11.4 Geotechnical Reports

Ninyo & Moore
Geotechnical & Environmental Sciences Consultants

May 7, 2020
Project No. 209701002

Mr. Eddie Torres, Department Manager
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Subject: Update to Preliminary Geotechnical Evaluation
Doheny Village
Dana Point, California

References: Ninyo & Moore, 2016, Preliminary Geotechnical Evaluation, Doheny Village Plan, Dana Point, California, Project No. 209701001, dated June 8.

Dear Mr. Torres:

In accordance with your request, Ninyo & Moore is pleased to provide this update to our referenced report for the Doheny Village project in Dana Point California.

Doheny Village consists of approximately 80 acres and is bounded on the north by the city of San Juan Capistrano and Interstate 5 (I-5), on the east by the I-5 off-ramp to Pacific Coast Highway (PCH), on the south by PCH, and on the west by the Southern California Regional Rail Authority/Orange County Transportation Authority railroad right-of-way and San Juan Creek. The site is currently occupied by a mixed-use of residential, commercial and light industrial developments. The northern roughly third of the project site is currently occupied by a trailer park. The western roughly third of the site is occupied by commercial and light industrial properties.

The project involves creation of a development plan with alternatives for future build-out of the project area. The plan calls for mixed-use residential, commercial, and industrial development. The City has requested the preparation of an updated environmental impact report (EIR) for the project in accordance with the guidelines of the CEQA. The purpose of our original preliminary geotechnical study (Ninyo & Moore, 2016) was to provide input to the preparation of the EIR regarding the potential geologic, soils, and seismic impacts that may affect the Project. We understand the proposed land uses have been modified which has resulted in the need to update the original EIR.

The overall area, site conditions, and nature of the project have remained unchanged since our original report was issued. As a result, the majority of the findings, conclusions, and preliminary recommendations of the report remain valid and applicable. The only update needed is to the seismic ground shaking section, which has been updated to meet the current State of California and California Building Code (CBC) (2019) criteria. The following section updates and replaces Section 9.2 of the referenced preliminary geotechnical report.

9.2. Seismic Ground Shaking

Earthquake events from one of the regional active or potentially active faults near the project area could result in strong ground shaking which could affect the project site and proposed improvements. The level of ground shaking at a given location depends on many factors, including the size and type of earthquake, distance from the earthquake, and subsurface geologic conditions. The type of construction also affects how particular structures and improvements perform during ground shaking.

Considering the proximity of the site to active faults capable of producing a maximum moment magnitude of 6.0 or more, the project area has a high potential for experiencing strong ground motion. The 2019 CBC specifies that the risk-targeted maximum considered earthquake (MCER) ground motion response accelerations be used to evaluate seismic loads for design of buildings and other structures. Per the 2019 CBC, a site-specific ground motion hazard analysis shall be performed for structures on Site Class D with a mapped MCER, 5 percent damped, spectral response acceleration parameter at a period of 1 second (S1) greater than or equal to 0.2g in accordance with Sections 21.2 and 21.3 of the American Society of Civil Engineers (ASCE) Publication 7-16 (2016) for the Minimum Design Loads and Associated Criteria for Building and Other Structures. We calculated that the S1 for the site is equal to 0.44g using the 2019 Structural Engineers Association of California [SEAOC]/Office of Statewide Health Planning and Development [OSHPD] seismic design tool. This analyses is web-based; therefore, prior to final design of any proposed improvements, a site-specific ground motion hazard analysis should be performed for the project area.

The 2019 CBC specifies that the potential for liquefaction and soil strength loss be evaluated, where applicable, for the mapped PGA (PGAM) which is defined as the Maximum Considered Earthquake Geometric Mean (MCEG) PGA with adjustment for site class effects in accordance with the American Society of Civil Engineers (ASCE) 7-16 Standard. The MCEG PGA is based on the geometric mean PGA with a 2 percent probability of exceedance in 50 years. The MCEG PGA was calculated using the SEAOC/OSHPD (2020) seismic design tool that yielded a mapped MCEG PGA of 0.59g for the site and a site coefficient (FPGA) of 1.1 for Site Class D.

This potential level of ground shaking could have high impacts on project improvements without appropriate design mitigation, and should be considered during the detailed design phase of the project. As noted above, a site-specific ground motion hazard analysis should be performed for the project area, as part of a full geotechnical evaluation, prior to final design. Mitigation of the potential impacts of seismic ground shaking can be achieved through project structural design. Structural elements of planned improvements can be designed to resist or accommodate appropriate site-specific ground motions and to conform to the current seismic design standards, including CBC building regulations. Appropriate structural design and mitigation techniques would reduce the impacts related to seismic ground shaking. Earthquake events from one of the regional active or potentially active faults near the project area could result in strong ground shaking which could affect the project site and proposed improvements. The level of ground shaking at a given location depends on many factors, including the size and type of earthquake, distance from the earthquake, and subsurface geologic conditions. The type of construction also affects how particular structures and improvements perform during ground shaking.

Ninyo & Moore appreciates the opportunity to provide our services for this project.

Respectfully submitted,
NINYO & MOORE

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Ninyo & Moore
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PRELIMINARY GEOTECHNICAL EVALUATION
DOHENY VILLAGE PLAN
DANA POINT, CALIFORNIA

PREPARED FOR:
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June 8, 2016
Project No. 209701001

June 8, 2016
Project No. 209701001

Mr. Eddie Torres
Michael Baker International
14725 Alton Parkway
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Subject: Preliminary Geotechnical Evaluation
Doheny Village Plan
Dana Point, California

Dear Mr. Torres:

In accordance with your request and authorization, Ninyo & Moore has performed a preliminary geotechnical evaluation regarding the Doheny Village Plan Project in Dana Point, California. The preliminary geotechnical evaluation has been performed in general accordance with Ninyo & Moore's proposal dated November 5, 2015. This report presents our findings and conclusions regarding the subject project.

We appreciate the opportunity to provide geotechnical consulting services for this project.

Sincerely,
NINYO & MOORE

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1. INTRODUCTION

In accordance with your request and authorization, Ninyo & Moore has performed a preliminary geotechnical evaluation of the Doheny Village Plan project in the city of Dana Point, California (Figures 1 and 2). Based on information provided by the City of Dana Point (City) dated October 2015, the mixed-use project involves creation of a development plan with alternatives for future build-out of the area. The plan calls for mixed-use residential, commercial, and industrial development.

The purpose of this preliminary geotechnical evaluation was to assess the geologic conditions at the site and develop preliminary conclusions regarding potential geologic and seismic impacts associated with the project in accordance with the California Environmental Quality Act (CEQA). Where appropriate, recommendations to mitigate potential geologic hazards, as noted in this report, have been provided.

This evaluation addresses the site geologic conditions and the impacts associated with potential geologic and seismic hazards within the Doheny Village Plan area for inclusion in the environmental planning documents for the project. Our geotechnical evaluation was based on review of readily available geologic and seismic data and published geotechnical literature pertinent to the project site, and site reconnaissance. Our evaluation did not include subsurface exploration and associated laboratory testing. The results of our evaluation are intended for preliminary planning purposes. During detailed project design, subsurface exploration should be conducted by the project geotechnical consultant at the location of proposed site improvements to evaluate the site-specific geologic conditions and provide appropriate geotechnical recommendations for design and construction of the project in conjunction with the structural engineer.

2. SCOPE OF SERVICES

Ninyo & Moore's scope of services has included review of geotechnical background materials, geologic reconnaissance of the project area, and geotechnical analysis. Specifically, we have performed the following tasks:

- Review of readily available topographic and geologic maps, published geotechnical literature, geologic and seismic data, soil data, groundwater data, and aerial photographs.
- Review of in-house information related to our previous work in the project vicinity.
- Research and review of readily available geotechnical reports at the State of California GeoTracker (2016) website for commercial properties in the project area that included subsurface geotechnical data relative to the subject evaluation.
- Review of geotechnical aspects of project plans and documents pertaining to the Doheny Village site vicinity.
- Geotechnical site reconnaissance by a representative from Ninyo & Moore conducted on April 19, 2016, to observe and document the existing surface conditions at the project site.
- Compilation and analysis of existing geotechnical data pertaining to the site.
- Assessment of the general geologic conditions and seismic hazards affecting the area and evaluation of their potential impacts on the project.
- Preparation of this report presenting the results of our study, as well as our conclusions regarding the project's geologic and seismic impacts, and recommendations to address the impacts to be included in the environmental planning documents.

3. PROJECT DESCRIPTION

The mixed-use project involves creation of a development plan with alternatives for future build-out of the project area. The plan calls for mixed-use residential, commercial, and industrial development. The City has requested the preparation of an environmental impact report (EIR) for the project in accordance with the guidelines of the CEQA. The purpose of our preliminary geotechnical study is to provide input to the preparation of the EIR regarding the potential geologic, soils, and seismic impacts that may affect the Project. Our services have been performed in general accordance with CEQA guidelines.

4. SITE DESCRIPTION

Doheny Village consists of approximately 80 acres and is bounded on the north by the city of San Juan Capistrano and Interstate 5 (I-5), on the east by the I-5 off-ramp to Pacific Coast Highway (PCH), on the south by PCH, and on the west by the Southern California Regional Rail Authority/Orange County Transportation Authority railroad right-of-way and San Juan Creek. The site is currently occupied by a mixed-use of residential, commercial and light industrial developments. The northern roughly third of the project site is currently occupied by a trailer park. The western roughly third of the site is occupied by commercial and light industrial properties.

The project study area ranges in elevation from approximately 20 feet above Mean Sea Level (MSL) along the western edge of the site to approximately 100 feet above MSL adjacent to I-5 and the PCH along the northeastern and eastern edges of the site.

5. GEOLOGY

5.1. Regional Geology

The State of California is divided into geomorphic provinces defined by geographic location, large-scale bedrock types, and tectonic structure. The project site is situated at the northwest end of the Peninsular Ranges geomorphic province of southern California. This geomorphic province encompasses an area that extends approximately 125 miles from the Transverse Ranges province and the Los Angeles Basin south to the Mexican border, and beyond another approximately 775 miles to the tip of Baja California. The Peninsular Ranges province varies in width from approximately 30 to 100 miles and is characterized by northwest-trending mountain range blocks separated by similarly northwest-trending faults (Norris and Webb, 1990).

The predominant rock type that underlies the Peninsular Ranges province is a Cretaceous-age igneous rock (granitic rock) referred to as the Southern California batholith. Older Jurassic-age metavolcanic and metasedimentary rocks and older Paleozoic limestone, altered schist, and gneiss are present within the province. Cretaceous period marine sedimentary rocks, and younger Tertiary period rocks comprised of volcanic, marine, and non-marine sediments overlie the older rocks (Norris and Webb, 1990). More recent Quaternary period sediments, primarily of alluvial origin, comprise the low-lying valley and drainage areas within the region, while Quaternary marine terrace deposits and beach deposits are present along the coastal areas.

5.2. Site Geology

The Doheny Village Plan project is located along the eastern side of the alluvial valley of San Juan Creek between the San Joaquin Hills to the west and San Clemente Hills to the east. Regional geologic maps indicate the site is underlain by Holocene-age flood plain deposits comprised of sand, sandy silt, and clay. Fill soils of varying thickness and material types related to roadways and existing developments are also present over portions of the project area. A regional geologic map of the site vicinity showing the distribution of geologic units is presented on Figure 3.

The adjacent hills north and east of the site are underlain by Tertiary age marine sedimentary formations, predominantly the Capistrano Formation comprised of siltstone, claystone and sandstone. Younger Tertiary age Niguel Formation comprised of sandstone and siltstone overlies the Capistrano Formation in scattered outcrops in the adjacent hills. Older Tertiary age San Onofre Breccia underlies the Capistrano Formation to the west of the site (Tan, 1999).

5.3. Groundwater

The project study area extends along relatively low-lying terrain and groundwater is anticipated at or above sea level. Various boring logs in the vicinity of the project site indicate that the groundwater elevations in the project area range from elevations of approximately 3 to 20 feet above MSL. These elevations correspond to depths of roughly 5 to 40 feet below existing ground surfaces. In general, the reported groundwater elevations are higher along the coastline, on the order of 2 to 7 above MSL. The reported groundwater depths are generally deeper away from the coastline, on the order of 10 to 30 feet below ground surfaces (approximate elevations of 15 to 40 feet above MSL). General groundwater flow is to the south-southwest (Boyle, 2007).

The California Geological Survey (CGS) Seismic Hazard Zone report for the project area indicates that the historic high groundwater in the vicinity of the site is approximately 5 feet below the ground surface (CGS, 2001a). Fluctuations in the depth to groundwater will occur due to tidal variations, flood events, seasonal precipitation, variations in ground elevations, groundwater pumping, projected sea level rise and other factors.

6. FAULTING AND SEISMICITY

The project site is located in a seismically active area, as is the majority of southern California, and the potential for strong ground motion at the site is considered significant during the design life of proposed improvements. Table 1 lists selected principal known active faults within approximately 50 miles of the approximate center of the site and the maximum moment magnitude (M_{max}) as published by the United States Geological Survey (USGS, 2014a) in general accordance with the Uniform California Earthquake Rupture Forecast, version 3 (Field, et al., 2013). The approximate fault-to-site distances listed in Table 1 were calculated using the USGS web-based program (USGS, 2008).

Table 1 – Principal Regional Active Faults

Fault	Approximate Fault-to-Site Distance miles (kilometers)[1]	Maximum Moment Magnitude (M_{max})[1]
Newport-Inglewood/Offshore Zone of Deformation	3.0 (4.8)	7.1
San Joaquin Hills (Blind Thrust)	9.0 (15.0)	6.6
Newport-Inglewood (L.A. Basin)	17.8 (28.6)	7.1
Palos Verdes	18.0 (29.0)	7.3
Coronado Bank	18.5 (29.8)	7.6
Elsinore	22.0 (35.4)	6.8
Whittier	25.8 (41.5)	6.8
Chino-Central Avenue	25.9 (41.7)	6.7
Offshore Zone of Deformation	27.8 (44.7)	7.2
Puente Hills (Blind Thrust)	31.4 (50.5)	7.1
San Jose	41.3 (66.5)	6.4
San Jacinto	44.4 (71.4)	6.7
Sierra Madre	45.7 (73.5)	7.2
Cucamonga	45.8 (73.7)	6.9
Upper Elysian Park (Blind Thrust)	48.2 (77.6)	6.4
Raymond	51.3 (82.5)	6.5
Clamshell – Sawpit Canyon	52.6 (84.6)	6.5
Verdugo	53.5 (86.1)	6.9
San Andreas	54.3 (87.4)	7.4
Hollywood	55.1 (88.7)	6.4

Notes:
[1] United States Geological Survey (USGS), 2008.

The faults in southern California are classified as active, potentially active, and inactive faults. As defined by the CGS, active faults are faults that have ruptured within Holocene time, or within approximately the last 11,000 years. Potentially active faults are those that show evidence of movement during Quaternary time (approximately the last 1.6 million years) but for which evidence of Holocene movement has not been established. Inactive faults have not ruptured in the last approximately 1.6 million years. Figure 4 shows the approximate site location relative to the principal faults in the region based on the Fault Activity Map of California (Jennings and Bryant, 2010).

Nearby active faults in the vicinity of the Doheny Village Plan site include the active Newport-Inglewood/Offshore Zone of Deformation fault zone located offshore approximately 3 miles west of the site and the active San Joaquin Hills Blind Thrust fault located approximately 9 miles northwest of the site. Blind thrust faults, including the San Joaquin Hills fault, are low-angle faults at depths that do not break the ground surface and are, therefore, not shown on Figure 4. Although blind thrust faults do not have a surface trace, they can be capable of generating damaging earthquakes and are included in Table 1.

Based on our background review, the site vicinity is not transected by known active or potentially active faults. The site is not located within a State of California Earthquake Fault Zone (EFZ) (Hart and Bryant, 1997). The site is located within a State of California Seismic Hazard Zone as an area considered susceptible to liquefaction (CGS, 2001a, 2001b), as shown on Figure 5.

7. METHODOLOGY FOR GEOLOGIC IMPACT AND HAZARD ANALYSES

As outlined by the CEQA, the Doheny Village Plan project site has been evaluated with respect to potential geologic and seismic impacts associated with the project. Evaluation of impacts due to potential geologic and seismic hazards is based on our review of readily available published geotechnical literature and geologic and seismic data pertinent to the proposed project, and site reconnaissance. The references and data reviewed include, but are not limited to, the following:

- Geologic maps and fault maps from the CGS and USGS.
- Topographic maps from the USGS.

- State of California EFZ Maps.
- State of California Seismic Hazards Zones Reports and Maps.
- Seismic data from the CGS and USGS.
- Geotechnical publications by the CGS and USGS.
- Subsurface geotechnical data from previous subsurface explorations in the project vicinity.
- Aerial photographs.

8. THRESHOLDS OF SIGNIFICANCE

A summary of the potential geologic and seismic impacts that could affect the project site are presented in Table 2. According to Appendix G of the CEQA guidelines (California Environmental Resources Evaluation System [CERES], 2005a, 2005b), a project is considered to have a geologic impact if its implementation would result in or expose people/structures to potential substantial adverse effects, including the risk of loss, injury, or death involving hazards involving one or more of the geologic conditions presented in Table 2. Table 2 also presents the impact potential as defined by CEQA associated with each of the geologic conditions discussed in the following sections.

Table 2 – Summary of Potential Geologic Impacts/Hazards

Geologic Condition	Impact Potential[1]			
	Potentially Significant Impact	Less than Significant with Mitigation Incorporation	Less than Significant Impact	No Impact
Earthquake Fault Rupture			x	
Strong Seismic Ground Shaking		x		
Seismically Related Ground Failure, Including Liquefaction		x		
Landslides			x	
Substantial Soil Erosion			x	
Subsidence			x	
Compressible/Collapsible Soils		x		
Expansive Soils		x		
Groundwater and Excavations		x		

Note:
[1]Reference: CERES, 2005, Appendix G – Environmental Checklist Form, Final Text, dated October 26.
Website: http://ceres.ca.gov/topic/envlaw/ceqa/guidelines/appendices.html

9. CONCLUSIONS AND RECOMMENDATIONS FOR POTENTIAL GEOLOGIC AND SEISMIC IMPACTS/HAZARDS

The purpose of our evaluation was to provide an overview of the geotechnical site conditions and the potential geologic/seismic hazards that may affect developing the Doheny Village Plan property as part of the Doheny Village project. Our evaluation was based on review of readily available geologic, seismic and groundwater data, previous subsurface exploration data by Ninyo & Moore and others, site reconnaissance, and engineering analyses. Based on the results of our geotechnical evaluation, implementation of the proposed Doheny Village project facilities in the Doheny Village Plan area is not anticipated to have a significant impact on the geologic environment. However, future development within the project area may be subjected to potential impacts from geologic and seismic hazards.

The potential geologic/seismic hazards and geotechnical constraints described in the following sections will involve various types of mitigation in order to reduce the potential impacts and suitably prepare the site and proposed structures for development. Mitigation generally includes sound engineering practice in the design and construction of future development, including the implementation of appropriate geotechnical recommendations prior to the design and construction of the facilities, in the project area. General mitigation concepts regarding the potential geotechnical hazards and constraints at the Doheny Village Plan site are presented in the following sections. Prior to design of future improvements, detailed subsurface geotechnical evaluation should be performed to address the site-specific conditions at the locations of the planned improvements and to provide detailed recommendations for design and construction.

9.1. Surface Fault Rupture

Surface fault rupture is the offset or rupturing of the ground surface by relative displacement across a fault during an earthquake. Based on our review of referenced geologic and fault hazard data and site reconnaissance, the project site is not transected by known active or potentially active faults. The active Newport-Inglewood/Offshore Zone of Deformation fault zone is located offshore approximately 3 miles east of the site. The site is not located within a State of California EFZ (Hart and Bryant, 1997). Therefore, the potential for surface rupture is considered low. However, lurching or cracking of the ground surface as a result of nearby seismic events is possible.

9.2. Seismic Ground Shaking

Earthquake events from one of the regional active or potentially active faults near the project area could result in strong ground shaking which could affect the project site and proposed improvements. The level of ground shaking at a given location depends on many factors, including the size and type of earthquake, distance from the earthquake, and subsurface geologic conditions. The type of construction also affects how particular structures and improvements perform during ground shaking.

The 2013 California Building Code (CBC) specifies that the Risk-Targeted, Maximum Considered Earthquake (MCE_R) ground motion response accelerations be used to evaluate seismic loads for design of buildings and other structures. The MCE_R ground motion response accelerations are based on the spectral response accelerations for 5 percent damping in the direction of maximum horizontal response and incorporate a target risk for structural collapse equivalent to 1 percent in 50 years with deterministic limits for near-source effects. The horizontal peak ground acceleration (PGA) that corresponds to the MCE_R for the site was calculated as 0.57g using the USGS (USGS, 2014) seismic design tool (web-based).

The 2013 CBC specifies that the potential for liquefaction and soil strength loss be evaluated, where applicable, for the mapped PGA (PGA_M) which is defined as the Maximum Considered Earthquake Geometric Mean (MCE_G) PGA with adjustment for site class effects in accordance with the American Society of Civil Engineers (ASCE) 7-10 Standard. The MCE_G PGA is based on the geometric mean PGA with a 2 percent probability of exceedance in 50 years. The MCE_G PGA was calculated using the USGS (USGS, 2014c) seismic design tool that yielded a mapped MCE_G PGA of 0.57g for the site and a site coefficient (F_{PGA}) of 1.00 for Site Class D.

This potential level of ground shaking could have high impacts on project improvements without appropriate design mitigation, and should be considered during the detailed design phase of the project. Mitigation of the potential impacts of seismic ground shaking can be achieved through project structural design. Structural elements of planned improvements can be designed to resist or accommodate appropriate site-specific ground motions and to conform to the current seismic design standards, including CBC building regulations. Appropriate structural design and mitigation techniques would reduce the impacts related to seismic ground shaking.

9.3. Liquefaction

Liquefaction is the phenomenon in which loosely deposited granular soils located below the water table undergo rapid loss of shear strength due to excess pore pressure generation when subjected to strong earthquake-induced ground shaking. Ground shaking of sufficient duration results in the loss of grain-to-grain contact due to rapid rise in pore water pressure causing the soil to behave as a fluid for a short period of time. Liquefaction is known generally to occur in saturated or near-saturated cohesionless soils at depths shallower than 50 feet. Factors known to influence liquefaction potential include composition and thickness of soil layers, grain size, relative density, groundwater level, degree of saturation, and both intensity and duration of ground shaking. The potential damaging effects of liquefaction include differential settlement, loss of ground support for foundations, ground cracking, heaving and cracking of slabs due to sand boiling, buckling of deep foundations due to liquefaction-induced ground settlement.

According to Seismic Hazard Zones Maps published by the State of California (CGS, 2001a and 2001b), the site is located within an area considered susceptible to liquefaction (Figure 5). Recent data indicate that groundwater depths in the site vicinity are on the order of 3 to 20 feet below the ground surface; and the historic high groundwater depths in the site vicinity are on the order of 5 feet.

A liquefaction evaluation report was recently prepared recently for the project by Coastal Geotechnical (2016). Their evaluation included review of previous geotechnical evaluations in the project area, drilling four additional borings, performing laboratory analyses, and performing liquefaction analyses. The report concluded "... it appears that liquefaction is likely in the event of the design earthquake for the portion of the Doheny Village Planning Area generally west of Doheny Park Road due to the generally loose, sandy nature of the soils in the area. Calculated liquefaction induced settlement for various peak ground accelerations and depths of groundwater range from 1.5 inches to 6.8 inches in this area." The report also concluded that individual geotechnical investigations and liquefaction evaluations should be performed on individual properties to assess the liquefaction potential at any specific location.

Detailed assessment of the potential for liquefaction and seismically induced dynamic settlement and its effect on the Doheny Village Plan improvements would be evaluated prior to design and construction of project improvements, and incorporated into the design, as appropriate. Site-specific geotechnical evaluations to assess the liquefaction and dynamic settlement characteristics of the on-site soils would include drilling of exploratory borings, cone penetration tests, evaluation of groundwater depths, and laboratory testing of soils

Structural design and mitigation techniques would be developed to reduce the impacts related to liquefaction. Mitigation alternatives for potential dynamic settlement related to liquefaction include supporting structures on deep pile foundations that extend through the liquefiable zones into competent material or stabilization of the liquefiable soils using in-situ ground improvement techniques such as vibro-replacement stone columns, rammed aggregate piers, compaction grouting, soil-cement mixing, or jet grouting. Soil stabilization would mitigate the liquefaction hazard and the new structures could then be supported on shallow foundation systems.

9.4. Landslides

Landslides, slope failures, and mudflows of earth materials generally occur where slopes are steep and/or the earth materials are too weak to support themselves. Earthquake-induced landslides may also occur due to seismic ground shaking. According to the Seismic Hazard Zones map (Figure 5), the areas adjacent to the northeastern and eastern edges of the site are mapped as being generally susceptible to landsliding. The Capistrano Formation, the formational unit that underlies the slopes and hills adjacent to the site, is considered prone to landsliding and slope instability. However, landslides are not mapped on or adjacent to the site. The majority of the site is relatively level and has been extensively developed with pavements, hardscape, and structures. Accordingly, the potential for landslides or mudflows to affect the project site is considered low.

9.5. Tsunamis

Tsunamis are long seismic sea waves (long compared to ocean depth) generated by sudden movements of the sea floor caused by submarine earthquakes, landslides, or volcanic activity. As shown on Figure 6 (California Emergency Management Agency, 2009), the project area is not mapped within a tsunami inundation zone. Based on this information and the elevation of the site, the potential for a tsunami to impact the site is considered low.

9.6. Soil Erosion

Erosion is a process by which soil or earth material is loosened or dissolved and removed from its original location. Future construction at the site will result in ground surface disruption during demolition, excavation, grading, and trenching that would create the potential for erosion to occur. Erosion can occur by varying processes and may occur at the site where bare soil is exposed to wind or moving water (both rainfall and surface runoff). The processes of erosion are generally a function of material type, terrain steepness, rainfall or irrigation levels, surface drainage conditions, and general land uses.

Based on our review of geologic references and site reconnaissance, the materials exposed at the surface of the project site include sands, silty sands, and clayey soils. Sandy soils typically have low cohesion, and have a relatively higher potential for erosion from surface runoff when exposed in cut slopes or utilized near the face of fill embankments. Surface soils with higher amounts of clay tend to be less erodible as the clay acts as a binder to hold the soil particles together.

Future construction at the site may create the potential for soil erosion during excavation, grading, and trenching activities. However, a Storm Water Pollution Prevention Program incorporating Best Management Practices (BMPs) for erosion control is typically prepared prior to the start of construction to mitigate erosion during site construction. Typical BMPs include erosion prevention mats or geofabrics, silt fencing, sandbags, plastic sheeting, temporary drainage devices, and positive surface drainage to allow surface runoff to flow away from site improvements or areas susceptible to erosion. Surface drainage design provisions and site maintenance practices would reduce potential soil erosion following site development.

9.7. Subsidence

Subsidence is characterized as a sinking of the ground surface relative to surrounding areas, and can generally occur where deep soil deposits are present. Subsidence in areas of deep soil deposits is typically associated with regional groundwater withdrawal or other fluid withdrawal from the ground such as oil and natural gas. Subsidence can result in the development of ground cracks and damage to subsurface vaults, pipelines and other improvements.

Historic evidence of subsidence is not known to have occurred at the project site and the potential for subsidence in the project area is considered to be relatively low. To evaluate the potential for subsidence to affect future project components, surface reconnaissance and subsurface evaluation should be performed. During the detailed design phase of the project, site-specific geotechnical evaluations would be performed to assess the settlement potential of the on-site natural soils and undocumented fill. This may include detailed surface reconnaissance to evaluate site conditions, and drilling of exploratory borings or test pits and laboratory testing of soils, where appropriate, to evaluate site conditions.

9.8. Compressible/Collapsible Soils

Compressible soils are generally comprised of soils that undergo consolidation when exposed to new loading, such as fill or foundation loads. Soil collapse is a phenomenon where the soils undergo a significant decrease in volume upon increase in moisture content, with or without an increase in external loads. Buildings, structures and other improvements may be subject to excessive settlement-related distress when compressible soils or collapsible soils are present.

Based on our background review, the project area is underlain by younger to older alluvial deposits that are considered poorly to relatively well consolidated. Due to the presence of potentially compressible/collapsible soils at the site, there is a potential for differential settlement to affect future improvements without appropriate mitigation during detailed project design and construction.

To evaluate the potential for settlement to affect future project components, surface reconnaissance and subsurface evaluation should be performed. During the detailed design phase of the project, site-specific geotechnical evaluations would be performed to assess the settlement potential of the on-site natural soils and undocumented fill. This may include detailed surface reconnaissance to evaluate site conditions, and drilling of exploratory borings or test pits and laboratory testing of soils, where appropriate, to evaluate site conditions.

Alternatives to mitigate potential settlement due to compressible soils at the site include over-excavation and re-compaction, supporting structures on pile foundations, or in-situ ground improvement to limit settlement to acceptable levels so that structures are not adversely impacted. To mitigate potential settlement for other relatively light minor structures, new pavements and hardscape, loose/soft soils encountered at the subgrade and foundation levels of these improvements during construction can be removed and replaced with suitable compacted fill, based on detailed design stage recommendations.

9.9. Expansive Soils

Expansive soils include clay minerals that are characterized by their ability to undergo significant volume change (shrink or swell) due to variations in moisture content. Sandy soils are generally not expansive. Changes in soil moisture content can result from rainfall, irrigation, pipeline leakage, surface drainage, perched groundwater, drought, or other factors. Volumetric change of expansive soil may cause excessive cracking and heaving of structures with shallow foundations, concrete slabs-on-grade, or pavements supported on these materials.

The Doheny Village Plan site has a wide areal extent and variable surface soils are anticipated at the site. Detailed assessment of the potential for expansive soils would be evaluated during the design phase of the project and mitigation techniques would be developed, as appropriate, to reduce the impacts related to expansive soils.

The potential for expansive soils to impact site improvements can be mitigated by removal of near-surface expansive soils and replacement with low expansive material during construction and providing positive surface drainage for site improvements to reduce infiltration of water into the subsurface. Additionally, expansive soil mitigation can involve design of site improvements to resist the effects of expansive soils, including deepening foundation members and strengthening foundations and slabs with additional reinforcement, or utilizing post-tensioned slabs.

9.10. Groundwater and Excavations

The depth of historic high groundwater at the project site is on the order of 5 feet below the ground surface (CGS, 1998a). Based on the data from monitoring wells and logs of exploratory borings located in the Doheny Village Plan project study area, the depth to groundwater ranges from approximately 5 to 30 feet below the ground surface (California State Water Resources Control Board, 2016).

Proposed future improvements at the project site are anticipated to include excavations and site grading for new structures. Based on the groundwater levels reported in the site vicinity and the anticipated depth of construction activities, groundwater may have a significant impact on excavations for the planned project improvements.

Wet or saturated soil conditions encountered in excavations during construction for the project can cause instability of the excavations, and present a constraint to construction activities. Excavations in areas with shallow groundwater may need to be cased/shored and/or dewatered to maintain stability of the excavations and adjacent improvements and provide access for construction.

Groundwater levels may be influenced by seasonal variations, precipitation, irrigation, soil/rock types, tidal fluctuations, groundwater pumping, and other factors and are subject to fluctuations. On-site infiltration of stormwater related to low impact development guidelines may have an impact on existing and planned site improvements and should be evaluated during the detailed design phase of the project.

Further study, including subsurface exploration, should be performed during the detailed design phase of planned improvements to evaluate the presence of groundwater, and to evaluate the potential for stormwater infiltration at the site, and the potential impacts on design and construction of project improvements. Mitigation techniques should be developed, as appropriate, to reduce the impacts related to groundwater. The potential impacts due to groundwater would be reduced with incorporation of techniques such as casing, shoring and/or construction dewatering.

10. LIMITATIONS

The purpose of this study was to evaluate geotechnical conditions and potential geologic and seismic hazards at the site by reviewing readily available geotechnical data, and performing a site reconnaissance to provide a preliminary geotechnical report which can be utilized in the preparation of environmental documents for the project.

The geotechnical analyses presented in this report have been conducted in accordance with current engineering practice and the standard of care exercised by reputable geotechnical consultants performing similar tasks in this area. No other warranty, implied or expressed, is made regarding the conclusions, recommendations, and professional opinions expressed in this report. Our preliminary conclusions and recommendations are based on a review of readily available geotechnical literature, geologic and seismic data, and an analysis of the observed conditions. Variations may exist and conditions not observed or described in this report may be encountered.

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AERIAL PHOTOGRAPHS				
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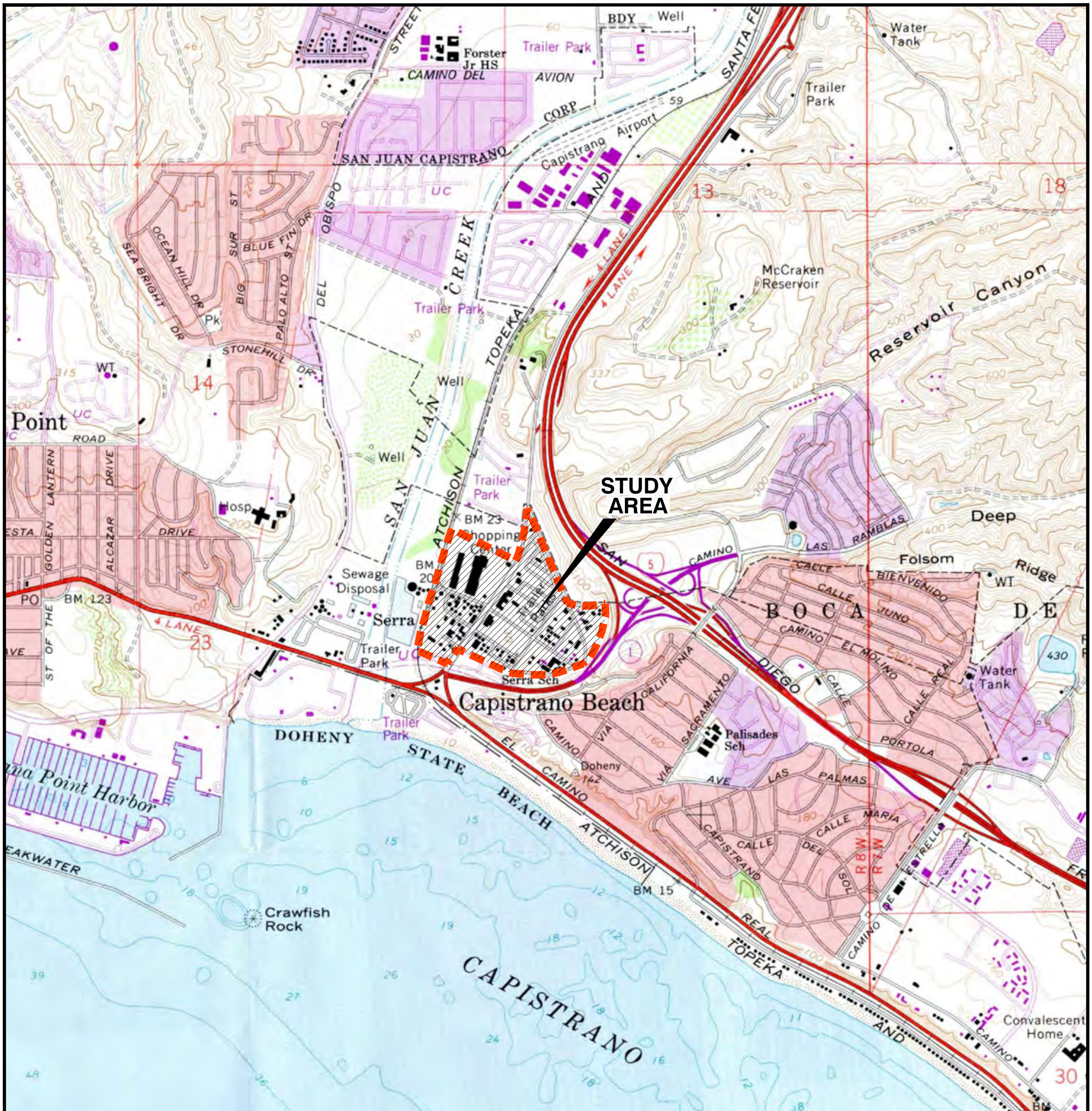

REFERENCE: 7.5 MINUTE USGS TOPOGRAPHIC MAP OF DANA POINT, CALIFORNIA QUADRANGLE, DATED 1968, SCALE 1:24,000.

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SCALE IN FEET

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NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.

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Ninyo & Moore		STUDY AREA	FIGURE
PROJECT NO.	DATE	DOHENY VILLAGE PLAN DANA POINT, CALIFORNIA	1
209701001	6/16		

REFERENCE: GOOGLE EARTH, PHOTOGRAPH DATED APRIL 16, 2013.

SCALE IN FEET

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NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.

Ninyo & Moore		SITE PLAN	FIGURE
PROJECT NO.	DATE	DOHENY VILLAGE PLAN DANA POINT, CALIFORNIA	2
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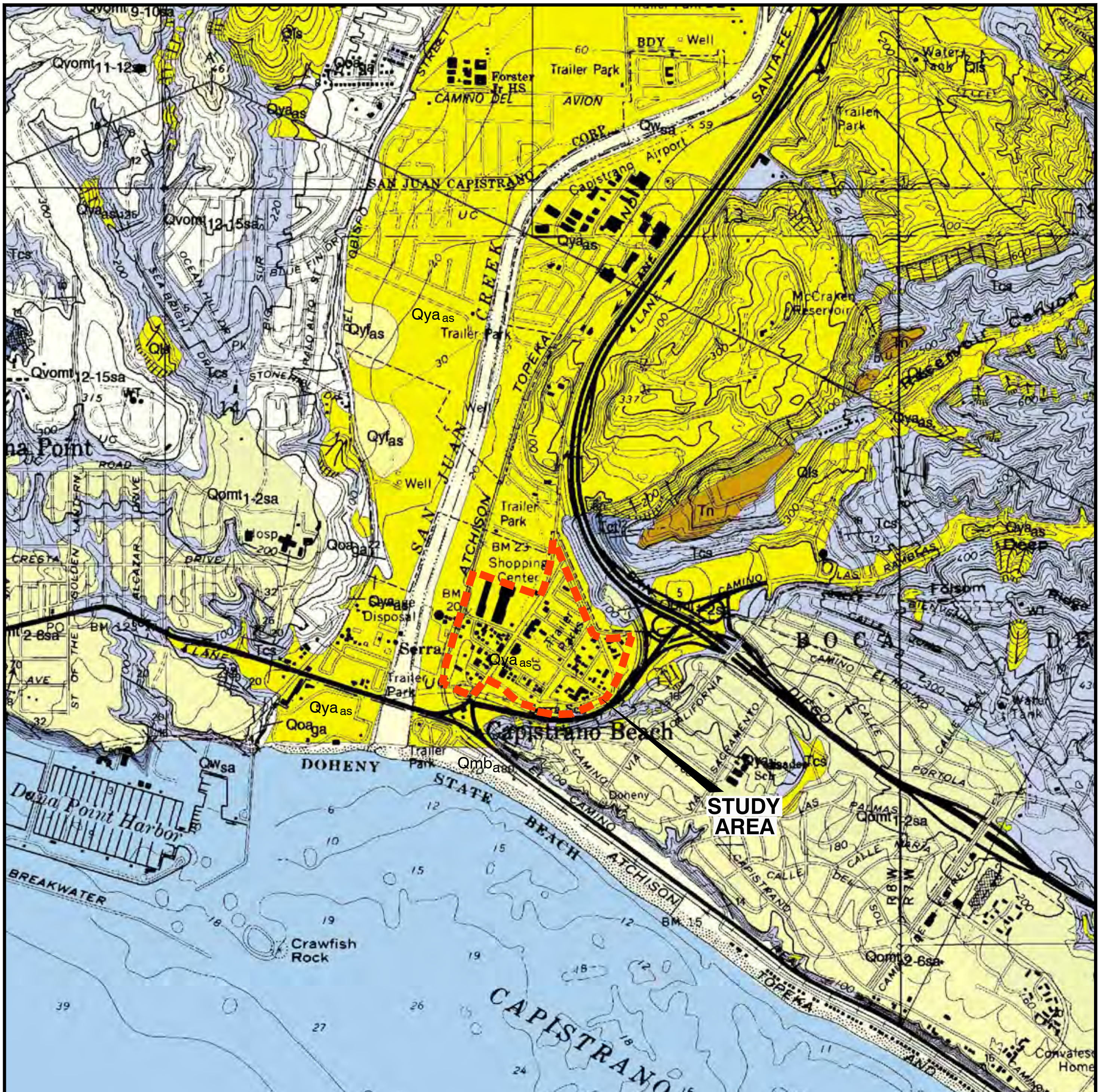

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N

SCALE IN FEET

0 2,000 4,000

NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.

LEGEND

Qw_{sa}	ACTIVE CHANNEL AND WASH DEPOSITS
Qmb_a	ACTIVE MARINE BEACH DEPOSITS
Qya_{as}	YOUNGER (HOLOCENE, (NOT ACTIVE) ALLUVIAL FLOOD PLAIN DEPOSITS
Tcs	CAPISTRANO FORMATION
	GEOLOGIC CONTACT

Ninyo & Moore

REGIONAL GEOLOGY

DOHENY VILLAGE PLAN
DANA POINT, CALIFORNIA

PROJECT NO.	DATE
209701001	6/16

FIGURE

3

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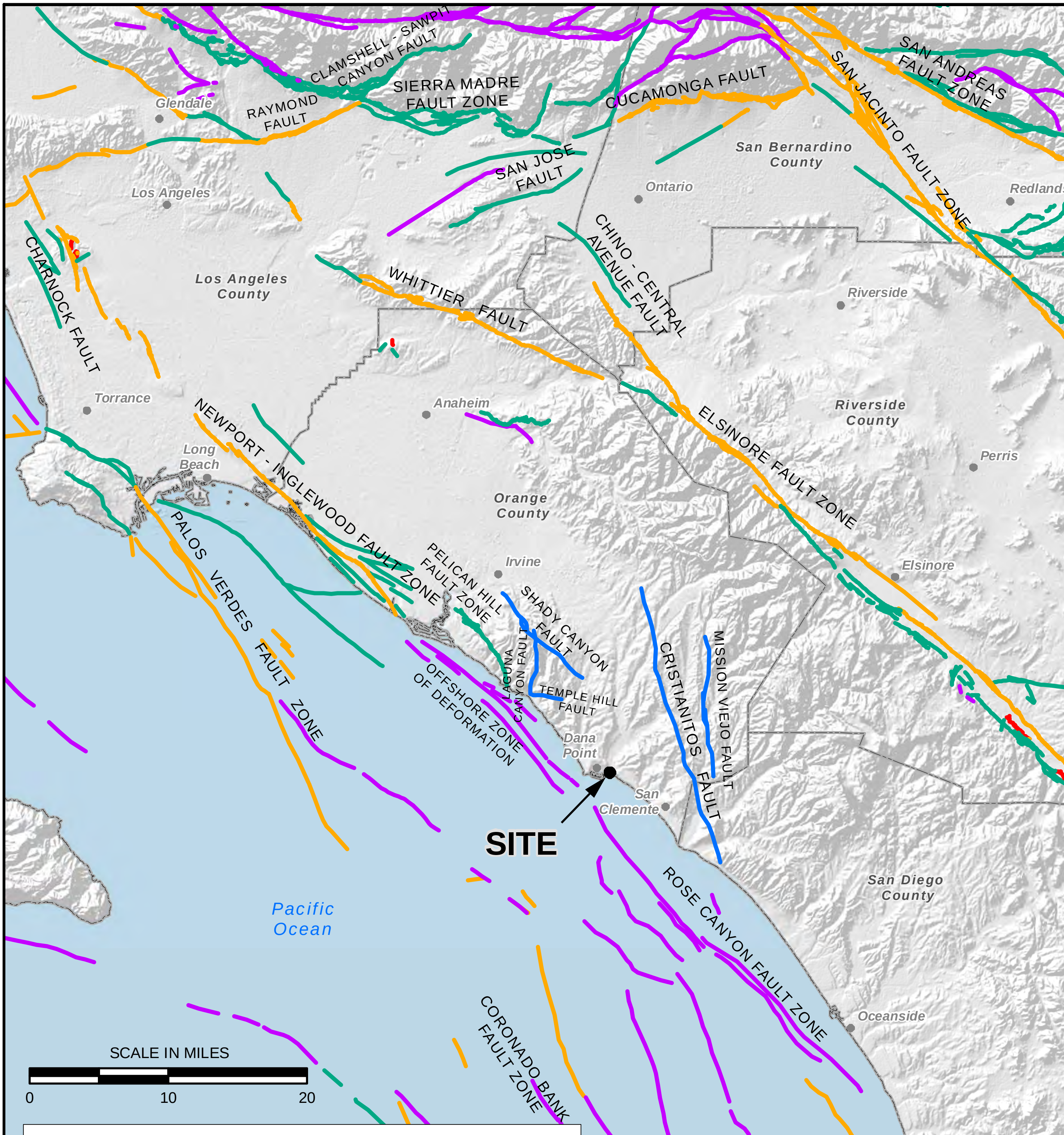

LEGEND

CALIFORNIA FAULT ACTIVITY

- HISTORICALLY ACTIVE
- HOLOCENE ACTIVE
- LATE QUATERNARY (POTENTIALLY ACTIVE)
- QUATERNARY (POTENTIALLY ACTIVE)
- QUATERNARY (INACTIVE)
- STATE/COUNTY BOUNDARY

N

DATA SOURCE: U.S. GEOLOGICAL SURVEY AND CALIFORNIA GEOLOGICAL SURVEY, 2006, QUATERNARY FAULT AND FOLD DATABASE FOR THE UNITED STATES, ACCESSED 2011, FROM USGS WEB SITE: HTTP//EARTHQUAKES.USGS.GOV/REGIONAL/QFAULTS/.

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NOTE: DIRECTIONS, DIMENSIONS AND LOCATIONS ARE APPROXIMATE.

Ninyo & Moore		FAULT LOCATIONS	FIGURE
PROJECT NO.	DATE	DOHENY VILLAGE PLAN DANA POINT, CALIFORNIA	4
209701001	6/16		

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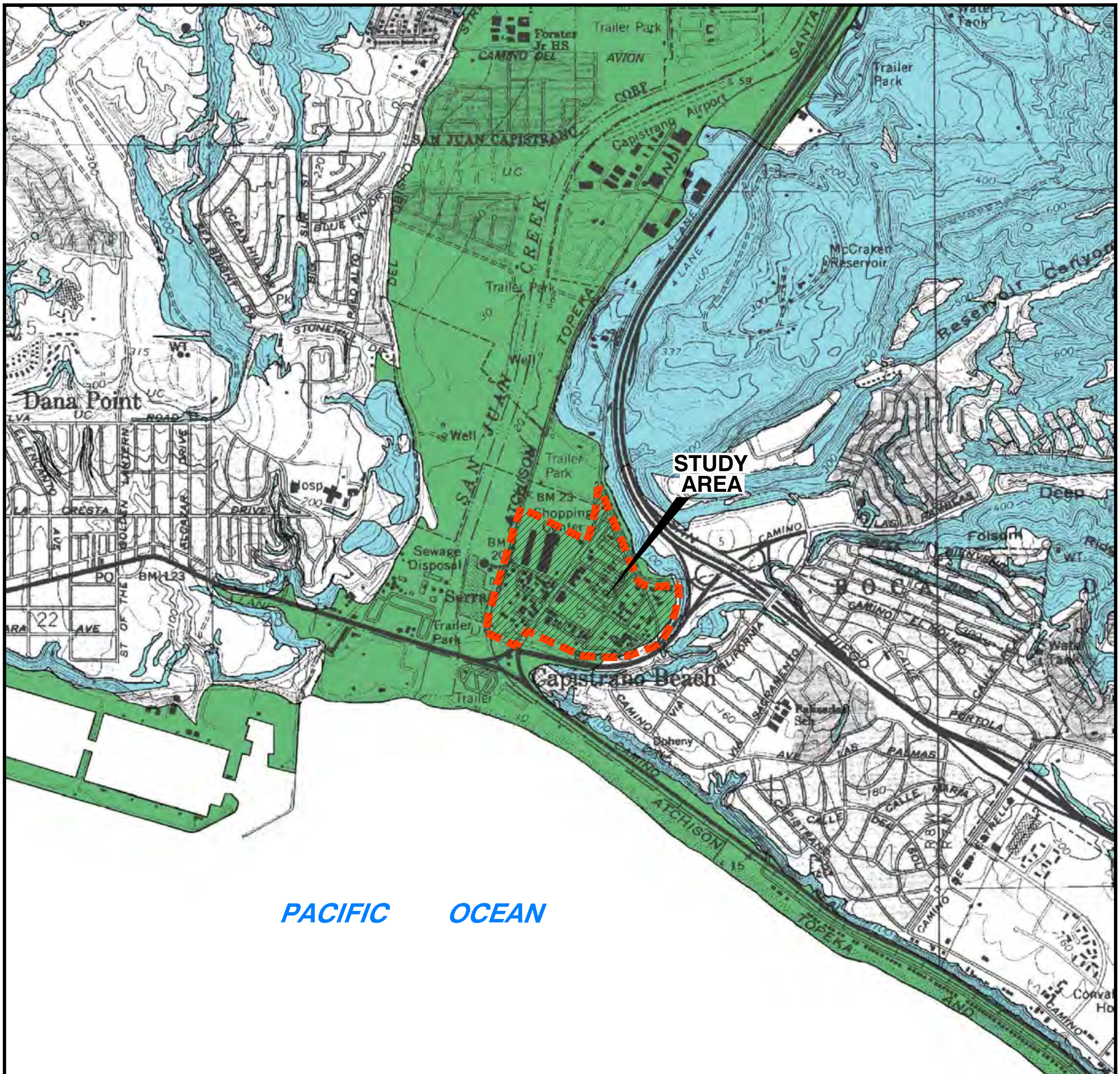

REFERENCE: CALIFORNIA GEOLOGICAL SURVEY, STATE OF CALIFORNIA, 2001, SEISMIC HAZARD ZONES MAP OFFICIAL REVISED MAP DANA POINT QUADRANGLE, 7.5-MINUTE SERIES: SCALE 1:24,000.

N

SCALE IN FEET

0 2,000 4,000

NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.

LEGEND

EARTHQUAKE-INDUCED LANDSLIDES
Areas where previous occurrence of landslide movement, or local topographic, geological, geotechnical and subsurface water conditions indicate a potential for permanent ground displacements such that mitigation as defined in Public Resources Code Section 2693(c) would be required.

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.

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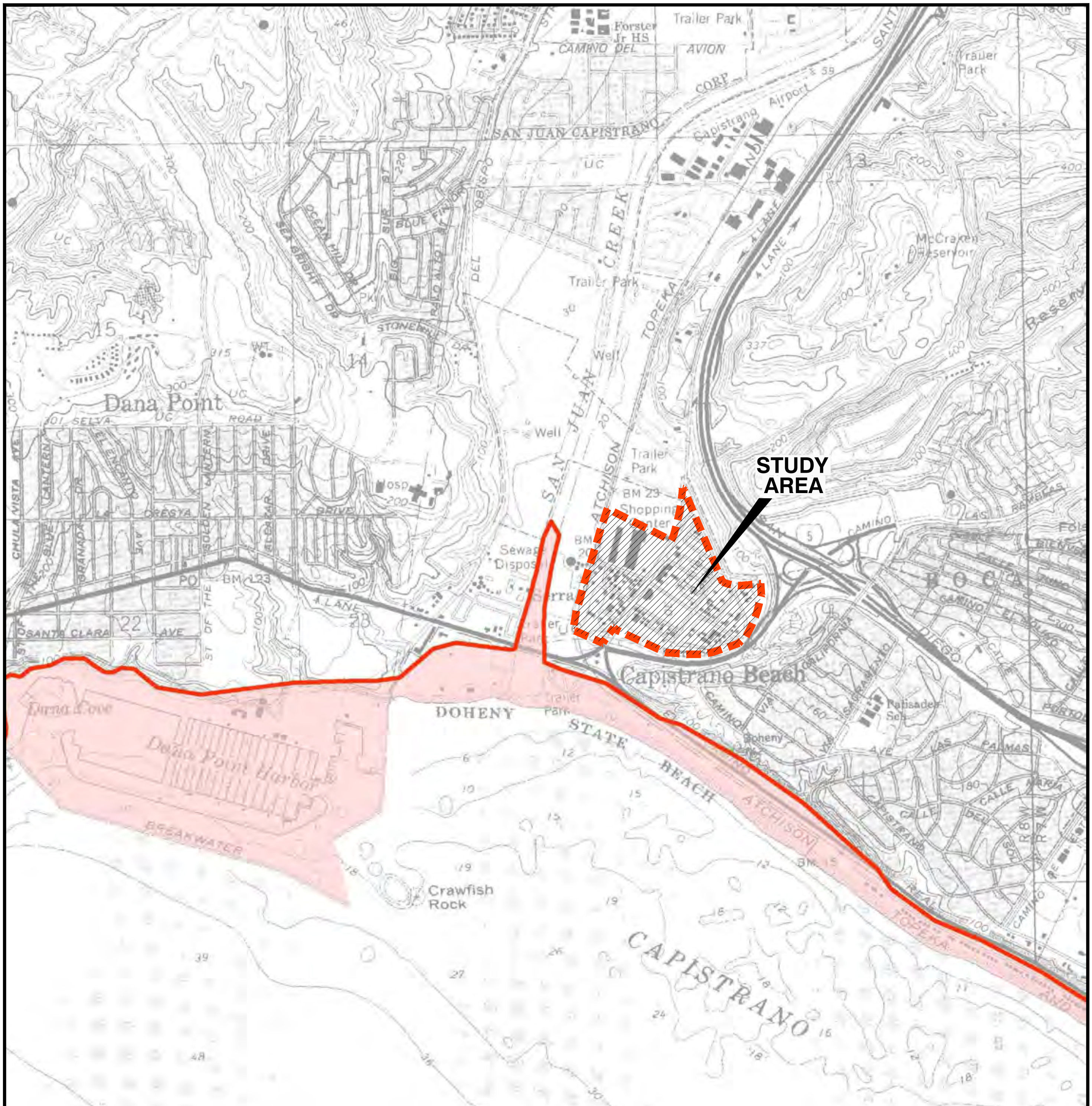
Ninyo & Moore

PROJECT NO.	DATE
209701001	6/16

SEISMIC HAZARD ZONES

DOHENY VILLAGE PLAN
DANA POINT, CALIFORNIA

FIGURE 5



REFERENCE: CALIFORNIA EMERGENCY MANAGEMENT AGENCY, 2009, TSUNAMI INUNDATION MAP FOR EMERGENCY PLANNING, COUNTY OF ORANGE, DANA POINT QUADRANGLE, SAN JUAN CAPISTRANO QUADRANGLE, DATED MARCH 15.

SCALE IN FEET

0 2,000 4,000

N

LEGEND

TSUNAMI INUNDATION LINE

TSUNAMI INUNDATION AREA

NOTE: DIMENSIONS, DIRECTIONS AND LOCATIONS ARE APPROXIMATE.

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Ninyo & Moore

PROJECT NO.	DATE
209701001	6/16

TSUNAMI INUNDATION

DOHENY VILLAGE PLAN
DANA POINT, CALIFORNIA

FIGURE

6

SOIL & FOUNDATION ENGINEERING
ENGINEERING GEOLOGY • HYDROGEOLOGY

April 8, 2016
Project No. 7743.1CG
Log No. 18264

City of Dana Point
Public Works – Engineering Services
33282 Golden Lantern, Suite 212
Dana Point, California 92629

Attention: Mr. Matthew Kunk

Subject: LIQUEFACTION EVALUATION
Doheny Village Planning Area
Dana Point, California

References: Attached

Dear Mr. Kunk:

In accordance with your request, we have performed a liquefaction evaluation of the Doheny Village Planning Area. Our work was performed during January and February 2016. The purpose of our evaluation was to supplement previous geotechnical work performed in the planning area by others to assist the City of Dana Point in planning for future development.

With the above in mind, our scope of services included the following:

- Review of existing available geotechnical reports, plans and geologic literature for the Doheny Village Planning Area (see References).
- Excavation of four new hollow-stem auger borings for geologic observation, soil sampling and standard penetration testing to a maximum depth of 51.5-feet.
- Laboratory testing of samples obtained during the subsurface exploration.
- Engineering and geologic analysis.
- Preparation of this report presenting the results of our field and laboratory work, analyses, and our findings and conclusions.

SITE DESCRIPTION

The subject site consists of approximately 80-acres in the southern portion of the City of Dana Point, California (see Location Map, Figure 1). The site is situated on the alluviated flood plain of San Juan Creek at the historic drainage outlet of Deep and Reservoir Canyons. Topographically, the site area is gently west sloping with topographic relief of approximately 20-feet.

PUBLISHED GEOLOGIC DATA

The entire Doheny Village Planning Area is located within a State of California liquefaction seismic hazard zone (References 15 and 16). A portion of the seismic hazard zone map is attached as Figure 2. Reference 16 indicates the historic high groundwater level in the area to be 5-feet below the ground surface. References 18 and 22 indicate the planning area is underlain by alluvium.

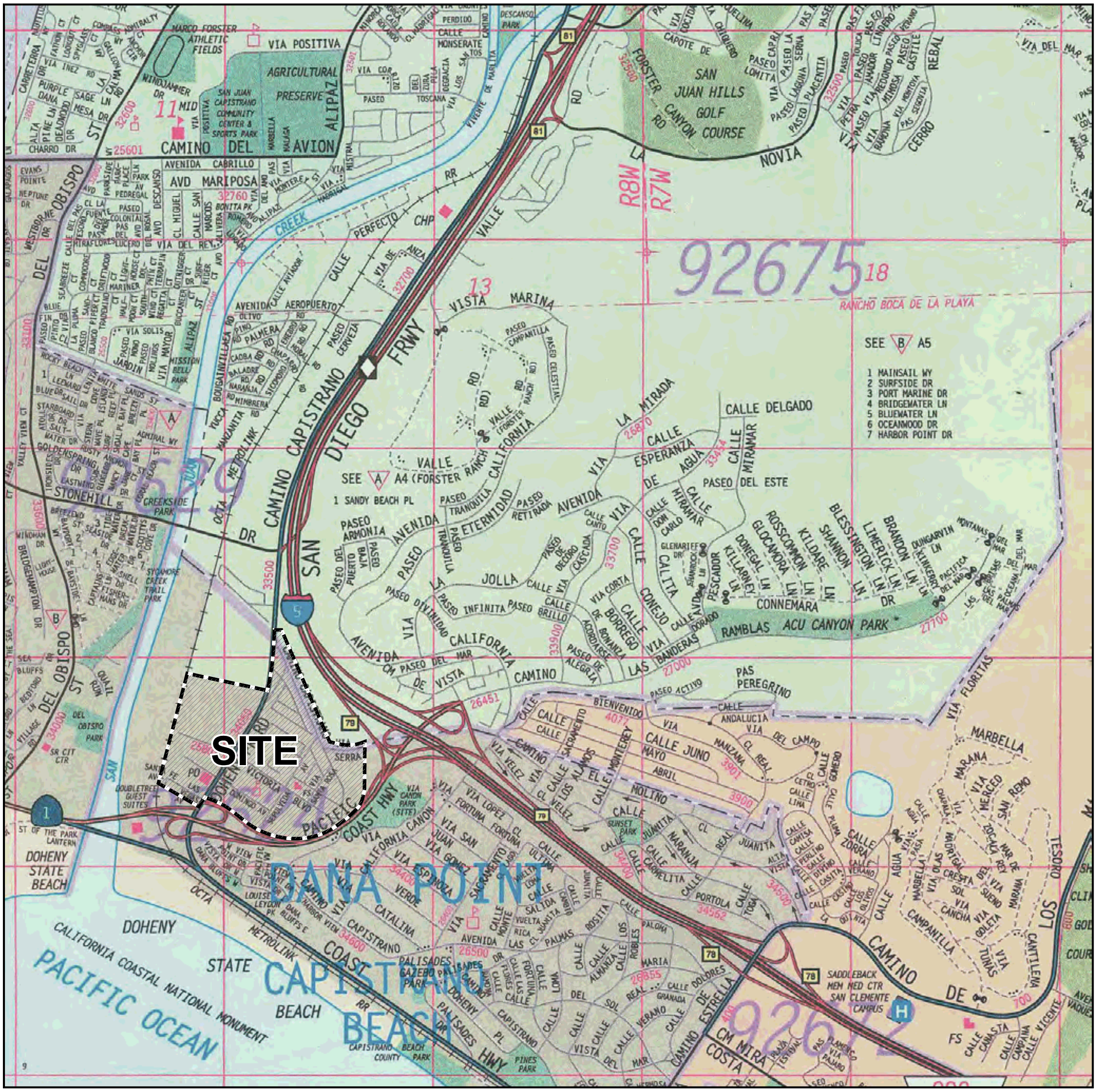
PREVIOUS GEOTECHNICAL WORK

The City of Dana Point provided geotechnical reports by others to Coastal Geotechnical for properties in the Doheny Village Planning Area (References 1 through 11). Of these reports, four included site specific liquefaction analyses (References 7, 8, 10 and 11). The following tabulation provides a summary of the liquefaction analyses including liquefaction induced settlement and the results of the analyses are also shown on the attached Plot Plan, Plate 1.

Reference No./ Consultant/Date	Type* Testing	Ground Acceleration	Depth to Groundwater	Liquefaction Induced Settlement
7/ ViaGeos/November 30, 2004	SPT	0.36g	13-feet	1.5-inches
8/ Kleinfelder/June 30, 2010	SPT/ CPT	0.40g	12-feet	2 to 3-inches
10/ Geofirm/May 30, 2014	CPT	0.56g	5-feet	2.5-inches
11/ Terradyne/May 18, 2015	SPT	0.56g	18-feet	4-inches

* SPT – Standard Penetration Test
  CPT – Cone Penetration Test

It should be noted that the method for determining the ground acceleration for liquefaction analyses was modified in the 2013 California Building Code resulting in generally higher ground acceleration, more soils subject to seismically induced



ADAPTED FROM: The Thomas Guide, Orange County, 51st Edition, Page 972

N

SCALE: 1" - 2000'
(1 Grid Equals: 0.5 x 0.5 miles)

LOCATION MAP

COASTAL GEOTECHNICAL
GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, California

PROJECT NO. 7743.2CG | FIGURE NO. 1

BASE MAP: State of California Seismic Hazard Zones, Dana Point 7-1/2 Minute Quadrangle, Official Map December 21, 2001

AREAS WHERE HISTORIC OCCURENCE 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.

AREAS WHERE PREVIOUS OCCURENCE OF LANDSLIDE MOVEMENT, OR LOCAL TOPOGRAPHIC, GEOLOGIC, GOETECHNICAL AND SUBSURFACE WATER CONDITIONS INDICATE A POTENTIAL FOR PERMANENT GROUND DISPLACEMENT SUCH THAT MITIGATION AS DEFINED IN PUBLIC RESOURCES CODE SECTION 2693(C) WOULD BE REQUIRED.

N

SCALE: 1" = 1000'

SEISMIC HAZARD ZONE MAP

COASTAL GEOTECHNICAL
GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, California

PROJECT NO. 7743.1CG | FIGURE NO. 2

liquefaction and greater resulting liquefaction induced settlement. The liquefaction analyses for References 7 and 8 were rerun, to the extent possible, for comparative purposes using the higher ground acceleration and a depth to groundwater of 5-feet and the results are included in Appendix A and are shown on the Plot Plan, Plate 1.

SUBSURFACE EXPLORATION

Subsurface exploration performed by this office consisted of excavating four borings to maximum depth of 51.5-feet below the existing ground surface using a truck-mounted hollow stem auger drill rig. The approximate locations of the borings are shown on the accompanying Plot Plan, Plate 1. Boring B-4 was terminated after encountering concrete at a depth of 3.5-feet.

The subsurface exploration was supervised by an engineer from this office, who obtained bulk samples for laboratory testing. Standard Penetration Tests were performed in accordance with ASTM: D 1586. The soils were visually classified according to the Unified Soil Classification System. Classifications are shown on the attached Boring Logs, Figures 3 through 12.

LABORATORY TESTING

Laboratory testing was performed on samples obtained during the subsurface exploration. Tests performed consisted of:

- Particle Size Analysis of Soils (ASTM: D 422)
- Atterberg Limits (ASTM: D 4318)
- Moisture Content (ASTM : D 2216)
- Material Finer Than No. 200 Sieve (ASTM: D 1140)

The results of the moisture content determinations are shown on the Boring Logs, Figures 3 through 12. The remaining laboratory test results are presented on Figures 13 through 50.

SUBSURFACE CONDITIONS

Our exploratory borings encountered fill to an approximate depth of 2-feet. Alluvium underlies the fill. The alluvium consists primarily of sandy silt/clay to the total explored depth of 51.5-feet below the ground surface.

Groundwater was encountered at a depth of approximately 15 to 16-feet below the ground surface in borings B-1 and B-2 during our investigation. Caving conditions prevented a determination of groundwater level in boring B-3. Groundwater in boring B-3 was estimated to be 16 to 18-feet below the ground surface. Historic high groundwater is estimated to be 5-feet below the ground surface. Fluctuations in the amount and level of groundwater may occur due to variations in rainfall, irrigation, and other factors, which may not have been evident at the time of our field exploration. It is noted that this area has been in drought conditions for much of the last decade with particularly low rainfall in 2013, 2014 and 2015.

GROUND ACCELERATION

The most significant earthquake to effect the property is considered to be a 7.0 magnitude earthquake on the Newport-Inglewood fault. Based on Section 1803.5.12 of the 2013 California Building Code and Section 11.8.3 of ASCE 7-10, a peak ground acceleration (PGA_M) of about 0.56g is possible for the design earthquake. Mean earthquake magnitude based on de-aggregation was not used.

LIQUEFACTION

Liquefaction is a phenomenon in which earthquake induced cyclic stresses generate excess pore water pressure in cohesionless soils, causing a temporary loss of shear strength. The primary factors that influence liquefaction potential are as follows:

a. In-place soil density.

b. Duration of sustained pressure (cyclic stresses).

c. Depth to groundwater.

d. Soil type/gradation.

Evaluation of the liquefaction potential of the subject site soils was made by the empirical procedure for liquefaction analysis using Standard Penetration Test N-values based on NCEER and NCEER/NSF workshops; JGGE Vol. 127, No. 4 (April 2001). Liquefaction behavior was determined using a peak ground acceleration of 0.56g for the maximum considered earthquake. The analyses were performed for the conditions determined from our subsurface exploration and using a historic high groundwater level of 5-feet below the ground surface.

The Liquefaction Analyses are included in Appendix A and the results of the analyses are shown on the attached Plot Plan, Plate 1.

CONCLUSIONS

Based on the findings of the geotechnical reports by others provided to us by the City of Dana Point, it appears that liquefaction is likely in the event of the design earthquake for the portion of the Doheny Village Planning Area generally west of Doheny Park Road (see Plot Plan, Plate 1) due to the generally loose, sandy nature of the soils in this area. Calculated liquefaction induced settlement for various peak ground accelerations and depths to groundwater range from 1.5-inches to 6.8-inches in this area.

Based on the results of our subsurface exploration, laboratory testing and liquefaction analyses, it appears that liquefaction and liquefaction induced settlement is unlikely in the event of the design earthquake for the portion of the Doheny Village Planning Area generally east of Doheny Park Road (see Plot Plan, Plate 1) due to the generally silt-clay nature of the soils in this area. Deformation of the silt-clay soils could still occur in this area during an earthquake due to cyclic softening.

Due to the limited nature of available data and the dynamic depositional environment of the underlying alluvium, the line of demarcation between liquefiable and non-liquefiable areas is not precise and is likely gradational. Geotechnical investigations for future construction in the Doheny Village Planning Area should consider liquefaction and cyclic softening.

Individual property owners/developers should perform individual geotechnical investigations and liquefaction evaluations to assess site specific geotechnical conditions and determine the liquefaction potential of their property.

LIMITATIONS

The analyses and conclusions contained in this report are based on site conditions as they existed at the time of our investigation and further assume the excavations to be representative of the subsurface conditions throughout the site. If different subsurface conditions from those encountered during our exploration are observed or appear to be present in excavations, the Geotechnical Consultant should be promptly notified for review and reconsideration of recommendations.

Our investigation was performed using the degree of care and skill ordinarily exercised, under similar circumstances, by reputable Geotechnical Engineers and Engineering Geologists practicing in this or similar localities. No other warranty, express or implied, is made as to the conclusions and professional advice included in this report.

This opportunity to be of service is sincerely appreciated. If you have any questions regarding this report, please contact our office at your convenience.

Sincerely,
HETHERINGTON ENGINEERING, INC.

Mark D. Hetherington
Civil Engineer 30488
Geotechnical Engineer 397
(expires 3/31/18)

REGISTERED PROFESSIONAL ENGINEER
MARK D. HETHERINGTON
No. 397
Exp. Date
GEOTECHNICAL
STATE OF CALIFORNIA

Paul A. Bogseth
Professional Geologist 3772
Certified Engineering Geologist 1153
Certified Hydrogeologist 59
(expires 3/31/18)

CERTIFIED ENGINEERING GEOLOGIST
PAUL A. BOGSETH
E.G. 1153
Exp.
STATE OF CALIFORNIA

Attachments:	Location Map	Figure 1
	Seismic Hazard Zone Map	Figure 2
	Logs of Borings	Figures 3 through 12
	Laboratory Test Data	Figures 13 through 50
	Plot Plan	Plate 1
	Liquefaction Analyses	Appendix A

Distribution: 4-Addressee
1-via e-mail (mkunk@danapoint.org)
1-via e-mail (bboka@danapoint.org)

REFERENCES

Consultants Reports – (chronologic)

1) "Plot Plan and Borings Logs, Proposed Anglo-American Apartments, Capistrano Beach, California," by Baca Associates, dated August 8, 1987.

2) "Foundation Study, Retail Complex, Southwest Corner of Doheny Park Road and Domingo Avenue, Capistrano Beach, California," by Moore & Taber, dated May 31, 1989.

3) "Preliminary Geotechnical Investigation – Proposed Tenant Improvement for the Sampson Commercial Roofing Facility – Located at 34222 Doheny Park Road, Capistrano Beach, in the City of Dana Point, California (Legal Description: Assessor's Parcel No. 668-331-03)," by NorCal Engineering, dated August 23, 1994.

4) "Subsurface Exploration and Foundation Evaluation, Cox Communications Facility, NEC Victoria Blvd. & Via Santa Rosa, Dana Point, California," by PSI Environmental Geotechnical Construction, dated September 16, 1996.

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DRILLING COMPANY: **Scotts Drilling** RIG: **Hollow Stem** DATE: **01/11/16**

BORING DIAMETER: **10"** DRIVE WEIGHT: **140 lb** DROP: **30"** ELEVATION: **' ±**

BORING NO. **B-1**

DEPTH (FEET)	BULK SAMPLE	DRIVE SAMPLE	BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
0.0						CL	**FILL:** Dark brown silty clay, moist, firm
						CL CH ML	**ALLUVIUM:**
4		X	7/6" 8/6" 7/6"		14.6		@ 4': Light brown sandy clay, moist, stiff
5.0	X						
8		X	3/6" 7/6" 8/6"		22.8		@ 8': Dark brown to black silty clay, moist, stiff, precipitate stringers
10.0							@ 10': Presence of siltstone fragment
12		X	2/6" 2/6" 5/6"		29.3		@ 12': Olive brown silty clay, very moist, stiff
15.0	X						
16		X	1/6" 3/6" 3/6"		33.4 ▽		@ 16': Olive brown sandy silty clay, very moist, firm
20.0							

BORING LOG

COASTAL GEOTECHNICAL

GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **3**

DRILLING COMPANY: **Scotts Drilling**	RIG: **Hollow Stem**	DATE: **01/11/16**

BORING DIAMETER: **10"**	DRIVE WEIGHT: **140 lb**	DROP: **30"**	ELEVATION: **' ±**

BORING NO. **B-1**

DEPTH (FEET)	BULK SAMPLE	DRIVE SAMPLE	BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
20.0			3/6" 6/6" 9/6"		29.5		@ 20': Olive brown sandy clay, very moist, stiff
			2/6" 3/6" 5/6"		42.3		@ 24': Olive brown sandy clay, wet, stiff
25.0							
			4/6" 5/6" 6/6"		30.7		@ 28': Olive brown sandy clay, very moist to wet, stiff
30.0							
			3/6" 5/6" 7/6"		32.9		@ 32': Olive and grey brown sandy clay, wet, stiff
35.0							
			4/6" 6/6" 6/6"		34.0		@ 36': Olive brown silty clay, wet, stiff
40.0							

BORING LOG

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Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **4**

DRILLING COMPANY: **Scotts Drilling**	RIG: **Hollow Stem**	DATE: **01/11/16**

BORING DIAMETER:	**10"**	DRIVE WEIGHT:	**140 lb**	DROP:	**30"**	ELEVATION:	**' ±**

BORING NO. **B-1**

DEPTH (FEET)	BULK SAMPLE	DRIVE SAMPLE	BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
40.0			4/6" 5/6" 6/6"		35.6		@ 40': Olive brown silty clay, wet, stiff, gypsum fragments
			3/6" 5/6" 7/6"		33.1		@ 44': Gray silty clay, very moist, stiff
45.0							
50.0			3/6" 6/6" 10/6"		37.4		@ 50': Gray clayey silt, very moist, stiff
							Total depth 51.5-feet Groundwater @ 16-feet
55.0							
60.0							

BORING LOG

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Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **5**

DRILLING COMPANY: **Scotts Drilling**	RIG: **Hollow Stem**	DATE: **01/11/16**	
BORING DIAMETER: **10"**	DRIVE WEIGHT: **140 lb**	DROP: **30"**	ELEVATION: **' ±**

BORING NO. **B-2**

DEPTH (FEET)	BULK SAMPLE	DRIVE SAMPLE	BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
0.0						CL	**FILL:** Dark brown silty clay, very moist, soft
						CL ML	**ALLUVIUM:**
4		X	1/6" 2/6" 2/6"		32.3		@ 4': Brown sandy clay, very moist, soft to firm
5.0							
6–11	X						
8		X	2/6" 2/6" 2/6"		40.0		@ 8': Brown silty to sandy clay, wet, soft to firm
10.0							
12		X	2/6" 3/6" 5/6"		27.3		@ 12': Brown sandy clay, moist, firm
15.0	X				▽		
16		X	2/6" 4/6" 5/6"		29.3		@ 16': Olive brown silty clay, moist, stiff
20.0							

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Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **6**

DRILLING COMPANY: **Scotts Drilling**	RIG: **Hollow Stem**	DATE: **01/11/16**	
BORING DIAMETER: **10"**	DRIVE WEIGHT: **140 lb**	DROP: **30"**	ELEVATION: **' ±**

BORING NO. **B-2**

DEPTH (FEET)	BULK SAMPLE	DRIVE SAMPLE	BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
20.0			3/6" 5/6" 5/6"		33.2		@ 20': Olive brown silty clay, wet, stiff
			3/6" 6/6" 5/6"		30.8		@ 24': Olive brown sandy clay, wet, stiff
25.0							
			5/6" 6/6" 6/6"		30.5		@ 28': Olive brown silty clay, wet, stiff
30.0							
			5/6" 6/6" 8/6"		33.2		@ 32': Olive brown sandy clay, wet, stiff
35.0							
			5.6" 6/6" 7/6"		30.4		@ 36': Olive brown sandy clay, wet, stiff
40.0							

BORING LOG

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Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **7**

DRILLING COMPANY: **Scotts Drilling**	RIG: **Hollow Stem**	DATE: **01/11/16**

BORING DIAMETER:	**10"**	DRIVE WEIGHT:	**140 lb**	DROP:	**30"**	ELEVATION:	**' ±**

BORING NO. **B-2**

DEPTH (FEET)	BULK SAMPLE	DRIVE SAMPLE	BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
40.0			5/6" 6/6" 7/6"		32.2		@ 40': Gray clayey sandy silt to sandy clay, very moist, stiff
			3/6" 5/6" 5/6"		35.2		@ 44': Gray sandy clay, wet, stiff
45.0							
50.0			13/6" 10/6" 7/6"		34.5		@ 50': Gray gravelly sandy clay, very stiff, wet
							Total depth 51.5-feet Groundwater @ 15'
55.0							
60.0							

BORING LOG

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Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **8**

DRILLING COMPANY: **Scotts Drilling**	RIG: **Hollow Stem**	DATE: **01/12/16**

BORING DIAMETER: **10"**	DRIVE WEIGHT: **140 lb**	DROP: **30"**	ELEVATION: **' ±**

BORING NO. **B-3**

DEPTH (FEET)	BULK SAMPLE	DRIVE SAMPLE	BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
0.0							**ASPHALT CONCRETE/BASE:** 3-inches/2-inches
						SM	**FILL:** Light brown clayey to silty sand, moist, loose
						CL ML	**ALLUVIUM:**
5.0			2/6" 2/6" 3/6"		17.5		@ 4.5': Dark brown clayey sandy silt, moist, firm
			2/6" 4/6" 4/6"		20.3		@ 8': Dark brown sandy silt, moist, firm
10.0							
			4/6" 5/6" 7/6"		20.9		@ 12': Brown sandy clay, moist, stiff
15.0							
			2/6" 4/6" 5/6"		26.3		@ 16': Olive brown silty clay, moist, stiff
20.0							

BORING LOG

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Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **9**

DRILLING COMPANY: **Scotts Drilling**		RIG: **Hollow Stem**		DATE: **01/12/16**
BORING DIAMETER: **10"**	DRIVE WEIGHT: **140 lb**	DROP: **30"**	ELEVATION: **' ±**	

BORING NO. **B-3**

DEPTH (FEET)	BULK SAMPLE	DRIVE SAMPLE	BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
20.0			2/3" 3/6" 3/6"		30.9		@ 20': Olive brown sandy clay, very moist, firm
			2/6" 3/6" 4/6"		34.8		@ 24': Olive brown sandy clayey silt, wet, firm
25.0							
			2/6" 3/6" 4/6"		33.5		@ 28': Olive brown sandy clay, wet, firm
30.0							
			2/6" 6/6" 6/6"		30.5		@ 32': Olive brown sandy clay, wet, stiff
35.0							
			5/6" 5/6" 7/6"		31.5		@ 36': Olive brown sandy clay, wet, stiff
40.0							

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Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **10**

DRILLING COMPANY: **Scotts Drilling**	RIG: **Hollow Stem**	DATE: **01/12/16**

BORING DIAMETER: **10"**	DRIVE WEIGHT: **140 lb**	DROP: **30"**	ELEVATION: **' ±**

BORING NO. **B-3**

DEPTH (FEET)	BULK SAMPLE	DRIVE SAMPLE	BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
40.0			4/6" 11/6" 10/6"		32.0		@ 40': Brown sandy clay, wet, very stiff
			4/6" 9/6" 6/6"		33.2		@ 44': Olive brown sandy clay, wet, stiff
45.0							
50.0			4/6" 5/6" 7/6"		32.5		@ 50': Gray sandy clay, wet, stiff
							Total depth 51.5-feet Groundwater @ 18 - 20-feet
55.0							
60.0							

BORING LOG

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Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **11**

DRILLING COMPANY: **Scotts Drilling**	RIG: **Hollow Stem**	DATE: **01/12/16**

BORING DIAMETER:	**10"**	DRIVE WEIGHT:	**140 lb**	DROP:	**30"**	ELEVATION:	**' ±**

BORING NO. **B-4**

DEPTH (FEET)	BULK SAMPLE	DRIVE SAMPLE	BLOWS/FOOT	DRY DENSITY (pcf)	MOISTURE CONTENT (%)	SOIL CLASS. (U.S.C.S.)	SOIL DESCRIPTION
0.0							**CONCRETE:**- 6-inches
						SC	**FILL:** Light brown clayey sand, moist, medium dense
							@ 3.5': Refusal on concrete
							Total depth 3.5-feet
5.0							
10.0							
15.0							
20.0							

BORING LOG

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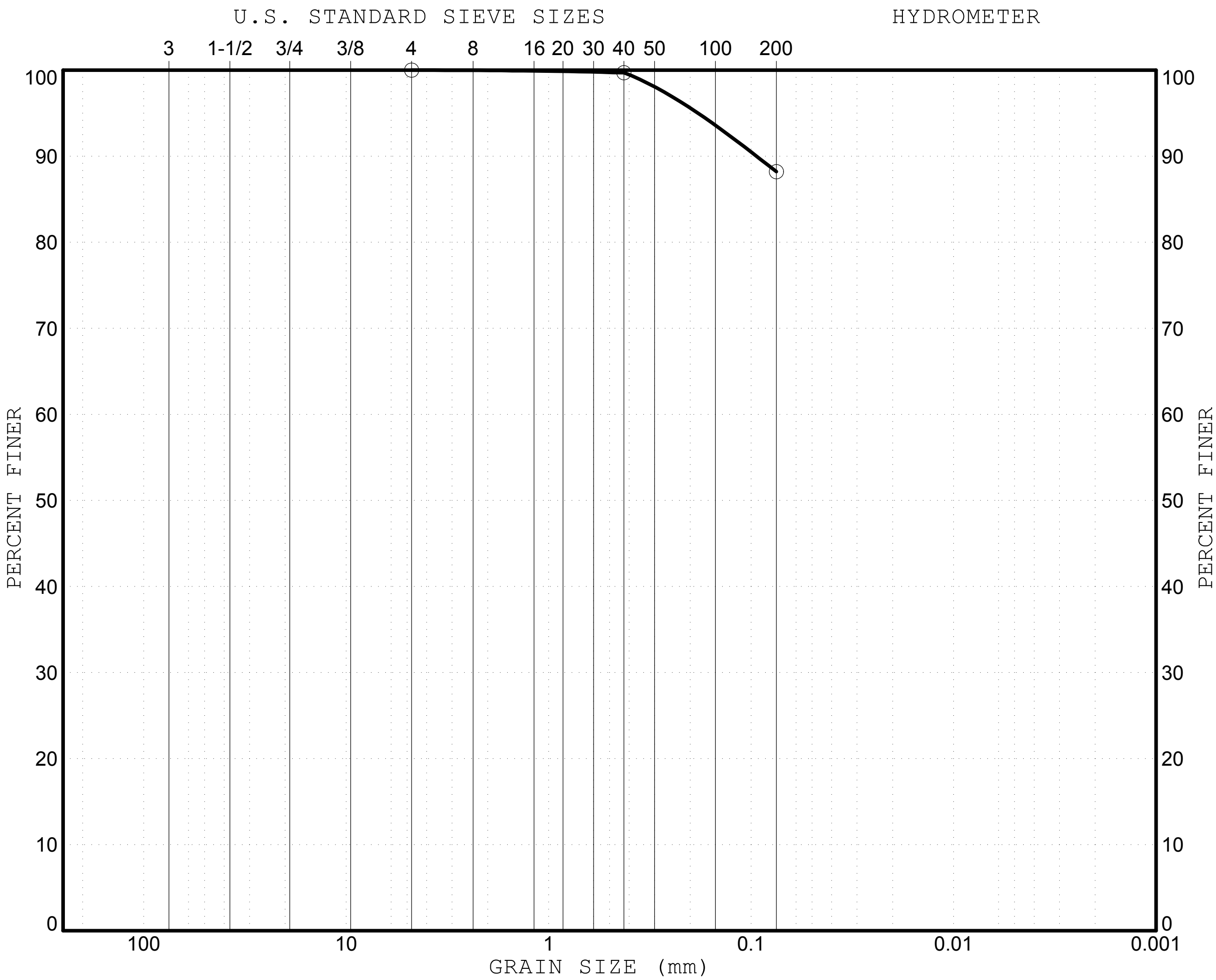
Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **12**

ATTERBERG LIMITS
(ASTM: D 4318)

Sample Location	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	U.S.C.S. Class
B-1 @ 8'	50	26	24	CL/CH
B-1 @ 12'	52	26	26	CH
B-1 @ 24'	54	26	28	CH
B-1 @ 32'	59	29	30	CH
B-1 @ 50'	45	29	16	ML
B-2 @ 8'	42	25	17	CL
B-2 @ 12'	45	26	19	CL
B-2 @ 24'	42	25	17	CL
B-2 @ 40'	44	26	18	CL
B-3 @ 12'	45	25	20	CL
B-3 @ 24'	41	26	15	ML
B-3 @ 36'	49	27	22	CL
B-3 @ 44'	53	27	26	CL



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-1 at 4.0	100	88		CH

GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL
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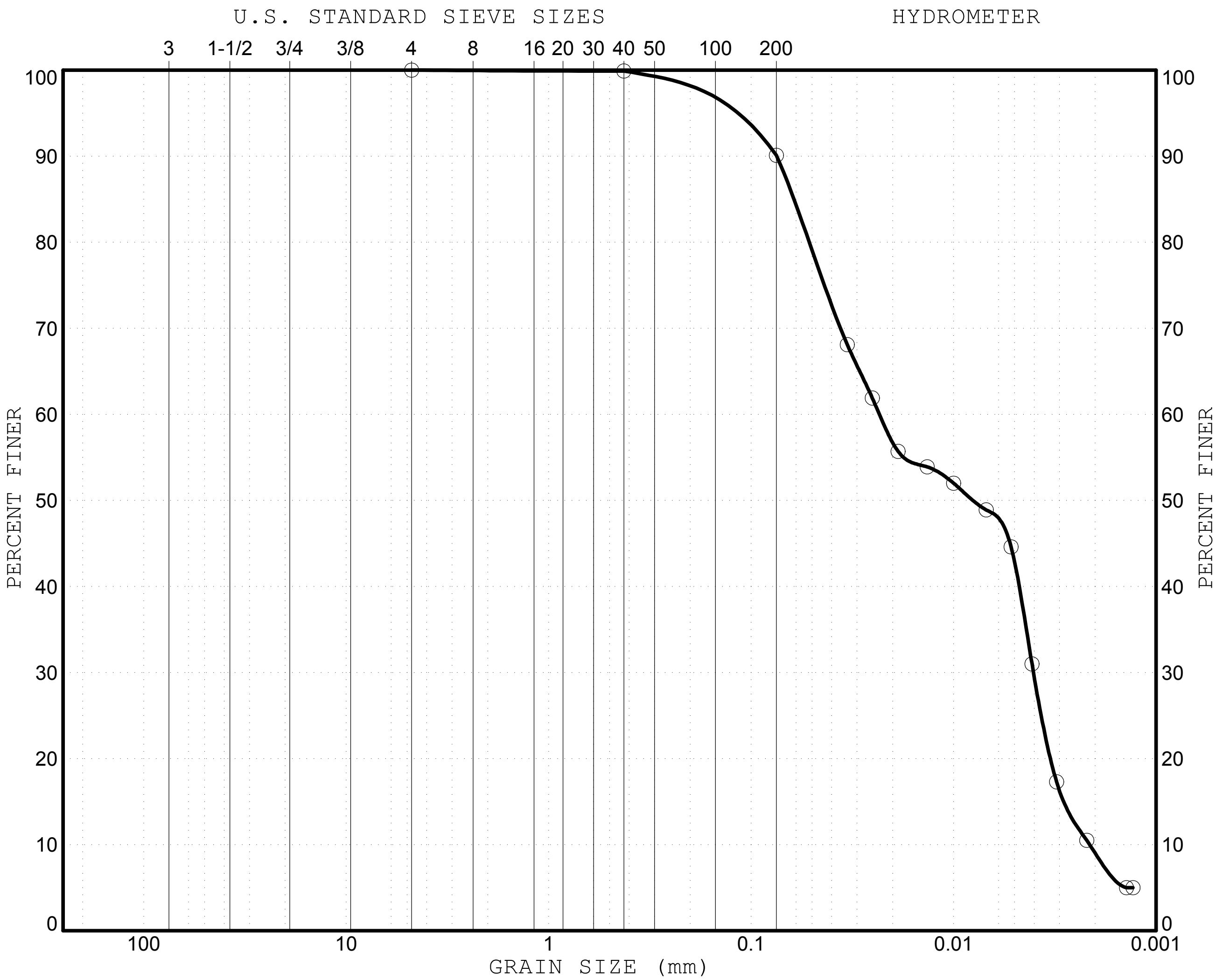
Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **14**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-1 at 8.0	100	90	9	CH

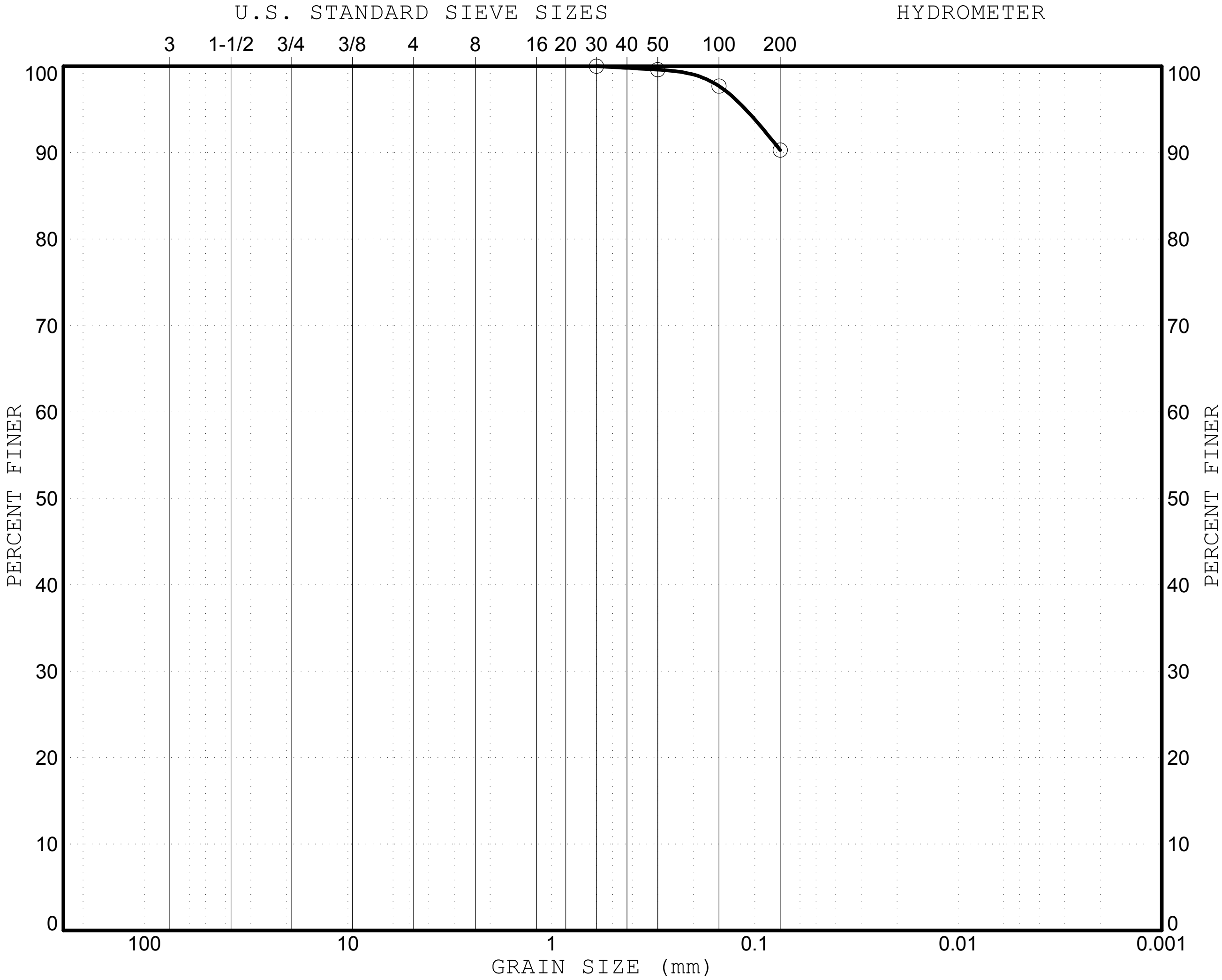
GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL

GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **15**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-1 at 12.0		90		CH

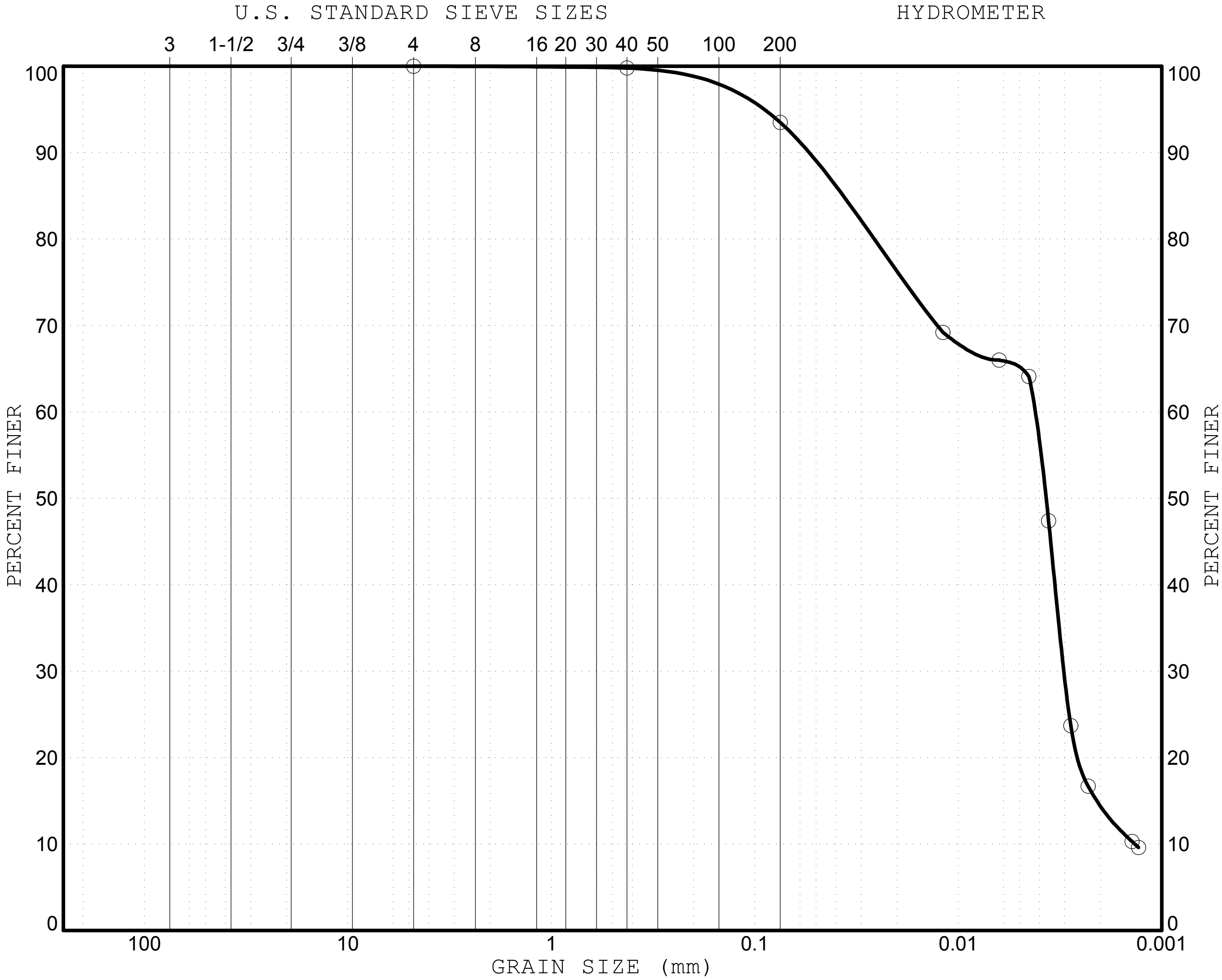
GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL

GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **16**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

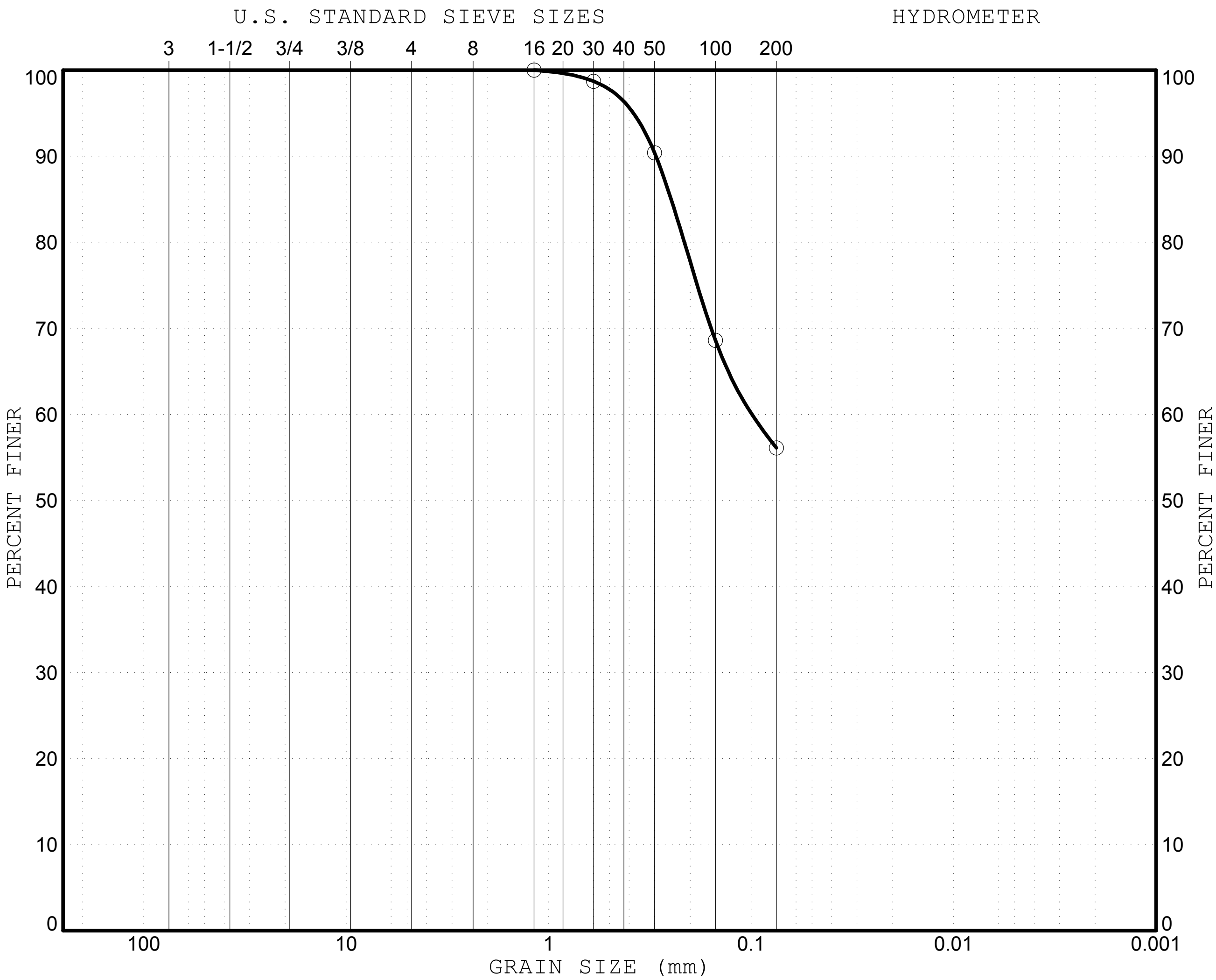
SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-1 at 16.0	100	94	15	CH

GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL
GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **17**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

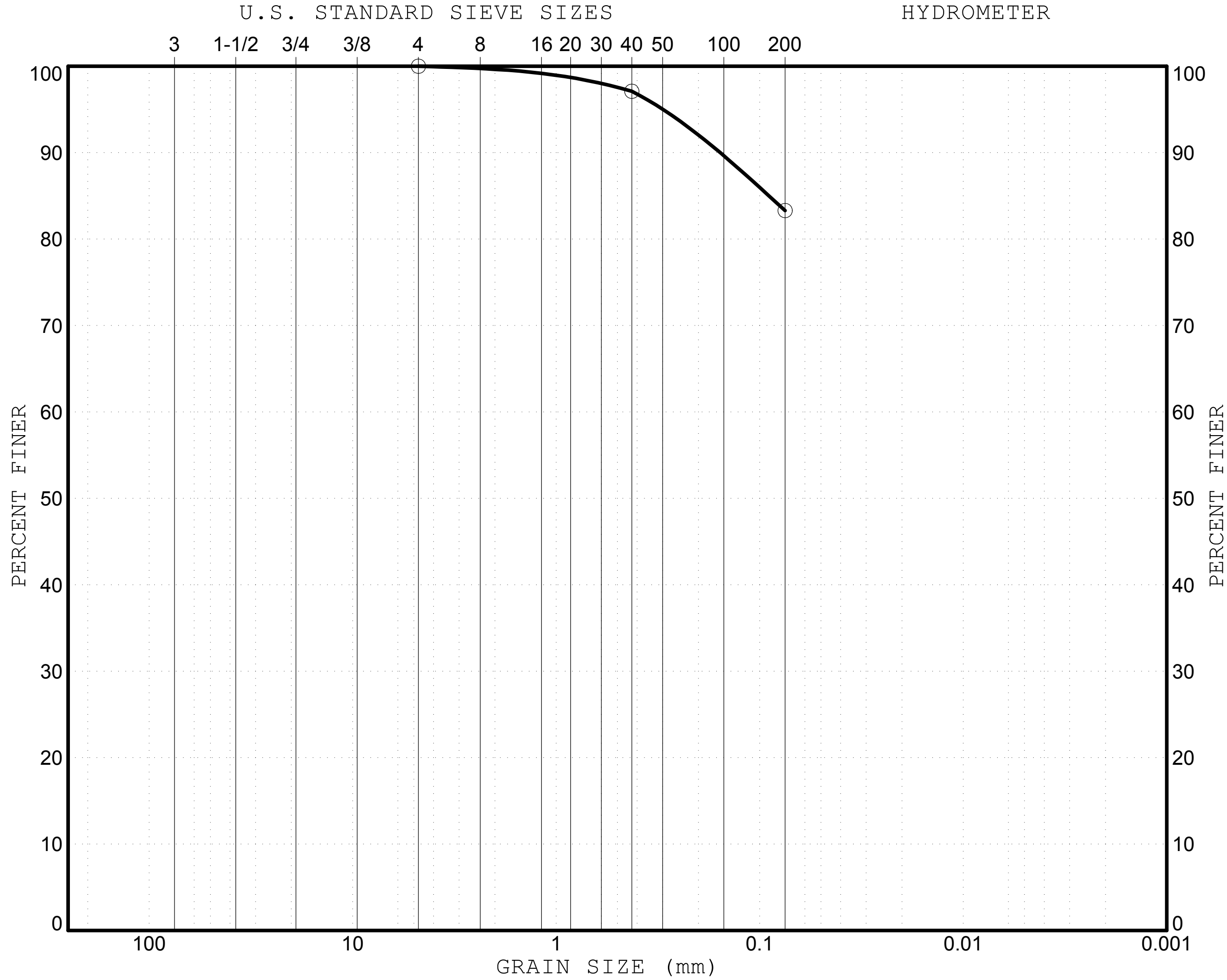
SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-1 at 20.0		56		CH

GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL
GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **18**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

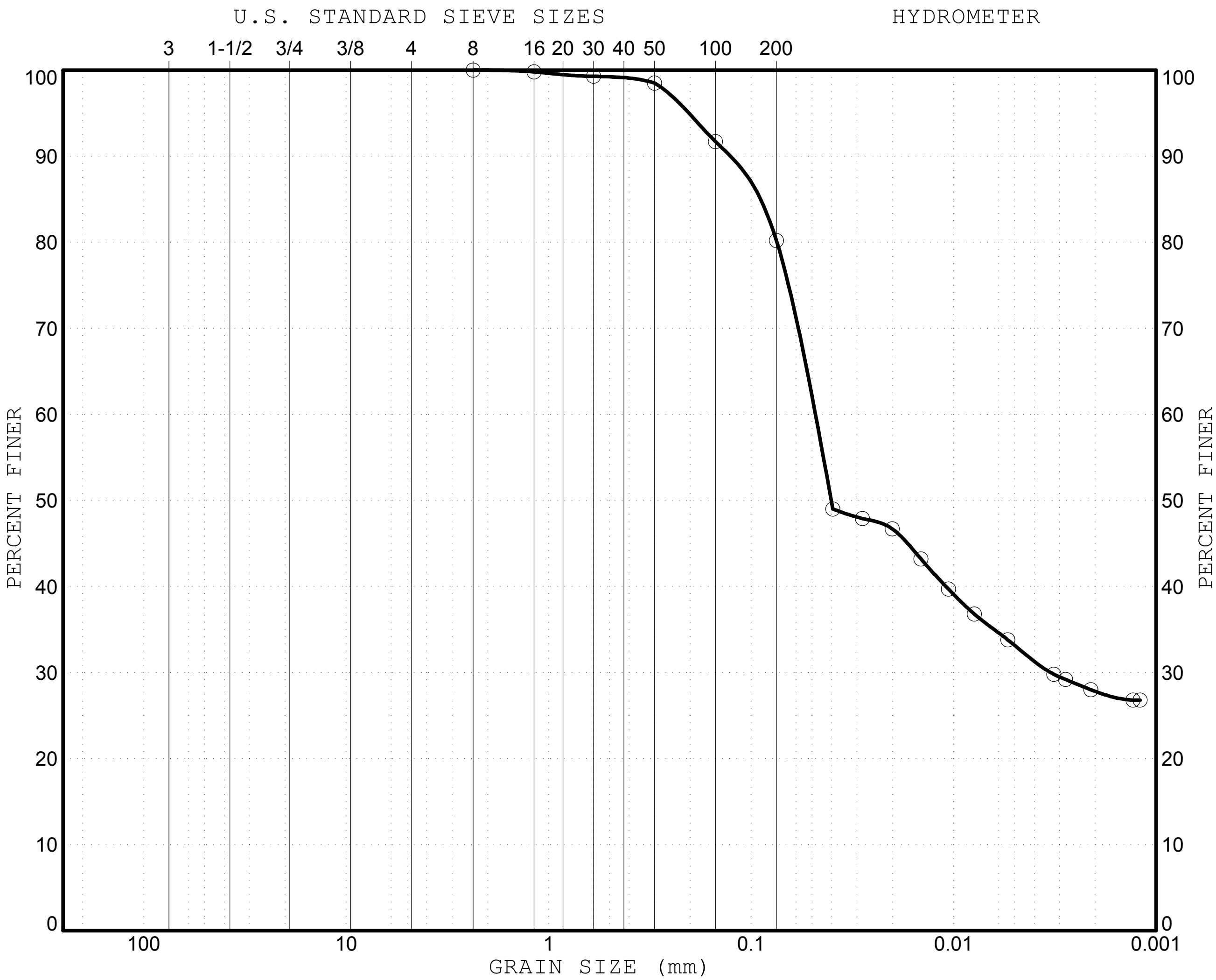
SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-1 at 24.0	100	83		CH

GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL
GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **19**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-1 at 28.0		80	28	CH

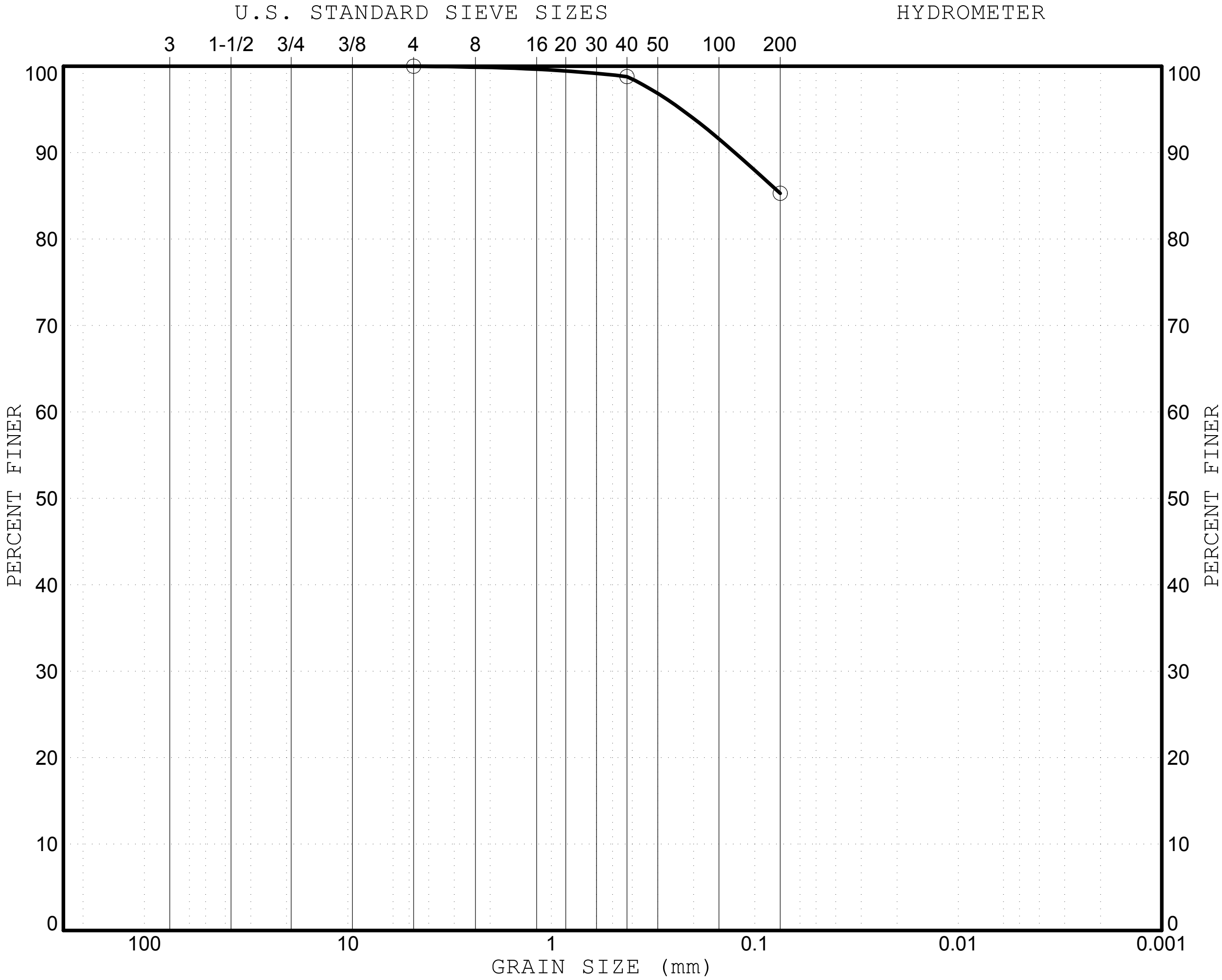
GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL

GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **20**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-1 at 32.0	100	85		CH

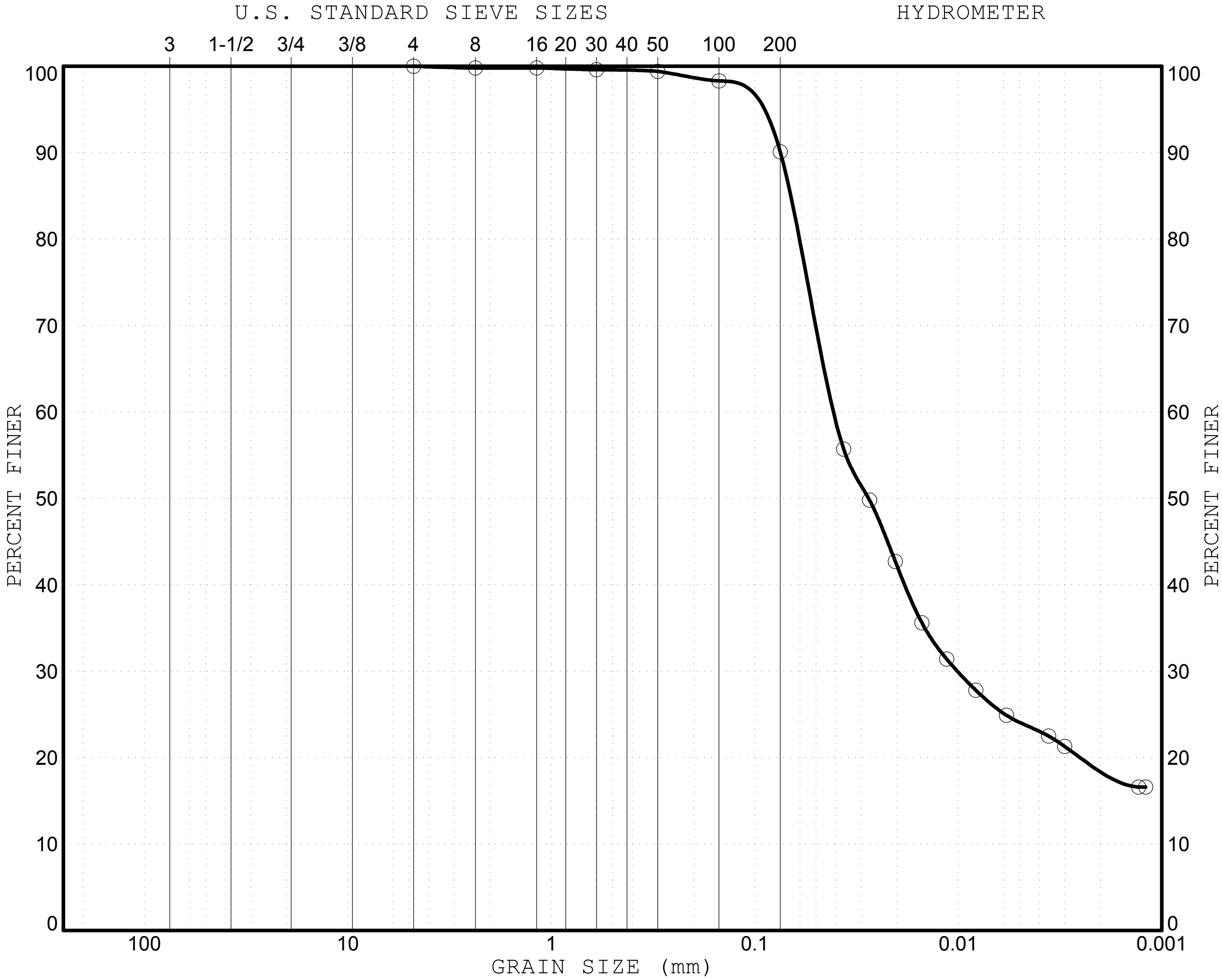
GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL

GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **21**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-1 at 36.0	100	90	19	CH

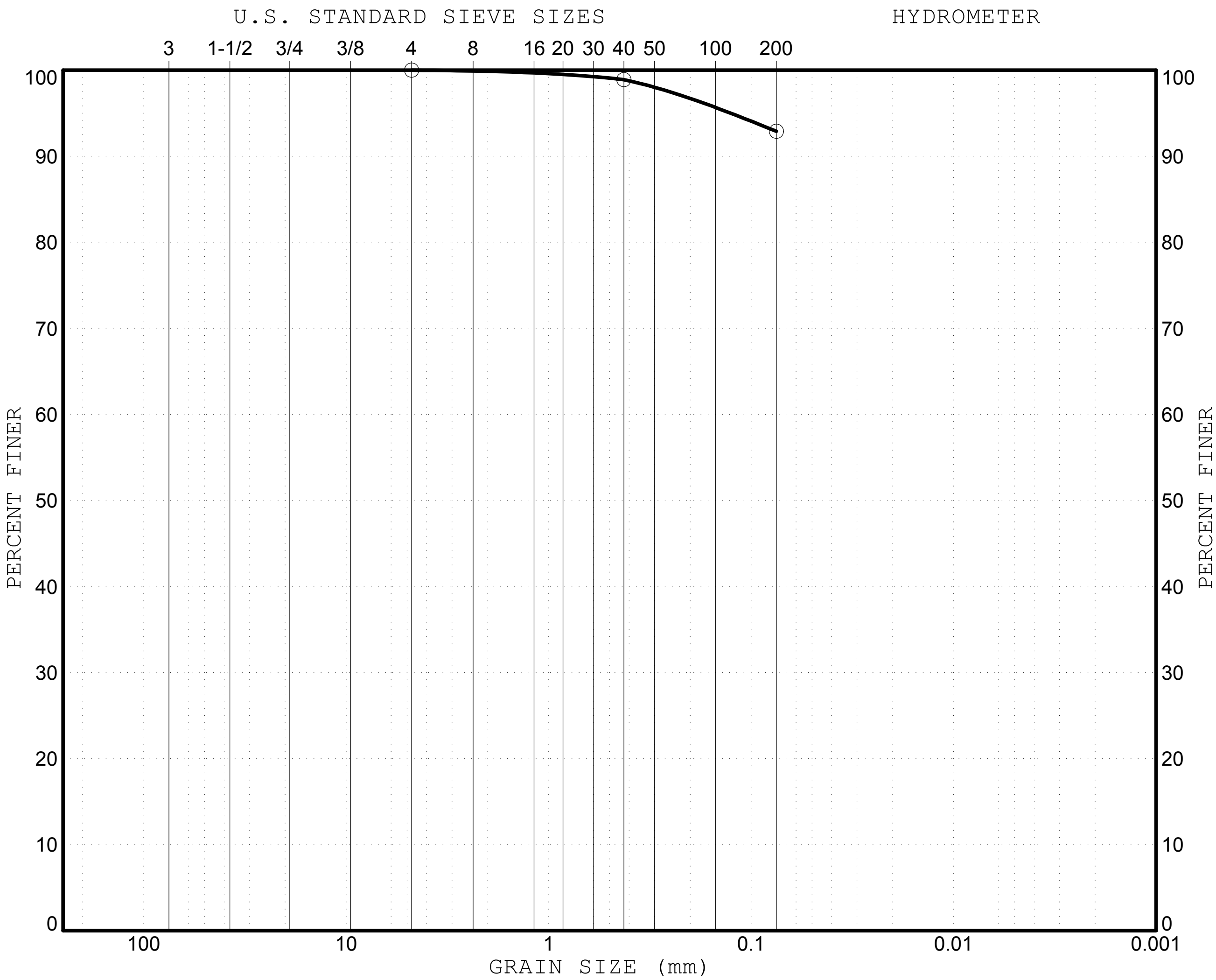
GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL

GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **22**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-1 at 40.0	100	93		CH

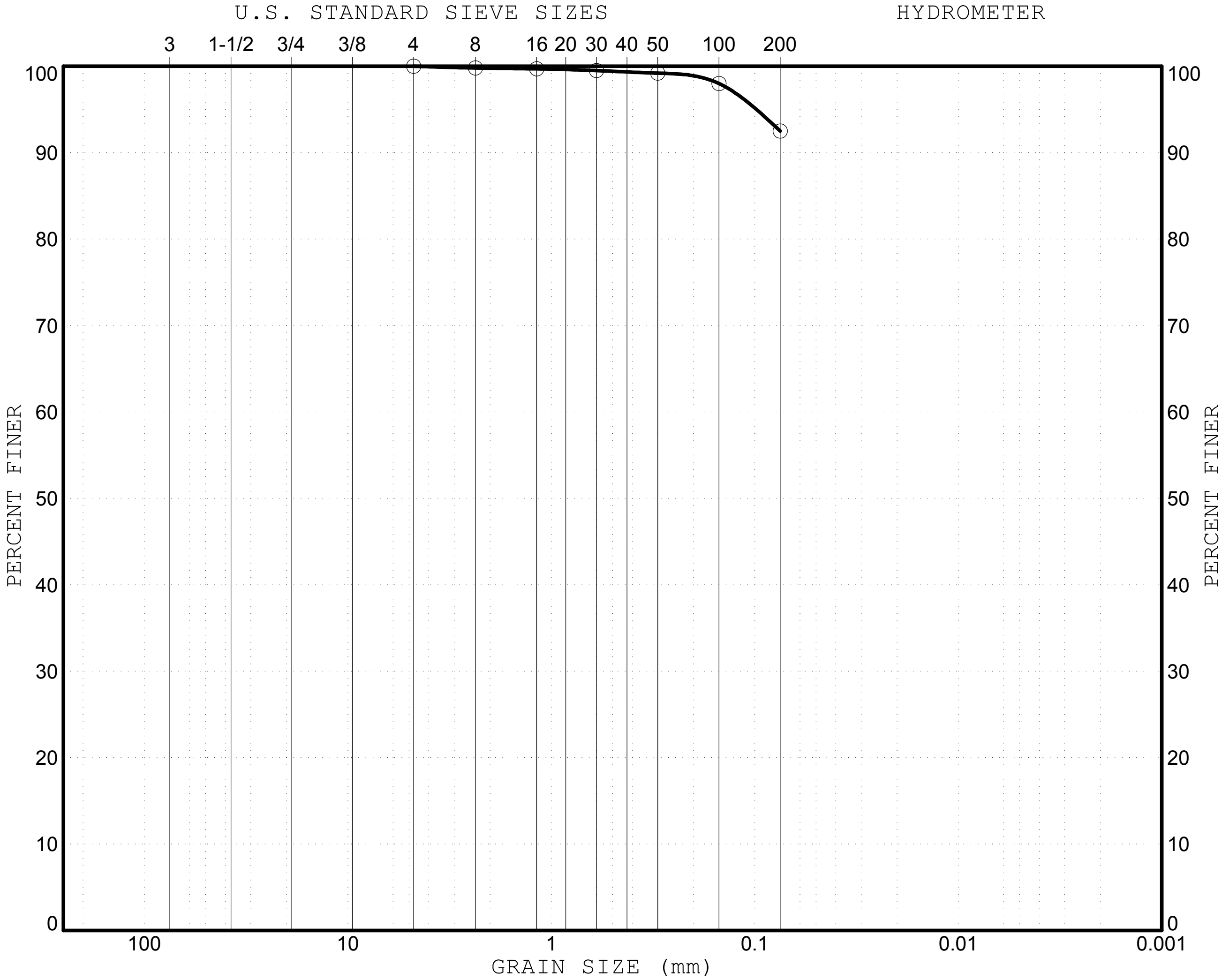
GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL

GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **23**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-1 at 44.0	100	93		CH

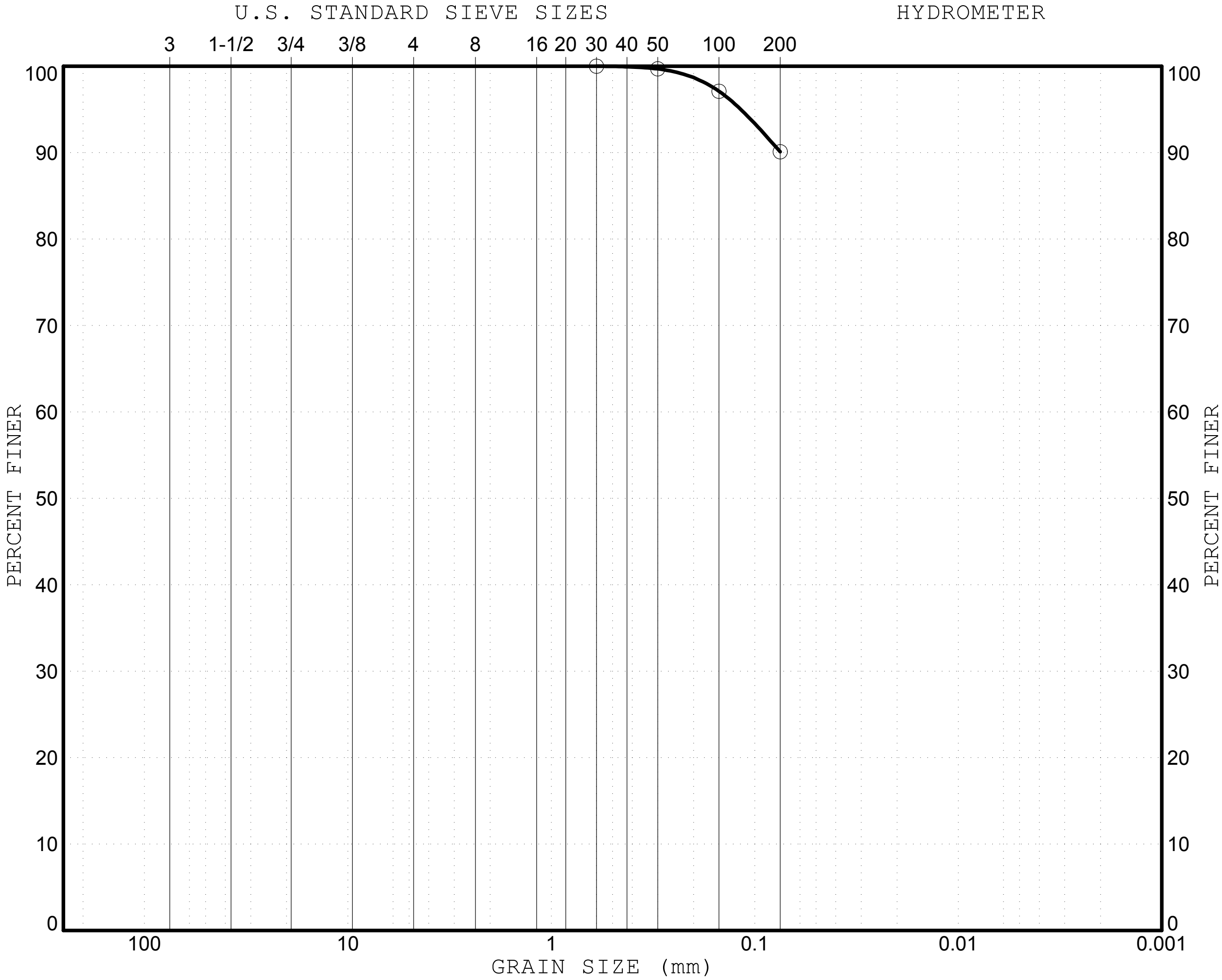
GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL

GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **24**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

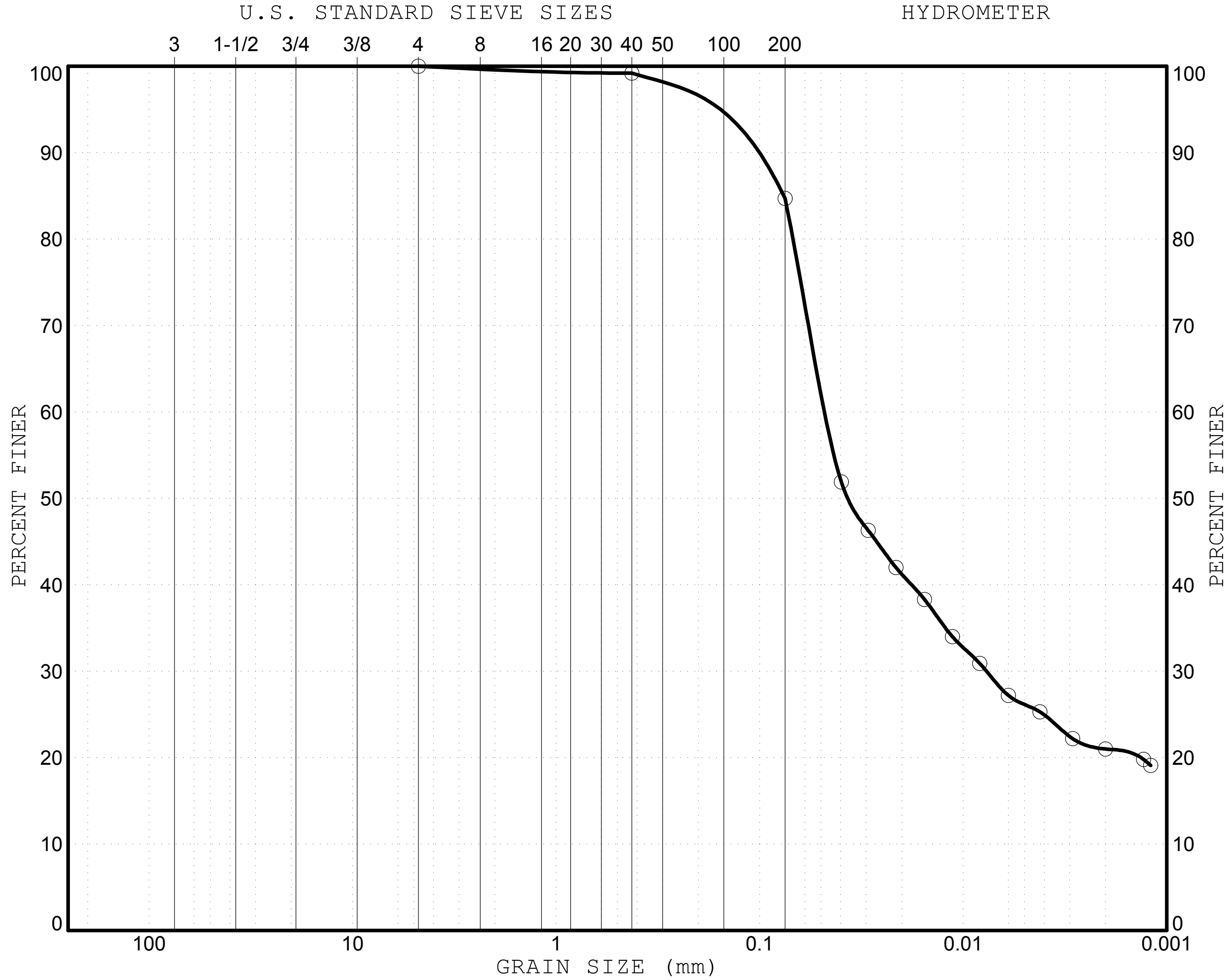
SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-1 at 50.0		90		ML

GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL
GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **25**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

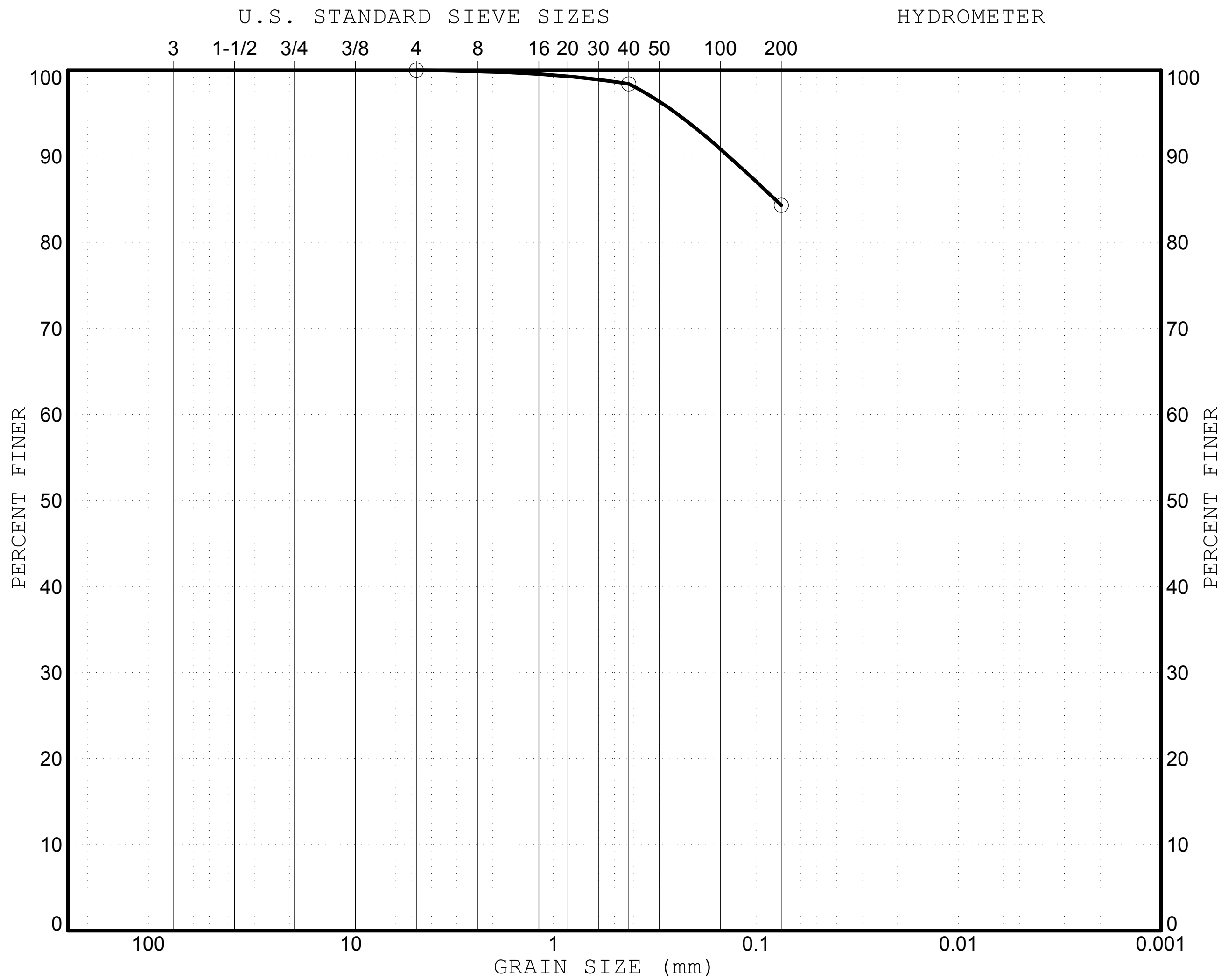
SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-2 at 4.0	100	85	21	CL

GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL
GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **26**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-2 at 8.0	100	84		CL

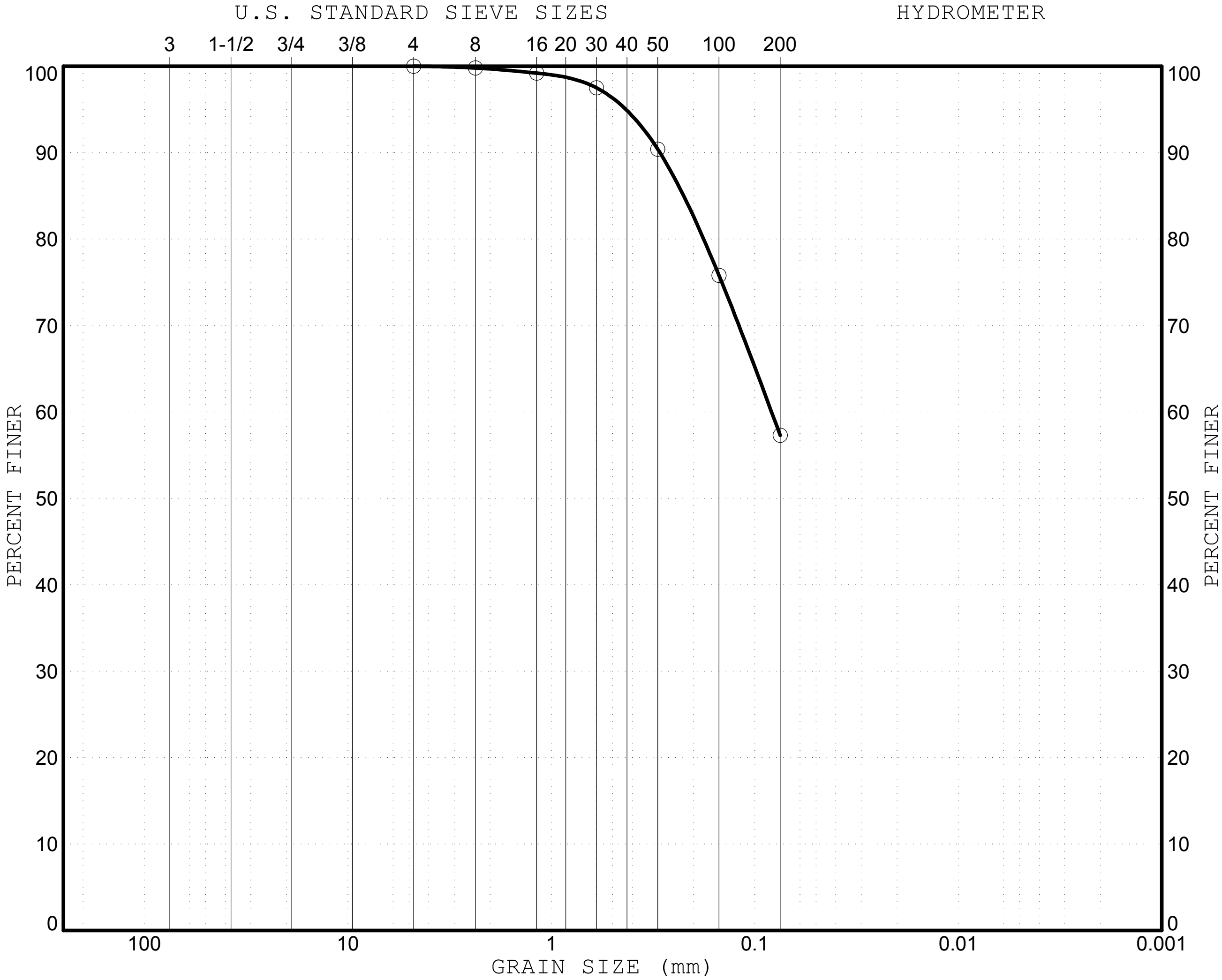
GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL

GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **27**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

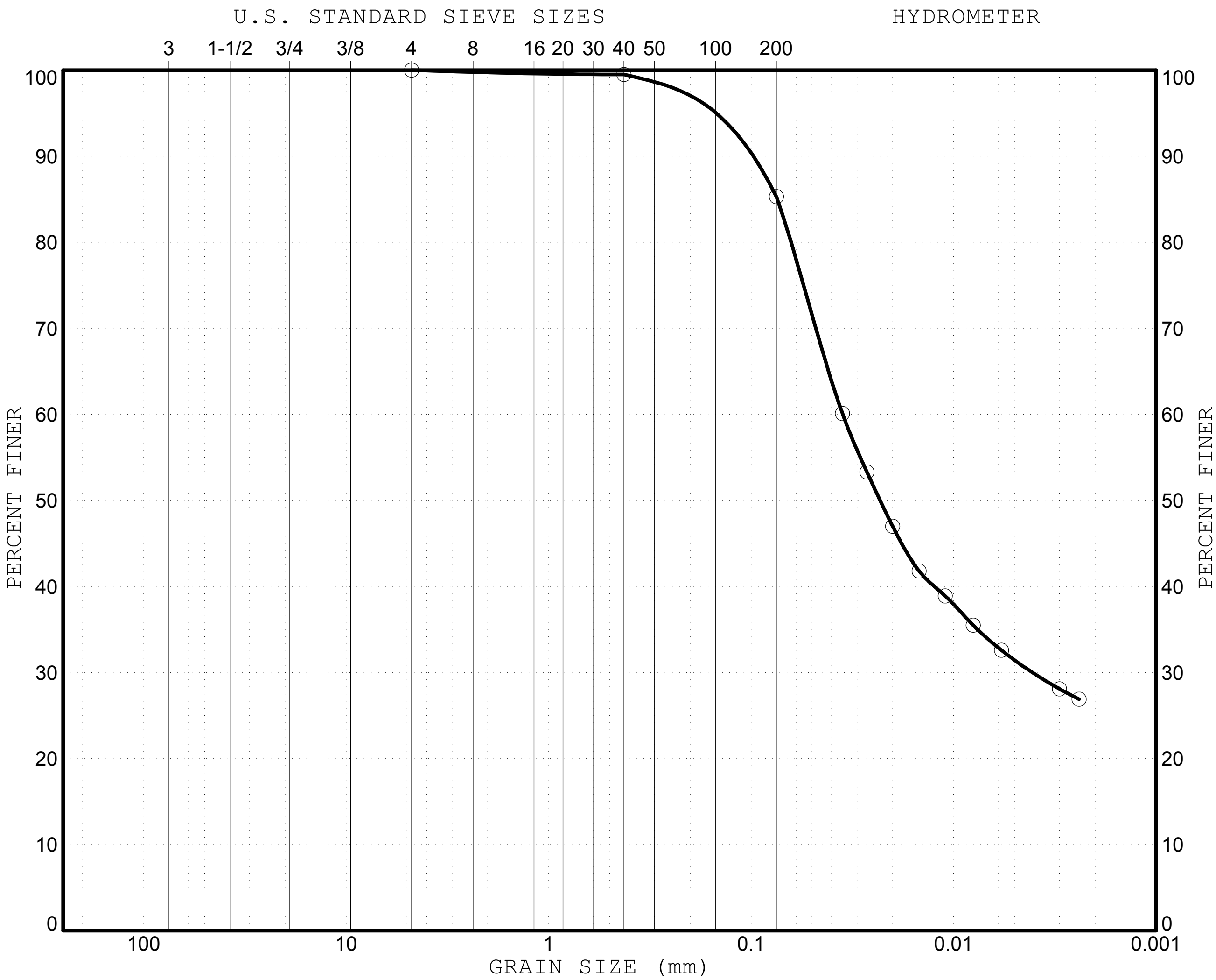
SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-2 at 8.1	100	57		CL

GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL
GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **28**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-2 at 12.0	100	85	26	CL

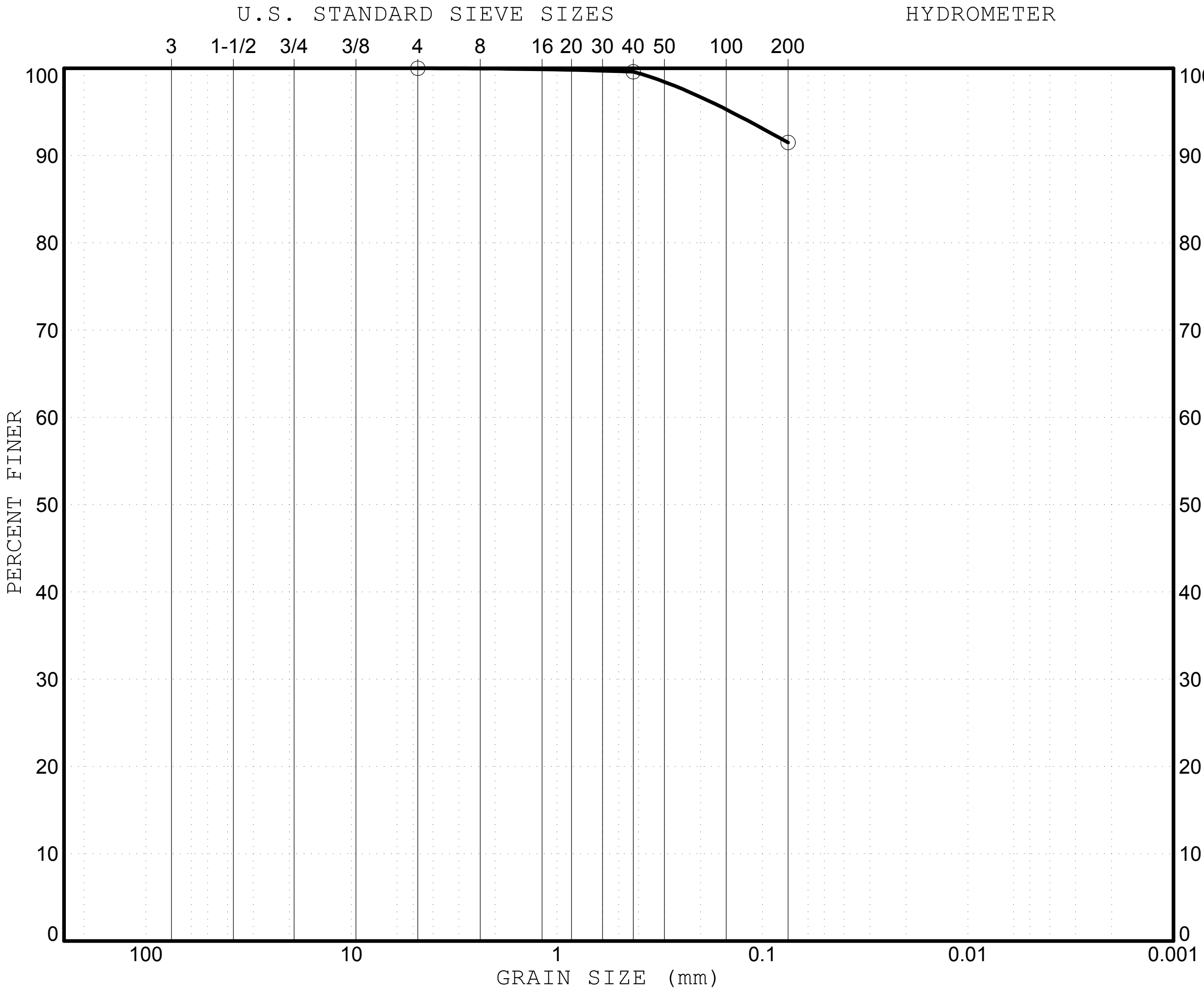
GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL

GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **29**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-2 at 16.0	100	92		CL

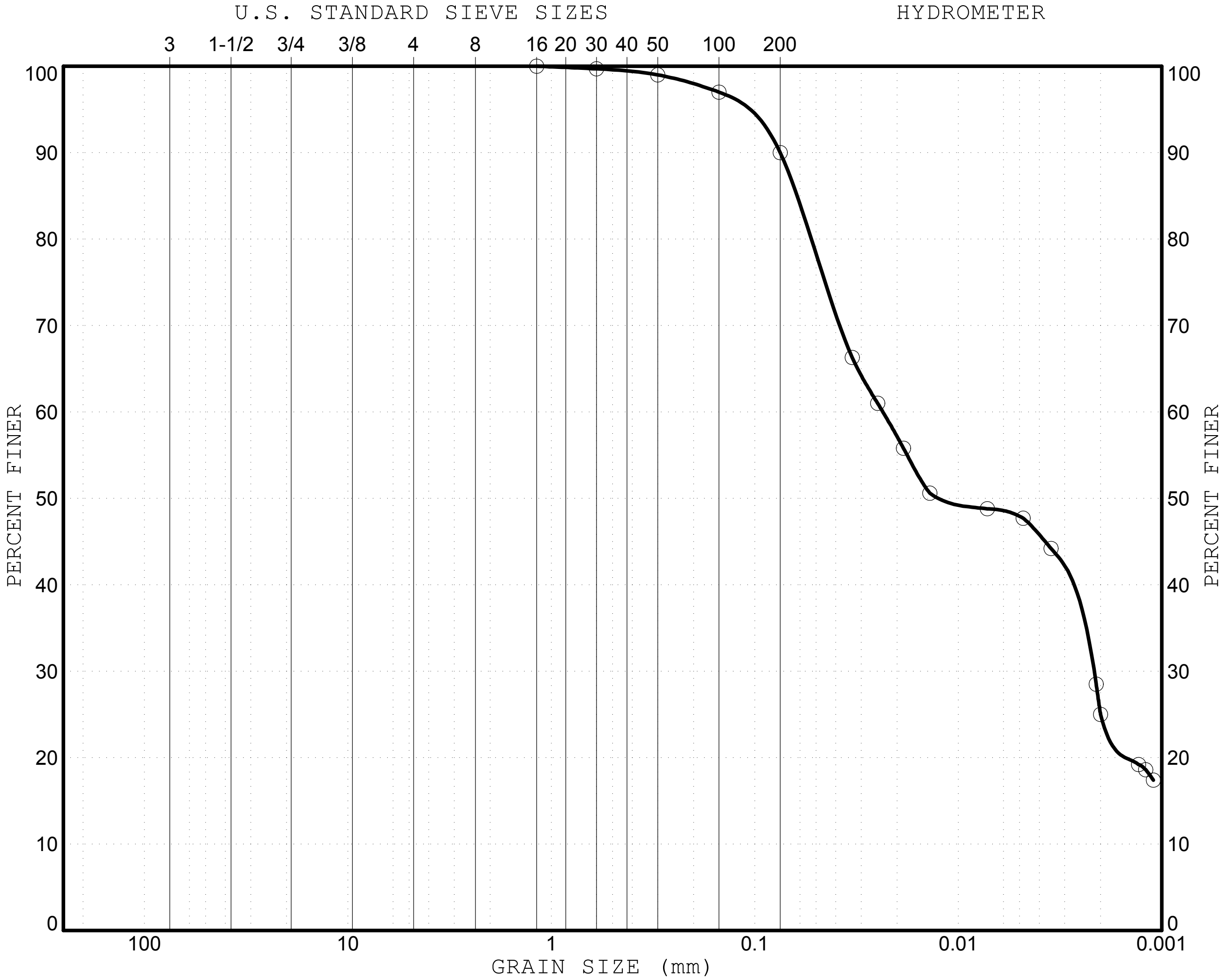
GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL

GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **30**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

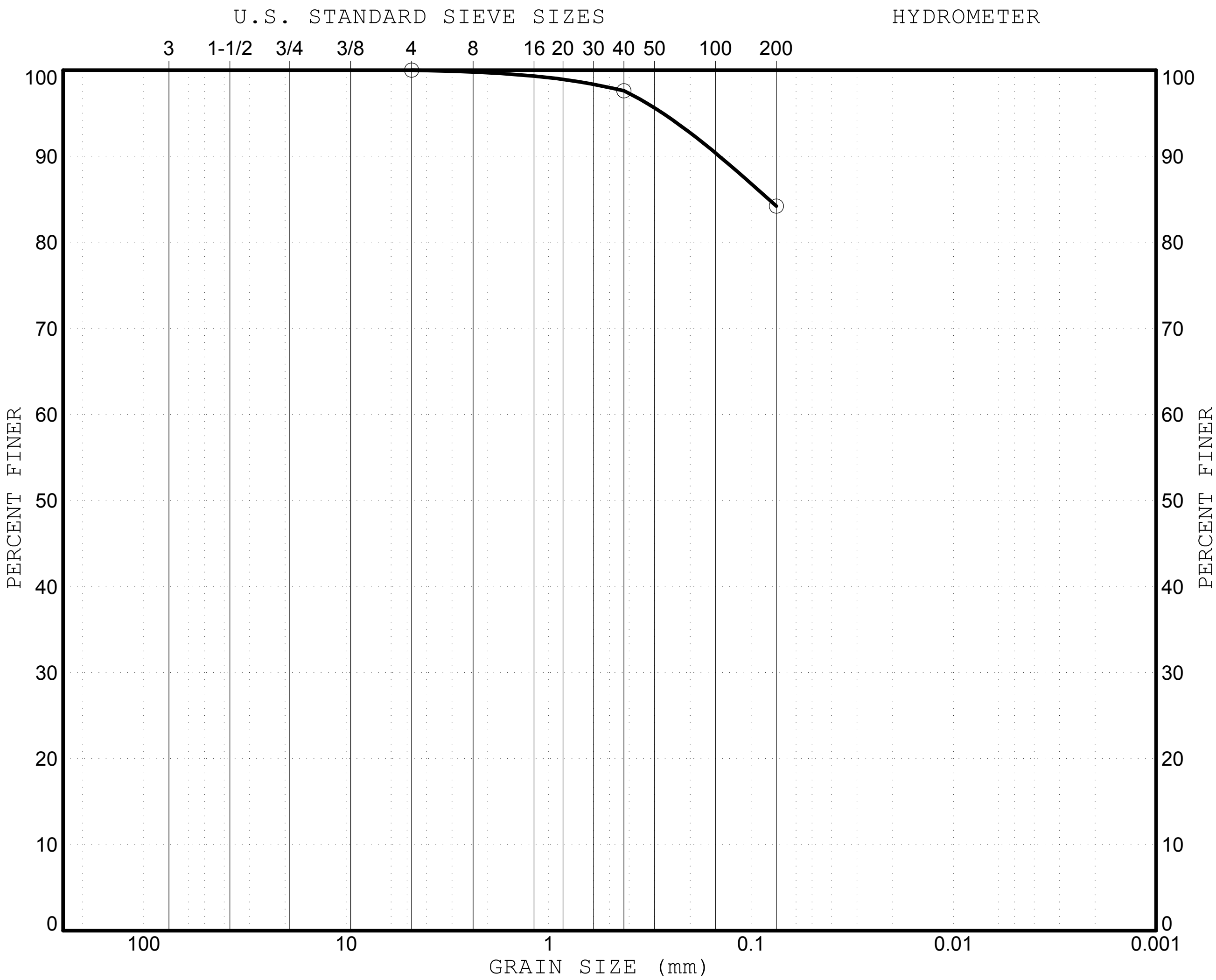
SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-2 at 20.0		90	25	CL

GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL
GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **31**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

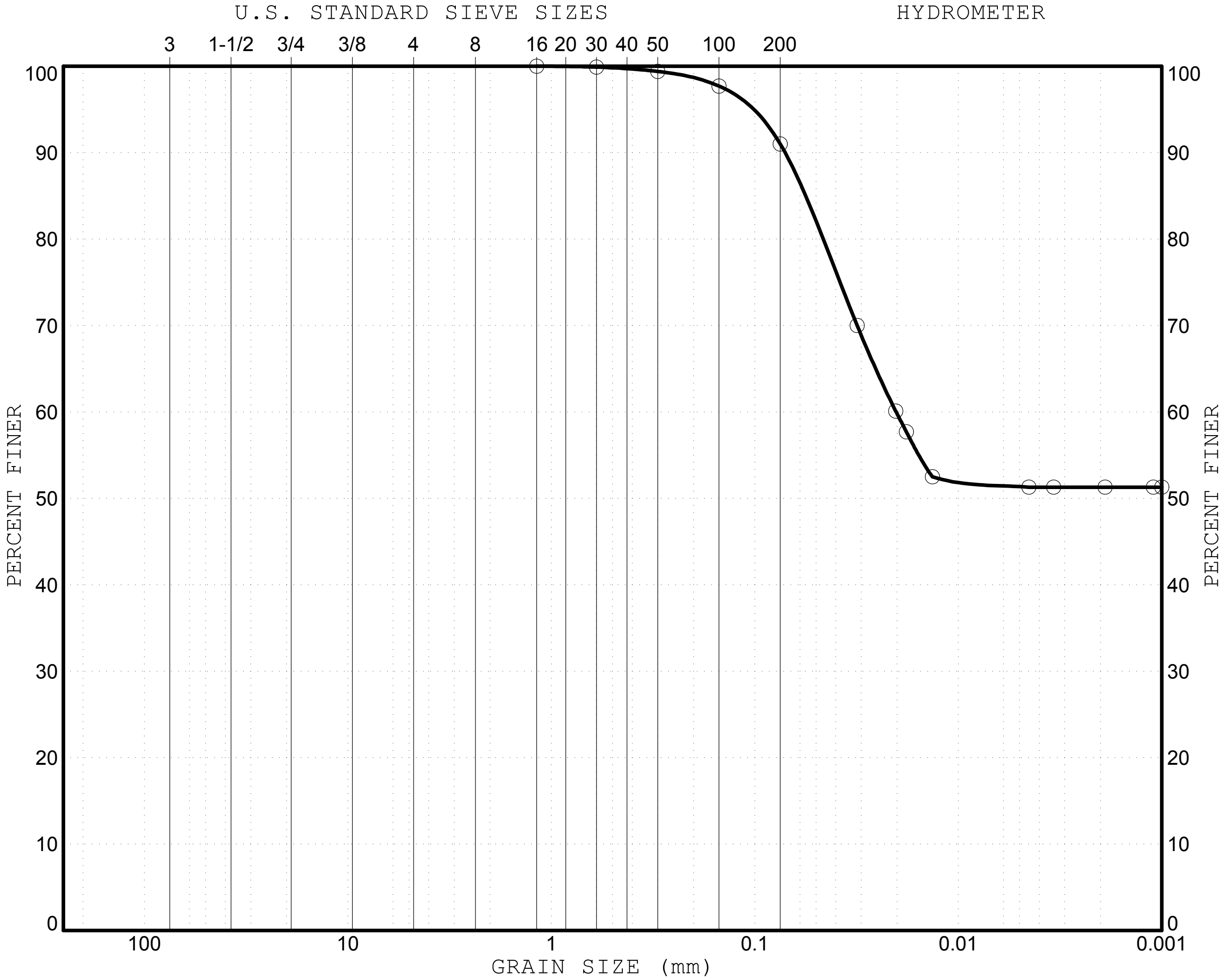
SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-2 at 24.0	100	84		CL

GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL
GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **32**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-2 at 28.0		91	51	CL

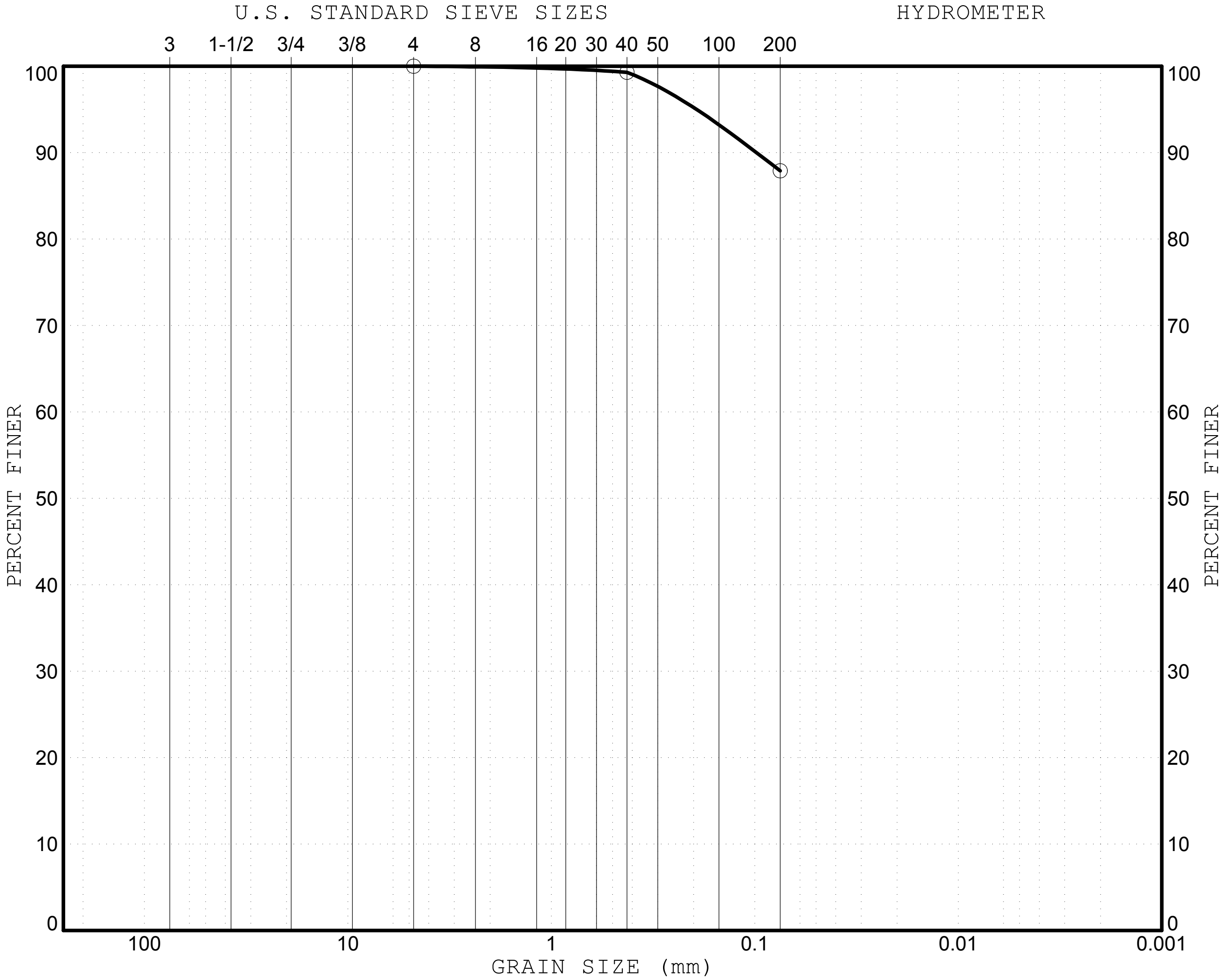
GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL

GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **33**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

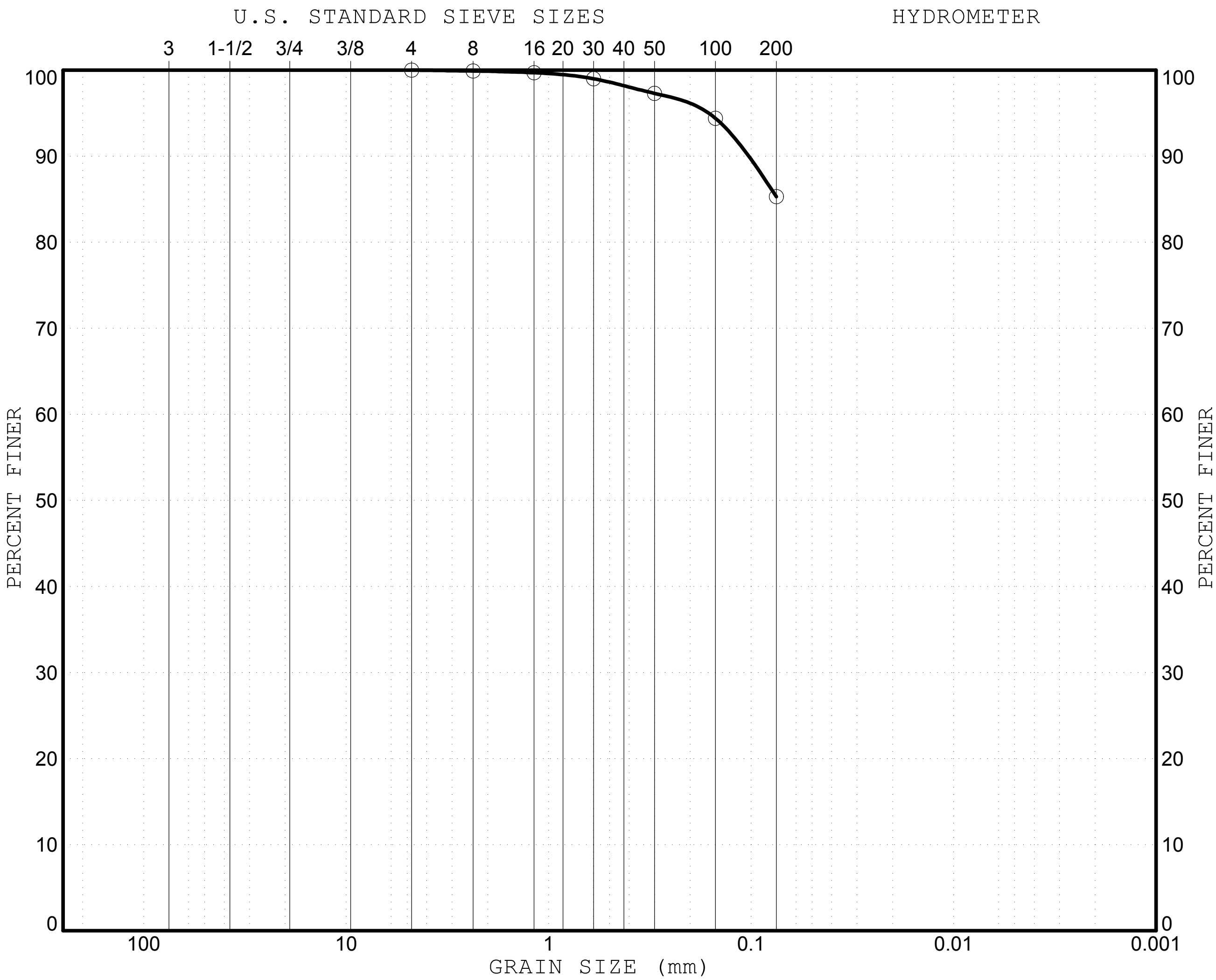
SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-2 at 32.0	100	88		CL

GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL
GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **34**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-2 at 36.0	100	85		CL

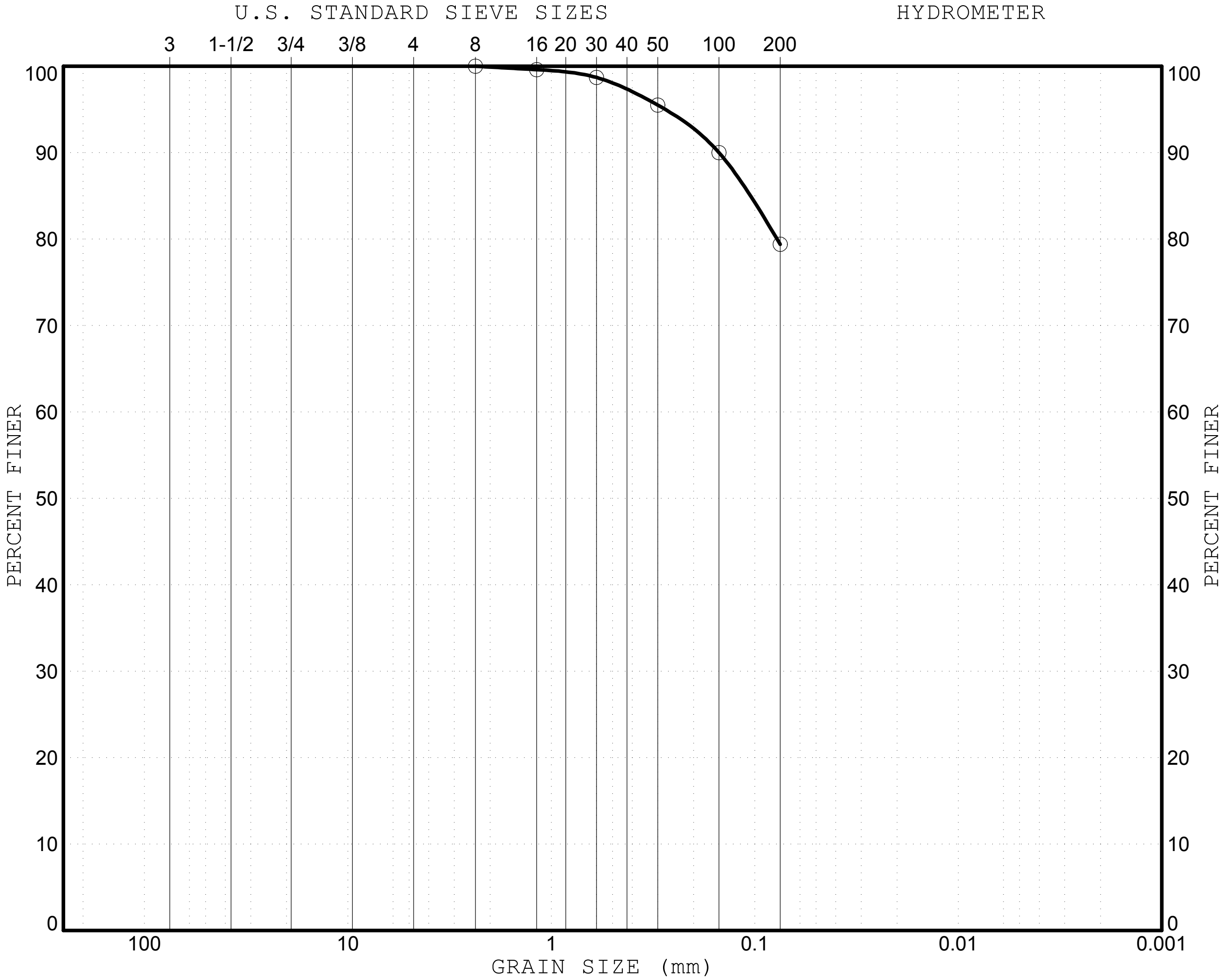
GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL

GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **35**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

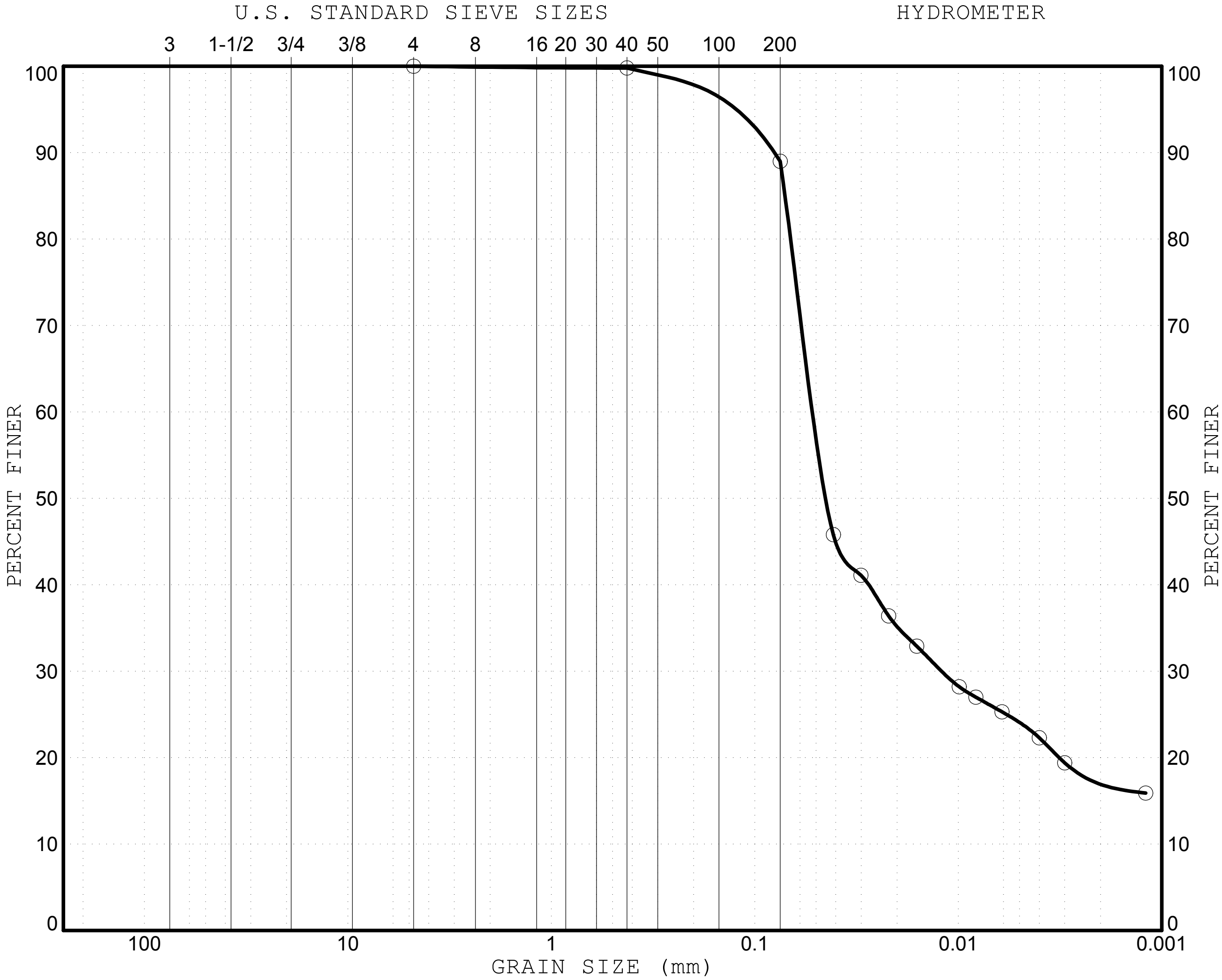
SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-2 at 40.0		79		CL

GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL
GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **36**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

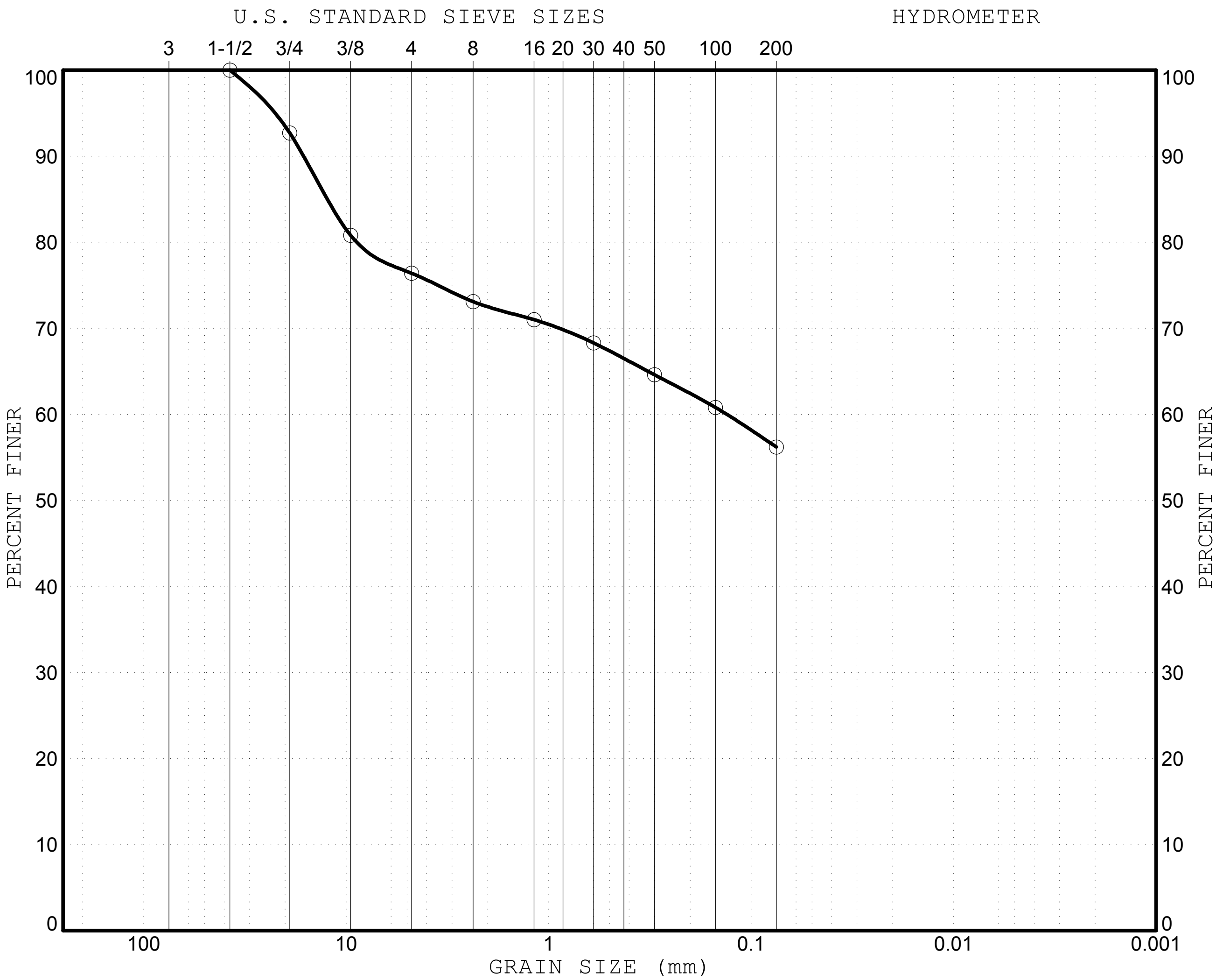
SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-2 at 44.0	100	89	18	ML

GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL
GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **37**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-2 at 50.0	76	56		CL

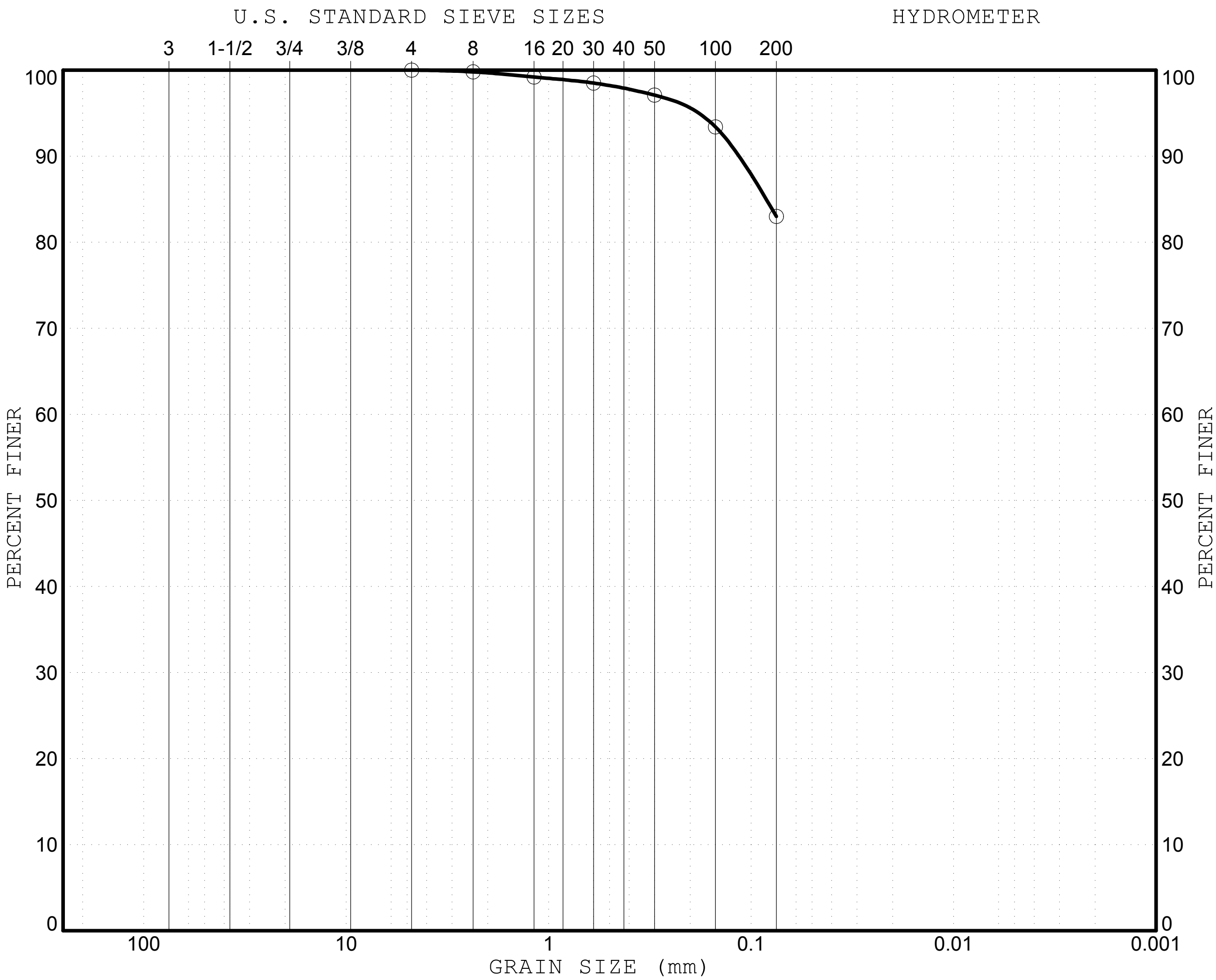
GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL

GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **38**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

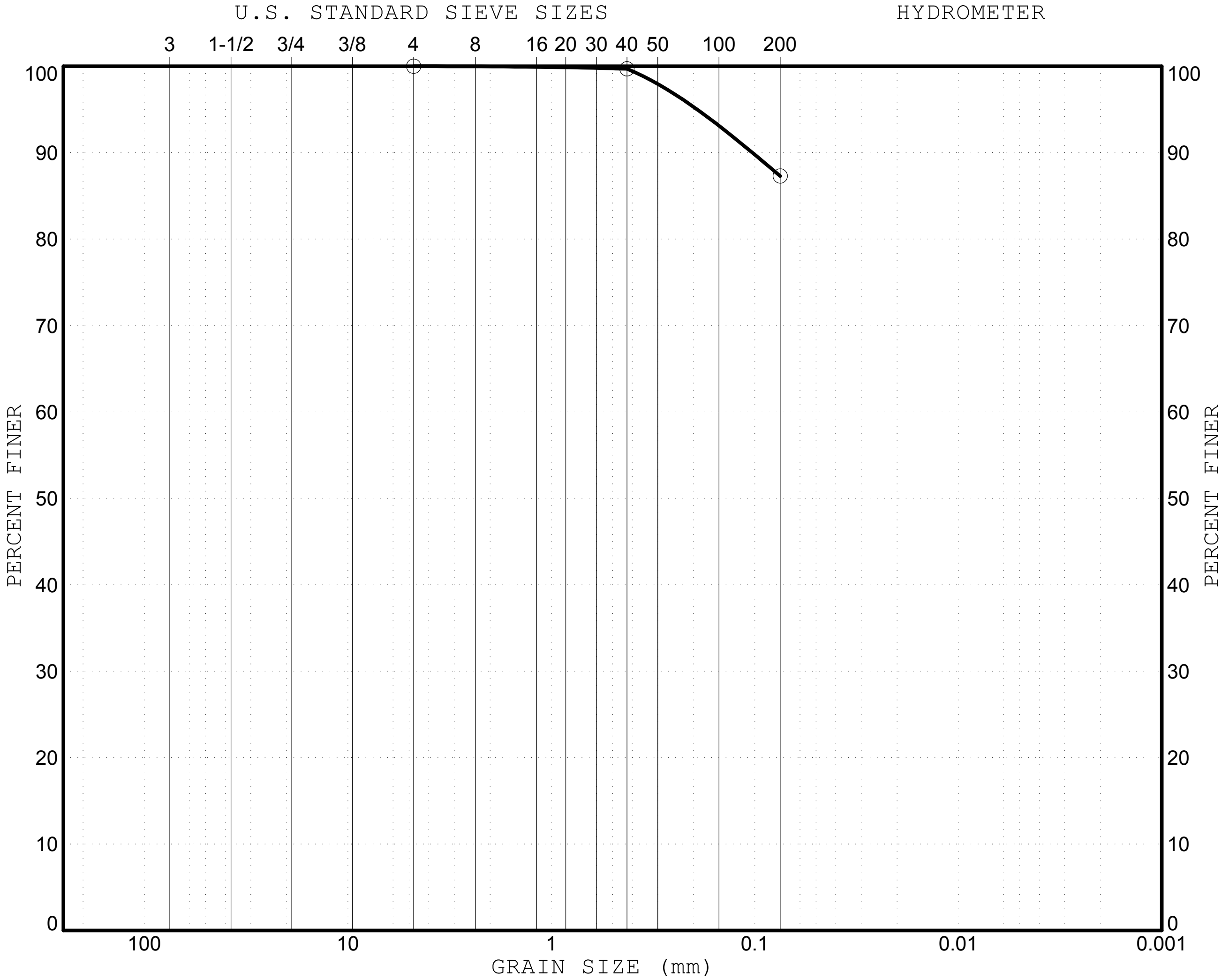
SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-3 at 4.5	100	83		ML

GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL
GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **39**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-3 at 8.0	100	87		ML

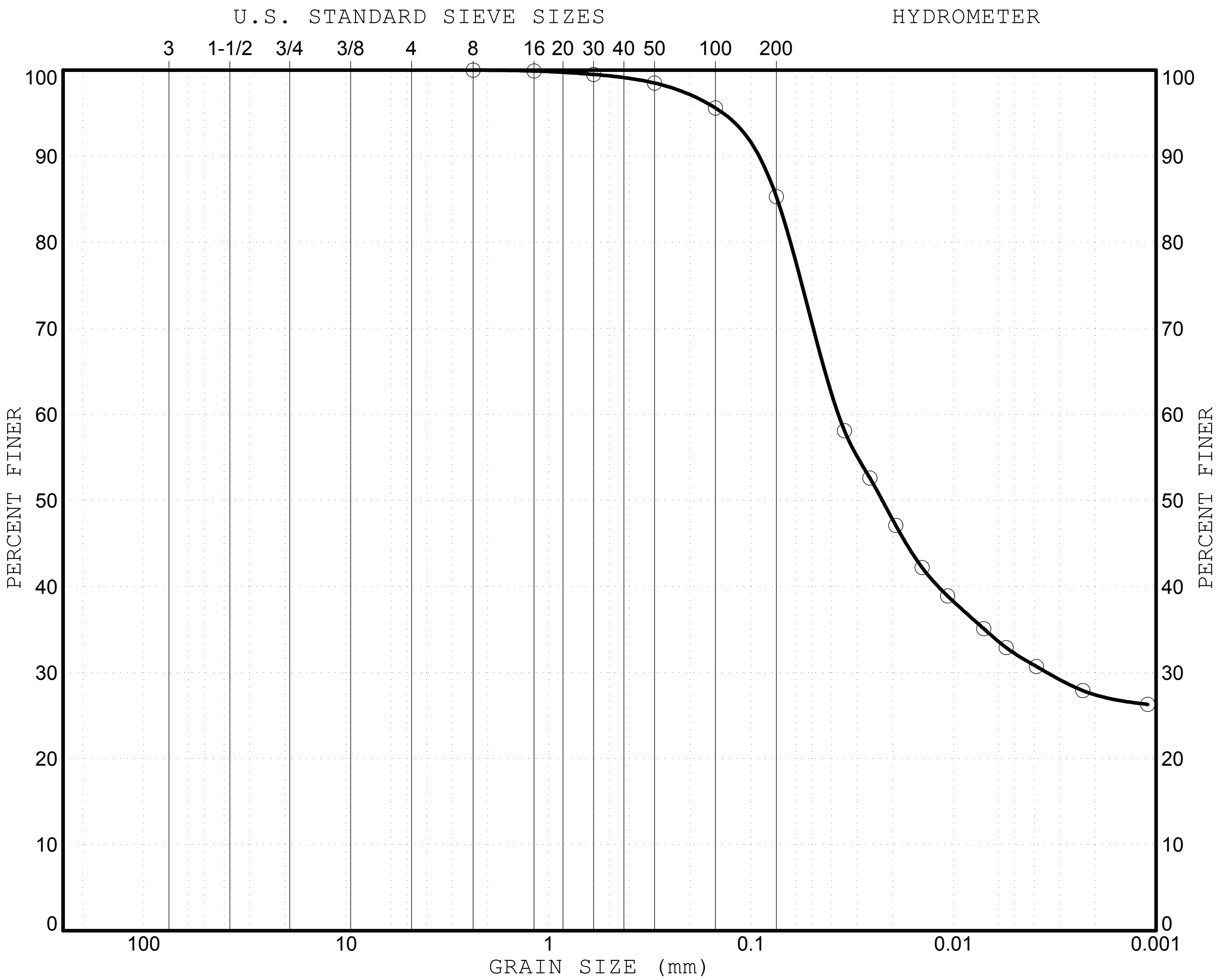
GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL

GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **40**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-3 at 12.0		85	28	CL

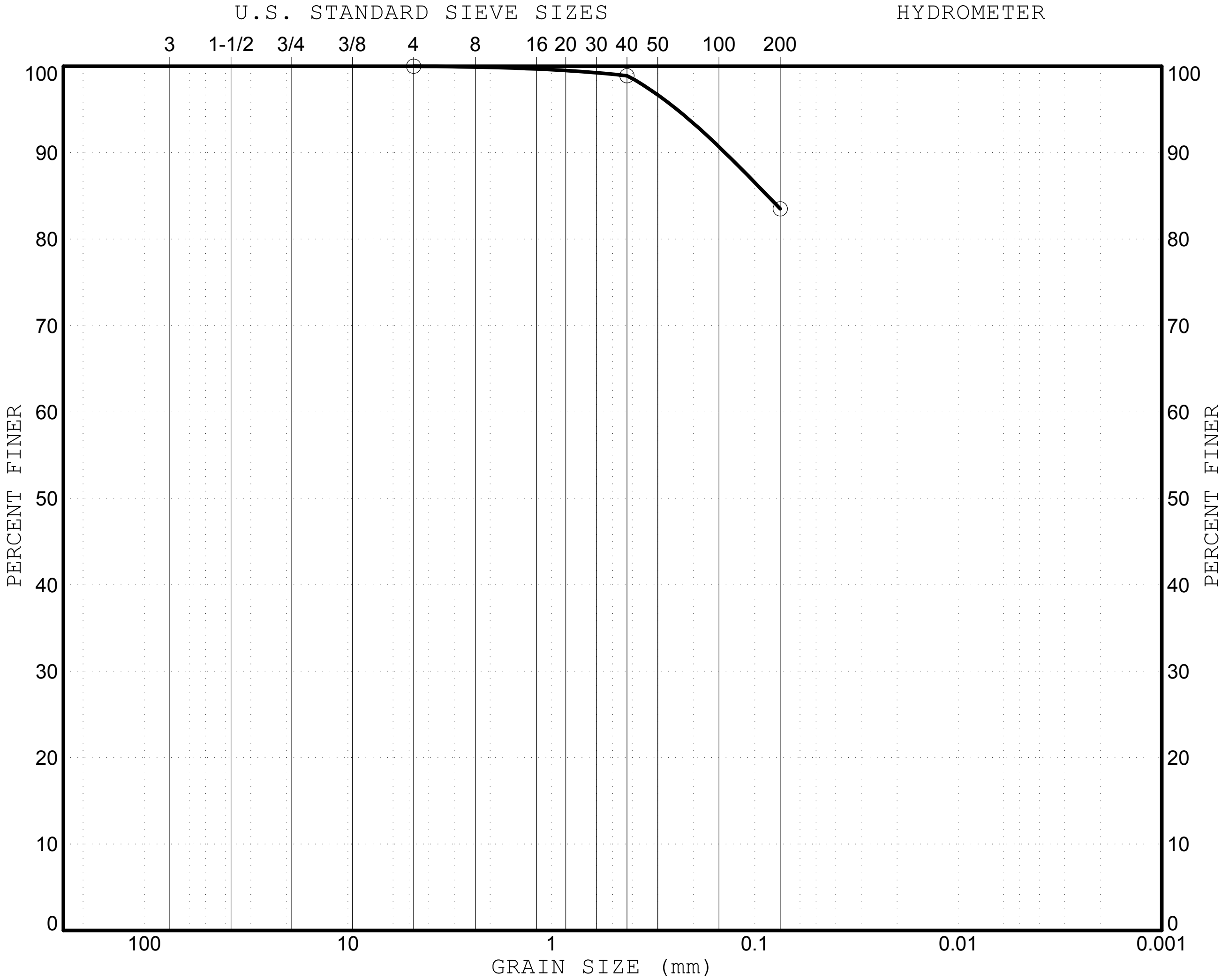
GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL

GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **41**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-3 at 16.0	100	84		CL

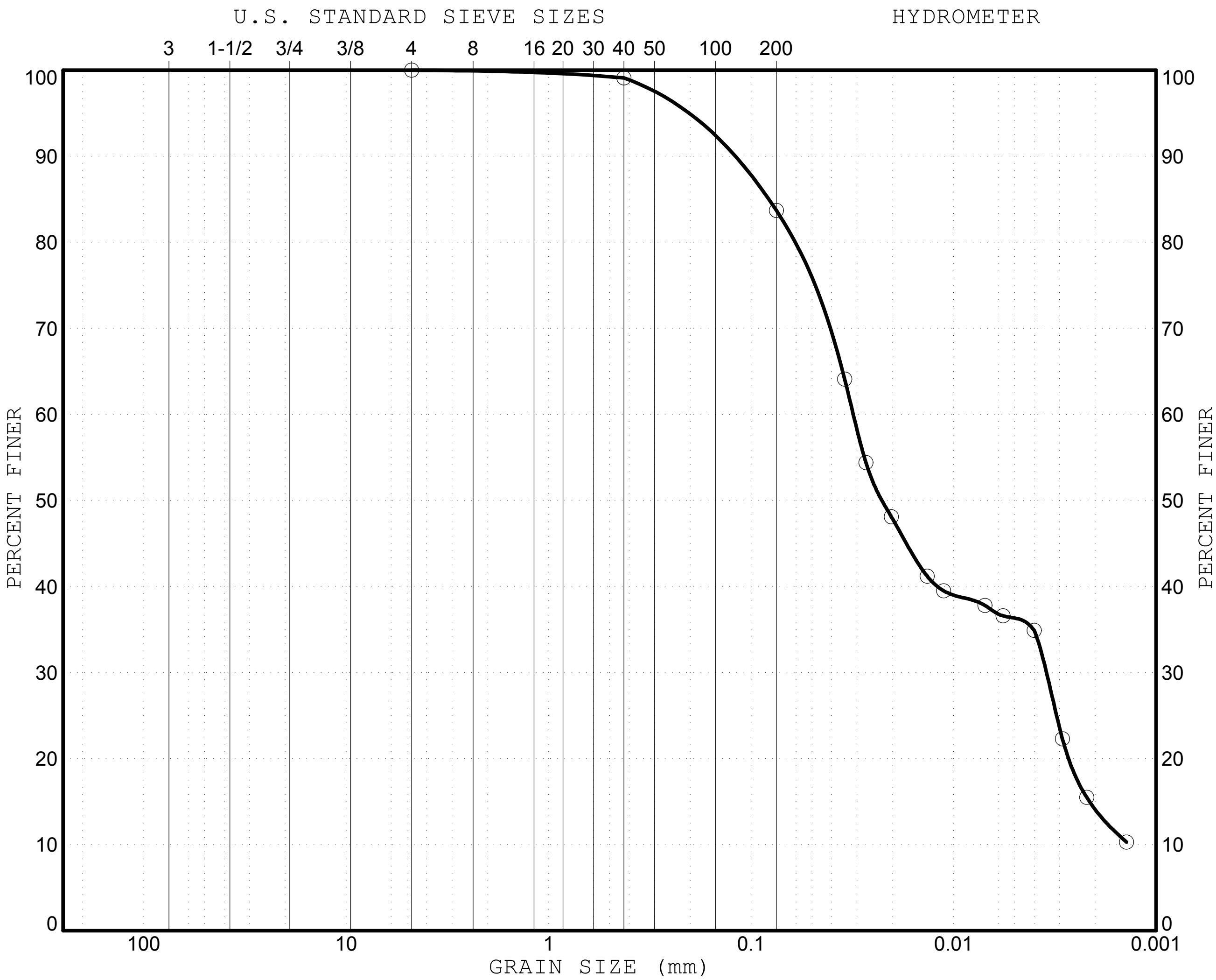
GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL

GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **42**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-3 at 20.0	100	84	14	CL

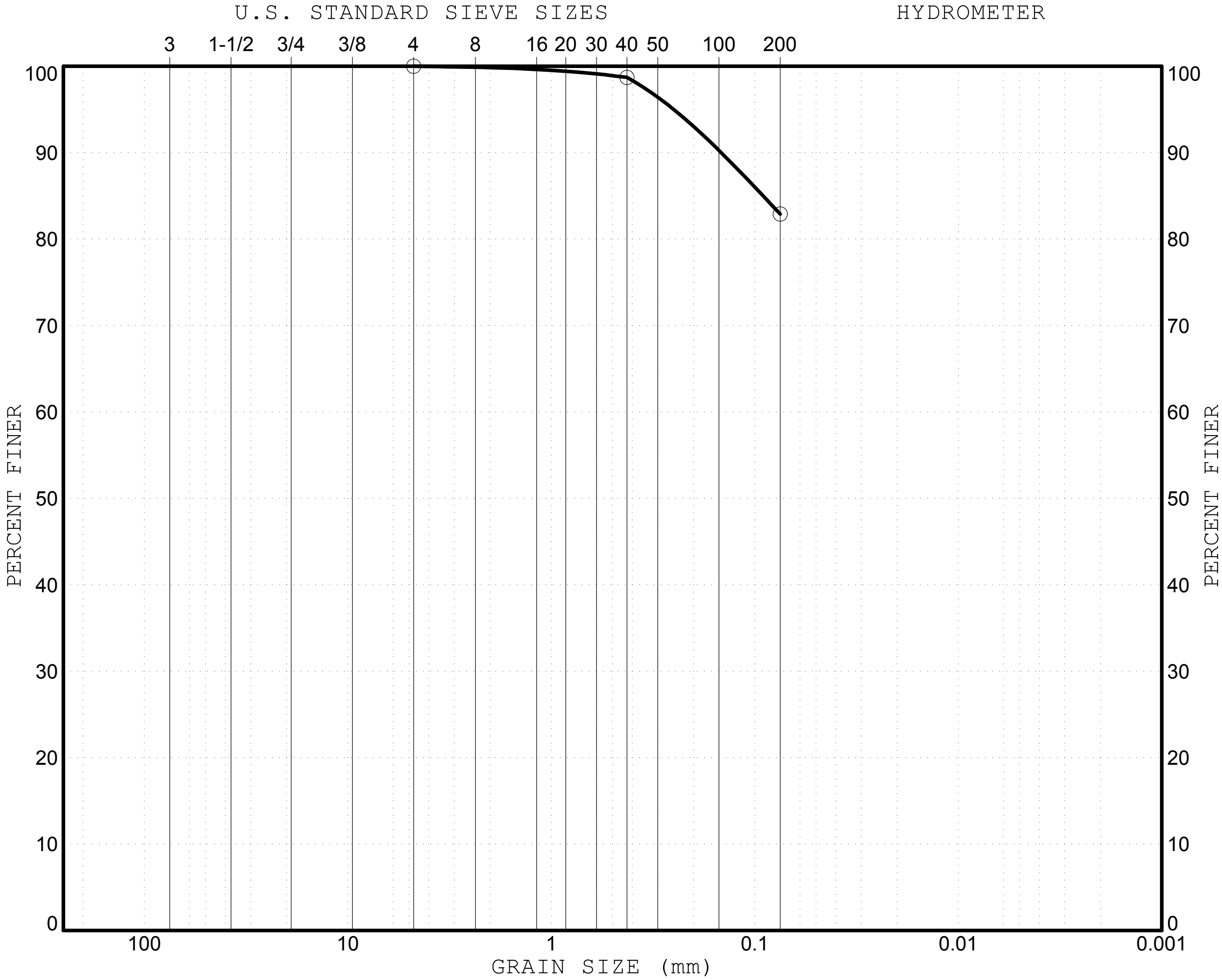
GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL

GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **43**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-3 at 24.0	100	83		ML

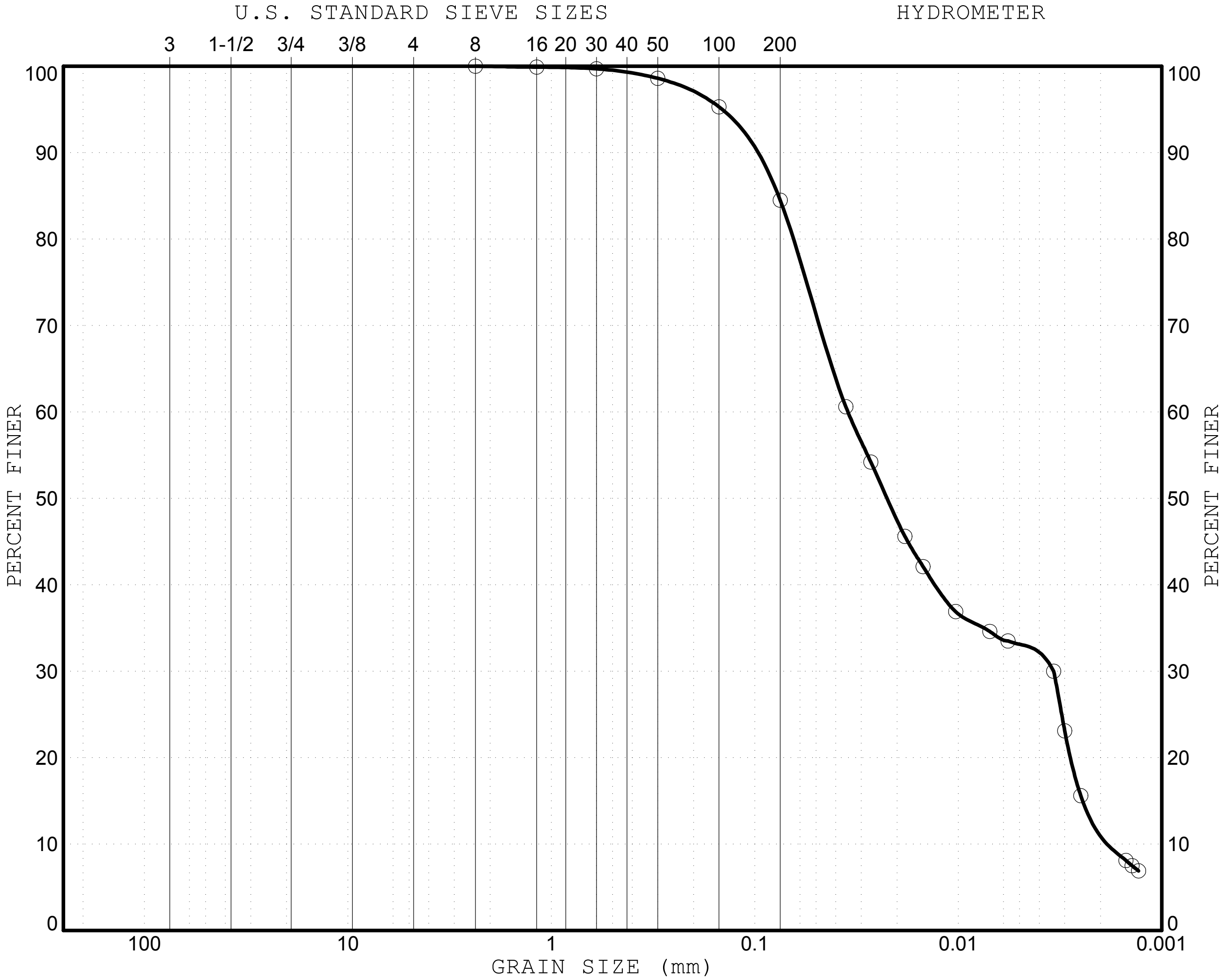
GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL

GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **44**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-3 at 28.0		85	12	CL

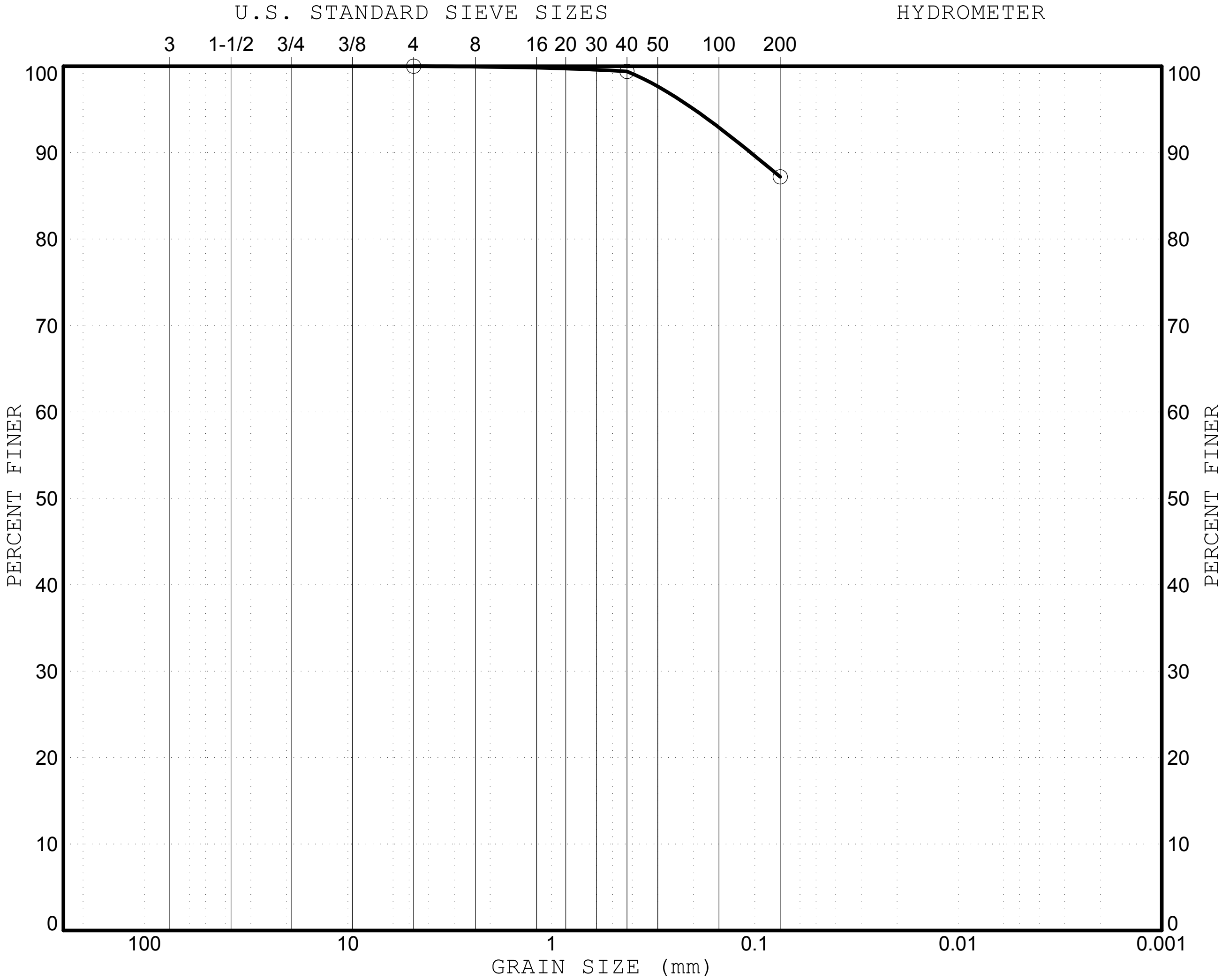
GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL

GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **45**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-3 at 32.0	100	87		CL

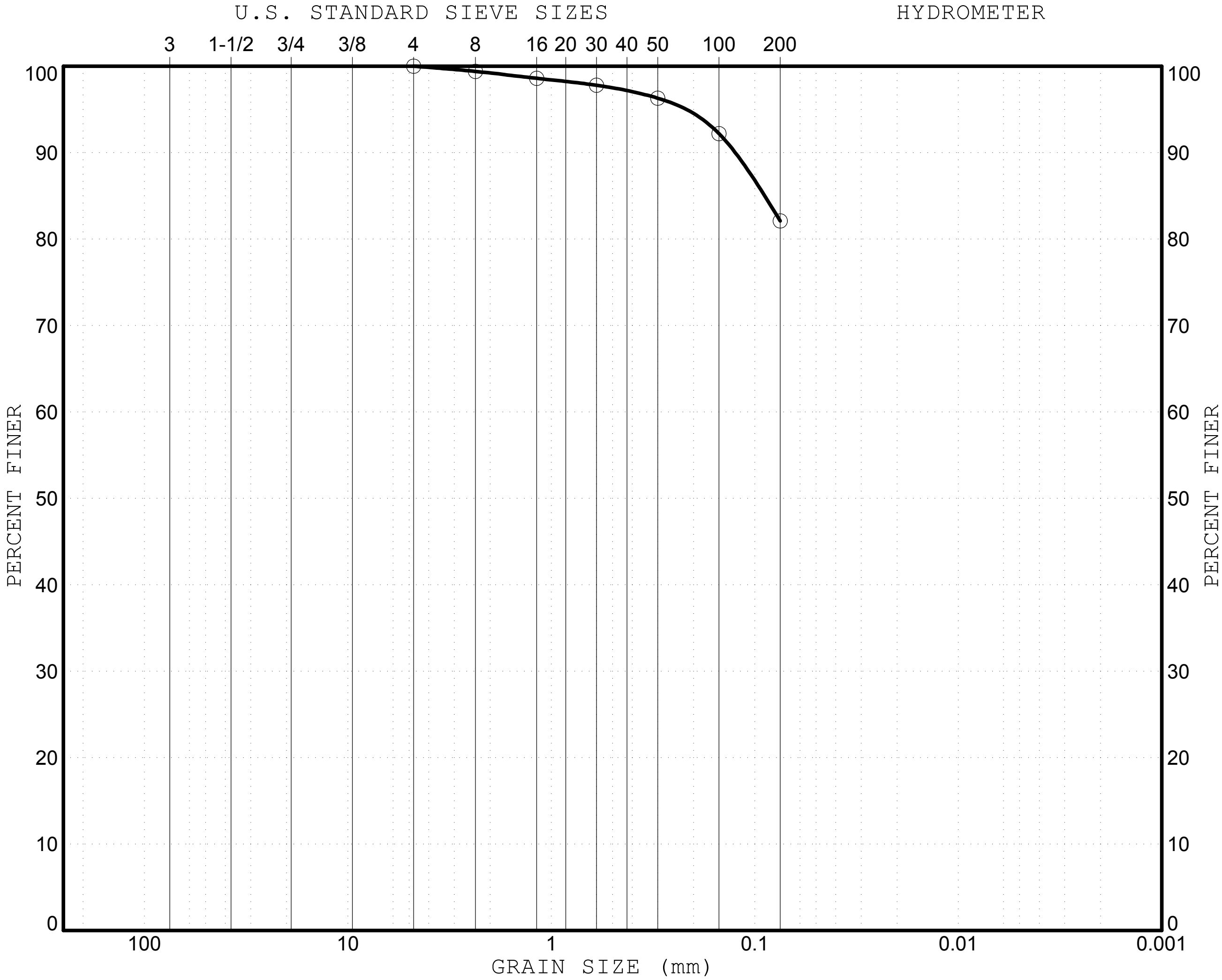
GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL

GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **46**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-3 at 36.0	100	82		CL

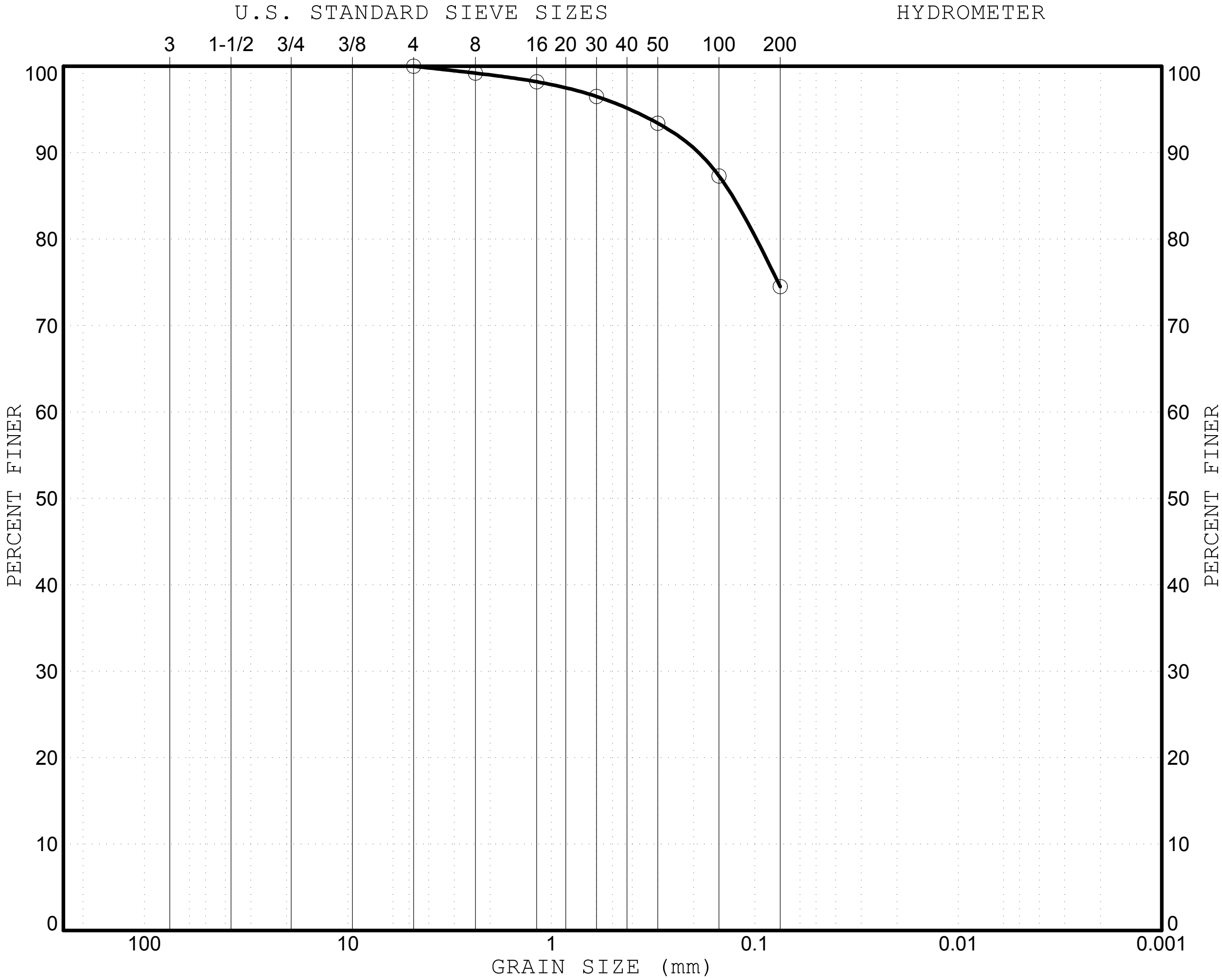
GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL

GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **47**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

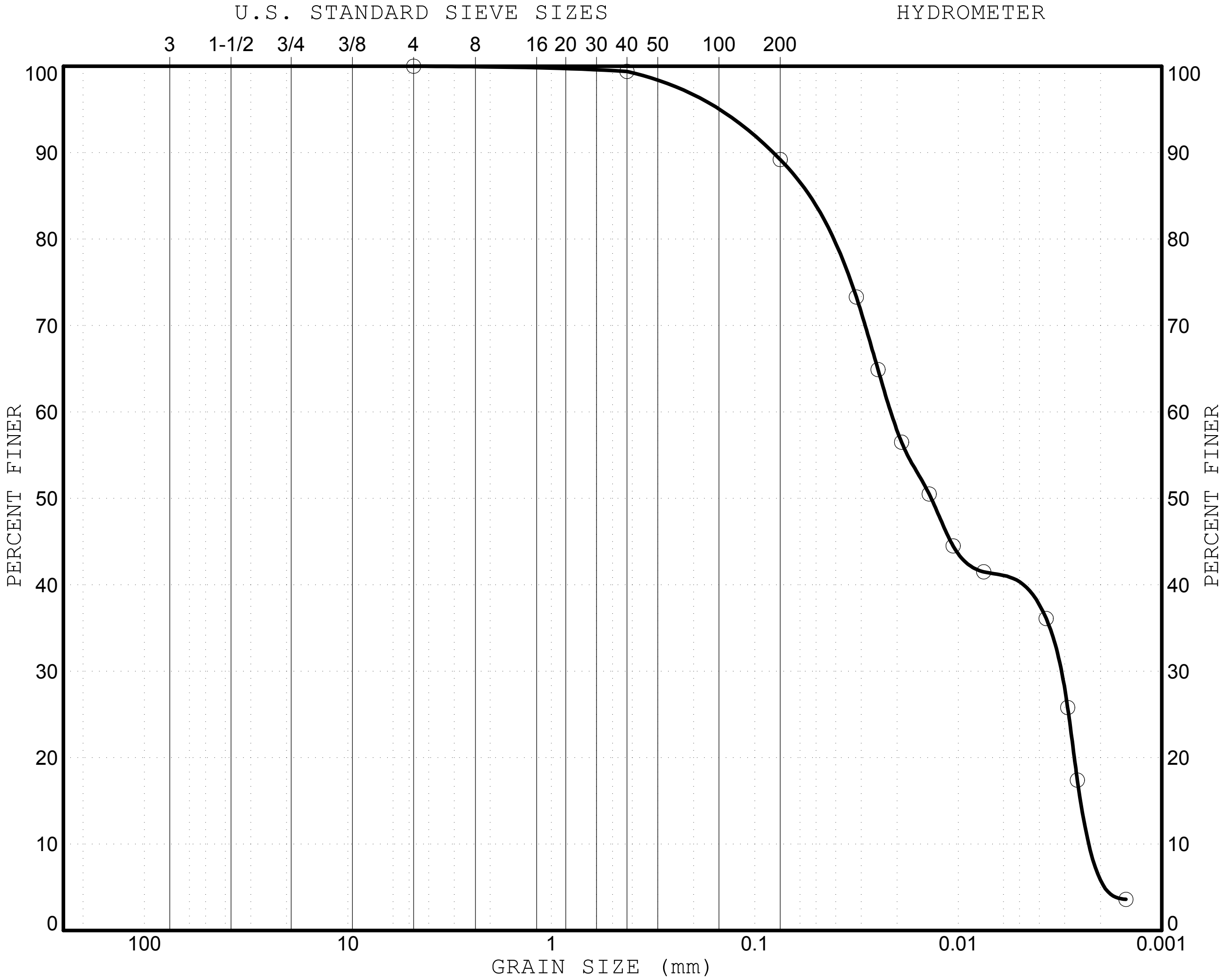
SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-3 at 40.0	100	75		CL

GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL
GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **48**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-3 at 44.0	100	89	11	CH

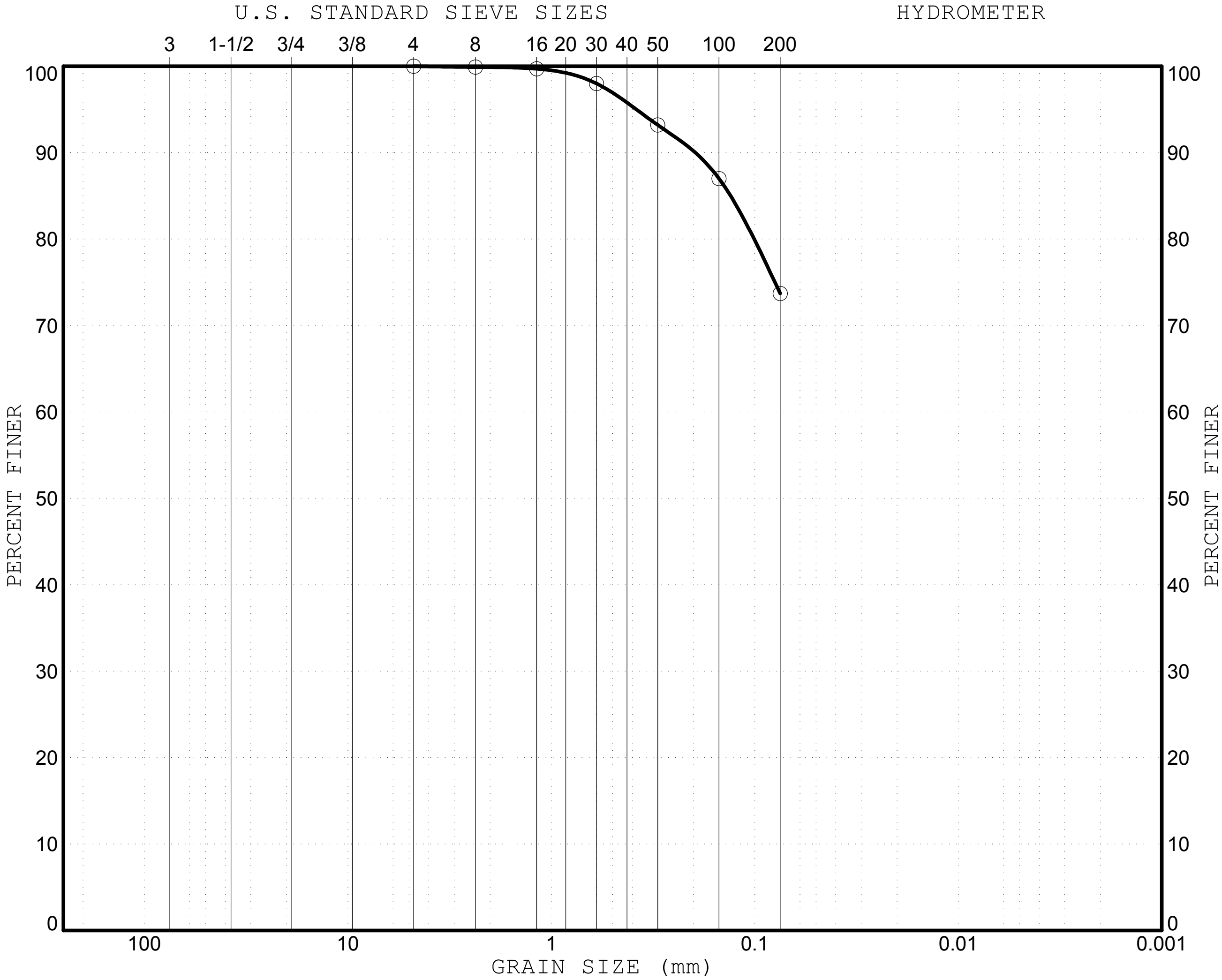
GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL

GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **49**



COBBLES	GRAVEL		SAND			SILT and CLAY
	Coarse	Fine	Coarse	Medium	Fine	

SYMBOL	SAMPLE LOCATION	% PASSING NO. 4 SIEVE	% PASSING NO. 200 SIEVE	% FINER 2 MICRONS	UNIFIED SOIL CLASSIFICATION
○	B-3 at 50.0	100	74		CL

GRADATION TEST RESULTS (ASTM: D 422)

COASTAL GEOTECHNICAL
GEOTECHNICAL CONSULTANTS

Doheny Village Planning Area
Dana Point, CA

PROJECT NO. **7743.2CG** FIGURE NO. **50**

APPENDIX A
(Liquefaction Analyses)

2/8/16

Evaluation of Initiation of Liquefaction
Based on NCEER and NCEER/NSF workshops;
JGGE vol. 127, no. 4, (April 2001)

Seismic parameters:			
PGA [g] =	0.56		
M =	7.0	MSF:	1.22

boring	top depth (ft)	av depth (ft)	$(N_1)_{60}$	σ_{vo} (psf)	σ'_{vo} (psf)	r_d	CSR	fines correction % fines FC	Clay Fraction[b]	α	β	$(N_1)_{60cs}$	interp $CRR_{7.5}$	FS_L	liquefaction? (y/n)	remark[c]
B-1	4	5.00	23	575	575	0.989	0.360	88		5.00	1.20	33	-	-	n	hbc
	8	9.00	19	1035	785	0.980	0.470	90	45	5.00	1.20	28	0.347	0.90	n	cf
	12	13.00	8	1495	996	0.971	0.531	90		5.00	1.20	15	0.163	0.38	n	cf
	16	17.00	6	1955	1206	0.962	0.568	94	65	5.00	1.20	13	0.137	0.29	n	cf
	20	21.00	16	2415	1417	0.953	0.591	56		5.00	1.20	24	0.271	0.56	n	cf
	24	25.00	8	2875	1627	0.944	0.607	83		5.00	1.20	15	0.167	0.33	n	cf
	28	29.00	11	3335	1837	0.935	0.618	80	33	5.00	1.20	18	0.204	0.40	n	cf
	32	33.00	12	3795	2048	0.905	0.611	85		5.00	1.20	20	0.220	0.44	n	cf
	36	37.00	12	4255	2258	0.873	0.599	90	25	5.00	1.20	19	0.214	0.44	n	cf
	40	41.00	11	4715	2469	0.840	0.584	93		5.00	1.20	18	0.195	0.41	n	cf
	44	45.00	11	5175	2679	0.808	0.568	93		5.00	1.20	18	0.203	0.44	n	cf
	50	51.00	14	5865	2995	0.759	0.541	90		5.00	1.20	22	0.247	0.56	n	cf

boring	top depth (ft)	av depth (ft)	$(N_1)_{60}$	σ_{vo} (psf)	σ'_{vo} (psf)	r_d	CSR	fines correction % fines FC	Clay Fraction[b]	α	β	$(N_1)_{60cs}$	interp $CRR_{7.5}$	FS_L	liquefaction? (y/n)	remark[c]
B-2	4	5.00	3	575	575	0.989	0.360	85	27	5.00	1.20	9	0.098	0.33	n	cf
	8	9.00	3	1035	785	0.980	0.470	57		5.00	1.20	8	0.092	0.24	n	cf
	12	13.00	9	1495	996	0.971	0.531	85	31	5.00	1.20	16	0.180	0.41	n	cf
	16	17.00	10	1955	1206	0.962	0.568	92		5.00	1.20	17	0.182	0.39	n	cf
	20	21.00	11	2415	1417	0.953	0.591	90	48	5.00	1.20	19	0.206	0.42	n	cf
	24	25.00	12	2875	1627	0.944	0.607	84		5.00	1.20	19	0.213	0.43	n	cf
	28	29.00	12	3335	1837	0.935	0.618	91	51	5.00	1.20	20	0.221	0.44	n	cf
	32	33.00	15	3795	2048	0.905	0.611	88		5.00	1.20	22	0.253	0.51	n	cf
	36	37.00	13	4255	2258	0.873	0.599	85		5.00	1.20	21	0.230	0.47	n	cf
	40	41.00	13	4715	2469	0.840	0.584	79		5.00	1.20	20	0.224	0.47	n	cf
	44	45.00	10	5175	2679	0.808	0.568	89	24	5.00	1.20	17	0.192	0.41	n	cf
	50	51.00	15	5865	2995	0.759	0.541	56		5.00	1.20	23	0.264	0.60	n	cf

2/8/16

Doheny Village Planning Area

Evaluation of Initiation of Liquefaction
Based on NCEER and NCEER/NSF workshops;
JGGE vol. 127, no. 4, (April 2001)

Seismic parameters:			
PGA [g] =	0.56		
M =	7.0	MSF:	1.22

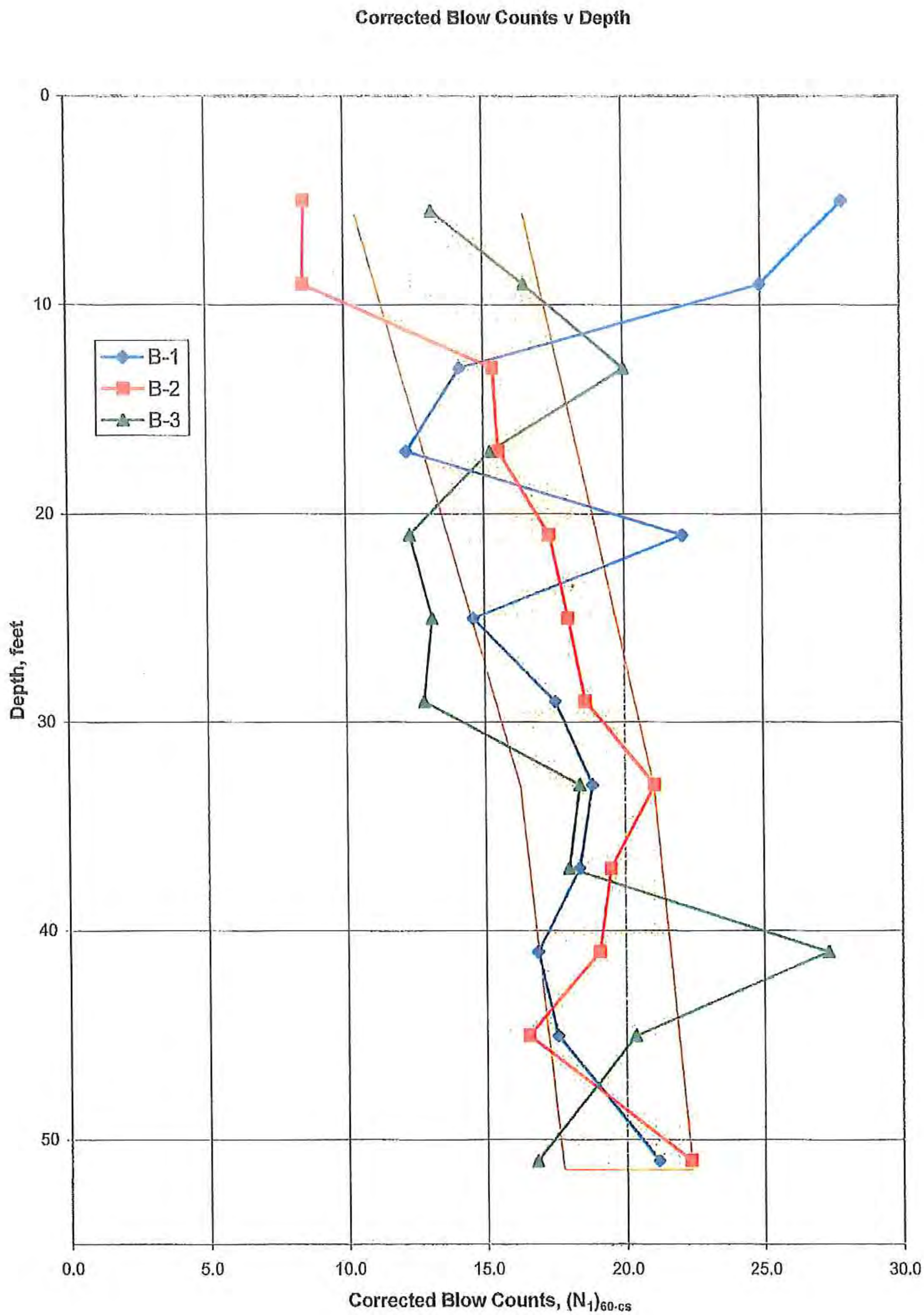
boring	top depth (ft)	av depth (ft)	$(N_1)_{60}$	σ_{vo} (psf)	σ'_{vo} (psf)	r_d	CSR	fines correction: % fines FC	Clay Fraction[b]	α	β	$(N_1)_{60cs}$	interp $CRR_{7.5}$	FS_L	liquefaction? (y/n)	remark[c]
B-3	4.5	5.50	8	633	601	0.988	0.378	83		5.00	1.20	14	0.155	0.50	n	cf
	8	9.00	10	1035	785	0.980	0.470	87		5.00	1.20	17	0.188	0.49	n	cf
	12	13.00	14	1495	996	0.971	0.531	85	32	5.00	1.20	22	0.247	0.57	n	cf
	16	17.00	9	1955	1206	0.962	0.568	84		5.00	1.20	16	0.178	0.38	n	cf
	20	21.00	6	2415	1417	0.953	0.591	84	37	5.00	1.20	13	0.140	0.29	n	cf
	24	25.00	7	2875	1627	0.944	0.607	83		5.00	1.20	14	0.149	0.30	n	cf
	28	29.00	7	3335	1837	0.935	0.618	85	33	5.00	1.20	13	0.146	0.29	n	cf
	32	33.00	12	3795	2048	0.905	0.611	87		5.00	1.20	19	0.217	0.43	n	cf
	36	37.00	12	4255	2258	0.873	0.599	82		5.00	1.20	19	0.211	0.43	n	cf
	40	41.00	20	4715	2469	0.840	0.584	75		5.00	1.20	29	0.387	0.81	n	cf
	44	45.00	14	5175	2679	0.808	0.568	89	40	5.00	1.20	21	0.239	0.51	n	cf
	50	51.00	10	5865	2995	0.759	0.541	74		5.00	1.20	18	0.194	0.44	n	cf

[a] σ_{vo}: post-development elevations are at existing grades

[b] Clay Fraction: %<0.005mm
italicized font numbers for *% fines* and *CF* are assumed.

[c] ngw: absence of groundwater
hbc: high blow counts
cf: high clay fraction

Assumed gw depth, [ft]:	
B-1	5
B-2	5
B-3	5


Corrected Blow Counts v Depth
Depth, feet
Corrected Blow Counts, $(N_1)_{60\text{-}cs}$
B-1
B-2
B-3
0
10
20
30
40
50
0.0
5.0
10.0
15.0
20.0
25.0
30.0

Kleinfelder, K-1

Doheny Village Planning Area, Kleinfelder, K-1

Replication of Kleinfelder Results: 3/4/2010

4/8/16

Evaluation of Initiation of Liquefaction

Based on NCEER and NCEER/NSF workshops;

JGGE vol. 127, no. 4, (April 2001)

Seismic parameters:			
PGA [g] =	0.40		
M =	6.9	MSF:	1.24

boring	USCS	top depth (ft)	bot. depth (ft)	av depth (ft)	$(N_1)_{60}$	σ_{vo} (psf)	σ'_{vo} (psf)	r_d	CSR	α	β	$(N_1)_{60cs}$	interp $CRR_{7.5}$	FS_L	liquefaction? (y/n)	remark[c]
K-1	SM	0	6	3.0	10.0	360	360	0.993	0.258	3.61	1.08	14.5	0.158	0.76	n	ngw
	CL	6	8	7.0	16.2	840	840	0.984	0.256	5.00	1.20	24.4	0.282	1.37	n	cf
	SM	8	11	9.5	6.5	1140	1140	0.979	0.254	1.89	1.04	8.7	0.099	0.48	n	ngw
	CL	11	12	11.5	7.8	1380	1380	0.974	0.253	5.00	1.20	14.4	0.158	0.77	n	cf
	CL	12	18	15.0	9.0	1800	1613	0.967	0.280	5.00	1.20	15.8	0.174	0.77	n	cf
	SP-SM	18	23	20.5	10.7	2460	1930	0.954	0.316	0.00	1.00	10.7	0.118	0.46	y	
	SP-SM	23	28	25.5	14.2	3060	2218	0.943	0.338	0.87	1.02	15.4	0.169	0.62	y	
	SP-SM	28	33	30.5	39.2	3673	2518	0.926	0.351	0.03	1.00	39.2	-	-	n	
	SP-SM	33	38	35.5	43.2	4298	2831	0.885	0.349	0.03	1.00	43.2	-	-	n	
	SP-SM	38	43	40.5	39.9	4923	3144	0.844	0.344	0.03	1.00	40.0	-	-	n	
	SP-SM	43	52	47.5	38.4	5798	3582	0.787	0.331	0.03	1.00	38.4	-	-	n	

[a] σ_{vo}: post-development elevations are at approx. existing grades

[b] Clay Fraction: %<0.005mm
italicized font numbers for *% fines* and *CF*

[c] ngw: absence of groundwater
hbc: high blow counts
cf: high clay fraction

Assumed gw depth, [ft]:	
K-1	12

depth (ft):	γ (pcf):
28	120
28+	125

This agrees with Kleinfelder

4/8/16

Kleinfelder parameters (3/4/2010)

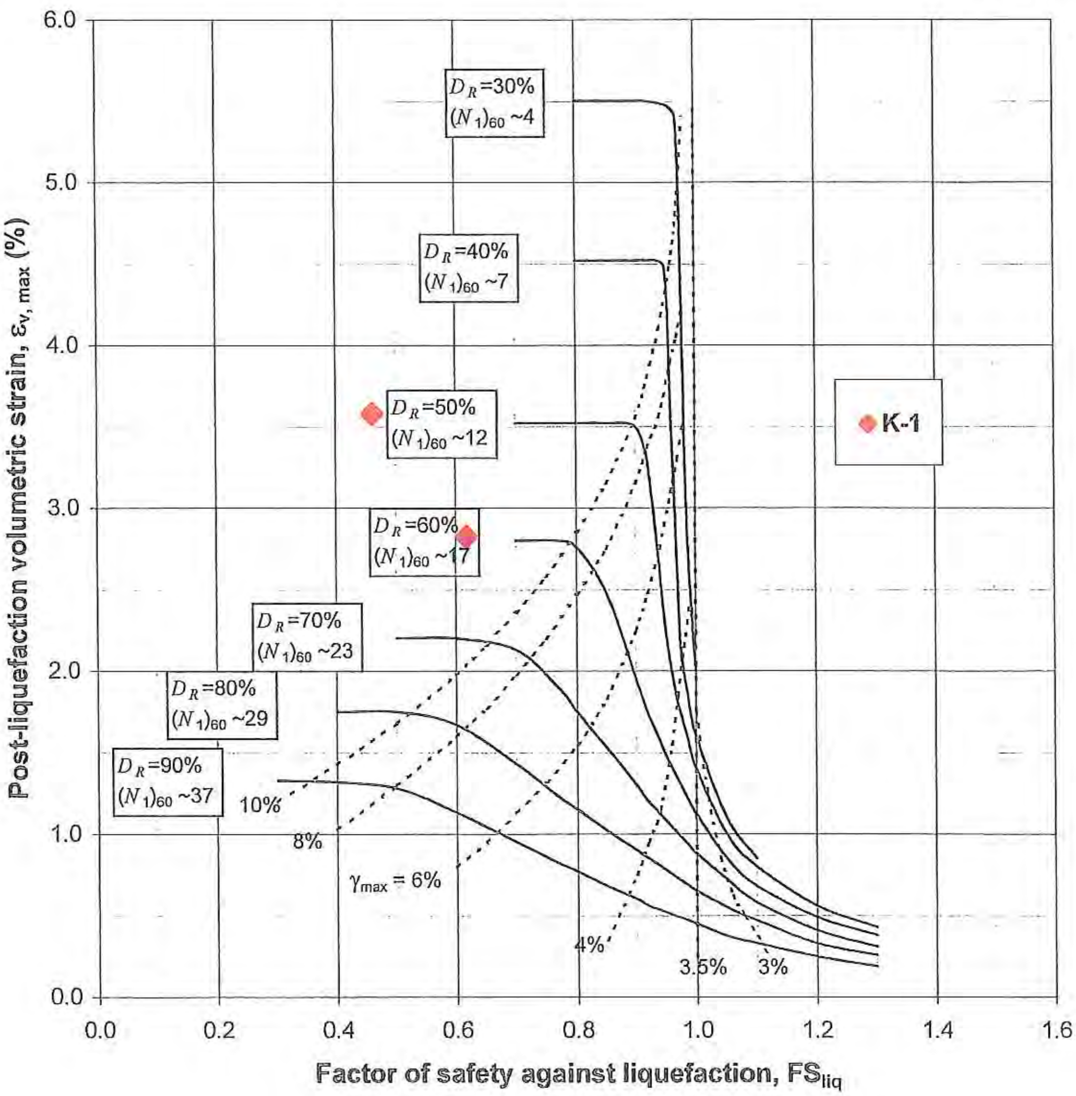
Settlement of Saturated Sand Following Liquefaction
Ishihara and Yoshimine (1992)
Idriss, Boulanger, MNO-12 (2008)

Seismic parameters:	
PGA [g] =	0.40
M =	6.9

	layer				$(N_1)_{60}$	FC	$\Delta(N_1)_{60}$	$(N_1)_{60\text{-cs}}$	FS_L	lim. strain	F_α	CSR	γ_{max}	vol. strain[a]	settle-ment
	no.	top [ft.]	bottom [ft.]	ΔH [ft.]		(%)				γ_{lim}		τ_{av}/σ'_{vo} γ_{max}		ε_v (%)	[in]
K-1	1				No liquefaction										
	2														
	3	18.0	23.0	5.0	10.7	5	0.0	10.7	0.46	0.436	0.897	0.316	0.44	3.6	2.15
	4	23.0	28.0	5.0	14.2	10	1.1	15.3	0.62	0.265	0.740	0.338	0.26	2.8	1.70
														Σ:	3.85

[a] from MNO-12, Fig. 103

Kleinfelder gets 2.5% & 1.9%, unknown method



Doheny Village Planning Area, Kleinfelder, K-1 4/8/16

Adjustment (Mag, PGA, groundwater) of Kleinfelder Results

Evaluation of Initiation of Liquefaction

Based on NCEER and NCEER/NSF workshops;

JGGE vol. 127, no. 4, (April 2001)

Seismic parameters:			
PGA [g] =	0.56		
M =	7.0	MSF:	1.22

boring	USCS	top depth (ft)	bot. depth (ft)	av depth (ft)	$(N_1)_{60}$	σ_{vo} (psf)	σ'_{vo} (psf)	r_d	CSR	α	β	$(N_1)_{60cs}$	interp $CRR_{7.5}$	FS_L	liquefaction? (y/n)	remark[c]
K-1	SM	0	6	3.0	10.0	360	360	0.993	0.362	3.61	1.08	14.5	0.158	0.53	y	*some*
	CL	6	8	7.0	16.2	840	715	0.984	0.421	5.00	1.20	24.4	0.282	0.82	n	cf
	SM	8	11	9.5	6.5	1140	859	0.979	0.473	1.89	1.04	8.7	0.099	0.25	y	
	CL	11	12	11.5	7.8	1380	974	0.974	0.502	5.00	1.20	14.4	0.158	0.38	n	cf
	CL	12	18	15.0	9.0	1800	1176	0.967	0.538	5.00	1.20	15.8	0.174	0.39	n	cf
	SP-SM	18	23	20.5	10.7	2460	1493	0.954	0.572	0.00	1.00	10.7	0.118	0.25	y	
	SP-SM	23	28	25.5	14.2	3060	1781	0.943	0.590	0.87	1.02	15.4	0.169	0.35	y	
	SP-SM	28	33	30.5	39.2	3673	2081	0.926	0.595	0.03	1.00	39.2	-	-	n	
	SP-SM	33	38	35.5	43.2	4298	2394	0.885	0.578	0.03	1.00	43.2	-	-	n	
	SP-SM	38	43	40.5	39.9	4923	2707	0.844	0.559	0.03	1.00	40.0	-	-	n	
	SP-SM	43	52	47.5	38.4	5798	3146	0.787	0.528	0.03	1.00	38.4	-	-	n	

[a] σ_{vo}: post-development elevations are at approx. existing grades

[b] Clay Fraction: %<0.005mm
italicized font numbers for *% fines* and *CF*

[c] ngw: absence of groundwater
hbc: high blow counts
cf: high clay fraction

Assumed gw depth, [ft]:	
K-1	5

depth (ft):	γ (pcf):
28	120
28+	125

these layers liquefiable with raised groundwater

4/8/16

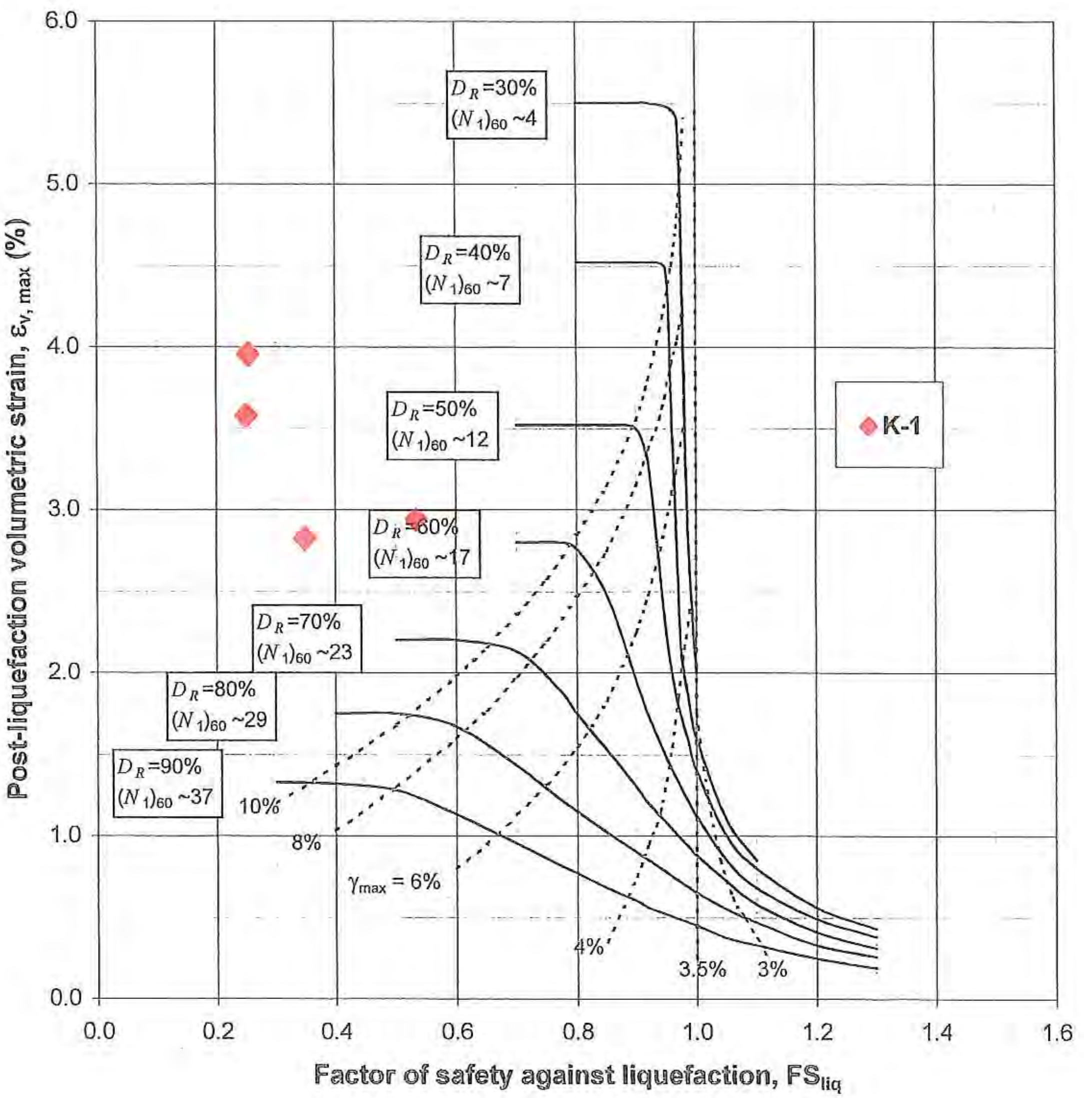
Kleinfelder data, adjusted parameters

Settlement of Saturated Sand Following Liquefaction
Ishihara and Yoshimine (1992)
Idriss, Boulanger, MNO-12 (2008)

Seismic parameters:	
PGA [g] =	0.560
M =	7.0

	layer				$(N_1)_{60}$	FC	$\Delta(N_1)_{60}$	$(N_1)_{60\text{-cs}}$	FS_L	lim. strain	F_α	CSR	γ_{max}	vol. strain[a]	settle-ment
	no.	top [ft.]	bottom [ft.]	ΔH [ft.]		(%)				γ_{lim}		τ_{av}/σ'_{vo} γ_{max}		ε_v (%)	[in]
K-1	1	5.0	6.0	1.0	10.0	20	4.5	14.5	0.53	0.290	0.774	0.36	0.29	2.9	**0.35**
	2	8.0	11.0	3.0	6.5	13	2.5	9.0	0.25	0.527	0.931	0.47	0.53	4.0	**1.42**
	3	18.0	23.0	5.0	10.7	5	0.0	10.7	0.25	0.436	0.897	0.57	0.44	3.6	**2.15**
	4	23.0	28.0	5.0	14.2	10	1.1	15.3	0.35	0.265	0.740	0.59	0.26	2.8	**1.70**
														Σ:	**5.62**

[a] from MNO-12, Fig. 103



Doheny Village Planning Area 4/8/16

Kleinfelder, K-1 data

Blow Count Corrections
Based on NCEER and NCEER/NSF workshops;
JGGE vol. 127, no. 4, (April 2001)

boring	depth (ft.)	sampler	USCS	N_m	σ_{vo} (psf)	σ'_{vo} (psf)	C_N	C_R	C_S	$(N_1)_{60}$
K-1	5	CA	SM	10	600	600	1.70	0.75	1.00	10.0
	8	CA	CL	19	960	960	1.44	0.75	1.00	16.2
	11	CA	SM	9	1320	1320	1.23	0.75	1.00	6.5
	13	CA	CL	11	1560	1560	1.13	0.80	1.00	7.8
	16	CA	CL	14	1920	1920	1.02	0.80	1.00	9.0
	21	CA	SP-SM	18	2520	2520	0.89	0.85	1.00	10.7
	26	CA	SP-SM	23	3120	2933	0.83	0.95	1.00	14.2
	31	SPT	SP-SM	35	3735	3236	0.79	0.95	1.20	39.2
	36	CA	SP-SM	73	4360	3549	0.75	1.00	1.00	43.2
	41	SPT	SP-SM	37	4985	3862	0.72	1.00	1.20	39.9
	46	SPT	SP-SM	37	5610	4175	0.69	1.00	1.20	38.4

gw depth (ft):	
K-1	23.0

corrections:	
C_B:	1.00
C_E:	1.25
$C_N = (1/\sigma'_{vo})^{1/2}$	

[illegible]
1.0

depth (ft):	γ (pcf):
28	120
28+	125

Purkis, B-1

Doheny Village Planning Area
Replication of Purkis Results: 11/29/2004

4/8/16

Evaluation of Initiation of Liquefaction
Based on NCEER and NCEER/NSF workshops;
JGGE vol. 127, no. 4, (April 2001)

Seismic parameters:			
PGA [g] =	0.36		
M =	6.5	MSF:	1.52

boring	depth (ft)	$(N_1)_{60}$	σ_{vo} (psf)	σ'_{vo} (psf)	r_d	CSR	fines correction: % fines FC	fines correction: Clay Fraction[b]	fines correction: α	fines correction: β	fines correction: $(N_1)_{60cs}$	interp $CRR_{7.5}$	FS_L	liquefaction? (y/n)	remark[c]
B-1	5.0	22.0	575	575	0.989	0.231	100.0		5.00	1.20	31	-	-	n	hbc
	10.0	20.5	1150	1150	0.978	0.229	100.0		5.00	1.20	30	0.476	3.16	n	
	15.0	8.2	1725	1600	0.967	0.244	4.1		0.00	1.00	8	0.094	0.59	y	
	20.0	10.2	2300	1863	0.955	0.276	100.0		5.00	1.20	17	0.190	1.05	y	?
	25.0	25.4	2875	2126	0.944	0.299	0.5		0.00	1.00	25	0.300	1.53	n	
	30.0	52.5	3450	2389	0.930	0.314	100.0		5.00	1.20	68	-	-	n	hbc
	35.0	55.4	4025	2652	0.889	0.316	100.0		5.00	1.20	72	-	-	n	hbc
	40.0	31.4	4600	2915	0.848	0.313	100.0		5.00	1.20	43	-	-	n	hbc
	45.0	19.2	5175	3178	0.808	0.308	100.0		5.00	1.20	28	0.358	1.77	n	
	50.0	39.5	5750	3441	0.767	0.300	100.0		5.00	1.20	52	-	-	n	hbc

[a] σ_{vo}: post-development elevations are at existing grades

[b] Clay Fraction: %<0.005mm
italicized font numbers for *% fines* and *CF* are assumed.

[c] ngw: absence of groundwater
hbc: high blow counts
cf: high clay fraction

Assumed gw depth, [ft]:	
B-1	13

4/8/16

Purkis parameters (11/29/2004)

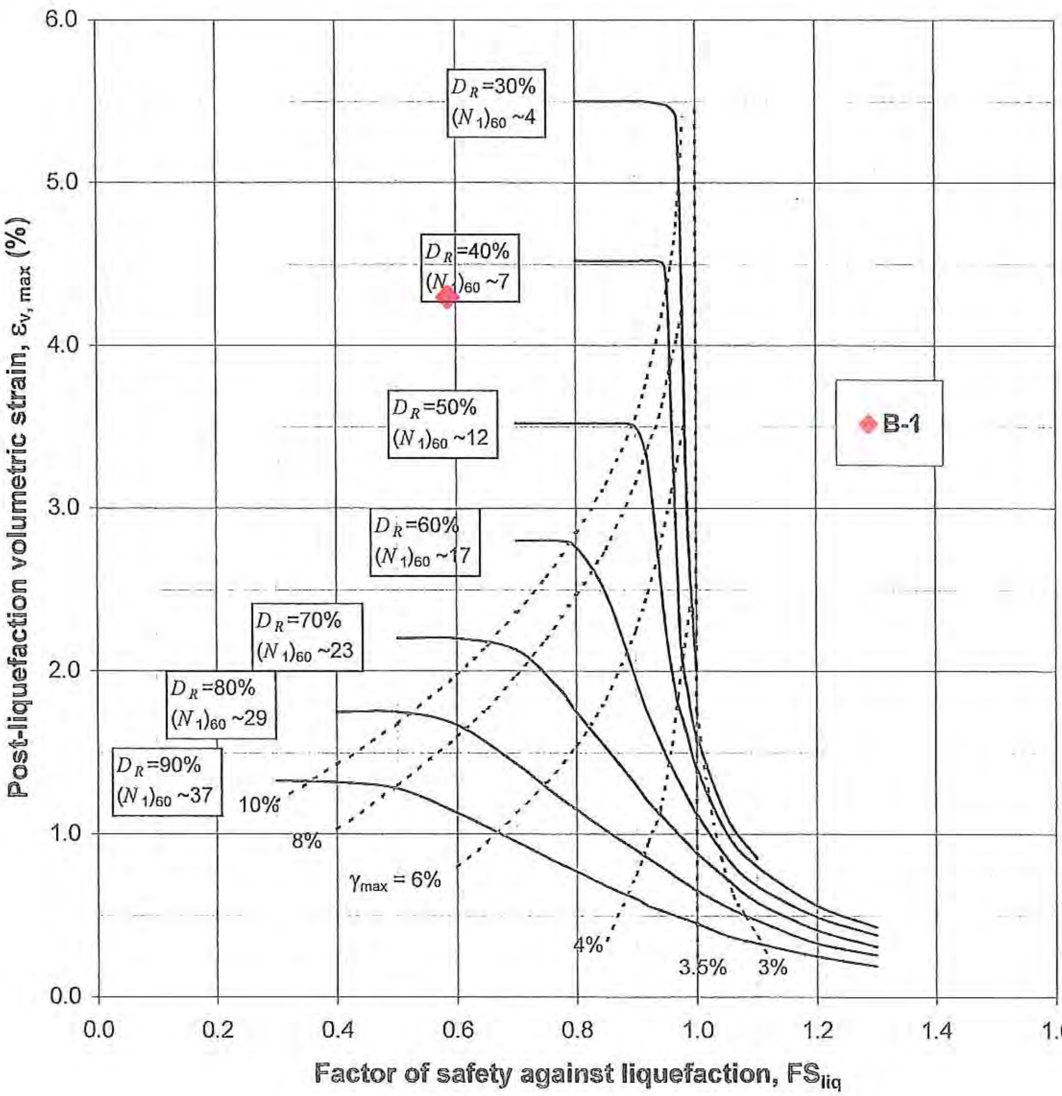
Settlement of Saturated Sand Following Liquefaction
Ishihara and Yoshimine (1992)
Idriss, Boulanger, MNO-12 (2008)

Seismic parameters:	
PGA [g] =	0.36
M =	6.5

	layer				$(N_1)_{60}$	FC (%)	$\Delta(N_1)_{60}$	$(N_1)_{60\text{-cs}}$	FS_L	lim. strain γ_{lim}	F_α	CSR τ_{av}/σ'_{vo} γ_{max}	γ_{max}	vol. strain[a] ε_v (%)	**settle-ment [in]**
	no.	top [ft.]	bottom [ft.]	ΔH [ft.]											
B-1	1	12.0	18.5	6.5	8.2	4.1	0.0	8.2	0.59	0.579	0.942	0.244	0.58	4.3	**3.35**
	2				No liquefaction										
	3														
	4														
														Σ:	**3.35**

[a] from MNO-12, Fig. 103

my assumption



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Doheny Village Planning Area

Adjustment (Mag, PGA, groundwater) of Purkis Results

Evaluation of Initiation of Liquefaction
Based on NCEER and NCEER/NSF workshops;
JGGE vol. 127, no. 4, (April 2001)

Seismic parameters:			
PGA [g] =	0.56		
M =	7.0	MSF:	1.22

boring	depth (ft)	$(N_1)_{60}$	σ_{vo} (psf)	σ'_{vo} (psf)	r_d	CSR	fines correction: % fines FC	Clay Fraction[b]	α	β	$(N_1)_{60cs}$	interp $CRR_{7.5}$	FS_L	liquefaction? (y/n)	remark[c]
B-1	5.0	22.0	575	575	0.989	0.360	100.0		5.00	1.20	31	-	-	n	hbc
	10.0	20.5	1150	838	0.978	0.488	100.0		5.00	1.20	30	0.476	1.19	n	
	15.0	8.2	1725	1101	0.967	0.551	4.1		0.00	1.00	8	0.094	0.21	y	
	20.0	10.2	2300	1364	0.955	0.586	100.0		5.00	1.20	17	0.190	0.40	y	?
	25.0	25.4	2875	1627	0.944	0.607	0.5		0.00	1.00	25	0.300	0.60	y	
	30.0	52.5	3450	1890	0.930	0.618	100.0		5.00	1.20	68	-	-	n	hbc
	35.0	55.4	4025	2153	0.889	0.605	100.0		5.00	1.20	72	-	-	n	hbc
	40.0	31.4	4600	2416	0.848	0.588	100.0		5.00	1.20	43	-	-	n	hbc
	45.0	19.2	5175	2679	0.808	0.568	100.0		5.00	1.20	28	0.358	0.77	y	
	50.0	39.5	5750	2942	0.767	0.546	100.0		5.00	1.20	52	-	-	n	hbc

[a] σ_{vo}: post-development elevations are at existing grades

[b] Clay Fraction: %<0.005mm
italicized font numbers for *% fines* and *CF* are assumed.

[c] ngw: absence of groundwater
hbc: high blow counts
cf: high clay fraction

Assumed gw depth, [ft]:	
B-1	5

?

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Purkis data, adjusted parameters

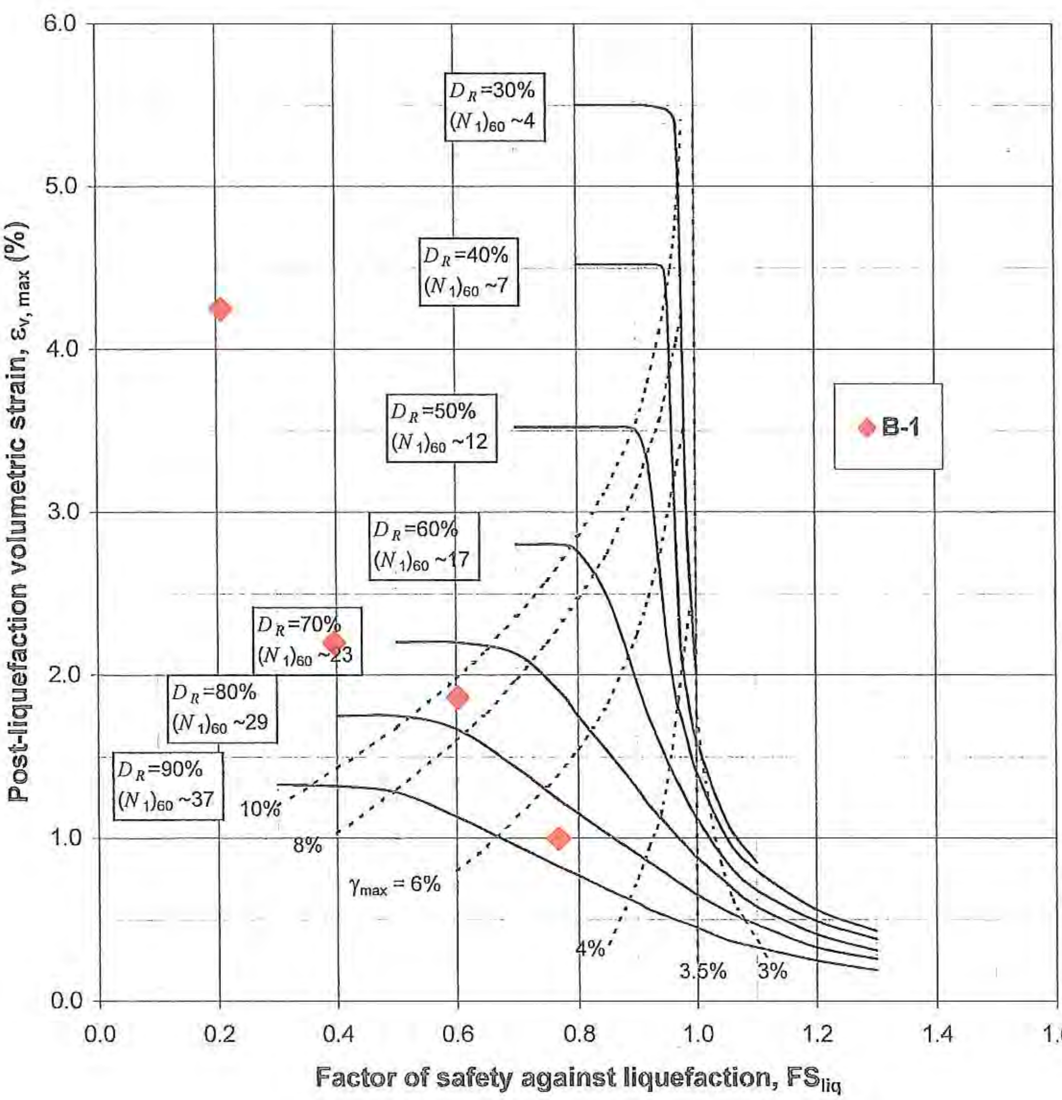
Settlement of Saturated Sand Following Liquefaction
Ishihara and Yoshimine (1992)
Idriss, Boulanger, MNO-12 (2008)

Seismic parameters:	
PGA [g] =	0.56
M =	7.0

	layer				$(N_1)_{60}$	FC	$\Delta(N_1)_{60}$	$(N_1)_{60\text{-cs}}$	FS_L	lim. strain γ_{lim}	F_α	CSR τ_{av}/σ'_{vo} γ_{max}	γ_{max}	vol. strain[a] ε_v (%)	settle-ment
	no.	top [ft.]	bottom [ft.]	ΔH [ft.]		(%)									[in]
B-1	1	12.0	18.5	6.5	8.2	4.1	0.0	8.2	0.21	0.579	0.942	0.551	0.58	4.3	3.32
B-1	2	18.5	25.0	6.5	17.2	100	5.5	22.7	0.40	0.117	0.368	0.586	0.12	2.2	1.72
B-1	3	25.0	30.0	5.0	25.4	0.5	0.0	25.4	0.60	0.084	0.206	0.607	0.08	1.9	1.12
B-1	4	45.0	50.0	5.0	28.0	100	5.5	33.5	0.77	0.028	-0.328	0.568	0.03	1.0	0.60
														Σ:	6.75

[a] from MNO-12, Fig. 103

w/ assumptions



Doheny Village Planning Area 4/8/16

Purkis, B-1 data

Blow Count Corrections
Based on NCEER and NCEER/NSF workshops;
JGGE vol. 127, no. 4, (April 2001)

boring	depth (ft.)	sampler	N_m	σ_{vo} (psf)	σ'_{vo} (psf)	C_N	C_R	C_S	$(N_1)_{60}$
B-1	5	SPT	10	575	575	1.70	0.75	1.00	22.0
	10	SPT	12	1150	1150	1.32	0.75	1.00	20.5
	15	SPT	5	1725	1600	1.12	0.85	1.00	8.2
	20	SPT	6	2300	1863	1.04	0.95	1.00	10.2
	25	SPT	16	2875	2126	0.97	0.95	1.00	25.4
	30	SPT	35	3450	2389	0.91	0.95	1.00	52.5
	35	SPT	37	4025	2652	0.87	1.00	1.00	55.4
	40	SPT	22	4600	2915	0.83	1.00	1.00	31.4
	45	SPT	14	5175	3178	0.79	1.00	1.00	19.2
	50	SPT	30	5750	3441	0.76	1.00	1.00	39.5

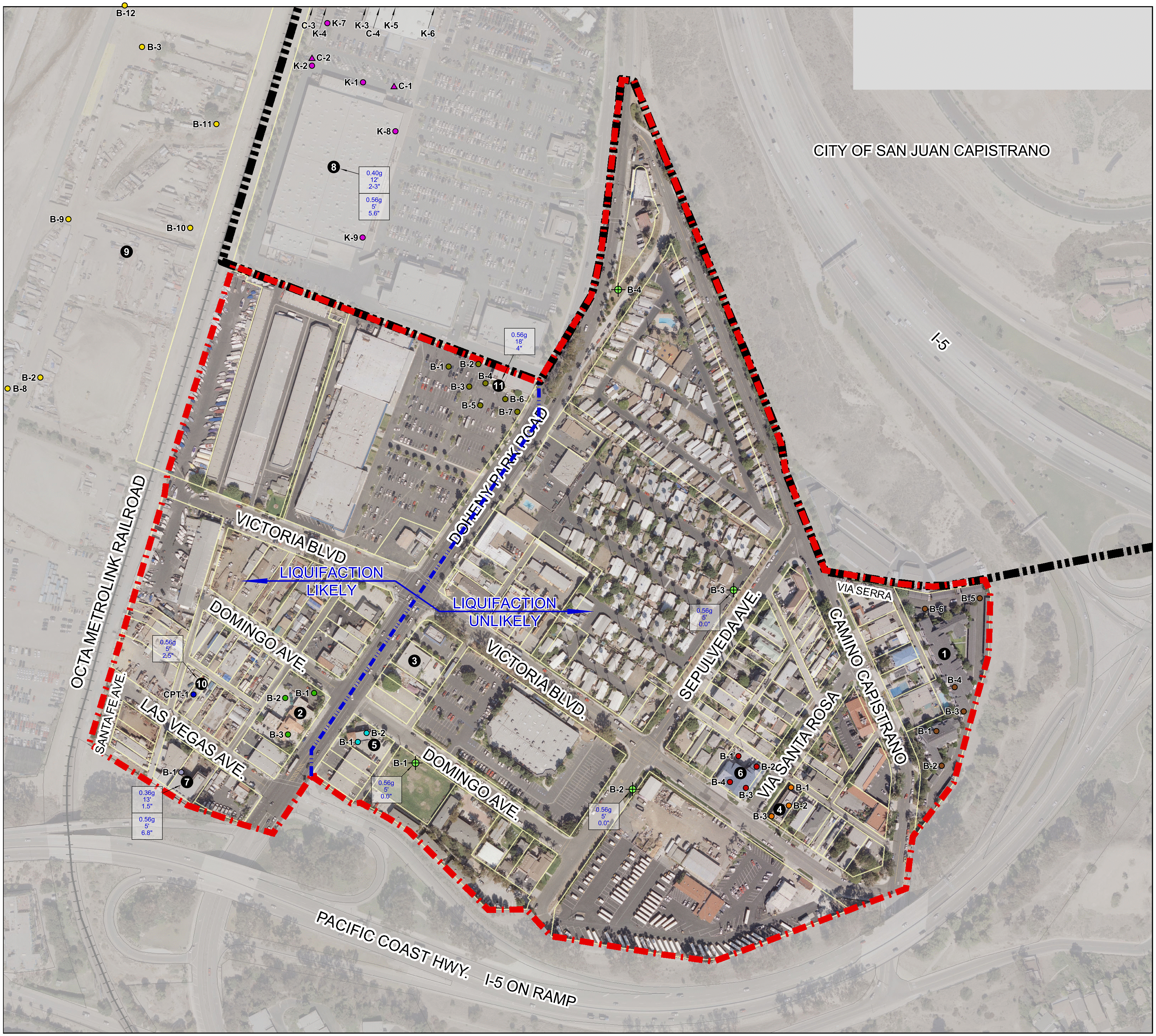
Additional rod, (ft):	2

gw depth (ft):	
B-1	13.0

depth (ft):	γ (pcf):
50	115
50+	115

corrections:	
C_B:	1.15
C_E:	1.50
C_N =	$(1/\sigma'_{vo})^{1/2}$

very high selection



Doheny Village Planning Area

Base Map

Legend

- Doheny Village Project Area Boundary
- City Boundary

LEGEND

B-4	APPROXIMATE LOCATION OF BORING BY COASTAL GEOTECHNICAL
B-3	APPROXIMATE LOCATION OF BORING BY MOORE & TABER (1989)
B-3	APPROXIMATE LOCATION OF BORING BY PSI (1994)
B-2	APPROXIMATE LOCATION OF BORING BY AGI GEOTECHNICAL (1997)
TP-1	APPROXIMATE LOCATION OF TEST PIT BY GMU (2002)
B-4	APPROXIMATE LOCATION OF BORING BY GEO-ETKA (2003)
K-9	APPROXIMATE LOCATION OF BORING BY KLEINFELDER (2010)
C-4	APPROXIMATE LOCATION OF CORING BY KLEINFELDER (2010)

GEOTECHNICAL REPORTS

1. BACA ASSOCIATES (8/8/87)
2. MOORE & TABER (5/31/89)
3. NORCAL ENGINEERING (8/23/94)
4. PSI (9/16/96)
5. AGI GEOTECHNICAL (12/5/97)
6. GEO-ETKA (2/17/03)
7. ViaGeos ((11/30/04)
8. KLEINFELDER (6/30/10)
9. NINYO & MOORE (5/16/14)
10. GEOFIRM (5/30/14)
11. TERRADYNE (5/18/15)

SEE REPORTS FOR LOGS OF EXPLORATION

LIQUEFACTION DATA:

GROUND ACCELERATION
DEPTH TO GROUNDWATER
CALCULATED GROUND SETTLEMENT

SCALE: 1" = 100'

0 50 100 200 300 400 500 Feet

PLOT PLAN		
COASTAL GEOTECHNICAL GEOTECHNICAL CONSULTANTS	Doheny Village Planning Area Dana Point, California	
	PROJECT NO. 7743.1CG	PLATE NO. 1

04/07/16