INVITATION TO BID #2018-06
Canby 2 Paving Project
ADDENDUM NUMBER 3
March 6, 2018

On January 30, 2018, Clackamas County ("County") published Invitation to Bid #2018-06 ("BID") and amended with Amendment #1 on February 14, 2018, and Amendment #2 on February 15, 2018. The County has found that it is in its interest to amend the BID through the issuance of this Addendum #3. Except as expressly amended below, all other terms and conditions of the original BID and subsequent Addenda shall remain unchanged.

1. **Add the following to the Project Information, Plans, Specifications and Drawings:**

   The Scope further includes the following Plans, Specifications, and Drawings:
   - Pavement Design Report – Sconce Road Canby-Marquam Highway to West End Clackamas County, Oregon, dated September 18, 2017.

Attachments: Pavement Design Report – Sconce Road Canby-Marquam Highway to West End Clackamas County, Oregon, dated September 18, 2017.

End of Addendum #3

GEODESIGN INC

PAVEMENT DESIGN REPORT

Sconce Road from Canby-Marquam Highway to West End
Clackamas County, Oregon

For
Clackamas County Transportation and Development
September 18, 2017

GeoDesign Project: ClackCo-94-01

GEODESIGN INC

September 18, 2017

Clackamas County Transportation and Development
Development Services Building
150 Beavercreek Road
Oregon City, OR 97045

Attention: Vince Hall, P.E.

Pavement Design Report
Sconce Road from Canby-Marquam Highway to West End
Clackamas County, Oregon
GeoDesign Project: ClackCo-94-01

GeoDesign, Inc. is pleased to submit this pavement design report for the proposed improvements to Sconce Road from the Canby-Marquam Highway to the western end in Clackamas County, Oregon. We appreciate the opportunity to be of service to Clackamas County. Please contact us if you have questions regarding this report.

Sincerely,

GeoDesign, Inc.

Krey D. Younger, P.E., G.E.
Senior Associate Engineer

George Saunders, P.E., G.E. Signed for
Principal Engineer

KDY:JDT:kt
Attachments
One copy submitted (via email only)
Document ID: ClackCo-94-01-091817-geor.docx

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1.0 INTRODUCTION

GeoDesign, Inc. is pleased to present this pavement design report for improvements to Sconce Road from Canby-Marquam Highway to the western end in Clackamas County, Oregon. Our pavement design is based on the results of subsurface explorations and laboratory data. Traffic ESALs are based on current vehicle classification counts provided by County Services, Inc. forecasted into future traffic for the 20-year design period. Our recommendations are based on our understanding that Clackamas County (County) wishes to reconstruct the road section from edge to edge within the project limits and that a cement FDR option is preferred.

The approximate location of the site is shown on Figure 1. The approximate locations of pavement explorations are shown on Figures 2 and 3.

Acronyms and abbreviations used herein are defined at the end of this document.

2.0 PURPOSE AND SCOPE

The purposes of our services were to conduct pavement testing and explorations and provide pavement reconstruction recommendations. Our specific scope of services was as follows:

- Completed a traffic control plan for the proposed field work.
- Provided traffic control during the explorations.
- Obtained lane closure and test bore permits.
- Explored subsurface conditions in the existing pavement by completing 14 core borings.
- Maintained a detailed log of the explorations and collected samples of the pavement, base, and subgrade materials encountered.
- Collected soil samples at select depths in the core explorations and completed the following laboratory tests on select samples:
  - Fourteen moisture content tests on select grab samples
  - Two tests for cement content determination from bulk samples
- Analyzed traffic loadings based on classification counts provided by the County.
- Evaluated reconstruction options based on above-referenced information.
- Provided design recommendations for reconstruction using full-depth reclamation.
- Provided recommendations for materials and construction.
- Provided this report summarizing our recommendations.

3.0 SITE CONDITIONS

3.1 GENERAL

Sconce Road is an AC-surfaced rural county road with one lane in each direction, narrow unimproved shoulders, and ditches at the edges. The road surface is in poor to very poor condition. Driveways and other local roads intersect throughout. In addition, there is a bridge over Rock Creek just west of Barlow Road.

3.2 *SUBSURFACE CONDITIONS*

A total of 14 borings (C-1 through C-14) were completed. The approximate locations of the borings are shown on Figures 2 and 3, and the exploration logs are presented Appendix A. The following sections summarize our findings from these borings.

At the exploration locations the AC thickness varies from 1.0 to 3.3 inches and the aggregate base thickness varies from 0 to 3.2 inches. In addition, we observed an oil mat between the AC and aggregate base at 10 of the 14 locations observed. Subgrade varies from medium stiff to stiff throughout. Moisture content of the silt subgrade at the time of testing varied from 18 to 32 percent. A summary of the AC, oil mat, and aggregate base is presented in Table 1.

Table 1. Existing Pavement Thicknesses

Boring Number	Direction	Thickness (inches)		
		AC	Oil Mat	Aggregate Base
C-1	Eastbound	2.3	2.7	1.0
C-2	Eastbound	2.5	2.8	2.7
C-3	Westbound	3.0	2.0	1.0
C-4	Eastbound	2.0	2.0	3.0
C-5	Westbound	3.0	1.5	2.0
C-6	Eastbound	3.3	1.7	1.0
C-7	Westbound	2.5	2.3	1.2
C-8	Eastbound	2.0	Not present	1.0
C-9	Eastbound	1.8	Not present	3.2
C-10	Westbound	3.0	3.0	1.0
C-11	Eastbound	2.0	2.0	2.0
C-12	Eastbound	2.3	1.0	Not present
C-13	Westbound	1.3	Not present	Not present
C-14	Eastbound	1.0	Not present	1.7

We conducted DCP testing in accordance with ASTM D 6951 to estimate the resilient modulus of the subgrade at each odd-numbered exploration. We used least squares regression to determine the slopes of the DCP curves and the equation from the ODOT Pavement Design Guide[1] to estimate the moduli using a correction factor $c_f = 0.62$ for estimating the base layer resilient moduli and $c_f = 0.35$ for estimating the subgrade resilient moduli. Our estimates of base layer resilient modulus and subgrade resilient modulus at each test location are presented in Table 2.

[1] ODOT Pavement Design Guide, Pavement Services Unit, Oregon Department of Transportation, August 2011.

Table 2. DCP Test Results

Boring Number	Estimated Resilient Modulus (psi)
C-1	4,400
C-3	5,590
C-5	5,160
C-7	5,630
C-9	4,120
C-11	3,740
C-13	3,780

3.3 CEMENT AMENDMENT LABORATORY TESTING

Bulk samples were collected at select boring locations for the purpose of preparing molded laboratory specimens with a range of cement contents. Due to the length of the project, we completed two trial sections (C-1 through C-7 and C-8 through C-14). Based on our understanding that FDR construction would use the existing AC and aggregate base, we summarized the core thickness data and combined AC, aggregate base, and subgrade materials for a 50 percent AC/Base to 50 percent subgrade mixture for C-1 through C-7 and a 35 percent AC/Base to 65 percent subgrade sample for C-8 through C-14.

Compressive strength tests were performed by our subcontractor on molded specimens in general accordance with ASTM D 1633 Method A. We prepared specimens using a 4-inch-diameter mold using cement ratios of 4.0, 6.0, and 8.0 percent by dry weight. A specimen was compacted at each cement content. All specimens were extracted intact from the compaction molds and placed in a moist, temperature-controlled environment for seven days. Following the curing period, the specimens were immersed in water for four hours immediately prior to conducting the compressive strength tests. Test results are presented in Appendix B.

4.0 PAVEMENT DESIGN

The standards used for pavement design are listed below:

- ODOT Pavement Design Guide, ODOT (August 2011)
- Guide for Design of Pavement Structures, AASHTO (1993)

The subgrade resilient moduli are based on subsurface explorations. Effective structural numbers of the existing pavements are based on subsurface explorations and surface condition observations. Traffic loading is based on classification traffic counts provided by the County. Descriptions of our input parameters and the recommended pavement designs are summarized below.

4.1 ESAL CALCULATIONS

Traffic classification count information was provided by the County. Results include one reading 850 feet west of Barlow Road and one reading 800 feet west of Meridian Road. Count data was obtained over a 24-hour period in May 2017. The ODOT method was used to calculate ESAL values for each vehicle class using a 2.0 percent annual increase rate. Our resulting 20-year ESAL values are 45,000 near Barlow Road and 107,000 near Meridian Road. We recommend design based on the 107,000 ESAL value.

4.2 SUBGRADE RESILIENT MODULUS

We evaluated information from the subsurface explorations to estimate the subgrade resilient modulus value used in our design. We recommend an average subgrade resilient modulus of 4,600 psi based on the DCP analysis results.

4.3 OTHER DESIGN PARAMETERS

Other pavement design parameters used in our analysis are summarized below. These input parameters are recommended in the ODOT Pavement Design Guide.

4.3.1 Reliability

A reliability of 80 percent was selected for the rural road section.

4.3.2 Serviceability

We used initial and terminal serviceability values of 4.2 and 2.5, respectively.

4.3.3 Overall Standard Deviation

We used an overall standard deviation value of 0.49.

4.3.4 Structural Layer Coefficients

We used structural layer coefficients of 0.42 and 0.10 for AC and aggregate base, respectively. The structural layer of FDR is assumed to be 0.10 for compressive strength between 150 and 200 psi.

5.0 CONSTRUCTION RECOMMENDATIONS

The following includes pavement structural recommendations for cement amendment with FDR as well as conventional AC over aggregate base. Our FDR design options treat the material as a cement-amended subbase with the assumption that an aggregate base layer between the AC and subbase is not required. In addition, our recommendations include construction considerations and material properties.

5.1 PAVEMENT SECTIONS

- **AC over FDR (4.0 inches of AC over 12.0 inches of cement-stabilized subbase)**
  - 2.0-inch-thick, Level 2, ½-inch, dense ACP wearing course (one lift)
  - 2.0-inch-thick, Level 2, ½-inch, dense ACP
  - 12.0-inch-thick cement-stabilized subgrade

- **AC over aggregate base (4.0 inches of AC over 12.0 inches of aggregate base)**
  - 2.0-inch-thick, Level 3, ½-inch, dense ACP wearing course (one lift)
  - 2.0-inch-thick, Level 3, ½-inch, dense ACP (two lifts)
  - 12.0-inch-thick aggregate base
  - Stabilization material, if required
  - Subgrade geotextile

5.2 PAVEMENT MATERIALS

A submittal should be made for each pavement material prior to the start of paving operations. Each submittal should include the test information necessary to evaluate the degree to which the material's properties comply with the properties that were recommended or specified. The geotechnical engineer and other appropriate members of the design team should review each submittal.

5.2.1 Aggregate Base

Imported granular material used as aggregate base should be clean, crushed rock or crushed gravel and sand that are dense-graded. The aggregate base should meet the gradation defined in OSSC 00641 (Aggregate Subbase, Base, and Shoulders), with the exception that the aggregate has less than 5 percent by dry weight passing the U.S. Standard No. 200 sieve, a maximum particle size of 1½ inches, and at least two mechanically fractured faces. The aggregate base should be compacted to not less than 95 percent of the maximum dry density, as determined by AASHTO T 99.

5.2.2 AC

The AC should be Level 2, ½-inch, dense ACP according to OSSC 00744 (Asphalt Concrete Pavement). Minimum and maximum lift thicknesses are 2.0 and 3.0 inches for ½-inch ACP, respectively. An adjustment to lift thicknesses outside this range should be reviewed by both GeoDesign and the County. Asphalt binder should be performance graded. For typical Level 2 ACP we recommend PG 64-22 binder; however, the binder grade should be adjusted depending on the aggregate gradation and amount of recycled asphalt pavement and/or recycled asphalt shingles in the contractor's mix design submittal.

5.2.3 Stabilization Material

Stabilization material should consist of pit- or quarry-run rock, crushed rock, or crushed gravel and sand and should meet the requirements set forth in OSSC 00330.14 (Selected Granular Backfill) and OSSC 00330.15 (Selected Stone Backfill), have a maximum particle size of 3 inches for selected granular backfill and 6 inches for selected stone backfill, have less than 5 percent by dry weight passing the U.S. Standard No. 4 sieve, and have at least two mechanically fractured faces. The material should be free of organic matter and other deleterious material. Stabilization material should be placed over a geotextile fabric in one lift and compacted to a firm condition.

5.2.4 Subgrade Geotextile

The subgrade geotextile should conform to OSSC 00350 (Geosynthetic Installation). The geotextile should have a "Level B" certification. A minimum initial aggregate base lift of 6 inches is required over geotextiles.

5.2.5 Portland Cement

The portland cement used for cement amendment should conform to Type II portland cement per ASTM C 150. Alternatively, Type I/II portland cement can be used provided it meets the requirements for Type II as per ASTM C 150.

5.2.6 FDR Subbase

FDR subbase construction is amendment of the AC, aggregate base, and subgrade soils with cement using heavy construction equipment. Successful use of soil amendment depends on the use of correct mixing techniques, soil moisture content, and amendment quantities. Soil amending should be conducted in accordance with OSSC 00344 (Treated Subgrade) and the project documents.

We recommend a cement content of 6 percent based on the laboratory cement content testing and the in situ moisture content, which was approximately 10 percent higher than optimum. The amount of cement added to the soil may need to be adjusted based on field observations and performance. Depending on the time of year and moisture content levels during amendment, water may need to be applied during tilling to appropriately condition the soil moisture content. The amount of cement used during treatment should be based on a dry unit weight of 114 pcf based on the cement content testing from the C-8 through C-14 combined sample.

We recommend the following additional considerations:

- Construction should occur during a period of dry weather.
- Cement-amended soil has minimal abrasion resistance, so vehicle traffic on cement-amended subgrade should be limited to light traffic. Heavy traffic should not be allowed to travel on cement-amended surfacing.
- Grading should not be attempted at greater than three hours after initial tilling of the cement-soil mixture.
- Paving within 24 hours of final grading or application of a curing sealant (e.g., emulsion) and a minimum curing period of four days prior to placement of the AC paving.
- During curing, FDR sections should be closed to through traffic and be limited to local non-truck traffic only.
- Construction equipment, materials, and additional curing information as shown in the project specifications.
- A pre-FDR conference scheduled by the project team and attended by the contractor prior to the FDR work. We recommend that the contract documents require the contractor to provide the following information at the FDR conference:
  - A list of proposed equipment.
  - A schedule showing phasing for each FDR section. The schedule should show the planned FDR curing and paving schedule.
  - A proposal for construction methodology.
  - A quality control plan.

6.0 OBSERVATION OF CONSTRUCTION

Satisfactory earthwork and pavement performance depends to a large degree on the quality of construction. Sufficient observation of the contractor's activities is a key part of determining that the work is completed in accordance with the construction drawings and specifications. Subsurface conditions observed during construction should be compared with those encountered during the subsurface explorations. Recognition of changed conditions often requires experience; therefore, qualified personnel should visit the site with sufficient frequency to determine if subsurface conditions change significantly from those anticipated.

7.0 LIMITATIONS

We have prepared this report for use by Clackamas County and the construction team for the proposed project. The report can be used for bidding or estimating purposes, but our report, conclusions, and interpretations should not be construed as warranty of the subsurface conditions and are not applicable to other sites.

Exploration observations indicate soil conditions and pavement conditions only at specific locations and only to the depths penetrated. They do not necessarily reflect soil strata, pavement, or water level variations that may exist between exploration locations. If subsurface conditions differing from those described are noted during the course of excavation and construction, re-evaluation will be necessary.

The scope of our services does not include services related to construction safety precautions, and our recommendations are not intended to direct the contractor's methods, techniques, sequences, or procedures, except as specifically described in our report for consideration in design.

Within the limitations of scope, schedule, and budget, our services have been executed in accordance with generally accepted practices in this area at the time the report was prepared. No warranty, express or implied, should be understood.

♦ ♦ ♦

We appreciate the opportunity to be of continued service to you. Please call if you have questions concerning this report or if we can provide additional services.

Sincerely,

GeoDesign, Inc.

Krey D. Younger, P.E., G.E.
Senior Associate Engineer

George Saunders, P.E., G.E. Signed for
Principal Engineer

REGISTERED PROFESSIONAL ENGINEER
50382
OREGON
JAN. 14 2003
KREY D. YOUNGER
EXPIRES: 6/30/18

FIGURES

GEODESIGN INC 9450 SW Commerce Circle - Suite 300 Wilsonville OR 97070 503.968.8787 www.geodesigninc.com	CLACKCO-94-01	**VICINITY MAP**	
	SEPTEMBER 2017	SCONCE RD: CANBY-MARQUAM HWY TO WEST END CLACKAMAS COUNTY, OR	**FIGURE 1**

Printed By: mmiller | Print Date: 9/18/2017 8:09:34 AM
File Name: J:\A-D\ClackCo\ClackCo-94\ClackCo-94-01\Figures\CAD\ClackCo-94-01-VM01.dwg | Layout: FIGURE 1

LEGEND:

C-1 ⊙ PAVEMENT CORE

0 500 1000

(SCALE IN FEET)

N

SITE PLAN BASED ON AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH PRO®, SEPTEMBER 7, 2017

GEODESIGN INC 9450 SW Commerce Circle - Suite 300 Wilsonville OR 97070 503.968.8787 www.geodesigninc.com	CLACKCO-94-01	SITE PLAN	
	SEPTEMBER 2017	SCONCE RD: CANBY-MARQUAM HWY TO WEST END CLACKAMAS COUNTY, OR	FIGURE 2

Printed By: mmiller | Print Date: 9/18/2017 8:09:39 AM
File Name: J:\A-D\ClackCo\ClackCo-94\ClackCo-94-01\Figures\CAD\ClackCo-94-01-SP01.dwg | Layout: FIGURE 3

LEGEND:

C-1 ⦿ PAVEMENT CORE

0 500 1000

(SCALE IN FEET)

N

SITE PLAN BASED ON AERIAL PHOTOGRAPH OBTAINED FROM GOOGLE EARTH PRO®, SEPTEMBER 7, 2017

GEODESIGN INC 9450 SW Commerce Circle - Suite 300 Wilsonville OR 97070 503.968.8787 www.geodesigninc.com	CLACKCO-94-01	SITE PLAN	
	SEPTEMBER 2017	SCONCE RD: CANBY-MARQUAM HWY TO WEST END CLACKAMAS COUNTY, OR	FIGURE 3

APPENDIX A

APPENDIX A

FIELD EXPLORATION DATA

GENERAL

We explored the existing pavement conditions along the roadway alignment by drilling 14 pavement borings (C-1 through C-14) between June 12 and 13, 2017. The approximate locations of the explorations are shown on Figures 2 and 3. The asphalt cores were recovered using a portable core drill with a 5-inch-diameter, diamond core barrel, and the borings were drilled with a 4-inch-diameter, solid-stem auger. The borings were filled with polymer modified cold-patch asphalt. The exploration logs are presented in this appendix.

SOIL SAMPLING

A member of our geology staff observed the explorations. We collected representative samples of the various soils encountered in the borings for geotechnical laboratory testing. Samples were collected from the borings using 1½-inch-inside diameter, split-spoon sampler (SPT). The split-spoon sampling was conducted in general accordance with ASTM D 1586. The split-spoon samplers were driven into the soil with a 140-pound hammer free-falling 30 inches. The samplers were driven a total distance of 18 inches. The number of blows required to drive the sampler the final 12 inches is recorded in the exploration logs, unless otherwise noted. Representative grab samples of the soil were obtained from the auger cuttings. Sampling methods and intervals are shown on the exploration logs.

We understand that calibration of the SPT hammer used by Dan J. Fischer Excavating, Inc. has not been completed. The SPT blow counts completed by Dan J. Fischer Excavating, Inc. were conducted using two wraps around the cathead.

SOIL CLASSIFICATION

The soil samples were classified in accordance with the "Exploration Key" (Table A-1) and "Soil Classification System" (Table A-2), which are presented in this appendix. The exploration logs indicate the depths at which the soils or their characteristics change, although the change actually could be gradual. Classifications are shown on the exploration logs.

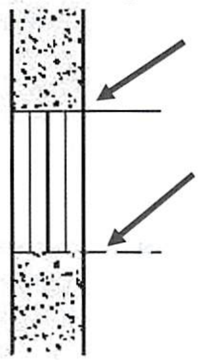
LABORATORY TESTING

MOISTURE CONTENT

We tested the natural moisture content of selected soil samples in general accordance with ASTM D 2216. The natural moisture content is a ratio of the weight of the water to the weight of soil in a test sample and is expressed as a percentage. The test results are presented in this appendix.

SYMBOL	SAMPLING DESCRIPTION
	Location of sample obtained in general accordance with ASTM D 1586 Standard Penetration Test with recovery
	Location of sample obtained using thin-wall Shelby tube or Geoprobe® sampler in general accordance with ASTM D 1587 with recovery
	Location of sample obtained using Dames & Moore sampler and 300-pound hammer or pushed with recovery
	Location of sample obtained using Dames & Moore and 140-pound hammer or pushed with recovery
	Location of sample obtained using 3-inch-O.D. California split-spoon sampler and 140-pound hammer
	Location of grab sample
	Rock coring interval
	Water level during drilling
	Water level taken on date shown

Graphic Log of Soil and Rock Types



GEOTECHNICAL TESTING EXPLANATIONS

ATT	Atterberg Limits	PP	Pocket Penetrometer
CBR	California Bearing Ratio	P200	Percent Passing U.S. Standard No. 200 Sieve
CON	Consolidation		
DD	Dry Density	RES	Resilient Modulus
DS	Direct Shear	SIEV	Sieve Gradation
HYD	Hydrometer Gradation	TOR	Torvane
MC	Moisture Content	UC	Unconfined Compressive Strength
MD	Moisture-Density Relationship	VS	Vane Shear
OC	Organic Content	kPa	Kilopascal
P	Pushed Sample		

ENVIRONMENTAL TESTING EXPLANATIONS

CA	Sample Submitted for Chemical Analysis	ND	Not Detected
P	Pushed Sample	NS	No Visible Sheen
PID	Photoionization Detector Headspace Analysis	SS	Slight Sheen
		MS	Moderate Sheen
ppm	Parts per Million	HS	Heavy Sheen

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EXPLORATION KEY

TABLE A-1

RELATIVE DENSITY - COARSE-GRAINED SOILS

Relative Density	Standard Penetration Resistance	Dames & Moore Sampler (140-pound hammer)	Dames & Moore Sampler (300-pound hammer)
Very Loose	0 – 4	0 - 11	0 - 4
Loose	4 – 10	11 - 26	4 - 10
Medium Dense	10 – 30	26 - 74	10 - 30
Dense	30 – 50	74 - 120	30 - 47
Very Dense	More than 50	More than 120	More than 47

CONSISTENCY - FINE-GRAINED SOILS

Consistency	Standard Penetration Resistance	Dames & Moore Sampler (140-pound hammer)	Dames & Moore Sampler (300-pound hammer)	Unconfined Compressive Strength (tsf)
Very Soft	Less than 2	Less than 3	Less than 2	Less than 0.25
Soft	2 - 4	3 – 6	2 - 5	0.25 - 0.50
Medium Stiff	4 - 8	6 – 12	5 - 9	0.50 - 1.0
Stiff	8 - 15	12 – 25	9 - 19	1.0 - 2.0
Very Stiff	15 - 30	25 – 65	19 – 31	2.0 - 4.0
Hard	More than 30	More than 65	More than 31	More than 4.0

PRIMARY SOIL DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE-GRAINED SOILS (more than 50% retained on No. 200 sieve)	GRAVEL (more than 50% of coarse fraction retained on No. 4 sieve)	CLEAN GRAVELS (< 5% fines)	GW or GP	GRAVEL
		GRAVEL WITH FINES (≥ 5% and ≤ 12% fines)	GW-GM or GP-GM	GRAVEL with silt
			GW-GC or GP-GC	GRAVEL with clay
		GRAVELS WITH FINES (> 12% fines)	GM	silty GRAVEL
			GC	clayey GRAVEL
			GC-GM	silty, clayey GRAVEL
	SAND (50% or more of coarse fraction passing No. 4 sieve)	CLEAN SANDS (<5% fines)	SW or SP	SAND
		SANDS WITH FINES (≥ 5% and ≤ 12% fines)	SW-SM or SP-SM	SAND with silt
			SW-SC or SP-SC	SAND with clay
		SANDS WITH FINES (> 12% fines)	SM	silty SAND
			SC	clayey SAND
			SC-SM	silty, clayey SAND
FINE-GRAINED SOILS (50% or more passing No. 200 sieve)	SILT AND CLAY	Liquid limit less than 50	ML	SILT
			CL	CLAY
			CL-ML	silty CLAY
			OL	ORGANIC SILT or ORGANIC CLAY
		Liquid limit 50 or greater	MH	SILT
			CH	CLAY
			OH	ORGANIC SILT or ORGANIC CLAY
HIGHLY ORGANIC SOILS			PT	PEAT

MOISTURE CLASSIFICATION

Term	Field Test
dry	very low moisture, dry to touch
moist	damp, without visible moisture
wet	visible free water, usually saturated

ADDITIONAL CONSTITUENTS

Secondary granular components or other materials such as organics, man-made debris, etc.

Percent	Silt and Clay In: Fine-Grained Soils	Silt and Clay In: Coarse-Grained Soils	Percent	Sand and Gravel In: Fine-Grained Soils	Sand and Gravel In: Coarse-Grained Soils
< 5	trace	trace	< 5	trace	trace
5 - 12	minor	with	5 - 15	minor	minor
> 12	some	silty/clayey	15 - 30	with	with
			> 30	sandy/gravelly	Indicate %

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SOIL CLASSIFICATION SYSTEM

TABLE A-2

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION / DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT %	COMMENTS

C-1

DEPTH FEET	MATERIAL DESCRIPTION	DEPTH	BLOW COUNT	COMMENTS
0.0	ASPHALT CONCRETE (2.3 inches).	0.2		
	OIL MAT (2.7 inches).	0.4		
	AGGREGATE BASE (1.0 inch).	0.5		
	Medium stiff, brown SILT (ML), minor sand; moist, sand is medium.		5	
2.5	Exploration completed at a depth of 2.3 feet. Hammer efficiency factor is unknown. SPT completed using two wraps with a cathead.	2.3		CORE DETAILS: No patch observed. No crack at core.
5.0				
7.5				

C-2

DEPTH FEET	MATERIAL DESCRIPTION	DEPTH	BLOW COUNT	COMMENTS
0.0	ASPHALT CONCRETE (2.5 inches).	0.3		
	OIL MAT (2.8 inches).	0.4		
	AGGREGATE BASE (2.7 inches).	0.7		
	Stiff, gray SILT with sand (ML); moist, sand is fine. brown with gray mottles at 2.0 feet		11	
2.5	Exploration completed at a depth of 2.3 feet. Hammer efficiency factor is unknown. SPT completed using two wraps with a cathead.	2.3		CORE DETAILS: No patch observed. No crack at core.
5.0				
7.5				

DRILLED BY: Dan J. Fischer Excavating, Inc. LOGGED BY: CR COMPLETED: 06/12/17

BORING METHOD: core drill/solid-stem auger (see document text) BORING BIT DIAMETER: 4 inches/5 inches

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CLACKCO-94-01

SEPTEMBER 2017

BORING

SCONCE RD: CANBY-MARQUAM HWY TO WEST END
CLACKAMAS COUNTY, OR

FIGURE A-1

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT %	COMMENTS
C-3						0 50 100	
0.0		ASPHALT CONCRETE (3.0 inches).	0.3				
		OIL MAT (2.0 inches).	0.4			11	
		AGGREGATE BASE (1.0 inch).	0.5				
		Stiff, brown with gray mottled SILT (ML), minor sand; moist, sand is fine.					
2.5		Exploration completed at a depth of 2.2 feet. Hammer efficiency factor is unknown. SPT completed using two wraps with a cathead.	2.2				CORE DETAILS: No patch observed. No crack at core.
5.0							
7.5						0 50 100	
C-4						0 50 100	
0.0		ASPHALT CONCRETE (2.0 inches).	0.2				
		OIL MAT (2.0 inches).	0.3				
		AGGREGATE BASE (3.0 inches).	0.6			6	
		Medium stiff, gray SILT (ML); moist.					
2.5		Exploration completed at a depth of 2.5 feet. Hammer efficiency factor is unknown. SPT completed using two wraps with a cathead.	2.5				CORE DETAILS: No patch observed. No crack at core.
5.0							
7.5						0 50 100	

DRILLED BY: Dan J. Fischer Excavating, Inc. LOGGED BY: CR COMPLETED: 06/12/17

BORING METHOD: core drill/solid-stem auger (see document text) BORING BIT DIAMETER: 4 inches/5 inches

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % (0 50 100)	COMMENTS

C-5

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	BLOW COUNT	COMMENTS
0.0	ASPHALT CONCRETE (3.0 inches).	0.3		
	OIL MAT (1.5 inches).	0.4		
	AGGREGATE BASE (2.0 inches).	0.5	8	
	Medium stiff, brown SILT (ML), trace sand; moist, sand is fine.	2.2		
2.5	Exploration completed at a depth of 2.2 feet. Hammer efficiency factor is unknown. SPT completed using two wraps with a cathead.			CORE DETAILS: No patch observed. No crack at core.
5.0				
7.5				

C-6

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	BLOW COUNT	COMMENTS
0.0	ASPHALT CONCRETE (3.3 inches).	0.3		
	OIL MAT (1.7 inches).	0.4		
	AGGREGATE BASE (1.0 inch).	0.5	6	
	Medium stiff, brown with orange mottled SILT (ML), minor sand; moist, sand is fine to coarse.	2.0		
2.5	Exploration completed at a depth of 2.0 feet. Hammer efficiency factor is unknown. SPT completed using two wraps with a cathead.			CORE DETAILS: No patch observed. No crack at core.
5.0				
7.5				

DRILLED BY: Dan J. Fischer Excavating, Inc. LOGGED BY: CR COMPLETED: 06/12/17

BORING METHOD: core drill/solid-stem auger (see document text) BORING BIT DIAMETER: 4 inches/5 inches

BORING LOG - 2 PER PAGE CLACKCO-94-01-C1_14.GPJ GEODESIGN.GDT PRINT DATE: 9/18/17:RC

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT % (0 50 100)	COMMENTS
C-7							
0.0		ASPHALT CONCRETE (2.5 inches).	0.2				
		OIL MAT (2.3 inches).	0.4				
		AGGREGATE BASE (1.2 inches).	0.5				
		Stiff, brown SILT (ML), trace sand; moist, sand is fine to medium.				▲ 11 ●	
2.5		Exploration completed at a depth of 2.5 feet. Hammer efficiency factor is unknown. SPT completed using two wraps with a cathead.	2.5				CORE DETAILS: No patch observed. No crack at core.
5.0							
7.5							
C-8							
0.0		ASPHALT CONCRETE (2.0 inches).	0.2				
		AGGREGATE BASE (1.0 inch).	0.3				
		Medium stiff, brown SILT (ML), trace sand; moist, sand is fine.				▲ 5 ●	
2.5		Exploration completed at a depth of 2.0 feet. Hammer efficiency factor is unknown. SPT completed using two wraps with a cathead.	2.0				CORE DETAILS: No patch observed. Cored on moderate fatigue crack.
5.0							
7.5							

DRILLED BY: Dan J. Fischer Excavating, Inc. LOGGED BY: CR COMPLETED: 06/12/17

BORING METHOD: core drill/solid-stem auger (see document text) BORING BIT DIAMETER: 4 inches/5 inches

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT %	COMMENTS

C-9

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	BLOW COUNT (0 50 100)	COMMENTS
0.0	ASPHALT CONCRETE (1.8 inches).	0.2		
	AGGREGATE BASE (3.2 inches).	0.4		
	Medium stiff, brown SILT (ML), trace sand; moist.		6	
2.5	Exploration completed at a depth of 2.2 feet. Hammer efficiency factor is unknown. SPT completed using two wraps with a cathead.	2.2		CORE DETAILS: No patch observed. Cored on moderate fatigue crack.
5.0				
7.5				

C-10

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	BLOW COUNT (0 50 100)	COMMENTS
0.0	ASPHALT CONCRETE (3.0 inches).	0.3		
	OIL MAT (3.0 inches).	0.5		
	AGGREGATE BASE (1.0 inch).	0.6		
	Stiff, brown SILT with sand (ML); moist, sand is fine.		11	
2.5	Exploration completed at a depth of 2.3 feet. Hammer efficiency factor is unknown. SPT completed using two wraps with a cathead.	2.3		CORE DETAILS: No patch observed. No crack at core.
5.0				
7.5				

DRILLED BY: Dan J. Fischer Excavating, Inc. LOGGED BY: CR COMPLETED: 06/12/17

BORING METHOD: core drill/solid-stem auger (see document text) BORING BIT DIAMETER: 4 inches/5 inches

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT %	COMMENTS
C-11						0 50 100	
0.0		ASPHALT CONCRETE (2.0 inches).	0.2				
		OIL MAT (2.0 inches).	0.3				
		AGGREGATE BASE (2.0 inches).	0.5				
		Medium stiff, brown SILT (ML), trace sand; moist, sand is fine.				▲ 7 ●	
2.5		Exploration completed at a depth of 2.2 feet. Hammer efficiency factor is unknown. SPT completed using two wraps with a cathead.	2.2				CORE DETAILS: No patch observed. No crack at core.
5.0							
7.5							
						0 50 100	
C-12						0 50 100	
0.0		ASPHALT CONCRETE (2.3 inches).	0.2				
		OIL MAT (1.0 inch).	0.3				
		Medium stiff, brown SILT (ML), trace sand; moist, sand is fine to medium.				▲ 8 ●	
2.5		Exploration completed at a depth of 1.8 feet. Hammer efficiency factor is unknown. SPT completed using two wraps with a cathead.	1.8				CORE DETAILS: No patch observed. No crack at core.
5.0							
7.5							
						0 50 100	

DRILLED BY: Dan J. Fischer Excavating, Inc.　LOGGED BY: CR　COMPLETED: 06/13/17

BORING METHOD: core drill/solid-stem auger (see document text)　BORING BIT DIAMETER: 4 inches/5 inches

DEPTH FEET	GRAPHIC LOG	MATERIAL DESCRIPTION	ELEVATION DEPTH	TESTING	SAMPLE	▲ BLOW COUNT ● MOISTURE CONTENT %	COMMENTS

C-13

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	BLOW COUNT (0–50–100)	COMMENTS
0.0	ASPHALT CONCRETE (1.3 inches).	0.1		
	Stiff, brown SILT (ML), some clay; moist.		9	
2.5	Exploration completed at a depth of 2.0 feet. Hammer efficiency factor is unknown. SPT completed using two wraps with a cathead.	2.0		CORE DETAILS: No patch observed. Cored on severe fatigue crack.
5.0				
7.5				

C-14

DEPTH FEET	MATERIAL DESCRIPTION	ELEVATION DEPTH	BLOW COUNT (0–50–100)	COMMENTS
0.0	ASPHALT CONCRETE (1.0 inch).	0.1		
	AGGREGATE BASE (1.7 inches).	0.2		
	Stiff, brown with orange mottled SILT (ML), trace sand; moist, sand is fine to coarse.		9	
2.5	Exploration completed at a depth of 1.8 feet. Hammer efficiency factor is unknown. SPT completed using two wraps with a cathead.	1.8		CORE DETAILS: No patch observed. No crack at core.
5.0				
7.5				

DRILLED BY: Dan J. Fischer Excavating, Inc. LOGGED BY: CR COMPLETED: 06/13/17

BORING METHOD: core drill/solid-stem auger (see document text) BORING BIT DIAMETER: 4 inches/5 inches

SAMPLE INFORMATION			MOISTURE CONTENT (PERCENT)	DRY DENSITY (PCF)	SIEVE			ATTERBERG LIMITS		
EXPLORATION NUMBER	SAMPLE DEPTH (FEET)	ELEVATION (FEET)			GRAVEL (PERCENT)	SAND (PERCENT)	P200 (PERCENT)	LIQUID LIMIT	PLASTIC LIMIT	PLASTICITY INDEX
C-1	0.8		25							
C-2	0.8		24							
C-3	0.3		27							
C-4	0.7		23							
C-5	0.7		21							
C-6	0.5		20							
C-7	0.5		21							
C-8	0.5		20							
C-9	0.3		24							
C-10	0.8		25							
C-11	0.7		27							
C-12	0.3		23							
C-13	0.5		32							
C-14	0.3		18							

GEODESIGN INC
9450 SW Commerce Circle - Suite 300
Wilsonville OR 97070
503.968.8787 www.geodesigninc.com

CLACKCO-94-01

SEPTEMBER 2017

SUMMARY OF LABORATORY DATA

SCONCE RD: CANBY-MARQUAM HWY TO WEST END
CLACKAMAS COUNTY, OR

FIGURE A-8

APPENDIX B

APPENDIX B

CEMENT CONTENT TRIALS

We tested laboratory-molded specimens prepared using a range of cement contents to determine a target content for construction purposes. Tests were conducted in general accordance with ASTM D 1633. A summary of the laboratory results is presented in the table below and on the attached laboratory results sheets.

Cement Amendment Trial Results

Section	Cement Content (percent)	Moisture Content (percent)	Dry Unit Weight (pcf)	Compressive Strength (psi)
C-1 through C-7	4	11.9	118.6	130
	6	11.7	118.7	210
	8	11.4	119.0	270
C-8 through C-14	4	13.7	113.7	130
	6	14.1	113.7	180
	8	13.7	113.8	230

ASPHALT CONCRETE SOILS TESTING, INC
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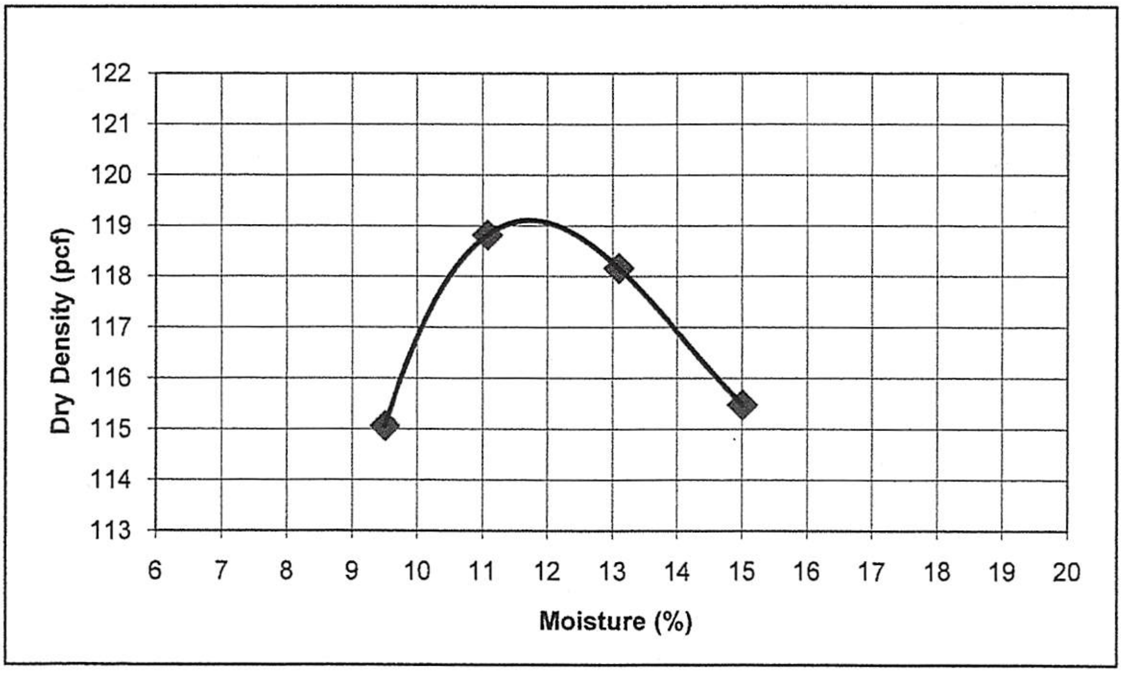
Tigard, OR. 97223
Ph: 503-443-3799 Fax:503-620-2748

GEO DESIGN INC
15575 SW SEQUOIA PKWY, STE 100
PORTLAND, OR 97224

PROJECT:	SCONE RD	**JOB NO:**	17-7054
LOCATION:	N/A	**WORK ORDER NO:**	8839
MATERIAL:	50% GRAVEL A/C AND 50% SOIL 6% Cement	**LAB NO:**	10021
SAMPLE SOURCE:	C1-C7	**SAMPLE DATE:**	6/22/2017

MOISTURE- DENSITY RELATIONS OF SOIL - CEMENT MIXTURES(ASTM D558)

	English (pcf)	Metric (kg/ cu.m.)
Maximum dry density:	119.1	
Optimum moisture (%):	11.7	



NOTES:

Reviewed by:

DOUG ESQUIVEL, VP OPERATIONS

DE/js

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GEO DESIGN INC
15575 SW SEQUOIA PKWY, STE 100
PORTLAND, OR 97224

PROJECT: Sconce Road
LOCATION:
MATERIAL: 50% Base/50% Soil Mix
SAMPLE SOURCE: C1-C7

17-7054
8839
LAB NO: 10021
DATE SAMPLED: 6/22/17

SOIL CEMENT PLUGS COMPRESSIVE STRENGTH

SAMPLE ID	WET SAMPLE WEIGHT (g)	MOISTURE (%)	DRY DENSITY (pcf)	DIAMETER (in)	CEMENT CONTENT (%)	MAX LOAD (lbs)	STRESS (psi)	AGE IN DAYS
1	3,496	11.9%	118.4	4.00	4.0	1,560	120	7
2	3,490	11.8%	118.2	4.01	4.0	1,630	130	7
3	3,523	12.1%	119.1	3.99	4.0	1,590	130	7
					4.0			
					AVERAGE STRESS(psi):		130	
4	3,521	11.8%	119.4	4.00	6.0	2,530	200	7
5	3,500	11.7%	118.7	4.01	6.0	2,600	210	7
6	3,476	11.5%	118.1	4.00	6.0	2,660	210	7
					AVERAGE STRESS(psi):		210	
7	3,511	11.4%	119.4	4.00	8.0	3,340	270	7
8	3,500	11.6%	118.9	4.00	8.0	3,410	270	7
9	3,485	11.2%	118.8	4.00	8.0	3,390	270	7
					AVERAGE STRESS(psi):		270	

Notes: D558 119.1 @11.7% MC

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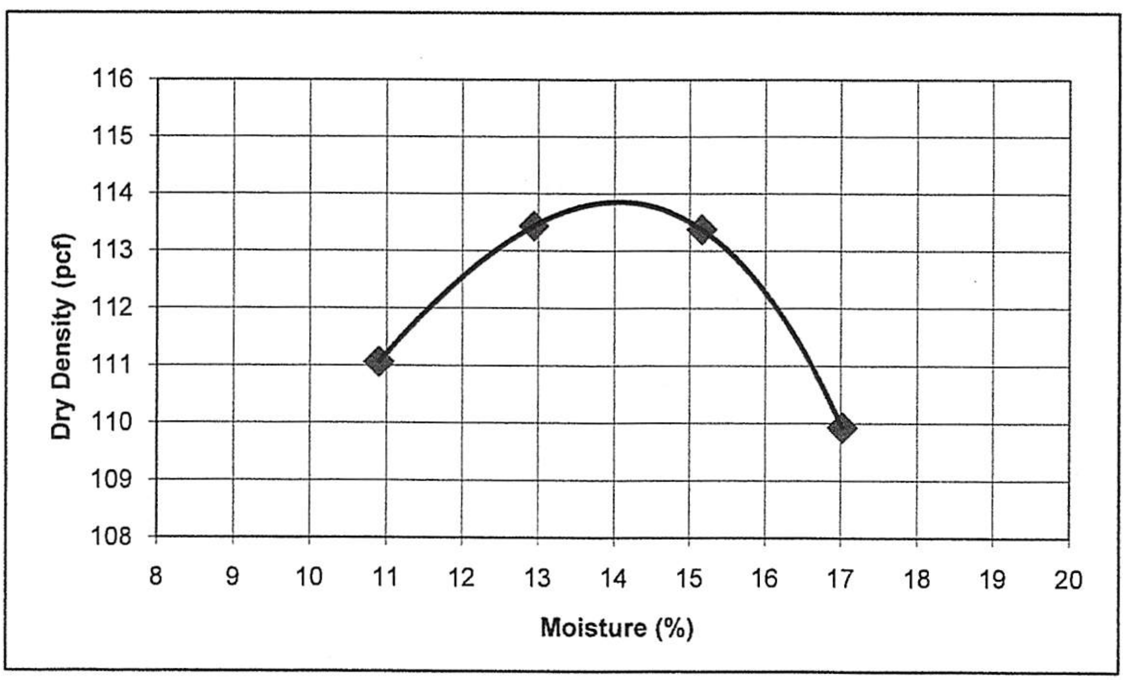
GEO DESIGN INC
15575 SW SEQUOIA PKWY, STE 100
PORTLAND, OR 97224

PROJECT:	SCONCE RD	**JOB NO:**	17-7054
LOCATION:	N/A	**WORK ORDER NO:**	8839
MATERIAL:	35% GRAVEL AND 65% SOIL 6% Cement	**LAB NO:**	10022
SAMPLE SOURCE:	C8-C14	**SAMPLE DATE:**	6/22/2017

MOISTURE- DENSITY RELATIONS OF SOIL - CEMENT MIXTURES(ASTM D558)

	English (pcf)	Metric (kg/ cu.m.)
Maximum dry density:	113.9	
Optimum moisture (%):	14.1	



NOTES:

Reviewed by:

DOUG ESQUIVEL, VP OPERATIONS

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GEO DESIGN INC
15575 SW SEQUOIA PKWY, STE 100
PORTLAND, OR 97224

PROJECT: Sconce Road 17-7054
LOCATION: 8839
MATERIAL: 35% Base/65% Soil Mix LAB NO: 10022
SAMPLE SOURCE: C8-C14 DATE SAMPLED: 6/22/17

SOIL CEMENT PLUGS COMPRESSIVE STRENGTH

SAMPLE ID	WET SAMPLE WEIGHT (g)	MOISTURE (%)	DRY DENSITY (pcf)	DIAMETER (in)	CEMENT CONTENT (%)	MAX LOAD (lbs)	STRESS (psi)	AGE IN DAYS
1	3,399	13.7%	113.3	4.00	4.0	1,600	130	7
2	3,424	13.5%	114.3	3.99	4.0	1,820	150	7
3	3,416	13.9%	113.6	3.99	4.0	1,540	120	7
					AVERAGE STRESS(psi):		130	
4	3,421	14.0%	113.7	4.00	6.0	2,430	190	7
5	3,431	14.0%	114.0	4.00	6.0	2,280	180	7
6	3,421	14.2%	113.5	4.00	6.0	2,250	180	7
					6.0			
					AVERAGE STRESS(psi):		180	
7	3,411	13.9%	113.5	4.00	8.0	2,860	230	7
8	3,421	13.5%	114.2	3.99	8.0	3,030	240	7
9	3,410	13.8%	113.6	4.00	8.0	2,810	220	7
					AVERAGE STRESS(psi):		230	

Notes: D558 113.9 @14.1% MC

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ACRONYMS AND ABBREVIATIONS

ACRONYMS AND ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
AC	asphalt concrete
ACP	asphalt concrete pavement
ASTM	American Society for Testing and Materials
DCP	dynamic cone penetrometer
ESAL	equivalent single-axle load
FDR	full-depth reclamation
ODOT	Oregon Department of Transportation
OSSC	Oregon Standard Specifications for Construction (2015)
pcf	pounds per cubic foot
PG	performance grade
psi	pounds per square inch
SPT	standard penetration test

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