |
| | | | | | | 10 | 20 | 30 | 40 | 50 | 60 | 70 | |
| | | | Soft brown and dark brown fine sandy clay, wet w/a little fine gravel and occasional decayed organics (fill) | 5 | | | | | | | | | |
| | | | Medium dense light gray and red clayey fine sand w/trace fine to coarse gravel | 23 | | | | | | | | | 35 |
| | | | - dense below 4 ft | 31 | | | | | | | | | |
| 5 | | | | | | | | | | | | | |
| | | | Dense to very dense light tan and gray silty fine sand w/clayey fine sand pockets | 50/10" | | | | | | | | | |
| | | | Dense to very dense tan silty fine sand w/trace fine gravel | 50/8" | | | | | | | | | 45 |
| 10 | | | | | | | | | | | | | |
| | | | Dense to very dense tan silty fine to coarse sand w/some fine gravel | 50/10" | | | | | | | | | 23 |
| 15 | | | | | | | | | | | | | |
| | | | - with more fine to coarse gravel below 18 ft | 50/5" | | | | | | | | | |
| 20 | | | | | | | | | | | | | |
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**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

LOG OF BORING NO. W4

070513 - Hwy 51 over I-30
Clark County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 119+00, 35 ft Lt

[illegible]



LOG OF BORING NO. W5

070513 - Hwy 51 over I-30
Clark County, Arkansas

TYPE: Auger

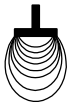
LOCATION: Approx Sta 118+90, 25 ft Rt

[illegible]

COMPLETION DEPTH: 20.0 ft
DATE: 2-3-21

DEPTH TO WATER
IN BORING: 14.6 ft

DATE: 2/3/2021



LOG OF BORING NO. W6

070513 - Hwy 51 over I-30
Clark County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 119+15, 50 ft Rt

[illegible]

COMPLETION DEPTH: 20.0 ft
DATE: 2-3-21

DEPTH TO WATER
IN BORING: 13.2 ft

DATE: 2/3/2021



**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

LOG OF BORING NO. P1

070513 - Hwy 51 over I-30
Clark County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 115+90, CL

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT | | | | | | | - No. 200 % |
|---|--------|---------|--|--------------|-------------------------|-----------------------|-----------------------|-----|---------------|-----|-----|----------------------|-------------|
| | | | | | | 0.2 | 0.4 | 0.6 | 0.8 | 1.0 | 1.2 | 1.4 | |
| | | | | | | PLASTIC LIMIT + | WATER CONTENT ● | | | | | LIQUID LIMIT + | |
| | | | SURF. EL: 244± | | | 10 | 20 | 30 | 40 | 50 | 60 | 70 | |
| | | | Loose tan and reddish brown fine sandy silt w/trace fine gravel (fill) | 9 | | ● | | | -NON PLASTIC- | | | | 55 |
| | | | Firm to stiff brown and red fine sandy clay | 10 | | + | ● | - - | + | | | | 66 |
| 5 | | | - very soft, tan and gray at 4 to 6 ft | 3 | | | ● | | | | | | |
| | | | - very stiff, red, gray and reddish tan below 6 ft | 29 | | | ● | | | | | | |
| 10 | | | | 35 | | ● | | | | | | | |
| | | | Dense tan and gray silty fine sand, slightly clayey | 35 | | | | | | | | | |
| 15 | | | | | | | | | | | | | |
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| 20 | | | | | | | | | | | | | |
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| 25 | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| COMPLETION DEPTH: 15.0 ft DEPTH TO WATER IN BORING: Dry DATE: 1/28/2021 | | | | | | | | | | | | | |

COMPLETION DEPTH: 15.0 ft
DATE: 1-28-21

DEPTH TO WATER
IN BORING: Dry

DATE: 1/28/2021



**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**
Consulting Engineers

LOG OF BORING NO. P2

070513 - Hwy 51 over I-30
Clark County, Arkansas

TYPE: Auger

LOCATION: Approx Sta 120+10, CL

| DEPTH, FT | SYMBOL | SAMPLES | DESCRIPTION OF MATERIAL | BLOWS PER FT | UNIT DRY WT LB/CU FT | COHESION, TON/SQ FT | | | | | | | - No. 200 % |
|-----------|--------|---------|---|--------------|-------------------------|---|-----------------------|----|----|----|----|----------------------|-------------|
| | | | | | | 0.2 0.4 0.6 0.8 1.0 1.2 1.4 | | | | | | | |
| | | | | | | PLASTIC LIMIT + | WATER CONTENT ● | | | | | LIQUID LIMIT + | |
| | | | SURF. EL: 239± | | | 10 | 20 | 30 | 40 | 50 | 60 | 70 | |
| | | | Loose grayish brown silty fine sand | 6 | | | ● | | | | | | 37 |
| | | | - dense with ferrous nodules and stains and trace fine gravel below 2 ft | 35 | | | ● | | | | | | |
| 5 | | | Stiff reddish tan fine sandy clay | 15 | | | ● | + | | | | | 59 |
| | | | - gray, red and tan below 6 ft | 12 | | | ● | | | | | | |
| 10 | | | | 20 | | | ● | | | | | | |
| | | | Dense to very dense tan clayey fine sand w/some fine to coarse chert gravel | 50/8" | | | ● | | | | | | |
| 15 | | | | | | | | | | | | | |
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| 20 | | | | | | | | | | | | | |
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COMPLETION DEPTH: 15.0 ft
DATE: 2-3-21

DEPTH TO WATER
IN BORING: Dry

DATE: 2/3/2021



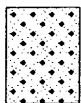
SYMBOLS AND TERMS USED ON BORING LOGS

SOIL TYPES

(SHOWN IN SYMBOLS COLUMN)



Gravel



Sand



Silt



Clay

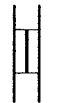
Predominant type shown heavy

SAMPLER TYPES

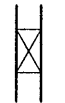
(SHOWN ON SAMPLES COLUMN)



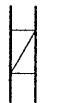
Shelby
Tube



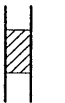
Rock
Core



Split
Spoon



No
Recovery



Cutting

TERMS DESCRIBING CONSISTENCY OR CONDITION

COARSE GRAINED SOILS (major portion retained on No. 200 sieve): Includes (1) Clean gravels and sands, and (2) silty or clayey gravels and sands. Condition is rated according to relative density, as determined by laboratory tests.

DESCRIPTIVE TERM

VERY LOOSE

LOOSE

MEDIUM DENSE

DENSE

VERY DENSE

N-VALUE

0-4

4-10

10-30

30-50

50 and above

RELATIVE DENSITY

0-15%

15-35%

35-65%

65-85%

85-100%

FINE GRAINED SOILS (major portion passing No. 200 sieve): Includes (1) Inorganic and organic silts and clays, (2) gravelly, sandy, or silty clays, and (3) clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings or by unconfined compression tests.

DESCRIPTIVE TERM

VERY SOFT

SOFT

FIRM

STIFF

VERY STIFF

HARD

UNCONFINED COMPRESSIVE STRENGTH TON/SQ. FT.

Less than 0.25

0.25-0.50

0.50-1.00

1.00-2.00

2.00-4.00

4.00 and higher

NOTE: Slickensided and fissured clays may have lower unconfined compressive strengths than shown above, because of planes of weakness or cracks in the soil. The consistency ratings of such soils are based on penetrometer readings.

TERMS CHARACTERIZING SOIL STRUCTURE

SLICKENSIDED - having inclined planes of weakness that are slick and glossy in appearance.

FISSURED - containing shrinkage cracks, frequently filled with fine sand or silt; usually more or less vertical.

LAMINATED - composed of thin layers of varying color and texture.

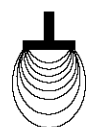
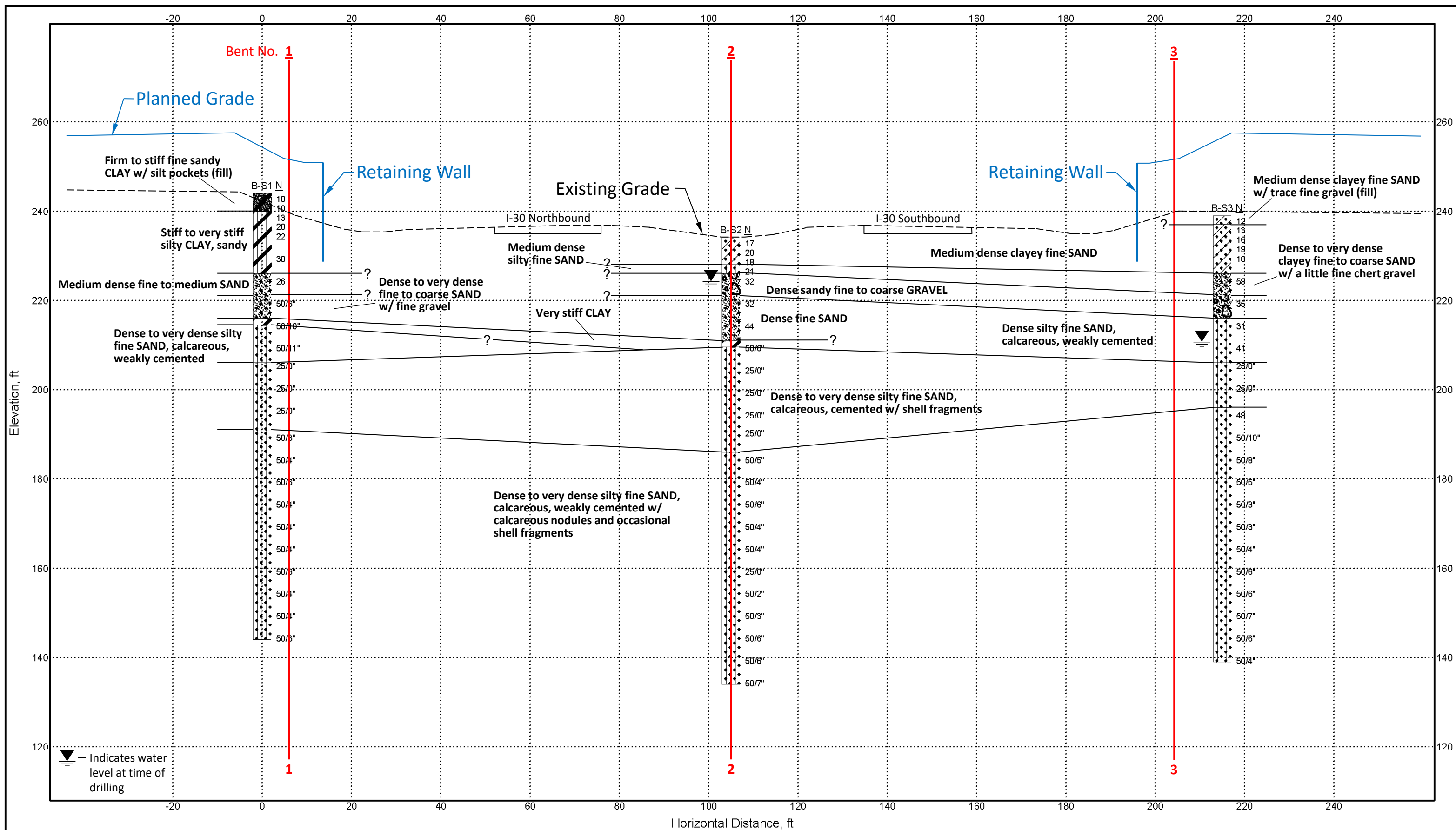
INTERBEDDED - composed of alternate layers of different soil types.

CALCAREOUS - containing appreciable quantities of calcium carbonate.

WELL GRADED - having a wide range in grain sizes and substantial amounts of all intermediate particle sizes.

POORLY GRADED - predominantly of one grain size, or having a range of sizes with some intermediate sizes missing.

Terms used on this report for describing soils according to their texture or grain size distribution are in accordance with the UNIFIED SOIL CLASSIFICATION SYSTEM, as described in Technical Memorandum No.3-357, Waterways Experiment Station, March 1953



**Grubbs, Hoskyn,
Barton & Wyatt, Inc.**

NOTES:

1. Subsurface conditions have been inferred between discrete boring locations. Actual conditions may vary.
2. Ground surface approximate.

SCALE:

1" = 20' Horizontal
1" = 20' Vertical

Generalized Subsurface Profile
070513 - Hwy 51 over I-30
Clark County, Arkansas
Project Number: 19-070

Plate 21

APPENDIX A

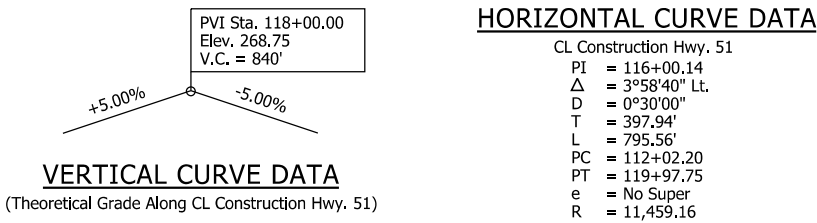
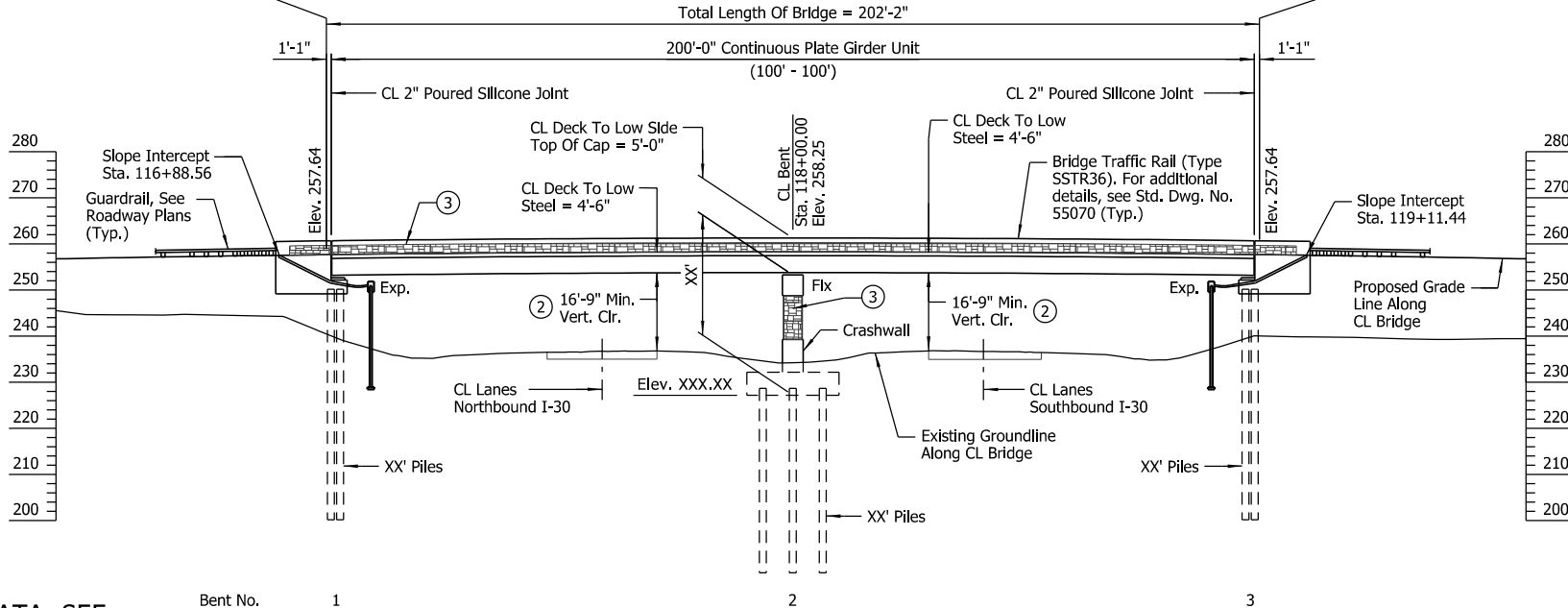
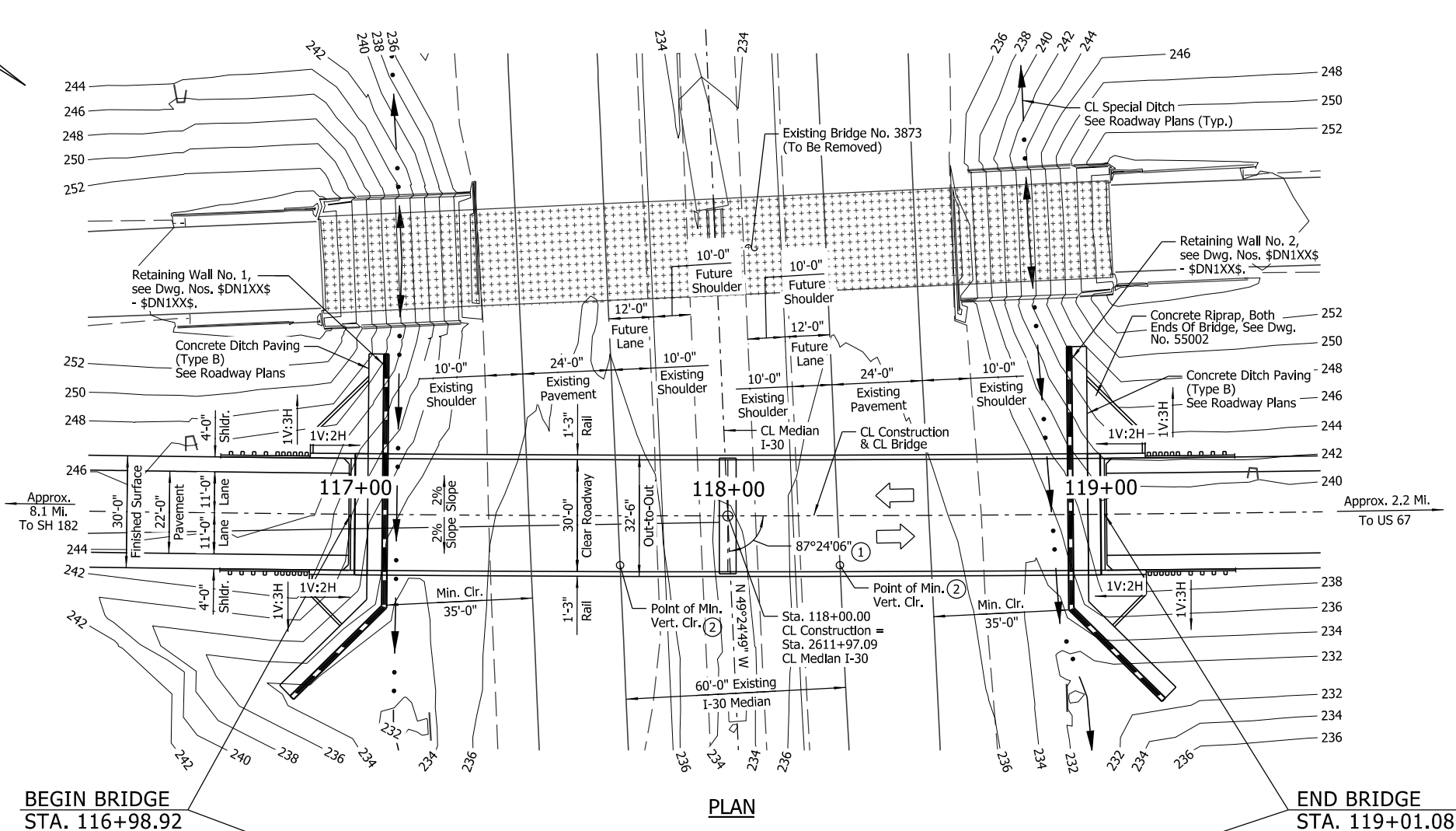
| DATE REVISED | DATE FILMED | DATE REVISED | DATE FILMED | FED. ROAD DIST. NO. | STATE | FED. AID PROJ. NO. | SHEET NO. | TOTAL SHEETS |
|--------------|-------------|--------------|-------------|---------------------|--------|--------------------|-----------|--------------|
| | | | | 6 | ARK. | | | |
| | | | | JOB NO. | | 070513 | \$SN101\$ | \$ST\$ |
| | | | | ① \$BN01\$ | LAYOUT | | \$DN101\$ | |

NOTES:
For "GENERAL NOTES", see Dwg. No. \$DN103\$.

For "ELEVATION OF SOIL BORINGS", "BORING LEGEND", & "N-VALUES", see Dwg. No. \$DN102\$.

For details of proposed grading and excavation of existing embankment, See Dwg. Nos. \$DNXXX\$ and \$DNXXX\$.

- ① Angle measured between CL Median I-30 and local tangent to CL Construction at Sta. 118+00.00
- ② Vertical profile has been set to accommodate 12'-0" future widening of existing I-30 as shown. Cross-slope of future lane is assumed to slope 2% upward towards median. Minimum vertical clearance to edge of future lane is calculated as 16.56'.
- ③ Ashlar Stone Pattern, See Special Provision "ARCHITECTURAL FINISH".



PRELIMINARY
NOT FOR
CONSTRUCTION

SHEET 1 OF 2
LAYOUT OF BRIDGE
HIGHWAY 51 OVER I-30
I-30 STR. & APPRS. (HWY. 51) (S)
CLARK COUNTY
ROUTE 51 SEC. 1
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.
DRAWN BY: HEW DATE: NOV. 2020 FILENAME: b070513_L1.dgn
CHECKED BY: XXX DATE: XXX. 2020 SCALE: 1" = 20'
DESIGNED BY: JME DATE: NOV. 2020
BRIDGE NO. \$BN01\$ DRAWING NO. \$DN101\$

NOTES:
Use Type I Special Approach Gutters at each end of bridge. See Dwg. No. \$DNXXX\$.

Use Type C2 Approach Slab at each end of bridge See Std. Dwg. No. 55040C2.

FOR R/W DATA, SEE
ROADWAY PLANS

NOTE:
Stations shown are along CL Construction. Elevations shown are theoretical working point elevations at CL Bridge. Any vertical dimension referenced to CL Deck is based on theoretical working point elevation at CL Bridge. See "ROUNDING DETAIL" on Std. Dwg. No. 55007 for additional information.

JME:edwards 12/14/2020 4:43:12 PM
WORKSPACE: ARDOT Bridge (2019)
L:\2017\17017634 - 070513 I-30 Str-Apprs Hwy 51\Drawings\070513_L01.dgn
REVISED DATE:

APPENDIX B

SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: 070513 - Hwy 51 over I-30

LOCATION: Clark County, Arkansas

GHBW JOB NUMBER: 19-070

| BORING No. | SAMPLE DEPTH (ft) | WATER CONTENT (%) | ATTERBERG LIMITS | | | SIEVE ANALYSIS | | | | | | | | USCS CLASS. | AASHTO CLASS. |
|---------------|----------------------|-------------------------|------------------|------------------|---------------------|-----------------|-------|---------|---------|-----|-----|-----|------|----------------|------------------|
| | | | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | PERCENT PASSING | | | | | | | | | |
| | | | | | | 2 in. | 1 in. | 3/4 in. | 3/8 in. | #4 | #10 | #40 | #200 | | |
| S1 | 2.5-3.5 | 16 | 22 | 16 | 6 | --- | --- | --- | --- | 99 | --- | --- | 59 | ML-CL | A-4 |
| S1 | 6.5-7.5 | 21 | 39 | 20 | 19 | --- | --- | --- | --- | 100 | --- | --- | 77 | CL | A-6 |
| S1 | 19-20 | 3 | --- | --- | --- | 100 | 100 | 100 | 100 | 100 | 100 | 87 | 4 | SP | A-3 |
| S1 | 24-25 | 25 | --- | --- | --- | 100 | 100 | 100 | 94 | 62 | 30 | 17 | 9 | SM-SP | A-1-a |
| S1 | 29-29.5 | 30 | 52 | 19 | 33 | --- | --- | --- | --- | --- | --- | --- | --- | CH | A-7-6 |
| S1 | 34-35 | 24 | NON-PLASTIC | | | --- | --- | --- | --- | 100 | --- | --- | 17 | SM | A-2-4 |
| S1 | 44-45 | 66 | --- | --- | --- | 100 | 100 | 100 | 100 | 99 | 98 | 92 | 48 | SM | A-4 |
| S1 | 59-60 | 29 | NON-PLASTIC | | | 100 | 100 | 100 | 100 | 100 | 99 | 98 | 23 | SM | A-2-4 |
| | | | | | | | | | | | | | | | |
| S2 | 2.5-3.5 | 15 | 21 | 16 | 5 | --- | --- | --- | --- | 94 | --- | --- | 32 | SM-SC | A-2-4 |
| S2 | 6.5-7.5 | 12 | NON-PLASTIC | | | 100 | 100 | 100 | 100 | 100 | 100 | 92 | 13 | SM | A-2-4 |
| S2 | 9-10 | 11 | --- | --- | --- | 100 | 88 | 78 | 52 | 31 | 18 | 10 | 4 | GP | A-1-a |
| S2 | 19-20 | 26 | --- | --- | --- | 100 | 100 | 100 | 100 | 100 | 100 | 99 | 9 | SM-SP | A-3 |
| S2 | 24-25 | 31 | 52 | 18 | 34 | --- | --- | --- | --- | --- | --- | --- | --- | CH | A-7-6 |
| S2 | 49-50 | 33 | --- | --- | --- | 100 | 100 | 100 | 100 | 100 | 98 | 96 | 19 | SM | A-2-4 |
| | | | | | | | | | | | | | | | |
| S3 | 0.5-1.5 | 13 | 25 | 15 | 10 | --- | --- | --- | --- | 92 | --- | --- | 43 | SC | A-4 |
| S3 | 2.5-3.5 | 16 | 31 | 18 | 13 | --- | --- | --- | --- | 97 | --- | --- | 49 | SC | A-6 |
| S3 | 14-15 | 11 | --- | --- | --- | 100 | 100 | 100 | 99 | 86 | 73 | 61 | 16 | SC | A-2-6 |
| S3 | 19-20 | 7 | --- | --- | --- | 100 | 100 | 92 | 67 | 51 | 36 | 23 | 7 | GM-GW | A-1-a |
| S3 | 24-25 | 22 | NON-PLASTIC | | | 100 | 100 | 100 | 98 | 97 | 96 | 95 | 29 | SM | A-2-4 |
| S3 | 49-50 | 25 | NON-PLASTIC | | | --- | --- | --- | --- | 100 | --- | --- | 42 | SM | A-4 |
| | | | | | | | | | | | | | | | |
| W1 | 4.5-5.5 | 20 | NON-PLASTIC | | | --- | --- | --- | --- | 100 | --- | --- | 71 | ML | A-4 |
| W1 | 9-10 | 8 | --- | --- | --- | --- | --- | --- | --- | 77 | --- | --- | 21 | SM | A-2-4 |
| W1 | 14-15 | 18 | NON-PLASTIC | | | 100 | 100 | 100 | 77 | 50 | 33 | 20 | 6 | GM-GW | A-1-a |

SUMMARY of CLASSIFICATION TEST RESULTS

PROJECT: 070513 - Hwy 51 over I-30

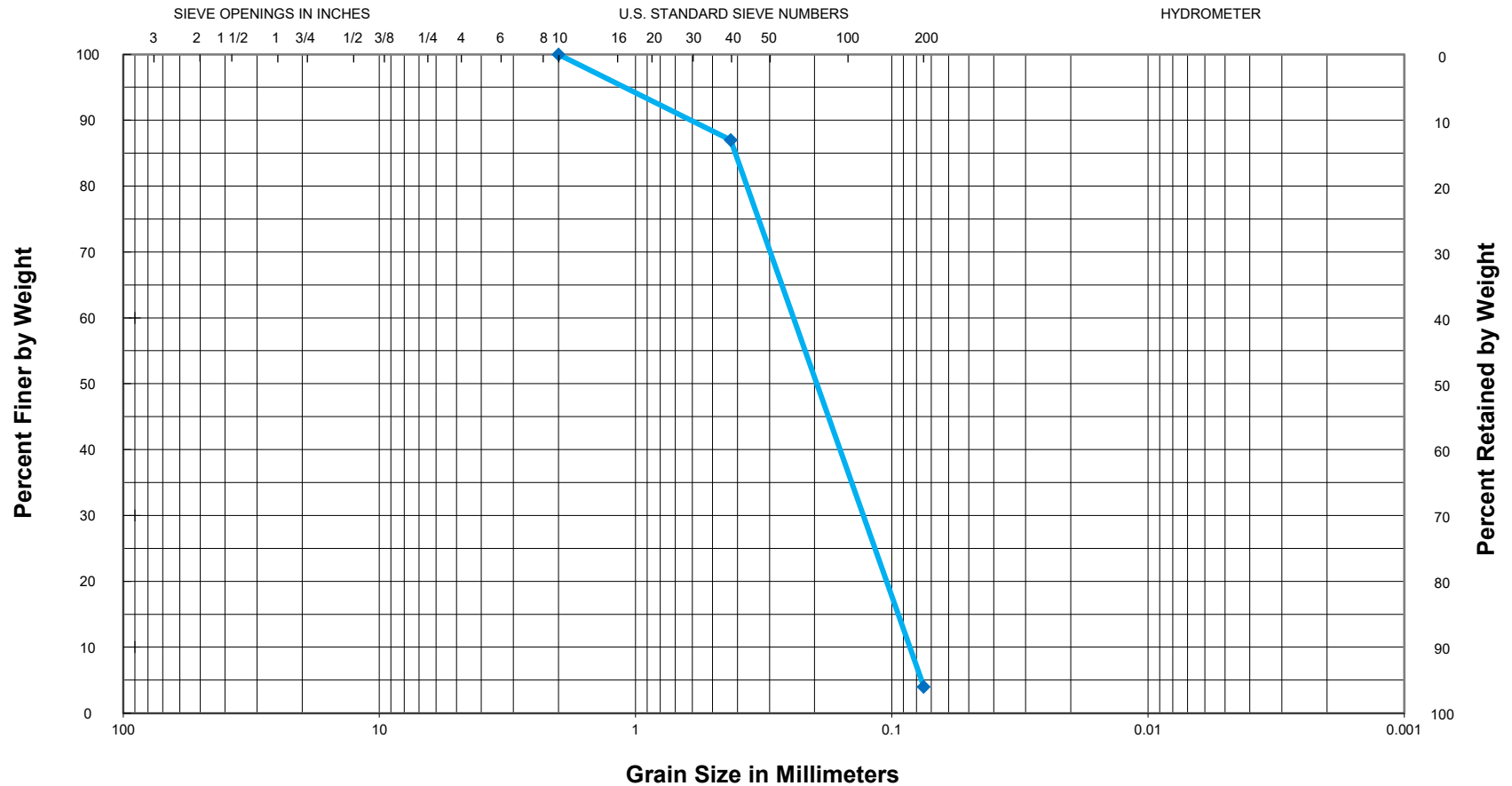
LOCATION: Clark County, Arkansas

GHBW JOB NUMBER: 19-070

| BORING No. | SAMPLE DEPTH (ft) | WATER CONTENT (%) | ATTERBERG LIMITS | | | SIEVE ANALYSIS | | | | | | | | USCS CLASS. | AASHTO CLASS. |
|---------------|----------------------|-------------------------|------------------|------------------|---------------------|-----------------|-------|---------|---------|-----|-----|-----|------|----------------|------------------|
| | | | LIQUID LIMIT | PLASTIC LIMIT | PLASTICITY INDEX | PERCENT PASSING | | | | | | | | | |
| | | | | | | 2 in. | 1 in. | 3/4 in. | 3/8 in. | #4 | #10 | #40 | #200 | | |
| W2 | 2.5-3.5 | 18 | 34 | 19 | 15 | --- | --- | --- | --- | 99 | --- | --- | 79 | CL | A-6 |
| W2 | 4.5-5.5 | 18 | NON-PLASTIC | | | --- | --- | --- | --- | 100 | --- | --- | 50 | SM | A-4 |
| W2 | 6.5-7.5 | 21 | --- | --- | --- | --- | --- | --- | --- | 100 | --- | --- | 30 | SM | A-4 |
| | | | | | | | | | | | | | | | |
| W3 | 2.5-3.5 | 12 | 30 | 19 | 11 | --- | --- | --- | --- | 69 | --- | --- | 35 | SC | A-2-6 |
| W3 | 9-10 | 15 | NON-PLASTIC | | | --- | --- | --- | --- | 97 | --- | --- | 45 | SM | A-4 |
| W3 | 14-15 | 5 | --- | --- | --- | 100 | 100 | 100 | 80 | 71 | 56 | 43 | 23 | SM | A-1-b |
| | | | | | | | | | | | | | | | |
| W4 | 0.5-1.5 | 11 | 21 | 15 | 6 | --- | --- | --- | --- | 76 | --- | --- | 36 | SM-SC | A-4 |
| W4 | 6.5-7.5 | 15 | 31 | 17 | 14 | --- | --- | --- | --- | 88 | --- | --- | 51 | CL | A-6 |
| | | | | | | | | | | | | | | | |
| W5 | 4.5-5.5 | 16 | 20 | 18 | 2 | --- | --- | --- | --- | 91 | --- | --- | 46 | SM | A-4 |
| W5 | 19-20 | 24 | --- | --- | --- | 100 | 91 | 88 | 86 | 84 | 80 | 75 | 7 | SM-SP | A-3 |
| | | | | | | | | | | | | | | | |
| W6 | 2.5-3.5 | 17 | 24 | 20 | 4 | --- | --- | --- | --- | 85 | --- | --- | 50 | SM | A-4 |
| W6 | 6.5-7.5 | 15 | NON-PLASTIC | | | --- | --- | --- | --- | 100 | --- | --- | 20 | SM | A-2-4 |
| W6 | 14-15 | 36 | --- | --- | --- | 100 | 100 | 67 | 44 | 37 | 32 | 26 | 9 | GM-GW | A-1-a |
| | | | | | | | | | | | | | | | |
| P1 | 0.5-1.5 | 13 | NON-PLASTIC | | | --- | --- | --- | --- | 96 | --- | --- | 55 | ML | A-4 |
| P1 | 2.5-3.5 | 18 | 30 | 16 | 14 | --- | --- | --- | --- | 100 | --- | --- | 66 | CL | A-6 |
| | | | | | | | | | | | | | | | |
| P2 | 0.5-1.5 | 16 | NON-PLASTIC | | | --- | --- | --- | --- | 99 | --- | --- | 37 | SM | A-4 |
| P2 | 4.5-5.5 | 14 | 25 | 15 | 10 | --- | --- | --- | --- | 100 | --- | --- | 59 | CL | A-4 |

19-070

GRAIN SIZE CURVE



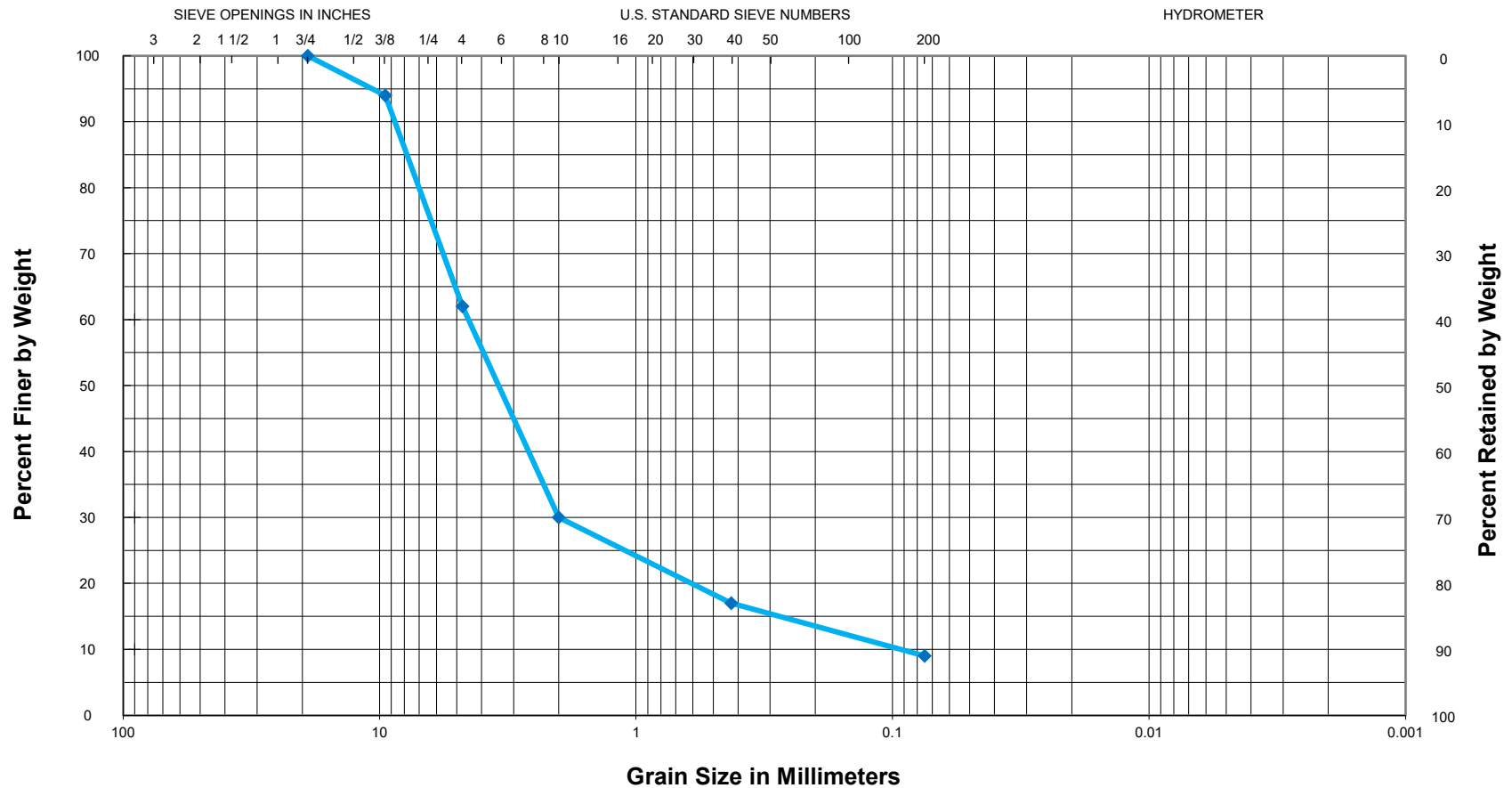
| GRAVEL | | SAND | | | SILT | OR | CLAY |
|--------|------|--------|--------|------|------|----|------|
| COARSE | FINE | COARSE | MEDIUM | FINE | | | |

Sample: Boring S1, 19-20 ft
Description: Light gray fine to medium SAND

USCS Classification = SP
AASHTO Classification = A-3

19-070

GRAIN SIZE CURVE



| GRAVEL | | SAND | | | SILT | OR | CLAY |
|--------|------|--------|--------|------|------|----|------|
| COARSE | FINE | COARSE | MEDIUM | FINE | | | |

Sample: Boring S1, 24-25 ft

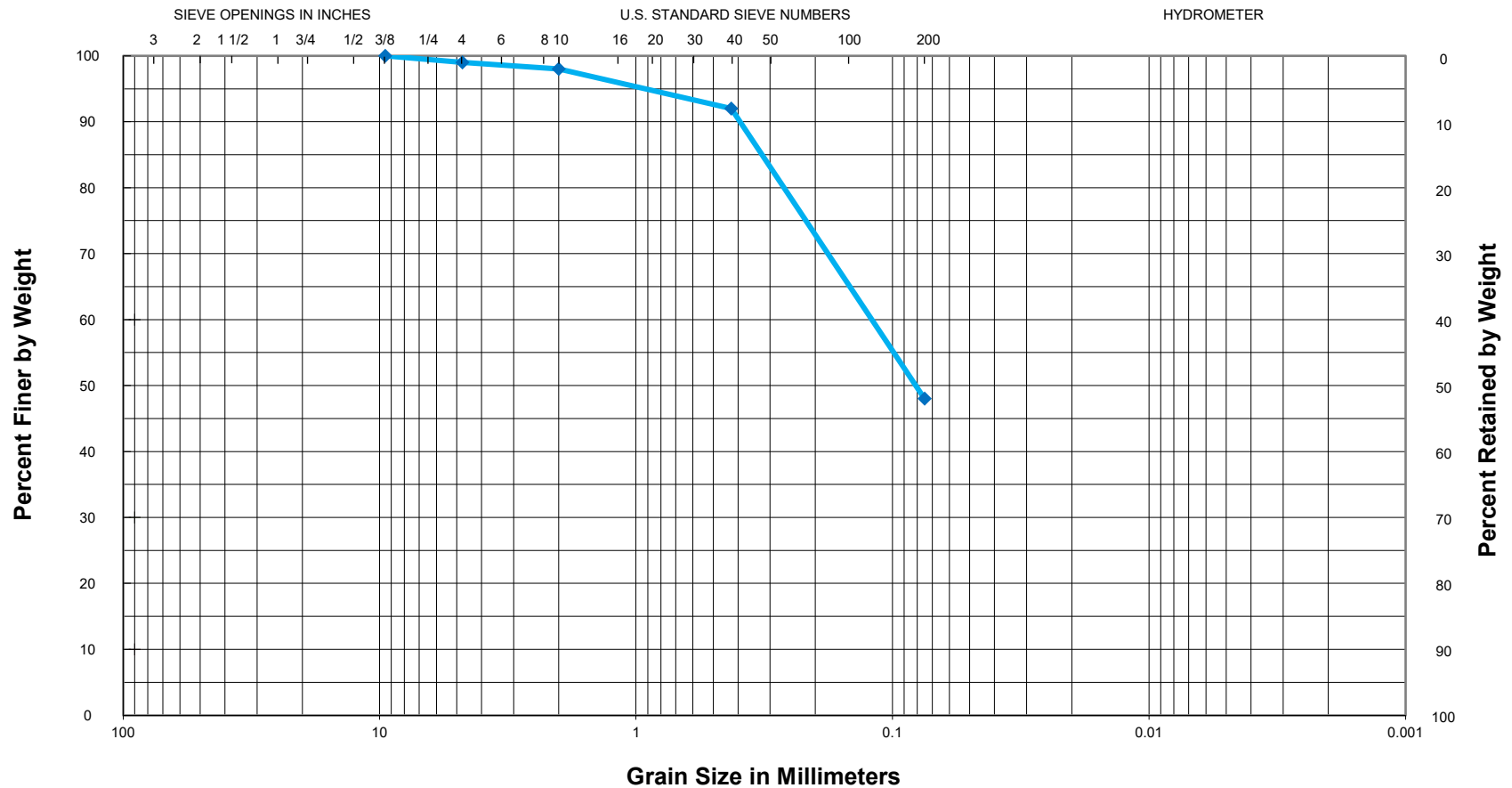
Description: Tan and reddish tan fine to coarse SAND, slightly silty w/ fine gravel

USCS Classification = SM-SP

AASHTO Classification = A-1-a

19-070

GRAIN SIZE CURVE



| GRAVEL | | SAND | | | SILT | OR | CLAY |
|--------|------|--------|--------|------|------|----|------|
| COARSE | FINE | COARSE | MEDIUM | FINE | | | |

Sample: Boring S1, 44-45 ft

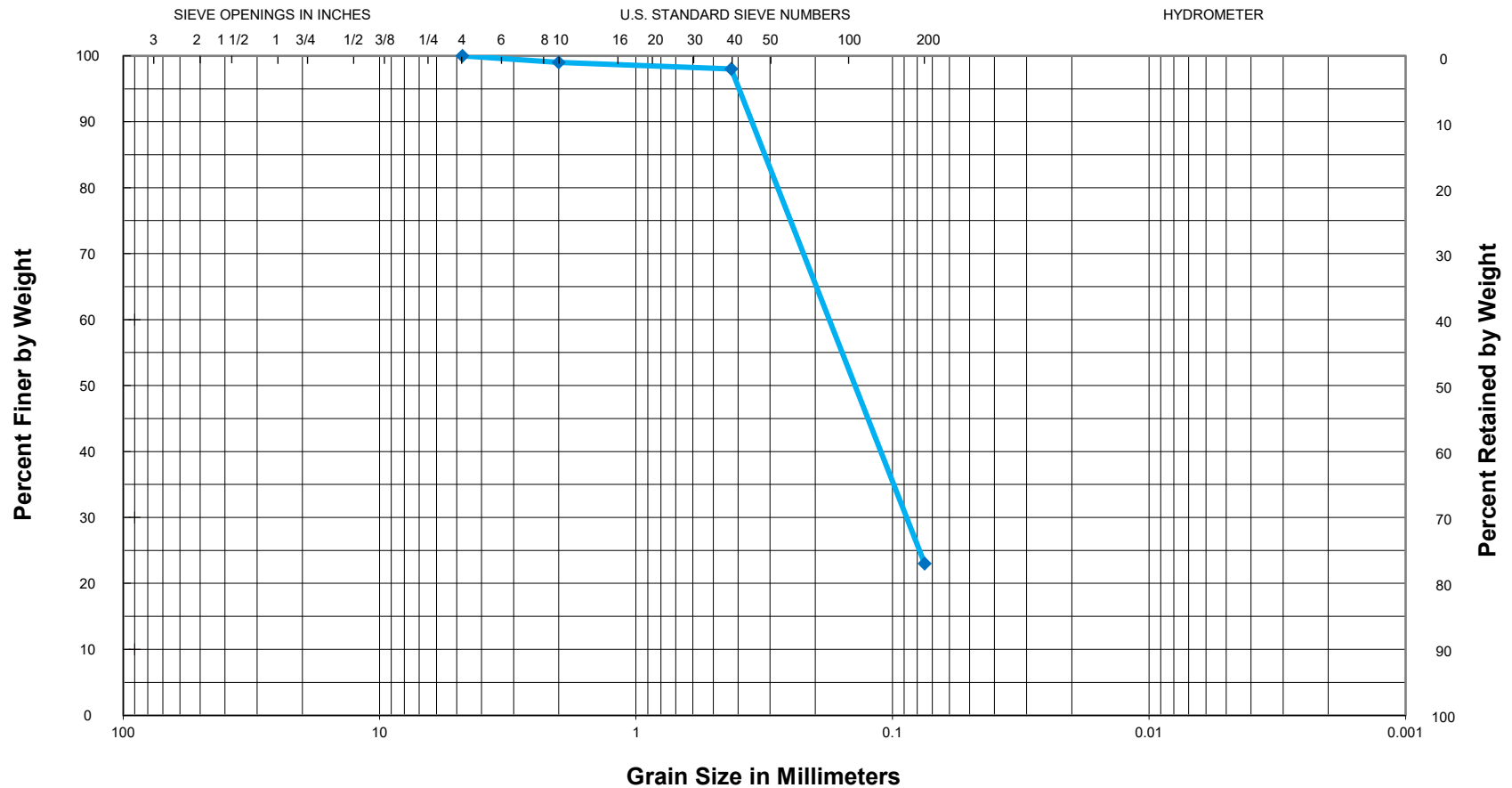
Description: Gray silty fine SAND, calcareous, cemented w/ occasional fine gravel-sized sandstone nodules

USCS Classification = SM

AASHTO Classification = A-4

19-070

GRAIN SIZE CURVE



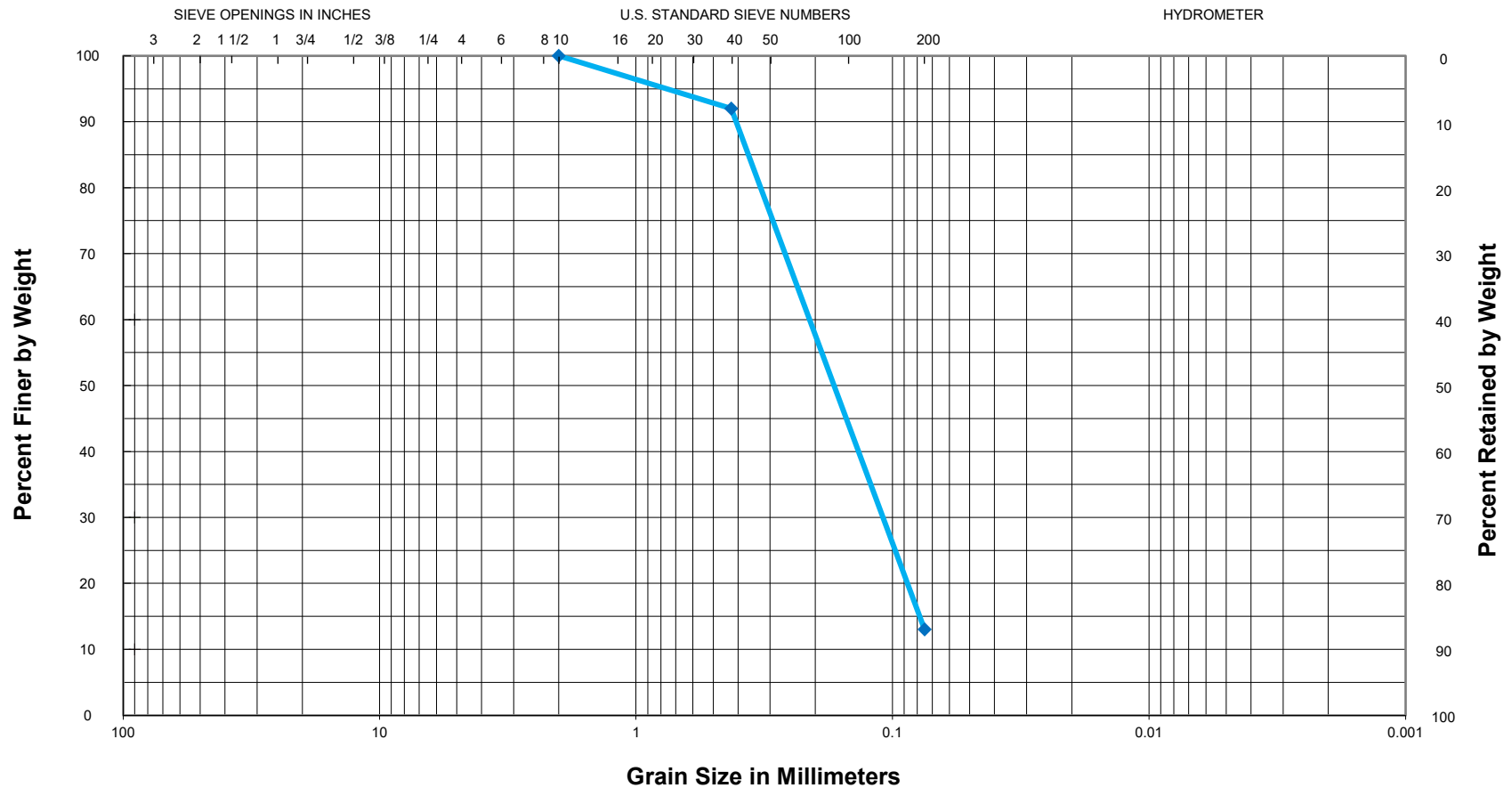
| GRAVEL | | SAND | | | SILT | OR | CLAY |
|--------|------|--------|--------|------|------|----|------|
| COARSE | FINE | COARSE | MEDIUM | FINE | | | |

Sample: Boring S1, 59-60 ft; NON-PLASTIC
Description: Bluish gray silty fine SAND, calcareous and weakly cemented w/ occasional calcareous nodules and inclusions

USCS Classification = SM
AASHTO Classification = A-2-4

19-070

GRAIN SIZE CURVE



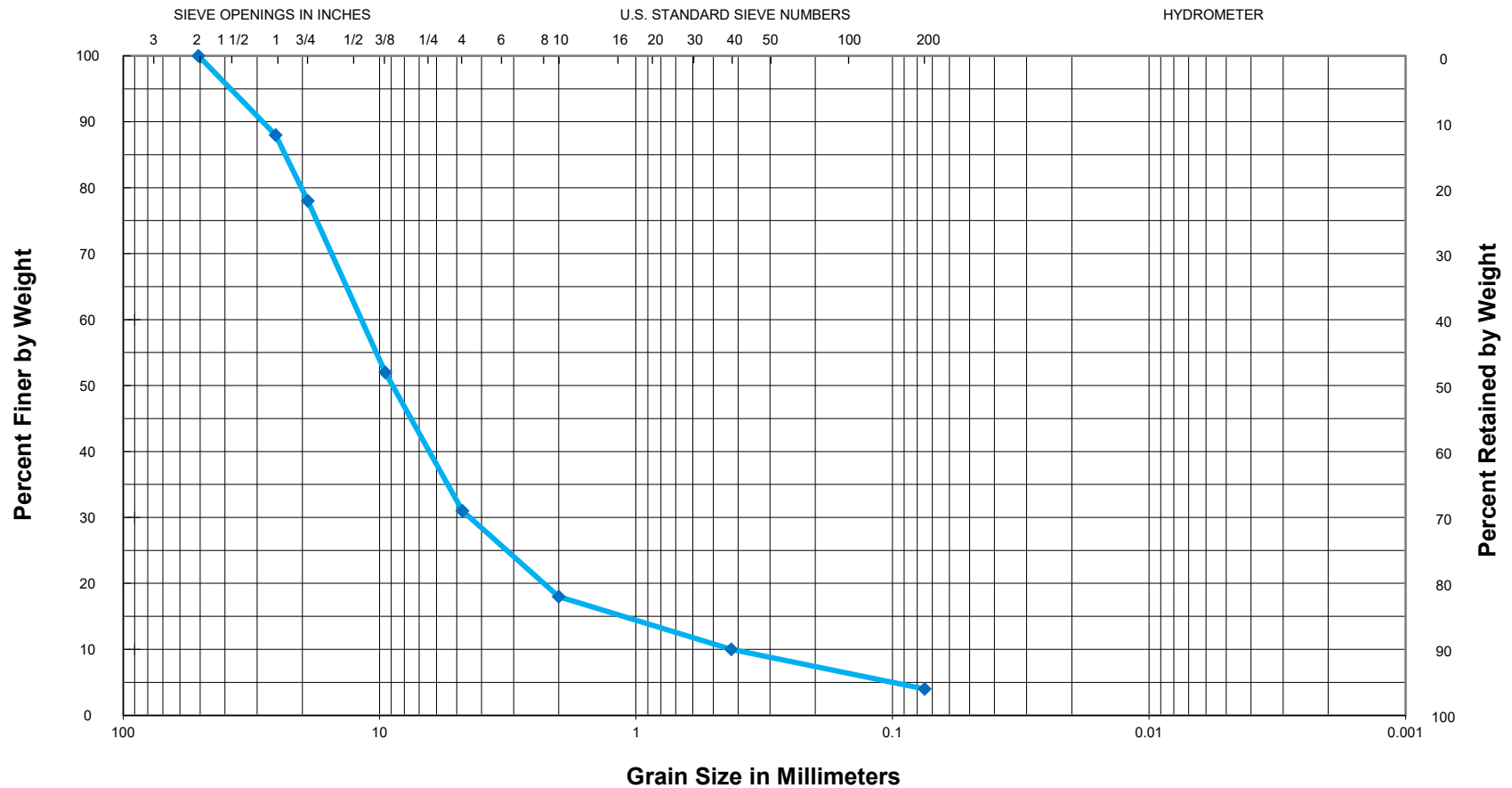
| GRAVEL | | SAND | | | SILT | OR | CLAY |
|--------|------|--------|--------|------|------|----|------|
| COARSE | FINE | COARSE | MEDIUM | FINE | | | |

Sample: Boring S2, 6.5-7.5 ft; NON-PLASTIC
Description: Yellowish tan, reddish brown, and gray silty fine SAND

USCS Classification = SM
AASHTO Classification = A-2-4

19-070

GRAIN SIZE CURVE



| GRAVEL | | SAND | | | SILT | OR | CLAY |
|--------|------|--------|--------|------|------|----|------|
| COARSE | FINE | COARSE | MEDIUM | FINE | | | |

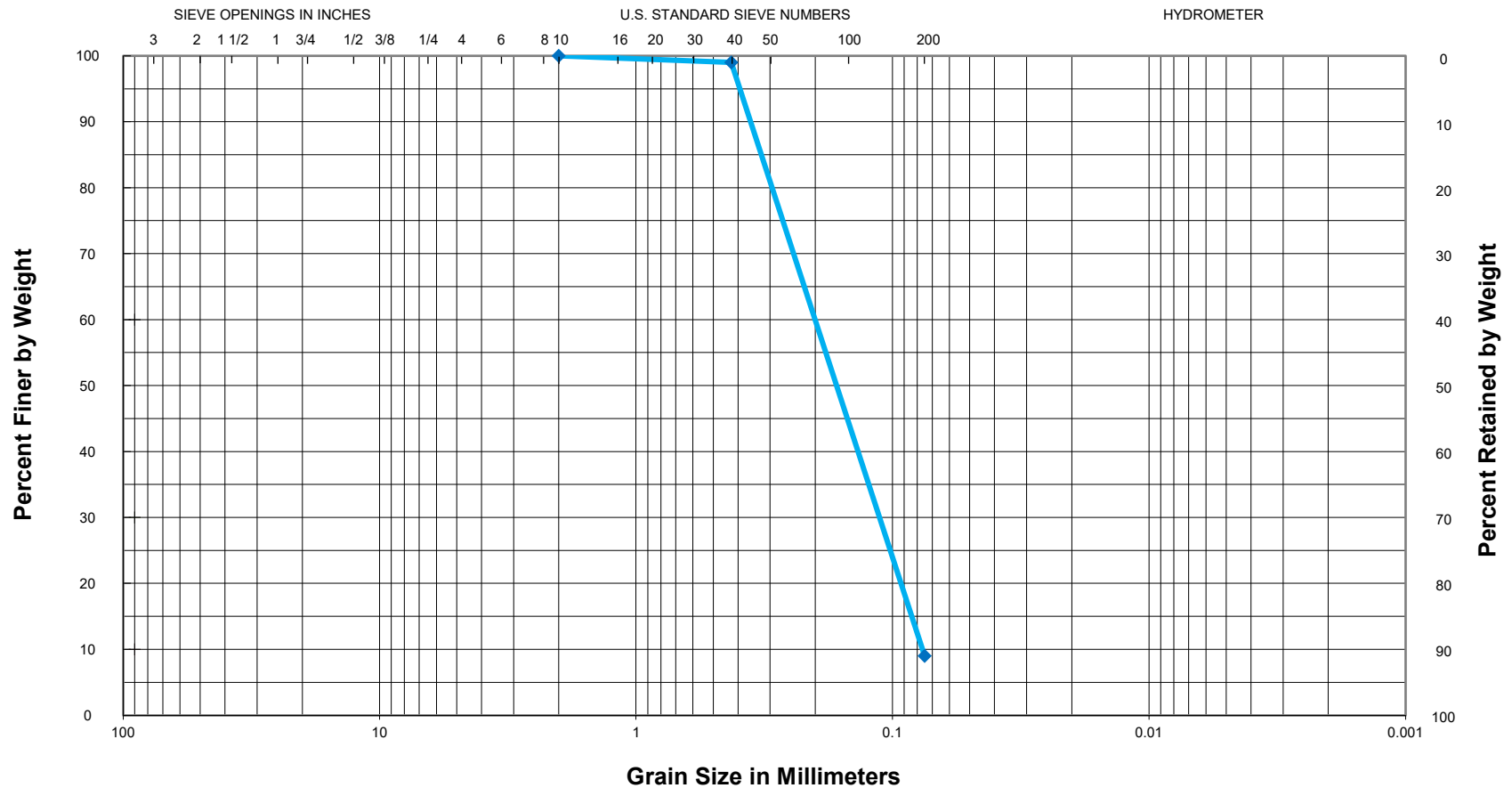
Sample: Boring S2, 9-10 ft

Description: Reddish brown sandy fine to coarse GRAVEL

USCS Classification = GP
AASHTO Classification = A-1-a

19-070

GRAIN SIZE CURVE



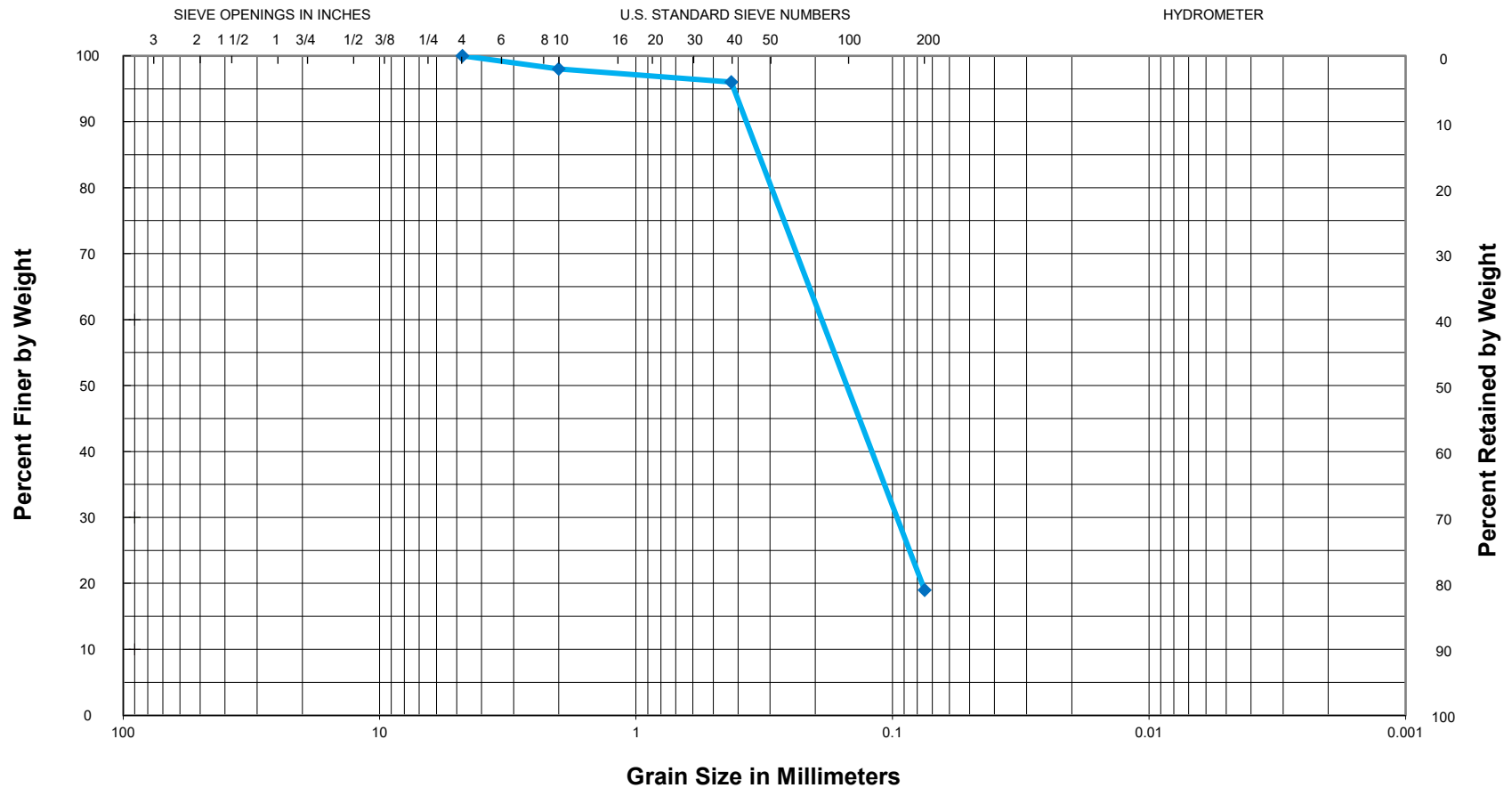
| GRAVEL | | SAND | | | SILT | OR | CLAY |
|--------|------|--------|--------|------|------|----|------|
| COARSE | FINE | COARSE | MEDIUM | FINE | | | |

Sample: Boring S2, 19-20 ft
Description: Gray and tan fine SAND, slightly silty

USCS Classification = SM-SP
AASHTO Classification = A-3

19-070

GRAIN SIZE CURVE



| GRAVEL | | SAND | | | SILT | OR | CLAY |
|--------|------|--------|--------|------|------|----|------|
| COARSE | FINE | COARSE | MEDIUM | FINE | | | |

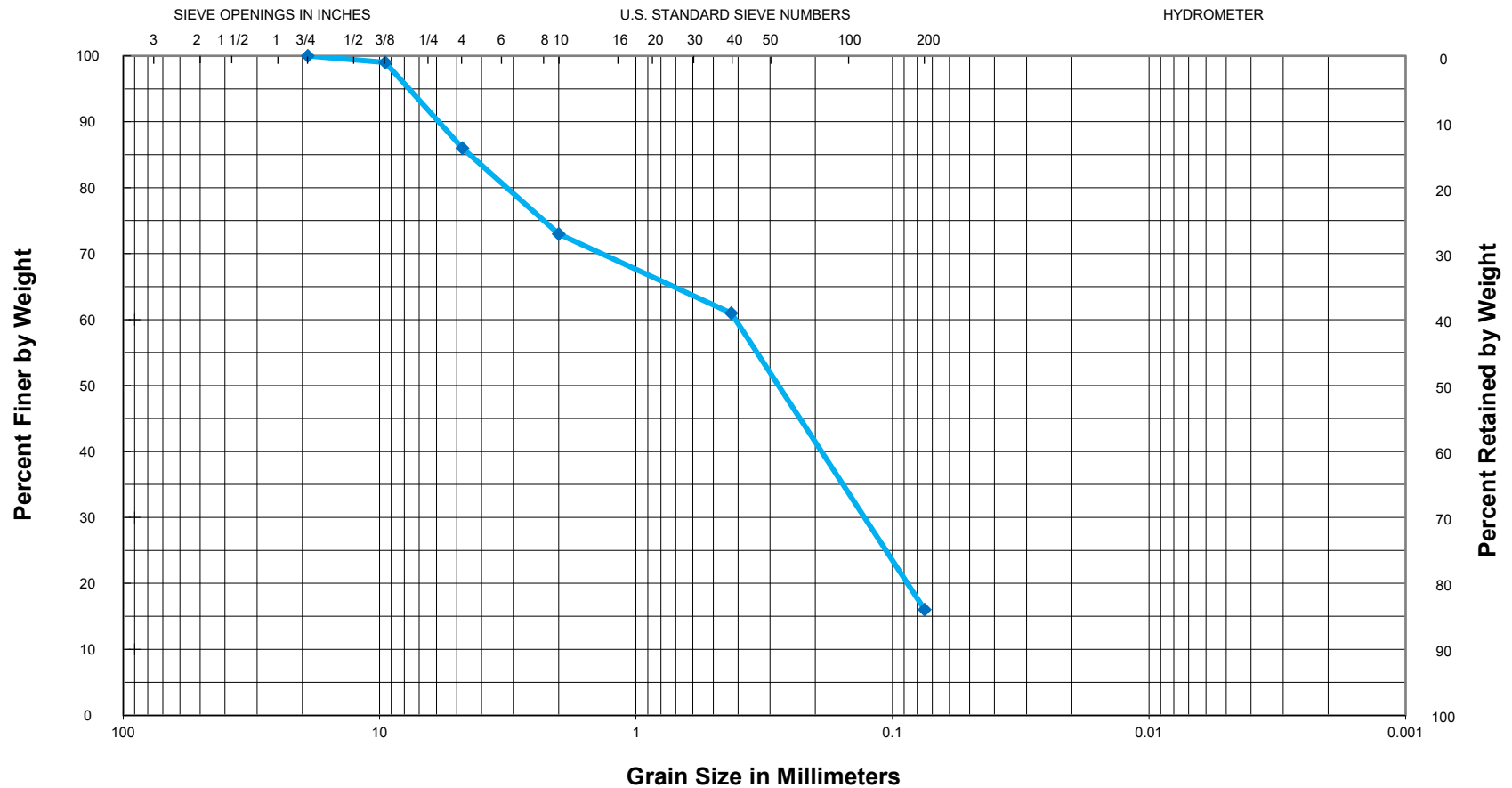
Sample: Boring S2, 49-50 ft

Description: Bluish gray silty fine SAND, calcareous, weakly cemented

USCS Classification = SM
AASHTO Classification = A-2-4

19-070

GRAIN SIZE CURVE



| GRAVEL | | SAND | | | SILT | OR | CLAY |
|--------|------|--------|--------|------|------|----|------|
| COARSE | FINE | COARSE | MEDIUM | FINE | | | |

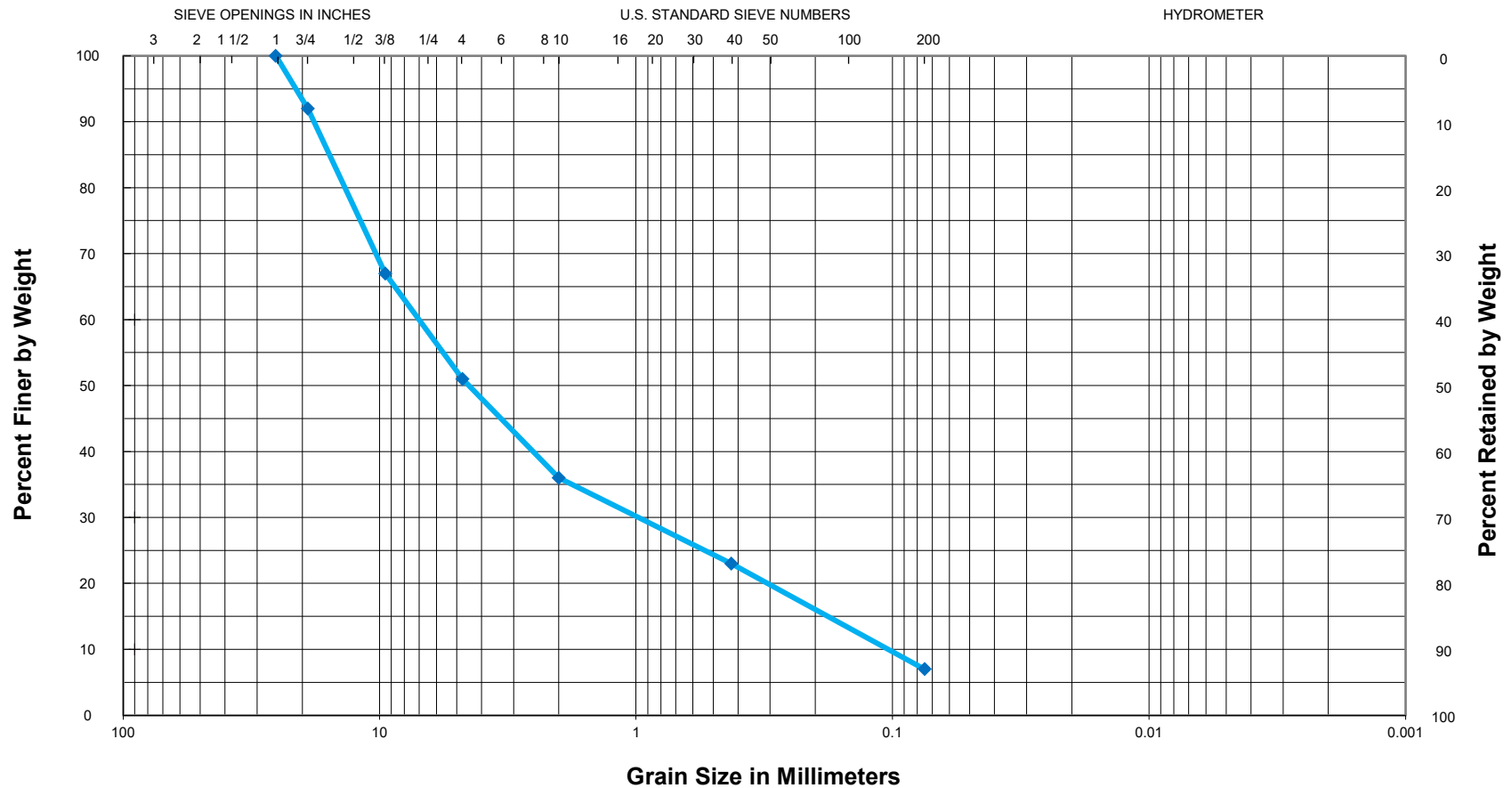
Sample: Boring S3, 14-15 ft

Description: Tan and gray clayey fine to coarse SAND w/ a little fine chert gravel

USCS Classification = SC
AASHTO Classification = A-2-6

19-070

GRAIN SIZE CURVE



| GRAVEL | | SAND | | | SILT | OR | CLAY |
|--------|------|--------|--------|------|------|----|------|
| COARSE | FINE | COARSE | MEDIUM | FINE | | | |

Sample: Boring S3, 19-20 ft

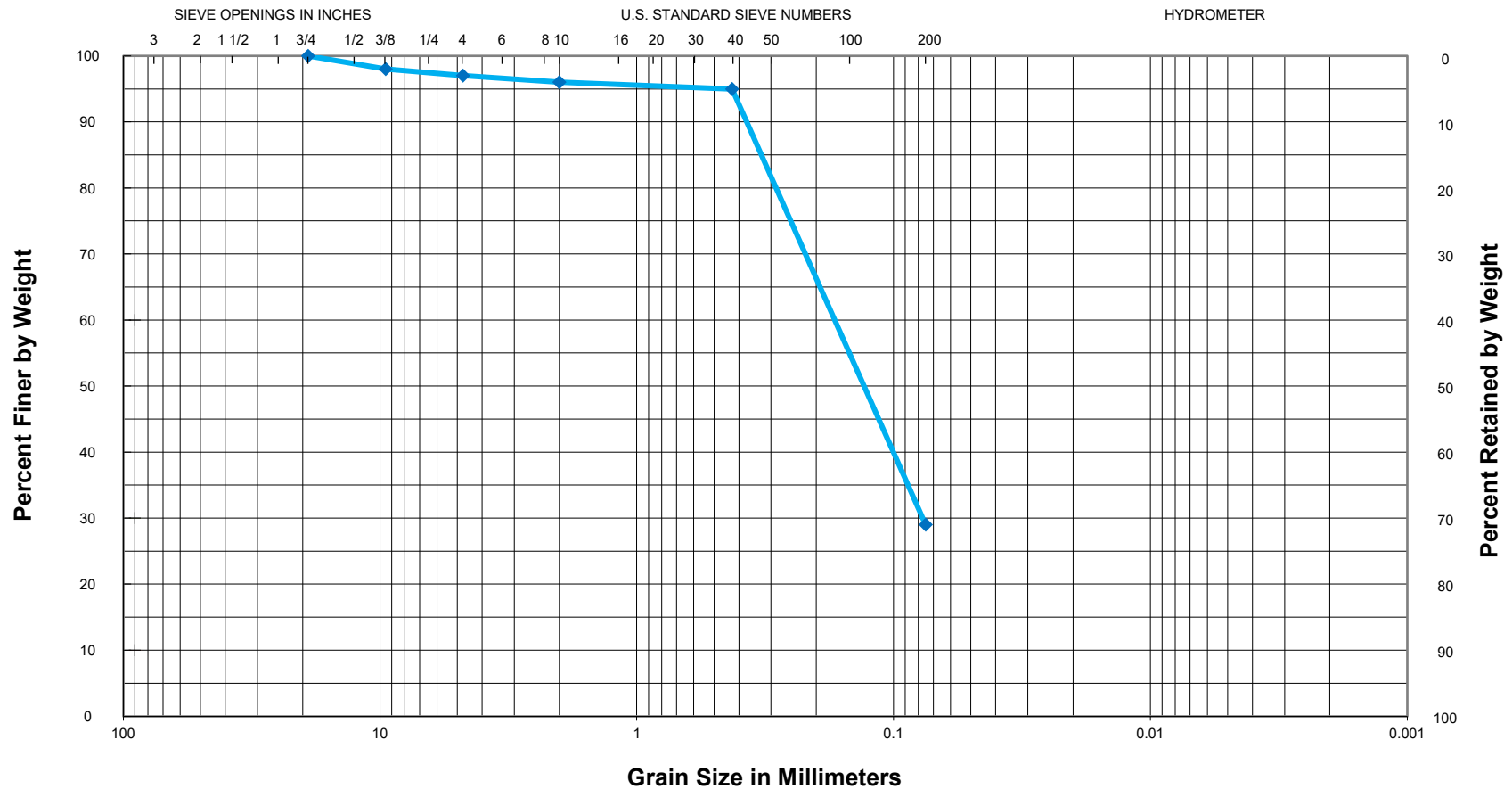
Description: Tan sandy fine to coarse gravel, slightly silty

USCS Classification = GM-GW

AASHTO Classification = A-1-a

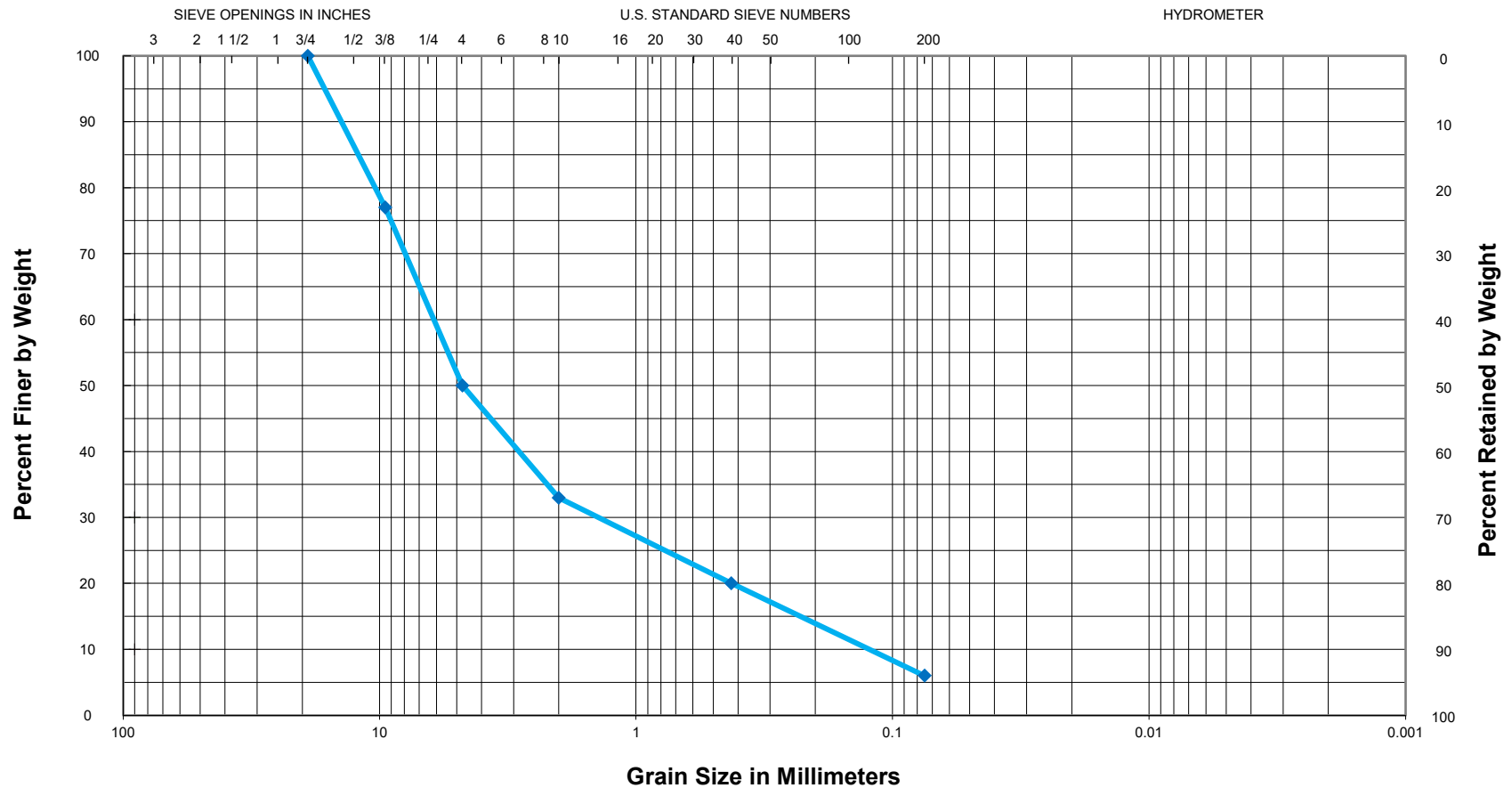
19-070

GRAIN SIZE CURVE



19-070

GRAIN SIZE CURVE



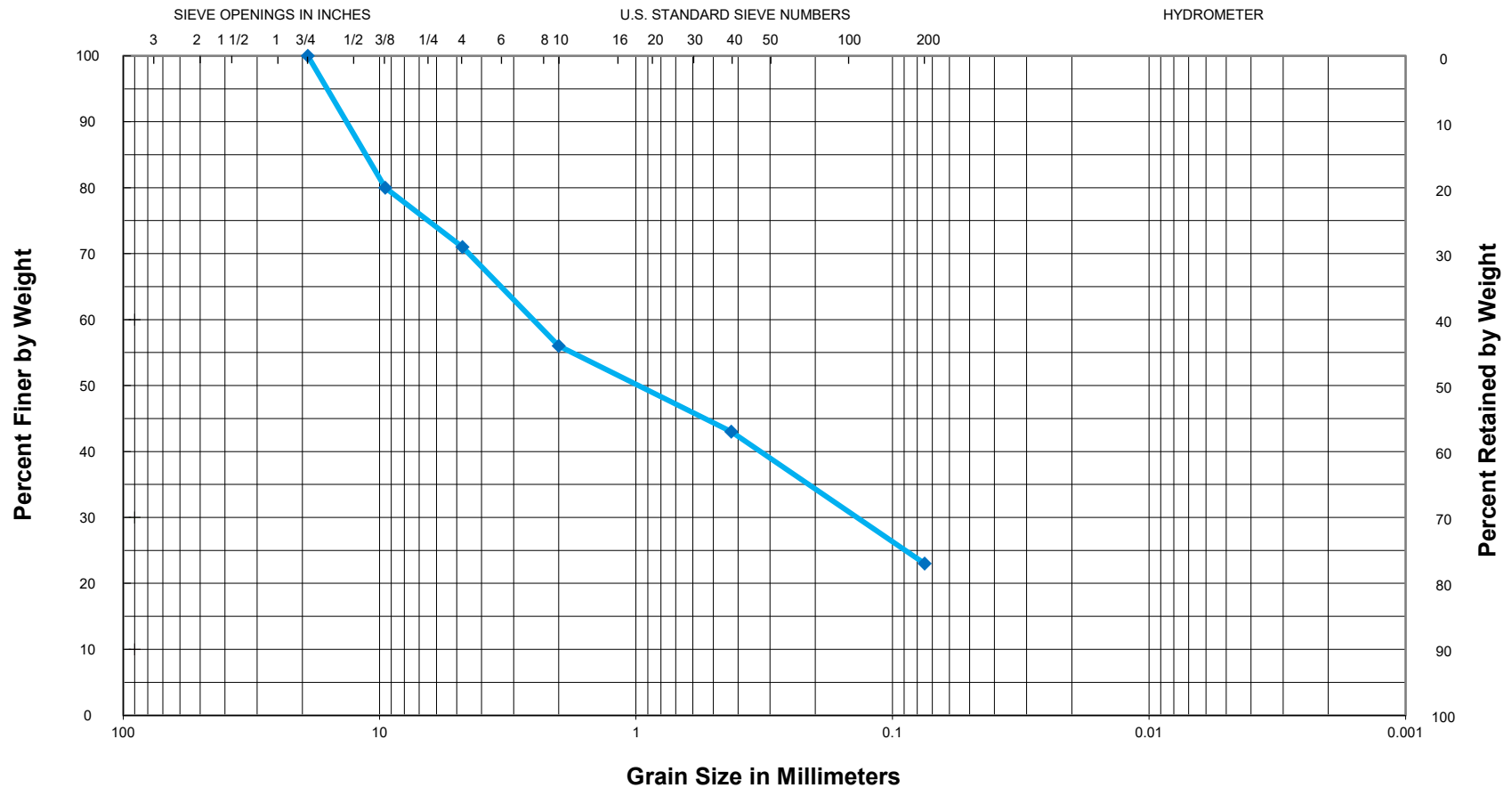
| GRAVEL | | SAND | | | SILT | OR | CLAY |
|--------|------|--------|--------|------|------|----|------|
| COARSE | FINE | COARSE | MEDIUM | FINE | | | |

Sample: Boring W1, 14-15 ft; NON-PLASTIC
Description: Light tan and reddish tan sandy fine chert GRAVEL, slightly silty

USCS Classification = GM-GW
AASHTO Classification = A-1-a

19-070

GRAIN SIZE CURVE



| GRAVEL | | SAND | | | SILT | OR | CLAY |
|--------|------|--------|--------|------|------|----|------|
| COARSE | FINE | COARSE | MEDIUM | FINE | | | |

Sample: Boring W3, 14-15 ft

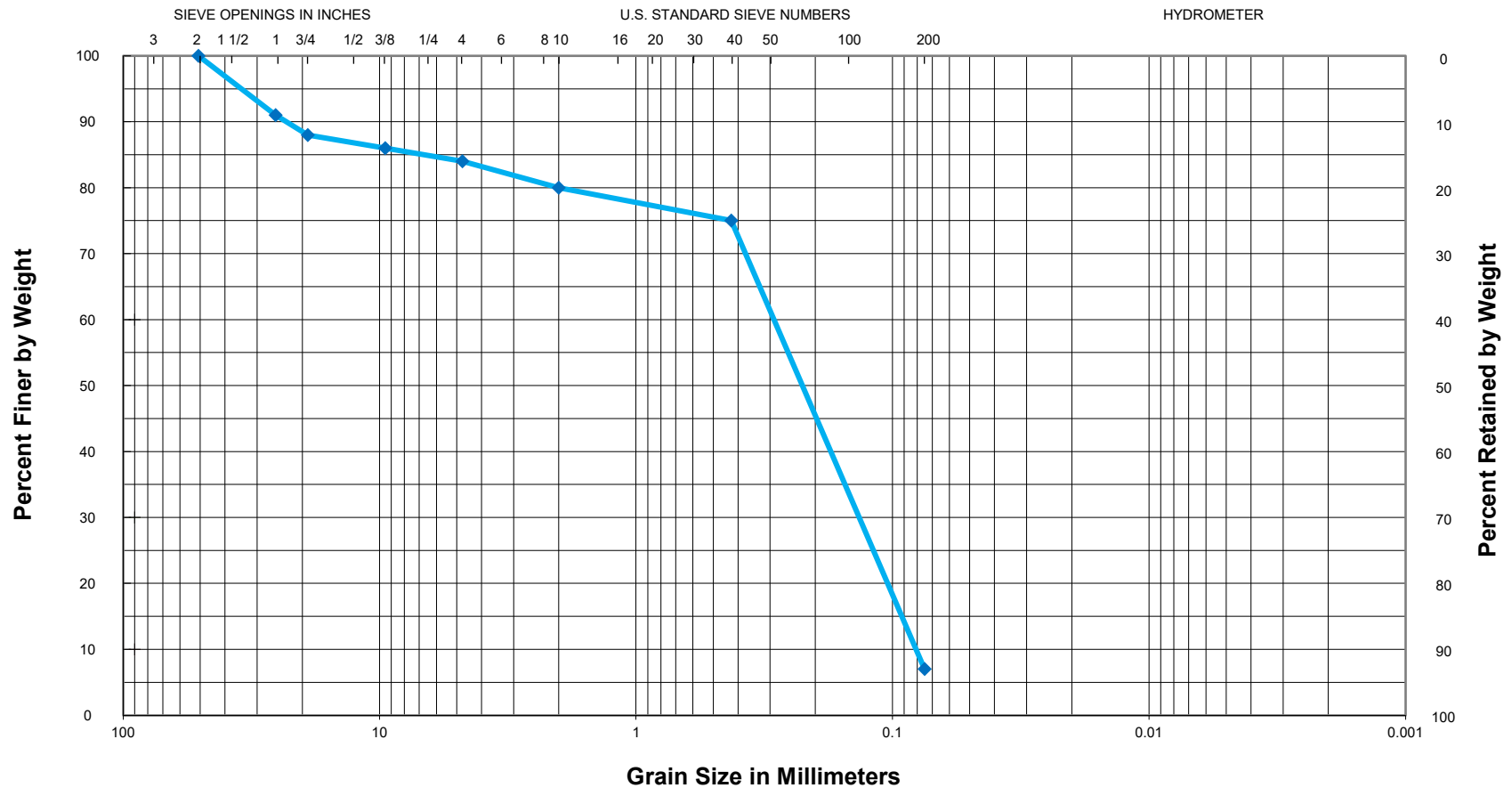
Description: Tan silty fine to coarse SAND, slightly clayey w/ some fine gravel

USCS Classification = SM

AASHTO Classification = A-1-b

19-070

GRAIN SIZE CURVE



| GRAVEL | | SAND | | | SILT | OR | CLAY |
|--------|------|--------|--------|------|------|----|------|
| COARSE | FINE | COARSE | MEDIUM | FINE | | | |

Sample: Boring W5, 19-20 ft

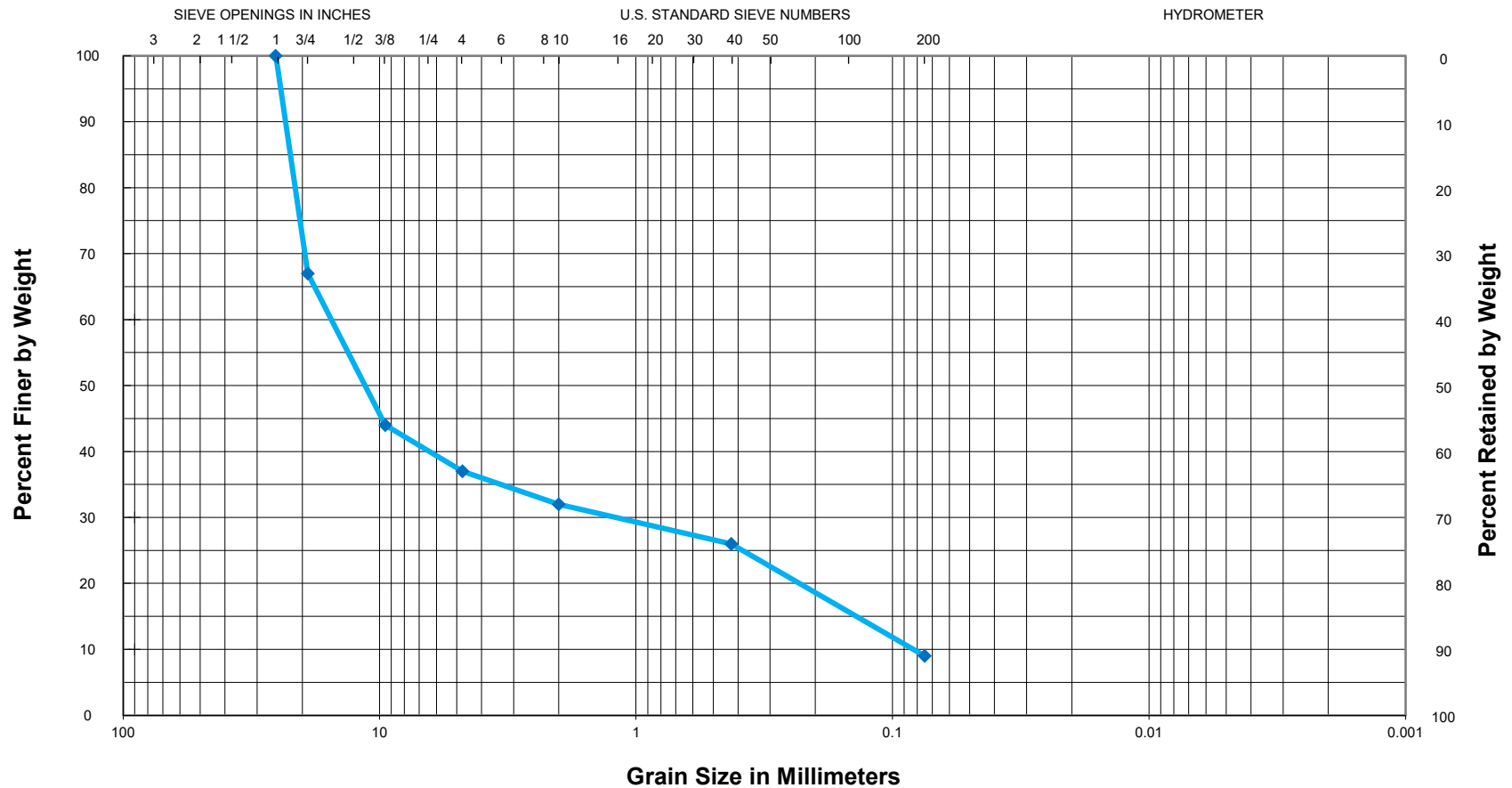
Description: Tan fine to coarse SAND, slightly silty w/ a little fine to coarse gravel

USCS Classification = SM-SP

AASHTO Classification = A-3

19-070

GRAIN SIZE CURVE



| GRAVEL | | SAND | | | SILT | OR | CLAY |
|--------|------|--------|--------|------|------|----|------|
| COARSE | FINE | COARSE | MEDIUM | FINE | | | |

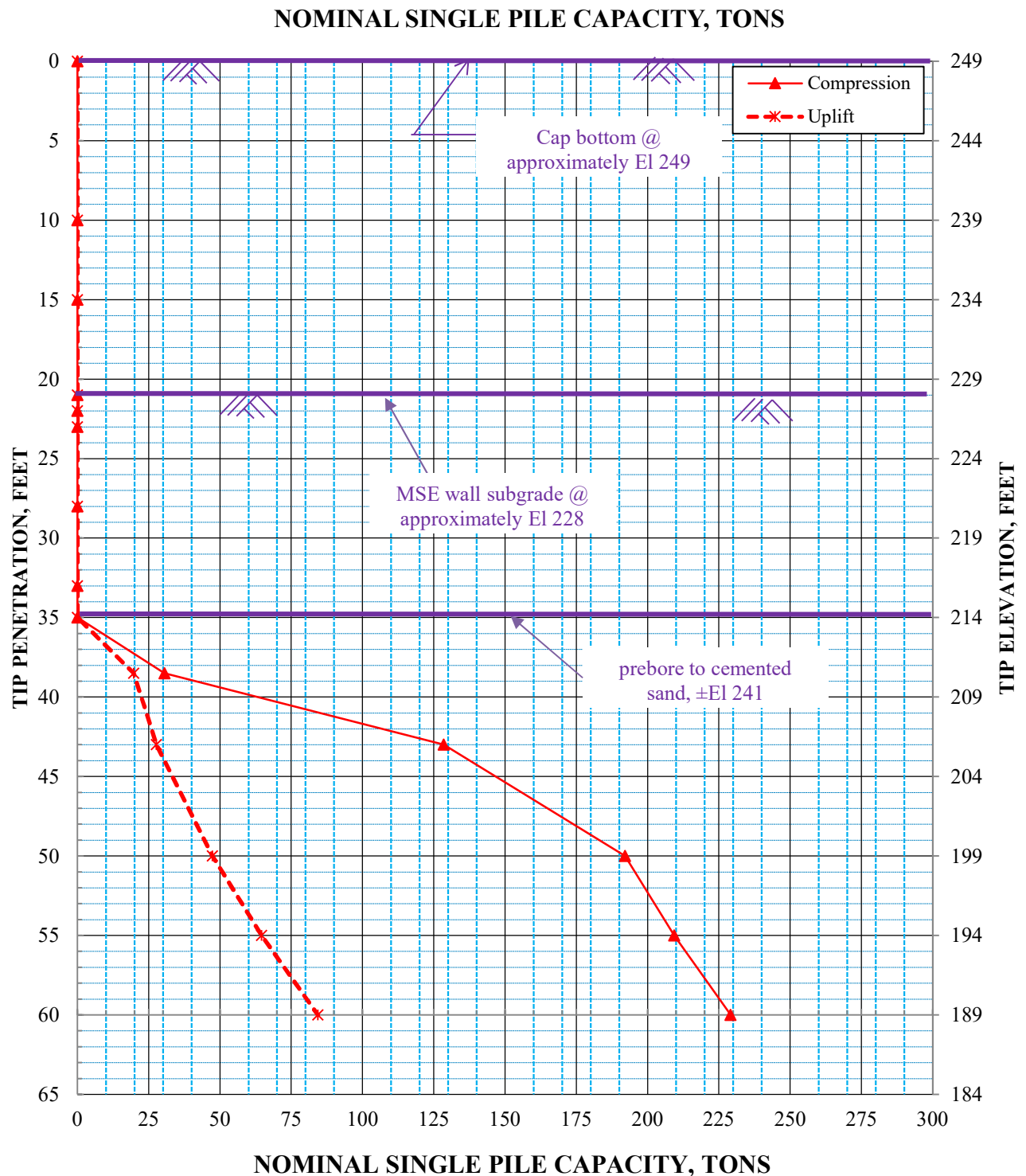
Sample: Boring W6, 14-15 ft

Description: Tan and reddish tan sandy fine to coarse GRAVEL, slightly silty

USCS Classification = GM-GW

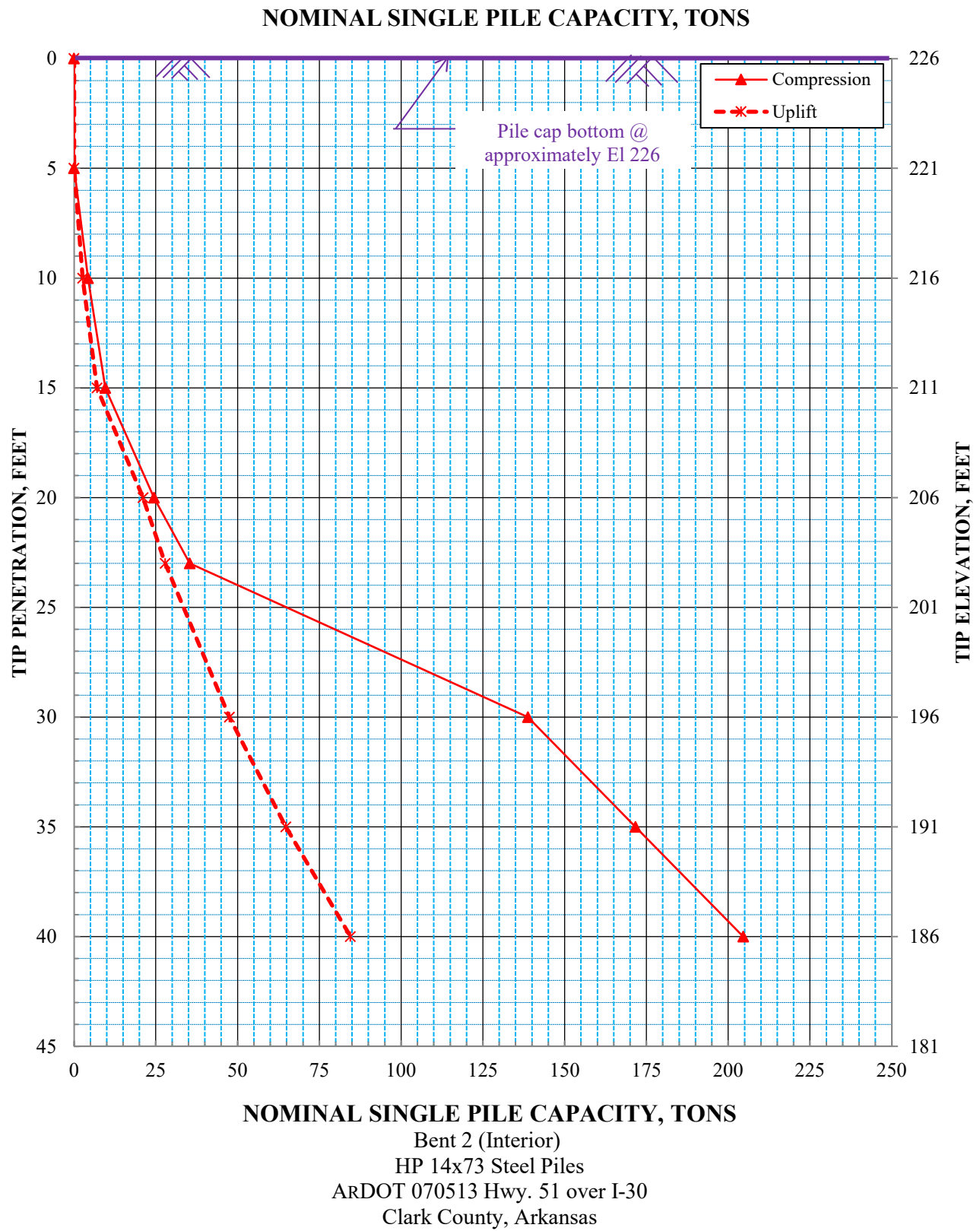
AASHTO Classification = A-1-a

APPENDIX C

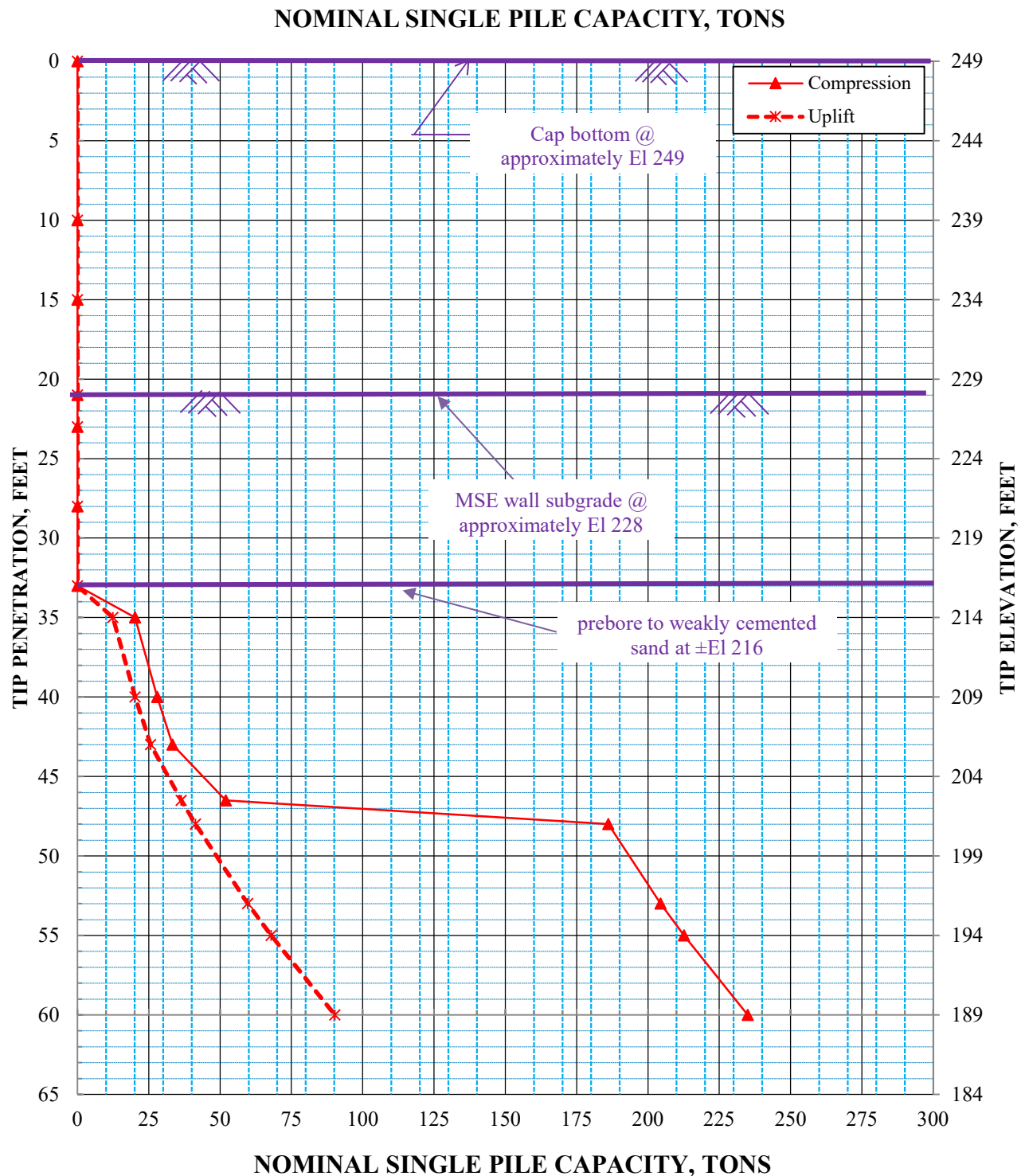


Bent 1 (South Bridge End)
 HP14x73 Steel Piles
 ARDOT 070513 Hwy. 51 over I-30
 Clark County, Arkansas

- Notes: 1. Piles driven from MSE leveling pad elevation.
 2. Piles driven prior to MSE wall backfill placed.



Note: Piles driven from cap bottom elevation



NOMINAL SINGLE PILE CAPACITY, TONS

Bent 3 (North Bridge End)
 HP 14x73 Steel Piles
 ARDOT 070513 Hwy. 51 over I-30
 Clark County, Arkansas

- Notes: 1. Piles driven from MSE leveling pad elevation.
 2. Piles driven prior to MSE wall backfill placed.

APPENDIX D

SUMMARY OF LATERAL LOAD PARAMETERS

Hwy. 51 over I-30 - Bent 1 (South Bridge End)

PROJECT: 070513 I-30 Str. & Apprs. (Hwy. 51) (S)

LOCATION: Clark County, Arkansas

GHBW JOB NUMBER: 19-070

Bent 1: Recommended Parameters for Lateral Load Analyses Using LPILE©

| Generalized Stratigraphy | Neglect MSE Wall Backfill | Stiff to very stiff silty CLAY | Medium dense fine to medium SAND | Dense to very dense fine to coarse SAND | Dense to very dense silty fine SAND | Dense to very dense fine SAND |
|---|---------------------------|--------------------------------|----------------------------------|---|-------------------------------------|-------------------------------|
| Depth below assumed pile cap bottom, ft | 0-21 | 21-23 | 23-28 | 28-35 | 35-43 | 43 and deeper |
| Approximate El, ft | 249-228 | 228-226 | 226-221 | 221-214 | 214-206 | Below 206 |
| Recommend soil type | Neglect | Stiff Clay without free water | Sand (Reese) | Sand (Reese) | Sand (Reese) | Sand (Reese) |
| Effective unit weight (γ), lbs per cu ft | 125 | 115 | 63 | 63 | 63 | 63 |
| Cohesion (c), lbs per sq ft | Not applicable | 2750 | 0 | 0 | 0 | 0 |
| Angle of internal friction (ϕ), ° | Not applicable | 0 | 33 | 36 | 36 | 38 |
| Soil modulus (k), lbs per cu in. | Not applicable | 1000 | 60 | 125 | 125 | 125 |
| Strain at 50% (EE50) | Not applicable | 0.005 | Not applicable | Not applicable | Not applicable | Not applicable |

Note: Cap bottom at El 249±

SUMMARY OF LATERAL LOAD PARAMETERS

Hwy. 51 over I-30 - Bent 2 (Interior)

PROJECT: 070513 I-30 Str. & Apprs. (Hwy. 51) (S)

LOCATION: Clark County, Arkansas

GHBW JOB NUMBER: 19-070

Bent 2: Recommended Parameters for Lateral Load Analyses Using LPILE©

| Generalized Stratigraphy | Neglect | Dense fine SAND | Dense to very dense silty fine SAND |
|---|----------------|-----------------|-------------------------------------|
| Depth below assumed pile cap bottom, ft | 0-5 | 5-15 | 15 and deeper |
| Approximate El, ft | 226-221 | 221-211 | Below 211 |
| Recommend soil type | Neglect | Sand (Reese) | Sand (Reese) |
| Effective unit weight (γ), lbs per cu ft | 125 | 63 | 63 |
| Cohesion (c), lbs per sq ft | Not applicable | 0 | 0 |
| Angle of internal friction (ϕ), ° | Not applicable | 34 | 38 |
| Soil modulus (k), lbs per cu in. | Not applicable | 100 | 125 |
| Strain at 50% (EE50) | Not applicable | Not applicable | Not applicable |

Note: Cap bottom at El 226±

SUMMARY OF LATERAL LOAD PARAMETERS

Hwy. 51 over I-30 - Bent 3 (North Bridge End)

PROJECT: 070513 I-30 Str. & Apprs. (Hwy. 51) (S)

LOCATION: Clark County, Arkansas

GHBW JOB NUMBER: 19-070

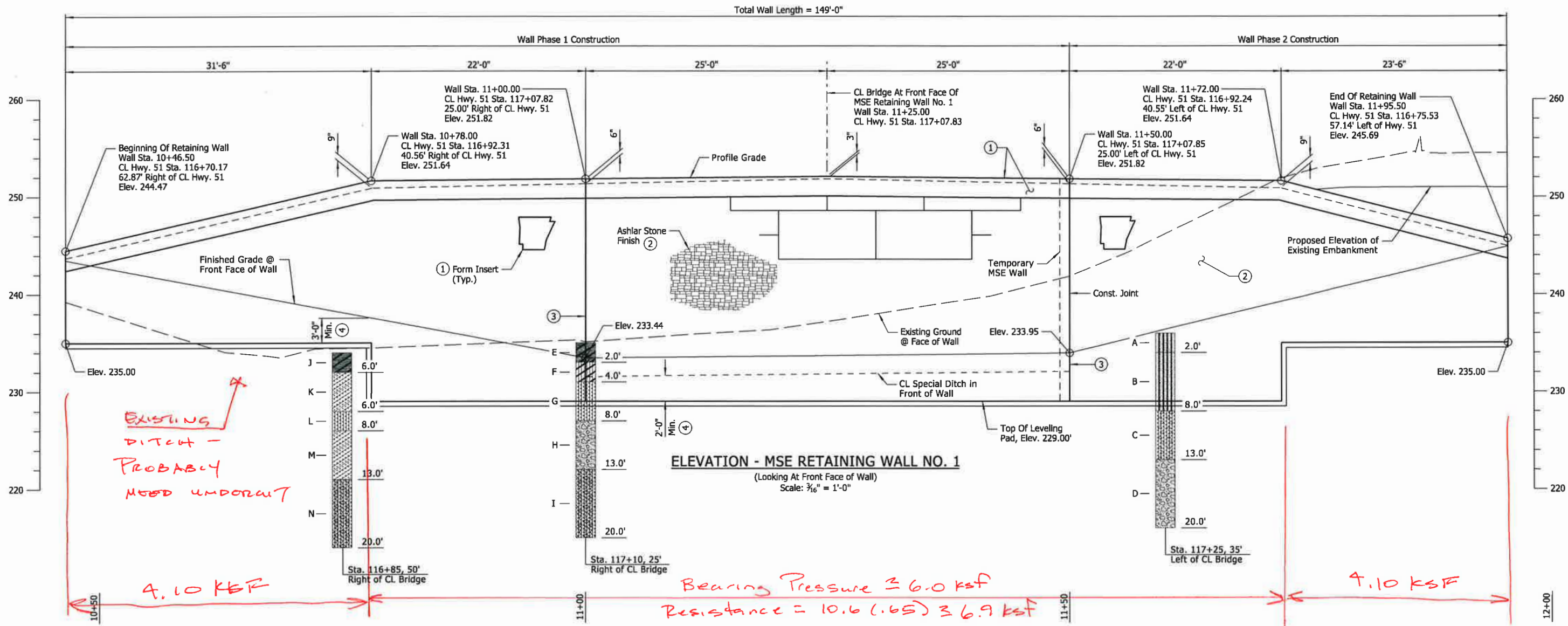
Bent 3: Recommended Parameters for Lateral Load Analyses Using LPILE©

| Generalized Stratigraphy | Neglect MSE Wall Backfill | Medium dense clayey fine SAND | Dense to very dense fine to coarse SAND | Dense fine to coarse GRAVEL | Dense silty fine SAND | Dense to very dense silty fine SAND |
|---|---------------------------|-------------------------------|---|-----------------------------|-----------------------|-------------------------------------|
| Depth below assumed pile cap bottom, ft | 0-21 | 21-23 | 23-28 | 28-33 | 33-43 | 43 and deeper |
| Approximate El, ft | 249-228 | 228-226 | 226-221 | 221-216 | 216-206 | Below 206 |
| Recommend soil type | Neglect | Sand (Reese) | Sand (Reese) | Sand (Reese) | Sand (Reese) | Sand (Reese) |
| Effective unit weight (γ), lbs per cu ft | 125 | 125 | 125 | 125 | 63 | 63 |
| Cohesion (c), lbs per sq ft | Not applicable | 0 | 0 | 0 | 0 | 0 |
| Angle of internal friction (ϕ), ° | Not applicable | 30 | 35 | 36 | 34 | 38 |
| Soil modulus (k), lbs per cu in. | Not applicable | 75 | 125 | 125 | 125 | 125 |
| Strain at 50% (EE50) | Not applicable | Not applicable | Not applicable | Not applicable | Not applicable | Not applicable |

Note: Cap bottom at El 249±

APPENDIX E

| DATE REVISED | DATE FILMED | DATE REVISED | DATE FILMED | FED. ROAD DIST. NO. | STATE | FED. AID PROJ. NO. | SHEET NO. | TOTAL SHEETS |
|--------------|-------------|--------------|-------------|---------------------|--------|--------------------|-----------|--------------|
| | | | | 6 | ARK. | | | |
| | | | | JOB NO. | 070513 | \$BN203\$ | \$ST\$ | |
| | | | | RETAINING WALLS | | \$BN01\$ | \$DN203\$ | |



WALL NO. 1 DESIGN PARAMETERS

| Factored Bearing Resistance (KSF) | Minimum Strap Length (FT) |
|-----------------------------------|---------------------------|
| X.X | .7H |

NOTE:
"H" shall be measured from the top of leveling pad elevation to the finished surface of the roadway.

TABLE OF QUANTITIES (WALL NO. 1)
(FOR INFORMATION ONLY)

| ITEM NO. | 210 | 605 | SP JOB 070513 | SP JOB 070513 | SP JOB 070513 | SP JOB 070513 |
|------------|-------------------------|--------------------------------|--------------------------|----------------|-------------------------|--------------------------|
| ITEM | UNCLASSIFIED EXCAVATION | CONCRETE DITCH PAVING (TYPE B) | SELECT GRANULAR BACKFILL | RETAINING WALL | TEXTURED COATING FINISH | TEMPORARY RETAINING WALL |
| UNIT | CU. YD. | SQ. YD. | CU. YD. | SQ. FT. | SQ. YD. | SQ. FT. |
| Wall No. 1 | XX | XX | XX | XX | XX | XX |

N-VALUES

| Sta. 117+25, 35' Left of CL Bridge | Sta. 117+10, 25' Right of CL Bridge | Sta. 111+45, 85' Left of CL Bridge |
|---------------------------------------|--|---------------------------------------|
| 0.5-1.5, N=5 | 0.5-1.5, N=6 | 0.5-1.5, N=5 |
| 2.5-3.5, N=39 | 2.5-3.5, N=18 | 2.5-3.5, N=23 |
| 4.5-5.5, N=26 | 4.5-5.5, N=24 | 4.5-5.5, N=31 |
| 6.5-7.5, N=26 | 6.5-7.5, N=29 | 6.5-7.5, N=50/10" |
| 9.0-10.0, N=50/8" | 9.0-10.0, N=49 | 9.0-10.0, N=50/8" |
| 14.0-15.0, N=50/6" | 14.0-15.0, N=50/10" | 14.0-15.0, N=50/10" |
| 19.0-20.0, N=50/4" | 19.0-20.0, N=46 | 19.0-20.0, N=50/5" |

BORING LEGEND

A - Loose reddish tan, red and gray fine sandy silt
B - Dense light gray w/red fine sandy silt
C - Dense to very dense light tan w/reddish tan silty fine sand w/some fine chert gravel
D - Dense to very dense light tan and reddish tan sandy fine chert gravel, slightly silty
E - Soft dark brown fine sandy clay w/a little fine to coarse gravel and occasional rootlets (fill)
F - Stiff reddish tan, gray and red silty clay, sandy
G - Medium dense light tan w/reddish tan and red silty fine sand
H - Dense tan and reddish tan sandy fine to coarse chert gravel, slightly silty
I - Dense to very dense tan silty fine to coarse sand w/some fine to coarse gravel
J - Soft brown and drak brown fine sandy clay, wet w/a little fine gravel and occasional decayed organics (fill)
K - Medium dense light gray and red clayey fine sand w/trace fine to coarse gravel
L - Dense to very dense light tan and gray silty fine sand w/clayey fine sand pockets
M - Dense to very dense tan silty fine sand w/tace fine gravel
N - Dense to very dense tan silty fine to coarse sand w/some fine gravel

NOTES:
Offset dimensions and stationing are measured from CL Construction Hwy. 51 to front vertical face of retaining wall.

For "FORM INSERT DETAILS", see Dwg. No. \$DN207\$.

For "GENERAL NOTES", see Dwg. No. \$DN201\$.

LEGEND

U.N.O. = Unless Noted Otherwise

- Class 3 Textured Coating Finish (Color = Brown, Color Chip No. 33522)
- "Ashlar Stone" Pattern & Class 3 Textured Coating Finish (Color = Brown, Color Chip No. 30219)
- 45° break in horizontal alignment of retaining wall. Provide obtuse corner element at each break point.
- Embed the leveling pad a minimum of 3'-0" below proposed grade at wall step locations and a minimum of 2'-0" below CL Special Ditch along the North face of the retaining wall.

SHEET 3 OF 7 DETAILS OF RETAINING WALLS

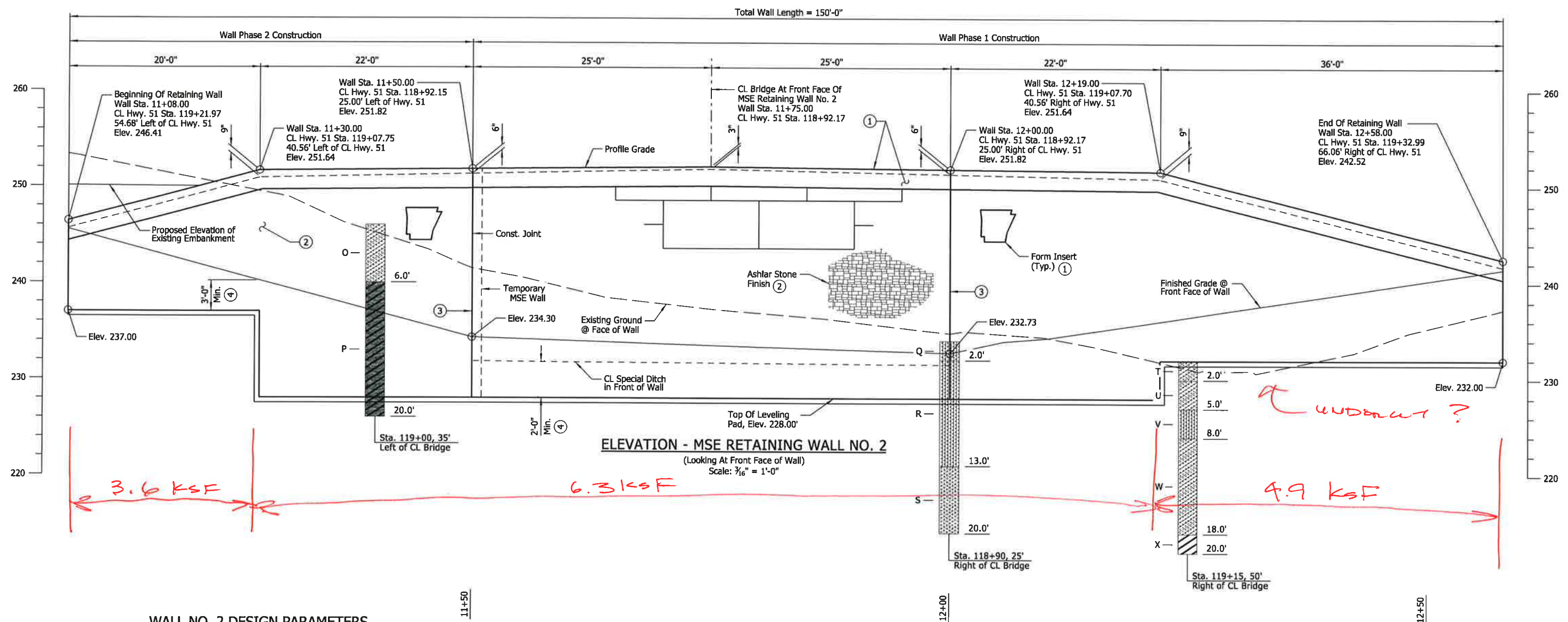
ROUTE SEC.
ARKANSAS STATE HIGHWAY COMMISSION
LITTLE ROCK, ARK.

DRAWN BY: HEW DATE: JAN. 2021 FILENAME: b070513_RW3.dgn
CHECKED BY: JHR DATE: FEB. 2021 SCALE: As Shown
DESIGNED BY: JME DATE: JAN. 2021
BRIDGE NO. \$BN01\$ DRAWING NO. \$DN203\$

PRELIMINARY
NOT FOR
CONSTRUCTION

BRIDGE ENGINEER

| DATE REVISED | DATE FILMED | DATE REVISED | DATE FILMED | FED. ROAD DIST. NO. | STATE | FED. AID PROJ. NO. | SHEET NO. | TOTAL SHEETS |
|-----------------|----------------|-----------------|----------------|------------------------|----------|--------------------|--------------|-----------------|
| | | | | 6 | ARK. | | | |
| | | | | JOB NO. | | 070513 | \$SN204 | \$ST\$ |
| | | | | 1 | \$BNO1\$ | RETAINING WALLS | \$DN204\$ | |



WALL NO. 2 DESIGN PARAMETERS

| | |
|-----------------------------------|---------------------------|
| Factored Bearing Resistance (KSF) | Minimum Strap Length (FT) |
| XX | .7H |

NOTE:
"H" shall be measured from the top of leveling pad elevation to the finished surface of the roadway.

TABLE OF QUANTITIES (WALL NO. 2)
(FOR INFORMATION ONLY)

| ITEM NO. | 210 | 605 | 303 | SP JOB 070513 | SP JOB 070513 | SP JOB 070513 | SP JOB 070513 |
|------------|----------------------------|--------------------------------------|--|--------------------------------|-------------------|-------------------------------|--------------------------------|
| ITEM | UNCLASSIFIED EXCAVATION | CONCRETE DITCH PAVING (TYPE B) | AGGREGATE BASE COURSE (CLASS 7) | SELECT GRANULAR BACKFILL | RETAINING WALL | TEXTURED COATING FINISH | TEMPORARY RETAINING WALL |
| UNIT | CJ. YD. | SQ. YD. | TON | CJ. YD. | SQ. FT. | SQ. YD. | SQ. FT. |
| Wall No. 2 | XX | XX | XX | XX | XX | XX | XX |

N-VALUES

| Sta. 119+00, 35' Left of CL Bridge | Sta. 118+90, 25' Right of CL Bridge | Sta. 119+15, 50' Right of CL Bridge |
|---|--|--|
| 0.5-1.5, N=11 | 0.5-1.5, N=3 | 0.5-1.5, N=6 |
| 2.5-3.5, N=10 | 2.5-3.5, N=19 | 2.5-3.5, N=9 |
| 4.5-5.5, N=7 | 4.5-5.5, N=19 | 4.5-5.5, N=15 |
| 6.5-7.5, N=21 | 6.5-7.5, N=13 | 6.5-7.5, N=16 |
| 9.0-10.0, N=14 | 9.0-10.0, N=39 | 9.0-10.0, N=27 |
| 14.0-15.0, N=25 | 14.0-15.0, N=42 | 14.0-15.0, N=42 |
| 19.0-20.0, N=34 | 19.0-20.0, N=44 | 19.0-20.0, N=43 |

BORING LEGEND

- O - Medium dense brown and reddish brown clayey fine sand, silty w/a little fine to coarse gravel (fill)
- P - Stiff red and gray fine sandy clay
- Q - Very loose tan, reddish tan and dark brown silty fine sand, slightly clayey w/trace fine gravel (fill)
- R - Medium dense tan silty fine sand, slightly clayey
- S - Dense tan fine to coarse sand, slightly silty w/a little fine to coarse gravel
- T - Loose brown and reddish brown clayey fine sand, silty w/trace fine gravel (fill)
- U - Loose tan, gray and red clayey fine sand, silty
- V - Medium dense tan silty fine sand
- W - Medium dense tan and reddish tan clayey fine to coarse sand, slightly silty w/a little fine to coarse gravel
- X - Very stiff reddish tan and grayish brown clay, slightly sandy, varved

NOTES:
Offset dimensions are measured from CL Construction Hwy. 51
to outside vertical face of retaining wall.

For "FORM INSERT DETAILS", see Dwg. No. \$DN207\$.

For "GENERAL NOTES", see Dwg. No. \$DN201\$.

LEGEND

U.N.O. = Unless Noted Otherwise

- ① Class 3 Textured Coating Finish (Color = Brown, Color Chip No. 33522)
- ② "Ashlar Stone" Pattern & Class 3 Textured Coating Finish (Color = Brown, Color Chip No. 30219)
- ③ 45° break in horizontal alignment of retaining wall. Provide obtuse corner element at each break point.
- ④ Embed the leveling pad a minimum of 3'-0" below proposed grade at wall step locations and a minimum of 2'-0" below CL Special Diff along the South face of the retaining wall.

SHEET 4 OF 7
DETAILS OF RETAINING WALLS

ROUTE SEC.
ARKANSAS STATE HIGHWAY COMMISSION
 LITTLE ROCK, ARK.

DRAWN BY: HEW DATE: JAN. 2021 FILENAME: b070513_RW4.dgn
 CHECKED BY: JHR DATE: FEB. 2021 SCALE: As Shown
 DESIGNED BY: JME DATE: JAN. 2021
 BRIDGE NO. **\$BN01\$** DRAWING NO. **\$DN204\$**

PRELIMINARY
NOT FOR
CONSTRUCTION

BRIDGE ENGINEER

Summary of Recommendations for Hwy 51 MSE Walls

PROJECT: 070513 Hwy. 51 over I-30

LOCATION: Clark County, Arkansas

GHBW JOB NO.: 19-070

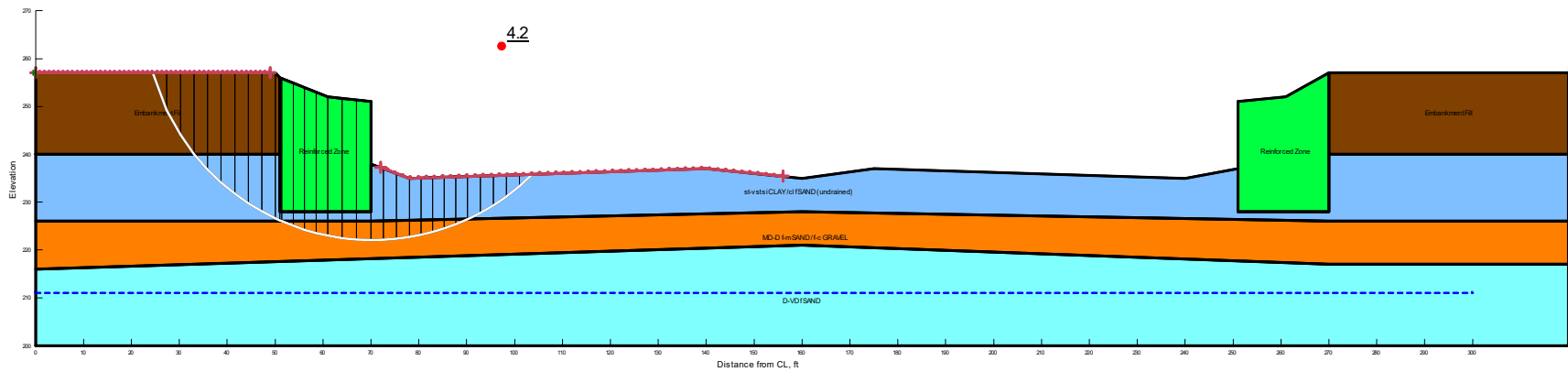
| Wall Station | Approx Wall Section Length, ft | Wall Height, ft | Ground improvement method | Leveling Pad El, ft | Estimated Bearing Pressure, ksf | Calculated Nominal Unit Bearing Resistance, ksf | Recommended Resistance Factor (ϕ_b) | Factored Unit Bearing Resistance, ksf | Bearing Stratum |
|------------------------|--------------------------------|-----------------|---|---------------------|---------------------------------|---|--|---------------------------------------|---|
| Wall 1 (Bent 1) | | | | | | | | | |
| 10+47 - 10+78 | 31 | 9.5 - 16.6 | Undercut 2 ft, more or less, below existing grades (to nominal El 233±) | 235 | 4.1 | 8.3 | 0.65 | 5.4 | SM-1 or Class 7 base undercut backfill or on-site medium dense clayey fine sand |
| 10+78 - 11+72 | 94 | 16.6 - 22.8 | Minimum undercut anticipated, undercut as needed for construction | 229 | 6.0 | 10.6 | 0.65 | 6.9 | Very stiff silty clay, medium dense to dense silty fine sand or undercut with Class 7 base backfill |
| 11+72 - 11+96 | 24 | 22.8 - 10.7 | Undercut 2 ft, more or less, below existing grades (to nominal El 232±) | 235 | 4.1 | 8.3 | 0.65 | 5.4 | Undercut with SM-1 or Class 7 base backfill or on-site medium dense clayey fine sand |
| Wall 2 (Bent 3) | | | | | | | | | |
| 11+08 - 11+27 | 21 | 9.4 - 14.6 | Minimum undercut anticipated, undercut as needed for construction | 237 | 3.6 | 8.9 | 0.65 | 5.8 | Very stiff fine sandy clay or undercut with SM-1 or Class 7 base backfill |
| 11+27 - 12+22 | 95 | 14.6 - 23.8 | Minimum undercut anticipated, undercut as needed for construction | 228 | 6.3 | 10.6 | 0.65 | 6.9 | Very stiff fine sandy clay, medium dense clayey fine sand, or undercut with Class 7 base backfill |
| 12+22 - 12+58 | 36 | 23.8 - 10.5 | Undercut 4 ft, more or less, below existing grade (to nominal El 228±) | 232 | 4.9 | 9.7 | 0.65 | 6.3 | Undercut with SM-1 or Class 7 base backfill or on-site medium dense silty fine sand |

- Notes: 1. Minimum MSE wall embedment of 2 ft below lowest adjacent grade. Embedment must comply with designers criteria if greater than noted.
2. The suitability of the MSE wall bearing stratum must be field verified by the Engineer or Department at the time of construction.
3. Undercuts required to develop suitable bearing should be backfilled with appropriate material as recommended above.
4. Undercuts should extend at least 5 ft outside the reinforced zone to the extent possible.
5. Undercuts required to develop suitable bearing should be backfilled as recommended with selected material (ARDOT Standard Specifications Section 302, SM-1), Class 7 base (ARDOT Standard Specifications Section 303, Class 7), stone backfill (ARDOT Standard Specifications Section 207), or an approved alternate.

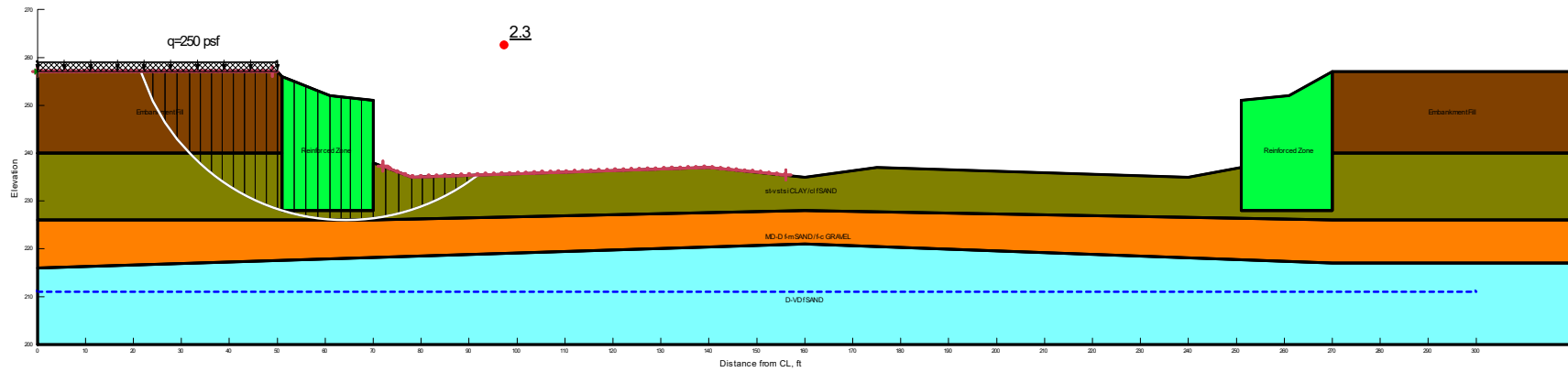
APPENDIX F

Summary of Stability Analysis Results
ARDOT Job No. 070513 Hwy. 51 over I-30
GHBW Job No. 19-070
Clark County, Arkansas

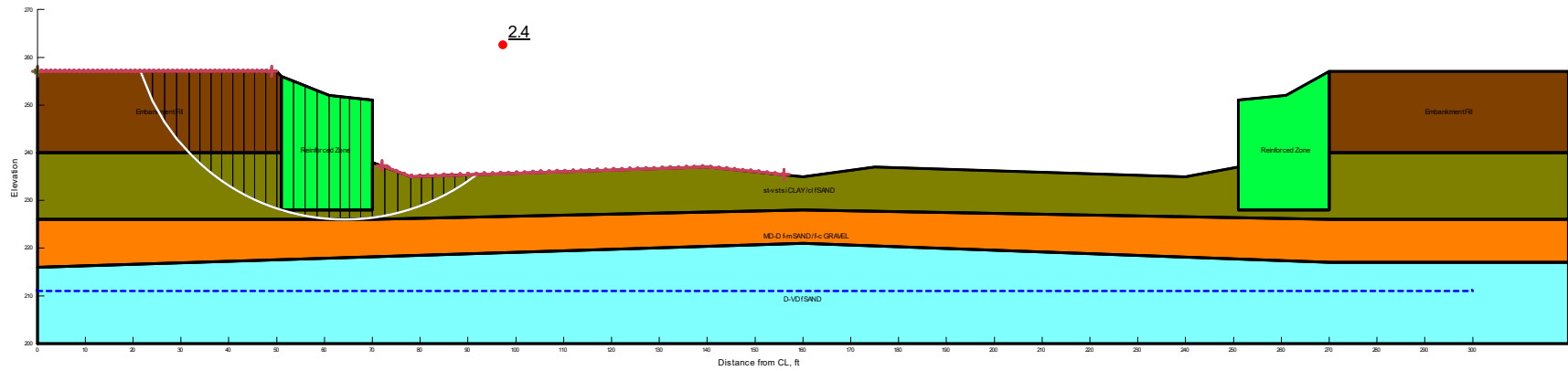
| Bridge End | Design Loading Condition | Calculated Minimum Factor of Safety |
|--------------------------------------|-----------------------------------|--|
| MSE Wall @ South Bridge End (Bent 1) | End of Construction | 4.2 |
| | Long Term | 2.3 |
| | Seismic ($k_h = 0.5A_s = 0.04$) | 2.4 |
| South Side Slope (Bent 1) | End of Construction | 6.3 |
| | Long Term | 3.6 |
| | Seismic ($k_h = 0.5A_s = 0.04$) | 3.2 |
| MSE Wall @ North Bridge End (Bent 3) | End of Construction | 4.1 |
| | Long Term | 2.3 |
| | Seismic ($k_h = 0.5A_s = 0.04$) | 2.3 |
| North Side Slope (Bent 3) | End of Construction | 4.7 |
| | Long Term | 2.8 |
| | Seismic ($k_h = 0.5A_s = 0.04$) | 2.7 |



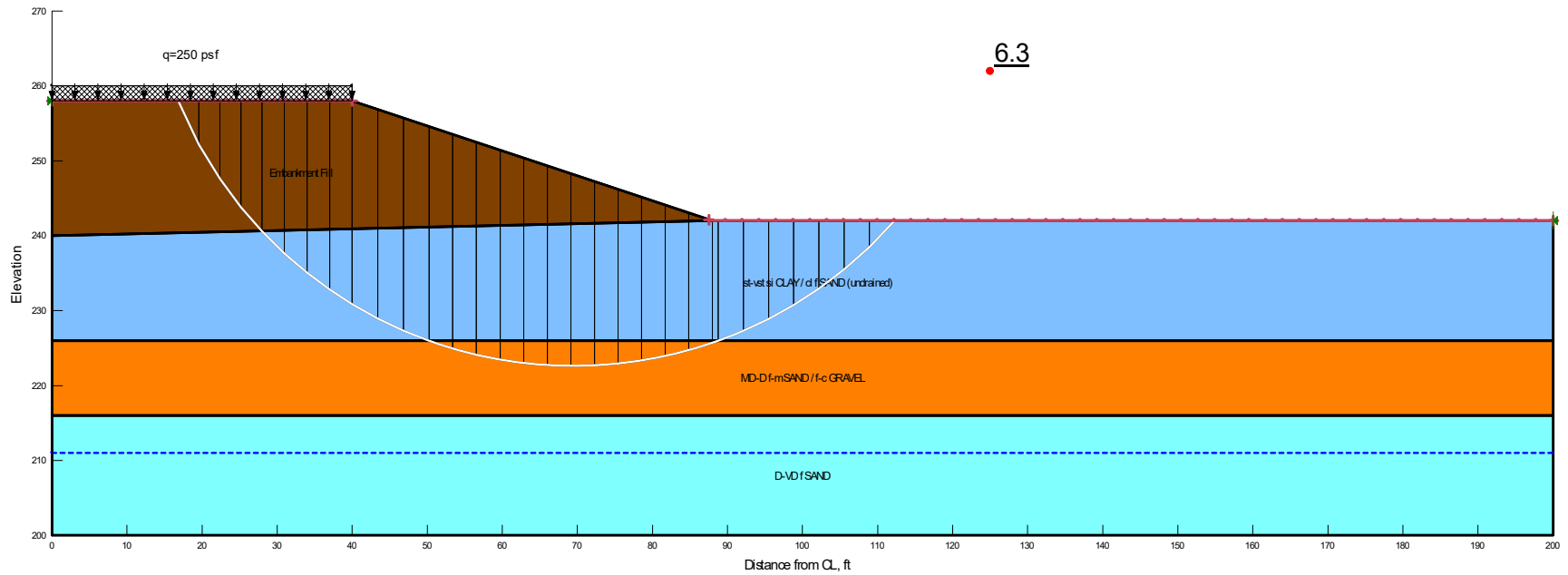
Results of Stability Analyses – End of Construction Condition
 MSE Wall @ South Bridge End (Bent 1)
 ARDOT Job No. 070513 Hwy. 51 over I-30
 GHBW Job No. 19-070
 Clark County, Arkansas



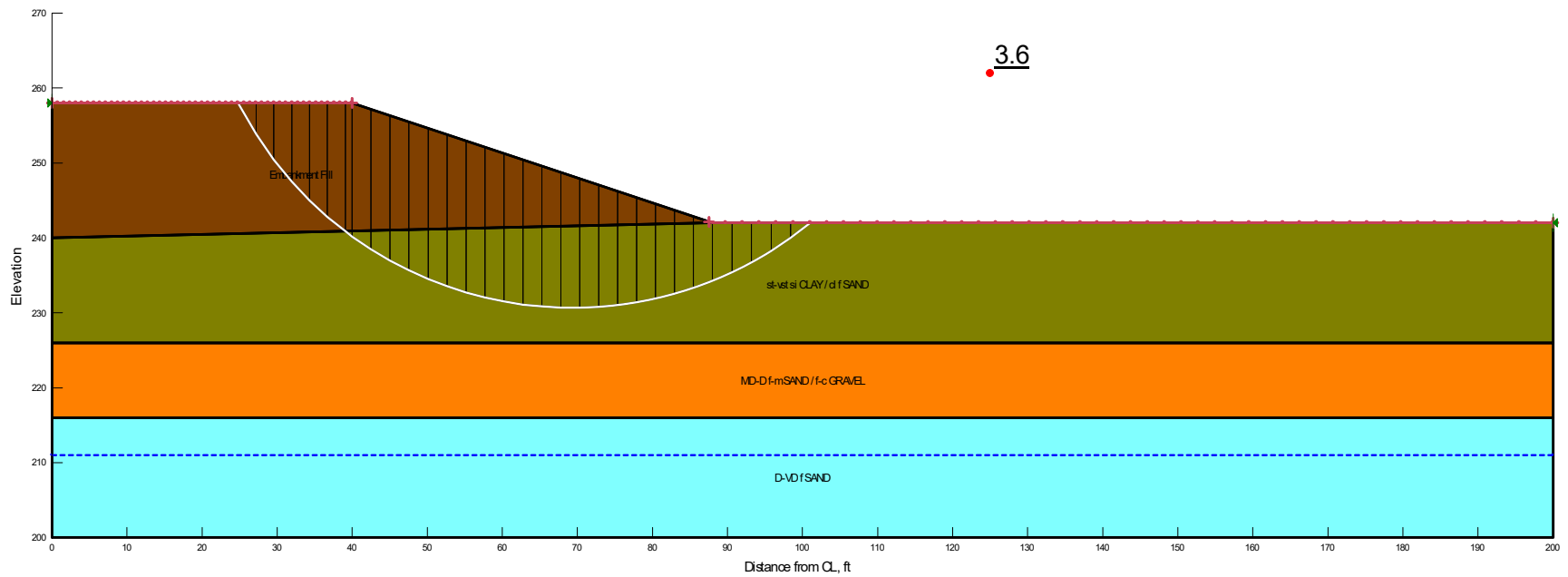
Results of Stability Analyses – Long Term Condition
 MSE Wall @ South Bridge End (Bent 1)
 ARDOT Job No. 070513 Hwy. 51 over I-30
 GHBW Job No. 19-070
 Clark County, Arkansas



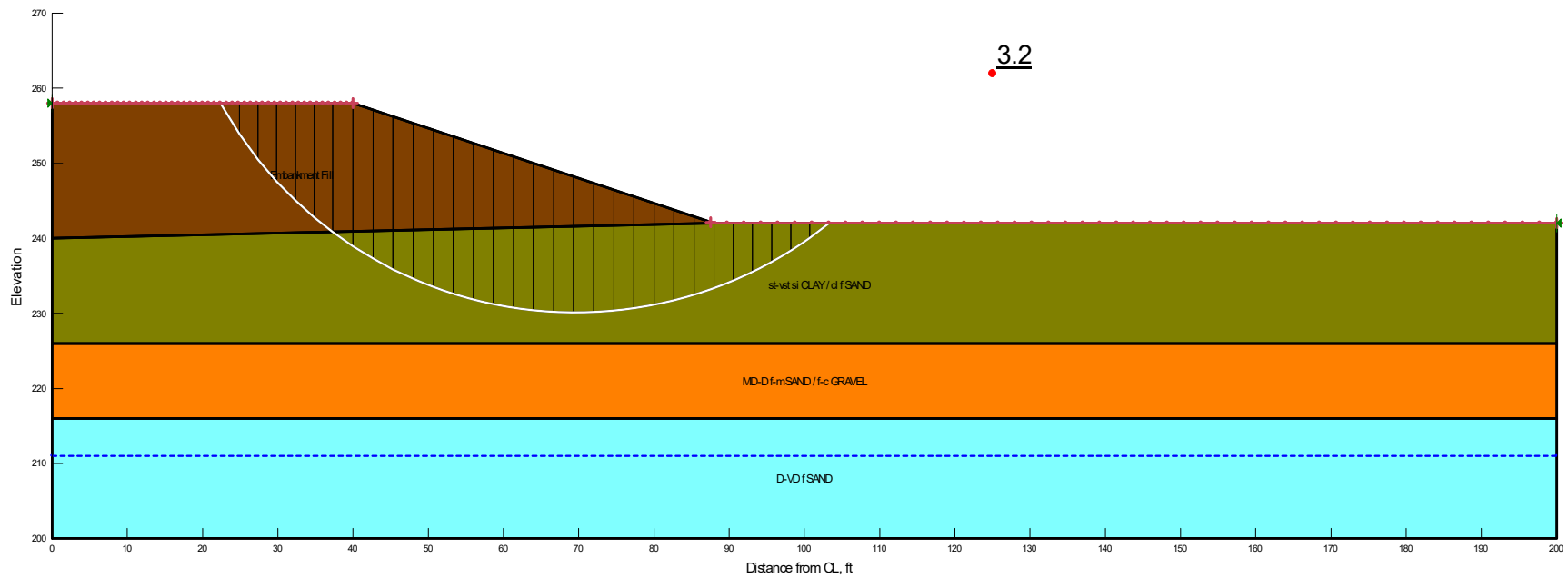
Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_s = 0.04$)
 MSE Wall @ South Bridge End (Bent 1)
 ARDOT Job No. 070513 Hwy. 51 over I-30
 GHBW Job No. 19-070
 Clark County, Arkansas



Results of Stability Analyses – End of Construction Condition
 South Side Slope (Bent 1)
 ARDOT Job No. 070513 Hwy. 51 over I-30
 GHBW Job No. 19-070
 Clark County, Arkansas



Results of Stability Analyses – Long Term Condition
 South Side Slope (Bent 1)
 ARDOT Job No. 070513 Hwy. 51 over I-30
 GHBW Job No. 19-070
 Clark County, Arkansas



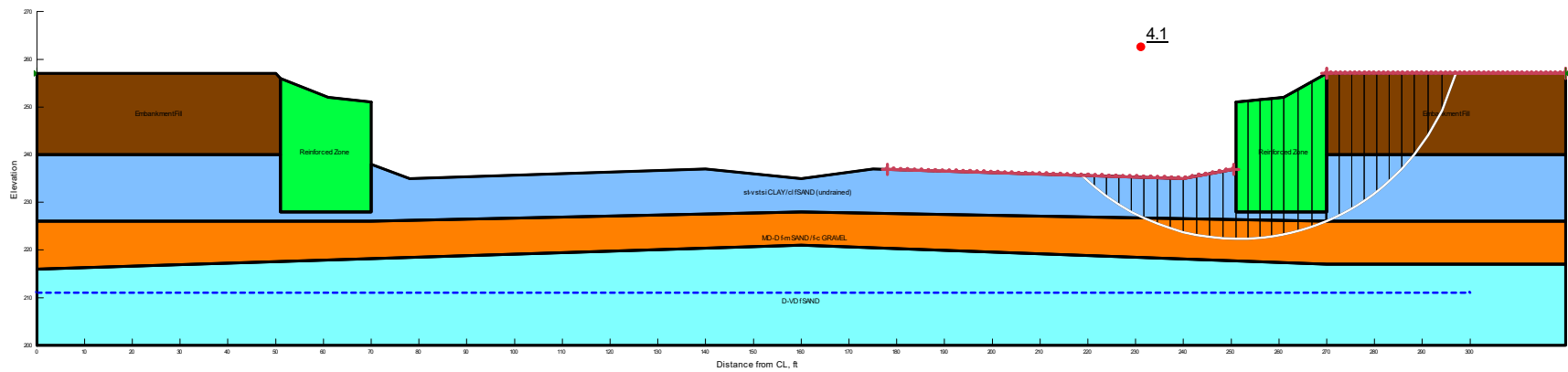
Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_S = 0.04$)

South Side Slope (Bent 1)

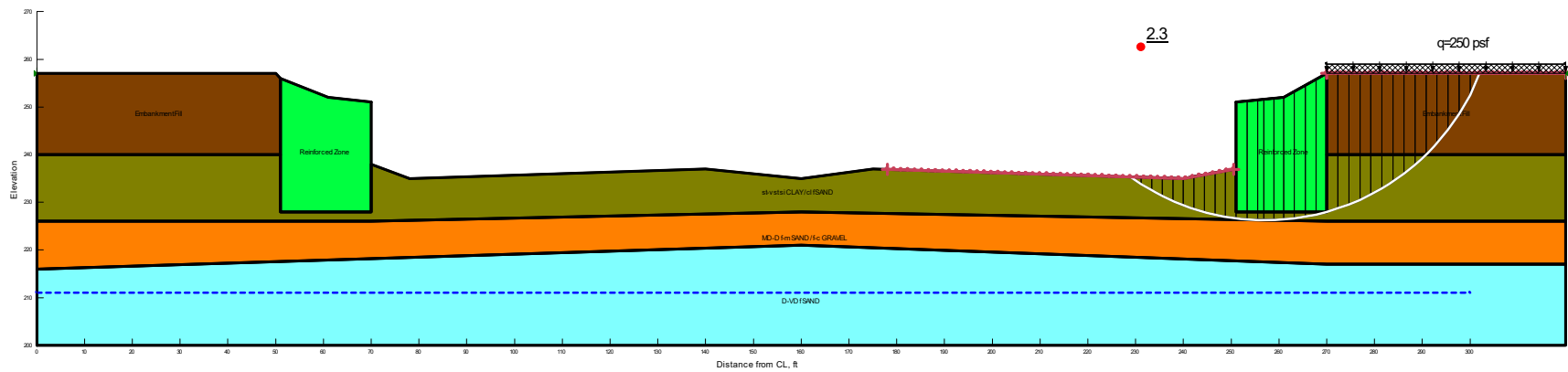
ARDOT Job No. 070513 Hwy. 51 over I-30

GHBW Job No. 19-070

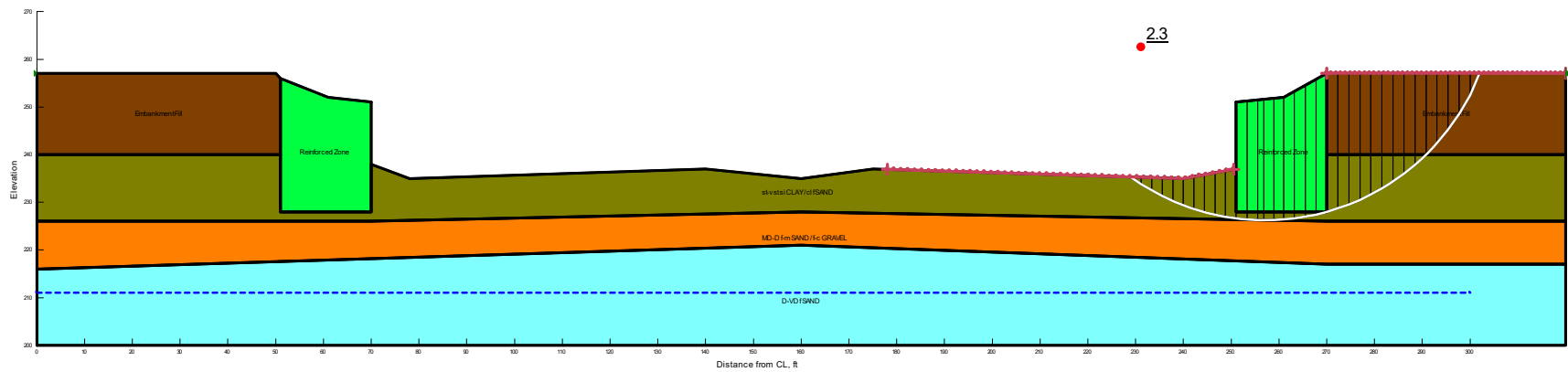
Clark County, Arkansas



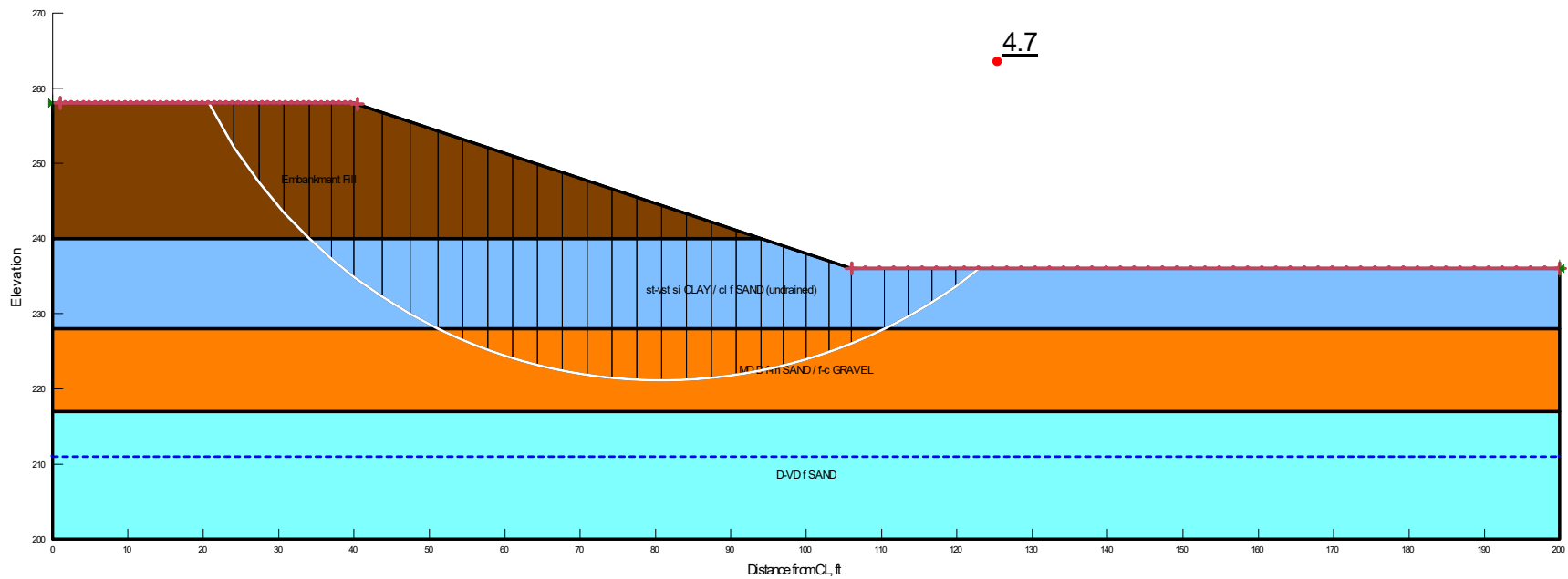
Results of Stability Analyses – End of Construction Condition
 MSE Wall @ North Bridge End (Bent 3)
 ARDOT Job No. 070513 Hwy. 51 over I-30
 GHBW Job No. 19-070
 Clark County, Arkansas



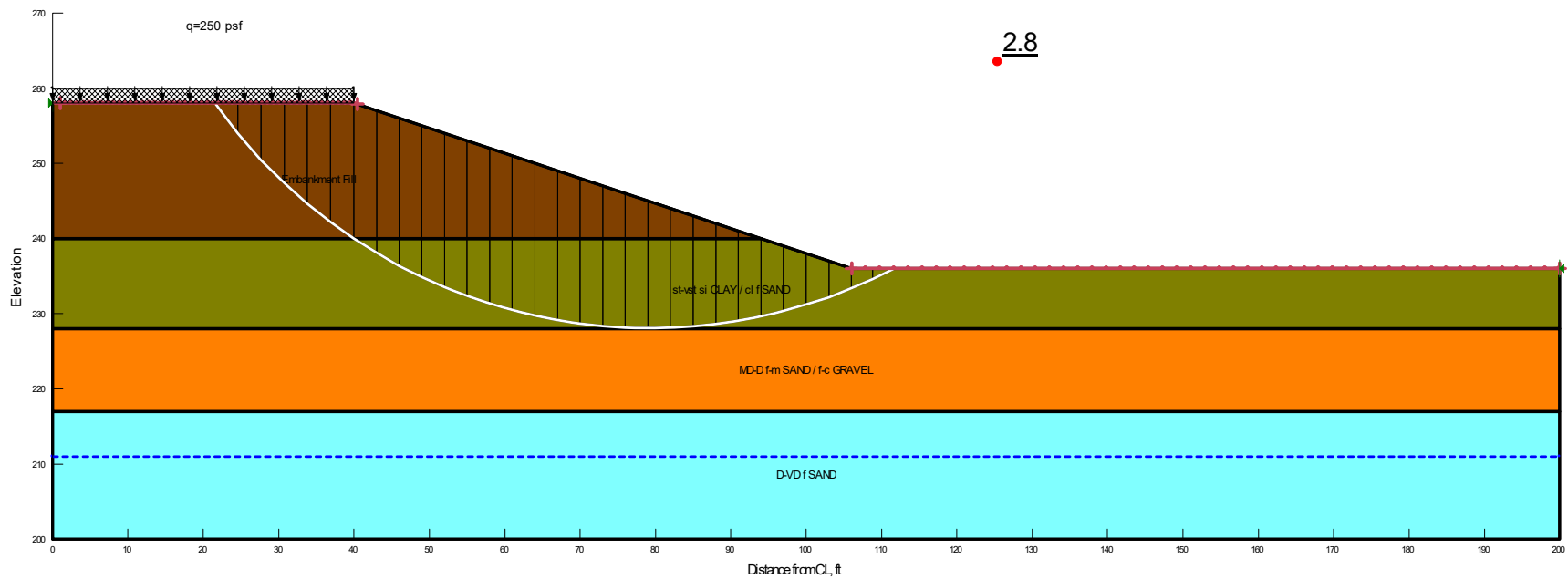
Results of Stability Analyses – Long Term Condition
 MSE Wall @ North Bridge End (Bent 3)
 ARDOT Job No. 070513 Hwy. 51 over I-30
 GHBW Job No. 19-070
 Clark County, Arkansas



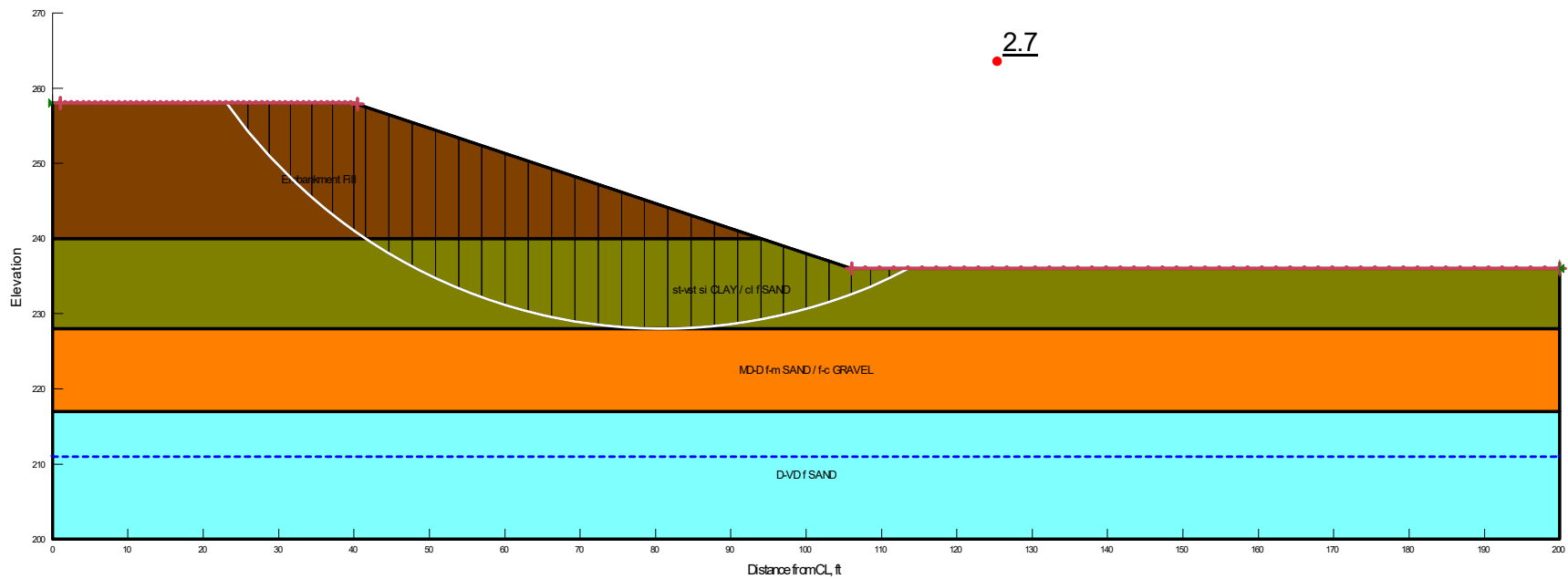
Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_S = 0.04$)
 MSE Wall @ North Bridge End (Bent 3)
 ARDOT Job No. 070513 Hwy. 51 over I-30
 GHBW Job No. 19-070
 Clark County, Arkansas



Results of Stability Analyses – End of Construction Condition
 North Side Slope (Bent 3)
 ARDOT Job No. 070513 Hwy. 51 over I-30
 GHBW Job No. 19-070
 Clark County, Arkansas



Results of Stability Analyses – Long Term Condition
 North Side Slope (Bent 3)
 ARDOT Job No. 070513 Hwy. 51 over I-30
 GHBW Job No. 19-070
 Clark County, Arkansas



Results of Stability Analyses – Seismic Condition ($k_h = 0.5A_S = 0.04$)

North Side Slope (Bent 3)

ARDOT Job No. 070513 Hwy. 51 over I-30

GHBW Job No. 19-070

Clark County, Arkansas