San Onofre Nuclear Generating Station

Large Organism Exclusion Device

Marine Biological Resources

Technical Appendix

Prepared for

AECOM

San Diego, CA 92101

Submitted by

MBC *Applied Environmental Sciences*

Costa Mesa, California

August 23, 2012

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1.0 EXECUTIVE SUMMARY

1.1 INTRODUCTION

In May 2010, the State Water Resources Control Board enacted the *Water Quality Control Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling* which requires the installation of a barrier with bars spaced no more than 9 inches (in) on center on all offshore cooling water intakes to exclude large marine organisms such as seals, sea lions, and sea turtles. Local seal and sea lion populations have increased since the San Onofre Nuclear Generating Station (SONGS) Units 2 and 3 intake structures were built and the units began operating. This has led to the occasional entrainment of marine mammals in the SONGS cooling water intakes. Threatened or endangered sea turtles also occur infrequently in the vicinity of the SONGS intakes, and are likewise occasionally entrained/drawn into the plant. The presence of multiple giant kelp beds in the area and the volume of cooling water needed by SONGS present a challenge to comply with the Policy's requirements. A large organism exclusion device (LOED) designed to meet this challenge is scheduled to be installed over each primary offshore intake structure (POIS) within the State Lands Commission easement. This report summarizes environmental analyses and sampling completed to evaluate potential impacts from the installation and operation of the LOEDs and establishes the pre-installation baseline conditions offshore of SONGS.

1.2 CURRENT CONDITIONS

Environmental monitoring since 2000 indicates that the fish community surrounding each POIS is dominated by northern anchovy (*Engraulis mordax*), white croaker (*Genyonemus lineatus*), queenfish (*Seriphus politus*), and Pacific sardine (*Sardinops sagax*). Northern anchovies and Pacific sardines are midwater, pelagic schooling fishes that are in near-constant motion. White croaker and queenfish are also schooling fishes, but they are more closely associated with the seafloor than either northern anchovy or Pacific sardine. Very active at night, queenfish are known to settle near the seafloor and remain comparatively inactive during the day. White croaker is known to remain near the seafloor most of the time foraging on benthic prey living in the sediments. Local invertebrate communities are dominated by blackspotted bay shrimp (*Crangon nigromaculata*), which is common in nearshore, soft-bottom habitats throughout the Southern California Bight.

Giant kelp (*Macrocystis pyrifera*) beds persist both upcoast and downcoast of the POISs. The San Onofre Kelp forest is the closest of the two forests, but the main portion lies at least 700 m (2,300 ft) southwest of the Unit 3 POIS. Turbidity offshore of SONGS is generally below average for the coastal environment with a clear seasonal pattern. A temporary increase in turbidity is likely to result during installation of the LOEDs, especially during the sediment excavations. This increase will likely depend on the season and ambient conditions in the area, but it will nonetheless result in *de minimus* impacts to the San Onofre Kelp due to dispersion by the local currents.

Sediments in each California State Lands Commission easement surrounding the POISs are dominated by medium sand, with minimal grain size differences among stations sampled. Particle size distribution

curves generated for Unit 2 sediments were nearly identical, while minor differences were detected among the Unit 3 sediments. The differences detected in sediments collected near Unit 3 were largely a reflection of the increased occurrence of gravel at some stations.

Diver surveys of the stone blanket surrounding each POIS (where the LOEDs are likely to be positioned) recorded few animals (fish or invertebrates). No special status or Fishery Management Plan-managed species were observed in the area. Sand dominated the area, but occasional rocky habitat was observed. Giant kelp was observed growing anchored to either exposed rock or growing out of the sand and likely anchored to rock below the sand. Seagrass was observed on a rocky outcrop near the Unit 3 POIS.

1.3 FISHERY ANALYSIS

The California Department of Fish and Game fishing block that encompasses the SONGS intakes and outfalls (block 756) is intensively targeted by recreational anglers and commercial invertebrate fisheries. Anglers caught more recreational fish species in block 756 than any other block in the area. Commercial invertebrate fishery landings from block 756 were more valuable than all but two other blocks, largely due to California spiny lobster (*Panulirus interruptus*) and market squid (*Doryteuthis opalescens*) landings. Commercial finfish landings in block 756 were among the least valuable, with the highest value areas occurring farther offshore. While the waters offshore SONGS are prized by fishing interests, the existence of a marine exclusion zone encompassing the SONGS intakes ensures the installation and operation of the LOEDs will have no impact to legitimate fishing activities in the area.

1.4 ESSENTIAL FISH HABITAT ASSESSMENT

Several species managed under a National Marine Fisheries Service Fishery Management Plan (FMP) occur offshore SONGS. These include representatives of both the Coastal Pelagic Species (CPS) and Pacific Groundfish FMPs. Historically, two salmon species managed under the Pacific Salmon FMP occurred, but at a highly infrequent periodicity. The most numerous species in the area include northern anchovy, Pacific sardine, and jacksmelt (*Atherinops californiensis*) based on long-term impingement monitoring at SONGS. These three species are also regulated/monitored as part of the CPS FMP. Each is a midwater or surface-oriented, schooling species that remains in near-constant motion. Installation of each LOED is likely to have a less-than-significant effect on these species as they will likely leave the area temporarily while the installation is occurring. LOED operation will likely have no impact on these species; due to their relatively small size, each will be capable of swimming in and out of the LOED at their discretion. Therefore, the operation will result in no long term changes to the migratory or spawning behavior of the species and no population-level changes in abundance will occur as a result of the LOED operation.

Groundfish are less common offshore SONGS than the aforementioned CPS. Based on impingement and trawl sampling, species most likely to occur near the POISs and in the LOED installation footprint include California scorpionfish (*Scorpaena guttata*), brown rockfish (*Sebastes auriculatus*), and bocaccio (*Sebastes paucispinis*). As with the CPS, the habitat affected by the installation and operation of the LOEDs represents a small fraction of the habitat that is widely available throughout the area.

Furthermore, most groundfish are expected to temporarily leave during the installation. No impacts from the LOED operation are likely to occur. To the contrary, the creation of new subtidal, high-relief substrate will benefit the groundfish in the area that prefer this type of habitat.

Any impacts to habitat areas of particular concern (HAPCs), such as kelp and seagrass beds, will be restricted to the installation and periodic cleaning activities. Potential impacts could include reduced ambient light via increased turbidity resulting from sediment removal and/or suspension, burial, or shading from the work vessels, in addition to vessel anchoring. The SONGS intake area is normally a turbid environment yet kelp beds sustain, producing floating canopies at or near historic sizes in recent years. Reductions in ambient light will be short term and transient. The LOED operation will not alter ambient light penetration in the area. Anchoring impacts can be minimized by placing anchors in areas not currently supporting giant kelp. At its recent maximum extent, the canopy from the San Onofre Kelp forest was 700 m (2,300 ft) southwest of the Unit 3 POIS. Additional, small areas of kelp lie inshore of the Unit 3 POIS, but any impacts to these will likely be temporary. Giant kelp will likely recolonize the area from seed sources located nearby, namely the San Mateo Point Kelp forest and the San Onofre Kelp forest.

1.5 MARINE RESOURCES IMPACT ASSESSMENT

Excavation and sidecasting sediments within the California State Lands Commission easement should result in no impacts to the sidecast areas, as all the sediments in the area are similar medium sand. The installation process may temporarily increase turbidity, but these effects are expected to be minimal and temporary as well. Few animals were observed near the POISs, and once installed the LOEDs will create new, high-relief, hard substrate similar to rock reefs that will provide new shelter for a wide variety of species including California spiny lobster and various reef fishes. Sufficient space exists between the nearest kelp forest and the project area that vessel activities, including anchoring, should not result in any significant impacts. Noise from the installation is unlikely to result in permanent impacts and those temporary impacts that may occur are likely to be minimal. No long-term impacts of the LOED operation are expected with the most likely sources of impact resulting from periodic cleanings that could temporarily increase turbidity. Long-term LOED operation is not expected to result in any adverse impacts to the environment. Long-term benefits from LOED operation include reduced entrapment and impingement of larger fishes, marine mammals, and sea turtles. Recent nearshore installation projects in southern California, similar to the proposed project, have not resulted in significant turbidity increases.

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2.0 INTRODUCTION

The San Onofre Nuclear Generating Station (SONGS) is located on the coast south of San Clemente, California. Units 2 and 3 both began start-up testing in 1982, and they became commercially operational in 1983 (Unit 2) and 1984 (Unit 3). Each unit has an operating capacity of 1,100 MW and its own once-through-cooling intake and outfall structures, with each discharging up to 4,610,632 m^3 (1,218 million gallons) per day. Ocean currents in the area are predominantly longshore, flowing northwest to southeast, which affects both the source water for the intake but also the fate of any outfall or other alteration of the biogeochemical composition of the coastal waters.

Several marine mammal and sea turtle species have been recorded in the waters offshore of SONGS, and all are afforded some protection by federal resource agencies. All marine mammals are protected under the Marine Mammal Protection Act (MMPA) of 1972, and some are protected by the Endangered Species Act (ESA) of 1973. All species of sea turtles that could occur offshore SONGS are federally listed as threatened or endangered. To date, no whales or dolphins have been entrained by the SONGS cooling water systems. Pinnipeds (seals and sea lions) and sea turtles have been infrequently entrained. Pacific harbor seal (*Phoca vitulina richardsi*) and California sea lion (*Zalophus californianus californianus*) have been entrained in the SONGS cooling water systems. Four sea turtle species could occur in the waters offshore SONGS, including loggerhead (*Caretta caretta*), green (*Chelonia mydas*), leatherback (*Dermochelys coriacea*), and Olive Ridley (*Lepidochelys olivacea*) sea turtles. All four species have been entrained at SONGS.

As of 2011, 498 California sea lions, 367 harbor seals, and 44 sea turtles (all species combined) have been entrained in the SONGS Units 2 and 3 cooling water intake systems. Of these, 26%, 63%, and 91%, respectively, have been released alive. Once observed, specialized cages were lowered into the fish return system to capture seals and sea lions. Sea turtles were removed by a specialized net in the fish return systems. Recent California pinniped stock assessments estimated the populations at 296,750 California sea lions (southern California) and 30,196 harbor seals (NMFS 2011b, a). In 2011, 15 California sea lions and nine harbor seals were taken by SONGS, with nine and five, respectively, returned to the ocean alive. These total takes (dead and returned alive combined) represent 0.01% and 0.03% of the respective standing stocks. Since 1975, California sea lion pup counts have increased nearly every year through 2011, while harbor seal numbers (pups and adults) have increased at a slower rate since 1980. Both populations are at or near their historic peaks. The significance of this pattern is that more animals are available in the environment and, in the absence of modifications to the POISs, will likely result in continued entrainment at SONGS.

Unlike California sea lions and harbor seals, all species of sea turtle continue to receive protection due to low population numbers. No comparable, recent stock assessments or population information is available for sea turtles. In addition to these species, a recent sighting (R. Moore, July 2012 personal communication) of a southern sea otter (*Enhydra lutris nereis*) offshore of SONGS has added another protected species to the list of large marine organisms susceptible to entrainment by the SONGS intakes.

The operation of the Units 2 and 3 intakes are now subject to provisions in the California State Water Resource Control Board's *Water Quality Control Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling* (Policy). One provision in the Policy requires the installation of a barrier with bars spaced no more than 9 inches (in) on center on all offshore intakes to exclude large marine organisms such as seals, sea lions, and turtles. This poses unique challenges to SONGS due to the location of both primary offshore intake structures (POISs) and the volume of cooling water needed. Both POISs are located offshore of SONGS nominally along the 9.1 m isobath directly adjacent to the San Onofre kelp bed (SOK) and downcoast from the San Mateo kelp forest (SMK). Drift algae generated from each of these kelp beds, and others, is routinely entrained by the cooling water intakes. A barrier with 9-in bar spacing is likely to become fouled with marine debris, especially drift algae such as kelp. Southern California Edison has designed the LOED(s) with these considerations in mind. The proposed LOEDs are larger than each of the existing intake structures, with footprints designed to occupy the area between the velocity cap on each POIS and the edges of the stone blankets, a distance of about 22 ft (6.7 m). The area is still within the California State Lands Commission Lease easement for each intake. All sediments will be excavated down to the stone blanket before placement of the LOED support structures (K. Anthony, June 2012 personal communication). Excavated sediments will be sidecast adjacent to the stone blankets but within the easements. Installation processes and the structures themselves may result in effects to the local marine environment that could range from brief to long term. These effects warrant evaluation and assessment to determine their significance.

This report was intended to summarize existing information and report on newly collected samples that provide valuable insight into the marine environment likely to be directly affected by the installation and and long-term presence of the LOEDs. Surveys of the current sedimentary conditions in the State Lands Commission easement around each POIS were made, in addition to a biological survey of the area surrounding each POIS. Using readily available data, an Essential Fish Habitat assessment was prepared to determine what, if any, effect the project will have on those species managed by a fishery management plan implemented by the National Marine Fisheries Service under the Magnuson-Stevens Act. Lastly, these resources will be synthesized and conclusions drawn to estimate the potential impacts to the marine environment that may result from the project. These conclusions may help direct later environmental analyses needed to obtain permits from relevant regulatory agencies. Therefore, impacts were evaluated based on requirements similar to other projects in southern California that have been permitted by: the U.S. Army Corps of Engineers under Section 10 (Rivers and Harbors Act), Nationwide Permit, Clean Water Act Section 404 permit; California Regional Water Quality Control Boards and their issuance of Clean Water Act Section 401 Water Quality Certifications; and Coastal Development Permits (and waivers) issued by the California Coastal Commission.

3.0 CURRENT CONDITIONS

3.1 INTRODUCTION

Extensive environmental monitoring has occurred offshore of SONGS, as well as impingement monitoring within the plant, documenting the fish fauna (midwater and demersal), oceanographic conditions, and kelp bed resources. These data have been published in annual monitoring reports through 2011 (documenting conditions in 2010). Demersal invertebrate community composition has also been recorded during trawl surveys offshore SONGS. Recent data on the sediments and biological communities surrounding the POISs were collected to supplement existing knowledge. Historic descriptions of the area characterized the seafloor as almost entirely boulder-cobble patches mixed with areas of fine sand (North and Jones 1991). It was noted that sedimentary shifts are common, likely predicated on the wave direction and intensity, resulting in hard, rocky substrates alternating between exposed and buried by sand.

3.2 MATERIALS AND METHODS

3.2.1 Historic Data Analysis

Data collected during the SONGS National Pollutant Discharge Elimination System (NPDES) monitoring program were reviewed and synthesized to document existing environmental conditions. Sampling methods for these surveys are described in SCE (2011). Data recorded for demersal trawls (fish and invertebrates) was limited to those animals caught at Station SO3, located offshore of SONGS on the 20-ft isobath, the trawl station closest to the intakes. Commercial and recreational fish catch data for the 2000-2010 period were examined, while the availability of invertebrate data was limited to 2003-2010. Impingement data was limited to data recorded during heat treatments and fish chases, or operation of the fish return, during the 2000-2010 period. Marine mammal and sea turtle abundances in the area were characterized using observation logs completed during field surveys offshore of SONGS (2007-2011) and SONGS large organism entrapment records (2006-2011). All relevant kelp bed monitoring data was reviewed, including maximum annual canopies, for the period 1967-2011, and subtidal surveys (2006-2011). The extended period for kelp canopy is reflective of the high interannual variability commonly displayed by giant kelp. In recent years, the aerial surveys were conducted quarterly, with data processed for the 1998-2008 period. More refined seasonal characterizations can be made using quarterly data and allow a more accurate determination of the likelihood of kelp being present (and its location) in relation to the POISs. Prior knowledge of the recent spatial extent and dimensions of SOK can be informative when designing the anchoring plan for the installation barges and support craft. Seafloor habitat descriptions completed during subtidal surveys in the SOK (2000-2011) were used to perform a generalized benthic habitat characterization. The light transmittance (a measure of turbidity) sampling station array offshore of SONGS was included in the analysis, with only the downcoast stations (C22S, F22S, H22S, J22S, and M22S) excluded. Light transmittance data was available for 2003-2010 only. Data at 5 m was examined as this depth represents mid-depth at the intake structures.

3.2.2 Grain Size Characterization

Surface sediments were collected at 10 stations around each intake by commercial divers (C&W Diving Solutions, Inc.; Figure 3-1 and 3-2). Sediments were collected over the stone blankets and outside the blankets, but within the California State Lands Commission lease easements. Stations were designated based on prior surveys of the area by Precon Marine, Inc. completed on 16 May 2012. Six stations (C1 - C6) on each stone blanket located approximately 4.6 m (15 ft) from the edge of each velocity cap were within the areas to be excavated. Four stations (C7 - C10) located about 15 m (50 ft) from each velocity cap in the corner of each easement represented the areas where the excavated sediments could be sidecast. Divers scooped sediment into clean, pre-labeled, plastic 1-L jars after being directed to each station by the biologist on the support vessel. The MBC biologist took custody of the samples once they were brought to the surface, and maintained custody until delivery to the analytical laboratory. Sediment grain size patterns were described using methods ASTM D1140 and D422 to determine the percentage of gravel, sand, and fine sediments (fines), which includes silt and clay. Gravel includes grain sizes greater than 4.75 mm. Sand includes coarse, medium, and fine subcategories with an overall range of 4.75 mm to 0.075 mm. Fines pass through the #200 sieve with grain size diameters less than 0.075 mm. Median grain size (D_{50}) was calculated and presented for comparison among sampling sites. All laboratory reports are included in Appendix A.

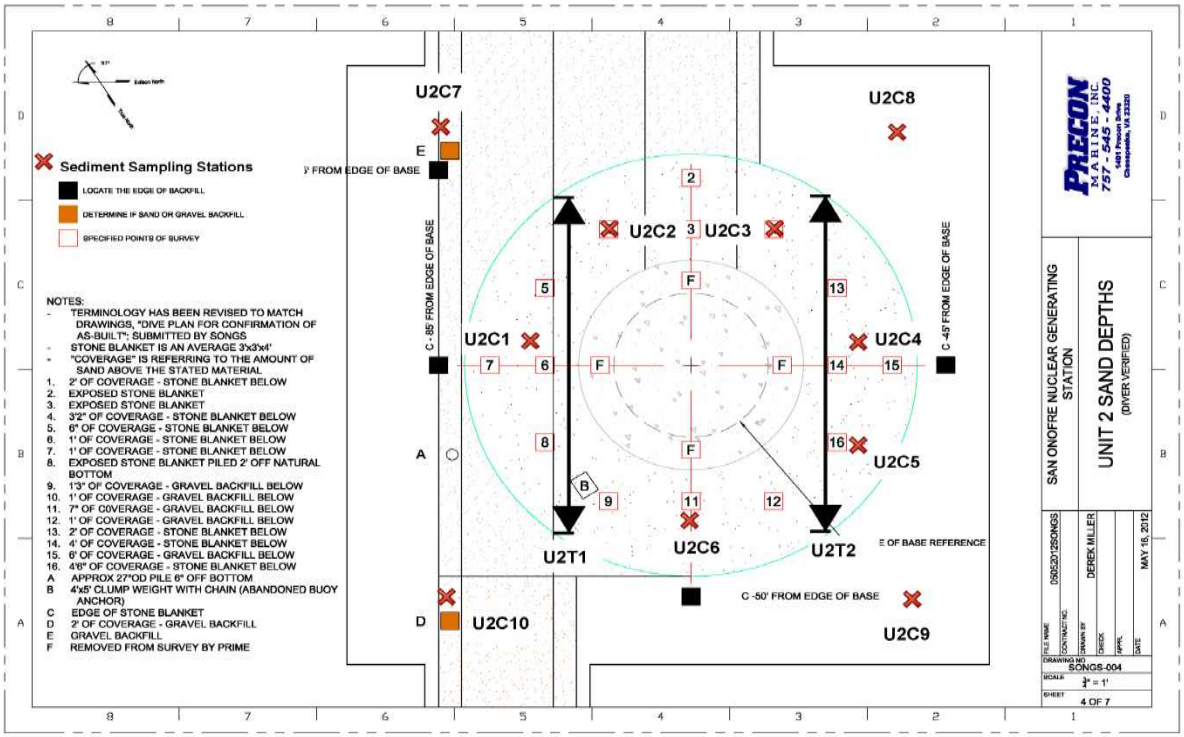

Figure 3-1. Sediment sampling locations and biological transect survey paths within the California State Lands Commission easement surrounding Unit 2. Figure was adapted from an initial sediment composition and depth survey completed by Precon Marine, Inc.

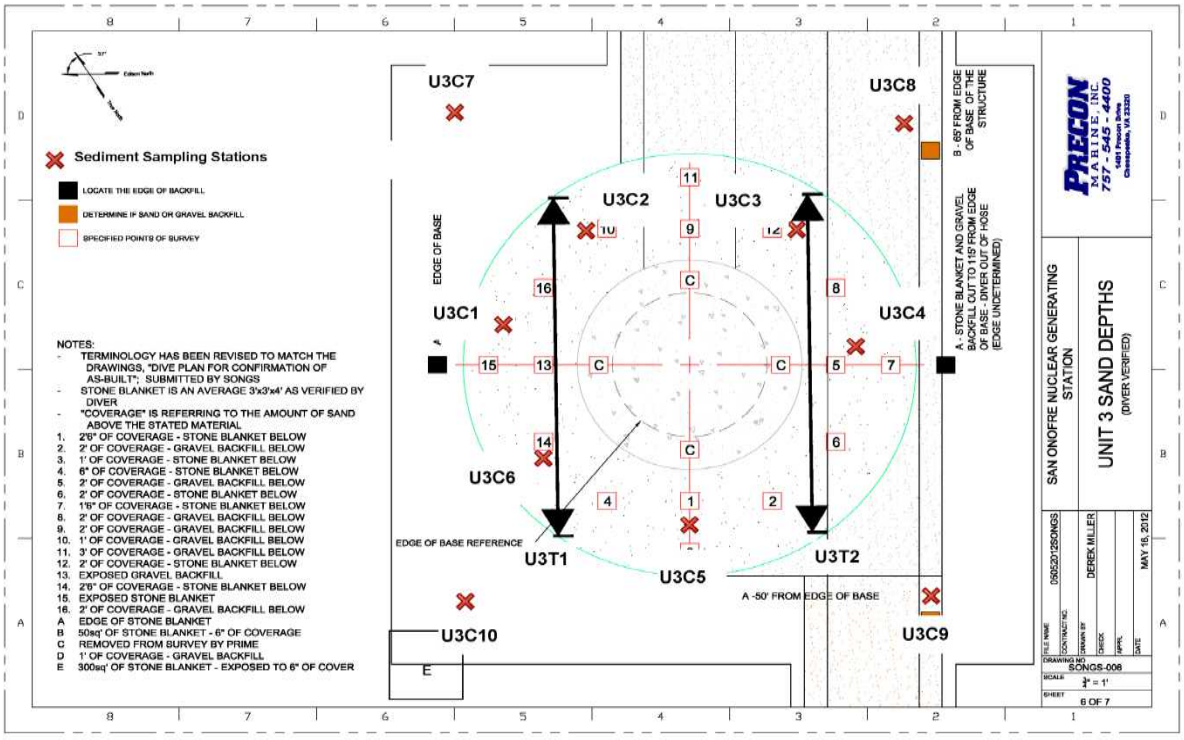

Figure 3-2. Sediment sampling locations and biological transect survey paths within the California State Lands Commission easement surrounding Unit 3. Figure was adapted from an initial sediment composition and depth survey completed by Precon Marine, Inc.

3.2.3 Biological Characterization Near the Intakes

Commercial divers walked two 20-m (65-ft) transects along both sides (north and south) of each POIS at a distance of approximately 3 m (10 ft) from the intakes, with a live video feed to the surface for the biologist to view and direct their movements. When an organism of interest was observed, the diver was instructed to zoom in or otherwise manipulate the camera or the organism to allow for a better view. The video feed was also recorded onto DVD media for later review of fast-moving organisms, such as fishes. Specific interest was given to the presence of algae, fish, and commercially important invertebrates such as California spiny lobster (*Panulirus interruptus*).

3.3 RESULTS

3.3.1 Historic Data Analysis

3.3.1.1 Demersal Fish and Invertebrates

Trawl-caught and impinged representations of the fish populations off SONGS are dominated by a handful of species (Tables 3-1 and 3-2). Winter catches of demersal fish are lowest in terms of total catch (969 fish) and mean catch/trawl (8 fish) (Table 3-1). Summer catches rank first in total catch and are tied with spring sampling for mean catch/trawl while fall sampling ranks third in each metric. Catches of northern anchovy (*Engraulis mordax*), white croaker (*Genyonemus lineatus*), and queenfish (*Seriphus*

politus) have each exceeded 31 fish/trawl over the period analyzed. Winter impingement monitoring recorded the lowest total abundance while spring impingement surveys had the least fish/survey. Summer ranked first in both metrics followed by fall. Impingement was dominated by northern anchovy, queenfish, and Pacific sardine (*Sardinops sagax*) (Table 3-2). At least 660 fish/survey from each species was recorded during surveys in the analyzed time frame. The remaining species were represented by fewer than 550 fish/survey on average. No State or Federal listed threatened or endangered marine fish species has been taken in the area within the last five years.

Table 3-1. Mean catch per trawl of the five fish species most commonly taken during trawl sampling offshore of SONGS along the 20-ft isobath by season, 2000 - 2010. The total catch by season for all fishes combined across the 2000 - 2010 period is also presented.

Species	Common name	Winter	Spring	Summer	Fall	Grand Mean
Engraulis mordax	northern anchovy	41	49	56	127	68
Genyonemus lineatus	white croaker	4	70	25	3	32
Seriphus politus	queenfish	18	19	51	24	31
Anchoa delicatissima	slough anchovy	3	0	30	15	19
Hyperprosopon argenteum	walleye surfperch	2	21	17	6	14
Total Catch (2000 - 2010)		969	2937	3561	2143	9610
Mean Catch/Trawl		8	17	17	12	14

Table 3-2. Mean abundance per impingement survey of the five fish species most commonly impinged at SONGS (both units combined) by season, 2000 - 2010. The impingement by season for all fishes combined across the 2000 - 2010 period is also presented.

Species	Common Name	Winter	Spring	Summer	Fall	Grand Mean
Engraulis mordax	northern anchovy	1479	795	3604	3499	2393
Seriphus politus	queenfish	815	652	1045	781	835
Sardinops sagax	Pacific sardine	1088	431	729	500	660
Xenistius californiensis	salema	263	408	788	493	549
Umbrina roncador	yellowfin croaker	13	36	1077	120	483
Total Impingement (2000 - 2010)		217,111	257,578	857,579	411,498	1,743,766
Mean Impingement/Survey		168	113	315	252	220

Invertebrates taken during trawl surveys were dominated by blackspotted bay shrimp (*Crangon nigromaculata*), which accounted for 74% (2,223) of the total catch from 2000-2010 (3,020). Seasonally, the blackspotted bay shrimp catch represented between 63% in the summer and 81% in the spring. Seven California spiny lobsters were taken during the surveys, which accounted for 0.2% of the total catch. No State or Federal listed threatened or endangered marine invertebrate species has been taken in the area within the last five years.

3.3.1.2 Marine Mammals and Turtles

Common dolphins (*Delphinus delphis*) are the most frequently encountered marine mammal species offshore of SONGS, followed by California sea lion (*Zalophus californianus*) (Table 3-3). Over 78% of marine mammal observations have occurred during the winter and spring months. Sightings in November account for an additional 12% of the total. Few animals have been observed during the summer months. Other marine mammals have been observed infrequently. California sea lion is also the most common marine mammal entrapped by the POISs, followed by harbor seals (*Phoca vitulina*). There are distinct seasonal patterns to marine mammal entrapment. Entrapment is highest in April (17% of the annual total),

May (26%), and June (10%). Entrapment in each of the remaining nine months averages 5% of the total. No other marine mammals have been entrapped. Several species of sea turtle have been infrequently entrapped, but in highly irregular patterns and frequency.

Table 3-3. Marine mammals and sea turtles observed during environmental monitoring surveys offshore of SONGS (field observations, 2007-2011) and combined entrapment in the Units 2 and 3 cooling water systems (2006-2011).

Field Observations		Year						
Species	Common name	2006	2007	2008	2009	2010	2011	Total
Delphinus delphis	common dolphin		0	0	43	17	170	230
Zalophus californianus californianus	California sea lion		2	5	8	4	5	24
Tursiops truncatus	bottlenose dolphin		0	1	3	0	15	19
Grampus griseus	Risso's dolphin		0	0	0	0	15	15
Eschrichtius robustus	gray whale		0	0	4	0	2	6
Phoca vitulina richardsi	harbor seal		0	0	2	0	0	2
Enhydra lutris nereis	southern sea otter		0	0	0	0	1	1
Delphinidae	unidentified dolphin		0	0	1	0	0	1
Balaenoptera musculus	blue whale		0	0	0	0	1	1
SONGS Entrapment								
Zalophus californianus californianus	California sea lion	31	40	33	21	18	15	158
Phoca vitulina richardsi	harbor seal	31	27	19	13	16	9	115
Chelonia mydas	green sea turtle	3	2	0	1	2	1	9
Caretta caretta	loggerhead sea turtle	0	0	0	0	1	0	1
Lepidochelys olivacea	Olive Ridley sea turtle	0	0	0	1	0	0	1

3.3.1.3 Kelp

The nearby San Onofre Kelp bed has sustained an above-average canopy since 2006, but it declined substantially between 2010 and 2011 (Figure 3-3). Adult giant kelp densities during the 2000-2010 period averaged between 0.0 and 0.50 plants/m^2 during semi-annual surveys (SCE 2011). Quarterly aerial surveys between 1998 and 2008 documented a clear seasonal pattern in the size of the SOK surface canopy. The canopy peaked in the fall and winter and typically reached its minimum in summer The Unit 3 POIS was approximately 700 m (2,300 ft) northwest of the SOK when the surface canopy was at its recent maximum extent in 2008 (Figure 3-4). Some small areas of kelp exist in closer proximity to the POISs, including inshore of the intakes, but none are as large as the SOK. Mapping of these areas was not attempted during the dive surveys. Based on the resulting videos, each area was less than an estimated 1 m^2 (11 ft^2).

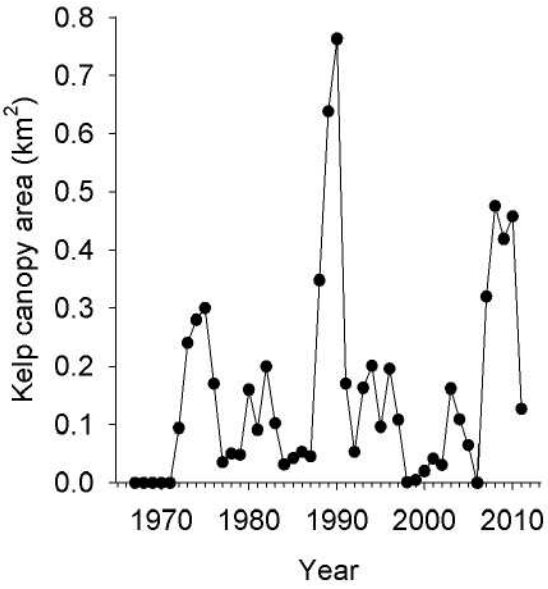

Figure 3-3. Annual maximum kelp canopy (km^2) observed for the San Onofre Kelp bed, 1967-2011.

3.3.1.4 Seafloor Description

Seafloor sediments off SONGS are predominantly sand with a mixture of boulders and cobble interspersed. At the six fixed stations routinely monitored in the SOK, the sediments are typically

comprised of 43% sand, 29% cobble, and 27% boulder. These values, however, are highly variable among sites. Sand ranges from 15% to 76% while boulder ranges from 18% to 34%. During dive surveys conducted on 24-25 July 2012 near each POIS (discussed below), the seafloor spatial composition was similar to that described by the prior subtidal surveys: sand with intermittent rocky areas of boulders or cobble.

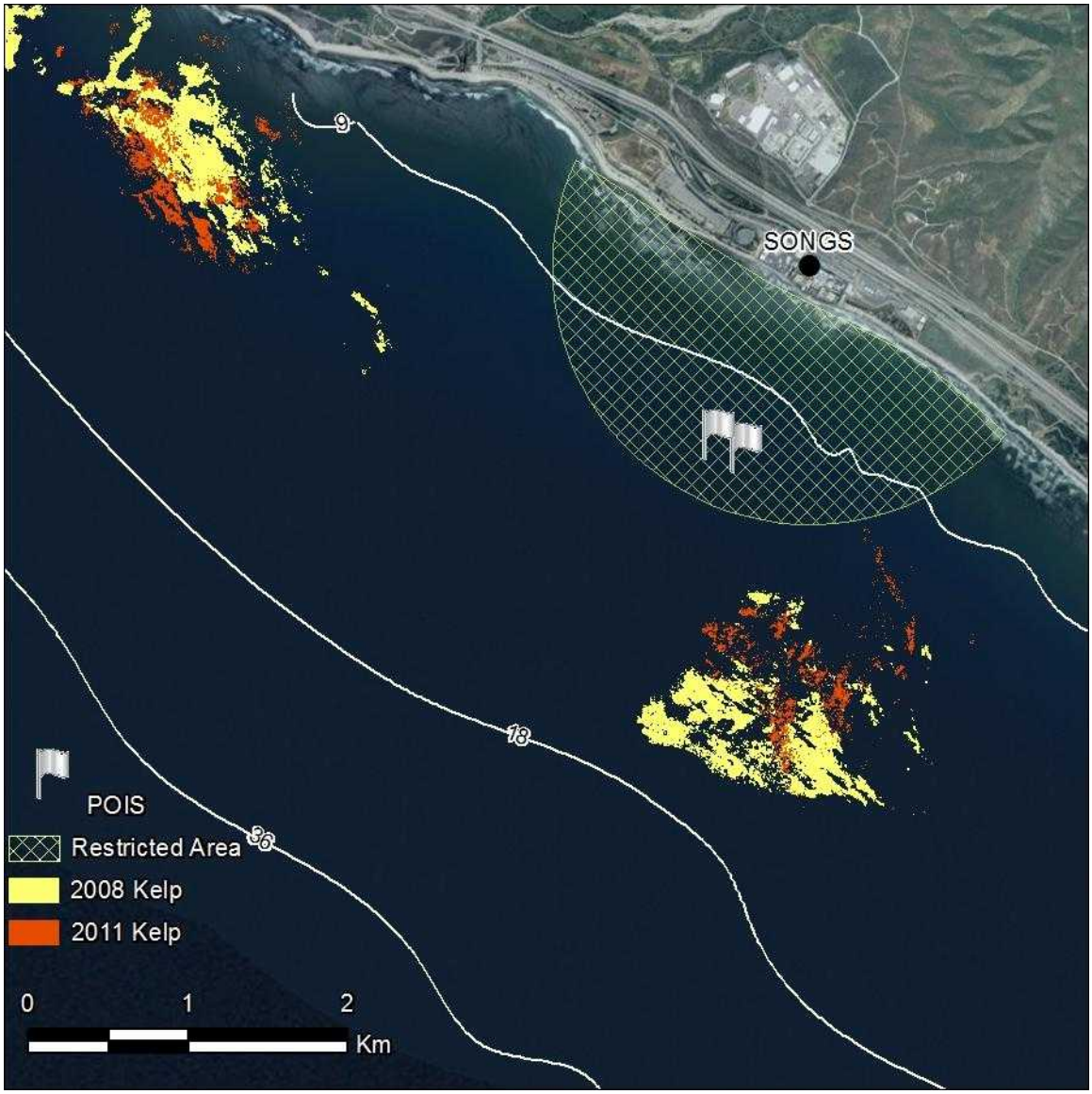

Figure 3-4. Aerial overview of the area surrounding the San Onofre Nuclear Generating Station. The Units 2 and 3 POISs are depicted, as is the 1 nautical mile restricted area excluding all vessel traffic. Both the recent maximum kelp canopy extent (2008) and results of the most recent kelp canopy survey (2011) of the San Onofre Kelp forest are presented. The 2008 canopy was about 700 m (2,300 ft) southwest of the Unit 3 POIS; this distance was 800 m (2,600 ft) in 2011. (Isobaths in meters).

3.3.1.5 Turbidity

Turbidity offshore of SONGS at 5 m deep is typically highest during the spring upwelling season and least during the summer when the thermocline becomes better defined (Figure 3-5). At the three stations nearest the intake structures (C1S, C2S, X0), light transmission in spring was lowest in 2007 (36%), averaged across all three stations. Spring light transmittance in the area peaked in 2009 with 76%. Summer conditions have ranged from 52% to 82%, although in most years light transmittance is 75% or higher. During each season, average light transmittance is lowest near the intakes and quickly increases with distance up or downcoast from the intake areas. Light transmittance remains low in the onshore-offshore direction matching the orientation of the outfall diffusers.

On 24 July, visibility was less than one meter near the seafloor at Unit 2. Conditions were similar throughout the day and impacted diving operations and the total viewing area seen by the on-board biologist supervising the dive. Visibility improved during the morning the following day, 25 July, during the Unit 3 survey with over 3 m (10 ft) of visibility reported. This resulted in some sightings of macrofauna. By the afternoon, however, conditions changed as shifting currents brought considerably more turbid water over the survey site. Visibility was reduced to approximately 1 m (3 ft), and waters were more seafoam-green during transect surveys.

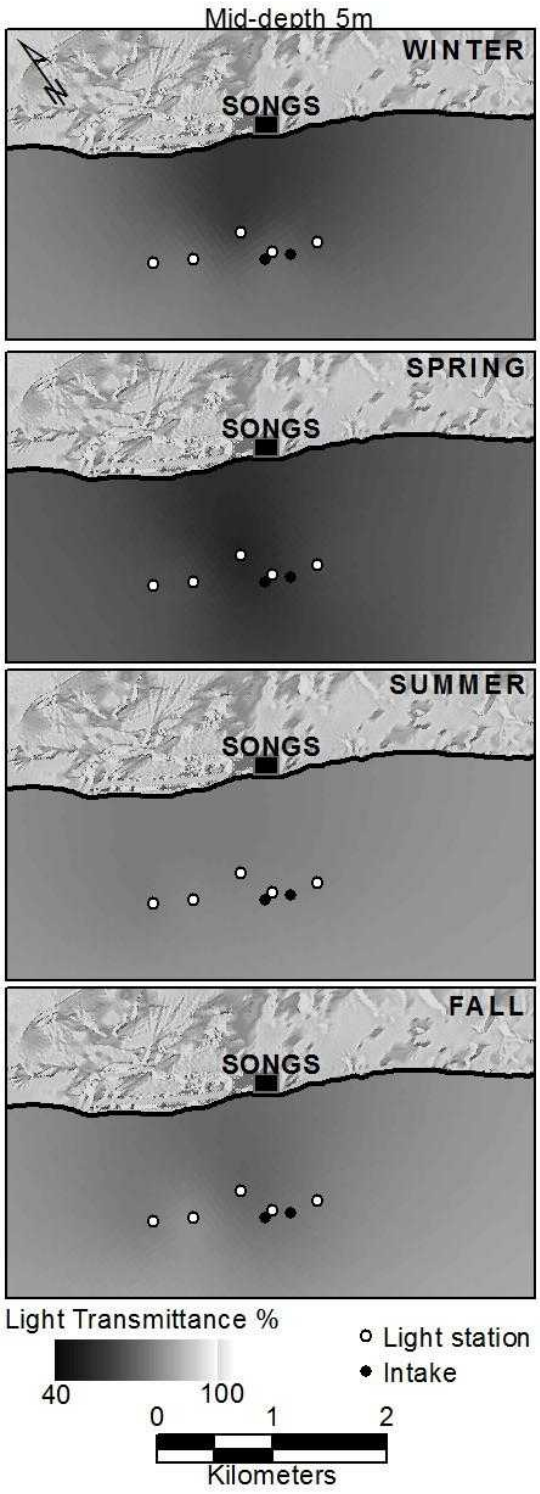

Figure 3-5. Light transmission (% transmittance) at 5 m deep offshore of SONGS, 2003-2010.

3.3.2 Sediment Analysis

The area surrounding both POISs was largely covered by sand although more rock, rip-rap and other hard substrate was observed near the Unit 2 POIS than near the Unit 3 POIS (Figure 3-6). At both locations, rocky substrate was randomly interspersed throughout the area, often as small- to medium-sized boulders less than 3 ft (1 m) in diameter. Occasionally, a small grouping of boulders was encountered.

Sediments collected at Stations C1-C6 were on the stone blanket and within the footprints of the LOEDs, and would therefore be excavated. Sediments at Stations C7-C10 were within areas likely to receive the sidecast sediments. Macroscopic examination of the sediment samples suggests they were primarily coarse sand with shell fragments and little fine-grained material. There were minor differences between the two POISs. Sediments near each POIS averaged nearly 99% sand with minimal gravel and fine sediments (Table 3-4).

Unit 2 POIS

Unit 3 POIS

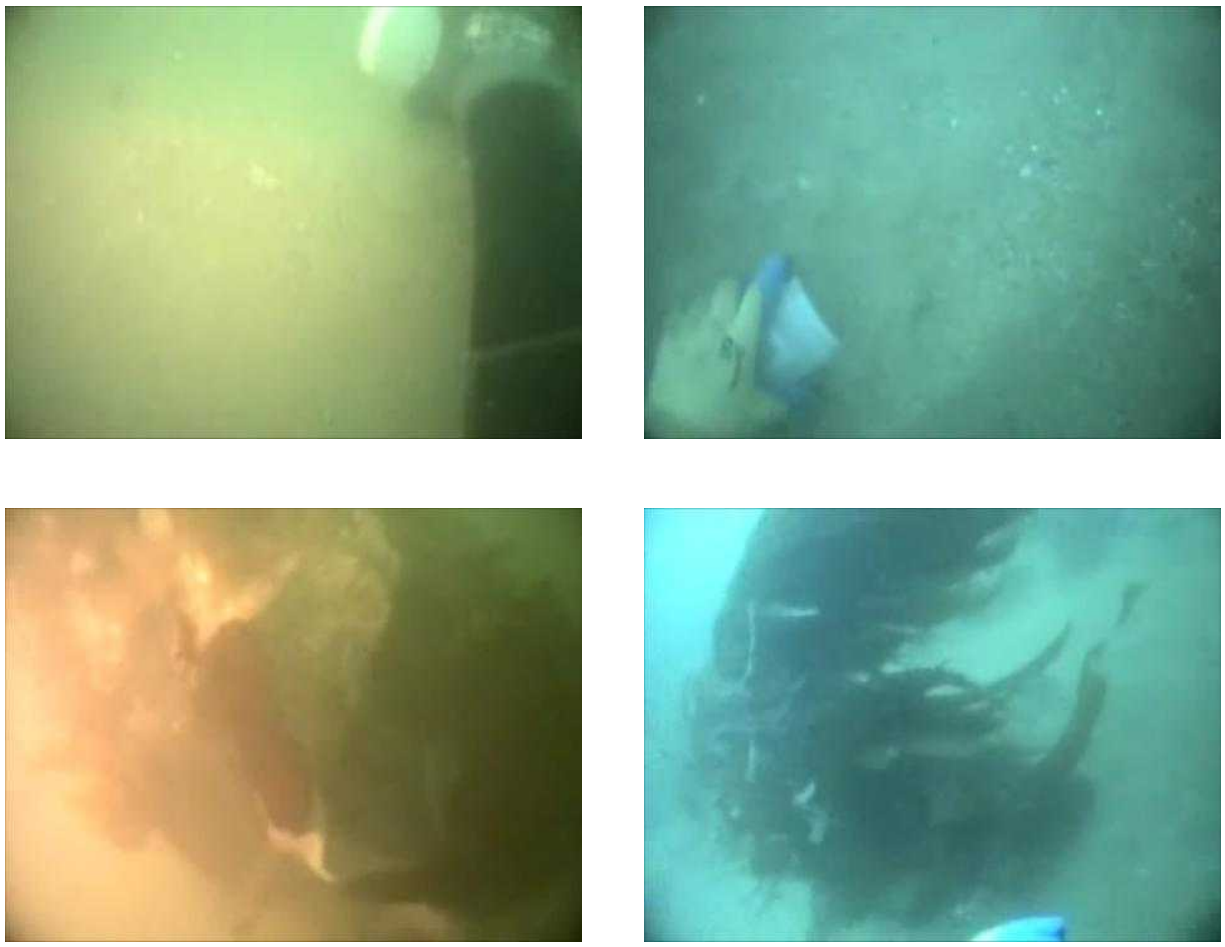

Figure 3-6. Images from the sediment sampling and transect surveys conducted by C & W Diving Solutions, Inc. under the supervision of MBC biologists. Both upper panels illustrate the sediments and the lower panels illustrate representative hard substrate and algae.

Differences of 0.2 mm or less were observed between the median grain sizes in the Unit 2 POIS area and the sidecast areas in the Unit 2 easement (Figure 3-7). Based on the median grain size, all sediments were medium sand. This similarity was reflected in all measures, including median grain size (Table 3-4) and the particle size distribution curves, which showed all stations following the same general grain size distribution (Figure 3-8). The uniformity coefficient (C_u) indicates a moderate degree of heterogeneity in the grain sizes. All sediments had some proportion of grains that measured between 2.000 and 0.075 mm. This was consistent with the particle size distribution curve where the biggest change in the percent passing through each sieve occurred between the #20 and #40 sieves. Sediments near Unit 2 were generally well graded with Coefficients of Curvature (C_c) between 1 and 3 for all samples. Coefficient of curvature describes the shape of the gradation curve or the grain size distribution (Figure 3-8).

Table 3-4. Sediment grain size characteristics around both POISs. D_{50} = Median grain size (mm), C_u = Uniformity coefficient, and C_c = Coefficient of curvature.

Station	% Gravel	% Sand	% Fines	D_{50}	C_u	C_c
Unit 2						
C1	0.0	98.6	1.4	0.6	2.2	1.1
C2	0.1	98.8	1.1	0.6	2.2	1.1
C3	0.1	98.8	1.1	0.7	5.3	2.3
C4	0.0	98.8	1.2	0.6	4.7	2.1
C5	0.0	98.7	1.3	0.6	4.7	1.9
C6	0.4	98.5	1.1	0.6	4.6	2.3
C7	0.0	98.5	1.5	0.5	3.9	1.2
C8	0.3	98.4	1.3	0.8	6.6	1.9
C9	0.0	98.9	1.1	0.6	2.2	1.1
C10	0.0	98.9	1.1	0.6	4.7	2.2
POIS Mean	0.1	98.7	1.2	0.6	4.0	1.8
SC Mean	0.1	98.7	1.3	0.6	4.4	1.6
Unit 3						
C1	0.0	99.0	1.0	1.0	2.7	1.0
C2	0.0	98.4	1.6	0.5	4.1	1.1
C3	0.1	98.2	1.7	0.7	7.3	0.7
C4	0.4	98.7	0.9	1.1	2.8	1.0
C5	0.0	99.0	1.0	0.7	5.2	2.3
C6	0.6	98.2	1.2	0.7	6.2	1.8
C7	0.1	98.5	1.4	0.8	7.0	1.8
C8	0.1	98.9	1.0	0.8	6.6	2.1
C9	6.8	91.9	1.3	0.8	7.5	1.8
C10	2.0	96.7	1.3	0.7	6.3	2.1
POIS Mean	0.2	98.6	1.2	0.8	4.7	1.3
SC Mean	2.3	96.5	1.3	0.8	6.9	2.0

POIS = Primary Offshore Intake Structure

SC = Sidecast destination

At Unit 3, sediments in the sidecast area were 2.3% gravel versus 0.2% near the POIS (Table 3-4). The differences resulted largely from Stations C9 and C10, where sediments were 6.8% and 2.0% gravel, respectively. Despite these differences, the median grain size averaged 0.6 mm both at the sidecast sites and near the POIS. Fines in both sidecast and POIS areas were similar. There was a band of slightly larger sediments running southwest to northeast from Station C9 through Station C7, including through the POIS area. These differences, however, were minimal in comparison to the full spectrum of grain sizes included under sand. The maximum difference between station-specific median grain sizes was only 0.59 mm. Sediments in the sidecast areas were more heterogeneous (mean C_u = 6.9) than near the POIS (mean C_u = 4.7). The Unit 3 particle size distribution curves by sampling station were more dissimilar than those from the Unit 2 area, but most of the disparity among station-specific sediments occurred in the percentages of larger grain sizes (Figure 3-8).

Similar percentages of small grain sizes were taken from sediments at most stations. Like the sediments near Unit 2, the largest percentage of sediments would not pass through the #40 sieve, but a substantially lower percentage of Unit 3 sediments passed through the #20 sieve in comparison to the Unit 2 sediments. Most Unit 3 sediments were well graded, although the sediments at Station C3 were poorly graded (C_c = 0.7).

3.3.3 Intake Area Biological Characterization

Three flatfish were observed near Unit 2 and no fish near Unit 3. Their identity could not be confirmed from the video due to turbidity near the bottom, their size, and the speed with which the fish left the view of the diver's camera. No invertebrates were observed on either set of transects, but during the sediment collection three California spiny lobsters were observed in the rip-rap at the Unit 2 POIS (Figure 3-9). A sheep crab (*Loxorhynchus grandis*) was observed near the Unit 3 POIS during the sediment collection. Multiple sand dollars (*Dendraster* sp.) were observed in the sediment while it was being collected. Sand was the dominant substrate, but some hard substrate was found during

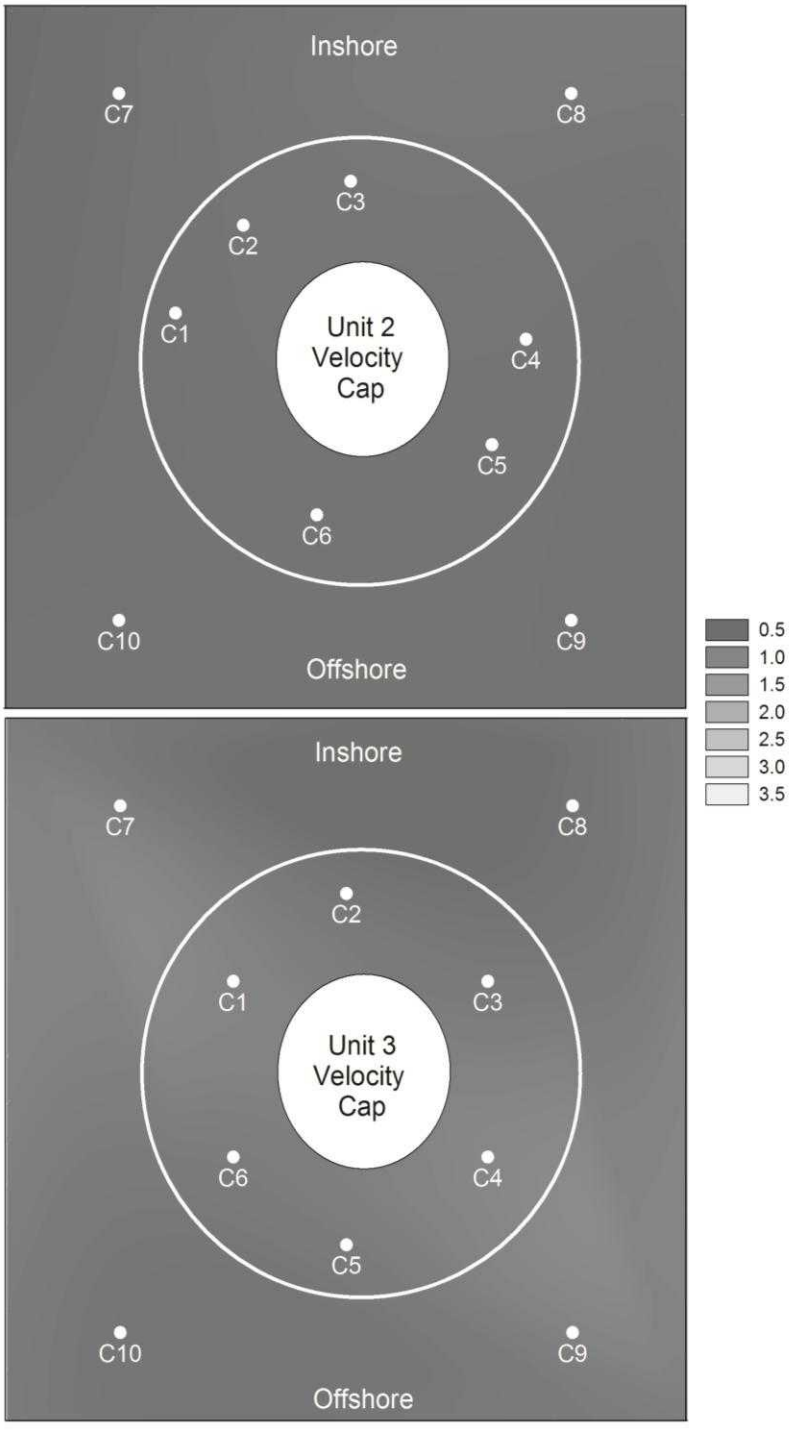

Figure 3-7. Contour plot depicting median grain size (mm) of sediments collected at each station around each POIS.

the sediment collection and during the transect surveys. These areas often supported small groupings of algae or colonial invertebrates. When observed, algae were dominated by low-lying species such as *Laminaria farlowii* and *Rhodymenia*. Isolated giant kelp (*Macrocystis pyrifera*) stipes were scattered near each POIS, often growing on isolated rocky outcrops, occasionally small boulders, and some attached to hard substrate that was buried (Figure 3-5). Seagrass (*Phyllospadix* sp.) was observed near Sediment Station U3C1 growing on a small boulder (Figure 3-9). No other protected or managed species were observed, including garibaldi (*Hypsypops rubicundus*) individuals or nests.

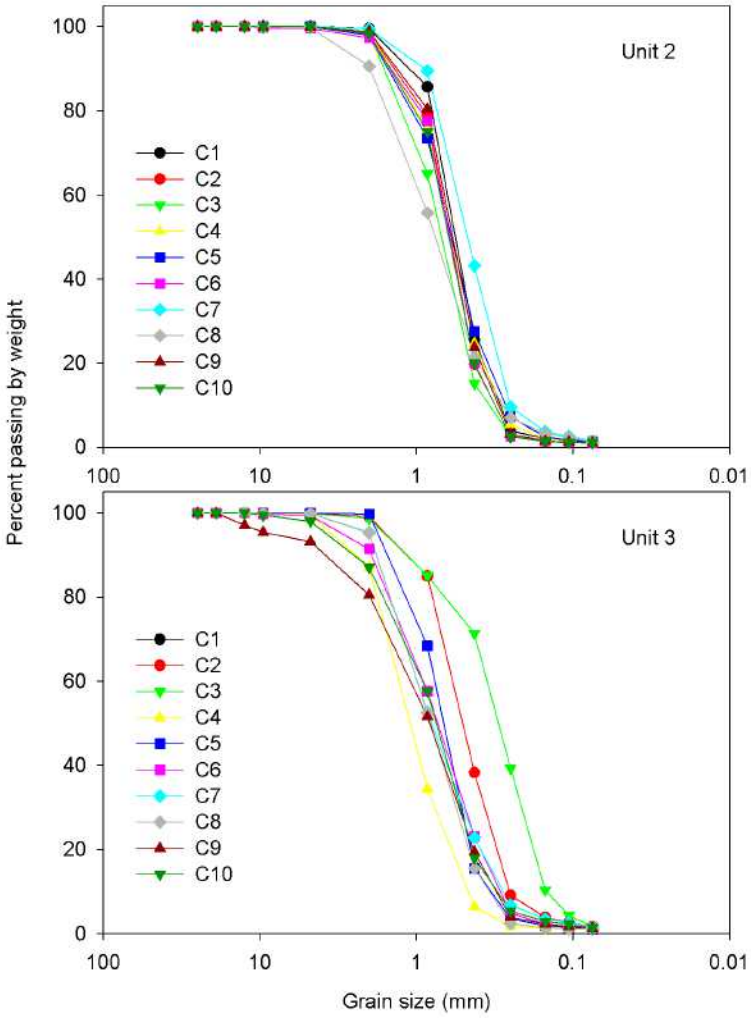

Figure 3-8. Particle size distribution curves for each sampling station. Data is plotted as the percent passing each sieve, with grain size (mm) on the logarithmic x-axis.

3.4 DISCUSSION

Biological communities in the general area of the SONGS POISs are consistent with those documented from similar habitats found elsewhere in southern California (Dailey, et al. 1993, Allen, L.G. and Pondella 2006, Allen, M. J., et al. 2011). No unique, threatened, or endangered subtidal habitat or species has been recorded in the area other than the random occurrence of sea turtles and marine mammals. These species are both large enough and sufficiently mobile to evade the work area during the LOED installation. Simple mitigation measures can be implemented to further ensure their safety, such as stationing monitors in the installation area to notify the installation foreman of their presence. Once notified, procedures can be implemented to avoid injuring or otherwise impacting the animal. Scheduling installation during periods of low abundance could minimize the potential for impacts to marine mammals. Similar practices have been used in other projects in the coastal zone, e.g. rip-rap replacement offshore Pebbly Beach Generating Station (MBC 2008).

Figure 3-9. Images of biological resources observed during the diver transects and sediment collection. Upper left: California spiny lobster observed near Unit 2 POIS; Lower left: sand dollar found while collecting sediment near Unit 2 POIS; Upper right: sheep crab encountered during sediment collection near Unit 3 POIS; Lower right: seagrass growing on a rock near Unit 3 POIS.

Few macroorganisms, or those easily seen through a video camera such as fish, crabs, etc., were found in the surrounding area adjacent to either POIS. The habitat was considerably uniform with a dominance of soft-bottom habitat in the likely footprint of the LOED and occasional rocky substrate seen during the sediment collection and transects. Hard substrate was mostly limited to the rip-rap and stone blanket around each POIS. With the exception of the small group of California spiny lobsters, no other managed, protected, or commercially targeted biota was observed in the likely footprint of the LOED.

The biological community surrounding the SONGS POISs includes a diverse set of habitats and species assemblages along multiple gradients extending away from each POIS. A large kelp forest, cobblestone reef, soft-bottom habitat, and seagrass beds all exist within one kilometer of the POISs. Most of these, however, are well outside of the likely LOED footprint and the area that may be affected by the LOED

installation process. Small patches of these habitats lie within the expected LOED footprints over the stone blankets and will likely be impacted when the sediments are excavated in preparation for the installation. These impacts, however, are expected to be less than significant. The installation of the LOEDs will create additional hard substrate. The LOEDs will likely be colonized by both algae and surfgrass (from the local seed sources), in addition to invertebrates residing on the rocky substrate, such as crabs and California spiny lobster. The installation of the LOEDs will likely enhance the numbers of California spiny lobsters by excluding predators that are too large to fit between the 9-in bars, such as giant sea bass (*Stereolepis gigas*). Sufficient soft-bottom habitat exists in the area to support the fish species displaced by the sediment removal.

Additional impacts may occur as a result of the positioning of the surface vessels, including anchoring. At a minimum, if anchor placement is restricted to ≤700 m (2,300 ft) from the Unit 3 POIS, then no anchoring impacts should occur to the SOK. Some of the smaller patches of kelp within that range may be impacted, but these impacts will be less than significant.

Sediments differed between the two POIS areas. Those within the easement area around the Unit 2 POIS were almost uniformly sand, with median grain diameters of about 0.6 mm. Little variation was observed between those stations likely to be excavated near the POIS on the stone blanket and those in the corners of the easement off the stone blanket where excavated sediments will likely be sidecast. Slightly more variation was observed near Unit 3, but the median grain size was medium sand, consistent with the Unit 2 area. Sediments were slightly larger in the Unit 3 POIS area than in the Unit 2 area, on average. All sediments collected from both areas, however, were within the medium sand classification. The sediment distribution patterns are likely a result of fine-scale current differences that may accelerate the winnowing of small sediments.

Waters near the POISs are typically turbid on a seasonal cycle, with peak turbidity during the spring upwelling period and minimal turbidity during the summer when the coastal waters are highly stratified. The seasonal nature of turbidity in the coastal waters near the POISs factor into the potential impact from the LOED installation as a summer installation may result in greater percent light transmittance reduction than during the spring or winter periods when the coastal waters are already turbid. Turbidity can be problematic as giant kelp is sensitive to limitations on light penetration and sedimentation. Suspended sediments can result in diminished light penetration, while sedimentation on rocky reefs can impede recruitment if not removed (Dayton 1985). With a predominantly southeast-flowing longshore current, any turbid plume generated at the POISs during the installation or maintenance operations will likely be distributed towards the SOK. The speed of the current will substantially affect the mixing rate of the plume and it subsequent dissipation returning light transmittance levels to ambient levels.

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4.0 FISHERY ANALYSIS

4.1 INTRODUCTION

Located in northern San Diego County, the San Onofre Nuclear Generating Station (SONGS) Units 2 and 3 intakes lie in close proximity to two fishing ports: Dana Point Harbor and Oceanside Harbor. Both commercial and recreational fishing vessels depart each harbor, including commercial passenger fishing vessels (CPFVs). The California Department of Fish and Game (CDFG), who regulates the CPFV fishery, designated a uniform 10 minute latitude x 10 minute longitude pattern of blocks offshore California to be used by CPFV captains to designate their location. SONGS's intakes and outfalls is located in block 756 (Figure 4-1). Private recreational anglers are not required to submit fishing logs, although they are still subject to the same recreational fishing regulations on the species, number of fish, fish size, and areas fished that govern the CPFV fleet. Commercial fishing interests in the State are subject to many of the same regulations governing the recreational fishery with some additional conditions. The combinations of these records afford a robust view of the recreational and commercial fisheries in southern California. Both POISs are within a one-nautical-mile restricted access zone centered on SONGS (California Division of Boating and Waterways 2012). Without authorization from the United States Coast Guard Captain of the Port Activities, San Diego, no vessels are allowed to anchor, transit, or otherwise be present in the restricted access zone. Therefore, fishing is prohibited in the area near the POISs. The SONGS intakes are situated near a variety of diverse habitats that affect the distribution of fishing effort and harvest rates. The continental shelf is narrow along this portion of the California coastline with 600-m (2,000 ft) depths available less than 15 km (9.3 miles) offshore. This brings both soft- and hard-bottom, deep-water habitat closer to shore than in other areas of southern California. In this assessment, available recreational and commercial fishing data was compiled and reviewed. Recreational and commercial logbook data (1980-2012) were reviewed. All recreational fishing is done using hook and line, spear, hand collection, and hoop nets for California spiny lobster. Commercial fishing in the area surrounding the POISs includes trap, hook and line, and seine. Monetary values for all fishes and invertebrates taken by the commercial fisheries were calculated after adjusting to 2010 dollars (Oregon State University 2012). Through this review, the spatiotemporal patterns were derived to assist with describing the setting surrounding the intake structures prior to the installation and operation of the LOEDs. Specific goals were to: 1) describe the overall, pre-installation spatial trends in the area's fisheries to establish a baseline for future comparisons, 2) identify potential gradients in effort and harvest

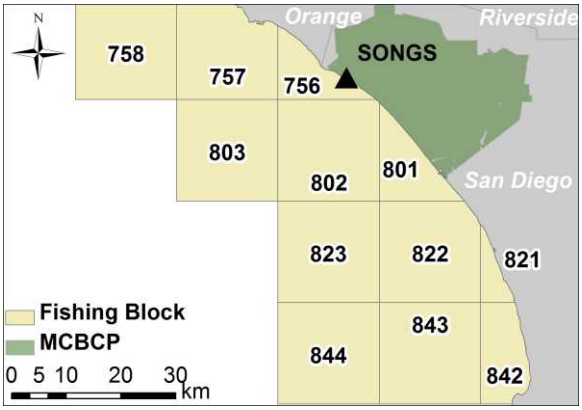

Figure 4-1. California Department of Fish and Game fishing blocks included in the fishery analysis. The location of SONGS is presented for reference. Both SONGS operating intakes scheduled to receive a LOED are within fishing block 756.

among the area fishing blocks, and 3) determine the potential for the LOED installation and operation to affect local fishery resources.

Block 756 is targeted most often with 215,000 anglers/year on average, by far the most intensively fished block of the 12 analyzed (Figure 4-2). The largest recreational catch occurred in block 756 (78,000 fish/year) (Figure 4-3). Finfish landings from block 756 were of comparatively minimal value while the invertebrate fisheries in the area were amongst the most valuable due to high catches of California spiny lobster and market squid (*Doryteuthis opalescens*).

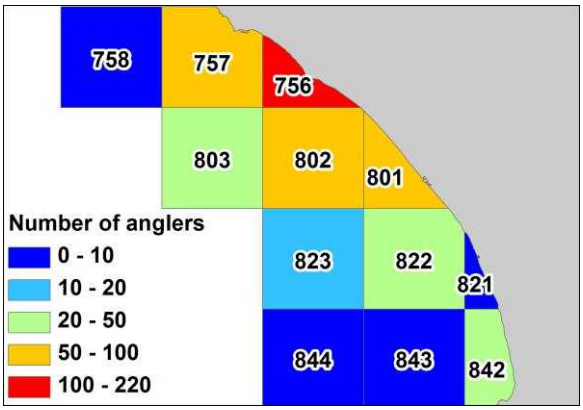

Figure 4-2. Annual mean number of recreational anglers (x 100) targeting each fishing block, 1980-2010.

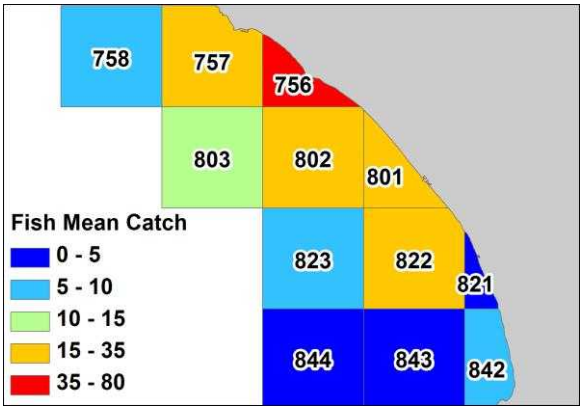

Figure 4-3. Annual mean total recreational catch (x 1000 individuals) for each fishing block, 1980-2010.

Fishery resources in block 756 are clearly among the most frequently targeted in the general area with the more fish caught in block 756 than the remaining 11 included in the analysis. Fishing in the immediate vicinity of the intakes is not allowed as they lie within a restricted zone. Therefore, it is unlikely that the installation or operation of the LOEDs will materially affect legitimate local fishing activities. Despite the existence of the exclusion zone, anglers have been seen fishing in close proximity to the intakes. Therefore, a local notice to mariners should suffice to minimize any potential impact to fishing activities. Fishery resources are also unlikely to be affected by the operation of the LOEDs, because they should not result in any additional mortality of fishery targeted species, nor significantly reduce the amount of available habitat for migration or spawning behaviors. Rather, the creation of new, high-relief subtidal habitat may benefit those fishes that prefer high-relief habitat such as kelp bass and California spiny lobster. The installation and operation of the LOEDs should not impact the local fishery resources.

5.0 ESSENTIAL FISH HABITAT ASSESSMENT

5.1 INTRODUCTION

Essential Fish Habitat is managed under the Magnuson-Stevens Fishery Conservation and Management Act (Magnuson Act). This act protects waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity (Magnuson-Stevens Act, 16 U.S.C. 1801 et seq.). Substrates include sediment, hard bottom, structures underlying waters, and associated biological communities (NMFS 2002). This essential fish habitat assessment is prepared for the installation-related activities and ultimate operation of large organism exclusion devices (LOEDs) on each primary offshore intake structure (POIS) for Southern California Edison's San Onofre Nuclear Generating Station (SONGS) in conformance with the Magnuson Act. NMFS (2002) defines specific EFH terms as follows (50 Code of Federal Regulations [C.F.R.] §§ 600.05–600.930):

• "Waters" include all aquatic areas and their associated biological, chemical, and physical properties that are used by fish and may include aquatic areas historically used by fish where appropriate.

• "Substrate" includes sediment, hard bottom, structures underlying the waters, and associated biological communities.

• "Necessary" means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem; and "Spawning, breeding, feeding, or growth to maturity" covers a species' full life cycle.

5.1.1 Project Description and Project Objectives

The project involves the installation of a Large Organism Exclusion Device (LOED) around each Primary Offshore Intake Structure (POIS) at Unit 2 and Unit 3 at the San Onofre Nuclear Generating Station (SONGS). The work associated with the project will be conducted primarily on barges staged on the ocean surface above the existing intake structures, and on the seafloor immediately adjacent to, and surrounding the two POISs. Surface support craft required to safely install and position the LOEDs will execute a multi-point anchoring plan over the POISs, which may result in additional impact to the area resources.

The LOEDs have been designed, and are being installed to exclude large marine animals (e.g., California sea lion (*Zalophus californianus*), green sea turtles (*Chelonia mydas*), black sea bass (*Stereolepis gigas*), and large white sea bass (*Atractoscion nobilis*), from entering or being drawn into the POISs, which can result in injury or death of the animals.

The LOEDs are being installed in consultation with the State Water Resources Control Board under the State's *Water Quality Control Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling* ("Once-Through Cooling" [OTC] Policy).

5.1.2 Fishery Management Plans

Under the Magnuson Act, the federal government has jurisdiction to manage fisheries in the U. S. Exclusive Economic Zone (EEZ), which extends from the outer boundary of state waters (5.6 kilometer [km] or 3 nautical miles [nm] from shore) to a distance of 370 km (200 nm) from shore. Fishery Management Plans (FMPs) are extensive documents that are constantly revised and updated. The goals of the management plans include, but are not limited to: the promotion of an efficient and profitable fishery, achievement of optimal yield, provision of adequate forage for dependent species, prevention of overfishing, and development of long-term research plans (PFMC 1998, 2008a). There are three FMPs that encompass the proposed project site: the Coastal Pelagic Species FMP, the Pacific Groundfish FMP, and the Pacific salmon FMP.

Coastal Pelagic Species - Until 2008, the Coastal Pelagic Species FMP (CPS) covered one invertebrate, market squid (*Doryteuthis opalescens*), and four fish species (northern anchovy [*Engraulis mordax*], jack mackerel [*Trachurus symmetricus*], Pacific [chub] mackerel [*Scomber japonicus*], and Pacific sardine [*Sardinops sagax*]). Amendment 12 to the FMP was introduced in 2006 "to ensure the preservation of a key trophic relationship between fished and unfished elements in the California Current ecosystem by protecting krill resources off the U. S. West Coast" (PFMC 2008b). Krill (euphausiids) are small, shrimp-like crustaceans that serve as the basis of the marine food chain. They are eaten by many species of fish, whales, and seabirds. Although there was no fishery for krill off the U.S. West Coast, krill are fished in Antarctica, Japan, and off the west coast of Canada. They are used in aquaculture and livestock feed and for fish bait and pet foods. NMFS published the proposed amendment in the Federal Register in May 2008, and Amendment 12 was enacted on July 13, 2009 (Federal Register 74(132):33372-3). Amendment 13 enacted on June 28, 2011 (Federal Register 76(124): 37761-3) added jacksmelt (*Atherinops californiensis*) and Pacific herring (*Clupea pallasii pallasii*) to the CPS as ecosystem component (EC) species to monitor their bycatch in the other CPS fisheries. EFH for CPS species is defined as all marine and estuarine waters from the shoreline of the coasts of California, Oregon, and Washington offshore to the limits of the EEZ and above the thermocline. The thermocline is the portion of the water column where water temperature changes rapidly, usually warmer surface waters transitioning to cooler subsurface waters.

Pacific Groundfish - There are 89 fish species covered under the Pacific Groundfish FMP, including: ratfish (*Hydrolagus colliei*), finescale codling (*Antimora microlepis*), Pacific rattail (*Coryphaenoides acrolepis*), three species of sharks, three skates, six species of roundfish, 62 species of scorpionfishes and thornyheads, and 12 species of flatfishes. For Pacific Groundfish, EFH includes all waters off southern California between Mean Higher High Water (MHHW) and depths less than or equal to 3,500 m (11,500 ft). It also considers EFH to include areas of the upriver extent of saltwater intrusion.

Pacific Salmon - Of the three salmon species included in the Pacific salmon FMP, only chinook salmon (*Oncorhynchus tshawytscha*) can be taken in southern California. Chinook salmon spawn as far south as Central California, but they have been taken by ocean anglers south to Baja California. They are periodically taken in deeper water near submarine canyons in southern California. Coho salmon

(*Oncorhynchus kisutch*) are listed as federally endangered species in southern California. Therefore their take is not allowed. Chum salmon once spawned as far south as the San Lorenzo River in Central California, but their biogeographic range extends south into Baja California. Pink salmon (*Oncorhynchus gorbuscha*) are less common south of Central California with historic spawning in the Russian and Sacramento Rivers.

Habitat Areas of Particular Concern - Habitat Areas of Particular Concern (HAPCs) have been identified as: estuaries, giant kelp (*Macrocystis pyrifera*), surfgrass (*Phyllospadix torreyi*), rocky reefs, and other specific areas (such as seamounts).

5.1.3 Relevant Species

Although there are nearly 100 fish/invertebrate species covered under the CPS and Pacific Groundfish FMPs, not all occur near the proposed project site. Table 5-1 lists species that have been collected or observed during studies near the project site. Most data were recorded during impingement surveys at SONGS, demersal fish surveys conducted in support of the SONGS environmental monitoring program, larval surveys in support of SONGS, larval surveys completed as a part of the California Cooperative Oceanic Fisheries Investigations (CalCOFI), and recreational and commercial fishery records maintained by the California Department of Fish and Game (CDFG) and provided to MBC. Data collected between 2000 and 2010 in each of the aforementioned programs were reviewed.

Coastal Pelagic Species - All CPS occur or have occurred in the vicinity of the proposed project (Tables 1 and 2). Pacific chub mackerel, Pacific sardine, jack mackerel, and northern anchovy are among the most common and abundant fish species offshore SONGS, indicated by both the commercial fishery landings and impingement survey results. Jacksmelt is commonly impinged at SONGS but was also taken during beach seines along the Camp Pendleton shoreline (Tetra Tech 2010). A single Pacific herring was impinged at SONGS in 2009, but has not been recorded in the area otherwise. Market squid is very common, accounting for the highest commercially landed biomass in several of the 10 years reviewed. Krill is generally common in the area with species-specific distributions well described by Brinton (1981), but they are commonly observed offshore near the Channel Islands where baleen whales, e.g blue whale (*Balaenoptera musculus*), can be seen foraging (Fiedler et al. 1998).

Pacific Groundfish - Several of the species covered under the Pacific Groundfish FMP are considered common or abundant in the project area, although many are found at deeper depths than the SONGS intakes. Many are associated with hard substrate or kelp (Leet, et al. 2001, Love, et al. 2002), similar to the habitat surrounding the SONGS intakess. The species classified as abundant in Table 5-1 are predominantly taken further offshore in deeper waters by commercial fisheries, such as sablefish. Those species most likely to occur in the immediate project area are best represented by those impinged in relatively high numbers at SONGS as impingement records represent an indication of the fish community surrounding the intake structure (Miller, et al. 2011). Eighteen groundfish species are labeled as common or abundant in Table 5-1, but

Table 5-1. Adult depth and potential habitat use, larval occurrence, and juvenile/adult occurrence for each species managed under a federal Fishery Management Plan that has occurred in the project area.

		Occurrence	
Common name	**Adult Depth and Potential Habitat Use[1,2,3,4]**	**Larval[1,2,7]**	**Juvenile/Adult[1,2,3,4]**
Coastal Pelagic Species			
Anchovy, northern	Surface to 310 m. Open water.	Abundant	Abundant
Jacksmelt	Surface to 29 m. Open water.	Common	Common
Mackerel, jack	Surface to 403 m. Open water, young over shallow banks and juveniles around kelp beds.	Rare	Abundant
Mackerel, Pacific chub	Surface to 300 m. Open water, juveniles off sandy beaches and around kelp beds.	-	Abundant
Herring, Pacific	Surface to 150 m, most commonly. Open water.	-	Rare
Sardine, Pacific	Surface to 150 m. Open water.	Common	Abundant
Squid, market	Surface to 800 m. Open water. Rare near bays, estuaries, and river mouths.	Common	Abundant
Krill	Surface to ~ 200 m, species-specific. Open water	N/A	Common
Pacific Groundfish			
Cabezon	Intertidal to 76 m. Prefer hard substrata and rocky interfaces.	Rare	Common
Greenling, kelp	Intertidal to 20 m, most commonly. Rocky reefs	Rare	Rare
Lingcod	Intertidal to 475 m. Multiple habitat associations but prefer hard substrata and rocky interfaces	-	Common
Ratfish, spotted	125 to 893 m. Soft and hard bottom on the continental slope	-	Rare
Rockfish, aurora	Prefer 31 to 247 m. Aggregate in midwater over hard bottom	-	Rare
Rockfish, bank	Intertidal to 37 m. Common on hard substrate such as kelp - rock reef	-	Rare
Rockfish, black and yellow	In southern California, 125 - 625 m. Hard bottom.	-	Rare
Rockfish, blackgill	Intertidal to 549 m. Multiple habitat associations but prefer hard substrata	-	Rare
Rockfish, blue	Surface to 475 m. Multiple habitat associations but prefer hard substrata	Uncommon	Uncommon
Rockfish, bocaccio	Surface to 135 m. Common on hard substrate, kelp	-	Common
Rockfish, brown	18 to 256 m. Multiple habitat associations but prefer hard substrata and rocky interfaces.	-	Common
Rockfish, calico	Surface to 425 m. Schooling midwater over or benthic near rocky areas.	-	Rare
Rockfish, canary	50 to 250 m. High relief rocky areas.	-	Rare
Rockfish, chilipepper	Surface to 183 m. Rocky and rock-sand bottoms	-	Uncommon
Rockfish, copper	21 to 366 m. High relief rocky areas.	-	Uncommon
Rockfish, cowcod	30 to 183 m most commonly. Hard bottom often near white anemones.	Rare	Uncommon
Rockfish, flag	Intertidal to 86 m. Common on hard substrate, kelp	-	Uncommon
Rockfish, gopher	Intertidal to 56 m. Common on hard substrate, kelp, and eelgrass habitats	-	Common
Rockfish, grass	55 to 491 m. High relief rocky areas.	-	Common
Rockfish, greenblotched	90 to 363 m. High relief rocky areas.	-	Rare
Rockfish, greenspotted	52 to 828 m. Rocky and soft bottom habitat.	-	Uncommon
Rockfish, greenstriped	15 to 402 m. Multiple habitat associations but prefer hard substrata	-	Rare
Rockfish, halfbanded	Surface to 558 m. High relief rocky areas	-	Common
Rockfish, harlequin	30 to 270 m. Multiple habitat associations but prefer hard substrata	-	Rare

Rockfish, honeycomb	3 to 58 m. Common on hard substrate, kelp	-	Rare
Rockfish, kelp	76 to 350 m. High relief rocky areas.	-	Uncommon
Rockfish, Mexican	Surface to 174 m. Typically midwater above hard bottom.	-	Rare
Rockfish, olive	25 to 825 m. Hard bottom.	-	Uncommon
Rockfish, Pacific ocean perch	45 to 366 m. Multiple habitats but affinity for soft bottom.	-	Rare
Rockfish, pink	49 to 625 m. Multiple habitats but affinity for soft bottom.	-	Rare
Rockfish, redbanded	25 to 549 m. Hard bottom.	-	Rare
Rockfish, rosethorn	7 to 262 m. Hard bottom and soft bottom.	-	Rare
Rockfish, rosy	50 to 450 m, most commonly. Soft bottom.	-	Rare
Rockfish, rougheye	50 to 350 m. Multiple habitat associations but prefer hard substrata	Common	Rare
Rockfish, shortbelly	18 to 366 m. Midwater over rocks.	-	Rare
Rockfish, speckled	80 to 800 m. Non-rocky habitat.	-	Rare
Rockfish, splitnose	18 to 224 m. High relief rocky areas.	-	Uncommon
Rockfish, squarespot	24 to 274 m. Hard bottom	-	Rare
Rockfish, starry	100 to 350 m, most commonly. Soft bottom.	-	Uncommon
Rockfish, stripetail	Intertidal to 97 m. Hard substrate often near kelp	-	Common
Rockfish, treefish	7 to 436 m. Hard bottom and rocky reefs.	-	Common
Rockfish, vermilion	100 to 350 m, most commonly. Mainly hard bottom, but also occurs over soft bottom.	-	Abundant
Rockfish, widow	25 to 475 m. Rocky areas	-	Uncommon
Rockfish, yelloweye	Most abundant 200 to 1000 m. Soft bottom	-	Rare
Sablefish	5 to 150 m, most commonly. Soft bottom habitats	Rare	Abundant
Sanddab, Pacific	Intertidal to 183 m. Benthic, on soft and hard bottoms, as well as around structures	-	Abundant
Scorpionfish, California	Surface to 156 m. Multiple habitat associations, including soft bottoms, and near structure, kelp, and eelgrass	N/A	Abundant
Shark, leopard	Surface to 1,100 m. Open water.	N/A	Common
Shark, soupfin	Interttidal to 1,446 m. Pelagic and on muddy bottoms	N/A	Common
Shark, spiny dogfish	13 to 1,600 m. Soft bottom habitat.	N/A	Uncommon
Skate, California	7 to 349 m. Soft bottom habitats	Rare	Uncommon
Sole, curlfin	10 to 1600 m. Soft bottom habitats	Rare	Uncommon
Sole, Dover	Intertidal to 550 m. Soft bottom habitats	Rare	Uncommon
Sole, English	0 to 850 m. Soft bottom habitats	Rare	Uncommon
Sole, rex	Surface to 971 m. Low-relief hard bottom, e.g. cobble beds	N/A	Rare
Skate, longnose	9 to 1,069 m. Soft bottom habitat	N/A	Rare
Sole, sand	1 to 325 m. Soft bottom habitats	-	Rare
Thornyhead, longspine	201 to 1755 m. Soft bottom.	-	Common
Thornyhead, shortspine	20 to 1524 m. Muddy bottoms sometimes mud mixed with cobble.	-	Abundant
Whiting, Pacific	50 to 400 m. Midwater	Rare	Uncommon

Sources: 1 – McCain et al. (2005), 2 – Love et al. (2005), 3 – CalCOFI, 4 – SONGS Environmental Monitoring Data, 5 – CDFG Fishery Data, 6 – SDCWA Technical Studies, 7 - SCE (2008): Abundant>Common>Uncommon>Rare. N/A = Not applicable, internal fertilization. Note - Most rockfish larvae not identifiable to species. "-" indicates none recorded.

many of these assessments derive from local fishing records. After accounting for primary depth distributions and historic observations during impingement monitoring at SONGS, ten species are most likely to occur in the area near the two POISs. These include: bocaccio (*Sebastes paucispinis*), brown rockfish (*S. auriculatus*), gopher rockfish (*S. carnatus*), grass rockfish (*S. rastrelliger*), treefish (*S.*

serriceps), vermilion rockfish (*S. miniatus*), Pacific sanddab (*Citharichthys sordidus*), California scorpionfish (*Scorpaena guttata*), and leopard shark (*Triakis semifasciata*).

Pacific Salmon - No pink salmon have been taken in the project area. Chinook salmon have been taken by both the recreational and commercial fisheries in the area. Chum salmon has only been taken recreationally. One chum salmon was recorded during impingement monitoring at SONGS; that occurred in 1991. Both species are uncommon in the area near the POISs.

Habitat Areas of Particular Concern - Rocky reefs, giant kelp, and surfgrass are documented in the vicinity of installation sites for each LOED. The offshore location removes estuaries from consideration. The San Mateo Point Kelp forest and the San Onofre Kelp bed (SOK) each exist near the project site with the SOK being the most proximate (SCE 2011). The main body of the SOK canopy lies at least 700 m (2,300 ft) southeast of the Unit 3 POIS. Therefore, minimal impacts will likely occur to the main forest assuming all surface support vessels involved with the installation remain within the open area and avoid placing anchors within the boundaries of the SOK observed in 2008, which represents the recent historic maximum area of the kelp forest surface canopy. In addition to giant kelp forests, each of these sites includes a subtidal rocky reef to which the kelp is anchored. Both giant kelp and rocky substrate is randomly distributed around each POIS in the LOED footprints, but no expanses of either habitat were observed. Rather, each was represented by irregularly spaced outcrops, likely the stone blanket installed by SCE when the SONGS POISs were installed protruding through the overlying sediments. Surfgrass beds have been identified inshore of the Unit 1 intake and outfall (MBC 2003), which is located upcoast of the LOED installation sites, and a small patch was observed within the Unit 3 LOED footprint. No seamounts are known to occur near the project site and are therefore not likely to be impacted.

5.2 DISCUSSION

Several marine species managed under an FMP and habitats of concern occur along the southern Orange and northern San Diego Counties' coastline, or in the vicinity of the SONGS intake structures where the LOEDs will be installed and operated. While many of the managed species have occurred in the area during the decade examined, few were common or abundant. Of those species that were abundant, most were CPS species while only a few groundfish were considered common in the area. Of those groundfish considered common or abundant, many of these designations were the result of commercial fishing several kilometers offshore from the SONGS intake structures, such as sablefish. Those groundfish potentially occurring in the project area were limited to shallow water species.

If any CPS fishes are present in the area when work begins, the installation effects, including anchoring, will be minimal and temporary as these mobile species will likely leave the area during the installation. Groundfish may be more impacted due to their more sedentary nature, but these species are also likely to temporarily move out of the area during installation. Individuals offshore SONGS represent a small fraction of populations for species in both groups (CPS and groundfish). The habitat in the project area is not limiting as it is common throughout the Southern California Bight. Therefore, no population level changes in abundance or behavior (migration, spawning, etc.) will likely result from the LOED

installation. Longer term effects of the operation of the LOEDs are expected to be minimal and similar in scope to the pre-installation effects of the POISs themselves. The LOED is a stationary structure that will allow FMP-listed species the opportunity to swim in and out of the structure based on the low flow rates at the LOED screen face (K. Anthony July 2012 personal communication). Each LOED will reduce the take of large marine organisms, which may benefit structure-associated species, such as rockfish, by providing refuge from larger predators that are unable to access areas inside the LOEDs. As the LOED becomes colonized by settling organisms, such as barnacles and mussels, after installation and between cleanings, additional prey resources will develop to provide forage for some species, which may ultimately result in a net ecological benefit to the local fish resources.

Minor impacts to HAPCs will result during installation (including anchoring) and periodic LOED cleanings, but not from routine operation. During installation, sediment excavation will impact those small areas of giant kelp, seagrass, and rocky substrate identified around the POISs. Light transmittance will likely be reduced due to temporary shading and possibly increased turbidity resulting from sediment suspension during the installation and periodic cleanings. These impacts will be less than significant due largely to their short duration as the installation is anticipated to last less than one calendar month (30 days) barring inclement weather. Effects of anchoring on the HAPCs will be less than significant due to the small area of the affected habitat and the high likelihood of recolonization of the LOEDs from local seed sources once the installation is complete. Furthermore, anchor placement will be done to minimize impacts to HAPCs to the extent possible.

It is likely that periodic cleanings will be required to maintain sufficient flow through the LOED. These cleaning events will likely suspend food particles from the structure and provide forage for area fishes, including some CPS. Outside of these periodic cleanings, the passive operation of the LOEDs will not affect HAPCs. Rocky reef habitat will not be disturbed by the installation or operation and any increased turbidity occurring during the installation and periodic cleanings will be temporary. There will be no impacts to giant kelp or surfgrass in the project area.

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6.0 MARINE RESOURCES IMPACT ASSESSMENT

6.1 INTRODUCTION

San Onofre Nuclear Generating Station (SONGS) is required to install structures to prevent the take of large marine organisms, primarily seals, sea lions, and sea turtles. The California State Water Resource Control Board's *Water Quality Control Policy on the Use of Coastal and Estuarine Waters for Power Plant Cooling* requires the structure have bars spaced no more than 9-inches (in) on center. This poses unique challenges to SONGS given the habitat surrounding the intakes, specifically the presence of multiple giant kelp beds that produce drift algae (marine debris) that can impinge upon, or foul, any potential large organism exclusion device (LOED) installed on the SONGS intakes. The likelihood of fouling necessitates a large surface area to ensure adequate cooling water flow during the range of likely LOED fouled scenarios. Impacts of the installation and operation of the LOED on the surrounding environment are predicated on the size of the LOED. Unlike other once-through-cooled power plants that utilize an offshore, submerged, velocity-capped intake structure and have been able to add or modify exclusion barriers in the gap between the intake riser and the velocity cap, the SONGS LOEDs necessarily extend out beyond the velocity caps. This will result in disturbance to the seafloor in the footprint of the LOEDs and temporary impacts to the ambient water quality conditions during installation. These temporary changes to local water quality can result in additional effects on biological resources, especially light-sensitive giant kelp. Therefore, the preceding chapters have examined various environmental parameters that may or may not be affected by the LOED installation and operation.

6.2 PROPOSED PROJECT

The prefabricated LOEDs will be transported by barge to the Project site. Number of vessels (barges) and port of origin have yet to be determined, but will likely originate from the Port of Los Angeles. Project parameters on site include sediment removal from around the POISs with all material sidecast within the State Lands Commission lease easement surrounding each POIS. Four holes in the seafloor at the corners of each LOED will be drilled to accommodate concrete footings cast in place. The LOED will be attached to the footings using stainless steel hardware. Additional anchorage will be through placement of four kicker panels, on per LOED side. Kicker panels consist of large, precast concrete blocks set on the seafloor anchoring the LOED from lateral movement via steel cable. All anchorage equipment will be placed within the lease easement. Once installed, each LOED will remain in place as an impediment to large marine organisms approaching and reaching the POIS. Periodic cleaning will be required to clean the LOEDs of all marine fouling growth at a yet to be determined frequency. Operational experience will be needed to determine the cleaning frequency. Cleaning will likely encompass hydroblasting the LOED bars clean by divers.

6.3 POTENTIAL EFFECTS ON CURRENT CONDITIONS

6.3.1 Demersal Fish and Invertebrates

The demersal fish community in the vicinity of the intakes is dominated by midwater, schooling fishes that are likely to leave the area during the installation. Demersal invertebrates are dominated by the small, unfished blackspotted bay shrimp. Little is known of its ecology, but its population is wide ranging and commonly the dominant fauna in the nearshore Southern California Bight (Allen, M. J., et al. 2011). Temporary impacts resulting from the installation of the LOEDs are not likely to result in systemic changes to local populations. The new presence of high-relief, hard substrate may alter the community by promoting the presence of hard-substrate attracted species, such as those that commonly occur near rocky reefs. The transient midwater fish community may alter their distribution in response, but they in turn may become attracted as the LOED becomes colonized with micro- and macrofauna attaching to or inhabiting the new substrate. Any effect of the LOED installation and operation on existing marine resources, however, will be less than significant.

Construction noise may result in some temporary impacts to fishes. Construction of the LOEDs could include drilling, anchoring, and digging. Ambient noise in the open ocean (along the central California coast) was estimated to range between 74 and 100 dB_{PEAK} (or the peak sound pressure level in decibels) (ICF and Illingworth and Rodkin, 2009). By comparison, a recent baseline hydroacoustic study in Cerritos Channel (in both Los Angeles and Long Beach Harbors) recorded L_{90} values (sound levels that were exceeded 90 percent of the time during the measurement period) of 120 to 132 dB (Tetra Tech, 2011). Construction of the LOEDs would create underwater sound. Although this sound is not expected to cause injury to marine mammals, it may be of a sufficient volume and range to cause some temporary acoustic impacts to fish. Acoustic impacts may include avoidance of the area, injury, or death (in rare occasions). The extent of acoustic impacts would depend on the construction methods used. Because smaller fish are more susceptible to acoustic injury, the species most likely to suffer mortality would be northern anchovy, Pacific sardine, and topsmelt. A peak sound level of 180 dB_{PEAK} has been identified as an injury threshold for small fish. Impact driving of concrete piles would create sound of levels of about 183 to 193 dB_{PEAK} to a radius of up to 33 ft from each pile (Illingworth and Rodkin, 2007; ICF and Illingworth and Rodkin, 2009). However, due to the limited potential impact area and the reasonable certainty that small pelagic fish would avoid the temporary construction disturbance, this is not considered a substantial disruption.

6.3.2 Marine Mammals

Common dolphins, California sea lions, and Pacific harbor seals are the most common marine mammals offshore SONGS. Sound transmission in the underwater environment can be affected by local bathymetry, substrates, currents, and stratification of the water column. Based on underwater studies of gray whale (*Eschrichtius robustus*) behavior, a disturbance threshold (Level B harassment) of 160 dBRMS has been identified for marine mammals based on previous research on cetaceans (Federal Register, 2006). Exposure to sound at this level would likely cause avoidance, but not injury, for marine

mammals. The current Level A harassment (injury) threshold for non-explosive sounds is 180 dBRMS for cetaceans and 190 dBRMS for pinnipeds.

Impact driving of 24-inch concrete piles (of unspecified shape) has produced peak sound volumes of 183-193 dB_{PEAK}, and volumes of 171-175 dB_{RMS} at a distance of 33 feet (ICF and Illingworth & Rodkin, 2009). This is consistent with Illingworth and Rodkin who measured sound pressures from impact pile-driving of 24-inch concrete piles of 185-188 dB_{PEAK} and 170-176 (dB_{RMS}) within 33 ft of the source (Illingworth and Rodkin, 2007). However, construction methods for the proposed project are expected to create sound levels lower than those measured during concrete pile-driving. Therefore, impacts would not result in disturbance (Level B harassment) to marine mammals in the vicinity of construction operations. Marine mammals in the proposed Project area at the time of construction could be temporarily disturbed by construction activities; however any individuals present would likely avoid the work area.

6.3.3 Kelp

The main body of the SOK bed is located 700-800 m (2,300-2,600 ft), depending on the size of the kelp canopy, southwest (offshore and downcoast) of the Unit 3 POIS (Figure 3-4). Located to the northwest (offshore and upcoast), the San Mateo Point Kelp bed is more than one kilometer away from the Unit 2 POIS. Installation activities are unlikely to directly impact either bed, except through potentially temporary turbidity increases resulting from sediment excavation, and possible impacts from anchoring the installation support vessels. Vessel impacts, including anchoring, will be minimal if all activities are restricted within the 700-m (2,300-ft) buffer between the POISs and the SOK. Long-term impacts from LOED operation are unlikely as the structures will passively prevent large marine organisms from getting close to the intakes. Sediment removal prior to the installation and periodic cleaning to remove marine growth may result in a temporary plume of turbid waters that, based on the predominant current patterns, will be carried southeast towards the SOK. The resulting reduced light transmittance will likely be short-lived with no lasting effect. Impacts to local kelp resources are likely to be less than significant.

6.3.4 Turbidity

Waters in the immediate vicinity of the intakes and outfalls are more turbid than the surrounding area, but in seasonal patterns. The spring upwelling period results in minimal light transmittance, on average, while light transmittance is higher during summer months. Similar recent projects have found no significant increases in turbidity. Therefore, similar results are expected with the LOED installations. Any impacts are anticipated to be less than significant as previously described for kelp. No other organism is expected to be impacted by the temporary turbidity increases.

6.3.5 Sediments

Medium sand dominated both intake areas. Slightly larger grain size was collected at some Unit 3 stations than near Unit 2, but these differences were minimal and resulted in no classification change. The data suggest sediments in the easements surrounding each POIS are relatively homogenous. Therefore, little, if any, effect of sidecasting the sediments excavated from the stone blanket surrounding each POIS will result.

6.3.6 Biological Resources Near the POISs

Areas near each POIS surveyed by divers during both the sediment collection and dedicated transects recorded minimal biological resources. Few fish or invertebrates were observed in the area within the LOED footprint. Some algae, including giant kelp, and seagrass were found near each POIS, but their occurrence was irregular and infrequent. While small areas of seagrass (covering a small rocky outcropping) and small aggregations of giant kelp will be impacted by the installation of the LOED, these impacts will be less than significant. The resulting addition of new, high-relief, hard substrate provides additional habitat for both seagrass and giant kelp. With seed sources in close proximity, it is likely that the biomass impacted by the LOED installation process will recolonize the LOEDs once they are in place.

6.3.7 Fishery Resources

While the SONGS intakes scheduled to receive an LOED exist in the most intensively fished block in the area, the exclusion zone encompassing the intakes minimizes the likelihood that any impacts to the area's legitimate fishing activities will result from the installation or operation of the LOED. As discussed in Section 6.2.1, less than significant impacts to fish resources are expected. As previously noted, however, anglers have been observed within the exclusion zone. Therefore, a local notice to mariners will further assist in minimizing any impacts from the installation process on fishing activities in the area. Less than significant impacts to fishery resources are also expected as no spawning or migratory habitat is likely to be affected. The creation of high-relief subtidal habitat may enhance fishery resources in the area for those species that naturally aggregate to rocky reefs.

6.3.8 Avian Resources

Avian resources were not analyzed previously and are unlikely to be impacted by the project due to its offshore subtidal location. By virtue of its offshore location, nesting habitat will not disturbed. Except for species such as common loon (*Gavia immer*) and various cormorants (*Phalacrocorax* spp.), the subtidal depth of the LOED is greater than most seabirds and shorebirds can dive and therefore significantly reduces the likelihood of impacts to avian resources. The temporary presence of the installation support vessels (barges) may briefly, and minimally, alter the distribution of forage fishes such as northern anchovy in the immediate vicinity of the Project area, but this is will be, at most, a less than significant impact.

6.4 CONCLUSION

The installation of the LOEDs on each POIS will result in some temporary, less than significant impacts to coastal resources. These impacts, however, will be of short duration and minimal in comparison to some of the potential benefits that may occur, such as a reduction of large marine organism entrapment into the POISs. Furthermore, most of the impacts will likely be offset by the creation of high-relief, hard subtidal habitat that can be colonized by, or attract, a variety of organisms commonly observed on rocky reefs.

7.0 MARINE MITIGATION MEASURES

7.1 MARINE LIFE

The installation of the LOEDs may have a direct impact on local marine mammal, fish, and sea turtle species. California sea lions and harbor seals are the species most likely to occur, but other listed species such as gray whale, blue whale, and green sea turtle could possibly occur in the area during installation activities. Potential impacts include collision during transport from the port of origin to the Project site or during the installation, as well as acoustic impacts during both of these phases of installation. Sound levels from the surface vessels would not likely exceed thresholds developed by the NMFS (180 decibels root mean square [180 dBRMS] injury threshold for cetaceans and 190 dBRMS for pinnipeds). Noise levels likely to result from the required drilling are unknown, but are anticipated to be less than what is produced during the pile-driving discussed in Section 6.3.2. Fishes are susceptible to submerged noise, but it is anticipated species sensitive to the sound levels produced during installation will temporarily move out of the area to adjacent, suitable habitat and return after the installation is complete. Motile invertebrates and birds in the area are likewise expected to move out of the area.

Potential impacts discussed above will be minimized by performing the marine mammal monitoring and protection plan (Appendix C) developed to ensure the protection of large marine organisms during the transit, installation, and operation of the LOEDs. With the execution of the marine mammal monitoring and protection plan, less-than-significant impacts are anticipated to result from the Project. Mitigation measures include the following:

Marine Mammal Monitoring and Protection Plan.

SCE's chosen contractor will execute the Marine Mammal Monitoring and Protection Plan (MMPP) (Appendix C) during vessel transit to and from the project site as well as during installation of the LOEDs. A NMFS-approved marine mammal monitor will conduct a training session for all vessel crews to review the purpose and need for this MMPP, but be on board during the transport. The need to evade, to the extent safely possible, crossing the path of migrating whales will be stressed to all crews so they may act appropriately if a mammal is encountered during the transit. If possible, vessels should maintain a distance of no closer than 1000 feet from migrating whales during transits to and from the project site. In the event a whale approaches to within 1000 feet of the vessel in a manner outside of the vessel captain's control, all forward propulsion should be stopped, if safe to do so, until the animal has moved away. In the event a whale strike occurs, the vessel captain must notify the U.S. Coast Guard immediately and provide information on an "Injured Marine Mammal and Ship Strike Report log". Subsequent notifications must be made to NMFS and SCE.

A NMFS-approved marine mammal monitor will be onsite to observe for the presence of marine mammals within the project area during the installation. The onsite construction foreman will be notified in the event a marine mammal approaches within 200 feet of the POIS where the installations are underway with an accompanying recommendation that all installation activities be suspended. Marine

mammals that are seaward of the construction barge or that may surface near the barge to investigate shall be closely observed. The monitors shall have the discretion to continue operation if it is not likely the mammal will swim into the activity zone. Mammals attempting to haul out on the barge or on other equipment shall be chased away using approved methods from the NMFS and subject to the monitor's approval. All sightings shall be documented in a monitor logbook with a date-stamped photograph taken of the animal, if possible. Any unique markings the animal possesses shall be catalogued, such as tags, scars, and/or discolorations.

7.2 SURROUNDING HABITAT

The LOED installation may impact the surrounding marine habitat and community. Likely impacts will result from turbidity generated during sediment excavation, drilling, and subsequent cleaning that will be required with future operation of the LOEDs. San Onofre Kelp (SOK) is the giant kelp bed closest to the Project site located approximately 2,300 feet from the Unit 3 proposed installation area. The SOK is unlikely to be disturbed during the installations. Seagrass was noted at several locations growing on cobble surrounding the now inactive SONGS Unit 1 intake and discharge conduits (MBC 2003) and is not likely to be affected. Small, widely distributed areas (less than approximately 11 square feet, each) of kelp and seagrass occur much closer (less than 33 feet) and could be affected by reduced water clarity, removed during excavation, and/or could be smothered by settling sediments. Seagrass and kelp occurrences near the POISs could not be mapped during July 2012 dive surveys to derive exact measurements. These areas of sensitive habitat likely to be impacted are a small fraction of each habitat type available in the immediate area. Disturbance to these areas will not result in corresponding population-level effects to communities using these habitats due to the availability of replacement habitat within approximately 1 mile. After the installation of the LOEDs, the high-relief, hard substrate of the structures will likely be recolonized by sensitive macrophytes and macroalgae from local seed sources. Thus, installation and operation of the LOEDs on each POIS would result in a less-than-significant impact with mitigation on local sensitive communities (giant kelp and seagrass).

Turbidity Monitoring Plan

A Turbidity Monitoring Plan has been developed for the LOED installation and will be reviewed by the San Diego RWQCB prior to implementation. The plan will be implemented during installation to monitor any effects to water clarity in the immediate areas of installation. Corrective actions will be prescribed by the plan when conditions warrant and require corresponding levels of reporting to the RWQCB and SCE.

7.3 CONCLUSION

There is no other proposed mitigation for the LOED installation or operation. The Project will have no impact on wetlands as the Project occurs offshore and no federally protected wetlands occur in the immediate (1.2-mile radius) vicinity of the Project site. The LOEDs would also not likely interfere with the movement of native or migratory fish because relatively few truly migratory fish species are found in the nearshore southern California waters where the LOEDs will be installed. The operation of the LOEDs would be completely passive and would be designed to reduce the entrainment of larger fishes that may

migrate past the intake locations, thereby offering a net benefit to species that would have otherwise been affected by the intake without the LOED in place. Installation and operation (existence) of the LOEDs will not conflict with any local policies or ordinances designed to protect natural resources. Lastly, there is no natural community conservation, or similar, plan established for the either the transportation corridor or Project site. Under these conditions, the two aforementioned mitigation measures would sufficiently protect the marine environment from significant adverse environmental impacts.

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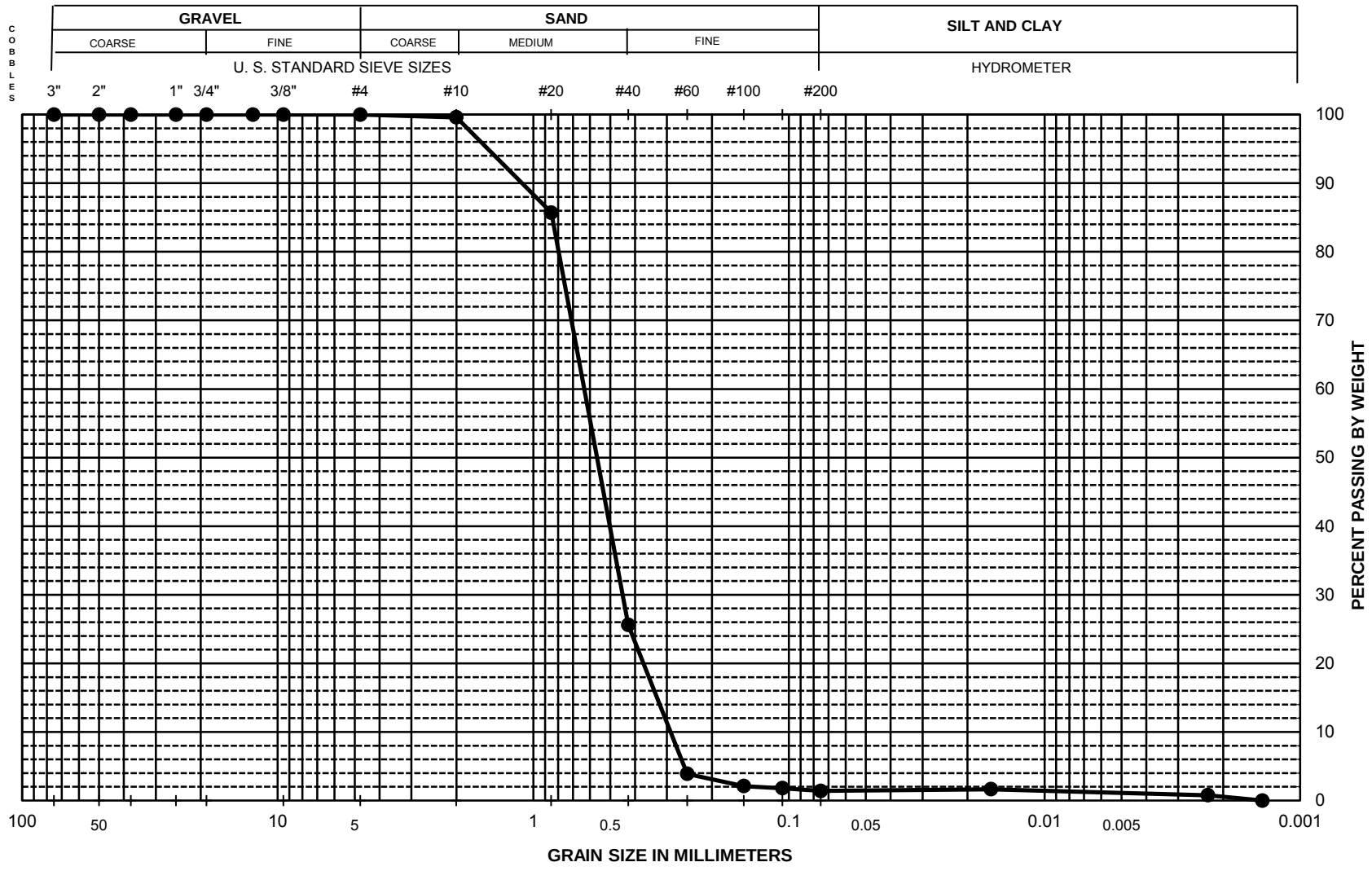
Appendix A: URS Sediment Grain Size Analysis Laboratory Reports

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	100.0
#4	4.75	100.0
#10	2.00	99.6
#20	0.850	85.7
#40	0.425	25.6
#60	0.250	3.9
#100	0.150	2.1
#140	0.106	1.8
#200	0.075	1.4
Hydrometer Analysis	0.0162	1.6
	0.0023	0.8
	0.0014	0.0

% Cobbles	--
% Gravel	0.0
% Sand	98.6
% Fines	1.4

D_{85}	0.8432
D_{60}	0.6320
D_{30}	0.4471
D_{15}	0.3280
D_{10}	0.2902
C_u	2.2
C_c	1.1

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
U2C1	---	---	●	NA	NA	NA	1	**Dark gray poorly graded Sand with seashells (SP)**

PROJECT NAME: **SONGS LOED permitting**

PROJECT NUMBER: **12206A**

PARTICLE-SIZE DISTRIBUTION CURVES

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

GRADATION OF SOILS by Sieving using Soil Sieve Sizes & with Water Content

ASTM D6913, D422 and D2216

Project Number: 12206A | Task Number: | Boring No.: U2C1

Project Name: SONGS LOED permitting | Sample No.: ---

Project Engineer: E Miller | Depth (ft): ---

Visual Description: Dark gray poorly graded Sand with seashells (SP)

SPECIMEN: Selected From:

Bulk Sample	x		Other - Jar
SPT Sample			Thin-Walled Tube
Calif. Sample			Engr. Test Specimen's WC
			Whole sample used
			See Bulk Sample Processing Form

Selection Method:

		Sieves (1) - whole sample used
x		Sieves (1) - partial sample used & selected by Method(s)
c		Method

(a): Splitter; (use for dry soils or that which will segregate)

(b): Quartering; (use for dry soils or that which will segregate)

(c) : Representative scoop after mixing, or slice of intact sample. (use for moist soils or that which will not segregate)

Preparation: Sample/Specimen:

As-Received	x
Air Dried	
Oven-Dried	

Test Method

Method A	
Method B	x

Oven-Dried Soil Broken Up Before:

Selecting partial sample: No x | Yes

Washing:

	No	Yes
Whole Specimen Washed on No. 200 sieve ?		x
Retained Fraction: 1st Split Washed ?		
Fine Fraction Washed on No. 200 sieve ?		

By: Mortar & Pestle | Hand | Pulverizer | Other

and Soil Soaked for: ~6 hrs.

MASS OF TEST SPECIMEN (g)	Total Test Specimen with Coarse Fraction	Partial or Whole Test Specimen	Soil Retained (after washing)	**Water Content** As Recieved or Container No.	
Min.sieve size in sieving sequence (3)	#N/A	# 200	+200	Wet, M1 (g)	
Container Number		SF7	SF7	Dry, M2 (g)	XXX
Mass of Container and Dry Soil, (g)		512.56	507.73	Cont.,M3 (g)	XXX
Mass of Container, (g)		153.84	153.9	**Water Content (%)**	**NA**
Dry Soil, Ws (g)		358.72	353.83		

SIEVING RESULTS % error: 0.03

See (1)	Sieve No.	Cum. Mass Retained (g)	Total Specimen % Finer N'
	3 "		
	2 "		
	1 1/2"		
	1 "		
	3/4 "		
	1/2 "		
	3/8 "		
	4		
	Pan		XXXXXXXX

Req. Mass of Test Spec. for 1% (kg)
3"= 70
1 1/2"=10
3/4"= 1.1
3/8"= 0.25
#4 = 0.1
#10 = 0.1

Shape of Grains

	Rounded
x	Angular
	Flat

Sieve No.	Sieve mm	Cum. Mass Retained (g)	Partial Test Specimen	Total Specimen % Finer N'
3 "	75			
2 "	50			
1-1/2"	37.5			
1 "	25			
3/4 "	19			
1/2 "	12.5			
3/8 "	9.5	0		100
#4	325	0.09	seashells	100
#10	180	1.54	seashells	99.6
#20	115	51.46		85.7
#40	75	266.81		25.6
#60	60	344.67		3.9
#100	40	351.13		2.1
#140*	30	352.22		1.8
#200	20	353.63		1.4
Pan		353.73	XXXXXXXX	XXXXXXXXXX

SUMMARY: Shape & Filter Parameters

% COBBLES	---	D60	0.632	D85	0.84
% GRAVEL	0	D30	0.447	D50	0.56
% SAND	98.6	D10	0.290	D15	0.33
% FINES	1.4	Cu =	2.2	Cc =	1.1

* Denotes sieve added to better define gradation curve

Cc = D30^2 / (D60 * D10)

Cu = D60 / D10

(1) X in box denotes sieve on which split was made.

(2) Proposed allowable amount of soil retained on 8" dia. sieve.

(3) Sieve size given, denotes min. sieve size used in the appropriate sieving sequence.

The above values D## denotes particle size (mm) at the corresponding percent passing.

Mica Noted: x No | Yes Amount Adjective:

Particle Hardness

x Hard | Soft | Weathered

SET-UP BY: TJO DATE 07/30/12 CALCULATED BY: TJO CHECKED BY: YS

SUBMITTED BY: Thomas J. O'Mara

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

PARTICLE-SIZE ANALYSIS : by Hydrometer

ASTM C117 or D422 or if Double Hydrometer Performed, D4221

Project Number: 12206A Task Number: Boring No.: U2C1

Project Name: SONGS LOED permitting Sample No.: ---

Project Engineer: E Miller Depth (ft): ---

Visual Description: Dark gray poorly graded Sand with seashells (SP)

State of Specimen before Processing	
	Moist State ☐ Oven Dried
x	Air Dried
	See bulk sample proc. form (S-106)
Soil broken up by:	Other:
	Mortar & pestle
x	Passing soil through #10 sieve or
Dispersing Agent:(1)	
x	125ml Std. 4% or ____ solution
	Other
Date Soaking Initiated:	7/31/2012
Time Soaked:	x Overnight; Other
x	ASTM Dispersion Cup & Mixer used for 1 min
	Air dispersion device used for ____ min
	Other
Defoaming Agent Used:	X No; ☐ Yes

Oven- or Air-Dried Set-Up	
Drying container No.	
Mass Container+Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil (g)	

Set-Up Water Content	x	Minus No. 10 or
Container No.		m66
Mass Container + Wet Soil (g), M1		338.92
Mass Container + Dry Soil (g), M2		338.58
Mass Container (g), M3		101.66
Water Content, w (%)		**0.14**

Test Notes: (1) Dispersing Agent is Sodium Hexametaphosphate

Mass of Dry Soil Used in Test, Ws	
For Oven-dry set-up, Ws (g)	
For Moist or ____ set-up	
Wwet = Estimated Ws x (1 + w)	
Est = ____ x (1 + ____) =	
Act (Wwet) =	99.03 (g)
Ws = Wwet /(1 + w/100) =	98.89 (g)
After Test Actual Ws	
Container No.	
Mass Container + Dispersant + Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil + Dispersant (g)	
Mass Dispersant (g)	
Mass Dry Soil (g)	

Soaking Beaker No. 832 Graduate No. 2 152H Hydrometer No. 972 Meniscus Correction, Cm = calibrated (3)

Date 12 (yr) (m:d)	Time (hr:min)	Elapsed Time (min)	Temp (ºC)	Hyd. Reading Soil (2) R	Hyd. Reading Water (3) Rw	Diameter D (mm)	Total specimen % finer N'
8/1	9:53	0		XXXXXXXX		XXXXXXXX	XXXXXXX
		1	24.2	2.0	1.4	0.0515	0.6
		2	24.2	2.0	1.4	0.0364	0.6
		5	24.2	3.0	1.4	0.0229	1.6
		10	24.3	3.0	1.3	0.0162	1.6
		31	24.2	3.0	1.4	0.0092	1.6
		90	24.1	2.5	1.5	0.0054	1.0
		204	24.0	2.5	1.6	0.0036	0.9
		504	24.4	2.0	1.2	0.0023	0.8
		1357	23.7	2.0	2.0	0.0014	0.0

Sieving Performed on Hyd. Test Spec.	
Complete Sieve Analysis Performed: See Form S-104	☐ Yes ☐ No
x	Wash analysis performed to check appropriateness of hyd. spec.
Container No.	sf6
Mass Container + Dry Soil (g)	244.2
Mass Container (g)	147.18
Total Specimen % Finer	1.8

Dry Sieving After Washing

Sieve No.	Cumulative Mass Retained (g)	Total Specimen % Finer, N'
40	69.38	28.9
100	95.85	3.0
200	96.95	1.9
Pan	96.95	XXXXXXX

Calculations: Average Temperature used in calculating test, ºC = 24.1

"X" in temperature column indicates where actural temperature used, and this value not included in the average.

Specific Gravity, Gs = 2.70

N'= a Pc (R - Rw) / Ws = (Total % finer Factor) x (R - Rw)

D (mm) = K $\sqrt{L / t}$ ☐ Tested x Assumed

a = 0.99 from Table 1 (D 422) or ____

K from Table A1.3 (Draft Std.), K = 0.01280

Pc = Percent of soil passing No. 10 sieve = 96.8 %

Ws = Dry mass of soil placed in cylinder = 98.89 g

Total % finer Factor = (a*Pc/Ws) = 0.969

Cal. Notes: (2) Soil, Water & Dispersion Solution

(3) Water & Dispersion Solution

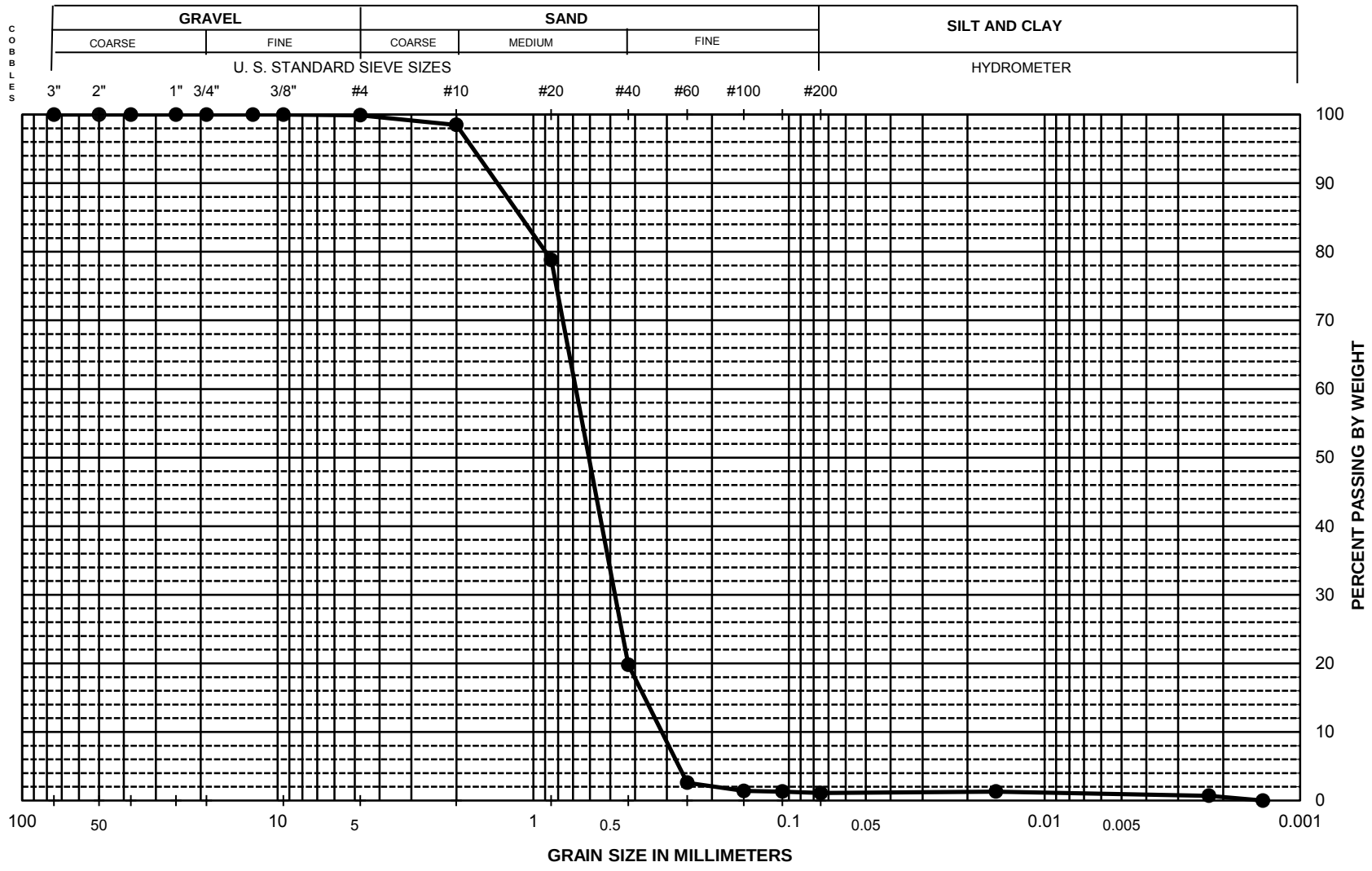
D(mm) = {(16.3 -(R-Rw)*0.164) / time}^0.5 *K

Remarks:

SET-UP BY: TJO RUN BY: YS CALCULATED BY: YS REVIEWED BY: TJO

SUBMITTED BY: Thomas J O'Mara

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	100.0
#4	4.75	99.9
#10	2.00	98.5
#20	0.850	78.8
#40	0.425	19.8
#60	0.250	2.6
#100	0.150	1.4
#140	0.106	1.3
#200	0.075	1.1
Hydrometer Analysis	0.0155	1.3
	0.0023	0.7
	0.0014	0.0

% Cobbles	--
% Gravel	0.1
% Sand	98.8
% Fines	1.1

D_{85}	1.1127
D_{60}	0.6815
D_{30}	0.4791
D_{15}	0.3665
D_{10}	0.3141
C_u	2.2
C_c	1.1

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
U2C2	---	---	●	NA	NA	NA	1	**Brown poorly graded Sand with seashells (SP)**

PROJECT NAME: **SONGS LOED permitting**

PROJECT NUMBER: **12206A**

PARTICLE-SIZE DISTRIBUTION CURVES

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

GRADATION OF SOILS by Sieving using Soil Sieve Sizes & with Water Content

ASTM D6913, D422 and D2216

Project Number: 12206A | Task Number: | Boring No.: U2C2

Project Name: SONGS LOED permitting | Sample No.: ---

Project Engineer: E Miller | Depth (ft): ---

Visual Description: Brown poorly graded Sand with seashells (SP)

SPECIMEN: Selected From:

Bulk Sample	x		Other - Jar
SPT Sample			Thin-Walled Tube
Calif. Sample			Engr. Test Specimen's WC
			Whole sample used
			See Bulk Sample Processing Form

Selection Method:

	Sieves (1) - whole sample used
x	Sieves (1) - partial sample used & selected by Method(s)
c	Method

(a): Splitter; (use for dry soils or that which will segregate)
(b): Quartering; (use for dry soils or that which will segregate)
(c) : Representative scoop after mixing, or slice of intact sample. (use for moist soils or that which will not segregate)

Preparation: Sample/Specimen:

As-Received	x
Air Dried	
Oven-Dried	

Test Method

Method A	
Method B	x

Oven-Dried Soil Broken Up Before:

Selecting partial sample: No x | Yes

By: Mortar & Pestle | Hand | Pulverizer | Other

Washing:

	No	Yes
Whole Specimen Washed on No. 200 sieve ?		x
Retained Fraction: 1st Split Washed ?		
Fine Fraction Washed on No. 200 sieve ?		

and Soil Soaked for: ~6 hrs.

MASS OF TEST SPECIMEN (g)	Total Test Specimen with Coarse Fraction	Partial or Whole Test Specimen	Soil Retained (after washing)	**Water Content** As Recieved or Container No.	
Min.sieve size in sieving sequence (3)	#N/A	# 200	+200	Wet, M1 (g)	
Container Number		x17	x17	Dry, M2 (g)	XXX
Mass of Container and Dry Soil, (g)		489.25	485.59	Cont.,M3 (g)	XXX
Mass of Container, (g)		139.29	139.32	**Water Content (%)**	**NA**
Dry Soil, Ws (g)		349.96	346.27		

SIEVING RESULTS % error: 0.03

See (1)	Sieve No.	Cum. Mass Retained (g)	Total Specimen % Finer N'
	3 "		
	2 "		
	1 1/2"		
	1 "		
	3/4 "		
	1/2 "		
	3/8 "		
	4		
	Pan		XXXXXXXX

Req. Mass of Test Spec. for 1% (kg)
3"= 70
1 1/2"=10
3/4"= 1.1
3/8"= 0.25
#4 = 0.1
#10 = 0.1

Shape of Grains

	Rounded
x	Angular
	Flat

Sieve No.	Sieve mm	Cum. Mass Retained (g)	Partial Test Specimen	Total Specimen % Finer N'
3 "	75			
2 "	50			
1-1/2"	37.5			
1 "	25			
3/4 "	19			
1/2 "	12.5			
3/8 "	9.5	0		100
#4	325	0.2	seashells	99.9
#10	180	5.19		98.5
#20	115	74.17		78.8
#40	75	280.52		19.8
#60	60	340.93		2.6
#100	40	345.01		1.4
#140*	30	345.53		1.3
#200	20	346.11		1.1
Pan		346.18	XXXXXXXX	XXXXXXXXXX

SUMMARY: Shape & Filter Parameters

% COBBLES	---	D60	0.682	D85	1.11
% GRAVEL	0.1	D30	0.479	D50	0.61
% SAND	98.8	D10	0.314	D15	0.37
% FINES	1.1	Cu =	2.2	Cc =	1.1

* Denotes sieve added to better define gradation curve

Cc = D30^2 / (D60 * D10)

Cu = D60 / D10

(1) X in box denotes sieve on which split was made.

(2) Proposed allowable amount of soil retained on 8" dia. sieve.

(3) Sieve size given, denotes min. sieve size used in the appropriate sieving sequence.

The above values D## denotes particle size (mm) at the corresponding percent passing.

Mica Noted: x No | Yes Amount Adjective:

Particle Hardness

x Hard | Soft | Weathered

SET-UP BY: TJO DATE 07/30/12 CALCULATED BY: TJO CHECKED BY: YS

SUBMITTED BY: Thomas J. O'Mara

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

PARTICLE-SIZE ANALYSIS : by Hydrometer

ASTM C117 or D422 or if Double Hydrometer Performed, D4221

Project Number: 12206A Task Number: Boring No.: U2C2

Project Name: SONGS LOED permitting Sample No.: ---

Project Engineer: E Miller Depth (ft): ---

Visual Description: Brown poorly graded Sand with seashells (SP)

State of Specimen before Processing	
	Moist State / Oven Dried
x	Air Dried
	See bulk sample proc. form (S-106)
Soil broken up by:	Other:
	Mortar & pestle
x	Passing soil through #10 sieve or
Dispersing Agent:(1)	
x	125ml Std. 4% or ____ solution
	Other
Date Soaking Initiated:	7/31/2012
Time Soaked: x	Overnight / Other
x	ASTM Dispersion Cup & Mixer used for 1 min
	Air dispersion device used for ____ min
	Other
Defoaming Agent Used:	X No; / Yes

Oven- or Air-Dried Set-Up	
Drying container No.	
Mass Container+Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil (g)	

Set-Up Water Content	x	Minus No. 10 / or
Container No.		m71
Mass Container + Wet Soil (g), M1		296.3
Mass Container + Dry Soil (g), M2		295.96
Mass Container (g), M3		109.29
Water Content, w (%)		**0.18**

Test Notes: (1) Dispersing Agent is Sodium Hexametaphosphate

Mass of Dry Soil Used in Test, Ws	
For Oven-dry set-up, Ws (g)	
For Moist or ____ set-up	
Wwet = Estimated Ws x (1 + w)	
Est = ____ x (1 + ____) =	
Act (Wwet) =	113.41 (g)
Ws = Wwet /(1 + w/100) =	113.20 (g)
After Test Actual Ws	
Container No.	
Mass Container + Dispersant + Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil + Dispersant (g)	
Mass Dispersant (g)	
Mass Dry Soil (g)	

Soaking Beaker No. 839 Graduate No. 12 152H Hydrometer No. 972 Meniscus Correction, Cm = calibrated (3)

Date 12 (yr) (m:d)	Time (hr:min)	Elapsed Time (min)	Temp (ºC)	Hyd. Reading Soil (2) R	Hyd. Reading Water (3) Rw	Diameter D (mm)	Total specimen % finer N'
8/1	9:39	0		XXXXXXXX		XXXXXXXX	XXXXXXX
		1	24.1	2.0	1.5	0.0516	0.4
		2	24.1	3.0	1.5	0.0363	1.3
		5	24.1	3.0	1.5	0.0230	1.3
		11	24.1	3.0	1.5	0.0155	1.3
		30	24.1	3.0	1.5	0.0094	1.3
		90	24.0	2.5	1.6	0.0054	0.8
		214	24.0	2.5	1.6	0.0035	0.8
		514	24.4	2.0	1.2	0.0023	0.7
		1369	23.7	2.0	2.0	0.0014	0.0

Sieving Performed on Hyd. Test Spec.	
Complete Sieve Analysis Performed: See Form S-104	Yes / No
x Wash analysis performed to check appropriateness of hyd. spec.	
Container No.	x8
Mass Container + Dry Soil (g)	251.31
Mass Container (g)	139.8
Total Specimen % Finer	1.5

Dry Sieving After Washing		
Sieve No.	Cumulative Mass Retained (g)	Total Specimen % Finer, N'
40	90.44	19.9
100	110.72	2.2
200	111.47	1.5
Pan	111.49	XXXXXXX

Calculations: Average Temperature used in calculating test, ºC = 24.1

"X" in temperature column indicates where actural temperature used, and this value not included in the average.

Specific Gravity, Gs = 2.70

N'= a Pc (R - Rw) / Ws = (Total % finer Factor) x (R - Rw)

D (mm) = K $\sqrt{L / t}$ Tested / x Assumed

a = 0.99 from Table 1 (D 422) or ____

K from Table A1.3 (Draft Std.), K = 0.01281

Pc = Percent of soil passing No. 10 sieve = 99.1 %

Cal. Notes: (2) Soil, Water & Dispersion Solution

Ws = Dry mass of soil placed in cylinder = 113.20 g

(3) Water & Dispersion Solution

Total % finer Factor = (a*Pc/Ws) = 0.867

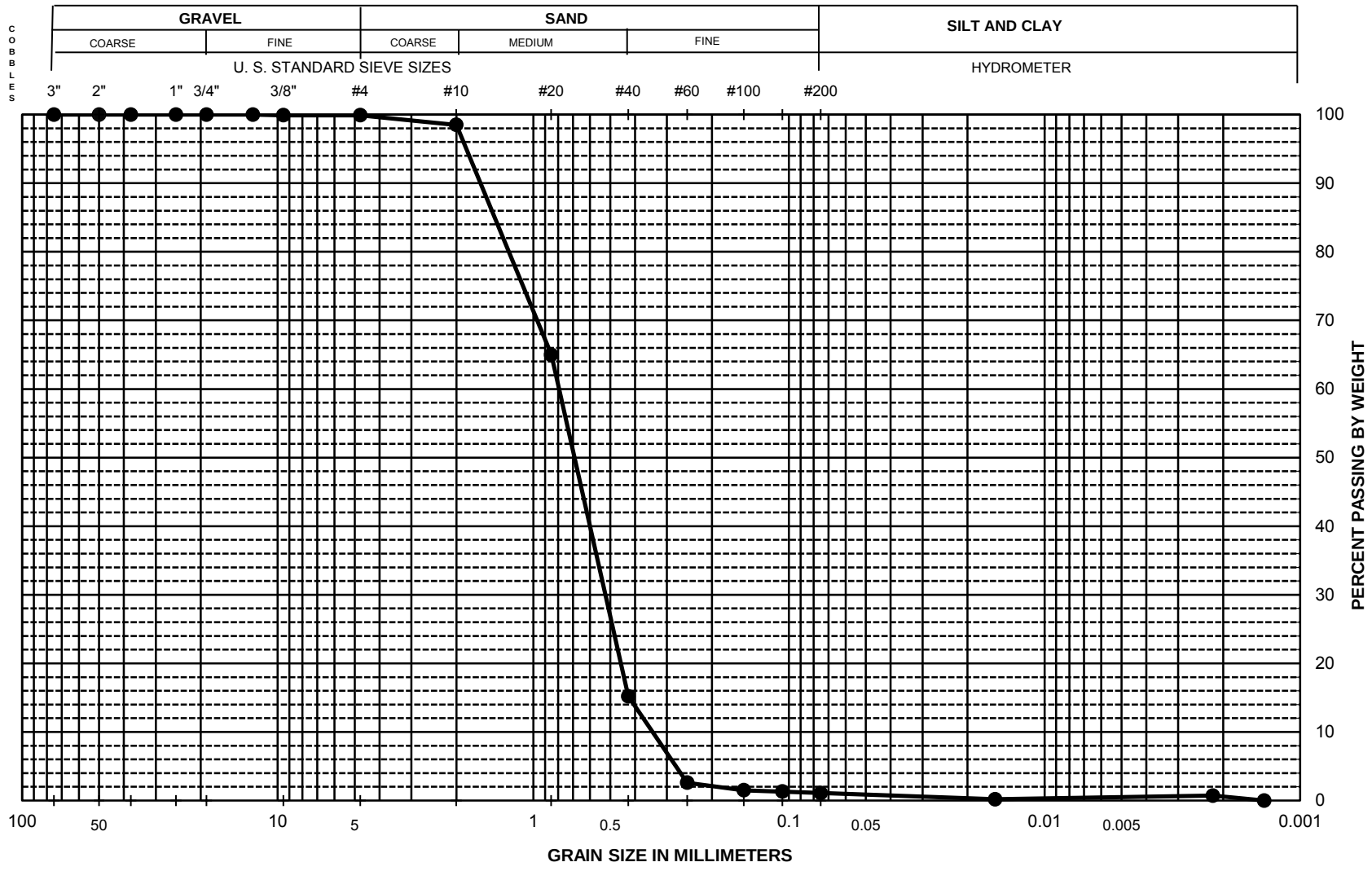
D(mm) = {(16.3 -(R-Rw)*0.164) / time}^0.5 *K

Remarks:

SET-UP BY: TJO RUN BY: YS CALCULATED BY: YS REVIEWED BY: TJO

SUBMITTED BY: Thomas J O'Mara

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	99.9
#4	4.75	99.9
#10	2.00	98.5
#20	0.850	65.0
#40	0.425	15.2
#60	0.250	2.6
#100	0.150	1.5
#140	0.106	1.3
#200	0.075	1.1
Hydrometer Analysis	0.0156	0.2
	0.0022	0.7
	0.0014	0.0

% Cobbles	--
% Gravel	0.1
% Sand	98.8
% Fines	1.1

D_{85}	1.4167
D_{60}	0.7929
D_{30}	0.5222
D_{15}	0.1797
D_{10}	0.1482
C_u	5.3
C_c	2.3

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
U2C3	---	---	●	NA	NA	NA	1	**Brown poorly graded Sand with seashells (SP)**

PROJECT NAME: **SONGS LOED permitting**

PROJECT NUMBER: **12206A**

PARTICLE-SIZE DISTRIBUTION CURVES

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

GRADATION OF SOILS by Sieving using Soil Sieve Sizes & with Water Content

ASTM D6913, D422 and D2216

Project Number: 12206A | Task Number: | Boring No.: U2C3

Project Name: SONGS LOED permitting | Sample No.: ---

Project Engineer: E Miller | Depth (ft): ---

Visual Description: Brown poorly graded Sand with seashells (SP)

SPECIMEN: Selected From:

Bulk Sample	x		Other - Jar
SPT Sample			Thin-Walled Tube
Calif. Sample			Engr. Test Specimen's WC
			Whole sample used
			See Bulk Sample Processing Form

Selection Method:

		Sieves (1) - whole sample used
x		Sieves (1) - partial sample used & selected by Method(s)
c		Method

(a): Splitter; (use for dry soils or that which will segregate)

(b): Quartering; (use for dry soils or that which will segregate)

(c) : Representative scoop after mixing, or slice of intact sample. (use for moist soils or that which will not segregate)

Preparation: Sample/Specimen:

As-Received	x
Air Dried	
Oven-Dried	

Test Method

Method A	
Method B	x

Oven-Dried Soil Broken Up Before:

Selecting partial sample: No x | Yes

By: Mortar & Pestle | Hand | Pulverizer | Other

Washing:

	No	Yes
Whole Specimen Washed on No. 200 sieve ?		x
Retained Fraction: 1st Split Washed ?		
Fine Fraction Washed on No. 200 sieve ?		

and Soil Soaked for: ~6 hrs.

MASS OF TEST SPECIMEN (g)	Total Test Specimen with Coarse Fraction	Partial or Whole Test Specimen	Soil Retained (after washing)	**Water Content** As Recieved or Container No.	
Min.sieve size in sieving sequence (3)	#N/A	# 200	+200	Wet, M1 (g)	
Container Number		x28	x28	Dry, M2 (g)	XXX
Mass of Container and Dry Soil, (g)		517.77	514.22	Cont.,M3 (g)	XXX
Mass of Container, (g)		153.4	153.4	**Water Content (%)**	**NA**
Dry Soil, Ws (g)		364.37	360.82		

SIEVING RESULTS % error: 0.06

See (1)	Sieve No.	Cum. Mass Retained (g)	Total Specimen % Finer N'
	3 "		
	2 "		
	1 1/2"		
	1 "		
	3/4 "		
	1/2 "		
	3/8 "		
	4		
	Pan		XXXXXXXX

Req. Mass of Test Spec. for 1% (kg)
3"= 70
1 1/2"=10
3/4"= 1.1
3/8"= 0.25
#4 = 0.1
#10 = 0.1

Shape of Grains

	Rounded
x	Angular
	Flat

Sieve No.	mm	Cum. Mass Retained (g)	Partial Test Specimen	Total Specimen % Finer N'
3 "	75			
2 "	50			
1-1/2"	37.5			
1 "	25			
3/4 "	19			
1/2 "	12.5	0		100
3/8 "	9.5	0.44	seashells	99.9
#4	325	0.46	seashells	99.9
#10	180	5.47		98.5
#20	115	127.63		65
#40	75	309.14		15.2
#60	60	354.85		2.6
#100	40	358.89		1.5
#140*	30	359.64		1.3
#200	20	360.52		1.1
Pan		360.59	XXXXXXXX	XXXXXXXXXX

SUMMARY: Shape & Filter Parameters

% COBBLES	---	D60	0.793	D85	1.42
% GRAVEL	0.1	D30	0.522	D50	0.69
% SAND	98.8	D10	0.148	D15	0.18
% FINES	1.1	Cu =	5.3	Cc =	2.3

* Denotes sieve added to better define gradation curve

Cc = D30^2 / (D60 * D10)

Cu = D60 / D10

(1) X in box denotes sieve on which split was made.

(2) Proposed allowable amount of soil retained on 8" dia. sieve.

Mica Noted: x No | Yes Amount Adjective:

(3) Sieve size given, denotes min. sieve size used in the appropriate sieving sequence.

The above values D## denotes particle size (mm) at the corresponding percent passing.

Particle Hardness

x Hard | Soft | Weathered

SET-UP BY: TJO DATE 07/30/12 CALCULATED BY: TJO CHECKED BY: YS

SUBMITTED BY: Thomas J. O'Mara

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

PARTICLE-SIZE ANALYSIS : by Hydrometer

ASTM C117 or D422 or if Double Hydrometer Performed, D4221

Project Number: 12206A Task Number: Boring No.: U2C3

Project Name: SONGS LOED permitting Sample No.: ---

Project Engineer: E Miller Depth (ft): ---

Visual Description: Brown poorly graded Sand with seashells (SP)

State of Specimen before Processing	
	Moist State ☐ Oven Dried
x	Air Dried
	See bulk sample proc. form (S-106)
Soil broken up by:	Other:
	Mortar & pestle
x	Passing soil through #10 sieve or
Dispersing Agent:(1)	
x	125ml Std. 4% or ____ solution
	Other
Date Soaking Initiated:	7/31/2012
Time Soaked:	x Overnight; Other
x	ASTM Dispersion Cup & Mixer used for 1 min
	Air dispersion device used for ____ min
	Other
Defoaming Agent Used:	X No; ☐ Yes

Oven- or Air-Dried Set-Up	
Drying container No.	
Mass Container+Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil (g)	

Set-Up Water Content	x Minus No. 10 ☐ or
Container No.	f-110
Mass Container + Wet Soil (g), M1	319.56
Mass Container + Dry Soil (g), M2	319.16
Mass Container (g), M3	109.55
Water Content, w (%)	**0.19**

Test Notes: (1) Dispersing Agent is Sodium Hexametaphosphate

Mass of Dry Soil Used in Test, Ws	
For Oven-dry set-up, Ws (g)	
For Moist or ____ set-up	
Wwet = Estimated Ws x (1 + w)	
Est = ____ x (1 + ____) =	
Act (Wwet) =	110.20 (g)
Ws = Wwet /(1 + w/100) =	109.99 (g)
After Test Actual Ws	
Container No.	
Mass Container + Dispersant + Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil + Dispersant (g)	
Mass Dispersant (g)	
Mass Dry Soil (g)	

Soaking Beaker No. 839 Graduate No. 12 152H Hydrometer No. 972 Meniscus Correction, Cm = calibrated (3)

Date 12 (yr) (m:d)	Time (hr:min)	Elapsed Time (min)	Temp (ºC)	Hyd. Reading Soil (2) R	Hyd. Reading Water (3) Rw	Diameter D (mm)	Total specimen % finer N'
8/1	9:00	0		XXXXXXXX		XXXXXXXX	XXXXXXX
		1	23.8	1.0	--	--	--
		2	23.8	1.0	--	--	--
		5	24.0	2.0	1.6	0.0231	0.4
		11	23.9	2.0	1.8	0.0156	0.2
		30	23.8	2.5	1.9	0.0094	0.5
		90	23.7	2.5	2.0	0.0054	0.4
		253	24.0	2.5	1.6	0.0032	0.8
		553	24.4	2.0	1.2	0.0022	0.7
		1406	23.7	2.0	2.0	0.0014	0.0

Sieving Performed on Hyd. Test Spec.	
Complete Sieve Analysis Performed: See Form S-104	☐ Yes ☐ No
x	Wash analysis performed to check appropriateness of hyd. spec.
Container No.	sf8
Mass Container + Dry Soil (g)	259.76
Mass Container (g)	151.28
Total Specimen % Finer	1.4

Dry Sieving After Washing

Sieve No.	Cumulative Mass Retained (g)	Total Specimen % Finer, N'
40	92.23	15.9
100	107.82	1.9
200	108.5	1.3
Pan	108.52	XXXXXXX

Calculations: Average Temperature used in calculating test, ºC = 23.9

"X" in temperature column indicates where actural temperature used, and this value not included in the average.

Specific Gravity, Gs = 2.70

N'= a Pc (R - Rw) / Ws = (Total % finer Factor) x (R - Rw)

D (mm) = K $\sqrt{L / t}$ ☐ Tested x Assumed

a = 0.99 from Table 1 (D 422) or ____

K from Table A1.3 (Draft Std.), K = 0.01284

Pc = Percent of soil passing No. 10 sieve = 98.7 %

Ws = Dry mass of soil placed in cylinder = 109.99 g

Total % finer Factor = (a*Pc/Ws) = 0.888

Cal. Notes: (2) Soil, Water & Dispersion Solution

(3) Water & Dispersion Solution

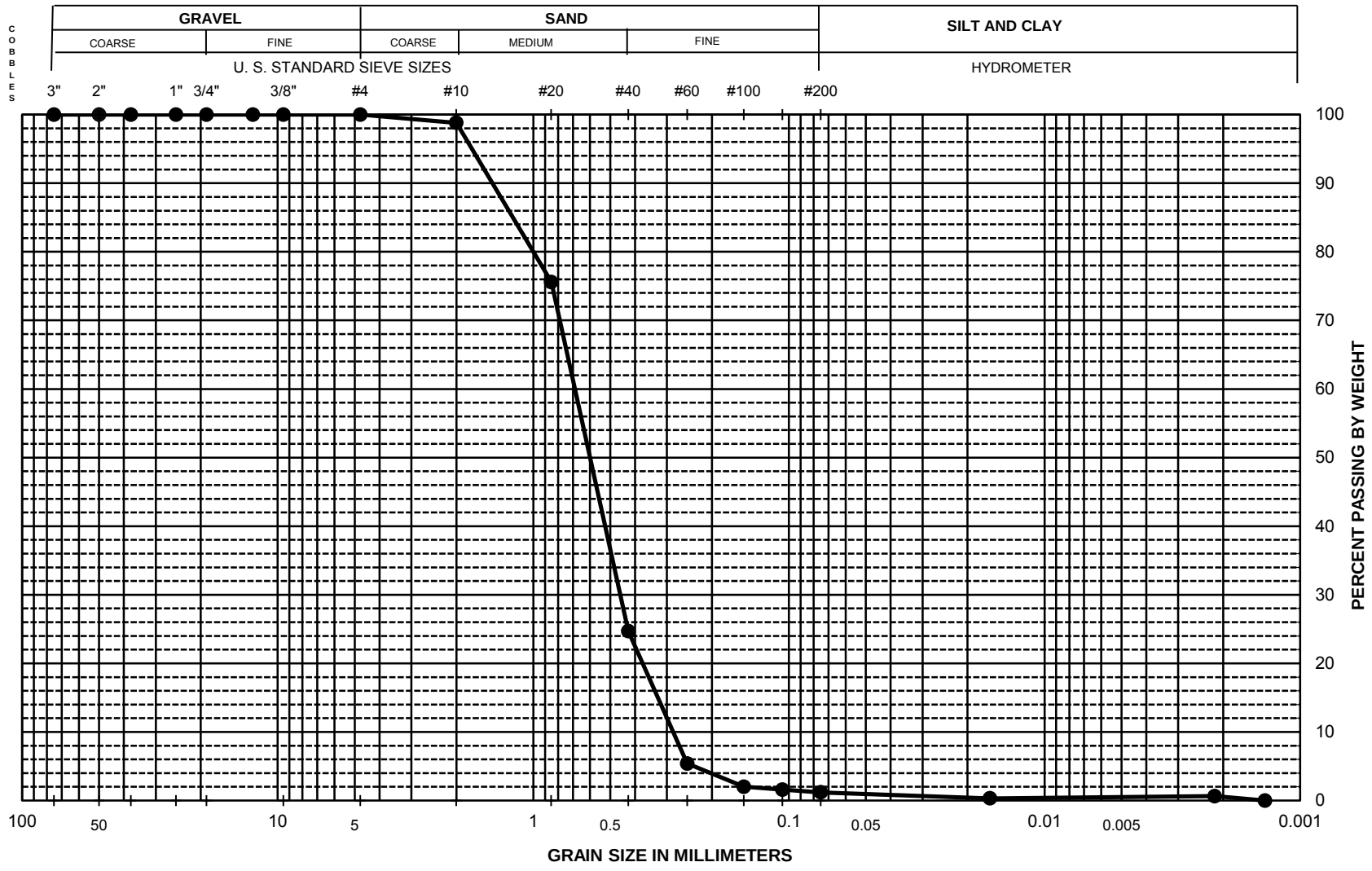
D(mm) = {(16.3 -(R-Rw)*0.164) / time}^0.5 *K

Remarks:

SET-UP BY: TJO RUN BY: YS CALCULATED BY: YS REVIEWED BY: TJO

SUBMITTED BY: Thomas J. O'Mara

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	100.0
#4	4.75	100.0
#10	2.00	98.8
#20	0.850	75.6
#40	0.425	24.7
#60	0.250	5.4
#100	0.150	2.0
#140	0.106	1.6
#200	0.075	1.2
Hydrometer Analysis	0.0163	0.3
	0.0022	0.6
	0.0014	0.0

% Cobbles	--
% Gravel	0.0
% Sand	98.8
% Fines	1.2

D_{85}	1.2022
D_{60}	0.6873
D_{30}	0.4568
D_{15}	0.1779
D_{10}	0.1466
C_u	4.7
C_c	2.1

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
U2C4	---	---	●	NA	NA	NA	1	**Brown poorly graded Sand (SP)**

PROJECT NAME: **SONGS LOED permitting**

PROJECT NUMBER: **12206A**

PARTICLE-SIZE DISTRIBUTION CURVES

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

GRADATION OF SOILS by Sieving using Soil Sieve Sizes & with Water Content

ASTM D6913, D422 and D2216

Project Number: 12206A | Task Number: | Boring No.: U2C4

Project Name: SONGS LOED permitting | Sample No.: ---

Project Engineer: E Miller | Depth (ft): ---

Visual Description: Brown poorly graded Sand (SP)

SPECIMEN: Selected From:

Bulk Sample	x		Other - Jar
SPT Sample			Thin-Walled Tube
Calif. Sample			Engr. Test Specimen's WC
			Whole sample used
			See Bulk Sample Processing Form

Selection Method:

		Sieves (1) - whole sample used
	x	Sieves (1) - partial sample used & selected by Method(s)
	c	Method

(a): Splitter; (use for dry soils or that which will segregate)

(b): Quartering; (use for dry soils or that which will segregate)

(c) : Representative scoop after mixing, or slice of intact sample. (use for moist soils or that which will not segregate)

Preparation: Sample/Specimen:

As-Received	x
Air Dried	
Oven-Dried	

Test Method

Method A	
Method B	x

Oven-Dried Soil Broken Up Before:

Selecting partial sample: No x | Yes

Washing:

	No	Yes
Whole Specimen Washed on No. 200 sieve ?		x
Retained Fraction: 1st Split Washed ?		
Fine Fraction Washed on No. 200 sieve ?		

By: Mortar & Pestle | Hand | Pulverizer | Other

and Soil Soaked for: ~6 hrs.

MASS OF TEST SPECIMEN (g)	Total Test Specimen with Coarse Fraction	Partial or Whole Test Specimen	Soil Retained (after washing)	**Water Content** As Recieved or Container No.
Min.sieve size in sieving sequence (3)	#N/A	# 200	+200	Wet, M1 (g)
Container Number		sf8	sf8	Dry, M2 (g) XXX
Mass of Container and Dry Soil, (g)		482.58	478.73	Cont.,M3 (g) XXX
Mass of Container, (g)		151.29	151.29	**Water Content (%)** **NA**
Dry Soil, Ws (g)		331.29	327.44	

SIEVING RESULTS % error: 0.06

See (1)	Sieve No.	Cum. Mass Retained (g)	Total Specimen % Finer N'
	3 "		
	2 "		
	1 1/2"		
	1 "		
	3/4 "		
	1/2 "		
	3/8 "		
	4		
	Pan		XXXXXXXX

Req. Mass of Test Spec. for 1% (kg)
3"= 70
1 1/2"=10
3/4"= 1.1
3/8"= 0.25
#4 = 0.1
#10 = 0.1

Shape of Grains

	Rounded
x	Angular
	Flat

Sieve No.	Sieve mm	Cum. Mass Retained (g)	Partial Test Specimen	Total Specimen % Finer N'
3 "	75			
2 "	50			
1-1/2"	37.5			
1 "	25			
3/4 "	19			
1/2 "	12.5			
3/8 "	9.5			
#4	325	0		100
#10	180	4.05		98.8
#20	115	80.68		75.6
#40	75	249.41		24.7
#60	60	313.4		5.4
#100	40	324.62		2
#140*	30	326.13		1.6
#200	20	327.19		1.2
Pan		327.23	XXXXXXXX	XXXXXXXXXX

SUMMARY: Shape & Filter Parameters

% COBBLES	---	D60	0.687	D85	1.20
% GRAVEL	0	D30	0.457	D50	0.60
% SAND	98.8	D10	0.147	D15	0.18
% FINES	1.2	Cu =	4.7	Cc =	2.1

* Denotes sieve added to better define gradation curve

Cc = D30^2 / (D60 * D10)

Cu = D60 / D10

(1) X in box denotes sieve on which split was made.

(2) Proposed allowable amount of soil retained on 8" dia. sieve.

(3) Sieve size given, denotes min. sieve size used in the appropriate sieving sequence.

The above values D## denotes particle size (mm) at the corresponding percent passing.

Mica Noted: x No | Yes Amount Adjective:

Particle Hardness

x Hard | Soft | Weathered

SET-UP BY: TJO DATE 07/30/12 CALCULATED BY: TJO CHECKED BY: YS

SUBMITTED BY: Thomas J. O'Mara

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

PARTICLE-SIZE ANALYSIS : by Hydrometer

ASTM C117 or D422 or if Double Hydrometer Performed, D4221

Project Number: 12206A Task Number: Boring No.: U2C4

Project Name: SONGS LOED permitting Sample No.: ---

Project Engineer: E Miller Depth (ft): ---

Visual Description: Brown poorly graded Sand (SP)

State of Specimen before Processing	
	Moist State / Oven Dried
x	Air Dried
	See bulk sample proc. form (S-106)
Soil broken up by:	Other:
	Mortar & pestle
x	Passing soil through #10 sieve or
Dispersing Agent:(1)	
x	125ml Std. 4% or ____ solution
	Other
Date Soaking Initiated:	7/31/2012
Time Soaked: x	Overnight / Other
x	ASTM Dispersion Cup & Mixer used for 1 min
	Air dispersion device used for ____ min
	Other
Defoaming Agent Used:	X No; / Yes

Oven- or Air-Dried Set-Up	
Drying container No.	
Mass Container+Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil (g)	

Set-Up Water Content	x	Minus No. 10 / or
Container No.		n51
Mass Container + Wet Soil (g), M1		323.96
Mass Container + Dry Soil (g), M2		323.66
Mass Container (g), M3		104.87
Water Content, w (%)		**0.14**

Test Notes: (1) Dispersing Agent is Sodium Hexametaphosphate

Mass of Dry Soil Used in Test, Ws	
For Oven-dry set-up, Ws (g)	
For Moist or ____ set-up	
Wwet = Estimated Ws x (1 + w)	
Est = ____ x (1 + ____) =	
Act (Wwet) =	109.12 (g)
Ws = Wwet /(1 + w/100) =	108.97 (g)
After Test Actual Ws	
Container No.	
Mass Container + Dispersant + Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil + Dispersant (g)	
Mass Dispersant (g)	
Mass Dry Soil (g)	

Soaking Beaker No. 833 Graduate No. 13 152H Hydrometer No. 972 Meniscus Correction, Cm = calibrated (3)

Date 12 (yr) (m:d)	Time (hr:min)	Elapsed Time (min)	Temp (ºC)	Hyd. Reading Soil (2) R	Hyd. Reading Water (3) Rw	Diameter D (mm)	Total specimen % finer N'
8/1	8:39	0		XXXXXXXX		XXXXXXXX	XXXXXXX
		1	24.0	1.0	--	--	--
		2	24.0	1.0	--	--	--
		5	24.0	2.0	1.6	0.0231	0.3
		10	24.0	2.0	1.6	0.0163	0.3
		31	23.9	3.0	1.7	0.0092	1.0
		90	23.8	2.5	1.8	0.0054	0.6
		271	24.1	3.0	1.5	0.0031	1.2
		571	24.4	2.0	1.2	0.0022	0.6
		1424	23.7	2.0	2.0	0.0014	0.0

Sieving Performed on Hyd. Test Spec.		
Complete Sieve Analysis Performed: See Form S-104		Yes / No
x	Wash analysis performed to check appropriateness of hyd. spec.	
Container No.		x1
Mass Container + Dry Soil (g)		254.55
Mass Container (g)		147.39
Total Specimen % Finer		1.4

Dry Sieving After Washing

Sieve No.	Cumulative Mass Retained (g)	Total Specimen % Finer, N'
40	77.1	25.5
100	105.83	2.5
200	107.14	1.5
Pan	107.14	XXXXXXX

Calculations: Average Temperature used in calculating test, ºC = 24.0

"X" in temperature column indicates where actural temperature used, and this value not included in the average.

Specific Gravity, Gs = 2.70

N'= a Pc (R - Rw) / Ws = (Total % finer Factor) x (R - Rw)

D (mm) = K $\sqrt{L / t}$ Tested / x Assumed

a = 0.99 from Table 1 (D 422) or ____

K from Table A1.3 (Draft Std.), K = 0.01282

Pc = Percent of soil passing No. 10 sieve = 87.1 %

Cal. Notes: (2) Soil, Water & Dispersion Solution

Ws = Dry mass of soil placed in cylinder = 108.97 g

(3) Water & Dispersion Solution

Total % finer Factor = (a*Pc/Ws) = 0.791

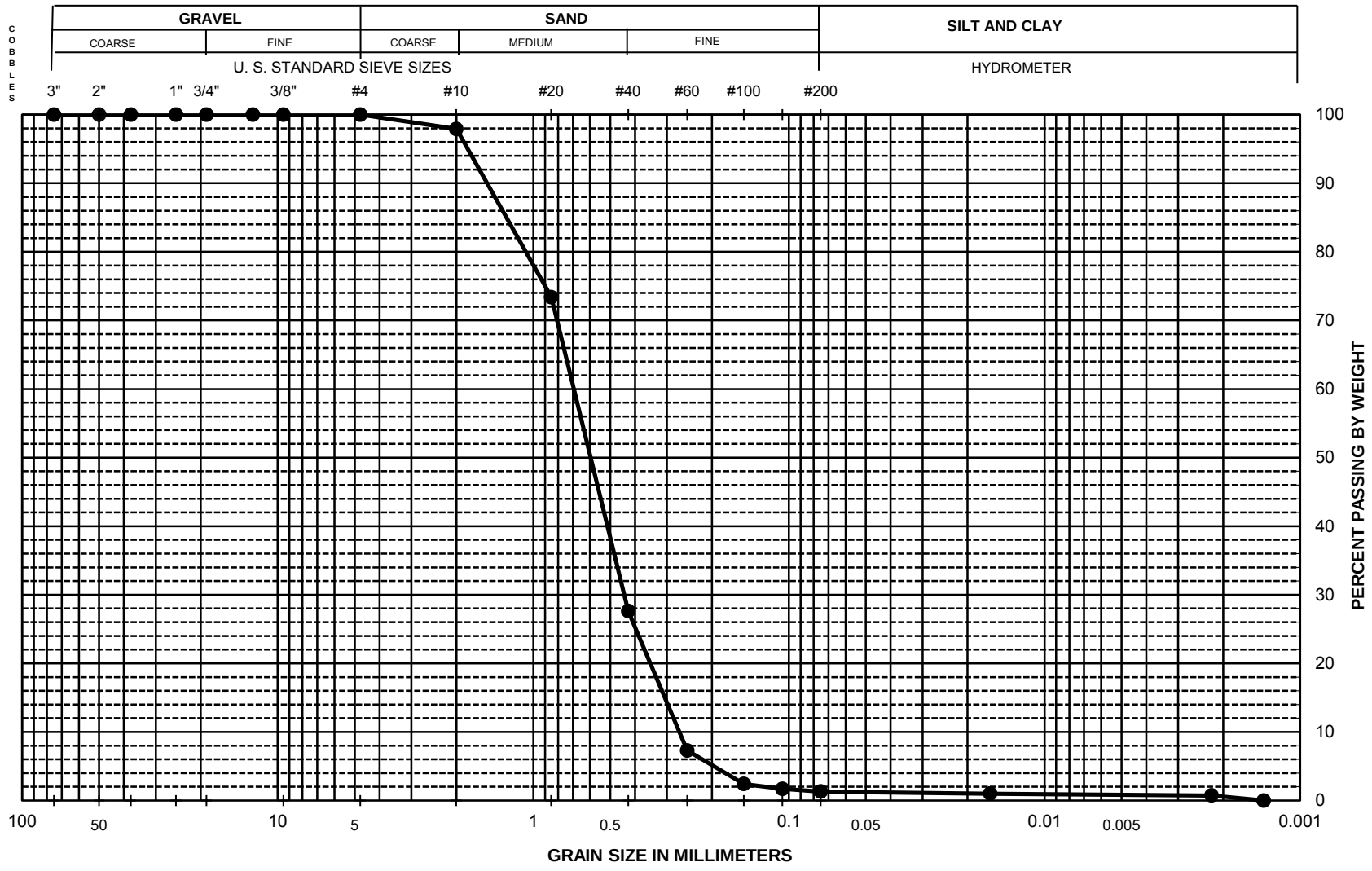
D(mm) = {(16.3 -(R-Rw)*0.164) / time}^0.5 *K

Remarks:

SET-UP BY: TJO RUN BY: YS CALCULATED BY: YS REVIEWED BY: TJO

SUBMITTED BY: Thomas J O'Mara

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	100.0
#4	4.75	100.0
#10	2.00	97.9
#20	0.850	73.4
#40	0.425	27.6
#60	0.250	7.3
#100	0.150	2.4
#140	0.106	1.7
#200	0.075	1.3
Hydrometer Analysis	0.0163	1.0
	0.0022	0.7
	0.0014	0.0

% Cobbles	--
% Gravel	0.0
% Sand	98.7
% Fines	1.3

D_{85}	1.2746
D_{60}	0.6940
D_{30}	0.4407
D_{15}	0.1773
D_{10}	0.1461
C_u	4.7
C_c	1.9

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
U2C5	---	---	●	NA	NA	NA	1	**Grayish brown poorly graded Sand with seashells (SP)**

PROJECT NAME: **SONGS LOED permitting**

PROJECT NUMBER: **12206A**

PARTICLE-SIZE DISTRIBUTION CURVES

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

GRADATION OF SOILS by Sieving using Soil Sieve Sizes & with Water Content

ASTM D6913, D422 and D2216

Project Number: 12206A | Task Number: | Boring No.: U2C5

Project Name: SONGS LOED permitting | Sample No.: ---

Project Engineer: E Miller | Depth (ft): ---

Visual Description: Grayish brown poorly graded Sand with seashells (SP)

SPECIMEN: Selected From:

Bulk Sample	x		Other - Jar
SPT Sample			Thin-Walled Tube
Calif. Sample			Engr. Test Specimen's WC
			Whole sample used
			See Bulk Sample Processing Form

Selection Method:

	Sieves (1) - whole sample used
x	Sieves (1) - partial sample used & selected by Method(s)
c	Method

(a): Splitter; (use for dry soils or that which will segregate)

(b): Quartering; (use for dry soils or that which will segregate)

(c) : Representative scoop after mixing, or slice of intact sample. (use for moist soils or that which will not segregate)

Preparation: Sample/Specimen:

As-Received	x
Air Dried	
Oven-Dried	

Test Method

Method A	
Method B	x

Oven-Dried Soil Broken Up Before:

Selecting partial sample: No x | Yes

Washing:

	No	Yes
Whole Specimen Washed on No. 200 sieve ?		x
Retained Fraction: 1st Split Washed ?		
Fine Fraction Washed on No. 200 sieve ?		

By: Mortar & Pestle | Hand | Pulverizer | Other

and Soil Soaked for: ~6 hrs.

MASS OF TEST SPECIMEN (g)	Total Test Specimen with Coarse Fraction	Partial or Whole Test Specimen	Soil Retained (after washing)	**Water Content** As Recieved or Container No.	
Min.sieve size in sieving sequence (3)	#N/A	# 200	+200	Wet, M1 (g)	
Container Number		x8	x8	Dry, M2 (g)	XXX
Mass of Container and Dry Soil, (g)		534.94	530.27	Cont.,M3 (g)	XXX
Mass of Container, (g)		139.8	139.82	**Water Content (%)**	**NA**
Dry Soil, Ws (g)		395.14	390.45		

SIEVING RESULTS % error: 0.05

See (1)	Sieve No.	Cum. Mass Retained (g)	Total Specimen % Finer N'
	3 "		
	2 "		
	1 1/2"		
	1 "		
	3/4 "		
	1/2 "		
	3/8 "		
	4		
	Pan		XXXXXXXX

Req. Mass of Test Spec. for 1% (kg)
3"= 70
1 1/2"=10
3/4"= 1.1
3/8"= 0.25
#4 = 0.1
#10 = 0.1

Shape of Grains

	Rounded
x	Angular
	Flat

Sieve No.	Sieve mm	Cum. Mass Retained (g)	Partial Test Specimen	Total Specimen % Finer N'
3 "	75			
2 "	50			
1-1/2"	37.5			
1 "	25			
3/4 "	19			
1/2 "	12.5			
3/8 "	9.5	0		100
#4	325	0.02	seashells	100
#10	180	8.41	seashells	97.9
#20	115	105.02		73.4
#40	75	285.92		27.6
#60	60	366.21		7.3
#100	40	385.67		2.4
#140*	30	388.56		1.7
#200	20	390.17		1.3
Pan		390.26	XXXXXXXX	XXXXXXXXXX

SUMMARY: Shape & Filter Parameters

% COBBLES	---	D60	0.694	D85	1.27
% GRAVEL	0	D30	0.441	D50	0.60
% SAND	98.7	D10	0.146	D15	0.18
% FINES	1.3	Cu =	4.7	Cc =	1.9

* Denotes sieve added to better define gradation curve

Cc = D30^2 / (D60 * D10)

Cu = D60 / D10

(1) X in box denotes sieve on which split was made.

(2) Proposed allowable amount of soil retained on 8" dia. sieve.

(3) Sieve size given, denotes min. sieve size used in the appropriate sieving sequence.

The above values D## denotes particle size (mm) at the corresponding percent passing.

Mica Noted: x No | Yes Amount Adjective:

Particle Hardness

x Hard | Soft | Weathered

SET-UP BY: TJO DATE 07/30/12 CALCULATED BY: TJO CHECKED BY: YS

SUBMITTED BY: Thomas J. O'Mara

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

PARTICLE-SIZE ANALYSIS : by Hydrometer

ASTM C117 or D422 or if Double Hydrometer Performed, D4221

Project Number: 12206A Task Number: Boring No.: U2C5

Project Name: SONGS LOED permitting Sample No.: ---

Project Engineer: E Miller Depth (ft): ---

Visual Description: Grayish brown poorly graded Sand with seashells (SP)

State of Specimen before Processing	
	Moist State ☐ Oven Dried
x	Air Dried
	See bulk sample proc. form (S-106)
Soil broken up by:	Other:
	Mortar & pestle
x	Passing soil through #10 sieve or
Dispersing Agent:(1)	
x	125ml Std. 4% or ____ solution
	Other
Date Soaking Initiated:	7/31/2012
Time Soaked:	x Overnight; Other
x	ASTM Dispersion Cup & Mixer used for 1 min
	Air dispersion device used for ____ min
	Other
Defoaming Agent Used:	X No; ☐ Yes

Oven- or Air-Dried Set-Up	
Drying container No.	
Mass Container+Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil (g)	

Set-Up Water Content	x Minus No. 10 ☐ or
Container No.	m89
Mass Container + Wet Soil (g), M1	296.73
Mass Container + Dry Soil (g), M2	296.43
Mass Container (g), M3	109.5
Water Content, w (%)	**0.16**

Test Notes: (1) Dispersing Agent is Sodium Hexametaphosphate

Mass of Dry Soil Used in Test, Ws	
For Oven-dry set-up, Ws (g)	
For Moist or ____ set-up	
Wwet = Estimated Ws x (1 + w)	
Est = ____ x (1 + ____) =	
Act (Wwet) =	107.77 (g)
Ws = Wwet /(1 + w/100) =	107.60 (g)
After Test Actual Ws	
Container No.	
Mass Container + Dispersant + Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil + Dispersant (g)	
Mass Dispersant (g)	
Mass Dry Soil (g)	

Soaking Beaker No. 835 Graduate No. 6 152H Hydrometer No. 972 Meniscus Correction, Cm = calibrated (3)

Date 12 (yr) (m:d)	Time (hr:min)	Elapsed Time (min)	Temp (ºC)	Hyd. Reading Soil (2) R	Hyd. Reading Water (3) Rw	Diameter D (mm)	Total specimen % finer N'
8/1	9:13	0		XXXXXXXX		XXXXXXXX	XXXXXXX
		1	24.0	1.0	--	--	--
		2	24.0	1.0	--	--	--
		5	23.8	2.0	1.9	0.0232	0.1
		10	23.8	3.0	1.9	0.0163	1.0
		31	23.8	3.0	1.9	0.0093	1.0
		90	23.8	2.5	1.9	0.0054	0.6
		241	24.0	2.5	1.6	0.0033	0.8
		541	24.4	2.0	1.2	0.0022	0.7
		1394	23.7	2.0	2.0	0.0014	0.0

Sieving Performed on Hyd. Test Spec.	
Complete Sieve Analysis Performed: See Form S-104	☐ Yes ☐ No
x	Wash analysis performed to check appropriateness of hyd. spec.
Container No.	x18
Mass Container + Dry Soil (g)	233.52
Mass Container (g)	127.86
Total Specimen % Finer	1.8

Dry Sieving After Washing

Sieve No.	Cumulative Mass Retained (g)	Total Specimen % Finer, N'
40	75.58	29.7
100	104.14	3.2
200	105.64	1.8
Pan	105.66	XXXXXXX

Calculations: Average Temperature used in calculating test, ºC = 23.9

"X" in temperature column indicates where actural temperature used, and this value not included in the average.

Specific Gravity, Gs = 2.70

N'= a Pc (R - Rw) / Ws = (Total % finer Factor) x (R - Rw)

D (mm) = K $\sqrt{L / t}$ ☐ Tested x Assumed

a = 0.99 from Table 1 (D 422) or ____

K from Table A1.3 (Draft Std.), K = 0.01283

Pc = Percent of soil passing No. 10 sieve = 99.8 %

Ws = Dry mass of soil placed in cylinder = 107.60 g

Total % finer Factor = (a*Pc/Ws) = 0.918

Cal. Notes: (2) Soil, Water & Dispersion Solution

(3) Water & Dispersion Solution

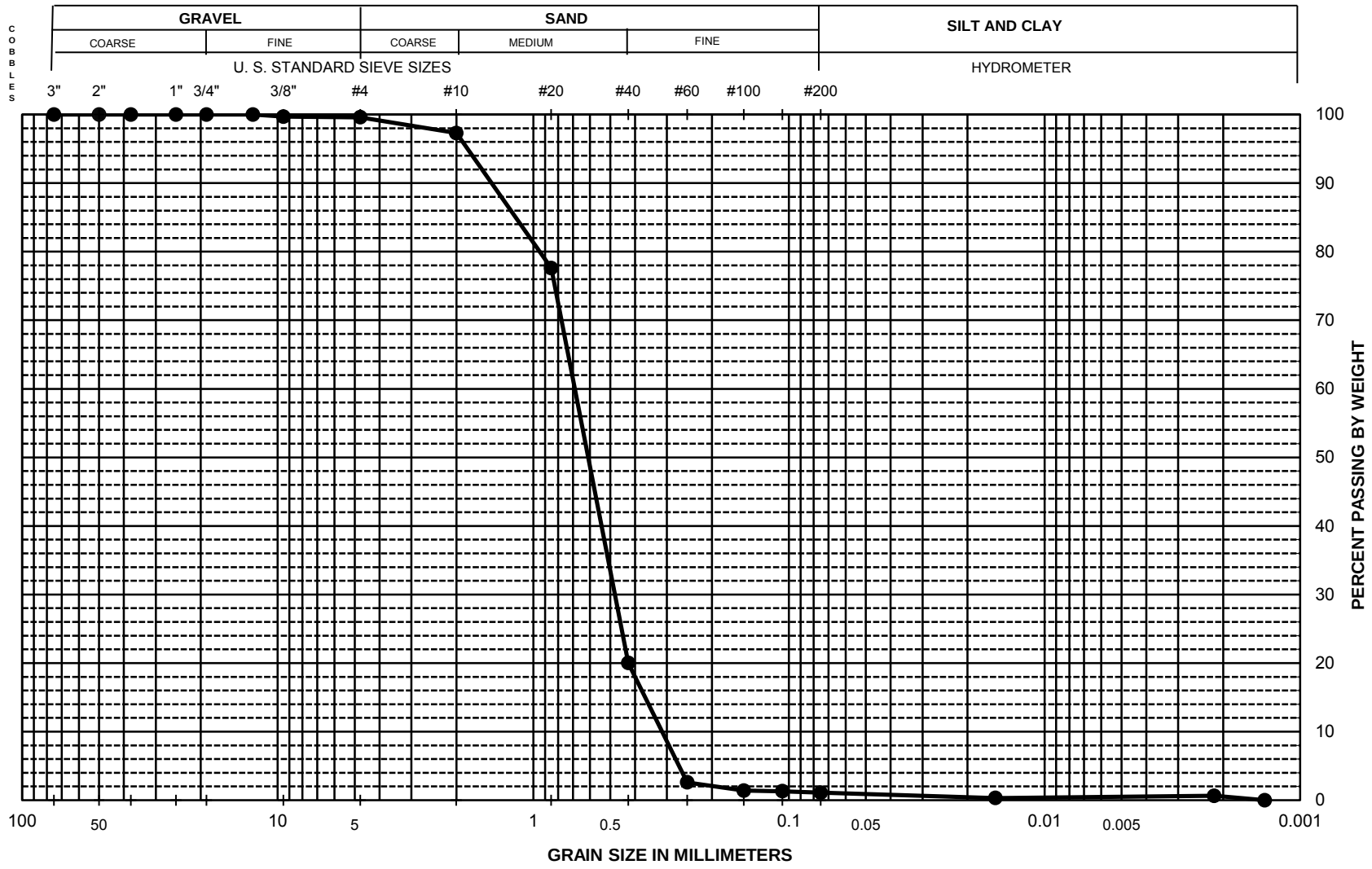
D(mm) = {(16.3 -(R-Rw)*0.164) / time}^0.5 *K

Remarks:

SET-UP BY: TJO RUN BY: YS CALCULATED BY: YS REVIEWED BY: TJO

SUBMITTED BY: Thomas J O'Mara

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	99.7
#4	4.75	99.6
#10	2.00	97.3
#20	0.850	77.6
#40	0.425	20.0
#60	0.250	2.6
#100	0.150	1.4
#140	0.106	1.3
#200	0.075	1.1
Hydrometer Analysis	0.0156	0.3
	0.0022	0.6
	0.0014	0.0

% Cobbles	--
% Gravel	0.4
% Sand	98.5
% Fines	1.1
D_{85}	1.1722
D_{60}	0.6878
D_{30}	0.4793
D_{15}	0.1797
D_{10}	0.1482
C_u	4.6
C_c	2.3

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
U2C6	---	---	●	NA	NA	NA		**Yellowish brown poorly graded Sand with seashells (SP)**

PROJECT NAME: **SONGS LOED permitting**

PROJECT NUMBER: **12206A**

PARTICLE-SIZE DISTRIBUTION CURVES

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

GRADATION OF SOILS by Sieving using Soil Sieve Sizes & with Water Content

ASTM D6913, D422 and D2216

Project Number: 12206A | Task Number: | Boring No.: U2C6

Project Name: SONGS LOED permitting | Sample No.: ---

Project Engineer: E Miller | Depth (ft): ---

Visual Description: Yellowish brown poorly graded Sand with seashells (SP)

SPECIMEN: Selected From:

Bulk Sample	x		Other - Jar
SPT Sample			Thin-Walled Tube
Calif. Sample			Engr. Test Specimen's WC
			Whole sample used
			See Bulk Sample Processing Form

Selection Method:

	Sieves (1) - whole sample used
x	Sieves (1) - partial sample used & selected by Method(s)
c	Method

(a): Splitter; (use for dry soils or that which will segregate)

(b): Quartering; (use for dry soils or that which will segregate)

(c) : Representative scoop after mixing, or slice of intact sample. (use for moist soils or that which will not segregate)

Preparation: Sample/Specimen:

As-Received	x
Air Dried	
Oven-Dried	

Test Method

Method A	
Method B	x

Oven-Dried Soil Broken Up Before:

Selecting partial sample: No x | Yes

By: Mortar & Pestle | Hand | Pulverizer | Other

Washing:

	No	Yes
Whole Specimen Washed on No. 200 sieve ?		x
Retained Fraction: 1st Split Washed ?		
Fine Fraction Washed on No. 200 sieve ?		

and Soil Soaked for: ~6 hrs.

MASS OF TEST SPECIMEN (g)	Total Test Specimen with Coarse Fraction	Partial or Whole Test Specimen	Soil Retained (after washing)	**Water Content** As Recieved or Container No.	
Min.sieve size in sieving sequence (3)	#N/A	# 200	+200	Wet, M1 (g)	
Container Number		x18	x18	Dry, M2 (g)	XXX
Mass of Container and Dry Soil, (g)		476.55	472.91	Cont.,M3 (g)	XXX
Mass of Container, (g)		127.86	127.87	**Water Content (%)**	**NA**
Dry Soil, Ws (g)		348.69	345.04		

SIEVING RESULTS % error: 0.01

See (1)	Sieve No.	Cum. Mass Retained (g)	Total Specimen % Finer N'
	3 "		
	2 "		
	1 1/2"		
	1 "		
	3/4 "		
	1/2 "		
	3/8 "		
	4		
	Pan		XXXXXXXX

Req. Mass of Test Spec. for 1% (kg)
3"= 70
1 1/2"=10
3/4"= 1.1
3/8"= 0.25
#4 = 0.1
#10 = 0.1

Shape of Grains

	Rounded
x	Angular
	Flat

Sieve No.	mm	Cum. Mass Retained (g)	Partial Test Specimen	Total Specimen % Finer N'
3 "	75			
2 "	50			
1-1/2"	37.5			
1 "	25			
3/4 "	19			
1/2 "	12.5	0		100
3/8 "	9.5	1.13	seashells	99.7
#4	325	1.35	seashells	99.6
#10	180	9.49		97.3
#20	115	77.95		77.6
#40	75	279.1		20
#60	60	339.71		2.6
#100	40	343.66		1.4
#140*	30	344.28		1.3
#200	20	344.93		1.1
Pan		344.99	XXXXXXXX	XXXXXXXXXX

SUMMARY: Shape & Filter Parameters

% COBBLES	---	D60	0.688	D85	1.17
% GRAVEL	0.4	D30	0.479	D50	0.61
% SAND	98.5	D10	0.148	D15	0.18
% FINES	1.1	Cu =	4.6	Cc =	2.3

* Denotes sieve added to better define gradation curve

Cc = D30^2 / (D60 * D10)

Cu = D60 / D10

(1) X in box denotes sieve on which split was made.

(2) Proposed allowable amount of soil retained on 8" dia. sieve.

(3) Sieve size given, denotes min. sieve size used in the appropriate sieving sequence.

The above values D## denotes particle size (mm) at the corresponding percent passing.

Mica Noted: x No | Yes Amount Adjective:

Particle Hardness

x Hard | Soft | Weathered

SET-UP BY: TJO DATE 07/30/12 CALCULATED BY: TJO CHECKED BY: YS

SUBMITTED BY: Thomas J. O'Hara

PARTICLE-SIZE ANALYSIS : by Hydrometer

ASTM C117 or D422 or if Double Hydrometer Performed, D4221

Project Number: 12206A Task Number: Boring No.: U2C6

Project Name: SONGS LOED permitting Sample No.: ---

Project Engineer: E Miller Depth (ft): ---

Visual Description: Yellowish brown poorly graded Sand with seashells (SP)

State of Specimen before Processing	
	Moist State / Oven Dried
x	Air Dried
	See bulk sample proc. form (S-106)
Soil broken up by:	Other:
	Mortar & pestle
x	Passing soil through #10 sieve or
Dispersing Agent:(1)	
x	125ml Std. 4% or ____ solution
	Other
Date Soaking Initiated:	7/31/2012
Time Soaked: x	Overnight / Other
x	ASTM Dispersion Cup & Mixer used for 1 min
	Air dispersion device used for ____ min
	Other
Defoaming Agent Used:	X No; / Yes

Oven- or Air-Dried Set-Up	
Drying container No.	
Mass Container+Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil (g)	

Set-Up Water Content	x	Minus No. 10 / or
Container No.		n5
Mass Container + Wet Soil (g), M1		313.45
Mass Container + Dry Soil (g), M2		313.11
Mass Container (g), M3		104.63
Water Content, w (%)		**0.16**

Test Notes: (1) Dispersing Agent is Sodium Hexametaphosphate

Mass of Dry Soil Used in Test, Ws	
For Oven-dry set-up, Ws (g)	
For Moist or ____ set-up	
Wwet = Estimated Ws x (1 + w)	
Est = ____ x (1 + ____) =	
Act (Wwet) =	112.55 (g)
Ws = Wwet /(1 + w/100) =	112.37 (g)
After Test Actual Ws	
Container No.	
Mass Container + Dispersant + Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil + Dispersant (g)	
Mass Dispersant (g)	
Mass Dry Soil (g)	

Soaking Beaker No. 847 Graduate No. 5 152H Hydrometer No. 972 Meniscus Correction, Cm = calibrated (3)

Date 12 (yr) (m:d)	Time (hr:min)	Elapsed Time (min)	Temp (ºC)	Hyd. Reading Soil (2) R	Hyd. Reading Water (3) Rw	Diameter D (mm)	Total specimen % finer N'
8/1	8:45	0		XXXXXXXX		XXXXXXXX	XXXXXXX
		1	24.0	1.0	--	--	--
		2	24.0	1.0	--	--	--
		5	24.1	2.0	1.6	0.0231	0.3
		11	24.0	2.0	1.6	0.0156	0.3
		31	23.9	2.5	1.8	0.0093	0.6
		90	23.9	3.0	1.8	0.0054	1.0
		266	24.1	3.0	1.5	0.0031	1.2
		566	24.4	2.0	1.2	0.0022	0.6
		1419	23.7	2.0	2.0	0.0014	0.0

Sieving Performed on Hyd. Test Spec.		
Complete Sieve Analysis Performed: See Form S-104		Yes / No
x	Wash analysis performed to check appropriateness of hyd. spec.	
Container No.		sna13
Mass Container + Dry Soil (g)		256.83
Mass Container (g)		146.04
Total Specimen % Finer		1.3

Dry Sieving After Washing

Sieve No.	Cumulative Mass Retained (g)	Total Specimen % Finer, N'
40	86.18	21.3
100	109.97	1.9
200	110.76	1.3
Pan	110.76	XXXXXXX

Calculations: Average Temperature used in calculating test, ºC = 24.0

"X" in temperature column indicates where actural temperature used, and this value not included in the average.

Specific Gravity, Gs = 2.70

N'= a Pc (R - Rw) / Ws = (Total % finer Factor) x (R - Rw)

D (mm) = K $\sqrt{L / t}$ Tested / x Assumed

a = 0.99 from Table 1 (D 422) or ____

K from Table A1.3 (Draft Std.), K = 0.01282

Pc = Percent of soil passing No. 10 sieve = 91.4 %

Cal. Notes: (2) Soil, Water & Dispersion Solution

Ws = Dry mass of soil placed in cylinder = 112.37 g

(3) Water & Dispersion Solution

Total % finer Factor = (a*Pc/Ws) = 0.805

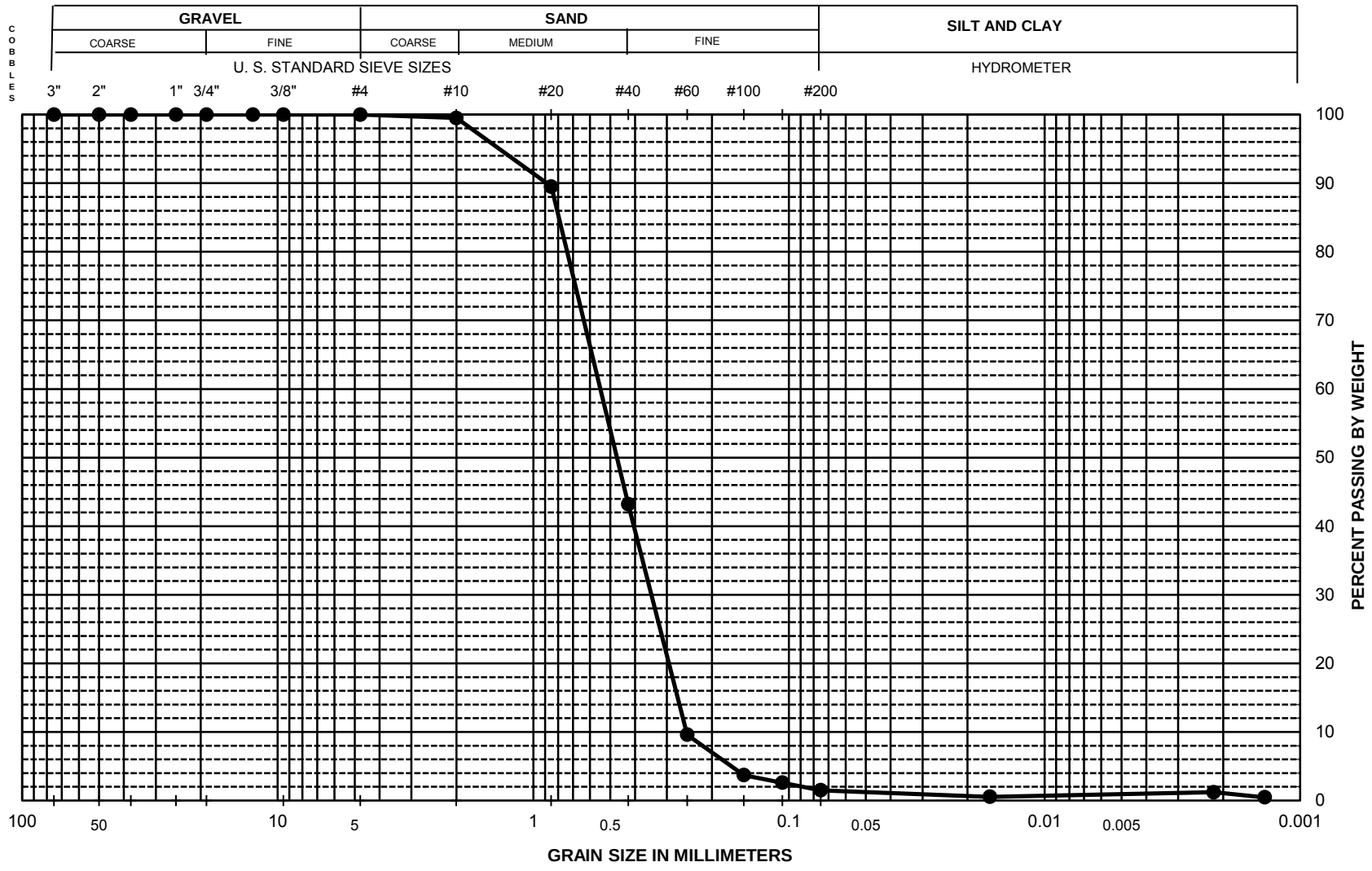
D(mm) = {(16.3 -(R-Rw)*0.164) / time}^0.5 *K

Remarks:

SET-UP BY: TJO RUN BY: YS CALCULATED BY: YS REVIEWED BY: TJO

SUBMITTED BY: Thomas J. O'Mara

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	100.0
#4	4.75	100.0
#10	2.00	99.5
#20	0.850	89.5
#40	0.425	43.2
#60	0.250	9.6
#100	0.150	3.7
#140	0.106	2.6
#200	0.075	1.5
Hydrometer Analysis	0.0163	0.6
	0.0022	1.2
	0.0014	0.5

% Cobbles	--
% Gravel	0.0
% Sand	98.5
% Fines	1.5
D_{85}	0.7946
D_{60}	0.5465
D_{30}	0.3089
D_{15}	0.1720
D_{10}	0.1415
C_u	3.9
C_c	1.2

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
U2C7	---	---	●	NA	NA	NA	1	**Grayish brown poorly graded Sand (SP)**

PROJECT NAME: **SONGS LOED permitting**

PROJECT NUMBER: **12206A**

PARTICLE-SIZE DISTRIBUTION CURVES

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

GRADATION OF SOILS by Sieving using Soil Sieve Sizes & with Water Content

ASTM D6913, D422 and D2216

Project Number: 12206A | Task Number: | Boring No.: U2C7

Project Name: SONGS LOED permitting | Sample No.: ---

Project Engineer: E Miller | Depth (ft): ---

Visual Description: Grayish brown poorly graded Sand (SP)

SPECIMEN: Selected From:

Bulk Sample	x		Other - Jar
SPT Sample			Thin-Walled Tube
Calif. Sample			Engr. Test Specimen's WC
			Whole sample used
			See Bulk Sample Processing Form

Selection Method:

	Sieves (1) - whole sample used
x	Sieves (1) - partial sample used & selected by Method(s)
c	Method

(a): Splitter; (use for dry soils or that which will segregate)

(b): Quartering; (use for dry soils or that which will segregate)

(c) : Representative scoop after mixing, or slice of intact sample. (use for moist soils or that which will not segregate)

Preparation: Sample/Specimen:

As-Received	x
Air Dried	
Oven-Dried	

Test Method

Method A	
Method B	x

Oven-Dried Soil Broken Up Before:

Selecting partial sample: No x | Yes

Washing:

	No	Yes
Whole Specimen Washed on No. 200 sieve ?		x
Retained Fraction: 1st Split Washed ?		
Fine Fraction Washed on No. 200 sieve ?		

By: Mortar & Pestle | Hand | Pulverizer | Other

and Soil Soaked for: ~6 hrs.

MASS OF TEST SPECIMEN (g)	Total Test Specimen with Coarse Fraction	Partial or Whole Test Specimen	Soil Retained (after washing)	**Water Content** As Recieved or Container No.	
Min.sieve size in sieving sequence (3)	#N/A	# 200	+200	Wet, M1 (g)	
Container Number		x6	x6	Dry, M2 (g)	XXX
Mass of Container and Dry Soil, (g)		499.12	494.28	Cont.,M3 (g)	XXX
Mass of Container, (g)		154.78	154.81	**Water Content (%)**	**NA**
Dry Soil, Ws (g)		344.34	339.47		

SIEVING RESULTS % error: 0.06

See (1)	Sieve No.	Cum. Mass Retained (g)	Total Specimen % Finer N'
	3 "		
	2 "		
	1 1/2"		
	1 "		
	3/4 "		
	1/2 "		
	3/8 "		
	4		
	Pan		XXXXXXXX

Req. Mass of Test Spec. for 1% (kg)
3"= 70
1 1/2"=10
3/4"= 1.1
3/8"= 0.25
#4 = 0.1
#10 = 0.1

Shape of Grains

	Rounded
x	Angular
	Flat

Sieve No.	Sieve mm	Cum. Mass Retained (g)	Partial Test Specimen	Total Specimen % Finer N'
3 "	75			
2 "	50			
1-1/2"	37.5			
1 "	25			
3/4 "	19			
1/2 "	12.5			
3/8 "	9.5			
#4	325	0		100
#10	180	1.61		99.5
#20	115	36		89.5
#40	75	195.58		43.2
#60	60	311.22		9.6
#100	40	331.65		3.7
#140*	30	335.55		2.6
#200	20	339.13		1.5
Pan		339.25	XXXXXXXX	XXXXXXXXXX

SUMMARY: Shape & Filter Parameters

% COBBLES	---	D60	0.547	D85	0.79
% GRAVEL	0	D30	0.309	D50	0.47
% SAND	98.5	D10	0.142	D15	0.17
% FINES	1.5	Cu =	3.9	Cc =	1.2

* Denotes sieve added to better define gradation curve

Cc = D30^2 / (D60 * D10)

Cu = D60 / D10

(1) X in box denotes sieve on which split was made.

(2) Proposed allowable amount of soil retained on 8" dia. sieve.

(3) Sieve size given, denotes min. sieve size used in the appropriate sieving sequence.

The above values D## denotes particle size (mm) at the corresponding percent passing.

Mica Noted: x No | Yes Amount Adjective:

Particle Hardness

x Hard | Soft | Weathered

SET-UP BY: TJO DATE 07/30/12 CALCULATED BY: TJO CHECKED BY: YS

SUBMITTED BY: Thomas J. O'Mara

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

PARTICLE-SIZE ANALYSIS : by Hydrometer

ASTM C117 or D422 or if Double Hydrometer Performed, D4221

Project Number: 12206A Task Number: Boring No.: U2C7

Project Name: SONGS LOED permitting Sample No.: ---

Project Engineer: E Miller Depth (ft): ---

Visual Description: Grayish brown poorly graded Sand (SP)

State of Specimen before Processing
[ ] Moist State [ ] Oven Dried
[x] Air Dried
[ ] See bulk sample proc. form (S-106)
Soil broken up by: Other:
[ ] Mortar & pestle
[x] Passing soil through #10 sieve or
Dispersing Agent:(1)
[x] 125ml Std. 4% or ____ solution
[ ] Other
Date Soaking Initiated: 7/31/2012
Time [x] Overnight
Soaked: [ ] Other
[x] ASTM Dispersion Cup & Mixer used for 1 min
[ ] Air dispersion device used for ____ min
[ ] Other
Defoaming Agent Used: [X] No; [ ] Yes

Oven- or Air-Dried Set-Up
Drying container No.
Mass Container+Dry Soil (g)
Mass Container (g)
Mass Dry Soil (g)

Set-Up Water Content	[x] Minus No. 10 [ ] or	
Container No.		m67
Mass Container + Wet Soil (g), M1		284.38
Mass Container + Dry Soil (g), M2		284.15
Mass Container (g), M3		110.4
Water Content, w (%)		**0.13**

Test Notes: (1) Dispersing Agent is Sodium Hexametaphosphate

Mass of Dry Soil Used in Test, Ws	
For Oven-dry set-up, Ws (g)	
For Moist or ____ set-up	
Wwet = Estimated Ws x (1 + w)	
Est = ____ x (1 + ____) =	
Act (Wwet) = 102.27 (g)	
Ws = Wwet /(1 + w/100) = 102.13 (g)	
After Test Actual Ws	
Container No.	
Mass Container + Dispersant + Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil + Dispersant (g)	
Mass Dispersant (g)	
Mass Dry Soil (g)	

Soaking Beaker No. 821 Graduate No. 7 152H Hydrometer No. 972 Meniscus Correction, Cm = calibrated (3)

Date 12 (yr) (m:d)	Time (hr:min)	Elapsed Time (min)	Temp (ºC)	Hyd. Reading Soil (2) R	Hyd. Reading Water (3) Rw	Diameter D (mm)	Total specimen % finer N'
8/1	8:53	0		XXXXXXXX		XXXXXXXX	XXXXXXX
		1	23.8	1.0	--	--	--
		2	23.8	1.5	--	--	--
		5	23.8	1.5	--	--	--
		10	23.8	2.5	1.9	0.0163	0.6
		31	23.8	3.0	1.9	0.0093	1.0
		90	23.8	2.5	1.9	0.0054	0.6
		259	24.0	2.5	1.6	0.0032	0.8
		559	24.4	2.5	1.2	0.0022	1.2
		1412	23.7	2.5	2.0	0.0014	0.5

Sieving Performed on Hyd. Test Spec.	
Complete Sieve Analysis Performed: See Form S-104	[ ] Yes [ ] No
[x] Wash analysis performed to check appropriateness of hyd. spec.	
Container No.	x7
Mass Container + Dry Soil (g)	256.7
Mass Container (g)	156.69
Total Specimen % Finer	2.0

Dry Sieving After Washing

Sieve No.	Cumulative Mass Retained (g)	Total Specimen % Finer, N'
40	54.78	44.2
100	97.02	4.8
200	99.91	2.1
Pan	99.94	XXXXXXX

Calculations: Average Temperature used in calculating test, ºC = 23.9

"X" in temperature column indicates where actural temperature used, and this value not included in the average.

Specific Gravity, Gs = 2.70

N'= a Pc (R - Rw) / Ws = (Total % finer Factor) x (R - Rw)

D (mm) = K $\sqrt{L / t}$ [ ] Tested [x] Assumed

a = 0.99 from Table 1 (D 422) or ____

K from Table A1.3 (Draft Std.), K = 0.01284

Pc = Percent of soil passing No. 10 sieve = 95.4 %

Cal. Notes: (2) Soil, Water & Dispersion Solution

Ws = Dry mass of soil placed in cylinder = 102.13 g

(3) Water & Dispersion Solution

Total % finer Factor = (a*Pc/Ws) = 0.925

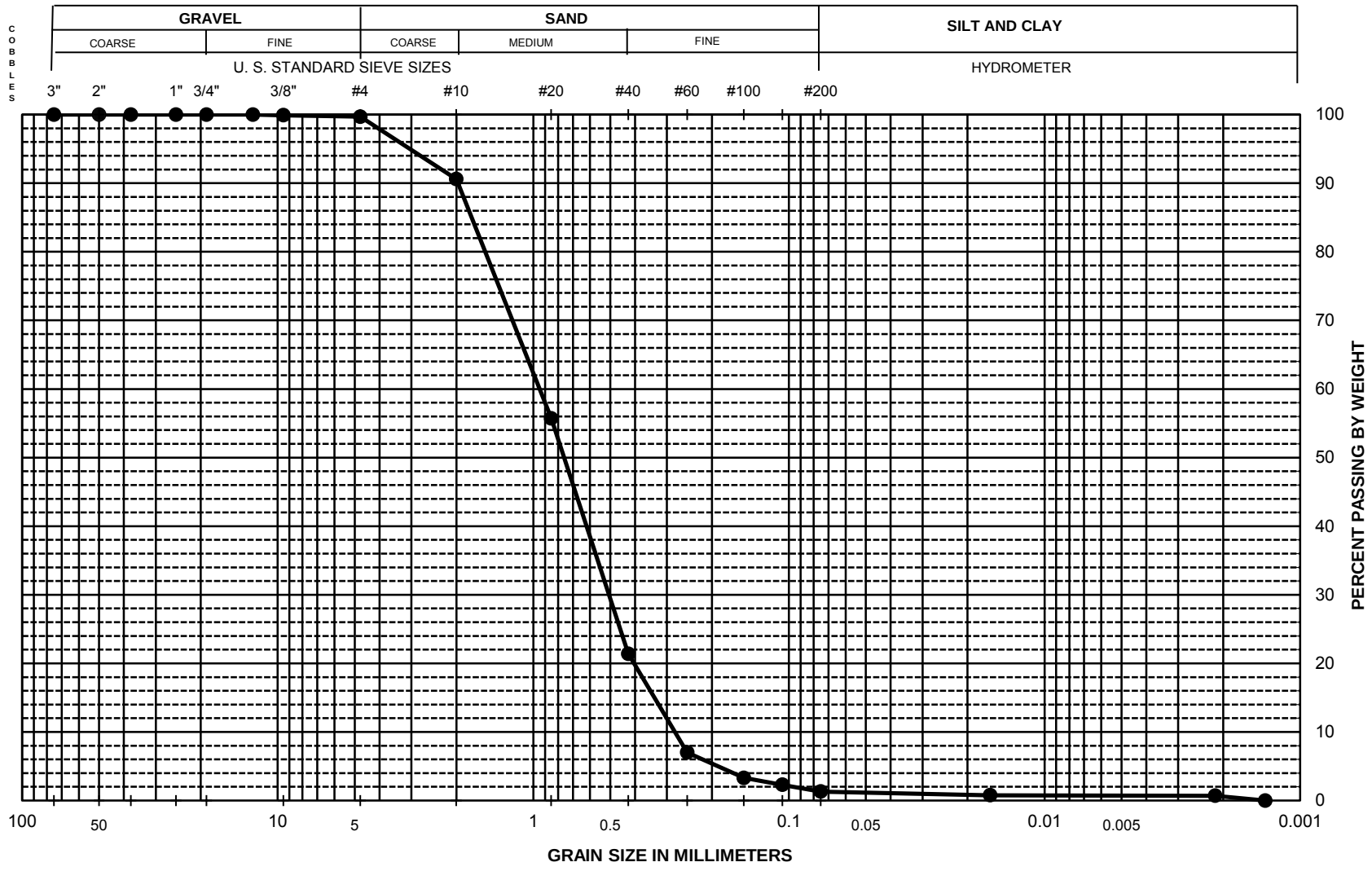
D(mm) = {(16.3 -(R-Rw)*0.164) / time}^0.5 *K

Remarks:

SET-UP BY: TJO RUN BY: YS CALCULATED BY: YS REVIEWED BY: TJO

SUBMITTED BY: Thomas J O'Mara

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	99.9
#4	4.75	99.7
#10	2.00	90.6
#20	0.850	55.7
#40	0.425	21.4
#60	0.250	7.0
#100	0.150	3.3
#140	0.106	2.3
#200	0.075	1.3
Hydrometer Analysis	0.0163	0.8
	0.0021	0.7
	0.0014	0.0

% Cobbles	--
% Gravel	0.3
% Sand	98.4
% Fines	1.3
D_{85}	1.7434
D_{60}	0.9445
D_{30}	0.5057
D_{15}	0.1738
D_{10}	0.1430
C_u	6.6
C_c	1.9

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
U2C8	---	---	●	NA	NA	NA	1	**Grayish brown well-graded Sand with seashells (SW)**

PROJECT NAME: **SONGS LOED permitting**

PROJECT NUMBER: **12206A**

PARTICLE-SIZE DISTRIBUTION CURVES

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

GRADATION OF SOILS by Sieving using Soil Sieve Sizes & with Water Content

ASTM D6913, D422 and D2216

Project Number: 12206A | Task Number: | Boring No.: U2C8

Project Name: SONGS LOED permitting | Sample No.: ---

Project Engineer: E Miller | Depth (ft): ---

Visual Description: Grayish brown well-graded Sand with seashells (SW)

SPECIMEN: Selected From:

Bulk Sample	x		Other - Jar
SPT Sample			Thin-Walled Tube
Calif. Sample			Engr. Test Specimen's WC
			Whole sample used
			See Bulk Sample Processing Form

Selection Method:

		Sieves (1) - whole sample used
x		Sieves (1) - partial sample used & selected by Method(s)
c		Method

(a): Splitter; (use for dry soils or that which will segregate)

(b): Quartering; (use for dry soils or that which will segregate)

(c) : Representative scoop after mixing, or slice of intact sample. (use for moist soils or that which will not segregate)

Preparation: Sample/Specimen:

As-Received	x
Air Dried	
Oven-Dried	

Test Method

Method A	
Method B	x

Oven-Dried Soil Broken Up Before:

Selecting partial sample: No x | Yes

Washing:

	No	Yes
Whole Specimen Washed on No. 200 sieve ?		x
Retained Fraction: 1st Split Washed ?		
Fine Fraction Washed on No. 200 sieve ?		

By: Mortar & Pestle | Hand | Pulverizer | Other

and Soil Soaked for: ~6 hrs.

Water Content

MASS OF TEST SPECIMEN (g)	Total Test Specimen with Coarse Fraction	Partial or Whole Test Specimen	Soil Retained (after washing)	As Recieved or Container No.	
Min.sieve size in sieving sequence (3)	#N/A	# 200	+200	Wet, M1 (g)	
Container Number		sf6	sf6	Dry, M2 (g)	XXX
Mass of Container and Dry Soil, (g)		592.81	587.74	Cont.,M3 (g)	XXX
Mass of Container, (g)		147.17	147.19	**Water Content (%)**	**NA**
Dry Soil, Ws (g)		445.64	440.55		

SIEVING RESULTS % error: 0.09

See (1)	Sieve No.	Cum. Mass Retained (g)	Total Specimen % Finer N'
	3 "		
	2 "		
	1 1/2"		
	1 "		
	3/4 "		
	1/2 "		
	3/8 "		
	4		
	Pan		XXXXXXXX

Req. Mass of Test Spec. for 1% (kg)
3"= 70
1 1/2"=10
3/4"= 1.1
3/8"= 0.25
#4 = 0.1
#10 = 0.1

Shape of Grains

	Rounded
x	Angular
	Flat

Sieve No.	mm	Cum. Mass Retained (g)	Partial Test Specimen	Total Specimen % Finer N'
3 "	75			
2 "	50			
1-1/2"	37.5			
1 "	25			
3/4 "	19			
1/2 "	12.5	0		100
3/8 "	9.5	0.44	seashells	99.9
#4	325	1.36		99.7
#10	180	41.83		90.6
#20	115	197.23		55.7
#40	75	350.12		21.4
#60	60	414.62		7
#100	40	430.92		3.3
#140*	30	435.43		2.3
#200	20	439.95		1.3
Pan		440.14	XXXXXXXX	XXXXXXXXXX

SUMMARY: Shape & Filter Parameters

% COBBLES	---	D60	0.945	D85	1.74
% GRAVEL	0.3	D30	0.506	D50	0.76
% SAND	98.4	D10	0.143	D15	0.17
% FINES	1.3	Cu =	6.6	Cc =	1.9

* Denotes sieve added to better define gradation curve

Cc = D30^2 / (D60 * D10)

(1) X in box denotes sieve on which split was made.

Cu = D60 / D10

(2) Proposed allowable amount of soil retained on 8" dia. sieve.

Mica Noted: x No | Yes Amount Adjective:

(3) Sieve size given, denotes min. sieve size used in the appropriate sieving sequence.

The above values D## denotes particle size (mm) at the corresponding percent passing.

Particle Hardness

x Hard | Soft | Weathered

SET-UP BY: TJO DATE 07/30/12 CALCULATED BY: TJO CHECKED BY: YS

SUBMITTED BY: Thomas J. O'Mara

PARTICLE-SIZE ANALYSIS : by Hydrometer

ASTM C117 or D422 or if Double Hydrometer Performed, D4221

Project Number: 12206A Task Number: Boring No.: U2C8

Project Name: SONGS LOED permitting Sample No.: ---

Project Engineer: E Miller Depth (ft): ---

Visual Description: Grayish brown well-graded Sand with seashells (SW)

State of Specimen before Processing	
	Moist State ☐ Oven Dried
x	Air Dried
	See bulk sample proc. form (S-106)
Soil broken up by:	Other:
	Mortar & pestle
x	Passing soil through #10 sieve or
Dispersing Agent:(1)	
x	125ml Std. 4% or ____ solution
	Other
Date Soaking Initiated:	7/31/2012
Time Soaked:	x Overnight; Other
x	ASTM Dispersion Cup & Mixer used for 1 min
	Air dispersion device used for ____ min
	Other
Defoaming Agent Used:	X No; ☐ Yes

Oven- or Air-Dried Set-Up	
Drying container No.	
Mass Container+Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil (g)	

Set-Up Water Content	x	Minus No. 10 or
Container No.		m72
Mass Container + Wet Soil (g), M1		291.38
Mass Container + Dry Soil (g), M2		291.12
Mass Container (g), M3		108.6
Water Content, w (%)		**0.14**

Test Notes: (1) Dispersing Agent is Sodium Hexametaphosphate

Mass of Dry Soil Used in Test, Ws	
For Oven-dry set-up, Ws (g)	
For Moist or ____ set-up	
Wwet = Estimated Ws x (1 + w)	
Est = ____ x (1 + ____) =	
Act (Wwet) =	109.33 (g)
Ws = Wwet /(1 + w/100) =	109.17 (g)
After Test Actual Ws	
Container No.	
Mass Container + Dispersant + Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil + Dispersant (g)	
Mass Dispersant (g)	
Mass Dry Soil (g)	

Soaking Beaker No. 823 Graduate No. 15 152H Hydrometer No. 972 Meniscus Correction, Cm = calibrated (3)

Date 12 (yr) (m:d)	Time (hr:min)	Elapsed Time (min)	Temp (ºC)	Hyd. Reading Soil (2) R	Hyd. Reading Water (3) Rw	Diameter D (mm)	Total specimen % finer N'
8/1	8:32	0		XXXXXXXX		XXXXXXXX	XXXXXXX
		1	23.9	1.0	--	--	--
		2	23.9	1.0	--	--	--
		5	23.9	2.0	--	--	--
		10	23.9	2.5	1.6	0.0163	0.8
		32	23.8	2.5	1.6	0.0091	0.8
		90	23.8	3.0	1.6	0.0054	1.2
		277	24.1	2.5	1.5	0.0031	0.9
		577	24.4	2.0	1.2	0.0021	0.7
		1430	23.7	2.0	2.0	0.0014	0.0

Sieving Performed on Hyd. Test Spec.		
Complete Sieve Analysis Performed: See Form S-104		Yes
		No
x	Wash analysis performed to check appropriateness of hyd. spec.	
Container No.		x34
Mass Container + Dry Soil (g)		244.03
Mass Container (g)		136.88
Total Specimen % Finer		1.8

Dry Sieving After Washing

Sieve No.	Cumulative Mass Retained (g)	Total Specimen % Finer, N'
40	84.51	21.5
100	105.05	3.6
200	107.11	1.8
Pan	107.12	XXXXXXX

Calculations: Average Temperature used in calculating test, ºC = 23.9

"X" in temperature column indicates where actural temperature used, and this value not included in the average.

Specific Gravity, Gs = 2.70

N'= a Pc (R - Rw) / Ws = (Total % finer Factor) x (R - Rw)

D (mm) = K $\sqrt{L / t}$ ☐ Tested x Assumed

a = 0.99 from Table 1 (D 422) or ____

K from Table A1.3 (Draft Std.), K = 0.01283

Pc = Percent of soil passing No. 10 sieve = 95.2 %

Ws = Dry mass of soil placed in cylinder = 109.17 g

Total % finer Factor = (a*Pc/Ws) = 0.863

Cal. Notes: (2) Soil, Water & Dispersion Solution

(3) Water & Dispersion Solution

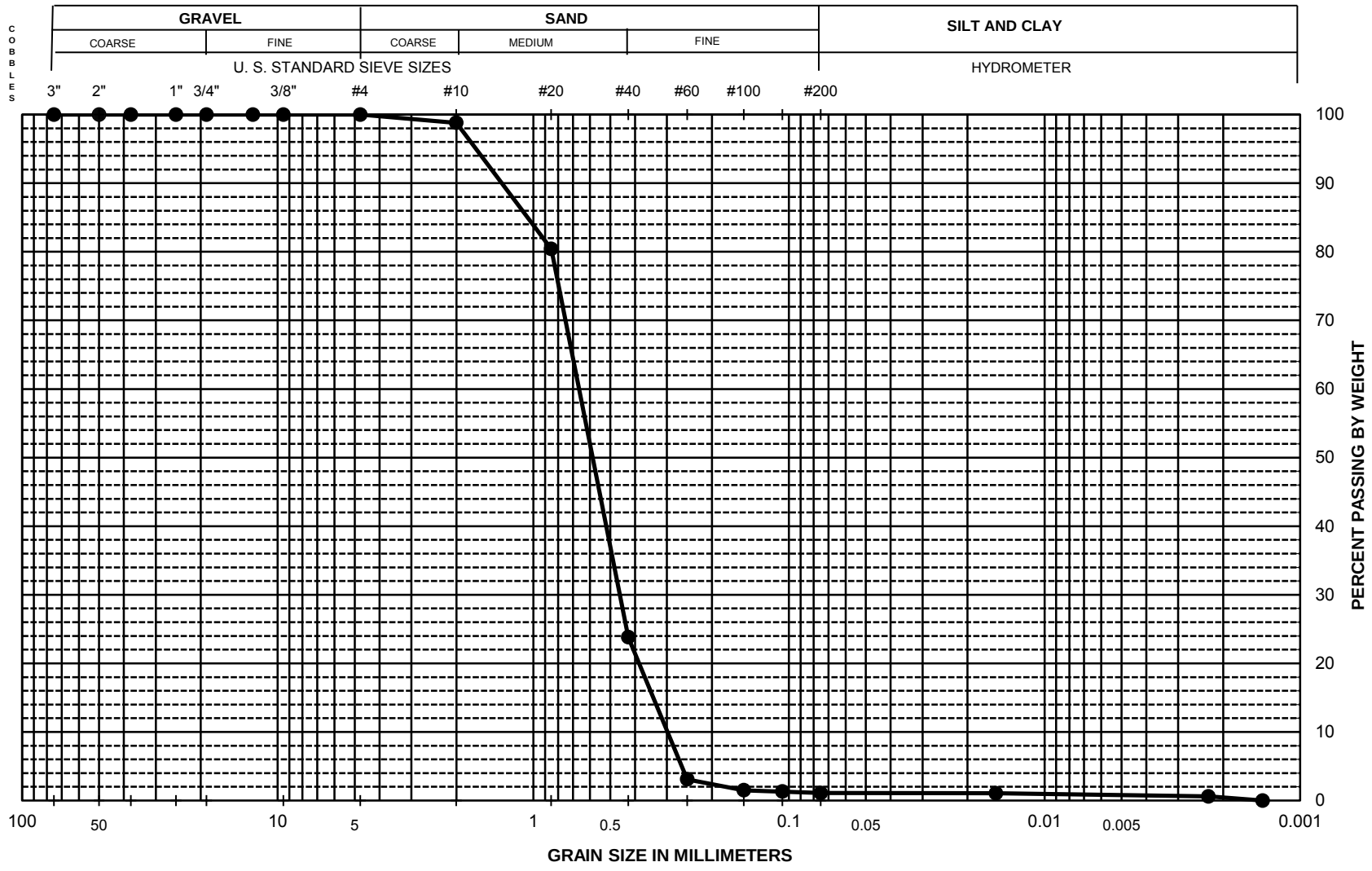
D(mm) = {(16.3 -(R-Rw)*0.164) / time}^0.5 *K

Remarks:

SET-UP BY: TJO RUN BY: YS CALCULATED BY: YS REVIEWED BY: TJO

SUBMITTED BY: Thomas J O'Mara

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	100.0
#4	4.75	100.0
#10	2.00	98.8
#20	0.850	80.4
#40	0.425	23.8
#60	0.250	3.1
#100	0.150	1.5
#140	0.106	1.3
#200	0.075	1.1
Hydrometer Analysis	0.0155	1.1
	0.0023	0.6
	0.0014	0.0

% Cobbles	--
% Gravel	0.0
% Sand	98.9
% Fines	1.1

D_{85}	1.0527
D_{60}	0.6621
D_{30}	0.4585
D_{15}	0.3392
D_{10}	0.2984
C_u	2.2
C_c	1.1

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
U2C9	---	---	●	NA	NA	NA	1	**Grayish brown poorly graded Sand (SP)**

PROJECT NAME: **SONGS LOED permitting**

PROJECT NUMBER: **12206A**

PARTICLE-SIZE DISTRIBUTION CURVES

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

GRADATION OF SOILS by Sieving using Soil Sieve Sizes & with Water Content

ASTM D6913, D422 and D2216

Project Number: 12206A | Task Number: | Boring No.: U2C9

Project Name: SONGS LOED permitting | Sample No.: ---

Project Engineer: E Miller | Depth (ft): ---

Visual Description: Grayish brown poorly graded Sand (SP)

SPECIMEN: Selected From:

Bulk Sample	x		Other - Jar
SPT Sample			Thin-Walled Tube
Calif. Sample			Engr. Test Specimen's WC
			Whole sample used
			See Bulk Sample Processing Form

Selection Method:

	Sieves (1) - whole sample used
x	Sieves (1) - partial sample used & selected by Method(s)
c	Method

(a): Splitter; (use for dry soils or that which will segregate)

(b): Quartering; (use for dry soils or that which will segregate)

(c) : Representative scoop after mixing, or slice of intact sample. (use for moist soils or that which will not segregate)

Preparation: Sample/Specimen:

As-Received	x
Air Dried	
Oven-Dried	

Test Method

Method A	
Method B	x

Oven-Dried Soil Broken Up Before:

Selecting partial sample: No x | Yes

Washing:

	No	Yes
Whole Specimen Washed on No. 200 sieve ?		x
Retained Fraction: 1st Split Washed ?		
Fine Fraction Washed on No. 200 sieve ?		

By: Mortar & Pestle | Hand | Pulverizer | Other

and Soil Soaked for: ~6 hrs.

MASS OF TEST SPECIMEN (g)	Total Test Specimen with Coarse Fraction	Partial or Whole Test Specimen	Soil Retained (after washing)	**Water Content** As Recieved or Container No.	
Min.sieve size in sieving sequence (3)	#N/A	# 200	+200	Wet, M1 (g)	
Container Number		x11	x11	Dry, M2 (g)	XXX
Mass of Container and Dry Soil, (g)		535.74	531.92	Cont.,M3 (g)	XXX
Mass of Container, (g)		157.85	157.88	**Water Content (%)**	**NA**
Dry Soil, Ws (g)		377.89	374.04		

SIEVING RESULTS % error: 0.10

See (1)	Sieve No.	Cum. Mass Retained (g)	Total Specimen % Finer N'
	3 "		
	2 "		
	1 1/2"		
	1 "		
	3/4 "		
	1/2 "		
	3/8 "		
	4		
	Pan		XXXXXXXX

Req. Mass of Test Spec. for 1% (kg)
3"= 70
1 1/2"=10
3/4"= 1.1
3/8"= 0.25
#4 = 0.1
#10 = 0.1

Shape of Grains

	Rounded
x	Angular
	Flat

Sieve No.	mm	Cum. Mass Retained (g)	Partial Test Specimen	Total Specimen % Finer N'
3 "	75			
2 "	50			
1-1/2"	37.5			
1 "	25			
3/4 "	19			
1/2 "	12.5			
3/8 "	9.5			
#4	325	0		100
#10	180	4.52		98.8
#20	115	73.95		80.4
#40	75	288		23.8
#60	60	366.31		3.1
#100	40	372.19		1.5
#140*	30	373.01		1.3
#200	20	373.62		1.1
Pan		373.67	XXXXXXXX	XXXXXXXXXX

SUMMARY: Shape & Filter Parameters

% COBBLES	---	D60	0.662	D85	1.05
% GRAVEL	0	D30	0.459	D50	0.59
% SAND	98.9	D10	0.298	D15	0.34
% FINES	1.1	Cu =	2.2	Cc =	1.1

* Denotes sieve added to better define gradation curve

Cc = D30^2 / (D60 * D10)

Cu = D60 / D10

(1) X in box denotes sieve on which split was made.

(2) Proposed allowable amount of soil retained on 8" dia. sieve.

Mica Noted: x No | Yes Amount Adjective:

(3) Sieve size given, denotes min. sieve size used in the appropriate sieving sequence.

The above values D## denotes particle size (mm) at the corresponding percent passing.

Particle Hardness

x Hard | Soft | Weathered

SET-UP BY: TJO DATE 07/30/12 CALCULATED BY: TJO CHECKED BY: YS

SUBMITTED BY: Thomas J. O'Mara

PARTICLE-SIZE ANALYSIS : by Hydrometer

ASTM C117 or D422 or if Double Hydrometer Performed, D4221

Project Number: 12206A Task Number: Boring No.: U2C9

Project Name: SONGS LOED permitting Sample No.: ---

Project Engineer: E Miller Depth (ft): ---

Visual Description: Grayish brown poorly graded Sand (SP)

State of Specimen before Processing
[ ] Moist State [ ] Oven Dried
[x] Air Dried
[ ] See bulk sample proc. form (S-106)
Soil broken up by: Other:
[ ] Mortar & pestle
[x] Passing soil through #10 sieve or
Dispersing Agent:(1)
[x] 125ml Std. 4% or ____ solution
[ ] Other
Date Soaking Initiated: 7/31/2012
Time [x] Overnight
Soaked: [ ] Other
[x] ASTM Dispersion Cup & Mixer used for 1 min
[ ] Air dispersion device used for ____ min
[ ] Other
Defoaming Agent Used: [X] No; [ ] Yes

Oven- or Air-Dried Set-Up
Drying container No.
Mass Container+Dry Soil (g)
Mass Container (g)
Mass Dry Soil (g)

Set-Up Water Content	[x] Minus No. 10 [ ] or
Container No.	sx37
Mass Container + Wet Soil (g), M1	362.85
Mass Container + Dry Soil (g), M2	362.52
Mass Container (g), M3	105.64
Water Content, w (%)	**0.13**

Test Notes: (1) Dispersing Agent is Sodium Hexametaphosphate

Mass of Dry Soil Used in Test, Ws	
For Oven-dry set-up, Ws (g)	
For Moist or ____ set-up	
Wwet = Estimated Ws x (1 + w)	
Est = ____ x (1 + ____) =	
Act (Wwet) = 104.92 (g)	
Ws = Wwet /(1 + w/100) = 104.79 (g)	
After Test Actual Ws	
Container No.	
Mass Container + Dispersant + Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil + Dispersant (g)	
Mass Dispersant (g)	
Mass Dry Soil (g)	

Soaking Beaker No. 827 Graduate No. 11 152H Hydrometer No. 972 Meniscus Correction, Cm = calibrated (3)

Date 12 (yr) (m:d)	Time (hr:min)	Elapsed Time (min)	Temp (ºC)	Hyd. Reading Soil (2) R	Hyd. Reading Water (3) Rw	Diameter D (mm)	Total specimen % finer N'
8/1	9:46	0		XXXXXXXX		XXXXXXXX	XXXXXXX
		1	24.1	3.0	1.6	0.0514	1.1
		2	24.1	3.0	1.6	0.0363	1.1
		5	24.1	3.0	1.6	0.0230	1.1
		11	24.1	3.0	1.6	0.0155	1.1
		30	24.1	3.0	1.6	0.0094	1.1
		90	24.0	2.5	1.5	0.0054	0.8
		210	24.0	2.5	1.5	0.0036	0.8
		510	24.4	2.0	1.2	0.0023	0.6
		1363	23.7	2.0	2.0	0.0014	0.0

Sieving Performed on Hyd. Test Spec.	
Complete Sieve Analysis Performed: See Form S-104	[ ] Yes [ ] No
[x] Wash analysis performed to check appropriateness of hyd. spec.	
Container No.	x6
Mass Container + Dry Soil (g)	257.88
Mass Container (g)	154.78
Total Specimen % Finer	1.3

Dry Sieving After Washing

Sieve No.	Cumulative Mass Retained (g)	Total Specimen % Finer, N'
40	75.73	22.3
100	102.19	2.0
200	103.1	1.3
Pan	103.11	XXXXXXX

Calculations: Average Temperature used in calculating test, ºC = 24.1

"X" in temperature column indicates where actural temperature used, and this value not included in the average.

Specific Gravity, Gs = 2.70

N'= a Pc (R - Rw) / Ws = (Total % finer Factor) x (R - Rw)

D (mm) = K $\sqrt{L / t}$ [ ] Tested [x] Assumed

a = 0.99 from Table 1 (D 422) or ____

K from Table A1.3 (Draft Std.), K = 0.01281

Pc = Percent of soil passing No. 10 sieve = 80.5 %

Cal. Notes: (2) Soil, Water & Dispersion Solution

Ws = Dry mass of soil placed in cylinder = 104.79 g

(3) Water & Dispersion Solution

Total % finer Factor = (a*Pc/Ws) = 0.761

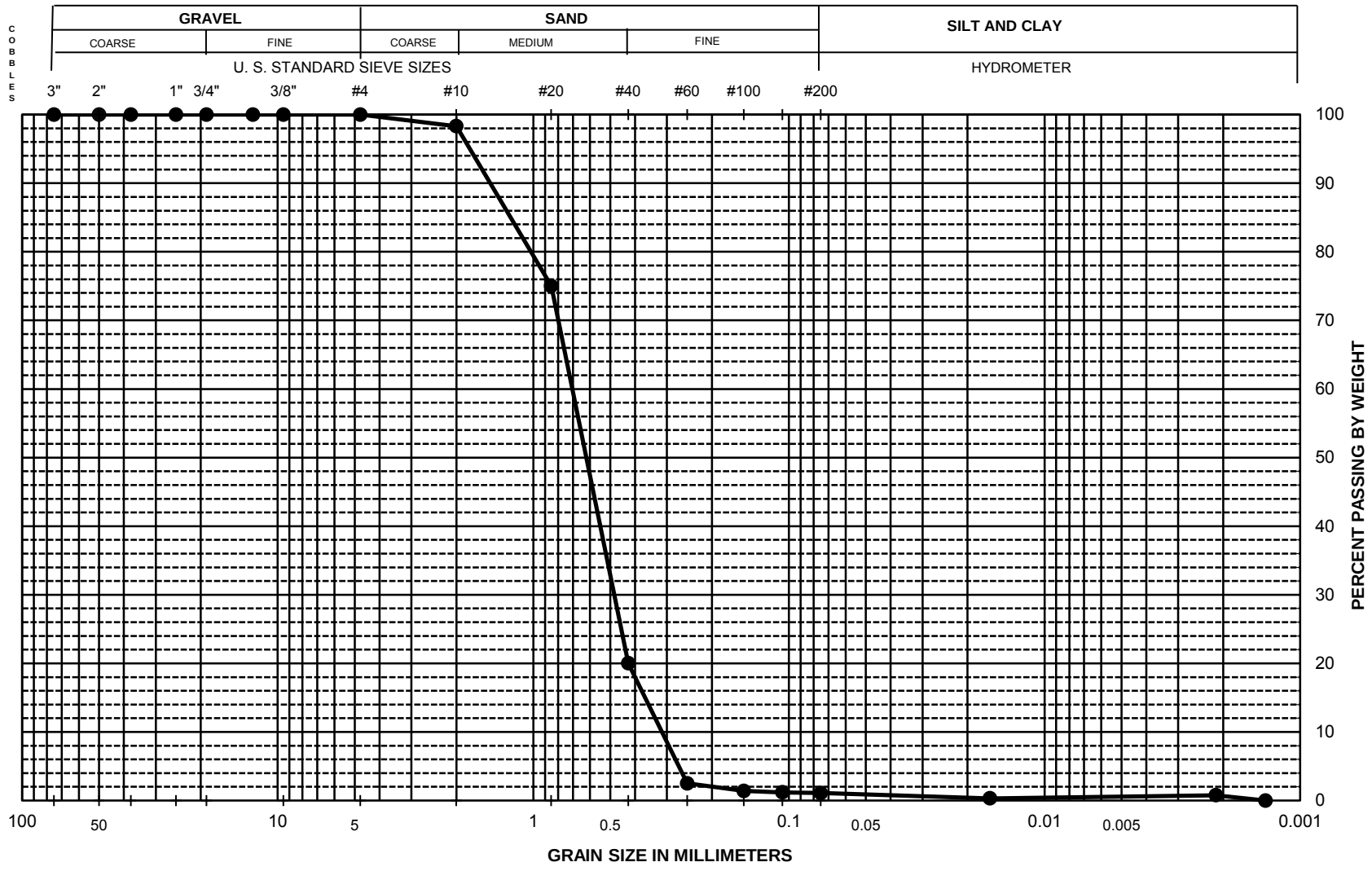
D(mm) = {(16.3 -(R-Rw)*0.164) / time}^0.5 *K

Remarks:

SET-UP BY: TJO RUN BY: YS CALCULATED BY: YS REVIEWED BY: TJO

SUBMITTED BY: Thomas J O'Mara

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	100.0
#4	4.75	100.0
#10	2.00	98.3
#20	0.850	75.0
#40	0.425	20.0
#60	0.250	2.5
#100	0.150	1.4
#140	0.106	1.2
#200	0.075	1.1
Hydrometer Analysis	0.0163	0.3
	0.0021	0.8
	0.0014	0.0

% Cobbles	--
% Gravel	0.0
% Sand	98.9
% Fines	1.1

D_{85}	1.2272
D_{60}	0.7036
D_{30}	0.4821
D_{15}	0.1803
D_{10}	0.1487
C_u	4.7
C_c	2.2

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
U2C10	---	---	●	NA	NA	NA	1	**Brown poorly graded Sand (SP)**

PROJECT NAME: **SONGS LOED permitting**

PROJECT NUMBER: **12206A**

PARTICLE-SIZE DISTRIBUTION CURVES

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

GRADATION OF SOILS by Sieving using Soil Sieve Sizes & with Water Content

ASTM D6913, D422 and D2216

Project Number: 12206A | Task Number: | Boring No.: U2C10

Project Name: SONGS LOED permitting | Sample No.: ---

Project Engineer: E Miller | Depth (ft): ---

Visual Description: Brown poorly graded Sand (SP)

SPECIMEN: Selected From:

Bulk Sample	x		Other - Jar
SPT Sample			Thin-Walled Tube
Calif. Sample			Engr. Test Specimen's WC
			Whole sample used
			See Bulk Sample Processing Form

Selection Method:

	Sieves (1) - whole sample used
x	Sieves (1) - partial sample used & selected by Method(s)
c	Method

(a): Splitter; (use for dry soils or that which will segregate)

(b): Quartering; (use for dry soils or that which will segregate)

(c) : Representative scoop after mixing, or slice of intact sample. (use for moist soils or that which will not segregate)

Preparation: Sample/Specimen:

As-Received	x
Air Dried	
Oven-Dried	

Test Method

Method A	
Method B	x

Oven-Dried Soil Broken Up Before:

Selecting partial sample: No x | Yes

Washing:

	No	Yes
Whole Specimen Washed on No. 200 sieve ?		x
Retained Fraction: 1st Split Washed ?		
Fine Fraction Washed on No. 200 sieve ?		

By: Mortar & Pestle | Hand | Pulverizer | Other

and Soil Soaked for: ~6 hrs.

Water Content

MASS OF TEST SPECIMEN (g)	Total Test Specimen with Coarse Fraction	Partial or Whole Test Specimen	Soil Retained (after washing)	As Recieved or Container No.	
Min.sieve size in sieving sequence (3)	#N/A	# 200	+200	Wet, M1 (g)	
Container Number		m5	m5	Dry, M2 (g)	XXX
Mass of Container and Dry Soil, (g)		425.2	421.83	Cont.,M3 (g)	XXX
Mass of Container, (g)		91.26	91.29	**Water Content (%)**	**NA**
Dry Soil, Ws (g)		333.94	330.54		

SIEVING RESULTS % error: 0.05

See (1)	Sieve No.	Cum. Mass Retained (g)	Total Specimen % Finer N'
	3 "		
	2 "		
	1 1/2"		
	1 "		
	3/4 "		
	1/2 "		
	3/8 "		
	4		
	Pan		XXXXXXXX

Req. Mass of Test Spec. for 1% (kg)
3"= 70
1 1/2"=10
3/4"= 1.1
3/8"= 0.25
#4 = 0.1
#10 = 0.1

Shape of Grains

	Rounded
x	Angular
	Flat

Sieve No.	Sieve mm	Cum. Mass Retained (g)	Partial Test Specimen	Total Specimen % Finer N'
3 "	75			
2 "	50			
1-1/2"	37.5			
1 "	25			
3/4 "	19			
1/2 "	12.5			
3/8 "	9.5	0		100
#4	325	0.15		100
#10	180	5.83		98.3
#20	115	83.44		75
#40	75	267.01		20
#60	60	325.62		2.5
#100	40	329.41		1.4
#140*	30	329.87		1.2
#200	20	330.34		1.1
Pan		330.36	XXXXXXXX	XXXXXXXXXX

SUMMARY: Shape & Filter Parameters

% COBBLES	---	D60	0.704	D85	1.23
% GRAVEL	0	D30	0.482	D50	0.62
% SAND	98.9	D10	0.149	D15	0.18
% FINES	1.1	Cu =	4.7	Cc =	2.2

* Denotes sieve added to better define gradation curve

Cc = D30^2 / (D60 * D10)

Cu = D60 / D10

(1) X in box denotes sieve on which split was made.

(2) Proposed allowable amount of soil retained on 8" dia. sieve.

(3) Sieve size given, denotes min. sieve size used in the appropriate sieving sequence.

The above values D## denotes particle size (mm) at the corresponding percent passing.

Mica Noted: x No | Yes Amount Adjective:

Particle Hardness

x Hard | Soft | Weathered

SET-UP BY: TJO DATE 07/30/12 CALCULATED BY: TJO CHECKED BY: YS

SUBMITTED BY: Thomas J. O'Mara

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

PARTICLE-SIZE ANALYSIS : by Hydrometer

ASTM C117 or D422 or if Double Hydrometer Performed, D4221

Project Number: 12206A Task Number: Boring No.: U2C10

Project Name: SONGS LOED permitting Sample No.: ---

Project Engineer: E Miller Depth (ft): ---

Visual Description: Brown poorly graded Sand (SP)

State of Specimen before Processing	
	Moist State / Oven Dried
x	Air Dried
	See bulk sample proc. form (S-106)
Soil broken up by:	Other:
	Mortar & pestle
x	Passing soil through #10 sieve or
Dispersing Agent:(1)	
x	125ml Std. 4% or ____ solution
	Other
Date Soaking Initiated:	7/31/2012
Time Soaked: x	Overnight / Other
x	ASTM Dispersion Cup & Mixer used for 1 min
	Air dispersion device used for ____ min
	Other
Defoaming Agent Used:	X No; / Yes

Oven- or Air-Dried Set-Up	
Drying container No.	
Mass Container+Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil (g)	

Set-Up Water Content	x	Minus No. 10 / or
Container No.		L21
Mass Container + Wet Soil (g), M1		372.89
Mass Container + Dry Soil (g), M2		372.15
Mass Container (g), M3		136.53
Water Content, w (%)		**0.31**

Test Notes: (1) Dispersing Agent is Sodium Hexametaphosphate

Mass of Dry Soil Used in Test, Ws	
For Oven-dry set-up, Ws (g)	
For Moist or ____ set-up	
Wwet = Estimated Ws x (1 + w)	
Est = ____ x (1 + ____) =	
Act (Wwet) =	110.43 (g)
Ws = Wwet /(1 + w/100) =	110.08 (g)
After Test Actual Ws	
Container No.	
Mass Container + Dispersant + Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil + Dispersant (g)	
Mass Dispersant (g)	
Mass Dry Soil (g)	

Soaking Beaker No. 827 Graduate No. 11 152H Hydrometer No. 972 Meniscus Correction, Cm = calibrated (3)

Date 12 (yr) (m:d)	Time (hr:min)	Elapsed Time (min)	Temp (ºC)	Hyd. Reading Soil (2) R	Hyd. Reading Water (3) Rw	Diameter D (mm)	Total specimen % finer N'
8/1	8:25	0		XXXXXXXX		XXXXXXXX	XXXXXXX
		1	24.0	1.5	--	--	--
		2	24.0	2.0	1.6	0.0365	0.3
		5	24.0	2.0	1.6	0.0231	0.3
		10	24.0	2.0	1.6	0.0163	0.3
		32	23.9	2.5	1.8	0.0091	0.5
		91	23.8	3.0	1.9	0.0054	0.9
		283	24.0	2.5	1.6	0.0031	0.7
		583	24.5	2.0	1.0	0.0021	0.8
		1436	23.7	2.0	2.0	0.0014	0.0

Sieving Performed on Hyd. Test Spec.	
Complete Sieve Analysis Performed: See Form S-104	Yes / No
x Wash analysis performed to check appropriateness of hyd. spec.	
Container No.	X16
Mass Container + Dry Soil (g)	242.16
Mass Container (g)	133.34
Total Specimen % Finer	1.0

Dry Sieving After Washing

Sieve No.	Cumulative Mass Retained (g)	Total Specimen % Finer, N'
40	86.8	18.4
100	108.22	1.5
200	108.81	1.0
Pan	108.82	XXXXXXX

Calculations: Average Temperature used in calculating test, ºC = 24.0

"X" in temperature column indicates where actural temperature used, and this value not included in the average.

Specific Gravity, Gs = 2.70

N'= a Pc (R - Rw) / Ws = (Total % finer Factor) x (R - Rw)

D (mm) = K $\sqrt{L / t}$ Tested / x Assumed

a = 0.99 from Table 1 (D 422) or ____

K from Table A1.3 (Draft Std.), K = 0.01282

Pc = Percent of soil passing No. 10 sieve = 87.1 %

Cal. Notes: (2) Soil, Water & Dispersion Solution

Ws = Dry mass of soil placed in cylinder = 110.08 g

(3) Water & Dispersion Solution

Total % finer Factor = (a*Pc/Ws) = 0.783

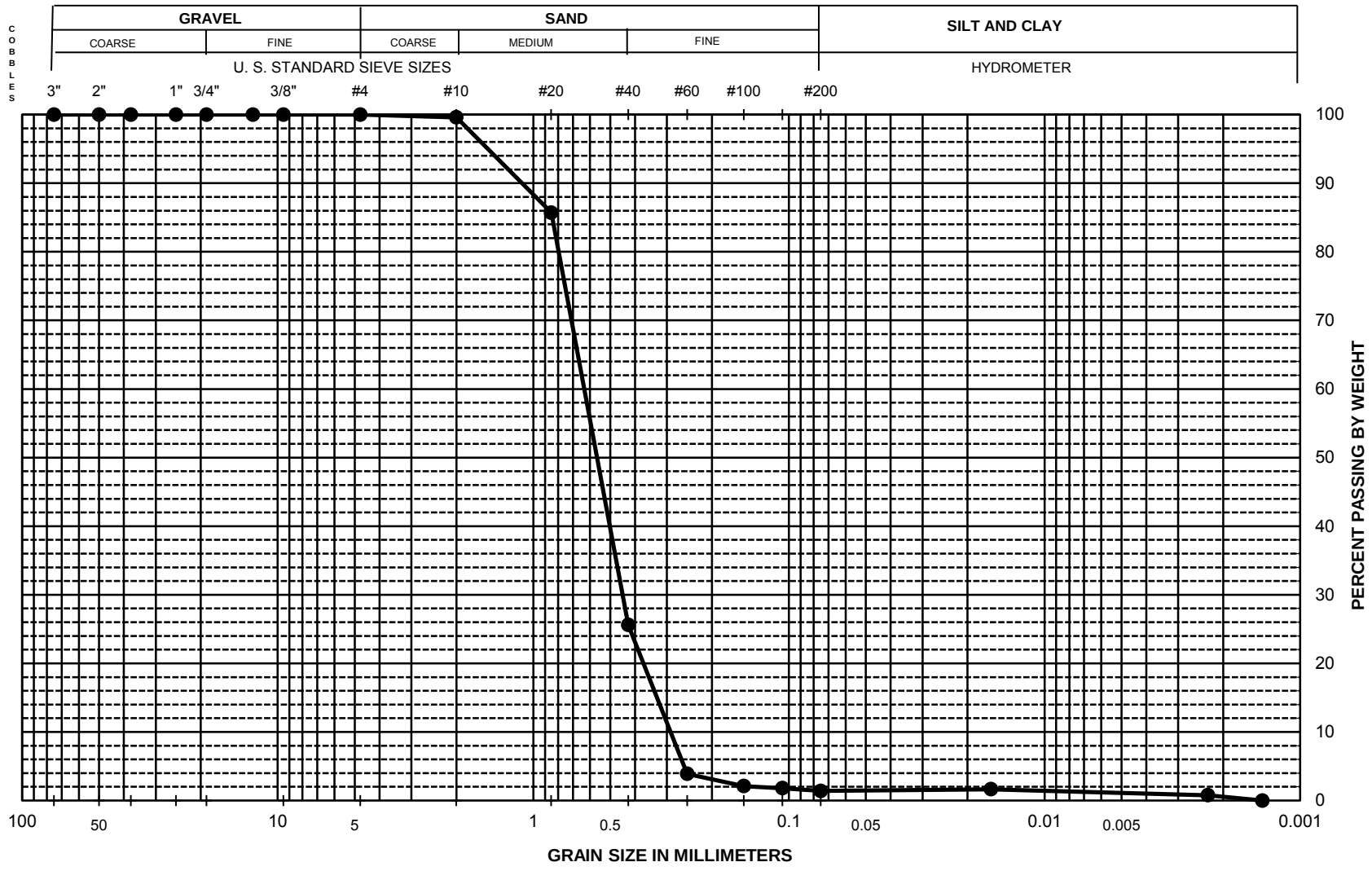
D(mm) = {(16.3 -(R-Rw)*0.164) / time}^0.5 *K

Remarks:

SET-UP BY: TJO RUN BY: YS CALCULATED BY: YS REVIEWED BY: TJO

SUBMITTED BY: Thomas J O'Mara

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	100.0
#4	4.75	100.0
#10	2.00	99.6
#20	0.850	85.7
#40	0.425	25.6
#60	0.250	3.9
#100	0.150	2.1
#140	0.106	1.8
#200	0.075	1.4
Hydrometer Analysis	0.0162	1.6
	0.0023	0.8
	0.0014	0.0

% Cobbles	--
% Gravel	0.0
% Sand	98.6
% Fines	1.4

D_{85}	0.8432
D_{60}	0.6320
D_{30}	0.4471
D_{15}	0.3280
D_{10}	0.2902
C_u	2.2
C_c	1.1

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
U2C1	---	---	●	NA	NA	NA	1	**Dark gray poorly graded Sand with seashells (SP)**

PROJECT NAME: **SONGS LOED permitting**

PROJECT NUMBER: **12206A**

PARTICLE-SIZE DISTRIBUTION CURVES

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

GRADATION OF SOILS by Sieving using Soil Sieve Sizes & with Water Content

ASTM D6913, D422 and D2216

Project Number: 12206A | Task Number: | Boring No.: U2C1

Project Name: SONGS LOED permitting | Sample No.: ---

Project Engineer: E Miller | Depth (ft): ---

Visual Description: Dark gray poorly graded Sand with seashells (SP)

SPECIMEN: Selected From:

Bulk Sample	x		Other - Jar
SPT Sample			Thin-Walled Tube
Calif. Sample			Engr. Test Specimen's WC
			Whole sample used
			See Bulk Sample Processing Form

Selection Method:

		Sieves (1) - whole sample used
x		Sieves (1) - partial sample used & selected by Method(s)
c		Method

(a): Splitter; (use for dry soils or that which will segregate)

(b): Quartering; (use for dry soils or that which will segregate)

(c) : Representative scoop after mixing, or slice of intact sample. (use for moist soils or that which will not segregate)

Preparation: Sample/Specimen:

As-Received	x
Air Dried	
Oven-Dried	

Test Method

Method A	
Method B	x

Oven-Dried Soil Broken Up Before:

Selecting partial sample: No x | Yes

Washing:

	No	Yes
Whole Specimen Washed on No. 200 sieve ?		x
Retained Fraction: 1st Split Washed ?		
Fine Fraction Washed on No. 200 sieve ?		

By: Mortar & Pestle | Hand | Pulverizer | Other

and Soil Soaked for: ~6 hrs.

MASS OF TEST SPECIMEN (g)	Total Test Specimen with Coarse Fraction	Partial or Whole Test Specimen	Soil Retained (after washing)	**Water Content** As Recieved or Container No.	
Min.sieve size in sieving sequence (3)	#N/A	# 200	+200	Wet, M1 (g)	
Container Number		SF7	SF7	Dry, M2 (g)	XXX
Mass of Container and Dry Soil, (g)		512.56	507.73	Cont.,M3 (g)	XXX
Mass of Container, (g)		153.84	153.9	**Water Content (%)**	**NA**
Dry Soil, Ws (g)		358.72	353.83		

SIEVING RESULTS % error: 0.03

See (1)	Sieve No.	Cum. Mass Retained (g)	Total Specimen % Finer N'
	3 "		
	2 "		
	1 1/2"		
	1 "		
	3/4 "		
	1/2 "		
	3/8 "		
	4		
	Pan		XXXXXXXX

Req. Mass of Test Spec. for 1% (kg)
3"= 70
1 1/2"=10
3/4"= 1.1
3/8"= 0.25
#4 = 0.1
#10 = 0.1

Shape of Grains

	Rounded
x	Angular
	Flat

Sieve No.	Sieve mm	Cum. Mass Retained (g)	Partial Test Specimen	Total Specimen % Finer N'
3 "	75			
2 "	50			
1-1/2"	37.5			
1 "	25			
3/4 "	19			
1/2 "	12.5			
3/8 "	9.5	0		100
#4	325	0.09	seashells	100
#10	180	1.54	seashells	99.6
#20	115	51.46		85.7
#40	75	266.81		25.6
#60	60	344.67		3.9
#100	40	351.13		2.1
#140*	30	352.22		1.8
#200	20	353.63		1.4
Pan		353.73	XXXXXXXX	XXXXXXXXXX

SUMMARY: Shape & Filter Parameters

% COBBLES	---	D60	0.632	D85	0.84
% GRAVEL	0	D30	0.447	D50	0.56
% SAND	98.6	D10	0.290	D15	0.33
% FINES	1.4	Cu =	2.2	Cc =	1.1

* Denotes sieve added to better define gradation curve

Cc = D30^2 / (D60 * D10)

Cu = D60 / D10

(1) X in box denotes sieve on which split was made.

(2) Proposed allowable amount of soil retained on 8" dia. sieve.

(3) Sieve size given, denotes min. sieve size used in the appropriate sieving sequence.

The above values D## denotes particle size (mm) at the corresponding percent passing.

Mica Noted: x No | Yes Amount Adjective:

Particle Hardness

x Hard | Soft | Weathered

SET-UP BY: TJO DATE 07/30/12 CALCULATED BY: TJO CHECKED BY: YS

SUBMITTED BY: Thomas J. O'Mara

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

PARTICLE-SIZE ANALYSIS : by Hydrometer

ASTM C117 or D422 or if Double Hydrometer Performed, D4221

Project Number: 12206A Task Number: Boring No.: U2C1

Project Name: SONGS LOED permitting Sample No.: ---

Project Engineer: E Miller Depth (ft): ---

Visual Description: Dark gray poorly graded Sand with seashells (SP)

State of Specimen before Processing	
	Moist State ☐ Oven Dried
x	Air Dried
	See bulk sample proc. form (S-106)
Soil broken up by:	Other:
	Mortar & pestle
x	Passing soil through #10 sieve or
Dispersing Agent:(1)	
x	125ml Std. 4% or ____ solution
	Other
Date Soaking Initiated:	7/31/2012
Time Soaked:	x Overnight; Other
x	ASTM Dispersion Cup & Mixer used for 1 min
	Air dispersion device used for ____ min
	Other
Defoaming Agent Used:	X No; ☐ Yes

Oven- or Air-Dried Set-Up	
Drying container No.	
Mass Container+Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil (g)	

Set-Up Water Content	x	Minus No. 10 or
Container No.		m66
Mass Container + Wet Soil (g), M1		338.92
Mass Container + Dry Soil (g), M2		338.58
Mass Container (g), M3		101.66
Water Content, w (%)		**0.14**

Test Notes: (1) Dispersing Agent is Sodium Hexametaphosphate

Mass of Dry Soil Used in Test, Ws	
For Oven-dry set-up, Ws (g)	
For Moist or ____ set-up	
Wwet = Estimated Ws x (1 + w)	
Est = ____ x (1 + ____) =	
Act (Wwet) =	99.03 (g)
Ws = Wwet /(1 + w/100) =	98.89 (g)
After Test Actual Ws	
Container No.	
Mass Container + Dispersant + Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil + Dispersant (g)	
Mass Dispersant (g)	
Mass Dry Soil (g)	

Soaking Beaker No. 832 Graduate No. 2 152H Hydrometer No. 972 Meniscus Correction, Cm = calibrated (3)

Date 12 (yr) (m:d)	Time (hr:min)	Elapsed Time (min)	Temp (ºC)	Hyd. Reading Soil (2) R	Hyd. Reading Water (3) Rw	Diameter D (mm)	Total specimen % finer N'
8/1	9:53	0		XXXXXXXX		XXXXXXXX	XXXXXXX
		1	24.2	2.0	1.4	0.0515	0.6
		2	24.2	2.0	1.4	0.0364	0.6
		5	24.2	3.0	1.4	0.0229	1.6
		10	24.3	3.0	1.3	0.0162	1.6
		31	24.2	3.0	1.4	0.0092	1.6
		90	24.1	2.5	1.5	0.0054	1.0
		204	24.0	2.5	1.6	0.0036	0.9
		504	24.4	2.0	1.2	0.0023	0.8
		1357	23.7	2.0	2.0	0.0014	0.0

Sieving Performed on Hyd. Test Spec.	
Complete Sieve Analysis Performed: See Form S-104	☐ Yes ☐ No
x	Wash analysis performed to check appropriateness of hyd. spec.
Container No.	sf6
Mass Container + Dry Soil (g)	244.2
Mass Container (g)	147.18
Total Specimen % Finer	1.8

Dry Sieving After Washing

Sieve No.	Cumulative Mass Retained (g)	Total Specimen % Finer, N'
40	69.38	28.9
100	95.85	3.0
200	96.95	1.9
Pan	96.95	XXXXXXX

Calculations: Average Temperature used in calculating test, ºC = 24.1

"X" in temperature column indicates where actural temperature used, and this value not included in the average.

Specific Gravity, Gs = 2.70

N'= a Pc (R - Rw) / Ws = (Total % finer Factor) x (R - Rw)

D (mm) = K $\sqrt{L / t}$ ☐ Tested x Assumed

a = 0.99 from Table 1 (D 422) or ____

K from Table A1.3 (Draft Std.), K = 0.01280

Pc = Percent of soil passing No. 10 sieve = 96.8 %

Ws = Dry mass of soil placed in cylinder = 98.89 g

Total % finer Factor = (a*Pc/Ws) = 0.969

Cal. Notes: (2) Soil, Water & Dispersion Solution

(3) Water & Dispersion Solution

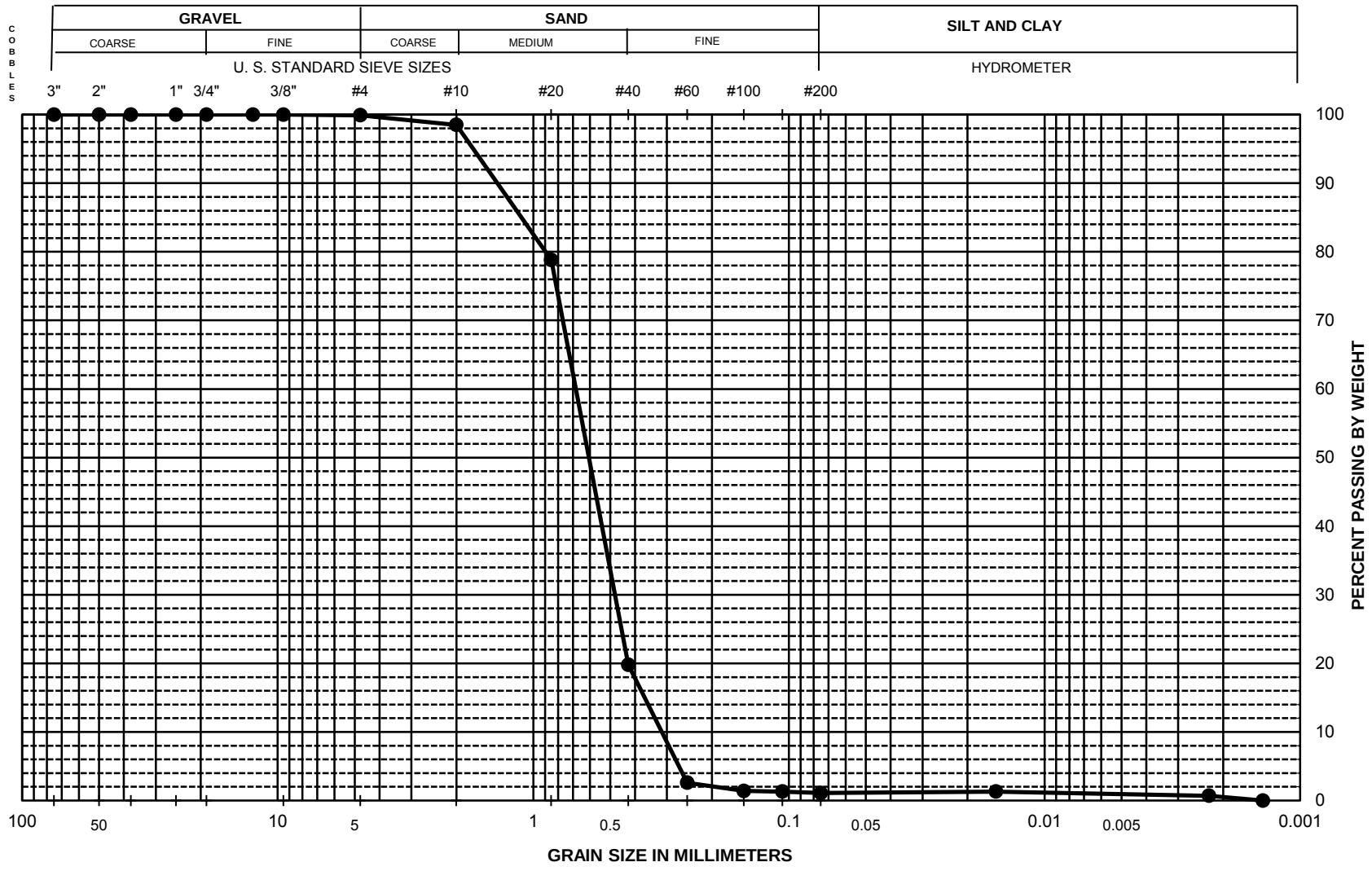
D(mm) = {(16.3 -(R-Rw)*0.164) / time}^0.5 *K

Remarks:

SET-UP BY: TJO RUN BY: YS CALCULATED BY: YS REVIEWED BY: TJO

SUBMITTED BY: Thomas J O'Mara

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	100.0
#4	4.75	99.9
#10	2.00	98.5
#20	0.850	78.8
#40	0.425	19.8
#60	0.250	2.6
#100	0.150	1.4
#140	0.106	1.3
#200	0.075	1.1
Hydrometer Analysis	0.0155	1.3
	0.0023	0.7
	0.0014	0.0

% Cobbles	--
% Gravel	0.1
% Sand	98.8
% Fines	1.1

D_{85}	1.1127
D_{60}	0.6815
D_{30}	0.4791
D_{15}	0.3665
D_{10}	0.3141
C_u	2.2
C_c	1.1

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
U2C2	---	---	●	NA	NA	NA	1	**Brown poorly graded Sand with seashells (SP)**

PROJECT NAME: **SONGS LOED permitting**

PROJECT NUMBER: **12206A**

PARTICLE-SIZE DISTRIBUTION CURVES

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

GRADATION OF SOILS by Sieving using Soil Sieve Sizes & with Water Content

ASTM D6913, D422 and D2216

Project Number: 12206A | Task Number: | Boring No.: U2C2

Project Name: SONGS LOED permitting | Sample No.: ---

Project Engineer: E Miller | Depth (ft): ---

Visual Description: Brown poorly graded Sand with seashells (SP)

SPECIMEN: Selected From:

Bulk Sample	x		Other - Jar
SPT Sample			Thin-Walled Tube
Calif. Sample			Engr. Test Specimen's WC
			Whole sample used
			See Bulk Sample Processing Form

Selection Method:

	Sieves (1) - whole sample used
x	Sieves (1) - partial sample used & selected by Method(s)
c	Method

(a): Splitter; (use for dry soils or that which will segregate)
(b): Quartering; (use for dry soils or that which will segregate)
(c) : Representative scoop after mixing, or slice of intact sample. (use for moist soils or that which will not segregate)

Preparation: Sample/Specimen:

As-Received	x
Air Dried	
Oven-Dried	

Test Method

Method A	
Method B	x

Oven-Dried Soil Broken Up Before:

Selecting partial sample: No x | Yes

By: Mortar & Pestle | Hand | Pulverizer | Other

Washing:

	No	Yes
Whole Specimen Washed on No. 200 sieve ?		x
Retained Fraction: 1st Split Washed ?		
Fine Fraction Washed on No. 200 sieve ?		

and Soil Soaked for: ~6 hrs.

MASS OF TEST SPECIMEN (g)	Total Test Specimen with Coarse Fraction	Partial or Whole Test Specimen	Soil Retained (after washing)	**Water Content** As Recieved or Container No.	
Min.sieve size in sieving sequence (3)	#N/A	# 200	+200	Wet, M1 (g)	
Container Number		x17	x17	Dry, M2 (g)	XXX
Mass of Container and Dry Soil, (g)		489.25	485.59	Cont.,M3 (g)	XXX
Mass of Container, (g)		139.29	139.32	**Water Content (%)**	**NA**
Dry Soil, Ws (g)		349.96	346.27		

SIEVING RESULTS % error: 0.03

See (1)	Sieve No.	Cum. Mass Retained (g)	Total Specimen % Finer N'
	3 "		
	2 "		
	1 1/2"		
	1 "		
	3/4 "		
	1/2 "		
	3/8 "		
	4		
	Pan		XXXXXXXX

Req. Mass of Test Spec. for 1% (kg)
3"= 70
1 1/2"=10
3/4"= 1.1
3/8"= 0.25
#4 = 0.1
#10 = 0.1

Shape of Grains

	Rounded
x	Angular
	Flat

Sieve No.	Sieve mm	Cum. Mass Retained (g)	Partial Test Specimen	Total Specimen % Finer N'
3 "	75			
2 "	50			
1-1/2"	37.5			
1 "	25			
3/4 "	19			
1/2 "	12.5			
3/8 "	9.5	0		100
#4	325	0.2	seashells	99.9
#10	180	5.19		98.5
#20	115	74.17		78.8
#40	75	280.52		19.8
#60	60	340.93		2.6
#100	40	345.01		1.4
#140*	30	345.53		1.3
#200	20	346.11		1.1
Pan		346.18	XXXXXXXX	XXXXXXXXXX

SUMMARY: Shape & Filter Parameters

% COBBLES	---	D60	0.682	D85	1.11
% GRAVEL	0.1	D30	0.479	D50	0.61
% SAND	98.8	D10	0.314	D15	0.37
% FINES	1.1	Cu =	2.2	Cc =	1.1

* Denotes sieve added to better define gradation curve

Cc = D30^2 / (D60 * D10)

Cu = D60 / D10

(1) X in box denotes sieve on which split was made.

(2) Proposed allowable amount of soil retained on 8" dia. sieve.

(3) Sieve size given, denotes min. sieve size used in the appropriate sieving sequence.

The above values D## denotes particle size (mm) at the corresponding percent passing.

Mica Noted: x No | Yes Amount Adjective:

Particle Hardness

x Hard | Soft | Weathered

SET-UP BY: TJO DATE 07/30/12 CALCULATED BY: TJO CHECKED BY: YS

SUBMITTED BY: Thomas J. O'Mara

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

PARTICLE-SIZE ANALYSIS : by Hydrometer

ASTM C117 or D422 or if Double Hydrometer Performed, D4221

Project Number: 12206A Task Number: Boring No.: U2C2

Project Name: SONGS LOED permitting Sample No.: ---

Project Engineer: E Miller Depth (ft): ---

Visual Description: Brown poorly graded Sand with seashells (SP)

State of Specimen before Processing	
	Moist State / Oven Dried
x	Air Dried
	See bulk sample proc. form (S-106)
Soil broken up by:	Other:
	Mortar & pestle
x	Passing soil through #10 sieve or
Dispersing Agent:(1)	
x	125ml Std. 4% or ____ solution
	Other
Date Soaking Initiated:	7/31/2012
Time Soaked: x	Overnight / Other
x	ASTM Dispersion Cup & Mixer used for 1 min
	Air dispersion device used for ____ min
	Other
Defoaming Agent Used:	X No; / Yes

Oven- or Air-Dried Set-Up	
Drying container No.	
Mass Container+Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil (g)	

Set-Up Water Content	x	Minus No. 10 / or
Container No.		m71
Mass Container + Wet Soil (g), M1		296.3
Mass Container + Dry Soil (g), M2		295.96
Mass Container (g), M3		109.29
Water Content, w (%)		**0.18**

Test Notes: (1) Dispersing Agent is Sodium Hexametaphosphate

Mass of Dry Soil Used in Test, Ws	
For Oven-dry set-up, Ws (g)	
For Moist or ____ set-up	
Wwet = Estimated Ws x (1 + w)	
Est = ____ x (1 + ____) =	
Act (Wwet) =	113.41 (g)
Ws = Wwet /(1 + w/100) =	113.20 (g)
After Test Actual Ws	
Container No.	
Mass Container + Dispersant + Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil + Dispersant (g)	
Mass Dispersant (g)	
Mass Dry Soil (g)	

Soaking Beaker No. 839 Graduate No. 12 152H Hydrometer No. 972 Meniscus Correction, Cm = calibrated (3)

Date 12 (yr) (m:d)	Time (hr:min)	Elapsed Time (min)	Temp (ºC)	Hyd. Reading Soil (2) R	Hyd. Reading Water (3) Rw	Diameter D (mm)	Total specimen % finer N'
8/1	9:39	0		XXXXXXXX		XXXXXXXX	XXXXXXX
		1	24.1	2.0	1.5	0.0516	0.4
		2	24.1	3.0	1.5	0.0363	1.3
		5	24.1	3.0	1.5	0.0230	1.3
		11	24.1	3.0	1.5	0.0155	1.3
		30	24.1	3.0	1.5	0.0094	1.3
		90	24.0	2.5	1.6	0.0054	0.8
		214	24.0	2.5	1.6	0.0035	0.8
		514	24.4	2.0	1.2	0.0023	0.7
		1369	23.7	2.0	2.0	0.0014	0.0

Sieving Performed on Hyd. Test Spec.	
Complete Sieve Analysis Performed: See Form S-104	Yes / No
x Wash analysis performed to check appropriateness of hyd. spec.	
Container No.	x8
Mass Container + Dry Soil (g)	251.31
Mass Container (g)	139.8
Total Specimen % Finer	1.5

Dry Sieving After Washing		
Sieve No.	Cumulative Mass Retained (g)	Total Specimen % Finer, N'
40	90.44	19.9
100	110.72	2.2
200	111.47	1.5
Pan	111.49	XXXXXXX

Calculations: Average Temperature used in calculating test, ºC = 24.1

"X" in temperature column indicates where actural temperature used, and this value not included in the average.

Specific Gravity, Gs = 2.70

N'= a Pc (R - Rw) / Ws = (Total % finer Factor) x (R - Rw)

D (mm) = K $\sqrt{L / t}$ Tested / x Assumed

a = 0.99 from Table 1 (D 422) or ____

K from Table A1.3 (Draft Std.), K = 0.01281

Pc = Percent of soil passing No. 10 sieve = 99.1 %

Cal. Notes: (2) Soil, Water & Dispersion Solution

Ws = Dry mass of soil placed in cylinder = 113.20 g

(3) Water & Dispersion Solution

Total % finer Factor = (a*Pc/Ws) = 0.867

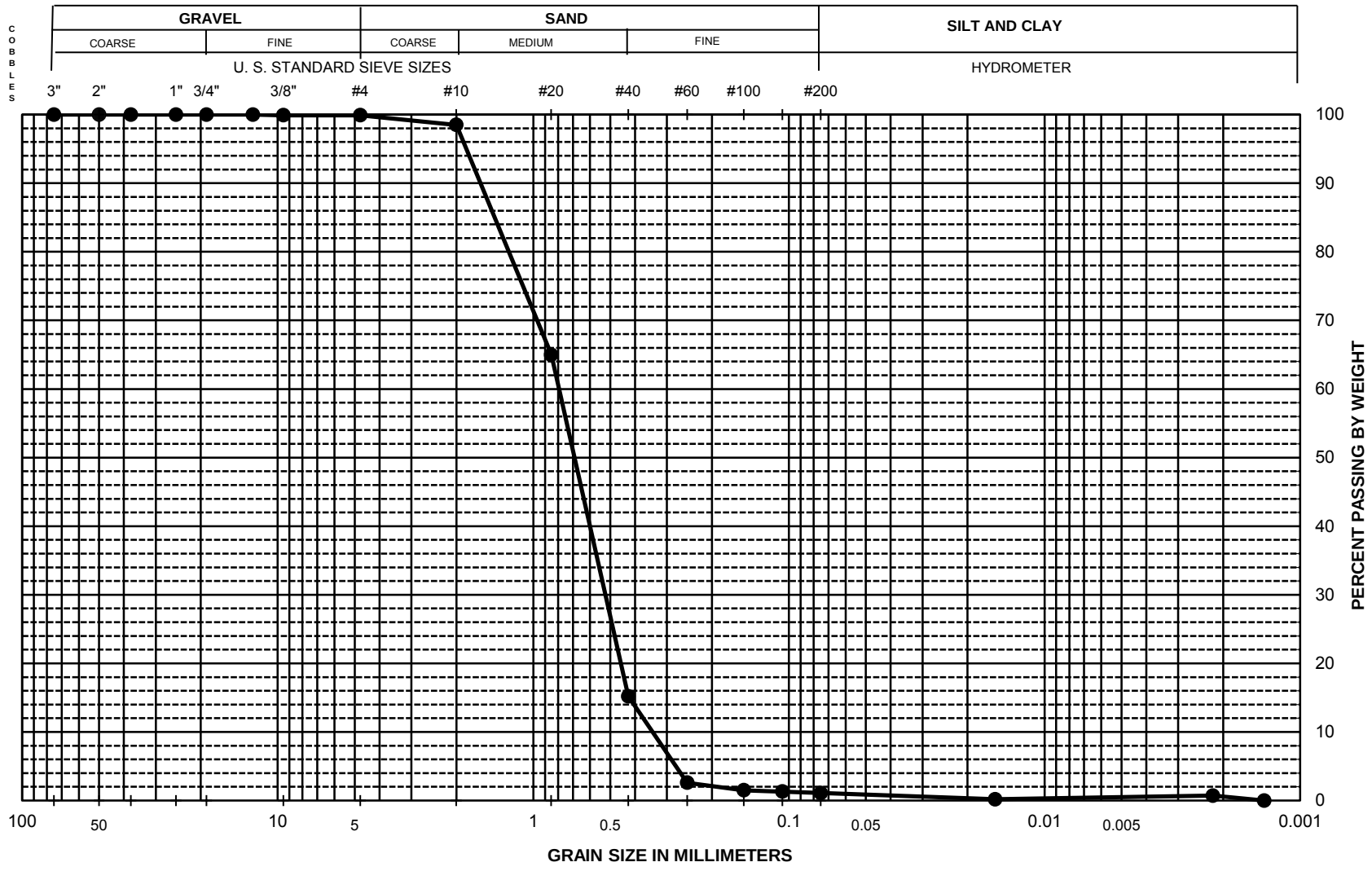
D(mm) = {(16.3 -(R-Rw)*0.164) / time}^0.5 *K

Remarks:

SET-UP BY: TJO RUN BY: YS CALCULATED BY: YS REVIEWED BY: TJO

SUBMITTED BY: Thomas J O'Mara

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	99.9
#4	4.75	99.9
#10	2.00	98.5
#20	0.850	65.0
#40	0.425	15.2
#60	0.250	2.6
#100	0.150	1.5
#140	0.106	1.3
#200	0.075	1.1
Hydrometer Analysis	0.0156	0.2
	0.0022	0.7
	0.0014	0.0

% Cobbles	--
% Gravel	0.1
% Sand	98.8
% Fines	1.1

D_{85}	1.4167
D_{60}	0.7929
D_{30}	0.5222
D_{15}	0.1797
D_{10}	0.1482
C_u	5.3
C_c	2.3

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
U2C3	---	---	●	NA	NA	NA	1	**Brown poorly graded Sand with seashells (SP)**

PROJECT NAME: **SONGS LOED permitting**

PROJECT NUMBER: **12206A**

PARTICLE-SIZE DISTRIBUTION CURVES

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

GRADATION OF SOILS by Sieving using Soil Sieve Sizes & with Water Content

ASTM D6913, D422 and D2216

Project Number: 12206A | Task Number: | Boring No.: U2C3

Project Name: SONGS LOED permitting | Sample No.: ---

Project Engineer: E Miller | Depth (ft): ---

Visual Description: Brown poorly graded Sand with seashells (SP)

SPECIMEN: Selected From:

Bulk Sample	x		Other - Jar
SPT Sample			Thin-Walled Tube
Calif. Sample			Engr. Test Specimen's WC
			Whole sample used
			See Bulk Sample Processing Form

Selection Method:

		Sieves (1) - whole sample used
x		Sieves (1) - partial sample used & selected by Method(s)
c		Method

(a): Splitter; (use for dry soils or that which will segregate)

(b): Quartering; (use for dry soils or that which will segregate)

(c) : Representative scoop after mixing, or slice of intact sample. (use for moist soils or that which will not segregate)

Preparation: Sample/Specimen:

As-Received	x
Air Dried	
Oven-Dried	

Test Method

Method A	
Method B	x

Oven-Dried Soil Broken Up Before:

Selecting partial sample: No x | Yes

By: Mortar & Pestle | Hand | Pulverizer | Other

Washing:

	No	Yes
Whole Specimen Washed on No. 200 sieve ?		x
Retained Fraction: 1st Split Washed ?		
Fine Fraction Washed on No. 200 sieve ?		

and Soil Soaked for: ~6 hrs.

MASS OF TEST SPECIMEN (g)	Total Test Specimen with Coarse Fraction	Partial or Whole Test Specimen	Soil Retained (after washing)	**Water Content** As Recieved or Container No.	
Min.sieve size in sieving sequence (3)	#N/A	# 200	+200	Wet, M1 (g)	
Container Number		x28	x28	Dry, M2 (g)	XXX
Mass of Container and Dry Soil, (g)		517.77	514.22	Cont.,M3 (g)	XXX
Mass of Container, (g)		153.4	153.4	**Water Content (%)**	**NA**
Dry Soil, Ws (g)		364.37	360.82		

SIEVING RESULTS % error: 0.06

See (1)	Sieve No.	Cum. Mass Retained (g)	Total Specimen % Finer N'
	3 "		
	2 "		
	1 1/2"		
	1 "		
	3/4 "		
	1/2 "		
	3/8 "		
	4		
	Pan		XXXXXXXX

Req. Mass of Test Spec. for 1% (kg)
3"= 70
1 1/2"=10
3/4"= 1.1
3/8"= 0.25
#4 = 0.1
#10 = 0.1

Shape of Grains

	Rounded
x	Angular
	Flat

Sieve No.	mm	Cum. Mass Retained (g)	Partial Test Specimen	Total Specimen % Finer N'
3 "	75			
2 "	50			
1-1/2"	37.5			
1 "	25			
3/4 "	19			
1/2 "	12.5	0		100
3/8 "	9.5	0.44	seashells	99.9
#4	325	0.46	seashells	99.9
#10	180	5.47		98.5
#20	115	127.63		65
#40	75	309.14		15.2
#60	60	354.85		2.6
#100	40	358.89		1.5
#140*	30	359.64		1.3
#200	20	360.52		1.1
Pan		360.59	XXXXXXXX	XXXXXXXXXX

SUMMARY: Shape & Filter Parameters

% COBBLES	---	D60	0.793	D85	1.42
% GRAVEL	0.1	D30	0.522	D50	0.69
% SAND	98.8	D10	0.148	D15	0.18
% FINES	1.1	Cu =	5.3	Cc =	2.3

* Denotes sieve added to better define gradation curve

Cc = D30^2 / (D60 * D10)

Cu = D60 / D10

(1) X in box denotes sieve on which split was made.

(2) Proposed allowable amount of soil retained on 8" dia. sieve.

Mica Noted: x No | Yes Amount Adjective:

(3) Sieve size given, denotes min. sieve size used in the appropriate sieving sequence.

The above values D## denotes particle size (mm) at the corresponding percent passing.

Particle Hardness

x Hard | Soft | Weathered

SET-UP BY: TJO DATE 07/30/12 CALCULATED BY: TJO CHECKED BY: YS

SUBMITTED BY: Thomas J. O'Mara

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

PARTICLE-SIZE ANALYSIS : by Hydrometer

ASTM C117 or D422 or if Double Hydrometer Performed, D4221

Project Number: 12206A Task Number: Boring No.: U2C3

Project Name: SONGS LOED permitting Sample No.: ---

Project Engineer: E Miller Depth (ft): ---

Visual Description: Brown poorly graded Sand with seashells (SP)

State of Specimen before Processing	
	Moist State ☐ Oven Dried
x	Air Dried
	See bulk sample proc. form (S-106)
Soil broken up by:	Other:
	Mortar & pestle
x	Passing soil through #10 sieve or
Dispersing Agent:(1)	
x	125ml Std. 4% or ____ solution
	Other
Date Soaking Initiated:	7/31/2012
Time Soaked:	x Overnight; Other
x	ASTM Dispersion Cup & Mixer used for 1 min
	Air dispersion device used for ____ min
	Other
Defoaming Agent Used:	X No; ☐ Yes

Oven- or Air-Dried Set-Up	
Drying container No.	
Mass Container+Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil (g)	

Set-Up Water Content	x Minus No. 10 ☐ or
Container No.	f-110
Mass Container + Wet Soil (g), M1	319.56
Mass Container + Dry Soil (g), M2	319.16
Mass Container (g), M3	109.55
Water Content, w (%)	**0.19**

Test Notes: (1) Dispersing Agent is Sodium Hexametaphosphate

Mass of Dry Soil Used in Test, Ws	
For Oven-dry set-up, Ws (g)	
For Moist or ____ set-up	
Wwet = Estimated Ws x (1 + w)	
Est = ____ x (1 + ____) =	
Act (Wwet) =	110.20 (g)
Ws = Wwet /(1 + w/100) =	109.99 (g)
After Test Actual Ws	
Container No.	
Mass Container + Dispersant + Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil + Dispersant (g)	
Mass Dispersant (g)	
Mass Dry Soil (g)	

Soaking Beaker No. 839 Graduate No. 12 152H Hydrometer No. 972 Meniscus Correction, Cm = calibrated (3)

Date 12 (yr) (m:d)	Time (hr:min)	Elapsed Time (min)	Temp (ºC)	Hyd. Reading Soil (2) R	Hyd. Reading Water (3) Rw	Diameter D (mm)	Total specimen % finer N'
8/1	9:00	0		XXXXXXXX		XXXXXXXX	XXXXXXX
		1	23.8	1.0	--	--	--
		2	23.8	1.0	--	--	--
		5	24.0	2.0	1.6	0.0231	0.4
		11	23.9	2.0	1.8	0.0156	0.2
		30	23.8	2.5	1.9	0.0094	0.5
		90	23.7	2.5	2.0	0.0054	0.4
		253	24.0	2.5	1.6	0.0032	0.8
		553	24.4	2.0	1.2	0.0022	0.7
		1406	23.7	2.0	2.0	0.0014	0.0

Sieving Performed on Hyd. Test Spec.	
Complete Sieve Analysis Performed: See Form S-104	☐ Yes ☐ No
x	Wash analysis performed to check appropriateness of hyd. spec.
Container No.	sf8
Mass Container + Dry Soil (g)	259.76
Mass Container (g)	151.28
Total Specimen % Finer	1.4

Dry Sieving After Washing

Sieve No.	Cumulative Mass Retained (g)	Total Specimen % Finer, N'
40	92.23	15.9
100	107.82	1.9
200	108.5	1.3
Pan	108.52	XXXXXXX

Calculations: Average Temperature used in calculating test, ºC = 23.9

"X" in temperature column indicates where actural temperature used, and this value not included in the average.

Specific Gravity, Gs = 2.70

N'= a Pc (R - Rw) / Ws = (Total % finer Factor) x (R - Rw)

D (mm) = K $\sqrt{L / t}$ ☐ Tested x Assumed

a = 0.99 from Table 1 (D 422) or ____

K from Table A1.3 (Draft Std.), K = 0.01284

Pc = Percent of soil passing No. 10 sieve = 98.7 %

Ws = Dry mass of soil placed in cylinder = 109.99 g

Total % finer Factor = (a*Pc/Ws) = 0.888

Cal. Notes: (2) Soil, Water & Dispersion Solution

(3) Water & Dispersion Solution

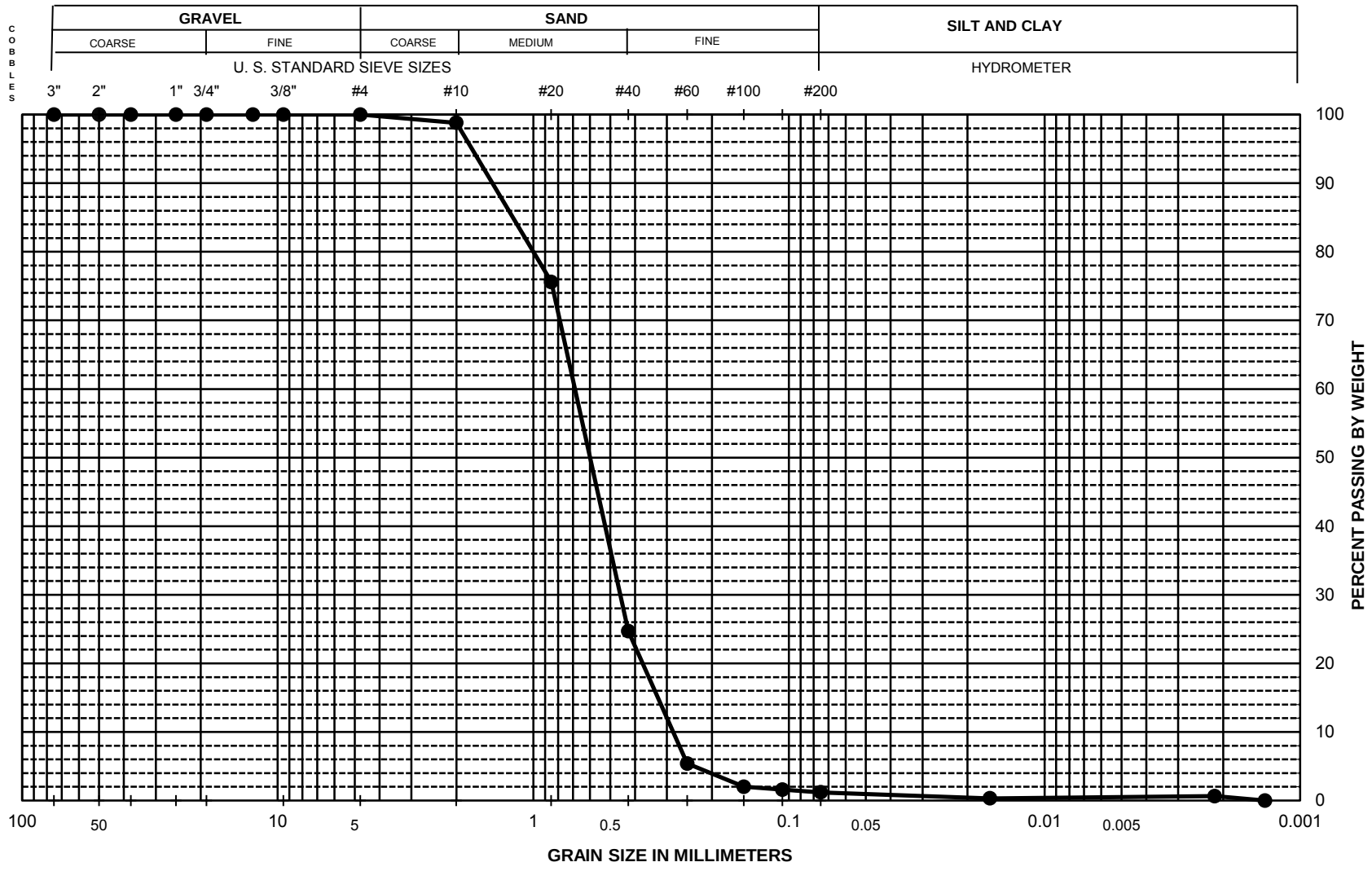
D(mm) = {(16.3 -(R-Rw)*0.164) / time}^0.5 *K

Remarks:

SET-UP BY: TJO RUN BY: YS CALCULATED BY: YS REVIEWED BY: TJO

SUBMITTED BY: Thomas J. O'Mara

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	100.0
#4	4.75	100.0
#10	2.00	98.8
#20	0.850	75.6
#40	0.425	24.7
#60	0.250	5.4
#100	0.150	2.0
#140	0.106	1.6
#200	0.075	1.2
Hydrometer Analysis	0.0163	0.3
	0.0022	0.6
	0.0014	0.0

% Cobbles	--
% Gravel	0.0
% Sand	98.8
% Fines	1.2

D_{85}	1.2022
D_{60}	0.6873
D_{30}	0.4568
D_{15}	0.1779
D_{10}	0.1466
C_u	4.7
C_c	2.1

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
U2C4	---	---	●	NA	NA	NA	1	**Brown poorly graded Sand (SP)**

PROJECT NAME: **SONGS LOED permitting**

PROJECT NUMBER: **12206A**

PARTICLE-SIZE DISTRIBUTION CURVES

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

GRADATION OF SOILS by Sieving using Soil Sieve Sizes & with Water Content

ASTM D6913, D422 and D2216

Project Number: 12206A | Task Number: | Boring No.: U2C4

Project Name: SONGS LOED permitting | Sample No.: ---

Project Engineer: E Miller | Depth (ft): ---

Visual Description: Brown poorly graded Sand (SP)

SPECIMEN: Selected From:

Bulk Sample	x		Other - Jar
SPT Sample			Thin-Walled Tube
Calif. Sample			Engr. Test Specimen's WC
			Whole sample used
			See Bulk Sample Processing Form

Selection Method:

		Sieves (1) - whole sample used
	x	Sieves (1) - partial sample used & selected by Method(s)
	c	Method

(a): Splitter; (use for dry soils or that which will segregate)

(b): Quartering; (use for dry soils or that which will segregate)

(c) : Representative scoop after mixing, or slice of intact sample. (use for moist soils or that which will not segregate)

Preparation: Sample/Specimen:

As-Received	x
Air Dried	
Oven-Dried	

Test Method

Method A	
Method B	x

Oven-Dried Soil Broken Up Before:

Selecting partial sample: No x | Yes

Washing:

	No	Yes
Whole Specimen Washed on No. 200 sieve ?		x
Retained Fraction: 1st Split Washed ?		
Fine Fraction Washed on No. 200 sieve ?		

By: Mortar & Pestle | Hand | Pulverizer | Other

and Soil Soaked for: ~6 hrs.

MASS OF TEST SPECIMEN (g)	Total Test Specimen with Coarse Fraction	Partial or Whole Test Specimen	Soil Retained (after washing)	**Water Content** As Recieved or Container No.
Min.sieve size in sieving sequence (3)	#N/A	# 200	+200	Wet, M1 (g)
Container Number		sf8	sf8	Dry, M2 (g) XXX
Mass of Container and Dry Soil, (g)		482.58	478.73	Cont.,M3 (g) XXX
Mass of Container, (g)		151.29	151.29	**Water Content (%)** **NA**
Dry Soil, Ws (g)		331.29	327.44	

SIEVING RESULTS % error: 0.06

See (1)	Sieve No.	Cum. Mass Retained (g)	Total Specimen % Finer N'
	3 "		
	2 "		
	1 1/2"		
	1 "		
	3/4 "		
	1/2 "		
	3/8 "		
	4		
	Pan		XXXXXXXX

Req. Mass of Test Spec. for 1% (kg)
3"= 70
1 1/2"=10
3/4"= 1.1
3/8"= 0.25
#4 = 0.1
#10 = 0.1

Shape of Grains

	Rounded
x	Angular
	Flat

Sieve No.	Sieve mm	Cum. Mass Retained (g)	Partial Test Specimen	Total Specimen % Finer N'
3 "	75			
2 "	50			
1-1/2"	37.5			
1 "	25			
3/4 "	19			
1/2 "	12.5			
3/8 "	9.5			
#4	325	0		100
#10	180	4.05		98.8
#20	115	80.68		75.6
#40	75	249.41		24.7
#60	60	313.4		5.4
#100	40	324.62		2
#140*	30	326.13		1.6
#200	20	327.19		1.2
Pan		327.23	XXXXXXXX	XXXXXXXXXX

SUMMARY: Shape & Filter Parameters

% COBBLES	---	D60	0.687	D85	1.20
% GRAVEL	0	D30	0.457	D50	0.60
% SAND	98.8	D10	0.147	D15	0.18
% FINES	1.2	Cu =	4.7	Cc =	2.1

* Denotes sieve added to better define gradation curve

Cc = D30^2 / (D60 * D10)

Cu = D60 / D10

(1) X in box denotes sieve on which split was made.

(2) Proposed allowable amount of soil retained on 8" dia. sieve.

(3) Sieve size given, denotes min. sieve size used in the appropriate sieving sequence.

The above values D## denotes particle size (mm) at the corresponding percent passing.

Mica Noted: x No | Yes Amount Adjective:

Particle Hardness

x Hard | Soft | Weathered

SET-UP BY: TJO DATE 07/30/12 CALCULATED BY: TJO CHECKED BY: YS

SUBMITTED BY: Thomas J. O'Mara

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

PARTICLE-SIZE ANALYSIS : by Hydrometer

ASTM C117 or D422 or if Double Hydrometer Performed, D4221

Project Number: 12206A Task Number: Boring No.: U2C4

Project Name: SONGS LOED permitting Sample No.: ---

Project Engineer: E Miller Depth (ft): ---

Visual Description: Brown poorly graded Sand (SP)

State of Specimen before Processing	
	Moist State / Oven Dried
x	Air Dried
	See bulk sample proc. form (S-106)
Soil broken up by:	Other:
	Mortar & pestle
x	Passing soil through #10 sieve or
Dispersing Agent:(1)	
x	125ml Std. 4% or ____ solution
	Other
Date Soaking Initiated:	7/31/2012
Time Soaked: x	Overnight / Other
x	ASTM Dispersion Cup & Mixer used for 1 min
	Air dispersion device used for ____ min
	Other
Defoaming Agent Used:	X No; / Yes

Oven- or Air-Dried Set-Up	
Drying container No.	
Mass Container+Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil (g)	

Set-Up Water Content	x	Minus No. 10 / or
Container No.		n51
Mass Container + Wet Soil (g), M1		323.96
Mass Container + Dry Soil (g), M2		323.66
Mass Container (g), M3		104.87
Water Content, w (%)		**0.14**

Test Notes: (1) Dispersing Agent is Sodium Hexametaphosphate

Mass of Dry Soil Used in Test, Ws	
For Oven-dry set-up, Ws (g)	
For Moist or ____ set-up	
Wwet = Estimated Ws x (1 + w)	
Est = ____ x (1 + ____) =	
Act (Wwet) =	109.12 (g)
Ws = Wwet /(1 + w/100) =	108.97 (g)
After Test Actual Ws	
Container No.	
Mass Container + Dispersant + Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil + Dispersant (g)	
Mass Dispersant (g)	
Mass Dry Soil (g)	

Soaking Beaker No. 833 Graduate No. 13 152H Hydrometer No. 972 Meniscus Correction, Cm = calibrated (3)

Date 12 (yr) (m:d)	Time (hr:min)	Elapsed Time (min)	Temp (ºC)	Hyd. Reading Soil (2) R	Hyd. Reading Water (3) Rw	Diameter D (mm)	Total specimen % finer N'
8/1	8:39	0		XXXXXXXX		XXXXXXXX	XXXXXXX
		1	24.0	1.0	--	--	--
		2	24.0	1.0	--	--	--
		5	24.0	2.0	1.6	0.0231	0.3
		10	24.0	2.0	1.6	0.0163	0.3
		31	23.9	3.0	1.7	0.0092	1.0
		90	23.8	2.5	1.8	0.0054	0.6
		271	24.1	3.0	1.5	0.0031	1.2
		571	24.4	2.0	1.2	0.0022	0.6
		1424	23.7	2.0	2.0	0.0014	0.0

Sieving Performed on Hyd. Test Spec.		
Complete Sieve Analysis Performed: See Form S-104		Yes / No
x	Wash analysis performed to check appropriateness of hyd. spec.	
Container No.		x1
Mass Container + Dry Soil (g)		254.55
Mass Container (g)		147.39
Total Specimen % Finer		1.4

Dry Sieving After Washing

Sieve No.	Cumulative Mass Retained (g)	Total Specimen % Finer, N'
40	77.1	25.5
100	105.83	2.5
200	107.14	1.5
Pan	107.14	XXXXXXX

Calculations: Average Temperature used in calculating test, ºC = 24.0

"X" in temperature column indicates where actural temperature used, and this value not included in the average.

Specific Gravity, Gs = 2.70

N'= a Pc (R - Rw) / Ws = (Total % finer Factor) x (R - Rw)

D (mm) = K $\sqrt{L / t}$ Tested / x Assumed

a = 0.99 from Table 1 (D 422) or ____

K from Table A1.3 (Draft Std.), K = 0.01282

Pc = Percent of soil passing No. 10 sieve = 87.1 %

Cal. Notes: (2) Soil, Water & Dispersion Solution

Ws = Dry mass of soil placed in cylinder = 108.97 g

(3) Water & Dispersion Solution

Total % finer Factor = (a*Pc/Ws) = 0.791

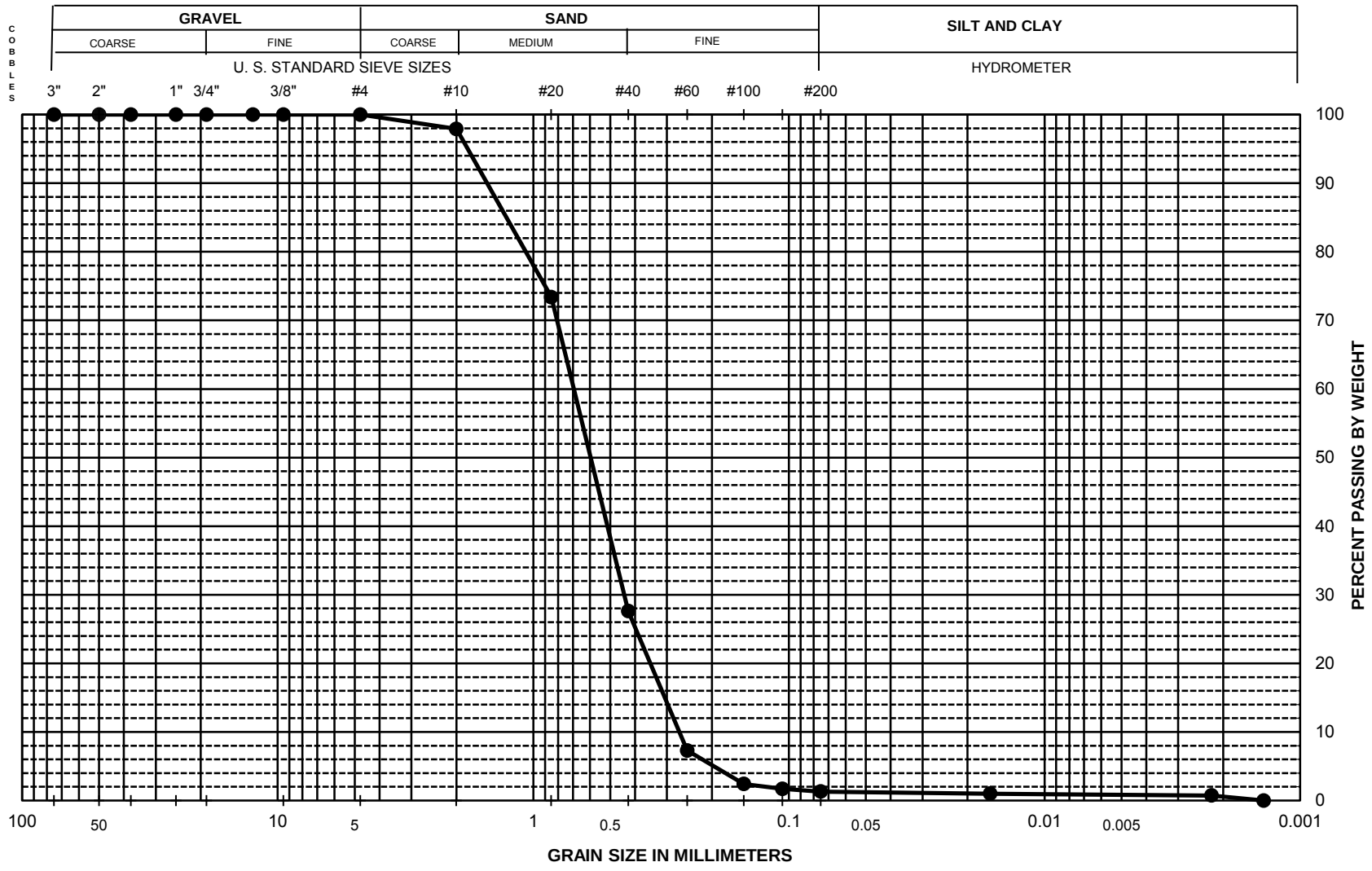
D(mm) = {(16.3 -(R-Rw)*0.164) / time}^0.5 *K

Remarks:

SET-UP BY: TJO RUN BY: YS CALCULATED BY: YS REVIEWED BY: TJO

SUBMITTED BY: Thomas J O'Mara

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	100.0
#4	4.75	100.0
#10	2.00	97.9
#20	0.850	73.4
#40	0.425	27.6
#60	0.250	7.3
#100	0.150	2.4
#140	0.106	1.7
#200	0.075	1.3
Hydrometer Analysis	0.0163	1.0
	0.0022	0.7
	0.0014	0.0

% Cobbles	--
% Gravel	0.0
% Sand	98.7
% Fines	1.3

D_{85}	1.2746
D_{60}	0.6940
D_{30}	0.4407
D_{15}	0.1773
D_{10}	0.1461
C_u	4.7
C_c	1.9

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
U2C5	---	---	●	NA	NA	NA	1	**Grayish brown poorly graded Sand with seashells (SP)**

PROJECT NAME: **SONGS LOED permitting**

PROJECT NUMBER: **12206A**

PARTICLE-SIZE DISTRIBUTION CURVES

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

GRADATION OF SOILS by Sieving using Soil Sieve Sizes & with Water Content

ASTM D6913, D422 and D2216

Project Number: 12206A | Task Number: | Boring No.: U2C5

Project Name: SONGS LOED permitting | Sample No.: ---

Project Engineer: E Miller | Depth (ft): ---

Visual Description: Grayish brown poorly graded Sand with seashells (SP)

SPECIMEN: Selected From:

Bulk Sample	x		Other - Jar
SPT Sample			Thin-Walled Tube
Calif. Sample			Engr. Test Specimen's WC
			Whole sample used
			See Bulk Sample Processing Form

Selection Method:

	Sieves (1) - whole sample used
x	Sieves (1) - partial sample used & selected by Method(s)
c	Method

(a): Splitter; (use for dry soils or that which will segregate)

(b): Quartering; (use for dry soils or that which will segregate)

(c) : Representative scoop after mixing, or slice of intact sample. (use for moist soils or that which will not segregate)

Preparation: Sample/Specimen:

As-Received	x
Air Dried	
Oven-Dried	

Test Method

Method A	
Method B	x

Oven-Dried Soil Broken Up Before:

Selecting partial sample: No x | Yes

Washing:

	No	Yes
Whole Specimen Washed on No. 200 sieve ?		x
Retained Fraction: 1st Split Washed ?		
Fine Fraction Washed on No. 200 sieve ?		

By: Mortar & Pestle | Hand | Pulverizer | Other

and Soil Soaked for: ~6 hrs.

MASS OF TEST SPECIMEN (g)	Total Test Specimen with Coarse Fraction	Partial or Whole Test Specimen	Soil Retained (after washing)	**Water Content** As Recieved or Container No.	
Min.sieve size in sieving sequence (3)	#N/A	# 200	+200	Wet, M1 (g)	
Container Number		x8	x8	Dry, M2 (g)	XXX
Mass of Container and Dry Soil, (g)		534.94	530.27	Cont.,M3 (g)	XXX
Mass of Container, (g)		139.8	139.82	**Water Content (%)**	**NA**
Dry Soil, Ws (g)		395.14	390.45		

SIEVING RESULTS % error: 0.05

See (1)	Sieve No.	Cum. Mass Retained (g)	Total Specimen % Finer N'
	3 "		
	2 "		
	1 1/2"		
	1 "		
	3/4 "		
	1/2 "		
	3/8 "		
	4		
	Pan		XXXXXXXX

Req. Mass of Test Spec. for 1% (kg)
3"= 70
1 1/2"=10
3/4"= 1.1
3/8"= 0.25
#4 = 0.1
#10 = 0.1

Shape of Grains

	Rounded
x	Angular
	Flat

Sieve No.	Sieve mm	Cum. Mass Retained (g)	Partial Test Specimen	Total Specimen % Finer N'
3 "	75			
2 "	50			
1-1/2"	37.5			
1 "	25			
3/4 "	19			
1/2 "	12.5			
3/8 "	9.5	0		100
#4	325	0.02	seashells	100
#10	180	8.41	seashells	97.9
#20	115	105.02		73.4
#40	75	285.92		27.6
#60	60	366.21		7.3
#100	40	385.67		2.4
#140*	30	388.56		1.7
#200	20	390.17		1.3
Pan		390.26	XXXXXXXX	XXXXXXXXXX

SUMMARY: Shape & Filter Parameters

% COBBLES	---	D60	0.694	D85	1.27
% GRAVEL	0	D30	0.441	D50	0.60
% SAND	98.7	D10	0.146	D15	0.18
% FINES	1.3	Cu =	4.7	Cc =	1.9

* Denotes sieve added to better define gradation curve

Cc = D30^2 / (D60 * D10)

Cu = D60 / D10

(1) X in box denotes sieve on which split was made.

(2) Proposed allowable amount of soil retained on 8" dia. sieve.

(3) Sieve size given, denotes min. sieve size used in the appropriate sieving sequence.

The above values D## denotes particle size (mm) at the corresponding percent passing.

Mica Noted: x No | Yes Amount Adjective:

Particle Hardness

x Hard | Soft | Weathered

SET-UP BY: TJO DATE 07/30/12 CALCULATED BY: TJO CHECKED BY: YS

SUBMITTED BY: Thomas J. O'Mara

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

PARTICLE-SIZE ANALYSIS : by Hydrometer

ASTM C117 or D422 or if Double Hydrometer Performed, D4221

Project Number: 12206A Task Number: Boring No.: U2C5

Project Name: SONGS LOED permitting Sample No.: ---

Project Engineer: E Miller Depth (ft): ---

Visual Description: Grayish brown poorly graded Sand with seashells (SP)

State of Specimen before Processing	
	Moist State ☐ Oven Dried
x	Air Dried
	See bulk sample proc. form (S-106)
Soil broken up by:	Other:
	Mortar & pestle
x	Passing soil through #10 sieve or
Dispersing Agent:(1)	
x	125ml Std. 4% or ____ solution
	Other
Date Soaking Initiated:	7/31/2012
Time Soaked:	x Overnight; Other
x	ASTM Dispersion Cup & Mixer used for 1 min
	Air dispersion device used for ____ min
	Other
Defoaming Agent Used:	X No; ☐ Yes

Oven- or Air-Dried Set-Up	
Drying container No.	
Mass Container+Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil (g)	

Set-Up Water Content	x Minus No. 10 ☐ or
Container No.	m89
Mass Container + Wet Soil (g), M1	296.73
Mass Container + Dry Soil (g), M2	296.43
Mass Container (g), M3	109.5
Water Content, w (%)	**0.16**

Test Notes: (1) Dispersing Agent is Sodium Hexametaphosphate

Mass of Dry Soil Used in Test, Ws	
For Oven-dry set-up, Ws (g)	
For Moist or ____ set-up	
Wwet = Estimated Ws x (1 + w)	
Est = ____ x (1 + ____) =	
Act (Wwet) =	107.77 (g)
Ws = Wwet /(1 + w/100) =	107.60 (g)
After Test Actual Ws	
Container No.	
Mass Container + Dispersant + Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil + Dispersant (g)	
Mass Dispersant (g)	
Mass Dry Soil (g)	

Soaking Beaker No. 835 Graduate No. 6 152H Hydrometer No. 972 Meniscus Correction, Cm = calibrated (3)

Date 12 (yr) (m:d)	Time (hr:min)	Elapsed Time (min)	Temp (ºC)	Hyd. Reading Soil (2) R	Hyd. Reading Water (3) Rw	Diameter D (mm)	Total specimen % finer N'
8/1	9:13	0		XXXXXXXX		XXXXXXXX	XXXXXXX
		1	24.0	1.0	--	--	--
		2	24.0	1.0	--	--	--
		5	23.8	2.0	1.9	0.0232	0.1
		10	23.8	3.0	1.9	0.0163	1.0
		31	23.8	3.0	1.9	0.0093	1.0
		90	23.8	2.5	1.9	0.0054	0.6
		241	24.0	2.5	1.6	0.0033	0.8
		541	24.4	2.0	1.2	0.0022	0.7
		1394	23.7	2.0	2.0	0.0014	0.0

Sieving Performed on Hyd. Test Spec.	
Complete Sieve Analysis Performed: See Form S-104	☐ Yes ☐ No
x	Wash analysis performed to check appropriateness of hyd. spec.
Container No.	x18
Mass Container + Dry Soil (g)	233.52
Mass Container (g)	127.86
Total Specimen % Finer	1.8

Dry Sieving After Washing

Sieve No.	Cumulative Mass Retained (g)	Total Specimen % Finer, N'
40	75.58	29.7
100	104.14	3.2
200	105.64	1.8
Pan	105.66	XXXXXXX

Calculations: Average Temperature used in calculating test, ºC = 23.9

"X" in temperature column indicates where actural temperature used, and this value not included in the average.

Specific Gravity, Gs = 2.70

N'= a Pc (R - Rw) / Ws = (Total % finer Factor) x (R - Rw)

D (mm) = K $\sqrt{L / t}$ ☐ Tested x Assumed

a = 0.99 from Table 1 (D 422) or ____

K from Table A1.3 (Draft Std.), K = 0.01283

Pc = Percent of soil passing No. 10 sieve = 99.8 %

Ws = Dry mass of soil placed in cylinder = 107.60 g

Total % finer Factor = (a*Pc/Ws) = 0.918

Cal. Notes: (2) Soil, Water & Dispersion Solution

(3) Water & Dispersion Solution

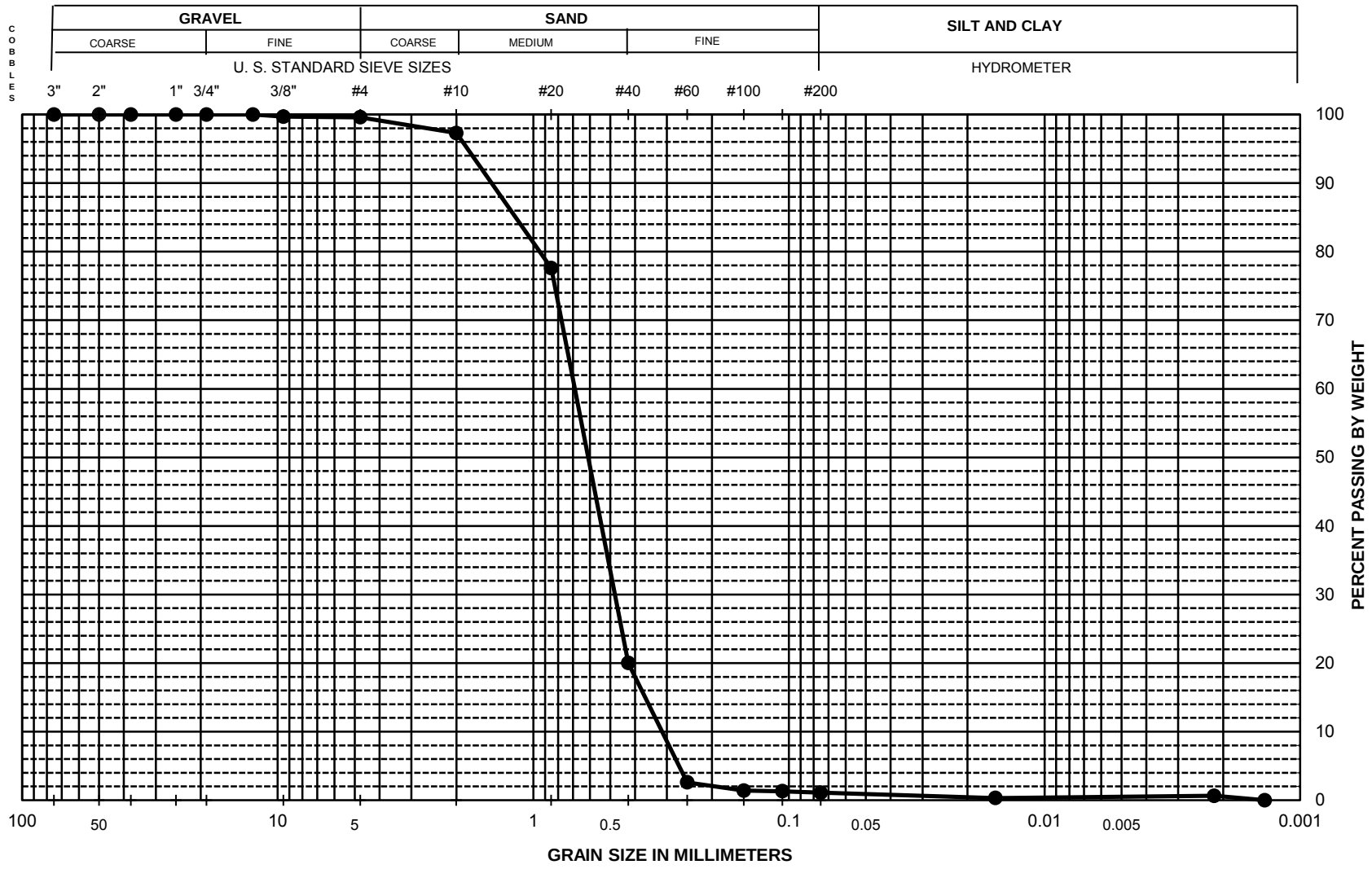
D(mm) = {(16.3 -(R-Rw)*0.164) / time}^0.5 *K

Remarks:

SET-UP BY: TJO RUN BY: YS CALCULATED BY: YS REVIEWED BY: TJO

SUBMITTED BY: Thomas J O'Mara

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	99.7
#4	4.75	99.6
#10	2.00	97.3
#20	0.850	77.6
#40	0.425	20.0
#60	0.250	2.6
#100	0.150	1.4
#140	0.106	1.3
#200	0.075	1.1
Hydrometer Analysis	0.0156	0.3
	0.0022	0.6
	0.0014	0.0

% Cobbles	--
% Gravel	0.4
% Sand	98.5
% Fines	1.1
D_{85}	1.1722
D_{60}	0.6878
D_{30}	0.4793
D_{15}	0.1797
D_{10}	0.1482
C_u	4.6
C_c	2.3

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
U2C6	---	---	●	NA	NA	NA		**Yellowish brown poorly graded Sand with seashells (SP)**

PROJECT NAME: **SONGS LOED permitting**

PROJECT NUMBER: **12206A**

PARTICLE-SIZE DISTRIBUTION CURVES

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

GRADATION OF SOILS by Sieving using Soil Sieve Sizes & with Water Content

ASTM D6913, D422 and D2216

Project Number: 12206A | Task Number: | Boring No.: U2C6

Project Name: SONGS LOED permitting | Sample No.: ---

Project Engineer: E Miller | Depth (ft): ---

Visual Description: Yellowish brown poorly graded Sand with seashells (SP)

SPECIMEN: Selected From:

Bulk Sample	x		Other - Jar
SPT Sample			Thin-Walled Tube
Calif. Sample			Engr. Test Specimen's WC
			Whole sample used
			See Bulk Sample Processing Form

Selection Method:

	Sieves (1) - whole sample used
x	Sieves (1) - partial sample used & selected by Method(s)
c	Method

(a): Splitter; (use for dry soils or that which will segregate)

(b): Quartering; (use for dry soils or that which will segregate)

(c) : Representative scoop after mixing, or slice of intact sample. (use for moist soils or that which will not segregate)

Preparation: Sample/Specimen:

As-Received	x
Air Dried	
Oven-Dried	

Test Method

Method A	
Method B	x

Oven-Dried Soil Broken Up Before:

Selecting partial sample: No x | Yes

By: Mortar & Pestle | Hand | Pulverizer | Other

Washing:

	No	Yes
Whole Specimen Washed on No. 200 sieve ?		x
Retained Fraction: 1st Split Washed ?		
Fine Fraction Washed on No. 200 sieve ?		

and Soil Soaked for: ~6 hrs.

MASS OF TEST SPECIMEN (g)	Total Test Specimen with Coarse Fraction	Partial or Whole Test Specimen	Soil Retained (after washing)	**Water Content** As Recieved or Container No.	
Min.sieve size in sieving sequence (3)	#N/A	# 200	+200	Wet, M1 (g)	
Container Number		x18	x18	Dry, M2 (g)	XXX
Mass of Container and Dry Soil, (g)		476.55	472.91	Cont.,M3 (g)	XXX
Mass of Container, (g)		127.86	127.87	**Water Content (%)**	**NA**
Dry Soil, Ws (g)		348.69	345.04		

SIEVING RESULTS % error: 0.01

See (1)	Sieve No.	Cum. Mass Retained (g)	Total Specimen % Finer N'
	3 "		
	2 "		
	1 1/2"		
	1 "		
	3/4 "		
	1/2 "		
	3/8 "		
	4		
	Pan		XXXXXXXX

Req. Mass of Test Spec. for 1% (kg)
3"= 70
1 1/2"=10
3/4"= 1.1
3/8"= 0.25
#4 = 0.1
#10 = 0.1

Shape of Grains

	Rounded
x	Angular
	Flat

Sieve No.	mm	Cum. Mass Retained (g)	Partial Test Specimen	Total Specimen % Finer N'
3 "	75			
2 "	50			
1-1/2"	37.5			
1 "	25			
3/4 "	19			
1/2 "	12.5	0		100
3/8 "	9.5	1.13	seashells	99.7
#4	325	1.35	seashells	99.6
#10	180	9.49		97.3
#20	115	77.95		77.6
#40	75	279.1		20
#60	60	339.71		2.6
#100	40	343.66		1.4
#140*	30	344.28		1.3
#200	20	344.93		1.1
Pan		344.99	XXXXXXXX	XXXXXXXXXX

SUMMARY: Shape & Filter Parameters

% COBBLES	---	D60	0.688	D85	1.17
% GRAVEL	0.4	D30	0.479	D50	0.61
% SAND	98.5	D10	0.148	D15	0.18
% FINES	1.1	Cu =	4.6	Cc =	2.3

* Denotes sieve added to better define gradation curve

Cc = D30^2 / (D60 * D10)

Cu = D60 / D10

(1) X in box denotes sieve on which split was made.

(2) Proposed allowable amount of soil retained on 8" dia. sieve.

(3) Sieve size given, denotes min. sieve size used in the appropriate sieving sequence.

The above values D## denotes particle size (mm) at the corresponding percent passing.

Mica Noted: x No | Yes Amount Adjective:

Particle Hardness

x Hard | Soft | Weathered

SET-UP BY: TJO DATE 07/30/12 CALCULATED BY: TJO CHECKED BY: YS

SUBMITTED BY: Thomas J. O'Hara

PARTICLE-SIZE ANALYSIS : by Hydrometer

ASTM C117 or D422 or if Double Hydrometer Performed, D4221

Project Number: 12206A Task Number: Boring No.: U2C6

Project Name: SONGS LOED permitting Sample No.: ---

Project Engineer: E Miller Depth (ft): ---

Visual Description: Yellowish brown poorly graded Sand with seashells (SP)

State of Specimen before Processing	
	Moist State / Oven Dried
x	Air Dried
	See bulk sample proc. form (S-106)
Soil broken up by:	Other:
	Mortar & pestle
x	Passing soil through #10 sieve or
Dispersing Agent:(1)	
x	125ml Std. 4% or ____ solution
	Other
Date Soaking Initiated:	7/31/2012
Time Soaked: x	Overnight / Other
x	ASTM Dispersion Cup & Mixer used for 1 min
	Air dispersion device used for ____ min
	Other
Defoaming Agent Used:	X No; / Yes

Oven- or Air-Dried Set-Up	
Drying container No.	
Mass Container+Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil (g)	

Set-Up Water Content	x	Minus No. 10 / or
Container No.		n5
Mass Container + Wet Soil (g), M1		313.45
Mass Container + Dry Soil (g), M2		313.11
Mass Container (g), M3		104.63
Water Content, w (%)		**0.16**

Test Notes: (1) Dispersing Agent is Sodium Hexametaphosphate

Mass of Dry Soil Used in Test, Ws	
For Oven-dry set-up, Ws (g)	
For Moist or ____ set-up	
Wwet = Estimated Ws x (1 + w)	
Est = ____ x (1 + ____) =	
Act (Wwet) =	112.55 (g)
Ws = Wwet /(1 + w/100) =	112.37 (g)
After Test Actual Ws	
Container No.	
Mass Container + Dispersant + Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil + Dispersant (g)	
Mass Dispersant (g)	
Mass Dry Soil (g)	

Soaking Beaker No. 847 Graduate No. 5 152H Hydrometer No. 972 Meniscus Correction, Cm = calibrated (3)

Date 12 (yr) (m:d)	Time (hr:min)	Elapsed Time (min)	Temp (ºC)	Hyd. Reading Soil (2) R	Hyd. Reading Water (3) Rw	Diameter D (mm)	Total specimen % finer N'
8/1	8:45	0		XXXXXXXX		XXXXXXXX	XXXXXXX
		1	24.0	1.0	--	--	--
		2	24.0	1.0	--	--	--
		5	24.1	2.0	1.6	0.0231	0.3
		11	24.0	2.0	1.6	0.0156	0.3
		31	23.9	2.5	1.8	0.0093	0.6
		90	23.9	3.0	1.8	0.0054	1.0
		266	24.1	3.0	1.5	0.0031	1.2
		566	24.4	2.0	1.2	0.0022	0.6
		1419	23.7	2.0	2.0	0.0014	0.0

Sieving Performed on Hyd. Test Spec.		
Complete Sieve Analysis Performed: See Form S-104		Yes / No
x	Wash analysis performed to check appropriateness of hyd. spec.	
Container No.		sna13
Mass Container + Dry Soil (g)		256.83
Mass Container (g)		146.04
Total Specimen % Finer		1.3

Dry Sieving After Washing

Sieve No.	Cumulative Mass Retained (g)	Total Specimen % Finer, N'
40	86.18	21.3
100	109.97	1.9
200	110.76	1.3
Pan	110.76	XXXXXXX

Calculations: Average Temperature used in calculating test, ºC = 24.0

"X" in temperature column indicates where actural temperature used, and this value not included in the average.

Specific Gravity, Gs = 2.70

N'= a Pc (R - Rw) / Ws = (Total % finer Factor) x (R - Rw)

D (mm) = K $\sqrt{L / t}$ Tested / x Assumed

a = 0.99 from Table 1 (D 422) or ____

K from Table A1.3 (Draft Std.), K = 0.01282

Pc = Percent of soil passing No. 10 sieve = 91.4 %

Cal. Notes: (2) Soil, Water & Dispersion Solution

Ws = Dry mass of soil placed in cylinder = 112.37 g

(3) Water & Dispersion Solution

Total % finer Factor = (a*Pc/Ws) = 0.805

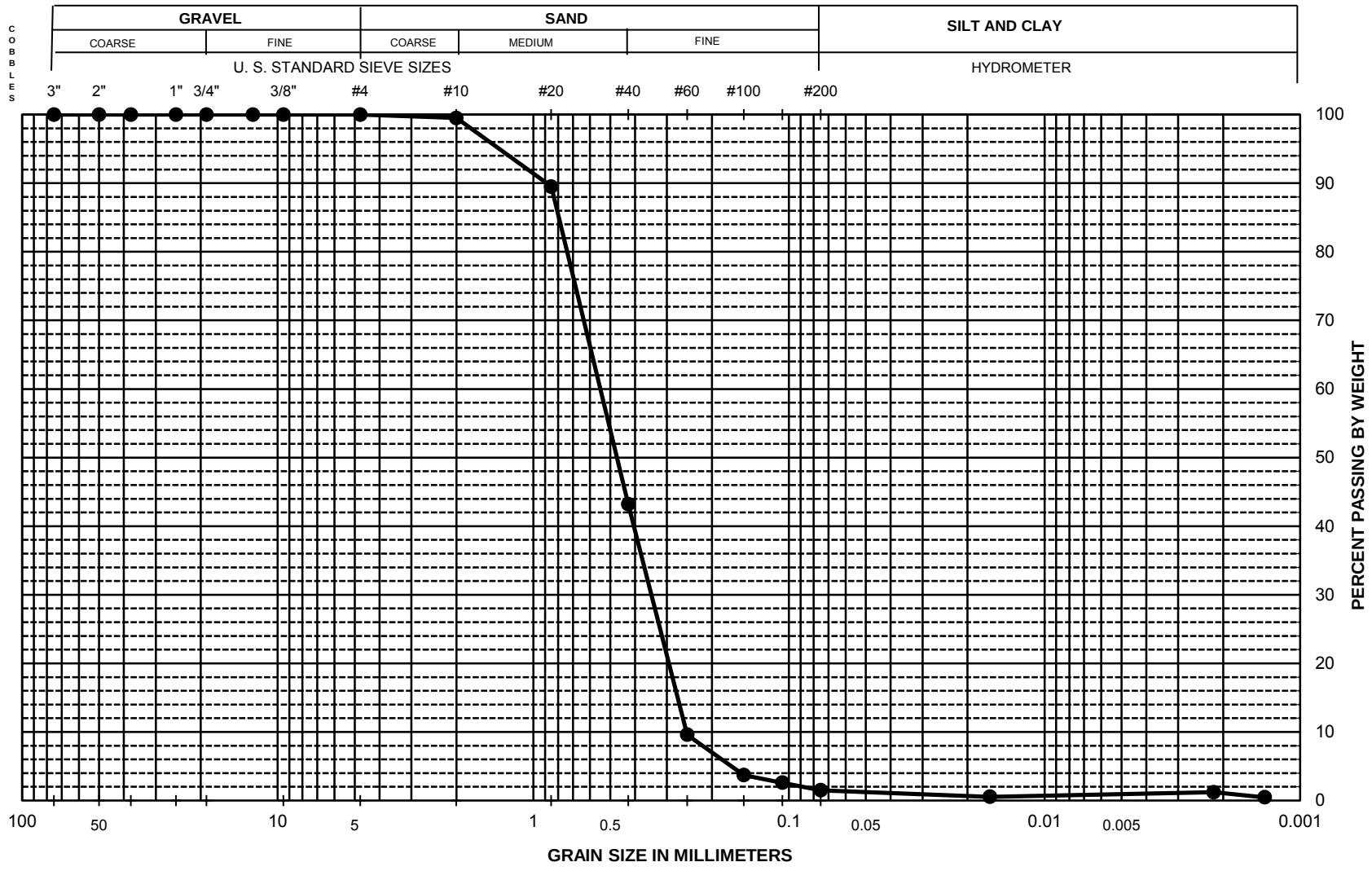
D(mm) = {(16.3 -(R-Rw)*0.164) / time}^0.5 *K

Remarks:

SET-UP BY: TJO RUN BY: YS CALCULATED BY: YS REVIEWED BY: TJO

SUBMITTED BY: Thomas J. O'Mara

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	100.0
#4	4.75	100.0
#10	2.00	99.5
#20	0.850	89.5
#40	0.425	43.2
#60	0.250	9.6
#100	0.150	3.7
#140	0.106	2.6
#200	0.075	1.5
Hydrometer Analysis	0.0163	0.6
	0.0022	1.2
	0.0014	0.5

% Cobbles	--
% Gravel	0.0
% Sand	98.5
% Fines	1.5
D_{85}	0.7946
D_{60}	0.5465
D_{30}	0.3089
D_{15}	0.1720
D_{10}	0.1415
C_u	3.9
C_c	1.2

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
U2C7	---	---	●	NA	NA	NA	1	**Grayish brown poorly graded Sand (SP)**

PROJECT NAME: **SONGS LOED permitting**

PROJECT NUMBER: **12206A**

PARTICLE-SIZE DISTRIBUTION CURVES

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

GRADATION OF SOILS by Sieving using Soil Sieve Sizes & with Water Content

ASTM D6913, D422 and D2216

Project Number: 12206A | Task Number: | Boring No.: U2C7

Project Name: SONGS LOED permitting | Sample No.: ---

Project Engineer: E Miller | Depth (ft): ---

Visual Description: Grayish brown poorly graded Sand (SP)

SPECIMEN: Selected From:

Bulk Sample	x		Other - Jar
SPT Sample			Thin-Walled Tube
Calif. Sample			Engr. Test Specimen's WC
			Whole sample used
			See Bulk Sample Processing Form

Selection Method:

	Sieves (1) - whole sample used
x	Sieves (1) - partial sample used & selected by Method(s)
c	Method

(a): Splitter; (use for dry soils or that which will segregate)

(b): Quartering; (use for dry soils or that which will segregate)

(c) : Representative scoop after mixing, or slice of intact sample. (use for moist soils or that which will not segregate)

Preparation: Sample/Specimen:

As-Received	x
Air Dried	
Oven-Dried	

Test Method

Method A	
Method B	x

Oven-Dried Soil Broken Up Before:

Selecting partial sample: No x | Yes

Washing:

	No	Yes
Whole Specimen Washed on No. 200 sieve ?		x
Retained Fraction: 1st Split Washed ?		
Fine Fraction Washed on No. 200 sieve ?		

By: Mortar & Pestle | Hand | Pulverizer | Other

and Soil Soaked for: ~6 hrs.

MASS OF TEST SPECIMEN (g)	Total Test Specimen with Coarse Fraction	Partial or Whole Test Specimen	Soil Retained (after washing)	**Water Content** As Recieved or Container No.	
Min.sieve size in sieving sequence (3)	#N/A	# 200	+200	Wet, M1 (g)	
Container Number		x6	x6	Dry, M2 (g)	XXX
Mass of Container and Dry Soil, (g)		499.12	494.28	Cont.,M3 (g)	XXX
Mass of Container, (g)		154.78	154.81	**Water Content (%)**	**NA**
Dry Soil, Ws (g)		344.34	339.47		

SIEVING RESULTS % error: 0.06

See (1)	Sieve No.	Cum. Mass Retained (g)	Total Specimen % Finer N'
	3 "		
	2 "		
	1 1/2"		
	1 "		
	3/4 "		
	1/2 "		
	3/8 "		
	4		
	Pan		XXXXXXXX

Req. Mass of Test Spec. for 1% (kg)
3"= 70
1 1/2"=10
3/4"= 1.1
3/8"= 0.25
#4 = 0.1
#10 = 0.1

Shape of Grains

	Rounded
x	Angular
	Flat

Sieve No.	Sieve mm	Cum. Mass Retained (g)	Partial Test Specimen	Total Specimen % Finer N'
3 "	75			
2 "	50			
1-1/2"	37.5			
1 "	25			
3/4 "	19			
1/2 "	12.5			
3/8 "	9.5			
#4	325	0		100
#10	180	1.61		99.5
#20	115	36		89.5
#40	75	195.58		43.2
#60	60	311.22		9.6
#100	40	331.65		3.7
#140*	30	335.55		2.6
#200	20	339.13		1.5
Pan		339.25	XXXXXXXX	XXXXXXXXXX

SUMMARY: Shape & Filter Parameters

% COBBLES	---	D60	0.547	D85	0.79
% GRAVEL	0	D30	0.309	D50	0.47
% SAND	98.5	D10	0.142	D15	0.17
% FINES	1.5	Cu =	3.9	Cc =	1.2

* Denotes sieve added to better define gradation curve

Cc = D30^2 / (D60 * D10)

Cu = D60 / D10

(1) X in box denotes sieve on which split was made.

(2) Proposed allowable amount of soil retained on 8" dia. sieve.

(3) Sieve size given, denotes min. sieve size used in the appropriate sieving sequence.

The above values D## denotes particle size (mm) at the corresponding percent passing.

Mica Noted: x No | Yes Amount Adjective:

Particle Hardness

x Hard | Soft | Weathered

SET-UP BY: TJO DATE 07/30/12 CALCULATED BY: TJO CHECKED BY: YS

SUBMITTED BY: Thomas J. O'Mara

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

PARTICLE-SIZE ANALYSIS : by Hydrometer

ASTM C117 or D422 or if Double Hydrometer Performed, D4221

Project Number: 12206A Task Number: Boring No.: U2C7

Project Name: SONGS LOED permitting Sample No.: ---

Project Engineer: E Miller Depth (ft): ---

Visual Description: Grayish brown poorly graded Sand (SP)

State of Specimen before Processing
[ ] Moist State [ ] Oven Dried
[x] Air Dried
[ ] See bulk sample proc. form (S-106)
Soil broken up by: Other:
[ ] Mortar & pestle
[x] Passing soil through #10 sieve or
Dispersing Agent:(1)
[x] 125ml Std. 4% or ____ solution
[ ] Other
Date Soaking Initiated: 7/31/2012
Time [x] Overnight
Soaked: [ ] Other
[x] ASTM Dispersion Cup & Mixer used for 1 min
[ ] Air dispersion device used for ____ min
[ ] Other
Defoaming Agent Used: [X] No; [ ] Yes

Oven- or Air-Dried Set-Up
Drying container No.
Mass Container+Dry Soil (g)
Mass Container (g)
Mass Dry Soil (g)

Set-Up Water Content	[x] Minus No. 10 [ ] or	
Container No.		m67
Mass Container + Wet Soil (g), M1		284.38
Mass Container + Dry Soil (g), M2		284.15
Mass Container (g), M3		110.4
Water Content, w (%)		**0.13**

Test Notes: (1) Dispersing Agent is Sodium Hexametaphosphate

Mass of Dry Soil Used in Test, Ws	
For Oven-dry set-up, Ws (g)	
For Moist or ____ set-up	
Wwet = Estimated Ws x (1 + w)	
Est = ____ x (1 + ____) =	
Act (Wwet) = 102.27 (g)	
Ws = Wwet /(1 + w/100) = 102.13 (g)	
After Test Actual Ws	
Container No.	
Mass Container + Dispersant + Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil + Dispersant (g)	
Mass Dispersant (g)	
Mass Dry Soil (g)	

Soaking Beaker No. 821 Graduate No. 7 152H Hydrometer No. 972 Meniscus Correction, Cm = calibrated (3)

Date 12 (yr) (m:d)	Time (hr:min)	Elapsed Time (min)	Temp (ºC)	Hyd. Reading Soil (2) R	Hyd. Reading Water (3) Rw	Diameter D (mm)	Total specimen % finer N'
8/1	8:53	0		XXXXXXXX		XXXXXXXX	XXXXXXX
		1	23.8	1.0	--	--	--
		2	23.8	1.5	--	--	--
		5	23.8	1.5	--	--	--
		10	23.8	2.5	1.9	0.0163	0.6
		31	23.8	3.0	1.9	0.0093	1.0
		90	23.8	2.5	1.9	0.0054	0.6
		259	24.0	2.5	1.6	0.0032	0.8
		559	24.4	2.5	1.2	0.0022	1.2
		1412	23.7	2.5	2.0	0.0014	0.5

Sieving Performed on Hyd. Test Spec.	
Complete Sieve Analysis Performed: See Form S-104	[ ] Yes [ ] No
[x] Wash analysis performed to check appropriateness of hyd. spec.	
Container No.	x7
Mass Container + Dry Soil (g)	256.7
Mass Container (g)	156.69
Total Specimen % Finer	2.0

Dry Sieving After Washing

Sieve No.	Cumulative Mass Retained (g)	Total Specimen % Finer, N'
40	54.78	44.2
100	97.02	4.8
200	99.91	2.1
Pan	99.94	XXXXXXX

Calculations: Average Temperature used in calculating test, ºC = 23.9

"X" in temperature column indicates where actural temperature used, and this value not included in the average.

Specific Gravity, Gs = 2.70

N'= a Pc (R - Rw) / Ws = (Total % finer Factor) x (R - Rw)

D (mm) = K $\sqrt{L / t}$ [ ] Tested [x] Assumed

a = 0.99 from Table 1 (D 422) or ____

K from Table A1.3 (Draft Std.), K = 0.01284

Pc = Percent of soil passing No. 10 sieve = 95.4 %

Cal. Notes: (2) Soil, Water & Dispersion Solution

Ws = Dry mass of soil placed in cylinder = 102.13 g

(3) Water & Dispersion Solution

Total % finer Factor = (a*Pc/Ws) = 0.925

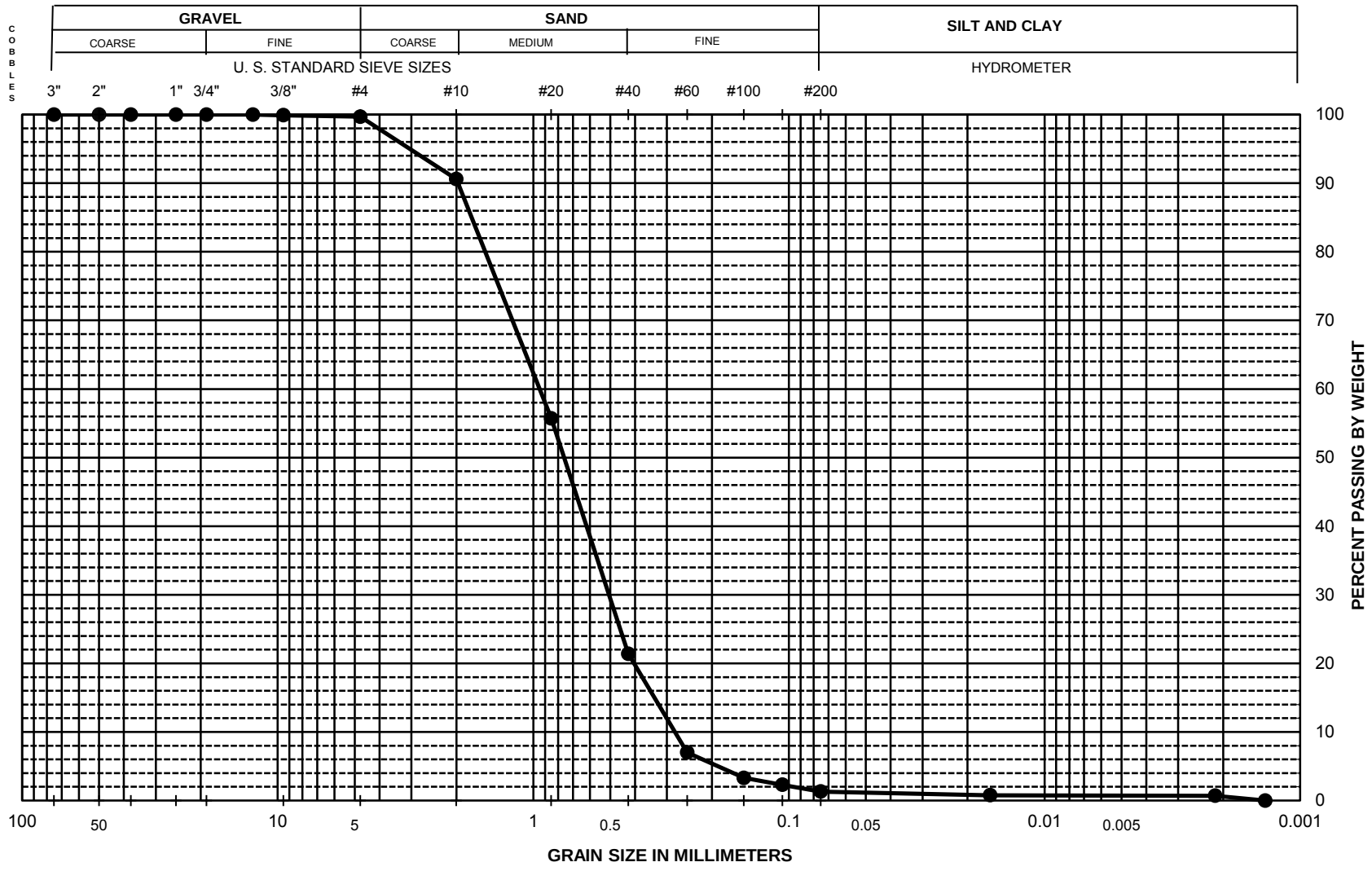
D(mm) = {(16.3 -(R-Rw)*0.164) / time}^0.5 *K

Remarks:

SET-UP BY: TJO RUN BY: YS CALCULATED BY: YS REVIEWED BY: TJO

SUBMITTED BY: Thomas J O'Mara

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	99.9
#4	4.75	99.7
#10	2.00	90.6
#20	0.850	55.7
#40	0.425	21.4
#60	0.250	7.0
#100	0.150	3.3
#140	0.106	2.3
#200	0.075	1.3
Hydrometer Analysis	0.0163	0.8
	0.0021	0.7
	0.0014	0.0

% Cobbles	--
% Gravel	0.3
% Sand	98.4
% Fines	1.3
D_{85}	1.7434
D_{60}	0.9445
D_{30}	0.5057
D_{15}	0.1738
D_{10}	0.1430
C_u	6.6
C_c	1.9

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
U2C8	---	---	●	NA	NA	NA	1	**Grayish brown well-graded Sand with seashells (SW)**

PROJECT NAME: **SONGS LOED permitting**

PROJECT NUMBER: **12206A**

PARTICLE-SIZE DISTRIBUTION CURVES

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

GRADATION OF SOILS by Sieving using Soil Sieve Sizes & with Water Content

ASTM D6913, D422 and D2216

Project Number: 12206A | Task Number: | Boring No.: U2C8

Project Name: SONGS LOED permitting | Sample No.: ---

Project Engineer: E Miller | Depth (ft): ---

Visual Description: Grayish brown well-graded Sand with seashells (SW)

SPECIMEN: Selected From:

Bulk Sample	x		Other - Jar
SPT Sample			Thin-Walled Tube
Calif. Sample			Engr. Test Specimen's WC
			Whole sample used
			See Bulk Sample Processing Form

Selection Method:

		Sieves (1) - whole sample used
x		Sieves (1) - partial sample used & selected by Method(s)
c		Method

(a): Splitter; (use for dry soils or that which will segregate)

(b): Quartering; (use for dry soils or that which will segregate)

(c) : Representative scoop after mixing, or slice of intact sample. (use for moist soils or that which will not segregate)

Preparation: Sample/Specimen:

As-Received	x
Air Dried	
Oven-Dried	

Test Method

Method A	
Method B	x

Oven-Dried Soil Broken Up Before:

Selecting partial sample: No x | Yes

Washing:

	No	Yes
Whole Specimen Washed on No. 200 sieve ?		x
Retained Fraction: 1st Split Washed ?		
Fine Fraction Washed on No. 200 sieve ?		

By: Mortar & Pestle | Hand | Pulverizer | Other

and Soil Soaked for: ~6 hrs.

Water Content

MASS OF TEST SPECIMEN (g)	Total Test Specimen with Coarse Fraction	Partial or Whole Test Specimen	Soil Retained (after washing)	As Recieved or Container No.	
Min.sieve size in sieving sequence (3)	#N/A	# 200	+200	Wet, M1 (g)	
Container Number		sf6	sf6	Dry, M2 (g)	XXX
Mass of Container and Dry Soil, (g)		592.81	587.74	Cont.,M3 (g)	XXX
Mass of Container, (g)		147.17	147.19	**Water Content (%)**	**NA**
Dry Soil, Ws (g)		445.64	440.55		

SIEVING RESULTS % error: 0.09

See (1)	Sieve No.	Cum. Mass Retained (g)	Total Specimen % Finer N'
	3 "		
	2 "		
	1 1/2"		
	1 "		
	3/4 "		
	1/2 "		
	3/8 "		
	4		
	Pan		XXXXXXXX

Req. Mass of Test Spec. for 1% (kg)
3"= 70
1 1/2"=10
3/4"= 1.1
3/8"= 0.25
#4 = 0.1
#10 = 0.1

Shape of Grains

	Rounded
x	Angular
	Flat

Sieve No.	mm	Cum. Mass Retained (g)	Partial Test Specimen	Total Specimen % Finer N'
3 "	75			
2 "	50			
1-1/2"	37.5			
1 "	25			
3/4 "	19			
1/2 "	12.5	0		100
3/8 "	9.5	0.44	seashells	99.9
#4	325	1.36		99.7
#10	180	41.83		90.6
#20	115	197.23		55.7
#40	75	350.12		21.4
#60	60	414.62		7
#100	40	430.92		3.3
#140*	30	435.43		2.3
#200	20	439.95		1.3
Pan		440.14	XXXXXXXX	XXXXXXXXXX

SUMMARY: Shape & Filter Parameters

% COBBLES	---	D60	0.945	D85	1.74
% GRAVEL	0.3	D30	0.506	D50	0.76
% SAND	98.4	D10	0.143	D15	0.17
% FINES	1.3	Cu =	6.6	Cc =	1.9

* Denotes sieve added to better define gradation curve

Cc = D30^2 / (D60 * D10)

(1) X in box denotes sieve on which split was made.

Cu = D60 / D10

(2) Proposed allowable amount of soil retained on 8" dia. sieve.

Mica Noted: x No | Yes Amount Adjective:

(3) Sieve size given, denotes min. sieve size used in the appropriate sieving sequence.

The above values D## denotes particle size (mm) at the corresponding percent passing.

Particle Hardness

x Hard | Soft | Weathered

SET-UP BY: TJO DATE 07/30/12 CALCULATED BY: TJO CHECKED BY: YS

SUBMITTED BY: Thomas J. O'Mara

PARTICLE-SIZE ANALYSIS : by Hydrometer

ASTM C117 or D422 or if Double Hydrometer Performed, D4221

Project Number: 12206A Task Number: Boring No.: U2C8

Project Name: SONGS LOED permitting Sample No.: ---

Project Engineer: E Miller Depth (ft): ---

Visual Description: Grayish brown well-graded Sand with seashells (SW)

State of Specimen before Processing	
	Moist State ☐ Oven Dried
x	Air Dried
	See bulk sample proc. form (S-106)
Soil broken up by:	Other:
	Mortar & pestle
x	Passing soil through #10 sieve or
Dispersing Agent:(1)	
x	125ml Std. 4% or ____ solution
	Other
Date Soaking Initiated:	7/31/2012
Time Soaked:	x Overnight; Other
x	ASTM Dispersion Cup & Mixer used for 1 min
	Air dispersion device used for ____ min
	Other
Defoaming Agent Used:	X No; ☐ Yes

Oven- or Air-Dried Set-Up	
Drying container No.	
Mass Container+Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil (g)	

Set-Up Water Content	x	Minus No. 10 or
Container No.		m72
Mass Container + Wet Soil (g), M1		291.38
Mass Container + Dry Soil (g), M2		291.12
Mass Container (g), M3		108.6
Water Content, w (%)		**0.14**

Test Notes: (1) Dispersing Agent is Sodium Hexametaphosphate

Mass of Dry Soil Used in Test, Ws	
For Oven-dry set-up, Ws (g)	
For Moist or ____ set-up	
Wwet = Estimated Ws x (1 + w)	
Est = ____ x (1 + ____) =	
Act (Wwet) =	109.33 (g)
Ws = Wwet /(1 + w/100) =	109.17 (g)
After Test Actual Ws	
Container No.	
Mass Container + Dispersant + Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil + Dispersant (g)	
Mass Dispersant (g)	
Mass Dry Soil (g)	

Soaking Beaker No. 823 Graduate No. 15 152H Hydrometer No. 972 Meniscus Correction, Cm = calibrated (3)

Date 12 (yr) (m:d)	Time (hr:min)	Elapsed Time (min)	Temp (ºC)	Hyd. Reading Soil (2) R	Hyd. Reading Water (3) Rw	Diameter D (mm)	Total specimen % finer N'
8/1	8:32	0		XXXXXXXX		XXXXXXXX	XXXXXXX
		1	23.9	1.0	--	--	--
		2	23.9	1.0	--	--	--
		5	23.9	2.0	--	--	--
		10	23.9	2.5	1.6	0.0163	0.8
		32	23.8	2.5	1.6	0.0091	0.8
		90	23.8	3.0	1.6	0.0054	1.2
		277	24.1	2.5	1.5	0.0031	0.9
		577	24.4	2.0	1.2	0.0021	0.7
		1430	23.7	2.0	2.0	0.0014	0.0

Sieving Performed on Hyd. Test Spec.		
Complete Sieve Analysis Performed: See Form S-104		Yes
		No
x	Wash analysis performed to check appropriateness of hyd. spec.	
Container No.		x34
Mass Container + Dry Soil (g)		244.03
Mass Container (g)		136.88
Total Specimen % Finer		1.8

Dry Sieving After Washing

Sieve No.	Cumulative Mass Retained (g)	Total Specimen % Finer, N'
40	84.51	21.5
100	105.05	3.6
200	107.11	1.8
Pan	107.12	XXXXXXX

Calculations: Average Temperature used in calculating test, ºC = 23.9

"X" in temperature column indicates where actural temperature used, and this value not included in the average.

Specific Gravity, Gs = 2.70

N'= a Pc (R - Rw) / Ws = (Total % finer Factor) x (R - Rw)

D (mm) = K $\sqrt{L / t}$ ☐ Tested x Assumed

a = 0.99 from Table 1 (D 422) or ____

K from Table A1.3 (Draft Std.), K = 0.01283

Pc = Percent of soil passing No. 10 sieve = 95.2 %

Ws = Dry mass of soil placed in cylinder = 109.17 g

Total % finer Factor = (a*Pc/Ws) = 0.863

Cal. Notes: (2) Soil, Water & Dispersion Solution

(3) Water & Dispersion Solution

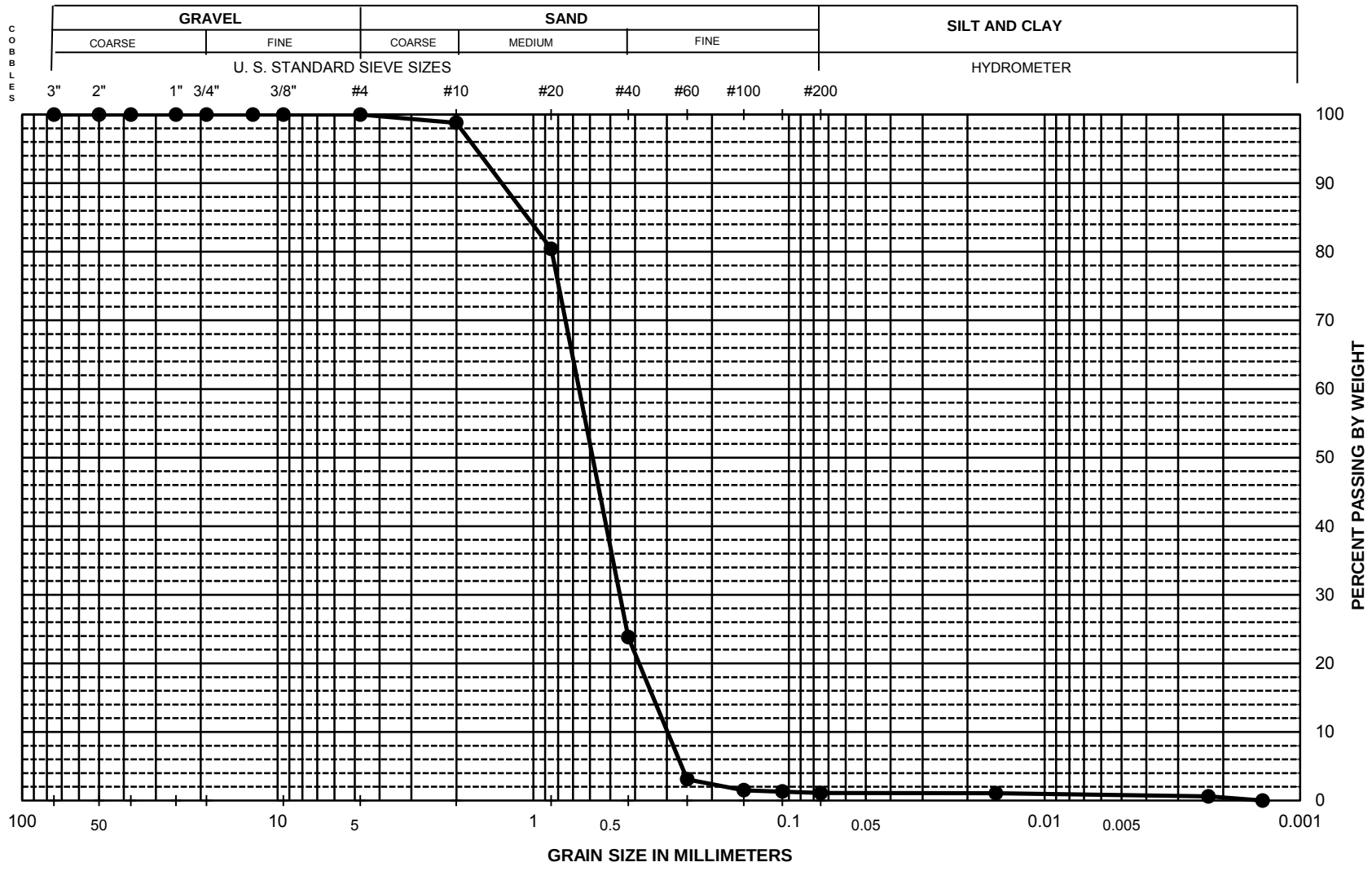
D(mm) = {(16.3 -(R-Rw)*0.164) / time}^0.5 *K

Remarks:

SET-UP BY: TJO RUN BY: YS CALCULATED BY: YS REVIEWED BY: TJO

SUBMITTED BY: Thomas J O'Mara

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	100.0
#4	4.75	100.0
#10	2.00	98.8
#20	0.850	80.4
#40	0.425	23.8
#60	0.250	3.1
#100	0.150	1.5
#140	0.106	1.3
#200	0.075	1.1
Hydrometer Analysis	0.0155	1.1
	0.0023	0.6
	0.0014	0.0

% Cobbles	--
% Gravel	0.0
% Sand	98.9
% Fines	1.1

D_{85}	1.0527
D_{60}	0.6621
D_{30}	0.4585
D_{15}	0.3392
D_{10}	0.2984
C_u	2.2
C_c	1.1

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
U2C9	---	---	●	NA	NA	NA	1	**Grayish brown poorly graded Sand (SP)**

PROJECT NAME: **SONGS LOED permitting**

PROJECT NUMBER: **12206A**

PARTICLE-SIZE DISTRIBUTION CURVES

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

GRADATION OF SOILS by Sieving using Soil Sieve Sizes & with Water Content

ASTM D6913, D422 and D2216

Project Number: 12206A | Task Number: | Boring No.: U2C9

Project Name: SONGS LOED permitting | Sample No.: ---

Project Engineer: E Miller | Depth (ft): ---

Visual Description: Grayish brown poorly graded Sand (SP)

SPECIMEN: Selected From:

Bulk Sample	x		Other - Jar
SPT Sample			Thin-Walled Tube
Calif. Sample			Engr. Test Specimen's WC
			Whole sample used
			See Bulk Sample Processing Form

Selection Method:

	Sieves (1) - whole sample used
x	Sieves (1) - partial sample used & selected by Method(s)
c	Method

(a): Splitter; (use for dry soils or that which will segregate)

(b): Quartering; (use for dry soils or that which will segregate)

(c) : Representative scoop after mixing, or slice of intact sample. (use for moist soils or that which will not segregate)

Preparation: Sample/Specimen:

As-Received	x
Air Dried	
Oven-Dried	

Test Method

Method A	
Method B	x

Oven-Dried Soil Broken Up Before:

Selecting partial sample: No x | Yes

Washing:

	No	Yes
Whole Specimen Washed on No. 200 sieve ?		x
Retained Fraction: 1st Split Washed ?		
Fine Fraction Washed on No. 200 sieve ?		

By: Mortar & Pestle | Hand | Pulverizer | Other

and Soil Soaked for: ~6 hrs.

MASS OF TEST SPECIMEN (g)	Total Test Specimen with Coarse Fraction	Partial or Whole Test Specimen	Soil Retained (after washing)	**Water Content** As Recieved or Container No.	
Min.sieve size in sieving sequence (3)	#N/A	# 200	+200	Wet, M1 (g)	
Container Number		x11	x11	Dry, M2 (g)	XXX
Mass of Container and Dry Soil, (g)		535.74	531.92	Cont.,M3 (g)	XXX
Mass of Container, (g)		157.85	157.88	**Water Content (%)**	**NA**
Dry Soil, Ws (g)		377.89	374.04		

SIEVING RESULTS % error: 0.10

See (1)	Sieve No.	Cum. Mass Retained (g)	Total Specimen % Finer N'
	3 "		
	2 "		
	1 1/2"		
	1 "		
	3/4 "		
	1/2 "		
	3/8 "		
	4		
	Pan		XXXXXXXX

Req. Mass of Test Spec. for 1% (kg)
3"= 70
1 1/2"=10
3/4"= 1.1
3/8"= 0.25
#4 = 0.1
#10 = 0.1

Shape of Grains

	Rounded
x	Angular
	Flat

Sieve No.	mm	Cum. Mass Retained (g)	Partial Test Specimen	Total Specimen % Finer N'
3 "	75			
2 "	50			
1-1/2"	37.5			
1 "	25			
3/4 "	19			
1/2 "	12.5			
3/8 "	9.5			
#4	325	0		100
#10	180	4.52		98.8
#20	115	73.95		80.4
#40	75	288		23.8
#60	60	366.31		3.1
#100	40	372.19		1.5
#140*	30	373.01		1.3
#200	20	373.62		1.1
Pan		373.67	XXXXXXXX	XXXXXXXXXX

SUMMARY: Shape & Filter Parameters

% COBBLES	---	D60	0.662	D85	1.05
% GRAVEL	0	D30	0.459	D50	0.59
% SAND	98.9	D10	0.298	D15	0.34
% FINES	1.1	Cu =	2.2	Cc =	1.1

* Denotes sieve added to better define gradation curve

Cc = D30^2 / (D60 * D10)

Cu = D60 / D10

(1) X in box denotes sieve on which split was made.

(2) Proposed allowable amount of soil retained on 8" dia. sieve.

Mica Noted: x No | Yes Amount Adjective:

(3) Sieve size given, denotes min. sieve size used in the appropriate sieving sequence.

The above values D## denotes particle size (mm) at the corresponding percent passing.

Particle Hardness

x Hard | Soft | Weathered

SET-UP BY: TJO DATE 07/30/12 CALCULATED BY: TJO CHECKED BY: YS

SUBMITTED BY: Thomas J. O'Mara

PARTICLE-SIZE ANALYSIS : by Hydrometer

ASTM C117 or D422 or if Double Hydrometer Performed, D4221

Project Number: 12206A Task Number: Boring No.: U2C9

Project Name: SONGS LOED permitting Sample No.: ---

Project Engineer: E Miller Depth (ft): ---

Visual Description: Grayish brown poorly graded Sand (SP)

State of Specimen before Processing
[ ] Moist State [ ] Oven Dried
[x] Air Dried
[ ] See bulk sample proc. form (S-106)
Soil broken up by: Other:
[ ] Mortar & pestle
[x] Passing soil through #10 sieve or
Dispersing Agent:(1)
[x] 125ml Std. 4% or ____ solution
[ ] Other
Date Soaking Initiated: 7/31/2012
Time [x] Overnight
Soaked: [ ] Other
[x] ASTM Dispersion Cup & Mixer used for 1 min
[ ] Air dispersion device used for ____ min
[ ] Other
Defoaming Agent Used: [X] No; [ ] Yes

Oven- or Air-Dried Set-Up
Drying container No.
Mass Container+Dry Soil (g)
Mass Container (g)
Mass Dry Soil (g)

Set-Up Water Content	[x] Minus No. 10 [ ] or
Container No.	sx37
Mass Container + Wet Soil (g), M1	362.85
Mass Container + Dry Soil (g), M2	362.52
Mass Container (g), M3	105.64
Water Content, w (%)	**0.13**

Test Notes: (1) Dispersing Agent is Sodium Hexametaphosphate

Mass of Dry Soil Used in Test, Ws	
For Oven-dry set-up, Ws (g)	
For Moist or ____ set-up	
Wwet = Estimated Ws x (1 + w)	
Est = ____ x (1 + ____) =	
Act (Wwet) = 104.92 (g)	
Ws = Wwet /(1 + w/100) = 104.79 (g)	
After Test Actual Ws	
Container No.	
Mass Container + Dispersant + Dry Soil (g)	
Mass Container (g)	
Mass Dry Soil + Dispersant (g)	
Mass Dispersant (g)	
Mass Dry Soil (g)	

Soaking Beaker No. 827 Graduate No. 11 152H Hydrometer No. 972 Meniscus Correction, Cm = calibrated (3)

Date 12 (yr) (m:d)	Time (hr:min)	Elapsed Time (min)	Temp (ºC)	Hyd. Reading Soil (2) R	Hyd. Reading Water (3) Rw	Diameter D (mm)	Total specimen % finer N'
8/1	9:46	0		XXXXXXXX		XXXXXXXX	XXXXXXX
		1	24.1	3.0	1.6	0.0514	1.1
		2	24.1	3.0	1.6	0.0363	1.1
		5	24.1	3.0	1.6	0.0230	1.1
		11	24.1	3.0	1.6	0.0155	1.1
		30	24.1	3.0	1.6	0.0094	1.1
		90	24.0	2.5	1.5	0.0054	0.8
		210	24.0	2.5	1.5	0.0036	0.8
		510	24.4	2.0	1.2	0.0023	0.6
		1363	23.7	2.0	2.0	0.0014	0.0

Sieving Performed on Hyd. Test Spec.	
Complete Sieve Analysis Performed: See Form S-104	[ ] Yes [ ] No
[x] Wash analysis performed to check appropriateness of hyd. spec.	
Container No.	x6
Mass Container + Dry Soil (g)	257.88
Mass Container (g)	154.78
Total Specimen % Finer	1.3

Dry Sieving After Washing

Sieve No.	Cumulative Mass Retained (g)	Total Specimen % Finer, N'
40	75.73	22.3
100	102.19	2.0
200	103.1	1.3
Pan	103.11	XXXXXXX

Calculations: Average Temperature used in calculating test, ºC = 24.1

"X" in temperature column indicates where actural temperature used, and this value not included in the average.

Specific Gravity, Gs = 2.70

N'= a Pc (R - Rw) / Ws = (Total % finer Factor) x (R - Rw)

D (mm) = K $\sqrt{L / t}$ [ ] Tested [x] Assumed

a = 0.99 from Table 1 (D 422) or ____

K from Table A1.3 (Draft Std.), K = 0.01281

Pc = Percent of soil passing No. 10 sieve = 80.5 %

Cal. Notes: (2) Soil, Water & Dispersion Solution

Ws = Dry mass of soil placed in cylinder = 104.79 g

(3) Water & Dispersion Solution

Total % finer Factor = (a*Pc/Ws) = 0.761

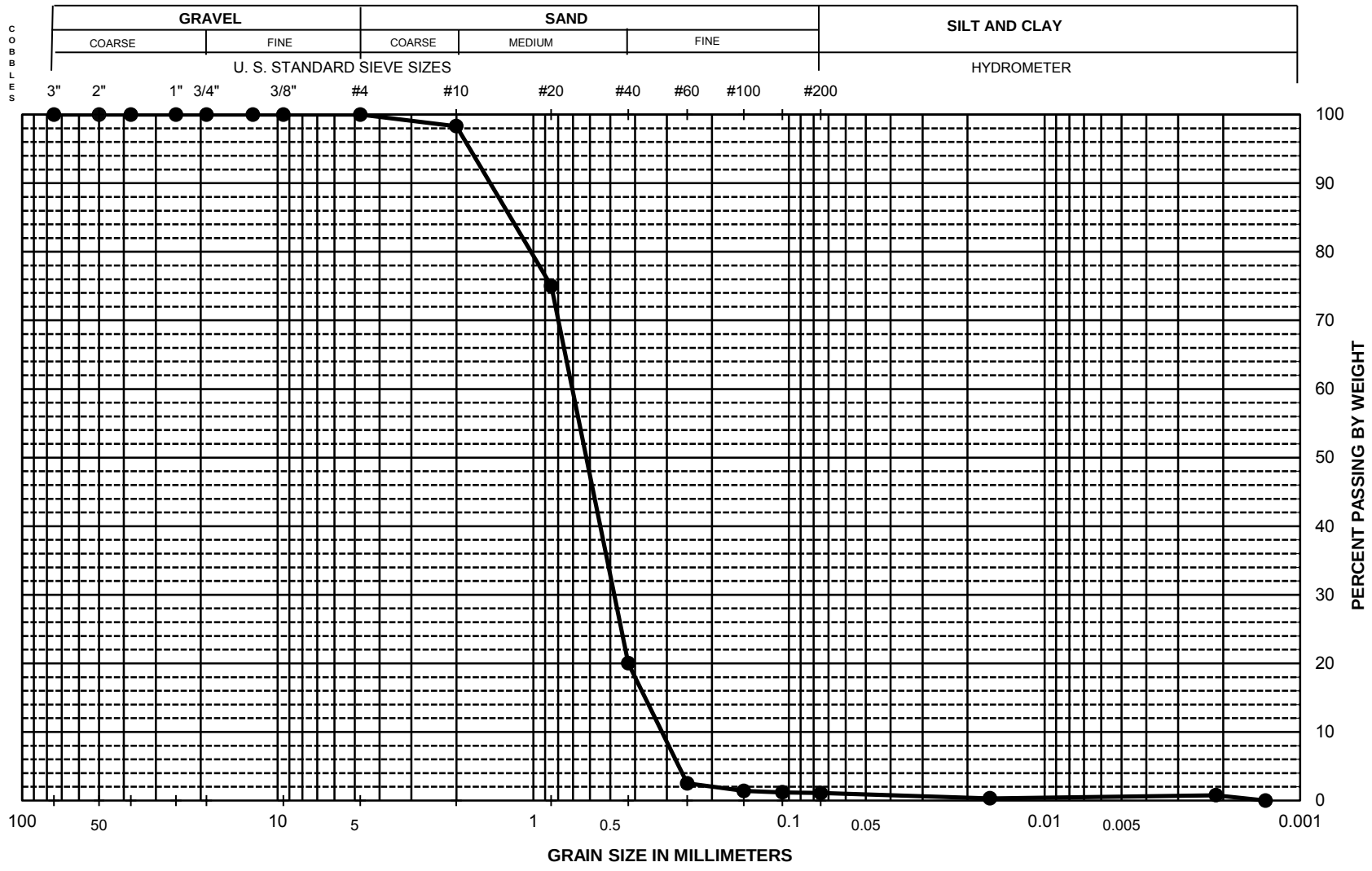
D(mm) = {(16.3 -(R-Rw)*0.164) / time}^0.5 *K

Remarks:

SET-UP BY: TJO RUN BY: YS CALCULATED BY: YS REVIEWED BY: TJO

SUBMITTED BY: Thomas J O'Mara

UNIFIED SOIL CLASSIFICATION



Sieve No.	Dia. mm	% Finer
3"	75.0	100.0
2"	50.0	100.0
1.5"	37.5	100.0
1"	25.0	100.0
3/4"	19.00	100.0
1/2"	12.50	100.0
3/8"	9.50	100.0
#4	4.75	100.0
#10	2.00	98.3
#20	0.850	75.0
#40	0.425	20.0
#60	0.250	2.5
#100	0.150	1.4
#140	0.106	1.2
#200	0.075	1.1
Hydrometer Analysis	0.0163	0.3
	0.0021	0.8
	0.0014	0.0

% Cobbles	--
% Gravel	0.0
% Sand	98.9
% Fines	1.1

D_{85}	1.2272
D_{60}	0.7036
D_{30}	0.4821
D_{15}	0.1803
D_{10}	0.1487
C_u	4.7
C_c	2.2

Boring No.	Sample No.	Depth (ft)	SYMBOL	Wn (%)	LL	PI	% 2 μm	Description and Classification
U2C10	---	---	●	NA	NA	NA	1	**Brown poorly graded Sand (SP)**

PROJECT NAME: **SONGS LOED permitting**

PROJECT NUMBER: **12206A**

PARTICLE-SIZE DISTRIBUTION CURVES

Appendix A-1. Unit 2 sediment grain size analysis resutls by station. LOED Pre-Construction

GRADATION OF SOILS by Sieving using Soil Sieve Sizes & with Water Content

ASTM D6913, D422 and D2216

Project Number: 12206A | Task Number: | Boring No.: U2C10

Project Name: SONGS LOED permitting | Sample No.: ---

Project Engineer: E Miller | Depth (ft): ---

Visual Description: Brown poorly graded Sand (SP)

SPECIMEN: Selected From:

Bulk Sample	x		Other - Jar
SPT Sample			Thin-Walled Tube
Calif. Sample			Engr. Test Specimen's WC
			Whole sample used
			See Bulk Sample Processing Form

Selection Method:

	Sieves (1) - whole sample used
x	Sieves (1) - partial sample used & selected by Method(s)
c	Method

(a): Splitter; (use for dry soils or that which will segregate)

(b): Quartering; (use for dry soils or that which will segregate)

(c) : Representative scoop after mixing, or slice of intact sample. (use for moist soils or that which will not segregate)

Preparation: Sample/Specimen:

As-Received	x
Air Dried	
Oven-Dried	

Test Method

Method A	
Method B	x

Oven-Dried Soil Broken Up Before:

Selecting partial sample: No x | Yes

Washing:

	No	Yes
Whole Specimen Washed on No. 200 sieve ?		x
Retained Fraction: 1st Split Washed ?		
Fine Fraction Washed on No. 200 sieve ?		

By: Mortar & Pestle | Hand | Pulverizer | Other

and Soil Soaked for: ~6 hrs.

Water Content

MASS OF TEST SPECIMEN (g)	Total Test Specimen with Coarse Fraction	Partial or Whole Test Specimen	Soil Retained (after washing)	As Recieved or Container No.	
Min.sieve size in sieving sequence (3)	#N/A	# 200	+200	Wet, M1 (g)	
Container Number		m5	m5	Dry, M2 (g)	XXX
Mass of Container and Dry Soil, (g)		425.2	421.83	Cont.,M3 (g)	XXX
Mass of Container, (g)		91.26	91.29	**Water Content (%)**	**NA**
Dry Soil, Ws (g)		333.94	330.54		

SIEVING RESULTS % error: 0.05

See (1)	Sieve No.	Cum. Mass Retained (g)	Total Specimen % Finer N'
	3 "		
	2 "		
	1 1/2"		
	1 "		
	3/4 "		
	1/2 "		
	3/8 "		
	4		
	Pan		XXXXXXXX

Req. Mass of Test Spec. for 1% (kg)
3"= 70
1 1/2"=10
3/4"= 1.1
3/8"= 0.25
#4 = 0.1
#10 = 0.1

Shape of Grains

	Rounded
x	Angular
	Flat

Sieve No.	Sieve mm	Cum. Mass Retained (g)	Partial Test Specimen	Total Specimen % Finer N'
3 "	75			
2 "	50			
1-1/2"	37.5			
1 "	25			
3/4 "	19			
1/2 "	12.5			
3/8 "	9.5	0		100
#4	325	0.15		100
#10	180	5.83		98.3
#20	115	83.44		75
#40	75	267.01		20
#60	60	325.62		2.5
#100	40	329.41		1.4
#140*	30	329.87		1.2
#200	20	330.34		1.1
Pan		330.36	XXXXXXXX	XXXXXXXXXX

SUMMARY: Shape & Filter Parameters

% COBBLES	---	D60	0.704	D85	1.23
% GRAVEL	0	D30	0.482	D50	0.62
% SAND	98.9	D10	0.149	D15	0.18
% FINES	1.1	Cu =	4.7	Cc =	2.2

* Denotes sieve added to better define gradation curve

Cc = D30^2 / (D60 * D10)

Cu = D60 / D10

(1) X in box denotes sieve on which split was made.

(2) Proposed allowable amount of soil retained on 8" dia. sieve.

(3) Sieve size given, denotes min. sieve size used in the appropriate sieving sequence.

The above values D## denotes particle size (mm) at the corresponding percent passing.

Mica Noted: x No | Yes Amount Adjective:

Particle Hardness

x Hard | Soft | Weathered

SET-UP BY: TJO DATE 07/30/12 CALCULATED BY: TJO CHECKED BY: YS

SUBMITTED BY: Thomas J. O'Mara