20 August 2024

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Ladies and Gentlemen:

Geotechnical Exploration
National Park Service
Jean Lafitte National Historic Park and Preserve
Jones Point Boat Storage and Parking
Marrero, Louisiana
Croft Project No. 2023-415, NPS JELA 325249
Croft Task Order No. 2023-415-Eustis-20240620-001_R2
Eustis Engineering Project No. 25290

Transmitted is an electronic copy of our report covering professional geotechnical services for the subject project. A hard copy is available upon request.

Thank you for asking us to perform these geotechnical services. If you have any questions or require further clarification, please do not hesitate to contact us.

Yours very truly,

EUSTIS ENGINEERING L.L.C.

JAMES M. WILLIAMS, P.E.

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CIVIL ENGINEERING

GEOTECHNICAL EXPLORATION

NATIONAL PARK SERVICE

JEAN LAFITTE NATIONAL HISTORIC PARK AND PRESERVE

JONES POINT BOAT STORAGE AND PARKING

MARRERO, LOUISIANA

CROFT PROJECT NO. 2023-415, NPS JELA 325249

CROFT TASK ORDER NO. 2023-415-EUSTIS-20240620-001_R2

EUSTIS ENGINEERING PROJECT NO. 25290

FOR
CROFT & ASSOCIATES, INC.
KENNESAW, GEORGIA

BY

EUSTIS
ENGINEERING L.L.C.
SINCE 1946
METAIRIE, LOUISIANA

20 AUGUST 2024

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GEOTECHNICAL EXPLORATION

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INTRODUCTION

1. This report contains the results of a geotechnical exploration performed for the proposed improvements to the Jones Point trailer site at the Jean Lafitte National Historical Park and Preserve located in Marrero, Louisiana. A site vicinity map is presented on Figure 1. This geotechnical exploration was performed in general accordance with Eustis Engineering L.L.C.'s proposal dated 7 May 2024. Our scope of service was authorized on 9 July 2024 by issuance of Task Order No. 2023-415-Eustis-20240620-001_R2 (Geotechnical Services) by Mr. Adam Lamb with Croft & Associates, Inc. (CROFT). The National Park Service is the project's owner.

SCOPE OF SERVICE

2. Our scope of service comprised a field exploration, laboratory testing program, and design recommendations based on our field and laboratory testing results. Our field exploration included drilling two 3-in. diameter undisturbed sample-type soil test borings

and two auger borings. Soil mechanics laboratory tests, performed on samples obtained from the borings, were used to evaluate the physical properties of the various substrata at the locations of the borings.

3. We performed engineering analyses, based on soil borings and laboratory test results to develop recommendations including estimates of allowable soil bearing values for shallow foundations; estimates of allowable vertical load capacity for various sizes and types of timber and square, precast concrete (SPC) piles; recommendations for pile installation procedures; estimates of settlement; estimates of lateral earthen pressure parameters; and discussion on seismic site classification. General construction recommendations regarding site preparation, drainage, structural fill, compaction, and pavement components and thicknesses are also provided.

FIELD EXPLORATION

General

4. The scope of the field services included drilling two undisturbed soil borings, designated as B-1 and B-2, and two auger borings designated as B-3 and B-4. Borings B-1 and B-2 were drilled to depths of 100 feet and 70 feet below the existing ground surface, respectively. Auger borings B-3 and B-4 were drilled to a depth of 10 feet below the existing ground surface. The approximate locations of the soil borings performed for the project are shown on Figure 2. Detailed descriptive logs of the borings made for the current exploration are shown in both tabular and graphical form in Appendix I.

5. Borings B-1 and B-2 were drilled using a truck-mounted drill rig. Borings B-3 and B-4 are auger borings and grab samples were collected from the auger blades. GPS coordinates were obtained by Eustis Engineering at the as-drilled boring locations using a handheld device and should be considered approximate. These coordinates are shown in terms of latitude and longitude on the boring logs in Appendix I. Upon completion of the field operations, the soil borings were grouted/backfilled with cement-grout mix in accordance with current regulatory requirements by the State of Louisiana.

Undisturbed Soil Borings (Borings B-1 and B-2)

6. Undisturbed Sampling. Relatively undisturbed samples of cohesive or semi-cohesive subsoils were obtained from the borings at close intervals or changes in stratum using a 3-in. diameter thinwall Shelby tube sampling barrel. The samples were immediately extruded from the sampling barrel, inspected, and visually classified by Eustis Engineering's soil technician. Pocket penetrometer tests were performed on the soil samples to give a general indication of their shear strength or consistency. The results of these tests are shown on the boring logs under the column heading "PP." Representative portions were then promptly placed in moisture-proof containers and sealed for preservation of their natural moisture content.

7. Standard Penetration Tests. Samples of cohesionless and semi-cohesive subsoils were obtained during the performance of in-situ Standard Penetration Tests. This test consists of driving a 2-in. diameter sampler 1 foot into the soil after first seating it 6 inches. A 140-lb weight dropped 30 inches is used to advance the sampler. The number of blows required to drive the sampler is indicative of the relative density of cohesionless soils and the consistency of cohesive soils. The samples were visually classified by our

soil technician and then placed in moisture-proof containers for preservation of their natural moisture content. The results of the Standard Penetration Tests are shown on the boring logs in Appendix I under the column heading "SPT."

Auger Borings

8. Grab samples were collected from the auger blades in the auger borings and visually classified by Eustis Engineering's soil technician. Representative samples were placed and sealed in moisture-proof containers for preservation of their natural moisture content for transportation to our laboratory and further testing.

LABORATORY TESTS

9. Soil mechanics laboratory tests consisted of visual classification, natural water content, unit weight, unconfined compression shear (UC), and one-point unconsolidated undrained triaxial compression shear (OB). In addition, the test establishing the percent passing a U.S. Standard No. 200 mesh sieve (#200) and Atterberg liquid limits (LL) and plastic limits (PL) tests were performed on selected representative samples. These tests were performed to aid in classification of the subsoils and to determine the relative strength and compressibility of the subsoils. The results of these laboratory tests are tabulated on the boring logs in Appendix I.

DESCRIPTION OF SURFACE AND SUBSOIL CONDITIONS

10. Site Conditions. The project site is the existing Jean Lafitte National Historic Park and Preserve located on the west side of Barataria Boulevard, approximately 1 mile north of

its intersection with Leo Kerner Lafitte Parkway in Marrero, Louisiana. The project site is located in the vicinity of an existing structure with an asphalt parking lot. Borings B-1 and B-2 were completed in the vicinity of the proposed location for the future boat storage structure. Borings B-3 and B-4 were located in the wooded area beyond the existing fence where additional asphalt paving is proposed. Recent satellite imagery of the project site is presented on Figure 2.

11. Stratigraphy. We present our interpretation of subsurface soil stratigraphy on the boring logs presented in Appendix I. The existing pavement at Boring B-1 is comprised of a 2-in. thick asphalt pavement underlain by approximately 4 inches of base materials. The soil stratigraphy consists of loose to medium dense, tan poorly graded sand with silt and silty sand extending to a depth of 3 to 5 feet at the locations of Borings B-1 and B-2. The sands are underlain by medium stiff, gray and tan lean clay to a depth of 11 to 14 feet followed by soft to medium stiff fat clay extending to the 79-ft depth in Boring B-1 and to the boring termination depth of 70 feet in Boring B-2. Very loose, gray poorly graded sand and silty sand extending from the 79-ft depth to the 93-ft depth in Boring B-1 is followed by stiff, gray fat clay with trace of silt pockets and lenses to the boring termination depth of 100 feet.

12. The soil stratigraphy in Borings B-3 and B-4 generally consists of dark gray and brown fat clay with few organic materials and silt pockets to depths of 3 to 5 feet underlain by gray and tan lean clay to the boring termination depths of 10 feet.

13. Groundwater. Groundwater observations were made at the time of our field exploration within the completed boings. The borings were drilled without the addition of water to the 1 to 3-ft depths. Observations were made in these borings during initial

drilling operations and after an observation period of 15 minutes. Our observations are summarized in Table 1.

TABLE 1: GROUNDWATER OBSERVATIONS

BORING DESIGNATION	INITIAL GROUNDWATER DEPTH BELOW GRADE OBSERVED DURING DRILLING IN FEET	GROUNDWATER DEPTH BELOW GRADE OBSERVED IN FEET (AFTER OBSERVATION PERIOD OF 15 MINUTES)
B-1	3.0	1.5
B-2	3.0	1.5
B-3	1.0	--
B-4	1.5	--

14. Seismic Site Classification. The site was classified in accordance with the 2010 ASCE Standard Minimum Design Loads for Buildings and Other Structures (ASCE/SEI 7-16). Using Table 20.3-1 of the ASCE/SEI 7-16, this site may be categorized as Site Class E, a "soft soil profile." The average undrained shear strength of the soils is generally less than 1,000 psf.

FOUNDATION ANALYSES

Furnished Information

15. Based on the furnished drawings, the proposed renovations include the addition of a new steel storage structure for boats with approximate dimensions of 12 feet by 140 feet and expansion of the existing asphalt pavement. The furnished drawings are included in Appendix II.

16. Based on correspondence with CROFT, the proposed steel storage structure is a prefabricated metal building with anticipated pile foundations comprised of timber or SPC piles. Shallow foundations are also anticipated for ancillary structures but no specific dimensions for bearing capacity estimates was provided. Pavements are anticipated to be relatively lightly loaded asphalt pavements to support traffic comprising passenger vehicles, larger boat trailers, dump trucks, and large flatbed trucks. No excavations or retaining structures are anticipated at this time.

Foundation Recommendations

17. Lightly loaded structures may be supported on shallow surface foundations provided the recommendations contained in this report regarding drainage and site preparation are adhered to, the structure loads do not exceed the estimates of allowable soil bearing value, and the structure's design will accommodate potential settlements. Concrete for footings should be placed integrally with grade beams. The structures should be made as rigid as possible to minimize the effects of settlement and differential settlement.

18. The new boat storage structure could be supported on deep foundations comprising driven timber piles or SPC piles. We recommend that all structural loads for each independent structure be supported on piles having the same approximate tip embedment below the existing ground surface to minimize differential settlement. Slabs should be cast monolithically with grade beams and pile caps to provide rigidity and to minimize the potential for differential settlement.

19. Consideration should be given to differential settlement between a pile-supported structure and any adjacent structures that are not pile-supported. Long-term recurring

maintenance of pavements and sidewalks should be anticipated, especially where surface-supported features adjoin pile-supported features. This includes joints between any pile-supported structures and grade-supported pavements, pads, and sidewalks. The structures should be designed as rigid as possible to minimize the potential for differential settlement.

20. Your structural engineer shall determine the appropriate foundation type and size based on actual structure loads and settlement tolerances. Consideration should be given to estimates of allowable soil bearing value, estimates of allowable pile capacity, and settlement estimates presented in this report. Any site grading fill placed above existing grades should be placed as far in advance of construction as possible to reduce the undesirable effects of subsoil consolidation from fill on the structure. Eustis Engineering should be notified if more than 1 foot of site grading fill will be placed at the site above existing grades.

21. A Visqueen® vapor barrier should be provided beneath concrete floor slabs to prevent capillary migration of moisture. The slab should be cast monolithically with grade beams which, in turn, are structurally connected to footings or pile caps to provide rigidity and minimize the potential for differential settlement. The slab, including the reinforcing and anchor connection details, should be designed by a structural engineer.

22. Pavements for the proposed parking features may be flexible asphalt pavement provided our recommendations regarding site preparation and materials are met. Our recommendations regarding pavement thickness are provided subsequently and are dependent upon our assumptions regarding anticipated vehicular traffic. Should your

site require heavier traffic loads, please contact Eustis Engineering for additional evaluation.

23. We understand no deep excavations or retaining walls are anticipated at the time of our report. We provide general information regarding excavations and lateral earthen pressures as requested in the scope of service documents for this project. These recommendations are for reference and planning. Should excavations or retaining structures be added to the project scope, please contact Eustis Engineering for additional project specific recommendations.

24. The near-surface soils at the site are moisture-sensitive. Without proper preparation and drainage, the underlying soils could produce excessive settlement and differential settlement and are subject to a reduction in shear strength. Therefore, site preparation and drainage are extremely important. Proper site drainage should be established prior to construction to minimize delays due to deteriorated site conditions due to inclement weather.

Groundwater Management

25. Drainage During Construction. The initial step to prepare the site for construction should be to establish adequate temporary and permanent drainage to prevent ponding of water and ensure immediate runoff of rainfall. We recommend the contractor maintain adequate surface drainage away from all foundation and pavement areas during and after construction. This may be accomplished by utilizing existing drainage features and by setting grades to ensure positive drainage of water away from the foundations and pavements. Sumps and pumps may be required to remove rainfall and

groundwater from ditches or shallow excavations. Throughout construction, the contractor should exercise caution during those times in which the subgrade may be saturated to ensure soil support is not degraded by construction operations.

26. Permanent Drainage. The near-surface soils are subject to a reduction in shear strength and excessive settlement if the moisture content increases (naturally or as a result of construction operations). We recommend adequate permanent drainage be provided to collect rainfall away from foundations and pavements after the completion of construction. All runoff should be directed into the site's stormwater collection and disposal system. Water should not be allowed to collect near the structure foundations or pavements.

Site Preparation

27. Demolition. Any remnant structures located within the proposed construction areas should be demolished and removed from the site. Provisions should be made to locate any abandoned underground utilities and foundations which could impact new construction. Existing footings or abandoned pipes should be excavated and removed from the site. These structures could impact the performance of new foundations if not properly removed, proofrolled, and backfilled with select fill material. Existing piles within the foundation footprints, if encountered, should not be removed. We recommend these features be cut off 3 feet below the lowest elevation of any proposed footings or pile caps, or 5 feet below the existing ground surface, whichever is greater. Removal and relocation of structures and obstructions should also comply with Section 202 of the Louisiana Standard Specifications for Roads and Bridges (LSSRB), 2016 edition.

28. Clearing and Stripping. The existing ground surface beneath construction areas should be cleared and then stripped of vegetation, stumps, loose topsoil, debris, loose fill, organic matter, and any other deleterious materials. Stripping should be to a depth necessary to remove vegetation and roots and reach firm undisturbed soil. The exact depth of stripping should be determined during construction. Clearing and stripping should also comply with Section 201 of the LSSRB. Weak zones, excavated areas, or depressions resulting from demolition, clearing, and stripping operations should be thoroughly cleaned out to the surface of firm undisturbed soil and backfilled with a select structural fill material placed and compacted under controlled conditions.

29. Subgrade Preparation. After the demolition, clearing, and stripping operations, the exposed ground surface beneath structures and future pavement areas should be proofrolled with a bulldozer, compactor, or tracked vehicle exerting a ground pressure between 10 and 15 psi. Smaller, hand operated equipment may also be considered if spatial limitations prevent proofrolling within the footing excavations if shallow foundations are considered as an alternative to support the proposed structure. The vibratory system on the compactor, if present, should not be used during proofrolling. Alternative proofrolling techniques may be proposed, but these methods should be approved by Eustis Engineering prior to their use at the site. Any depressions or weak areas identified should be thoroughly cleaned out to the surface of firm undisturbed soil and backfilled with a select structural fill material placed and compacted under controlled conditions.

30. Structural Fill. We recommend a select granular material, such as locally available river sand, be used as backfill and/or fill required to reach design grade. A select granular material, meeting the requirements of AASHTO A-3, should be used as backfill and/or fill

required to reach design grade for the site. Sand fill (AASHTO A-3) should be non-plastic and free of roots, clay lumps, and other deleterious materials with no more than 10% by weight of material passing a U.S. Standard No. 200 mesh sieve. The maximum organic content should not exceed 5% by weight. Prior to transporting structural fill on site, a sample should be tested to verify its conformance to these recommendations.

31. Non-Structural Fill. Non-structural fill may be used in areas where installation of structures or equipment are not planned and in open areas where grading is only required to reach a desired elevation and provide drainage.

32. Compaction of Fill. Structural fill beneath grade-supported structures should be placed in loose lifts of 6 to 8 inches and compacted to at least 95% of its maximum dry density within ±2% of its optimum moisture content in accordance with ASTM D1557. Structural fill used as backfill or form fill beneath pile-supported structures should be placed in loose lifts of 8 to 10 inches and compacted to at least 95% of its maximum dry density within ±2% of its optimum moisture content in accordance with ASTM D698. Structural fill or general fill used for non-structural grading should be spread in loose lifts of 10 to 12 inches and compacted by several passes of a bulldozer. Sand subbase beneath pavements should be placed and compacted as discussed in the "Pavements" section of this report.

33. Fill Material and Compaction - Crushed Stone. The crushed stone used for the proposed pavements should meet the material requirements and gradation outlined in Section 1003 of the LSSRB. Lifts may be placed in loose thicknesses of 6 to 10 inches. Stone placement should achieve compaction having a minimum density corresponding to at least 75% of the relative density as determined by ASTM D4253 and D4254.

34. Material Separation. Material separation should be included between the sand subbase and the existing subgrade to improve resiliency of the pavements. This may be accomplished with a geotextile stabilization fabric. The geotextile should meet or exceed the material requirements presented in Section 1019.01 of the LSSRB. A Class C geotextile should be used beneath the sand subbase. The geotextile should be placed directly on the undisturbed soil in accordance with the manufacturer's construction recommendations.

35. Quality Control. Prior to transporting structural fill to the site, a sample of the borrow material should be tested to verify its conformance to the project specifications. Density tests should be performed on each lift of the compacted structural fill to determine if the contractor has achieved the recommended density. The frequency of these tests is dependent on the individual structure, type of fill material, and site conditions and should be determined once these variables are known. If needed, Eustis Engineering is available to provide additional consultation. All clearing, filling, and compaction operations should be accomplished only during periods of dry weather. The contractor should exercise caution during and after inclement weather to ensure subsoil support is not degraded by construction operations.

Excavations

36. General. No details on proposed excavation locations or depths were provided at the time of our report. Presented recommendations are general and suitable for planning purposes. Contact Eustis Engineering for additional information if your project plans include excavations.

37. OSHA Soil Classification. In accordance with OSHA Standard No. 1926, Subpart P, Appendix A, the subsoils encountered to the approximate 20-ft depth may be classified as Type C soils. This classification should be used to ensure all excavations and trenching operations comply with OSHA requirements.

38. Bracing. All excavations more than 4 feet deep should be sheeted and adequately braced or opencut with a slope. Sheeting may be wood or steel. Strut loads, sheeting material properties, and sheeting penetration will depend on the excavation depth, excavation width, excavation duration, construction techniques, and bracing system. All sheeting and strut requirements should be designed by a civil engineer licensed in the State of Louisiana.

39. Opencuts. Assuming excavations are no deeper than 10 feet, the maximum recommended opencut slopes for long-term conditions are 1 vertical to 3 horizontal (1V:3H). For short-term conditions, we recommend a slope no steeper than 1V:2H. Excavations deeper than 10 feet should be evaluated for opencuts on an individual basis or supported by sheetpiles. Proximity to existing structures should be considered when evaluating opencuts.

40. Dewatering. Near-surface foundation soils are primarily poorly graded sands and silty sands underlain by clay. For shallow excavations (less than 5 feet in depth), the use of sumps and pumps should be adequate to dewater the excavation. If well points are required to maintain a dry excavation, Eustis Engineering should be notified to determine if drawdown of the groundwater table from well points will adversely affect surrounding structures. Note, maintaining a dry excavation for an extended period of time by using sumps and pumps or well points may result in subsidence of adjacent areas; therefore,

the contractor's plan should minimize the period of time when an excavation must be maintained in a dry condition. The magnitude of settlement due to prolonged pumping cannot be estimated without information regarding the pumping duration, excavation configurations, and foundation types of surrounding structures.

41. Working Surface. If a working surface is required in excavations, Eustis Engineering recommends at least 12 inches of granular fill or bedding material be placed at the bottom of the excavation. Furthermore, we recommend a geotextile fabric be placed in the bottom of the excavation to provide material separation between the bedding fill and natural subsoils. The geotextile fabric should meet the material and physical property requirements shown in Section 1019.01 of the LSSRB for Class C geotextile fabrics. As an alternative, a sealant slab may be provided at the base of prepared excavations in lieu of a geotextile. Flowable fill, if used for a sealant slab, should meet the material and placement requirements given in Section 710 of the LSSRB. Prior to placement of the geotextile fabric or flowable fill, the bottom of the excavation should be cleared of water, muck, and debris. In addition, construction sequencing for excavations should consider pile installation where applicable.

42. Excavation Effects on Settlement. Excavation and dewatering operations may result in settlement of adjacent structures. The amount of settlement depends on the depth and width of excavation, duration of excavation, and dewatering used to control seepage. If critical to adjacent structures, Eustis Engineering should be notified for further evaluation of specific excavation requirements.

Lateral Earthen Pressures

43. General. No specific earthen retaining structures or buried structures were included in the furnished plans. Therefore, we provide general recommendations for lateral earthen pressure parameters.

44. At-Rest Pressures. Lateral pressures on retaining structures should be determined using at-rest lateral earthen pressure coefficients. The lateral earthen pressure coefficients for various materials are listed in Table 2.

TABLE 2: RECOMMENDED VALUES FOR LATERAL EARTHEN PRESSURE COEFFICIENTS

MATERIAL	AT-REST LATERAL EARTHEN PRESSURE COEFFICIENT (K_O)
Class I Granular Structural Fill	0.55
In-Situ Clay Soils and Compacted Clay Backfill	1.00

45. Active and Passive Pressures. Methodology to determine active and passive pressures for compacted clays and granular backfill is described below. Suggested values for undrained shear strength (cohesion) and effective unit weights are shown in **Error! Reference source not found.**. Effective unit weight is the total unit weight minus the water unit weight (62.4 pcf).

$$P_A = \gamma' H K_A - 2S_U \sqrt{K_A}$$

$$P_P = \gamma' H K_P + 2S_U \sqrt{K_P}$$

Where:

P_A = Active pressure in psf

P_P = Passive pressure in psf

S_U = Undrained shear strength or cohesion

γ' = Effective unit weight

K_A = Active pressure coefficient

K_P = Passive pressure coefficient

H = Depth in feet

TABLE 3: DESIGN INPUTS FOR COMPUTING LATERAL EARTHEN PRESSURES

MATERIAL	c = UNDRAINED SHEAR STRENGTH IN PSF		γ = TOTAL UNIT WEIGHT IN PCF	ACTIVE PRESSURE COEFFICIENT (K_A)		PASSIVE PRESSURE COEFFICIENT (K_P)	
	LONG TERM	SHORT TERM		LONG TERM	SHORT TERM	LONG TERM	SHORT TERM
Compacted Clay Fill	0	600	115 (52.6)[(1)]	0.44	1.00	2.28	1.00
Structural Sand Fill	0	0	120 (57.6)[(1)]	0.36	0.36	2.77	2.77

(1) Recommended effective unit weight in pcf.

Fill Settlement

46. Less than 1 foot of additional fill is anticipated to be required to raise the site above existing grade to construction grade. Generally, less than 1 foot of fill will not appreciably affect consolidation of the underlying subsoils above and beyond settlements caused by the foundation loads of the structure. Should more than 1 foot of site grading fill be added to the site above existing grade, Eustis Engineering should be notified immediately to review our recommendations and revise as necessary.

Areal Subsidence

47. The project area is being affected by ongoing areal subsidence that is the result of past filling, drawdown of groundwater levels due to drainage improvements, and biodegradation of near-surface organic soils subsequent to groundwater drawdown. The amount of future subsidence cannot be reliably estimated from information developed for our report. Subsidence is generally observed to be a relatively uniform ground surface settlement over large areas. However, ongoing areal subsidence can result in differential settlement of grade-supported structures. Additional settlement of pile-founded structures may also be observed. Areal subsidence can also result in differential settlement magnitudes between grade-supported and pile-supported structures that are larger than what would be estimated by consolidation settlement theory.

Footing Foundations

48. Depth of Footings. We recommend continuous strip footings and isolated square footing foundations be placed to bear at least 2 feet below the existing grade on firm undisturbed soil or compacted structural fill. A shallow groundwater table was observed to be as shallow as 1 foot below existing grade. Precautions should be exercised so excavations for footings do not become wet prior to pouring concrete. Foundations should be poured immediately after the completion of the excavations. All footing excavations should be carefully inspected by qualified personnel to verify footings will be placed to bear on firm undisturbed soils or compacted fill at the recommended depths, and that the excavation is in a dry condition prior to pouring concrete. Eustis

Engineering should be retained to observe the condition within footing excavations prior to concrete placement.

49. Allowable Soil Bearing Value. Analyses have been made to estimate the net allowable soil bearing values for continuous strip footing and isolated square footing foundations. Shallow continuous footing foundations, having maximum widths of 3 feet, and shallow isolated square footing foundations, having maximum widths of 5 feet, may be designed for a net allowable soil bearing value of 700 psf. This allowable soil bearing value contains an estimated factor of safety of 3.0 against a soil shear failure and assumes footing foundations are placed to bear on firm undisturbed soil or compacted structural fill. A 33% increase in allowable soil bearing capacity may be utilized when evaluating temporary loads as allowed by applicable codes and appropriate testing.

50. Estimated Settlement. Assuming a long-term dead load pressure intensity of 640 psf, estimates of settlement were made for continuous strip footing and isolated square footing foundations. We also assumed the groundwater table to be at the ground surface in our analyses. We estimated the settlement due to a sustained structural load of 640 psf or less for a continuous strip footing with a maximum width of 3 feet and an isolated square footing with a maximum side width of 5 feet will be on the order of ½ inch or less.

51. Our estimates of settlement assume the minimum center-to-center spacing between continuous strip footings is not less than three times the footing width, or twice the largest side dimension for spread footings. To decrease the potential of differential movements, concrete for footings should be placed integrally with grade beams. If any

of our assumptions are not met, Eustis Engineering should be notified to reevaluate potential settlement.

Deep Foundations

52. Estimates of Allowable Pile Load Capacity. Engineering analyses have been made to estimate allowable single pile load capacity in compression and tension for treated ASTM D25 quality timber piles and SPC piles for support of the proposed boat storage structure. We present our estimates of allowable single pile load capacity for timber and SPC piles in Figures 3 and 4, respectively. Our capacity estimates neglect capacity contribution within the top 2 feet below the existing ground surface for embedment of the piles within the pile caps, and assume vertical pile installation. Your selection of pile embedment should include consideration for installation requirements and settlement potential as discussed subsequently in this report. Actual pile lengths should be determined based on the finished grade elevation.

53. Factors of Safety. The allowable load capacity estimates we present contain an estimated factor of safety of 3.0 against failure of a single pile through the soil. The use of a factor of safety of 3.0 assumes static load testing will not be performed and existing, pertinent load test data are not available. If static load testing is performed or existing, pertinent static load data are available, the allowable capacity estimates presented on Figures 3 and 4 may be adjusted for a factor of safety of 2.0. A 33% increase in vertical compressive and tensile capacities may be utilized when evaluating temporary loads as allowed by applicable codes and appropriate testing. As an alternative, dynamic pile testing (DPT) may be performed in lieu of static load testing to confirm the estimates of load capacity for driven SPC piles. If only DPT is used in lieu of static load testing to

confirm pile capacity estimates, a factor of safety of at least 2.5 should be used for compressive capacities and a factor of safety of 3.0 should be used for tensile capacities.

54. Timber Piles. We recommend treatment of all timber piles meet current American Wood Preservers Association Standards as outlined in Section 1014 of the LSSRB for preservative and quality assurance. Treatment should also follow Section 812.06 where applicable. Furthermore, we recommend all timber piles meet quality requirements (clean peeled, straightness, etc.) as outlined in ASTM D25 and size requirements as outlined in Table X1.5 of ASTM D25 for minimum pile tips. Pile dimensions assumed for our capacity estimates are shown on Figure 3.

55. Square, Prestressed, Precast Concrete Piles. We recommend the precast concrete piles meet the requirements outlined in Sections 804 and 805 of the LSSRB. The pile dimensions assumed in our analyses for the SPC piles are shown on Figure 4. Precast concrete piles should be designed to have a strand prestress that is structurally sufficient to facilitate driving of the piles without damage. Our analyses are based on a solid, square pile. Alternative precast pile configurations (pipe, triangle, etc.) should be further evaluated.

56. Pile Weight. The allowable load capacity estimates presented in this report do not include the weight of the pile. When computing the resultant net compressive capacity of the pile, a net load of 35 pcf may be used for the weight of the concrete (weight of the concrete minus the weight of soil removed). The full buoyant weight of the concrete of 87 pcf may be used to estimate the tensile capacity of the pile provided they are designed to transmit these loads. Similar procedures may be used to evaluate the net capacity of steel and timber piles.

57. Structural Capacity. The estimates of allowable load capacity we present are based only on a soil-pile relationship. The structural capacity of the individual piles to transmit these loads, and any connections between the piles and the structure, should be determined by a structural engineer.

58. Batter Piles. The estimates of pile capacity provided on Figures 3 and 4 are for piles installed vertically and may be used to determine the estimates of load capacity for batter piles. The vertical component of a batter pile will be equal to the capacity for a vertical pile installed to the same tip elevation. From this relationship, geometry may be used to estimate the axial capacity and horizontal component of the batter piles. This geometric relationship is shown on Figure 5. We do not recommend that timber piles be installed on a batter.

59. Pile Group Capacity. The piles considered will derive a majority of their supporting capacity from skin friction; therefore, it is necessary to consider the effects of group action for these piles. In this regard, the supporting value of the friction piles installed in groups should be investigated on the basis of group perimeter shear by the formula shown on Figure 6. For group effects on tensile capacities, the second term of the equation should be neglected. This formula is with regard to vertical group effects. Lateral group effects should be evaluated by detailed soil/structure interaction analyses.

60. Pile Spacing. The minimum center-to-center pile spacing within a pile group or row of piles should be established in accordance with the pile spacing formula shown on Figure 6. This spacing generally only considers the spacing required to achieve the estimates of vertical capacity and avoid interference during construction. The spacing required to minimize lateral group effects may be greater than those values. The

minimum spacing between rows or groups of piles should also meet the requirements discussed in the following paragraphs with respect to settlement.

61. Estimated Settlement Due to Structural Loads. We estimate single piles installed to a minimum tip embedment of 30 feet below the existing ground surface will settle ¼ inch or less due to sustained structural loads. These estimates do not include elastic deformation of the piles which should be added to the settlement estimate. Elastic deformation of the piles presented in this report may be estimated as 67% to 75% of the static column strain of a pile acting as a column. Eustis Engineering should be contacted to verify this settlement once structure loadings, dimensions, and pile layouts are available.

62. Groups of piles may experience settlement in excess of that estimated for a single pile. Eustis Engineering should be consulted to evaluate the settlement of pile groups once the design is available. Settlement due to structural loads is also additive to settlement due to fill placement, if applicable.

63. Our estimates of settlement are based on the assumption that piles will be installed in small groups or widely spaced rows. We have assumed the largest group dimension will be no greater than 20% of the pile length, and the center-to-center spacing between groups will be no closer than twice the largest group dimension. We have also assumed the center-to-center spacing between rows of single piles will be no closer than 8 feet or nine pile diameters, whichever is greater. In the event any of our assumptions are not met, Eustis Engineering should be contacted to evaluate the potential settlement of pile foundations.

64. Differential Settlement and Utilities. Your design should recognize the potential for differential settlement between grade-supported and pile-supported features. We recommend flexible-type connections be specified for all piping and utilities going to and from all pile-supported structures, new or existing, and any grade-supported structures, new or existing.

Installation of Driven Piles

65. Quality Control. Close field supervision should be maintained by experienced personnel to ensure proper procedures are followed and accurate records are kept for all pile driving operations. The driving record should include, as a minimum, the date, pile type, overall length, pile size (tip and butt diameter), embedment below finished grade, depth and diameter of predrill, hammer type, stroke height, and number of blows per foot of penetration for the full pile embedment. An accurate driving record is especially important to verify the piles are installed to the required tip embedment and to give an indication of any unusual driving characteristics which may indicate pile breakage. We recommend Eustis Engineering be retained to observe, record, and evaluate all pile driving operations with respect to the recommendations presented in this report.

66. Air Hammers. Small, treated ASTM D25 quality timber piles, having minimum tip diameters of 6 inches and minimum butt diameters of at least 8 inches, may be driven with a single-acting air or drop hammer having a rated energy of 7,500 ft-lbs per blow. For these piles, the ram weight should not exceed 2,500 pounds and the maximum stroke or drop should be limited to 3 feet. Larger treated ASTM D25 quality timber piles, having minimum tip diameters of 7 inches and minimum butt diameters of at least 12 inches, may be driven with a single-acting air hammer having a manufacturer's rated energy of

15,000 ft-lbs per blow. For these piles, the ram weight should not exceed 5,000 pounds and the maximum stroke should be limited to 3 feet. Generally, we recommend a single-acting air hammer be used to install precast concrete piles. The manufacturer's rated energy required to drive the piles will depend on the piles' allowable compressive capacity. The estimated hammer energy versus allowable compressive capacity (factor of safety ≈ 3.0) for SPC piles recommended in this report is provided in Table 4. For SPC piles, we also recommend the ram stroke be limited to 3 feet, and the ram weight be approximately one-half of the pile weight. A variable stroke hammer may be appropriate for the SPC piles and should be assessed through dynamic analyses and testing as outlined below.

TABLE 4: RECOMMENDED PILE HAMMER DRIVING ENERGY (SINGLE-ACTING AIR HAMMER)

ESTIMATES OF ALLOWABLE SINGLE PILE LOAD COMPRESSIVE CAPACITY IN TONS FACTOR OF SAFETY ≈ 3.0	APPROXIMATE RATED SINGLE-ACTING HAMMER ENERGY IN FT-LBS PER BLOW
Up to 40	19,500

67. Hydraulic or Diesel Hammer. In lieu of an air hammer, a diesel or hydraulic hammer may be used for the installation of concrete piles. We recommend a diesel hammer have a rated energy of one and one-half times the energy recommended for a comparable installation with a single-acting air hammer. Hydraulic hammers should be selected based on adjusted efficiency to produce similar energy as a corresponding air hammer. As noted previously, a variable energy hammer may be appropriate to control driving stresses and should be assessed through dynamic analyses and testing. This testing will reduce the risk of overstressing the piles which can occur during soft driving (i.e., excessive tensile stresses can develop when concrete piles advance rapidly through soft

soils, particularly when driven by a diesel hammer). Other impact hammer types may also be suitable for pile impact installation. We do not recommend a diesel hammer be used for installation of timber piles.

68. Pile Refusal. Refusal criteria for the timber piles may be taken as 25 blows per foot with the recommended hammer driving energies to minimize damage to these piles. Refusal criteria for the SPC piles should be estimated based on the results of a test pile program or dynamic testing and analyses. If the piles are driven with the aid of a follower, or if the pile driving helmet is allowed to impact the ground surface, Eustis Engineering should be consulted to adjust these refusal criteria. Wave Equation Analysis of Piles (WEAP) should be performed to verify the ability of the hammer to successfully install the proposed pile to the tip embedment depth.

69. Alternate Installation Methods. We do not recommend vibratory methods be utilized for pile installation. If a vibratory hammer is selected for the project, Eustis Engineering should be contacted to evaluate the reduction in the estimates of allowable pile load capacity presented. Also, we do not recommend the use of jetting to aid in the installation of the piles. Eustis Engineering should be consulted if these measures are allowed as this will also reduce the estimates of capacity presented. If any other alternative installation methods are selected, Eustis Engineering should be contacted to evaluate the effects on our estimates of capacity presented.

70. Predrilling. Shallow predrilling may be used to reduce vibrations for timber piles. Such predrilling should be to a depth of 10 feet with a bit no larger than 9 inches in diameter. Deeper predrilling may be required to assist the driving of SPC piles. This predrilling has the potential of minimizing vibrations resulting from pile driving operations and to reduce

the potential damage to piles. The predrill bit should be no larger than the butt diameter for timber piles and 75% of the side dimension of SPC piles. Predrilling should extend no deeper than 10 feet above the final tip elevation of the piles. The use of a predrill should be evaluated and determined, if necessary, during the test pile program.

71. Dynamic Analyses. The SPC piles should be designed by a structural engineer to have a cross-section which is structurally sufficient to facilitate handling and driving of the piles without damage. Dynamic analyses, or WEAP, can be performed to evaluate driving stresses, pile cushion, and driveability once the hammer and appurtenant equipment have been selected. WEAP is particularly important if a diesel hammer is proposed for installation of SPC piles for the project. As noted, a variable energy hammer may be necessary to control driving stresses during the installation of SPC piles and should be assessed through WEAP driveability analyses. Structural requirements can then be verified by a structural engineer and installation criteria can be established.

72. Pile Installation Sequence. Timber piles and SPC piles are considered displacement piles because soil is displaced laterally when the piles are driven into the subsurface. These piles could cause adjacent piles to refuse at shallower depths or, more likely, could result in heaving of piles that were previously installed. For these reasons, we recommend pile driving take place from the center of large foundations working outward.

Test Pile Program and Load Tests

73. Eustis Engineering considers a test pile program and load test as an extension of our geotechnical exploration; therefore, Eustis Engineering should be retained to perform these services. We recommend a probe pile be installed to assess the anticipated

driving resistance, vibrations from pile driving, and requirements for predrilling. The probe pile should be the same type and embedment anticipated for the job piles and installed with the same equipment and techniques proposed for the job piles. The probe pile may be installed at a job pile location.

74. If the basis of design will be a factor of safety of 2.0 and existing, pertinent static load test data are not available, a static load test must be performed. Eustis Engineering should evaluate existing load test data to determine relevance for the subject project. The test pile should be allowed to set for at least 14 days subsequent to the installation of the reaction system. The pile should then be load tested to failure in accordance with ASTM D1143, assuming the governing load case is the compressive capacity. The results should be evaluated by Eustis Engineering to verify the pile load capacity estimates presented in this report.

Dynamic Pile Testing. The initial installation of driven SPC probe piles and job piles may be monitored and evaluated using dynamic pile testing with a Pile Driving Analyzer® (PDA). The performance of DPT may be used to evaluate actual driving stresses, penetration of resistance, and integrity and capacity of the test piles and/or job piles. The PDA can also monitor energy transferred to the pile from the hammer and evaluate installation efficiency. To evaluate pile capacity, "restrike" DPT should be performed at least 14 days after its initial installation of friction piles. Shorter set times may be considered but the ultimate capacity of the pile may not be realized. In addition, an increased hammer energy may be required for restrike DPT to fully mobilize the pile. Data from this restrike should be further evaluated by CAPWAP® analyses to provide signal matching verification. Eustis Engineering is available to perform and evaluate the results of DPT and CAPWAP analyses. If a PDA is used as the sole means to evaluate

capacity, the factor of safety to establish estimates of allowable capacity should be reduced from 3.0 to 2.5, and the capacity estimates shown in Figure 4 adjusted accordingly.

Pavements

75. Method of Analysis. The pavement components and thicknesses for flexible pavement were estimated using methods presented in the AASHTO Guide for Design of Pavement Structures. Traffic data were converted to equivalent 18-kip single axle loads (E_{18}) using AASHTO equivalency factors for flexible pavements.

76. Design Assumptions. The resilient soil modulus (M_r) of the subgrade was estimated for pavements bearing on existing natural subgrade assuming probable drainage conditions and engineering experience. A 20-year design life and a terminal serviceability index (P_t) of 2.0 were used for the analyses of rigid and flexible pavements.

77. Traffic. Traffic information was not furnished for our review. We have assumed the parking area will experience primarily passenger vehicles comprising 25 passenger trucks, one large trailer, and one large flatbed per week. In addition, we have assumed drive aisles and parking area entrances/exits will experience twice this vehicular traffic in addition to two waste disposal trucks per week. Assumed axle loads used in our analyses are provided in Table 5.

TABLE 5: ASSUMED AXLE LOADS

VEHICLE TYPE	ESTIMATED FRONT AXLE LOAD IN KIPS	ESTIMATED REAR AXLE LOAD IN KIPS
Pickup Trucks, Vans, and SUVs	2(S)	5(S)
Waste Disposal Trucks	12(S)	34(T)
Truck and Boat Trailer or Flatbed Truck	12(S) 20(S)*	34(S)

S = Single axle, T = Tandem axles
*Middle axle

78. A California Bearing Ratio (CBR) of 1.5 was used in our analyses for the existing subgrade. All pavement recommendations presented subsequently may be utilized across the site unless weaker soils are encountered away from the available exploratory locations during site preparation. In this event, our pavement recommendations may need to be revised, or ground improvement may be required to provide subgrade support.

79. Our assumed traffic intensities should be verified prior to implementation of design. If traffic conditions are different than those presented, Eustis Engineering should be contacted to reevaluate the pavement recommendations contained in this report.

80. Flexible Pavement. The results of the flexible pavement analyses are shown in Table 6.

TABLE 6: FLEXIBLE PAVEMENT REQUIREMENTS

PARKING LOTS AND DRIVE AISLES	ASPHALTIC SURFACE COURSE THICKNESS IN INCHES	AGGREGATE BASE COURSE THICKNESS IN INCHES	SAND SUBBASE THICKNESS IN INCHES
	3	6	12

81. Our analyses assume all paving materials will conform to the LSSRB for Mix Level 1 asphaltic surface courses and binder courses. The asphaltic surface course should

conform to Section 502 of the LSSRB. The material for the crushed stone base course should conform to the requirements of Section 1003.03.1 of the LSSRB. The stone base course should be placed and compacted in accordance with Section 302 of the LSSRB for a Class II base course. Sand subbase should follow the recommendations given in the "Structural Fill" section of this report for a Class I structural sand fill. Silty/clayey sand fill should not be used as a subbase. Structural fill used as a subbase should be compacted to at least 95% of its maximum dry density in accordance with ASTM D1557.

82. Grades should provide for adequate drainage to prevent saturation of the subgrade, subbase, and base course materials. Otherwise, subsurface drainage and/or edge drains should be provided. The flexible pavement service life will be reduced if the subgrade remains saturated. If the type and thickness of flexible pavement components are changed, Eustis Engineering should be consulted to determine the suitability of these materials and the structural number of the flexible pavement.

83. Geotextile Fabric. After the subgrade has been prepared as recommended, a geotextile ground stabilization fabric should be provided for material separation between the prepared subgrade and pavement subbase. The geotextile fabric should meet or exceed material requirements contained in Section 1019 of the LSSRB for Class C geotextiles. Subsequent to clearing and stripping, the fabric should be placed directly on the undisturbed soils in accordance with the manufacturer's construction recommendations.

84. Quality Control. Density tests should be performed every 100 linear feet on each lift of the compacted crushed stone fill or sand subbase to determine if the contractor has achieved the recommended density. Clearing, filling, and compaction operations should only be accomplished during periods of dry weather. Wheeled equipment should not

be allowed on the subgrade once proofrolling operations are complete and the inspector has accepted the compacted subgrade.

Vibrations

85. General. Pile driving, hauling of fill materials, and other construction operations will cause vibrations that may affect nearby structures, pavements, and underground utilities. Damage due to construction vibrations is also associated with movements of equipment, particularly heavy trucks and cranes. Vibrations associated with vehicular construction traffic are dependent on the size and speed of individual vehicles as well as frequency.

86. Measurement. If vibrations are a concern, we recommend peak particle velocities due to construction operations be monitored at critical structures or pavements with a seismograph during all construction operations that have a potential to cause vibrations. The seismograph should be capable of recording the three orthogonal components of particle velocity as well as the vector sum of these components. The record of peak particle velocities will provide information in assessing potential damage and the types of changes best suited to the project requirements.

87. Generally, peak particle velocities of 1.50 to 2.00 in./sec are considered to be threshold levels for structural damage. Low peak particle velocity levels can also be a problem for poorly constructed buildings or structures that have been previously stressed by settlement or other movements. In such cases, vibrations on the order of 0.50 in./sec can initiate cosmetic damage or further cosmetic damage that has already taken place in the structure. Peak particle velocities between 0.25 and 0.50 in./sec may be sensed as being detrimental by human perception. In addition, peak particle velocities of

0.25 in./sec may densify cohesionless or semi-cohesive deposits (such as fill materials) and result in settlement of structures founded in these materials. Considering the potential for cosmetic damage and the adverse perception to human response, we recommend a level of 0.50 in./sec be set as a construction tolerance for transient construction activities (events less than 1 to 2 seconds). This level is generally achievable with current construction methods; however, if sustained peak particle velocities exceed 0.25 in./sec at a pavement, utility, or structure of concern, construction activities generating these vibrations should be suspended, Eustis Engineering notified, and consideration given to altering construction procedures.

88. Mitigation Techniques. Mitigation techniques to dampen the effects of vibrations on structures are generally associated with decreasing the energy exciting vibrations through the soil. For construction traffic, tight speed controls can greatly reduce the vibrations imparted to adjacent structures.

GEOTECHNICAL SERVICES DURING CONSTRUCTION

89. To provide continuity among the exploration, design, and construction phases, Eustis Engineering should be retained to provide additional geotechnical engineering services. These services may include consultation during design and construction, testing and approval of proposed fill materials, witnessing of proofrolling, concrete testing and inspection, vibration monitoring, and other soils materials testing services. We can also log the installation of probe piles, test piles, and job piles, and perform and evaluate static pile testing. Eustis Engineering offers a complete range of construction materials testing services which will provide quality control during construction and conformance to design specifications.

90. In summary, Eustis Engineering should be retained to monitor all geotechnical-related work performed by the contractor. If construction problems arise, Eustis Engineering should be notified to participate in the development of solutions. This participation permits the geotechnical engineer to evaluate the effects of unanticipated conditions and propose solutions on the geotechnical design assumptions particular to the project. The design geotechnical engineer may also be able to judge how site-specific soil and groundwater conditions will affect the success of the proposed construction.

LIMITATIONS

91. Eustis Engineering has striven to provide engineering services in accordance with generally accepted geotechnical engineering practices in this locality at this time. No warranty or guarantee is expressed or implied.

92. This report has been prepared for the exclusive use of CROFT for specific application to the subject site. In the event of any changes in the nature, design, or location of the proposed construction, the conclusions and recommendations contained in this report shall not be considered valid unless the changes are reviewed, and the conclusions of this report are modified and verified in writing by Eustis Engineering. Should these data be used by anyone other than CROFT, the user should contact Eustis Engineering for interpretation of data and to secure any other information pertinent to this project.

93. The analyses and recommendations contained in this report are based on data obtained from the soil borings performed for the project by Eustis Engineering. The boring logs are considered representative of subsurface conditions at the boring locations on the dates completed. No warranty is given that the boring logs are representative of

subsurface or groundwater conditions at other locations or times. The nature and extent of variations in subsurface or groundwater conditions, between and away from the boring locations, may not become evident until construction. If such variations then appear, it will be necessary to reevaluate the recommendations contained in this report.

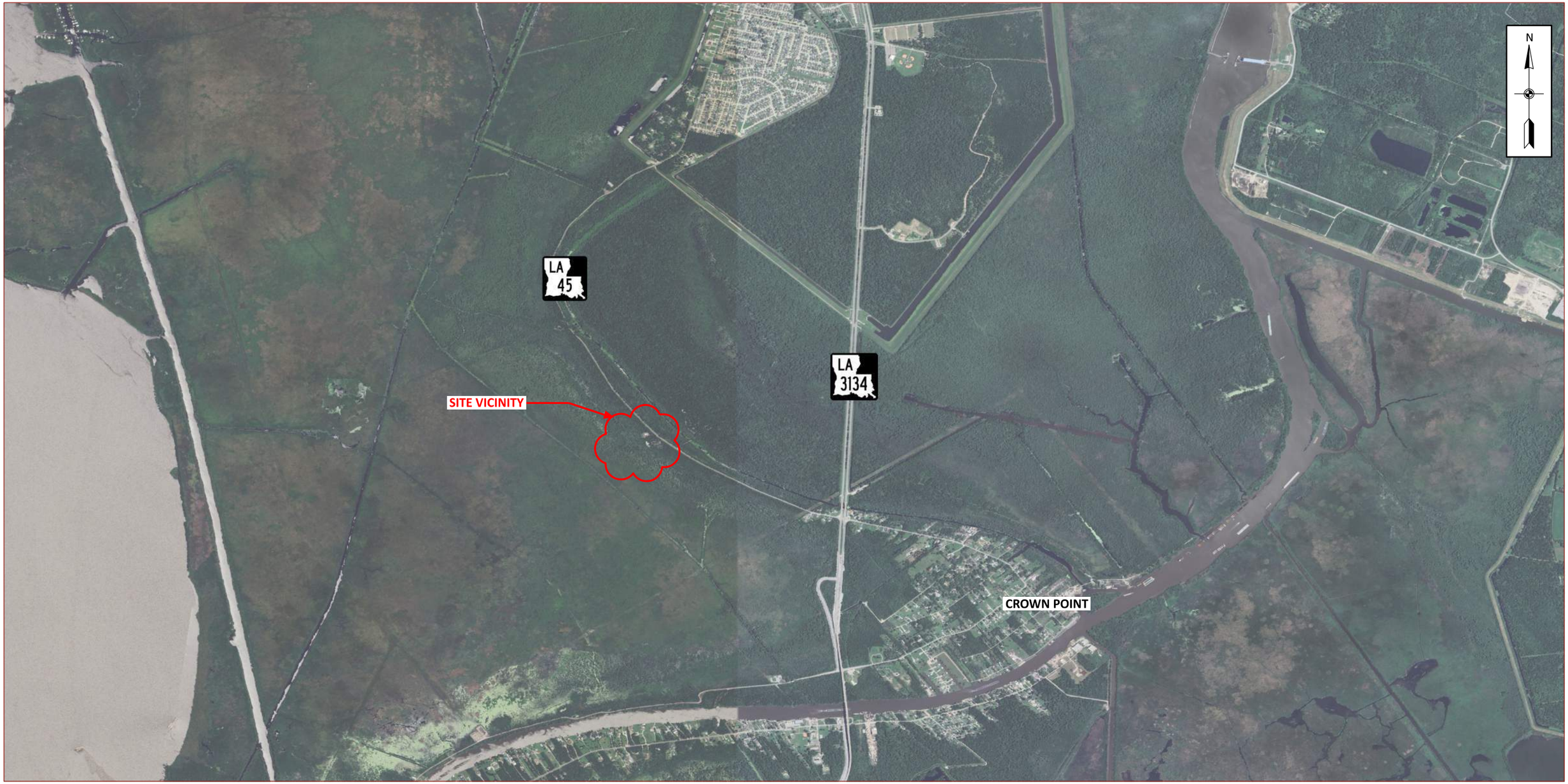
94. Recommendations and conclusions contained in this report are to some degree subjective, having partial basis in engineering judgment and experience particular to the design engineer. For this reason, this report should not be included in the contract plans and specifications; however, the results of the borings and laboratory tests contained in Appendix I of this report may be included in the plans and specifications. The construction contractor will then be obliged to make an independent interpretation of subsoil conditions at the site and their potential impact on means and methods used to achieve the plans and specifications.

95. This report is issued with the understanding the owner or owner's representative has the responsibility to bring the information and recommendations contained herein to the attention of the architect and engineers for the project, so they are incorporated into the plans and specifications for the project. The owner or owner's representative also has the responsibility to take the necessary steps to see that the general contractor and all subcontractors follow such recommendations. The owner or owner's representative is responsible for submittal of this report to the appropriate governing agencies.

96. The plans and specifications for the project should be provided to Eustis Engineering for a general review. This is to ensure the intent of this report is incorporated into the plans and specifications. If Eustis Engineering is not accorded the privilege of making this

recommended review, we can assume no responsibility for misinterpretation of our recommendations.

97. The scope of our service does not include an environmental assessment or an investigation for the presence or absence of wetlands and hazardous or toxic materials in the soil; surface water; groundwater; or air on, below, or adjacent to the subject property. Furthermore, the scope does not include the investigation or detection of biological pollutants at the site. The term “biological pollutants” includes, but is not limited to, molds, fungi, spores, bacteria, viruses, and the byproducts of any such biological organisms.



SATELLITE IMAGERY DATED: 1 JULY 2024

NOT TO SCALE

VICINITY PLAN

NATIONAL PARK SERVICE
JEAN LAFITTE NATIONAL HISTORIC PARK AND PRESERVE
JONES POINT BOAT STORAGE AND PARKING
MARRERO, LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

DRAWN BY: A.C.C.	JOB NO.: 25290
CHECKED BY: P.T.D.	DATE: 16 JUL 2024
CADD FILE: VICINITY PLAN.DGN	FIGURE 1



SATELLITE IMAGERY DATED: 1 JULY 2024

NOT TO SCALE

◓ DENOTES LOCATIONS OF UNDISTURBED AND AUGER SOIL BORINGS DRILLED BETWEEN 10 AND 12 JULY 2024.

BORING LOCATION PLAN

NATIONAL PARK SERVICE
JEAN LAFITTE NATIONAL HISTORIC PARK AND PRESERVE
JONES POINT BOAT STORAGE AND PARKING
MARRERO, LOUISIANA

EUSTIS ENGINEERING L.L.C. SINCE 1946

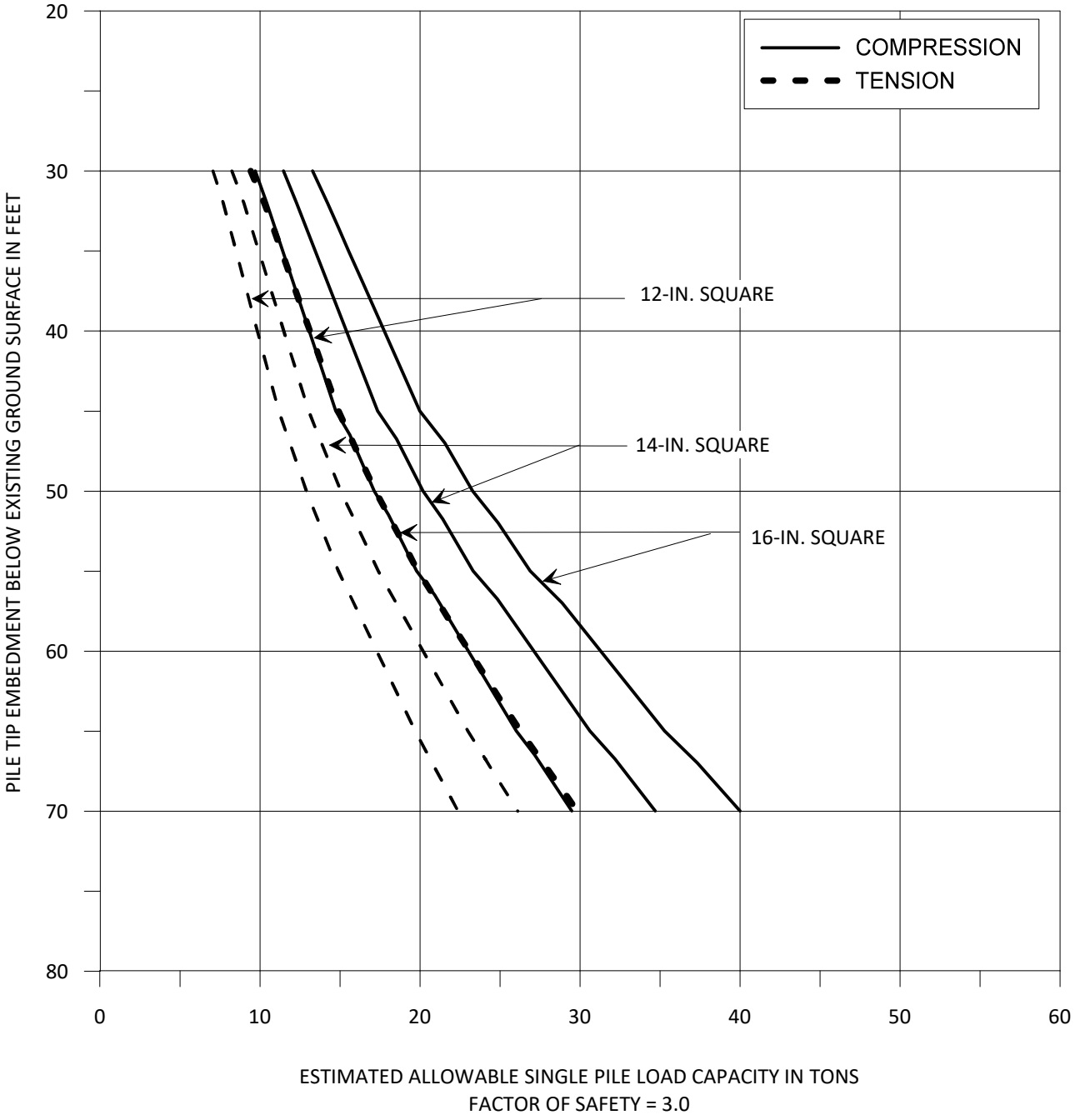
DRAWN BY: A.C.C.	JOB NO.: 25290
CHECKED BY: P.T.D.	DATE: 16 JUL 2024
CADD FILE: LOCATION PLAN.DGN	FIGURE 2

NATIONAL PARK SERVICE
JEAN LAFITTE NATIONAL HISTORIC PARK AND PRESERVE
JONES POINT BOAT STORAGE AND PARKING
CROWN POINT, LOUISIANA
EUSTIS ENGINEERING PROJECT NO. 25290

ESTIMATES OF ALLOWABLE SINGLE PILE LOAD CAPACITY
TREATED ASTM D25 QUALITY TIMBER PILES

PILE TYPE AND SIZE	PILE TIP EMBEDMENT BELOW EXISTING GROUND SURFACE IN FEET[1]	ESTIMATES OF ALLOWABLE SINGLE PILE LOAD CAPACITY IN TONS[2][3] FACTOR OF SAFETY ≈ 3.0[4]	
		COMPRESSION	TENSION
6-In. Tip 8-In. Butt	30 35 40	4 4 ½ 5 ½	2 ½ 3 3 ½
8-In. Tip 12-In. Butt	30 35	5 ½ 7	3 ½ 4 ½
7-In. Tip 12-In. Butt	40 45 50	7 ½ 8 ½ 10	5 5 ½ 6 ½

[1] Selection of pile tip embedment should also consider settlement potential. Actual pile lengths should be selected based on final grade.
[2] These estimates of capacity do not include limitations on structural capacity as imposed by some building codes.
[3] Piles assumed to be installed by impact driving equipment without assistance from vibratory equipment.
[4] Use of a factor of safety of 3.0 assumes a static pile load test will not be performed.



NOTES:

1. ALLOWABLE PILE LOAD CAPACITIES PRESENTED ON THIS FIGURE DO NOT INCLUDE THE WEIGHT OF THE PILES.
2. PILES ASSUMED TO BE INSTALLED BY IMPACT DRIVING EQUIPMENT WITHOUT ASSISTANCE FROM JETTING OR VIBRATORY EQUIPMENT.
3. USE OF A FACTOR OF SAFETY OF 3.0 ASSUMES A STATIC LOAD TEST WILL NOT BE PERFORMED.
4. ESTIMATES INCLUDE CAPACITY REDUCTION FOR A 2-FT CUTOFF AT THE PILE BUTT.

ESTIMATES OF ALLOWABLE PILE LOAD CAPACITY

SQUARE, PRECAST CONCRETE PILES

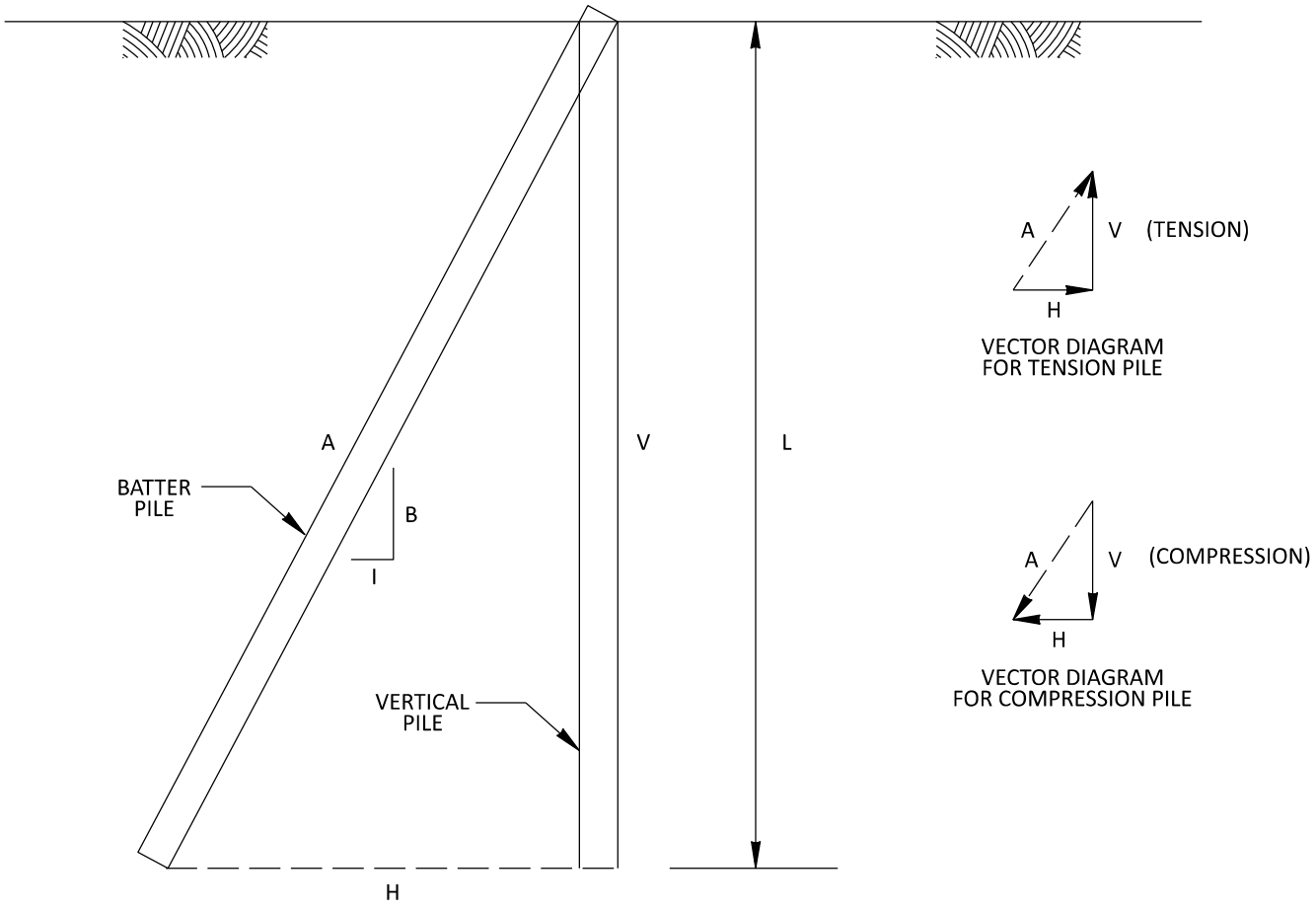
NATIONAL PARK SERVICE
JEAN LAFITTE NATIONAL HISTORIC PARK AND PRESERVE
JONES POINT BOAT STORAGE AND PARKING
MARRERO, LOUISIANA

EUSTIS ENGINEERING SINCE 1946

DRAWN BY: N.A.A.	JOB NO.: 25290
CHECKED BY: J.M.W.	DATE: 13 AUG 2024
FILE NAME: SPC APLC	FIGURE 4

EUSTIS ENGINEERING SINCE 1946

AXIAL AND HORIZONTAL RESISTANCE OF BATTER PILES ESTIMATED FROM ALLOWABLE VERTICAL LOAD CAPACITIES



L = VERTICAL COMPONENT OF BATTER PILE EMBEDMENT LENGTH.

V = ESTIMATED ALLOWABLE SINGLE LOAD CAPACITY OF A PILE DRIVEN VERTICALLY WITH EMBEDMENT LENGTH, L.

B = BATTER OF PILE EXPRESSED AS A RATIO OF VERTICAL DISTANCE TO ONE FOOT HORIZONTAL DISTANCE.

H = HORIZONTAL RESISTANCE OF BATTER PILE ESTIMATED AS FOLLOWS: $H = \frac{V}{B}$

A = ALLOWABLE AXIAL PILE LOAD CAPACITY OF A SINGLE BATTER PILE ESTIMATED AS FOLLOWS: $A = \sqrt{V^2(1+\frac{1}{B^2})}$

NOTE: THE AXIAL LOAD RESISTANCE OF A VERTICAL PILE, V, IS DEPENDENT ON THE TYPE OF LOADING - TENSION OR COMPRESSION. CAUTION SHOULD BE EXERCISED TO ENSURE THE CORRECT VERTICAL CAPACITY IS USED.

CAPACITY OF PILE GROUPS

The ***maximum allowable load carrying capacity*** of a pile group is no greater than the sum of the single pile load capacities, but may be limited to a ***lower*** value if so indicated by the result of the following formula.

$$Q_a = \frac{P\ x\ L\ x\ c}{(FSF)} + \frac{2.6\ q_u \left(1 + 0.2\ \frac{w}{b}\right) A}{(FSB)}$$

In Which:

Q_a	=	Allowable load carrying capacity of pile group, pounds
P	=	Perimeter distance of pile group, feet
L	=	Length of pile, feet
c	=	Average (weighted) cohesion or shear strength of material between surface and depth of pile tip, psf
q_u	=	Average unconfined compressive strength of material in the zone immediately below the pile tips, psf (unconfined compressive strength = cohesion x 2)
w	=	Width of base of pile group, feet
b	=	length of base pile group, feet
A	=	base area of pile group, square feet
FSF	=	Factor of safety for the friction area ≈ 2
FSB	=	Factor of safety for the base area ≈ 3

The values of c and q_u used in this formula should be based on applicable data shown on the Log of Boring and Test Results for this report. In the application of this formula, the weight of the piles, pile caps and mats, considering the effect of buoyancy, should be included.

SPACING WITHIN PILE GROUPS

SPAC = 0.05 (L_1) + 0.025 (L_2) + 0.0125 (L_3)

In Which:

SPAC	=	center-to-center of piles, feet
L_1	=	Pile penetration up to 100 feet
L_2	=	Pile penetration between 101 to 200 feet
L_3	=	Pile penetration beyond 200 feet

Note: Minimum pile spacing = 3 feet, 3 pile diameters, or SPAC, whichever is greater

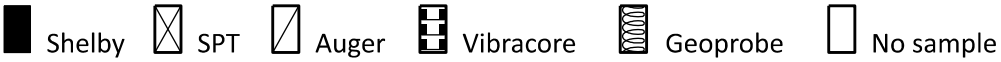
APPENDIX I

EUSTIS ENGINEERING SINCE 1946

LEGEND AND NOTES FOR LOG OF BORING AND TEST RESULTS

PP Pocket penetrometer: Resistance in tons per square foot

SPT Standard Penetration Test: Number of blows of a 140-lb hammer dropped 30 inches required to drive 2-in. O.D., 1.4-in. I.D. sampler a distance of 1 foot into the soil after first seating it 6 inches. Values shown have not been corrected.

SPLR Type of Sampling  Shelby, SPT, Auger, Vibracore, Geoprobe, No sample

SYMBOL Clay, Silt, Sand, Peat/Humus, Shells, Stone/Gravel



Predominant type shown heavy; modifying type shown light

USC Unified Soil Classification

DENSITY Unit weight in pounds per cubic foot

SHEAR TESTS

TYPE

- UC Unconfined compression shear
- OB Unconsolidated undrained triaxial compression shear on one specimen confined at the approximate overburden pressure
- UU Unconsolidated undrained triaxial compression shear
- ϕ Angle of internal friction in degrees
- c Cohesion in pounds per square foot

ATTERBERG LIMITS

- LL Liquid Limit
- PL Plastic Limit
- PI Plasticity Index

OTHER TESTS

- CON Consolidation
- -#200 Percent passing a U.S. No. 200 sieve
- SV Particle size distribution (sieve only)
- PD Particle size distribution (sieve and hydrometer)
- k Coefficient of permeability in centimeters per second
- SP Swelling pressure in pounds per square foot

Other laboratory test results reported on separate figures

GENERAL NOTES

(1) If a ground water depth is shown on the boring log, these observations were made at the time of drilling and were measured below the existing ground surface. These observations are shown on the boring logs. However, ground water levels may vary due to seasonal fluctuations and other factors. If important to construction, the depth to ground water should be determined by those persons responsible for construction immediately prior to beginning work.

(2) While the individual logs of borings are considered to be representative of subsurface conditions at their respective locations on the dates shown, it is not warranted that they are representative of subsurface conditions at other locations and times.

EUSTIS ENGINEERING SINCE 1946

LOG OF BORING AND TEST RESULTS

National Park Service
Jean Lafitte National Historic Park and Preserve
Jones Point Boat Storage and Parking
Marrero, Louisiana

Boring: B-1

Project No: 25290
Date: 07/10/2024
Latitude: 29.78454°
Longitude: -90.11566°

Water Depth: See Text
Total Depth: 100.0 ft

Scale in Feet	PP	SPT	S P L R	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	#200 Sieve (% Passing)	Other Tests
0					2" ASPHALT & 4" POORLY GRADED SAND W/SILT (base materials)		PB-1	0.17	8										
		15			Moist, medium dense tan fine SILTY SAND	SM	PB-2	0.5	15										
		5			Moist, medium stiff gray & tan LEAN CLAY	CL	PB-3	3.5	29						45	19	26		
5	0.50				w/trace of concretions		4	5	31	92	120	UC	--	595					
	0.25						5	8	32	91	120	OB	0	748	44	18	26		
10	0.50				Moist, medium stiff gray FAT CLAY w/trace of silt pockets	CH	6	11	42	80	113	UC	--	548					
	0.50						7	14	37	85	116	OB	0	600					
15	0.75				Moist, soft gray FAT CLAY	CH	8	18	45	73	106	UC	--	380					
20	0.75				Moist, medium stiff gray FAT CLAY	CH	9	23	44	77	111	OB	0	697					
25	0.75						10	28	67	61	101	UC	--	602	90	30	60		
30	0.75						11	33	68	59	100	OB	0	755					
35	0.75				w/few silt pockets		12	38	36	85	116	UC	--	523					
40	0.75						13	43	36	85	116	OB	0	508					
45	0.75						14	48	51	71	107	UC	--	663					
50																			

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NOTES:

EUSTIS ENGINEERING SINCE 1946

LOG OF BORING AND TEST RESULTS

National Park Service
Jean Lafitte National Historic Park and Preserve
Jones Point Boat Storage and Parking
Marrero, Louisiana

Boring: B-1

Project No: 25290
Date: 07/10/2024
Latitude: 29.78454°
Longitude: -90.11566°

Water Depth: See Text
Total Depth: 100.0 ft

Scale in Feet	PP	SPT	S P L R	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	#200 Sieve (% Passing)	Other Tests
50					Moist, medium stiff gray FAT CLAY	CH													
	0.75						15	53	49	72	108	UC	--	839					
55																			
	0.75				Moist, stiff gray FAT CLAY	CH	16	58	60	65	104	OB	0	1075					
60																			
	1.00						17	63	58	66	104	UC	--	1125					
65																			
	1.00				w/trace of silt pockets		18	68	57	67	105	UC	--	1027					
70																			
	1.00				w/trace of silt pockets & lenses		19	73	46	75	110	OB	0	1379					
75																			
	1.00						20	78	50	71	107	UC	--	1066					
80					Moist, very loose gray fine POORLY GRADED SAND	SP													
							21	84	30										
85					Moist, very loose gray fine SILTY SAND	SM													
							PB-22	89	30									26.2%	
90																			
	0.75				Moist, stiff gray FAT CLAY w/few silt pockets	CH	23	94	37	85	116	UC	--	1400					
95																			
	1.00						24	99	51	70	106	UC	--	1692					
100																			

EUSTIS_GINT_LIBRARY_6_5_2024.GLB EE BORROW BORING #200 25290.GPJ 8/20/24

NOTES:

LOG OF BORING AND TEST RESULTS

EUSTIS ENGINEERING SINCE 1946

National Park Service
Jean Lafitte National Historic Park and Preserve
Jones Point Boat Storage and Parking
Marrero, Louisiana

Boring: B-2

Project No: 25290
Date: 07/11/2024 - 07/12/2024
Latitude: 29.78466°
Longitude: -90.11544°
Water Depth: See Text
Total Depth: 70.0 ft

Scale in Feet	PP	SPT	S P L R	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	#200 Sieve (% Passing)	Other Tests
0		22			Moist, medium dense to loose tan fine POORLY GRADED SAND	SP	PB-1	0	3										
							PB-2	0.5	12										
		5			w/trace of clay		PB-3	3.5	20						NP	NP	NP		
5	0.75				Moist, medium stiff to soft gray & tan LEAN CLAY w/trace of concretions	CL	4	5	29	95	122	UC	--	624					
	0.50						5	8	32	91	120	OB	0	362					
10	0.75						6	11	34	87	116	OB	0	404					
	0.75				Moist, soft gray FAT CLAY w/trace of silt pockets	CH	7	14	37	85	116	UC	--	366					
15	1.00				Moist, medium stiff gray FAT CLAY w/trace of concretions	CH	8	19	46	72	105	OB	0	579					
20	1.00						9	24	40	82	114	UC	--	704					
25	1.00						10	29	41	80	113	OB	0	755					
30	0.75				Moist, soft to medium stiff gray FAT CLAY	CH	11	34	61	64	103	UC	--	464					
35	0.50						12	39	38	83	114	OB	0	583					
40	0.75				Moist, medium stiff gray FAT CLAY w/trace of silt pockets & lenses	CH	13	44	34	88	118	UC	--	607					
45	0.75						14	49	59						55	20	35		
50																			

EUSTIS_GINT_LIBRARY_6_5_2024.GLB EE BORROW BORING #200 25290.GPJ 8/20/24

NOTES:

EUSTIS ENGINEERING SINCE 1946

National Park Service
Jean Lafitte National Historic Park and Preserve
Jones Point Boat Storage and Parking
Marrero, Louisiana

LOG OF BORING AND TEST RESULTS

Boring: B-2

Project No: 25290
Date: 07/11/2024 - 07/12/2024
Latitude: 29.78466°
Longitude: -90.11544°
Water Depth: See Text
Total Depth: 70.0 ft

Scale in Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	#200 Sieve (% Passing)	Other Tests
50					Moist, medium stiff gray FAT CLAY w/trace of silt pockets & lenses	CH													
55	1.00						15	54	49	72	108	UC	--	763					
60	1.00						16	59	59	65	104	OB	0	900					
65	1.00						17	64	59	65	104	UC	--	916					
70	1.25				Moist, stiff gray FAT CLAY w/trace of silt pockets & lenses	CH	18	69	59	65	104	UC	--	1144					
75																			
80																			
85																			
90																			
95																			
100																			

EUSTIS_GINT_LIBRARY_6_5_2024.GLB EE BORROW BORING #200 25290.GPJ 8/20/24

NOTES:

EUSTIS ENGINEERING SINCE 1946

LOG OF BORING AND TEST RESULTS

National Park Service
Jean Lafitte National Historic Park and Preserve
Jones Point Boat Storage and Parking
Marrero, Louisiana

Boring: B-3

Project No: 25290
Date: 07/12/2024
Latitude: 29.78486°
Longitude: -90.11574°

Water Depth: See Text
Total Depth: 10.0 ft

Scale in Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	#200 Sieve (% Passing)	Other Tests
0					Moist, dark gray FAT CLAY w/few silt & organic matter	CH	PB-1	0	35										
							PB-2	0.5											
							PB-3	3											
5					Moist, gray & tan LEAN CLAY	CL	PB-4	5	30						27	17	10		
							PB-5	7											
10							PB-6	9	35										
15																			
20																			
25																			
30																			
35																			
40																			
45																			
50																			

EUSTIS_GINT_LIBRARY_6_5_2024.GLB EE BORROW BORING #200 25290.GPJ 8/20/24

NOTES:

EUSTIS ENGINEERING SINCE 1946

LOG OF BORING AND TEST RESULTS

National Park Service
Jean Lafitte National Historic Park and Preserve
Jones Point Boat Storage and Parking
Marrero, Louisiana

Boring: B-4

Project No: 25290
Date: 07/12/2024
Latitude: 29.78487°
Longitude: -90.11543°

Water Depth: See Text
Total Depth: 10.0 ft

Scale in Feet	PP	SPT	SPLR	Symbol	Visual Classification	USC	Sample Number	Depth in Feet	Water Content %	Density Dry pcf	Density Wet pcf	Shear Tests Type	Shear Tests ϕ	Shear Tests C psf	Atterberg Limits LL	Atterberg Limits PL	Atterberg Limits PI	#200 Sieve (% Passing)	Other Tests
0					Moist, brown FAT CLAY w/few silt pockets, trace of roots, & organic matter	CH	PB-1	0	31										
							PB-2	0.5											
					Moist, gray & tan LEAN CLAY	CL	PB-3	3	29						46	18	28		
5							PB-4	5											
							PB-5	6	33										
					Wet, gray & tan LEAN CLAY	CL	PB-6	9	36						33	17	16		
10																			
15																			
20																			
25																			
30																			
35																			
40																			
45																			
50																			

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NOTES:

APPENDIX II

BASE SCOPE OF WORK:
1. REN = ☐ "RENOVATE" INTERIOR SPACE TO ACCOMMODATE NEW CONFIGURATION OF SPACE. INCLUDES NEW WALLS, FLOORING, AND CEILING FINISHES. ALSO INCLUDES MECHANICAL, ELECTRICAL AND PLUMBING AS REQUIRED FOR COMPLETE RENOVATION OF SPACES.
2. ETR = "EXISTING TO REMAIN" (NO NEW WORK)

OPTIONS:
OPTION 3A - NOT USED.
OPTION 3B - NOT USED.
OPTION 3C - NEW STEEL PARKING STRUCTURE FOR BOATS - 12' X 140'
OPTION 3D - EXTEND NORTH SIDE OF PARKING LOT AND FENCING.
OPTION 3E - ELECTRICAL VEHICLE CHARGING STATIONS.
OPTION 3F - NOT USED.
OPTION 3G - REPAVE ENTIRE FM COMPOUND (16,000 SF)

RM STORAGE RELOCATED HERE - SEE **ALT 2C.**

INTERIOR RENOVATION - REFER TO VC (NEW ADMIN ALTERNATES)

INTERIOR RENOVATION - REFER TO VC (NEW ADMIN ALTERNATES)

VISITORS CENTER TRAIL HEAD

EXISTING 6' WIDE PATH - TO BE RE-LANDSCAPED

GEOTECH FOR NEW FOUNDATIONS FOR CANTILEVERED CANOPIES

EXISTING FIRE HYDRANT (COORDINATE WITH FIRE DEPT. / PROTECT WITH BOLLARD AS REQUIRED)

BOAT PARKING

BOAT PARKING

BOAT PARKING

BOAT PARKING

LUMBER STORAGE

MIXING AREA (10 X 10')

PESTICIDE STORAGE (6' X 8')

FUEL AND OIL STORAGE (10' X 10')

OPTION 3C - NEW STEEL PARKING STRUCTURE FOR BOATS - 12' X 132'

BASE SCOPE - REMOVE EXISTING STEEL HOIST BEAM FROM RIDGE BEAM (ALLOW BOAT PULL THROUGH)

EXISTING HOSE BIB

BAY 1 COVERED (ETR)

COVERED BOAT WORK BAYS (ETR)

EXISTING HOSE BIB

BAY 2 FOR WORK AREA (ETR)

BAY 1 TOOLS (ETR)

OVERHEAD COILING DOOR (ETR)

STRIPE 2 TEMPORARY GOVERNMENT PARKING SPACES

GEOTECH FOR NEW PAVED AREA

OPTION 3D - NEW RELOCATED FENCE AND EXPANDED ASPHALT PAVEMENT.

OPTION 3G - REPAVE ENTIRE FM COMPOUND (16,000 SF)

1 TRACTOR + MOWER

NEW FENCELINE TO BE PARALLEL WITH ROADWAY.

EXPAND PAVING TO BACKSIDE OF NEW FENCE LINE.

APPROXIMATE EDGE OF ROADWAY PAVEMENT

OPTION 3E - ELECTRICAL VEHICLE CHARGING STATIONS
GOVT EV PARKING SPACES:
TWO LEVEL 1 CAR CHARGERS
TWO LEVEL 2 CAR CHARGERS (CONFIRM LOCATION WITH JELA; PROVIDE ELECTRICAL POWER)

L2
L2
L1
L1

BASE SCOPE - AUTOMATIC GATE (ACCESS CONTROLLED). SOLAR POWERED WITH BATTERY BACKUP MOUNTED ON SKIDS FOR RESILIENCY.

VISITORS CENTER PARKING LOT

MOTOR COACH GUIDE

HIGHWAY 45

VISITOR CENTER (NEW ADMIN) SITE - SD PREFERRED ALTERNATIVE

04/15/2024