Test ID	Easting	Northing	Elevation (m)
CPT-01	380236	5765268	28.1
CPT-01A	380237	5765280	28.0
CPT-01B	380231	5765235	29.0
CPT-01C	380368	5765321	25.0
CPT-02A	380520	5765834	29.0
CPT-02B	380506	5765838	28.9
CPT-02C	380377	5765865	28.3
CPT-02D	380462	5765848	29.0
CPT-02F	380577	5765817	29.2
CPT-02G	380440	5765602	25.1
CPT-02H	380435	5765576	26.4
CPT-03A	380629	5765355	28.5
CPT-04A	381168	5765166	20.5
DPSH-01A	380237	5765268	28.1
DPSH-01B	380375	5765321	25.3
DPSH-01C	380437	5765314	24.8
DCP1A	380434	5765314	24.9
DCP1B	380440	5765314	24.7
DCP1C	380373	5765321	25.2
DCP3A	380629	5765354	28.5
DCP3B - DCP3F	380711	5765369	28.8

LEGEND:

CPT CONE PENETROMETER TEST (CPT) LOCATION

1:5000 0 100 200 300 400 500 m

CMW Geosciences

CLIENT: HANSON CONSTRUCTION MATERIALS		DRAWN: LK	PROJECT: MEL2022-0033
PROJECT: Yannathan Sand Quarry Geotechnical Assessment		CHECKED: JVS	FIGURE: 01
		REVISION: 1	SIZE: 1:5,000
TITLE: CONE PENETROMETER INVESTIGATION		DATE: 19/01/2023	SHEET: A3 L

LEGEND:

- CPT CONE PENETROMETER TEST (CPT) LOCATION
- DPSH DYNAMIC PROBING SUPER HEAVY (DPSH) LOCATION
- DCP DYNAMIC CONE PENETROMETER (DCP) LOCATION

1:1500 0 50 100 m

CMW Geosciences

CLIENT: HANSON CONSTRUCTION MATERIALS		DRAWN: LK	PROJECT: MEL2022-0033
PROJECT: Yannathan Sand Quarry Geotechnical Assessment		CHECKED: JVS	FIGURE: 02
		REVISION: 1	SIZE: 1:1,500
TITLE: CONE PENETROMETER INVESTIGATION		DATE: 20/01/2023	SHEET: A3 L

LEGEND:

CPT CONE PENETROMETER TEST (CPT) LOCATION

1:1500 0 50 100 150 m

CMW Geosciences

CLIENT: HANSON CONSTRUCTION MATERIALS		DRAWN: LK	PROJECT: MEL2022-0033
PROJECT: Yannathan Sand Quarry Geotechnical Assessment		CHECKED: JVS	FIGURE: 03
		REVISION: 1	SIZE: 1:1,500
TITLE: CONE PENETROMETER INVESTIGATION		DATE: 18/01/2023	SHEET: A3 L

LEGEND:

CPT CONE PENETROMETER TEST (CPT) LOCATION

1:1500 0 50 100 150 m

CMW Geosciences

CLIENT: HANSON CONSTRUCTION MATERIALS	DRAWN: LK	PROJECT: MEL2022-0033
PROJECT: Yannathan Sand Quarry Geotechnical Assessment	CHECKED: JVS	FIGURE: 04
	REVISION: 1	SIZE: 1:1,500
TITLE: CONE PENETROMETER INVESTIGATION	DATE: 18/01/2023	SHEET: A3 L

LEGEND:

CPT CONE PENETROMETER TEST (CPT) LOCATION

0 100 200 300 400 500 m

1:5000

CMW Geosciences

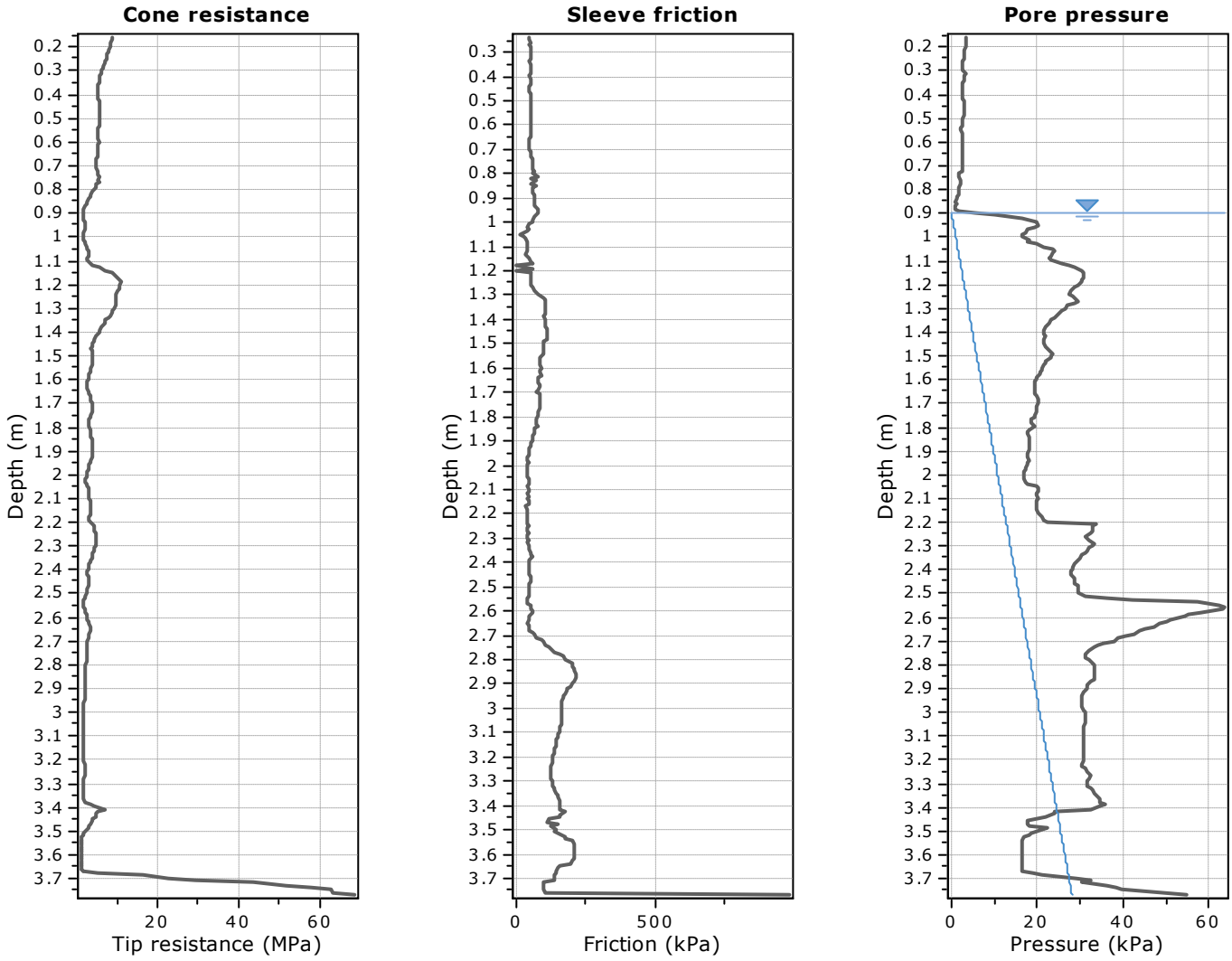
CLIENT: HANSON CONSTRUCTION MATERIALS		DRAWN: SP	PROJECT: MEL2022-0033
PROJECT: Yannathan Sand Quarry Geotechnical Assessment		CHECKED: JVS	FIGURE: 05
		REVISION: 0	SIZE: 1:5,000
TITLE: CONE PENETROMETER INVESTIGATION		DATE: 12/04/2023	SHEET: A3 L

Appendix B1: CPT IGS Results

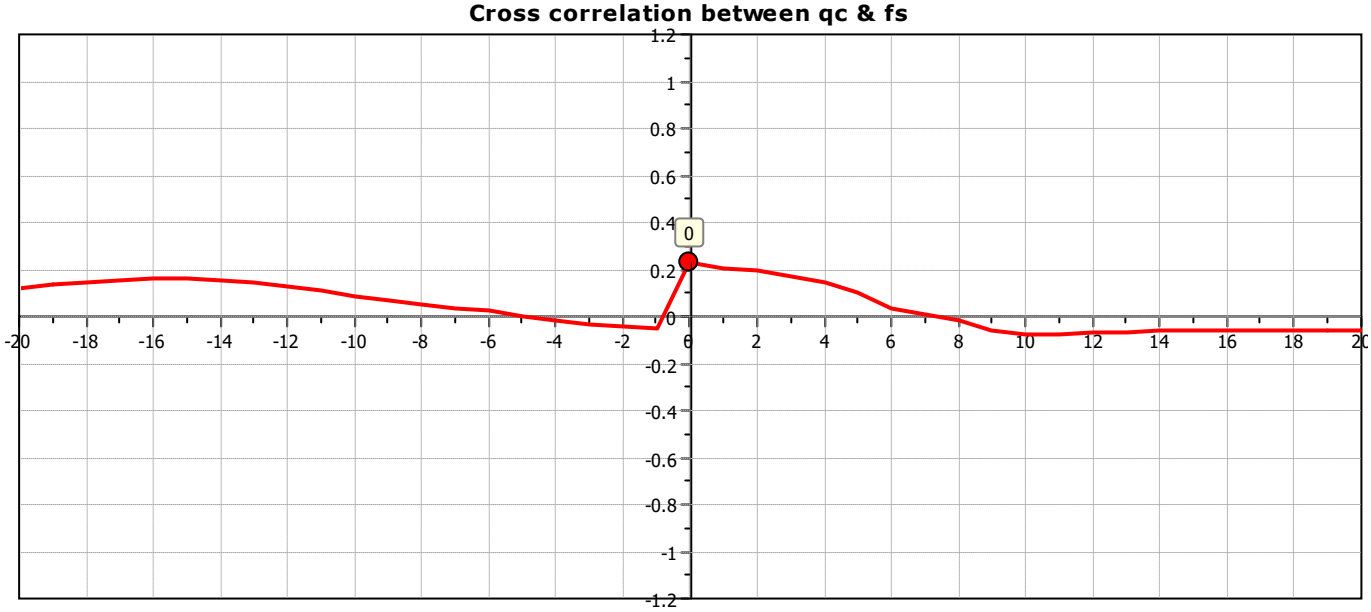
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

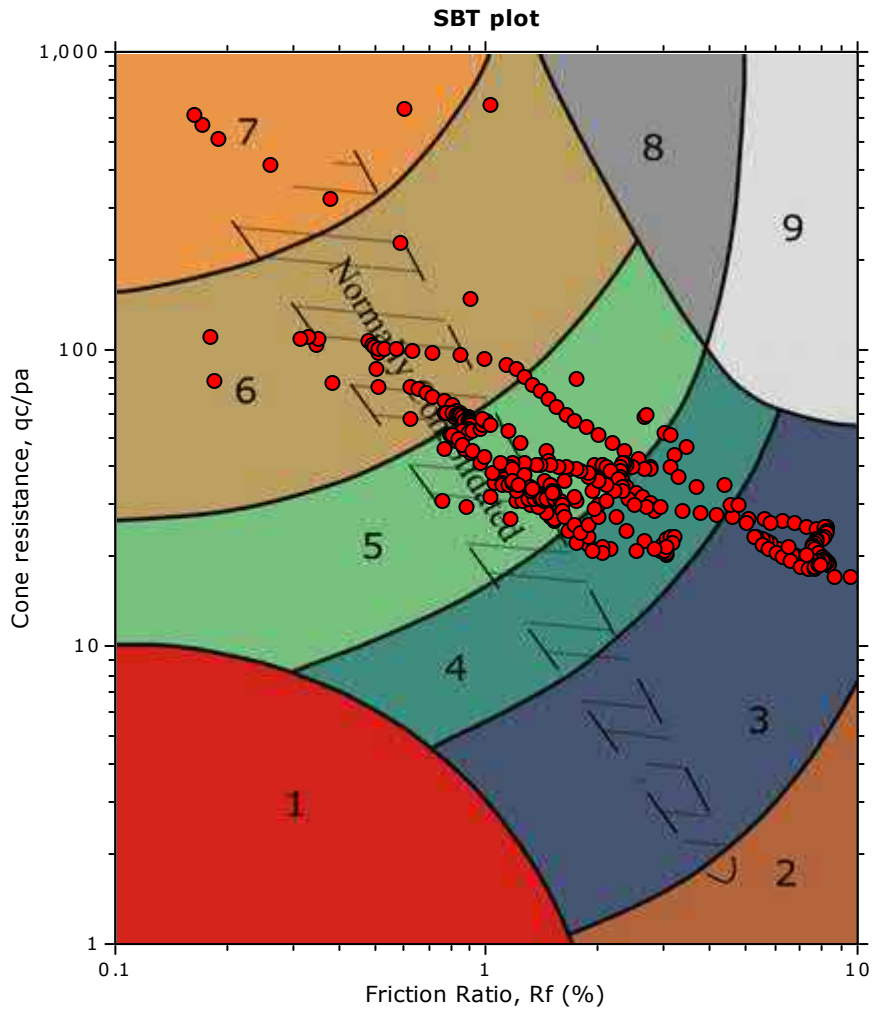


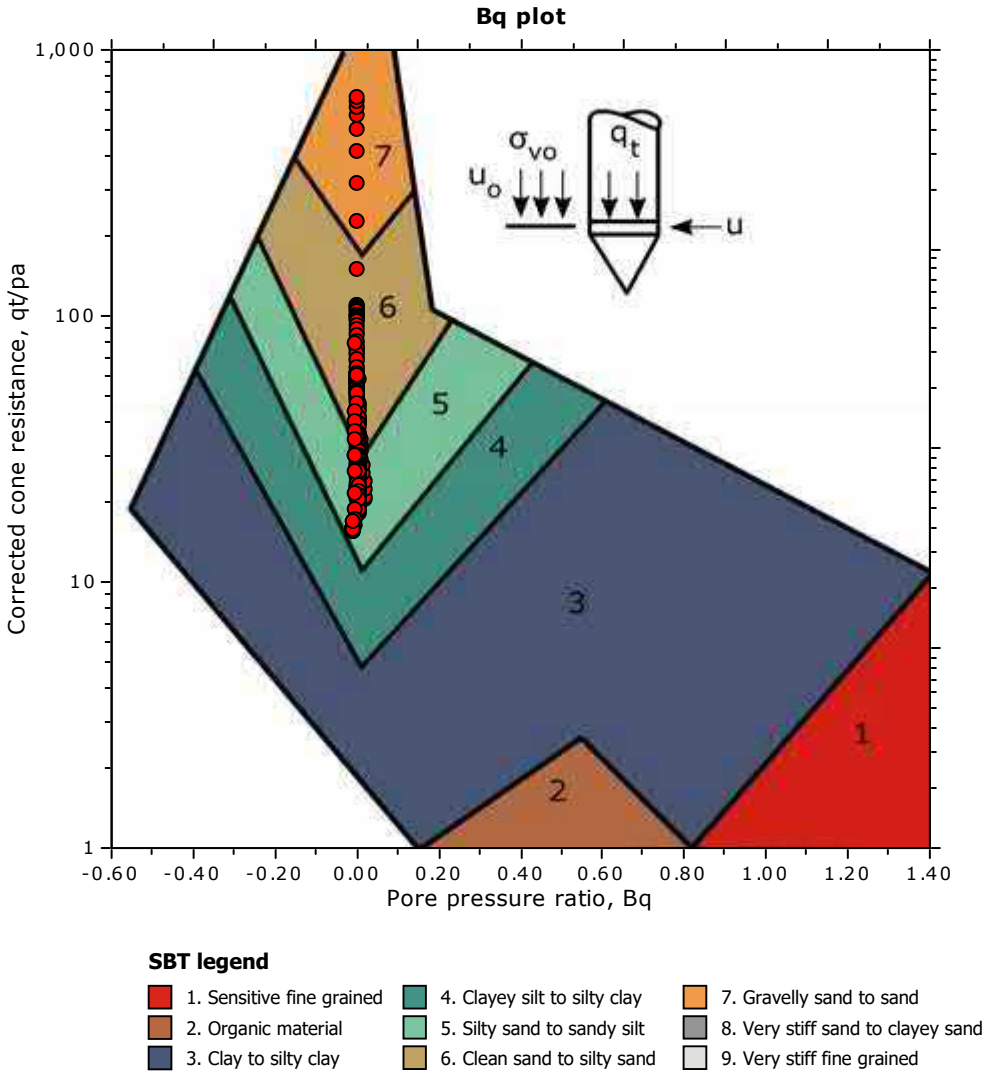
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots



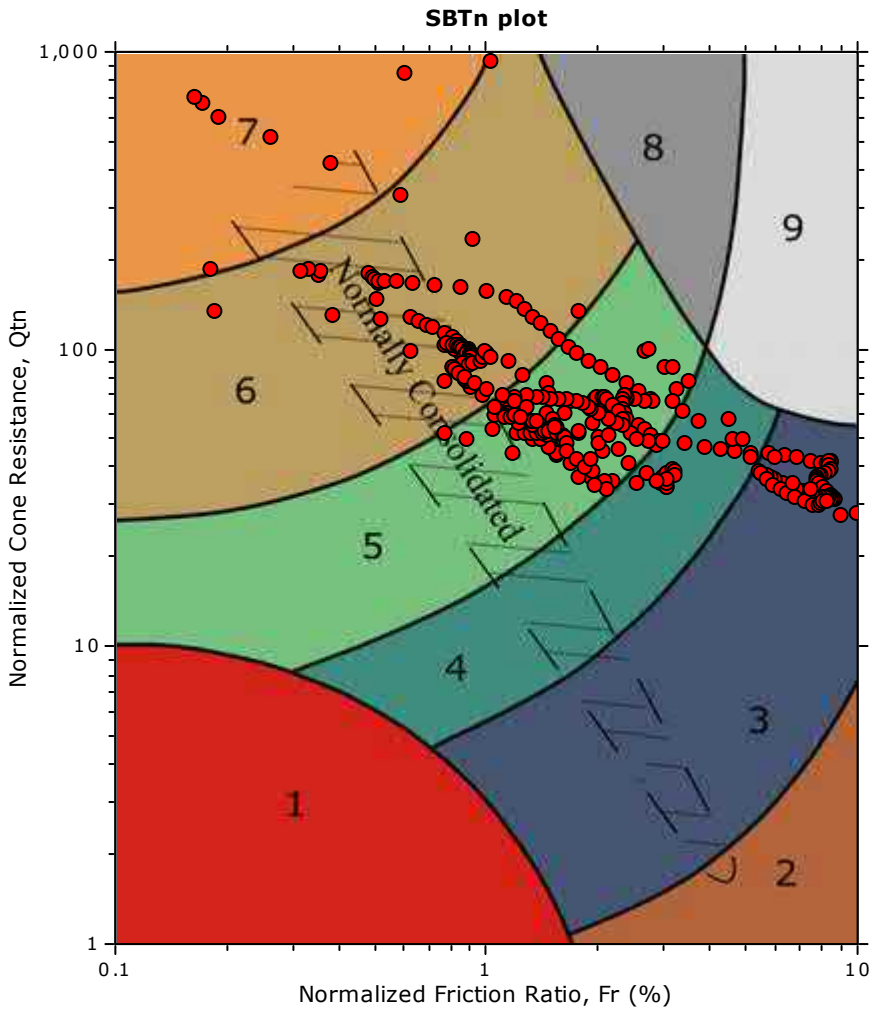


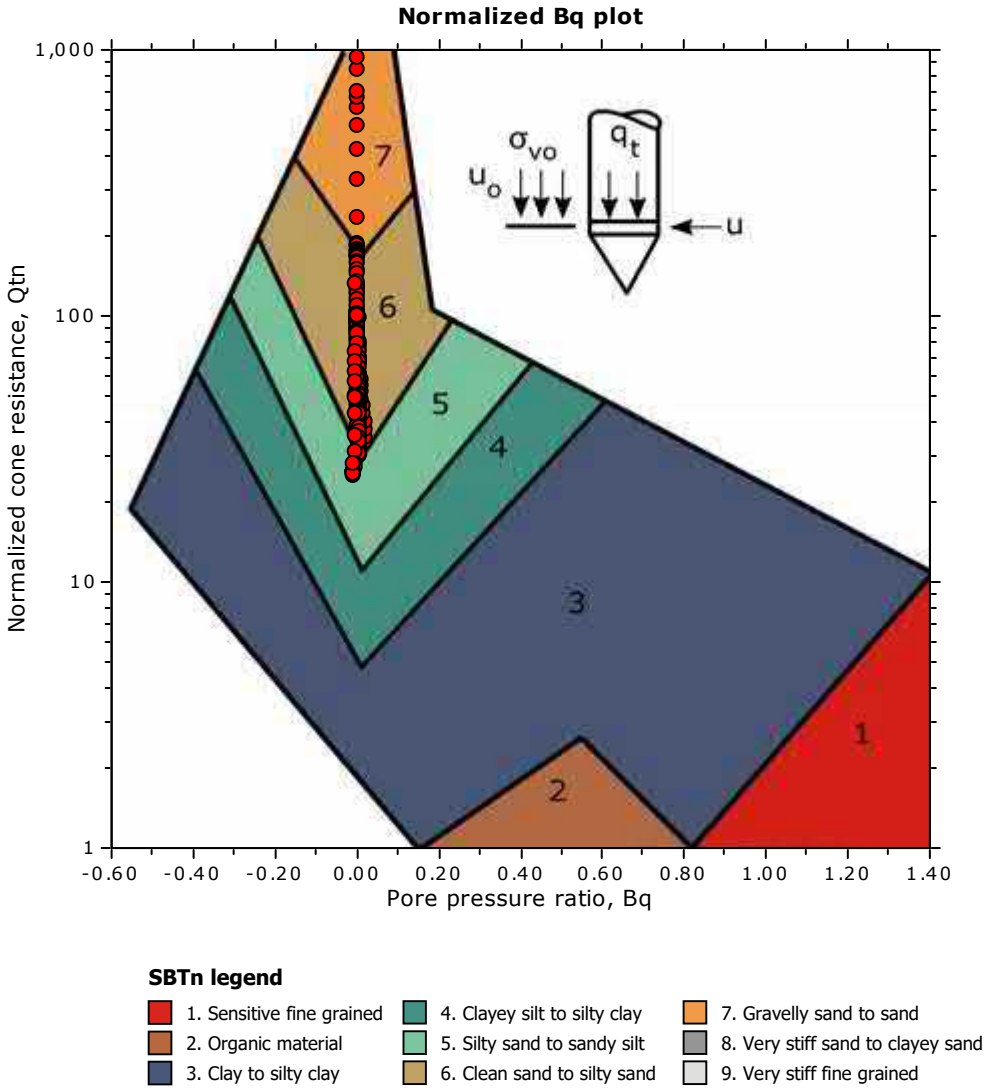
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots (normalized)





SBTn legend

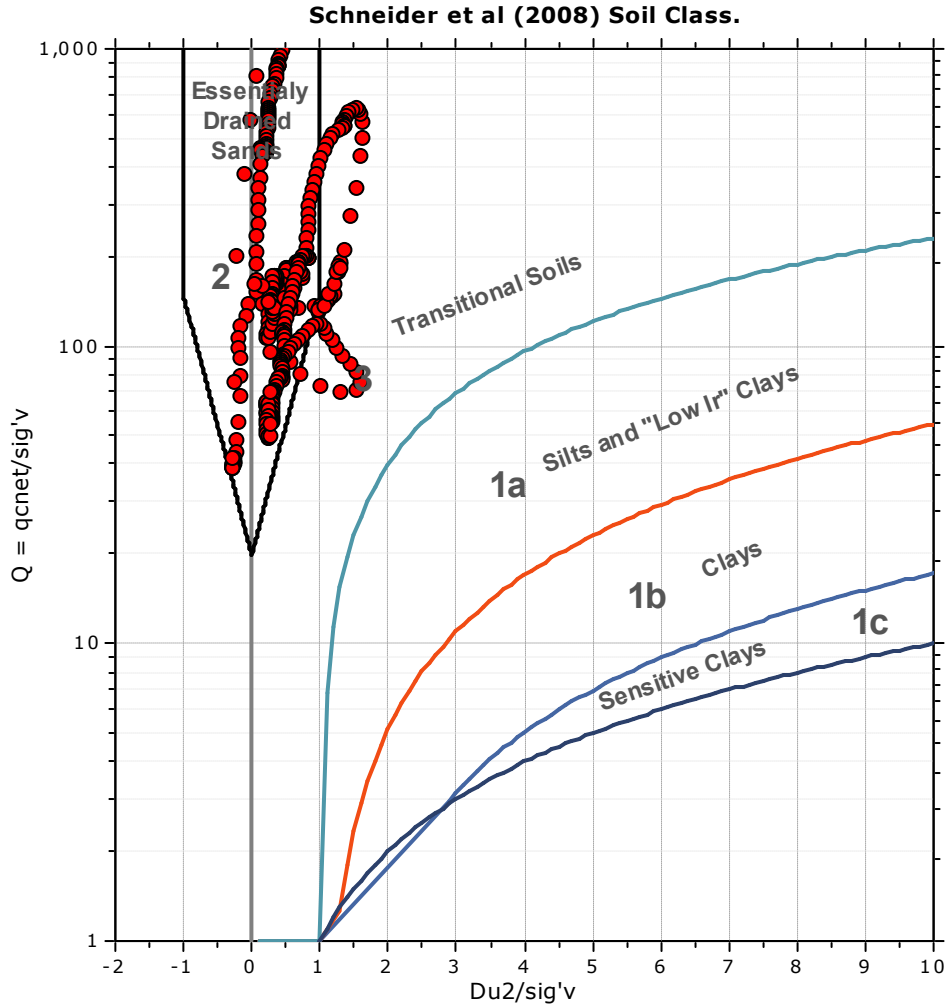
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

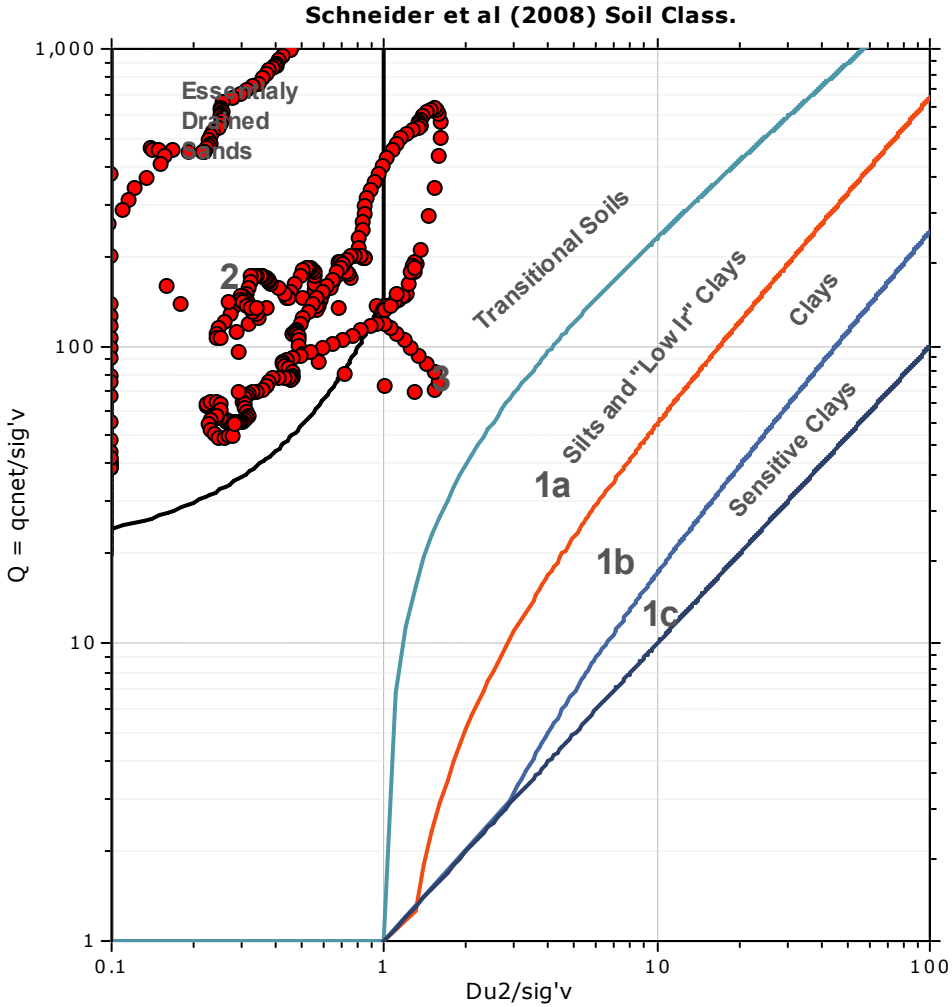
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

Bq plots (Schneider)

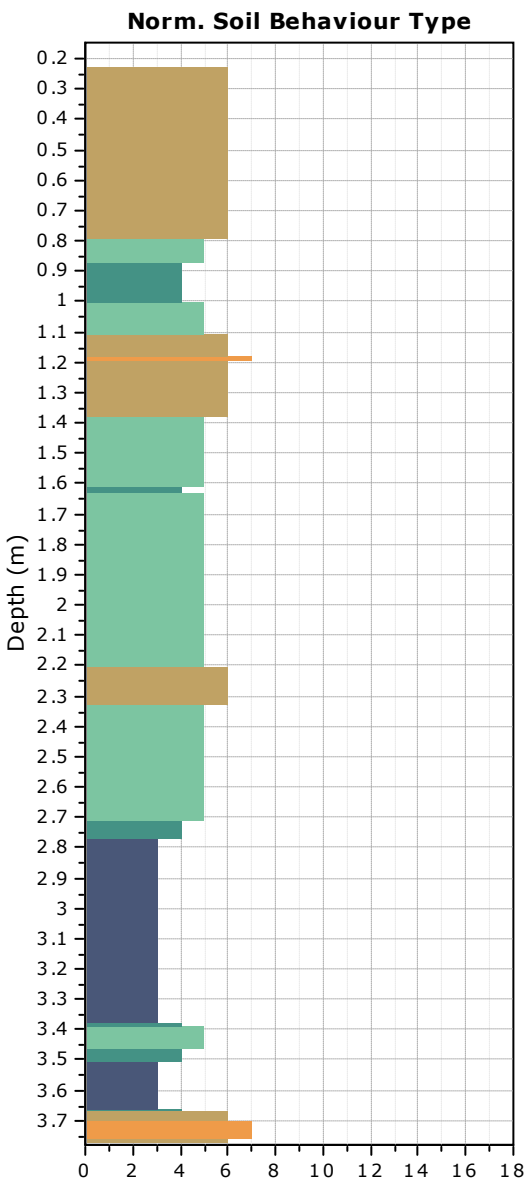


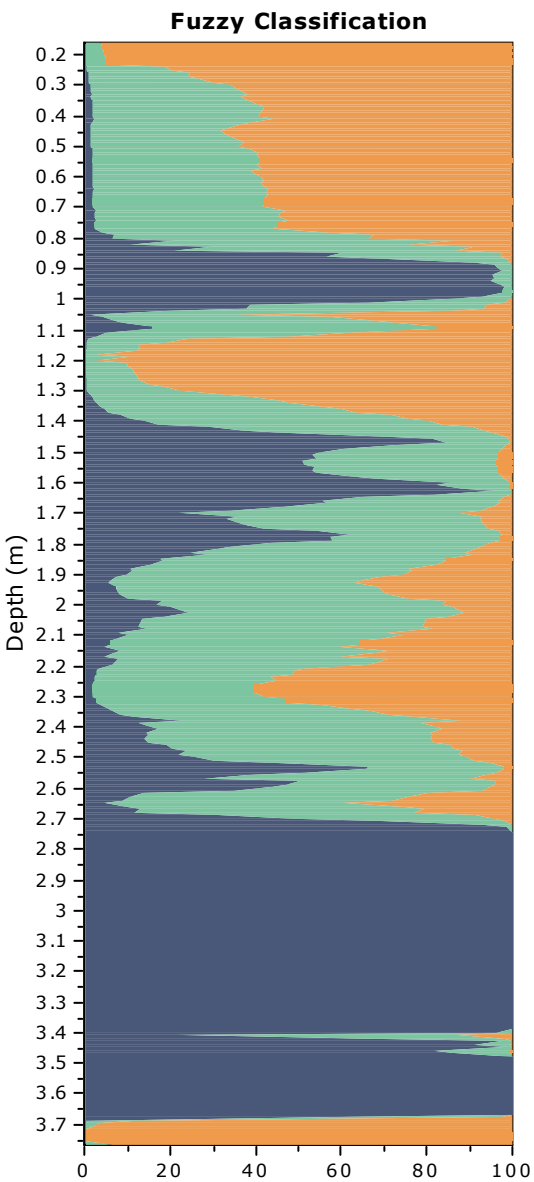


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



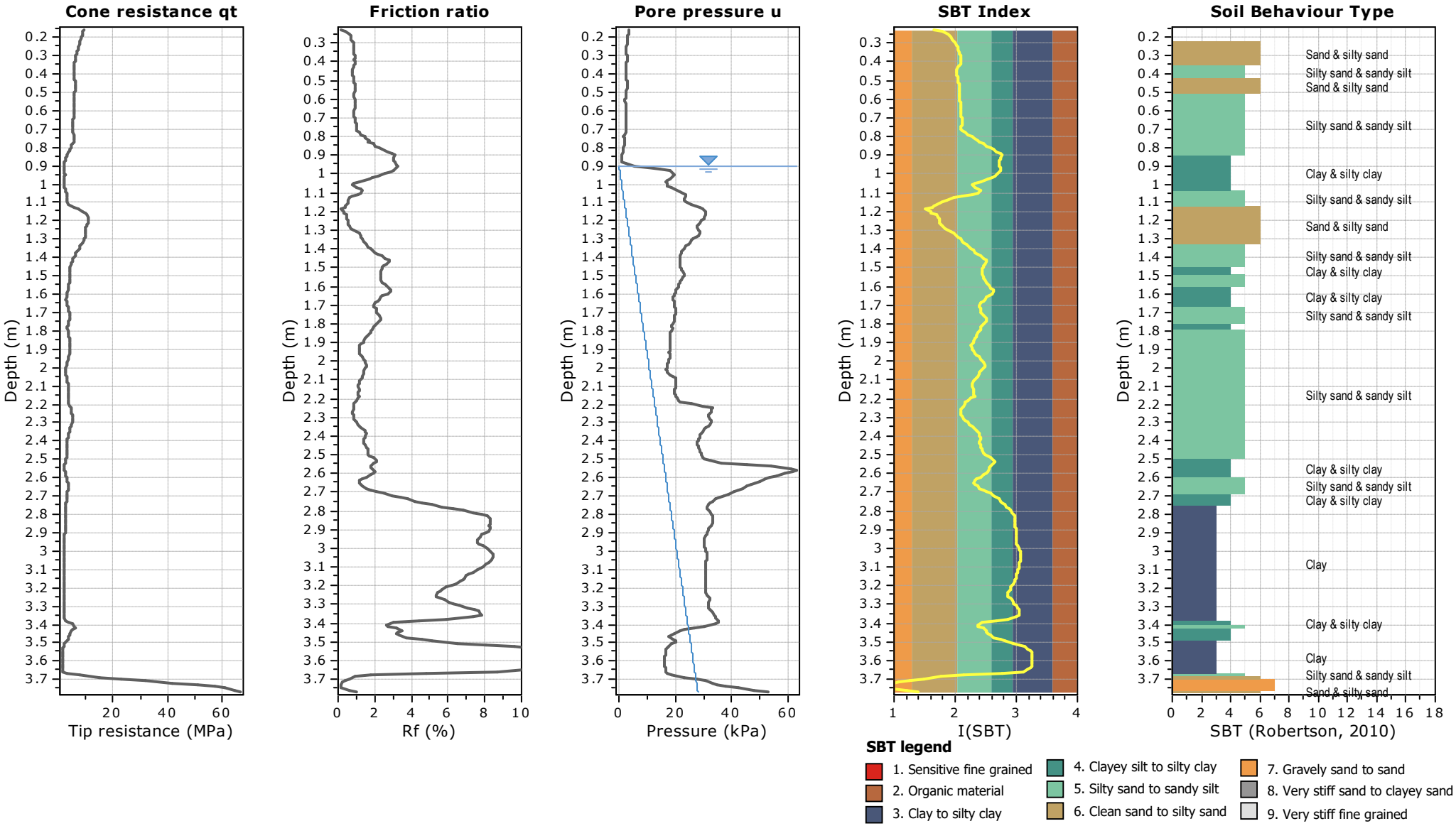


Fuzzy classifiaction legend
- Highly probable clayey soil
- Highly probable mixture soil
- Highly probable sandy soil

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

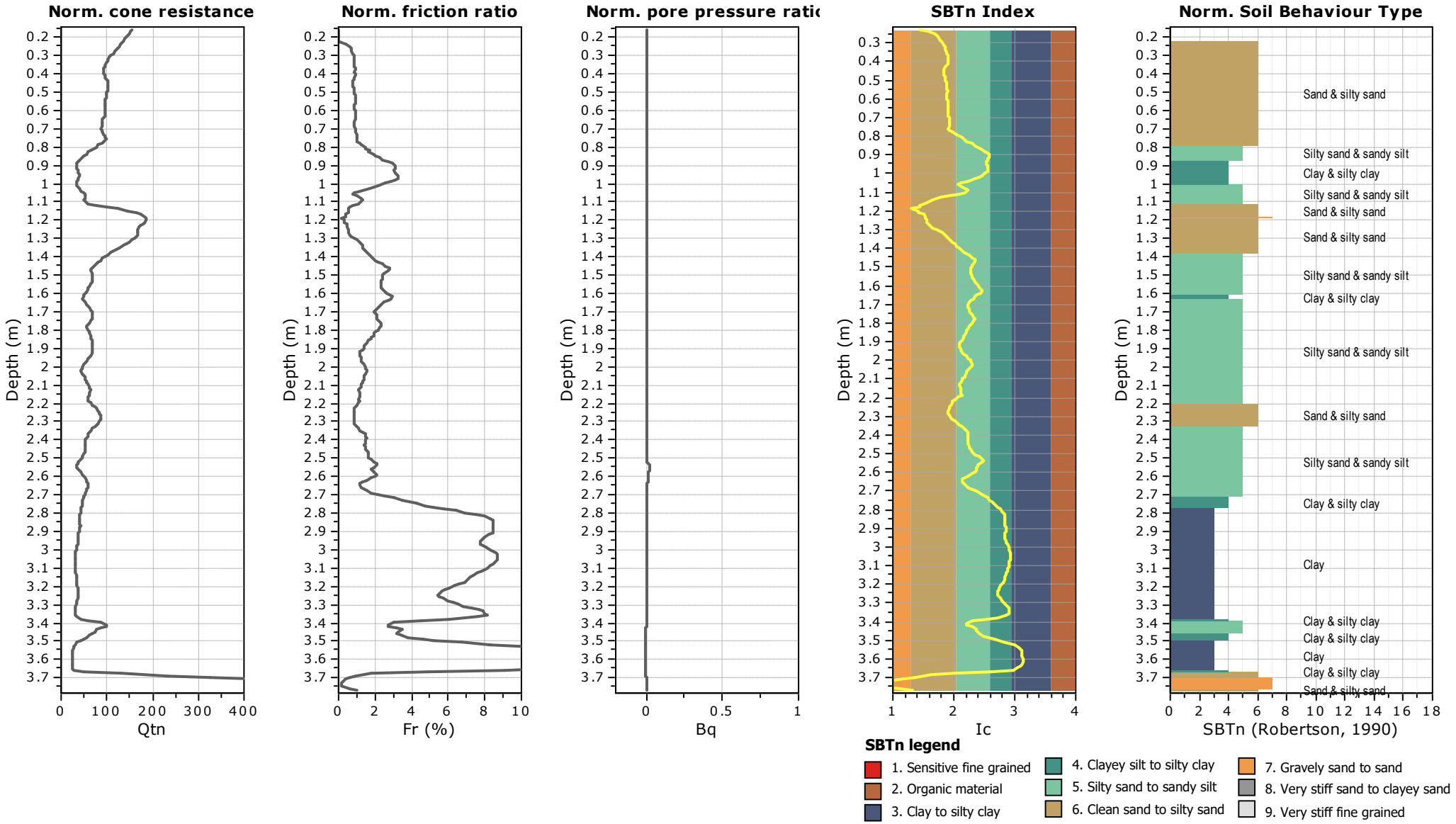
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

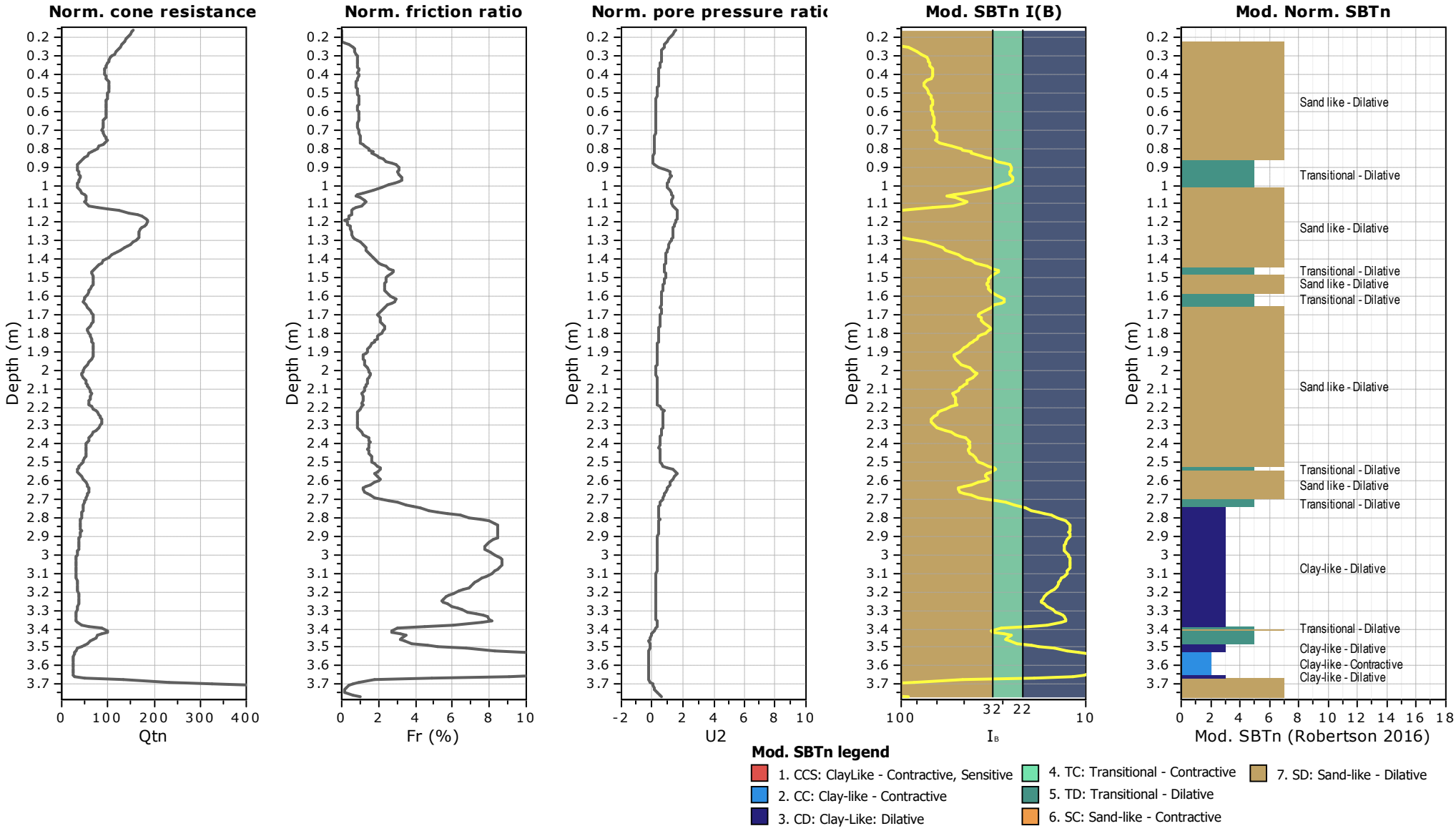
CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

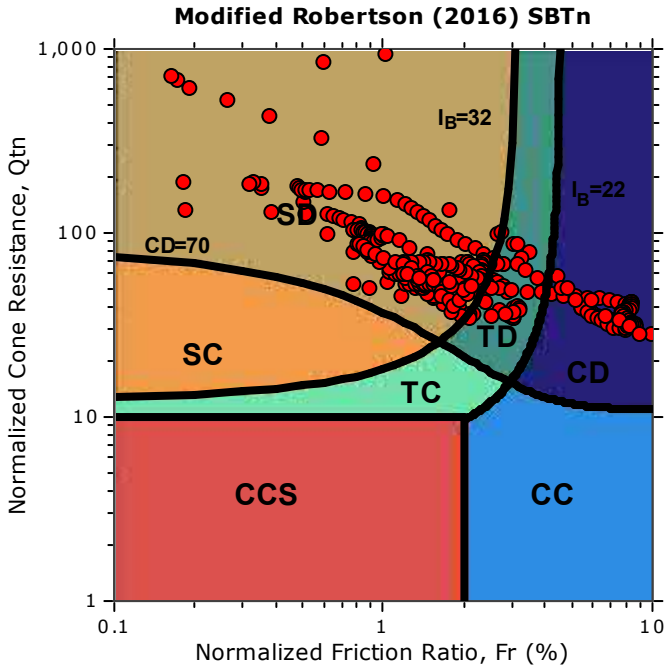


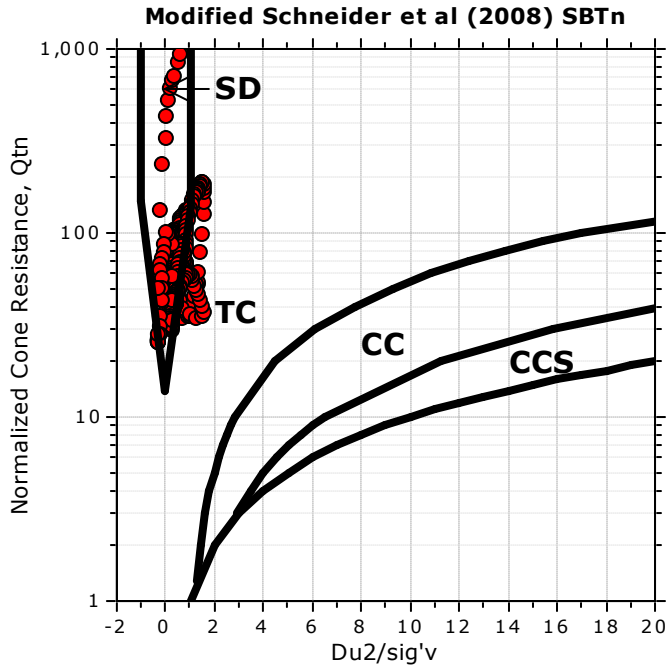
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

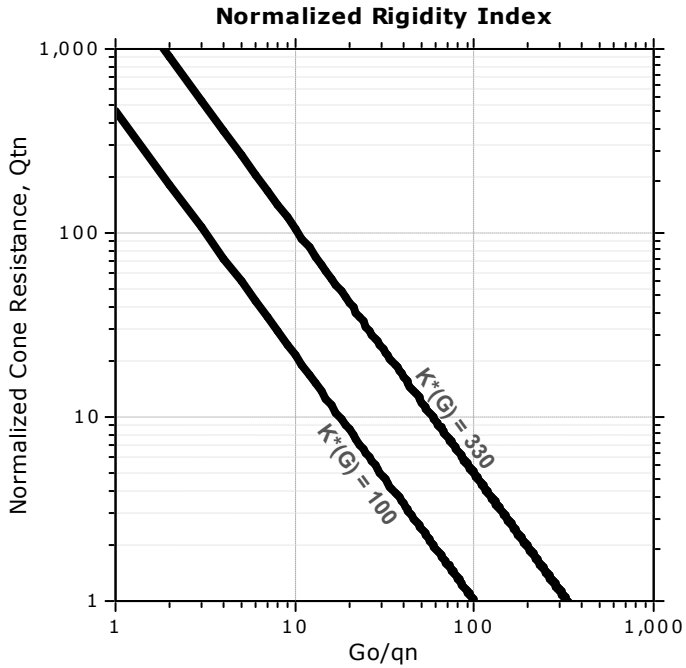
CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

Updated SBTn plots







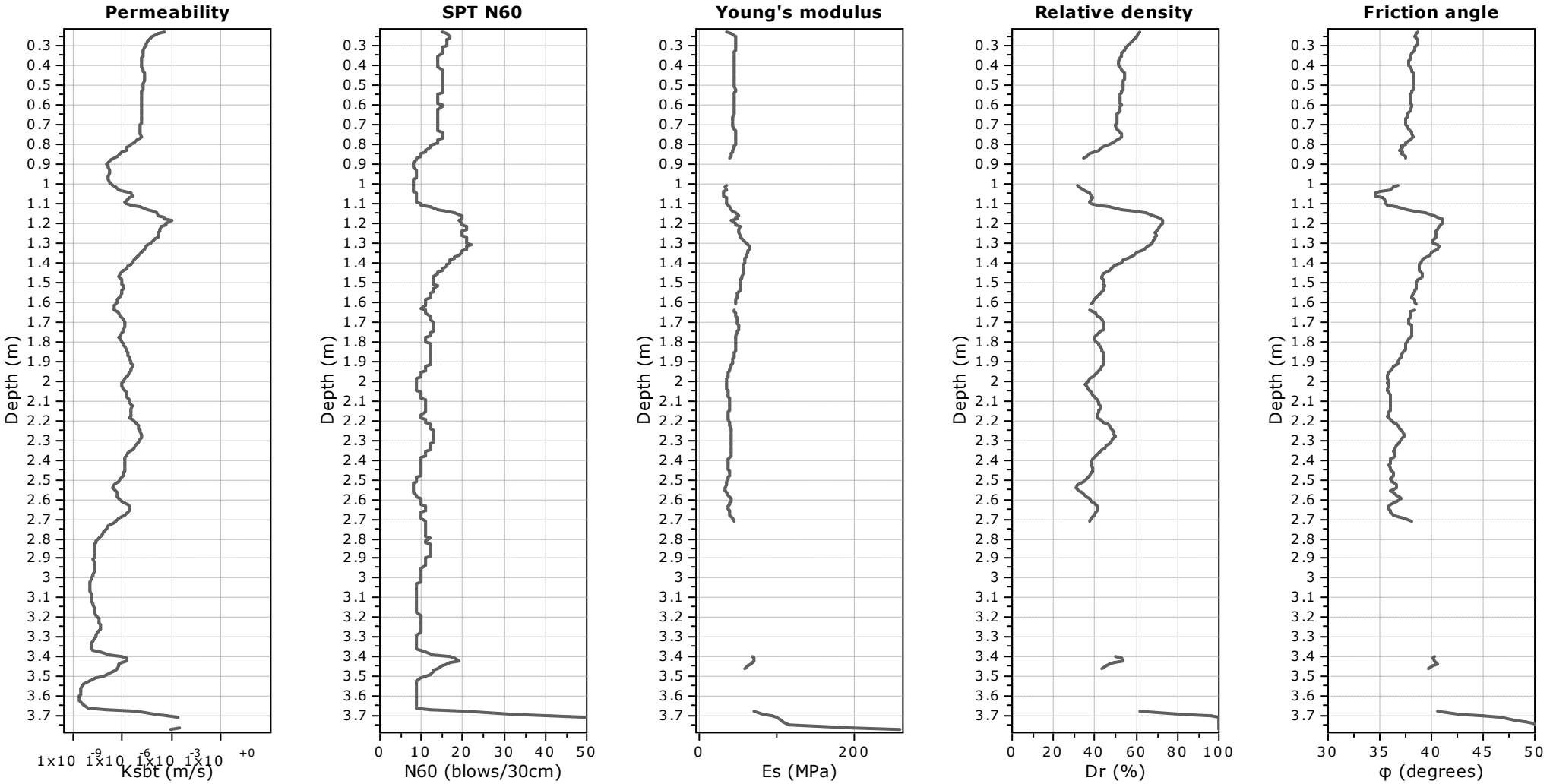
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



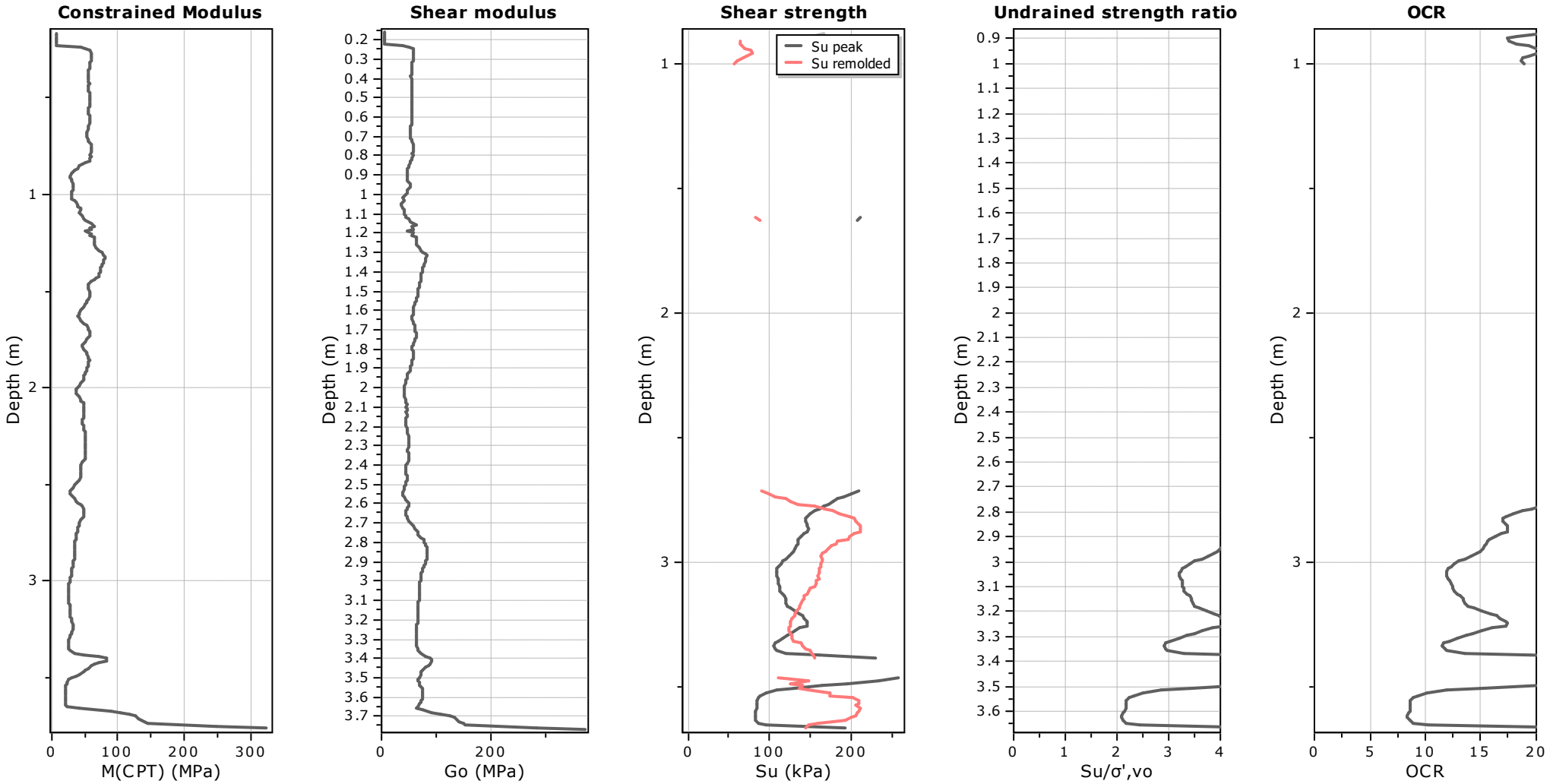
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



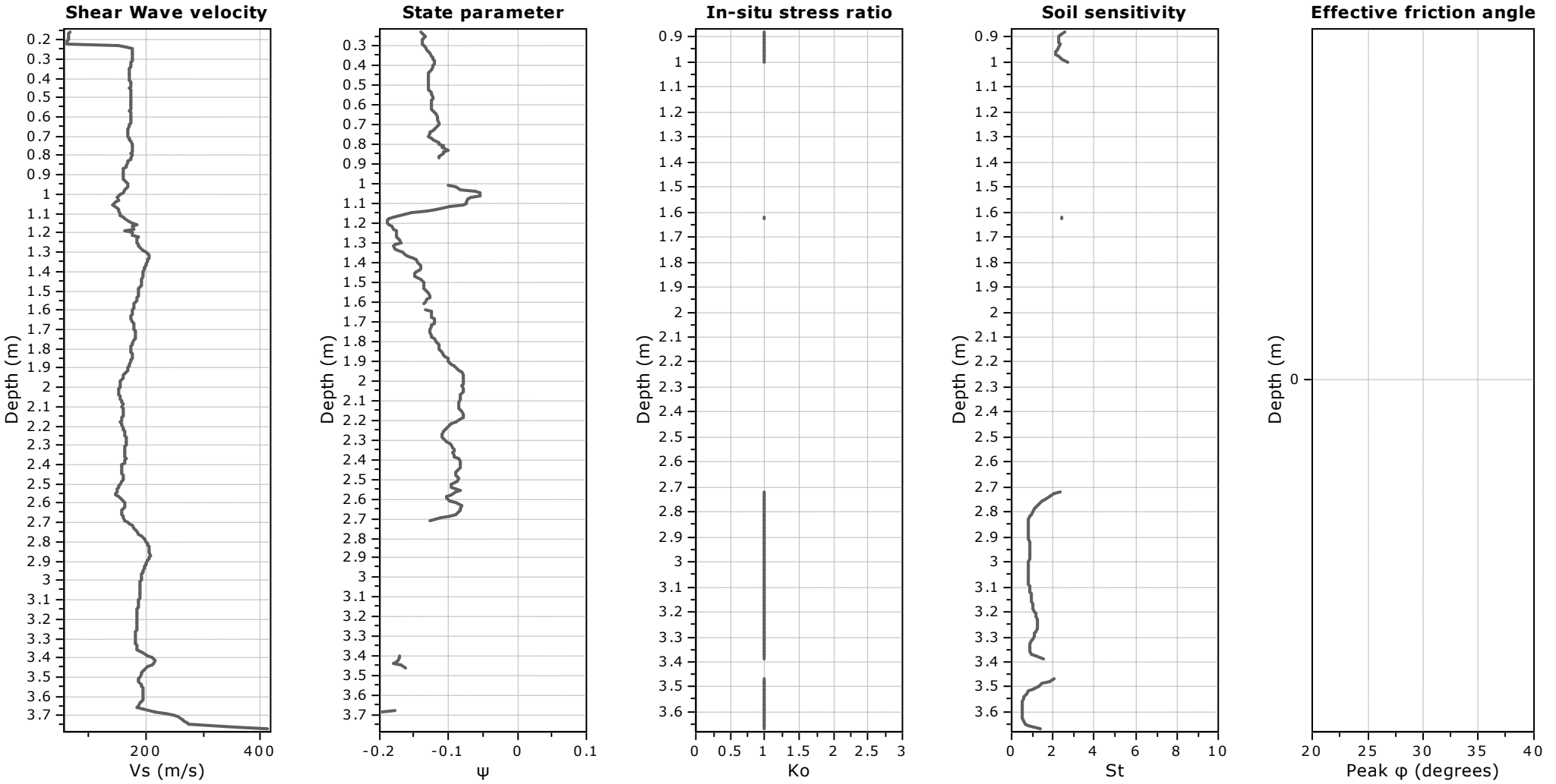
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto
OCR factor for clays, N_{kt}: Auto
Flat Dilatometer Test data

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



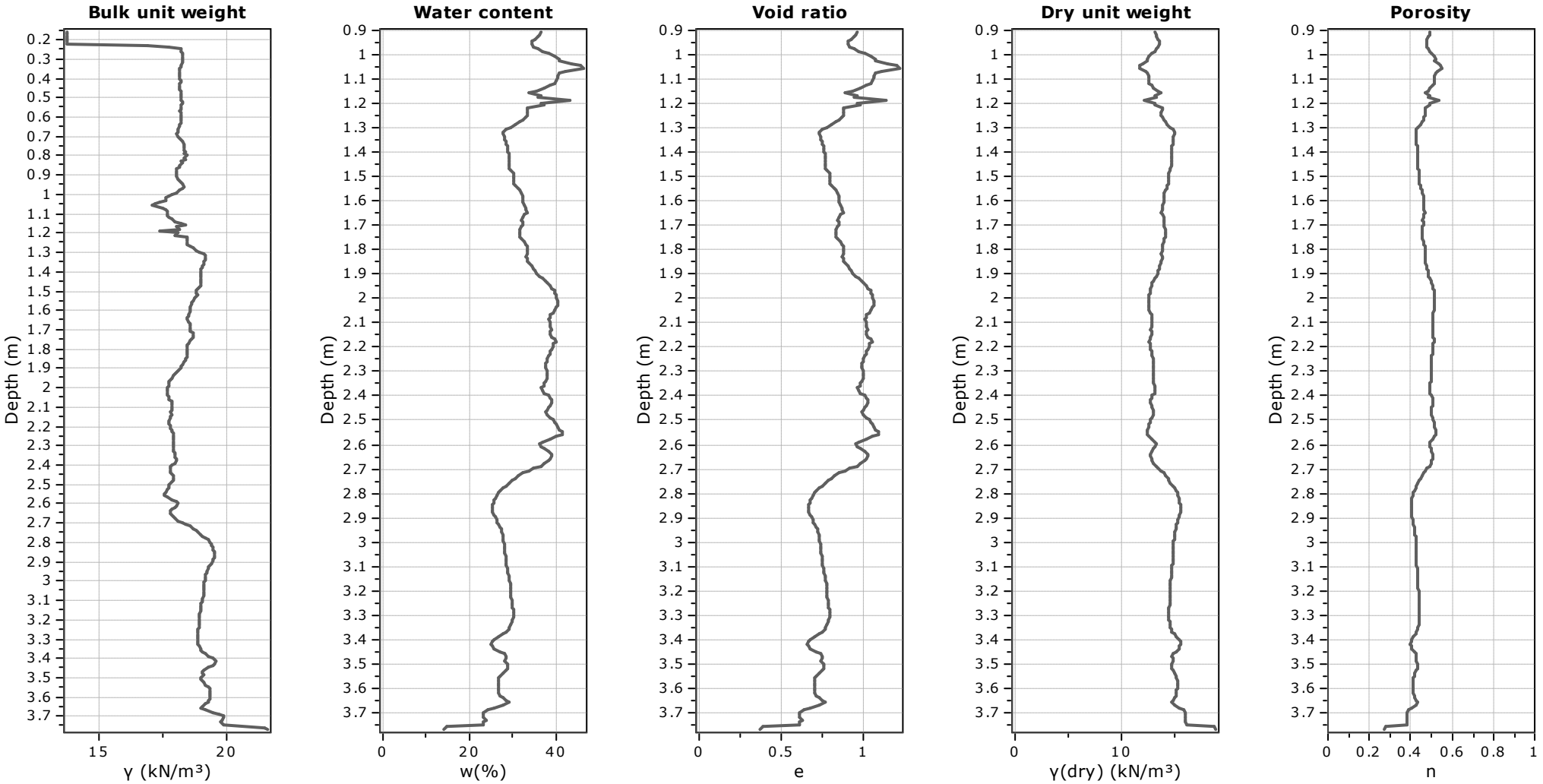
Calculation parameters

Soil Sensitivity factor, N_S: 7.00

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

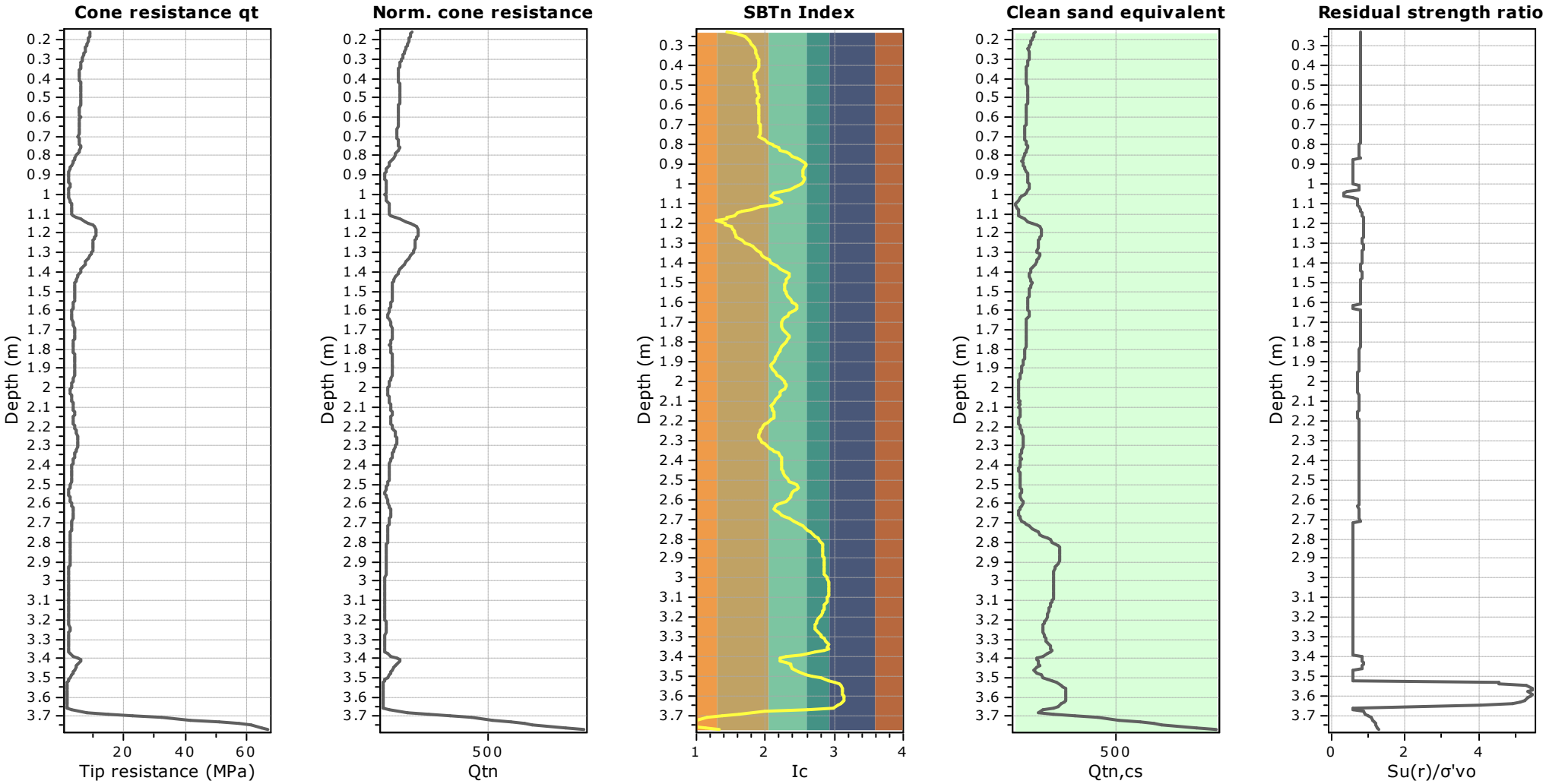
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

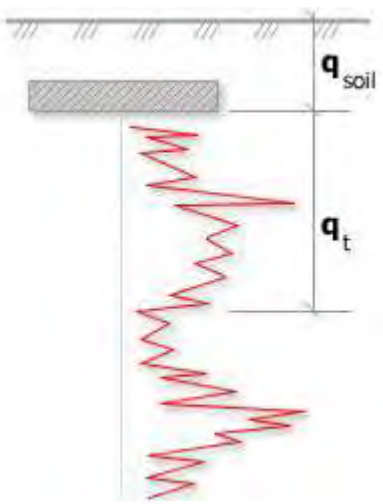
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

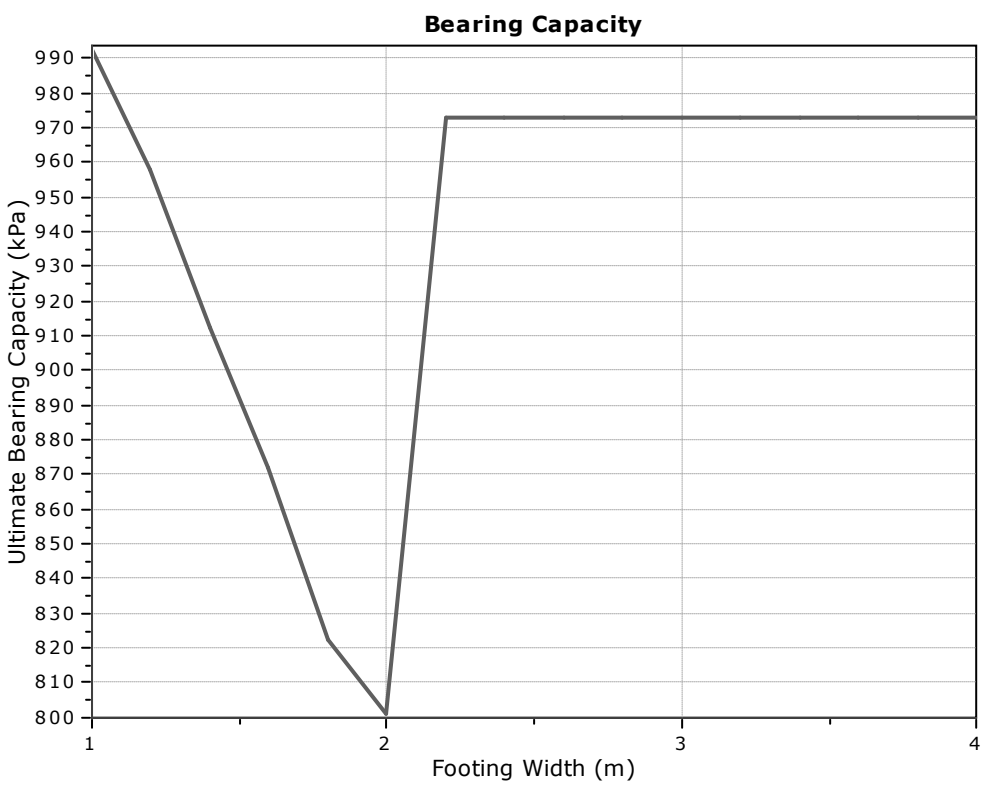
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



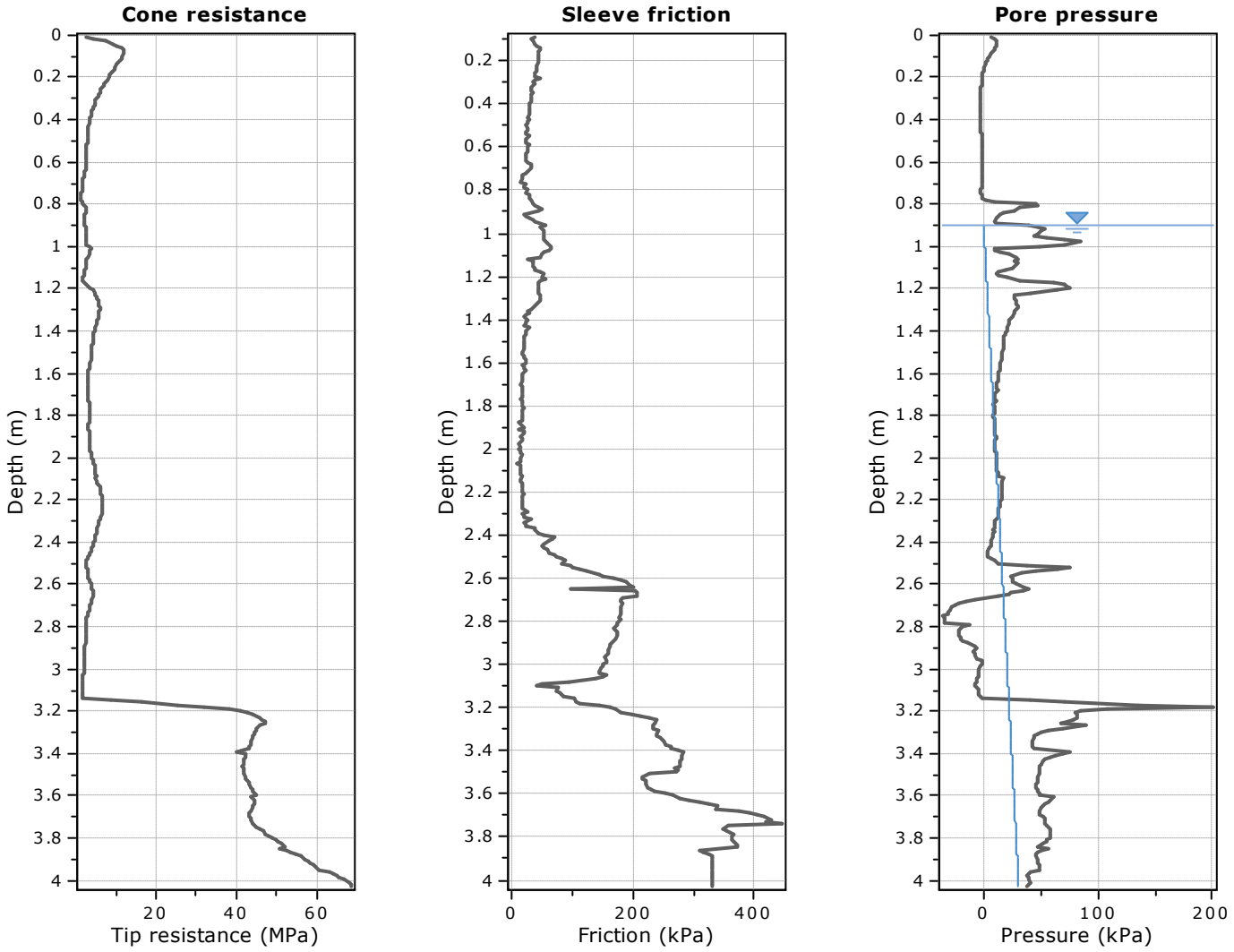
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	4.92	0.20	9.50	992.56
2	1.20	0.50	2.30	4.74	0.20	9.50	957.93
3	1.40	0.50	2.60	4.52	0.20	9.50	912.52
4	1.60	0.50	2.90	4.31	0.20	9.50	871.95
5	1.80	0.50	3.20	4.06	0.20	9.50	822.01
6	2.00	0.50	3.50	3.96	0.20	9.50	800.89
7	2.20	0.50	3.80	4.82	0.20	9.50	972.82
8	2.40	0.50	4.10	4.82	0.20	9.50	972.82
9	2.60	0.50	4.40	4.82	0.20	9.50	972.82
10	2.80	0.50	4.70	4.82	0.20	9.50	972.82
11	3.00	0.50	5.00	4.82	0.20	9.50	972.82
12	3.20	0.50	5.30	4.82	0.20	9.50	972.82
13	3.40	0.50	5.60	4.82	0.20	9.50	972.82
14	3.60	0.50	5.90	4.82	0.20	9.50	972.82
15	3.80	0.50	6.20	4.82	0.20	9.50	972.82
16	4.00	0.50	6.50	4.82	0.20	9.50	972.82

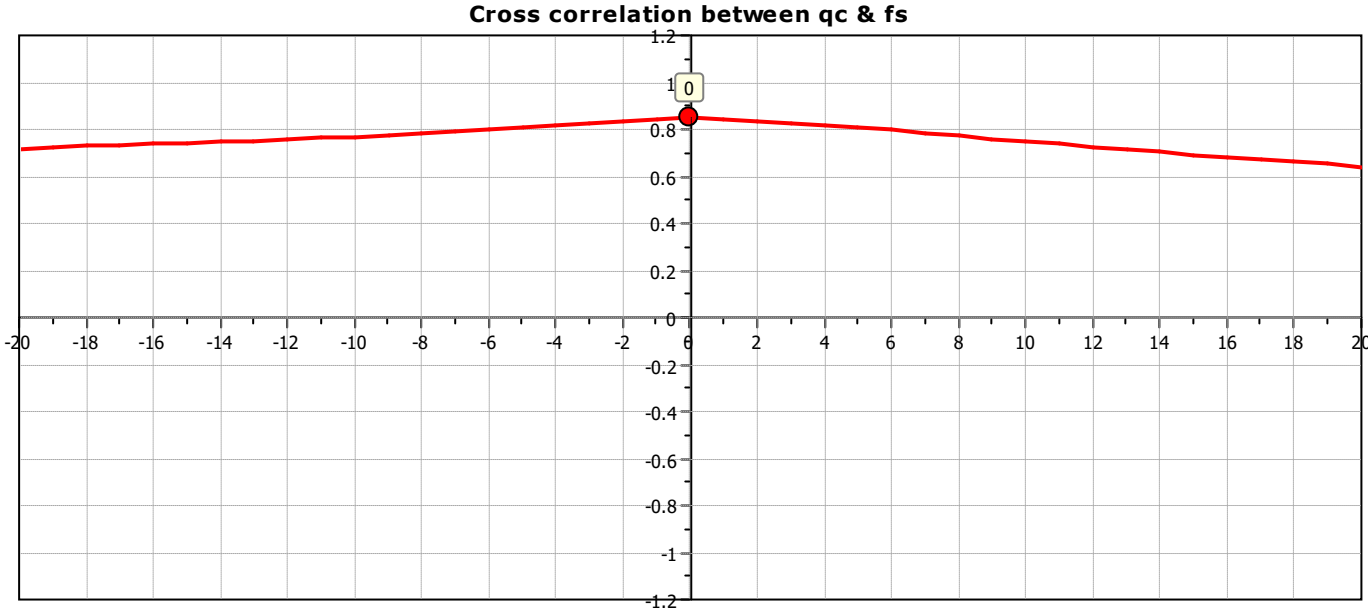
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

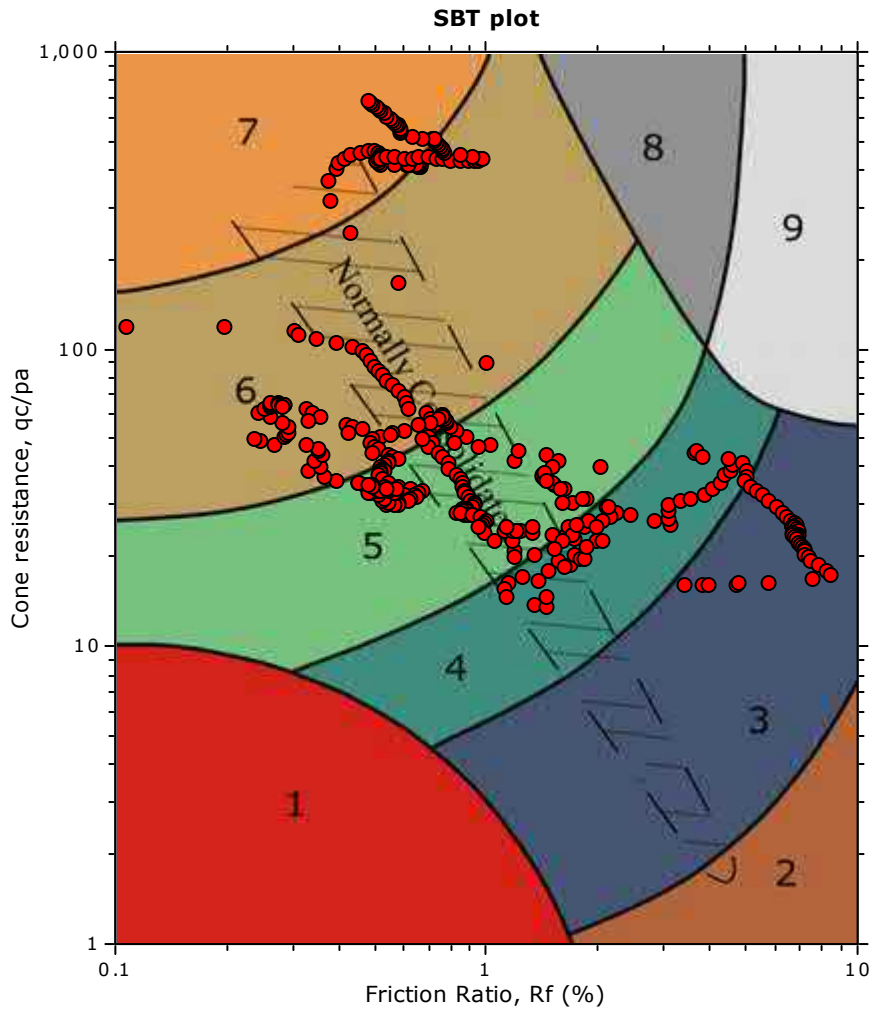


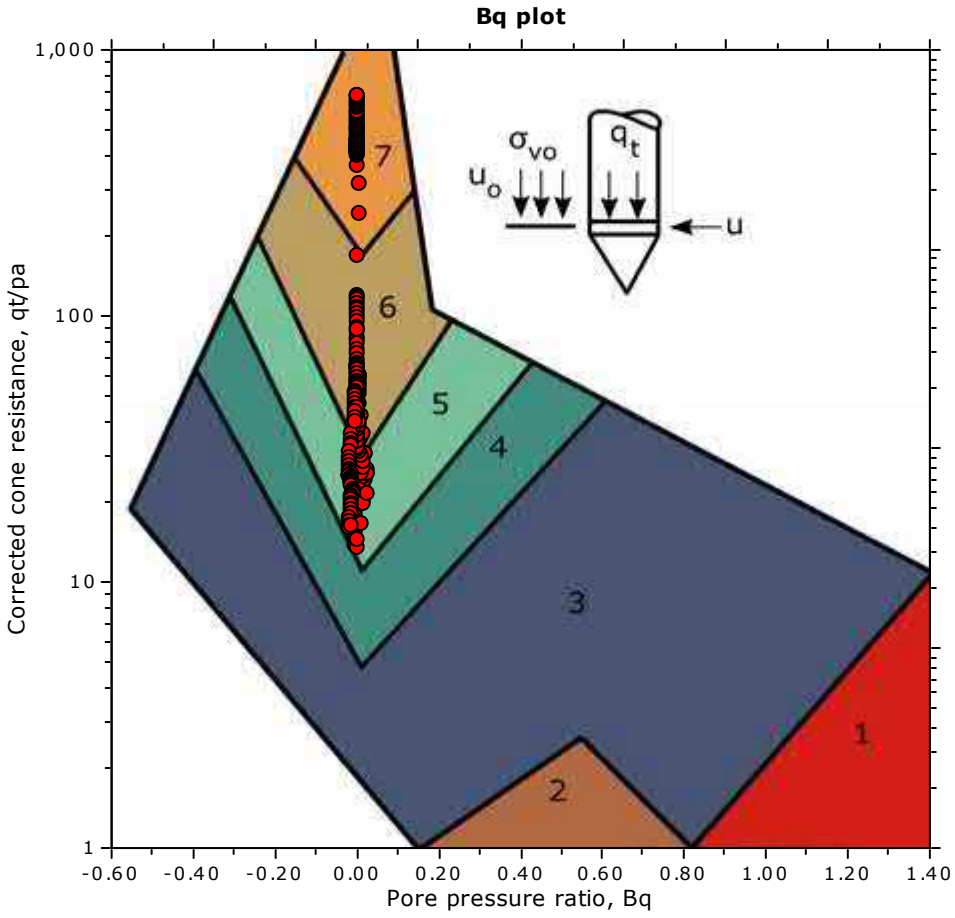
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots





SBT legend

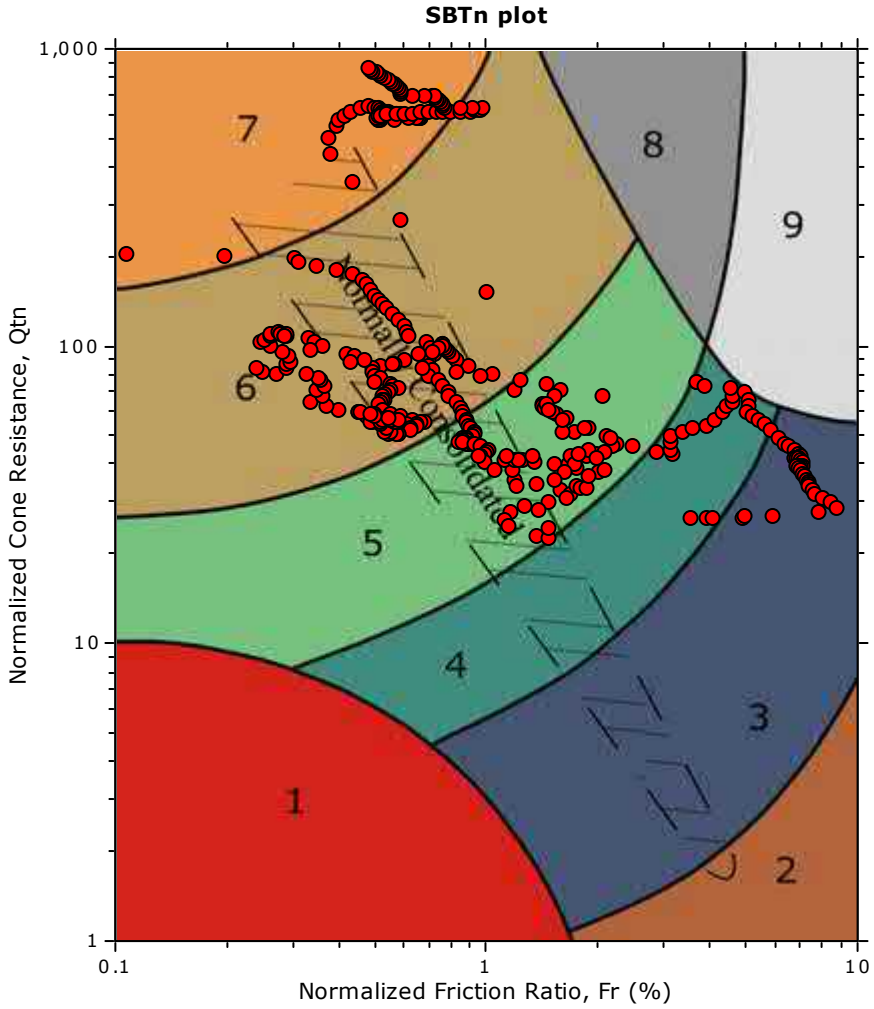
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

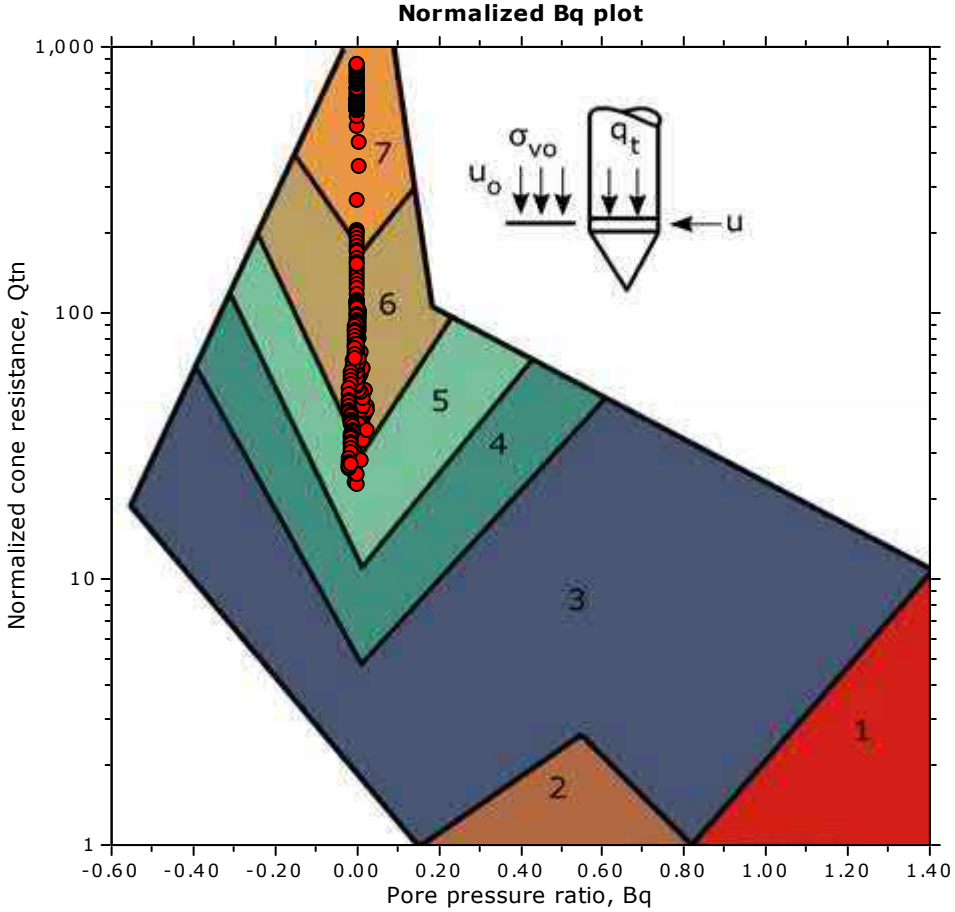
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots (normalized)





SBTn legend

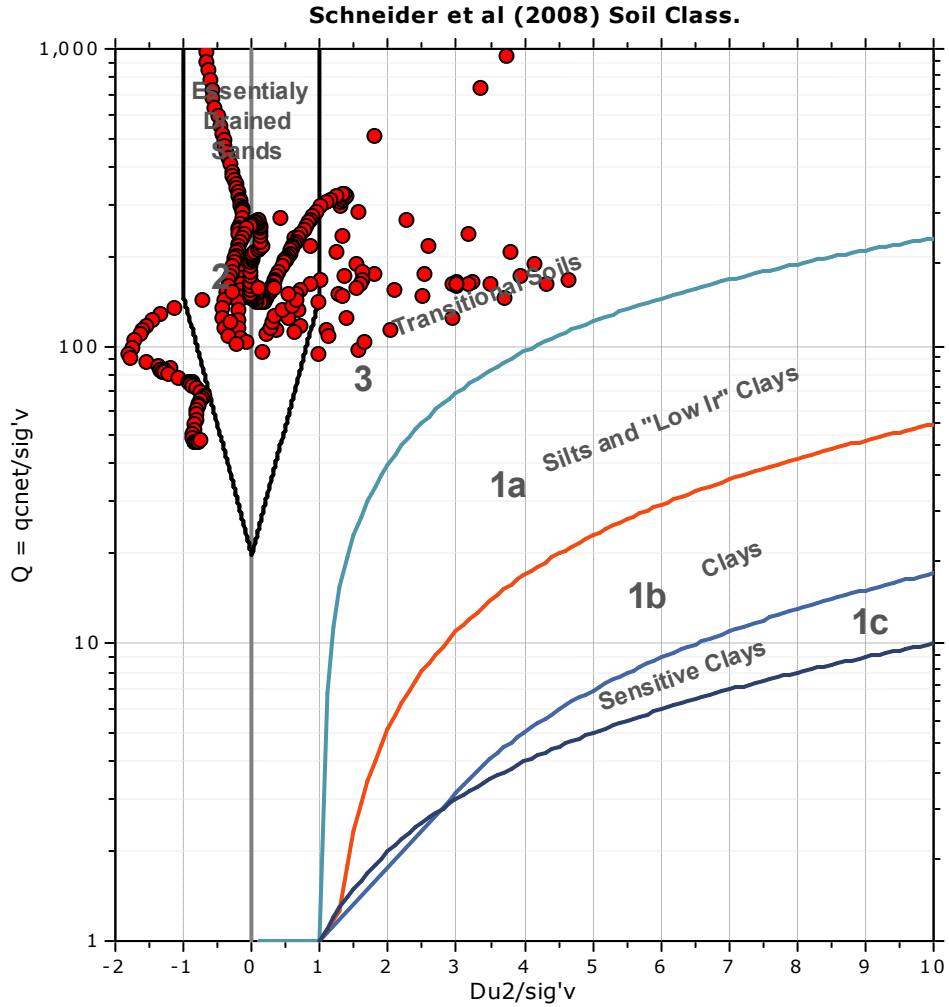
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

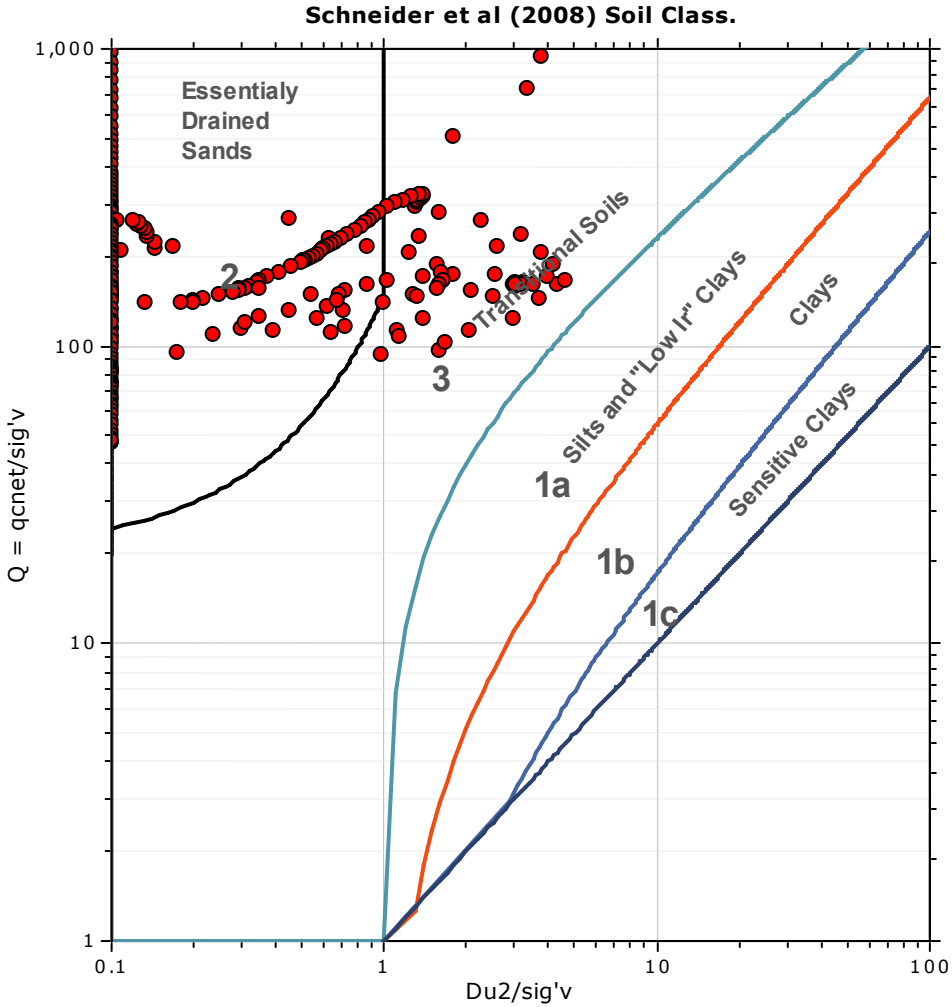
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Bq plots (Schneider)

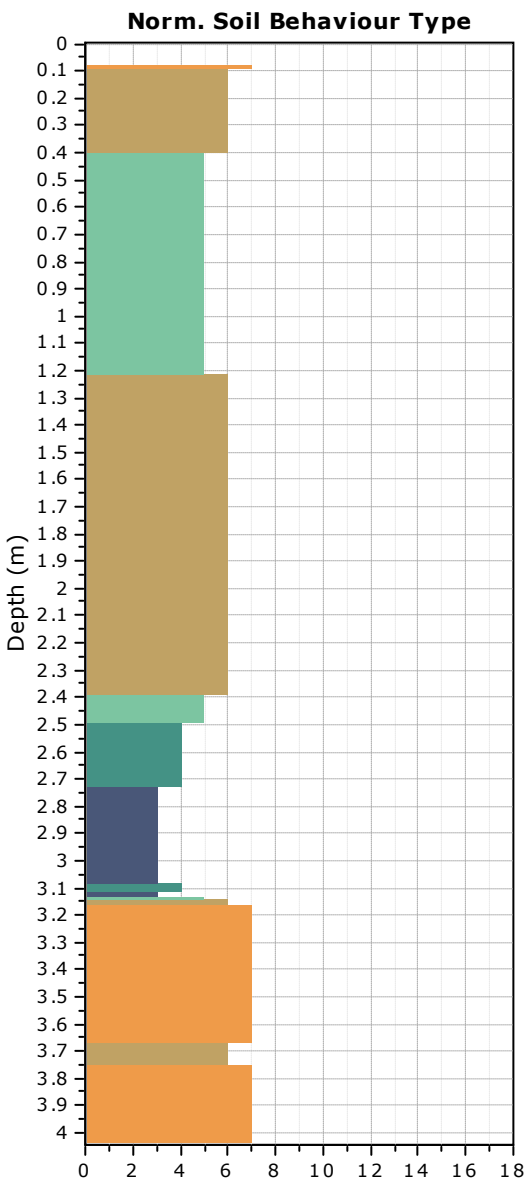


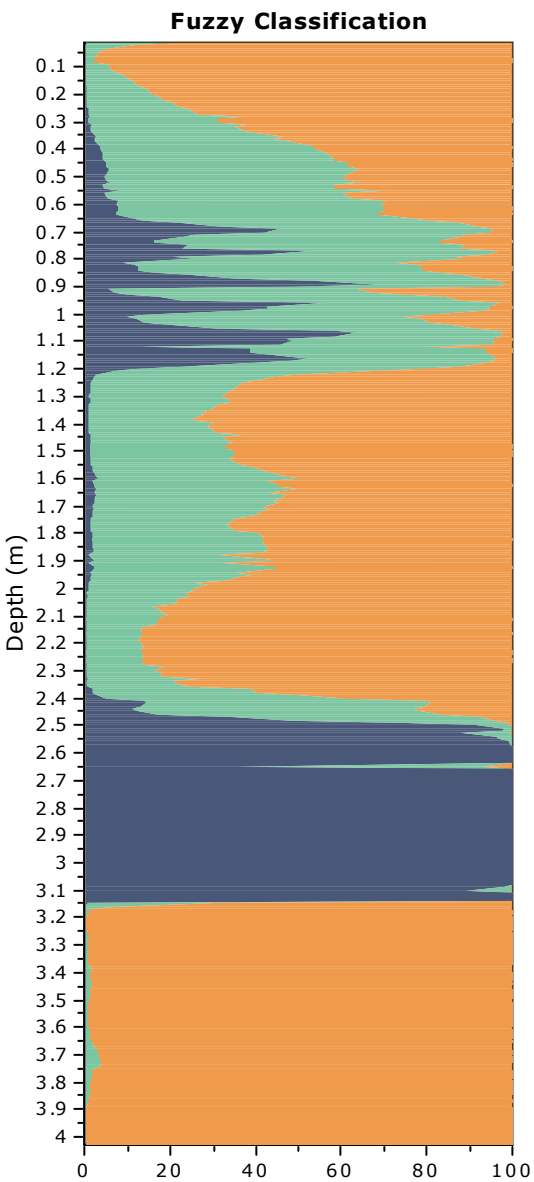


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



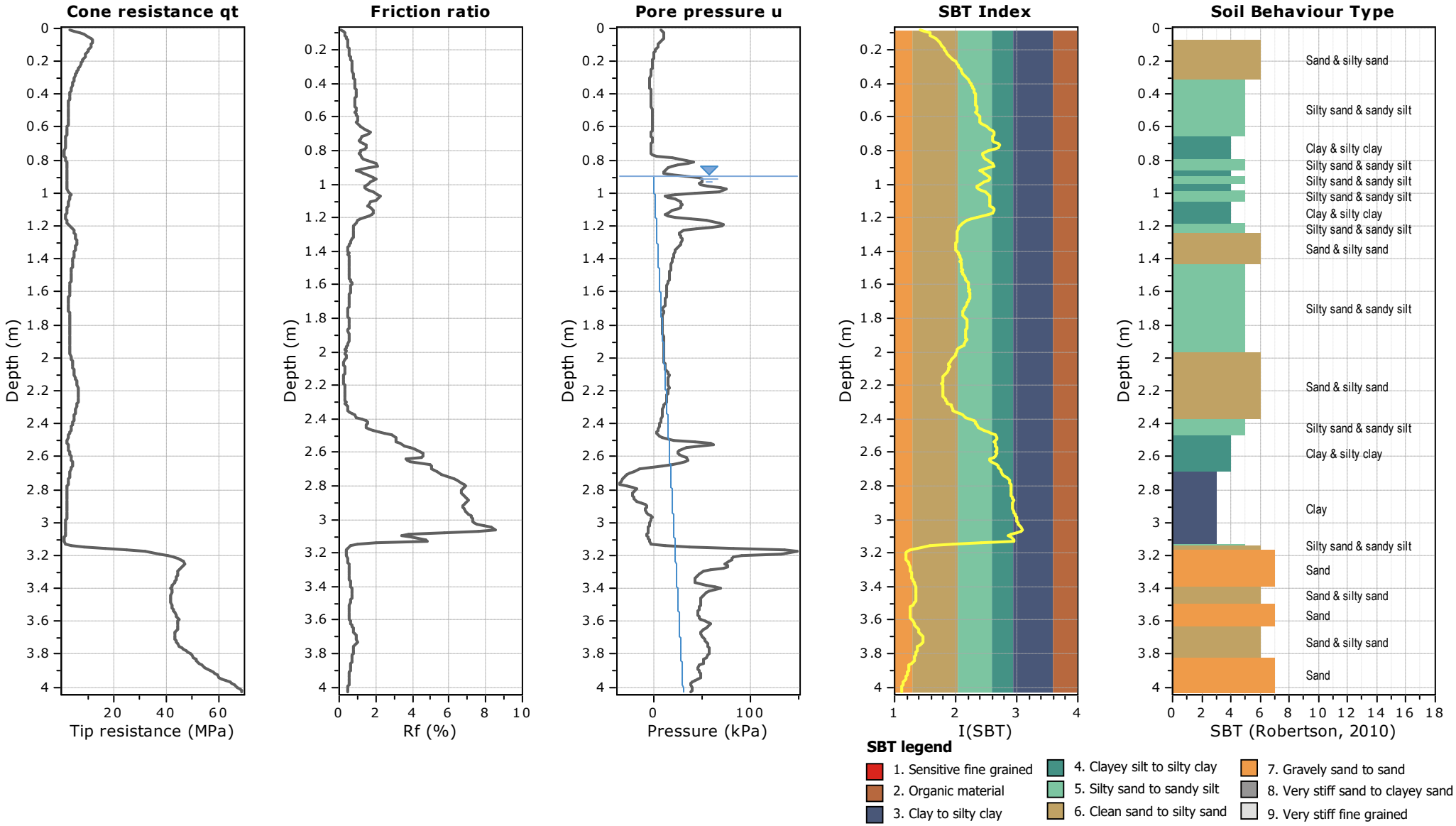


Fuzzy classifiaction legend
- Highly probable clayey soil
- Highly probable mixture soil
- Highly probable sandy soil

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

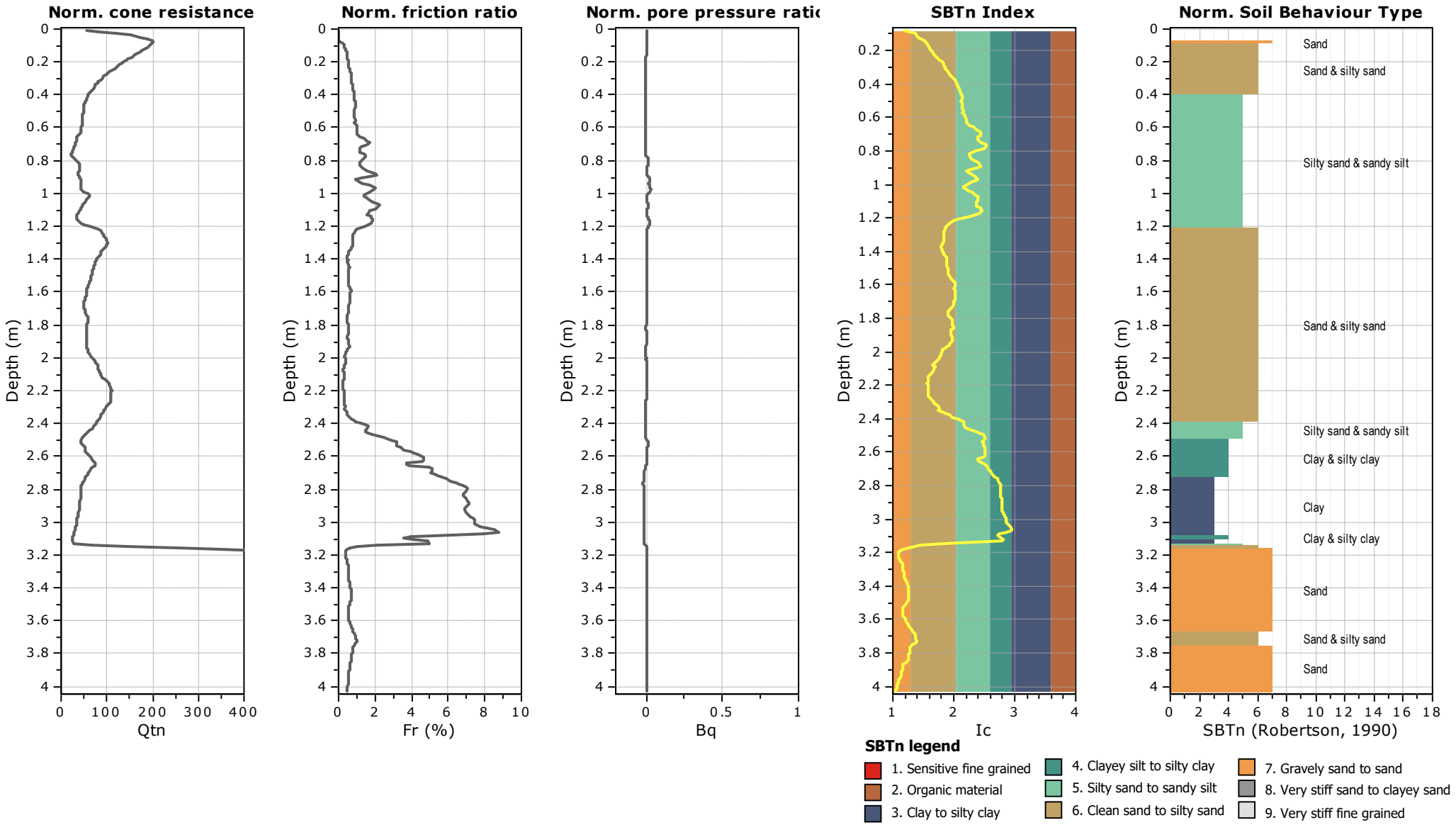
CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

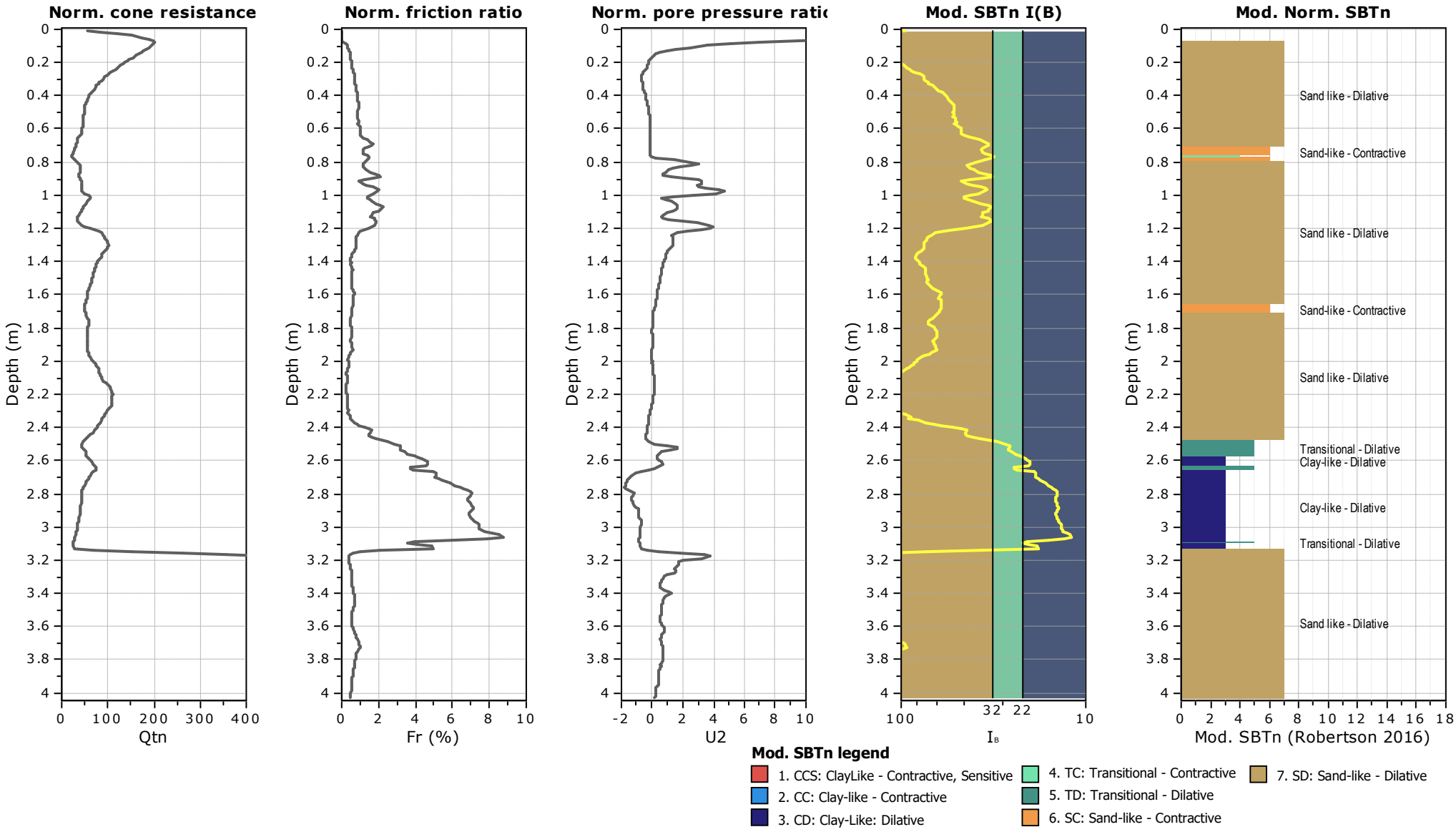
CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

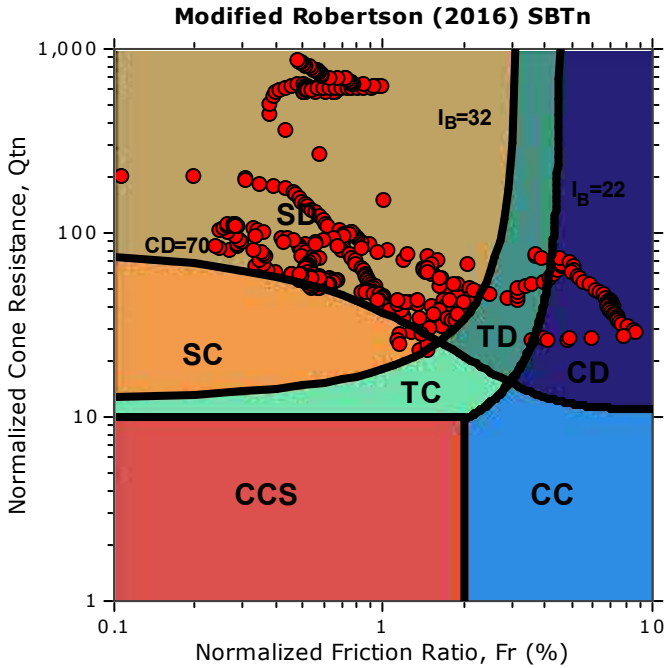


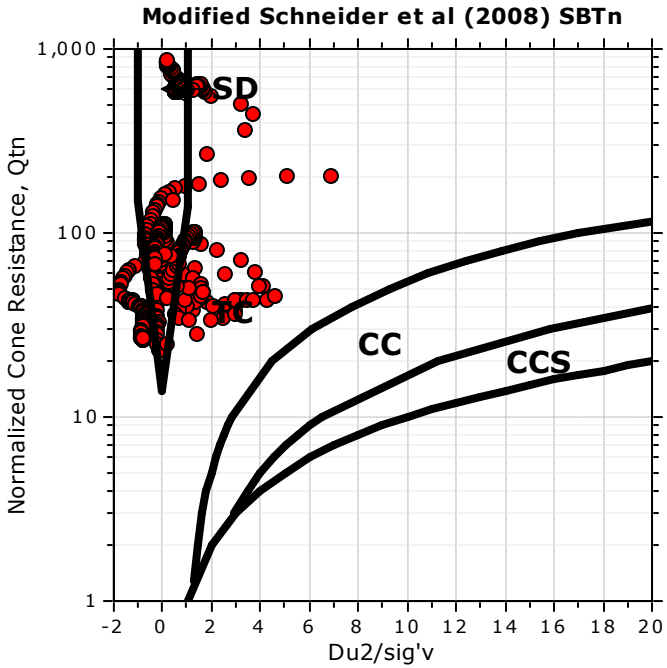
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

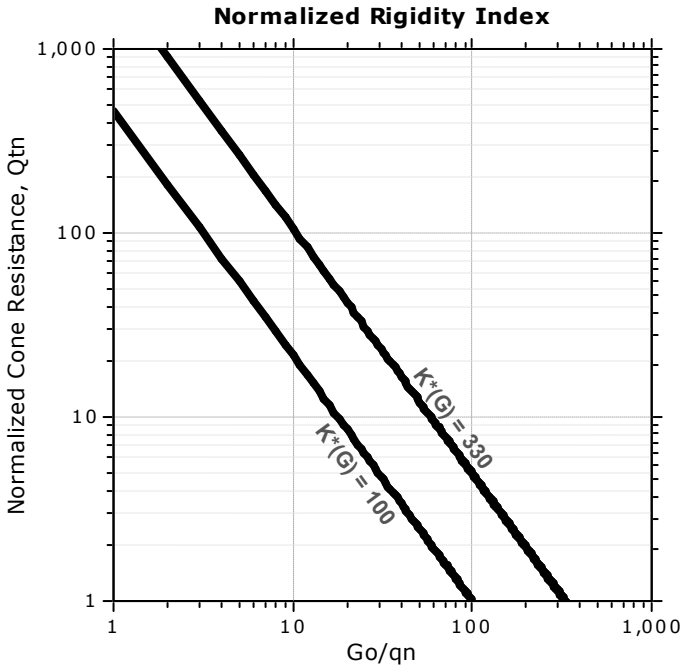
CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

Updated SBTn plots







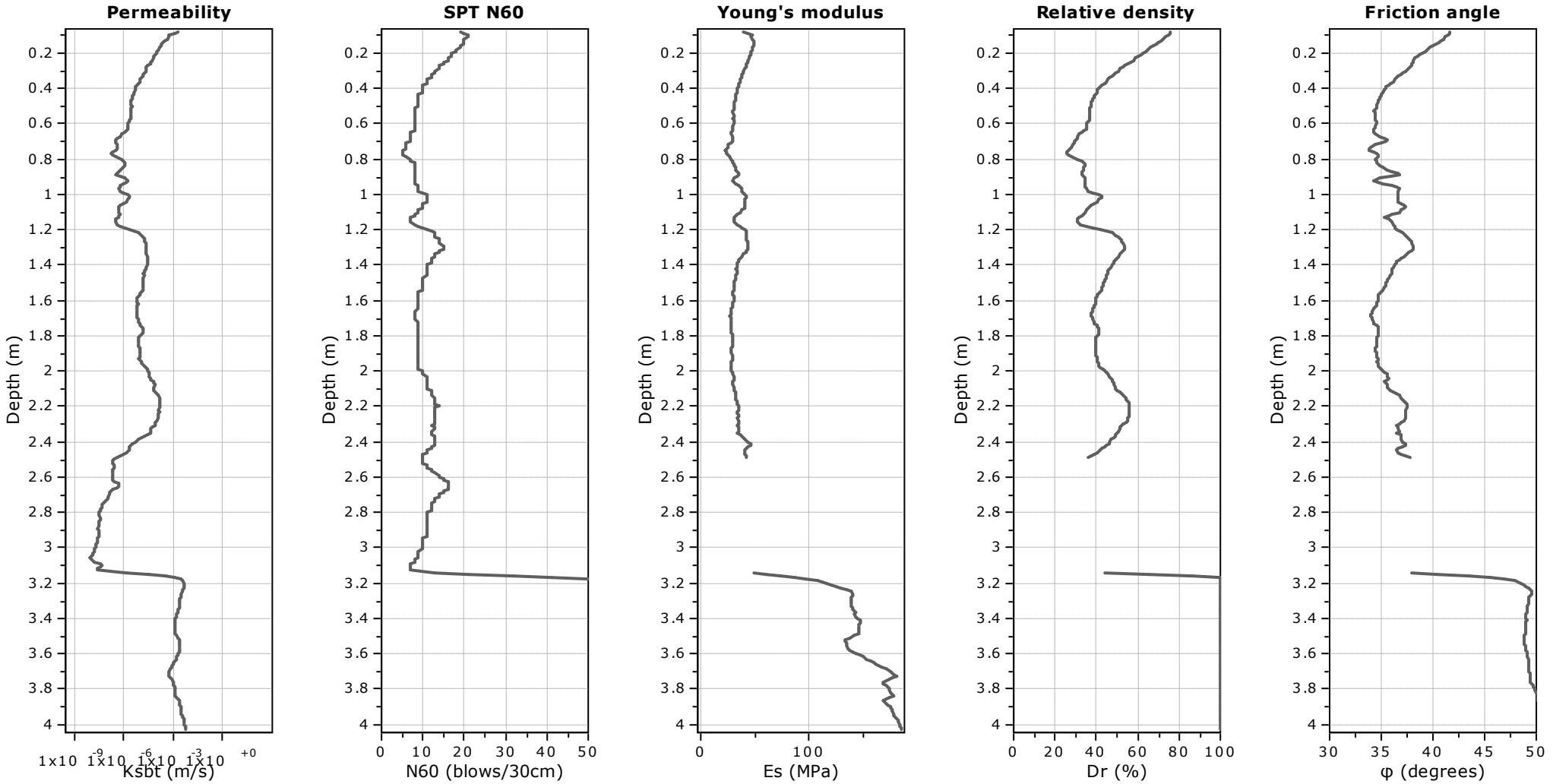
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



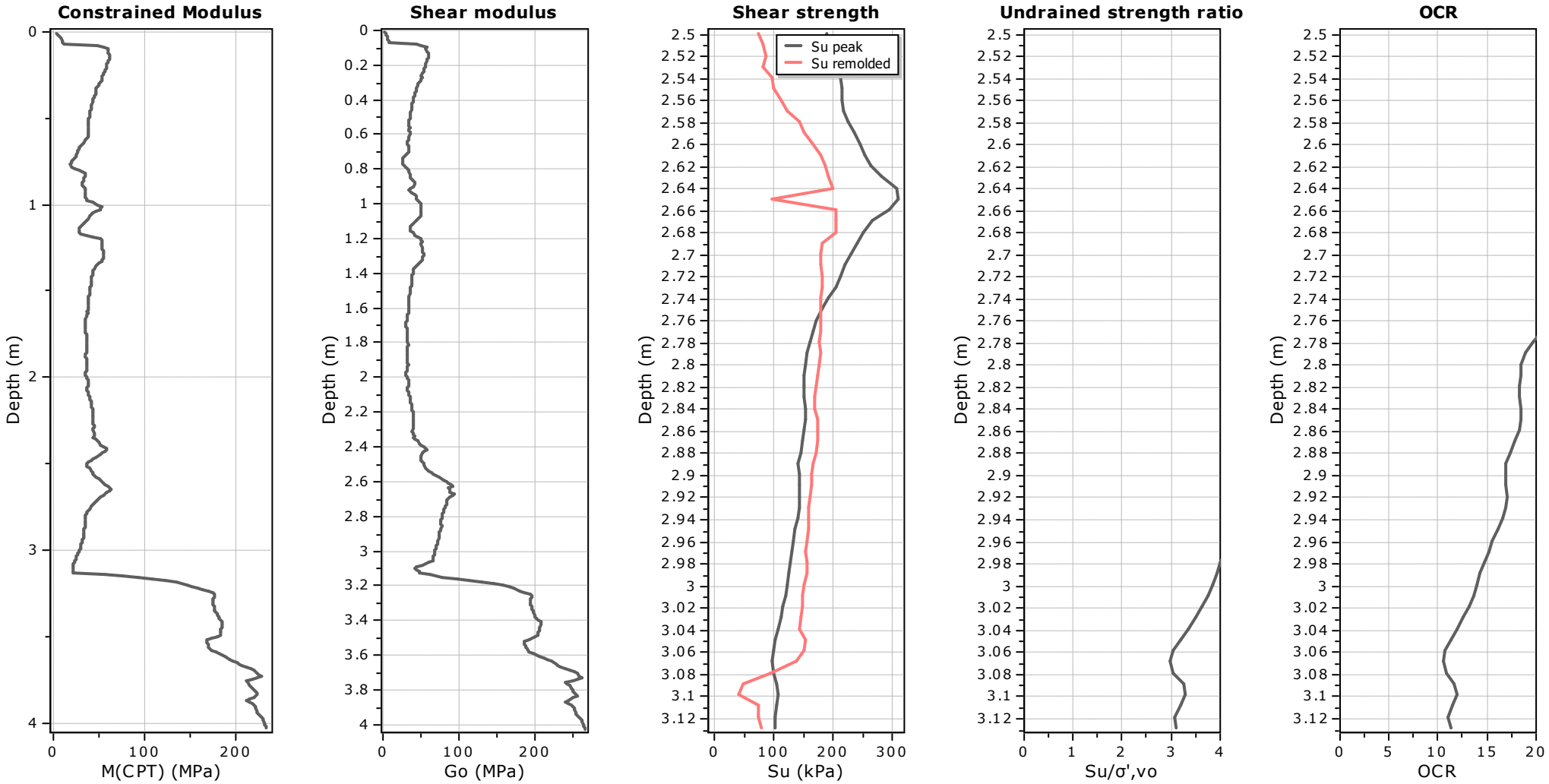
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



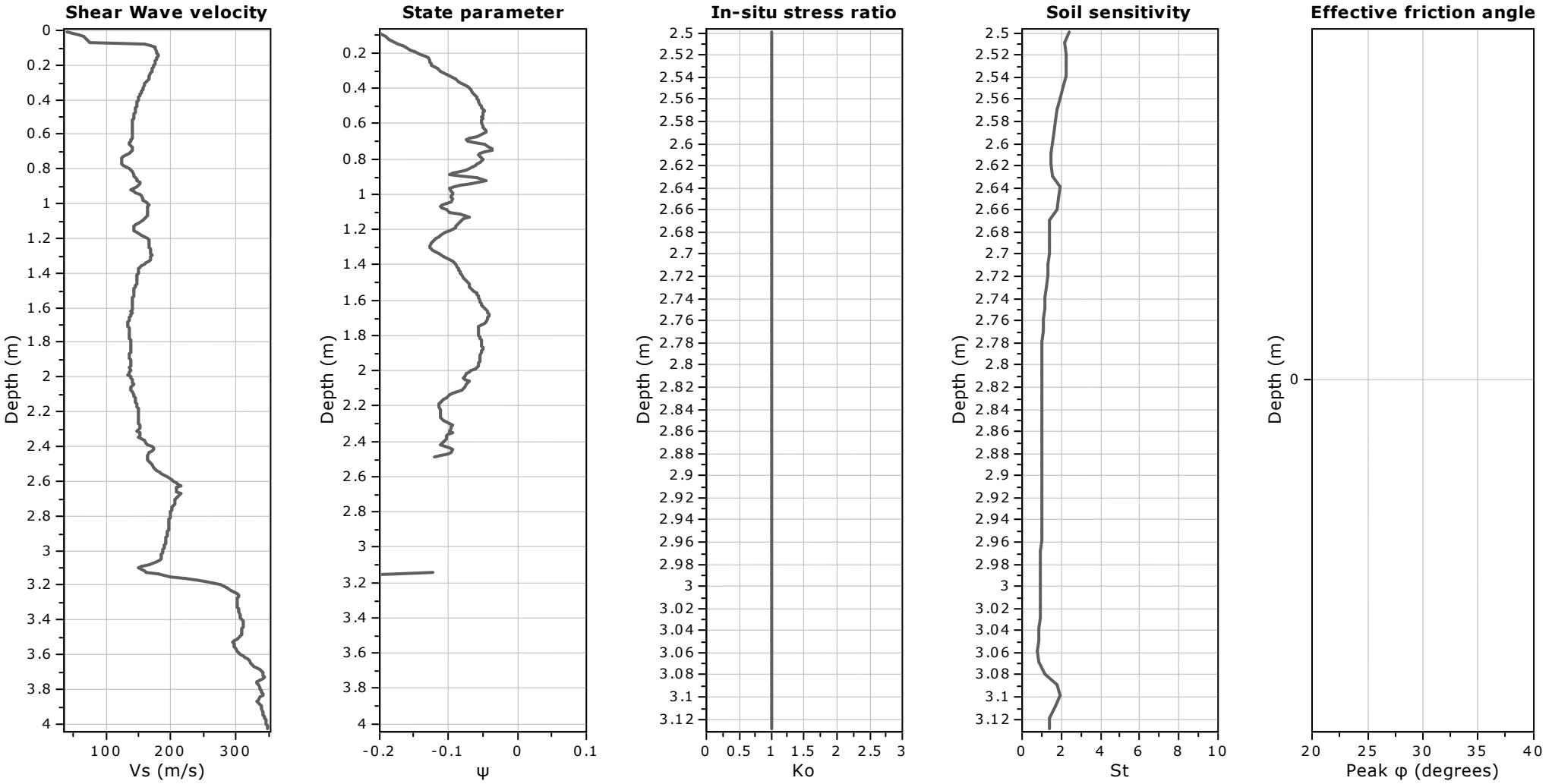
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto
OCR factor for clays, N_{kt}: Auto
Flat Dilatometer Test data

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



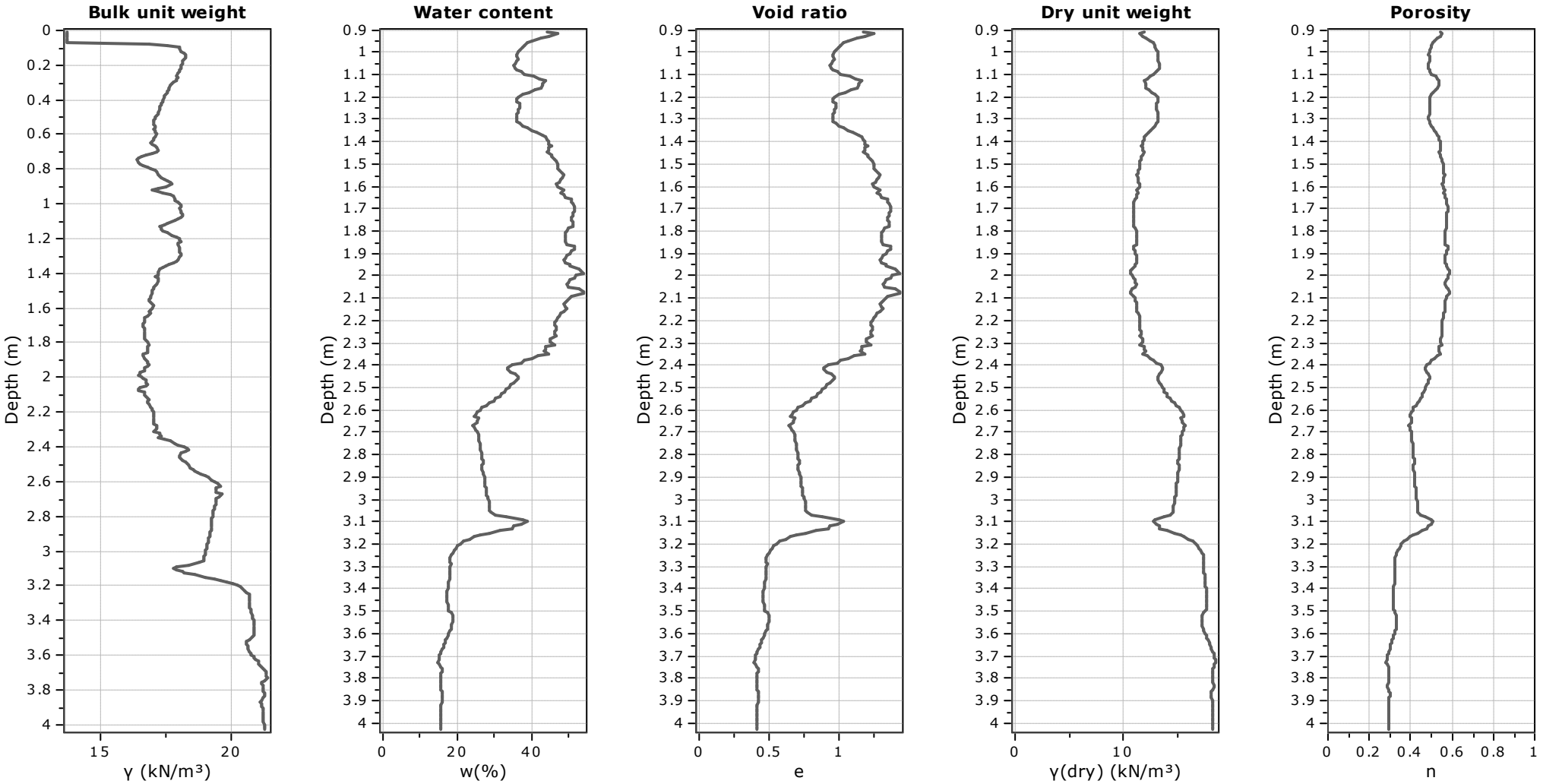
Calculation parameters

Soil Sensitivity factor, N_S: 7.00

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

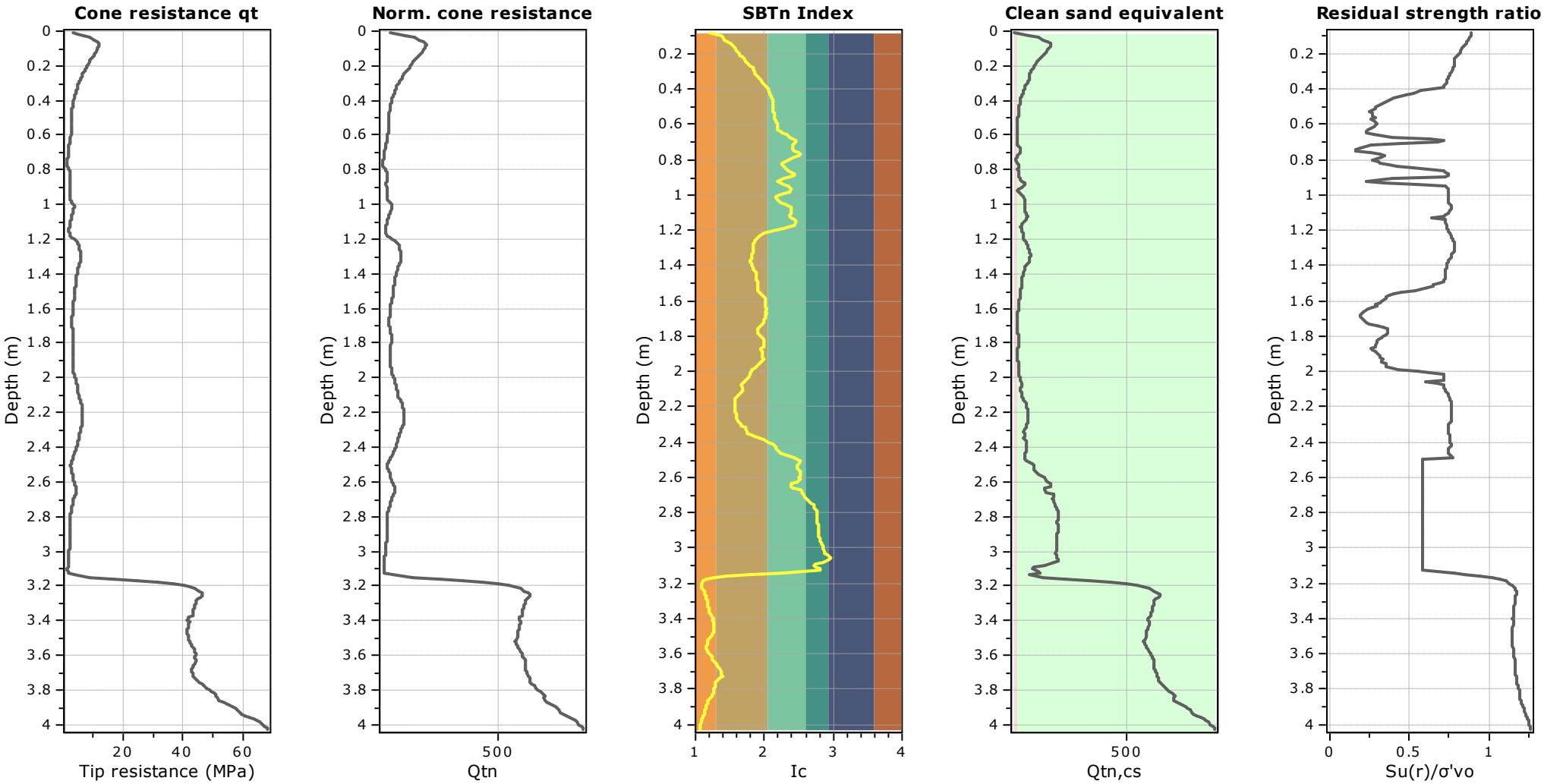
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

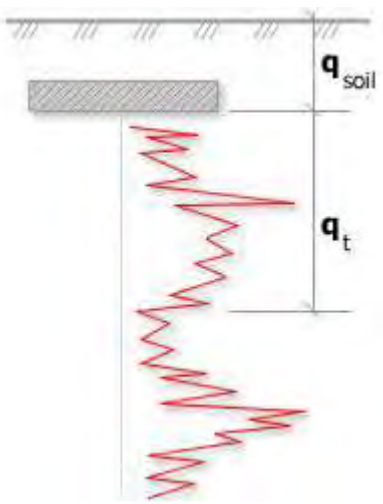


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

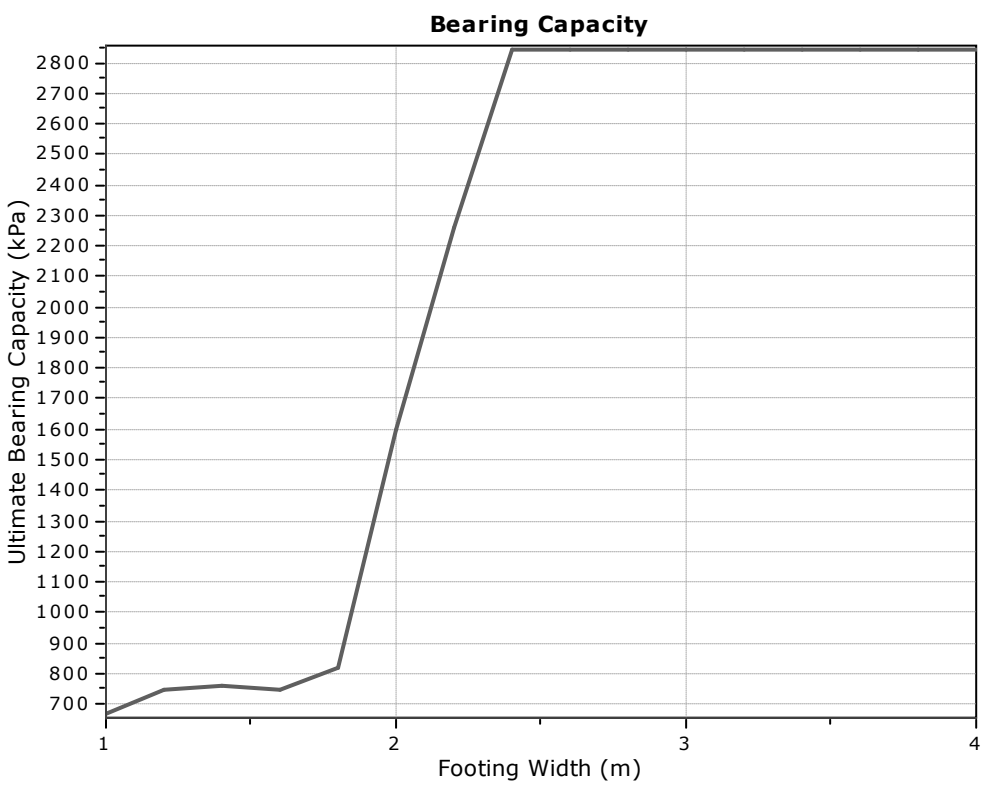




Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



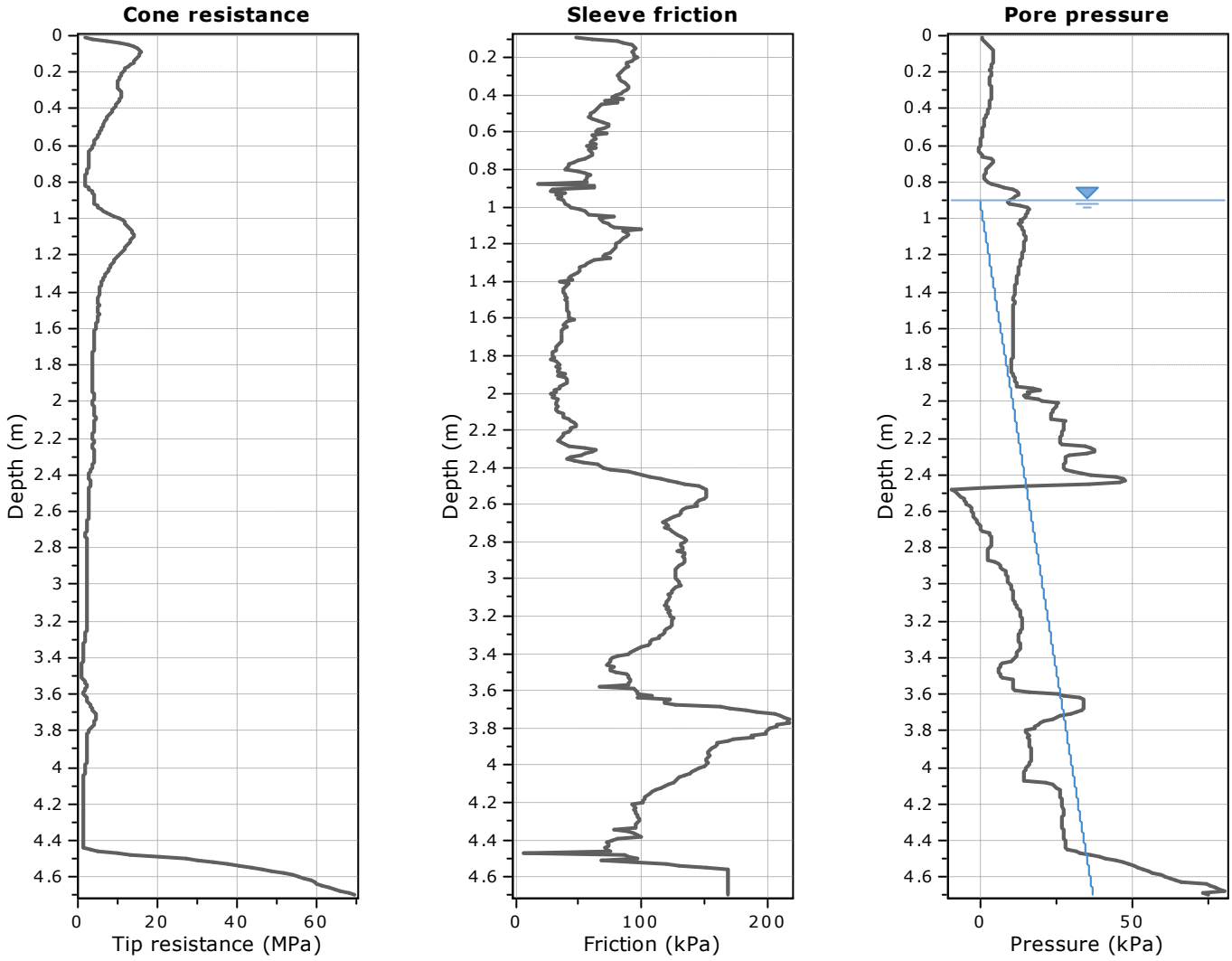
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	3.29	0.20	9.50	667.71
2	1.20	0.50	2.30	3.70	0.20	9.50	749.37
3	1.40	0.50	2.60	3.74	0.20	9.50	756.64
4	1.60	0.50	2.90	3.67	0.20	9.50	743.31
5	1.80	0.50	3.20	4.04	0.20	9.50	816.84
6	2.00	0.50	3.50	7.95	0.20	9.50	1600.29
7	2.20	0.50	3.80	11.24	0.20	9.50	2257.68
8	2.40	0.50	4.10	14.17	0.20	9.50	2843.11
9	2.60	0.50	4.40	14.17	0.20	9.50	2843.11
10	2.80	0.50	4.70	14.17	0.20	9.50	2843.11
11	3.00	0.50	5.00	14.17	0.20	9.50	2843.11
12	3.20	0.50	5.30	14.17	0.20	9.50	2843.11
13	3.40	0.50	5.60	14.17	0.20	9.50	2843.11
14	3.60	0.50	5.90	14.17	0.20	9.50	2843.11
15	3.80	0.50	6.20	14.17	0.20	9.50	2843.11
16	4.00	0.50	6.50	14.17	0.20	9.50	2843.11

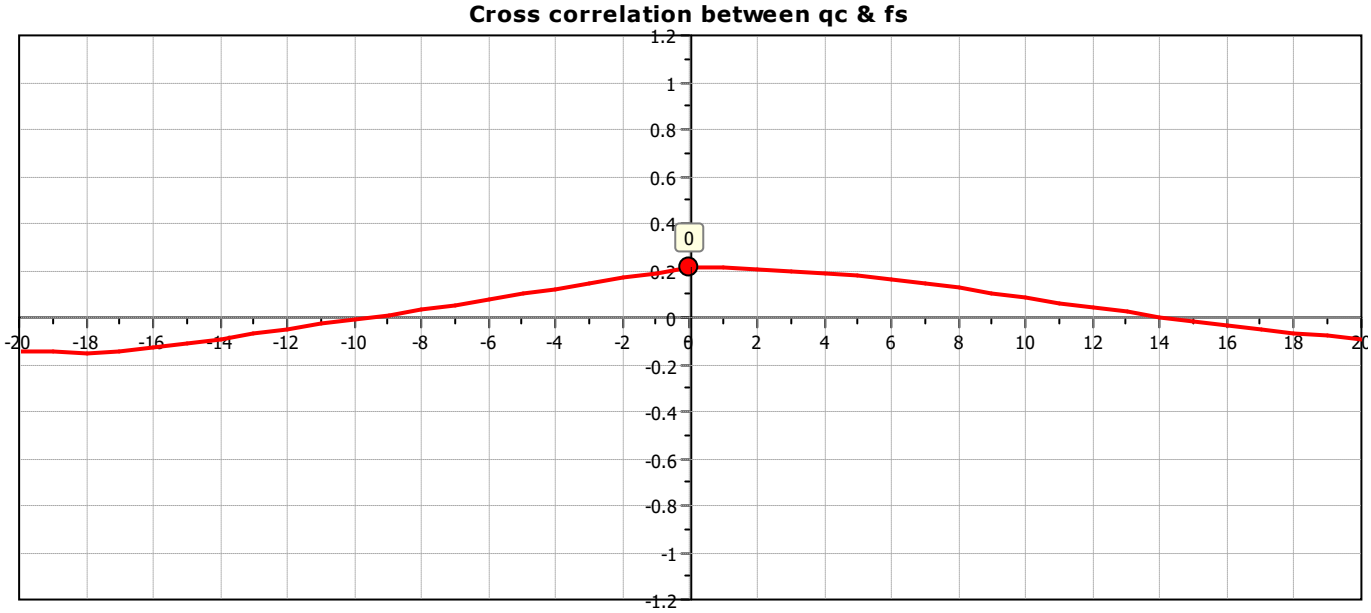
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

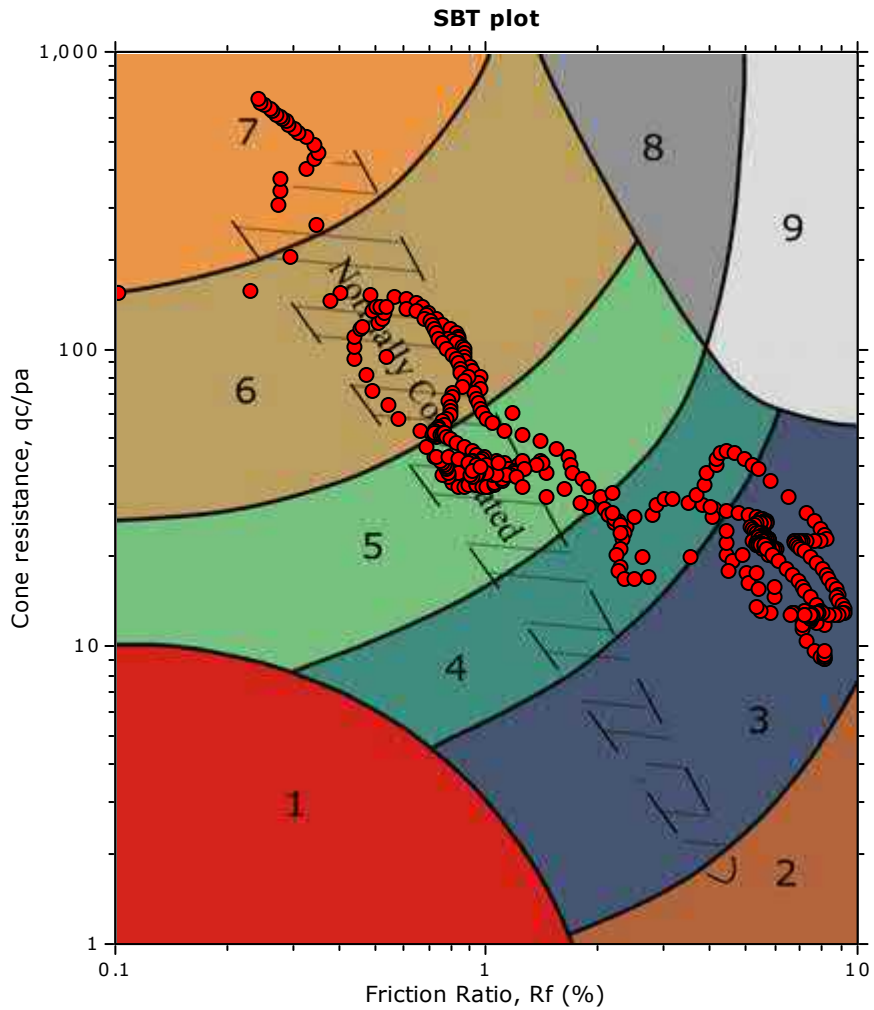


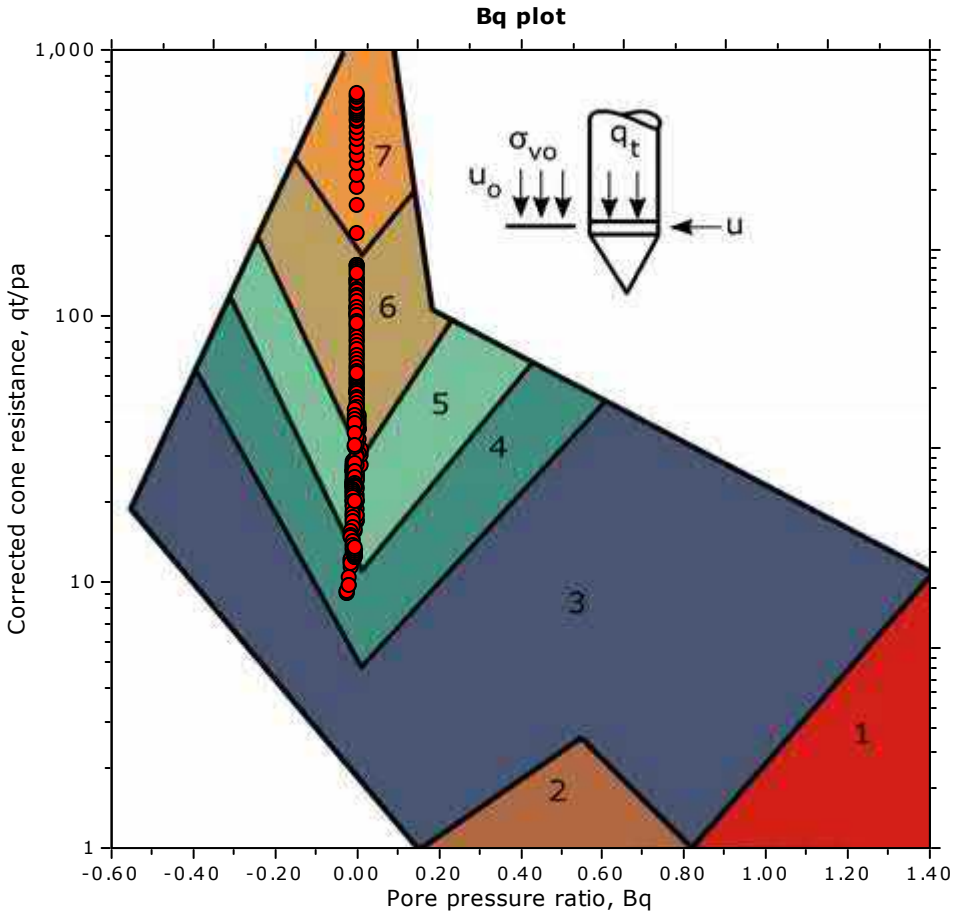
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots





SBT legend

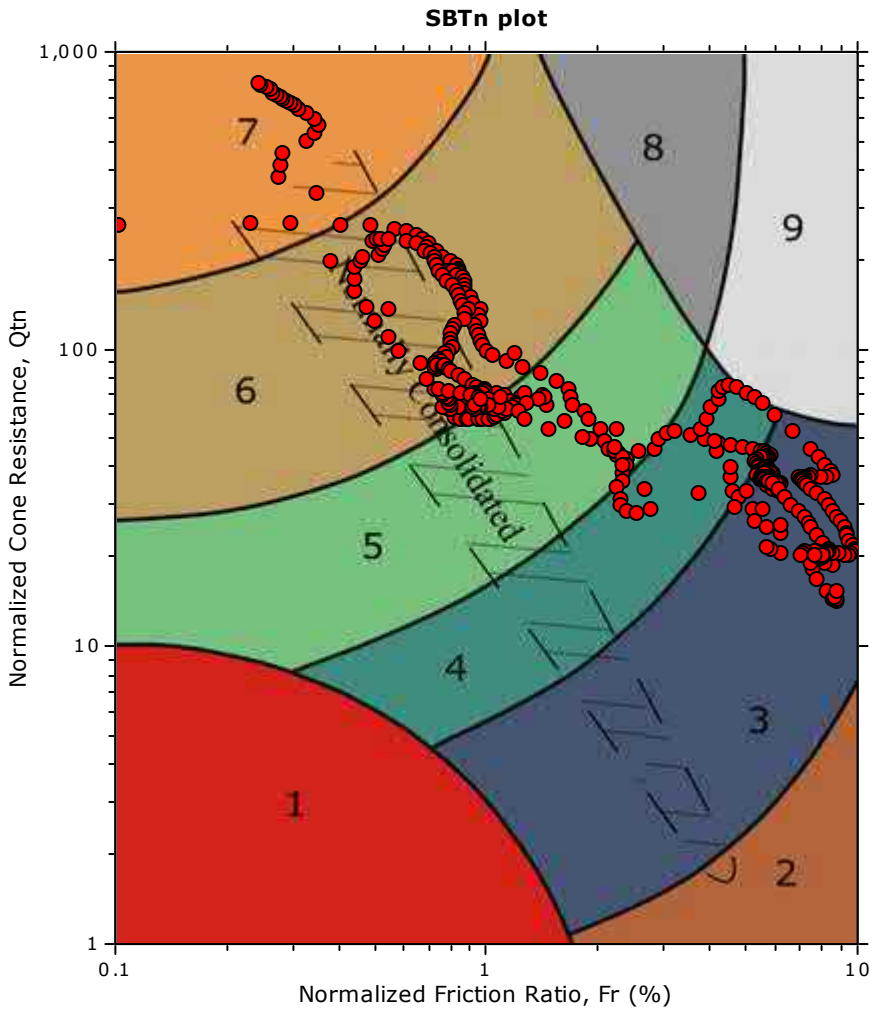
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

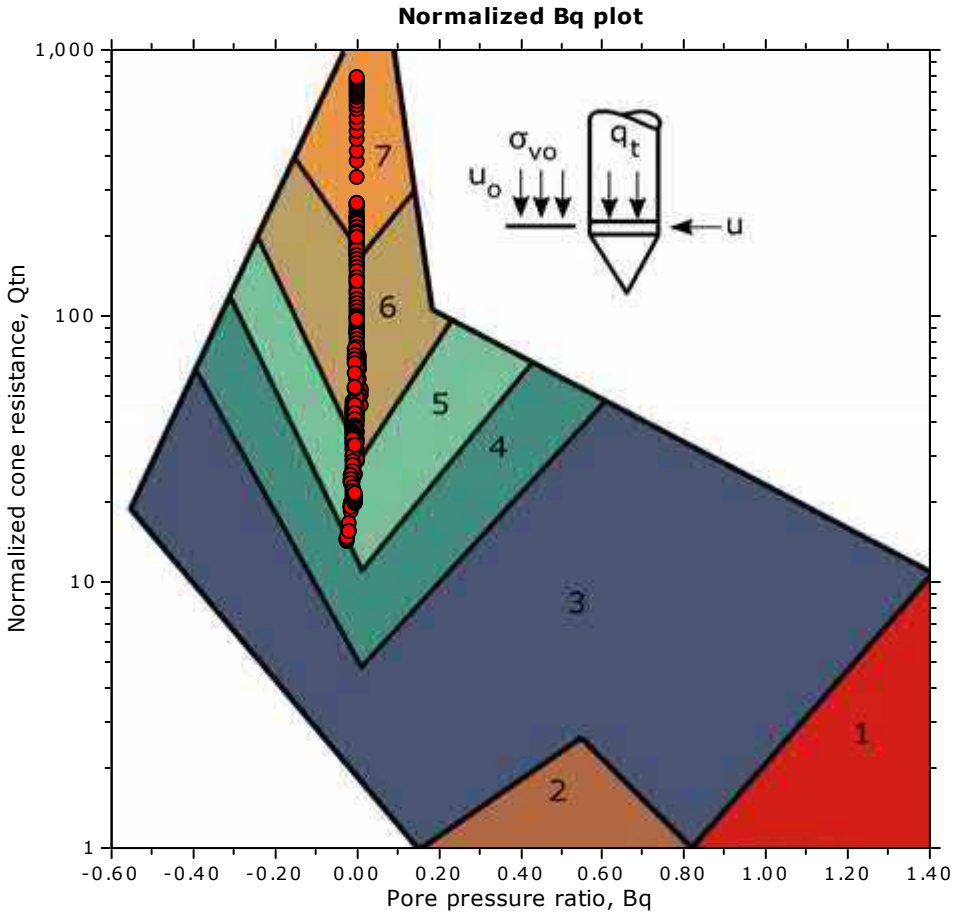
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots (normalized)





SBTn legend

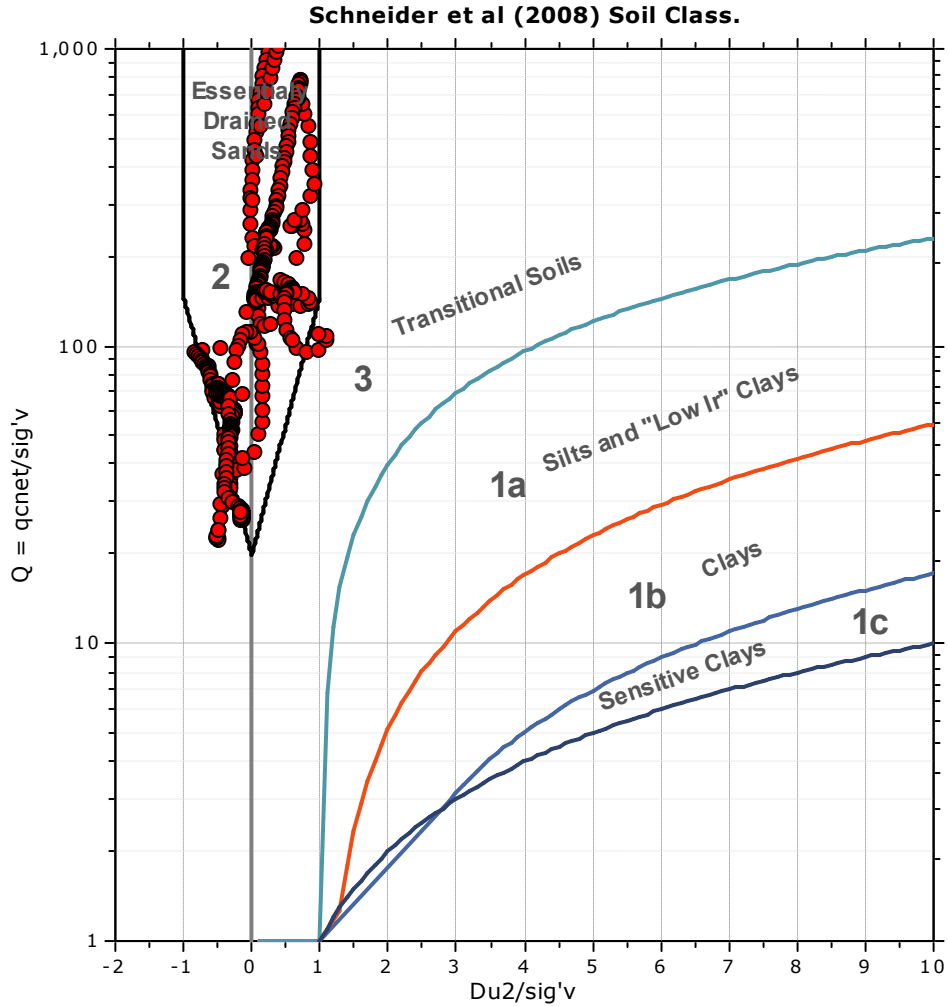
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

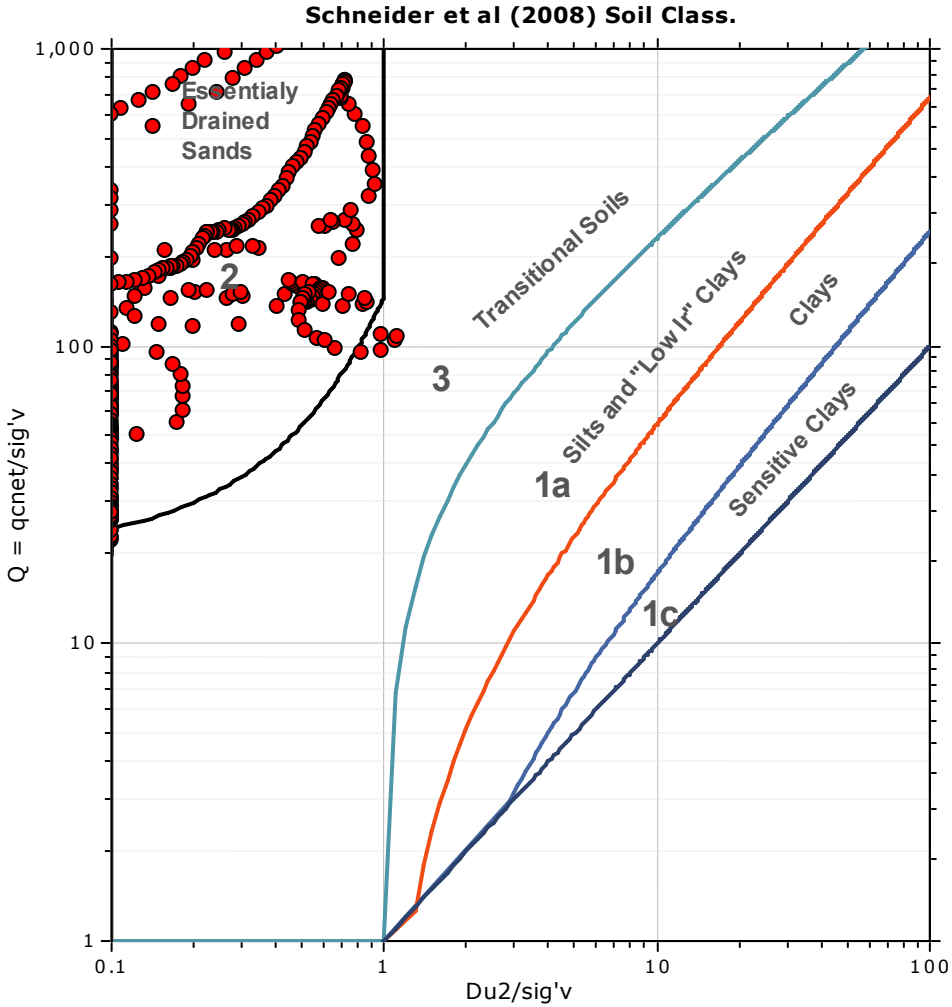
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

Bq plots (Schneider)

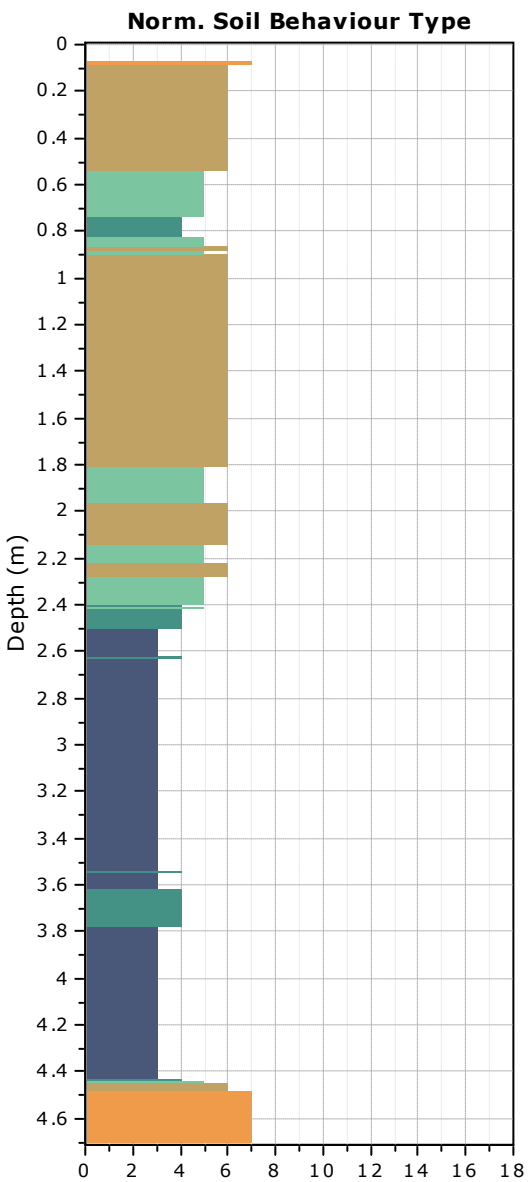


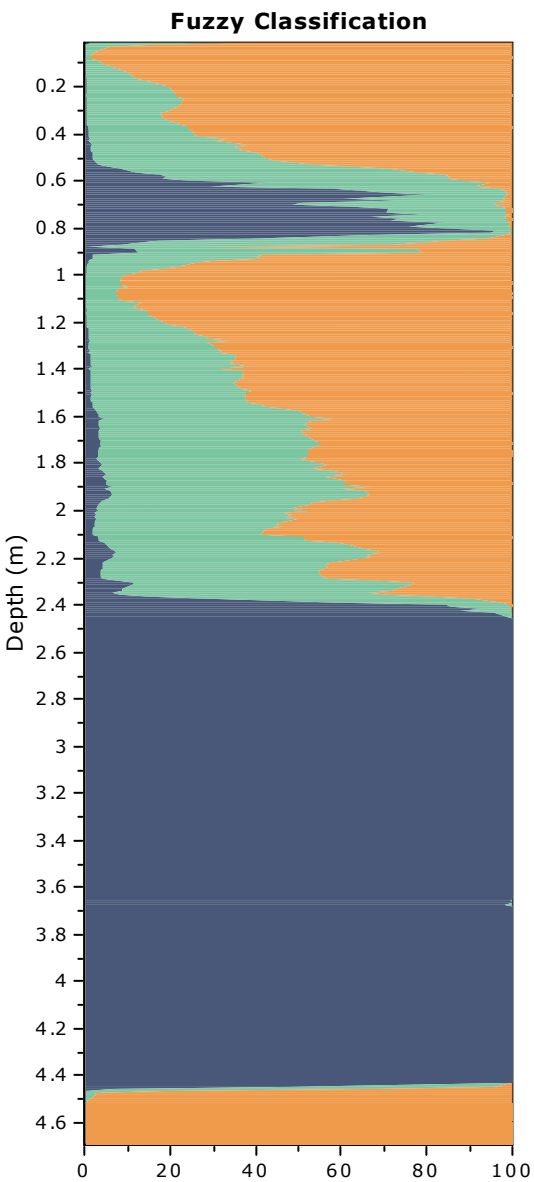


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



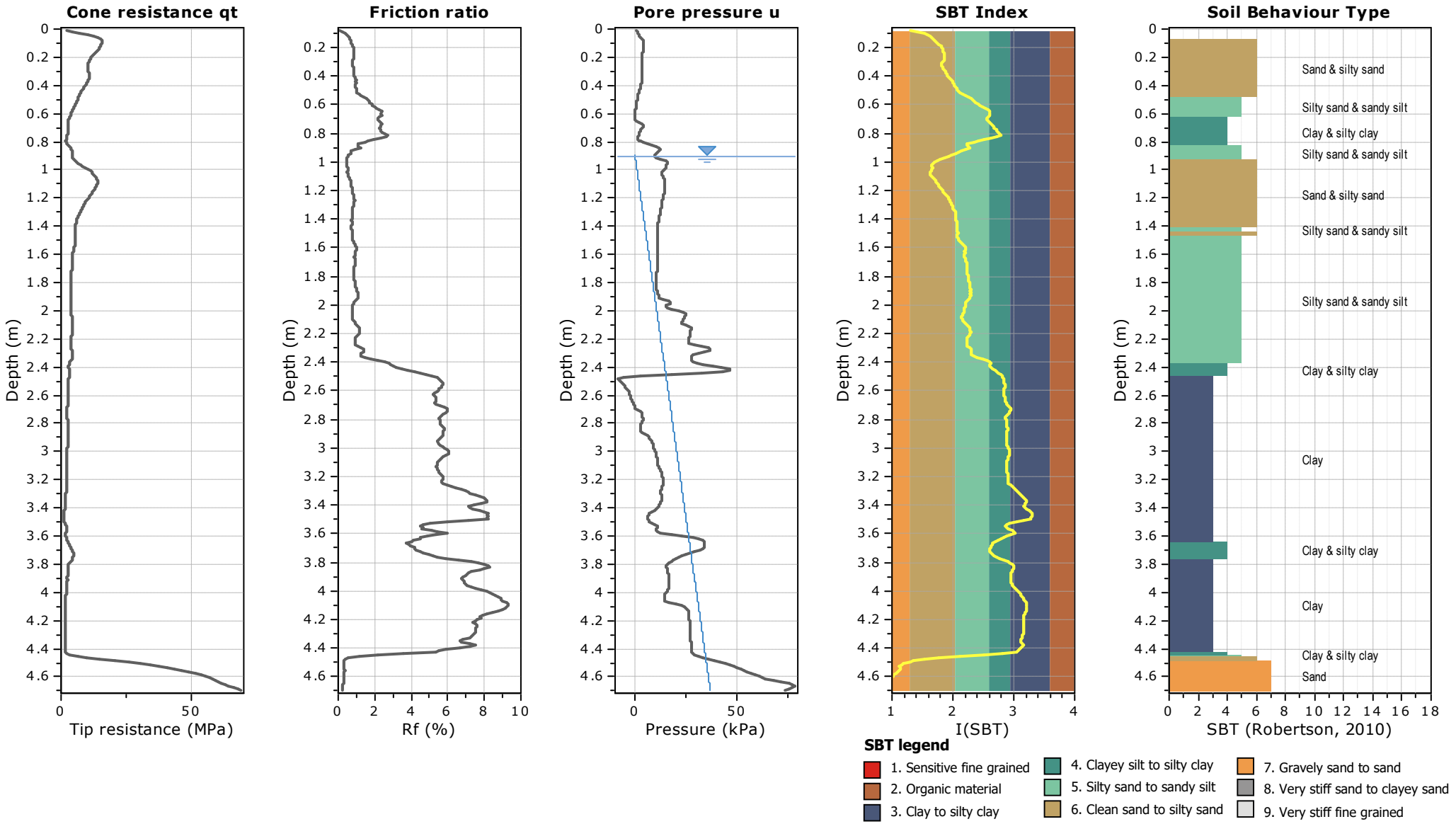


Fuzzy classifiaction legend
- Highly probable clayey soil
- Highly probable mixture soil
- Highly probable sandy soil

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

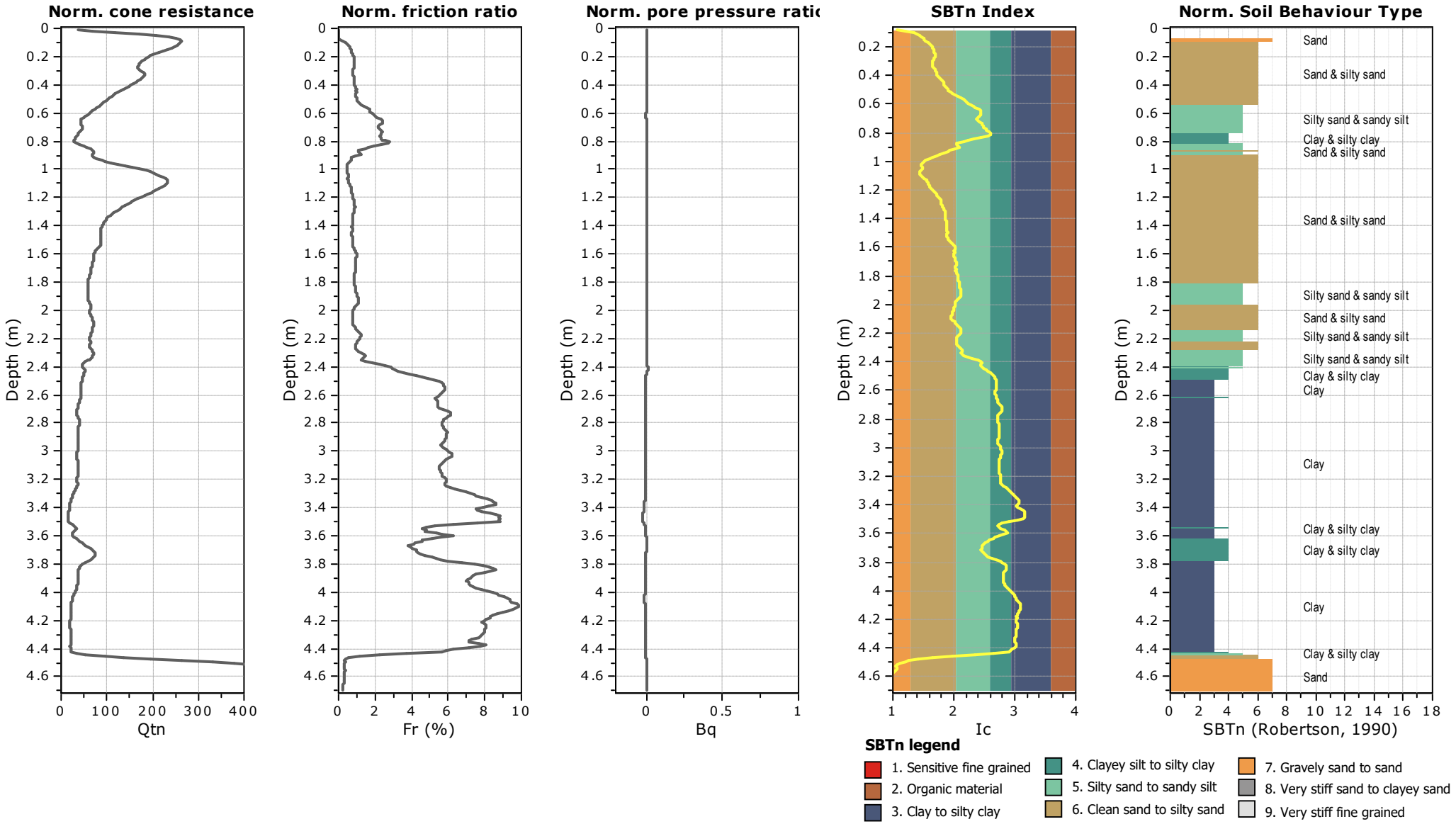
CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

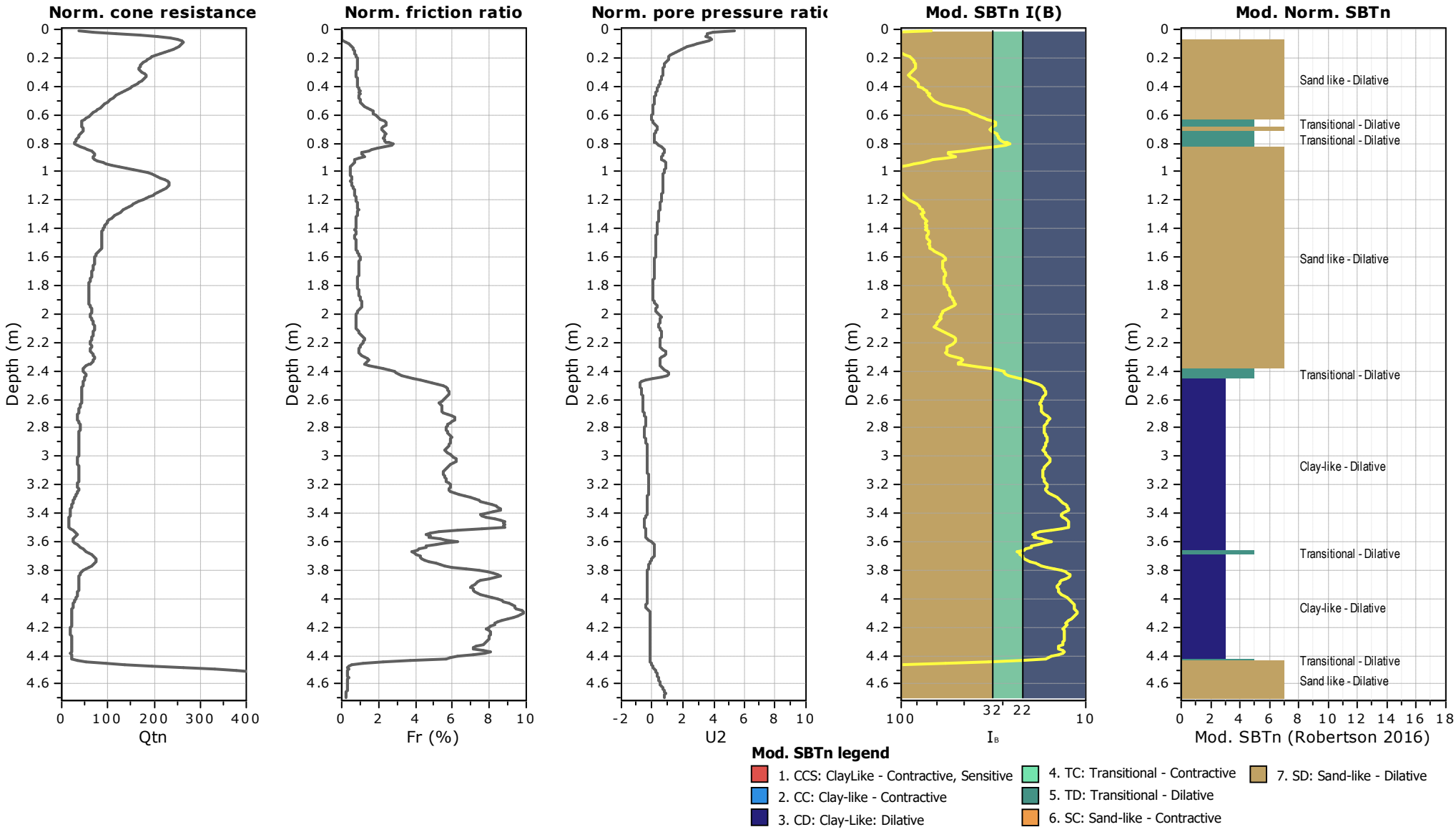
CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

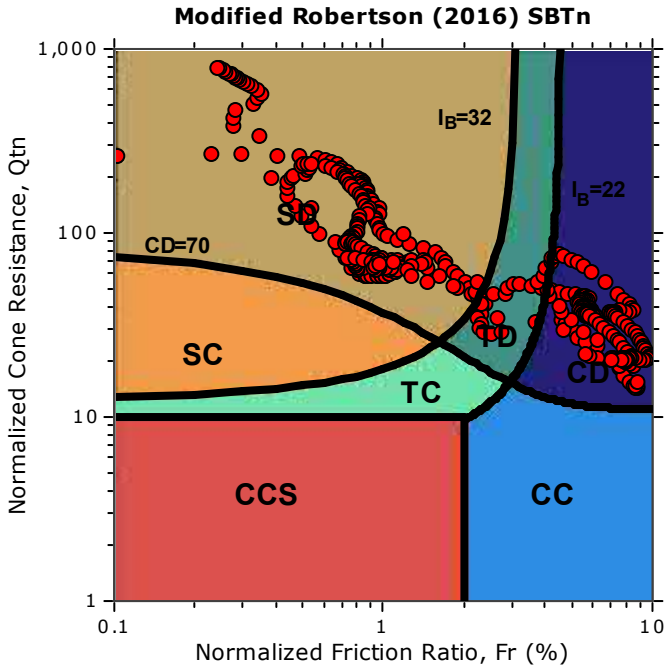


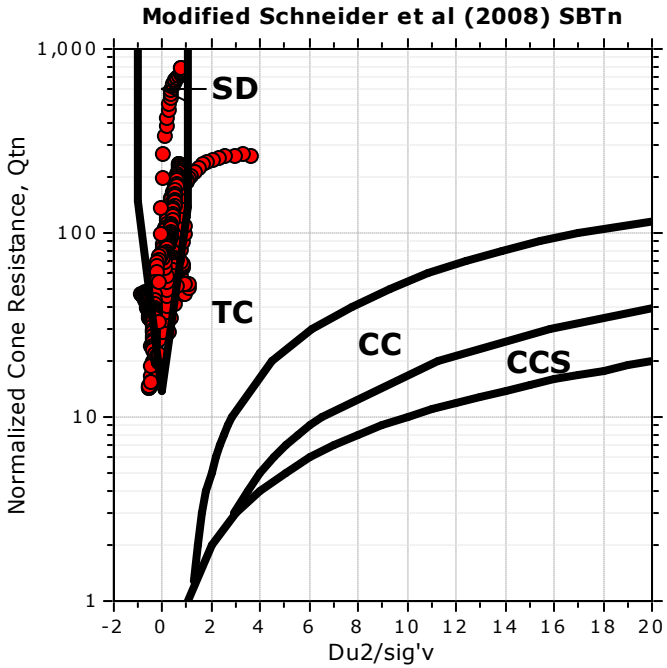
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

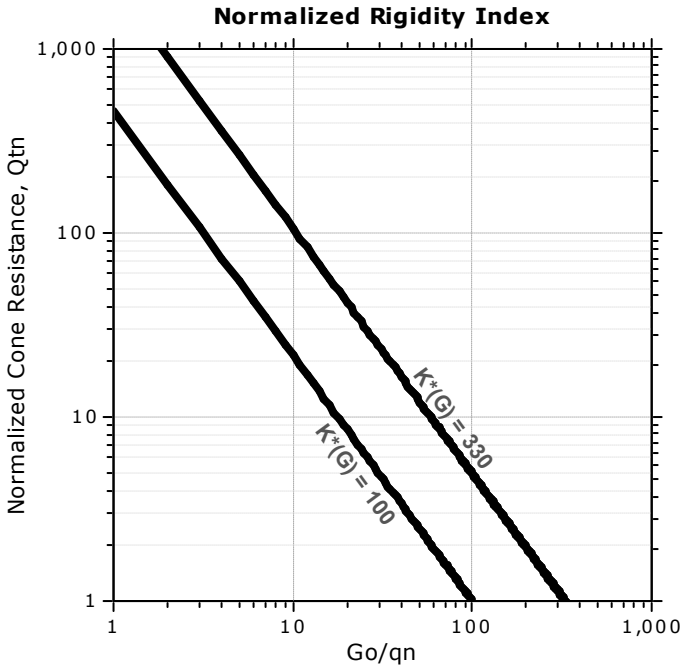
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Updated SBTn plots







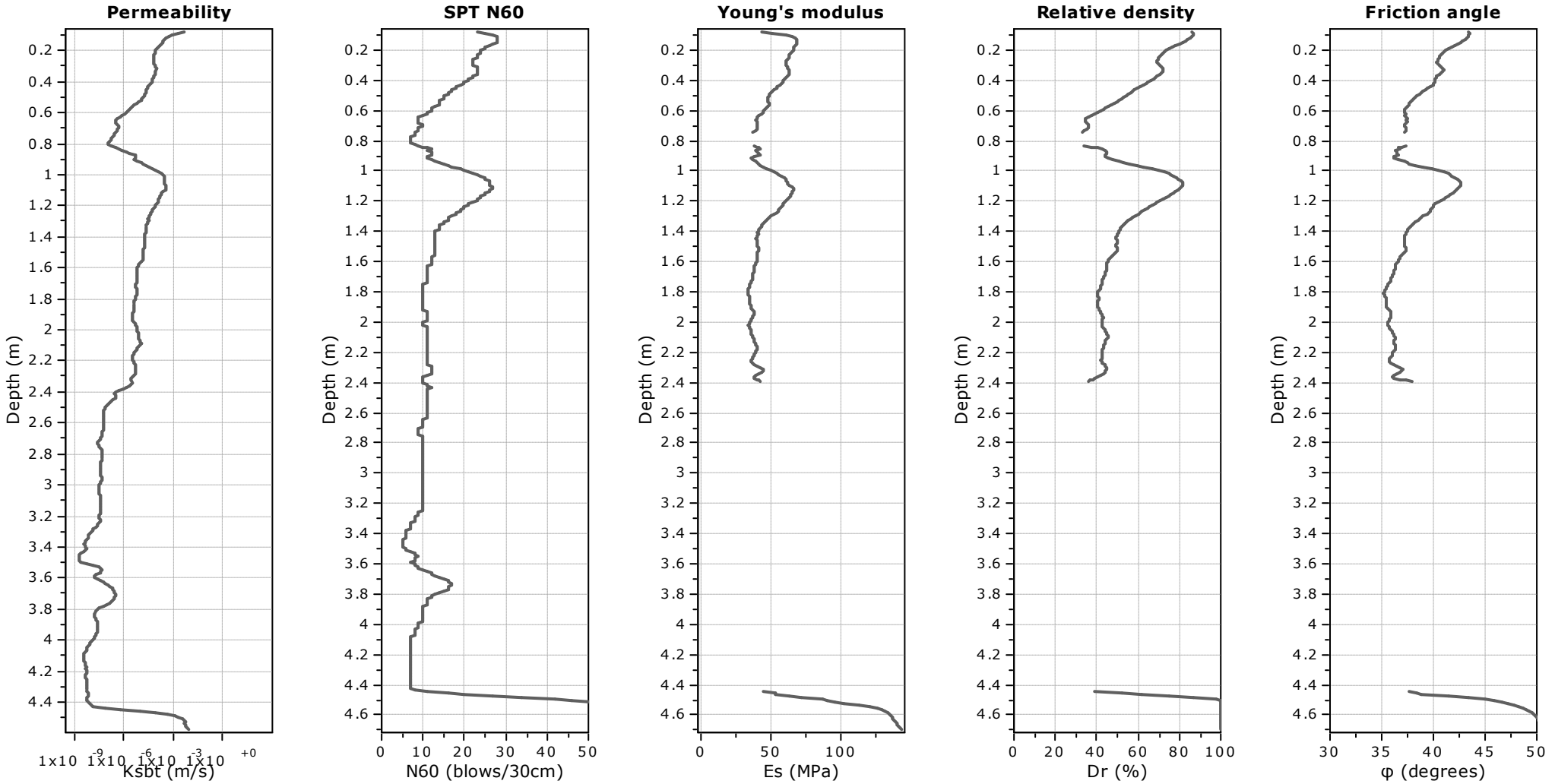
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



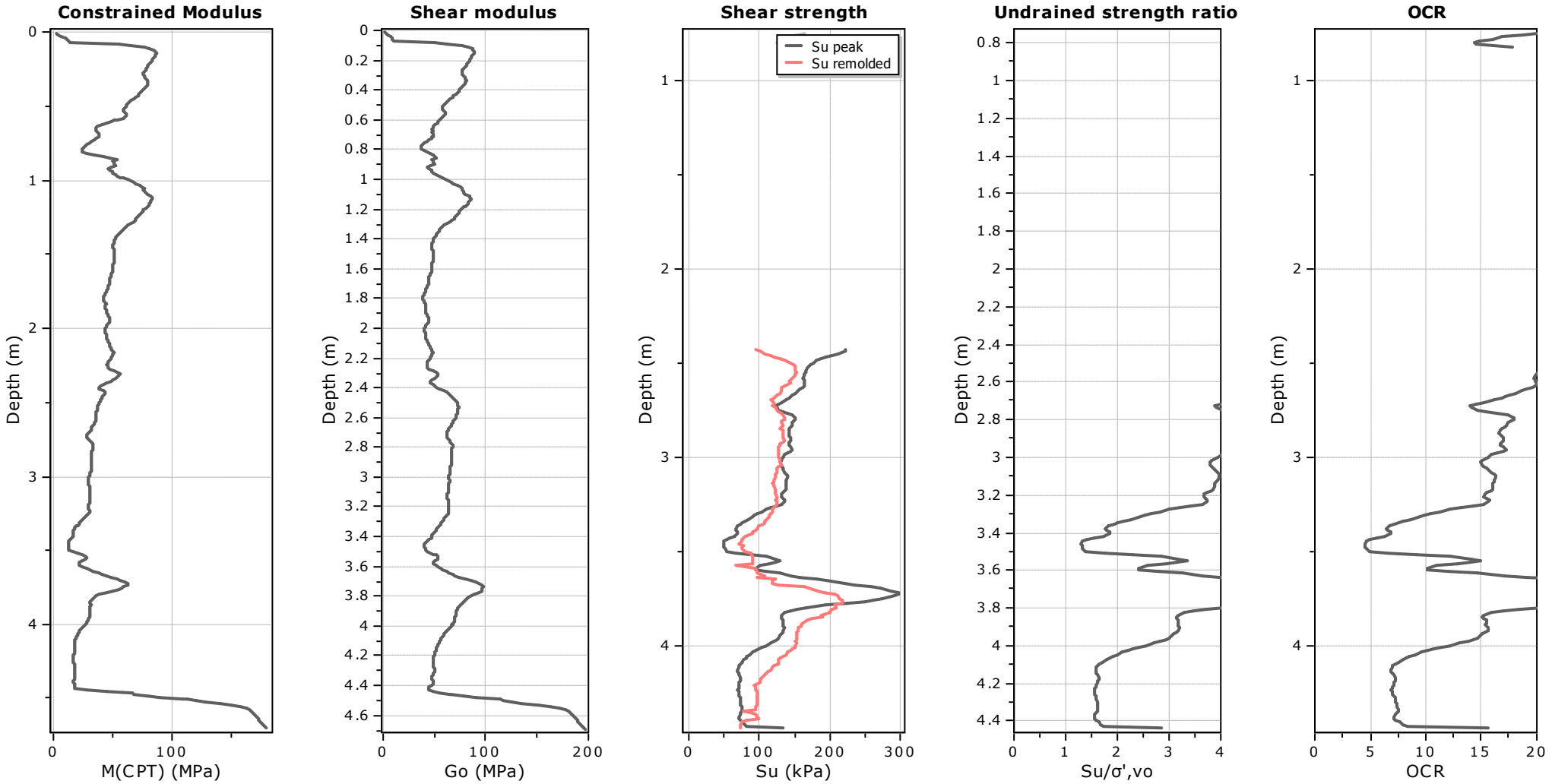
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



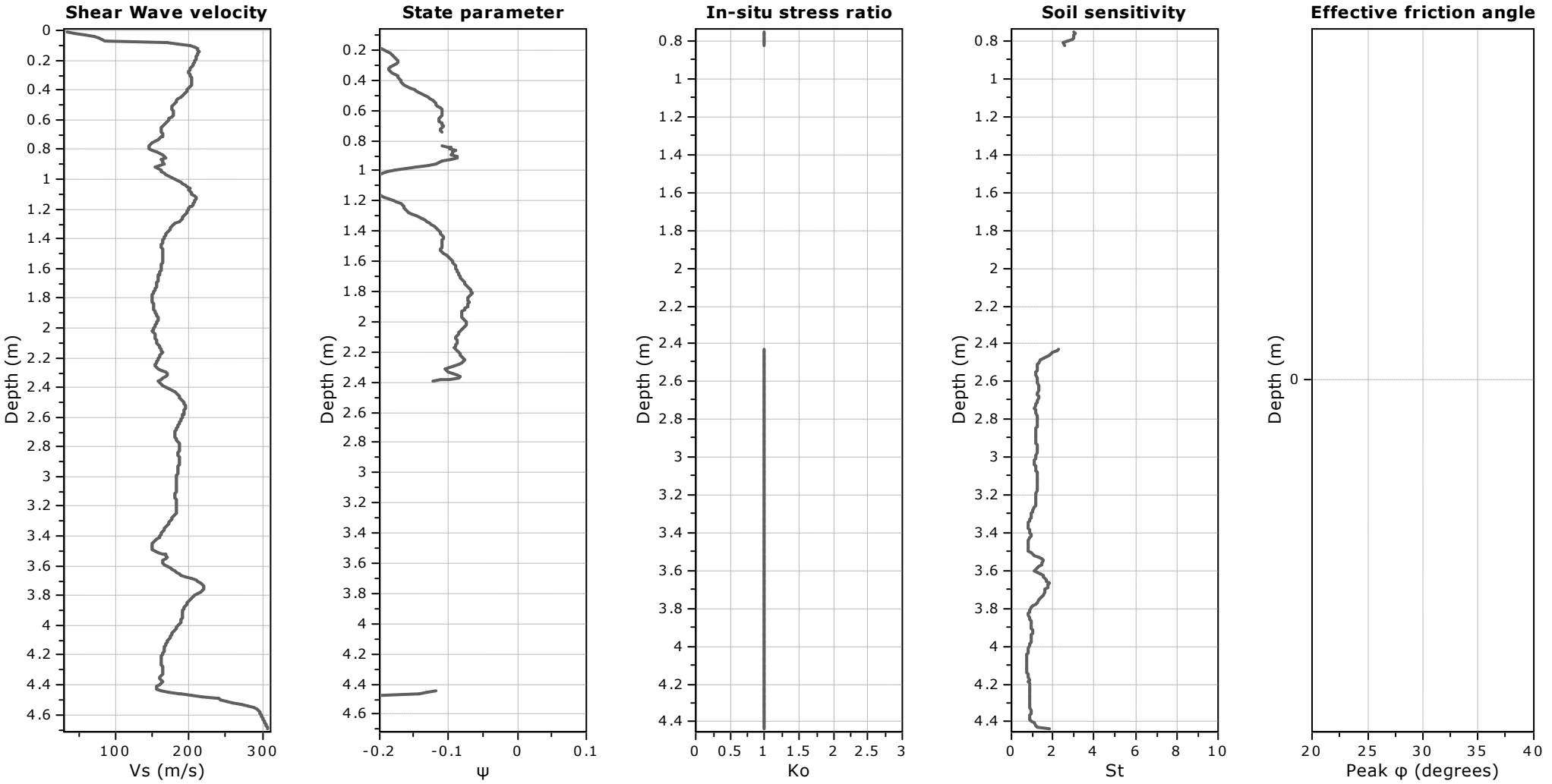
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto
OCR factor for clays, N_{kt}: Auto
Flat Dilatometer Test data

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



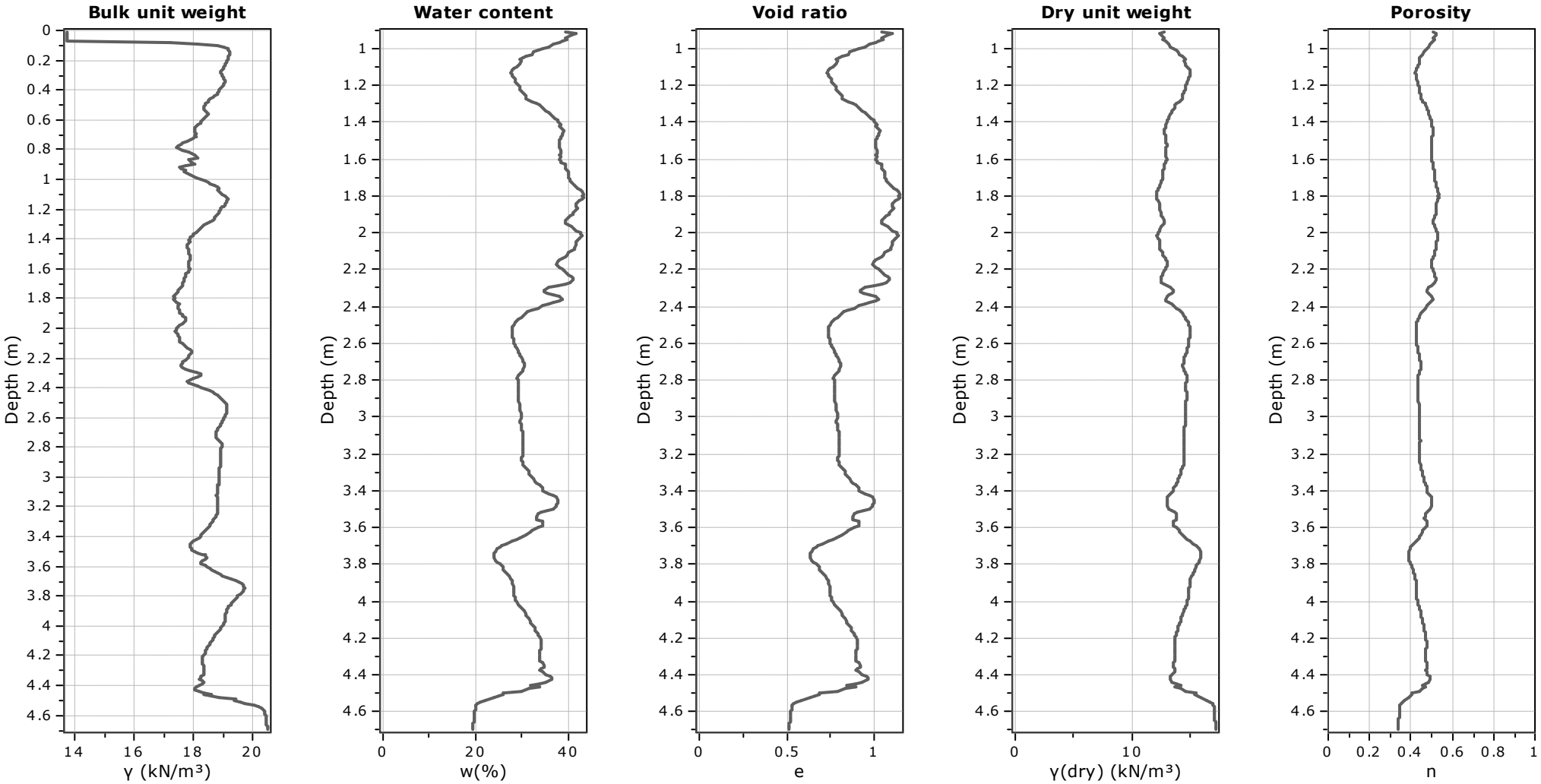
Calculation parameters

Soil Sensitivity factor, N_S: 7.00

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

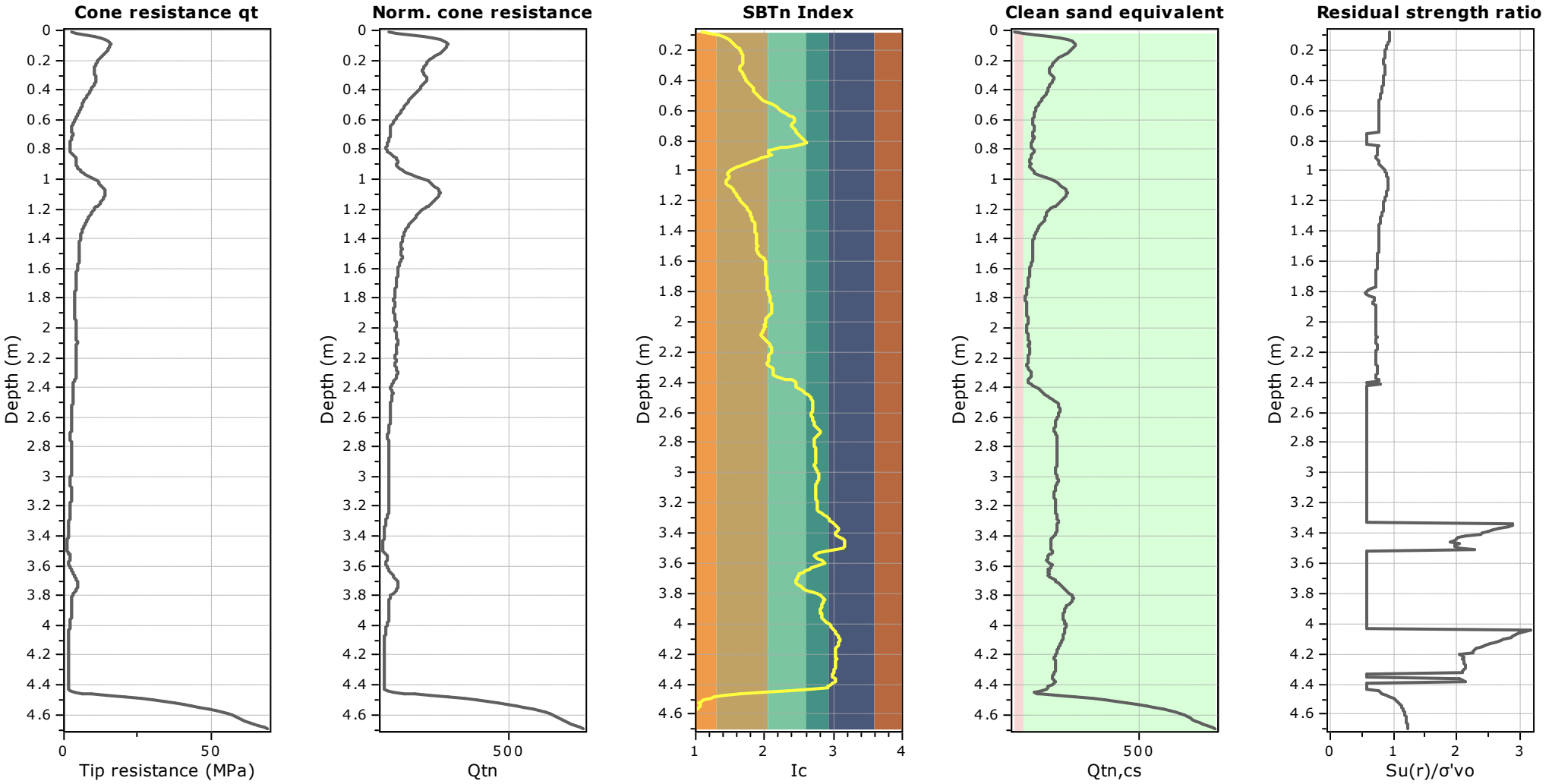
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

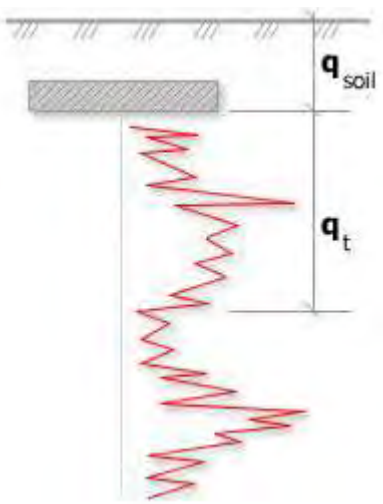
CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

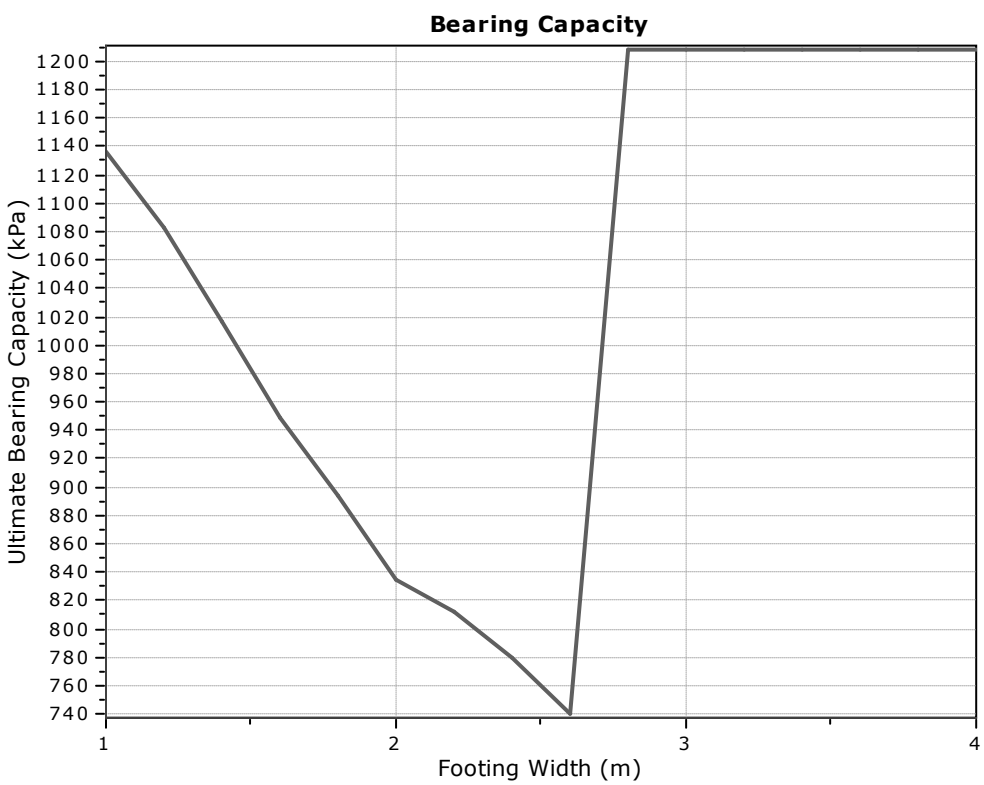
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



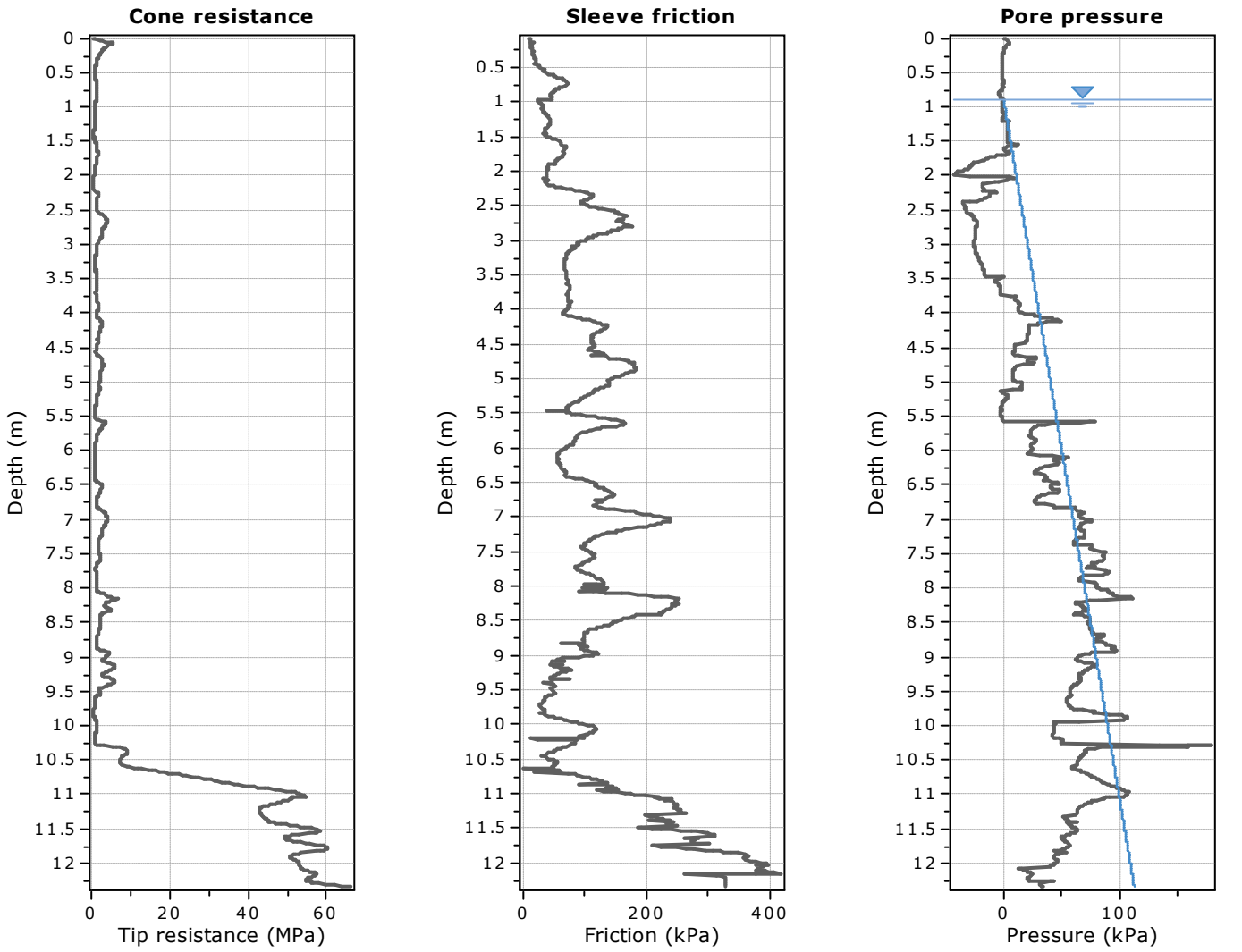
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	5.64	0.20	9.50	1136.82
2	1.20	0.50	2.30	5.37	0.20	9.50	1082.55
3	1.40	0.50	2.60	5.04	0.20	9.50	1016.86
4	1.60	0.50	2.90	4.70	0.20	9.50	949.24
5	1.80	0.50	3.20	4.42	0.20	9.50	894.49
6	2.00	0.50	3.50	4.13	0.20	9.50	835.25
7	2.20	0.50	3.80	4.01	0.20	9.50	812.38
8	2.40	0.50	4.10	3.85	0.20	9.50	779.32
9	2.60	0.50	4.40	3.65	0.20	9.50	740.09
10	2.80	0.50	4.70	5.99	0.20	9.50	1208.39
11	3.00	0.50	5.00	5.99	0.20	9.50	1208.39
12	3.20	0.50	5.30	5.99	0.20	9.50	1208.39
13	3.40	0.50	5.60	5.99	0.20	9.50	1208.39
14	3.60	0.50	5.90	5.99	0.20	9.50	1208.39
15	3.80	0.50	6.20	5.99	0.20	9.50	1208.39
16	4.00	0.50	6.50	5.99	0.20	9.50	1208.39

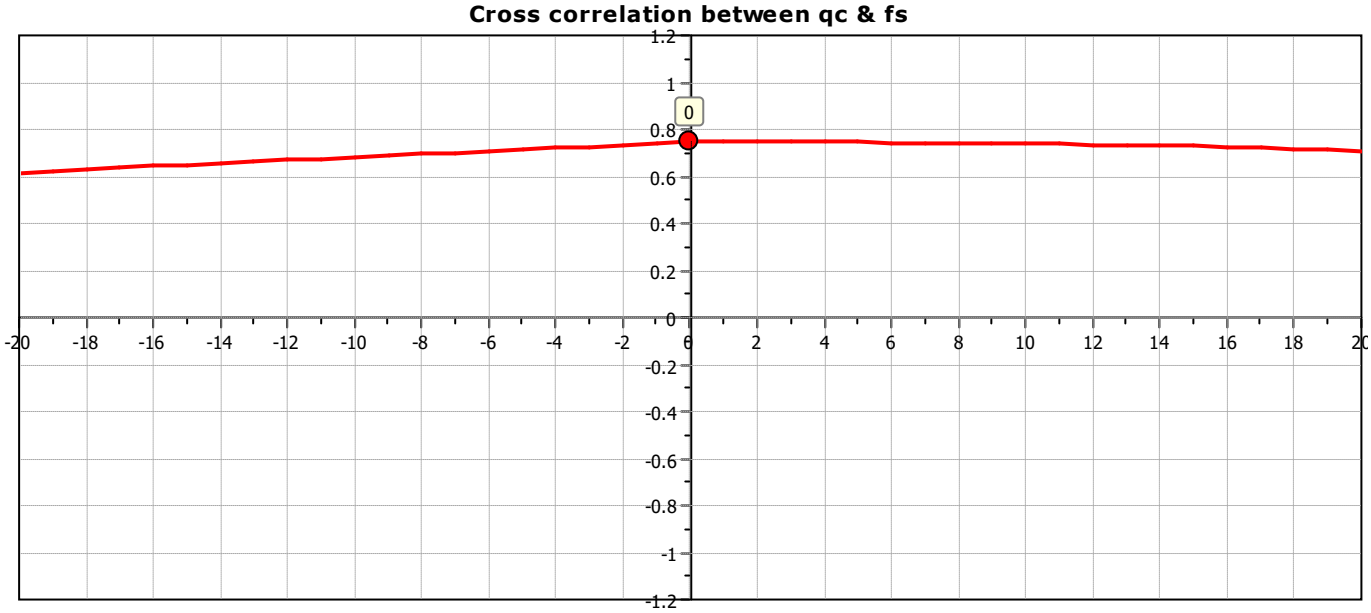
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

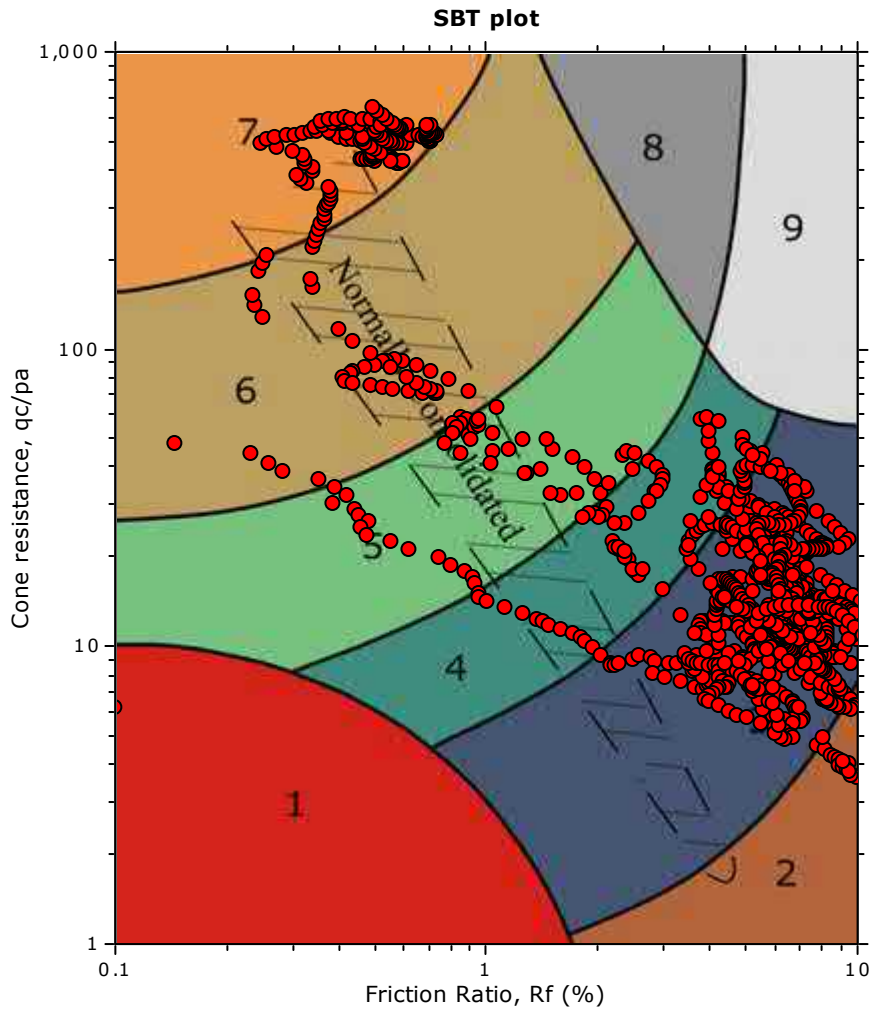


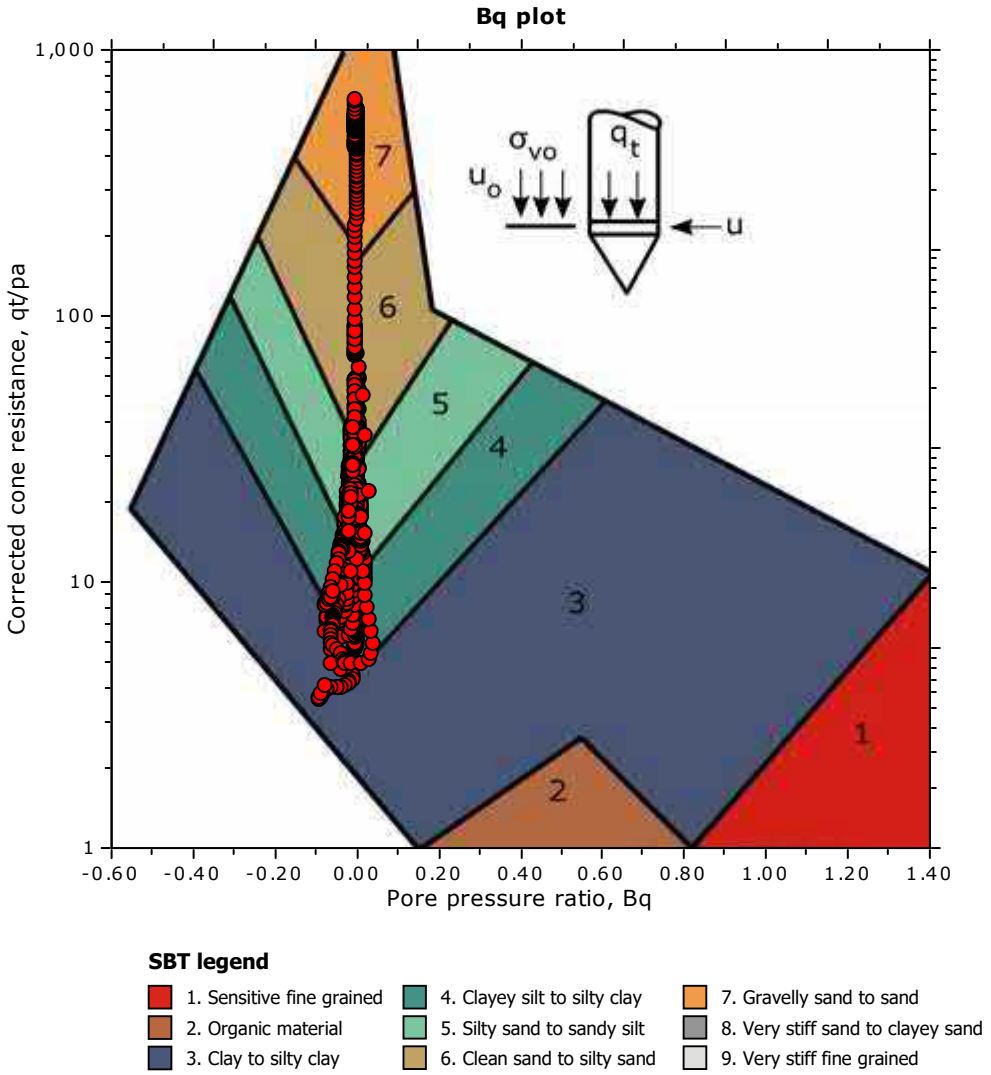
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots



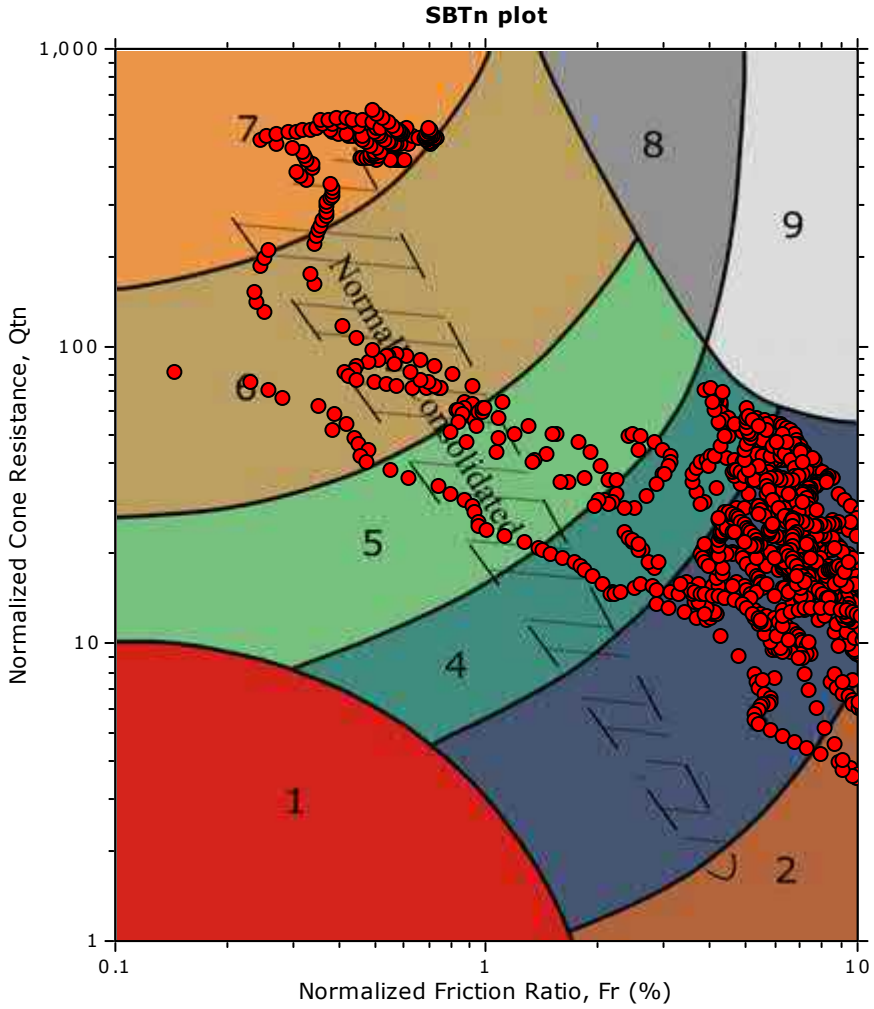


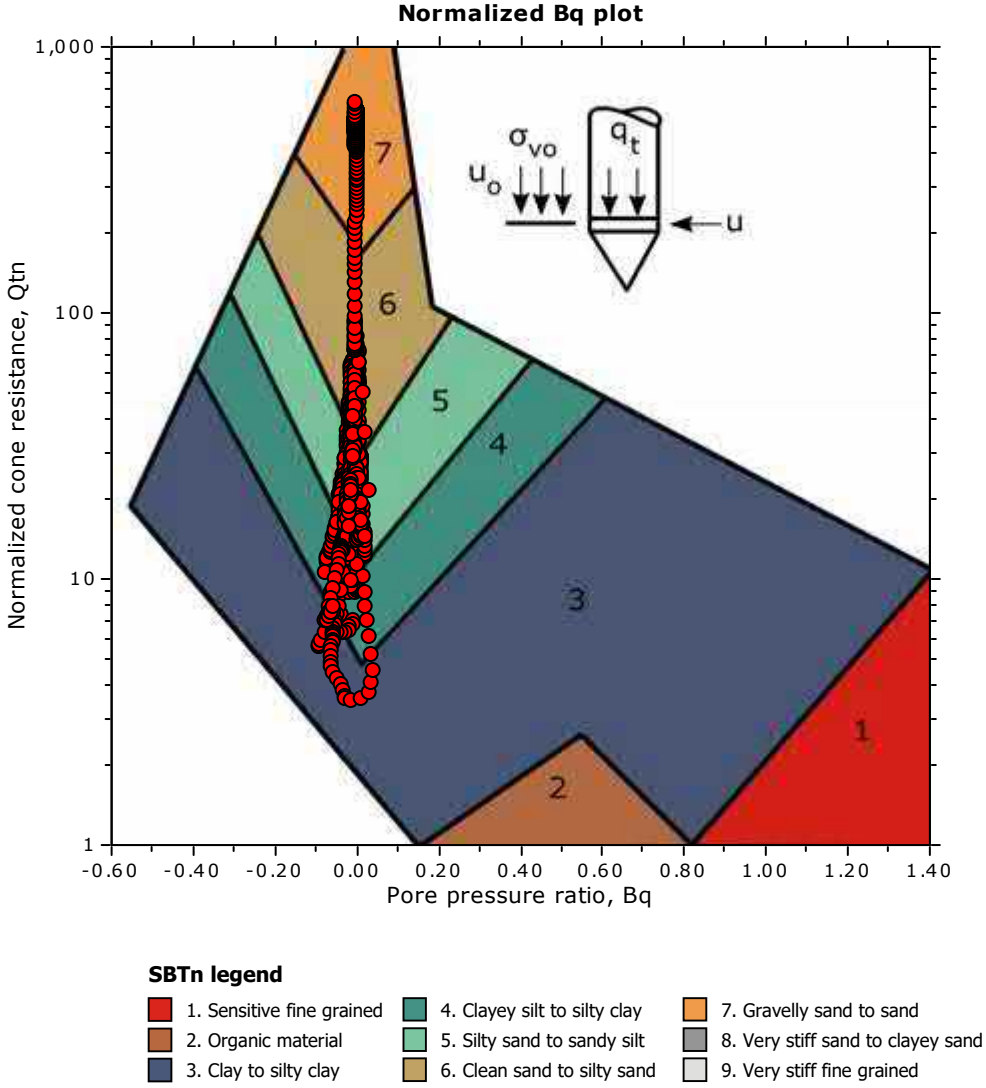
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots (normalized)





SBTn legend

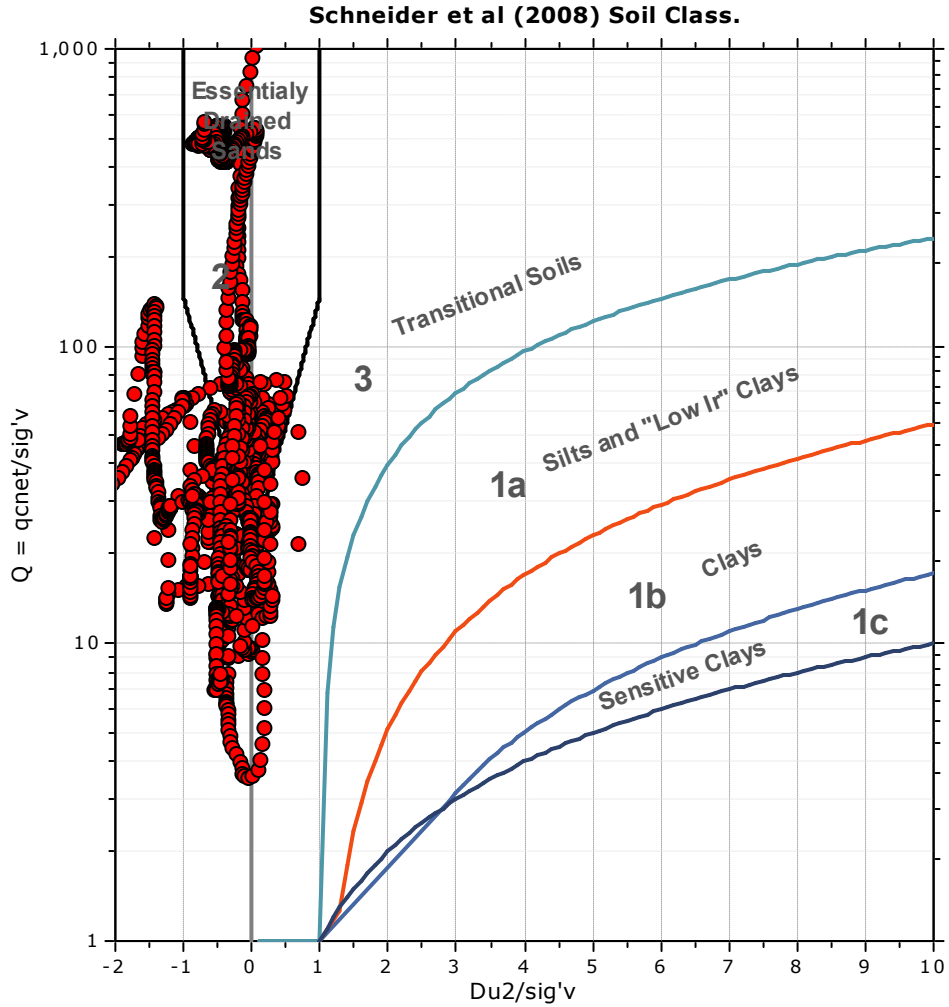
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

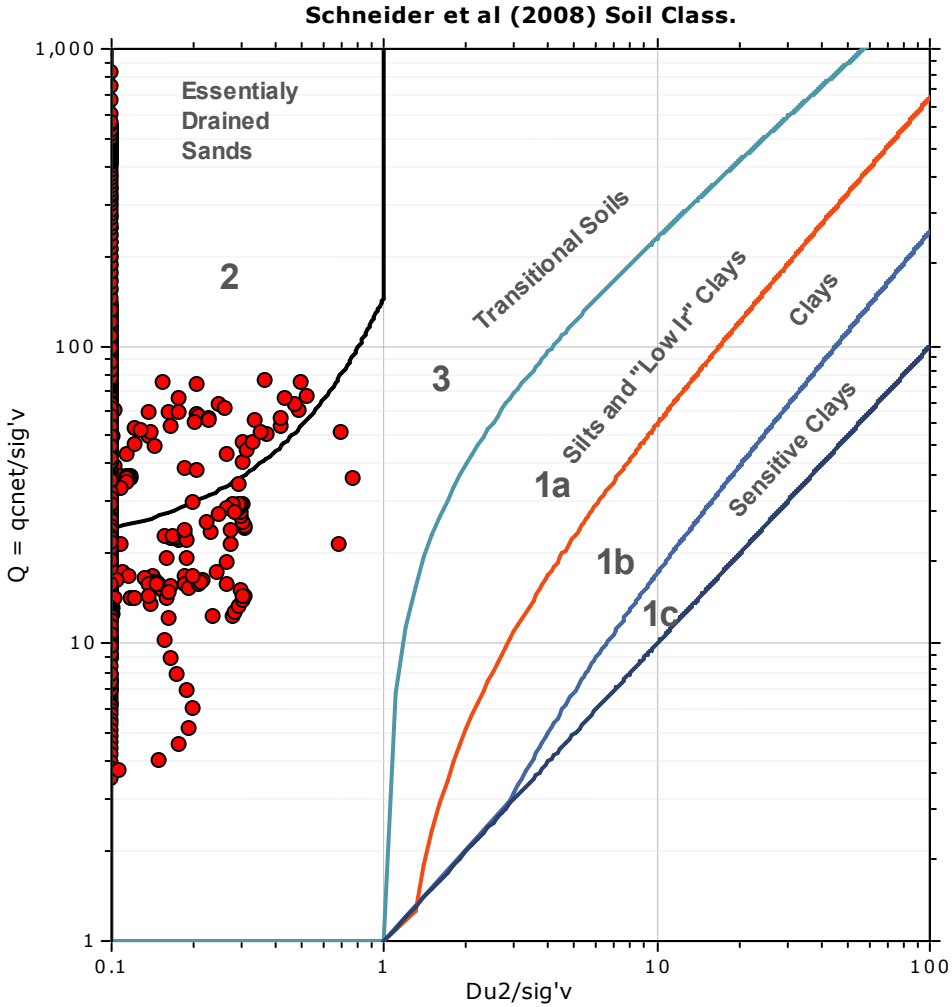
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Bq plots (Schneider)

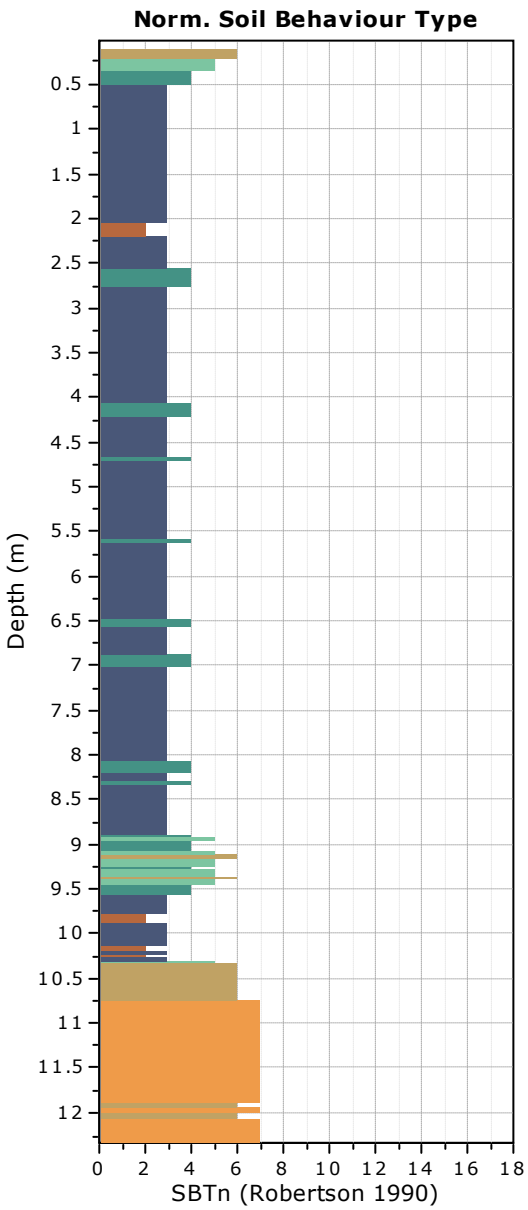


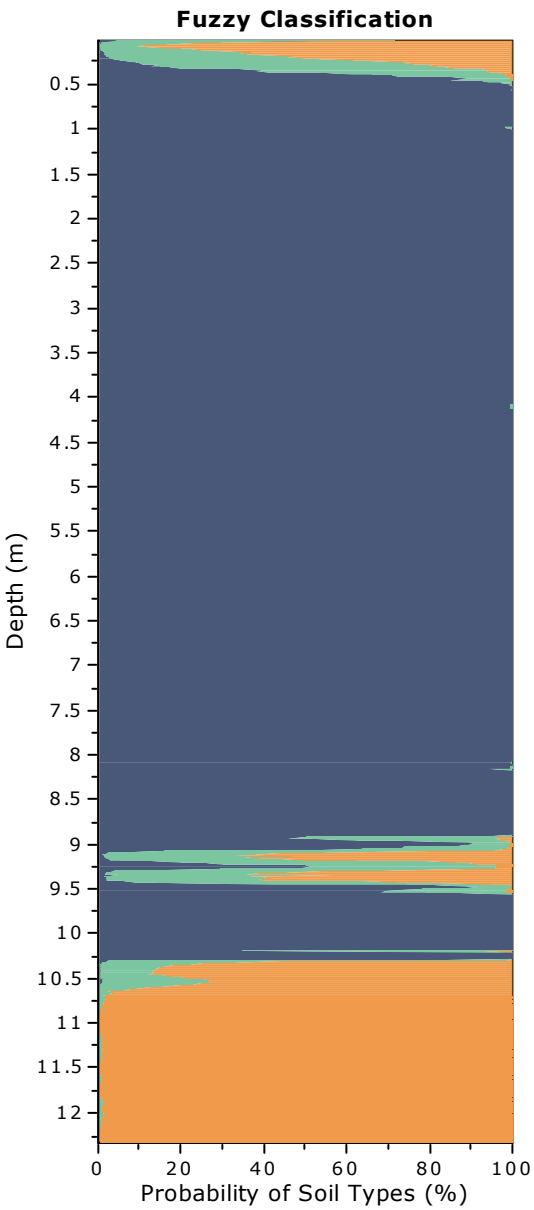


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



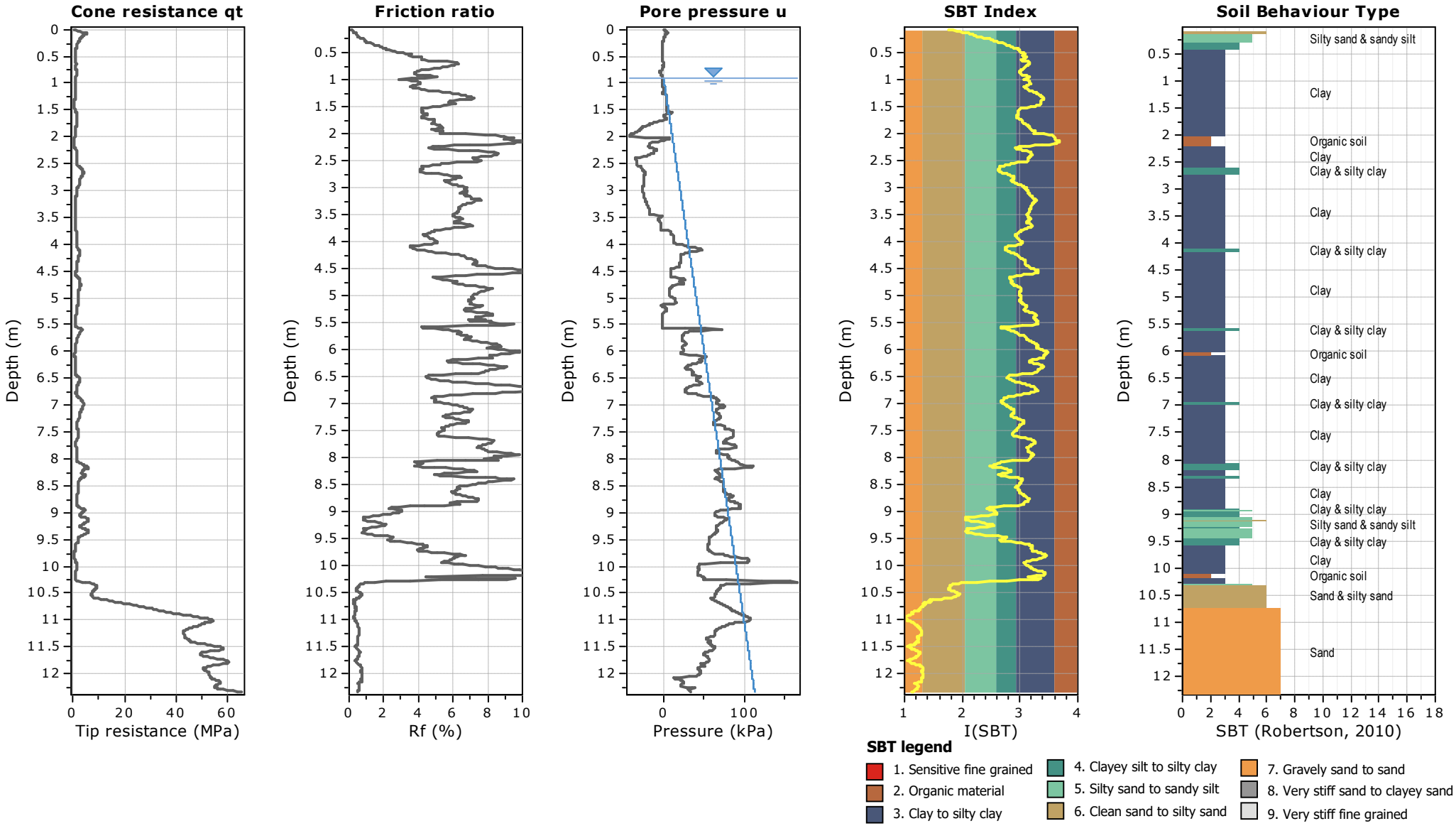


Fuzzy classifiaction legend
- Highly probable clayey soil
- Highly probable mixture soil
- Highly probable sandy soil

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

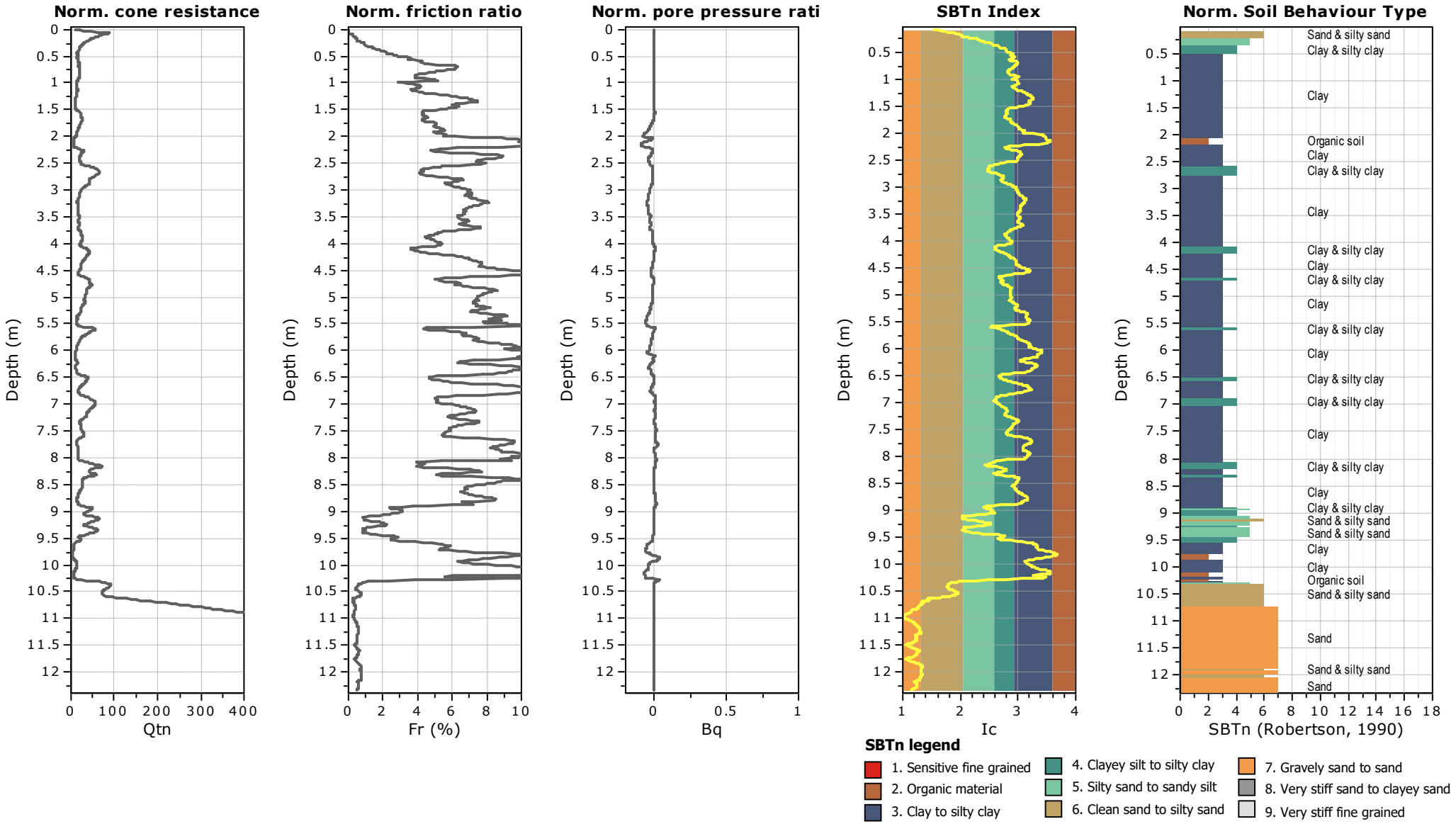
CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

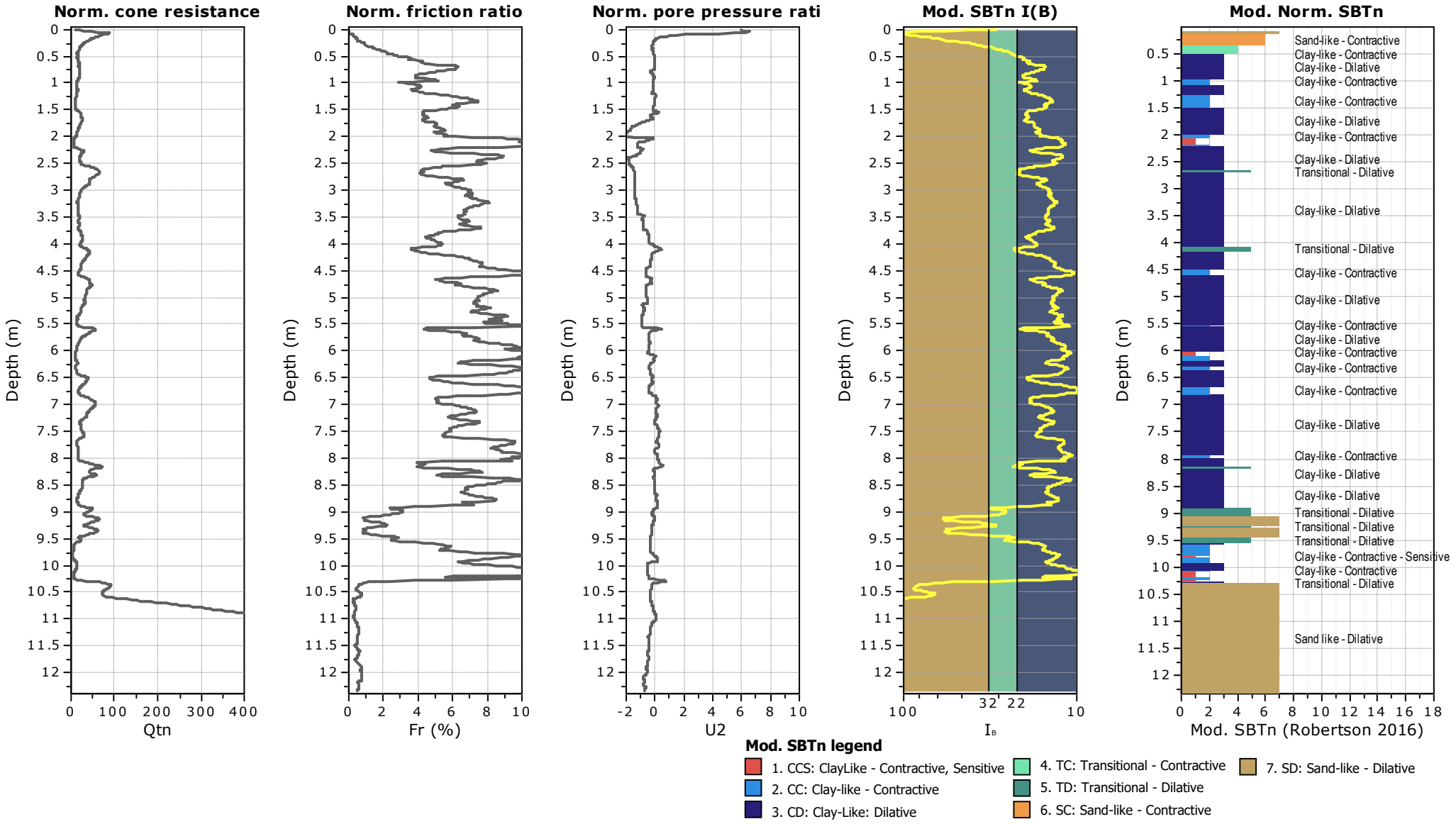
CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

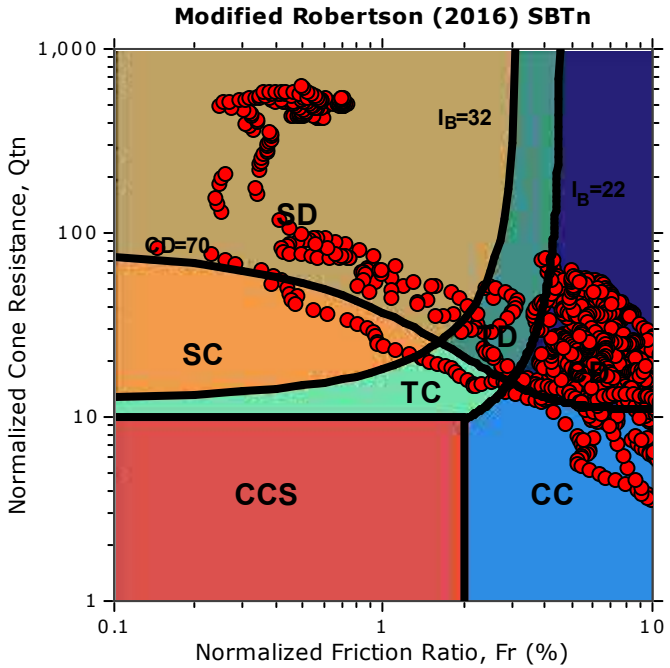


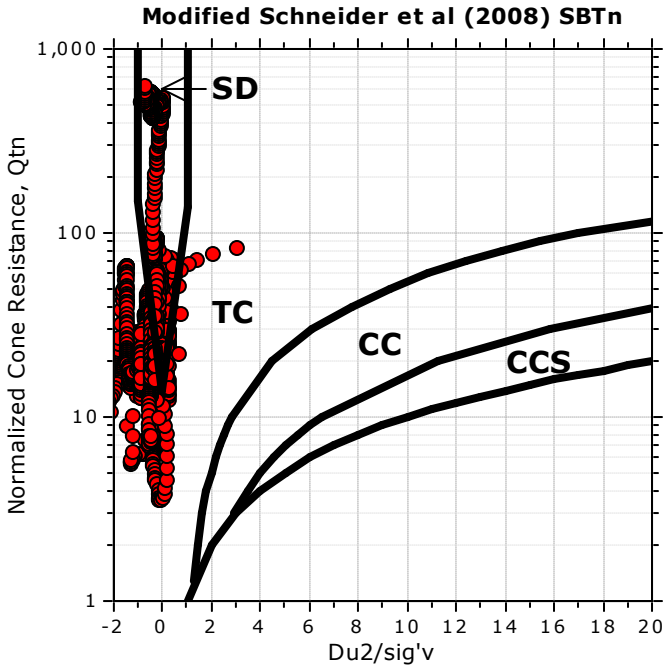
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

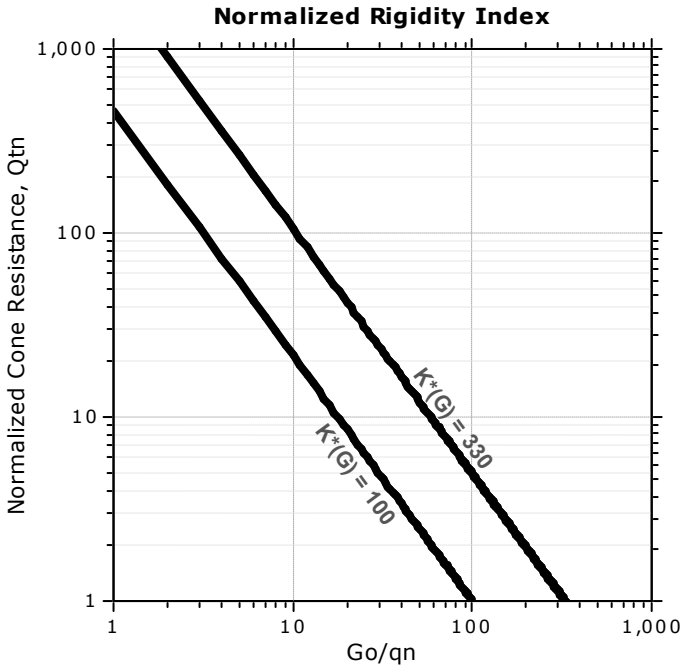
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Updated SBTn plots







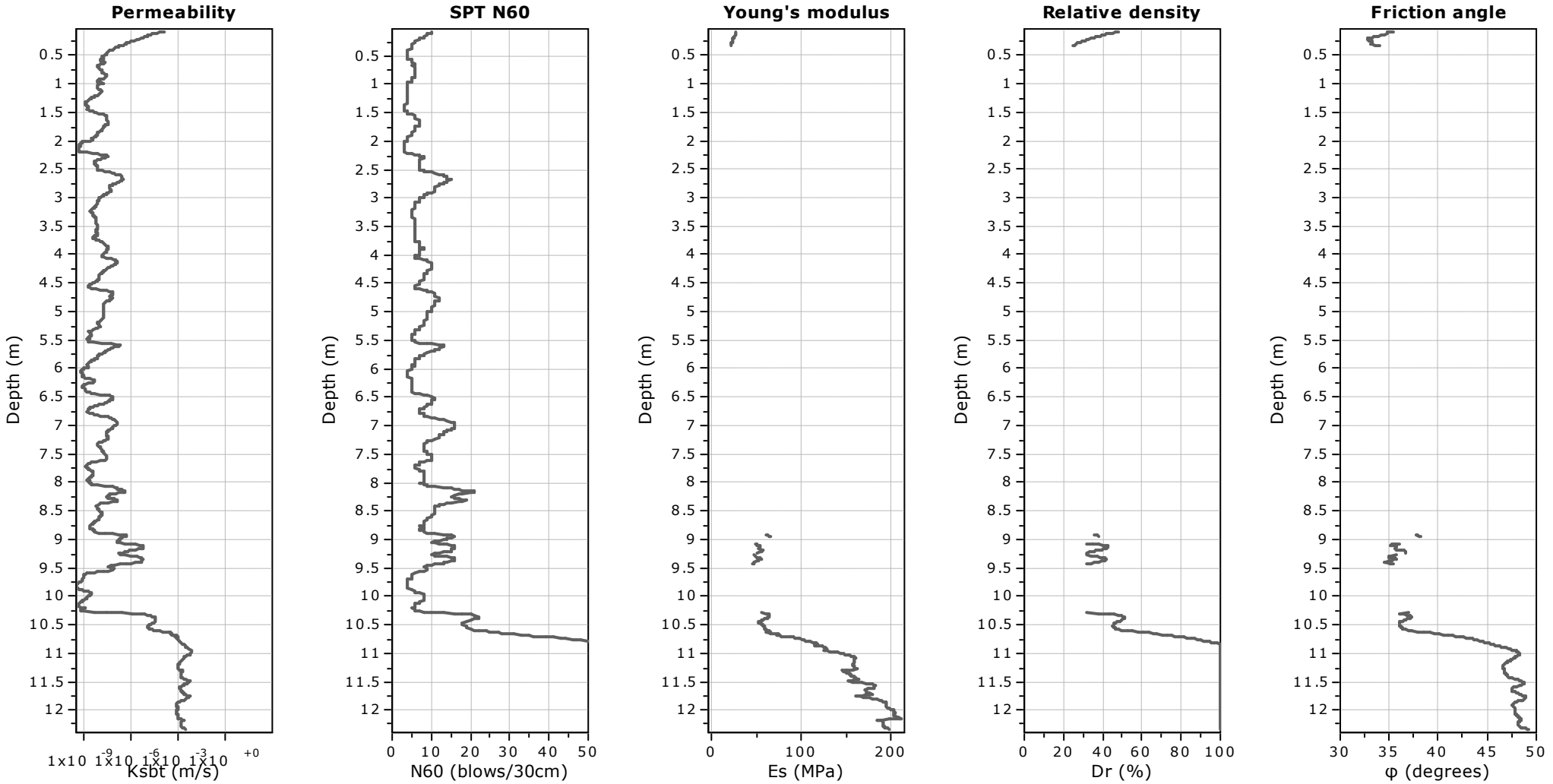
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



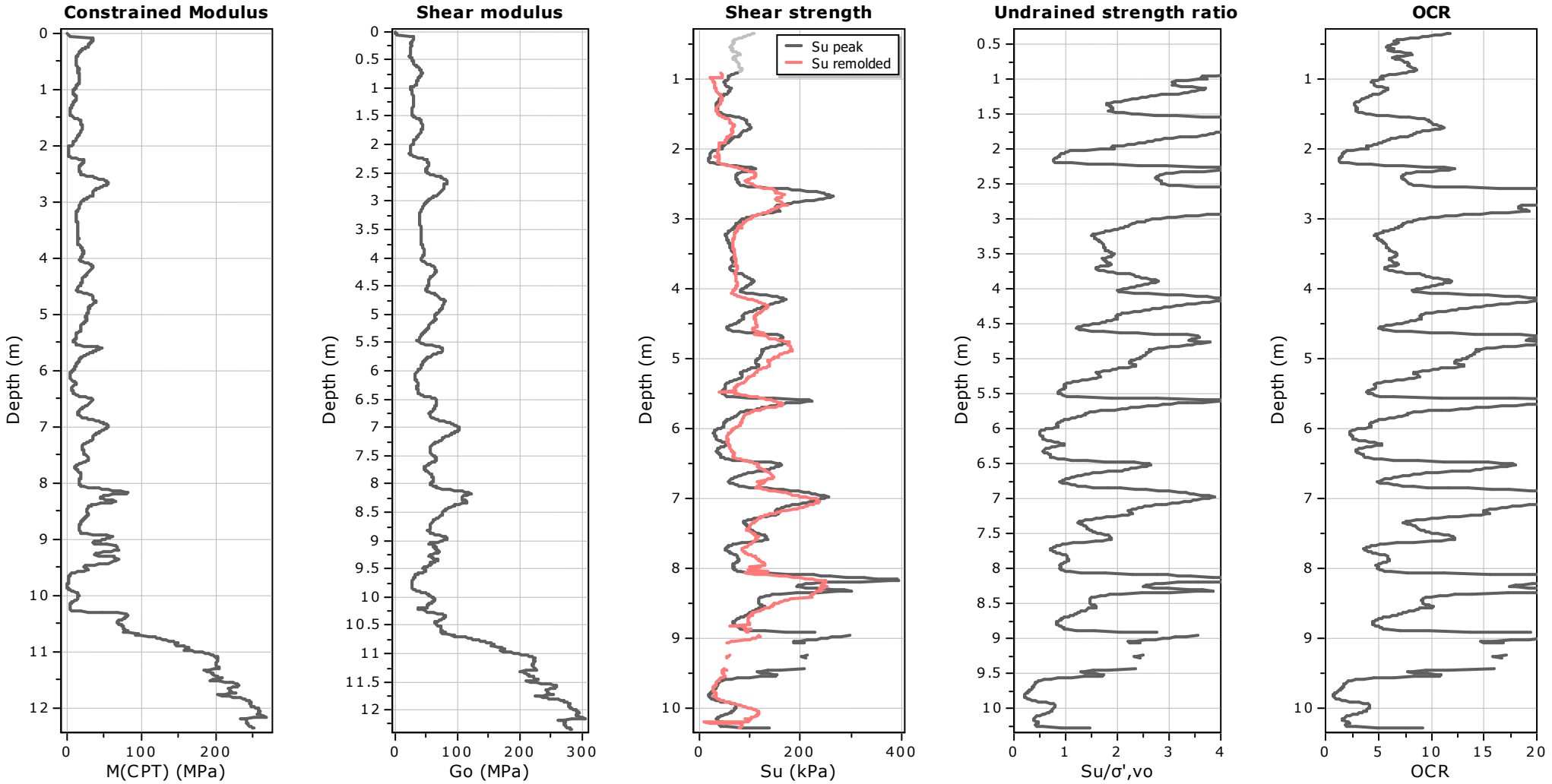
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



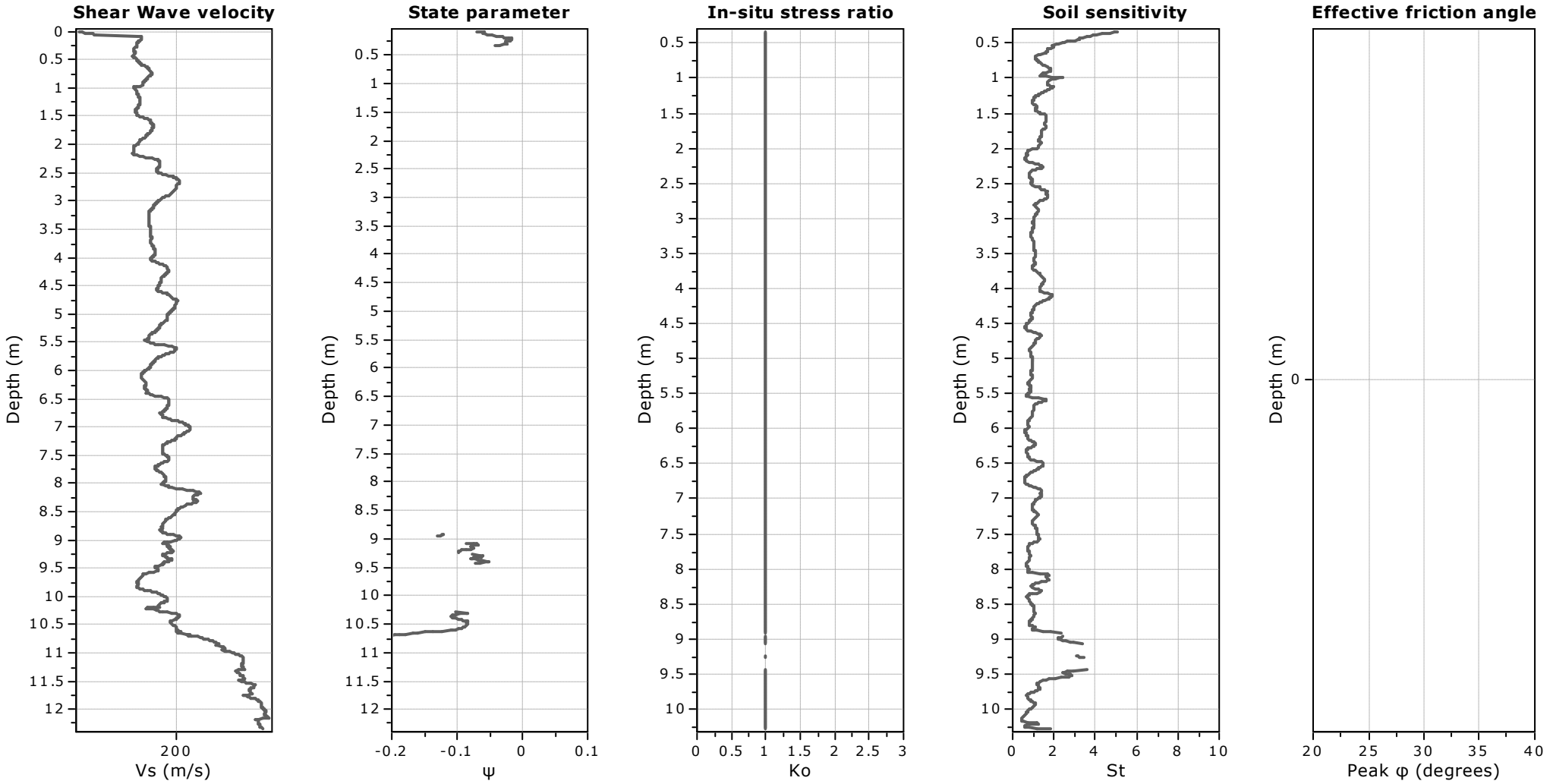
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto
OCR factor for clays, N_{kt}: Auto
Flat Dilatometer Test data

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



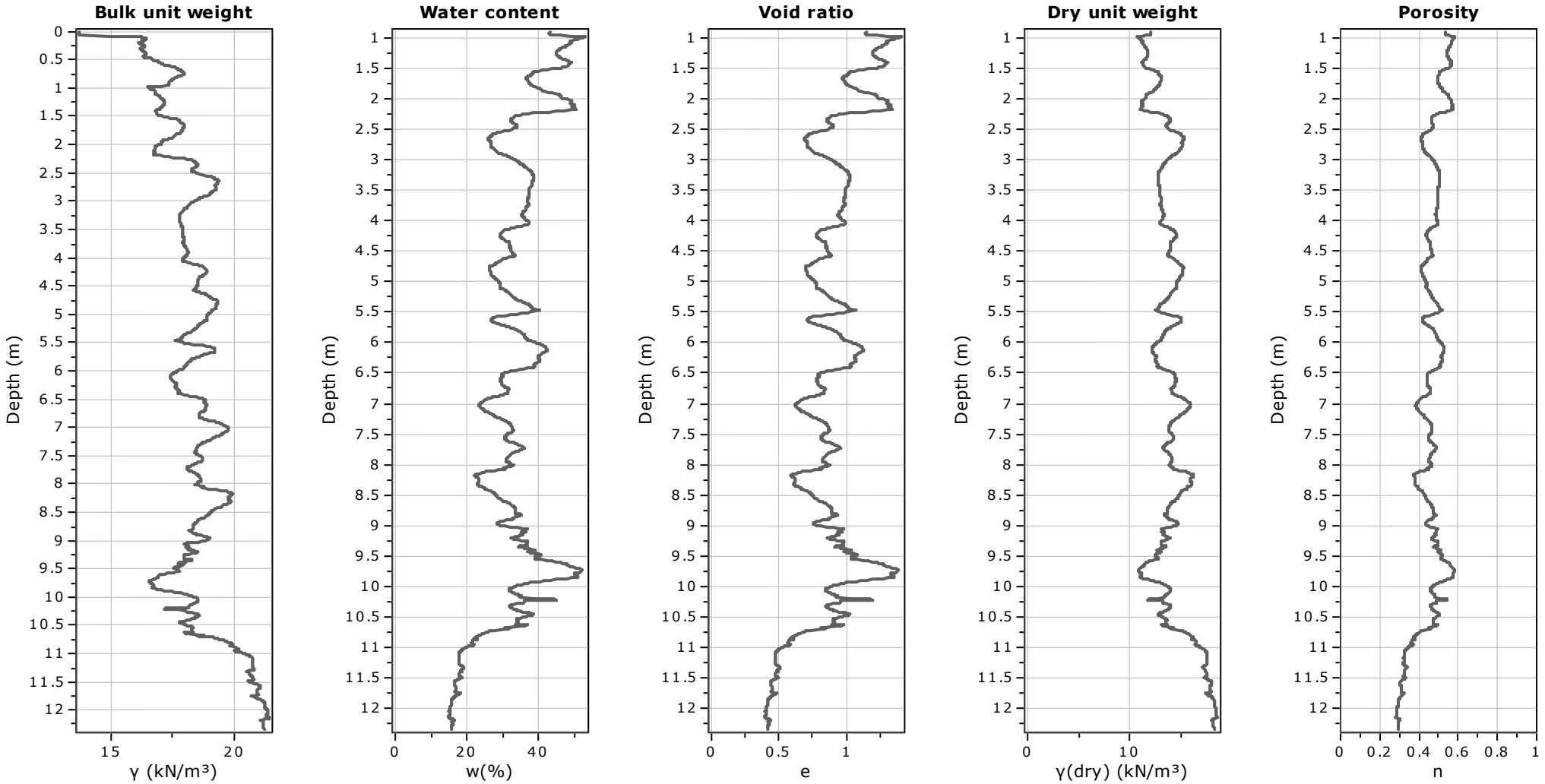
Calculation parameters

Soil Sensitivity factor, N_S: 7.00

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

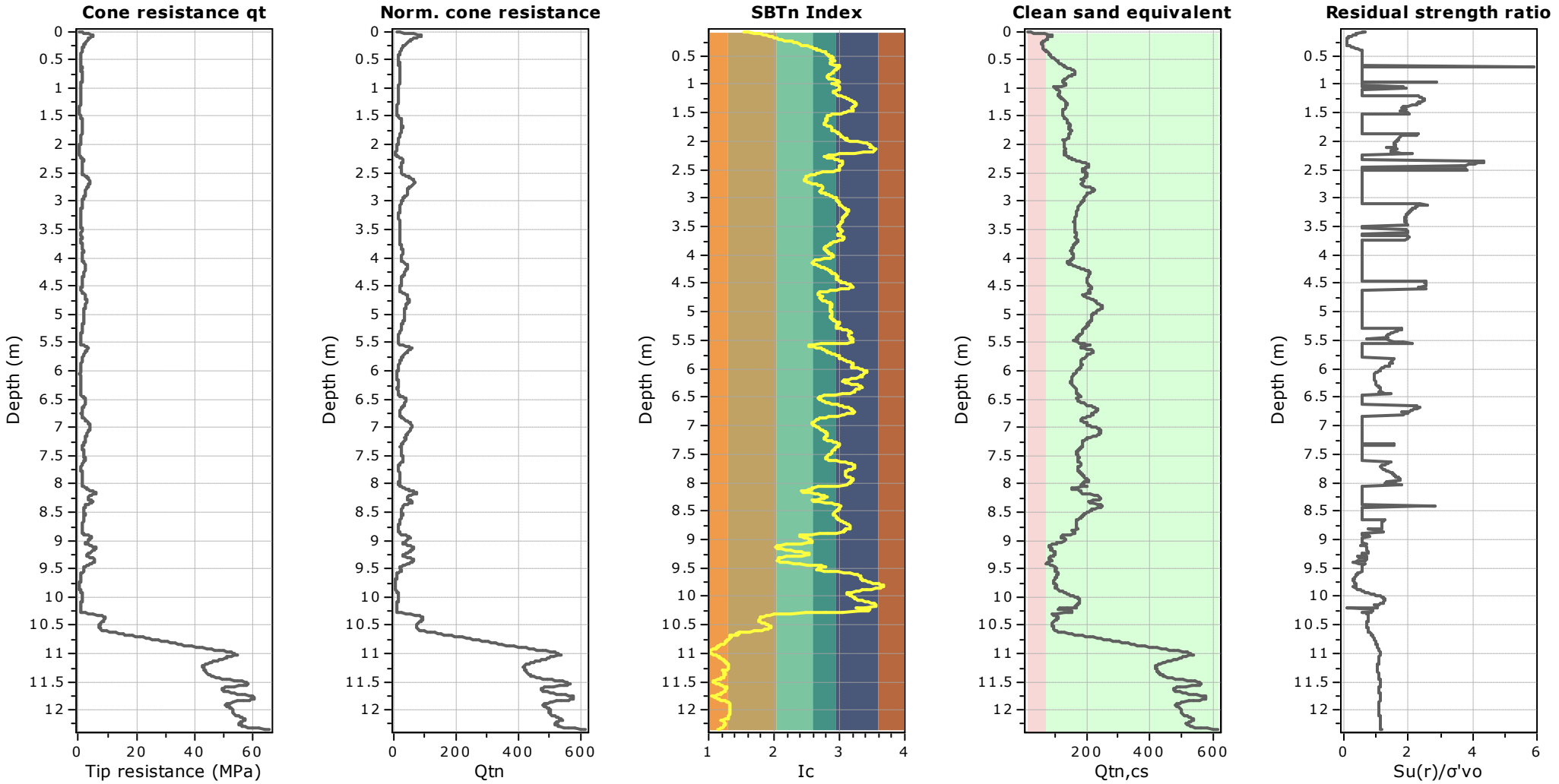
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

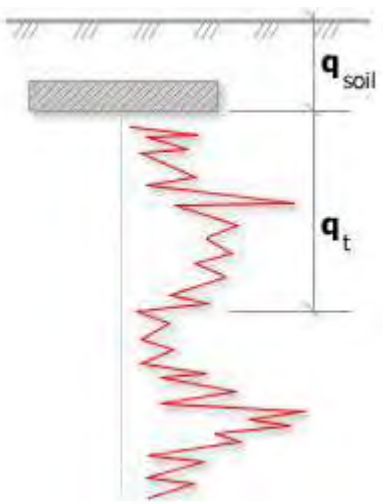


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

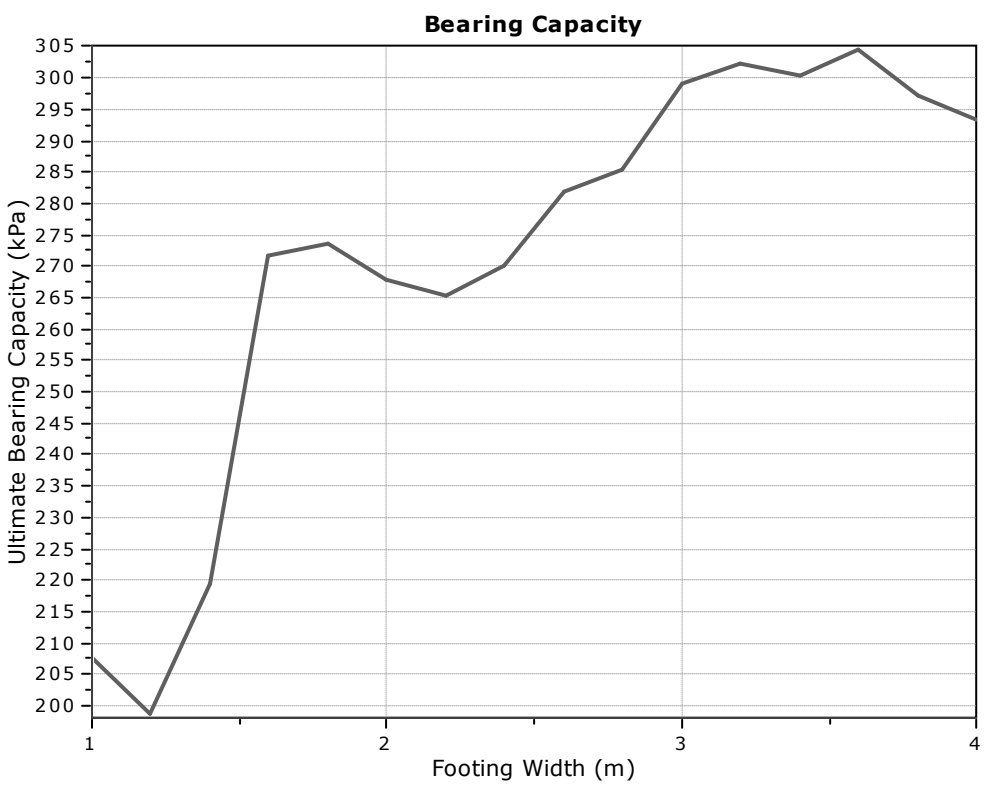




Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



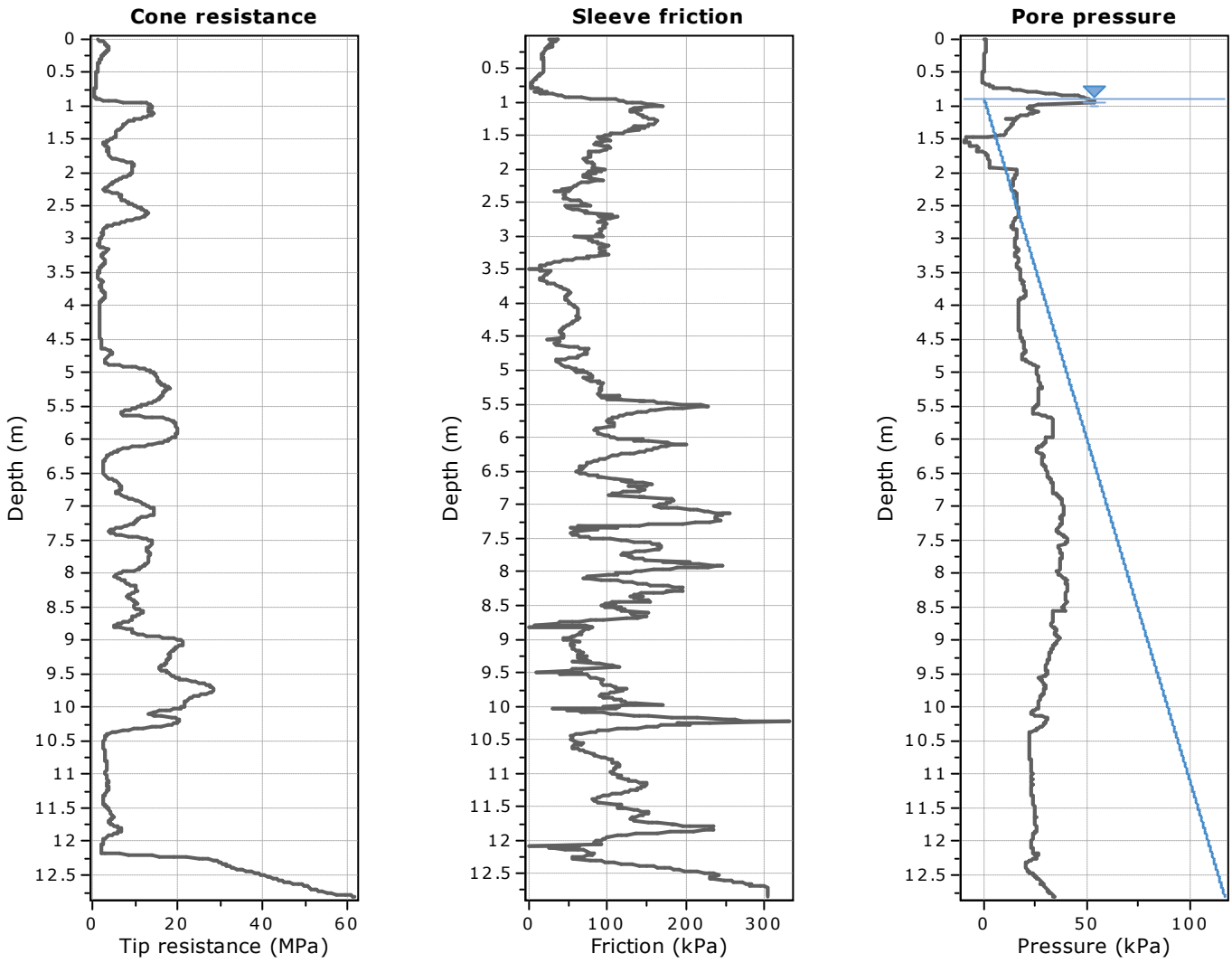
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	0.99	0.20	9.50	207.55
2	1.20	0.50	2.30	0.95	0.20	9.50	198.74
3	1.40	0.50	2.60	1.05	0.20	9.50	219.32
4	1.60	0.50	2.90	1.31	0.20	9.50	271.57
5	1.80	0.50	3.20	1.32	0.20	9.50	273.60
6	2.00	0.50	3.50	1.29	0.20	9.50	267.73
7	2.20	0.50	3.80	1.28	0.20	9.50	265.39
8	2.40	0.50	4.10	1.30	0.20	9.50	270.20
9	2.60	0.50	4.40	1.36	0.20	9.50	282.03
10	2.80	0.50	4.70	1.38	0.20	9.50	285.38
11	3.00	0.50	5.00	1.45	0.20	9.50	298.99
12	3.20	0.50	5.30	1.46	0.20	9.50	302.26
13	3.40	0.50	5.60	1.45	0.20	9.50	300.27
14	3.60	0.50	5.90	1.47	0.20	9.50	304.50
15	3.80	0.50	6.20	1.44	0.20	9.50	297.09
16	4.00	0.50	6.50	1.42	0.20	9.50	293.48

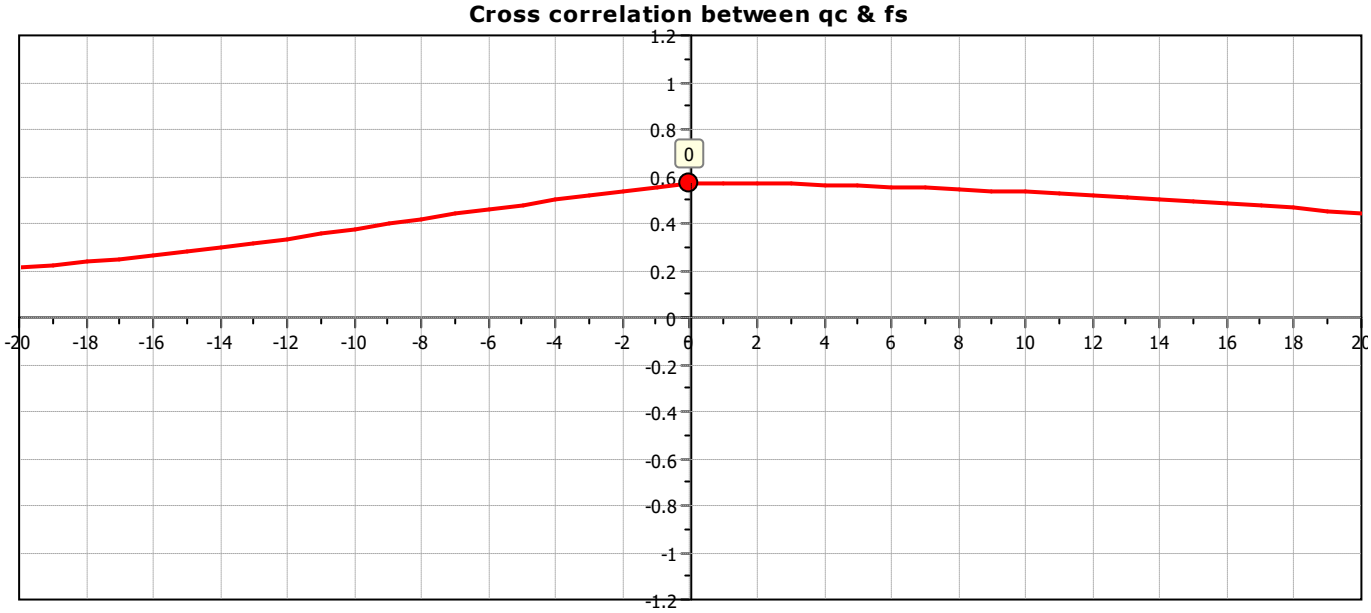
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

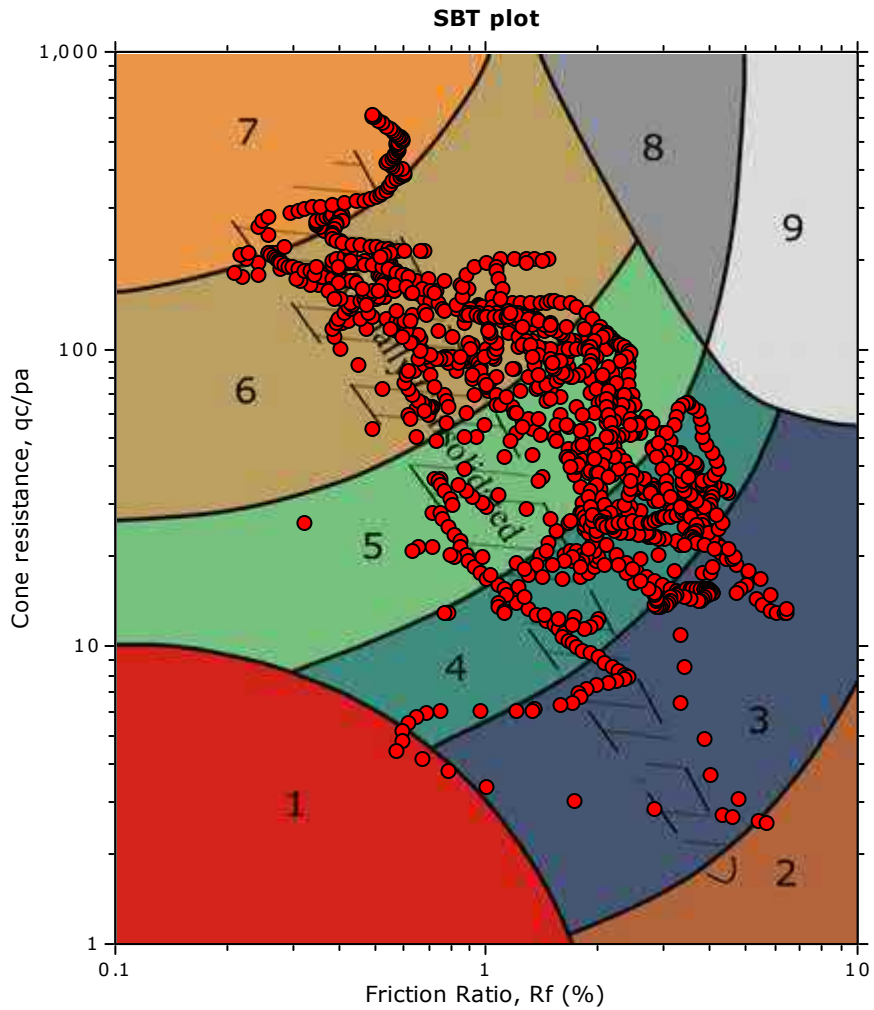


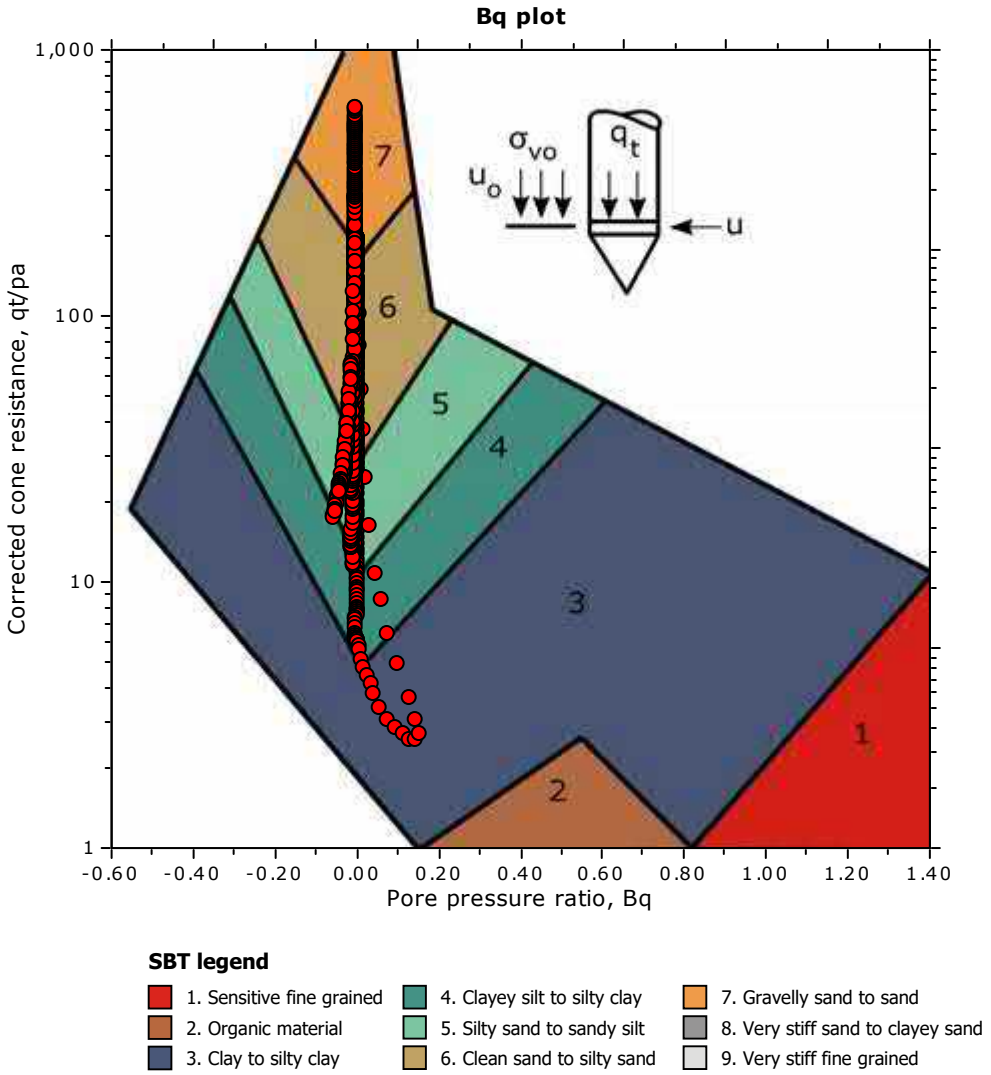
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots





SBT legend

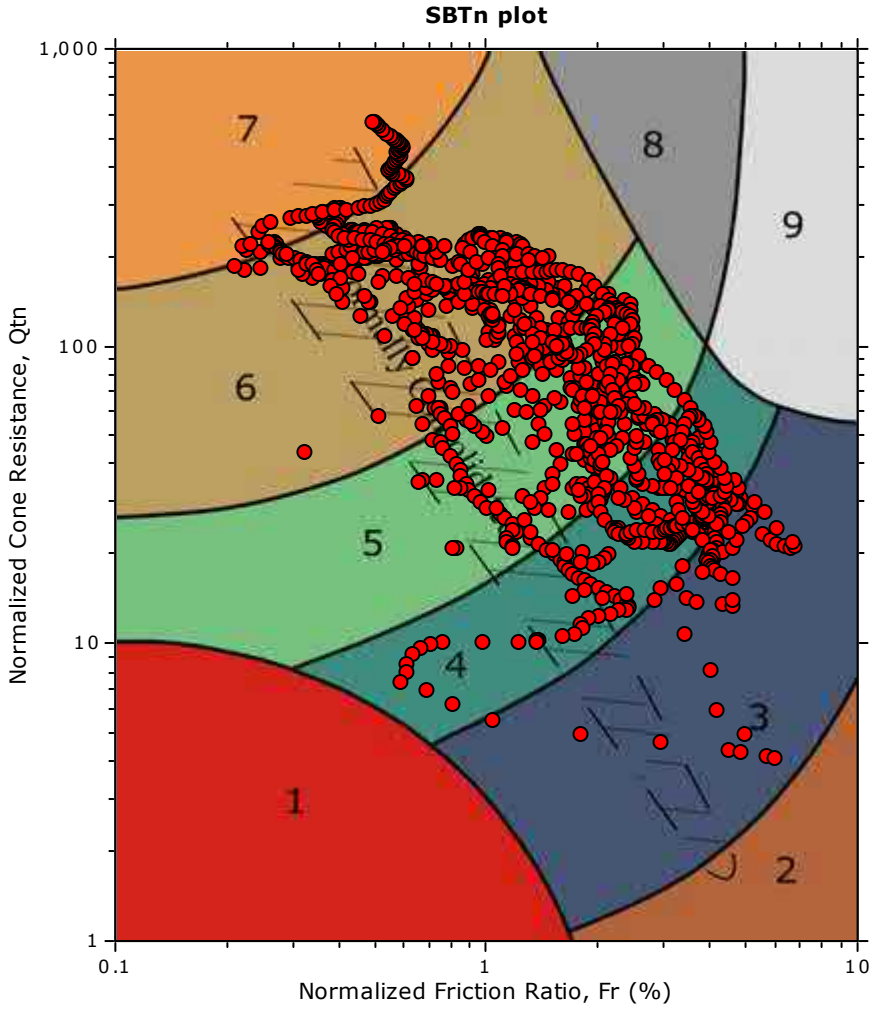
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

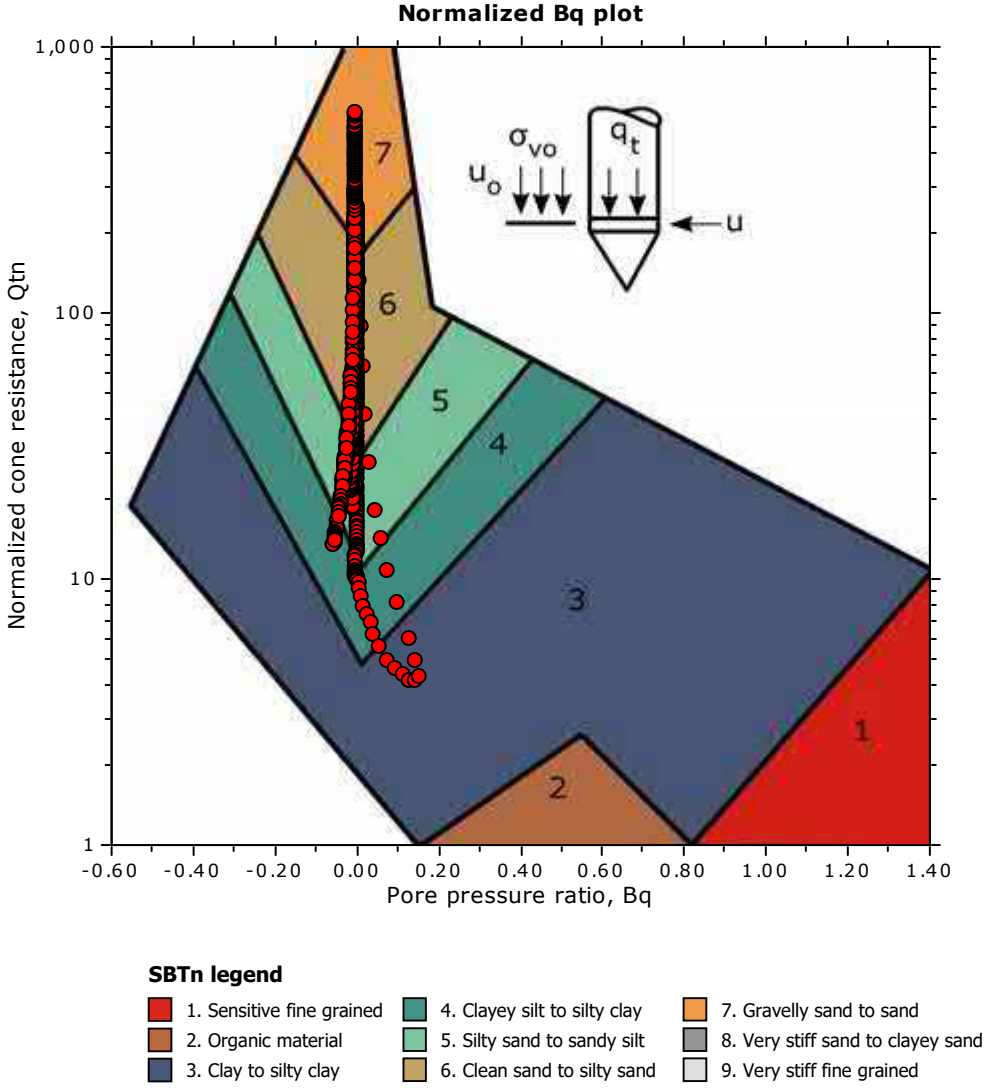
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots (normalized)





SBTn legend

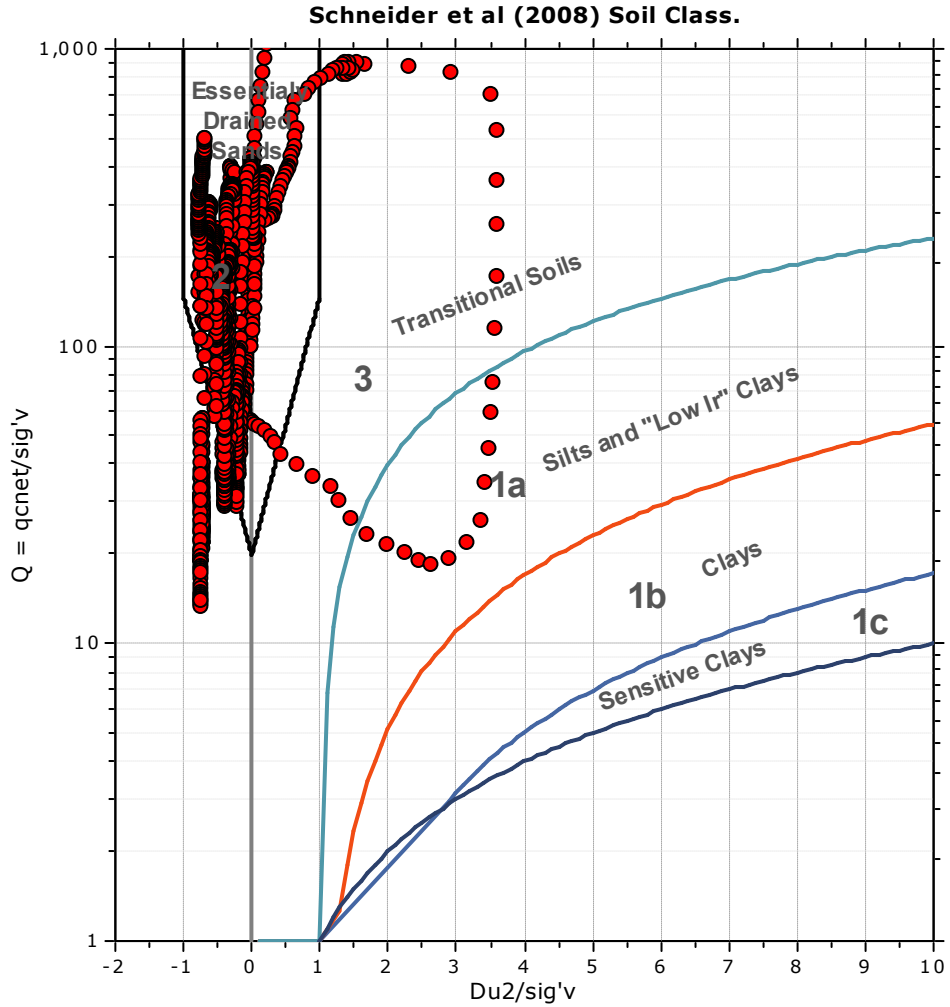
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

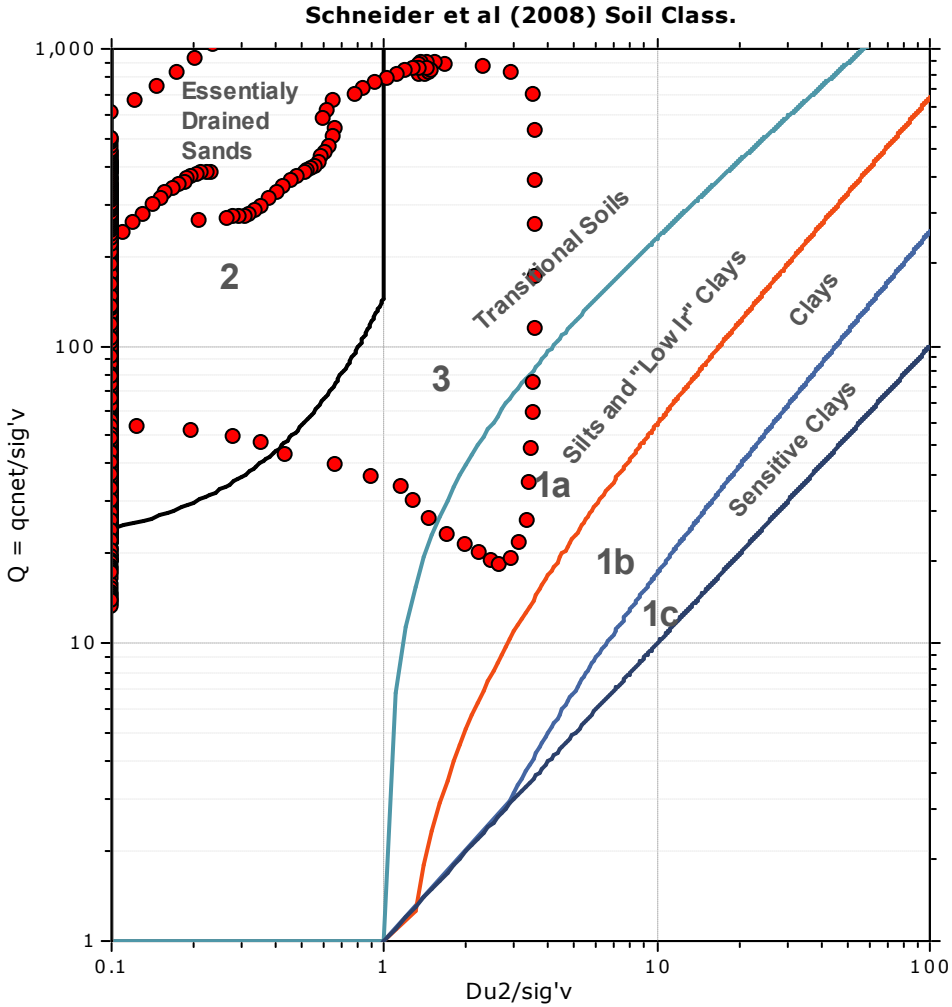
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Bq plots (Schneider)

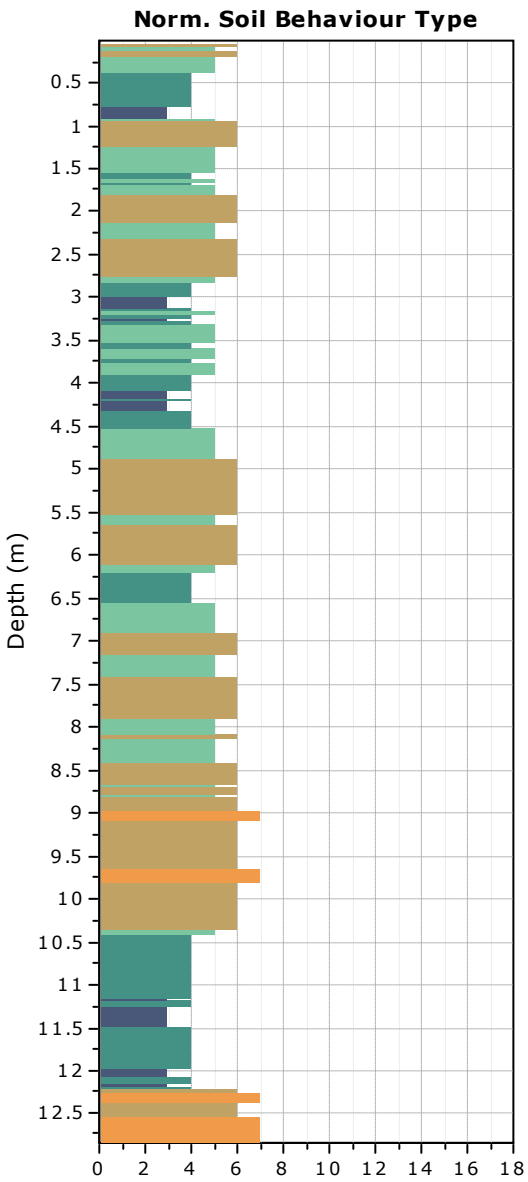


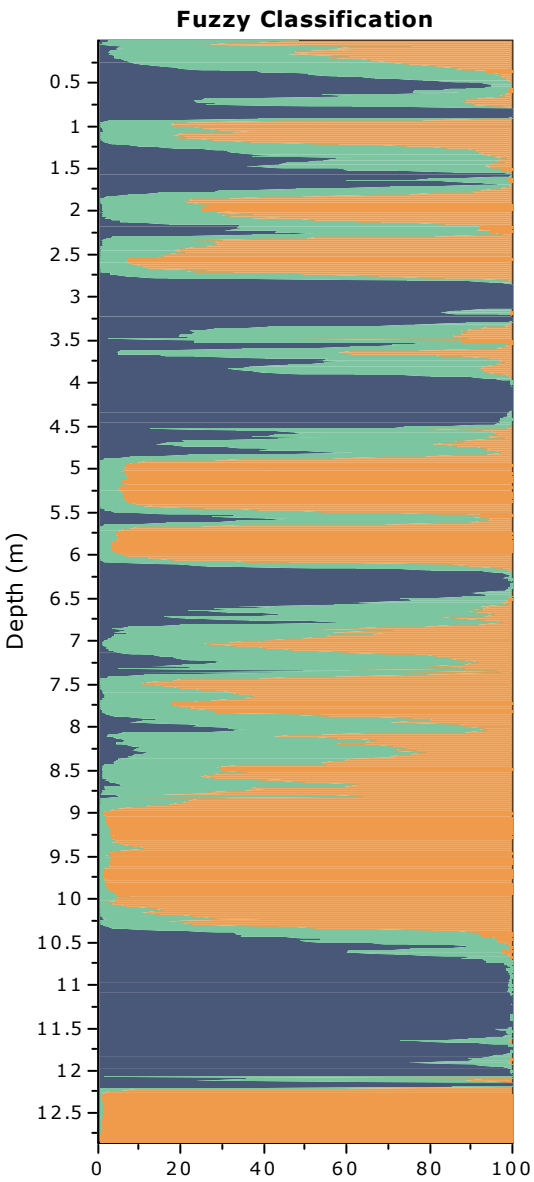


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



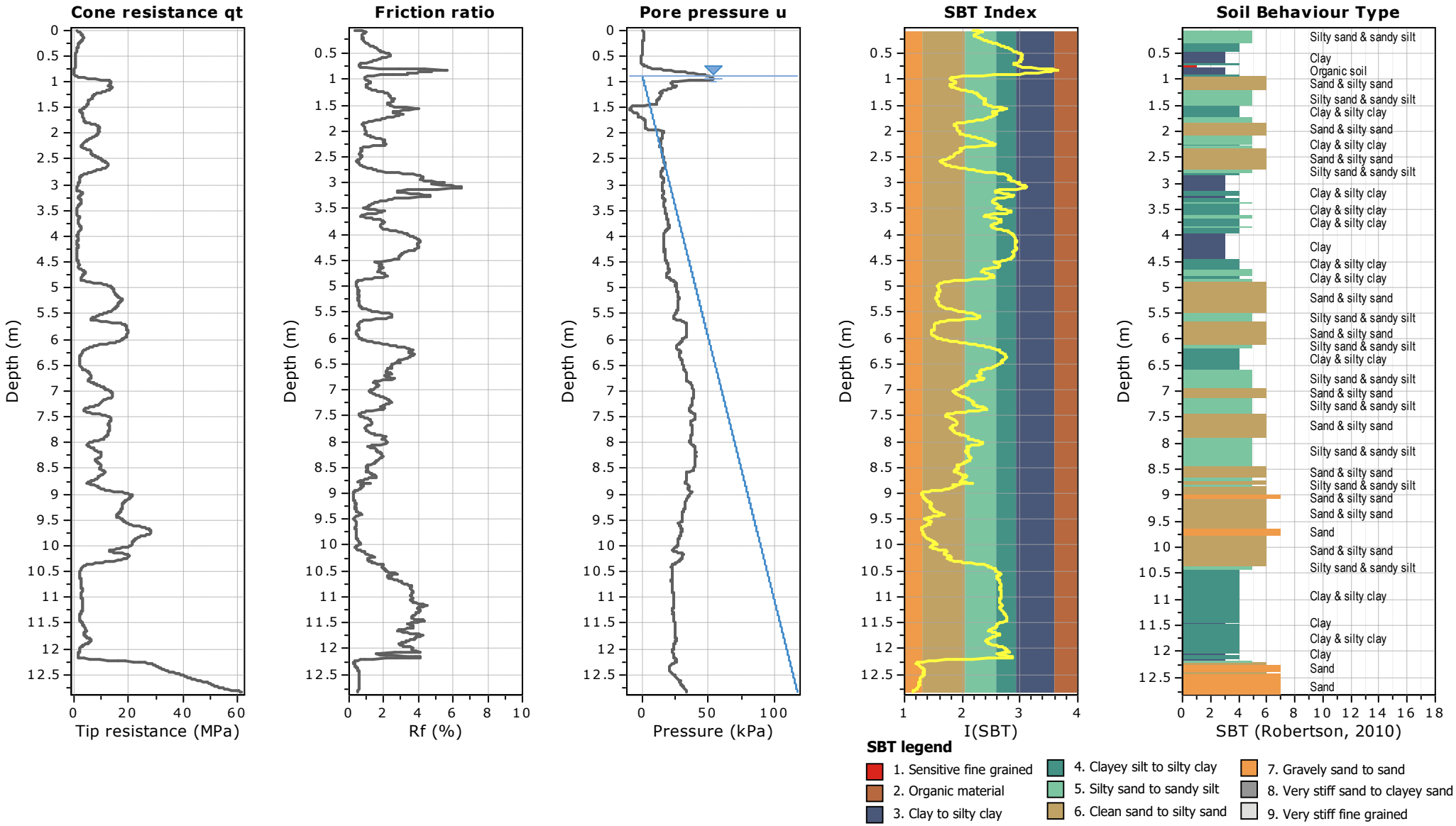


Fuzzy classifiaction legend
- Highly probable clayey soil
- Highly probable mixture soil
- Highly probable sandy soil

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

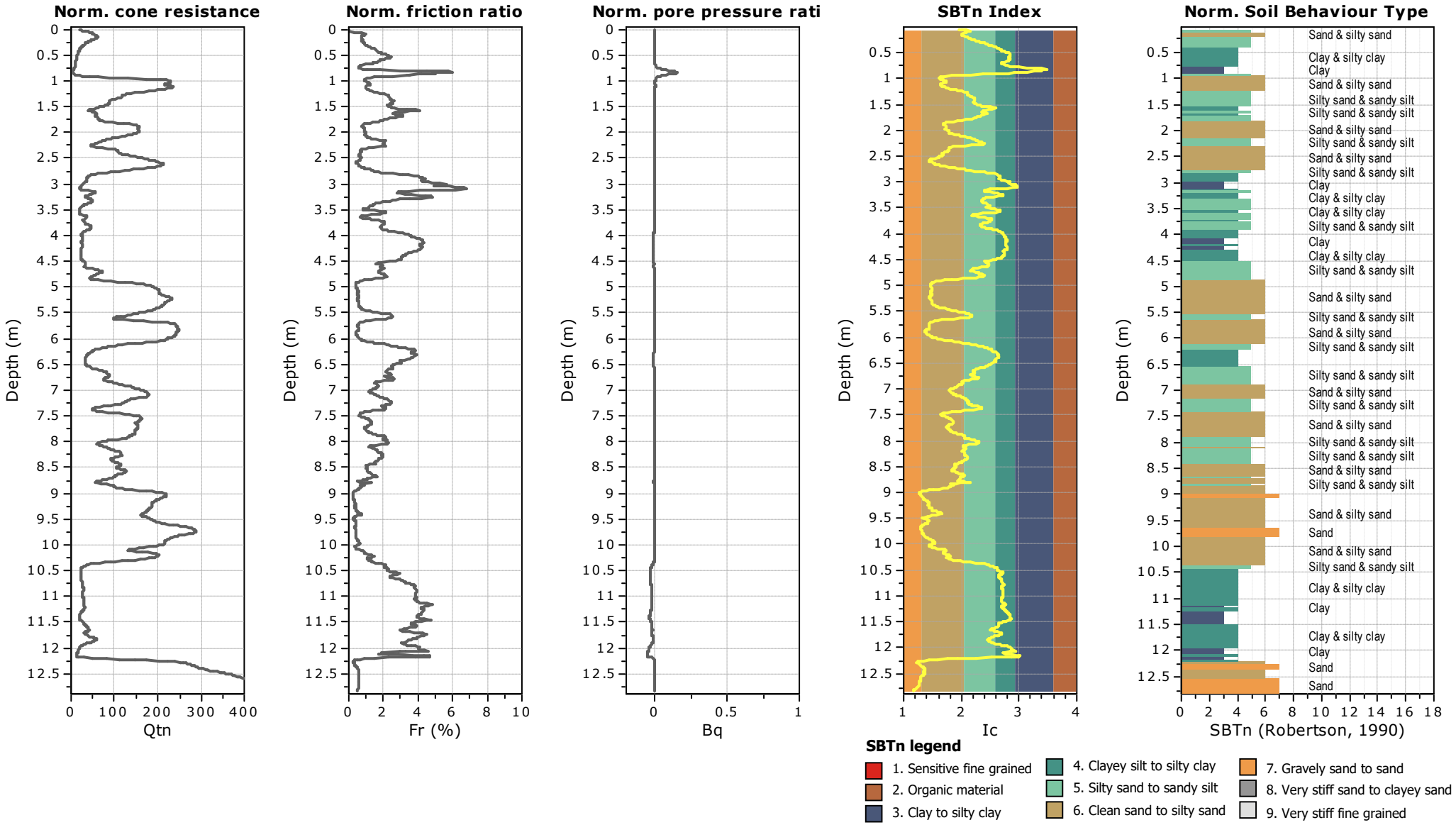
CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

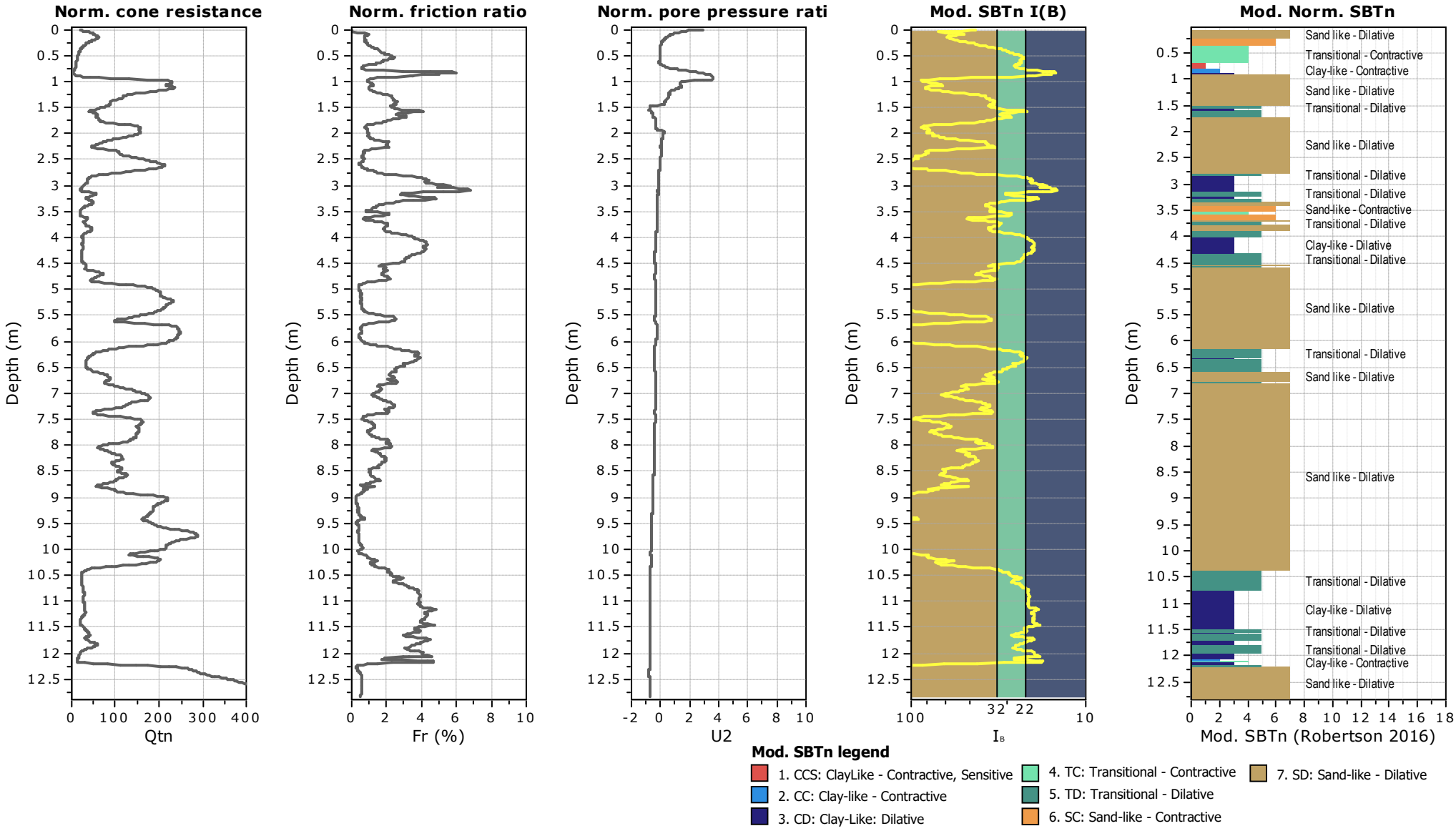
CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

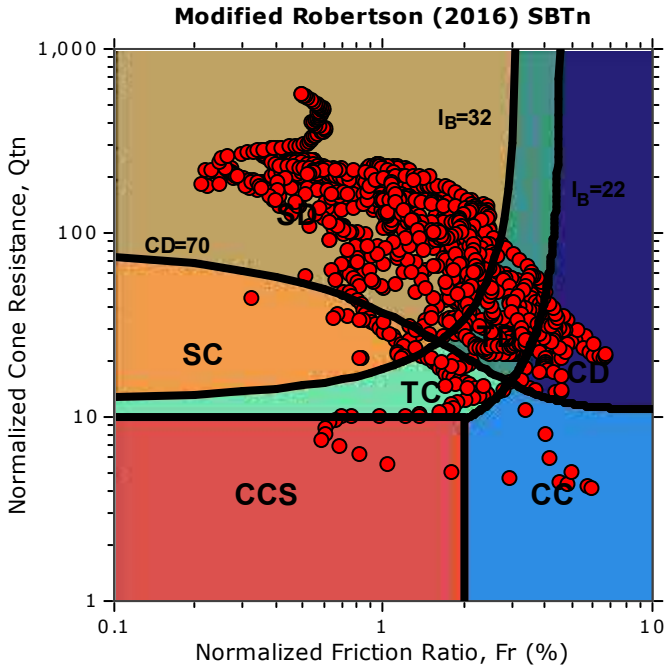


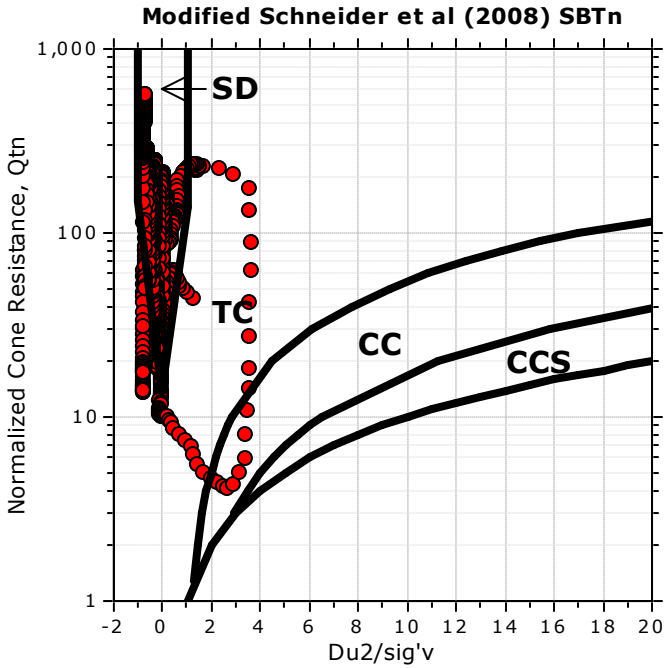
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

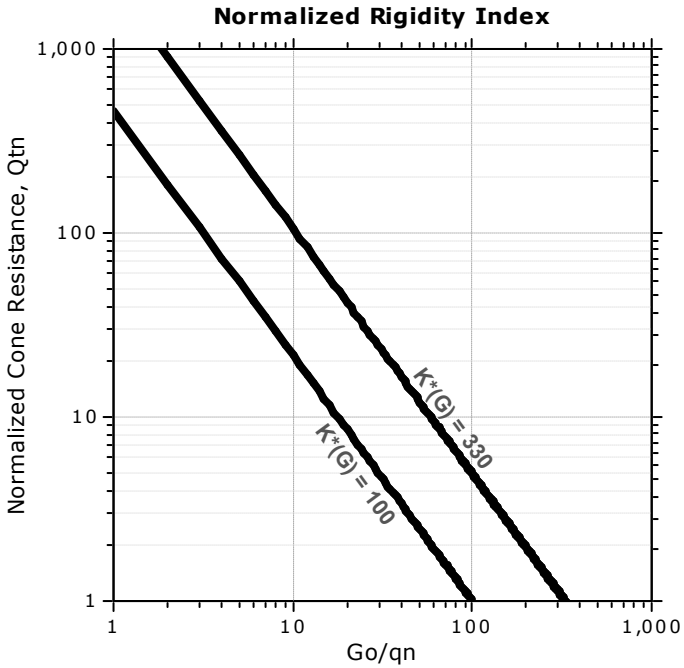
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Updated SBTn plots







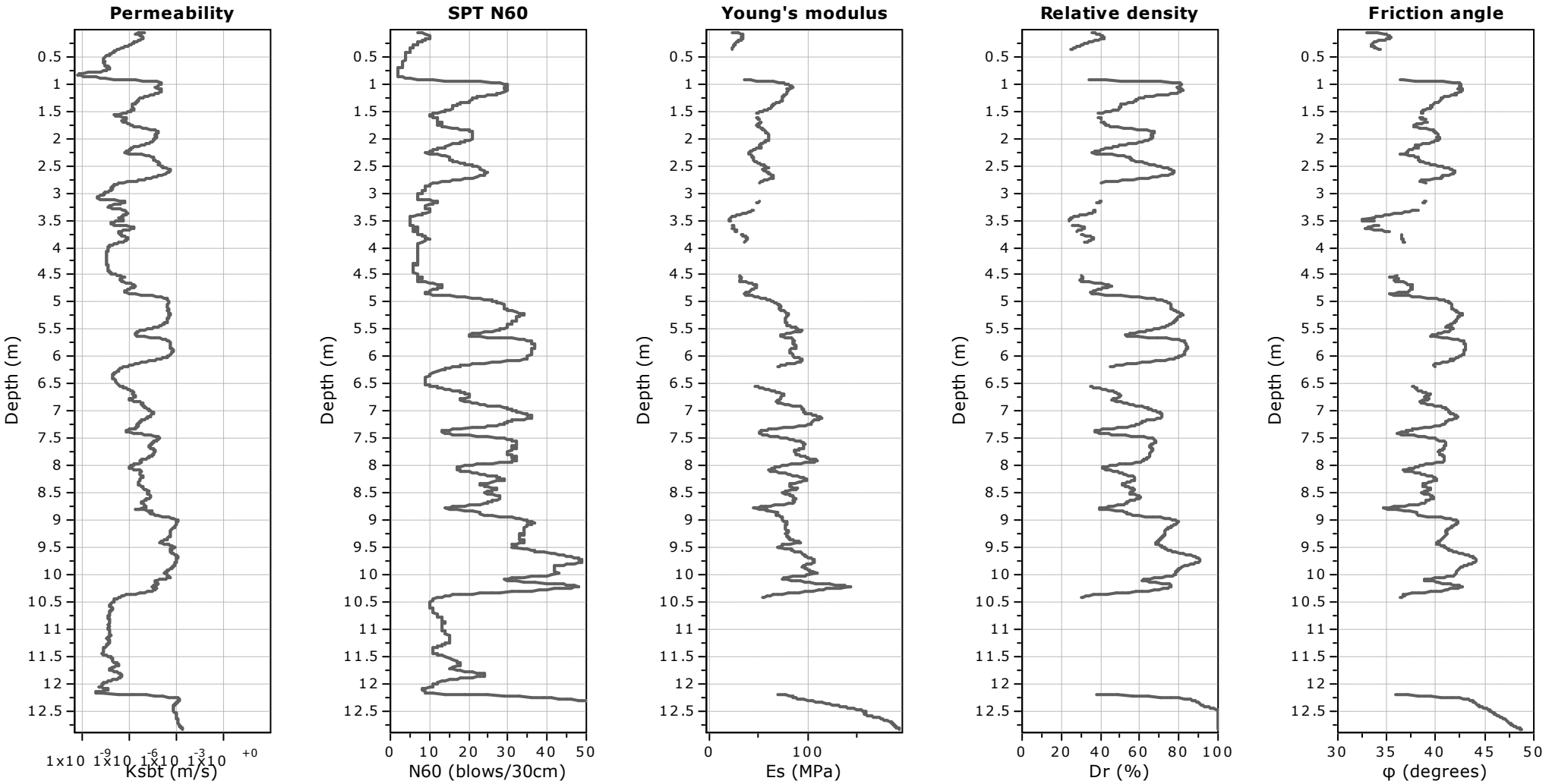
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



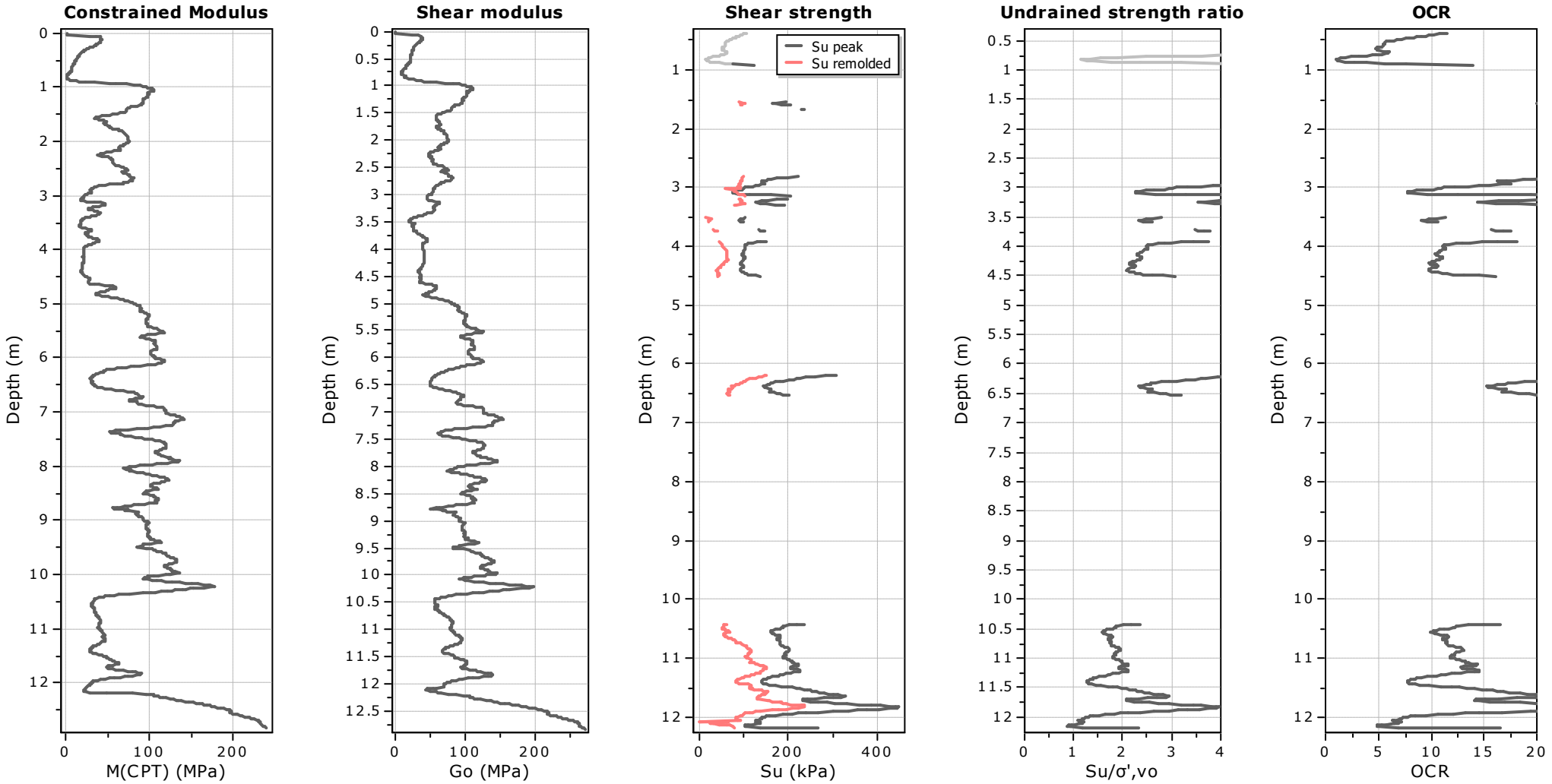
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



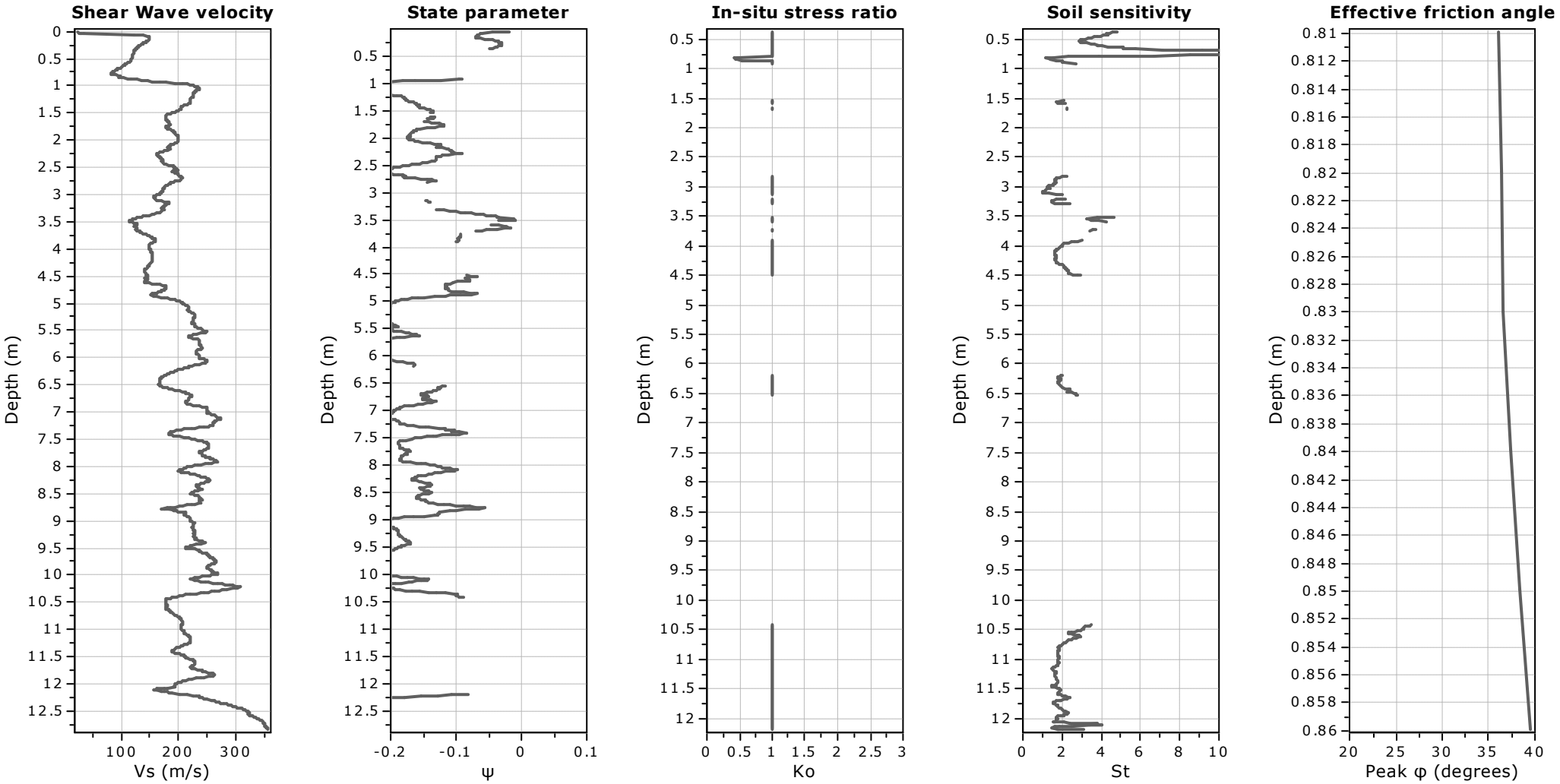
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto
OCR factor for clays, N_{kt}: Auto
Flat Dilatometer Test data

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



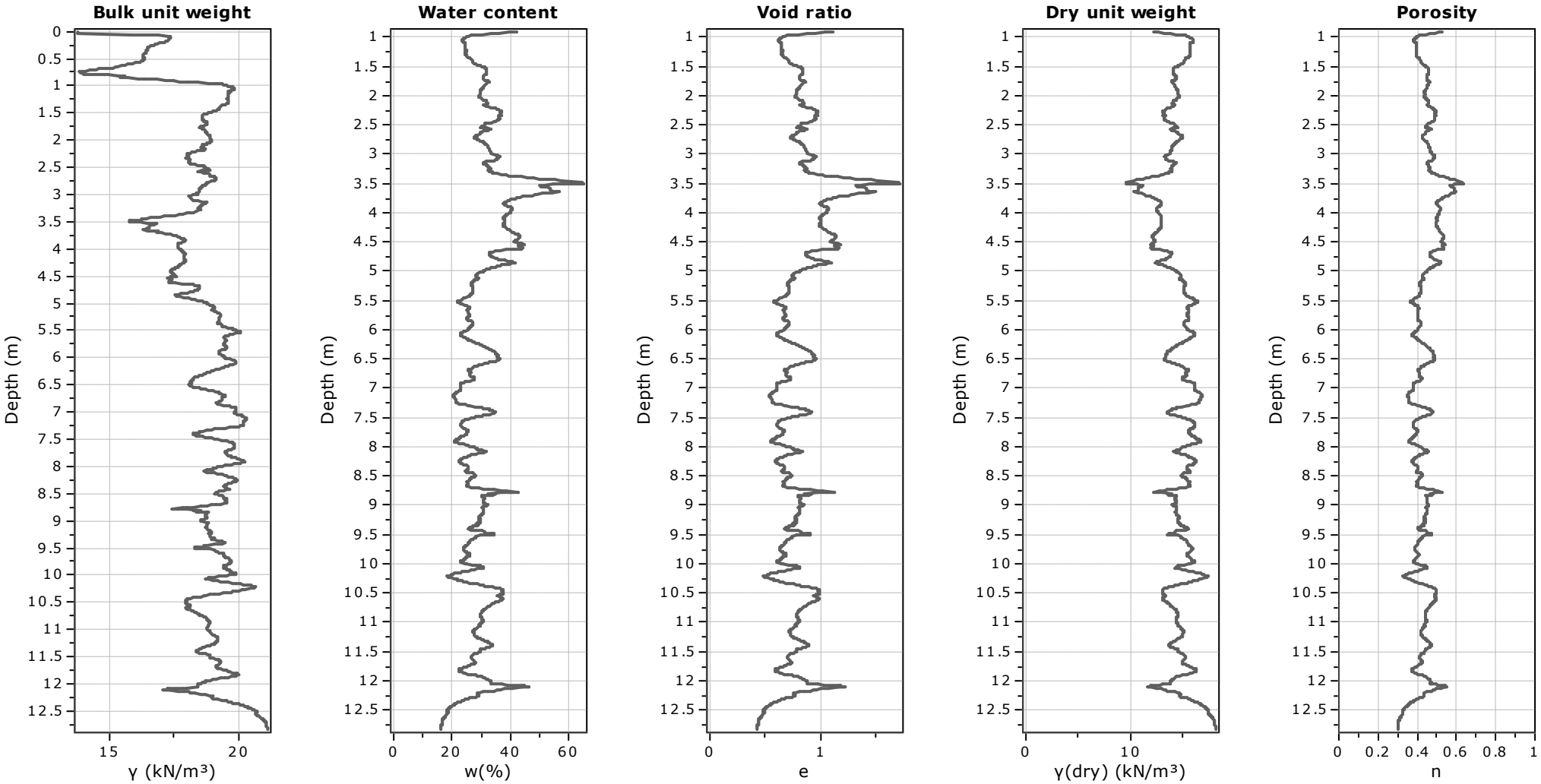
Calculation parameters

Soil Sensitivity factor, N_S: 7.00

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

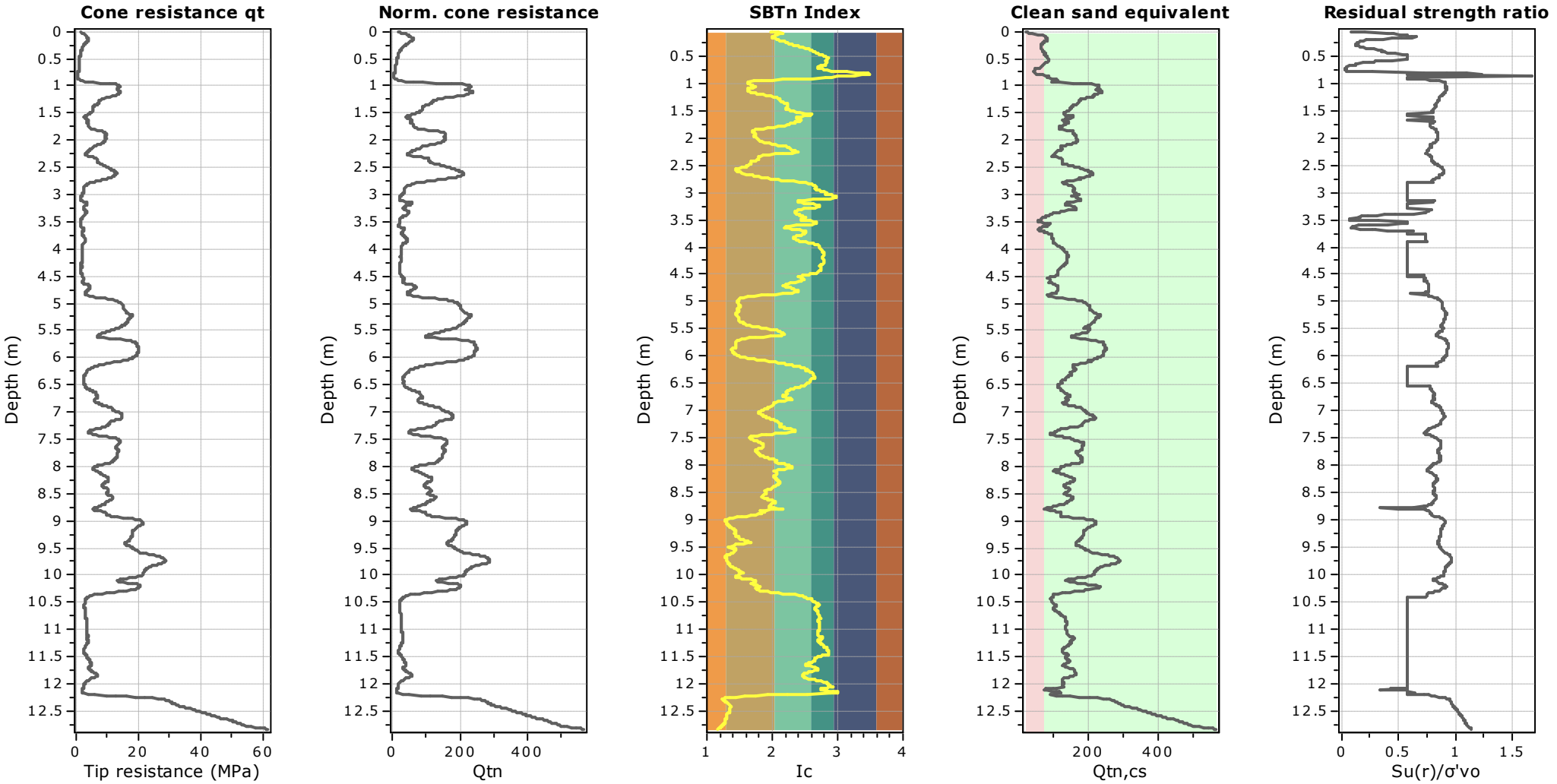
CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

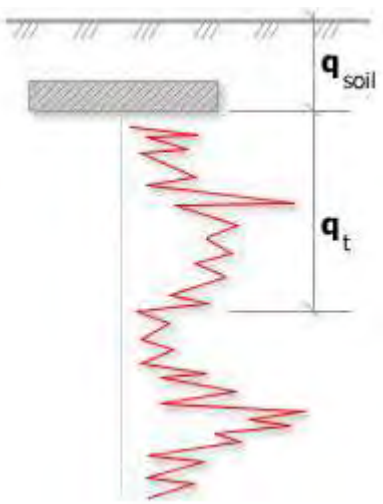
CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

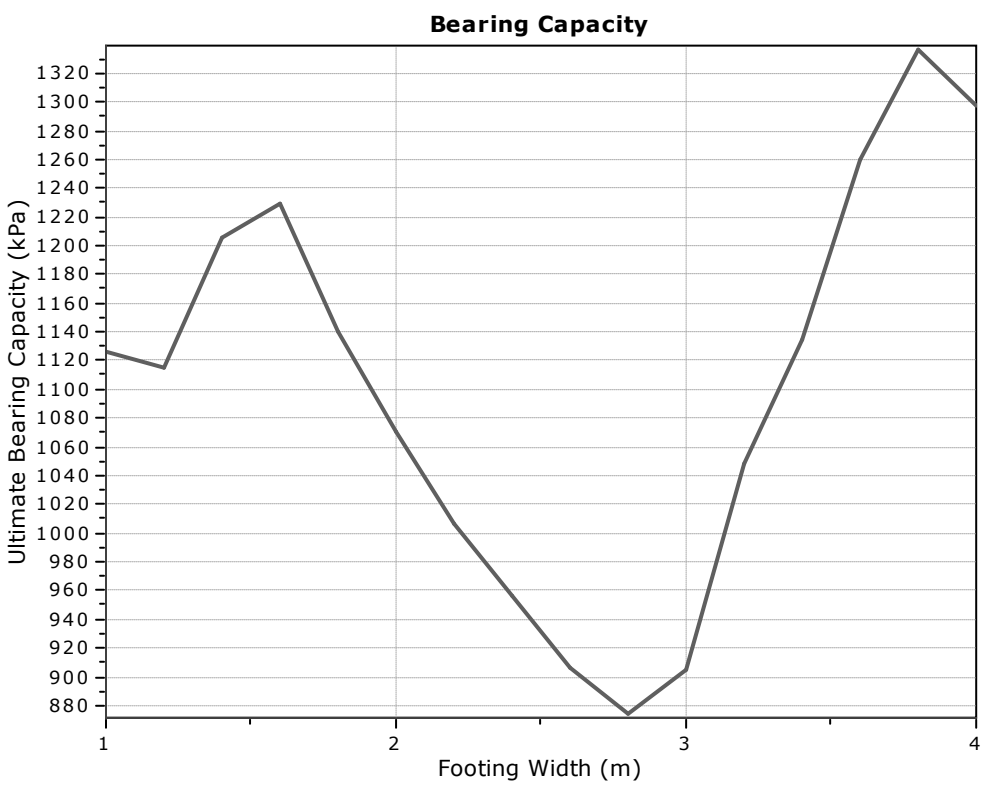
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



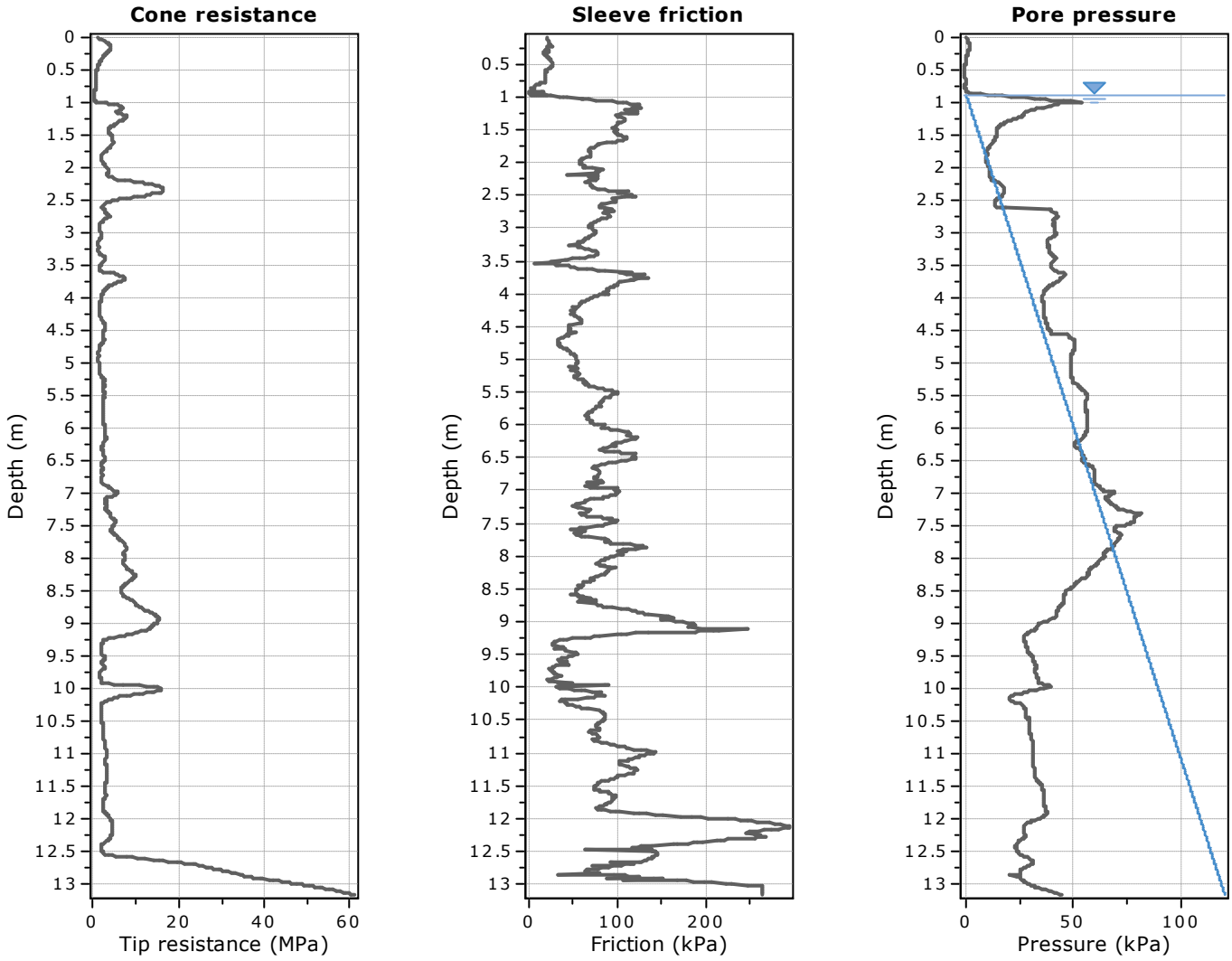
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	5.58	0.20	9.50	1125.71
2	1.20	0.50	2.30	5.53	0.20	9.50	1114.53
3	1.40	0.50	2.60	5.98	0.20	9.50	1205.13
4	1.60	0.50	2.90	6.10	0.20	9.50	1229.62
5	1.80	0.50	3.20	5.66	0.20	9.50	1140.77
6	2.00	0.50	3.50	5.31	0.20	9.50	1070.70
7	2.20	0.50	3.80	4.98	0.20	9.50	1006.36
8	2.40	0.50	4.10	4.73	0.20	9.50	956.26
9	2.60	0.50	4.40	4.49	0.20	9.50	906.61
10	2.80	0.50	4.70	4.32	0.20	9.50	874.30
11	3.00	0.50	5.00	4.47	0.20	9.50	904.37
12	3.20	0.50	5.30	5.19	0.20	9.50	1048.48
13	3.40	0.50	5.60	5.63	0.20	9.50	1134.94
14	3.60	0.50	5.90	6.25	0.20	9.50	1259.89
15	3.80	0.50	6.20	6.63	0.20	9.50	1336.41
16	4.00	0.50	6.50	6.44	0.20	9.50	1296.98

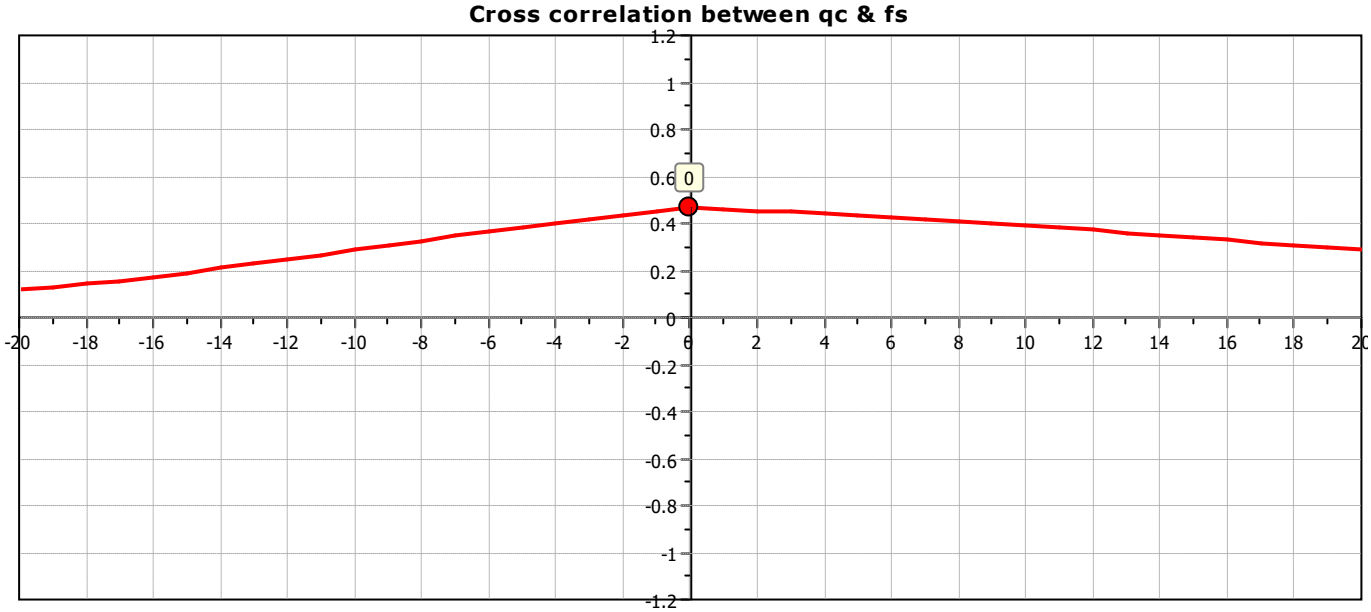
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

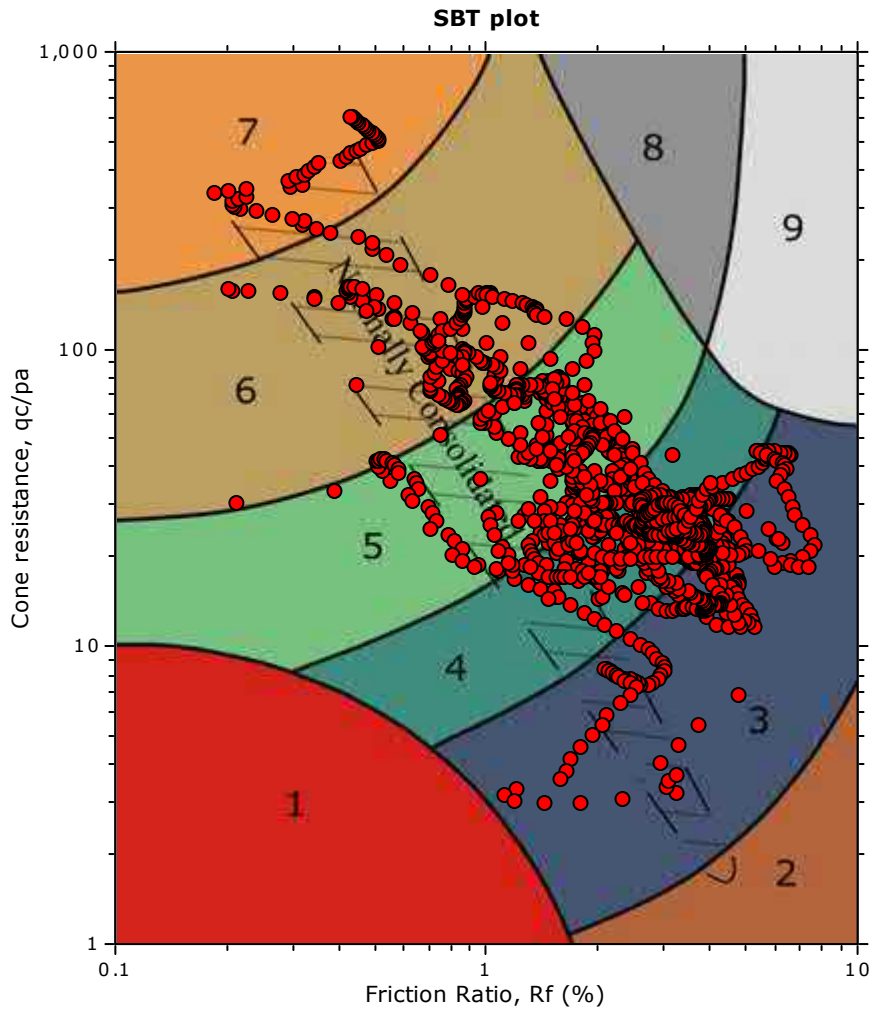


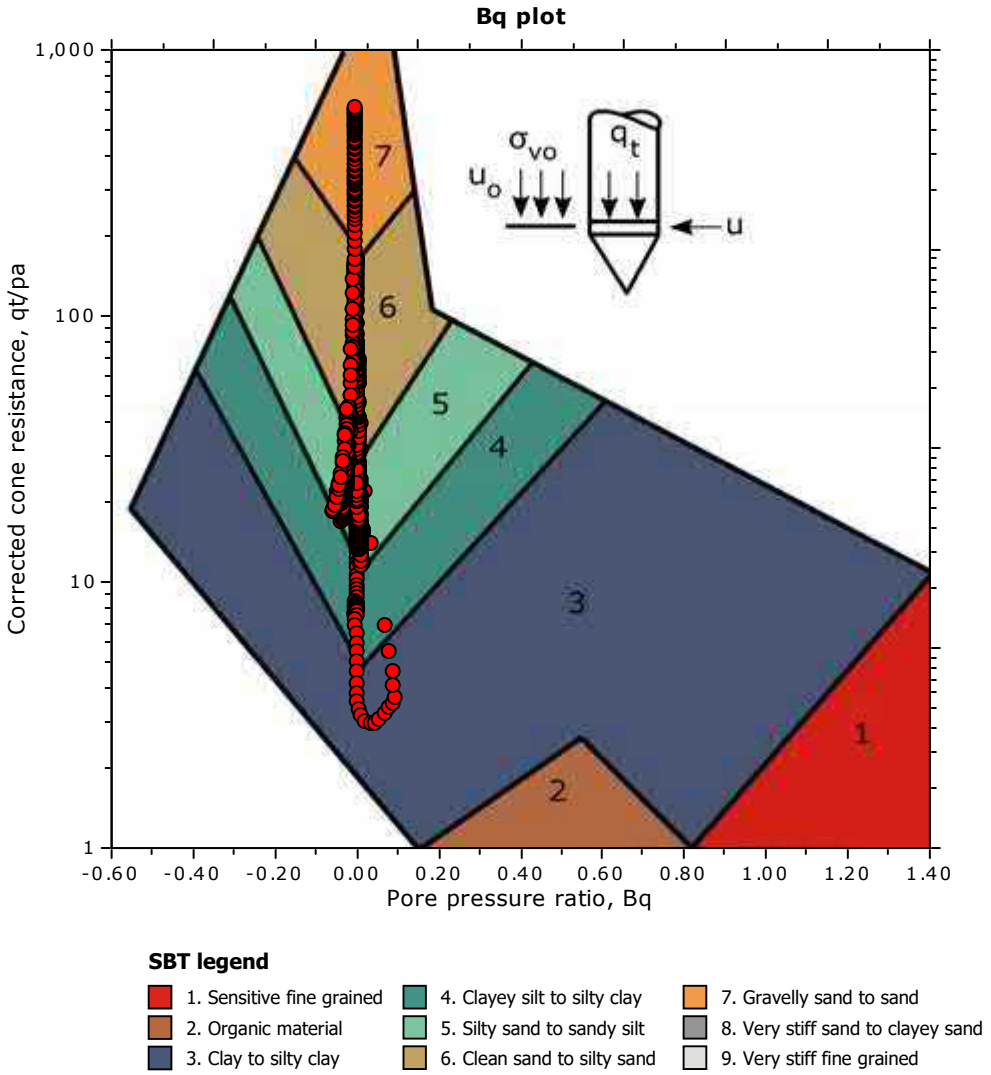
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots





SBT legend

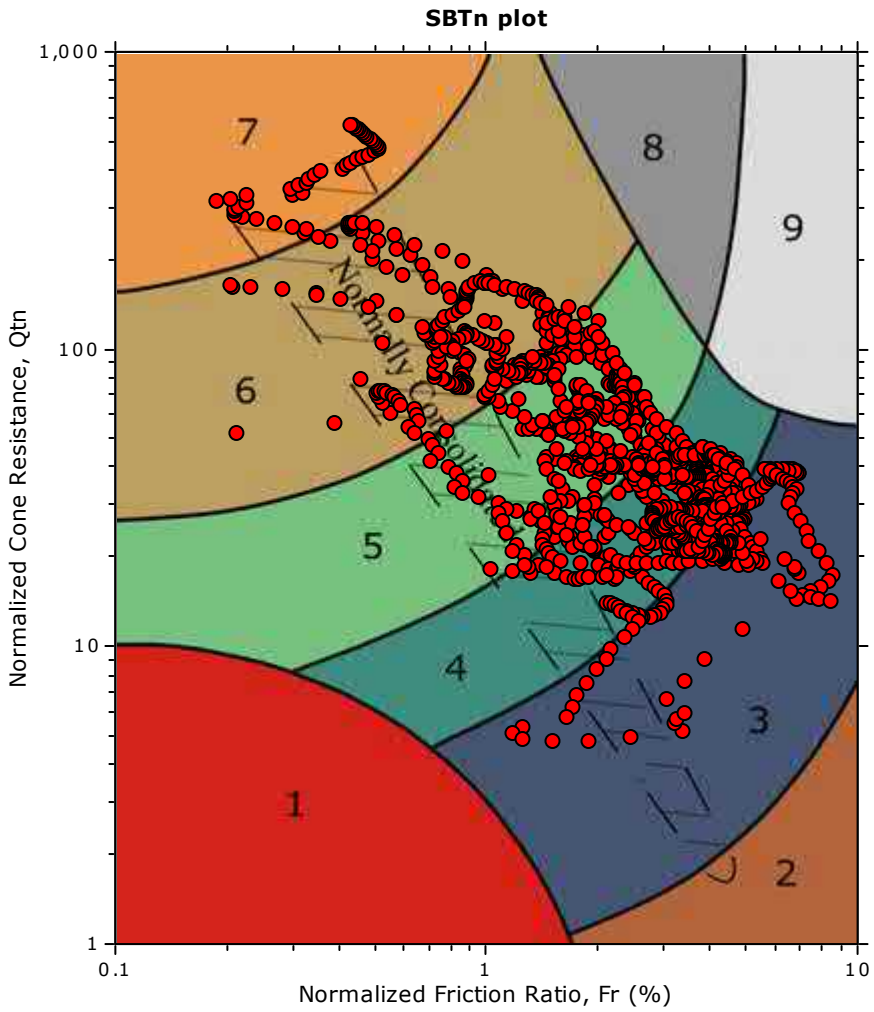
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

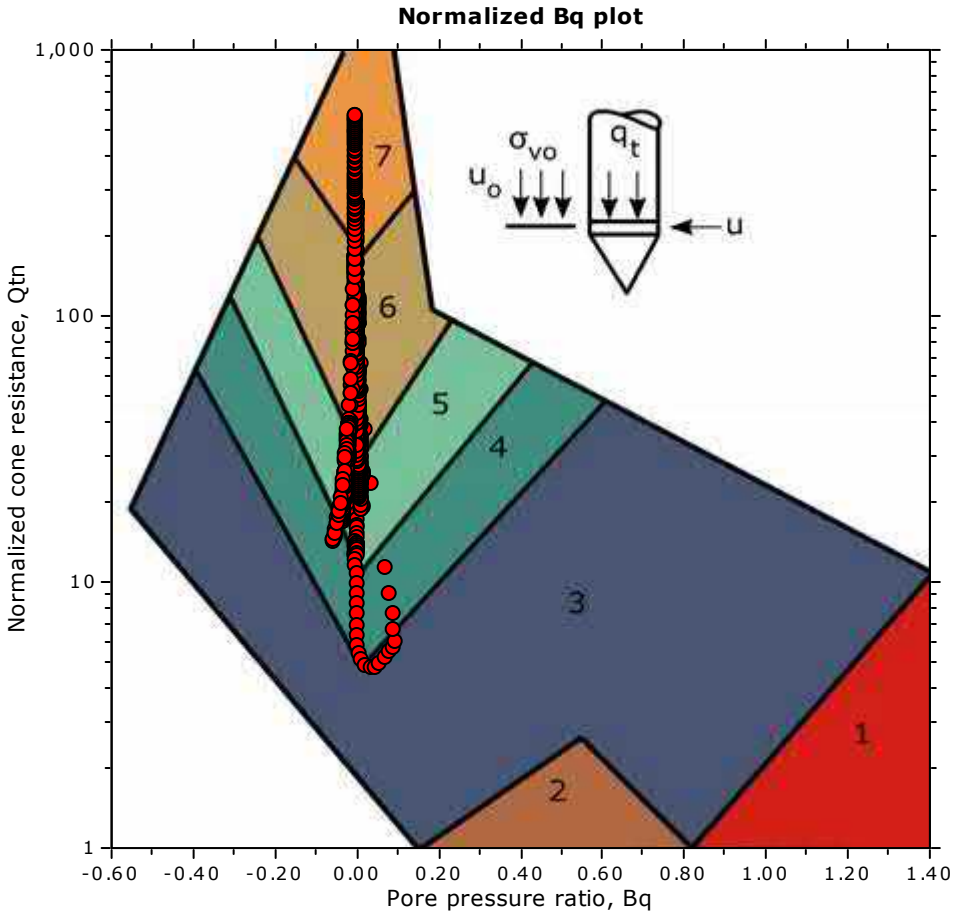
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots (normalized)





SBTn legend

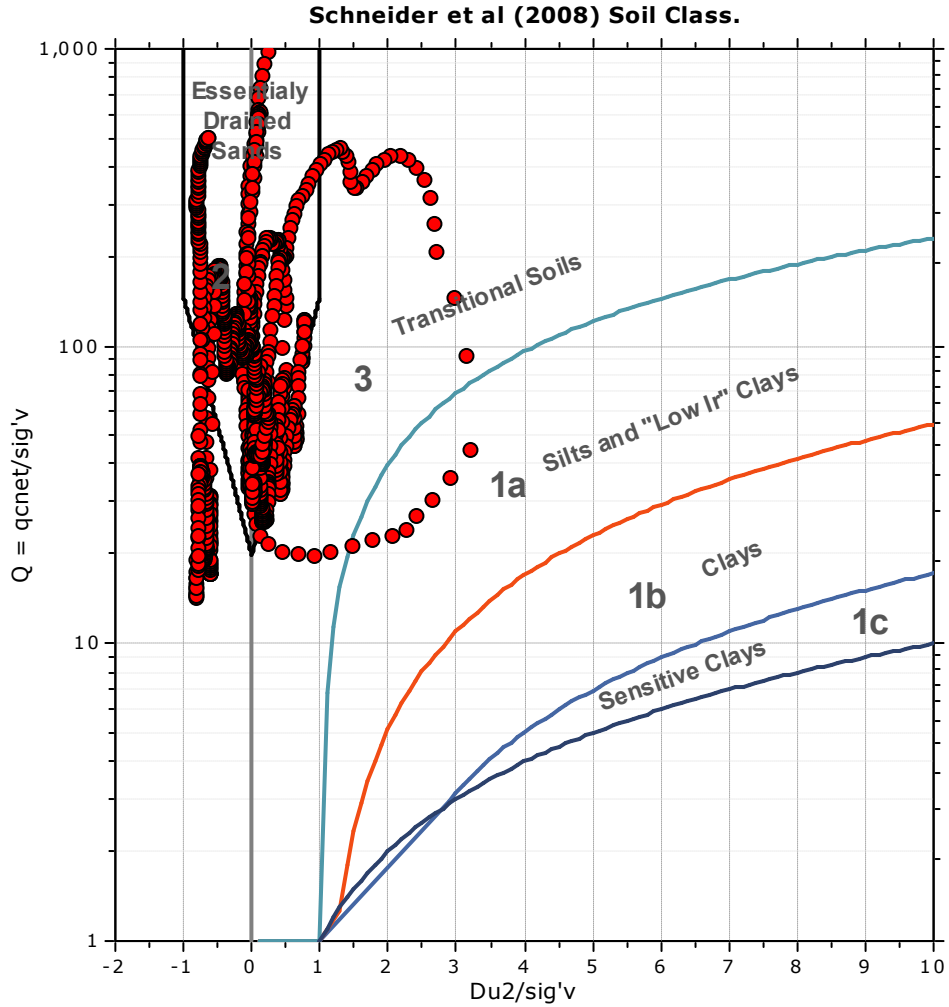
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

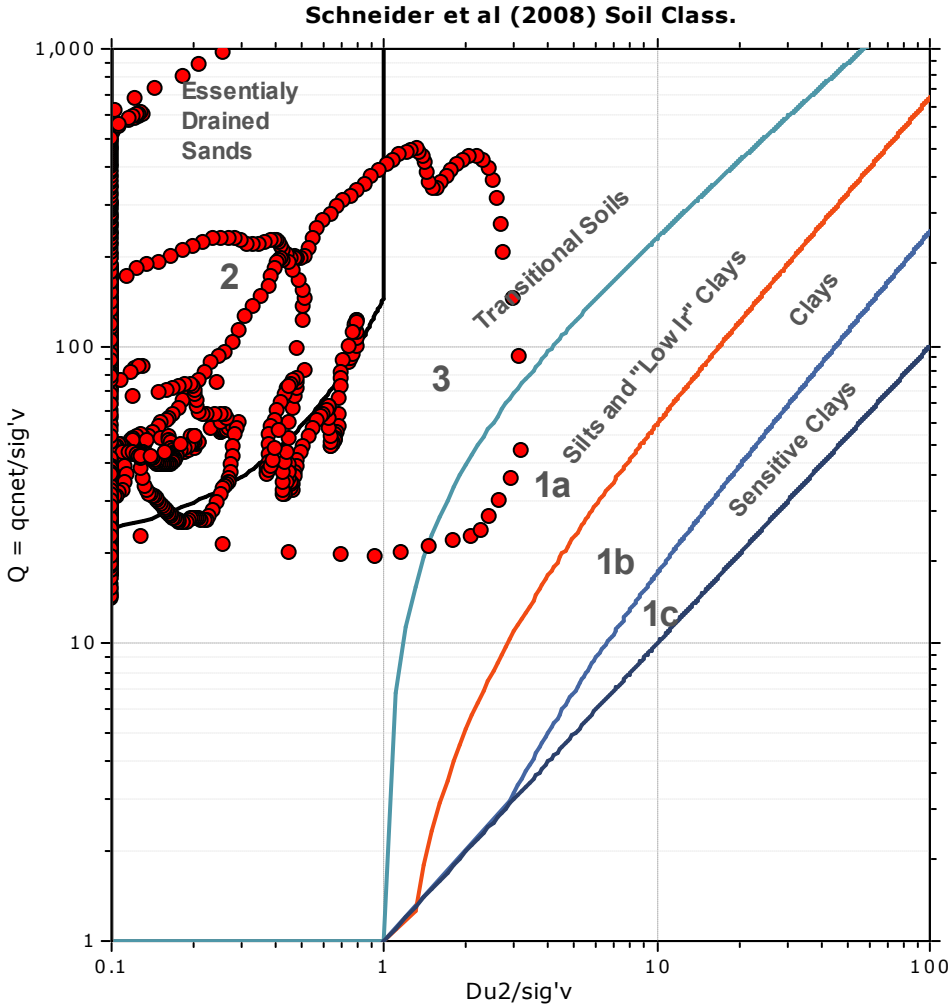
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Bq plots (Schneider)

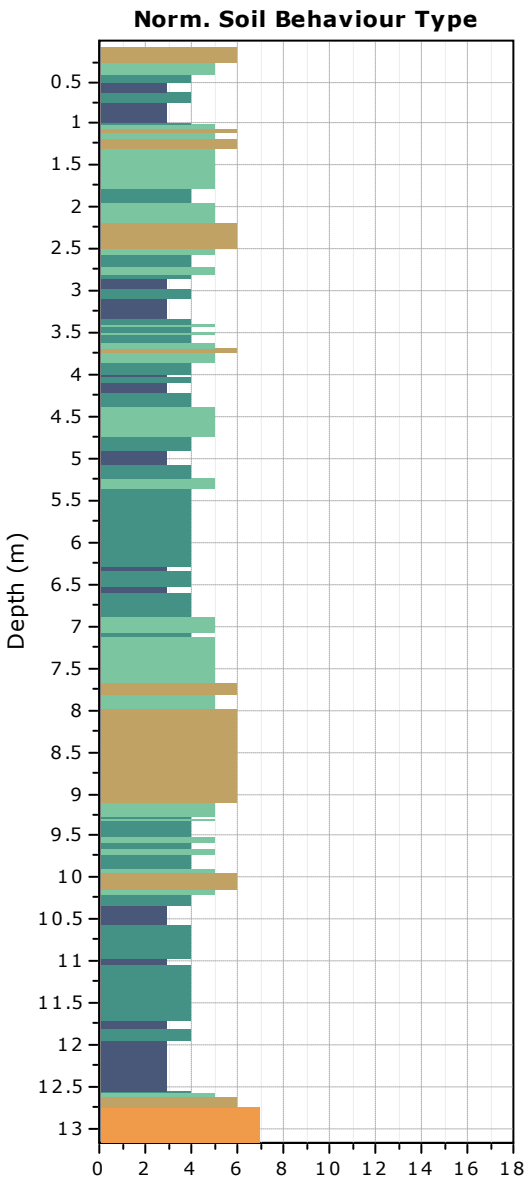


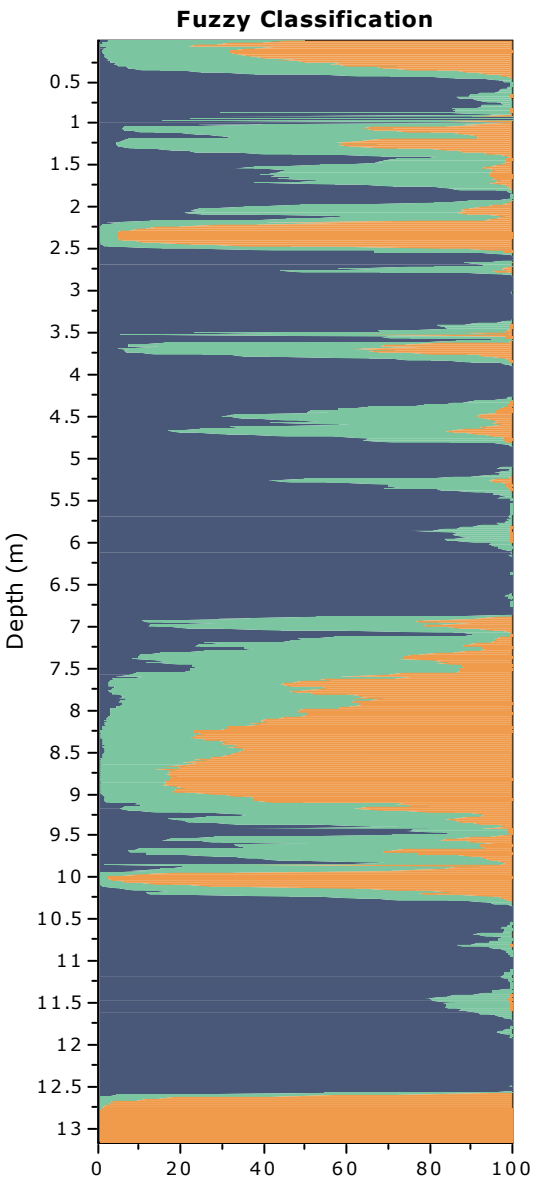


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



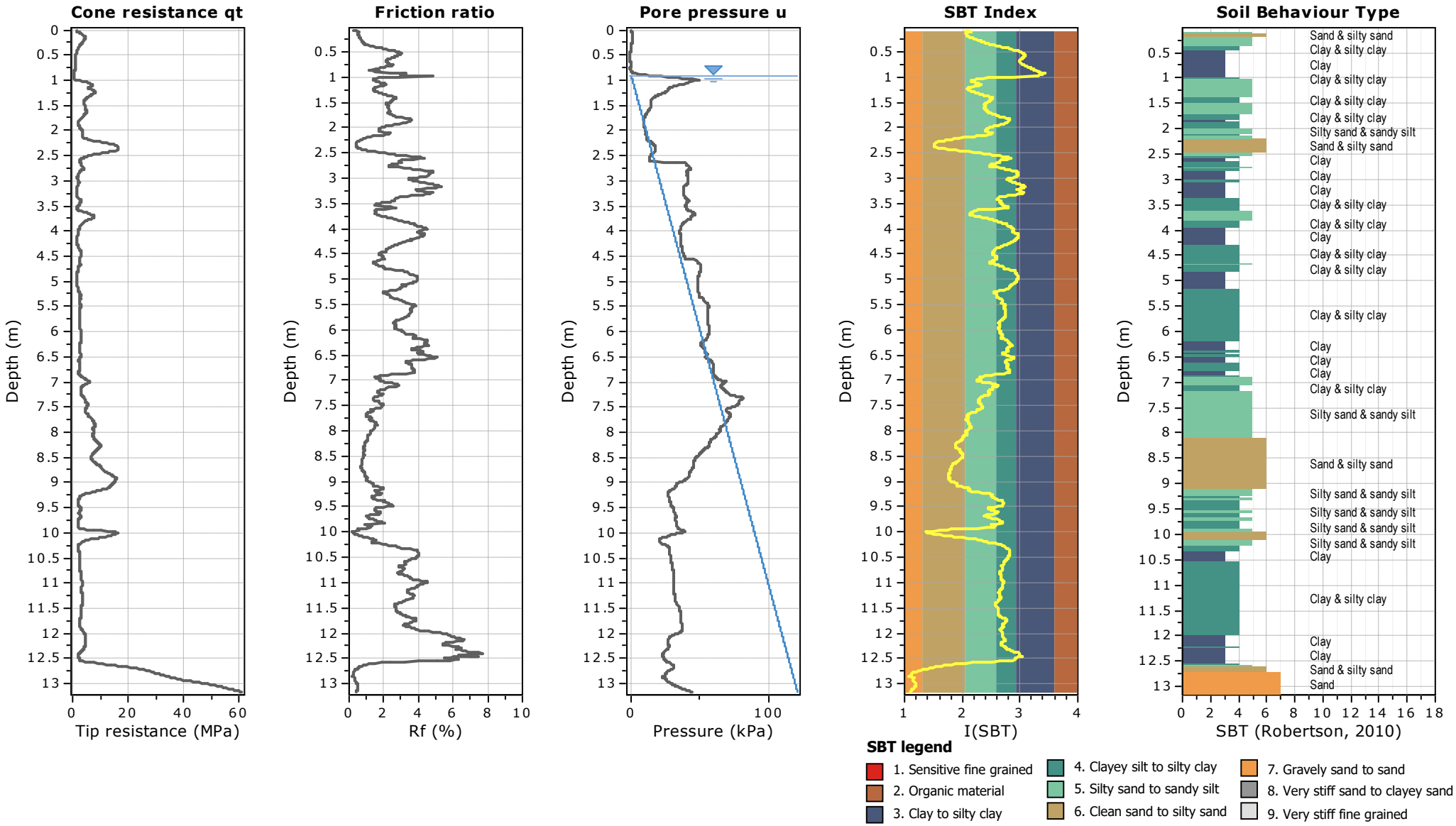


Fuzzy classifiaction legend
- Highly probable clayey soil
- Highly probable mixture soil
- Highly probable sandy soil

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

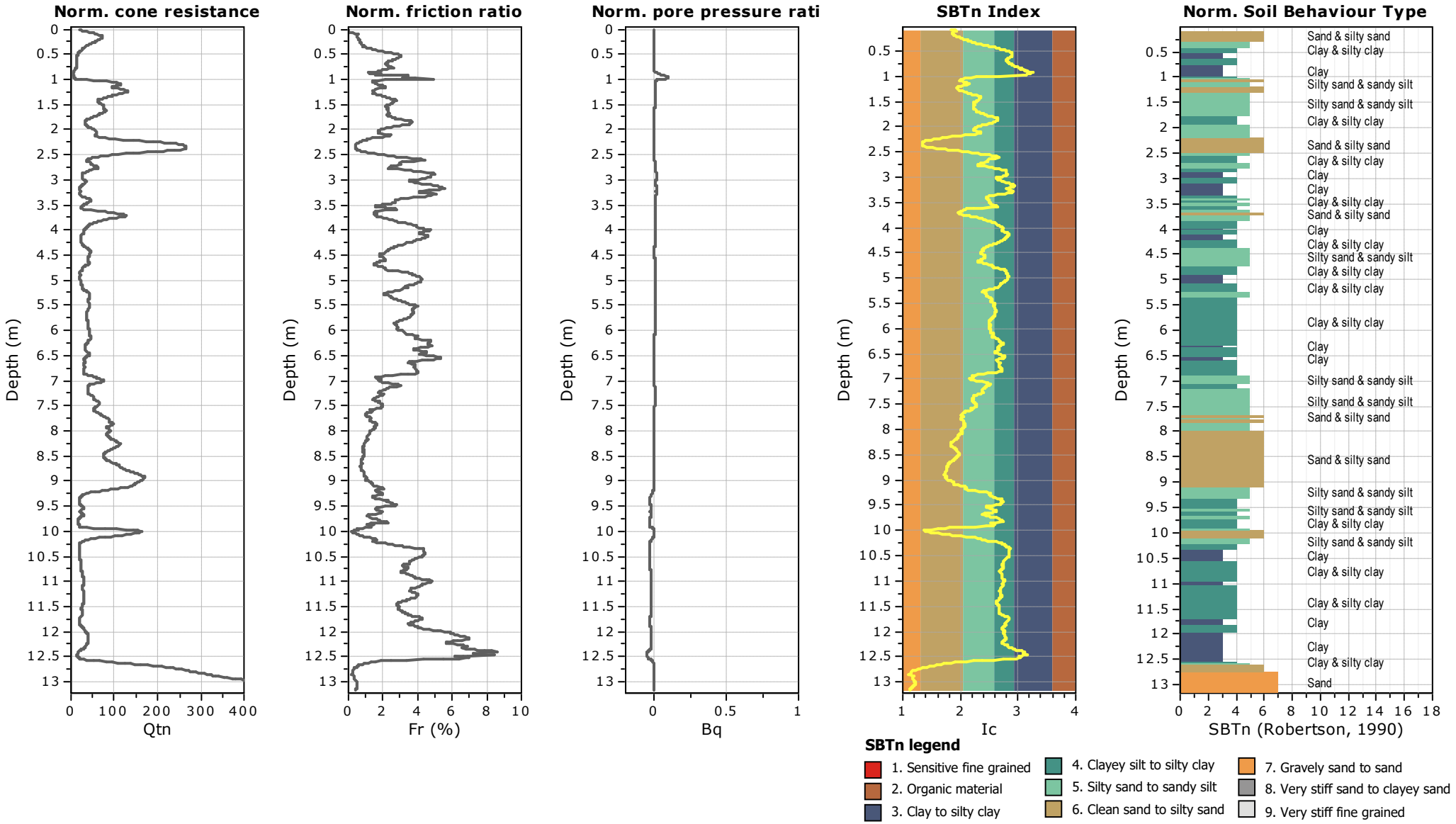
CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

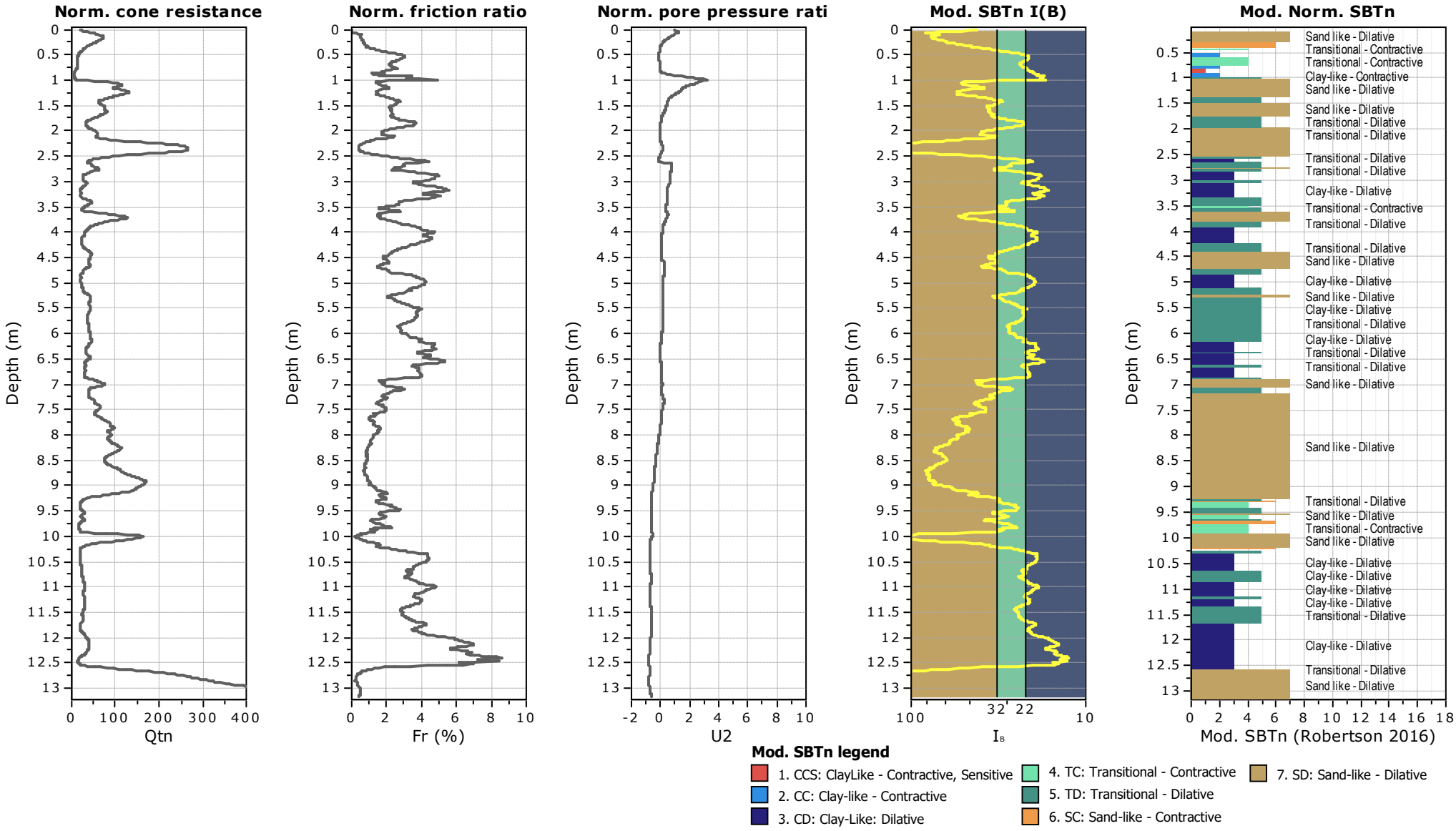
CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

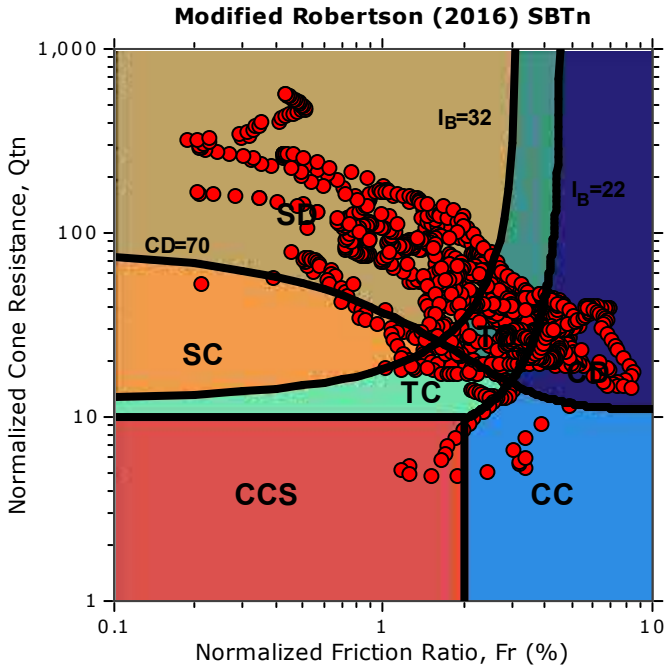


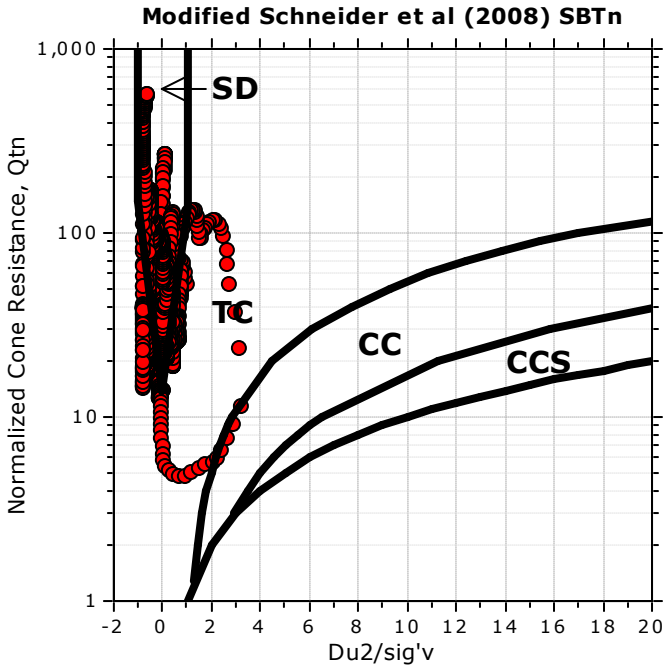
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

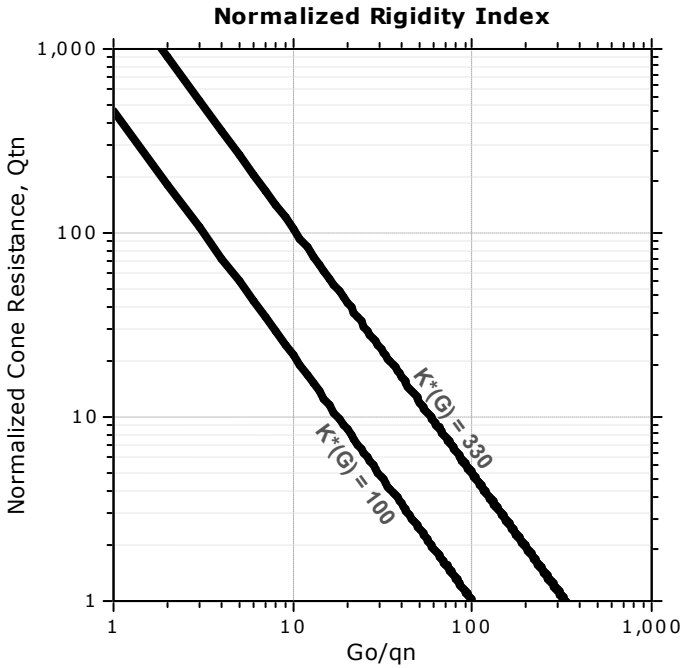
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Updated SBTn plots







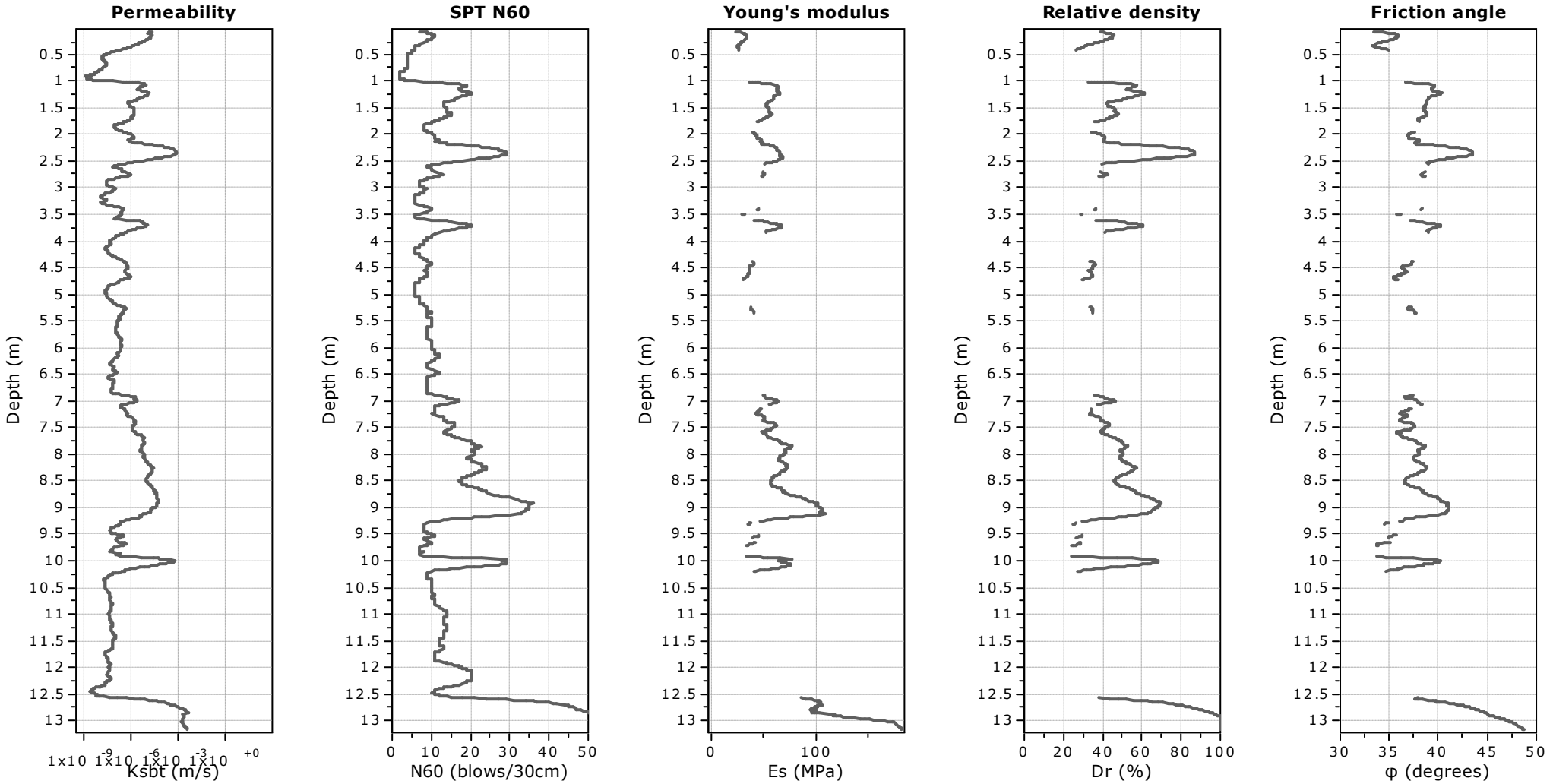
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



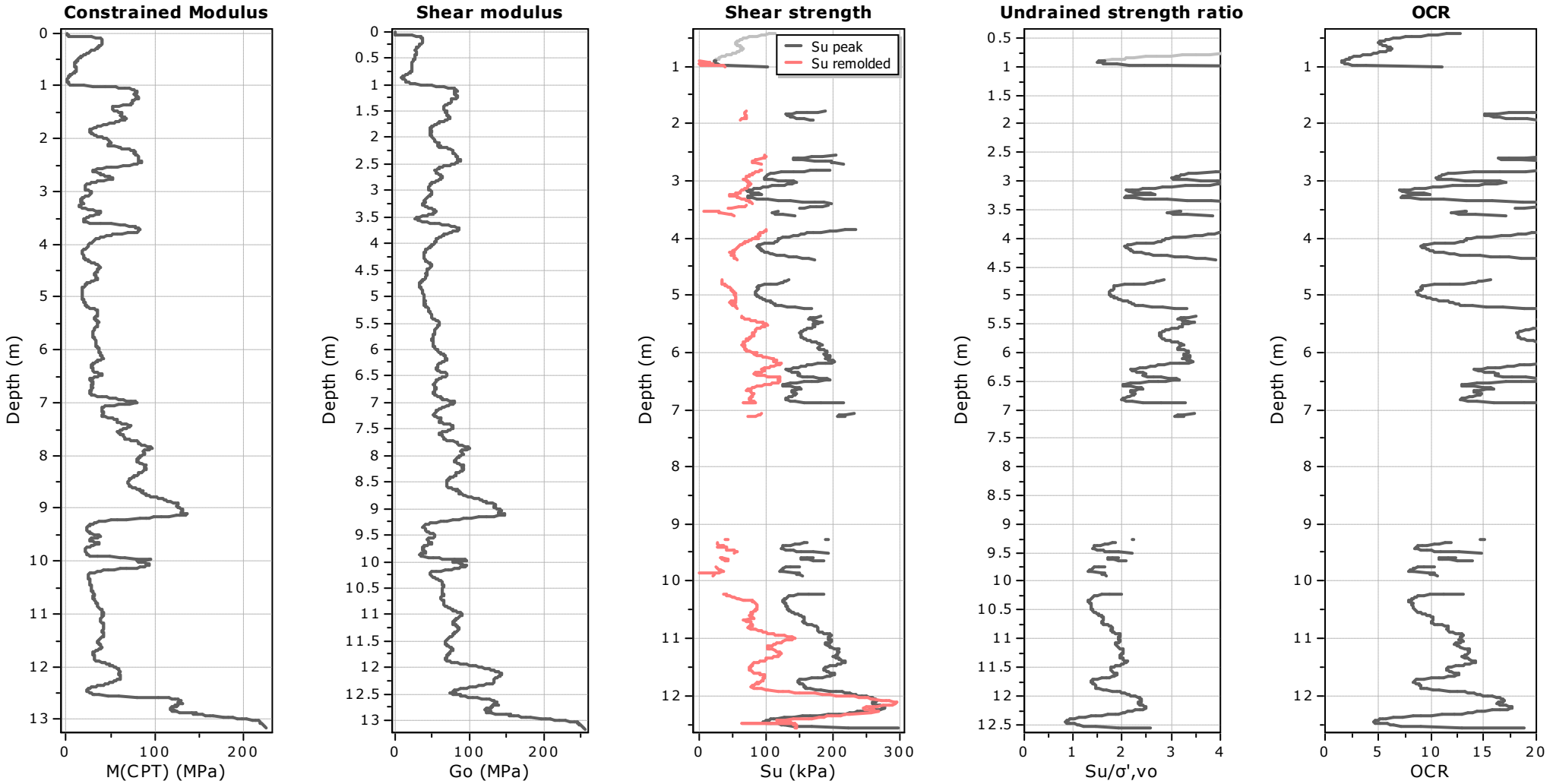
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



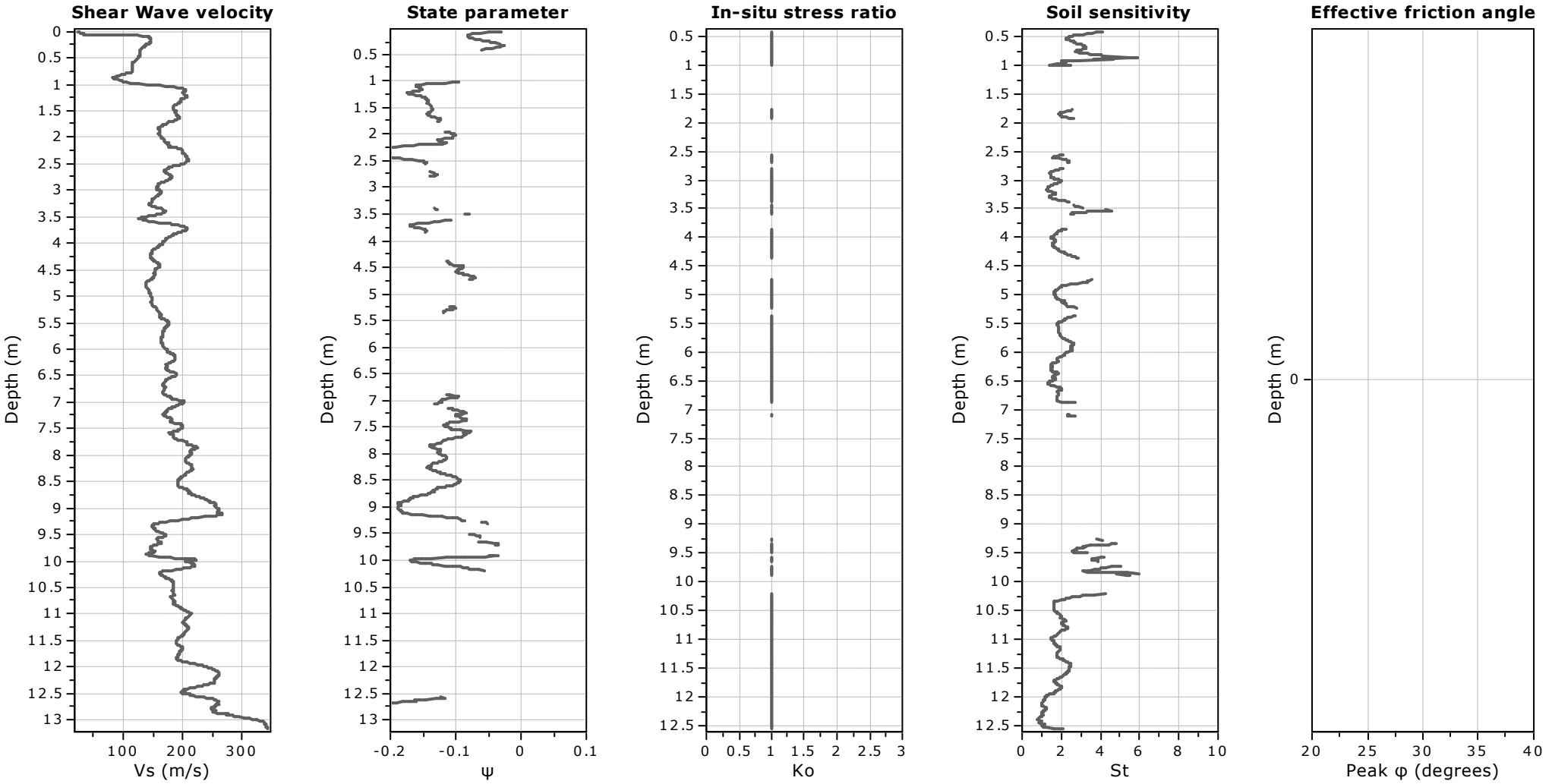
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto
OCR factor for clays, N_{kt}: Auto
Flat Dilatometer Test data

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



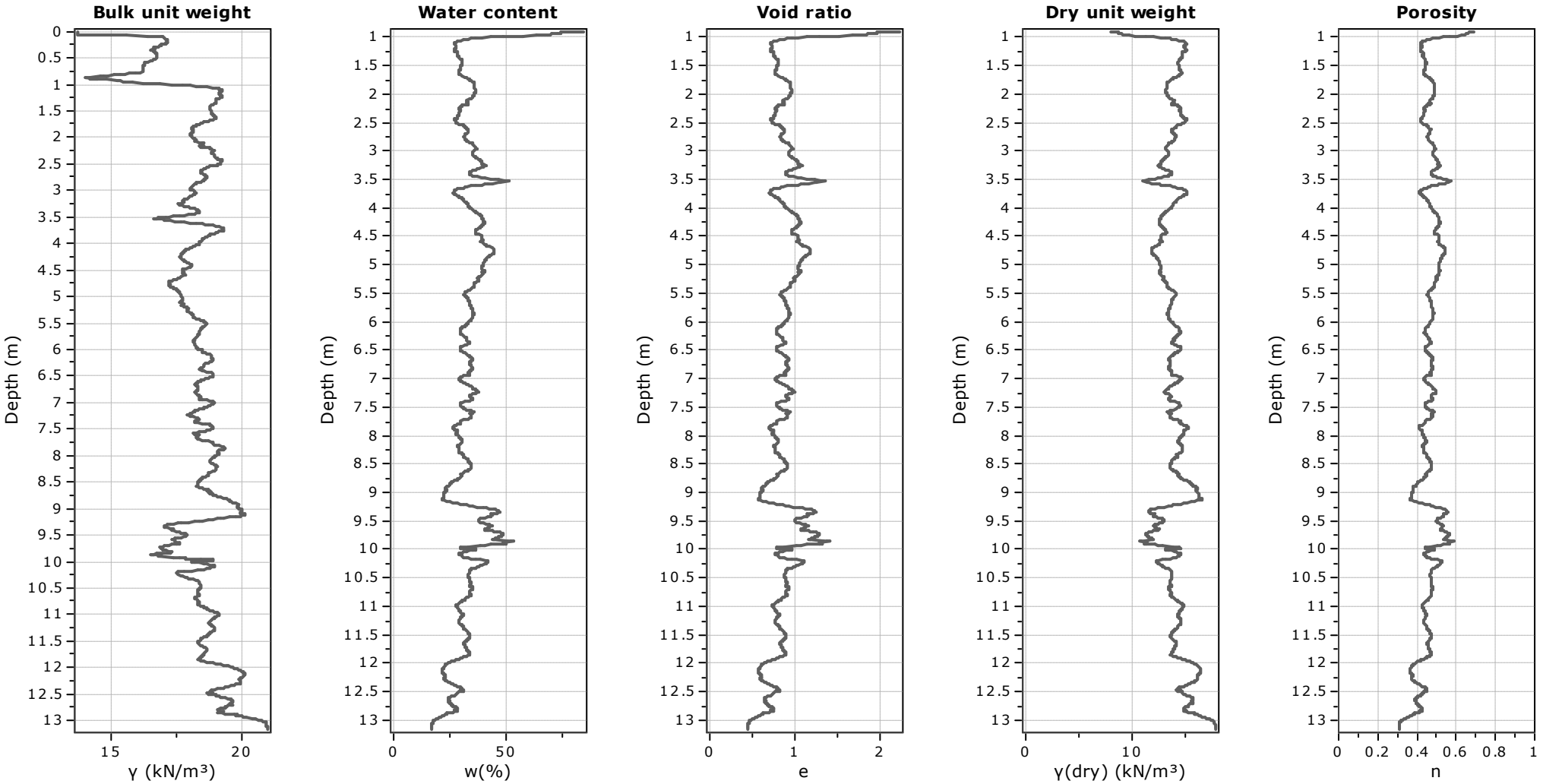
Calculation parameters

Soil Sensitivity factor, N_S: 7.00

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

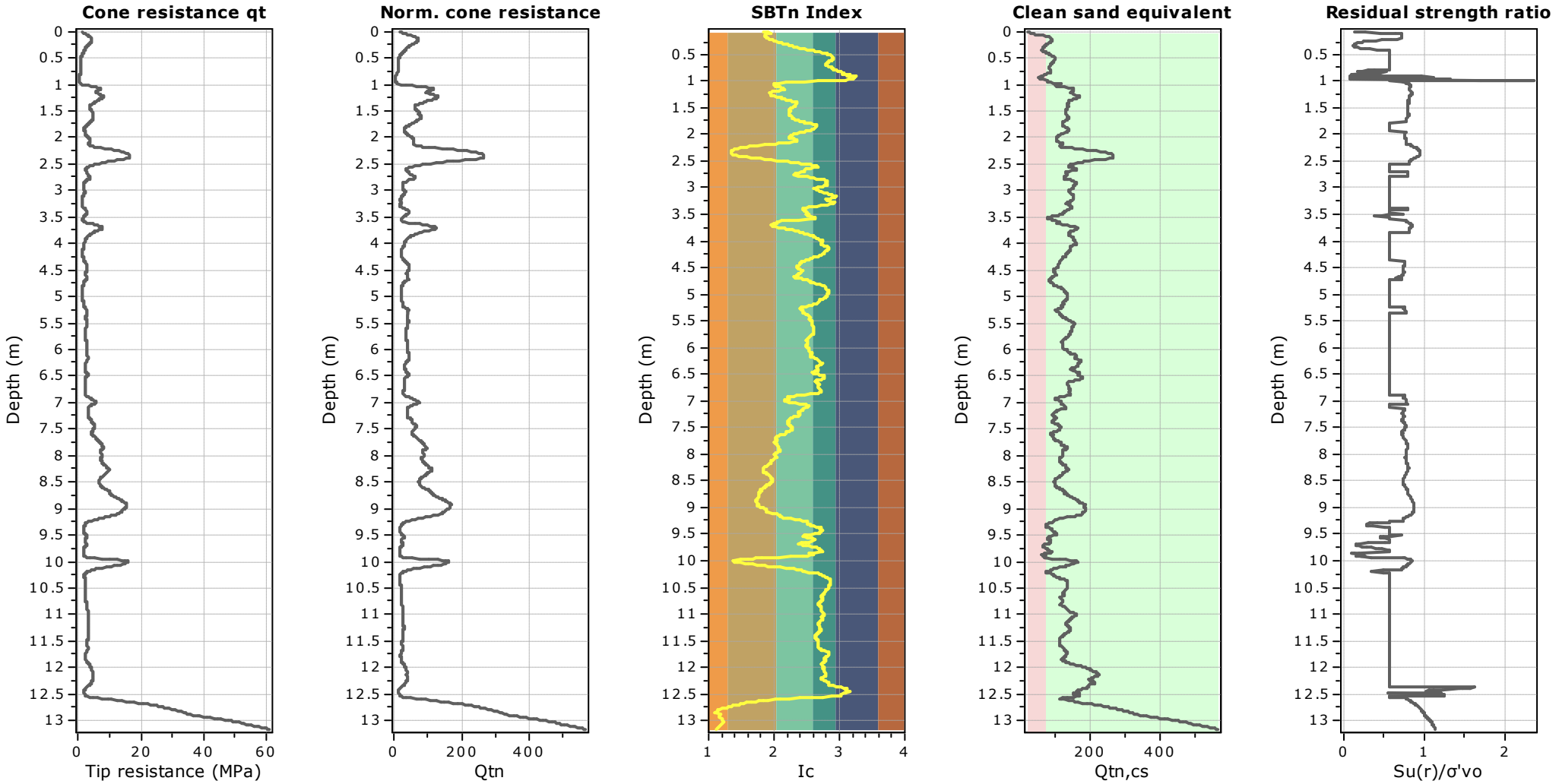
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

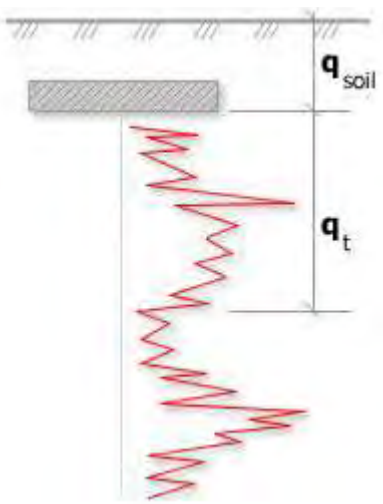
CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

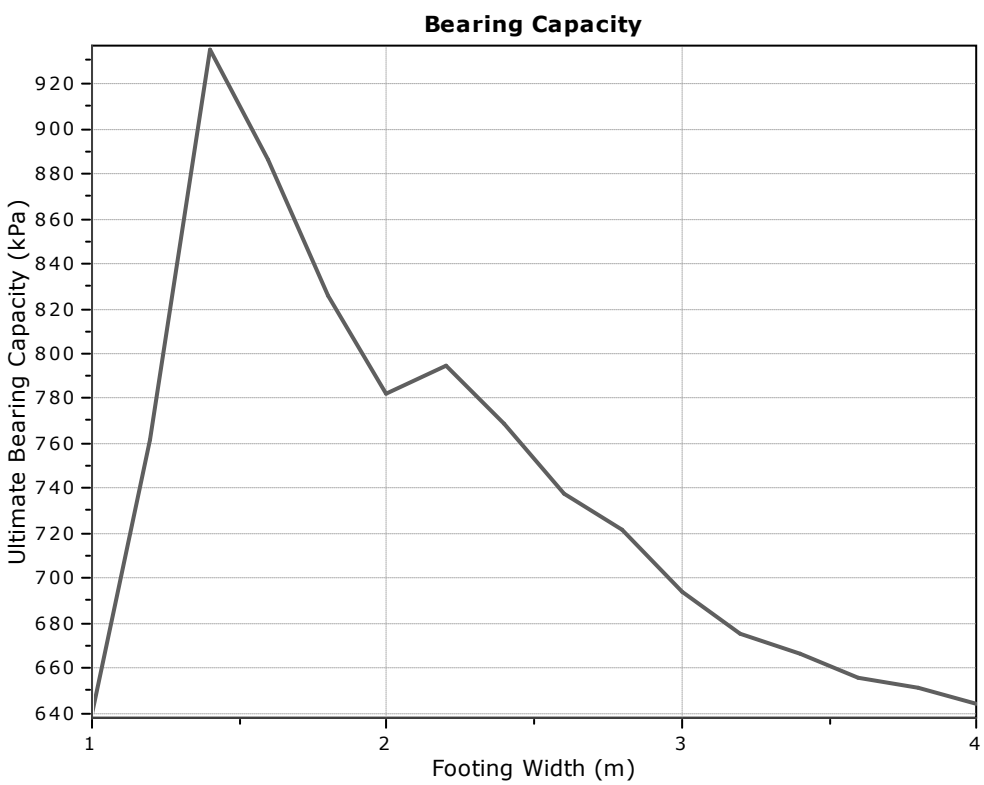
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



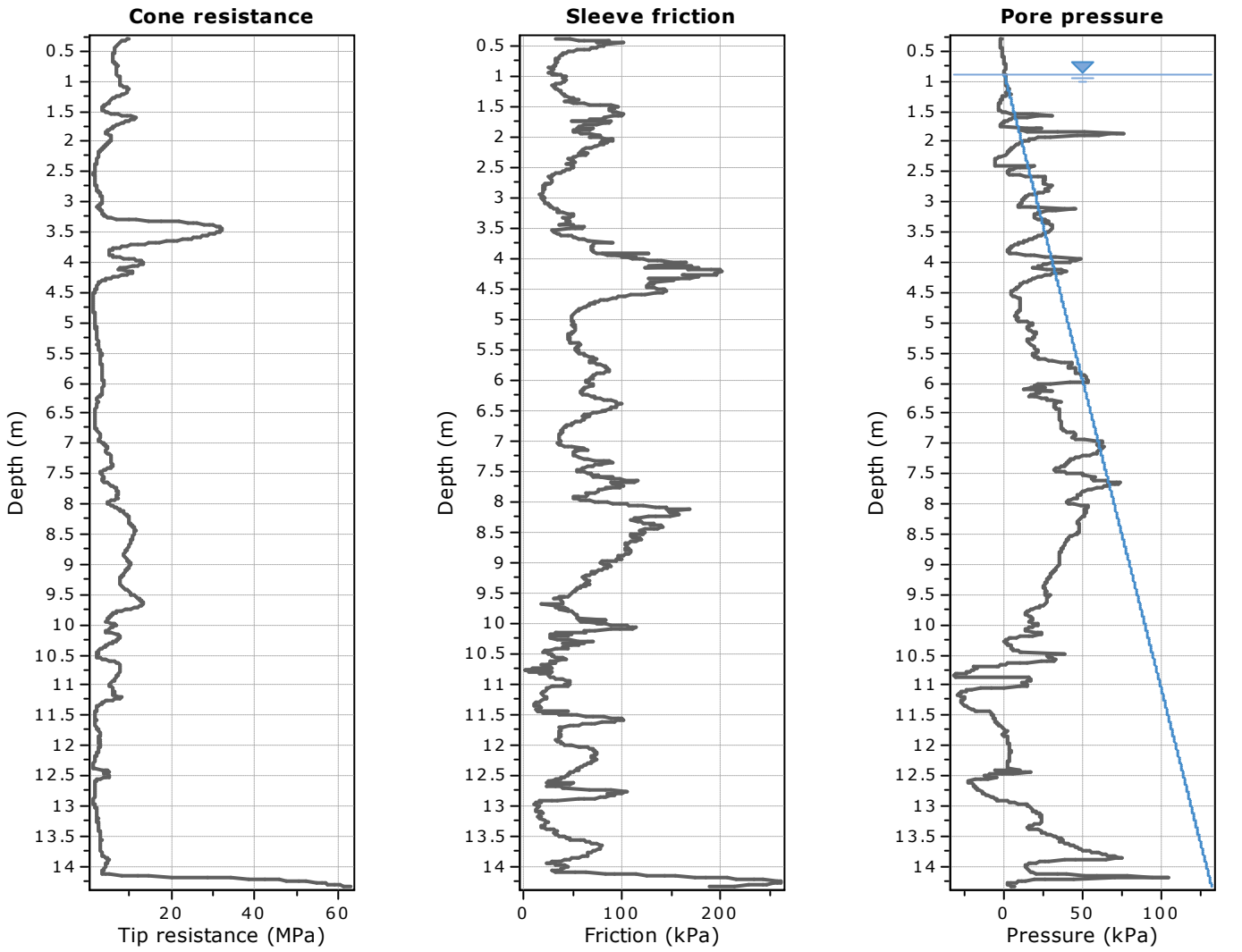
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	3.15	0.20	9.50	639.90
2	1.20	0.50	2.30	3.76	0.20	9.50	761.61
3	1.40	0.50	2.60	4.63	0.20	9.50	935.21
4	1.60	0.50	2.90	4.39	0.20	9.50	886.67
5	1.80	0.50	3.20	4.08	0.20	9.50	825.62
6	2.00	0.50	3.50	3.86	0.20	9.50	782.47
7	2.20	0.50	3.80	3.92	0.20	9.50	794.46
8	2.40	0.50	4.10	3.80	0.20	9.50	769.29
9	2.60	0.50	4.40	3.64	0.20	9.50	737.46
10	2.80	0.50	4.70	3.56	0.20	9.50	722.07
11	3.00	0.50	5.00	3.43	0.20	9.50	694.57
12	3.20	0.50	5.30	3.33	0.20	9.50	675.27
13	3.40	0.50	5.60	3.28	0.20	9.50	666.17
14	3.60	0.50	5.90	3.23	0.20	9.50	656.25
15	3.80	0.50	6.20	3.21	0.20	9.50	651.72
16	4.00	0.50	6.50	3.17	0.20	9.50	644.22

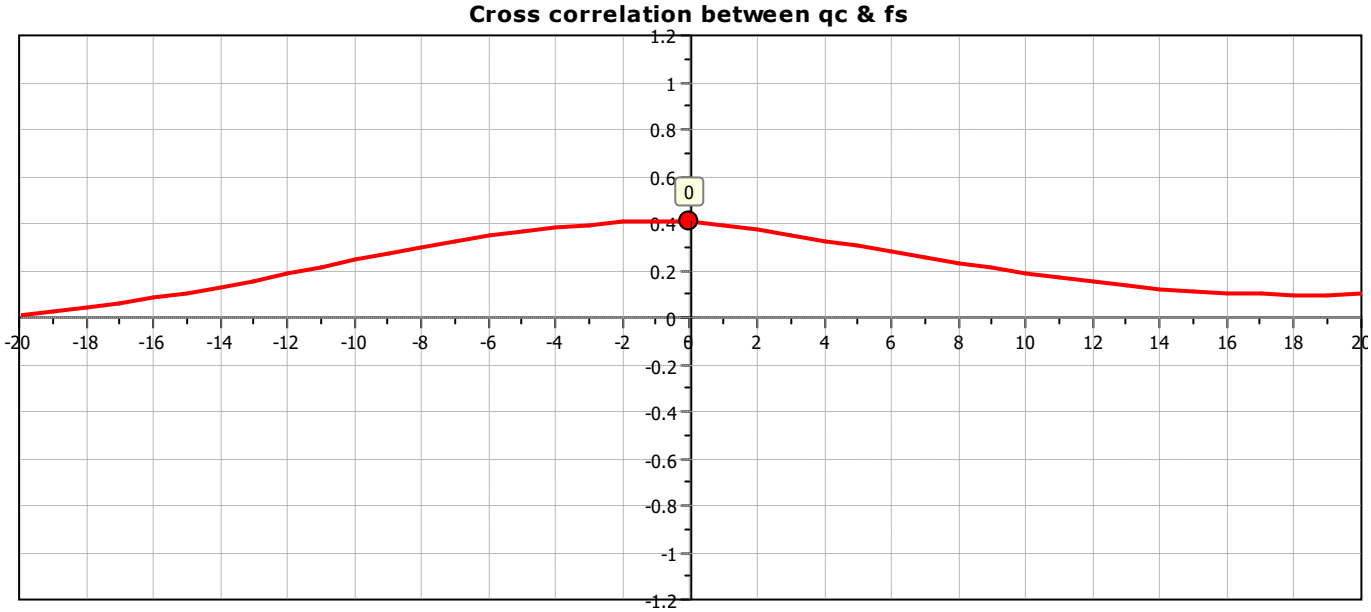
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

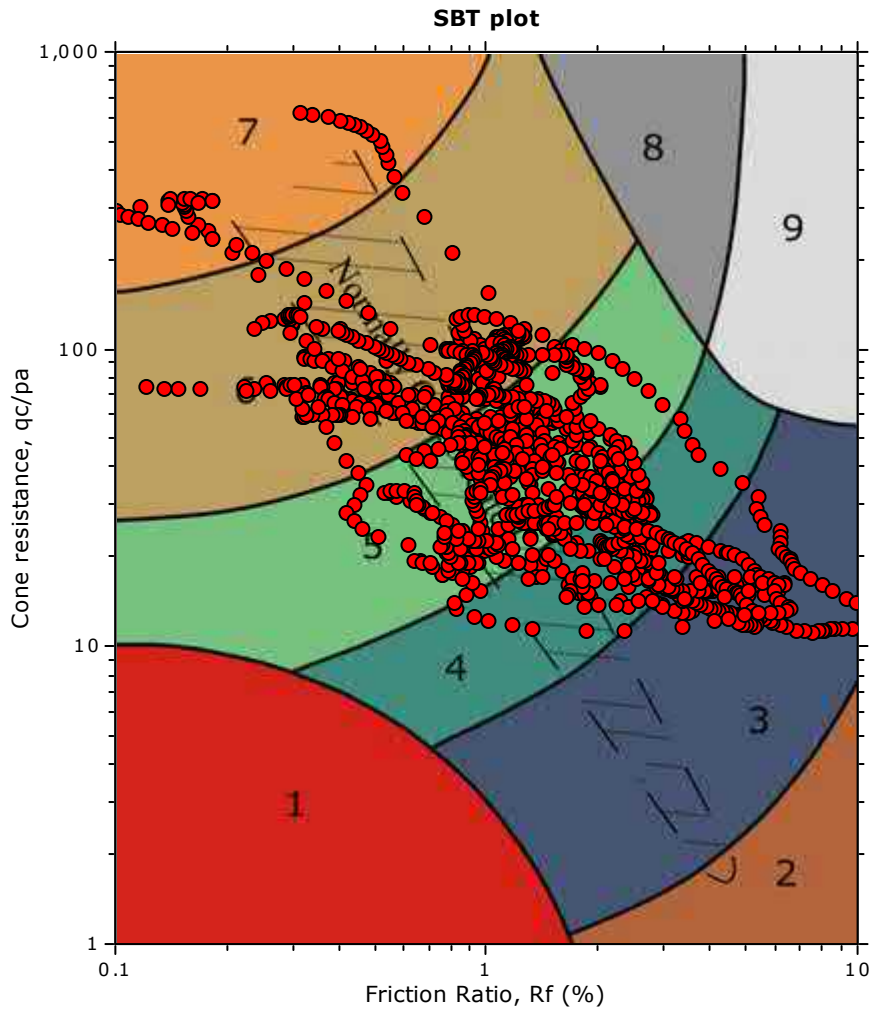


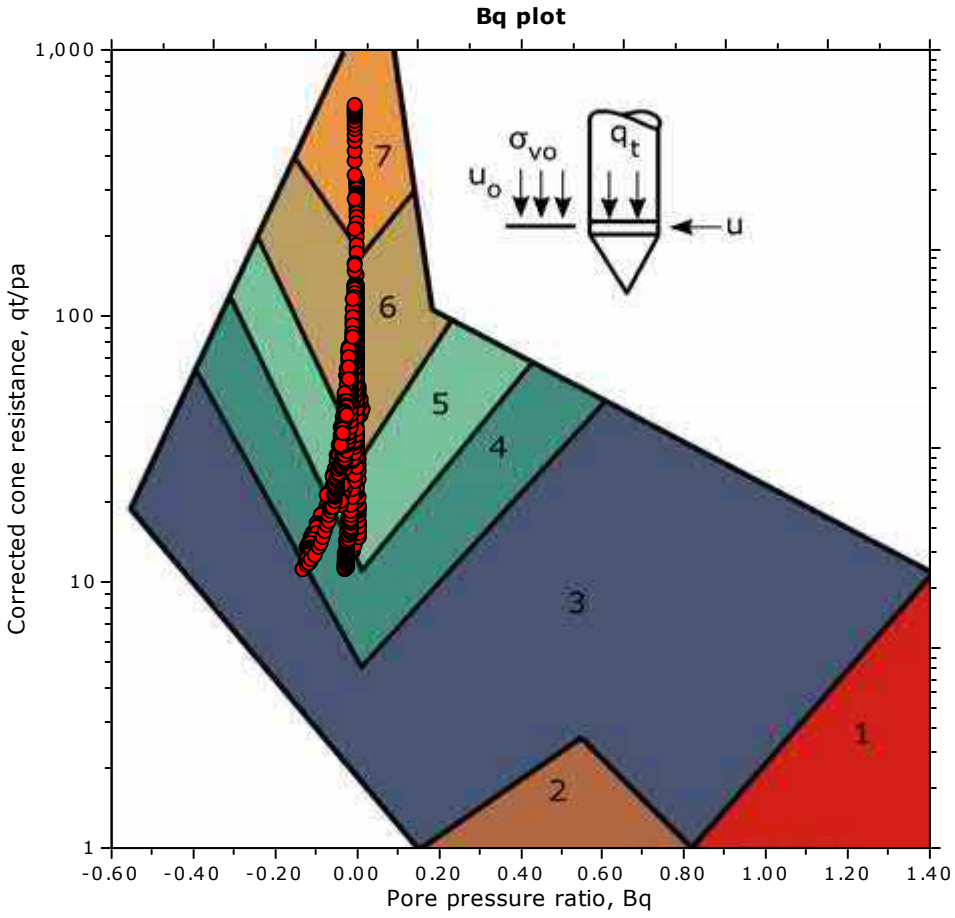
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots





SBT legend

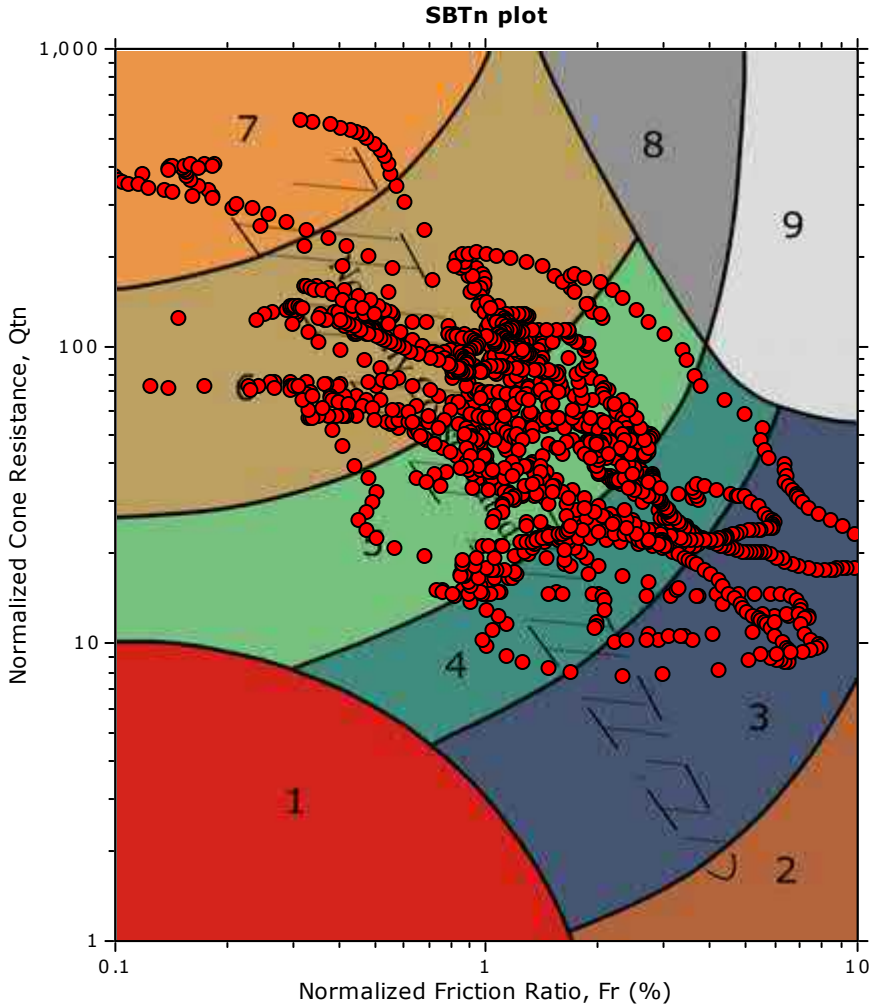
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

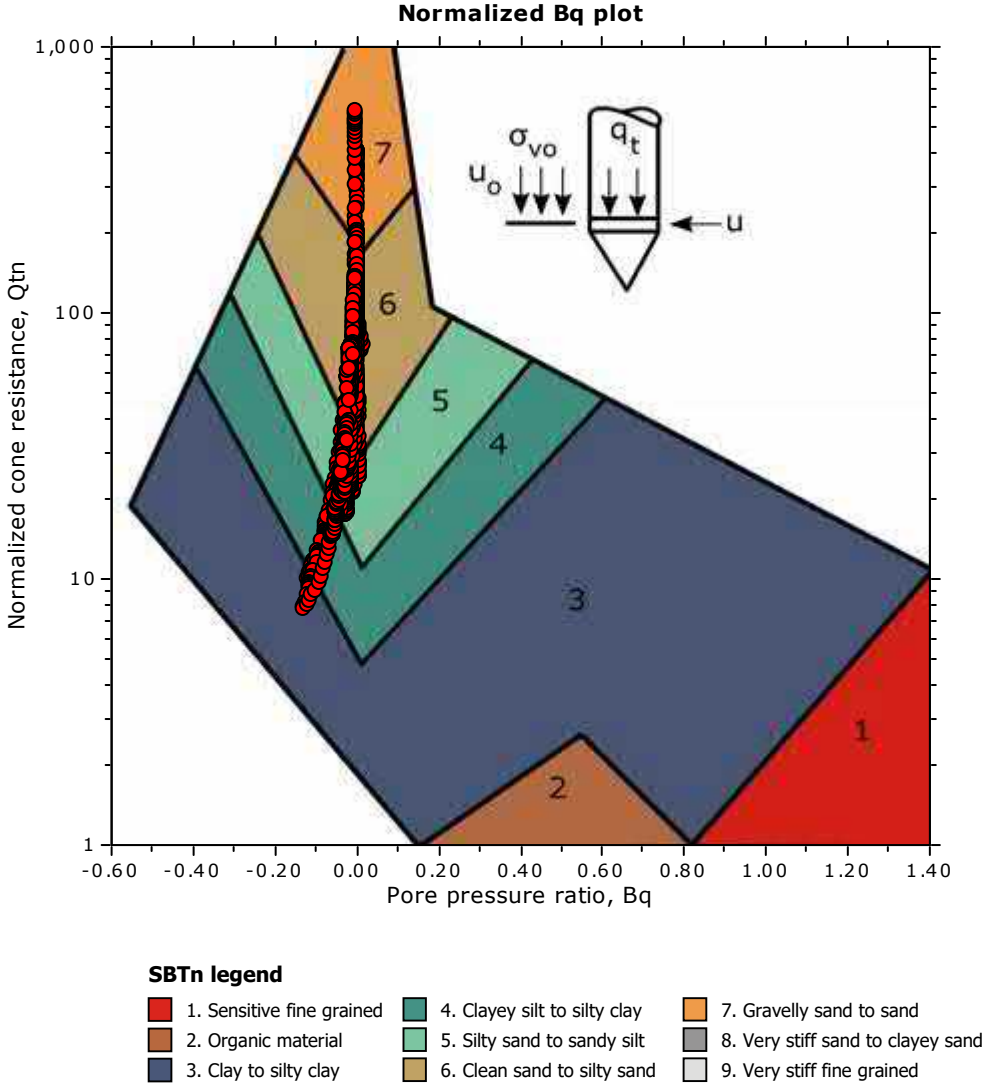
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots (normalized)





SBTn legend

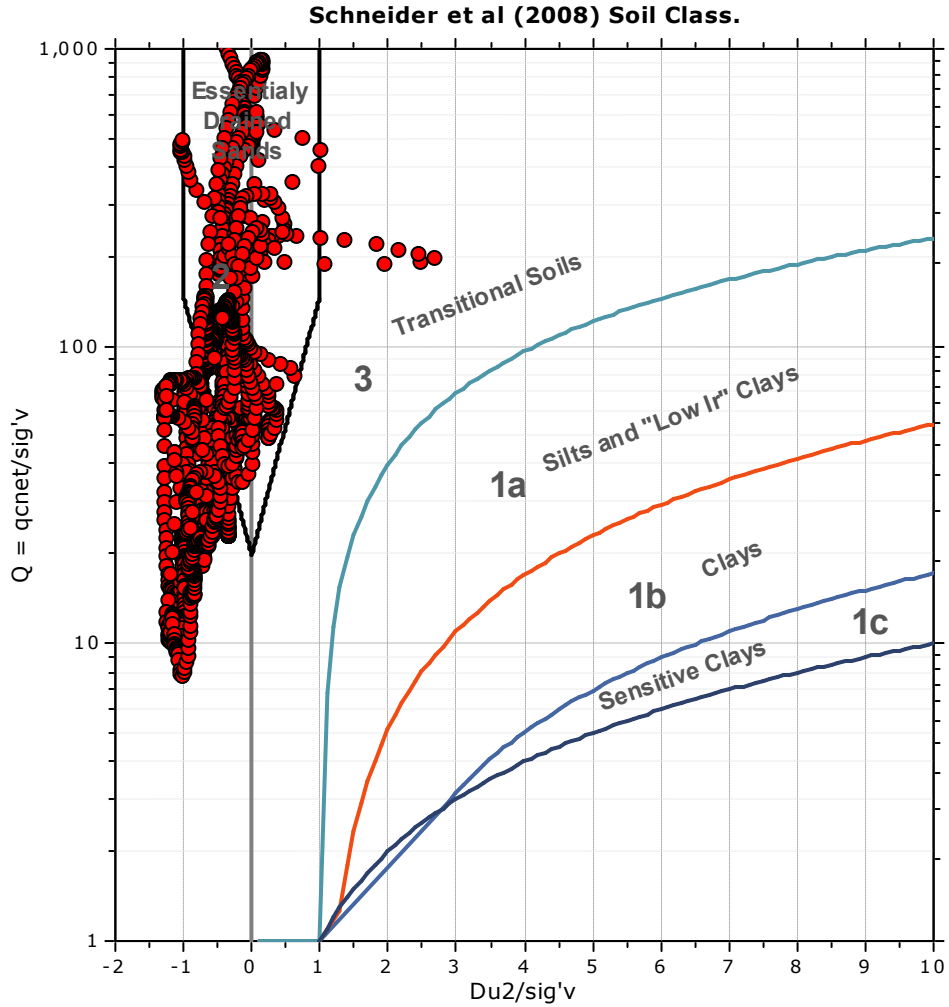
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

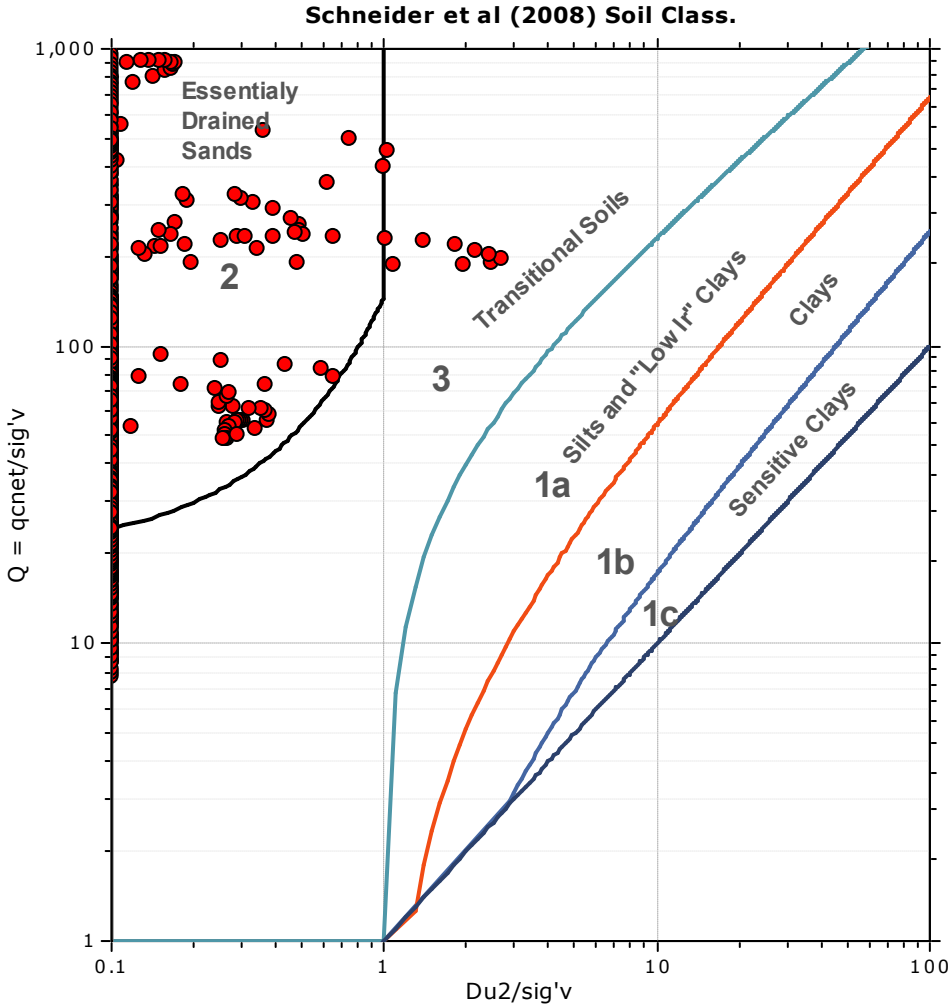
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Bq plots (Schneider)

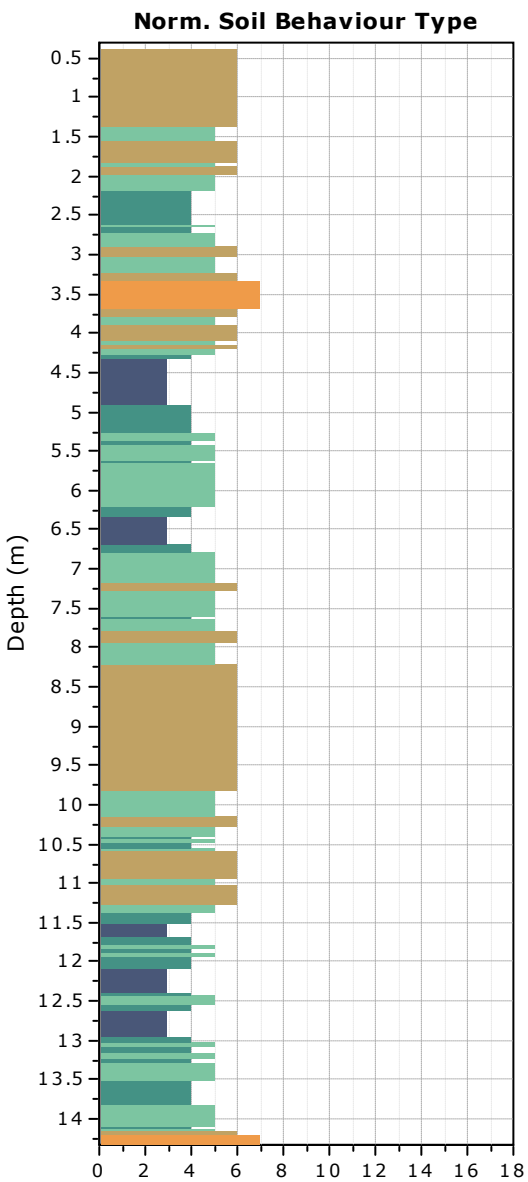


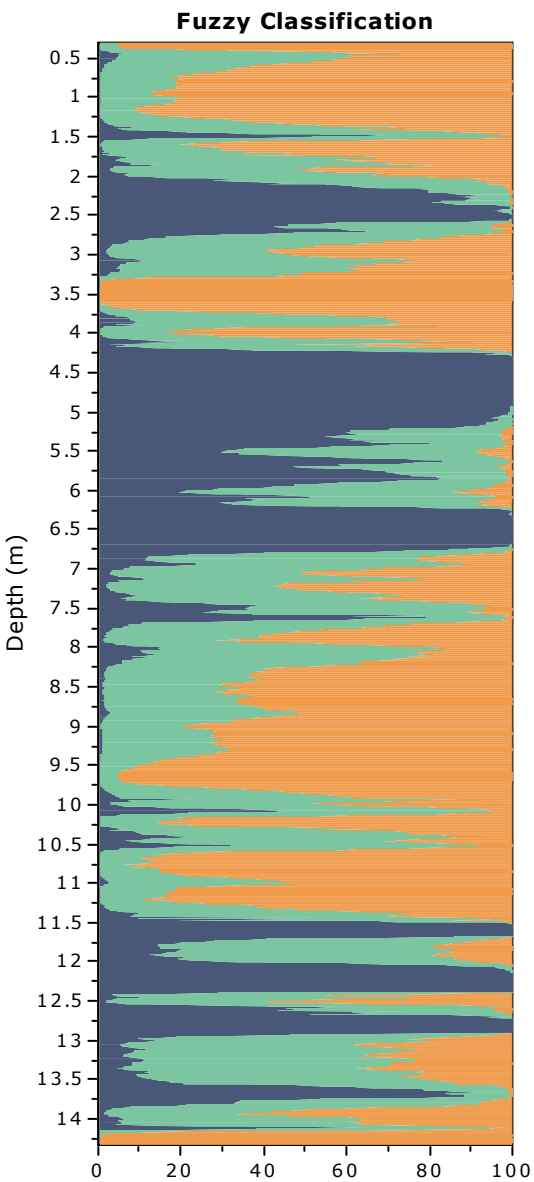


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



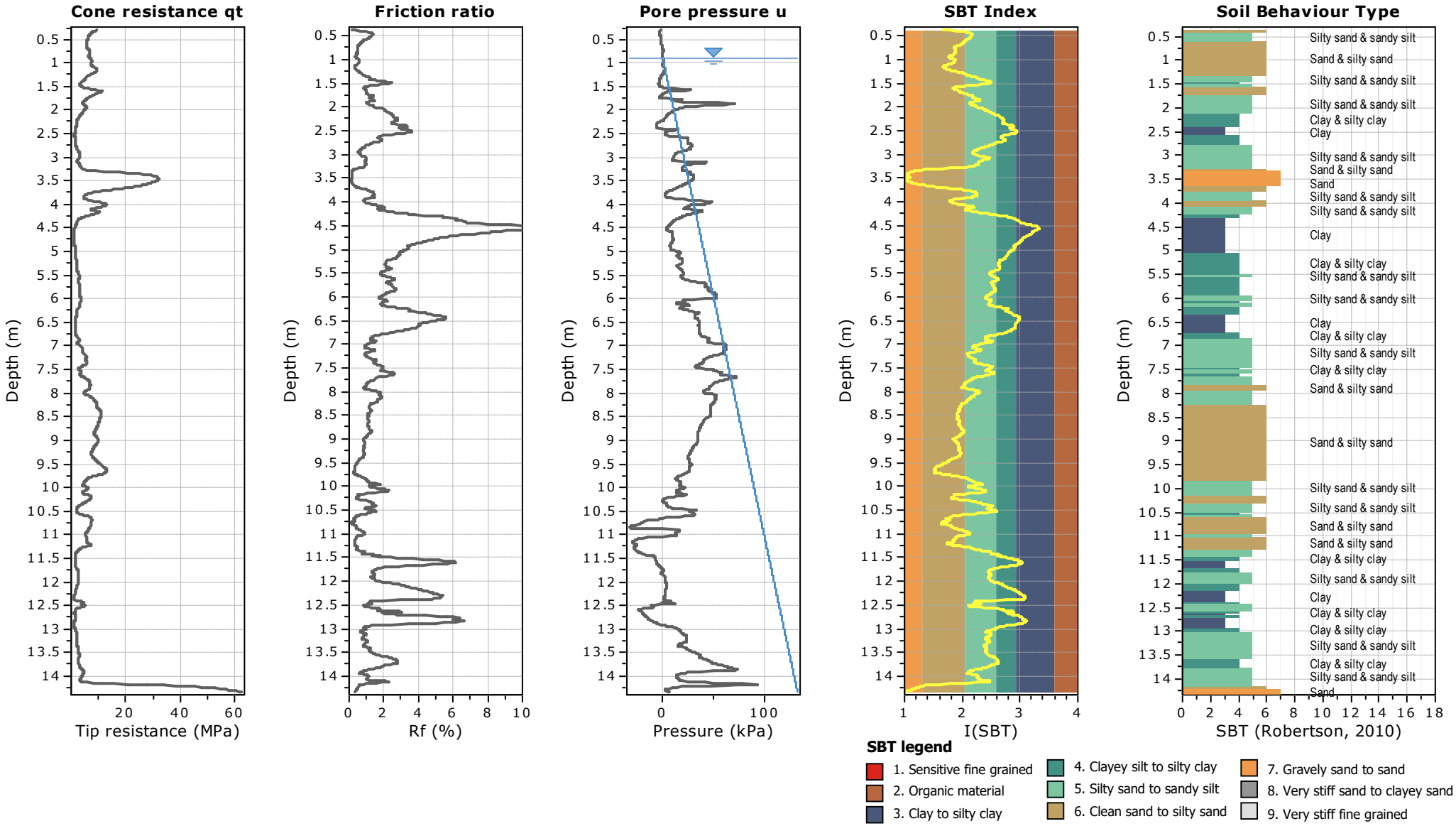


Fuzzy classifiaction legend
- Highly probable clayey soil
- Highly probable mixture soil
- Highly probable sandy soil

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

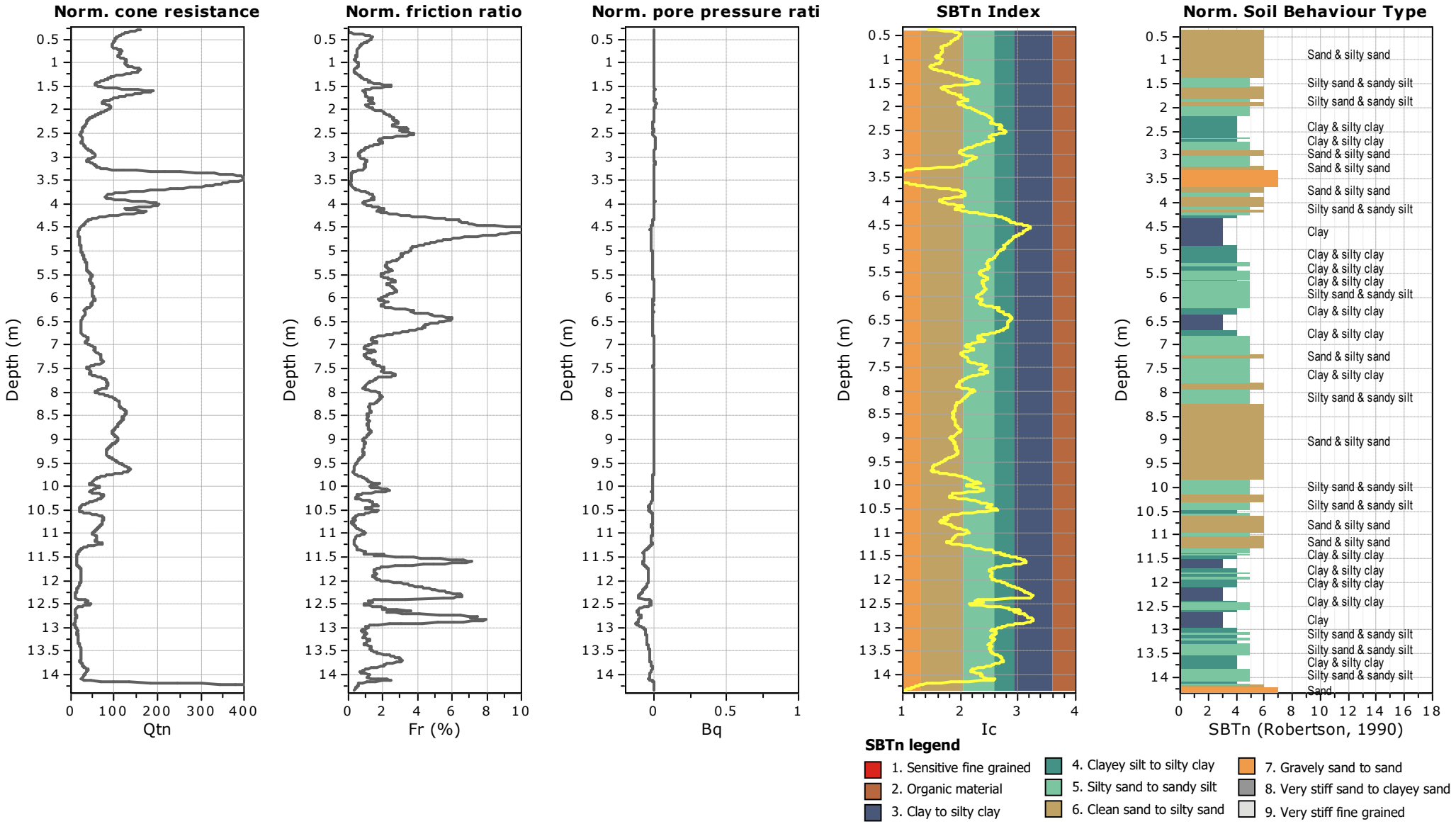
CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

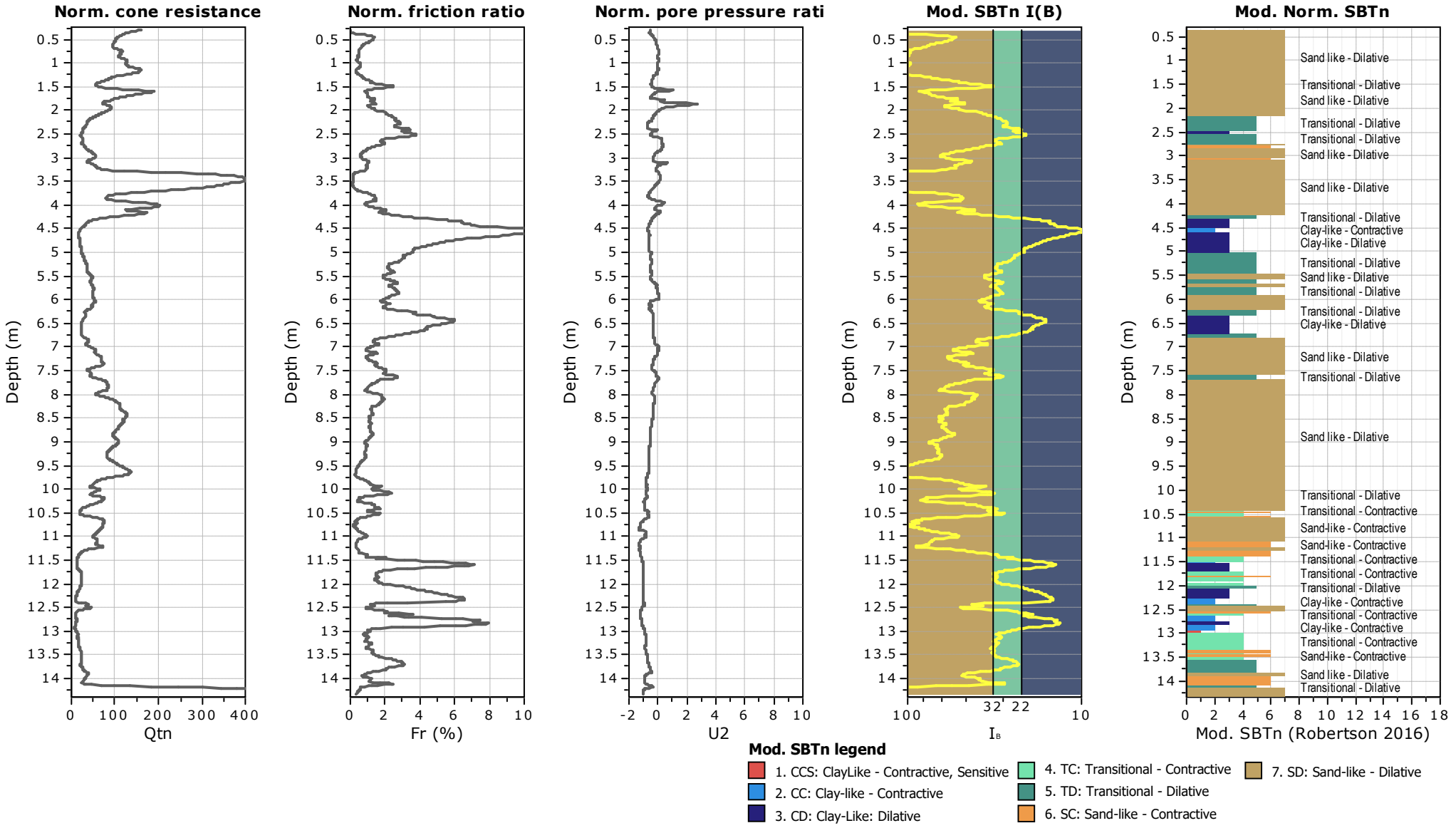
CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

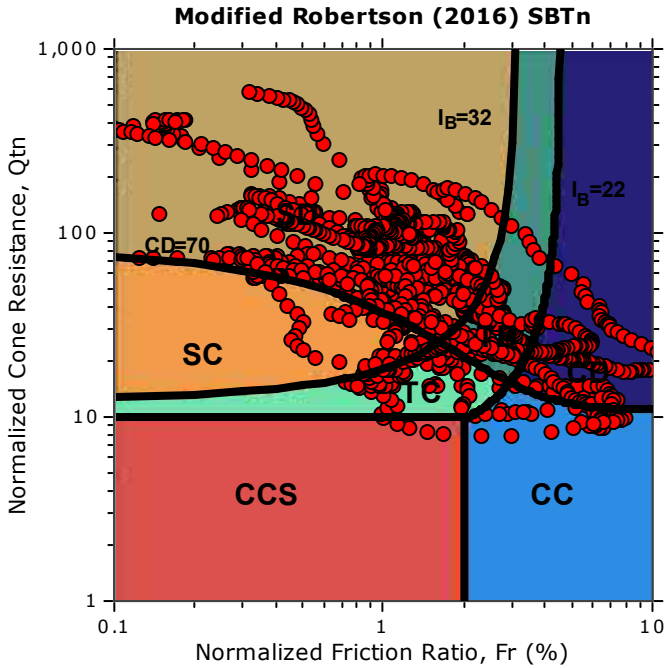


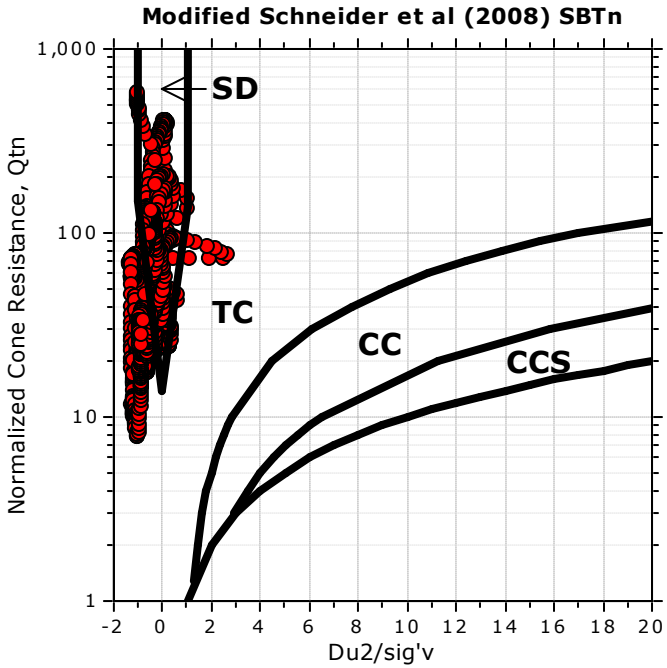
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

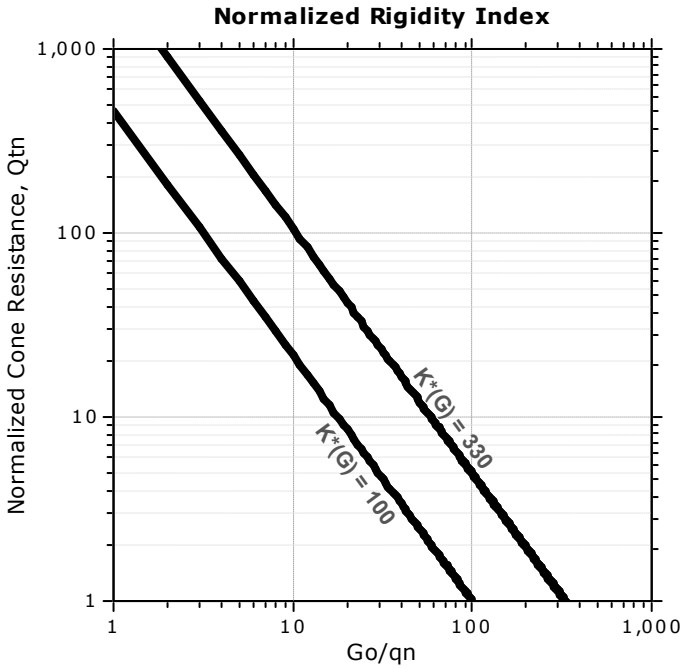
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Updated SBTn plots







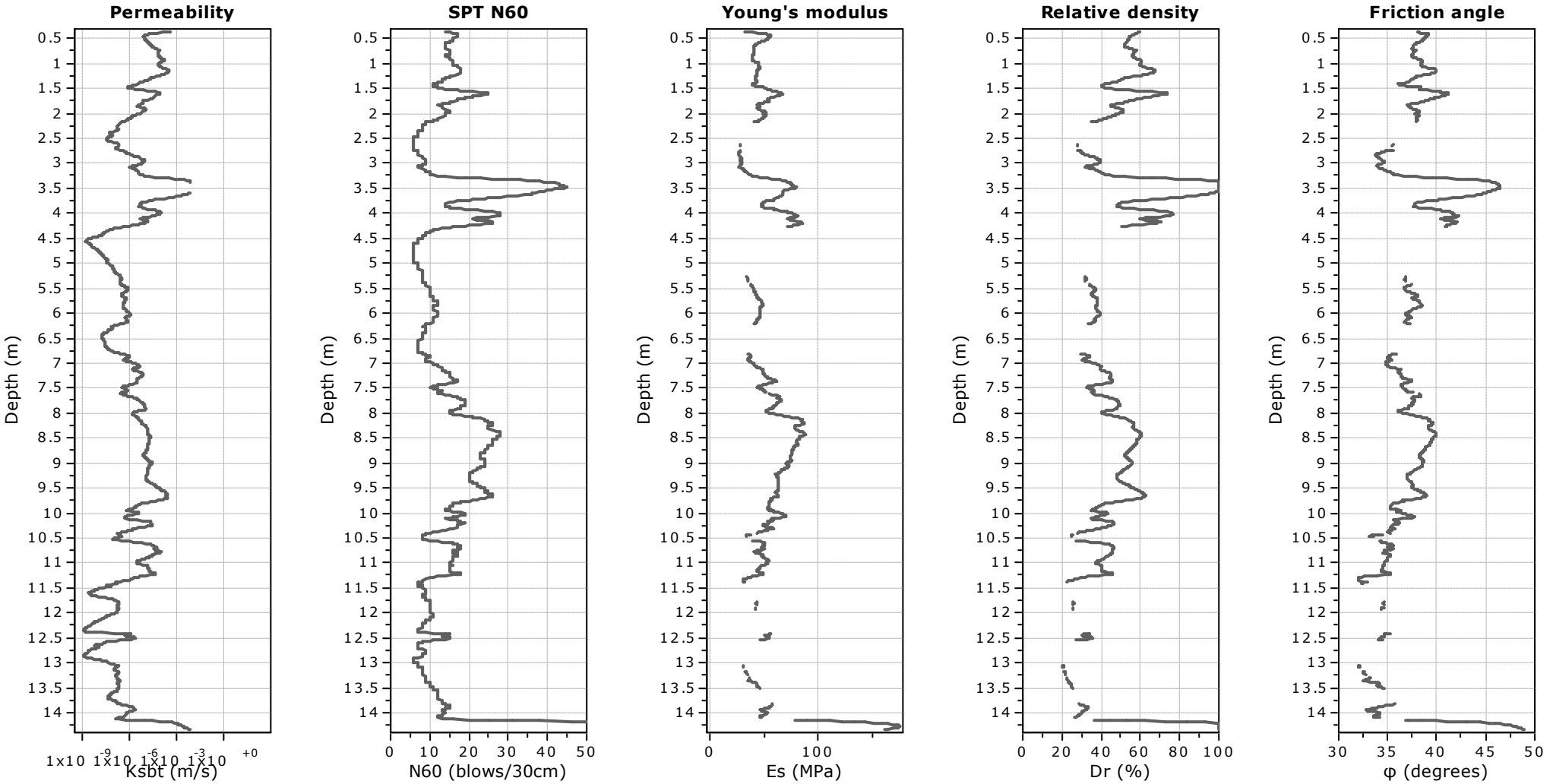
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



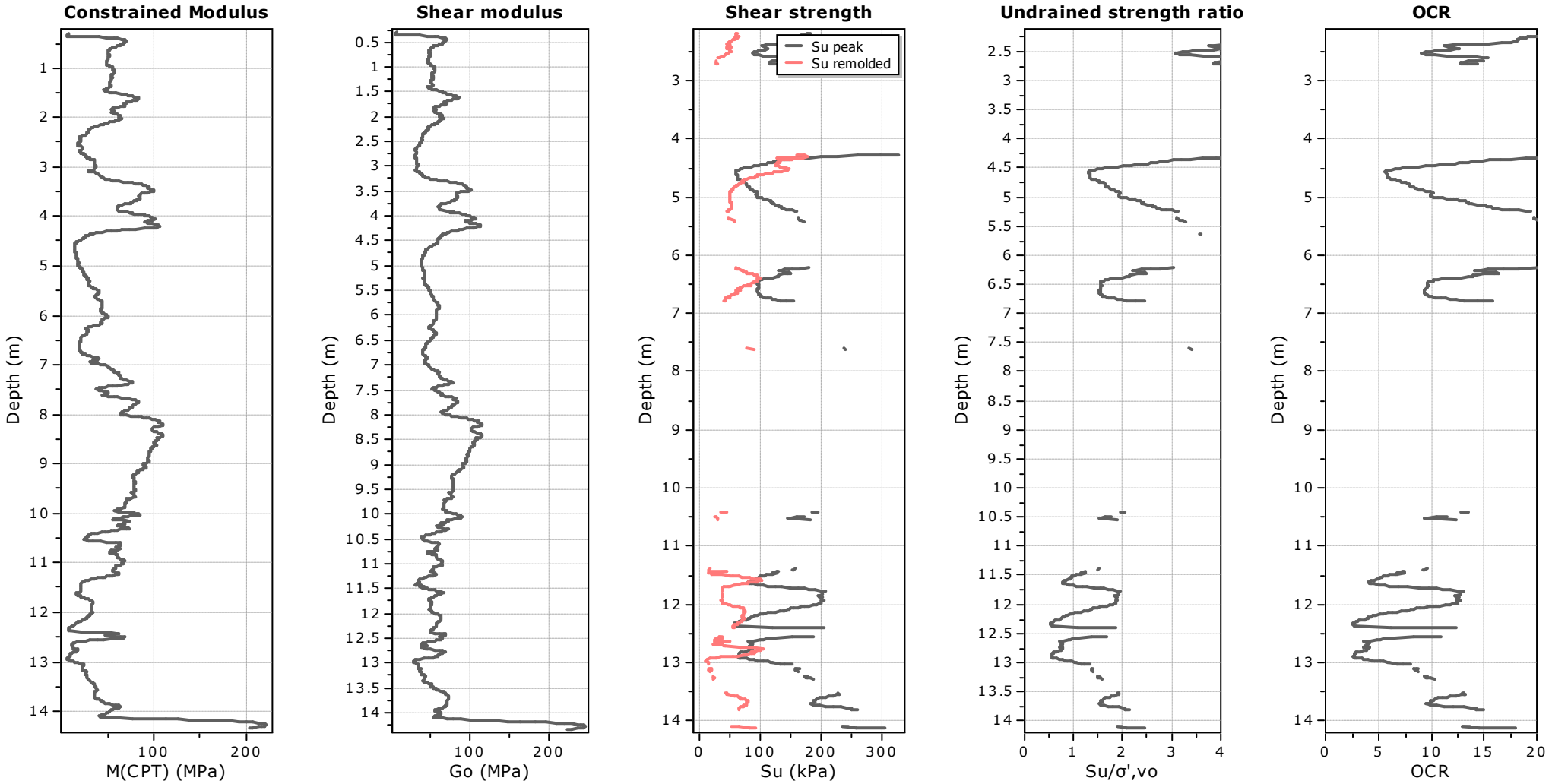
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



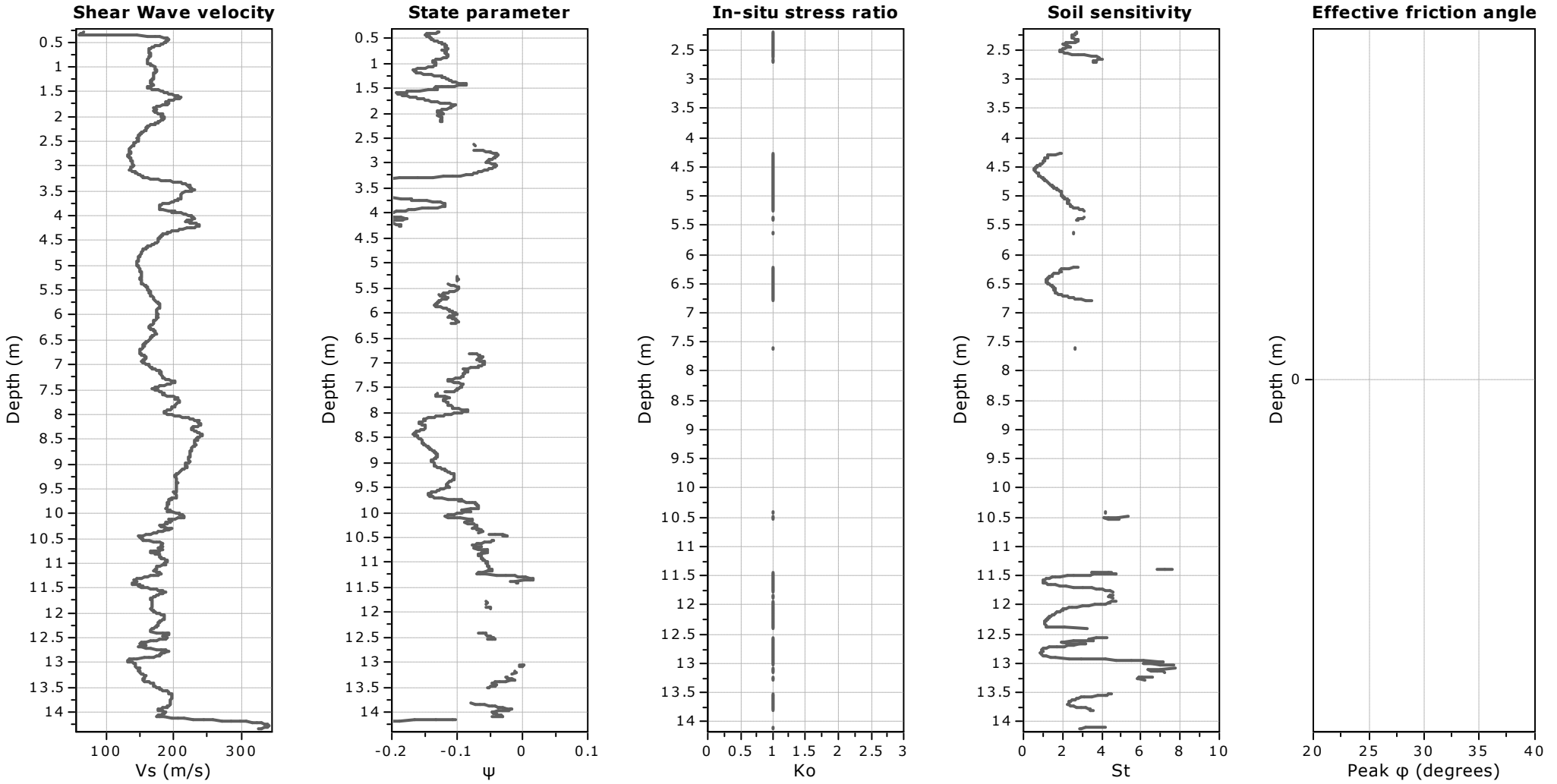
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto
OCR factor for clays, N_{kt}: Auto
Flat Dilatometer Test data

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



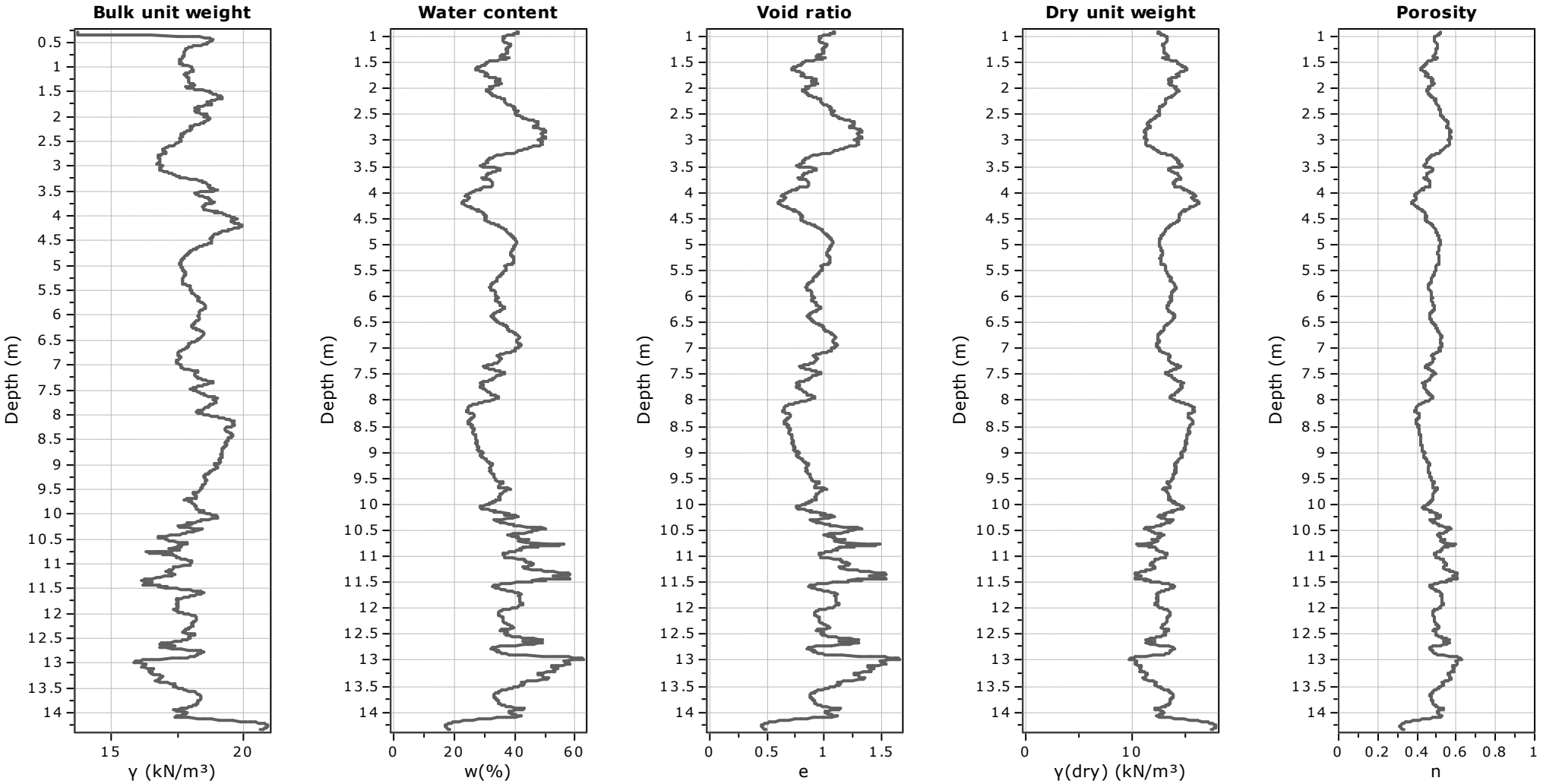
Calculation parameters

Soil Sensitivity factor, N_S: 7.00

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

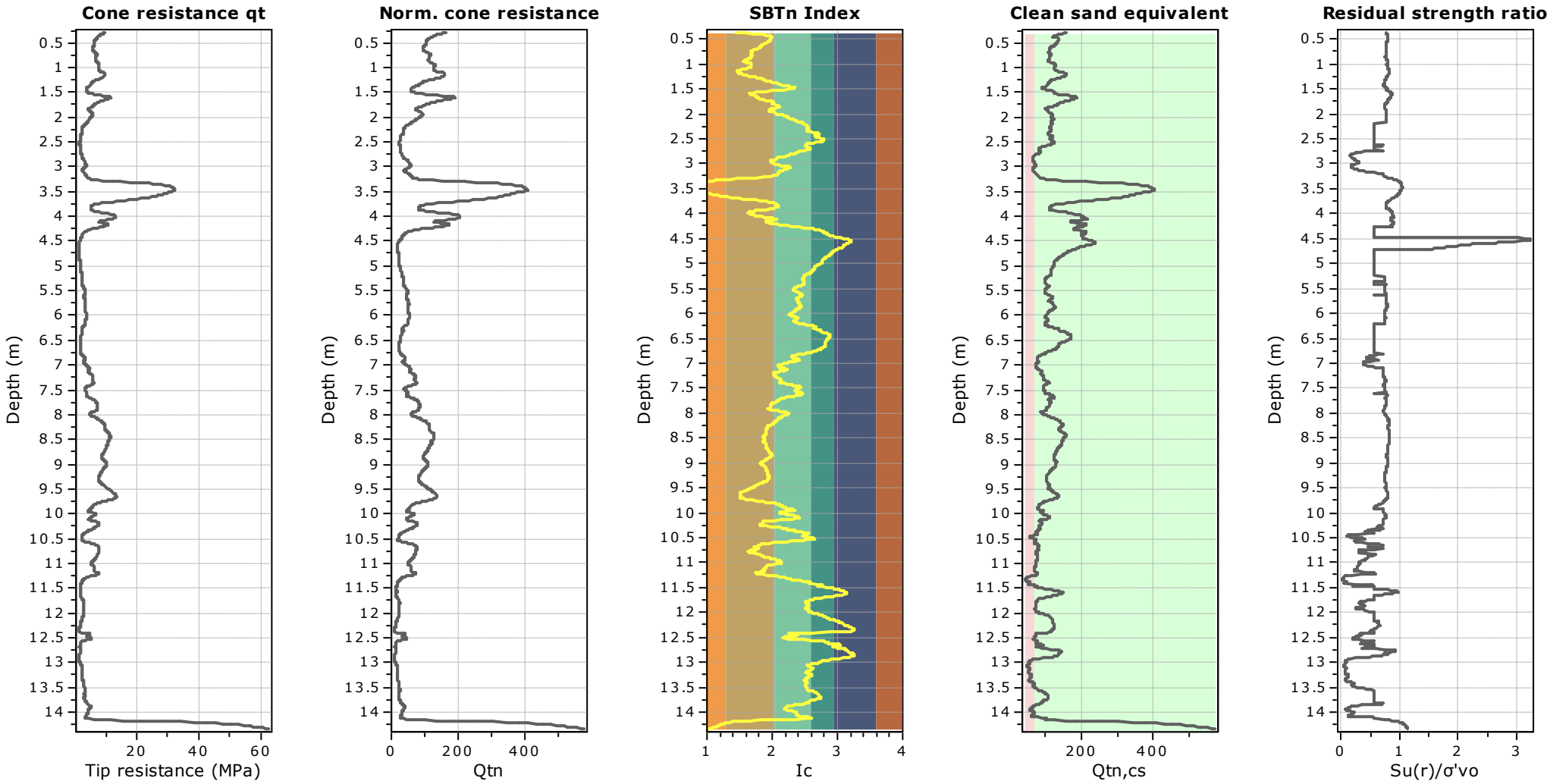
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

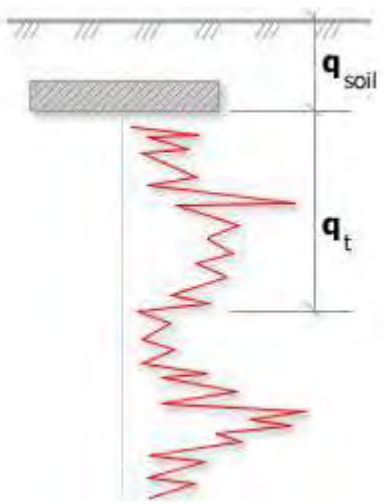
CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

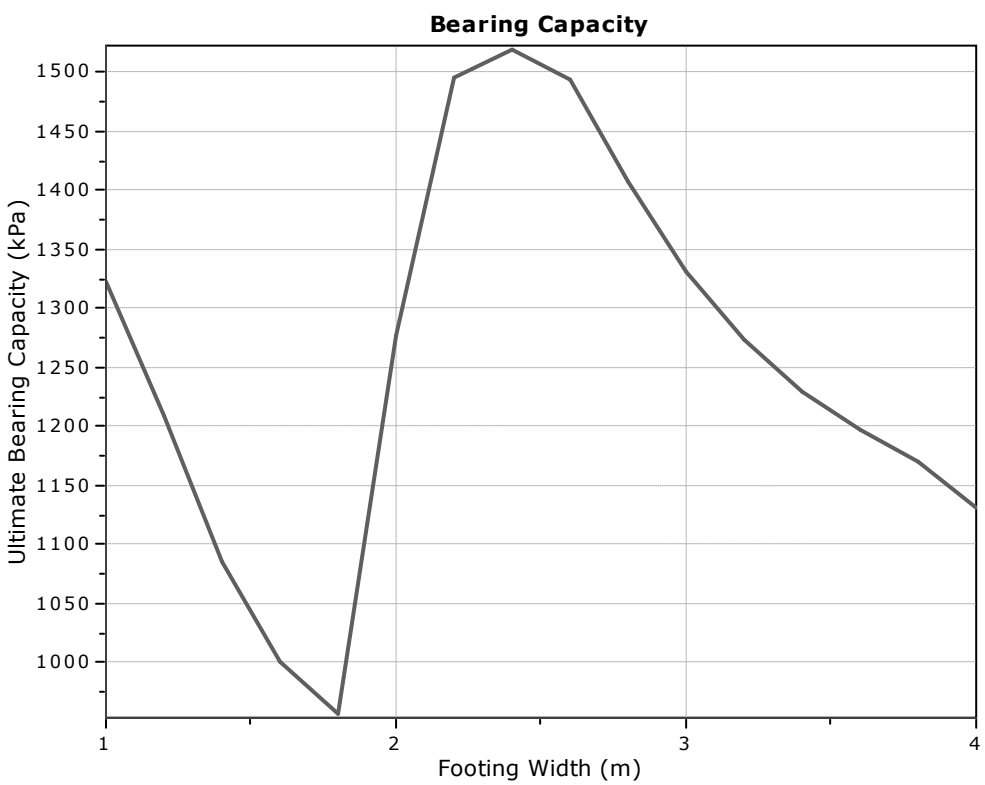
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



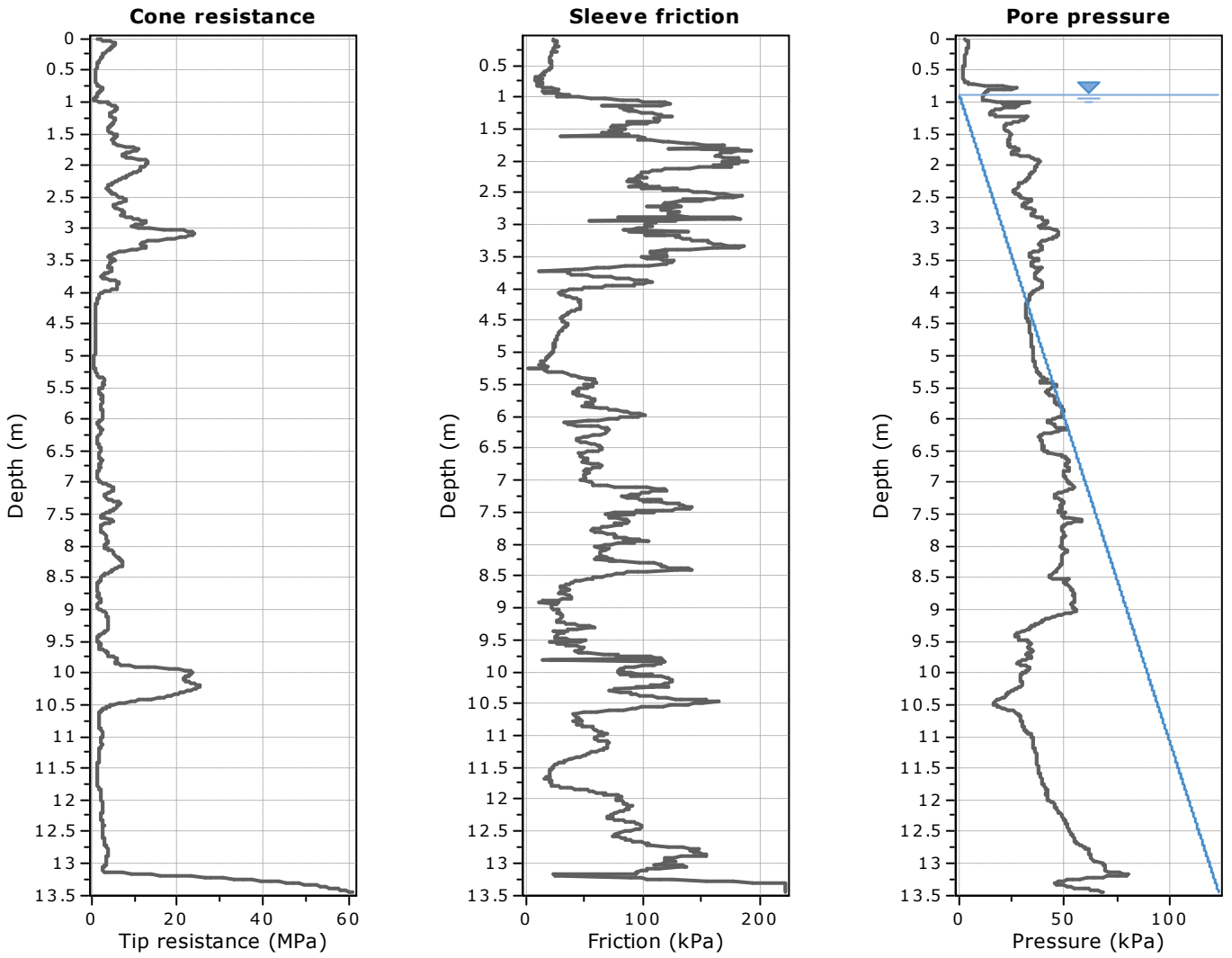
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	6.57	0.20	9.50	1322.53
2	1.20	0.50	2.30	6.00	0.20	9.50	1209.50
3	1.40	0.50	2.60	5.37	0.20	9.50	1084.45
4	1.60	0.50	2.90	4.95	0.20	9.50	999.97
5	1.80	0.50	3.20	4.73	0.20	9.50	956.15
6	2.00	0.50	3.50	6.33	0.20	9.50	1275.95
7	2.20	0.50	3.80	7.42	0.20	9.50	1494.27
8	2.40	0.50	4.10	7.55	0.20	9.50	1518.83
9	2.60	0.50	4.40	7.42	0.20	9.50	1492.61
10	2.80	0.50	4.70	6.98	0.20	9.50	1406.22
11	3.00	0.50	5.00	6.61	0.20	9.50	1331.24
12	3.20	0.50	5.30	6.31	0.20	9.50	1272.36
13	3.40	0.50	5.60	6.10	0.20	9.50	1228.94
14	3.60	0.50	5.90	5.93	0.20	9.50	1195.98
15	3.80	0.50	6.20	5.80	0.20	9.50	1169.13
16	4.00	0.50	6.50	5.61	0.20	9.50	1131.23

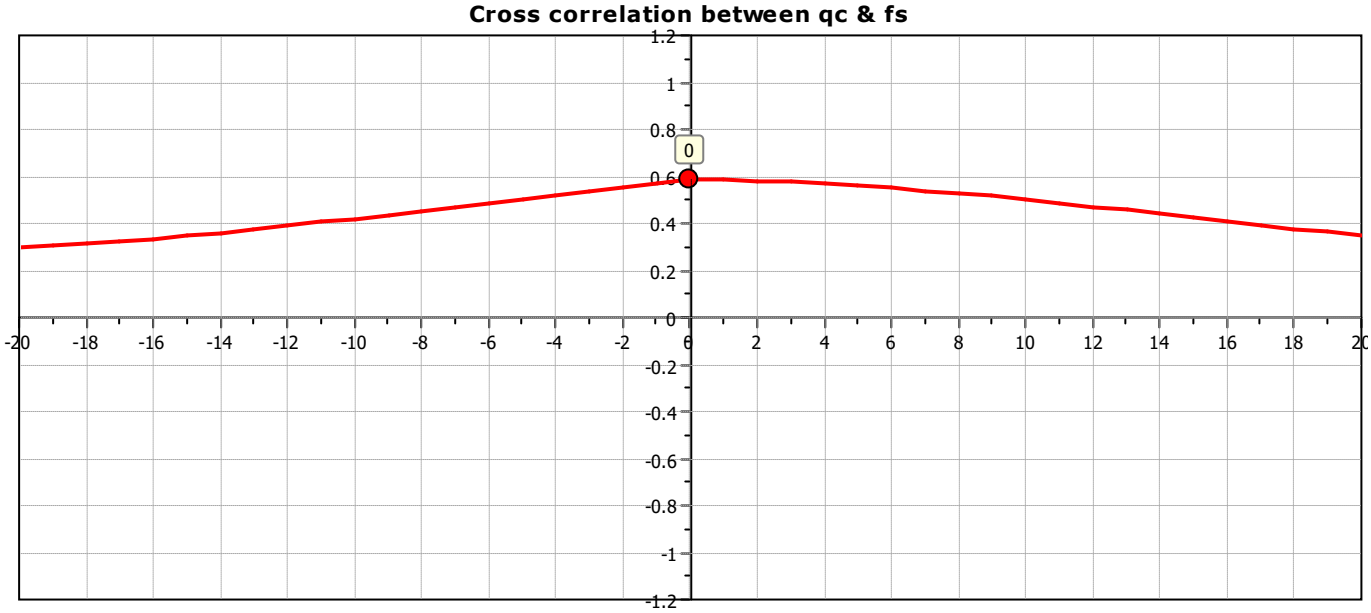
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

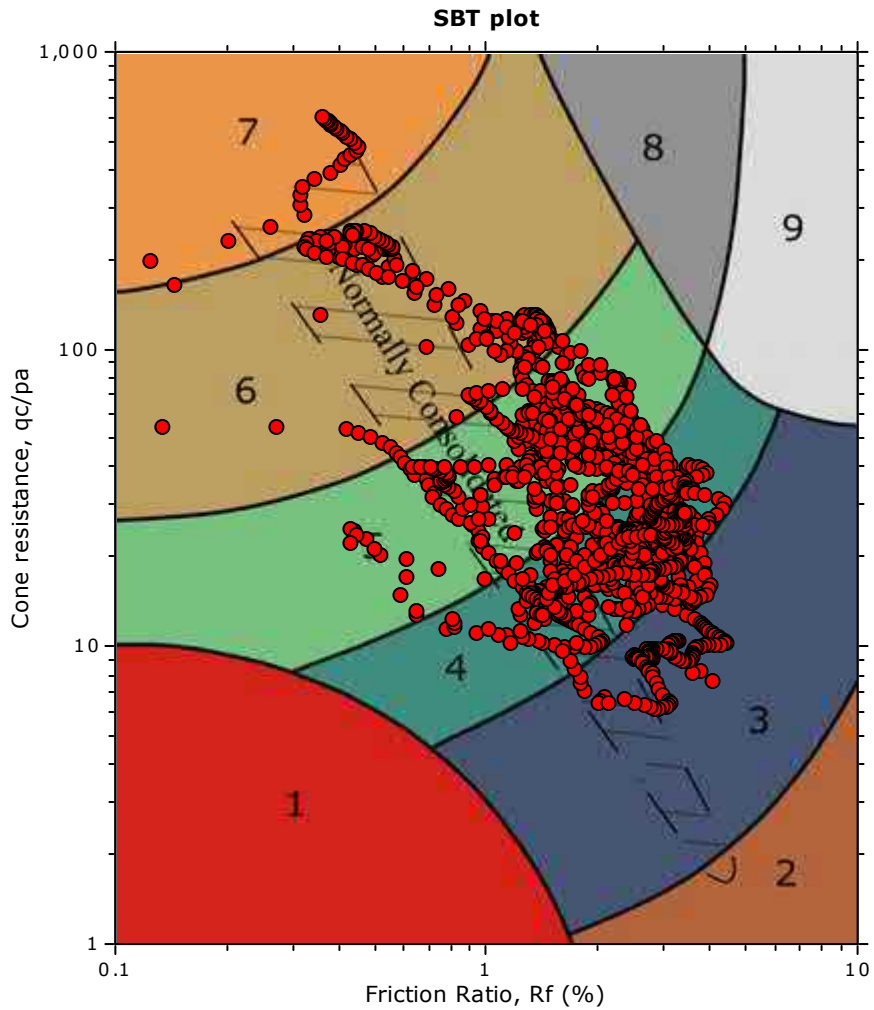


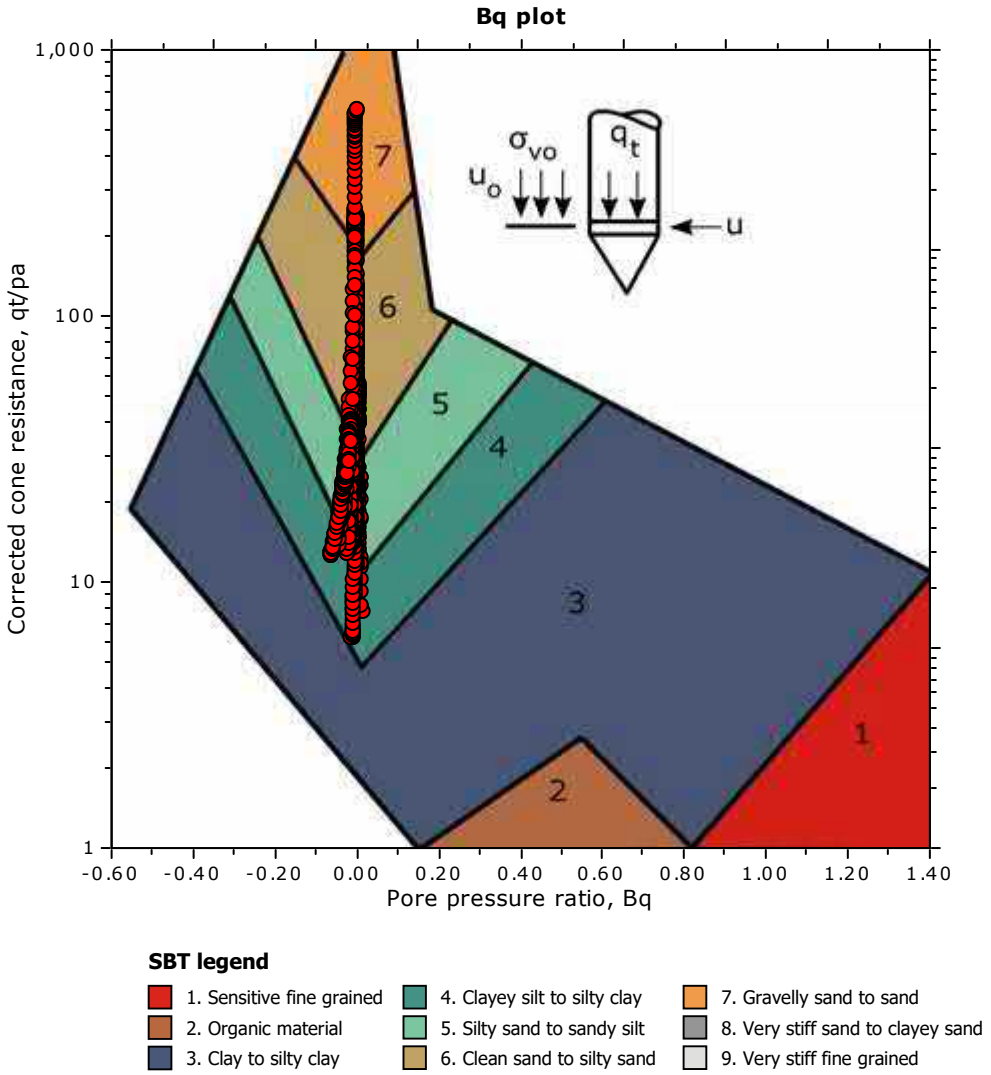
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots



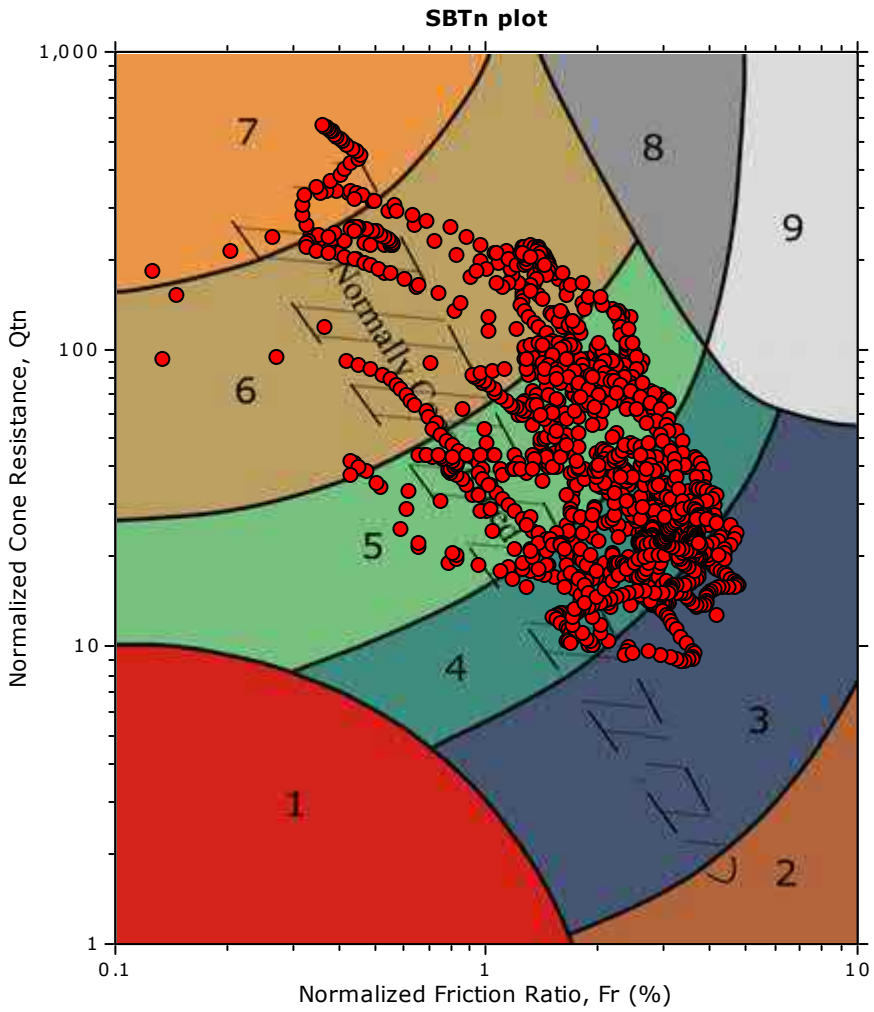


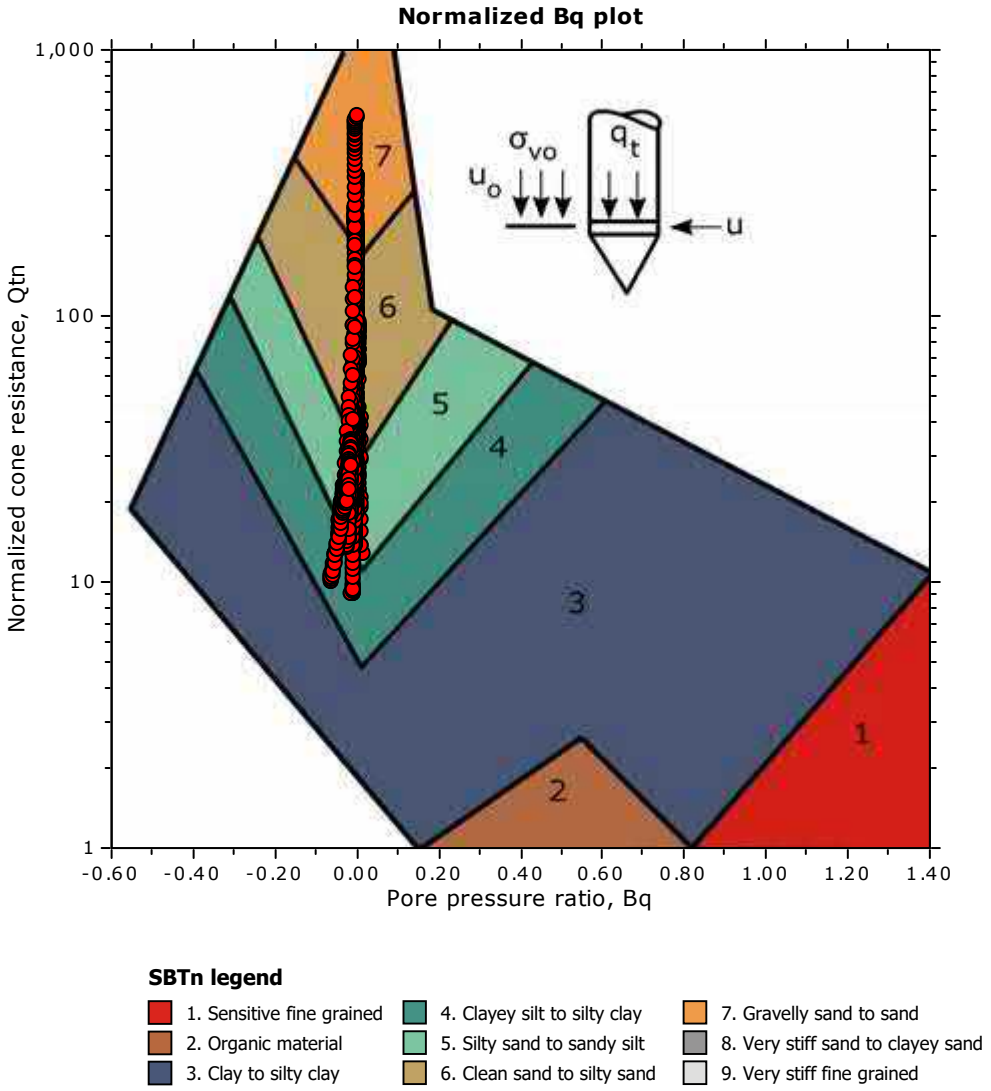
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots (normalized)



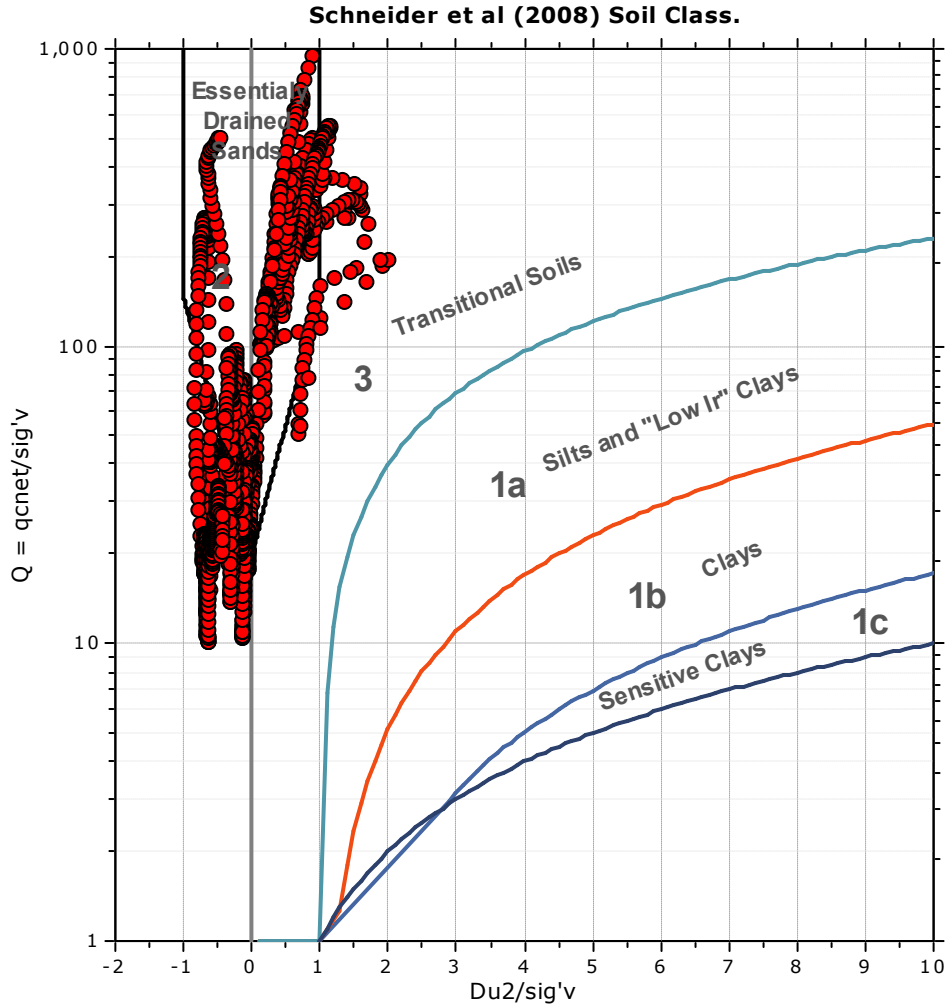


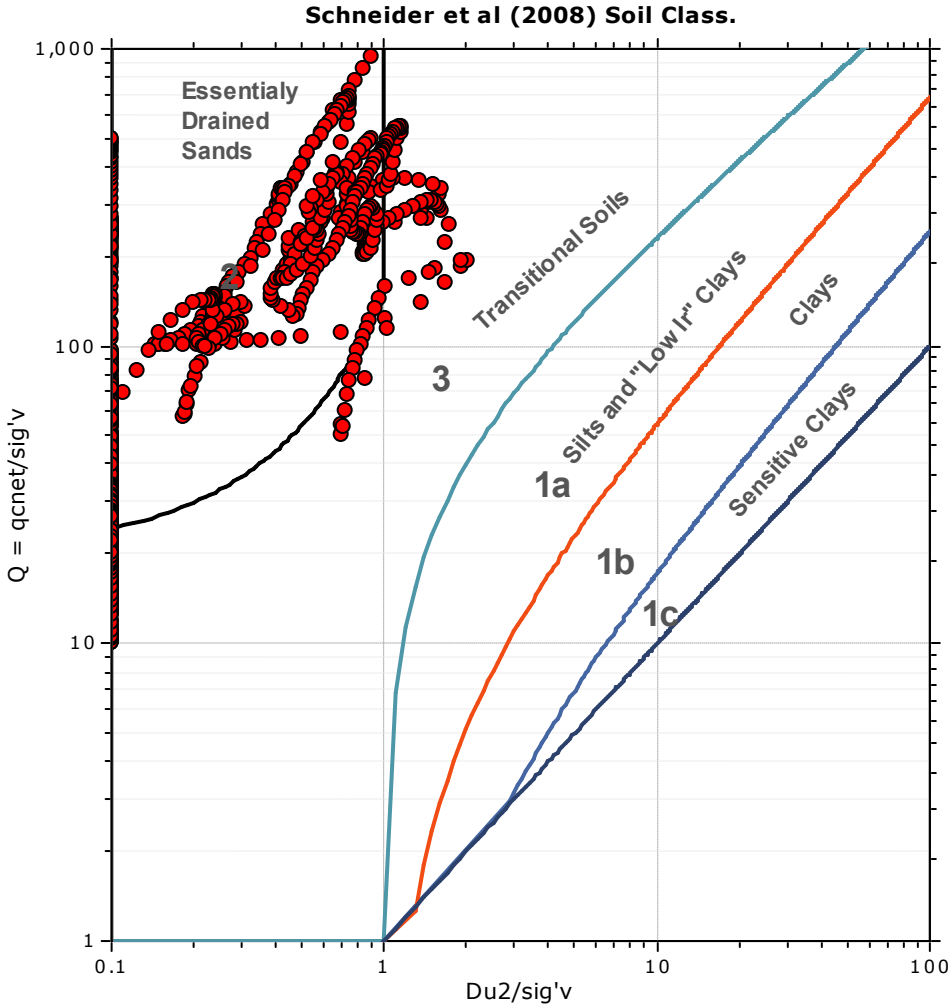
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

Bq plots (Schneider)

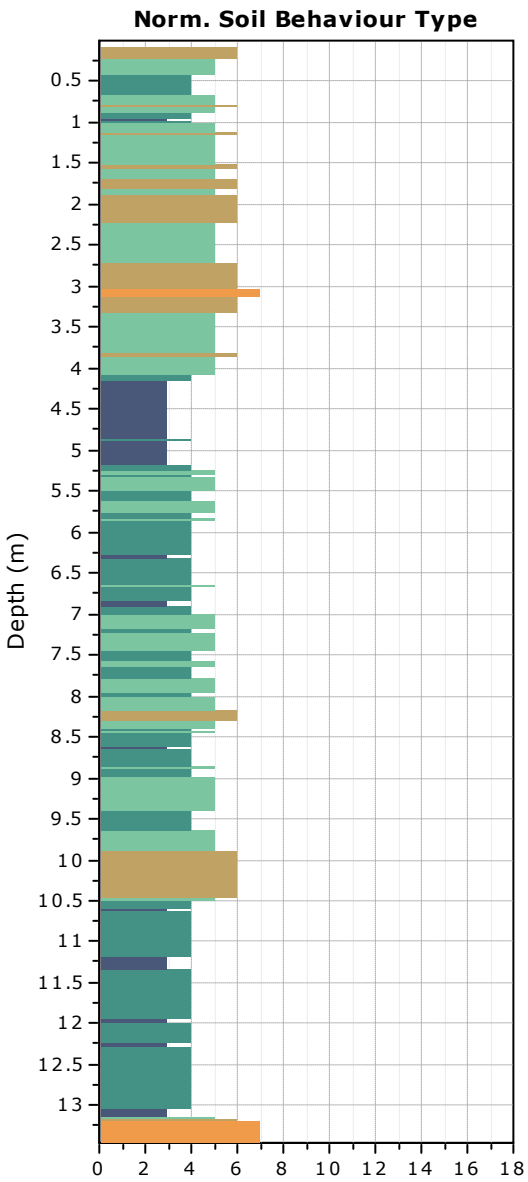


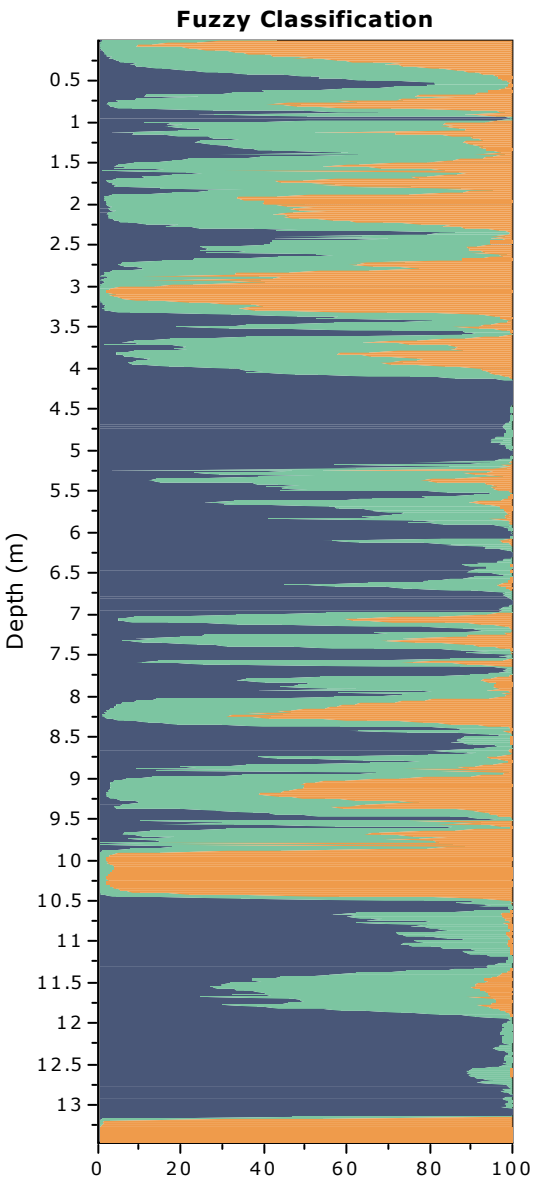


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



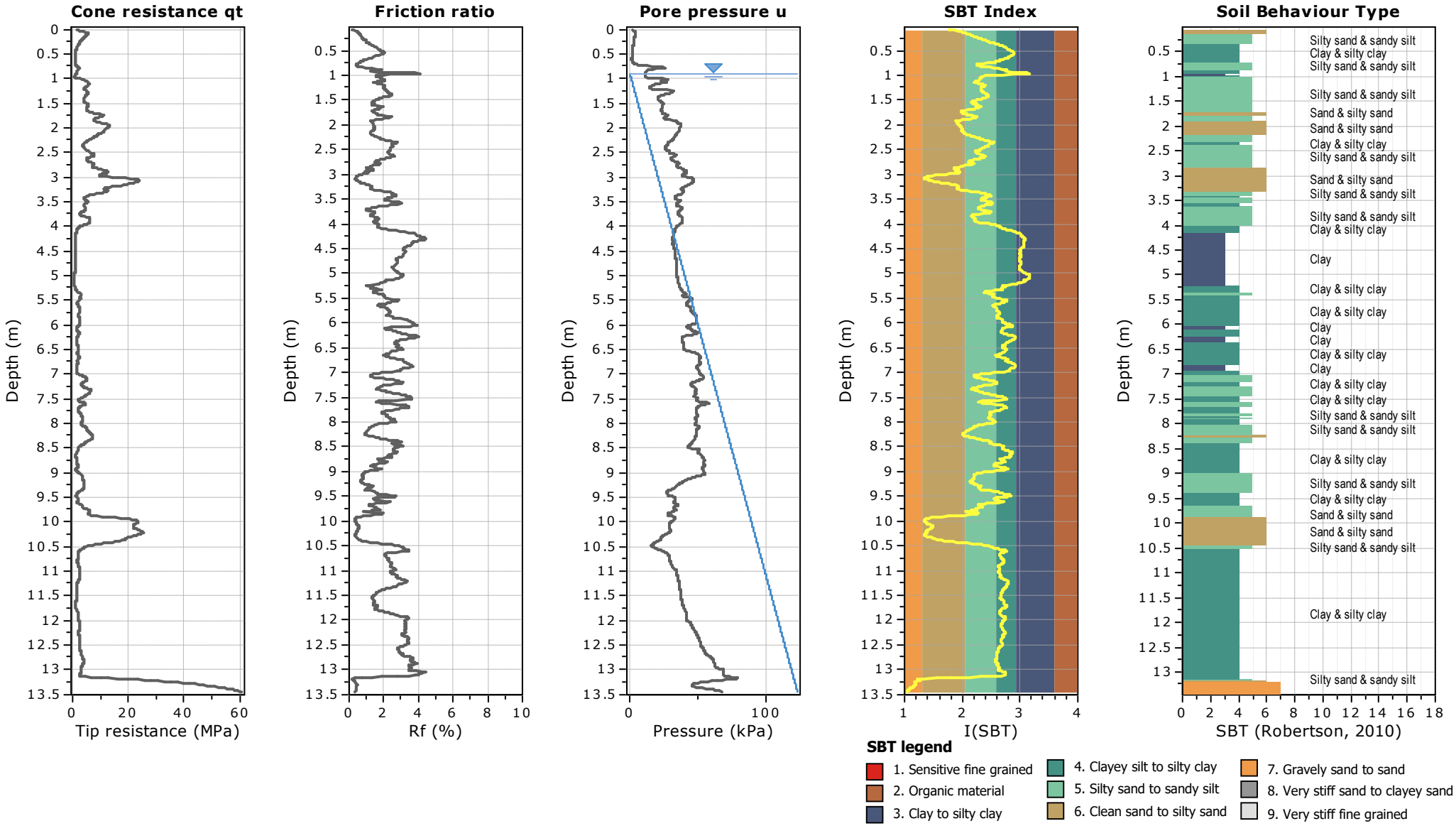


Fuzzy classifiaction legend
- Highly probable clayey soil
- Highly probable mixture soil
- Highly probable sandy soil

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

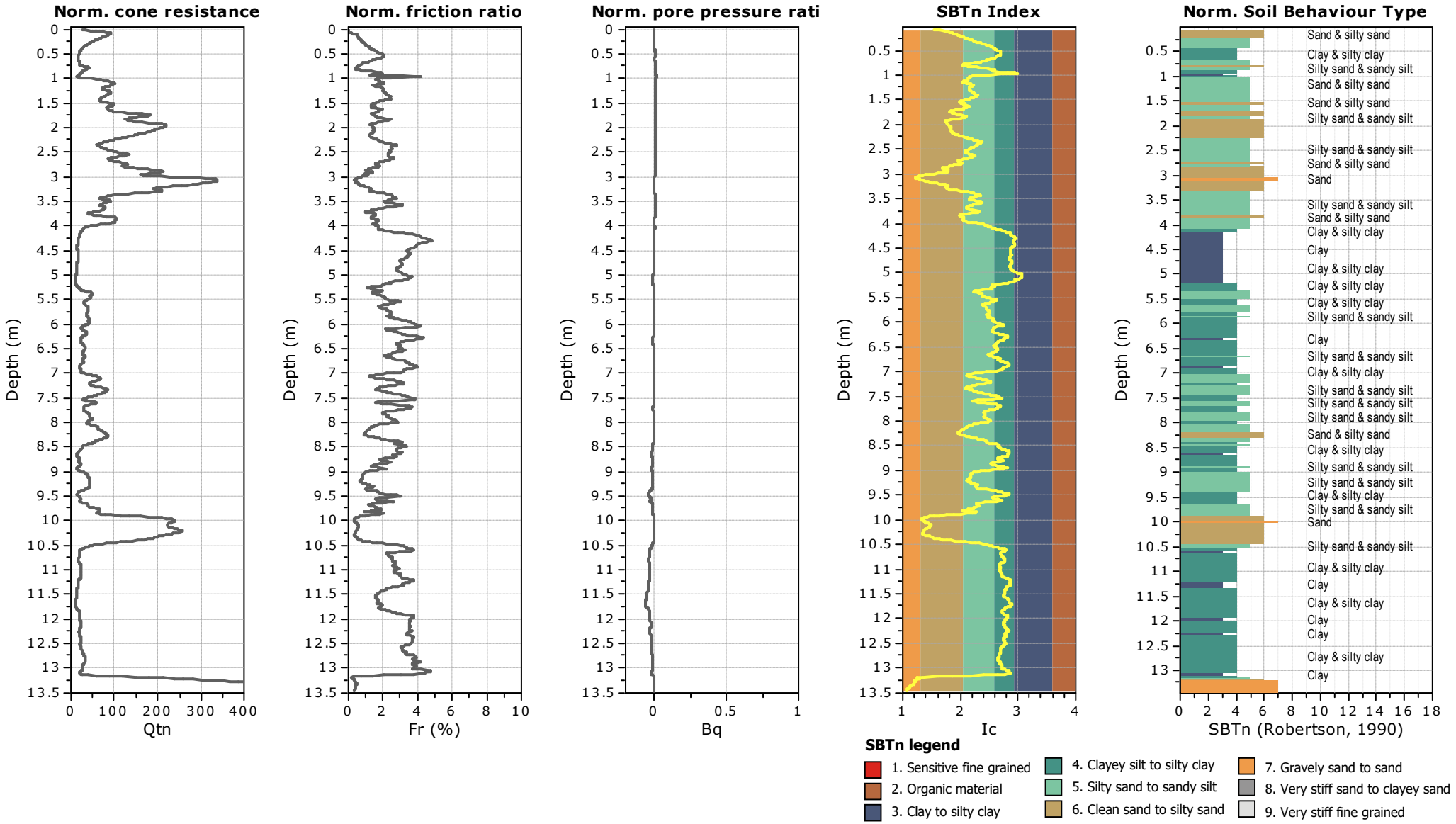
CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

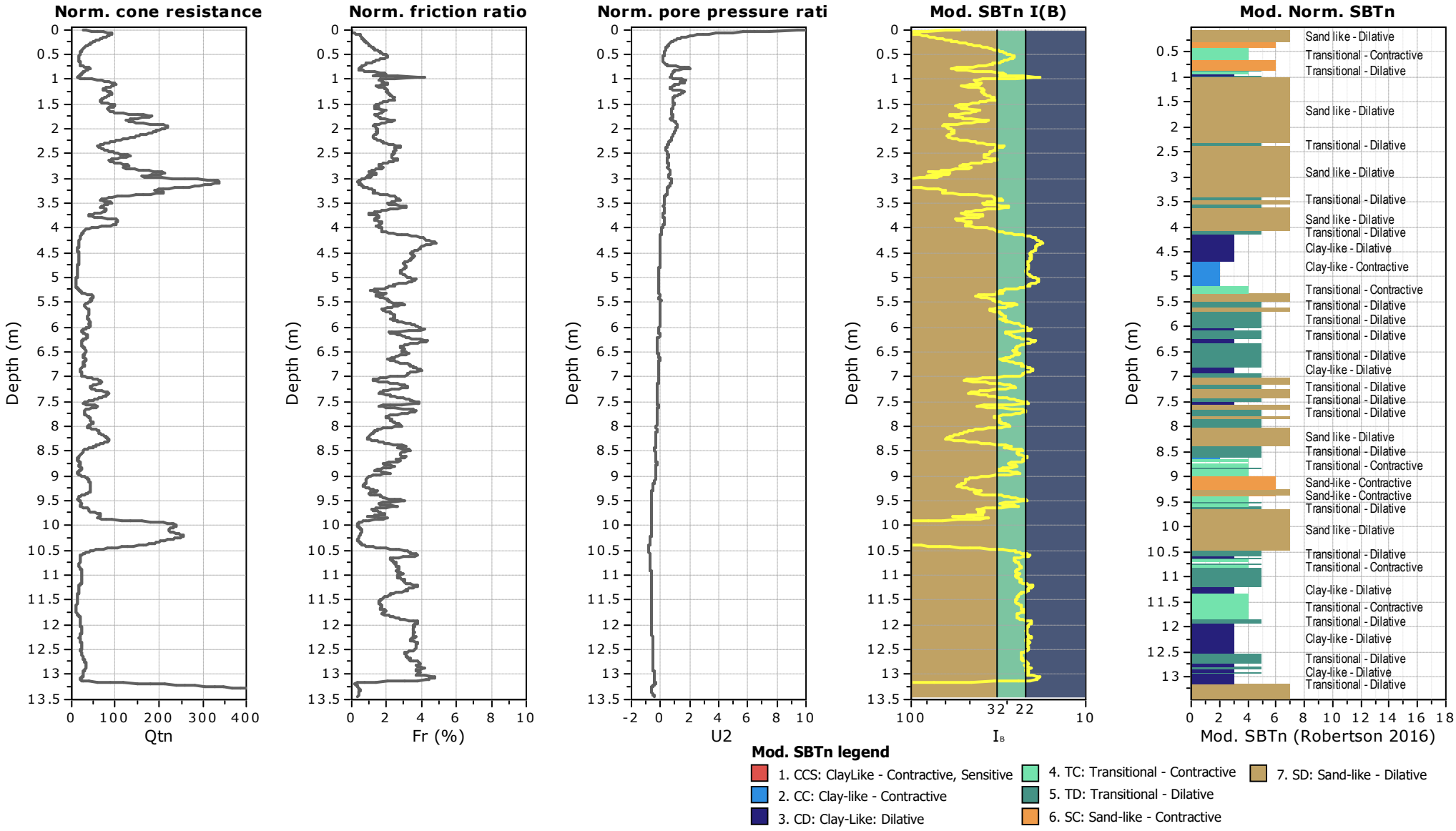
CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

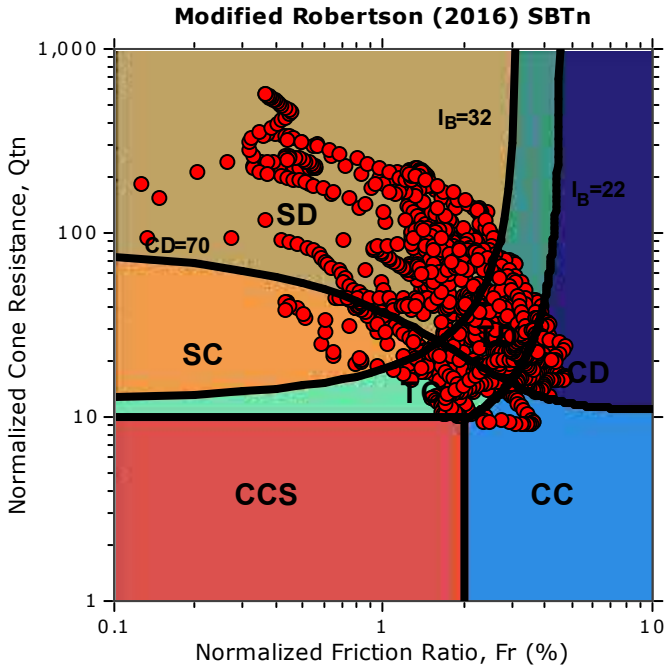


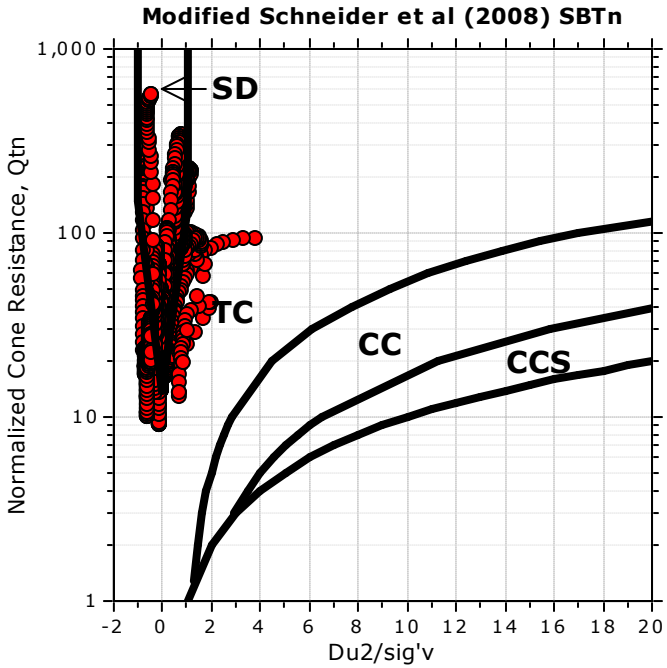
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

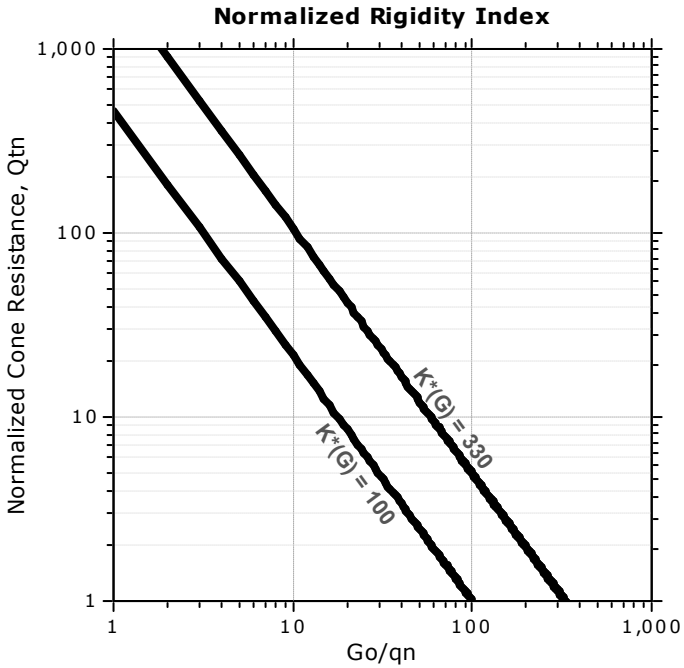
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Updated SBTn plots







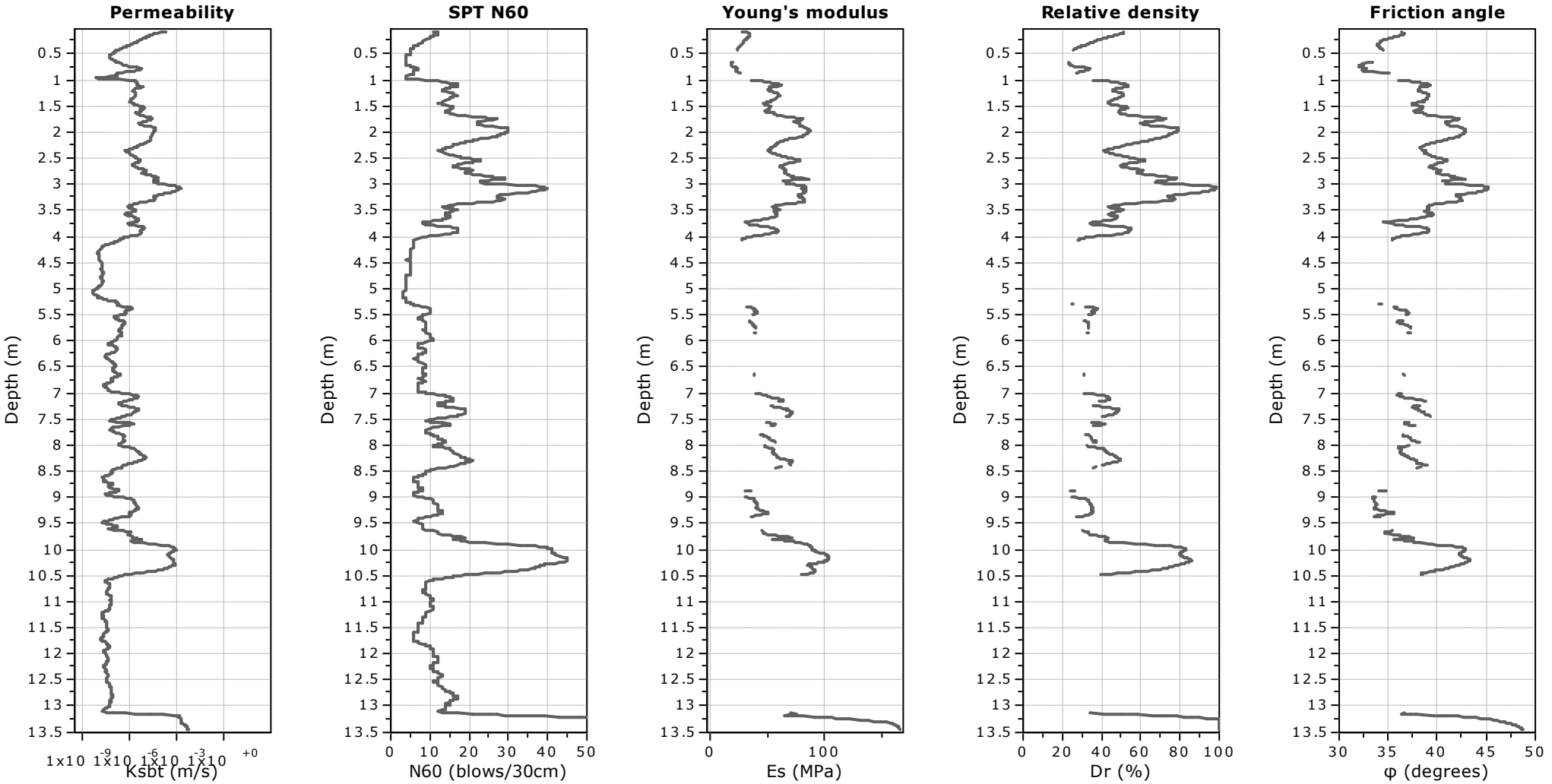
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



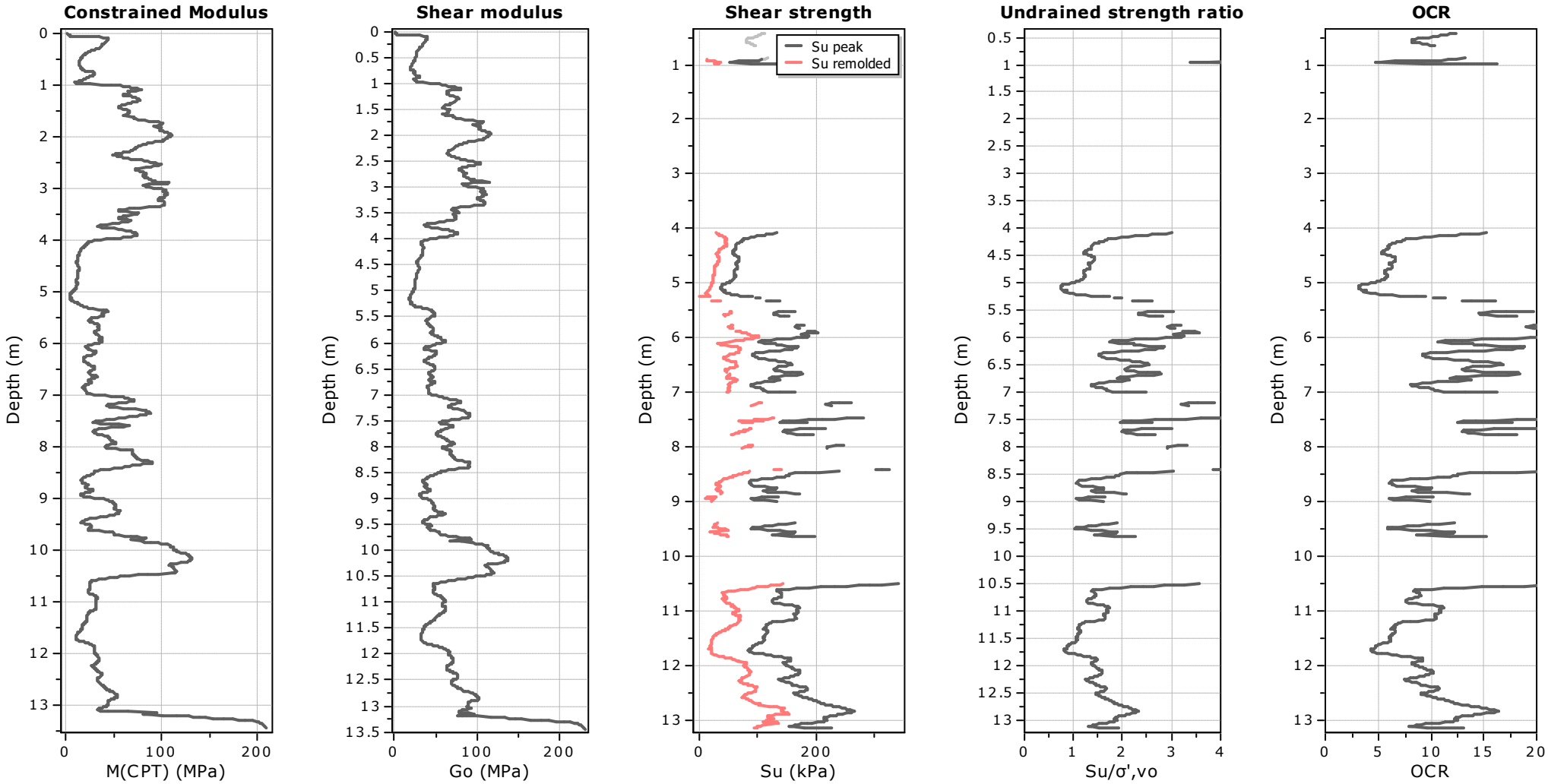
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



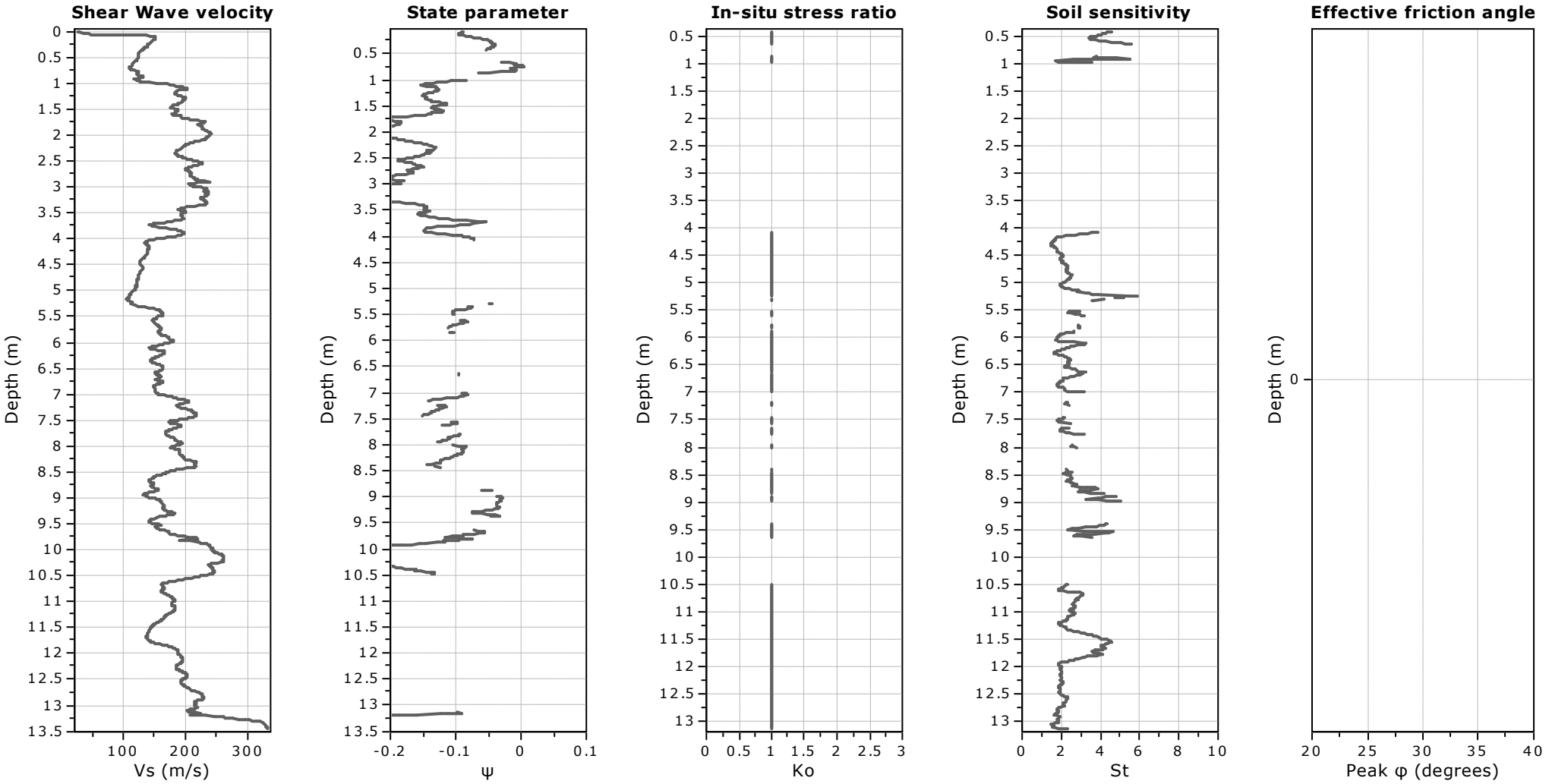
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto
OCR factor for clays, N_{kt}: Auto
Flat Dilatometer Test data

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



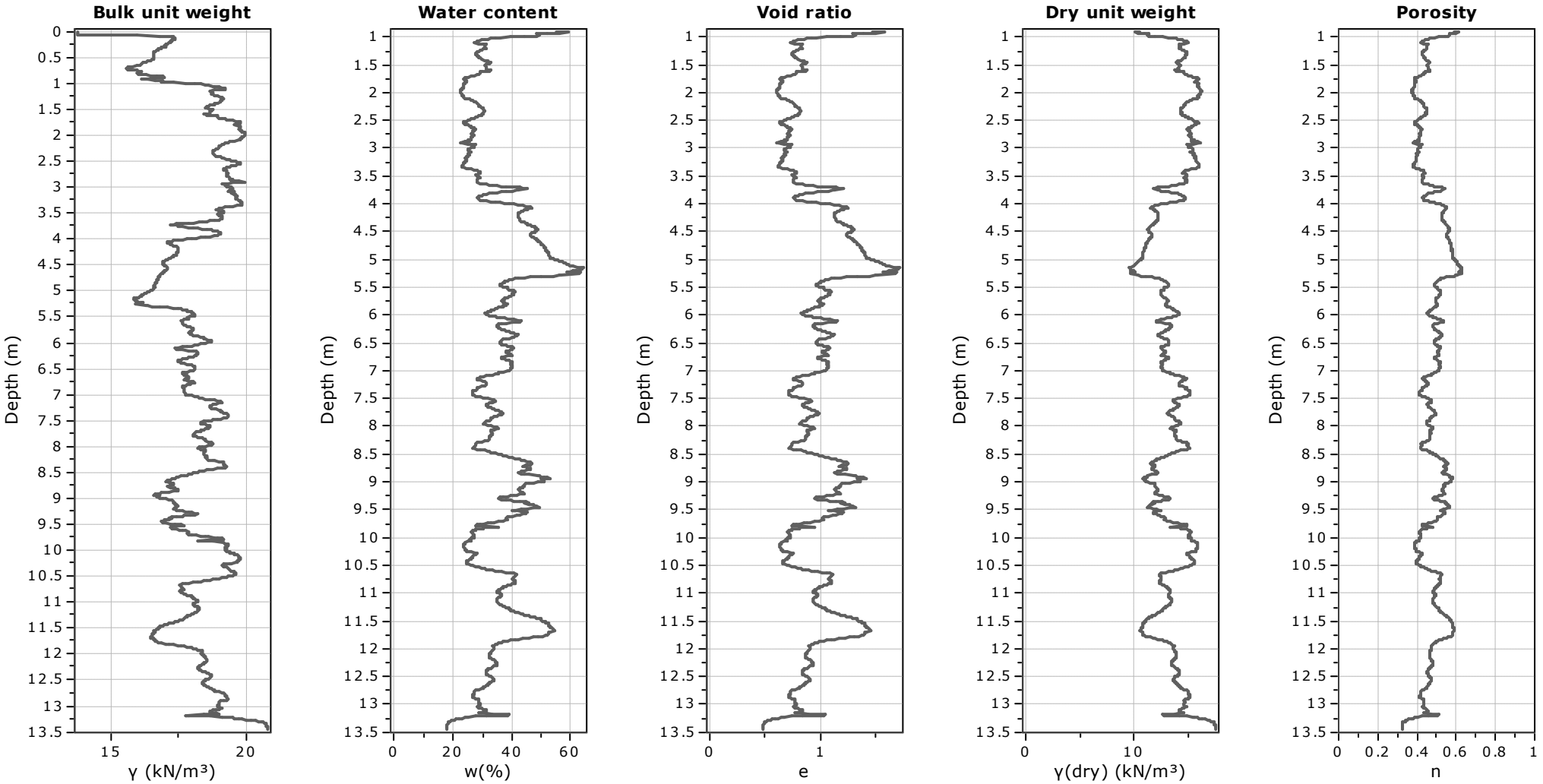
Calculation parameters

Soil Sensitivity factor, N_S: 7.00

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

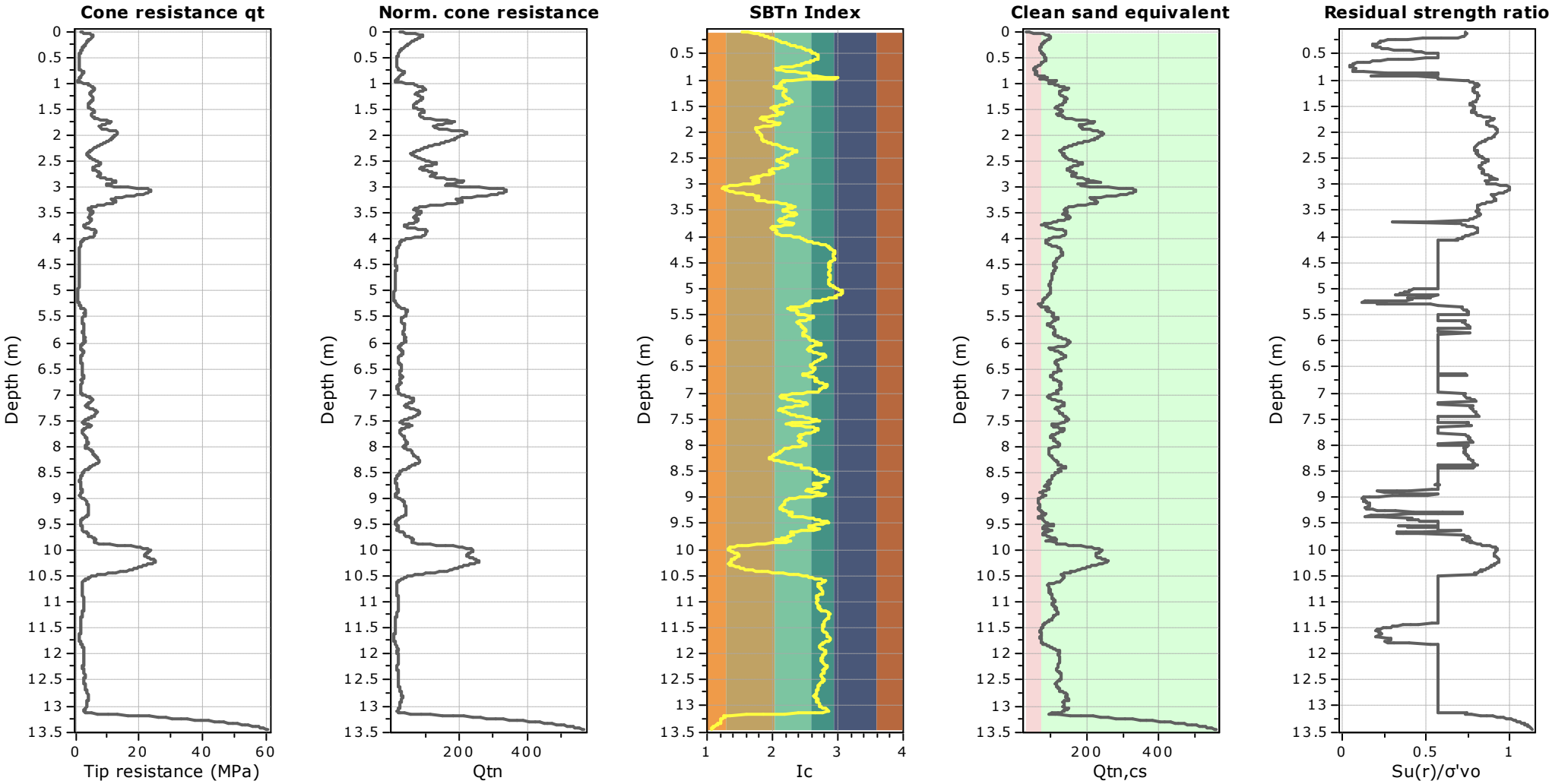
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

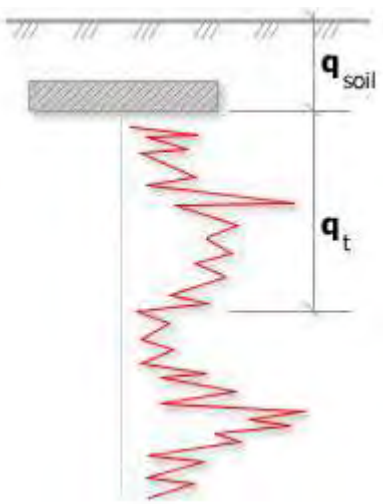
CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

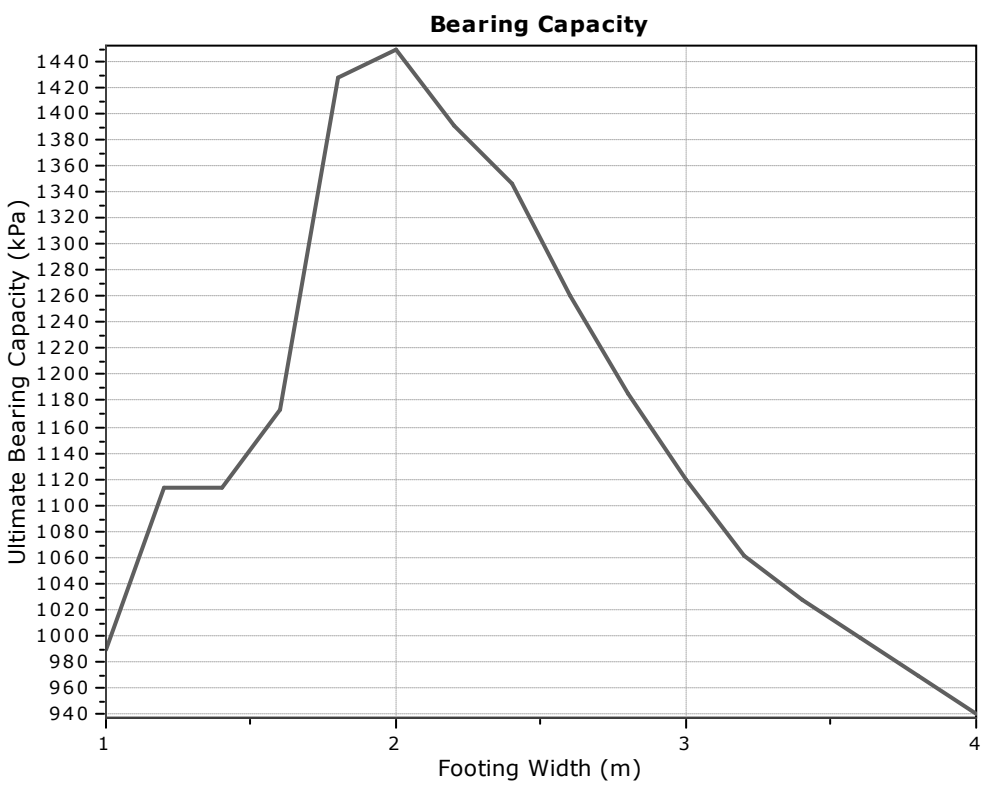
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



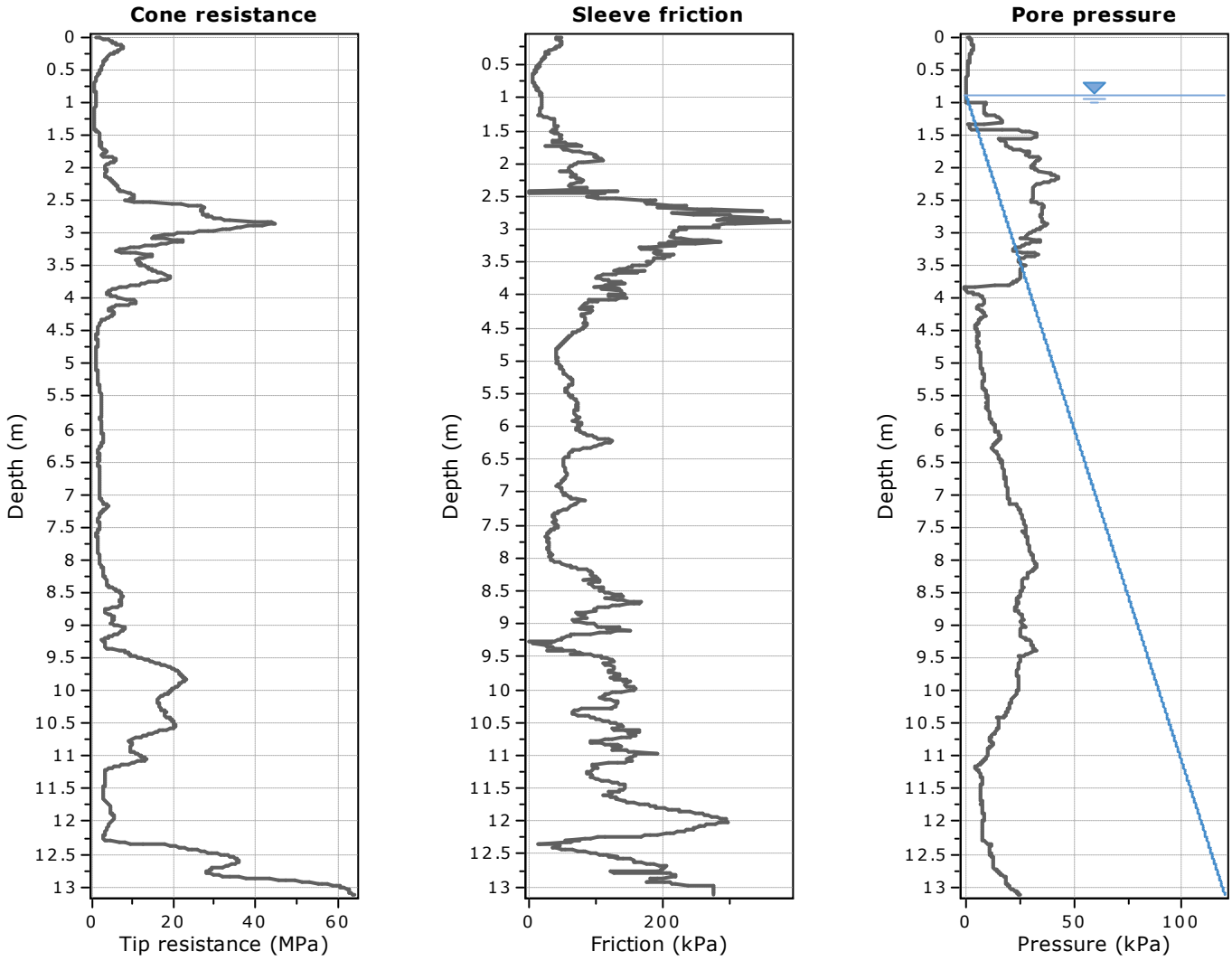
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	4.90	0.20	9.50	988.89
2	1.20	0.50	2.30	5.52	0.20	9.50	1112.95
3	1.40	0.50	2.60	5.52	0.20	9.50	1113.12
4	1.60	0.50	2.90	5.82	0.20	9.50	1173.55
5	1.80	0.50	3.20	7.09	0.20	9.50	1427.06
6	2.00	0.50	3.50	7.20	0.20	9.50	1448.64
7	2.20	0.50	3.80	6.90	0.20	9.50	1390.39
8	2.40	0.50	4.10	6.68	0.20	9.50	1345.82
9	2.60	0.50	4.40	6.26	0.20	9.50	1261.07
10	2.80	0.50	4.70	5.88	0.20	9.50	1185.96
11	3.00	0.50	5.00	5.55	0.20	9.50	1119.75
12	3.20	0.50	5.30	5.26	0.20	9.50	1060.75
13	3.40	0.50	5.60	5.09	0.20	9.50	1027.54
14	3.60	0.50	5.90	4.95	0.20	9.50	998.50
15	3.80	0.50	6.20	4.80	0.20	9.50	970.01
16	4.00	0.50	6.50	4.65	0.20	9.50	940.33

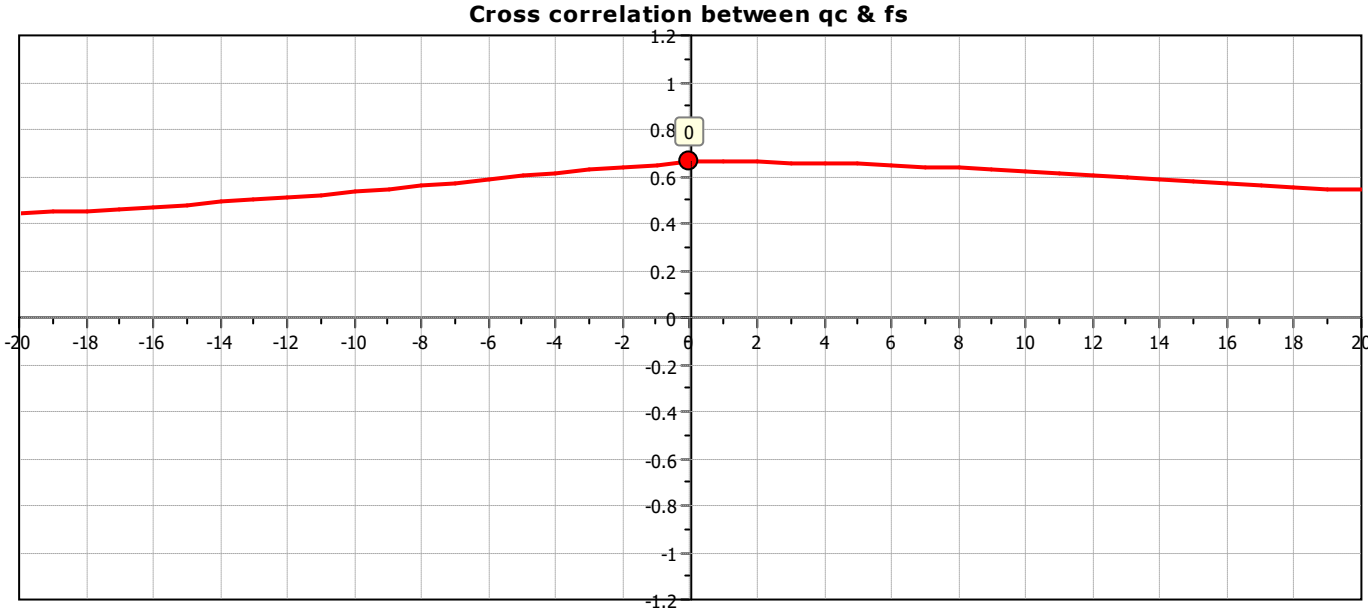
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

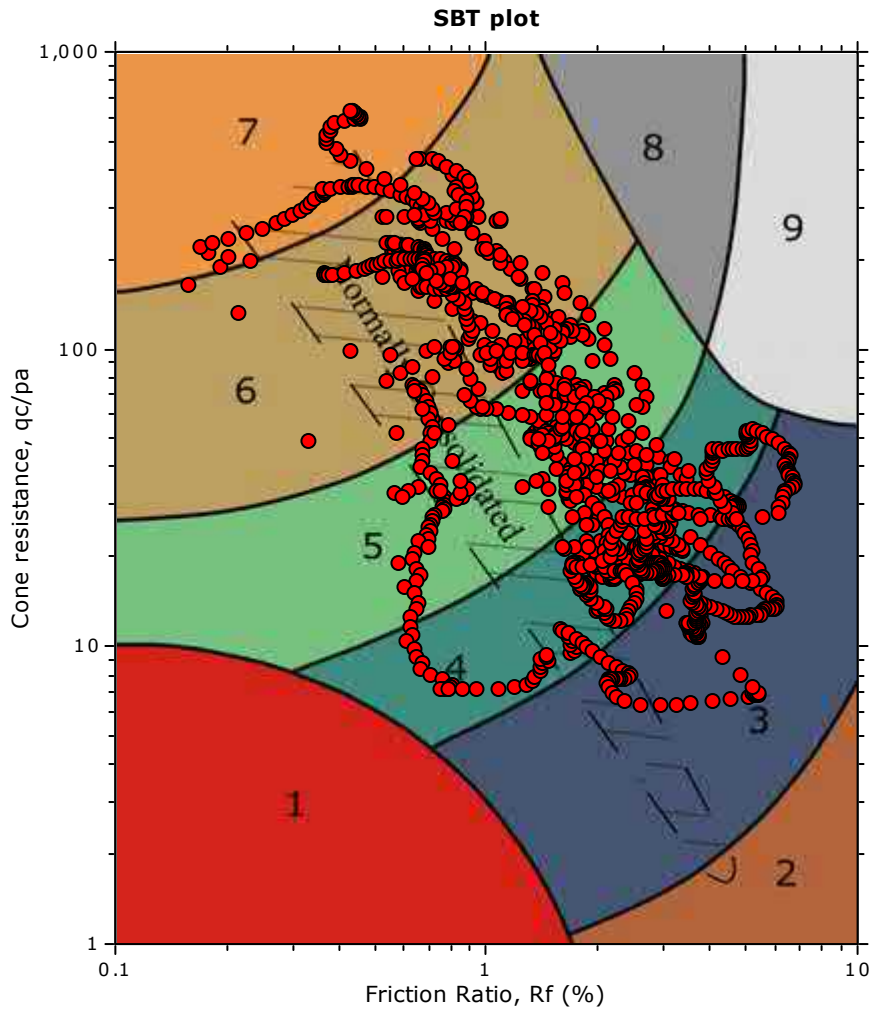


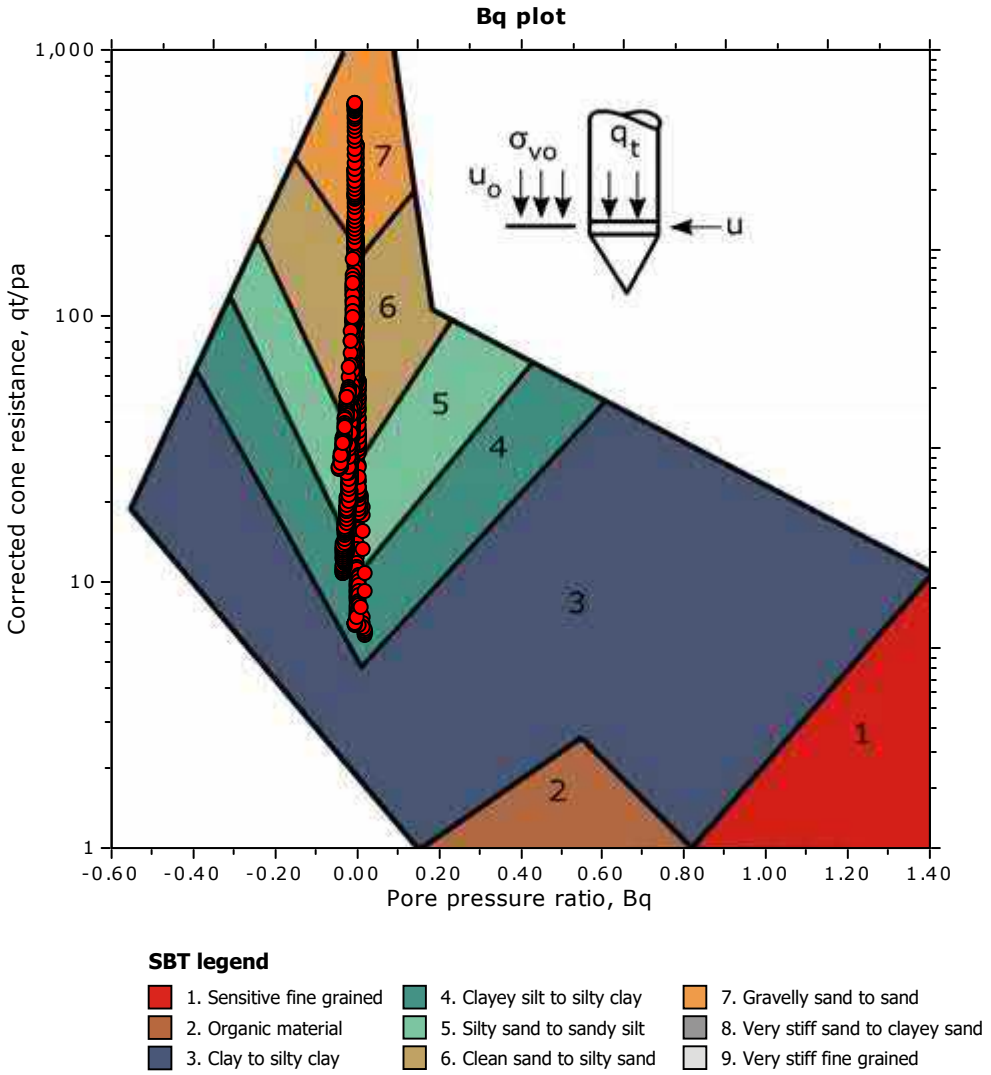
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots



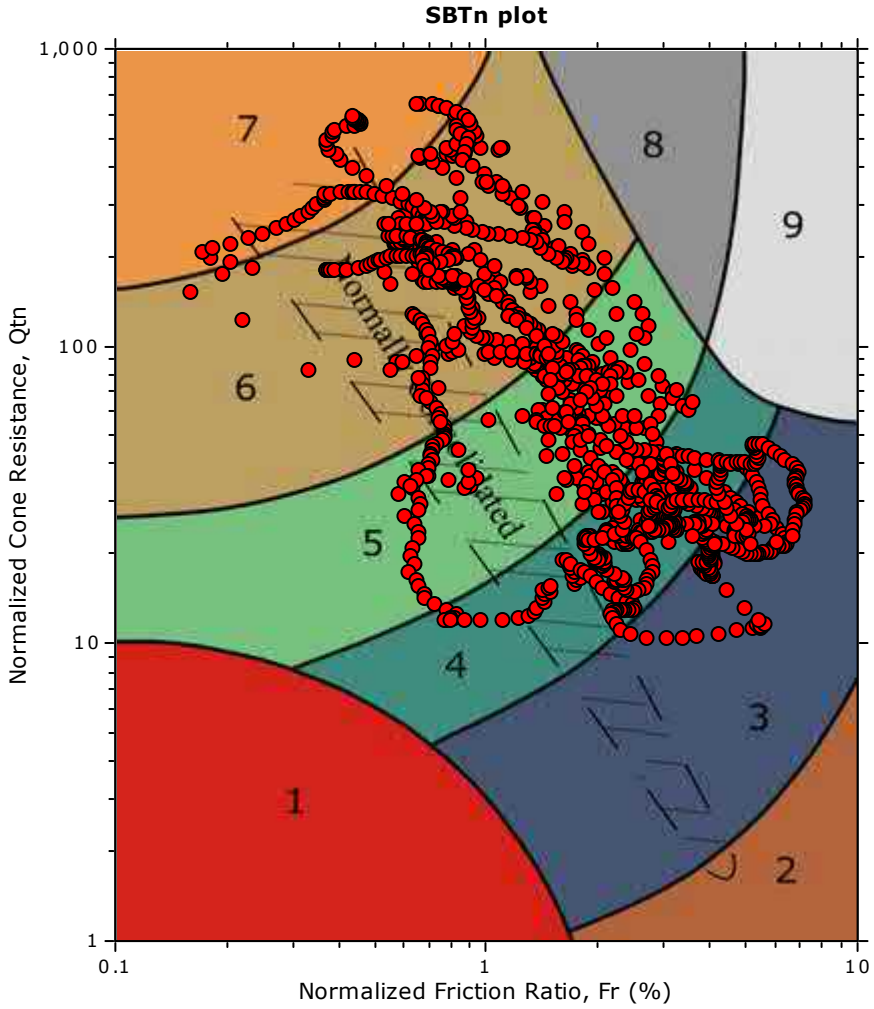


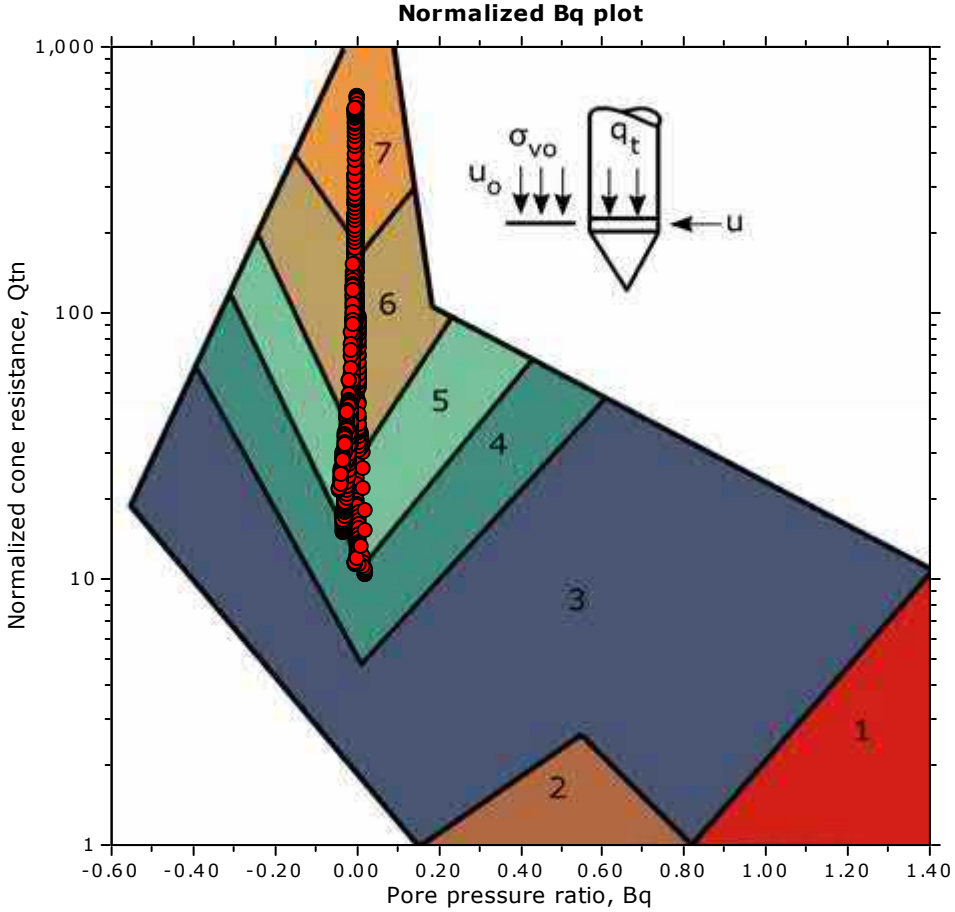
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots (normalized)





SBTn legend

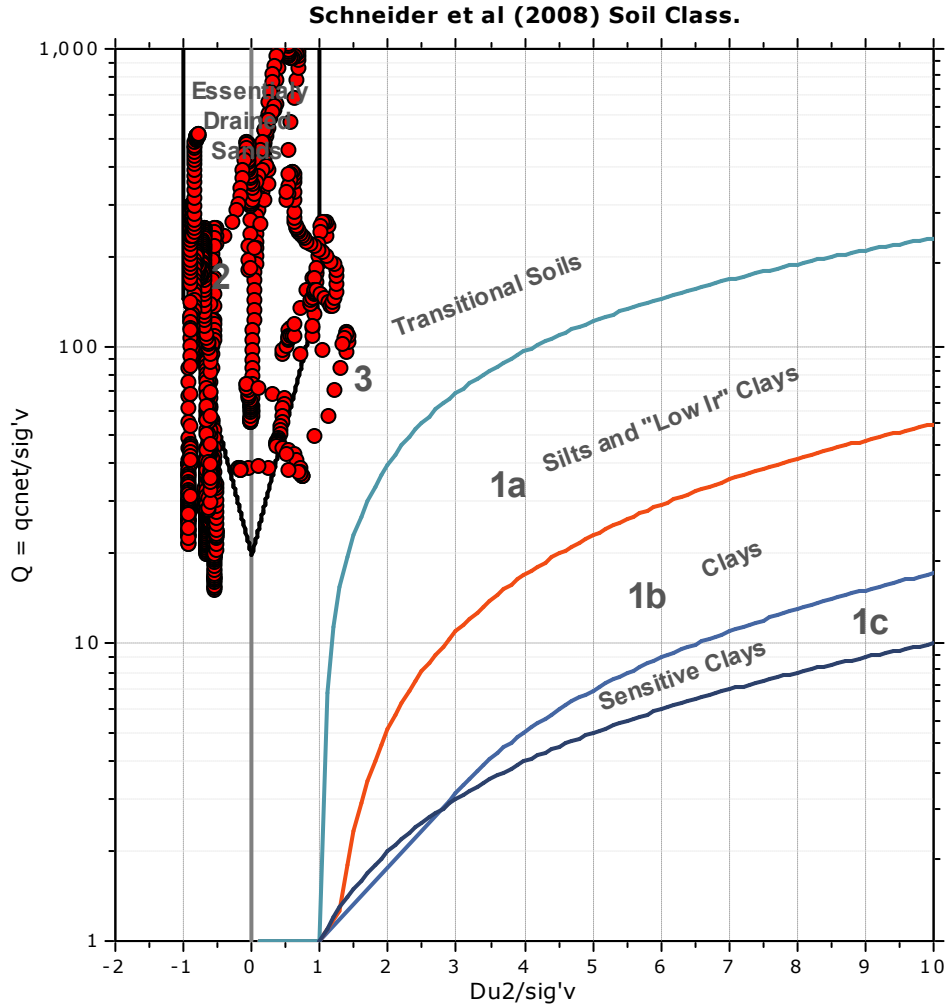
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

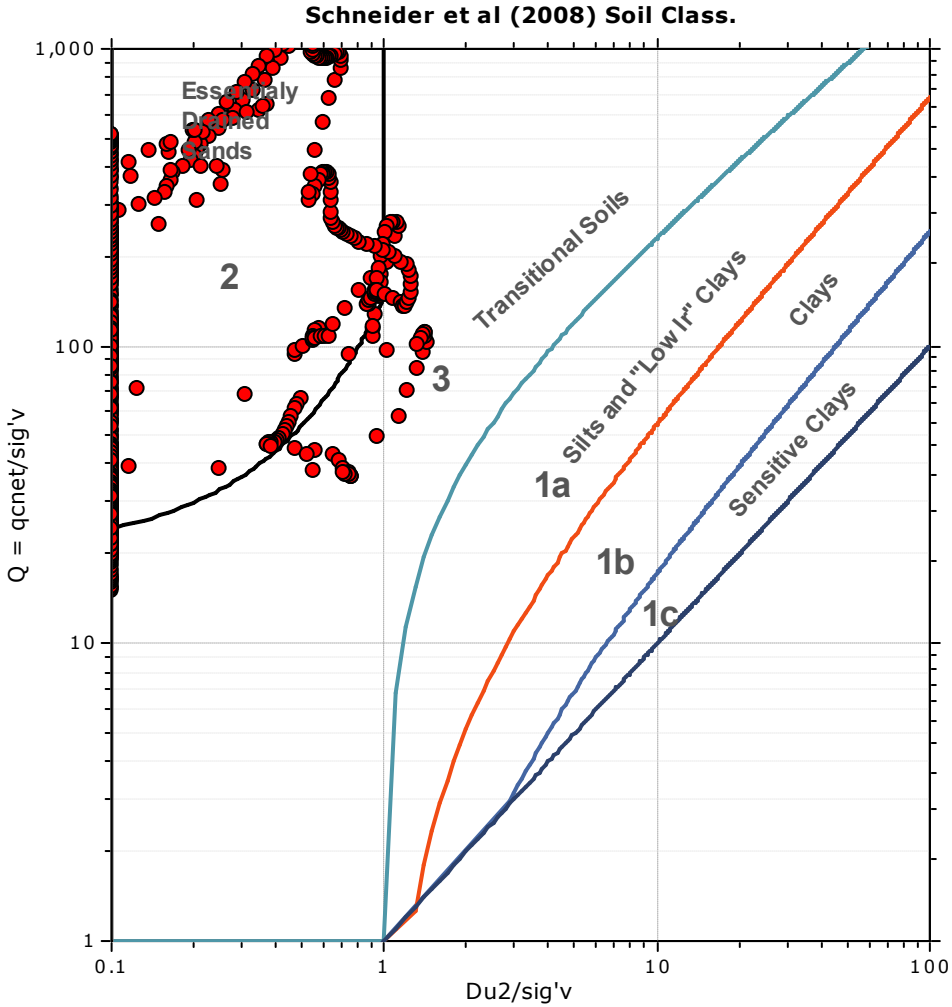
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Bq plots (Schneider)

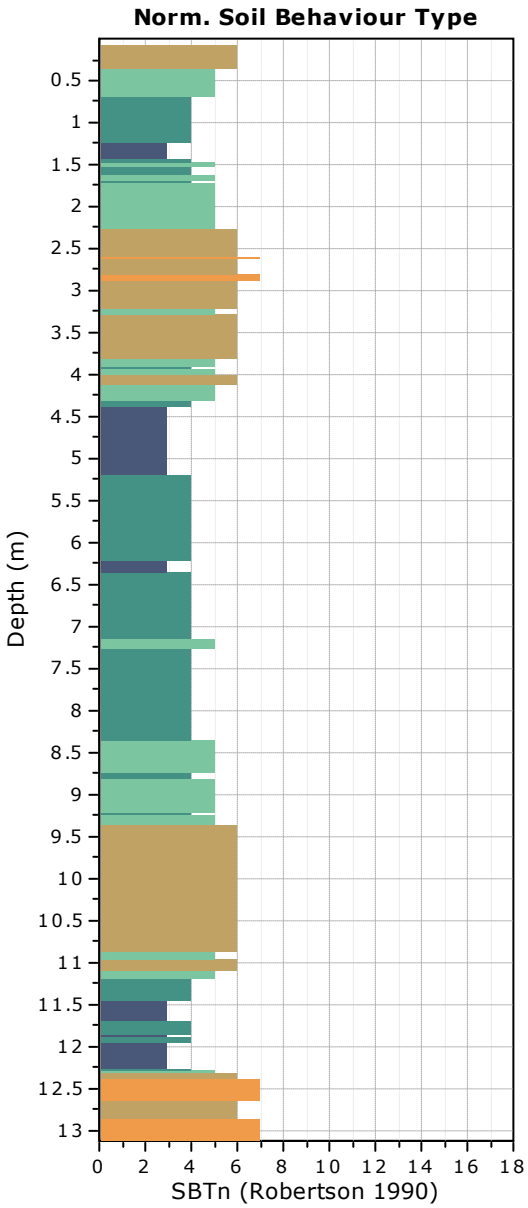


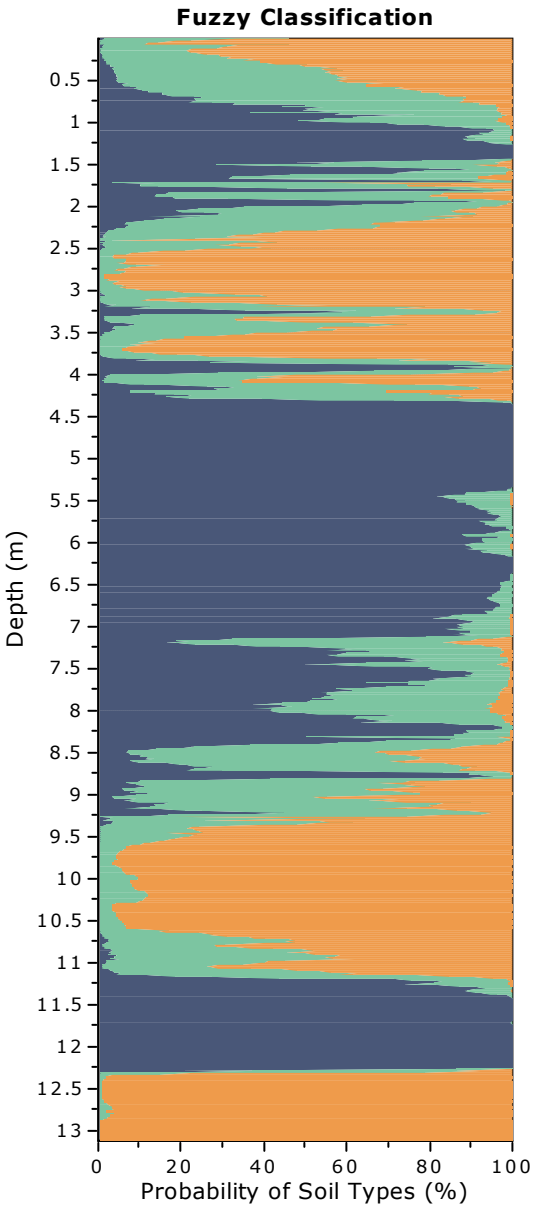


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



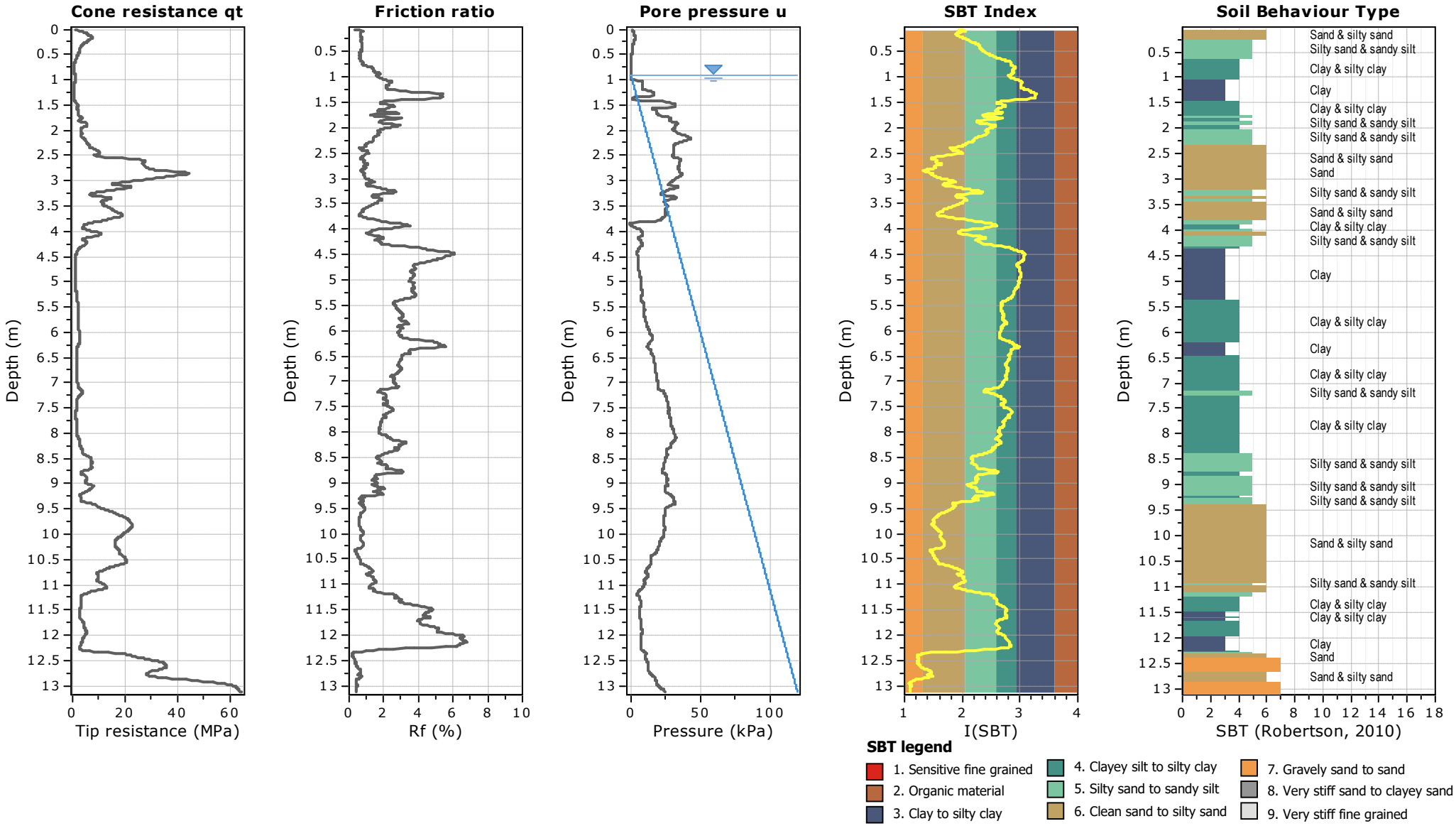


Fuzzy classifiaction legend
- Highly probable clayey soil
- Highly probable mixture soil
- Highly probable sandy soil

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

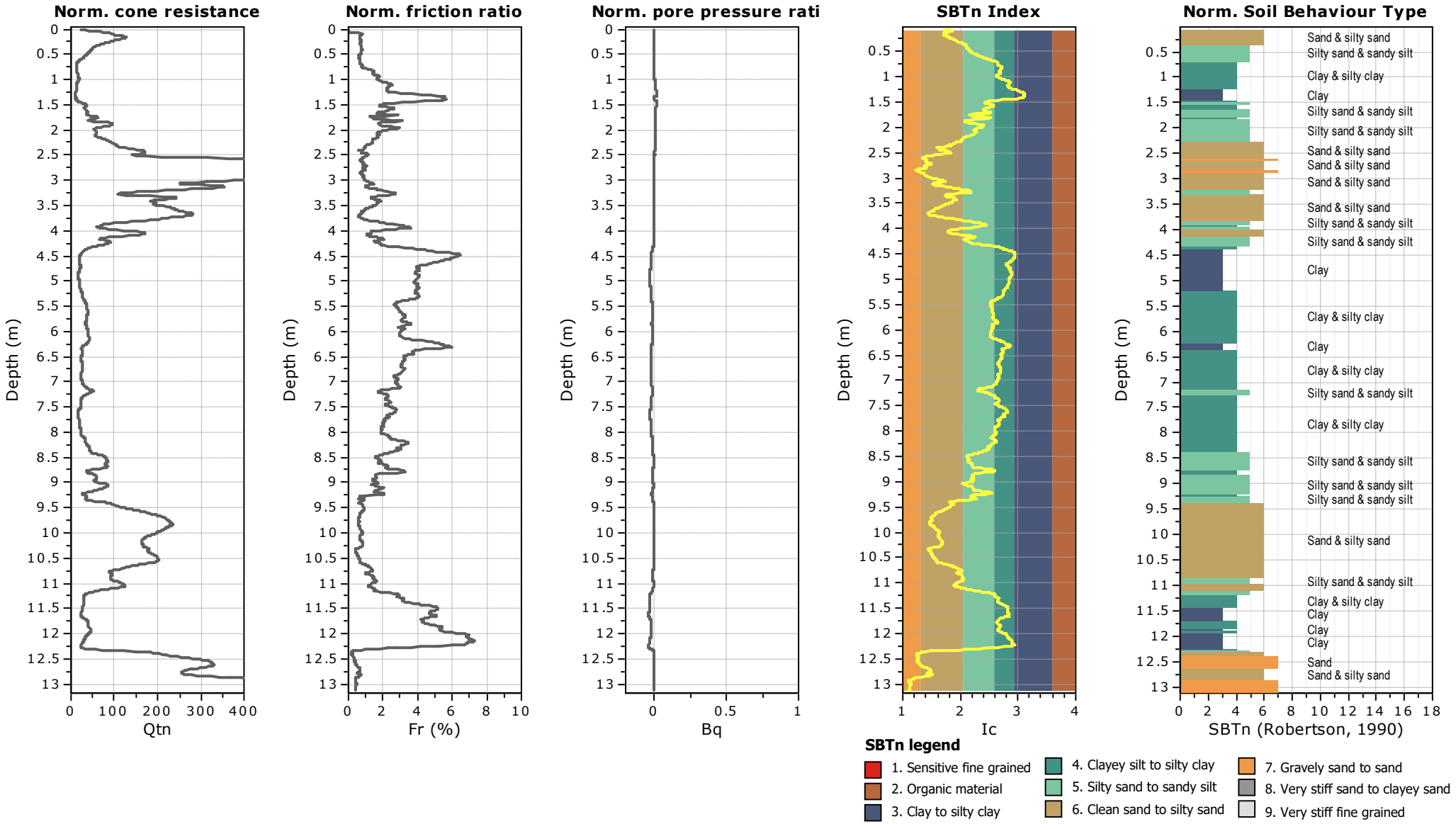
CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

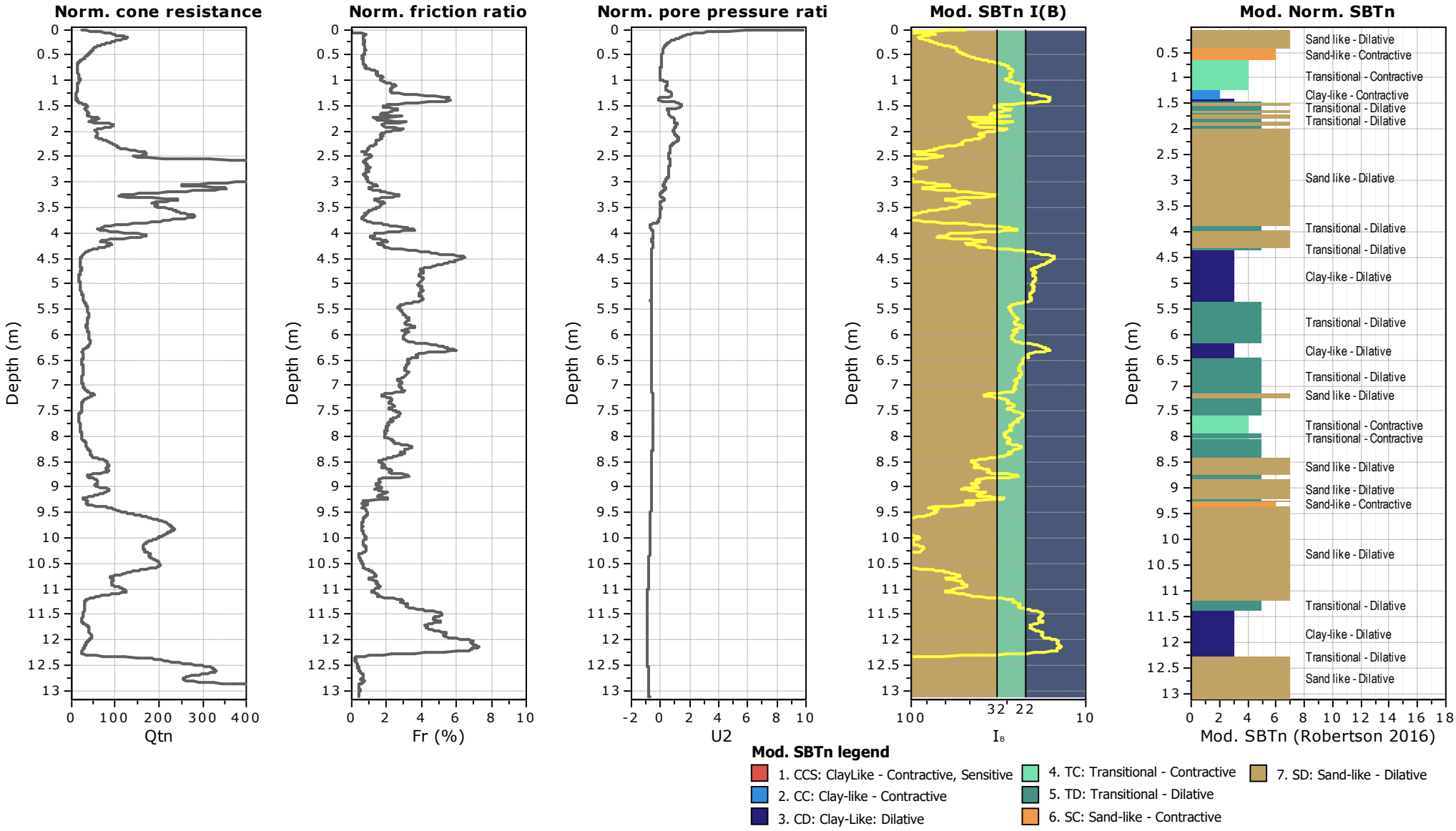
CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

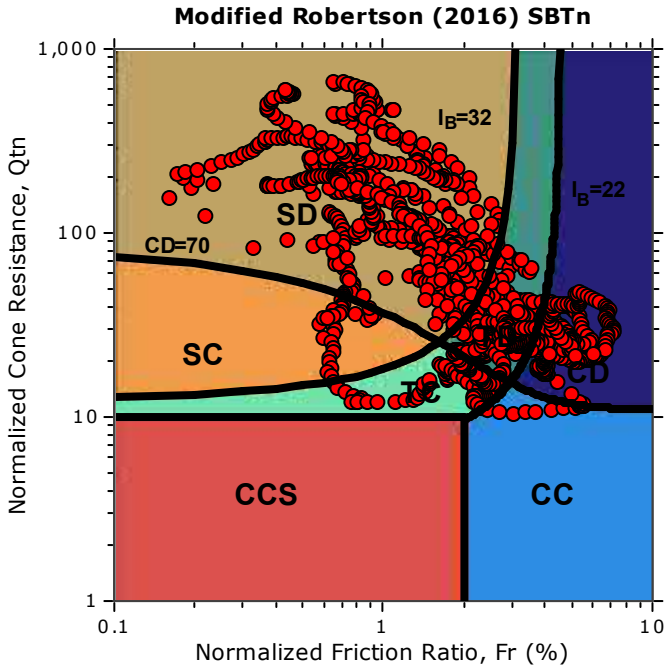


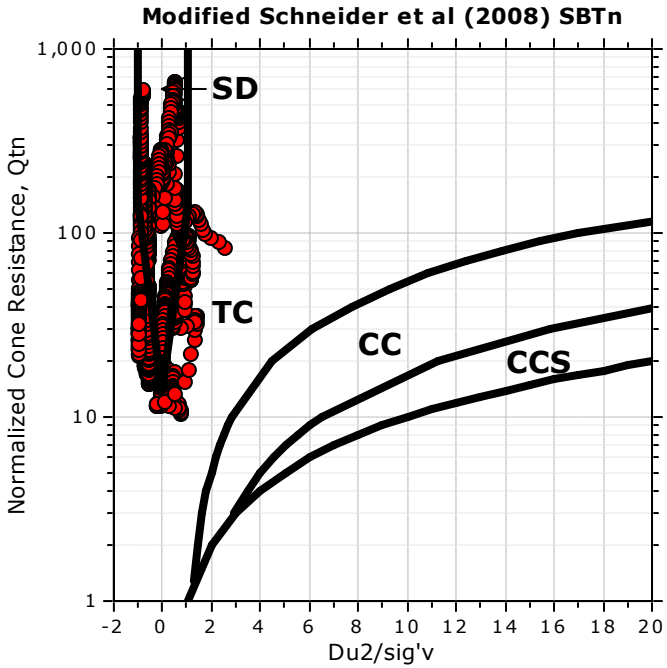
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

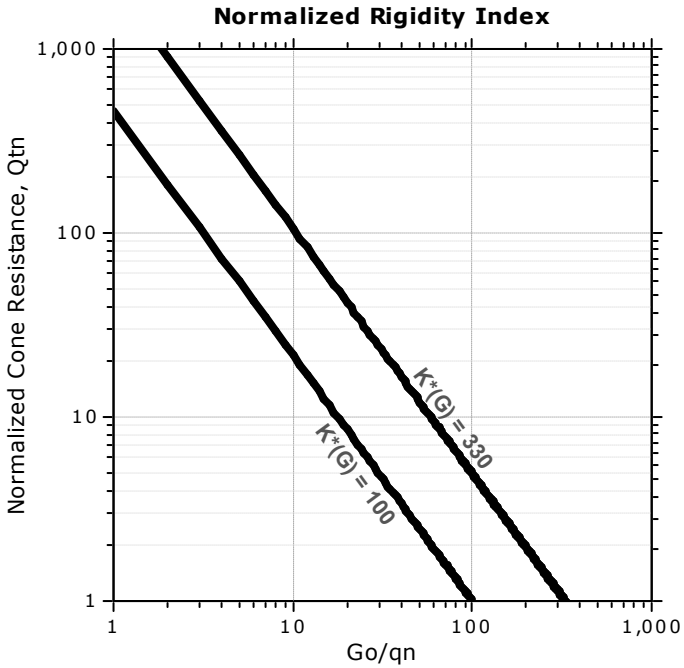
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Updated SBTn plots







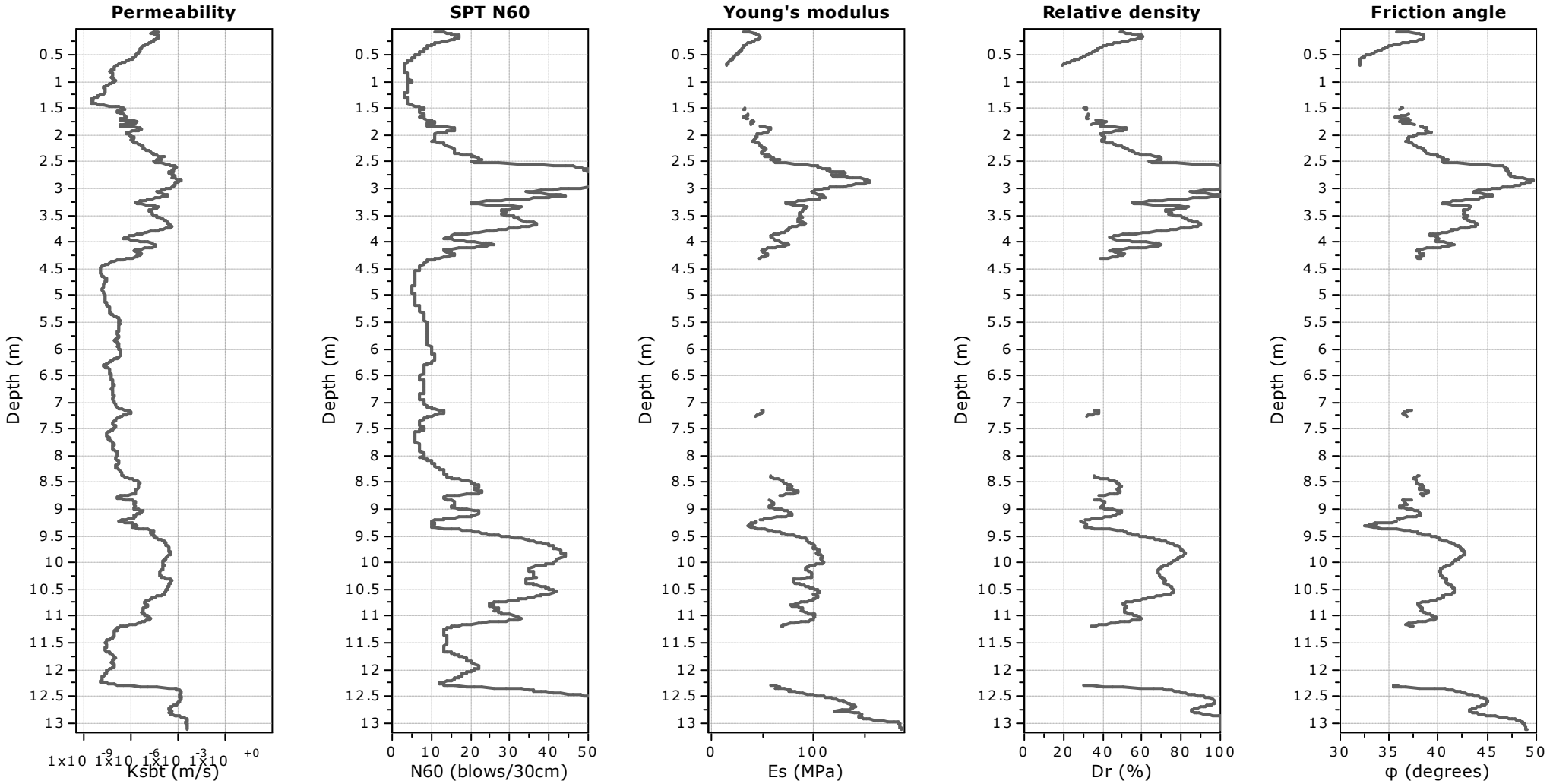
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



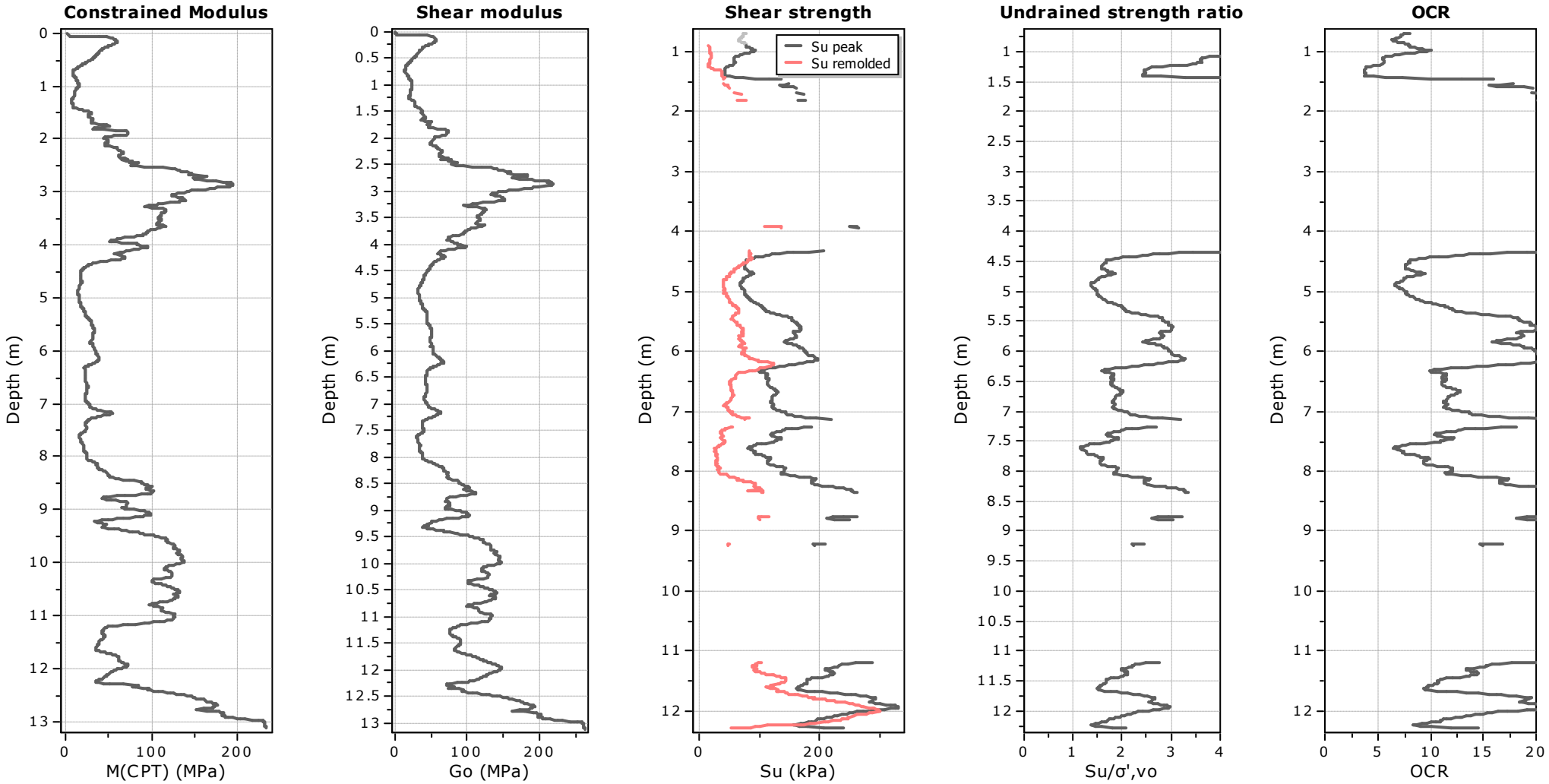
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



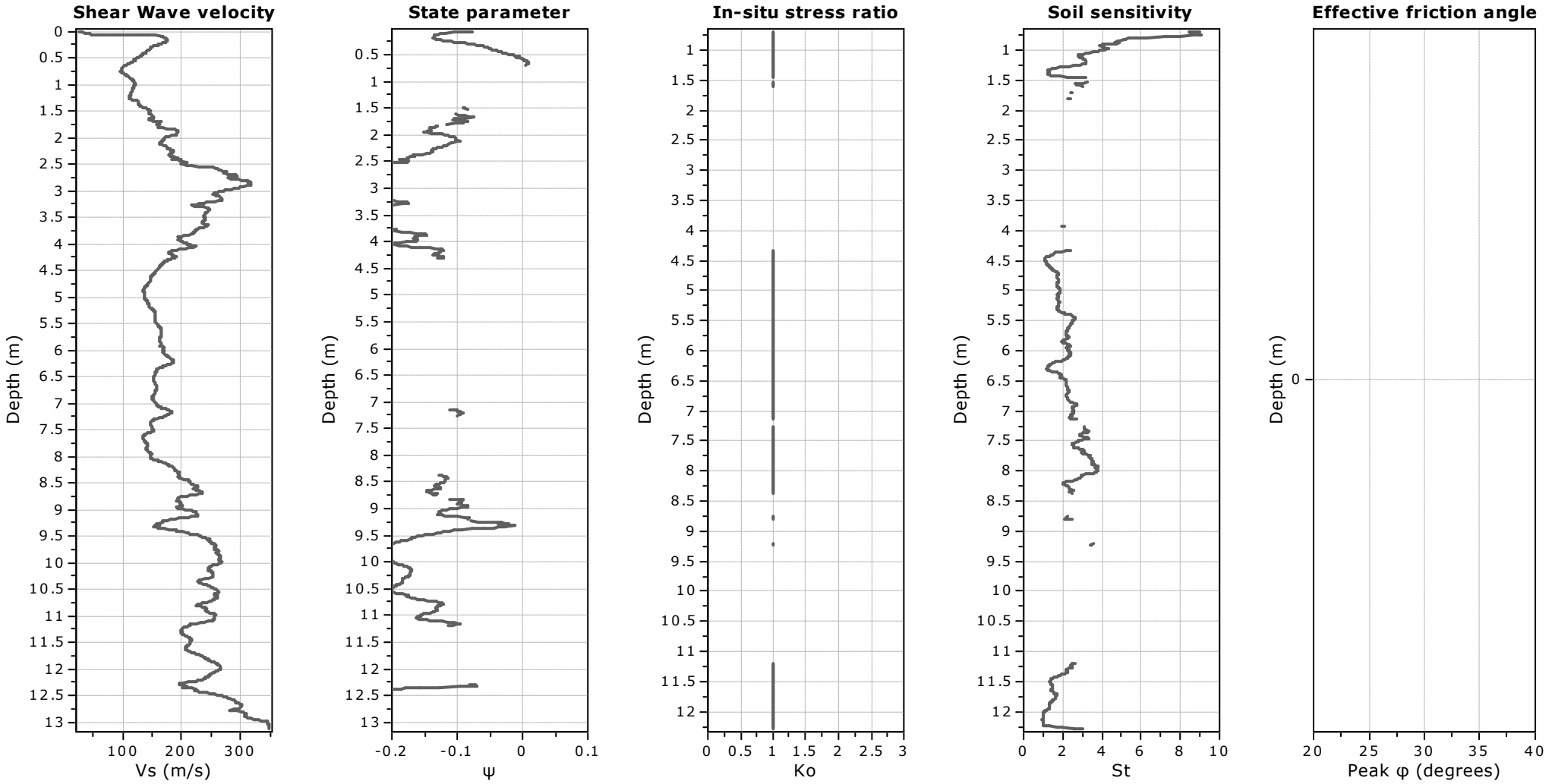
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto
OCR factor for clays, N_{kt}: Auto
Flat Dilatometer Test data

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



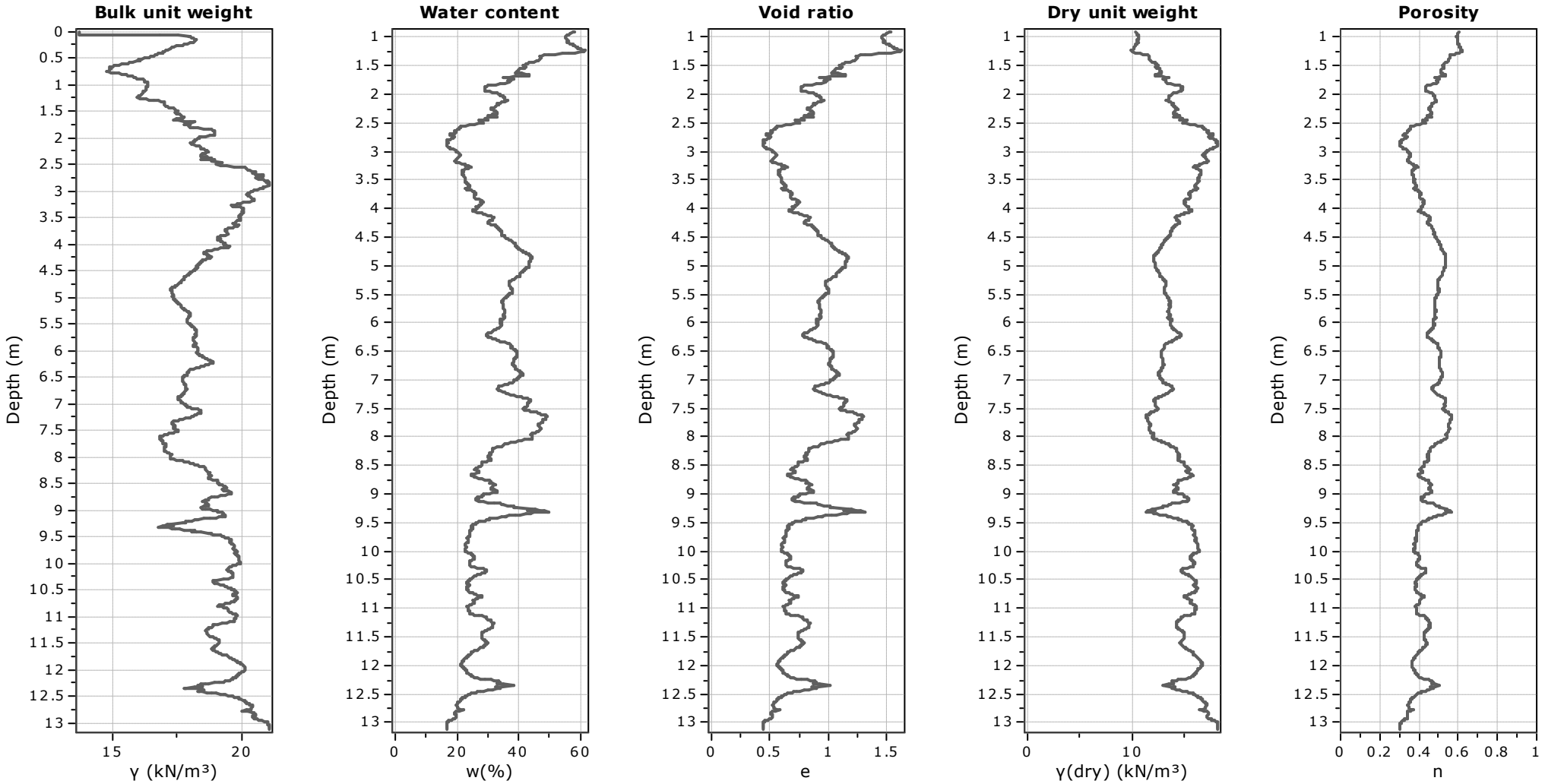
Calculation parameters

Soil Sensitivity factor, N_S: 7.00

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

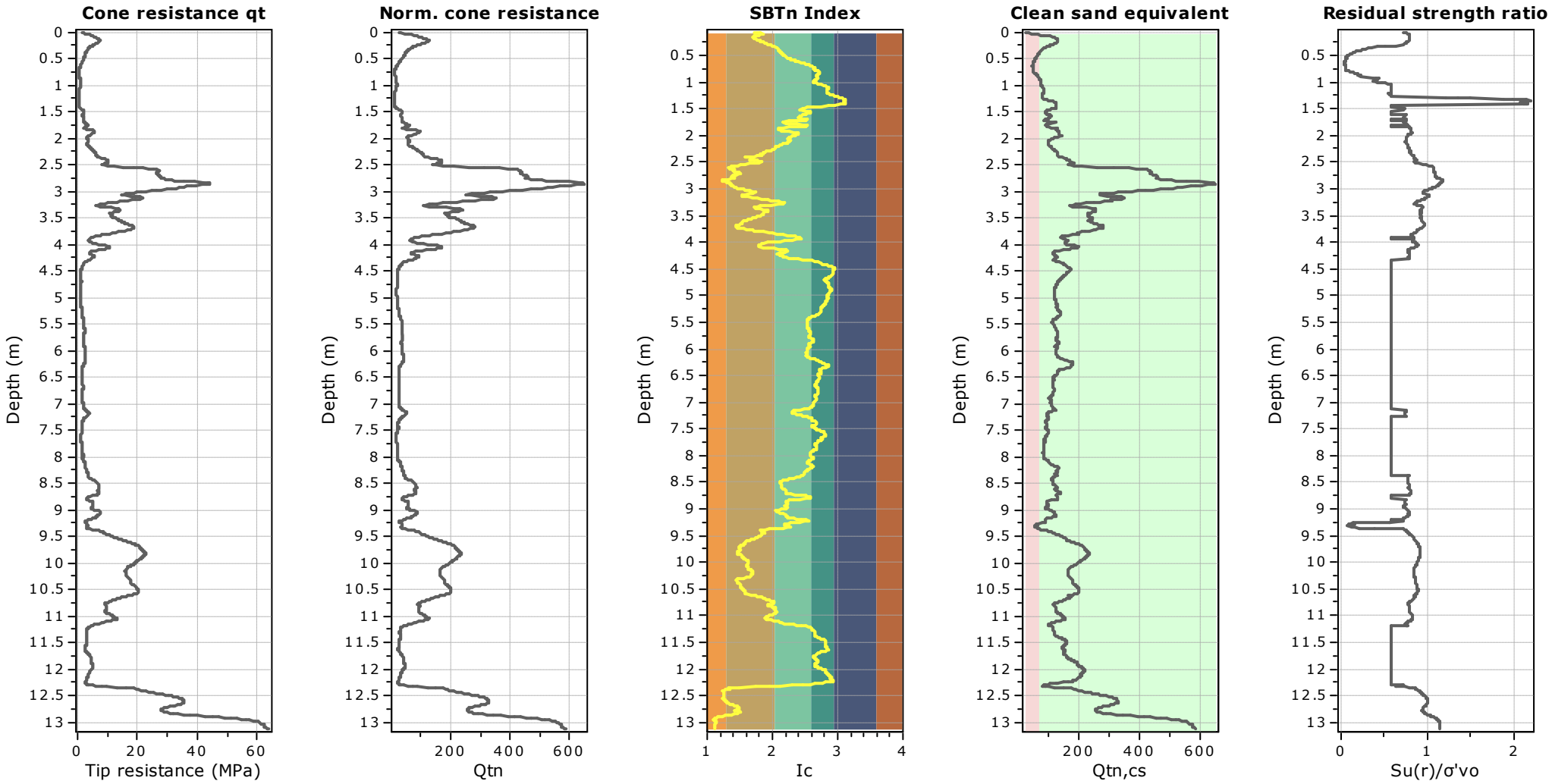
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

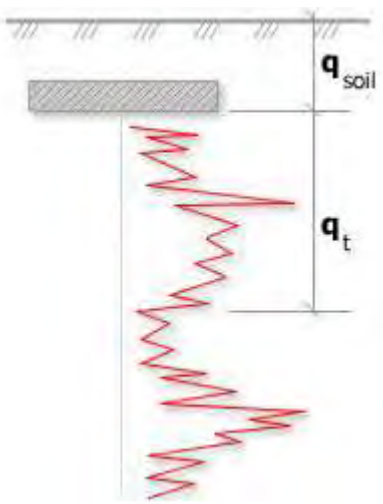
CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

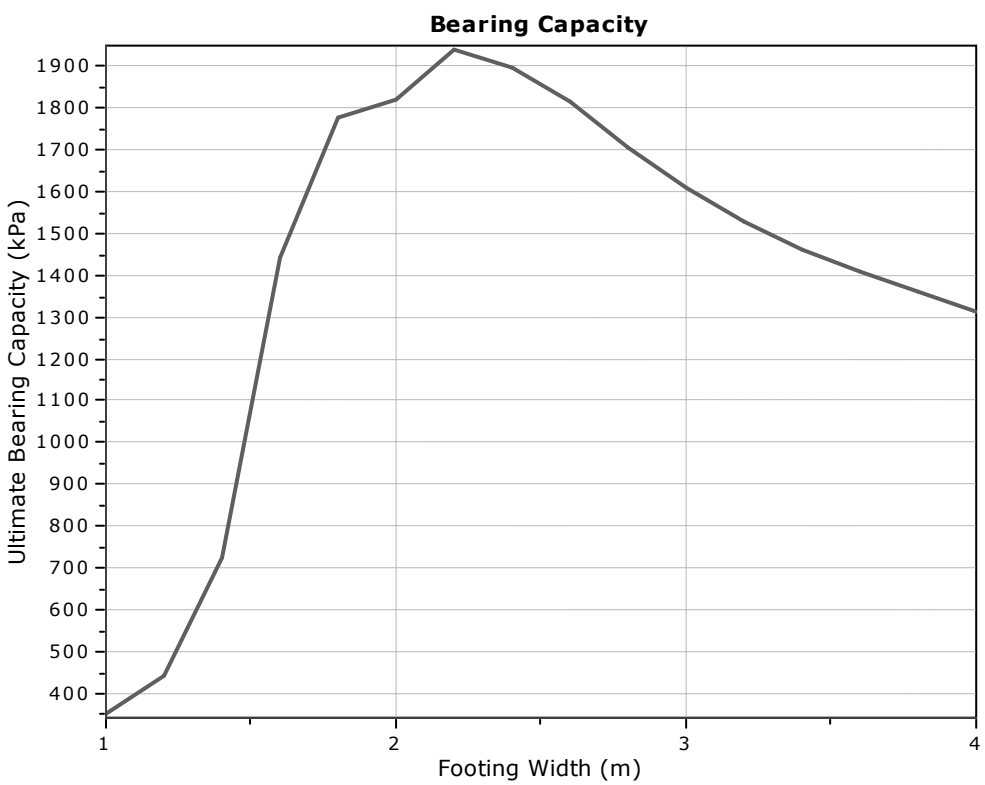
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



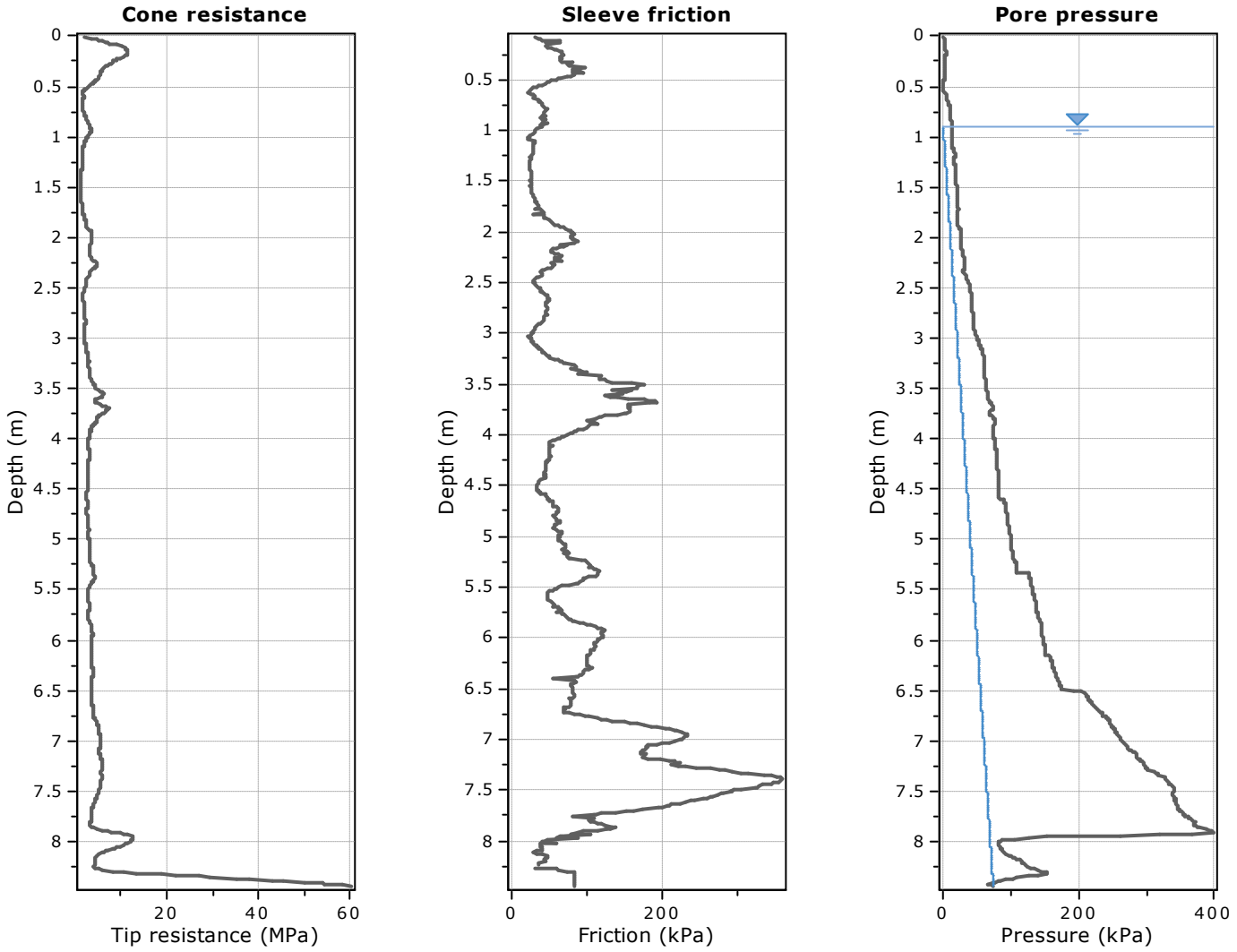
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	1.70	0.20	9.50	350.31
2	1.20	0.50	2.30	2.15	0.20	9.50	440.03
3	1.40	0.50	2.60	3.57	0.20	9.50	724.03
4	1.60	0.50	2.90	7.17	0.20	9.50	1444.13
5	1.80	0.50	3.20	8.83	0.20	9.50	1775.68
6	2.00	0.50	3.50	9.05	0.20	9.50	1819.40
7	2.20	0.50	3.80	9.65	0.20	9.50	1940.26
8	2.40	0.50	4.10	9.43	0.20	9.50	1895.97
9	2.60	0.50	4.40	9.03	0.20	9.50	1814.70
10	2.80	0.50	4.70	8.48	0.20	9.50	1705.77
11	3.00	0.50	5.00	8.00	0.20	9.50	1608.70
12	3.20	0.50	5.30	7.58	0.20	9.50	1526.50
13	3.40	0.50	5.60	7.26	0.20	9.50	1462.14
14	3.60	0.50	5.90	6.99	0.20	9.50	1407.26
15	3.80	0.50	6.20	6.76	0.20	9.50	1361.58
16	4.00	0.50	6.50	6.52	0.20	9.50	1313.13

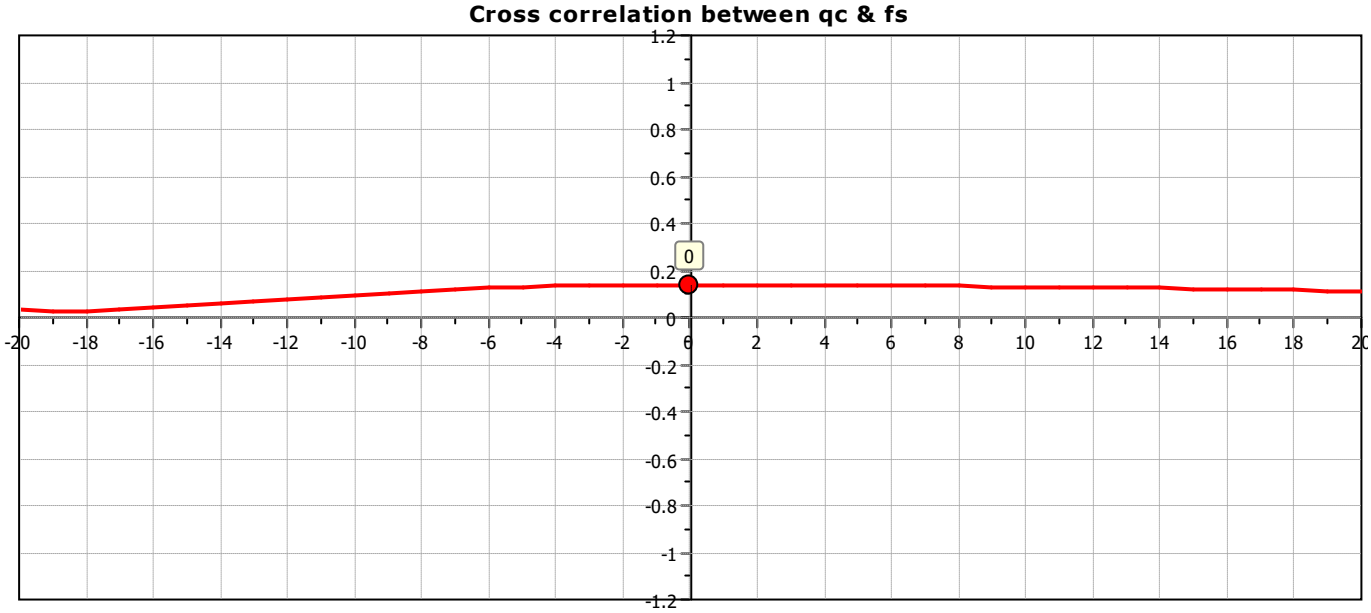
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

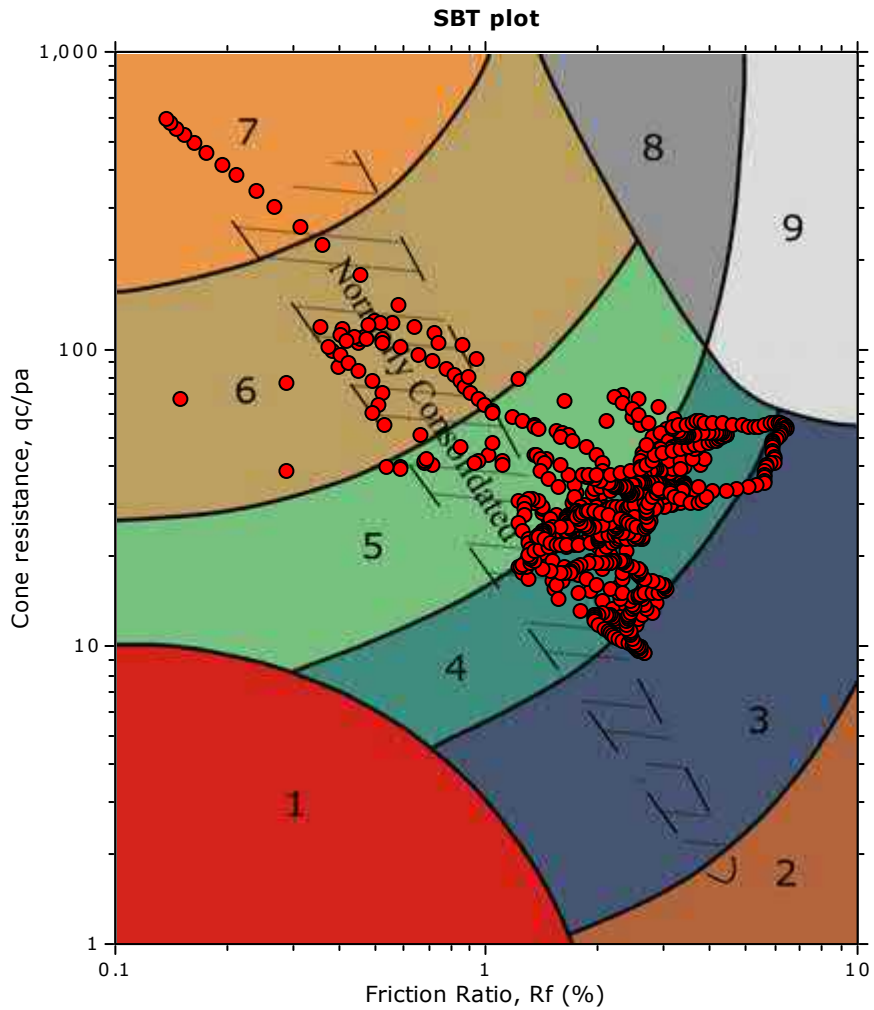


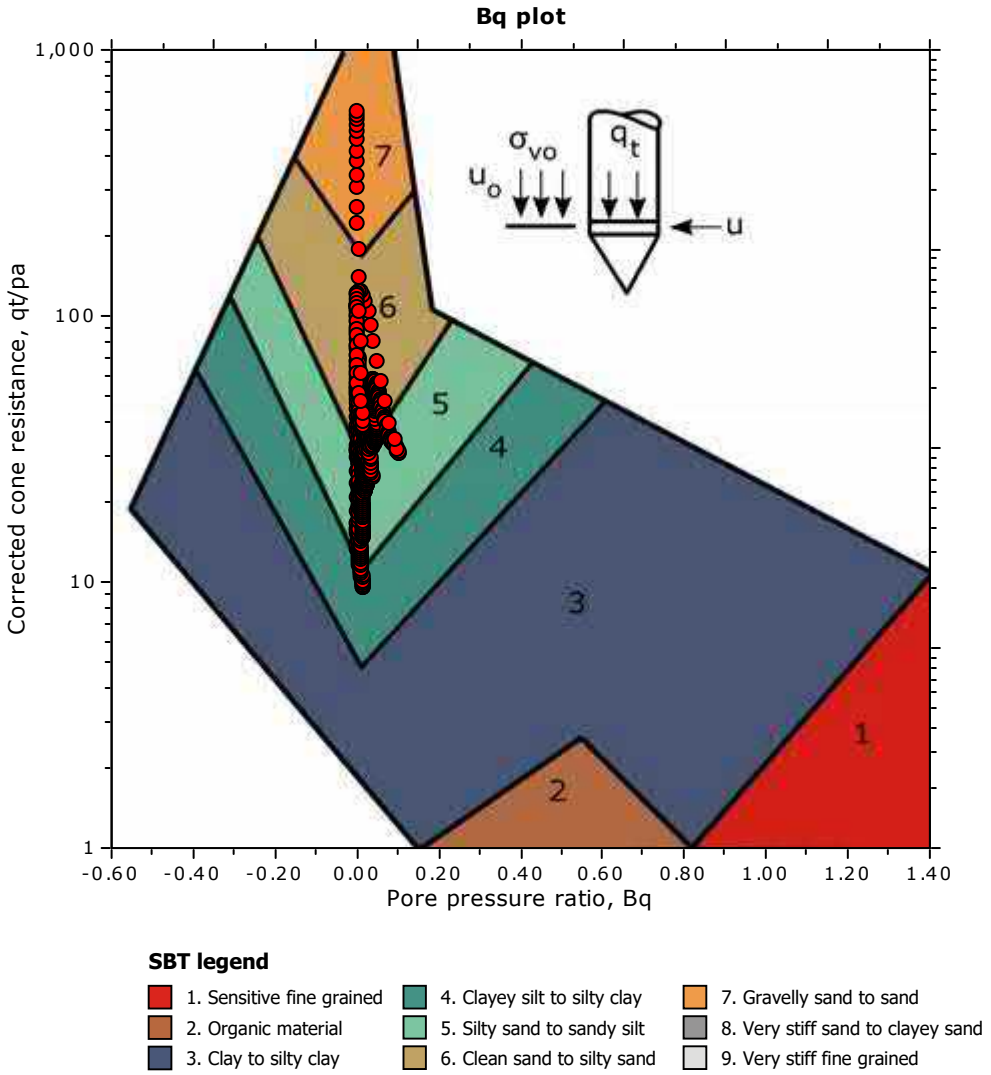
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots



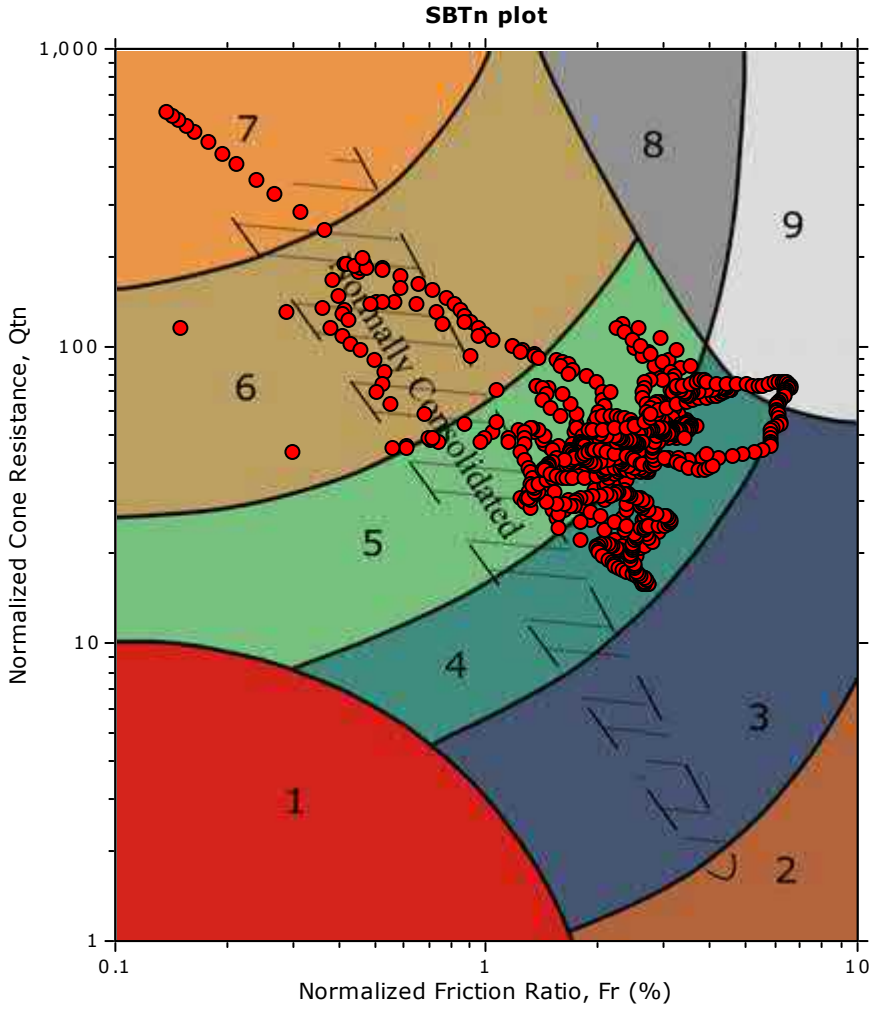


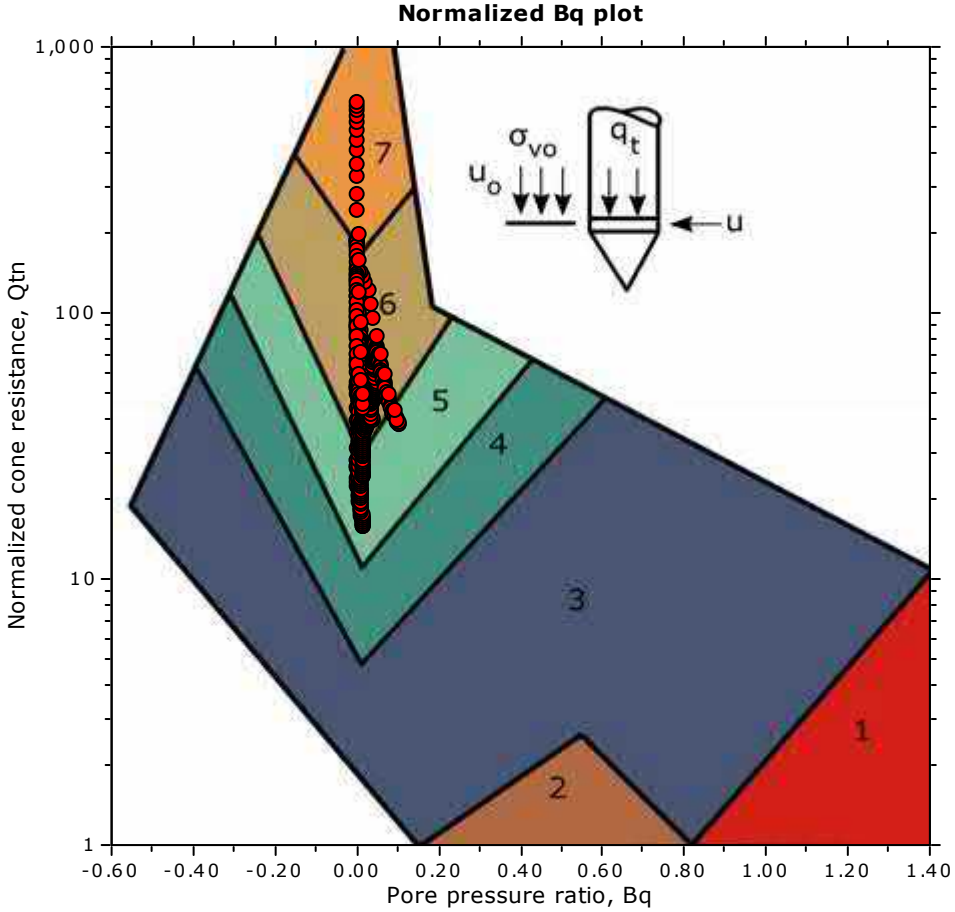
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots (normalized)





SBTn legend

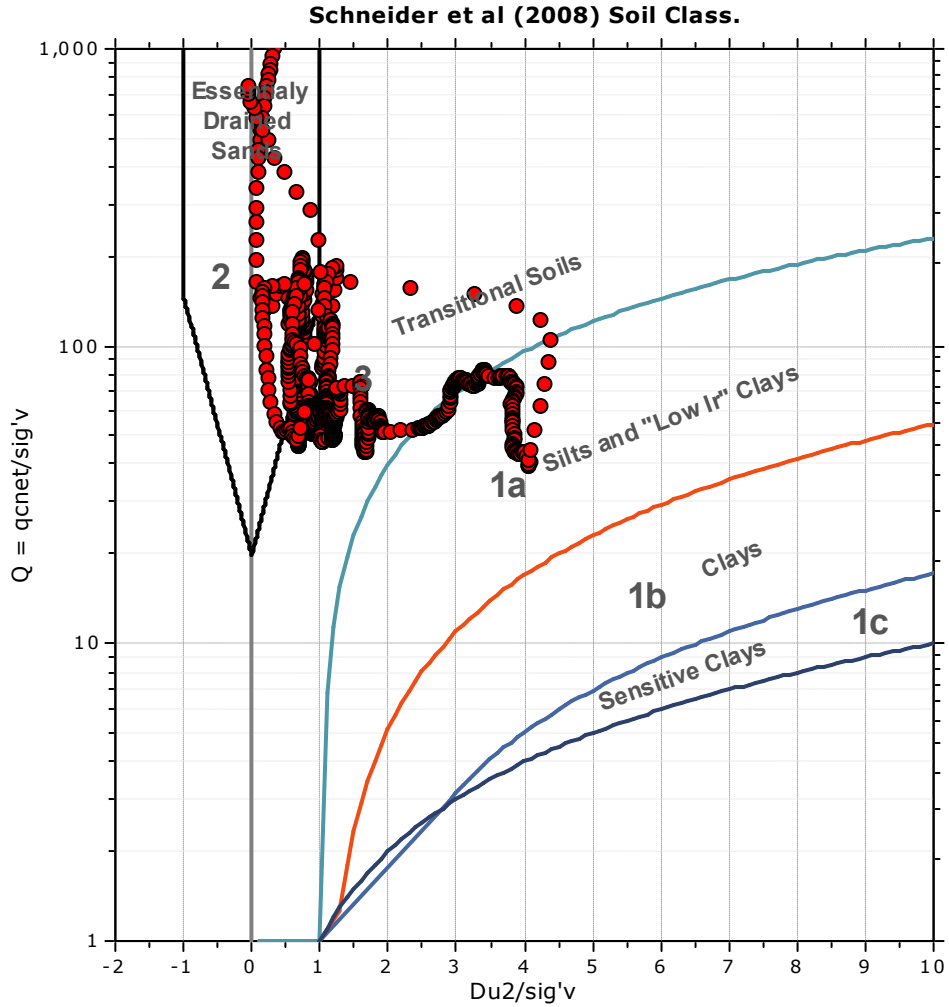
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

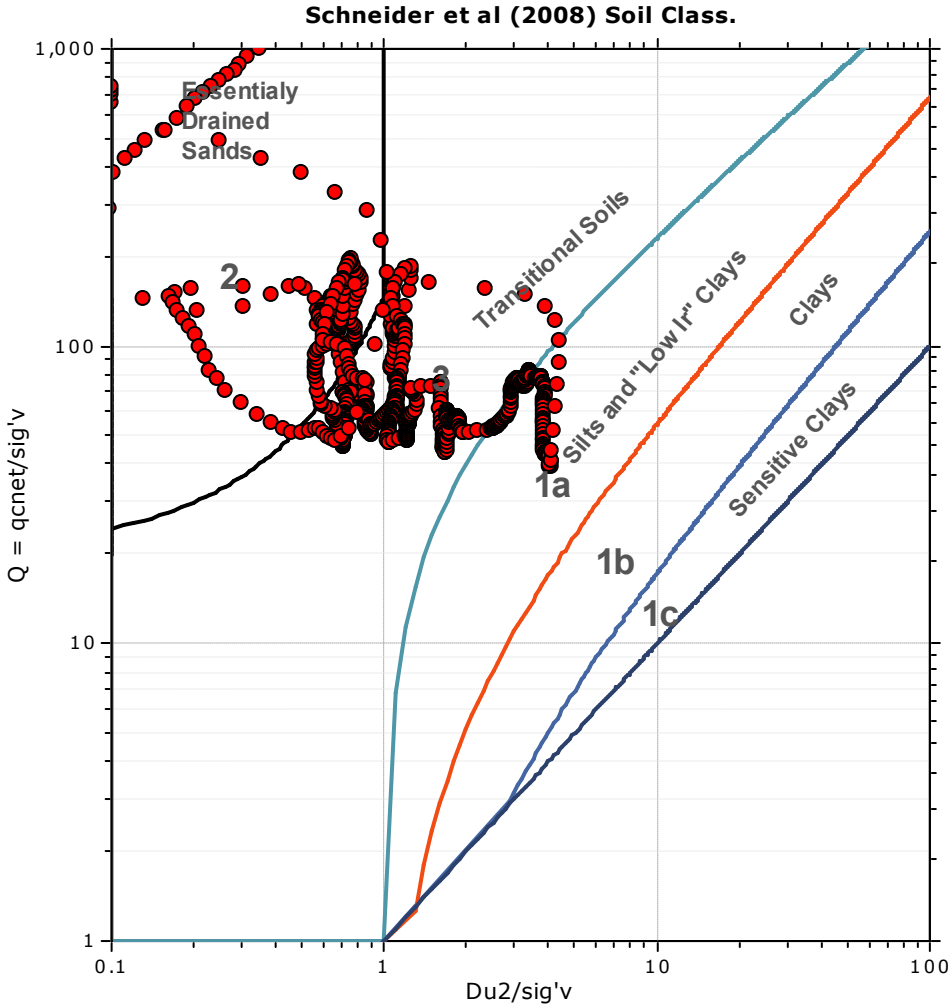
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Bq plots (Schneider)

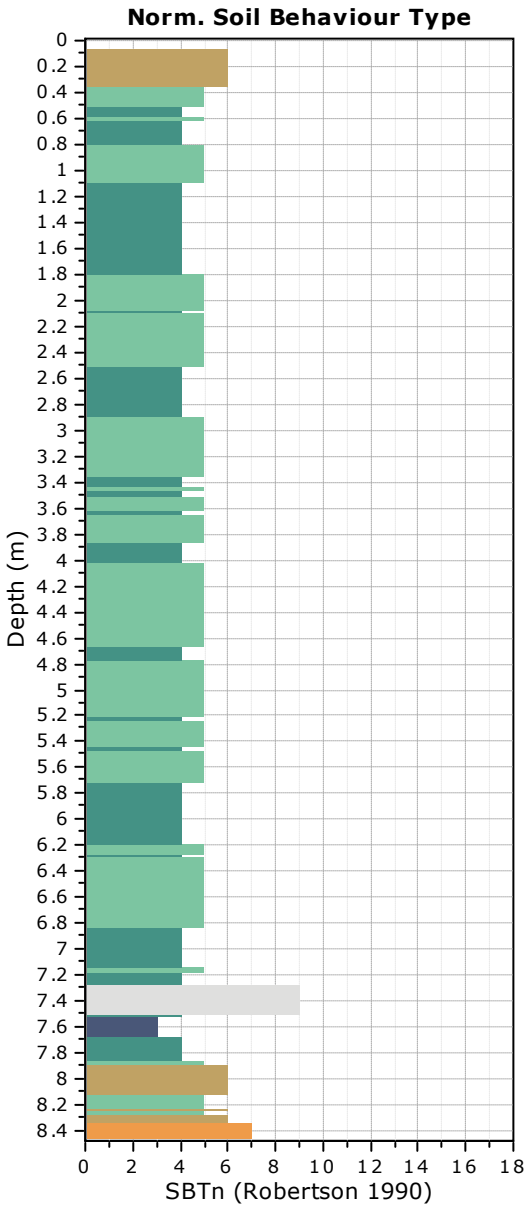


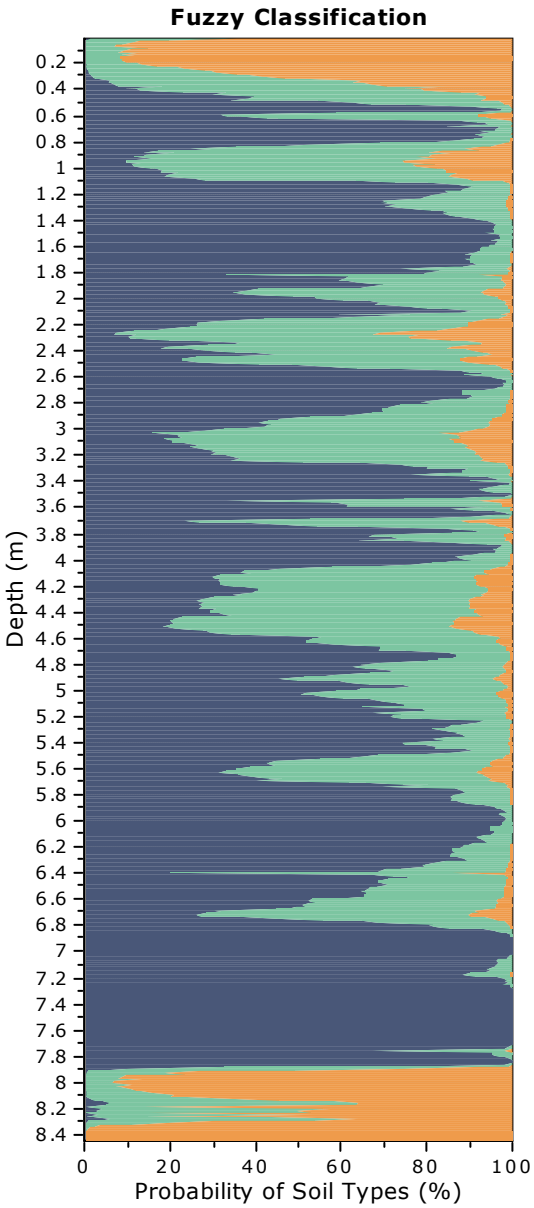


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



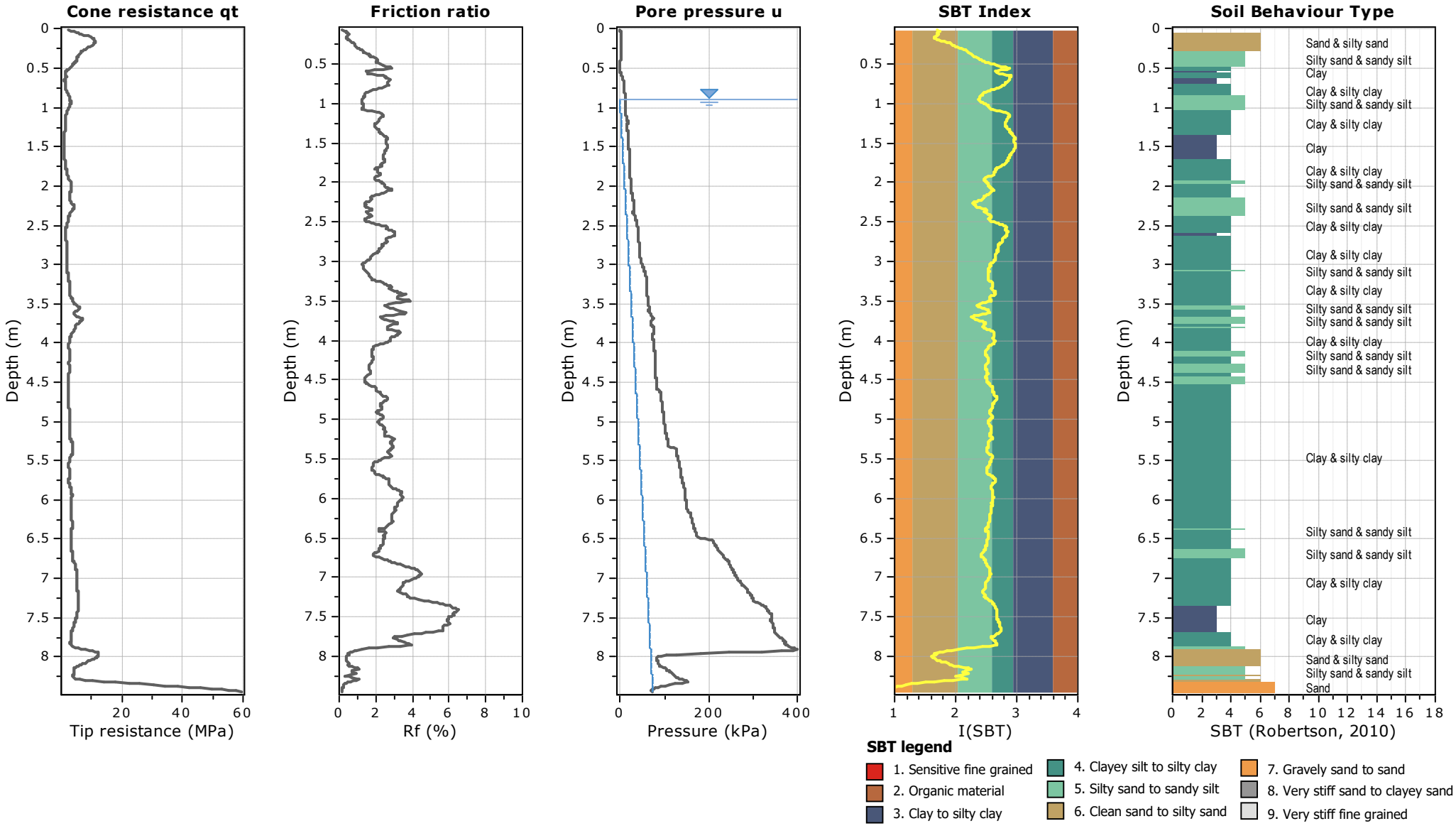


Fuzzy classifiaction legend
- Highly probable clayey soil
- Highly probable mixture soil
- Highly probable sandy soil

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

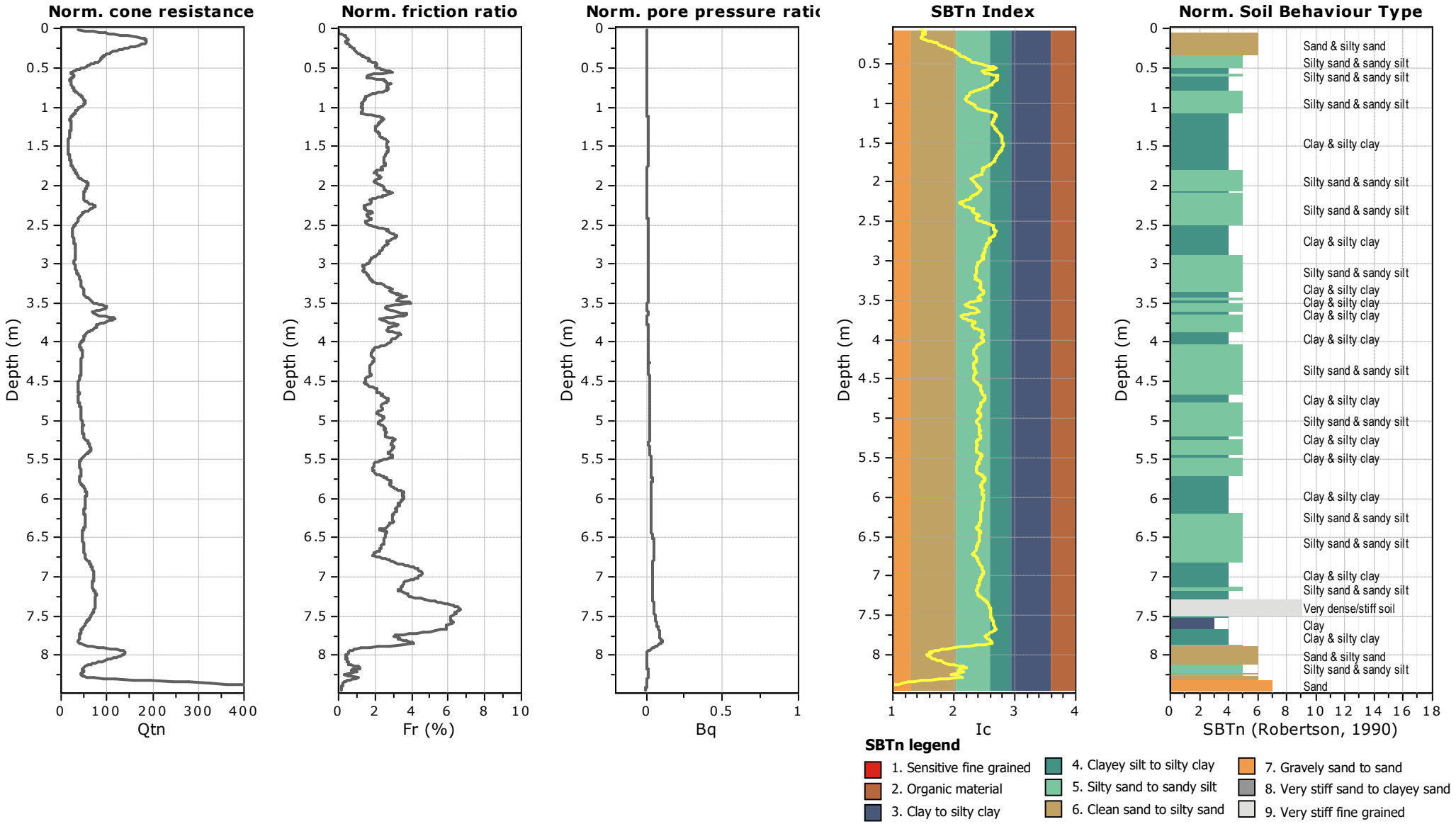
CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

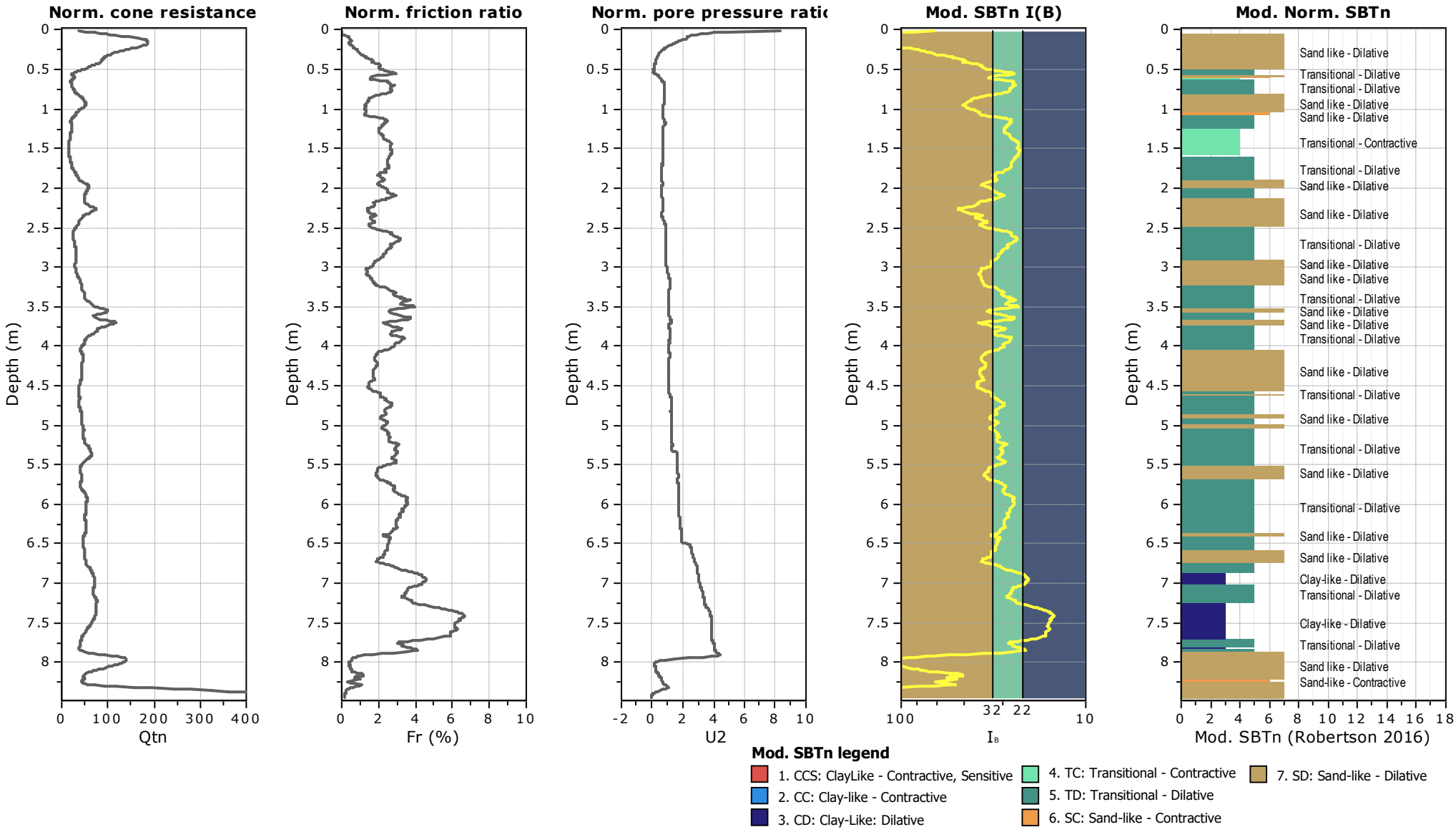
CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

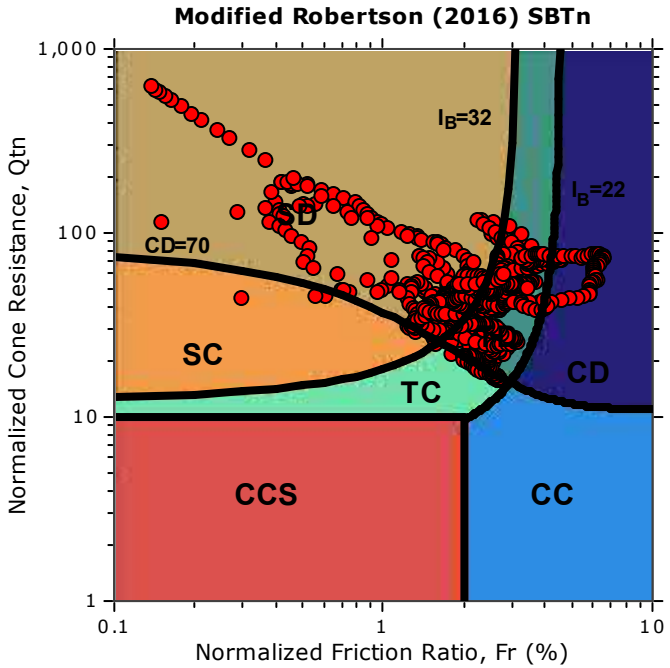


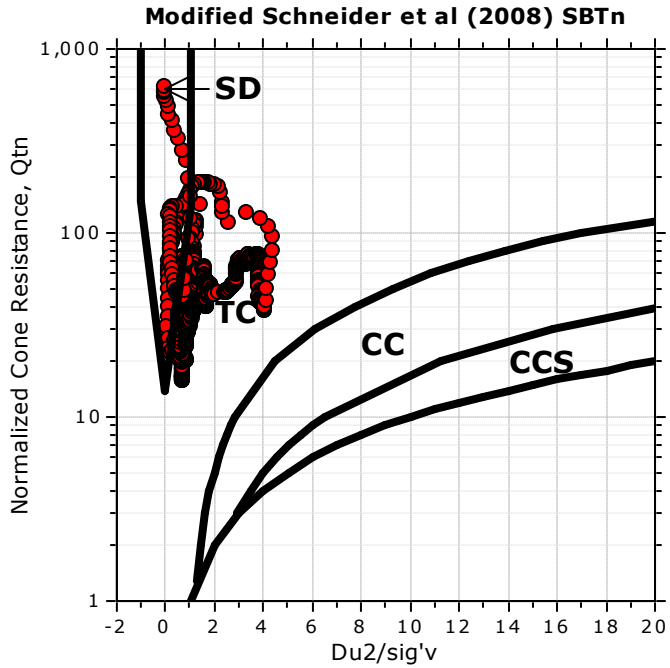
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

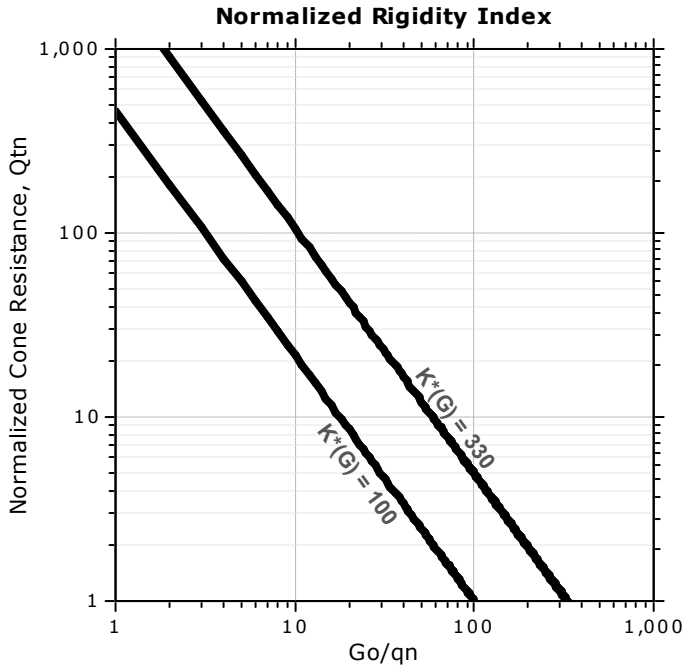
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Updated SBTn plots







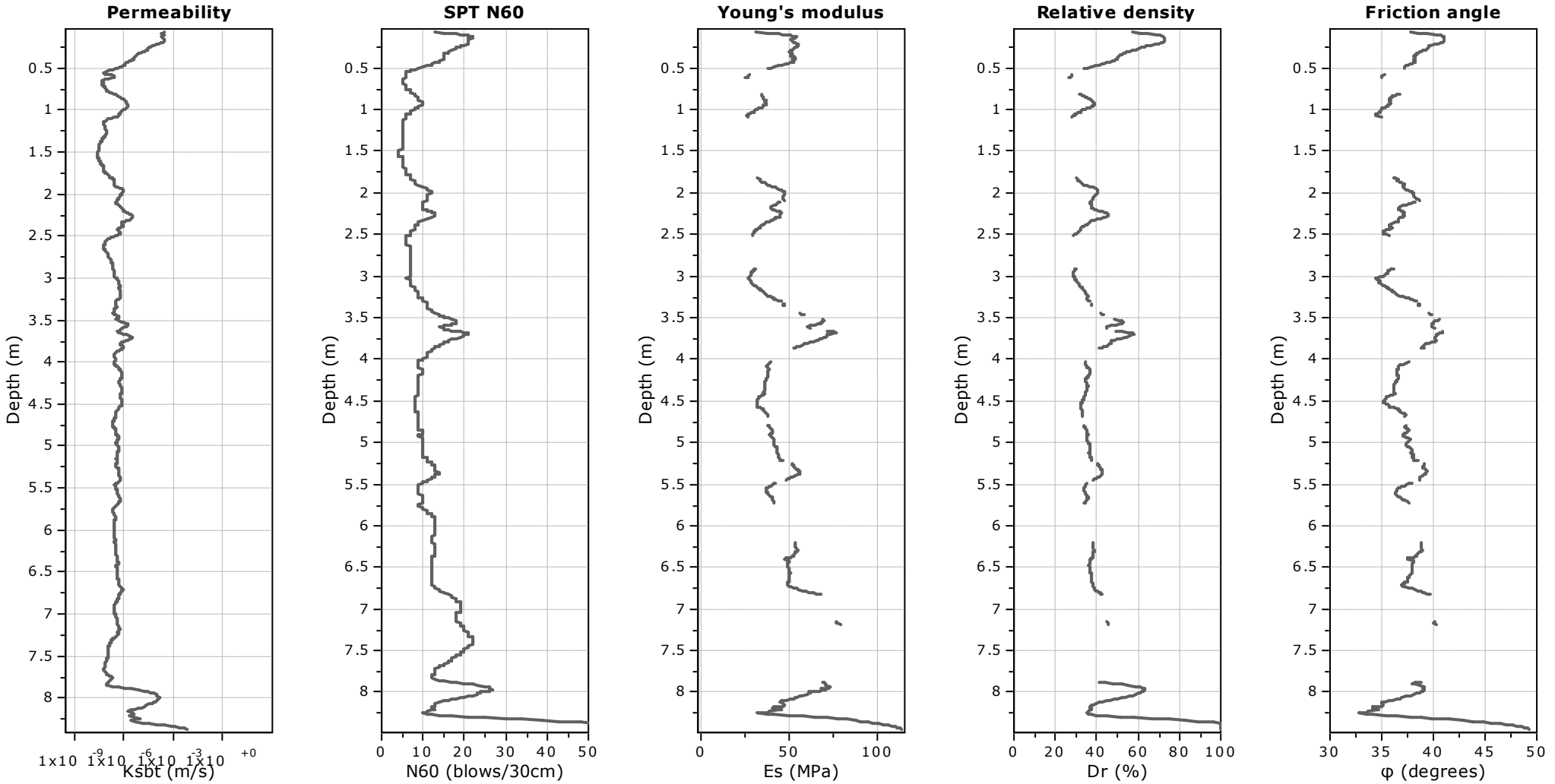
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



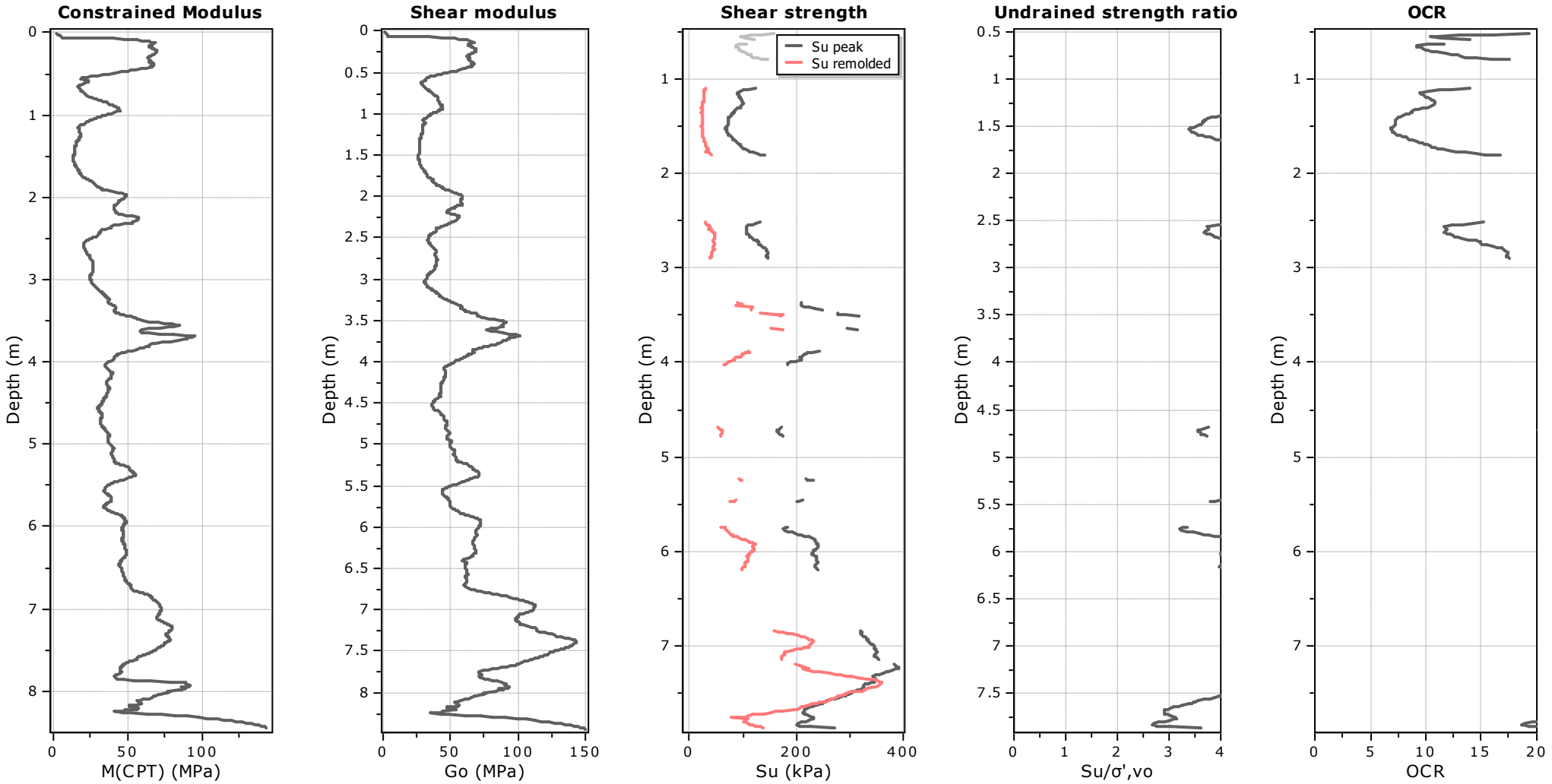
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC



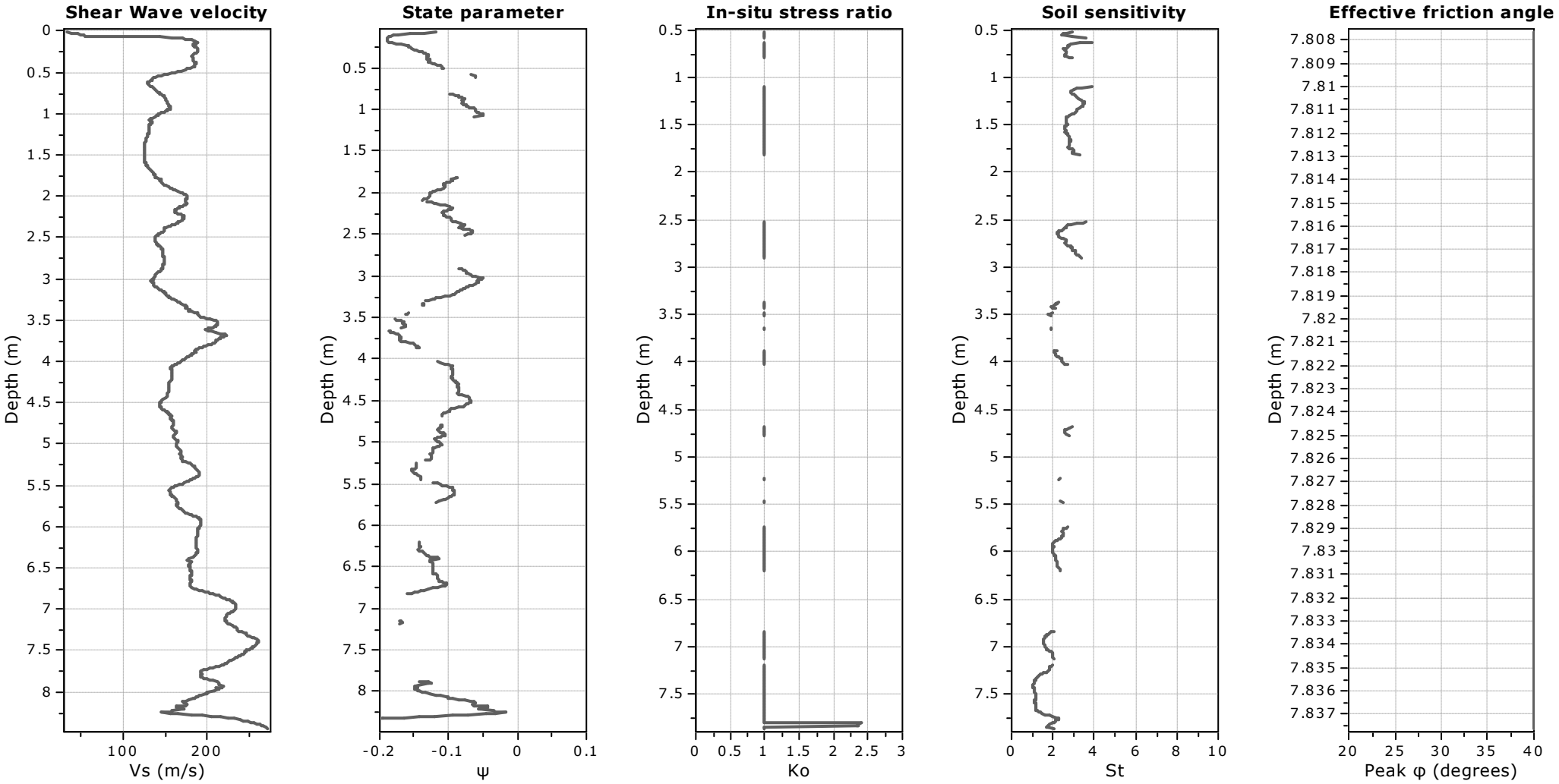
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto
OCR factor for clays, N_{kt}: Auto
Flat Dilatometer Test data

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



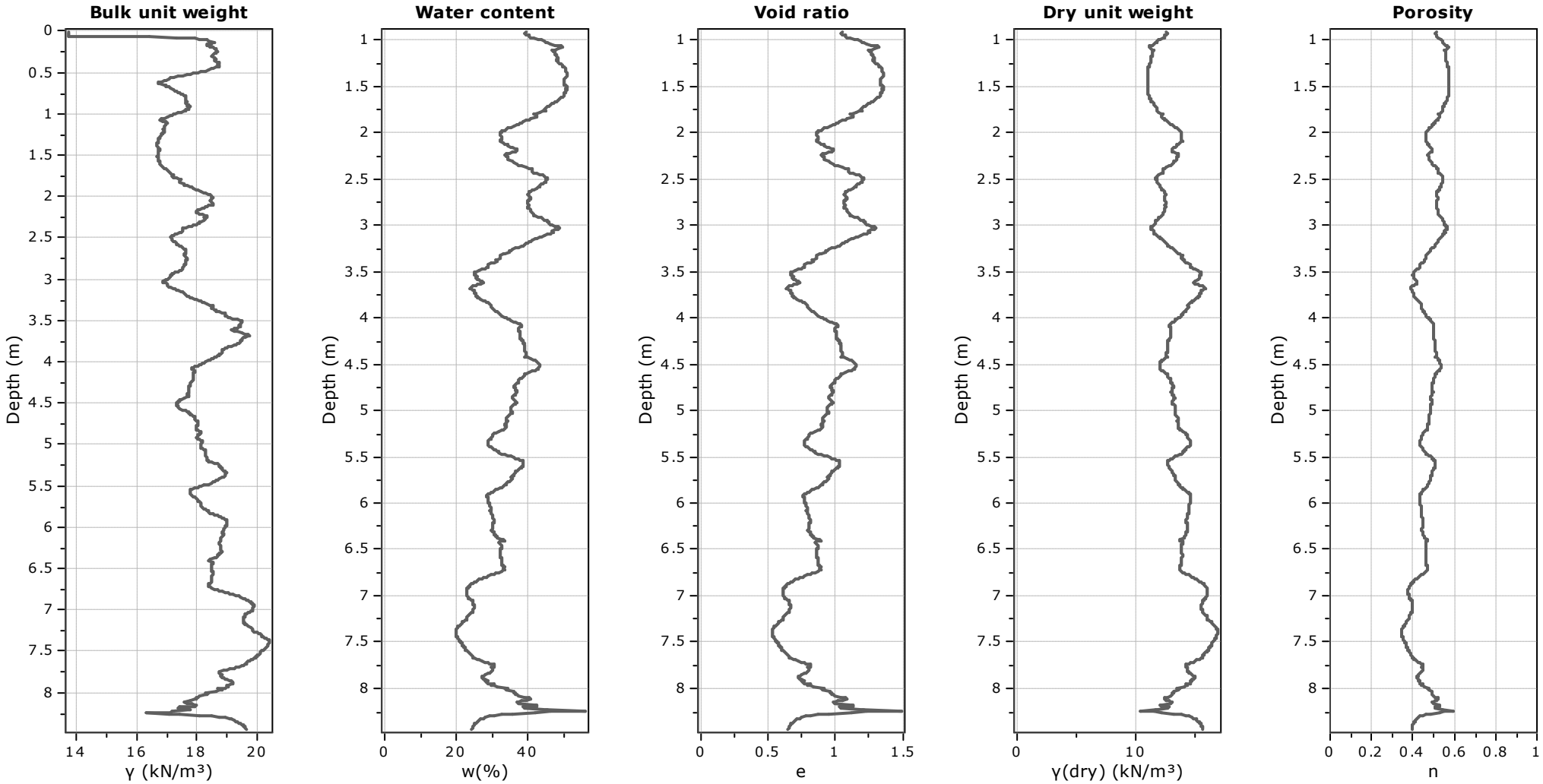
Calculation parameters

Soil Sensitivity factor, N_S: 7.00

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

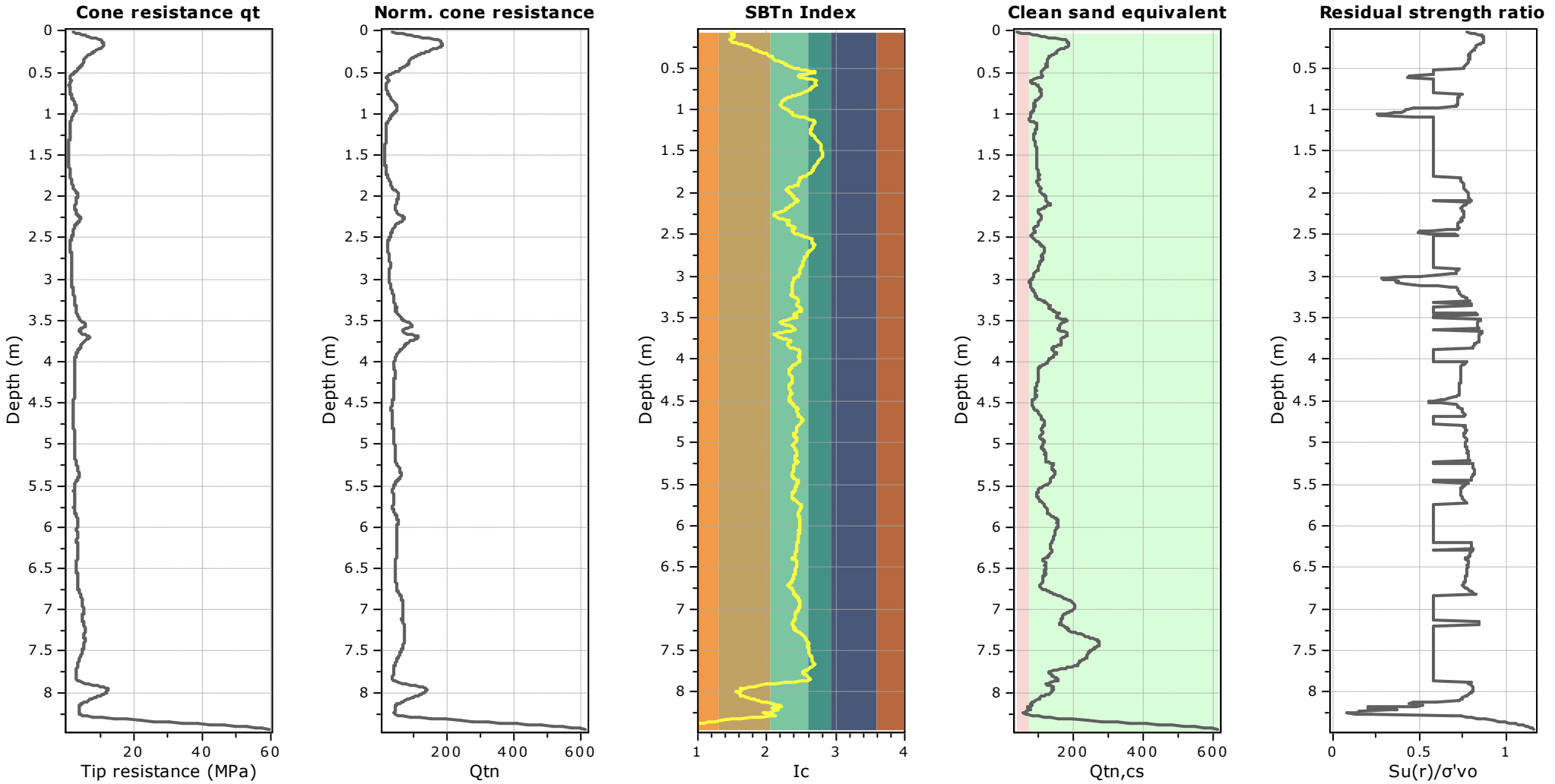
CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

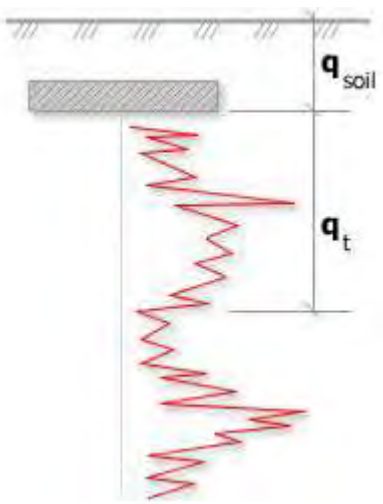
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

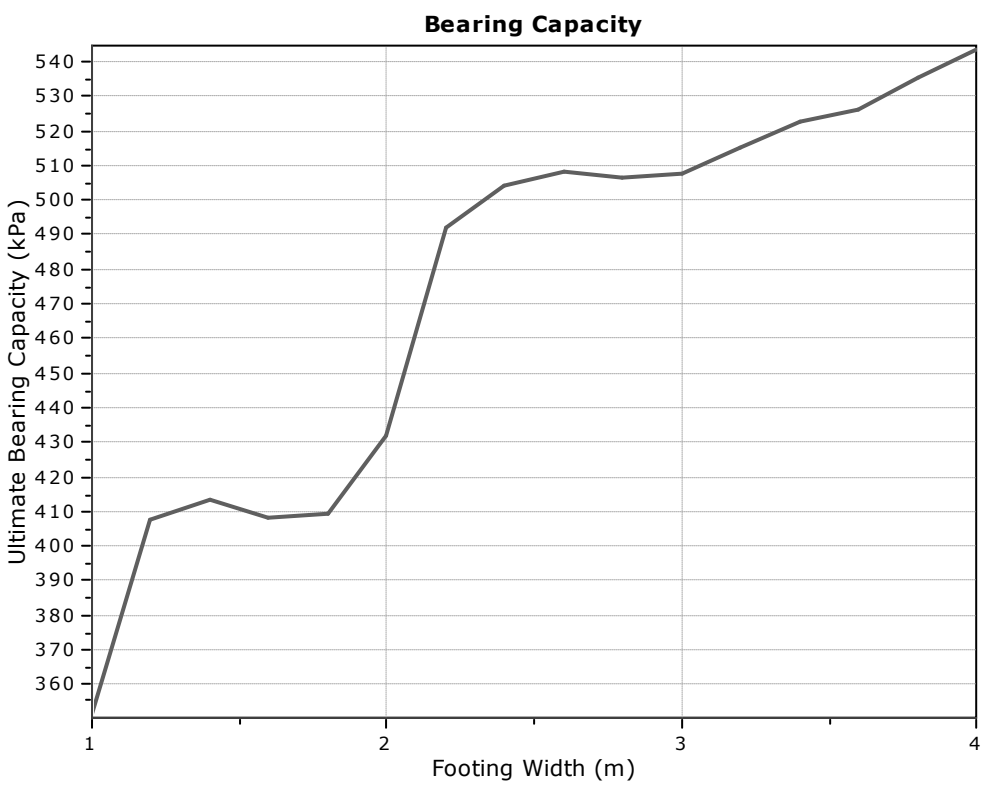
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



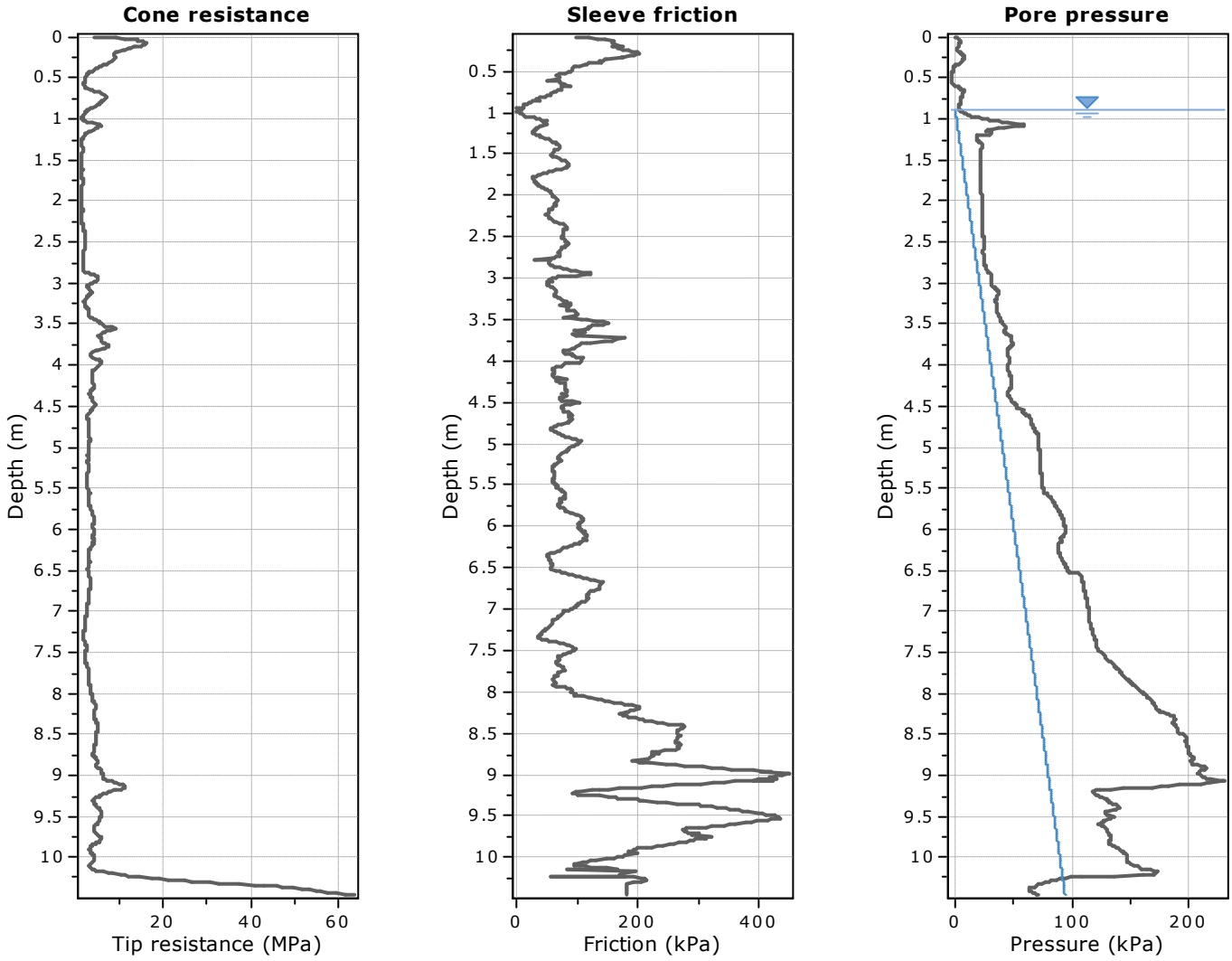
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	1.71	0.20	9.50	351.53
2	1.20	0.50	2.30	1.99	0.20	9.50	407.32
3	1.40	0.50	2.60	2.02	0.20	9.50	413.66
4	1.60	0.50	2.90	1.99	0.20	9.50	407.98
5	1.80	0.50	3.20	2.00	0.20	9.50	409.05
6	2.00	0.50	3.50	2.11	0.20	9.50	431.93
7	2.20	0.50	3.80	2.41	0.20	9.50	491.84
8	2.40	0.50	4.10	2.47	0.20	9.50	504.25
9	2.60	0.50	4.40	2.49	0.20	9.50	508.04
10	2.80	0.50	4.70	2.48	0.20	9.50	506.34
11	3.00	0.50	5.00	2.49	0.20	9.50	507.60
12	3.20	0.50	5.30	2.53	0.20	9.50	514.83
13	3.40	0.50	5.60	2.57	0.20	9.50	522.71
14	3.60	0.50	5.90	2.58	0.20	9.50	526.04
15	3.80	0.50	6.20	2.63	0.20	9.50	535.21
16	4.00	0.50	6.50	2.67	0.20	9.50	543.44

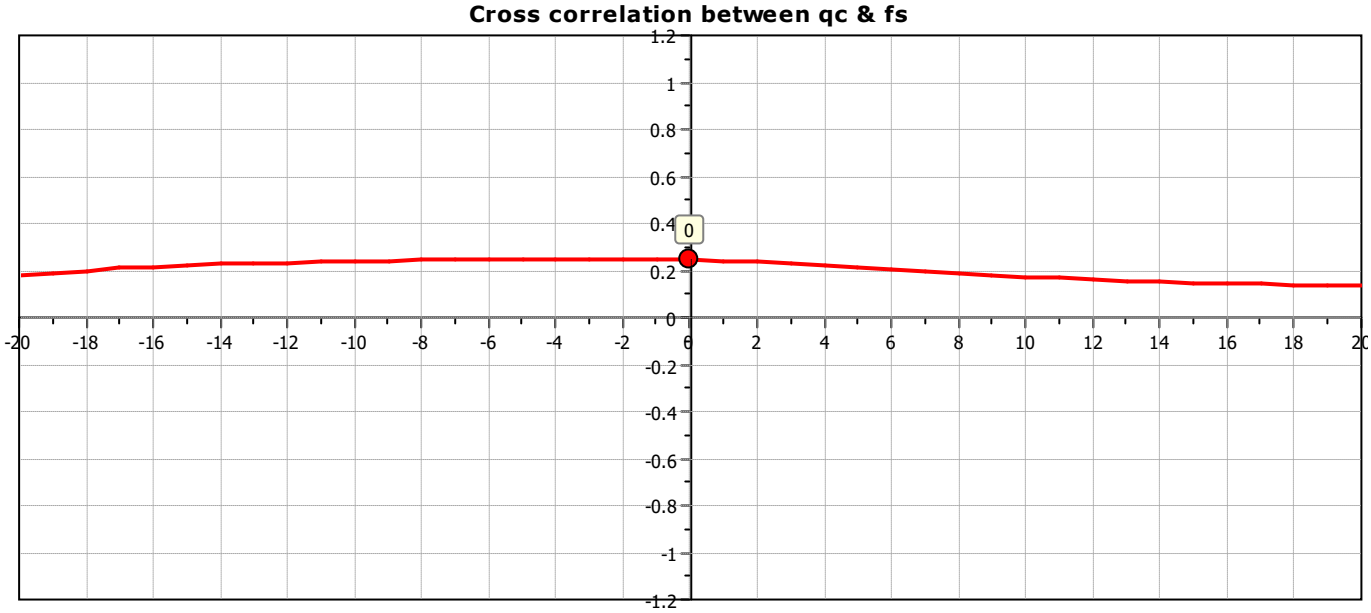
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

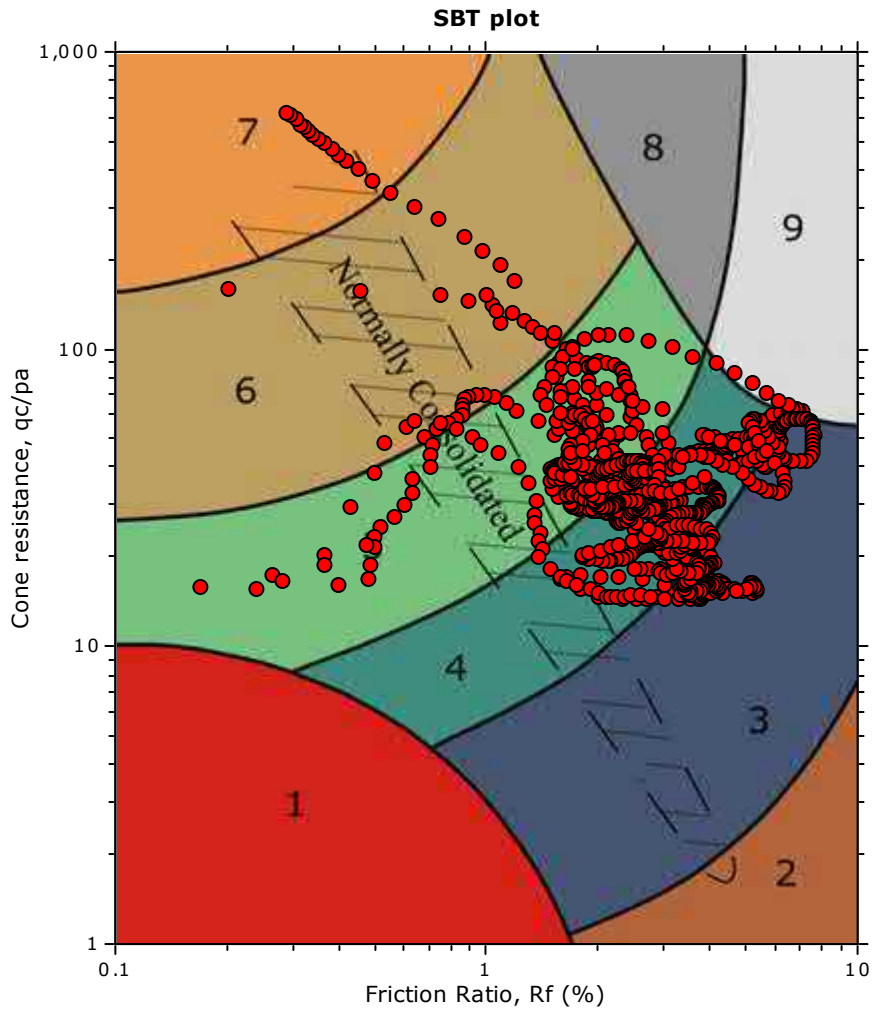


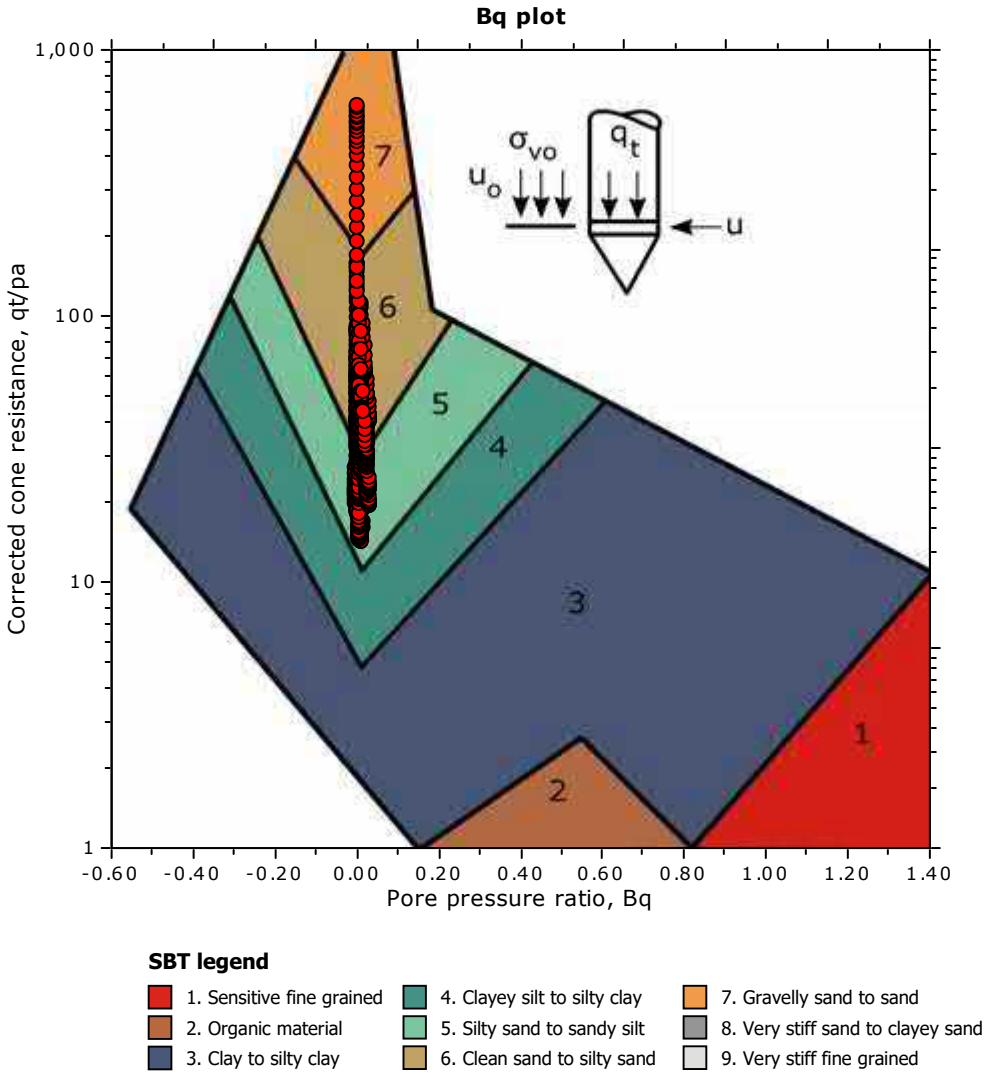
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots





SBT legend

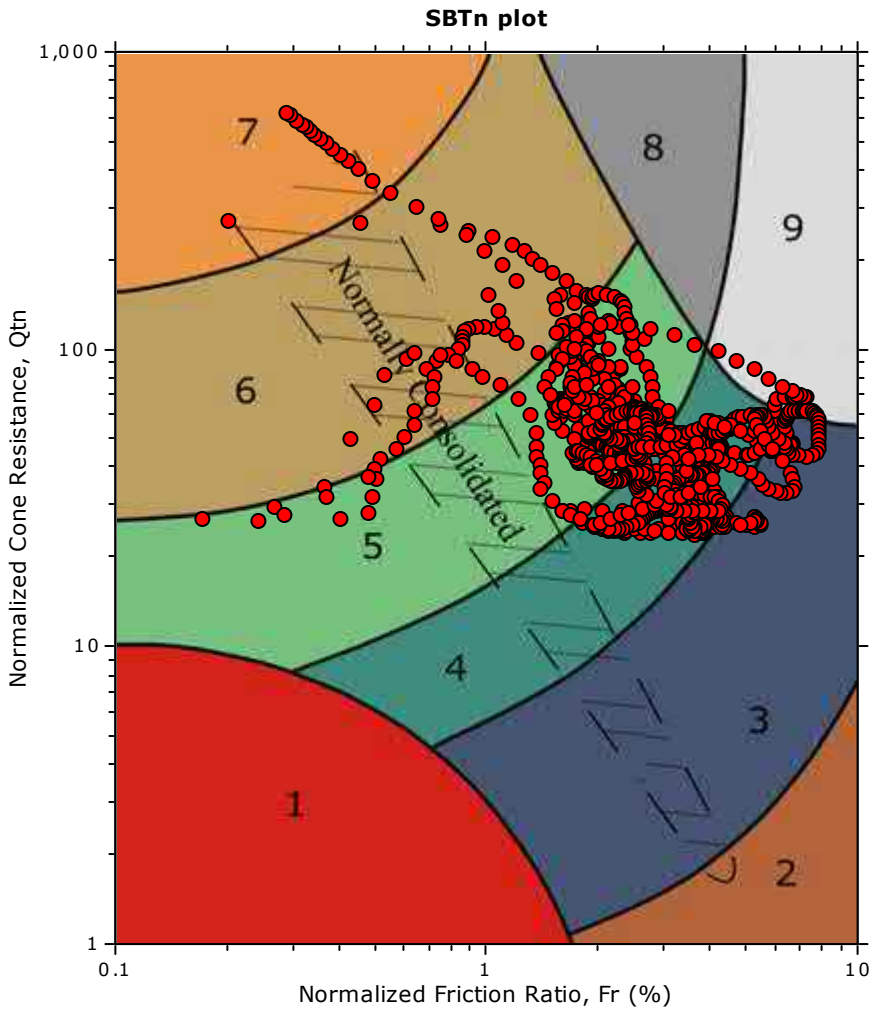
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

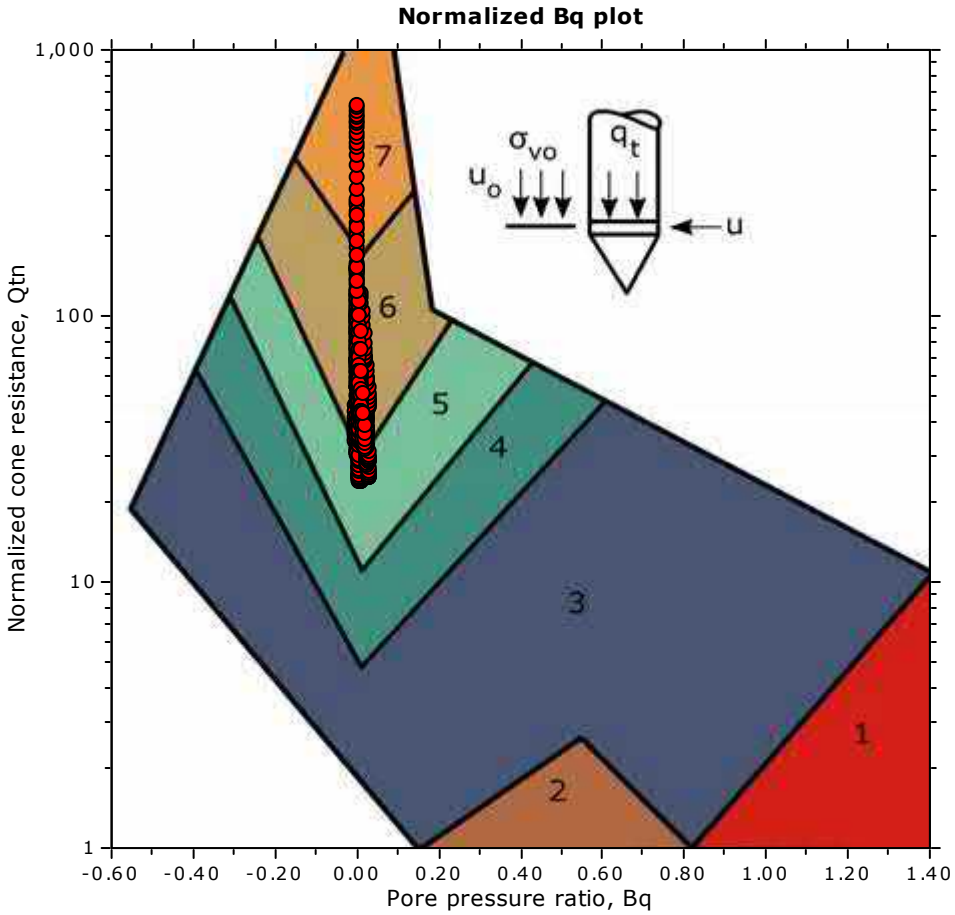
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots (normalized)





SBTn legend

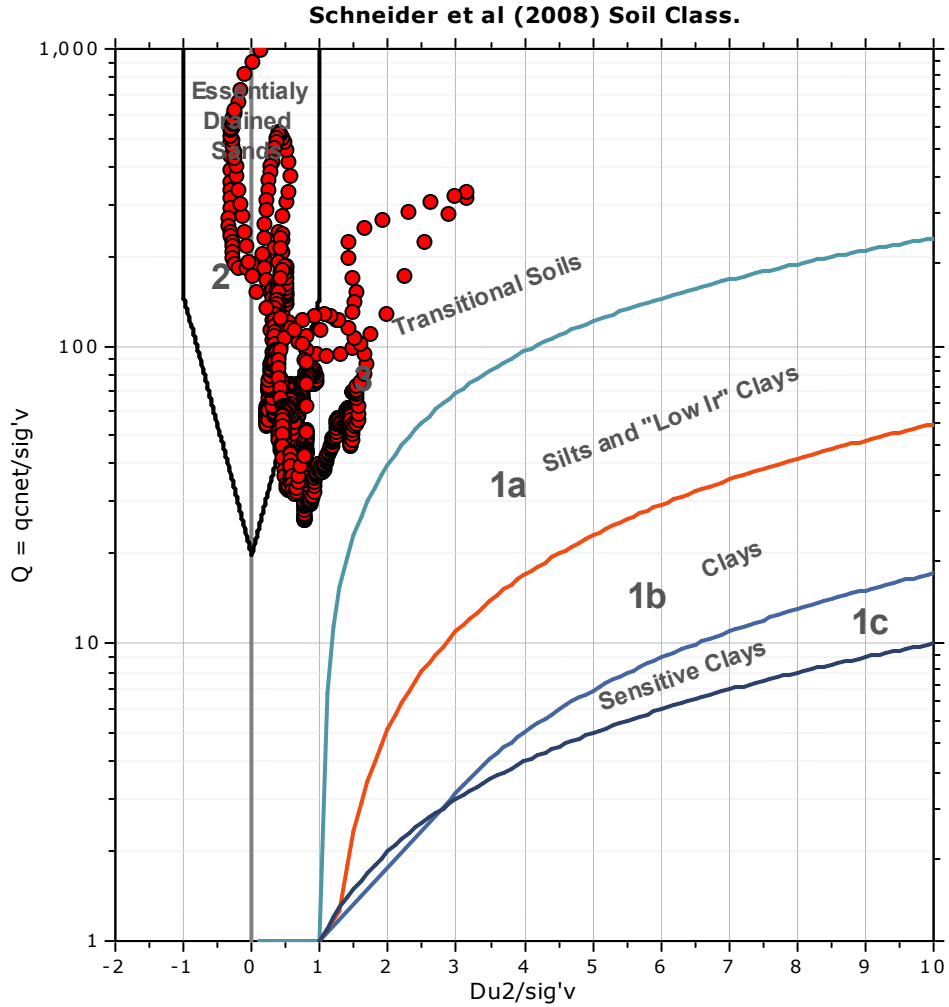
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

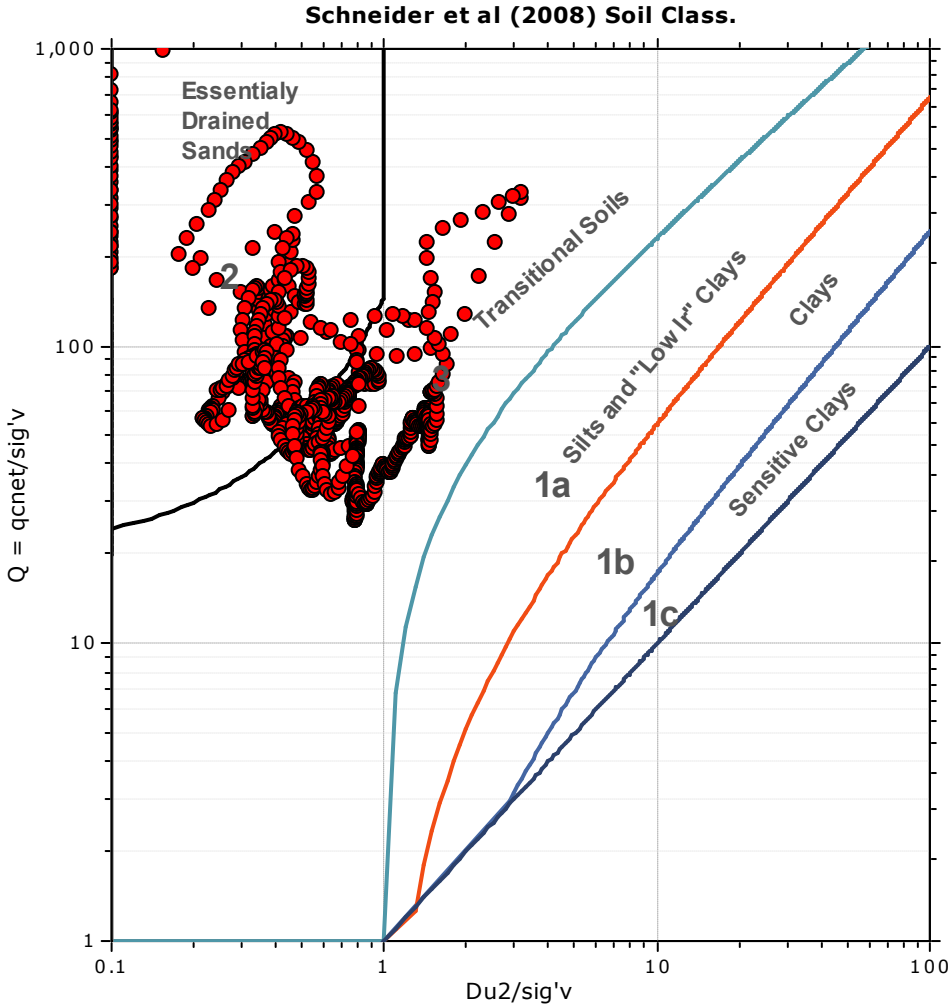
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Bq plots (Schneider)

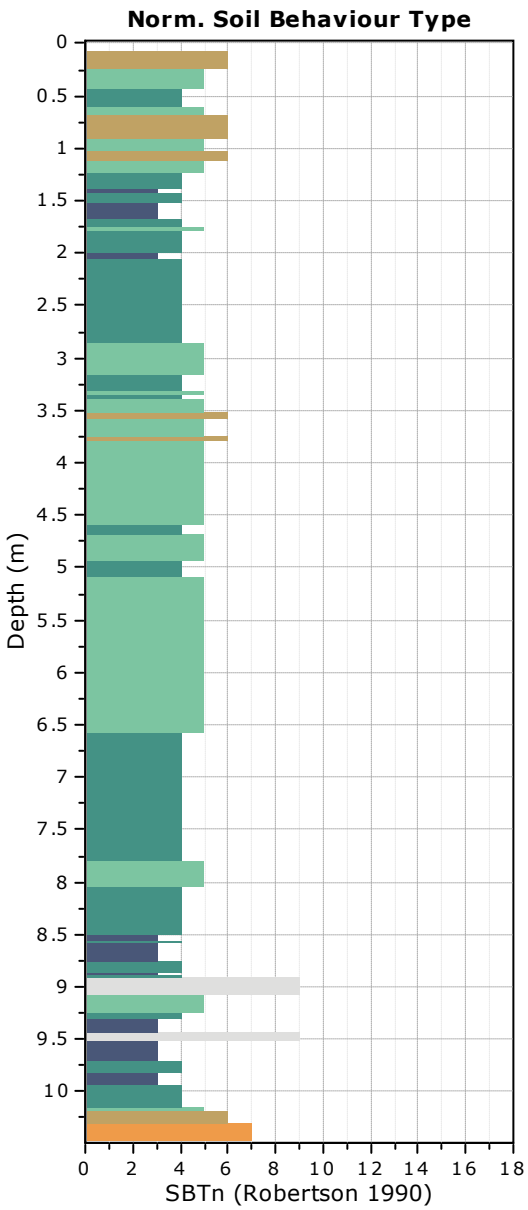


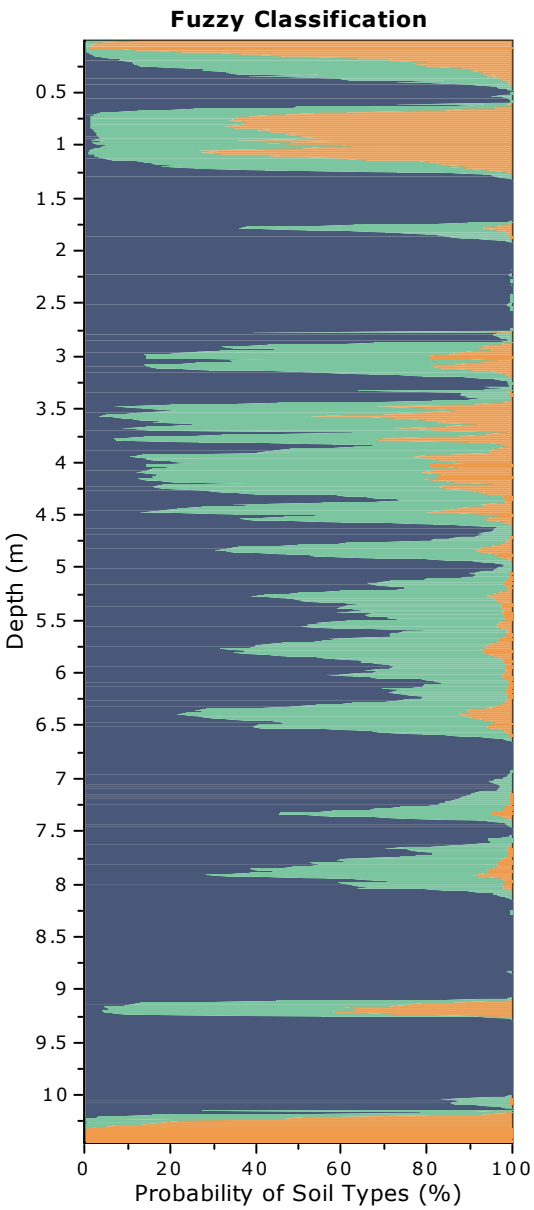


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



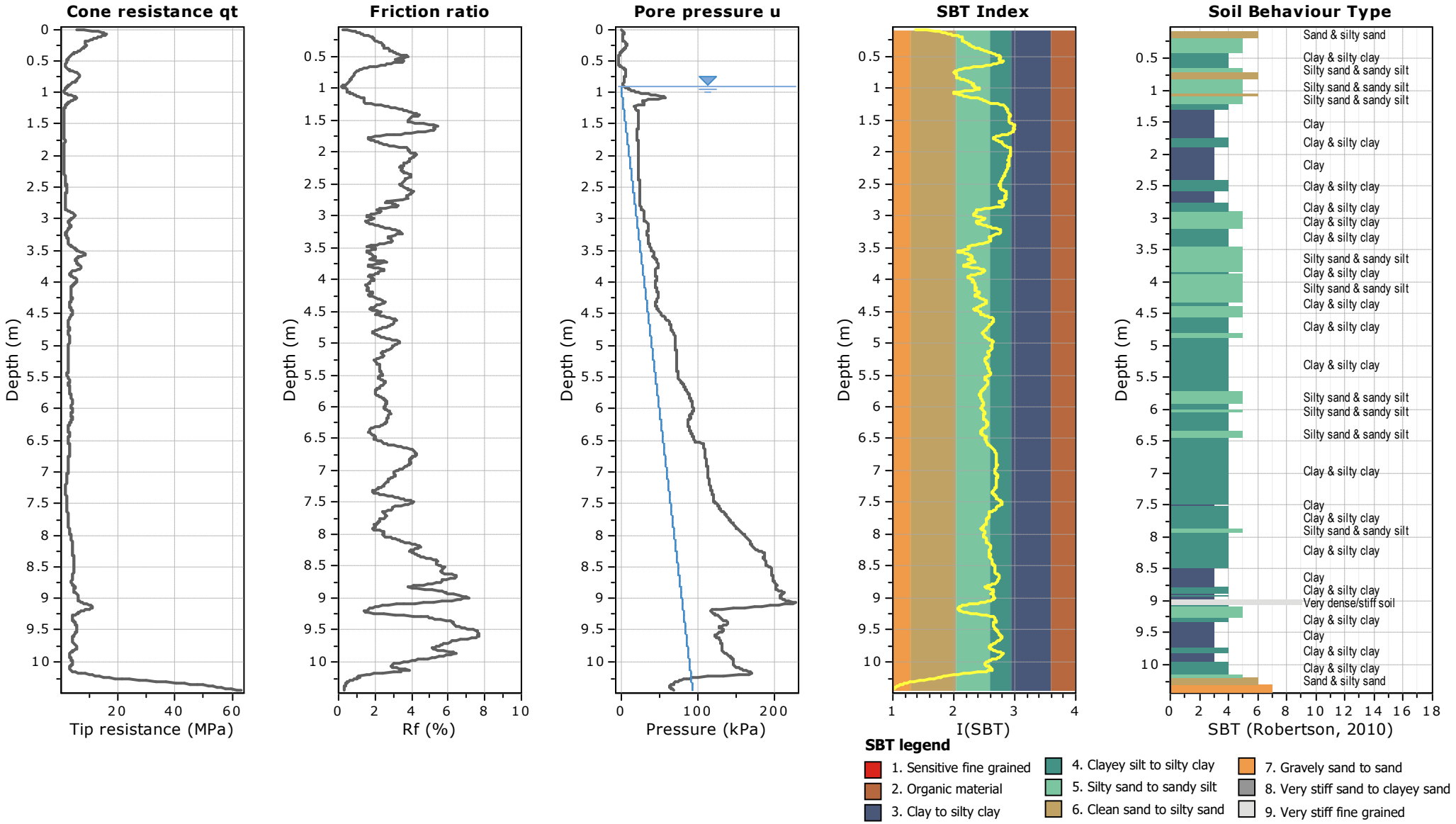


Fuzzy classifiaction legend
- Highly probable clayey soil
- Highly probable mixture soil
- Highly probable sandy soil

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

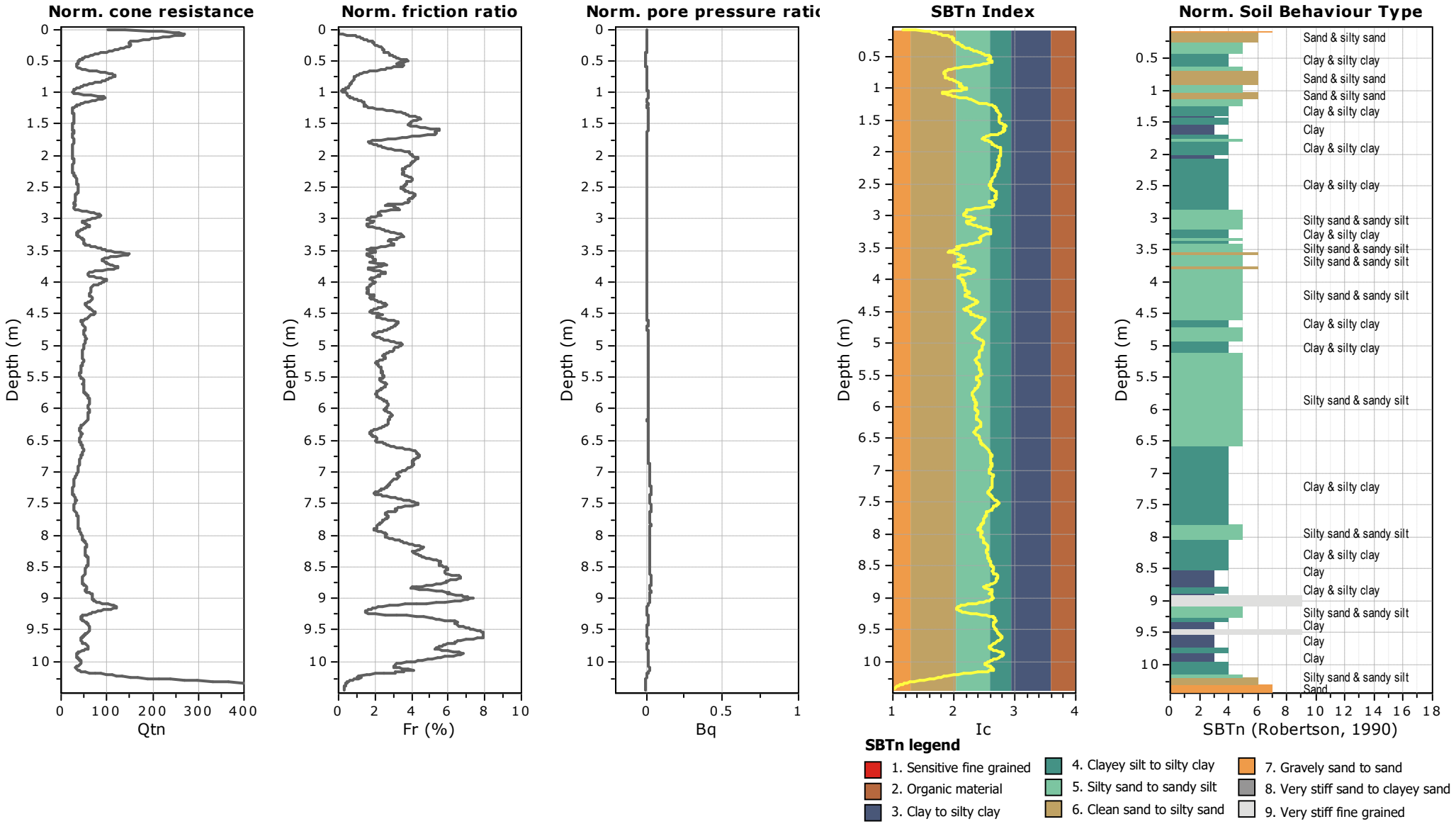
CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

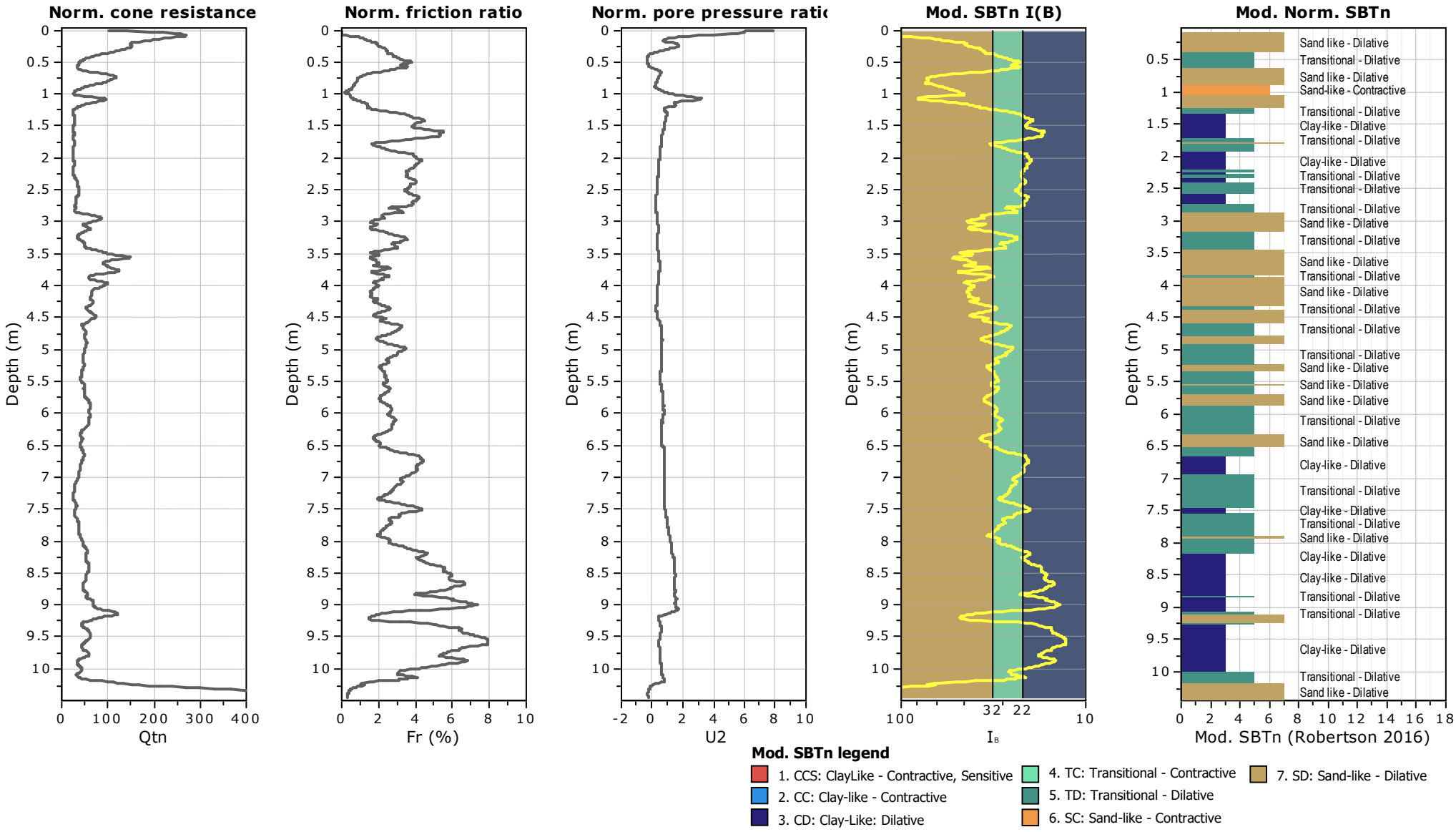
CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

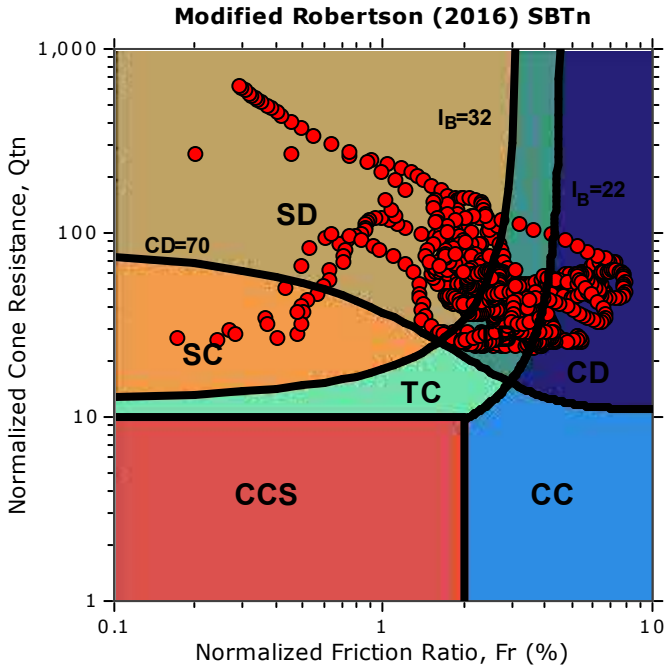


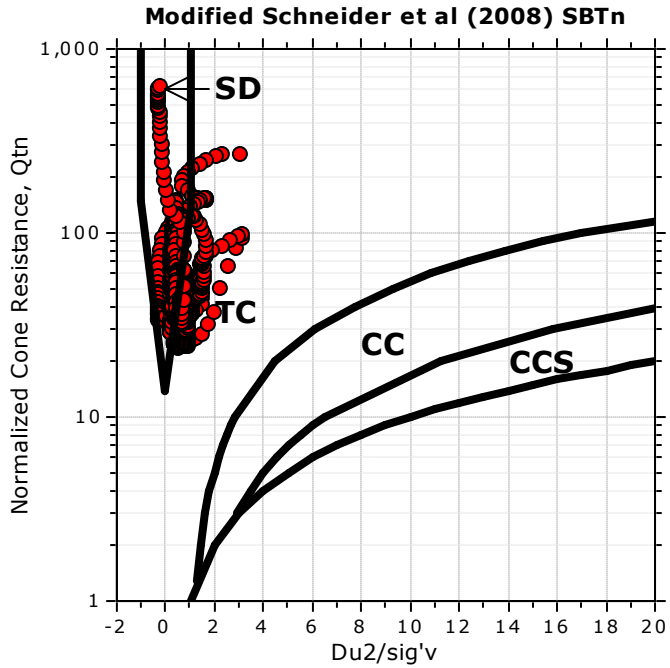
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

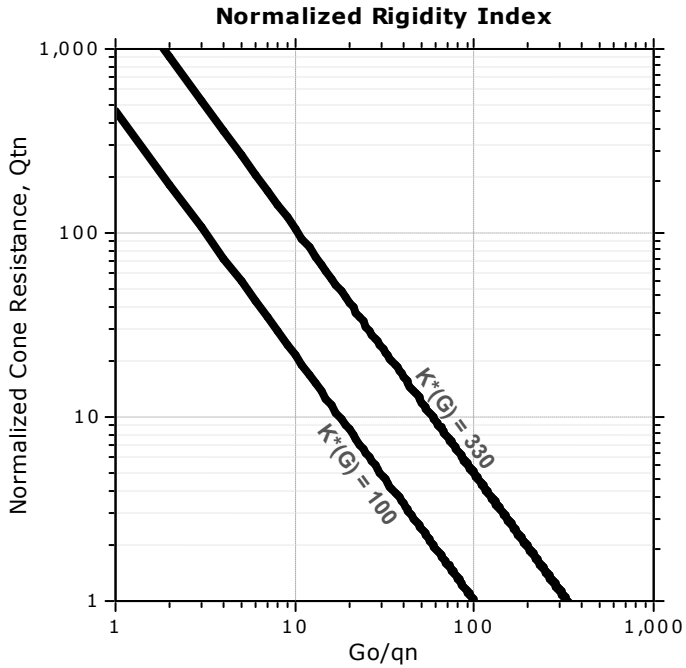
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Updated SBTn plots







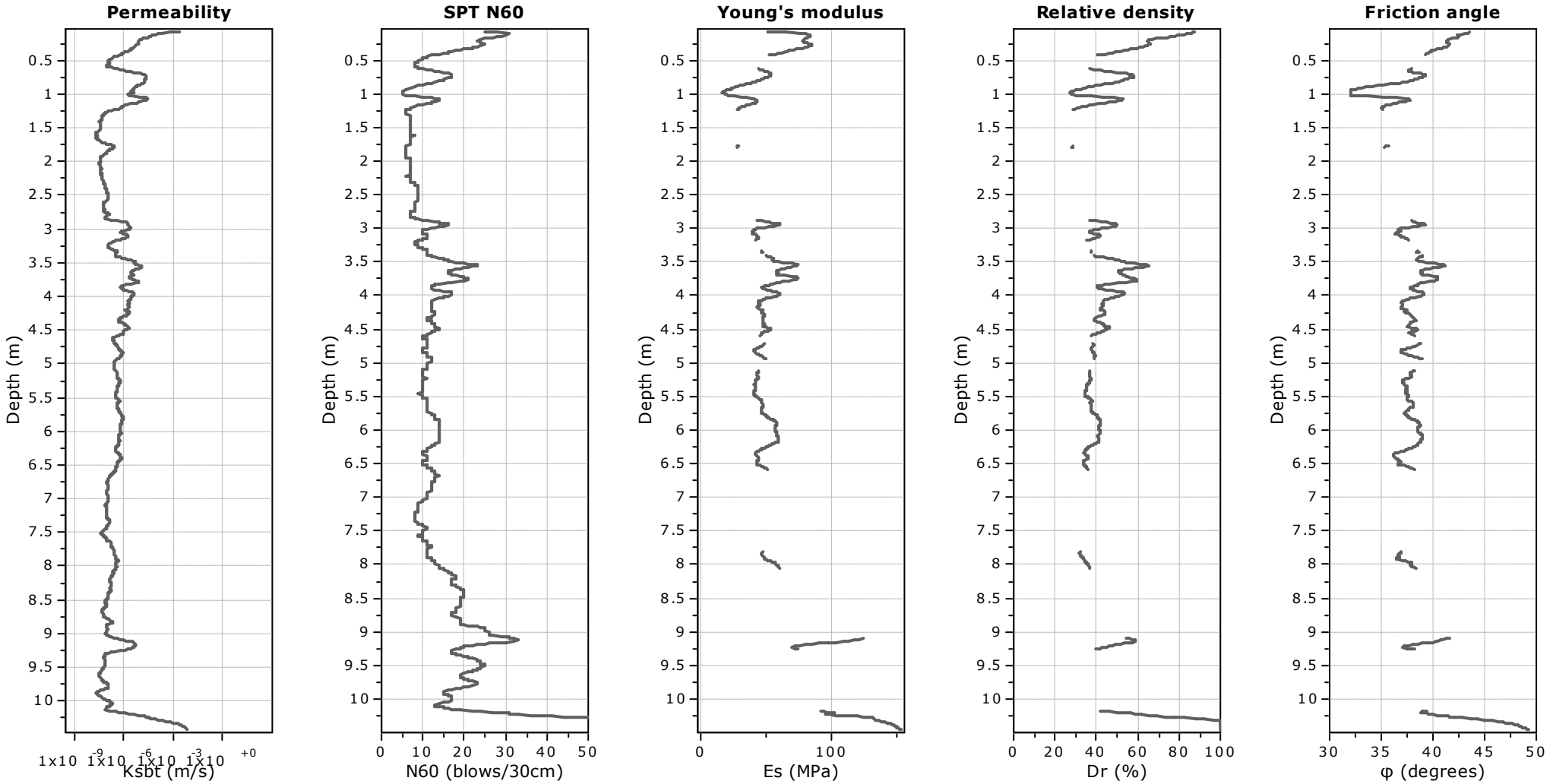
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



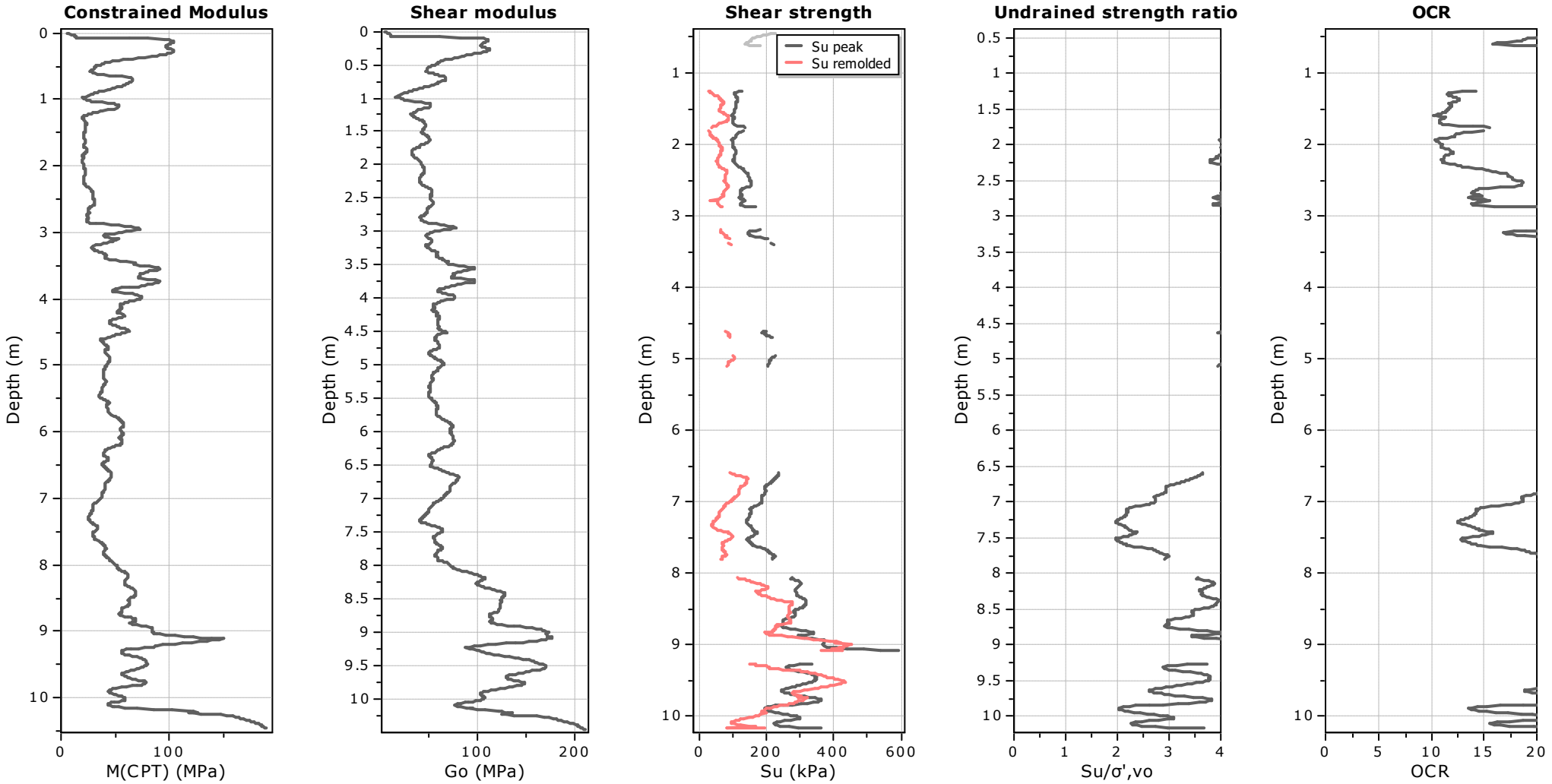
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



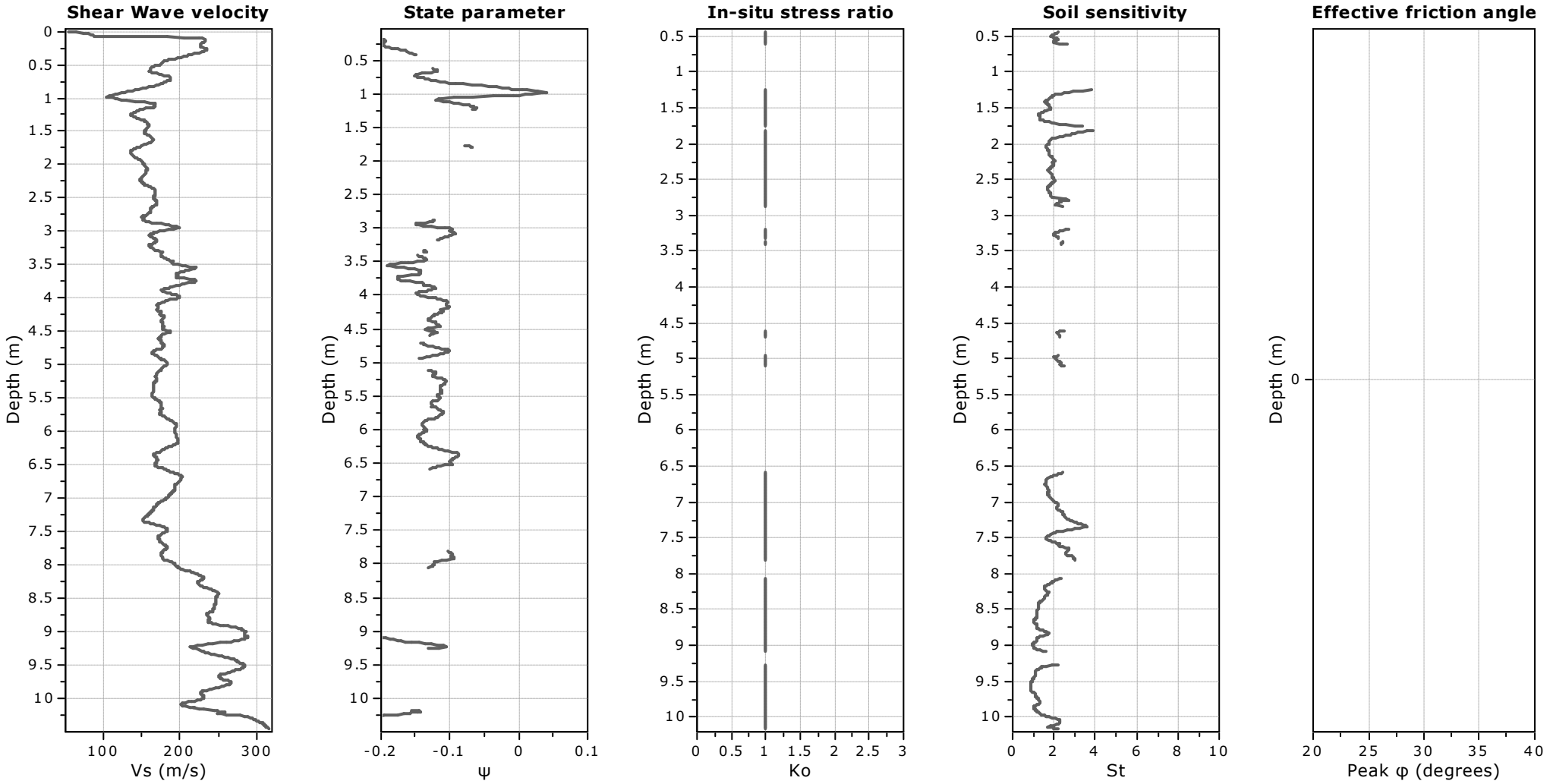
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto
OCR factor for clays, N_{kt}: Auto
Flat Dilatometer Test data

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



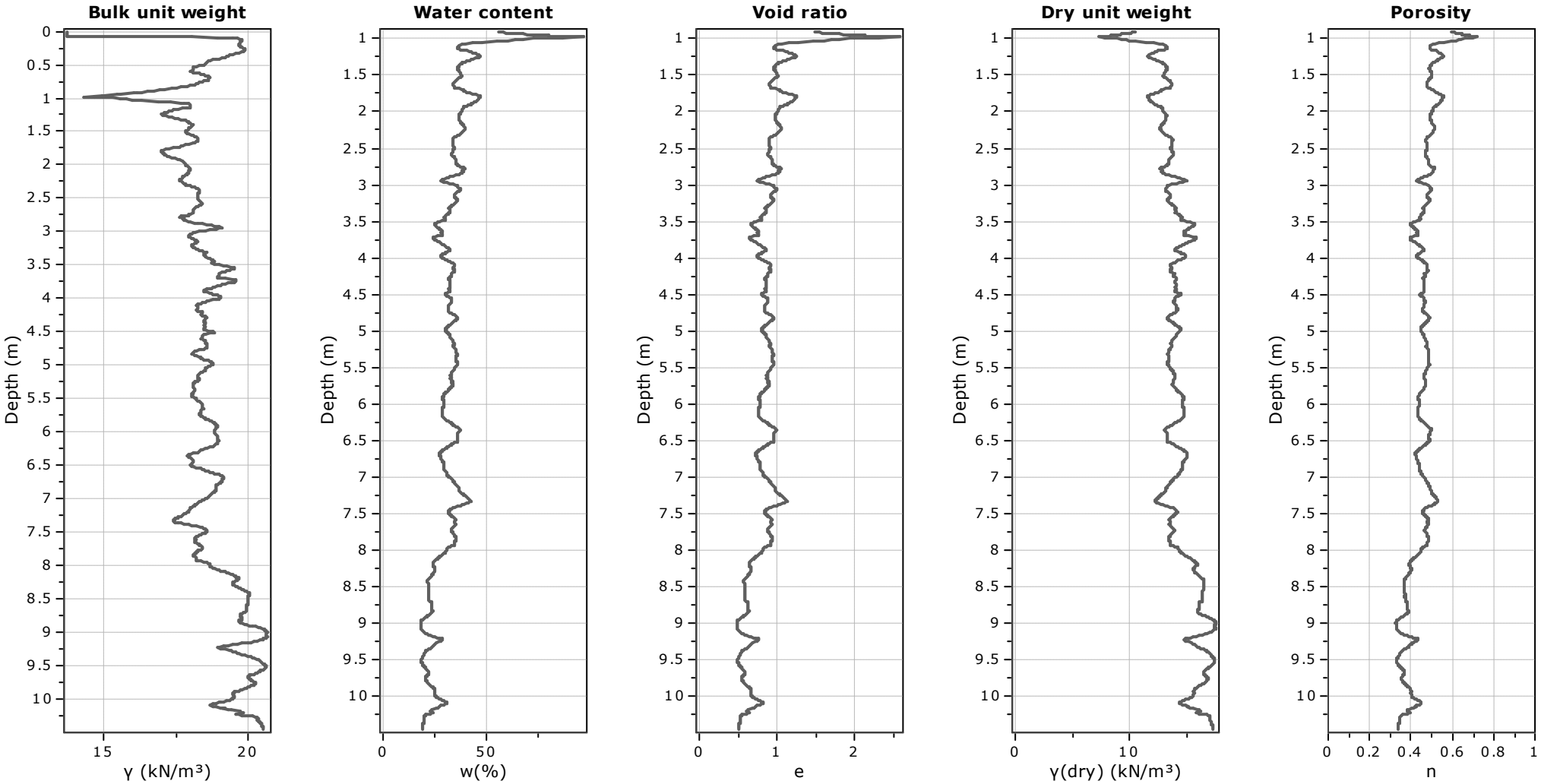
Calculation parameters

Soil Sensitivity factor, N_S: 7.00

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

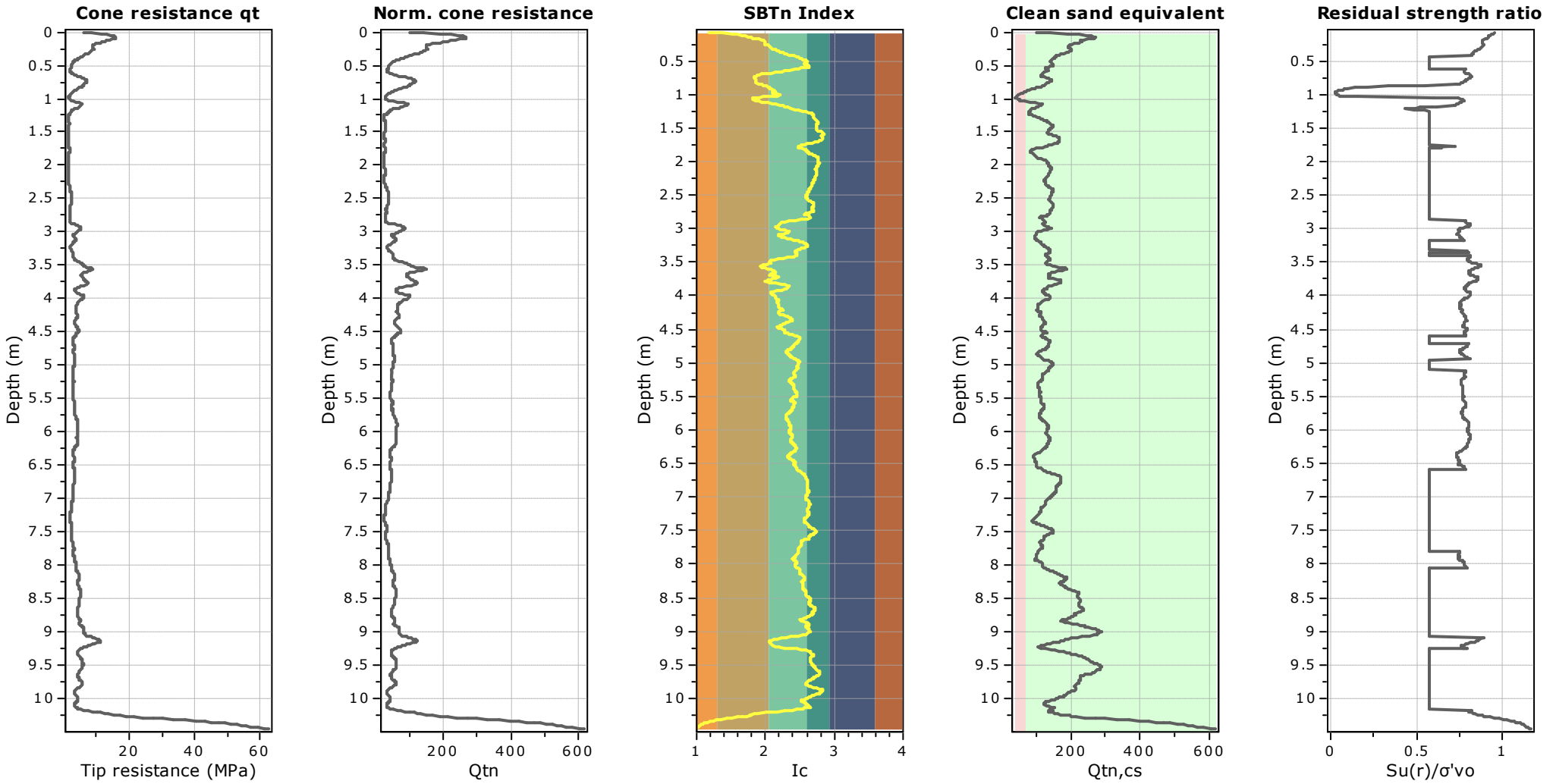
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

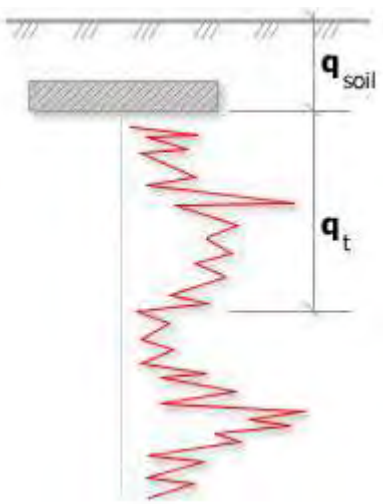
CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

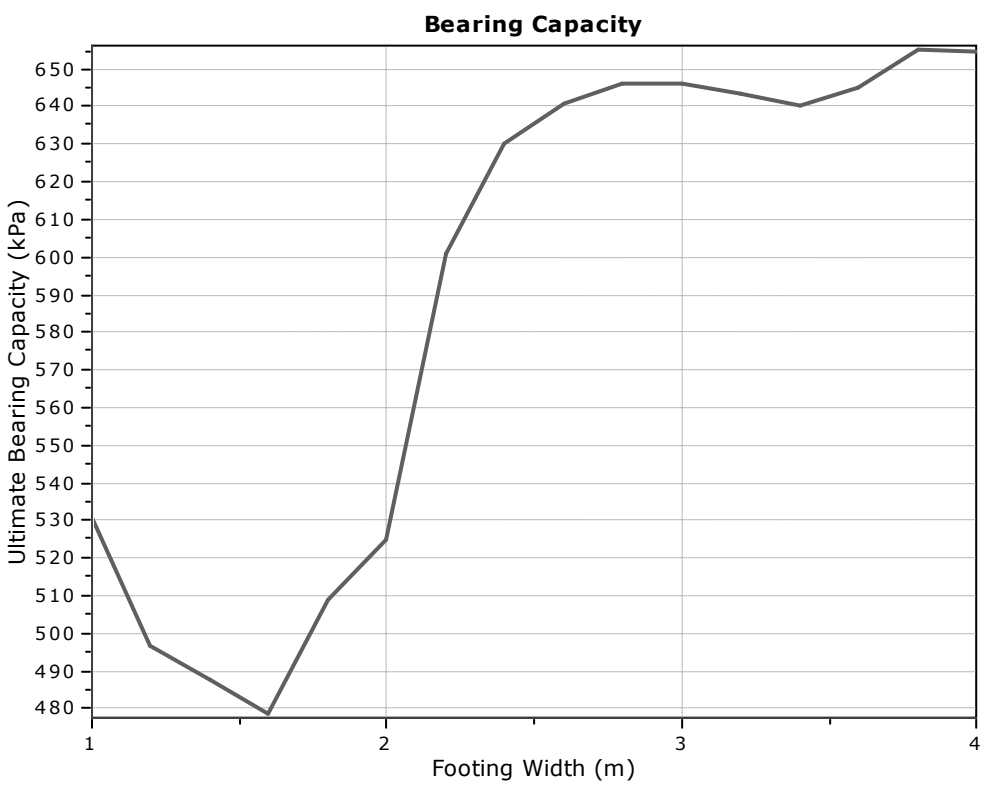
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



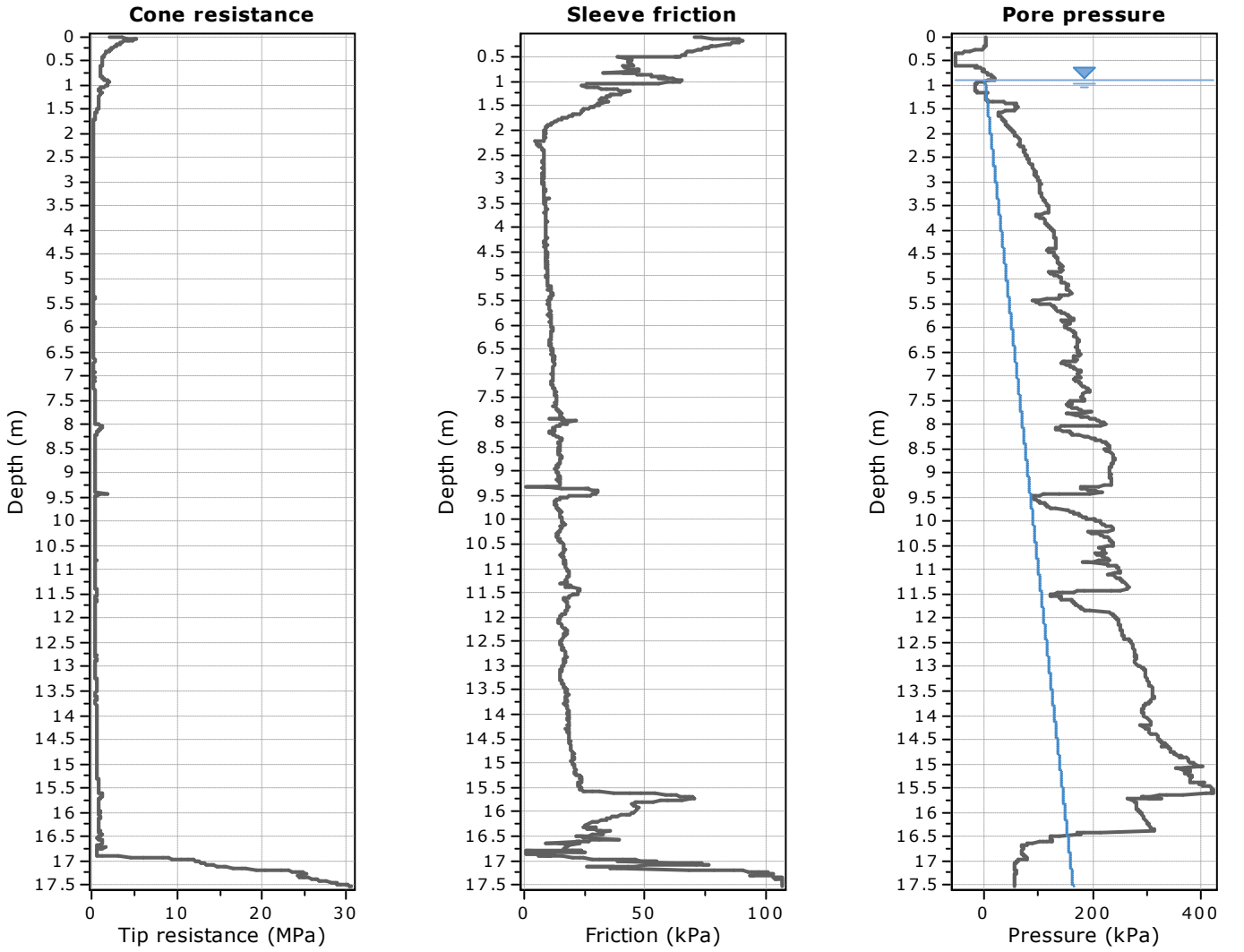
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	2.61	0.20	9.50	530.98
2	1.20	0.50	2.30	2.44	0.20	9.50	496.71
3	1.40	0.50	2.60	2.39	0.20	9.50	487.89
4	1.60	0.50	2.90	2.35	0.20	9.50	478.67
5	1.80	0.50	3.20	2.50	0.20	9.50	509.18
6	2.00	0.50	3.50	2.58	0.20	9.50	524.67
7	2.20	0.50	3.80	2.96	0.20	9.50	601.01
8	2.40	0.50	4.10	3.10	0.20	9.50	630.03
9	2.60	0.50	4.40	3.16	0.20	9.50	640.51
10	2.80	0.50	4.70	3.18	0.20	9.50	646.35
11	3.00	0.50	5.00	3.18	0.20	9.50	646.30
12	3.20	0.50	5.30	3.17	0.20	9.50	643.65
13	3.40	0.50	5.60	3.15	0.20	9.50	640.18
14	3.60	0.50	5.90	3.18	0.20	9.50	645.17
15	3.80	0.50	6.20	3.23	0.20	9.50	655.12
16	4.00	0.50	6.50	3.22	0.20	9.50	654.44

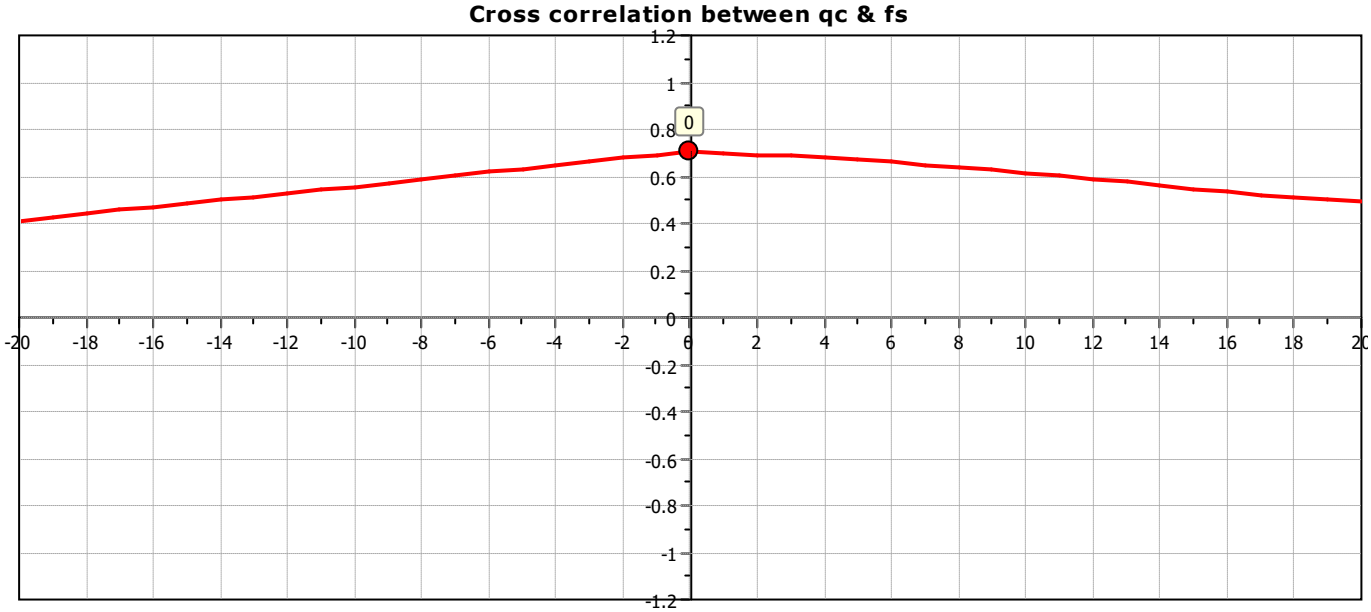
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

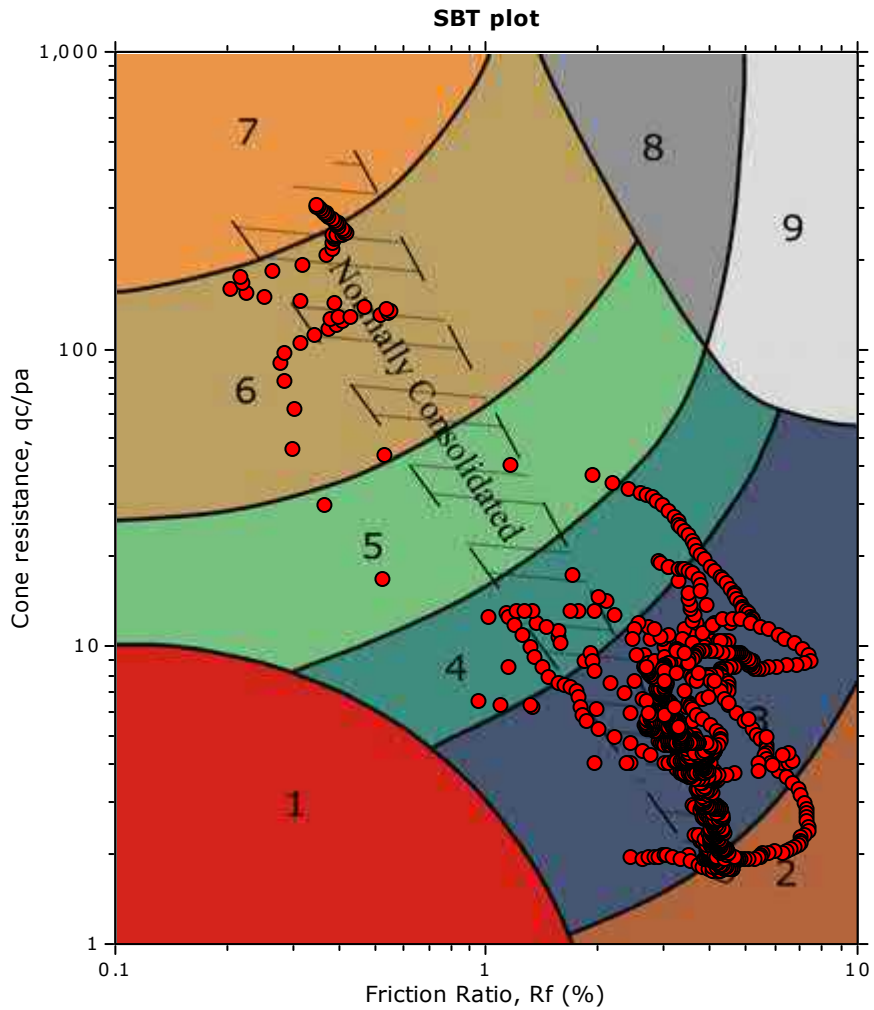


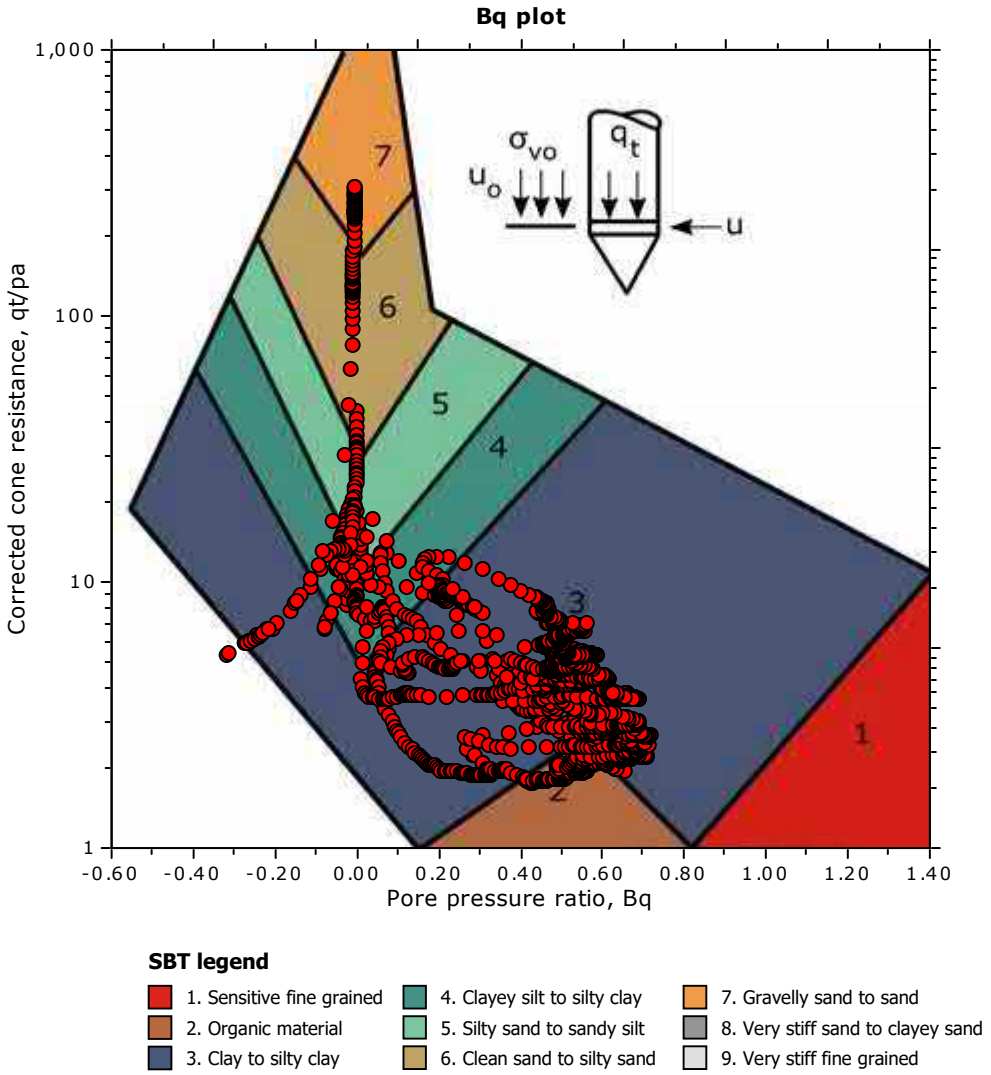
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots



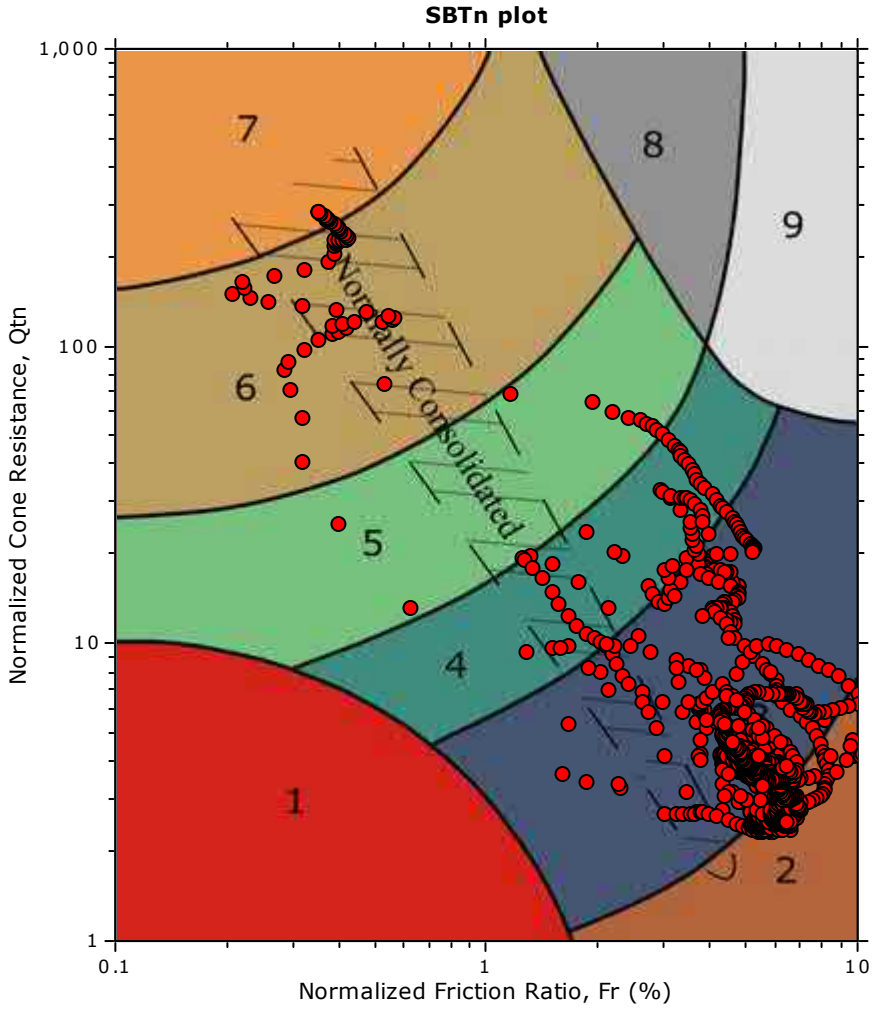


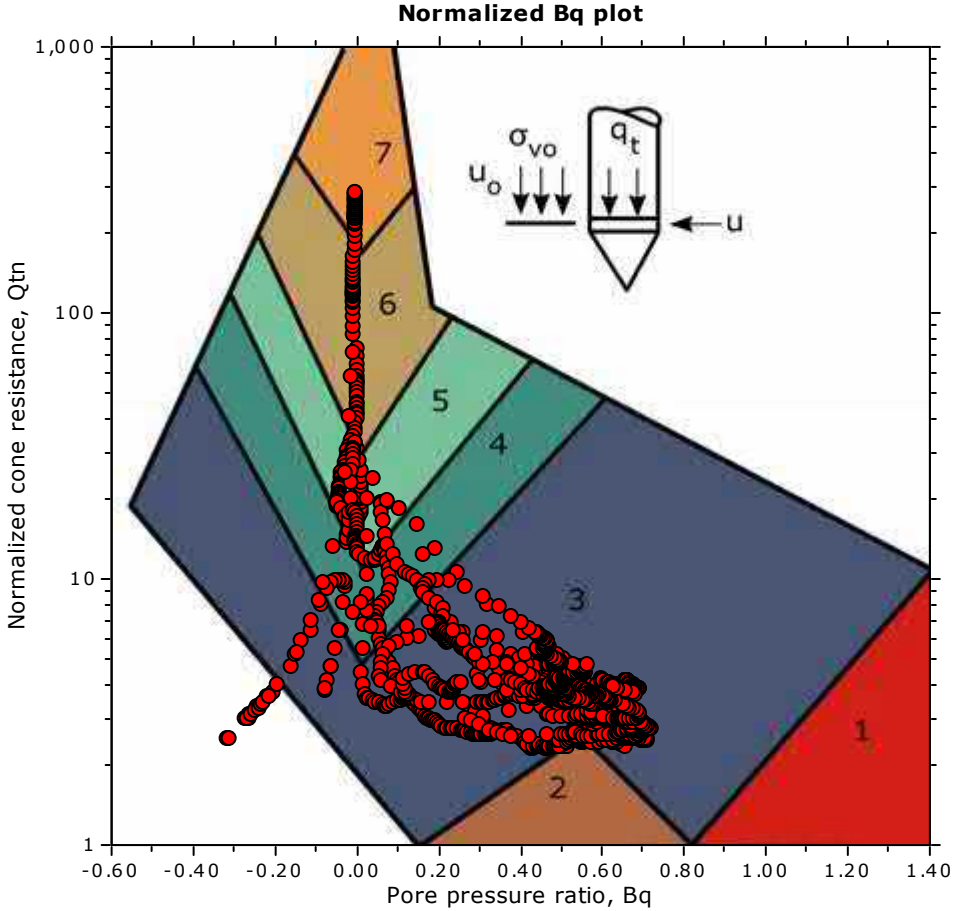
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots (normalized)





SBTn legend

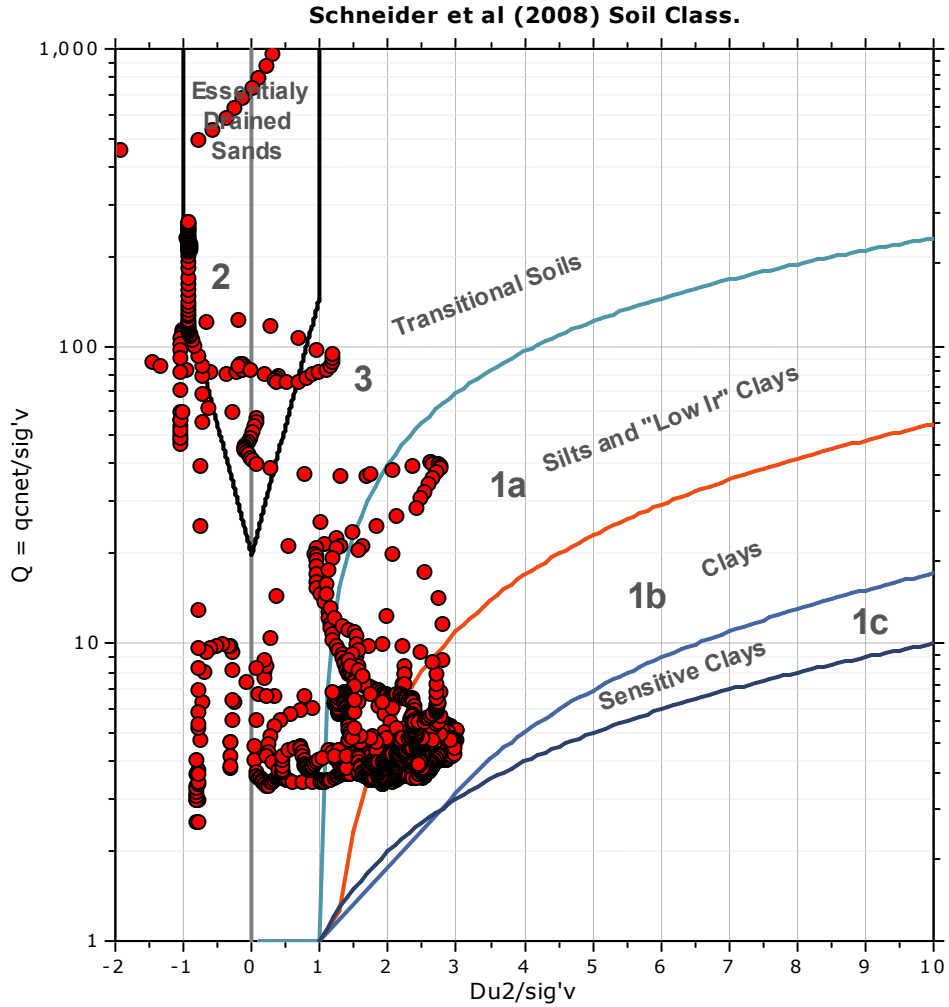
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

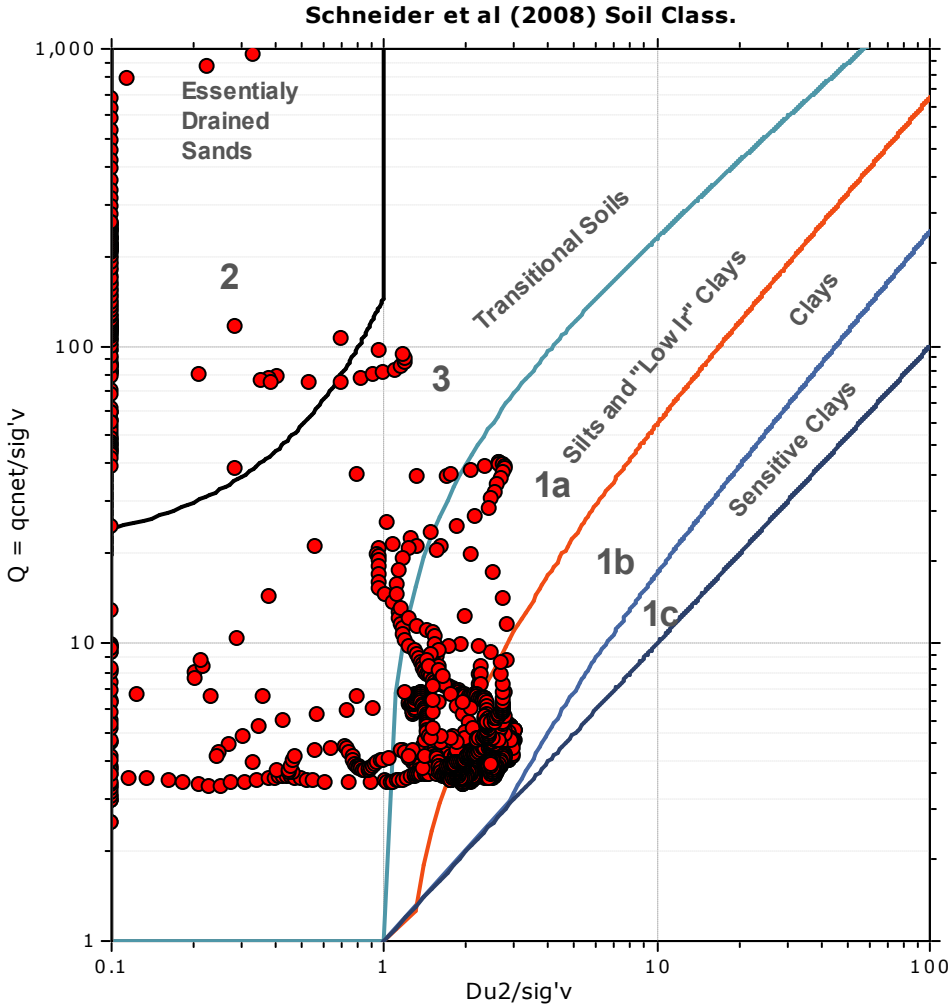
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Bq plots (Schneider)

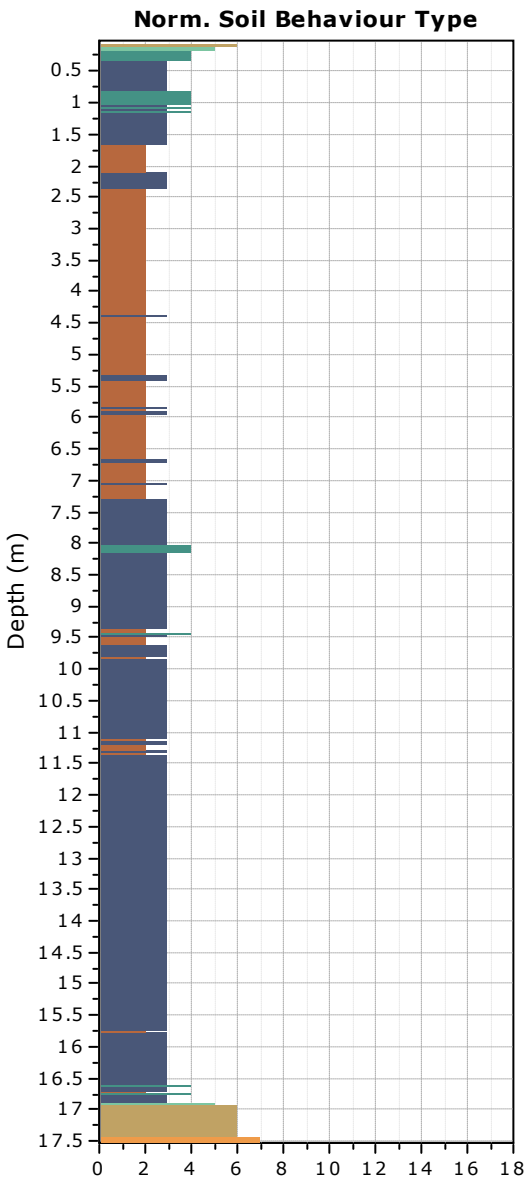


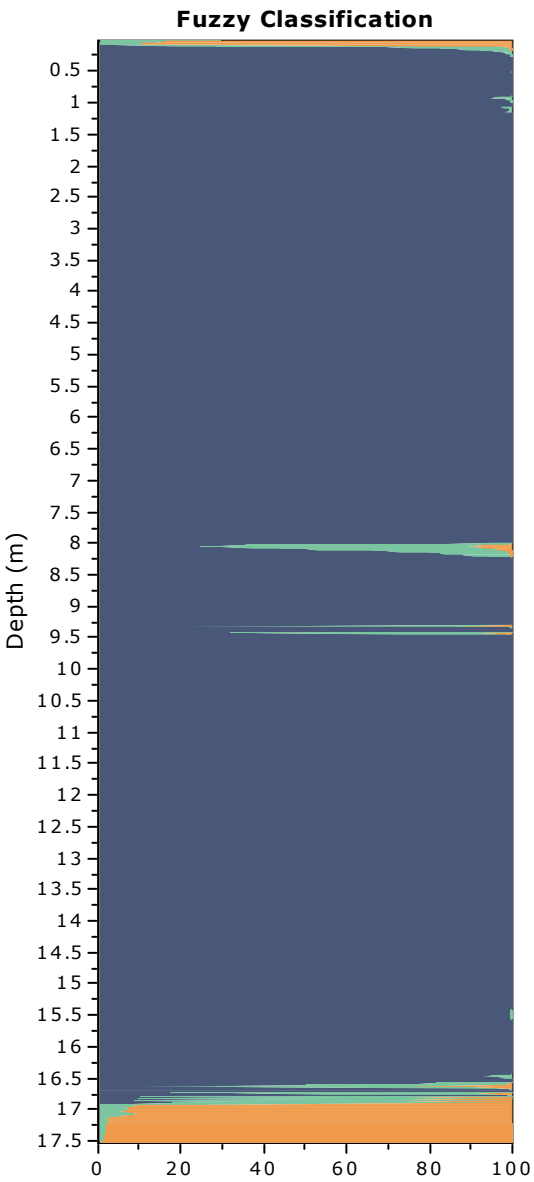


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



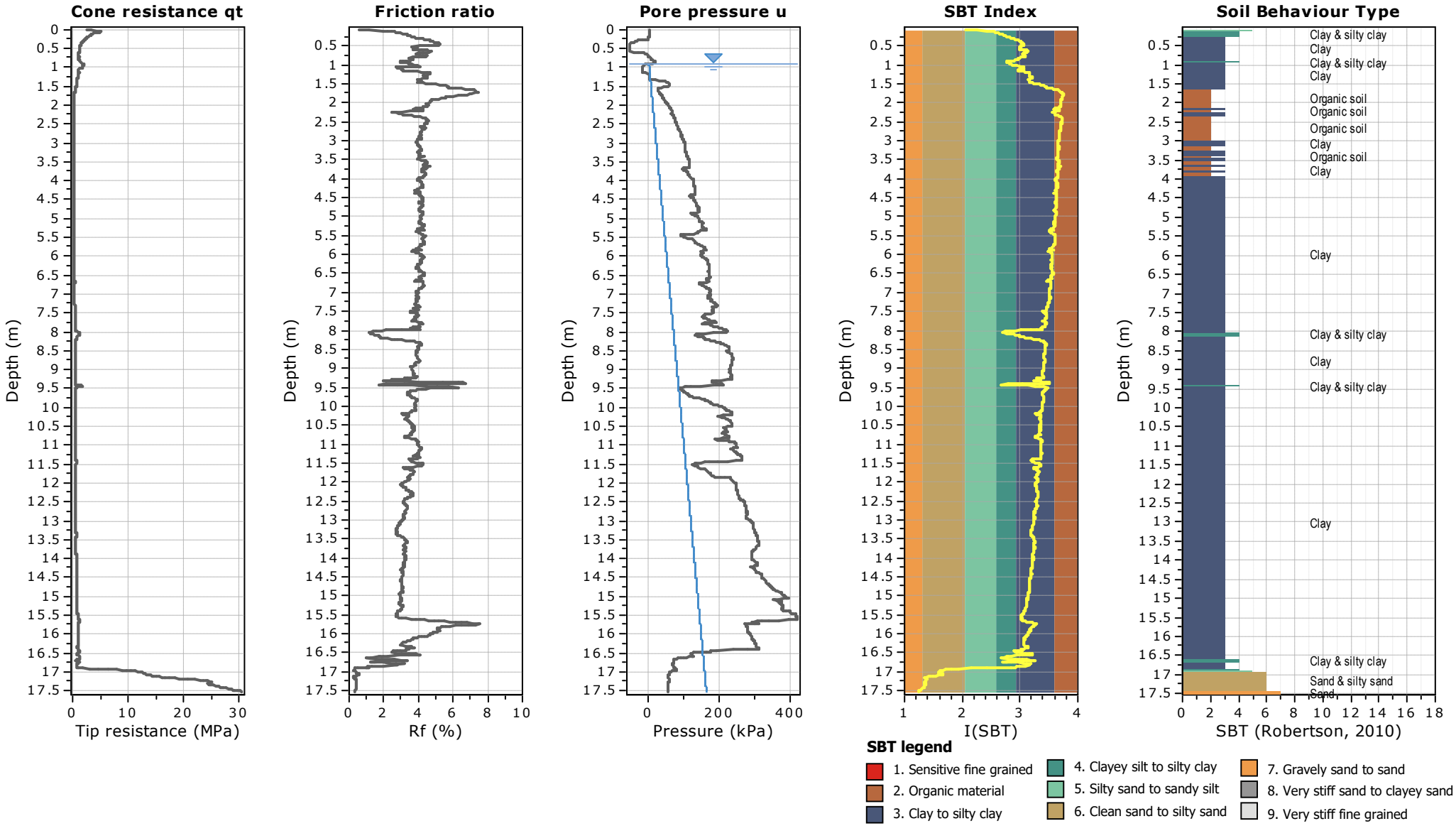


Fuzzy classifiaction legend
- Highly probable clayey soil
- Highly probable mixture soil
- Highly probable sandy soil

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

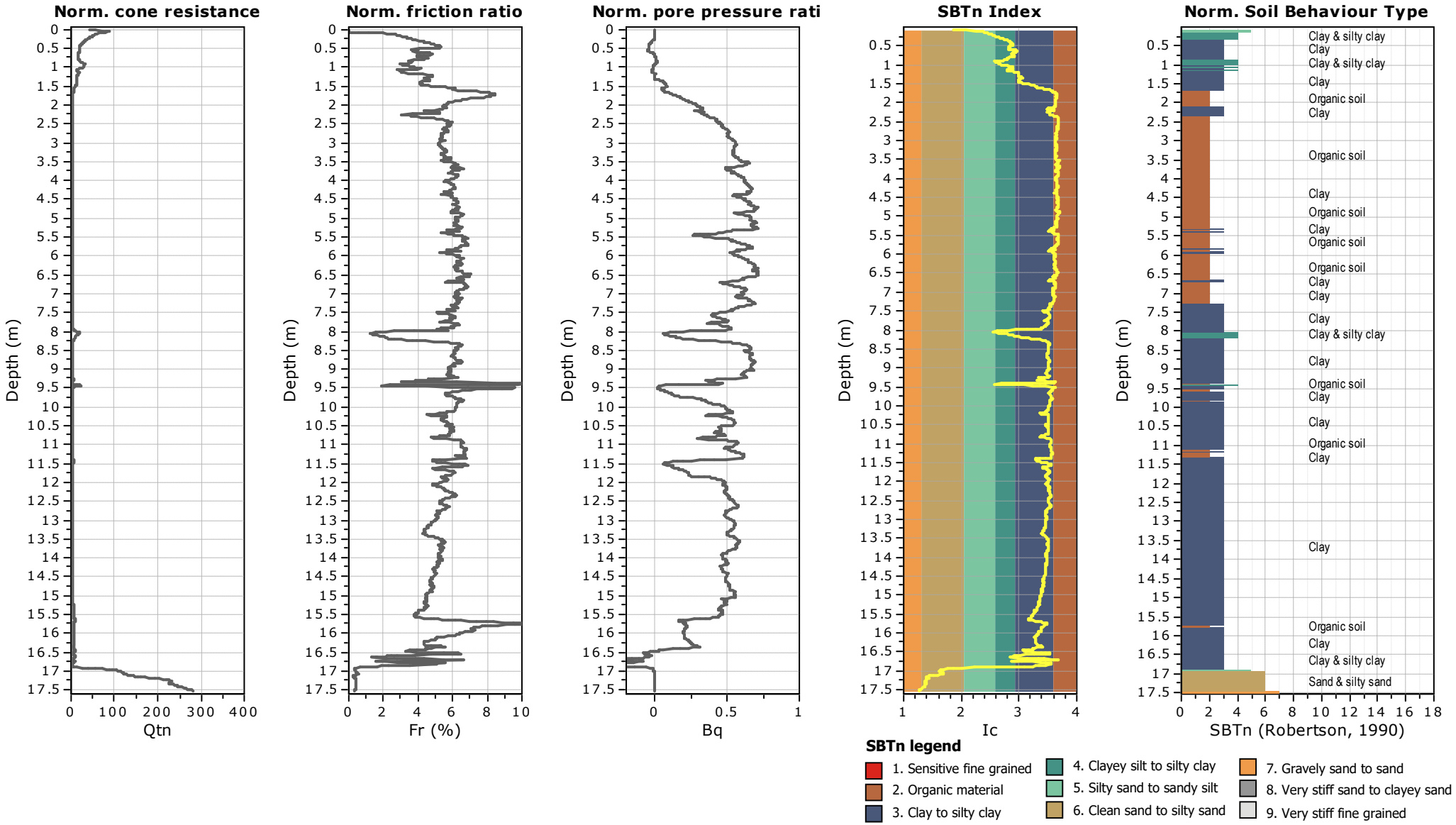
CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

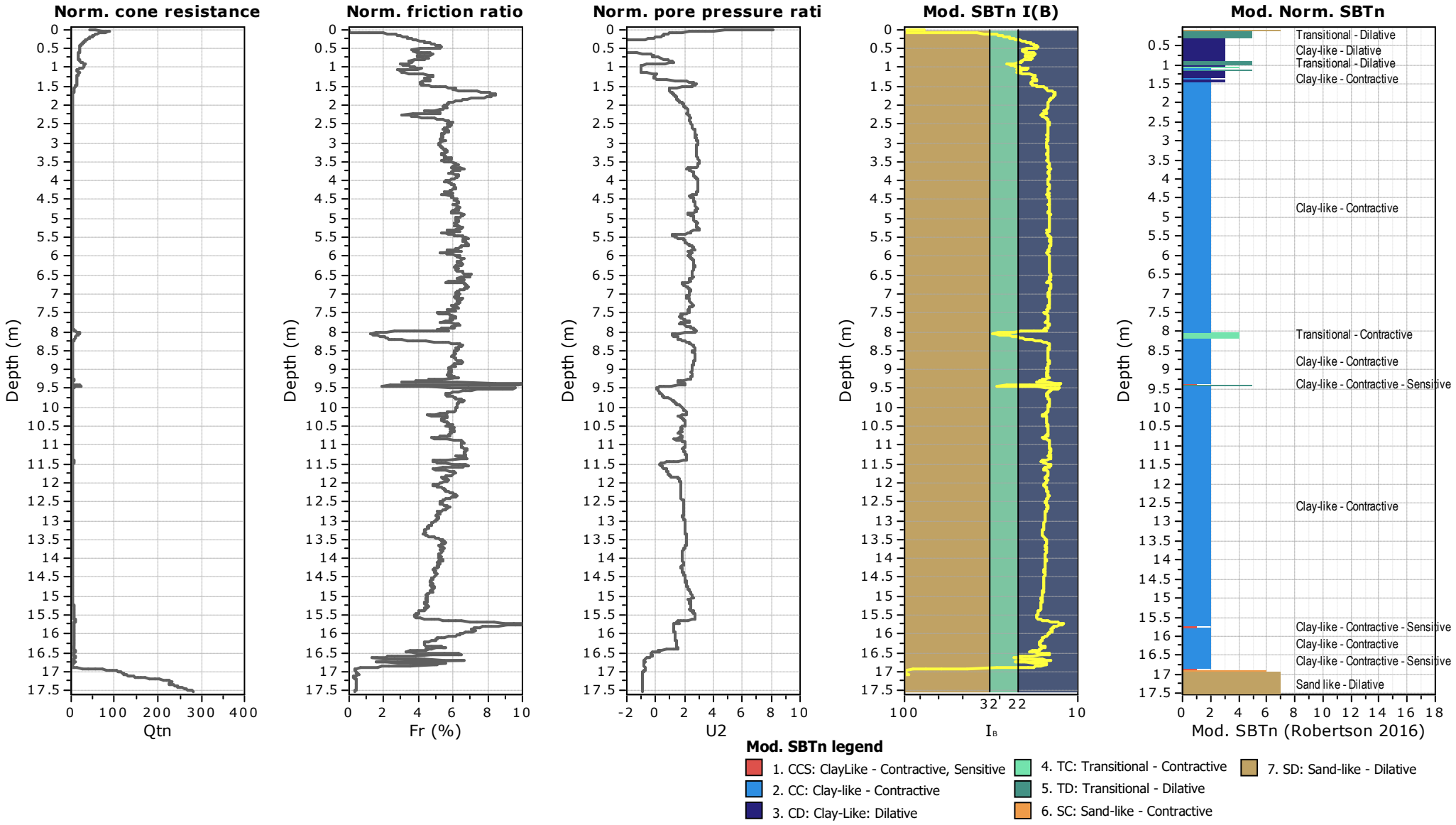
CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

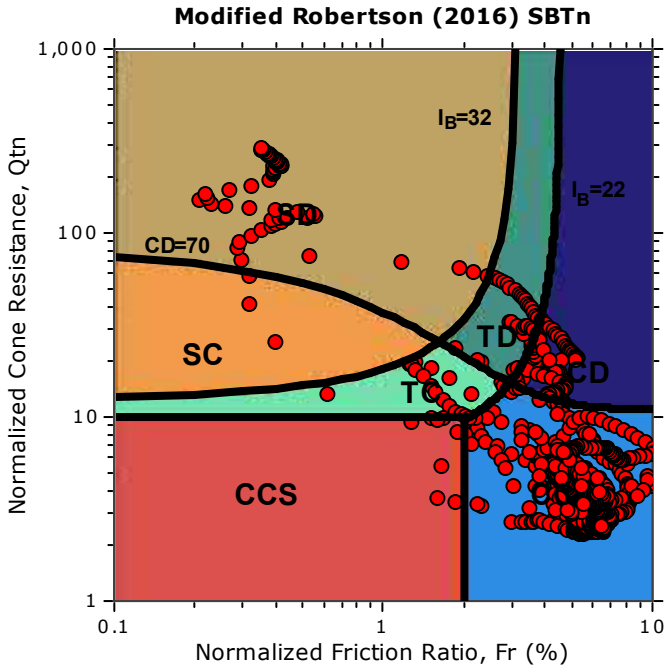


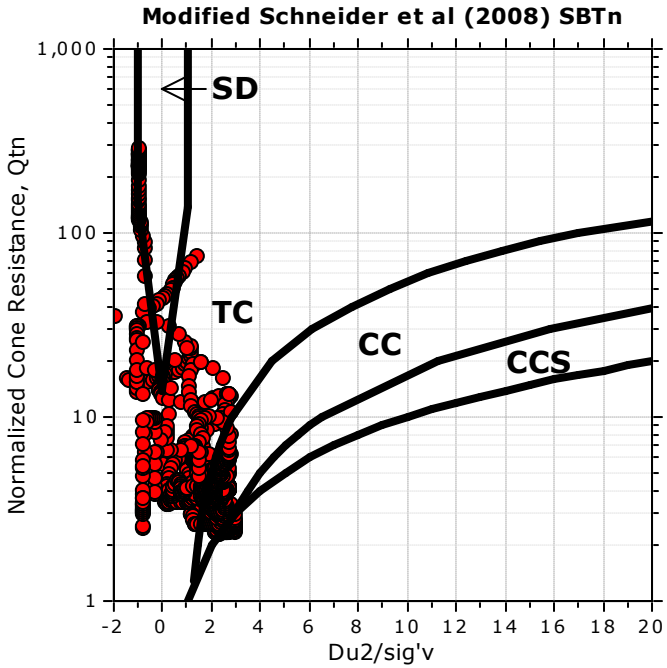
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

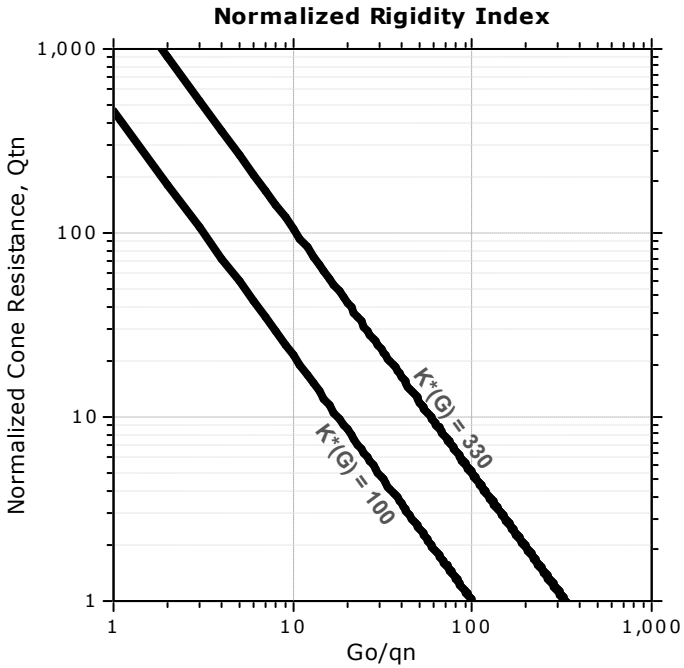
CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

Updated SBTn plots







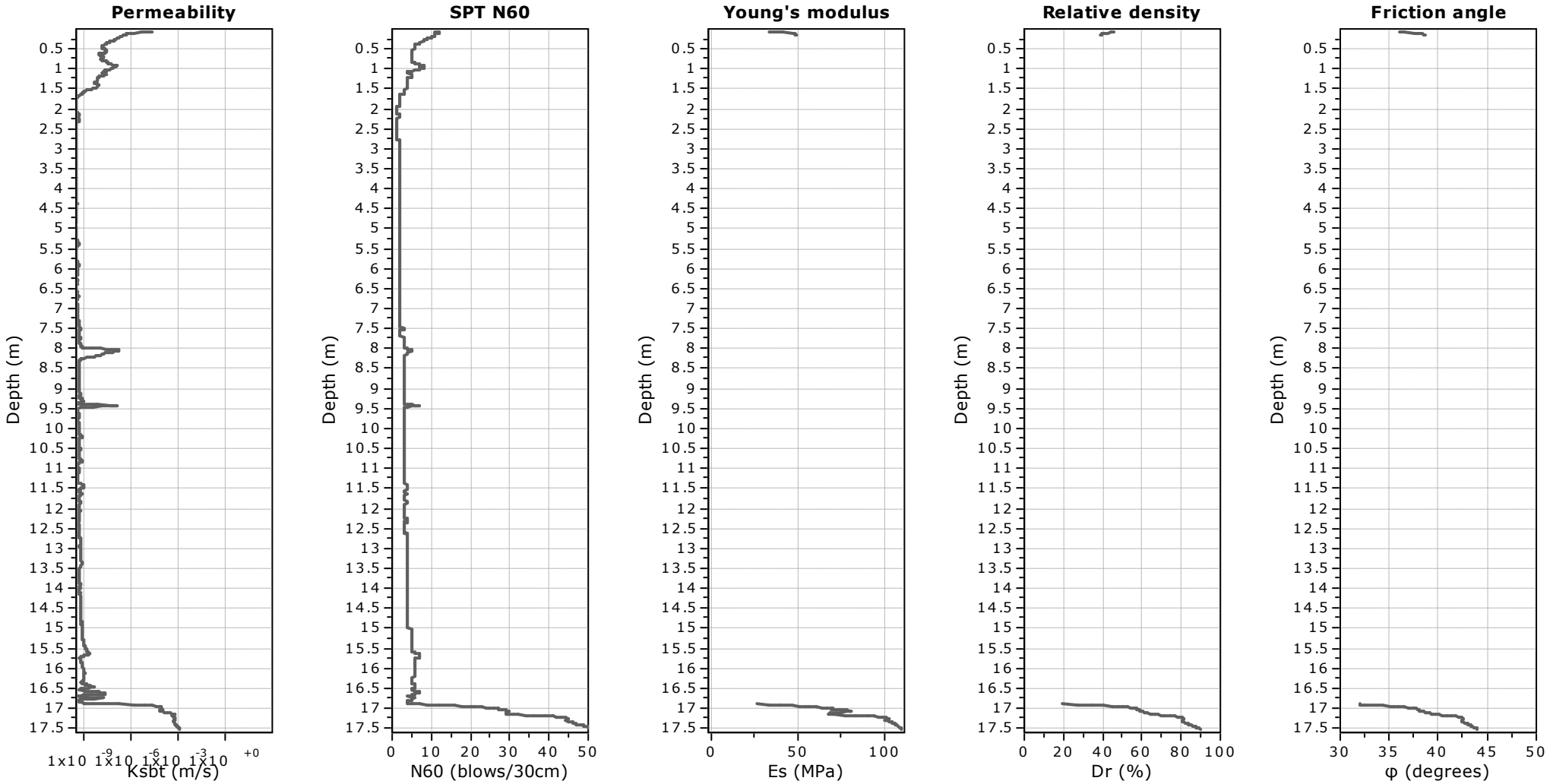
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



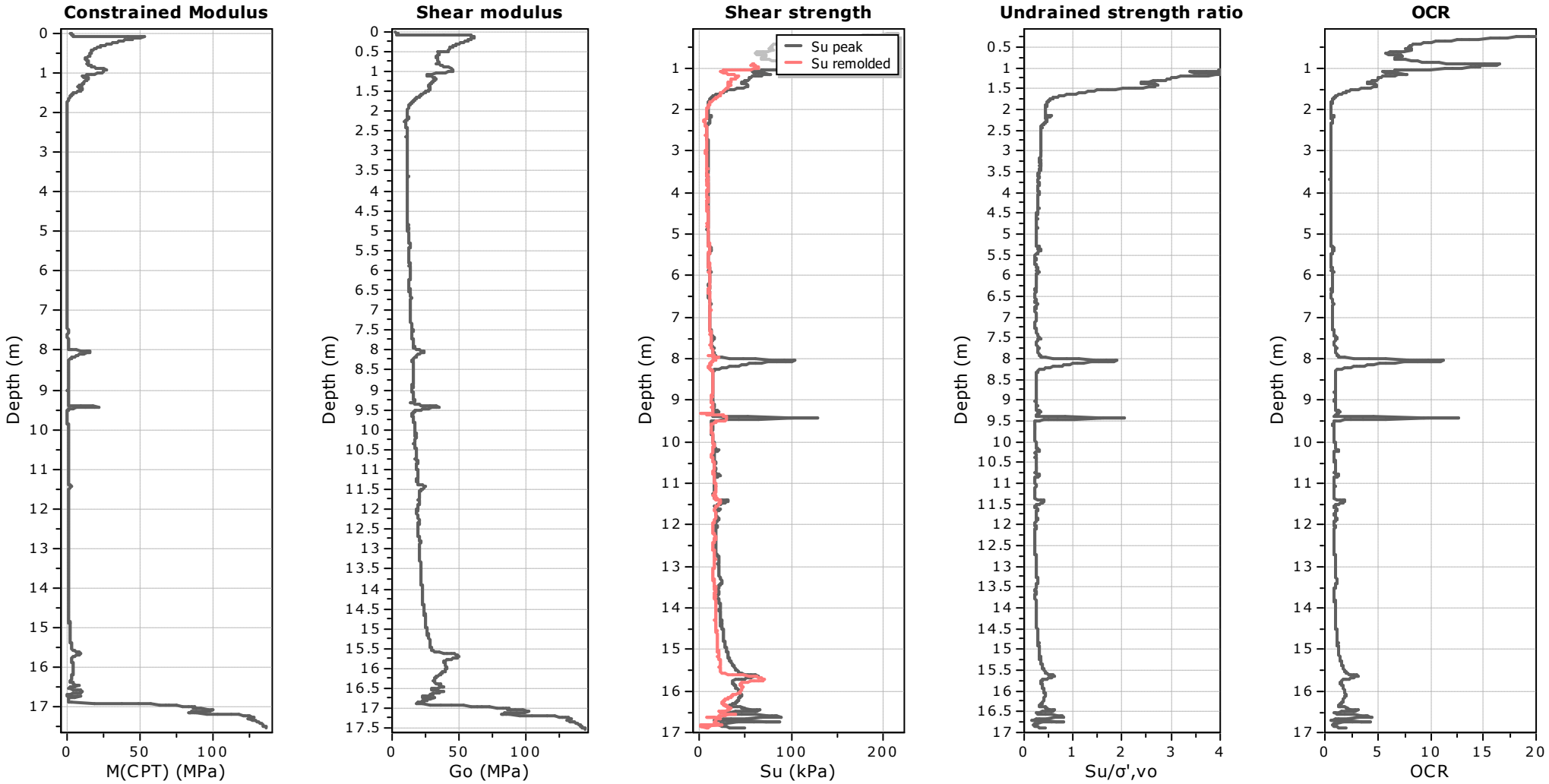
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



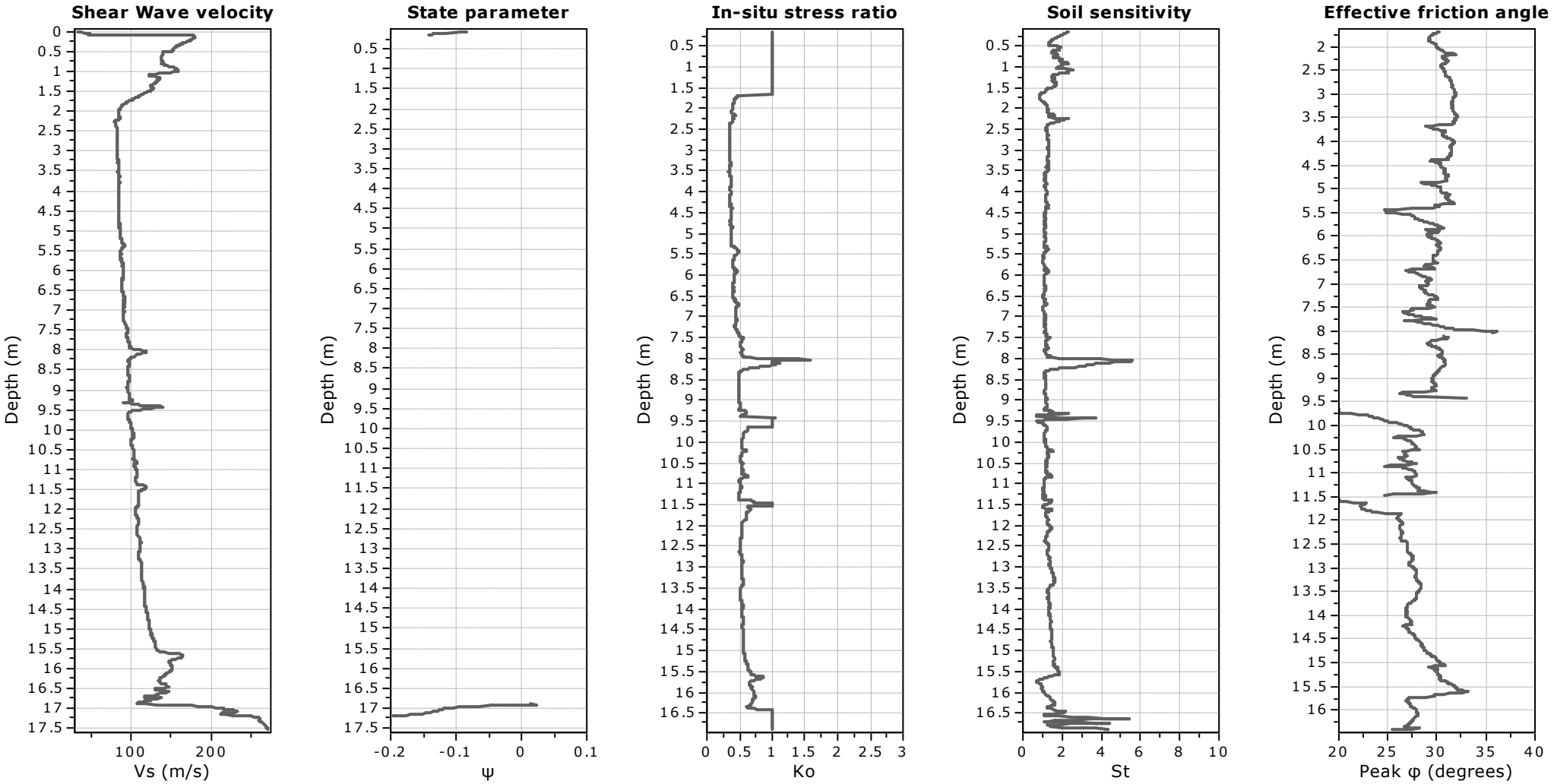
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto
OCR factor for clays, N_{kt}: Auto
Flat Dilatometer Test data

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



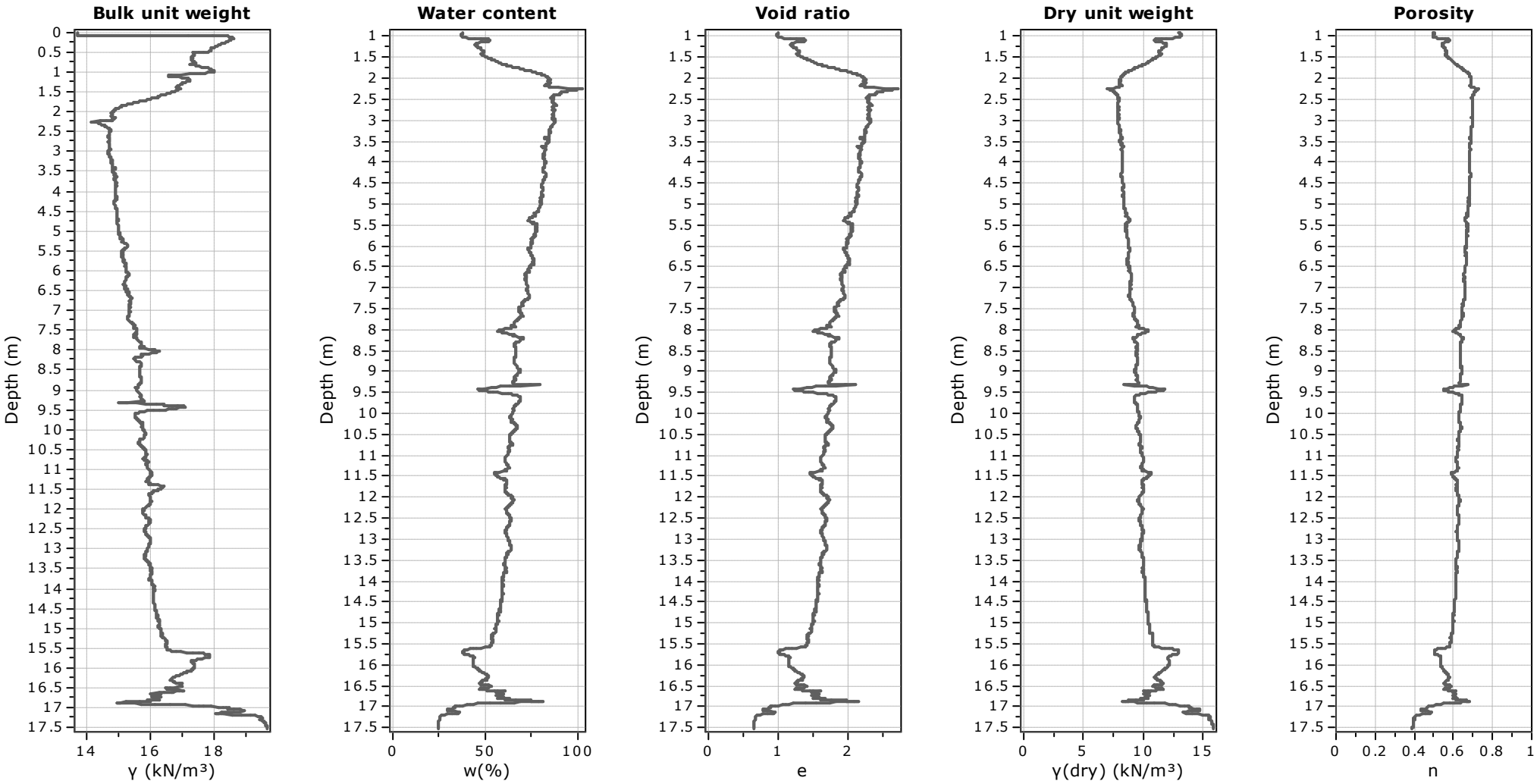
Calculation parameters

Soil Sensitivity factor, N_S: 7.00

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

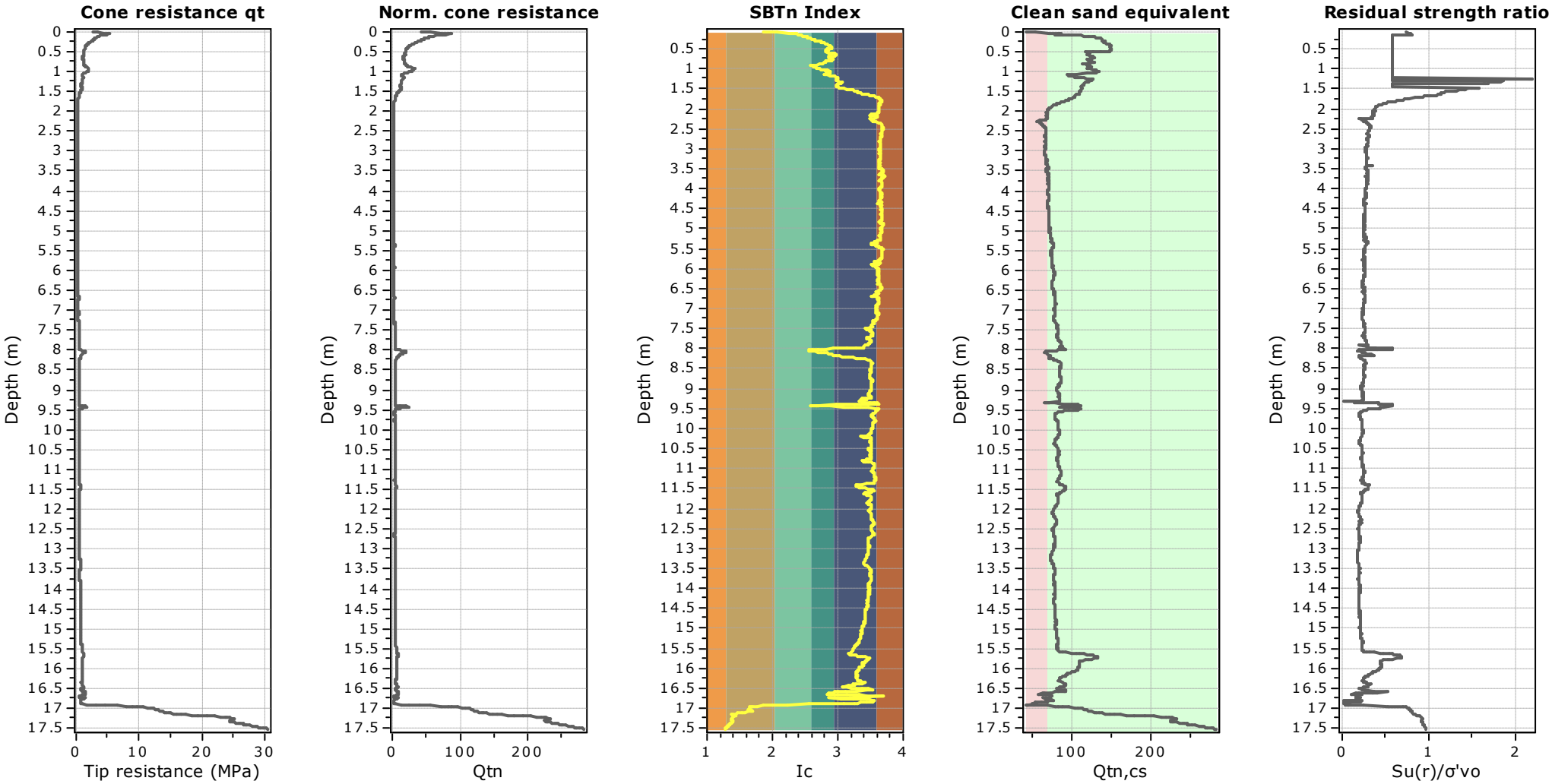
CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

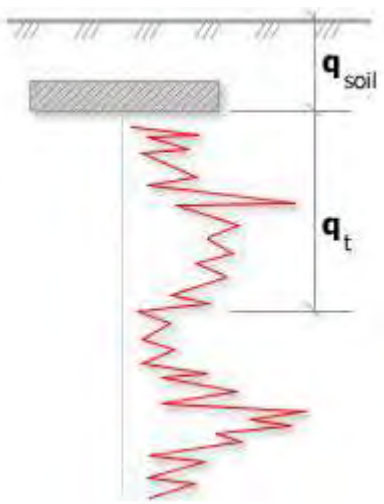
CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

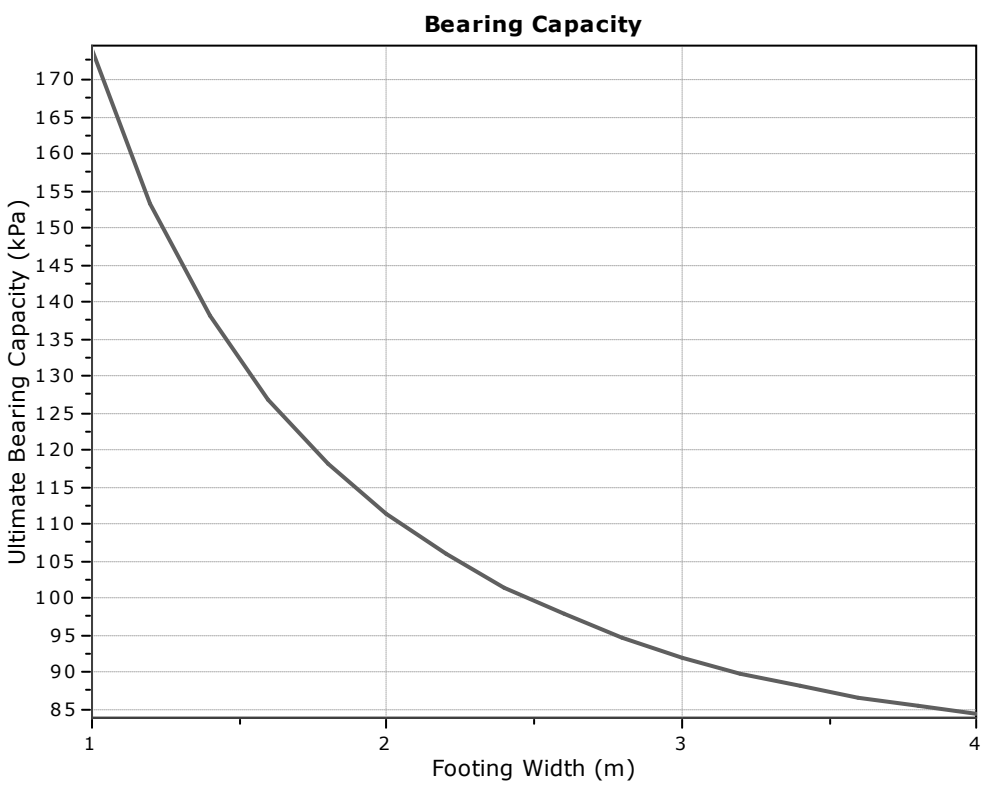
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



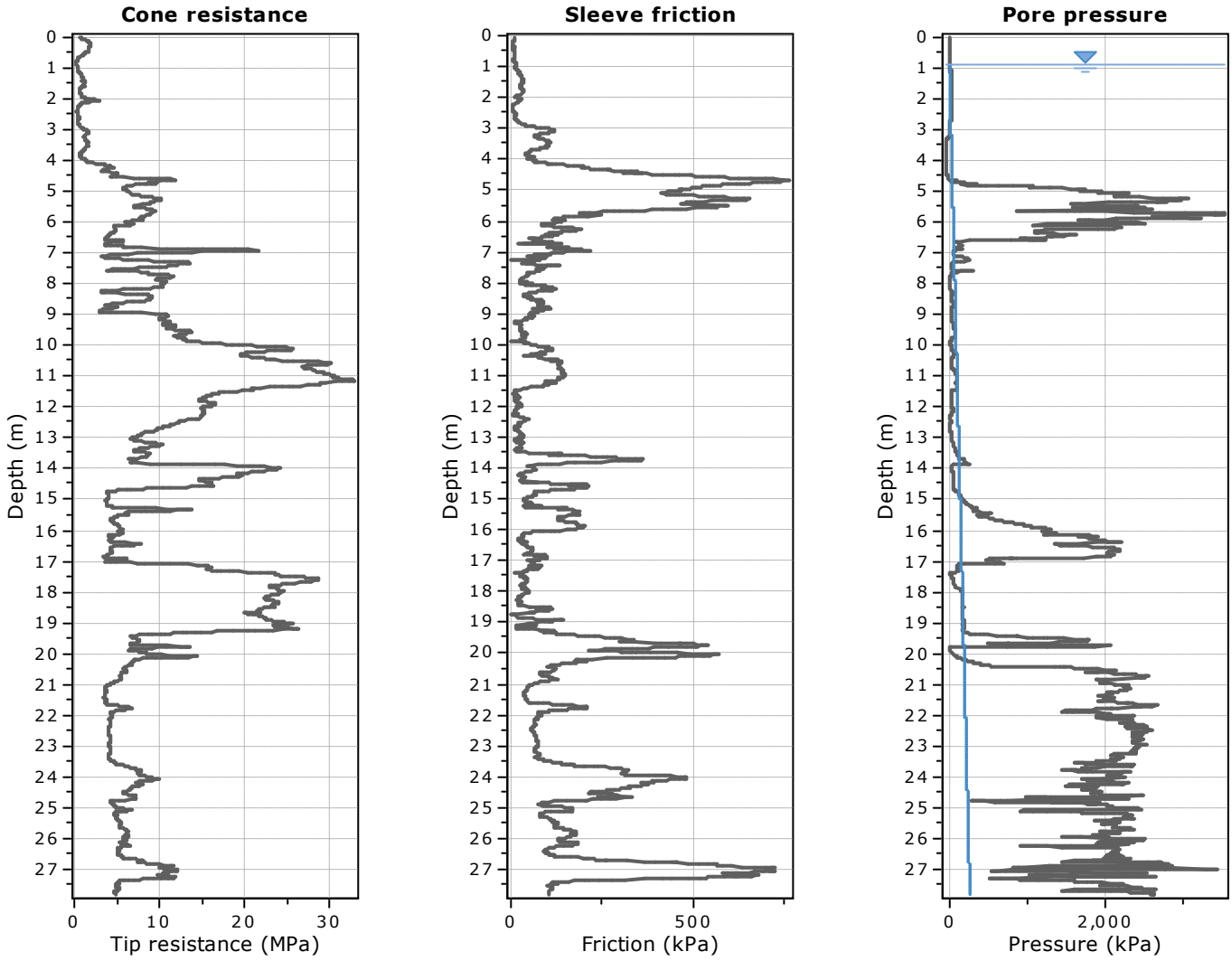
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	0.82	0.20	9.50	174.12
2	1.20	0.50	2.30	0.72	0.20	9.50	153.41
3	1.40	0.50	2.60	0.64	0.20	9.50	138.15
4	1.60	0.50	2.90	0.59	0.20	9.50	126.84
5	1.80	0.50	3.20	0.54	0.20	9.50	118.19
6	2.00	0.50	3.50	0.51	0.20	9.50	111.47
7	2.20	0.50	3.80	0.48	0.20	9.50	105.97
8	2.40	0.50	4.10	0.46	0.20	9.50	101.52
9	2.60	0.50	4.40	0.44	0.20	9.50	97.82
10	2.80	0.50	4.70	0.43	0.20	9.50	94.69
11	3.00	0.50	5.00	0.41	0.20	9.50	92.04
12	3.20	0.50	5.30	0.40	0.20	9.50	89.90
13	3.40	0.50	5.60	0.39	0.20	9.50	88.23
14	3.60	0.50	5.90	0.39	0.20	9.50	86.71
15	3.80	0.50	6.20	0.38	0.20	9.50	85.54
16	4.00	0.50	6.50	0.37	0.20	9.50	84.42

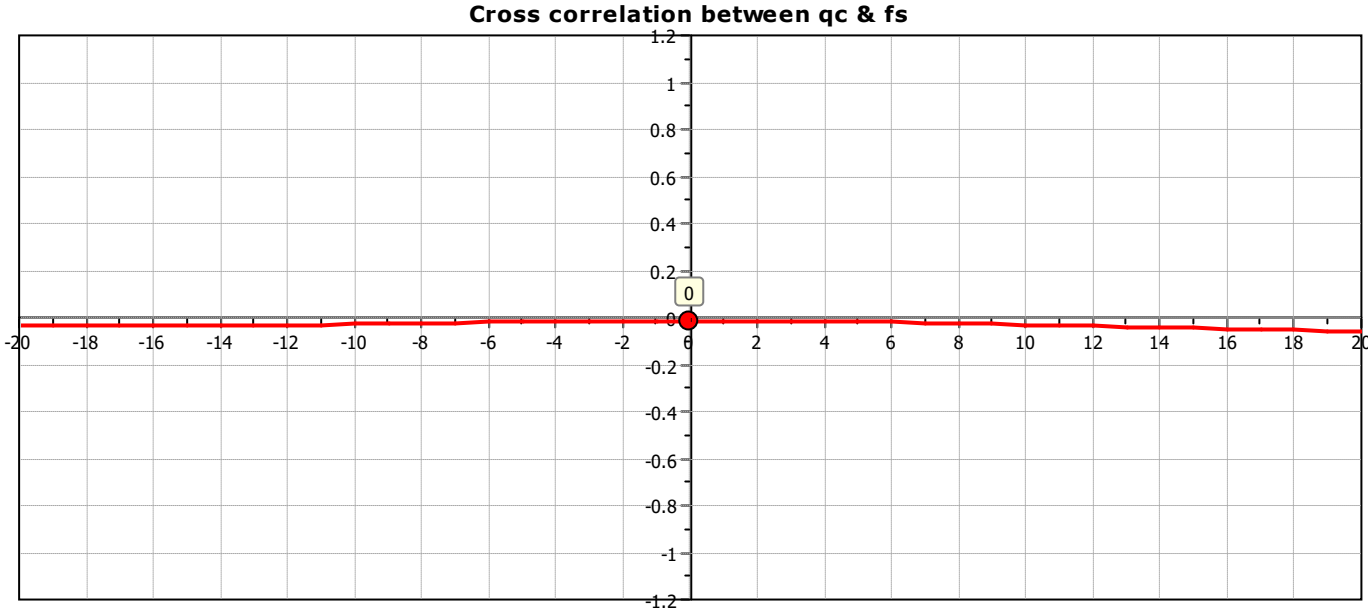
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

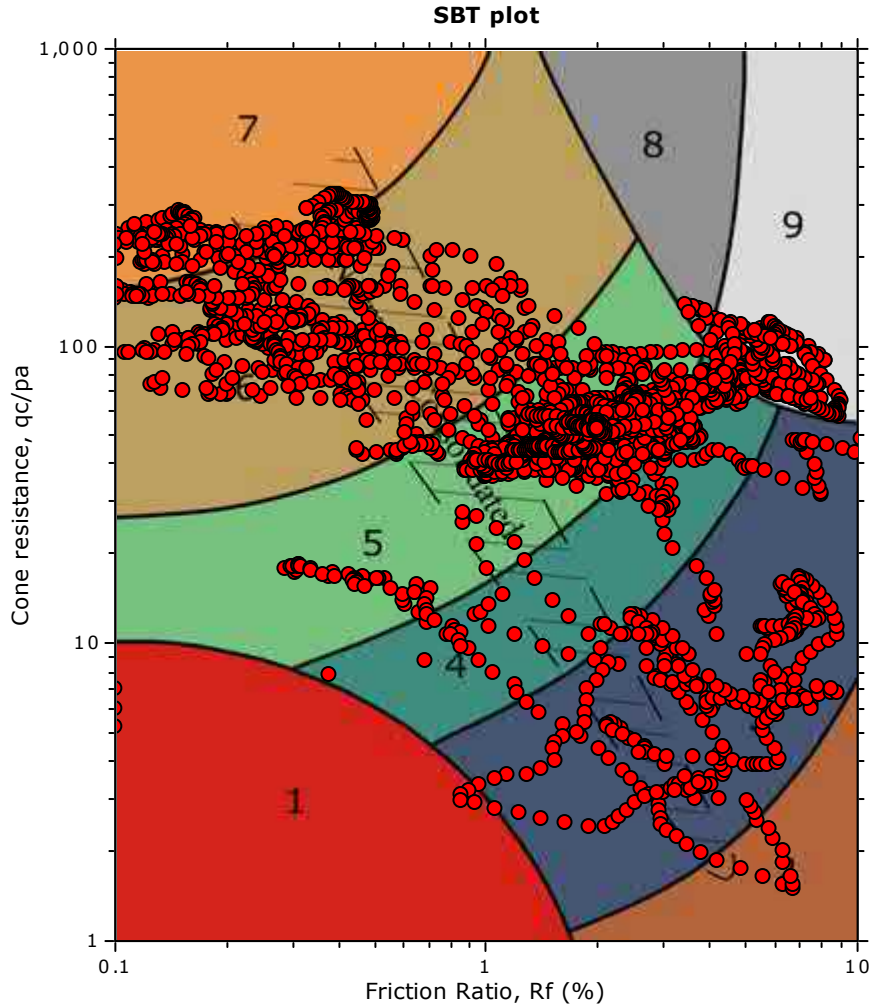


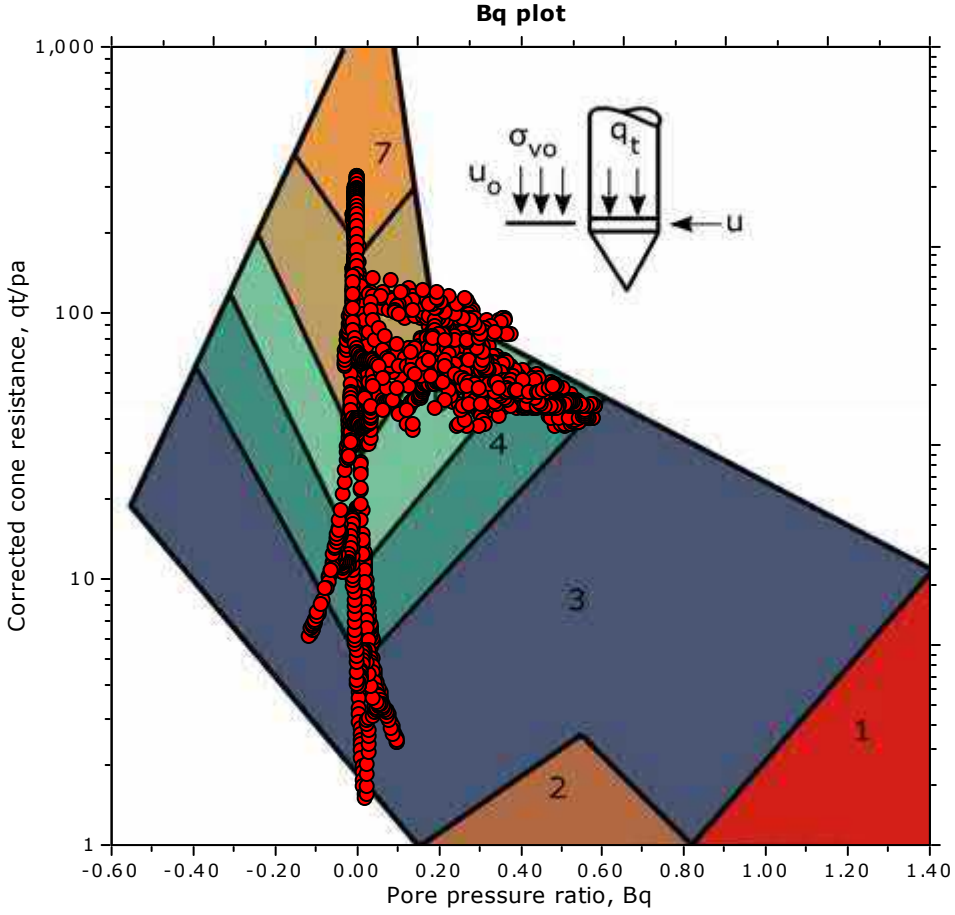
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots





SBT legend

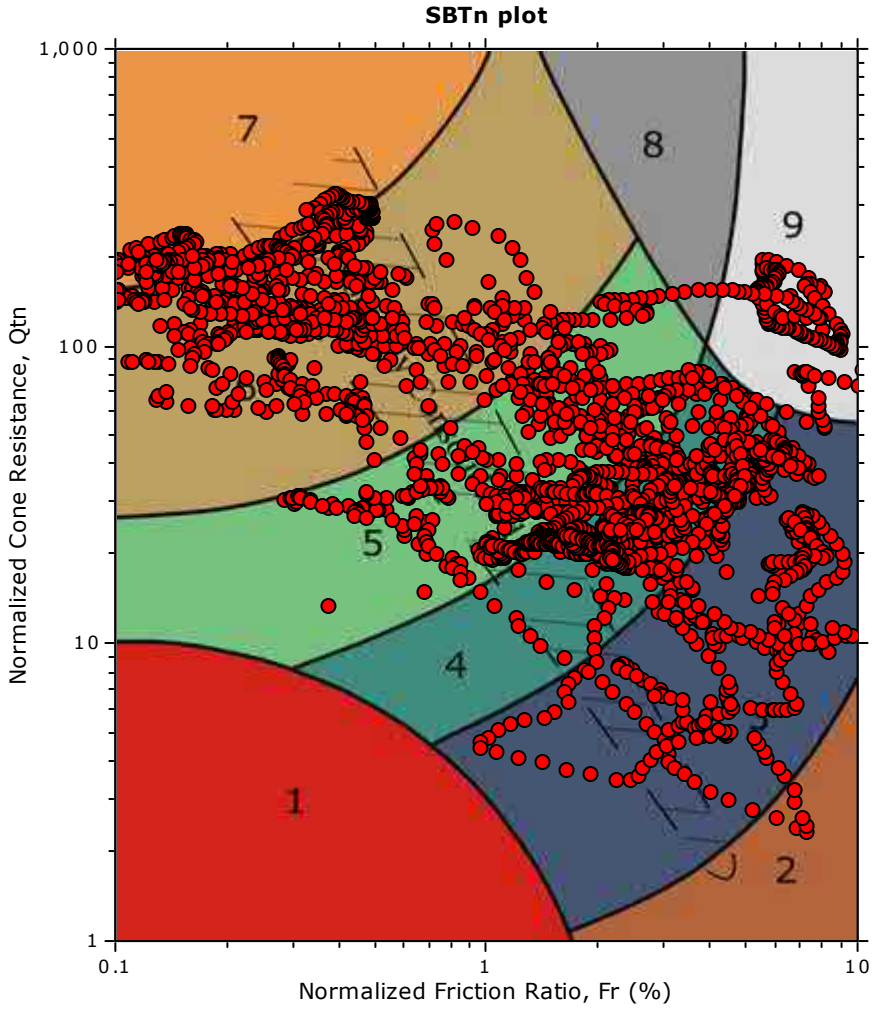
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

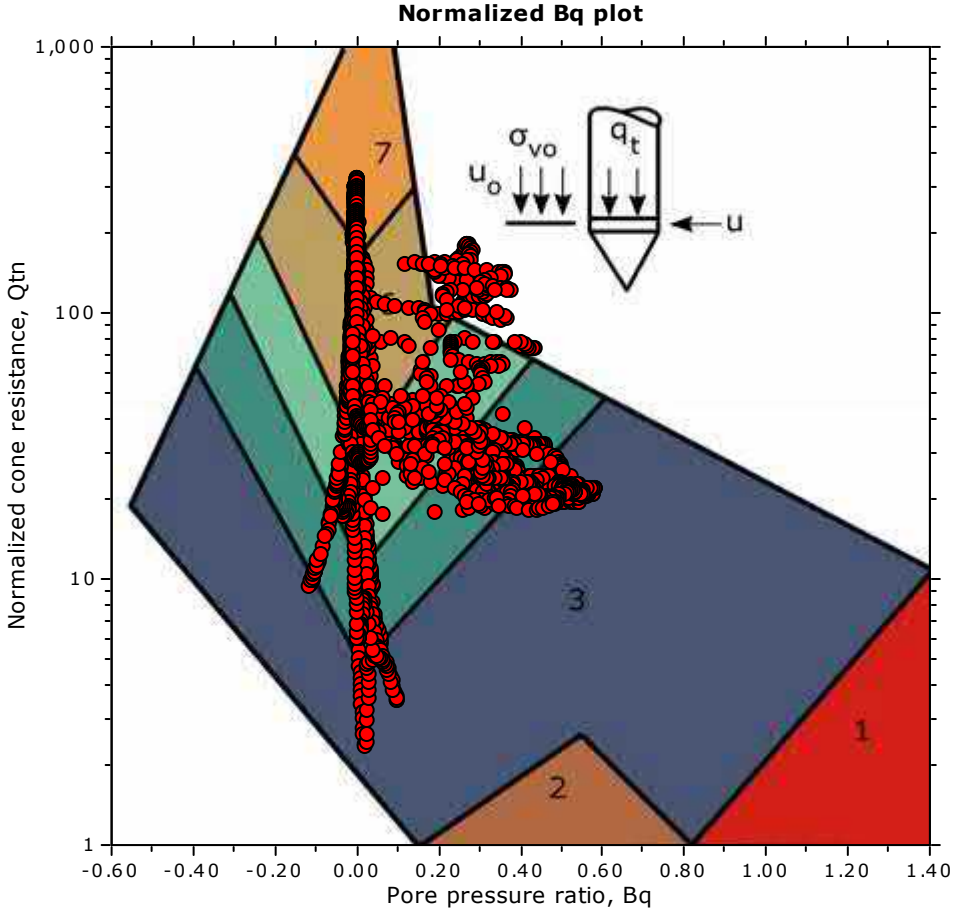
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots (normalized)





SBTn legend

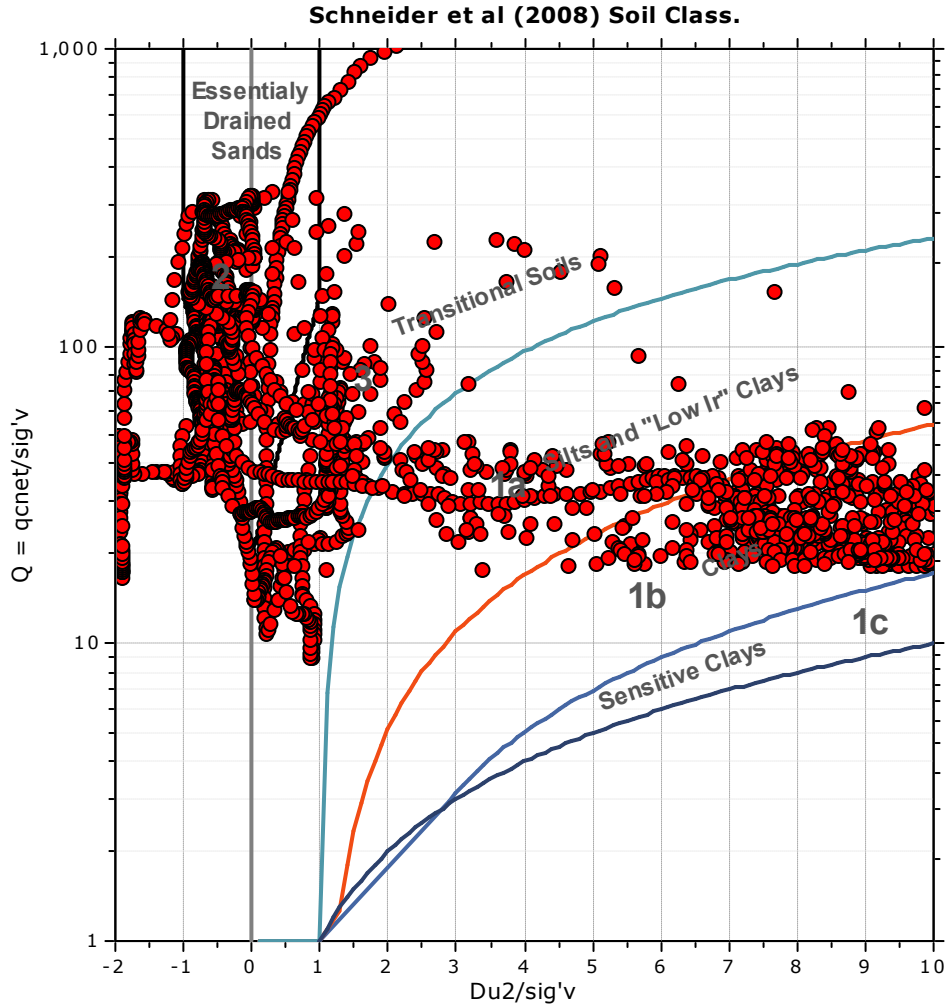
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

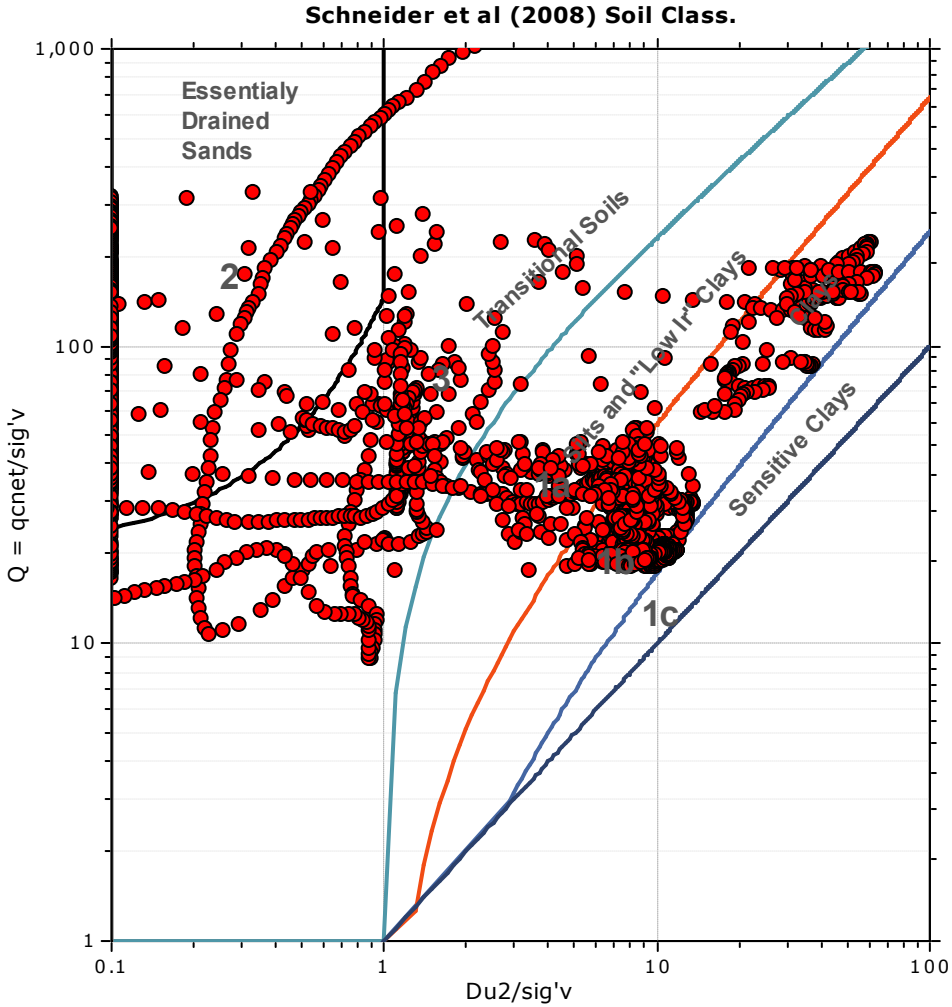
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Bq plots (Schneider)

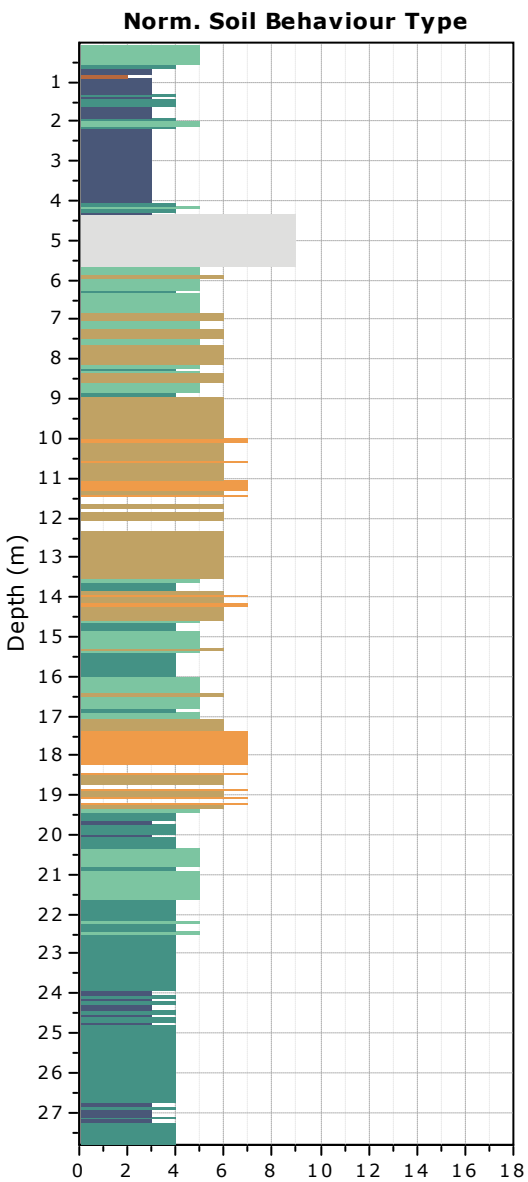


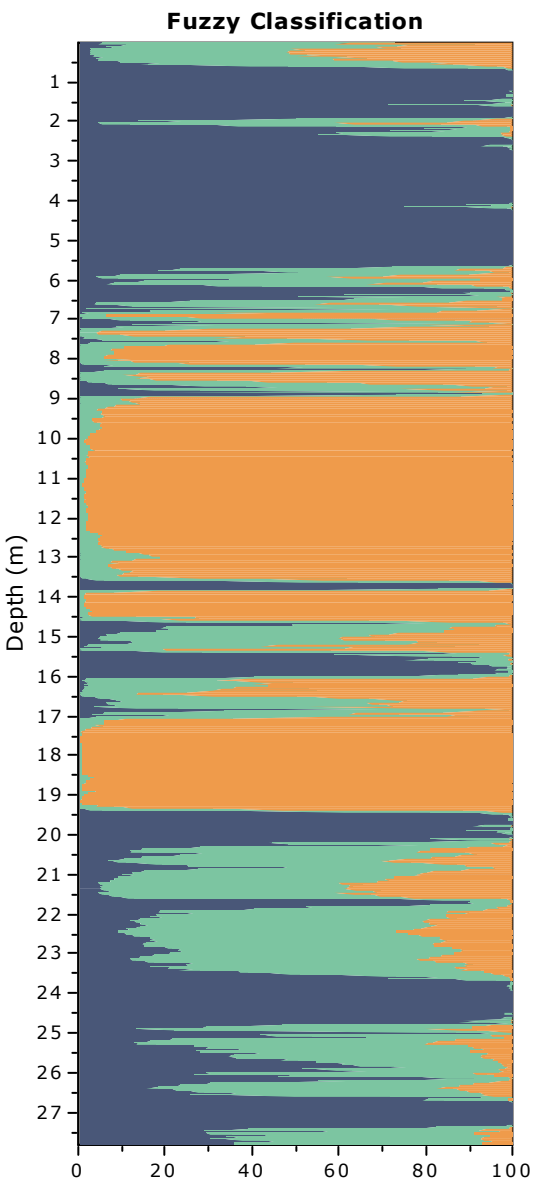


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



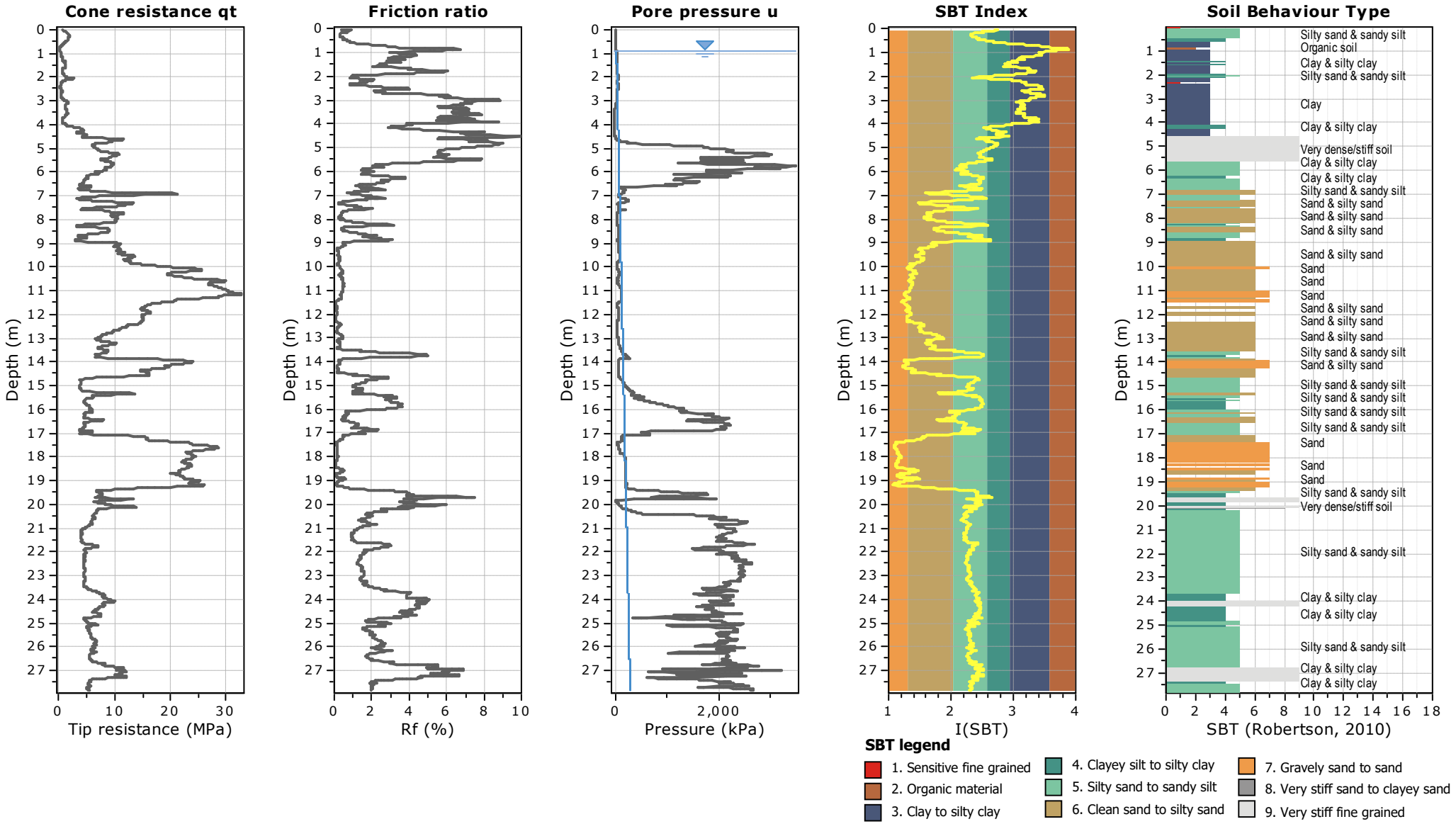


Fuzzy classifiaction legend
- Highly probable clayey soil
- Highly probable mixture soil
- Highly probable sandy soil

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

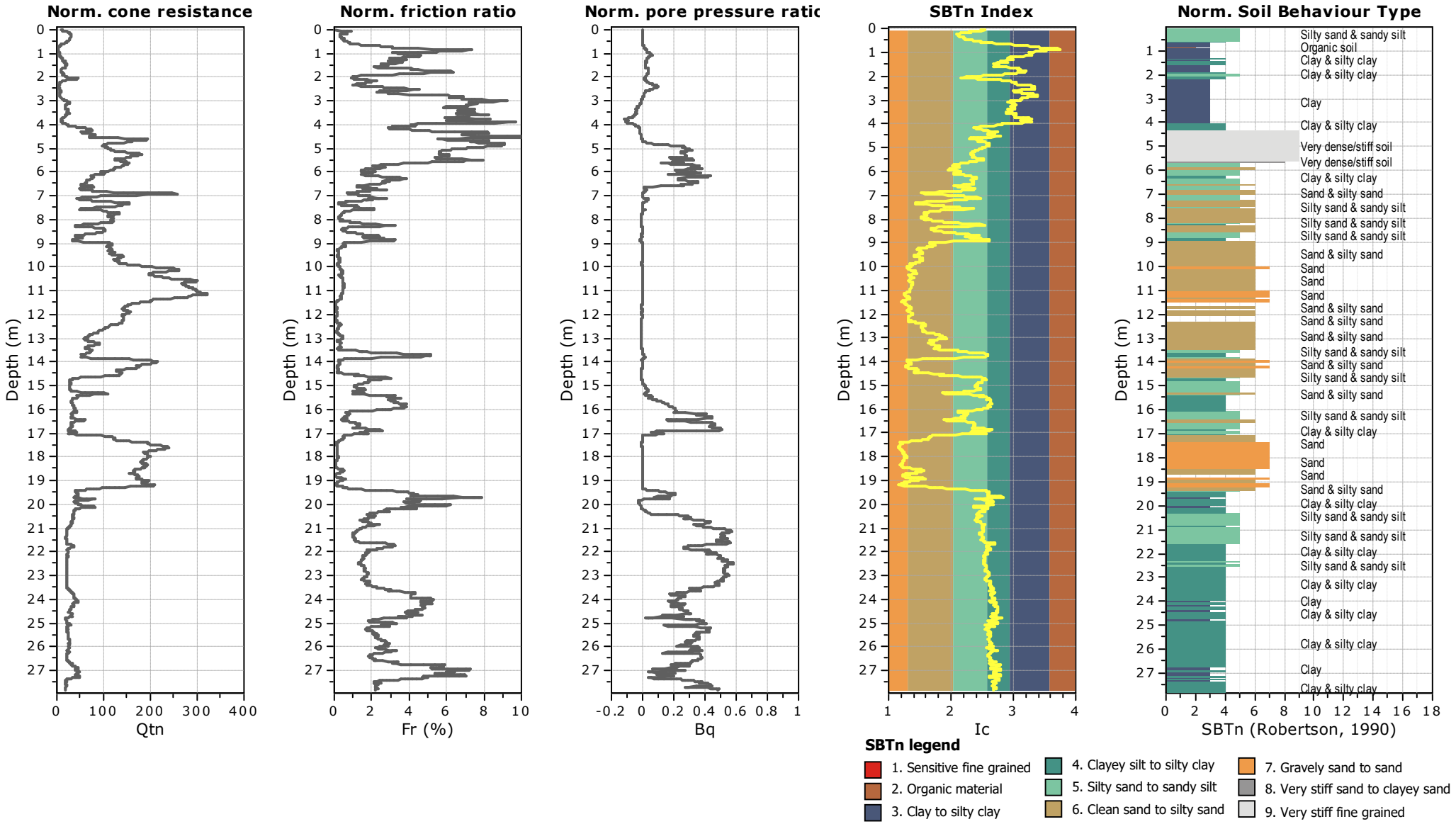
CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

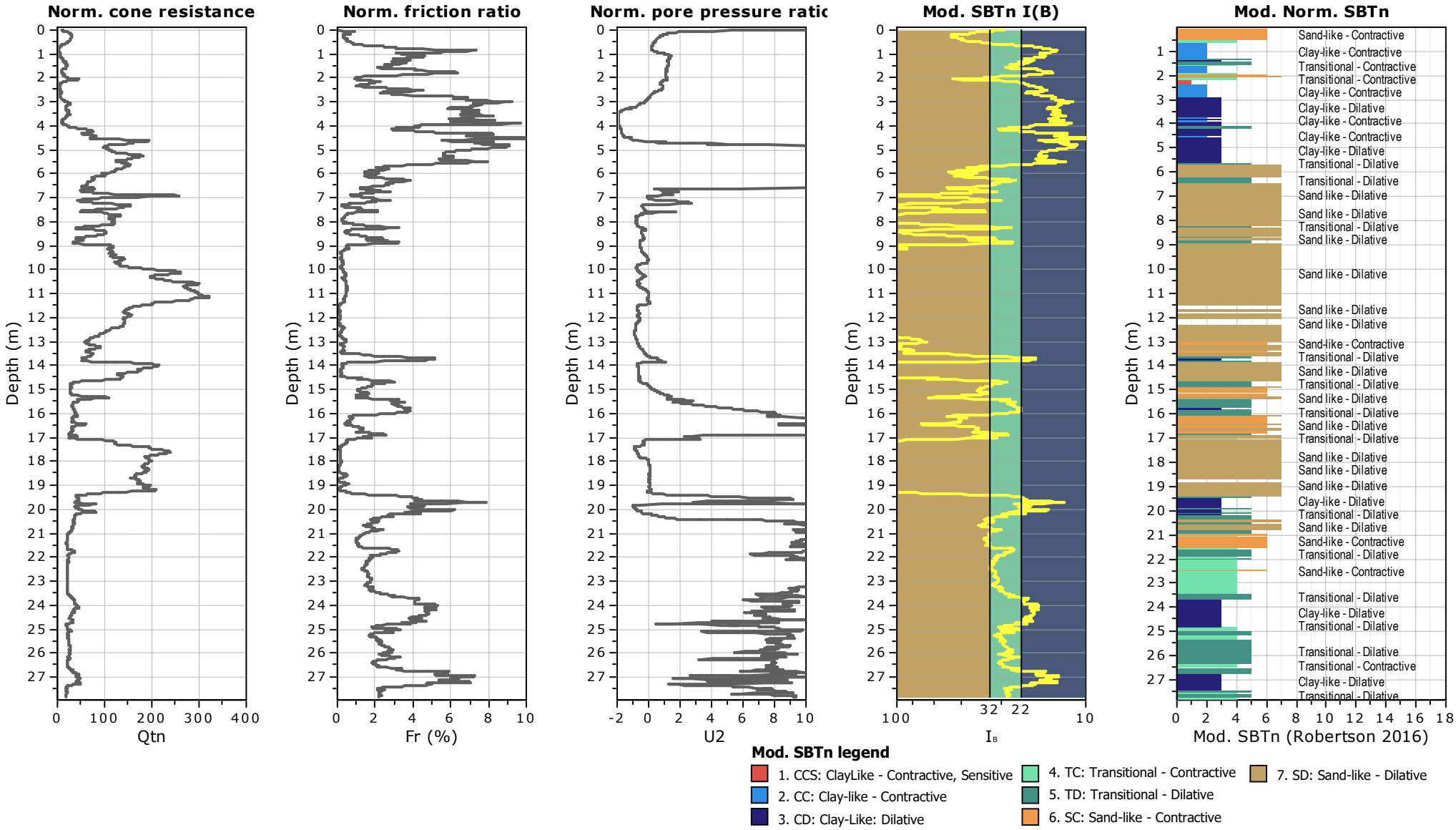
CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

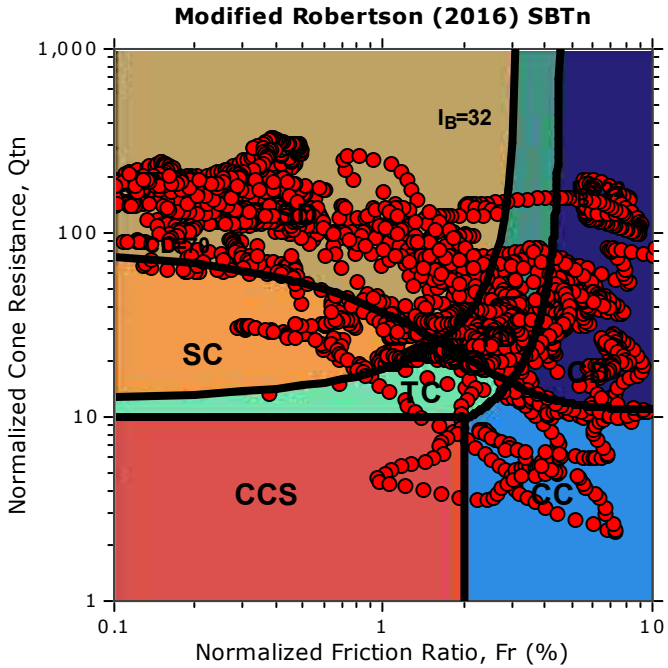


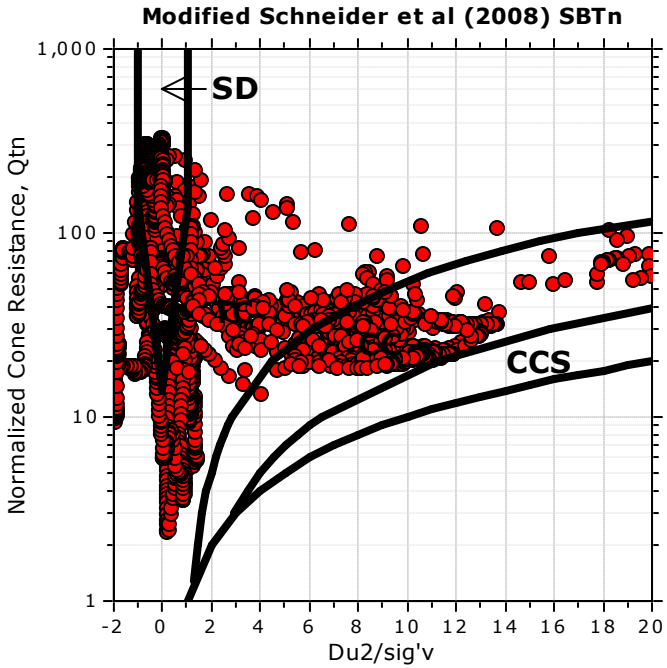
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

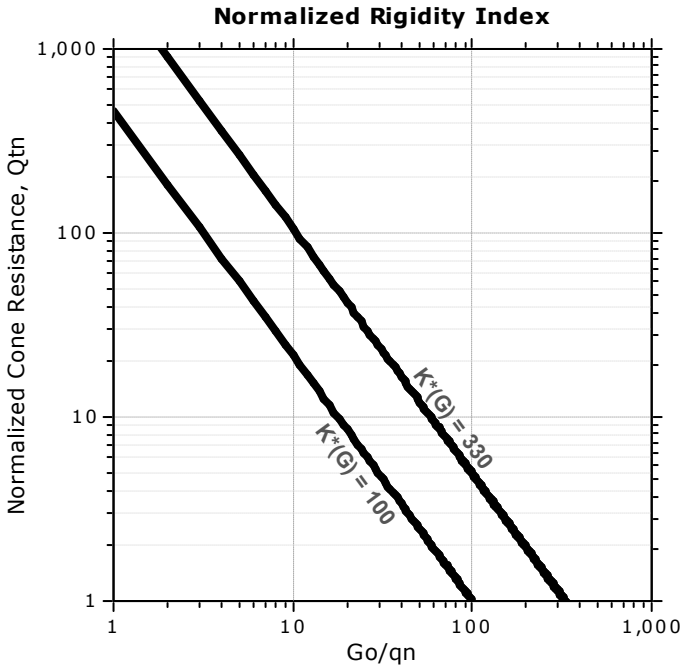
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Updated SBTn plots







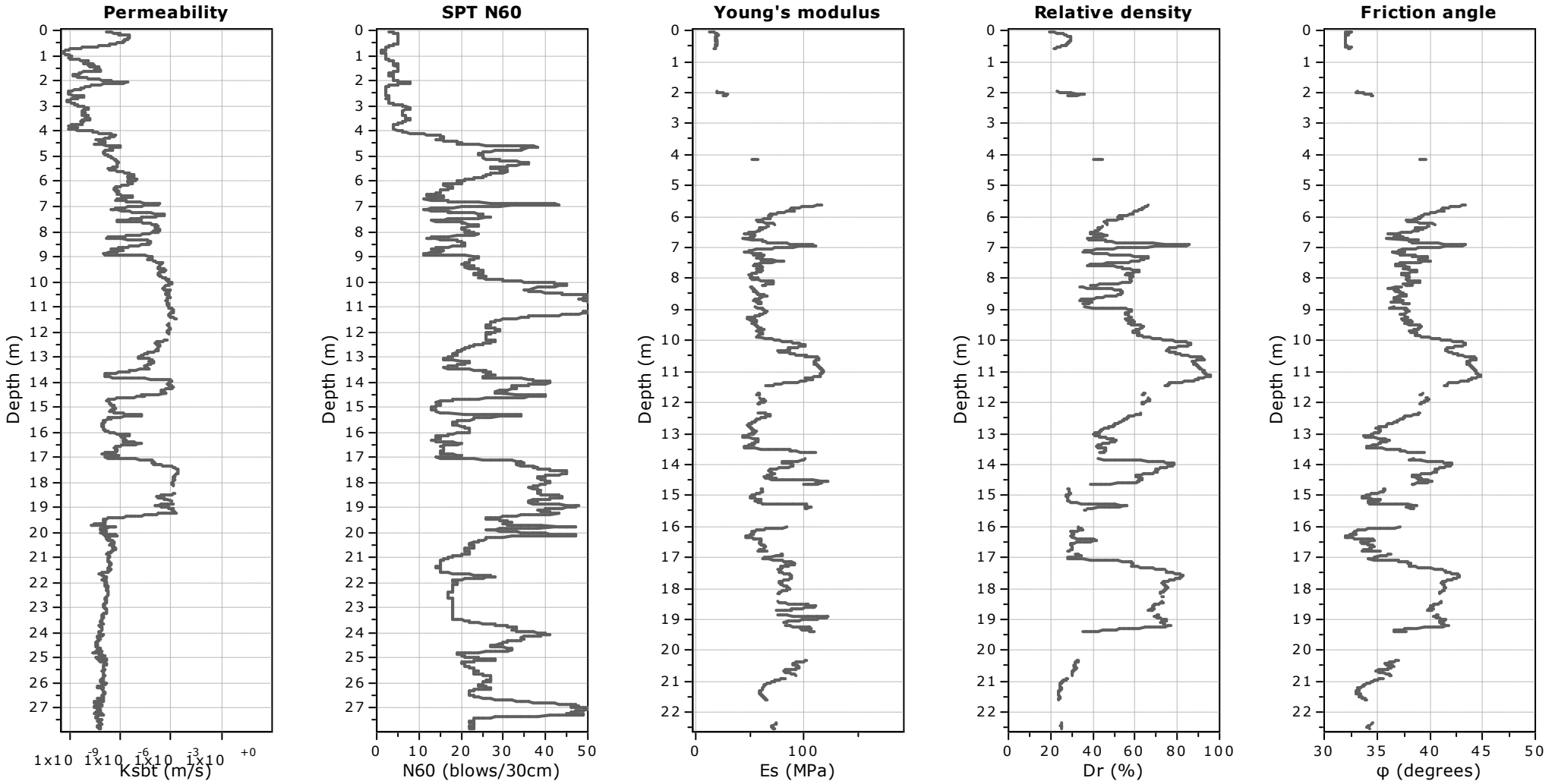
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



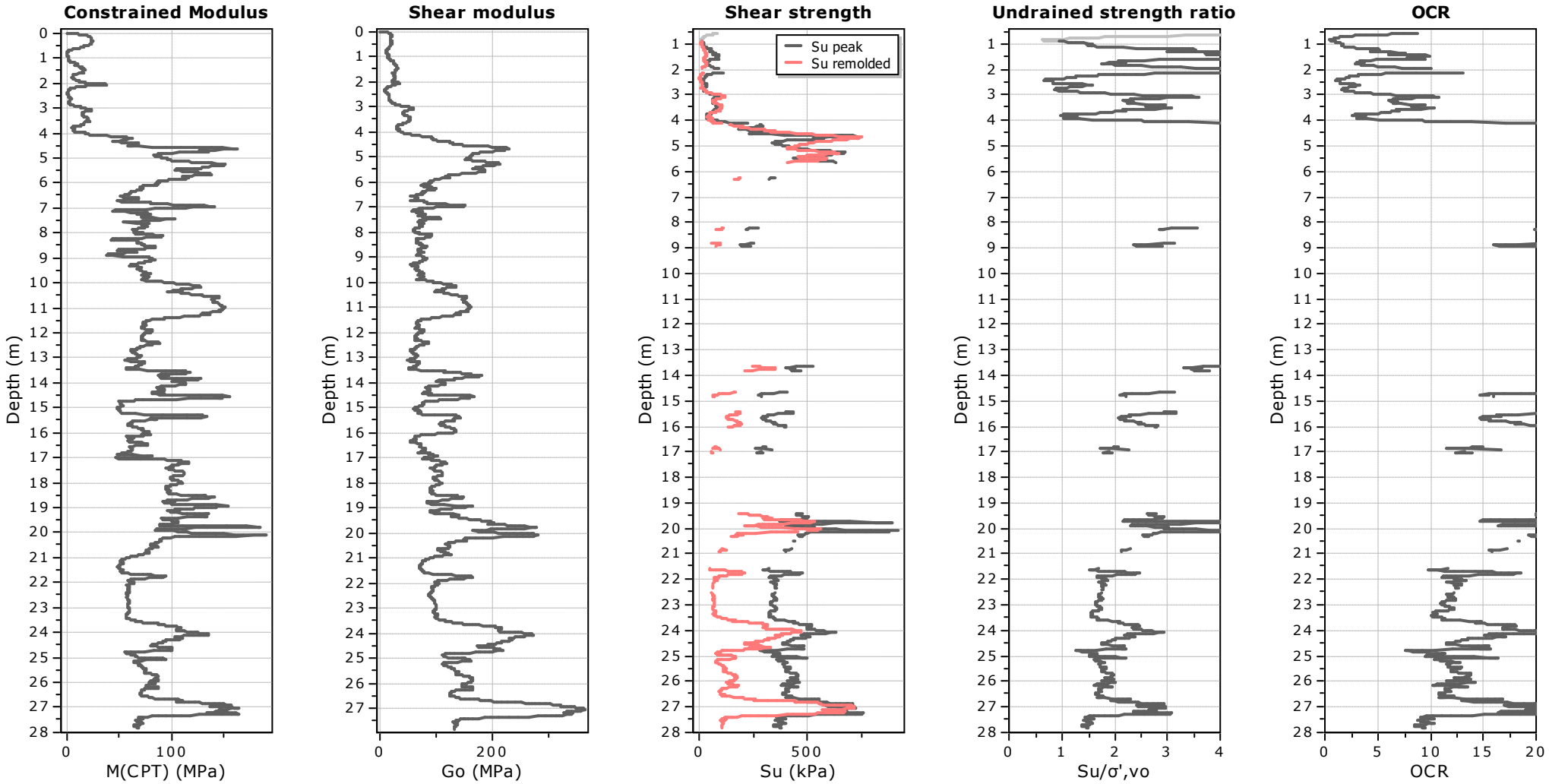
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC



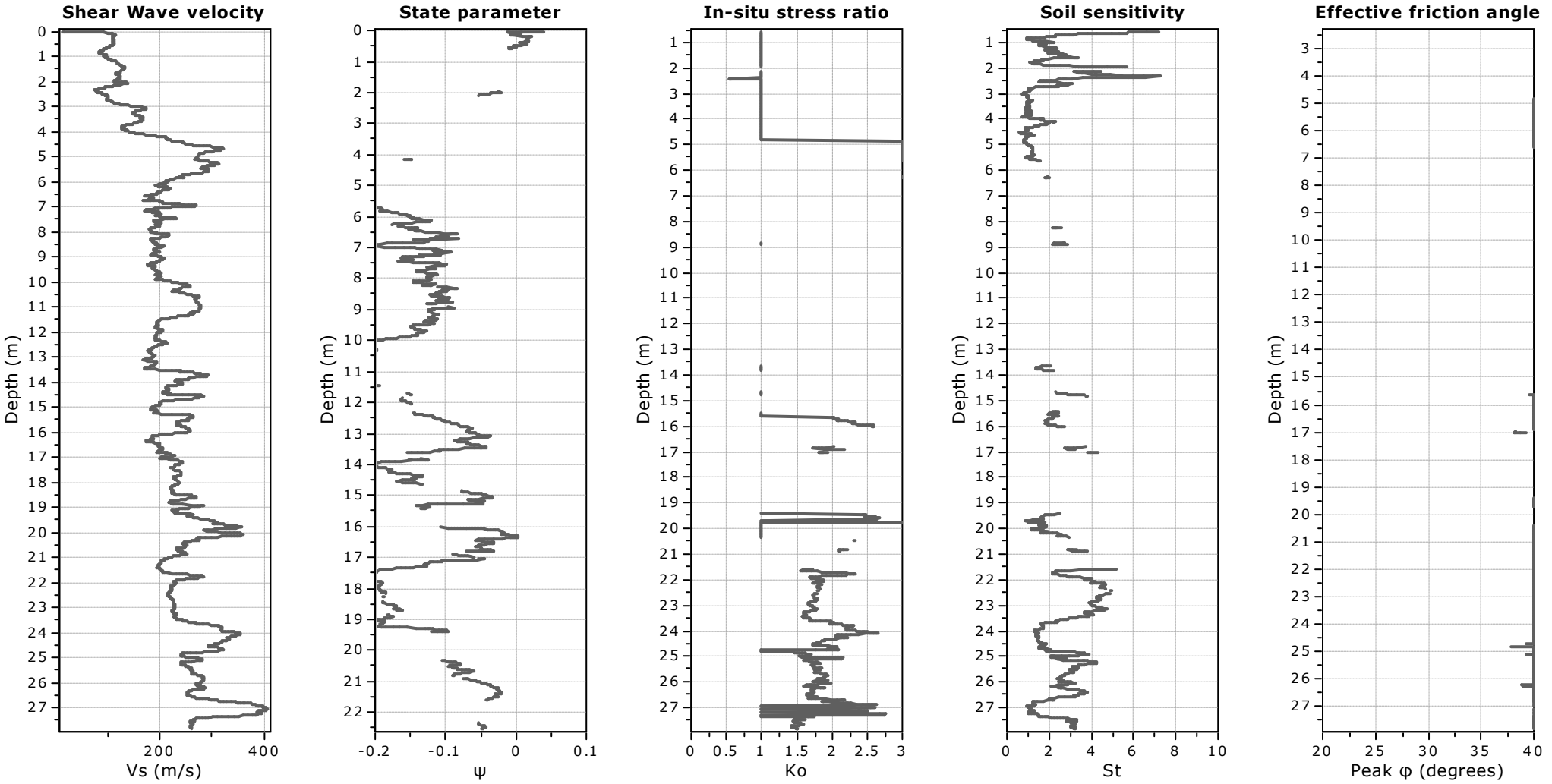
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto
OCR factor for clays, N_{kt}: Auto
Flat Dilatometer Test data

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



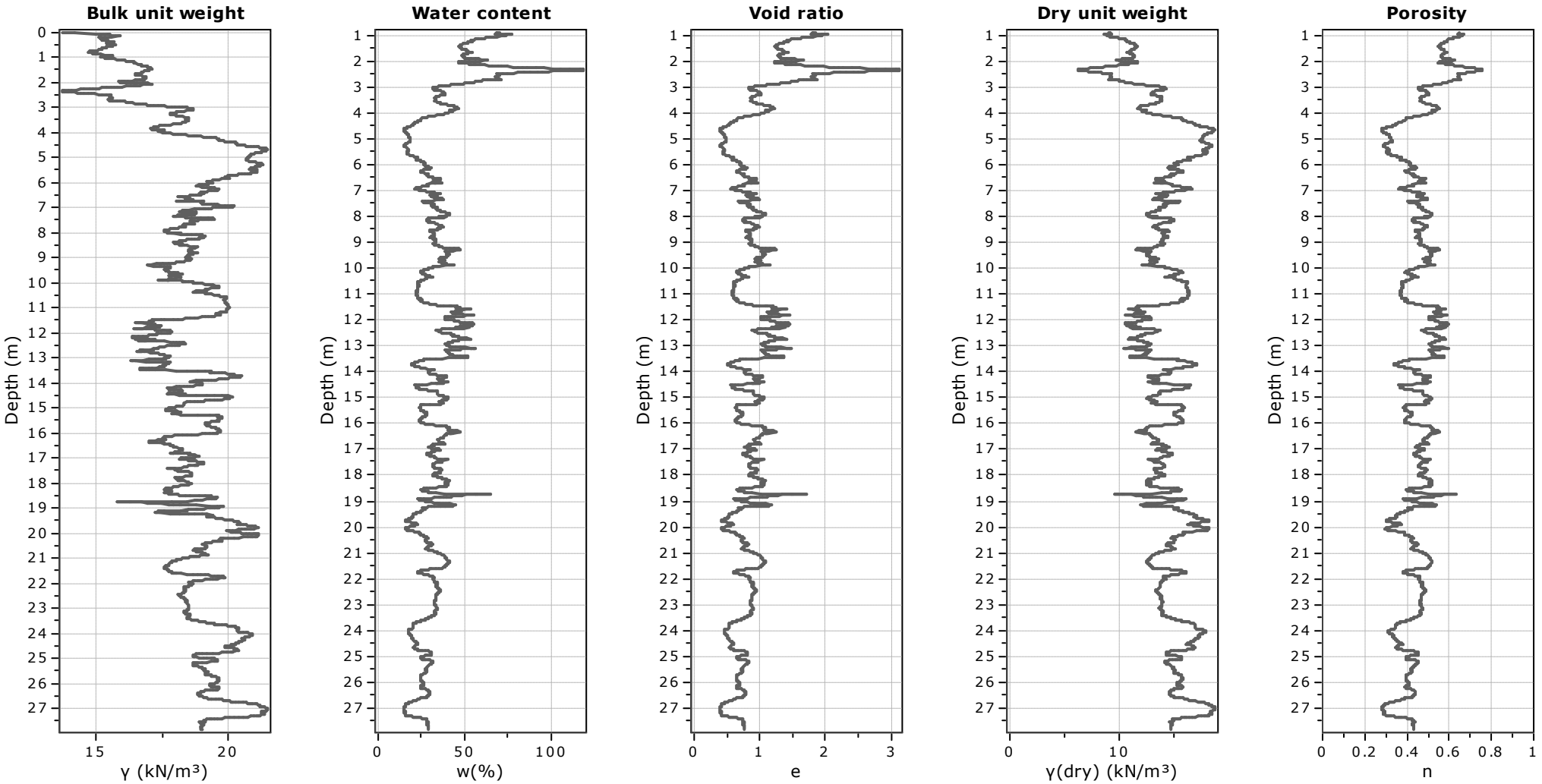
Calculation parameters

Soil Sensitivity factor, N_S: 7.00

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

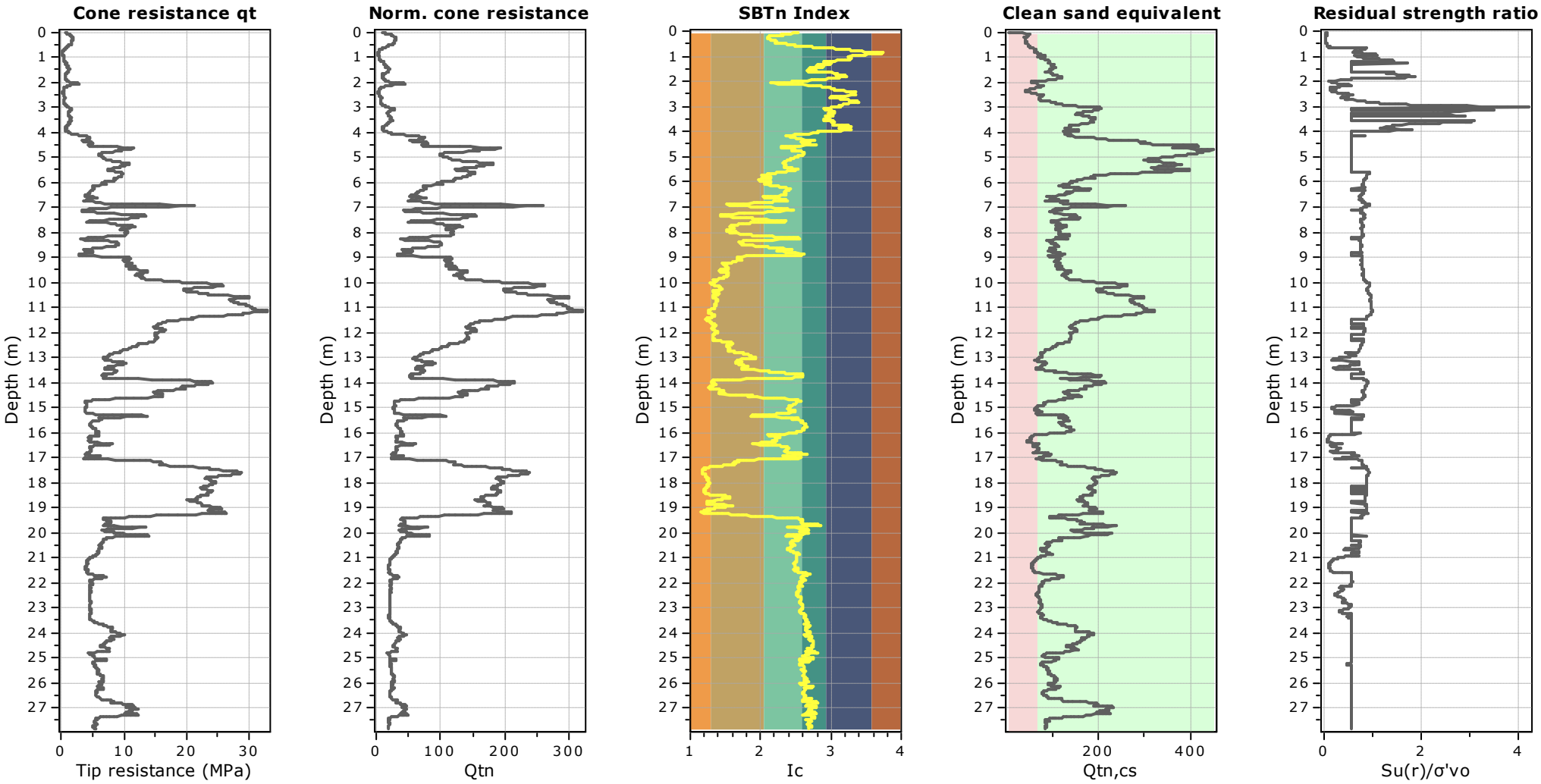
CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

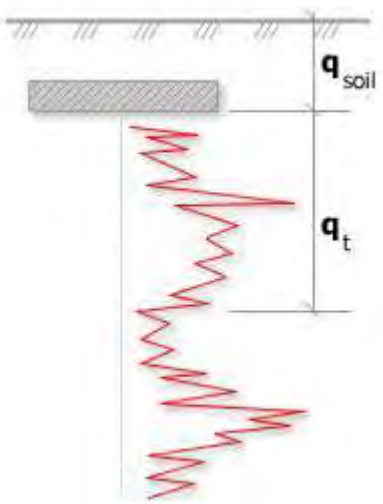
CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

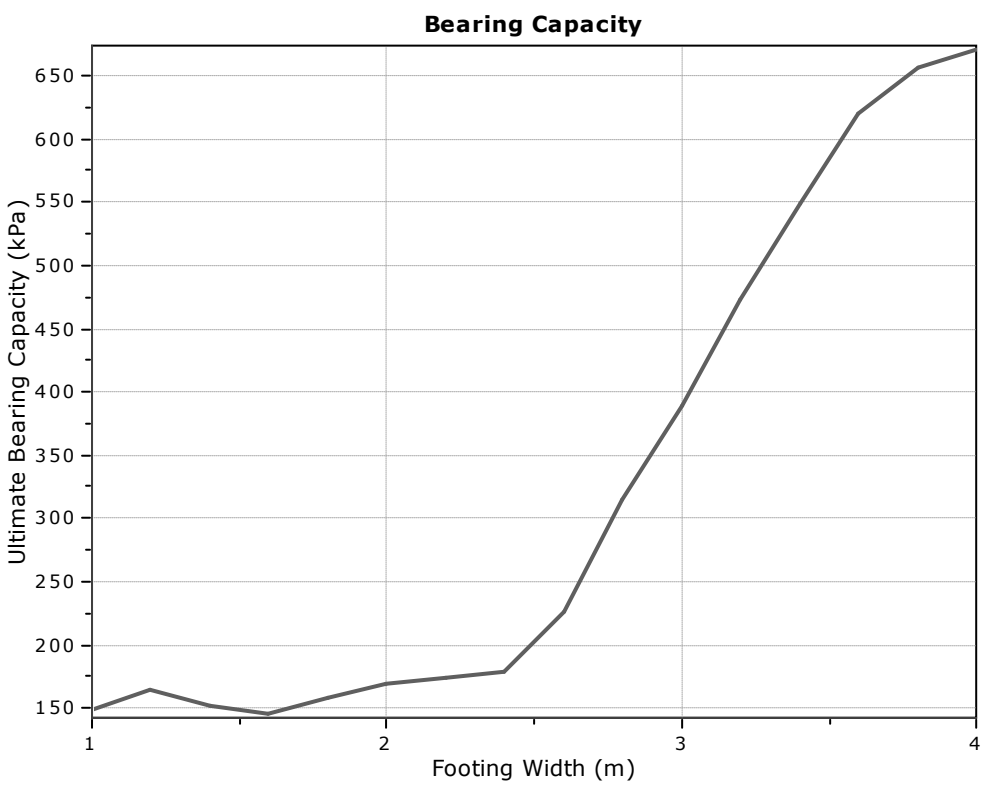
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	0.69	0.20	9.50	148.15
2	1.20	0.50	2.30	0.77	0.20	9.50	164.14
3	1.40	0.50	2.60	0.71	0.20	9.50	151.57
4	1.60	0.50	2.90	0.68	0.20	9.50	145.68
5	1.80	0.50	3.20	0.74	0.20	9.50	158.02
6	2.00	0.50	3.50	0.80	0.20	9.50	168.85
7	2.20	0.50	3.80	0.82	0.20	9.50	174.33
8	2.40	0.50	4.10	0.85	0.20	9.50	179.68
9	2.60	0.50	4.40	1.08	0.20	9.50	226.01
10	2.80	0.50	4.70	1.53	0.20	9.50	315.56
11	3.00	0.50	5.00	1.90	0.20	9.50	388.81
12	3.20	0.50	5.30	2.32	0.20	9.50	473.45
13	3.40	0.50	5.60	2.69	0.20	9.50	548.22
14	3.60	0.50	5.90	3.05	0.20	9.50	619.87
15	3.80	0.50	6.20	3.24	0.20	9.50	656.50
16	4.00	0.50	6.50	3.31	0.20	9.50	670.72

Presented below is a list of formulas used for the estimation of various soil properties. The formulas are presented in SI unit system and assume that all components are expressed in the same units.

:: Unit Weight, g (kN/m³) ::

$$g = g_w \cdot \left(0.27 \cdot \log(R_f) + 0.36 \cdot \log(\frac{q_t}{p_a}) + 1.236 \right)$$

where g_w = water unit weight

:: Permeability, k (m/s) ::

$I_c < 3.27$ and $I_c > 1.00$ then $k = 10^{0.952-3.04 \cdot I_c}$

$I_c \leq 4.00$ and $I_c > 3.27$ then $k = 10^{-4.52-1.37 \cdot I_c}$

:: N_{SPT} (blows per 30 cm) ::

$$N_{60} = \left(\frac{q_c}{P_a} \right) \cdot \frac{1}{10^{1.1268-0.2817 \cdot I_c}}$$

$$N_{1(60)} = Q_{tn} \cdot \frac{1}{10^{1.1268-0.2817 \cdot I_c}}$$

:: Young's Modulus, Es (MPa) ::

$$(q_t - \sigma_v) \cdot 0.015 \cdot 10^{0.55 \cdot I_c + 1.68}$$

(applicable only to $I_c < I_{c\_cutoff}$)

:: Relative Density, Dr (%) ::

$$100 \cdot \sqrt{\frac{Q_{tn}}{k_{DR}}}$$ (applicable only to SBT_n: 5, 6, 7 and 8 or $I_c < I_{c\_cutoff}$)

:: State Parameter, ψ ::

$$\psi = 0.56 - 0.33 \cdot \log(Q_{tn,cs})$$

:: Drained Friction Angle, φ (°) ::

$$\varphi = \varphi'_{cv} + 15.94 \cdot \log(Q_{tn,cs}) - 26.88$$

(applicable only to SBT_n: 5, 6, 7 and 8 or $I_c < I_{c\_cutoff}$)

:: 1-D constrained modulus, M (MPa) ::

If $I_c > 2.20$
$\alpha = 14$ for $Q_{tn} > 14$
$\alpha = Q_{tn}$ for $Q_{tn} \leq 14$
$M_{CPT} = \alpha \cdot (q_t - \sigma_v)$

If $I_c \geq 2.20$

$$M_{CPT} = 0.03 \cdot (q_t - \sigma_v) \cdot 10^{0.55 \cdot I_c + 1.68}$$

:: Small strain shear Modulus, Go (MPa) ::

$$G_0 = (q_t - \sigma_v) \cdot 0.0188 \cdot 10^{0.55 \cdot I_c + 1.68}$$

:: Shear Wave Velocity, Vs (m/s) ::

$$V_s = \left(\frac{G_0}{\rho} \right)^{0.50}$$

:: Undrained peak shear strength, Su (kPa) ::

$N_{kt} = 10.50 + 7 \cdot \log(F_r)$ or user defined

$$S_u = \frac{(q_t - \sigma_v)}{N_{kt}}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Remolded undrained shear strength, Su(rem) (kPa) ::

$S_{u(rem)} = f_s$ (applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Overconsolidation Ratio, OCR ::

$$k_{OCR} = \left[\frac{Q_{tn}^{0.20}}{0.25 \cdot (10.50 \cdot + 7 \cdot \log(F_r))} \right]^{1.25}$$ or user defined

$OCR = k_{OCR} \cdot Q_{tn}$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: In situ Stress Ratio, Ko ::

$$K_O = (1 - \sin\varphi') \cdot OCR^{\sin\varphi'}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Soil Sensitivity, S_t ::

$$S_t = \frac{N_S}{F_r}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Peak Friction Angle, φ' (°) ::

$$\varphi' = 29.5° \cdot B_q^{0.121} \cdot (0.256 + 0.336 \cdot B_q + \log Q_t)$$

(applicable for $0.10 < B_q < 1.00$)

References

• Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 5th Edition, November 2012

• Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)

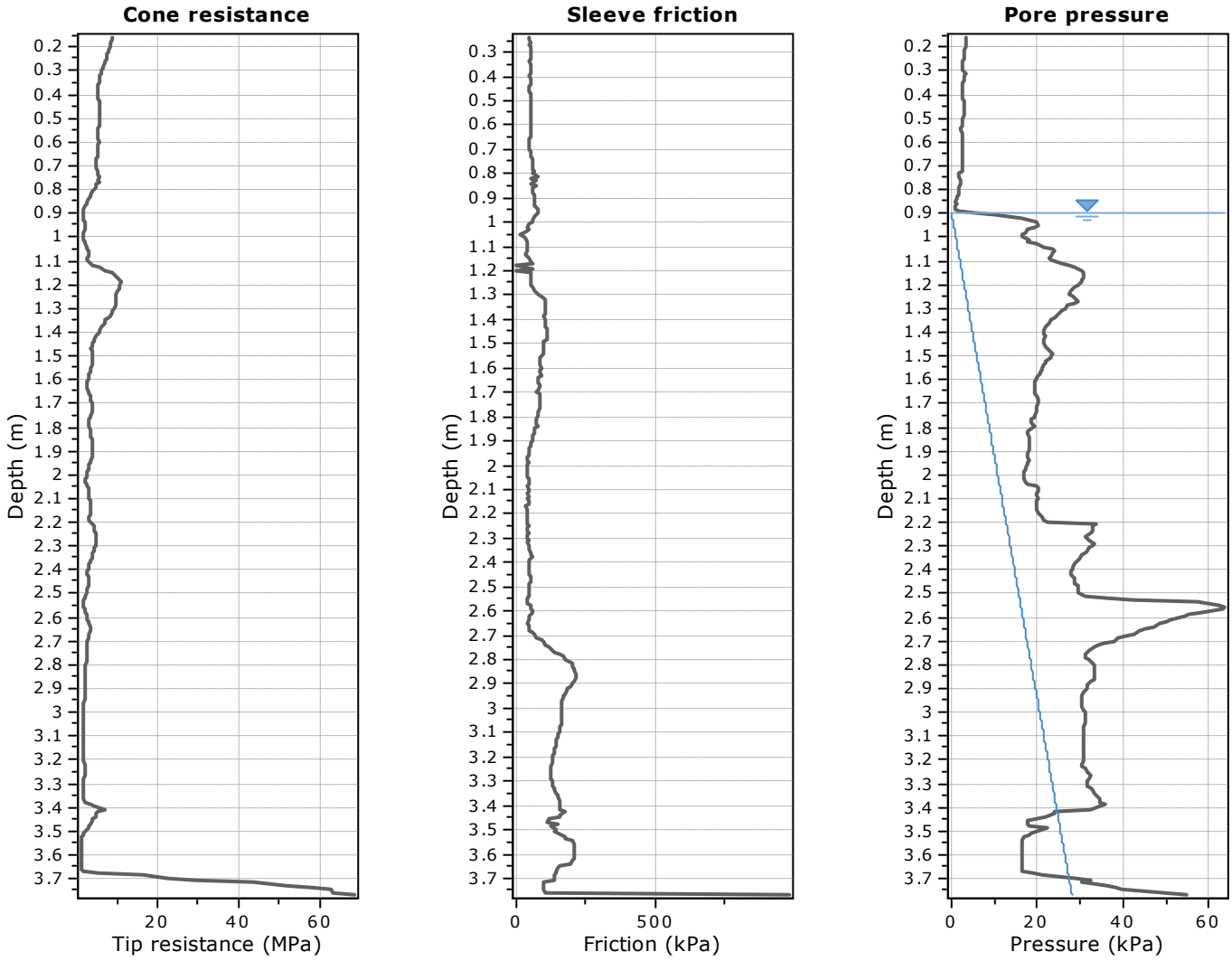
• N Barounis, J Philpot, Estimation of in-situ water content, void ratio, dry unit weight and porosity using CPT for saturated sands, Proc. 20th NZGS Geotechnical Symposium

Appendix B2: CPT CMW Analysis

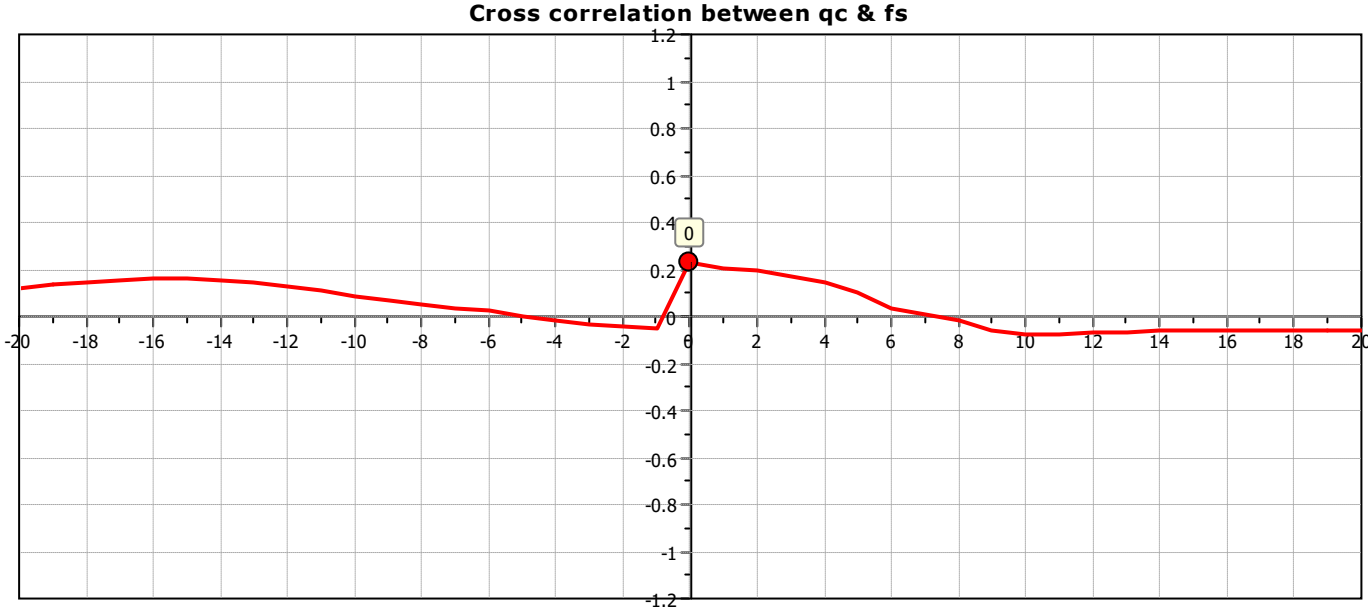
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

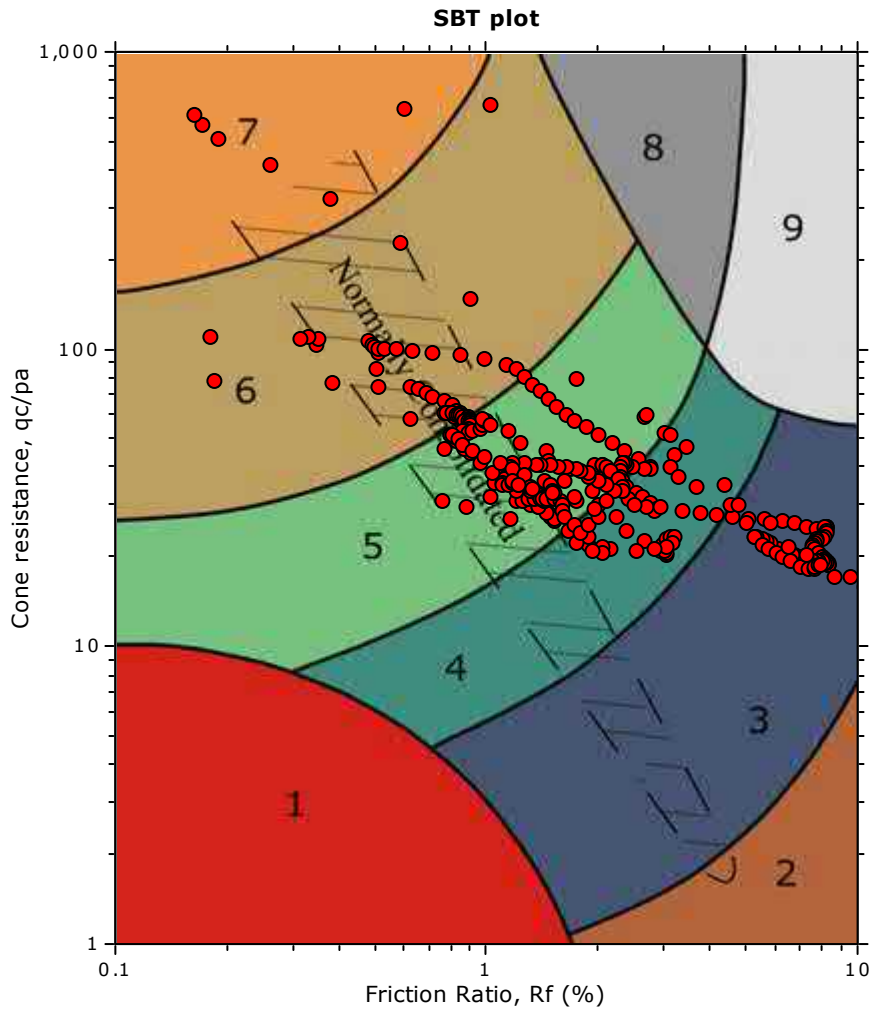


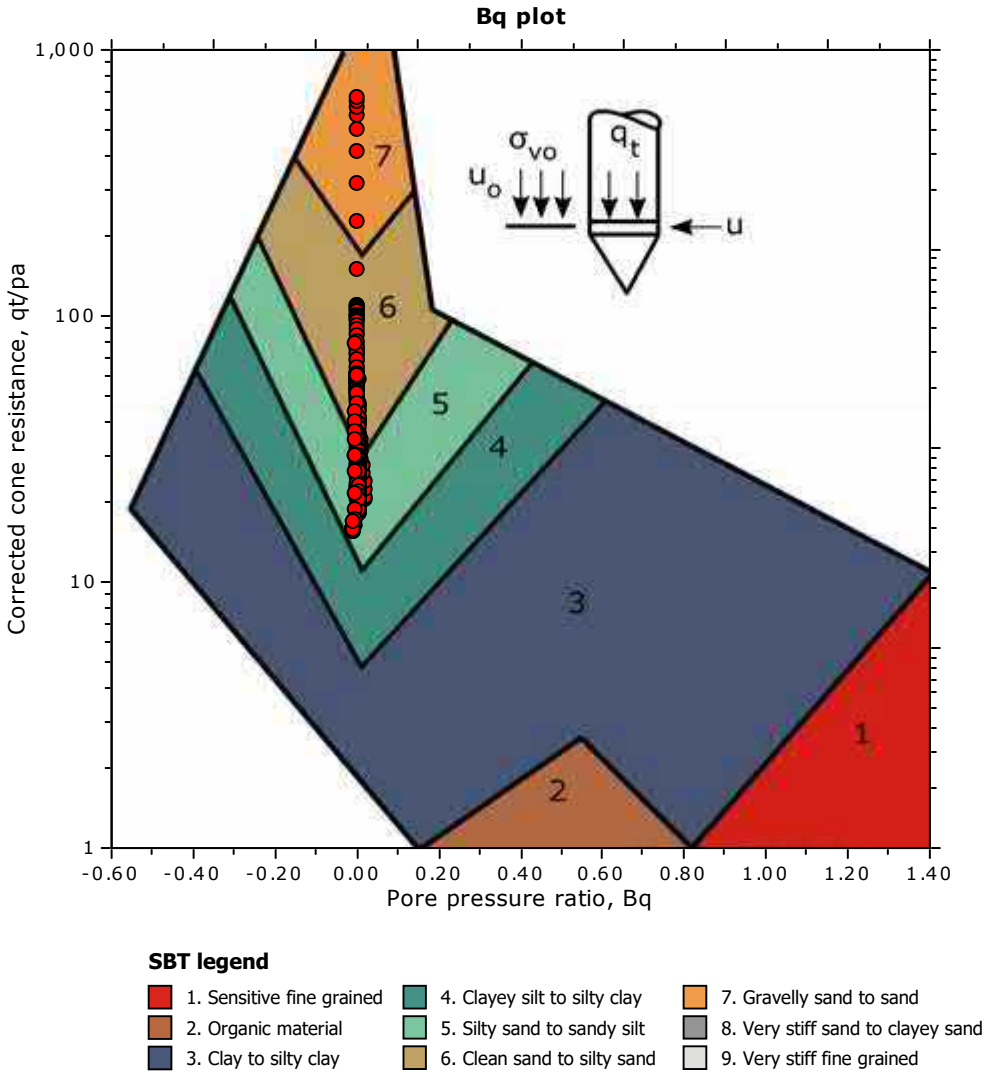
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots



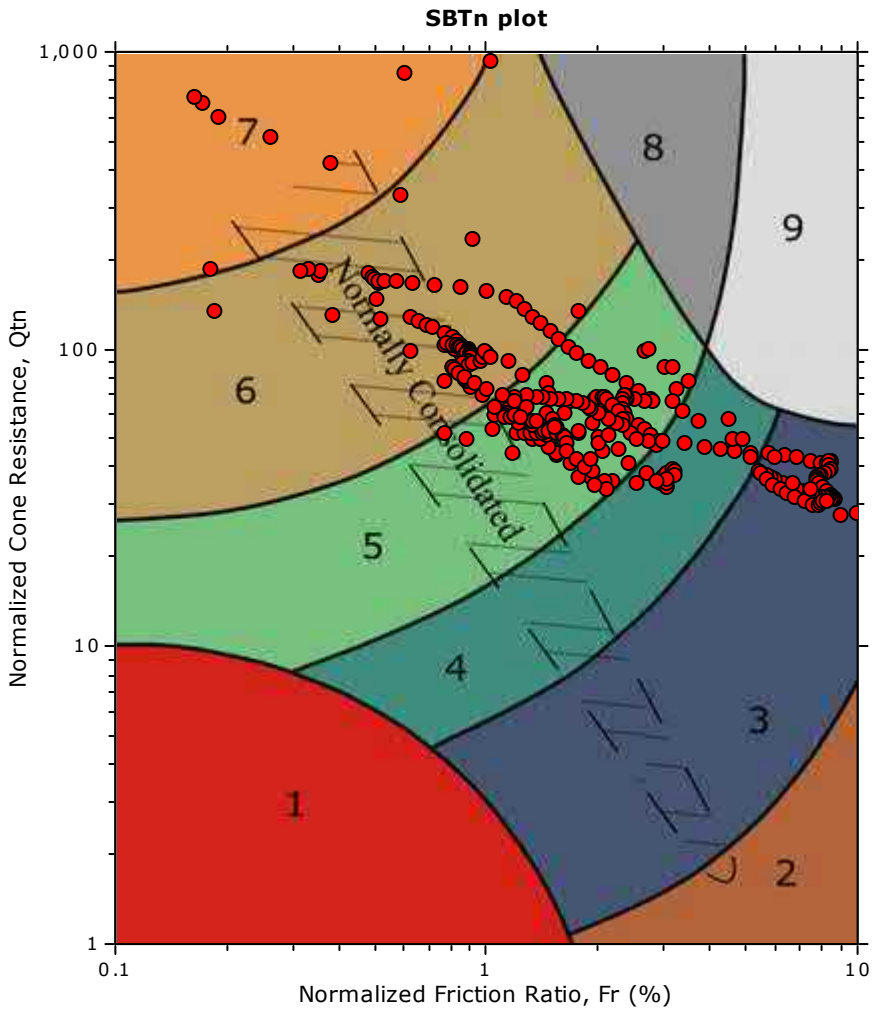


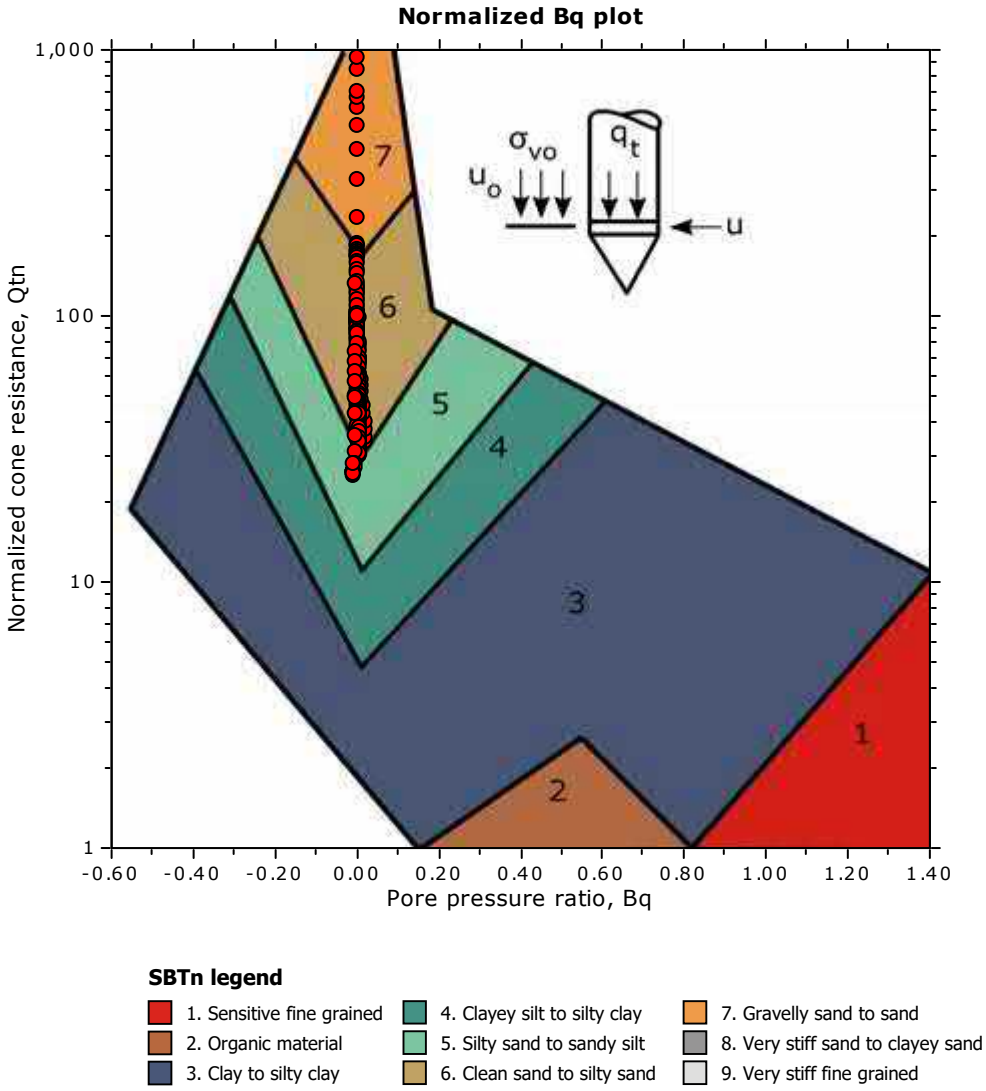
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots (normalized)





SBTn legend

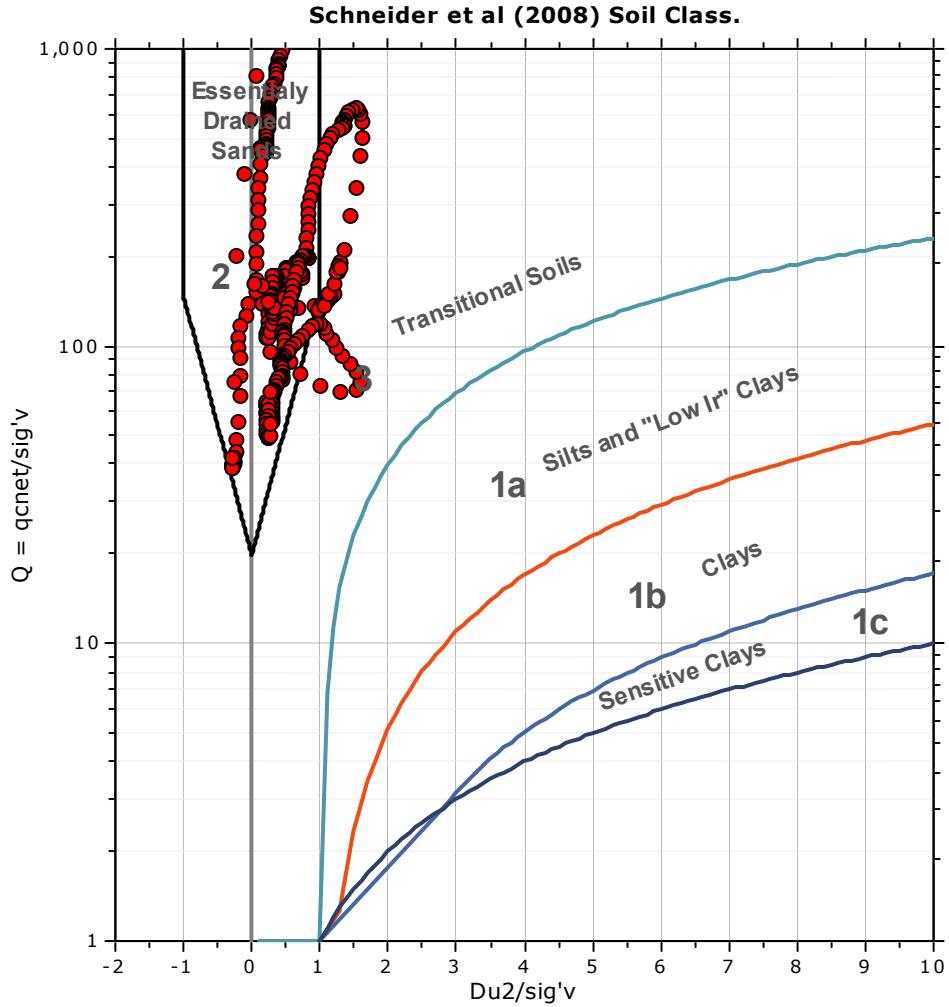
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

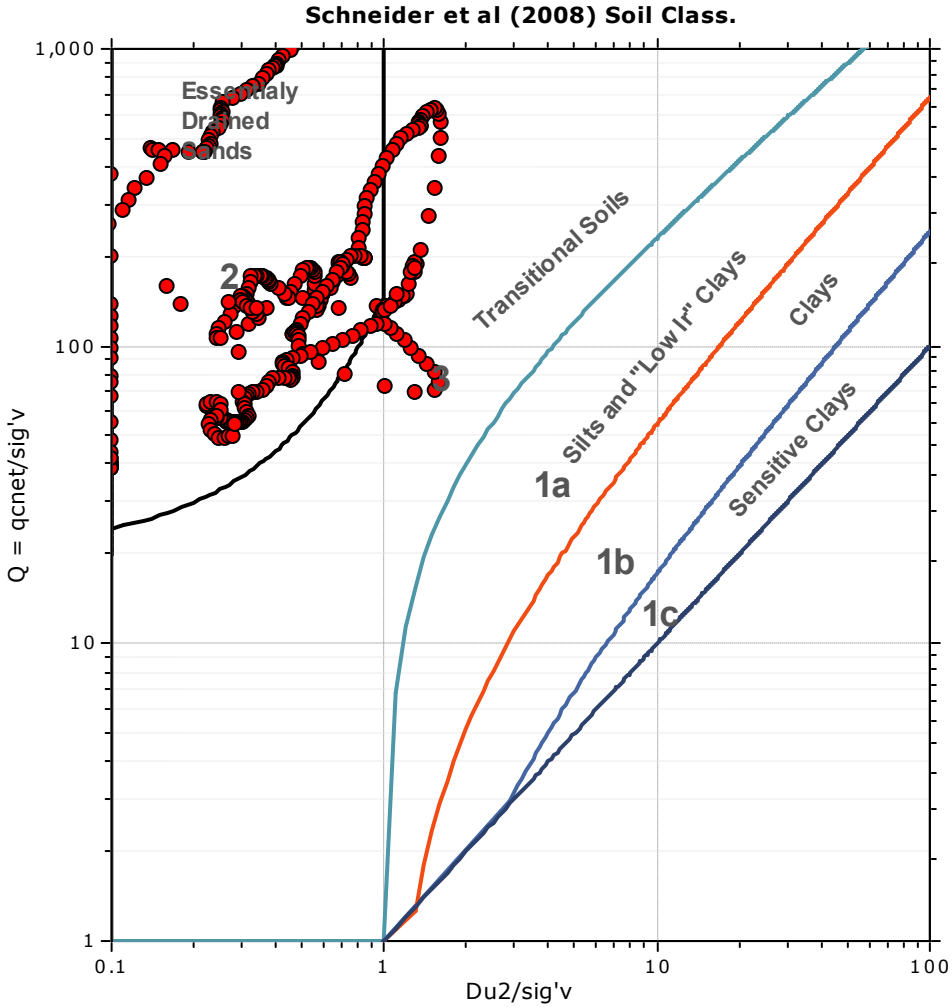
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

Bq plots (Schneider)

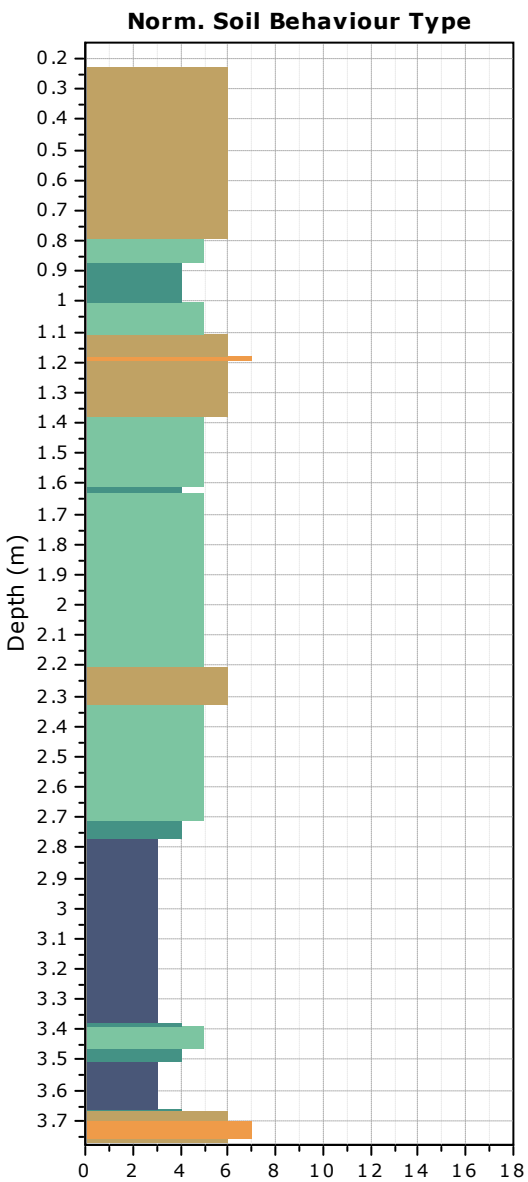


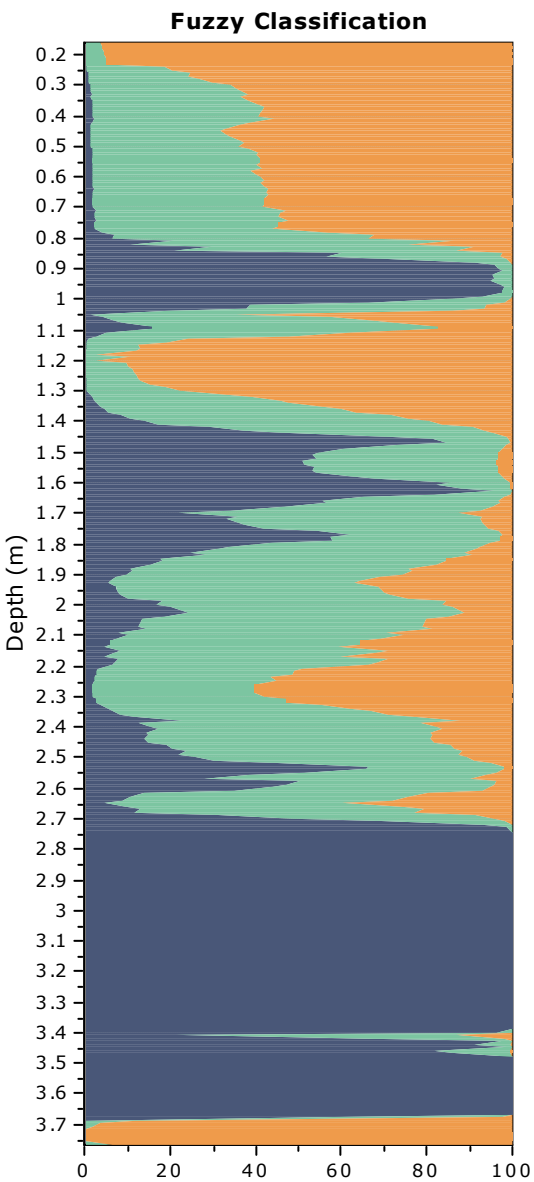


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



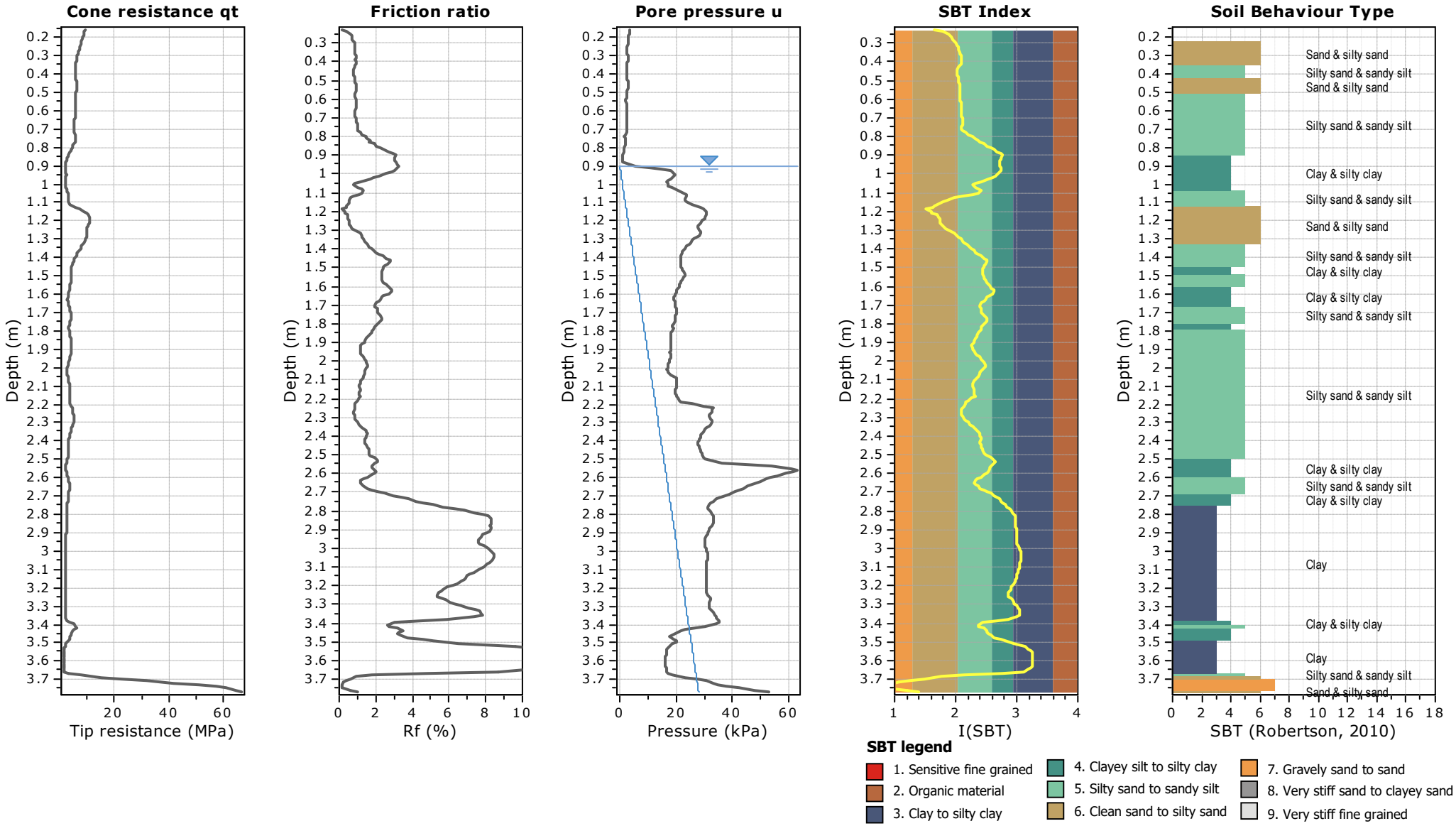


Fuzzy classifiaction legend
- Highly probable clayey soil
- Highly probable mixture soil
- Highly probable sandy soil

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

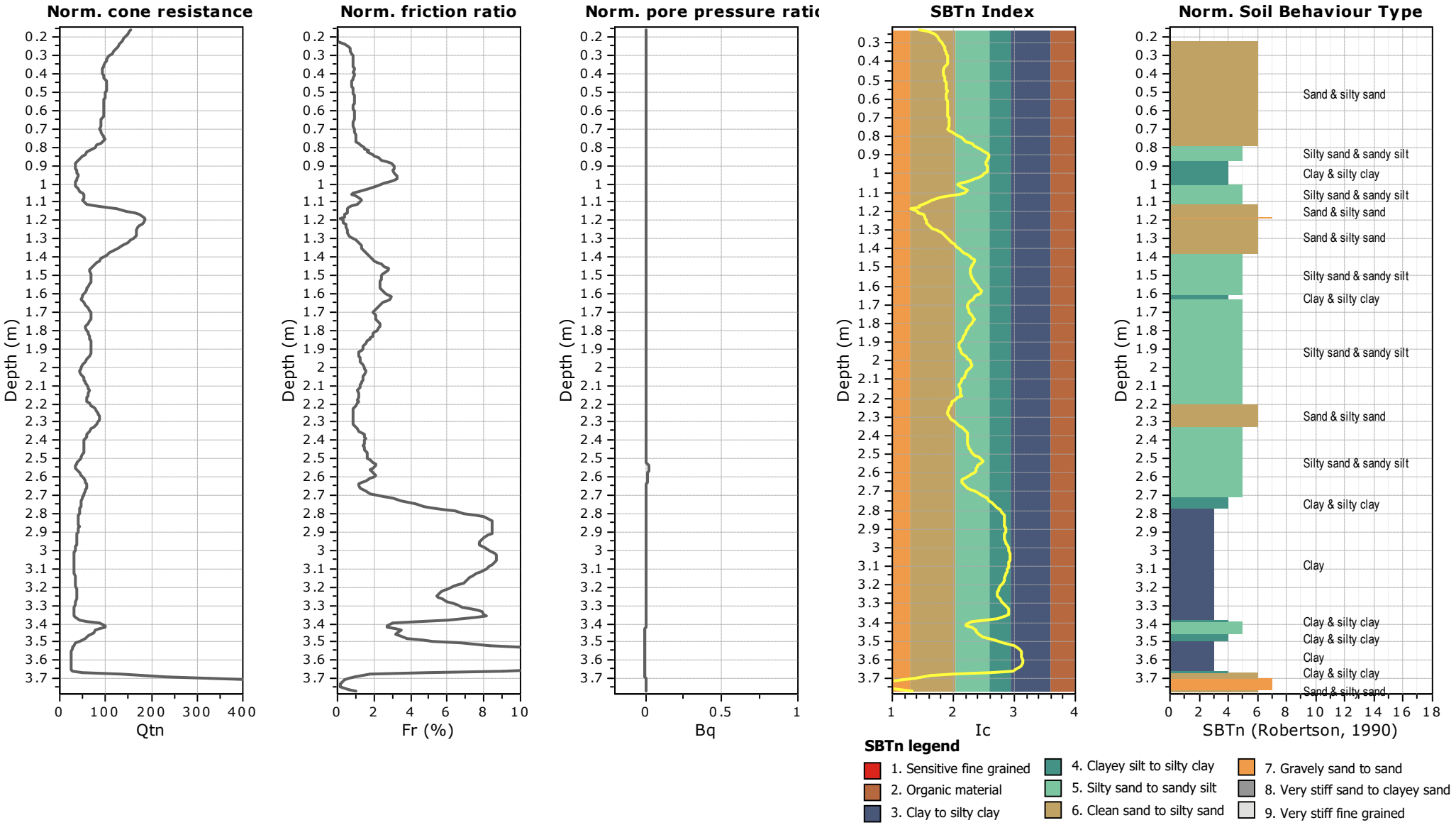
CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

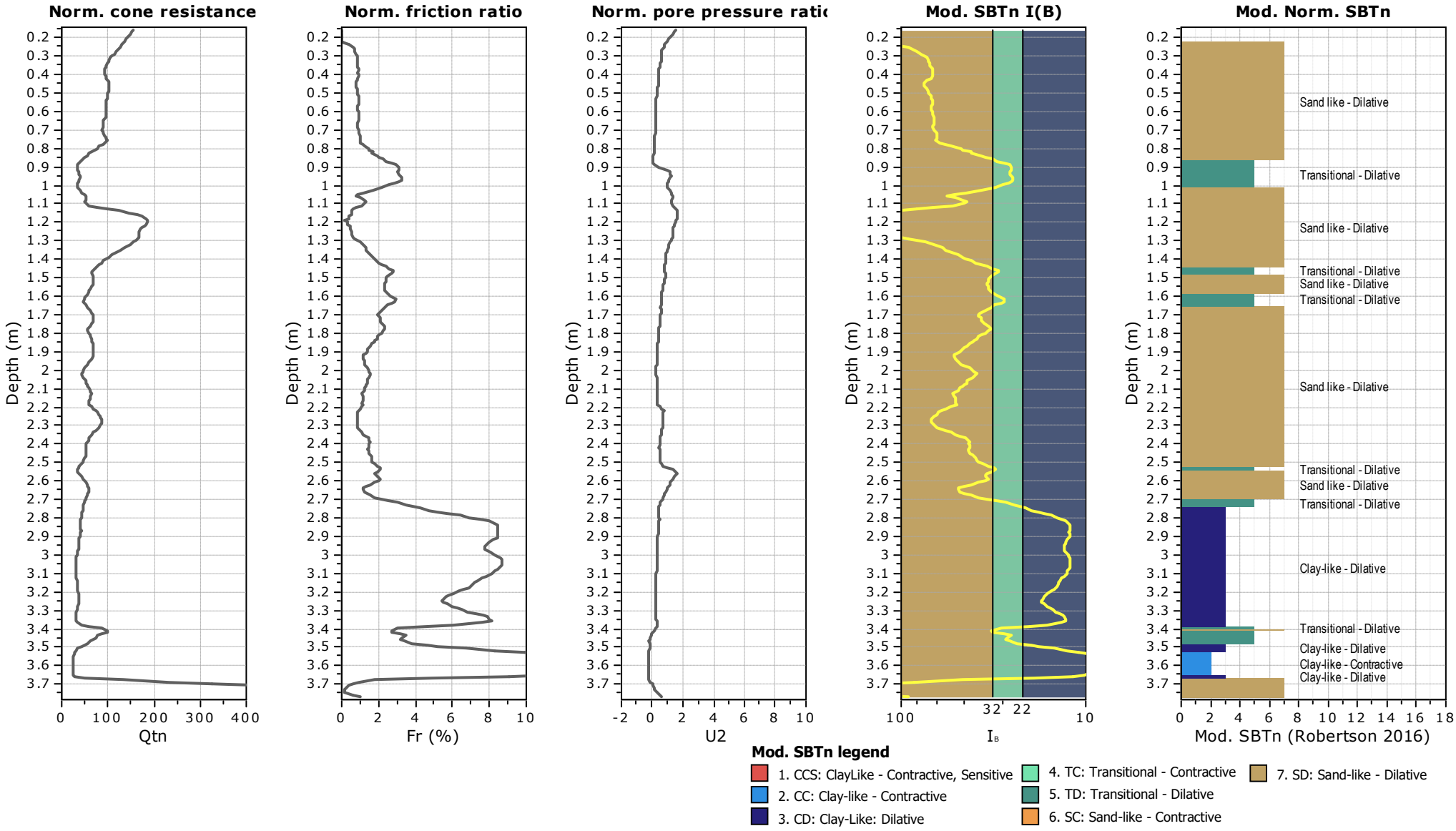
CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

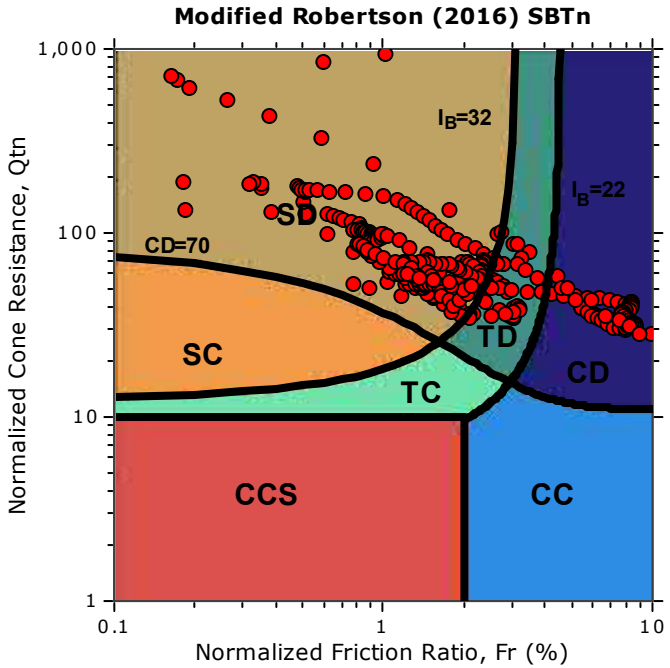


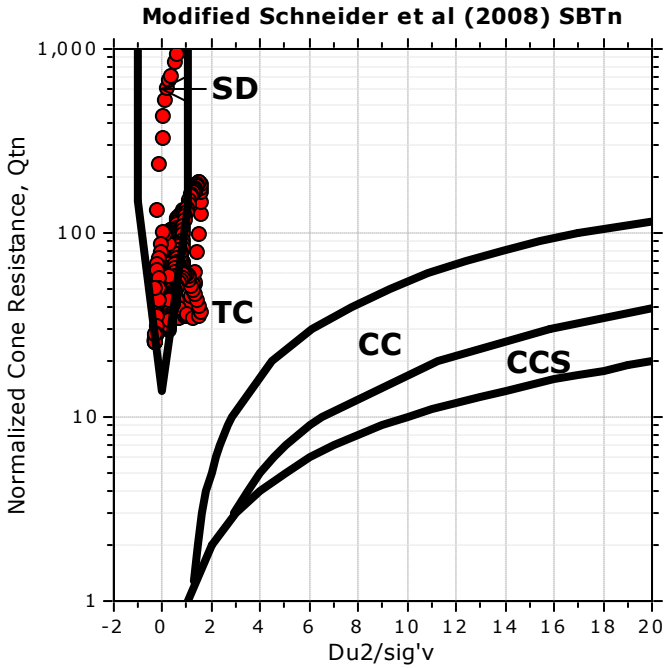
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

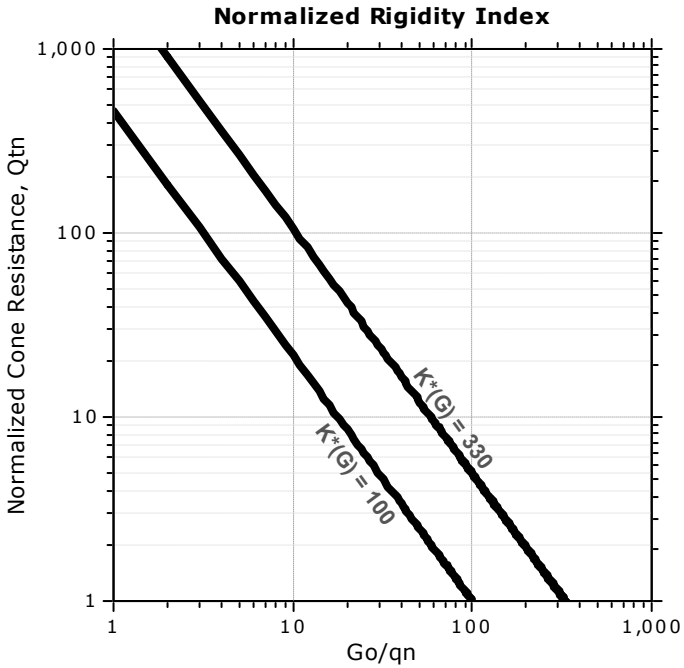
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Updated SBTn plots







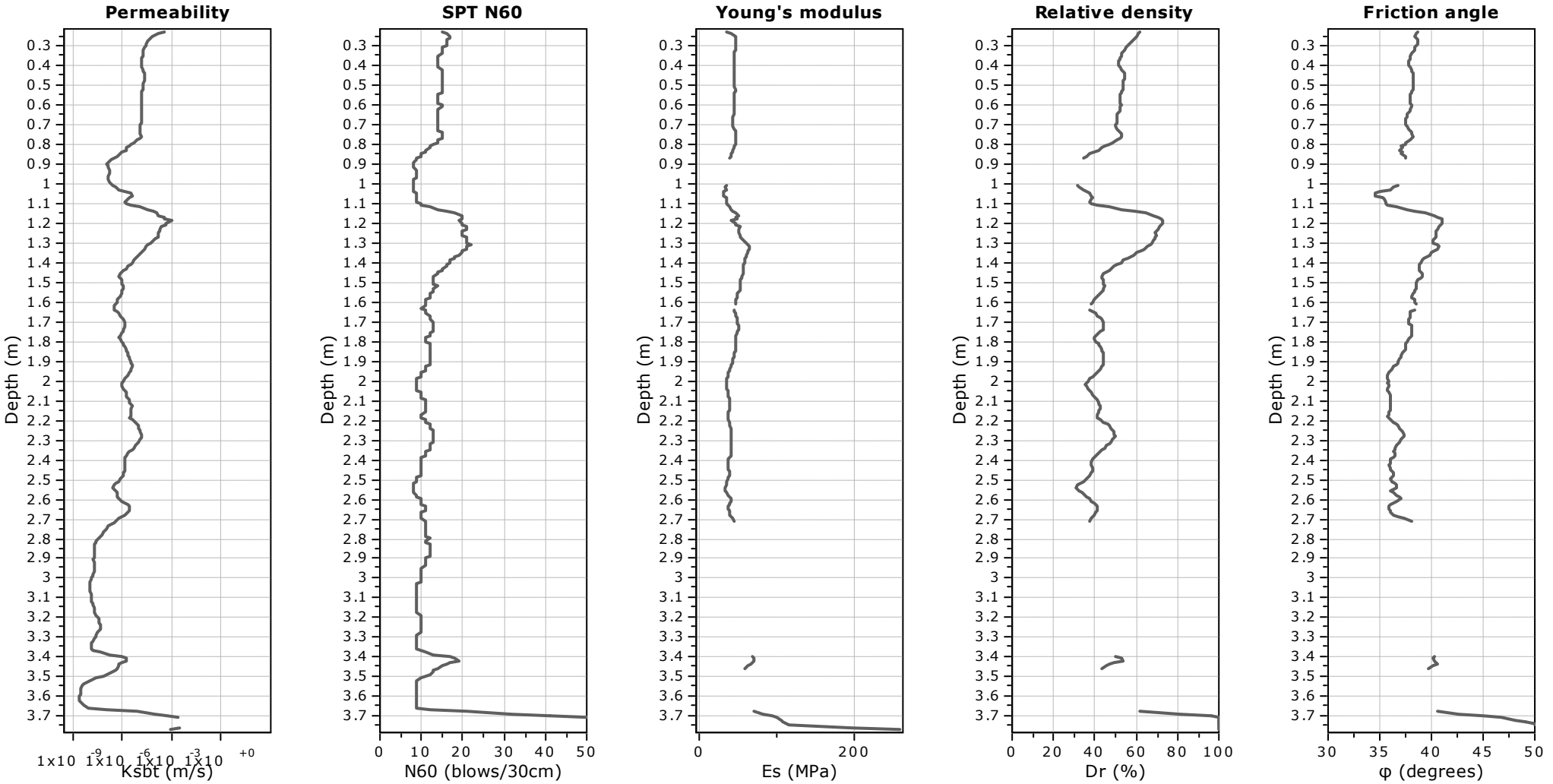
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



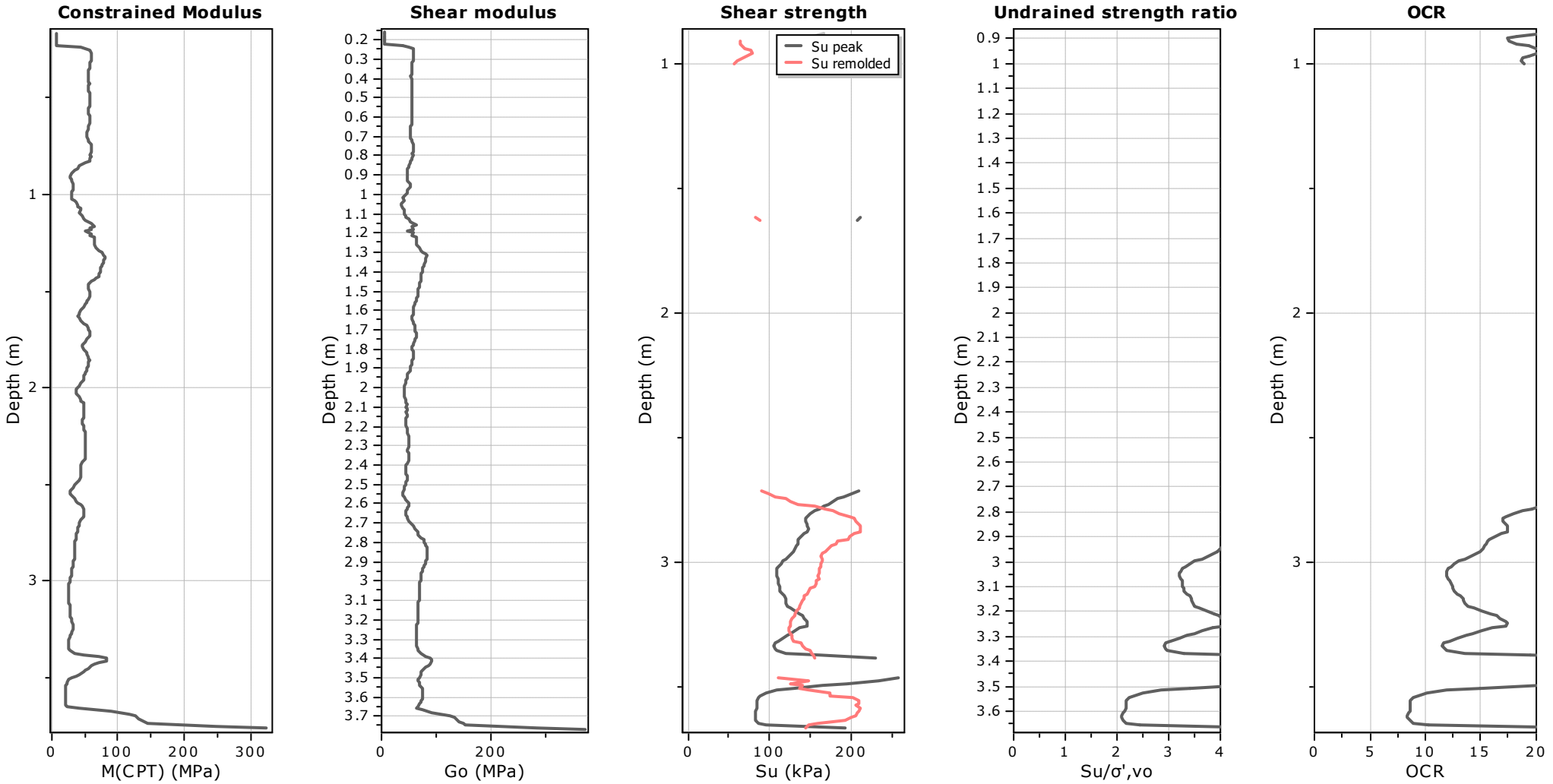
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



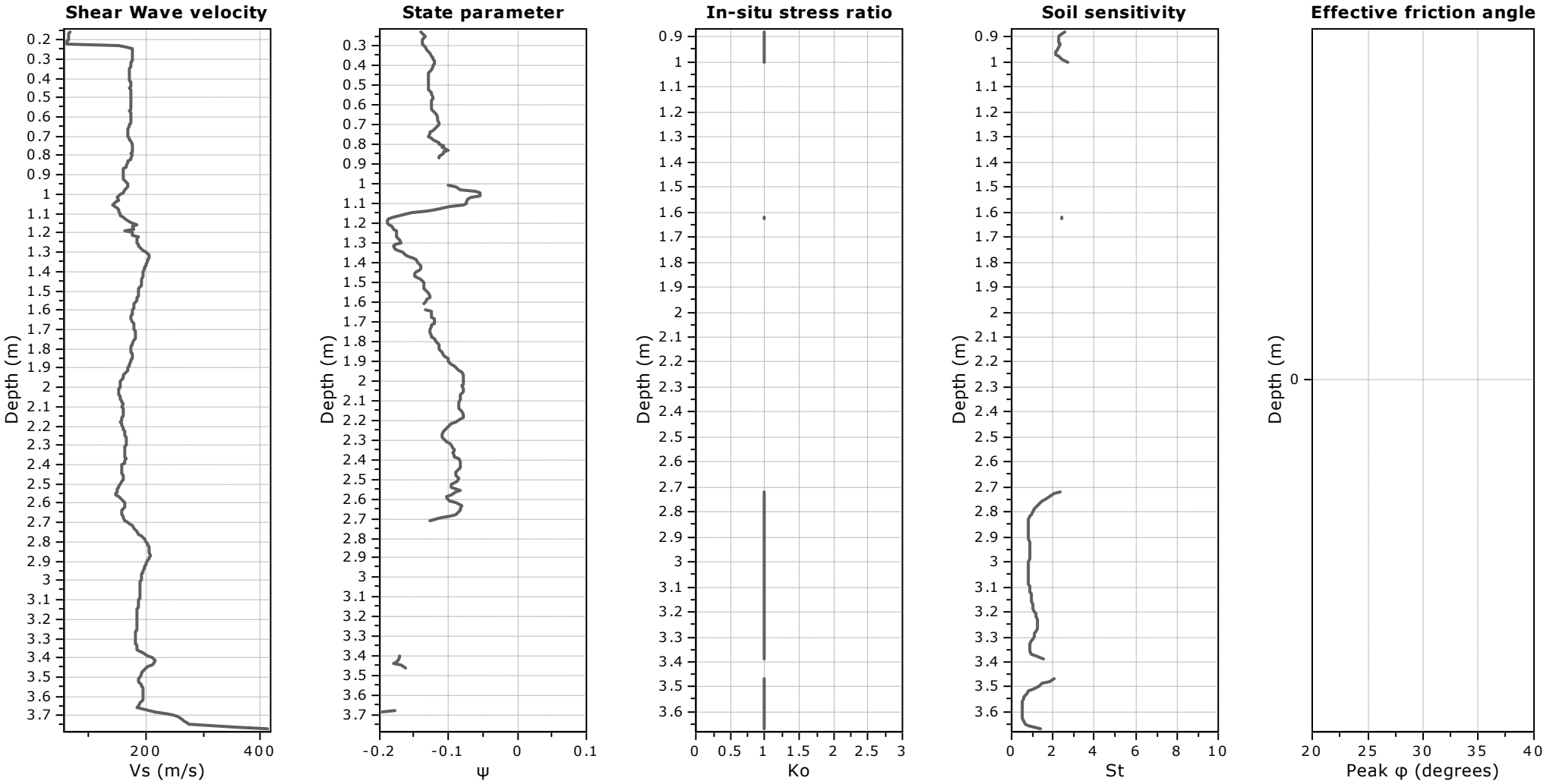
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto
OCR factor for clays, N_{kt}: Auto
Flat Dilatometer Test data

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



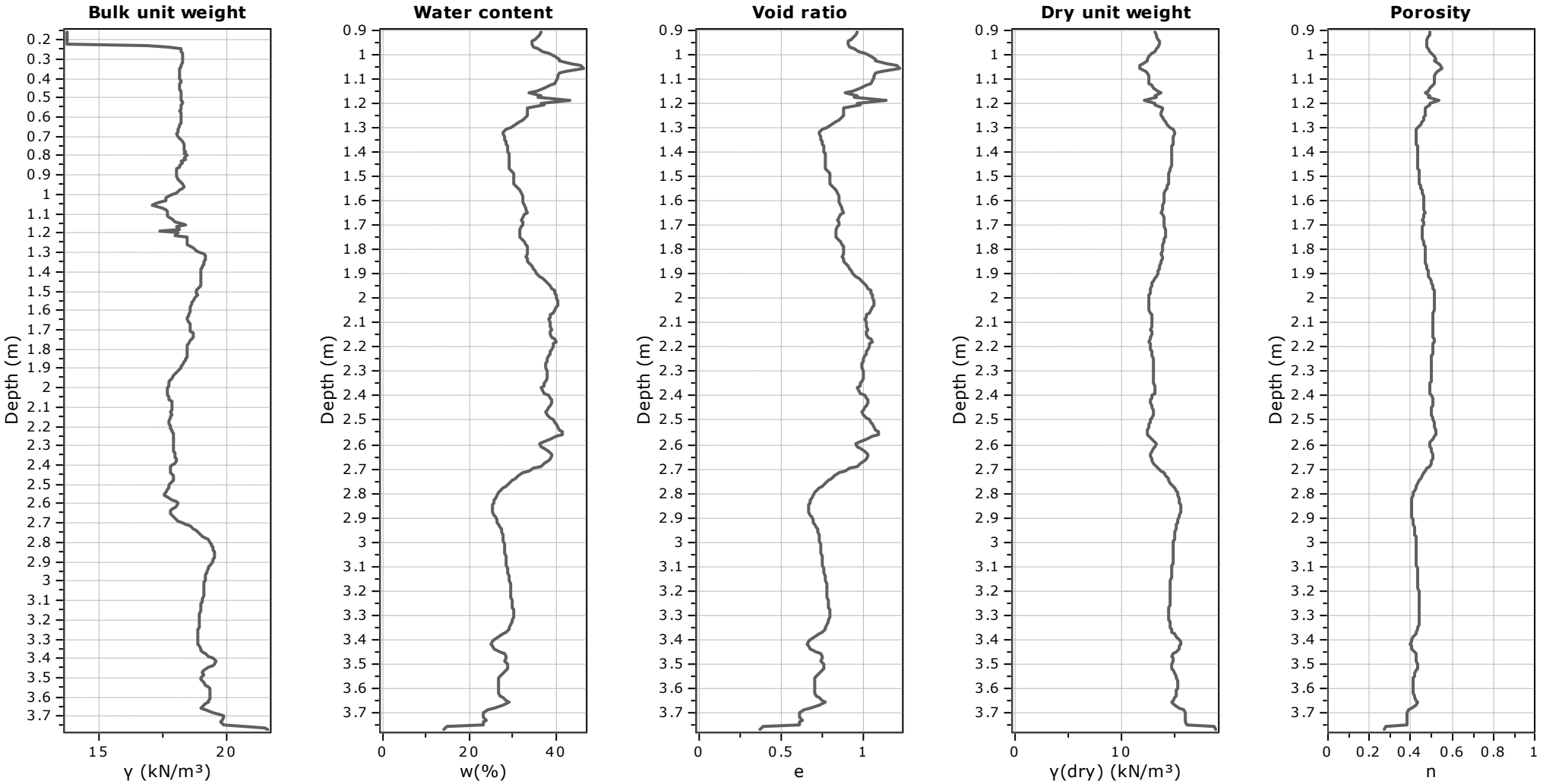
Calculation parameters

Soil Sensitivity factor, N_S: 7.00

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

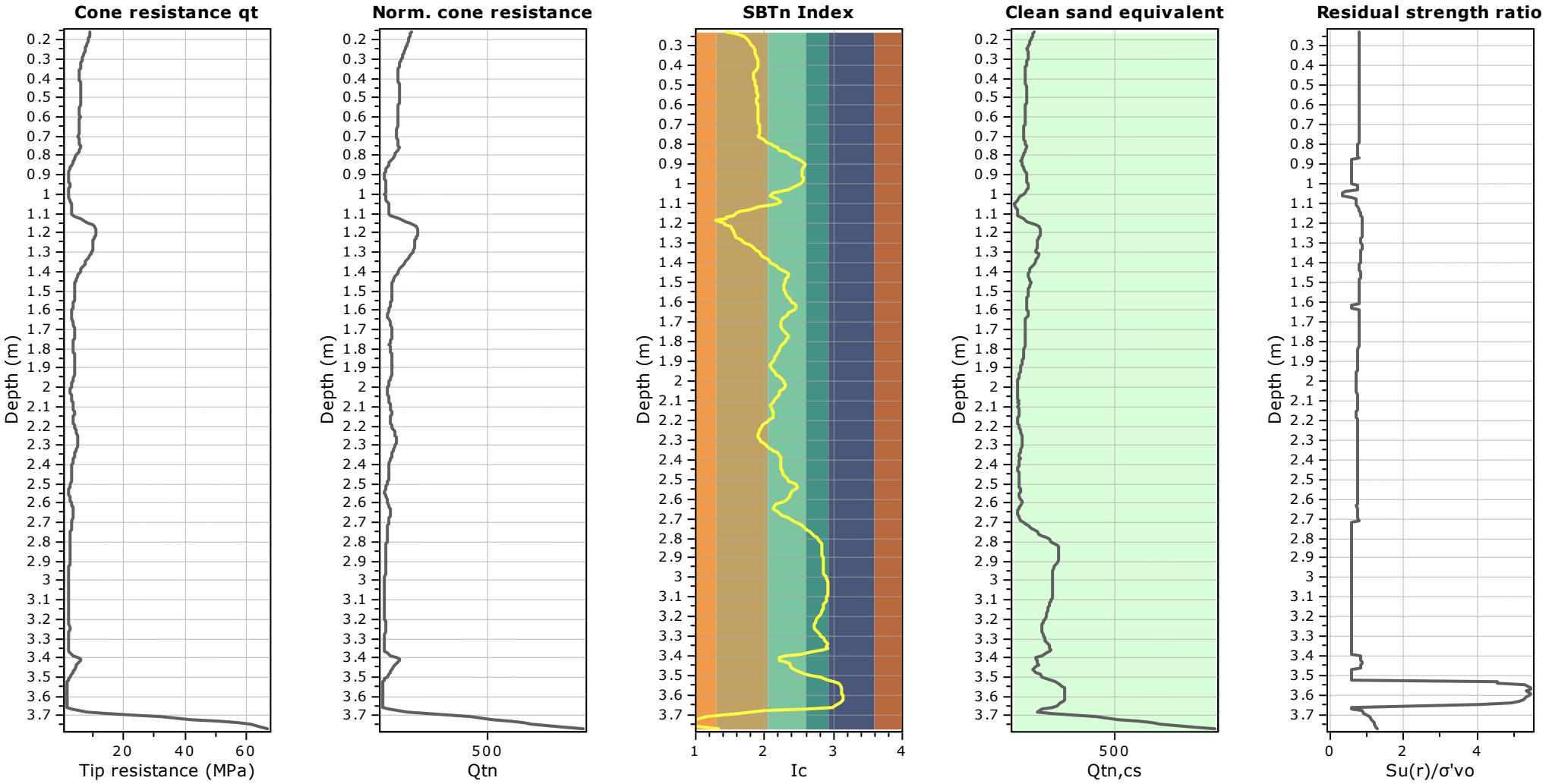
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

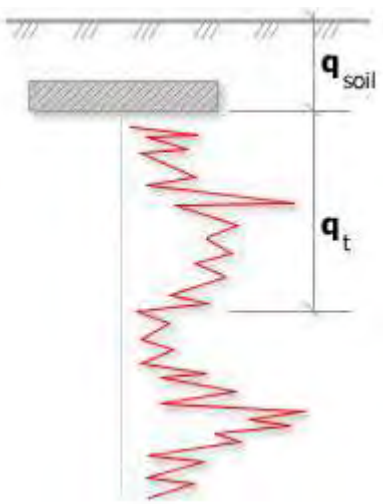


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

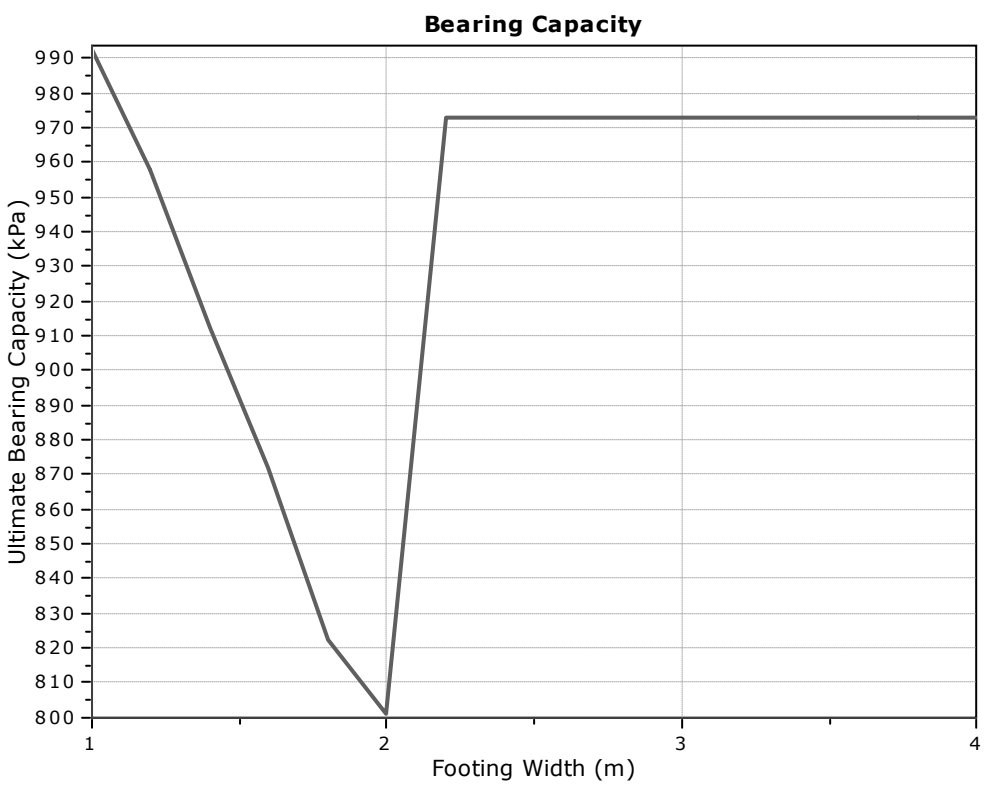




Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



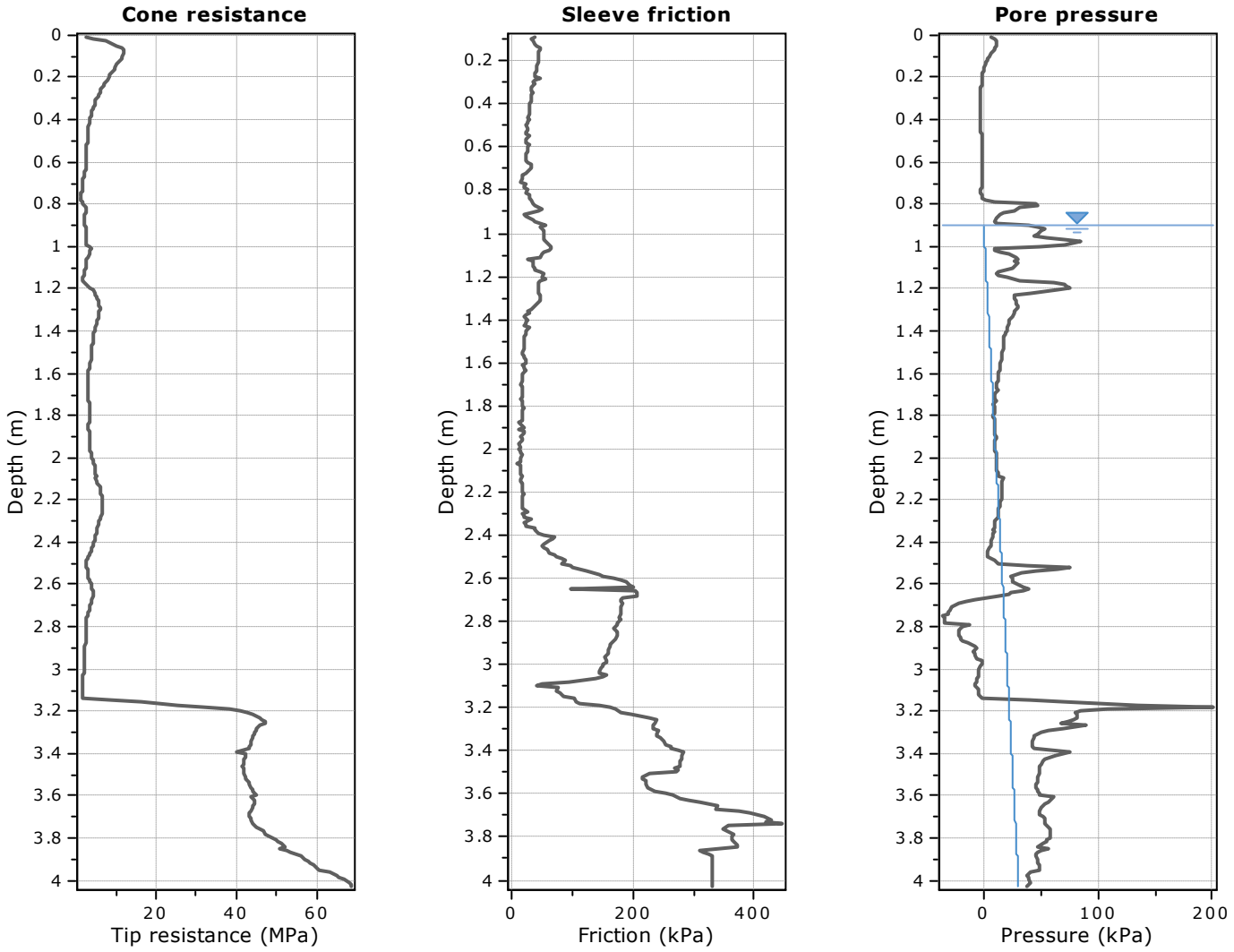
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	4.92	0.20	9.50	992.56
2	1.20	0.50	2.30	4.74	0.20	9.50	957.93
3	1.40	0.50	2.60	4.52	0.20	9.50	912.52
4	1.60	0.50	2.90	4.31	0.20	9.50	871.95
5	1.80	0.50	3.20	4.06	0.20	9.50	822.01
6	2.00	0.50	3.50	3.96	0.20	9.50	800.89
7	2.20	0.50	3.80	4.82	0.20	9.50	972.82
8	2.40	0.50	4.10	4.82	0.20	9.50	972.82
9	2.60	0.50	4.40	4.82	0.20	9.50	972.82
10	2.80	0.50	4.70	4.82	0.20	9.50	972.82
11	3.00	0.50	5.00	4.82	0.20	9.50	972.82
12	3.20	0.50	5.30	4.82	0.20	9.50	972.82
13	3.40	0.50	5.60	4.82	0.20	9.50	972.82
14	3.60	0.50	5.90	4.82	0.20	9.50	972.82
15	3.80	0.50	6.20	4.82	0.20	9.50	972.82
16	4.00	0.50	6.50	4.82	0.20	9.50	972.82

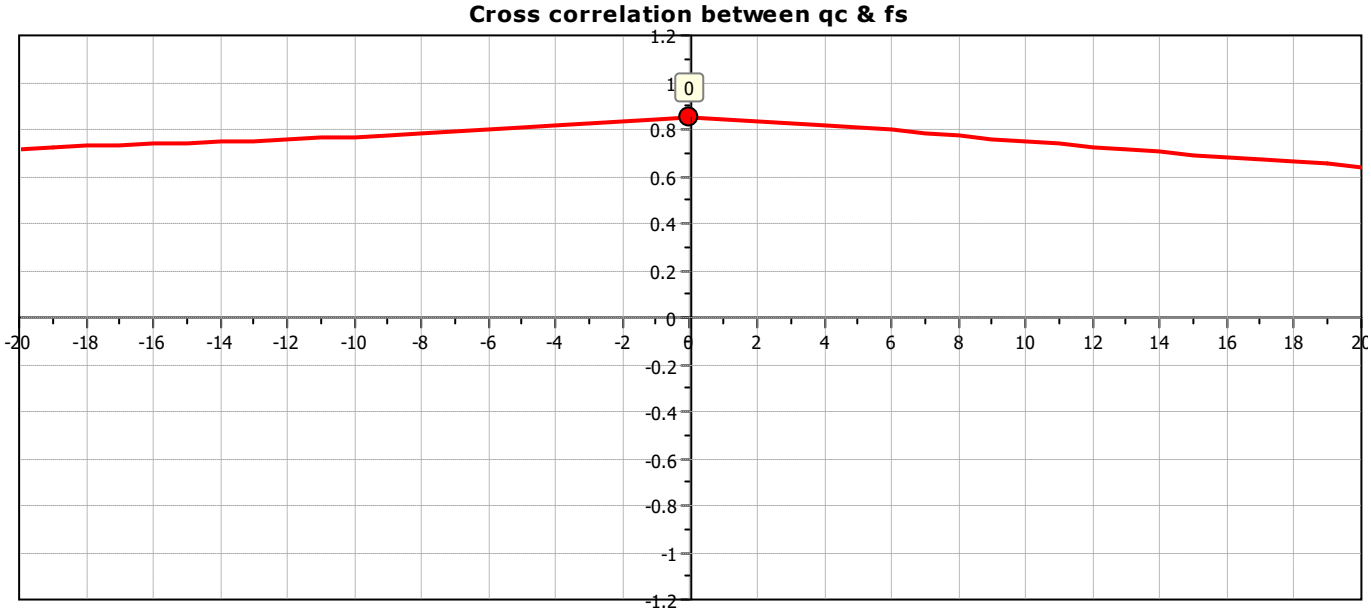
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

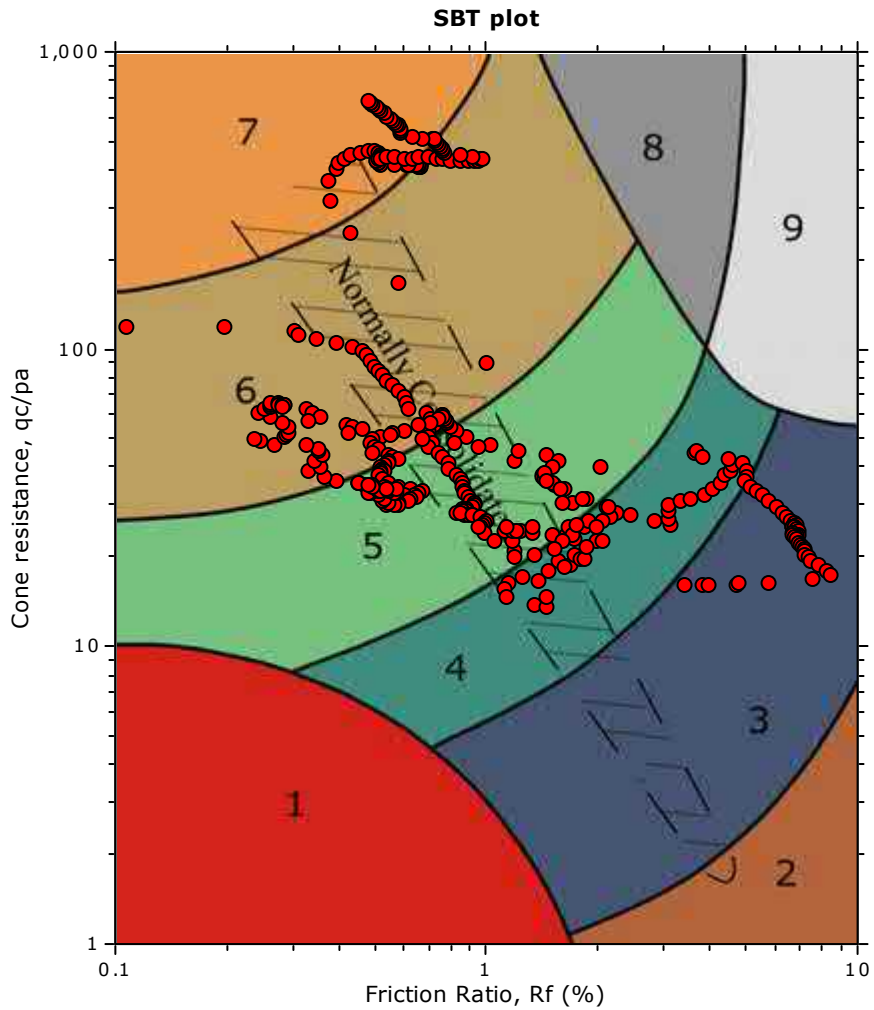


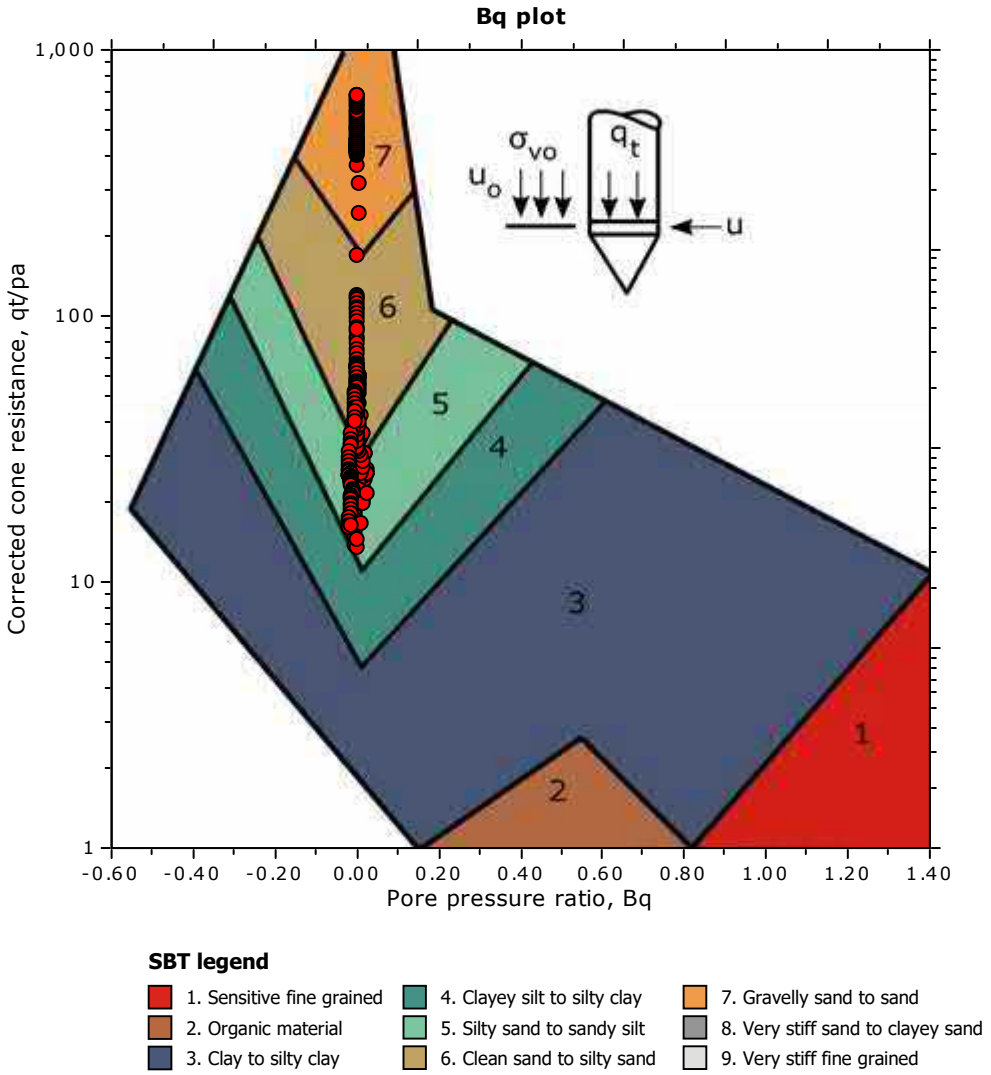
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots



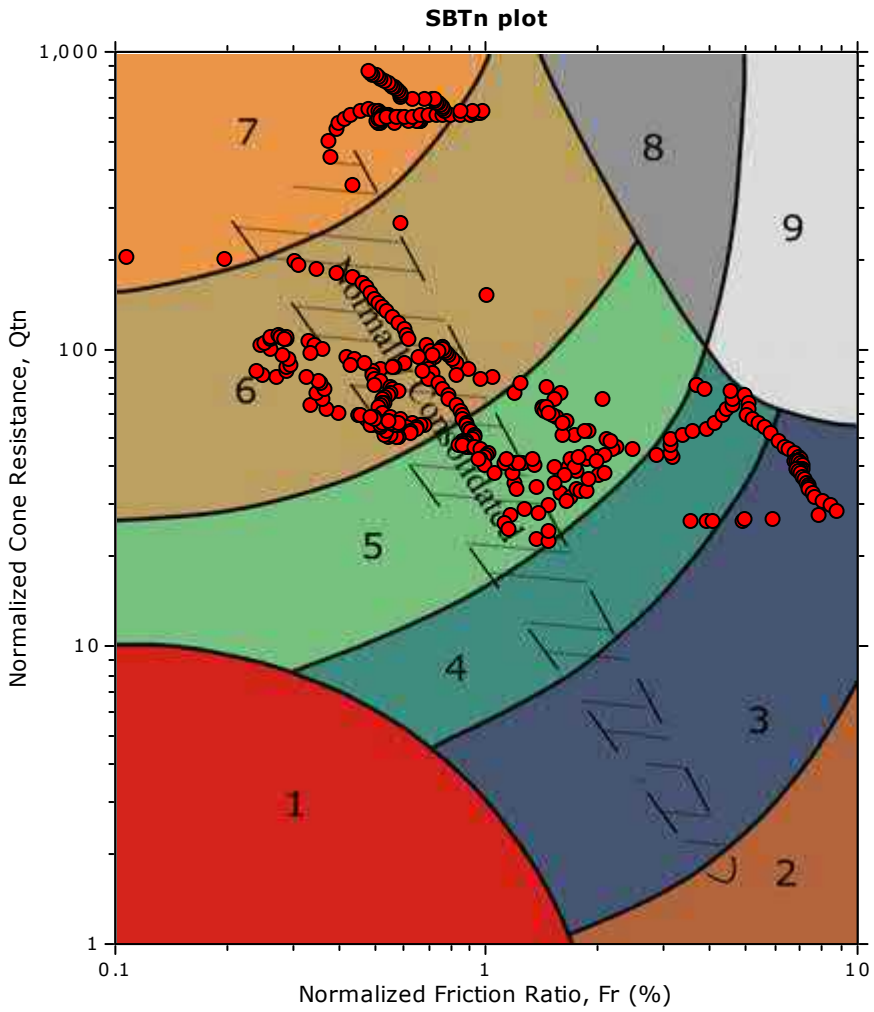


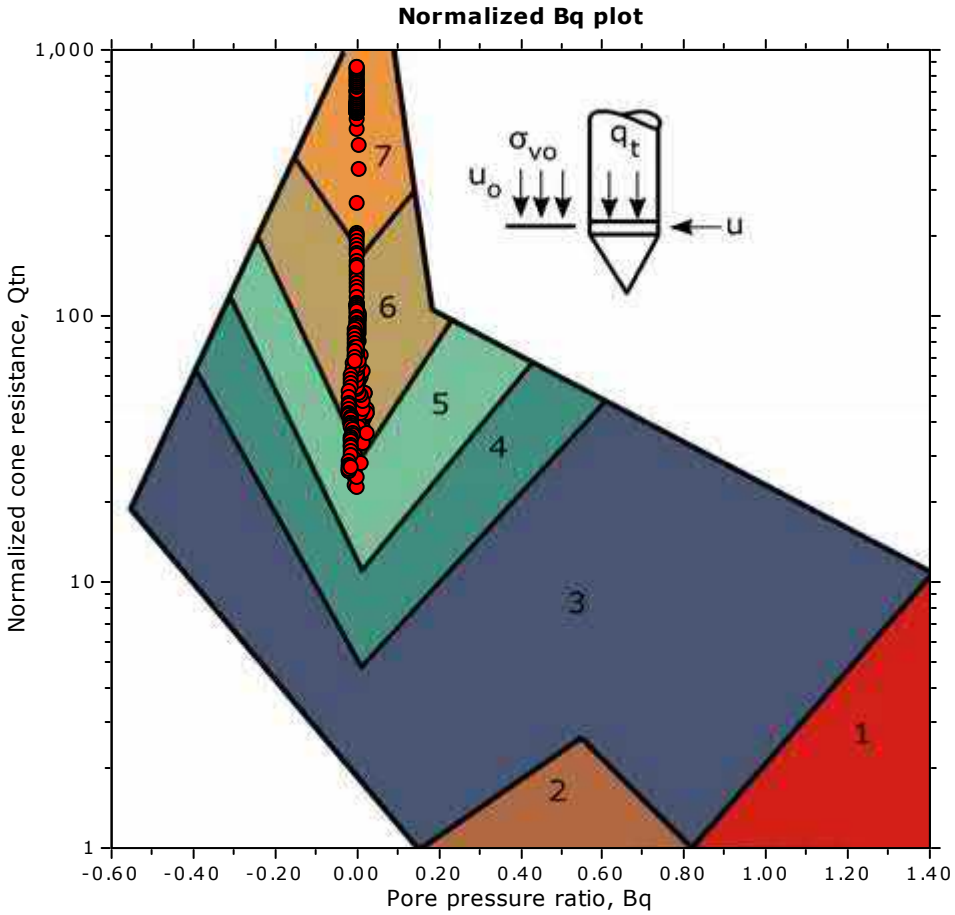
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots (normalized)





SBTn legend

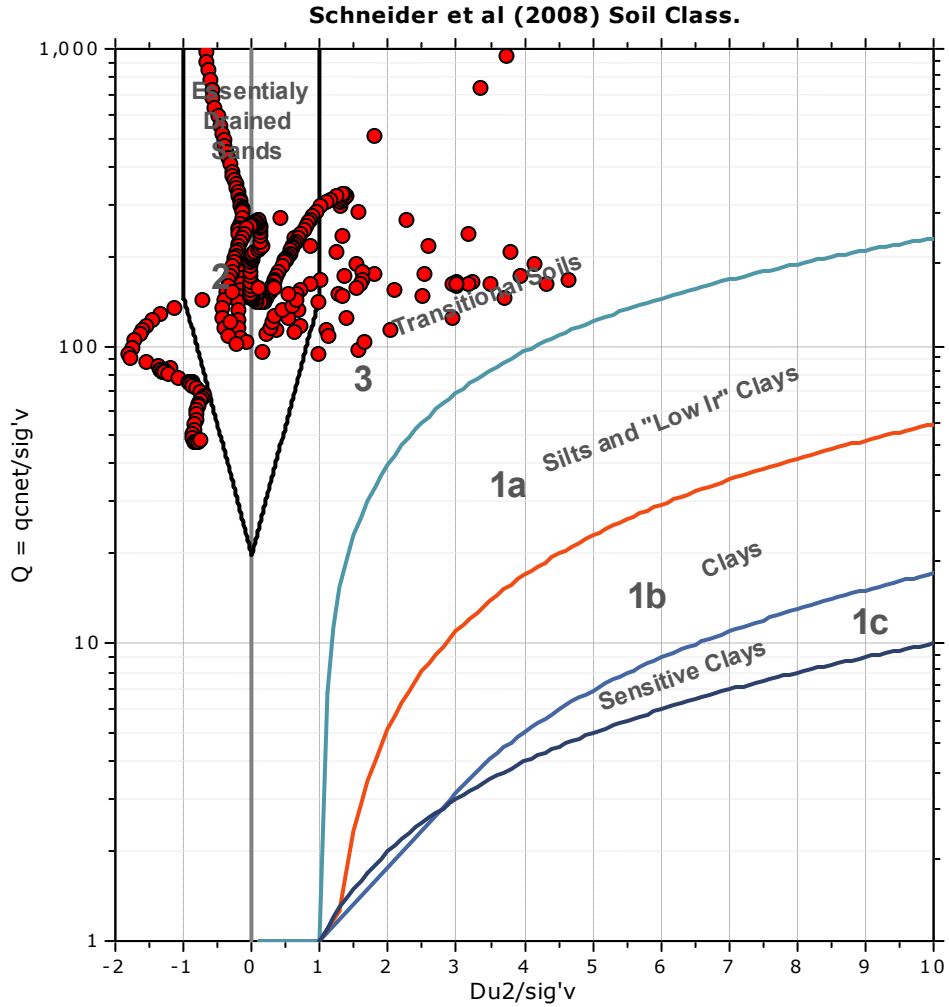
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

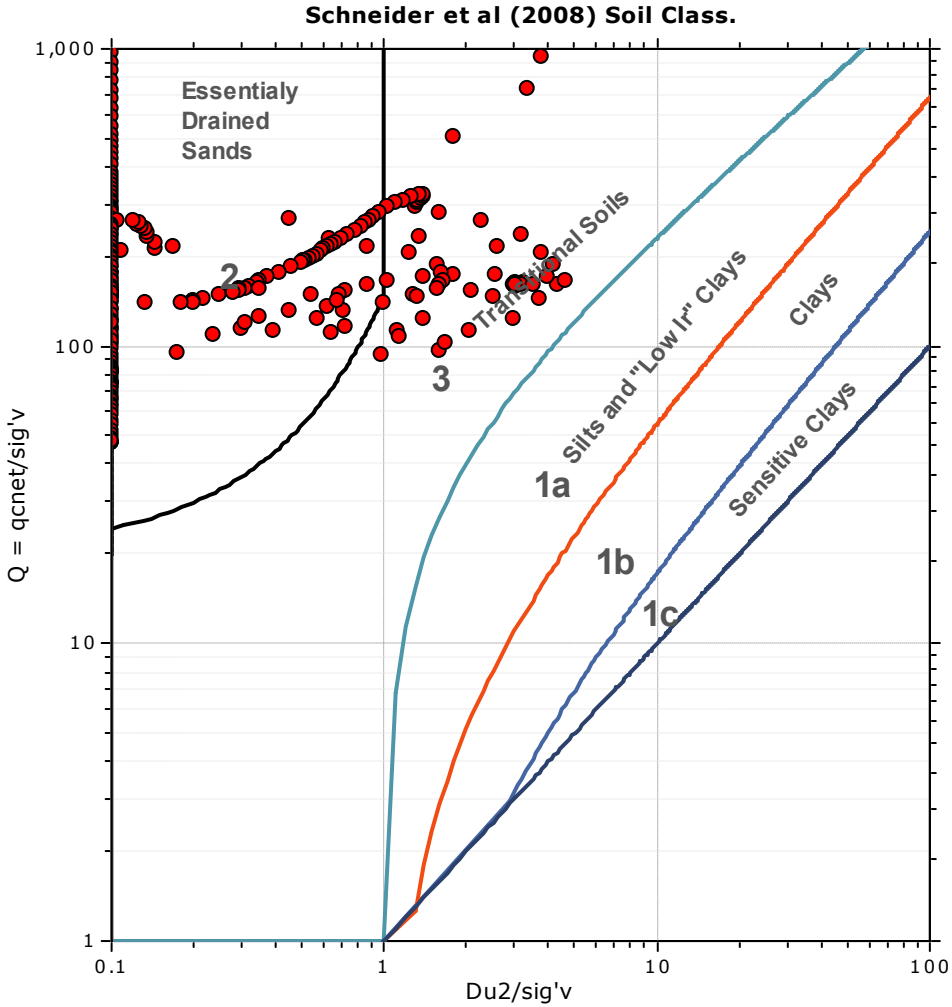
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Bq plots (Schneider)

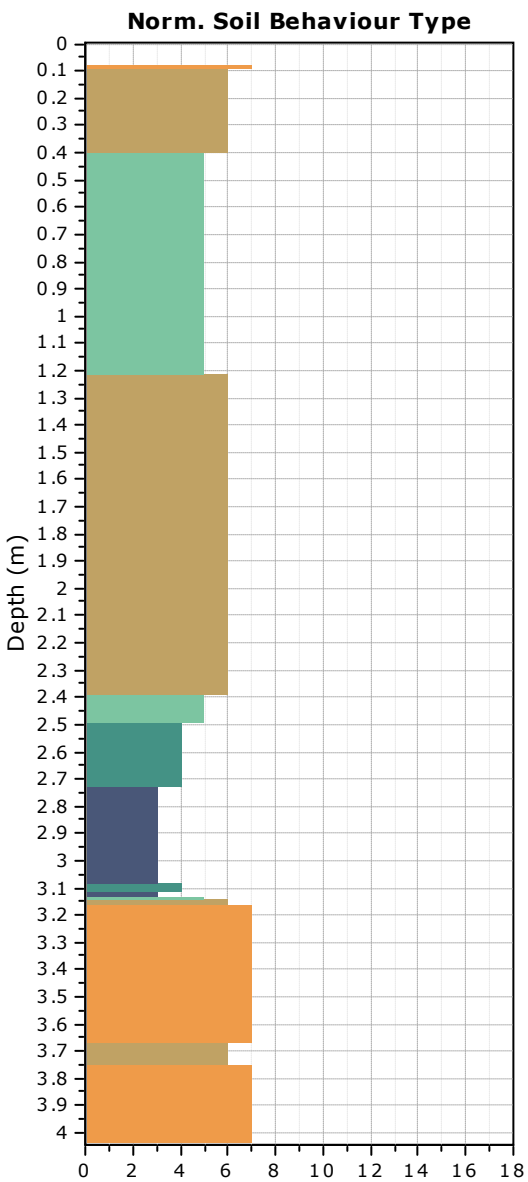


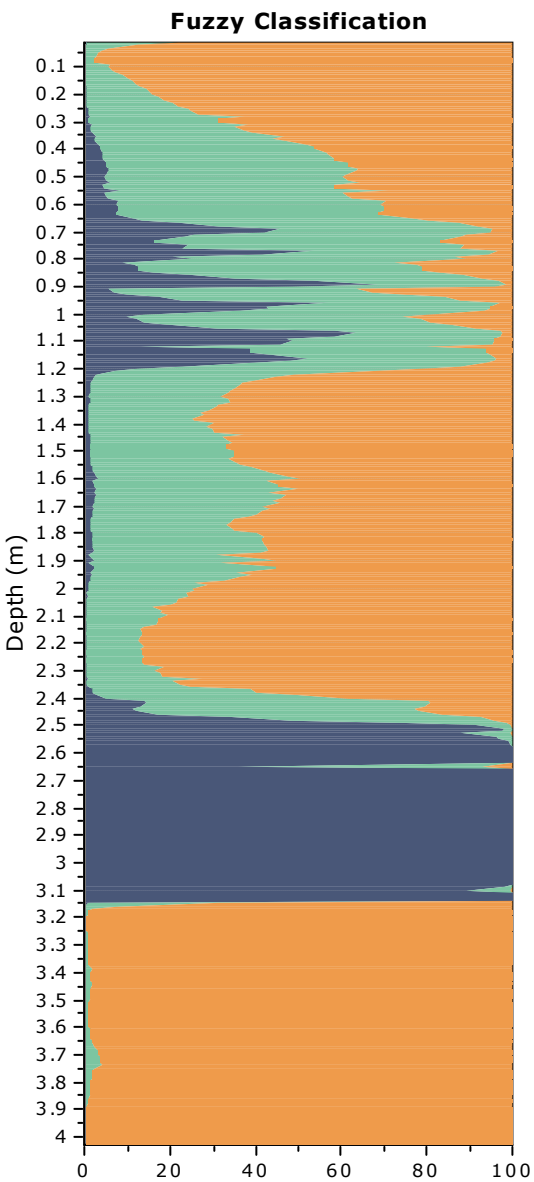


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



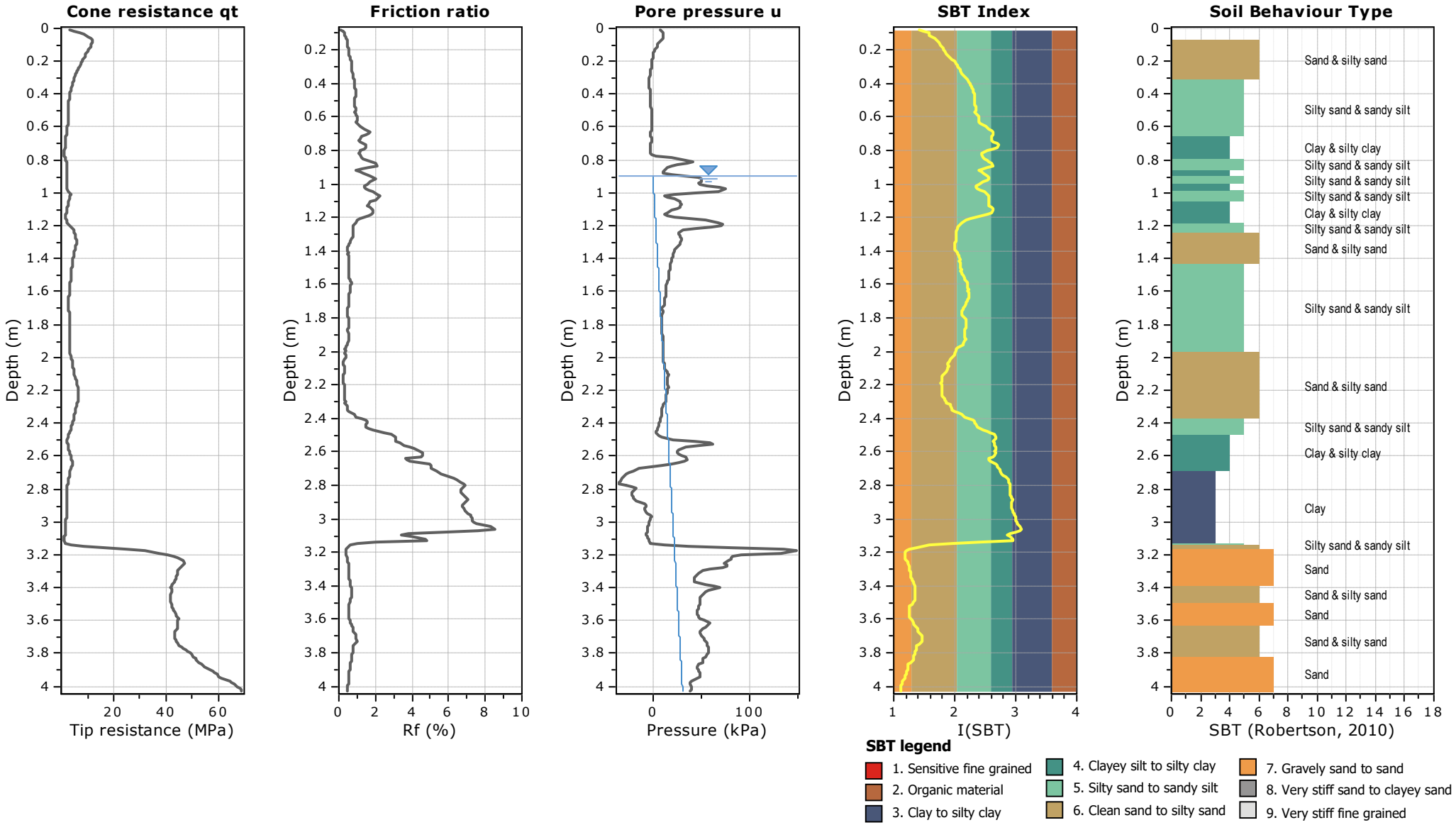


Fuzzy classifiaction legend
- Highly probable clayey soil
- Highly probable mixture soil
- Highly probable sandy soil

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

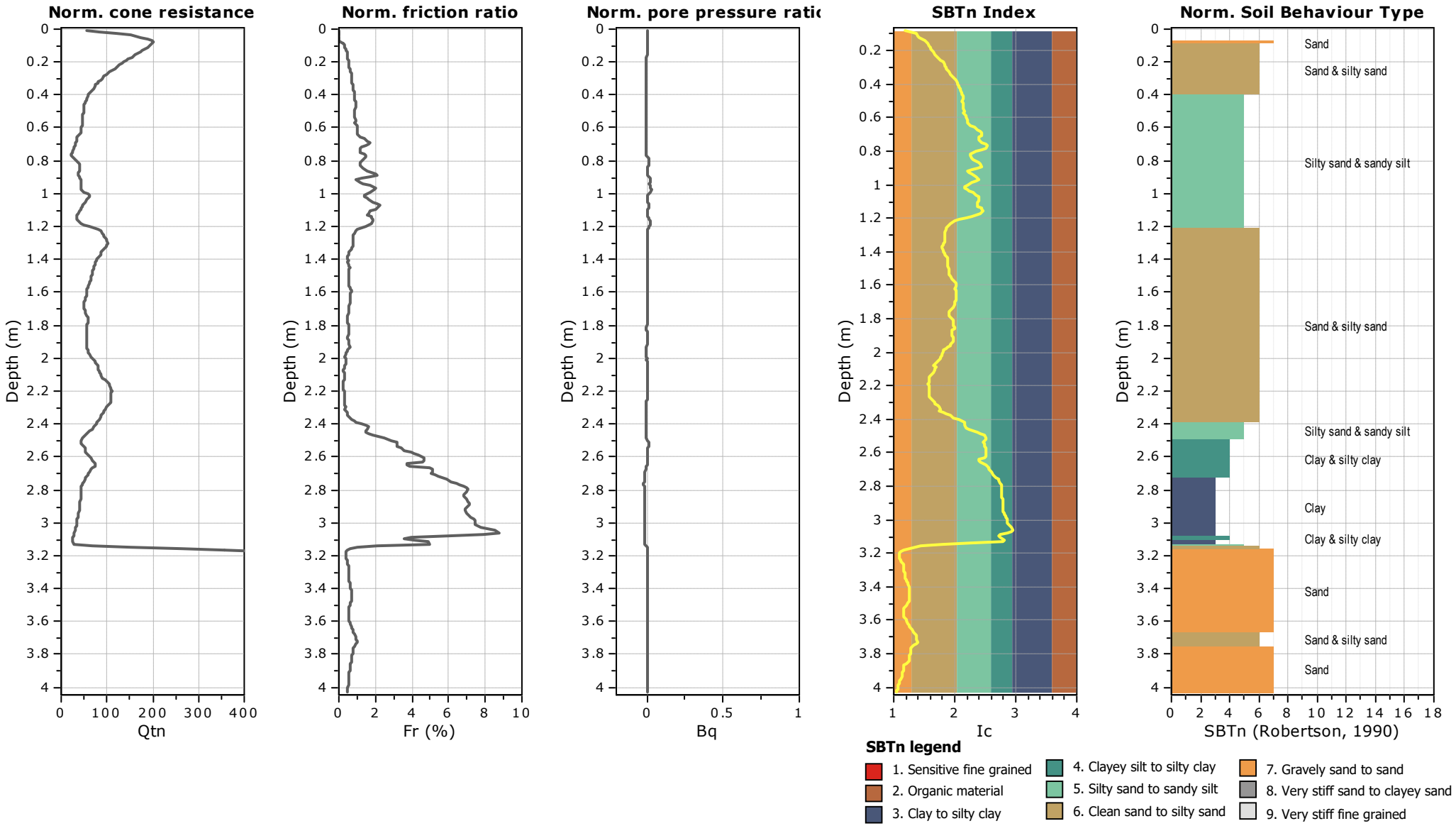
CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

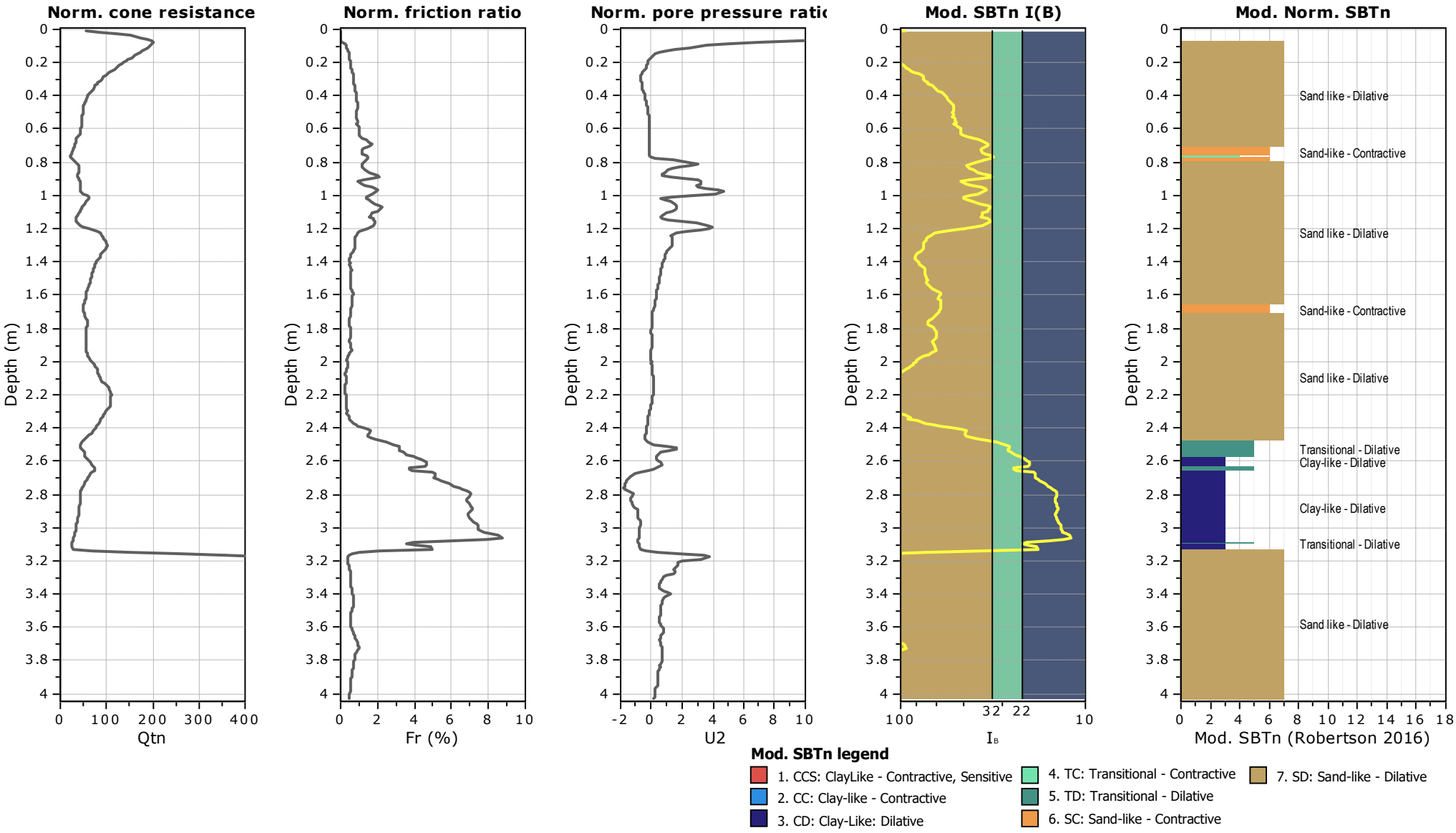
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

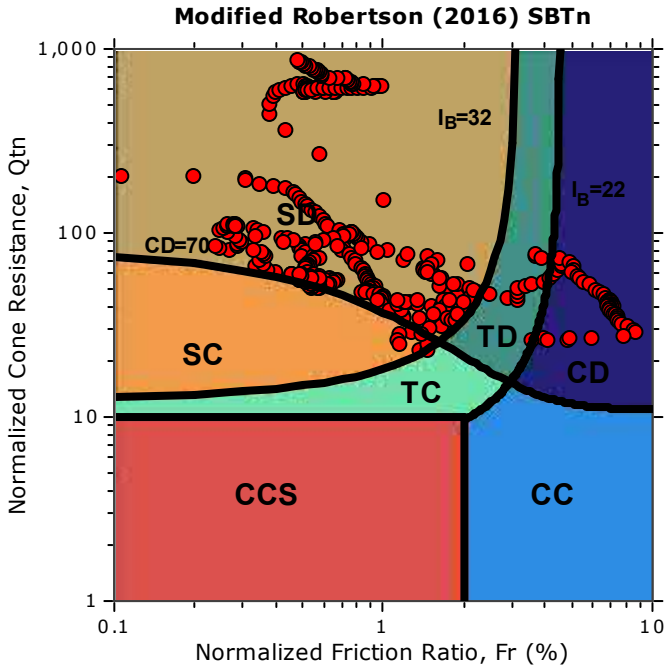


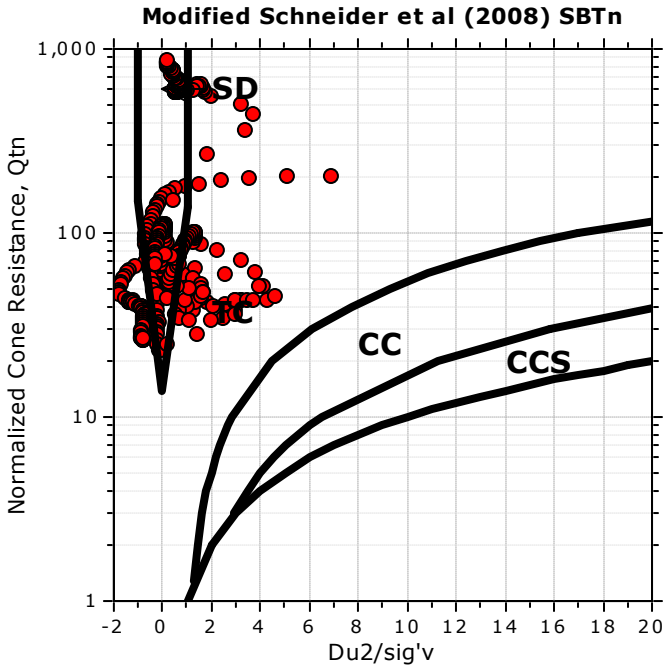
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

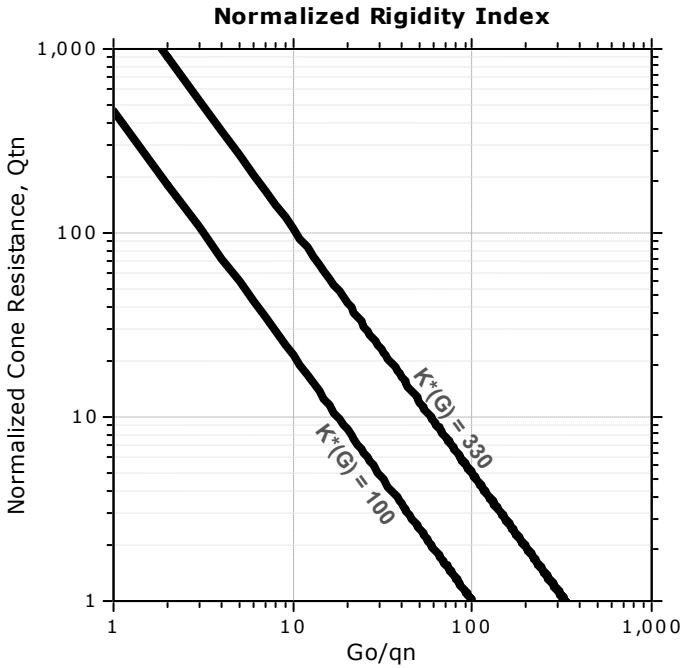
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Updated SBTn plots







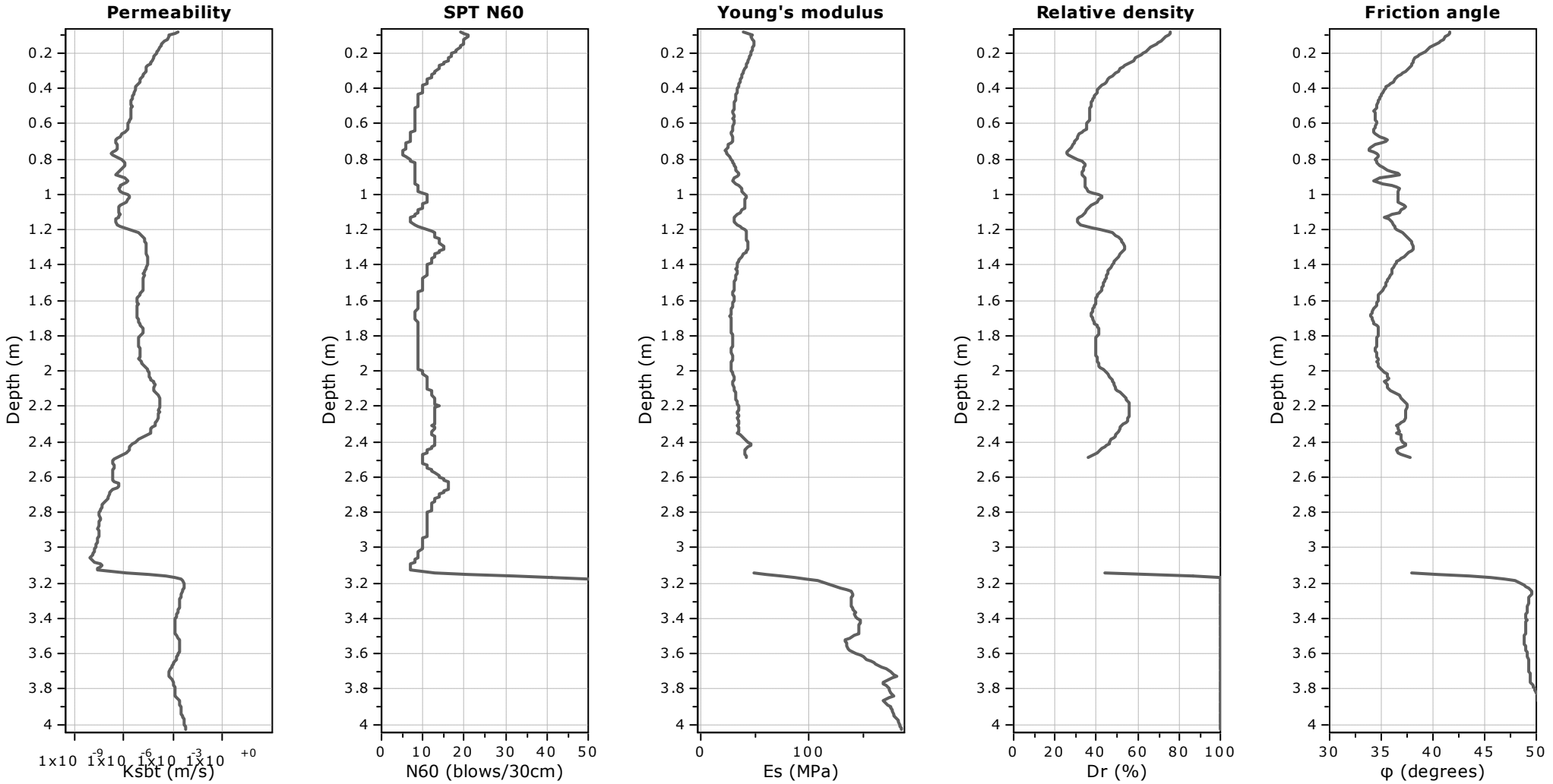
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



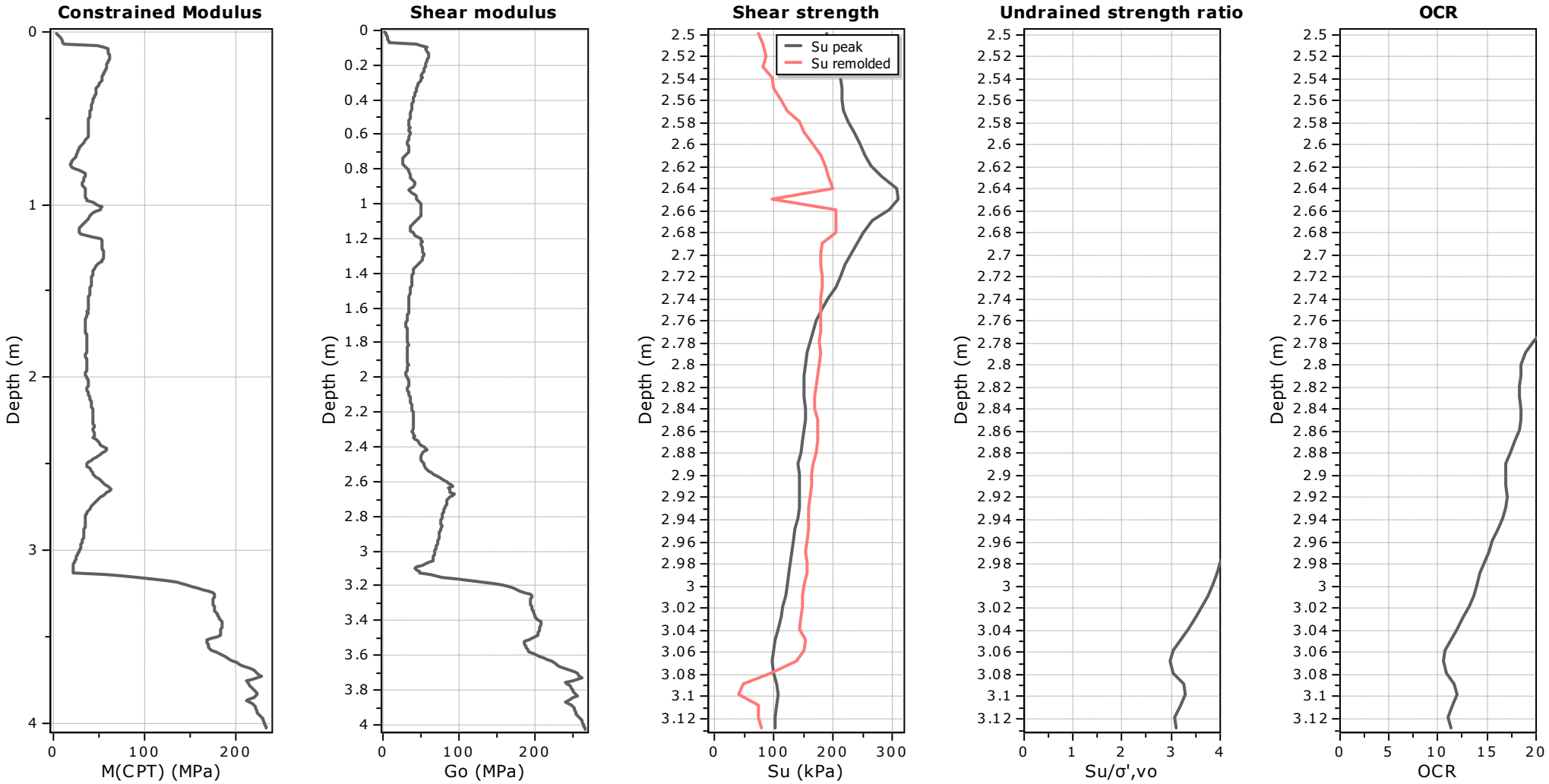
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



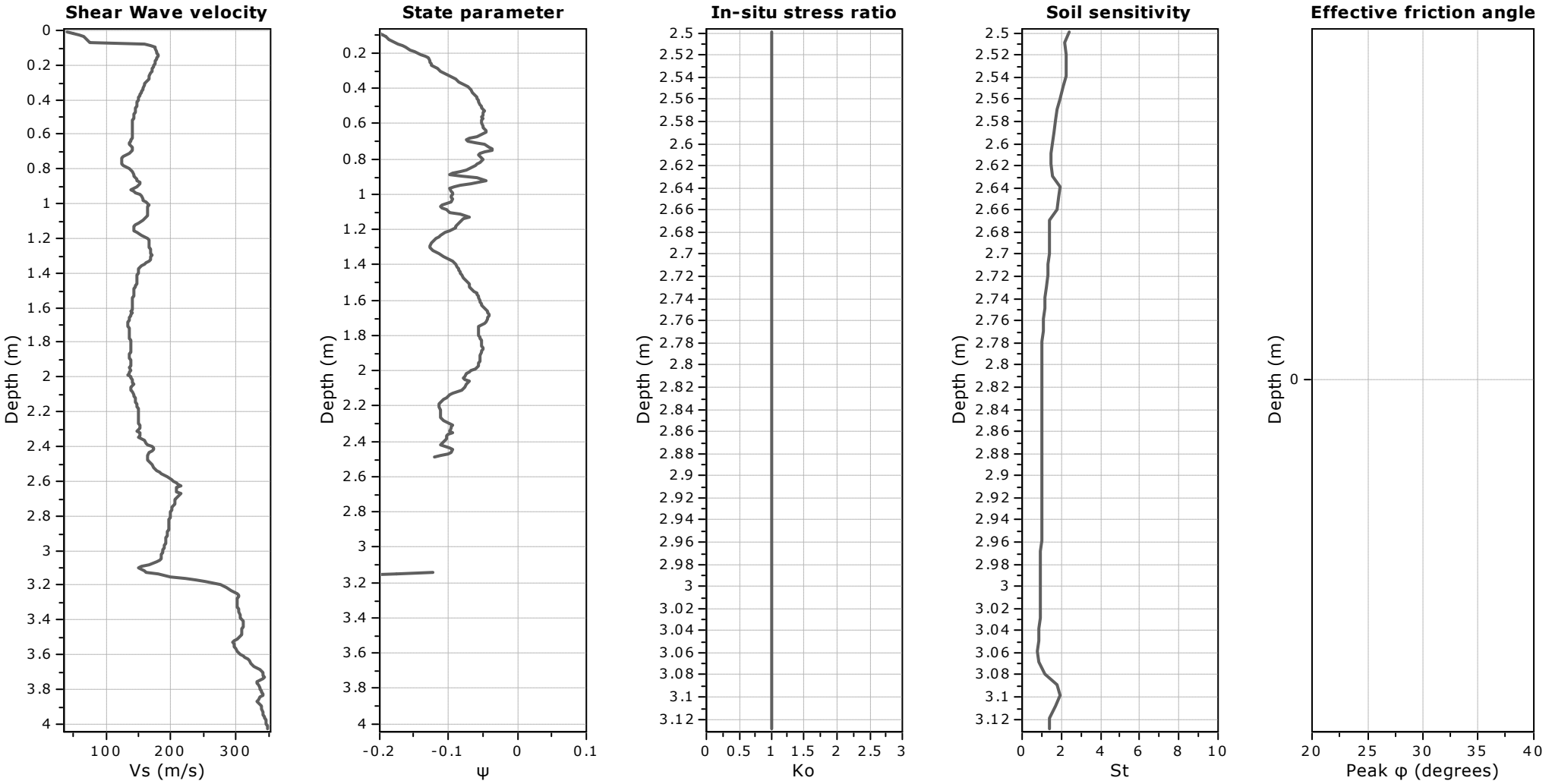
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto
OCR factor for clays, N_{kt}: Auto
Flat Dilatometer Test data

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



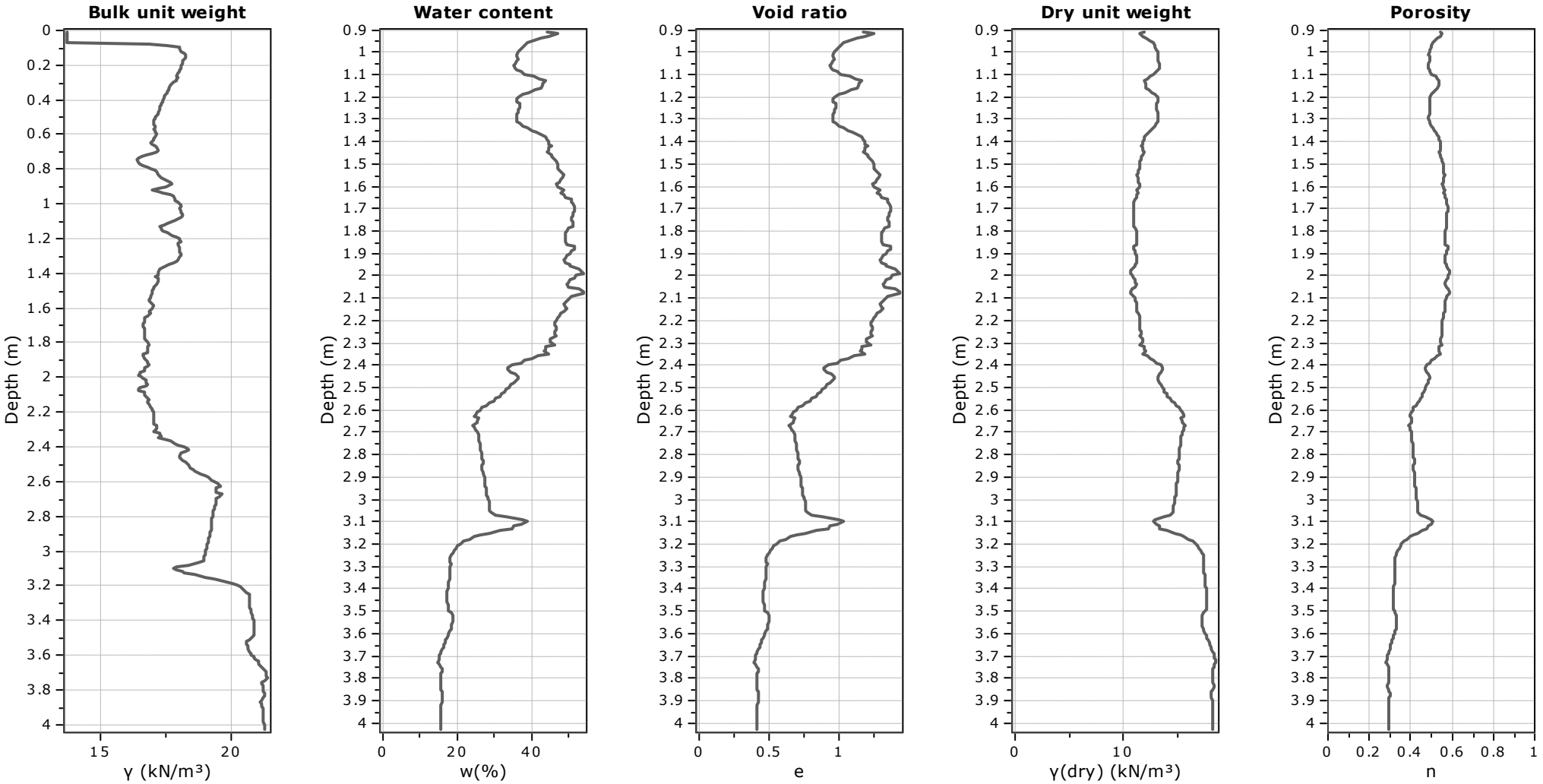
Calculation parameters

Soil Sensitivity factor, N_S: 7.00

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

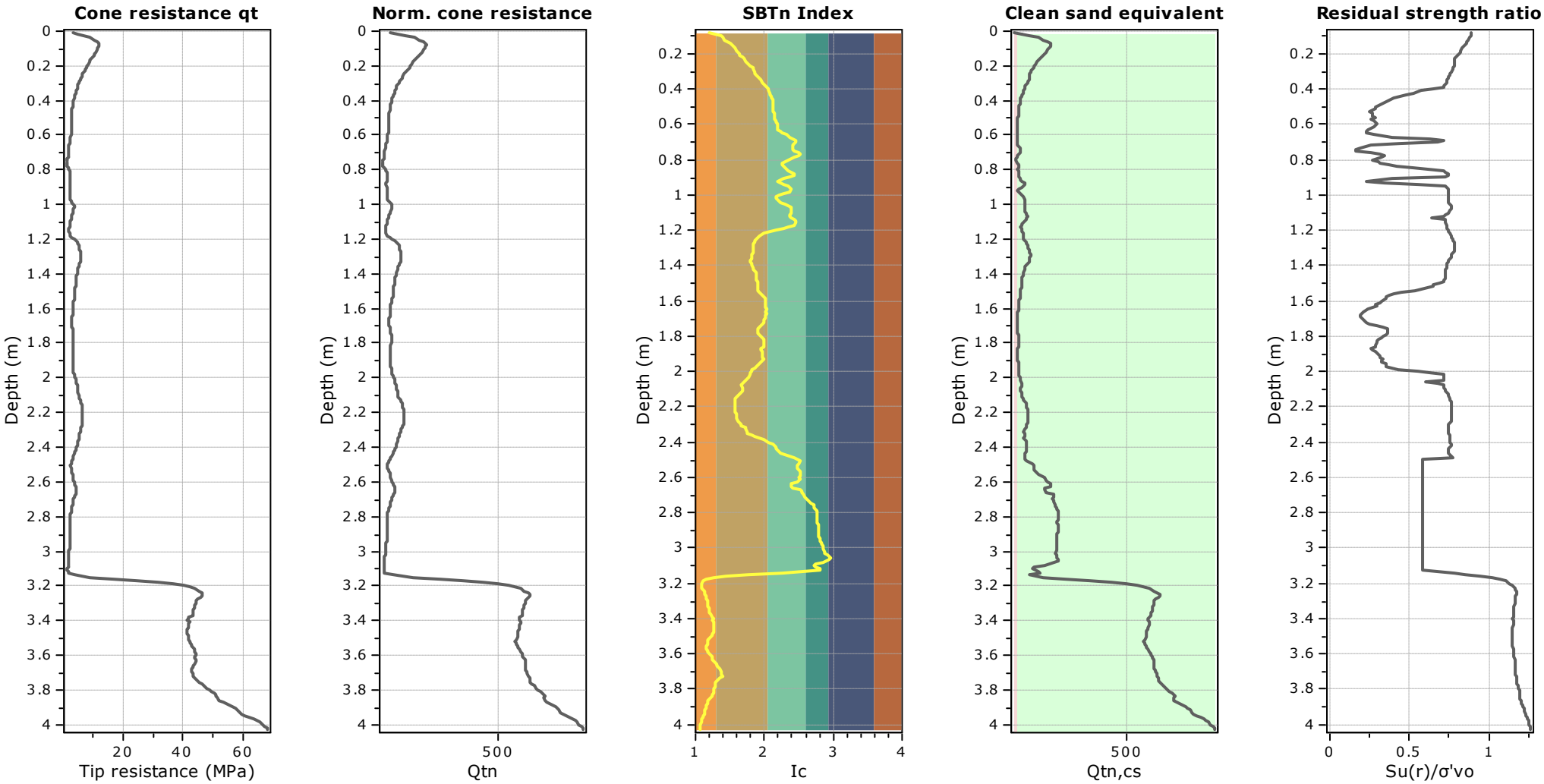
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

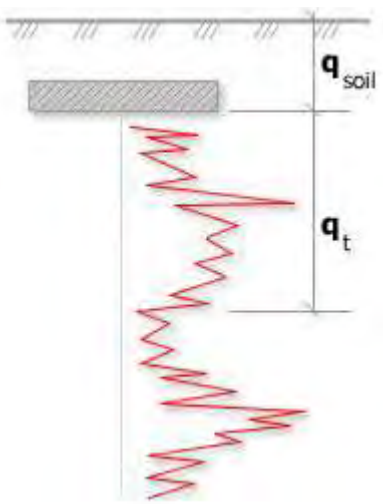


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

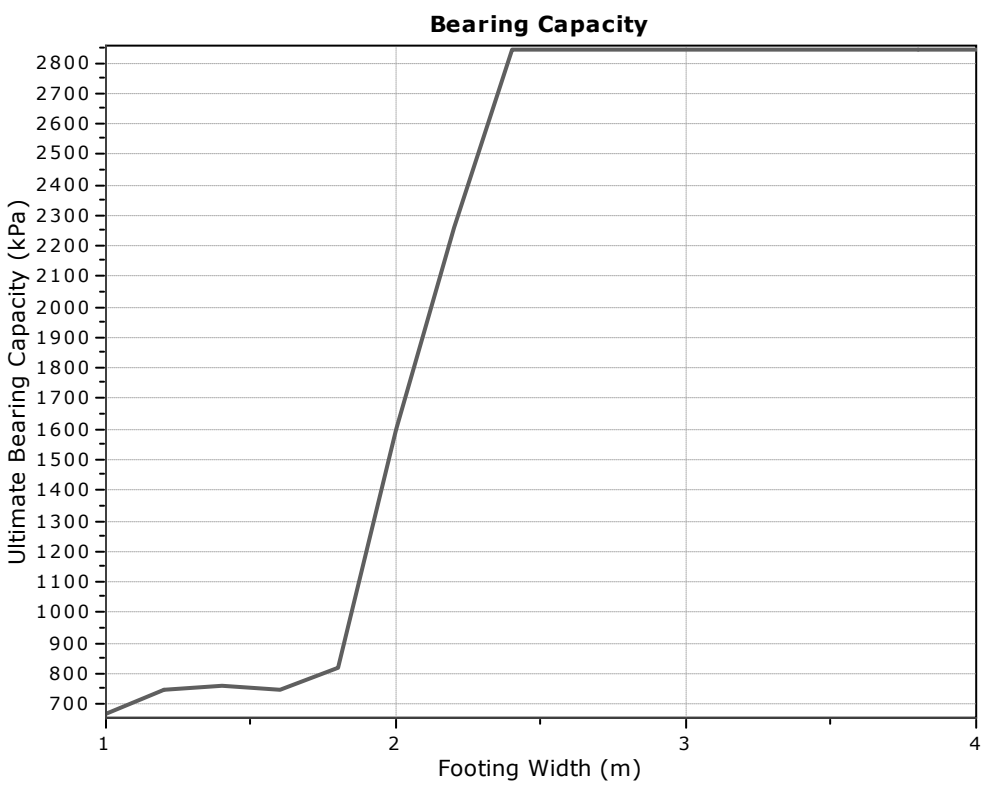




Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



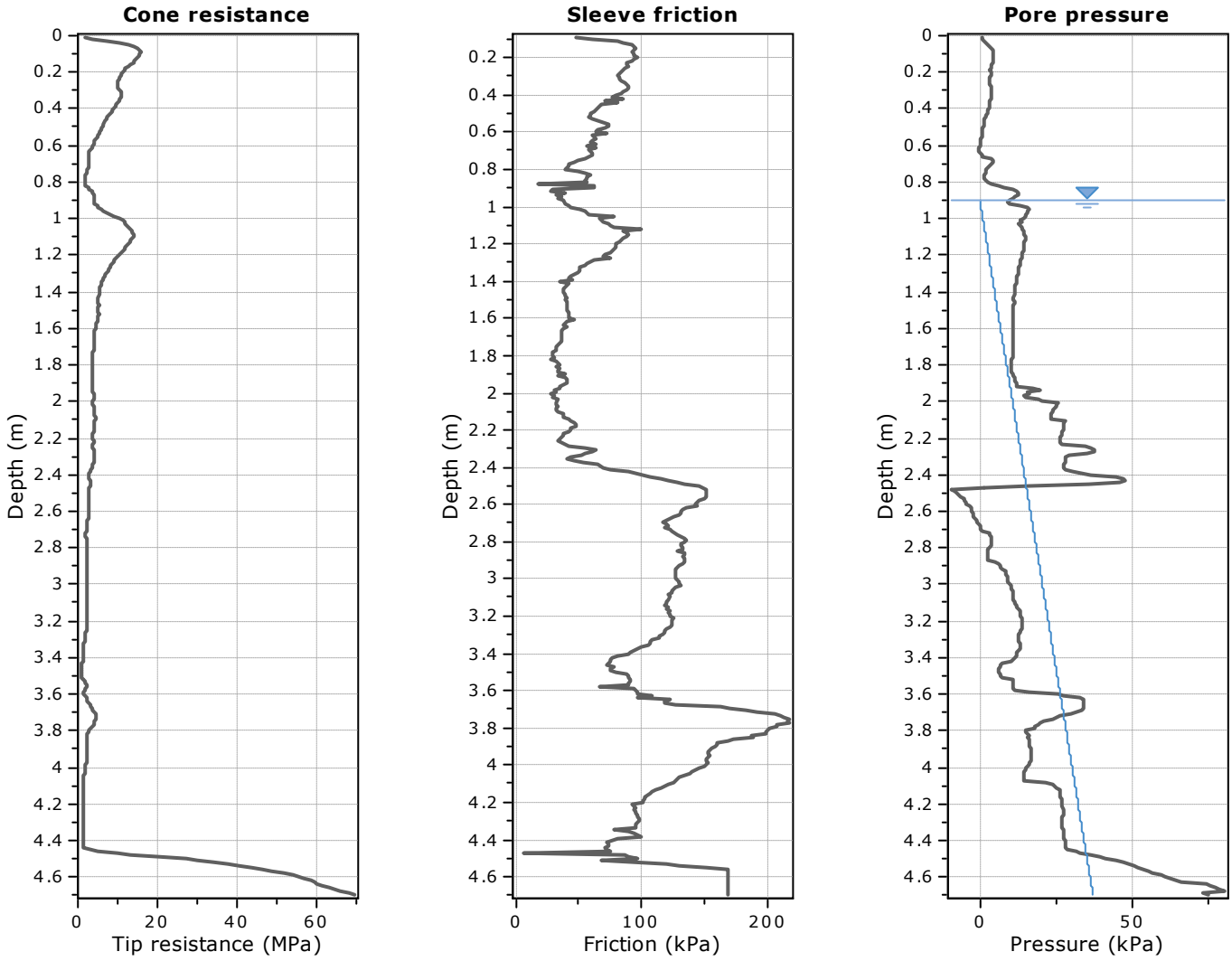
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	3.29	0.20	9.50	667.71
2	1.20	0.50	2.30	3.70	0.20	9.50	749.37
3	1.40	0.50	2.60	3.74	0.20	9.50	756.64
4	1.60	0.50	2.90	3.67	0.20	9.50	743.31
5	1.80	0.50	3.20	4.04	0.20	9.50	816.84
6	2.00	0.50	3.50	7.95	0.20	9.50	1600.29
7	2.20	0.50	3.80	11.24	0.20	9.50	2257.68
8	2.40	0.50	4.10	14.17	0.20	9.50	2843.11
9	2.60	0.50	4.40	14.17	0.20	9.50	2843.11
10	2.80	0.50	4.70	14.17	0.20	9.50	2843.11
11	3.00	0.50	5.00	14.17	0.20	9.50	2843.11
12	3.20	0.50	5.30	14.17	0.20	9.50	2843.11
13	3.40	0.50	5.60	14.17	0.20	9.50	2843.11
14	3.60	0.50	5.90	14.17	0.20	9.50	2843.11
15	3.80	0.50	6.20	14.17	0.20	9.50	2843.11
16	4.00	0.50	6.50	14.17	0.20	9.50	2843.11

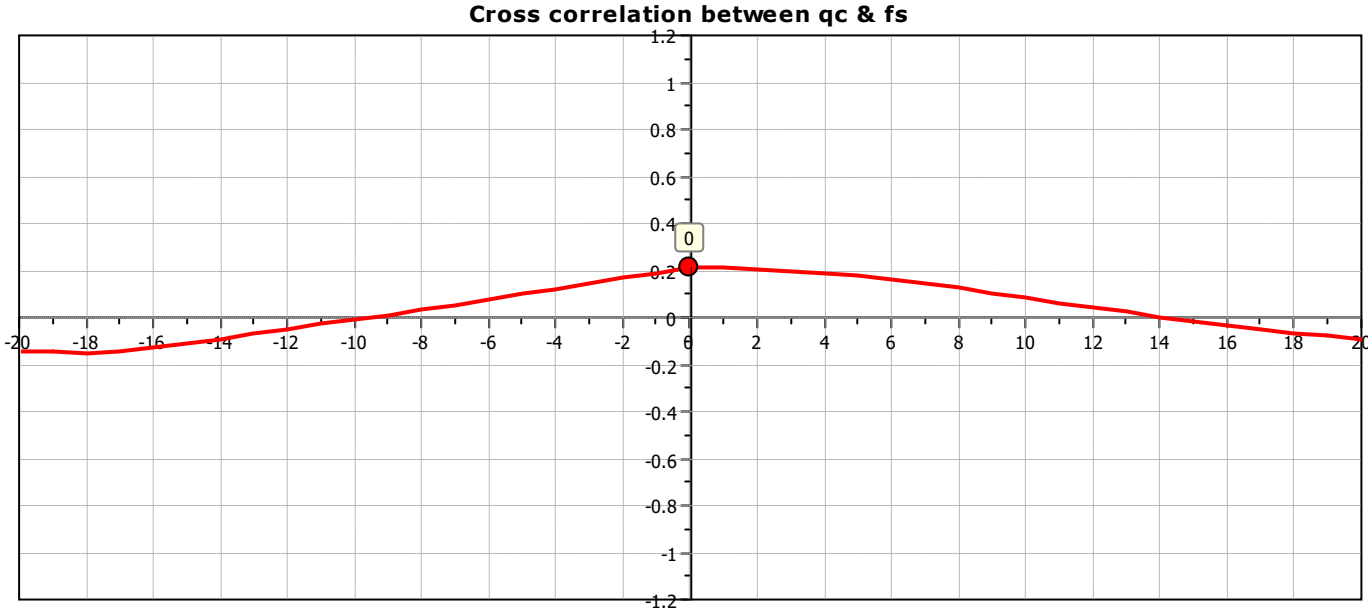
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

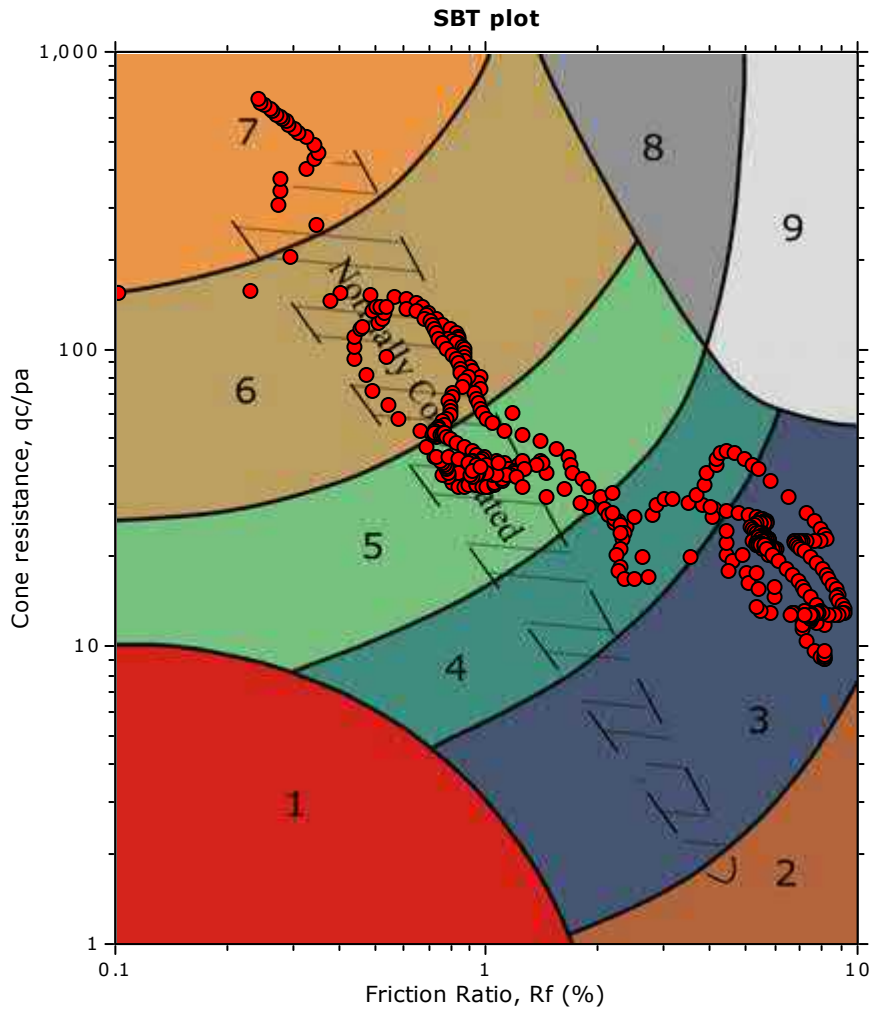


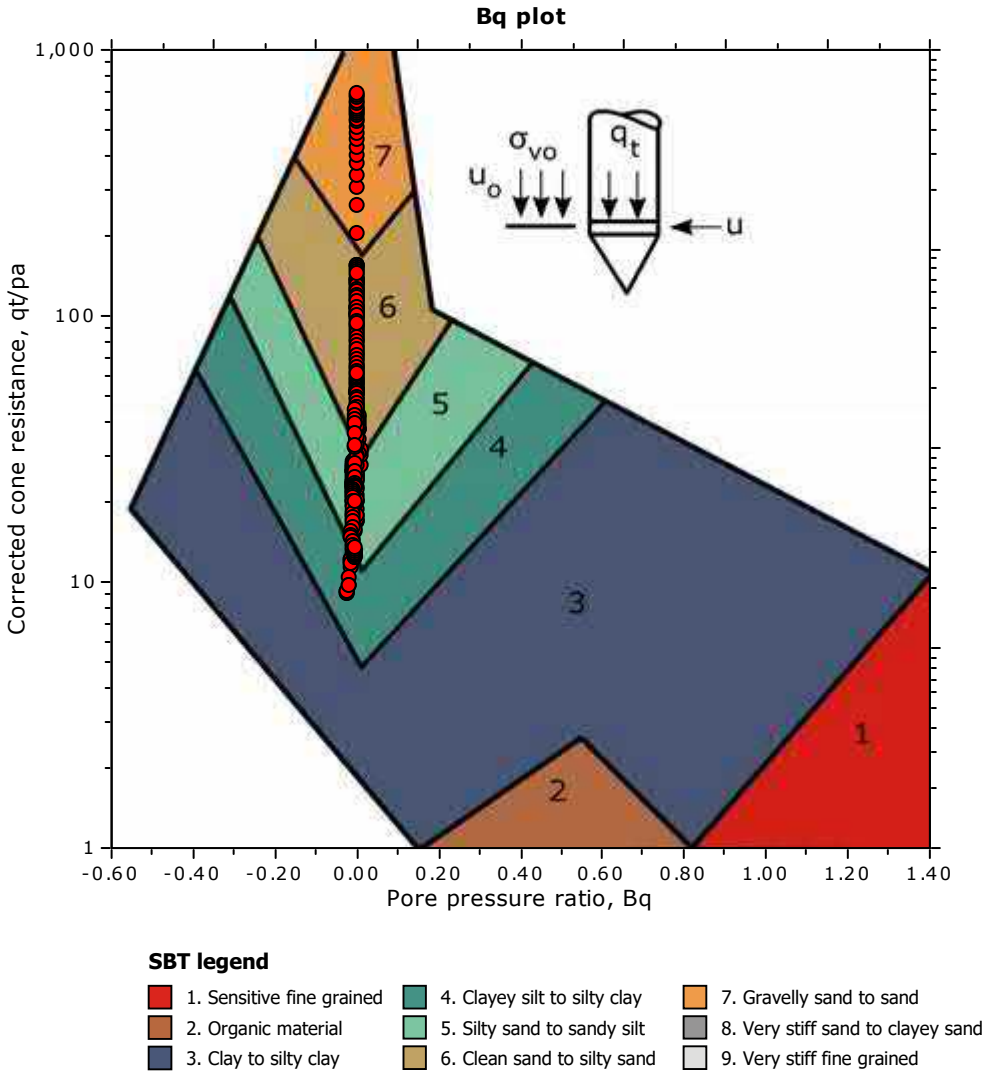
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots



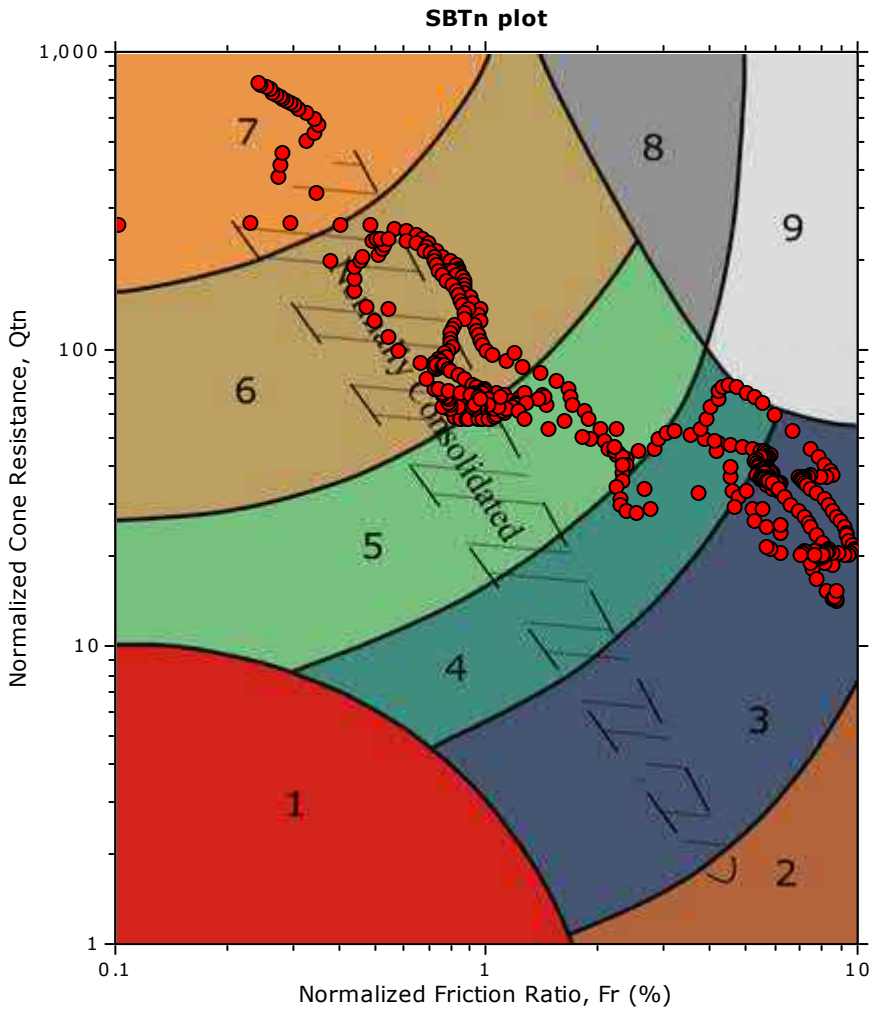


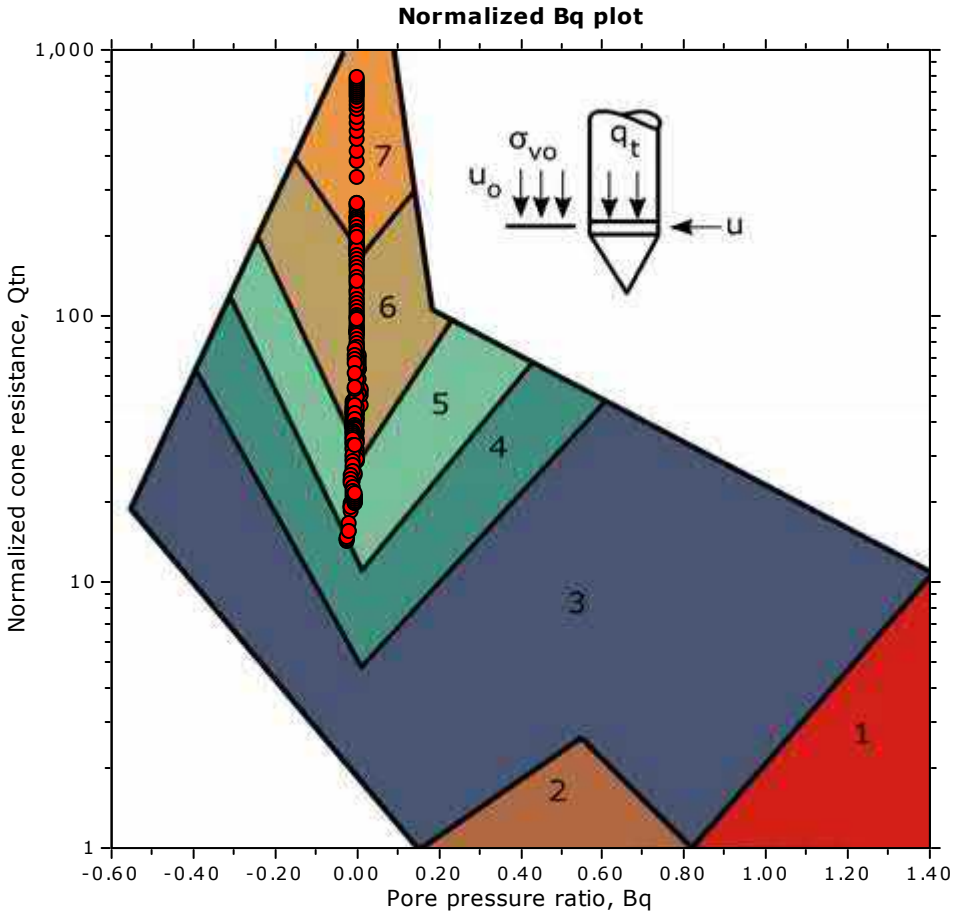
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots (normalized)





SBTn legend

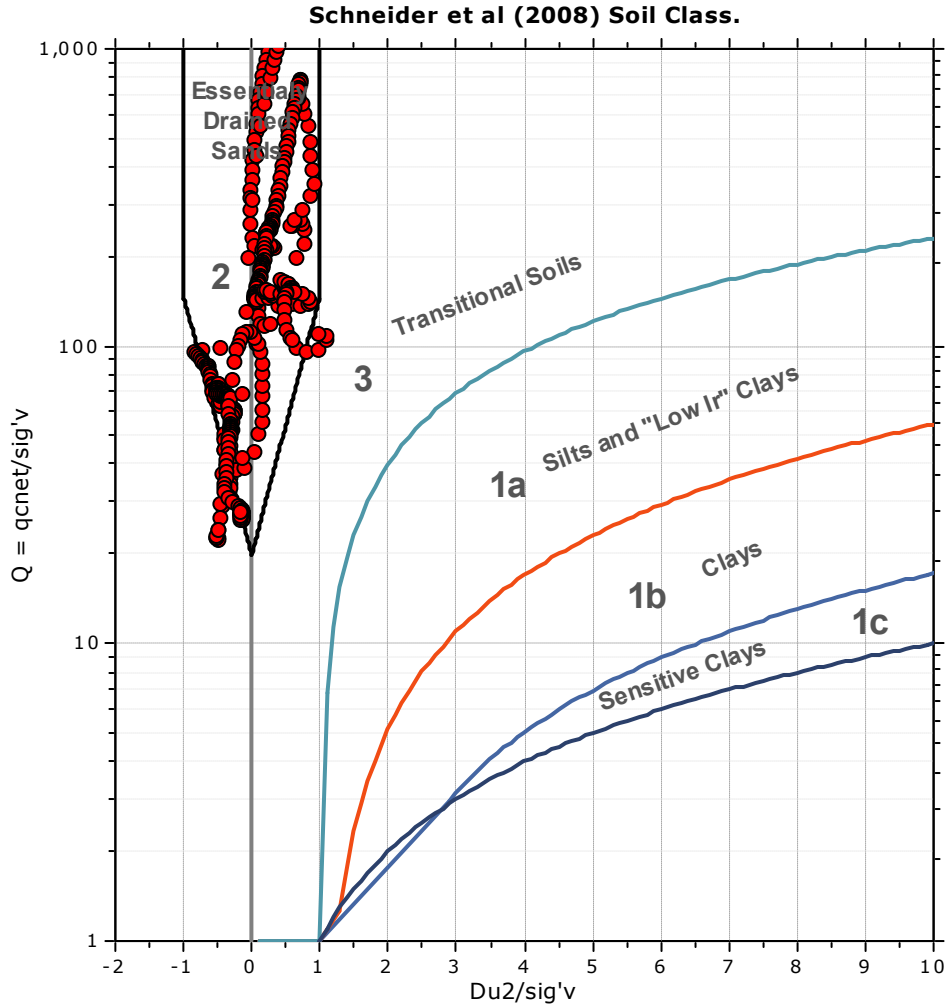
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

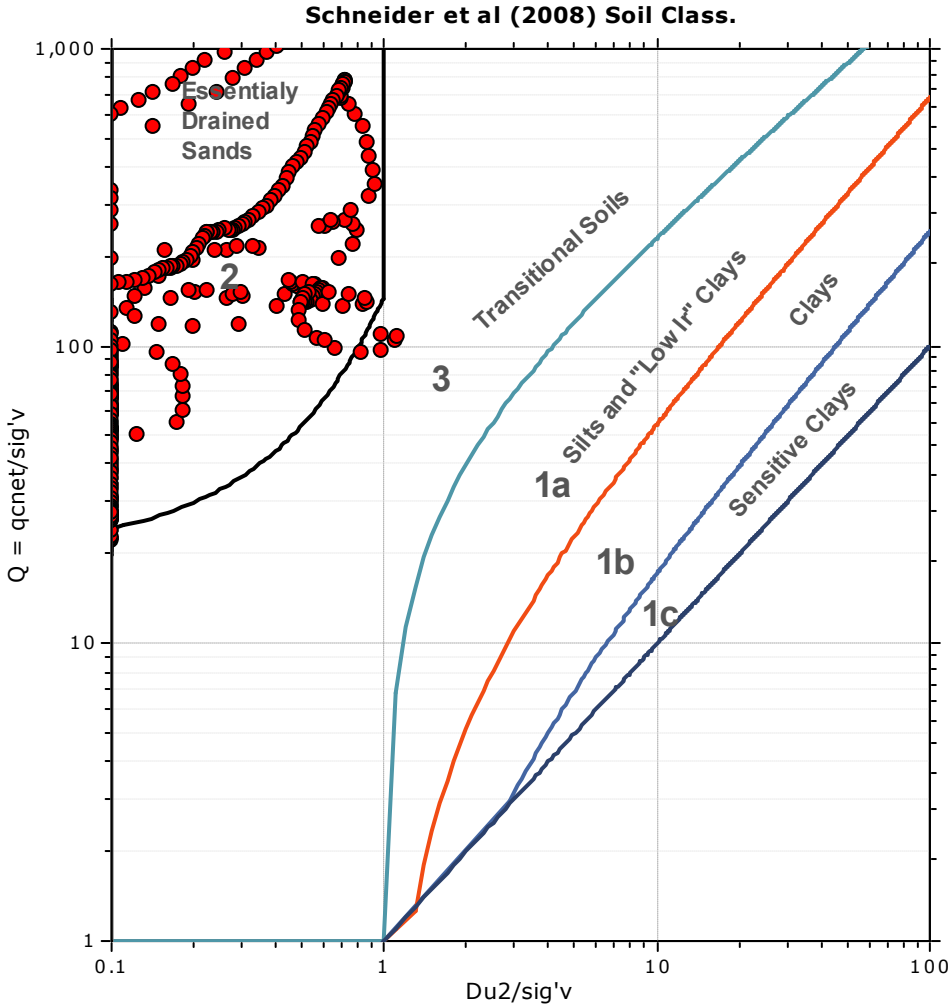
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

Bq plots (Schneider)

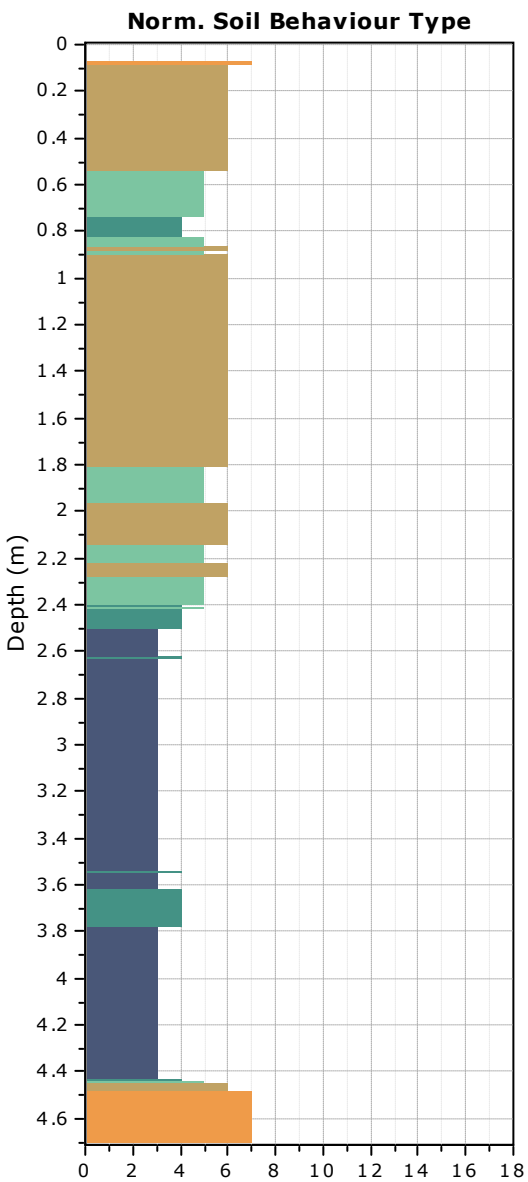


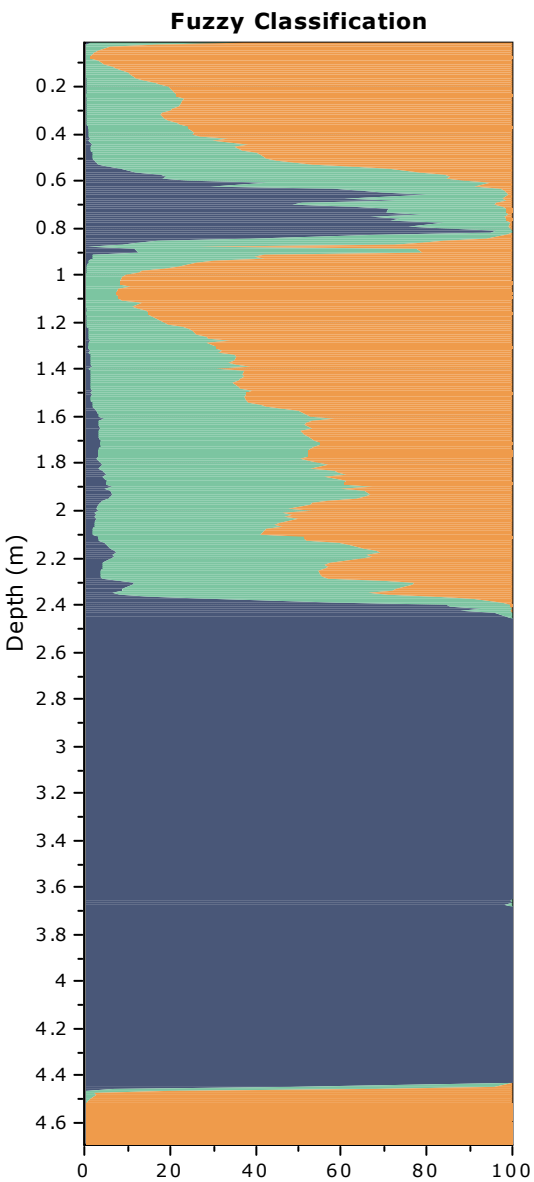


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



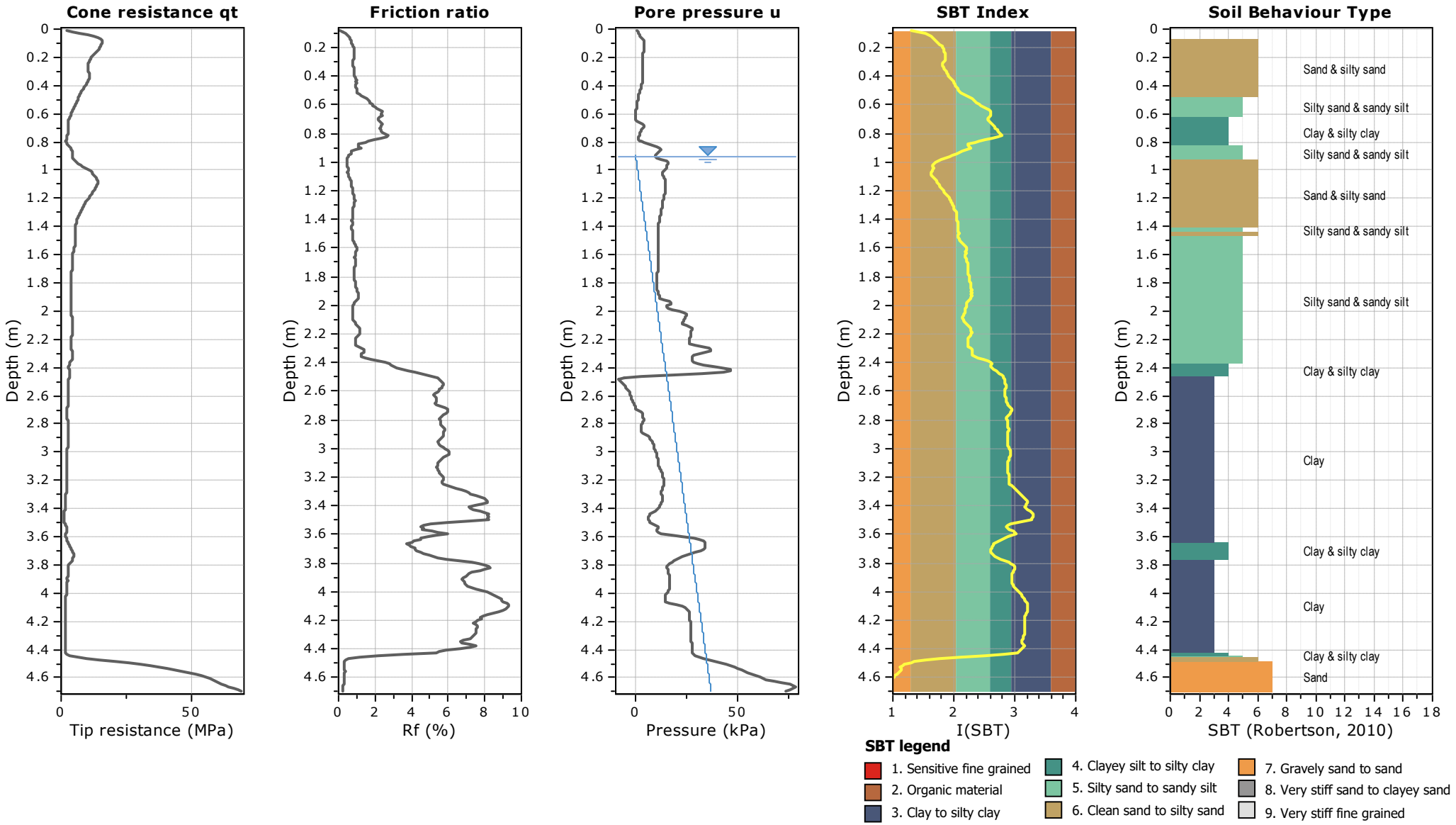


Fuzzy classifiaction legend
- Highly probable clayey soil
- Highly probable mixture soil
- Highly probable sandy soil

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

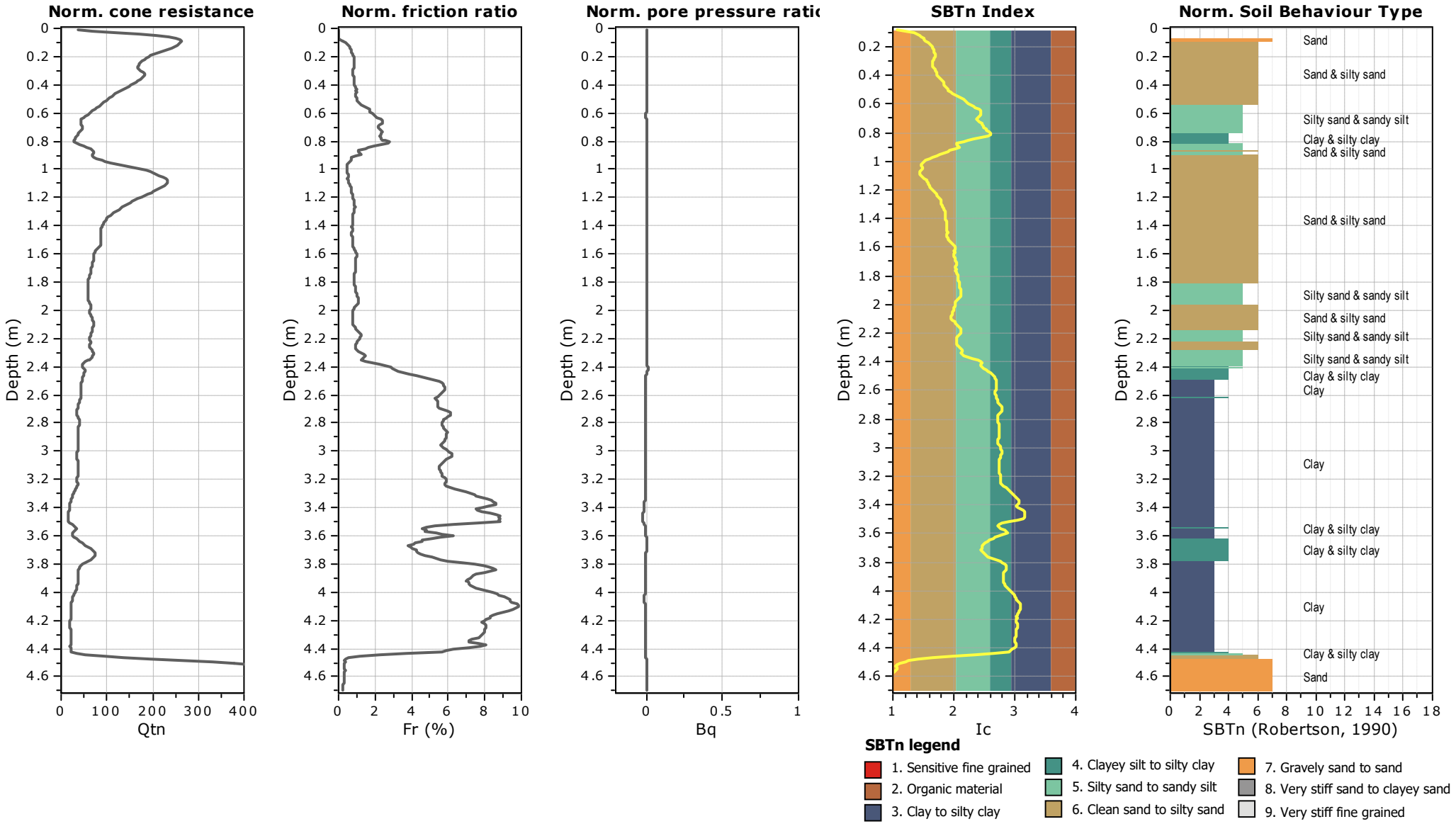
CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

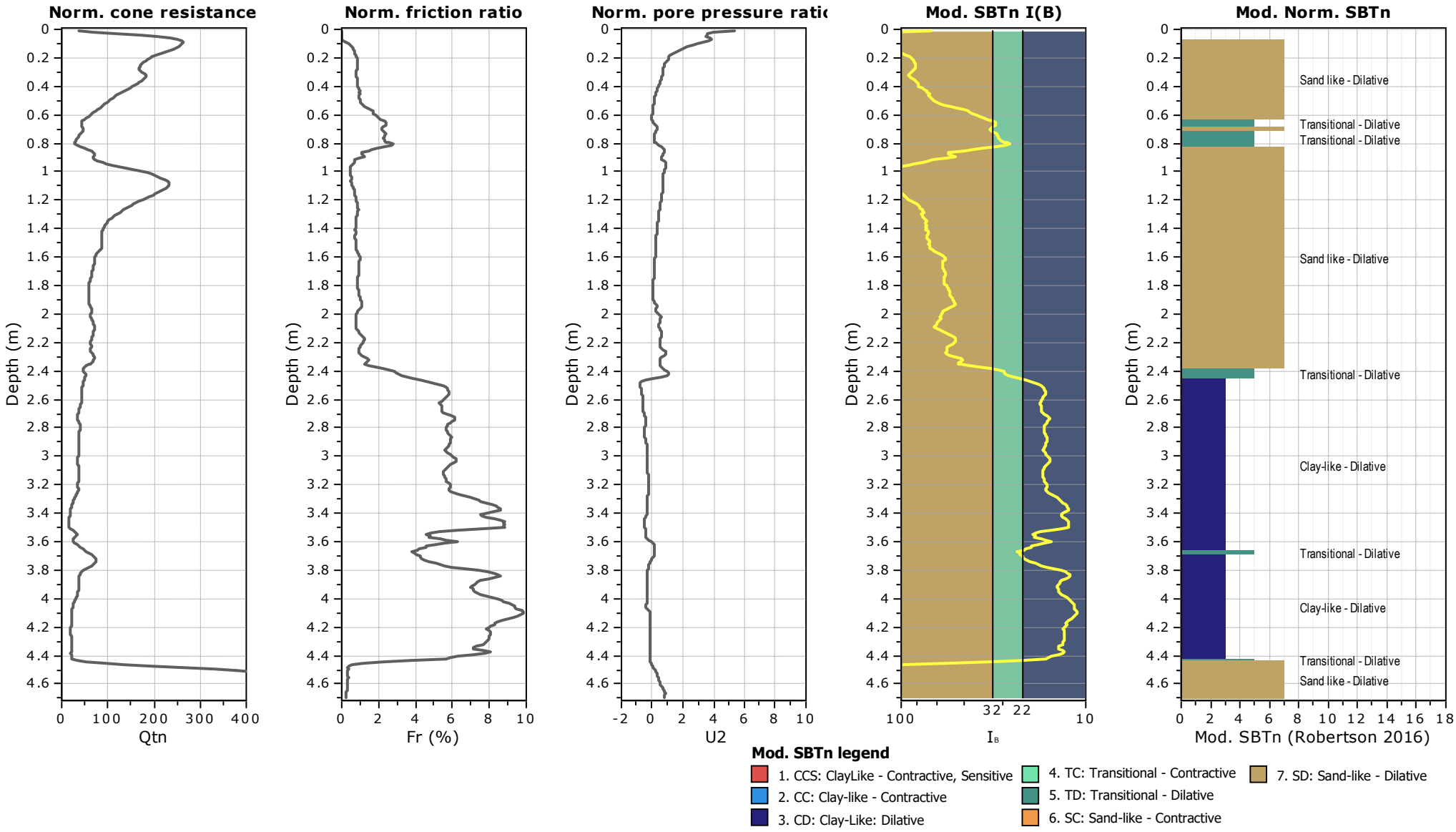
CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

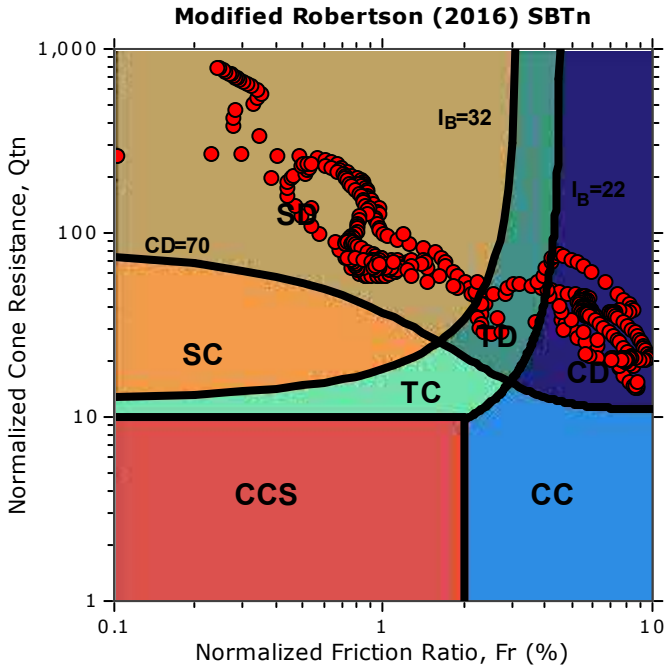


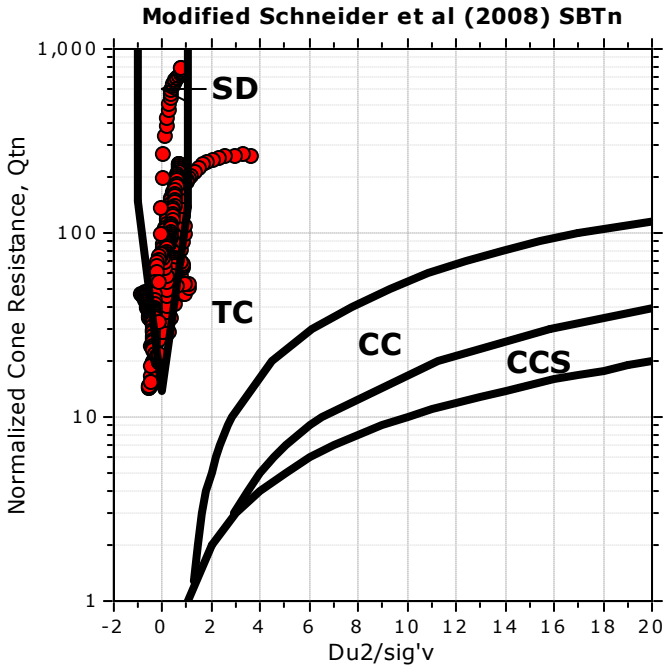
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

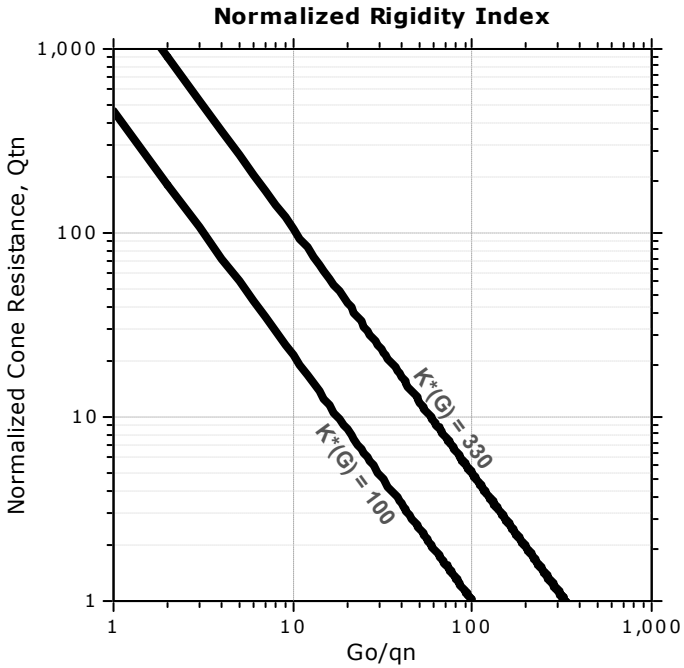
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Updated SBTn plots







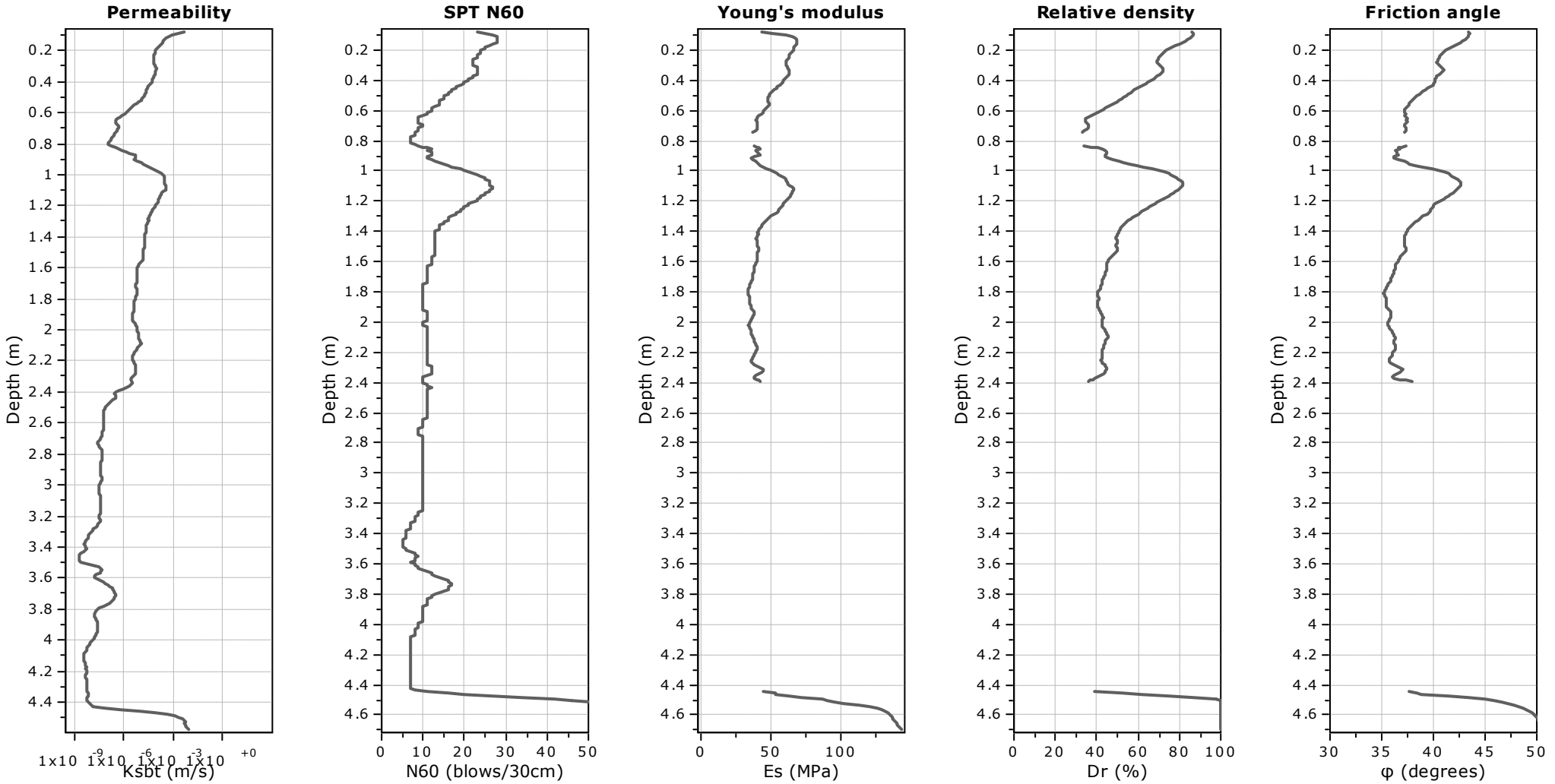
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



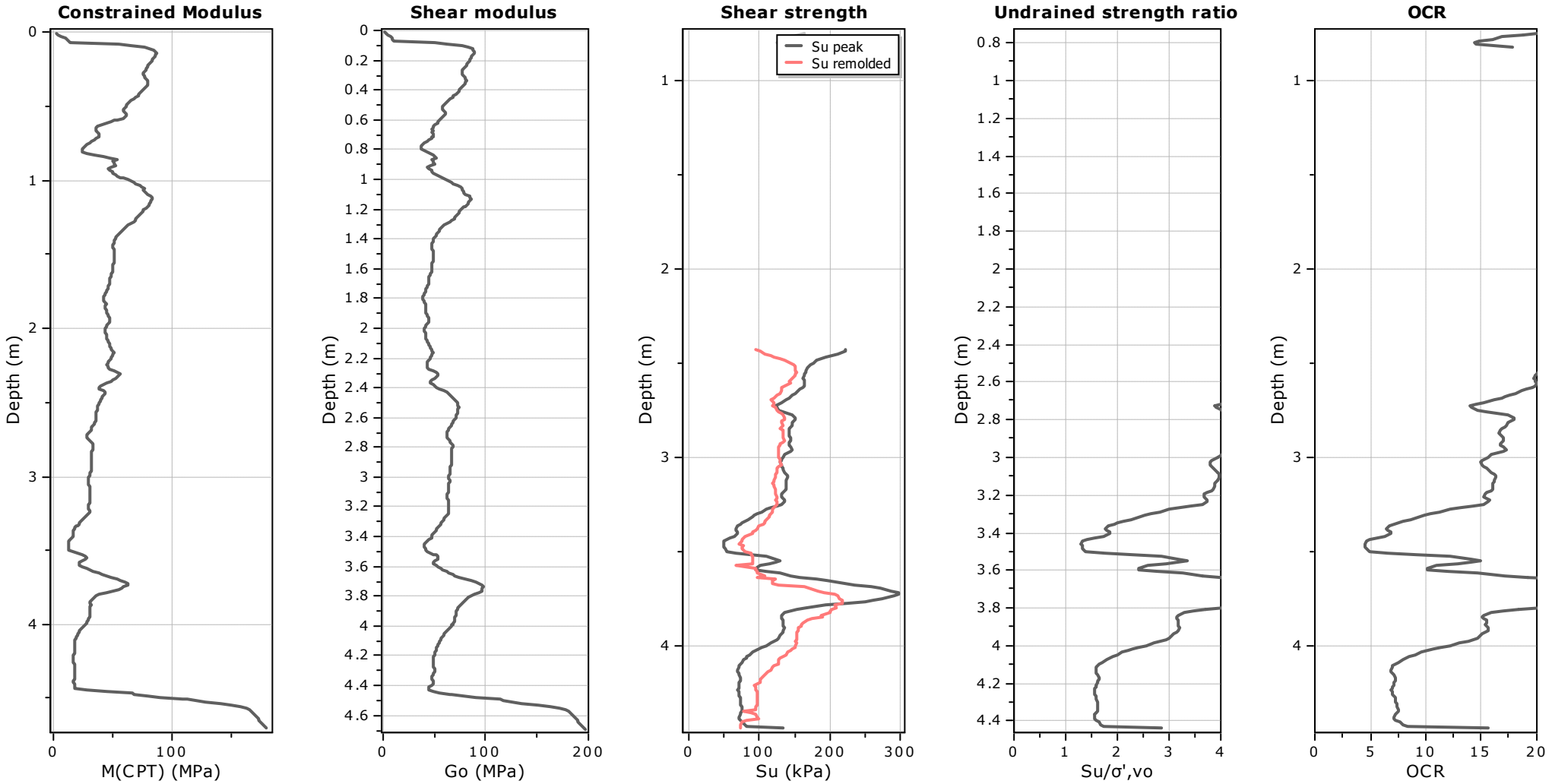
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



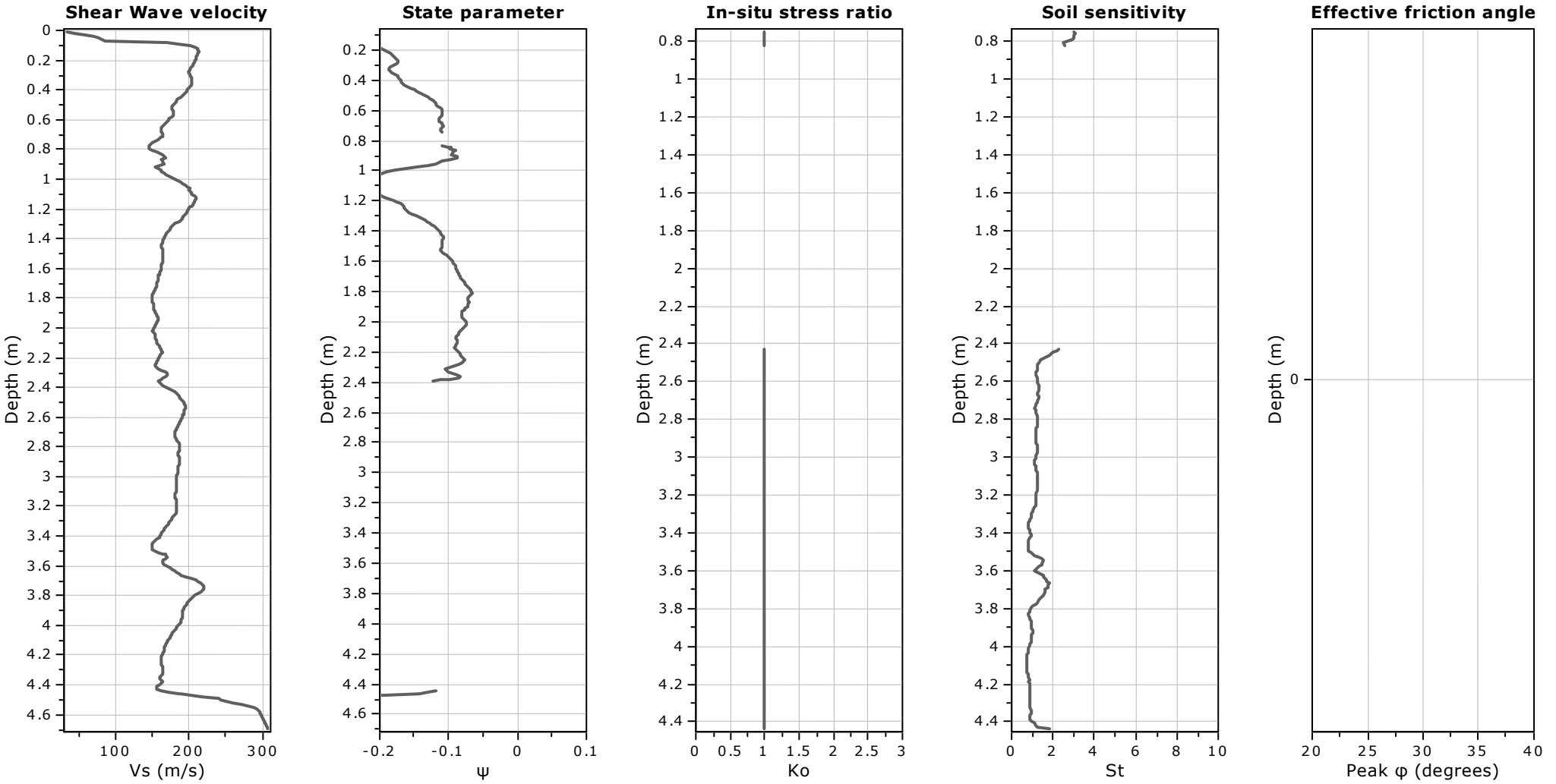
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto
OCR factor for clays, N_{kt}: Auto
Flat Dilatometer Test data

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



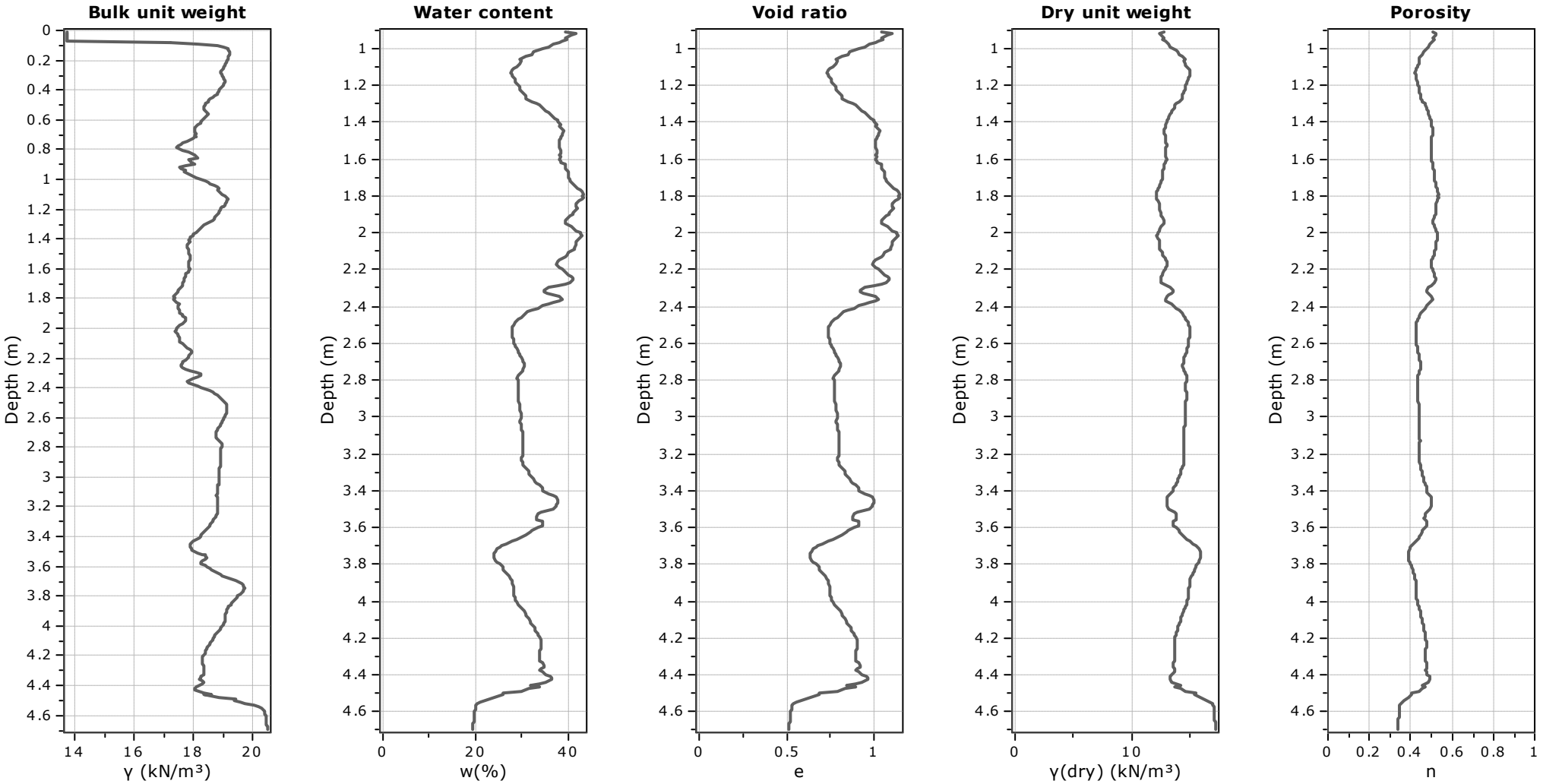
Calculation parameters

Soil Sensitivity factor, N_S: 7.00

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

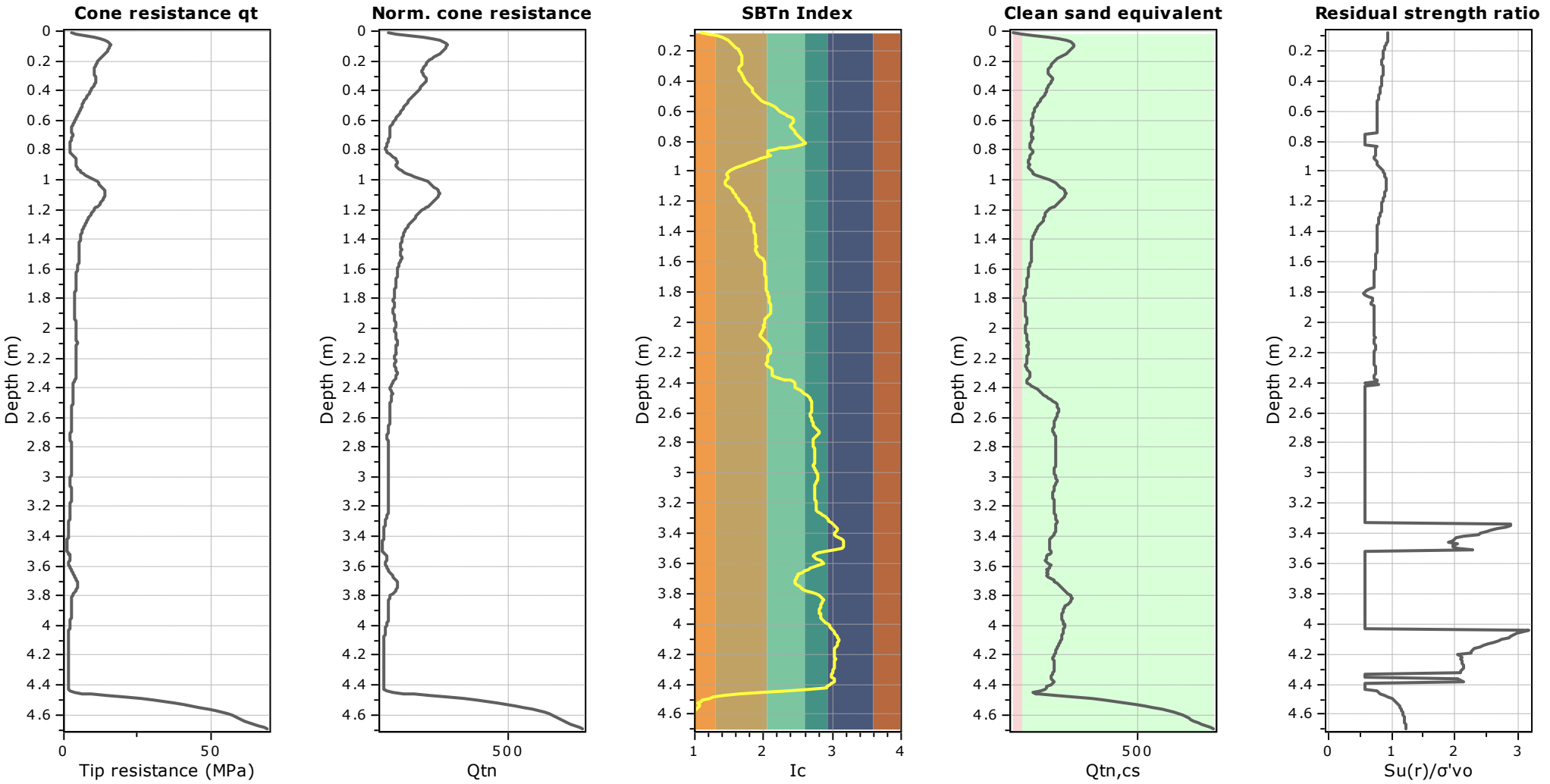
CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

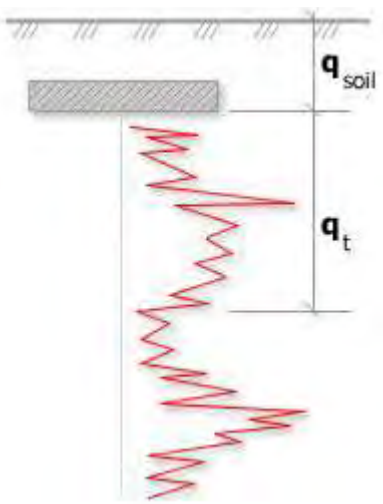
CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

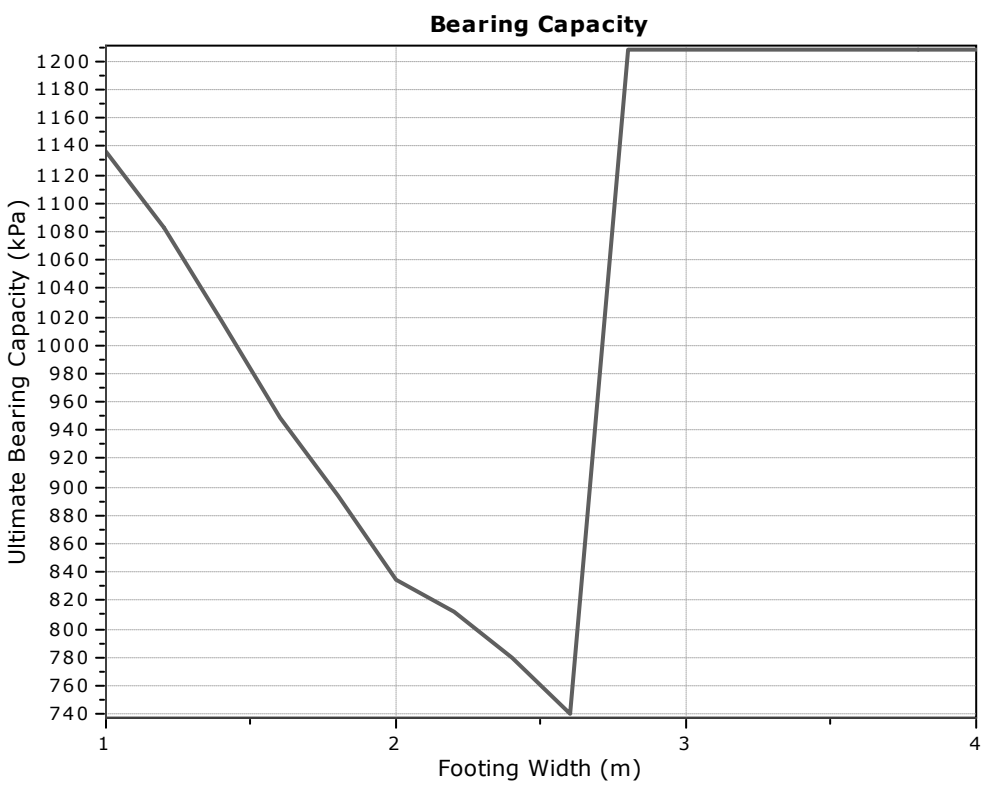
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



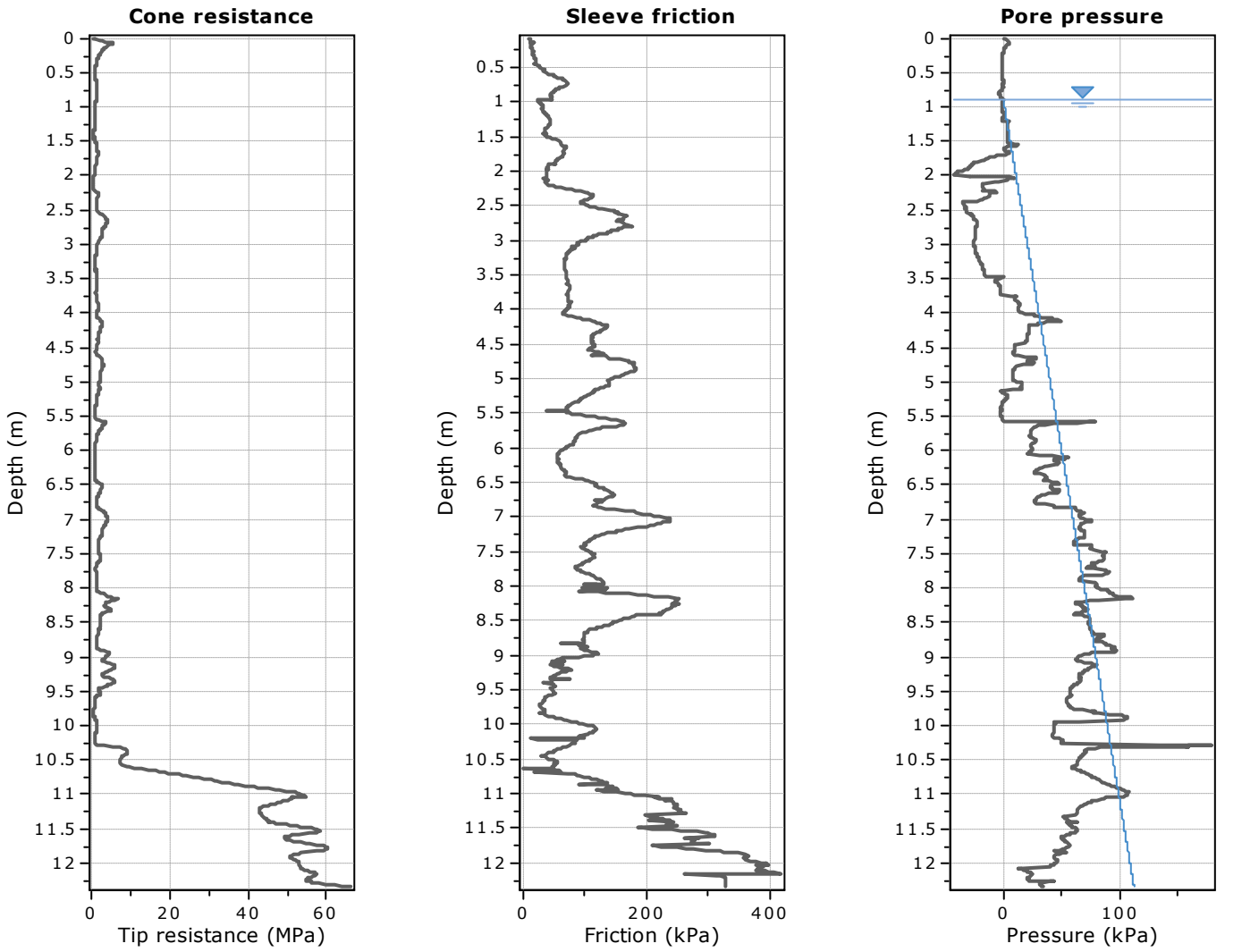
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	5.64	0.20	9.50	1136.82
2	1.20	0.50	2.30	5.37	0.20	9.50	1082.55
3	1.40	0.50	2.60	5.04	0.20	9.50	1016.86
4	1.60	0.50	2.90	4.70	0.20	9.50	949.24
5	1.80	0.50	3.20	4.42	0.20	9.50	894.49
6	2.00	0.50	3.50	4.13	0.20	9.50	835.25
7	2.20	0.50	3.80	4.01	0.20	9.50	812.38
8	2.40	0.50	4.10	3.85	0.20	9.50	779.32
9	2.60	0.50	4.40	3.65	0.20	9.50	740.09
10	2.80	0.50	4.70	5.99	0.20	9.50	1208.39
11	3.00	0.50	5.00	5.99	0.20	9.50	1208.39
12	3.20	0.50	5.30	5.99	0.20	9.50	1208.39
13	3.40	0.50	5.60	5.99	0.20	9.50	1208.39
14	3.60	0.50	5.90	5.99	0.20	9.50	1208.39
15	3.80	0.50	6.20	5.99	0.20	9.50	1208.39
16	4.00	0.50	6.50	5.99	0.20	9.50	1208.39

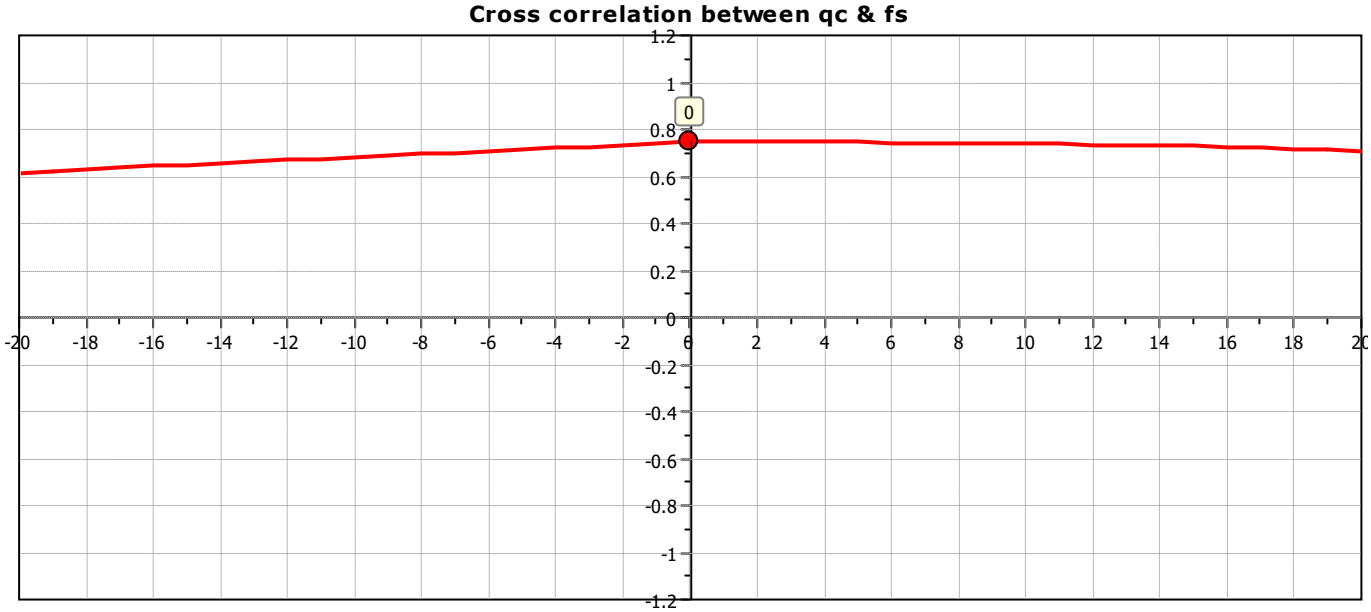
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

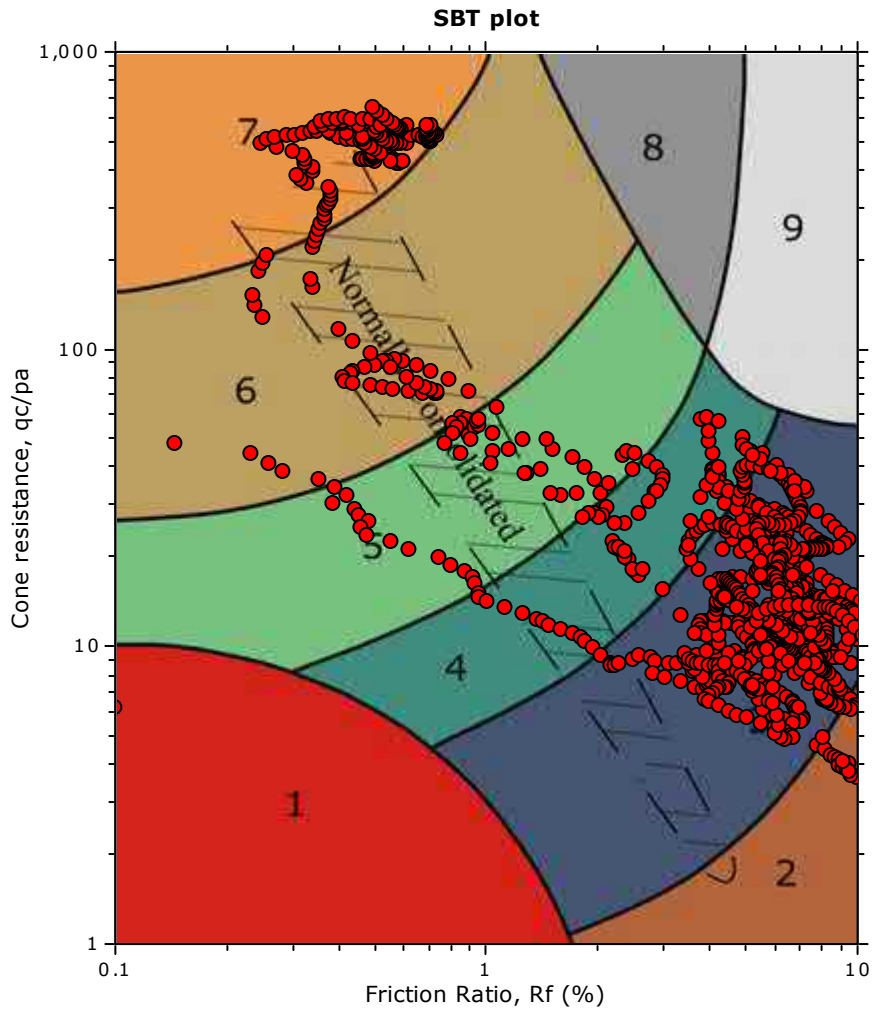


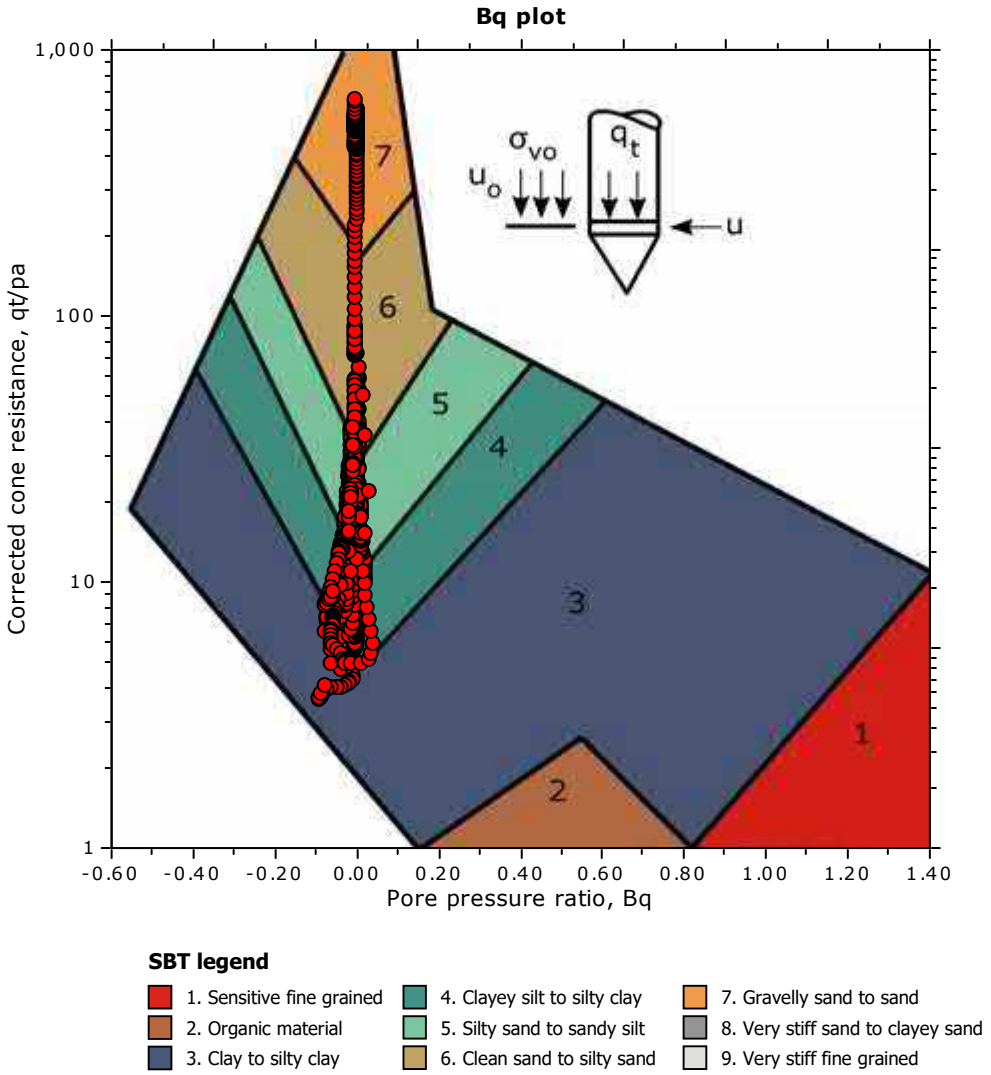
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots



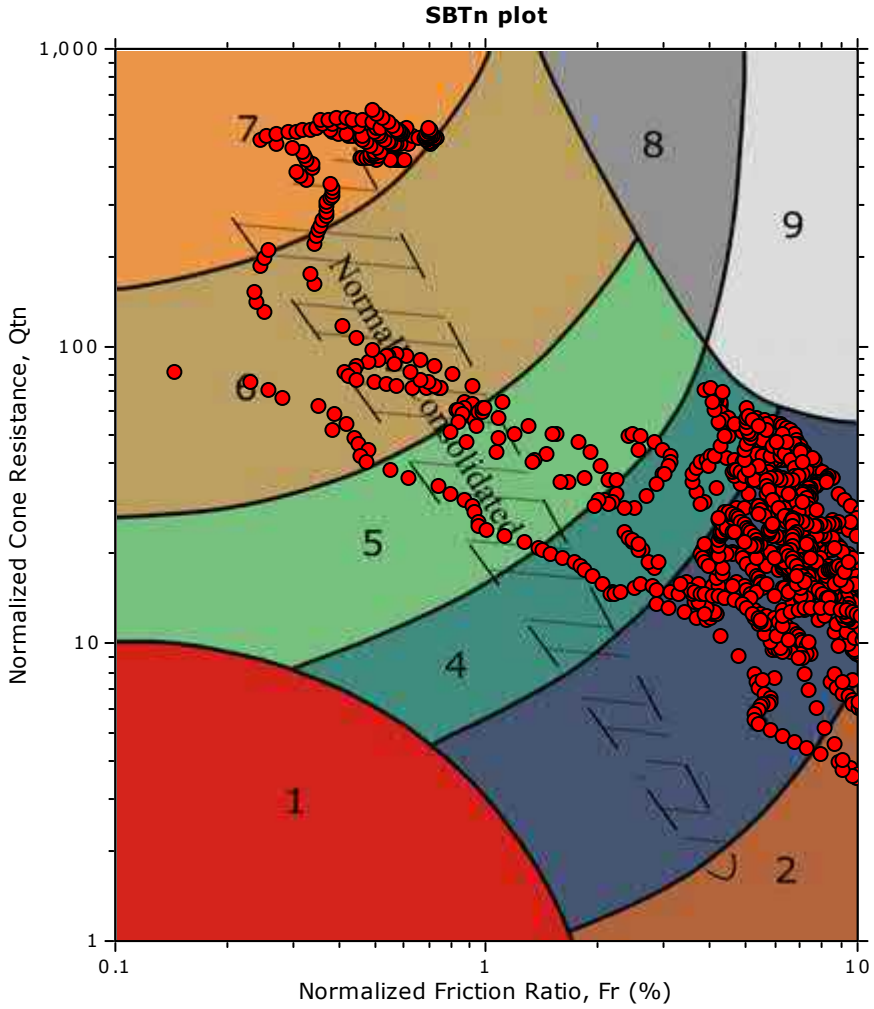


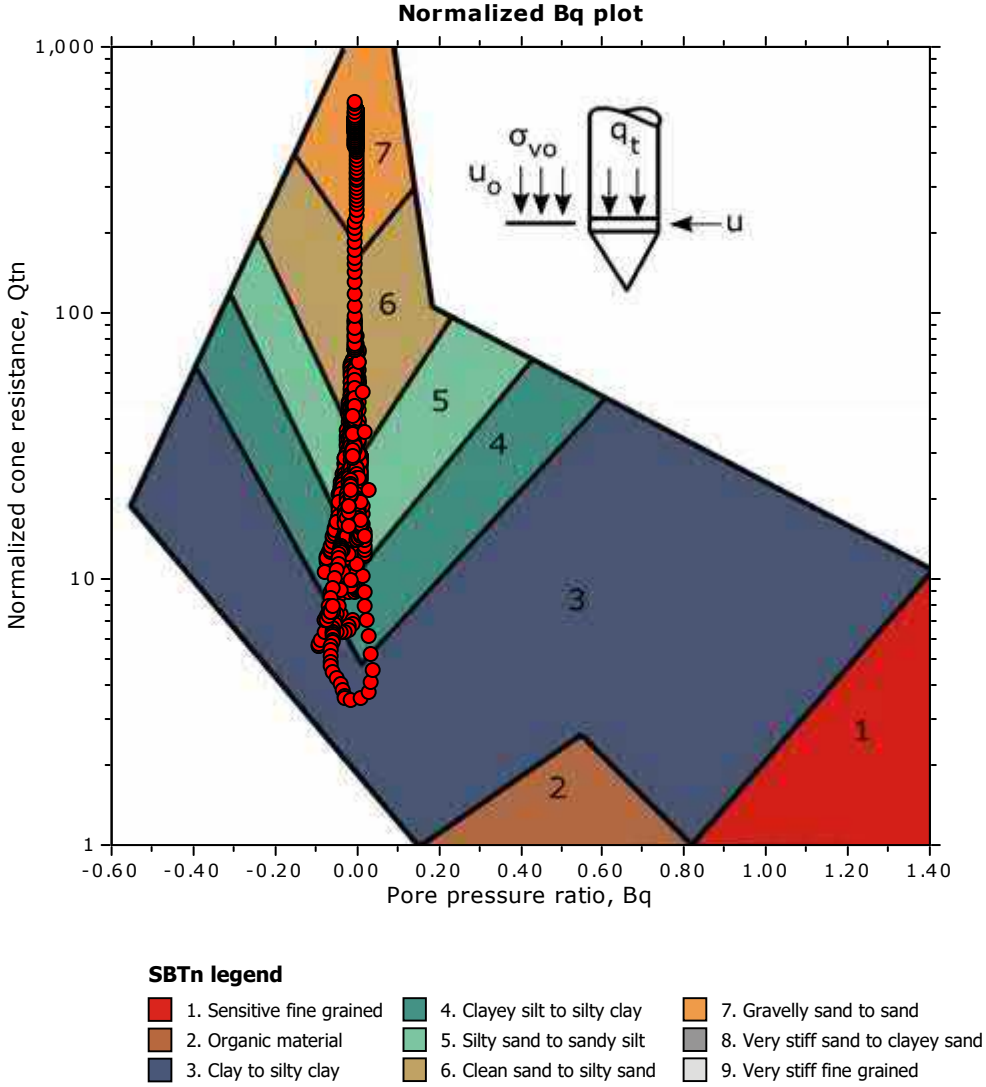
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots (normalized)





SBTn legend

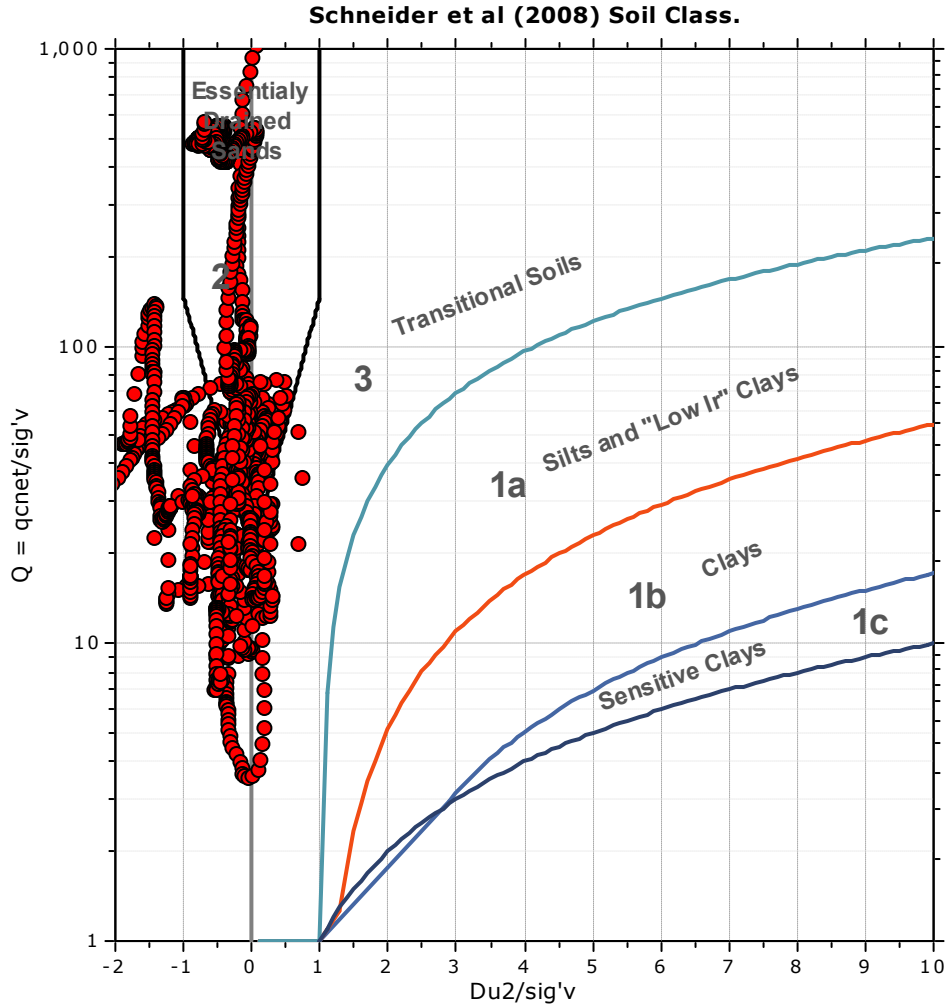
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

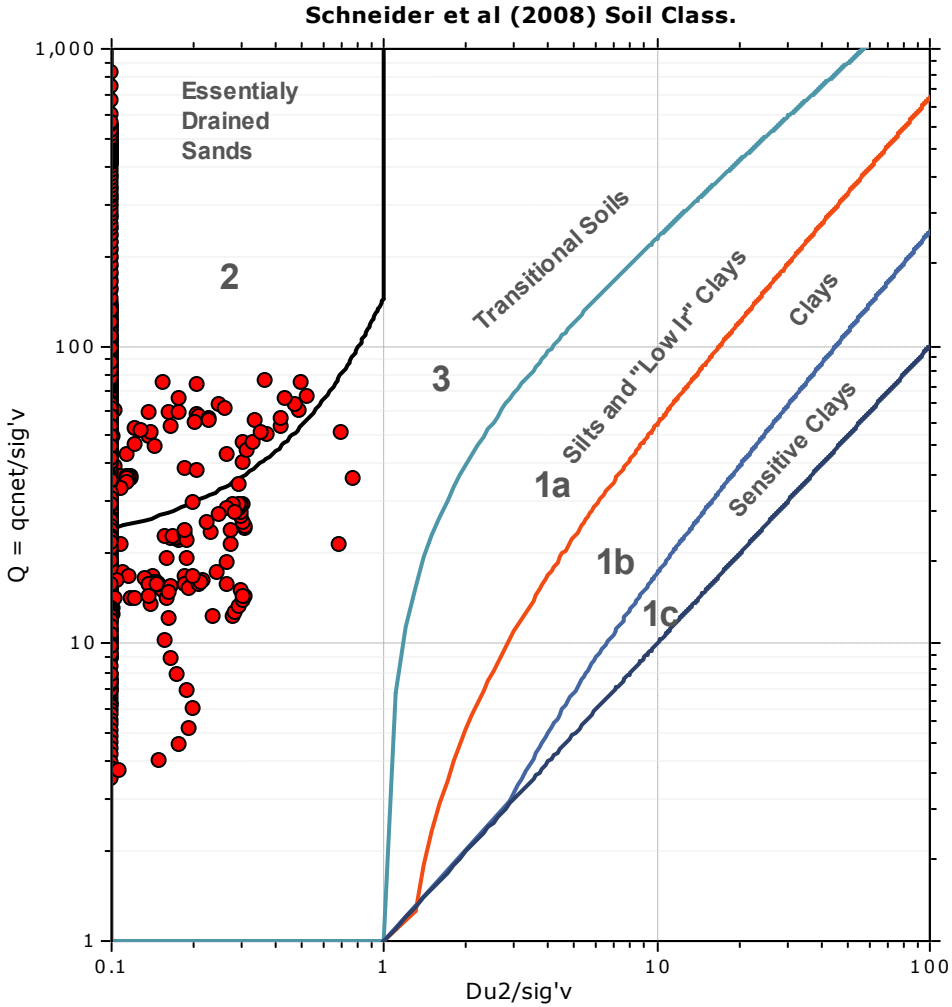
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Bq plots (Schneider)

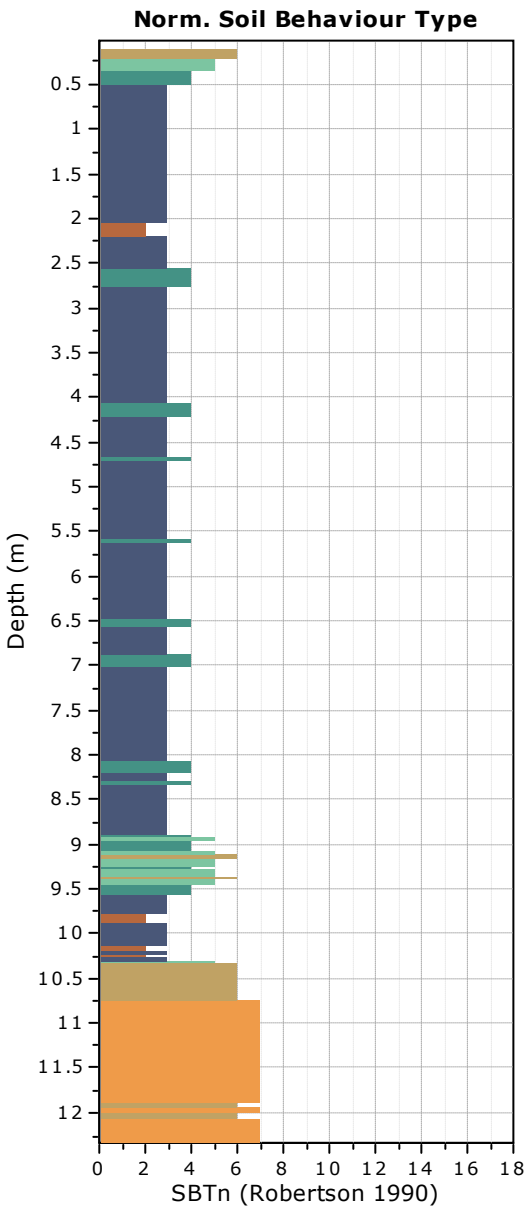


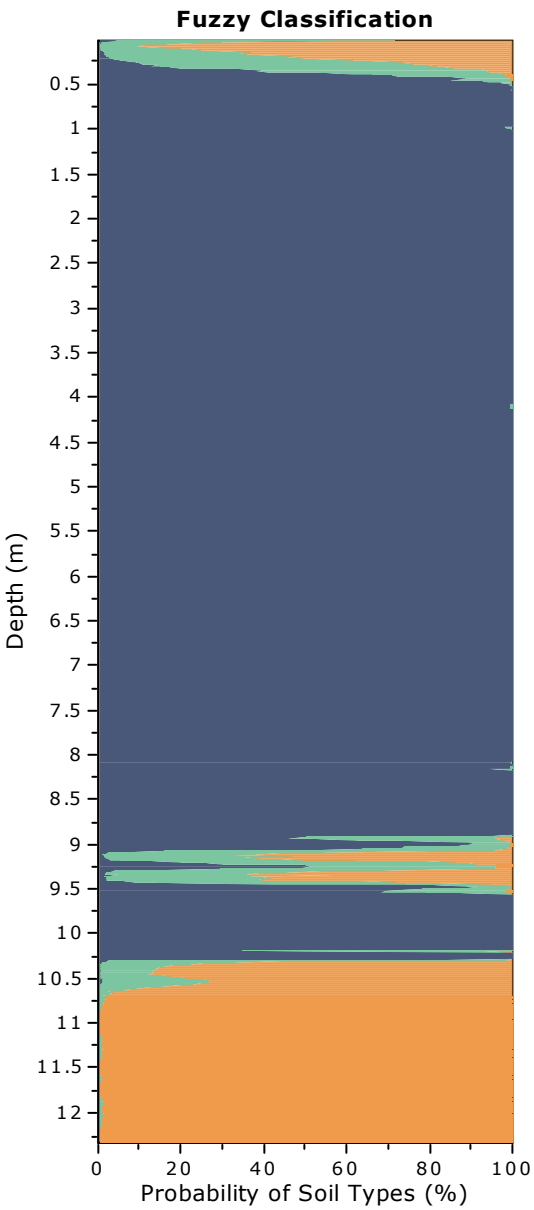


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



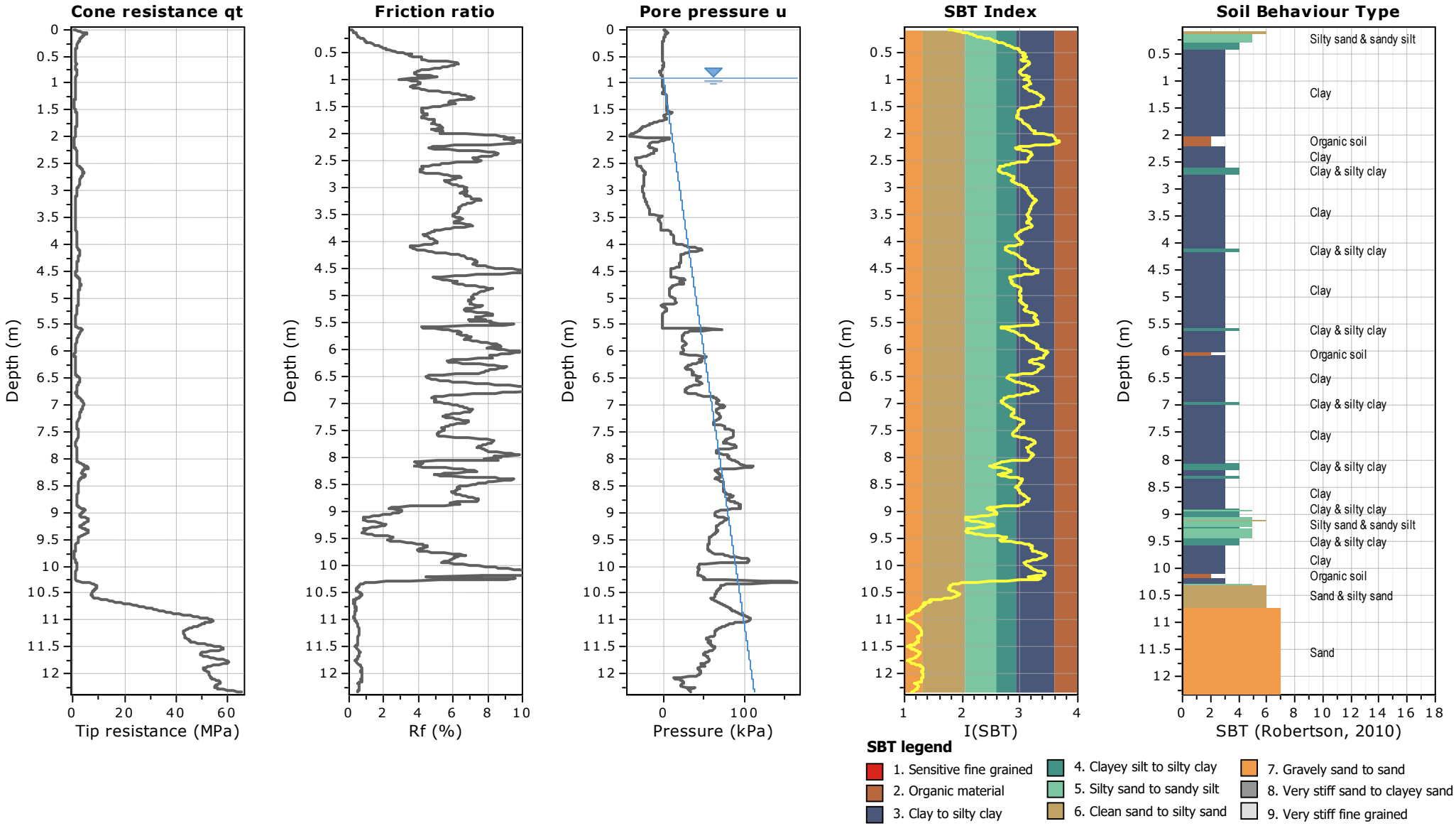


Fuzzy classifiaction legend
- Highly probable clayey soil
- Highly probable mixture soil
- Highly probable sandy soil

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

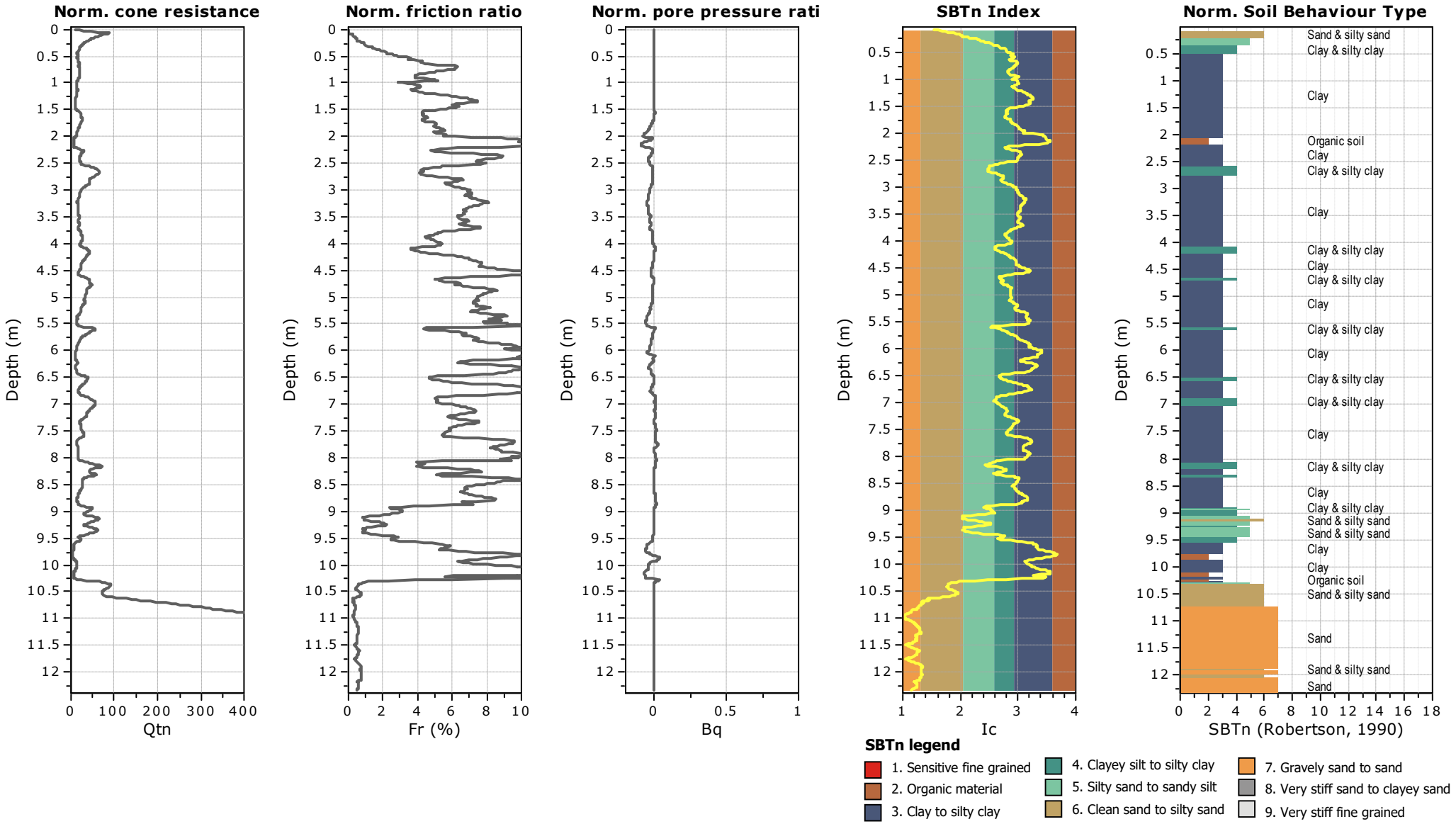
CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

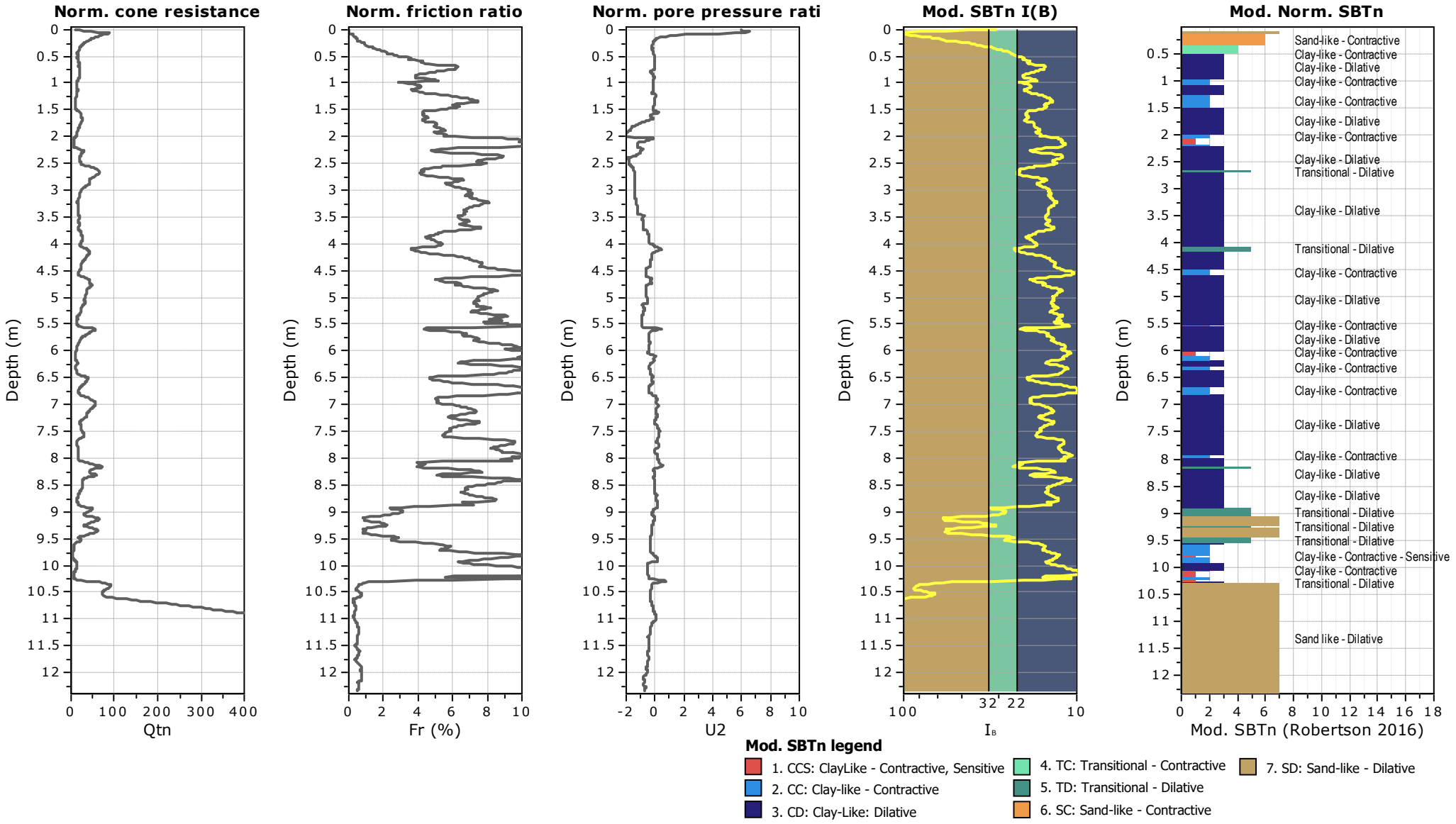
CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

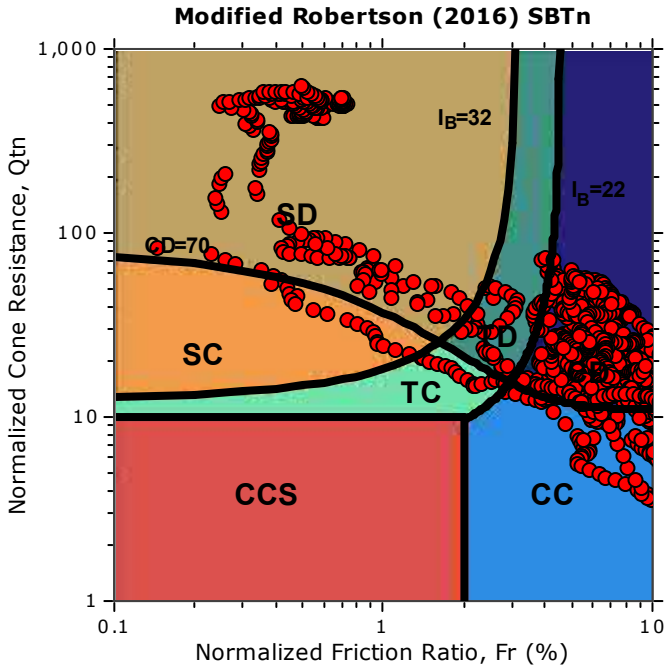


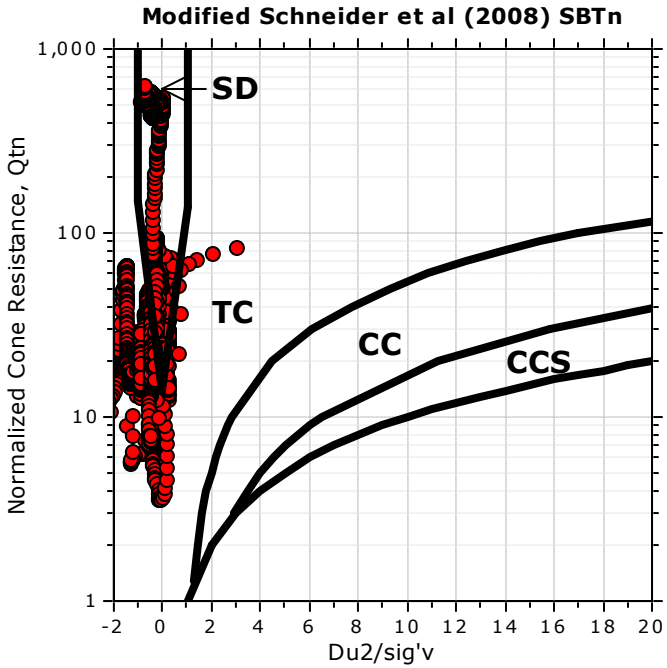
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

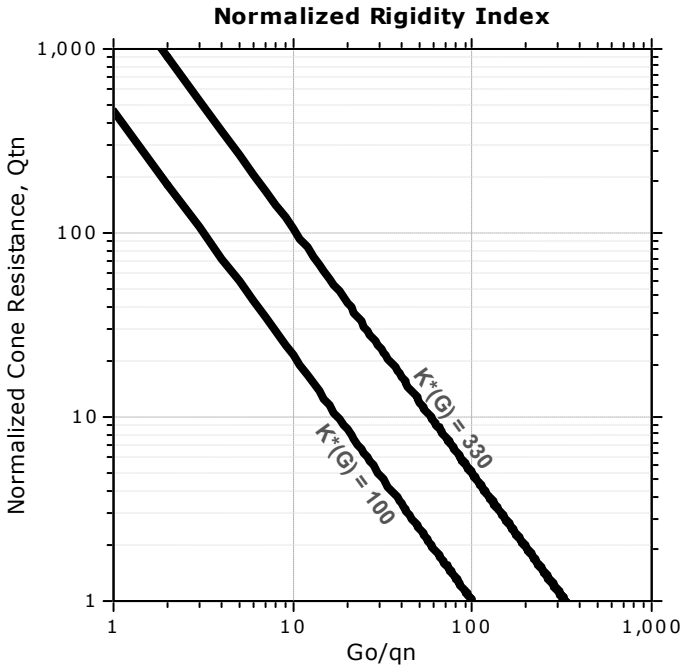
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Updated SBTn plots







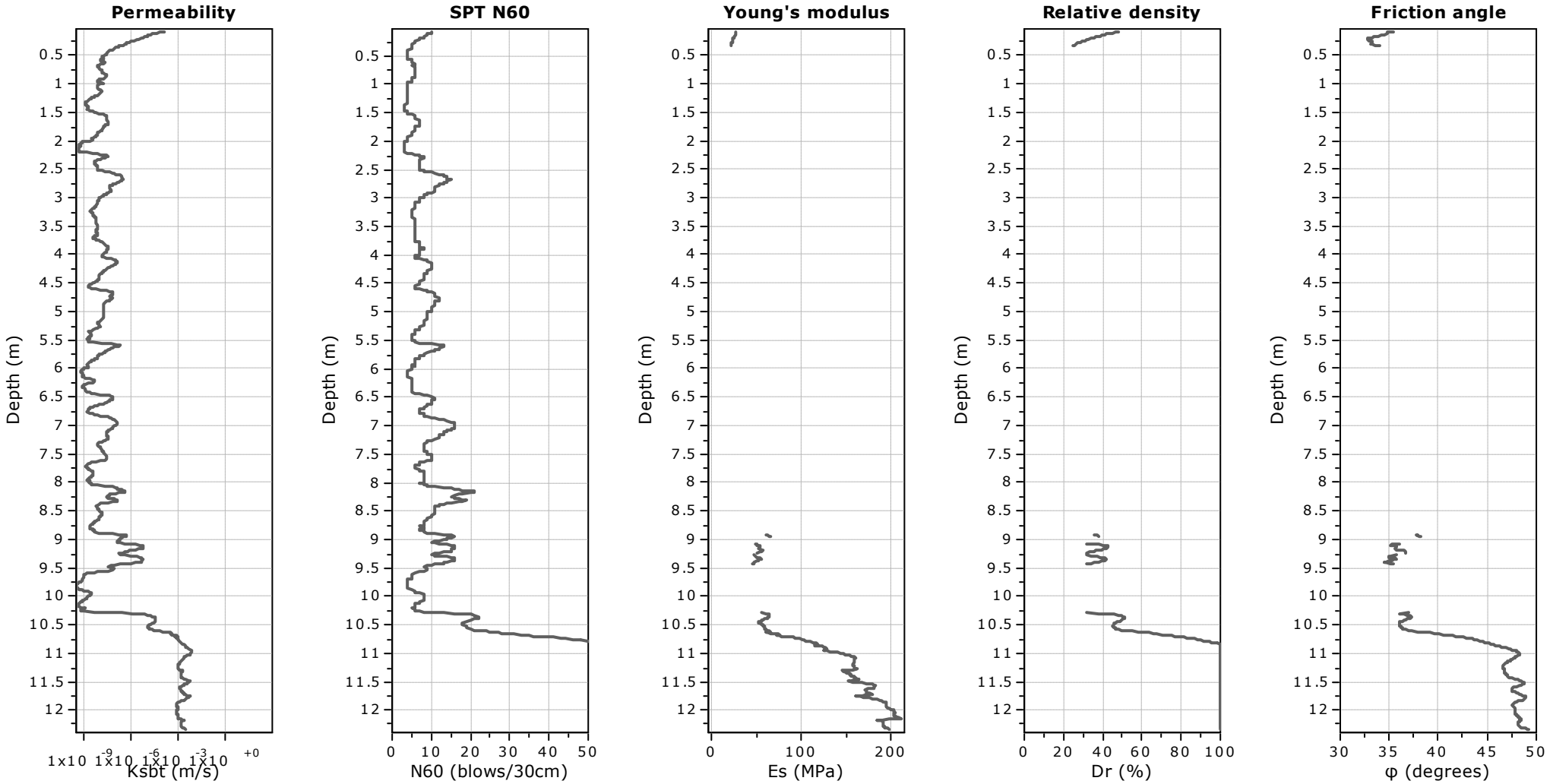
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



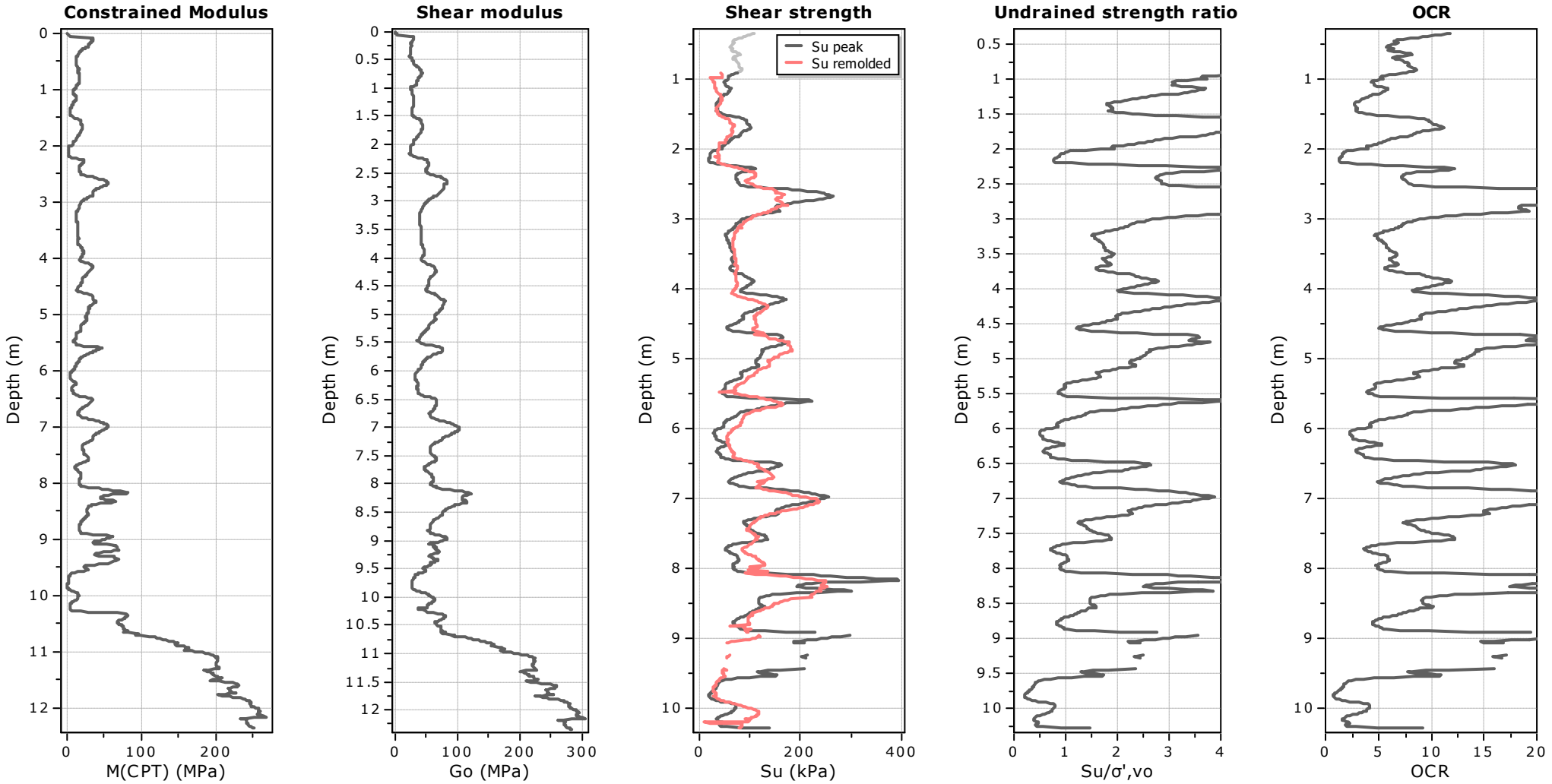
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



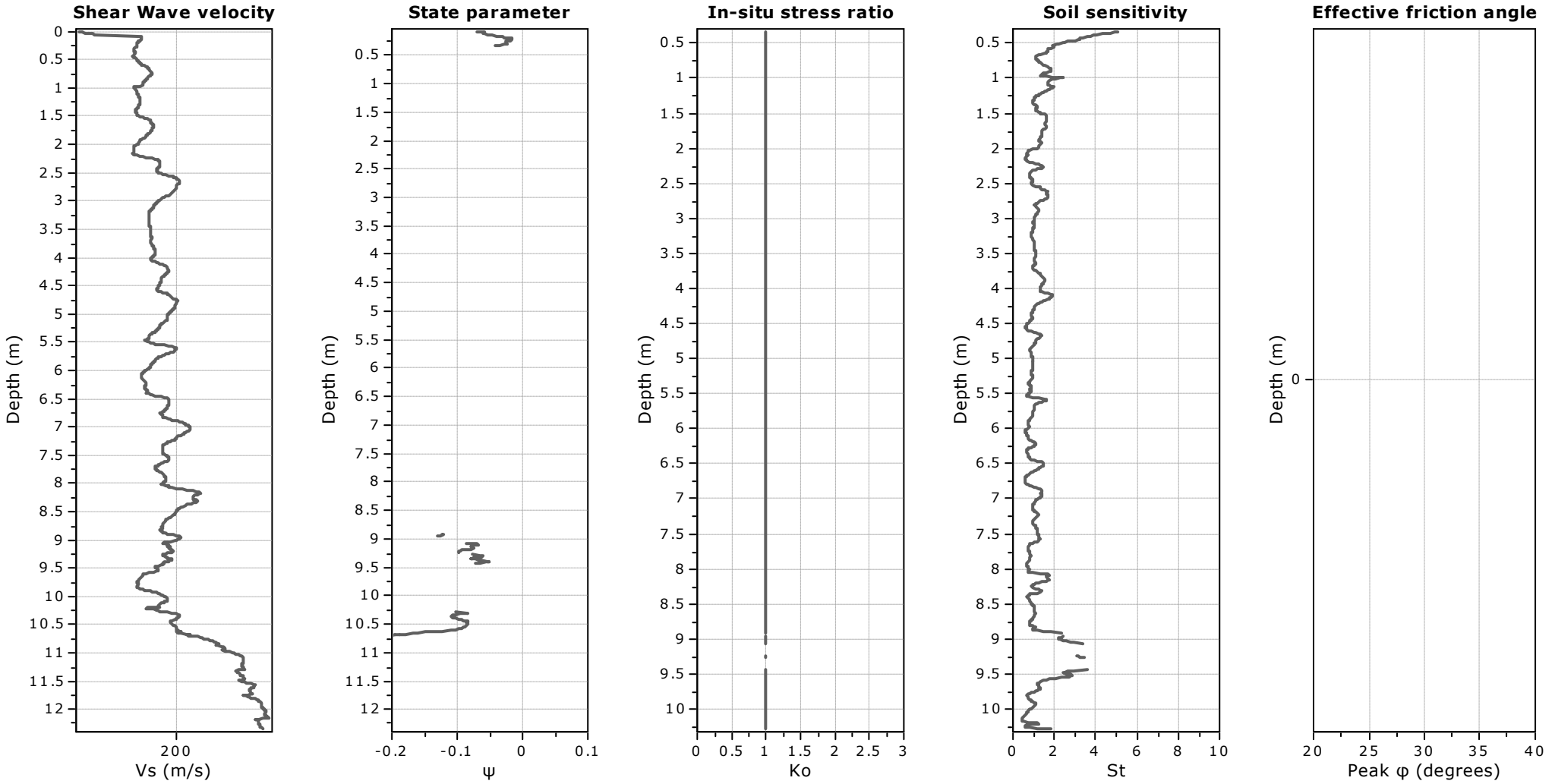
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto
OCR factor for clays, N_{kt}: Auto
Flat Dilatometer Test data

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



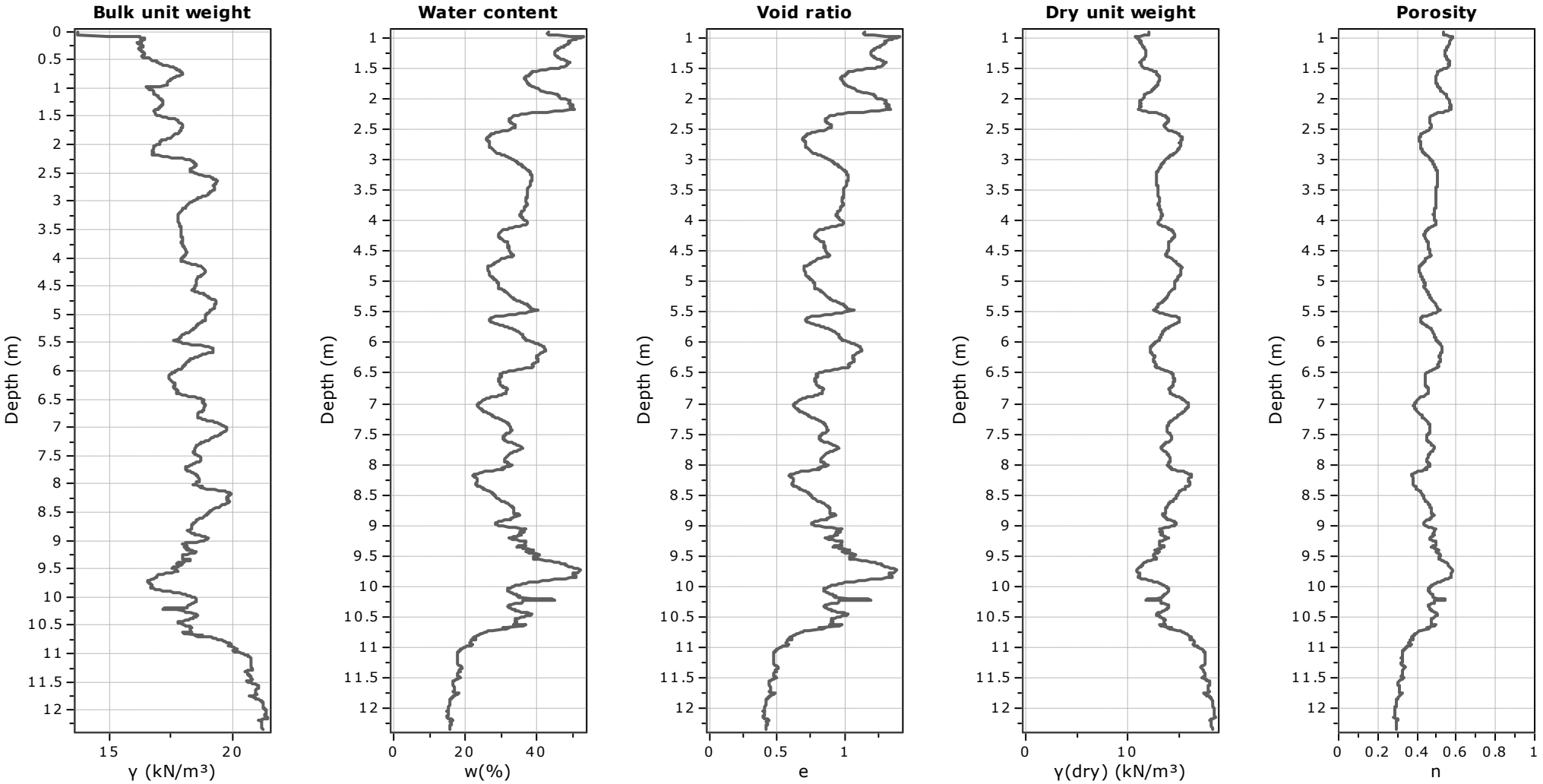
Calculation parameters

Soil Sensitivity factor, N_S: 7.00

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

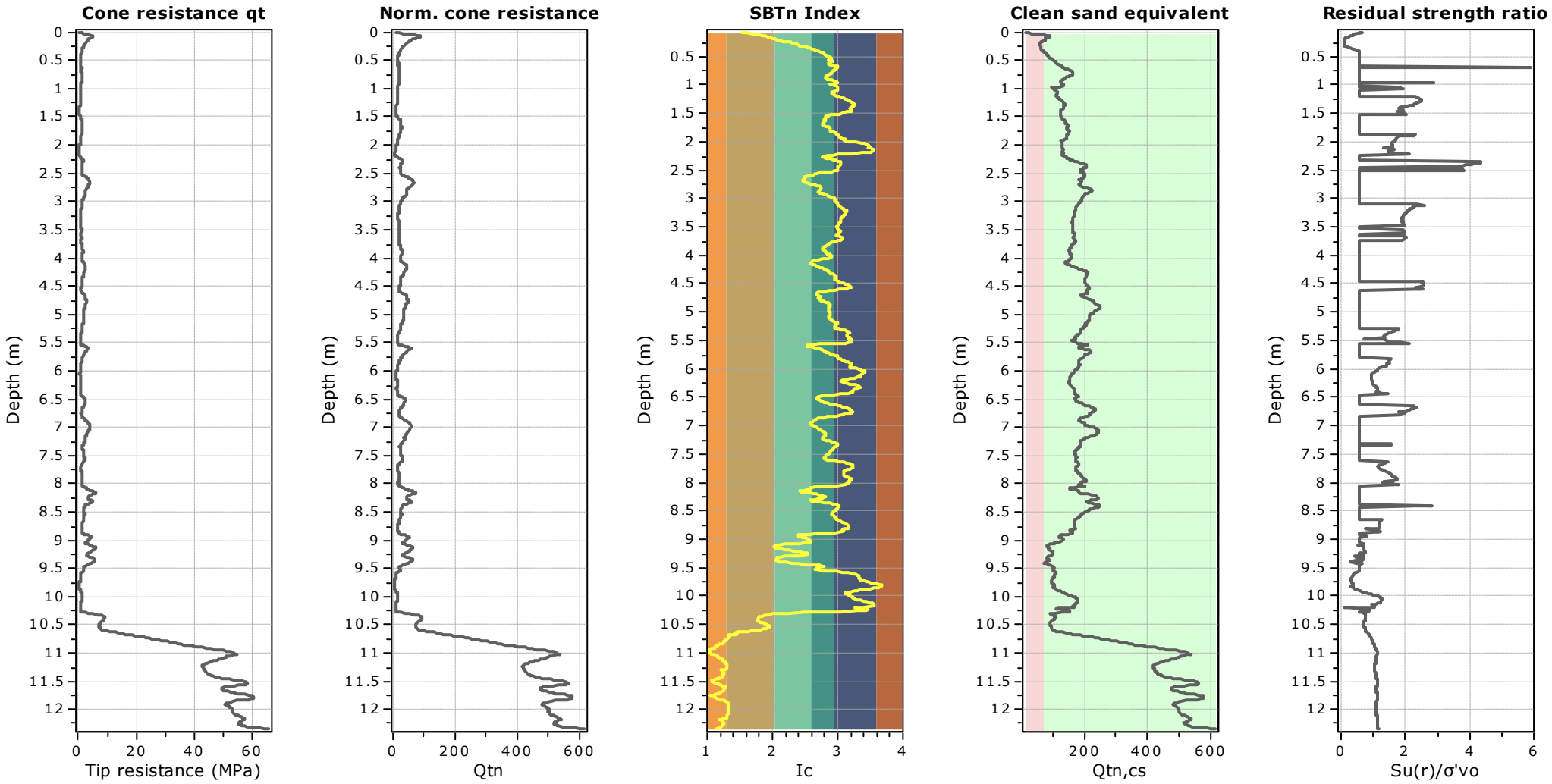
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

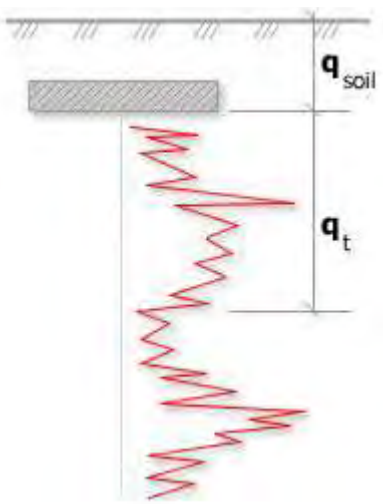


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

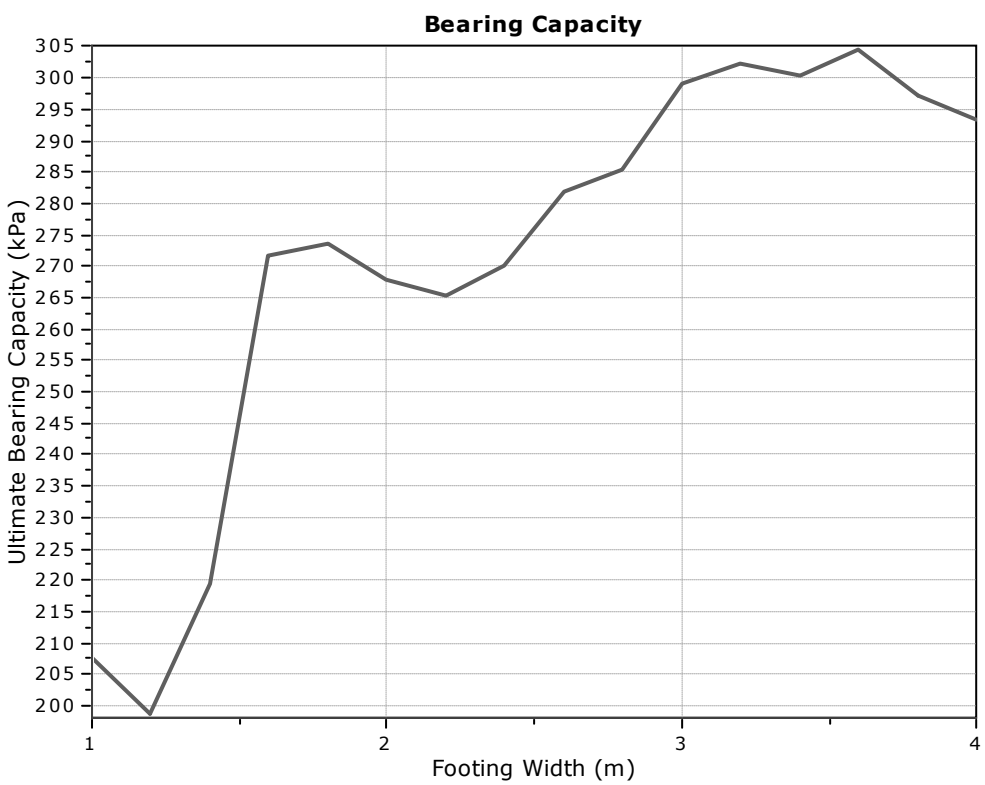




Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



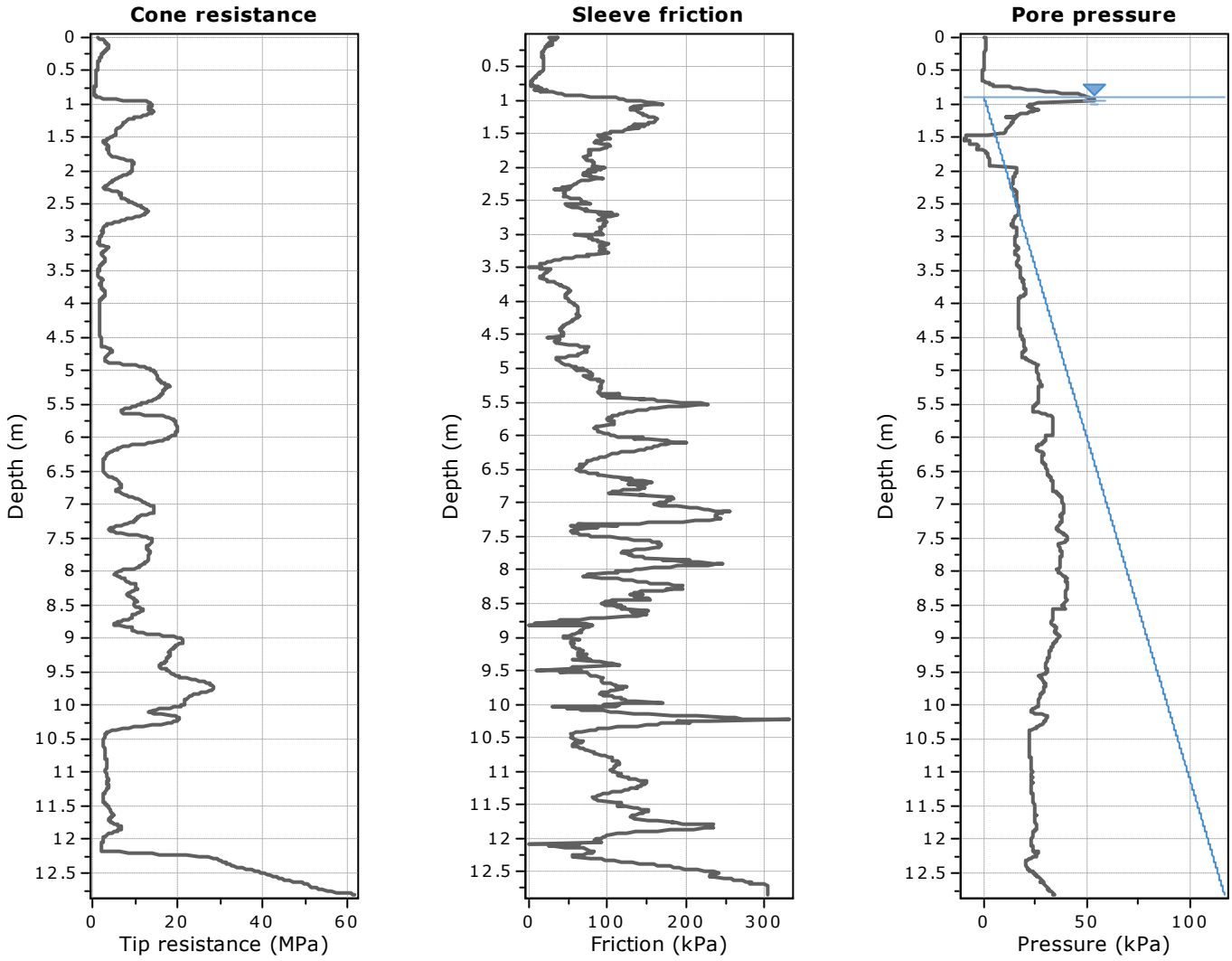
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	0.99	0.20	9.50	207.55
2	1.20	0.50	2.30	0.95	0.20	9.50	198.74
3	1.40	0.50	2.60	1.05	0.20	9.50	219.32
4	1.60	0.50	2.90	1.31	0.20	9.50	271.57
5	1.80	0.50	3.20	1.32	0.20	9.50	273.60
6	2.00	0.50	3.50	1.29	0.20	9.50	267.73
7	2.20	0.50	3.80	1.28	0.20	9.50	265.39
8	2.40	0.50	4.10	1.30	0.20	9.50	270.20
9	2.60	0.50	4.40	1.36	0.20	9.50	282.03
10	2.80	0.50	4.70	1.38	0.20	9.50	285.38
11	3.00	0.50	5.00	1.45	0.20	9.50	298.99
12	3.20	0.50	5.30	1.46	0.20	9.50	302.26
13	3.40	0.50	5.60	1.45	0.20	9.50	300.27
14	3.60	0.50	5.90	1.47	0.20	9.50	304.50
15	3.80	0.50	6.20	1.44	0.20	9.50	297.09
16	4.00	0.50	6.50	1.42	0.20	9.50	293.48

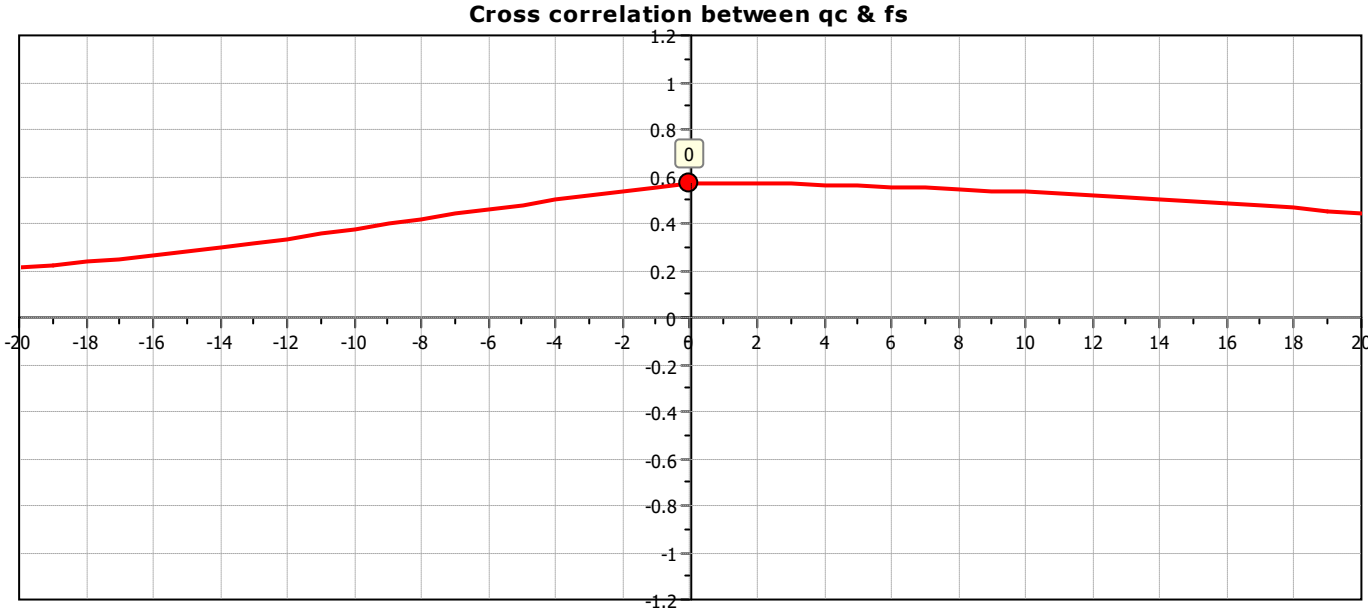
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

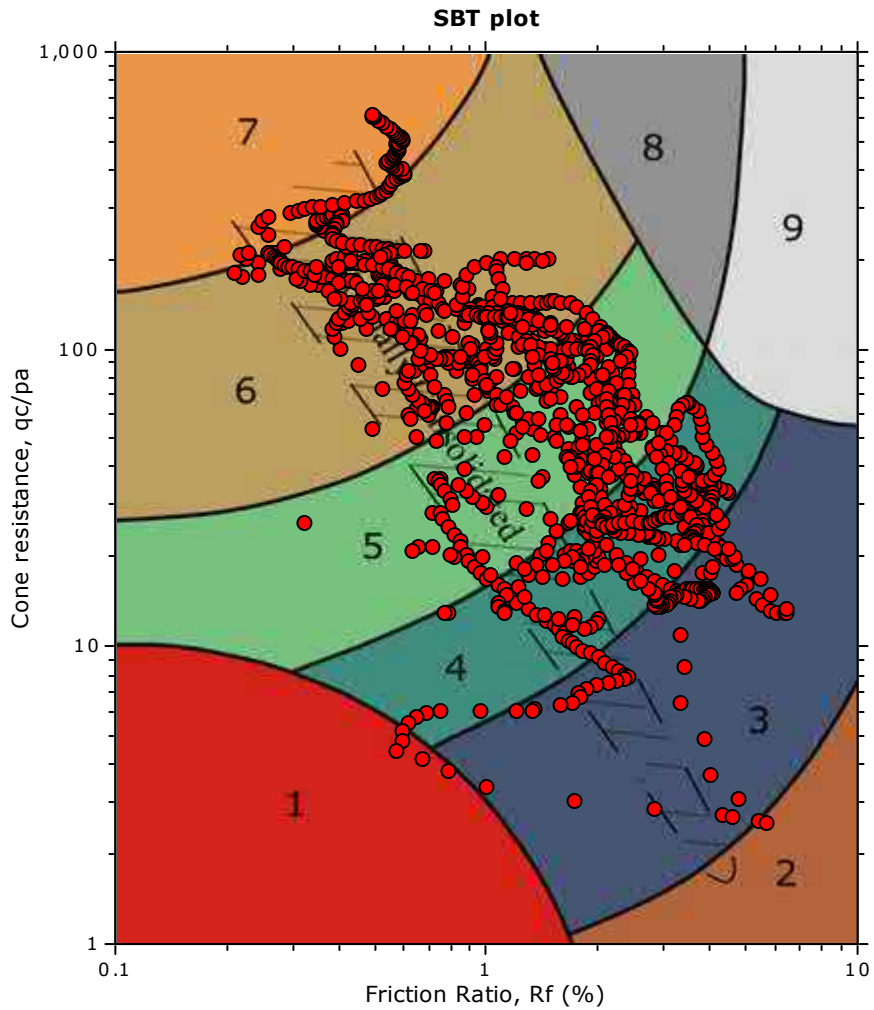


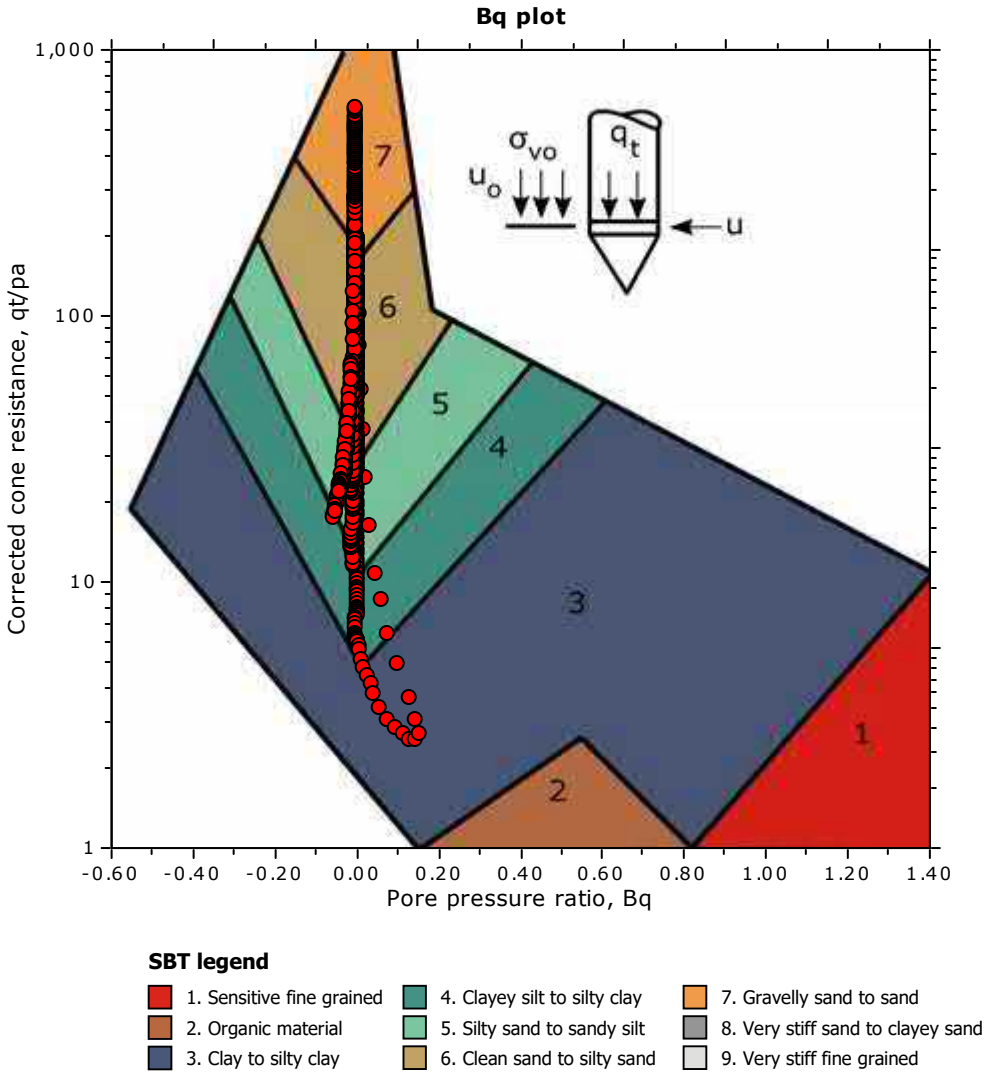
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots





SBT legend

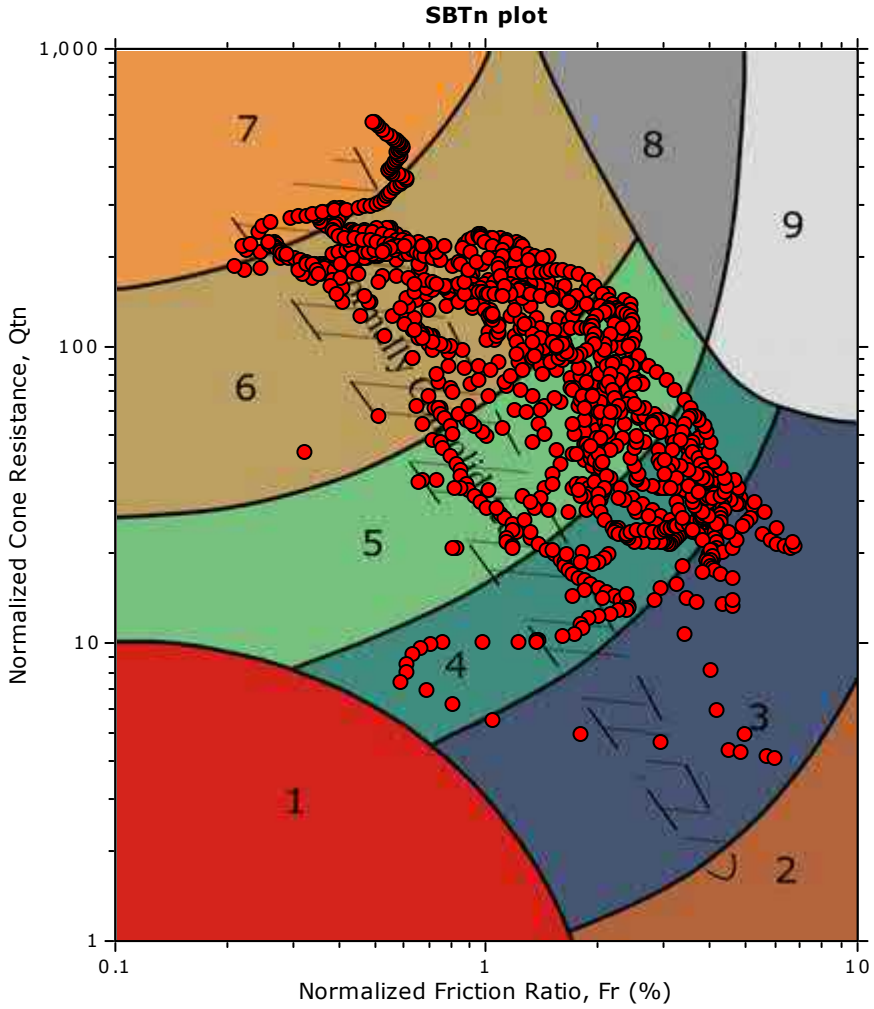
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

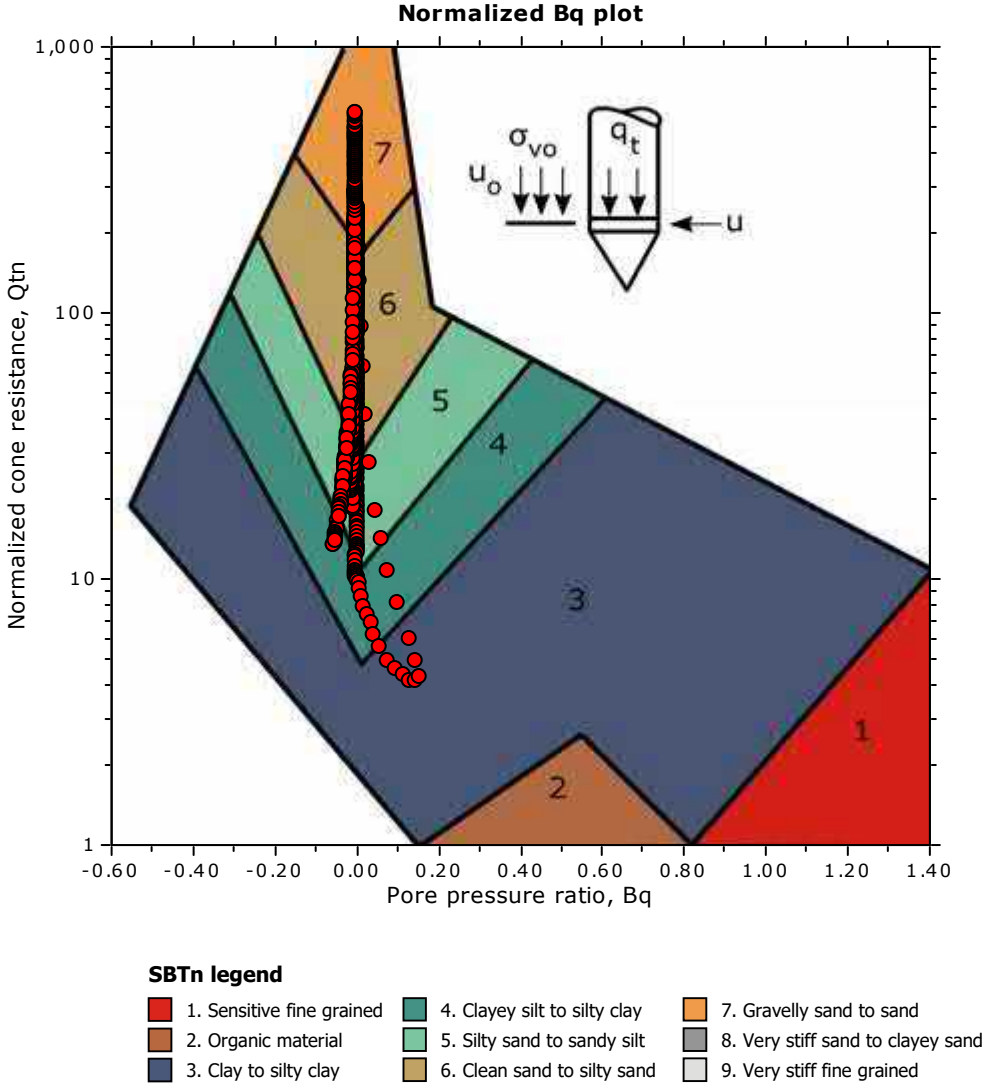
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots (normalized)





SBTn legend

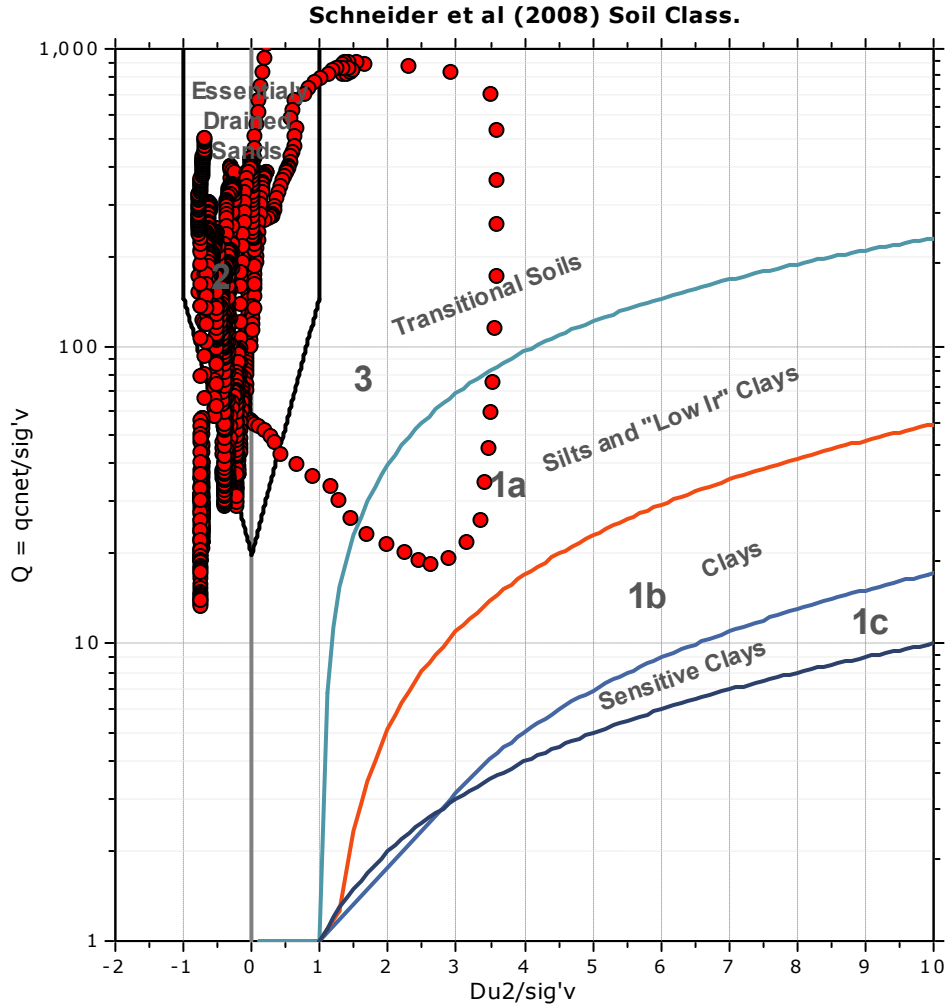
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

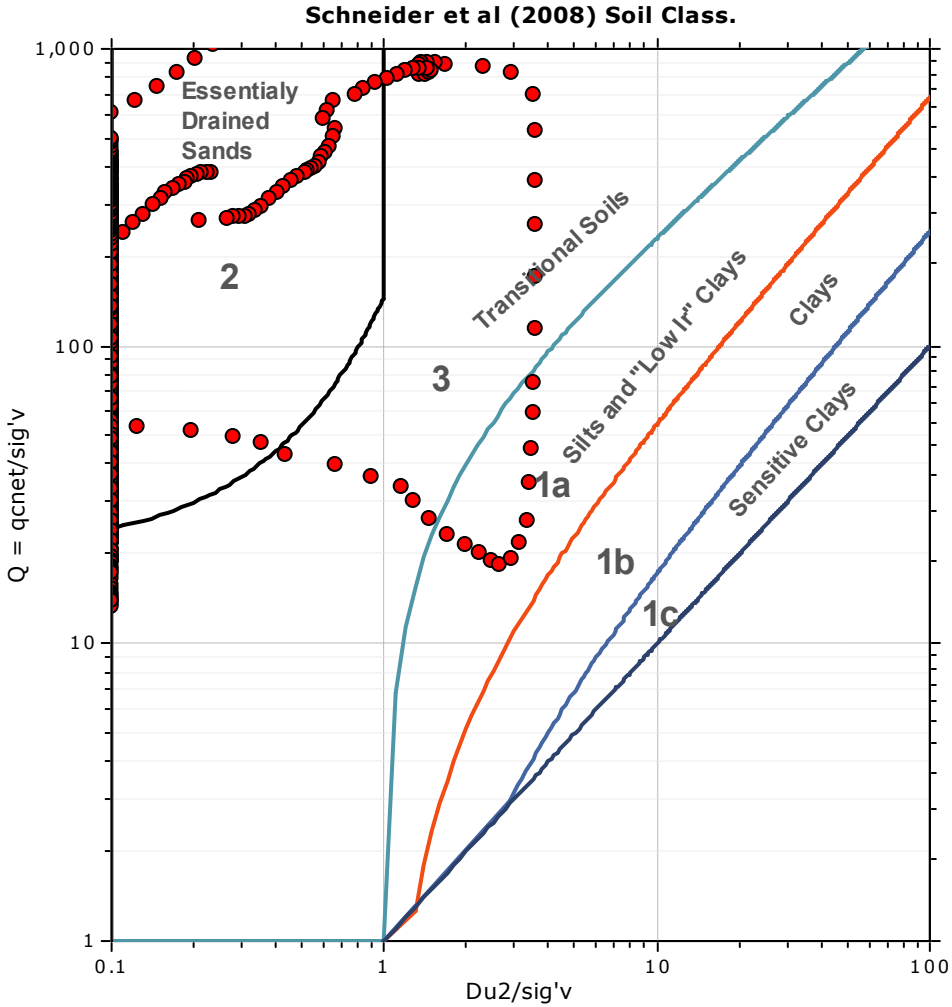
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Bq plots (Schneider)

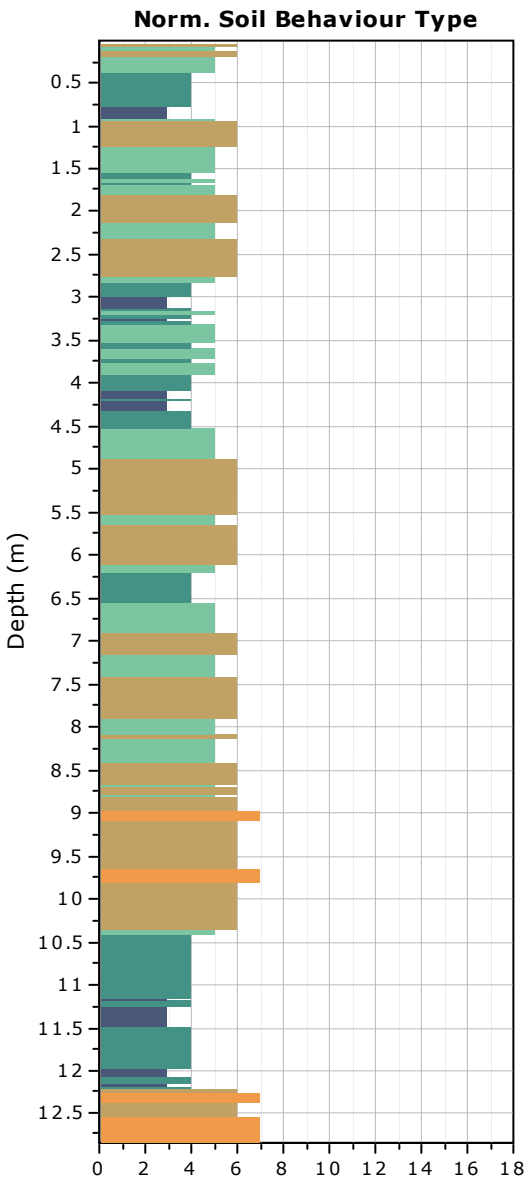


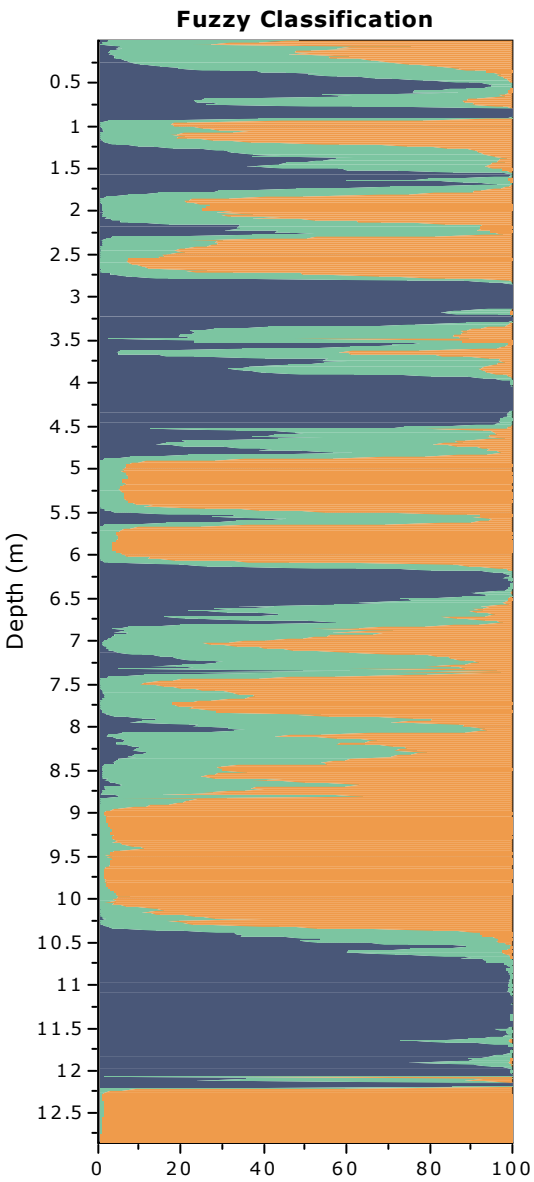


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



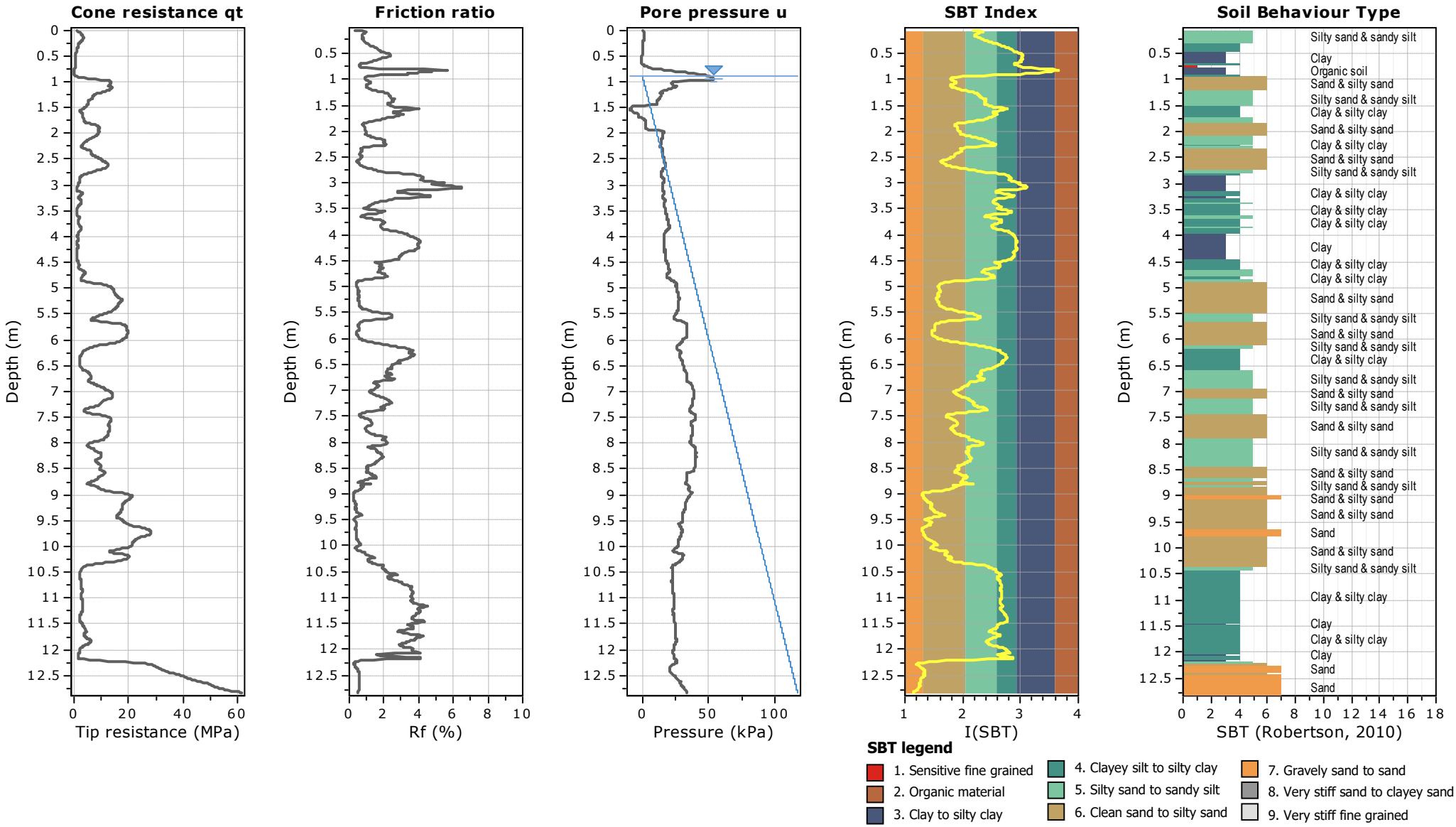


Fuzzy classifiaction legend
- Highly probable clayey soil
- Highly probable mixture soil
- Highly probable sandy soil

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

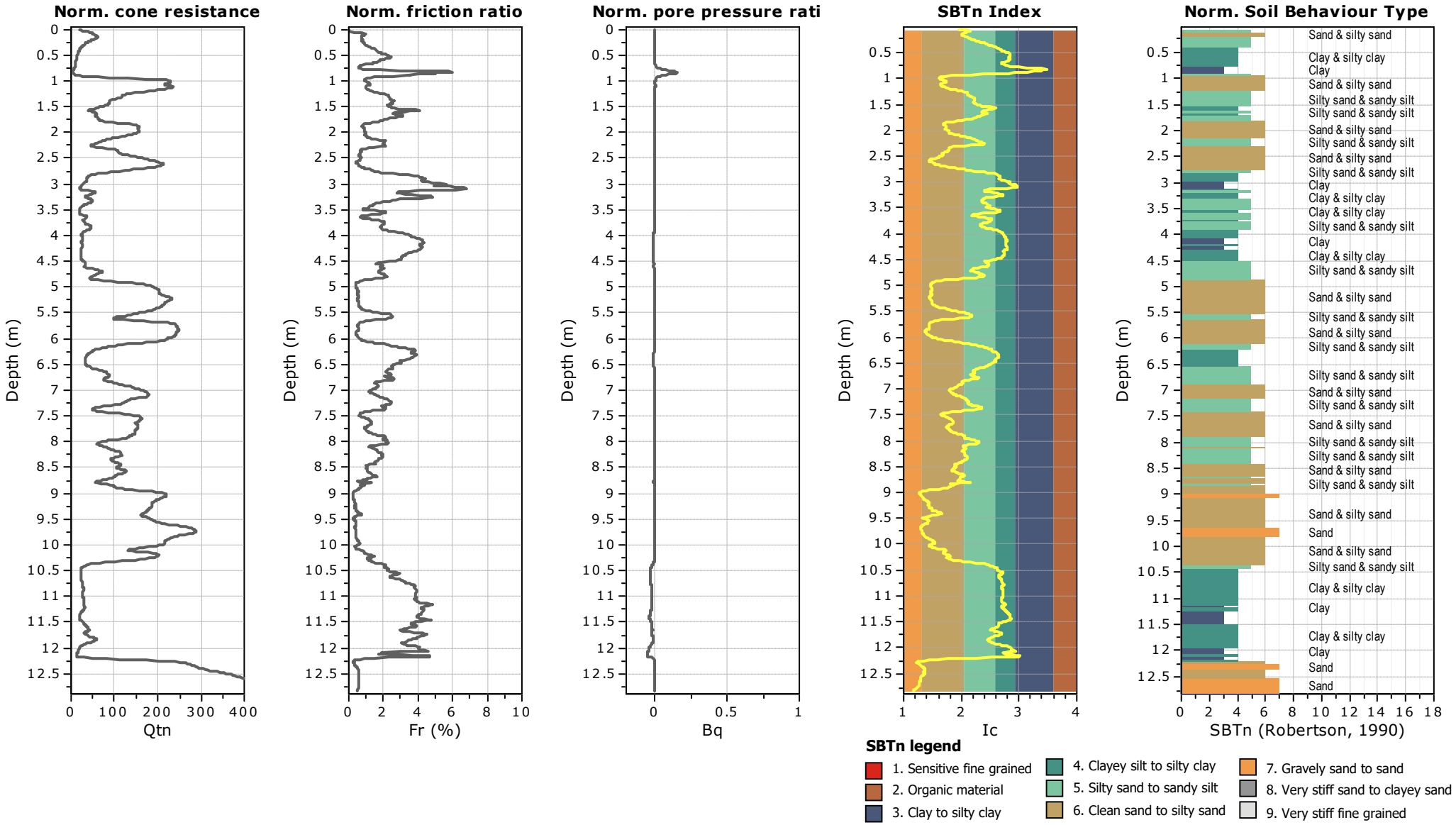
Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

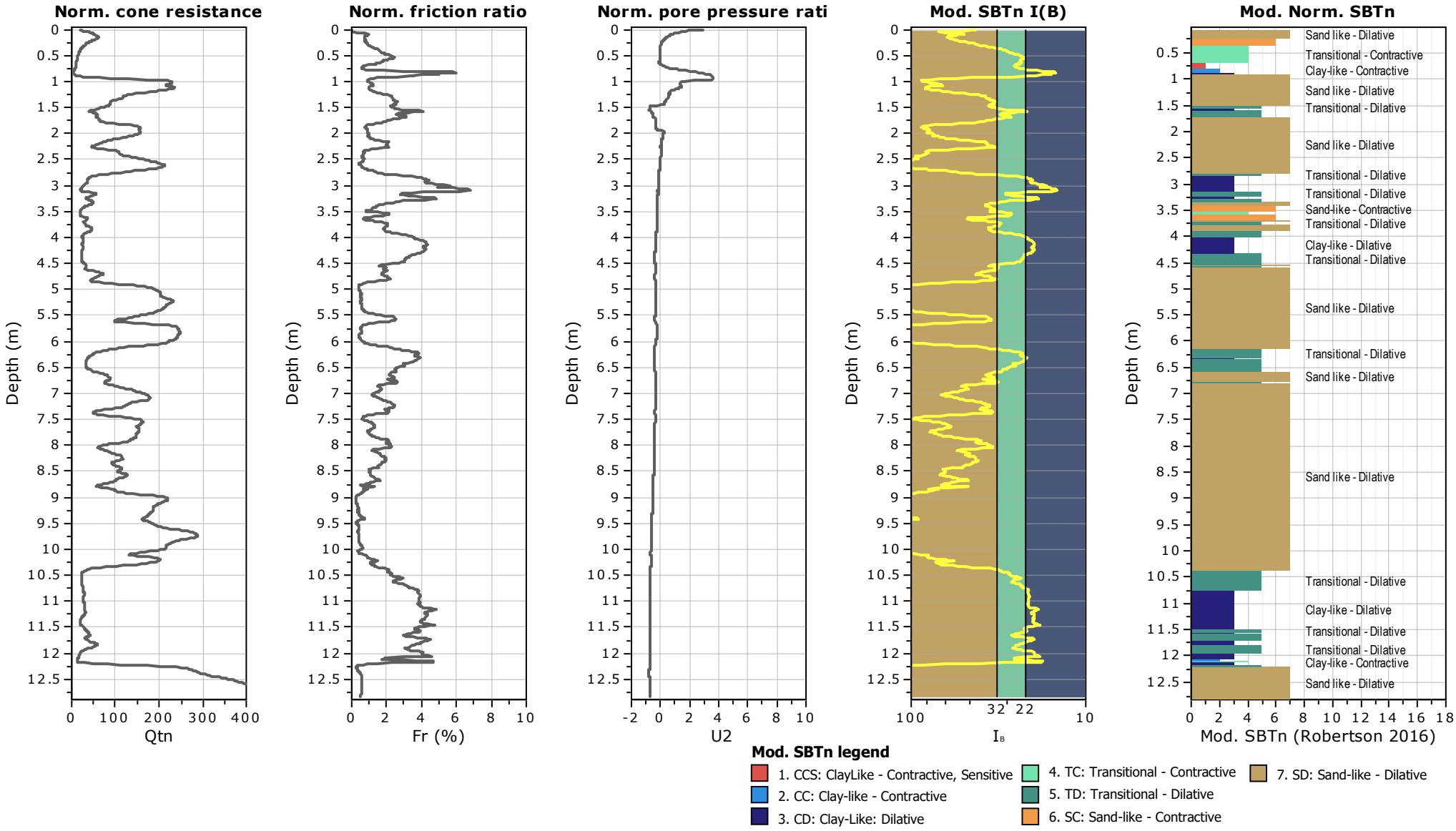
CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

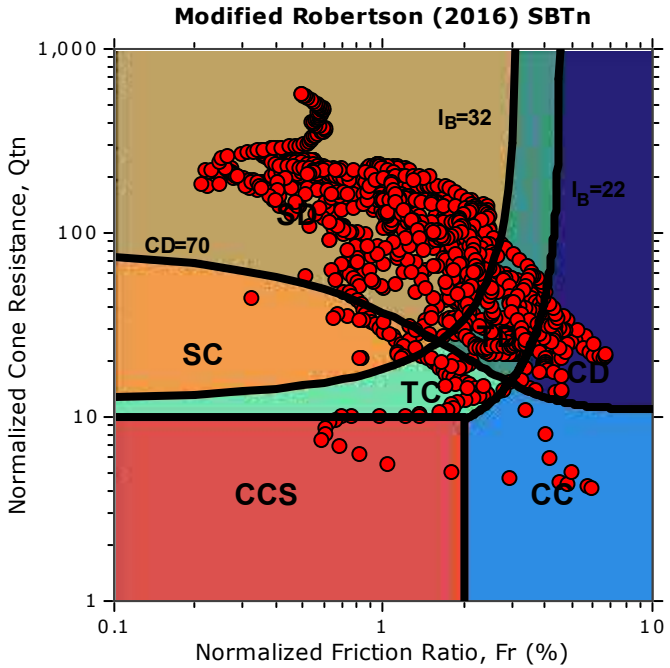


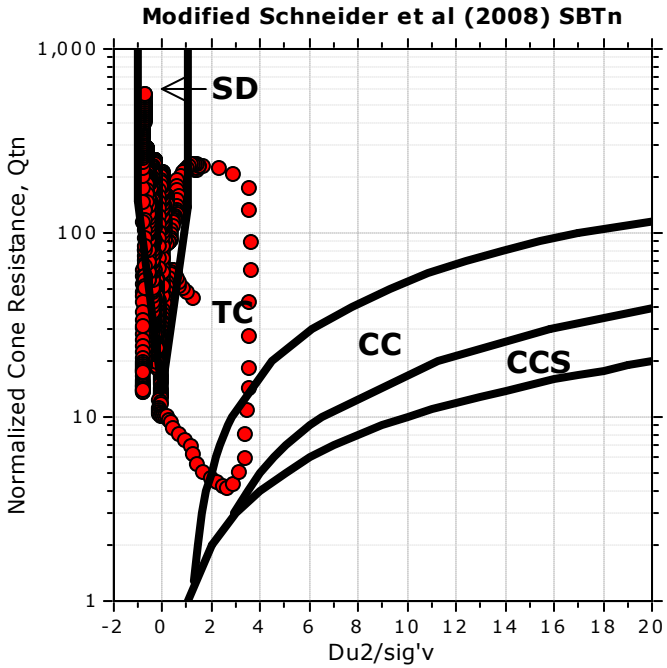
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

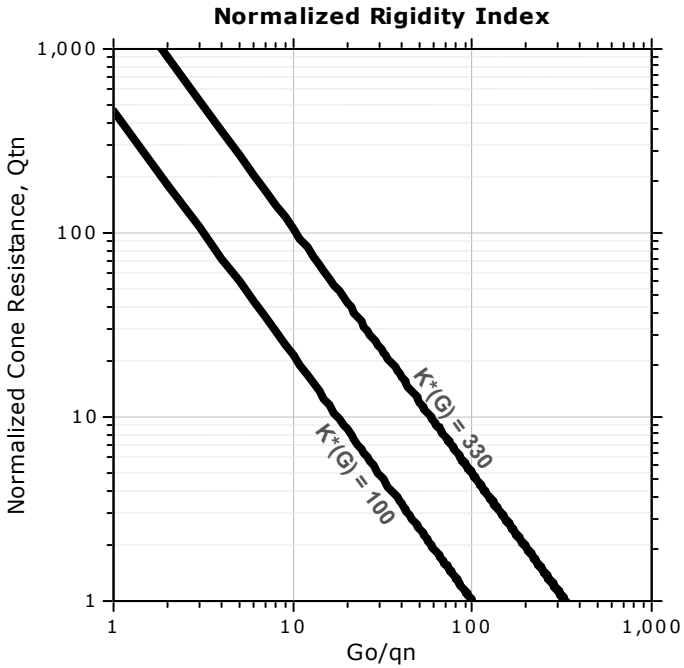
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Updated SBTn plots







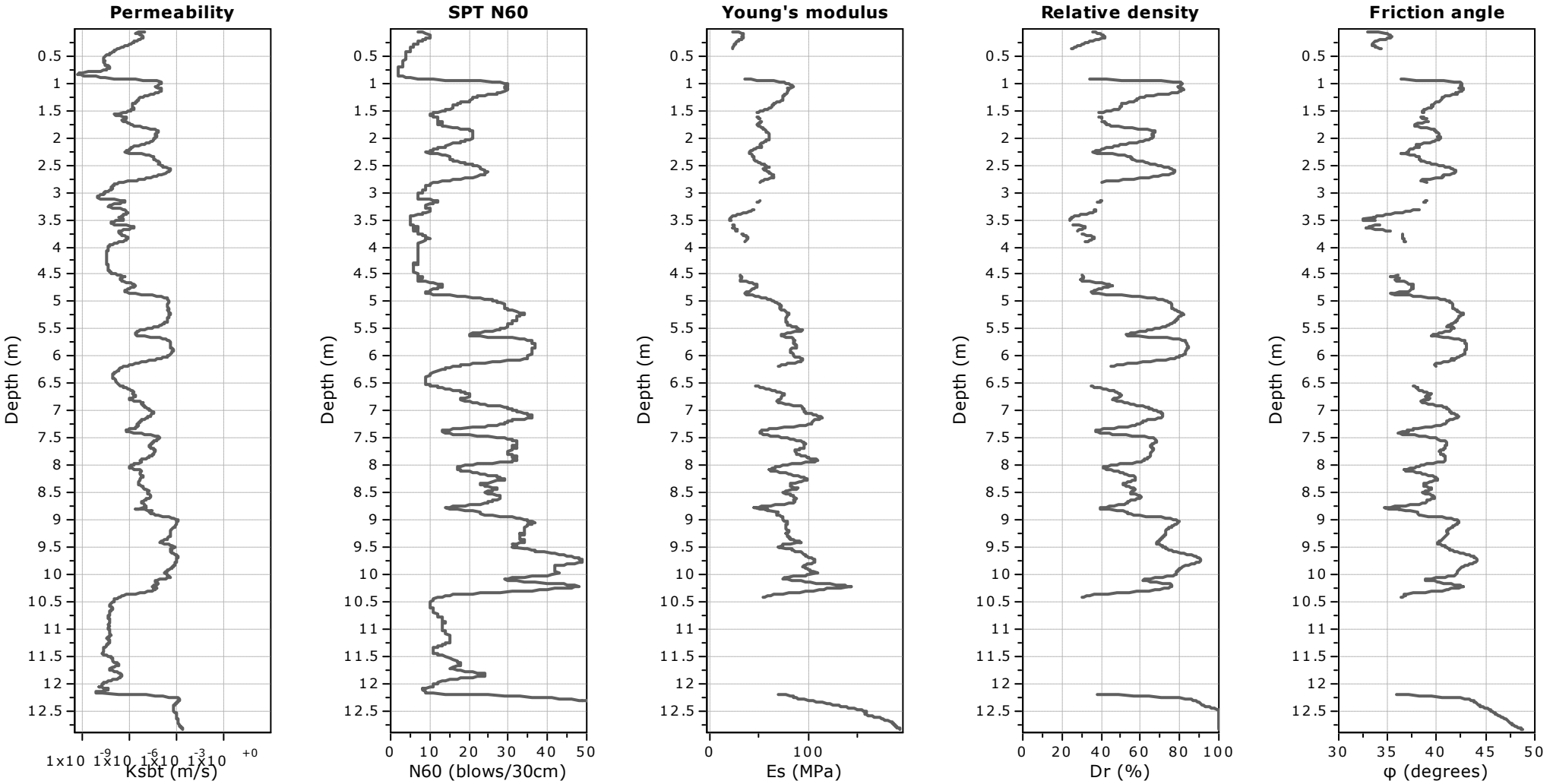
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



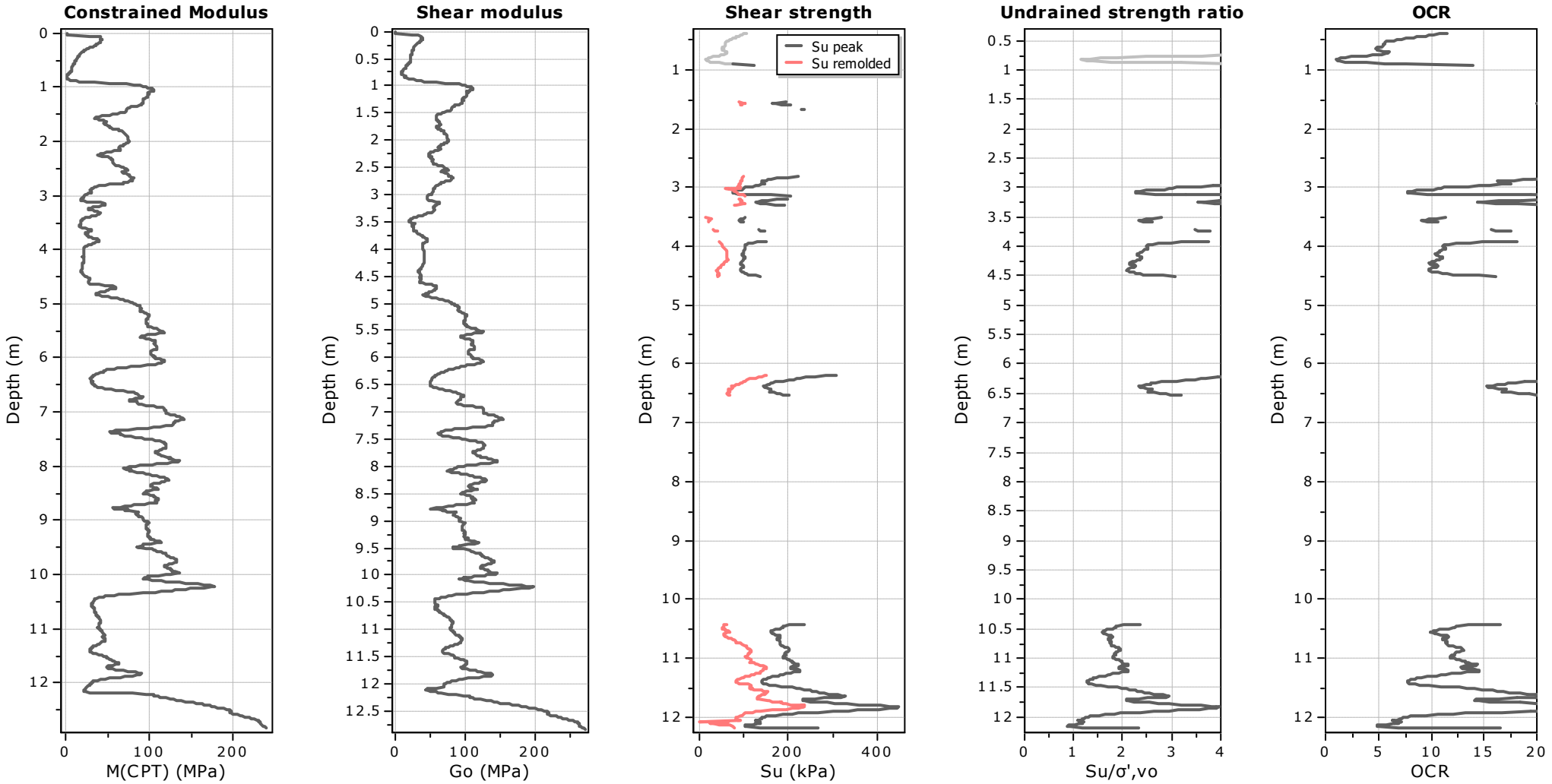
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



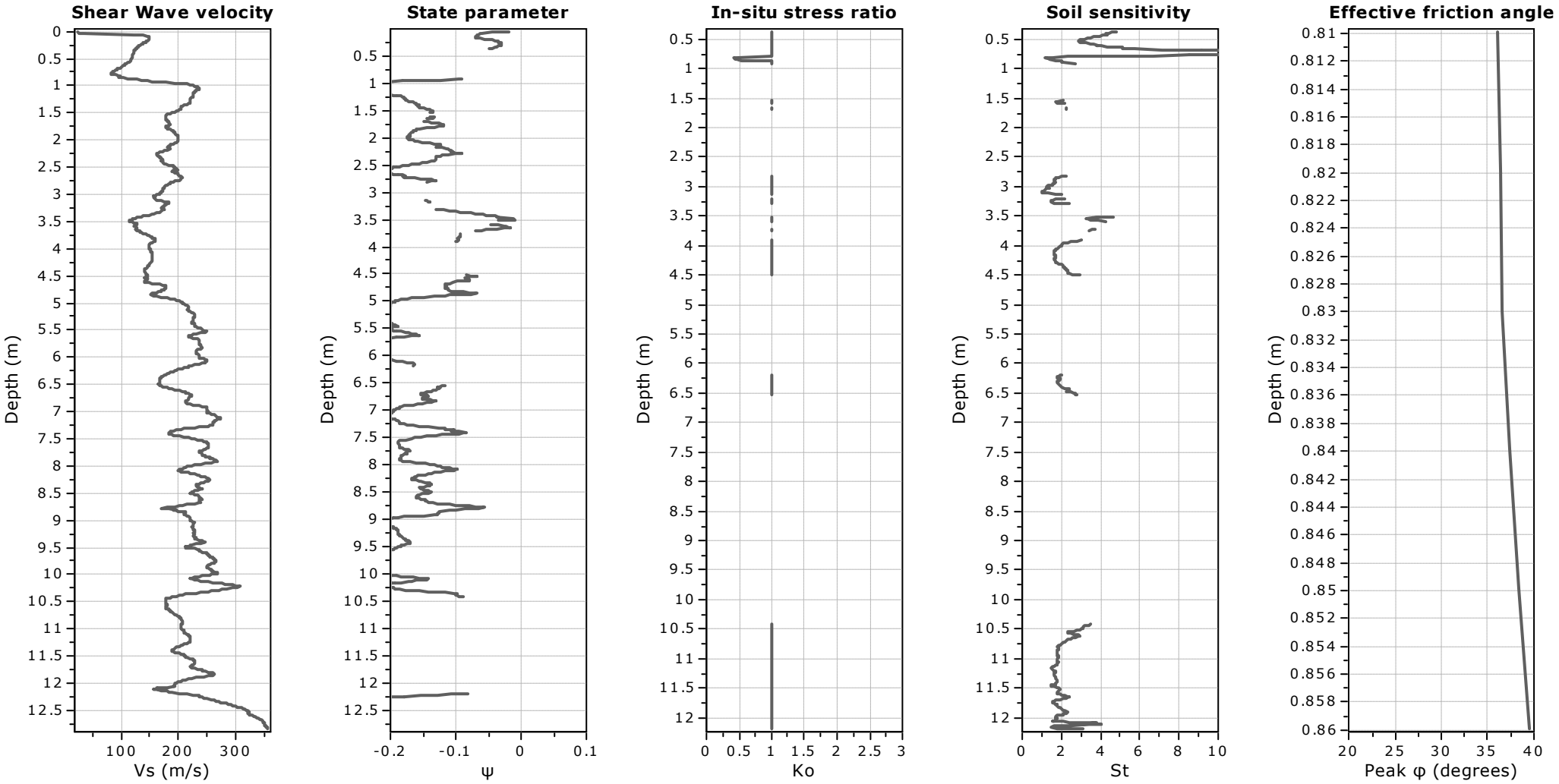
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto
OCR factor for clays, N_{kt}: Auto
Flat Dilatometer Test data

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



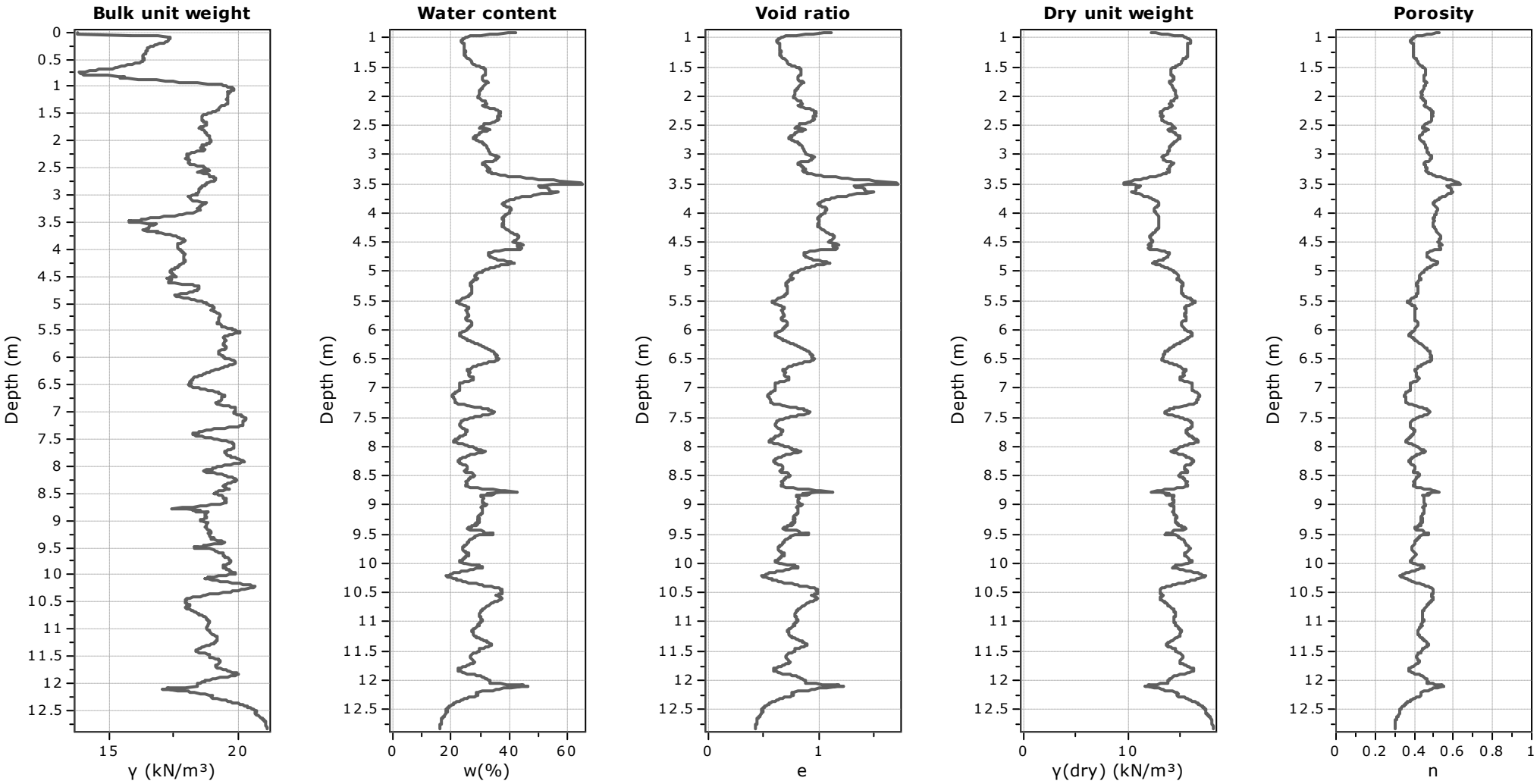
Calculation parameters

Soil Sensitivity factor, N_S: 7.00

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

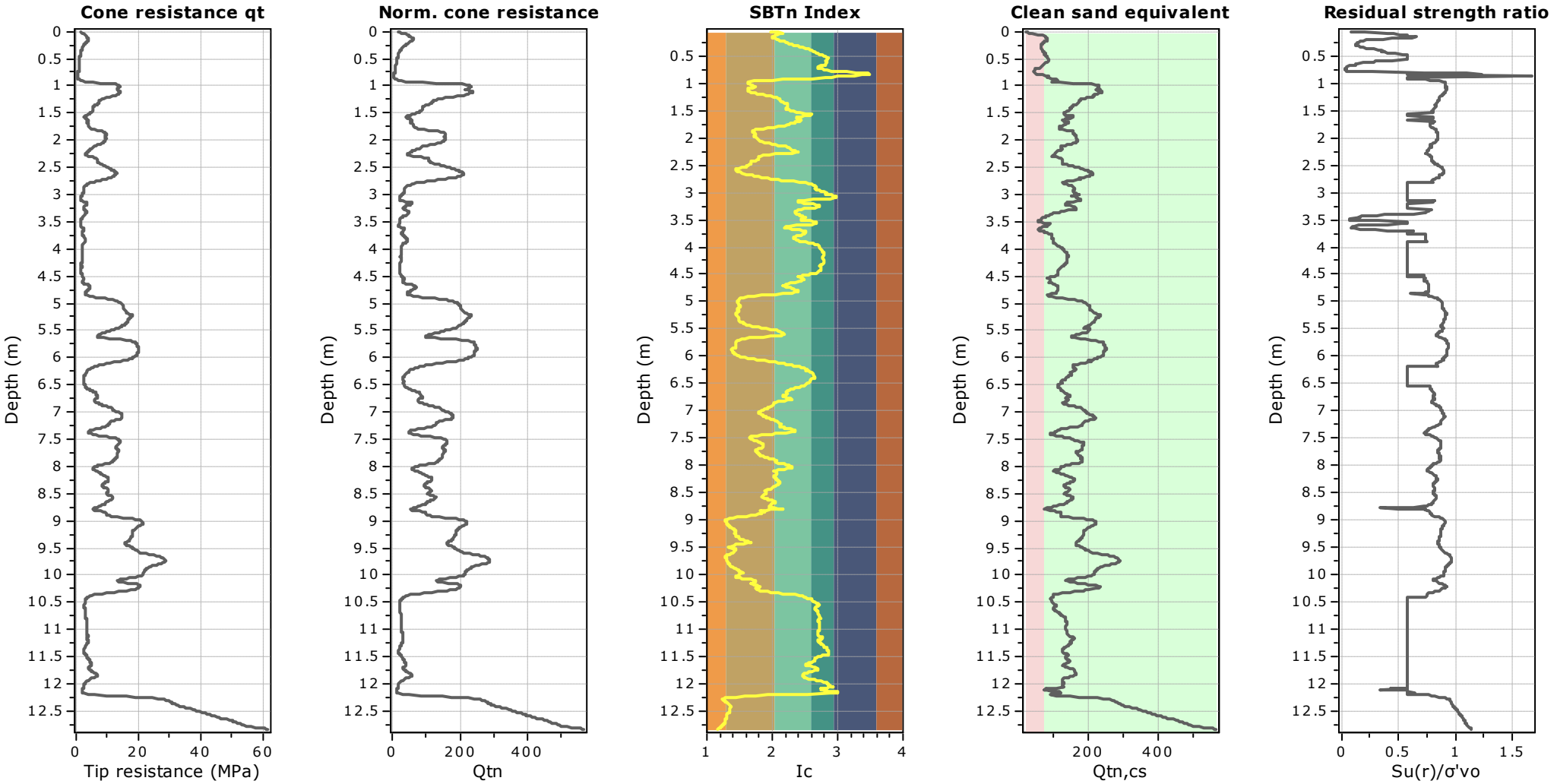
CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

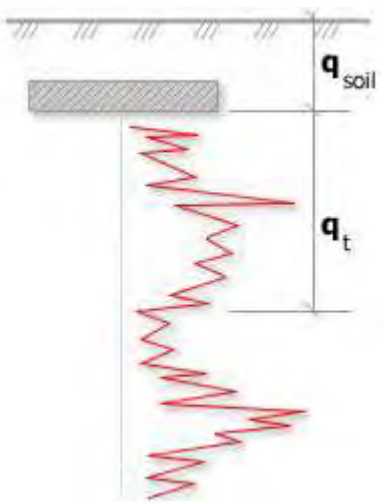
CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

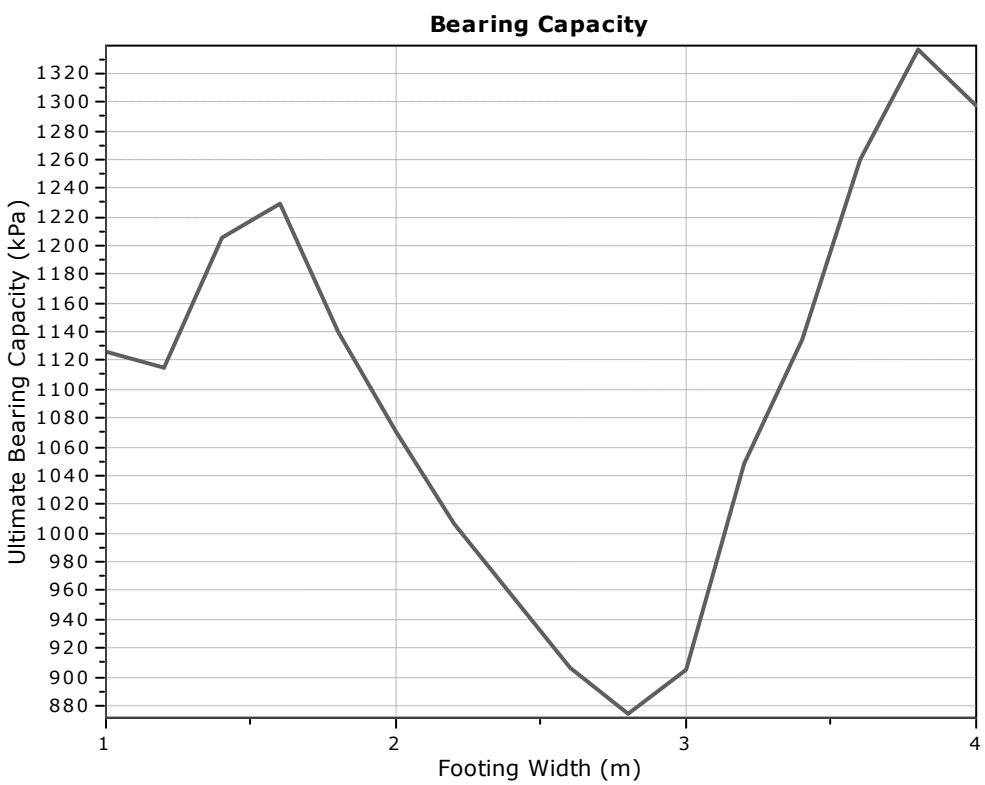
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



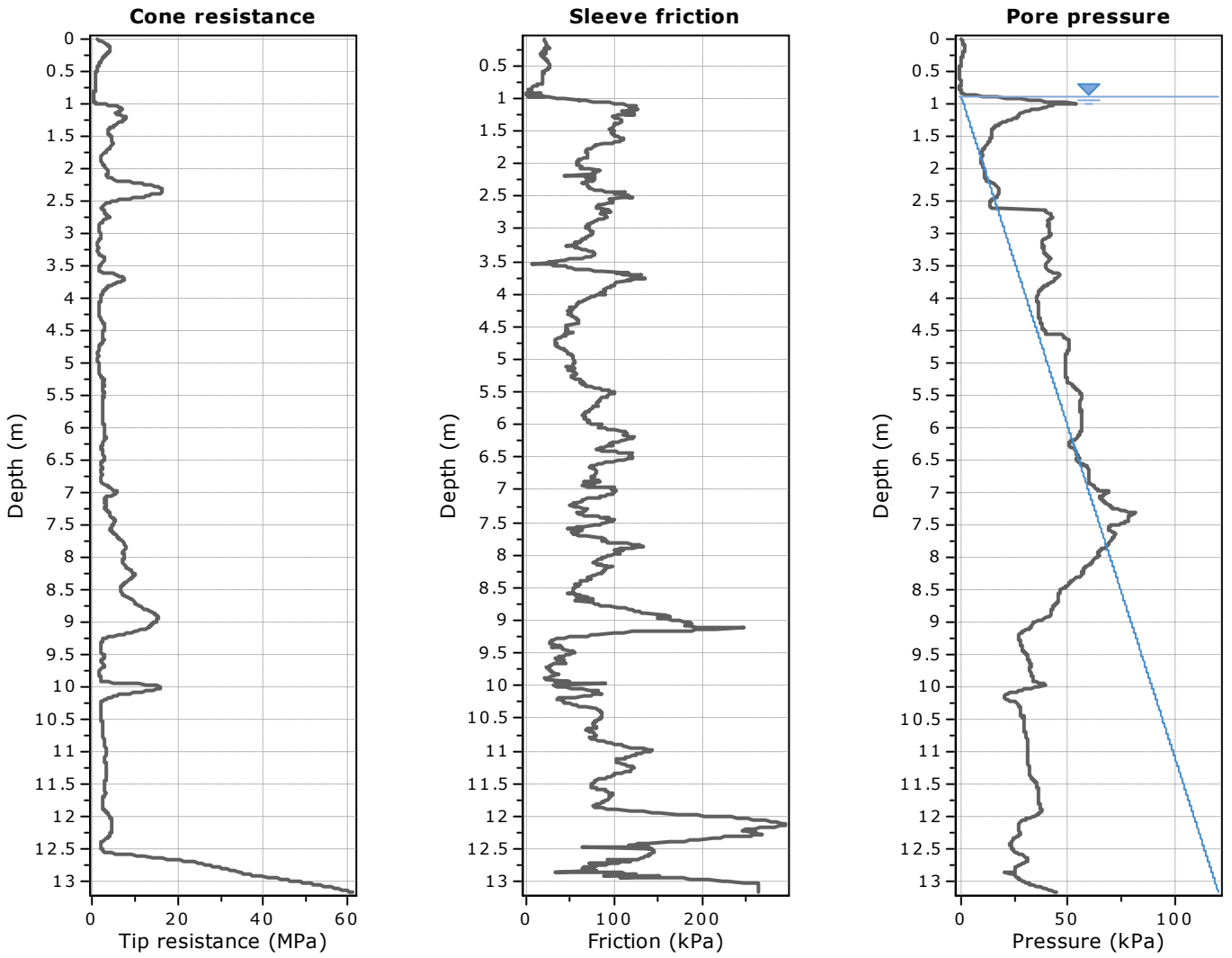
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	5.58	0.20	9.50	1125.71
2	1.20	0.50	2.30	5.53	0.20	9.50	1114.53
3	1.40	0.50	2.60	5.98	0.20	9.50	1205.13
4	1.60	0.50	2.90	6.10	0.20	9.50	1229.62
5	1.80	0.50	3.20	5.66	0.20	9.50	1140.77
6	2.00	0.50	3.50	5.31	0.20	9.50	1070.70
7	2.20	0.50	3.80	4.98	0.20	9.50	1006.36
8	2.40	0.50	4.10	4.73	0.20	9.50	956.26
9	2.60	0.50	4.40	4.49	0.20	9.50	906.61
10	2.80	0.50	4.70	4.32	0.20	9.50	874.30
11	3.00	0.50	5.00	4.47	0.20	9.50	904.37
12	3.20	0.50	5.30	5.19	0.20	9.50	1048.48
13	3.40	0.50	5.60	5.63	0.20	9.50	1134.94
14	3.60	0.50	5.90	6.25	0.20	9.50	1259.89
15	3.80	0.50	6.20	6.63	0.20	9.50	1336.41
16	4.00	0.50	6.50	6.44	0.20	9.50	1296.98

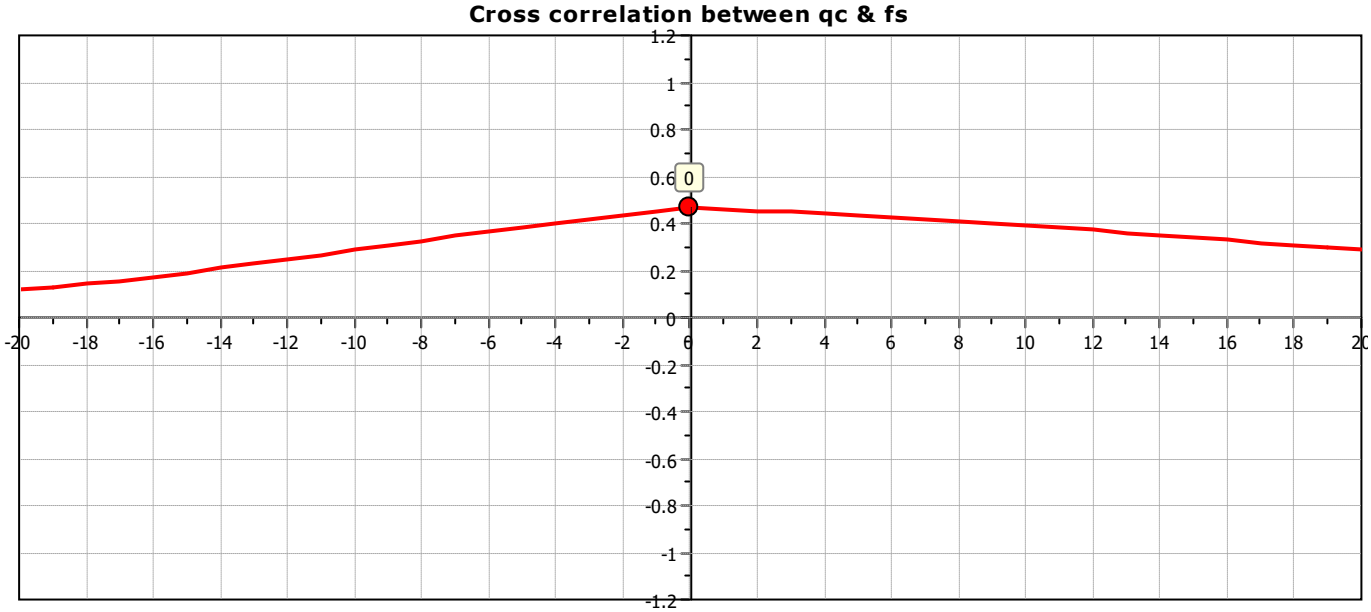
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

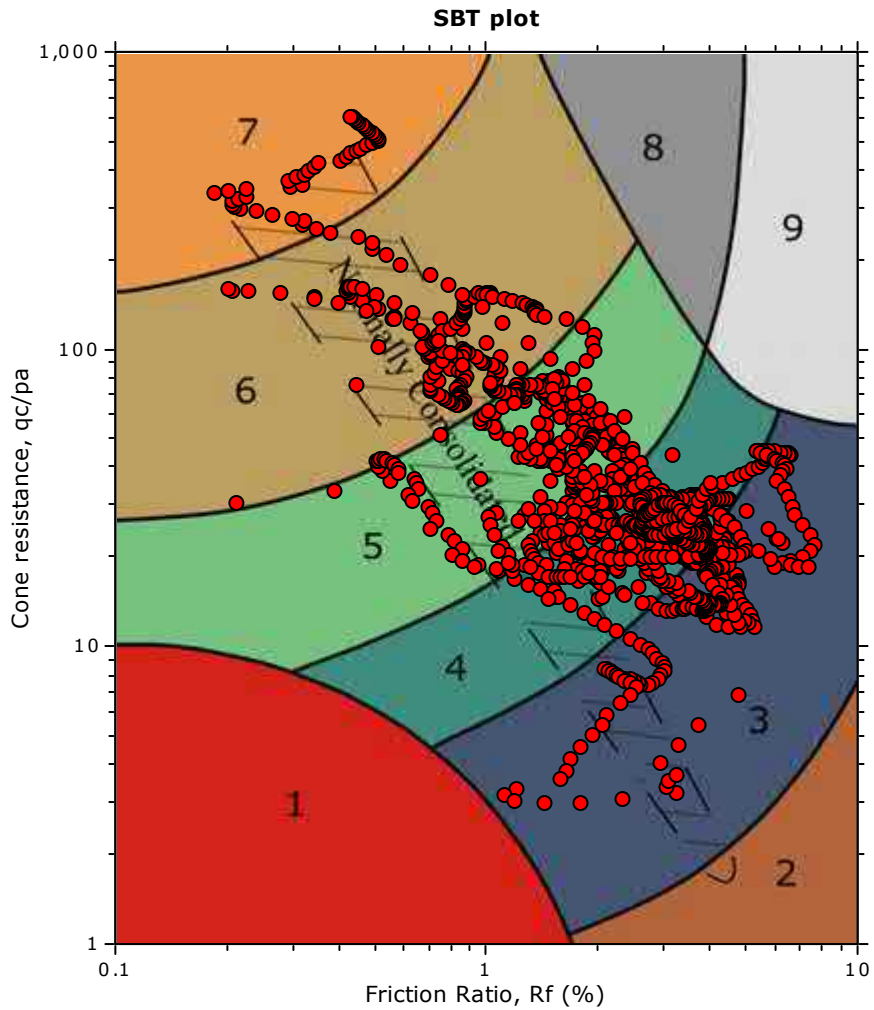


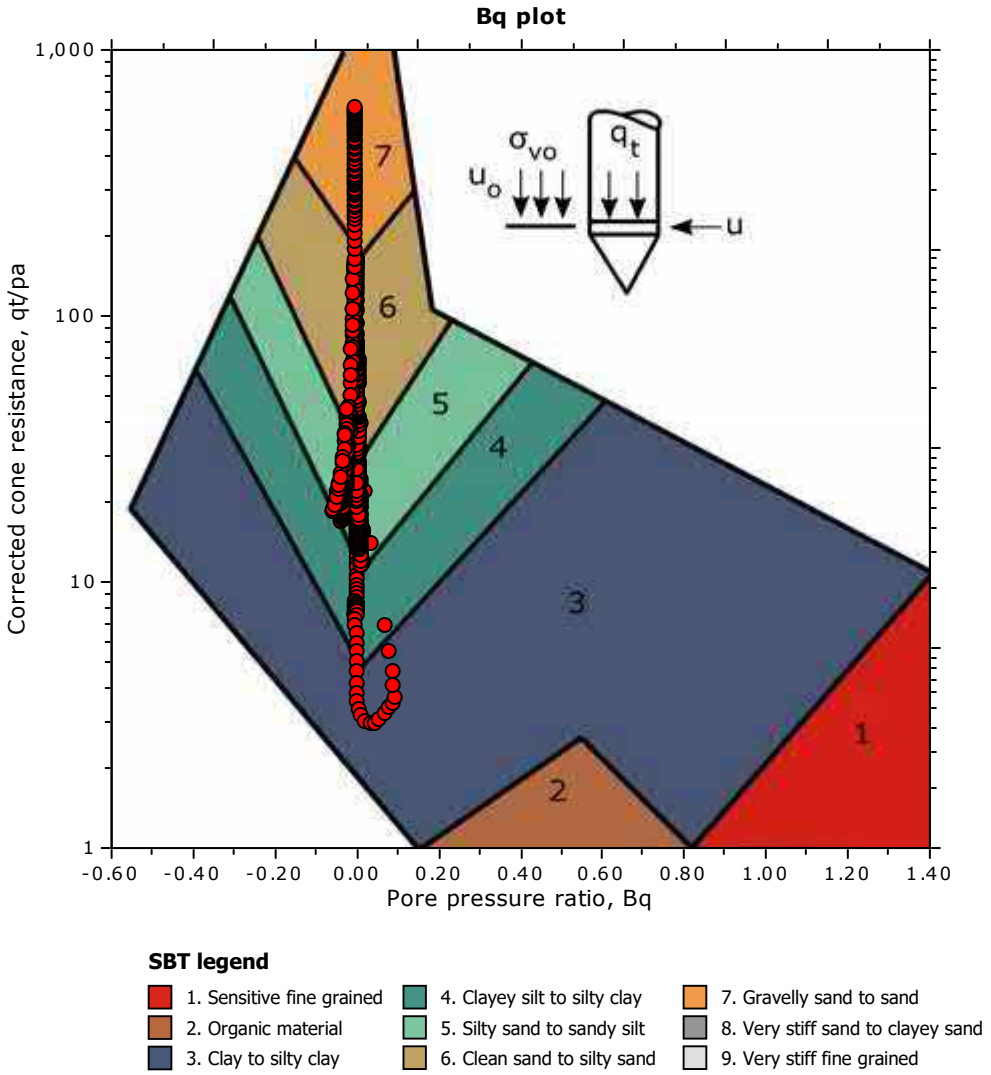
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots



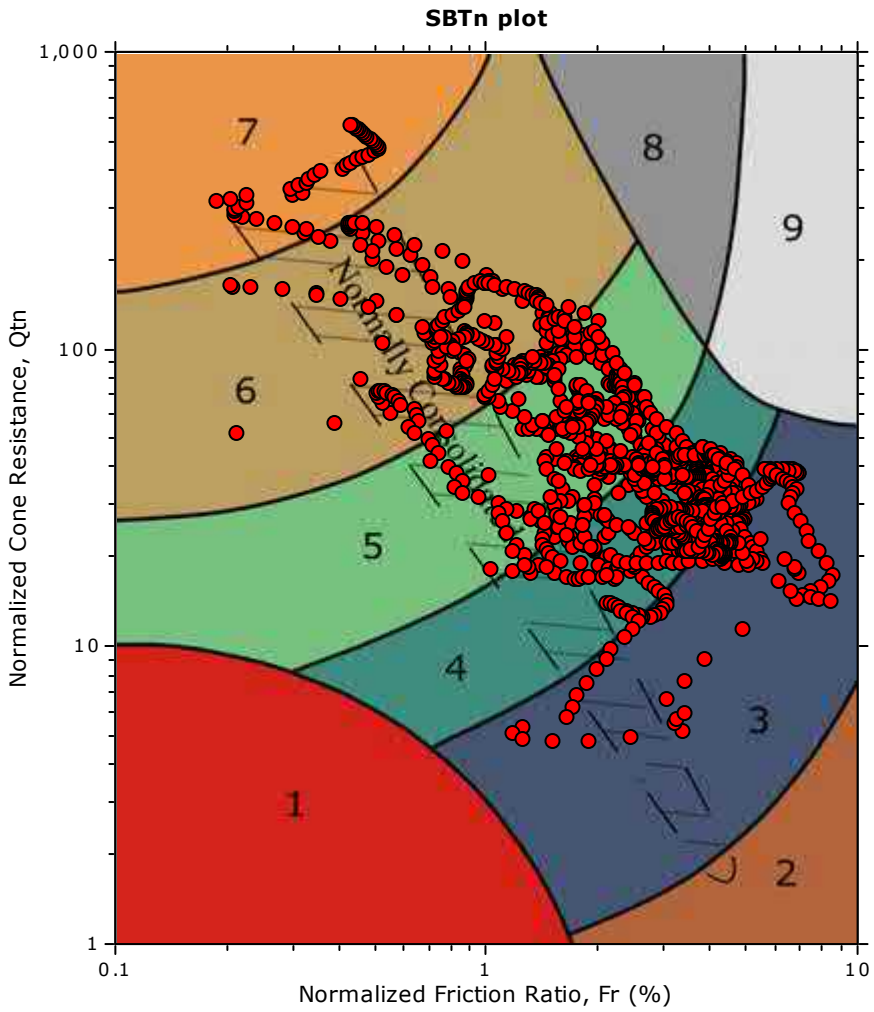


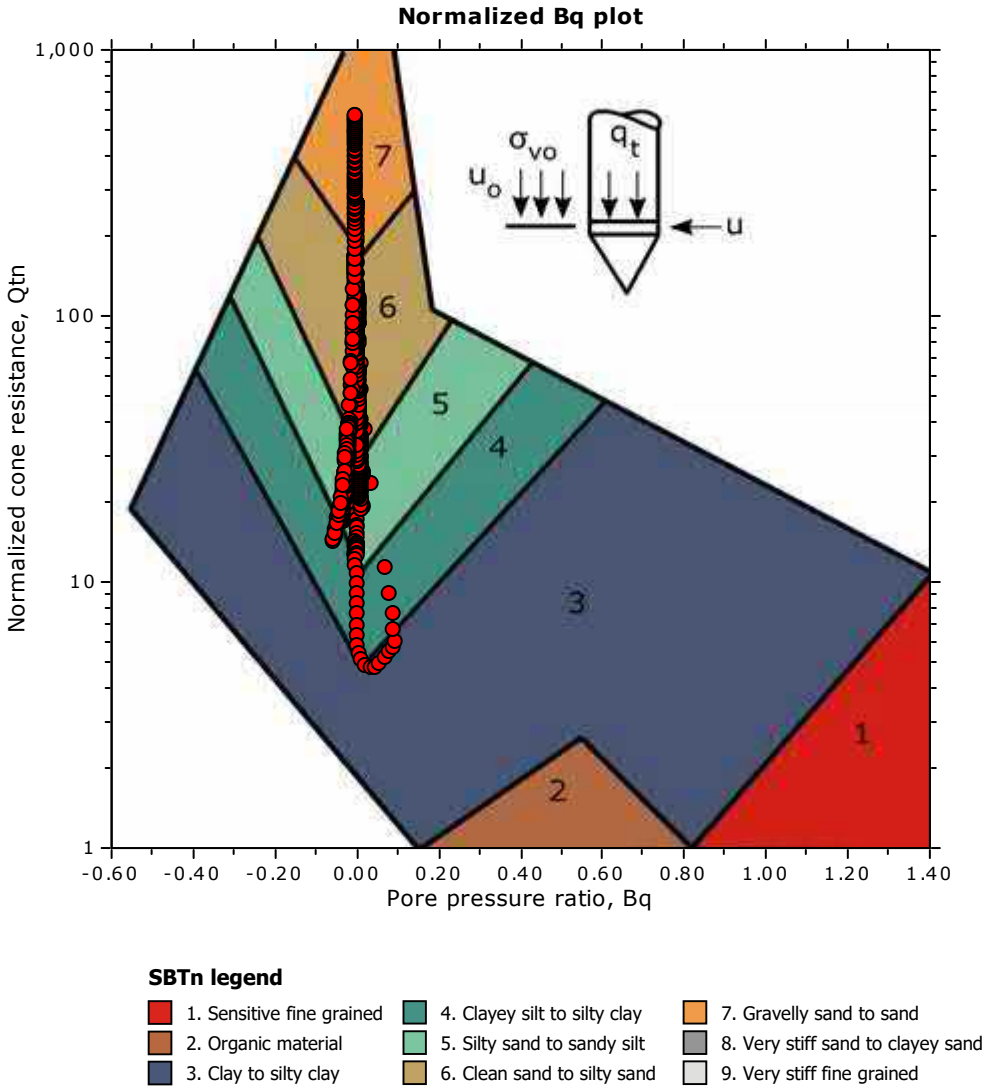
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots (normalized)



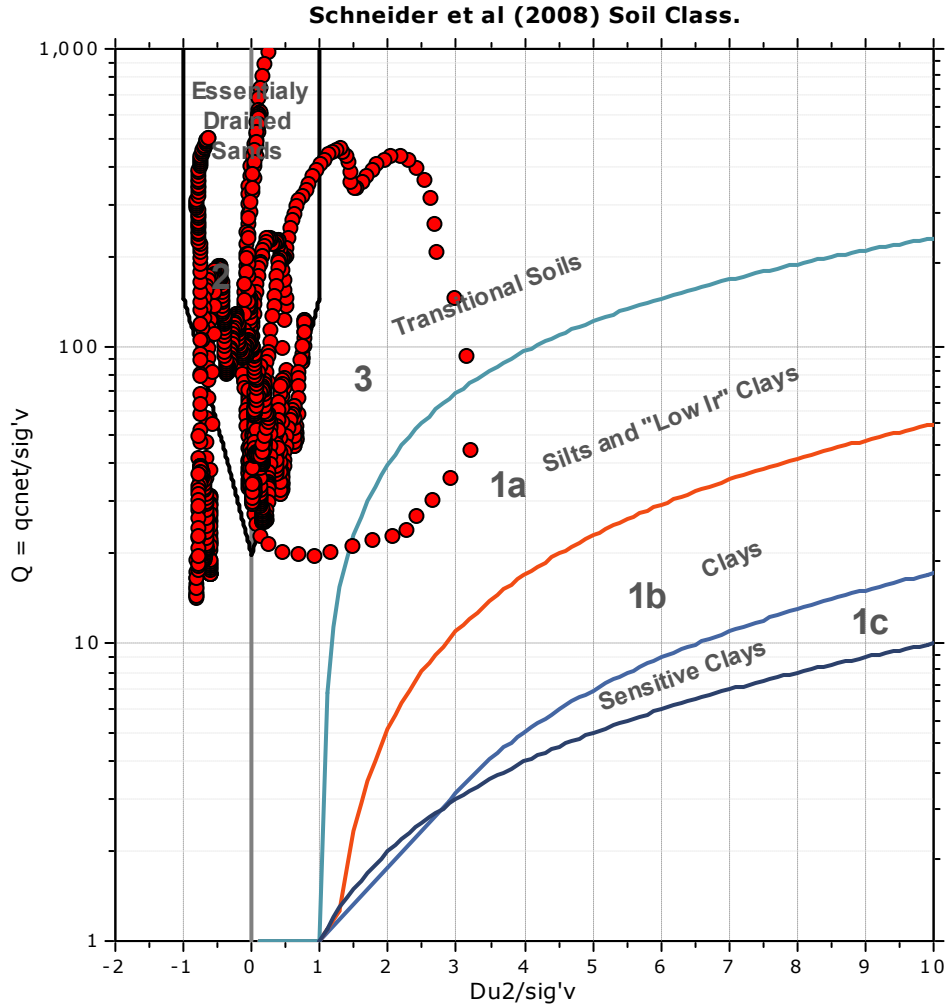


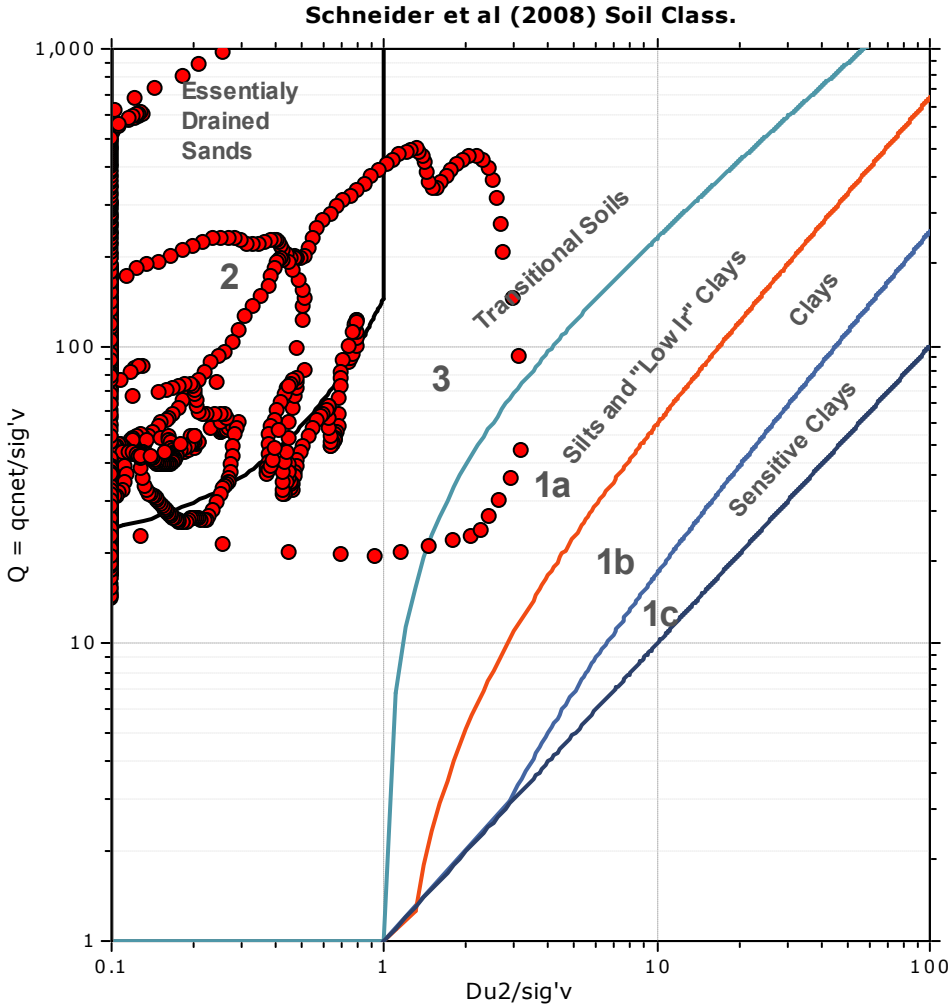
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Bq plots (Schneider)

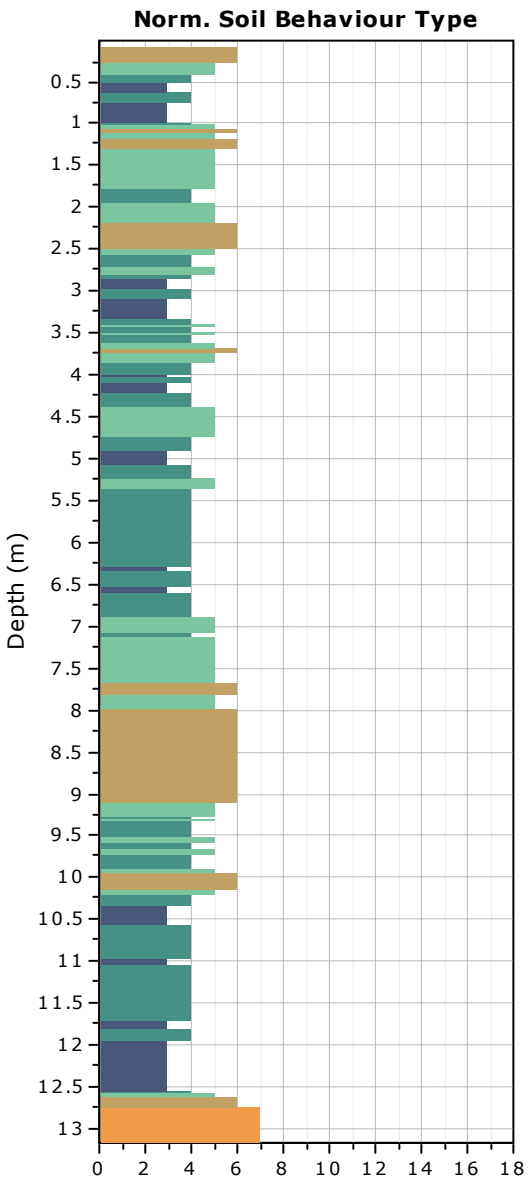


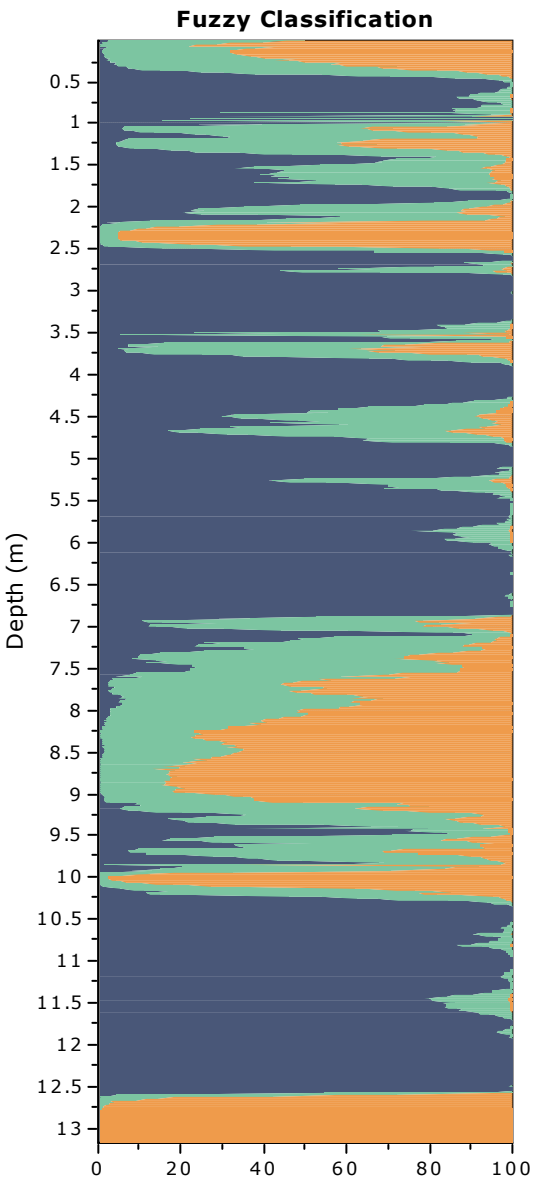


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



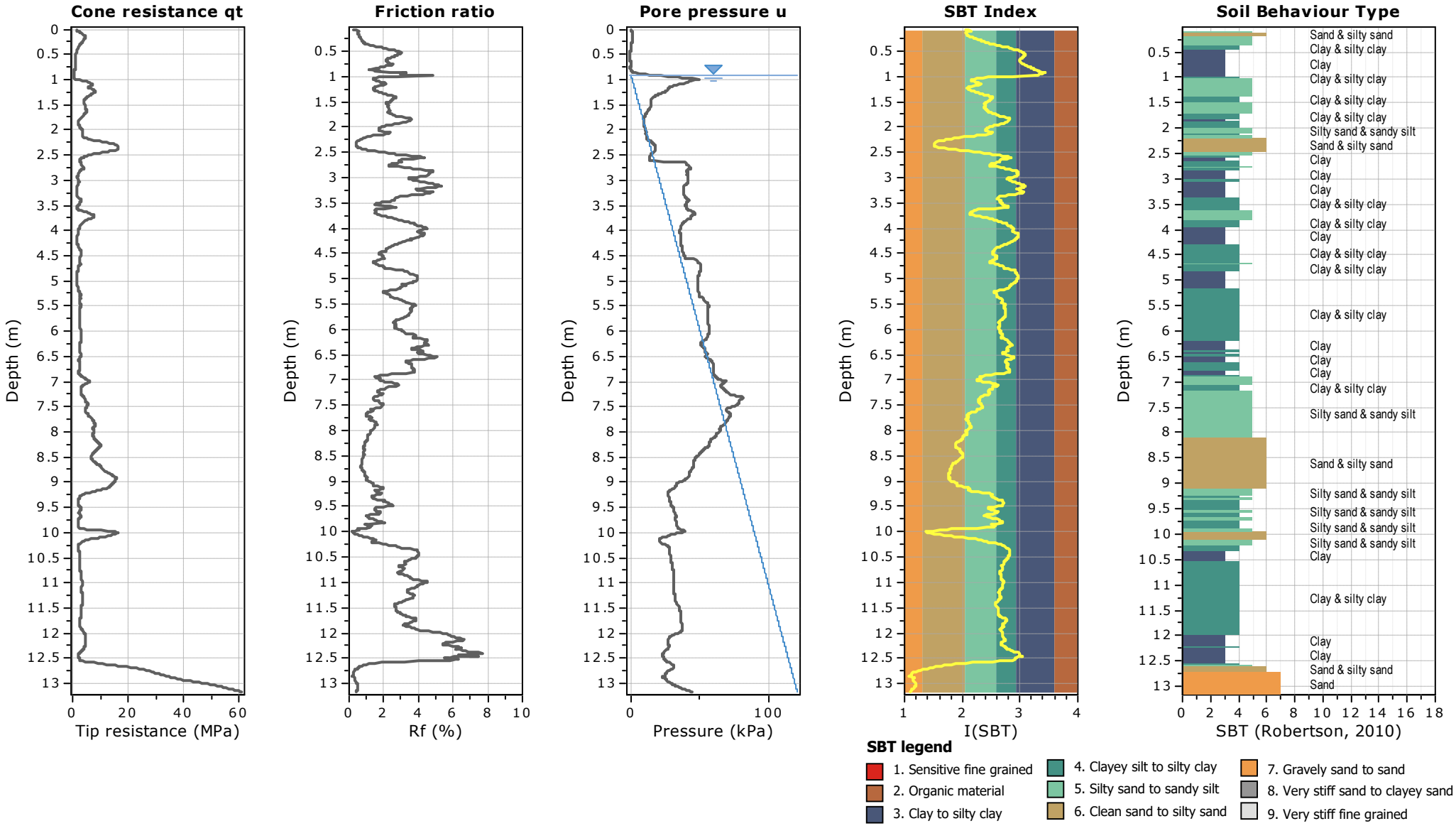


Fuzzy classifiaction legend
- Highly probable clayey soil
- Highly probable mixture soil
- Highly probable sandy soil

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

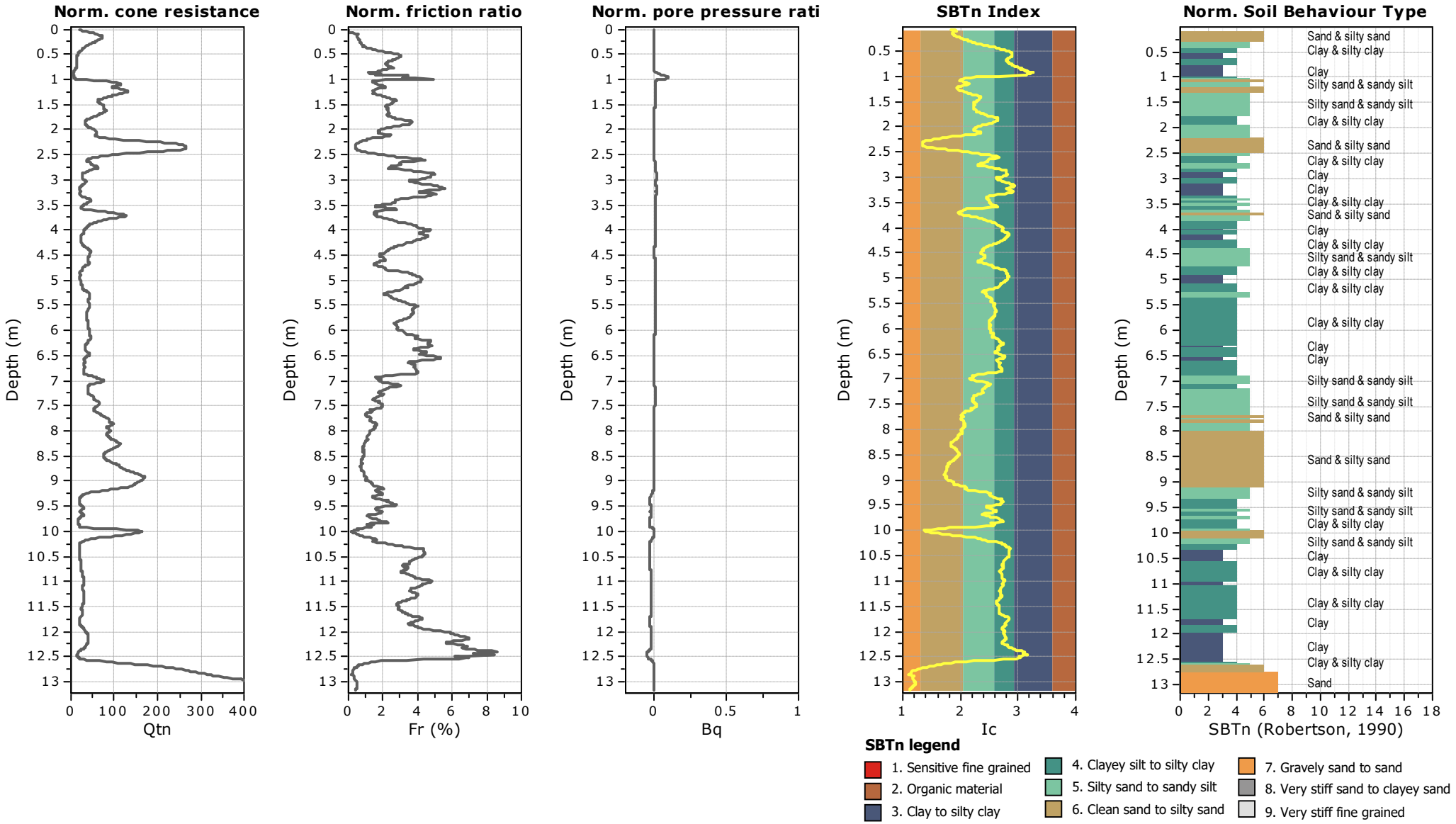
CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

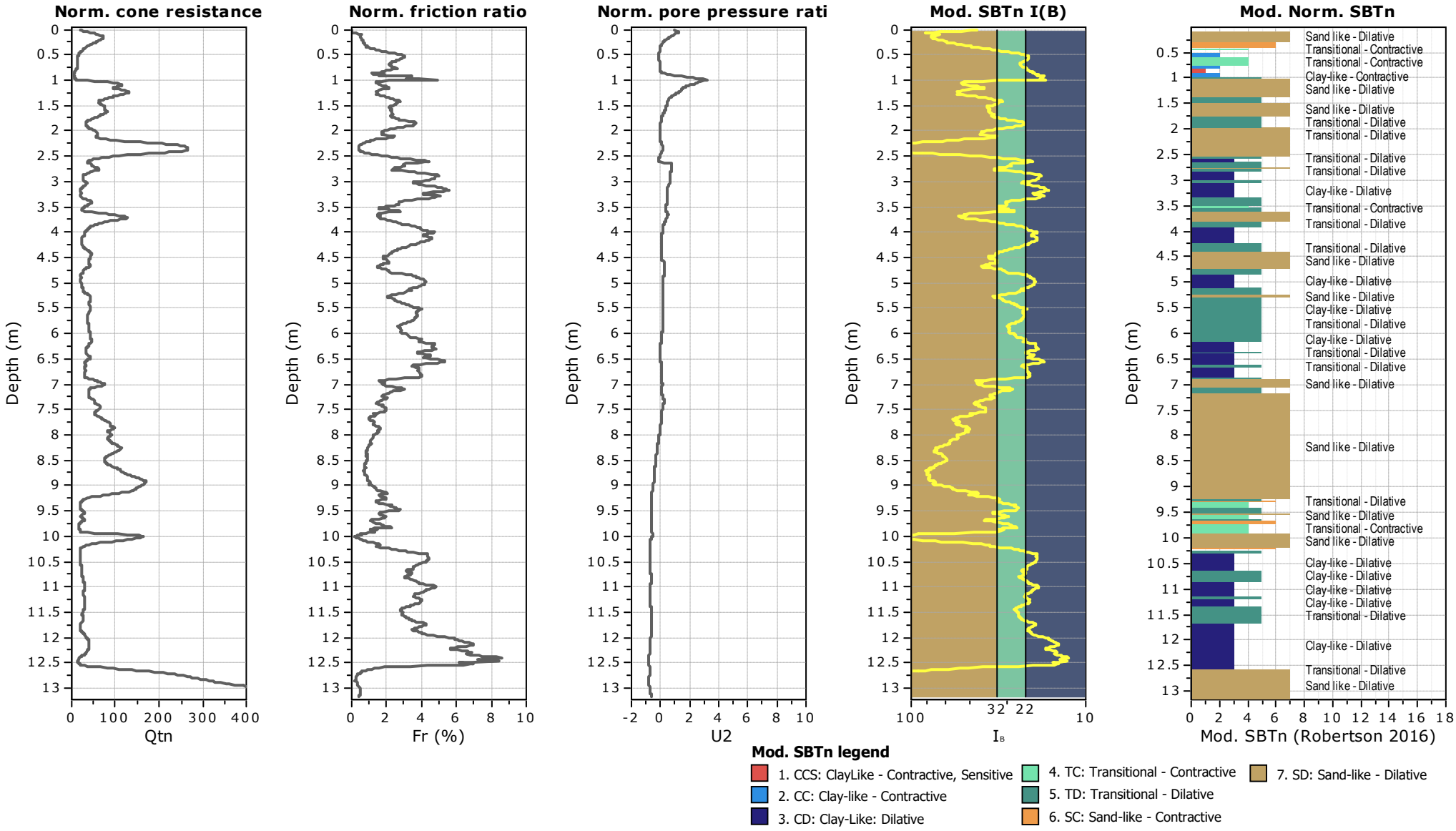
CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

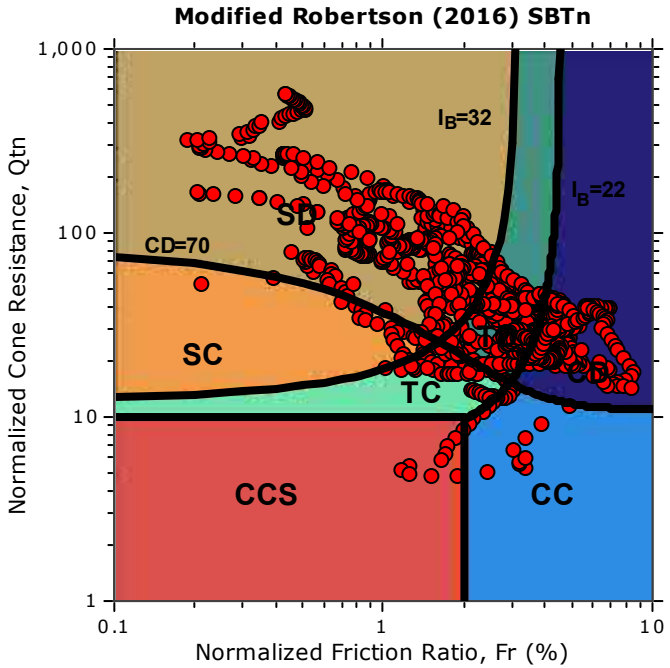


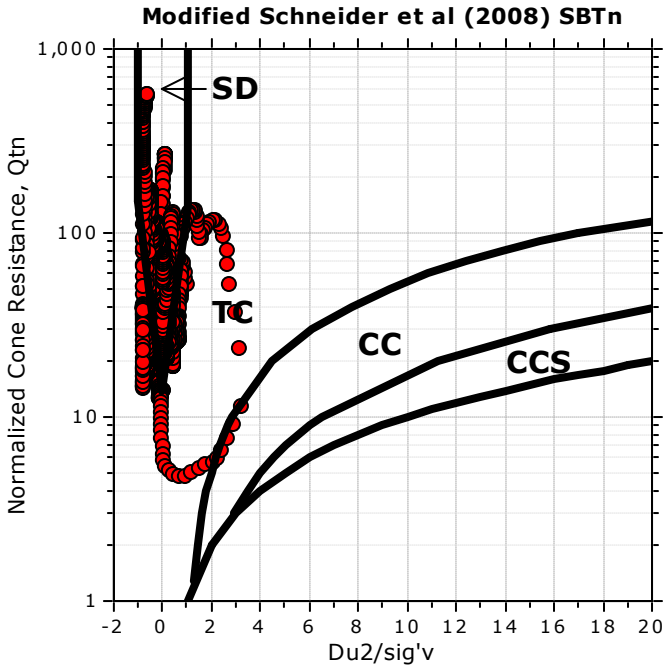
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

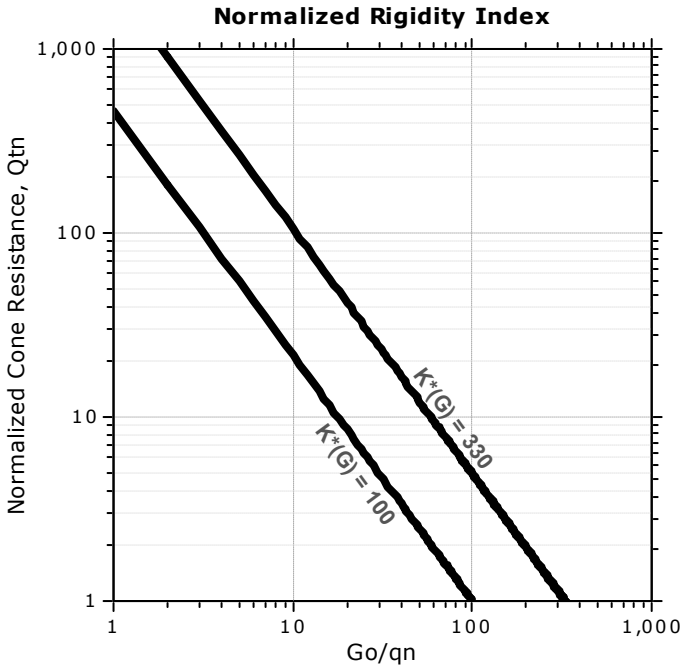
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Updated SBTn plots







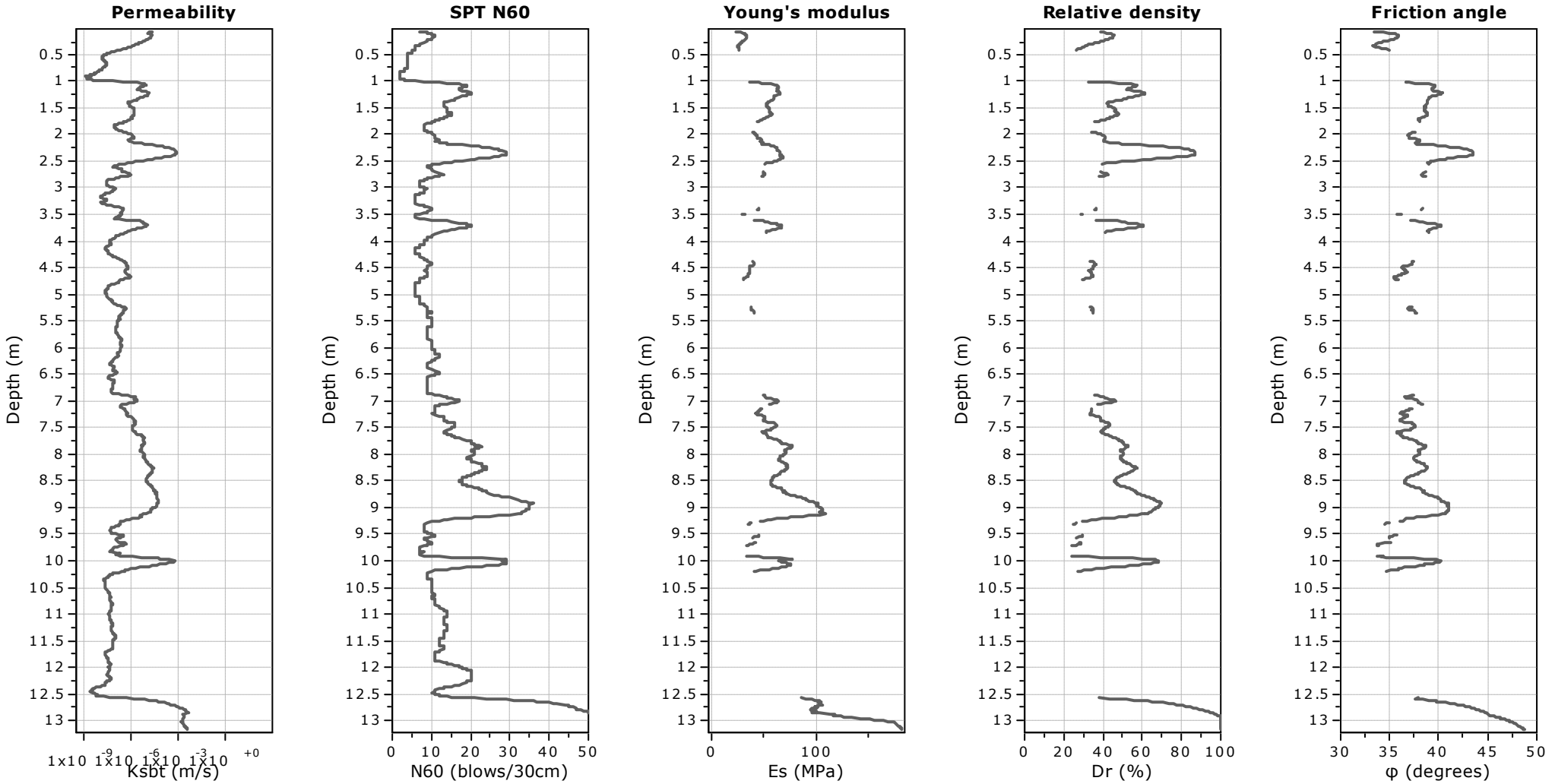
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



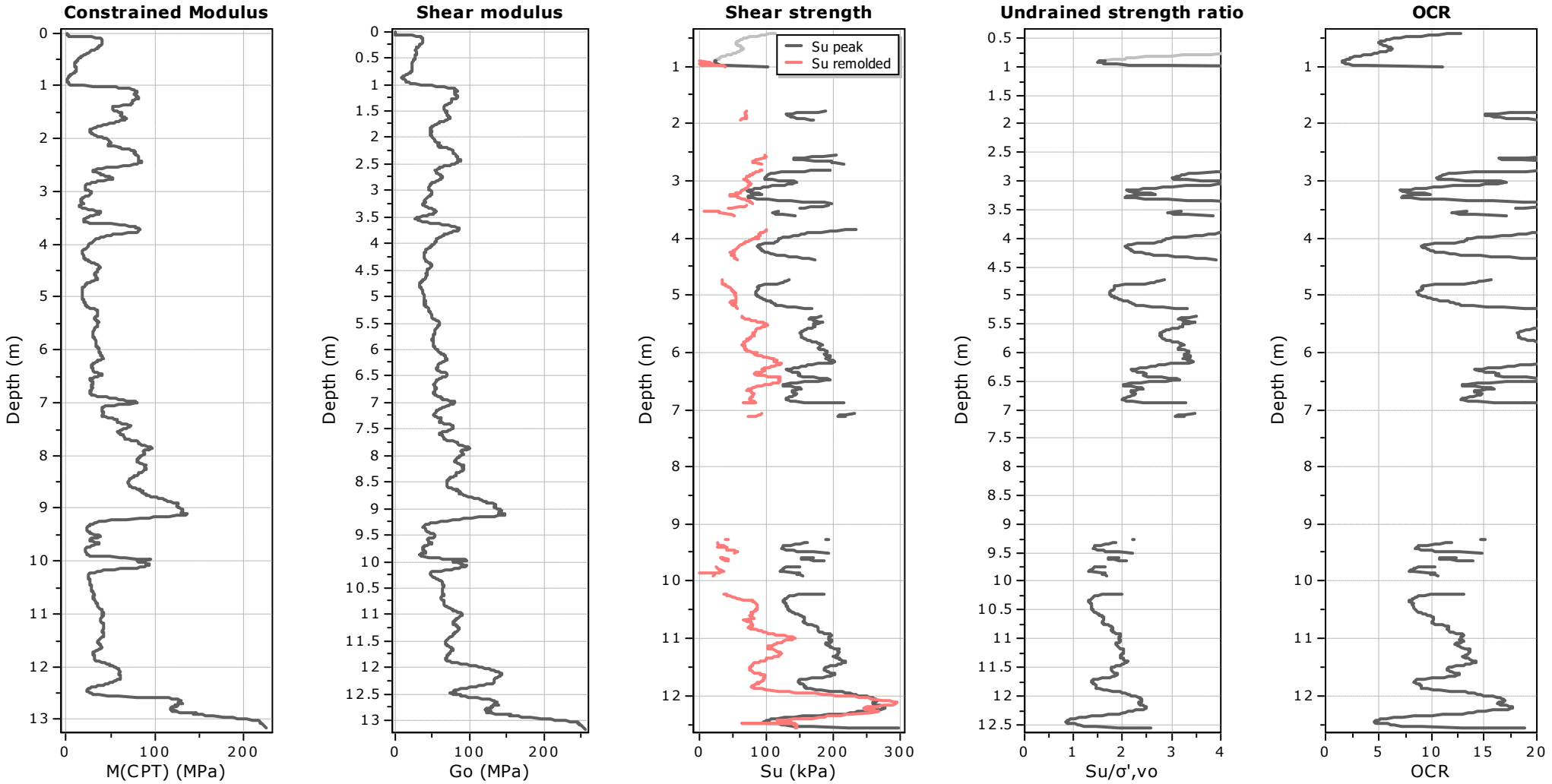
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



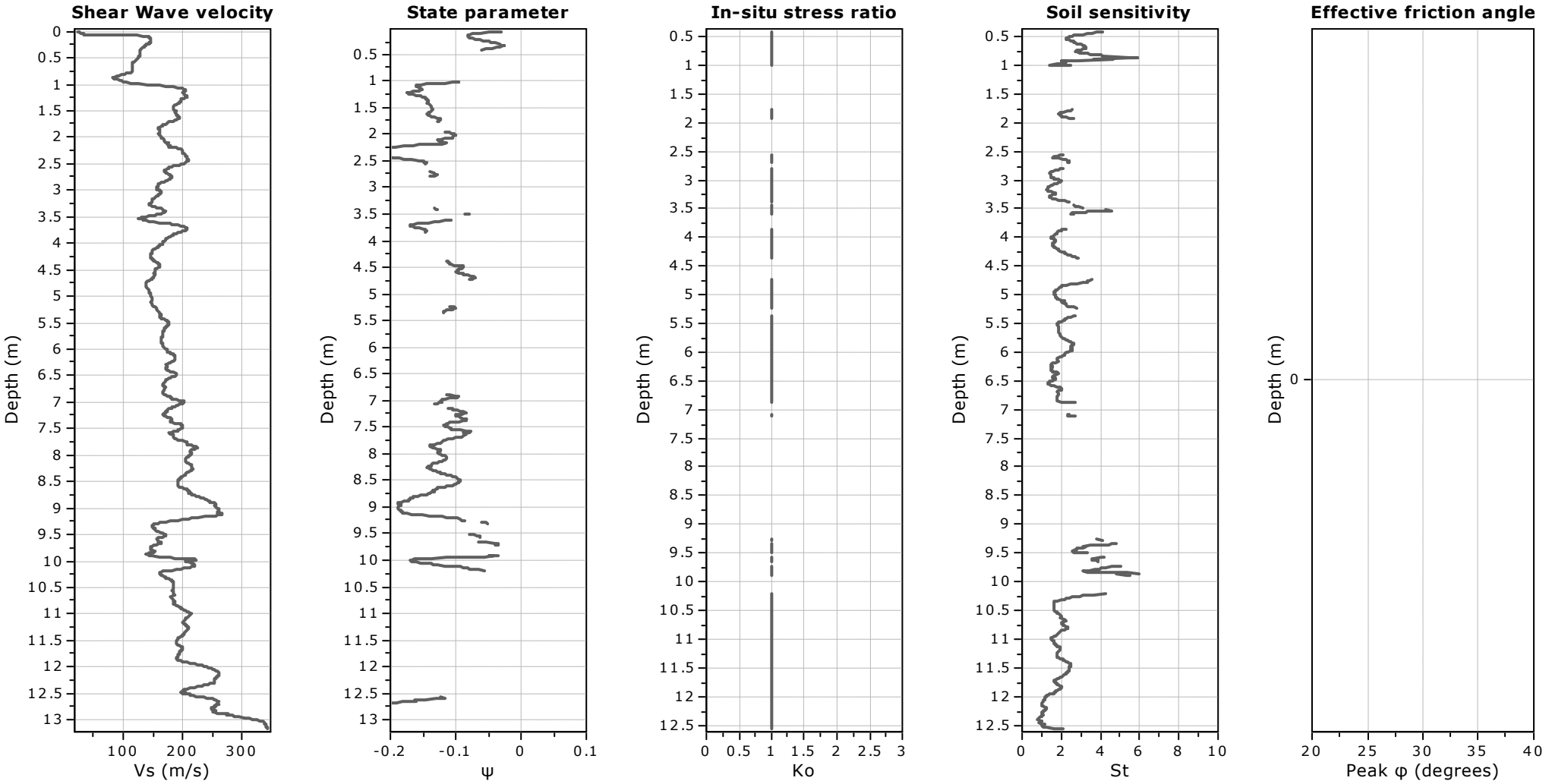
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto
OCR factor for clays, N_{kt}: Auto
Flat Dilatometer Test data

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



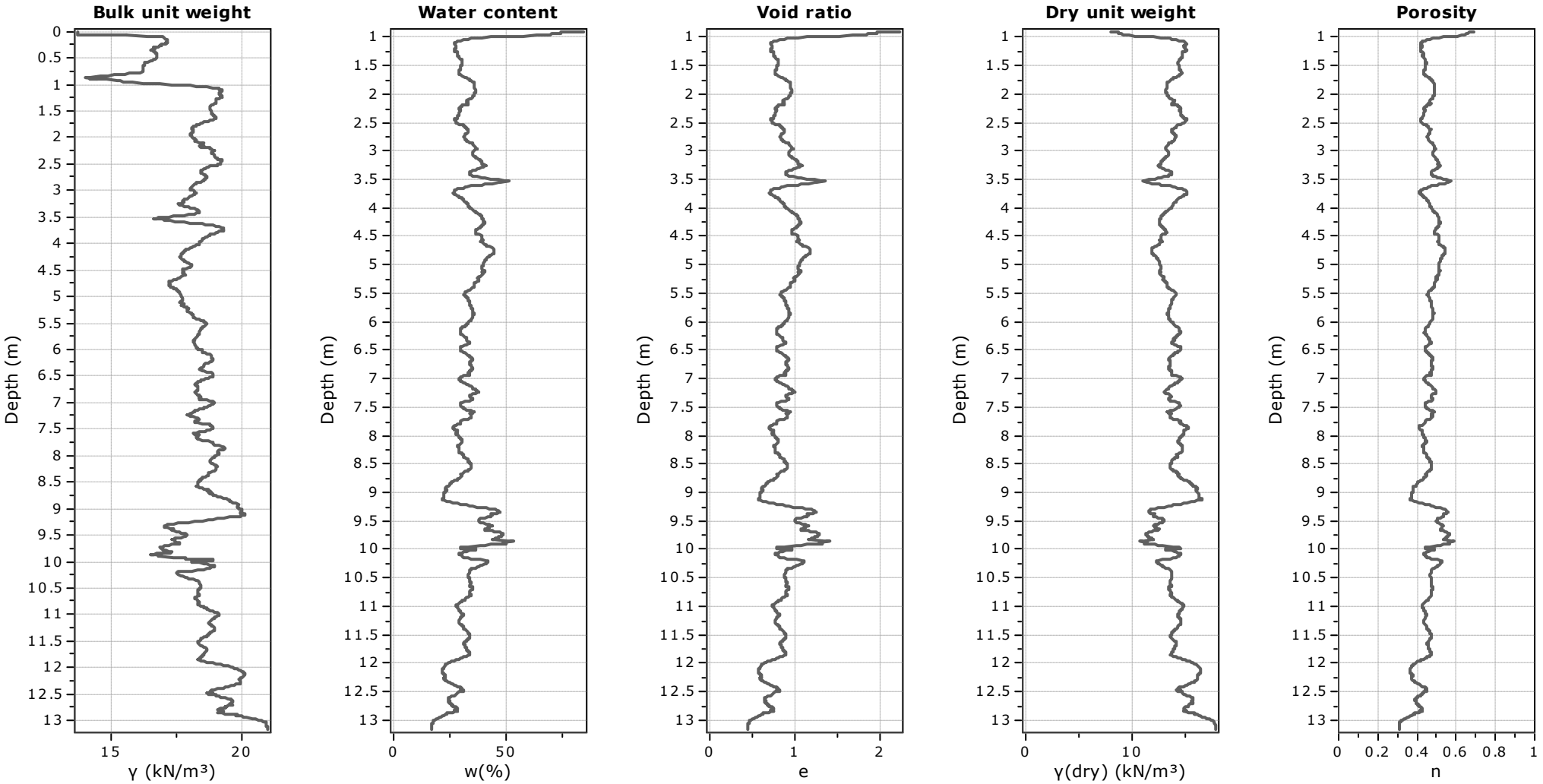
Calculation parameters

Soil Sensitivity factor, N_S: 7.00

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

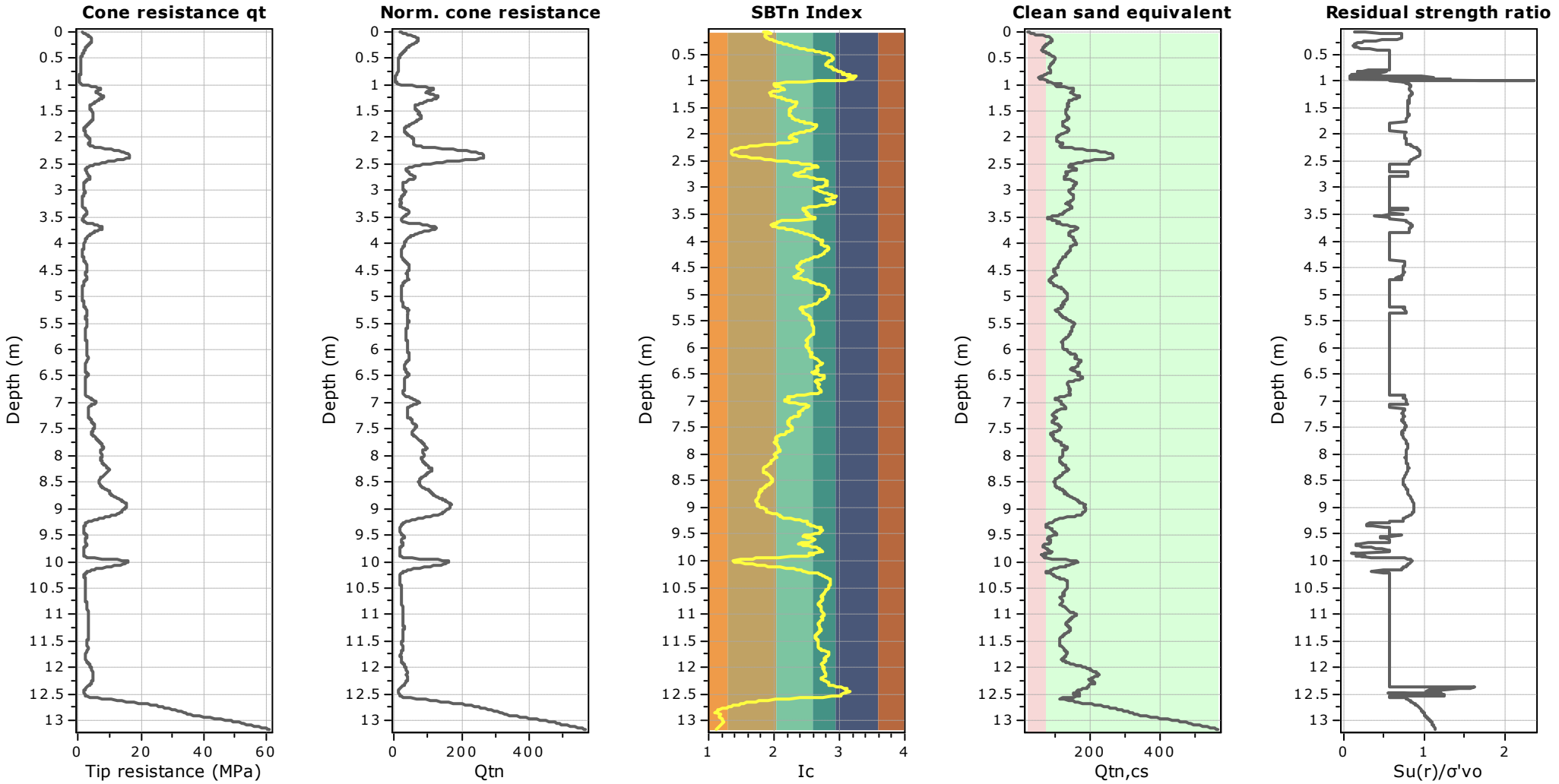
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

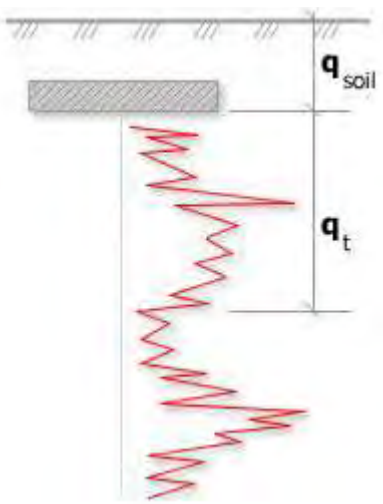
CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

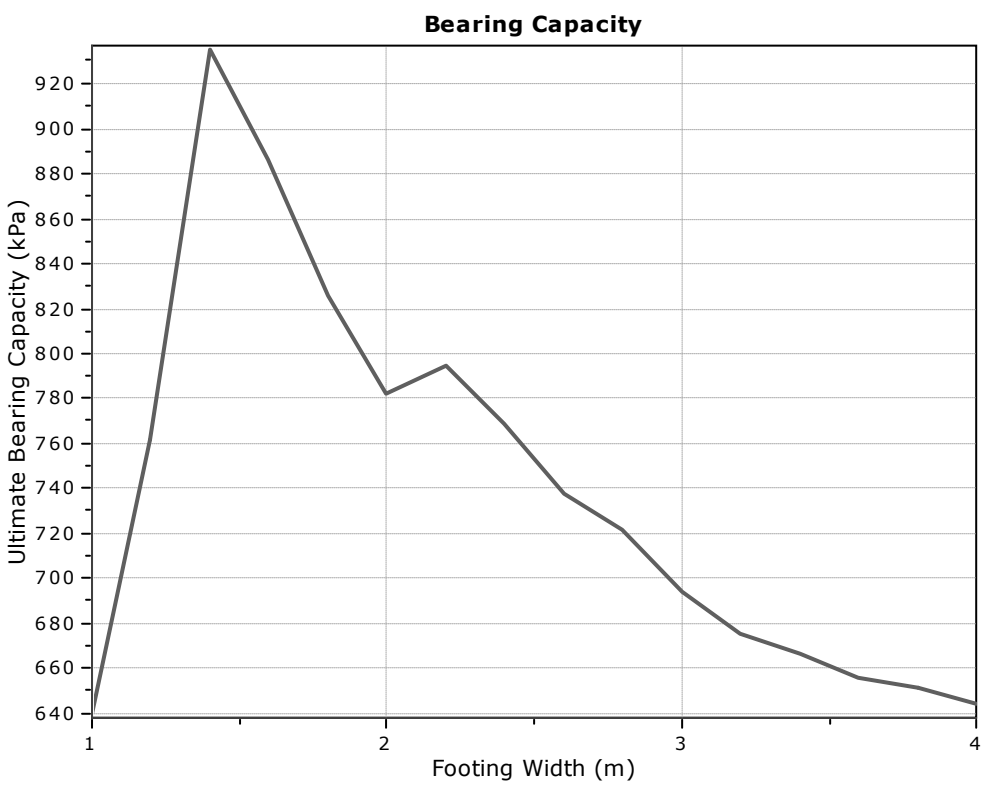
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



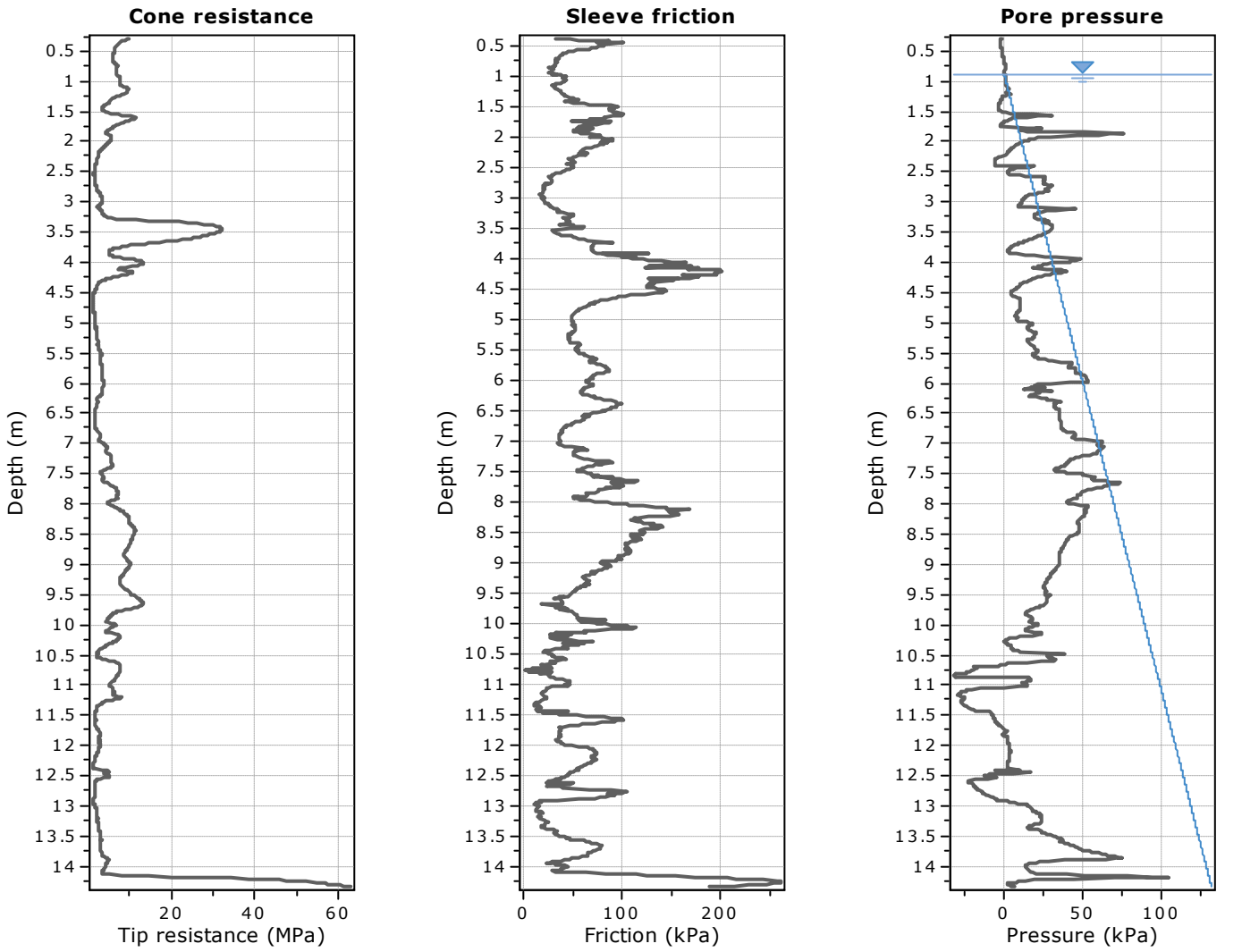
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	3.15	0.20	9.50	639.90
2	1.20	0.50	2.30	3.76	0.20	9.50	761.61
3	1.40	0.50	2.60	4.63	0.20	9.50	935.21
4	1.60	0.50	2.90	4.39	0.20	9.50	886.67
5	1.80	0.50	3.20	4.08	0.20	9.50	825.62
6	2.00	0.50	3.50	3.86	0.20	9.50	782.47
7	2.20	0.50	3.80	3.92	0.20	9.50	794.46
8	2.40	0.50	4.10	3.80	0.20	9.50	769.29
9	2.60	0.50	4.40	3.64	0.20	9.50	737.46
10	2.80	0.50	4.70	3.56	0.20	9.50	722.07
11	3.00	0.50	5.00	3.43	0.20	9.50	694.57
12	3.20	0.50	5.30	3.33	0.20	9.50	675.27
13	3.40	0.50	5.60	3.28	0.20	9.50	666.17
14	3.60	0.50	5.90	3.23	0.20	9.50	656.25
15	3.80	0.50	6.20	3.21	0.20	9.50	651.72
16	4.00	0.50	6.50	3.17	0.20	9.50	644.22

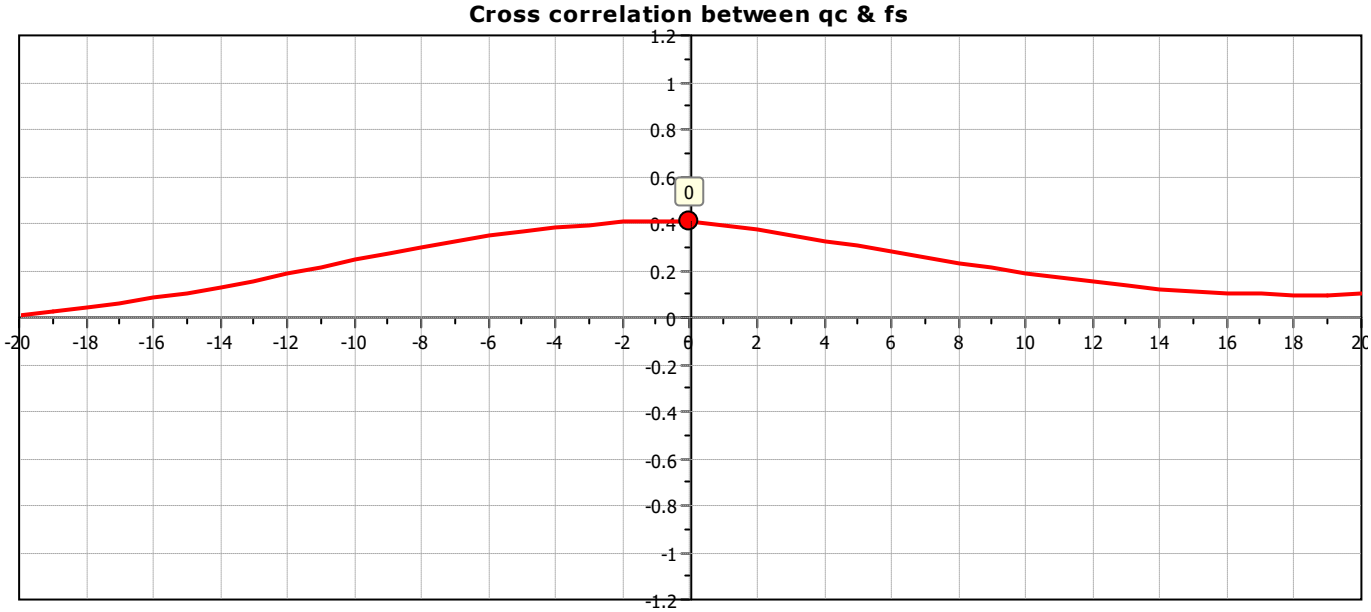
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

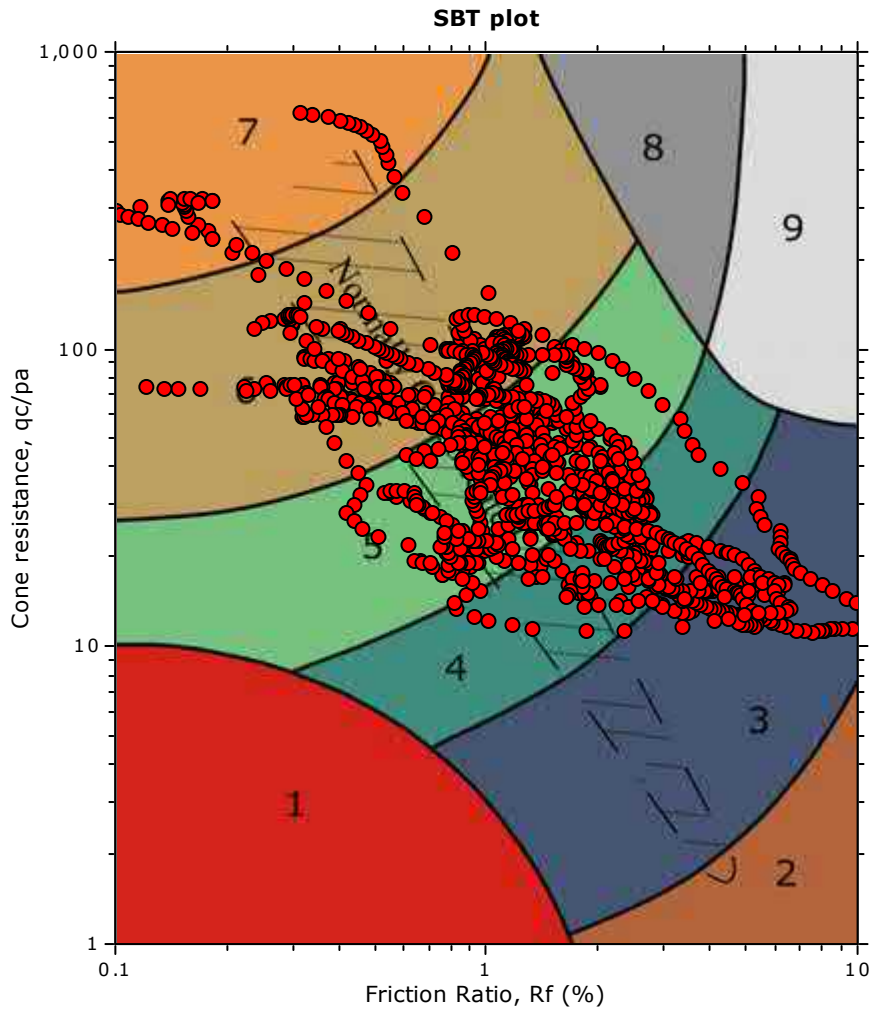


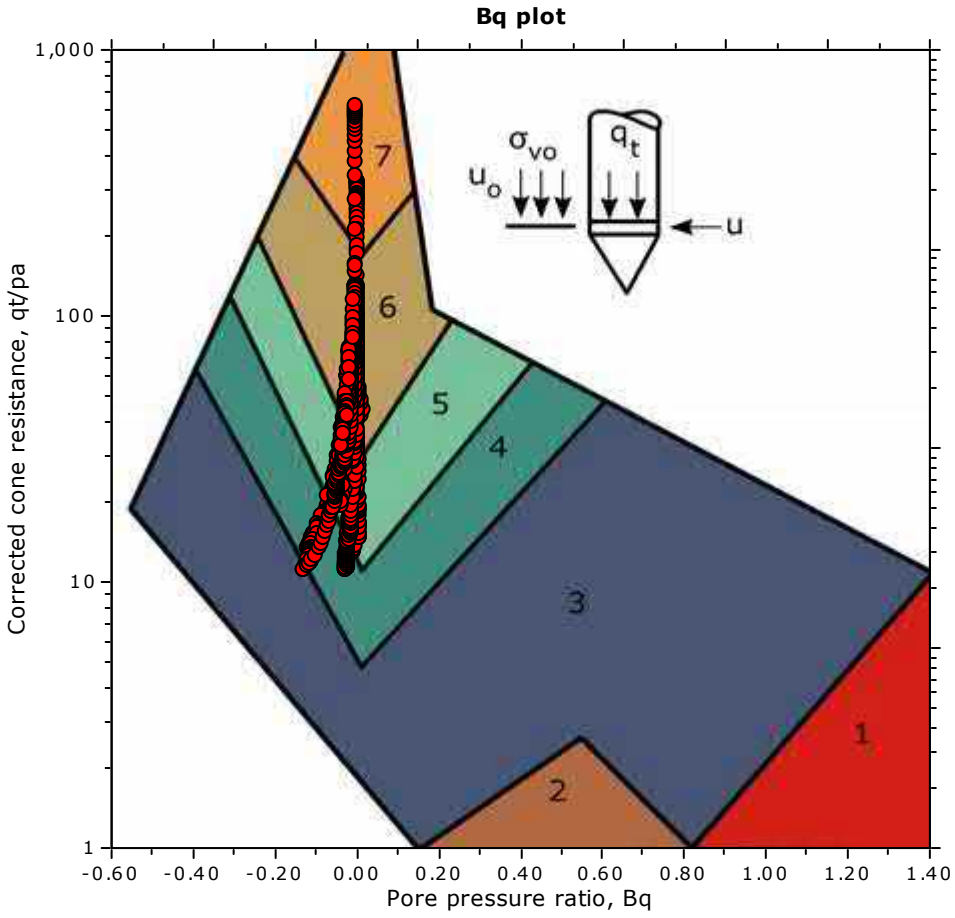
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots





SBT legend

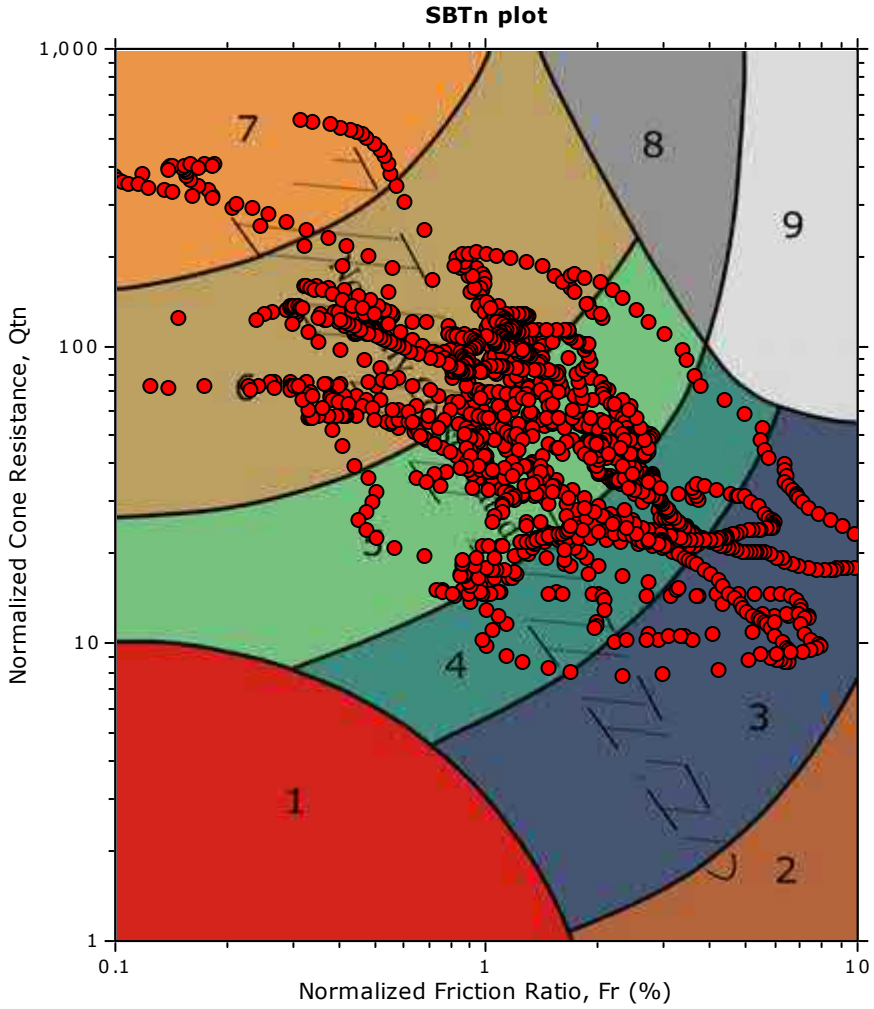
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

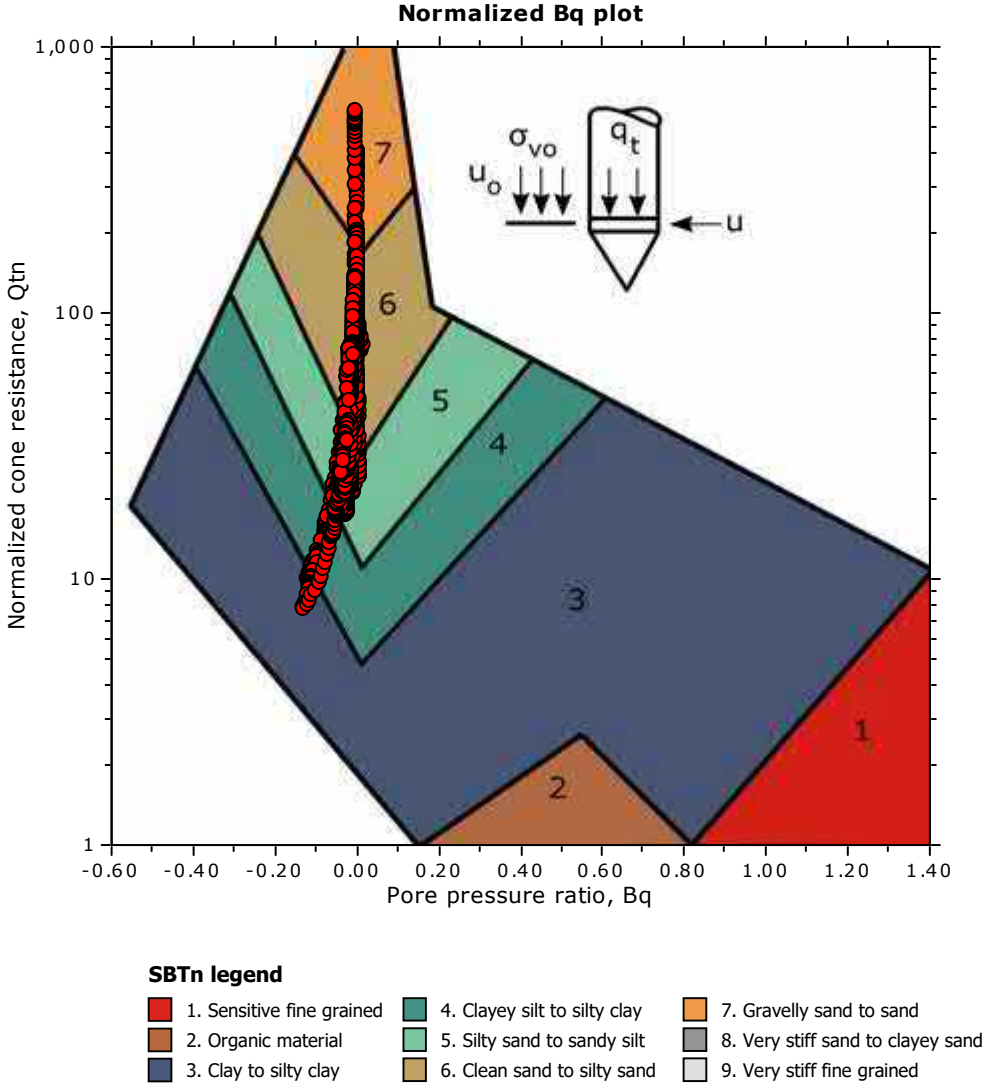
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots (normalized)





SBTn legend

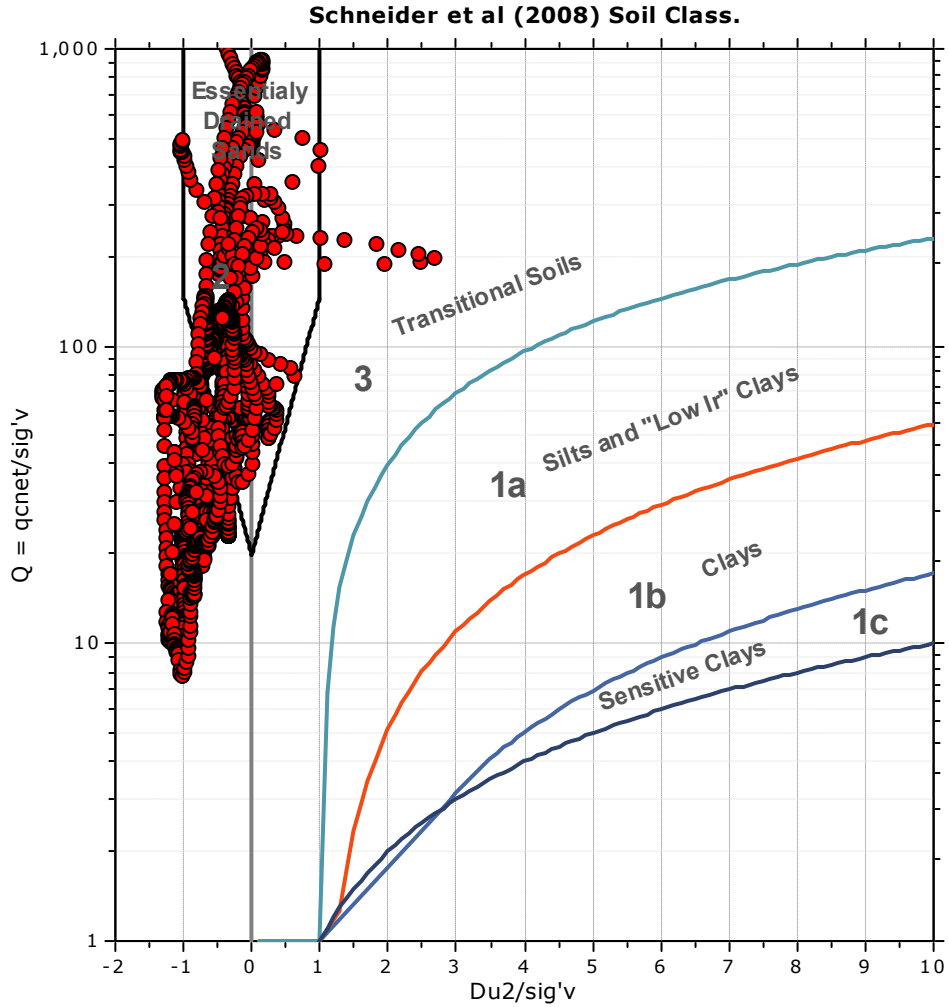
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

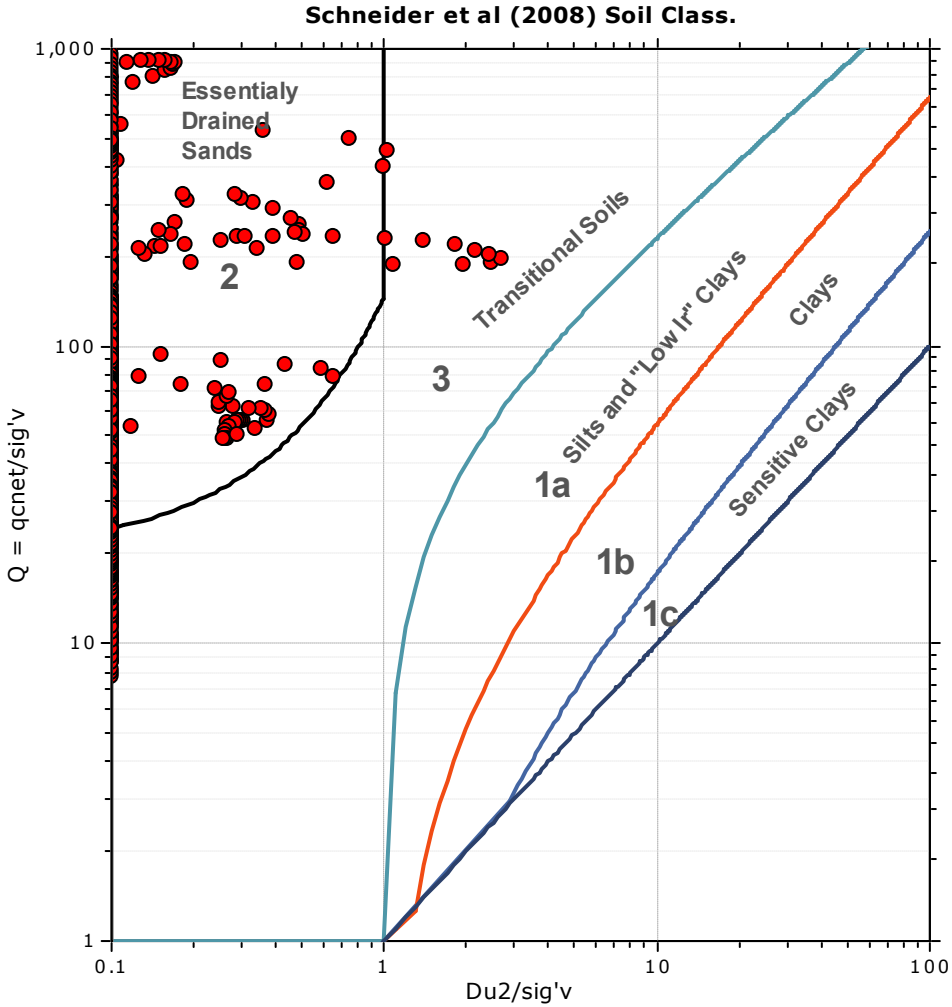
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Bq plots (Schneider)

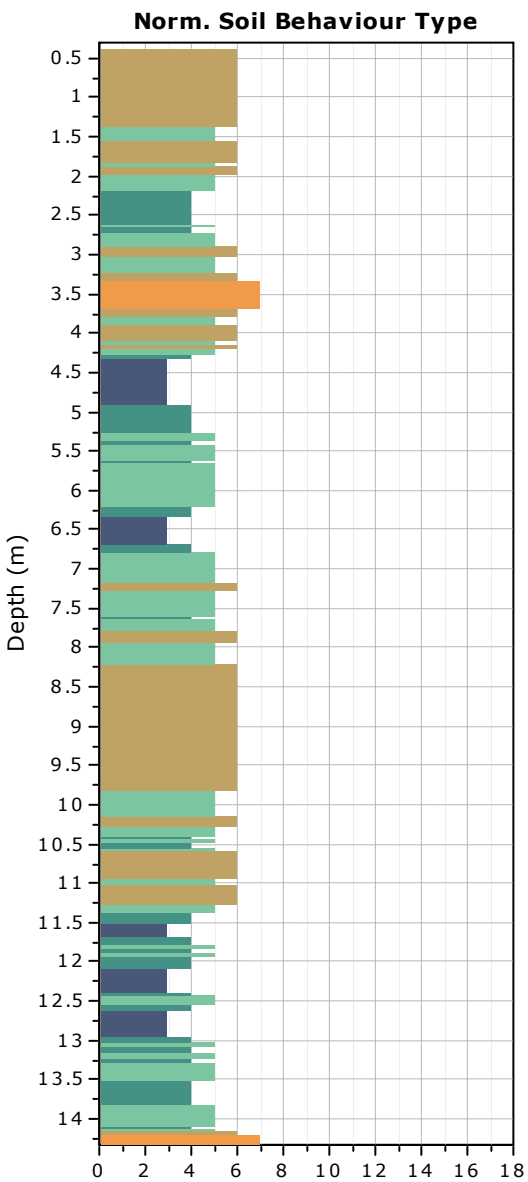


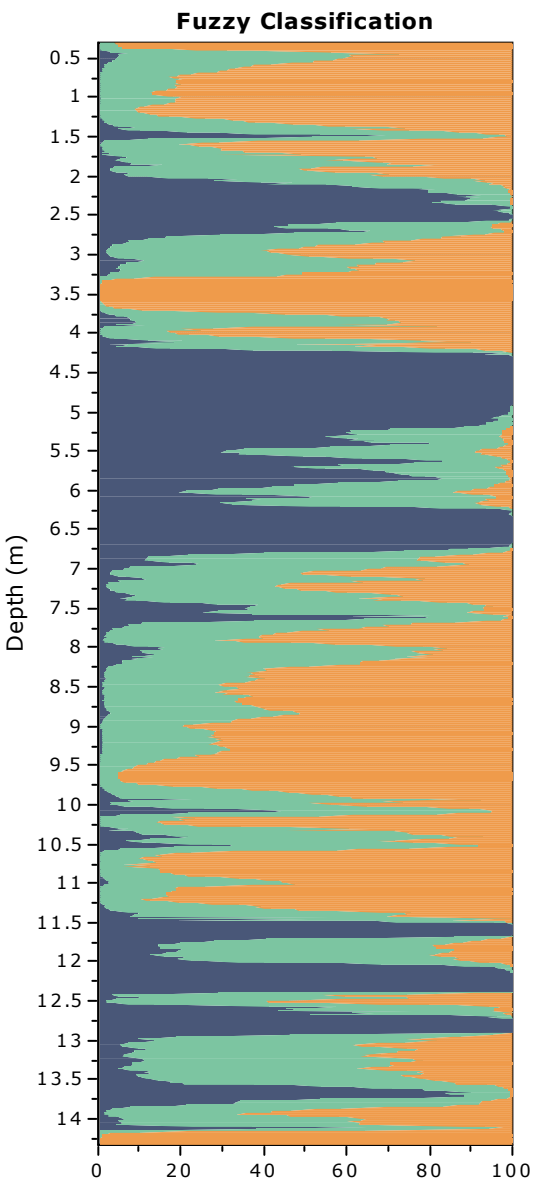


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



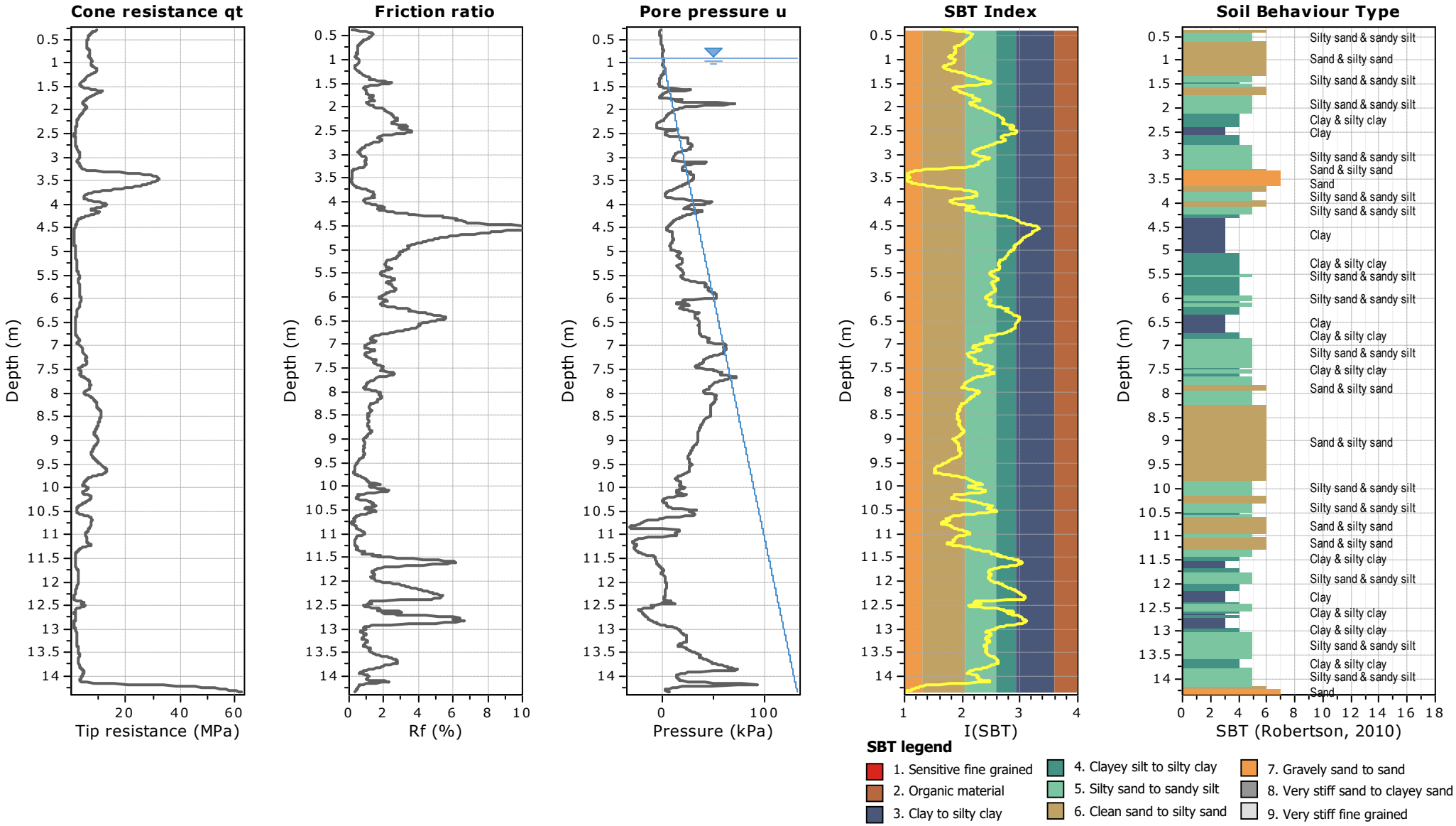


Fuzzy classifiaction legend
- Highly probable clayey soil
- Highly probable mixture soil
- Highly probable sandy soil

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

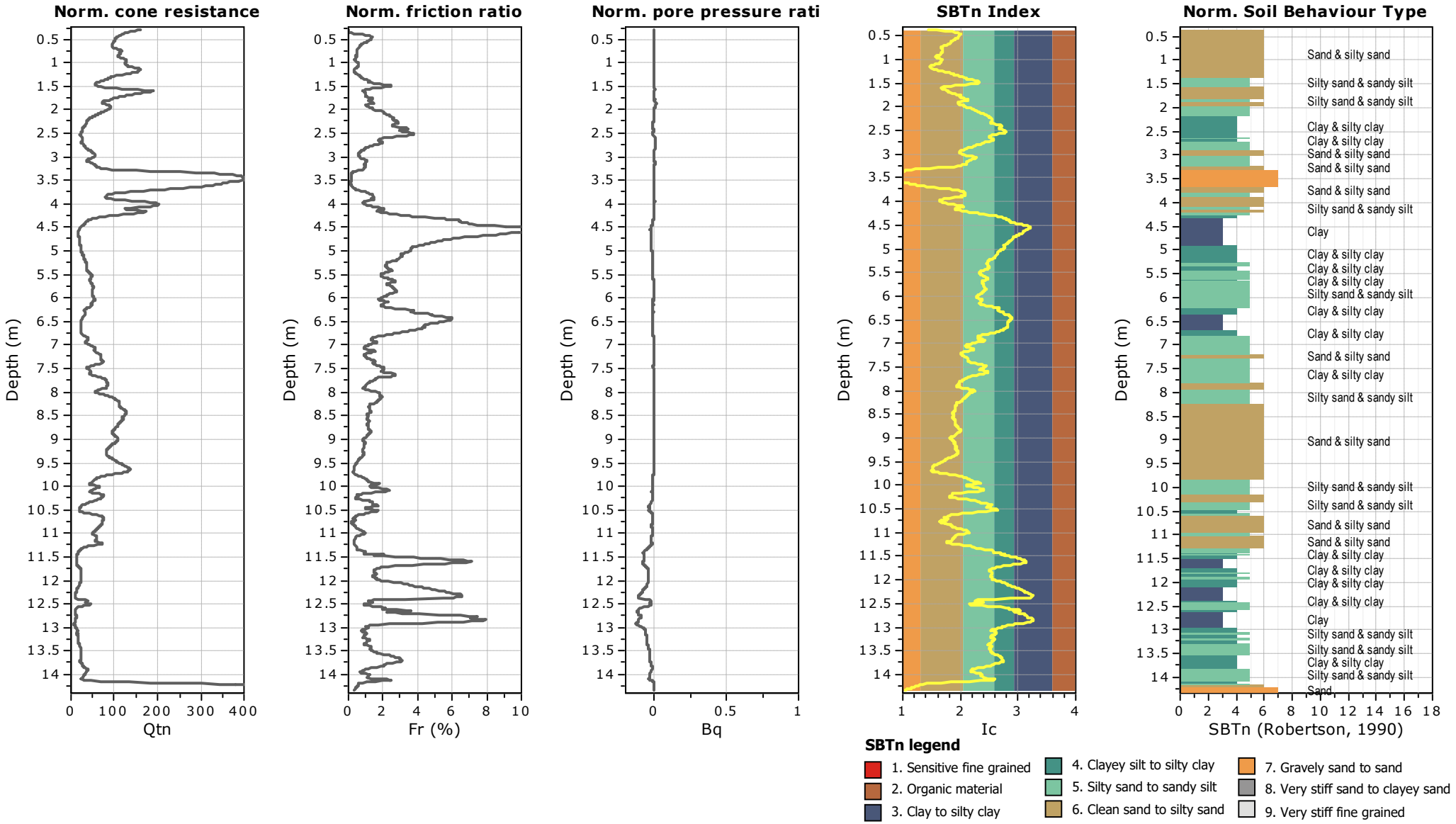
CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

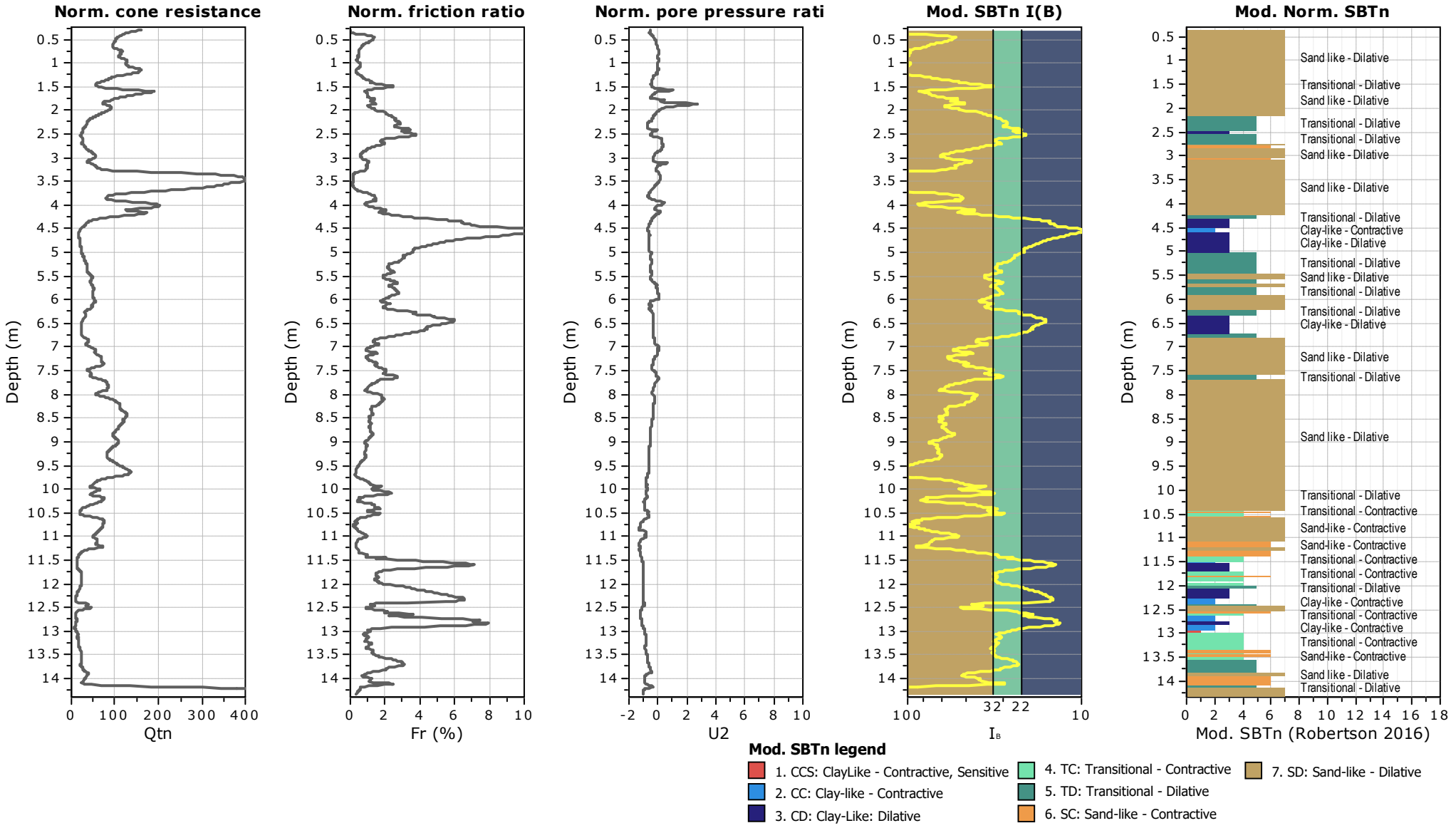
CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

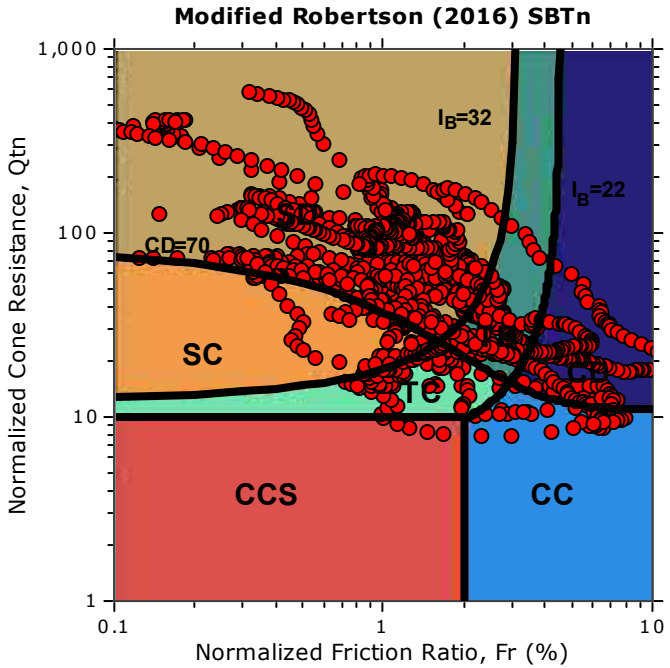


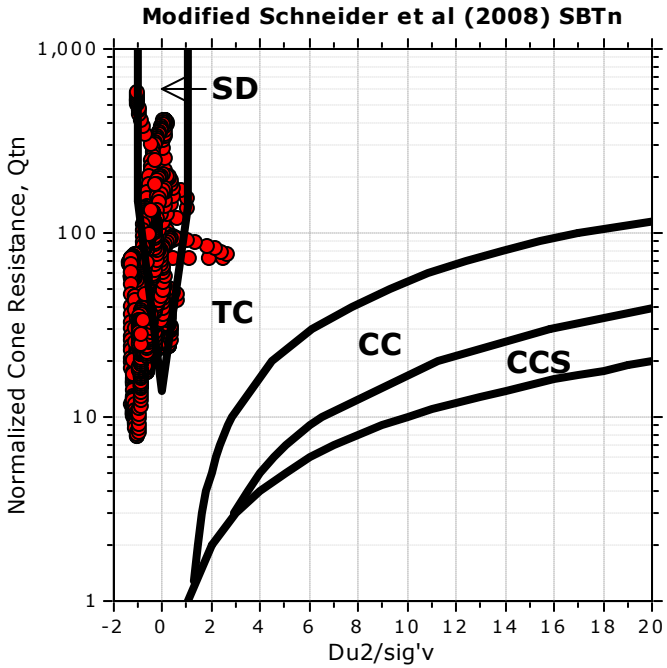
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

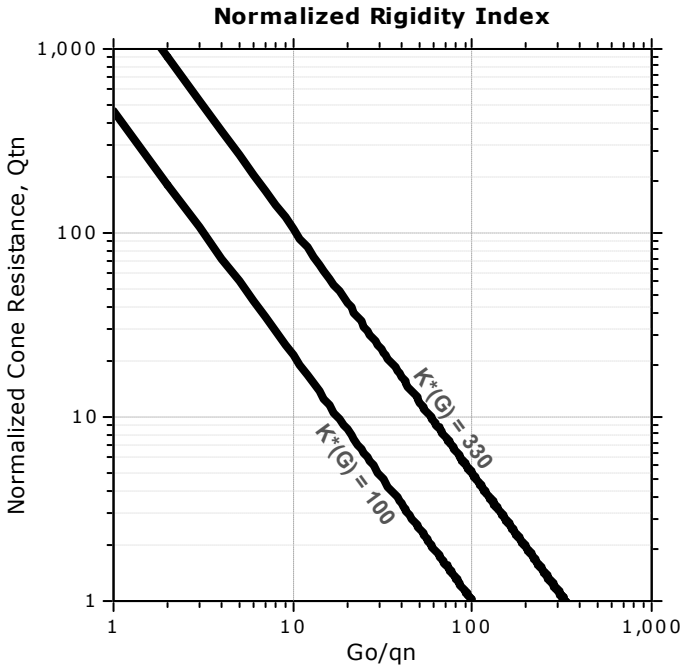
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Updated SBTn plots







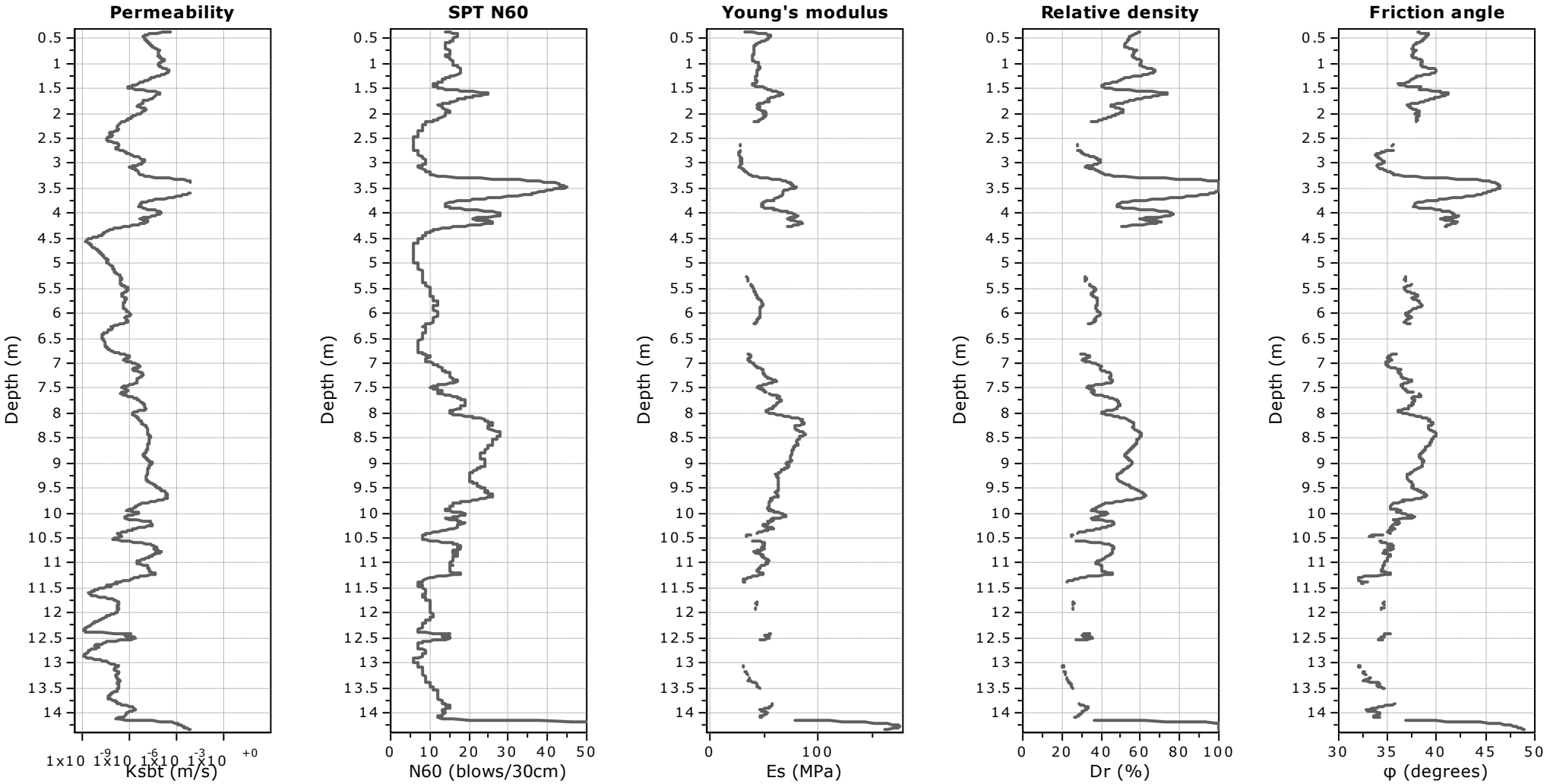
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



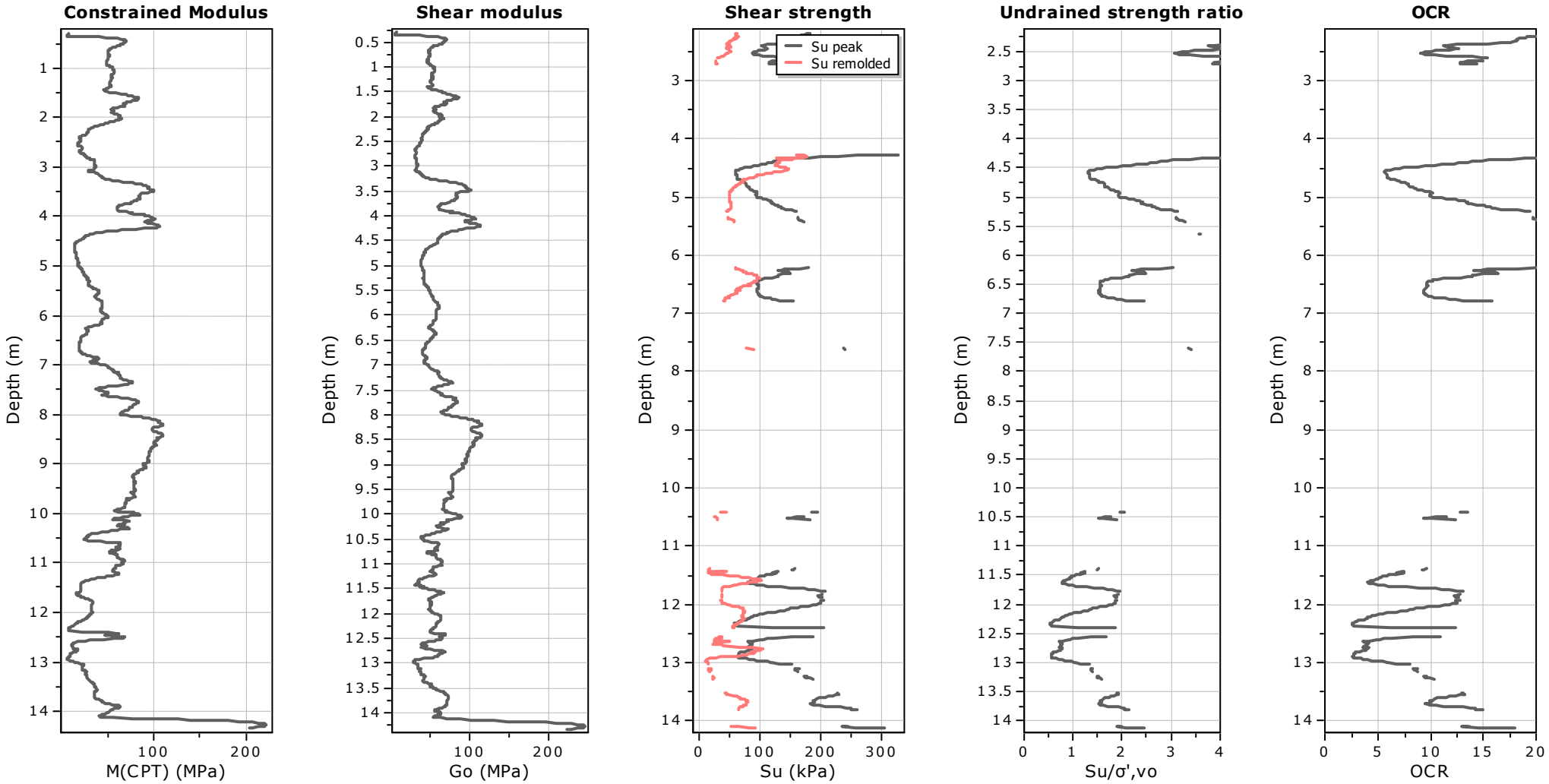
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC



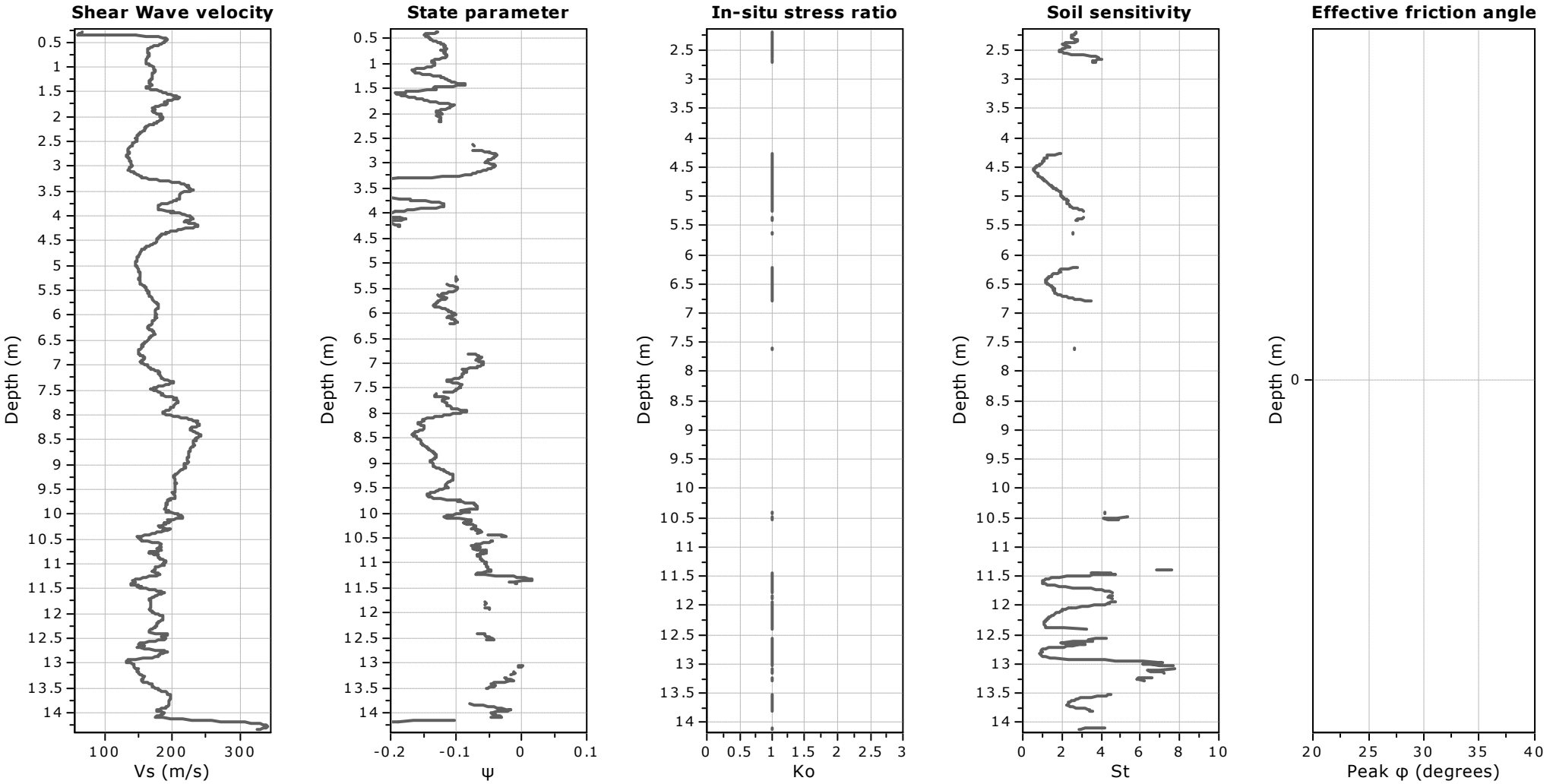
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto
OCR factor for clays, N_{kt}: Auto
Flat Dilatometer Test data

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



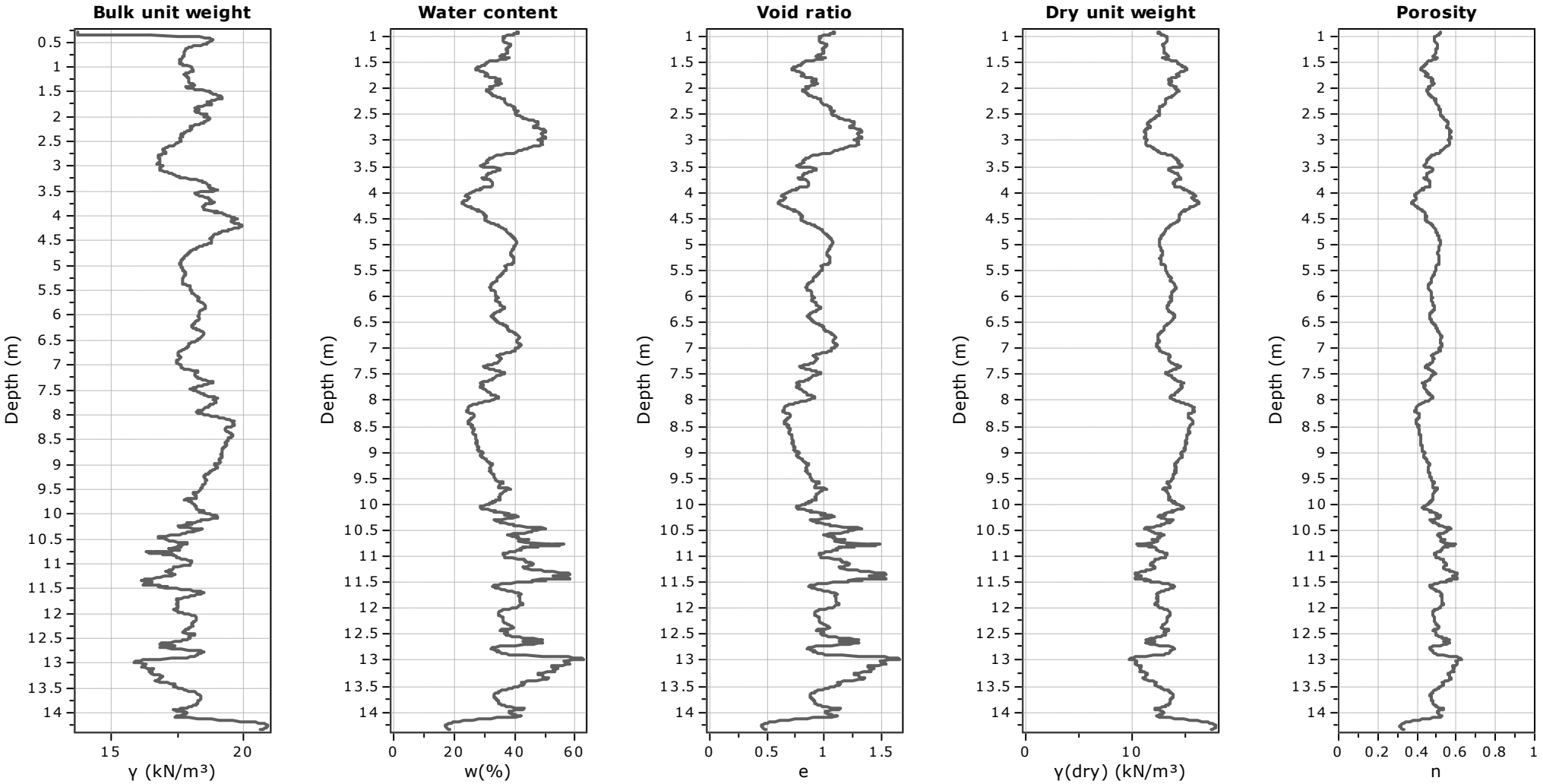
Calculation parameters

Soil Sensitivity factor, N_S: 7.00

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

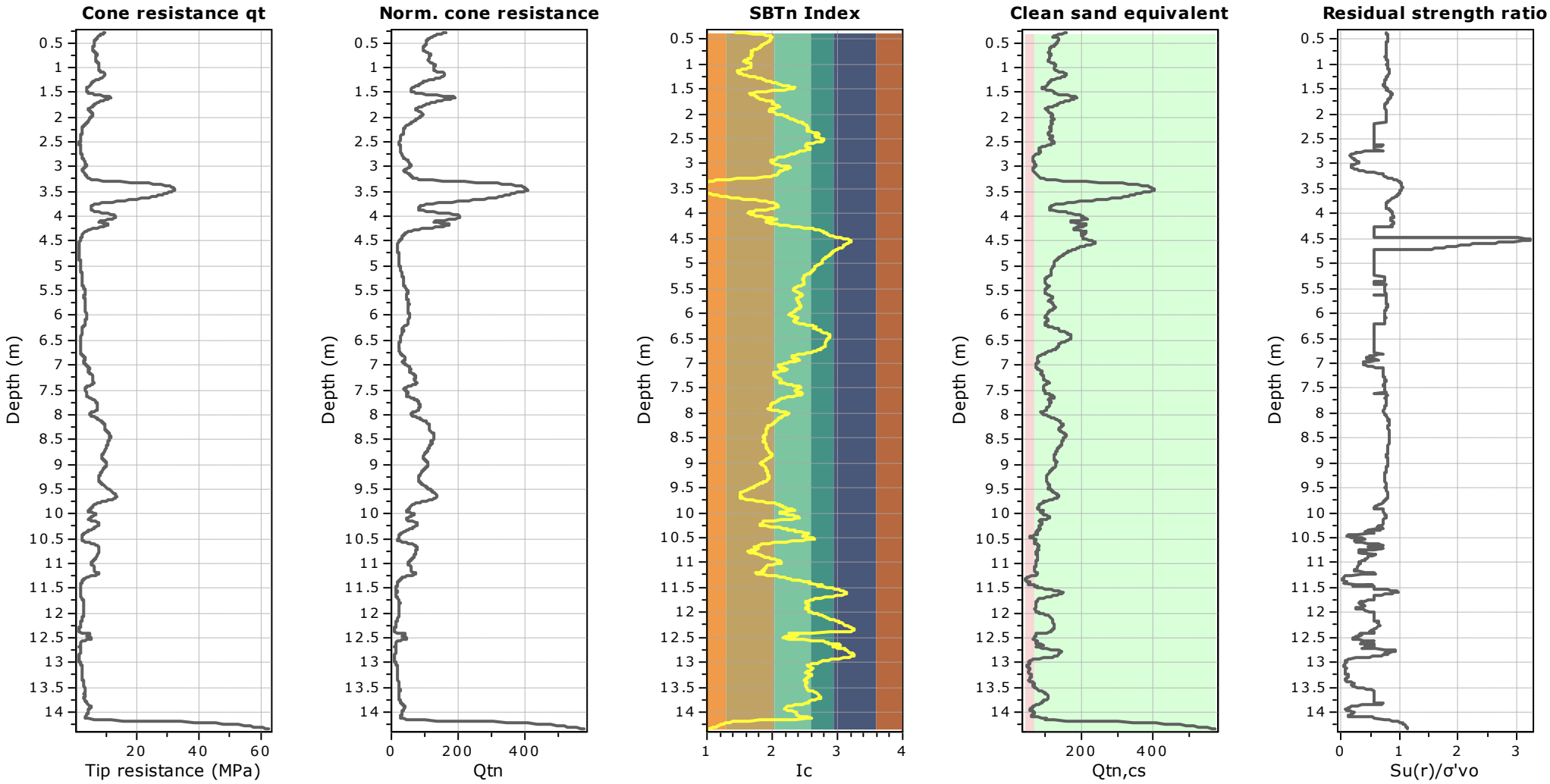
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

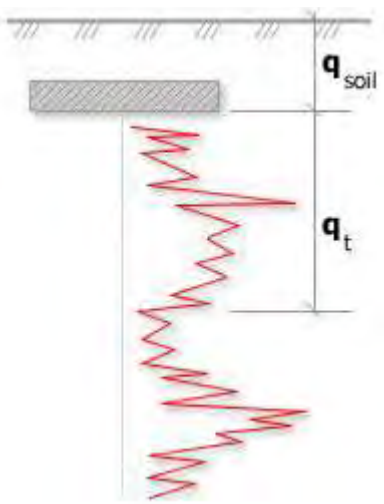
CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

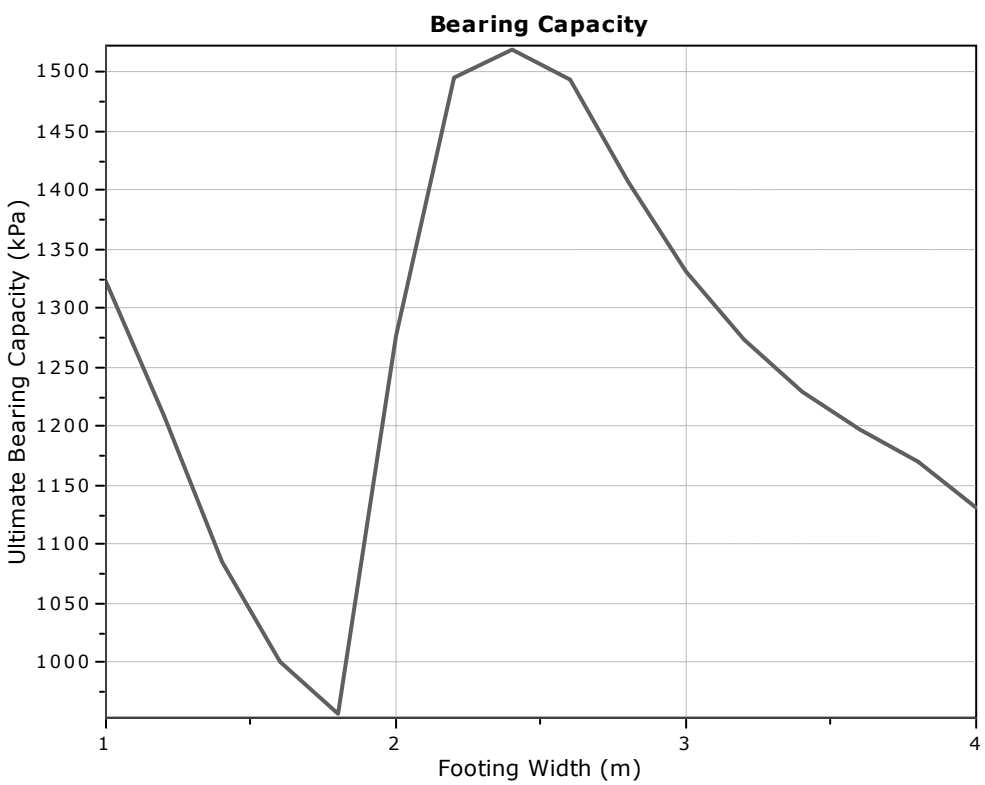
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



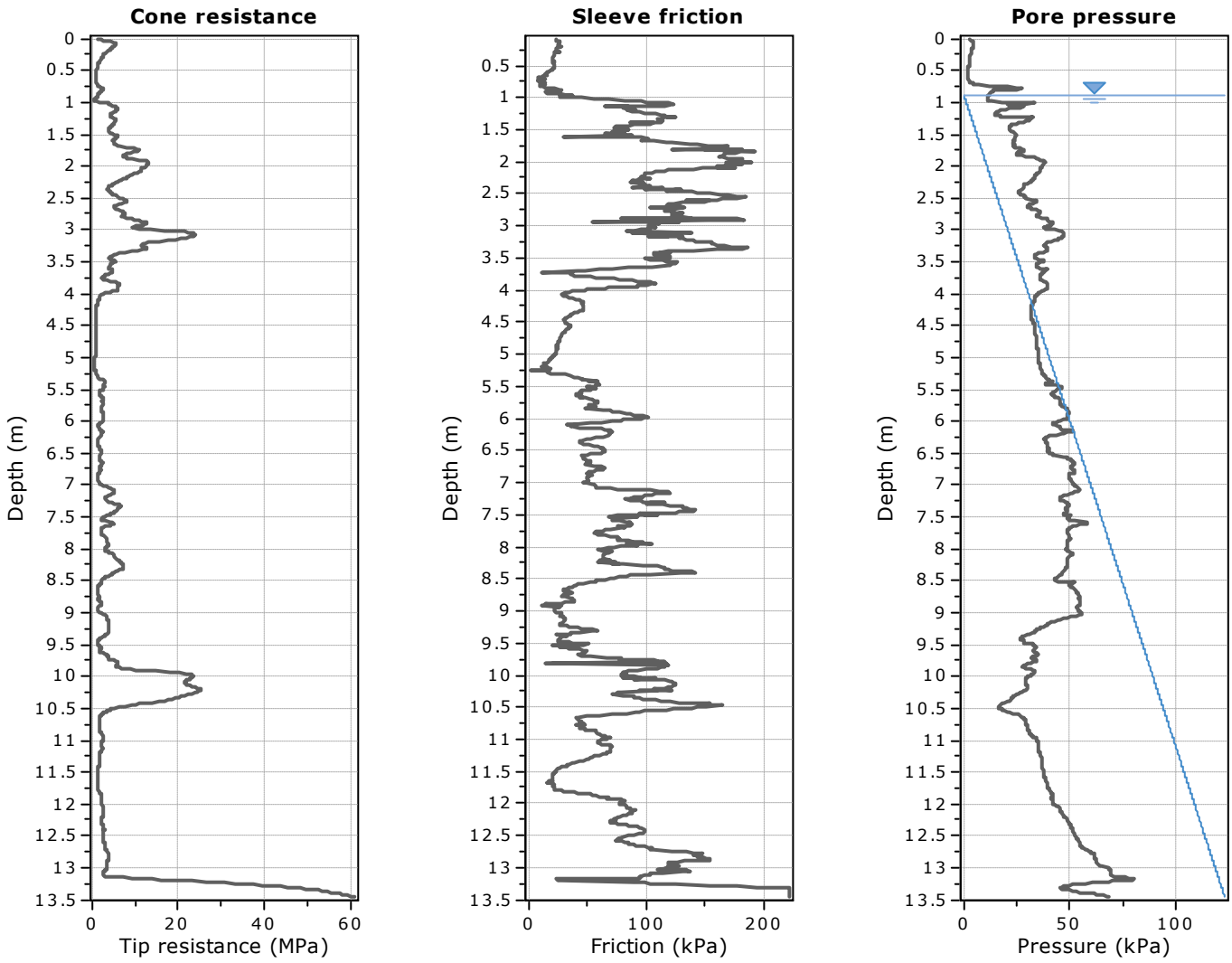
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	6.57	0.20	9.50	1322.53
2	1.20	0.50	2.30	6.00	0.20	9.50	1209.50
3	1.40	0.50	2.60	5.37	0.20	9.50	1084.45
4	1.60	0.50	2.90	4.95	0.20	9.50	999.97
5	1.80	0.50	3.20	4.73	0.20	9.50	956.15
6	2.00	0.50	3.50	6.33	0.20	9.50	1275.95
7	2.20	0.50	3.80	7.42	0.20	9.50	1494.27
8	2.40	0.50	4.10	7.55	0.20	9.50	1518.83
9	2.60	0.50	4.40	7.42	0.20	9.50	1492.61
10	2.80	0.50	4.70	6.98	0.20	9.50	1406.22
11	3.00	0.50	5.00	6.61	0.20	9.50	1331.24
12	3.20	0.50	5.30	6.31	0.20	9.50	1272.36
13	3.40	0.50	5.60	6.10	0.20	9.50	1228.94
14	3.60	0.50	5.90	5.93	0.20	9.50	1195.98
15	3.80	0.50	6.20	5.80	0.20	9.50	1169.13
16	4.00	0.50	6.50	5.61	0.20	9.50	1131.23

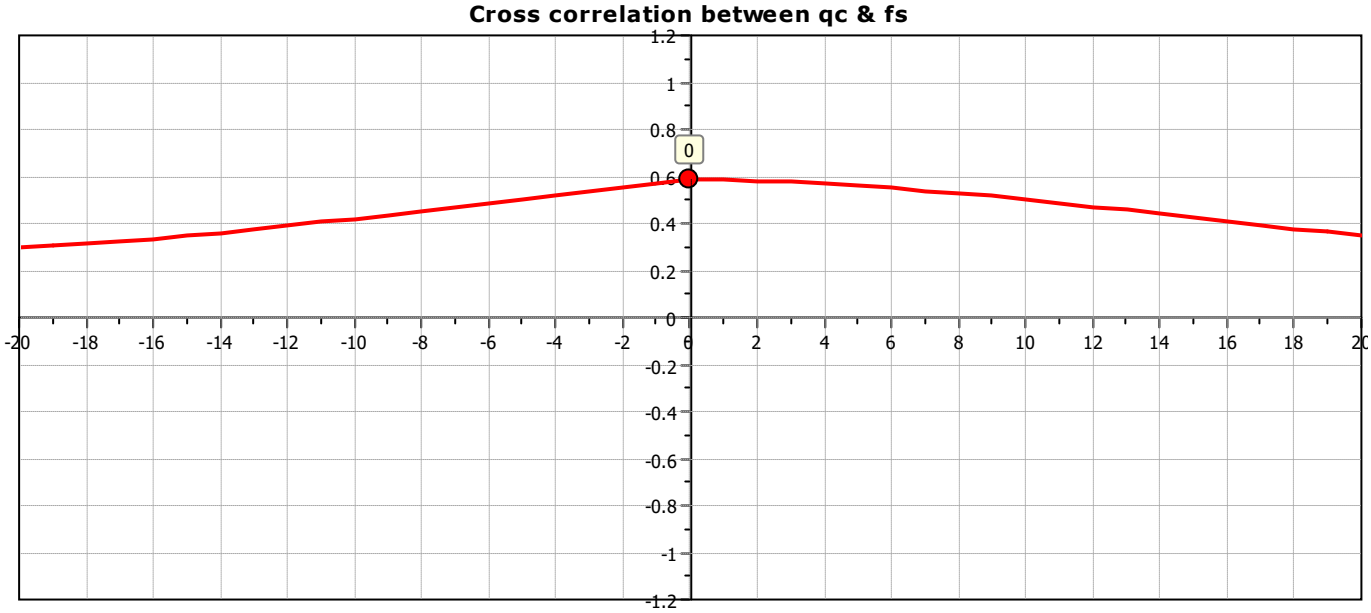
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

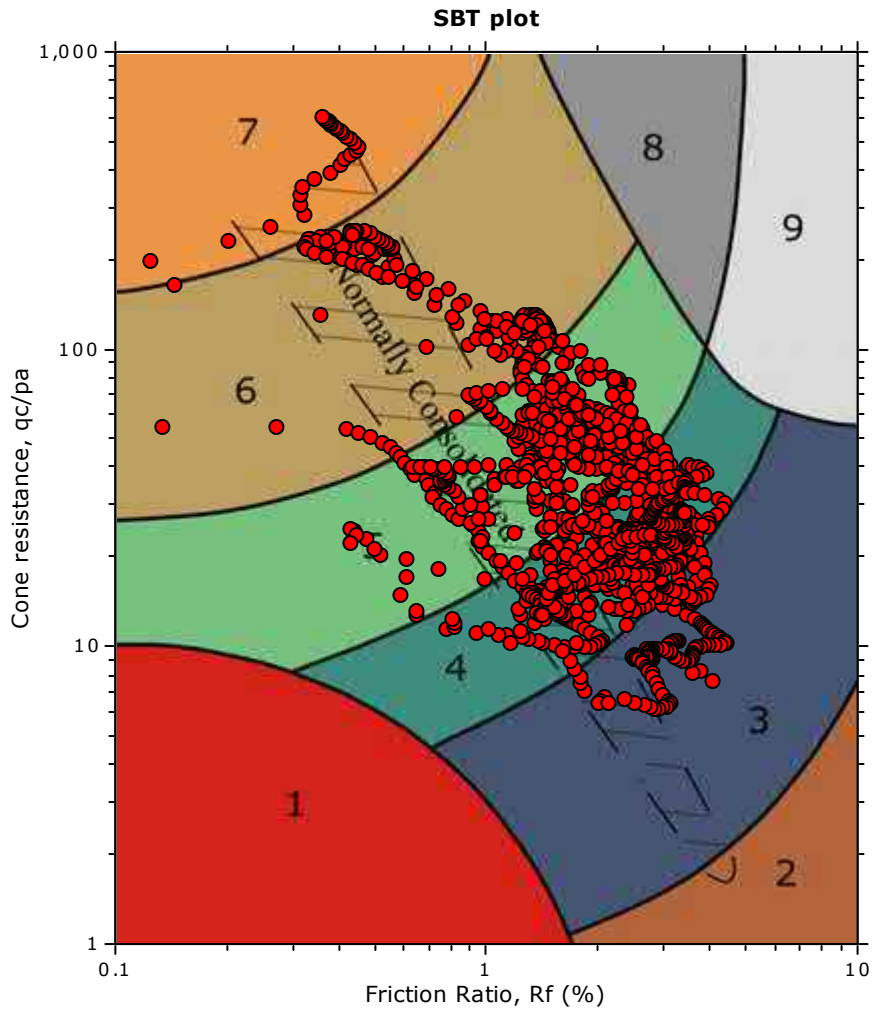


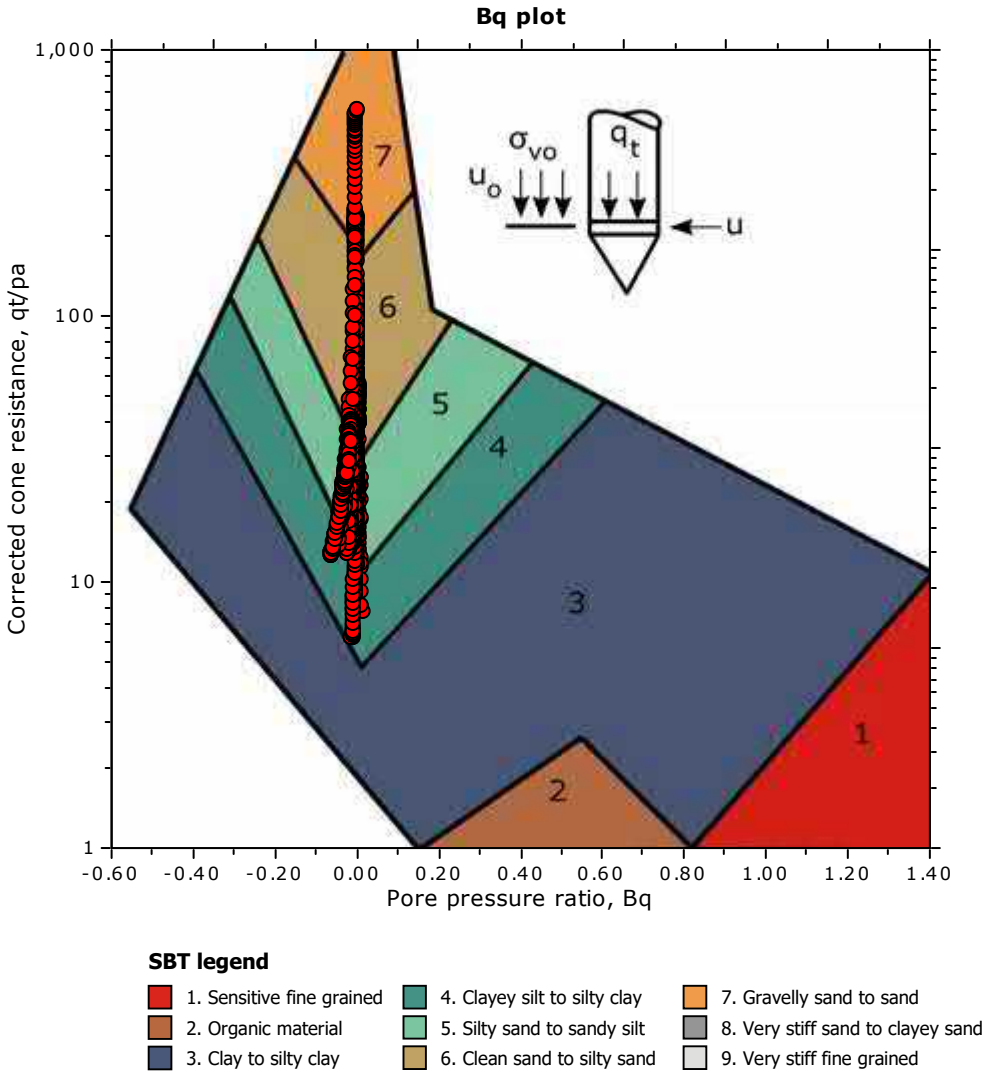
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots





SBT legend

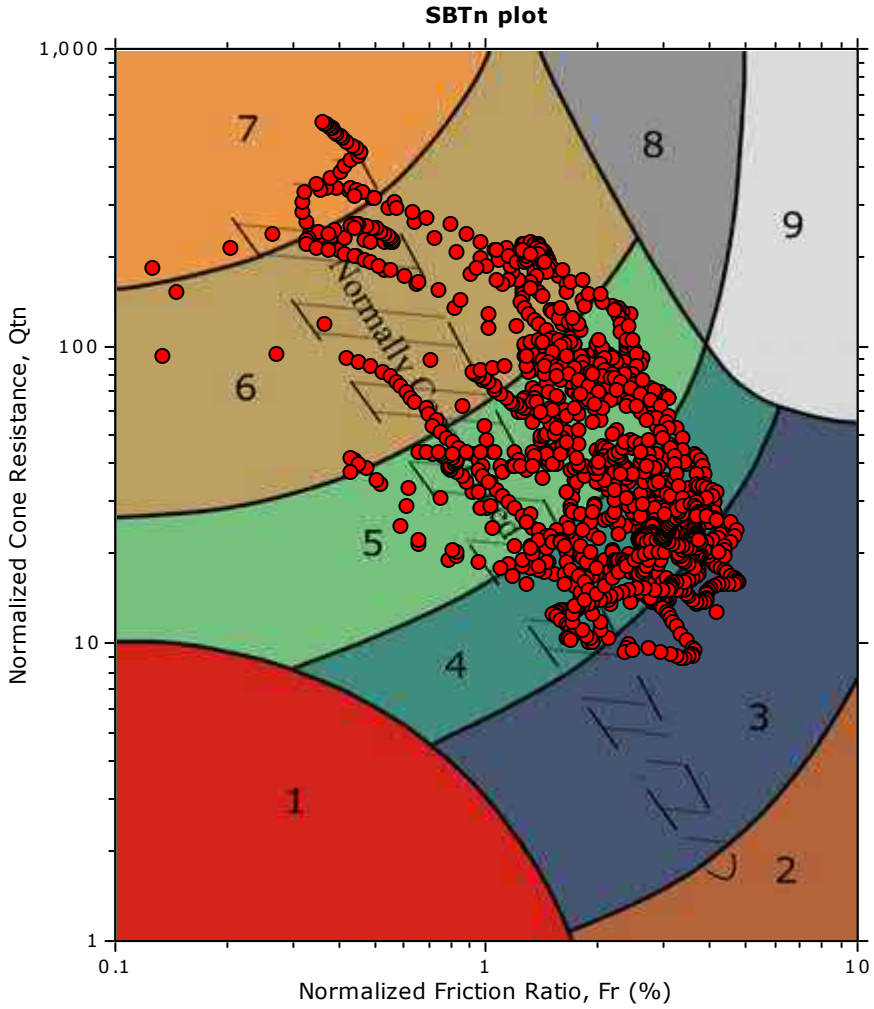
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

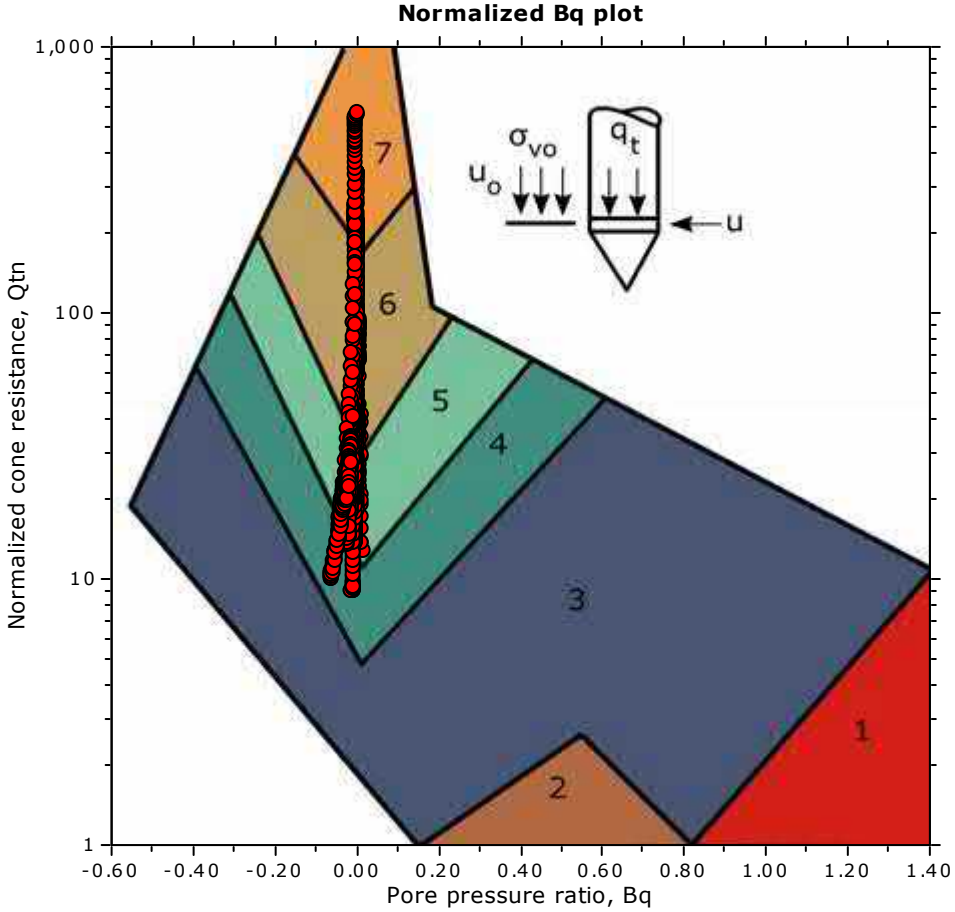
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots (normalized)





SBTn legend

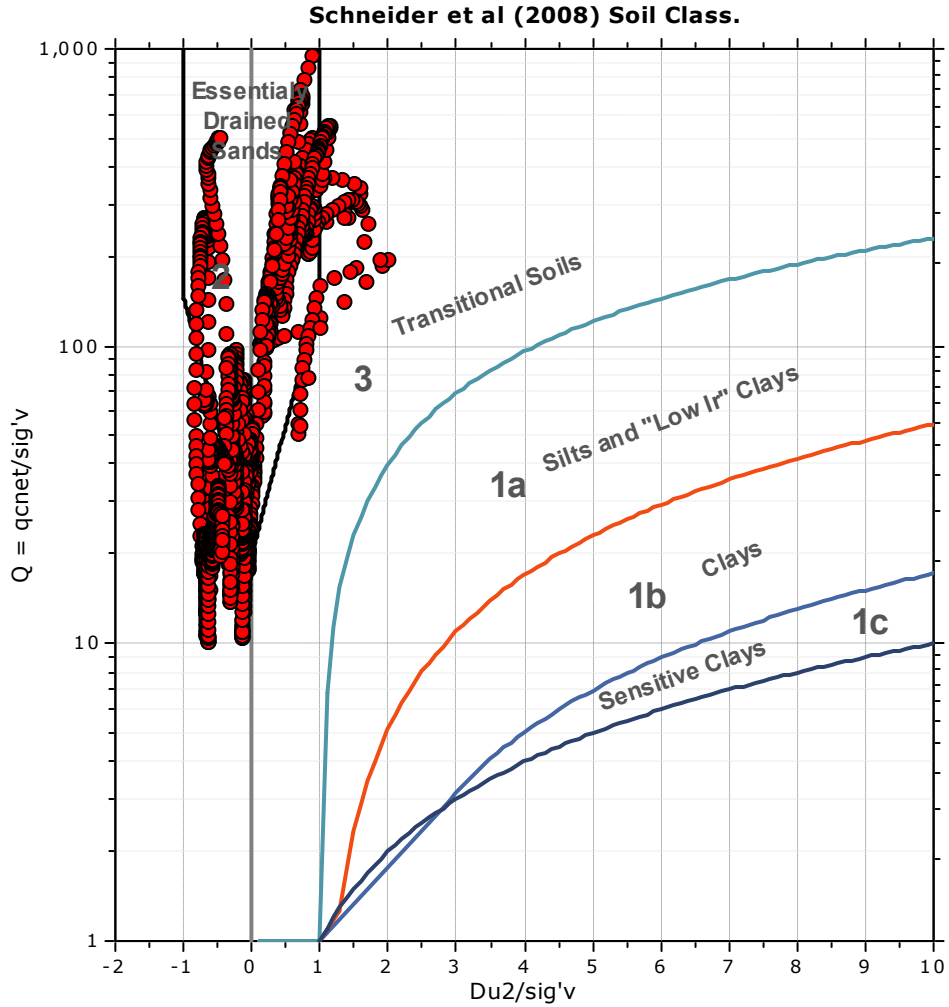
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

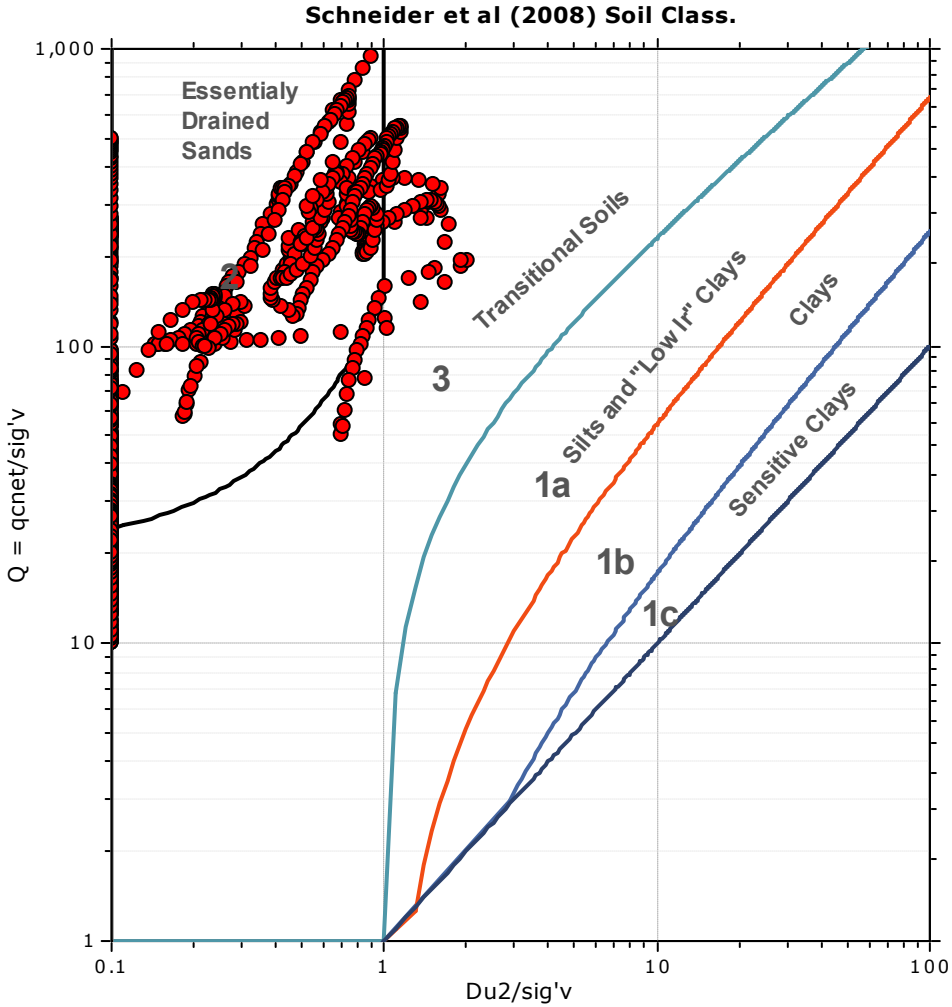
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

Bq plots (Schneider)

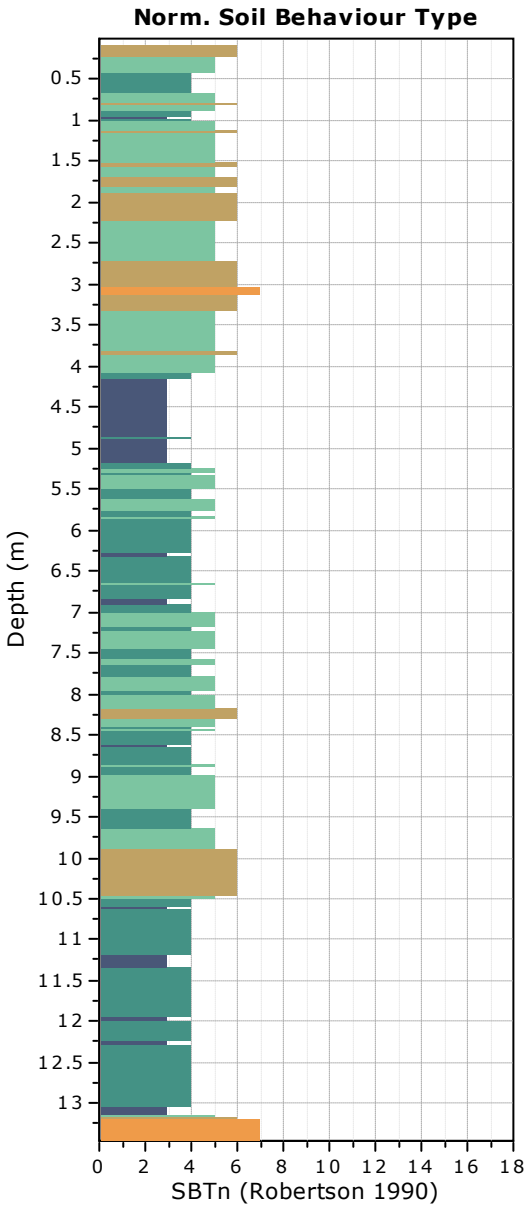


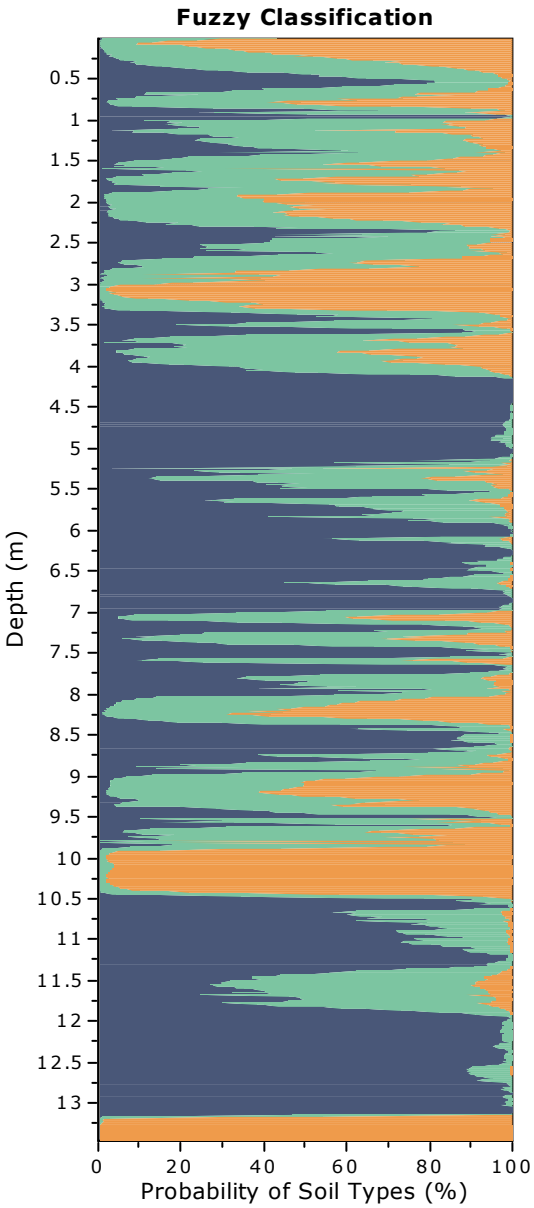


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**





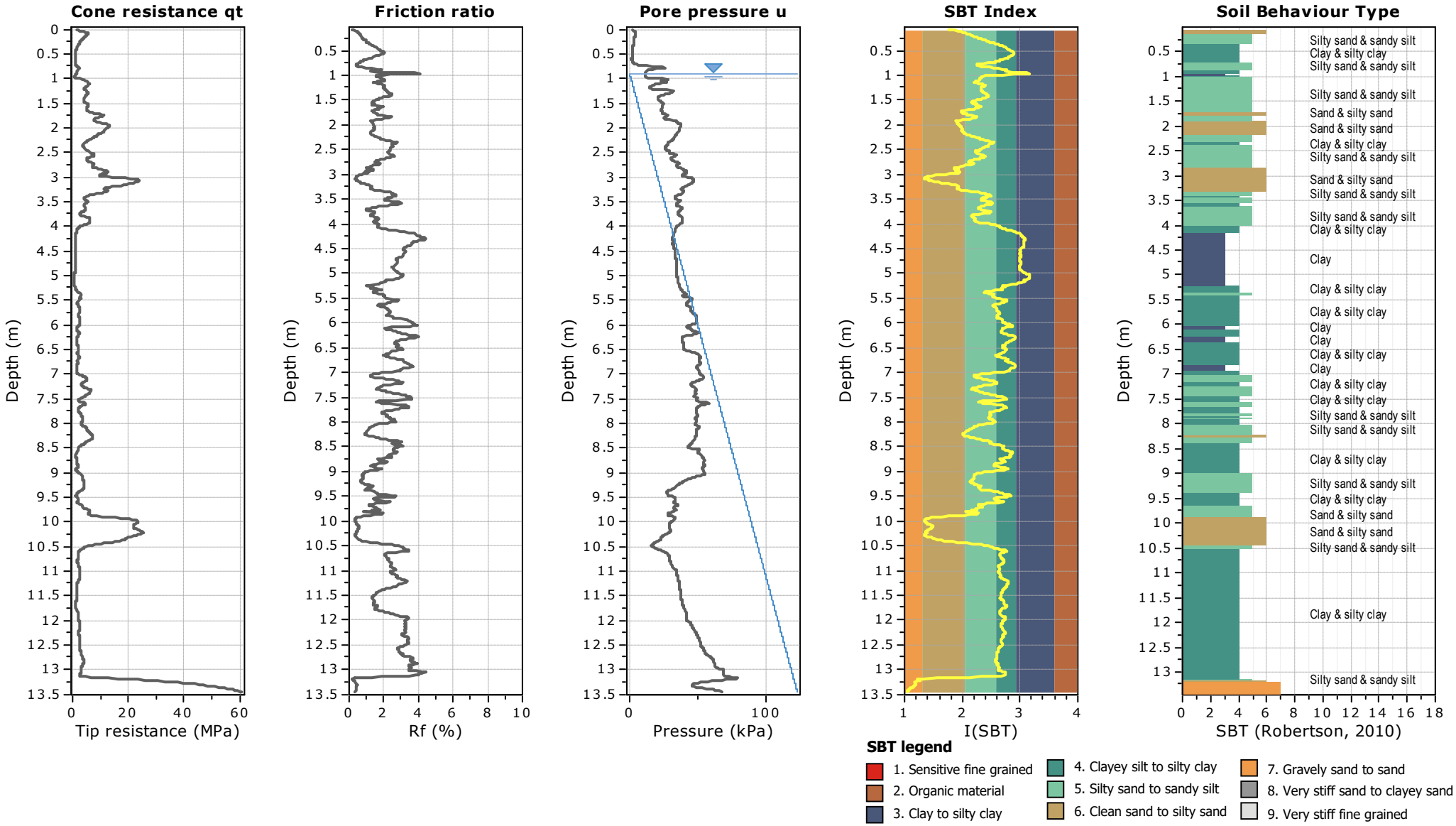
Fuzzy classifiaction legend

- Highly probable clayey soil
- Highly probable mixture soil
- Highly probable sandy soil

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

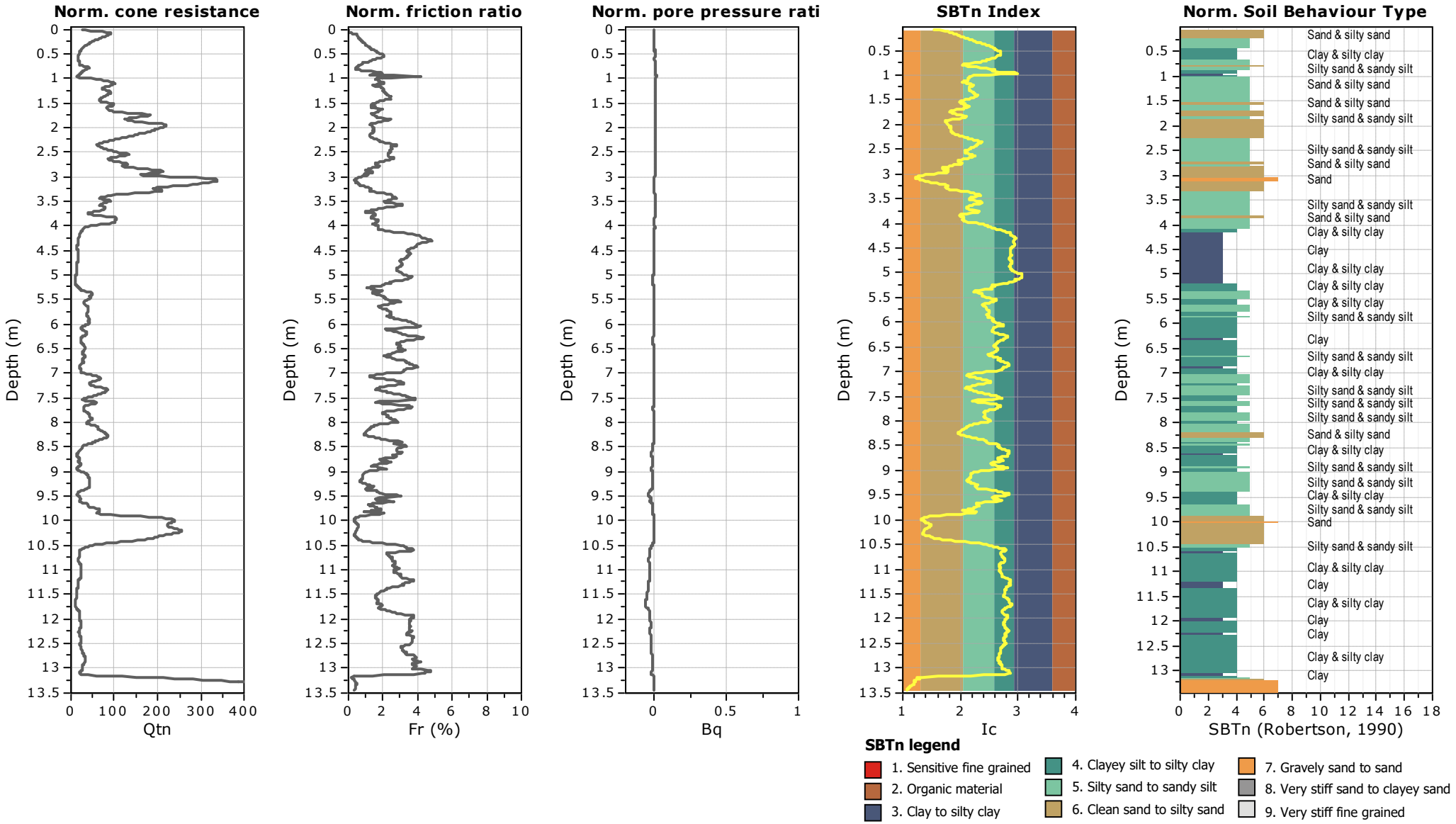
CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

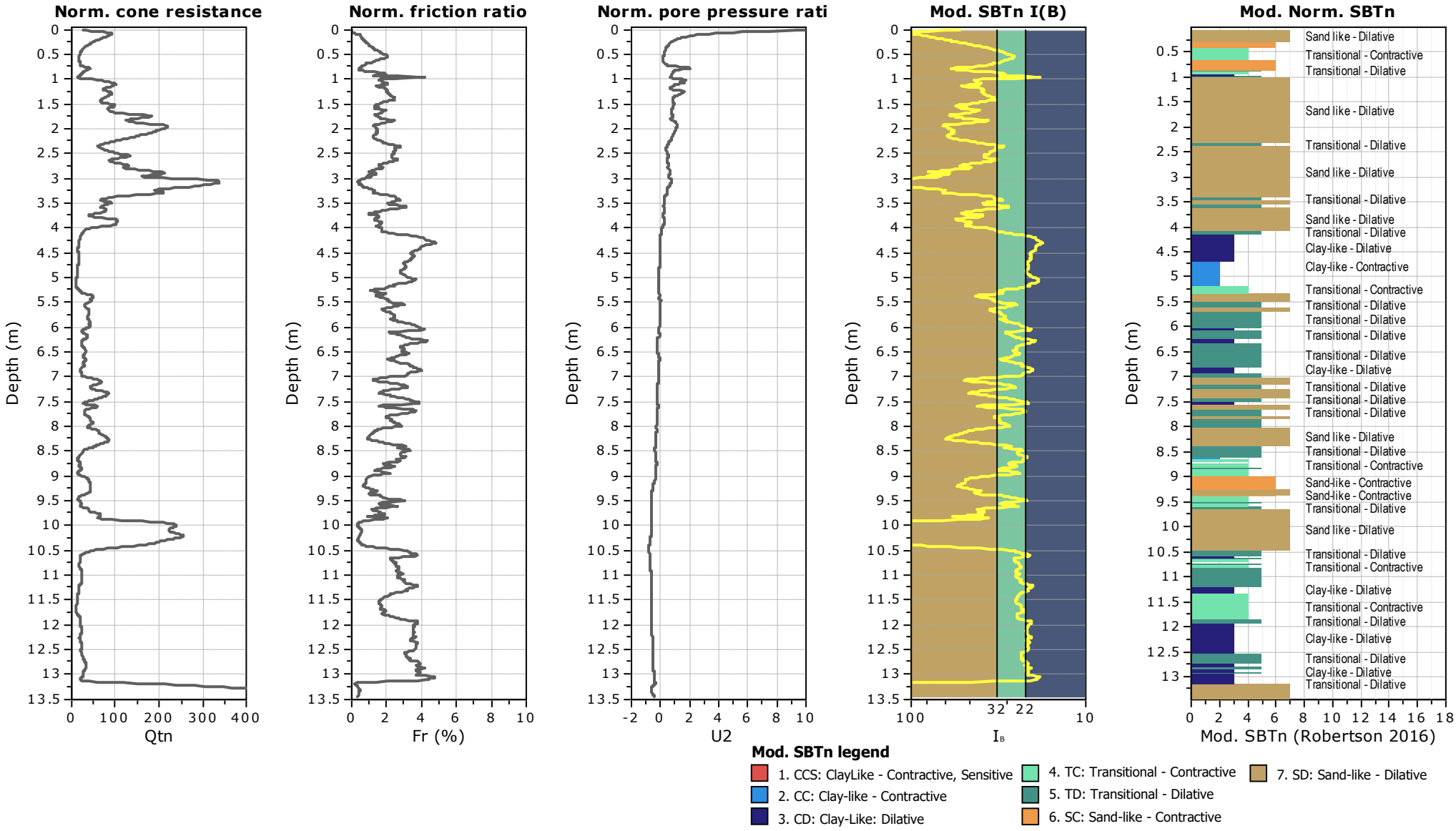
CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

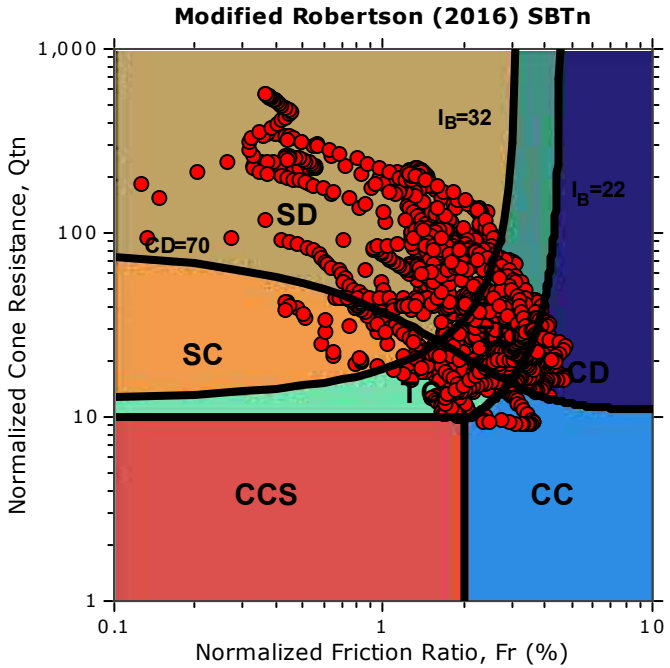


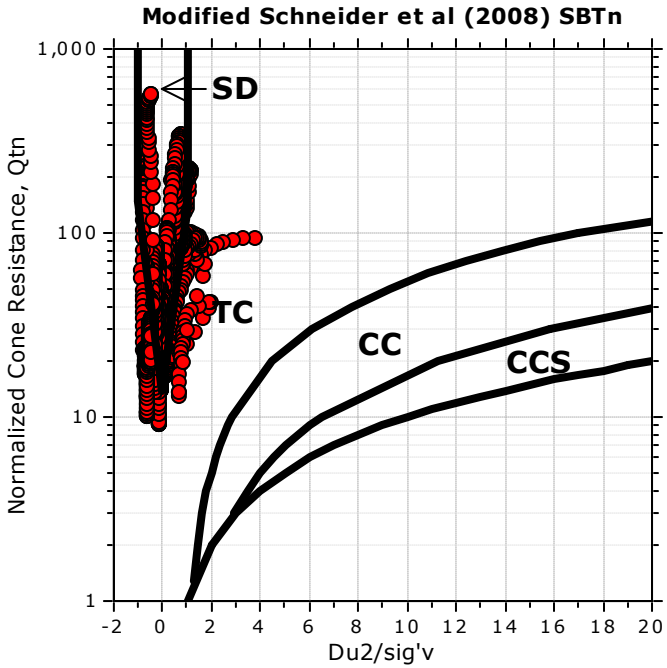
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

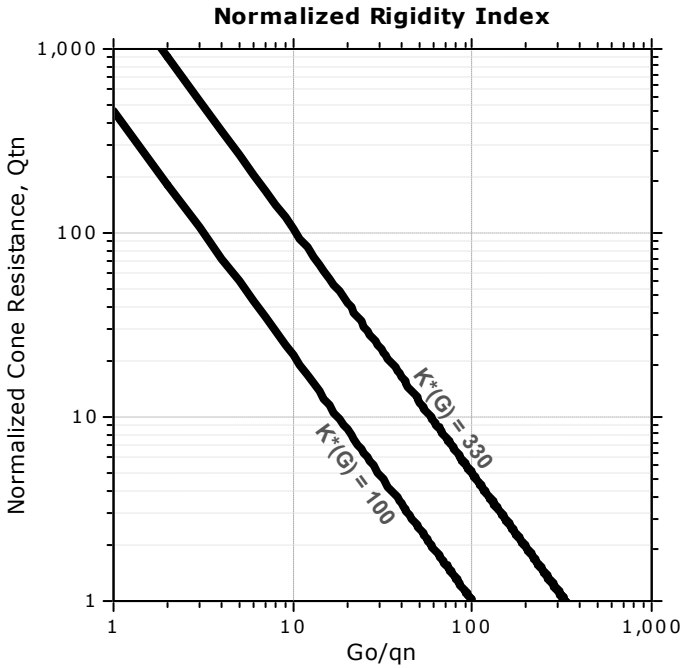
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Updated SBTn plots







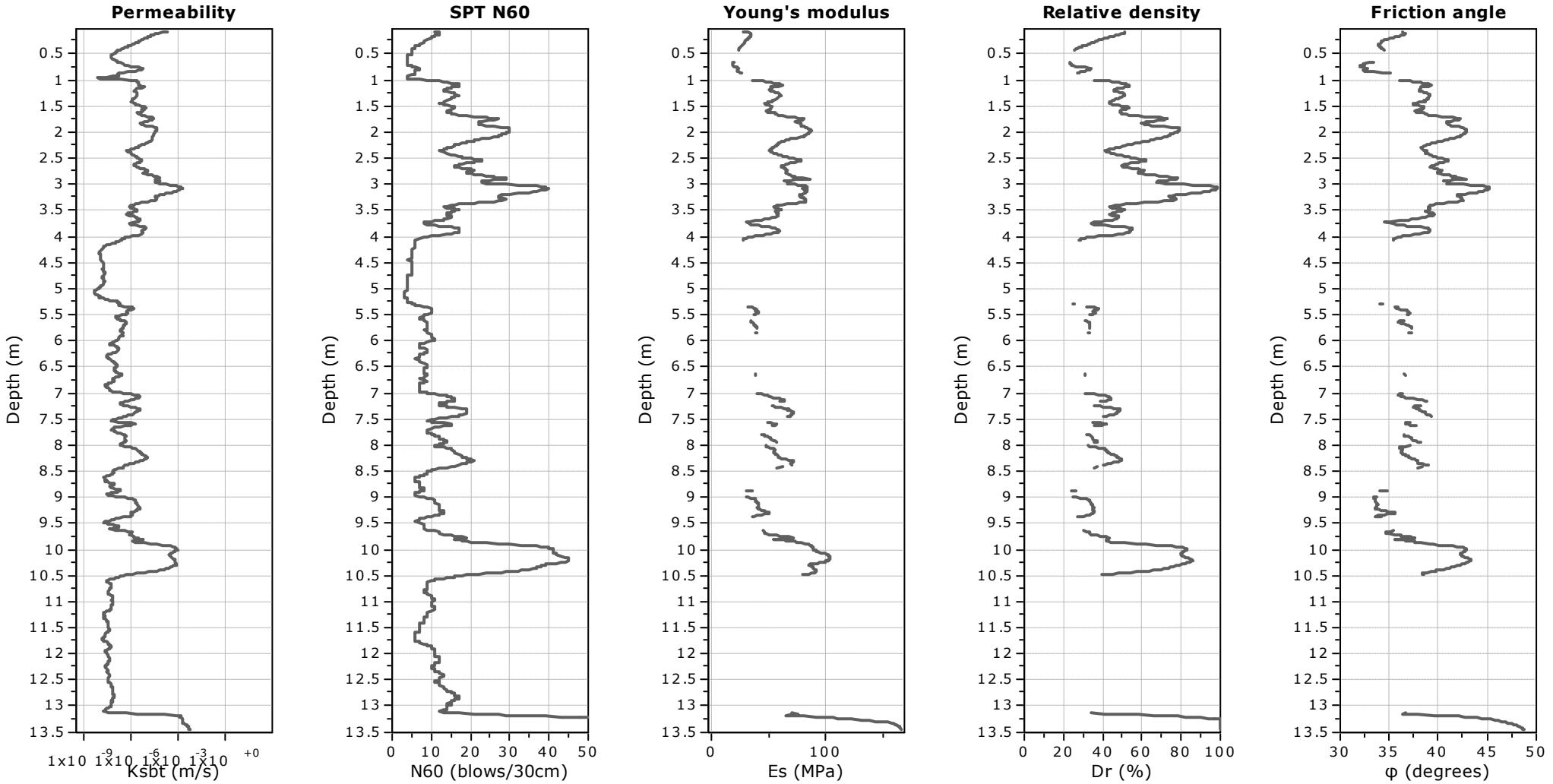
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



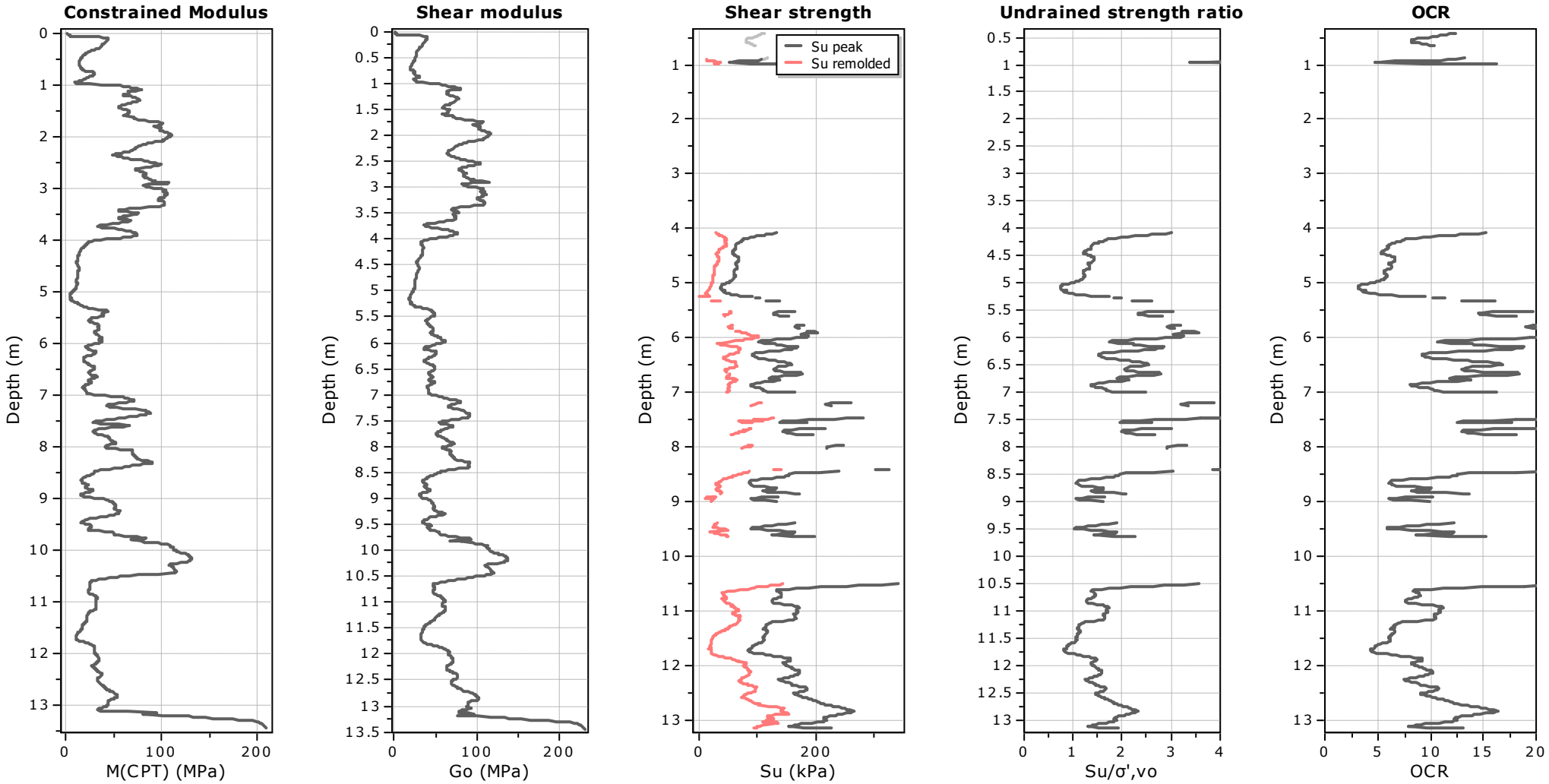
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



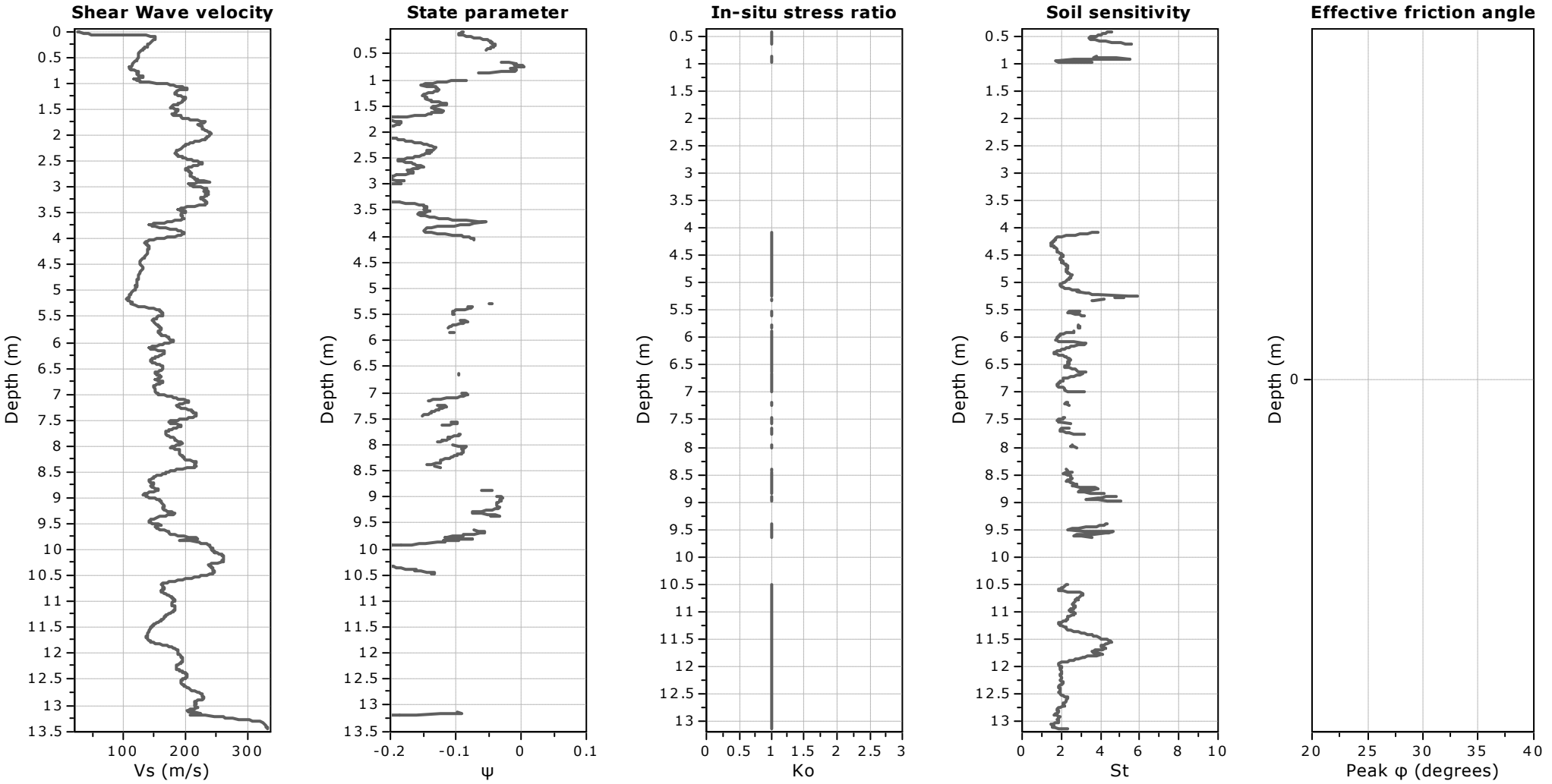
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto
OCR factor for clays, N_{kt}: Auto
Flat Dilatometer Test data

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



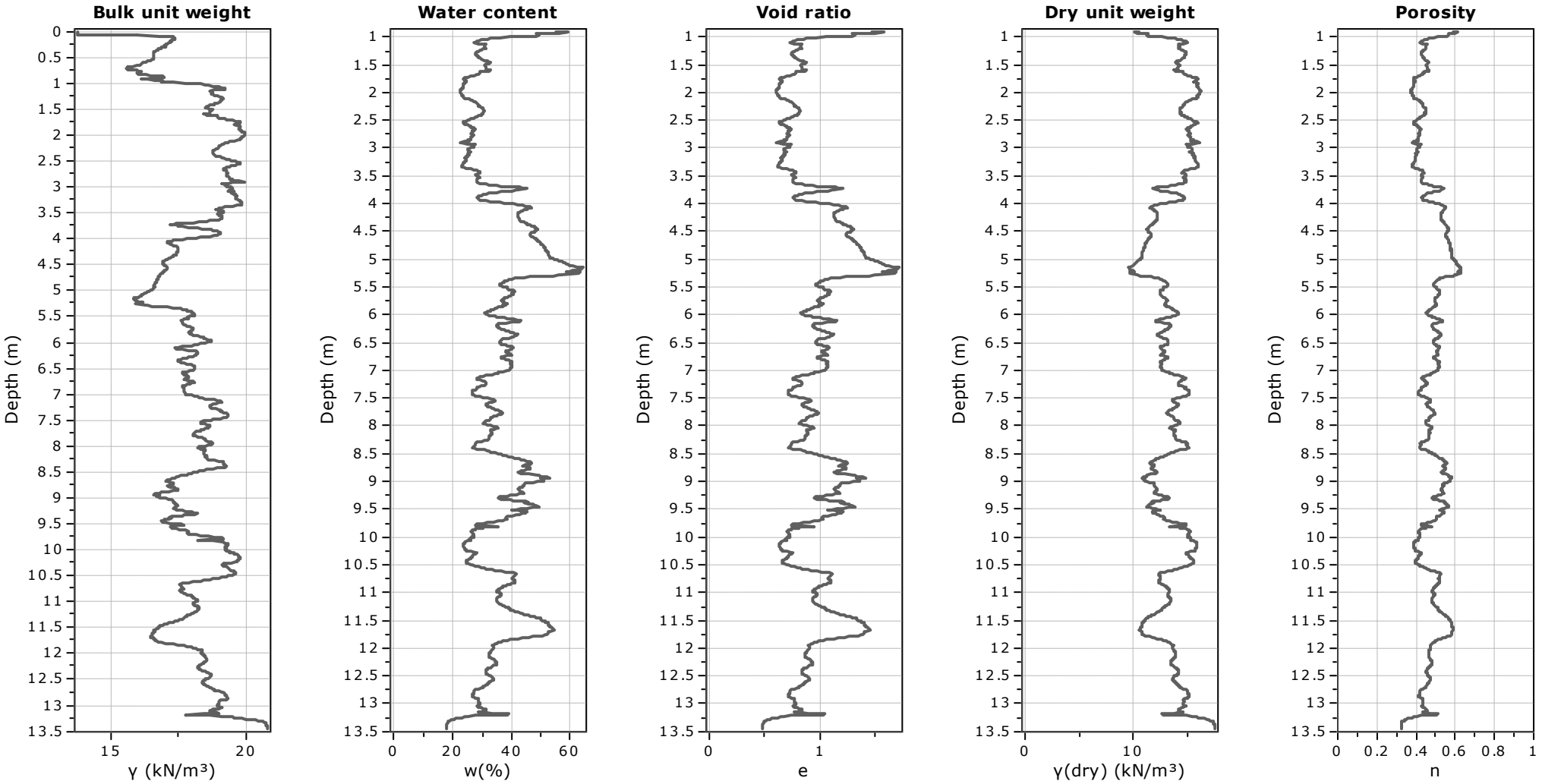
Calculation parameters

Soil Sensitivity factor, N_S: 7.00

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

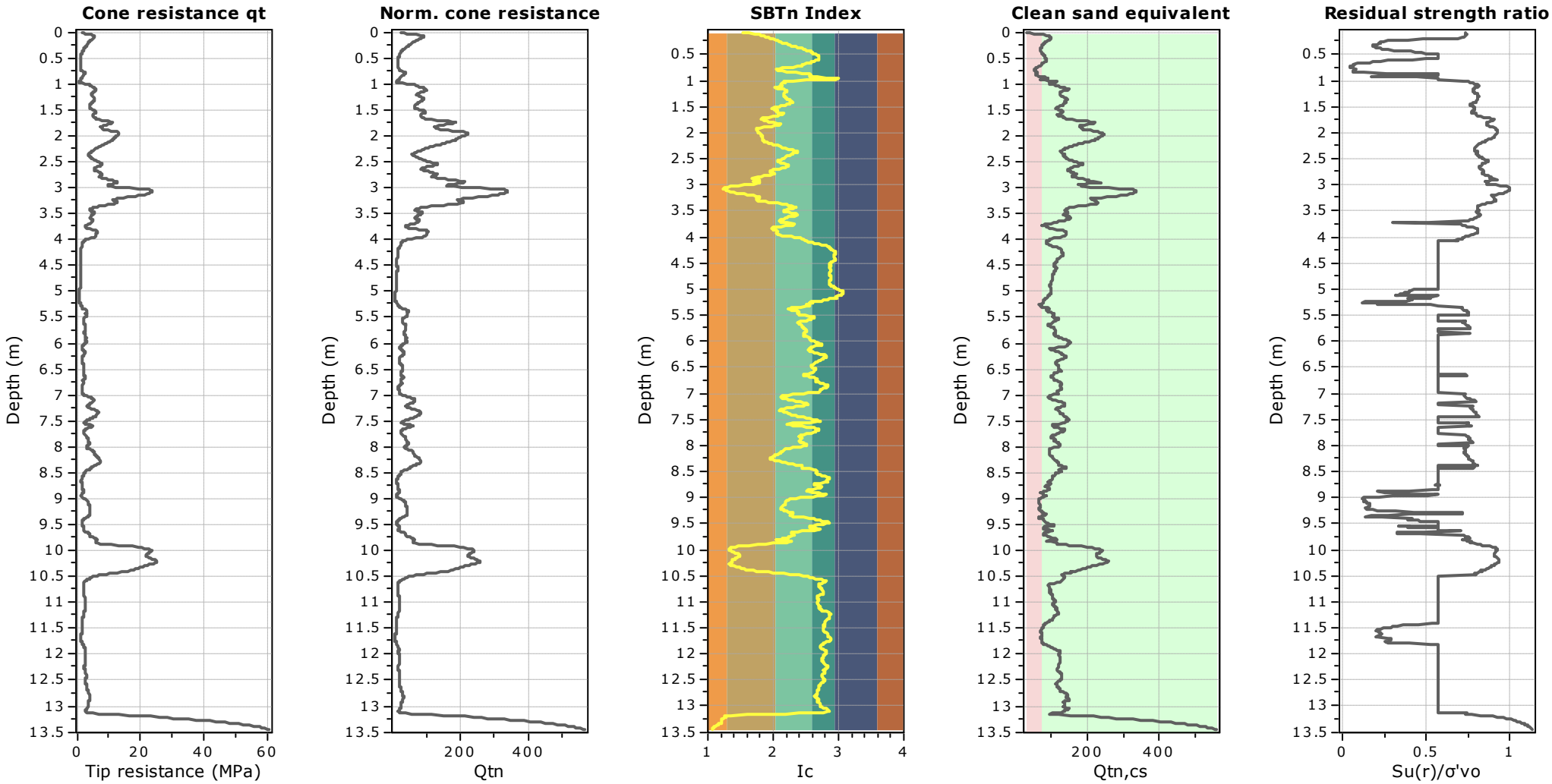
CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

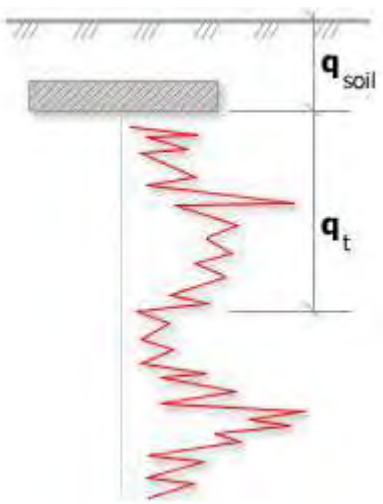
CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

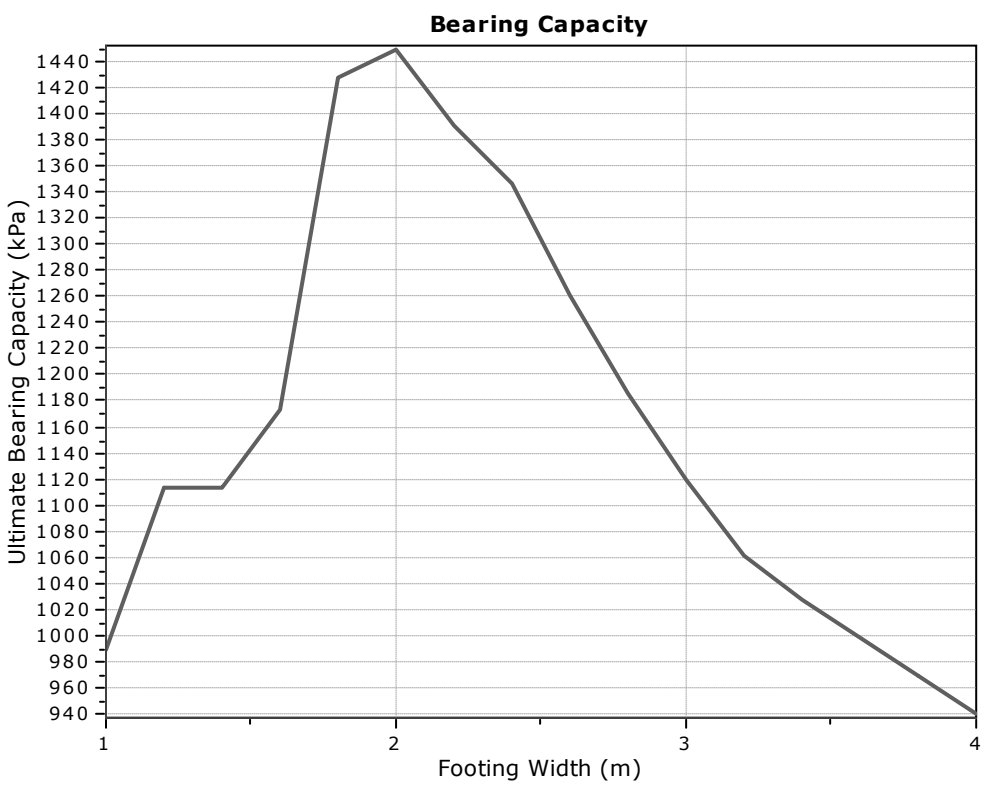
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



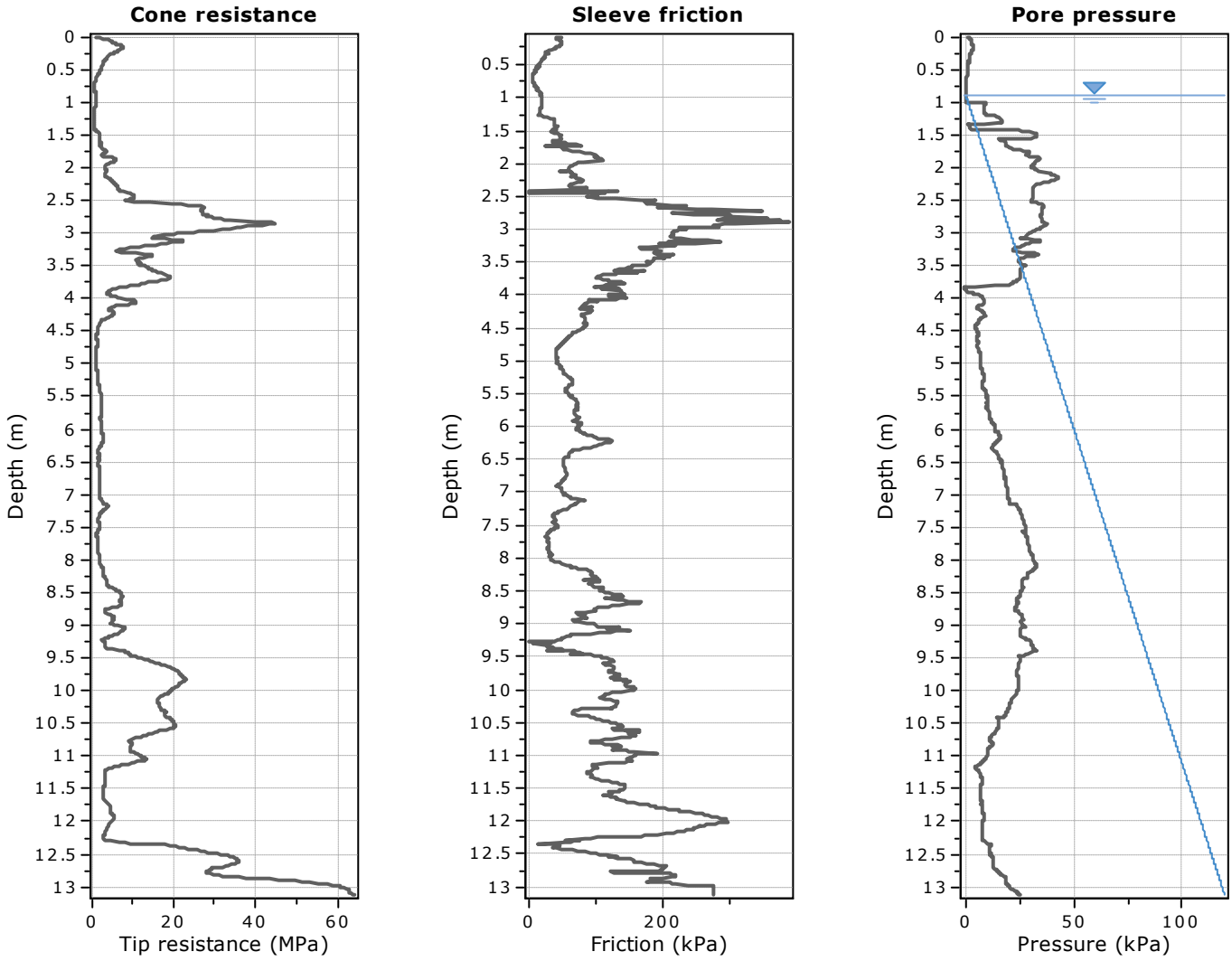
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	4.90	0.20	9.50	988.89
2	1.20	0.50	2.30	5.52	0.20	9.50	1112.95
3	1.40	0.50	2.60	5.52	0.20	9.50	1113.12
4	1.60	0.50	2.90	5.82	0.20	9.50	1173.55
5	1.80	0.50	3.20	7.09	0.20	9.50	1427.06
6	2.00	0.50	3.50	7.20	0.20	9.50	1448.64
7	2.20	0.50	3.80	6.90	0.20	9.50	1390.39
8	2.40	0.50	4.10	6.68	0.20	9.50	1345.82
9	2.60	0.50	4.40	6.26	0.20	9.50	1261.07
10	2.80	0.50	4.70	5.88	0.20	9.50	1185.96
11	3.00	0.50	5.00	5.55	0.20	9.50	1119.75
12	3.20	0.50	5.30	5.26	0.20	9.50	1060.75
13	3.40	0.50	5.60	5.09	0.20	9.50	1027.54
14	3.60	0.50	5.90	4.95	0.20	9.50	998.50
15	3.80	0.50	6.20	4.80	0.20	9.50	970.01
16	4.00	0.50	6.50	4.65	0.20	9.50	940.33

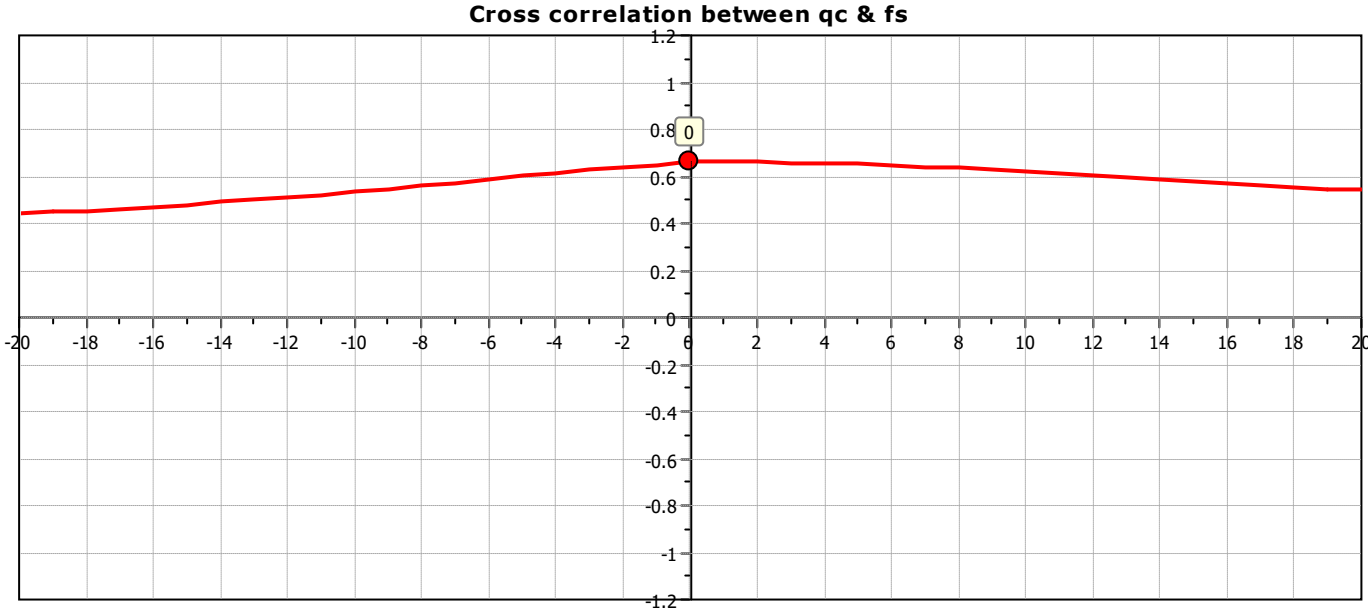
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

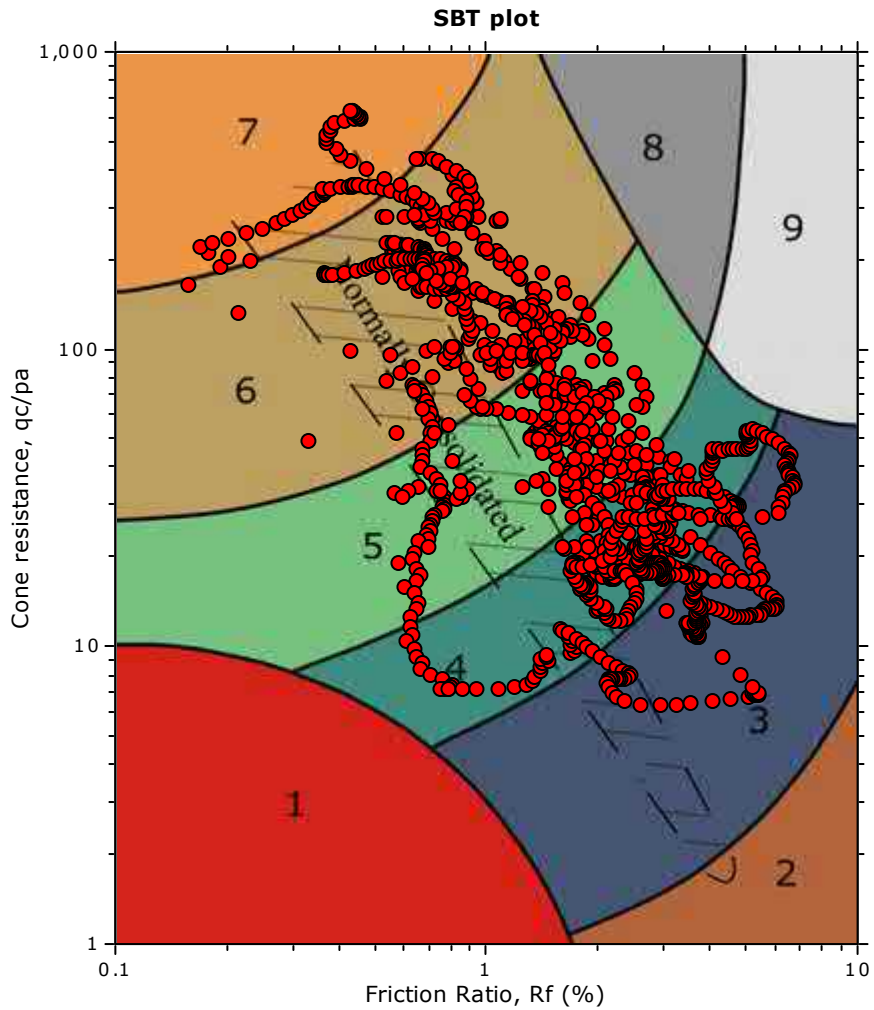


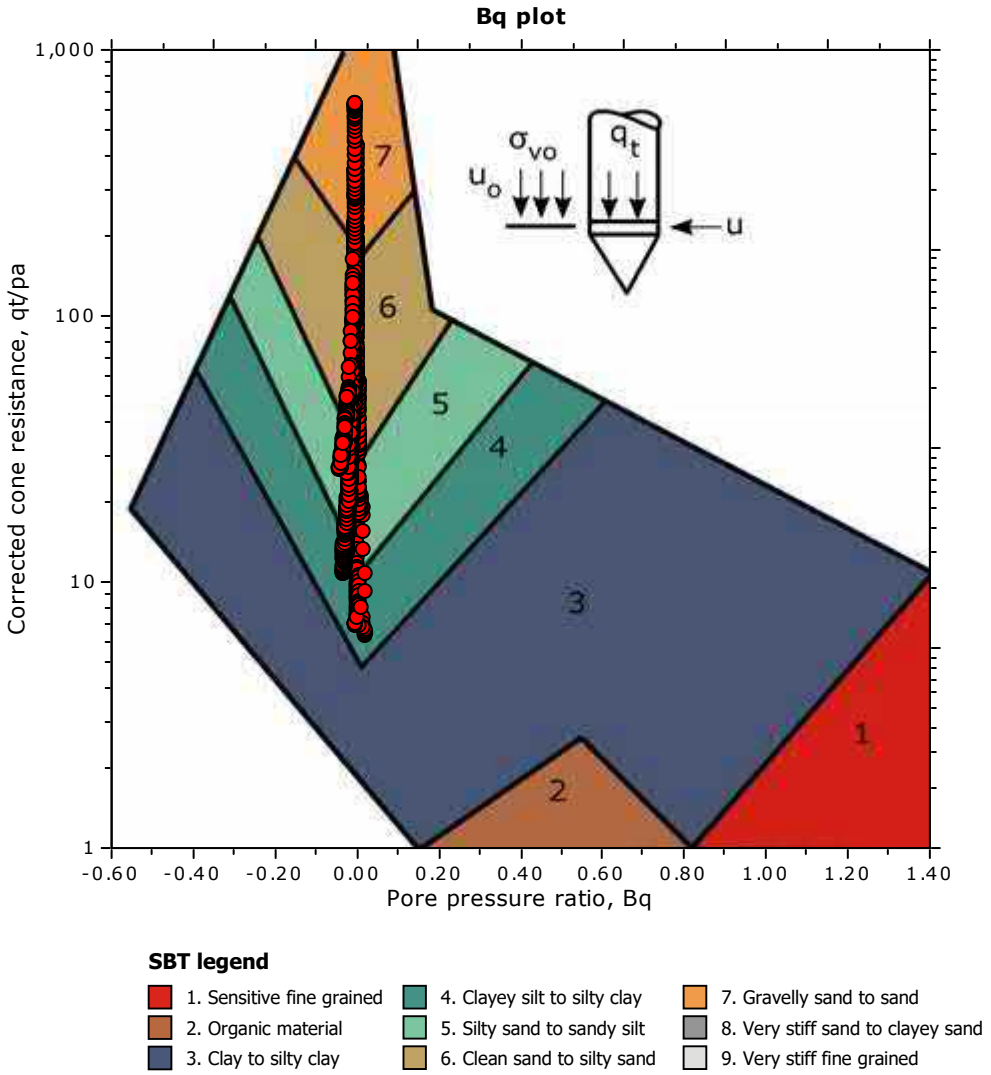
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots



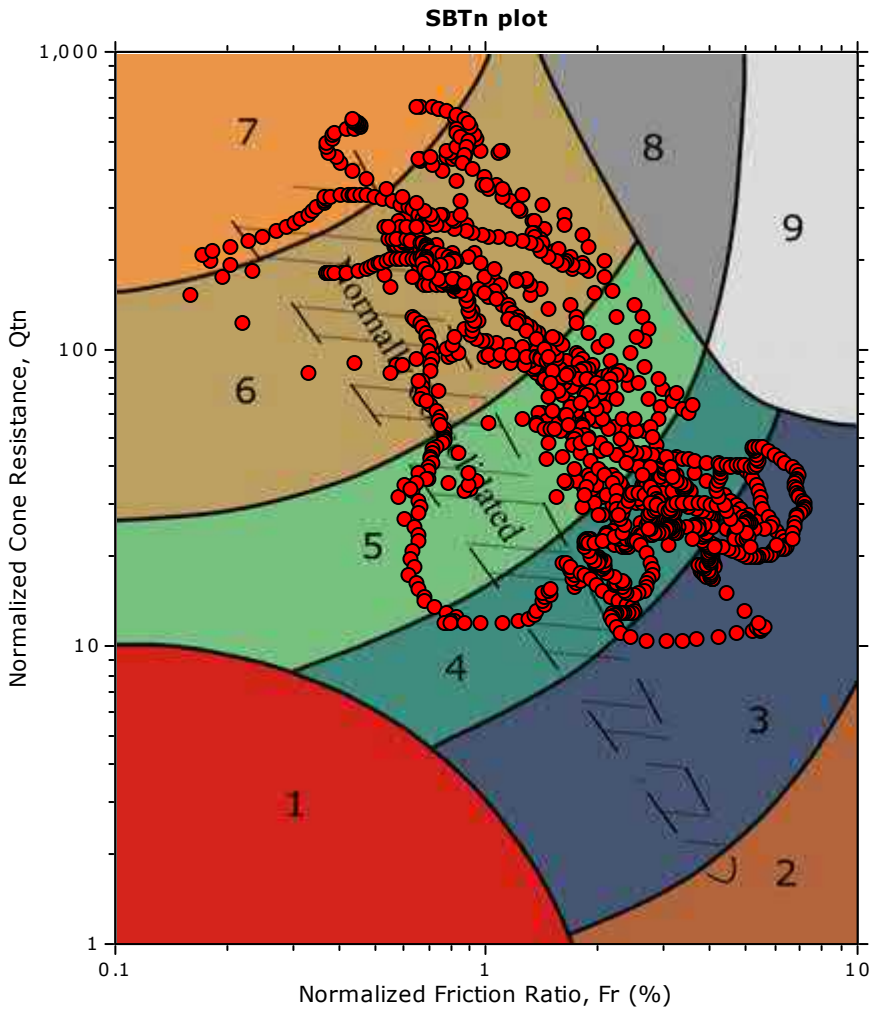


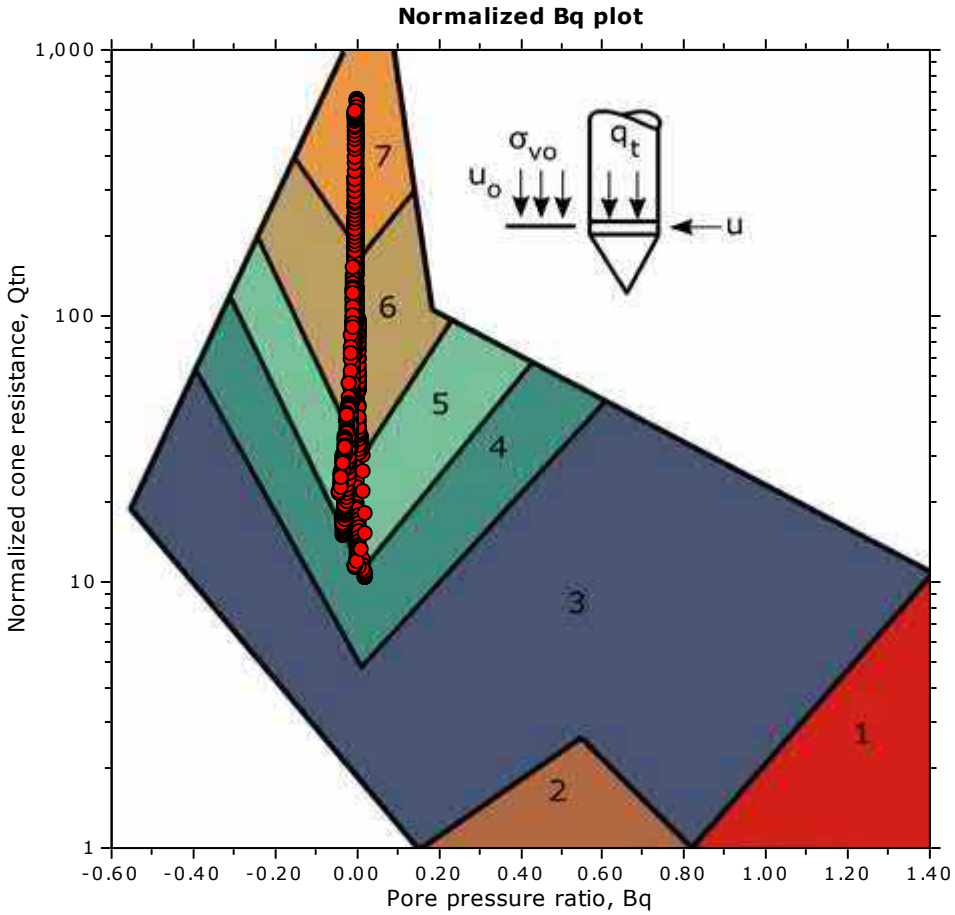
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots (normalized)





SBTn legend

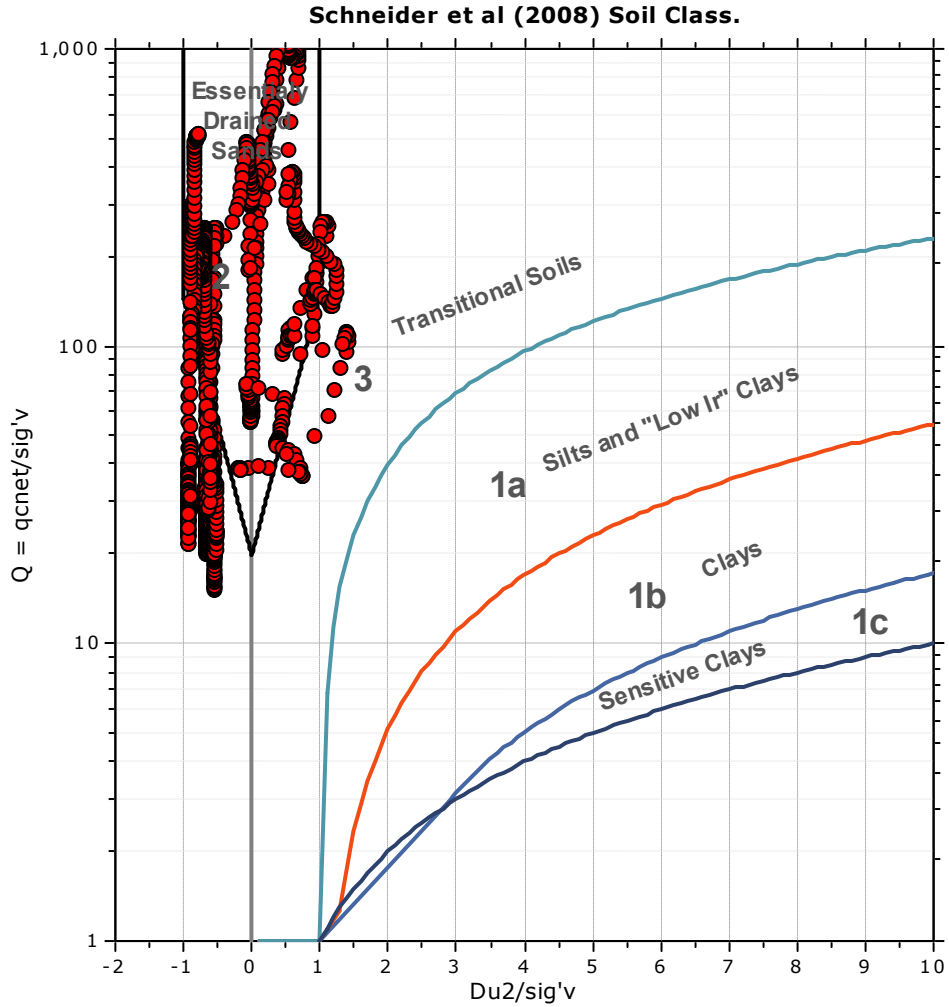
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

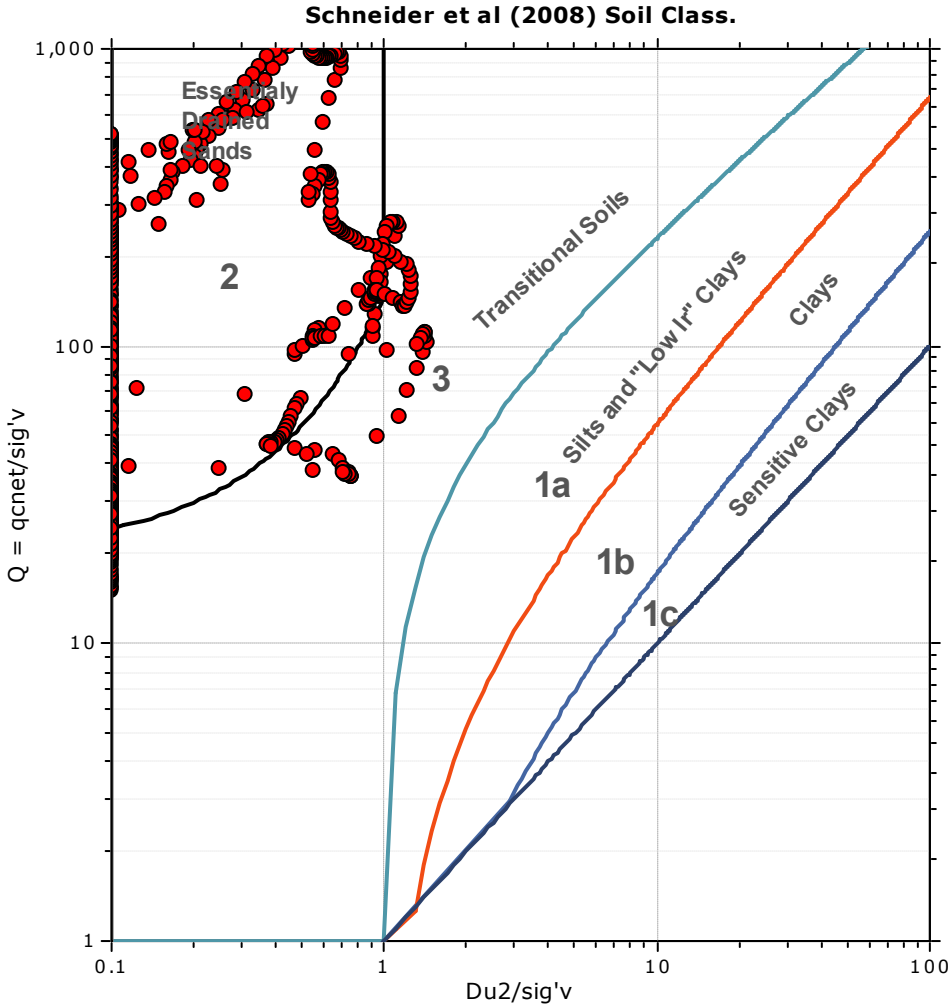
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Bq plots (Schneider)

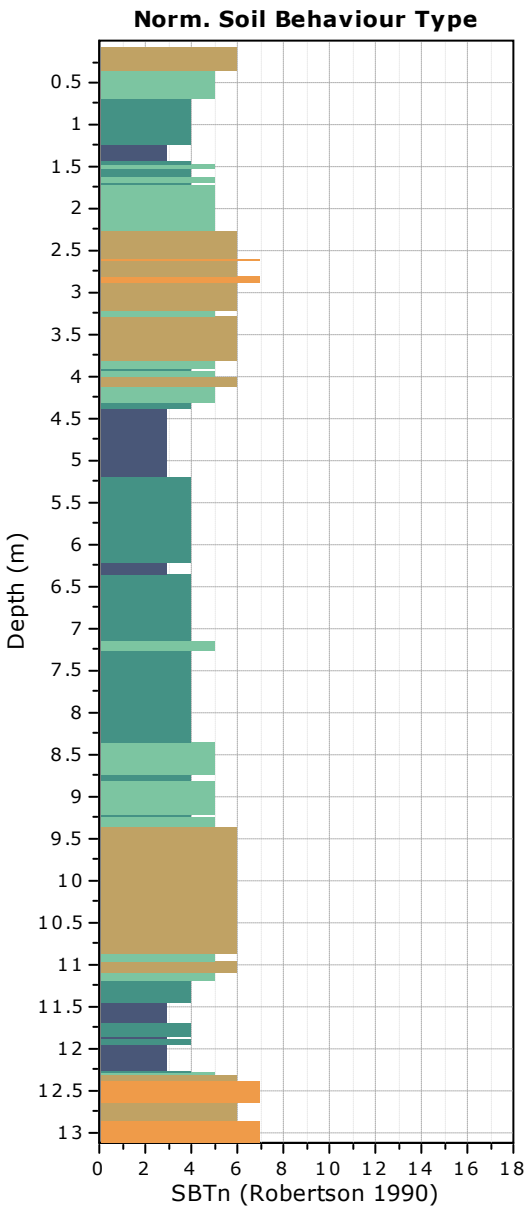


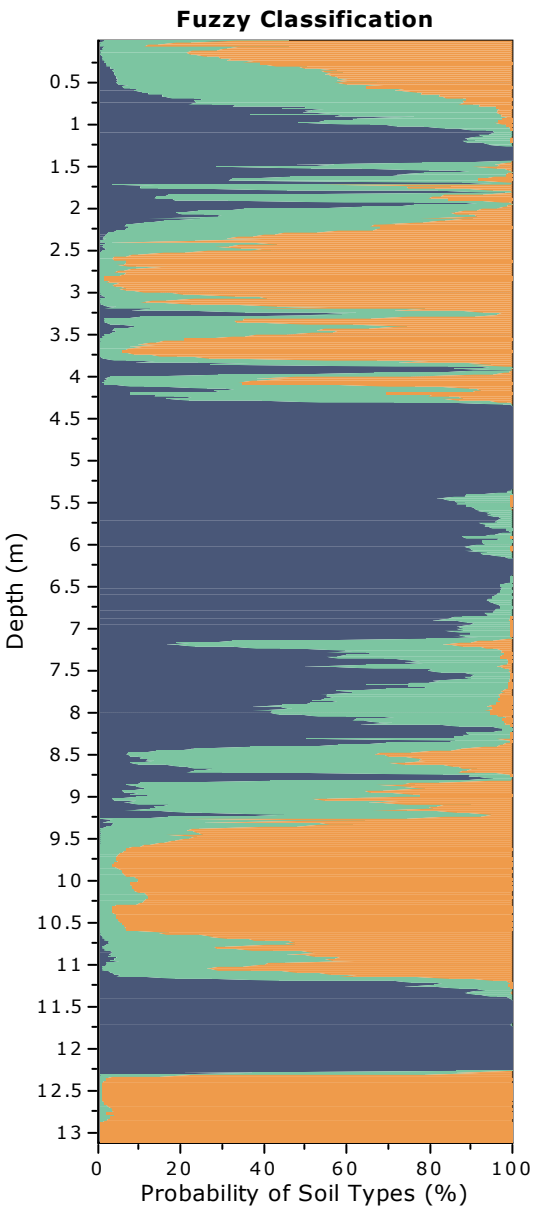


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



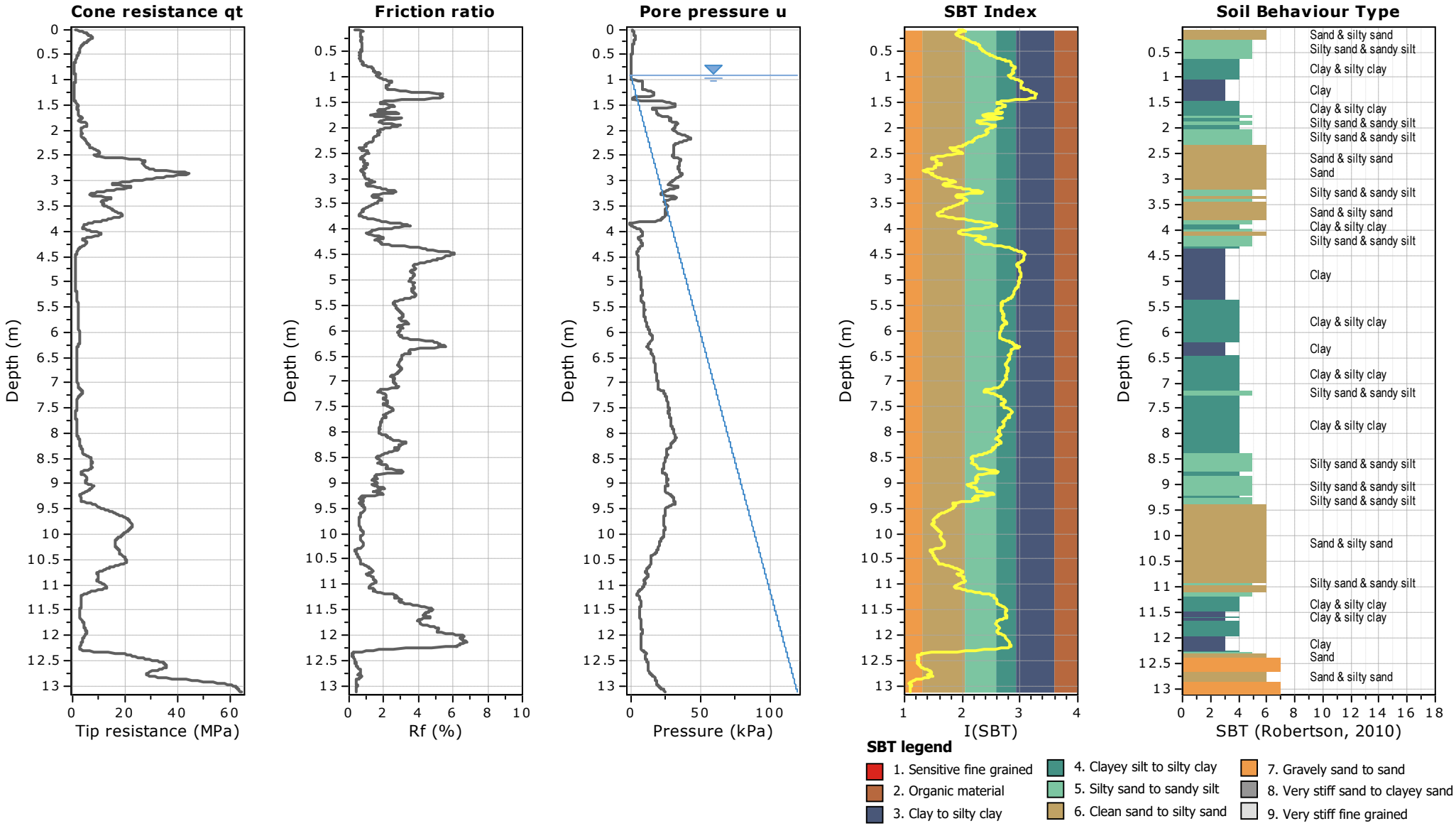


Fuzzy classifiaction legend
- Highly probable clayey soil
- Highly probable mixture soil
- Highly probable sandy soil

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

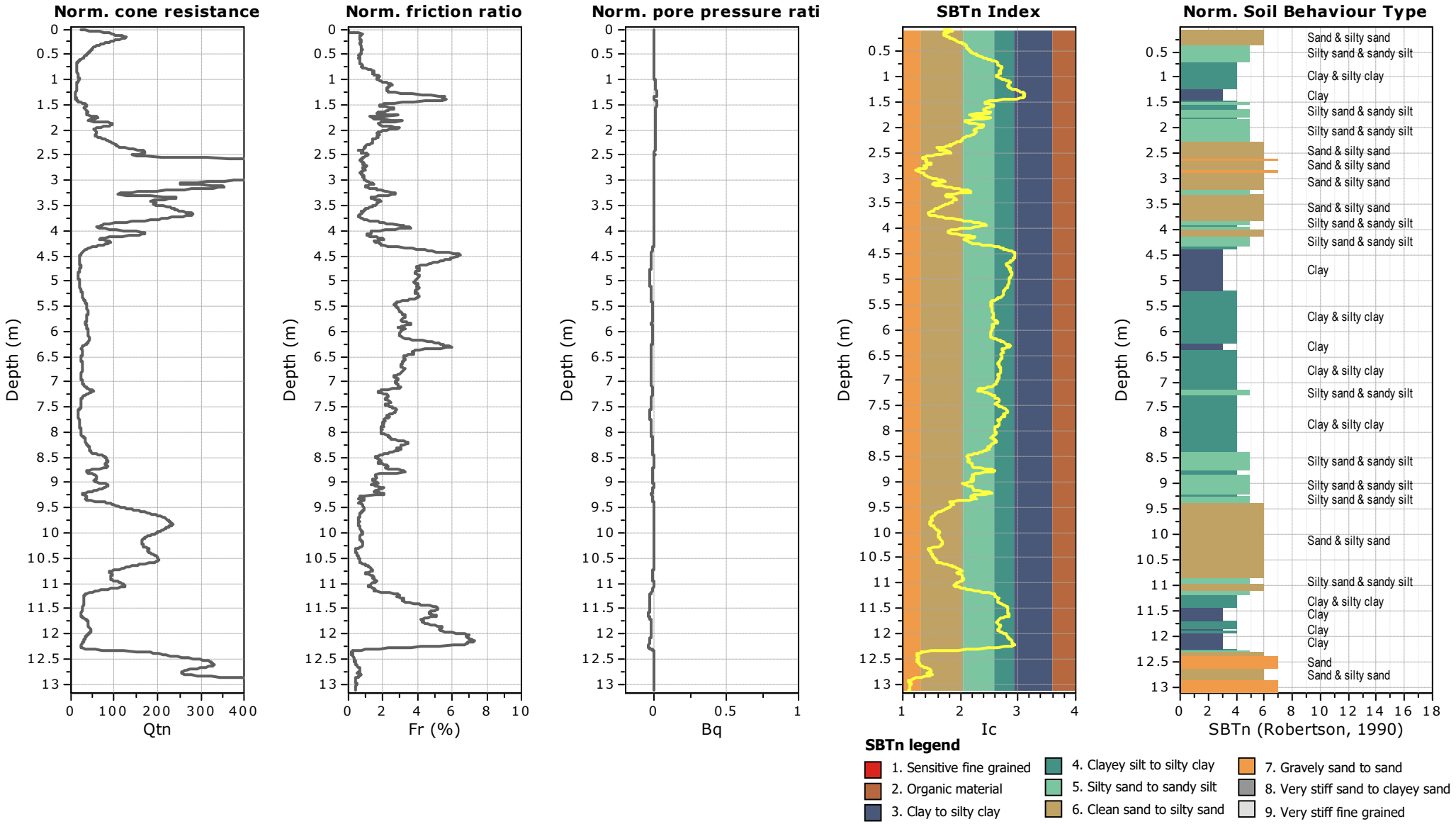
CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

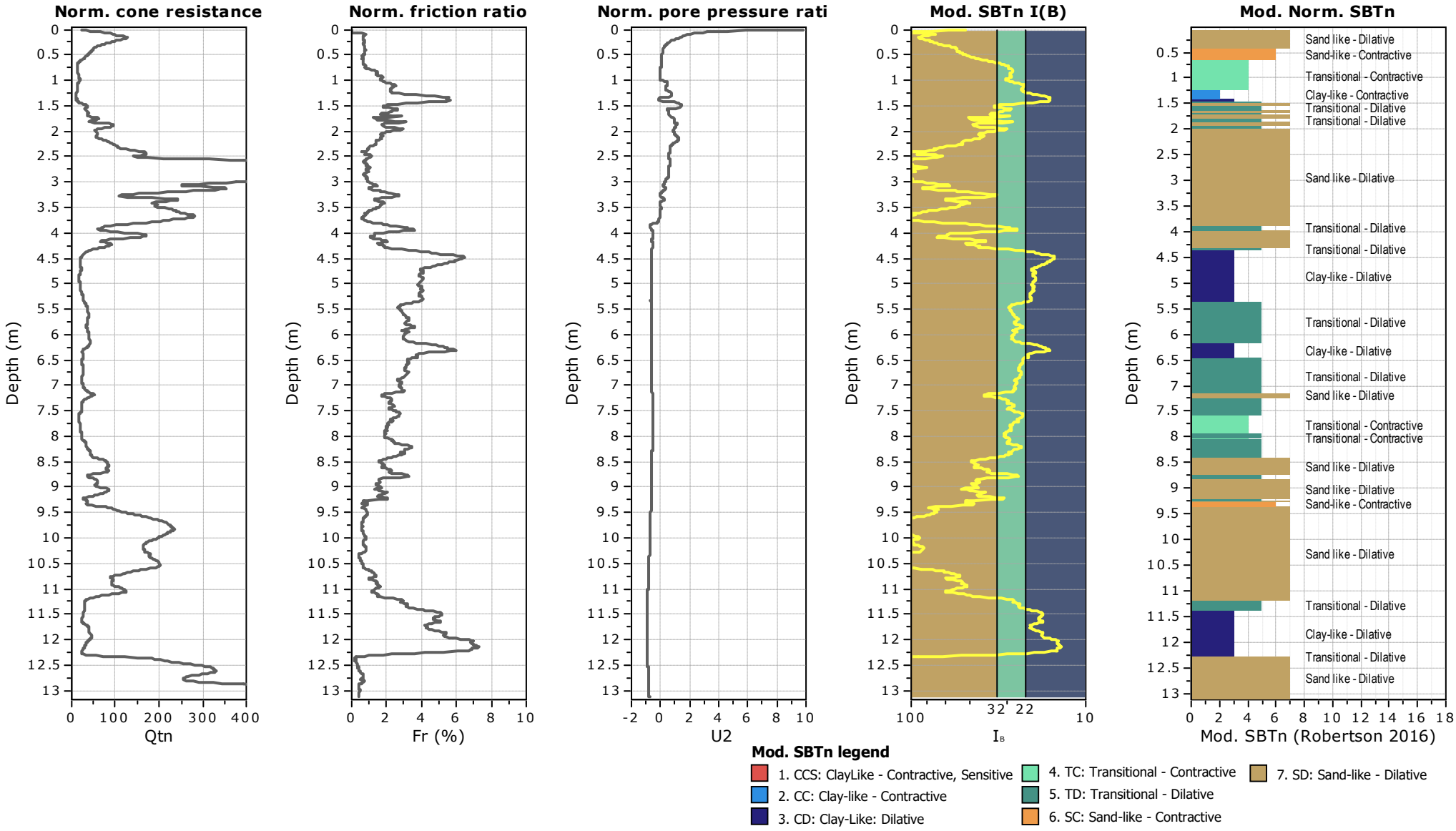
CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

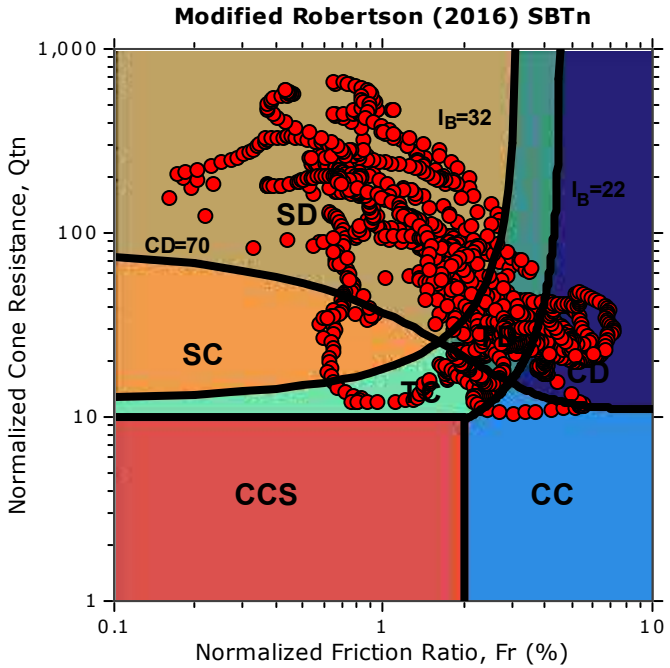


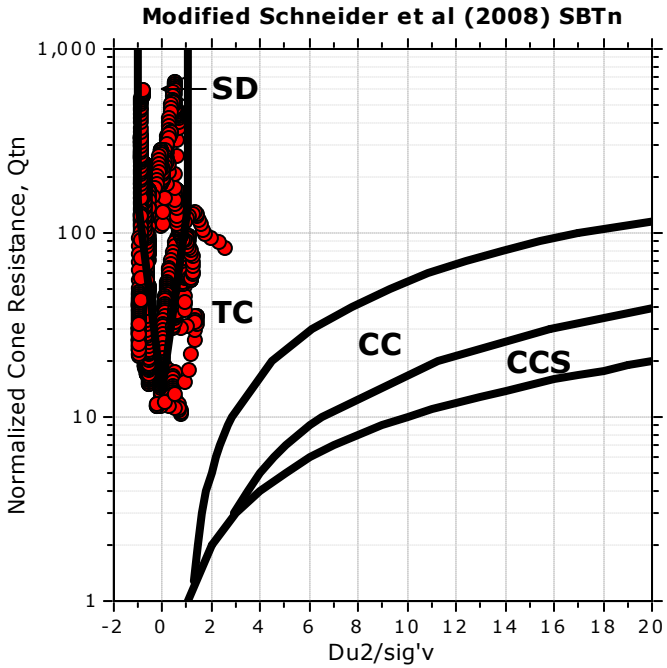
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

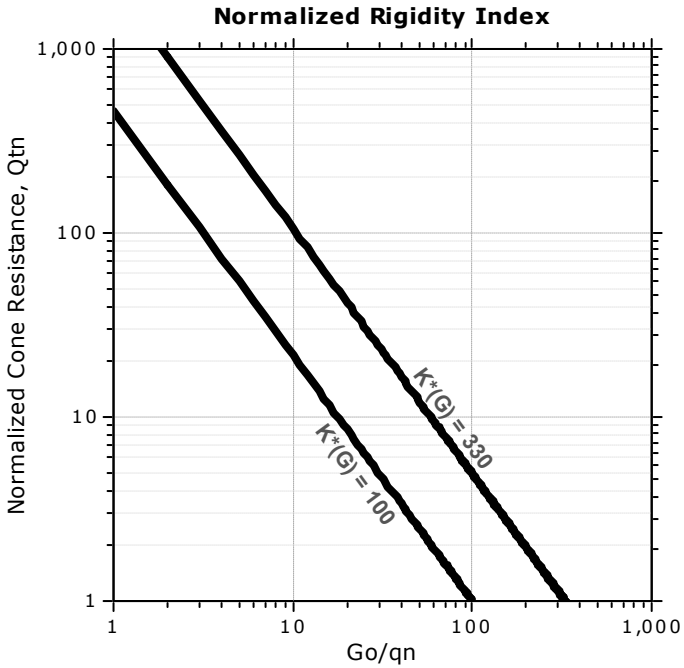
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Updated SBTn plots







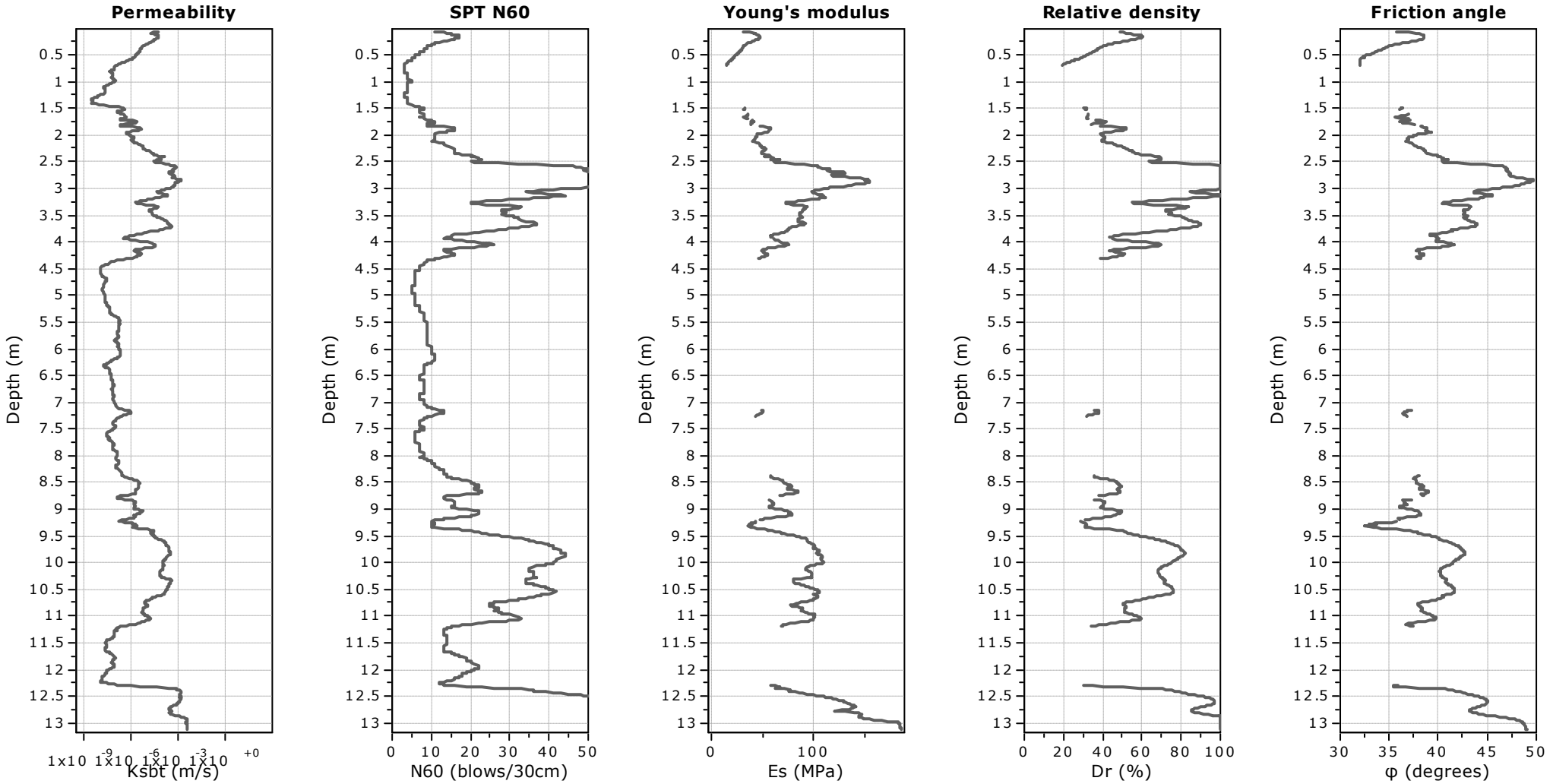
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



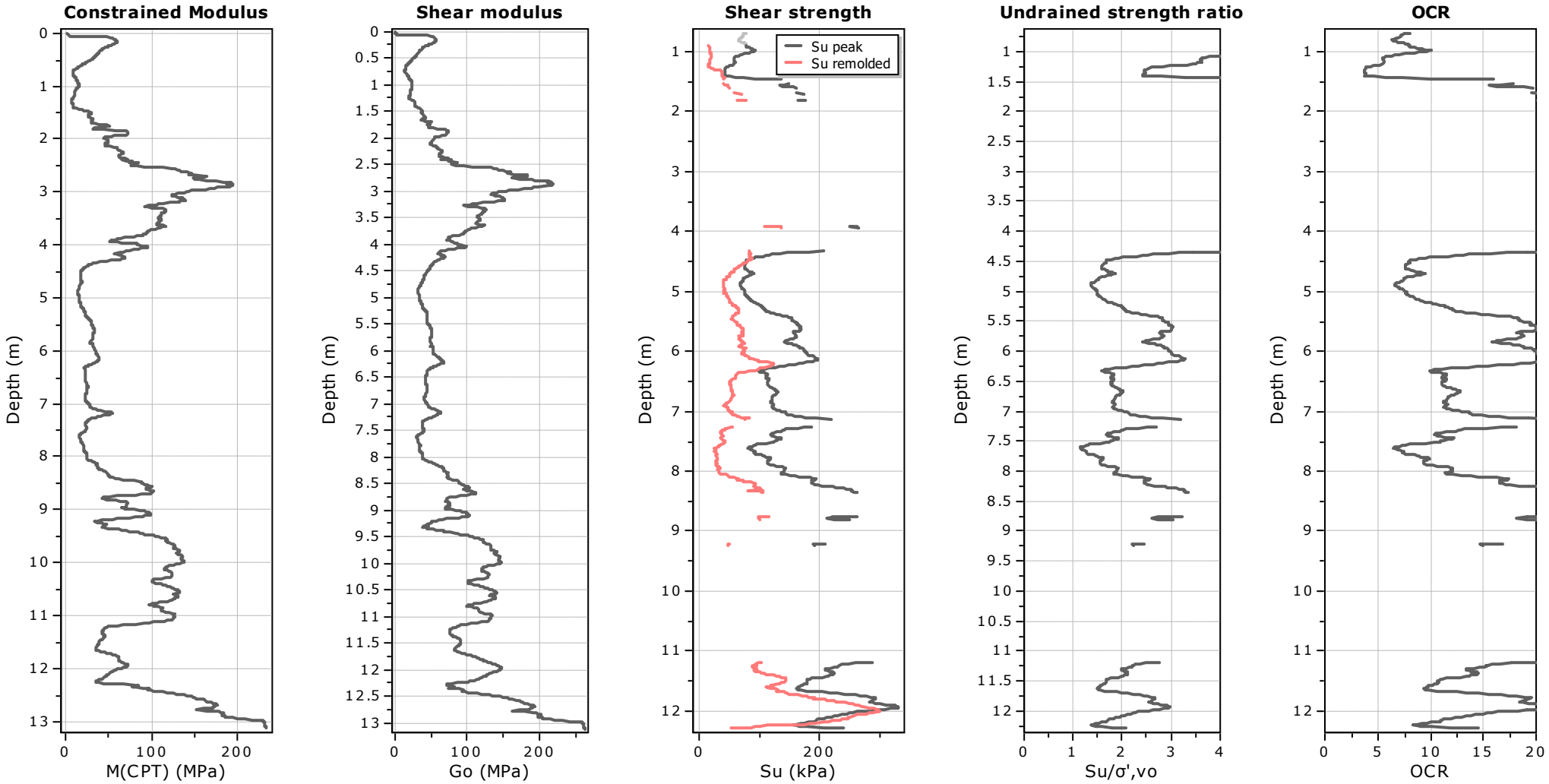
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



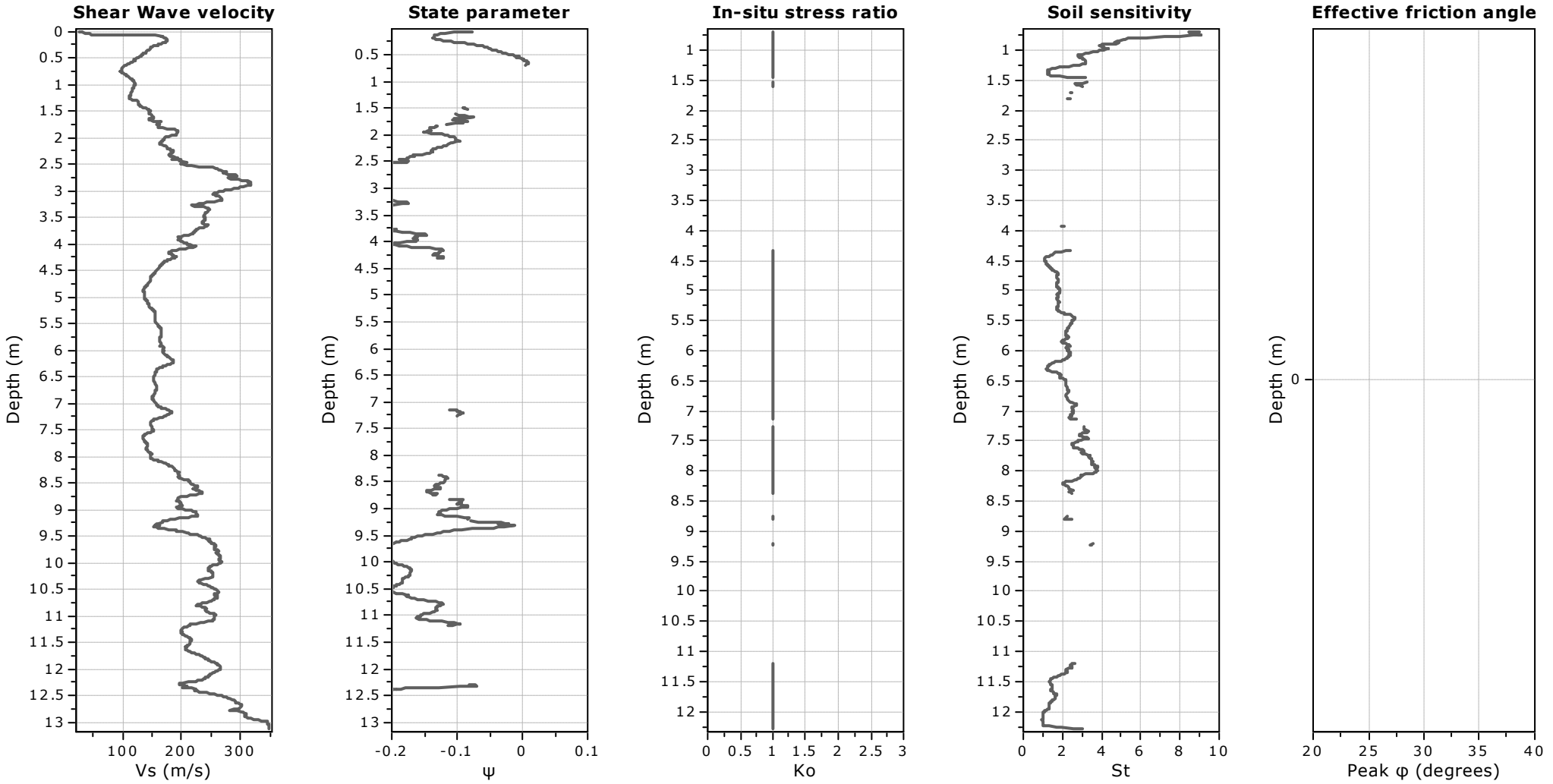
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto
OCR factor for clays, N_{kt}: Auto
Flat Dilatometer Test data

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



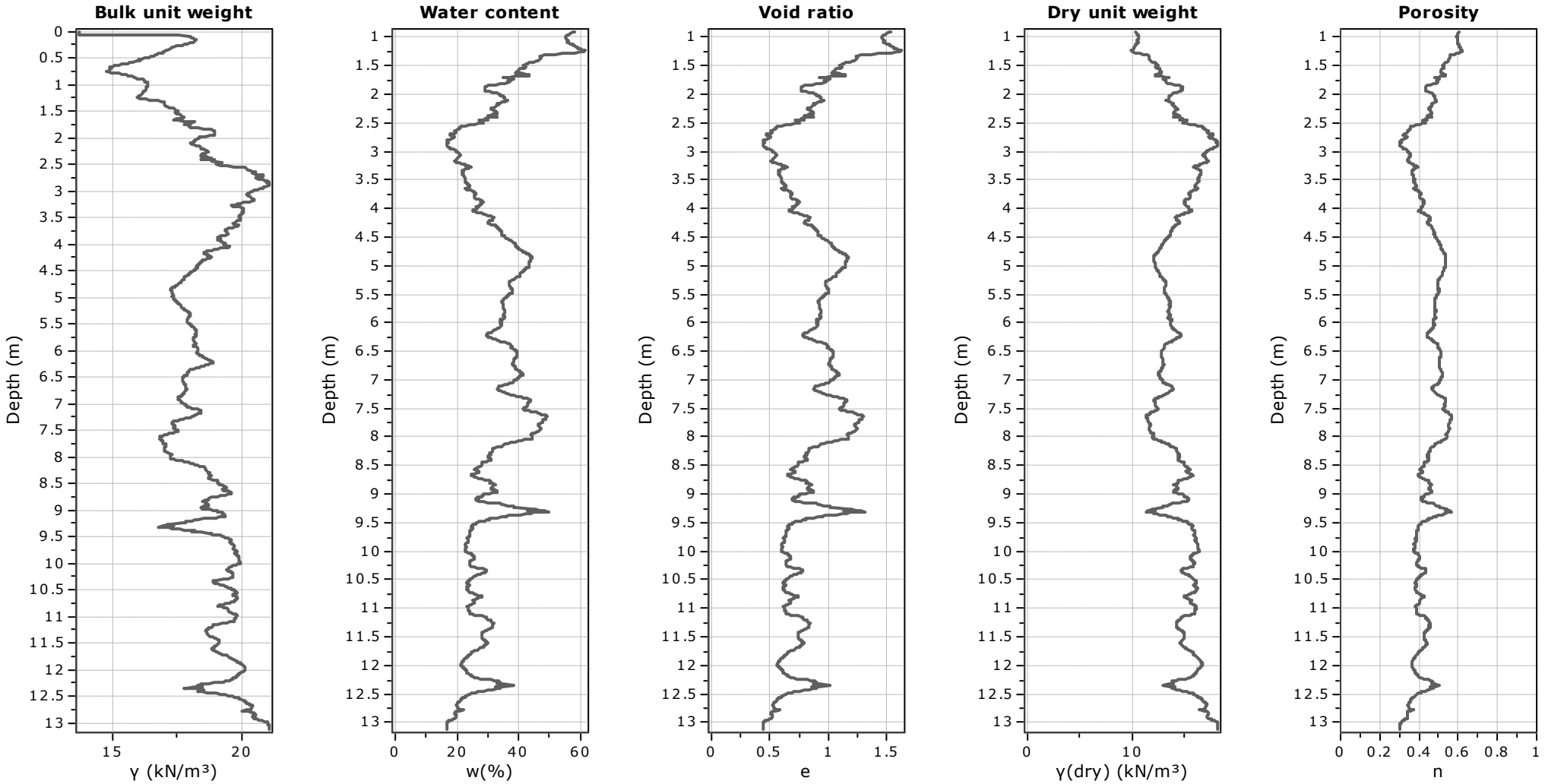
Calculation parameters

Soil Sensitivity factor, N_S: 7.00

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

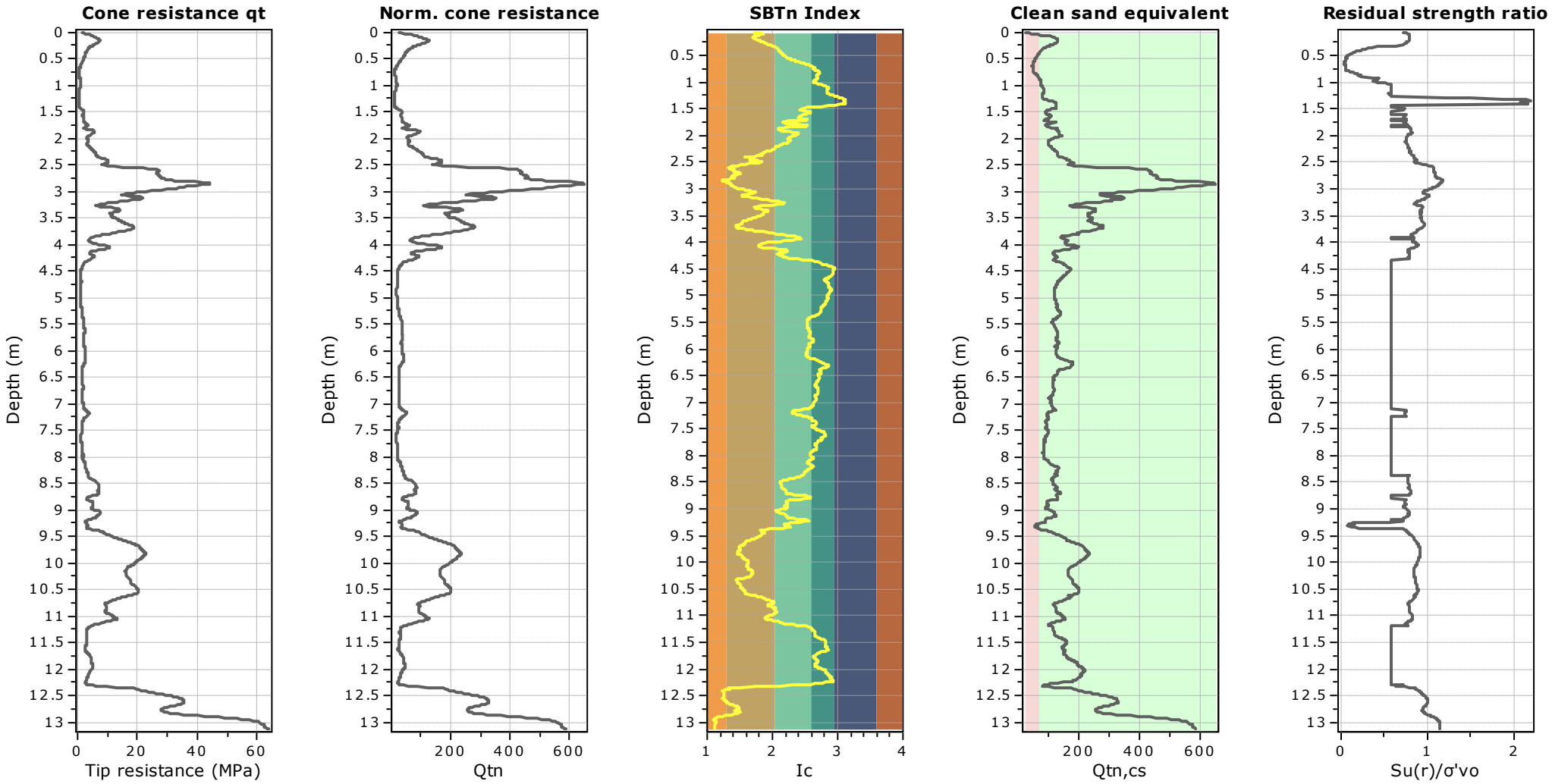
CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

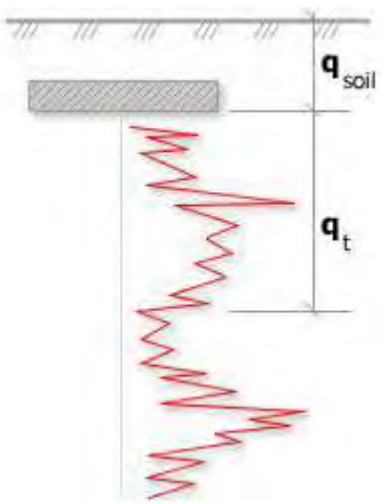
CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

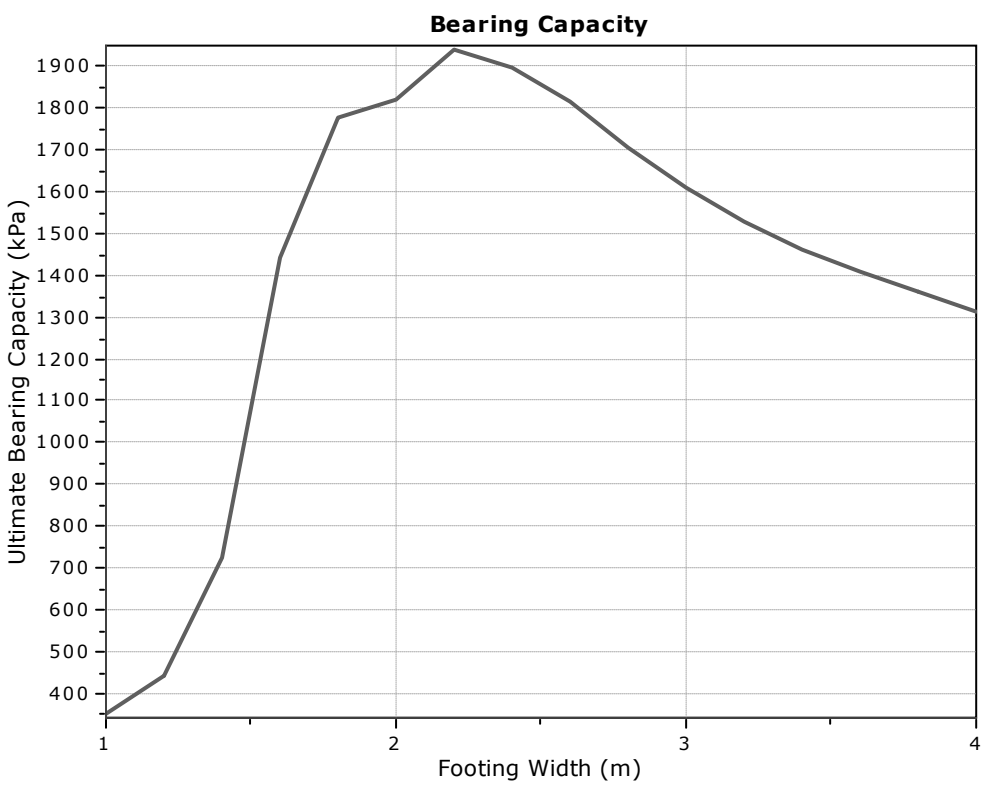
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



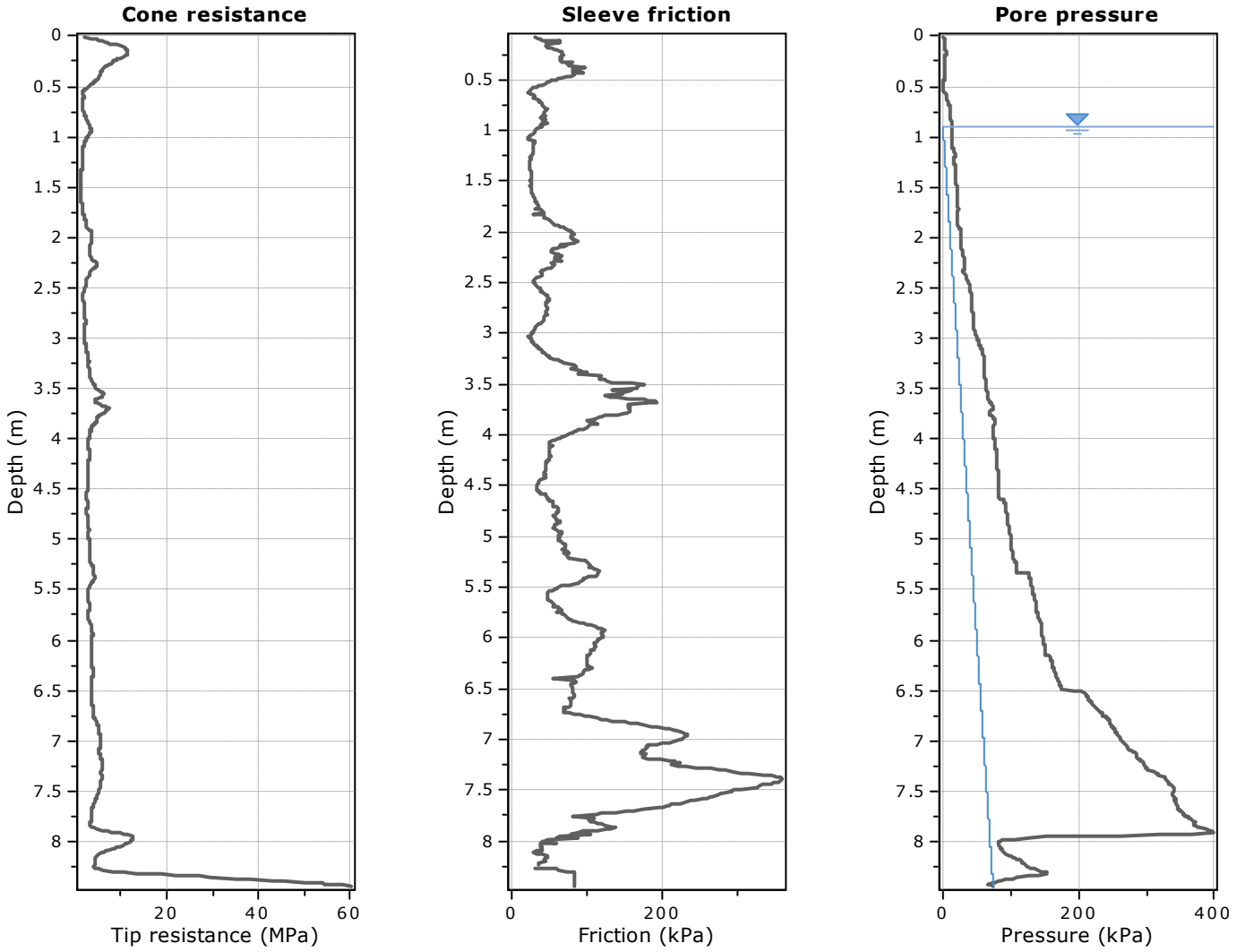
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	1.70	0.20	9.50	350.31
2	1.20	0.50	2.30	2.15	0.20	9.50	440.03
3	1.40	0.50	2.60	3.57	0.20	9.50	724.03
4	1.60	0.50	2.90	7.17	0.20	9.50	1444.13
5	1.80	0.50	3.20	8.83	0.20	9.50	1775.68
6	2.00	0.50	3.50	9.05	0.20	9.50	1819.40
7	2.20	0.50	3.80	9.65	0.20	9.50	1940.26
8	2.40	0.50	4.10	9.43	0.20	9.50	1895.97
9	2.60	0.50	4.40	9.03	0.20	9.50	1814.70
10	2.80	0.50	4.70	8.48	0.20	9.50	1705.77
11	3.00	0.50	5.00	8.00	0.20	9.50	1608.70
12	3.20	0.50	5.30	7.58	0.20	9.50	1526.50
13	3.40	0.50	5.60	7.26	0.20	9.50	1462.14
14	3.60	0.50	5.90	6.99	0.20	9.50	1407.26
15	3.80	0.50	6.20	6.76	0.20	9.50	1361.58
16	4.00	0.50	6.50	6.52	0.20	9.50	1313.13

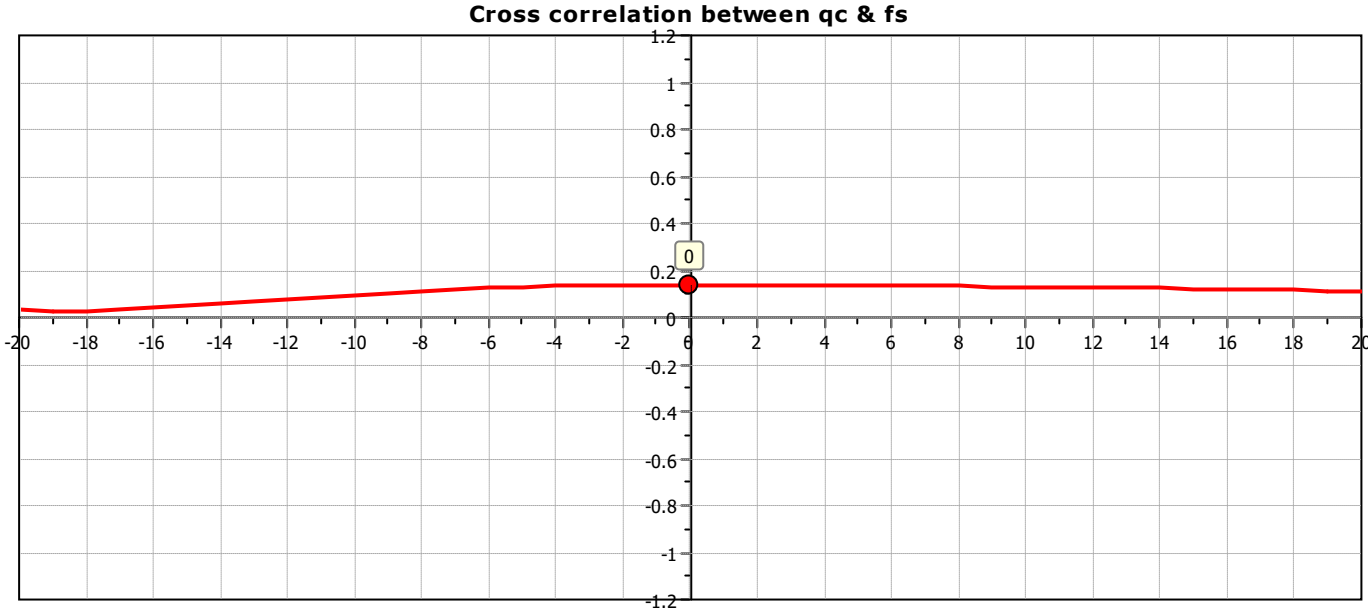
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

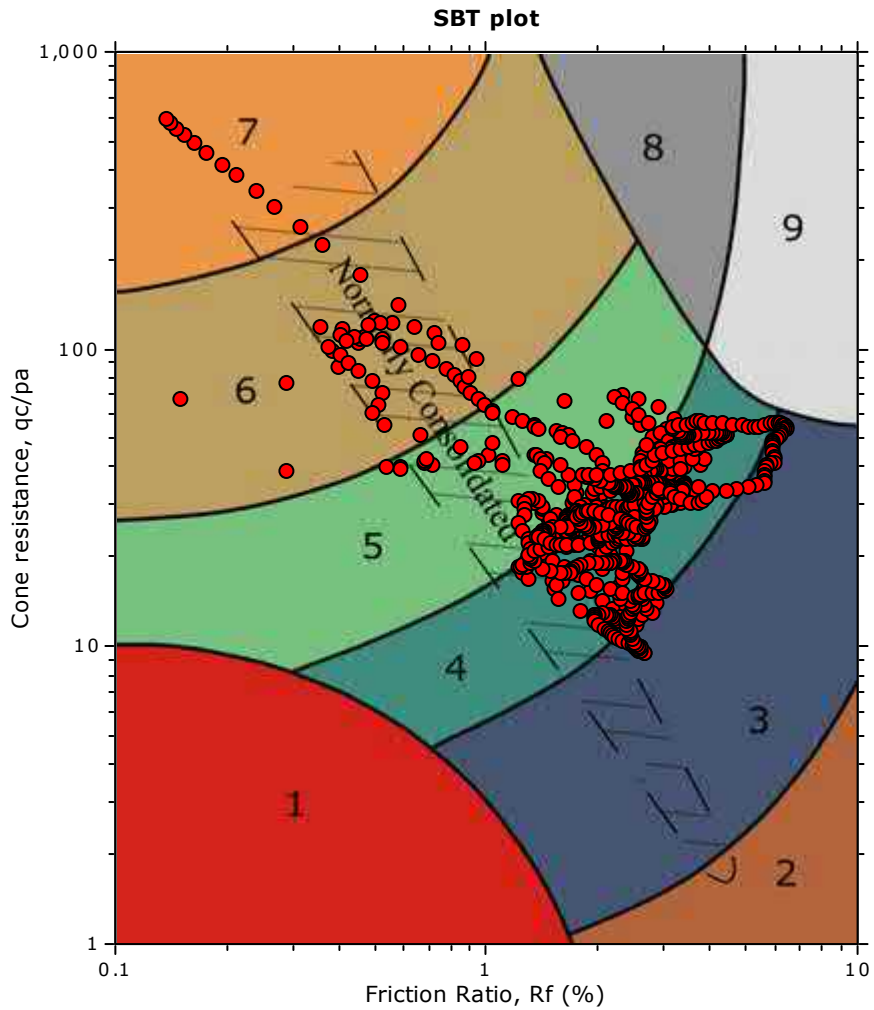


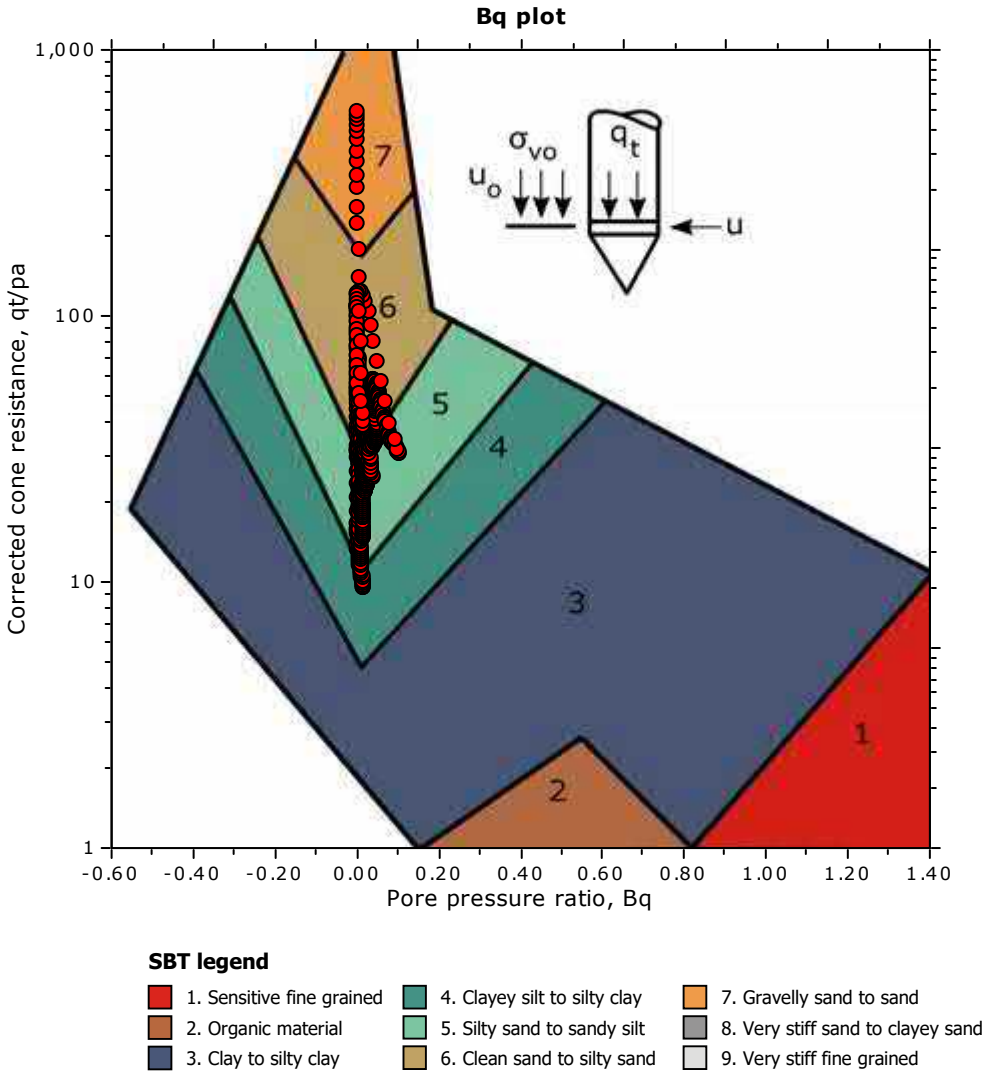
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots



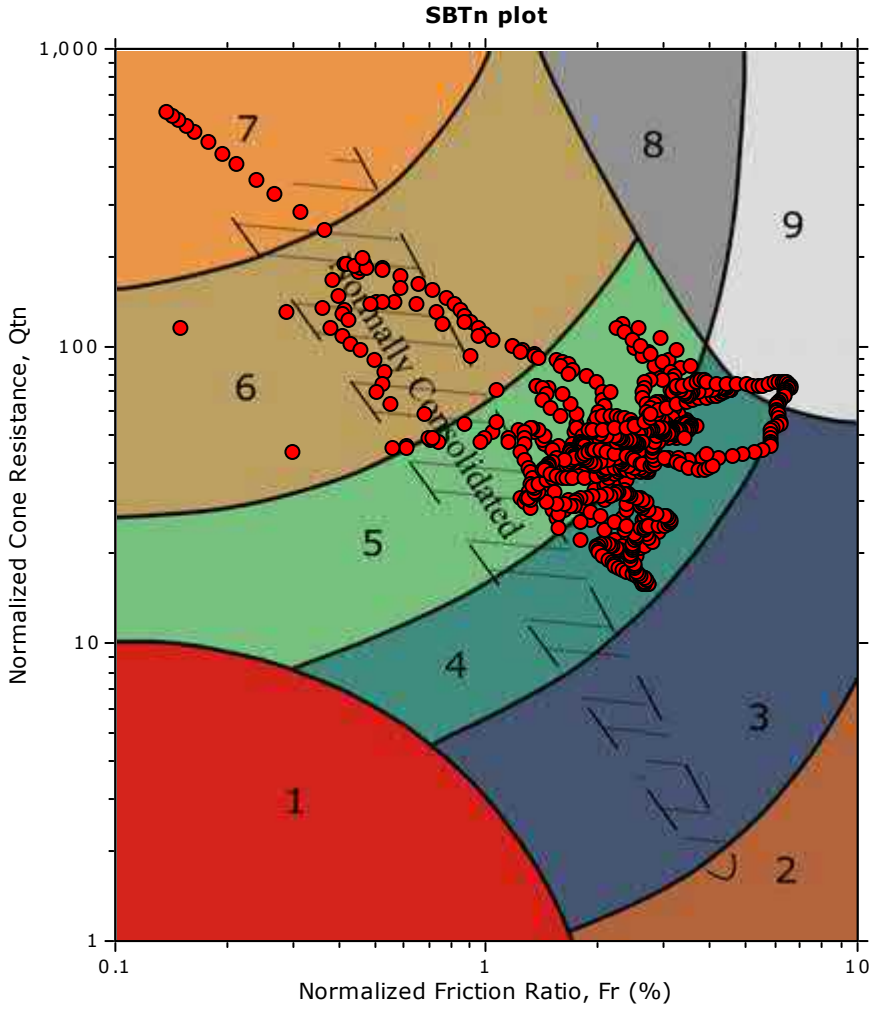


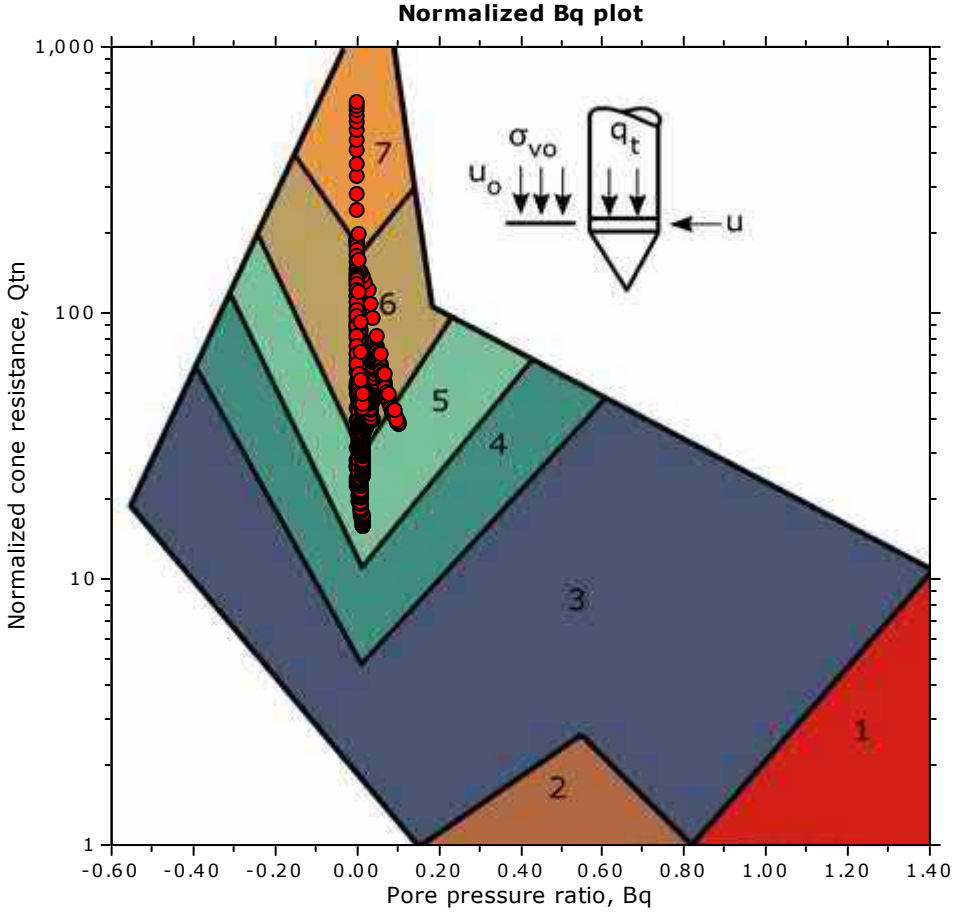
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots (normalized)





SBTn legend

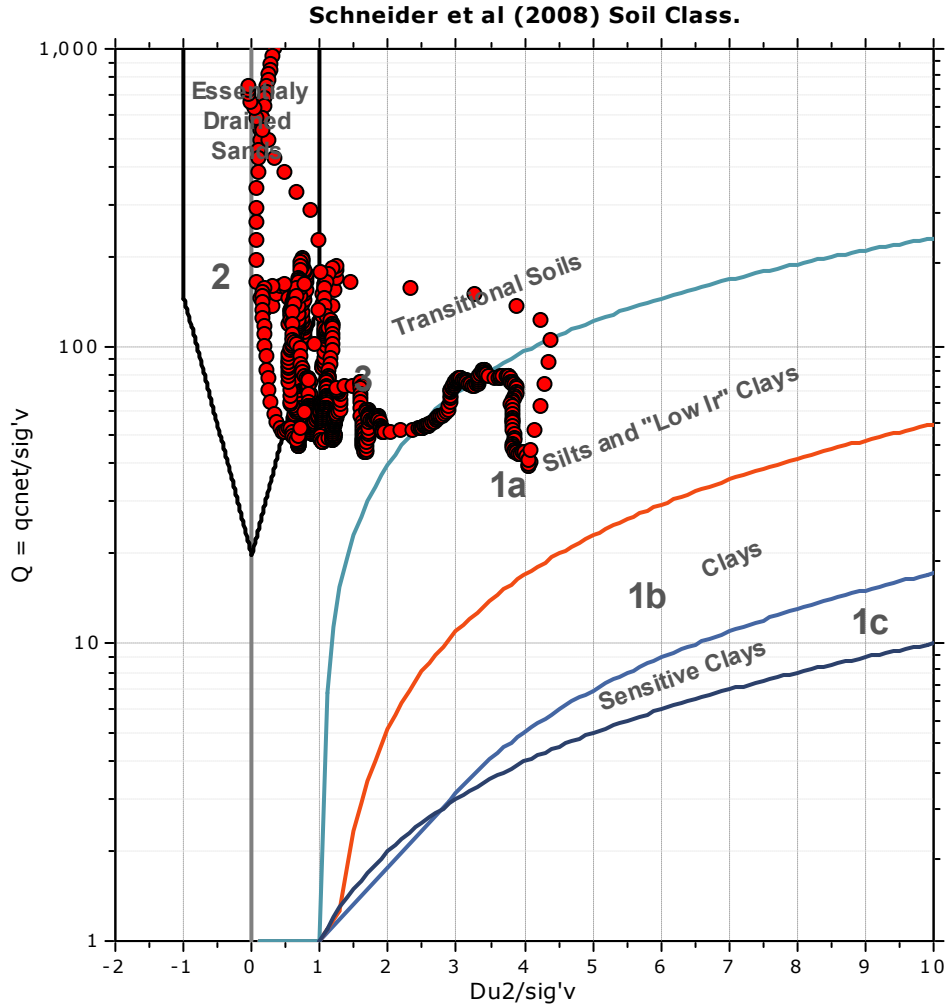
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

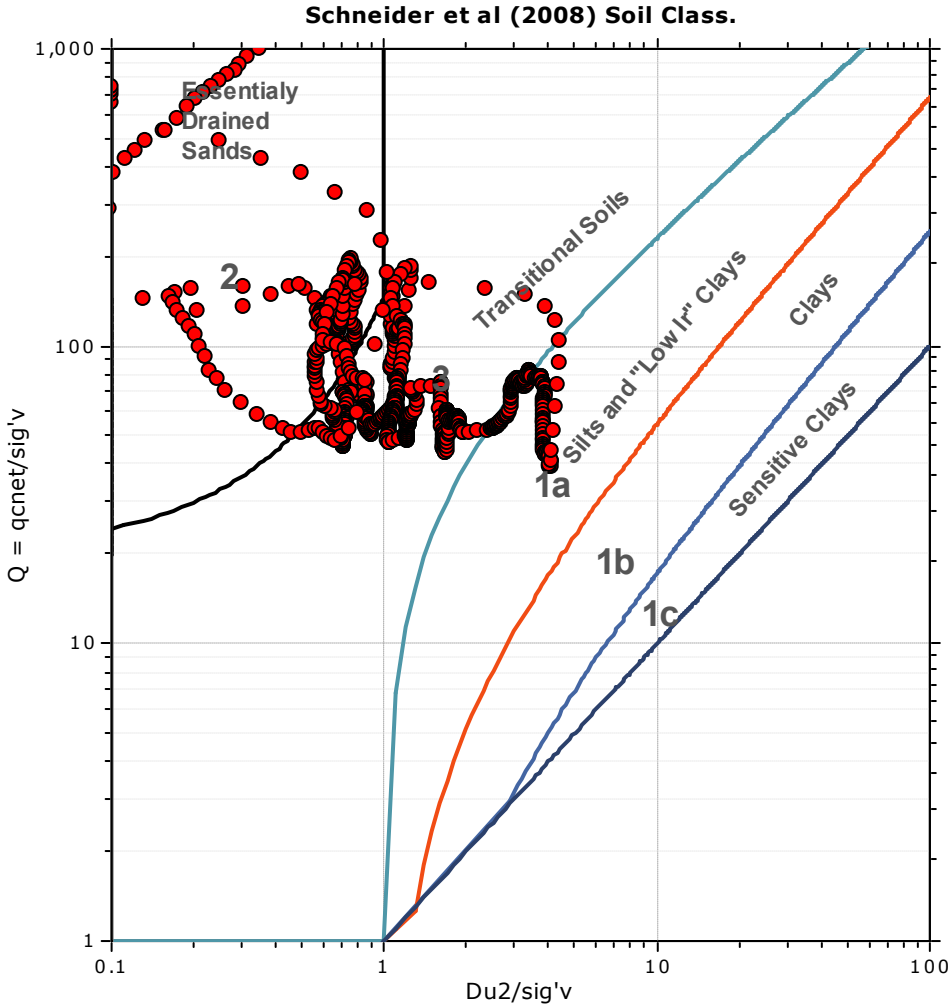
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Bq plots (Schneider)

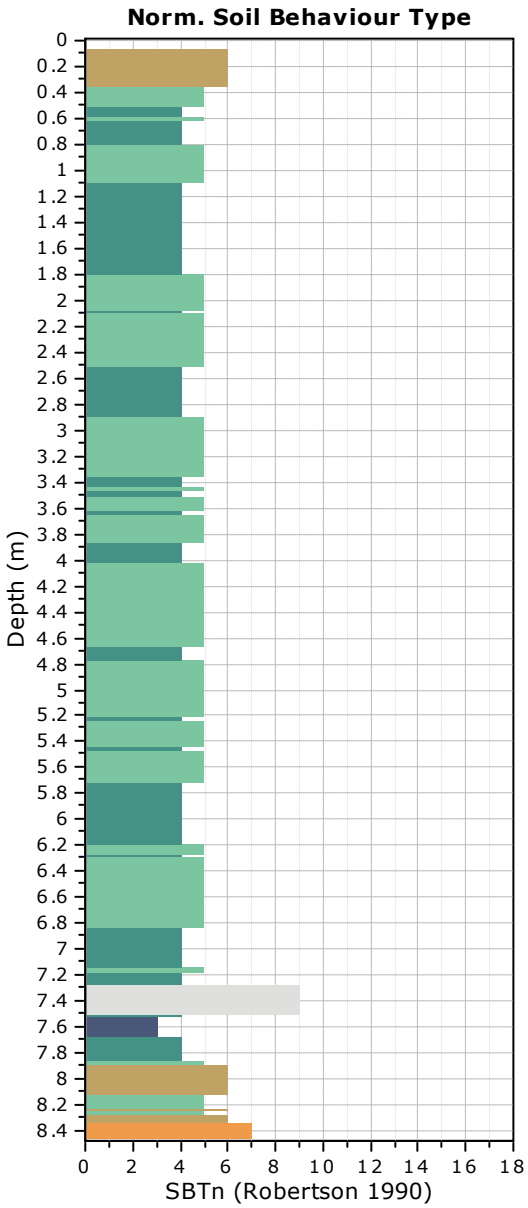


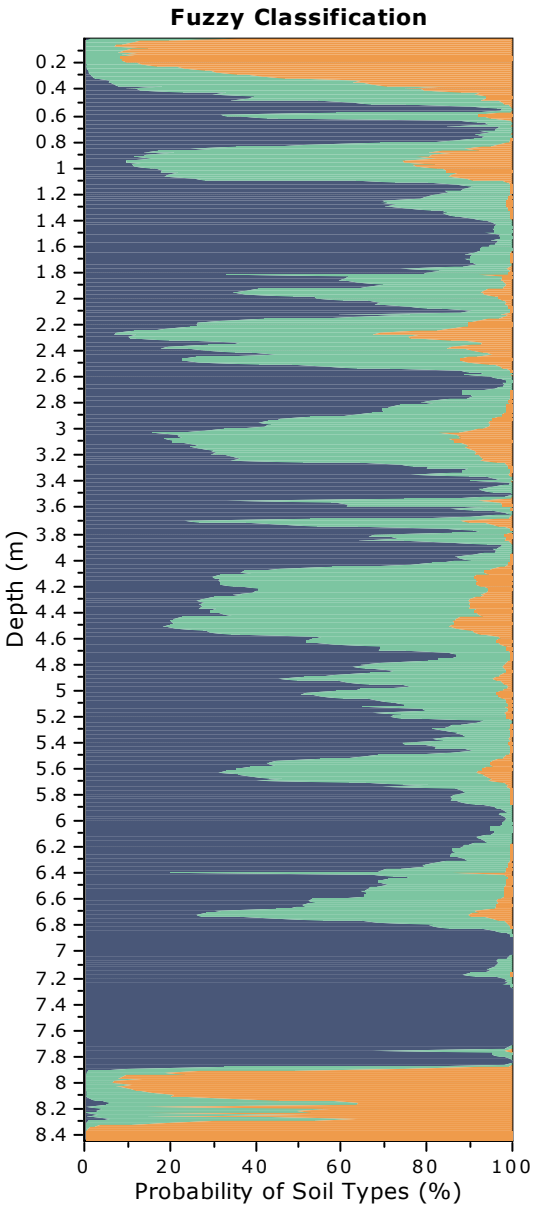


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



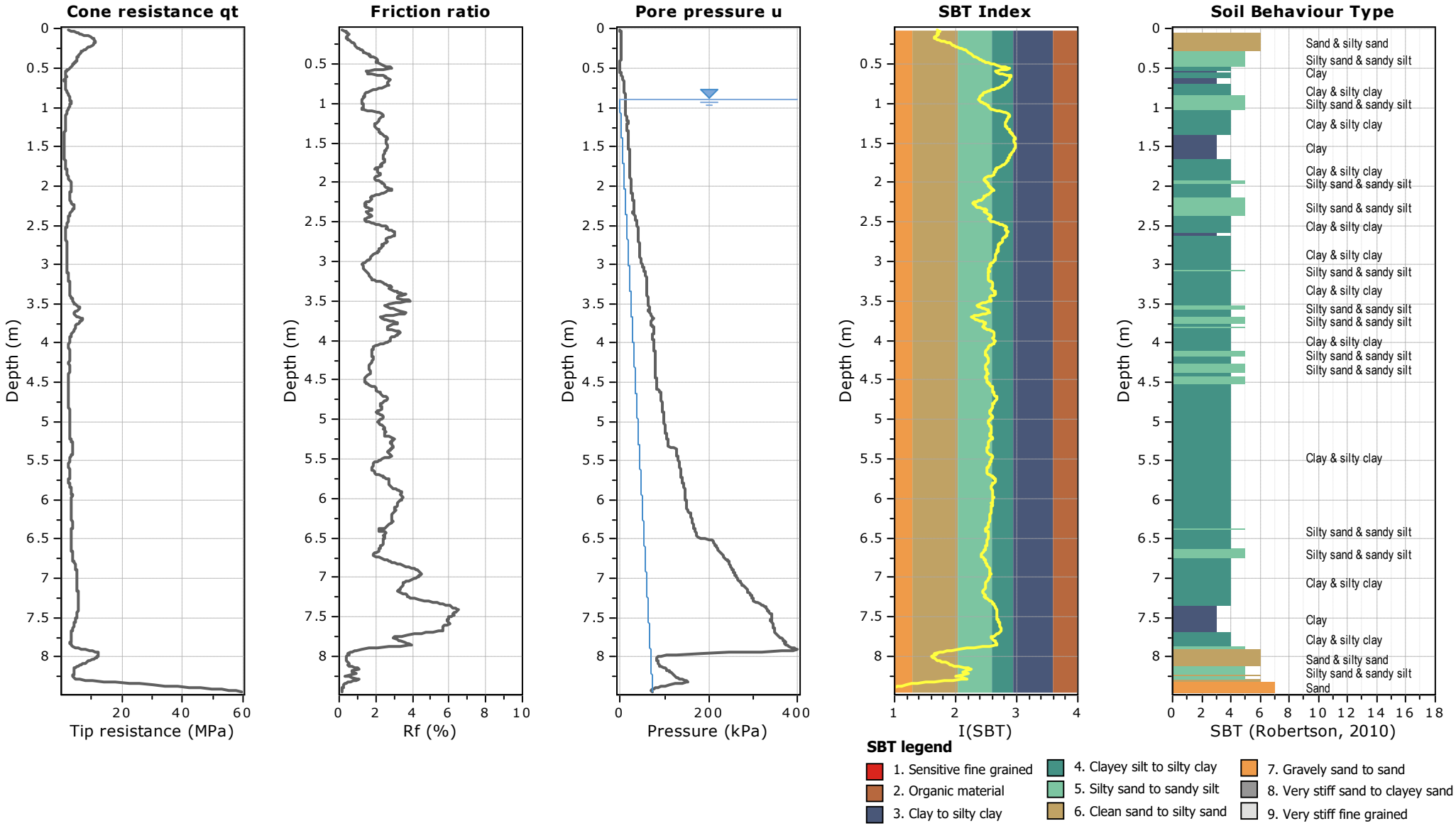


Fuzzy classifiaction legend
- Highly probable clayey soil
- Highly probable mixture soil
- Highly probable sandy soil

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

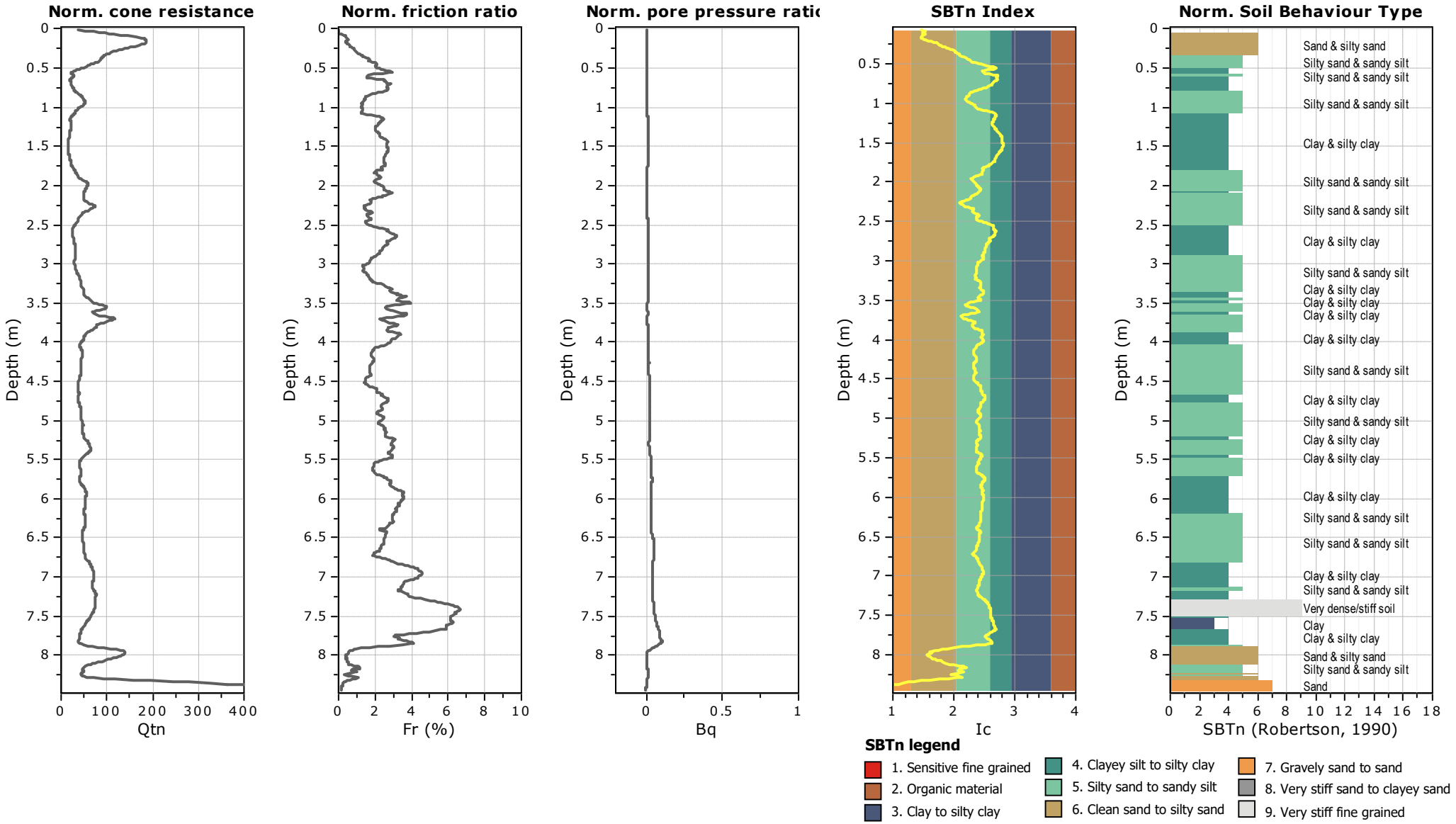
CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

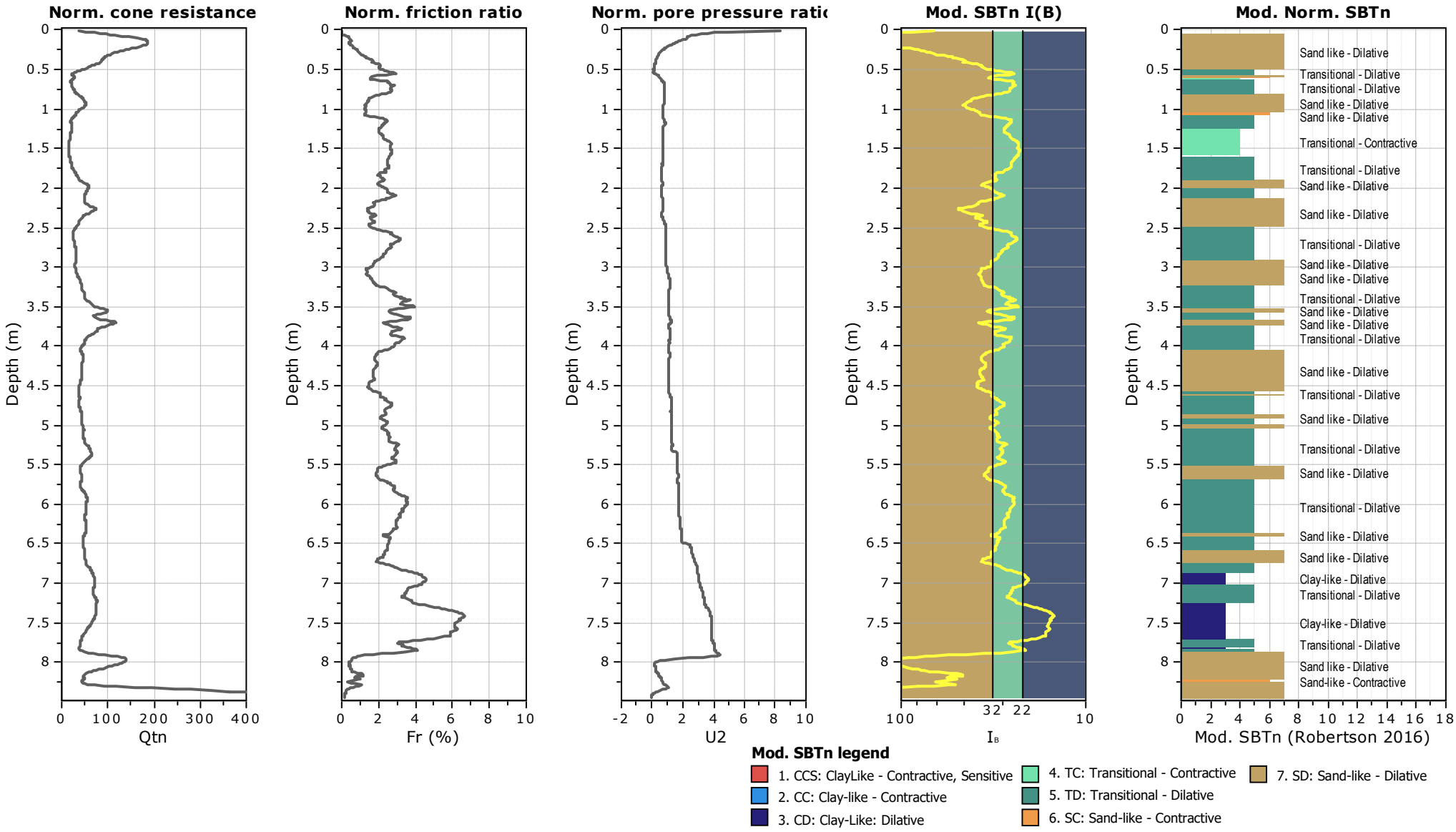
CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

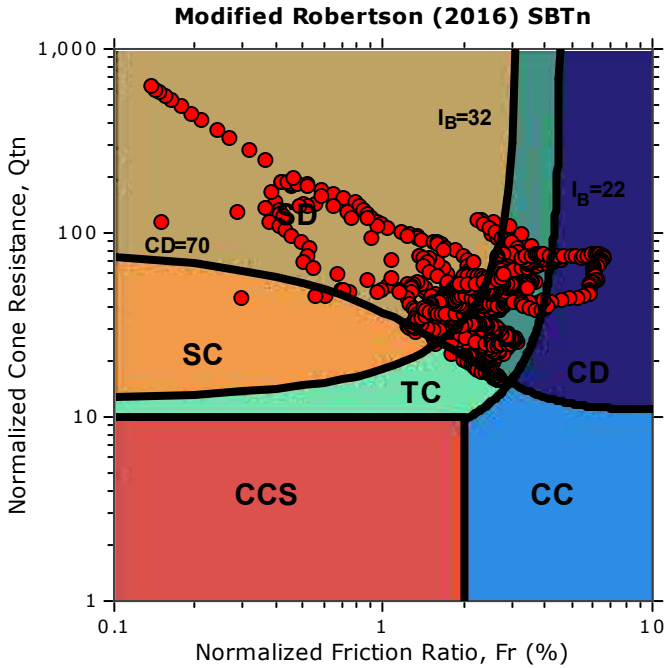


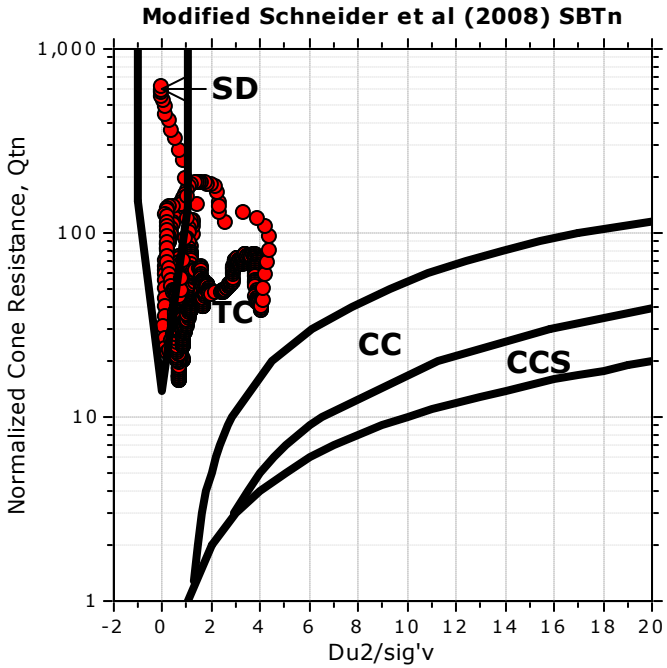
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

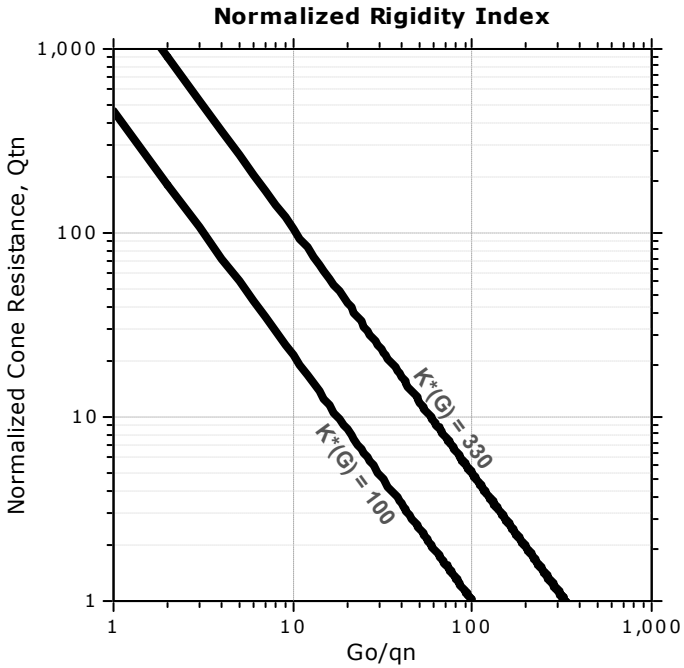
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Updated SBTn plots







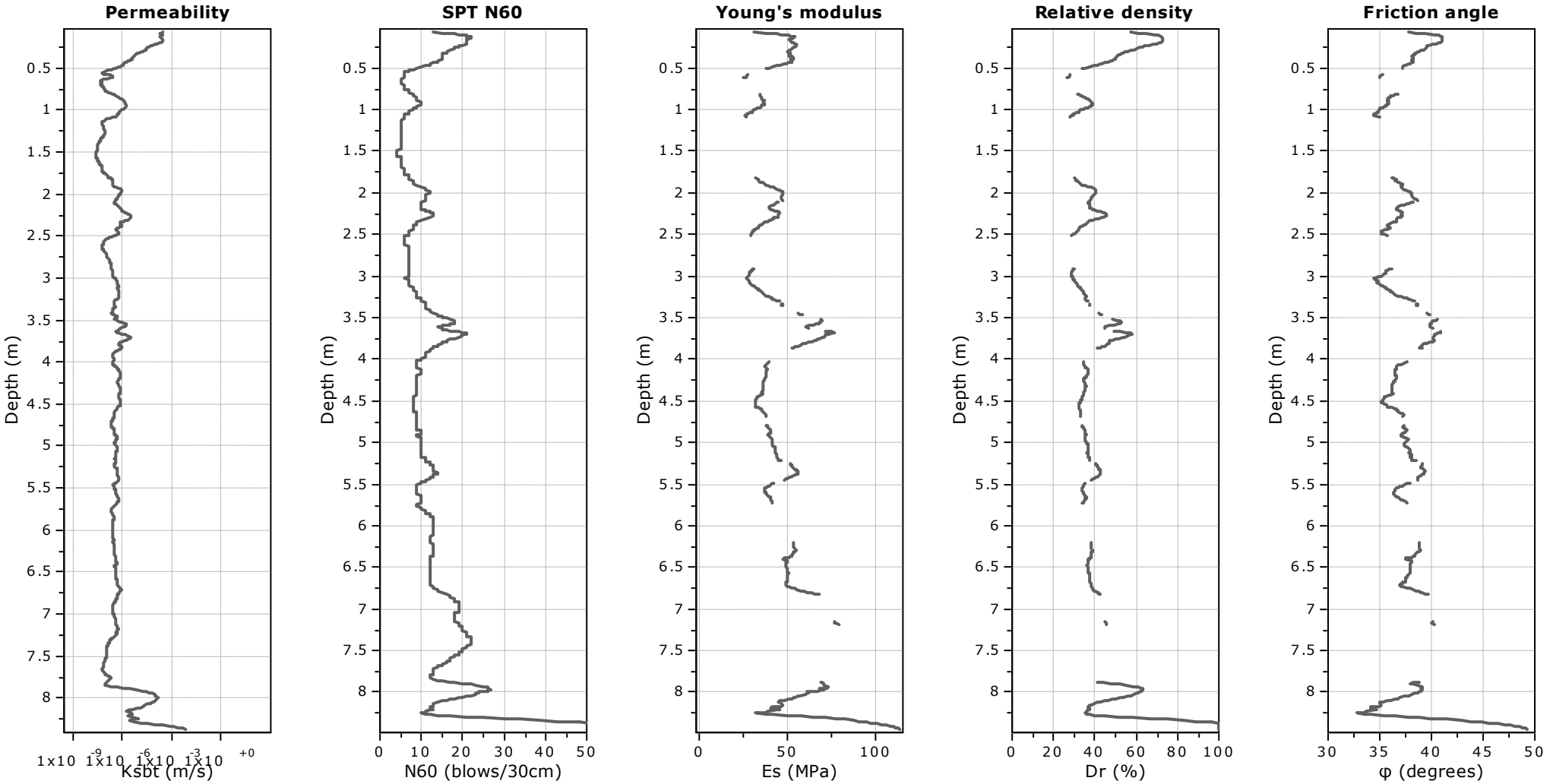
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

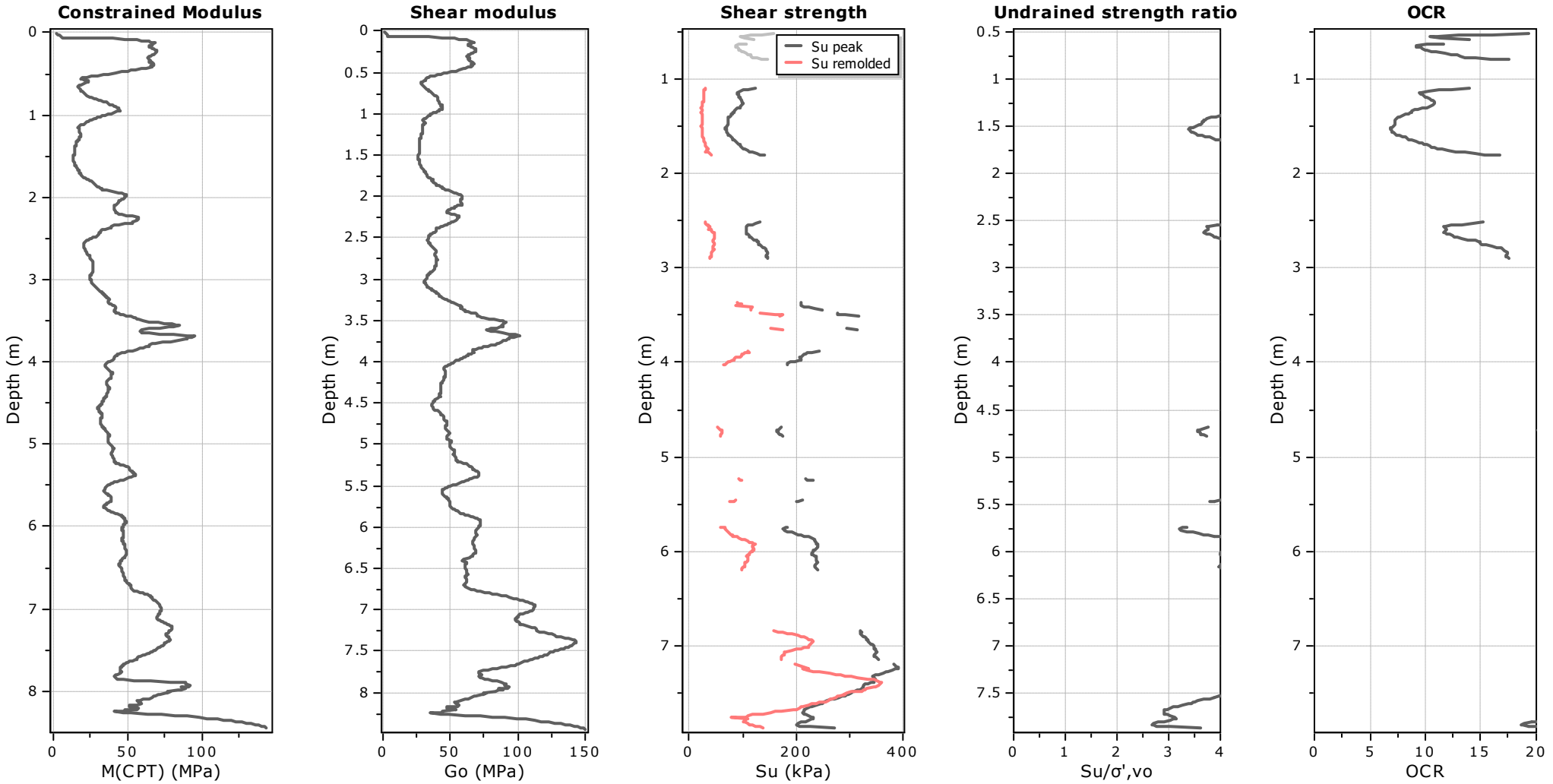


Calculation parameters
Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



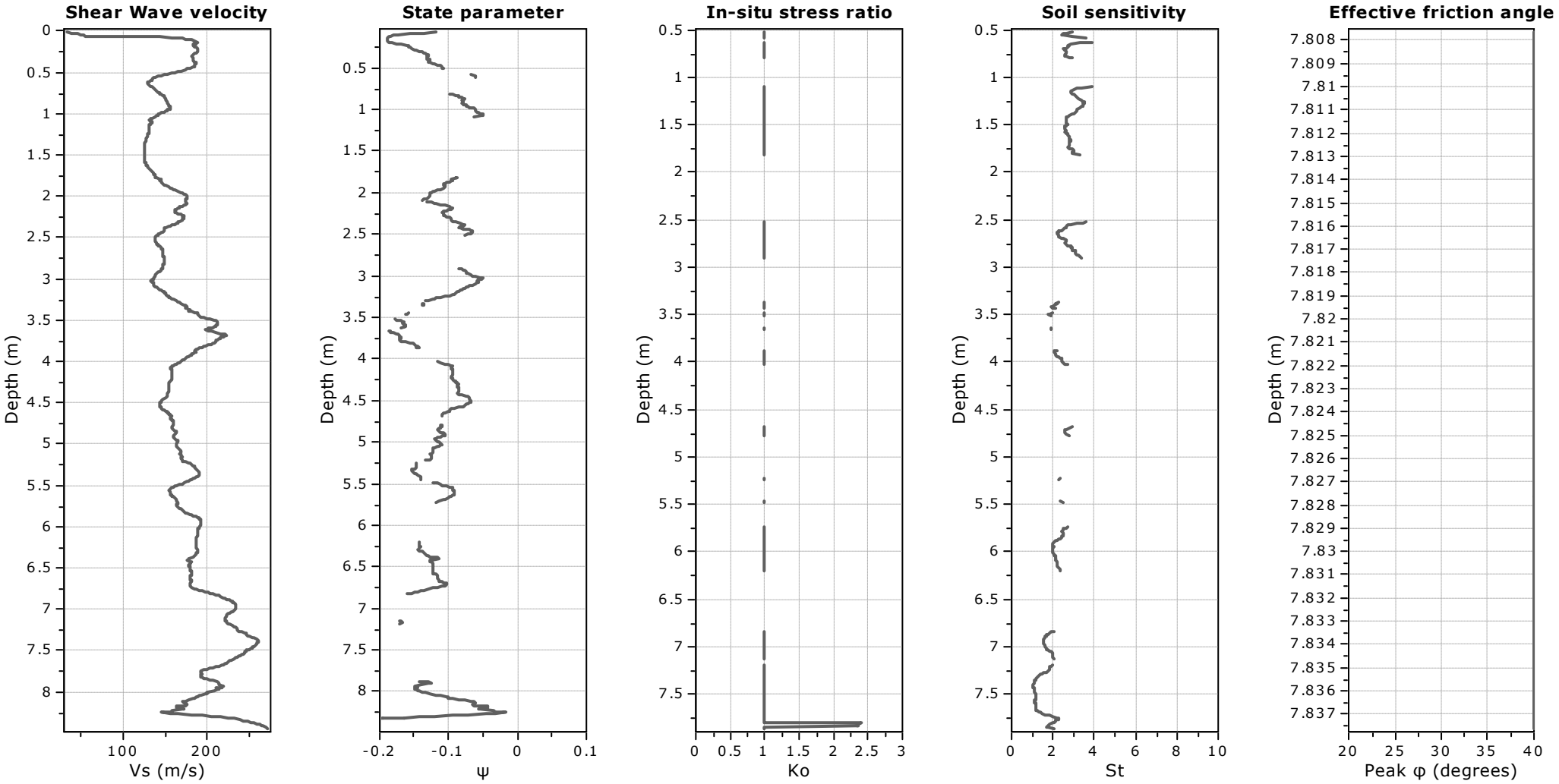
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto
OCR factor for clays, N_{kt}: Auto
Flat Dilatometer Test data

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



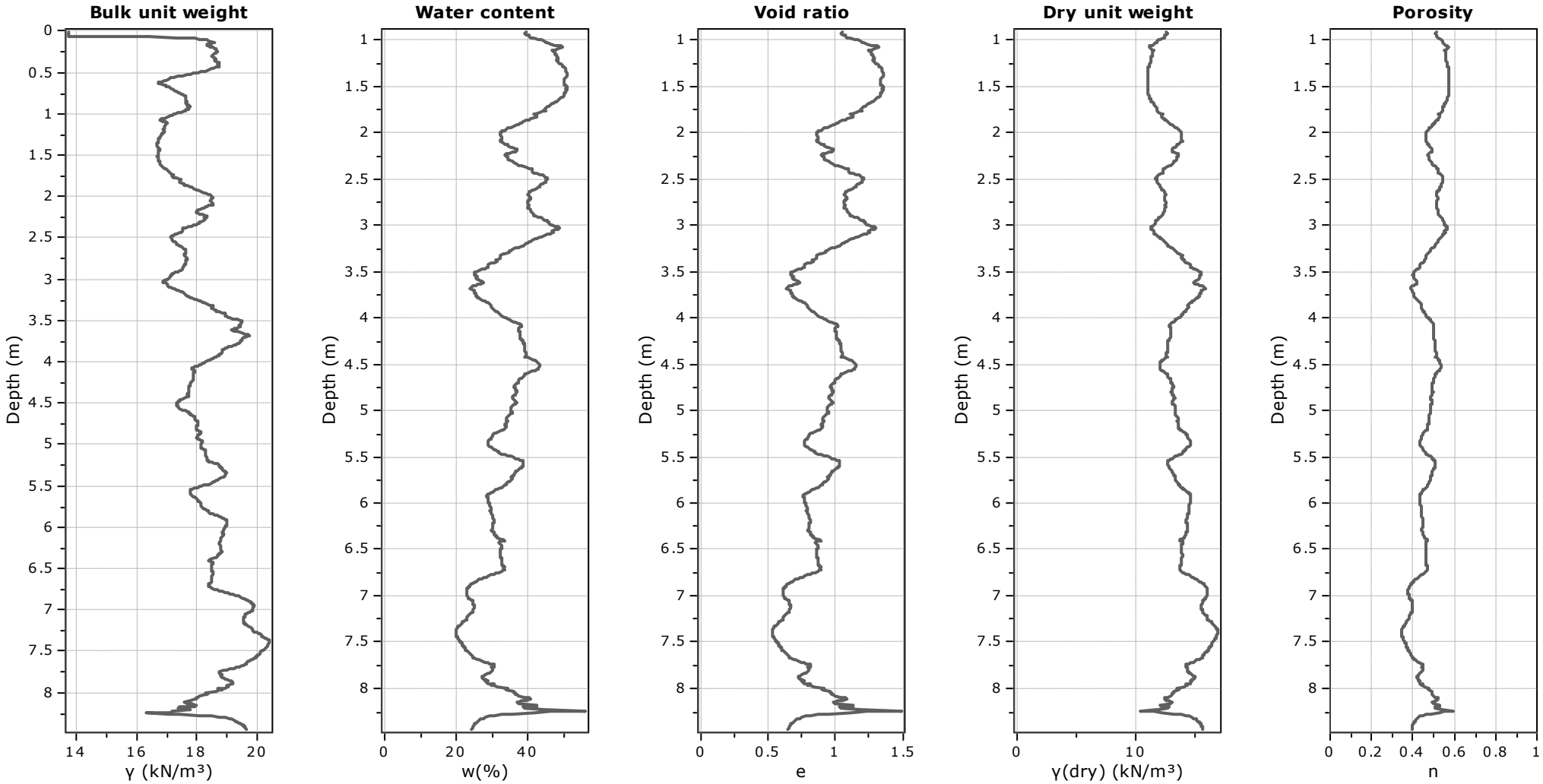
Calculation parameters

Soil Sensitivity factor, N_S: 7.00

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

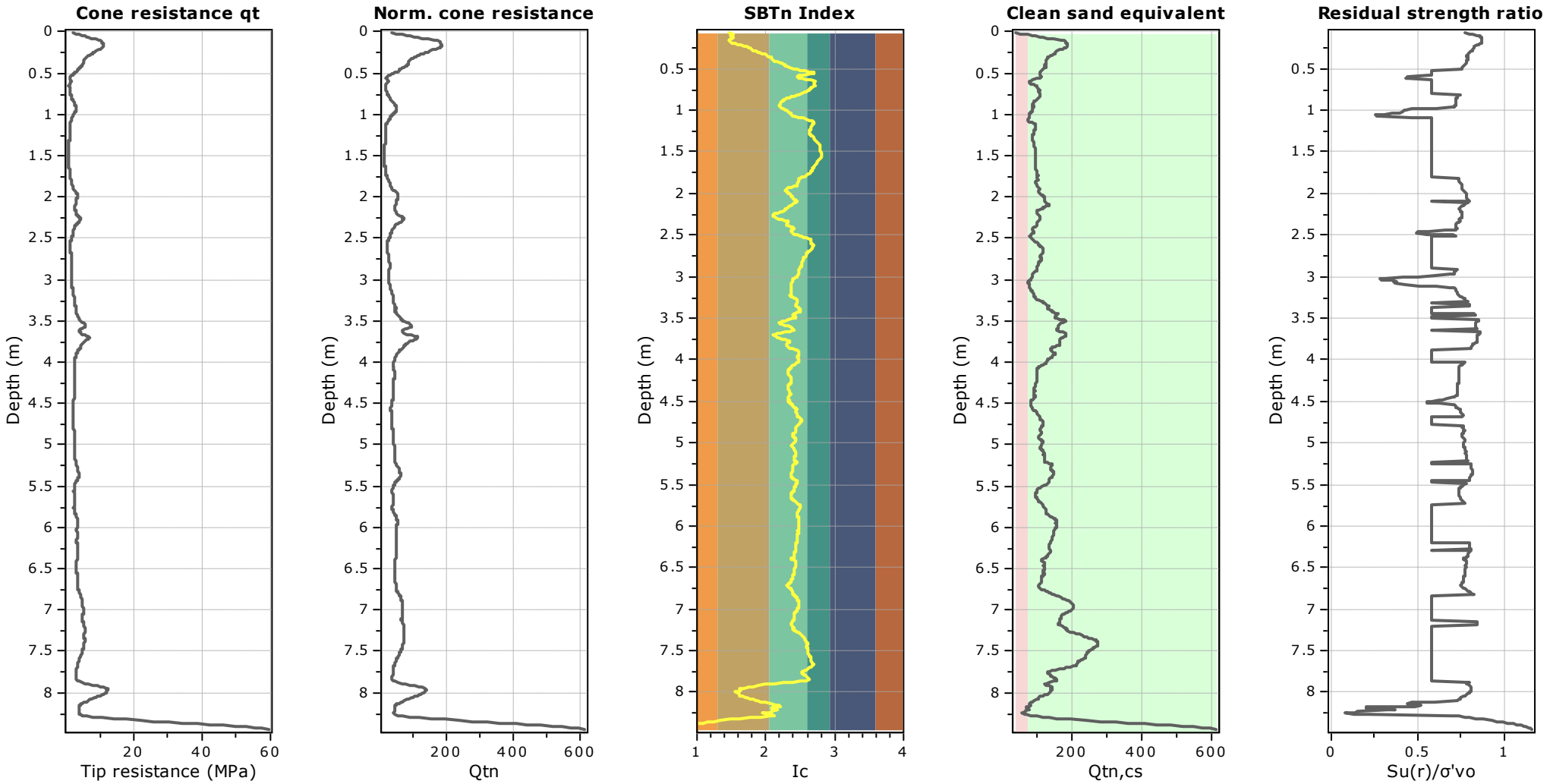
CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

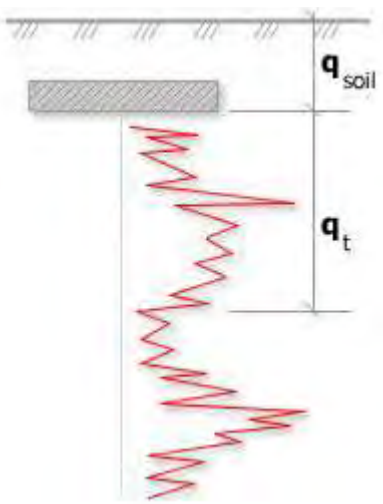
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

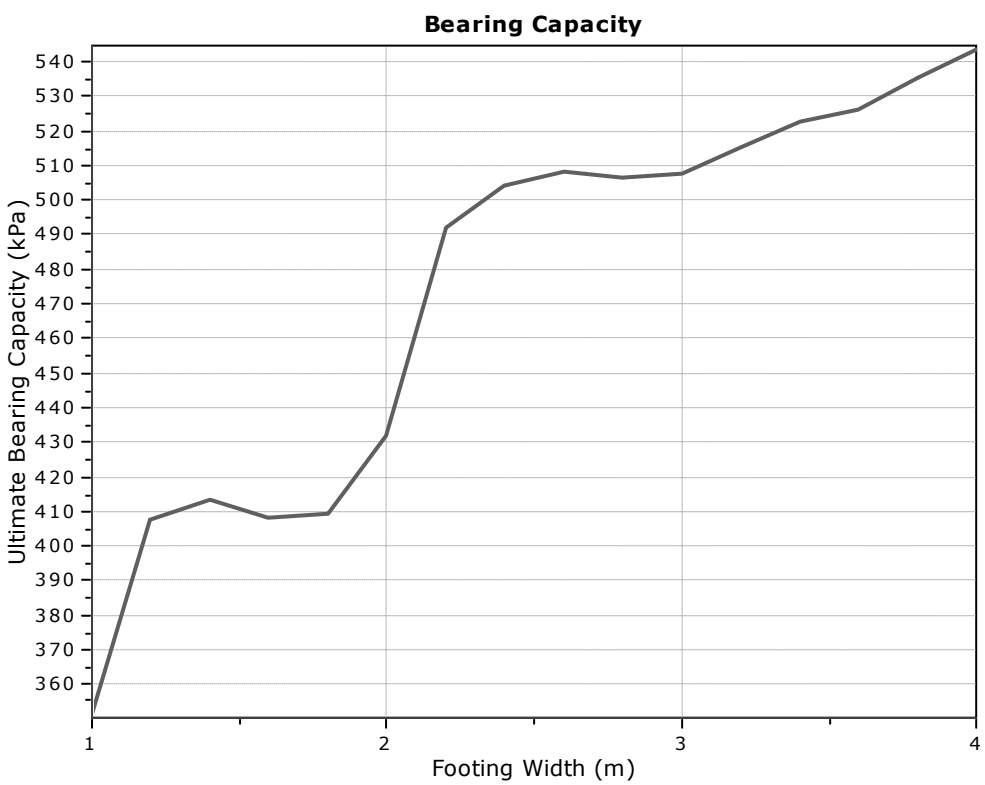
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



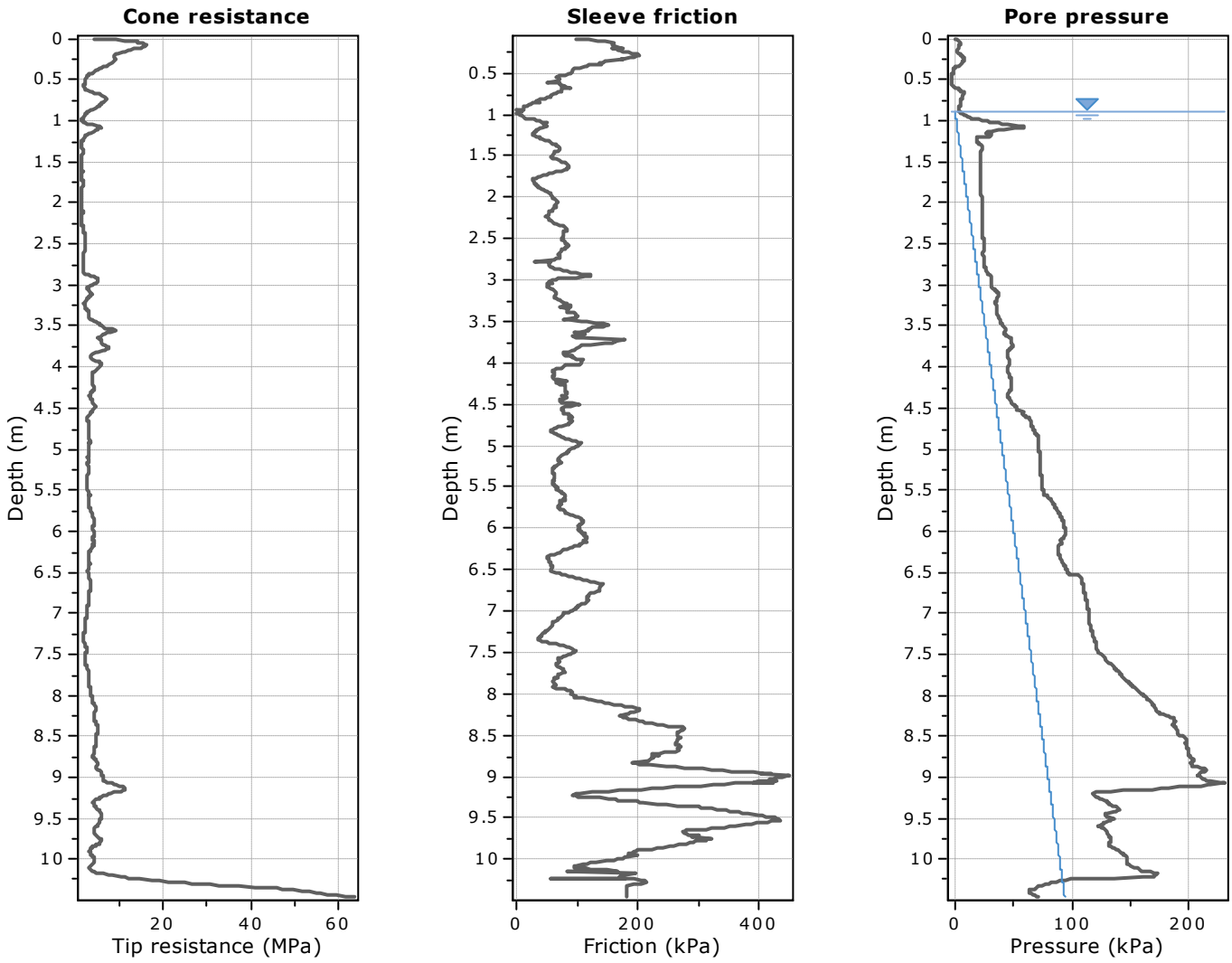
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	1.71	0.20	9.50	351.53
2	1.20	0.50	2.30	1.99	0.20	9.50	407.32
3	1.40	0.50	2.60	2.02	0.20	9.50	413.66
4	1.60	0.50	2.90	1.99	0.20	9.50	407.98
5	1.80	0.50	3.20	2.00	0.20	9.50	409.05
6	2.00	0.50	3.50	2.11	0.20	9.50	431.93
7	2.20	0.50	3.80	2.41	0.20	9.50	491.84
8	2.40	0.50	4.10	2.47	0.20	9.50	504.25
9	2.60	0.50	4.40	2.49	0.20	9.50	508.04
10	2.80	0.50	4.70	2.48	0.20	9.50	506.34
11	3.00	0.50	5.00	2.49	0.20	9.50	507.60
12	3.20	0.50	5.30	2.53	0.20	9.50	514.83
13	3.40	0.50	5.60	2.57	0.20	9.50	522.71
14	3.60	0.50	5.90	2.58	0.20	9.50	526.04
15	3.80	0.50	6.20	2.63	0.20	9.50	535.21
16	4.00	0.50	6.50	2.67	0.20	9.50	543.44

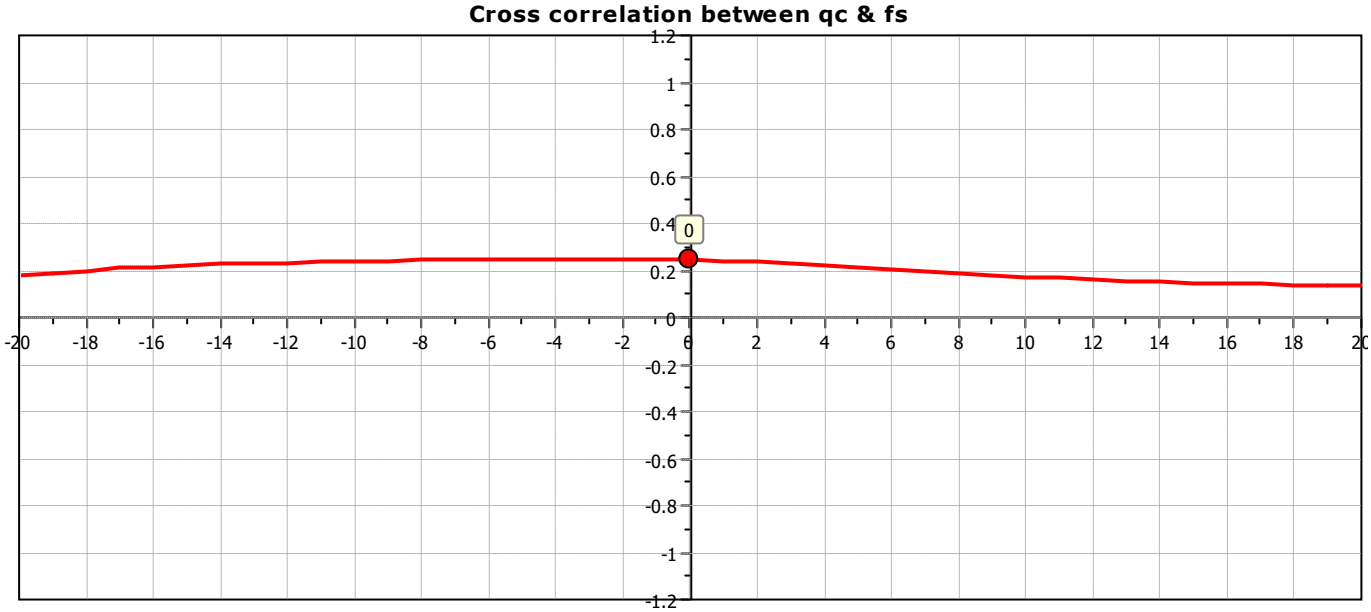
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

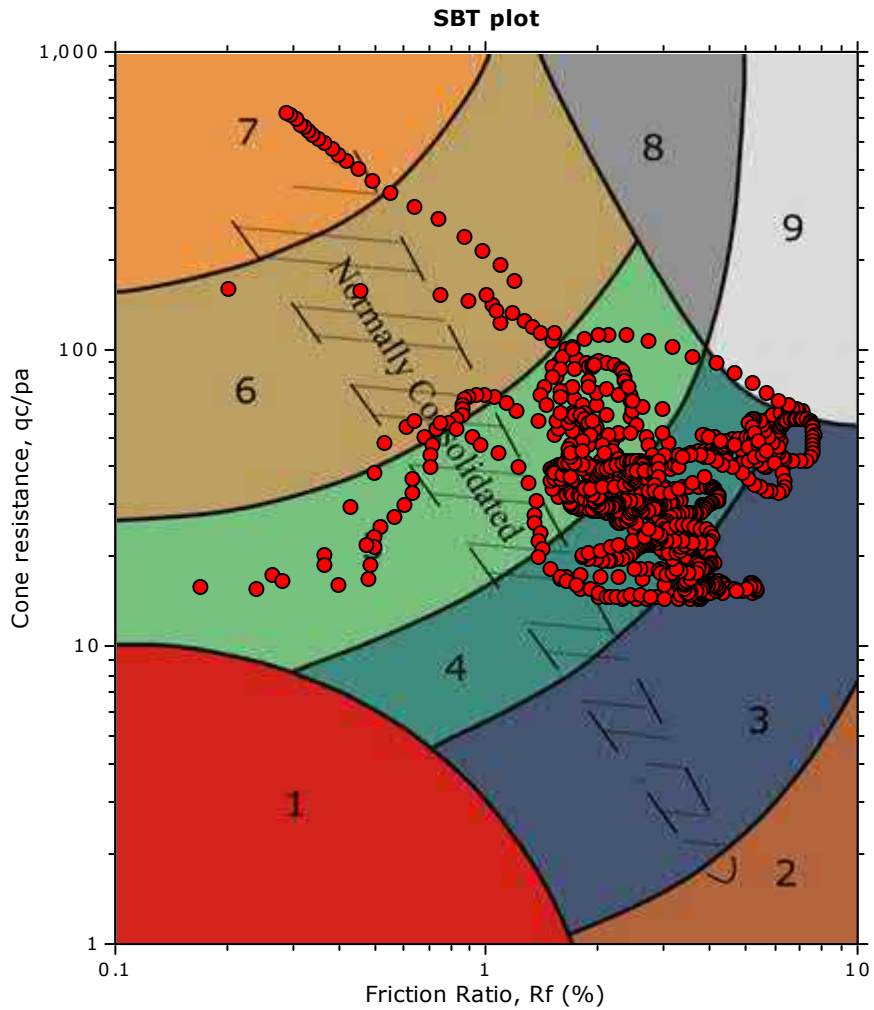


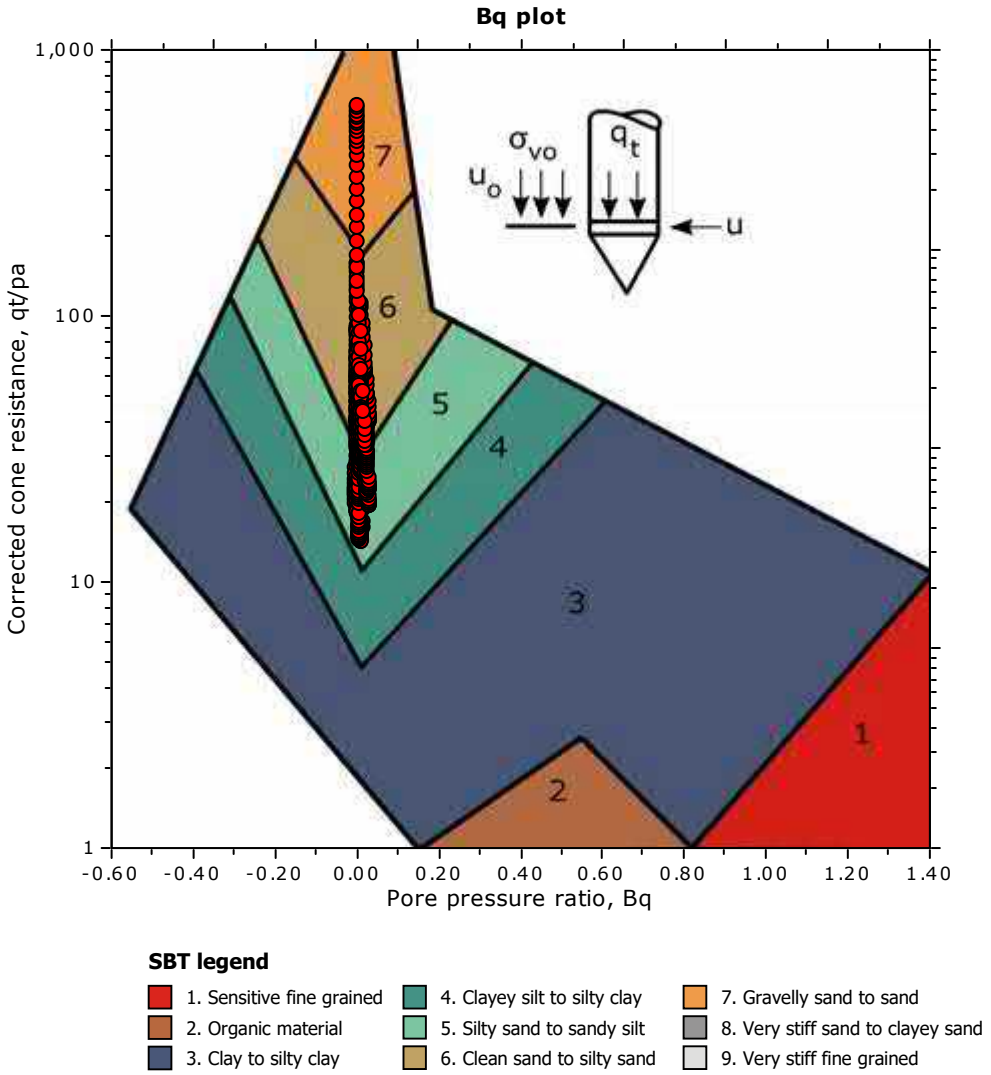
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots





SBT legend

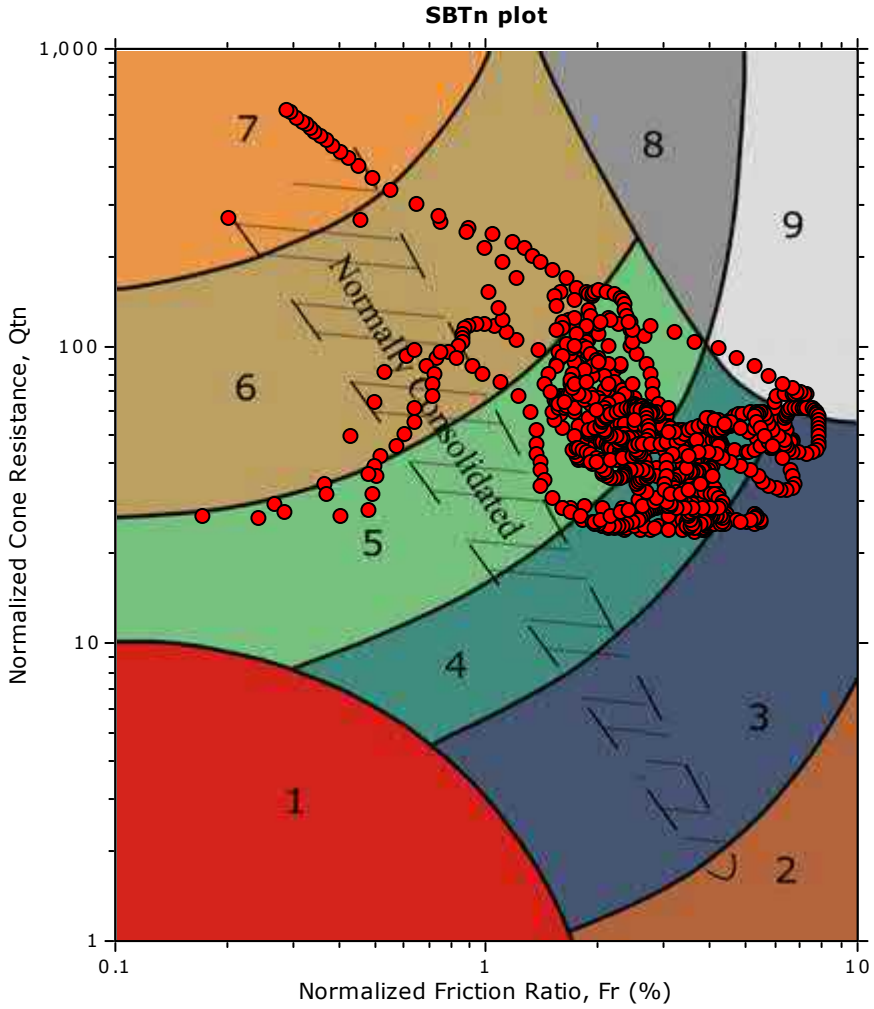
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

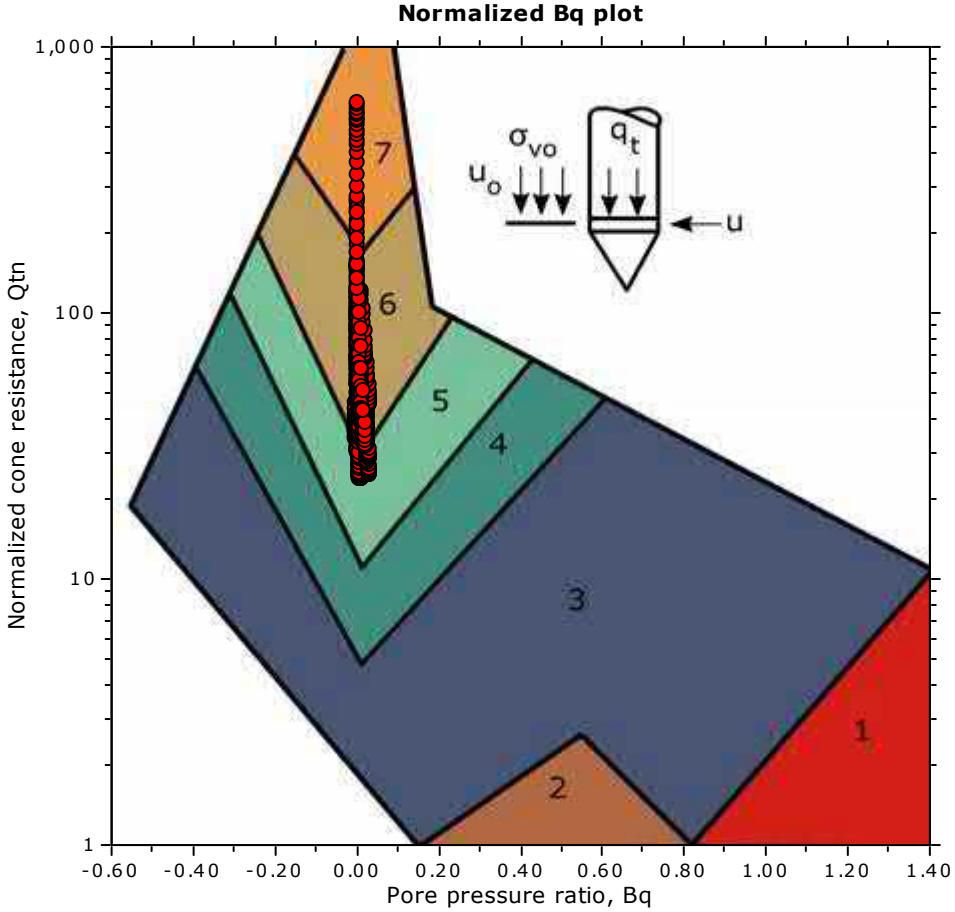
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots (normalized)





SBTn legend

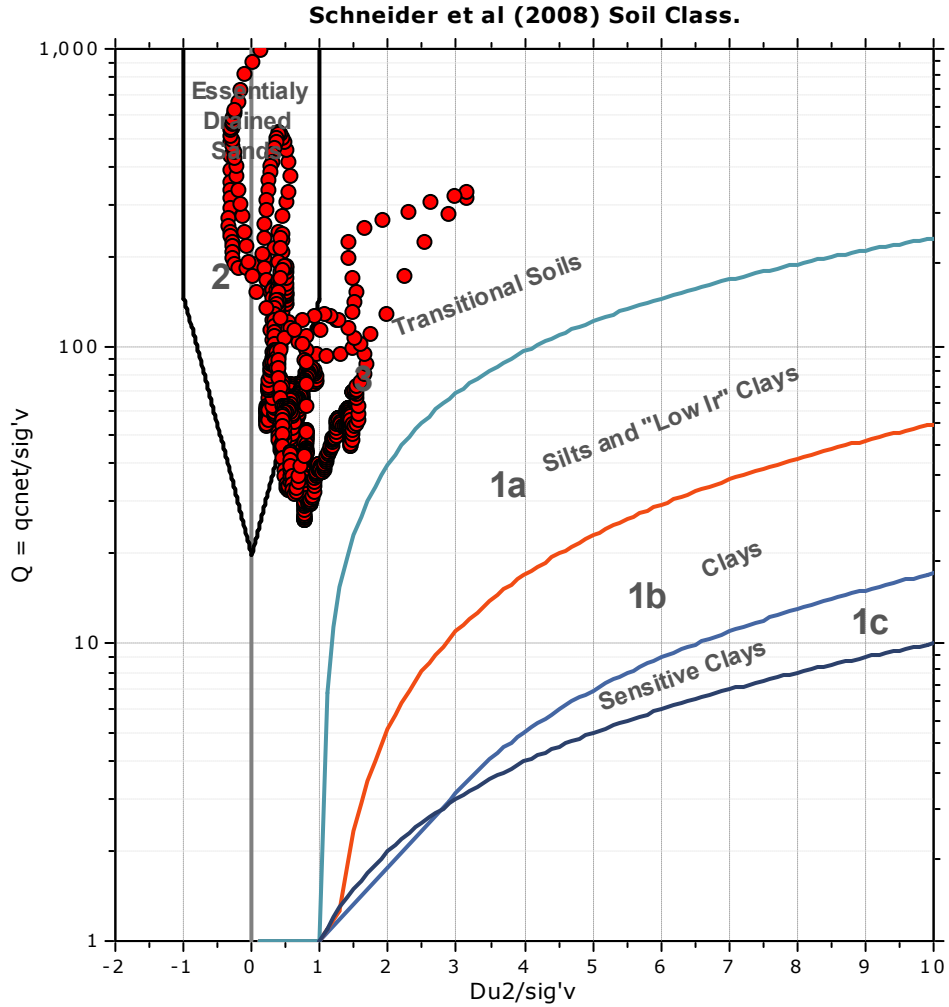
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

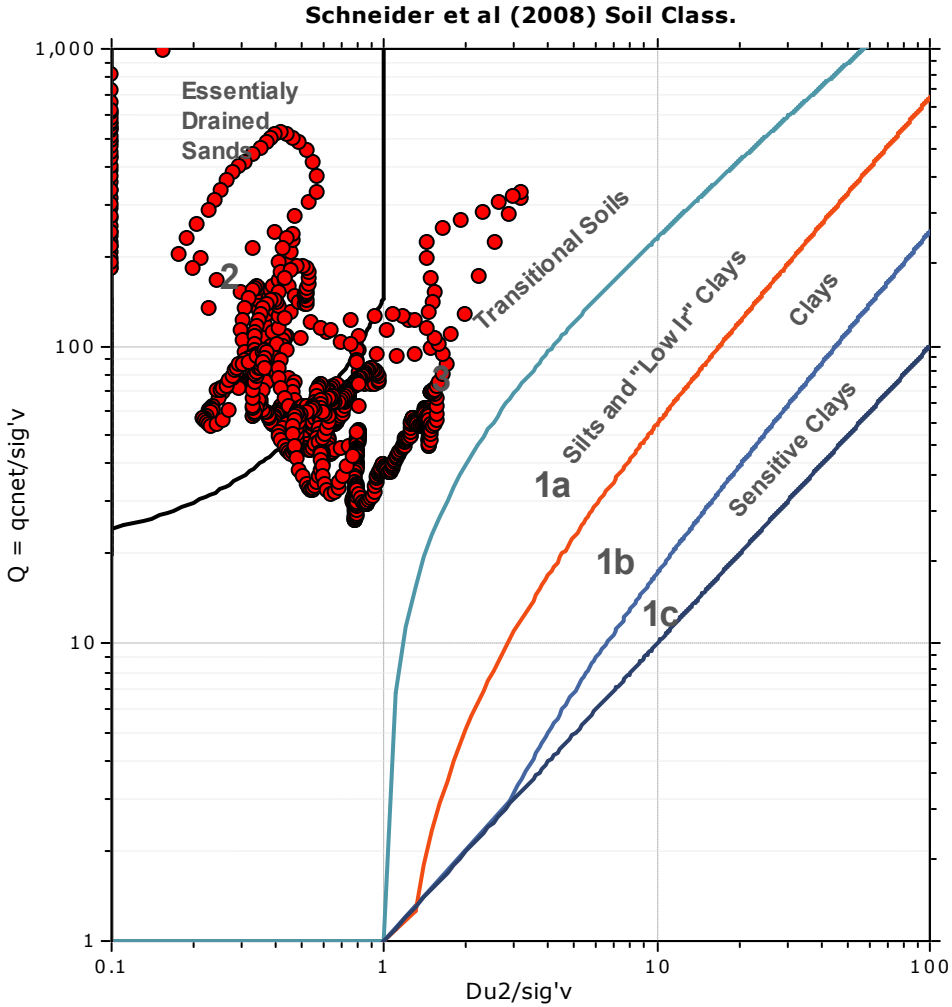
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Bq plots (Schneider)

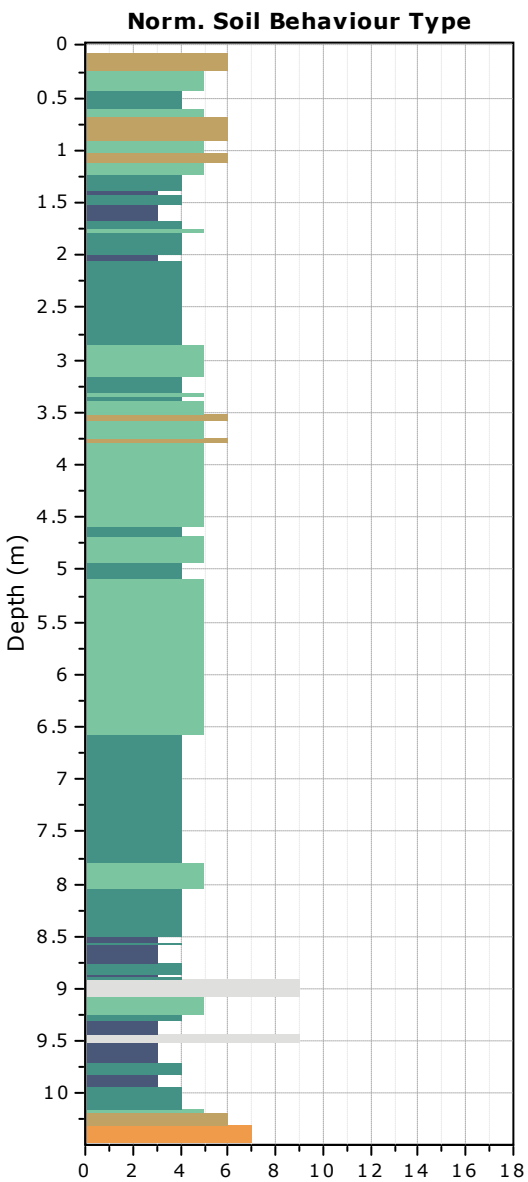


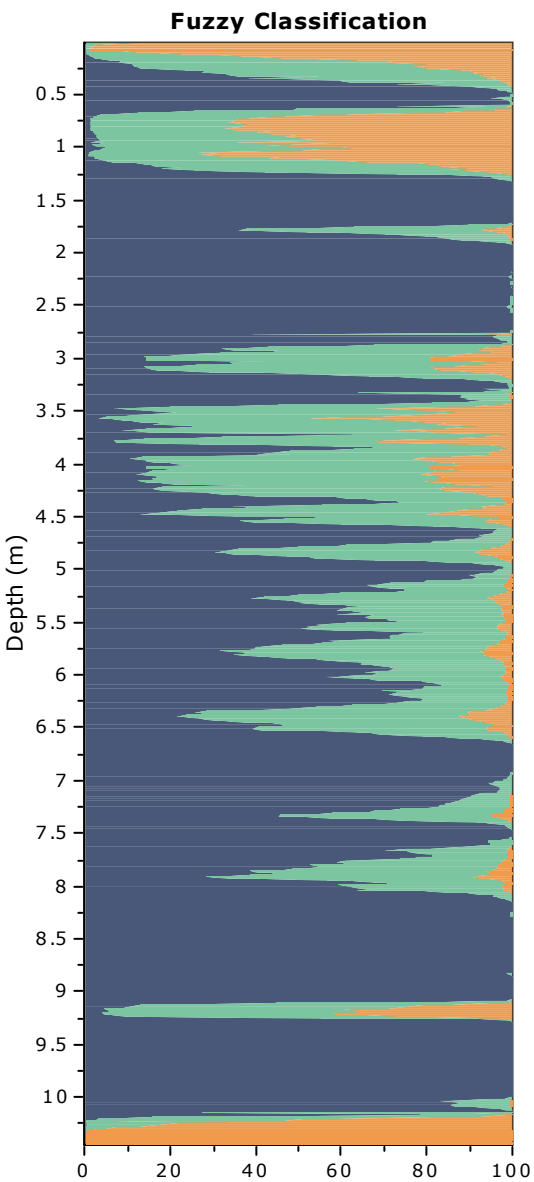


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



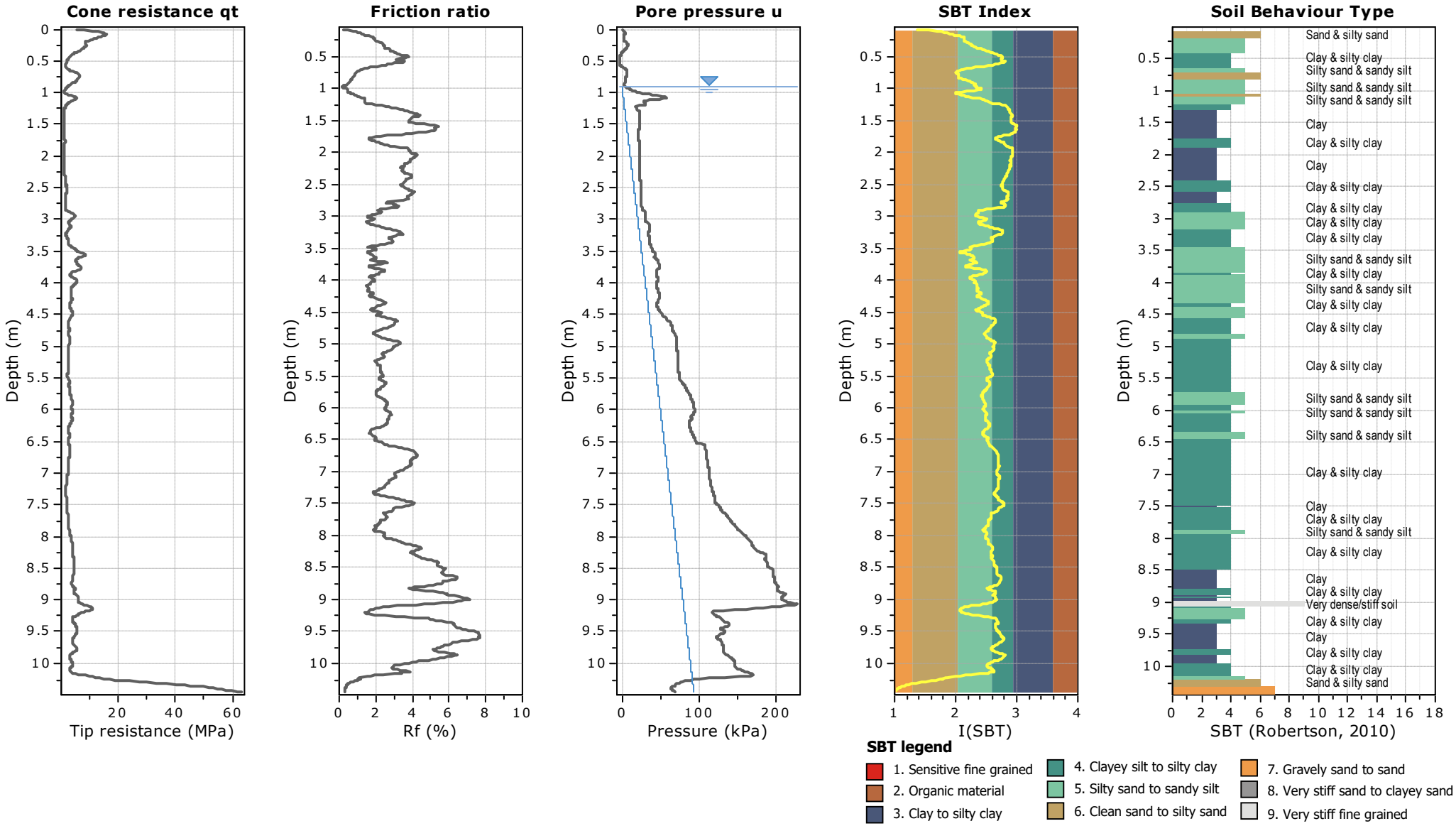


Fuzzy classifiaction legend
- Highly probable clayey soil
- Highly probable mixture soil
- Highly probable sandy soil

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

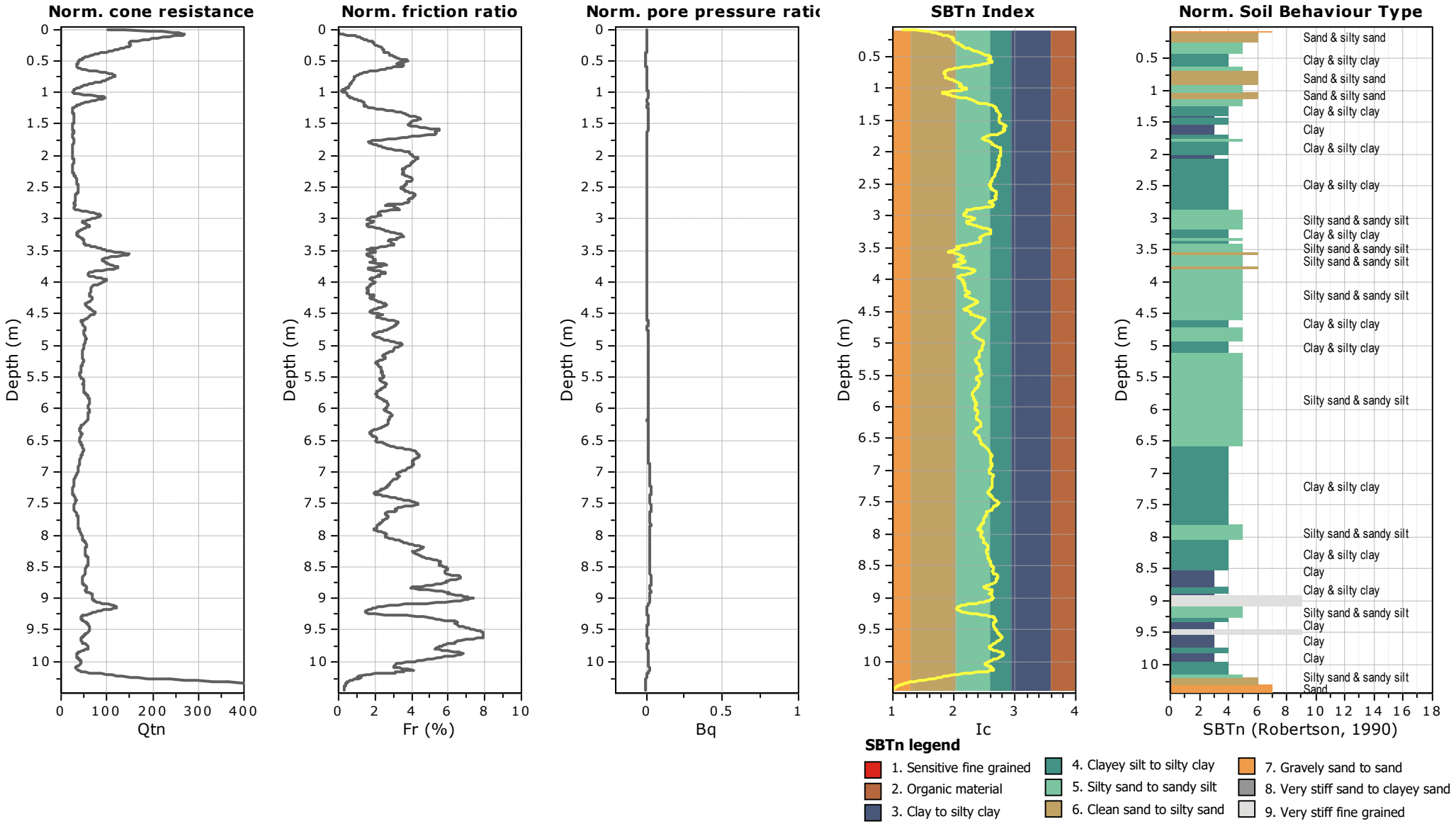
CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

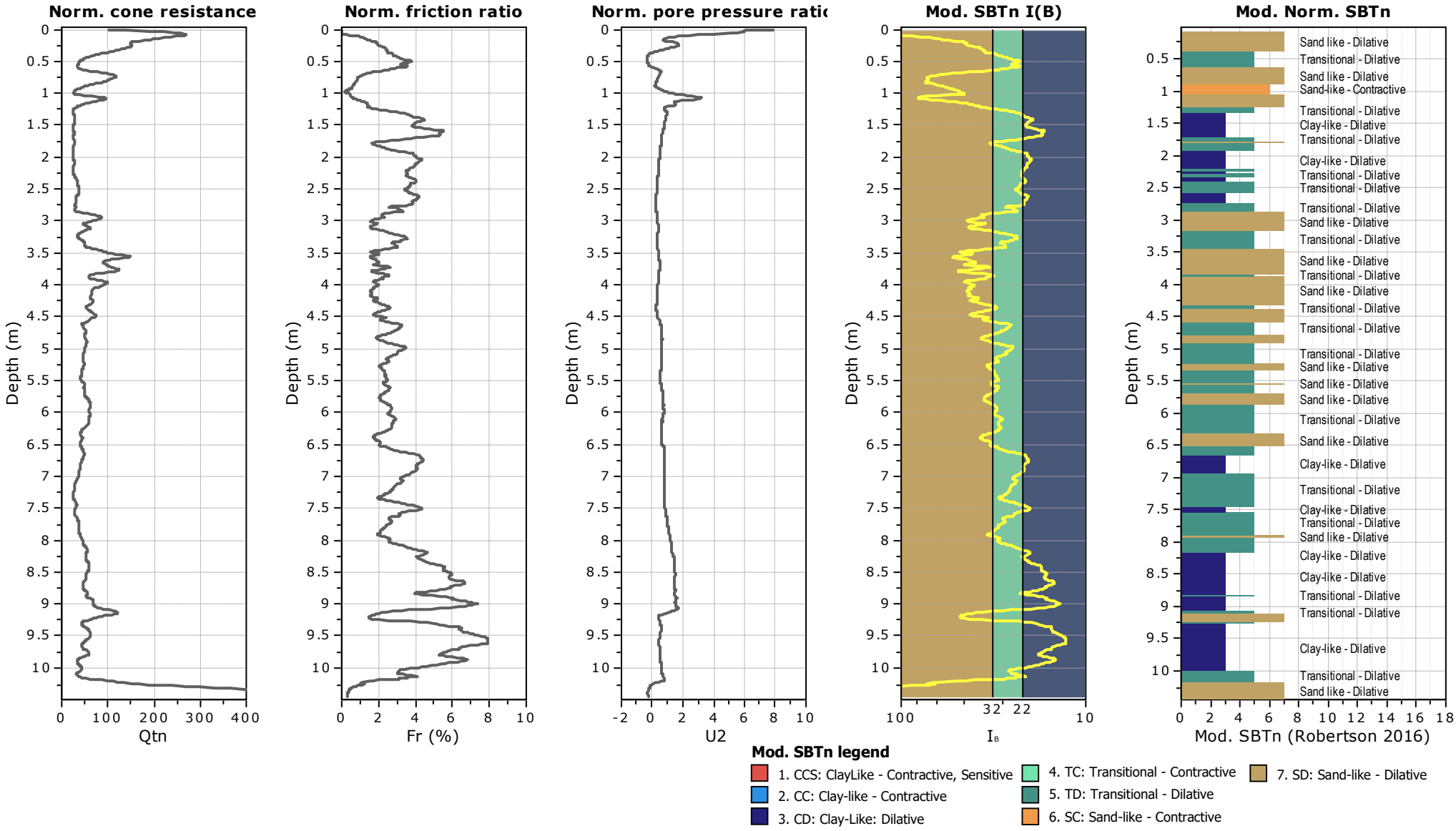
CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

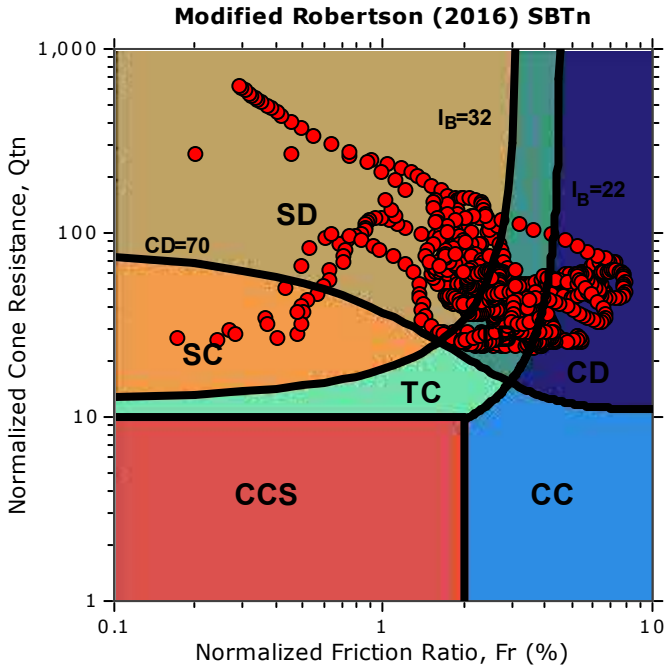


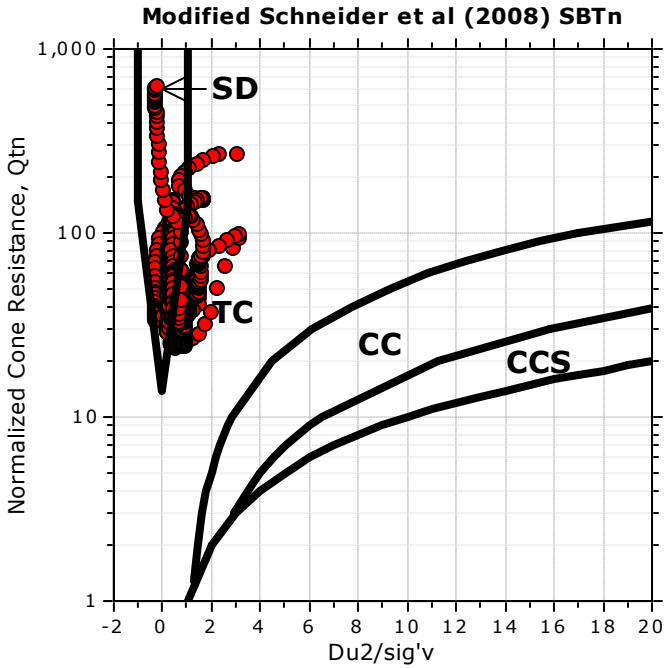
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

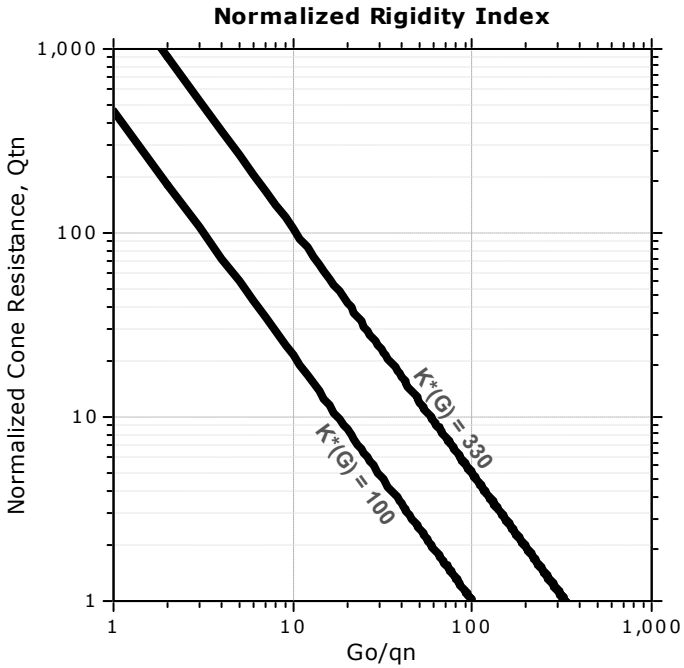
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Updated SBTn plots







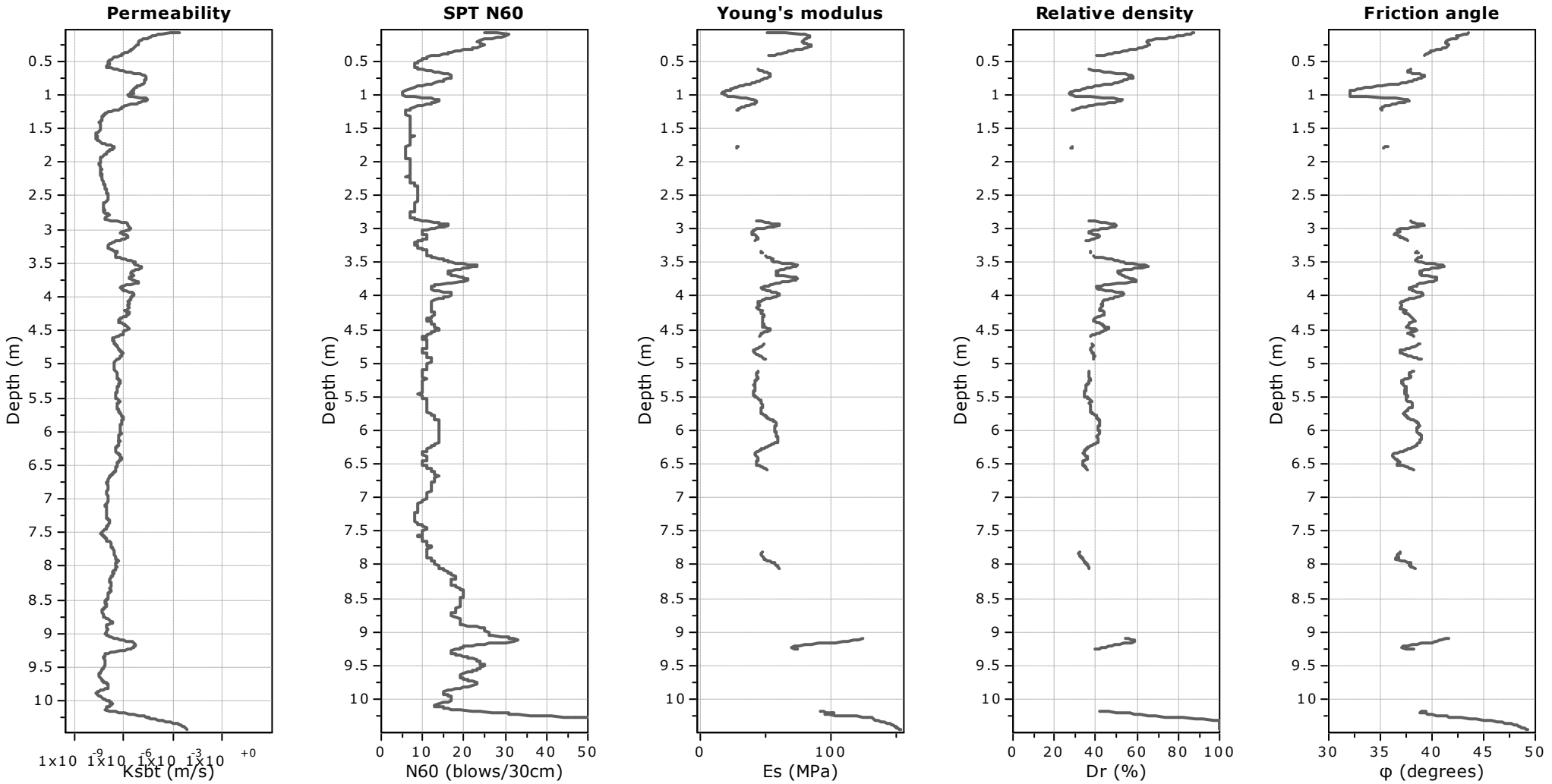
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



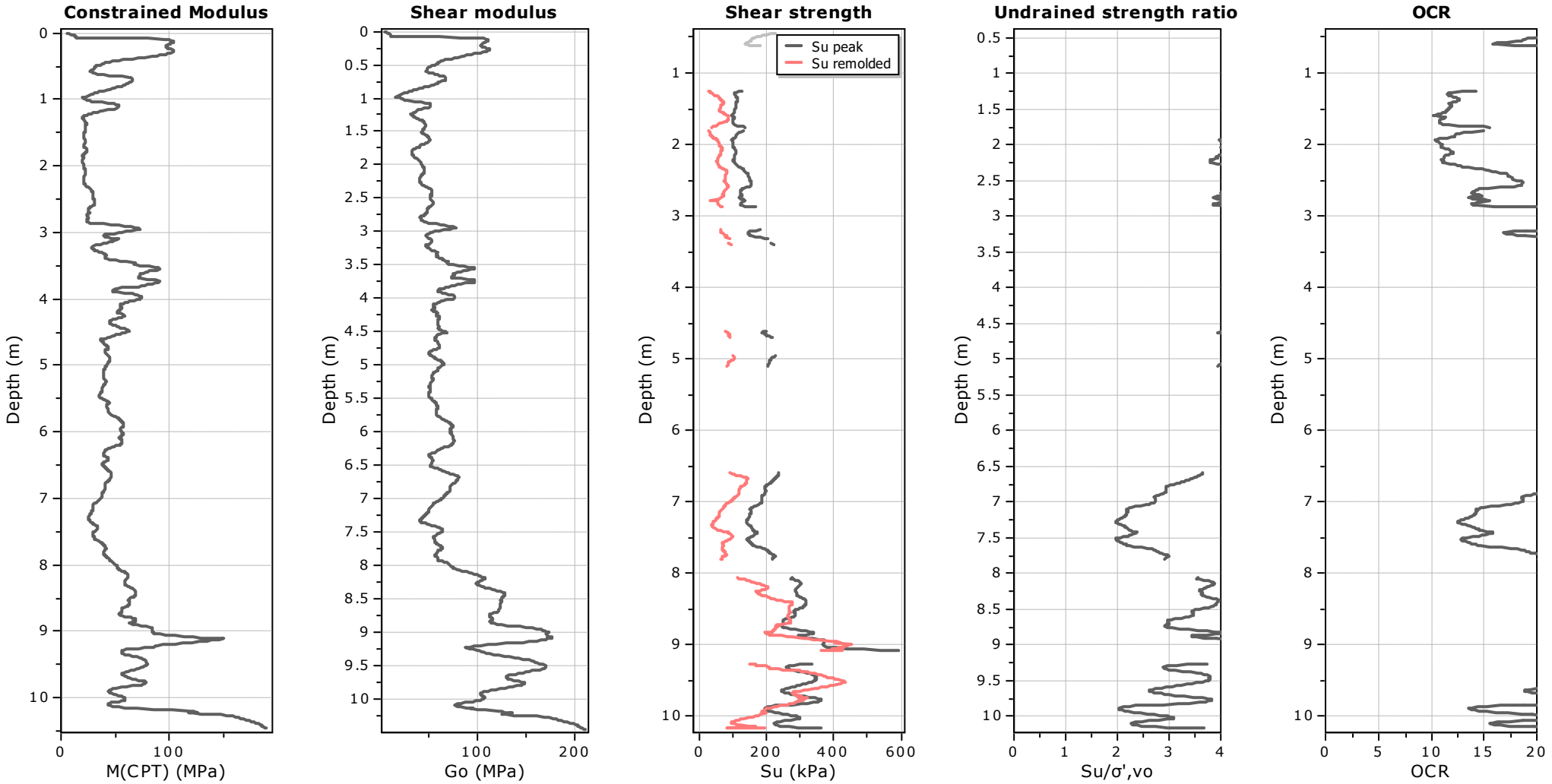
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



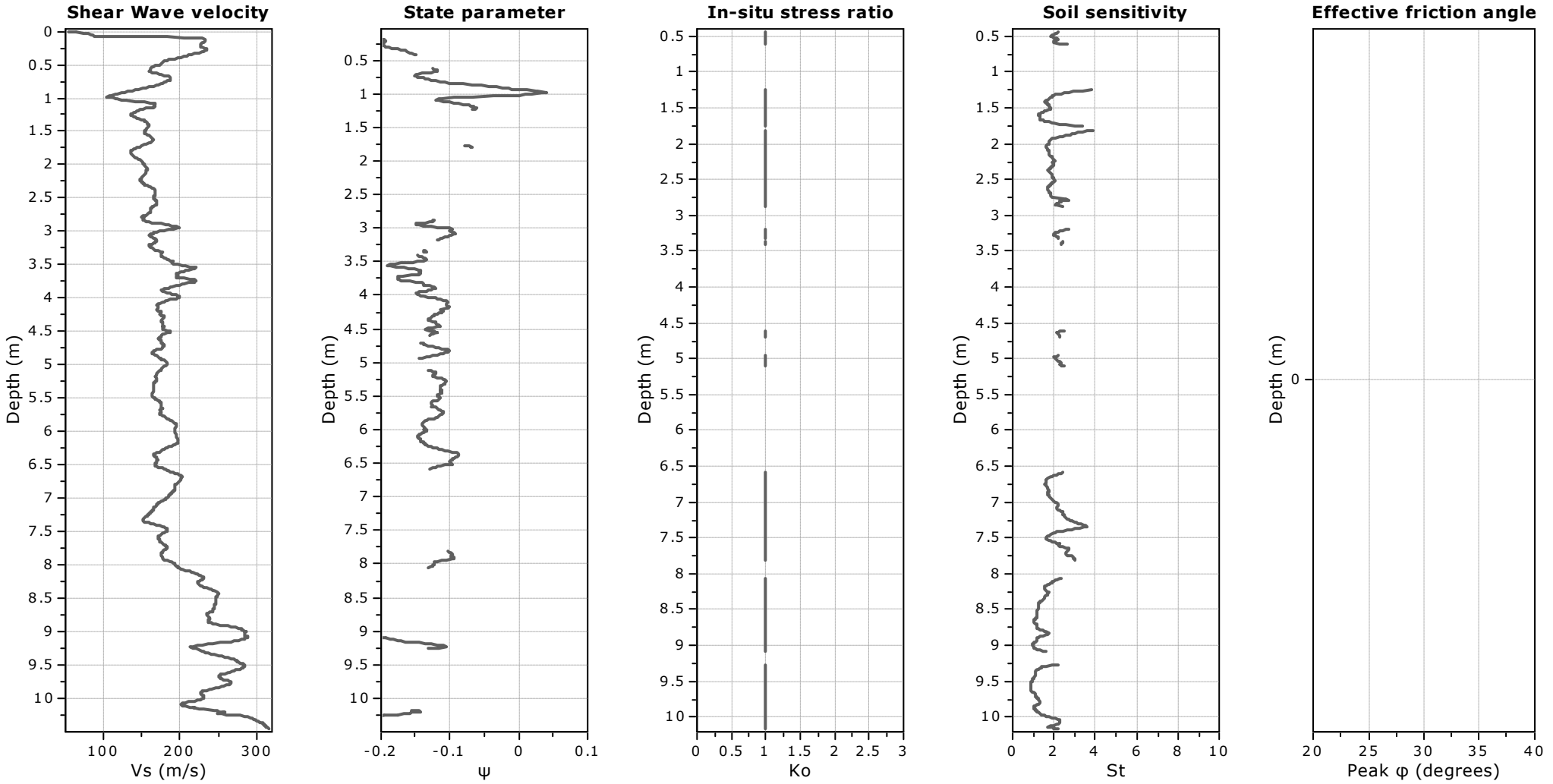
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto
OCR factor for clays, N_{kt}: Auto
Flat Dilatometer Test data

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



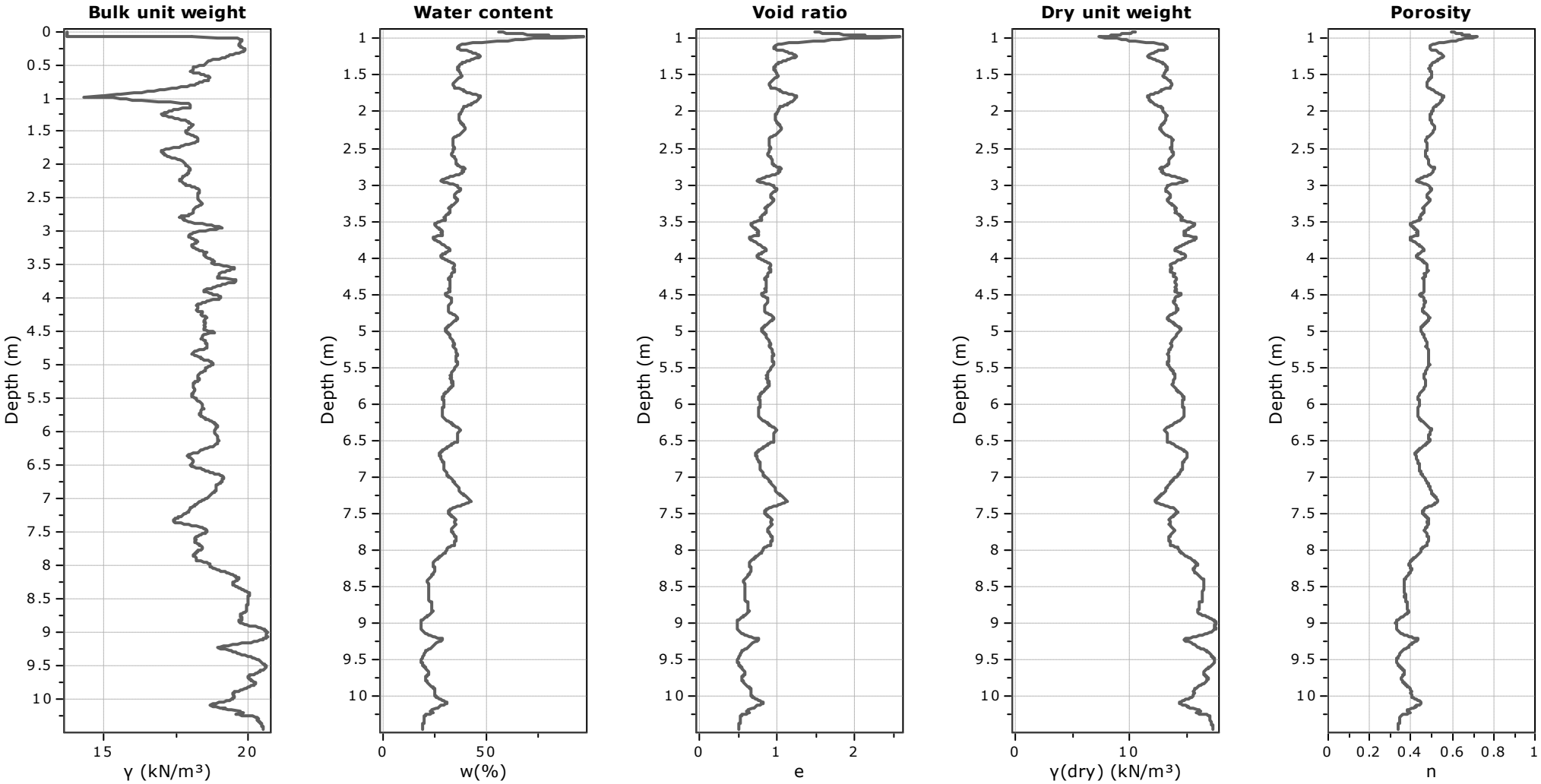
Calculation parameters

Soil Sensitivity factor, N_S: 7.00

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

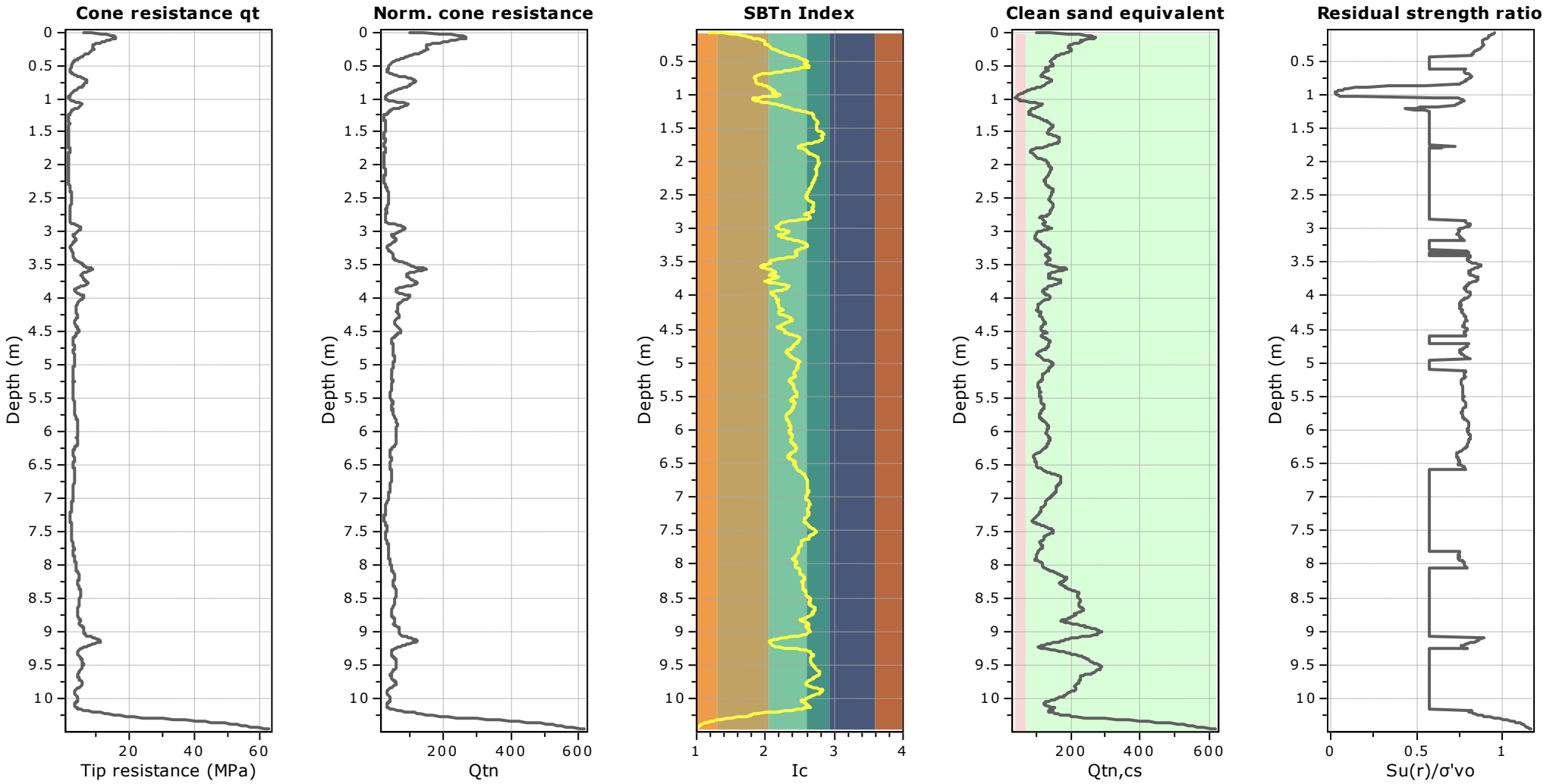
CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

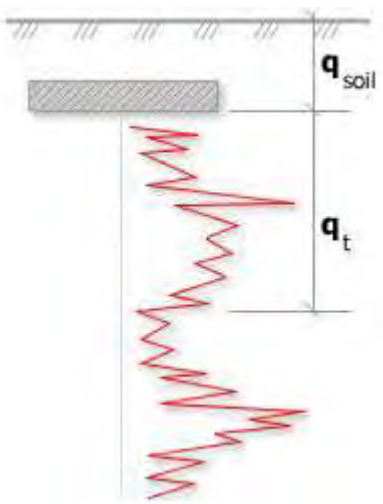
CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

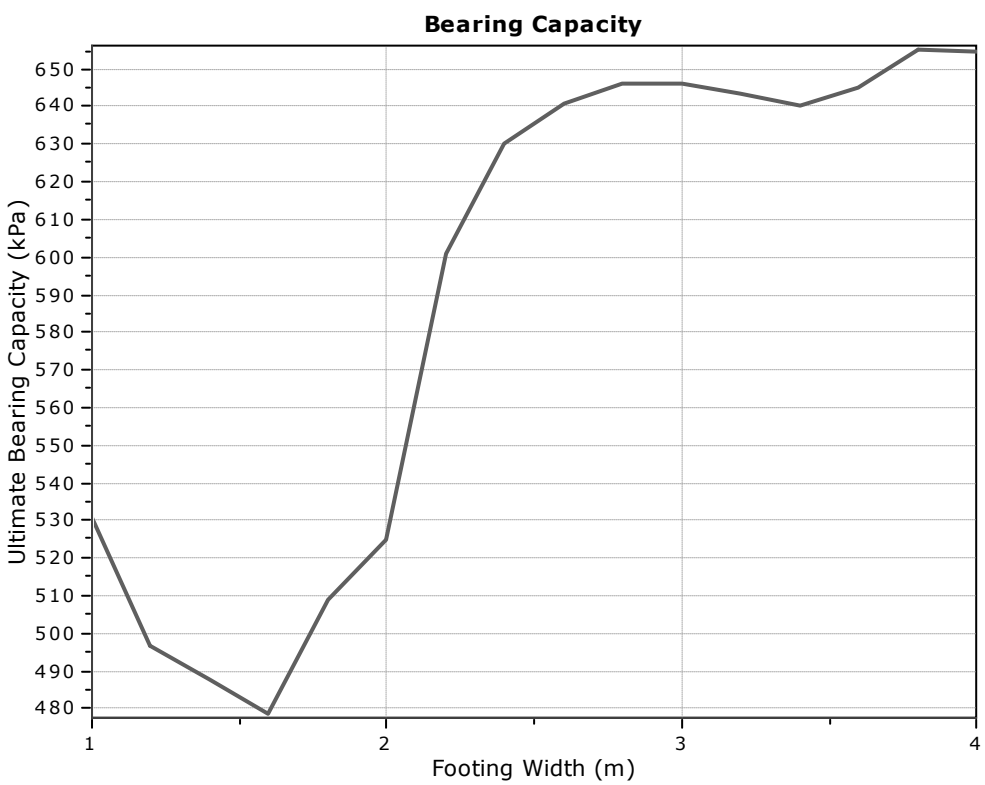
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



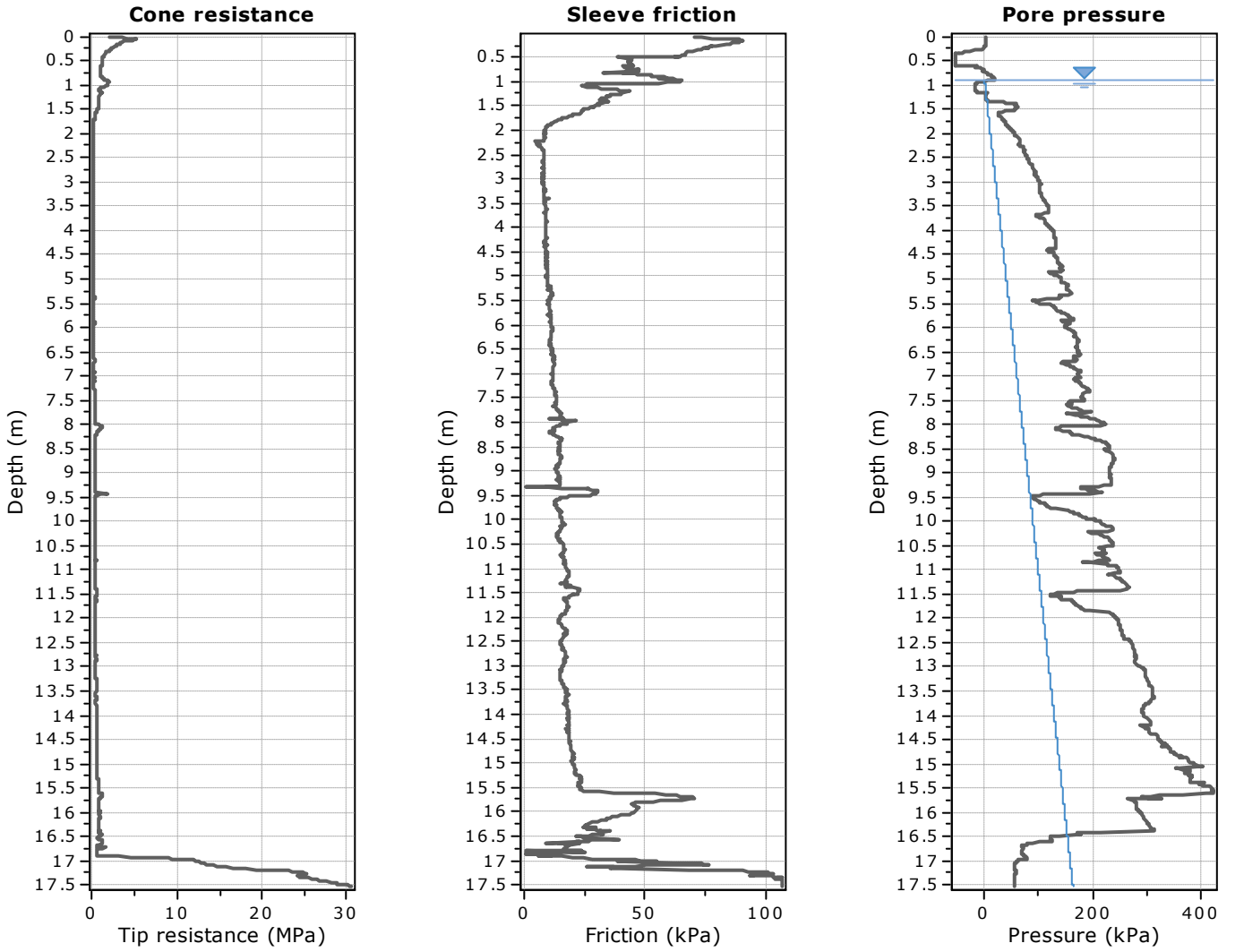
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	2.61	0.20	9.50	530.98
2	1.20	0.50	2.30	2.44	0.20	9.50	496.71
3	1.40	0.50	2.60	2.39	0.20	9.50	487.89
4	1.60	0.50	2.90	2.35	0.20	9.50	478.67
5	1.80	0.50	3.20	2.50	0.20	9.50	509.18
6	2.00	0.50	3.50	2.58	0.20	9.50	524.67
7	2.20	0.50	3.80	2.96	0.20	9.50	601.01
8	2.40	0.50	4.10	3.10	0.20	9.50	630.03
9	2.60	0.50	4.40	3.16	0.20	9.50	640.51
10	2.80	0.50	4.70	3.18	0.20	9.50	646.35
11	3.00	0.50	5.00	3.18	0.20	9.50	646.30
12	3.20	0.50	5.30	3.17	0.20	9.50	643.65
13	3.40	0.50	5.60	3.15	0.20	9.50	640.18
14	3.60	0.50	5.90	3.18	0.20	9.50	645.17
15	3.80	0.50	6.20	3.23	0.20	9.50	655.12
16	4.00	0.50	6.50	3.22	0.20	9.50	654.44

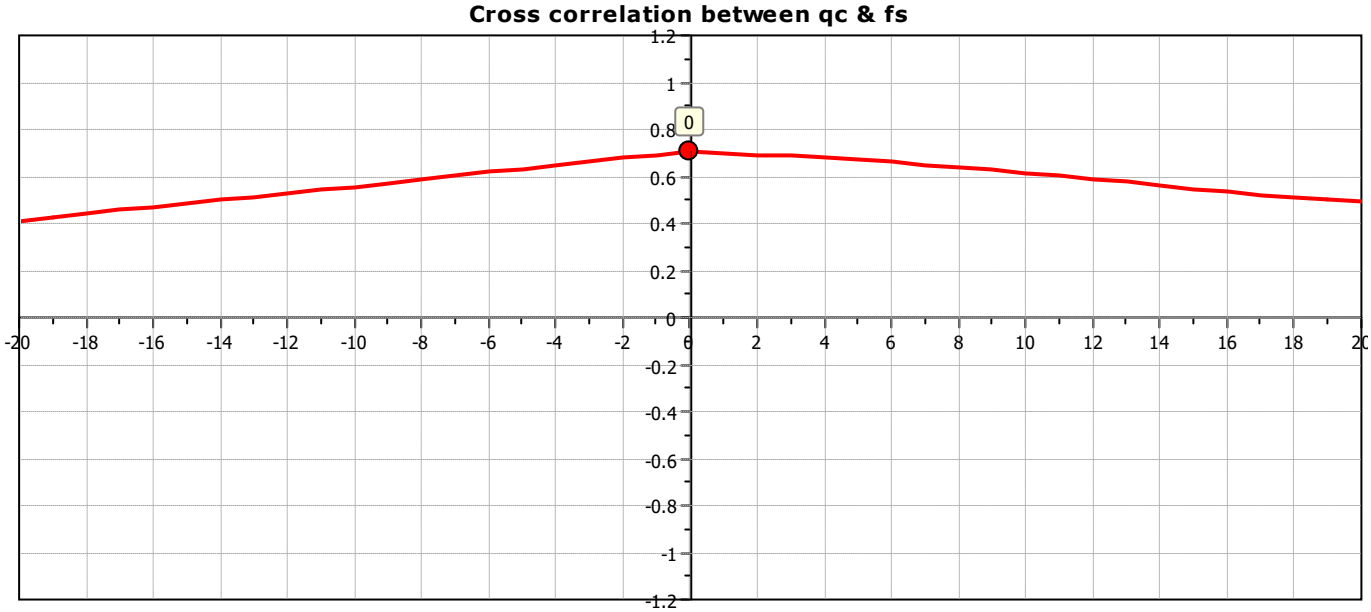
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

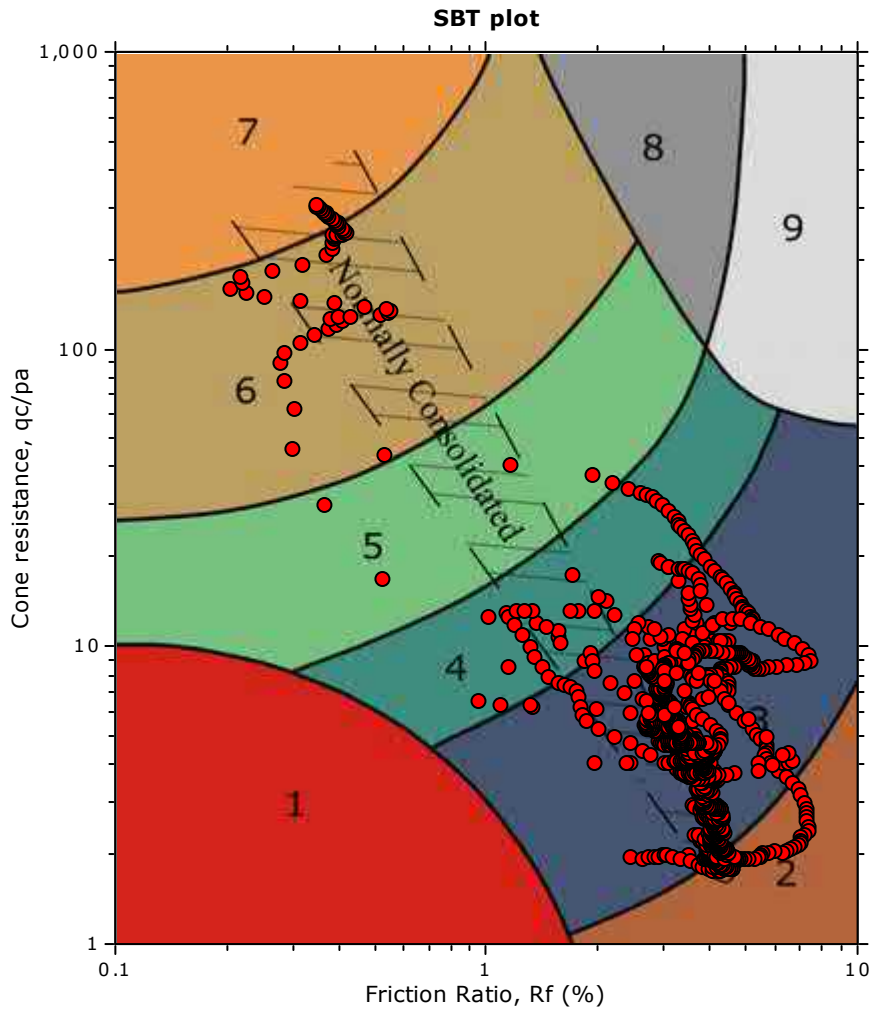


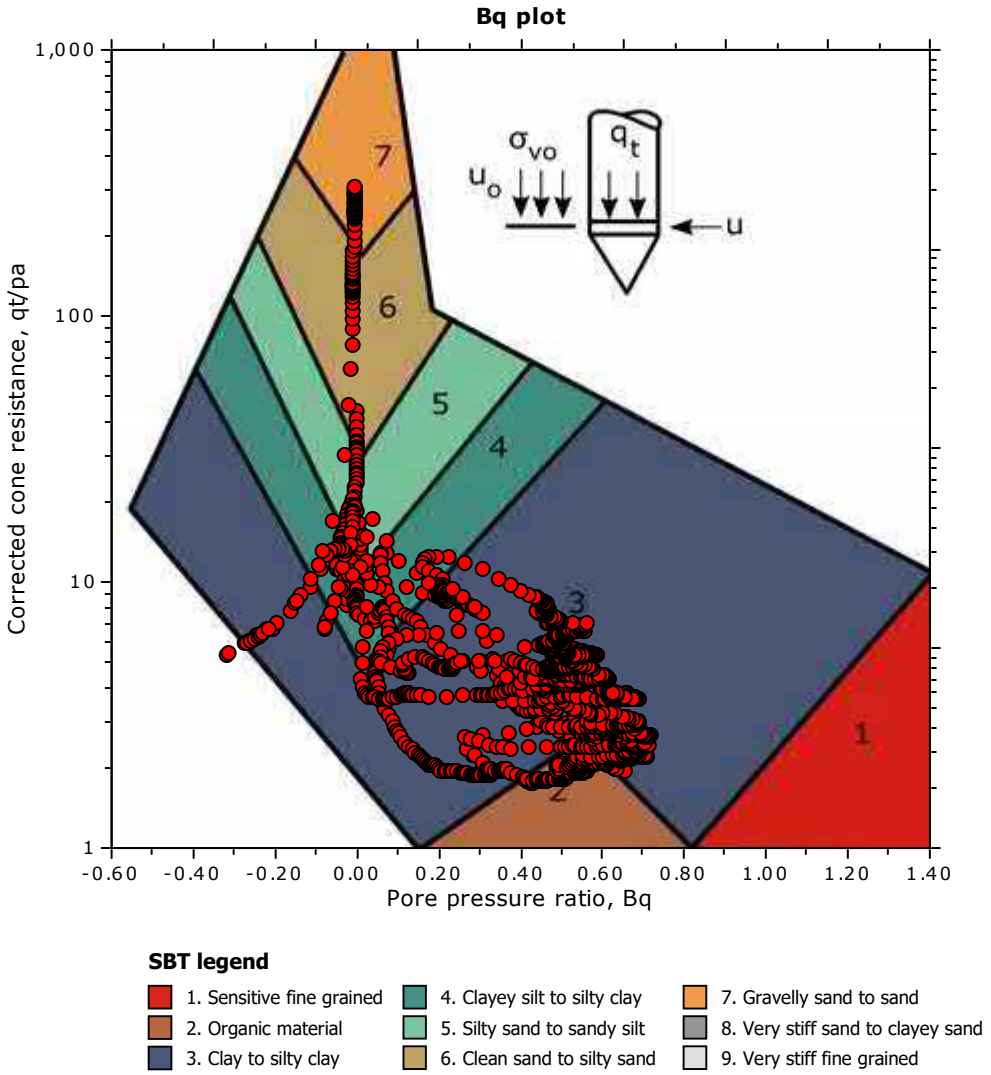
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots



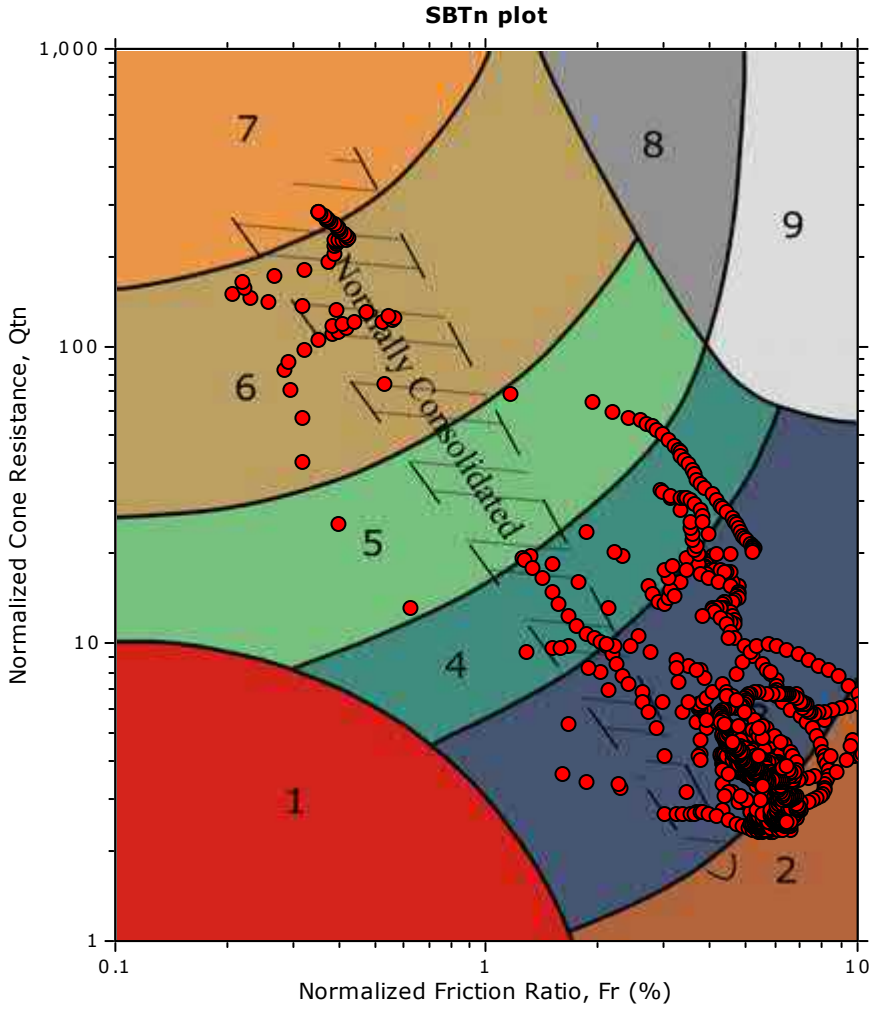


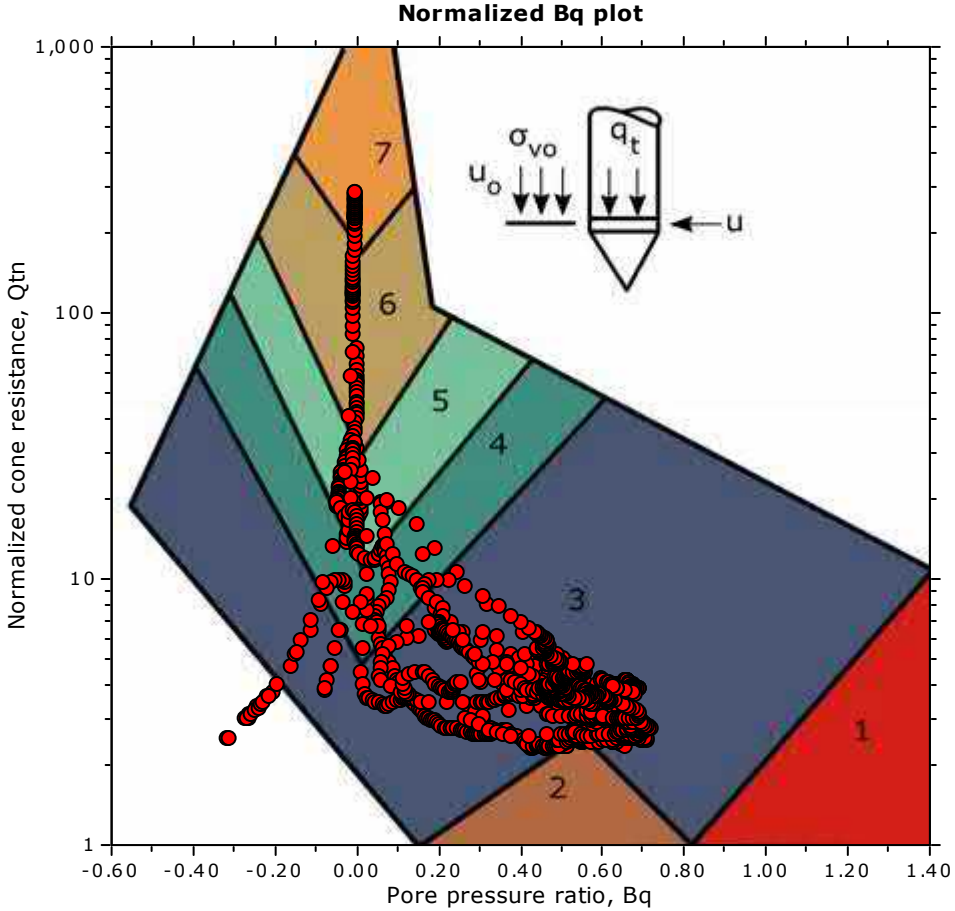
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots (normalized)





SBTn legend

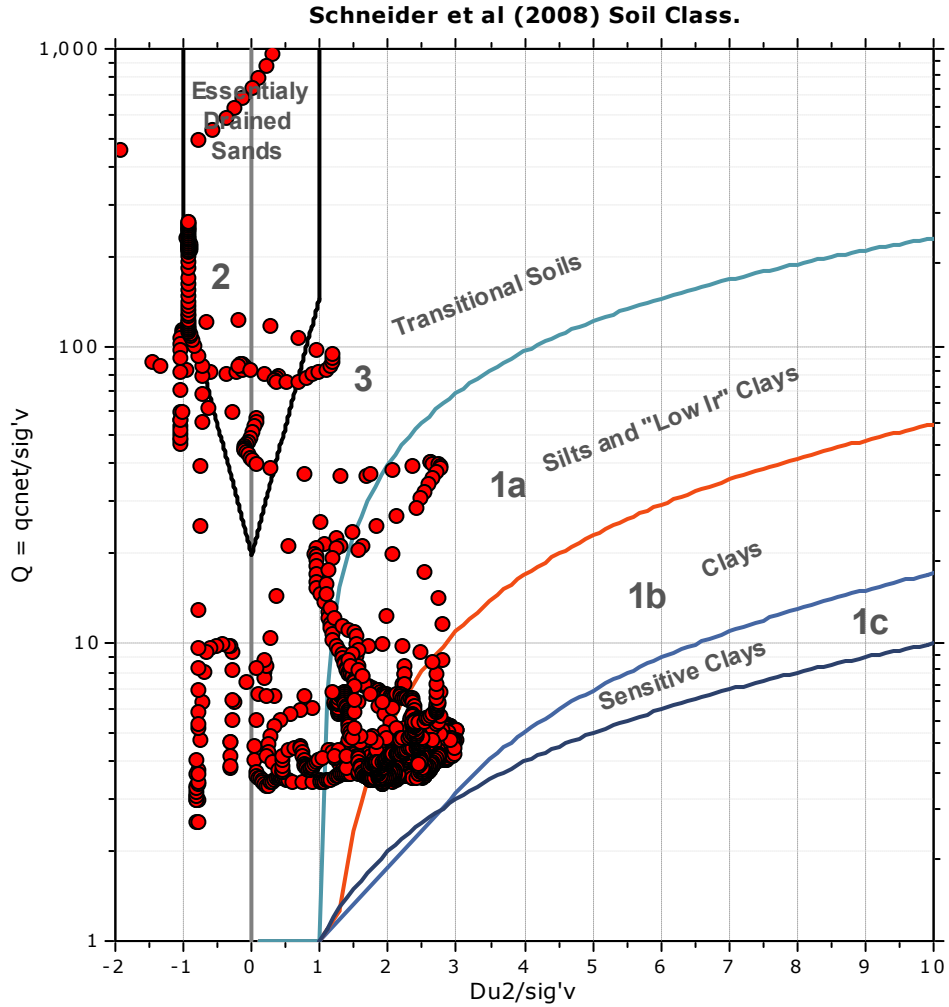
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

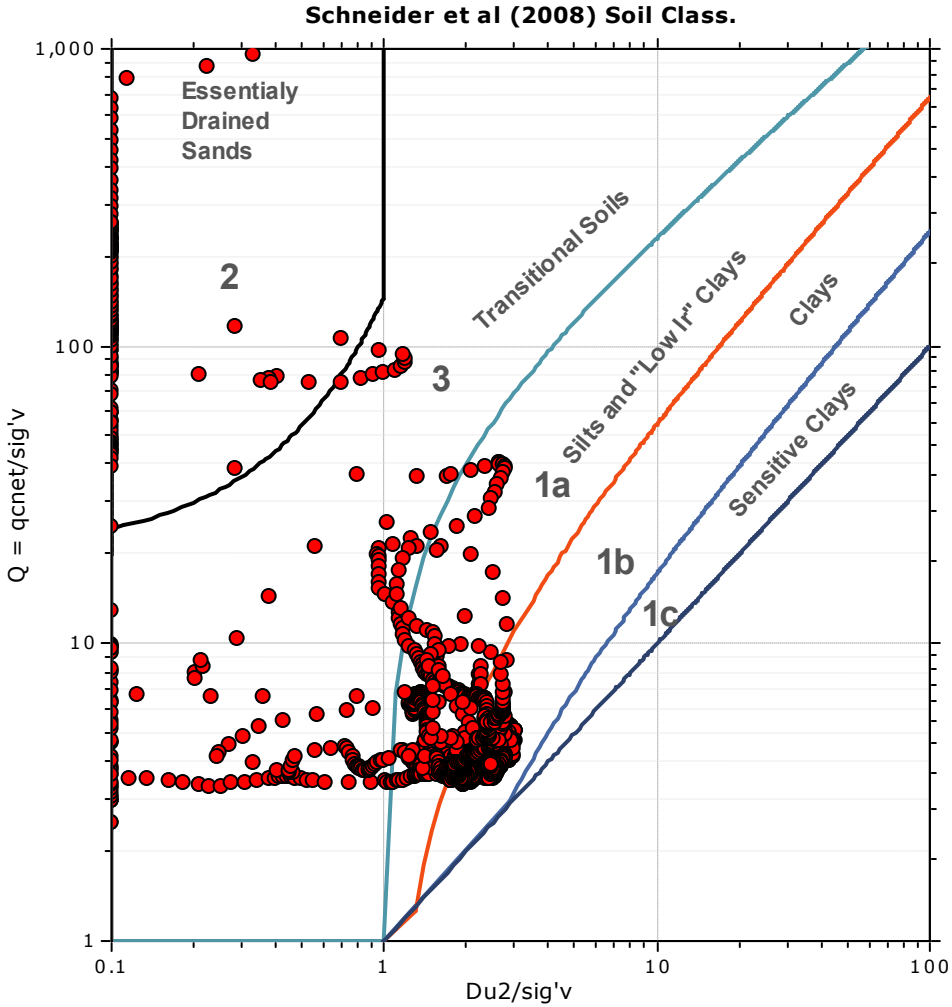
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Bq plots (Schneider)

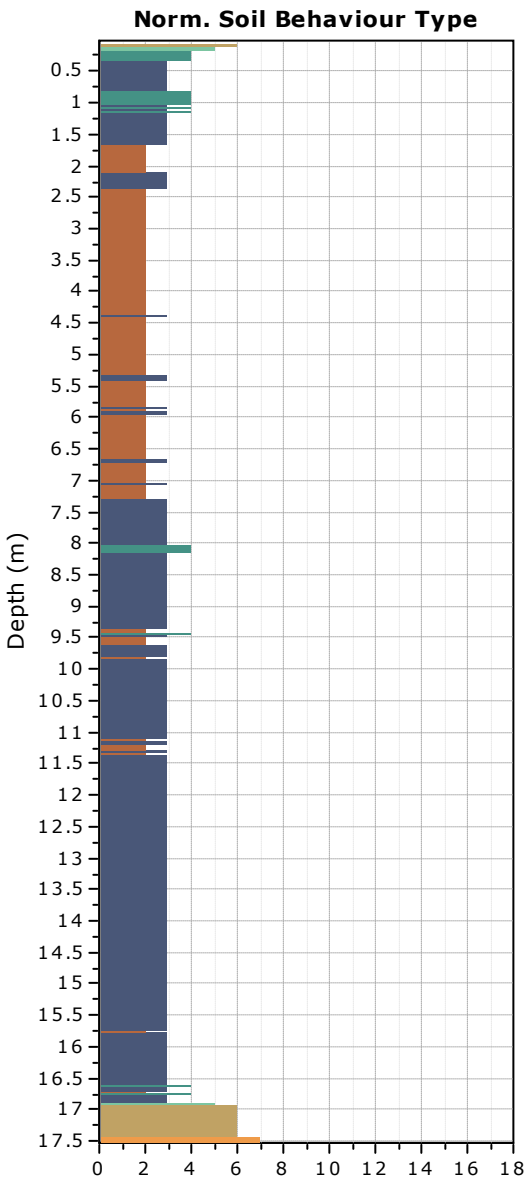


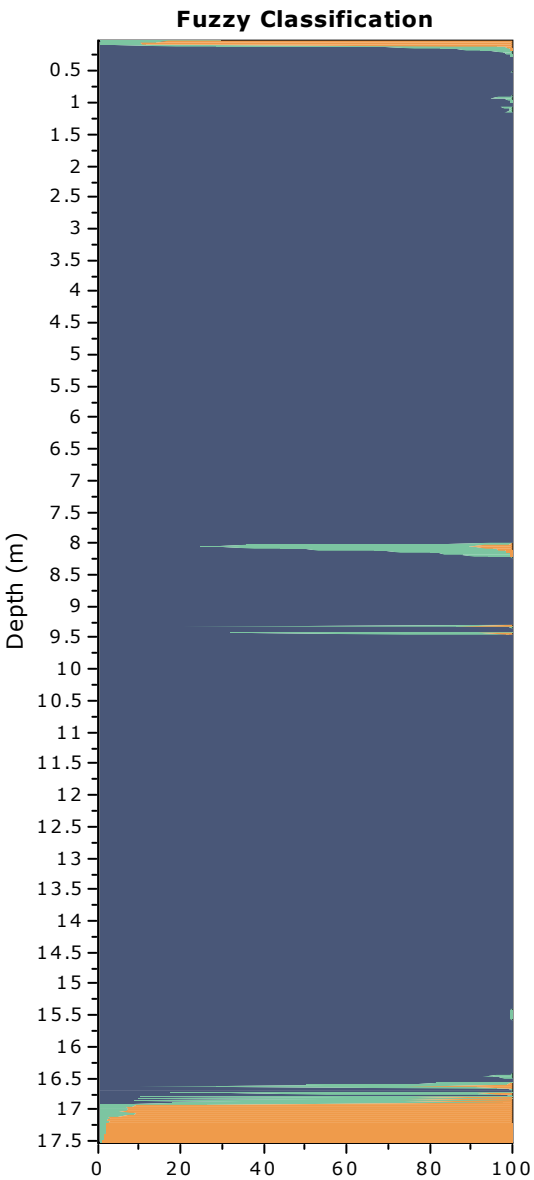


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



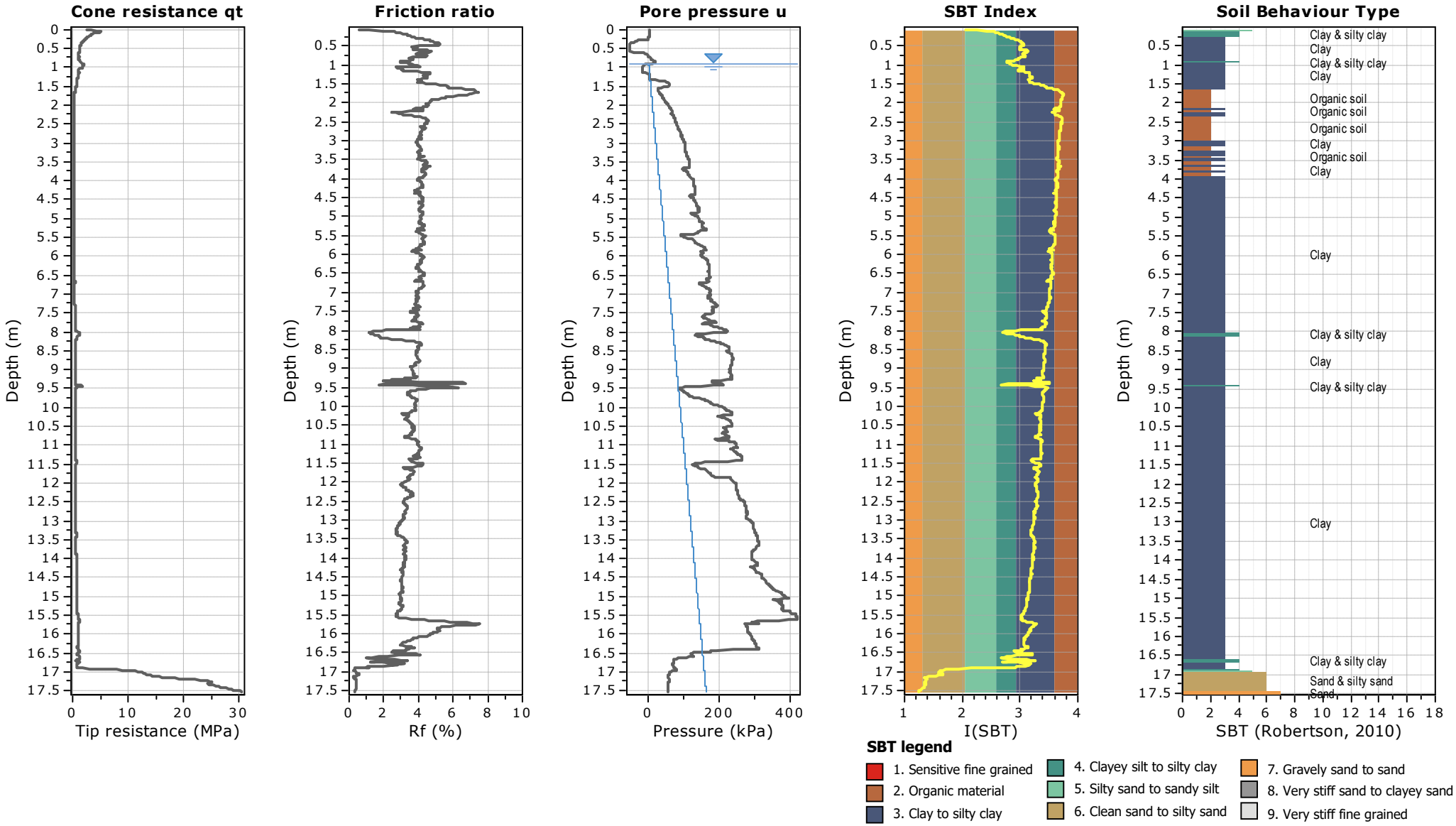


Fuzzy classifiaction legend
- Highly probable clayey soil
- Highly probable mixture soil
- Highly probable sandy soil

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

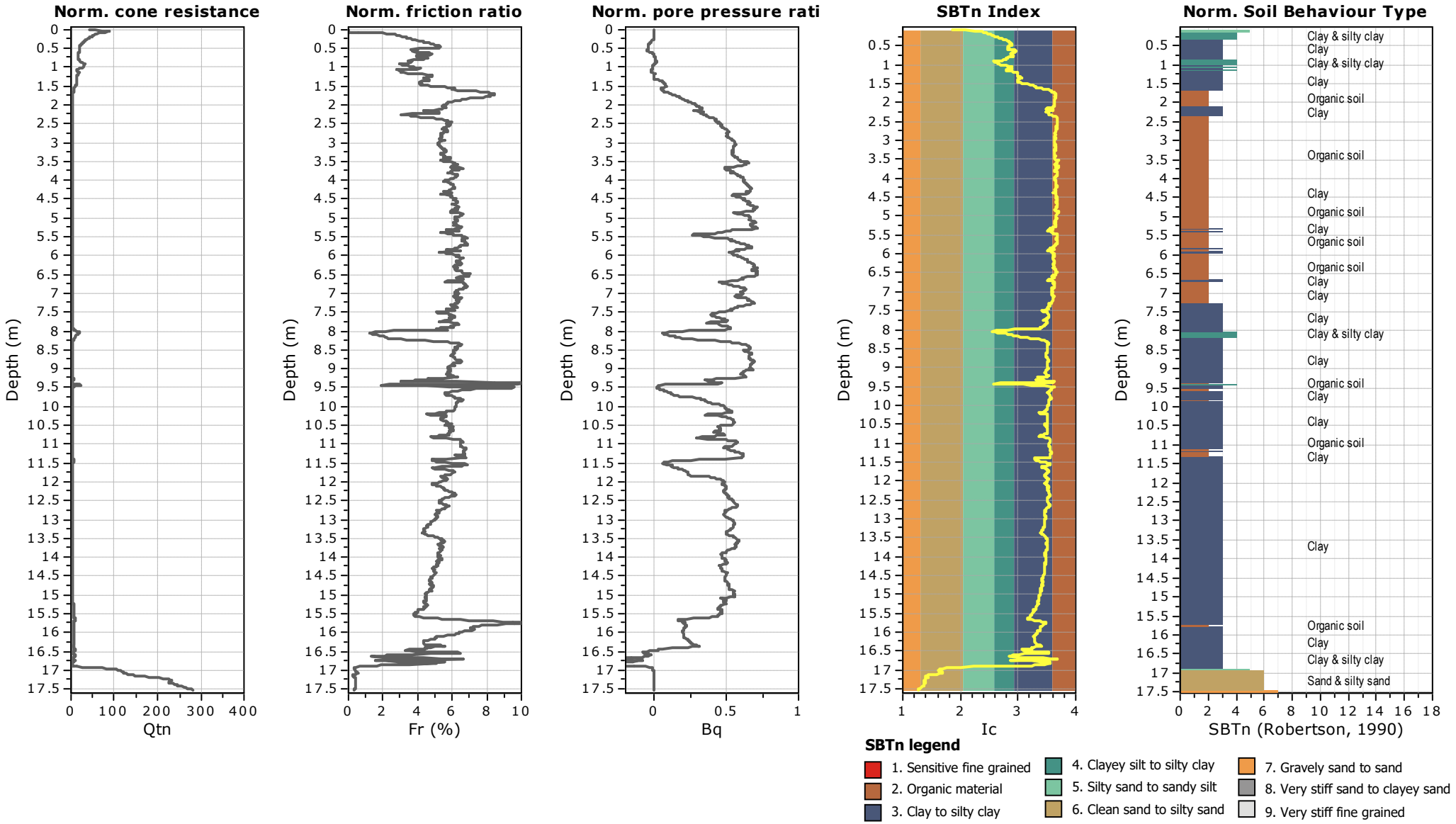
CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

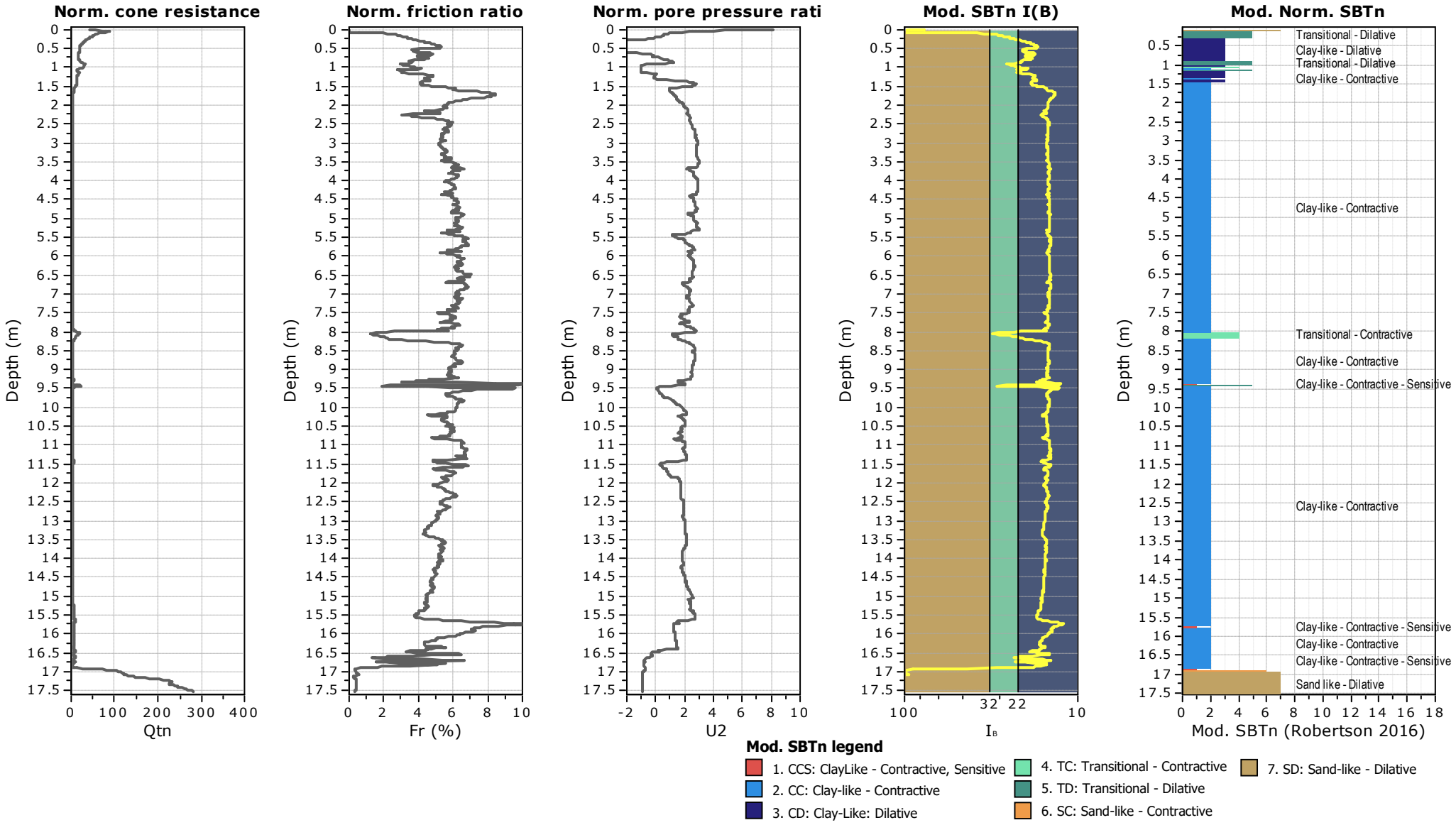
CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

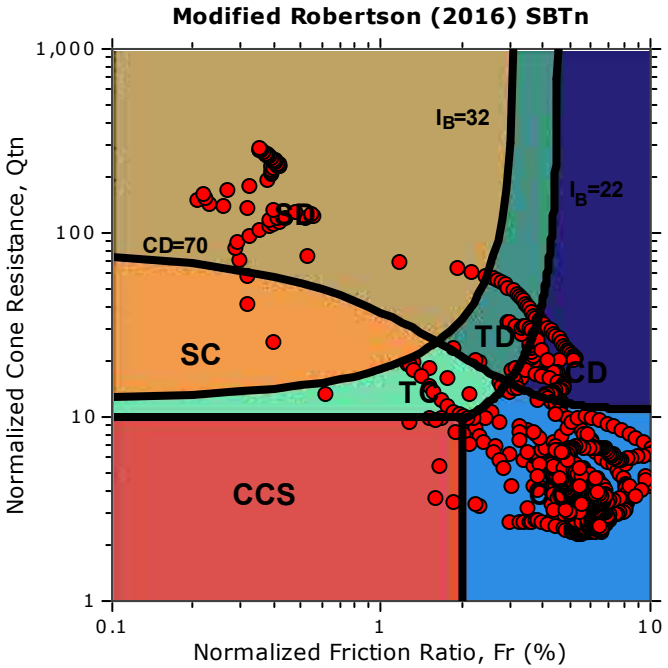


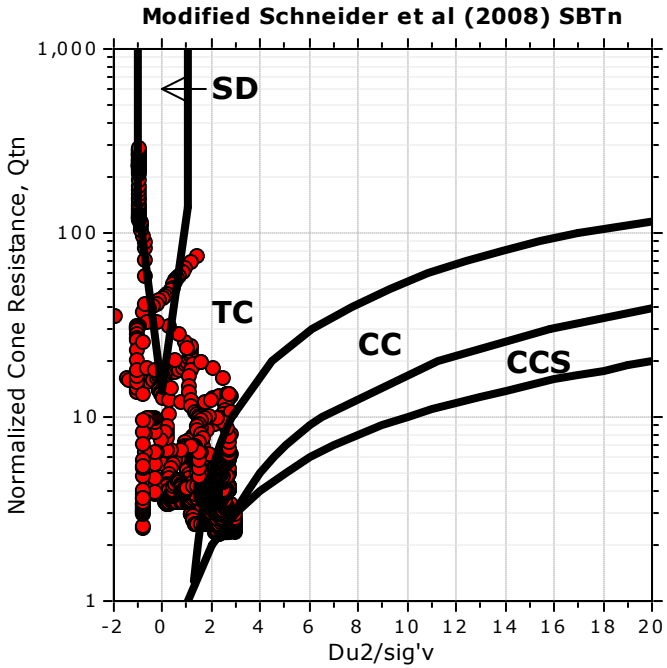
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

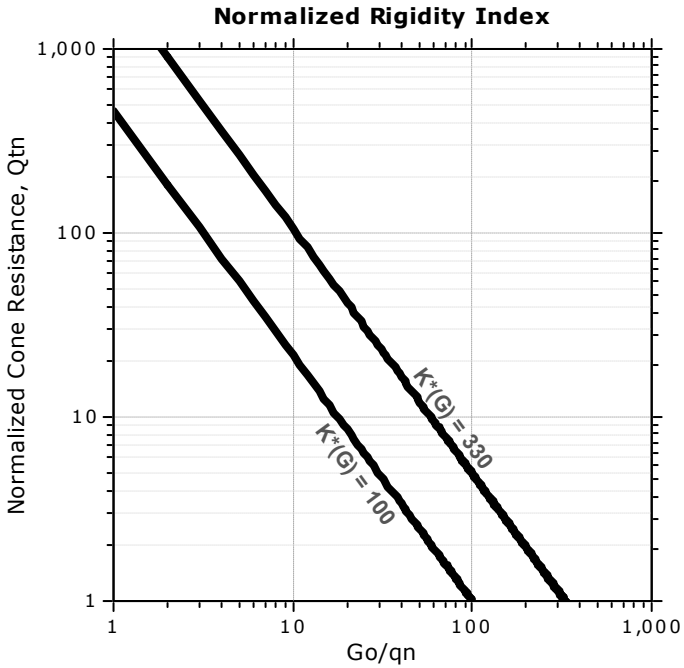
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Updated SBTn plots







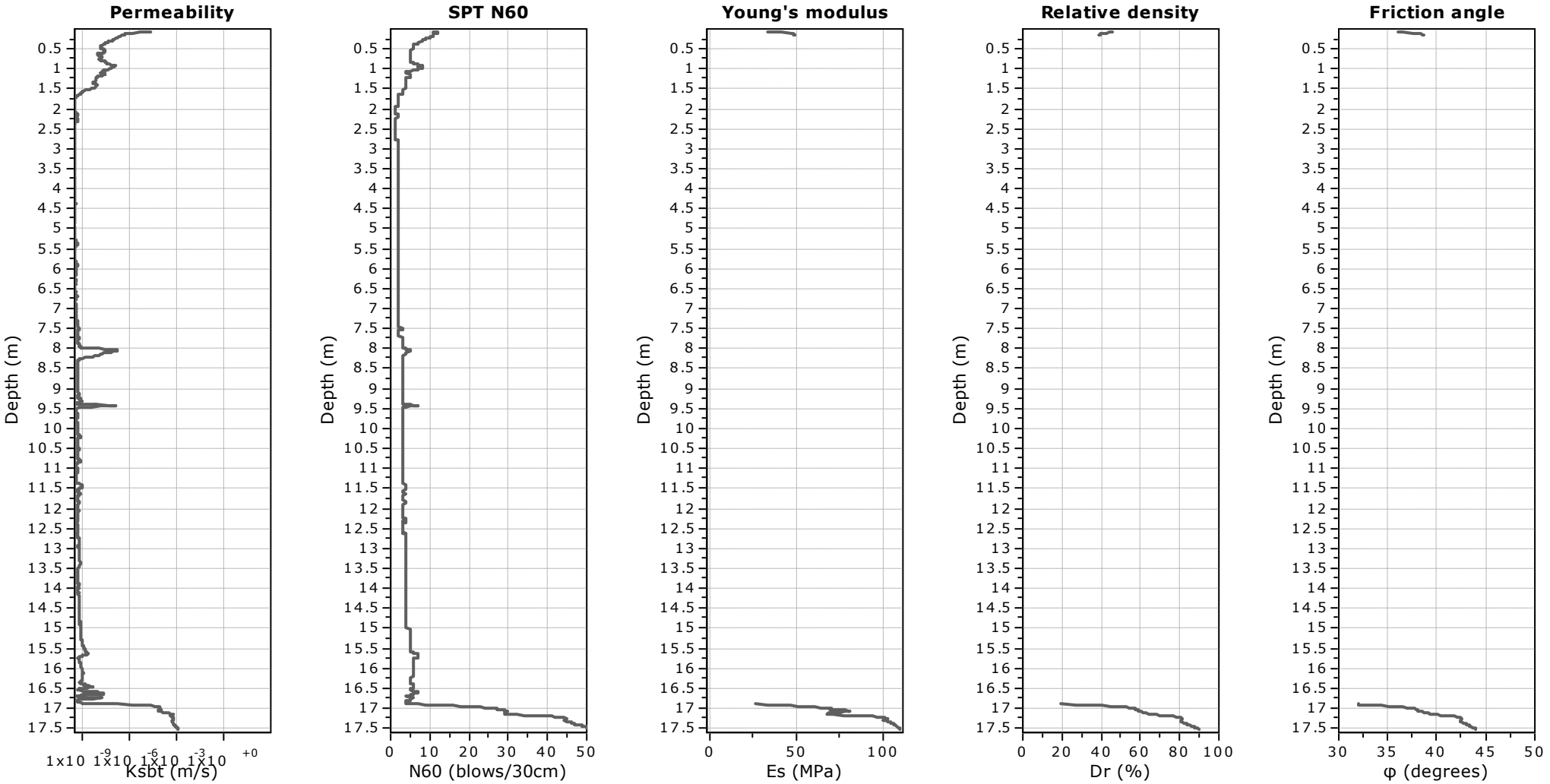
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



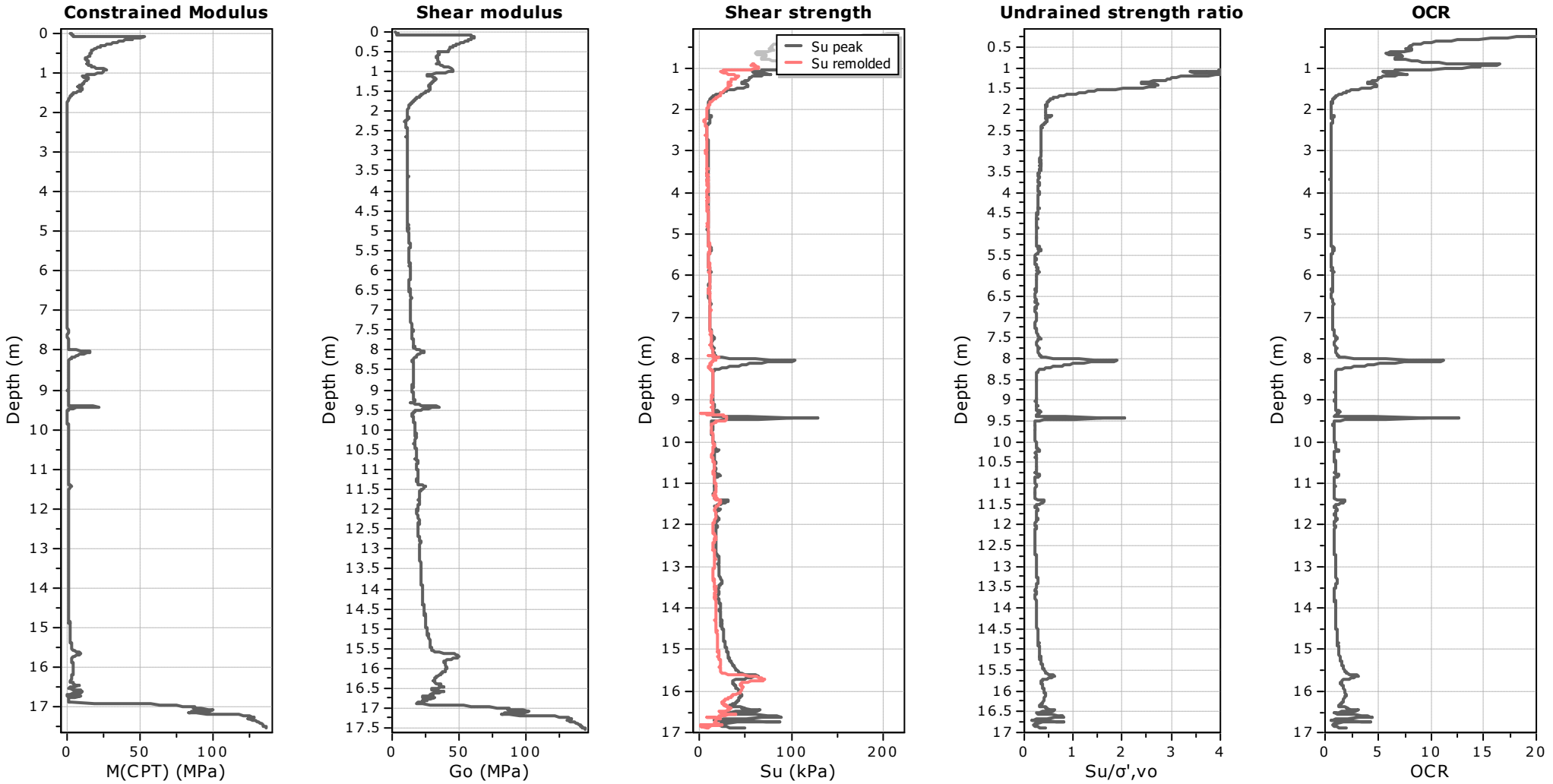
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



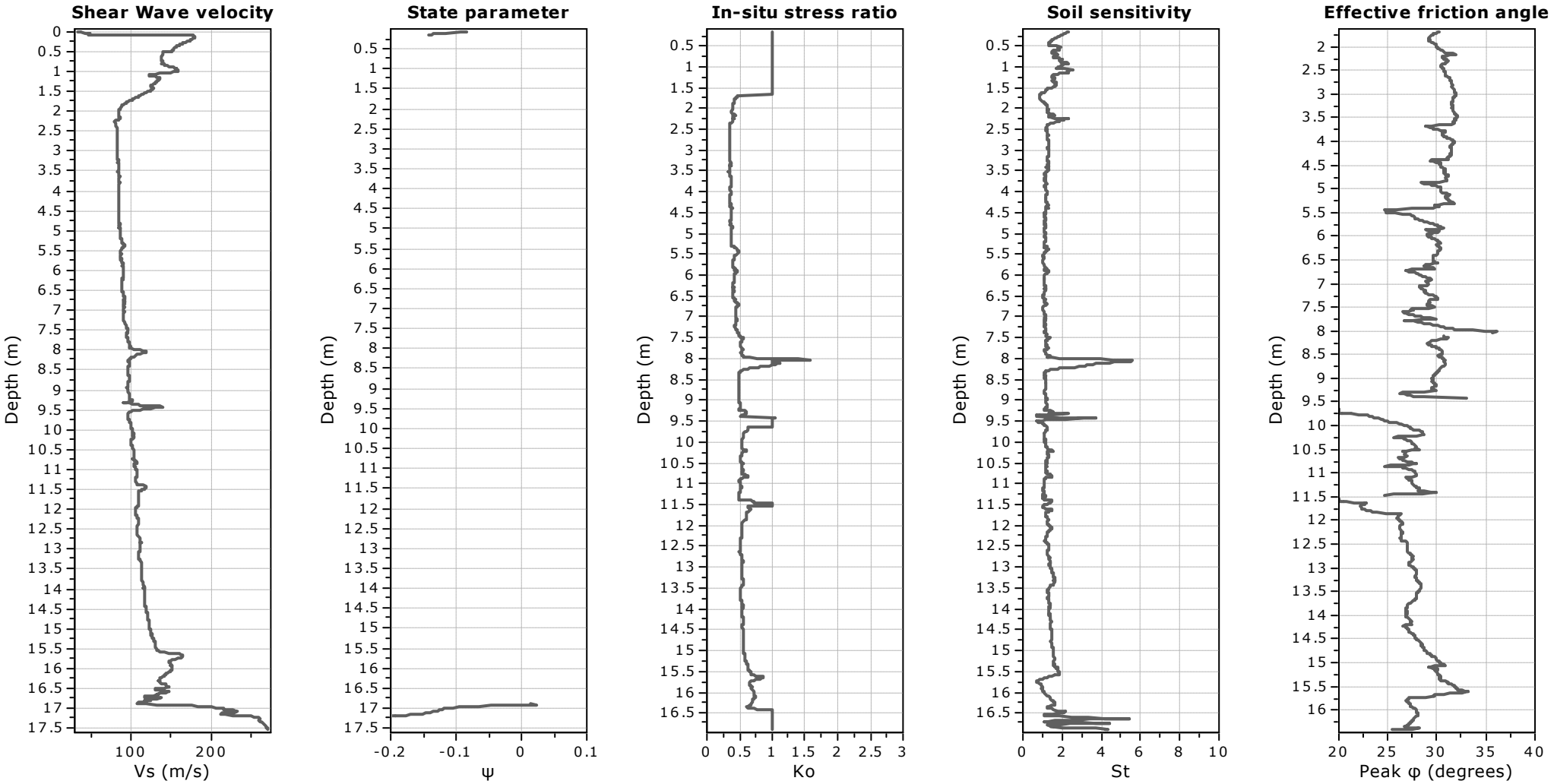
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto
OCR factor for clays, N_{kt}: Auto
Flat Dilatometer Test data

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



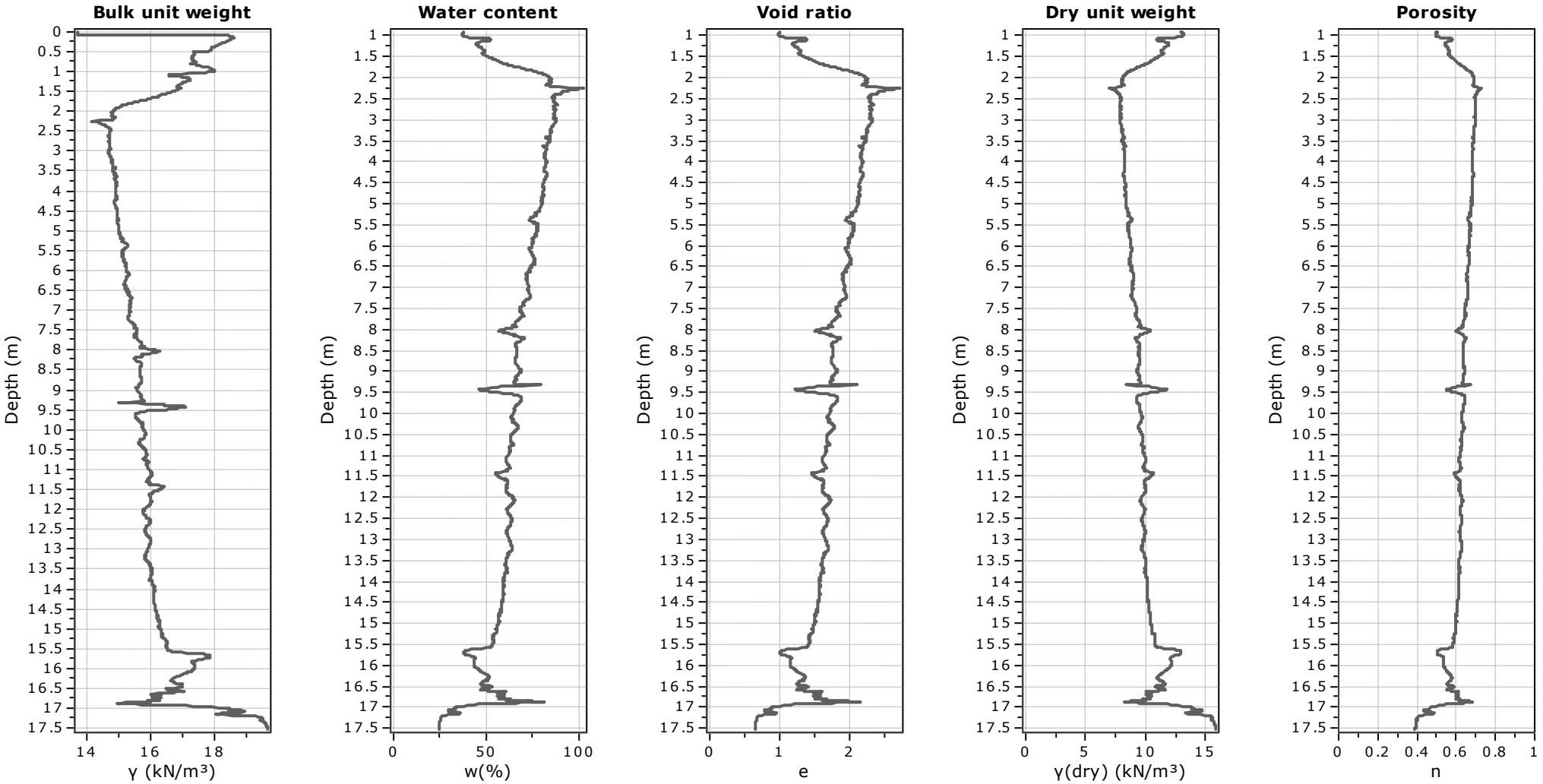
Calculation parameters

Soil Sensitivity factor, N_S: 7.00

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

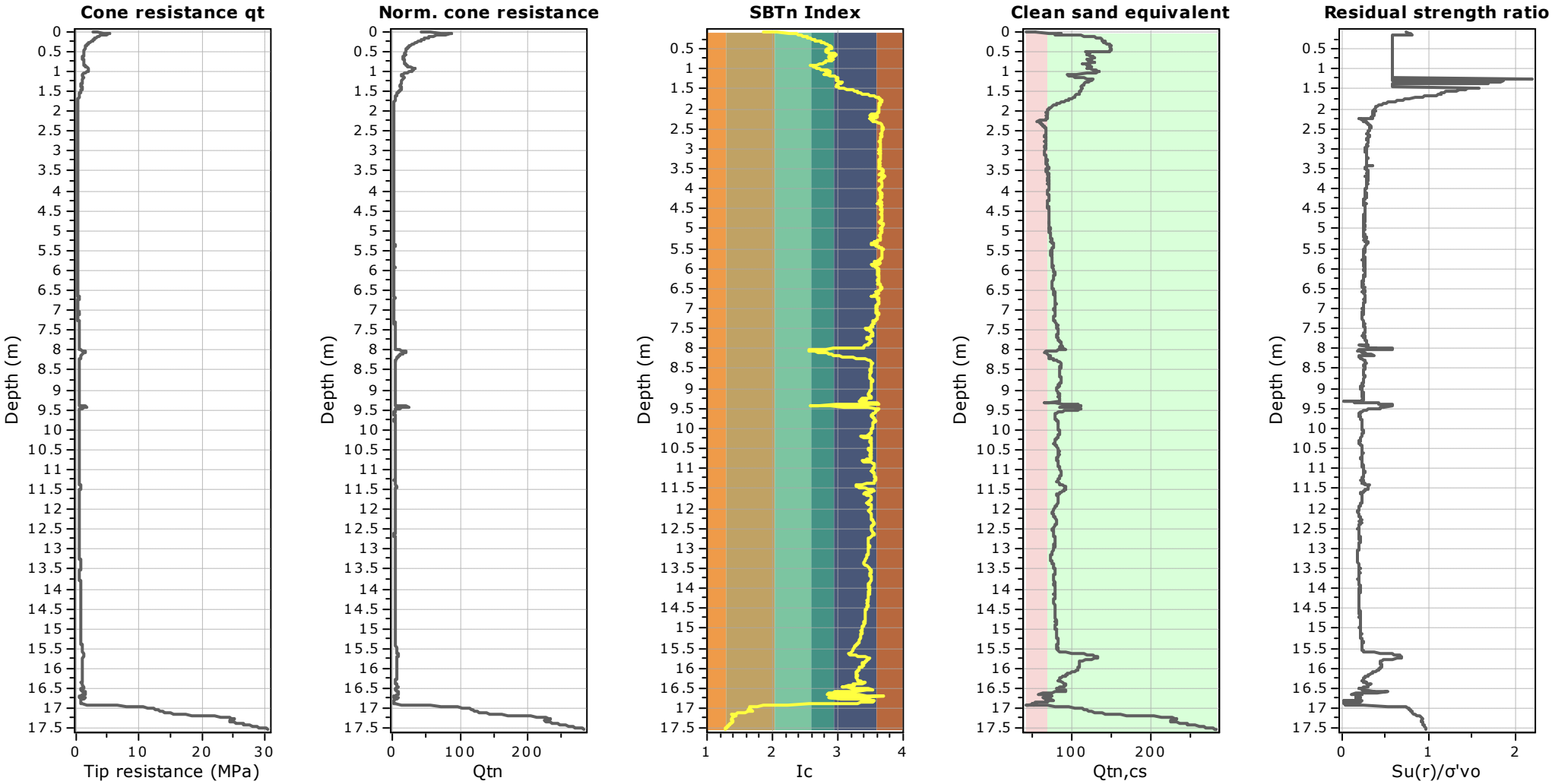
CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

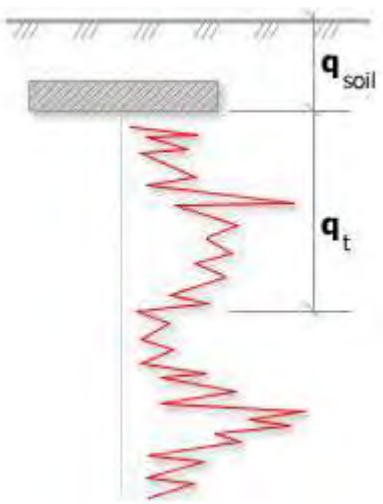
CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

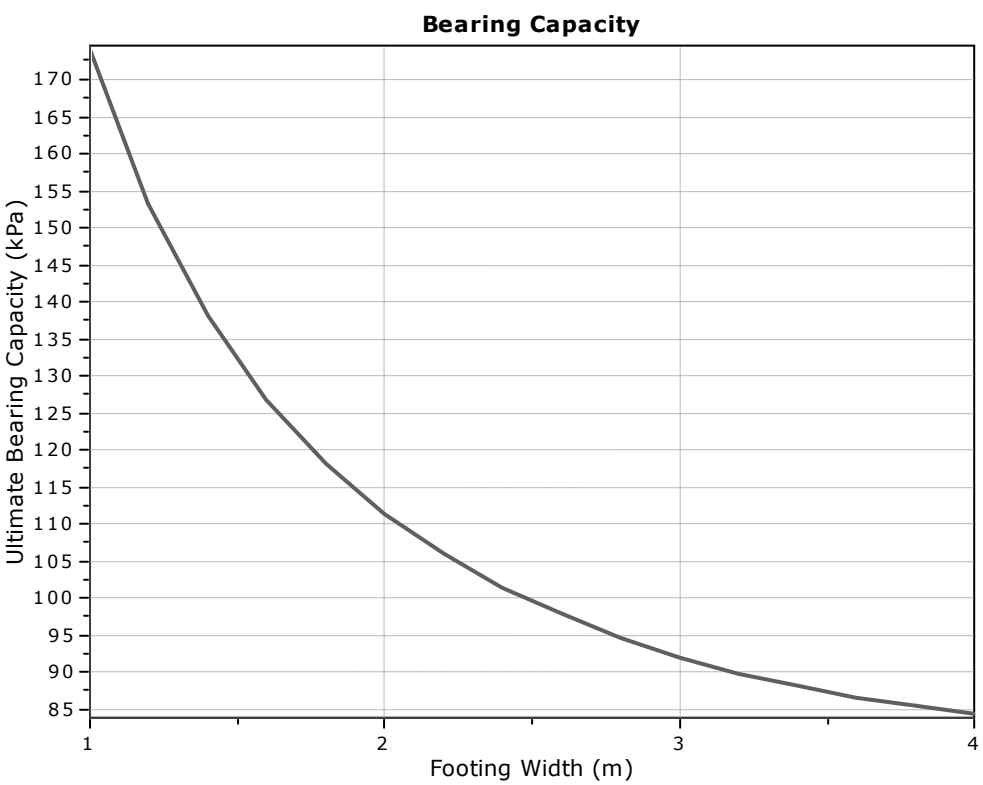
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



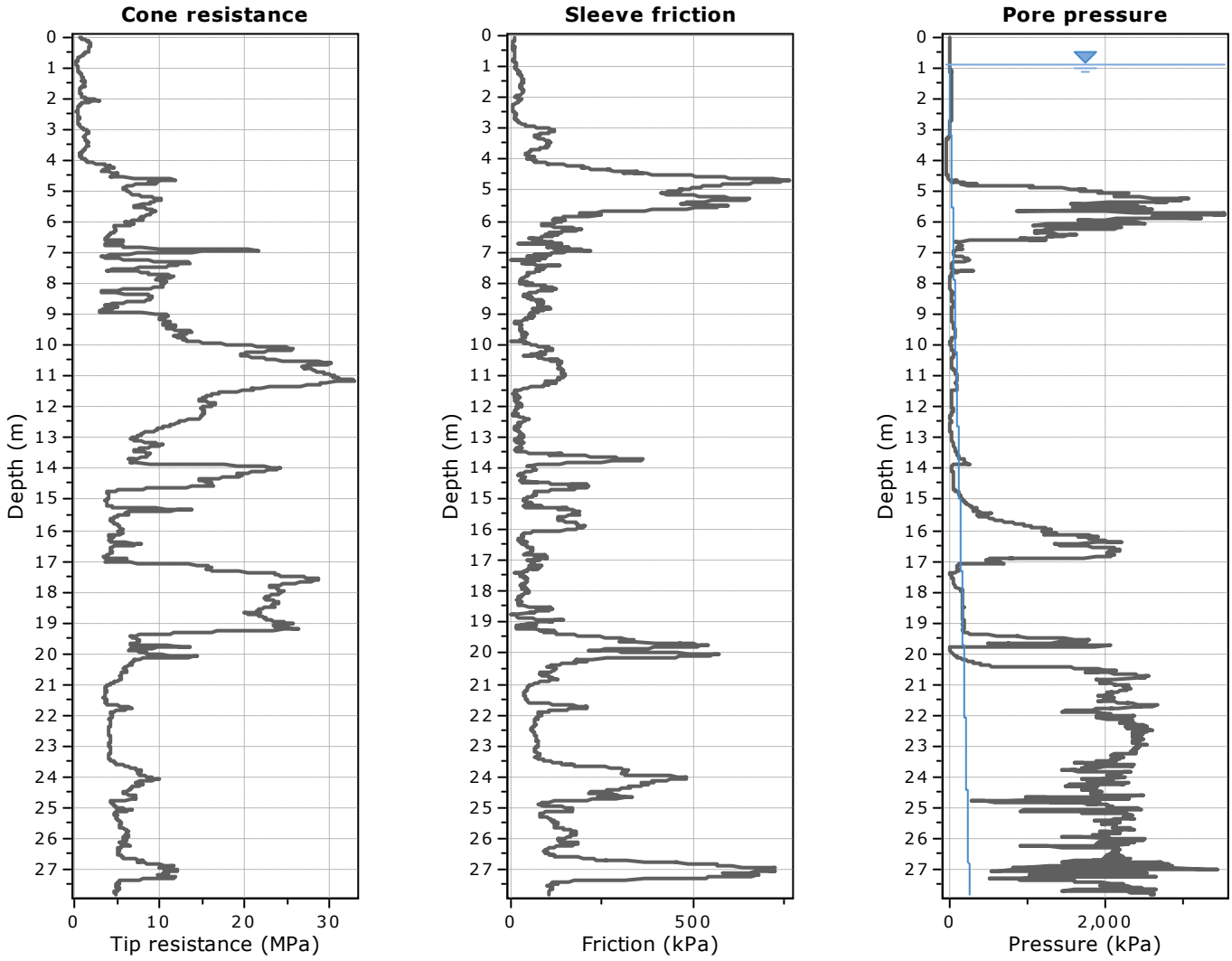
:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	0.82	0.20	9.50	174.12
2	1.20	0.50	2.30	0.72	0.20	9.50	153.41
3	1.40	0.50	2.60	0.64	0.20	9.50	138.15
4	1.60	0.50	2.90	0.59	0.20	9.50	126.84
5	1.80	0.50	3.20	0.54	0.20	9.50	118.19
6	2.00	0.50	3.50	0.51	0.20	9.50	111.47
7	2.20	0.50	3.80	0.48	0.20	9.50	105.97
8	2.40	0.50	4.10	0.46	0.20	9.50	101.52
9	2.60	0.50	4.40	0.44	0.20	9.50	97.82
10	2.80	0.50	4.70	0.43	0.20	9.50	94.69
11	3.00	0.50	5.00	0.41	0.20	9.50	92.04
12	3.20	0.50	5.30	0.40	0.20	9.50	89.90
13	3.40	0.50	5.60	0.39	0.20	9.50	88.23
14	3.60	0.50	5.90	0.39	0.20	9.50	86.71
15	3.80	0.50	6.20	0.38	0.20	9.50	85.54
16	4.00	0.50	6.50	0.37	0.20	9.50	84.42

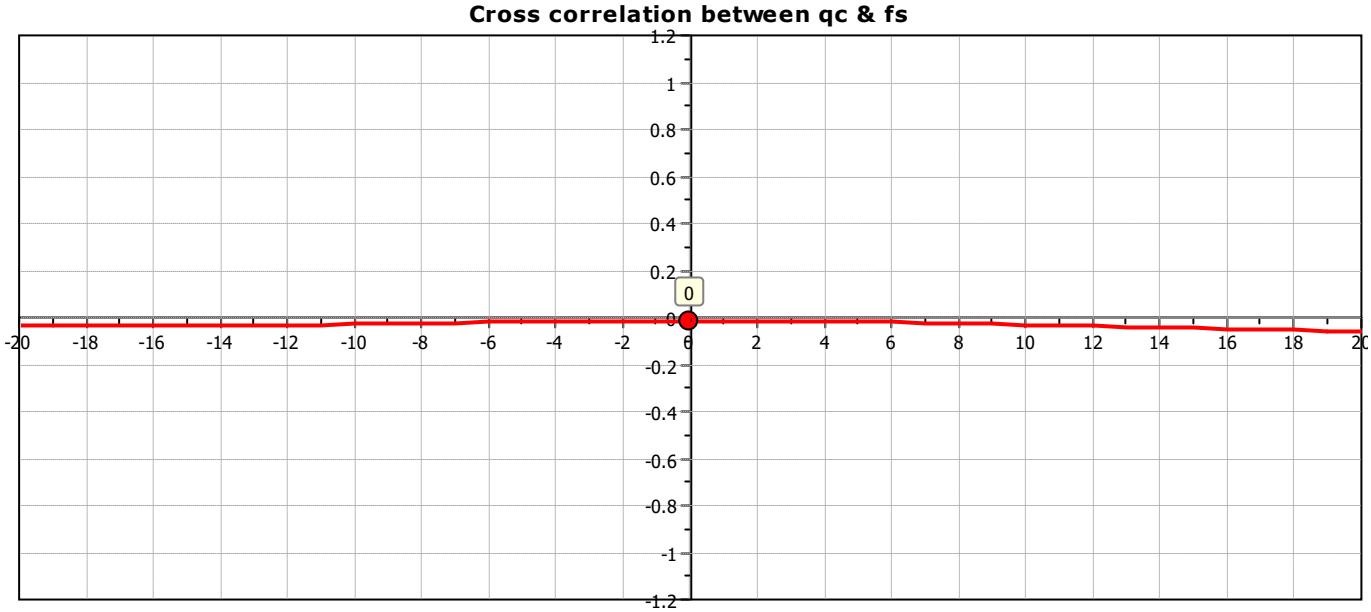
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



The plot below presents the cross correlation coeficient between the raw qc and fs values (as measured on the field). X axes presents the lag distance (one lag is the distance between two sucessive CPT measurements).

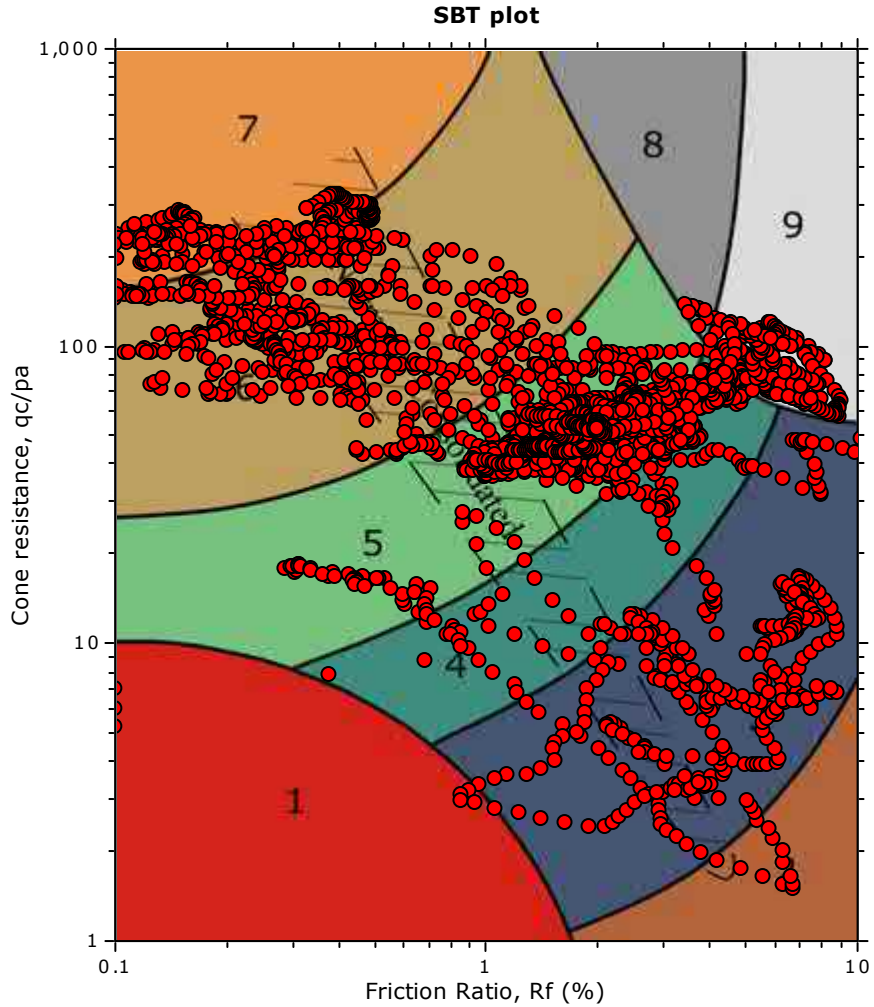


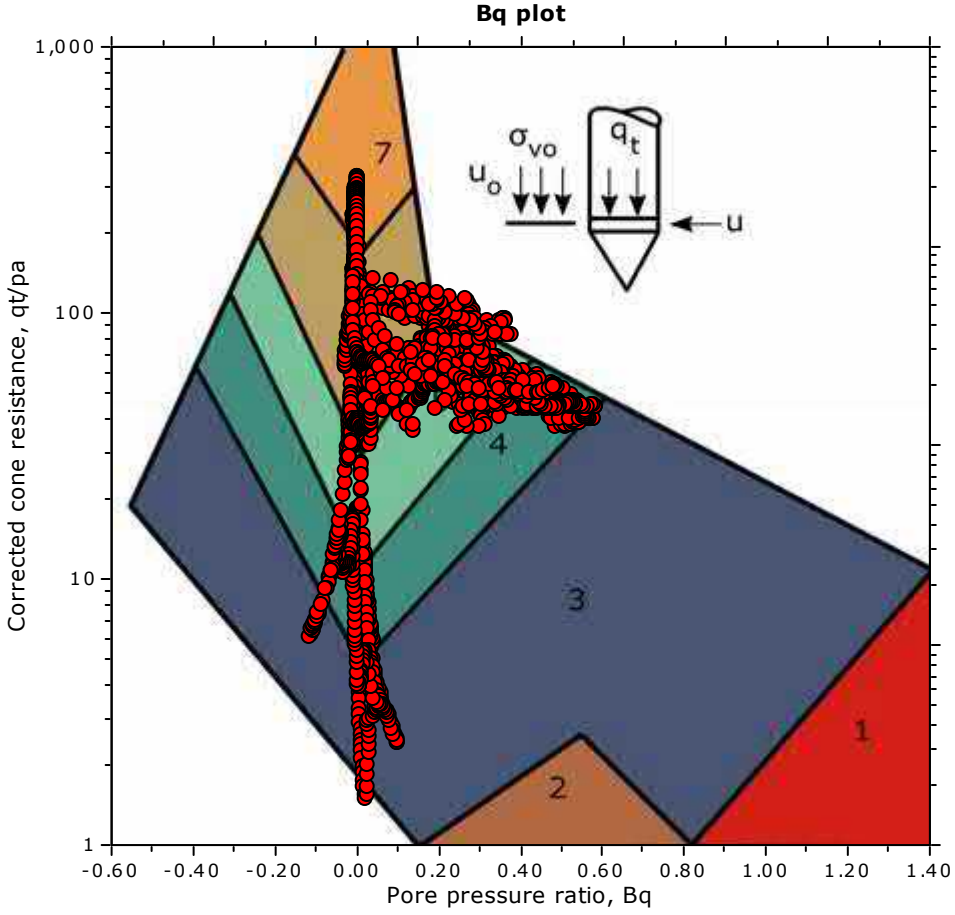
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots





SBT legend

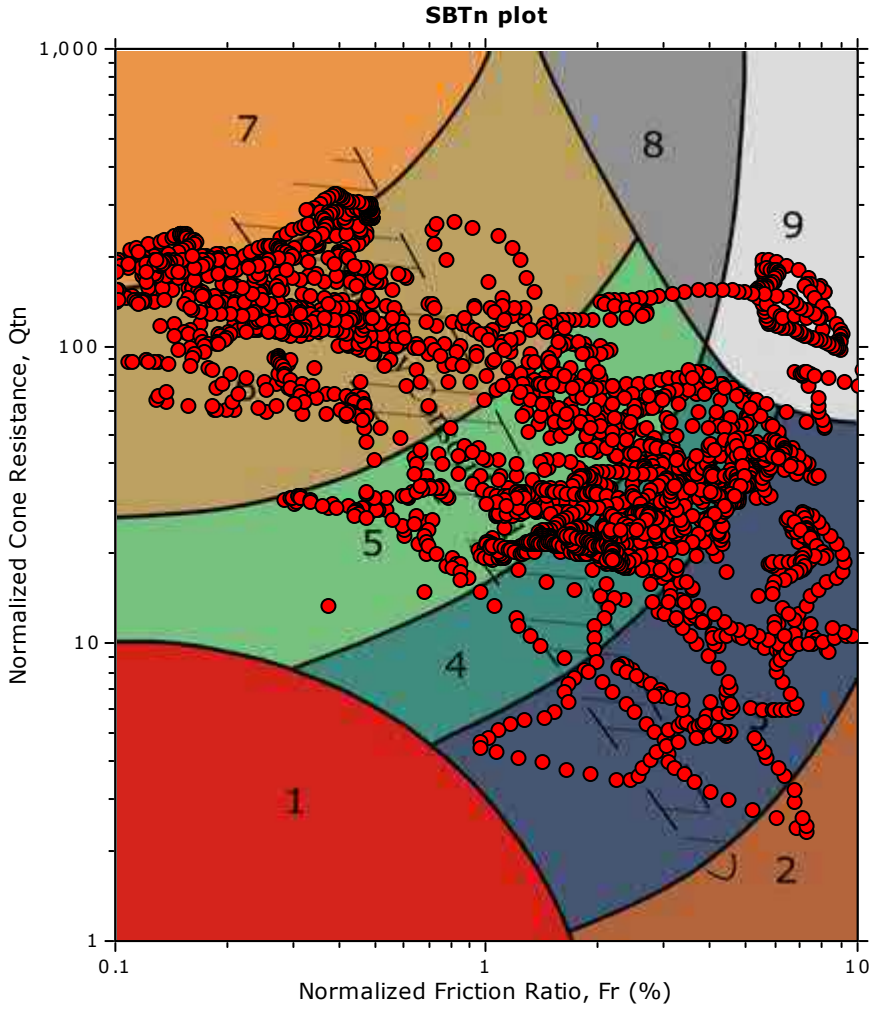
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

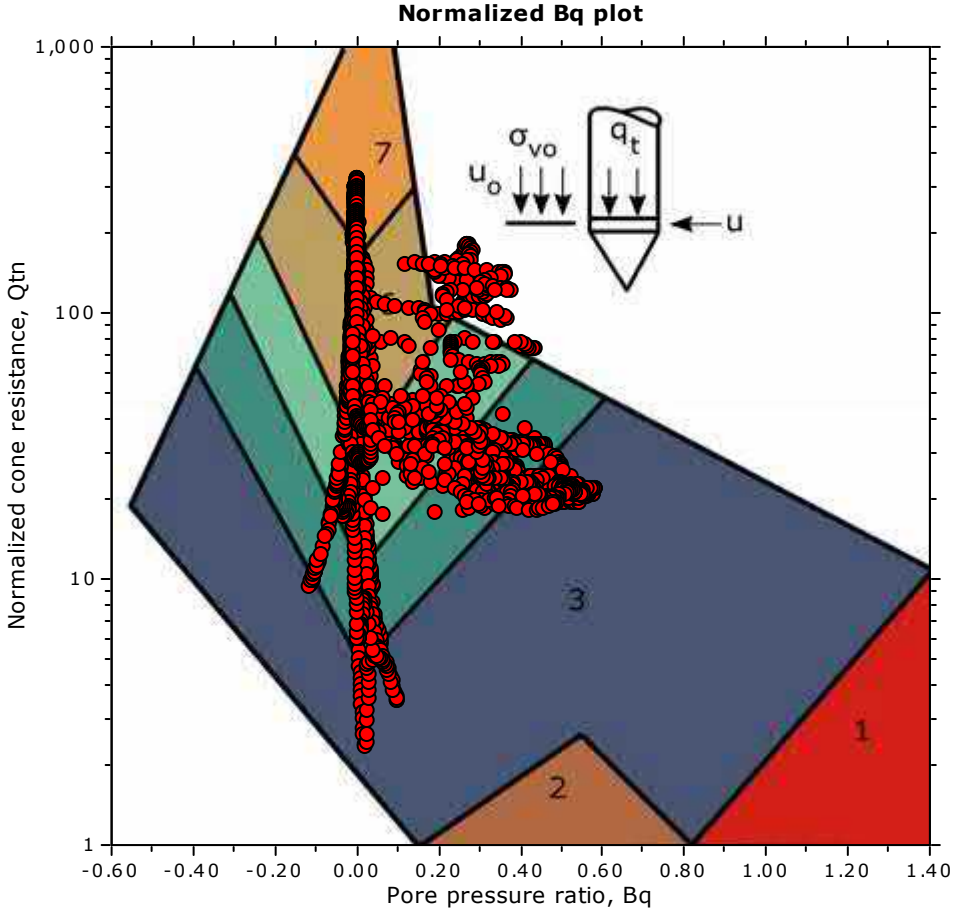
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

SBT - Bq plots (normalized)





SBTn legend

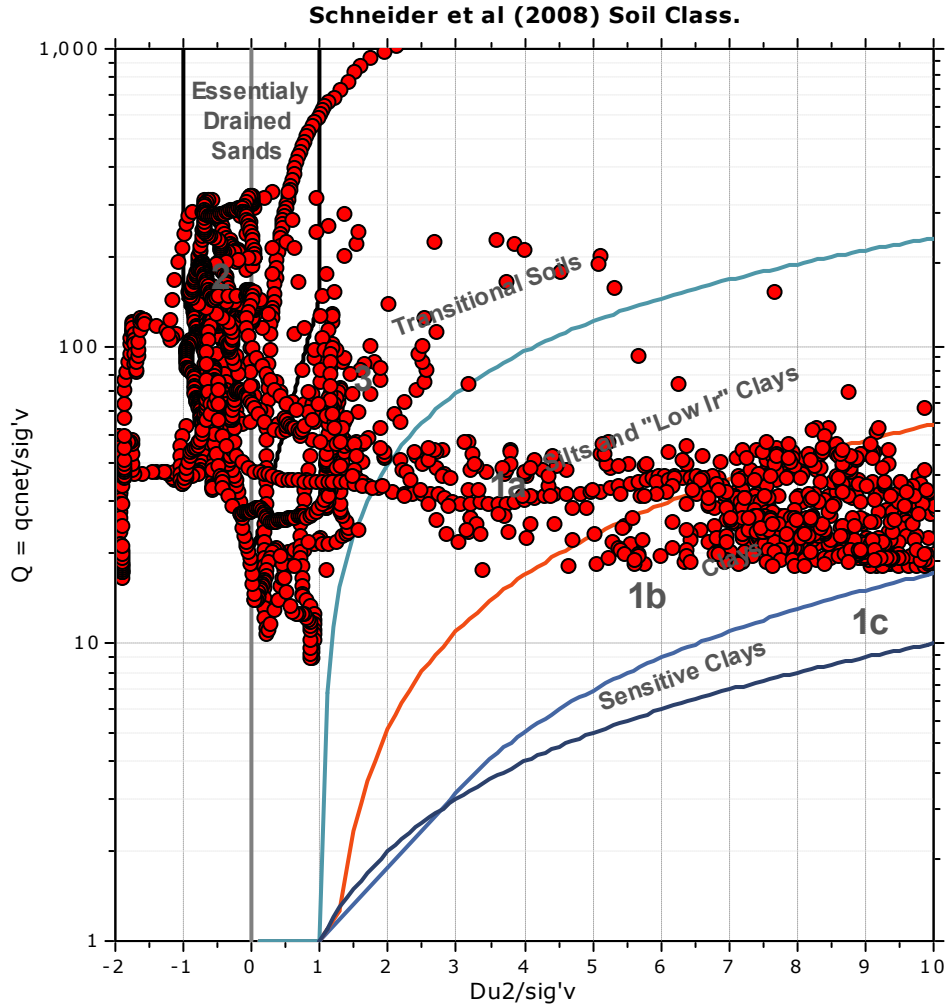
1. Sensitive fine grained	4. Clayey silt to silty clay	7. Gravelly sand to sand
2. Organic material	5. Silty sand to sandy silt	8. Very stiff sand to clayey sand
3. Clay to silty clay	6. Clean sand to silty sand	9. Very stiff fine grained

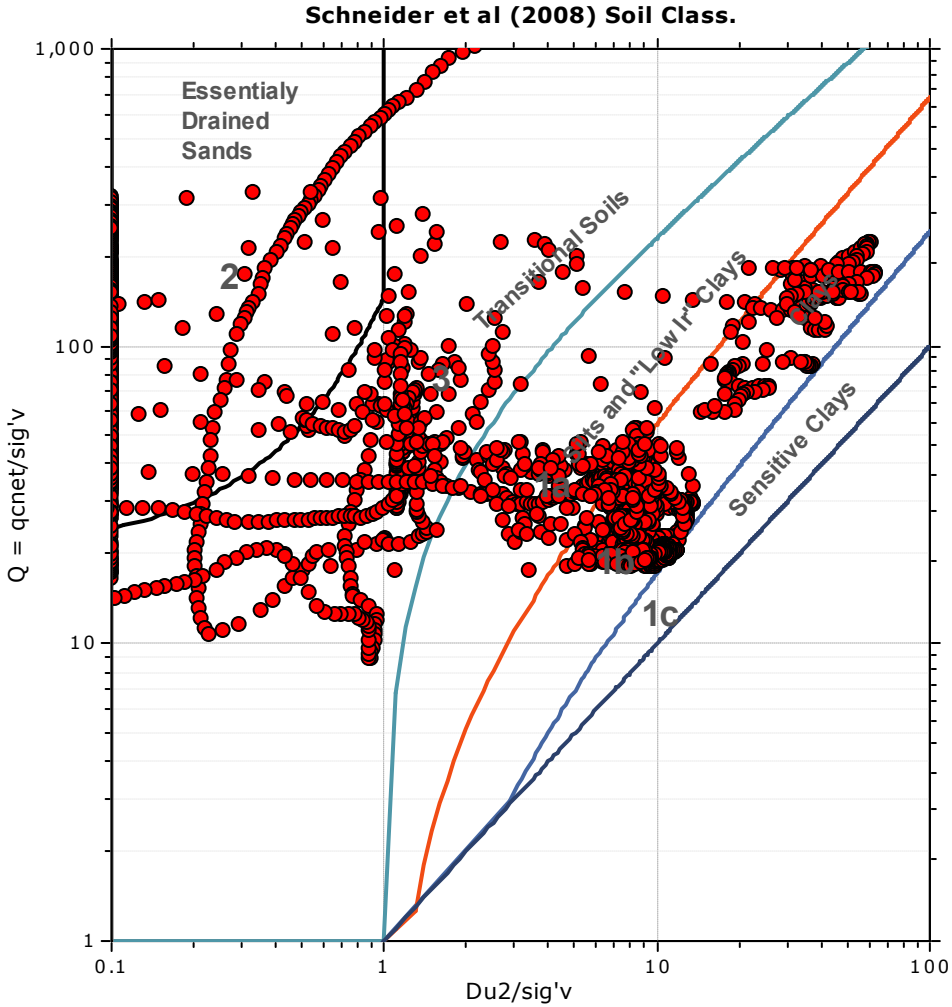
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Bq plots (Schneider)

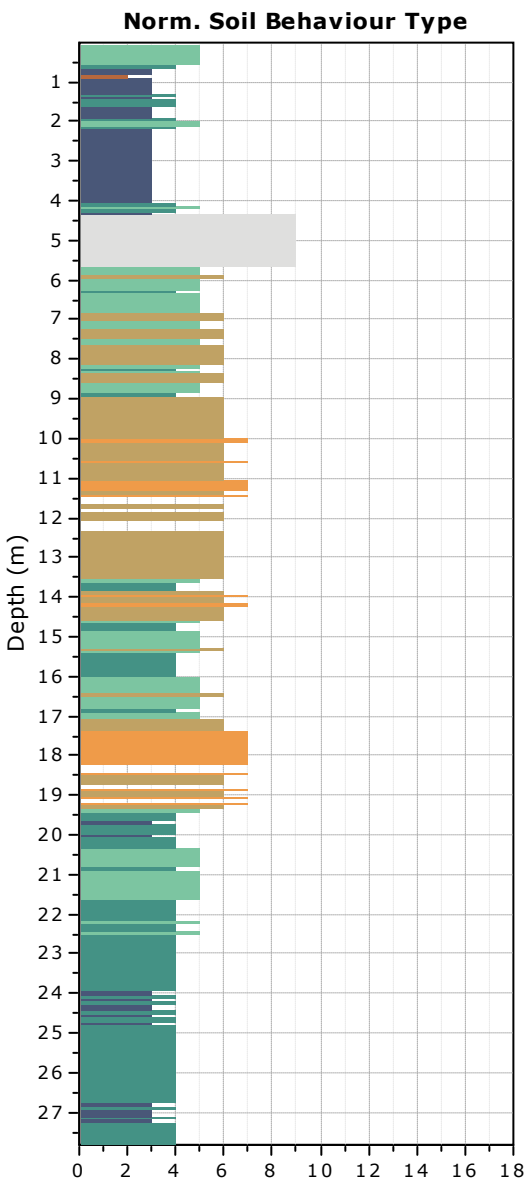


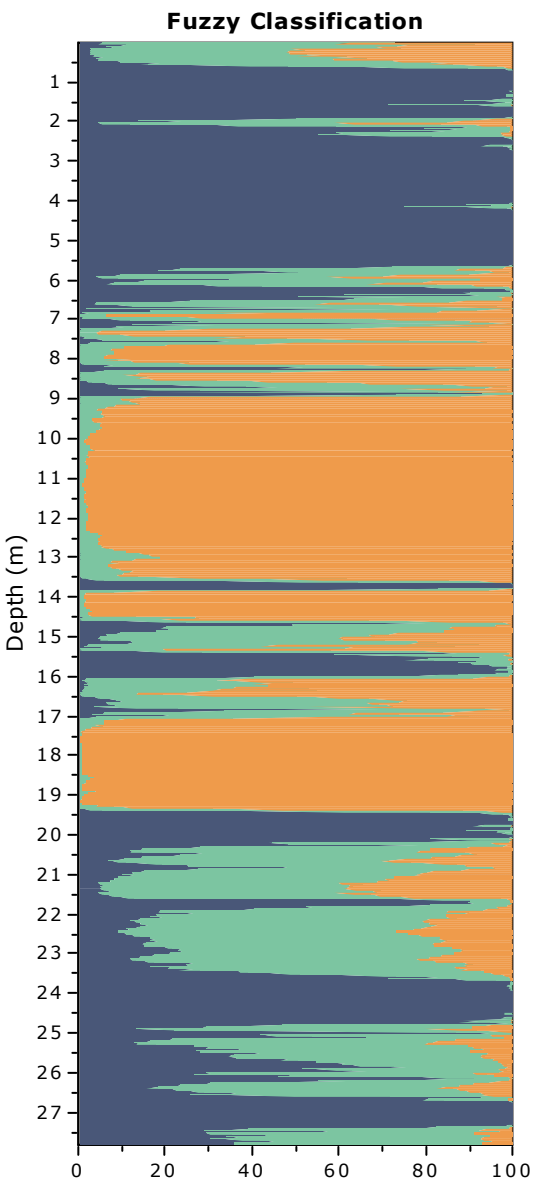


CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



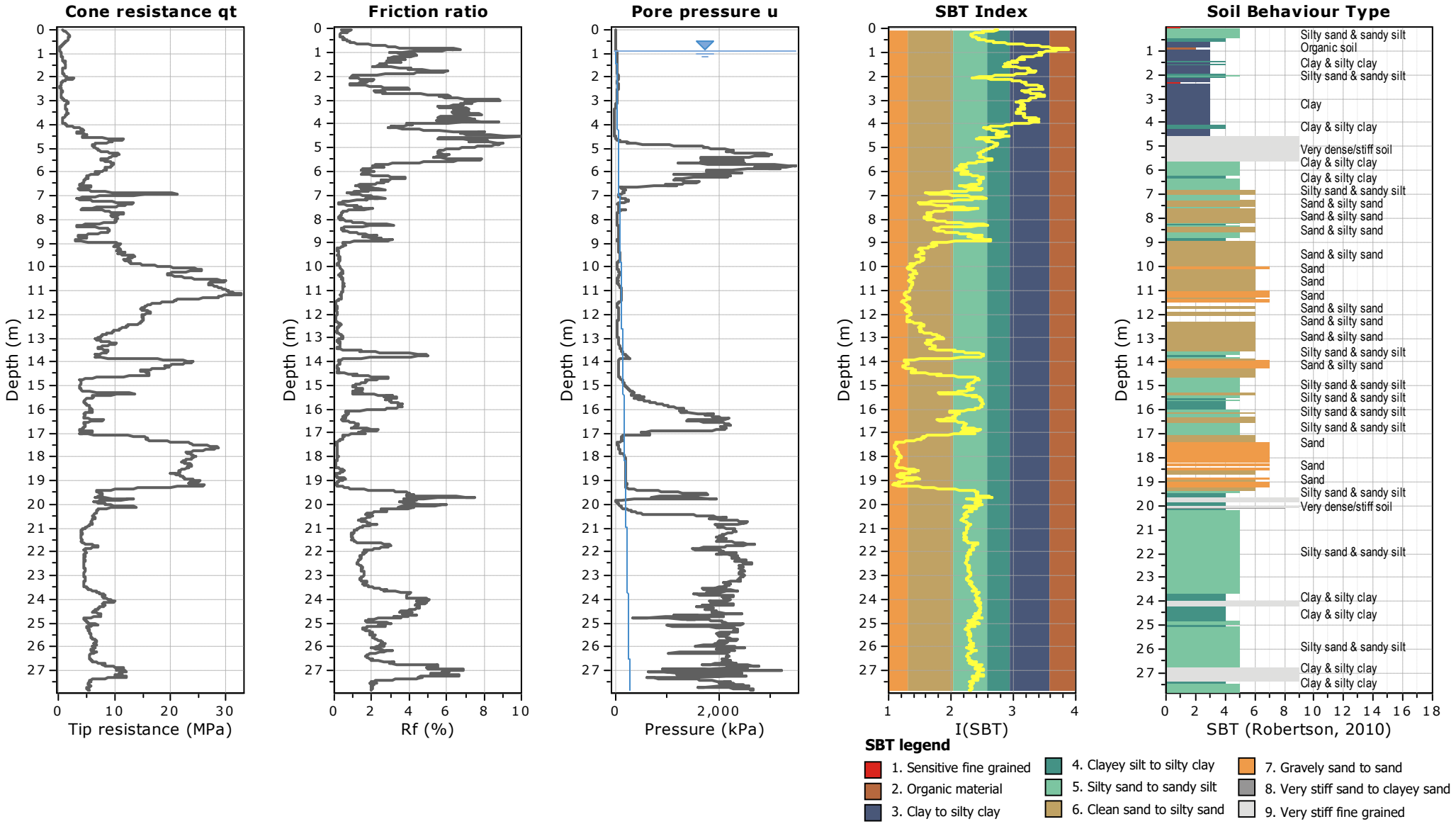


Fuzzy classifiaction legend
- Highly probable clayey soil
- Highly probable mixture soil
- Highly probable sandy soil

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

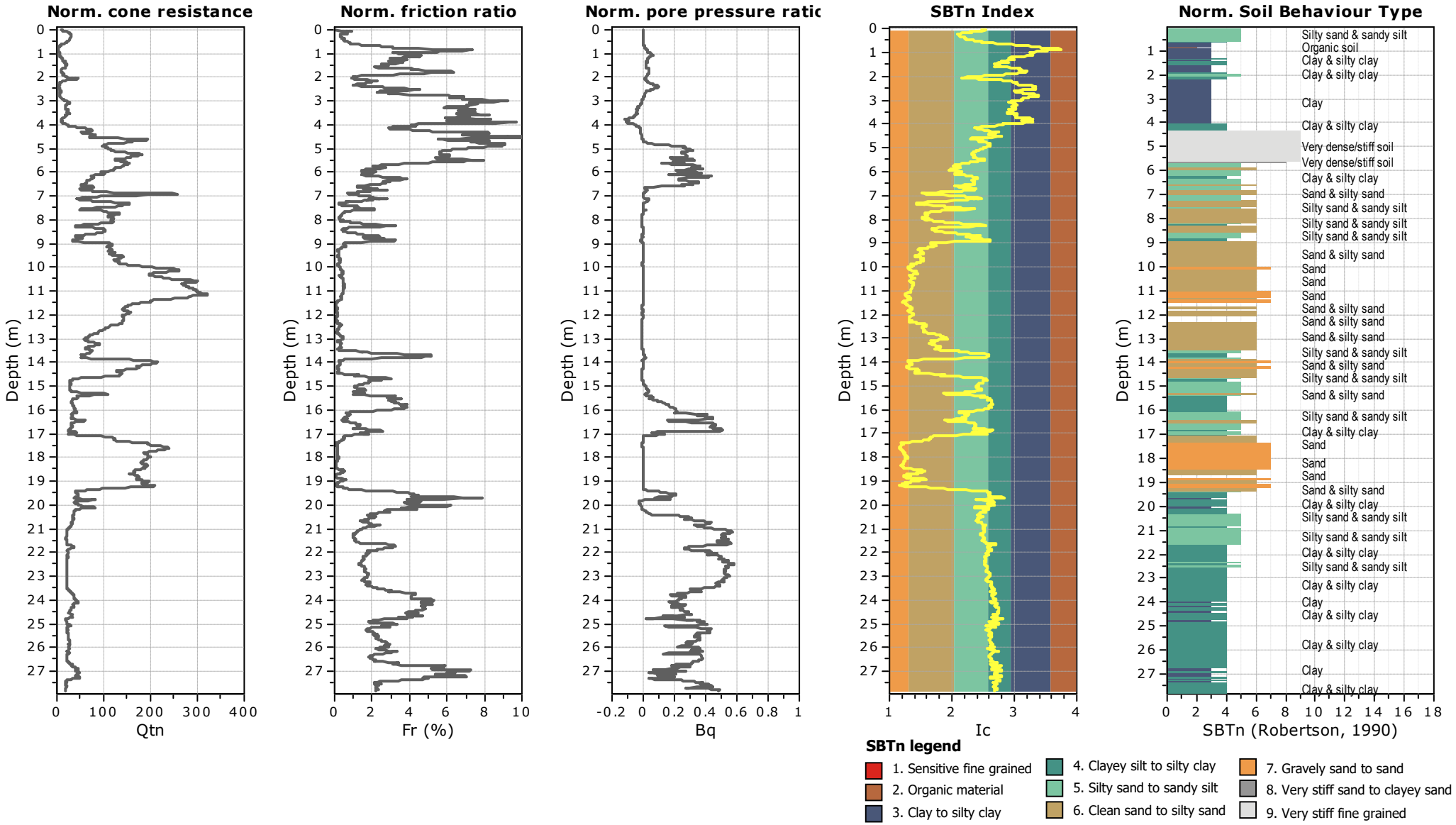
CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

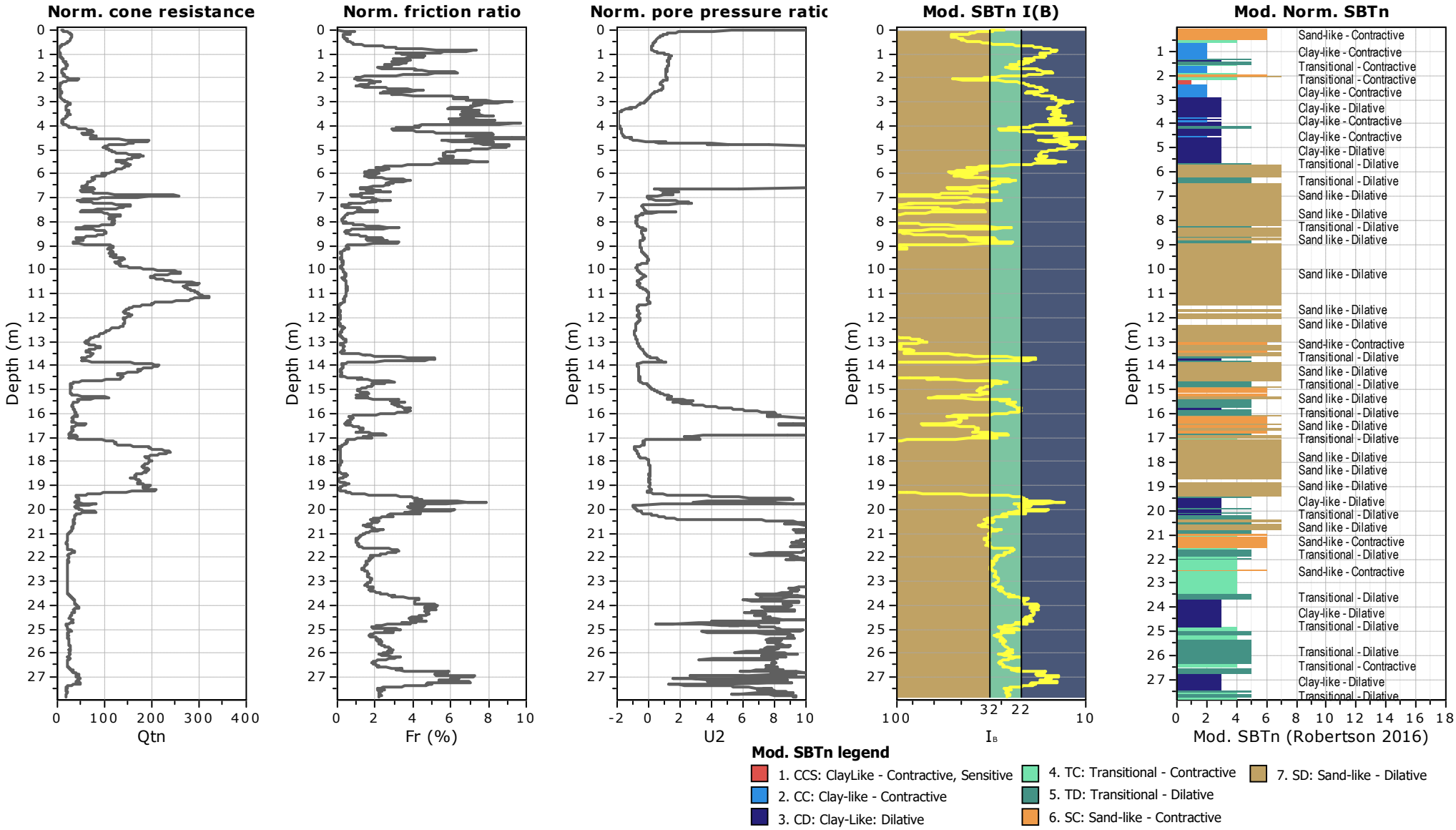
CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC

CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

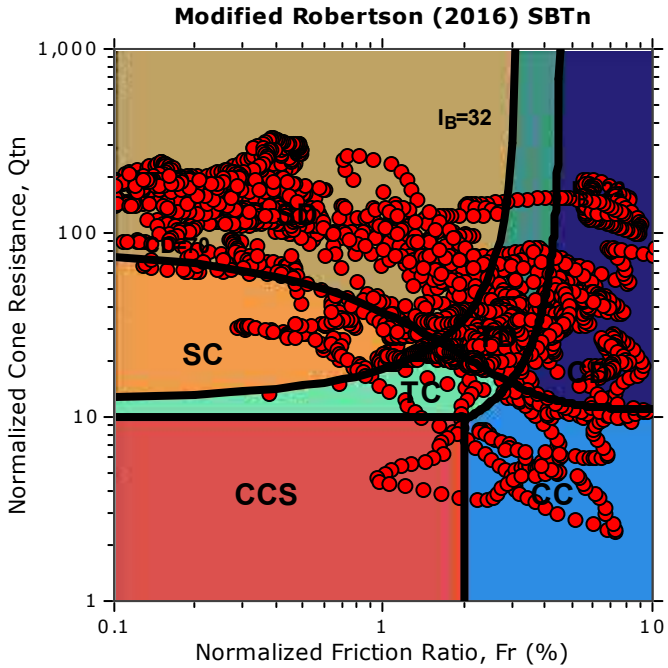


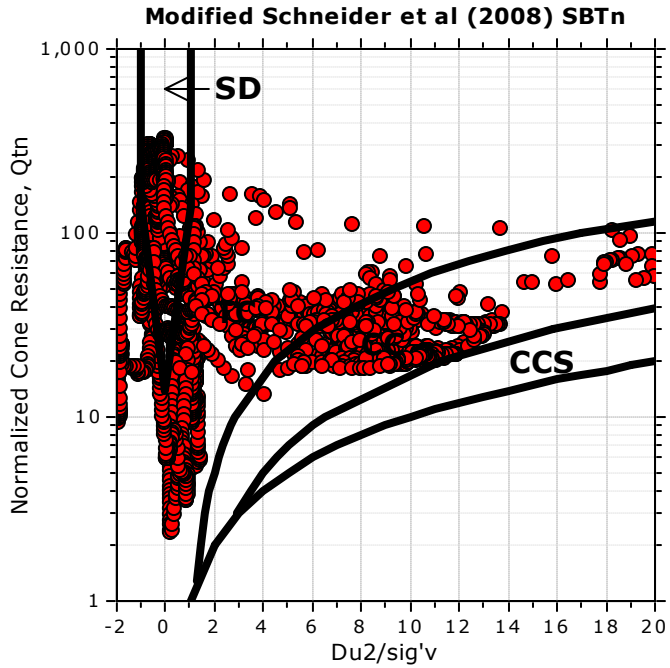
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

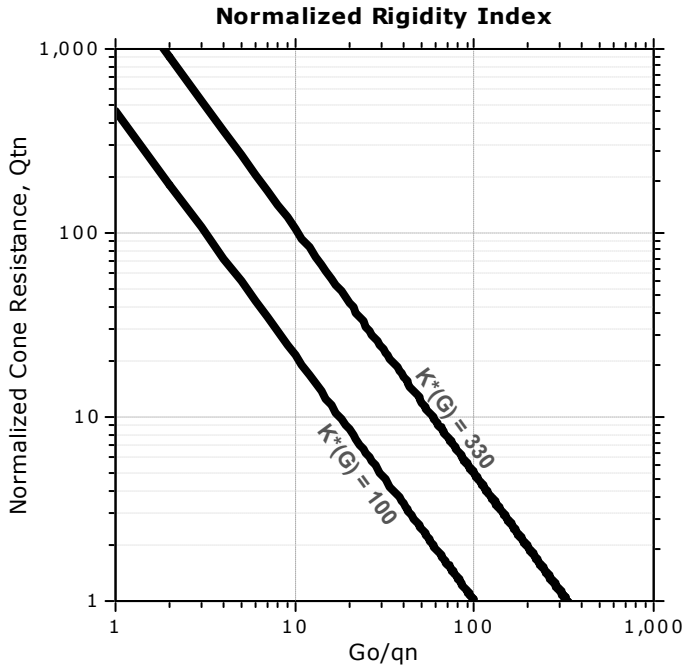
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Updated SBTn plots







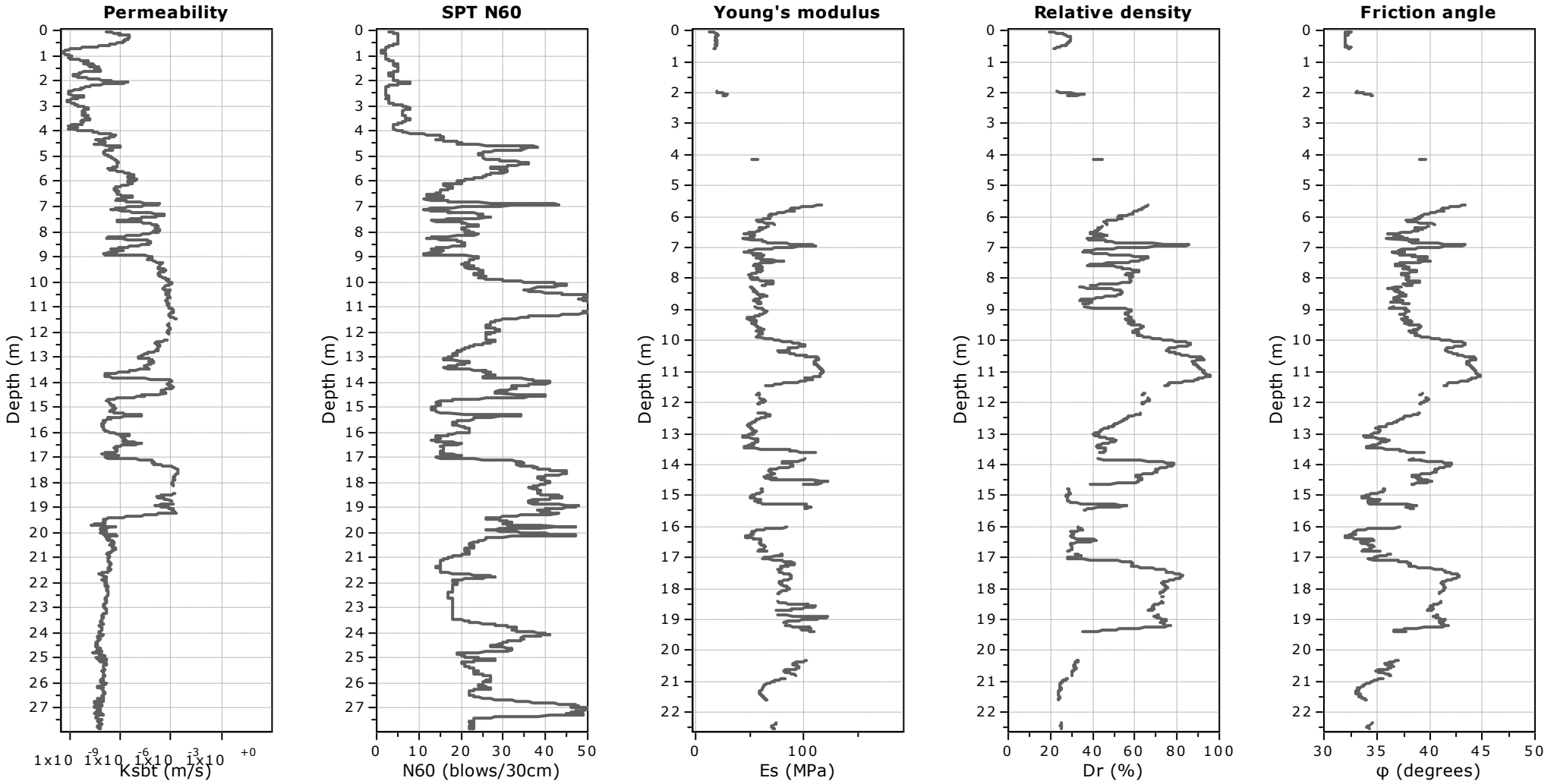
CCS: Clay-like - Contractive - Sensitive
CC: Clay-like - Contractive
CD: Clay-like - Dilative
TC: Transitional - Contractive
TD: Transitional - Dilative
SC: Sand-like - Contractive
SD: Sand-like - Dilative

K(G) > 330: Soils with significant microstructure (e.g. age/cementation)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



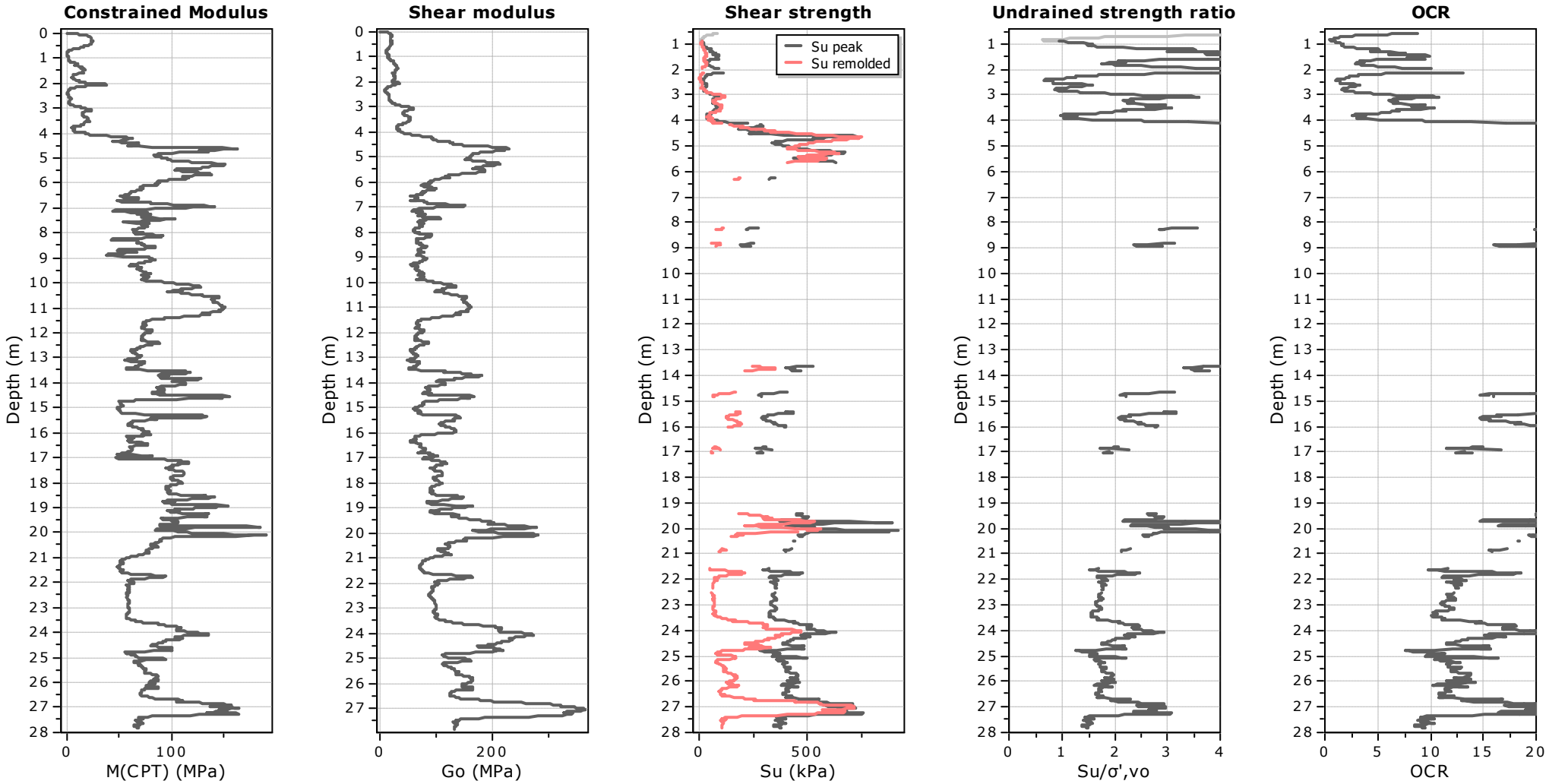
Calculation parameters

Permeability: Based on SBT_n
SPT N_{60}: Based on I_c and q_t
Young's modulus: Based on variable alpha using I_c (Robertson, 2009)
Relative density constant, C_{Dr}: 350.0
Phi: Based on Kulhawy & Mayne (1990)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: Yannathan Sand Quarry Geotechnical Assessment
Location: Yannathan VIC



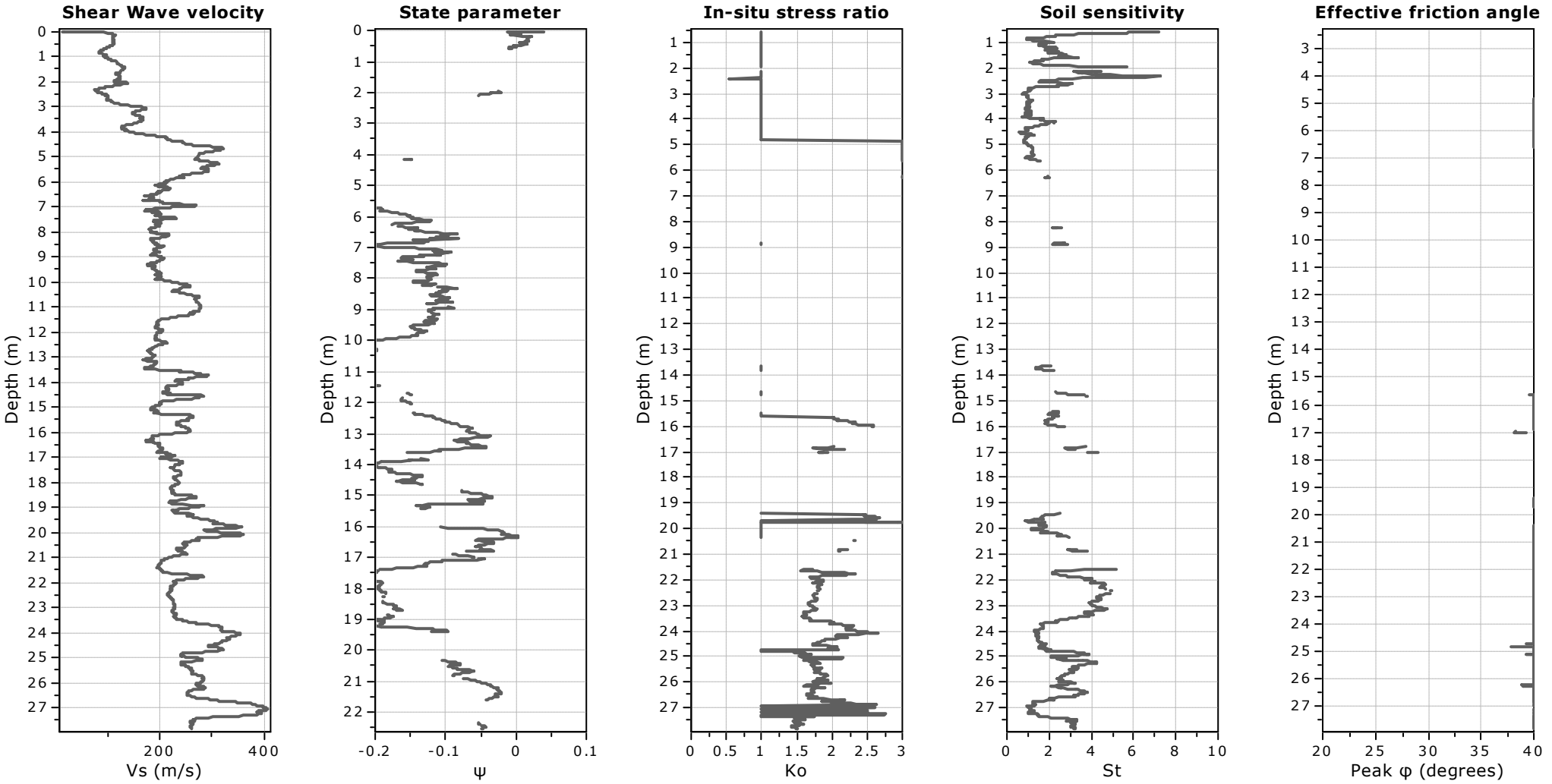
Calculation parameters

Constrained modulus: Based on variable *alpha* using I_c and Q_{tn} (Robertson, 2009)
Go: Based on variable *alpha* using I_c (Robertson, 2009)
Undrained shear strength cone factor for clays, N_{kt}: Auto
OCR factor for clays, N_{kt}: Auto
Flat Dilatometer Test data

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



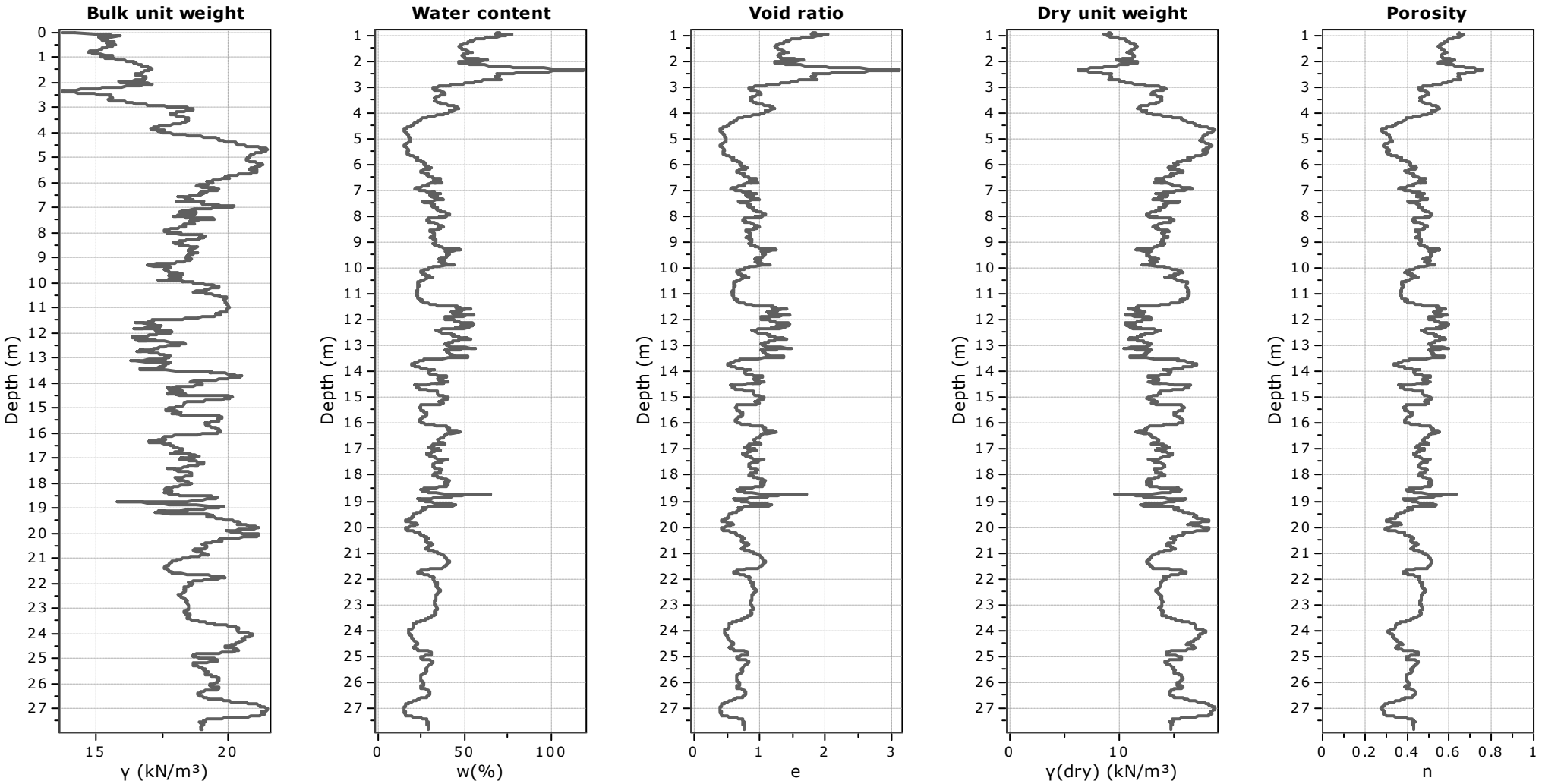
Calculation parameters

Soil Sensitivity factor, N_S: 7.00

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

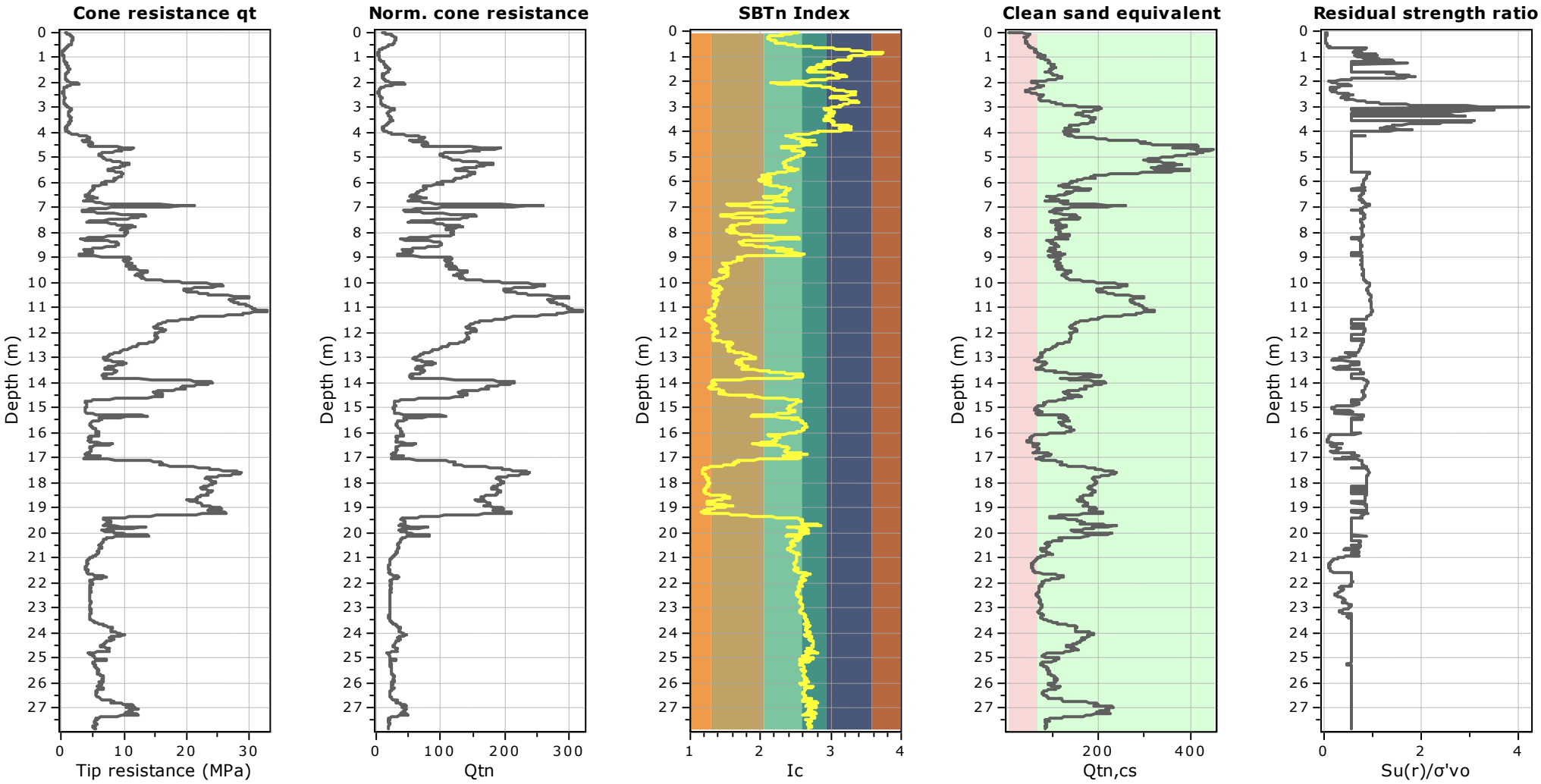
CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

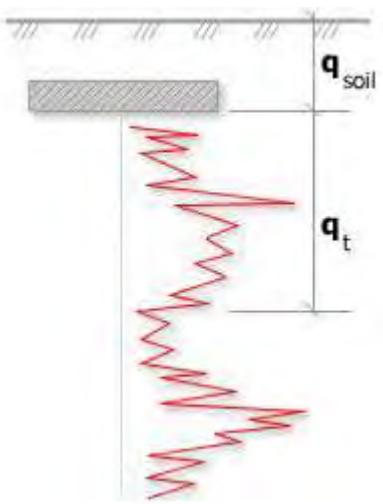
CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:



CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

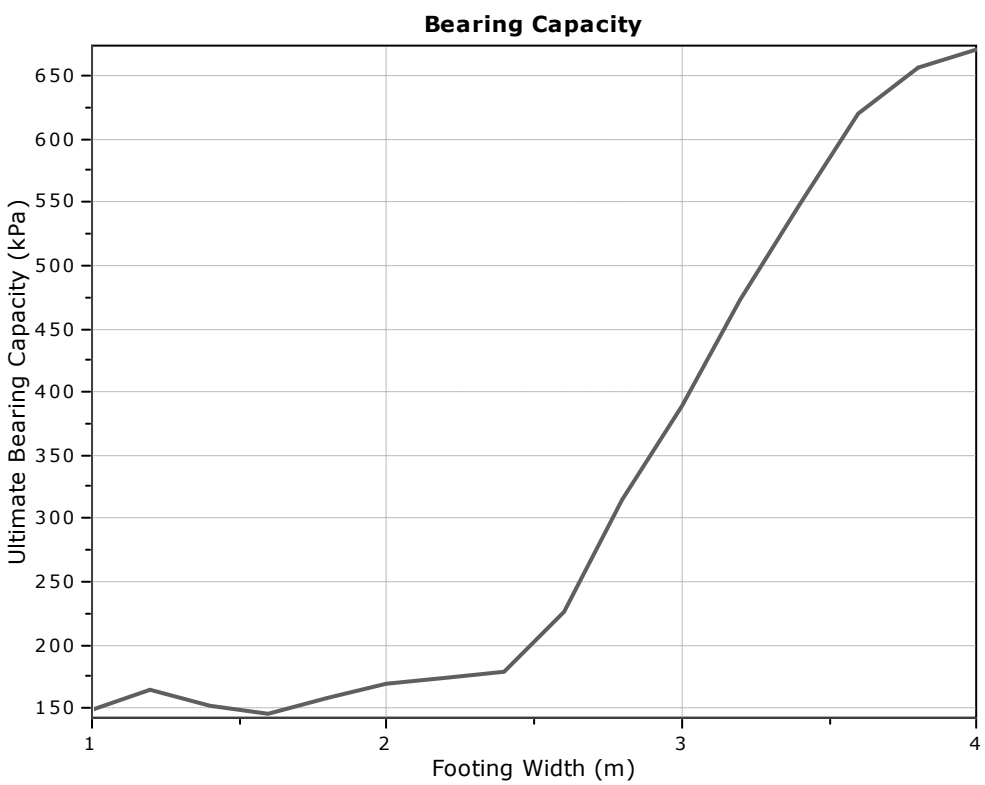
Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Bearing Capacity calculation is perfromed based on the formula:

$$Q_{ult} = R_k \times q_t + q_{soil}$$

where:
R_k: Bearing capacity factor
q_t: Average corrected cone resistance over calculation depth
q_{soil}: Pressure applied by soil above footing



:: Tabular results ::

No	B (m)	Start Depth (m)	End Depth (m)	Ave. q_t (MPa)	R_k	Soil Press. (kPa)	Ult. bearing cap. (kPa)
1	1.00	0.50	2.00	0.69	0.20	9.50	148.15
2	1.20	0.50	2.30	0.77	0.20	9.50	164.14
3	1.40	0.50	2.60	0.71	0.20	9.50	151.57
4	1.60	0.50	2.90	0.68	0.20	9.50	145.68
5	1.80	0.50	3.20	0.74	0.20	9.50	158.02
6	2.00	0.50	3.50	0.80	0.20	9.50	168.85
7	2.20	0.50	3.80	0.82	0.20	9.50	174.33
8	2.40	0.50	4.10	0.85	0.20	9.50	179.68
9	2.60	0.50	4.40	1.08	0.20	9.50	226.01
10	2.80	0.50	4.70	1.53	0.20	9.50	315.56
11	3.00	0.50	5.00	1.90	0.20	9.50	388.81
12	3.20	0.50	5.30	2.32	0.20	9.50	473.45
13	3.40	0.50	5.60	2.69	0.20	9.50	548.22
14	3.60	0.50	5.90	3.05	0.20	9.50	619.87
15	3.80	0.50	6.20	3.24	0.20	9.50	656.50
16	4.00	0.50	6.50	3.31	0.20	9.50	670.72

Presented below is a list of formulas used for the estimation of various soil properties. The formulas are presented in SI unit system and assume that all components are expressed in the same units.

:: Unit Weight, g (kN/m³) ::

$$g = g_w \cdot \left(0.27 \cdot \log(R_f) + 0.36 \cdot \log(\frac{q_t}{p_a}) + 1.236 \right)$$

where g_w = water unit weight

:: Permeability, k (m/s) ::

$I_c < 3.27$ and $I_c > 1.00$ then $k = 10^{0.952-3.04 \cdot I_c}$

$I_c \leq 4.00$ and $I_c > 3.27$ then $k = 10^{-4.52-1.37 \cdot I_c}$

:: N_{SPT} (blows per 30 cm) ::

$$N_{60} = \left(\frac{q_c}{P_a} \right) \cdot \frac{1}{10^{1.1268-0.2817 \cdot I_c}}$$

$$N_{1(60)} = Q_{tn} \cdot \frac{1}{10^{1.1268-0.2817 \cdot I_c}}$$

:: Young's Modulus, Es (MPa) ::

$$(q_t - \sigma_v) \cdot 0.015 \cdot 10^{0.55 \cdot I_c + 1.68}$$

(applicable only to $I_c < I_{c\_cutoff}$)

:: Relative Density, Dr (%) ::

$$100 \cdot \sqrt{\frac{Q_{tn}}{k_{DR}}}$$ (applicable only to SBT_n: 5, 6, 7 and 8 or $I_c < I_{c\_cutoff}$)

:: State Parameter, ψ ::

$$\psi = 0.56 - 0.33 \cdot \log(Q_{tn,cs})$$

:: Drained Friction Angle, φ (°) ::

$$\varphi = \varphi'_{cv} + 15.94 \cdot \log(Q_{tn,cs}) - 26.88$$

(applicable only to SBT_n: 5, 6, 7 and 8 or $I_c < I_{c\_cutoff}$)

:: 1-D constrained modulus, M (MPa) ::

If $I_c > 2.20$
$\alpha = 14$ for $Q_{tn} > 14$
$\alpha = Q_{tn}$ for $Q_{tn} \leq 14$
$M_{CPT} = \alpha \cdot (q_t - \sigma_v)$

If $I_c \geq 2.20$

$$M_{CPT} = 0.03 \cdot (q_t - \sigma_v) \cdot 10^{0.55 \cdot I_c + 1.68}$$

:: Small strain shear Modulus, Go (MPa) ::

$$G_0 = (q_t - \sigma_v) \cdot 0.0188 \cdot 10^{0.55 \cdot I_c + 1.68}$$

:: Shear Wave Velocity, Vs (m/s) ::

$$V_s = \left(\frac{G_0}{\rho} \right)^{0.50}$$

:: Undrained peak shear strength, Su (kPa) ::

$N_{kt} = 10.50 + 7 \cdot \log(F_r)$ or user defined

$$S_u = \frac{(q_t - \sigma_v)}{N_{kt}}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Remolded undrained shear strength, Su(rem) (kPa) ::

$S_{u(rem)} = f_s$ (applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Overconsolidation Ratio, OCR ::

$$k_{OCR} = \left[\frac{Q_{tn}^{0.20}}{0.25 \cdot (10.50 \cdot + 7 \cdot \log(F_r))} \right]^{1.25}$$ or user defined

$OCR = k_{OCR} \cdot Q_{tn}$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: In situ Stress Ratio, Ko ::

$$K_O = (1 - \sin\varphi') \cdot OCR^{\sin\varphi'}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Soil Sensitivity, S_t ::

$$S_t = \frac{N_S}{F_r}$$

(applicable only to SBT_n: 1, 2, 3, 4 and 9 or $I_c > I_{c\_cutoff}$)

:: Peak Friction Angle, φ' (°) ::

$$\varphi' = 29.5° \cdot B_q^{0.121} \cdot (0.256 + 0.336 \cdot B_q + \log Q_t)$$

(applicable for $0.10 < B_q < 1.00$)

References

• Robertson, P.K., Cabal K.L., Guide to Cone Penetration Testing for Geotechnical Engineering, Gregg Drilling & Testing, Inc., 5th Edition, November 2012

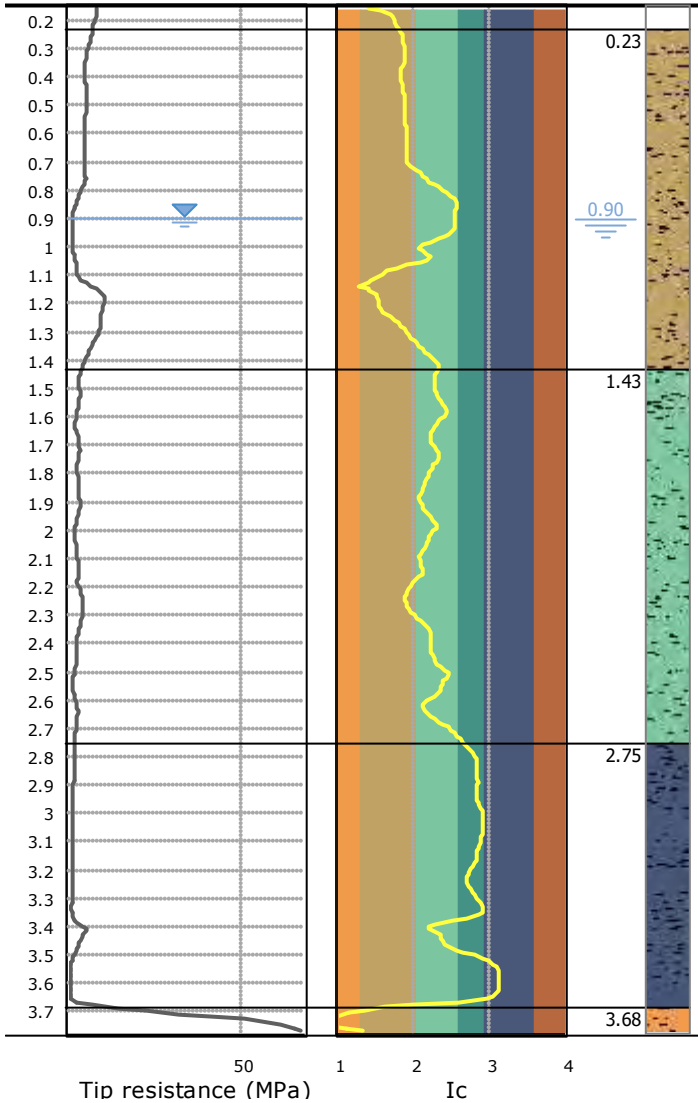
• Robertson, P.K., Interpretation of Cone Penetration Tests - a unified approach., Can. Geotech. J. 46(11): 1337–1355 (2009)

• N Barounis, J Philpot, Estimation of in-situ water content, void ratio, dry unit weight and porosity using CPT for saturated sands, Proc. 20th NZGS Geotechnical Symposium

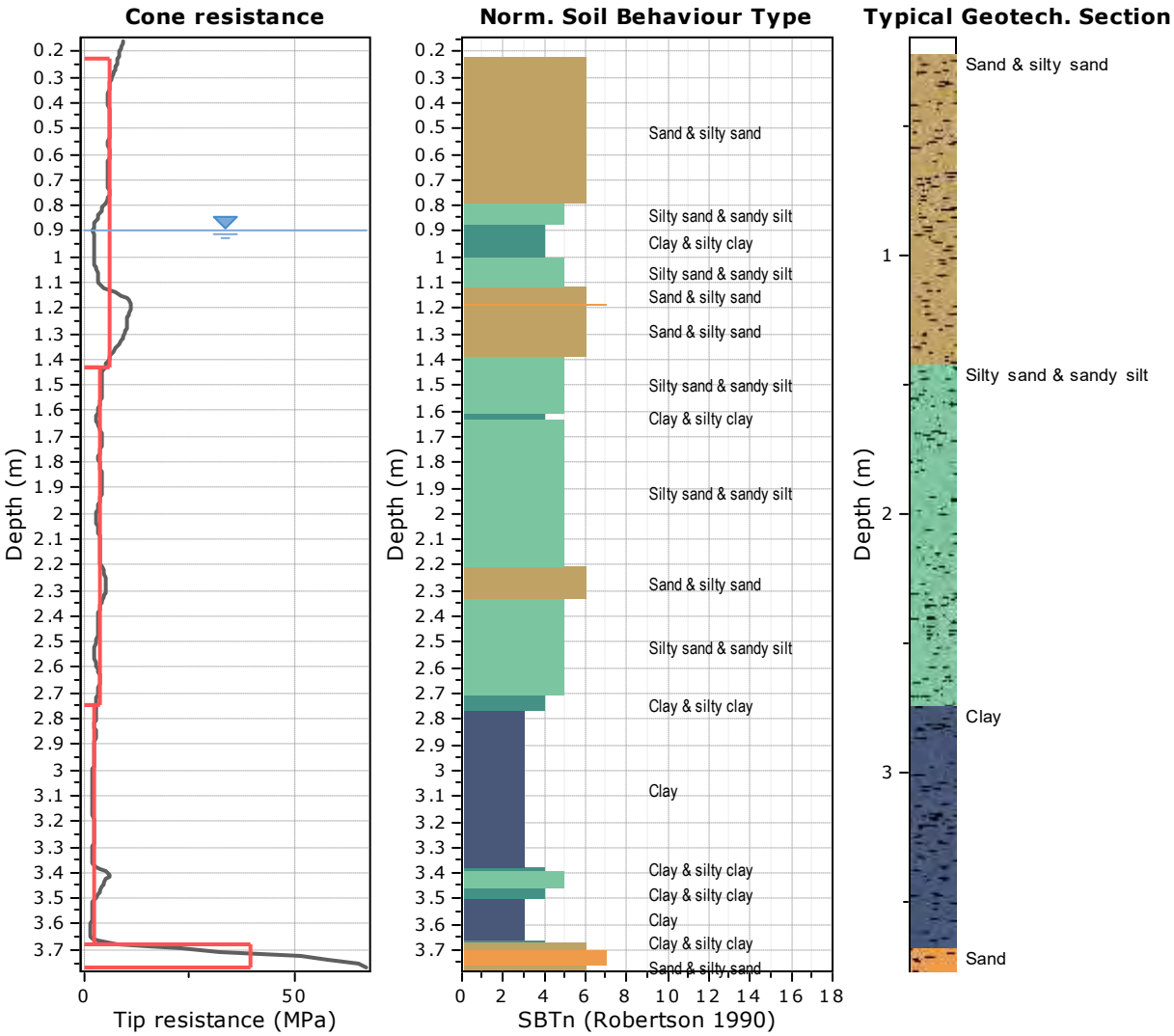
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Depth (m) Elevation: 0.00 (m)	Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
0.23	Sand & silty sand	5.8	5.12E-5	14.4	46.5	53.6	38.3	54.5	56.0	-	-	-	18.2
1.43	Silty sand & sandy silt	3.6	2.45E-6	11.1	42.3	41.3	37.0	47.5	52.0	-	-	-	18.1
2.75	Clay	2.5	1.86E-7	10.6	-	-	-	33.3	72.5	128.6	2.5	14.9	19.1
3.68	Sand	39.4	1.27E-3	56.9	109.5	93.3	47.1	137.2	147.7	-	-	-	20.0



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.23 (m), **End depth:** 1.43 (m)

Description: Sand & silty sand

Basic results	Estimation results	
Total cone resistance: 5.78 ±2.42 MPa	Permeability: 5.12E-05 ±1.28E-04 m/s	Constrained Mod.: 54.49 ±12.83 MPa
Sleeve friction: 56.66 ±20.35 kPa	N_{60}: 14.36 ±3.85 blows	Go: 56.05 ±9.97 MPa
Ic: 1.97 ±0.30	Es: 46.48 ±7.15 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 53.63 ±9.72	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 38.28 ±1.43 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.21 ±0.41 kN/m³	

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 1.43 (m), **End depth:** 2.75 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 3.59 ±0.66 MPa	Permeability: 2.45E-06 ±3.05E-06 m/s	Constrained Mod.: 47.52 ±7.09 MPa
Sleeve friction: 61.06 ±22.39 kPa	N_{60}: 11.11 ±1.51 blows	Go: 52.00 ±8.46 MPa
Ic: 2.23 ±0.14	Es: 42.35 ±5.91 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 41.25 ±3.88	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 36.95 ±0.99 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.13 ±0.41 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 2.75 (m), **End depth:** 3.68 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 2.45 ±1.06 MPa	Permeability: 1.86E-07 ±8.43E-07 m/s	Constrained Mod.: 33.32 ±13.80 MPa
Sleeve friction: 160.62 ±28.30 kPa	N_{60}: 10.65 ±2.37 blows	Go: 72.54 ±7.48 MPa
Ic: 2.80 ±0.22	Es: 0.00 ±0.00 MPa	Su: 128.59 ±33.89 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 2.54 ±0.53
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 14.94 ±5.04
	Unit weight: 19.13 ±0.21 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 3.68 (m), **End depth:** 3.77 (m)

Description: Sand

Basic results	Estimation results	
Total cone resistance: 39.36 ±20.95 MPa	Permeability: 1.27E-03 ±1.44E-03 m/s	Constrained Mod.: 137.25 ±44.98 MPa
Sleeve friction: 115.68 ±20.64 kPa	N_{60}: 56.89 ±24.04 blows	Go: 147.74 ±54.70 MPa
Ic: 1.19 ±0.41	Es: 109.51 ±35.89 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 7	Dr (%): 93.29 ±13.36	Su ratio: 0.00 ±0.00
SBTn description: Sand	φ (degrees): 47.07 ±3.69 °	O.C.R.: 0.00 ±0.00
	Unit weight: 19.95 ±0.58 kN/m³	

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01
Total depth: 3.77 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Summary table of mean values

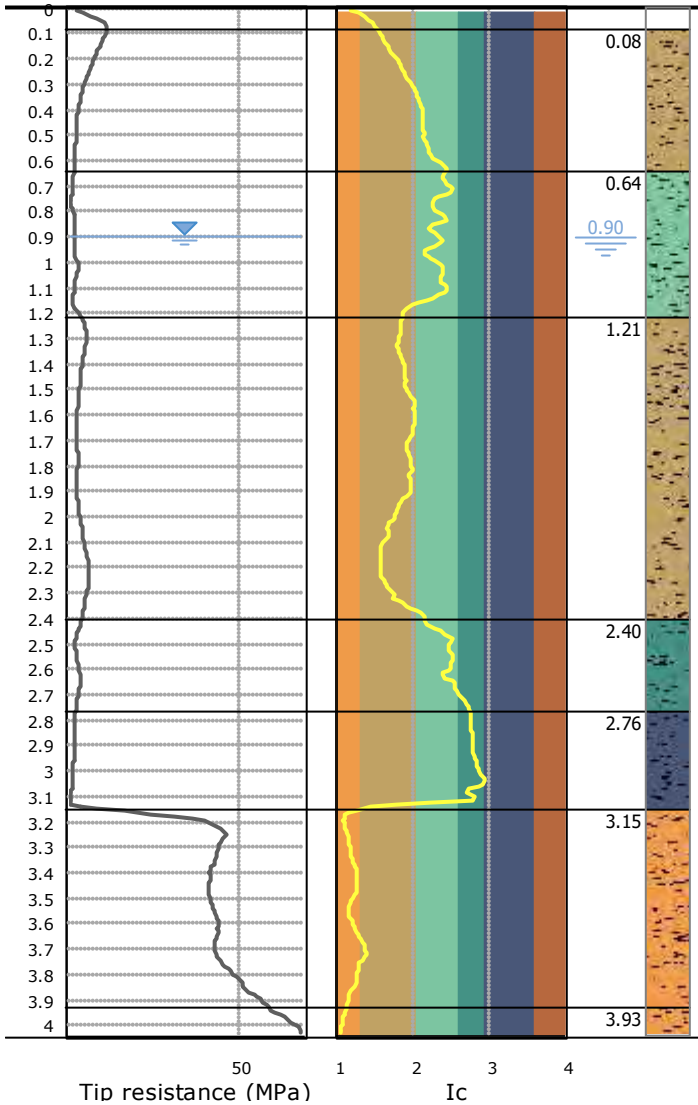
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r (%)	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.23	1.20	5.12E-05	14.4	46.5	53.6	38.3	54.5	56.0	0.0	0.0	0.0	18.2
1.43		(±1.28E-04)	(±3.9)	(±7.2)	(±9.7)	(±1.4)	(±12.8)	(±10.0)	(±0.0)	(±0.0)	(±0.0)	(±0.4)
1.43	1.32	2.45E-06	11.1	42.3	41.3	37.0	47.5	52.0	0.0	0.0	0.0	18.1
2.75		(±3.05E-06)	(±1.5)	(±5.9)	(±3.9)	(±1.0)	(±7.1)	(±8.5)	(±0.0)	(±0.0)	(±0.0)	(±0.4)
2.75	0.93	1.86E-07	10.6	0.0	0.0	0.0	33.3	72.5	128.6	2.5	14.9	19.1
3.68		(±8.43E-07)	(±2.4)	(±0.0)	(±0.0)	(±0.0)	(±13.8)	(±7.5)	(±33.9)	(±0.5)	(±5.0)	(±0.2)
3.68	0.09	1.27E-03	56.9	109.5	93.3	47.1	137.2	147.7	0.0	0.0	0.0	20.0
3.77		(±1.44E-03)	(±24.0)	(±35.9)	(±13.4)	(±3.7)	(±45.0)	(±54.7)	(±0.0)	(±0.0)	(±0.0)	(±0.6)

Depth values presented in this table are measured from free ground surface

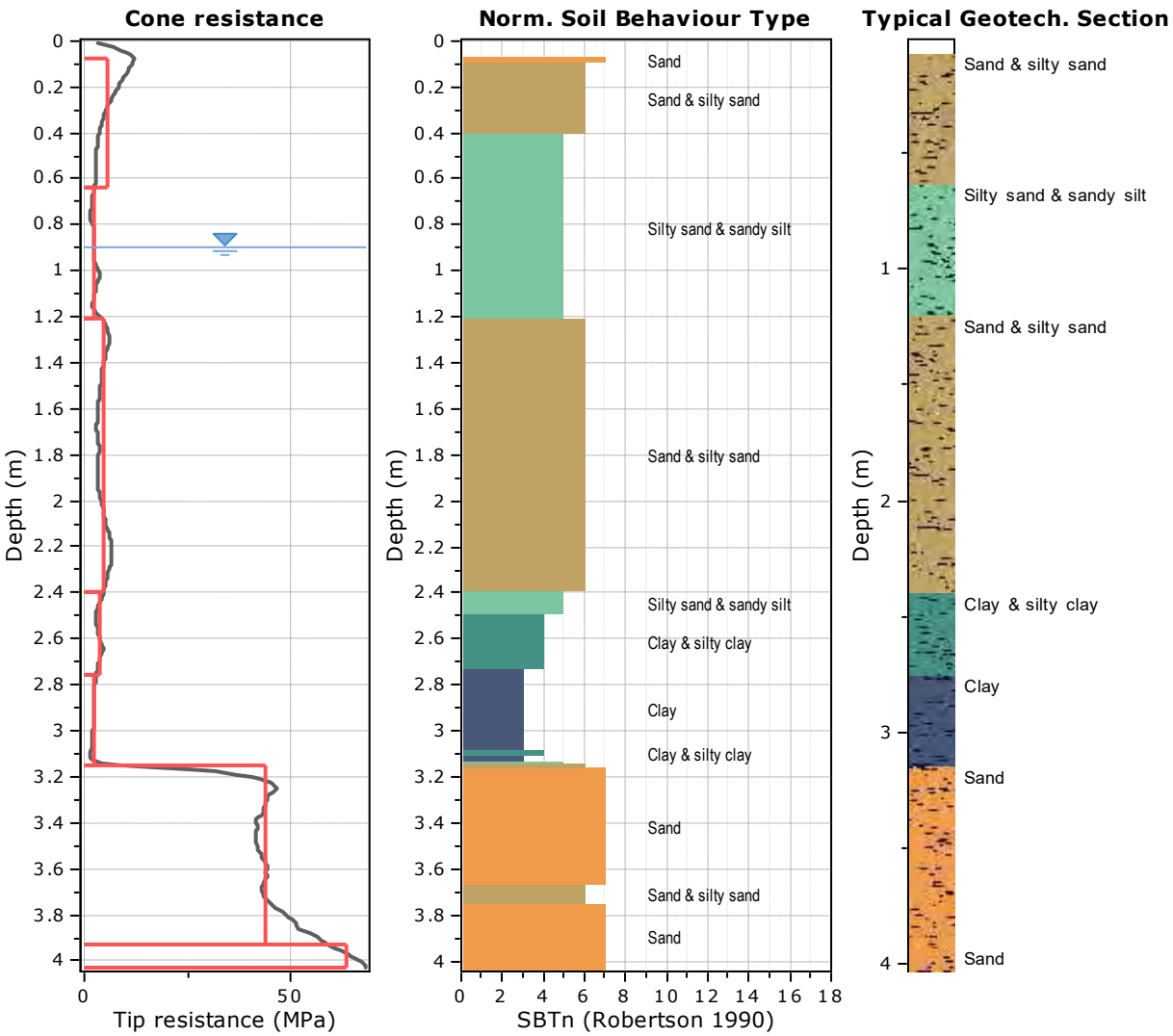
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Depth (m)	Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
0.08	Sand & silty sand	5.5	1.20E-4	12.6	37.9	49.3	36.8	47.4	44.8	-	-	-	17.6
0.64	Silty sand & sandy silt	2.4	8.59E-7	8.1	33.2	33.8	35.6	33.8	39.0	-	-	-	17.4
1.21	Sand & silty sand	4.5	3.72E-5	10.9	32.9	46.2	35.8	41.3	37.8	-	-	-	17.1
2.40	Clay & silty clay	3.6	7.14E-7	12.8	-	-	-	48.8	71.4	230.9	4.1	30.9	18.9
2.76	Clay	2.4	9.25E-7	10.3	-	-	-	32.1	69.0	132.7	2.6	15.5	19.0
3.15	Sand	44.2	1.92E-3	72.0	149.6	99.4	49.1	187.5	210.0	-	-	-	20.9
3.93	Sand	63.8	4.33E-3	95.6	182.5	100.0	51.2	228.8	260.2	-	-	-	21.3



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.08 (m), **End depth:** 0.64 (m)

Description: Sand & silty sand

Basic results	Estimation results	
Total cone resistance: 5.45 ±3.02 MPa	Permeability: 1.20E-04 ±3.33E-04 m/s	Constrained Mod.: 47.36 ±8.80 MPa
Sleeve friction: 32.93 ±8.66 kPa	N_{60}: 12.61 ±4.51 blows	Go: 44.82 ±9.27 MPa
Ic: 1.89 ±0.28	Es: 37.87 ±6.91 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 49.33 ±13.46	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 36.81 ±2.41 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.57 ±0.44 kN/m³	

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 0.64 (m), **End depth:** 1.21 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 2.44 ±0.63 MPa	Permeability: 8.59E-07 ±7.18E-07 m/s	Constrained Mod.: 33.82 ±8.62 MPa
Sleeve friction: 37.95 ±13.84 kPa	N_{60}: 8.12 ±1.72 blows	Go: 38.99 ±7.65 MPa
Ic: 2.34 ±0.10	Es: 33.20 ±5.60 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 33.79 ±4.37	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 35.62 ±1.02 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.43 ±0.50 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 1.21 (m), **End depth:** 2.40 (m)

Description: Sand & silty sand

Basic results	Estimation results	
Total cone resistance: 4.55 ±1.14 MPa	Permeability: 3.72E-05 ±4.28E-05 m/s	Constrained Mod.: 41.27 ±5.98 MPa
Sleeve friction: 22.87 ±10.16 kPa	N_{60}: 10.93 ±1.94 blows	Go: 37.85 ±6.59 MPa
Ic: 1.85 ±0.14	Es: 32.93 ±4.77 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 46.17 ±5.84	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 35.84 ±1.23 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.08 ±0.45 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 2.40 (m), **End depth:** 2.76 (m)

Description: Clay & silty clay

Basic results	Estimation results	
Total cone resistance: 3.56 ±0.60 MPa	Permeability: 7.14E-07 ±1.08E-06 m/s	Constrained Mod.: 48.83 ±7.92 MPa
Sleeve friction: 128.46 ±56.92 kPa	N_{60}: 12.81 ±2.00 blows	Go: 71.42 ±15.91 MPa
Ic: 2.44 ±0.16	Es: 0.00 ±0.00 MPa	Su: 230.94 ±38.84 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 4.14 ±0.70
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 30.88 ±6.53
	Unit weight: 18.93 ±0.58 kN/m³	

.:: Layer No: 5 ::.

Code: Layer_5 **Start depth:** 2.76 (m), **End depth:** 3.15 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 2.43 ±1.17 MPa	Permeability: 9.25E-07 ±5.46E-06 m/s	Constrained Mod.: 32.09 ±9.81 MPa
Sleeve friction: 145.19 ±38.78 kPa	N_{60}: 10.32 ±2.35 blows	Go: 69.00 ±10.95 MPa
Ic: 2.77 ±0.19	Es: 0.00 ±0.00 MPa	Su: 132.71 ±22.01 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 2.59 ±0.45
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 15.45 ±3.17
	Unit weight: 18.98 ±0.42 kN/m³	

.:: Layer No: 6 ::.

Code: Layer_6 **Start depth:** 3.15 (m), **End depth:** 3.93 (m)

Description: Sand

Basic results	**Estimation results**	
Total cone resistance: 44.15 ±7.26 MPa	Permeability: 1.92E-03 ±9.74E-04 m/s	Constrained Mod.: 187.51 ±30.18 MPa
Sleeve friction: 279.33 ±77.83 kPa	N_{60}: 72.03 ±11.22 blows	Go: 210.00 ±37.12 MPa
Ic: 1.23 ±0.10	Es: 149.61 ±24.08 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 7	Dr (%): 99.40 ±4.13	Su ratio: 0.00 ±0.00
SBTn description: Sand	φ (degrees): 49.08 ±1.38 °	O.C.R.: 0.00 ±0.00
	Unit weight: 20.86 ±0.44 kN/m³	

.:: Layer No: 7 ::.

Code: Layer_7 **Start depth:** 3.93 (m), **End depth:** 4.03 (m)

Description: Sand

Basic results	**Estimation results**	
Total cone resistance: 63.84 ±3.23 MPa	Permeability: 4.33E-03 ±8.21E-04 m/s	Constrained Mod.: 228.76 ±3.59 MPa
Sleeve friction: 331.62 ±0.00 kPa	N_{60}: 95.60 ±3.03 blows	Go: 260.23 ±4.32 MPa
Ic: 1.09 ±0.03	Es: 182.52 ±2.87 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 7	Dr (%): 100.00 ±0.00	Su ratio: 0.00 ±0.00
SBTn description: Sand	φ (degrees): 51.16 ±0.27 °	O.C.R.: 0.00 ±0.00
	Unit weight: 21.26 ±0.02 kN/m³	

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01A
Total depth: 4.03 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Summary table of mean values

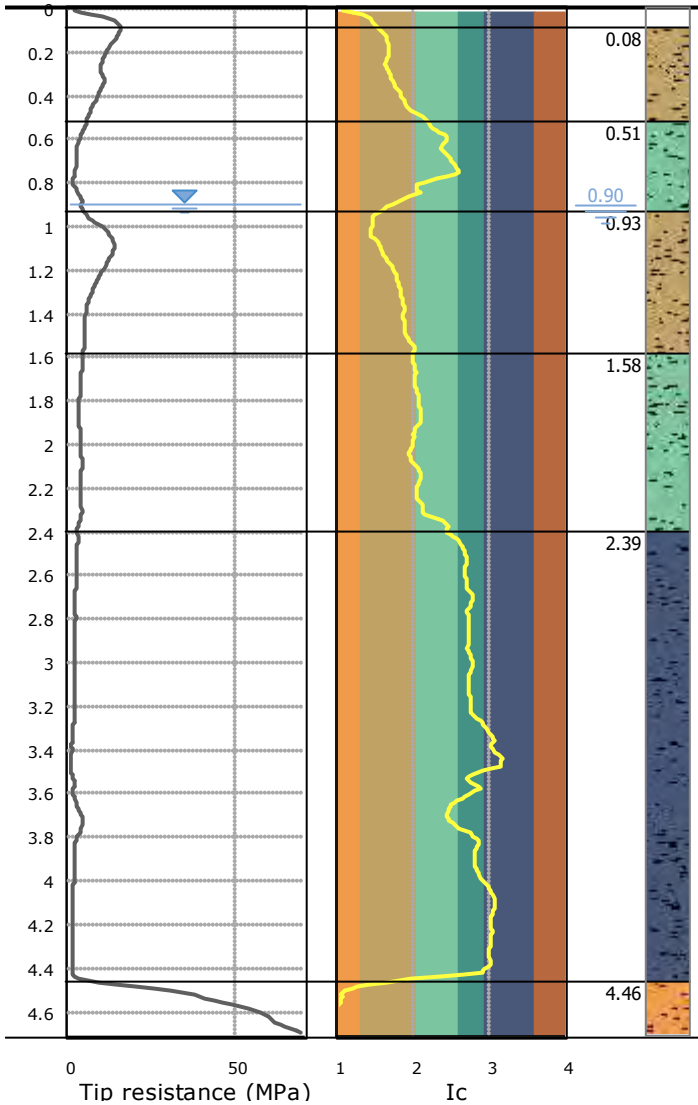
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r (%)	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.08 0.64	0.56	1.20E-04 (±3.33E-04)	12.6 (±4.5)	37.9 (±6.9)	49.3 (±13.5)	36.8 (±2.4)	47.4 (±8.8)	44.8 (±9.3)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	17.6 (±0.4)
0.64 1.21	0.57	8.59E-07 (±7.18E-07)	8.1 (±1.7)	33.2 (±5.6)	33.8 (±4.4)	35.6 (±1.0)	33.8 (±8.6)	39.0 (±7.6)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	17.4 (±0.5)
1.21 2.40	1.19	3.72E-05 (±4.28E-05)	10.9 (±1.9)	32.9 (±4.8)	46.2 (±5.8)	35.8 (±1.2)	41.3 (±6.0)	37.8 (±6.6)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	17.1 (±0.5)
2.40 2.76	0.36	7.14E-07 (±1.08E-06)	12.8 (±2.0)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	48.8 (±7.9)	71.4 (±15.9)	230.9 (±38.8)	4.1 (±0.7)	30.9 (±6.5)	18.9 (±0.6)
2.76 3.15	0.39	9.25E-07 (±5.46E-06)	10.3 (±2.3)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	32.1 (±9.8)	69.0 (±11.0)	132.7 (±22.0)	2.6 (±0.5)	15.5 (±3.2)	19.0 (±0.4)
3.15 3.93	0.78	1.92E-03 (±9.74E-04)	72.0 (±11.2)	149.6 (±24.1)	99.4 (±4.1)	49.1 (±1.4)	187.5 (±30.2)	210.0 (±37.1)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	20.9 (±0.4)
3.93 4.03	0.10	4.33E-03 (±8.21E-04)	95.6 (±3.0)	182.5 (±2.9)	100.0 (±0.0)	51.2 (±0.3)	228.8 (±3.6)	260.2 (±4.3)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	21.3 (±0.0)

Depth values presented in this table are measured from free ground surface

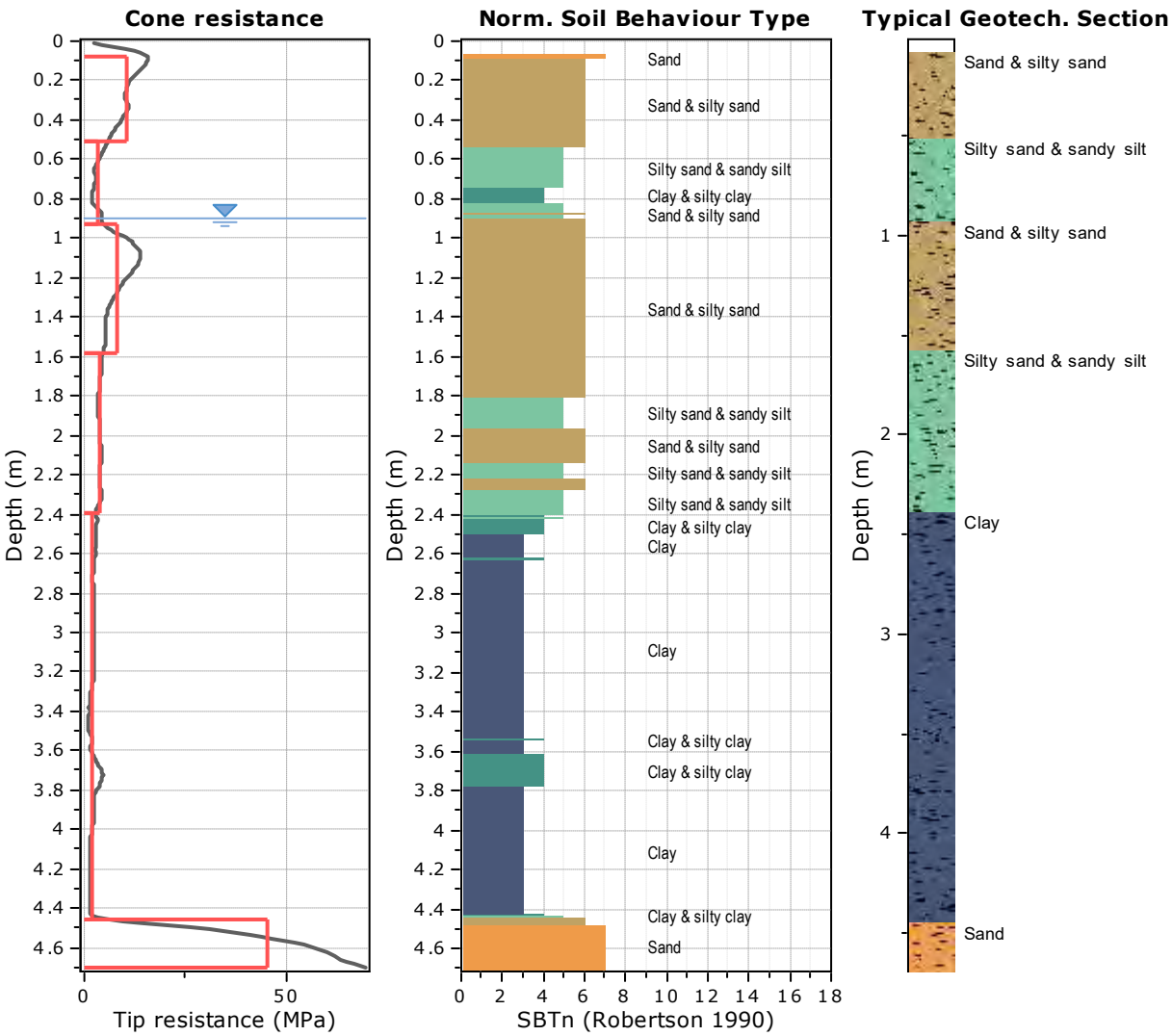
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
Sand & silty sand	10.6	2.58E-4	22.4	60.3	70.8	40.9	75.5	76.5	-	-	-	18.9
Silty sand & sandy silt	3.3	2.77E-6	10.4	42.1	41.4	37.2	42.9	49.1	-	-	-	18.0
Sand & silty sand	8.3	9.69E-5	18.1	50.1	61.8	39.3	62.8	62.0	-	-	-	18.3
Silty sand & sandy silt	3.9	5.35E-6	10.8	37.3	42.8	36.0	46.5	44.3	-	-	-	17.7
Clay	2.1	9.88E-8	9.4	-	-	-	28.8	62.2	127.7	2.4	15.0	18.8
Sand	45.0	3.69E-3	63.3	114.9	94.7	47.6	144.0	155.2	-	-	-	20.0



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.08 (m), **End depth:** 0.51 (m)

Description: Sand & silty sand

Basic results	Estimation results	
Total cone resistance: 10.63 ±2.72 MPa	Permeability: 2.58E-04 ±7.49E-04 m/s	Constrained Mod.: 75.54 ±7.95 MPa
Sleeve friction: 79.72 ±17.12 kPa	N_{60}: 22.36 ±3.61 blows	Go: 76.45 ±9.22 MPa
Ic: 1.65 ±0.17	Es: 60.27 ±6.34 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 70.77 ±9.21	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 40.85 ±1.40 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.88 ±0.36 kN/m³	

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 0.51 (m), **End depth:** 0.93 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 3.33 ±1.16 MPa	Permeability: 2.77E-06 ±3.87E-06 m/s	Constrained Mod.: 42.86 ±11.89 MPa
Sleeve friction: 55.48 ±12.39 kPa	N_{60}: 10.44 ±2.30 blows	Go: 49.12 ±6.53 MPa
Ic: 2.28 ±0.21	Es: 42.15 ±3.68 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 41.41 ±5.82	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 37.20 ±0.50 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.02 ±0.30 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 0.93 (m), **End depth:** 1.58 (m)

Description: Sand & silty sand

Basic results	Estimation results	
Total cone resistance: 8.28 ±3.20 MPa	Permeability: 9.69E-05 ±1.11E-04 m/s	Constrained Mod.: 62.78 ±12.02 MPa
Sleeve friction: 56.39 ±18.66 kPa	N_{60}: 18.09 ±5.09 blows	Go: 61.95 ±13.56 MPa
Ic: 1.73 ±0.17	Es: 50.09 ±9.59 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 61.78 ±11.96	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 39.27 ±2.01 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.35 ±0.50 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 1.58 (m), **End depth:** 2.39 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 3.87 ±0.32 MPa	Permeability: 5.35E-06 ±1.98E-06 m/s	Constrained Mod.: 46.51 ±3.09 MPa
Sleeve friction: 38.32 ±7.73 kPa	N_{60}: 10.83 ±0.64 blows	Go: 44.32 ±3.38 MPa
Ic: 2.06 ±0.07	Es: 37.34 ±2.39 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 42.84 ±1.81	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 35.99 ±0.45 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.68 ±0.21 kN/m³	

.:: Layer No: 5 ::.

Code: Layer_5 **Start depth:** 2.39 (m), **End depth:** 4.46 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 2.13 ±0.79 MPa	Permeability: 9.88E-08 ±6.32E-07 m/s	Constrained Mod.: 28.84 ±10.74 MPa
Sleeve friction: 123.49 ±32.59 kPa	N_{60}: 9.40 ±2.33 blows	Go: 62.23 ±11.81 MPa
Ic: 2.81 ±0.19	Es: 0.00 ±0.00 MPa	Su: 127.67 ±51.38 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 2.43 ±0.89
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 15.01 ±7.63
	Unit weight: 18.76 ±0.40 kN/m³	

.:: Layer No: 6 ::.

Code: Layer_6 **Start depth:** 4.46 (m), **End depth:** 4.70 (m)

Description: Sand

Basic results	**Estimation results**	
Total cone resistance: 45.00 ±18.77 MPa	Permeability: 3.69E-03 ±2.67E-03 m/s	Constrained Mod.: 144.01 ±37.60 MPa
Sleeve friction: 135.99 ±47.35 kPa	N_{60}: 63.25 ±21.91 blows	Go: 155.19 ±44.18 MPa
Ic: 1.08 ±0.27	Es: 114.90 ±30.00 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 7	Dr (%): 94.74 ±12.91	Su ratio: 0.00 ±0.00
SBTn description: Sand	φ (degrees): 47.60 ±3.68 °	O.C.R.: 0.00 ±0.00
	Unit weight: 19.96 ±0.71 kN/m³	

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01B
Total depth: 4.70 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Summary table of mean values

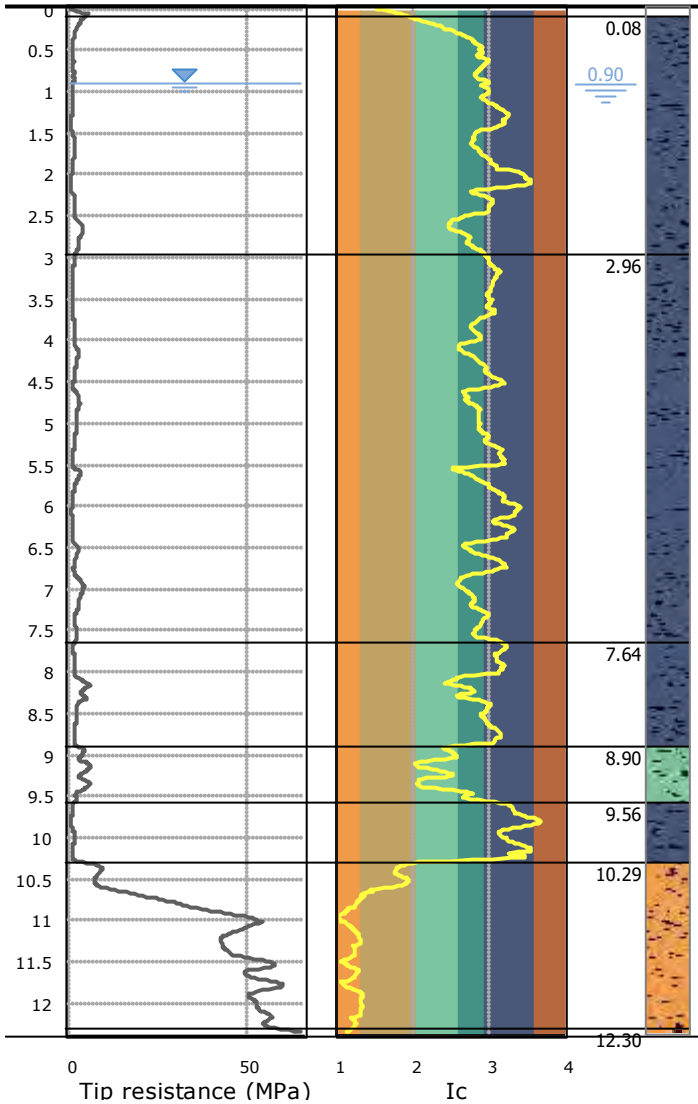
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r (%)	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.08	0.43	2.58E-04	22.4	60.3	70.8	40.9	75.5	76.5	0.0	0.0	0.0	18.9
0.51		(±7.49E-04)	(±3.6)	(±6.3)	(±9.2)	(±1.4)	(±7.9)	(±9.2)	(±0.0)	(±0.0)	(±0.0)	(±0.4)
0.51	0.42	2.77E-06	10.4	42.1	41.4	37.2	42.9	49.1	0.0	0.0	0.0	18.0
0.93		(±3.87E-06)	(±2.3)	(±3.7)	(±5.8)	(±0.5)	(±11.9)	(±6.5)	(±0.0)	(±0.0)	(±0.0)	(±0.3)
0.93	0.65	9.69E-05	18.1	50.1	61.8	39.3	62.8	62.0	0.0	0.0	0.0	18.3
1.58		(±1.11E-04)	(±5.1)	(±9.6)	(±12.0)	(±2.0)	(±12.0)	(±13.6)	(±0.0)	(±0.0)	(±0.0)	(±0.5)
1.58	0.81	5.35E-06	10.8	37.3	42.8	36.0	46.5	44.3	0.0	0.0	0.0	17.7
2.39		(±1.98E-06)	(±0.6)	(±2.4)	(±1.8)	(±0.4)	(±3.1)	(±3.4)	(±0.0)	(±0.0)	(±0.0)	(±0.2)
2.39	2.07	9.88E-08	9.4	0.0	0.0	0.0	28.8	62.2	127.7	2.4	15.0	18.8
4.46		(±6.32E-07)	(±2.3)	(±0.0)	(±0.0)	(±0.0)	(±10.7)	(±11.8)	(±51.4)	(±0.9)	(±7.6)	(±0.4)
4.46	0.24	3.69E-03	63.3	114.9	94.7	47.6	144.0	155.2	0.0	0.0	0.0	20.0
4.70		(±2.67E-03)	(±21.9)	(±30.0)	(±12.9)	(±3.7)	(±37.6)	(±44.2)	(±0.0)	(±0.0)	(±0.0)	(±0.7)

Depth values presented in this table are measured from free ground surface

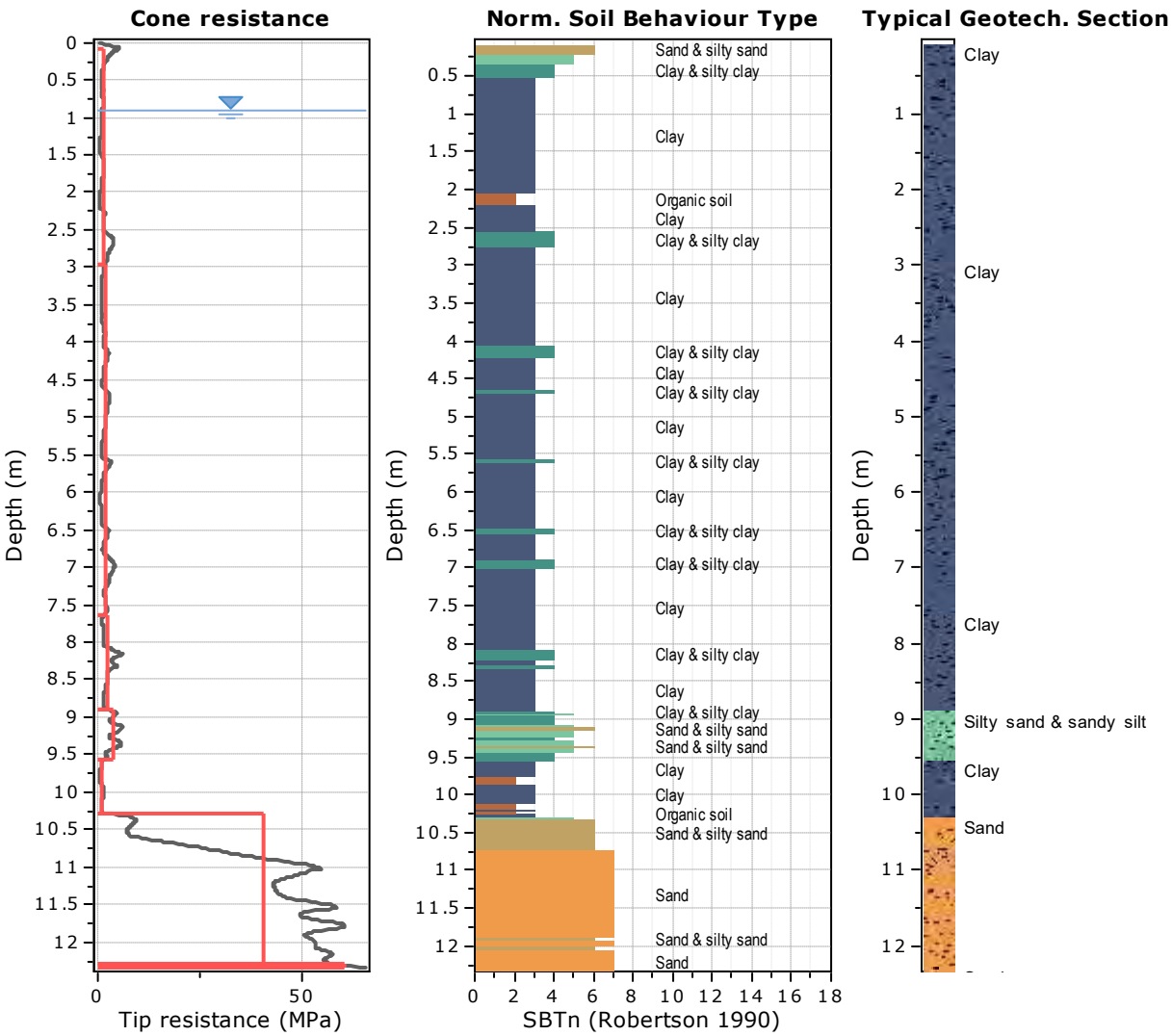
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Depth (m)	Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
0.08	Clay	1.4	1.29E-6	6.2	-	-	-	18.4	39.8	83.6	1.5	9.1	17.5
2.96	Clay	1.7	2.09E-8	8.1	-	-	-	22.1	55.5	98.2	1.8	10.3	18.5
7.64	Clay	2.2	3.12E-8	10.6	-	-	-	28.8	73.1	127.1	1.9	10.8	18.9
8.90	Silty sand & sandy silt	3.8	1.54E-6	12.8	53.3	38.0	35.8	49.2	62.7	-	-	-	18.2
9.56	Clay	1.0	2.16E-9	6.0	-	-	-	7.5	43.1	47.0	0.6	2.5	17.6
10.29	Sand	40.7	1.62E-3	67.6	143.9	89.2	45.3	179.5	198.5	-	-	-	20.2
12.30	Sand	60.3	2.12E-3	96.2	195.6	100.0	48.7	245.1	278.2	-	-	-	21.2



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.08 (m), **End depth:** 2.96 (m)

Description: Clay

Basic results

Total cone resistance: 1.43 ±0.94 MPa
Sleeve friction: 61.99 ±43.38 kPa
Ic: 2.86 ±0.34
SBT_n: 3
SBTn description: Clay

Estimation results

Permeability: 1.29E-06 ±8.67E-06 m/s
N_{60}: 6.20 ±2.86 blows
Es: 0.00 ±0.00 MPa
Dr (%): 0.00 ±0.00
φ (degrees): 0.00 ±0.00 °
Unit weight: 17.53 ±0.91 kN/m³
Constrained Mod.: 18.36 ±11.90 MPa
Go: 39.84 ±16.70 MPa
Su: 83.57 ±53.48 kPa
Su ratio: 1.53 ±0.97
O.C.R.: 9.11 ±7.56

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 2.96 (m), **End depth:** 7.64 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 1.69 ±0.75 MPa	Permeability: 2.09E-08 ±2.80E-08 m/s	Constrained Mod.: 22.09 ±10.58 MPa
Sleeve friction: 107.67 ±40.53 kPa	N_{60}: 8.06 ±2.67 blows	Go: 55.53 ±15.74 MPa
Ic: 2.95 ±0.19	Es: 0.00 ±0.00 MPa	Su: 98.18 ±48.19 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 1.82 ±0.79
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 10.30 ±5.95
	Unit weight: 18.46 ±0.56 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 7.64 (m), **End depth:** 8.90 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 2.21 ±1.22 MPa	Permeability: 3.12E-08 ±6.62E-08 m/s	Constrained Mod.: 28.76 ±17.15 MPa
Sleeve friction: 142.36 ±55.79 kPa	N_{60}: 10.55 ±3.99 blows	Go: 73.10 ±22.23 MPa
Ic: 2.97 ±0.21	Es: 0.00 ±0.00 MPa	Su: 127.09 ±82.35 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 1.87 ±1.08
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 10.84 ±8.83
	Unit weight: 18.87 ±0.58 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 8.90 (m), **End depth:** 9.56 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 3.84 ±1.29 MPa	Permeability: 1.54E-06 ±1.98E-06 m/s	Constrained Mod.: 49.16 ±15.25 MPa
Sleeve friction: 63.66 ±23.36 kPa	N_{60}: 12.81 ±2.64 blows	Go: 62.70 ±10.06 MPa
Ic: 2.39 ±0.24	Es: 53.27 ±4.87 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 38.02 ±3.45	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 35.80 ±0.94 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.20 ±0.39 kN/m³	

.:: Layer No: 5 ::.

Code: Layer_5 **Start depth:** 9.56 (m), **End depth:** 10.29 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 0.96 ±0.35 MPa	Permeability: 2.16E-09 ±5.28E-09 m/s	Constrained Mod.: 7.51 ±6.01 MPa
Sleeve friction: 63.64 ±33.68 kPa	N_{60}: 5.96 ±1.53 blows	Go: 43.10 ±13.00 MPa
Ic: 3.34 ±0.20	Es: 0.00 ±0.00 MPa	Su: 46.97 ±23.08 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 0.61 ±0.27
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 2.54 ±1.59
	Unit weight: 17.57 ±0.71 kN/m³	

.:: Layer No: 6 ::.

Code: Layer_6 **Start depth:** 10.29 (m), **End depth:** 12.30 (m)

Description: Sand

Basic results	**Estimation results**	
Total cone resistance: 40.73 ±17.91 MPa	Permeability: 1.62E-03 ±1.52E-03 m/s	Constrained Mod.: 179.47 ±63.40 MPa
Sleeve friction: 212.23 ±113.80 kPa	N_{60}: 67.58 ±26.75 blows	Go: 198.51 ±75.91 MPa
Ic: 1.35 ±0.28	Es: 143.92 ±49.75 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 7	Dr (%): 89.22 ±20.05	Su ratio: 0.00 ±0.00
SBTn description: Sand	φ (degrees): 45.28 ±4.33 °	O.C.R.: 0.00 ±0.00
	Unit weight: 20.25 ±1.12 kN/m³	

.:: Layer No: 7 ::.

Code: Layer_7 **Start depth:** 12.30 (m), **End depth:** 12.34 (m)

Description: Sand

Basic results	**Estimation results**	
Total cone resistance: 60.25 ±2.86 MPa	Permeability: 2.12E-03 ±4.38E-04 m/s	Constrained Mod.: 245.10 ±2.61 MPa
Sleeve friction: 325.60 ±0.00 kPa	N_{60}: 96.20 ±2.86 blows	Go: 278.25 ±3.20 MPa
Ic: 1.19 ±0.03	Es: 195.56 ±2.08 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 7	Dr (%): 100.00 ±0.00	Su ratio: 0.00 ±0.00
SBTn description: Sand	φ (degrees): 48.70 ±0.33 °	O.C.R.: 0.00 ±0.00
	Unit weight: 21.21 ±0.02 kN/m³	

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-01C
Total depth: 12.34 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Summary table of mean values

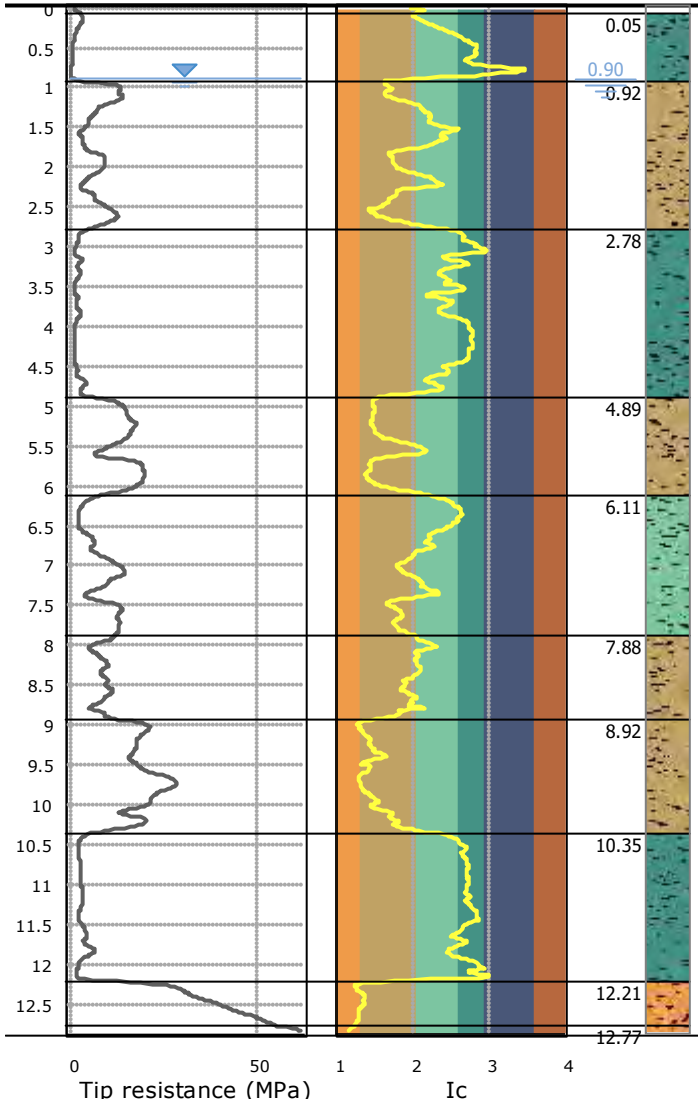
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r (%)	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.08	2.88	1.29E-06	6.2	0.0	0.0	0.0	18.4	39.8	83.6	1.5	9.1	17.5
2.96		(±8.67E-06)	(±2.9)	(±0.0)	(±0.0)	(±0.0)	(±11.9)	(±16.7)	(±53.5)	(±1.0)	(±7.6)	(±0.9)
2.96	4.68	2.09E-08	8.1	0.0	0.0	0.0	22.1	55.5	98.2	1.8	10.3	18.5
7.64		(±2.80E-08)	(±2.7)	(±0.0)	(±0.0)	(±0.0)	(±10.6)	(±15.7)	(±48.2)	(±0.8)	(±6.0)	(±0.6)
7.64	1.26	3.12E-08	10.6	0.0	0.0	0.0	28.8	73.1	127.1	1.9	10.8	18.9
8.90		(±6.62E-08)	(±4.0)	(±0.0)	(±0.0)	(±0.0)	(±17.1)	(±22.2)	(±82.4)	(±1.1)	(±8.8)	(±0.6)
8.90	0.66	1.54E-06	12.8	53.3	38.0	35.8	49.2	62.7	0.0	0.0	0.0	18.2
9.56		(±1.98E-06)	(±2.6)	(±4.9)	(±3.4)	(±0.9)	(±15.3)	(±10.1)	(±0.0)	(±0.0)	(±0.0)	(±0.4)
9.56	0.73	2.16E-09	6.0	0.0	0.0	0.0	7.5	43.1	47.0	0.6	2.5	17.6
10.29		(±5.28E-09)	(±1.5)	(±0.0)	(±0.0)	(±0.0)	(±6.0)	(±13.0)	(±23.1)	(±0.3)	(±1.6)	(±0.7)
10.29	2.01	1.62E-03	67.6	143.9	89.2	45.3	179.5	198.5	0.0	0.0	0.0	20.2
12.30		(±1.52E-03)	(±26.7)	(±49.8)	(±20.1)	(±4.3)	(±63.4)	(±75.9)	(±0.0)	(±0.0)	(±0.0)	(±1.1)
12.30	0.04	2.12E-03	96.2	195.6	100.0	48.7	245.1	278.2	0.0	0.0	0.0	21.2
12.34		(±4.38E-04)	(±2.9)	(±2.1)	(±0.0)	(±0.3)	(±2.6)	(±3.2)	(±0.0)	(±0.0)	(±0.0)	(±0.0)

Depth values presented in this table are measured from free ground surface

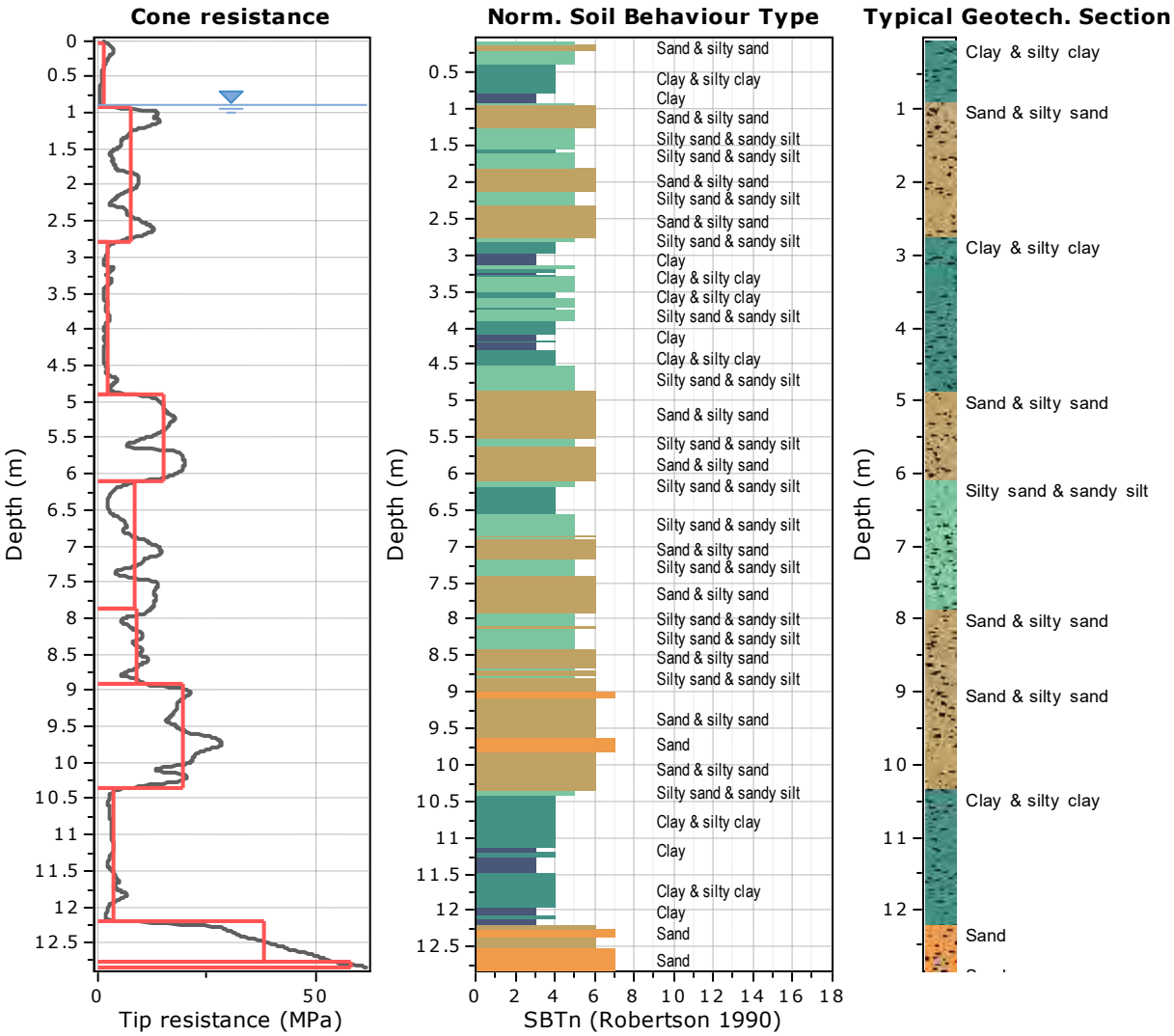
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Depth (m)	Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
0.05	Clay & silty clay	1.4	1.18E-6	5.0	-	-	-	17.5	23.7	57.7	0.8	5.6	16.1
0.92	Sand & silty sand	7.5	4.56E-5	18.5	58.6	59.3	39.7	69.7	74.0	-	-	-	18.9
2.78	Clay & silty clay	2.2	5.52E-7	8.1	-	-	-	29.0	43.5	115.8	2.0	13.1	17.8
4.89	Sand & silty sand	15.0	2.31E-4	30.6	78.8	74.7	41.7	98.7	102.3	-	-	-	19.3
6.11	Silty sand & sandy silt	8.3	1.26E-5	22.5	82.9	57.5	39.9	88.5	99.4	-	-	-	19.3
7.88	Sand & silty sand	8.8	9.49E-6	23.9	79.2	52.9	38.6	98.5	102.8	-	-	-	19.3
8.92	Sand & silty sand	19.6	4.42E-4	37.5	90.8	75.0	41.5	113.8	118.0	-	-	-	19.3
10.35	Clay & silty clay	3.4	1.86E-7	13.8	-	-	-	43.8	82.3	210.4	2.0	13.2	18.7
12.21	Sand	37.9	9.44E-4	65.4	142.9	93.2	45.0	179.0	196.3	-	-	-	20.3
12.77	Sand	57.8	1.99E-3	93.0	189.6	100.0	48.3	237.7	268.6	-	-	-	21.1



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.05 (m), **End depth:** 0.92 (m)

Description: Clay & silty clay

Basic results	Estimation results	
Total cone resistance: 1.42 ±1.05 MPa	Permeability: 1.18E-06 ±2.15E-06 m/s	Constrained Mod.: 17.48 ±13.71 MPa
Sleeve friction: 17.07 ±9.25 kPa	N_{60}: 4.98 ±2.58 blows	Go: 23.74 ±9.11 MPa
Ic: 2.58 ±0.48	Es: 0.00 ±0.00 MPa	Su: 57.74 ±23.79 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 0.84 ±0.36
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 5.58 ±2.79
	Unit weight: 16.07 ±1.01 kN/m³	

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 0.92 (m), **End depth:** 2.78 (m)

Description: Sand & silty sand

Basic results	Estimation results	
Total cone resistance: 7.54 ±3.43 MPa	Permeability: 4.56E-05 ±7.34E-05 m/s	Constrained Mod.: 69.68 ±17.75 MPa
Sleeve friction: 93.64 ±34.15 kPa	N_{60}: 18.52 ±5.75 blows	Go: 73.98 ±16.57 MPa
Ic: 1.95 ±0.30	Es: 58.61 ±11.54 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 59.33 ±13.39	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 39.74 ±1.63 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.87 ±0.49 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 2.78 (m), **End depth:** 4.89 (m)

Description: Clay & silty clay

Basic results	Estimation results	
Total cone resistance: 2.16 ±0.85 MPa	Permeability: 5.52E-07 ±1.96E-06 m/s	Constrained Mod.: 29.01 ±11.06 MPa
Sleeve friction: 56.22 ±25.00 kPa	N_{60}: 8.08 ±2.17 blows	Go: 43.50 ±10.76 MPa
Ic: 2.55 ±0.21	Es: 0.00 ±0.00 MPa	Su: 115.76 ±29.84 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 2.00 ±0.51
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 13.09 ±4.33
	Unit weight: 17.75 ±0.67 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 4.89 (m), **End depth:** 6.11 (m)

Description: Sand & silty sand

Basic results	Estimation results	
Total cone resistance: 15.04 ±3.80 MPa	Permeability: 2.31E-04 ±1.56E-04 m/s	Constrained Mod.: 98.73 ±12.67 MPa
Sleeve friction: 107.93 ±41.77 kPa	N_{60}: 30.55 ±5.04 blows	Go: 102.32 ±14.92 MPa
Ic: 1.60 ±0.22	Es: 78.77 ±10.11 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 74.74 ±8.59	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 41.73 ±1.11 °	O.C.R.: 0.00 ±0.00
	Unit weight: 19.32 ±0.42 kN/m³	

.:: Layer No: 5 ::.

Code: Layer_5 **Start depth:** 6.11 (m), **End depth:** 7.88 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 8.34 ±4.24 MPa	Permeability: 1.26E-05 ±1.75E-05 m/s	Constrained Mod.: 88.54 ±34.28 MPa
Sleeve friction: 137.32 ±52.42 kPa	N_{60}: 22.52 ±8.69 blows	Go: 99.40 ±30.12 MPa
Ic: 2.12 ±0.29	Es: 82.91 ±17.05 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 57.50 ±10.30	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 39.85 ±1.45 °	O.C.R.: 0.00 ±0.00
	Unit weight: 19.31 ±0.65 kN/m³	

.:: Layer No: 6 ::.

Code: Layer_6 **Start depth:** 7.88 (m), **End depth:** 8.92 (m)

Description: Sand & silty sand

Basic results	Estimation results	
Total cone resistance: 8.85 ±1.85 MPa	Permeability: 9.49E-06 ±8.59E-06 m/s	Constrained Mod.: 98.46 ±18.45 MPa
Sleeve friction: 125.01 ±49.68 kPa	N_{60}: 23.86 ±4.33 blows	Go: 102.81 ±21.01 MPa
Ic: 2.01 ±0.12	Es: 79.16 ±14.14 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 52.88 ±5.80	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 38.62 ±1.32 °	O.C.R.: 0.00 ±0.00
	Unit weight: 19.27 ±0.57 kN/m³	

.:: Layer No: 7 ::.

Code: Layer_7 **Start depth:** 8.92 (m), **End depth:** 10.35 (m)

Description: Sand & silty sand

Basic results	Estimation results	
Total cone resistance: 19.59 ±4.19 MPa	Permeability: 4.42E-04 ±3.41E-04 m/s	Constrained Mod.: 113.81 ±20.31 MPa
Sleeve friction: 98.92 ±52.30 kPa	N_{60}: 37.51 ±6.11 blows	Go: 118.00 ±24.56 MPa
Ic: 1.49 ±0.18	Es: 90.81 ±16.21 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 74.97 ±8.14	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 41.51 ±1.36 °	O.C.R.: 0.00 ±0.00
	Unit weight: 19.28 ±0.52 kN/m³	

.:: Layer No: 8 ::.

Code: Layer_8 **Start depth:** 10.35 (m), **End depth:** 12.21 (m)

Description: Clay & silty clay

Basic results	Estimation results	
Total cone resistance: 3.36 ±1.21 MPa	Permeability: 1.86E-07 ±9.06E-07 m/s	Constrained Mod.: 43.79 ±15.95 MPa
Sleeve friction: 108.83 ±42.24 kPa	N_{60}: 13.80 ±3.53 blows	Go: 82.31 ±19.72 MPa
Ic: 2.68 ±0.15	Es: 0.00 ±0.00 MPa	Su: 210.41 ±69.88 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 2.00 ±0.64
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 13.22 ±5.38
	Unit weight: 18.74 ±0.55 kN/m³	

.:: Layer No: 9 ::.

Code: Layer_9 **Start depth:** 12.21 (m), **End depth:** 12.77 (m)

Description: Sand

Basic results	Estimation results	
Total cone resistance: 37.89 ±10.84 MPa	Permeability: 9.44E-04 ±3.51E-04 m/s	Constrained Mod.: 179.05 ±42.95 MPa
Sleeve friction: 199.19 ±83.58 kPa	N_{60}: 65.40 ±17.09 blows	Go: 196.30 ±52.68 MPa
Ic: 1.33 ±0.12	Es: 142.86 ±34.27 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 7	Dr (%): 93.21 ±11.14	Su ratio: 0.00 ±0.00
SBTn description: Sand	φ (degrees): 45.04 ±2.32 °	O.C.R.: 0.00 ±0.00
	Unit weight: 20.32 ±0.72 kN/m³	

.:: Layer No: 10 ::.

Code: Layer_10 **Start depth:** 12.77 (m), **End depth:** 12.84 (m)

Description: Sand

Basic results	**Estimation results**	
Total cone resistance: 57.80 ±2.58 MPa	Permeability: 1.99E-03 ±3.84E-04 m/s	Constrained Mod.: 237.68 ±2.32 MPa
Sleeve friction: 304.72 ±0.00 kPa	N_{60}: 93.00 ±2.52 blows	Go: 268.65 ±2.84 MPa
Ic: 1.20 ±0.03	Es: 189.63 ±1.85 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 7	Dr (%): 100.00 ±0.00	Su ratio: 0.00 ±0.00
SBTn description: Sand	φ (degrees): 48.26 ±0.32 °	O.C.R.: 0.00 ±0.00
	Unit weight: 21.12 ±0.02 kN/m³	

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02A
Total depth: 12.84 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Summary table of mean values

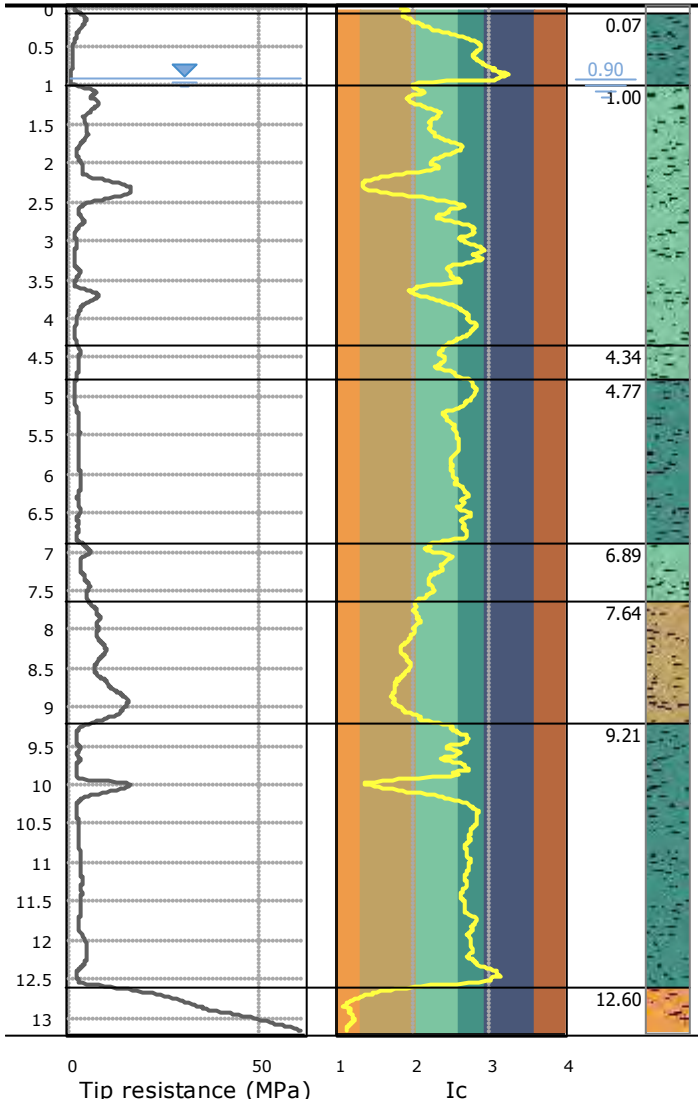
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r (%)	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.05	0.87	1.18E-06	5.0	0.0	0.0	0.0	17.5	23.7	57.7	0.8	5.6	16.1
0.92		(±2.15E-06)	(±2.6)	(±0.0)	(±0.0)	(±0.0)	(±13.7)	(±9.1)	(±23.8)	(±0.4)	(±2.8)	(±1.0)
0.92	1.86	4.56E-05	18.5	58.6	59.3	39.7	69.7	74.0	0.0	0.0	0.0	18.9
2.78		(±7.34E-05)	(±5.7)	(±11.5)	(±13.4)	(±1.6)	(±17.7)	(±16.6)	(±0.0)	(±0.0)	(±0.0)	(±0.5)
2.78	2.11	5.52E-07	8.1	0.0	0.0	0.0	29.0	43.5	115.8	2.0	13.1	17.8
4.89		(±1.96E-06)	(±2.2)	(±0.0)	(±0.0)	(±0.0)	(±11.1)	(±10.8)	(±29.8)	(±0.5)	(±4.3)	(±0.7)
4.89	1.22	2.31E-04	30.6	78.8	74.7	41.7	98.7	102.3	0.0	0.0	0.0	19.3
6.11		(±1.56E-04)	(±5.0)	(±10.1)	(±8.6)	(±1.1)	(±12.7)	(±14.9)	(±0.0)	(±0.0)	(±0.0)	(±0.4)
6.11	1.77	1.26E-05	22.5	82.9	57.5	39.9	88.5	99.4	0.0	0.0	0.0	19.3
7.88		(±1.75E-05)	(±8.7)	(±17.1)	(±10.3)	(±1.5)	(±34.3)	(±30.1)	(±0.0)	(±0.0)	(±0.0)	(±0.7)
7.88	1.04	9.49E-06	23.9	79.2	52.9	38.6	98.5	102.8	0.0	0.0	0.0	19.3
8.92		(±8.59E-06)	(±4.3)	(±14.1)	(±5.8)	(±1.3)	(±18.5)	(±21.0)	(±0.0)	(±0.0)	(±0.0)	(±0.6)
8.92	1.43	4.42E-04	37.5	90.8	75.0	41.5	113.8	118.0	0.0	0.0	0.0	19.3
10.35		(±3.41E-04)	(±6.1)	(±16.2)	(±8.1)	(±1.4)	(±20.3)	(±24.6)	(±0.0)	(±0.0)	(±0.0)	(±0.5)
10.35	1.86	1.86E-07	13.8	0.0	0.0	0.0	43.8	82.3	210.4	2.0	13.2	18.7
12.21		(±9.06E-07)	(±3.5)	(±0.0)	(±0.0)	(±0.0)	(±16.0)	(±19.7)	(±69.9)	(±0.6)	(±5.4)	(±0.5)
12.21	0.56	9.44E-04	65.4	142.9	93.2	45.0	179.0	196.3	0.0	0.0	0.0	20.3
12.77		(±3.51E-04)	(±17.1)	(±34.3)	(±11.1)	(±2.3)	(±43.0)	(±52.7)	(±0.0)	(±0.0)	(±0.0)	(±0.7)
12.77	0.07	1.99E-03	93.0	189.6	100.0	48.3	237.7	268.6	0.0	0.0	0.0	21.1
12.84		(±3.84E-04)	(±2.5)	(±1.9)	(±0.0)	(±0.3)	(±2.3)	(±2.8)	(±0.0)	(±0.0)	(±0.0)	(±0.0)

Depth values presented in this table are measured from free ground surface

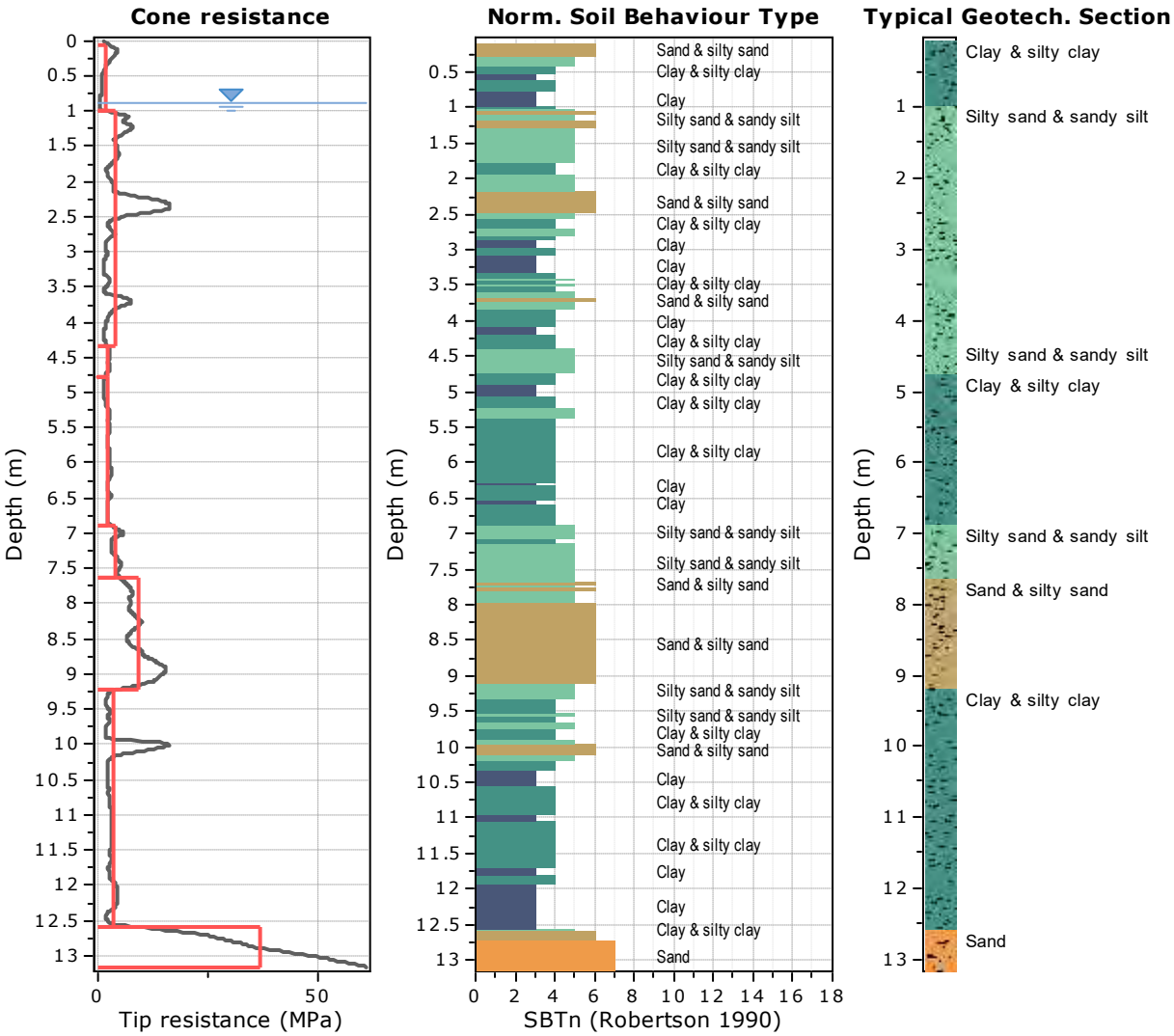
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Depth (m)	Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
0.07	Clay & silty clay	1.6	3.15E-6	5.3	-	-	-	17.9	25.0	54.0	0.9	5.1	16.3
1.00	Silty sand & sandy silt	4.1	3.21E-5	12.2	54.7	51.8	39.2	45.7	58.7	-	-	-	18.4
4.34	Silty sand & sandy silt	2.4	4.49E-7	8.6	35.9	34.1	36.4	32.6	42.1	-	-	-	17.7
4.77	Clay & silty clay	2.3	1.22E-7	9.0	-	-	-	30.3	52.2	148.7	2.5	16.9	18.2
6.89	Silty sand & sandy silt	4.2	1.14E-6	13.4	52.6	39.3	36.9	56.4	65.0	-	-	-	18.5
7.64	Sand & silty sand	9.3	1.71E-5	23.5	73.5	54.2	38.4	92.1	94.3	-	-	-	19.0
9.21	Clay & silty clay	3.4	1.01E-5	13.0	-	-	-	40.2	74.7	177.2	1.8	11.3	18.5
12.60	Sand	36.9	1.86E-3	60.8	128.0	89.6	44.7	160.5	173.3	-	-	-	20.0



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.07 (m), **End depth:** 1.00 (m)

Description: Clay & silty clay

Basic results

Total cone resistance: 1.59 ±1.29 MPa
Sleeve friction: 18.39 ±7.50 kPa
Ic: 2.58 ±0.52
SBT_n: 4
SBTn description: Clay & silty clay

Estimation results

Permeability: 3.15E-06 ±6.00E-06 m/s
N_{60}: 5.30 ±2.72 blows
Es: 0.00 ±0.00 MPa
Dr (%): 0.00 ±0.00
φ (degrees): 0.00 ±0.00 °
Unit weight: 16.27 ±0.83 kN/m³
Constrained Mod.: 17.92 ±13.73 MPa
Go: 25.00 ±8.09 MPa
Su: 54.03 ±22.29 kPa
Su ratio: 0.85 ±0.35
O.C.R.: 5.13 ±2.62

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 1.00 (m), **End depth:** 4.34 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 4.11 ±3.38 MPa	Permeability: 3.21E-05 ±1.28E-04 m/s	Constrained Mod.: 45.72 ±22.26 MPa
Sleeve friction: 80.60 ±22.27 kPa	N_{60}: 12.20 ±5.72 blows	Go: 58.73 ±14.95 MPa
Ic: 2.38 ±0.37	Es: 54.75 ±8.55 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 51.77 ±14.17	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 39.15 ±1.70 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.44 ±0.53 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 4.34 (m), **End depth:** 4.77 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 2.41 ±0.31 MPa	Permeability: 4.49E-07 ±1.91E-07 m/s	Constrained Mod.: 32.58 ±4.33 MPa
Sleeve friction: 46.09 ±9.12 kPa	N_{60}: 8.59 ±0.90 blows	Go: 42.11 ±4.42 MPa
Ic: 2.42 ±0.07	Es: 35.91 ±2.85 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 34.07 ±1.56	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 36.44 ±0.63 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.71 ±0.27 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 4.77 (m), **End depth:** 6.89 (m)

Description: Clay & silty clay

Basic results	Estimation results	
Total cone resistance: 2.27 ±0.47 MPa	Permeability: 1.22E-07 ±9.09E-08 m/s	Constrained Mod.: 30.27 ±6.48 MPa
Sleeve friction: 77.41 ±22.16 kPa	N_{60}: 9.03 ±1.57 blows	Go: 52.22 ±9.19 MPa
Ic: 2.62 ±0.11	Es: 0.00 ±0.00 MPa	Su: 148.70 ±33.26 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 2.45 ±0.52
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 16.90 ±4.51
	Unit weight: 18.25 ±0.41 kN/m³	

.:: Layer No: 5 ::.

Code: Layer_5 **Start depth:** 6.89 (m), **End depth:** 7.64 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 4.16 ±0.84 MPa	Permeability: 1.14E-06 ±6.69E-07 m/s	Constrained Mod.: 56.45 ±11.84 MPa
Sleeve friction: 75.11 ±16.58 kPa	N_{60}: 13.42 ±2.01 blows	Go: 64.99 ±8.37 MPa
Ic: 2.30 ±0.10	Es: 52.61 ±6.14 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 39.33 ±3.66	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 36.89 ±0.68 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.47 ±0.29 kN/m³	

.:: Layer No: 6 ::.

Code: Layer_6 **Start depth:** 7.64 (m), **End depth:** 9.21 (m)

Description: Sand & silty sand

Basic results	Estimation results	
Total cone resistance: 9.28 ±2.84 MPa	Permeability: 1.71E-05 ±1.37E-05 m/s	Constrained Mod.: 92.06 ±19.40 MPa
Sleeve friction: 99.94 ±41.69 kPa	N_{60}: 23.54 ±5.81 blows	Go: 94.31 ±22.68 MPa
Ic: 1.93 ±0.12	Es: 73.46 ±15.48 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 54.19 ±7.26	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 38.42 ±1.38 °	O.C.R.: 0.00 ±0.00
	Unit weight: 19.04 ±0.52 kN/m³	

.:: Layer No: 7 ::.

Code: Layer_7 **Start depth:** 9.21 (m), **End depth:** 12.60 (m)

Description: Clay & silty clay

Basic results	Estimation results	
Total cone resistance: 3.40 ±2.46 MPa	Permeability: 1.01E-05 ±6.27E-05 m/s	Constrained Mod.: 40.19 ±17.01 MPa
Sleeve friction: 99.65 ±65.75 kPa	N_{60}: 12.99 ±4.75 blows	Go: 74.69 ±25.99 MPa
Ic: 2.65 ±0.29	Es: 0.00 ±0.00 MPa	Su: 177.18 ±43.04 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 1.79 ±0.44
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 11.30 ±2.91
	Unit weight: 18.47 ±0.80 kN/m³	

.:: Layer No: 8 ::.

Code: Layer_8 **Start depth:** 12.60 (m), **End depth:** 13.17 (m)

Description: Sand

Basic results	Estimation results	
Total cone resistance: 36.87 ±14.49 MPa	Permeability: 1.86E-03 ±1.15E-03 m/s	Constrained Mod.: 160.45 ±42.02 MPa
Sleeve friction: 155.84 ±76.28 kPa	N_{60}: 60.77 ±19.87 blows	Go: 173.27 ±51.50 MPa
Ic: 1.30 ±0.24	Es: 128.02 ±33.52 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 7	Dr (%): 89.62 ±14.25	Su ratio: 0.00 ±0.00
SBTn description: Sand	φ (degrees): 44.71 ±2.96 °	O.C.R.: 0.00 ±0.00
	Unit weight: 20.01 ±0.69 kN/m³	

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02B
Total depth: 13.17 m, Date: 11/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Summary table of mean values

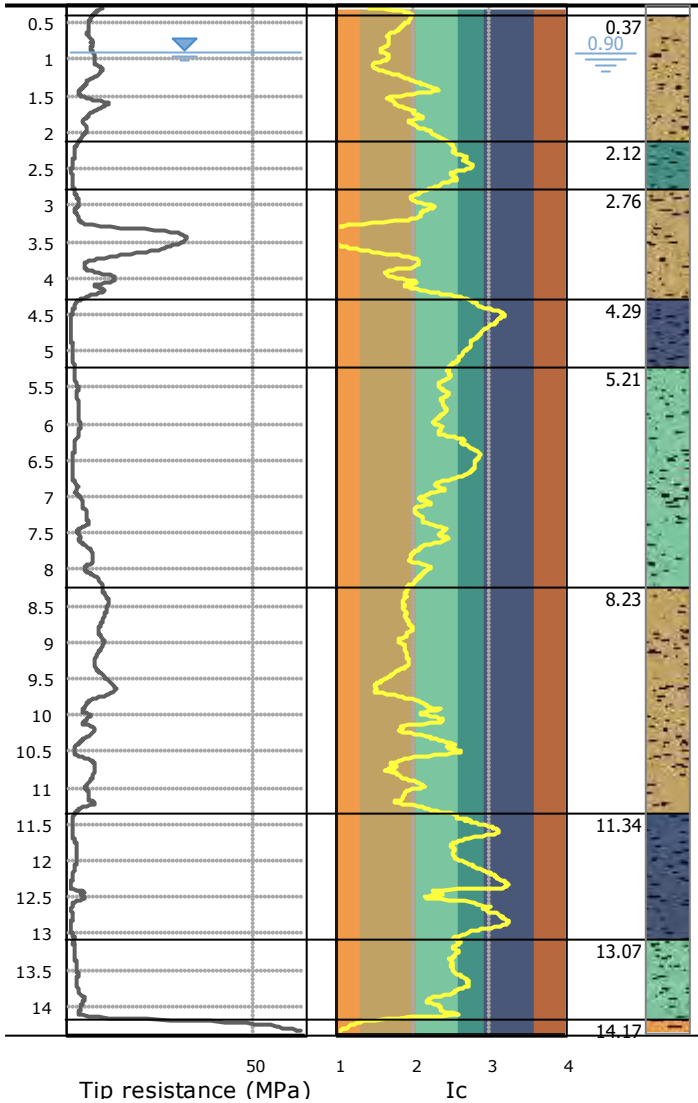
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r (%)	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.07	0.93	3.15E-06	5.3	0.0	0.0	0.0	17.9	25.0	54.0	0.9	5.1	16.3
1.00		(±6.00E-06)	(±2.7)	(±0.0)	(±0.0)	(±0.0)	(±13.7)	(±8.1)	(±22.3)	(±0.3)	(±2.6)	(±0.8)
1.00	3.34	3.21E-05	12.2	54.7	51.8	39.2	45.7	58.7	0.0	0.0	0.0	18.4
4.34		(±1.28E-04)	(±5.7)	(±8.5)	(±14.2)	(±1.7)	(±22.3)	(±14.9)	(±0.0)	(±0.0)	(±0.0)	(±0.5)
4.34	0.43	4.49E-07	8.6	35.9	34.1	36.4	32.6	42.1	0.0	0.0	0.0	17.7
4.77		(±1.91E-07)	(±0.9)	(±2.8)	(±1.6)	(±0.6)	(±4.3)	(±4.4)	(±0.0)	(±0.0)	(±0.0)	(±0.3)
4.77	2.12	1.22E-07	9.0	0.0	0.0	0.0	30.3	52.2	148.7	2.5	16.9	18.2
6.89		(±9.09E-08)	(±1.6)	(±0.0)	(±0.0)	(±0.0)	(±6.5)	(±9.2)	(±33.3)	(±0.5)	(±4.5)	(±0.4)
6.89	0.75	1.14E-06	13.4	52.6	39.3	36.9	56.4	65.0	0.0	0.0	0.0	18.5
7.64		(±6.69E-07)	(±2.0)	(±6.1)	(±3.7)	(±0.7)	(±11.8)	(±8.4)	(±0.0)	(±0.0)	(±0.0)	(±0.3)
7.64	1.57	1.71E-05	23.5	73.5	54.2	38.4	92.1	94.3	0.0	0.0	0.0	19.0
9.21		(±1.37E-05)	(±5.8)	(±15.5)	(±7.3)	(±1.4)	(±19.4)	(±22.7)	(±0.0)	(±0.0)	(±0.0)	(±0.5)
9.21	3.39	1.01E-05	13.0	0.0	0.0	0.0	40.2	74.7	177.2	1.8	11.3	18.5
12.60		(±6.27E-05)	(±4.8)	(±0.0)	(±0.0)	(±0.0)	(±17.0)	(±26.0)	(±43.0)	(±0.4)	(±2.9)	(±0.8)
12.60	0.57	1.86E-03	60.8	128.0	89.6	44.7	160.5	173.3	0.0	0.0	0.0	20.0
13.17		(±1.15E-03)	(±19.9)	(±33.5)	(±14.2)	(±3.0)	(±42.0)	(±51.5)	(±0.0)	(±0.0)	(±0.0)	(±0.7)

Depth values presented in this table are measured from free ground surface

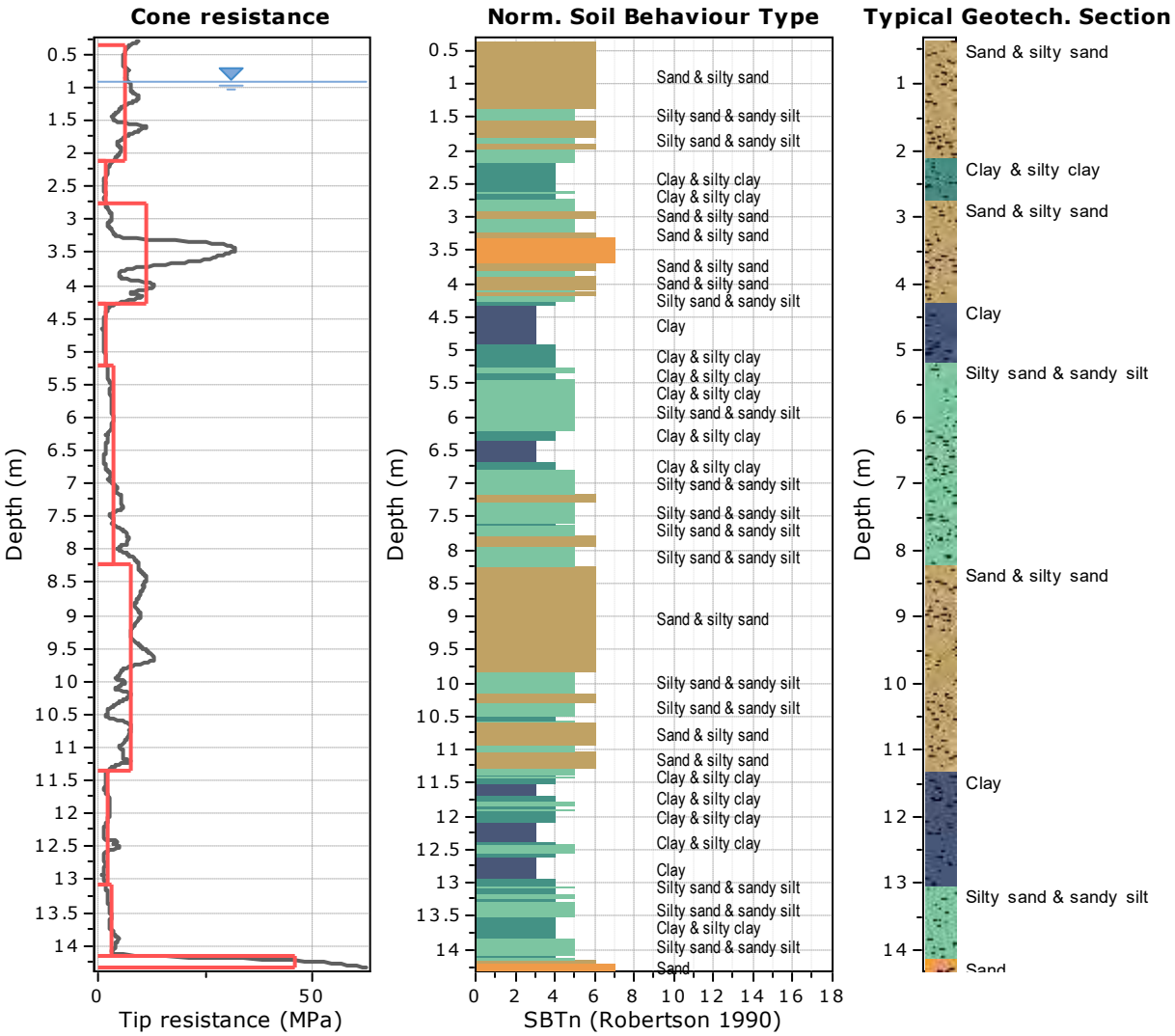
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
Sand & silty sand	6.4	5.16E-5	15.4	47.1	54.8	38.3	58.3	57.8	-	-	-	18.2
Clay & silty clay	1.9	1.80E-7	7.3	-	-	-	25.8	40.0	126.4	2.0	14.6	17.6
Sand & silty sand	11.1	5.03E-4	21.1	55.0	62.4	39.6	68.0	69.1	-	-	-	18.3
Clay	1.6	3.76E-8	7.4	-	-	-	21.5	49.1	99.7	1.8	11.0	18.2
Silty sand & sandy silt	3.8	1.68E-6	12.2	50.7	40.0	37.0	48.3	59.0	-	-	-	18.3
Sand & silty sand	7.6	2.71E-5	19.4	61.4	47.5	36.8	74.1	75.3	-	-	-	18.3
Clay	2.0	1.54E-7	8.9	-	-	-	24.0	51.3	114.8	1.0	6.2	17.6
Silty sand & sandy silt	3.3	6.55E-7	11.8	47.7	27.8	33.9	41.4	58.6	-	-	-	17.6
Sand	46.0	1.96E-3	75.8	159.6	94.7	46.2	200.1	221.7	-	-	-	20.7



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.37 (m), **End depth:** 2.12 (m)

Description: Sand & silty sand

Basic results	Estimation results	
Total cone resistance: 6.41 ±1.78 MPa	Permeability: 5.16E-05 ±7.10E-05 m/s	Constrained Mod.: 58.28 ±8.74 MPa
Sleeve friction: 56.89 ±22.94 kPa	N_{60}: 15.44 ±2.76 blows	Go: 57.84 ±9.84 MPa
Ic: 1.86 ±0.23	Es: 47.12 ±6.79 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 54.79 ±7.68	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 38.33 ±1.02 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.24 ±0.46 kN/m³	

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 2.12 (m), **End depth:** 2.76 (m)

Description: Clay & silty clay

Basic results	Estimation results	
Total cone resistance: 1.88 ±0.51 MPa	Permeability: 1.80E-07 ±1.44E-07 m/s	Constrained Mod.: 25.77 ±7.14 MPa
Sleeve friction: 47.58 ±14.68 kPa	N_{60}: 7.29 ±1.50 blows	Go: 40.01 ±7.38 MPa
Ic: 2.57 ±0.12	Es: 0.00 ±0.00 MPa	Su: 126.35 ±26.02 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 2.04 ±0.40
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 14.56 ±3.75
	Unit weight: 17.61 ±0.44 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 2.76 (m), **End depth:** 4.29 (m)

Description: Sand & silty sand

Basic results	Estimation results	
Total cone resistance: 11.12 ±9.76 MPa	Permeability: 5.03E-04 ±1.52E-03 m/s	Constrained Mod.: 68.00 ±25.28 MPa
Sleeve friction: 68.82 ±53.86 kPa	N_{60}: 21.14 ±11.94 blows	Go: 69.06 ±27.53 MPa
Ic: 1.78 ±0.46	Es: 54.96 ±19.93 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 62.39 ±23.70	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 39.58 ±4.28 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.32 ±1.02 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 4.29 (m), **End depth:** 5.21 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 1.62 ±0.53 MPa	Permeability: 3.76E-08 ±4.25E-08 m/s	Constrained Mod.: 21.50 ±7.46 MPa
Sleeve friction: 87.93 ±40.60 kPa	N_{60}: 7.40 ±1.89 blows	Go: 49.14 ±12.22 MPa
Ic: 2.86 ±0.19	Es: 0.00 ±0.00 MPa	Su: 99.73 ±37.11 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 1.84 ±0.64
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 10.98 ±5.30
	Unit weight: 18.19 ±0.55 kN/m³	

.:: Layer No: 5 ::.

Code: Layer_5 **Start depth:** 5.21 (m), **End depth:** 8.23 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 3.76 ±1.87 MPa	Permeability: 1.68E-06 ±2.36E-06 m/s	Constrained Mod.: 48.32 ±21.83 MPa
Sleeve friction: 70.29 ±25.80 kPa	N_{60}: 12.16 ±4.37 blows	Go: 58.99 ±16.60 MPa
Ic: 2.37 ±0.24	Es: 50.65 ±12.29 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 40.01 ±6.16	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 37.02 ±1.07 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.28 ±0.49 kN/m³	

.:: Layer No: 6 ::.

Code: Layer_6 **Start depth:** 8.23 (m), **End depth:** 11.34 (m)

Description: Sand & silty sand

Basic results	Estimation results	
Total cone resistance: 7.63 ±2.66 MPa	Permeability: 2.71E-05 ±4.74E-05 m/s	Constrained Mod.: 74.09 ±19.80 MPa
Sleeve friction: 63.02 ±36.17 kPa	N_{60}: 19.37 ±5.17 blows	Go: 75.28 ±20.22 MPa
Ic: 1.96 ±0.23	Es: 61.37 ±13.49 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 47.46 ±9.31	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 36.79 ±1.95 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.29 ±0.82 kN/m³	

.:: Layer No: 7 ::.

Code: Layer_7 **Start depth:** 11.34 (m), **End depth:** 13.07 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 2.05 ±0.85 MPa	Permeability: 1.54E-07 ±3.68E-07 m/s	Constrained Mod.: 24.01 ±13.30 MPa
Sleeve friction: 50.15 ±24.94 kPa	N_{60}: 8.91 ±2.03 blows	Go: 51.33 ±10.98 MPa
Ic: 2.81 ±0.29	Es: 0.00 ±0.00 MPa	Su: 114.85 ±44.93 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 1.02 ±0.33
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 6.22 ±3.19
	Unit weight: 17.57 ±0.68 kN/m³	

.:: Layer No: 8 ::.

Code: Layer_8 **Start depth:** 13.07 (m), **End depth:** 14.17 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 3.27 ±1.72 MPa	Permeability: 6.55E-07 ±2.52E-06 m/s	Constrained Mod.: 41.43 ±18.28 MPa
Sleeve friction: 45.20 ±27.52 kPa	N_{60}: 11.81 ±4.13 blows	Go: 58.64 ±18.75 MPa
Ic: 2.50 ±0.16	Es: 47.74 ±14.91 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 27.83 ±7.12	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 33.86 ±1.40 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.60 ±0.77 kN/m³	

.:: Layer No: 9 ::.

Code: Layer_9 **Start depth:** 14.17 (m), **End depth:** 14.33 (m)

Description: Sand

Basic results	Estimation results	
Total cone resistance: 46.04 ±14.19 MPa	Permeability: 1.96E-03 ±1.70E-03 m/s	Constrained Mod.: 200.05 ±25.38 MPa
Sleeve friction: 230.23 ±33.20 kPa	N_{60}: 75.82 ±16.52 blows	Go: 221.73 ±30.94 MPa
Ic: 1.29 ±0.21	Es: 159.62 ±20.25 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 7	Dr (%): 94.73 ±11.33	Su ratio: 0.00 ±0.00
SBTn description: Sand	φ (degrees): 46.22 ±2.68 °	O.C.R.: 0.00 ±0.00
	Unit weight: 20.67 ±0.32 kN/m³	

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02C
Total depth: 14.33 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Summary table of mean values

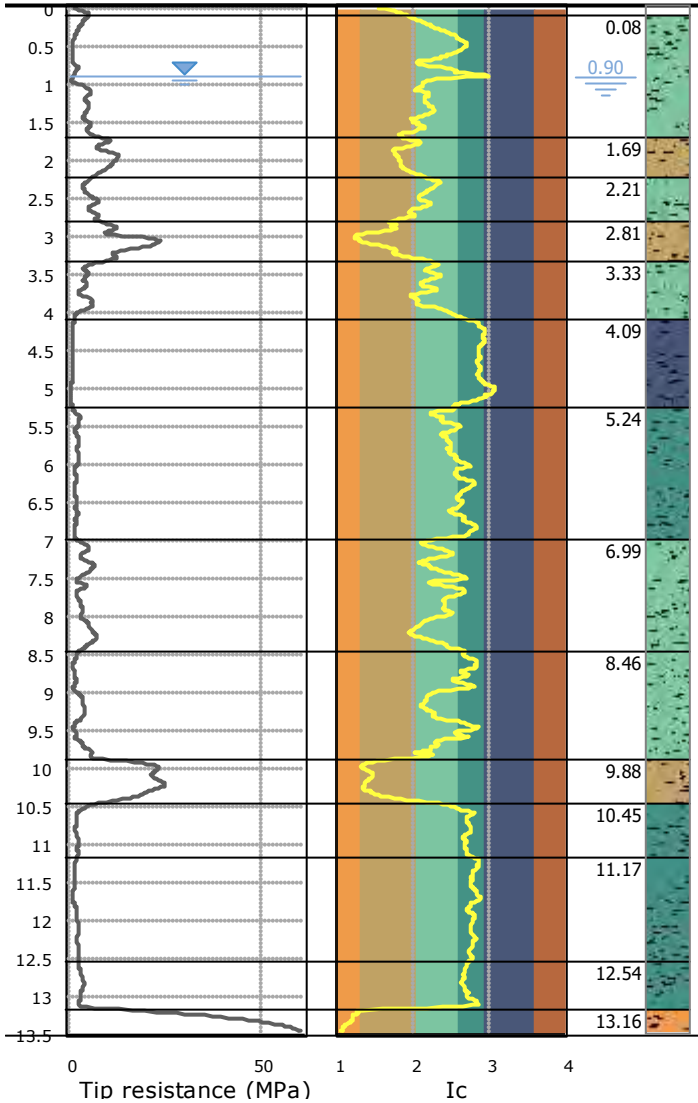
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r (%)	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.37 2.12	1.75	5.16E-05 (±7.10E-05)	15.4 (±2.8)	47.1 (±6.8)	54.8 (±7.7)	38.3 (±1.0)	58.3 (±8.7)	57.8 (±9.8)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	18.2 (±0.5)
2.12 2.76	0.64	1.80E-07 (±1.44E-07)	7.3 (±1.5)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	25.8 (±7.1)	40.0 (±7.4)	126.4 (±26.0)	2.0 (±0.4)	14.6 (±3.8)	17.6 (±0.4)
2.76 4.29	1.53	5.03E-04 (±1.52E-03)	21.1 (±11.9)	55.0 (±19.9)	62.4 (±23.7)	39.6 (±4.3)	68.0 (±25.3)	69.1 (±27.5)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	18.3 (±1.0)
4.29 5.21	0.92	3.76E-08 (±4.25E-08)	7.4 (±1.9)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	21.5 (±7.5)	49.1 (±12.2)	99.7 (±37.1)	1.8 (±0.6)	11.0 (±5.3)	18.2 (±0.5)
5.21 8.23	3.02	1.68E-06 (±2.36E-06)	12.2 (±4.4)	50.7 (±12.3)	40.0 (±6.2)	37.0 (±1.1)	48.3 (±21.8)	59.0 (±16.6)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	18.3 (±0.5)
8.23 11.34	3.11	2.71E-05 (±4.74E-05)	19.4 (±5.2)	61.4 (±13.5)	47.5 (±9.3)	36.8 (±1.9)	74.1 (±19.8)	75.3 (±20.2)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	18.3 (±0.8)
11.34 13.07	1.73	1.54E-07 (±3.68E-07)	8.9 (±2.0)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	24.0 (±13.3)	51.3 (±11.0)	114.8 (±44.9)	1.0 (±0.3)	6.2 (±3.2)	17.6 (±0.7)
13.07 14.17	1.10	6.55E-07 (±2.52E-06)	11.8 (±4.1)	47.7 (±14.9)	27.8 (±7.1)	33.9 (±1.4)	41.4 (±18.3)	58.6 (±18.7)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	17.6 (±0.8)
14.17 14.33	0.16	1.96E-03 (±1.70E-03)	75.8 (±16.5)	159.6 (±20.3)	94.7 (±11.3)	46.2 (±2.7)	200.1 (±25.4)	221.7 (±30.9)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	20.7 (±0.3)

Depth values presented in this table are measured from free ground surface

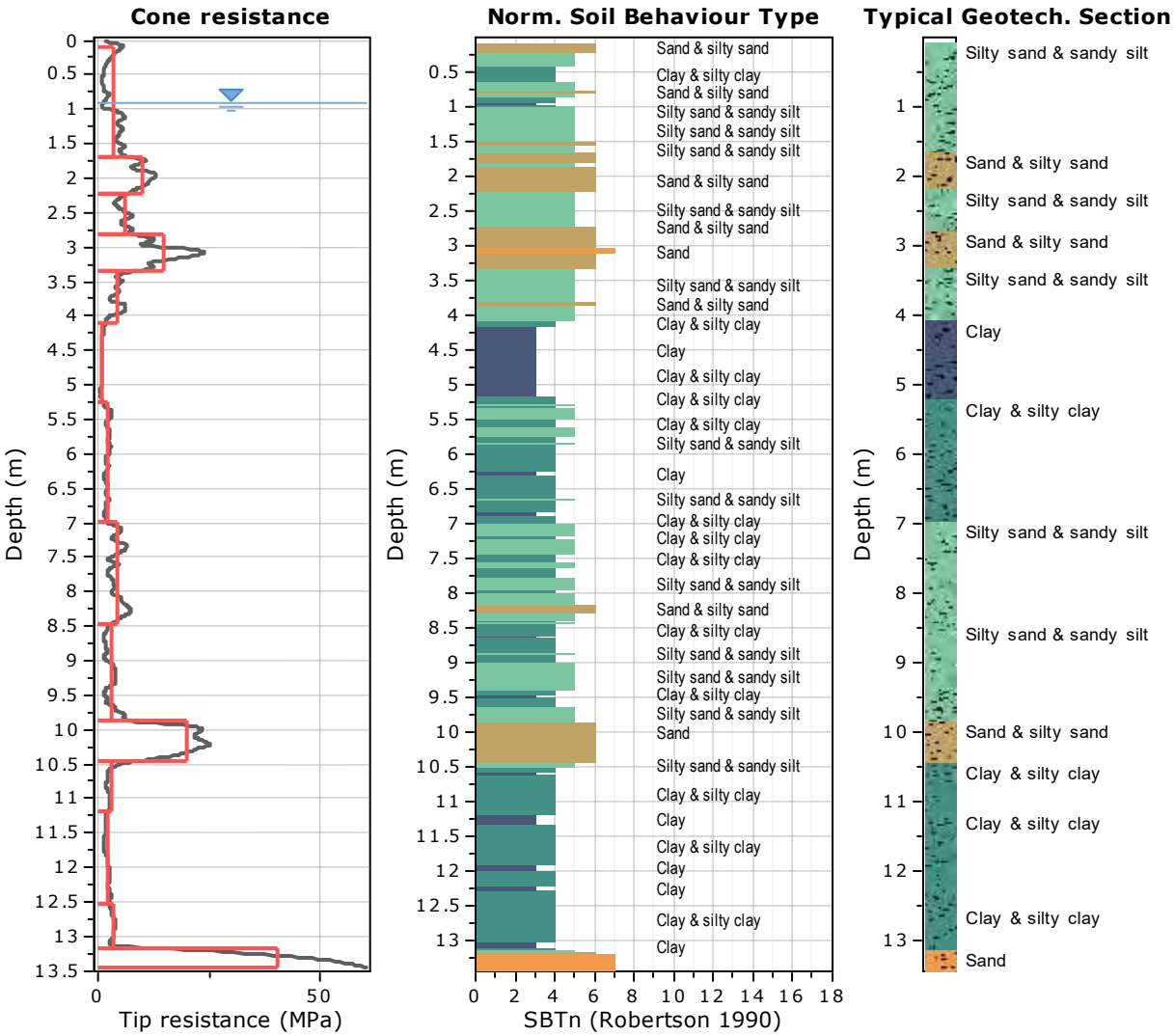
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Depth (m)	Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
0.08	Silty sand & sandy silt	3.3	5.13E-6	10.0	41.7	42.3	36.5	42.5	45.4	-	-	-	17.5
1.69	Sand & silty sand	10.1	2.12E-5	25.0	77.0	69.2	41.6	96.5	101.5	-	-	-	19.6
2.21	Silty sand & sandy silt	5.9	3.72E-6	17.4	62.6	52.8	39.5	75.6	80.7	-	-	-	19.2
2.81	Sand & silty sand	14.7	3.22E-4	29.9	77.7	80.4	42.7	97.4	101.8	-	-	-	19.5
3.33	Silty sand & sandy silt	4.5	2.63E-6	13.6	51.0	45.8	38.1	58.3	63.3	-	-	-	18.5
4.09	Clay	1.0	1.99E-8	4.6	-	-	-	11.8	27.3	62.7	1.1	6.1	16.8
5.24	Clay & silty clay	2.1	1.95E-7	8.2	-	-	-	27.8	44.2	134.8	2.1	14.5	17.8
6.99	Silty sand & sandy silt	4.4	1.59E-6	14.3	58.3	41.3	37.4	57.1	70.4	-	-	-	18.6
8.46	Silty sand & sandy silt	2.8	7.90E-7	10.0	47.5	34.8	34.8	37.3	48.6	-	-	-	17.5
9.88	Sand & silty sand	20.3	4.05E-4	38.6	93.0	76.3	41.8	116.6	121.3	-	-	-	19.4
10.45	Clay & silty clay	2.9	2.77E-7	11.4	-	-	-	36.9	63.4	164.2	1.6	10.8	18.2
11.17	Clay & silty clay	2.1	2.96E-8	9.4	-	-	-	25.4	55.1	135.7	1.2	7.7	17.7
12.54	Clay & silty clay	3.4	9.31E-8	14.3	-	-	-	44.3	87.0	213.2	1.9	12.4	18.9
13.16	Sand	40.4	2.29E-3	64.3	130.8	90.5	45.2	163.9	177.5	-	-	-	20.0



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.08 (m), **End depth:** 1.69 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 3.33 ±1.82 MPa	Permeability: 5.13E-06 ±1.70E-05 m/s	Constrained Mod.: 42.47 ±22.55 MPa
Sleeve friction: 50.65 ±38.42 kPa	N_{60}: 9.97 ±4.72 blows	Go: 45.40 ±20.80 MPa
Ic: 2.27 ±0.27	Es: 41.67 ±14.54 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 42.27 ±9.57	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 36.48 ±2.40 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.51 ±1.18 kN/m³	

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 1.69 (m), **End depth:** 2.21 (m)

Description: Sand & silty sand

Basic results	**Estimation results**	
Total cone resistance: 10.12 ±1.90 MPa	Permeability: 2.12E-05 ±1.12E-05 m/s	Constrained Mod.: 96.47 ±9.94 MPa
Sleeve friction: 152.06 ±27.66 kPa	N_{60}: 24.98 ±3.49 blows	Go: 101.46 ±11.71 MPa
Ic: 1.88 ±0.10	Es: 76.97 ±7.93 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 69.21 ±6.59	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 41.64 ±0.94 °	O.C.R.: 0.00 ±0.00
	Unit weight: 19.63 ±0.27 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 2.21 (m), **End depth:** 2.81 (m)

Description: Silty sand & sandy silt

Basic results	**Estimation results**	
Total cone resistance: 5.94 ±1.34 MPa	Permeability: 3.72E-06 ±2.90E-06 m/s	Constrained Mod.: 75.62 ±13.02 MPa
Sleeve friction: 123.20 ±26.63 kPa	N_{60}: 17.38 ±2.93 blows	Go: 80.69 ±11.13 MPa
Ic: 2.14 ±0.12	Es: 62.63 ±7.65 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 52.79 ±6.18	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 39.54 ±0.77 °	O.C.R.: 0.00 ±0.00
	Unit weight: 19.17 ±0.30 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 2.81 (m), **End depth:** 3.33 (m)

Description: Sand & silty sand

Basic results	**Estimation results**	
Total cone resistance: 14.68 ±4.95 MPa	Permeability: 3.22E-04 ±4.70E-04 m/s	Constrained Mod.: 97.35 ±7.63 MPa
Sleeve friction: 124.35 ±28.90 kPa	N_{60}: 29.92 ±5.60 blows	Go: 101.78 ±8.66 MPa
Ic: 1.62 ±0.21	Es: 77.68 ±6.08 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 80.45 ±10.64	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 42.73 ±1.44 °	O.C.R.: 0.00 ±0.00
	Unit weight: 19.53 ±0.18 kN/m³	

.:: Layer No: 5 ::.

Code: Layer_5 **Start depth:** 3.33 (m), **End depth:** 4.09 (m)

Description: Silty sand & sandy silt

Basic results	**Estimation results**	
Total cone resistance: 4.50 ±1.64 MPa	Permeability: 2.63E-06 ±2.41E-06 m/s	Constrained Mod.: 58.30 ±18.59 MPa
Sleeve friction: 86.30 ±40.86 kPa	N_{60}: 13.61 ±4.14 blows	Go: 63.27 ±18.57 MPa
Ic: 2.21 ±0.15	Es: 51.02 ±12.71 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 45.75 ±8.37	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 38.06 ±1.70 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.52 ±0.76 kN/m³	

.:: Layer No: 6 ::.

Code: Layer_6 **Start depth:** 4.09 (m), **End depth:** 5.24 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 0.97 ±0.21 MPa	Permeability: 1.99E-08 ±2.41E-08 m/s	Constrained Mod.: 11.79 ±3.74 MPa
Sleeve friction: 29.30 ±9.52 kPa	N_{60}: 4.55 ±0.87 blows	Go: 27.31 ±4.95 MPa
Ic: 2.89 ±0.10	Es: 0.00 ±0.00 MPa	Su: 62.71 ±16.10 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 1.05 ±0.26
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 6.09 ±2.01
	Unit weight: 16.78 ±0.46 kN/m³	

.:: Layer No: 7 ::.

Code: Layer_7 **Start depth:** 5.24 (m), **End depth:** 6.99 (m)

Description: Clay & silty clay

Basic results	Estimation results	
Total cone resistance: 2.10 ±0.47 MPa	Permeability: 1.95E-07 ±2.26E-07 m/s	Constrained Mod.: 27.82 ±6.69 MPa
Sleeve friction: 54.02 ±15.48 kPa	N_{60}: 8.16 ±1.36 blows	Go: 44.21 ±7.10 MPa
Ic: 2.58 ±0.13	Es: 0.00 ±0.00 MPa	Su: 134.77 ±29.24 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 2.07 ±0.46
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 14.48 ±4.03
	Unit weight: 17.80 ±0.45 kN/m³	

.:: Layer No: 8 ::.

Code: Layer_8 **Start depth:** 6.99 (m), **End depth:** 8.46 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 4.37 ±1.46 MPa	Permeability: 1.59E-06 ±2.20E-06 m/s	Constrained Mod.: 57.08 ±17.51 MPa
Sleeve friction: 86.82 ±24.91 kPa	N_{60}: 14.26 ±3.26 blows	Go: 70.41 ±12.25 MPa
Ic: 2.34 ±0.20	Es: 58.33 ±8.17 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 41.32 ±5.12	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 37.38 ±0.89 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.62 ±0.38 kN/m³	

.:: Layer No: 9 ::.

Code: Layer_9 **Start depth:** 8.46 (m), **End depth:** 9.88 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 2.85 ±1.43 MPa	Permeability: 7.90E-07 ±1.04E-06 m/s	Constrained Mod.: 37.33 ±19.56 MPa
Sleeve friction: 42.51 ±24.09 kPa	N_{60}: 9.95 ±3.61 blows	Go: 48.59 ±15.03 MPa
Ic: 2.49 ±0.25	Es: 47.50 ±11.83 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 34.81 ±4.93	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 34.81 ±1.33 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.54 ±0.61 kN/m³	

.:: Layer No: 10 ::.

Code: Layer_10 **Start depth:** 9.88 (m), **End depth:** 10.45 (m)

Description: Sand & silty sand

Basic results	Estimation results	
Total cone resistance: 20.27 ±4.48 MPa	Permeability: 4.05E-04 ±2.54E-04 m/s	Constrained Mod.: 116.57 ±8.75 MPa
Sleeve friction: 101.45 ±19.23 kPa	N_{60}: 38.64 ±5.48 blows	Go: 121.25 ±10.29 MPa
Ic: 1.50 ±0.19	Es: 93.01 ±6.99 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 76.26 ±9.30	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 41.77 ±1.40 °	O.C.R.: 0.00 ±0.00
	Unit weight: 19.42 ±0.20 kN/m³	

.:: Layer No: 11 ::.

Code: Layer_11 **Start depth:** 10.45 (m), **End depth:** 11.17 (m)

Description: Clay & silty clay

Basic results	Estimation results	
Total cone resistance: 2.87 ±1.63 MPa	Permeability: 2.77E-07 ±1.01E-06 m/s	Constrained Mod.: 36.87 ±20.76 MPa
Sleeve friction: 71.22 ±33.23 kPa	N_{60}: 11.39 ±4.19 blows	Go: 63.45 ±18.86 MPa
Ic: 2.66 ±0.16	Es: 0.00 ±0.00 MPa	Su: 164.17 ±42.84 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 1.62 ±0.47
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 10.78 ±3.84
	Unit weight: 18.16 ±0.59 kN/m³	

.:: Layer No: 12 ::.

Code: Layer_12 **Start depth:** 11.17 (m), **End depth:** 12.54 (m)

Description: Clay & silty clay

Basic results	Estimation results	
Total cone resistance: 2.08 ±0.50 MPa	Permeability: 2.96E-08 ±8.03E-09 m/s	Constrained Mod.: 25.38 ±8.01 MPa
Sleeve friction: 57.28 ±27.43 kPa	N_{60}: 9.38 ±2.20 blows	Go: 55.14 ±15.49 MPa
Ic: 2.80 ±0.04	Es: 0.00 ±0.00 MPa	Su: 135.68 ±28.88 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 1.25 ±0.31
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 7.67 ±1.82
	Unit weight: 17.74 ±0.77 kN/m³	

.:: Layer No: 13 ::.

Code: Layer_13 **Start depth:** 12.54 (m), **End depth:** 13.16 (m)

Description: Clay & silty clay

Basic results	Estimation results	
Total cone resistance: 3.40 ±0.67 MPa	Permeability: 9.31E-08 ±2.68E-07 m/s	Constrained Mod.: 44.34 ±9.47 MPa
Sleeve friction: 113.82 ±23.46 kPa	N_{60}: 14.35 ±1.85 blows	Go: 86.96 ±10.34 MPa
Ic: 2.70 ±0.10	Es: 0.00 ±0.00 MPa	Su: 213.19 ±30.36 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 1.93 ±0.29
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 12.41 ±2.24
	Unit weight: 18.87 ±0.28 kN/m³	

.:: Layer No: 14 ::.

Code: Layer_14 **Start depth:** 13.16 (m), **End depth:** 13.45 (m)

Description: Sand

Basic results	**Estimation results**	
Total cone resistance: 40.43 ±16.22 MPa	Permeability: 2.29E-03 ±1.40E-03 m/s	Constrained Mod.: 163.92 ±45.78 MPa
Sleeve friction: 156.51 ±73.10 kPa	N_{60}: 64.30 ±22.13 blows	Go: 177.49 ±55.51 MPa
Ic: 1.25 ±0.24	Es: 130.79 ±36.53 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 7	Dr (%): 90.46 ±16.64	Su ratio: 0.00 ±0.00
SBTn description: Sand	φ (degrees): 45.16 ±3.60 °	O.C.R.: 0.00 ±0.00
	Unit weight: 19.98 ±0.95 kN/m³	

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

Summary table of mean values

From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r (%)	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.08 1.69	1.61	5.13E-06 (±1.70E-05)	10.0 (±4.7)	41.7 (±14.5)	42.3 (±9.6)	36.5 (±2.4)	42.5 (±22.5)	45.4 (±20.8)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	17.5 (±1.2)
1.69 2.21	0.52	2.12E-05 (±1.12E-05)	25.0 (±3.5)	77.0 (±7.9)	69.2 (±6.6)	41.6 (±0.9)	96.5 (±9.9)	101.5 (±11.7)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	19.6 (±0.3)
2.21 2.81	0.60	3.72E-06 (±2.90E-06)	17.4 (±2.9)	62.6 (±7.7)	52.8 (±6.2)	39.5 (±0.8)	75.6 (±13.0)	80.7 (±11.1)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	19.2 (±0.3)
2.81 3.33	0.52	3.22E-04 (±4.70E-04)	29.9 (±5.6)	77.7 (±6.1)	80.4 (±10.6)	42.7 (±1.4)	97.4 (±7.6)	101.8 (±8.7)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	19.5 (±0.2)
3.33 4.09	0.76	2.63E-06 (±2.41E-06)	13.6 (±4.1)	51.0 (±12.7)	45.8 (±8.4)	38.1 (±1.7)	58.3 (±18.6)	63.3 (±18.6)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	18.5 (±0.8)
4.09 5.24	1.15	1.99E-08 (±2.41E-08)	4.6 (±0.9)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	11.8 (±3.7)	27.3 (±5.0)	62.7 (±16.1)	1.1 (±0.3)	6.1 (±2.0)	16.8 (±0.5)
5.24 6.99	1.75	1.95E-07 (±2.26E-07)	8.2 (±1.4)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	27.8 (±6.7)	44.2 (±7.1)	134.8 (±29.2)	2.1 (±0.5)	14.5 (±4.0)	17.8 (±0.4)
6.99 8.46	1.47	1.59E-06 (±2.20E-06)	14.3 (±3.3)	58.3 (±8.2)	41.3 (±5.1)	37.4 (±0.9)	57.1 (±17.5)	70.4 (±12.3)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	18.6 (±0.4)
8.46 9.88	1.42	7.90E-07 (±1.04E-06)	10.0 (±3.6)	47.5 (±11.8)	34.8 (±4.9)	34.8 (±1.3)	37.3 (±19.6)	48.6 (±15.0)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	17.5 (±0.6)
9.88 10.45	0.57	4.05E-04 (±2.54E-04)	38.6 (±5.5)	93.0 (±7.0)	76.3 (±9.3)	41.8 (±1.4)	116.6 (±8.8)	121.3 (±10.3)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	19.4 (±0.2)
10.45 11.17	0.72	2.77E-07 (±1.01E-06)	11.4 (±4.2)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	36.9 (±20.8)	63.4 (±18.9)	164.2 (±42.8)	1.6 (±0.5)	10.8 (±3.8)	18.2 (±0.6)
11.17 12.54	1.37	2.96E-08 (±8.03E-09)	9.4 (±2.2)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	25.4 (±8.0)	55.1 (±15.5)	135.7 (±28.9)	1.2 (±0.3)	7.7 (±1.8)	17.7 (±0.8)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02D
Total depth: 13.45 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Summary table of mean values

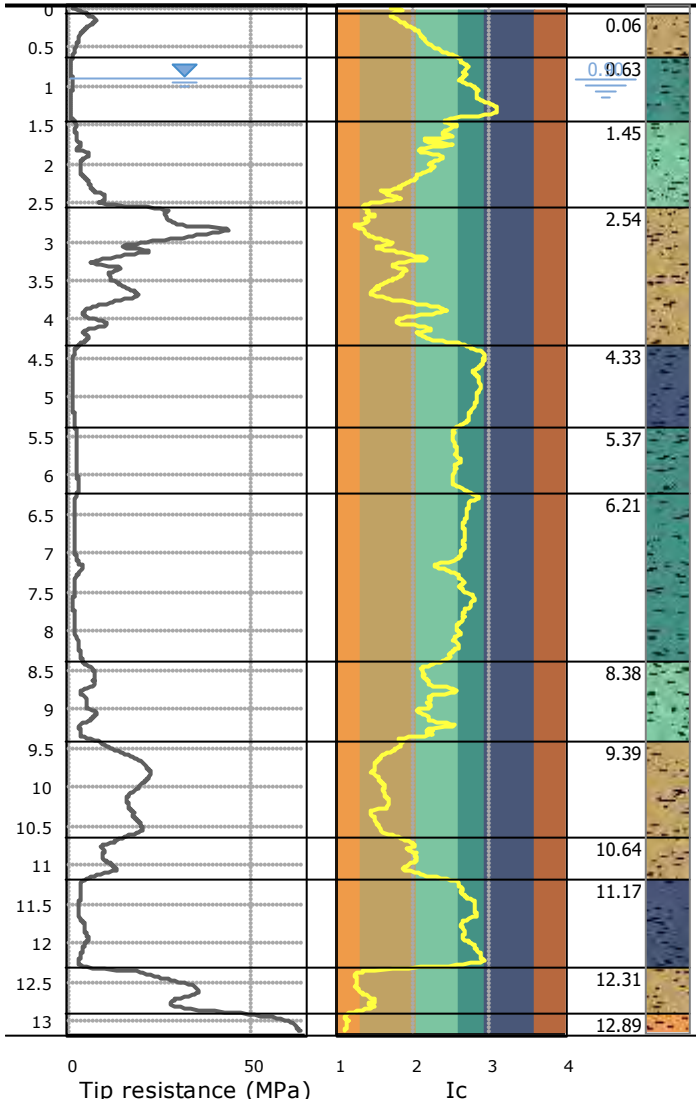
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r (%)	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
12.54	0.62	9.31E-08	14.3	0.0	0.0	0.0	44.3	87.0	213.2	1.9	12.4	18.9
13.16		(±2.68E-07)	(±1.9)	(±0.0)	(±0.0)	(±0.0)	(±9.5)	(±10.3)	(±30.4)	(±0.3)	(±2.2)	(±0.3)
13.16	0.29	2.29E-03	64.3	130.8	90.5	45.2	163.9	177.5	0.0	0.0	0.0	20.0
13.45		(±1.40E-03)	(±22.1)	(±36.5)	(±16.6)	(±3.6)	(±45.8)	(±55.5)	(±0.0)	(±0.0)	(±0.0)	(±1.0)

Depth values presented in this table are measured from free ground surface

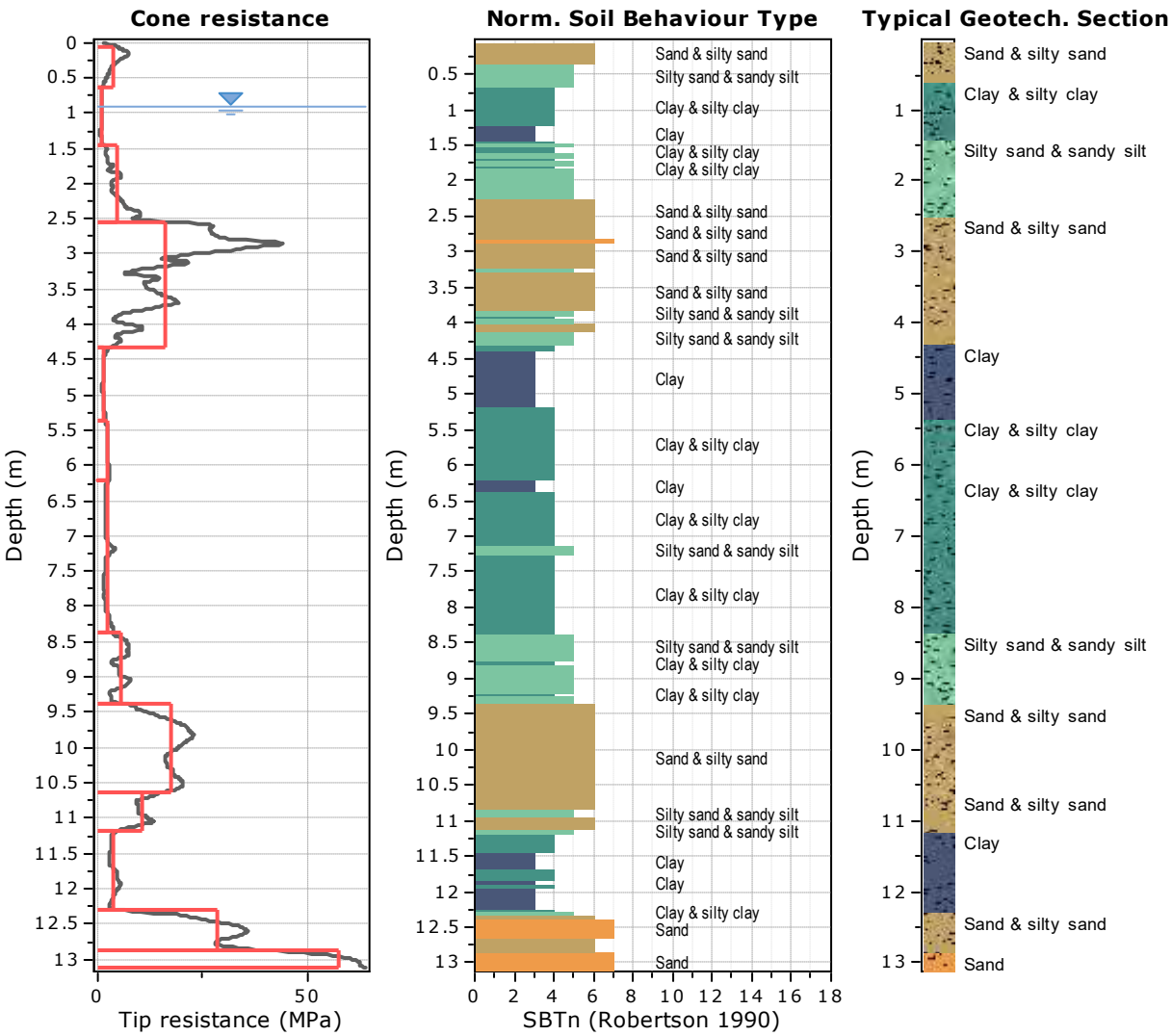
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Depth (m)	Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
0.06	Sand & silty sand	3.9	1.52E-5	10.0	32.5	41.7	35.2	39.3	37.1	-	-	-	17.0
0.63	Clay & silty clay	0.8	5.54E-8	3.8	-	-	-	10.7	21.9	64.6	1.0	6.3	16.1
1.45	Silty sand & sandy silt	4.7	1.29E-5	13.1	48.5	48.0	38.1	52.2	57.7	-	-	-	18.3
2.54	Sand & silty sand	16.2	1.99E-4	33.8	91.5	78.3	43.2	112.3	122.0	-	-	-	19.9
4.33	Clay	1.4	2.96E-8	6.5	-	-	-	18.7	40.4	89.6	1.6	9.5	17.8
5.37	Clay & silty clay	2.4	1.47E-7	9.3	-	-	-	32.1	51.9	164.2	2.6	19.0	18.2
6.21	Clay & silty clay	2.1	1.16E-7	8.5	-	-	-	27.3	46.6	136.4	1.8	12.5	17.8
8.38	Silty sand & sandy silt	5.4	1.82E-6	16.8	63.9	41.8	36.9	71.5	79.5	-	-	-	18.7
9.39	Sand & silty sand	17.7	1.48E-4	36.7	95.1	71.4	40.9	119.2	124.9	-	-	-	19.5
10.64	Sand & silty sand	10.7	9.88E-6	28.3	91.9	53.9	38.8	114.7	120.6	-	-	-	19.5
11.17	Clay	3.7	7.43E-8	16.1	-	-	-	49.3	103.4	228.4	2.3	14.3	19.3
12.31	Sand & silty sand	28.6	8.13E-4	51.0	115.1	85.2	43.1	144.0	153.6	-	-	-	19.7
12.89	Sand	57.7	3.31E-3	88.6	172.6	100.0	48.3	216.4	241.7	-	-	-	20.9



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.06 (m), **End depth:** 0.63 (m)

Description: Sand & silty sand

Basic results

Total cone resistance: 3.90 ±2.01 MPa
Sleeve friction: 26.15 ±14.82 kPa
Ic: 1.99 ±0.34
SBT_n: 6
SBTn description: Sand & silty sand

Estimation results

Permeability: 1.52E-05 ±1.76E-05 m/s
N_{60}: 10.04 ±4.08 blows
Es: 32.53 ±9.44 MPa
Dr (%): 41.66 ±11.37
φ (degrees): 35.16 ±2.37 °
Unit weight: 17.00 ±0.98 kN/m³

Constrained Mod.: 39.34 ±13.76 MPa
Go: 37.14 ±13.39 MPa
Su: 0.00 ±0.00 kPa
Su ratio: 0.00 ±0.00
O.C.R.: 0.00 ±0.00

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 0.63 (m), **End depth:** 1.45 (m)

Description: Clay & silty clay

Basic results	Estimation results	
Total cone resistance: 0.84 ±0.15 MPa	Permeability: 5.54E-08 ±6.50E-08 m/s	Constrained Mod.: 10.66 ±2.81 MPa
Sleeve friction: 18.43 ±10.45 kPa	N_{60}: 3.78 ±0.63 blows	Go: 21.91 ±4.74 MPa
Ic: 2.79 ±0.18	Es: 0.00 ±0.00 MPa	Su: 64.62 ±15.06 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 0.97 ±0.18
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 6.31 ±1.82
	Unit weight: 16.08 ±0.69 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 1.45 (m), **End depth:** 2.54 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 4.73 ±2.81 MPa	Permeability: 1.29E-05 ±2.66E-05 m/s	Constrained Mod.: 52.23 ±18.53 MPa
Sleeve friction: 68.36 ±25.61 kPa	N_{60}: 13.14 ±5.20 blows	Go: 57.71 ±14.78 MPa
Ic: 2.18 ±0.28	Es: 48.46 ±10.15 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 47.97 ±12.63	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 38.14 ±1.59 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.33 ±0.55 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 2.54 (m), **End depth:** 4.33 (m)

Description: Sand & silty sand

Basic results	Estimation results	
Total cone resistance: 16.22 ±10.29 MPa	Permeability: 1.99E-04 ±2.99E-04 m/s	Constrained Mod.: 112.33 ±36.90 MPa
Sleeve friction: 179.63 ±70.04 kPa	N_{60}: 33.76 ±15.82 blows	Go: 122.00 ±41.68 MPa
Ic: 1.76 ±0.32	Es: 91.48 ±27.75 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 78.26 ±19.36	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 43.25 ±3.26 °	O.C.R.: 0.00 ±0.00
	Unit weight: 19.86 ±0.69 kN/m³	

.:: Layer No: 5 ::.

Code: Layer_5 **Start depth:** 4.33 (m), **End depth:** 5.37 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 1.42 ±0.32 MPa	Permeability: 2.96E-08 ±3.53E-08 m/s	Constrained Mod.: 18.70 ±4.49 MPa
Sleeve friction: 58.38 ±15.26 kPa	N_{60}: 6.48 ±1.13 blows	Go: 40.45 ±6.23 MPa
Ic: 2.83 ±0.09	Es: 0.00 ±0.00 MPa	Su: 89.57 ±22.99 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 1.60 ±0.38
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 9.50 ±3.21
	Unit weight: 17.76 ±0.35 kN/m³	

.:: Layer No: 6 ::.

Code: Layer_6 **Start depth:** 5.37 (m), **End depth:** 6.21 (m)

Description: Clay & silty clay

Basic results	**Estimation results**	
Total cone resistance: 2.40 ±0.24 MPa	Permeability: 1.47E-07 ±3.24E-08 m/s	Constrained Mod.: 32.12 ±3.30 MPa
Sleeve friction: 72.46 ±13.29 kPa	N_{60}: 9.29 ±0.88 blows	Go: 51.85 ±5.51 MPa
Ic: 2.56 ±0.04	Es: 0.00 ±0.00 MPa	Su: 164.21 ±16.16 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 2.62 ±0.20
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 18.97 ±1.79
	Unit weight: 18.23 ±0.22 kN/m³	

.:: Layer No: 7 ::.

Code: Layer_7 **Start depth:** 6.21 (m), **End depth:** 8.38 (m)

Description: Clay & silty clay

Basic results	**Estimation results**	
Total cone resistance: 2.08 ±0.64 MPa	Permeability: 1.16E-07 ±1.47E-07 m/s	Constrained Mod.: 27.29 ±8.92 MPa
Sleeve friction: 55.34 ±23.71 kPa	N_{60}: 8.46 ±2.00 blows	Go: 46.64 ±11.10 MPa
Ic: 2.65 ±0.11	Es: 0.00 ±0.00 MPa	Su: 136.37 ±37.71 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 1.83 ±0.46
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 12.54 ±3.69
	Unit weight: 17.78 ±0.54 kN/m³	

.:: Layer No: 8 ::.

Code: Layer_8 **Start depth:** 8.38 (m), **End depth:** 9.39 (m)

Description: Silty sand & sandy silt

Basic results	**Estimation results**	
Total cone resistance: 5.37 ±1.60 MPa	Permeability: 1.82E-06 ±1.42E-06 m/s	Constrained Mod.: 71.52 ±21.02 MPa
Sleeve friction: 92.97 ±37.20 kPa	N_{60}: 16.75 ±4.09 blows	Go: 79.52 ±19.15 MPa
Ic: 2.25 ±0.14	Es: 63.85 ±13.48 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 41.82 ±6.12	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 36.95 ±1.64 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.70 ±0.69 kN/m³	

.:: Layer No: 9 ::.

Code: Layer_9 **Start depth:** 9.39 (m), **End depth:** 10.64 (m)

Description: Sand & silty sand

Basic results	**Estimation results**	
Total cone resistance: 17.74 ±3.70 MPa	Permeability: 1.48E-04 ±9.32E-05 m/s	Constrained Mod.: 119.24 ±15.40 MPa
Sleeve friction: 117.44 ±27.46 kPa	N_{60}: 36.72 ±5.96 blows	Go: 124.90 ±18.08 MPa
Ic: 1.61 ±0.12	Es: 95.14 ±12.29 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 71.38 ±7.96	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 40.86 ±1.34 °	O.C.R.: 0.00 ±0.00
	Unit weight: 19.52 ±0.40 kN/m³	

.:: Layer No: 10 ::.

Code: Layer_10 **Start depth:** 10.64 (m), **End depth:** 11.17 (m)

Description: Sand & silty sand

Basic results	Estimation results	
Total cone resistance: 10.66 ±2.10 MPa	Permeability: 9.88E-06 ±6.73E-06 m/s	Constrained Mod.: 114.71 ±12.78 MPa
Sleeve friction: 138.10 ±23.26 kPa	N_{60}: 28.31 ±4.01 blows	Go: 120.58 ±13.55 MPa
Ic: 1.99 ±0.10	Es: 91.89 ±9.18 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 53.92 ±5.70	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 38.76 ±0.96 °	O.C.R.: 0.00 ±0.00
	Unit weight: 19.54 ±0.27 kN/m³	

.:: Layer No: 11 ::.

Code: Layer_11 **Start depth:** 11.17 (m), **End depth:** 12.31 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 3.74 ±0.80 MPa	Permeability: 7.43E-08 ±1.20E-07 m/s	Constrained Mod.: 49.32 ±11.24 MPa
Sleeve friction: 170.14 ±69.33 kPa	N_{60}: 16.06 ±3.01 blows	Go: 103.42 ±23.57 MPa
Ic: 2.73 ±0.12	Es: 0.00 ±0.00 MPa	Su: 228.43 ±49.15 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 2.27 ±0.50
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 14.30 ±3.83
	Unit weight: 19.30 ±0.52 kN/m³	

.:: Layer No: 12 ::.

Code: Layer_12 **Start depth:** 12.31 (m), **End depth:** 12.89 (m)

Description: Sand & silty sand

Basic results	Estimation results	
Total cone resistance: 28.64 ±8.14 MPa	Permeability: 8.13E-04 ±5.00E-04 m/s	Constrained Mod.: 144.01 ±35.31 MPa
Sleeve friction: 134.76 ±64.84 kPa	N_{60}: 50.98 ±13.12 blows	Go: 153.62 ±42.06 MPa
Ic: 1.39 ±0.20	Es: 115.07 ±27.82 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 85.21 ±14.52	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 43.13 ±2.46 °	O.C.R.: 0.00 ±0.00
	Unit weight: 19.71 ±0.83 kN/m³	

.:: Layer No: 13 ::.

Code: Layer_13 **Start depth:** 12.89 (m), **End depth:** 13.12 (m)

Description: Sand

Basic results	Estimation results	
Total cone resistance: 57.75 ±6.25 MPa	Permeability: 3.31E-03 ±5.37E-04 m/s	Constrained Mod.: 216.35 ±19.84 MPa
Sleeve friction: 245.99 ±40.70 kPa	N_{60}: 88.58 ±8.90 blows	Go: 241.74 ±24.75 MPa
Ic: 1.13 ±0.03	Es: 172.62 ±15.83 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 7	Dr (%): 100.00 ±0.00	Su ratio: 0.00 ±0.00
SBTn description: Sand	φ (degrees): 48.26 ±0.80 °	O.C.R.: 0.00 ±0.00
	Unit weight: 20.86 ±0.24 kN/m³	

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Summary table of mean values

From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r (%)	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.06 0.63	0.57	1.52E-05 (±1.76E-05)	10.0 (±4.1)	32.5 (±9.4)	41.7 (±11.4)	35.2 (±2.4)	39.3 (±13.8)	37.1 (±13.4)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	17.0 (±1.0)
0.63 1.45	0.82	5.54E-08 (±6.50E-08)	3.8 (±0.6)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	10.7 (±2.8)	21.9 (±4.7)	64.6 (±15.1)	1.0 (±0.2)	6.3 (±1.8)	16.1 (±0.7)
1.45 2.54	1.09	1.29E-05 (±2.66E-05)	13.1 (±5.2)	48.5 (±10.1)	48.0 (±12.6)	38.1 (±1.6)	52.2 (±18.5)	57.7 (±14.8)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	18.3 (±0.5)
2.54 4.33	1.79	1.99E-04 (±2.99E-04)	33.8 (±15.8)	91.5 (±27.8)	78.3 (±19.4)	43.2 (±3.3)	112.3 (±36.9)	122.0 (±41.7)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	19.9 (±0.7)
4.33 5.37	1.04	2.96E-08 (±3.53E-08)	6.5 (±1.1)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	18.7 (±4.5)	40.4 (±6.2)	89.6 (±23.0)	1.6 (±0.4)	9.5 (±3.2)	17.8 (±0.3)
5.37 6.21	0.84	1.47E-07 (±3.24E-08)	9.3 (±0.9)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	32.1 (±3.3)	51.9 (±5.5)	164.2 (±16.2)	2.6 (±0.2)	19.0 (±1.8)	18.2 (±0.2)
6.21 8.38	2.17	1.16E-07 (±1.47E-07)	8.5 (±2.0)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	27.3 (±8.9)	46.6 (±11.1)	136.4 (±37.7)	1.8 (±0.5)	12.5 (±3.7)	17.8 (±0.5)
8.38 9.39	1.01	1.82E-06 (±1.42E-06)	16.8 (±4.1)	63.9 (±13.5)	41.8 (±6.1)	36.9 (±1.6)	71.5 (±21.0)	79.5 (±19.2)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	18.7 (±0.7)
9.39 10.64	1.25	1.48E-04 (±9.32E-05)	36.7 (±6.0)	95.1 (±12.3)	71.4 (±8.0)	40.9 (±1.3)	119.2 (±15.4)	124.9 (±18.1)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	19.5 (±0.4)
10.64 11.17	0.53	9.88E-06 (±6.73E-06)	28.3 (±4.0)	91.9 (±9.2)	53.9 (±5.7)	38.8 (±1.0)	114.7 (±12.8)	120.6 (±13.6)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	19.5 (±0.3)
11.17 12.31	1.14	7.43E-08 (±1.20E-07)	16.1 (±3.0)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	49.3 (±11.2)	103.4 (±23.6)	228.4 (±49.2)	2.3 (±0.5)	14.3 (±3.8)	19.3 (±0.5)
12.31 12.89	0.58	8.13E-04 (±5.00E-04)	51.0 (±13.1)	115.1 (±27.8)	85.2 (±14.5)	43.1 (±2.5)	144.0 (±35.3)	153.6 (±42.1)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	19.7 (±0.8)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02F
Total depth: 13.12 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Summary table of mean values

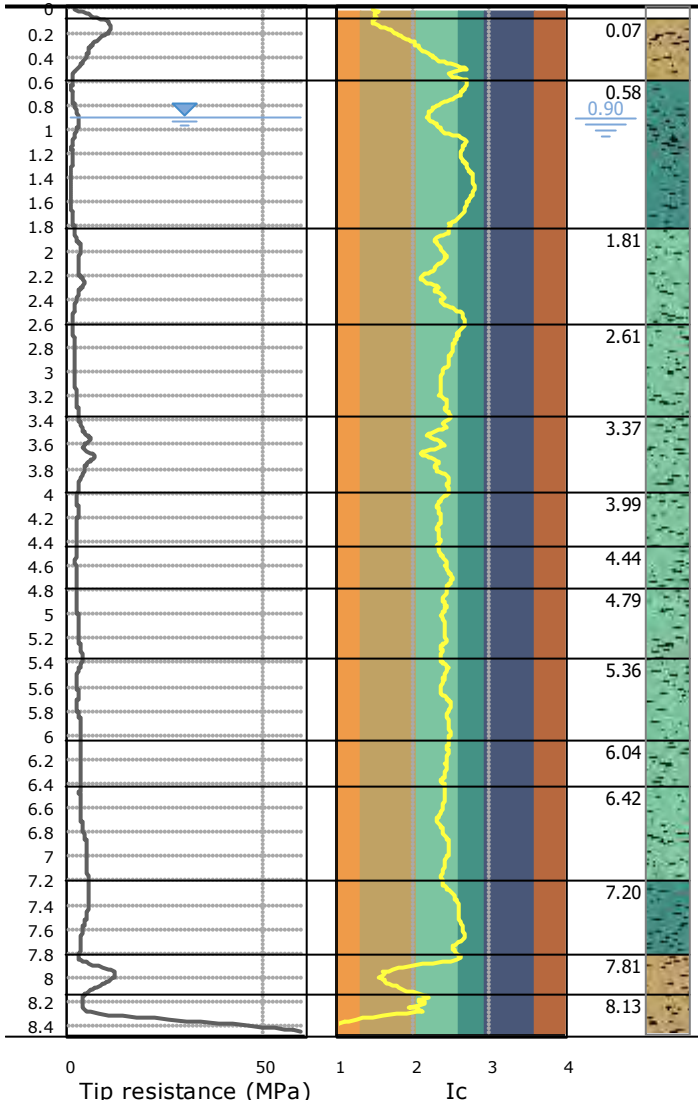
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r (%)	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
12.89	0.23	3.31E-03	88.6	172.6	100.0	48.3	216.4	241.7	0.0	0.0	0.0	20.9
13.12		(±5.37E-04)	(±8.9)	(±15.8)	(±0.0)	(±0.8)	(±19.8)	(±24.8)	(±0.0)	(±0.0)	(±0.0)	(±0.2)

Depth values presented in this table are measured from free ground surface

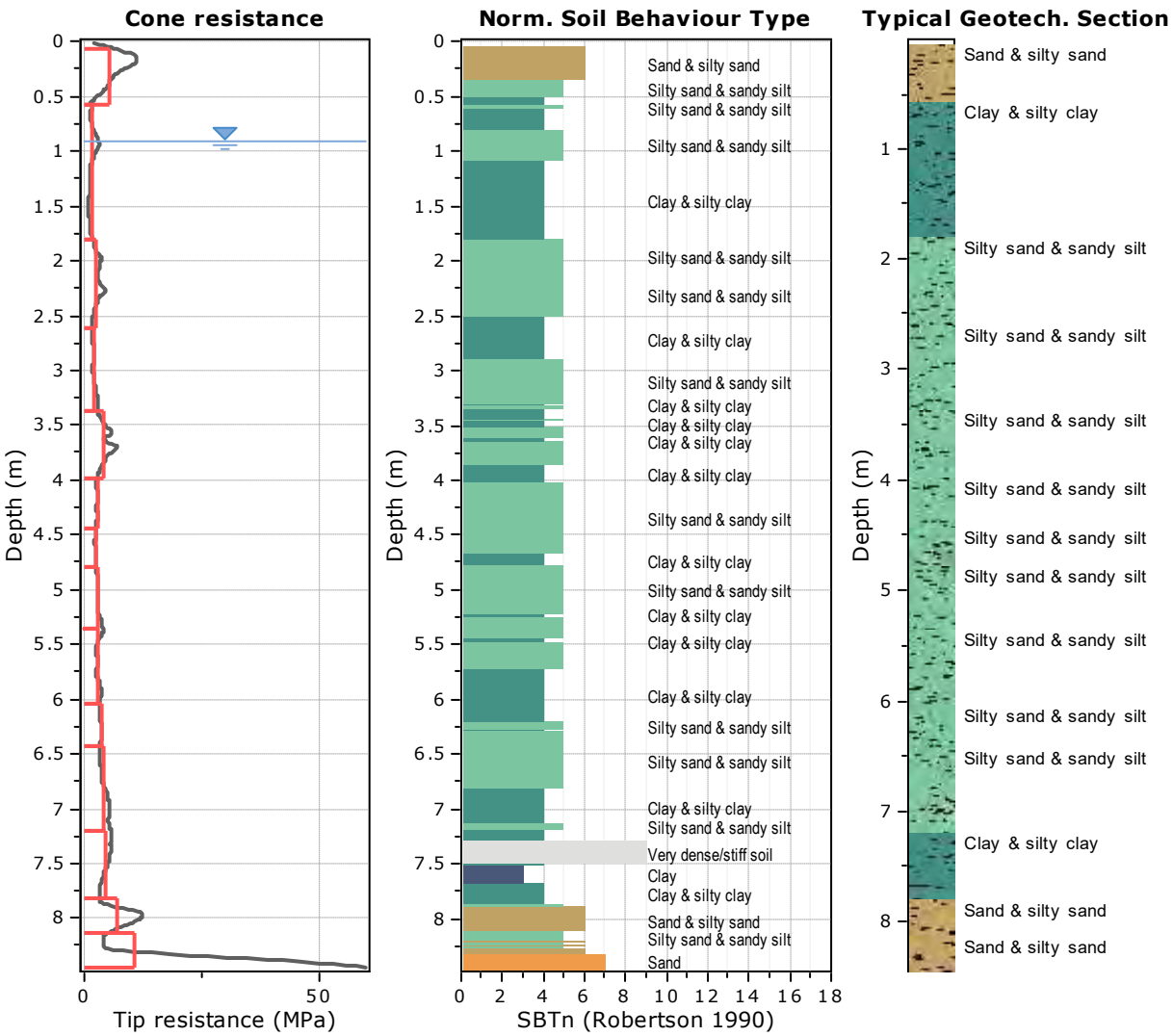
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Depth (m)	Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
0.07	Sand & silty sand	5.4	9.53E-6	14.3	49.6	55.9	39.1	52.4	57.1	-	-	-	18.3
0.58	Clay & silty clay	1.5	1.14E-7	5.8	-	-	-	20.1	31.7	91.8	1.5	9.7	17.1
1.81	Silty sand & sandy silt	2.6	5.12E-7	9.0	39.3	36.7	36.9	36.1	45.5	-	-	-	17.9
2.61	Silty sand & sandy silt	2.1	2.57E-7	7.6	33.4	32.5	36.1	28.3	39.6	-	-	-	17.6
3.37	Silty sand & sandy silt	4.3	6.21E-7	14.5	64.4	48.8	40.0	58.6	76.2	-	-	-	19.1
3.99	Silty sand & sandy silt	2.7	5.63E-7	9.2	37.0	35.4	36.4	36.4	45.0	-	-	-	17.9
4.44	Silty sand & sandy silt	2.4	3.79E-7	8.5	33.9	33.0	36.1	31.8	41.7	-	-	-	17.7
4.79	Silty sand & sandy silt	3.0	4.12E-7	10.5	43.7	37.1	37.9	40.3	54.0	-	-	-	18.3
5.36	Silty sand & sandy silt	3.0	3.51E-7	10.9	42.5	36.4	37.5	41.0	56.9	-	-	-	18.4
6.04	Silty sand & sandy silt	3.5	3.45E-7	12.6	52.3	38.2	38.4	47.1	66.7	-	-	-	18.7
6.42	Silty sand & sandy silt	4.3	4.24E-7	15.0	53.8	38.6	38.1	57.9	80.3	-	-	-	19.1
7.20	Clay & silty clay	4.6	1.36E-7	17.9	-	-	-	62.2	110.2	287.7	4.2	30.4	19.8
7.81	Sand & silty sand	7.2	9.52E-6	18.8	60.5	53.7	37.8	66.8	75.1	-	-	-	18.5
8.13	Sand & silty sand	10.6	2.02E-5	23.0	61.9	55.6	38.9	77.5	76.3	-	-	-	18.4



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.07 (m), **End depth:** 0.58 (m)

Description: Sand & silty sand

Basic results

Total cone resistance: 5.40 ±3.36 MPa
Sleeve friction: 0.00 ±63.87 kPa
Ic: 1.93 ±0.39
SBT_n: 6
SBTn description: Sand & silty sand

Estimation results

Permeability: 9.53E-06 ±1.30E-04 m/s
N_{60}: 14.27 ±4.98 blows
Es: 49.63 ±5.20 MPa
Dr (%): 55.93 ±11.91
φ (degrees): 39.07 ±1.28 °
Unit weight: 18.28 ±0.53 kN/m³

Constrained Mod.: 52.44 ±16.22 MPa
Go: 57.08 ±11.31 MPa
Su: 0.00 ±0.00 kPa
Su ratio: 0.00 ±0.00
O.C.R.: 0.00 ±0.00

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 0.58 (m), **End depth:** 1.81 (m)

Description: Clay & silty clay

Basic results	**Estimation results**	
Total cone resistance: 1.46 ±0.62 MPa	Permeability: 1.14E-07 ±4.99E-07 m/s	Constrained Mod.: 20.14 ±8.72 MPa
Sleeve friction: 30.27 ±6.96 kPa	N_{60}: 5.81 ±1.54 blows	Go: 31.65 ±5.26 MPa
Ic: 2.59 ±0.18	Es: 0.00 ±0.00 MPa	Su: 91.84 ±17.94 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 1.45 ±0.27
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 9.71 ±2.42
	Unit weight: 17.06 ±0.34 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 1.81 (m), **End depth:** 2.61 (m)

Description: Silty sand & sandy silt

Basic results	**Estimation results**	
Total cone resistance: 2.63 ±0.80 MPa	Permeability: 5.12E-07 ±8.41E-07 m/s	Constrained Mod.: 36.06 ±10.73 MPa
Sleeve friction: 51.44 ±17.03 kPa	N_{60}: 9.04 ±2.11 blows	Go: 45.50 ±8.79 MPa
Ic: 2.38 ±0.13	Es: 39.26 ±5.76 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 36.69 ±4.42	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 36.87 ±0.90 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.89 ±0.46 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 2.61 (m), **End depth:** 3.37 (m)

Description: Silty sand & sandy silt

Basic results	**Estimation results**	
Total cone resistance: 2.07 ±0.44 MPa	Permeability: 2.57E-07 ±1.92E-07 m/s	Constrained Mod.: 28.29 ±6.10 MPa
Sleeve friction: 42.48 ±16.71 kPa	N_{60}: 7.62 ±1.38 blows	Go: 39.59 ±7.49 MPa
Ic: 2.48 ±0.10	Es: 33.45 ±6.41 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 32.46 ±3.05	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 36.08 ±1.27 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.58 ±0.44 kN/m³	

.:: Layer No: 5 ::.

Code: Layer_5 **Start depth:** 3.37 (m), **End depth:** 3.99 (m)

Description: Silty sand & sandy silt

Basic results	**Estimation results**	
Total cone resistance: 4.26 ±1.20 MPa	Permeability: 6.21E-07 ±7.74E-07 m/s	Constrained Mod.: 58.62 ±16.38 MPa
Sleeve friction: 128.15 ±30.65 kPa	N_{60}: 14.48 ±3.02 blows	Go: 76.25 ±12.74 MPa
Ic: 2.35 ±0.11	Es: 64.43 ±6.54 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 48.83 ±4.72	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 39.97 ±0.52 °	O.C.R.: 0.00 ±0.00
	Unit weight: 19.13 ±0.36 kN/m³	

.:: Layer No: 6 ::.

Code: Layer_6 **Start depth:** 3.99 (m), **End depth:** 4.44 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 2.68 ±0.10 MPa	Permeability: 5.63E-07 ±1.59E-07 m/s	Constrained Mod.: 36.44 ±1.46 MPa
Sleeve friction: 50.01 ±8.30 kPa	N_{60}: 9.21 ±0.42 blows	Go: 44.98 ±2.92 MPa
Ic: 2.37 ±0.05	Es: 37.00 ±1.20 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 35.36 ±0.71	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 36.44 ±0.34 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.87 ±0.17 kN/m³	

.:: Layer No: 7 ::.

Code: Layer_7 **Start depth:** 4.44 (m), **End depth:** 4.79 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 2.35 ±0.08 MPa	Permeability: 3.79E-07 ±2.02E-07 m/s	Constrained Mod.: 31.78 ±1.10 MPa
Sleeve friction: 45.09 ±10.98 kPa	N_{60}: 8.46 ±0.51 blows	Go: 41.74 ±4.09 MPa
Ic: 2.42 ±0.07	Es: 33.92 ±2.32 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 33.00 ±0.66	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 36.10 ±0.77 °	O.C.R.: 0.00 ±0.00
	Unit weight: 17.70 ±0.27 kN/m³	

.:: Layer No: 8 ::.

Code: Layer_8 **Start depth:** 4.79 (m), **End depth:** 5.36 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 2.97 ±0.40 MPa	Permeability: 4.12E-07 ±6.98E-08 m/s	Constrained Mod.: 40.32 ±5.63 MPa
Sleeve friction: 72.65 ±18.80 kPa	N_{60}: 10.46 ±1.34 blows	Go: 54.05 ±7.53 MPa
Ic: 2.41 ±0.02	Es: 43.68 ±5.29 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 37.08 ±2.53	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 37.93 ±0.70 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.34 ±0.31 kN/m³	

.:: Layer No: 9 ::.

Code: Layer_9 **Start depth:** 5.36 (m), **End depth:** 6.04 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 3.03 ±0.45 MPa	Permeability: 3.51E-07 ±1.26E-07 m/s	Constrained Mod.: 41.04 ±6.23 MPa
Sleeve friction: 78.32 ±26.91 kPa	N_{60}: 10.91 ±1.67 blows	Go: 56.92 ±10.32 MPa
Ic: 2.44 ±0.05	Es: 42.49 ±6.56 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 36.44 ±3.18	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 37.48 ±1.02 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.43 ±0.43 kN/m³	

.:: Layer No: 10 ::.

Code: Layer_10 **Start depth:** 6.04 (m), **End depth:** 6.42 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 3.48 ±0.07 MPa	Permeability: 3.45E-07 ±6.92E-08 m/s	Constrained Mod.: 47.14 ±1.02 MPa
Sleeve friction: 98.60 ±10.68 kPa	N_{60}: 12.61 ±0.49 blows	Go: 66.72 ±2.72 MPa
Ic: 2.44 ±0.03	Es: 52.28 ±2.16 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 38.17 ±0.58	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 38.45 ±0.48 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.75 ±0.13 kN/m³	

.:: Layer No: 11 ::.

Code: Layer_11 **Start depth:** 6.42 (m), **End depth:** 7.20 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 4.26 ±0.83 MPa	Permeability: 4.24E-07 ±1.38E-07 m/s	Constrained Mod.: 57.88 ±11.50 MPa
Sleeve friction: 124.78 ±60.36 kPa	N_{60}: 14.98 ±3.07 blows	Go: 80.34 ±20.86 MPa
Ic: 2.41 ±0.04	Es: 53.79 ±9.14 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 38.60 ±2.72	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 38.11 ±0.91 °	O.C.R.: 0.00 ±0.00
	Unit weight: 19.10 ±0.58 kN/m³	

.:: Layer No: 12 ::.

Code: Layer_12 **Start depth:** 7.20 (m), **End depth:** 7.81 (m)

Description: Clay & silty clay

Basic results	Estimation results	
Total cone resistance: 4.58 ±0.96 MPa	Permeability: 1.36E-07 ±1.21E-07 m/s	Constrained Mod.: 62.22 ±13.44 MPa
Sleeve friction: 227.61 ±81.66 kPa	N_{60}: 17.91 ±3.30 blows	Go: 110.17 ±22.76 MPa
Ic: 2.57 ±0.08	Es: 0.00 ±0.00 MPa	Su: 287.66 ±60.51 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 4.24 ±0.98
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 30.44 ±8.56
	Unit weight: 19.82 ±0.52 kN/m³	

.:: Layer No: 13 ::.

Code: Layer_13 **Start depth:** 7.81 (m), **End depth:** 8.13 (m)

Description: Sand & silty sand

Basic results	Estimation results	
Total cone resistance: 7.15 ±3.45 MPa	Permeability: 9.52E-06 ±6.17E-05 m/s	Constrained Mod.: 66.79 ±17.00 MPa
Sleeve friction: 64.55 ±38.47 kPa	N_{60}: 18.83 ±5.06 blows	Go: 75.12 ±12.51 MPa
Ic: 1.93 ±0.38	Es: 60.54 ±9.58 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 53.66 ±7.66	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 37.81 ±1.29 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.55 ±0.53 kN/m³	

.:: Layer No: 14 ::.

Code: Layer_14 **Start depth:** 8.13 (m), **End depth:** 8.45 (m)

Description: Sand & silty sand

Basic results	**Estimation results**	
Total cone resistance: 10.61 ±20.25 MPa	Permeability: 2.02E-05 ±1.77E-03 m/s	Constrained Mod.: 77.48 ±35.92 MPa
Sleeve friction: 0.00 ±63.98 kPa	N_{60}: 23.01 ±22.74 blows	Go: 76.31 ±40.22 MPa
Ic: 1.58 ±0.53	Es: 61.91 ±28.61 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 55.61 ±28.57	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 38.90 ±5.82 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.40 ±0.98 kN/m³	

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

Summary table of mean values

From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r (%)	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.07 0.58	0.51	9.53E-06 (±1.30E-04)	14.3 (±5.0)	49.6 (±5.2)	55.9 (±11.9)	39.1 (±1.3)	52.4 (±16.2)	57.1 (±11.3)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	18.3 (±0.5)
0.58 1.81	1.23	1.14E-07 (±4.99E-07)	5.8 (±1.5)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	20.1 (±8.7)	31.7 (±5.3)	91.8 (±17.9)	1.5 (±0.3)	9.7 (±2.4)	17.1 (±0.3)
1.81 2.61	0.80	5.12E-07 (±8.41E-07)	9.0 (±2.1)	39.3 (±5.8)	36.7 (±4.4)	36.9 (±0.9)	36.1 (±10.7)	45.5 (±8.8)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	17.9 (±0.5)
2.61 3.37	0.76	2.57E-07 (±1.92E-07)	7.6 (±1.4)	33.4 (±6.4)	32.5 (±3.1)	36.1 (±1.3)	28.3 (±6.1)	39.6 (±7.5)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	17.6 (±0.4)
3.37 3.99	0.62	6.21E-07 (±7.74E-07)	14.5 (±3.0)	64.4 (±6.5)	48.8 (±4.7)	40.0 (±0.5)	58.6 (±16.4)	76.2 (±12.7)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	19.1 (±0.4)
3.99 4.44	0.45	5.63E-07 (±1.59E-07)	9.2 (±0.4)	37.0 (±1.2)	35.4 (±0.7)	36.4 (±0.3)	36.4 (±1.5)	45.0 (±2.9)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	17.9 (±0.2)
4.44 4.79	0.35	3.79E-07 (±2.02E-07)	8.5 (±0.5)	33.9 (±2.3)	33.0 (±0.7)	36.1 (±0.8)	31.8 (±1.1)	41.7 (±4.1)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	17.7 (±0.3)
4.79 5.36	0.57	4.12E-07 (±6.98E-08)	10.5 (±1.3)	43.7 (±5.3)	37.1 (±2.5)	37.9 (±0.7)	40.3 (±5.6)	54.0 (±7.5)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	18.3 (±0.3)
5.36 6.04	0.68	3.51E-07 (±1.26E-07)	10.9 (±1.7)	42.5 (±6.6)	36.4 (±3.2)	37.5 (±1.0)	41.0 (±6.2)	56.9 (±10.3)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	18.4 (±0.4)
6.04 6.42	0.38	3.45E-07 (±6.92E-08)	12.6 (±0.5)	52.3 (±2.2)	38.2 (±0.6)	38.4 (±0.5)	47.1 (±1.0)	66.7 (±2.7)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	18.7 (±0.1)
6.42 7.20	0.78	4.24E-07 (±1.38E-07)	15.0 (±3.1)	53.8 (±9.1)	38.6 (±2.7)	38.1 (±0.9)	57.9 (±11.5)	80.3 (±20.9)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	19.1 (±0.6)
7.20 7.81	0.61	1.36E-07 (±1.21E-07)	17.9 (±3.3)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	62.2 (±13.4)	110.2 (±22.8)	287.7 (±60.5)	4.2 (±1.0)	30.4 (±8.6)	19.8 (±0.5)

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02G
Total depth: 8.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Summary table of mean values

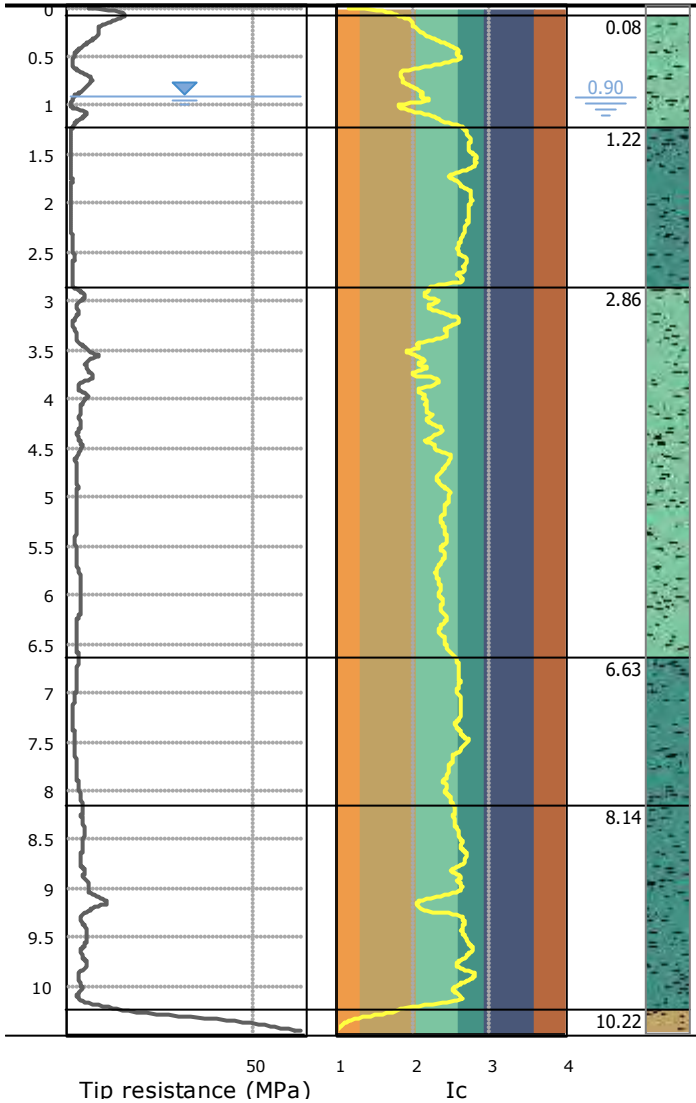
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r (%)	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
7.81	0.32	9.52E-06	18.8	60.5	53.7	37.8	66.8	75.1	0.0	0.0	0.0	18.5
8.13		(±6.17E-05)	(±5.1)	(±9.6)	(±7.7)	(±1.3)	(±17.0)	(±12.5)	(±0.0)	(±0.0)	(±0.0)	(±0.5)
8.13	0.32	2.02E-05	23.0	61.9	55.6	38.9	77.5	76.3	0.0	0.0	0.0	18.4
8.45		(±1.77E-03)	(±22.7)	(±28.6)	(±28.6)	(±5.8)	(±35.9)	(±40.2)	(±0.0)	(±0.0)	(±0.0)	(±1.0)

Depth values presented in this table are measured from free ground surface

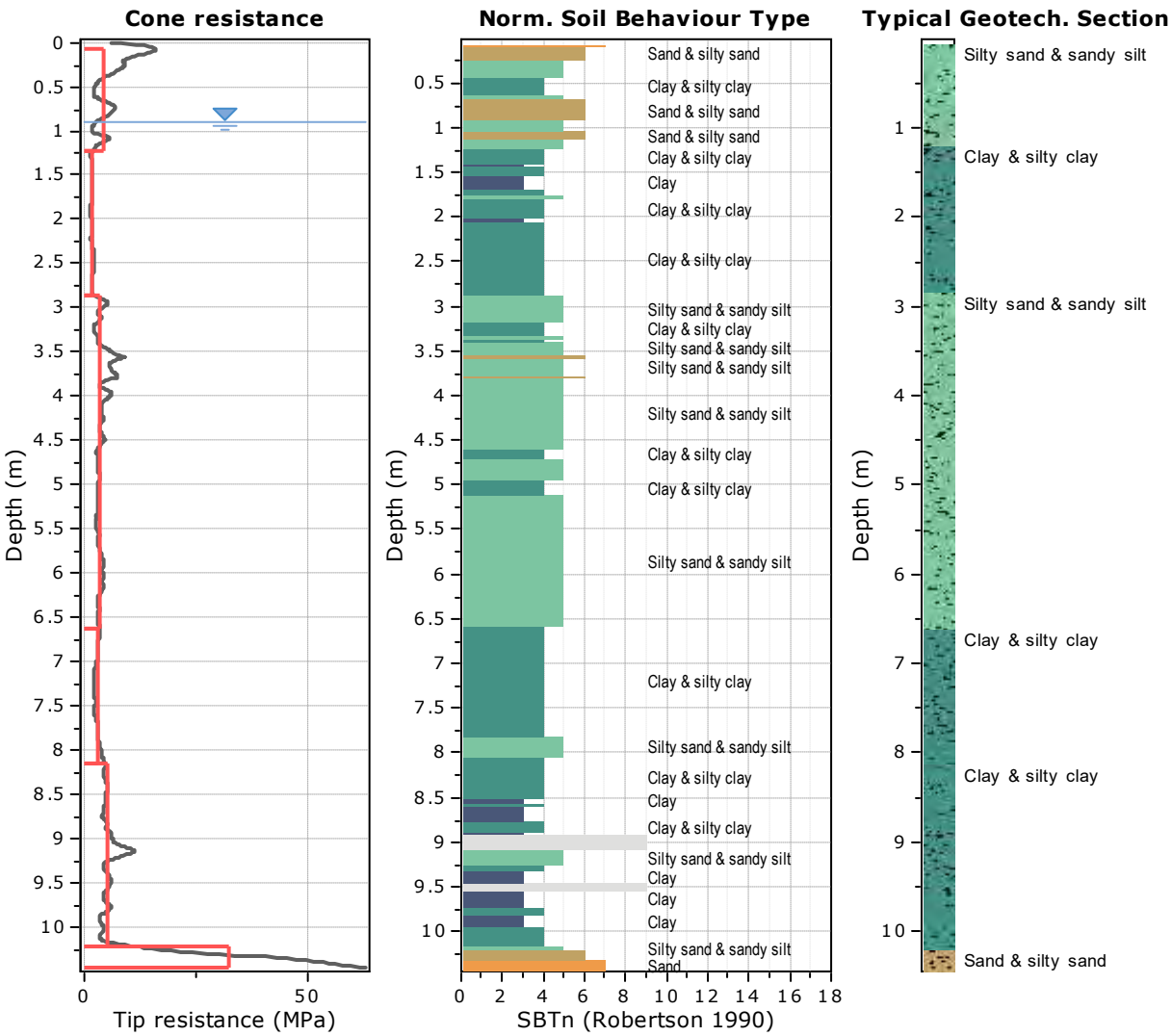
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Depth (m)	Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
0.08	Silty sand & sandy silt	4.4	3.47E-6	12.7	45.9	48.8	37.8	50.9	55.3	-	-	-	18.2
1.22	Clay & silty clay	1.7	6.04E-8	7.2	-	-	-	23.4	43.3	115.6	2.0	13.0	17.9
2.86	Silty sand & sandy silt	3.6	7.37E-7	12.1	49.1	41.2	38.0	49.0	60.5	-	-	-	18.5
6.63	Clay & silty clay	2.8	1.39E-7	10.9	-	-	-	37.3	61.2	182.5	2.5	17.5	18.4
8.14	Clay & silty clay	5.1	1.26E-7	19.9	-	-	-	67.9	123.3	293.2	3.7	25.0	19.9
10.22	Sand & silty sand	32.3	4.67E-4	58.1	131.3	87.0	44.9	164.5	178.8	-	-	-	20.3



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.08 (m), **End depth:** 1.22 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 4.39 ±3.58 MPa	Permeability: 3.47E-06 ±2.45E-04 m/s	Constrained Mod.: 50.90 ±27.83 MPa
Sleeve friction: 0.00 ±100.33 kPa	N_{60}: 12.75 ±7.25 blows	Go: 55.31 ±28.91 MPa
Ic: 2.09 ±0.29	Es: 45.93 ±21.80 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 48.75 ±15.37	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 37.81 ±3.32 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.20 ±1.31 kN/m³	

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 1.22 (m), **End depth:** 2.86 (m)

Description: Clay & silty clay

Basic results	**Estimation results**	
Total cone resistance: 1.71 ±0.24 MPa	Permeability: 6.04E-08 ±6.45E-08 m/s	Constrained Mod.: 23.39 ±3.24 MPa
Sleeve friction: 58.90 ±16.35 kPa	N_{60}: 7.19 ±0.92 blows	Go: 43.28 ±6.03 MPa
Ic: 2.69 ±0.08	Es: 0.00 ±0.00 MPa	Su: 115.62 ±16.61 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 2.00 ±0.28
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 12.95 ±2.37
	Unit weight: 17.88 ±0.37 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 2.86 (m), **End depth:** 6.63 (m)

Description: Silty sand & sandy silt

Basic results	**Estimation results**	
Total cone resistance: 3.63 ±1.19 MPa	Permeability: 7.37E-07 ±1.76E-06 m/s	Constrained Mod.: 48.98 ±13.56 MPa
Sleeve friction: 80.89 ±22.24 kPa	N_{60}: 12.10 ±2.70 blows	Go: 60.48 ±10.56 MPa
Ic: 2.33 ±0.13	Es: 49.07 ±7.68 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 41.23 ±6.51	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 38.00 ±0.93 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.54 ±0.36 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 6.63 (m), **End depth:** 8.14 (m)

Description: Clay & silty clay

Basic results	**Estimation results**	
Total cone resistance: 2.80 ±0.61 MPa	Permeability: 1.39E-07 ±9.91E-08 m/s	Constrained Mod.: 37.28 ±8.54 MPa
Sleeve friction: 81.40 ±30.71 kPa	N_{60}: 10.94 ±1.99 blows	Go: 61.20 ±12.10 MPa
Ic: 2.57 ±0.08	Es: 0.00 ±0.00 MPa	Su: 182.46 ±38.98 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 2.48 ±0.55
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 17.55 ±4.42
	Unit weight: 18.44 ±0.47 kN/m³	

.:: Layer No: 5 ::.

Code: Layer_5 **Start depth:** 8.14 (m), **End depth:** 10.22 (m)

Description: Clay & silty clay

Basic results	**Estimation results**	
Total cone resistance: 5.06 ±1.63 MPa	Permeability: 1.26E-07 ±1.15E-06 m/s	Constrained Mod.: 67.93 ±20.35 MPa
Sleeve friction: 238.90 ±90.33 kPa	N_{60}: 19.90 ±4.10 blows	Go: 123.28 ±24.70 MPa
Ic: 2.58 ±0.17	Es: 0.00 ±0.00 MPa	Su: 293.24 ±54.24 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 3.66 ±0.75
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 24.99 ±6.36
	Unit weight: 19.91 ±0.46 kN/m³	

.:: Layer No: 6 ::.

Code: Layer_6 **Start depth:** 10.22 (m), **End depth:** 10.45 (m)

Description: Sand & silty sand

Basic results	**Estimation results**	
Total cone resistance: 32.32 ±17.54 MPa	Permeability: 4.67E-04 ±2.87E-03 m/s	Constrained Mod.: 164.52 ±22.01 MPa
Sleeve friction: 179.95 ±29.72 kPa	N_{60}: 58.15 ±18.52 blows	Go: 178.81 ±25.97 MPa
Ic: 1.34 ±0.34	Es: 131.26 ±17.56 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 87.00 ±15.76	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 44.94 ±3.35 °	O.C.R.: 0.00 ±0.00
	Unit weight: 20.31 ±0.28 kN/m³	

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-02H
Total depth: 10.45 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Summary table of mean values

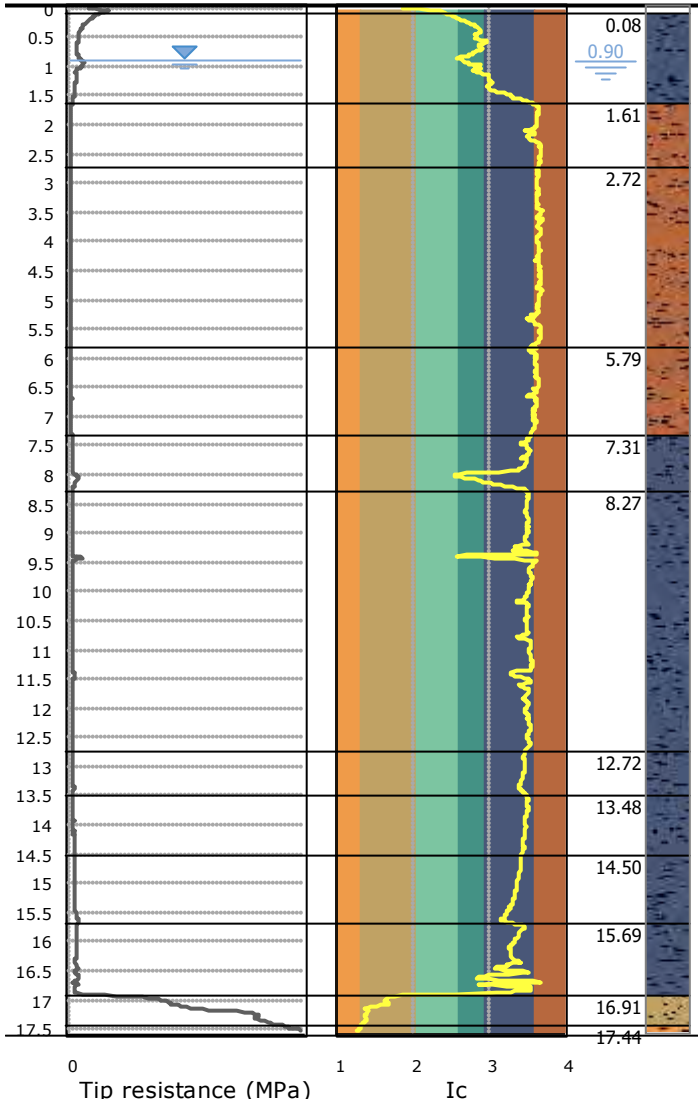
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r (%)	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.08 1.22	1.14	3.47E-06 (±2.45E-04)	12.7 (±7.2)	45.9 (±21.8)	48.8 (±15.4)	37.8 (±3.3)	50.9 (±27.8)	55.3 (±28.9)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	18.2 (±1.3)
1.22 2.86	1.64	6.04E-08 (±6.45E-08)	7.2 (±0.9)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	23.4 (±3.2)	43.3 (±6.0)	115.6 (±16.6)	2.0 (±0.3)	13.0 (±2.4)	17.9 (±0.4)
2.86 6.63	3.77	7.37E-07 (±1.76E-06)	12.1 (±2.7)	49.1 (±7.7)	41.2 (±6.5)	38.0 (±0.9)	49.0 (±13.6)	60.5 (±10.6)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	18.5 (±0.4)
6.63 8.14	1.51	1.39E-07 (±9.91E-08)	10.9 (±2.0)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	37.3 (±8.5)	61.2 (±12.1)	182.5 (±39.0)	2.5 (±0.6)	17.5 (±4.4)	18.4 (±0.5)
8.14 10.22	2.08	1.26E-07 (±1.15E-06)	19.9 (±4.1)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	67.9 (±20.4)	123.3 (±24.7)	293.2 (±54.2)	3.7 (±0.8)	25.0 (±6.4)	19.9 (±0.5)
10.22 10.45	0.23	4.67E-04 (±2.87E-03)	58.1 (±18.5)	131.3 (±17.6)	87.0 (±15.8)	44.9 (±3.4)	164.5 (±22.0)	178.8 (±26.0)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	20.3 (±0.3)

Depth values presented in this table are measured from free ground surface

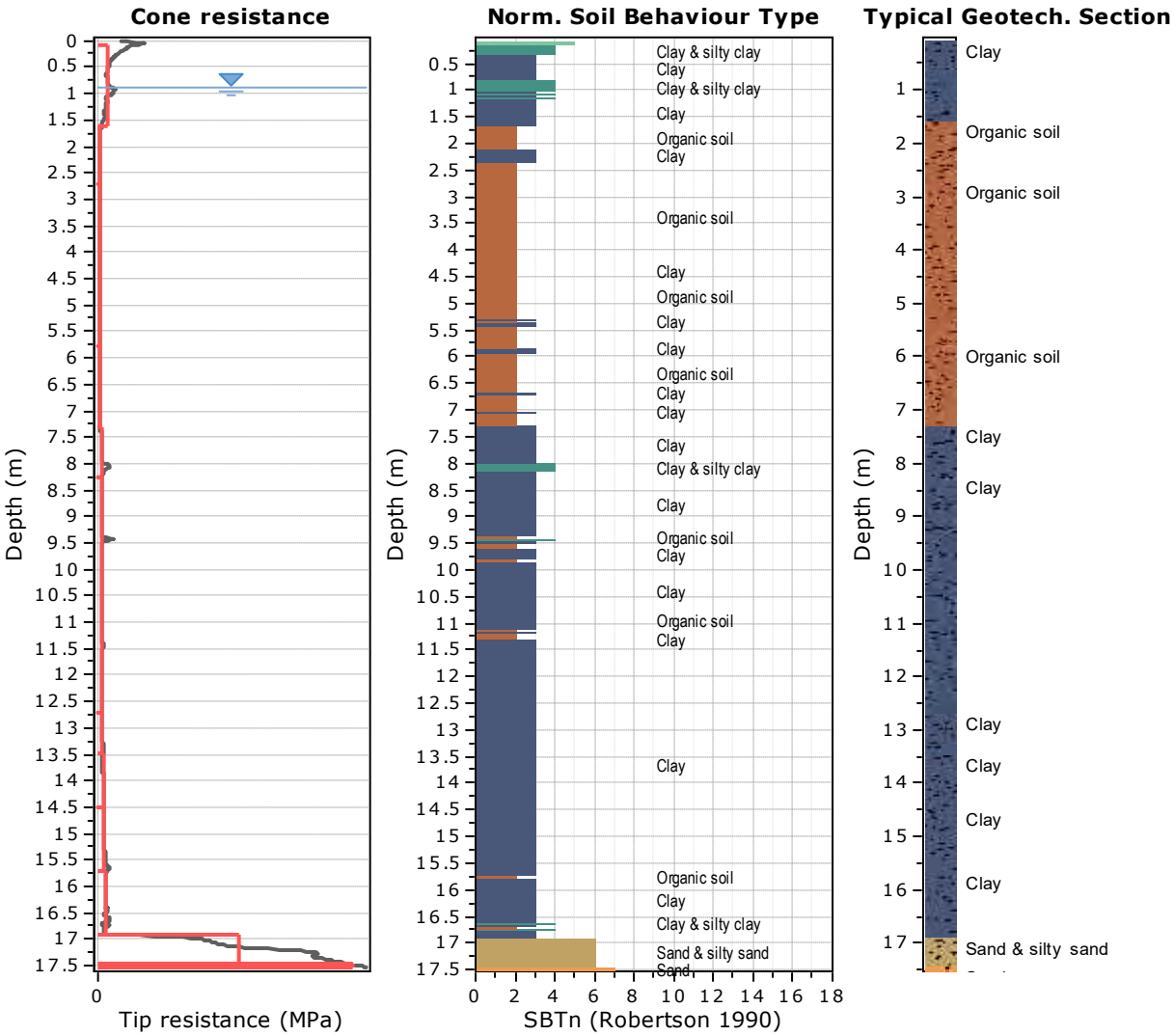
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
Clay	1.2	2.12E-8	5.5	-	-	-	15.3	35.8	73.7	1.3	7.4	17.5
Organic soil	0.2	3.36E-10	1.3	-	-	-	0.5	11.7	10.5	0.2	0.6	15.0
Organic soil	0.2	2.99E-10	2.0	-	-	-	0.4	11.3	9.6	0.2	0.6	15.0
Organic soil	0.3	3.43E-10	2.0	-	-	-	0.5	12.8	11.2	0.2	0.7	15.3
Clay	0.4	1.30E-9	2.8	-	-	-	1.6	15.8	21.0	0.4	1.5	15.7
Clay	0.4	5.01E-10	3.1	-	-	-	1.1	17.5	17.2	0.3	1.0	15.9
Clay	0.5	5.63E-10	4.0	-	-	-	1.3	20.2	21.8	0.3	1.0	15.9
Clay	0.6	5.15E-10	4.0	-	-	-	1.3	21.9	22.2	0.3	1.0	16.1
Clay	0.7	8.25E-10	4.7	-	-	-	2.5	27.2	32.8	0.4	1.4	16.5
Clay	0.9	1.10E-9	5.6	-	-	-	3.7	33.3	41.1	0.4	1.7	16.8
Sand & silty sand	16.1	1.94E-4	32.0	78.8	64.9	39.7	97.6	99.0	-	-	-	18.8
Sand	29.1	9.62E-4	50.0	108.0	87.7	43.6	135.4	142.4	-	-	-	19.7



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.08 (m), **End depth:** 1.61 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 1.19 ±0.78 MPa	Permeability: 2.12E-08 ±1.63E-06 m/s	Constrained Mod.: 15.34 ±11.06 MPa
Sleeve friction: 0.00 ±53.46 kPa	N_{60}: 5.52 ±2.26 blows	Go: 35.77 ±10.40 MPa
Ic: 2.83 ±0.23	Es: 0.00 ±0.00 MPa	Su: 73.72 ±39.60 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 1.31 ±0.66
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 7.38 ±5.40
	Unit weight: 17.47 ±0.60 kN/m³	

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 1.61 (m), **End depth:** 2.72 (m)

Description: Organic soil

Basic results	**Estimation results**	
Total cone resistance: 0.20 ±0.04 MPa	Permeability: 3.36E-10 ±9.15E-11 m/s	Constrained Mod.: 0.46 ±0.37 MPa
Sleeve friction: 9.50 ±4.77 kPa	N_{60}: 1.31 ±0.54 blows	Go: 11.66 ±2.67 MPa
Ic: 3.62 ±0.07	Es: 0.00 ±0.00 MPa	Su: 10.51 ±2.73 kPa
SBT_n: 2	Dr (%): 0.00 ±0.00	Su ratio: 0.20 ±0.06
SBTn description: Organic soil	φ (degrees): 0.00 ±0.00 °	O.C.R.: 0.65 ±0.23
	Unit weight: 14.97 ±0.48 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 2.72 (m), **End depth:** 5.79 (m)

Description: Organic soil

Basic results	**Estimation results**	
Total cone resistance: 0.22 ±0.02 MPa	Permeability: 2.99E-10 ±2.88E-11 m/s	Constrained Mod.: 0.40 ±0.06 MPa
Sleeve friction: 9.14 ±0.94 kPa	N_{60}: 1.97 ±0.15 blows	Go: 11.27 ±0.59 MPa
Ic: 3.65 ±0.03	Es: 0.00 ±0.00 MPa	Su: 9.64 ±0.68 kPa
SBT_n: 2	Dr (%): 0.00 ±0.00	Su ratio: 0.18 ±0.01
SBTn description: Organic soil	φ (degrees): 0.00 ±0.00 °	O.C.R.: 0.58 ±0.05
	Unit weight: 14.95 ±0.15 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 5.79 (m), **End depth:** 7.31 (m)

Description: Organic soil

Basic results	**Estimation results**	
Total cone resistance: 0.28 ±0.01 MPa	Permeability: 3.43E-10 ±3.34E-11 m/s	Constrained Mod.: 0.55 ±0.06 MPa
Sleeve friction: 11.42 ±0.56 kPa	N_{60}: 2.00 ±0.00 blows	Go: 12.83 ±0.36 MPa
Ic: 3.61 ±0.03	Es: 0.00 ±0.00 MPa	Su: 11.19 ±0.71 kPa
SBT_n: 2	Dr (%): 0.00 ±0.00	Su ratio: 0.22 ±0.01
SBTn description: Organic soil	φ (degrees): 0.00 ±0.00 °	O.C.R.: 0.70 ±0.06
	Unit weight: 15.30 ±0.07 kN/m³	

.:: Layer No: 5 ::.

Code: Layer_5 **Start depth:** 7.31 (m), **End depth:** 8.27 (m)

Description: Clay

Basic results	**Estimation results**	
Total cone resistance: 0.44 ±0.26 MPa	Permeability: 1.30E-09 ±3.33E-08 m/s	Constrained Mod.: 1.61 ±4.37 MPa
Sleeve friction: 13.54 ±1.70 kPa	N_{60}: 2.77 ±0.86 blows	Go: 15.79 ±2.52 MPa
Ic: 3.31 ±0.30	Es: 0.00 ±0.00 MPa	Su: 21.00 ±23.96 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 0.37 ±0.31
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 1.53 ±2.68
	Unit weight: 15.67 ±0.21 kN/m³	

.:: Layer No: 6 ::.

Code: Layer_6 **Start depth:** 8.27 (m), **End depth:** 12.72 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 0.44 ±0.11 MPa	Permeability: 5.01E-10 ±7.57E-09 m/s	Constrained Mod.: 1.07 ±1.74 MPa
Sleeve friction: 15.95 ±3.12 kPa	N_{60}: 3.12 ±0.43 blows	Go: 17.47 ±2.55 MPa
Ic: 3.50 ±0.10	Es: 0.00 ±0.00 MPa	Su: 17.20 ±8.75 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 0.28 ±0.12
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 0.99 ±0.87
	Unit weight: 15.86 ±0.24 kN/m³	

.:: Layer No: 7 ::.

Code: Layer_7 **Start depth:** 12.72 (m), **End depth:** 13.48 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 0.54 ±0.02 MPa	Permeability: 5.63E-10 ±4.63E-11 m/s	Constrained Mod.: 1.29 ±0.11 MPa
Sleeve friction: 15.98 ±0.87 kPa	N_{60}: 4.00 ±0.00 blows	Go: 20.20 ±0.50 MPa
Ic: 3.45 ±0.03	Es: 0.00 ±0.00 MPa	Su: 21.76 ±1.23 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 0.28 ±0.01
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 1.02 ±0.06
	Unit weight: 15.94 ±0.06 kN/m³	

.:: Layer No: 8 ::.

Code: Layer_8 **Start depth:** 13.48 (m), **End depth:** 14.50 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 0.56 ±0.02 MPa	Permeability: 5.15E-10 ±3.42E-11 m/s	Constrained Mod.: 1.30 ±0.12 MPa
Sleeve friction: 17.93 ±0.57 kPa	N_{60}: 4.00 ±0.00 blows	Go: 21.92 ±0.72 MPa
Ic: 3.48 ±0.02	Es: 0.00 ±0.00 MPa	Su: 22.22 ±1.36 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 0.27 ±0.01
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 0.97 ±0.05
	Unit weight: 16.09 ±0.05 kN/m³	

.:: Layer No: 9 ::.

Code: Layer_9 **Start depth:** 14.50 (m), **End depth:** 15.69 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 0.74 ±0.15 MPa	Permeability: 8.25E-10 ±3.59E-10 m/s	Constrained Mod.: 2.51 ±1.86 MPa
Sleeve friction: 22.61 ±9.66 kPa	N_{60}: 4.67 ±0.79 blows	Go: 27.18 ±5.70 MPa
Ic: 3.34 ±0.07	Es: 0.00 ±0.00 MPa	Su: 32.85 ±9.08 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 0.36 ±0.09
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 1.44 ±0.48
	Unit weight: 16.46 ±0.37 kN/m³	

.:: Layer No: 10 ::.

Code: Layer_10 **Start depth:** 15.69 (m), **End depth:** 16.91 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 0.89 ±0.19 MPa	Permeability: 1.10E-09 ±1.34E-08 m/s	Constrained Mod.: 3.70 ±2.66 MPa
Sleeve friction: 28.33 ±16.02 kPa	N_{60}: 5.58 ±0.78 blows	Go: 33.33 ±6.93 MPa
Ic: 3.30 ±0.18	Es: 0.00 ±0.00 MPa	Su: 41.06 ±14.96 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 0.42 ±0.12
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 1.72 ±0.81
	Unit weight: 16.84 ±0.61 kN/m³	

.:: Layer No: 11 ::.

Code: Layer_11 **Start depth:** 16.91 (m), **End depth:** 17.44 (m)

Description: Sand & silty sand

Basic results	Estimation results	
Total cone resistance: 16.07 ±7.48 MPa	Permeability: 1.94E-04 ±2.94E-04 m/s	Constrained Mod.: 97.57 ±27.98 MPa
Sleeve friction: 58.90 ±33.83 kPa	N_{60}: 32.04 ±11.47 blows	Go: 98.96 ±31.14 MPa
Ic: 1.52 ±0.23	Es: 78.79 ±21.49 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 64.86 ±16.03	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 39.66 ±3.12 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.75 ±0.93 kN/m³	

.:: Layer No: 12 ::.

Code: Layer_12 **Start depth:** 17.44 (m), **End depth:** 17.53 (m)

Description: Sand

Basic results	Estimation results	
Total cone resistance: 29.07 ±0.88 MPa	Permeability: 9.62E-04 ±1.27E-04 m/s	Constrained Mod.: 135.36 ±0.96 MPa
Sleeve friction: 106.71 ±0.00 kPa	N_{60}: 49.99 ±0.82 blows	Go: 142.35 ±1.09 MPa
Ic: 1.31 ±0.02	Es: 108.00 ±0.76 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 7	Dr (%): 87.68 ±1.34	Su ratio: 0.00 ±0.00
SBTn description: Sand	φ (degrees): 43.61 ±0.21 °	O.C.R.: 0.00 ±0.00
	Unit weight: 19.65 ±0.01 kN/m³	

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

CPT: CPT-03A
Total depth: 17.53 m, Date: 12/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Summary table of mean values

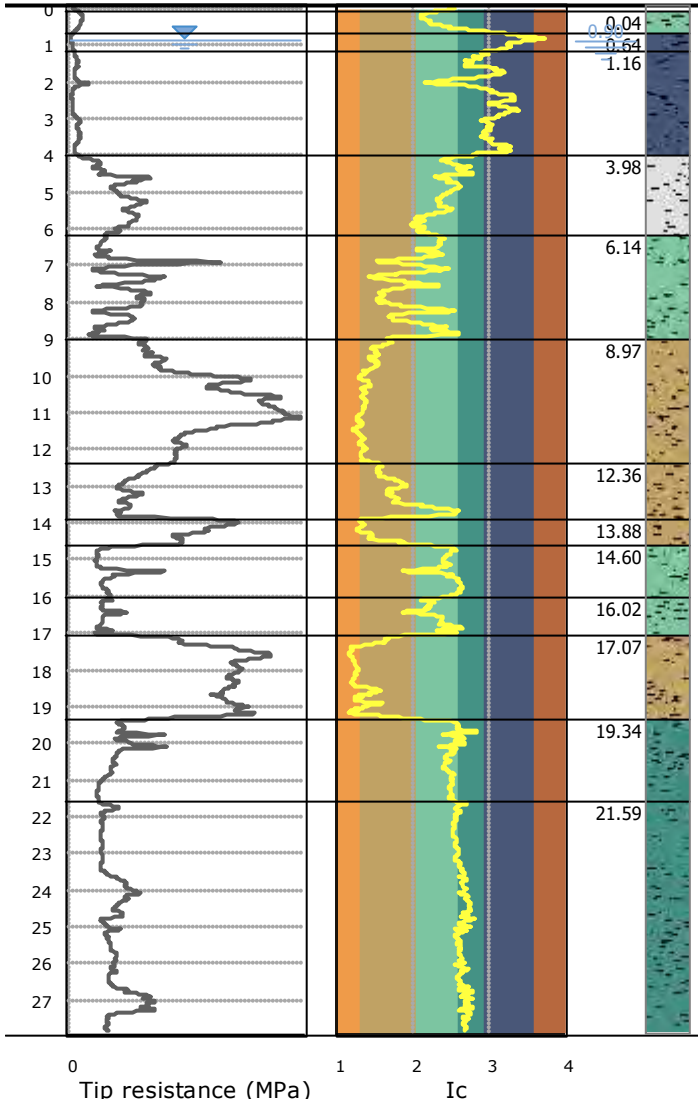
From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r (%)	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.08	1.53	2.12E-08	5.5	0.0	0.0	0.0	15.3	35.8	73.7	1.3	7.4	17.5
1.61		(±1.63E-06)	(±2.3)	(±0.0)	(±0.0)	(±0.0)	(±11.1)	(±10.4)	(±39.6)	(±0.7)	(±5.4)	(±0.6)
1.61	1.11	3.36E-10	1.3	0.0	0.0	0.0	0.5	11.7	10.5	0.2	0.6	15.0
2.72		(±9.15E-11)	(±0.5)	(±0.0)	(±0.0)	(±0.0)	(±0.4)	(±2.7)	(±2.7)	(±0.1)	(±0.2)	(±0.5)
2.72	3.07	2.99E-10	2.0	0.0	0.0	0.0	0.4	11.3	9.6	0.2	0.6	15.0
5.79		(±2.88E-11)	(±0.1)	(±0.0)	(±0.0)	(±0.0)	(±0.1)	(±0.6)	(±0.7)	(±0.0)	(±0.1)	(±0.1)
5.79	1.52	3.43E-10	2.0	0.0	0.0	0.0	0.5	12.8	11.2	0.2	0.7	15.3
7.31		(±3.34E-11)	(±0.0)	(±0.0)	(±0.0)	(±0.0)	(±0.1)	(±0.4)	(±0.7)	(±0.0)	(±0.1)	(±0.1)
7.31	0.96	1.30E-09	2.8	0.0	0.0	0.0	1.6	15.8	21.0	0.4	1.5	15.7
8.27		(±3.33E-08)	(±0.9)	(±0.0)	(±0.0)	(±0.0)	(±4.4)	(±2.5)	(±24.0)	(±0.3)	(±2.7)	(±0.2)
8.27	4.45	5.01E-10	3.1	0.0	0.0	0.0	1.1	17.5	17.2	0.3	1.0	15.9
12.72		(±7.57E-09)	(±0.4)	(±0.0)	(±0.0)	(±0.0)	(±1.7)	(±2.6)	(±8.7)	(±0.1)	(±0.9)	(±0.2)
12.72	0.76	5.63E-10	4.0	0.0	0.0	0.0	1.3	20.2	21.8	0.3	1.0	15.9
13.48		(±4.63E-11)	(±0.0)	(±0.0)	(±0.0)	(±0.0)	(±0.1)	(±0.5)	(±1.2)	(±0.0)	(±0.1)	(±0.1)
13.48	1.02	5.15E-10	4.0	0.0	0.0	0.0	1.3	21.9	22.2	0.3	1.0	16.1
14.50		(±3.42E-11)	(±0.0)	(±0.0)	(±0.0)	(±0.0)	(±0.1)	(±0.7)	(±1.4)	(±0.0)	(±0.1)	(±0.0)
14.50	1.19	8.25E-10	4.7	0.0	0.0	0.0	2.5	27.2	32.8	0.4	1.4	16.5
15.69		(±3.59E-10)	(±0.8)	(±0.0)	(±0.0)	(±0.0)	(±1.9)	(±5.7)	(±9.1)	(±0.1)	(±0.5)	(±0.4)
15.69	1.22	1.10E-09	5.6	0.0	0.0	0.0	3.7	33.3	41.1	0.4	1.7	16.8
16.91		(±1.34E-08)	(±0.8)	(±0.0)	(±0.0)	(±0.0)	(±2.7)	(±6.9)	(±15.0)	(±0.1)	(±0.8)	(±0.6)
16.91	0.53	1.94E-04	32.0	78.8	64.9	39.7	97.6	99.0	0.0	0.0	0.0	18.8
17.44		(±2.94E-04)	(±11.5)	(±21.5)	(±16.0)	(±3.1)	(±28.0)	(±31.1)	(±0.0)	(±0.0)	(±0.0)	(±0.9)
17.44	0.09	9.62E-04	50.0	108.0	87.7	43.6	135.4	142.4	0.0	0.0	0.0	19.7
17.53		(±1.27E-04)	(±0.8)	(±0.8)	(±1.3)	(±0.2)	(±1.0)	(±1.1)	(±0.0)	(±0.0)	(±0.0)	(±0.0)

Depth values presented in this table are measured from free ground surface

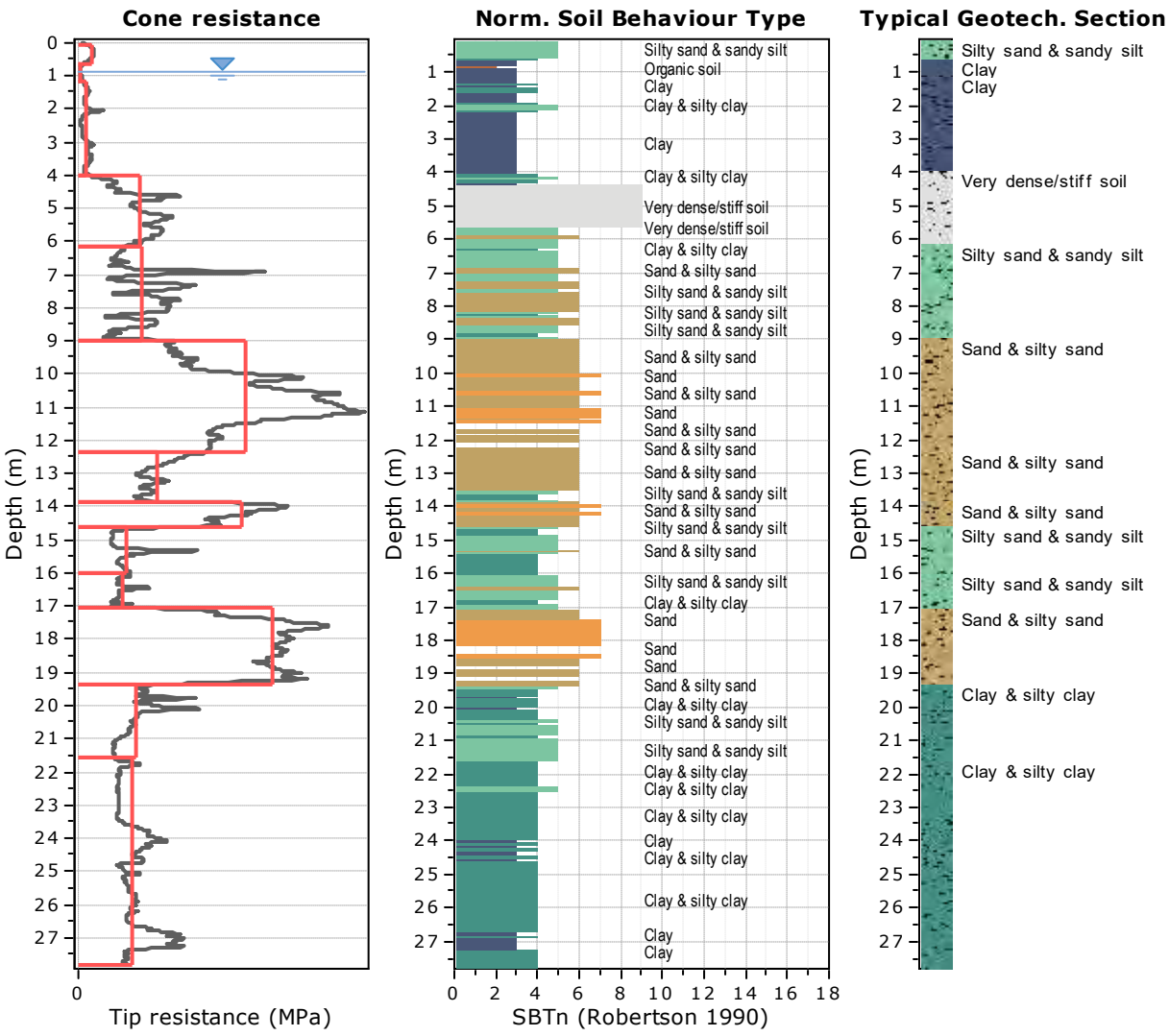
CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**



Depth (m)	Description	qt (MPa)	Ksbt (m/s)	N60	Es (MPa)	Dr	Phi (°)	M (MPa)	Go (MPa)	Su (kPa)	Su ratio	OCR	Gamma (kN/m³)
0.04	Silty sand & sandy silt	1.4	1.44E-6	4.6	18.9	26.7	32.1	19.5	19.3	-	-	-	15.4
0.64	Clay	0.3	1.92E-9	1.9	-	-	-	1.7	14.5	21.3	0.4	1.6	15.3
1.16	Clay	0.9	5.75E-8	4.5	-	-	-	10.9	30.1	53.8	1.0	5.1	16.8
3.98	Very dense/stiff soil	7.1	1.36E-6	24.1	-	-	-	94.8	140.4	417.7	8.1	66.1	20.3
6.14	Silty sand & sandy silt	7.3	4.25E-5	18.8	61.2	50.2	38.1	70.4	76.9	-	-	-	18.7
8.97	Sand & silty sand	19.1	5.91E-4	34.3	81.1	73.9	41.0	97.2	97.5	-	-	-	18.4
12.36	Sand & silty sand	9.1	7.21E-5	21.9	60.2	48.4	36.1	76.7	83.1	-	-	-	18.0
13.88	Sand & silty sand	18.6	5.88E-4	34.9	82.6	68.1	40.2	103.5	103.8	-	-	-	18.6
14.60	Silty sand & sandy silt	5.6	1.05E-6	19.6	73.8	35.0	35.9	71.2	105.2	-	-	-	19.0
16.02	Silty sand & sandy silt	5.1	1.98E-6	16.5	61.2	32.0	34.0	64.6	75.8	-	-	-	18.1
17.07	Sand & silty sand	22.3	1.05E-3	39.0	88.1	70.4	40.6	107.9	106.7	-	-	-	18.4
19.34	Clay & silty clay	6.6	3.69E-7	24.7	-	-	-	86.5	141.9	522.3	3.2	23.3	19.3
21.59	Clay & silty clay	6.3	9.11E-8	25.8	-	-	-	81.4	159.9	426.3	1.9	13.1	19.4



Tabular results

.:: Layer No: 1 ::.

Code: Layer_1 **Start depth:** 0.04 (m), **End depth:** 0.64 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 1.43 ±0.37 MPa	Permeability: 1.44E-06 ±1.23E-06 m/s	Constrained Mod.: 19.49 ±5.11 MPa
Sleeve friction: 7.74 ±1.95 kPa	N_{60}: 4.56 ±0.70 blows	Go: 19.34 ±1.71 MPa
Ic: 2.32 ±0.19	Es: 18.95 ±1.19 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 26.74 ±2.75	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 32.08 ±0.16 °	O.C.R.: 0.00 ±0.00
	Unit weight: 15.44 ±0.26 kN/m³	

.:: Layer No: 2 ::.

Code: Layer_2 **Start depth:** 0.64 (m), **End depth:** 1.16 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 0.32 ±0.11 MPa	Permeability: 1.92E-09 ±3.63E-09 m/s	Constrained Mod.: 1.75 ±1.23 MPa
Sleeve friction: 11.79 ±3.87 kPa	N_{60}: 1.94 ±0.57 blows	Go: 14.49 ±2.62 MPa
Ic: 3.33 ±0.21	Es: 0.00 ±0.00 MPa	Su: 21.29 ±9.03 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 0.36 ±0.13
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 1.60 ±0.86
	Unit weight: 15.31 ±0.42 kN/m³	

.:: Layer No: 3 ::.

Code: Layer_3 **Start depth:** 1.16 (m), **End depth:** 3.98 (m)

Description: Clay

Basic results	Estimation results	
Total cone resistance: 0.91 ±0.45 MPa	Permeability: 5.75E-08 ±2.70E-07 m/s	Constrained Mod.: 10.94 ±7.29 MPa
Sleeve friction: 42.47 ±32.43 kPa	N_{60}: 4.53 ±1.71 blows	Go: 30.15 ±12.88 MPa
Ic: 3.00 ±0.23	Es: 0.00 ±0.00 MPa	Su: 53.82 ±23.14 kPa
SBT_n: 3	Dr (%): 0.00 ±0.00	Su ratio: 0.97 ±0.44
SBTn description: Clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 5.12 ±2.68
	Unit weight: 16.83 ±1.18 kN/m³	

.:: Layer No: 4 ::.

Code: Layer_4 **Start depth:** 3.98 (m), **End depth:** 6.14 (m)

Description: Very dense/stiff soil

Basic results	Estimation results	
Total cone resistance: 7.06 ±2.53 MPa	Permeability: 1.36E-06 ±2.11E-06 m/s	Constrained Mod.: 94.80 ±34.56 MPa
Sleeve friction: 373.42 ±203.64 kPa	N_{60}: 24.13 ±7.82 blows	Go: 140.43 ±50.20 MPa
Ic: 2.40 ±0.22	Es: 0.00 ±0.00 MPa	Su: 417.71 ±170.29 kPa
SBT_n: 9	Dr (%): 0.00 ±0.00	Su ratio: 8.06 ±3.24
SBTn description: Very dense/stiff soil	φ (degrees): 0.00 ±0.00 °	O.C.R.: 66.12 ±32.11
	Unit weight: 20.27 ±0.97 kN/m³	

.:: Layer No: 5 ::.

Code: Layer_5 **Start depth:** 6.14 (m), **End depth:** 8.97 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 7.28 ±3.54 MPa	Permeability: 4.25E-05 ±7.54E-05 m/s	Constrained Mod.: 70.40 ±17.51 MPa
Sleeve friction: 83.10 ±40.11 kPa	N_{60}: 18.75 ±5.60 blows	Go: 76.89 ±16.24 MPa
Ic: 2.03 ±0.33	Es: 61.22 ±11.21 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 50.23 ±10.41	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 38.10 ±1.34 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.66 ±0.53 kN/m³	

.:: Layer No: 6 ::.

Code: Layer_6 **Start depth:** 8.97 (m), **End depth:** 12.36 (m)

Description: Sand & silty sand

Basic results	Estimation results	
Total cone resistance: 19.15 ±6.86 MPa	Permeability: 5.91E-04 ±3.38E-04 m/s	Constrained Mod.: 97.25 ±29.18 MPa
Sleeve friction: 60.62 ±46.42 kPa	N_{60}: 34.32 ±11.19 blows	Go: 97.46 ±35.05 MPa
Ic: 1.39 ±0.11	Es: 81.14 ±23.60 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 73.90 ±13.35	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 41.04 ±2.49 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.42 ±1.12 kN/m³	

.:: Layer No: 7 ::.

Code: Layer_7 **Start depth:** 12.36 (m), **End depth:** 13.88 (m)

Description: Sand & silty sand

Basic results	Estimation results	
Total cone resistance: 9.08 ±2.15 MPa	Permeability: 7.21E-05 ±7.53E-05 m/s	Constrained Mod.: 76.71 ±17.65 MPa
Sleeve friction: 71.92 ±95.24 kPa	N_{60}: 21.91 ±4.15 blows	Go: 83.14 ±37.03 MPa
Ic: 1.84 ±0.32	Es: 60.24 ±15.97 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 48.39 ±5.81	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 36.11 ±1.45 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.02 ±1.17 kN/m³	

.:: Layer No: 8 ::.

Code: Layer_8 **Start depth:** 13.88 (m), **End depth:** 14.60 (m)

Description: Sand & silty sand

Basic results	Estimation results	
Total cone resistance: 18.64 ±3.10 MPa	Permeability: 5.88E-04 ±3.96E-04 m/s	Constrained Mod.: 103.48 ±19.72 MPa
Sleeve friction: 62.05 ±47.23 kPa	N_{60}: 34.88 ±4.24 blows	Go: 103.82 ±24.13 MPa
Ic: 1.45 ±0.19	Es: 82.57 ±15.73 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 68.06 ±6.29	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 40.23 ±1.13 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.62 ±0.71 kN/m³	

.:: Layer No: 9 ::.

Code: Layer_9 **Start depth:** 14.60 (m), **End depth:** 16.02 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 5.56 ±2.37 MPa	Permeability: 1.05E-06 ±2.87E-06 m/s	Constrained Mod.: 71.21 ±25.53 MPa
Sleeve friction: 121.97 ±56.93 kPa	N_{60}: 19.63 ±5.60 blows	Go: 105.17 ±28.71 MPa
Ic: 2.46 ±0.18	Es: 73.79 ±23.05 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 34.96 ±9.52	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 35.89 ±1.85 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.99 ±0.74 kN/m³	

.:: Layer No: 10 ::.

Code: Layer_10 **Start depth:** 16.02 (m), **End depth:** 17.07 (m)

Description: Silty sand & sandy silt

Basic results	Estimation results	
Total cone resistance: 5.09 ±0.98 MPa	Permeability: 1.98E-06 ±3.26E-06 m/s	Constrained Mod.: 64.56 ±8.99 MPa
Sleeve friction: 52.24 ±23.80 kPa	N_{60}: 16.45 ±1.97 blows	Go: 75.83 ±12.89 MPa
Ic: 2.30 ±0.17	Es: 61.23 ±8.49 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 5	Dr (%): 32.03 ±3.25	Su ratio: 0.00 ±0.00
SBTn description: Silty sand & sandy silt	φ (degrees): 33.96 ±1.11 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.05 ±0.49 kN/m³	

.:: Layer No: 11 ::.

Code: Layer_11 **Start depth:** 17.07 (m), **End depth:** 19.34 (m)

Description: Sand & silty sand

Basic results	Estimation results	
Total cone resistance: 22.32 ±3.72 MPa	Permeability: 1.05E-03 ±7.87E-04 m/s	Constrained Mod.: 107.86 ±13.66 MPa
Sleeve friction: 47.02 ±29.00 kPa	N_{60}: 39.01 ±4.13 blows	Go: 106.66 ±17.30 MPa
Ic: 1.35 ±0.19	Es: 88.11 ±10.85 MPa	Su: 0.00 ±0.00 kPa
SBT_n: 6	Dr (%): 70.37 ±7.89	Su ratio: 0.00 ±0.00
SBTn description: Sand & silty sand	φ (degrees): 40.55 ±1.51 °	O.C.R.: 0.00 ±0.00
	Unit weight: 18.41 ±0.67 kN/m³	

.:: Layer No: 12 ::.

Code: Layer_12 **Start depth:** 19.34 (m), **End depth:** 21.59 (m)

Description: Clay & silty clay

Basic results	Estimation results	
Total cone resistance: 6.59 ±2.31 MPa	Permeability: 3.69E-07 ±1.05E-06 m/s	Constrained Mod.: 86.46 ±31.58 MPa
Sleeve friction: 185.86 ±155.56 kPa	N_{60}: 24.67 ±8.42 blows	Go: 141.95 ±61.66 MPa
Ic: 2.51 ±0.11	Es: 0.00 ±0.00 MPa	Su: 522.34 ±127.80 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 3.22 ±0.90
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 23.27 ±7.92
	Unit weight: 19.28 ±1.12 kN/m³	

.:: Layer No: 13 ::.

Code: Layer_13 **Start depth:** 21.59 (m), **End depth:** 27.82 (m)

Description: Clay & silty clay

Basic results	Estimation results	
Total cone resistance: 6.27 ±1.87 MPa	Permeability: 9.11E-08 ±3.99E-08 m/s	Constrained Mod.: 81.41 ±25.99 MPa
Sleeve friction: 194.72 ±162.79 kPa	N_{60}: 25.85 ±8.41 blows	Go: 159.93 ±68.51 MPa
Ic: 2.64 ±0.07	Es: 0.00 ±0.00 MPa	Su: 426.30 ±94.30 kPa
SBT_n: 4	Dr (%): 0.00 ±0.00	Su ratio: 1.91 ±0.53
SBTn description: Clay & silty clay	φ (degrees): 0.00 ±0.00 °	O.C.R.: 13.14 ±3.13
	Unit weight: 19.43 ±0.91 kN/m³	

CMW Geosciences
43 Bayside Avenue
Port Melbourne VIC 3207
https://www.cmwgeosciences.com/

CPT: CPT-04A
Total depth: 27.82 m, Date: 13/01/2023
Surface Elevation: 0.00 m
Coords: X:0.00, Y:0.00
Cone Type:
Cone Operator:

Project: **Yannathan Sand Quarry Geotechnical Assessment**
Location: **Yannathan VIC**

Summary table of mean values

From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r (%)	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
0.04 0.64	0.60	1.44E-06 (±1.23E-06)	4.6 (±0.7)	18.9 (±1.2)	26.7 (±2.7)	32.1 (±0.2)	19.5 (±5.1)	19.3 (±1.7)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	15.4 (±0.3)
0.64 1.16	0.52	1.92E-09 (±3.63E-09)	1.9 (±0.6)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	1.7 (±1.2)	14.5 (±2.6)	21.3 (±9.0)	0.4 (±0.1)	1.6 (±0.9)	15.3 (±0.4)
1.16 3.98	2.82	5.75E-08 (±2.70E-07)	4.5 (±1.7)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	10.9 (±7.3)	30.1 (±12.9)	53.8 (±23.1)	1.0 (±0.4)	5.1 (±2.7)	16.8 (±1.2)
3.98 6.14	2.16	1.36E-06 (±2.11E-06)	24.1 (±7.8)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	94.8 (±34.6)	140.4 (±50.2)	417.7 (±170.3)	8.1 (±3.2)	66.1 (±32.1)	20.3 (±1.0)
6.14 8.97	2.83	4.25E-05 (±7.54E-05)	18.8 (±5.6)	61.2 (±11.2)	50.2 (±10.4)	38.1 (±1.3)	70.4 (±17.5)	76.9 (±16.2)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	18.7 (±0.5)
8.97 12.36	3.39	5.91E-04 (±3.38E-04)	34.3 (±11.2)	81.1 (±23.6)	73.9 (±13.3)	41.0 (±2.5)	97.2 (±29.2)	97.5 (±35.1)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	18.4 (±1.1)
12.36 13.88	1.52	7.21E-05 (±7.53E-05)	21.9 (±4.2)	60.2 (±16.0)	48.4 (±5.8)	36.1 (±1.4)	76.7 (±17.7)	83.1 (±37.0)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	18.0 (±1.2)
13.88 14.60	0.72	5.88E-04 (±3.96E-04)	34.9 (±4.2)	82.6 (±15.7)	68.1 (±6.3)	40.2 (±1.1)	103.5 (±19.7)	103.8 (±24.1)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	18.6 (±0.7)
14.60 16.02	1.42	1.05E-06 (±2.87E-06)	19.6 (±5.6)	73.8 (±23.1)	35.0 (±9.5)	35.9 (±1.9)	71.2 (±25.5)	105.2 (±28.7)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	19.0 (±0.7)
16.02 17.07	1.05	1.98E-06 (±3.26E-06)	16.5 (±2.0)	61.2 (±8.5)	32.0 (±3.2)	34.0 (±1.1)	64.6 (±9.0)	75.8 (±12.9)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	18.1 (±0.5)
17.07 19.34	2.27	1.05E-03 (±7.87E-04)	39.0 (±4.1)	88.1 (±10.8)	70.4 (±7.9)	40.6 (±1.5)	107.9 (±13.7)	106.7 (±17.3)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	18.4 (±0.7)
19.34 21.59	2.25	3.69E-07 (±1.05E-06)	24.7 (±8.4)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	86.5 (±31.6)	141.9 (±61.7)	522.3 (±127.8)	3.2 (±0.9)	23.3 (±7.9)	19.3 (±1.1)

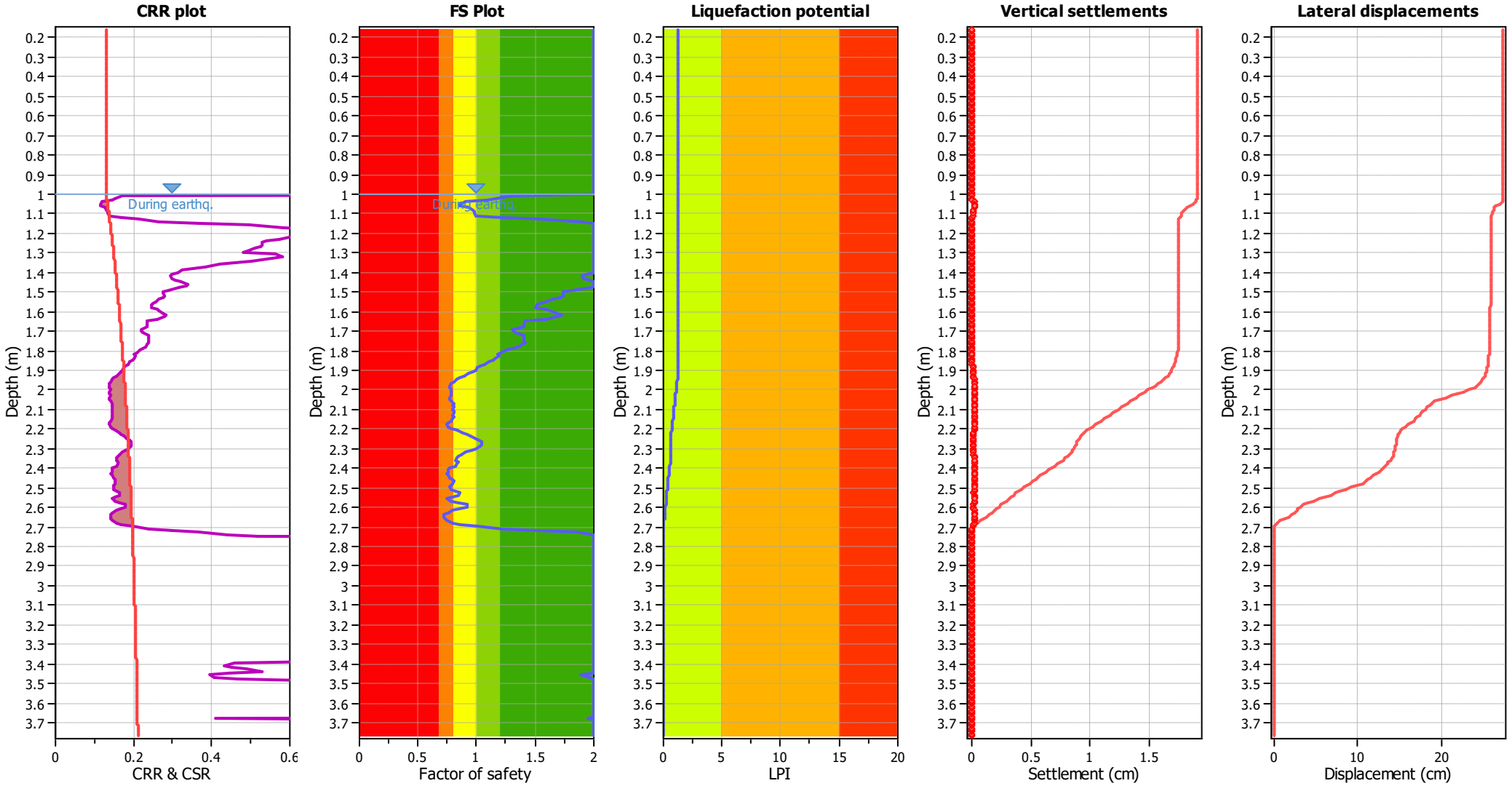
Summary table of mean values

From depth To depth (m)	Thickness (m)	Permeability (m/s)	SPT_{N60} (blows/30cm)	E_s (MPa)	D_r (%)	Friction angle	Constrained modulus, M (MPa)	Shear modulus, G_O (MPa)	Undrained strength, S_U (kPa)	Undrained strength ratio	OCR	Unit weight (kN/m³)
21.59 27.82	6.23	9.11E-08 (±3.99E-08)	25.8 (±8.4)	0.0 (±0.0)	0.0 (±0.0)	0.0 (±0.0)	81.4 (±26.0)	159.9 (±68.5)	426.3 (±94.3)	1.9 (±0.5)	13.1 (±3.1)	19.4 (±0.9)

Depth values presented in this table are measured from free ground surface

Appendix B3: CLiq CMW Analysis

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.24	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

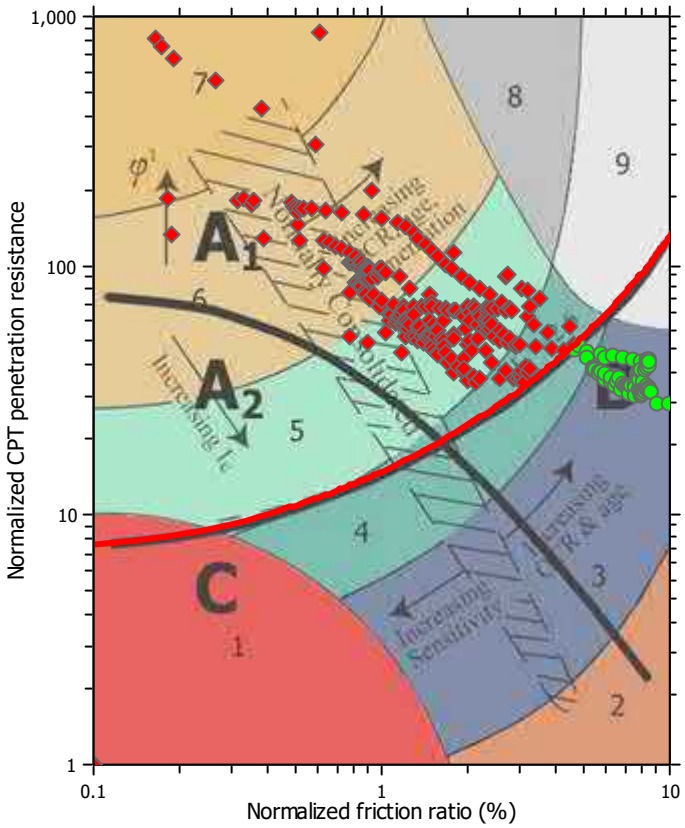
F.S. color scheme

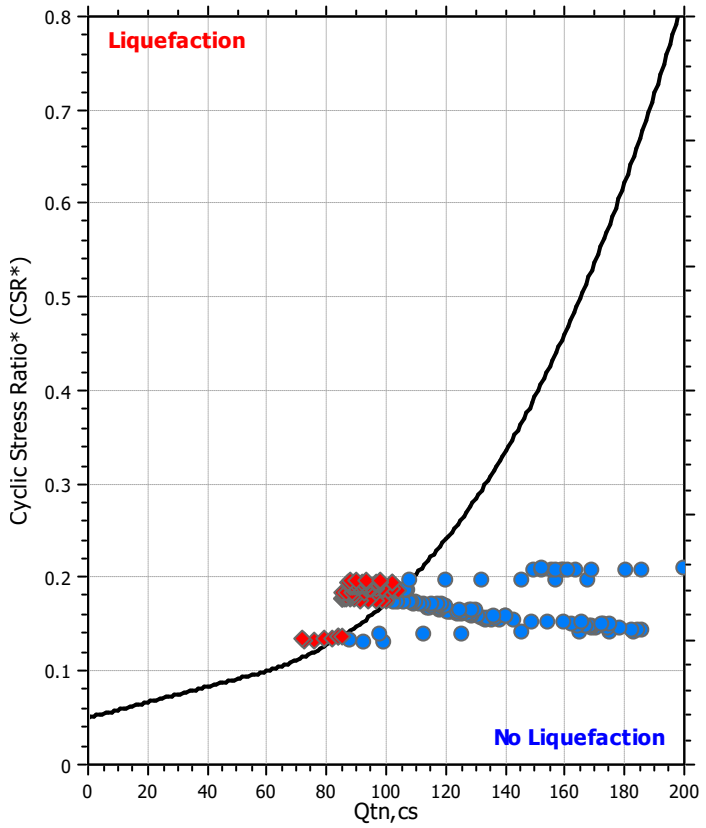
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

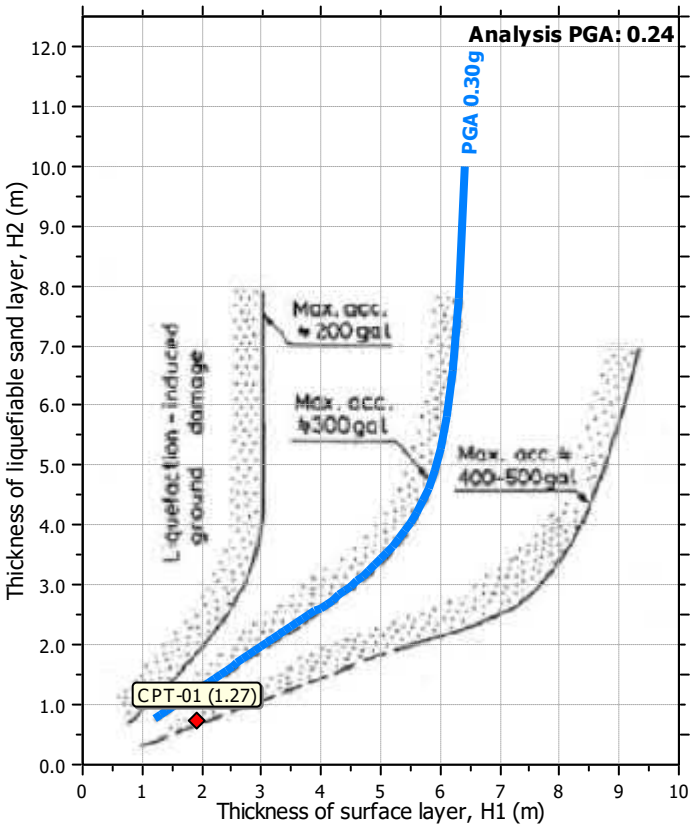
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



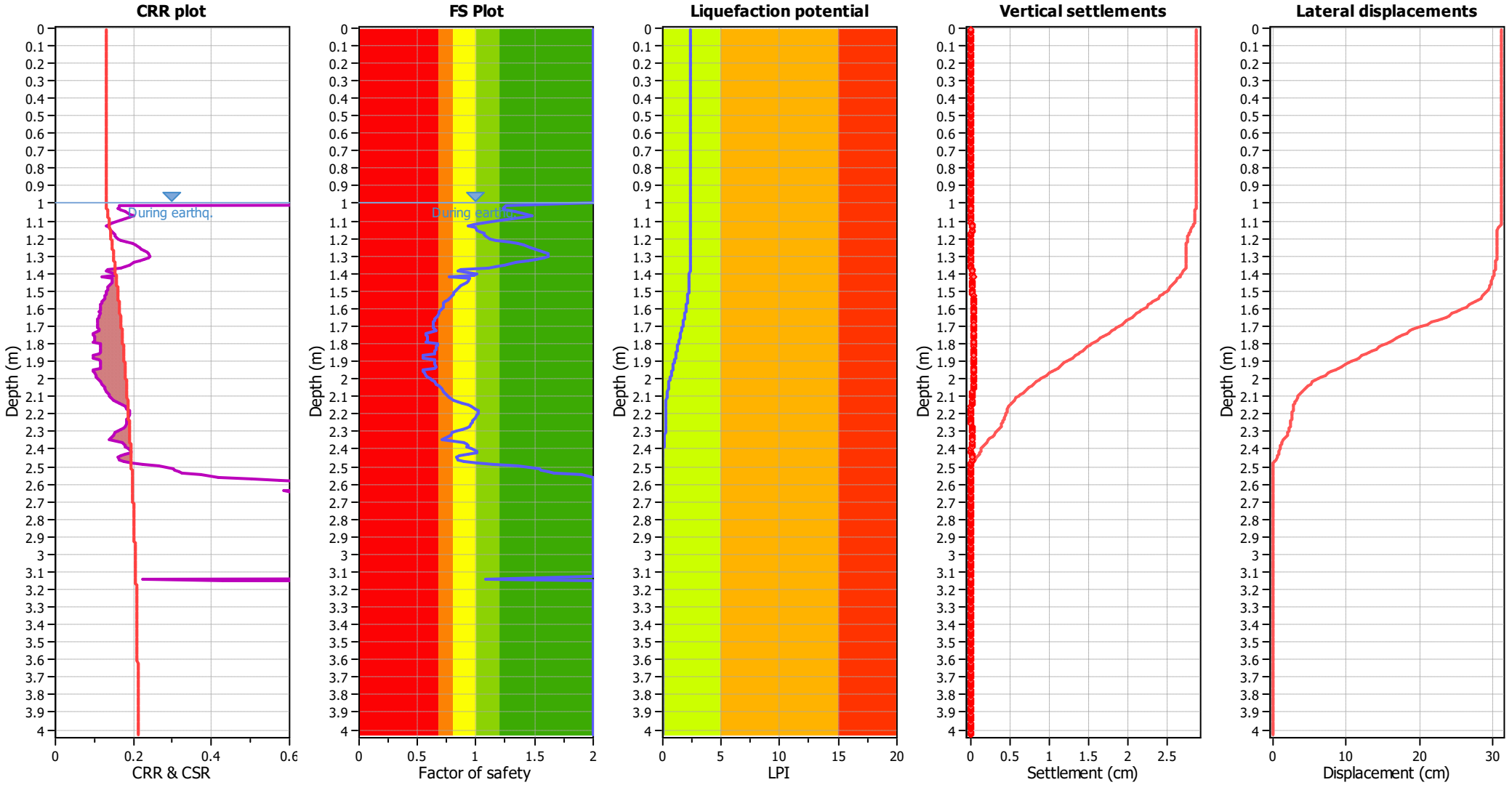




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.24	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.24	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

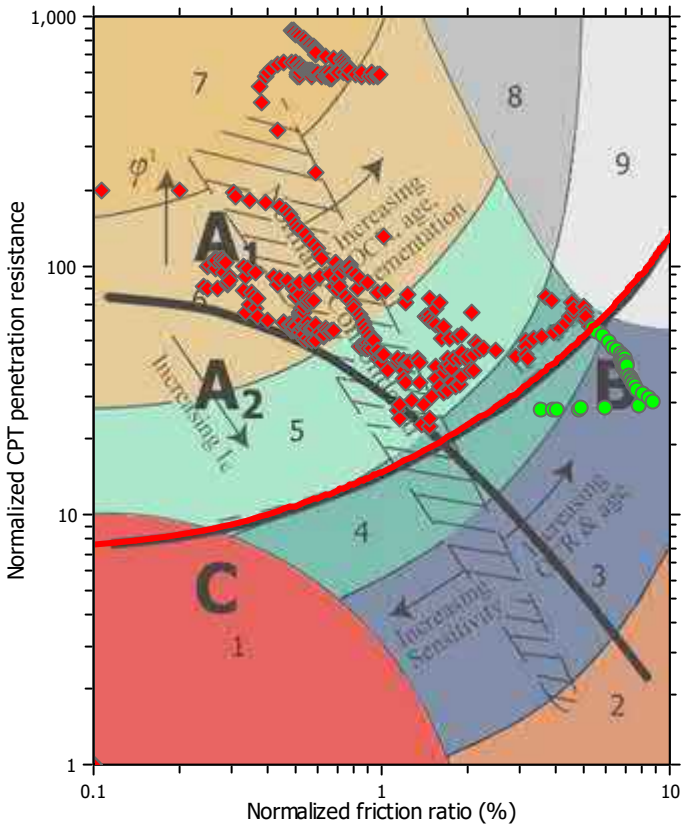
F.S. color scheme

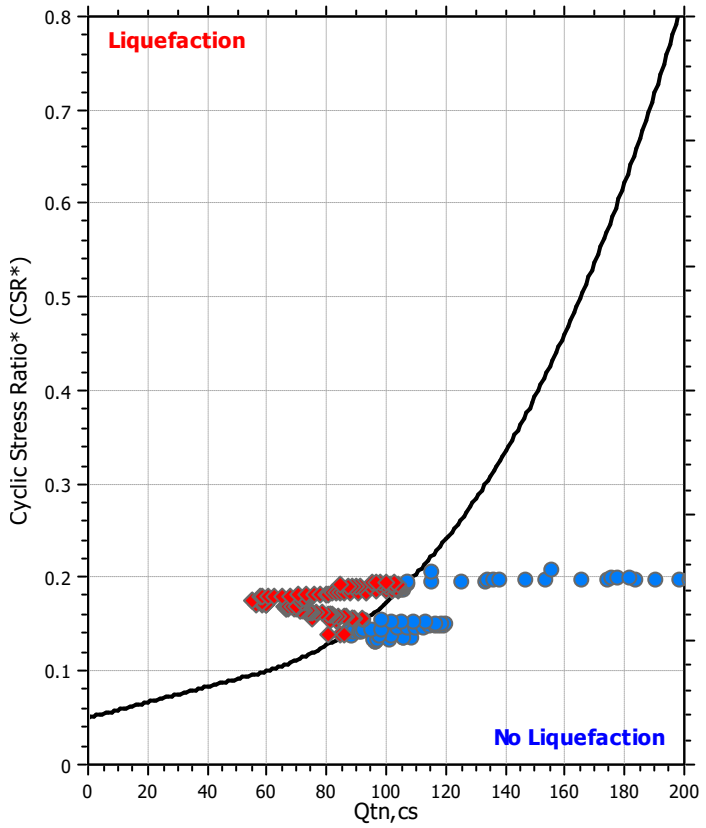
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

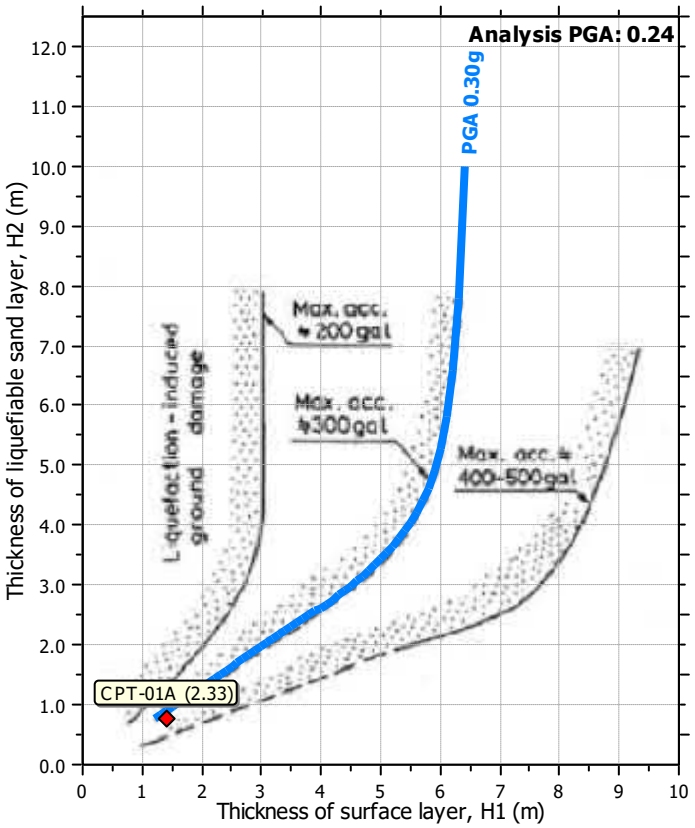
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



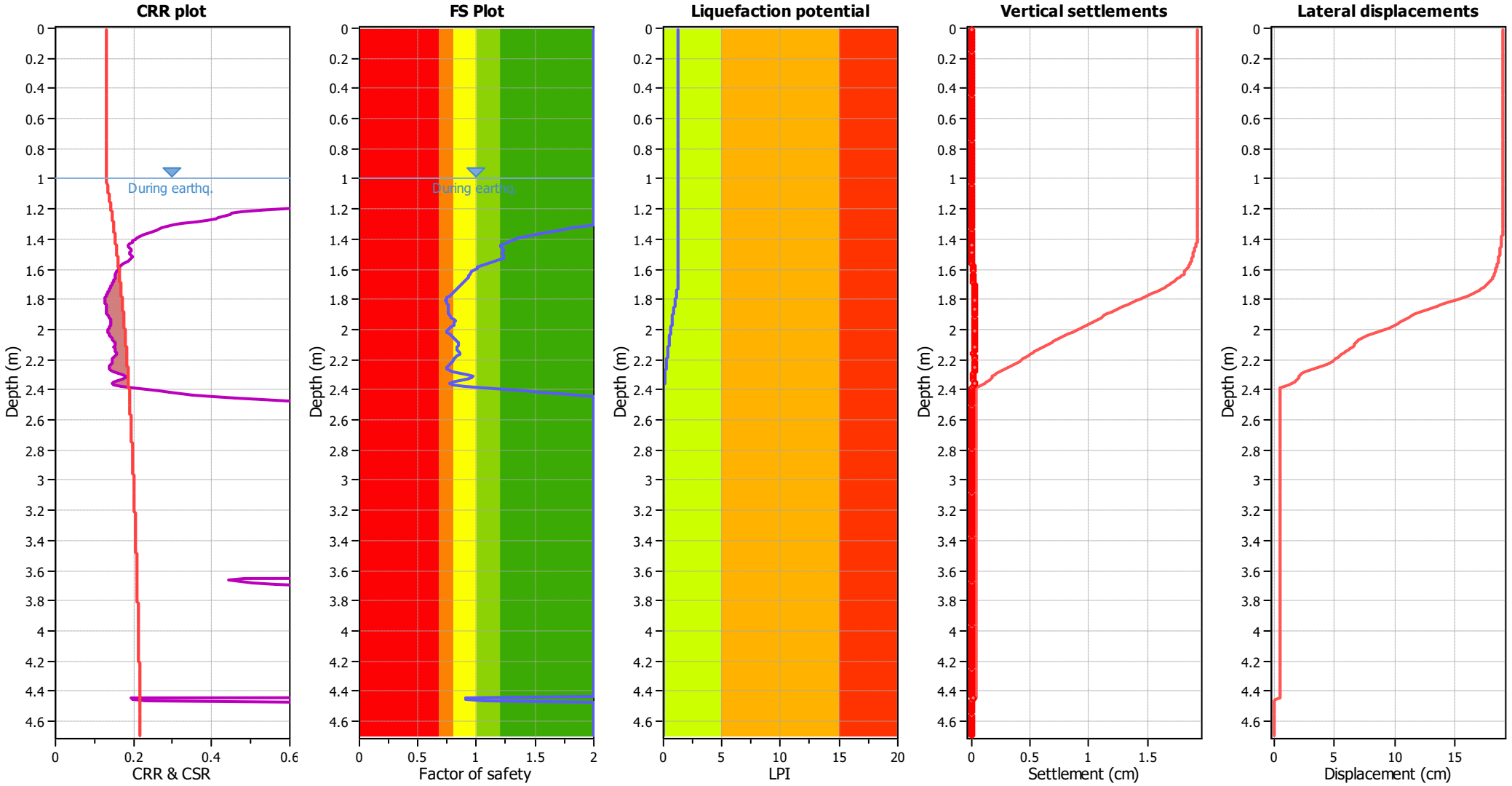




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.24	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.24	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

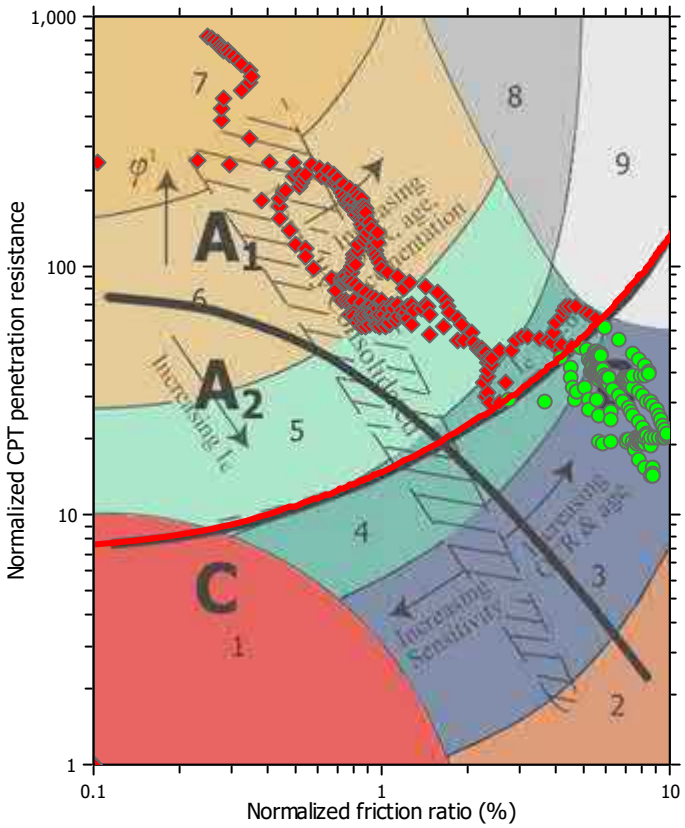
F.S. color scheme

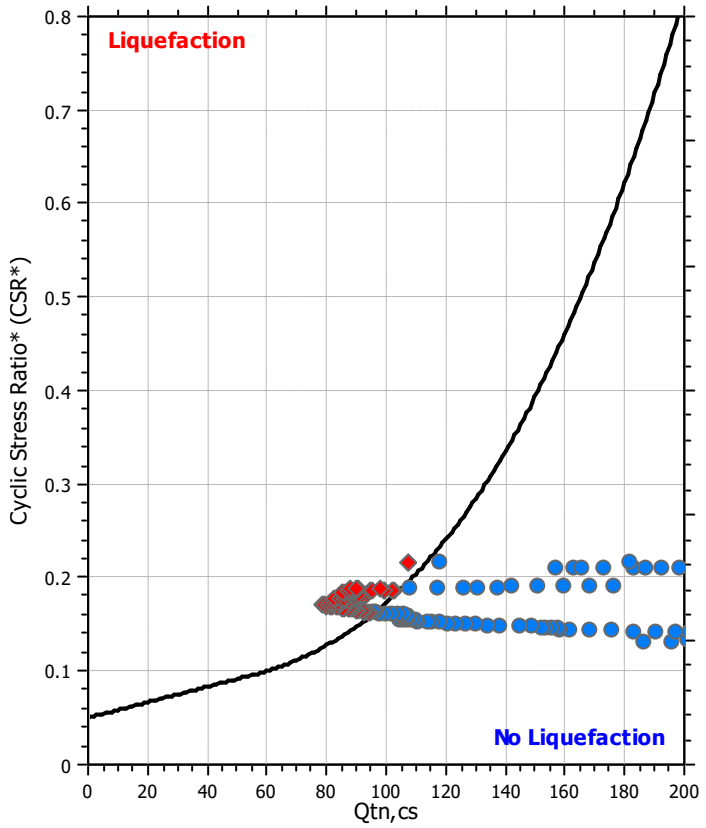
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

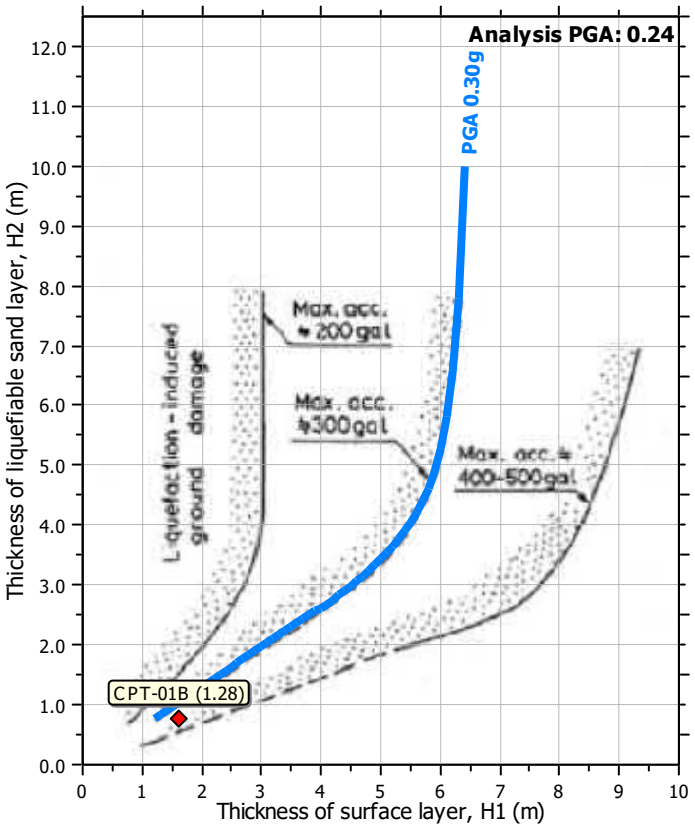
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



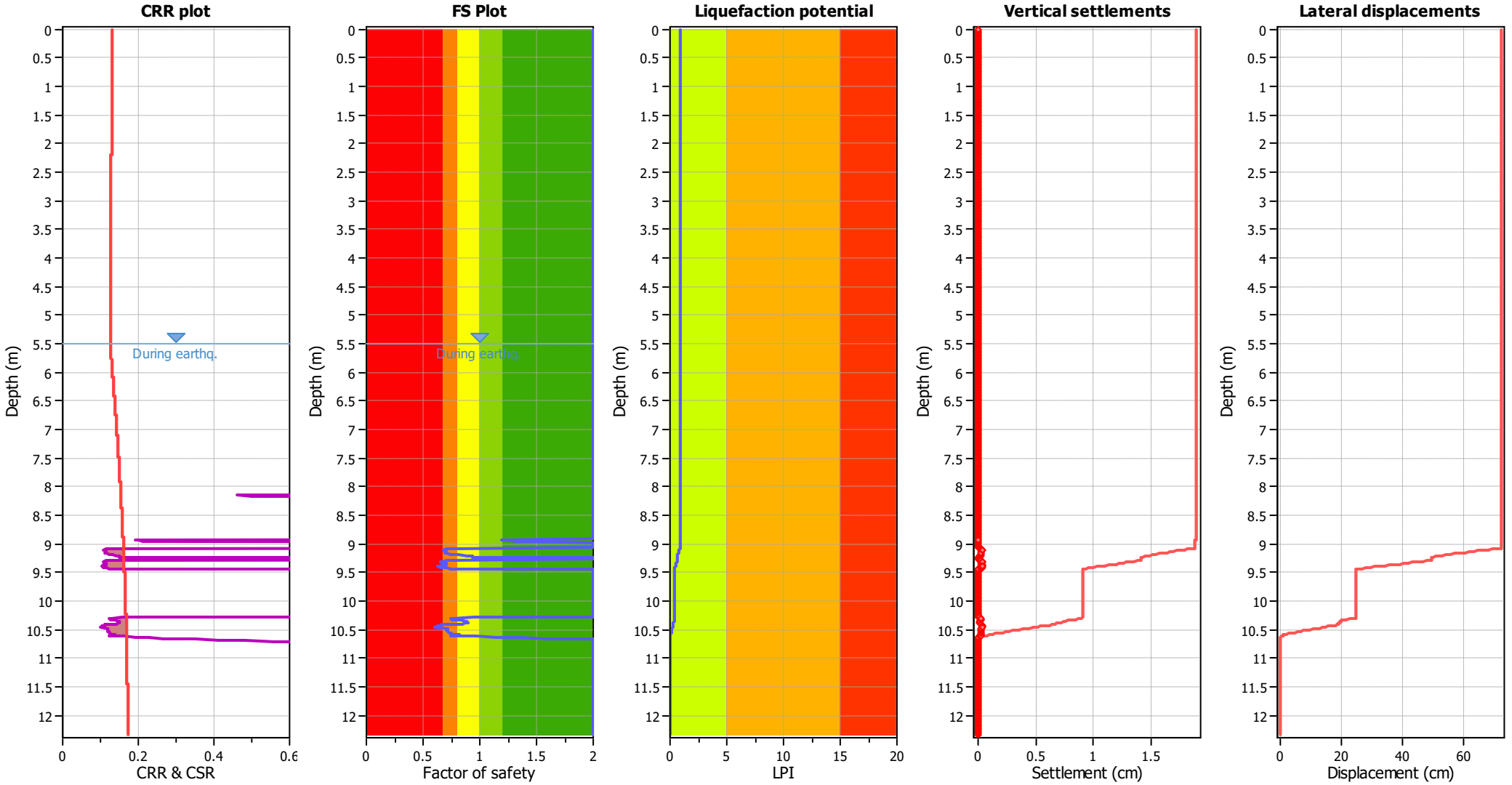




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.24	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	2.50 m	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	5.50 m	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.24	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.50 m	Fill height:	N/A	Limit depth:	N/A

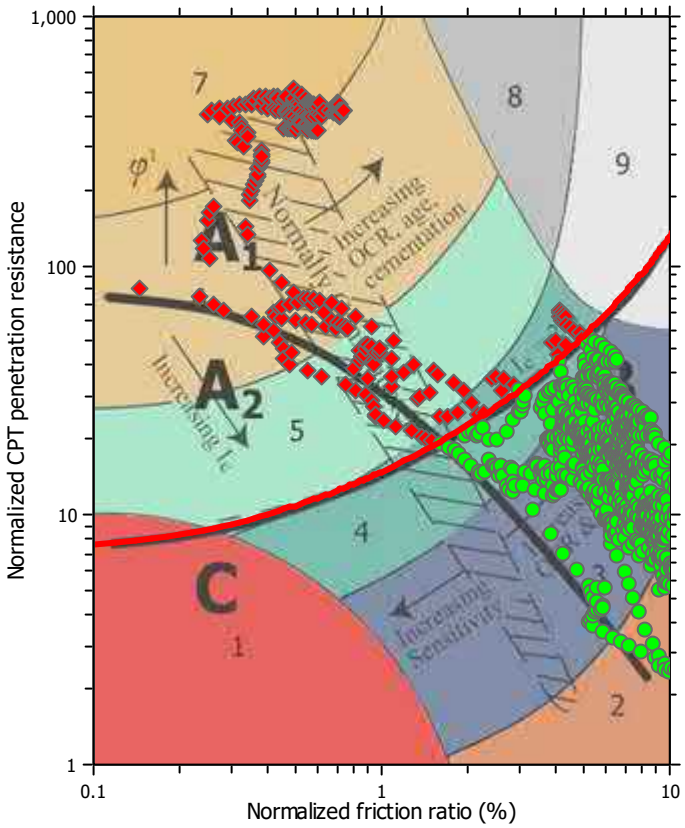
F.S. color scheme

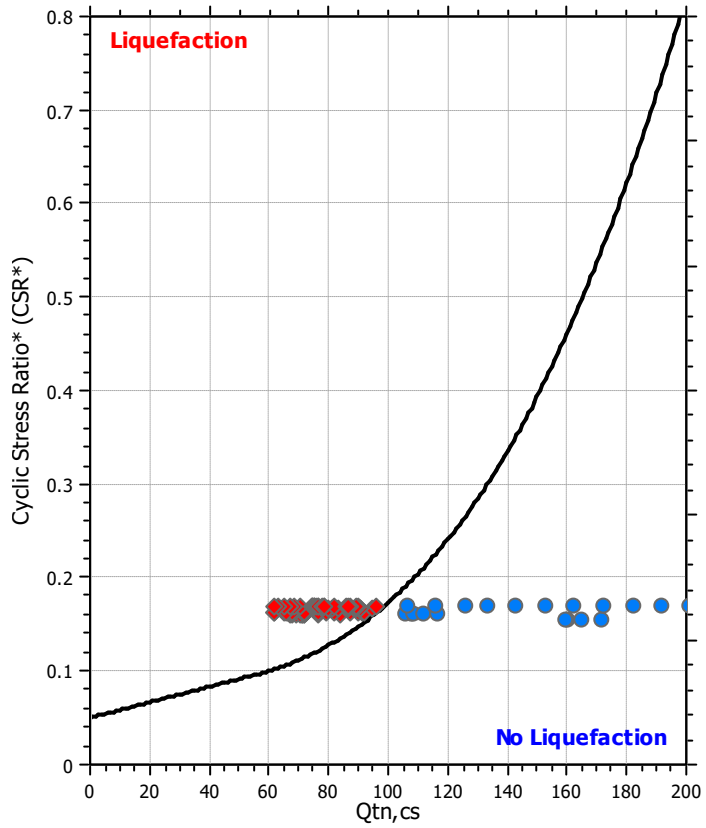
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

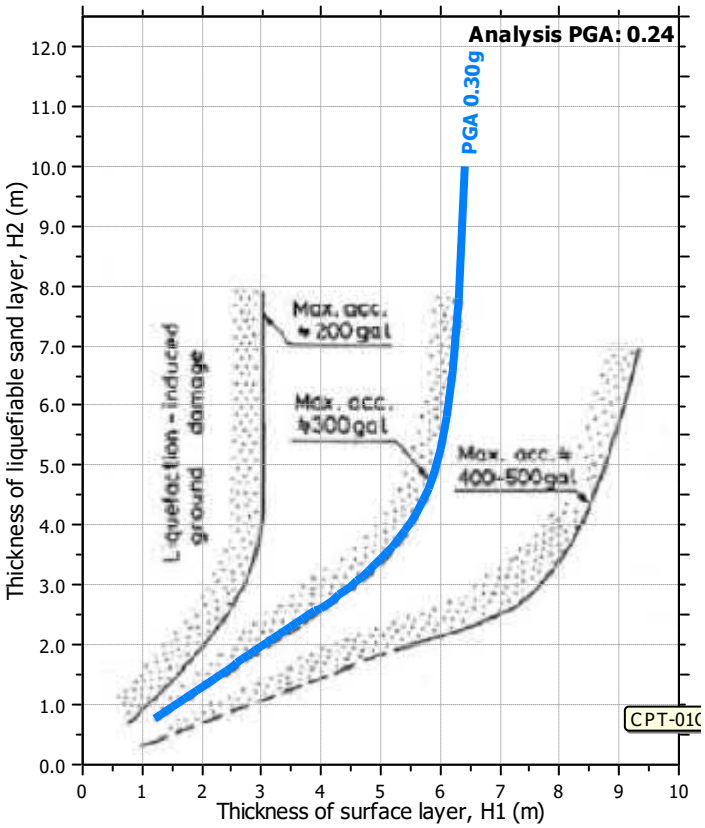
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



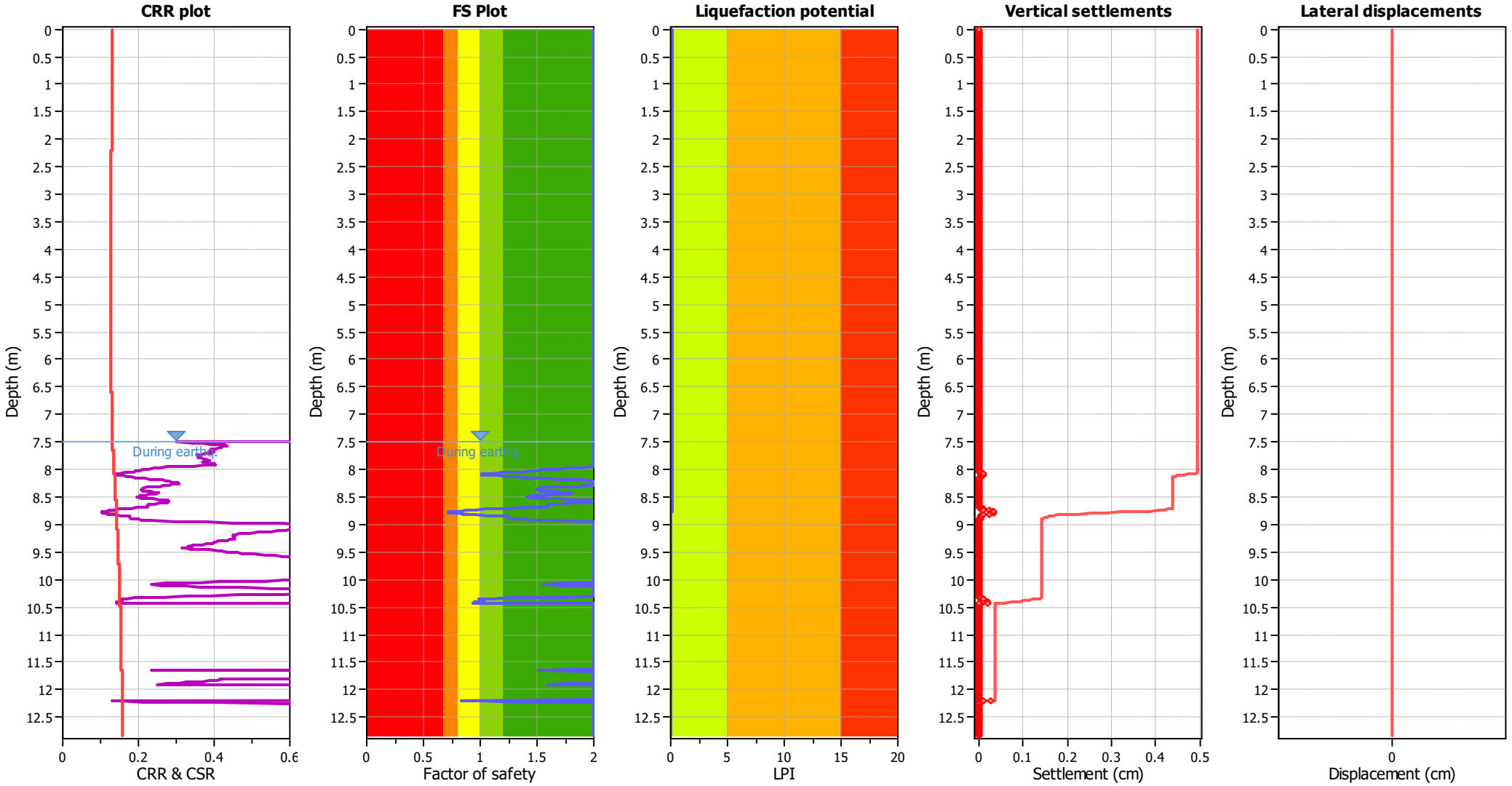




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	5.50 m	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.24	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.50 m	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.50 m	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.24	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	4.50 m	Fill height:	N/A	Limit depth:	N/A

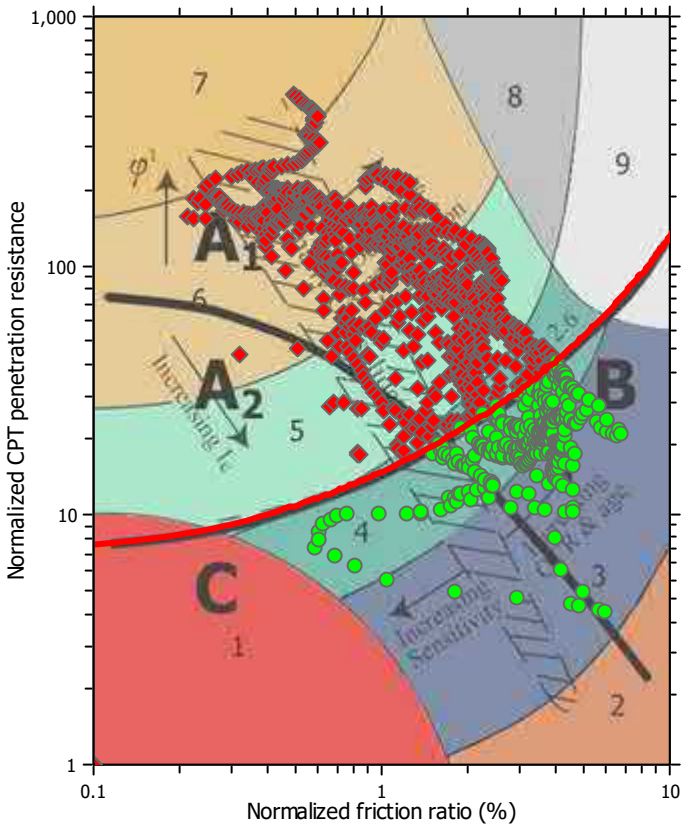
F.S. color scheme

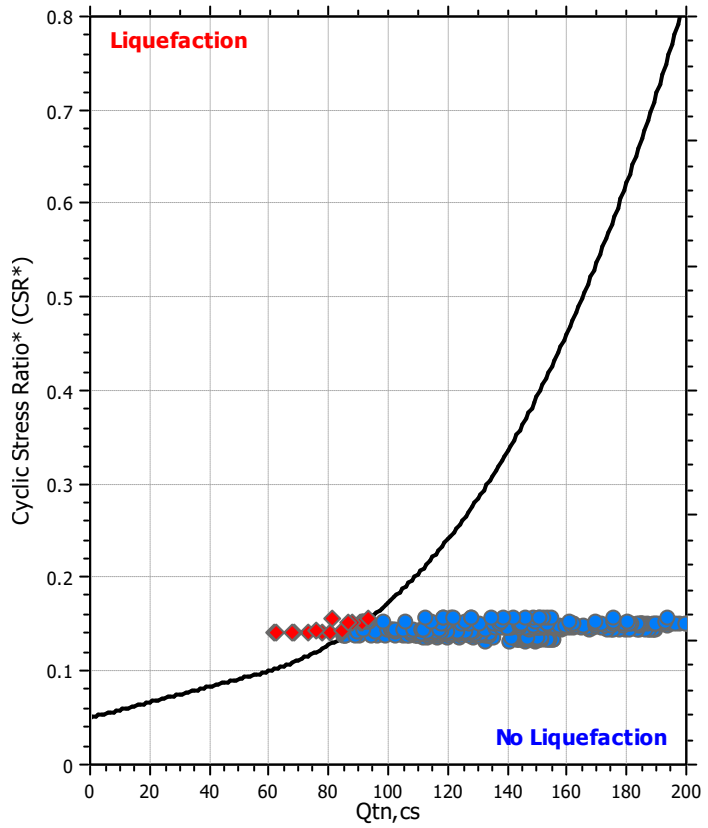
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

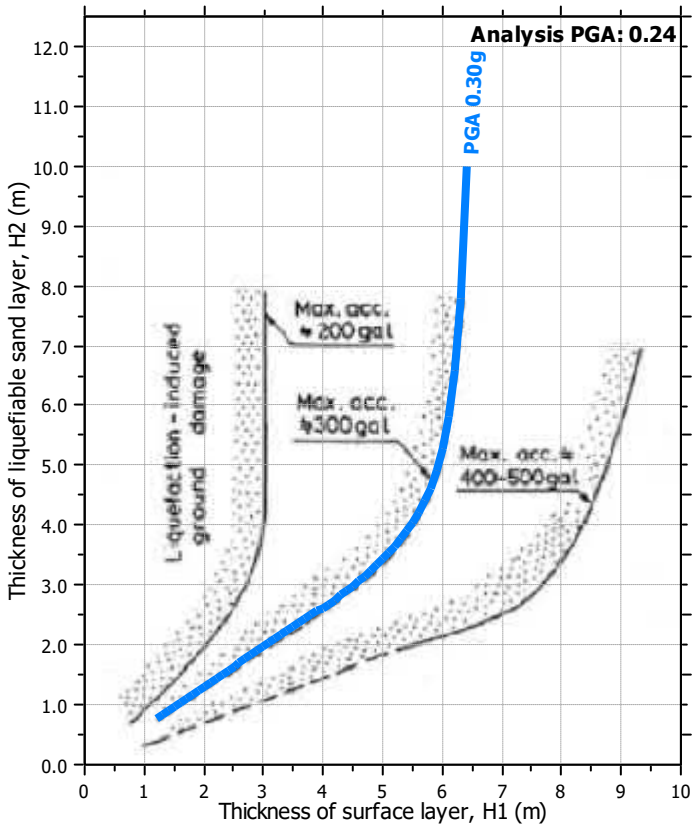
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



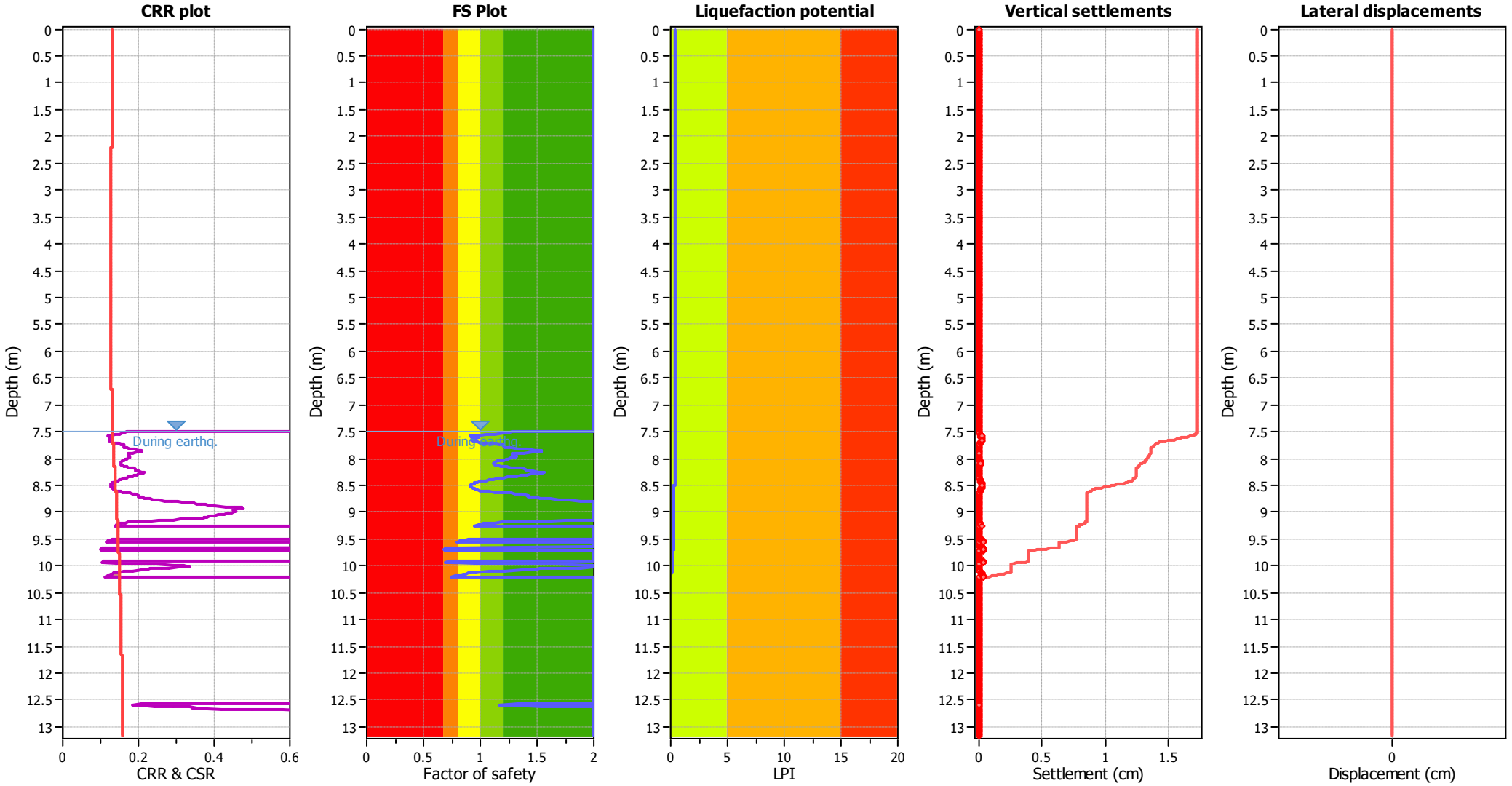




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.50 m	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.24	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	4.50 m	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.50 m	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.24	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	4.50 m	Fill height:	N/A	Limit depth:	N/A

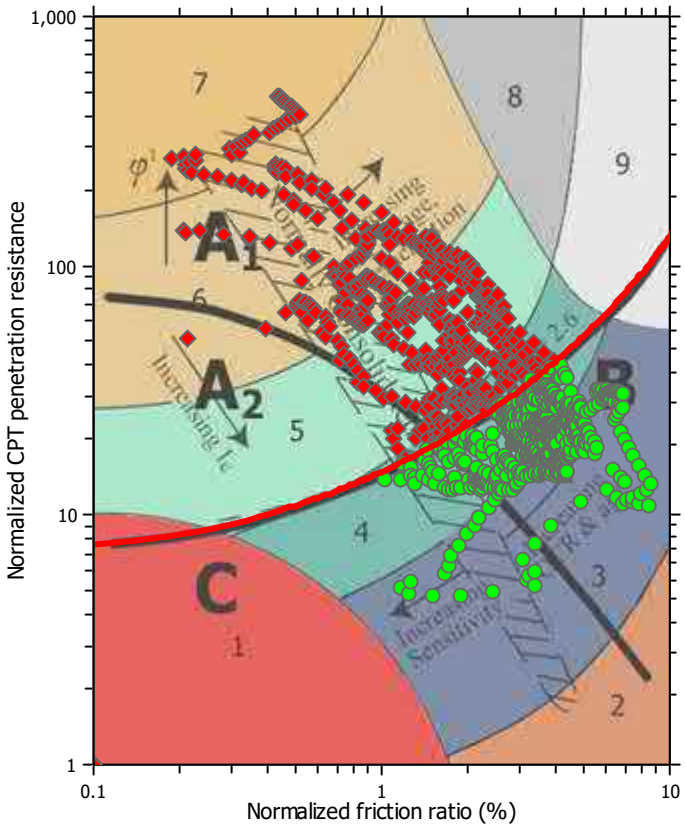
F.S. color scheme

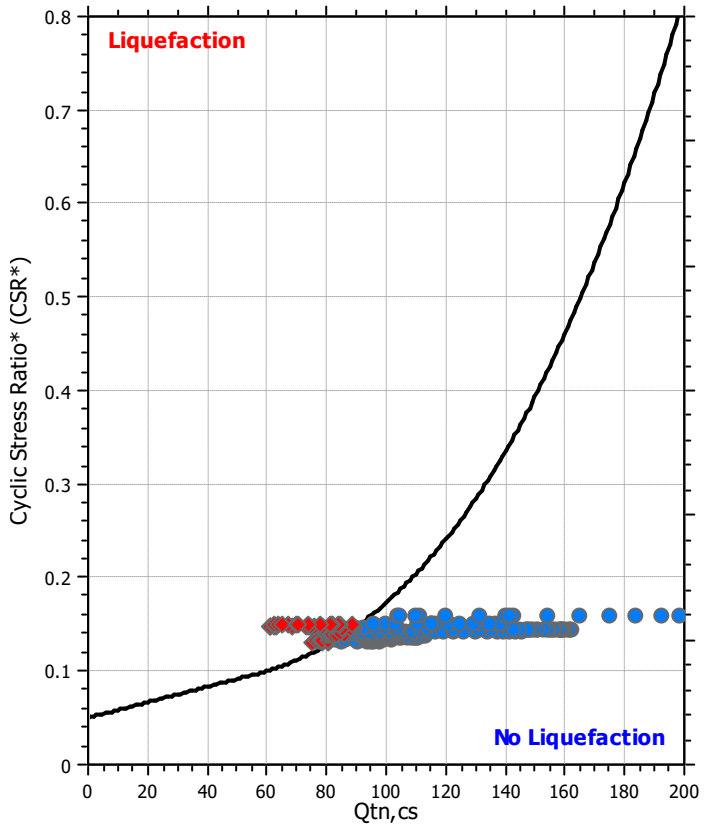
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

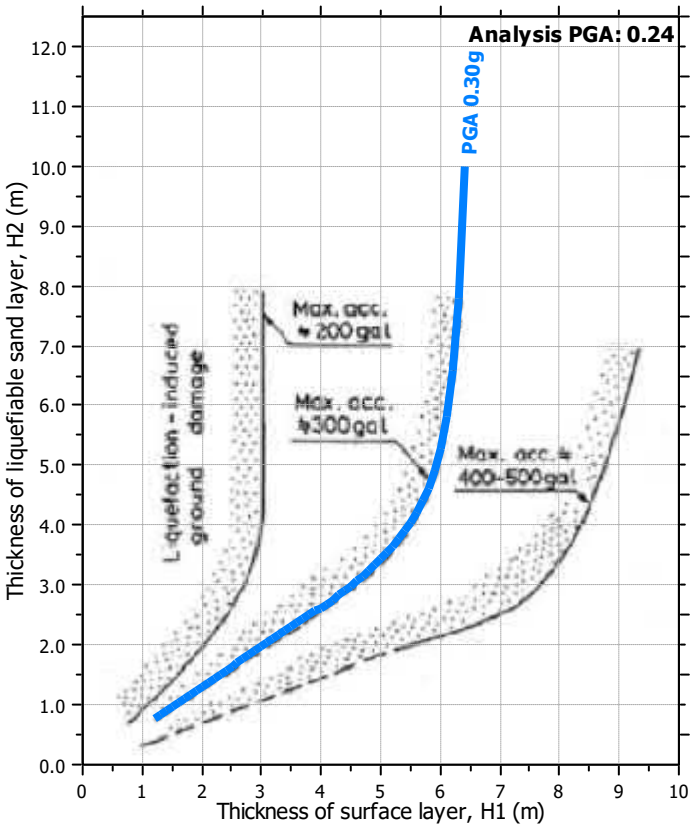
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



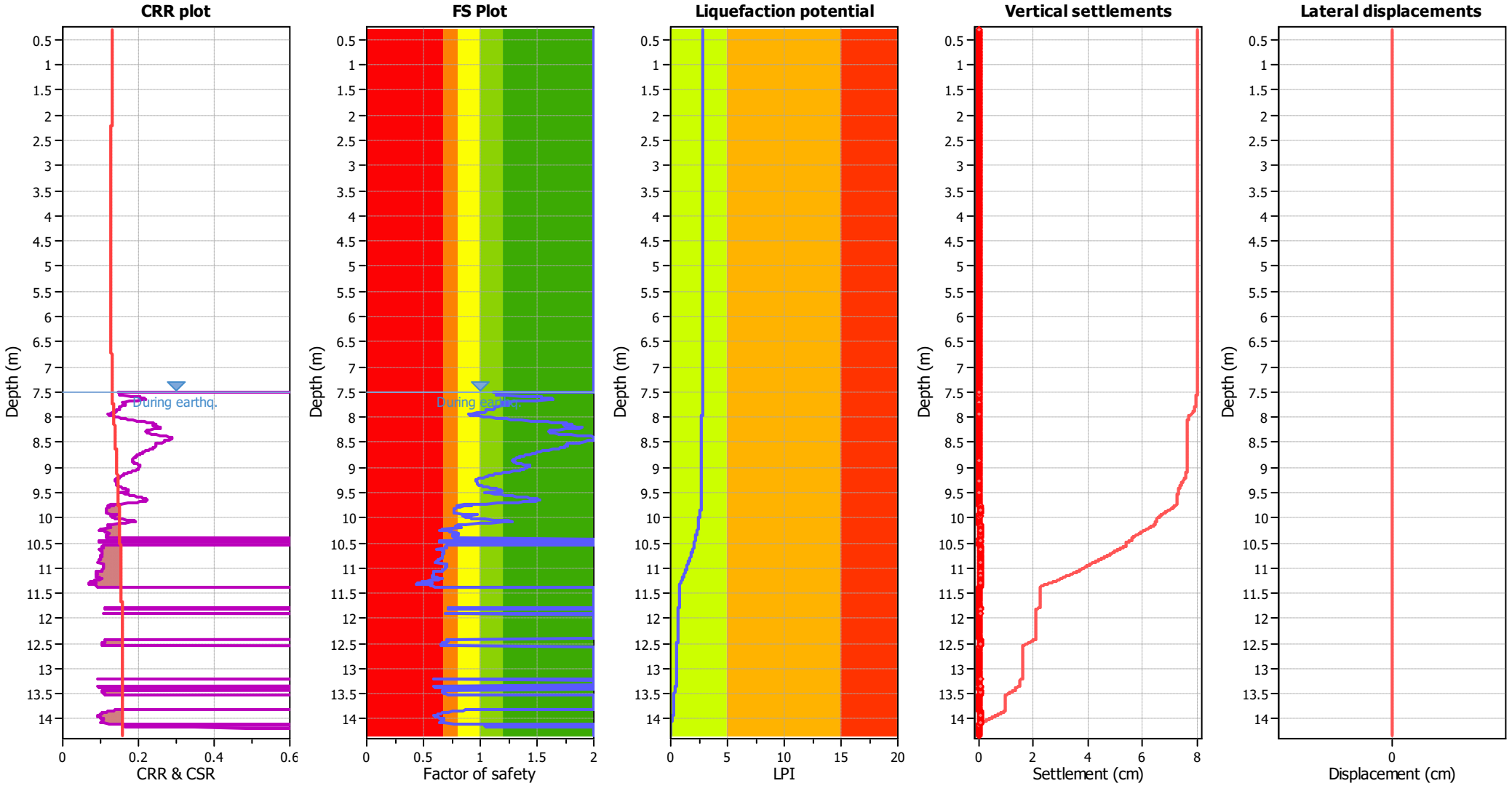




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.50 m	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.24	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	4.50 m	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.50 m	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.24	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	4.50 m	Fill height:	N/A	Limit depth:	N/A

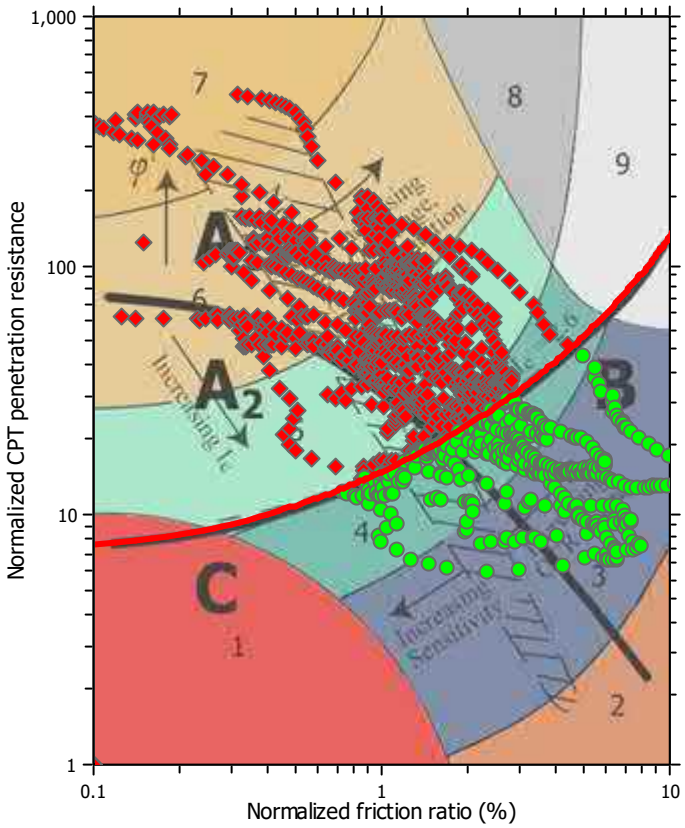
F.S. color scheme

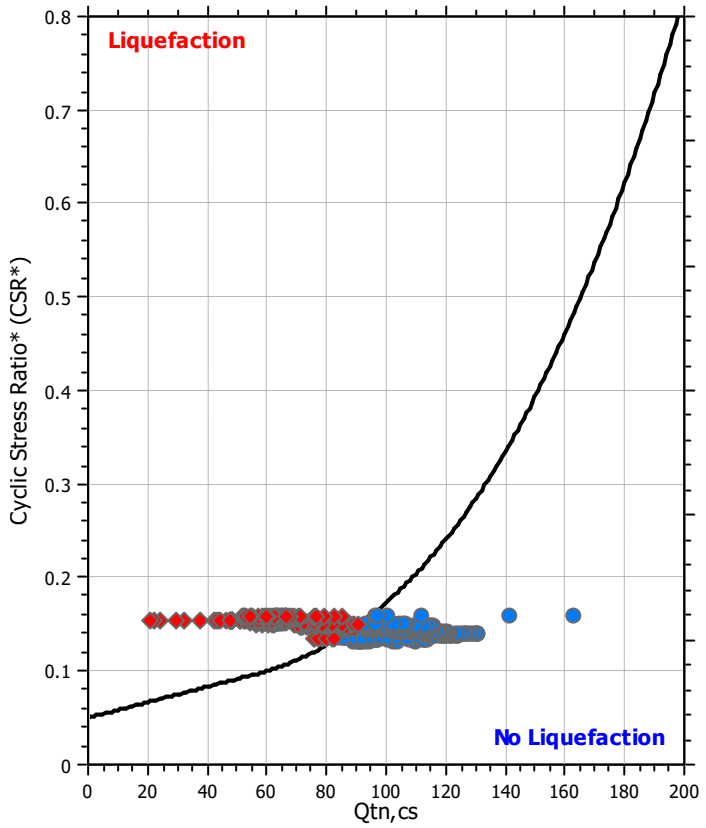
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

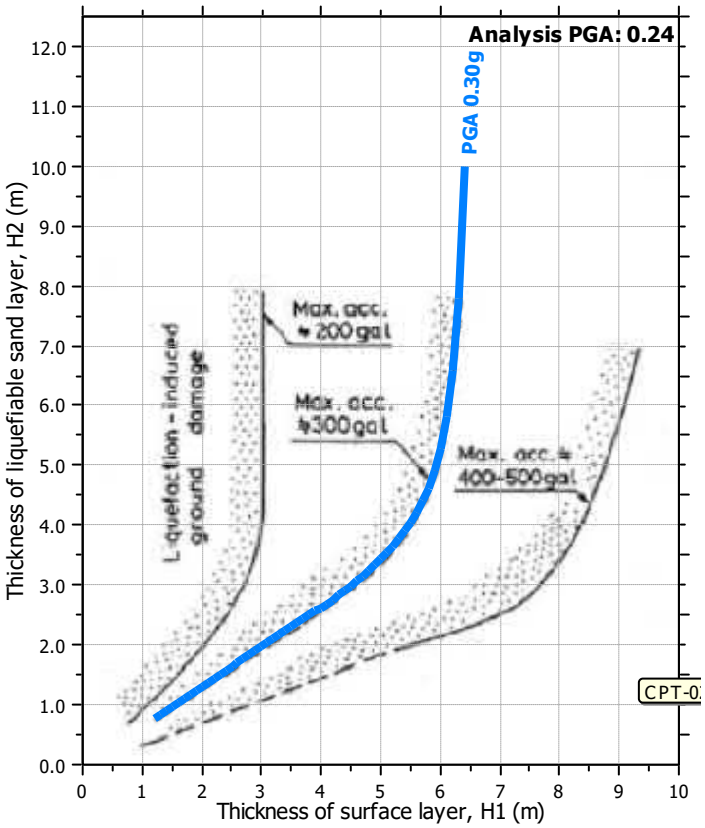
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



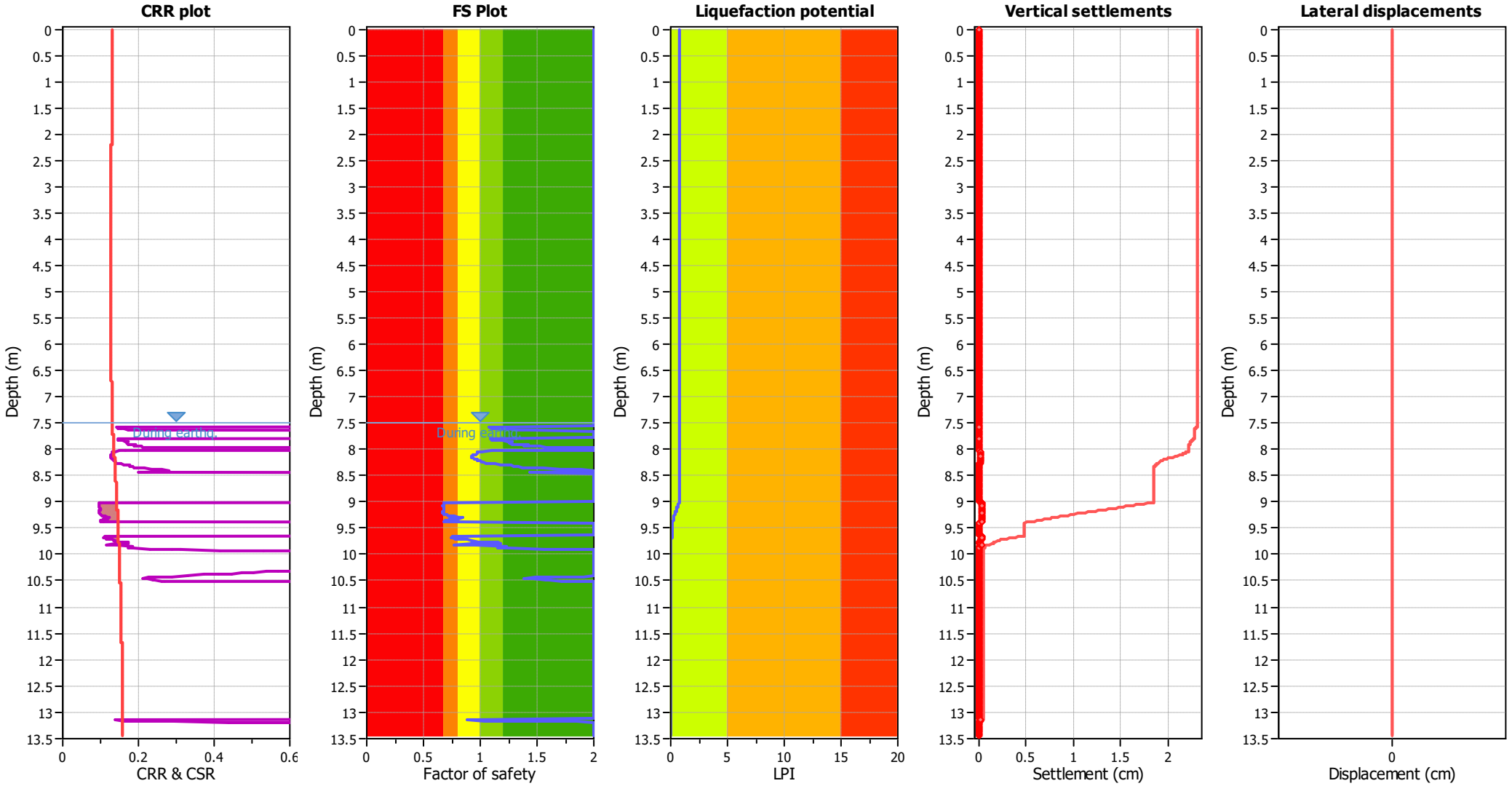




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.50 m	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.24	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	4.50 m	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.50 m	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.24	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	4.50 m	Fill height:	N/A	Limit depth:	N/A

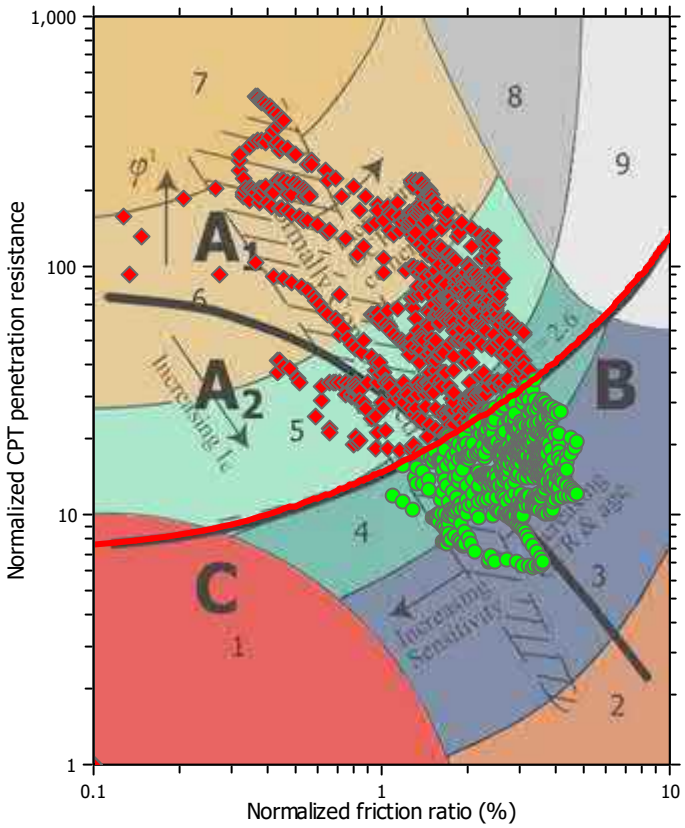
F.S. color scheme

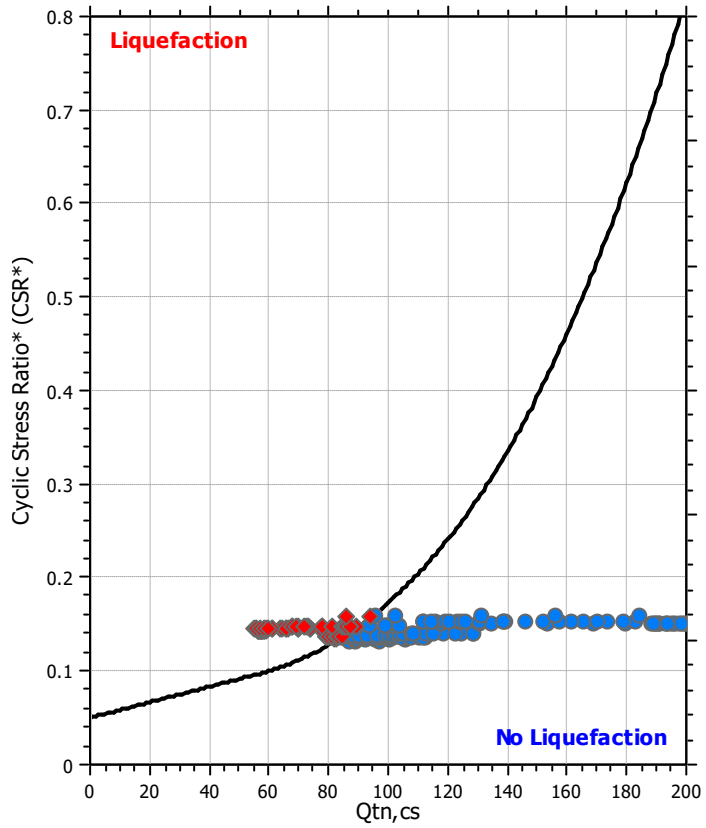
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

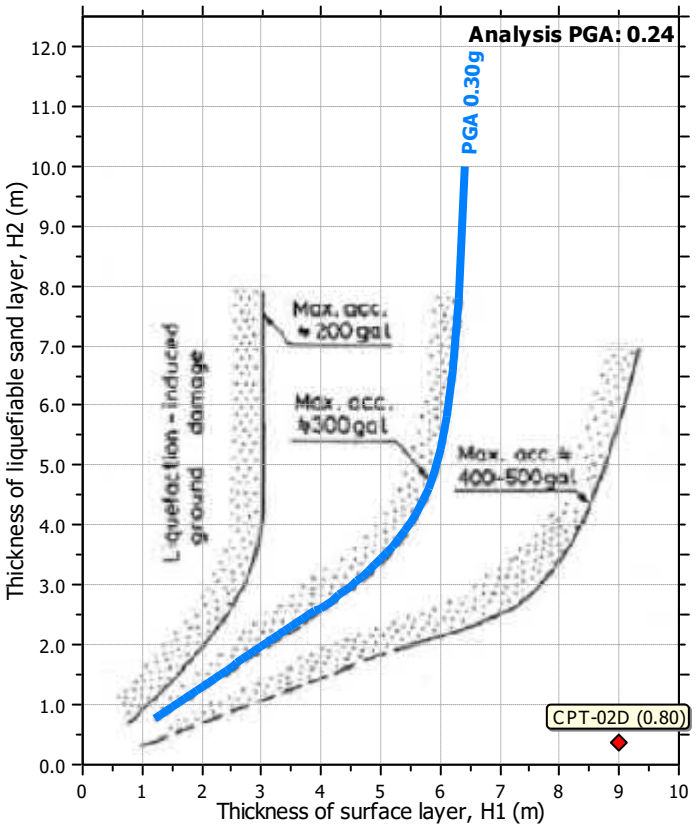
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



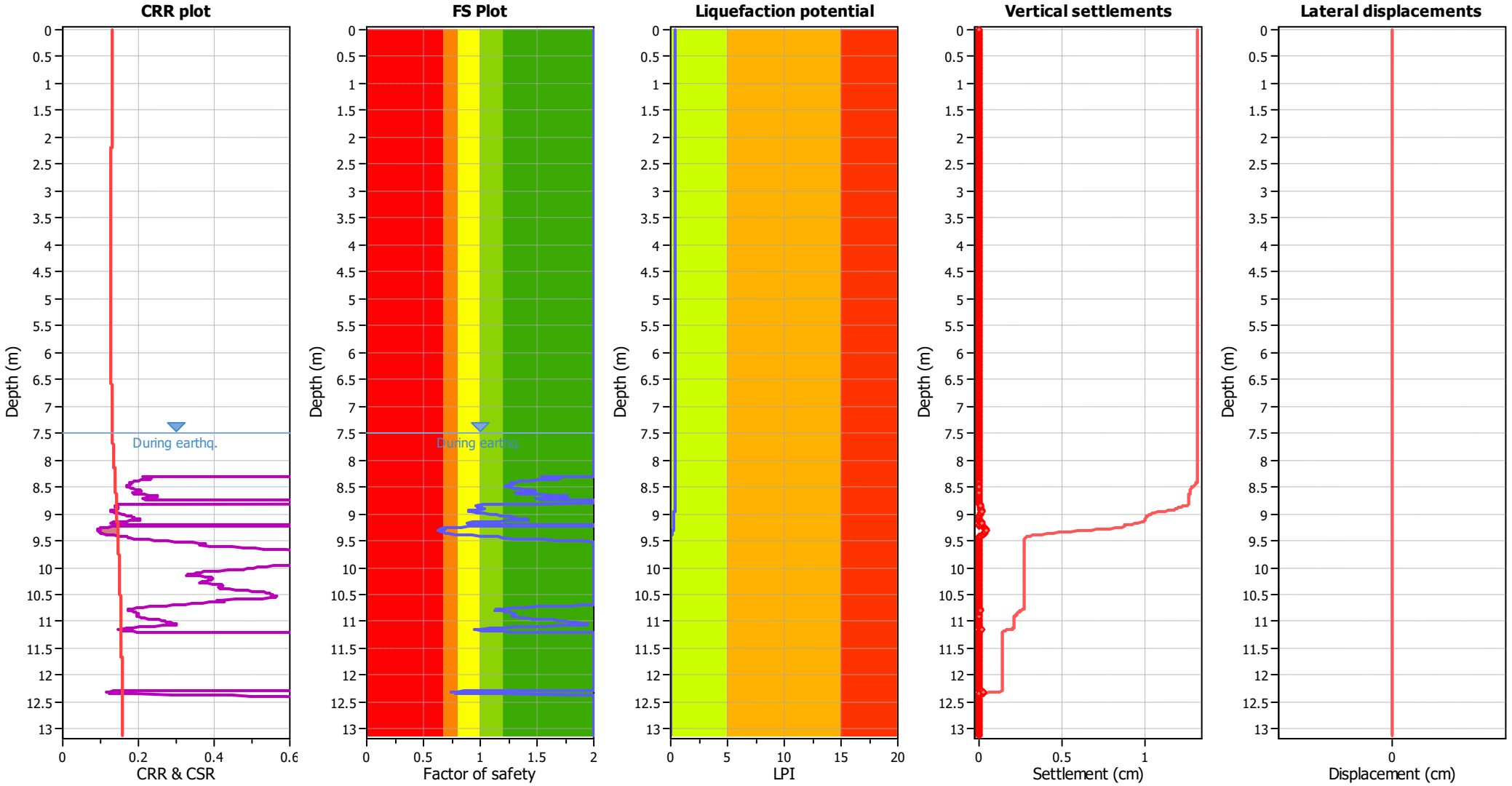




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.50 m	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.24	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	4.50 m	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.50 m	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.24	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	4.50 m	Fill height:	N/A	Limit depth:	N/A

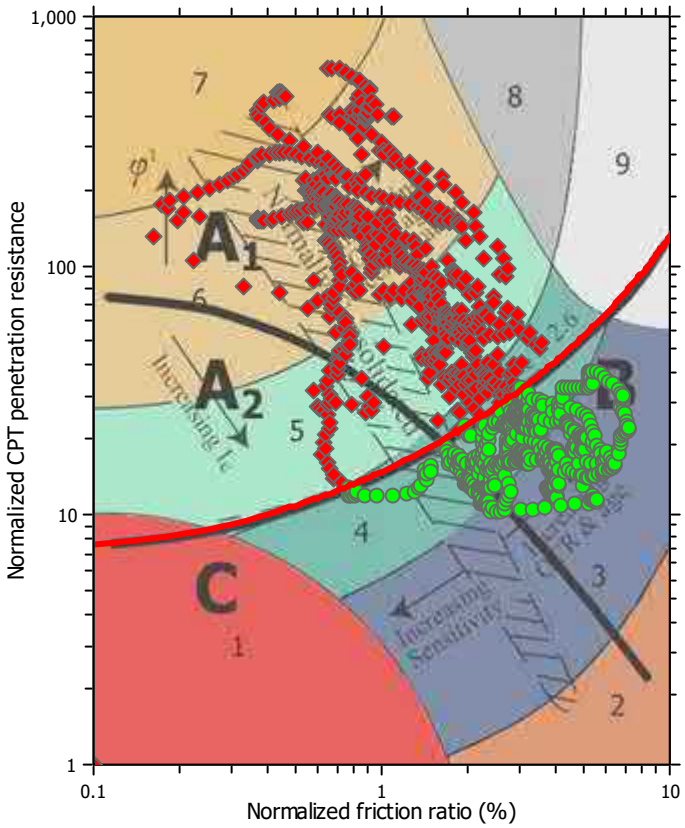
F.S. color scheme

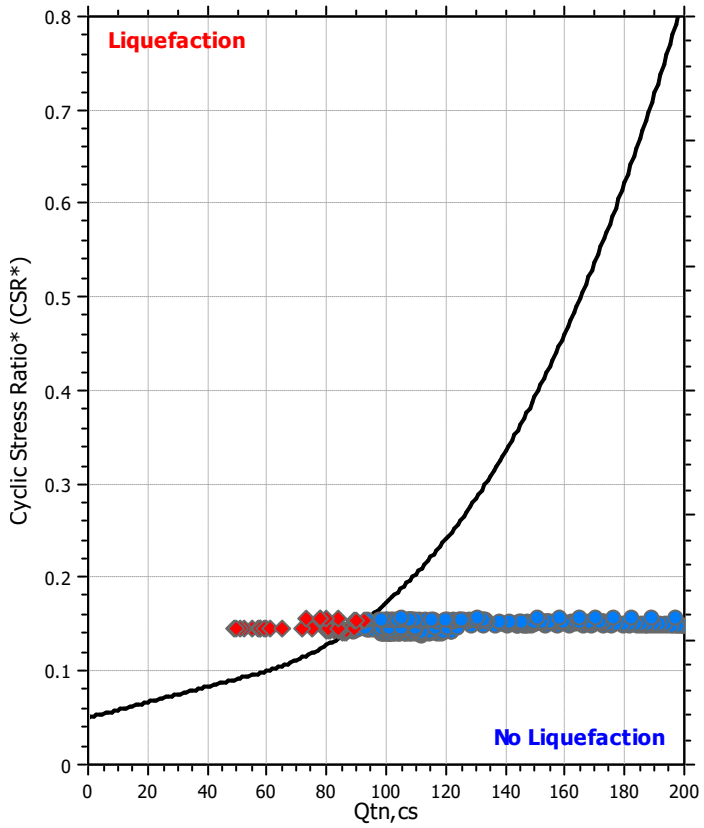
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

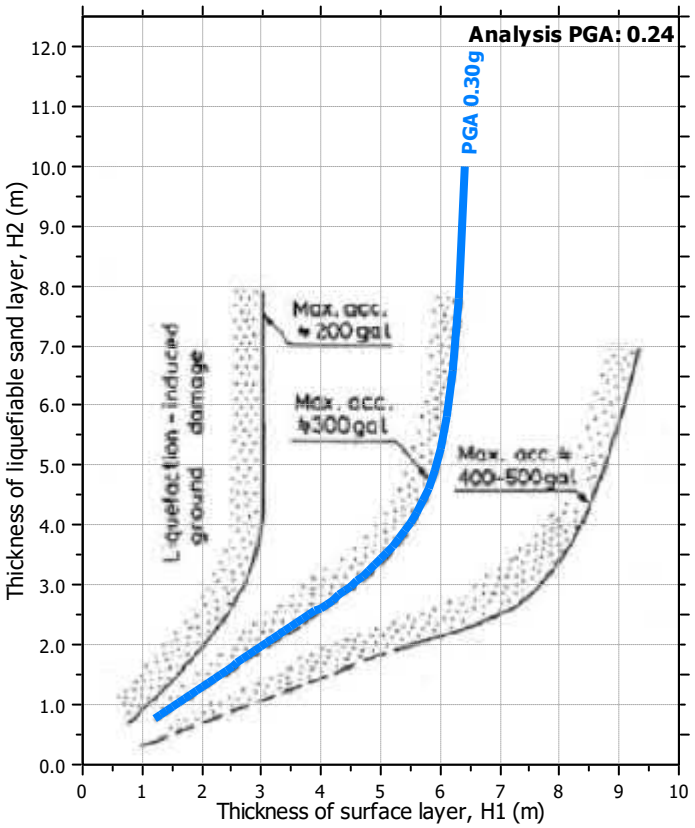
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



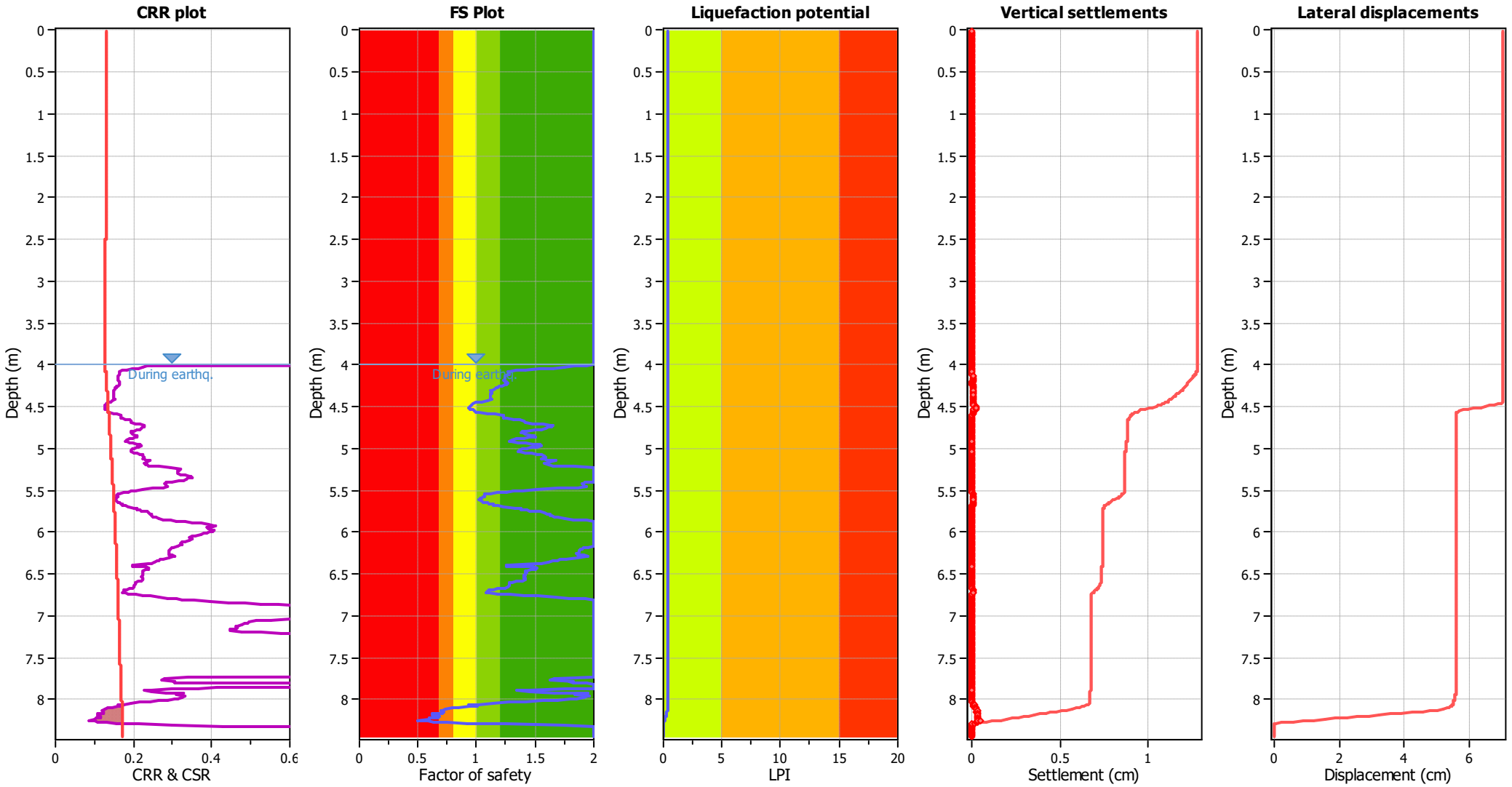




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	7.50 m	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.24	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	4.50 m	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	4.00 m	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.24	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

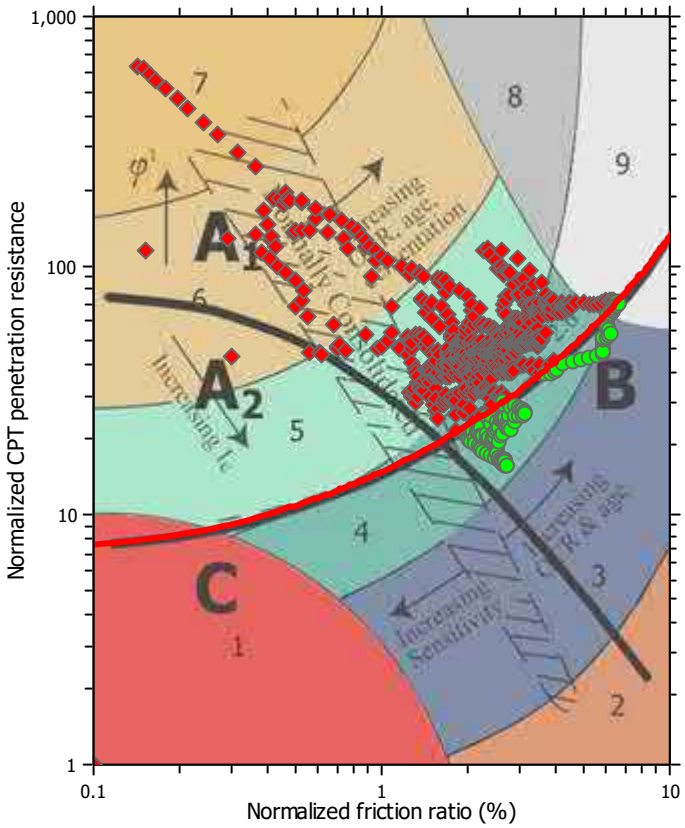
F.S. color scheme

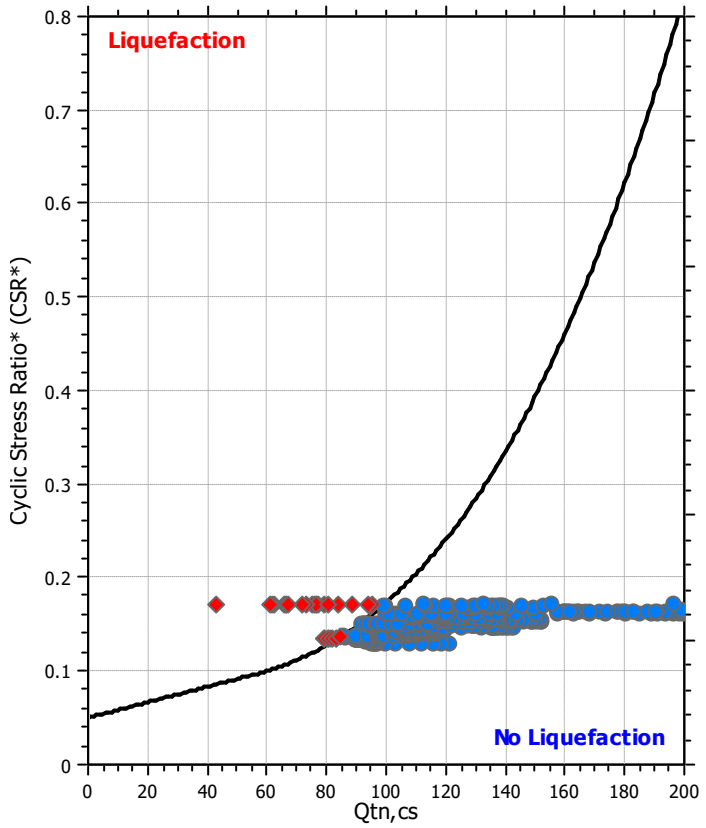
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

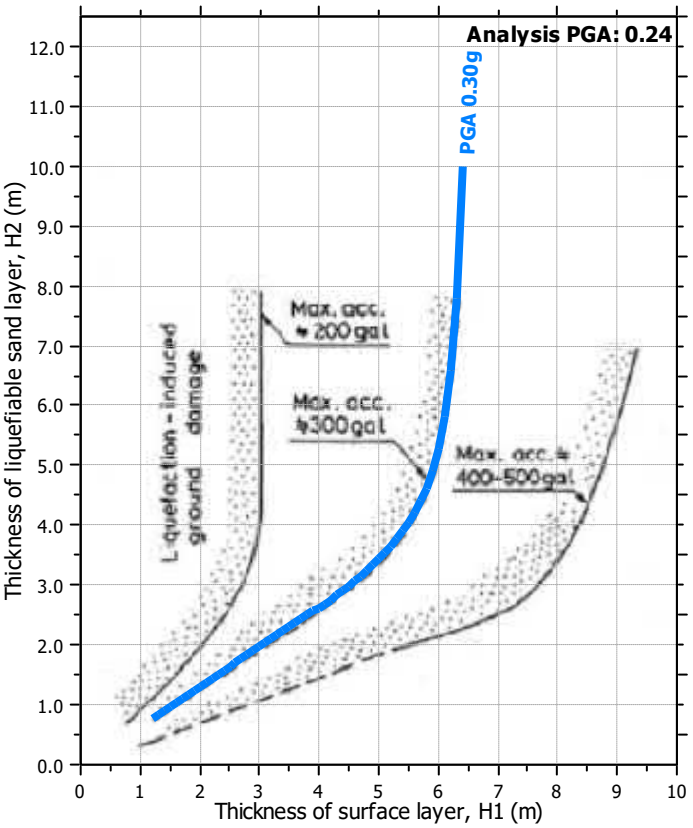
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



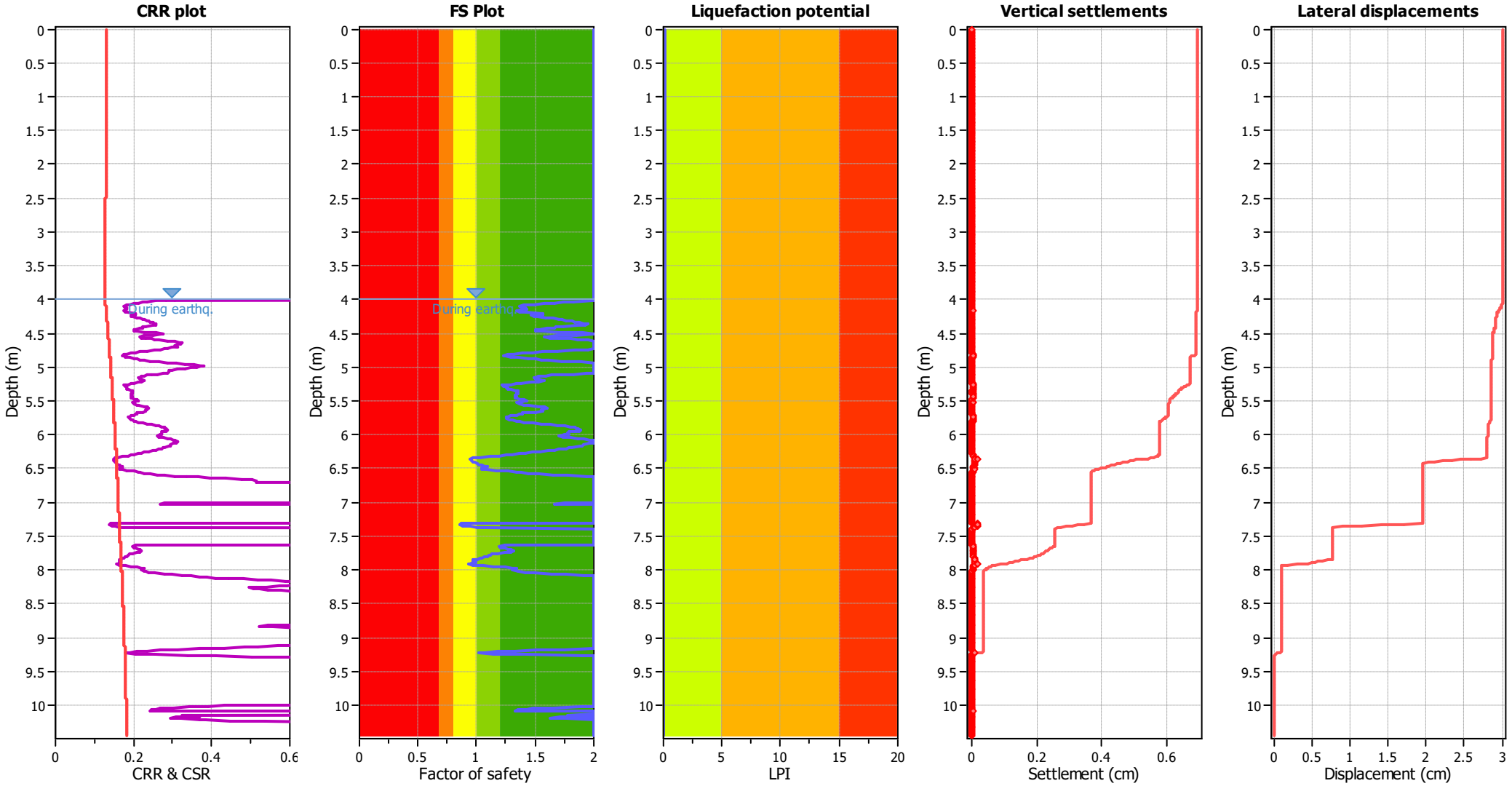




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	4.00 m	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.24	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	4.00 m	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.24	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

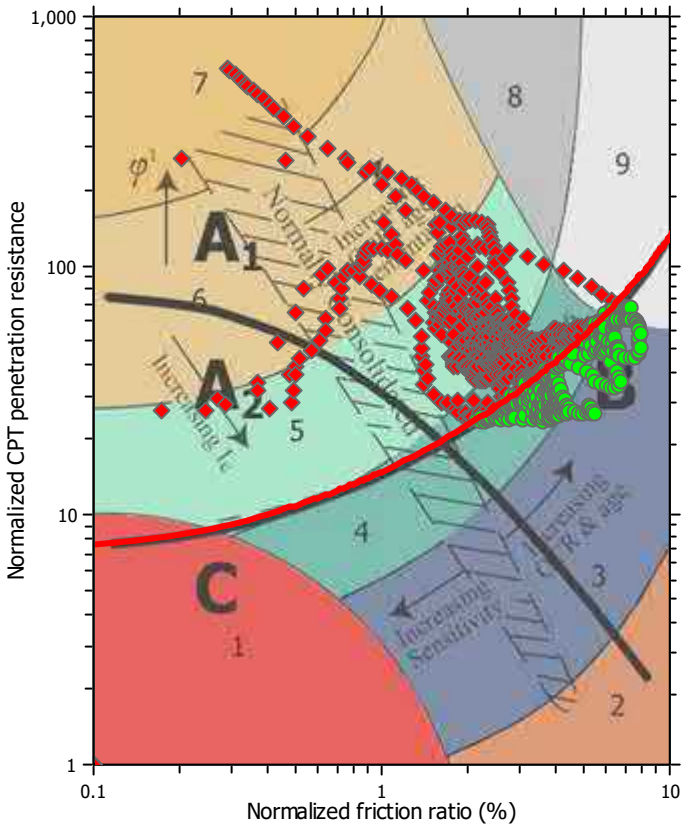
F.S. color scheme

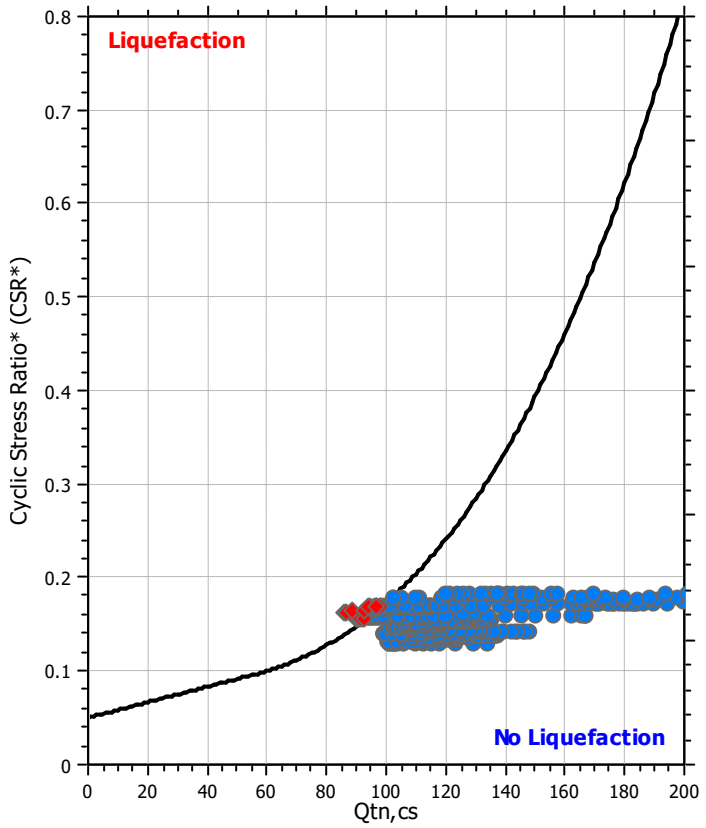
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

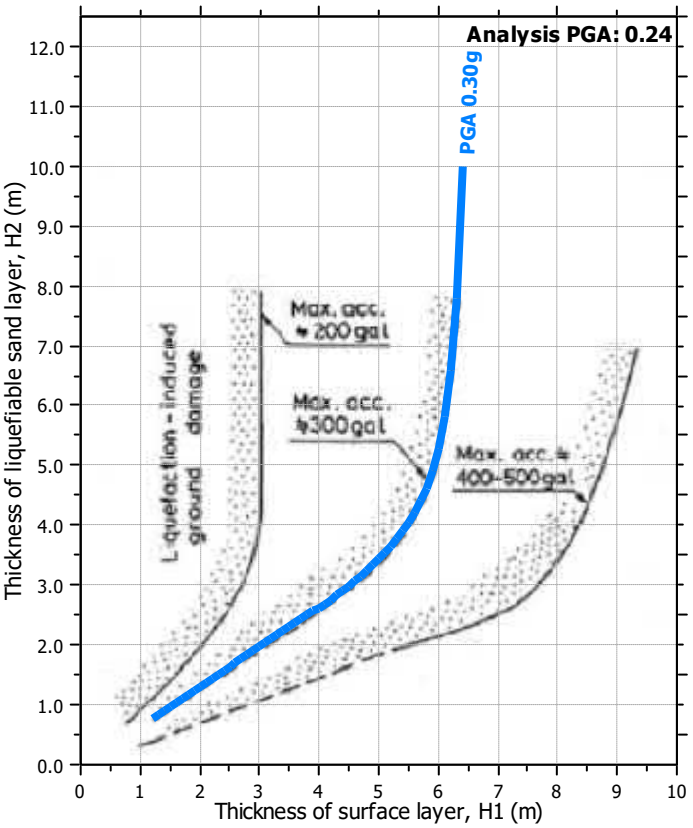
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



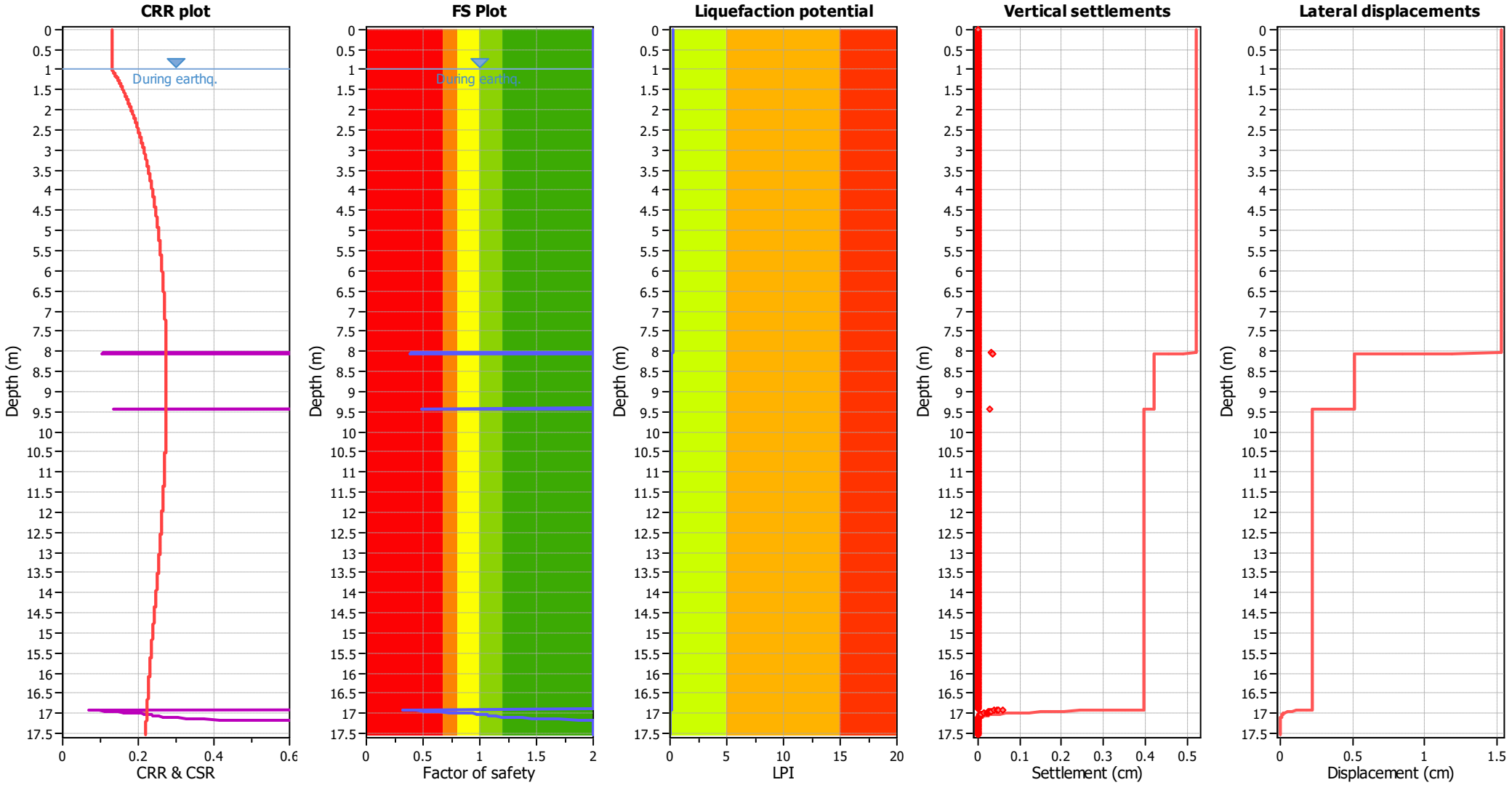




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	4.00 m	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.24	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.24	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

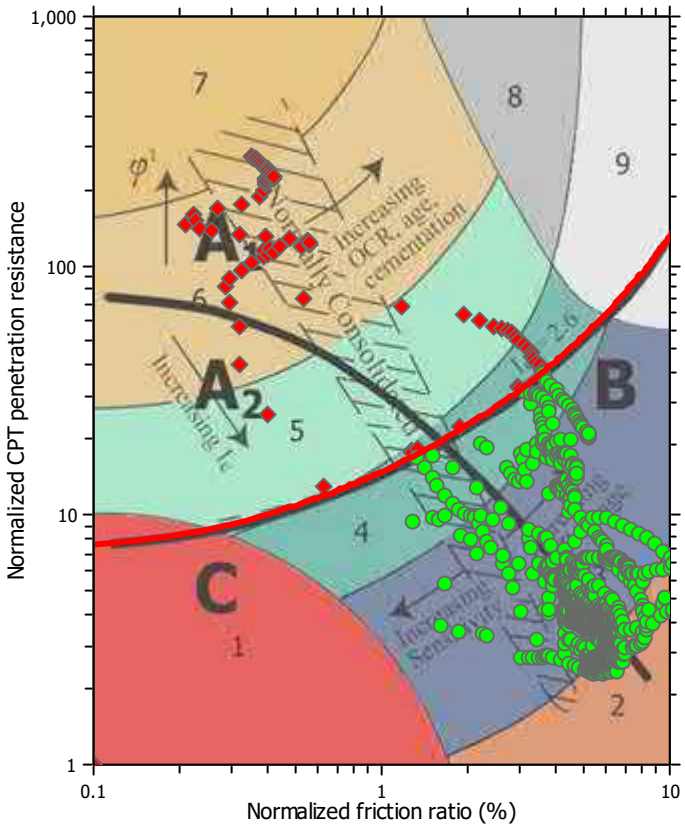
F.S. color scheme

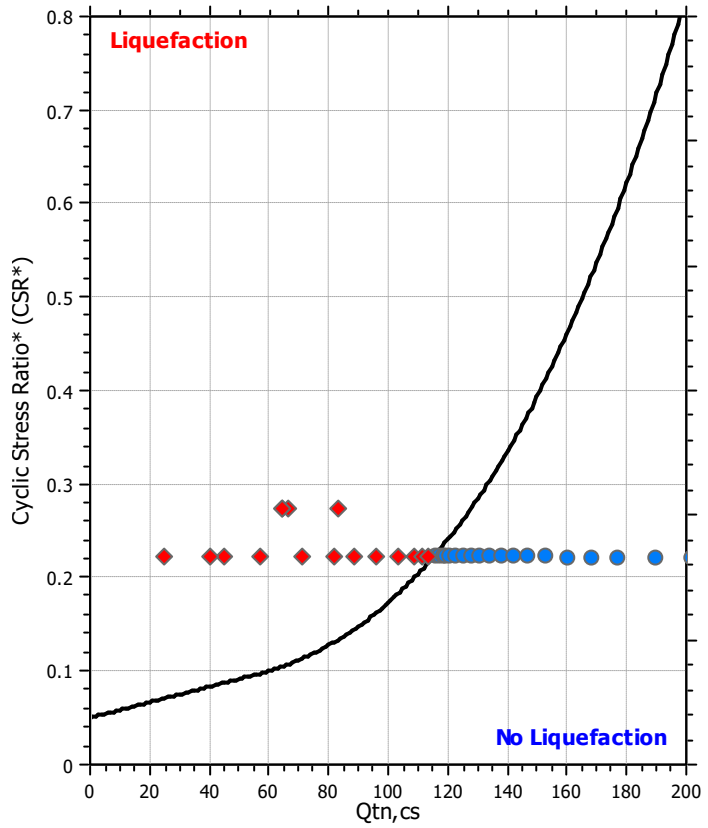
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

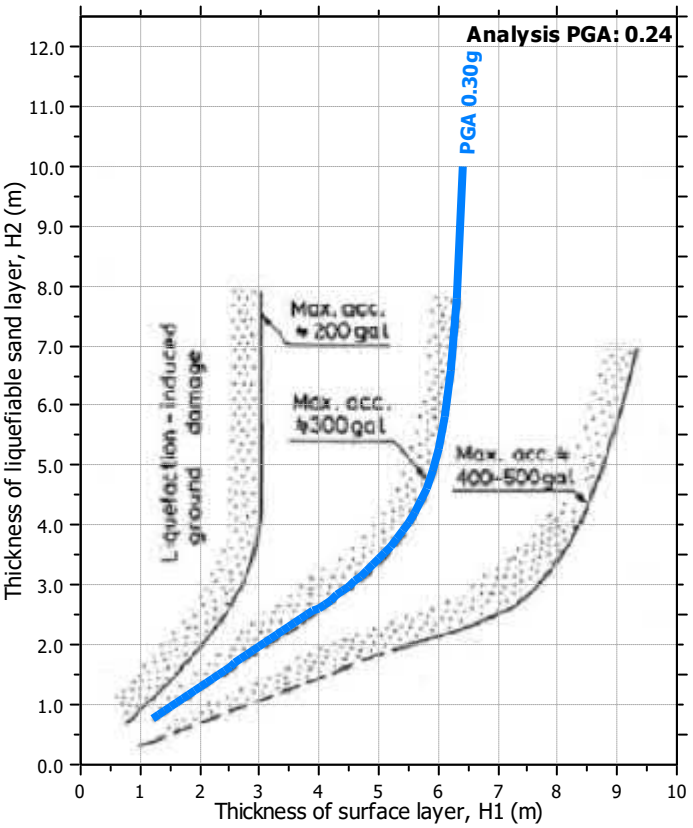
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots



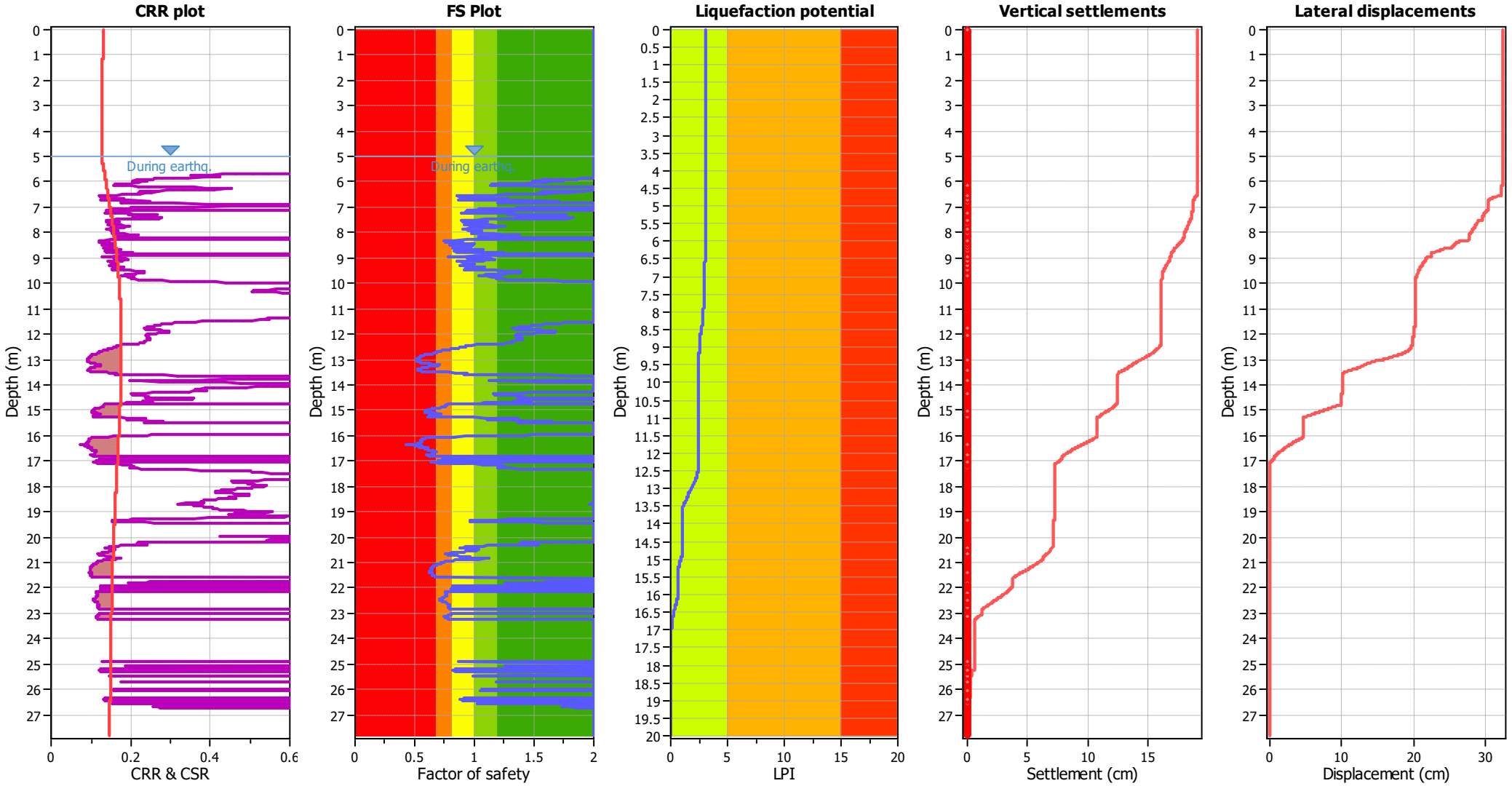




Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	1.00 m	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.24	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	1.00 m	Fill height:	N/A	Limit depth:	N/A

Liquefaction analysis overall plots



Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.24	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.00 m	Fill height:	N/A	Limit depth:	N/A

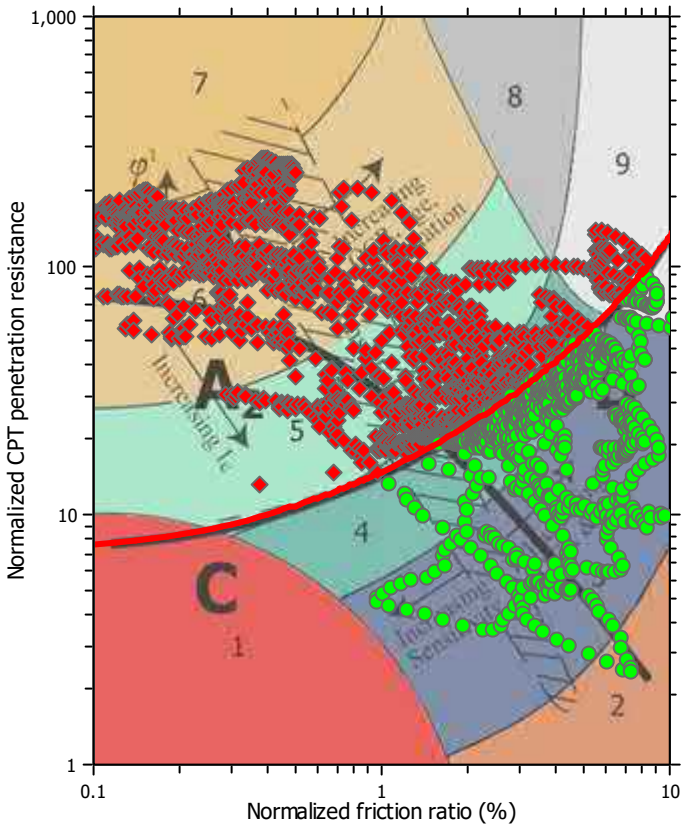
F.S. color scheme

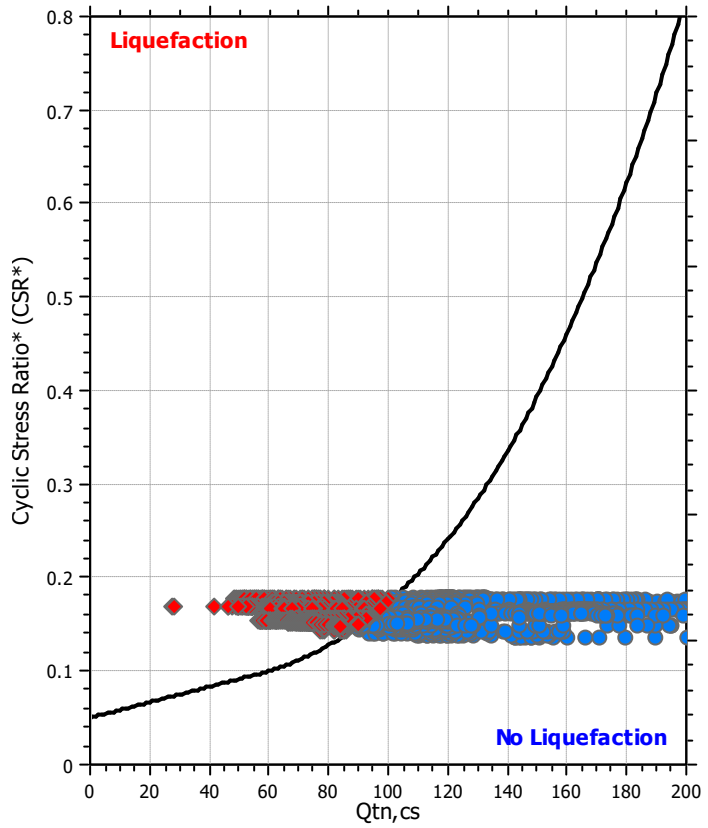
- Almost certain it will liquefy
- Very likely to liquefy
- Liquefaction and no liq. are equally likely
- Unlike to liquefy
- Almost certain it will not liquefy

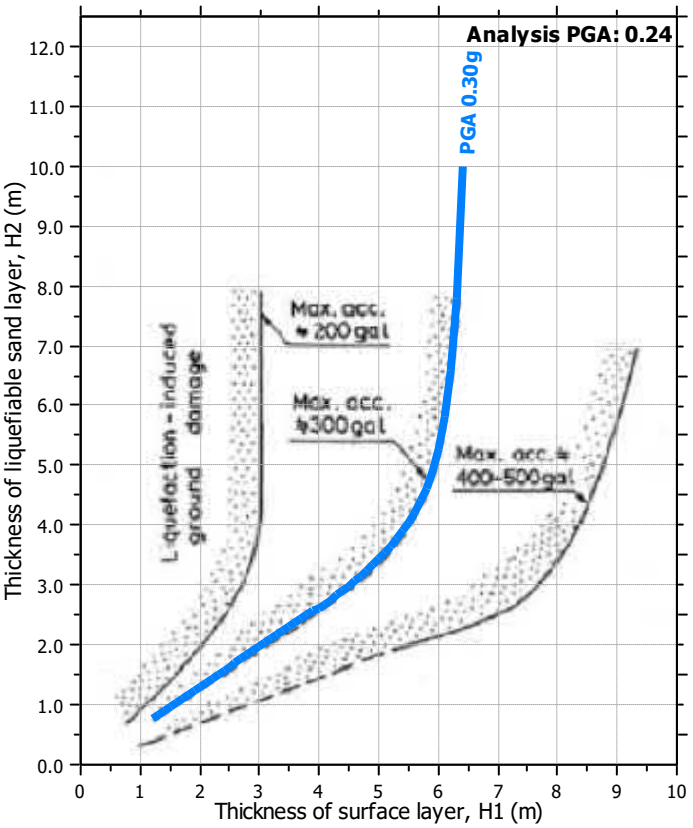
LPI color scheme

- Very high risk
- High risk
- Low risk

Liquefaction analysis summary plots







Input parameters and analysis data

Analysis method:	NCEER (1998)	Depth to water table (erthq.):	5.00 m	Fill weight:	N/A
Fines correction method:	NCEER (1998)	Average results interval:	3	Transition detect. applied:	No
Points to test:	Based on Ic value	Ic cut-off value:	2.60	K_σ applied:	Yes
Earthquake magnitude M_w:	7.00	Unit weight calculation:	Based on SBT	Clay like behavior applied:	Sands only
Peak ground acceleration:	0.24	Use fill:	No	Limit depth applied:	No
Depth to water table (insitu):	5.00 m	Fill height:	N/A	Limit depth:	N/A

Appendix B4: DPSH Results

DPSH-01A

Sounding :	DPSH-01A
Site :	MEL2022-0033
Date :	12/01/2023 - 23:01
Company :	CMW Geosciences
User :	Sanjaya Perera
Supervisor :	Jayendra Puvendran
UTM area :	55H
UTM E,N :	380237 | 5765268
Altitude :	22.5 m
Tracking :	

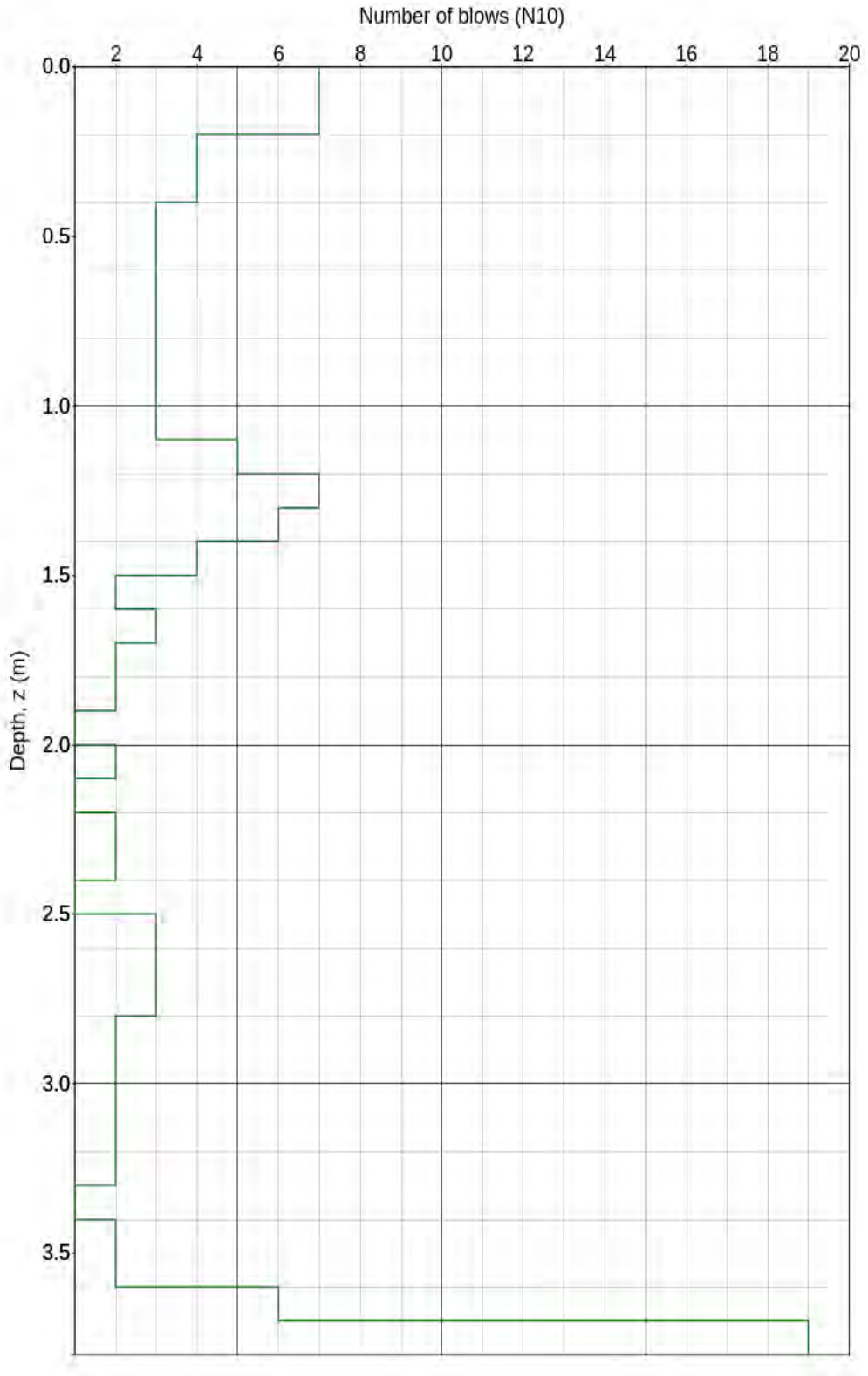
Test

Target depth :	20.0 m
Pre-drilling depth :	
Stop condition :	Voluntary
Reached depth :	3.87 m
Water table :	Not found
Stable level :	
Unstable level :	

Characteristics

Device type :	Grizzly
Hammering mode :	63.5 kg
Cone section :	20 cm²

GRIZZLY®



Observation

DPSH-01A

Sounding :	DPSH-01A
Site :	MEL2022-0033
Date :	12/01/2023 - 23:01
Company :	CMW Geosciences
User :	Sanjaya Perera
Supervisor :	Jayendra Puvendran
UTM area :	55H
UTM E,N :	380237 | 5765268
Altitude :	22.5 m
Tracking :	

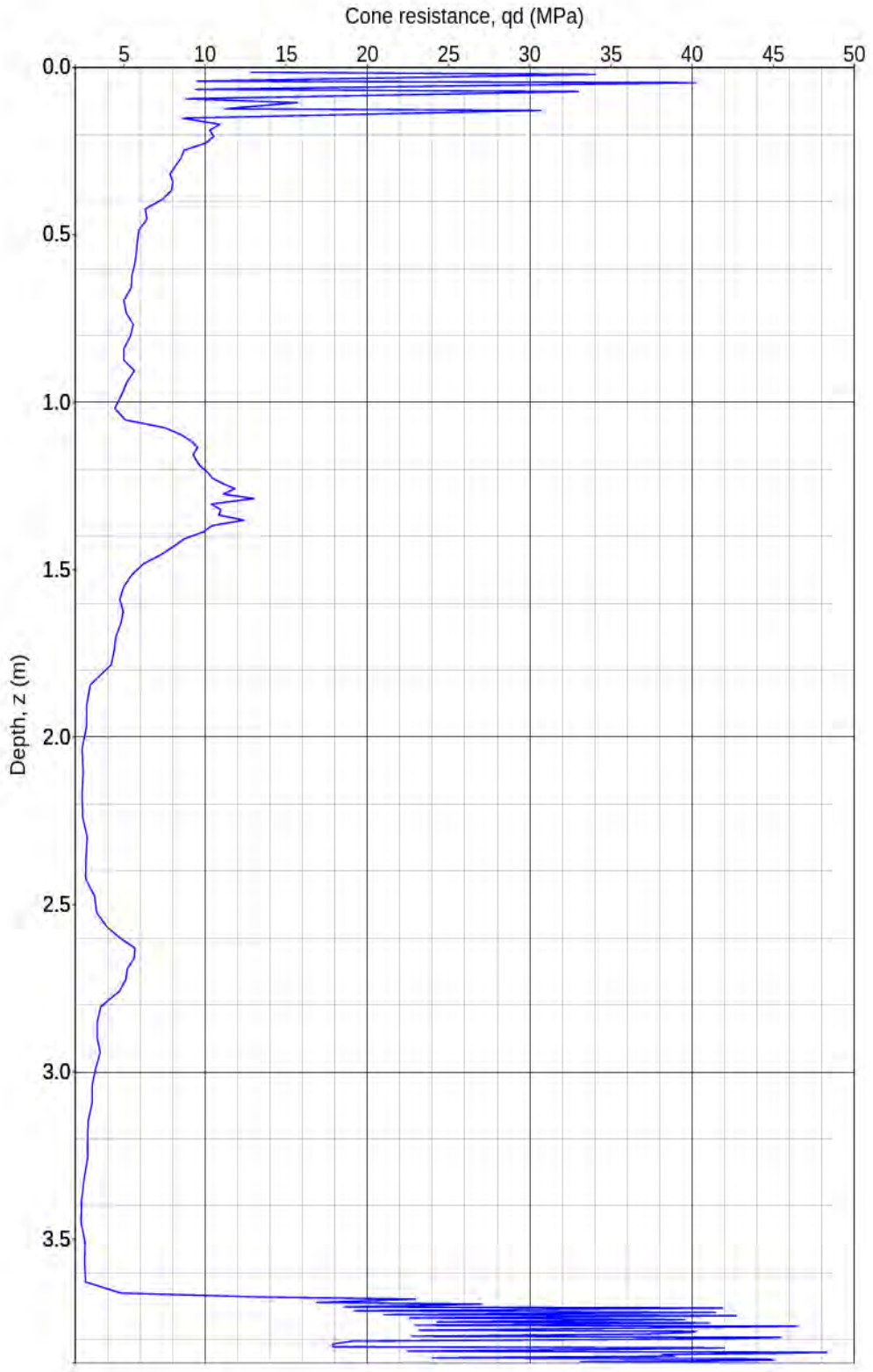
Test

Target depth :	20.0 m
Pre-drilling depth :	
Stop condition :	Voluntary
Reached depth :	3.87 m
Water table :	Not found
Stable level :	
Unstable level :	

Characteristics

Device type :	Grizzly
Hammering mode :	63.5 kg
Cone section :	20 cm²

GRIZZLY®



Observation

DPSH-01B

Sounding : DPSH-01B
Site : MEL2022-0033
Date : 13/01/2023 - 00:16
Company : CMW Geosciences
User : Sanjaya Perera
Supervisor : Jayendra Puvendran
UTM area : 55H
UTM E,N : 380377 | 5765326
Altitude : 27.9 m
Tracking :

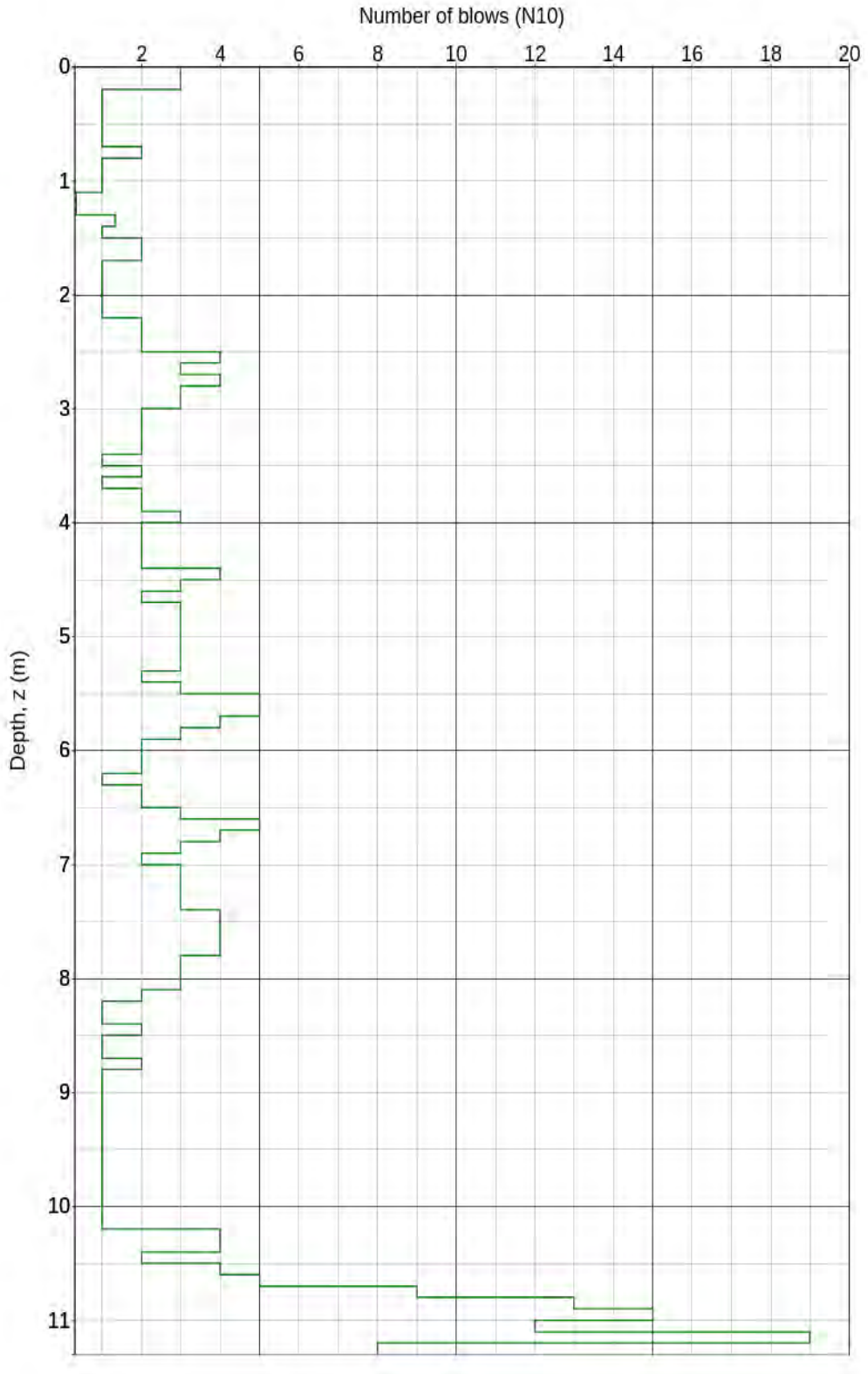
Test

Target depth : 20.0 m
Pre-drilling depth :
Stop condition : Voluntary
Reached depth : 11.33 m
Water table : Not found
Stable level :
Unstable level :

Characteristics

Device type : Grizzly
Hammering mode : 63.5 kg
Cone section : 20 cm²

GRIZZLY®



Observation

DPSH-01B

Sounding :	DPSH-01B
Site :	MEL2022-0033
Date :	13/01/2023 - 00:16
Company :	CMW Geosciences
User :	Sanjaya Perera
Supervisor :	Jayendra Puvendran
UTM area :	55H
UTM E,N :	380377 | 5765326
Altitude :	27.9 m
Tracking :	

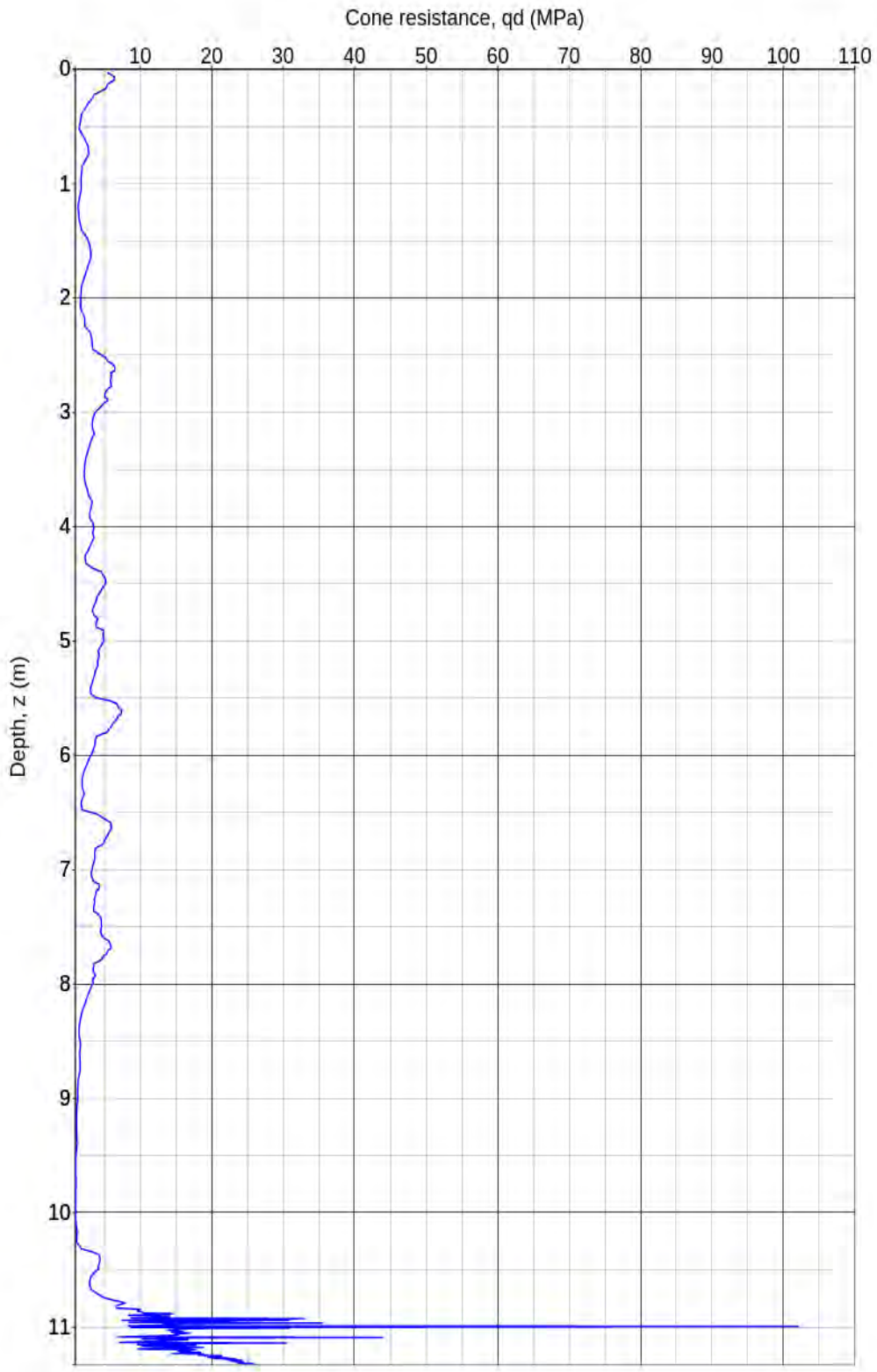
Test

Target depth :	20.0 m
Pre-drilling depth :	
Stop condition :	Voluntary
Reached depth :	11.33 m
Water table :	Not found
Stable level :	
Unstable level :	

Characteristics

Device type :	Grizzly
Hammering mode :	63.5 kg
Cone section :	20 cm²

GRIZZLY®



Observation

DPSH-01C

Sounding :	DPSH-01C
Site :	MEL2022-0033
Date :	13/01/2023 - 02:18
Company :	CMW Geosciences
User :	Sanjaya Perera
Supervisor :	Jayendra Puvendran
UTM area :	55H
UTM E,N :	380445 | 5765319
Altitude :	28.1 m
Tracking :	

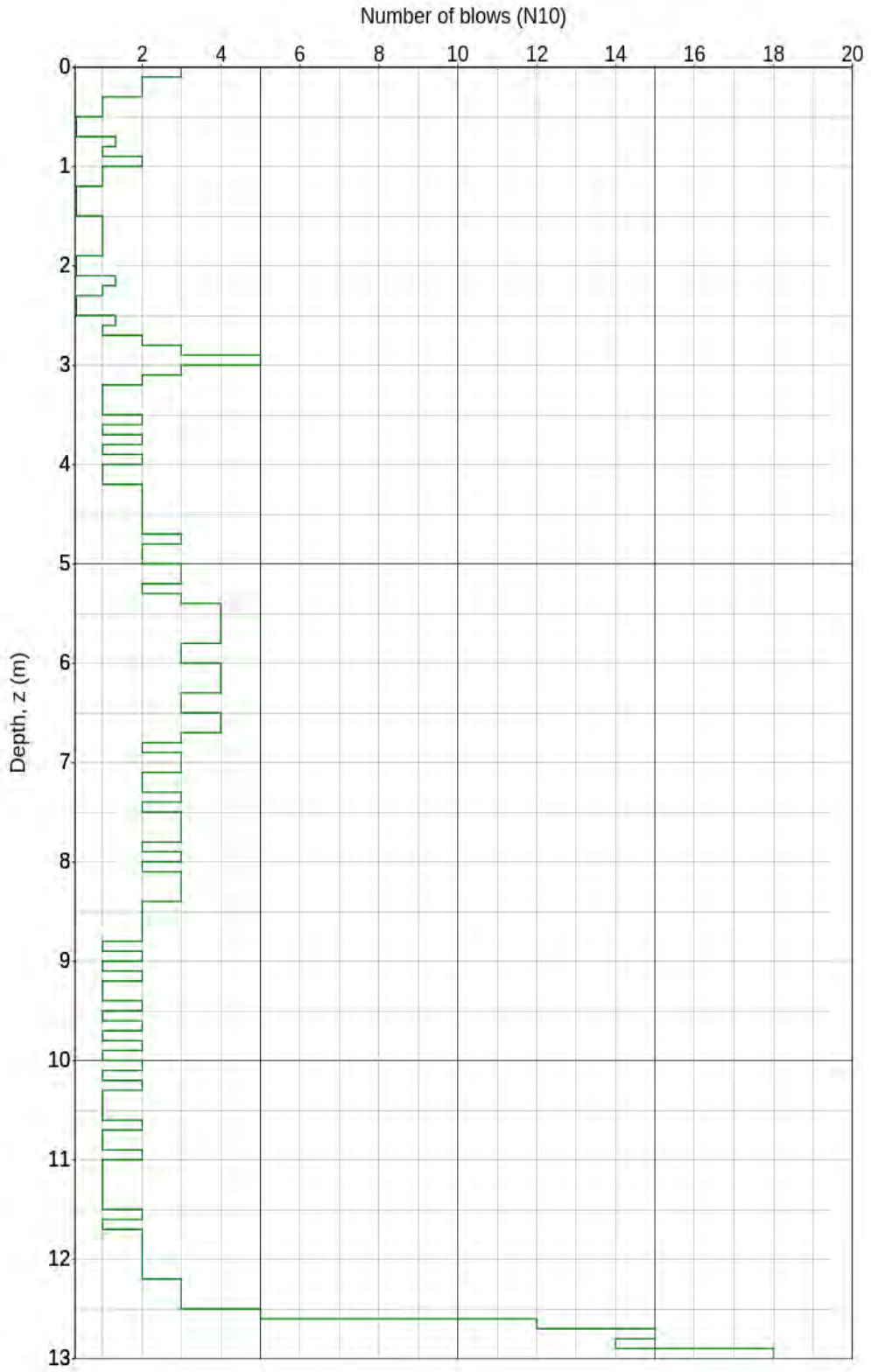
Test

Target depth :	20.0 m
Pre-drilling depth :	
Stop condition :	Voluntary
Reached depth :	13.07 m
Water table :	Not found
Stable level :	
Unstable level :	

Characteristics

Device type :	Grizzly
Hammering mode :	63.5 kg
Cone section :	20 cm²

GRIZZLY®



Observation

DPSH-01C

Sounding : DPSH-01C
Site : MEL2022-0033
Date : 13/01/2023 - 02:18
Company : CMW Geosciences
User : Sanjaya Perera
Supervisor : Jayendra Puvendran
UTM area : 55H
UTM E,N : 380445 | 5765319
Altitude : 28.1 m
Tracking :

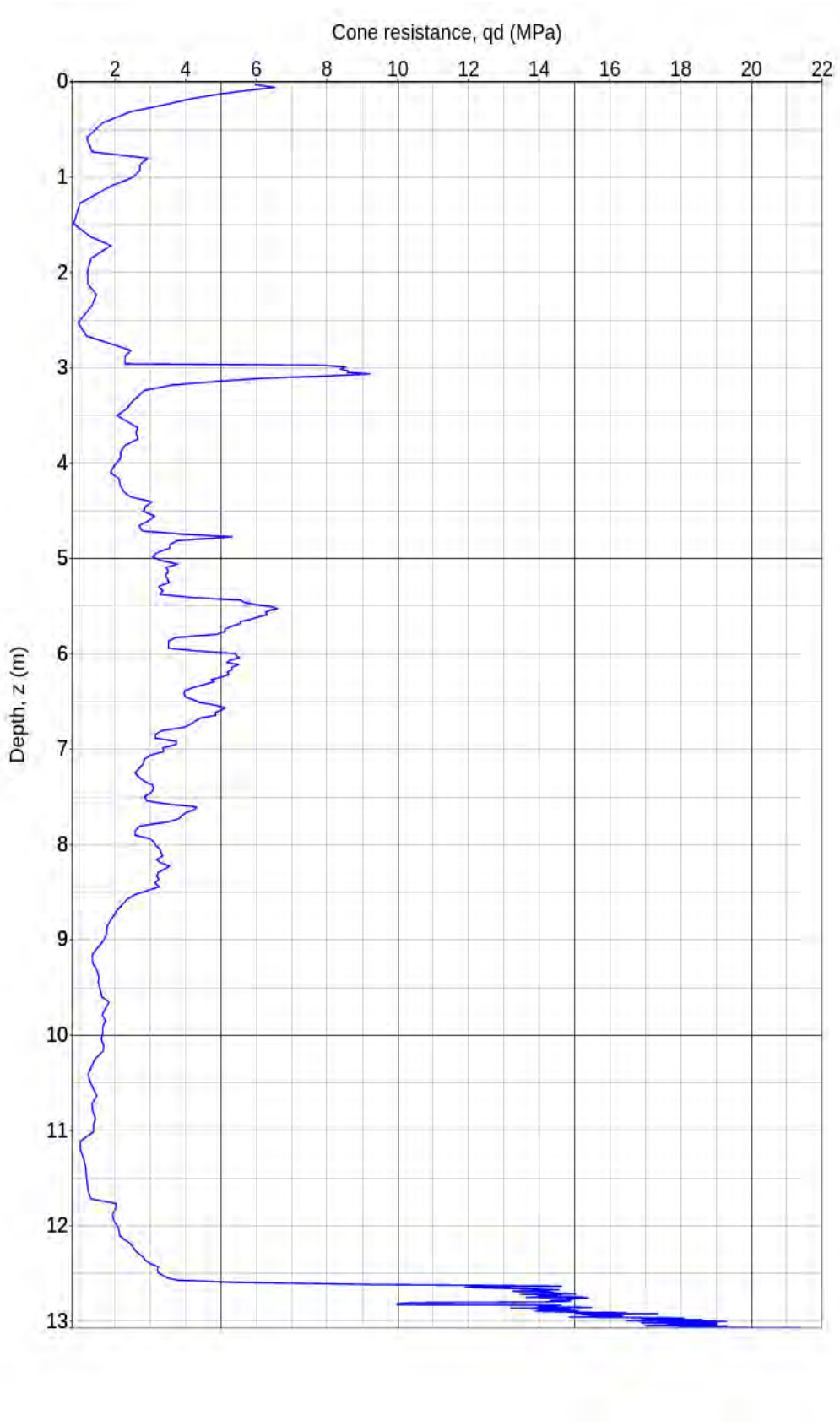
Test

Target depth : 20.0 m
Pre-drilling depth :
Stop condition : Voluntary
Reached depth : 13.07 m
Water table : Not found
Stable level :
Unstable level :

Characteristics

Device type : Grizzly
Hammering mode : 63.5 kg
Cone section : 20 cm²

GRIZZLY®



Observation

Appendix B5: DCP Results

DCP Test Results									
Hammer Weight: 9 kg					**Hammer Drop Height**: 510 mm				
Depth (m)	**DCP1A**	**DCP1B**	**DCP1C**	**DCP3A**	**DCP3B**	**DCP3C**	**DCP3D**	**DCP3E**	**DCP3F**
0.00 – 0.10	8	9	9	10	23	6	7	8	18
0.10 - 0.20	4	3	3	4	14HB	6HB	24	17HB	12
0.20 – 0.30	1	1	2	3	-	-	12	-	14
0.30 – 0.40	2	2	2	3	-	-	12	-	19HB
0.40 – 0.50	2	2	1	2	-	-	15HB	-	-
0.50 – 0.60	2	3	2	2	-	-	-	-	-
0.60 – 0.70	1	1	2	2	-	-	-	-	-
0.70 – 0.80	4	2	1	3	-	-	-	-	-
0.80 – 0.90	1	1	3	10	-	-	-	-	-
0.90 – 1.00	2	4	2	5	-	-	-	-	-
1.00 – 1.10	7	3	2	5	-	-	-	-	-
1.10 – 1.20	4	4	3	5	-	-	-	-	-
1.20 – 1.30	3	3	2	5	-	-	-	-	-
1.30 – 1.40	2	2	2	4	-	-	-	-	-
1.40 – 1.50	4	4	2	4	-	-	-	-	-
1.50 – 1.60	5	5	2	6	-	-	-	-	-
1.60 – 1.70	4	6	3	5	-	-	-	-	-

1.70 – 1.80	10	10	2	5	-	-	-	-	
1.80 – 1.90	3	14	3	6	-	-	-	-	-
1.90 – 2.00	3	11	2	8	-	-	-	-	-
2.00 – 2.10	5	8	9	6	-	-	-	-	-
2.10 – 2.20	3	3	4	7	-	-	-	-	-
2.20 – 2.30	3	3	6	5	-	-	-	-	-
2.30 – 2.40	5	4	9	6	-	-	-	-	--
2.40 – 2.50	4	5	8	7	-	-	-	-	-
2.50 – 2.60	6	7	15	11	-	-	-	-	-
2.60 – 2.70	12	14	13	10	-	-	-	-	-
2.70 – 2.80	10	9	12	11	-	-	-	-	-
2.80 – 2.90	6	7	11	9	-	-	-	-	-
2.90 – 3.00	7	8	11	7	-	-	-	-	-
3.00 – 3.10	7	16	17	8	-	-	-	-	-
3.10 – 3.20	10	19	22	11	-	-	-	-	-
3.20 – 3.30	14	15	19	12	-	-	-	-	-
Note: DCP = Dynamic Cone Penetration. HB = Hammer Bounce refusal. Results recorded in blows per 100mm									

Summary of slope stability analyses (Appendix C1)					
Page	**Case**	**Location**	**Conditions**	**Seismic**	**Minimum FoS**
C1-2	1	NW	Excavation to +9m RL at 1:2.5 Prior to buttress emplacement Drained clay material properties	No	1.721
C1-3	2	NC	As above	No	1.693
C1-4	3	NE1	As above	No	1.746
C1-5	4	NE2	As above	No	1.704
C1-6	5	NW	Excavation to +9m RL at 1:2.5 Prior to buttress emplacement Undrained clay material properties for clay buttress	Yes	1.543
C1-7	6	NC	As above	Yes	1.470
C1-8	7	NE1	As above	Yes	1.495
C1-9	8	NE2	As above	Yes	1.459
C1-10	9	NW	Excavation to +9m RL at 1:2.5 Buttress emplaced Drained clay material properties	No	1.972
C1-11	10	NC	As above	No	1.973
C1-12	11	NE1	As above	No	1.973
C1-13	12	NE2	As above	No	1.975
C1-14	13	NW	Excavation to +9m RL at 1:2.5 Buttress emplaced Undrained clay material properties for clay buttress	Yes	2.107
C1-15	14	NC	As above	Yes	2.166
C1-16	15	NE1	As above	Yes	2.143
C1-17	16	NE2	As above	Yes	2.109
C1-18	17	NW	Dredged excavation to -9m RL at 1:2 Buttress emplaced Drained clay material properties	No	1.608
C1-19	18	NC	As above	No	1.572
C1-20	19	NE1	As above	No	1.628
C1-21	20	NE2	As above	No	1.625
C1-22	21	NW	Dredged excavation to -9m RL at 1:2 Buttress emplaced Undrained clay material properties for clay buttress	Yes	1.423
C1-23	22	NC	As above	Yes	1.207
C1-24	23	NE1	As above	Yes	1.211
C1-25	24	NE2	As above	Yes	1.437
C1-26	25	NW	As above with water at rehabilitation level	No	1.791
C1-27	26	NC	As above	No	1.572
C1-28	27	NE1	As above	No	1.577
C1-29	28	NE2	As above	No	1.833

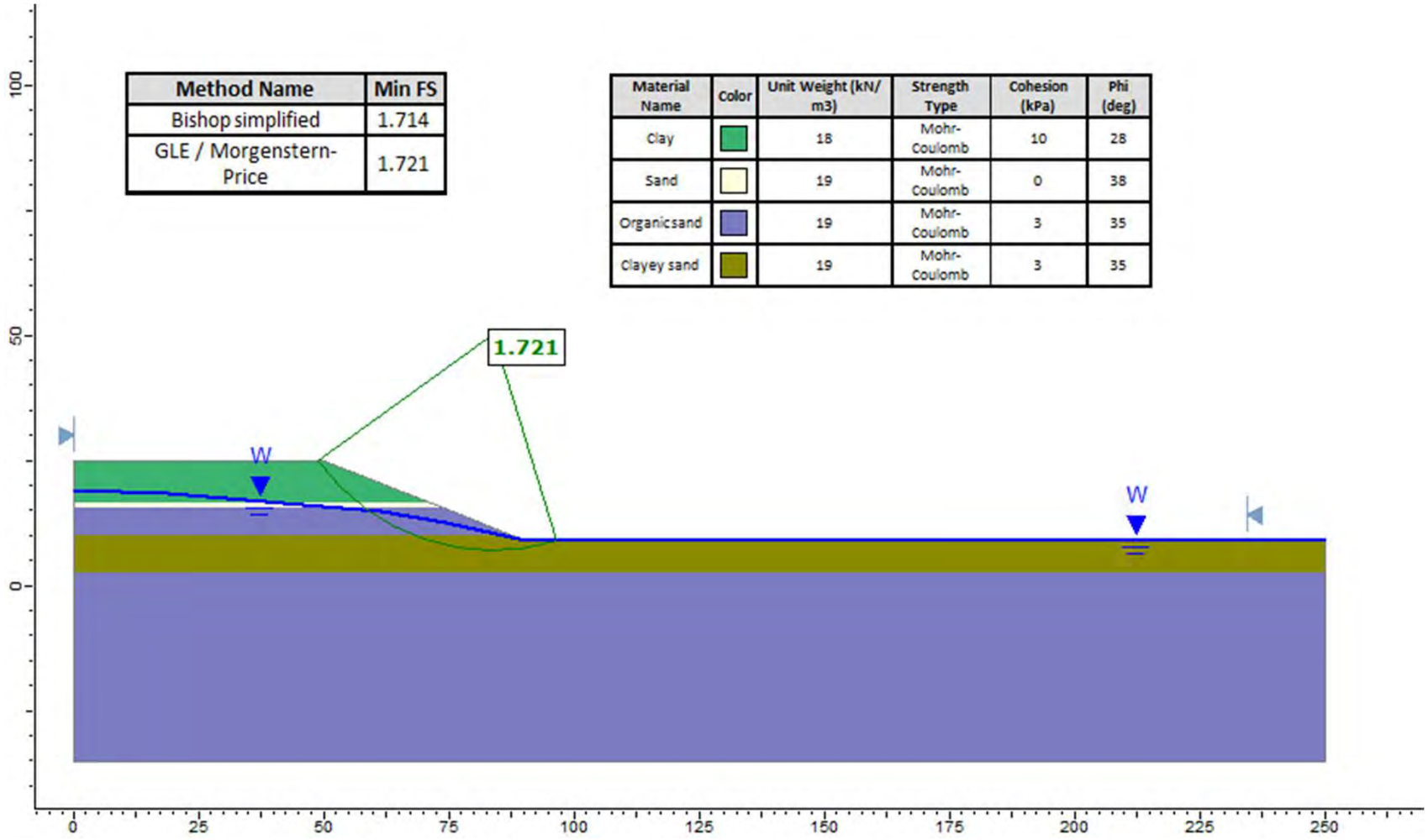
CMW Geosciences

DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1- 1
REVISION: 2	SCALE: as shown (metres)
DATE: 27 / 11 / 2023	SHEET: 1 of 1

Case 1
Location: Northwest
Excavation to +9m RL at 1:2.5
Prior to buttress emplacement
Drained clay material properties

Method Name	Min FS
Bishop simplified	1.714
GLE / Morgenstern-Price	1.721

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay		18	Mohr-Coulomb	10	28
Sand		19	Mohr-Coulomb	0	38
Organicsand		19	Mohr-Coulomb	3	35
Clayey sand		19	Mohr-Coulomb	3	35



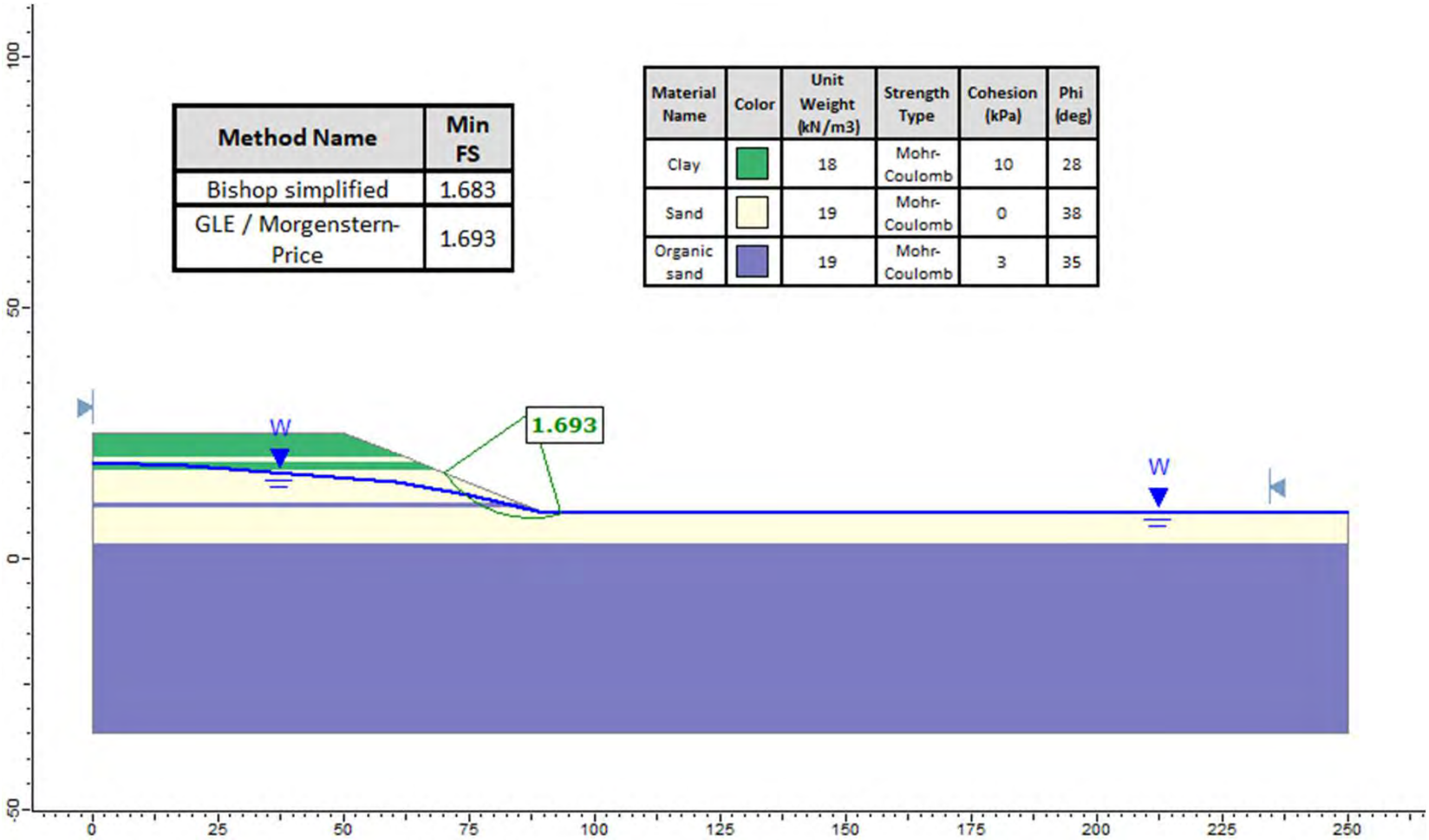
CMW Geosciences

DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1- 2
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

Case 2
Location: North central
Excavation to +9m RL at 1:2.5
Prior to buttress emplacement
Drained clay material properties

Method Name	Min FS
Bishop simplified	1.683
GLE / Morgenstern-Price	1.693

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay		18	Mohr-Coulomb	10	28
Sand		19	Mohr-Coulomb	0	38
Organic sand		19	Mohr-Coulomb	3	35



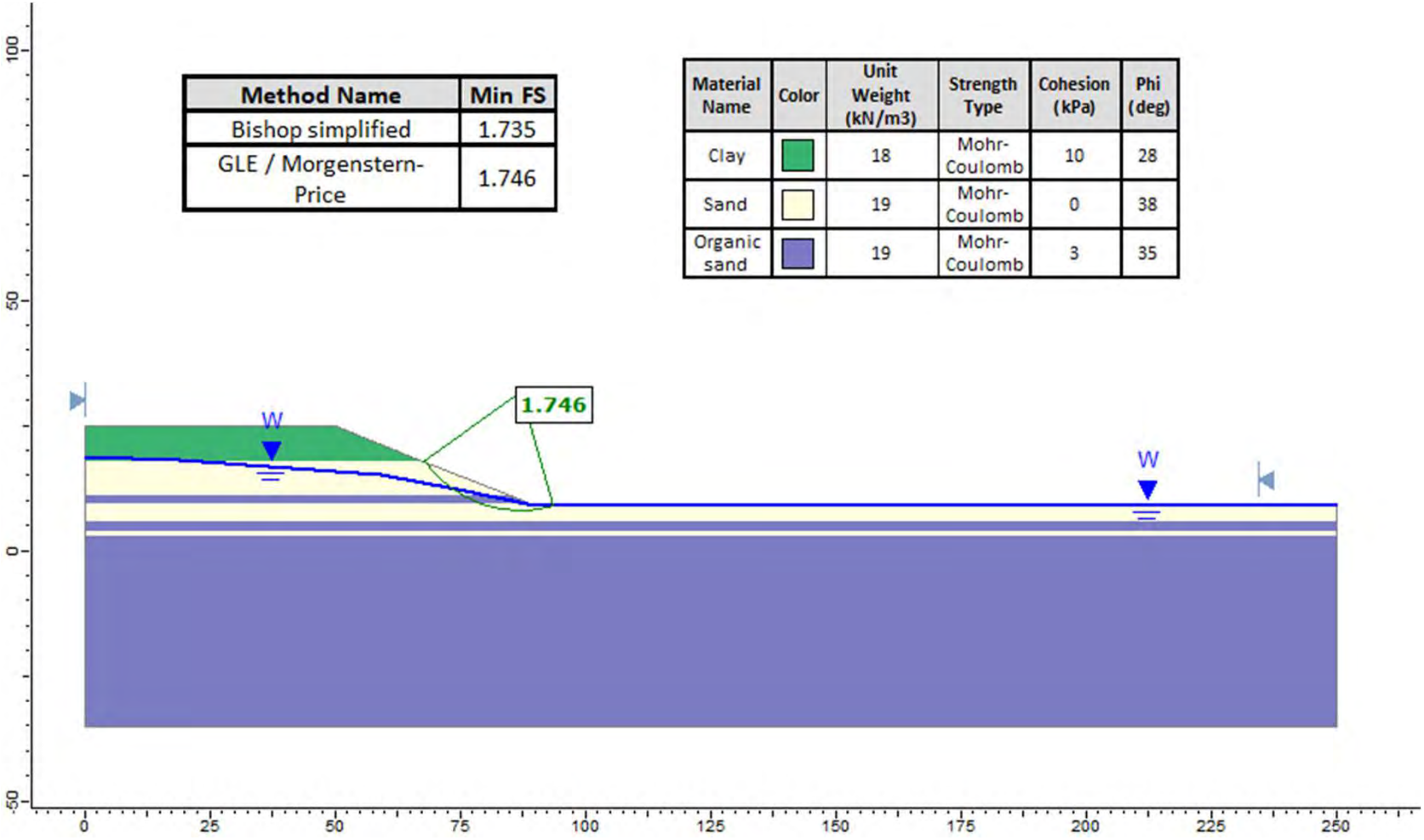
DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1- 3
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

CMW Geosciences

Case 3
Location: Northeast 1
Excavation to +9m RL at 1:2.5
Prior to buttress emplacement
Drained clay material properties

Method Name	Min FS
Bishop simplified	1.735
GLE / Morgenstern-Price	1.746

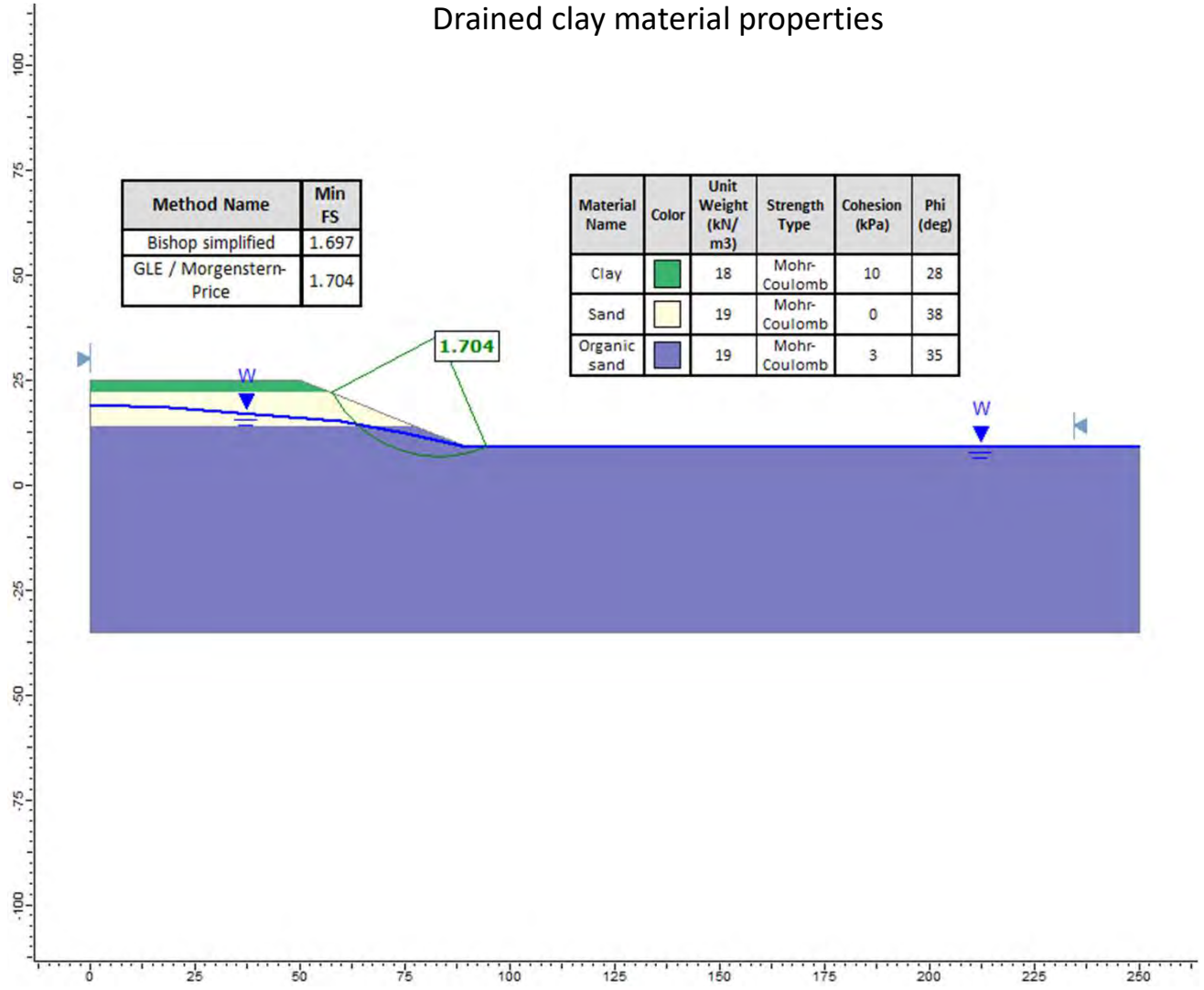
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay		18	Mohr-Coulomb	10	28
Sand		19	Mohr-Coulomb	0	38
Organic sand		19	Mohr-Coulomb	3	35



CMW Geosciences

DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1- 4
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

Case 4
Location: Northeast 2
Excavation to +9m RL at 1:2.5
Prior to buttress emplacement
Drained clay material properties



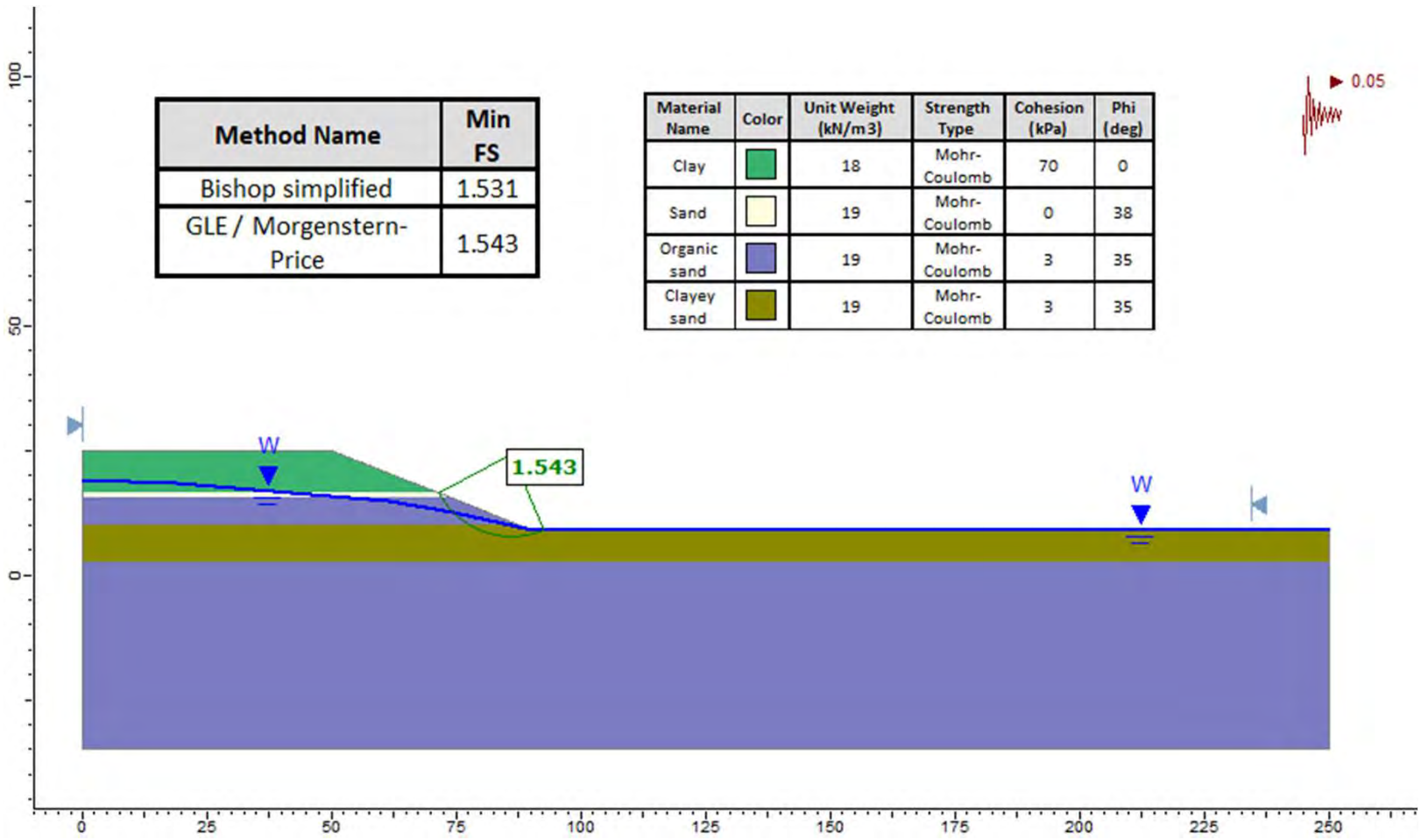
DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1- 5
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

CMW Geosciences

Case 5
Location: Northwest
Excavation to +9m RL at 1:2.5
Prior to buttress emplacement
Undrained clay material properties

Method Name	Min FS
Bishop simplified	1.531
GLE / Morgenstern-Price	1.543

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay		18	Mohr-Coulomb	70	0
Sand		19	Mohr-Coulomb	0	38
Organic sand		19	Mohr-Coulomb	3	35
Clayey sand		19	Mohr-Coulomb	3	35



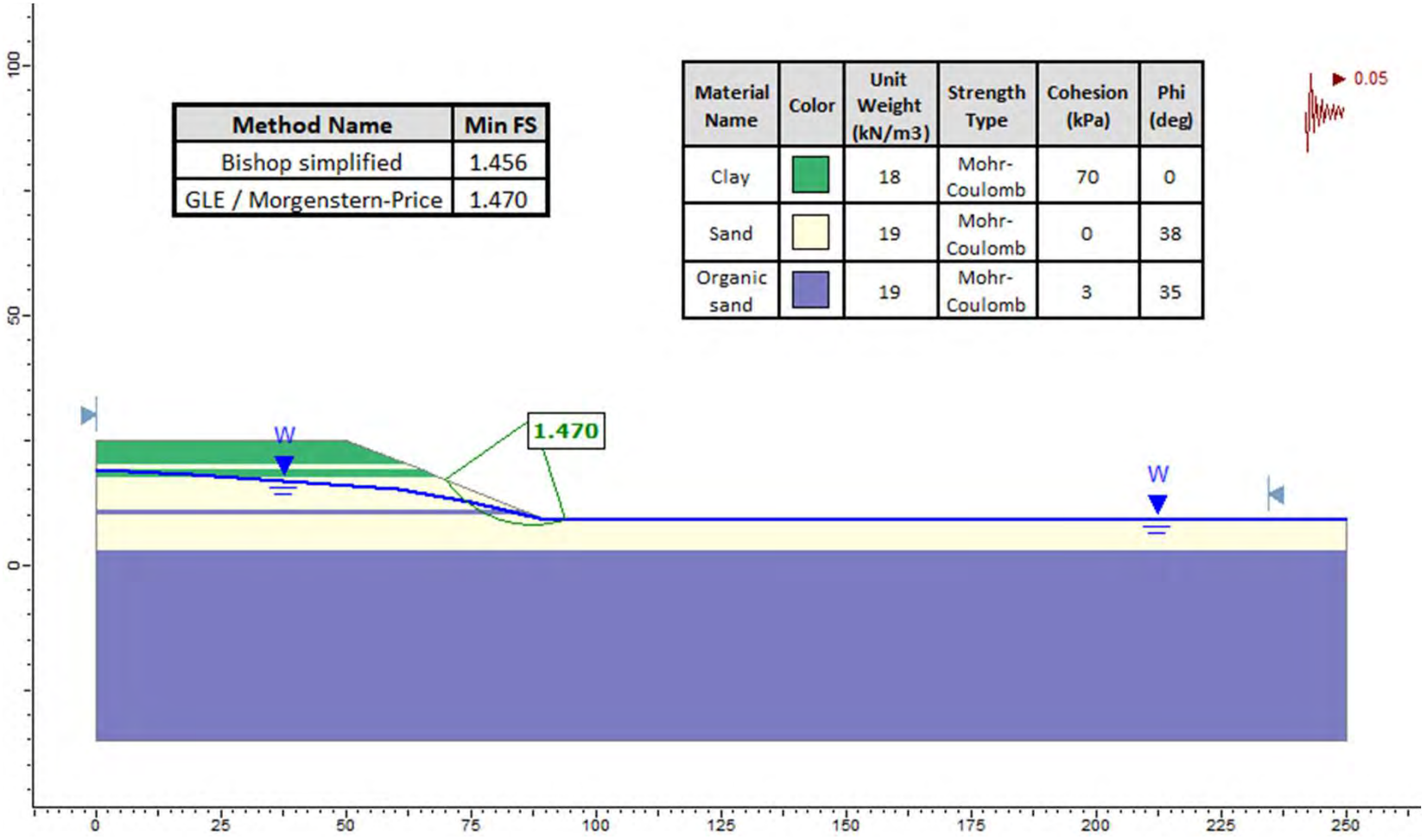
DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1- 6
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

CMW Geosciences

Case 6
Location: North central
Excavation to +9m RL at 1:2.5
Prior to buttress emplacement
Undrained clay material properties

Method Name	Min FS
Bishop simplified	1.456
GLE / Morgenstern-Price	1.470

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay		18	Mohr-Coulomb	70	0
Sand		19	Mohr-Coulomb	0	38
Organic sand		19	Mohr-Coulomb	3	35



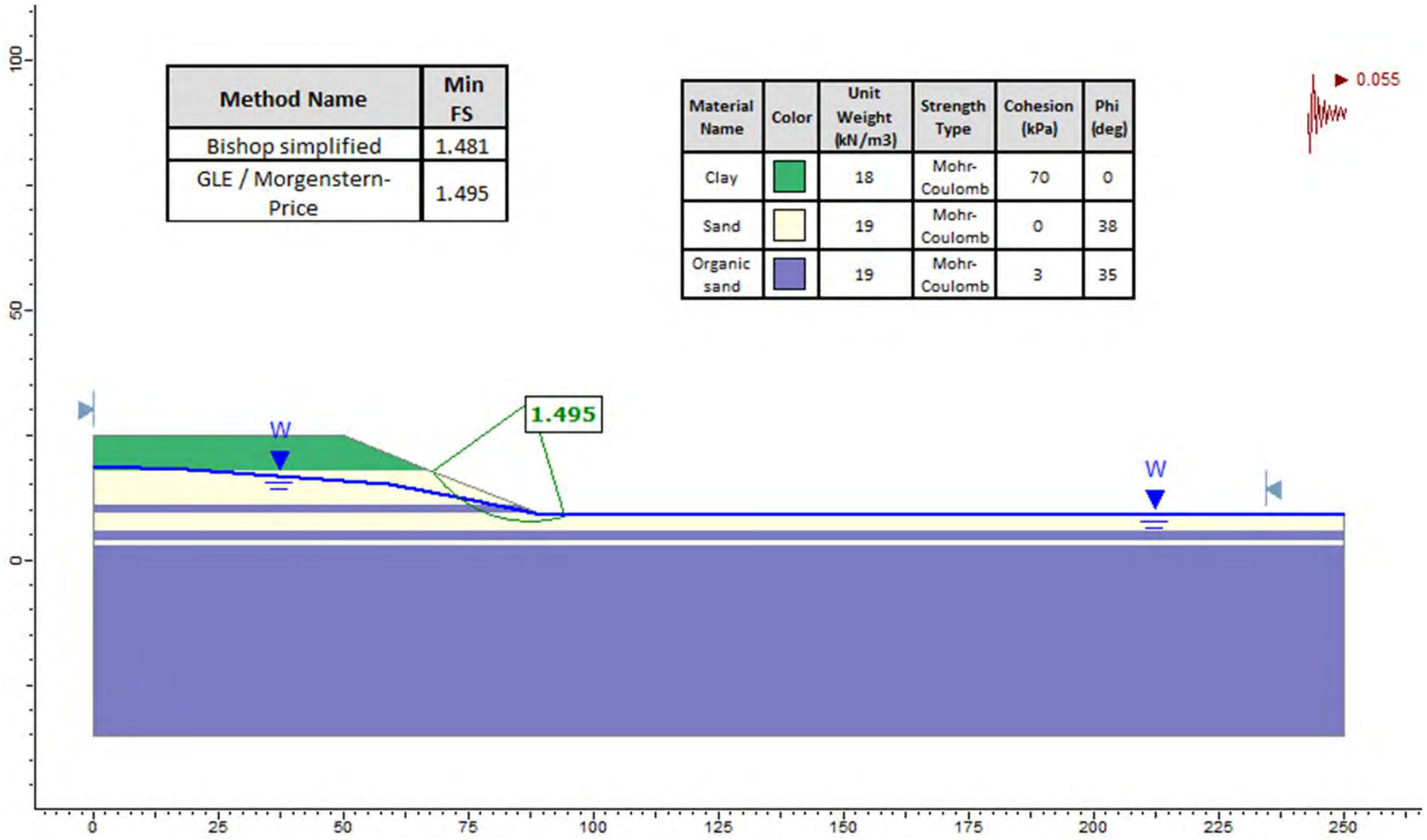
CMW Geosciences

DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1- 7
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

Case 7
Location: Northeast 1
Excavation to +9m RL at 1:2.5
Prior to buttress emplacement
Undrained clay material properties

Method Name	Min FS
Bishop simplified	1.481
GLE / Morgenstern-Price	1.495

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay		18	Mohr-Coulomb	70	0
Sand		19	Mohr-Coulomb	0	38
Organic sand		19	Mohr-Coulomb	3	35



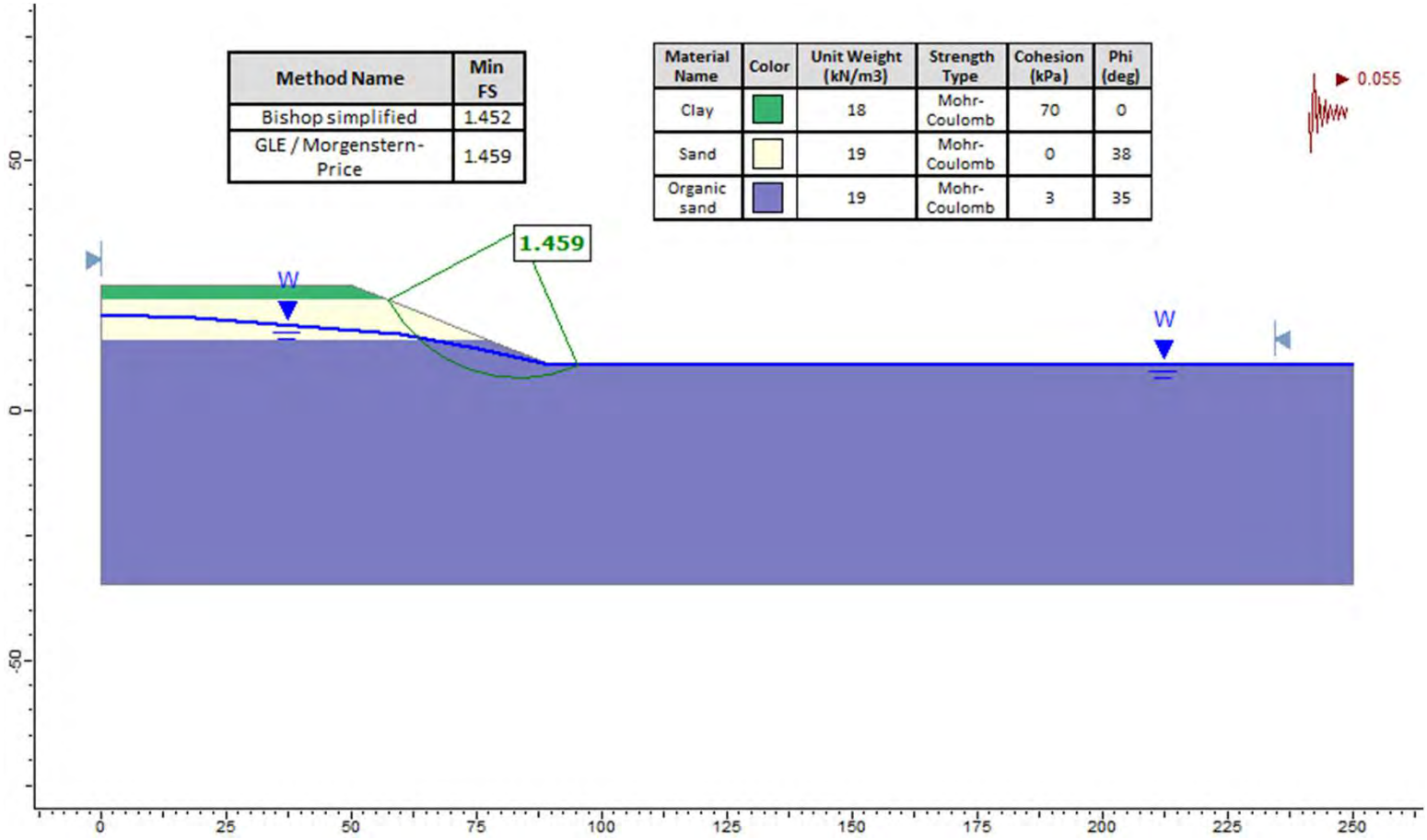
DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1- 8
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

CMW Geosciences

Case 8
Location: Northeast 2
Excavation to +9m RL at 1:2.5
Prior to buttress emplacement
Undrained clay material properties

Method Name	Min FS
Bishop simplified	1.452
GLE / Morgenstern-Price	1.459

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay		18	Mohr-Coulomb	70	0
Sand		19	Mohr-Coulomb	0	38
Organic sand		19	Mohr-Coulomb	3	35



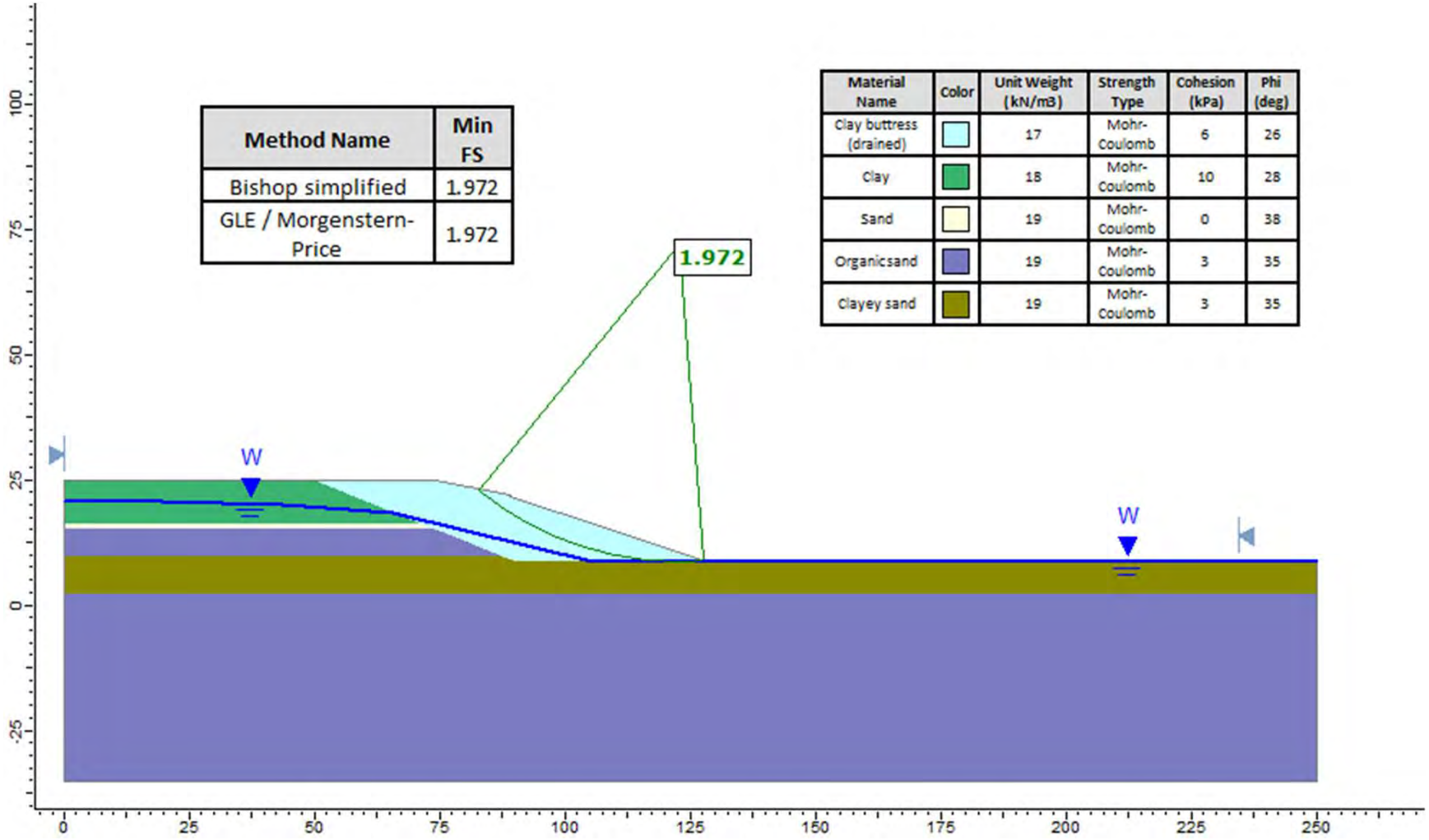
CMW Geosciences

DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1- 9
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

Case 9
Location: Northwest
Excavation to +9m RL at 1:2.5
Buttress emplaced
Drained clay material properties

Method Name	Min FS
Bishop simplified	1.972
GLE / Morgenstern-Price	1.972

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay buttress (drained)		17	Mohr-Coulomb	6	26
Clay		18	Mohr-Coulomb	10	28
Sand		19	Mohr-Coulomb	0	38
Organicsand		19	Mohr-Coulomb	3	35
Clayey sand		19	Mohr-Coulomb	3	35



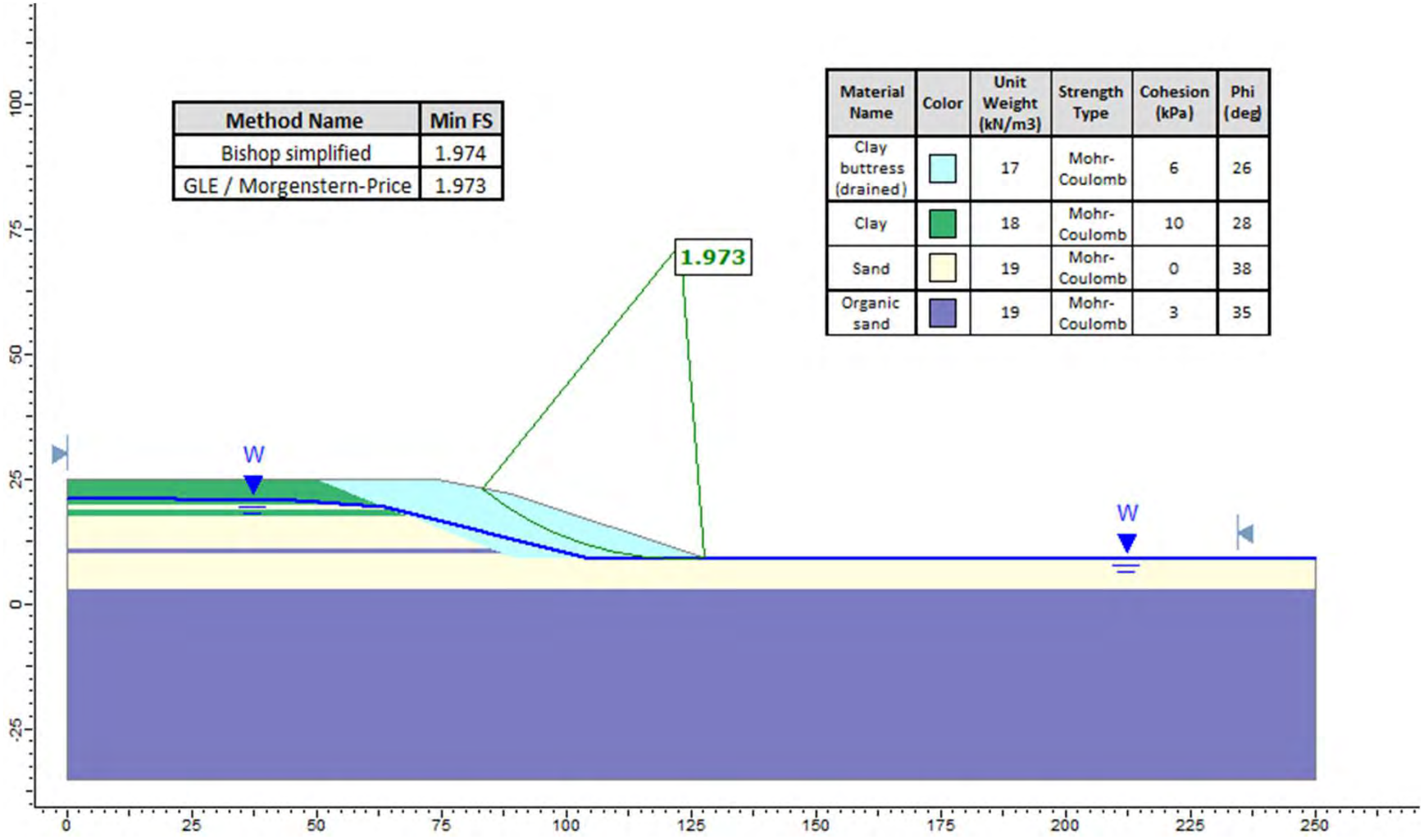
CMW Geosciences

DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1-10
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

Case 10
Location: North central
Excavation to +9m RL at 1:2.5
Buttress emplaced
Drained clay material properties

Method Name	Min FS
Bishop simplified	1.974
GLE / Morgenstern-Price	1.973

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay buttress (drained)		17	Mohr-Coulomb	6	26
Clay		18	Mohr-Coulomb	10	28
Sand		19	Mohr-Coulomb	0	38
Organic sand		19	Mohr-Coulomb	3	35



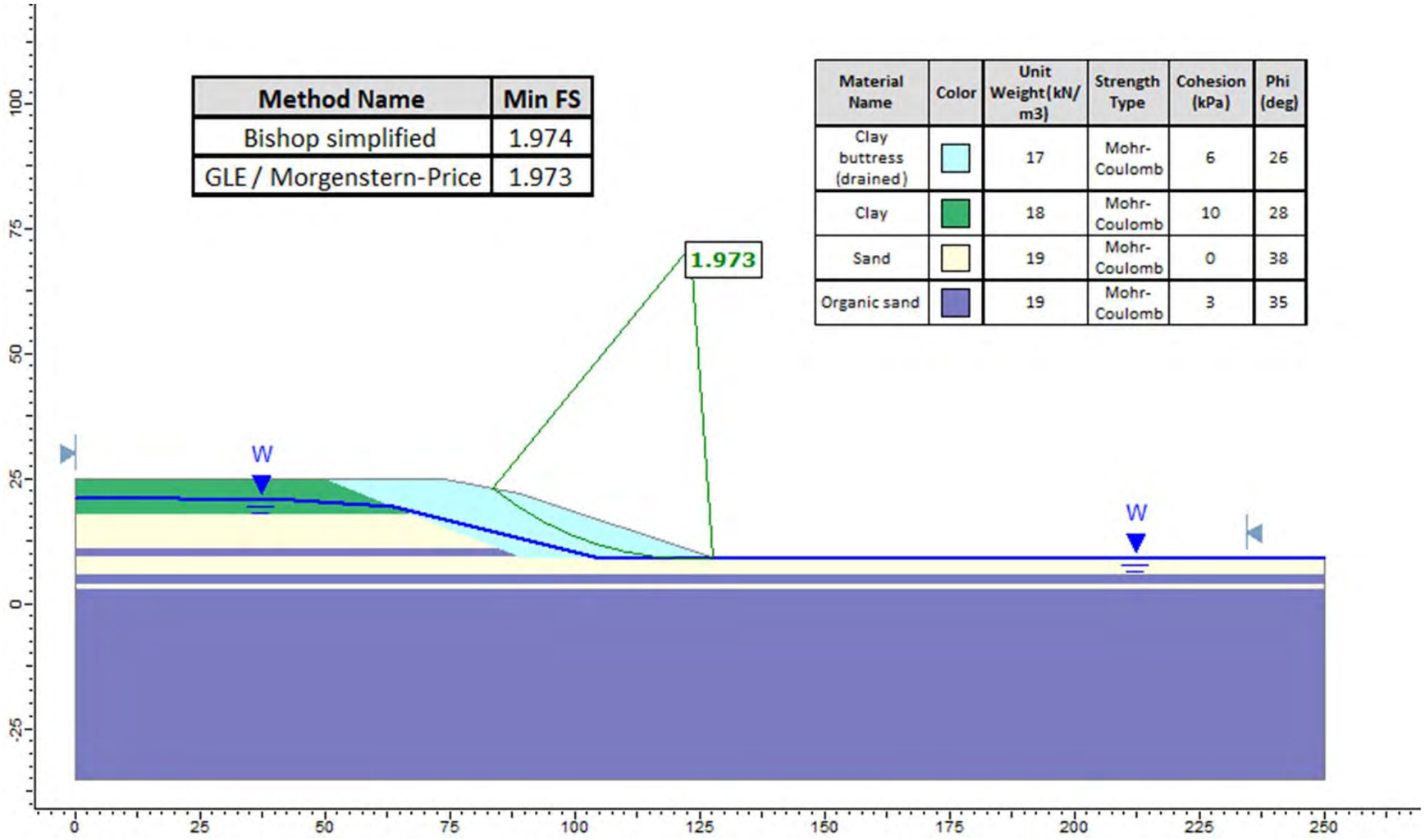
CMW Geosciences

DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1-11
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

Case 11
Location: Northeast1
Excavation to +9m RL at 1:2.5
Buttress emplaced
Drained clay material properties

Method Name	Min FS
Bishop simplified	1.974
GLE / Morgenstern-Price	1.973

Material Name	Color	Unit Weight(kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay buttress (drained)		17	Mohr-Coulomb	6	26
Clay		18	Mohr-Coulomb	10	28
Sand		19	Mohr-Coulomb	0	38
Organic sand		19	Mohr-Coulomb	3	35



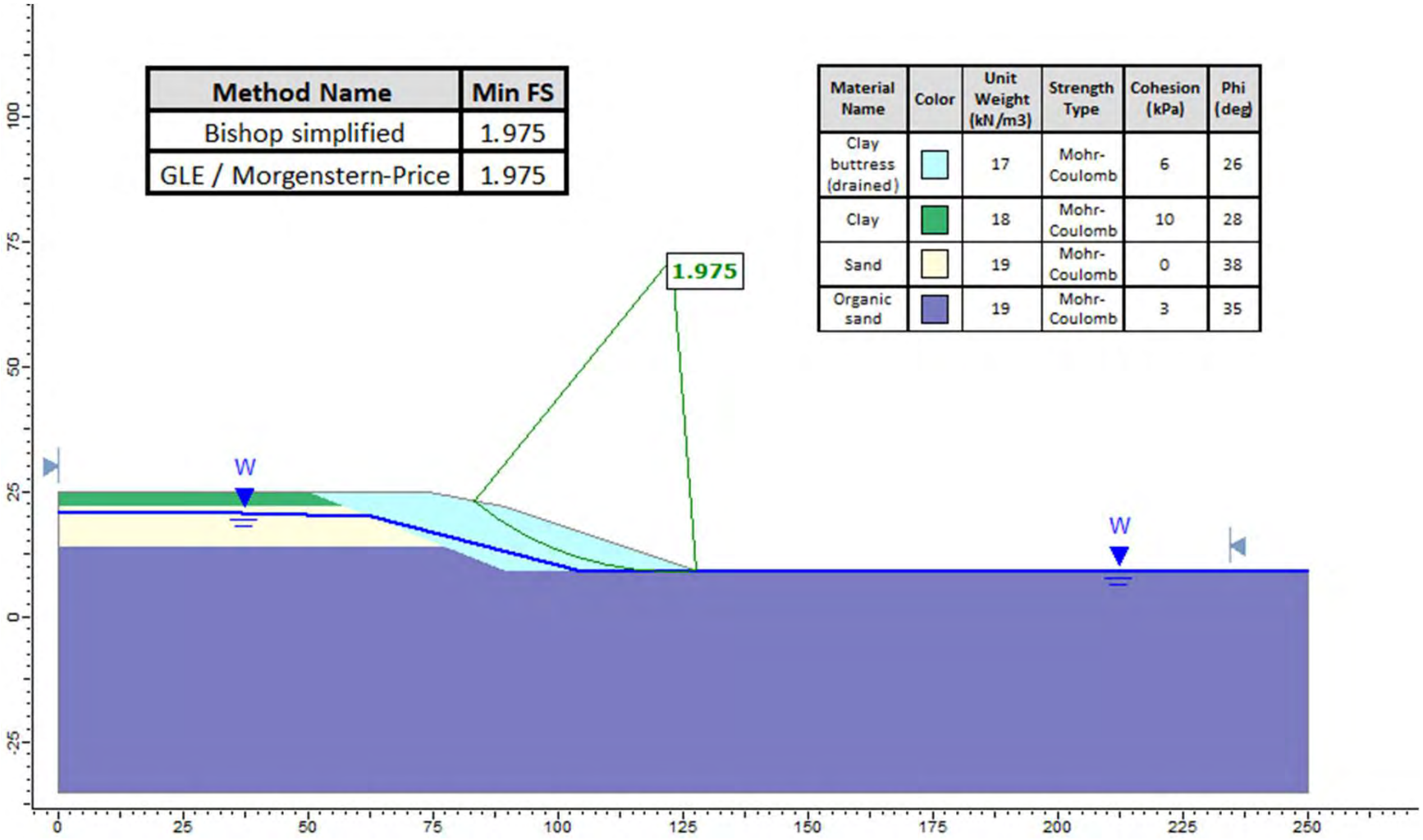
CMW Geosciences

DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1-12
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

Case 12
Location: Northeast2
Excavation to +9m RL at 1:2.5
Buttress emplaced
Drained clay material properties

Method Name	Min FS
Bishop simplified	1.975
GLE / Morgenstern-Price	1.975

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay buttress (drained)		17	Mohr-Coulomb	6	26
Clay		18	Mohr-Coulomb	10	28
Sand		19	Mohr-Coulomb	0	38
Organic sand		19	Mohr-Coulomb	3	35



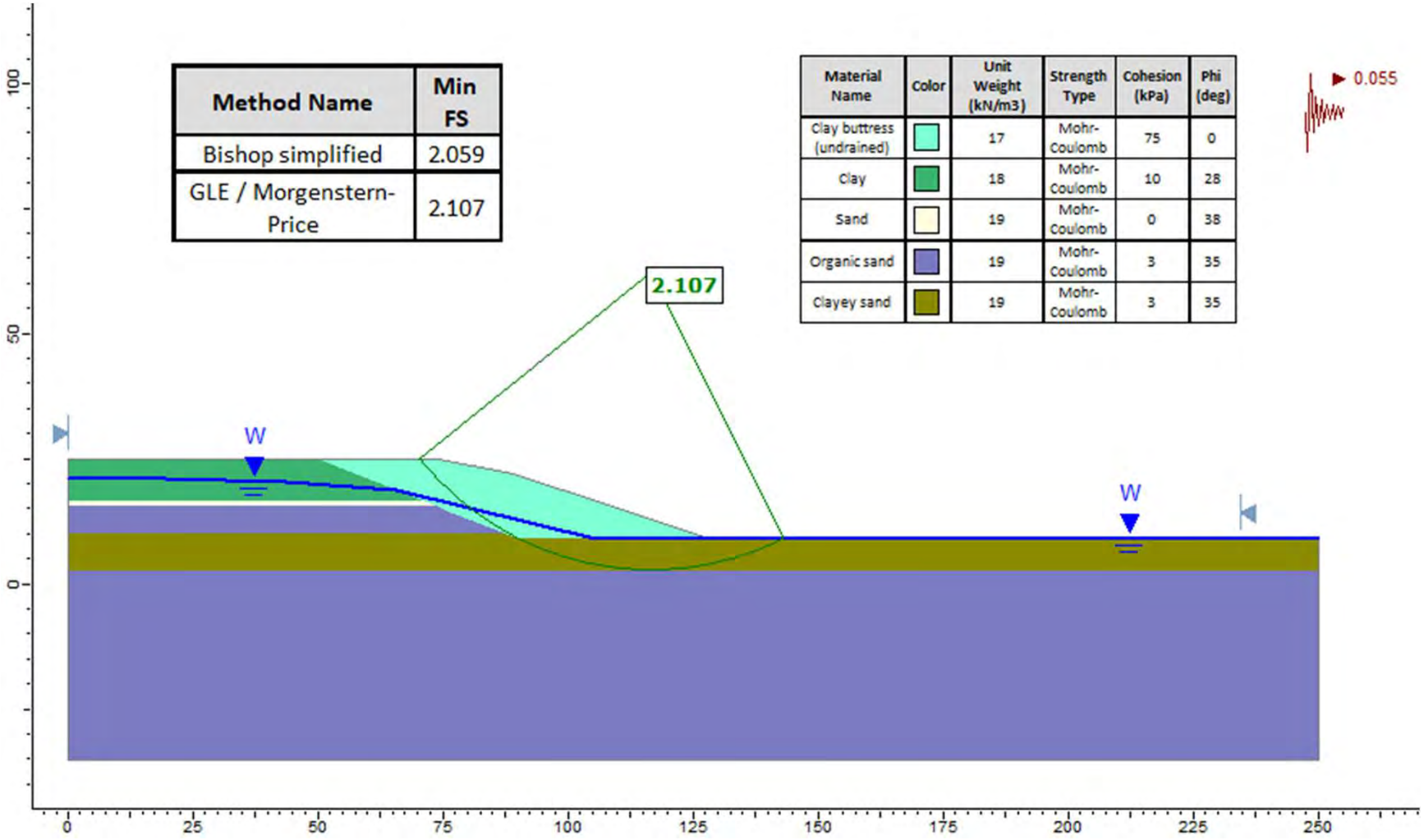
CMW Geosciences

DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1-13
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

Case 13
Location: Northwest
Excavation to +9m RL at 1:2.5
Buttress emplaced
Undrained clay material properties for clay buttress

Method Name	Min FS
Bishop simplified	2.059
GLE / Morgenstern-Price	2.107

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay buttress (undrained)		17	Mohr-Coulomb	75	0
Clay		18	Mohr-Coulomb	10	28
Sand		19	Mohr-Coulomb	0	38
Organic sand		19	Mohr-Coulomb	3	35
Clayey sand		19	Mohr-Coulomb	3	35

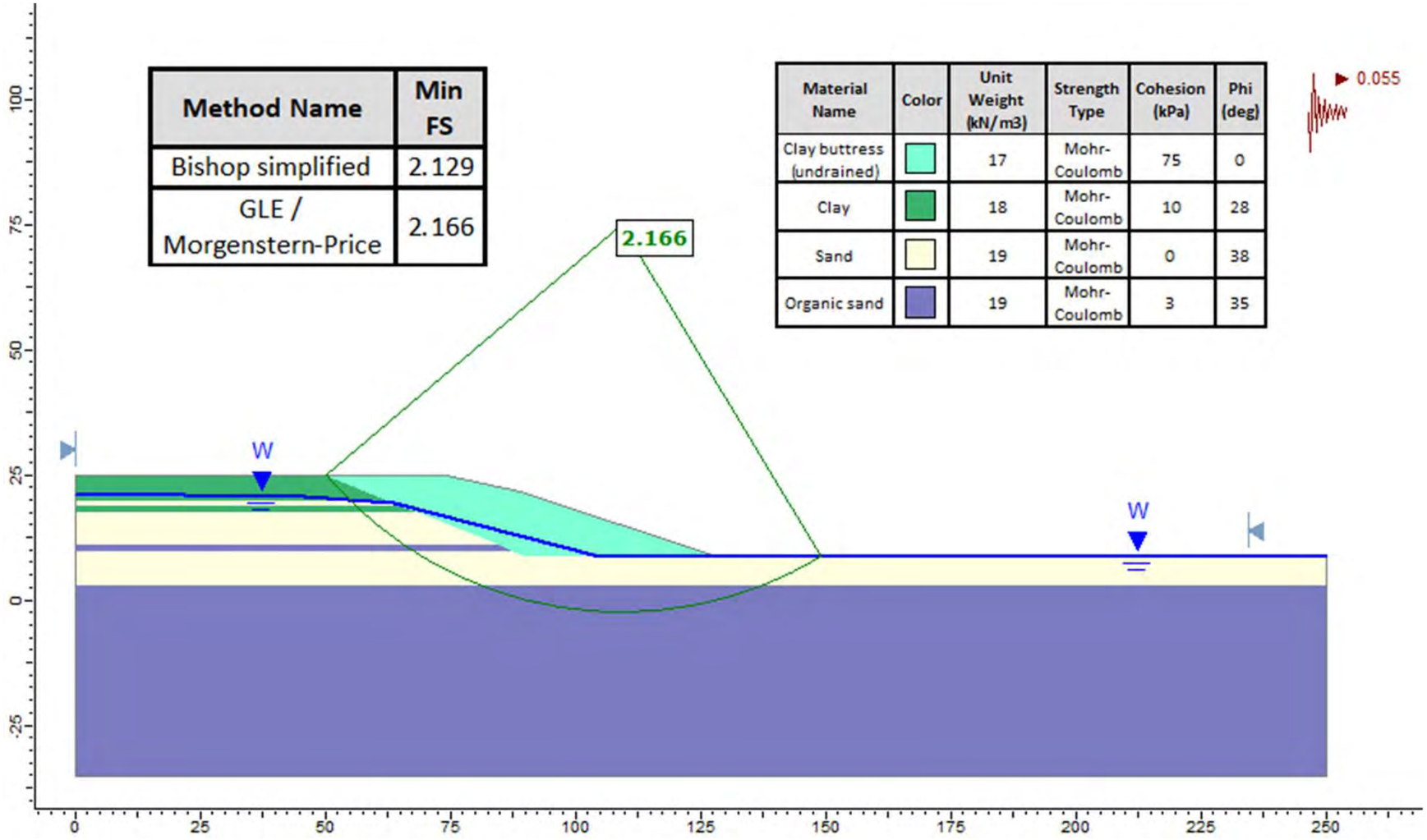


DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1-14
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

Case 14
Location: North central
Excavation to +9m RL at 1:2.5
Buttress emplaced
Undrained clay material properties for clay buttress

Method Name	Min FS
Bishop simplified	2.129
GLE / Morgenstern-Price	2.166

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay buttress (undrained)		17	Mohr-Coulomb	75	0
Clay		18	Mohr-Coulomb	10	28
Sand		19	Mohr-Coulomb	0	38
Organic sand		19	Mohr-Coulomb	3	35



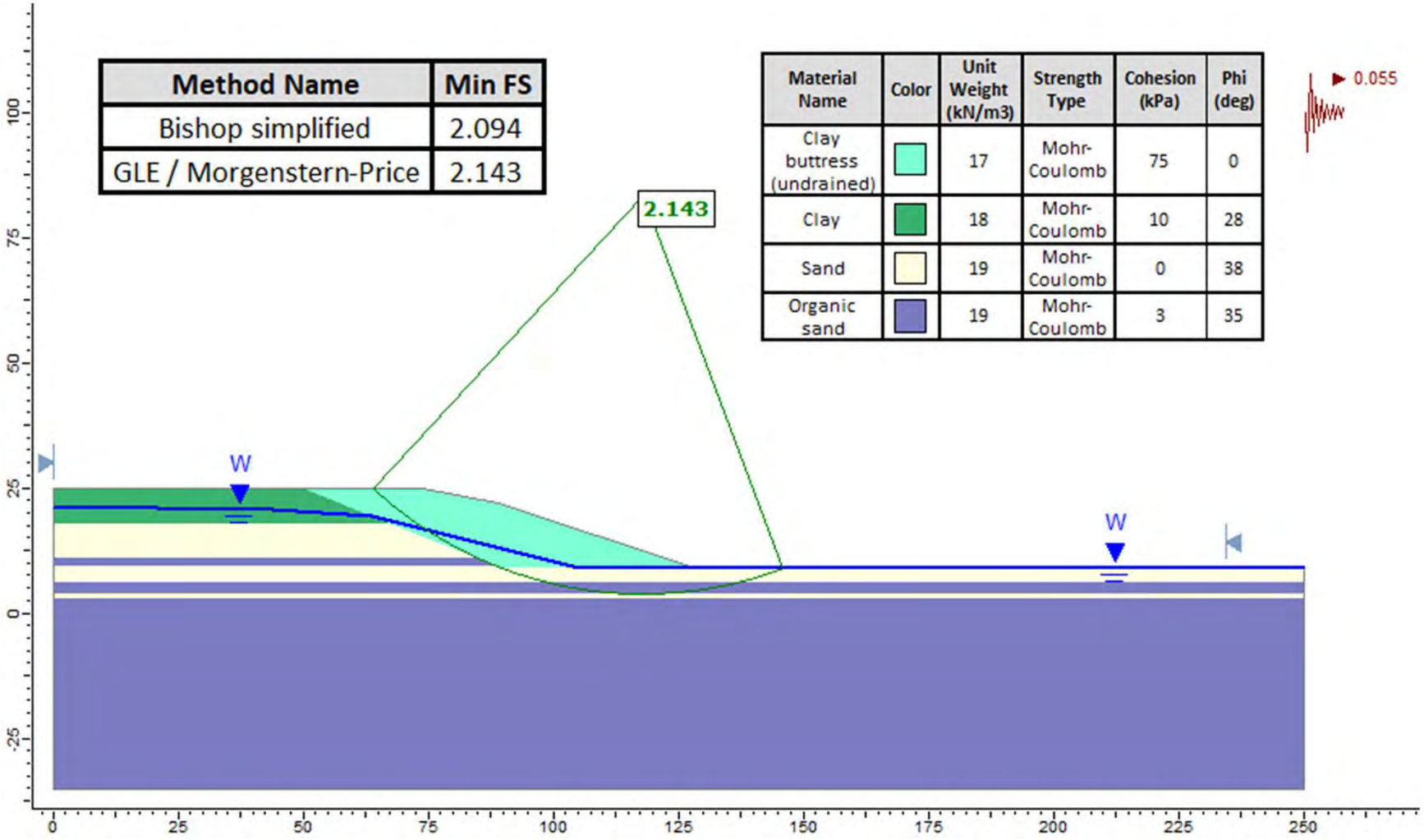
CMW Geosciences

DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1-15
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

Case 15
Location: Northeast1
Excavation to +9m RL at 1:2.5
Buttress emplaced
Undrained clay material properties for clay buttress

Method Name	Min FS
Bishop simplified	2.094
GLE / Morgenstern-Price	2.143

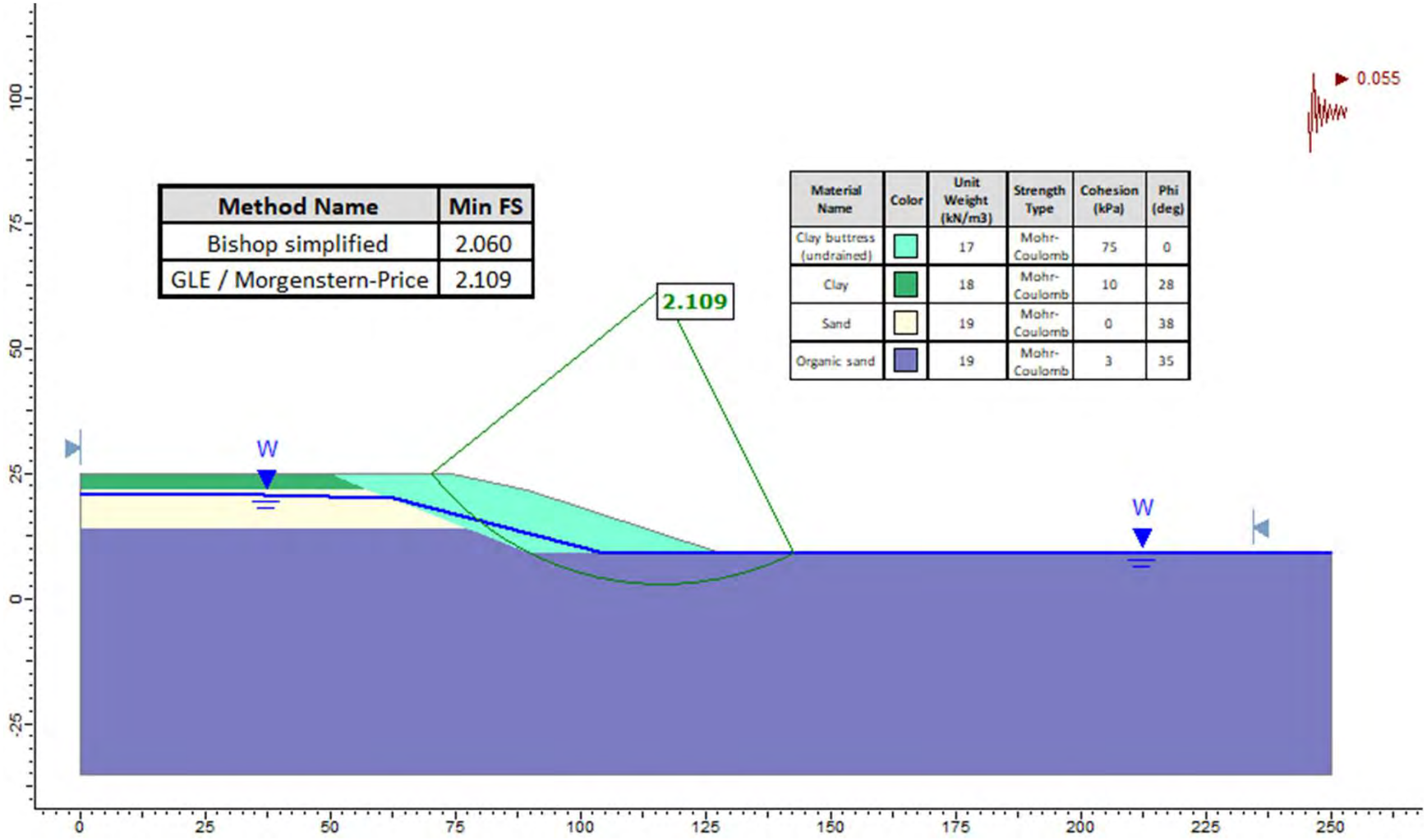
Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay buttress (undrained)		17	Mohr-Coulomb	75	0
Clay		18	Mohr-Coulomb	10	28
Sand		19	Mohr-Coulomb	0	38
Organic sand		19	Mohr-Coulomb	3	35



CMW Geosciences

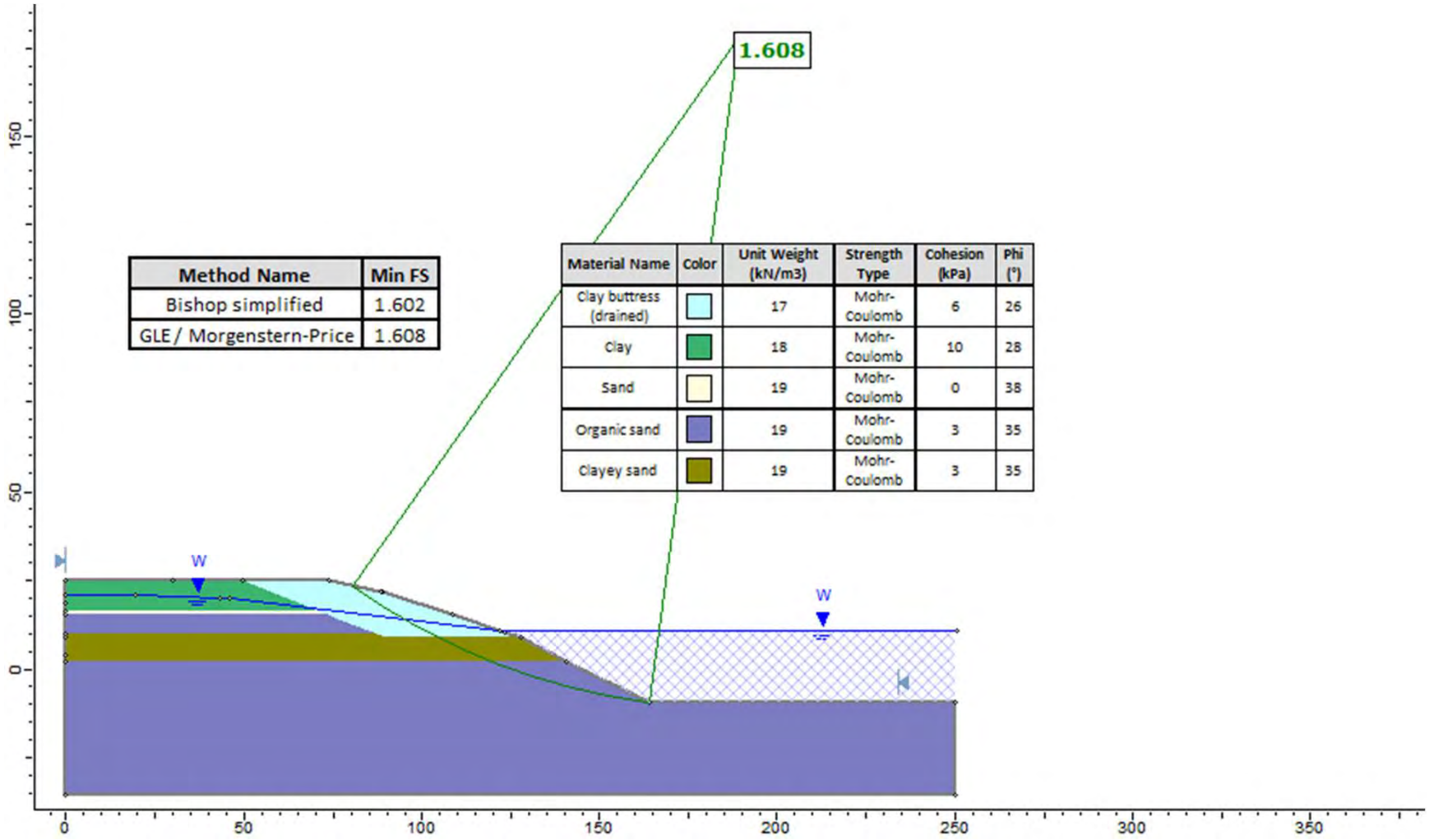
DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1-16
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

Case 16
Location: Northeast2
Excavation to +9m RL at 1:2.5
Buttress emplaced
Undrained clay material properties for clay buttress



DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1-17
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

Case 17
Location: Northwest
Dredged excavation to -9m RL at 1:2
Buttress emplaced
Drained clay material properties for clay buttress



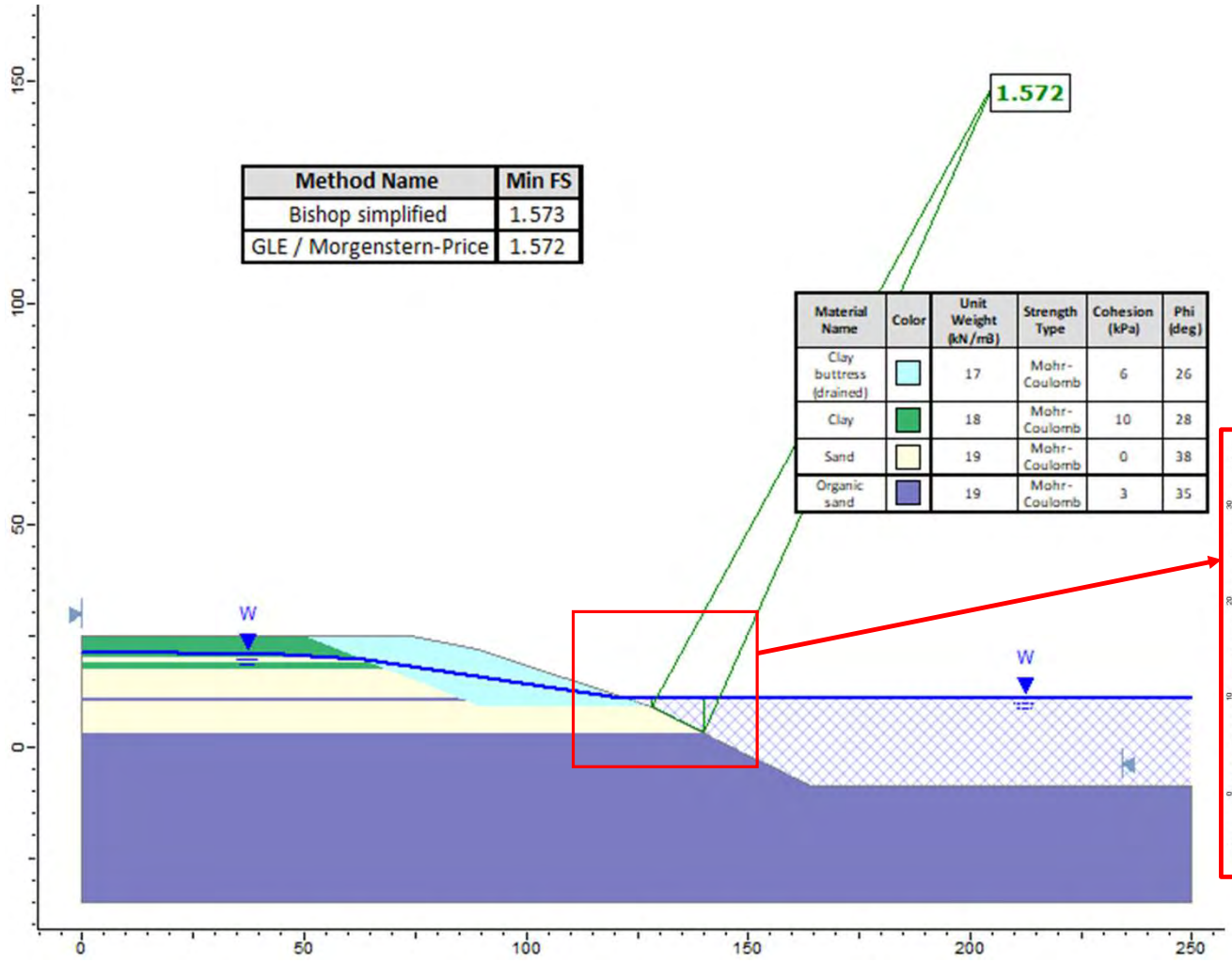
DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1-18
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

CMW Geosciences

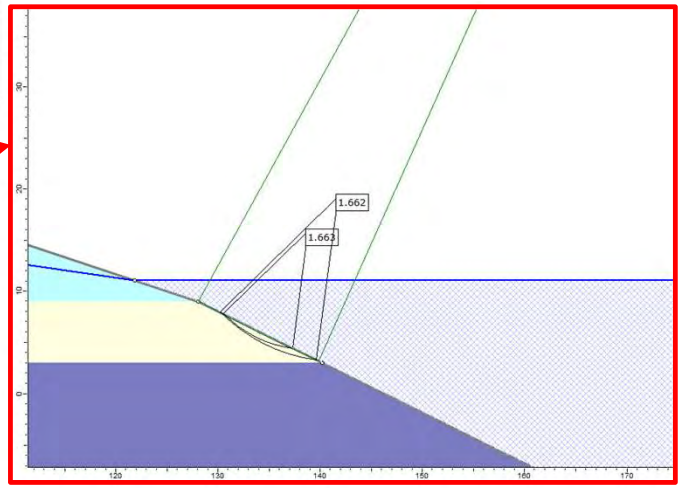
Case 18
Location: North central
Dredged excavation to -9m RL at 1:2
Buttress emplaced
Drained clay material properties for clay buttress

Method Name	Min FS
Bishop simplified	1.573
GLE / Morgenstern-Price	1.572

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay buttress (drained)		17	Mohr-Coulomb	6	26
Clay		18	Mohr-Coulomb	10	28
Sand		19	Mohr-Coulomb	0	38
Organic sand		19	Mohr-Coulomb	3	35



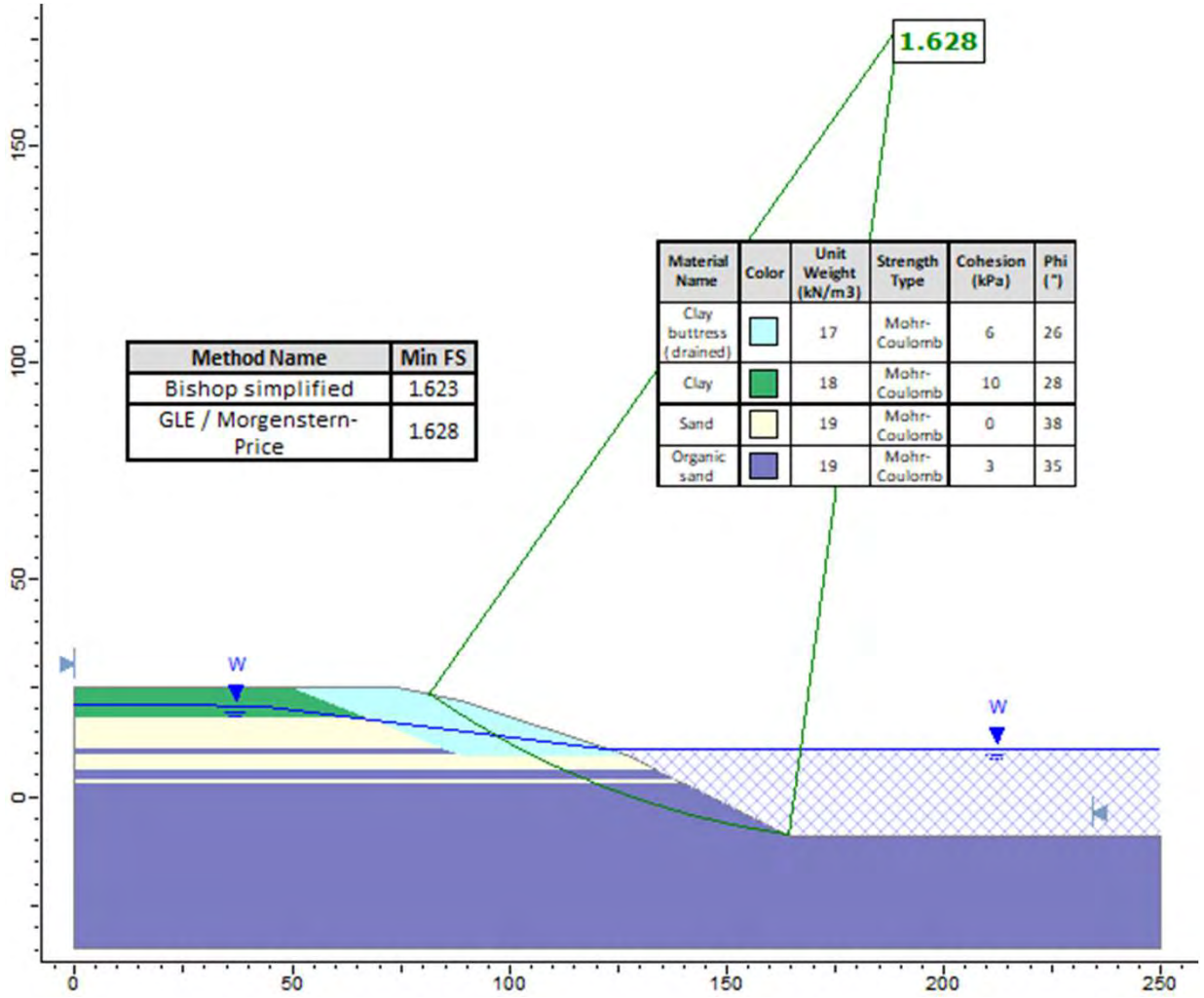
Inset shows FoS for slip circles with 1 m of penetration into the slope face (cf zero penetration of the “minimum slip circle”)



CMW Geosciences

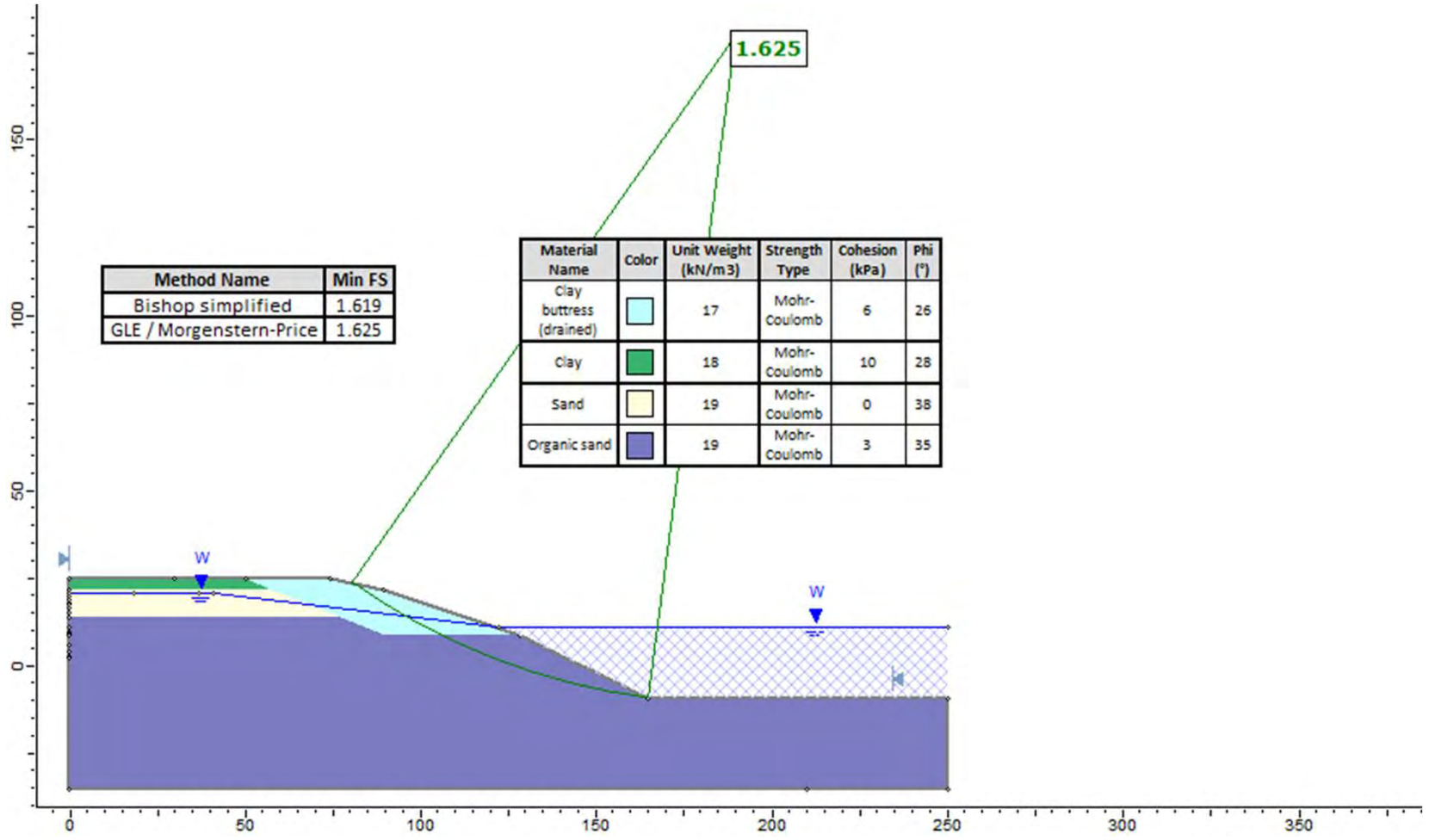
DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1-19
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

Case 19
Location: Northeast1
Dredged excavation to -9m RL at 1:2
Buttress emplaced
Drained clay material properties for clay buttress



DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1-20
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

Case 20
Location: Northeast2
Dredged excavation to -9m RL at 1:2
Buttress emplaced
Drained clay material properties for clay buttress

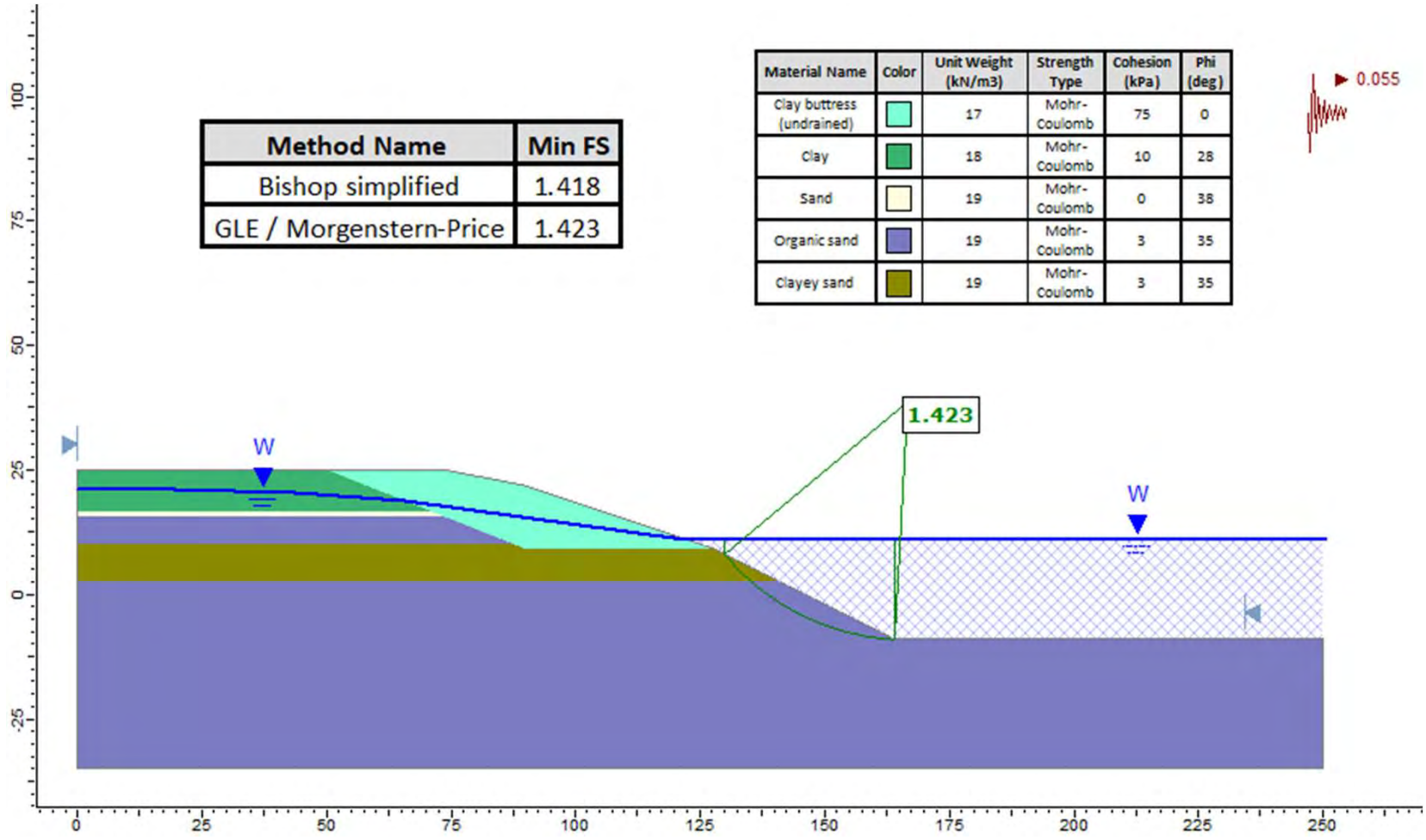


DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1-21
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

Case 21
Location: Northwest
Dredged excavation to -9m RL at 1:2
Buttress emplaced
Undrained clay material properties for clay buttress

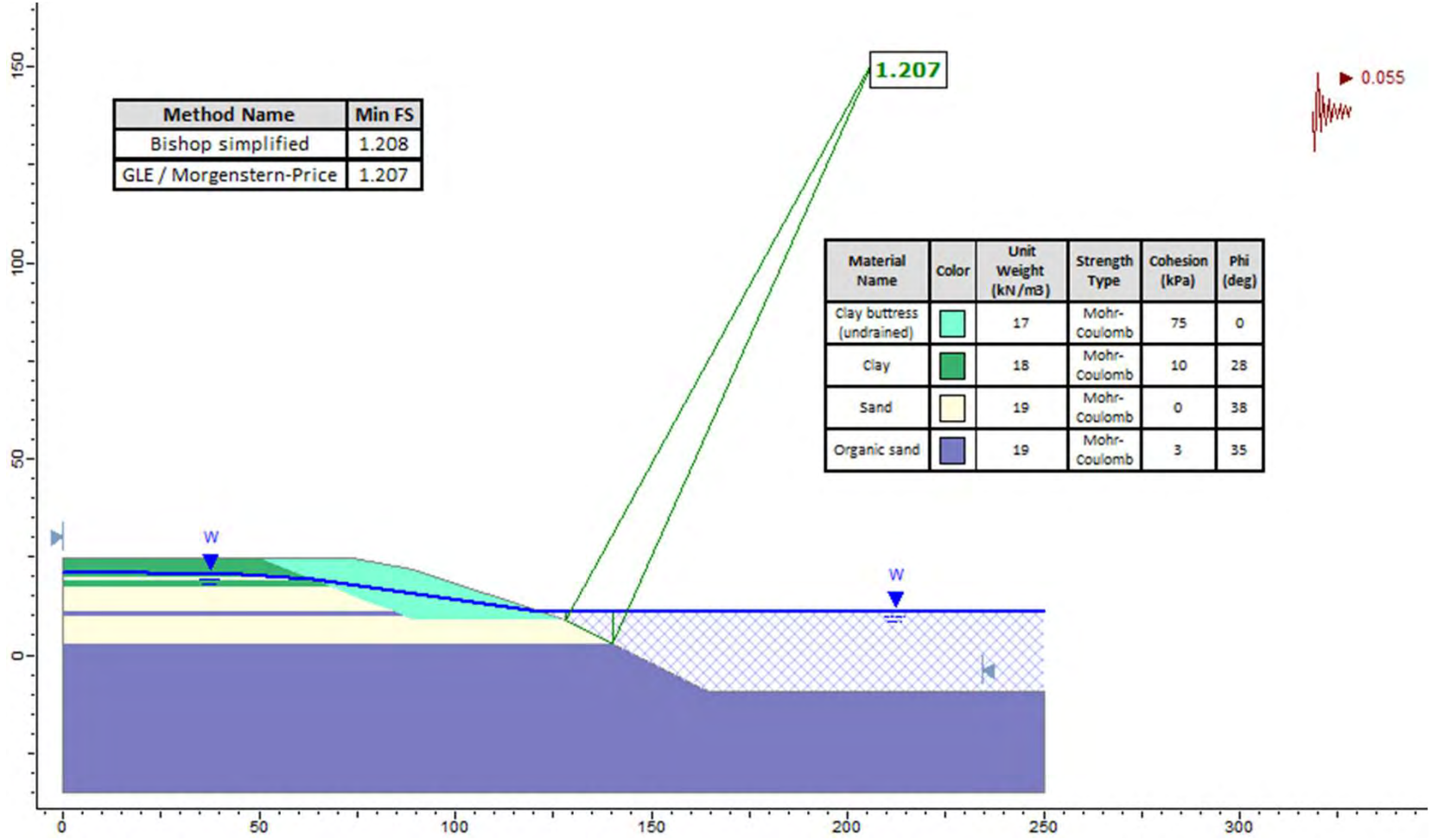
Method Name	Min FS
Bishop simplified	1.418
GLE / Morgenstern-Price	1.423

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay buttress (undrained)		17	Mohr-Coulomb	75	0
Clay		18	Mohr-Coulomb	10	28
Sand		19	Mohr-Coulomb	0	38
Organic sand		19	Mohr-Coulomb	3	35
Clayey sand		19	Mohr-Coulomb	3	35



DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1-22
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

Case 22
Location: North central
Dredged excavation to -9m RL at 1:2
Buttress emplaced
Undrained clay material properties for clay buttress



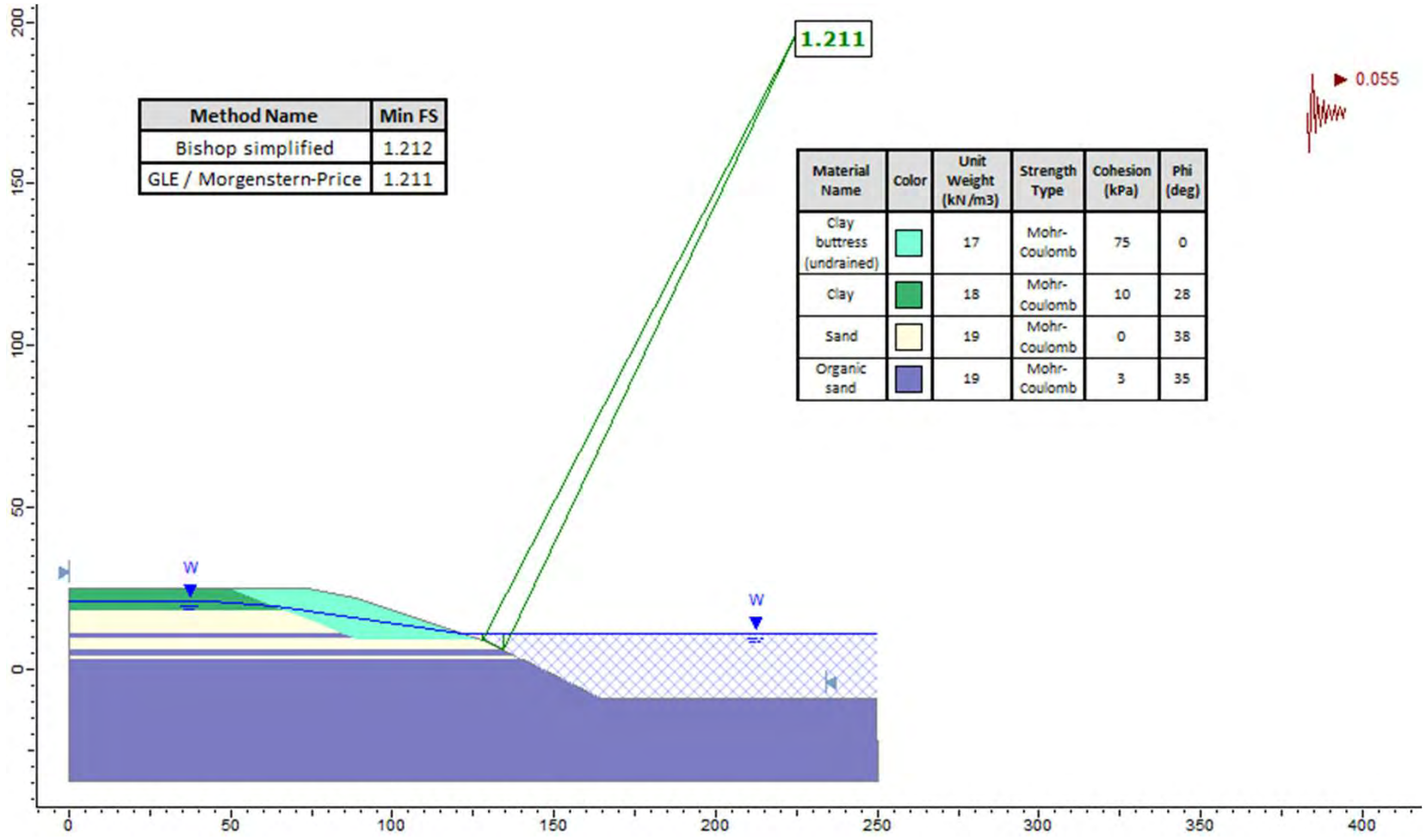
Method Name	Min FS
Bishop simplified	1.208
GLE / Morgenstern-Price	1.207

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay buttress (undrained)		17	Mohr-Coulomb	75	0
Clay		18	Mohr-Coulomb	10	28
Sand		19	Mohr-Coulomb	0	38
Organic sand		19	Mohr-Coulomb	3	35

CMW Geosciences

DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1-23
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

Case 23
Location: Northeast1
Dredged excavation to -9m RL at 1:2
Buttress emplaced
Undrained clay material properties for clay buttress



Method Name	Min FS
Bishop simplified	1.212
GLE / Morgenstern-Price	1.211

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay buttress (undrained)		17	Mohr-Coulomb	75	0
Clay		18	Mohr-Coulomb	10	28
Sand		19	Mohr-Coulomb	0	38
Organic sand		19	Mohr-Coulomb	3	35

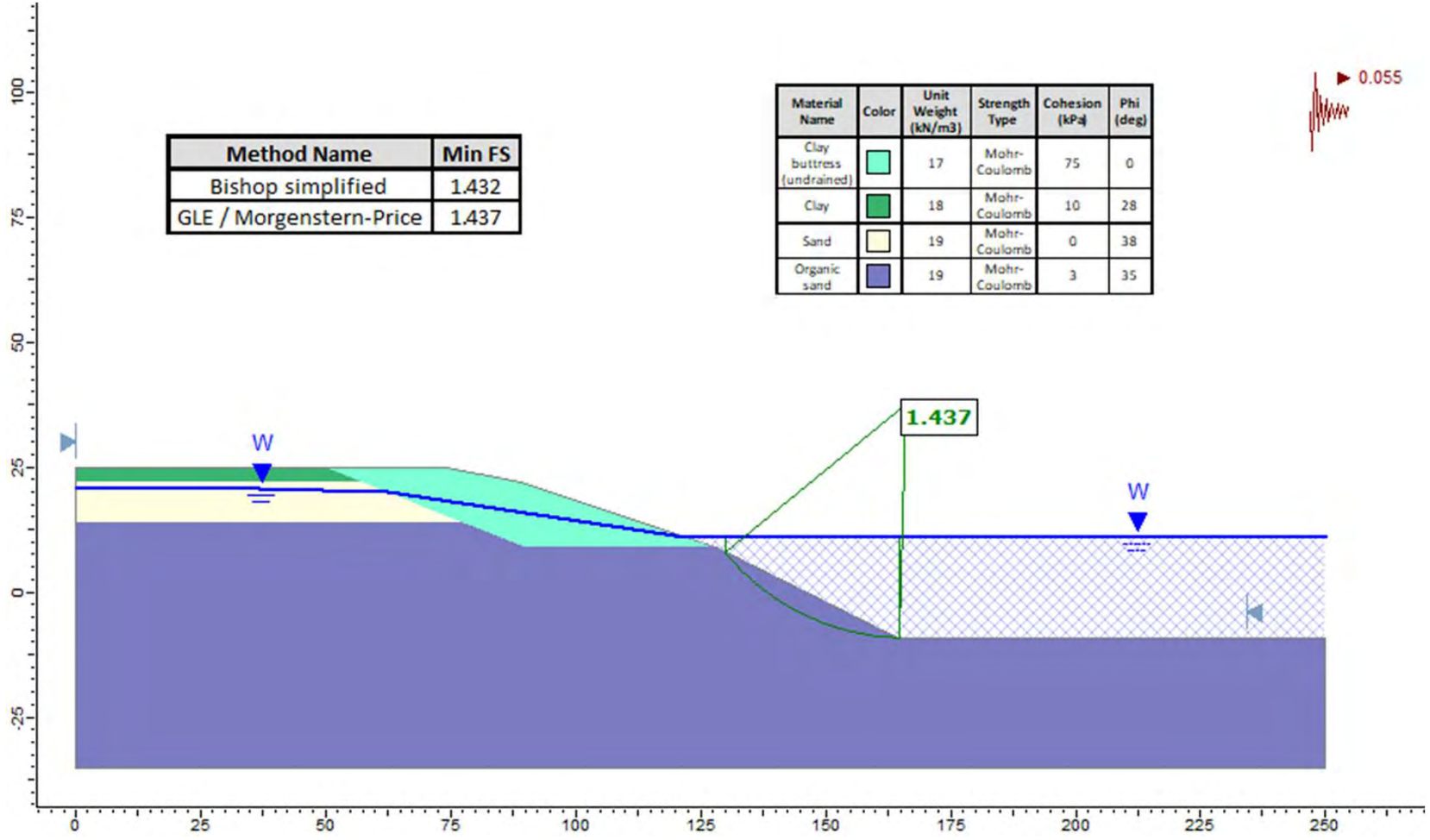
CMW Geosciences

DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1-24
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

Case 24
Location: Northeast2
Dredged excavation to -9m RL at 1:2
Buttress emplaced
Undrained clay material properties for clay buttress

Method Name	Min FS
Bishop simplified	1.432
GLE / Morgenstern-Price	1.437

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay buttress (undrained)		17	Mohr-Coulomb	75	0
Clay		18	Mohr-Coulomb	10	28
Sand		19	Mohr-Coulomb	0	38
Organic sand		19	Mohr-Coulomb	3	35



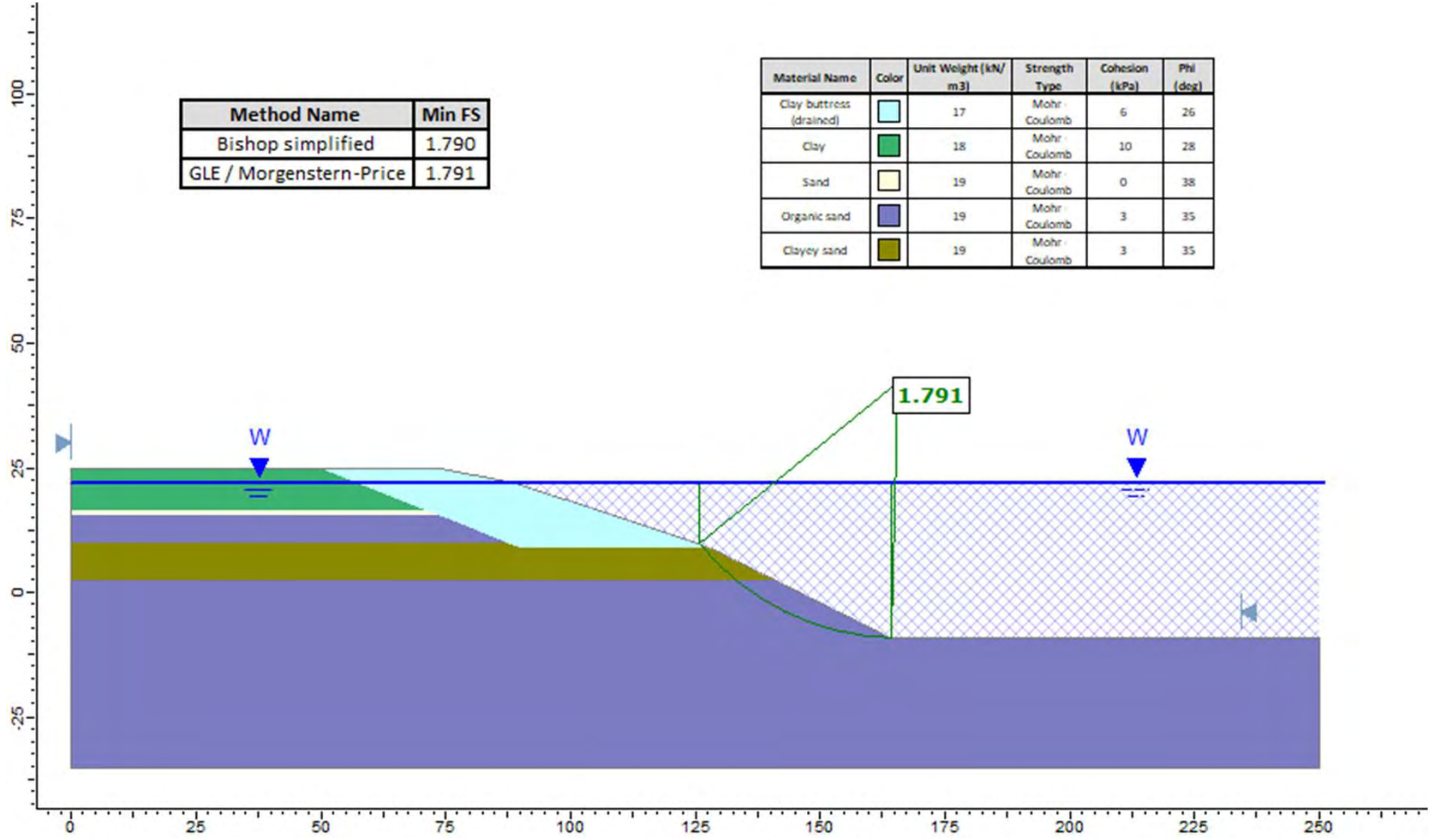
DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1-25
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

CMW Geosciences

Case 25
Location: Northwest
Dredged excavation to -9m RL at 1:2
Buttress emplaced
Undrained clay material properties for clay buttress
Water at rehabilitation level

Method Name	Min FS
Bishop simplified	1.790
GLE / Morgenstern-Price	1.791

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay buttress (drained)		17	Mohr-Coulomb	6	26
Clay		18	Mohr-Coulomb	10	28
Sand		19	Mohr-Coulomb	0	38
Organic sand		19	Mohr-Coulomb	3	35
Clayey sand		19	Mohr-Coulomb	3	35

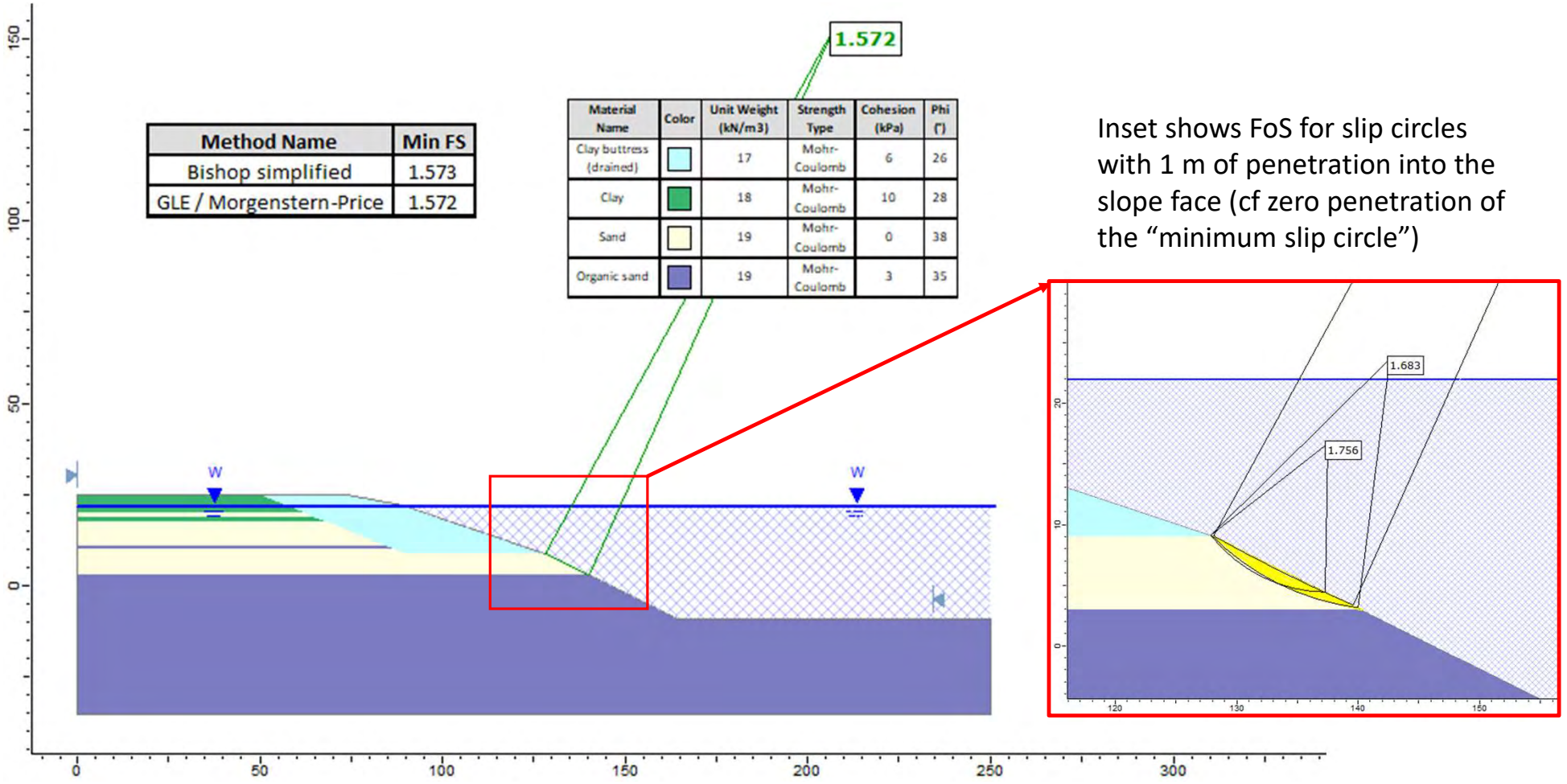


DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1-26
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

Case 26
Location: North central
Dredged excavation to -9m RL at 1:2
Buttress emplaced
Undrained clay material properties for clay buttress
Water at rehabilitation level

Method Name	Min FS
Bishop simplified	1.573
GLE / Morgenstern-Price	1.572

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)
Clay buttress (drained)		17	Mohr-Coulomb	6	26
Clay		18	Mohr-Coulomb	10	28
Sand		19	Mohr-Coulomb	0	38
Organic sand		19	Mohr-Coulomb	3	35



Inset shows FoS for slip circles with 1 m of penetration into the slope face (cf zero penetration of the “minimum slip circle”)

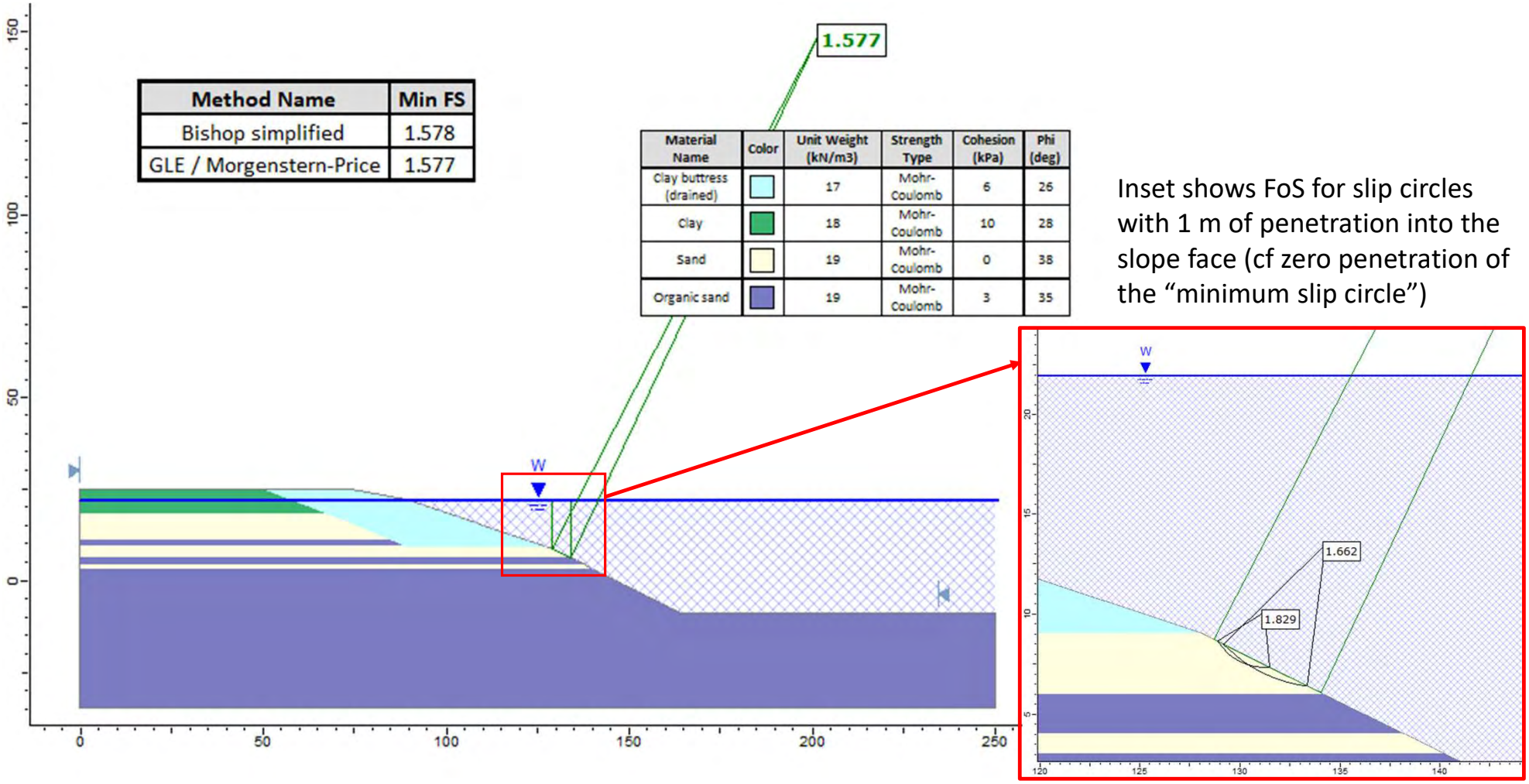
CMW Geosciences

DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1-27
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

Case 27
Location: Northeast1
Dredged excavation to -9m RL at 1:2
Buttress emplaced
Undrained clay material properties for clay buttress
Water at rehabilitation level

Method Name	Min FS
Bishop simplified	1.578
GLE / Morgenstern-Price	1.577

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay buttress (drained)		17	Mohr-Coulomb	6	26
Clay		18	Mohr-Coulomb	10	28
Sand		19	Mohr-Coulomb	0	38
Organic sand		19	Mohr-Coulomb	3	35



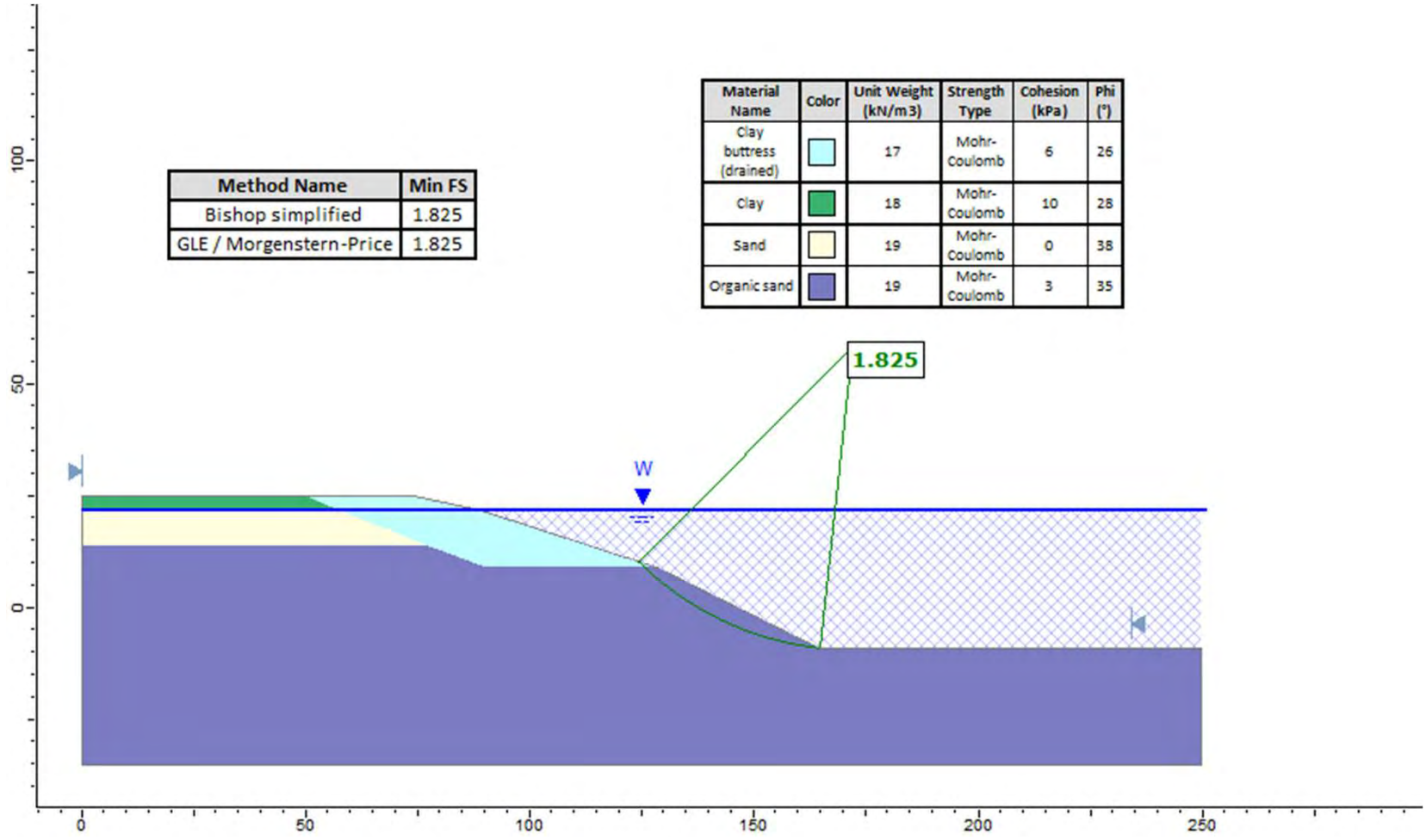
Inset shows FoS for slip circles with 1 m of penetration into the slope face (cf zero penetration of the "minimum slip circle")

DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1-28
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

Case 28
Location: Northeast2
Dredged excavation to -9m RL at 1:2
Buttress emplaced
Undrained clay material properties for clay buttress
Water at rehabilitation level

Method Name	Min FS
Bishop simplified	1.825
GLE / Morgenstern-Price	1.825

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (°)
Clay buttress (drained)		17	Mohr-Coulomb	6	26
Clay		18	Mohr-Coulomb	10	28
Sand		19	Mohr-Coulomb	0	38
Organic sand		19	Mohr-Coulomb	3	35



DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C1-29
REVISION: 2	SCALE: as shown (metres)
DATE: 27 /11/ 2023	SHEET: 1 of 1

Summary of slope stability analyses (Appendix C2) (Buttress width 30m unless stated otherwise)				
Page	**Case**	**Seismic**	**Conditions**	**Minimum FoS**
C31	C2-1	No	Embankment A – central impoundment @ 1:1.5 western slope, eastern slope as shown Drained clay material properties	2.319
C32	C2-2a	Yes (0.055g)	Embankment A – central impoundment @ 1:1.5 western slope, eastern slope as shown Drained clay material properties	2.004
C33	C2-2b	Yes (0.055g)	Embankment A – central impoundment @ 1:1.5 western slope, eastern slope as shown Undrained clay material properties	2.183
C34	C2-2c	Yes (0.16g)	Embankment A – central impoundment @ 1:1.5 western slope, eastern slope as shown Recovered water table	1.099
C35	C2-3	No	Embankment B – western landbridge @ as shown both slopes Drained clay material properties	1.548
C36	C2-4a	Yes (0.055g)	Embankment B – western landbridge @ as shown both slopes Drained clay material properties	1.338
C37	C2-4b	Yes (0.055g)	Embankment B – western landbridge @ as shown both slopes Undrained clay material properties	1.600
C38	C2-4c	Yes (0.16g)	Embankment B – western landbridge @ as shown both slopes Recovered water table	0.833 (1.492)*
C39	C2-5	No	Embankment C – central impoundment @ 1:2.5 northern slope, 1:2 southern slope Drained clay material properties	1.87
C40	C2-6a	Yes (0.055g)	Embankment C – central impoundment @ 1:2.5 northern slope, 1:2 southern slope Drained clay material properties	1.59
C41	C2-6b	Yes (0.055g)	Embankment C – central impoundment @ 1:2.5 northern slope, 1:2 southern slope Undrained clay material properties	1.80
C42	C2-6c	Yes (0.16g)	Embankment C – central impoundment @ 1:2.5 northern slope, 1:2 southern slope Recovered water table	1.48
C43	C2-7	No	Embankment D – eastern storage @ 1:3 both slopes, Drained clay material properties	1.63
C44	C2-8A	Yes (0.055g)	Embankment D – eastern storage @ 1:3 both slopes, Drained clay material properties	1.37
C45	C2-8B	Yes (0.055g)	Embankment D – eastern storage @ 1:3 both slopes, Undrained clay material properties	1.76
C46	C2-8C	Yes (0.16g)	Embankment D – eastern storage @ 1:3 both slopes, Recovered water table	1.41
C47	C2-9	No	Embankment E – eastern pit storage @ 1:3 both slopes, Drained clay material properties	2.02
C48	C210a	Yes (0.055g)	Embankment E – eastern pit storage @ 1:3 both slopes, Drained clay material properties	1.70
C49	C2-10b	Yes (0.055g)	Embankment E – eastern pit storage @ 1:3 both slopes, Undrained clay material properties	2.41
C50	C2-10c	Yes (0.16g)	Embankment E – eastern pit storage @ 1:3 both slopes, Recovered water table	2.01
C51	Hydraulic pressure model for buttress (undrained)			2.31
C52	Hydraulic pressure model for buttress (friction angle 36°)			2.42
C53	Hydraulic pressure model for buttress (undrained, seismic)			1.60
C54	Graphic of slope: Excavation to +9 mRL. Cut slope in sand 1:2.5. Prior to buttress emplacement (operational)			
C55	Graphic of slope: Excavation to +9 mRL. Clay buttress emplaced to 58 m width for waterway diversion.			
C56	Graphic of slope: Dredging to -9 mRL with waterway diversion buttress			
* Shallow submerged slip circle <1.0, loss of containment minimum slip circle 1.492				

CMW Geosciences

DRAWN: SP	PROJECT: MEL2022-0033AE
CHECKED : JS	FIGURE: App C2 30
REVISION: 2	SCALE: as shown (metres)
DATE: 27 / 11 / 2023	SHEET: 1 of 1

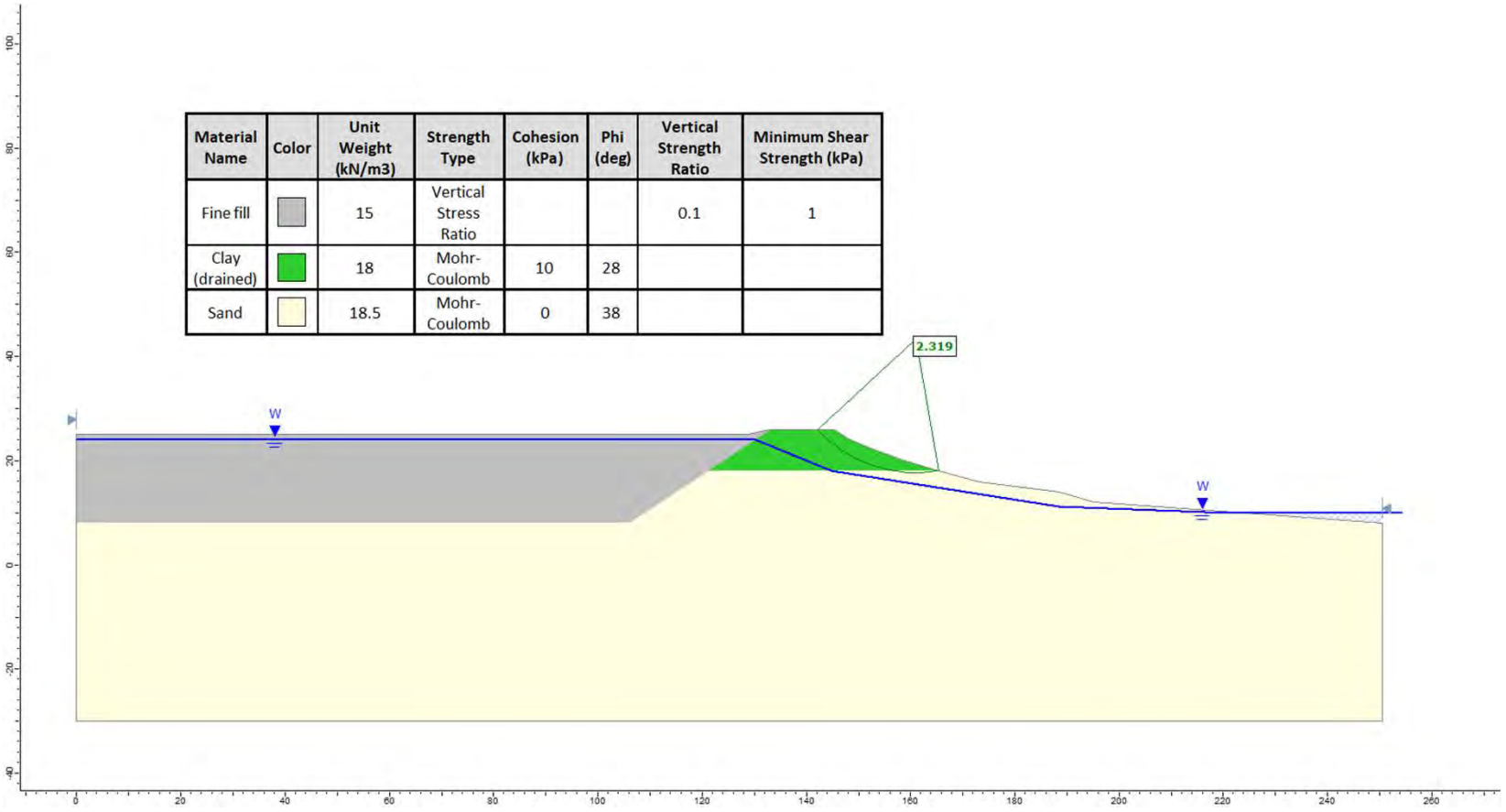
Case C2-1

Embankment A - impoundment

Section A-A'

Static conditions

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (kPa)
Fine fill		15	Vertical Stress Ratio			0.1	1
Clay (drained)		18	Mohr-Coulomb	10	28		
Sand		18.5	Mohr-Coulomb	0	38		



CMW Geosciences	DRAWN: SP	PROJECT: MEL2022-0033AE
	CHECKED : PC	FIGURE: App C 31
	REVISION: 2	SCALE: as shown (metres)
	DATE: 27 / 11 / 2023	SHEET: 1 of 1

Case C2-2a

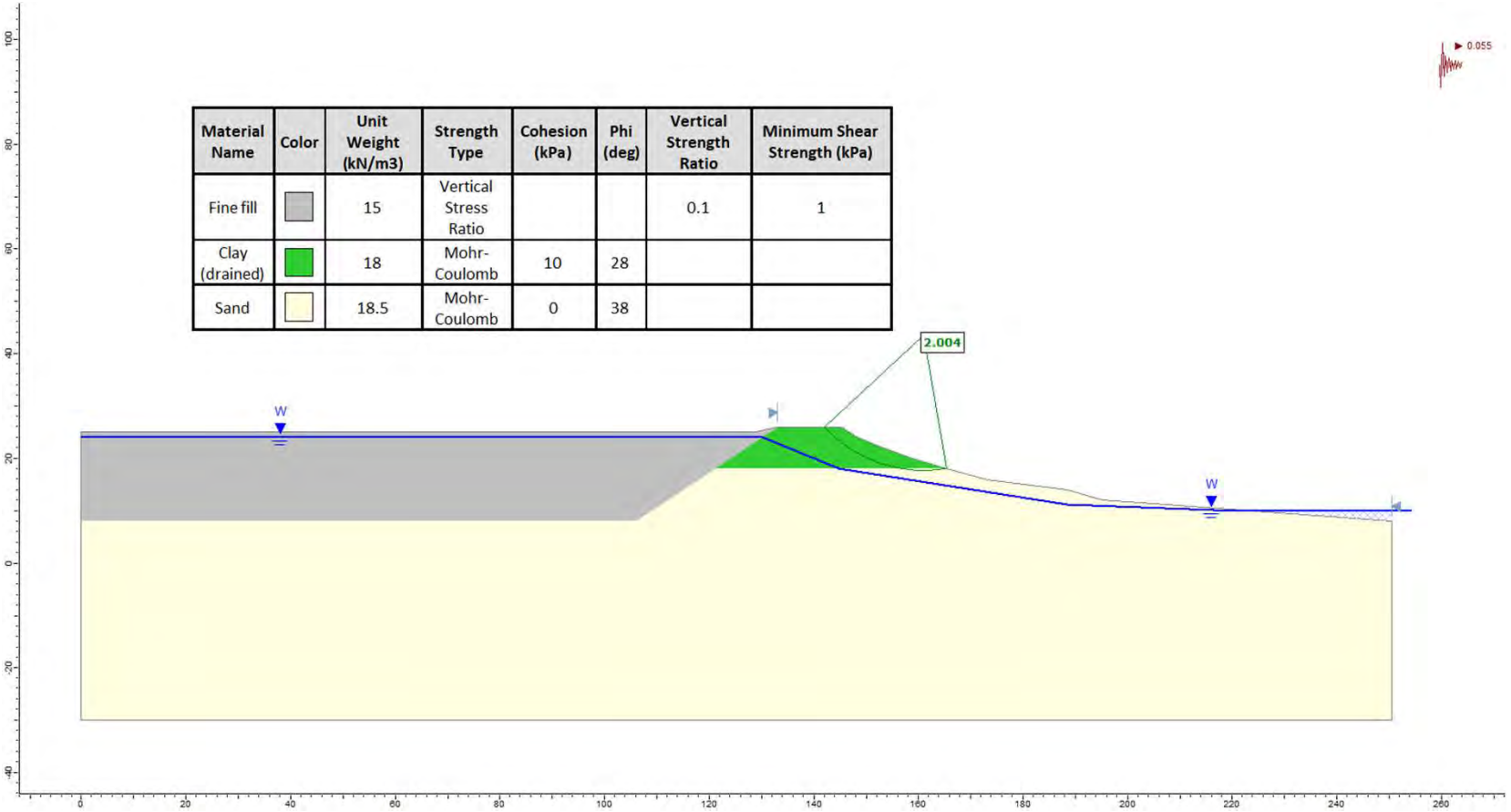
Embankment A - impoundment

Section A-A’

Seismic conditions

Drained clay properties

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (kPa)
Fine fill		15	Vertical Stress Ratio			0.1	1
Clay (drained)		18	Mohr-Coulomb	10	28		
Sand		18.5	Mohr-Coulomb	0	38		



CMW Geosciences	DRAWN: JS	PROJECT: MEL2022-0033AE
	CHECKED : PC	FIGURE: App C 13
	REVISION: 2	SCALE: as shown (metres)
	DATE: 27 / 11 / 2023	SHEET: 1 of 1

Case C2-2b

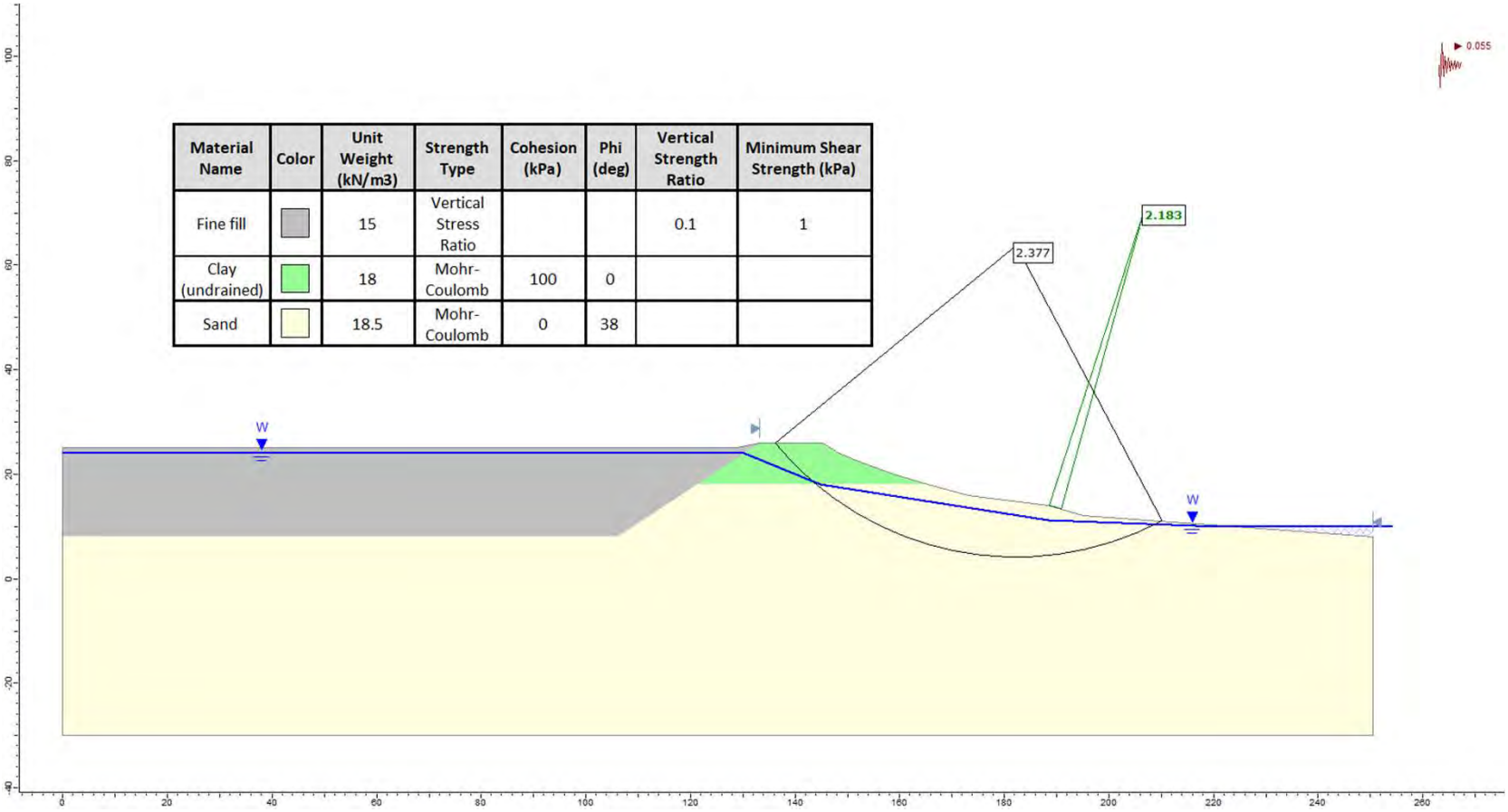
Embankment A - impoundment

Section A-A’

Seismic conditions

Undrained clay properties

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (kPa)
Fine fill		15	Vertical Stress Ratio			0.1	1
Clay (undrained)		18	Mohr-Coulomb	100	0		
Sand		18.5	Mohr-Coulomb	0	38		



CMW Geosciences	DRAWN: JS	PROJECT: MEL2022-0033AE
	CHECKED : PC	FIGURE: App C 14
	REVISION: 2	SCALE: as shown (metres)
	DATE: 27 / 11 / 2023	SHEET: 1 of 1

Case C2-2c

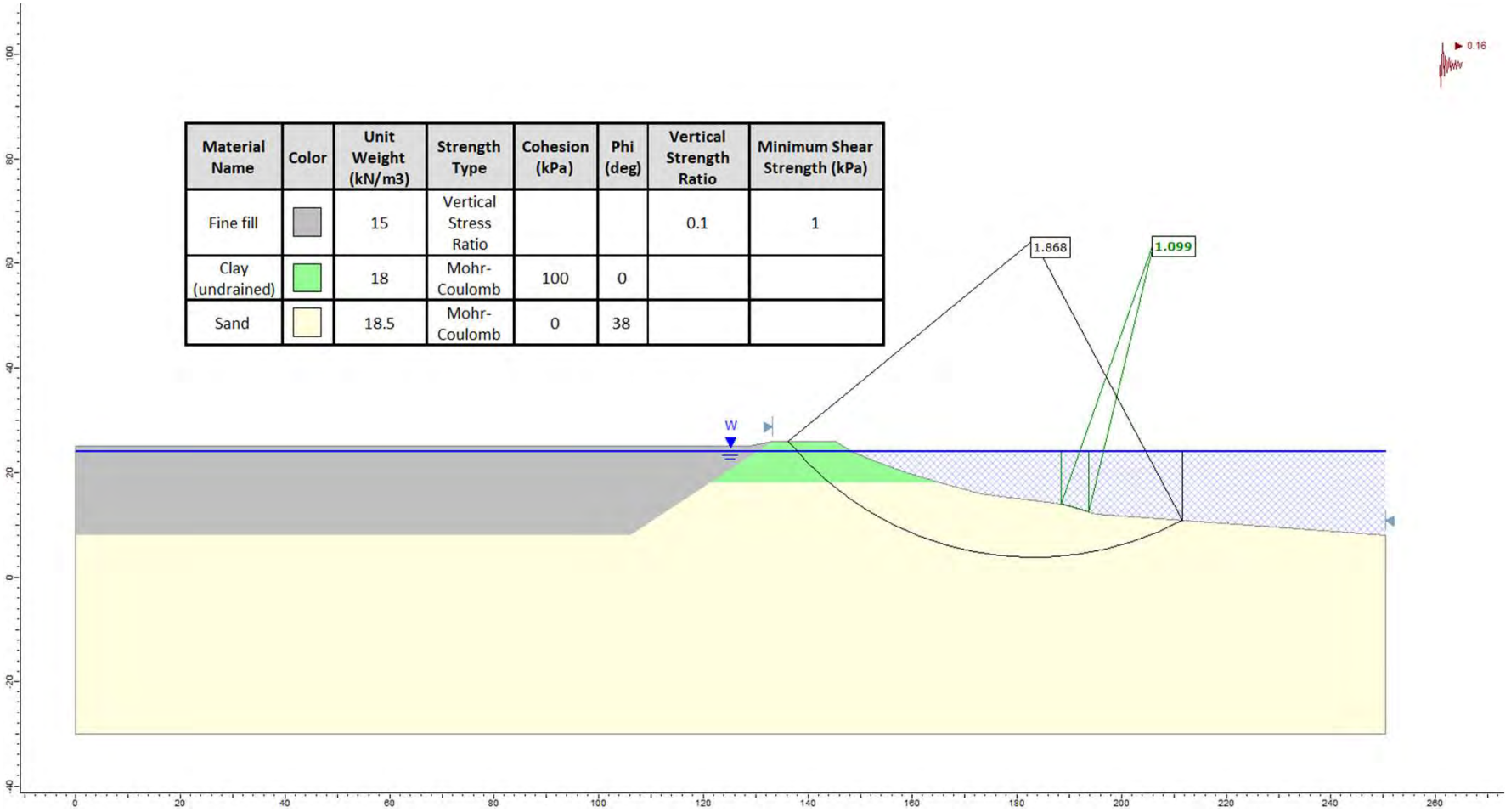
Embankment A - impoundment

Section A-A’

Seismic conditions

Recovered water table

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (kPa)
Fine fill		15	Vertical Stress Ratio			0.1	1
Clay (undrained)		18	Mohr-Coulomb	100	0		
Sand		18.5	Mohr-Coulomb	0	38		



CMW Geosciences

DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : PC	FIGURE: App C 15
REVISION: 2	SCALE: as shown (metres)
DATE: 27 / 11 / 2023	SHEET: 1 of 1

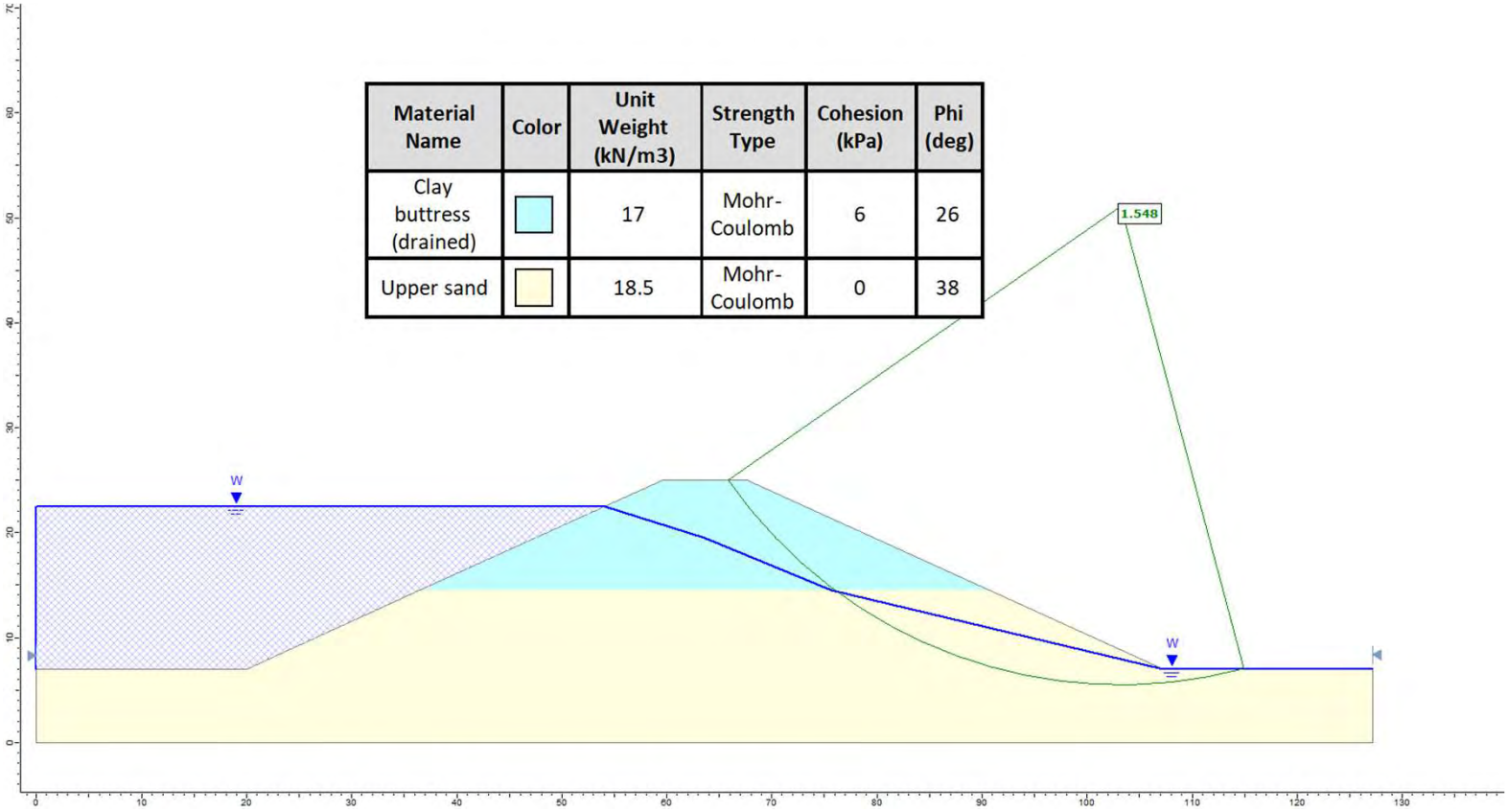
Case C2-3

Embankment B – landbridge western pit

Section B-B'

Static conditions

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay buttress (drained)		17	Mohr-Coulomb	6	26
Upper sand		18.5	Mohr-Coulomb	0	38



CMW Geosciences	DRAWN: SP	PROJECT: MEL2022-0033AE
	CHECKED : JS	FIGURE: App C 16
	REVISION: 2	SCALE: as shown (metres)
	DATE: 27 / 11 / 2023	SHEET: 1 of 1

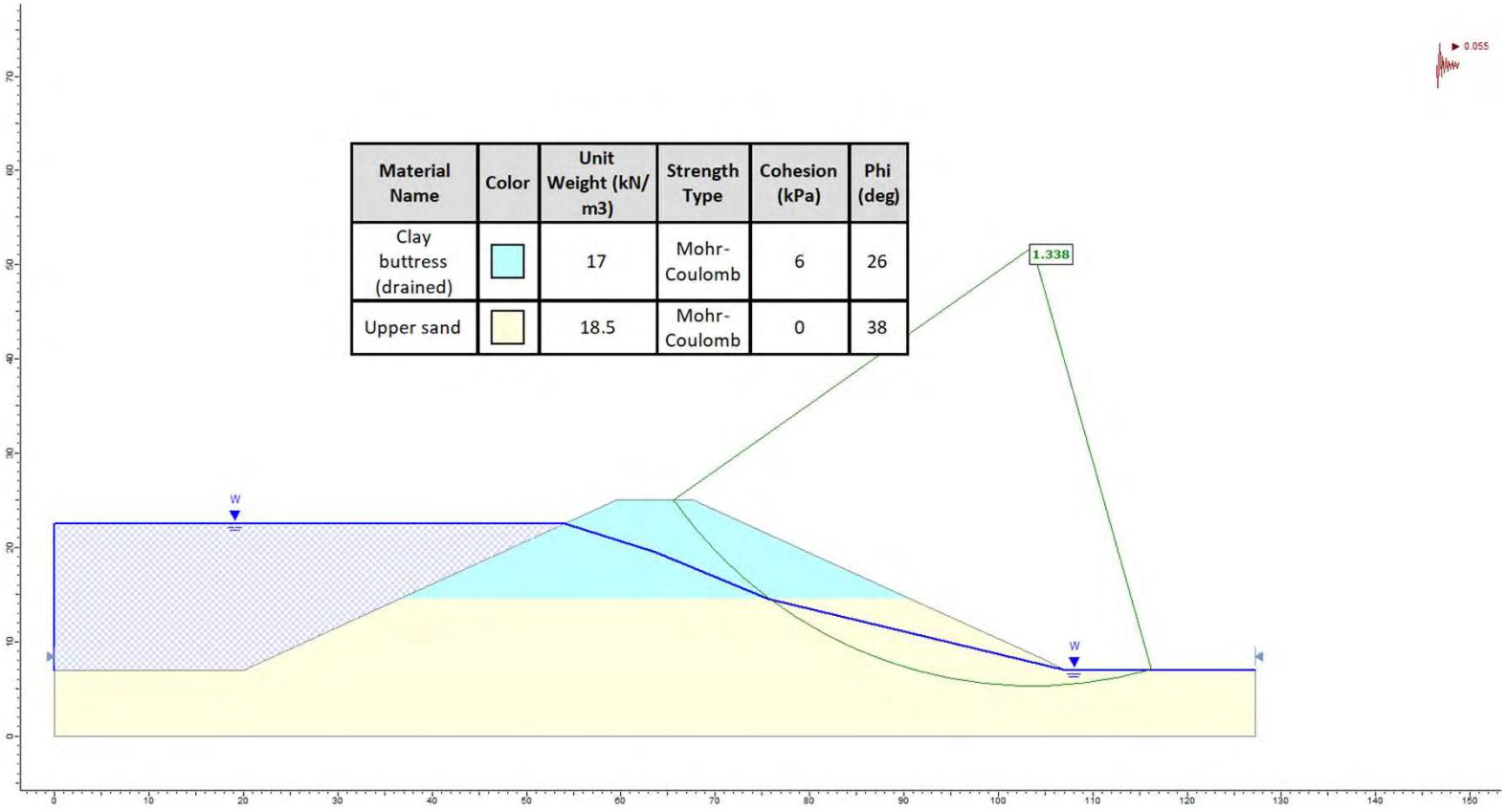
Case C2-4a

Embankment B – landbridge western pit

Section B-B’

Seismic conditions

Drained clay properties



CMW Geosciences	DRAWN: SP	PROJECT: MEL2022-0033AE	
	CHECKED : JS	FIGURE: App C 17	
	REVISION: 2	SCALE: as shown (metres)	
	DATE: 27 / 11 / 2023	SHEET: 1 of 1	

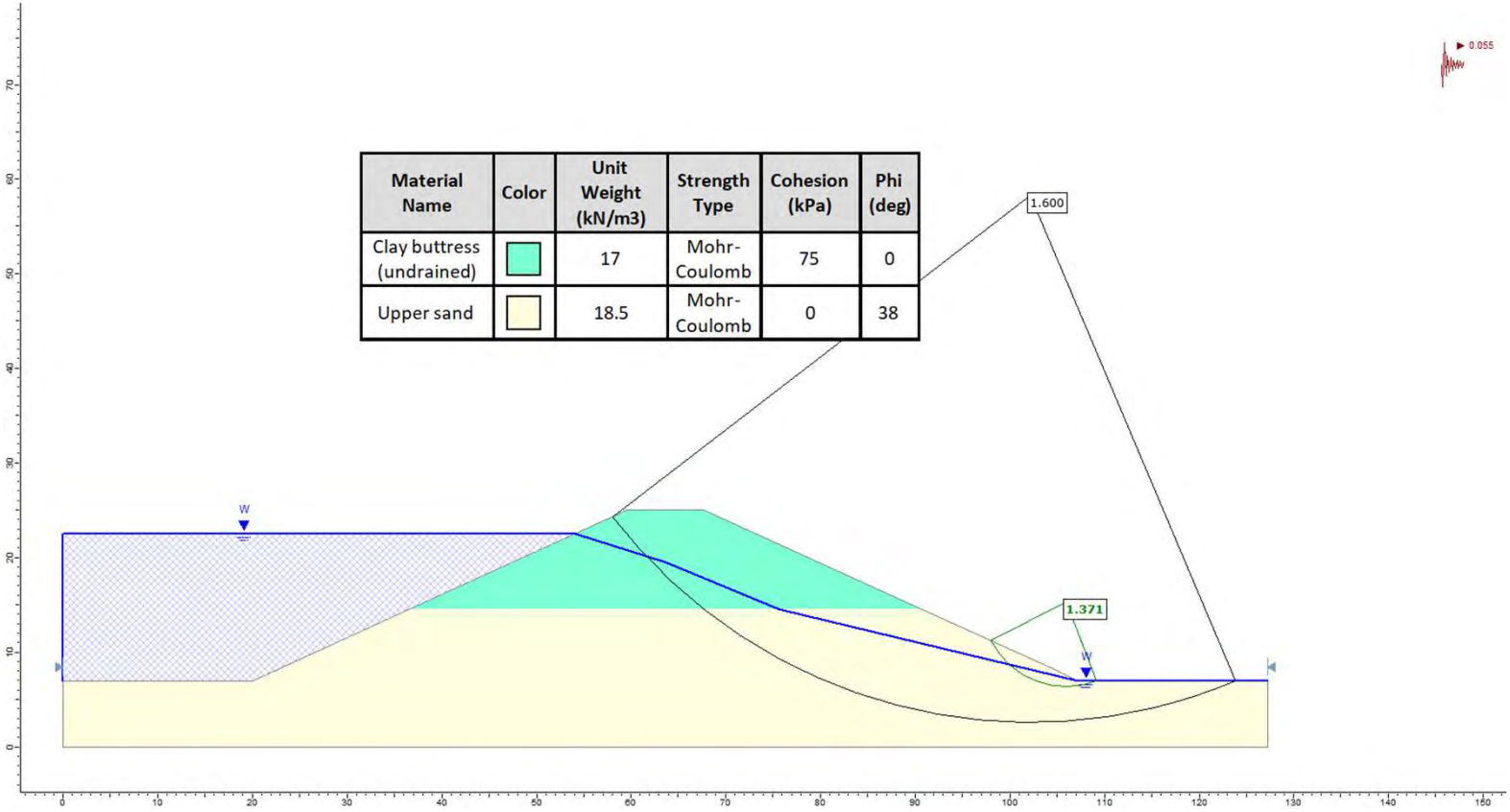
Case C2-4b

Embankment B – landbridge western pit

Section B-B’

Seismic conditions

Undrained clay properties



CMW Geosciences	DRAWN: SP	PROJECT: MEL2022-0033AE	
	CHECKED : JS	FIGURE: App C 18	
	REVISION: 2	SCALE: as shown (metres)	
	DATE: 27 / 11 / 2023	SHEET: 1 of 1	

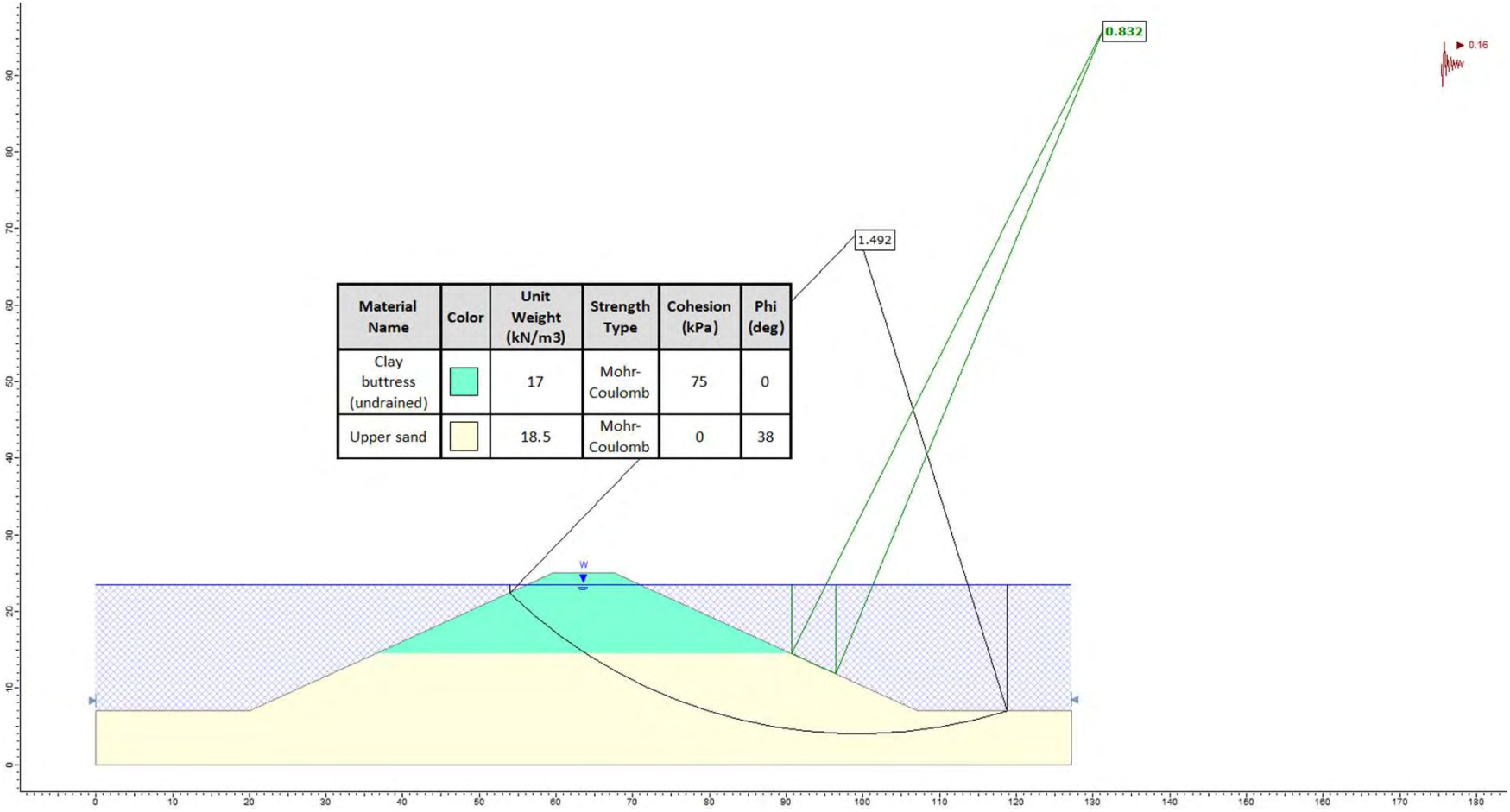
Case C2-4c

Embankment B – landbridge western pit

Section B-B’

Seismic conditions

Recovered water table



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay buttress (undrained)		17	Mohr-Coulomb	75	0
Upper sand		18.5	Mohr-Coulomb	0	38

CMW Geosciences

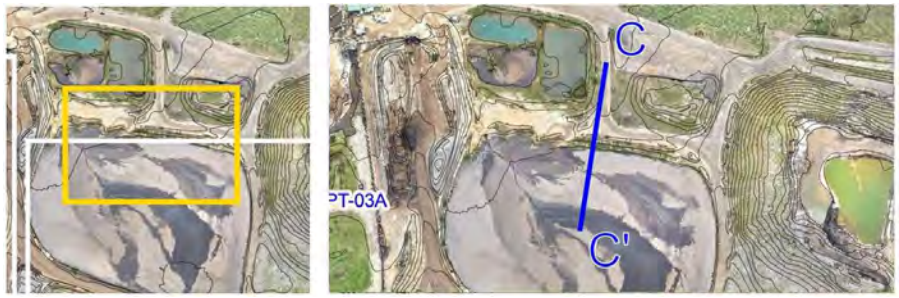
DRAWN: SP	PROJECT: MEL2022-0033AE
CHECKED : JS	FIGURE: App C 19
REVISION: 2	SCALE: as shown (metres)
DATE: 27 / 11 / 2023	SHEET: 1 of 1

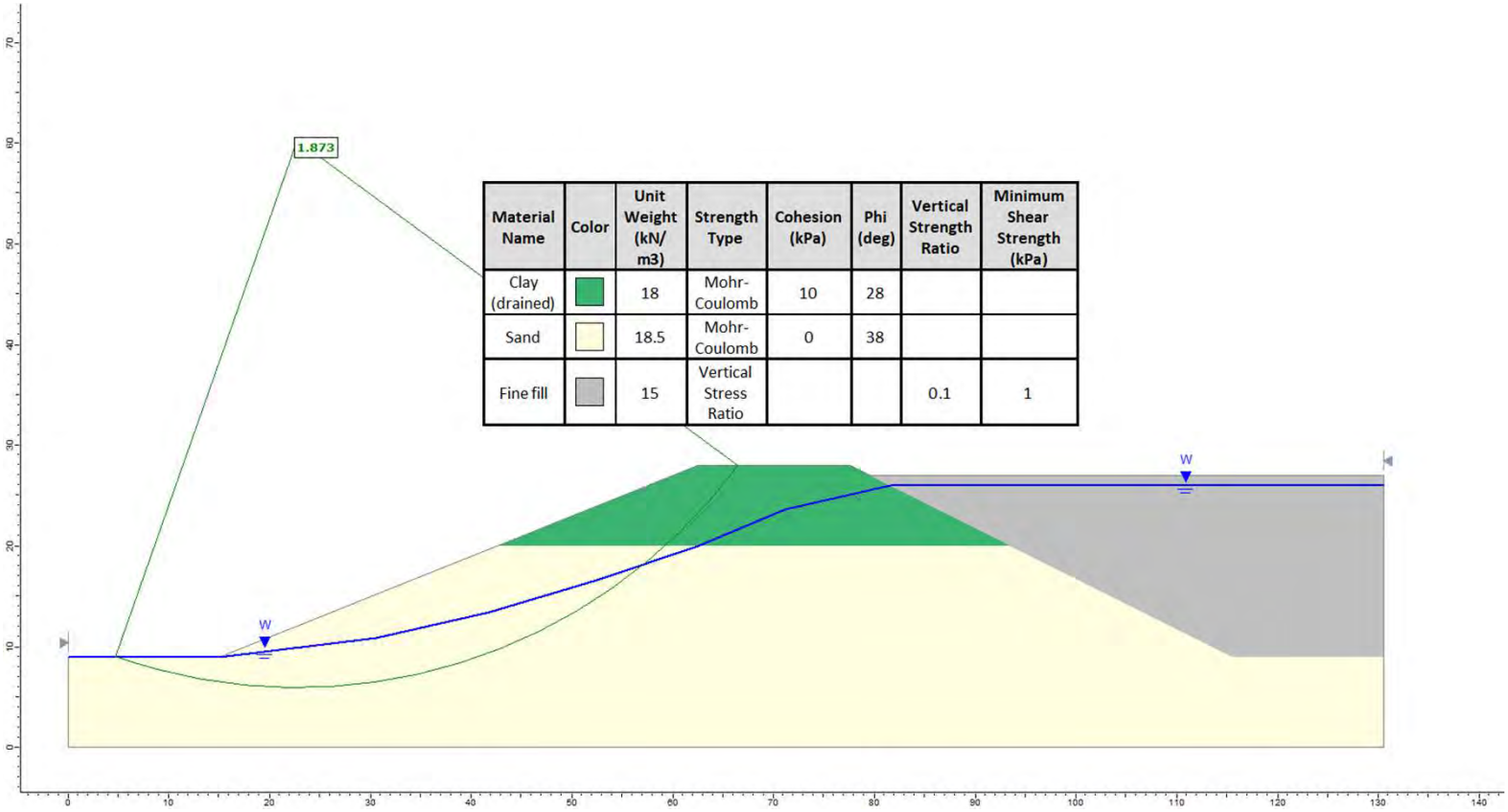
Case C2-5

Embankment C – central impoundment

Section C-C'

Static conditions





Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (kPa)
Clay (drained)		18	Mohr-Coulomb	10	28		
Sand		18.5	Mohr-Coulomb	0	38		
Fine fill		15	Vertical Stress Ratio			0.1	1

CMW Geosciences	DRAWN: SP	PROJECT: MEL2022-0033AE
	CHECKED : JS	FIGURE: App C 20
	REVISION: 2	SCALE: as shown (metres)
	DATE: 27 / 11 / 2023	SHEET: 1 of 1

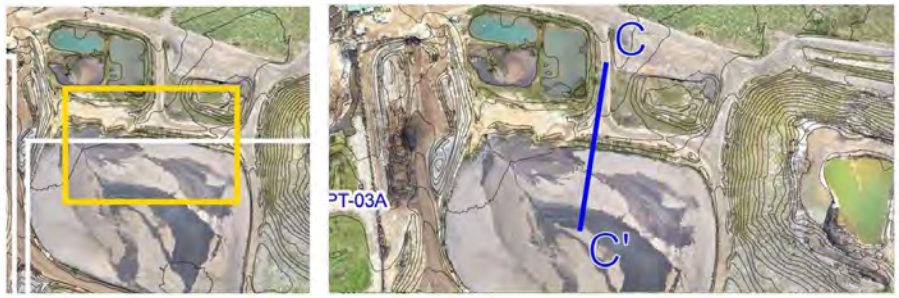
Case C2-6a

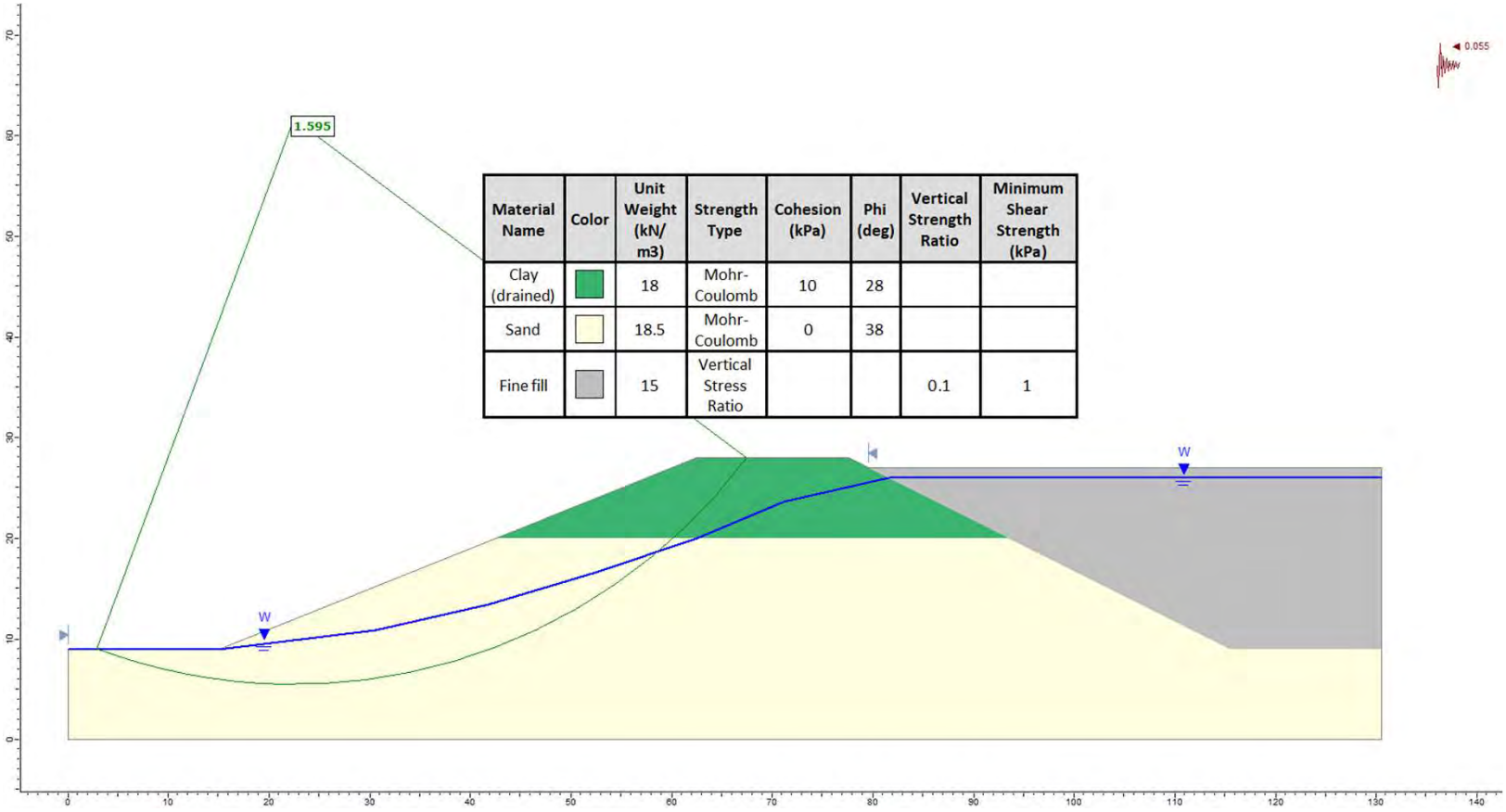
Embankment C – central impoundment

Section C-C'

Seismic conditions

Drained clay properties





Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (kPa)
Clay (drained)		18	Mohr-Coulomb	10	28		
Sand		18.5	Mohr-Coulomb	0	38		
Fine fill		15	Vertical Stress Ratio			0.1	1

CMW Geosciences

DRAWN: SP	PROJECT: MEL2022-0033AE
CHECKED : JS	FIGURE: App C 21
REVISION: 2	SCALE: as shown (metres)
DATE: 27 / 11 / 2023	SHEET: 1 of 1

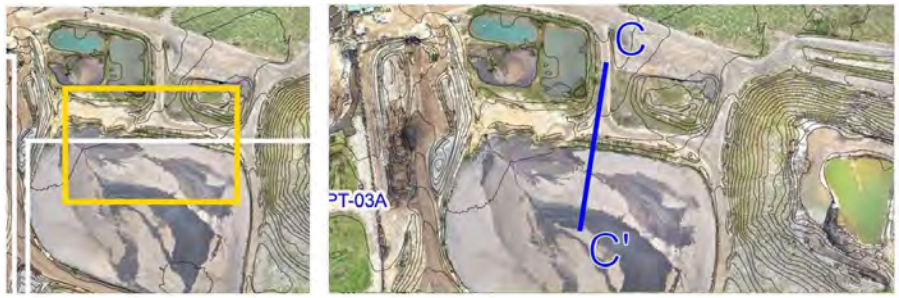
Case C2-6b

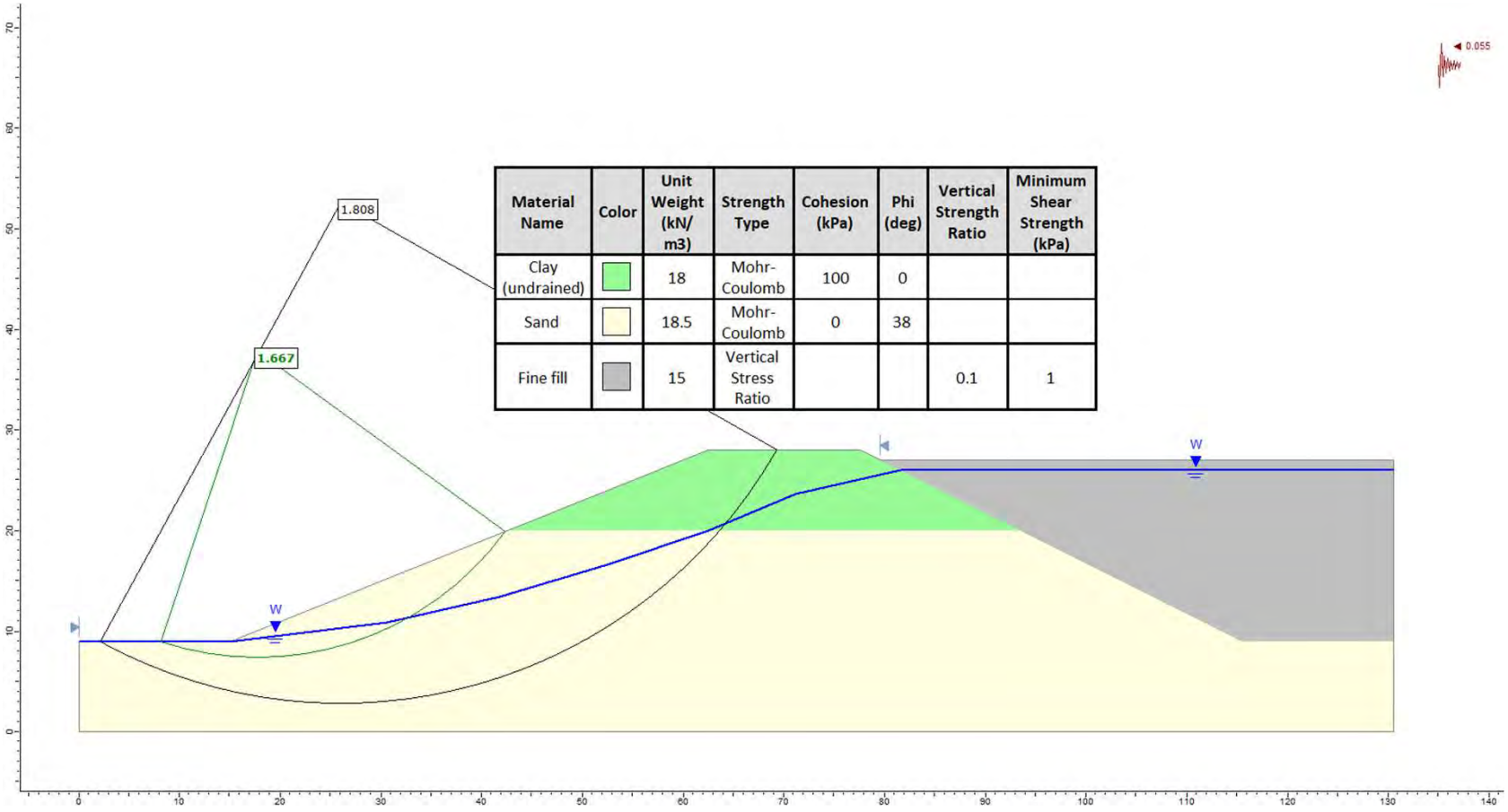
Embankment C – central impoundment

Section C-C'

Seismic conditions

Undrained clay properties





Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (kPa)
Clay (undrained)		18	Mohr-Coulomb	100	0		
Sand		18.5	Mohr-Coulomb	0	38		
Fine fill		15	Vertical Stress Ratio			0.1	1

CMW Geosciences	DRAWN: SP	PROJECT: MEL2022-0033AE
	CHECKED : JS	FIGURE: App C 22
	REVISION: 2	SCALE: as shown (metres)
	DATE: 27 / 11 / 2023	SHEET: 1 of 1

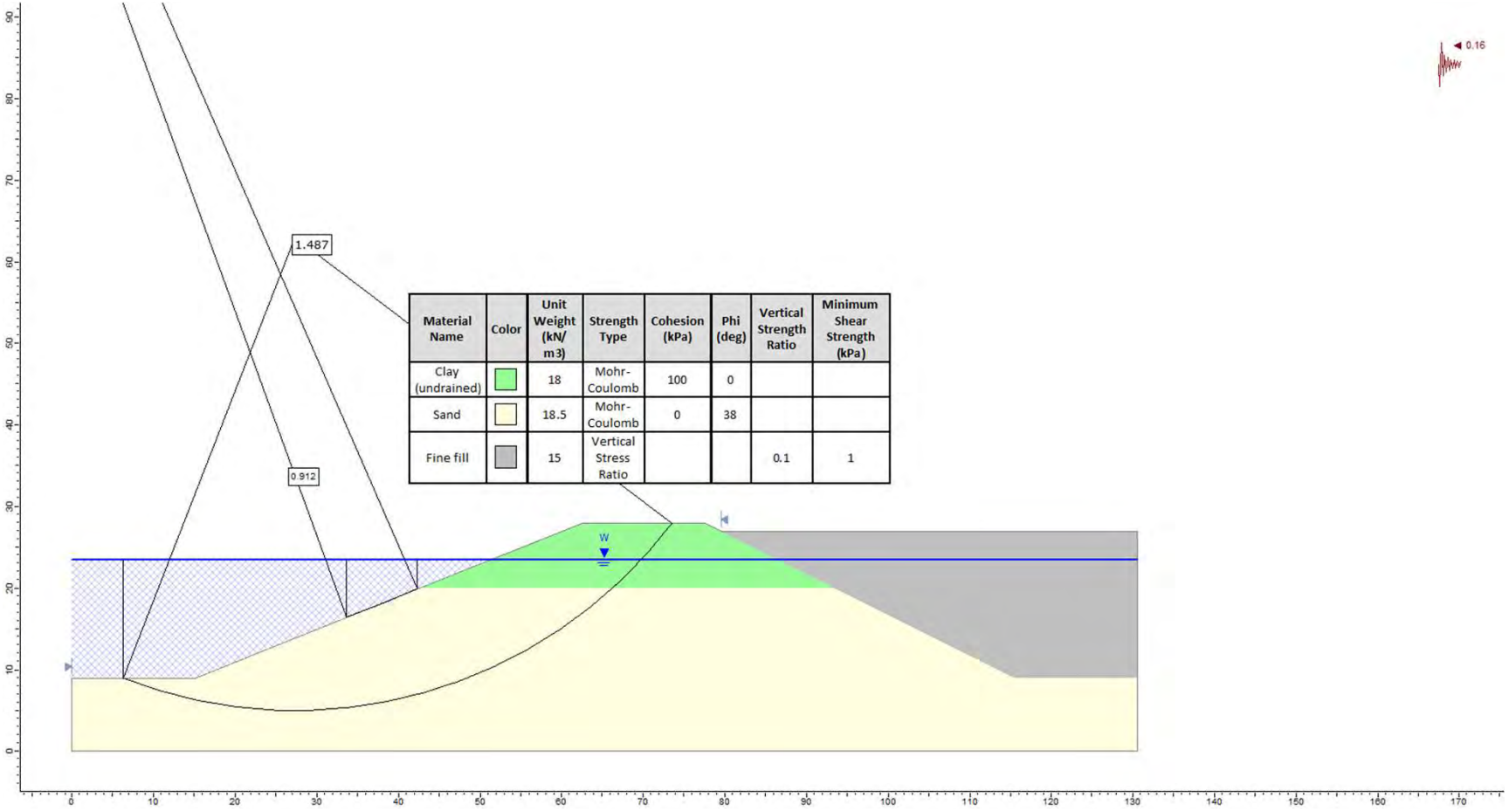
Case C2-6c

Embankment C – central impoundment

Section C-C’

Seismic conditions

Recovered water table



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)	Vertical Strength Ratio	Minimum Shear Strength (kPa)
Clay (undrained)		18	Mohr-Coulomb	100	0		
Sand		18.5	Mohr-Coulomb	0	38		
Fine fill		15	Vertical Stress Ratio			0.1	1

CMW Geosciences

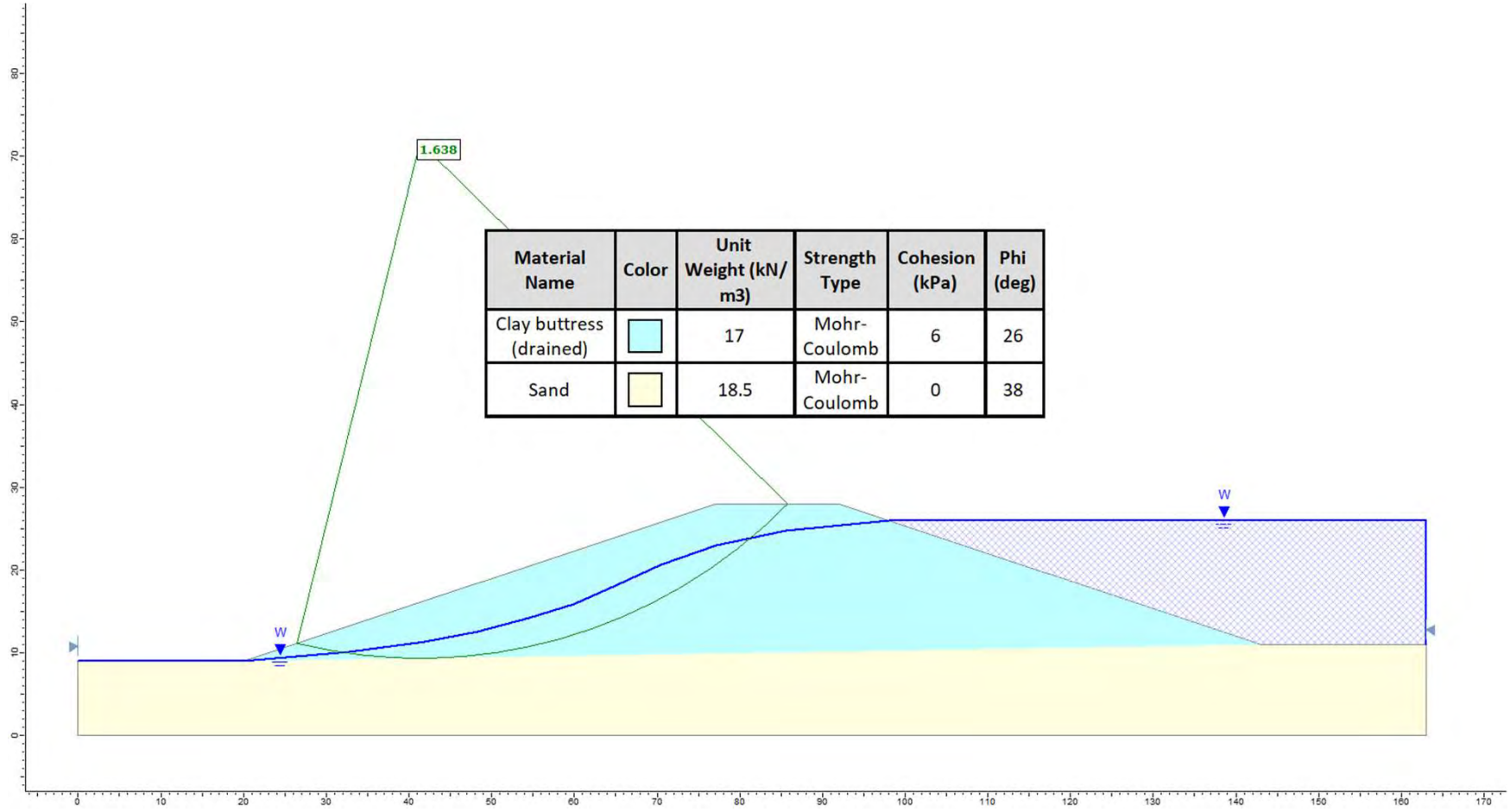
DRAWN: SP	PROJECT: MEL2022-0033AE
CHECKED : JS	FIGURE: App C 23
REVISION: 2	SCALE: as shown (metres)
DATE: 27 / 11 / 2023	SHEET: 1 of 1

Case C2-7

Embankment D – eastern storage

Section D-D'

Static conditions



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay buttress (drained)		17	Mohr-Coulomb	6	26
Sand		18.5	Mohr-Coulomb	0	38

CMW Geosciences

DRAWN: SP	PROJECT: MEL2022-0033AE
CHECKED : JS	FIGURE: App C 24
REVISION: 2	SCALE: as shown (metres)
DATE: 27 / 11 / 2023	SHEET: 1 of 1

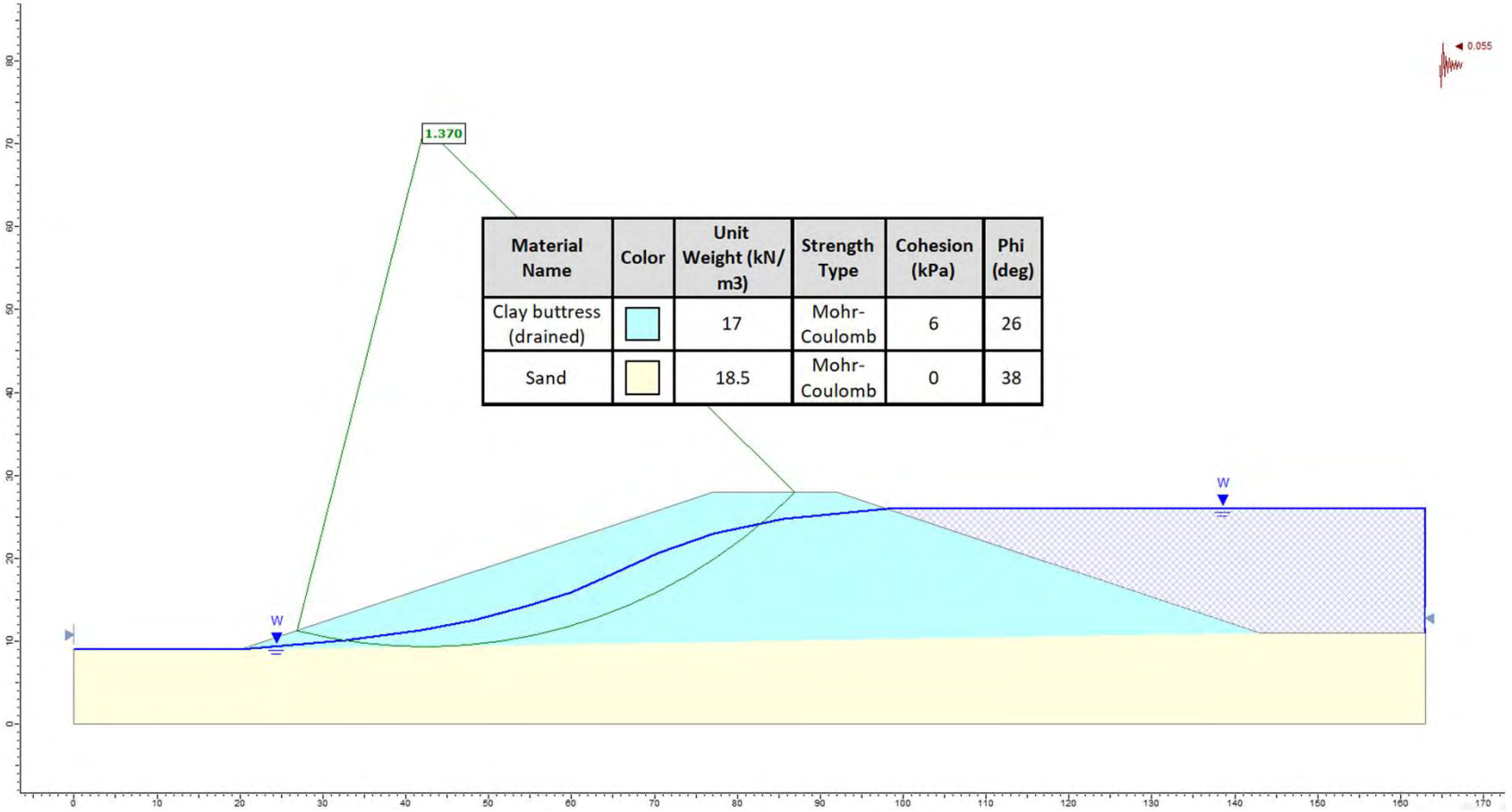
Case C2-8a

Embankment D – eastern storage

Section D-D'

Seismic conditions

Drained clay properties



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay buttress (drained)		17	Mohr-Coulomb	6	26
Sand		18.5	Mohr-Coulomb	0	38

CMW Geosciences

DRAWN: SP	PROJECT: MEL2022-0033AE
CHECKED : JS	FIGURE: App C 25
REVISION: 2	SCALE: as shown (metres)
DATE: 27 / 11 / 2023	SHEET: 1 of 1

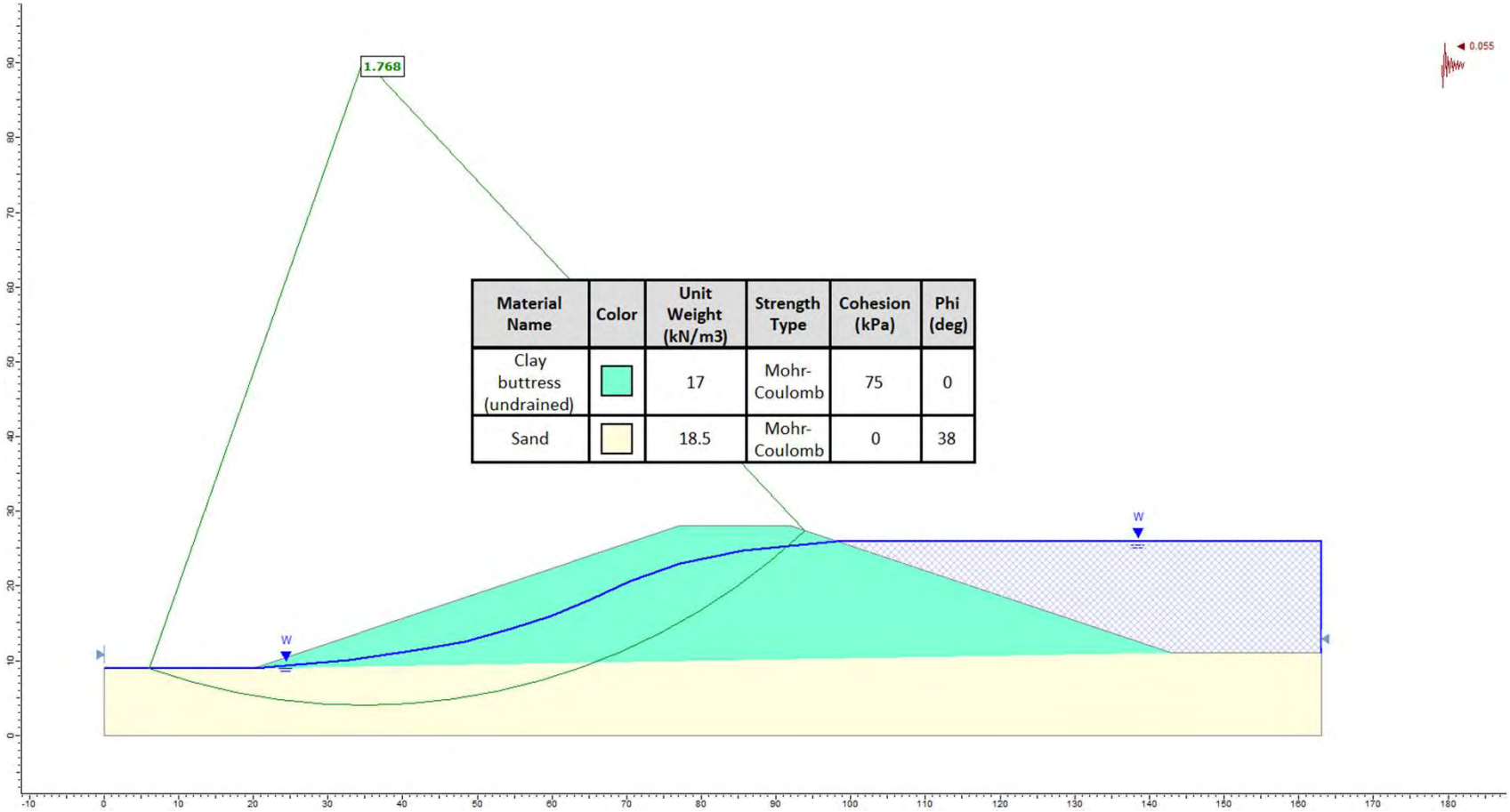
Case C2-8b

Embankment D – eastern storage

Section D-D’

Seismic conditions

Undrained clay properties



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay buttress (undrained)		17	Mohr-Coulomb	75	0
Sand		18.5	Mohr-Coulomb	0	38

CMW Geosciences

DRAWN: SP	PROJECT: MEL2022-0033AE
CHECKED : JS	FIGURE: App C 26
REVISION: 2	SCALE: as shown (metres)
DATE: 27 / 11 / 2023	SHEET: 1 of 1

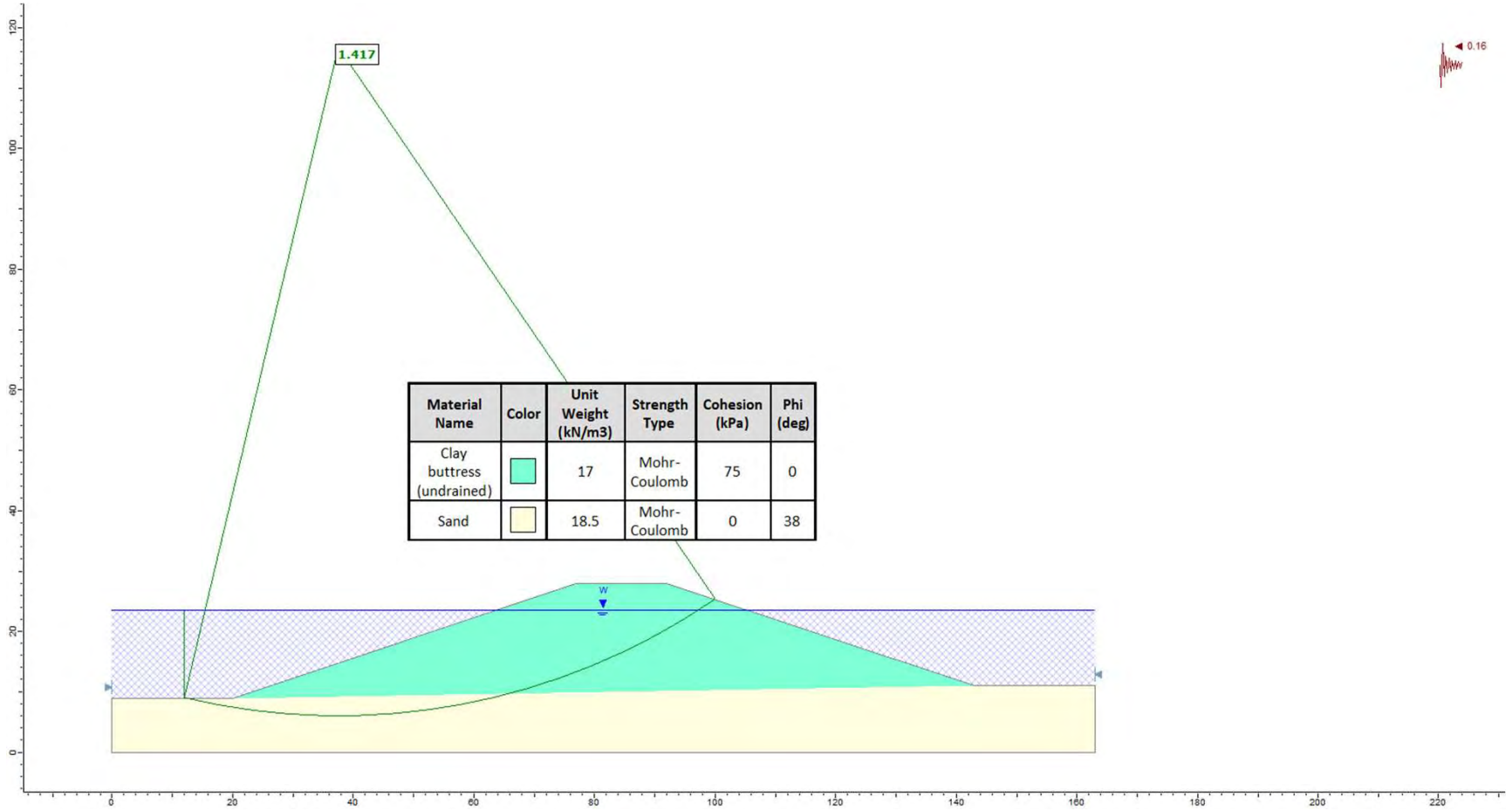
Case C2-8c

Embankment D – eastern storage

Section D-D’

Seismic conditions

Recovered water table



Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay buttress (undrained)		17	Mohr-Coulomb	75	0
Sand		18.5	Mohr-Coulomb	0	38

CMW Geosciences

DRAWN: SP	PROJECT: MEL2022-0033AE
CHECKED : JS	FIGURE: App C 27
REVISION: 2	SCALE: as shown (metres)
DATE: 27 / 11 / 2023	SHEET: 1 of 1

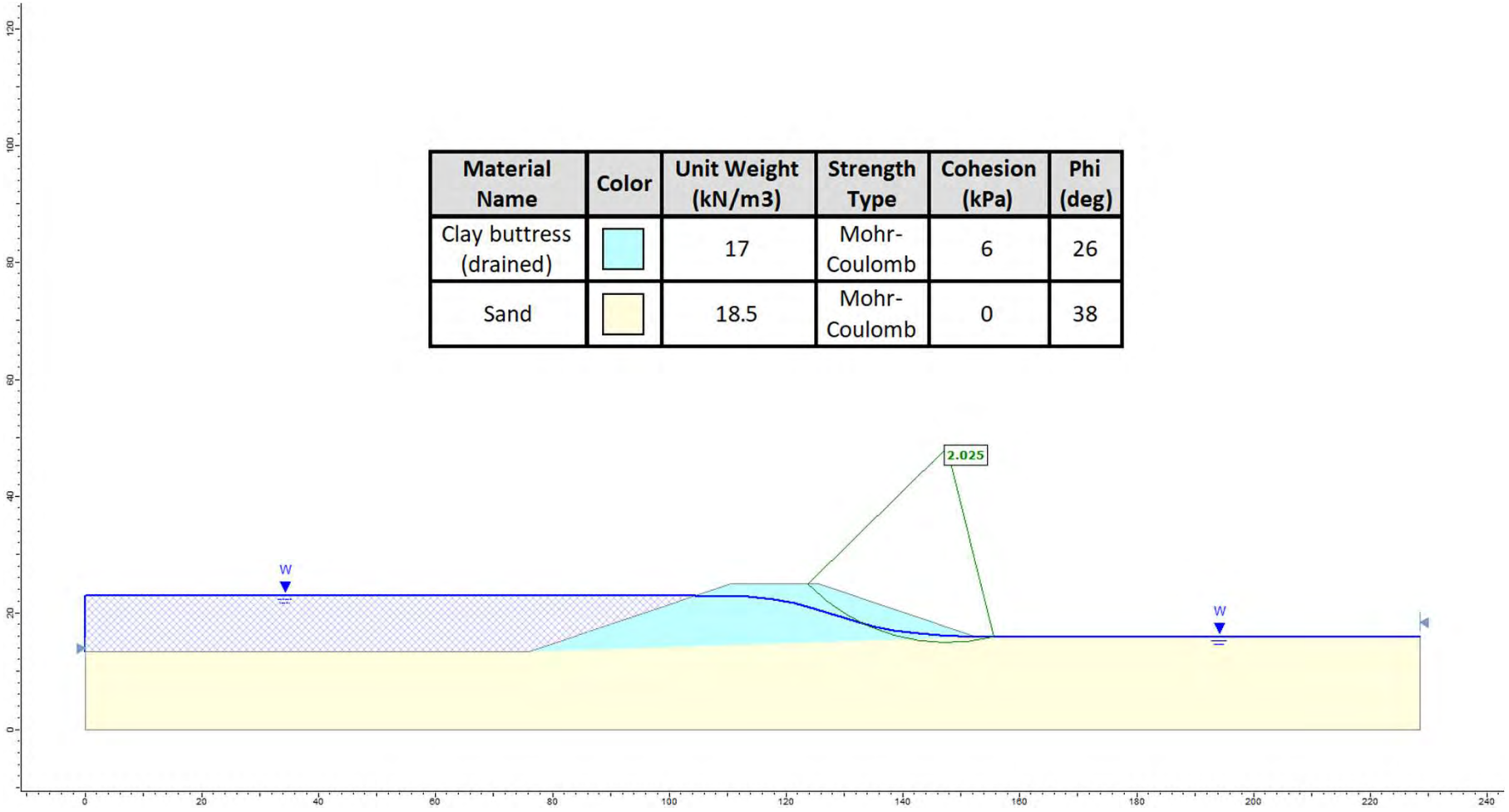
Case C2-9

Embankment E – eastern pit storage

Section E-E'

Static conditions

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay buttress (drained)		17	Mohr-Coulomb	6	26
Sand		18.5	Mohr-Coulomb	0	38



CMW Geosciences	DRAWN: SP	PROJECT: MEL2022-0033AE
	CHECKED : JS	FIGURE: App C 28
	REVISION: 2	SCALE: as shown (metres)
	DATE: 27 / 11 / 2023	SHEET: 1 of 1

Case C2-10a

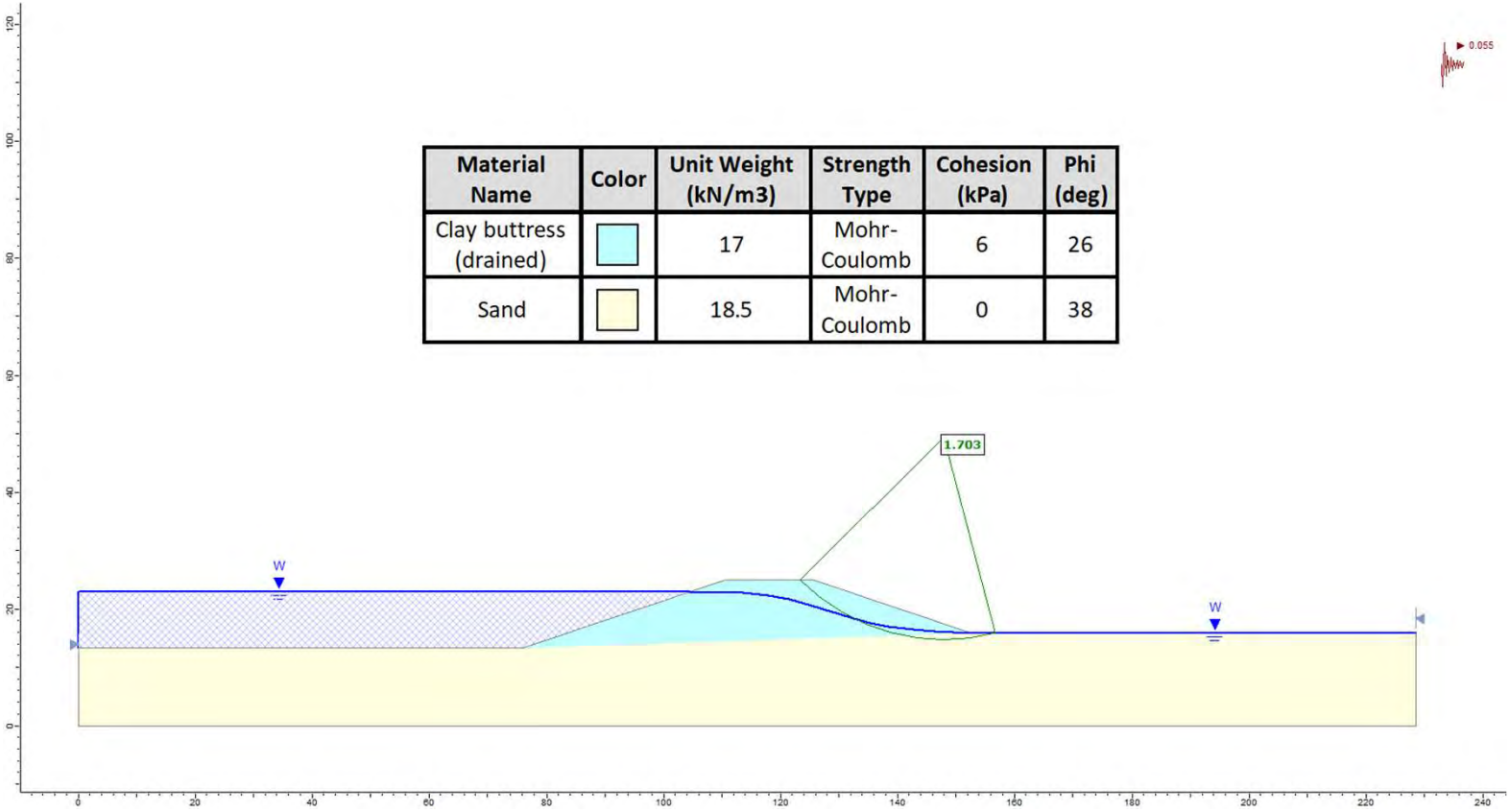
Embankment E – eastern pit storage

Section E-E'

Seismic conditions

Drained clay properties

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay buttress (drained)		17	Mohr-Coulomb	6	26
Sand		18.5	Mohr-Coulomb	0	38



CMW Geosciences	DRAWN: SP	PROJECT: MEL2022-0033AE
	CHECKED : JS	FIGURE: App C 29
	REVISION: 2	SCALE: as shown (metres)
	DATE: 27 / 11 / 2023	SHEET: 1 of 1

Case C210b

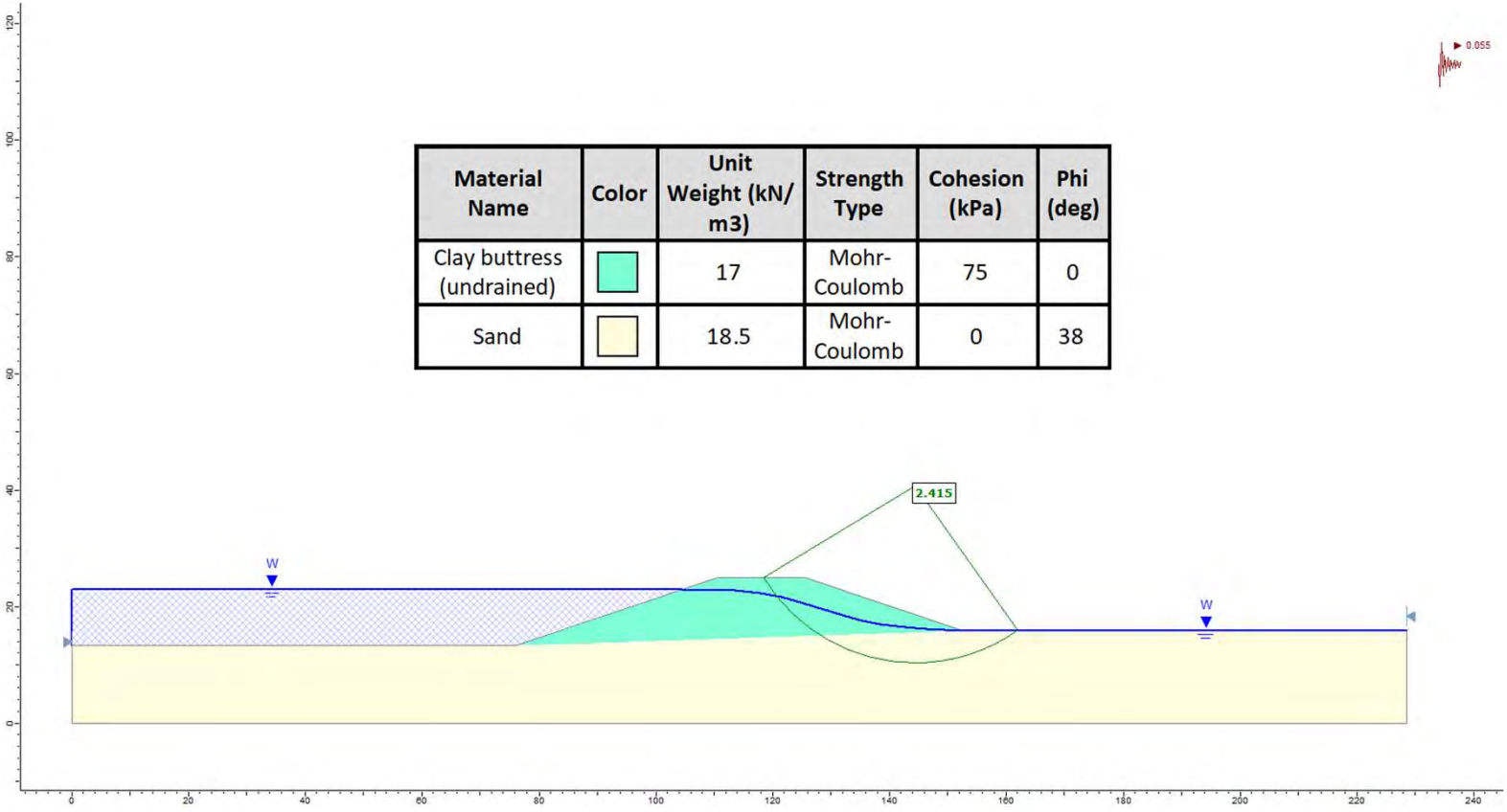
Embankment E – eastern pit storage

Section E-E'

Seismic conditions

Undrained clay properties

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay buttress (undrained)		17	Mohr-Coulomb	75	0
Sand		18.5	Mohr-Coulomb	0	38



DRAWN: SP	PROJECT: MEL2022-0033AE
CHECKED : JS	FIGURE: App C 30
REVISION: 2	SCALE: as shown (metres)
DATE: 27 / 11 / 2023	SHEET: 1 of 1

CMW Geosciences

Case C2-10c

Embankment E – eastern pit storage

Section E-E'

Seismic conditions

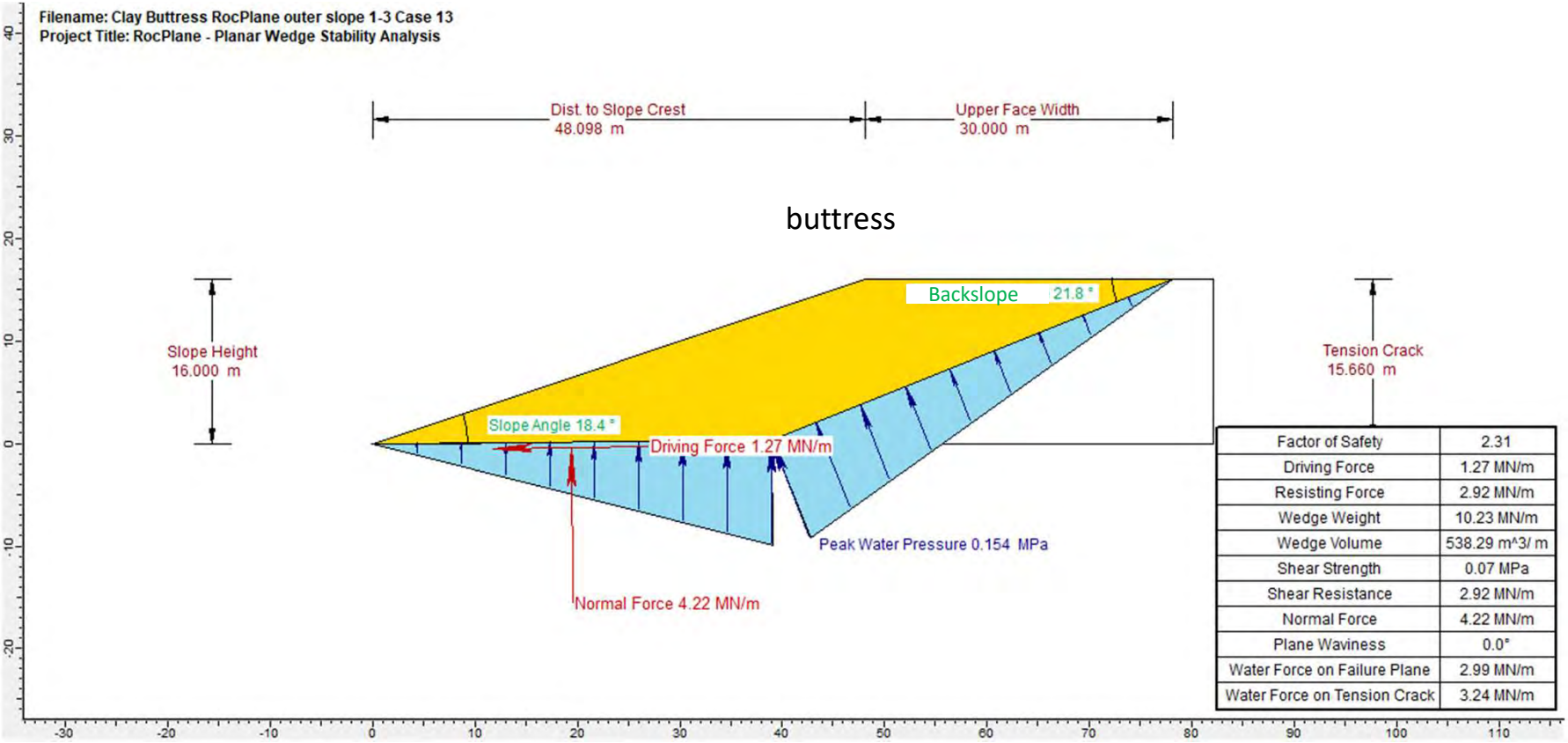
Undrained clay properties

Material Name	Color	Unit Weight (kN/m3)	Strength Type	Cohesion (kPa)	Phi (deg)
Clay buttress (undrained)		17	Mohr-Coulomb	75	0
Sand		18.5	Mohr-Coulomb	0	38

CMW Geosciences	DRAWN: SP	PROJECT: MEL2022-0033AE
	CHECKED : JS	FIGURE: App C 31
	REVISION: 2	SCALE: as shown (metres)
	DATE: 27 / 11 / 2023	SHEET: 1 of 1

Excavation to +9m RL

Undrained clay material properties (c'=75 kPa)



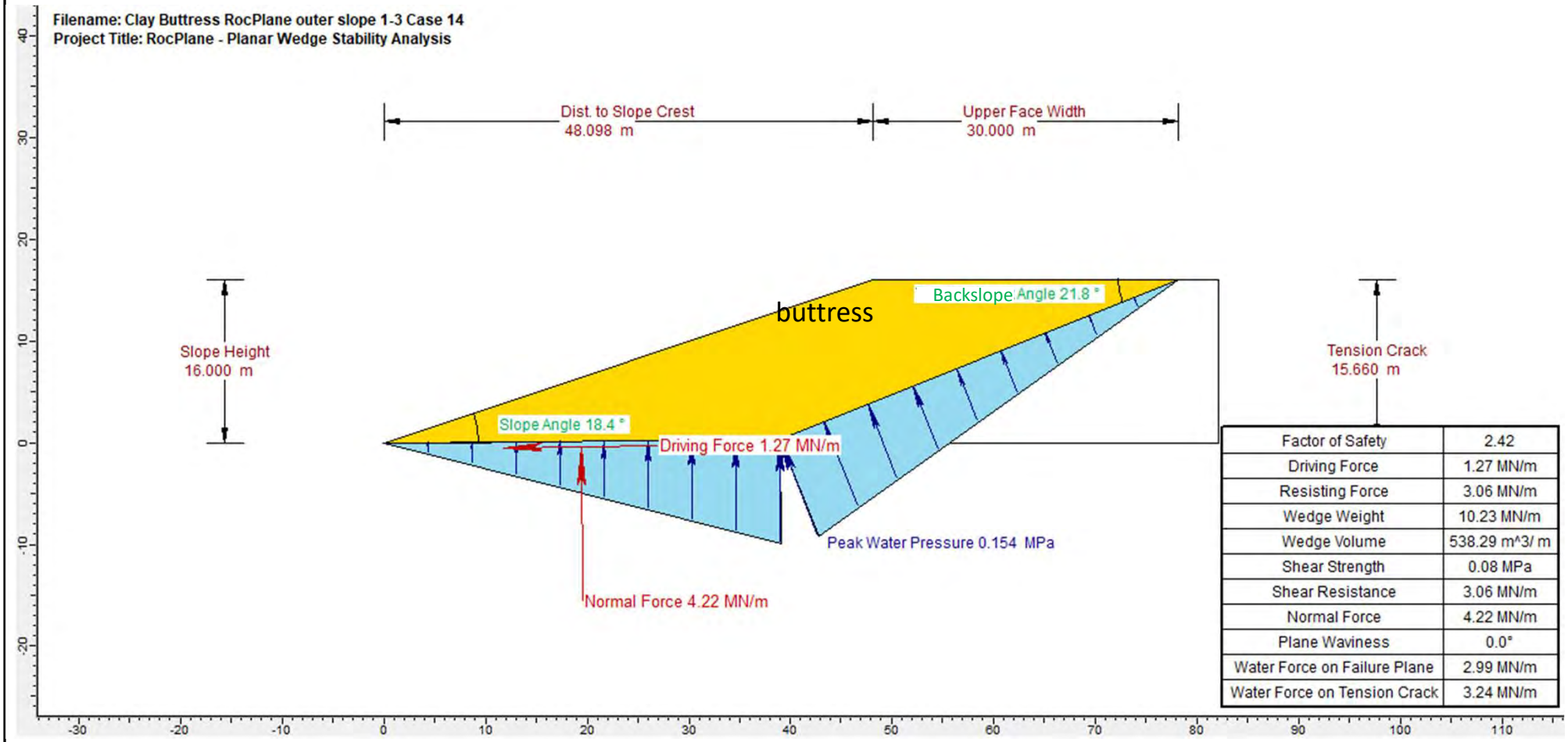
Factor of Safety	2.31
Driving Force	1.27 MN/m
Resisting Force	2.92 MN/m
Wedge Weight	10.23 MN/m
Wedge Volume	538.29 m^3/ m
Shear Strength	0.07 MPa
Shear Resistance	2.92 MN/m
Normal Force	4.22 MN/m
Plane Waviness	0.0°
Water Force on Failure Plane	2.99 MN/m
Water Force on Tension Crack	3.24 MN/m

CMW Geosciences

DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C 32
REVISION: 2	SCALE: as shown (metres)
DATE: 27 / 11 / 2023	SHEET: 1 of 1

Excavation to +9m RL

Sand material properties (ϕ'=36°)



Factor of Safety	2.42
Driving Force	1.27 MN/m
Resisting Force	3.06 MN/m
Wedge Weight	10.23 MN/m
Wedge Volume	538.29 m^3/ m
Shear Strength	0.08 MPa
Shear Resistance	3.06 MN/m
Normal Force	4.22 MN/m
Plane Waviness	0.0°
Water Force on Failure Plane	2.99 MN/m
Water Force on Tension Crack	3.24 MN/m

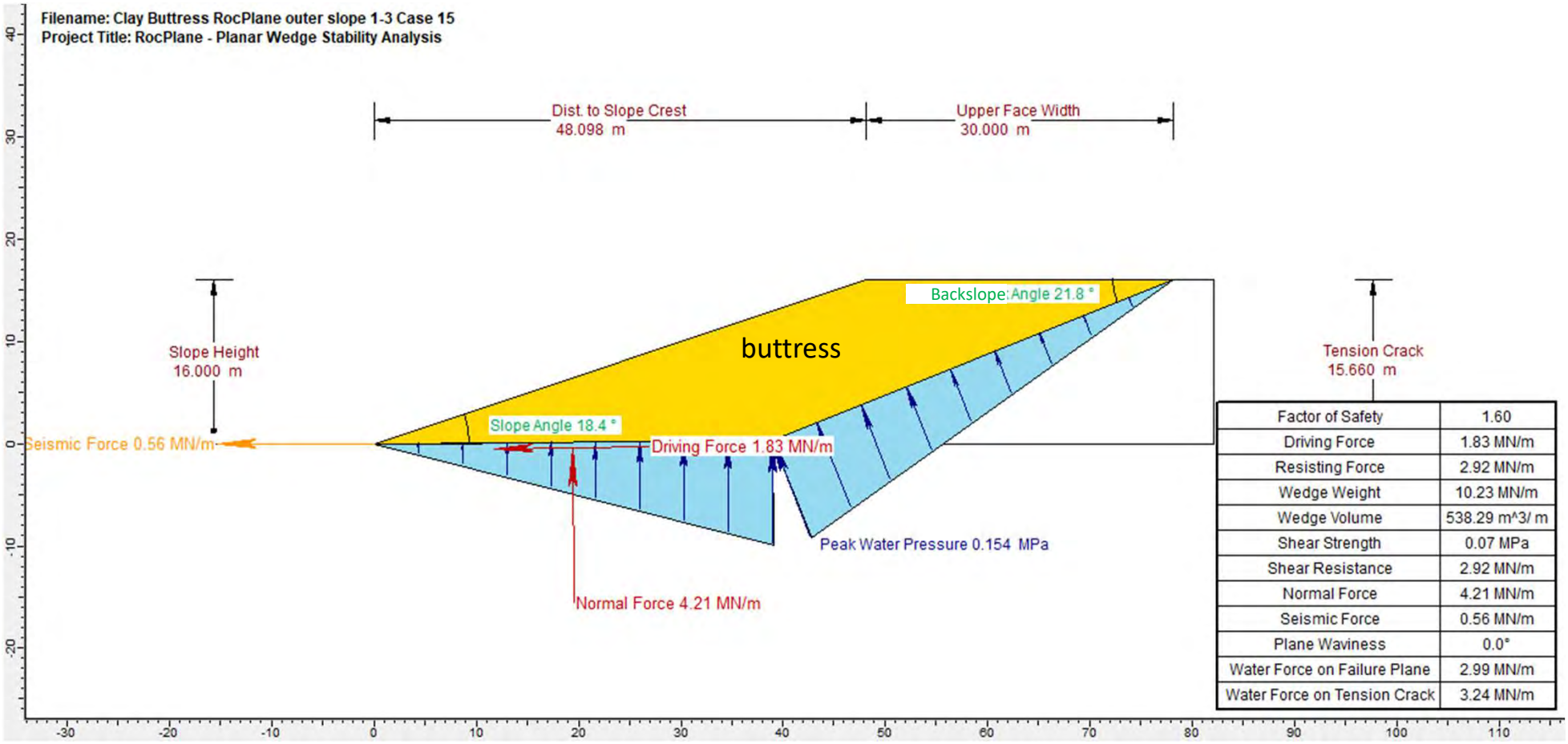
CMW Geosciences

DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C 33
REVISION: 2	SCALE: as shown (metres)
DATE: 27 / 11 / 2023	SHEET: 1 of 1

Excavation to +9m RL

Undrained clay material properties (c'=75 kPa)

Seismic conditions (0.055g horizontal)

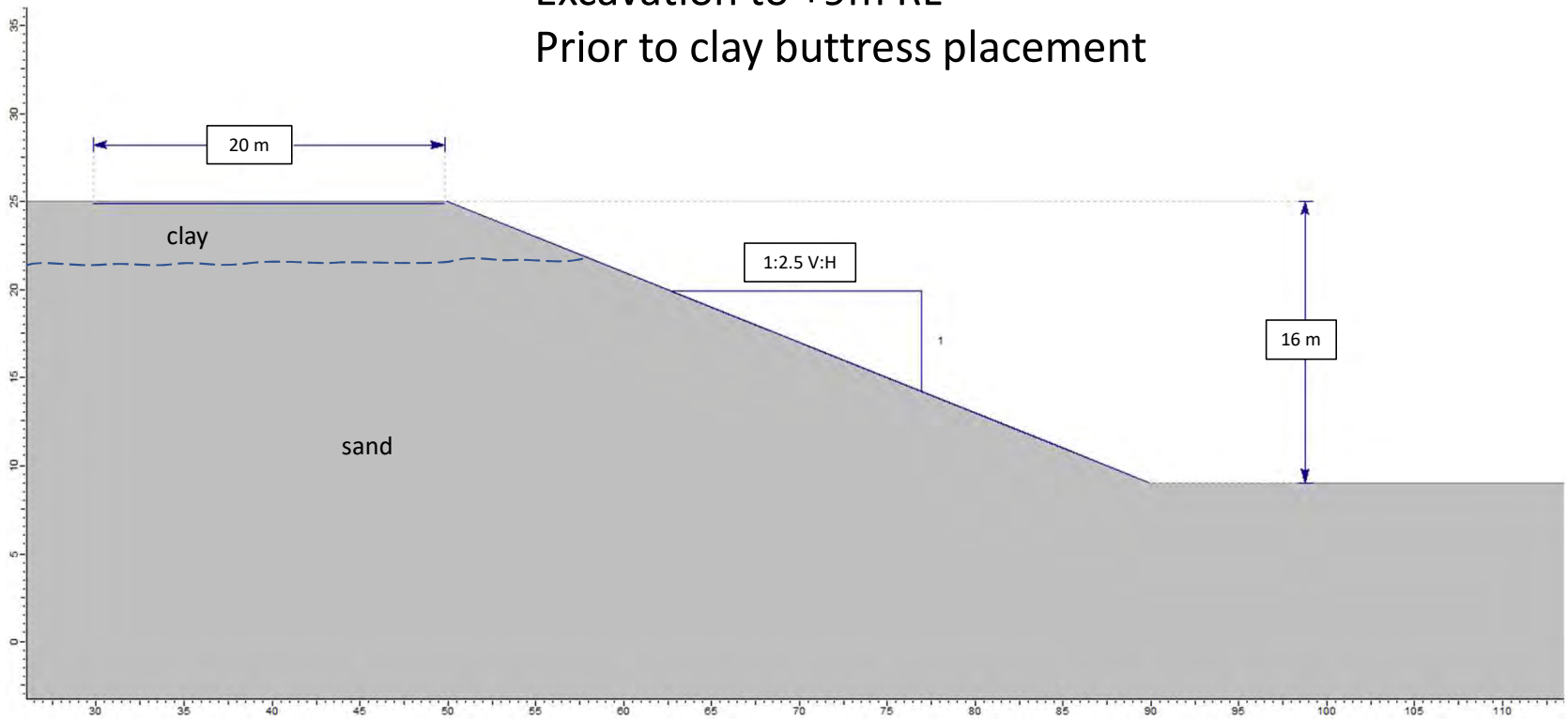


Factor of Safety	1.60
Driving Force	1.83 MN/m
Resisting Force	2.92 MN/m
Wedge Weight	10.23 MN/m
Wedge Volume	538.29 m^3/ m
Shear Strength	0.07 MPa
Shear Resistance	2.92 MN/m
Normal Force	4.21 MN/m
Seismic Force	0.56 MN/m
Plane Waviness	0.0°
Water Force on Failure Plane	2.99 MN/m
Water Force on Tension Crack	3.24 MN/m

CMW Geosciences

DRAWN: JS	PROJECT: MEL2022-0033AE
CHECKED : JM	FIGURE: App C 34
REVISION: 2	SCALE: as shown (metres)
DATE: 27 / 11 / 2023	SHEET: 1 of 1

Excavation to +9m RL
Prior to clay buttress placement

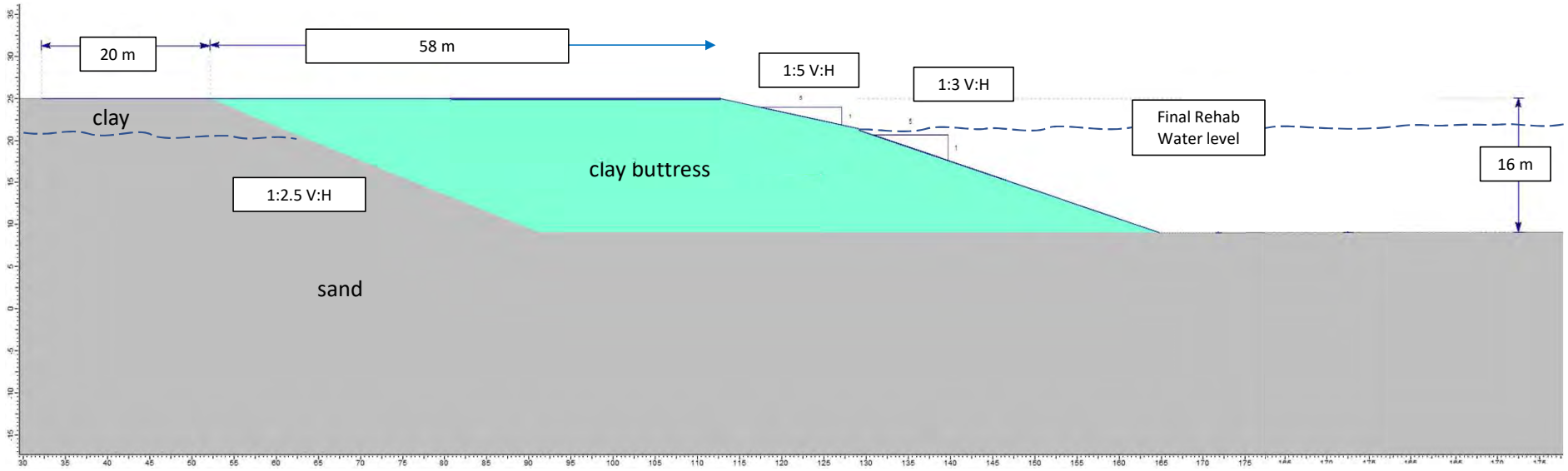


Natural clay-sand boundary depth varies

CMW Geosciences	DRAWN: JS	PROJECT: MEL2022-0033AE
	CHECKED : JM	FIGURE: App C 35
	REVISION: 2	SCALE: as shown (metres)
	DATE: 27 / 11 / 2023	SHEET: 1 of 1

Excavation to +9m RL
With clay buttress placed for waterway diversion

Waterway diversion
in place

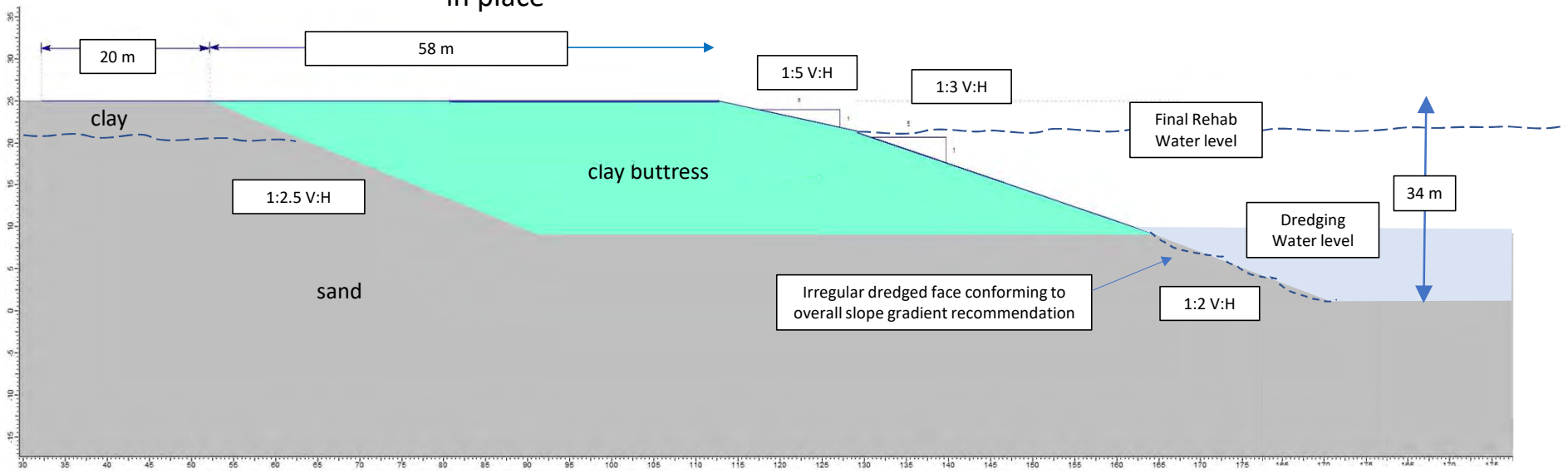


Natural clay-sand boundary depth varies
Clay buttress crest 30 m wide at top in locations where waterway diversion not present

CMW Geosciences	DRAWN: JS	PROJECT: MEL2022-0033AE
	CHECKED : JM	FIGURE: App C 36
	REVISION: 2	SCALE: as shown (metres)
	DATE: 27 / 11 / 2023	SHEET: 1 of 1

Excavation to -9m RL
With clay buttress placed for waterway diversion
Dredged excavation below +9 mRL

Waterway diversion
in place



Natural clay-sand boundary depth varies
Clay buttress crest 30 m wide at top in locations
where waterway diversion not present

CMW Geosciences	DRAWN: JS	PROJECT: MEL2022-0033AE
	CHECKED : JM	FIGURE: App C 37
	REVISION: 2	SCALE: as shown (metres)
	DATE: 27 / 11 / 2023	SHEET: 1 of 1