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26 April 2021

Mr. Sam Dionne
Business Development Manager – NE
Sunpin Energy Services, LLC
2020 Main Street, Suite 300
Irvine, CA 92614

Re: Report of Laboratory Testing
Solar PV Ground Mount Development Project
40 Sizer Drive, Wales, MA
Wood File No. 3652-20-0259

Mr. Dionne:

Wood Environment & Infrastructure Solutions, Inc. (Wood) provides the authorized laboratory test results, and herewith submits the data and our comments. We performed the services in accordance with the terms of our 11 March 2020 proposal to Sunpin Energy Services, LLC (Sunpin). The scope of services includes general subsurface sampling and testing of soil corrosion potential across the area of the proposed solar array construction.

A Wood professional staff member visited the site on 6 April 2021 and advanced four, shallow hand-augered soil borings to collect soil samples for corrosion testing. We established the sample locations in the field by estimating angles and measuring from existing site features; we logged the soil samples in the field. We field-classified soil samples with respect to material type and consistency. Appendix 1 contains a Sample Location Plan, which shows the approximate sample locations in relation to the currently proposed improvements. We reviewed the samples and selected specimens to test for corrosion properties including soil pH, electrical resistivity, sulfate, and chloride ion concentration at our subcontracted soil testing laboratory, GeoTesting Express. After testing, GeoTesting Express will temporarily store the remaining samples not consumed in the testing; they will dispose of these samples after 60 days unless you direct us otherwise. We provide a summary of results and the laboratory test reports in Appendix 2.

Table 1 provides a summary of the corrosion suite test results and Appendix 2 presents the complete results and test reports. We tested four samples for pH, electrical resistivity, chloride and sulfate ion concentration. Table 2 through Table 4 show the ranges of the various corrosion test references.

Table 1 Laboratory Corrosion Test Summary

Sample	Depth (ft)	Moisture (%)	Metal Corrosion Potential		Concrete Corrosion Potential	
			Electrical Resistivity (Ohm/cm)	Chloride (ppm)	pH	Sulfate (ppm)
HA-1	0-4	16.9	206,607	ND	5.6	22
Interpretation			Non-Corrosive	CR = 0 µm/year	Moderate	Not Applicable
HA-2	0-4	12.9	165,286	ND	5.3	ND
Interpretation			Non-corrosive	CR = 0 µm/year	Moderate	Not Applicable
HA-3	0-4	28.7	94,006	ND	5.0	10
Interpretation			Non-corrosive	CR = 0 µm/year	Moderate	Not Applicable
HA-4	0-4	10.4	216,938	ND	5.6	ND
Interpretation			Non-corrosive	CR = 0 µm/year	Moderate	Not Applicable

Comp – Composite Sample. ND - not detected, ppm – parts per million or milligrams per kilogram. n/t – not tested. CR – Corrosion Rate. (1) See Table 2, (2) See Section 1.2. (3) See Table 3, (4) See Table 4.

1.1 Electrical Resistivity and Steel

Table 2 provides a rating of soil corrosivity of uncoated steel based upon electrical resistivity [2].

Table 2 Corrosivity Rating for Uncoated Steel

Electrical Resistivity Range						
Soil Resistivity (Ohm-cm)	0 – 1,000	1,000 – 3,000	3,000 – 5,000	5,000 – 10,000	10,000 – 20,000	>20,000
Corrosivity Rating	Extremely Corrosive	Highly Corrosive	Corrosive	Moderately Corrosive	Mildly Corrosive	**non-Corrosive**

1.2 Chloride Ions and Steel

Chloride ions concentration affect corrosion rate of embedded steel. According to the ASCE article "Corrosion Rate Evaluation and Prediction for Piles Based on Long-Term Field Performance" [1], the relationship between corrosion rate and chloride concentration may be expressed as:

$$CR = (16.28*Ln(CL)-83.8)\ \mu m/year$$

Where: CL is the Chloride concentration in ppm. CR is the corrosion rate of steel in µm/year. For concentrations less than about 172 ppm, the CR is essentially zero.

1.3 Acidity (pH) and Concrete

Acidity affects the corrosion of concrete; Based on the NRCS, Table 618.81 [3], Table 3 shows the pH testing results and corresponding corrosion potential.

Table 3 Corrosion Potential for Concrete Per NRCS Table 618.81

Potential	Low	Moderate	High
Sandy and organic soil	*pH > 6.5*	*5.5 > pH > 6.5*	*pH < 5.5*
Loamy and clayey soil	*pH > 6.0*	***5.0 > pH > 6.0***	*pH < 5.0*

1.4 Sulfate Ions and Concrete

Sulfate ion concentration affects the corrosion of concrete; sulfate exposure Class is based upon ACI 318 classification, Table 19.3.1.1 [4]. Table 4 shows the classification the soil samples based upon ACI.

Table 4 Sulfate Corrosion Scale per ACI 318

Class	Sulfate (ppm)(1)	Corrosion Potential Description	
S0	<150	**Not Applicable**	(injurious sulfate attack is not a concern)
S1	150 to <1,500	Moderate	(equal to seawater exposure, Type II cement)
S2	1,500 to <10,000	Severe	(Type V cement)
S3	> 10,000	Very Severe	(Type V cement + pozzolan or slag)

(1) From ACI 318 Table 19.3.1.1

We prepared this report for the exclusive use of Sunpin Energy Services for the site and criteria stated herein. You should address questions or interpretation regarding any portion of the report directly to Wood. Reliance upon, usage, or implementation of the information or recommendations stated in this report by any member of the project team should not be undertaken without direct consultation of the client and Wood. Wood accepts no responsibility for damages, if any, suffered by any third party because of decisions made or actions based on this report.

Wood appreciates this opportunity to be of service to Sunpin Energy Services. At your convenience, we are available to discuss the details of this report and any questions that you may have.

Sincerely,
Wood

Douglas E. Tate, PE (MA)
Senior Geotechnical Engineer

COMMONWEALTH OF MASSACHUSETTS
DOUGLAS E. TATE
CIVIL
No. 40908
REGISTERED PROFESSIONAL ENGINEER

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Date: 2021.04.26 11:04:52-05'00'

Reviewed By: Thomas D. Humbert, PE (TN)
Geotechnical Engineer

2.0 REFERENCES

[1] J. R. K. a. E. J. Decker, "Corrosion rate evaluation and prediction for piles based on long-term field performance.," *Journal of geotechnical and geoenvironmental engineering, 134(3),* pp. 341-351., 2008.

[2] A. W. Peabody, Peabody's Control of Pipeline Corrosion, Houston, Texas: NACE international, 2001.

[3] NRCS, "618.81 Guide for Estimating Risk of Corrosion Potential for Concrete," 2017. [Online]. Available: https://www.nrcs.usda.gov/wps/portal/nrcs/detail/soils/ref/?cid=nrcs142p2_054224.

[4] ACI, ACI-318 Building Code Requirements for Structural Concrete and Commentary, Washington, D.C.: American Concrete Institute, 2019.

APPENDIX 1

SAMPLE LOCATION PLAN

24R GIZER DRIVE
N/F
TERRANCE J. & RENA C. O'KEEFE
D.B. 7506, PG. 283

HA-1

HA-2

HA-3

HA-4

TEMPORARY SEDIMENT TRAP 1

TEMPORARY SEDIMENT TRAP 2

TEMPORARY SEDIMENT TRAP 3

PROPOSED WETLAND CROSSING CULVERT

APPROXIMATE STREAM BANK

SHEET C-103

SHEET C-105

SHEET C-106

0' 60' 120' 180'

1" = 120' WHEN PLOTTED 24"x36"

HAND AUGER SAMPLE LOCATION PLAN

wood.

MAP 12
N/F

APPENDIX 2

LABORATORY RESULTS

Client:	Wood Environmental & Infrastructure, Inc.				
Project:	Wales, MA Ground Mount Solar				
Location:	Wales, MA			Project No:	GTX-313467
Boring ID:	---	Sample Type:	---	Tested By:	ckg
Sample ID:	---	Test Date:	04/19/21	Checked By:	bfs
Depth :	---	Test Id:	615418		

Moisture Content of Soil and Rock - ASTM D2216

Boring ID	Sample ID	Depth	Description	Moisture Content,%
HA1	1- 1	0-4 ft	Moist, yellowish brown silt	16.9
HA2	2- 1	0-4 ft	Moist, light brownish yellow silt	12.9
HA3	3- 1	0-4 ft	Moist, brown clay with gravel	28.7
HA4	4- 1	0-4 ft	Moist, brownish yellow silty sand	10.4

Notes: Temperature of Drying : 110º Celsius

Client:	Wood Environmental & Infrastructure, Inc.				
Project:	Wales, MA Ground Mount Solar				
Location:	Wales, MA			Project No:	GTX-313467
Boring ID:	---	Sample Type:	---	Tested By:	fmj
Sample ID:	---	Test Date:	04/19/21	Checked By:	bfs
Depth :	---	Test Id:	615422		

pH of Soil by ASTM D4972

Boring ID	Sample ID	Depth	Visual Description	pH of Soil in Distilled Water	pH of Soil in Calcium Chloride
HA1	1-1	0-4 ft	Moist, yellowish brown silt	5.6	4.8
HA2	2-1	0-4 ft	Moist, light brownish yellow silt	5.3	4.4
HA3	3-1	0-4 ft	Moist, brown clay with gravel	5.0	4.2
HA4	4-1	0-4 ft	Moist, brownish yellow silty sand	5.6	4.8

Notes: Sample Preparation: screened through #10 sieve

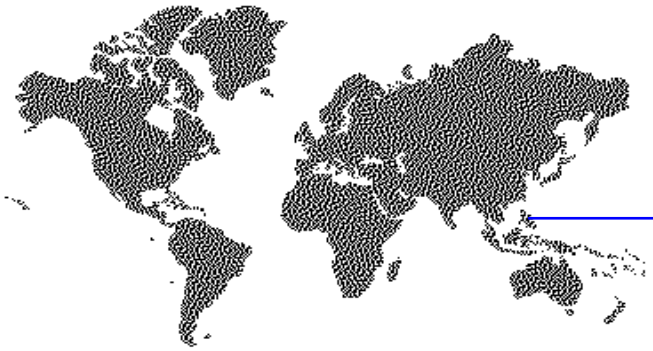
Method A, pH meter used

Client:	Wood Environmental & Infrastructure, Inc.
Project:	Wales, MA Ground Mount Solar
Location:	Wales, MA
GTX#:	313467
Test Date:	04/17/21
Tested By:	cl
Checked By:	bfs

Laboratory Measurement of Soil Resistivity Using the Wenner Four-Electrode Method by ASTM G57 (Laboratory Measurement)

Boring ID	Sample ID	Depth, ft.	Sample Description	Electrical Resistivity, ohm-cm	Electrical Conductivity, $(ohm\text{-}cm)^{-1}$
HA1	1-1	0-4	Moist, yellowish brown silt	206,607	4.84E-06
HA2	2-1	0-4	Moist, light brownish yellow silt	165,286	6.05E-06
HA3	3-1	0-4	Moist, brown clay with gravel	94,006	1.06E-05
HA4	4-1	0-4	Moist, brownish yellow silty sand	216,938	4.61E-06

Notes: Test Equipment: Nilsson Model 400 Soil Resistance Meter, MC Miller Soil Box
Water added to sample to create a thick slurry prior to testing (saturated condition).
Electrical Conductivity is calculated as inverse of Electrical Resistivity (per ASTM G57)
Test conducted in standard laboratory atmosphere: 68-73 F



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GEOTESTING EXPRESS INCORPORATED
125 NAGOG PARK
ACTON MA 01720-3451
USA

Analysis No.	TS-A2109523
Report Date	20 April 2021
Date Sampled	12 April 2021
Date Received	15 April 2021
Where Sampled	Acton, MA USA
Sampled By	Client

This is to attest that we have examined: Soil: Project: Wales Ground Mount Solar; Site Location: Wales, MA; Job Number: GTX-313467

When examined to the applicable requirements of:

ASTM D 512-12	“Standard Test Methods for Chloride Ion in Water” Method B
ASTM D 516-16	“Standard Test Method for Sulfate Ion in Water”

Results:

ASTM D 512 - Chloride Method B

Sample		Results		Detection Limit
		ppm (mg/kg)	%[1]	
HA1		< 10.	< 0.0010	10.
1-1	-			
HA2		< 10.	< 0.0010	
2-1	-			
HA3		< 10.	< 0.0010	
3-1	-			
HA4		< 10.	< 0.0010	
4-1	-			

NOTE: [1]Percent by weight after drying and prepared as per the Standard.

Testing Services analytical Laboratory
3455 South 500 West
Salt Lake City, UT 84115-4234 USA
TEL: +1 801 262 2448
FAX: +1 801 262 9870

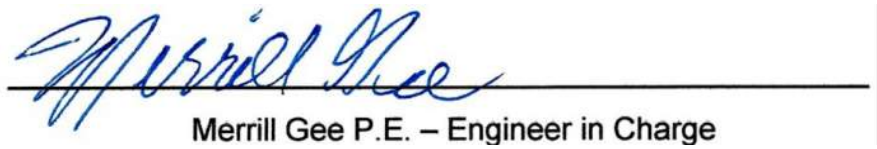
ASTM D 516 – Sulfates (Soluble)

Sample		Results		Detection Limit
		ppm (mg/kg)	%[1]	
HA1		22.	0.0022	10.
1-1	-			
HA2		< 10.	< 0.0010	
2-1	-			
HA3		10.	0.0010	
3-1	-			
HA4		< 10.	< 0.0010	
4-1	-			

NOTE: [1]Percent by weight after drying and prepared as per the Standard.

END OF ANALYSIS

USEPA Laboratory ID UT00930



Merrill Gee P.E. – Engineer in Charge