GEOTECHNICAL INVESTIGATION AND DESIGN REPORT

PROPOSED RESIDENTIAL DEVELOPMENT
HUNTINGTON BEACH, CALIFORNIA

Prepared for:

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Group Delta Project Number IR751
November 4, 2020

GROUP DELTA

November 5, 2020

Bonanni Development
5500 Bolsa Avenue, Suite 120
Huntington Beach, CA. 92649

Attention: Mr. Chris Segesman

Subject: Geotechnical Investigation and Design Report
Proposed Residential Development
Garfield and Main Street
Huntington Beach, California

Dear Mr. Segesman:

We are pleased to submit this geotechnical investigation and design report for the proposed residential development in Huntington Beach, California. This report and our associated geotechnical services were provided in general accordance with our proposal dated October 8, 2020. The proposed improvements will include construction of 2-story wood frame residential townhomes and associated improvements. No subterranean structures are planned for this development. Our findings indicate that the site is feasible for the proposed improvements provided the recommendations and guidelines presented in this report are implemented during project planning, design, and construction.

We appreciate the opportunity to assist you with the geotechnical aspects of the proposed development and look forward to our continued partnership during the construction phase of the project. If you have any questions, comments, or require additional information, please call us at (949) 450-2100.

Yours Sincerely,
Group Delta Consultants, Inc.

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1.0 INTRODUCTION

This report presents the results of our geotechnical investigation and design recommendations for the proposed residential development (Project) in Huntington Beach, California. Group Delta Consultants, Inc (Group Delta) geotechnical services were authorized by Bonanni Development (Bonanni) on October 8, 2020. The site is located at south west corner of Garfield Avenue and Main Street in the City of Huntington Beach, California (Site). The site encompasses the following APN numbers: 159-281-01 through 159-281-05. A vicinity map is shown in Figure 1.

1.1 Project Description

Based on the architectural site plan by WHA Architects dated September 11, 2020, the project consists on the construction of 2-story wooden frame residential townhomes with attached garages and associated at-grade parking areas, as shown in Figure 2. No subterranean structures are planned for this development. The Site has an approximate area of 1.8 acres and is currently occupied by a commercial business and unpaved parking lot. The architectural site plan also indicates the presence of three (3) abandon oil wells within the Site that are planned to be capped.

1.2 Scope of Work

The objective of this study was to provide site-specific geotechnical recommendations for grading and compaction requirements, foundation support, and associated surface improvements. The recommendations are based on review of existing data in the vicinity, our subsurface exploration, laboratory testing, engineering analyses, and previous experience with similar projects. This geotechnical investigation report includes the following:

- Review of relevant United States Geological Survey (USGS) and California Geological Survey (CGS) maps and reports;
- Perform a geotechnical field investigation to evaluate subsurface conditions, which includes drilling three (3) hollow-stem auger (HSA) borings; one (1) boring to a depth of 50 feet below ground surface (bgs) and two (2) borings to a depth of 20 feet bgs;
- Perform laboratory tests on selected soil samples to evaluate physical, engineering, and chemical (corrosion) properties of the onsite soils;
- Evaluate geologic and seismic hazards including local seismicity, surface fault rupture, ground shaking, liquefaction, and other considered geologic hazards;
- Evaluate seismic design parameters in accordance with the 2019 California Building Code;

- Evaluate geotechnical data and perform geotechnical analyses to provide recommendations for foundation type and design parameters (allowable bearing pressure, minimum size, and anticipated settlement);
- Provide recommendations on construction including excavation and backfill;
- Provide recommendations for pavement and underground utilities; and
- Prepare this geotechnical design report.

2.0 FIELD EXPLORATION AND LABORATORY TESTING

The subsurface conditions of the Site were investigated by Group Delta on October 26, 2020. Laboratory tests were conducted on selected soil samples obtained during our field exploration. A brief description of field investigation and laboratory testing is provided below.

2.1 Field Exploration

The limited field exploration consisted of drilling three (3) hollow stem auger borings (B-1 through B-3); one boring to a maximum depth of 51.5 feet bgs and two borings to a maximum depth of 21.5 feet bgs. Boring locations were cleared using Underground Service Alert (USA) prior to begin drilling. The approximate field exploration locations are shown in Figure 3. A detailed explanation of the field exploration including boring logs is presented in Appendix A.

2.2 Laboratory Testing

Laboratory testing was performed on selected soil samples obtained during the field exploration to help characterize the subsurface materials and to evaluate their index and engineering properties. The tests are identified on the boring logs in Appendix A. A detailed description of the laboratory testing program including test results is presented in Appendix B. The laboratory testing program consisted of the following:

- Soil classification
- Moisture content and dry density
- Atterberg limits
- Grain size analyses
- Expansion Index
- Soil Corrosivity
- R-Value

3.0 GEOLOGY, SITE AND SUBSURFACE CONDITIONS

3.1 Geology

The Site is located in the Peninsular Range Geomorphic Province which consists of northwest-southeast oriented complex blocks separated by similarly trending faults. Regional geology mapped by the USGS in the Santa Ana 30' X 60' Quadrangle indicates that the site is underlain by Pleistocene Old Paralic Deposits (Qop). The quaternary geologic map from the Newport Beach 7.5-Minute Quadrangle is presented in Figure 4 and has identified the same area as Late Pleistocene marine deposits (Qvom). The Qop and Qvom are identified as marine terrace deposits consisting of poorly sorted slits, clays, sand, and cobbles.

3.2 Surface Conditions

The 1.8-acre Site is located in a residential area, southwest corner of Garfield Avenue and Main Street intersection (Figure 1). The Site is bounded by existing residential areas to the north, west and southeast. Main Street runs diagonally along the southeastern portion and Holly Lane to the west. Two abandon oil wells exist in the northern region of the Site and one additional oil well at the southern region, for a total of three oil wells. The Site is currently occupied by an unpaved parking lot, which is used for vehicle storage. Additionally, a few small commercial warehouse-type buildings are located along the northwestern perimeter on Holly Lane. The site is relatively flat with an average elevation of about El. 66 feet to El. 68.5 feet above mean sea level (MSL). The surface drainage occurs with a gentle grade to the northeast.

3.3 Subsurface Soil Conditions

The field explorations performed at the site indicate the surface was covered in 3 inches of ¾-inches crush rock over 3 inches of aggregate base at the ground surface. Underlaying the top surface material, the native material mostly consisted of very stiff to hard sandy clays (CL) and silts (ML) in the upper 20 feet. Below 20 feet depth, soils are very stiff to hard sandy and silty clays (CL, CL-ML), very dense clayey sands (SC), silty sands (SM), and sands (SP-SM) to the maximum explored depth of 51.5 feet.

The corrected Standard Penetration Test (SPT) blow counts (N_{60}) ranged from 9 to 56 in the upper 20 feet and from 25 to more than 100 in the underlying materials. Moisture content of subsurface materials range from 3 to 17 percent and dry unit weight between approximately 92 and 122 pounds per cubic feet (pcf).

3.4 Groundwater

Groundwater was not encountered at any of our explorations to the maximum explored depth of 51.5 feet bgs. California Geological Survey (CGS, 1997) reported the historically highest groundwater table at 30 feet bgs for the Site (Figure 5). Groundwater may fluctuate seasonally and will be influenced by the water flow as well as variations in rainfall, pumping for irrigation, or site drainage conditions. Perched groundwater from surface sources is always a possibility at any site.

For engineering analyses, we assumed a design groundwater table of 30 feet bgs.

4.0 POTENTIAL SEISMIC AND GEOLOGIC HAZARDS

Potential seismic hazards during an earthquake include ground rupture, strong ground shaking, seismic slope instability, liquefaction and dynamic settlement, and earthquake induced flooding due to tsunamis or dam failures. Potential geologic hazards include landslides, erosion, subsidence, and poor soil conditions (compressible, collapsible or expansive soils). Each of the potential hazards is discussed below.

4.1 Earthquake Ground Motions

The Site is in a region with high seismic activity and there is a high potential for the Site to experience strong ground shaking from local and regional faults. The intensity of the ground shaking is highly dependent upon the distance of the Site to the earthquake source, the magnitude of the earthquake, and the underlaying soil conditions. A fault that is considered to be seismically active is one that has ruptured in the last approximate 11,700 years (Holocene). The location to the Site with respect to the regional faults is presented in Figure 6. A list of the active faults closest to the Site, along with their Fault Type, Maximum Magnitude (Mw) and Site-To-Source Rupture Distance (R_{rup}) is presented in Table 1.

Table 1. Significant Active Fault Near the Site

Fault	Fault Type	Maximum Magnitude M_W	Site-to-Source Distance R_{rup} (km)
Newport Inglewood (Connected alt 2)	Strike-Slip	7.2	0.62
Newport Inglewood (Connected alt 1)	Strike-Slip	7.2	0.76
Compton	Thrust	7.5	5.8
San Joaquin Hills	Thrust	7.0	6.1
Anaheim	Thrust	6.4	11.3
Palos Verdes Connected	Strike-Slip	7.4	17.4

The closest active fault is the Newport Inglewood (alt2 and alt1) located at about 0.6 kilometers (km) and 0.8 km (0.4 miles and 0.5 miles) southwest of the Site. The Newport-Inglewood fault is a right-lateral strike slip fault that extend for about 76 km (47 miles) from Culver City southeast to Newport Beach, where starts to extend southeast into the Pacific Ocean.

The proposed structures will be constructed in a highly active seismic zone, requiring the structural design of the buildings to be performed by experience structural engineers in accordance with the governing seismic codes.

4.2 Ground Rupture

The potential hazard for ground rupture is evaluated through consideration of distance to active earthquake faults. Active earthquake faults are faults which have evidence of surface rupture in the last approximate 11,700 years. The State of California provides the location of potential active faults and zone them under the Alquist-Priolo Act. The Project Site is not located within a State identified Earthquake Fault Zone of Required Investigation (CGS, 1977). The closest active fault is the Newport Inglewood Connected alt 2 fault located at about 0.6 km (0.4 miles) south of the site, as shown in Figure 6. Therefore, the potential hazard of ground surface rupture at the site is considered low.

4.3 Seismic Design Acceleration Parameters

Generic code-based seismic design parameters were obtained from the United States Geological Service (USGS) generic code-based seismic design maps webtool provided through the Office of Statewide Health Planning and Development (OSHPD) U.S. Seismic Design Maps website (https://seismicmaps.org/) available from the Structural Engineers Association of California (SEAOC). Table 2 provides the recommended seismic design parameters for the structures at the Site based on the available geotechnical information and on Section 1613 of the 2019 CBC.

An average shear wave velocity in the upper 30 meters of the subsurface soils ($V_{s,30}$) of approximately 268 meters per second (m/s) (880 feet per second, ft/s) was estimated using correlations to (SPT) blow counts. Therefore, Site Class D (CBC, 2019) corresponding to “Stiff Soil” profile was assigned to the site for seismic analysis.

Table 2. CBC 2019 / ASCE 7-16 Seismic Design Parameters

Design Parameters	General Seismic Design Parameter (ASCE 7-16 Section 11.4)
Site Latitude	33.686093
Site Longitude	-117.999151
S_s (g)	1.142
S_1 (g)	0.513
Site Class	D
F_a	1.000
F_v	1.787
T_S (sec)	0.769
T_L (sec)	8
S_{MS} (g)	1.191
S_{M1} (g)	0.916
S_{DS} (g)	0.794
S_{D1} (g)	0.611$^{(1)}$
PGA_M (g)	0.675

Notes
$^{(1)}$: If S_{D1} is used to obtain C_S with either equation 12.8-3 or 12.8-4 of ASCE 7-16, the value must be increased by a factor of 1.5. This may only be used for $T > 1.5\ T_S$.
$^{(2)}$ For $T \leq 1.5\ T_s$, S_{DS} should be used only to obtain Cs using Equation 12.8-2.

4.4 Liquefaction and Seismic Settlement

Liquefaction involves the sudden loss in strength of a saturated, cohesionless soil (sand and non-plastic silts) caused by the build-up of pore water pressure during cyclic loading, such as produced by an earthquake. This increase in pore water pressure can temporarily transform the soil into a fluid mass, resulting in vertical settlement and can also cause lateral ground deformations. The following three simultaneous conditions are required for liquefaction:

- Loose to medium dense cohesionless soils;
- Groundwater within 50 feet of the surface;
- Strong shaking, such as caused by an earthquake.

The Site is not located in a mapped liquefaction hazard zone on the California Seismic Hazard Zone Map for Newport Beach 7.5-minute Quadrangle (CGS, 1997) nor the City of Huntington Beach General Plan (Figure 7). The existing soils at the Site are generally very stiff to hard sandy clays and silts with no groundwater encountered to the maximum explored depth of approximately 51.5 feet bgs. Due to the presence of very stiff to hard clayey soils and the absence of groundwater table, it is our opinion that the potential for soil liquefaction at the Site is the event of strong ground shaking during an earthquake is very low.

4.5 Landslides and Lateral Spreads

The Site is not located within an area known for landslide hazard (CGS, 1997) and permanent cut slopes are not anticipated for the proposed improvements. The Site is relatively flat and lateral spreading is not a design concern.

4.6 Expansive Soils

A laboratory testing on one sample of the near surface materials had a measured Expansion Index (EI) value of 38 as shown in Figure B-3 of Appendix B. This indicates a low expansion potential (20<EI<50) based on American Society for Testing and Materials (ASTM) D4829 standard. Hence soil expansiveness is not a concern at the Site.

The clay soils encountered in the borings generally have a medium plasticity content. Atterberg limit testing was performed in three soils samples in the upper 20 feet of soil at the Site. The soils have plasticity indices between 13 and 18. Based on the limit testing performed for this study, the onsite soils above 20 feet are expected to have a low expansion potential.

4.7 Flooding, Seiches and Tsunamis

The Site is in a flood hazard zone X, area of minimal flood hazard, as established by the Federal Emergency Management Agency (FEMA). The Site is not located downstream of any large impounded bodies of water. Consequently, the potential for flooding due to seiches or dam failures is considered low.

The Site is not located within the tsunami inundation maps prepared by the State of California for the County of Orange (CGS, 2009). The Site is at an average elevation of about 65 feet and a distance of about 1 ½-mile away from the coastal region and therefore, the potential for hazard associated with tsunami impact is low.

5.0 KEY GEOTECHNICAL FINDINGS

The proposed development appears feasible from a geotechnical standpoint, provided that the recommendations presented in this report are implemented. A summary of key geotechnical considerations is provided below.

- The subsurface soils consist of very stiff to hard sandy clays (CL) and silts (ML) in the upper 20 feet. Below 20 feet depth, soils are very stiff to hard sandy and silty clays (CL, CL-ML), very dense clayey sands (SC), silty sands (SM), and sands (SP-SM) to the maximum explored depth of 51.5 feet.

- The Site is not located within an AP Earthquake Fault Zone (CGS, 1986). The closest distance to the known active fault is approximately 0.4 miles (0.6 km), and therefore, potential for subsurface rupture is low.

- Liquefaction and seismic settlement are not a design issue at the Site due to the presence of very stiff to hard clayey soils and absence of groundwater in the upper 50 feet bgs.

- The on-site near surface materials are generally clayey and silty soils. A laboratory testing on one sample of the near surface materials had a measured EI value of 38. This indicates a low expansion potential (20<EI<50) based on the ASTM D4829 standard.

- The on-site near surface materials are generally clayey and silty soils. A corrosion laboratory test on one sample of the near surface material clays had a measure resistivity of 824 Ohm-cm, sulfate content of 300 ppm and chloride content of 100 ppm. These values indicate low potential for sulfate and chloride attack on concrete. The resistivity result indicates a very high corrosion potential on metals. This should be considered in design of metal pipes. A corrosion consultant should provide appropriate design recommendations.

6.0 CONSTRUCTION RECOMMENDATIONS

This section of the report presents geotechnical recommendations regarding earthwork construction and design of the proposed improvements.

6.1 Plan Review

We recommend that the foundation and grading plans be reviewed by Group Delta prior to beginning of construction.

6.2 Excavation and Grading Observation

In general, foundation and grading excavations should be observed by Group Delta. During grading, Group Delta should continuously provide observation and testing services. Such observations are considered essential to identify field conditions that differ from those anticipated by this investigation, to adjust designs to the actual field conditions, and to evaluate that the grading is accomplished in accordance with our recommendations presented in this report.

6.3 Earthwork and Grading

Grading and earthwork should be conducted in general accordance with the applicable local grading ordinance and the requirements of the 2019 California Building Code. The following recommendations are provided regarding specific aspects of the proposed earthwork construction.

6.3.1 Site Preparation

6.3.1.1 Clearing and Grubbing

We understand that the existing office/commercial facility and crushed aggregate roadway for the parking lot will be demolished. The area that will be developed should be cleared and grubbed of all existing footings, other improvements, and vegetation in general accordance with Section 300-1 of the Standard Specifications for Public Works Construction [SSPWC] (Green Book, 2018).

Existing subsurface utilities that are to be abandoned should be removed and the excavations backfilled and compacted as described in Section 6.3.2. Alternatively, abandoned utilities may be grouted with a two-sack sand-cement slurry under the observation of Group Delta. After clearing and grubbing the site, remedial grading should be performed in the proposed development footprint and other general improvement areas as recommended in the following sections.

6.3.1.2 Remedial Grading

Near surface materials generally consist of very stiff to hard sandy clays and silts. These materials are considered potentially compressible and should be removed and recompacted as recommended in Section 6.3.2. Based on the Preliminary Grading Plan by WHA dated October 6, 2020, the proposed finish grade is at the existing grade at an approximate El 68 feet.

Based on the above considerations, a minimum depth of removal in the proposed townhomes development footprint area should be 3 feet below the existing grade or 2 feet below the bottom of footing, whichever is deeper. The remedial excavation areas should extend laterally at least 3 feet beyond the footing lines. Remedial grading to mitigate compressible soils in general areas (excluding building area) of surface improvements such as pavements, sidewalks and exterior flatwork should consist of excavating to a minimum of 2 feet below existing grade or 1-foot below the grading plane, whichever is deeper.

In general, the exposed subgrade at the bottom of overexcavation should be proof rolled with loaded heavy equipment under Group Delta observation to disclose any areas of deeper unsuitable soils. Areas of soft, loose, wet, pumping, or otherwise unsuitable soils should be further excavated or stabilized as recommended by Group Delta in the field. After proof-rolling the exposed subgrade should be scarified to a depth of 10 inches, brought to slightly above optimum moisture content, and compacted as described in Section 6.3.2. The excavation may then be backfilled from bottom of overexcavation to the planned finish subgrade with compacted fill. All backfill below footings and slabs should consist of “Very Low” expansion potential materials (EI<20).

6.3.2 Fill Compaction

All fill and backfill should be placed in horizontal lifts, not to exceed 10-inches in loose thickness, at slightly above optimum moisture content and compacted with equipment that is capable of producing a uniformly compacted product. In general, the minimum recommended relative compaction is 90 percent of the maximum dry density based on ASTM D1557. All fill placed within proposed building areas and below foundation should be compacted to at least 95 percent relative compaction. Sufficient observation and testing should be performed by Group Delta so that an opinion can be rendered as to the compaction achieved. Rocks or concrete fragments greater than 4-inches in maximum dimension should not be used in structural fill.

6.3.3 On-Site and Imported Fills

The on-site material consist of low expansive clays and should not be used as engineered fill. Imported fill materials should consist of granular soil with less than 35 percent passing the No. 200 sieve based on ASTM D1140 and an EI less than 20 based on ASTM D489.

Import fill sources should be observed and tested prior to hauling onto the site to evaluate the suitability for use and approved by the Project Geotechnical Engineer.

6.3.1 Temporary Excavations

No deep excavations are planned at the Site. Excavations can be readily accomplished with light to heavy effort using conventional heavy-duty grading equipment such as scrapers, loaders, dozers, and excavator.

The contractor is responsible for excavation safety, and all excavations should comply with the current California and Federal Occupational Safety and Health Administration (OSHA) requirements (29CFR-Part 1926, Subpart P), as applicable. For planning purposes, OSHA Type A soils may be assumed for temporary excavations, which allows for temporary slopes up to 20 feet high at a gradient of 3/4H:1V (horizontal:vertical).

7.0 FOUNDATION RECOMMENDATIONS

We understand that 2- to 3- story detached townhomes are planned to be built at the Site (Figure 2). No basement levels are planned for this development. The complete foundation plans and loads were not available at the time of preparing this report. The finish grade of the proposed improvements is at the approximate existing grade at El 68 based on the WHA Preliminary Gradient Plans dated October 6, 2020.

Based on the anticipated loads for a 2- to 3-story townhomes and subsurface soil conditions, it is recommended that the proposed development may be supported by conventional shallow foundations with slab-on-grade floors or mat foundations, provided site preparation and remedial grading are performed in accordance with our recommendations discussed in Section 6.3.

7.1 Spread Footings

7.1.1 Bearing Capacity

The footings should be a minimum of 18-inches wide and should be embedded at least 24-inches below the lowest adjacent grade, or in accordance with the local building code. The footings and slab should be placed on a minimum of 2 feet of compacted soil. Square and strip footings with this minimum width and embedment may be designed for an allowable bearing capacity of 2.5 ksf and 2 ksf, respectively. The allowable bearing pressure may be increased by one-third for short term wind or seismic loads.

7.1.2 Lateral Resistance

Resistance to lateral loads can be provided by friction developed between the bottom of the footings and the supporting soil, and by passive soil pressure developed on the face of the footing. For design purposes, an ultimate coefficient of friction of 0.35 may be assumed between concrete and soil, along with an allowable passive pressure of 200 pcf (equivalent fluid). Full mobilization of passive resistance may be assumed to occur at a lateral displacement of 2% of the footing embedment depth. The friction and mobilized passive resistance may be combined without reduction.

7.1.3 Settlement

Provided that remedial earthwork is conducted beneath the proposed condominium footprint as recommended in Section 6.3.1.2, we estimate that the total static settlement will be less than 1 inch. Differential settlement between similarly loaded columns is expected to be no more than ½-inch over a distance of 40 feet. The majority of the static settlement is anticipated to occur during or shortly after application of the structural loads.

7.1.4 Footing Observation

All foundation excavations should be observed by Group Delta as discussed in Section 6.2.

7.2 Slabs On-Grade

The existing surficial deposits at the Site are primarily clayey and silty soils. A representative sample of the subsurface clayey materials was tested for Expansion Index and found to a have a low expansion potential (20<EI<50). Site preparation and compaction requirements should follow the recommendations provided in Section 6.3. The actual slab thickness and reinforcement should be designed by the project structural engineer.

7.3 Mat Foundations

7.3.1 Subgrade Reaction

The modulus of subgrade reaction concept can be used in the design of the mat foundations and slabs-on-grade. The modulus of subgrade reaction is not an intrinsic property of the soil since it also depends on the dimensions and stiffness of the slab and the stress level. The mat slab foundation should be designed for bending moments using 200 pci for the normalized modulus of subgrade reaction coefficient K_{v1} (namely, corresponding to a 1-foot square bearing plate). To ensure rigidity of the foundation a subgrade reaction coefficient, K_v, should be used based on Terzaghi (1955) and is defined as:

$$K_v = K_{v1} * [(m + 0.5)/1.5m] * [(B+1)/2B]^2$$

where "B" is the width of the foundation measured in feet, and "m" is the ratio of length over width of a rectangular foundation. The flat concrete slab of the mat system should, at a minimum, have continuous two-way reinforcing at the top and the bottom and be designed by the project structural engineer.

7.3.2 Bearing Capacity and Settlement

An allowable bearing pressure of 1,000 psf may be used for design. The allowable bearing pressure may be increased by one-third for short term wind or seismic loads. The expected total post-construction settlement of the mat slab is expected to be less than 1 inch. The differential settlement is expected to be less than one half of the total settlement.

7.3.3 Lateral Resistance

Resistance to lateral loads can be provided by friction developed between the bottom of footings and the supporting soil, and by the passive soil pressure developed on the face of the footing. For preliminary design purposes, an allowable passive resist of 300 pounds per cubic foot (pcf) and a coefficient of friction of 0.35 may be used for lateral sliding resistance of footings.

7.4 Soil Corrosion Potential

The subsurface materials in the upper 20 feet generally consist of clayey and silty soils. One representative sample of the near surface soils from Borings B-1 was tested to evaluate corrosion characteristics. The test included pH, electrical resistivity, soluble chloride, and soluble sulfate concentrations. Test results are summarized in Table 3 below and are provided in Appendix B.

Table 3. Corrosion Potential Test Result

SAMPLE/DEPTH	pH	RESISTIVITY [Ohm-cm]	SULFATE CONTENT [ppm]	CHLORIDE CONTENT [ppm]
B-1 @ 0-5’	7.99	824	300	100

Based on pH and sulfate content of the test sample, the near surface soils are not corrosive to concrete. The correlation below can generally be used between electrical resistivity and corrosion potential.

Electrical Resistivity (Ohm-Cm)	Corrosion Potential
Less than 1,000	Severe
1,000 to 2,000	Corrosive
2,000 to 10,000	Moderate
Greater than 10,000	Mild

Based on the soluble chloride concentration and electrical resistivity results, the test sample is classified as corrosive to buried metals. Further evaluation/testing and recommendations for corrosion protection should be provided by a corrosion consultant.

7.5 Pavement

Near surface materials at the Site generally consist of clayey and silty soils. One R-value test was conducted on a near surface sandy clay sample collected from Boring B-1. The testing indicated an R-value of 12 as shown in Figure B-5 in Appendix B. Additional R-value tests should be performed during final design to refine the extent of low R-value areas.

The R-Value of 12 was used in preliminary pavement design at the Site. Table 4 provides Asphalt Concrete (AC) pavement recommendations for a 20-year design life in accordance with the Caltrans Highway Design Manual (Caltrans 2019) for Traffic Index (TI) values of 4, 5, and 6. These meet the City of Huntington Beach minimum thickness requirements.

Table 4. Pavement Sections

Traffic Index	AC Pavement Thickness	Class II Aggregate Base Thickness
4	0.33 feet (4 inches)	0.50 feet (6 inches)
5	0.33 feet (4 inches)	0.58 feet (7 inches)
6	0.33 feet (4 inches)	0.83 feet (10 inches)

A minimum TI of 4 or 5 is recommended for car parking and non-truck driveways. TI of 6 or higher may be use for truck areas or for streets. It is recommended that the Civil Engineer select an appropriate design TI based on anticipated vehicular loading. The upper 12-inches of subgrade supporting pavements should be compacted to at least 95 percent relative compaction (ASTM D1557).

8.0 LIMITATIONS

The report, exploration logs, and other materials associated with this investigation were prepared exclusively for use by Bonanni Development., and their consultants for the design and construction of the proposed improvements at the Site in Huntington Beach, California. The report is not suitable for use on any project other than the currently proposed developments. This report may not contain sufficient or appropriate information for such uses. If this report or portion of this report is provided to contractors or included in specifications, it is for information only.

This report presents recommendations pertaining to the subject site based on the assumptions that the subsurface conditions do not deviate appreciably from those disclosed by our explorations. In view of past grading and the general geology of the area, the possibility of different geologic conditions may not be discounted. It is the responsibility of the owner to bring any deviations or unexpected conditions observed during construction to the attention of Group Delta. In this way, any required supplemental recommendations can be made with a minimum of delay.

This investigation was performed in accordance with generally accepted geotechnical engineering principles and practice. The professional engineering work and judgments presented in this report meet the standard of care of our profession at this time. No warranty, express or implied, is made.

The recommendations for this project are to a high degree dependent upon proper quality control of grading and construction. Consequently, the recommendations are made contingent on the opportunity of Group Delta to observe the grading and improvement operations. If parties other than Group Delta are engaged to provide such services, they must be notified that they will be required to assume responsibility for the geotechnical phase of the project by concurring with the recommendations in this report or provide alternate recommendations as deemed appropriate.

9.0 REFERENCES

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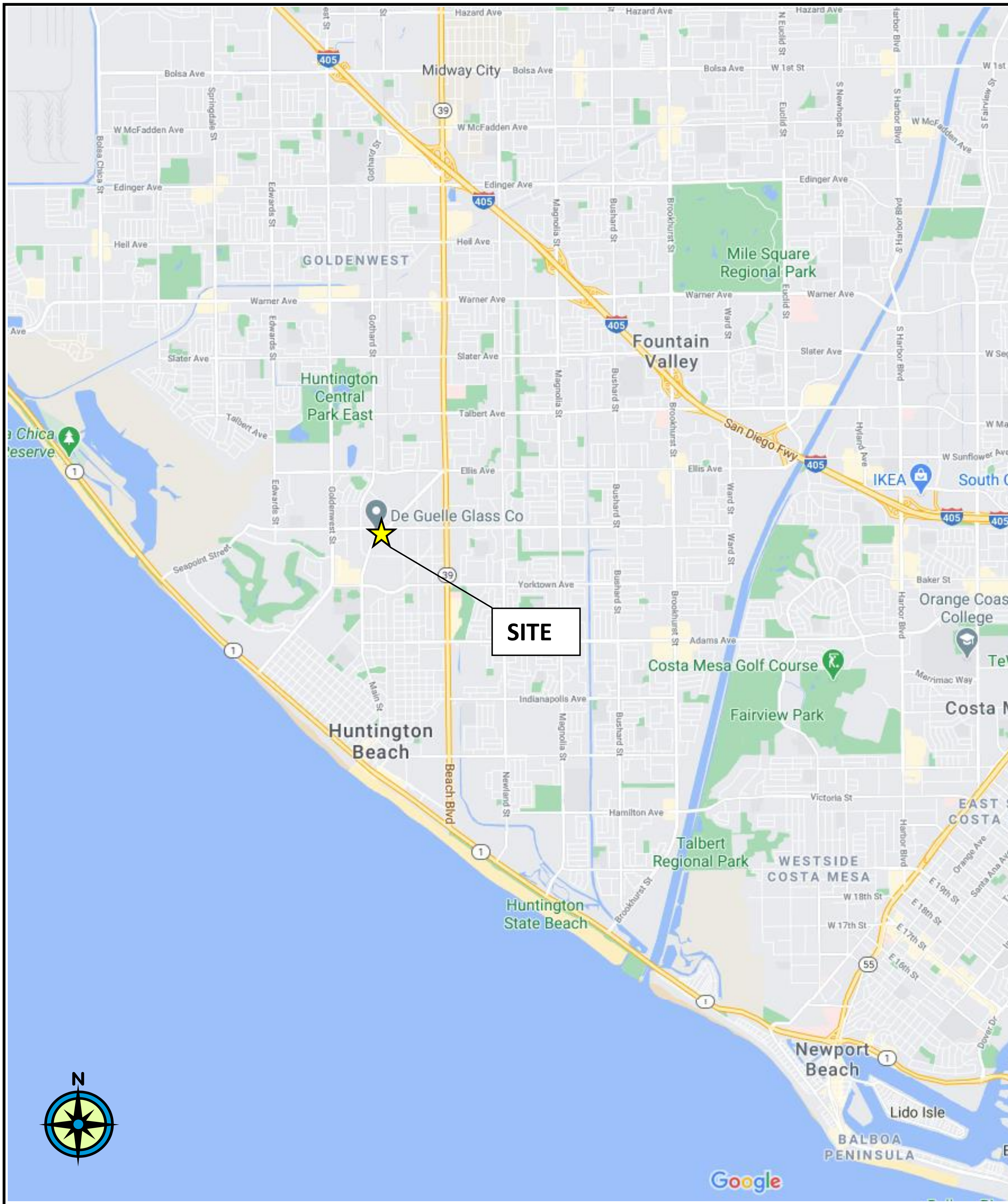
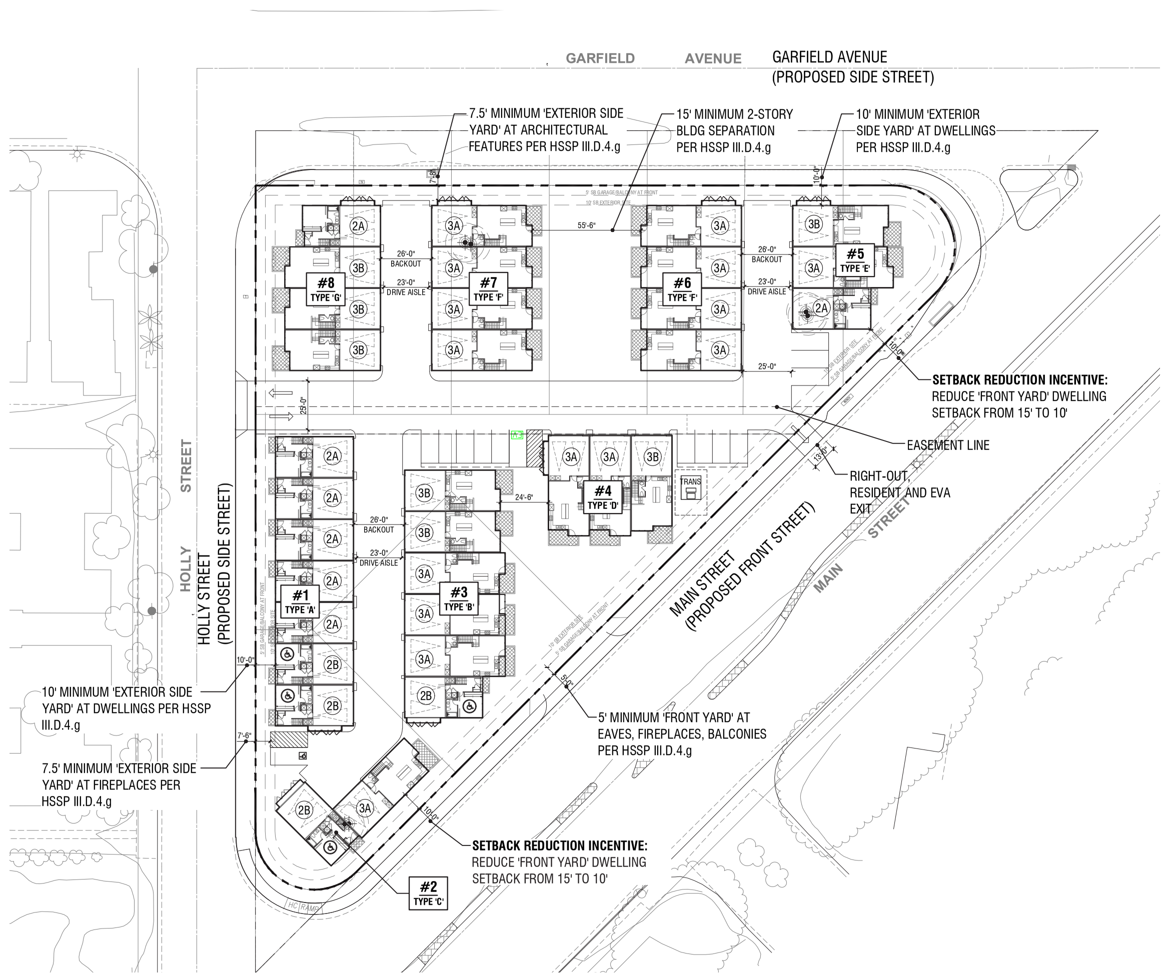
FIGURES

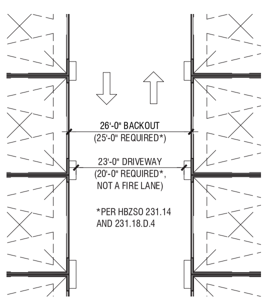


Reference: 2020 Google, Imagery

NOT TO SCALE

GROUP DELTA	**GROUP DELTA CONSULTANTS, INC.** ENGINEERS AND GEOLOGISTS 32 MAUCHLY, SUITE B IRVINE, CA 92618 (949) 450-2100	Figure Number: 1A
	Project Name: Garfield Avenue and Main Street Huntington Beach, California	Project Number: IR751
	SITE VICINITY MAP	





DRIVEWAY DIAGRAM

SITE PLAN SUMMARY

See Sheet CS2 for more information

Total Site Area:		**2.128 Acres Gross**
		1.801 Acres Net
Total Units:		**33 Dwelling Units**
2-Bedroom Units		11 Units (33.3%)
Unit 2A	7 Units	
Unit 2B	4 Units (Accessible)	
3-Bedroom Units		22 Units (66.7%)
Unit 3A	15 Units	
Unit 3B	7 Units	
(15% of Units to be Affordable per HSSP)		
Density:		
Allowed: (per RM Zoning)		15 du/gross ac
Allowed with Bonus:		**16.5 du/gross ac**
(10% bonus for 15% affordable)		
Provided:		**15.5 du/gross ac**
Parking:		
Required*:		**66 Spaces**
2-Bed = 2 Space/Unit		
3-Bed = 2 Space/Unit		
Guest = None Required		
*(HBMC 230.14.D, By-Right Reduction)		
Provided:		**80 Spaces**
Garage:	66 Spaces	
Open (off-street):	14 Spaces	
Required Accessible = 1 Space		
Unassigned Open (14 x 5%)		
Open Space (HSSP III.D.4.i):		
Total Open Space Required:		**10,300 S.F.**
Total Open Space Provided:		**xx,xxx S.F.**
Site Coverage (HSSP III.D.4.e):		
Maximum Allowed:		**50.0%**
Provided Site Coverage:		**XX.X%**
(XX,XXX S.F. Total Footprint / 92,699 S.F. Gross Site)		
Setbacks (HSSP III.D.4.f,g,h):		
Front Yard (to dwelling)		~~15 feet~~ 10 feet
Proposed Front Yard Reduction		
Front Yard (to eave/fireplace/balcony)		5 feet
Interior Side Yard (to dwelling)		5 feet
Street Side Yard (to dwelling)		10 feet
Street Side Yard (to eave/fireplace/arch feature)		8 feet
Building Separation (2-Story Buildings)		15 feet

Legend

- Adaptable Unit Per CBC 1102A.3 (4 Units total)
- Existing Oil Well Locations, To Be Capped, 3 Locations

N

SCALE: 1" = 30'
0' 30' 60' 90' 120'

ARCHITECTURAL SITE PLAN

HB TRI

GARFIELD AVENUE AND MAIN STREET
HUNTINGTON BEACH, CA

DRAFT A1.10

SCHEMATIC DESIGN
2020083.01 | 09-11-2020

BONANNI DEVELOPMENT

WHA I 2850 REDHILL AVENUE, SUITE 200 I SANTA ANA, CA 92705 I 949.250.0607

ARCHITECTS . PLANNERS . DESIGNERS
WHA
ORANGE COUNTY . LOS ANGELES . BAY AREA

FIGURE 2 - CONCEPTUAL SITE PLAN

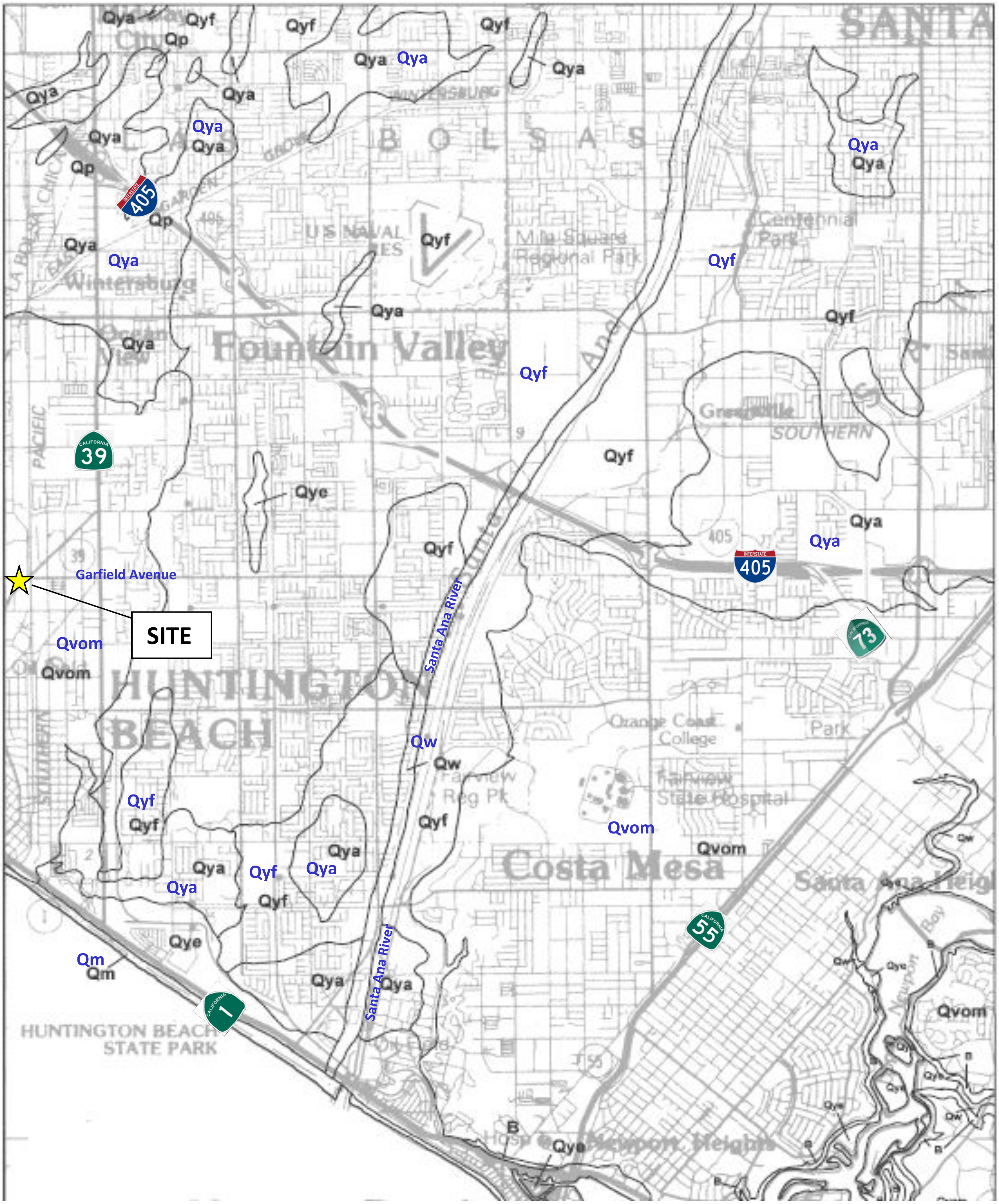
Reference: Google Earth, 2019

NOT TO SCALE

N

B-3 ⦿ Hollow Stem Auger (HSA) Boring Location

GROUP DELTA	GROUP DELTA CONSULTANTS, INC. ENGINEERS AND GEOLOGISTS 32 MAUCHLY, SUITE B IRVINE, CA 92618 (949) 450-2100	Figure Number: 3
	Project Name: Garfield Avenue and Main Street Huntington Beach, CA	Project Number: IR751
	EXPLORATION LOCATION MAP	



Reference: Seismic Hazard Zone Report for the Newport Beach 7.5-Minute Quadrangle, Orange County, California, CGS 1997.

NOT TO SCALE

Description of Map Units

- Qvom – Very old marine deposits
- Qyf – Young alluvial fan and valley deposits
- Qya – Young axial-channel deposits
- Qm – Marine deposits
- Qw – Wash deposits

GROUP DELTA

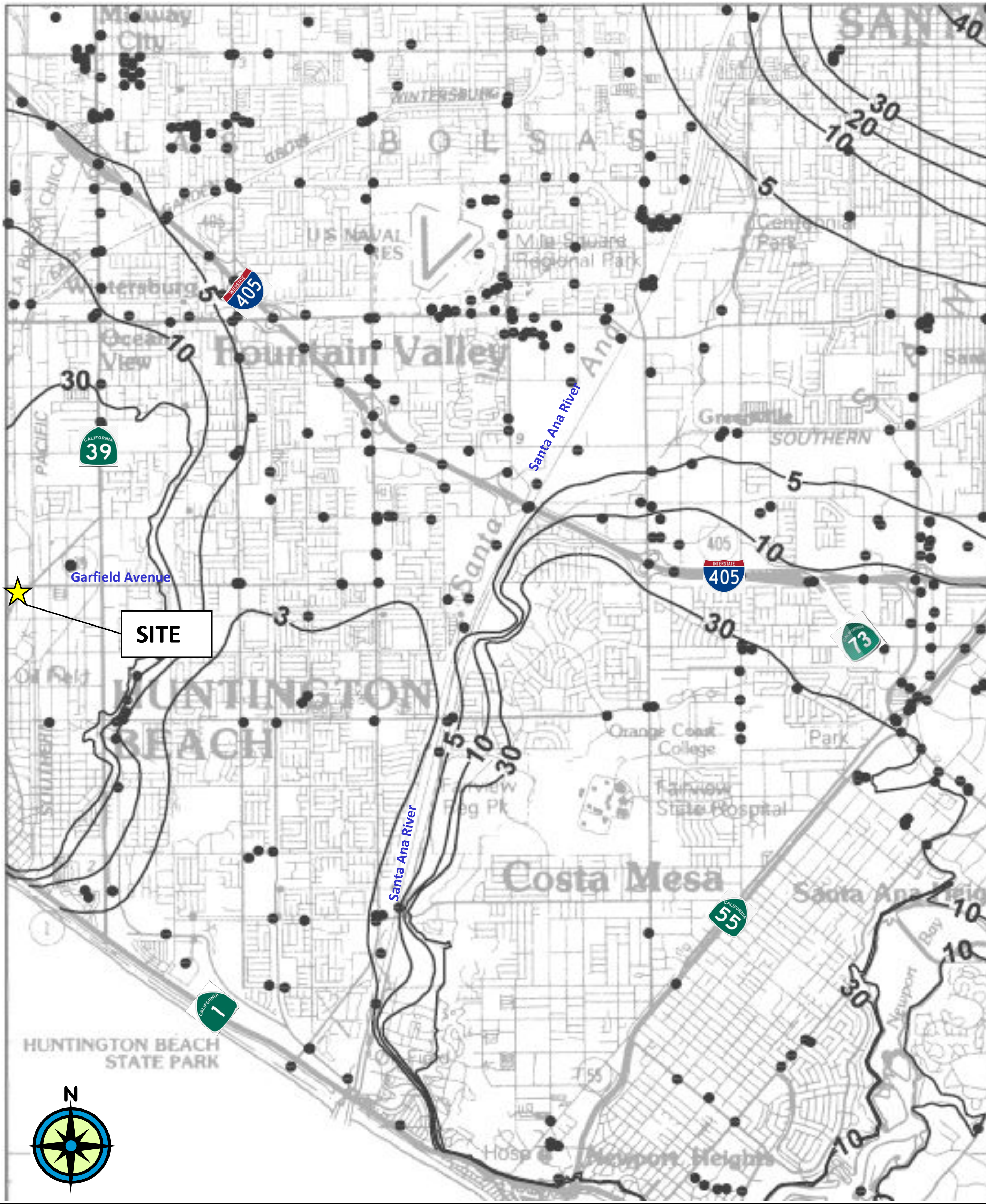
GROUP DELTA CONSULTANTS, INC.
ENGINEERS AND GEOLOGISTS
32 MAUCHLY, SUITE B
IRVINE, CA 92618 (949) 450-2100

Figure Number: 4

Project Name: Garfield Avenue and Main Street Huntington Beach, CA

Project Number: IR751

QUATERNARY GEOLOGIC MAP



Reference: Seismic Hazard Zone Report for the Newport Beach 7.5-Minute Quadrangle, Orange County, California, CGS 1997.

NOT TO SCALE

● Borehole Site

— 30 — Depth to ground water in feet

GROUP DELTA

GROUP DELTA CONSULTANTS, INC.
ENGINEERS AND GEOLOGISTS
32 MAUCHLY, SUITE B
IRVINE, CA 92618 (949) 450-2100

Figure Number: 5

Project Name: Garfield Avenue and Main Street Huntington Beach, CA

Project Number: IR751

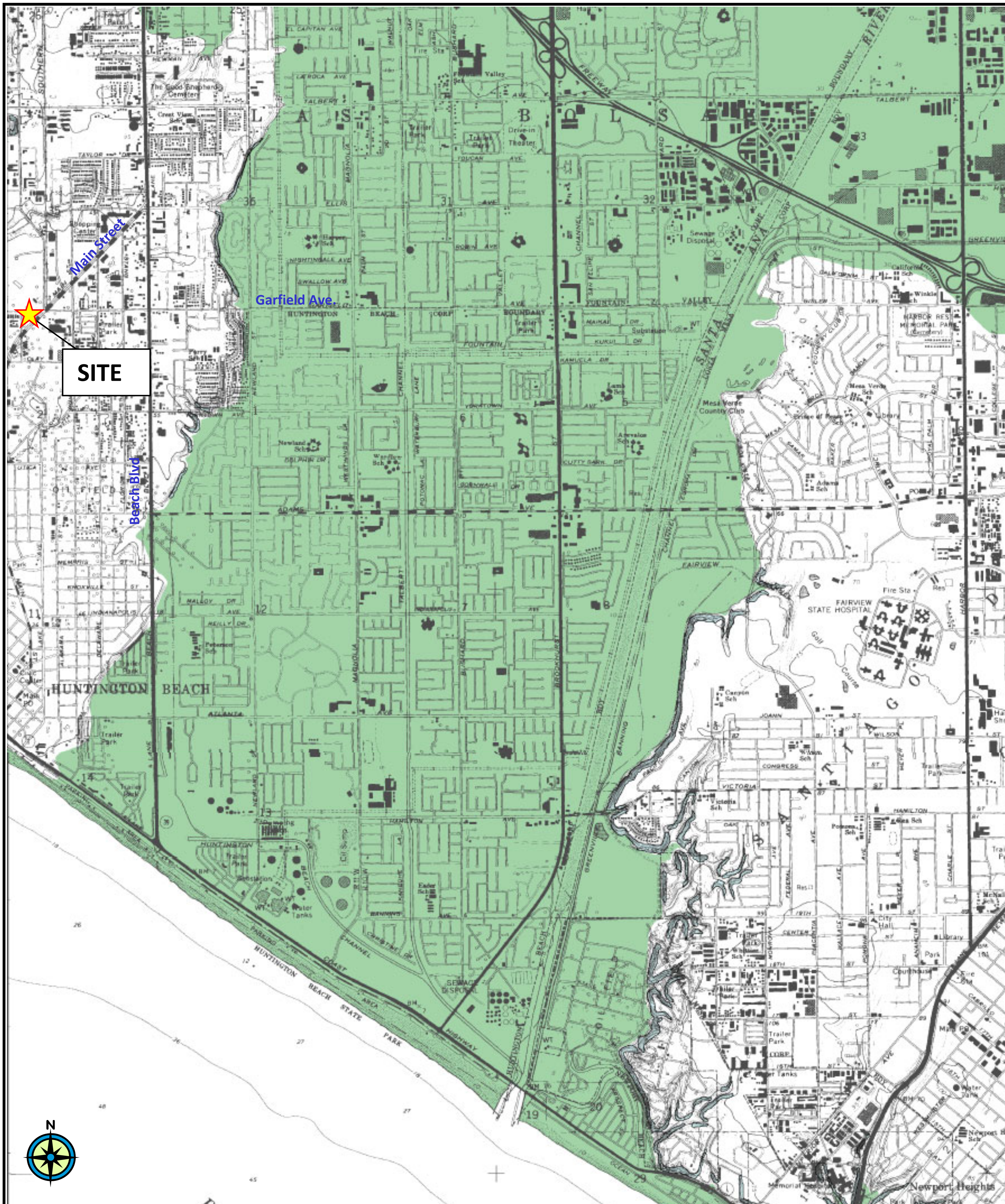
HISTORICALLY HIGHEST GROUNDWATER CONTOURS

Reference: USGS Quaternary Faults, NSHM 2014 Fault Sources https://usgs.maps.arcgis.com/apps/webappviewer/index.html

NSHM 2014 Fault Sources

- Normal
- Strike Slip
- Thrust
- Unassigned

GROUP DELTA CONSULTANTS, INC. ENGINEERS AND GEOLOGISTS 32 MAUCHLY, SUITE B IRVINE, CA 92618 (949) 450-2100	Figure Number: 6
GROUP DELTA	Project Name: Garfield Avenue and Main Street Huntington Beach, CA	Project Number: IR751
	REGIONAL FAULT MAP	



Reference: CGS, Newport Beach 7.5-Minute Quadrangle, Orange County, California.

NOT TO SCALE

MAP EXPLANATION

Zones of Required Investigation:

Liquefaction

Areas where historic occurrence of liquefaction, or local geological, geotechnical and groundwater conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

STATE OF CALIFORNIA

SEISMIC HAZARD ZONES

Delineated in compliance with Chapter 7.8, Division 2 of the California Public Resources Code (Seismic Hazards Mapping Act)

NEWPORT BEACH QUADRANGLE

OFFICIAL MAP

Liquefaction Zone Released: April 17, 1997

Landslide Zone Released: April 15, 1998

GROUP DELTA

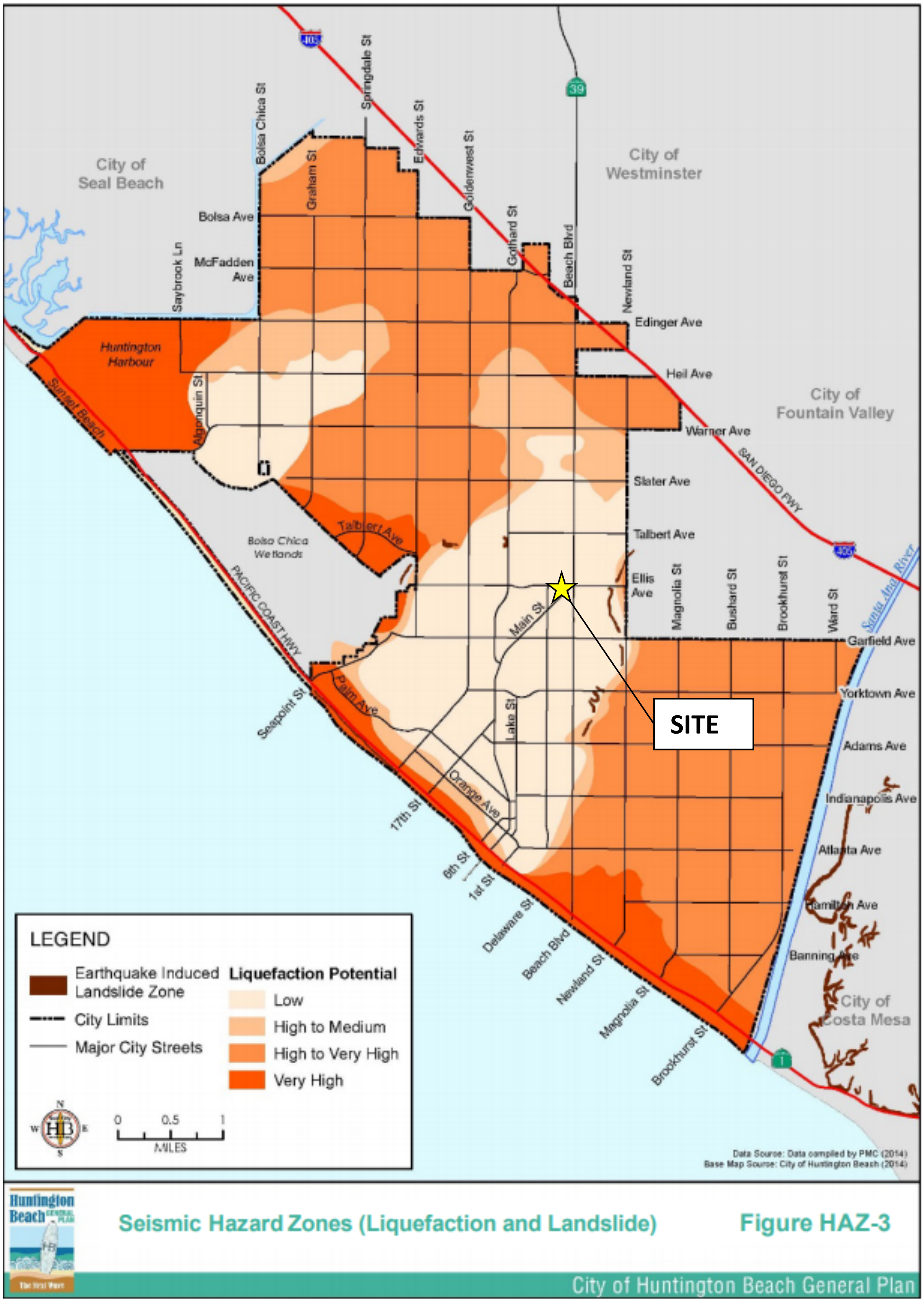
GROUP DELTA CONSULTANTS, INC.
ENGINEERS AND GEOLOGISTS
32 MAUCHLY, SUITE B
IRVINE, CA 92618 (949) 450-2100

Figure Number:
7

Project Name:
Garfield Avenue and Main Street
Huntington Beach, California

Project Number:
IR 751

LIQUEFACTION ZONE MAP



Reference: Figure modified from City of Huntington Beach General Plan, 2017

NOT TO SCALE

GROUP DELTA	GROUP DELTA CONSULTANTS, INC. ENGINEERS AND GEOLOGISTS 32 MAUCHLY, SUITE B IRVINE, CA 92618 (949) 450-2100	Figure Number: 8
	Project Name: Garfield Avenue and Main Street Huntington Beach, CA	Project Number: IR751
	CITY OF HUNTINGTON BEACH GENERAL PLAN	

APPENDIX A
FIELD INVESTIGATION

APPENDIX A
FIELD INVESTIGATION

A.1 Introduction

The subsurface conditions at the Garfield Avenue and Main Street project site were investigated by performing three (3) hollow stem auger borings on October 26, 2020. The locations of the explorations are presented in Exploration Location Map, Figure 3 of the main report. A summary of field explorations is presented in Table A-1.

Prior to beginning the exploration program, access permission and drilling permits were obtained as necessary from Bonanni Development and Orange County Health Agency, respectfully. Subsurface utility maps were reviewed prior to selecting locations for subsurface investigations. Underground Service Alert (USA) was notified and each exploration location was cleared for underground utilities. The exploration methods are described in the following sections.

A.2 Soil Drilling and Sampling

Drilling, Logging, and Soil Classification

Borings were performed by Group Delta's drilling subcontractors ABC Liovin Drilling under the continuous technical supervision of a Group Delta field engineer, who visually inspected the soil samples, measured groundwater levels, maintained detailed records of the borings, and visually / manually classified the soils in accordance with the ASTM D 2488 and the Unified Soil Classification System (USCS). Logging and classification was performed in general accordance with Caltrans "Soil and Rock Logging, Classification, and Presentation Manual (2010 Edition)". A Boring Record Legend and Key for Soil Classification are presented in Figures A-1A through A-2B. The boring records are presented in Figures A-3A through Figure A-5.

Sampling

Bulk samples of soil cuttings were collected at selected depths and drive samples were collected at a typical interval of 5 feet from the borings. The sampling was performed using Standard Penetration Test (SPT) samplers in accordance with ASTM D 1586 and Ring-Lined "California" Split Barrel samplers in accordance with ASTM D 3550.

Bulk samples were collected from auger cuttings and placed in plastic bags.

SPT drive samples were obtained using a 2-inch outside diameter and 1.375-inch inside diameter split-spoon sampler without lining. The soil recovered from the SPT sampling was sealed in plastic bags to preserve the natural moisture content.

California drive samples were collected with a 3-inch outside diameter 2.5-inch inside diameter split barrel sampler with a 2.42-inch inside diameter cutting shoe. The sampler barrel is lined with 18-inches of metal rings for sample collection and has an additional length of waste barrel. Stainless steel or brass liner rings for sample collection are 1-inch high, 2.42-inch inside diameter, and 2.5-inch outside diameter. California samples were removed from the sampler, retained in the metal rings and placed in sealed plastic canisters to prevent loss of moisture.

At each sampling interval, the drive samplers were fitted onto sampling rod, lowered to the bottom of the boring, and driven 18 inches or to refusal (50 blows per 6 inches) with a 140-lb hammer free-falling a height of 30-inches using an automatic hammer.

Compared to the SPT, the California sampler provides less disturbed samples.

Penetration Resistance

SPT blow counts adjusted to 60% hammer efficiency (N_{60}) are routinely used as an index of the relative density of coarse grained soils, and are sometimes used (but less reliable) to estimate consistency of cohesive soils. For samples collected using non-SPT samplers, different hammer weight and drop height, and/or efficiency different than 60%, correction factors can be applied to estimate the equivalent SPT N_{60} value following the approach of Burmister (1948) as follows:

$$N^*_{60} = N_R * C_E * C_H * C_S$$

where

N^*_{60} = equivalent SPT N_{60}

N_R = Raw Field Blowcount (blows per foot)

C_E = Hammer Efficiency Correction = Er_i / 60%

C_H = Hammer Energy Correction = (W * H) / (140 lb * 30 in)

C_S = Sampler Size Correction = $[(2.0\ in)^2-(1.375\ in)^2]/[D_o^2-D_i^2]$

Er_i = hammer efficiency, %

W= actual drive hammer weight, lbs

H = actual drive hammer drop, inch

D_o, D_i = actual sampler outside and inside diameter, respectively, inches

Burmister's correction assumes that penetration resistance (blowcount) is inversely proportional to the hammer energy. For a hammer other than a 140# hammer with 30" drop the hammer energy correction is equal to the ratio of the theoretical hammer energy (weight times drop) to the theoretical SPT hammer energy, or C_H = (W * H) / (140 lb * 30 in).

Burmister's correction assumes that penetration resistance (blowcount) is proportional to the annular end area of the drive sampler. For California drive samplers with D_o=3 inch and D_i=2.42 inch the sampler size correction factor is the ratio of the annular area of an SPT split spoon to that of the California Sampler, or $C_S = [2.0^2-1.375^2]/[3^2-2.42^2] = 0.67$.

To normalize the field SPT and California blowcounts to a hammer with 60% efficiency, an energy correction factor equal to Hammer Efficiency (%) / 60% was applied to the field blowcounts. Hammer efficiency was determined by Pile Driving Analyzer (PDA) measurement. Hammer efficiency measurements are presented in Figures A-4.

The correction factors applied to obtain N^*_{60} are summarized in the following table:

Borings	Hammer Type	Hammer Weight and Drop	C_H	Hammer Efficiency (%)	C_E	Cal Sampler Dimensions	C_S	Combined Correction Factor SPT Samples	Combined Correction Factor CAL Samples
B-1	CME Auto	140# 30"	1.0	79	1.3	D_o=3.0" D_i=2.42"	0.67	1.3	0.871

Corrected N^*_{60} are generally used, with due engineering judgment, only for qualitative assessment of in place density or consistency, and are not used for other more critical analyses such as liquefaction.

Relative Density and Consistency

Equivalent SPT N_{60} values were used as the basis for classifying relative density of granular/cohesionless soils. Wherever possible consistency classification of cohesive soils was based on undrained shear strength estimated in the field with a pocket penetrometer and by testing in the laboratory. Where pocket penetrometer or other tests could not be performed, consistency of cohesive soils was estimated by correlations to Equivalent SPT N_{60}. The correlations for consistency and relative density are shown in the Boring Record Legend, Figures A-1A through A-1C. Drive sample field blow counts, SPT N^*_{60} values, pocket penetrometer readings, and corresponding density/consistency classifications are presented on the boring records.

Borehole Abandonment

At the completion of the drilling groundwater was measured (where possible) and the borings were abandoned by backfilling the borehole with Portland bentonite grout for B-1 and drill cuttings for borings B-2 and B-3. Excess cuttings and drilling fluids were placed in 55 gallon drums, sampled and tested for contaminants, temporarily stored at an approved location, and legally disposed of off-site. Notes describing the borehole abandonment are presented at the bottom of each boring record.

Sample Handling and Transport

Geotechnical samples were sealed to prevent moisture loss, packed in appropriate protective containers, and transported to the geotechnical laboratory for further examination and geotechnical testing.

Laboratory Testing

The soils were further examined and tested in the laboratory and classified in accordance with the Unified Soil Classification System following ASTM D 2487 and D 2488 (see Figures B-1.1 through B-5). Field classifications presented on the records were modified where necessary on the basis of the laboratory test results. Descriptions of the laboratory tests performed and a summary of the results are presented in Appendix B.

A.3 List of Attached Tables and Figures

The following tables and figures are attached and complete this appendix:

List of Tables

List of Figures

Exploration No.	Date	Exploration			Groundwater		Figure No.
		Type	Surface Elevation (ft)	Total Depth (ft)	Depth (ft)	Elevation (ft)	
B-1	10/26/20	HSA	68.0	51.5	NE	NE	A-1 (a-b)
B-2	10/26/20	HSA	68.0	21.5	NE	NE	A-2
B-3	10/26/20	HSA	68.0	21.5	NE	NE	A-3

Notes:

1. Boring locations are illustrated in Figure 3 of the main report.
2. All borings drilled to full depth with Hollow-Stem Auger

Other notes and abbreviations as needed

HSA = Hollow-Stem Auger   NE = Not Encountered

SOIL IDENTIFICATION AND DESCRIPTION SEQUENCE

Sequence		Refer to Section: Field	Refer to Section: Lab	Required	Optional
1	Group Name	2.5.2	3.2.2	●	
2	Group Symbol	2.5.2	3.2.2	●	
	Description Components				
3	Consistency of Cohesive Soil	2.5.3	3.2.3	●	
4	Apparent Density of Cohesionless Soil	2.5.4		●	
5	Color	2.5.5		●	
6	Moisture	2.5.6		●	
7	Percent or Proportion of Soil	2.5.7	3.2.4	●	◍
	Particle Size	2.5.8	2.5.8	●	◍
	Particle Angularity	2.5.9			○
	Particle Shape	2.5.10			○
8	Plasticity (for fine-grained soil)	2.5.11	3.2.5		○
9	Dry Strength (for fine-grained soil)	2.5.12			○
10	Dilatency (for fine-grained soil)	2.5.13			○
11	Toughness (for fine-grained soil)	2.5.14			○
12	Structure	2.5.15			○
13	Cementation	2.5.16		●	
14	Percent of Cobbles and Boulders	2.5.17		●	
	Description of Cobbles and Boulders	2.5.18		●	
15	Consistency Field Test Result	2.5.3		●	
16	Additional Comments	2.5.19			○

Describe the soil using descriptive terms in the order shown

Minimum Required Sequence:

USCS Group Name (Group Symbol); Consistency or Density; Color; Moisture; Percent or Proportion of Soil; Particle Size; Plasticity (optional).

◍ = optional for non-Caltrans projects

Where applicable:

Cementation; % cobbles & boulders;
Description of cobbles & boulders;
Consistency field test result

Ref.: Caltrans Soil and Rock Logging Classification, and Presentation Manual (2010)

HOLE IDENTIFICATION

Holes are identified using the following convention:

H-YY-NNN

Where:
H: Hole Type Code
YY: 2-digit year
NNN: 3-digit number (001-999)

Hole Type Code	Description
A	Auger boring (hollow or solid stem, bucket)
R	Rotary drilled boring (conventional)
RC	Rotary core (self-cased wire-line, continuously-sampled)
RW	Rotary core (self-cased wire-line, not continuously sampled)
P	Rotary percussion boring (Air)
HD	Hand driven (1-inch soil tube)
HA	Hand auger
D	Driven (dynamic cone penetrometer)
CPT	Cone Penetration Test
O	Other (note on LOTB)

Description Sequence Examples:

SANDY lean CLAY (CL); very stiff; yellowish brown; moist; mostly fines; some SAND, from fine to medium; few gravels; medium plasticity; PP=2.75.

Well-graded SAND with SILT and GRAVEL and COBBLES (SW-SM); dense; brown; moist; mostly SAND, from fine to coarse; some fine GRAVEL; few fines; weak cementation; 10% GRANITE COBBLES; 3 to 6 inches; hard; subrounded.

Clayey SAND (SC); medium dense, light brown; wet; mostly fine sand,; little fines; low plasticity.

GROUP DELTA	GROUP DELTA CONSULTANTS, INC. GEOTECHNICAL ENGINEERS AND GEOLOGISTS	FIGURE NUMBER **A-1A**
	PROJECT NAME GARFIELD AVENUE AND MAIN STREET HUNTINGTON BEACH,CA	PROJECT NUMBER IR751
	BORING RECORD LEGEND #1	

GROUP SYMBOLS AND NAMES

Graphic / Symbol	Group Names
GW	Well-graded GRAVEL Well-graded GRAVEL with SAND
GP	Poorly graded GRAVEL Poorly graded GRAVEL with SAND
GW-GM	Well-graded GRAVEL with SILT Well-graded GRAVEL with SILT and SAND
GW-GC	Well-graded GRAVEL with CLAY (or SILTY CLAY) Well-graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GP-GM	Poorly graded GRAVEL with SILT Poorly graded GRAVEL with SILT and SAND
GP-GC	Poorly graded GRAVEL with CLAY (or SILTY CLAY) Poorly graded GRAVEL with CLAY and SAND (or SILTY CLAY and SAND)
GM	SILTY GRAVEL SILTY GRAVEL with SAND
GC	CLAYEY GRAVEL CLAYEY GRAVEL with SAND
GC-GM	SILTY, CLAYEY GRAVEL SILTY, CLAYEY GRAVEL with SAND
SW	Well-graded SAND Well-graded SAND with GRAVEL
SP	Poorly graded SAND Poorly graded SAND with GRAVEL
SW-SM	Well-graded SAND with SILT Well-graded SAND with SILT and GRAVEL
SW-SC	Well-graded SAND with CLAY (or SILTY CLAY) Well-graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SP-SM	Poorly graded SAND with SILT Poorly graded SAND with SILT and GRAVEL
SP-SC	Poorly graded SAND with CLAY (or SILTY CLAY) Poorly graded SAND with CLAY and GRAVEL (or SILTY CLAY and GRAVEL)
SM	SILTY SAND SILTY SAND with GRAVEL
SC	CLAYEY SAND CLAYEY SAND with GRAVEL
SC-SM	SILTY, CLAYEY SAND SILTY, CLAYEY SAND with GRAVEL
PT	PEAT
	COBBLES COBBLES and BOULDERS BOULDERS

Graphic / Symbol	Group Names
CL	Lean CLAY Lean CLAY with SAND Lean CLAY with GRAVEL SANDY lean CLAY SANDY lean CLAY with GRAVEL GRAVELLY lean CLAY GRAVELLY lean CLAY with SAND
CL-ML	SILTY CLAY SILTY CLAY with SAND SILTY CLAY with GRAVEL SANDY SILTY CLAY SANDY SILTY CLAY with GRAVEL GRAVELLY SILTY CLAY GRAVELLY SILTY CLAY with SAND
ML	SILT SILT with SAND SILT with GRAVEL SANDY SILT SANDY SILT with GRAVEL GRAVELLY SILT GRAVELLY SILT with SAND
OL	ORGANIC lean CLAY ORGANIC lean CLAY with SAND ORGANIC lean CLAY with GRAVEL SANDY ORGANIC lean CLAY SANDY ORGANIC lean CLAY with GRAVEL GRAVELLY ORGANIC lean CLAY GRAVELLY ORGANIC lean CLAY with SAND
OL	ORGANIC SILT ORGANIC SILT with SAND ORGANIC SILT with GRAVEL SANDY ORGANIC SILT SANDY ORGANIC SILT with GRAVEL GRAVELLY ORGANIC SILT GRAVELLY ORGANIC SILT with SAND
CH	Fat CLAY Fat CLAY with SAND Fat CLAY with GRAVEL SANDY fat CLAY SANDY fat CLAY with GRAVEL GRAVELLY fat CLAY GRAVELLY fat CLAY with SAND
MH	Elastic SILT Elastic SILT with SAND Elastic SILT with GRAVEL SANDY elastic SILT SANDY elastic SILT with GRAVEL GRAVELLY elastic SILT GRAVELLY elastic SILT with SAND
OH	ORGANIC fat CLAY ORGANIC fat CLAY with SAND ORGANIC fat CLAY with GRAVEL SANDY ORGANIC fat CLAY SANDY ORGANIC fat CLAY with GRAVEL GRAVELLY ORGANIC fat CLAY GRAVELLY ORGANIC fat CLAY with SAND
OH	ORGANIC elastic SILT ORGANIC elastic SILT with SAND ORGANIC elastic SILT with GRAVEL SANDY elastic ELASTIC SILT SANDY ORGANIC elastic SILT with GRAVEL GRAVELLY ORGANIC elastic SILT GRAVELLY ORGANIC elastic SILT with SAND
OL/OH	ORGANIC SOIL ORGANIC SOIL with SAND ORGANIC SOIL with GRAVEL SANDY ORGANIC SOIL SANDY ORGANIC SOIL with GRAVEL GRAVELLY ORGANIC SOIL GRAVELLY ORGANIC SOIL with SAND

FIELD AND LABORATORY TESTS

- **C** Consolidation (ASTM D 2435-04)
- **CL** Collapse Potential (ASTM D 5333-03)
- **CP** Compaction Curve (CTM 216 - 06)
- **CR** Corrosion, Sulfates, Chlorides (CTM 643 - 99; CTM 417 - 06; CTM 422 - 06)
- **CU** Consolidated Undrained Triaxial (ASTM D 4767-02)
- **DS** Direct Shear (ASTM D 3080-04)
- **EI** Expansion Index (ASTM D 4829-03)
- **M** Moisture Content (ASTM D 2216-05)
- **OC** Organic Content (ASTM D 2974-07)
- **P** Permeability (CTM 220 - 05)
- **PA** Particle Size Analysis (ASTM D 422-63 [2002])
- **PI** Liquid Limit, Plastic Limit, Plasticity Index (AASHTO T 89-02, AASHTO T 90-00)
- **PL** Point Load Index (ASTM D 5731-05)
- **PM** Pressure Meter
- **PP** Pocket Penetrometer
- **R** R-Value (CTM 301 - 00)
- **SE** Sand Equivalent (CTM 217 - 99)
- **SG** Specific Gravity (AASHTO T 100-06)
- **SL** Shrinkage Limit (ASTM D 427-04)
- **SW** Swell Potential (ASTM D 4546-03)
- **TV** Pocket Torvane
- **UC** Unconfined Compression - Soil (ASTM D 2166-06) Unconfined Compression - Rock (ASTM D 2938-95)
- **UU** Unconsolidated Undrained Triaxial (ASTM D 2850-03)
- **UW** Unit Weight (ASTM D 4767-04)
- **VS** Vane Shear (AASHTO T 223-96 [2004])

SAMPLER GRAPHIC SYMBOLS

- Standard Penetration Test (SPT)
- Standard California Sampler
- Modified California Sampler
- Shelby Tube
- Piston Sampler
- NX Rock Core
- HQ Rock Core
- Bulk Sample
- Other (see remarks)

DRILLING METHOD SYMBOLS

- Auger Drilling
- Rotary Drilling
- Dynamic Cone or Hand Driven
- Diamond Core

WATER LEVEL SYMBOLS

- First Water Level Reading (during drilling)
- Static Water Level Reading (after drilling, date)

Ref.: Caltrans Soil and Rock Logging Classification, and Presentation Manual (2010)

DEFINITIONS FOR CHANGE IN MATERIAL

Term	Definition	Symbol
Material Change	Change in material is observed in the sample or core, and the location of change can be accurately measured.	(solid line)
Estimated Material Change	Change in material cannot be accurately located because either the change is gradational or because of limitations in the drilling/sampling methods used.	(dashed line)
Soil/Rock Boundary	Material changes from soil characteristics to rock characteristics.	(wavy lines)

GROUP DELTA CONSULTANTS, INC. GEOTECHNICAL ENGINEERS AND GEOLOGISTS	FIGURE NUMBER A-1B
PROJECT NAME GARFIELD AVENUE AND MAIN STREET HUNTINGTON BEACH,CA	PROJECT NUMBER IR751

BORING RECORD LEGEND #2

CONSISTENCY OF COHESIVE SOILS				
Descriptor	**Shear Strength (tsf)**	**Pocket Penetrometer, PP Measurement (tsf)**	**Torvane, TV. Measurement (tsf)**	**Vane Shear, VS. Measurement (tsf)**
Very Soft	< 0.12	< 0.25	< 0.12	< 0.12
Soft	0.12 - 0.25	0.25 - 0.50	0.12 - 0.25	0.12 - 0.25
Medium Stiff	0.25 - 0.50	0.50 - 1.0	0.25 - 0.50	0.25 - 0.50
Stiff	0.50 - 1.0	1.0 - 2.0	0.50 - 1.0	0.50 - 1.0
Very Stiff	1.0 - 2.0	2.0 - 4.0	1.0 - 2.0	1.0 - 2.0
Hard	> 2.0	> 4.0	> 2.0	> 2.0

APPARENT DENSITY OF COHESIONLESS SOILS	
Descriptor	**SPT N_{60} - Value (blows / foot)**
Very Loose	0 - 5
Loose	5 - 10
Medium Dense	10 - 30
Dense	30 - 50
Very Dense	> 50

MOISTURE	
Descriptor	**Criteria**
Dry	No discernable moisture
Moist	Moisture present, but no free water
Wet	Visible free water

PERCENT OR PROPORTION OF SOILS	
Descriptor	**Criteria**
Trace	Particles are present but estimated to be less than 5%
Few	5 to 10%
Little	15 to 25%
Some	30 to 45%
Mostly	50 to 100%

PARTICLE SIZE		
Descriptor		**Size (in)**
Boulder		> 12
Cobble		3 - 12
Gravel	Coarse	3/4 - 3
	Fine	1/5 - 3/4
Sand	Coarse	1/16 - 1/5
	Medium	1/64 - 1/16
	Fine	1/300 - 1/64
Silt and Clay		< 1/300

PLASTICITY OF FINE-GRAINED SOILS	
Descriptor	**Criteria**
Nonplastic	A 1/8-inch thread cannot be rolled at any water content.
Low	The thread can barely be rolled, and the lump cannot be formed when drier than the plastic limit.
Medium	The thread is easy to roll, and not much time is required to reach the plastic limit; it cannot be rerolled after reaching the plastic limit. The lump crumbles when drier than the plastic limit.
High	It takes considerable time rolling and kneading to reach the plastic limit. The thread can be rerolled several times after reaching the plastic limit. The lump can be formed without crumbling when drier than the plastic limit.

CONSISTENCY OF COHESIVE SOILS VS. N_{60}	
Description	SPT N_{60} (blows / foot)
Very Soft	0 - 2
Soft	2 - 4
Medium Stiff	4 - 8
Stiff	8 - 15
Very Stiff	15 - 30
Hard	> 30

Ref: Peck, Hansen, and Thornburn, 1974, "Foundation Engineering", Second Edition

Note: Only to be used (with caution) when pocket penetrometer or other data on undrained shear strength are unavailable. Not allowed by Caltrans Soil and Rock Logging and Classificaton Manual, 2010

CEMENTATION	
Descriptor	**Criteria**
Weak	Crumbles or breaks with handling or little finger pressure.
Moderate	Crumbles or breaks with considerable finger pressure.
Strong	Will not crumble or break with finger pressure.

Ref.: Caltrans Soil and Rock Logging Classification, and Presentation Manual (2010), with the exception of consistency of cohesive soils vs. N_{60}.

GROUP DELTA

GROUP DELTA CONSULTANTS, INC. GEOTECHNICAL ENGINEERS AND GEOLOGISTS	FIGURE NUMBER A-1C
PROJECT NAME GARFIELD AVENUE AND MAIN STREET HUNTINGTON BEACH,CA	PROJECT NUMBER IR751

BORING RECORD LEGEND #3

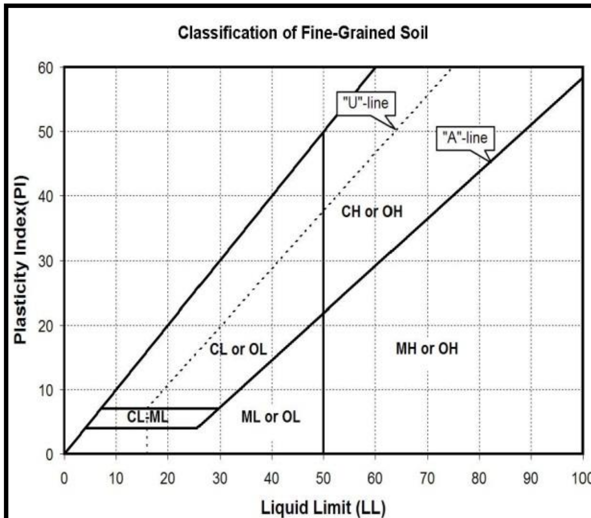
CLASSIFICATION OF INORGANIC FINE GRAINED SOILS (Soils with ≥50% finer than No. 200 Sieve)

GROUP SYMBOL				GROUP NAME
CL	<30% plus No. 200	<15% plus No. 200		Lean clay
		15-25% plus No. 200	%sand ≥%gravel	Lean clay with sand
			%sand <%gravel	Lean clay with gravel
	≥30% plus No. 200	% sand ≥ % gravel	<15% gravel	Sandy lean clay
			≥15% gravel	Sandy lean clay with gravel
		% sand < % gravel	<15% sand	Gravelly lean clay
			≥15% sand	Gravelly lean clay with sand
ML	<30% plus No. 200	<15% plus No. 200		Silt
		15-25% plus No. 200	%sand ≥%gravel	Silt with sand
			%sand <%gravel	Silt with gravel
	≥30% plus No. 200	% sand ≥ % gravel	<15% gravel	Sandy silt
			≥15% gravel	Sandy silt with gravel
		% sand < % gravel	<15% sand	Gravelly silt
			≥15% sand	Gravelly silt with sand
CH	<30% plus No. 200	<15% plus No. 200		Fat clay
		15-25% plus No. 200	%sand ≥%gravel	Fat clay with sand
			%sand <%gravel	Fat clay with gravel
	≥30% plus No. 200	% sand ≥ % gravel	<15% gravel	Sandy fat clay
			≥15% gravel	Sandy fat clay with gravel
		% sand < % gravel	<15% sand	Gravelly fat clay
			≥15% sand	Gravelly fat clay with sand
MH	<30% plus No. 200	<15% plus No. 200		Elastic silt
		15-25% plus No. 200	%sand ≥%gravel	Elastic silt with sand
			%sand <%gravel	Elastic silt with gravel
	≥30% plus No. 200	% sand ≥ % gravel	<15% gravel	Sandy elastic silt
			≥15% gravel	Sandy elastic silt with gravel
		% sand < % gravel	<15% sand	Gravelly elastic silt
			≥15% sand	Gravelly elastic silt with sand

Reference:
ASTM D 2487 and 2488

Laboratory Classification of Clay and Silt

REFERENCE: Caltrans Soil and Rock Logging, Classification, and Presentation Manual (2010).



CL: LL<50; above A-Line.

CH: LL≥50; above A-Line.

ML: LL<50; below A-Line, or PI<4, or Non-Plastic

MH: LL≥50; below A-Line.

CL-ML: above A-Line and PI=4 to 7

CL/CH, ML/MH: at or near LL=50

ML/CL, MH/CH: at or near the A-Line

Field Identification of Clays and Silts

Group Symbol	Dry Strength	Dilatancy	Toughness	Plasticity
ML	None to low	Slow to rapid	Low or thread cannot be formed	Low to nonplastic
CL	Medium to high	None to slow	Medium	Medium
MH	Low to medium	None to slow	Low to medium	Low to medium
CH	High to very high	None	High	High

GROUP DELTA

Group Delta Project No. IR751

Garfield Avenue and Main Street
Huntington Beach, CA

KEY FOR SOIL CLASSIFICATION #1

Figure A-2A

CLASSIFICATION OF COARSE-GRAINED SOILS (Soils with <50% "fines" passing No. 200 Sieve)

Soil	Fines	Gradation / Fines type	GROUP SYMBOL	Sand/Gravel	GROUP NAME
GRAVEL % GRAVEL> % SAND	≤5%fines (<5% fines)	Well-graded	GW	<15% sand	Well-graded gravel
				≥15% sand	Well-graded gravel with sand
		Poorly graded	GP	<15% sand	Poorly graded gravel
				≥15% sand	Poorly graded gravel with sand
	10%fines (5-12% fines)	Well-graded, Fines=ML or MH	GW-GM	<15% sand	Well-graded gravel with silt
				≥15% sand	Well-graded gravel with silt and sand
		Well-graded, Fines=CL or CH	GW-GC	<15% sand	Well-graded gravel with clay
				≥15% sand	Well-graded gravel with clay and sand
		Poorly graded, Fines=ML or MH	GP-GM	<15% sand	Poorly graded gravel with silt
				≥15% sand	Poorly graded gravel with silt and sand
		Poorly graded, Fines=CL or CH	GP-GC	<15% sand	Poorly graded gravel with clay
				≥15% sand	Poorly graded gravel with clay and sand
	≥15%fines (>12% fines)	Fines=ML or MH	GM	<15% sand	Silty gravel
				≥15% sand	Silty gravel with sand
		Fines=CL or CH	GC	<15% sand	Clayey gravel
				≥15% sand	Clayey gravel with sand
SAND % SAND≥ % GRAVEL	≤5%fines (<5% fines)	Well-graded	SW	<15% gravel	Well-graded sand
				≥15% gravel	Well-graded sand with gravel
		Poorly graded	SP	<15% gravel	Poorly-graded sand
				≥15% gravel	Poorly-graded sand with gravel
	10%fines (5-12% fines)	Well-graded, Fines=ML or MH	SW-SM	<15% gravel	Well-graded sand with silt
				≥15% gravel	Well-graded sand with silt and gravel
		Well-graded, Fines=CL or CH	SW-SC	<15% gravel	Well-graded sand with clay
				≥15% gravel	Well-graded sand with clay and gravel
		Poorly graded, Fines=ML or MH	SP-SM	<15% gravel	Poorly graded sand with silt
				≥15% gravel	Poorly graded sand with silt and gravel
		Poorly graded, Fines=CL or CH	SP-SC	<15% gravel	Poorly graded sand with clay
				≥15% gravel	Poorly graded sand with clay and gravel
	≥15%fines (>12% fines)	Fines=ML or MH	SM	<15% gravel	Silty sand
				≥15% gravel	Silty sand with gravel
		Fines=CL or CH	SC	<15% gravel	Clayey sand
				≥15% gravel	Clayey sand with gravel

Reference:

ASTM D 2487 and 2488

Note: Values estimated to nearest 5% to be used for visual identification, values in parentheses to be used for classification when based on laboratory grain size data.

Granular Soil Gradation Parameters

Coefficient of Uniformity: $C_u = D_{60}/D_{10}$

Coefficient of Curvature: $Cc = D_{30}^2 / (D_{60} \times D_{10})$

D_{10} = 10% of soil is finer than this diameter

D_{30} = 30% of soil is finer than this diameter

D_{60} = 60% of soil is finer than this diameter

Group Symbol	Gradation or Plasticity Requirement
SW	$C_u > 6$ and $1 \le C_c \le 3$
GW	$C_u > 4$ and $1 \le C_c \le 3$
GP or SP	Clean gravel or sand not meeting requirement for SW or GW
SM or GM	Non-plastic fines or below A-Line or PI<4
SC or GC	Plastic fines or above A-Line and PI>7

GROUP DELTA

Group Delta Project No. IR751

Garfield Avenue and Main Street
Huntington Beach, CA

KEY FOR SOIL CLASSIFICATION #2

Figure A-2B

BORING RECORD

PROJECT NAME	Bonanni-Residential Development
PROJECT NUMBER	IR751
HOLE ID	**B-1**
SITE LOCATION	Garfield Avenue and Main Street, Huntington Beach. CA
START	10/26/2020
FINISH	10/26/2020
SHEET NO.	1 of 2
DRILLING COMPANY	ABC Liovin
DRILL RIG	CME 75
DRILLING METHOD	Hollow Stem Auger
LOGGED BY	G. Valdivia
CHECKED BY	K. Reyes
HAMMER TYPE (WEIGHT/DROP)	Hammer: 140 lbs., Drop: 30 in.
HAMMER EFFICIENCY (ERi)	Auto
BORING DIA. (in)	8
TOTAL DEPTH (ft)	51.5
GROUND ELEV (ft)	68
DEPTH/*ELEV.* GW (ft)	∇ NE / *NE* DURING DRILLING; ▼ NE / *NE* AFTER DRILLING
DRIVE SAMPLER TYPE(S) & SIZE (ID)	SPT (1.4"), CAL (2.4")
NOTES	$N_{60} = 1.3\ N_{SPT} = 0.871 N_{MC}$

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
0	68														ROADWAY: 3-inch of 3/4-inch crushed rock.
															AGGREGATE BASE: 3-inch aggregate base, white-grey (7.5YR 8/1), dry, mostly coarse grained sand; few fines, nonplastic.
	65	Bulk	B-1									EI R CR			SANDY CLAY (CL): reddish brown (2.5YR 4/3), moist, mostly fines, some fine to medium grained SAND, with traces of GRAVEL, medium pasticity.
5		Cal	R-2	9 22 28	50	44			10.2	121.7	26:13				Stiff, dark red-brown (2.5YR 3/3).
	60														
10		SPT	S-3	4 3 4	7	9									SANDY SILT (ML): Stiff, light brown (7.5YR 6/4), moist, mostly fines, some fine grained SAND; medium plasticity.
	55														
15		Cal	R-4	8 16 28	44	38			16.8	98.0					Hard, PP=4.5tsf.
	50														
20		SPT	S-5	9 25 45	70	91					45:18				LEAN CLAY with SAND (CL): Hard, grey-brown (7.5 YR 6/1), mostly fines, few fine grained SAND, medium plasticity, PP=4.5tsf.
	45														
25		Cal	R-6	10 19 31	50	44			6.3	100.0					SILTY SAND (SM): Very dense, grey-brown (7.5YR 6/1) with orange stains, mostly fine grained SAND, little fines, nonplastic.
	40														

GDC_LOG_BORING_2016 IR751 - BONANI-GARFIELD AND MAIN.GPJ GDC2013.GDT 11/5/20

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Bonanni-Residential Development	IR751	**B-1**

SITE LOCATION	START	FINISH	SHEET NO.
Garfield Avenue and Main Street, Huntington Beach. CA	10/26/2020	10/26/2020	2 of 2

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
ABC Liovin	CME 75	Hollow Stem Auger	G. Valdivia	K. Reyes

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.	Auto	8	51.5	68	⊻ NE / *NE* DURING DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES	
SPT (1.4"), CAL (2.4")	N_{60} =1.3 N_{SPT} =0.871N_{MC}	▼ NE / *NE* AFTER DRILLING

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
		SPT	S-7	4 7 12	19	25									SILTY CLAY (CL-ML): Very stiff, yellow brown (10YR 7/6), moist, mostly fines, few fine grained SAND, medium plasticity, PP=1.5tsf
	35														
35		CAL	R-8	12 17 26	43	37			31.0	91.6					SANDY CLAY (CL): Very stiff to hard, orange brown (2.5Y 8/6), moist, mostly fines, some fine grained SAND; medium plasticity, PP=3.0tsf.
	30														
40		SPT	S-9	8 21 38	59	77									CLAYEY SAND (SC): Very dense, yellow-brown (10YR 6/6), moist, mostly fine grained SAND; little fines, low plasticity.
	25														
45		CAL	R-10	18 50/6"	>100	>100			4.1	98.0					POORLY GRADED SAND WITH SILT (SP-SM): Very dense, yellow-brown (10YR 6/6), moist, mostly fine grained SAND; few fines, nonplastic.
	20														
50		SPT	S-11	14 24 25	49	64									
	15														
55															
	10														

NOTES

1. Bottom of excavation at 51.5 feet below ground surface.
2. Excavation terminated at target depth.
3. Groundwater not encountered during drilling.
4. Borehole backfilled with Portland/Bentonite grout mix
5. This Boring Record was prepared in accordance with the Caltrans Soil & Rock Logging, Classification, and Presentation Manual (2010).

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Irvine, CA 92618

FIGURE A-3B

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Bonanni-Residential Development	IR751	B-2

SITE LOCATION	START	FINISH	SHEET NO.
Garfield Avenue and Main Street, Huntington Beach. CA	10/26/2020	10/26/2020	1 of 1

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
ABC Liovin	CME 75	Hollow Stem Auger	G. Valdivia	K. Reyes

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.	Auto	8	21.5	68	▽ NE / *NE* DURING DRILLING; ▼ NE / *NE* AFTER DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES
SPT (1.4"), CAL (2.4")	N_{60} =1.3 N_{SPT} =0.871N_{MC}

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
0	68														ROADWAY: 3-inch of 3/4-inch crushed rock.
															AGGREGATE BASE: 3-inch aggregate base, white-grey (7.5YR 8/1), dry, mostly coarse grained sand; few fines, nonplastic.
	65	Bulk	B-1												SANDY CLAY (CL): Dark brown (7.5YR 4/4), moist, mostly fines, some medium grained SAND, with traces of gravel, medium plasticity.
5		SPT	S-2	5 8 10	18	23									Very stiff, medium brown (7.5YR 4/3), fine to medium grained SAND.
	60														
10		CAL	R-3	7 7 9	16	14			10.4	116.9		PA			SANDY SILT (ML): Stiff, dark brown (7.5YR 3/3), moist, mostly fines, some fined grained SAND; low plasticity, (Sand=49% Fines=51%)
	55														
15		SPT	S-4	5 7 7	14	18					35:17				SANDY CLAY (CL): Very stiff, grey brown (10YR 6/3), moist, mostly fines, some medium grained SAND; medium plasticity. PP=2.0tsf.
	50														
20		CAL	R-5	12 23 50/5"	>100	>100			16.3	116.3					Hard, light grey brown (7.5YR 7/1), PP=4.5tsf.
	45														
25															
	40														

NOTES

1. Bottom of excavation at 21.5 feet below ground surface.
2. Excavation terminated at target depth.
3. Groundwater not encountered during drilling.
4. Borehole backfilled with soil cuttings.
5. This Boring Record was prepared in accordance with the Caltrans Soil &Rock Logging, Classification, and Presentation Manual (2010).

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FIGURE

A-4

BORING RECORD

PROJECT NAME	PROJECT NUMBER	HOLE ID
Bonanni-Residential Development	IR751	**B-3**

SITE LOCATION	START	FINISH	SHEET NO.
Garfield Avenue and Main Street, Huntington Beach. CA	10/26/2020	10/26/2020	1 of 1

DRILLING COMPANY	DRILL RIG	DRILLING METHOD	LOGGED BY	CHECKED BY
ABC Liovin	CME 75	Hollow Stem Auger	G. Valdivia	K. Reyes

HAMMER TYPE (WEIGHT/DROP)	HAMMER EFFICIENCY (ERi)	BORING DIA. (in)	TOTAL DEPTH (ft)	GROUND ELEV (ft)	DEPTH/*ELEV.* GW (ft)
Hammer: 140 lbs., Drop: 30 in.	Auto	8	21.5	68	▽ NE / *NE* DURING DRILLING; ▼ NE / *NE* AFTER DRILLING

DRIVE SAMPLER TYPE(S) & SIZE (ID)	NOTES
SPT (1.4"), CAL (2.4")	N_{60} =1.3 N_{SPT} =0.871N_{MC}

DEPTH (feet)	ELEVATION (feet)	SAMPLE TYPE	SAMPLE NO.	PENETRATION RESISTANCE (BLOWS / 6 IN)	BLOW/FT "N"	SPT N^*_{60}	RECOVERY (%)	RQD (%)	MOISTURE (%)	DRY DENSITY (pcf)	ATTERBERG LIMITS (LL:PI)	OTHER TESTS	DRILLING METHOD	GRAPHIC LOG	DESCRIPTION AND CLASSIFICATION
0	68		B-1												ROADWAY: 3-inch of 3/4-inch crushed rock
															AGGREGATE BASE: 3-inch aggregate base, white-grey (7.5YR 8/1), dry, mostly coarse grained sand; few fines, nonplastic.
	65														SANDY CLAY (CL): Medium brown (7.5YR 4/3), moist, mostly fines, some medium grained SAND; medium plasticity.
5			R-2	7 9 13	22	19			13.0	115.3		PA			Very stiff, dark brown (7.5YR 5/8), trace of gravel, (Gravel =1% Sand =38% Fines=61%).
	60														
10			S-3	7 11 12	23	30									SILTY SAND (SM): Dense, reddish brown (7.5YR 6/6), moist, mostly medium grianed SAND, little fines, nonplastic.
	55														
15			R-4	9 28 32	60	52			3.5	98.0		PA			POORLY GRADED SAND WITH SILT(SP-SM): Very dense, yellow brown (10YR 7/6), moist, mostly fine grained SAND, few fines, nonplastic. (Sand =92% Fines =8%)
	50														
20			S-5	6 15 28	43	56									SANDY CLAY (CL): Hard, medium brown (10YR 5/3), moist, mostly fines, some fine grained SAND; medium plasticity, PP=4.0tsf.
	45														
25															
	40														

NOTES

1. Bottom of excavation at 21.5 feet below ground surface.
2. Excavation terminated at target depth.
3. Groundwater not encountered during drilling.
4. Borehole backfilled with soil cuttings.
5. This Boring Record was prepared in accordance with the Caltrans Soil &Rock Logging, Classification, and Presentation Manual (2010).

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THIS SUMMARY APPLIES ONLY AT THE LOCATION OF THIS BORING AND AT THE TIME OF DRILLING. SUBSURFACE CONDITIONS MAY DIFFER AT OTHER LOCATIONS AND MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF THE ACTUAL CONDITIONS ENCOUNTERED.

FIGURE A-5

EARTHSPECTIVES
250 Goddard
Irvine, California 92618
Phone: (949) 777-1270
Fax: (949) 777-1283

September 12, 2019

ABC Liovin Drilling Inc.
1180 East Burnett Street
Signal Hill, California 90755

Attention: Mr. Ivan Liovin

Dear Mr. Liovin:

SPT Hammer Energy Measurement
Drill Rigs R-2 (D&R Limited Access), R-3 (Peterbilt CME 75), and R-4 (Peterbilt CME 85)
ES Project No. 190806-365

INTRODUCTION

This letter report summarizes the results of EarthSpectives' (ES) SPT hammer energy measurements performed on August 31, 2019. It provides a description of the test program and the results. Testing was performed on one Limited Access Rig, one CME 75, and one CME 85 Drill Rig equipped with Auto Trip hammers.

SPT energy measurements were accomplished using a Pile Driving Analyzer (PDA) system manufactured by Pile Dynamics, Inc. and was conducted in general accordance with ASTM 4945 and 6066 test standards. Results are summarized in Table 1, while more details regarding energy records are provided in Appendix A.

TESTING CONDITIONS

SPT hammer energy measurements were performed on three drill rig/hammer combination that were equipped with an automatic trip hammer. Drill rig R-2 was a D&R Limited Access Rig, R-3 was a Peterbilt CME 75 Rig, and R-4 was a Peterbilt CME-85 Rig. Samplings were performed using NWJ drilling rod.

INSTRUMENTATION

SPT energy measurements were performed by placing a 2 ft instrumented section of drill rod at the top of the drill string between the hammer and the sampling rods. The instruments consist of two sets of accelerometers and strain transducers, mounted on opposite sides of the drill rod, with a view to evaluate normal and eccentric effects. The analyzer acquired and processed the signals during sampling, and provided real-time evaluations of the maximum SPT hammer transferred energy. The raw data were stored directly on a portable field computer for subsequent analysis in the office.

RESULTS

Results from SPT hammer energy measurements are summarized in Tables 1. It shows the Energy Transfer Ratio (ETR) for every sampling depth for the tested drill rig/hammer. ETR is the ratio of the measured maximum transferred energy to rated energy of the hammer which is the product of the weight of the hammer times the height of fall (140 lb x 30 inches = 4200 lb-in = 0.35 kip-ft).

Plots of the maximum transferred energy, energy transfer ratio, and blow rate is provided as function of depth in Appendix A. Table immediately following the plot also provides the minimum, maximum, and average values at every sampling depth. In general, average ETR value for the tested hammers were 79.2%, 79.3%, and 78.7% for Drill Rigs R-2, R-3, and R-4, respectively, over all the sampling intervals as shown in Table 1.

TABLE 1 – SUMMARY OF SPT HAMMER ENERGY MEASUREMTS

Drill Rig Number Type and Model	**AVERAGE SPT HAMMER EFFICIENCY (ENERGY TRANSFER RATIO)**		
	Data Set # 1	Data Set # 2	Data Set # 3
Drill Rig R-2 D&R Limited Access Rig	81.8	80.4	77.4
Drill Rig R-3 Peterbilt CME 75	80.2	81.5	77.9
Drill Rig R-4 Peterbilt CME 85	75.2	78.8	80.4

LIMITATIONS

Professional judgments represented in this report are based on evaluations of the technical information gathered, our understanding of the proposed construction, and our general experience in the geotechnical field. We do not guarantee the performance of the project in any respect, only that our engineering work and judgments are rendered while striving to meet the standard of care of our profession at this time.

CLOSURE

We hope the above information satisfies the project needs at this time. Please call if you have any question or need more information.

Sincerely submitted for EarthSpectives,

Hossein K. Rashidi, PhD, PE
Principal Engineer

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APPENDIX B
LABORATORY TESTING

APPENDIX B
LABORATORY TESTING

B.1 General

The laboratory testing was performed using appropriate American Society for Testing and Materials (ASTM) and Caltrans Test Methods (CTM).

Modified California drive samples, Standard Penetration Test (SPT) drive samples and bulk samples collected during the field investigation were carefully sealed in the field to prevent moisture loss. The samples of earth materials were then transported to the laboratory for further examination and testing. Tests were performed on selected samples as an aid in classifying the earth materials and to evaluate their physical properties and engineering characteristics. Laboratory testing for this investigation included:

- Soil Classification: USCS (ASTM D 2487) and Visual Manual (ASTM D 2488);
- Moisture content (ASTM D 2216) and Dry Unit Weight (ASTM D 2937);
- Atterberg Limits (ASTM D 4318);
- Grain Size Distribution (ASTM D 422) & % Passing #200 Sieve (ASTM D 1140);
- Expansion Index (D 4829);
- Soil Corrosivity:
  - pH (CTM 643);
  - Water-Soluble Sulfate (ASTM D 516, CTM 417);
  - Water-Soluble Chloride(Ion-Specific Probe, CTM 422);
  - Minimum Electrical Resistivity (CTM 643);
- Resistance R-Value (CTM 301).

A summary of laboratory test results is presented in Table B-1. Brief descriptions of the laboratory testing program and test results are presented below.

B.2 Soil Classification

Earth materials recovered from subsurface explorations were classified in general accordance with Caltrans' "Soil and Rock Logging Classification Manual, 2010". The subsurface soils were classified visually / manually in the field in accordance with the Unified Soil Classification System (USCS) following ASTM D 2488; soil classifications were modified as necessary based on testing in the laboratory in accordance with ASTM D 2487. The details of the soil classification system and boring records presenting the classifications are presented in Appendix A.

B.3 Moisture Content and Dry Unit Weight

The in-situ moisture content of selected bulk, SPT and Ring samples was determined by oven drying in general accordance with ASTM D 2216. Selected California Ring samples were trimmed flush in the metal rings and wet weight was measured. After drying, the dry weight of each sample was measured, volume and weight of the metal containers was measured, and moisture content and dry density were calculated in general accordance with ASTM D 2216 and D 2937. Results of these tests are presented in Table B-1 and on the boring records in Appendix A.

B.4 Atterberg Limits

Characterization of the fine-grained fractions of soils was evaluated using the Atterberg Limits. This test includes Liquid Limit and Plastic Limit tests to determine the Plasticity Index in accordance with ASTM D 4318. Results of these tests are presented on the boring records in Appendix A, are summarized in Table B-1, and are plotted on a Plasticity Chart in Figures B-2.1 through B-2.3 of this Appendix.

B.5 Grain Size Distribution and Percent Passing No. 200 Sieve:

Representative samples were dried, weighed, soaked in water until individual soil particles were separated, and then washed on the No. 200 sieve. The percentage of fines (soil passing No. 200 sieve) was determined for selected samples in accordance with ASTM D 1140. The results of grain size distribution tests are plotted in Figures B-1.1 through B-1.3 of this appendix. The relative proportion (or percentage) by dry weight of gravel (retained on No. 4 sieve), sand (passing No. 4 and retained on No. 200 sieve), and fines (passing No. 200 sieve) are listed on the boring records in Appendix A and summarized in Table B-1.

B. 6 Expansion Index

The expansion potential of the site soils was estimated using the Expansion Index Test in accordance with ASTM D 4829. The results of this test are presented on Table B-3.

B.7 Soil Corrosivity

Tests were performed in order to determine corrosion potential of site soils on concrete and ferrous metals. Corrosivity testing included minimum electrical resistivity and soil pH (Caltrans method 643), water-soluble chlorides (Orion 170A+ Ion Probe) and water-soluble sulfates (ASTM D 516). The test results are summarized presented in Figures B-4 and in Table B-1 of this appendix.

B.8 R-Value

Resistance "R" Value tests were performed by stabilometer method on selected bulk samples of the subgrade soils. The tests were conducted in general accordance with CTM 301. The test results are presented in Figures B-5 and are summarized in Table B-1 of this appendix.

B.9 List of Attached Figures

The following tables and figures are attached and complete this appendix:

List of Tables

List of Figures

TABLE B-1: Summary of Laboratory Results

Project: Garfield Avenue and Main Street

Location: Huntington Beach CA

Number: IR751 — Sheet 1 of 1

Boring No.	Sample No.	Depth (ft)	Sample Type	Geologic Unit	USCS Group Symbol	SPT N*60 (blows/ft)	Undrained Shear Strength, Su (ksf) Pocket Pen.	Mini Vane	UU Test	Moisture Content (%)	Dry Unit Weight (pcf)	Total Unit Wt (pcf)	Atterberg Limits LL	PL	PI	Grain Size Distribution (%) by dry weight Gravel	Sand	Fines	Clay	Other Tests
B-1	B-1	0.0	BULK		CL															EI, R, CR
B-1	R-2	5.0	MC		CL	44				10.2	121.7	134.1	26	13	13					
B-1	S-3	10.0	SPT		ML	9														
B-1	R-4	15.0	MC		ML	38	4.5			16.8	98.0	114.5								
B-1	S-5	20.0	SPT		CL	91	4.5						45	18	27					
B-1	R-6	25.0	MC		SM	44				6.3	100.0	106.1								
B-1	S-7	30.0	SPT		CL	25	1.5													
B-1	R-8	35.0	MC		CL	37	3.0			31.0	91.6	119.9								
B-1	S-9	40.0	SPT		SC	77														
B-1	R-10	45.0	MC		SP-SM	>100				4.1	98.0	102.2								
B-1	S-11	50.0	SPT		SP-SM	64														
B-2	B-1	0.0	BULK		CL															
B-2	S-2	5.0	SPT		CL	23														
B-2	R-3	10.0	MC		ML	14				10.4	116.9	129.1				0	49	51		
B-2	S-4	15.0	SPT		CL	18	2.0						34	17	17					
B-2	R-5	20.0	MC		CL	>100	4.5			16.3	116.3	135.3								
B-3	B-1	0.0	BULK		CL															
B-3	R-2	5.0	MC		CL	19				13.0	115.3	130.3				1	38	61		
B-3	S-3	10.0	SPT		SM	30														
B-3	R-4	15.0	MC		SP-SM	52				3.5	98.0	101.4				0	92	8		
B-3	S-5	20.0	SPT		SP-SM	56	4.5													

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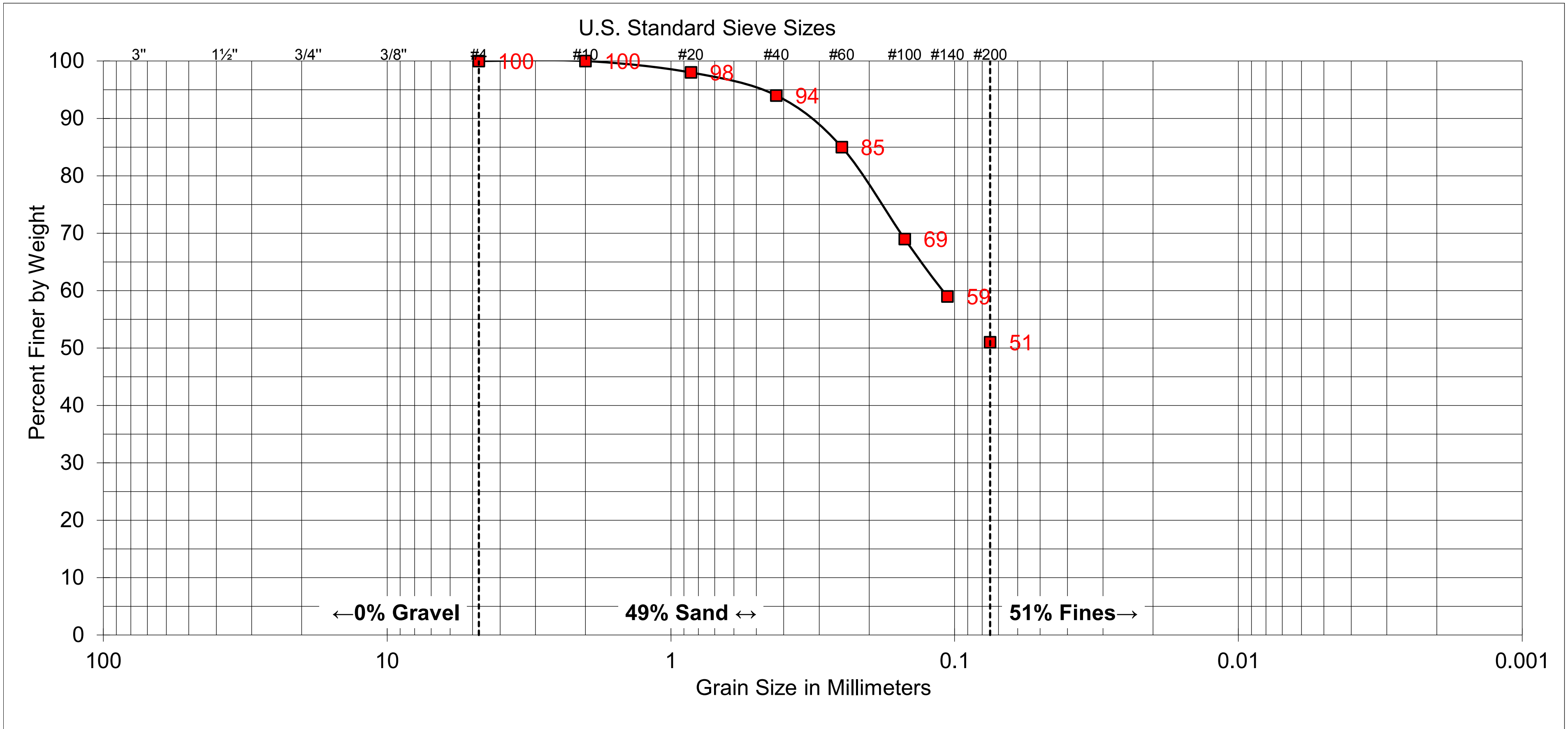

COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE B-2
SAMPLE NUMBER: R-3
SAMPLE DEPTH: 10'

UNIFIED SOIL CLASSIFICATION: ML

DESCRIPTION: SANDY SILT

ATTERBERG LIMITS
LIQUID LIMIT: 0
PLASTIC LIMIT: 0
PLASTICITY INDEX: 0

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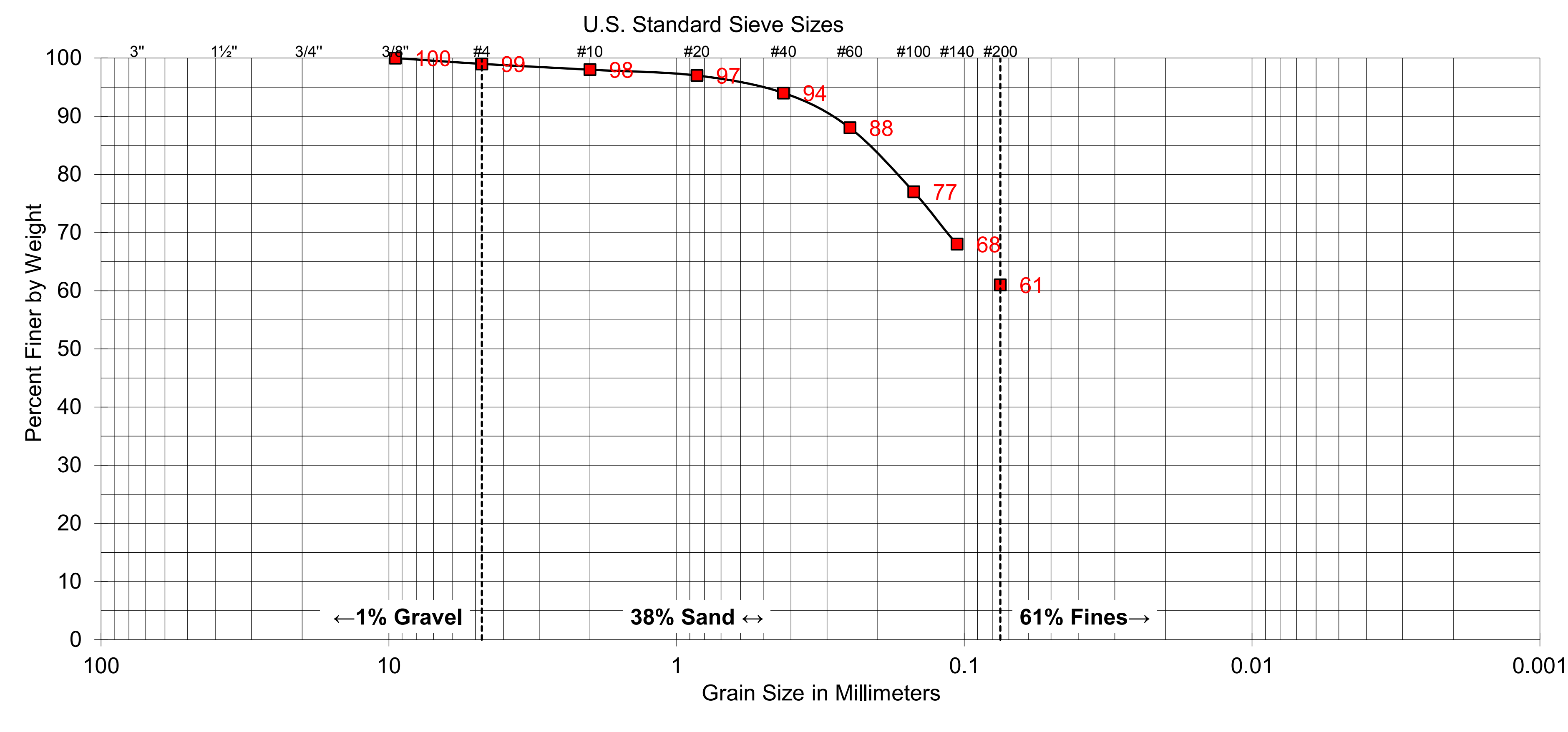
SOIL CLASSIFICATION

Laboratory No. SO5881
Project No. IR751
FIGURE B-1.1



GRAVEL		SAND			SILT AND CLAY
COARSE	FINE	COARSE	MEDIUM	FINE	

SAMPLE B-3
SAMPLE NUMBER: R-2
SAMPLE DEPTH: 5

UNIFIED SOIL CLASSIFICATION: CL

DESCRIPTION: SANDY CLAY

ATTERBERG LIMITS
LIQUID LIMIT: 0
PLASTIC LIMIT: 0
PLASTICITY INDEX: 0

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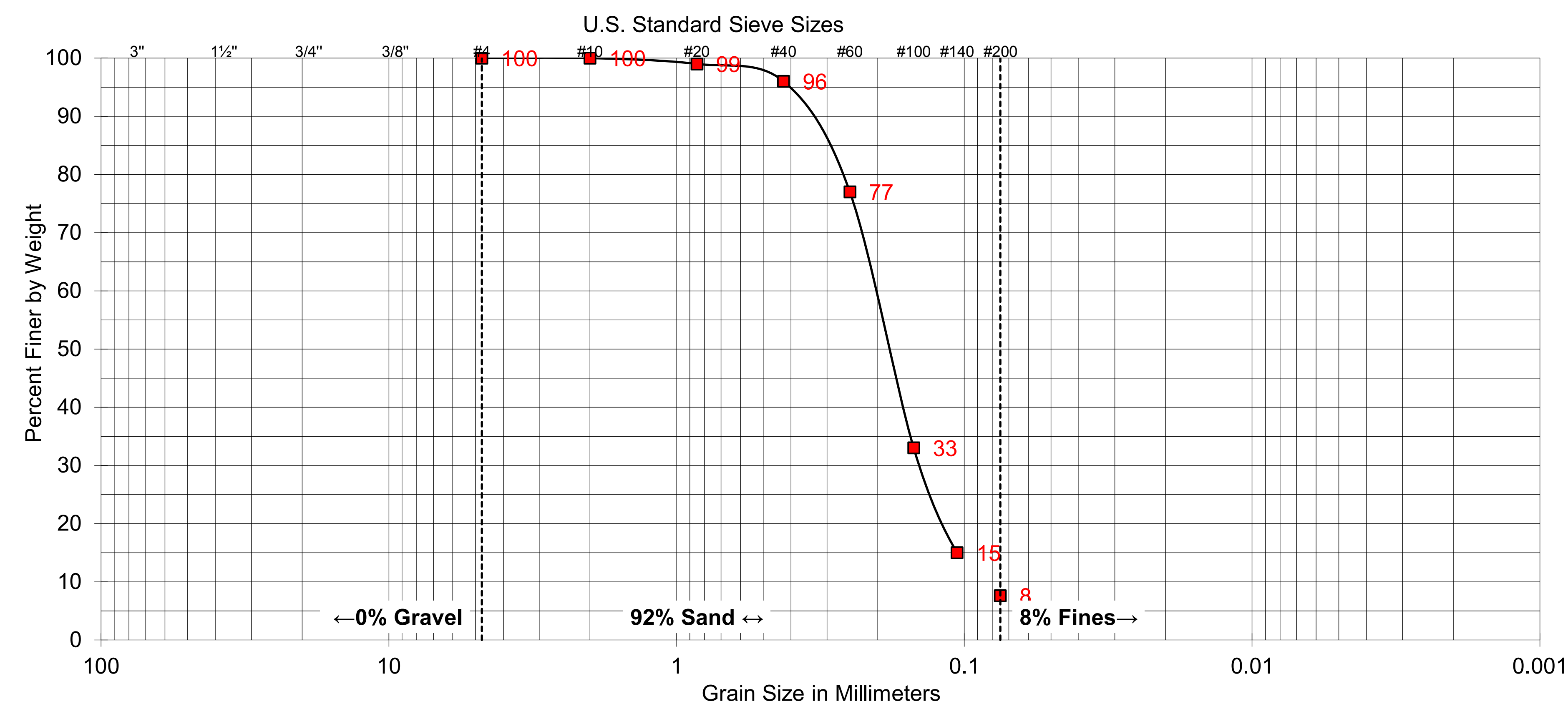
SOIL CLASSIFICATION

Laboratory No. SO5881
Project No. IR751
FIGURE B-1.2



COARSE	FINE	COARSE	MEDIUM	FINE	SILT AND CLAY
GRAVEL		SAND			

SAMPLE	B-3
SAMPLE NUMBER:	R-4
SAMPLE DEPTH:	15'

UNIFIED SOIL CLASSIFICATION: SP-SM

DESCRIPTION: POORLY GRADED SAND WITH SILT

ATTERBERG LIMITS	
LIQUID LIMIT:	0
PLASTIC LIMIT:	0
PLASTICITY INDEX:	0

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SOIL CLASSIFICATION

Laboratory No. SO5881
Project No. IR751
FIGURE B-1.3

ATTERBERG LIMITS

ASTM D-4318 / AASHTO T-89 / CTM 204

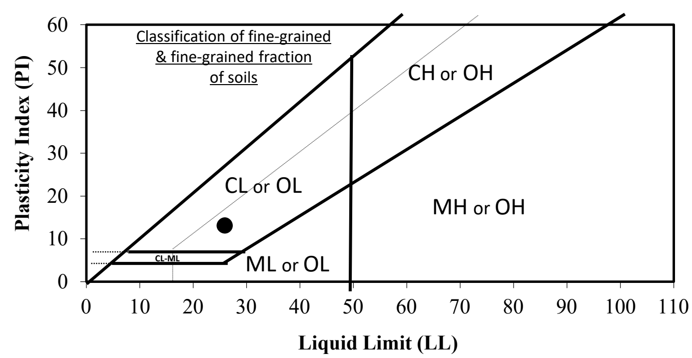
Project Name:	*Bonani-Garfield and Main*	Tested By :	*Eric Y.*	Date:	*10/30/20*
Project No. :	*IR751*	Data Input By:	*Eric Y.*	Date:	*11/02/20*
Boring No.:	*B-1*	Checked By:	*Kathy R.*	Date:	
Sample No. :	*R-2*	Depth (ft.) :	*5*		
Initial Moisture:		Container No.:	*AL-1*		
Description.:	*Dark Brown Sandy Clay - CL*				

	PLASTIC LIMIT		LIQUID LIMIT			
TEST NO.	1	2	1	2	3	4
Number of Blows [N]			33	24	17	
Container No.	1	2	3	4	5	
Wet Wt. of Soil + Cont. (gm.)	32.30	32.03	39.02	41.21	42.15	
Dry Wt. of Soil + Cont. (gm.)	31.50	31.24	36.37	38.11	38.79	
Wt. of Container (gm.)	25.51	25.30	25.79	26.34	26.65	
Moisture Content (%) [Wn]	13.36	13.30	25.05	26.34	27.68	

LIQUID LIMIT	**26**
PLASTIC LIMIT	**13**
PLASTICITY INDEX	**13**

PI at "A" - Line = 0.73(LL-20) = **4.4**

One - Point Liquid Limit Calculation $LL=Wn(N/25)^{0.121}$



PROCEDURES USED

- [ ] Wet Preparation
  Multipoint Wet Preparation
- [xx] Dry Preparation
  Multipoint Dry Preparation
- [x] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test

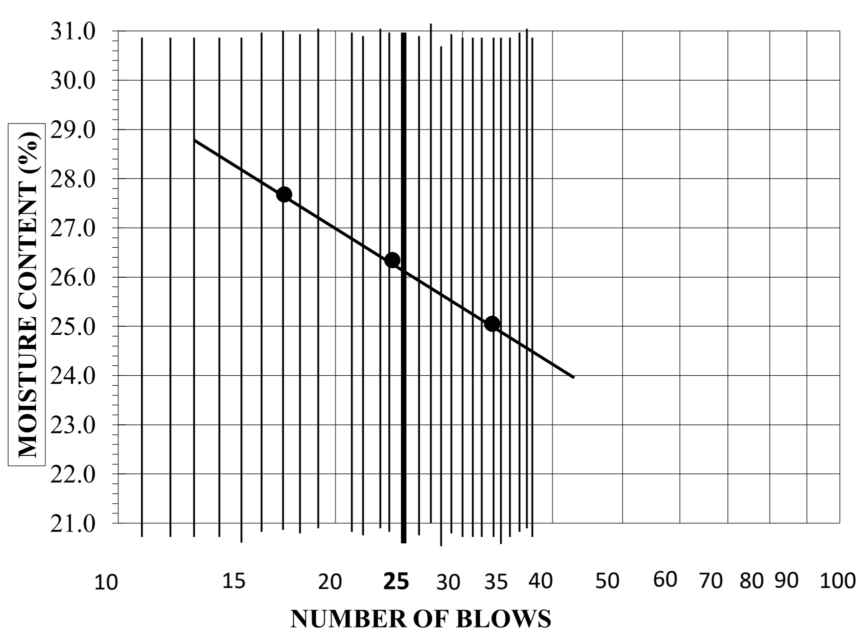


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Figure B-2.1

ATTERBERG LIMITS

ASTM D-4318 / AASHTO T-89 / CTM 204

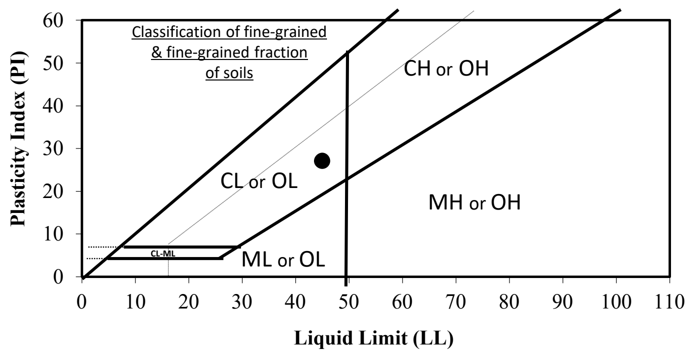
Project Name:	*Bonani-Garfield and Main*	Tested By :	*Eric Y.*	Date:	*10/30/20*
Project No. :	*IR751*	Data Input By:	*Eric Y.*	Date:	*11/02/20*
Boring No.:	*B-1*	Checked By:	*Kathy R.*	Date:	
Sample No. :	*S-5*	Depth (ft.) :	*20*		
Initial Moisture:		Container No.:	*AL-2*		
Description.:	*Olive Gray Lean Clay with Sand - CL*				

	PLASTIC LIMIT		LIQUID LIMIT			
TEST NO.	1	2	1	2	3	4
Number of Blows [N]			34	24	17	
Container No.	6	7	8	9	10	
Wet Wt. of Soil + Cont. (gm.)	32.69	32.99	37.86	39.98	39.24	
Dry Wt. of Soil + Cont. (gm.)	31.69	31.97	33.83	35.71	34.79	
Wt. of Container (gm.)	26.01	26.15	24.54	26.24	25.25	
Moisture Content (%) [Wn]	17.61	17.53	43.38	45.09	46.65	

LIQUID LIMIT	**45**
PLASTIC LIMIT	**18**
PLASTICITY INDEX	**27**

PI at "A" - Line = 0.73(LL-20) = **18.3**

One - Point Liquid Limit Calculation $LL = W_n(N/25)^{0.121}$



PROCEDURES USED

- [ ] Wet Preparation
  Multipoint Wet Preparation
- [XX] Dry Preparation
  Multipoint Dry Preparation
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test

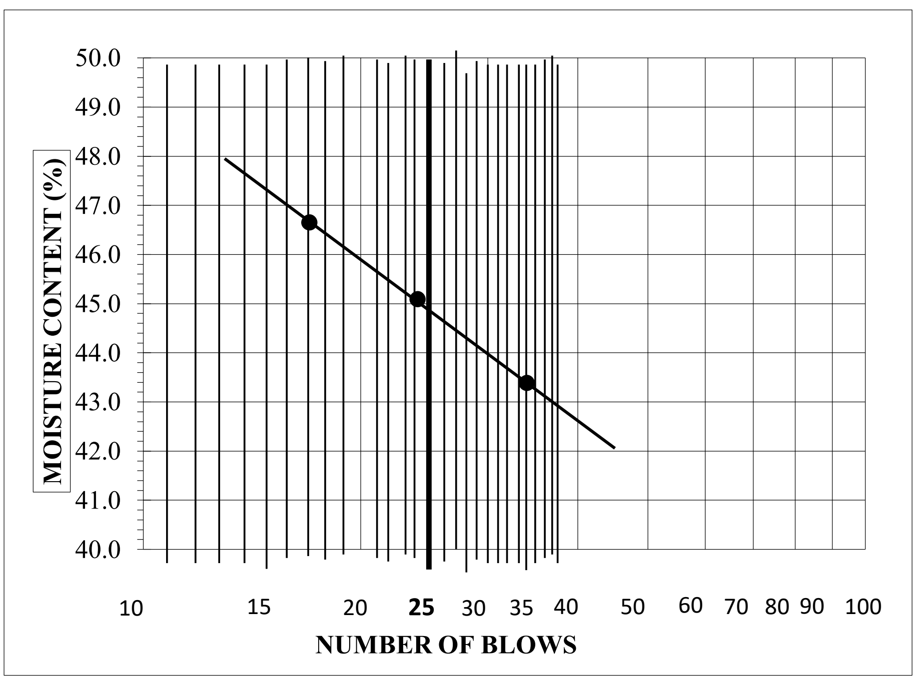


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Figure B-2.2

ATTERBERG LIMITS

ASTM D-4318 / AASHTO T-89 / CTM 204

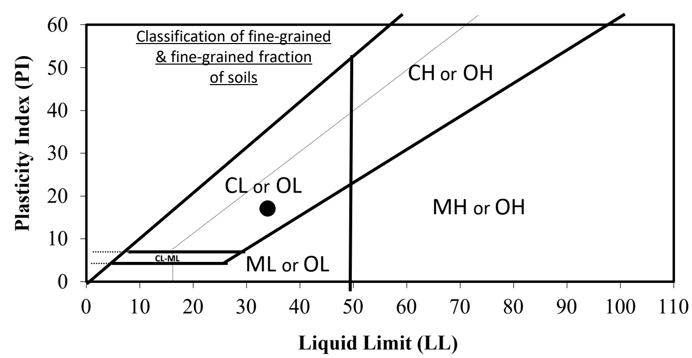
Project Name:	*Bonani-Garfield and Main*	Tested By :	*Eric Y.*	Date:	*10/30/20*
Project No. :	*IR751*	Data Input By:	*Eric Y.*	Date:	*11/02/20*
Boring No.:	*B-2*	Checked By:	*Kathy R.*	Date:	
Sample No. :	*S-4*	Depth (ft.) :	*15*		
Initial Moisture:		Container No.:	*AL-3*		
Description.:	*Dark Olive Gray Sandy Clay - CL*				

	PLASTIC LIMIT		LIQUID LIMIT			
TEST NO.	1	2	1	2	3	4
Number of Blows [N]			34	24	17	
Container No.	11	12	13	14	15	
Wet Wt. of Soil + Cont. (gm.)	31.52	32.33	39.77	38.23	40.07	
Dry Wt. of Soil + Cont. (gm.)	30.53	31.33	36.67	34.87	36.32	
Wt. of Container (gm.)	24.71	25.44	27.07	24.91	25.69	
Moisture Content (%) [Wn]	17.01	16.98	32.29	33.73	35.28	

LIQUID LIMIT	**34**
PLASTIC LIMIT	**17**
PLASTICITY INDEX	**17**

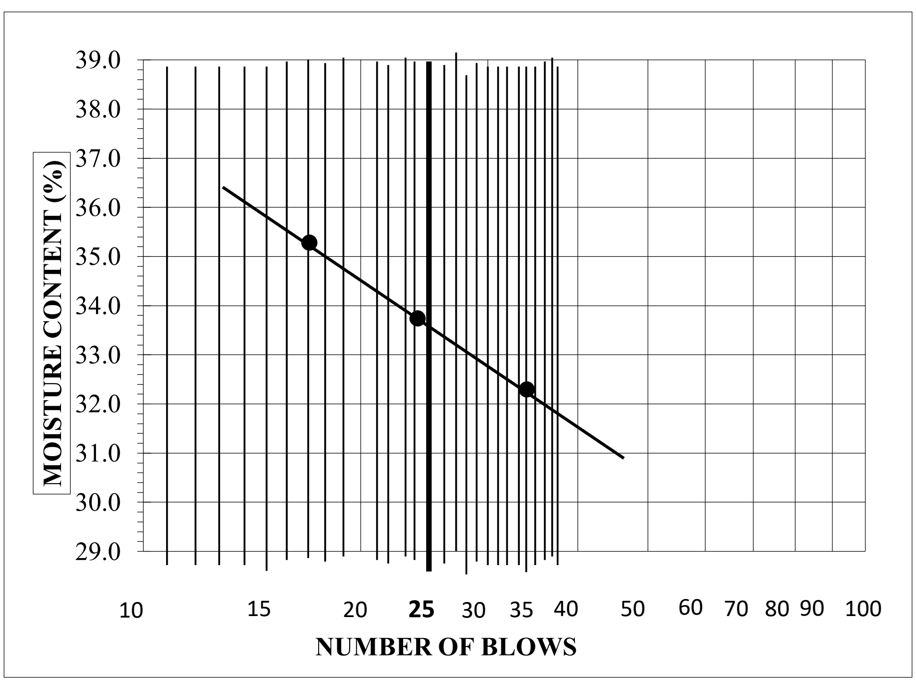
PI at "A" - Line = 0.73(LL-20) = **10.2**

One - Point Liquid Limit Calculation $LL=Wn(N/25)^{0.121}$



PROCEDURES USED

- [ ] Wet Preparation
  Multipoint Wet Preparation
- [xx] Dry Preparation
  Multipoint Dry Preparation
- [x] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



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EXPANSION INDEX OF SOIL

ASTM D-4829-10 / UBC 29-2

Lab Number: SO5881

Project Name	: Bonani-Garfield and Main	Sampled By : Giovani V.	Date : 10/26/2020
Project No.	: IR751	Prepared By : Eric Y.	Date : 10/28/2020
Boring No.	: B-1	Tested By : Eric Y.	Date : 10/29/2020
Sample No.	: Bulk-1	Calculated By : Eric Y.	Date : 11/2/2020
Depth (ft.)	: 0 - 5'	Checked By : Giovani V.	Date :
Description	: Dark Brown Sandy Clay with traces of Gravel		

Sample Preparation

1 | 1

Weight of Total Soil	2534.00	Weight of Soil Retained on No. 4 Sieve	26.70	% Passing No. 4 Sieve	98.95

Trail	1	2	3	4	Tested	M & D After Test	
Container No.	SB-1					Container No.	
Weight of Wet Soil + Container (gm)	612.66					Wet Soil+Cont.+Ring	
Weight of Dry Soil + Container (gm)	581.85					Dry Soil+Cont.+Ring	
Weight of Container (gm)	235.54					Wt. of Container	
Moisture Content (%)	8.90				8.90	Moisture Content	
Weight of Wet Soil + Ring (gm)	614.78						
Weight of Ring (gm) No. 2.0	198.70				198.70		
Weight of Wet Soil (gm)	416.08						
Wet Density of Soil (pcf)	125.51					Wet Density (pcf)	
Dry Density of Soil (pcf)	115.25					Dry Density (pcf)	
Precent Saturation of Soil $S_{(Meas.)}$	51.93				51.93	(%) Saturation	

Loading Machine No.			2	
Date	**Reading Time**	**Elapsed Time**	**Dial Reading**	**Expansion**
10/29/20	13:45:00	0:10:00		0.0000
10/29/20				
10/29/20	13:55:00	**0:00:00**	**0.3000**	**0.0000**
Add Distilled Water to Sample				
10/29/20	14:55:00	1:00:00	0.3337	0.0337
10/29/20	15:55:00	2:00:00	0.3355	0.0355
10/29/20	16:55:00	3:00:00	0.3365	0.0365
10/30/20	7:30:00	17:35:00	0.3368	0.0368
10/30/20	8:55:00	19:00:00	0.3368	0.0368
10/30/20	11:55:00	22:00:00	0.3368	0.0368
10/30/20	12:55:00	23:00:00	0.3368	0.0368
10/30/20	13:55:00	0:00:00	0.3368	0.0368

Remark :

1. Screen sample through **No. 4** *Sieve*

2. Sample should be compacted into a metal ring of the Degree of Saturation of **50 + / - 2% (48 - 52).**

3. Inundated sample in distilled water to 24 h, or until the rate of expansion > (0.0002 in./h), no less than 3 h.

Volume of Mold (ft^3)	0.00731	Specific Gravity	2.70
Rammer Weight (lb.)	5.0	Blows/Layer	15
Vertical Confining Pressure		1.0 (lbf/in^2) / 6.9 (kPa)	

$$(\%)\ S = \frac{S.G. \times W \times Dd}{Wd \times S.G. - Dd}$$

S.G.=Specific Gravity, W=Water Content

Dd=Dry Soil Density, Wd=Unit Wt. of Water

$$E.I._{(meas)} = \frac{\text{Change in High}}{\text{Initial Thickness}} \times 1000 = 36.80$$

$$\text{Expansion Index}_{(50)} = EI_{(meas.)} - (50 - S_{(meas.)}) \times \frac{65 + EI_{(meas.)}}{220 - S_{(meas.)}}$$

38	Low

Expansion Index	Potential Expansion
0 - 20	*Very Low*
21 - 50	*Low*
51 - 90	*Medium*
91 - 130	*High*
> 130	*Very High*

Figure B-3

CORROSIVITY TEST RESULTS
(ASTM D516, CTM 643)

SAMPLE	pH	RESISTIVITY (OHM-CM)	SULFATE CONTENT (%)	CHLORIDE CONTENT (%)
B-1 @ 0' - 5'	*7.99*	*824*	*0.03*	*0.01*

CORROSIVITY PARAMETERS

SULFATE CONTENT (%)	SULFATE EXPOSURE	CEMENT TYPE
0.00 to 0.10	Negligible	--
0.10 to 0.20	Moderate	II, IP(MS), IS(MS)
0.20 to 2.00	Severe	V
Above 2.00	Very Severe	V plus pozzolan

SOIL RESISTIVITY (OHM-CM)	GENERAL DEGREE OF CORROSIVITY TO FERROUS METALS
0 to 1,000	Very Corrosive
1,000 to 2,000	Corrosive
2,000 to 5,000	Moderately Corrosive
5,000 to 10,000	Mildly Corrosive
Above 10,000	Slightly Corrosive

CHLORIDE (Cl) CONTENT (%)	GENERAL DEGREE OF CORROSIVITY TO METALS
0.00 to 0.03	Negligible
0.03 to 0.15	Corrosive
Above 0.15	Severely Corrosive

SAMPLE NO.: B-1 **SAMPLE DATE:** 10/26/20

SAMPLE LOCATION: Bulk-1 @ 0 - 5' **TEST DATE:** 10/29/20

SAMPLE DESCRIPTION: Dark Brown Sandy Clay

LABORATORY TEST DATA

	TEST SPECIMEN	1	2	3	4	5	
A	COMPACTOR PRESSURE	125	100	75			[PSI]
B	INITIAL MOISTURE	10.0	10.0	10.0			[%]
C	BATCH SOIL WEIGHT	1200	1200	1200			[G]
D	WATER ADDED	55	65	75			[ML]
E	WATER ADDED (D*(100+B)/C)	5.0	6.0	6.9			[%]
F	COMPACTION MOISTURE (B+E)	15.0	16.0	16.9			[%]
G	MOLD WEIGHT	2077.4	2085.4	2069.7			[G]
H	TOTAL BRIQUETTE WEIGHT	3262.5	3258.6	3215.6			[G]
I	NET BRIQUETTE WEIGHT (H-G)	1185.1	1173.2	1145.9			[G]
J	BRIQUETTE HEIGHT	2.69	2.55	2.59			[IN]
K	DRY DENSITY (30.3*I/((100+F)*J))	116.0	120.2	114.7			[PCF]
L	EXUDATION LOAD	4405	3850	2905			[LB]
M	EXUDATION PRESSURE (L/12.54)	351	307	232			[PSI]
N	STABILOMETER AT 1000 LBS	70	60	42			[PSI]
O	STABILOMETER AT 2000 LBS	114	120	124			[PSI]
P	DISPLACEMENT FOR 100 PSI	5.79	6.39	6.98			[Turns]
Q	R VALUE BY STABILOMETER	15	12	9			
R	CORRECTED R-VALUE (See Fig. 14)	16	13	9			
S	EXPANSION DIAL READING	0.0000	0.0000	0.0000			[IN]
T	EXPANSION PRESSURE (S*43,300)	0	0	0			[PSF]
U	COVER BY STABILOMETER	0.77	0.79	0.83			[FT]
V	COVER BY EXPANSION	0.00	0.00	0.00			[FT]

TRAFFIC INDEX:	4.5
GRAVEL FACTOR:	1.58
UNIT WEIGHT OF COVER [PCF]:	130
R-VALUE BY EXUDATION:	12
R-VALUE BY EXPANSION:	100
R-VALUE AT EQUILIBRIUM:	12

*Note: Gravel factor estimated from pavement section using CTM 301, Section C, Part b.

REV. 2, DATED 1/31/15

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R-VALUE TEST RESULTS

Project No. IR751

FIGURE B-5