



U.S. Department
of Transportation

**Federal Highway
Administration**

Memorandum

Western Federal Lands Highway Division
610 E. Fifth Street
Vancouver, WA 98661-3801

Date: November 17, 2015

From: Dustin Woods, WFLHD
Geotechnical Engineer

To: Betty Chon, WFLHD Project
Manager

Subject: Final Bridge Foundation
Recommendation Memorandum
for NPS SITK 2013(1) Indian
River Bridge

In Reply Refer To: HFL-17

**DUSTIN PATRICK
WOODS**

Digitally signed by DUSTIN PATRICK
WOODS
DN: c=US, o=U.S. Government, ou=DOT
FHWA/VancouverWA, ou=FHWA
FHWA/VancouverWA, cn=DUSTIN PATRICK
WOODS
Date: 2015.11.17 16:31:35 -08'00'

Geotechnical Memorandum GM37-15

INTRODUCTION

This memorandum replaces and finalizes any previously provided information in Geotechnical Memorandum GM21-15. It provides geotechnical investigation results, analysis, and final foundation recommendations for the proposed Indian River Bridge replacement project located in Sitka Alaska in the Sitka National Historical Park.

PROJECT DESCRIPTION

This project will remove and replace an existing 115 foot long, 5 foot wide, arched, laminated wood, free span pedestrian bridge over the Indian River. The existing bridge is approximately 50 years old and as of August 17, 2012 was load rated at only 85 pounds per square foot. The new structure will be approximately 111 feet long and 7 feet wide to accommodate small park vehicles and be ADA compliant. The bridge is located approximately at 57.049309° North -135.316705° East.

GEOLOGY

Figure 1 shows the regional geology of the project area from the Geologic Map of Southeastern Alaska by Gehrels and Berg. A description of the Qs map unit was not found on the map and supporting documents, it is assumed that the unit is Quaternary Surficial Deposits as this was the type of material found during the subsurface investigation. These deposits are underlain with Sitka Graywacke (Ks) bedrock of late Jurassic and early Cretaceous age.

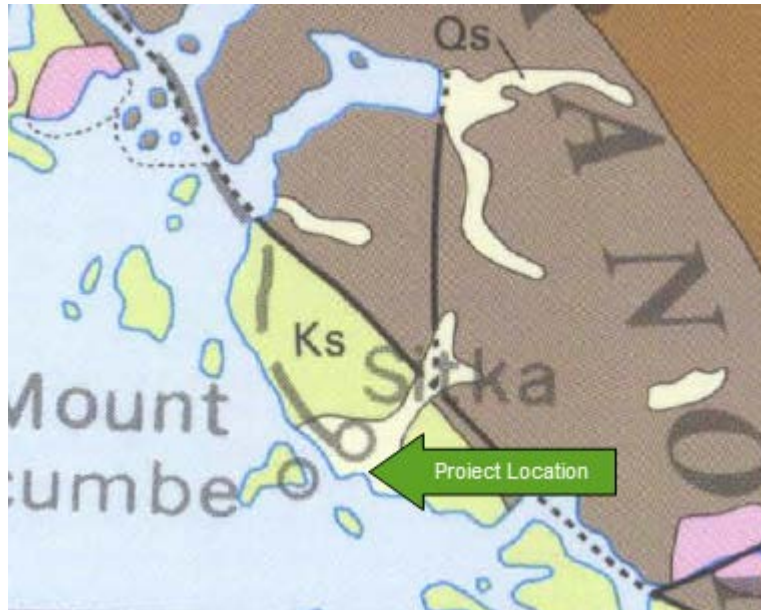


Figure 1. Gehrels and Berg Geologic Map of Southeastern Alaska.

Site Seismicity

The project is located in Seismic Zone 4, in Site Class D, with scaled peak ground acceleration, A_s of 0.324g. A liquefaction assessment is not required per AASHTO Bridge Design Specifications Section 10.5.4.2. AASHTO states that a liquefaction assessment is required in Seismic Zones 3 and 4 if both the ground water level at the site is within 50 feet of the existing ground surface and the soil characteristics within the upper 75 feet are low plasticity silts and sands. The ground water level is within 50 feet of the existing ground surface; however the underlying soils are dense gravels.

United States Geologic Survey Design Maps Detailed Report, showing seismic information for the area, has been included in Appendix 1.

SITE CONDITIONS

The site is generally flat in the vicinity of the proposed bridge location with the river banks approximately 10 feet above the river. The site is located in a coniferous forest. The as-built slope from the existing abutments down to the river is approximately 1V:2H. The pedestrian trail system to and from the bridge meanders and is narrow. The path on the west side of the bridge is gravel and varies in width from about 5 to 10 feet, is winding, and is roughly 500 feet in length from the parking area near the visitors center. The gravel path on the east side of the bridge is slightly wider and straighter with a fairly consistent width of approximately 10 feet. This path is roughly 600-700 feet in length originating from a small parking area.

SUBSURFACE CONDITIONS

A subsurface investigation of the site was done May 13 to 17, 2014 with one test boring per existing abutment. The western abutment (IRB14-01) was drilled to a depth of 71 feet below

the surface and the eastern abutment (IRB14-02) was drilled to a depth of 57 feet. Because of how close to sea level this project is, any elevation below sea level is shown as a negative number.

IRB14-01: This test boring ranged from an elevation of 20.5 to -52.5 and consisted of generally medium dense to very dense gravels with sand and silt. Bedrock was encountered at a depth of 67 feet below the ground surface (elevation -46.5) and consisted of a medium strong to strong Graywacke. Corrected $((N_1)_{60})$ blow counts ranged from 22 to 95 blows per foot (bpf) excluding a less dense layer between elevations -30 and -37.5 with corrected blow counts of 11 to 12 bpf.

IRB14-02: This test boring ranged from an elevation of 19 to -38 and consisted of generally medium dense to very dense gravels with sand and silt. Bedrock was not encountered. Corrected $((N_1)_{60})$ blow counts ranged from 22 to 80 bpf with a similar less dense layer between elevations -31.5 and -38. These corrected blow counts ranged from 8 to 12 bpf.

Cobbles and boulders were not found in the two subsurface borings. However, cobbles and boulders were observed in the stream bed and on the stream banks and are likely present in the subsurface.

The boring logs and laboratory test results are attached to this memorandum in Appendix 2.

ANALYSIS

All of the analyses completed in preparation of this memorandum followed the 2014 7th edition of the AASHTO Bridge Design Specifications.

Tables 1 and 2 list the interpreted soil properties for the Western (Abutment 1 and Pier 1) and Eastern (Pier 2 and Abutment 2) foundation locations respectively. These values were used in the analysis and foundation design.

Table 1. Western Structures Soil Properties.

Elevation		Moist Unit Weight, γ_m (pcf)	Internal Friction Angle, ϕ_f (°)	Cohesion, C (psf)
From	To			
20.5	16.5	130	30	0
16.5	-30	135	34	0
-30	-37.5	120	32	0
-37.5	-46.5	130	34	0
-46.5	-50.5	Bedrock		

Table 2. Eastern Structures Soil Properties.

Elevation		Moist Unit Weight, γ_m (pcf)	Internal Friction Angle, ϕ_f (°)	Cohesion, C (psf)
From	To			
19	15	125	30	0
15	-31.5	135	34	0
-31.5	-38	120	32	0

DESIGN RECOMMENDATIONS

Foundations

Final bridge loads and various load combinations for the foundation elements were provided by Eastern Federal Lands Structures section using the software RC Pier. The summary of the output file is located in Appendix 3.

The recommended foundation type for each abutment, and for both piers, is a spread footing foundation. Table 3 below lists the final footing geometry for each foundation element.

Table 3. Final Footing Geometry.

Structure	Width, B (ft-in)	Length, L (ft-in)
Abutment 1	6'-0"	9'-1/2"
Pier 1	9'-0"	14'-0"
Pier 2	9'-0"	14'-0"
Abutment 2	6'-0"	9'-1/2"

The minimum footing elevation for Abutment 1, Abutment 2, and each pier is 15.7, 12.8, and 3.0 feet . This is based primarily on the scour analysis provided by the WFL Hydraulics group and not removing the existing pier foundation elements. This footing elevation will also allow for the footing to be placed below the frost depth.

Using AASHTO Section 10.6.3.1.2, the service and strength limit state bearing resistances were calculated. Table 4 lists the service and strength limit resistances and corresponding bearing pressures for each structure. Bearing failure is assumed if the pressure exceeds the resistance for each limit state.

Table 4. Bearing Resistance Checks.

Structure	Nominal Bearing Resistance, q_n (ksf)	Service Limit State ($\phi_b=1.0$)		Strength Limit State ($\phi_b=0.45$)	
		Bearing Resistance, $q_R=q_n \phi_b$ (ksf)	Bearing Pressure, q_p (ksf)	Bearing Resistance, $q_R=q_n \phi_b$ (ksf)	Bearing Pressure, q_p (ksf)
Abutment 1	10.7	10.7	2.5	4.8	3.6
Pier 1	28.1	28.1	2.2	12.6	3.0
Pier 2	28.1	28.1	2.2	12.6	3.0
Abutment 2	10.7	10.7	2.5	4.8	3.6

Stream Scour

The total scour elevation as provided by the WFLHD hydraulics team is 2.9 feet.

Settlement

Because of the type and densities of subsurface materials in the area of the proposed foundations, total settlement at each foundation location would not be expected to exceed 0.5 inches.

Lateral Earth Pressures and Coefficient of Sliding

The Earth Pressure Coefficients and the Coefficient of Sliding are provided in Table 5 below. These coefficients were calculated using Coulomb's earth pressure theories and assuming a flat ground condition. Please note that the reduction factor, R, has been accounted for the listed passive pressure coefficient.

It is recommended that Equivalent Fluid Pressures are not used for this structure as the sieve analysis shows the percent passing the #200 sieve is less than 5%.

Table 5. Earth Pressure Design Parameters.

Parameter	Value
Active Earth Pressure Coeff., k_a	0.26
Passive Earth Pressure Coeff., k_p	6.07
At-Rest Earth Pressure Coeff., k_o	0.44
Coefficient of Sliding, $\tan \delta$	0.31

CONSTRUCTION CONSIDERATIONS

When considering construction requirements and sequencing, the following should be taken into account.

Temporary excavations without shoring should follow Occupational Health and Safety Association (OSHA) Sloping and Benching – 1926 Subpart P App B. Material testing results indicate that on-site subsurface materials will classify as Soil Type C according to OSHA standards.

The surrounding trees and pedestrian path result in both width restrictions and overhead obstructions that should be accounted for when considering constructability.

During drilling of both test borings, groundwater was encountered at elevation 10.5. It should be assumed that excavation of material near or below this elevation will be in a saturated or above optimum moisture content for compactive efforts. It is likely that the ground water elevation will vary based on the water level in the river and the time of year.

The laboratory test results show that the subsurface materials should meet the requirements for Structural Backfill as listed in the Standard Specifications for Construction of Roads and Bridges on Federal Highway Projects FP-14. The material may also meet the requirements for other fill types. While it is expected that excavated, on-site material will be suitable for re-use as Structural Backfill, suitability of the material will need to be assessed at the time of excavation.

Cobbles and boulders were not encountered in the borings; however they are present in the project area. It should be assumed that any excavations for bridge construction will contain cobbles and boulders similar in size to those that are visible near the existing bridge site.

CLOSING

This memorandum was prepared to provide subsurface investigation results and final geotechnical recommendations for a new bridge over the Indian River. It should be noted the borings may not represent potentially unfavorable subsurface conditions between borings. The observed water levels and/or conditions indicated on the boring logs are as recorded at the time of the exploration. The water levels and/or conditions may vary considerably, with time, according to the climate, rainfall, and other factors and are otherwise dependent of the duration of, and methods used in, and interpretations made from the exploration program.

If, during construction, soil conditions are encountered that vary from those discussed in this memorandum, or if design loads, project stationing, and/or configurations change, the WFLHD Geotechnical Team should be notified immediately to evaluate the effect, if any, on the recommendations contained in this memorandum. The recommendations presented in this memorandum are applicable only to this specific site. These data are not to be used for other purposes.

Please contact Dustin Woods at (360) 619-7541 or Dustin.Woods@dot.gov with any questions regarding the geotechnical recommendations outlined in this memorandum.

REFERENCES

American Association of State Highway and Transportation Officials. (2014). *AASHTO LRFD Bridge Design Specifications, Seventh Edition*. Washington, D.C: American Association of State Highway and Transportation Officials.

Gehrels, George E., and Henry C. Berg. *Geologic Map of Southeastern Alaska*. Rep. no. 2006-1290. N.p.: U.S. Geologic Survey, 1992.

Leon, Sven. *Indian River Pedestrian Bridge Final Hydraulics Report*. Rep. N.p.: FHWA, 2015.

cc: Benjamin Oltmann, WFLHD Structures Functional Manager
Ryan Hixson, WFLHD Highway Designer
Nathan Jenks, WFLHD Geotechnical Engineer
Geotechnical File

Attachments: Appendix 1, USGS Design Maps Detailed Report
Appendix 2, Boring Logs and Laboratory Test Results
Appendix 3, RC Pier Summary Output

Appendix 1

USGS Design Maps Detailed Report

 Design Maps Detailed Report

2009 AASHTO Guide Specifications for LRFD Seismic Bridge Design (57.04931°N, 135.31671°W)

Site Class D – “Stiff Soil”

Article 3.4.1 — Design Spectra Based on General Procedure

Note: Maps in the 2009 AASHTO Specifications are provided by AASHTO for Site Class B. Adjustments for other Site Classes are made, as needed, in Article 3.4.2.3.

From [Figure 3.4.1-18](#) ^[1]

PGA = 0.248 g

From [Figure 3.4.1-19](#) ^[2]

S_s = 0.587 g

From [Figure 3.4.1-20](#) ^[3]

S_1 = 0.351 g

Article 3.4.2.1 — Site Class Definitions

The authority having jurisdiction (not the USGS), site-specific geotechnical data, and/or the default has classified the site as Site Class D, based on the site soil properties in accordance with Article 3.4.2.

Table 3.4.2.1–1 Site Class Definitions

SITE CLASS	SOIL PROFILE NAME	Soil shear wave velocity, $\bar{v}_s$, (ft/s)	Standard penetration resistance, $\bar{N}$	Soil undrained shear strength, $\bar{s}_u$, (psf)
A	Hard rock	$\bar{v}_s > 5,000$	N/A	N/A
B	Rock	$2,500 < \bar{v}_s \leq 5,000$	N/A	N/A
C	Very dense soil and soft rock	$1,200 < \bar{v}_s \leq 2,500$	$\bar{N} > 50$	$> 2,000$ psf
D	Stiff soil profile	$600 \leq \bar{v}_s < 1,200$	$15 \leq \bar{N} \leq 50$	1,000 to 2,000 psf
E	Stiff soil profile	$\bar{v}_s < 600$	$\bar{N} < 15$	$< 1,000$ psf
E	—	Any profile with more than 10 ft of soil having the characteristics: 1. Plasticity index $PI > 20$, 2. Moisture content $w \geq 40\%$, and 3. Undrained shear strength $\bar{s}_u < 500$ psf		
F	—	Any profile containing soils having one or more of the following characteristics: 1. Soils vulnerable to potential failure or collapse under seismic loading such as liquefiable soils, quick and highly sensitive clays, collapsible weakly cemented soils. 2. Peats and/or highly organic clays ($H > 10$ feet of peat and/or highly organic clay where H = thickness of soil) 3. Very high plasticity clays ($H > 25$ feet with plasticity index $PI > 75$) 4. Very thick soft/medium stiff clays ($H > 120$ feet)		

For SI: 1ft/s = 0.3048 m/s 1lb/ft² = 0.0479 kN/m²

Article 3.4.2.3 — Site Coefficients

Table 3.4.2.3-1 (for F_{pga})—Values of F_{pga} as a Function of Site Class and Mapped Peak Ground Acceleration Coefficient

Site Class	Mapped Peak Ground Acceleration				
	PGA ≤ 0.10	PGA = 0.20	PGA = 0.30	PGA = 0.40	PGA ≥ 0.50
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See AASHTO Article 3.4.3				
Note: Use straight-line interpolation for intermediate values of PGA					

For Site Class = D and PGA = 0.248 g, $F_{PGA} = 1.303$

Table 3.4.2.3-1 (for F_a)—Values of F_a as a Function of Site Class and Mapped Short-Period Spectral Acceleration Coefficient

Site Class	Spectral Response Acceleration Parameter at Short Periods				
	$S_s \leq 0.25$	$S_s = 0.50$	$S_s = 0.75$	$S_s = 1.00$	$S_s \geq 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	See AASHTO Article 3.4.3				
Note: Use straight-line interpolation for intermediate values of S_s					

For Site Class = D and $S_s = 0.587$ g, $F_a = 1.330$

Table 3.4.2.3-2—Values of F_v as a Function of Site Class and Mapped 1-sec Period Spectral Acceleration Coefficient

Site Class	Mapped Spectral Response Acceleration Coefficient at 1-sec Periods				
	$S_1 \leq 0.10$	$S_1 = 0.20$	$S_1 = 0.30$	$S_1 = 0.40$	$S_1 \geq 0.50$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	See AASHTO Article 3.4.3				

Note: Use straight-line interpolation for intermediate values of S_1

For Site Class = D and $S_1 = 0.351$ g, $F_v = 1.698$

Equation (3.4.1-1):

$$A_S = F_{PGA} \text{ PGA} = 1.303 \times 0.248 = 0.324 \text{ g}$$

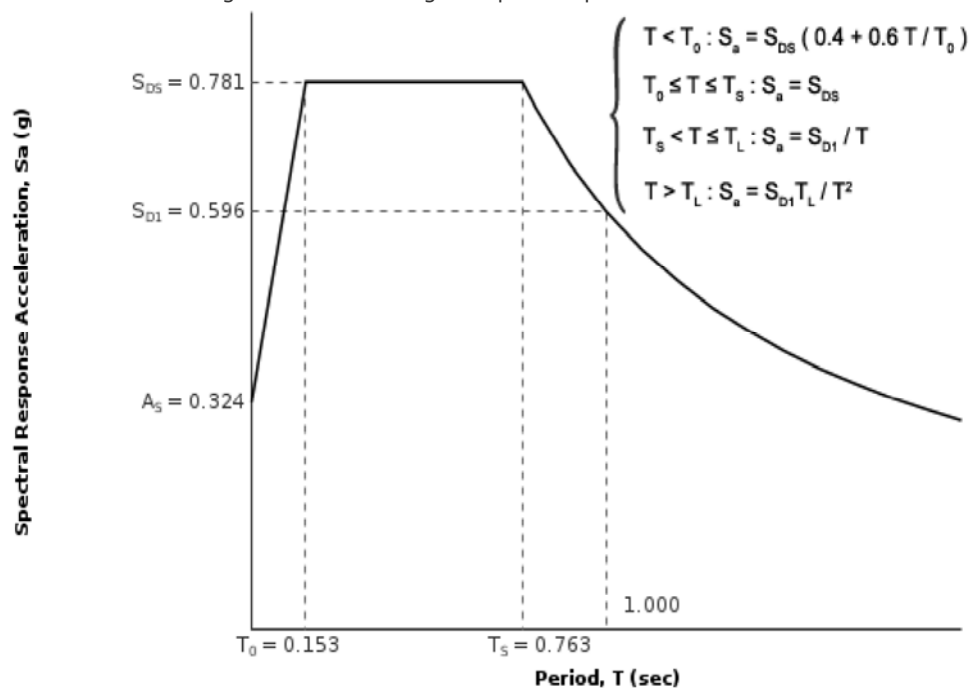
Equation (3.4.1-2):

$$S_{DS} = F_a S_S = 1.330 \times 0.587 = 0.781 \text{ g}$$

Equation (3.4.1-3):

$$S_{D1} = F_v S_1 = 1.698 \times 0.351 = 0.596 \text{ g}$$

Figure 3.4.1-1: Design Response Spectrum



Article 3.5 - Selection of Seismic Design Category (SDC)

Table 3.5-1—Partitions for Seismic Design Categories A, B, C, and D

VALUE OF S_{D1}	SDC
$S_{D1} < 0.15g$	A
$0.15g \leq S_{D1} < 0.30g$	B
$0.30g \leq S_{D1} < 0.50g$	C
$0.50g \leq S_{D1}$	D
For $S_{D1} = 0.596g$, Seismic Design Category = D	

Seismic Design Category $\equiv$ "the design category in accordance with Table 3.5-1" = D

References

1. *Figure 3.4.1-18*: <http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/AASHTO-2009-Figure-3.4.1-18.pdf>
2. *Figure 3.4.1-19*: <http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/AASHTO-2009-Figure-3.4.1-19.pdf>
3. *Figure 3.4.1-20*: <http://earthquake.usgs.gov/hazards/designmaps/downloads/pdfs/AASHTO-2009-Figure-3.4.1-20.pdf>

Appendix 2

Boring Logs and Laboratory Test Results



FEDERAL HIGHWAY ADMINISTRATION
VANCOUVER, WASHINGTON
GEOTECHNICAL SECTION

BORING LOG (US Customary Units)

DATE STARTED: 5/13/2014
DATE FINISHED: 5/15/2014
DRILLER: Sam Larson
COMPANY: Haztech
LOGGER: N. Jenks
WEATHER: light rain, becoming sunny

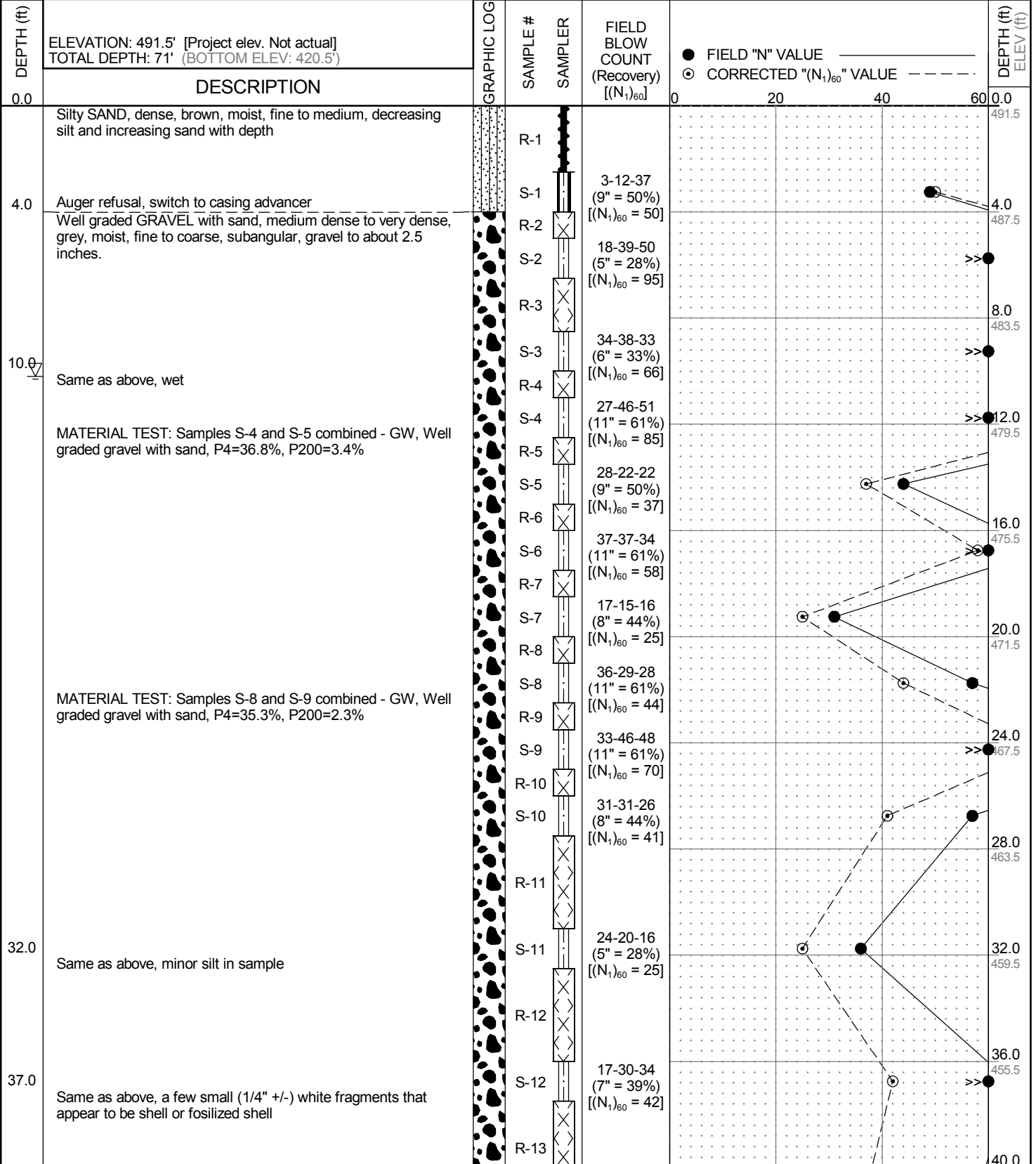
BORING IRB14-01

DRILL: Dietrich 25
HAMMER: Manual
DRILLING METHODS: 6.5" Hollow Stem
Auger, HQ Casing Adv, NQ Core

PROJECT: Indian River Bridge

NOTES: Indian River Bridge, South (West) Abutment. (N₁)₆₀ includes a conversion for sampler size.

STATION, OFFSET:



WATER LEVELS

10' ∇ WHILE DRILLING
∇ AT COMPLETION
∇ AFTER DRILLING

■ Solid Stem Auger

□ Casing Advancer

■ 3" OD Split Spoon (D&M)

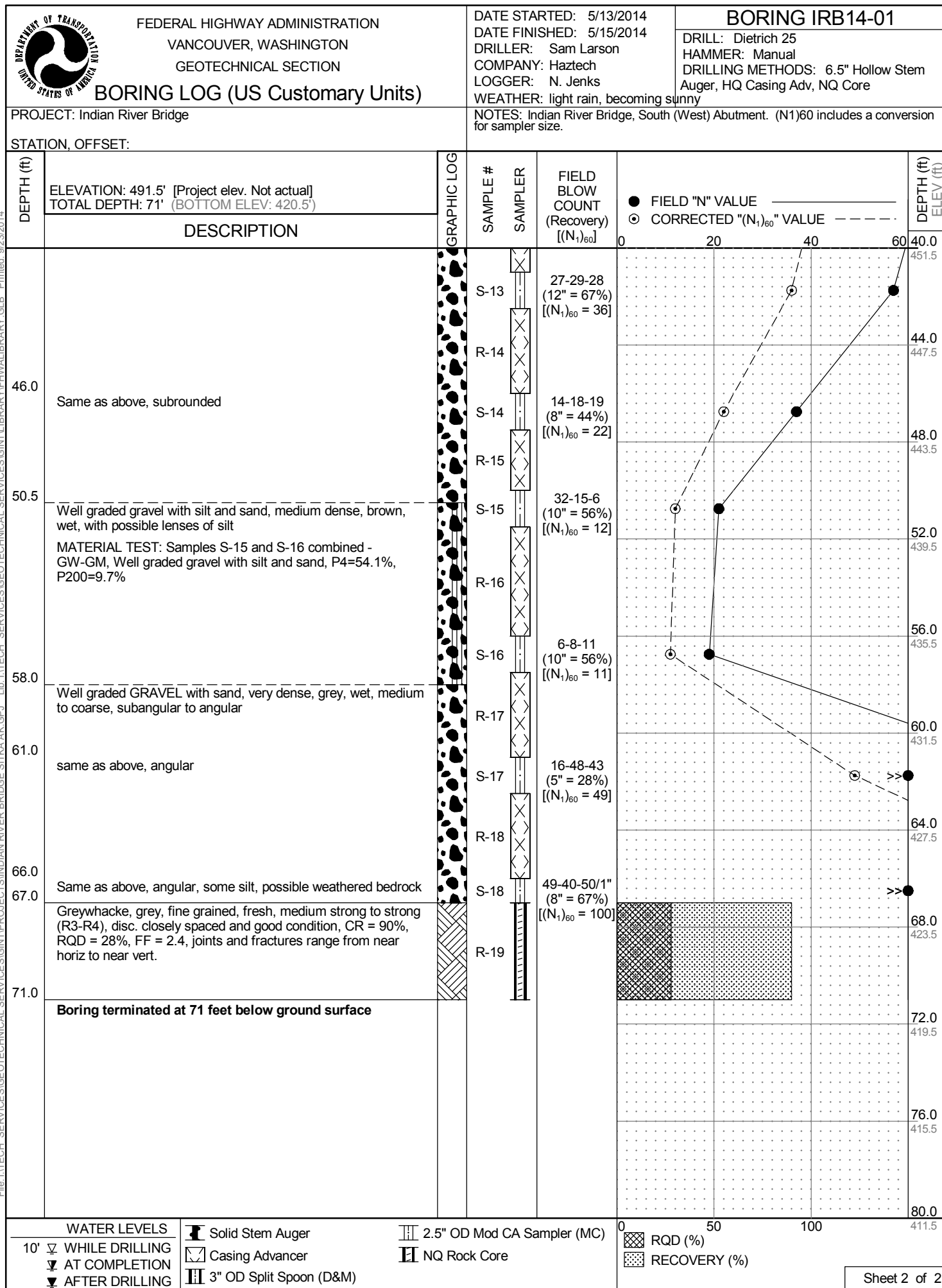
■ 2.5" OD Mod CA Sampler (MC)

■ NQ Rock Core

■ RQD (%)

■ RECOVERY (%)

File: I:\TECH SERVICES\GEO\PROJECTS\INDIAN RIVER BRIDGE SITKA AK.GPJ Lib: I:\TECH SERVICES\GEO\TECHNICAL SERVICES\GINT\LIBRARY\FHWALIBRARY.GLB Printed: 9/23/2014





Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: 17 Sep 2014
Lab Control Number: W-14-0680-SO

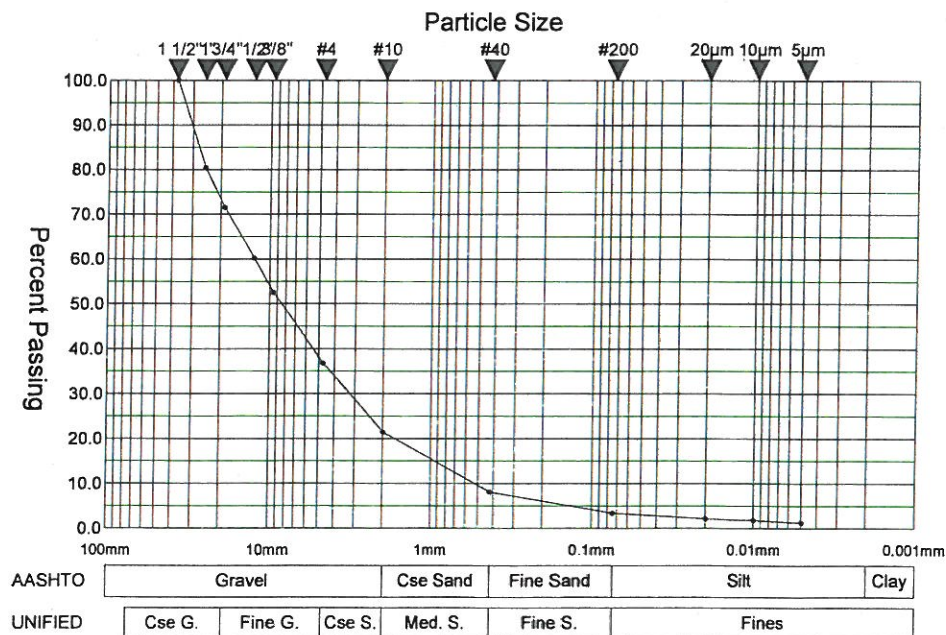


Project Name: Rehabilitate Indian River Bridge		Sample No: S-4 & S-5
Project Number: AK NPS SITK 2013(1)		Sampled By: Nathan Jenks
Acct. No.: 1517029835001	510.PE.G310.02	Date Sampled: 5/13/2014
Submitted By: Nathan Jenks		Address:
Phone: 360-619-7748		
Sample of:		Date Received: 8/21/2014
Quantity Rep:		No. & Containers: 2 Plastic bags
		Dates Tested: 08-21-14 to 09-11-14
Owner:	Milepost:	County: Sitka
Station: South Abut		Offset:
Boring No./Test Pit: IRB14-01		Depth: 11'- 15'
		State: AK

Site Description: Drive sample, South (West) Abutment, combined.

Sieve Analysis

Sieve Size	As Received % Passing
1 1/2"	100.0
1"	80.4
3/4"	71.5
1/2"	60.2
3/8"	52.5
#4	36.8
#10	21.4
#40	8.1
#200	3.4
20µm	2.1
10µm	1.8
5µm	1.2



Soil Classification (DL145)

AASHTO

Unified

A-1-a(0)

SI-SA-GRAVEL

GW; Well-graded gravel with sand

pH Value (T289)

5.9

Apparent Specific Gravity (T100)

2.808

Atterberg Limits (T89)

Liquid Limit

NP

Plasticity Index

NP

Insufficient material to run Minimum Resistivity (T288)



Walt Stong, Materials Laboratory Chief
For: Brad K. Neitzke, Materials Engineer



Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: 17 Sep 2014
Lab Control Number: W-14-0681-SO

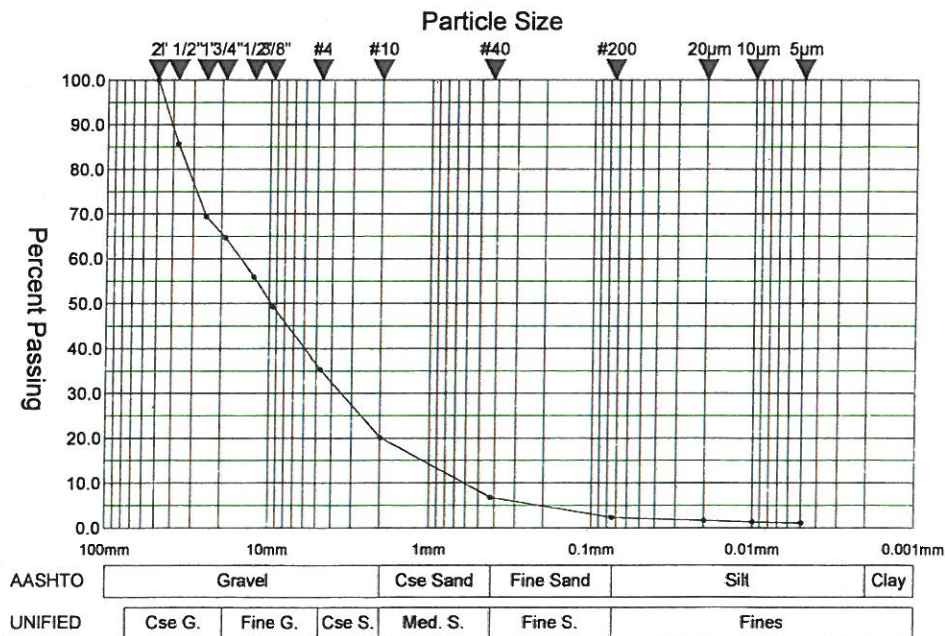


Project Name: Rehabilitate Indian River Bridge		Sample No: S-8 & S-9
Project Number: AK NPS SITK 2013(1)		Sampled By: Nathan Jenks
Acct. No.: 1517029835001	510.PE.G310.02	Date Sampled: 5/14/2014
Submitted By: Nathan Jenks		Address:
Phone: 360-619-7748		
Sample of:		Date Received: 8/21/2014
Quantity Rep:		No. & Containers: 2 Plastic bags
		Dates Tested: 08-21-14 to 09-11-14
Owner:	Milepost:	County: Sitka
Station: South Abut		Offset:
Boring No./Test Pit: IRB14-01		Depth: 21'- 25'
		State: AK

Site Description: Drive sample, South (West) Abutment, combined.

Sieve Analysis

Sieve Size	As Received % Passing
2"	100.0
1 1/2"	85.7
1"	69.4
3/4"	64.7
1/2"	55.9
3/8"	49.3
#4	35.3
#10	20.1
#40	6.8
#200	2.3
20µm	1.6
10µm	1.3
5µm	1.1



Soil Classification (DL145)

AASHTO
Unified

A-1-a(0)

SI-SA-GRAVEL

GW; Well-graded gravel with sand

pH Value (T289)

5.7

Apparent Specific Gravity (T100)

2.780

Atterberg Limits (T89)

Liquid Limit

NP

Plasticity Index

NP

Insufficient material to run Minimum Resistivity (T288).



Walt Stong, Materials Laboratory Chief
For: Brad K. Neitzke, Materials Engineer



Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: 17 Sep 2014
Lab Control Number: W-14-0682-SO

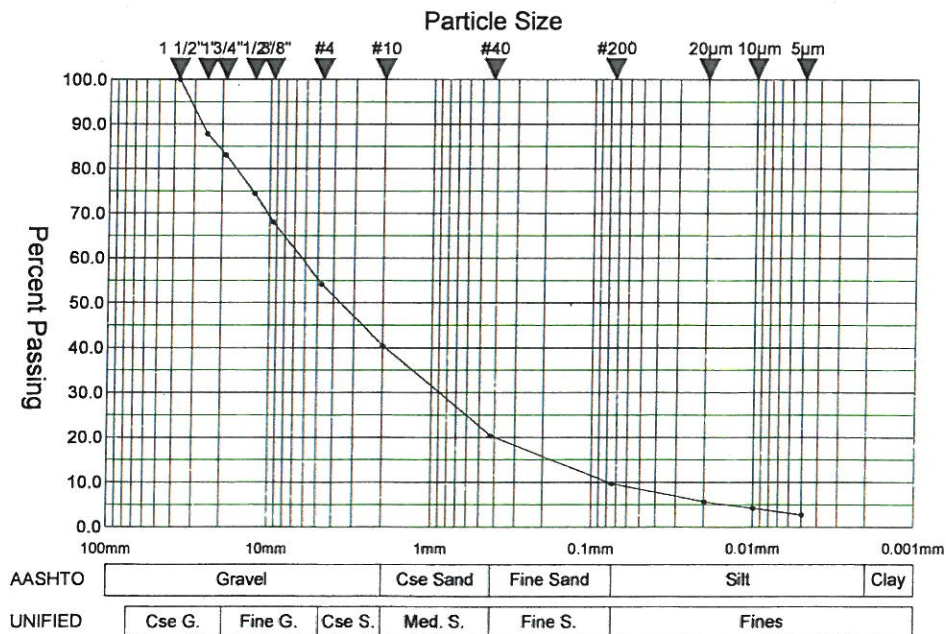


Project Name: Rehabilitate Indian River Bridge		Sample No: S-15 & S-16
Project Number: AK NPS SITK 2013(1)		Sampled By: Nathan Jenks
Acct. No.: 1517029835001	510.PE.G310.02	Date Sampled: 5/14/2014
Submitted By: Nathan Jenks		Address:
Phone: 360-619-7748		
Sample of:		Date Received: 8/21/2014
Quantity Rep:		No. & Containers: 2 Plastic bags
		Dates Tested: 08-21-14 to 09-11-14
Owner:		County: Sitka
Station: South Abut	Milepost:	Offset:
Boring No./Test Pit: IRB14-01		Depth: 50'- 57'
		State: AK

Site Description: Drive sample, South (West) Abutment, combined.

Sieve Analysis

Sieve Size	As Received % Passing
1 1/2"	100.0
1"	87.8
3/4"	83.0
1/2"	74.4
3/8"	68.0
#4	54.1
#10	40.4
#40	20.3
#200	9.7
20µm	5.6
10µm	4.2
5µm	2.7



Soil Classification (DL145)

AASHTO
Unified

A-1-a(0)

SI-SA-GRAVEL

GW-GM; Well-graded gravel with silt and sand

pH Value (T289)

5.8

Apparent Specific Gravity (T100)

2.755

Atterberg Limits (T89)

Liquid Limit
Plasticity Index

NP

NP

Insufficient material to run Minimum Resistivity (T288).

A handwritten signature in blue ink, appearing to read 'Walt Stong', is written over a horizontal line.

Walt Stong, Materials Laboratory Chief
For: Brad K. Neitzke, Materials Engineer



FEDERAL HIGHWAY ADMINISTRATION
VANCOUVER, WASHINGTON
GEOTECHNICAL SECTION

BORING LOG (US Customary Units)

DATE STARTED: 5/15/2014
DATE FINISHED: 5/17/2014

DRILLER: Sam Larson
COMPANY: Haztech
LOGGER: N. Jenks

WEATHER: Sunny to partly cloudy

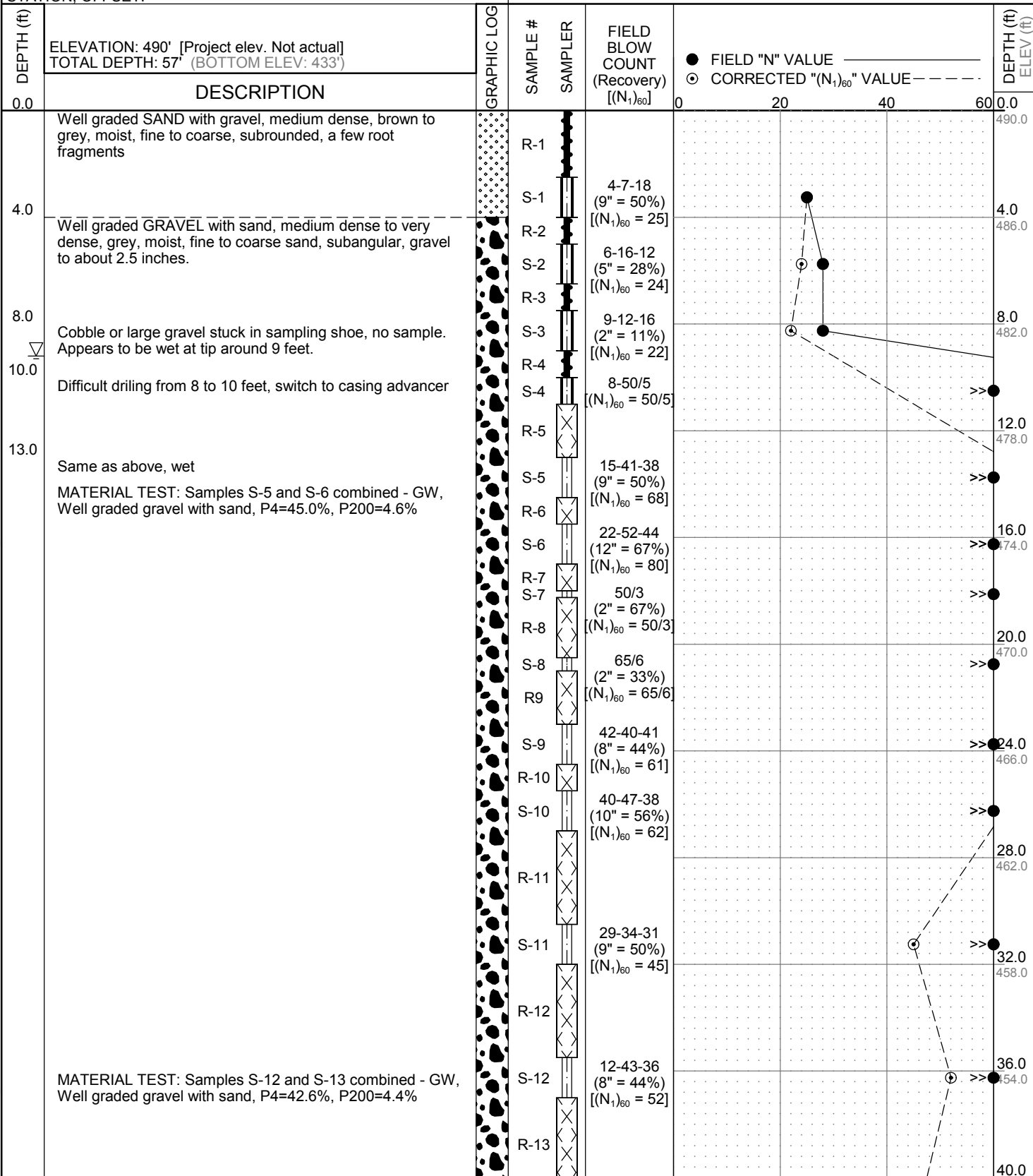
BORING IRB14-02

DRILL: Dietrich 25
HAMMER: Manual
DRILLING METHODS: 6.5" Hollow Stem
Auger, HQ Casing Adv, NQ Core

PROJECT: Indian River Bridge

NOTES: Indian River Bridge, North (East) Abutment. (N1)60 includes a conversion for sampler size.

STATION, OFFSET:



WATER LEVELS

9' ▽ WHILE DRILLING
▽ AT COMPLETION
▽ AFTER DRILLING

■ Solid Stem Auger

▣ Casing Advancer

▤ 3" OD Split Spoon (D&M)

▤ 2.5" OD Mod CA Sampler (MC)



FEDERAL HIGHWAY ADMINISTRATION
VANCOUVER, WASHINGTON
GEOTECHNICAL SECTION

BORING LOG (US Customary Units)

DATE STARTED: 5/15/2014
DATE FINISHED: 5/17/2014

DRILLER: Sam Larson
COMPANY: Haztech
LOGGER: N. Jenks

WEATHER: Sunny to partly cloudy

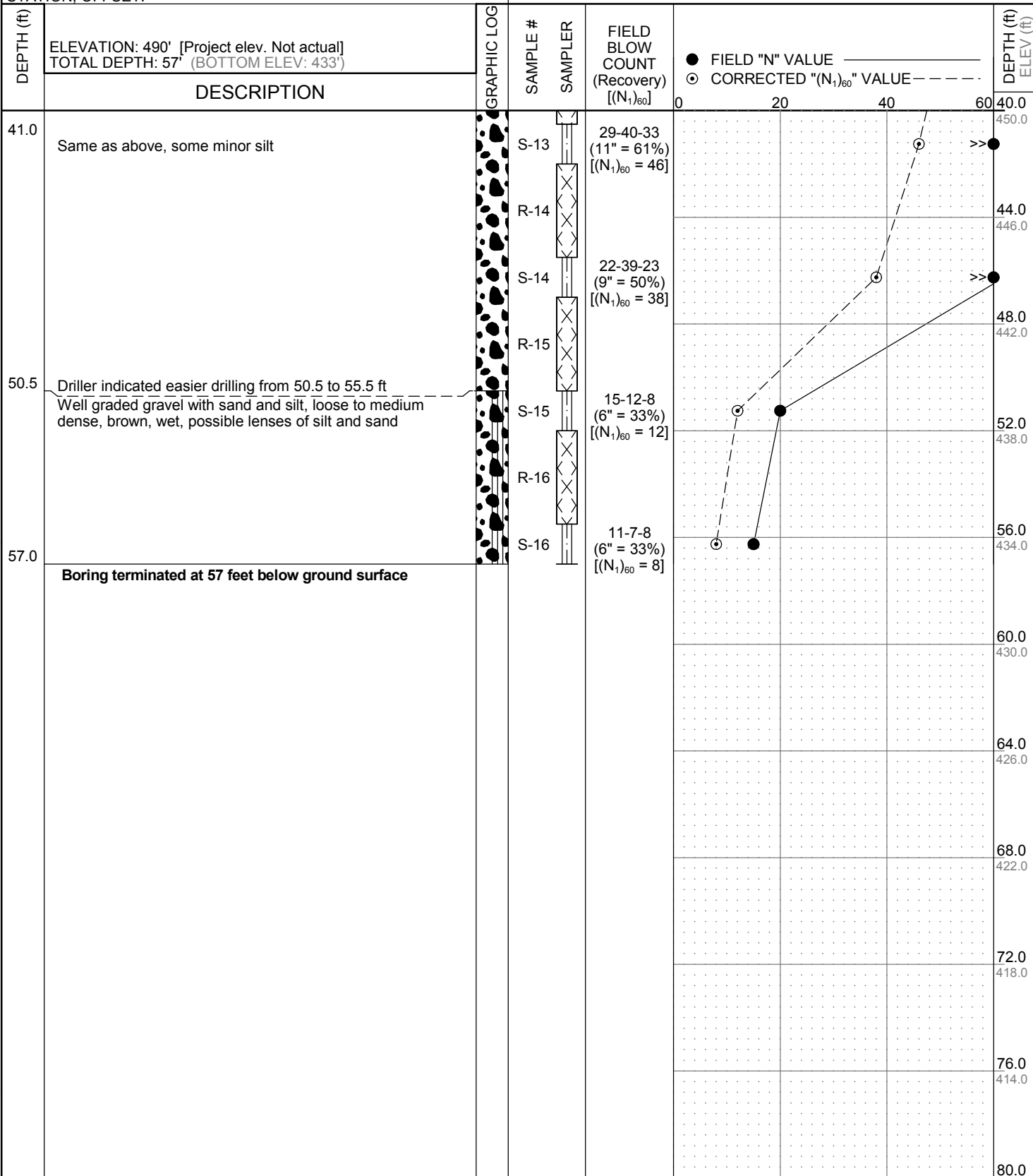
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Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: **17 Sep 2014**
Lab Control Number: **W-14-0683-SO**



Project Name: Rehabilitate Indian River Bridge
Project Number: AK NPS SITK 2013(1)

Acct. No.: 1517029835001 510.PE.G310.02

Submitted By: Nathan Jenks
Phone: 360-619-7748

Sample of:
Quantity Rep:

Owner:
Station: North Abut
Boring No./Test Pit: IRB14-02

Milepost:

Sample No: S-5 & S-6

Sampled By: Nathan Jenks

Date Sampled: 5/15/2014

Address:

Date Received: 8/21/2014

No. & Containers: 2 Plastic bags

Dates Tested: 08-21-14 to 09-11-14

County: Sitka

State: AK

Offset:

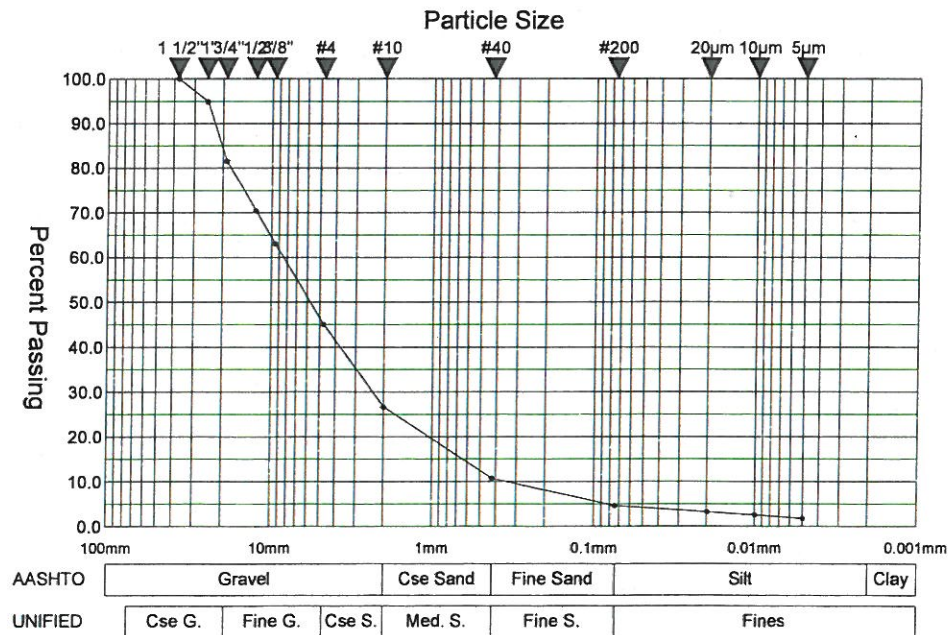
Depth: 13'- 17'

Site Description: Drive sample, North (East) Abutment, combined.

Sieve Analysis

As Received
Sieve Size % Passing

1 1/2"	100.0
1"	94.9
3/4"	81.5
1/2"	70.4
3/8"	63.0
#4	45.0
#10	26.6
#40	10.7
#200	4.6
20µm	3.2
10µm	2.5
5µm	1.7



Soil Classification (DL145)

AASHTO

Unified

A-1-a(0)

SI-SA-GRAVEL

GW; Well-graded gravel with sand

pH Value (T289)

5.9

Apparent Specific Gravity (T100)

2.790

Atterberg Limits (T89)

Liquid Limit

NP

Plasticity Index

NP

Insufficient material to run Minimum Resistivity(T288).



Walt Stong, Materials Laboratory Chief
For: Brad K. Neitzke, Materials Engineer



Western Federal Lands Highway Division
Materials Testing Laboratory
610 E. Fifth St, Vancouver, WA 98661

Test Report Issued: 17 Sep 2014
Lab Control Number: W-14-0684-SO

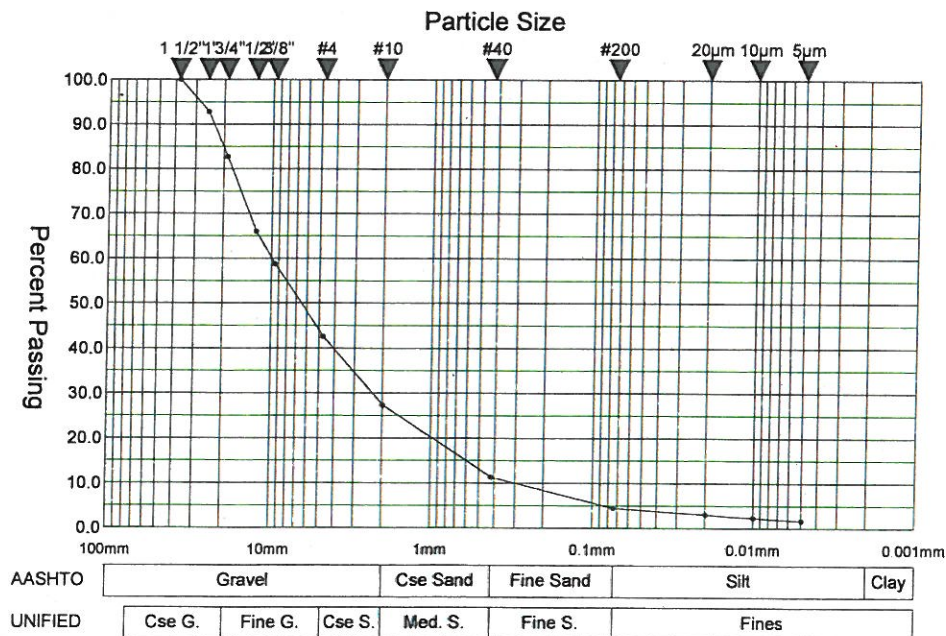


Project Name: Rehabilitate Indian River Bridge		Sample No: S-12 & S-13
Project Number: AK NPS SITK 2013(1)		Sampled By: Nathan Jenks
Acct. No.: 1517029835001	510.PE.G310.02	Date Sampled: 5/16/2014
Submitted By: Nathan Jenks		Address:
Phone: 360-619-7748		
Sample of:		Date Received: 8/21/2014
Quantity Rep:		No. & Containers: 2 Plastic bags
		Dates Tested: 08-21-14 to 09-11-14
Owner:	Milepost:	County: Sitka
Station: North Abut		Offset:
Boring No./Test Pit: IRB14-02		Depth: 36'- 42'
		State: AK

Site Description: Drive sample, North (East) Abutment, combined.

Sieve Analysis

As Received	
Sieve Size	% Passing
1 1/2"	100.0
1"	92.8
3/4"	82.7
1/2"	66.0
3/8"	58.7
#4	42.6
#10	27.3
#40	11.3
#200	4.4
20µm	3.0
10µm	2.3
5µm	1.6



Soil Classification (DL145)

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A-1-a(0) SI-SA-GRAVEL
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Plasticity Index

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NP

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Walt Stong, Materials Laboratory Chief
For: Brad K. Neitzke, Materials Engineer

Appendix 3

RC Pier Summary Output

Abutments

Max Soil Pressures, Service

Corner	X ft	Z ft	comb	Ovs	P kips	Mxx kft	Mzz kft	Soil press. ksf
1	4.75	-3.00	416	1.000	-37.10	-20.94	9.67	1.25
			421	1.000	-37.10	-9.96	34.43	0.78
2	-4.75	-3.00	418	1.000	-38.46	-15.45	41.91	1.73
			413	1.000	-35.73	-15.45	2.19	1.28
3	-4.75	3.00	421	1.000	-37.10	-9.96	34.43	2.50
			416	1.000	-37.10	-20.94	9.67	2.03
4	4.75	3.00	413	1.000	-35.73	-15.45	2.19	1.95
			418	1.000	-38.46	-15.45	41.91	1.60

Max Soil Pressures, Factored

Corner	X ft	Z ft	comb	Ovs	P kips	Mxx kft	Mzz kft	Soil press. ksf
1	4.750	-3.000	86	---	-47.71	-42.20	2.81	2.28
			61	---	-41.67	5.69	52.32	0.02
2	-4.750	-3.000	88	---	-50.44	-31.22	67.28	2.87
			133	---	-30.66	-2.85	-19.88	0.33
3	-4.750	3.000	41	---	-47.71	-6.41	52.32	3.61
			186	---	-33.39	-27.66	-4.91	1.52
4	4.750	3.000	33	---	-44.99	-17.39	-12.16	2.87
			188	---	-36.11	-16.67	59.57	1.20

Footing Design : Notes

Only max. positive pressure is considered for design.

Load effects (P, Mxx and Mzz) are reported at top of the footing.

Soil pressure are calculated based on the load effects at bottom of the footing.

Piers

Max Soil Pressures, Service

Corner	X ft	Z ft	comb	Ovs	P kips	Mxx kft	Mzz kft	Soil press. ksf
1	7.00	-4.50	73	1.000	-153.35	-64.17	-55.62	2.22
			80	1.000	-75.37	31.43	129.78	0.47
2	-7.00	-4.50	65	1.000	-150.77	-35.49	81.67	2.10
			82	1.000	-81.39	-35.49	-190.57	0.76
3	-7.00	4.50	68	1.000	-153.35	-6.81	55.62	1.79
			85	1.000	-75.37	-102.41	-129.78	0.04
4	7.00	4.50	70	1.000	-155.93	-35.49	-81.67	1.71
			77	1.000	-69.35	-35.49	190.57	0.23

Max Soil Pressures, Factored

Corner	X ft	Z ft	comb	Ovs	P kips	Mxx kft	Mzz kft	Soil press ksf
1	7.000	-4.500	13	---	-94.21	-151.59	-259.56	3.00
			7	---	-94.21	76.82	314.67	-0.08*
2	-7.000	-4.500	53	---	-133.20	-157.82	14.55	2.63
			20	---	-79.87	-17.75	-381.15	0.03
3	-7.000	4.500	8	---	-94.21	116.10	259.56	2.79
			11	---	-94.21	-62.45	-328.39	-0.02*
4	7.000	4.500	49	---	-133.20	157.82	-14.55	2.63
			5	---	-82.17	-17.75	381.15	-0.01*

Footing Design : Notes

* Negative pressure.

Only max. positive pressure is considered for design.

Load effects (P, Mxx and Mzz) are reported at top of the footing.

Soil pressure are calculated based on the load effects at bottom of the footing.