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USCS Site Soil Classification For OWDP Project

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1 PURPOSE

This report contains the results of the dry sieve analysis of three soil samples taken from points found on the map in Appendix A. The purpose of this report is to provide the USCS classification of the soil samples and recommendations on how this soil could be used on the OWDP lift station project.

2 METHODOLOGY

The soil samples were taken from the three points found in Appendix A; these samples were taken to get a basic idea of the soils present along each of the proposed force main routes. The soil samples were dry sieved by the procedure outlined in *Soil Mechanics Laboratory Manual 6th Edition,* (pgs. 15-21). All three soil samples were classified into the USCS classification system, based off the percent finer materials passing the #200 sieve, grain size graph, coefficient of uniformity and the coefficient of curvature.

2.1 METHOD FOR PERCENT FINER PASSING THE #200

To determine the percentage of soils passing the #200 sieve, the soil samples 1 through 3 were measured out to a sample size of 500.06g, 427.83g and 416.58g respectively. Samples 2 and 3 were smaller than the recommended sample size found in the laboratory procedure. However, these sample sizes were used, because the team did not believe a smaller sample size would negatively affect the data. Prior to being measured out, all three samples were oven dried at 220 Fahrenheit, because the original samples were moist and the procedure called for dry soil samples. Once the samples were dry, all three soil samples were sieved using #4, #10, #20, #40, #60, #140 and #200 sieves. The samples were sieved in a shaking machine for 12 minutes, as per the lab procedure, and data was gathered by using the techniques shown in the lab procedure. The sieves were cleaned thoroughly before each sieving, to reduce the possibility of mass gained

from left over soil from previous user's experiments. Careful care was taken during the weighing of each individual sieve to reduce the amount of soil lost or gained through improper measurement on the digital balance. To determine the exact amount of soil lost in the sieve analysis the following equation was used.

$$(W\text{-}W_1 / W) * 100\%$$

With W = mass of oven-dry specimen in grams and W_1= the sum of the masses retained on sieves #4 to the pan in grams.

Once the percent of soil lost during the analysis was determined to be within acceptable limits, below 2%, the percent finer materials passing the #200 sieve could be calculated based off the following equations.

$$Rn = (Wn / W1) * 100\%$$

$$100 - \sum Rn$$

With W_n = mass of soil retained on each sieve in grams and R_n = percent of mass retained on each sleeve.

2.2 METHOD FOR GRAIN SIZE GRAPH

With the percent finer materials passing through the #200 sieve known, the data was then graphed on a logarithmic grain size graph, which can be found in Appendix B. The data was placed onto the grain size graph, to determine the percentages of gravel, sands and fine soils present in the soil samples. These percentages were required for the calculation of the coefficients of uniformity and the coefficients of curvature.

2.3 METHOD FOR COEFFICIENT OF UNIFORMITY AND THE COEFFICIENT OF CURVATURE

The coefficient of uniformity and coefficient of curvature were calculated from the determination of the particle sizes of the soil samples at D_{10}, D_{30}, and D_{60}. The diameter value

were determined by extrapolating their position off the graph seen in Appendix B. The equations used to calculate the coefficient of uniformity and coefficient of curvature are as follows.

$$C_u = D_{60} / D_{10}$$

$$C_c = D^2_{30} / (D_{60} * D_{10})$$

With C_u= coefficient of uniformity and C_c= coefficient of curvature.

2.4 METHOD FOR CLASSIFICATION INTO USCS

With the percent finer materials passing the #200 sieves, grain size graph, coefficients of uniformity and the coefficients of curvature known, the soil samples could be classified using the guidelines for USCS soil classification, as found in chapter 5 of *Geotechnical Engineering Principles and Practices*, (pgs. 171-178). Percentages of sand, fines and gravels were also required to properly classify the three soil samples. The percentages of sand in each sample were calculated by subtracting the %fines passing the #200 sieve from the #4 sieve. The percentages of fines in each sample, was equal to the %fines passing the #200 sieves. The percentages of gravels in each sample, was equal to the sum of the sands and fines minus 100%.

3 RESULTS

W_1 for soil samples 1-3 was determined to be 499.49g, 423.48g and 416.46g respectively. The percent of mass lost during the three analyses was found to be 0.11%, 1.02% and 0.03%. Tables#1-3 below show the results of the sieve analyses, and the percent finer materials passing through the #200 sieve were found to be 2.20, 17.75 and 18.42 percent.

Table 1: *Sample #1 sieve analysis*

Sieves	Opening (mm)	Empty Weight (g)	Full Weight (g)	Diff (g)	Rn(%)	Cum. Rn(%)	% finer
4	4.75	523.3	555.72	32.42	6.48	6.48	93.52
10	2	410.19	532.91	122.72	24.54	31.02	68.98
20	0.853	415.66	559.95	144.29	28.85	59.88	40.12
40	0.422	391.28	490.43	99.15	19.83	79.71	20.29
60	0.25	372.44	416.99	44.55	8.91	88.62	11.38
140	0.106	338.98	370.28	31.3	6.26	94.87	5.13
200	0.075	350.39	365.04	14.65	2.93	97.8	2.2
Btm	0	367.79	378.2	10.41	2.08	99.89	0.11

Table 2: *Sample #2 sieve analysis*

Sieves	Opening (mm)	Empty Weight (g)	Full Weight (g)	Diff (g)	Rn(%)	Cum. Rn(%)	% finer
4	4.75	514.24	541.45	27.21	6.36	6.36	93.64
10	2	450.47	497.64	47.17	11.03	17.39	82.61
20	0.853	414.01	466.72	52.71	12.32	29.71	70.29
40	0.422	385.09	429.6	44.51	10.4	40.11	59.89
60	0.25	365.69	412.5	46.81	10.94	51.05	48.95
140	0.106	340.04	459.98	119.94	28.03	79.09	20.91
200	0.075	333.04	346.6	13.56	3.17	82.25	17.75
Btm	0	367.77	439.34	71.57	16.73	98.98	1.02

Table 3: *Sample #3 sieve analysis*

Sieves	Opening (mm)	Empty Weight (g)	Full Weight (g)	Diff (g)	Rn(%)	Cum. Rn(%)	% finer
4	4.75	523.39	526.3	2.91	0.7	0.7	99.3
10	2	410	431.57	21.57	5.18	5.88	94.12
20	0.853	415.7	449.32	33.62	8.07	13.95	86.05
40	0.422	391.22	422.99	31.77	7.63	21.57	78.43
60	0.25	372.4	417.86	45.46	10.91	32.49	67.51
140	0.106	338.95	458.12	119.17	28.61	61.09	38.91
200	0.075	350.39	435.74	85.35	20.49	81.58	18.42
Btm	0	367.79	444.4	76.61	18.39	99.97	0.03

3.1 GRAIN SIZE GRAPH

The grain size graph can be found in Appendix B.

3.2 COEFFICIENT OF UNIFORMITY AND THE COEFFICIENT OF CURVATURE

Table #4 shows the values of D_{10}, D_{30}, and D_{60} as extrapolated form the grain size graph found in Appendix B

Table 4: *Coefficient uniformity*

Sample #	D10 (mm)	D30 (mm)	D60 (mm)	Cu	Cc
1	0.17	0.64	1.65	9.71	1.46
2	0.05	0.15	0.42	8.44	1.07
3	0.05	0.09	0.2	4	0.81

3.3 SOIL CLASSIFICATIONS

In the USCS soil classification system; soil sample #1 can be classified as SW well graded sand, soil samples #2 and #3 are both classified as SC-SM silty, clayey sand.

4 CONCLUSION

The soil samples can be classified in the USCS soil system as a sand that is either well graded or a silty, clayey sand. The classifications were based off of the percent fines passing the #200 sieve, the grain size chart, and the calculated C_u and C_c determined by the D_{10}, D_{30}, D_{60} extrapolated from the graph.

5 RECOMMENDATIONS

Based off the USCS classification of these soil samples, the soils along each of the force main routes present no problem to excavation and can be used as potential cover after the pipes have been laid. The soils present at the site are manageable but it must be noted that while samples were being taken, rocks ranging in sizes of 3 to 6 inches, were encountered at depths of only 1ft. These rocks may have a negative effect on the excavation along the proposed force main. Appendix C shows examples of the rocks found at the sample sites. Larger boulders were also present along each of the three routes, ranging in size of 1 to 3 ft. in length, which could also pose problems for excavation.

REFERENCES

Coduto. P. Donald, Kitch. A. William, Yeung. Man-chu. *Geotechnical Engineering Principles and Practices,* Second Edition, Pearson Publishing

Das. M. Braja. 2002. *Soil Mechanics Laboratory Manual. 6th Edition*. Oxford University Press.

APPENDIX A

Figure 1: *Soil sample locations*

APPENDIX B

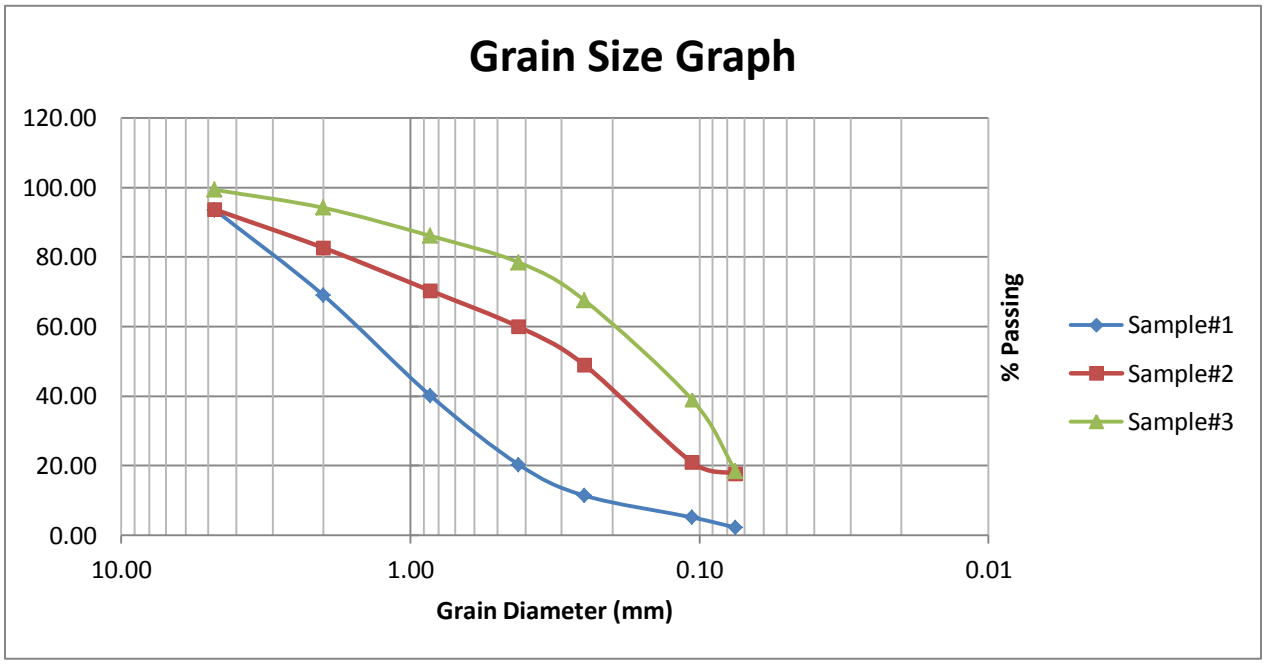

Figure 2: *Samples grain size graph*

APPENDIX C

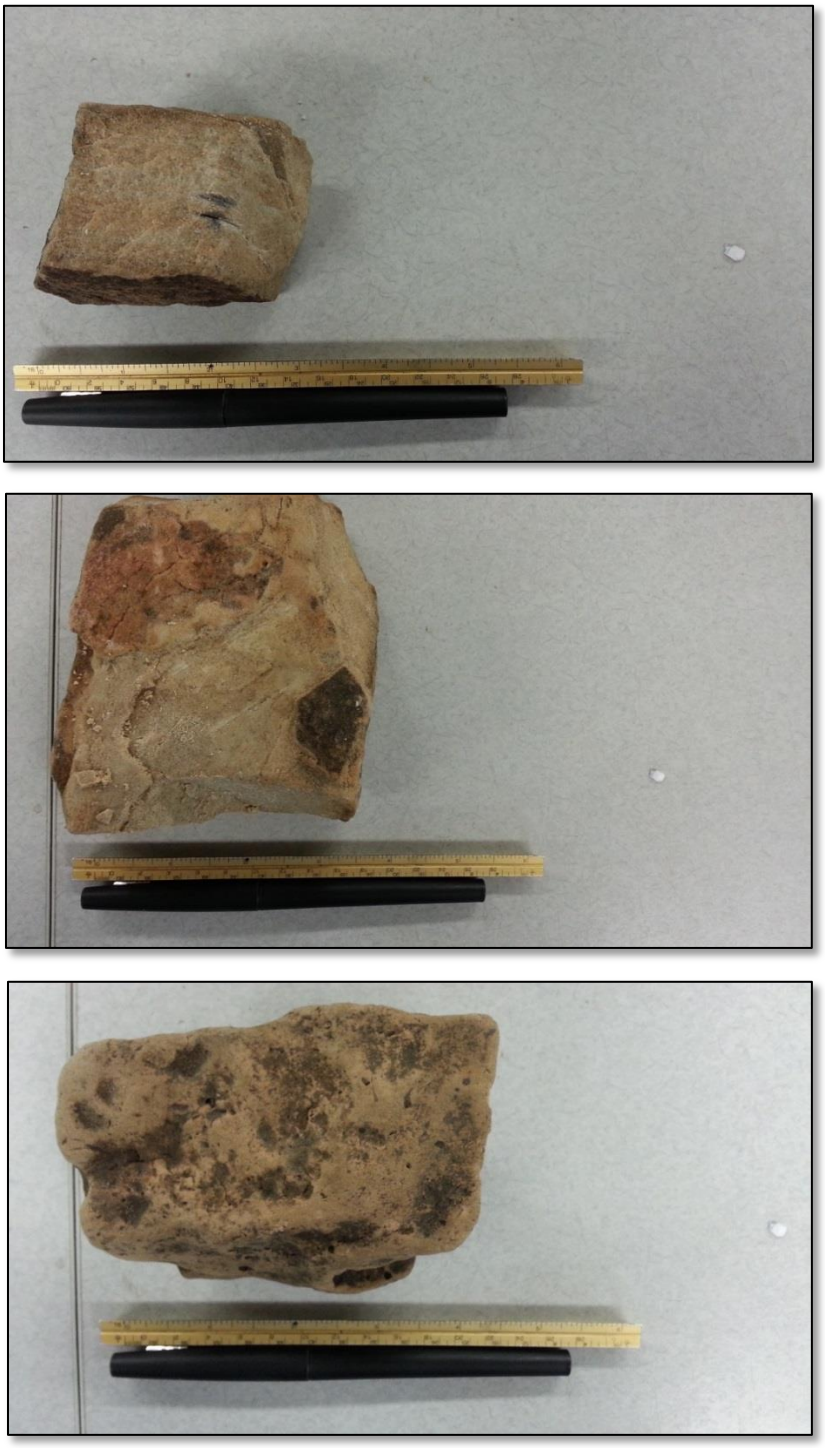

Figure 3: *Rocks samples from the site*

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