



Civil & Environmental Consultants, Inc.

Subsurface Investigation of a MSW Landfill for Site Specific Design Parameters

Christopher S. Dohner, P.E.

NEW YORK FEDERATION CONFERENCE
MAY 2022

Presentation Outline

- Project/Site Background
- Regulatory Review – Demonstrate Conservative Stability Model
- Subsurface Investigation Work Plan and Objectives
- Boring Investigation & Field Work
- Laboratory Testing
- Stability Model Soil Property Comparison
- Conclusion

General Project/Site Background

Existing Conditions

- Site located in Northeast United States
- Existing closed landfill
- Existing soil stockpile
- Existing compost operation

Proposed Conditions

- 9± acre landfill cell
- 35± foot high soil perimeter berm
- Berm located on virgin ground and within existing closed landfill

Existing Conditions Site Plan

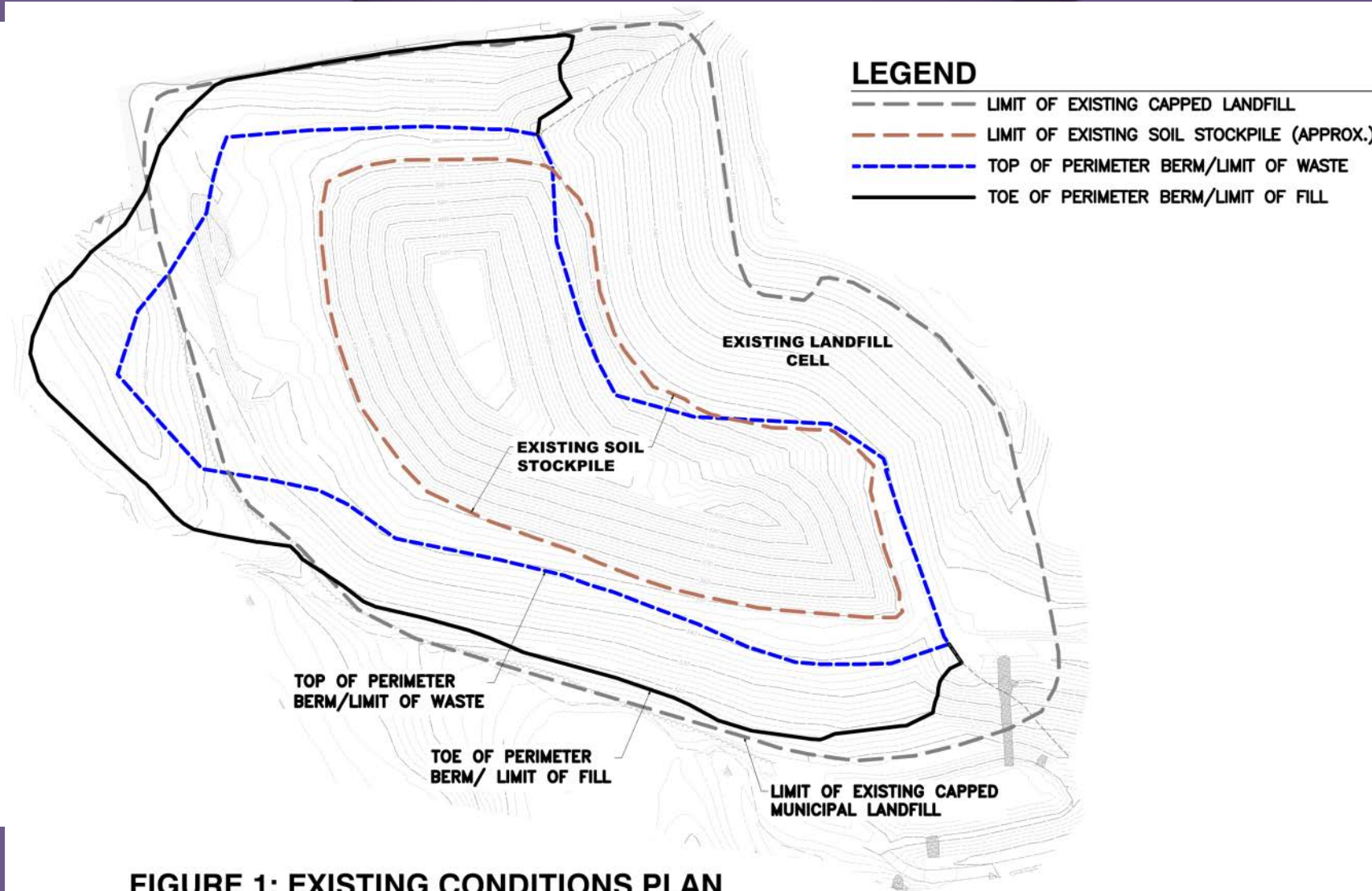


FIGURE 1: EXISTING CONDITIONS PLAN

SCALE: 1" = 60'



Regulatory Review – Demonstrate Conservative Stability Model

- Assure functional and structural integrity of all design components
- Account for settlement and compression in surcharged and non-surcharged areas
- Unless supported by field data obtained for materials modeled, all material properties shall be conservative to ensure satisfactory analysis.



Subsurface Investigation Work Plan and Objectives

- Confirm waste thickness, moisture, and degree of decomposition of in-situ waste materials
- Confirm primary and secondary compression indices for in-situ materials
- Confirm compression indices for surcharged and non-surcharged areas
- Confirm in-situ shear strength properties (i.e. internal friction angle and cohesion)



Boring Investigation Work Plan

Original work plan submitted to Regulators:

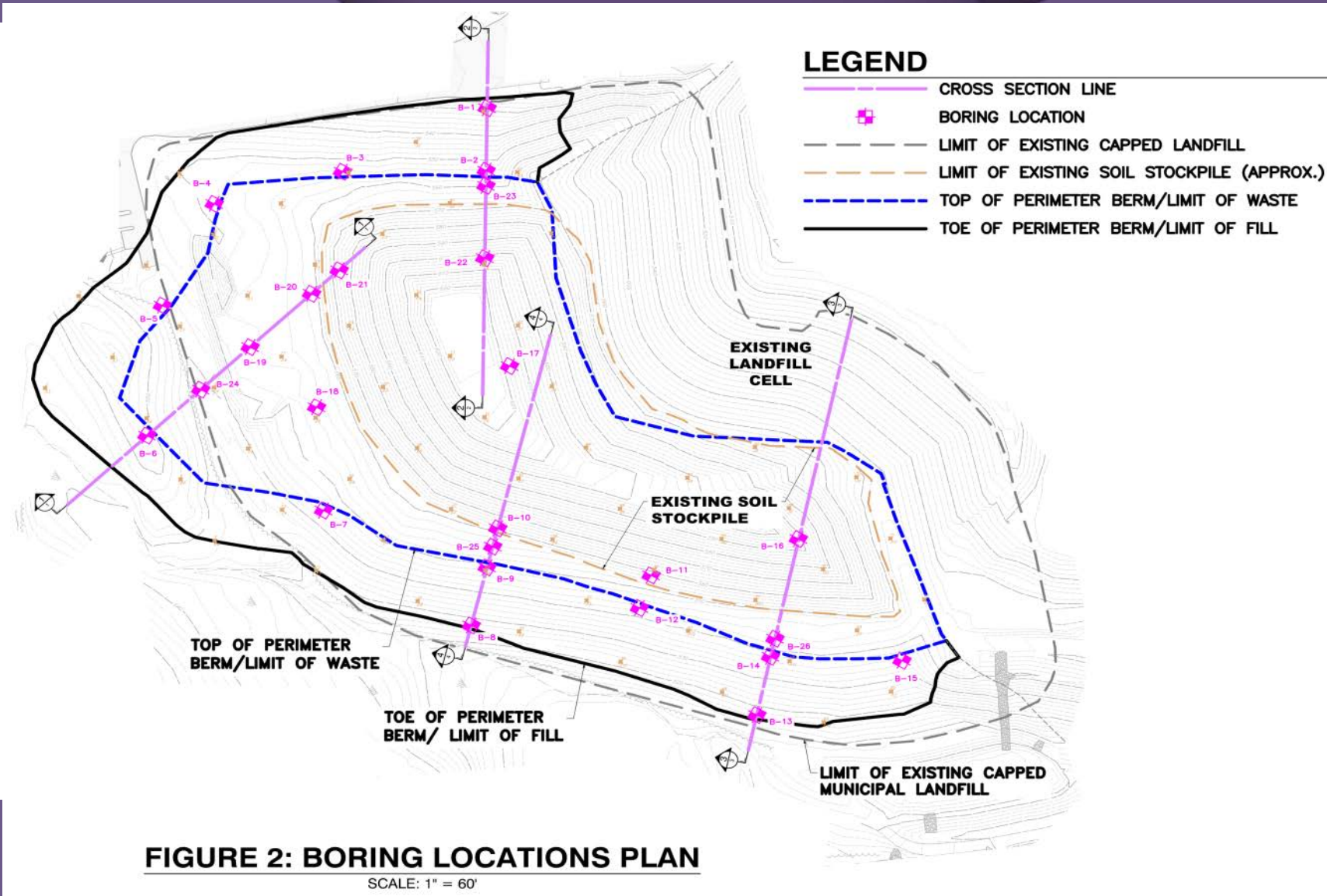
- 12 boring locations
- Top and toe of perimeter berm (at stability cross section locations)
- Within existing stockpile footprint (at stability cross section locations)
- Within existing closed landfill footprint (at stability cross section locations)

Final work plan approved by Regulators:

- **26** boring locations
- Centerline and toe of perimeter berm
- Middle and inner slope of each stability cross section
- Surcharged and non-surcharged areas



Boring Investigation Site Plan



Summary of Borings

**TABLE 1
SUMMARY OF BORINGS**

BORING NO. ¹	SETTLEMENT GRID POINT REFERENCE ¹	DATE DRILLED	BORING DEPTH (FT.) ²	DEPTH TO WATER (FT.) ³	SAMPLES COLLECTED
B-1	49 (H2)	8/4/2020	18.2	N/A	1 solid waste sample
B-2	50 (H3)	7/28/2020	47.6	N/A	1 solid waste sample
B-3	30 (F2)	8/11/2020	37.5	N/A	N/A
B-4	15 (D2)	8/12/2020	16.0	N/A	1 soil sample
B-5	9 (C3)	8/12/2020	6.2	N/A	N/A
B-6	5 (B4)	7/17/2020	6.2	N/A	1 soil sample
B-7	12 (C6)	8/10/2020	40.8	N/A	N/A
B-8	29 (E9)	7/16/2020	12.6	N/A	1 solid waste sample, 1 soil sample
B-9	28 (E8)	7/16/2020	14.0	N/A	1 solid waste sample
B-10	28 (E8)	8/3/2020	51.5	N/A	1 solid waste sample, 1 soil sample
B-11	46 (G9)	8/5/2020	55.1	N/A	N/A
B-12	46 (G9)	8/10/2020	33.8	N/A	N/A
B-13	48 (G11)	7/14/2020	21.0	N/A	1 solid waste sample, 1 soil sample
B-14	58 (H11)	7/13/2020	32.0	31.41	1 solid waste sample, 1 soil sample
B-15	69 (I12)	8/4/2020	31.0	N/A	1 soil sample
B-16	66 (I9)	7/30/2020	40.2	N/A	1 solid waste sample
B-17	42 (G5)	7/29/2020	46.7	N/A	1 solid waste sample
B-18	18 (D5)	8/11/2020	51.5	N/A	N/A
B-19	17 (D4)	7/20/2020	19.3	N/A	1 solid waste sample
B-20	23 (E3)	7/17/2020	22.4	17.4	2 solid waste samples
B-21	23 (E3)	7/20/2020	37.4	23.64	1 solid waste sample
B-22	41 (G4)	7/22/2020	47.2	N/A	1 solid waste sample
B-23	50 (H3)	7/27/2020	45.0	N/A	1 solid waste sample
B-24	10 (C4)	7/20/2020	8.0	N/A	1 soil sample
B-25	28 (E8)	7/15/2020	42.3	25.23	1 solid waste sample
B-26	58 (H11)	7/13/2020	25.6	N/A	1 solid waste sample

Field Work Photographs



Laboratory Testing

- 1 soil and 2 waste samples were collected from each of the four cross sections (i.e., 4 total soil and 8 total waste samples collected)
- Laboratory Tests Completed:
 - Water Content for Soil and Rock by Mass (ASTM D2216)
 - Density of Soil (ASTM D7263)
 - Direct Shear of Soil under Consolidated Drained Conditions (ASTM D3080)
 - One-Dimensional Consolidation Properties Using Incremental Loading (ASTM D2435)

Model Parameter Comparison (Soil)

TABLE 2A
STABILITY MODEL SOIL PARAMETERS COMPARISON TABLE

SOIL PROPERTY	SUBMITTED DESIGN PARAMETER VALUE	LABORATORY DETERMINED PARAMETER VALUE		
		MIN.	MAX.	AVG.
Existing Soil Compression Index (C_c)	N/A ⁽¹⁾	0.14	0.25	0.2
Existing Soil Direct Shear (Φ)	30°	35.3°	41.6°	38.7°

Notes:

1. Soil compression was not included in the original settlement analysis due to the significantly lower magnitude of soil settlement compared to waste settlement resulting from the relatively low soil thickness and low soil compression index.

Model Parameter Comparison (Waste)

TABLE 2B
STABILITY MODEL WASTE PARAMETERS COMPARISON TABLE

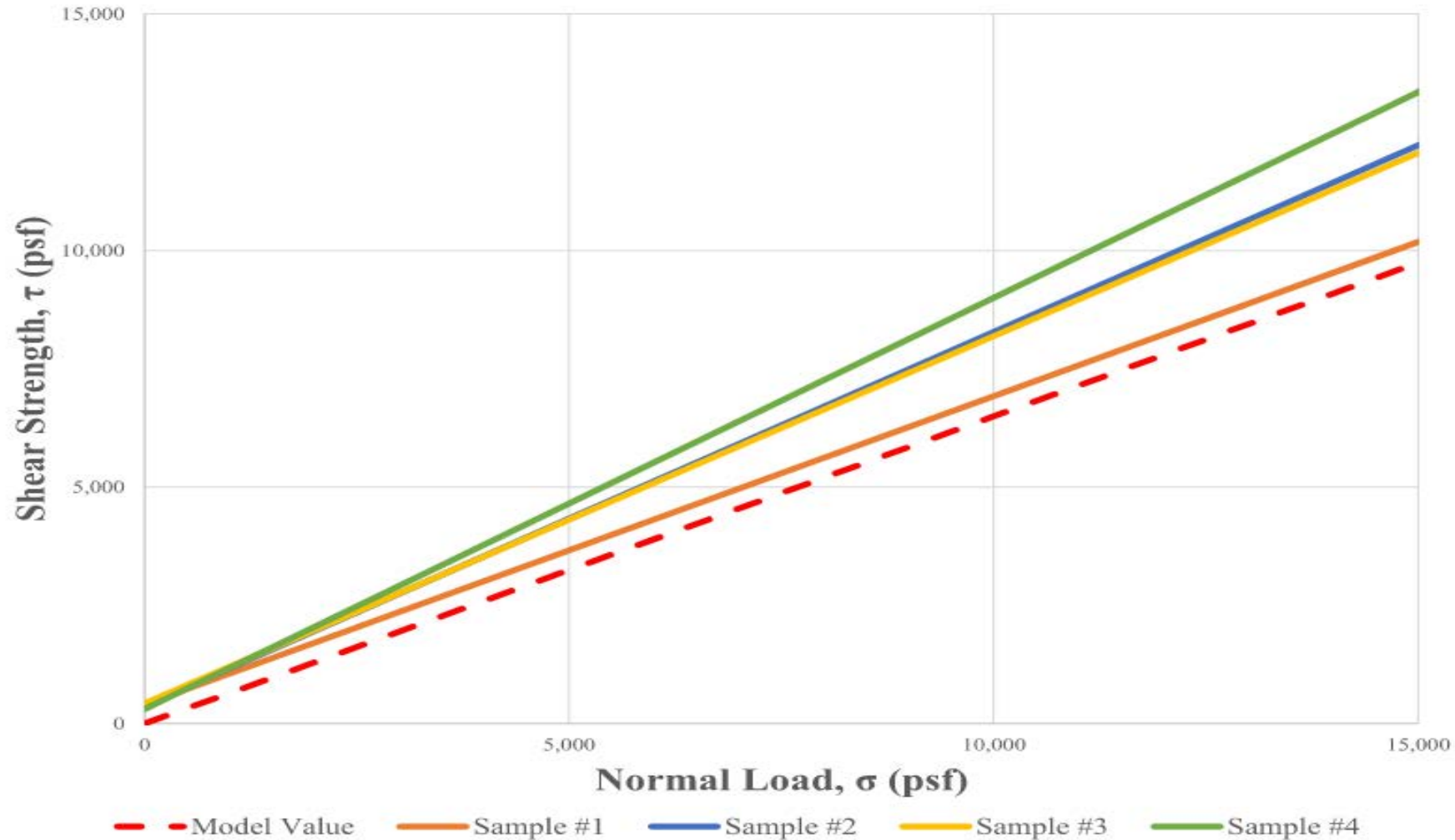
SOIL PROPERTY	SUBMITTED DESIGN PARAMETER VALUE	LABORATORY DETERMINED PARAMETER VALUE		
		MIN.	MAX.	AVG.
Existing Waste Compression Index (C_c)	1.05	0.14	0.4	0.25
Existing Waste Direct Shear (Φ)	33° ⁽¹⁾	33.1°	41.0°	37.6°
Existing Waste Cohesion (c, psf)	0° ⁽¹⁾	307	428	380

Notes:

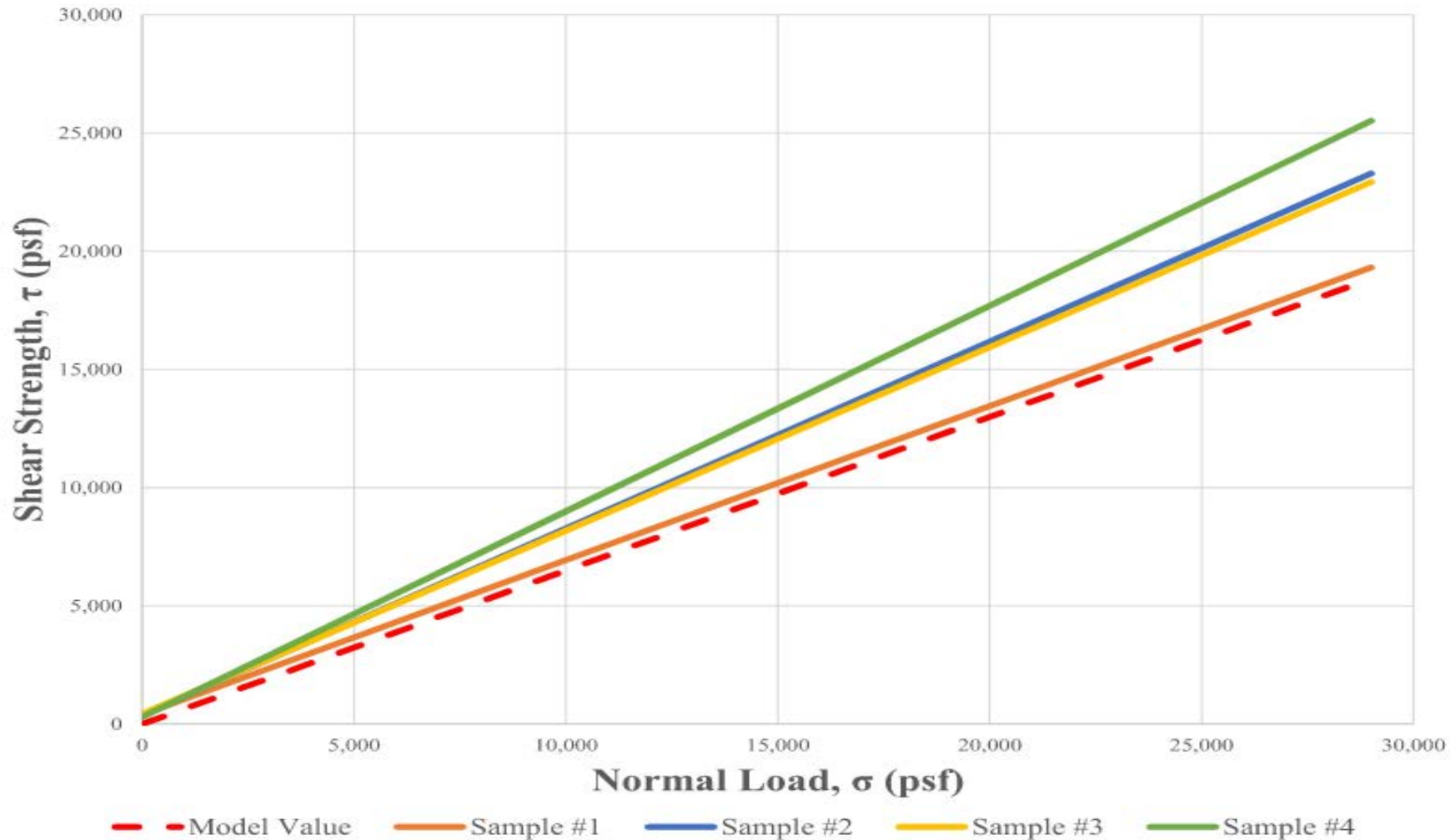
1. For normal loads greater than 500 psf.



Existing Waste Shear Strength Analysis (Project Normal Loads)



Existing Waste Shear Strength Analysis (to 30k PSF)



Conclusions

- The overall assumptions made in the original settlement and stability analysis were determined to be more conservative than actual site conditions
 - Waste thickness was less than expected
 - Waste was not saturated
 - Waste exhibited some cohesion (300± psf minimum)
 - Waste was in poor decomposition environment
- Direct shear and compression indices model parameters for existing waste and soils were determined to be more conservative than actual site conditions

Contact Information

Christopher S. Dohner, P.E.

T: 774-501-2176 ext. 2707

Email: cdohner@cecinc.com



Questions?

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