



Tonkin & Taylor

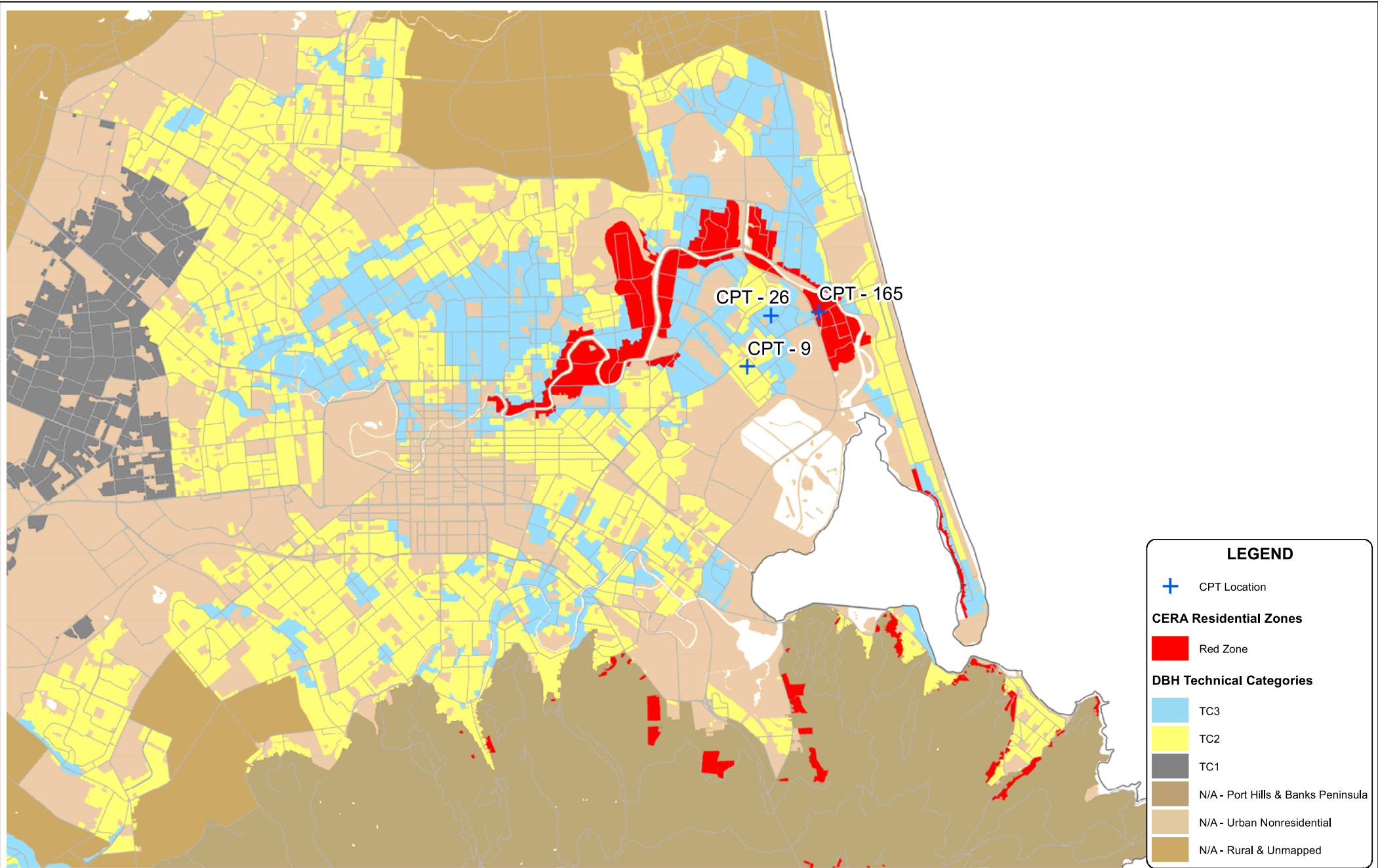
Appendix D: Individual CPT analyses

ENVIRONMENTAL AND ENGINEERING CONSULTANTS



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LEGEND

- + CPT Location

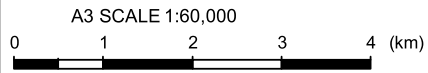
CERA Residential Zones

- Red Zone

DBH Technical Categories

- TC3
- TC2
- TC1
- N/A - Port Hills & Banks Peninsula
- N/A - Urban Nonresidential
- N/A - Rural & Unmapped

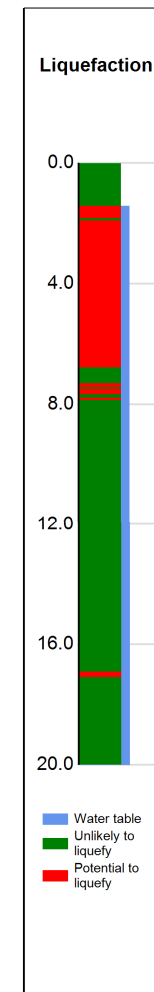
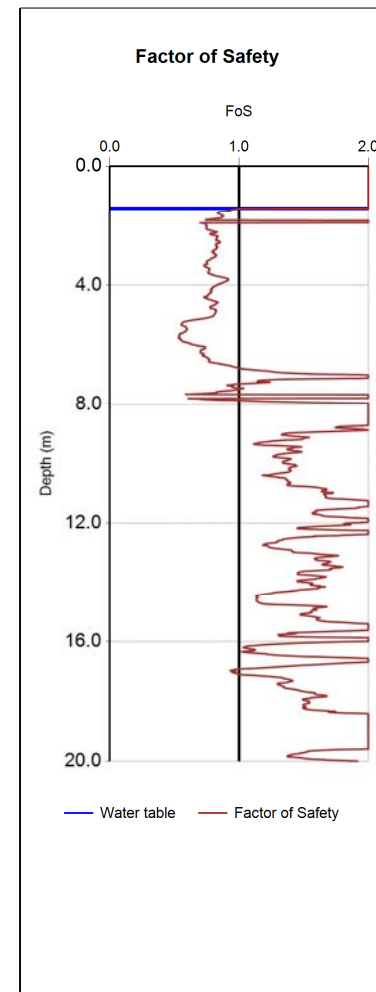
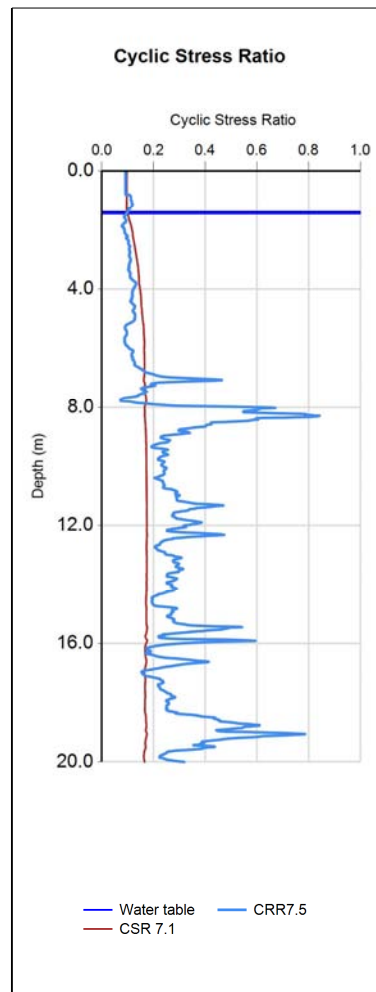
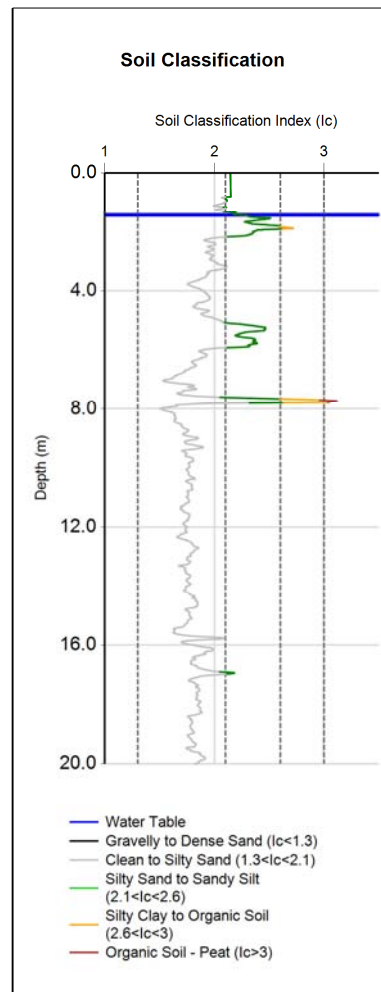
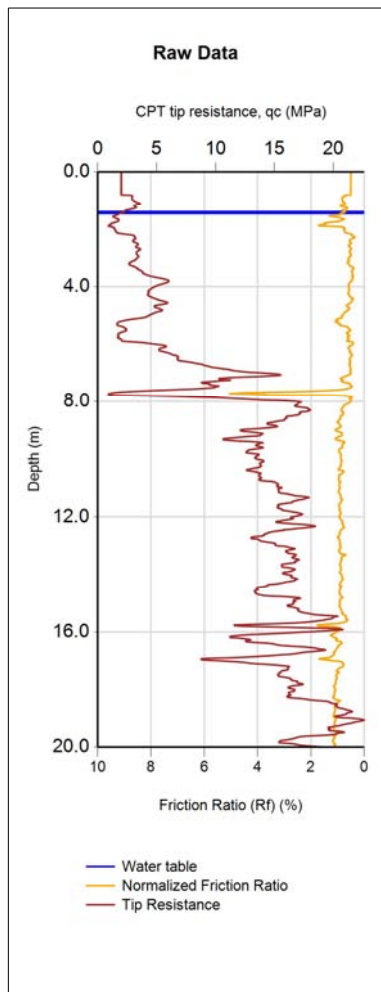
Notes: Road Database supplied by Terralink International Ltd. Rivers, lagoons and coastline licensed under Creative Commons Attribution 3.0 New Zealand and sourced from LINZ. Crown Copyright Reserved



DRAWN	CXP	Feb.13
CHECKED		
APPROVED		
ARCFILE	52020-0200-CPT007	
SCALE (AT A3 SIZE)	1:60,000	
PROJECT No.	52020-0200	

**EARTHQUAKE COMMISSION
CHRISTCHURCH CITY**
Seleted CPT locations for Case Studies

Date: 25/02/2013 Time: 9:42:24 a.m.



Surcharge used.

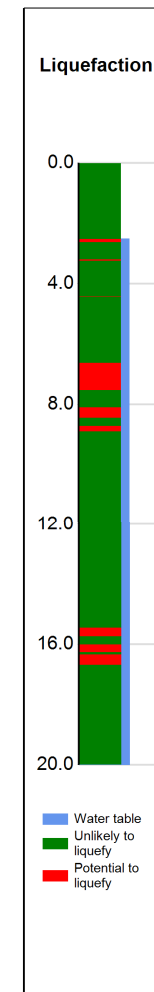
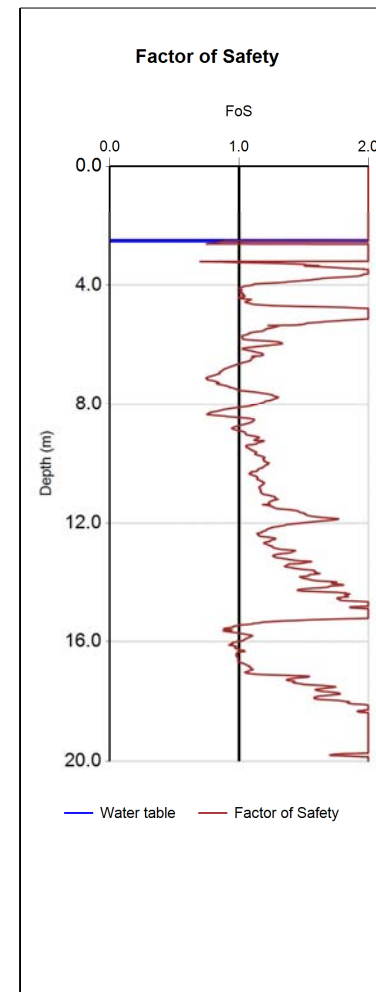
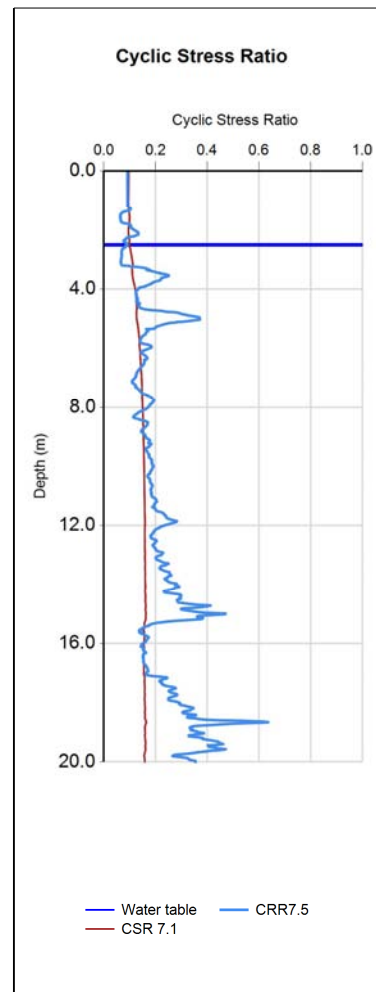
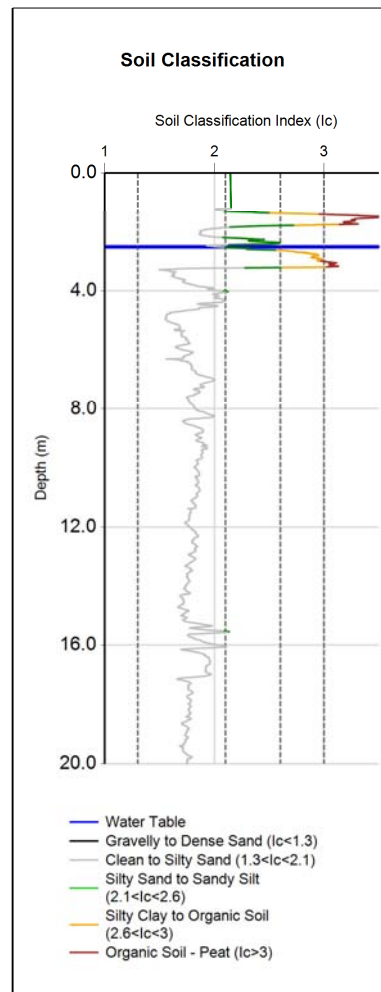
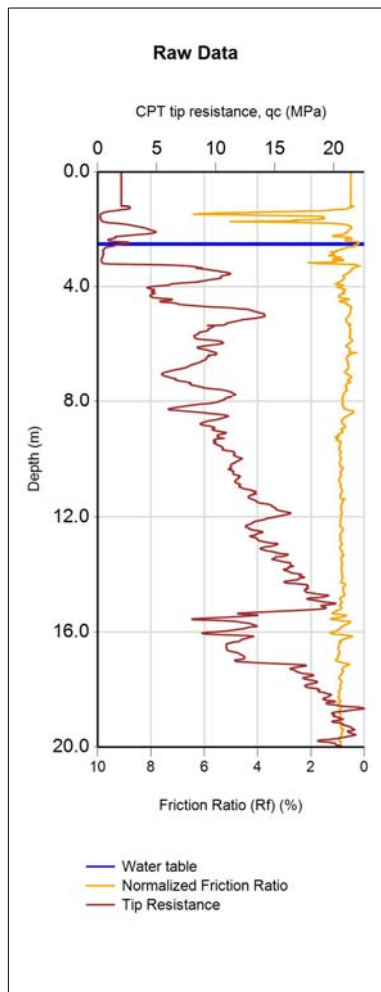
(Assumed predrill values)

CPT Name	Database ID	Investigation Date	Event and PGA	Magnitude	PGA (g)	GWD (m)	Trigger Method	Settlement Method	Pre-drill Depth (m)	Qc (MPa)	Fs (MPa)	γ (kN/m³)
INPUT: CPT-BEX-13	165	11/4/2010	CHCH Sept, UoC PGA	7.1	0.1823	1.4262	IB	ZRB	0.8	2	0.01	18

S - Calculated deformation (mm) CTL - Cumulative Thickness of Liquefaction (m) LPI - Liquefaction Potential Index LSN - Liquefaction Severity Number CT - Crust Thickness (m)

OUTPUT:	174	5.8	10	46	1.5
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<p>Tonkin & Taylor Environmental and Engineering consultants V1.1</p>	CLIENT, PROJECT	EQC Data analysis of increased vulnerability to liquefaction for the Canterbury Earthquake Sequence	LOCATION	Christchurch	DATE	3/4/2013
	TITLE	Case Study CPT - Red Zone, TC3, TC2	JOB NUMBER	52020.0200	ANALYSED	JLSS
			CHECKED		PAGE	Figure D2.A



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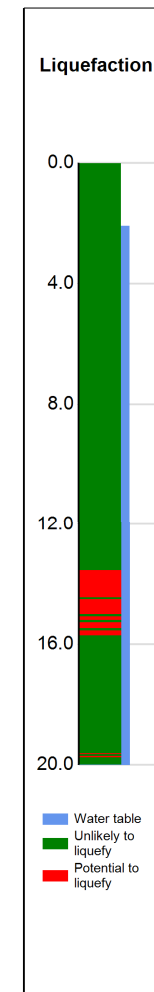
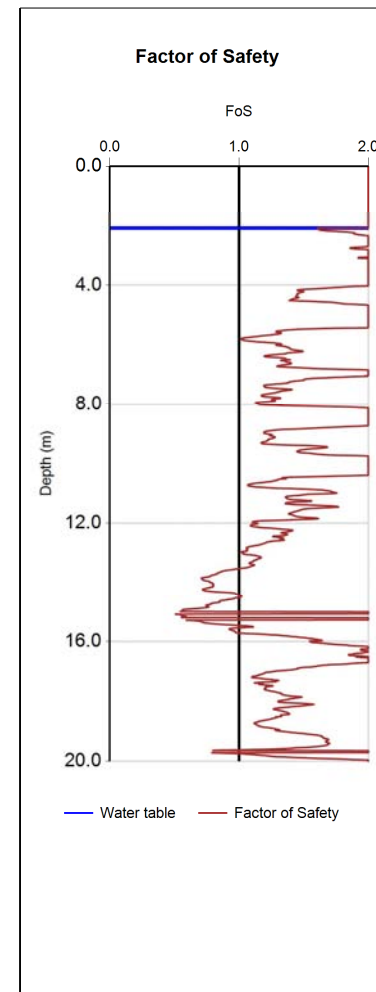
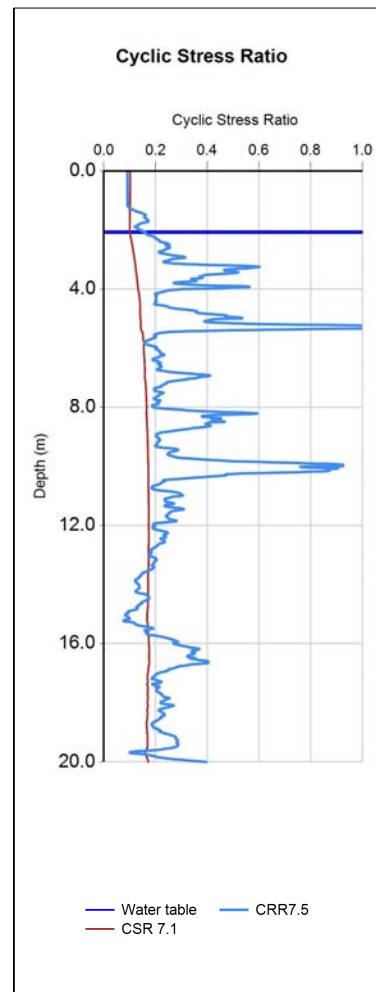
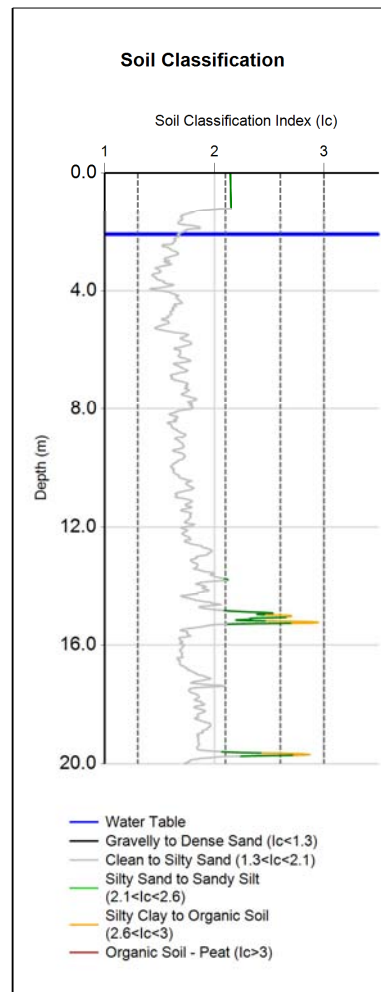
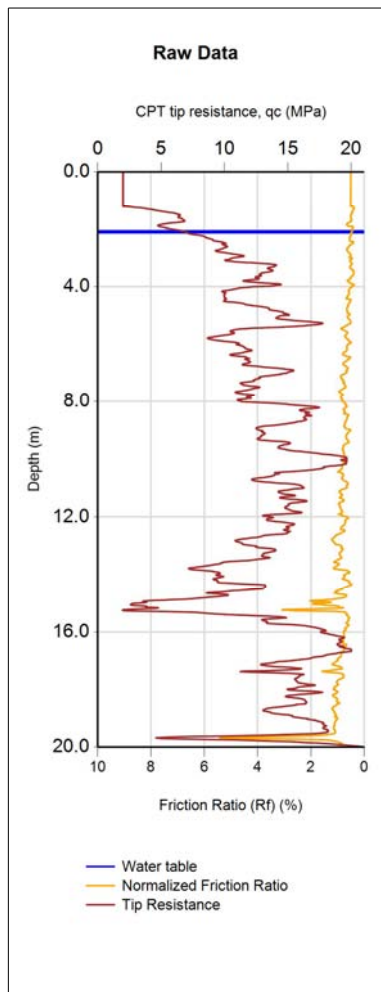
(Assumed predrill values)

CPT Name	Database ID	Investigation Date	Event and PGA	Magnitude	PGA (g)	GWD (m)	Trigger Method	Settlement Method	Pre-drill Depth (m)	Qc (MPa)	Fs (MPa)	γ (kN/m³)
INPUT: CPT-ARN-26	26	5/12/2011	CHCH Sept, UoC PGA	7.1	0.1806	2.514	IB	ZRB	1.2	2	0.01	18

S - Calculated deformation (mm) CTL - Cumulative Thickness of Liquefaction (m) LPI - Liquefaction Potential Index LSN - Liquefaction Severity Number CT - Crust Thickness (m)

OUTPUT:	82	2.4	1	11	2.6
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<p>Tonkin & Taylor Environmental and Engineering consultants V1.1</p>	CLIENT, PROJECT	EQC Data analysis of increased vulnerability to liquefaction for the Canterbury Earthquake Sequence	LOCATION	Christchurch	DATE	3/4/2013
	TITLE	Case Study CPT - Red Zone, TC3, TC2	JOB NUMBER	52020.0200	ANALYSED	JLSS
			CHECKED		PAGE	Figure D2.B



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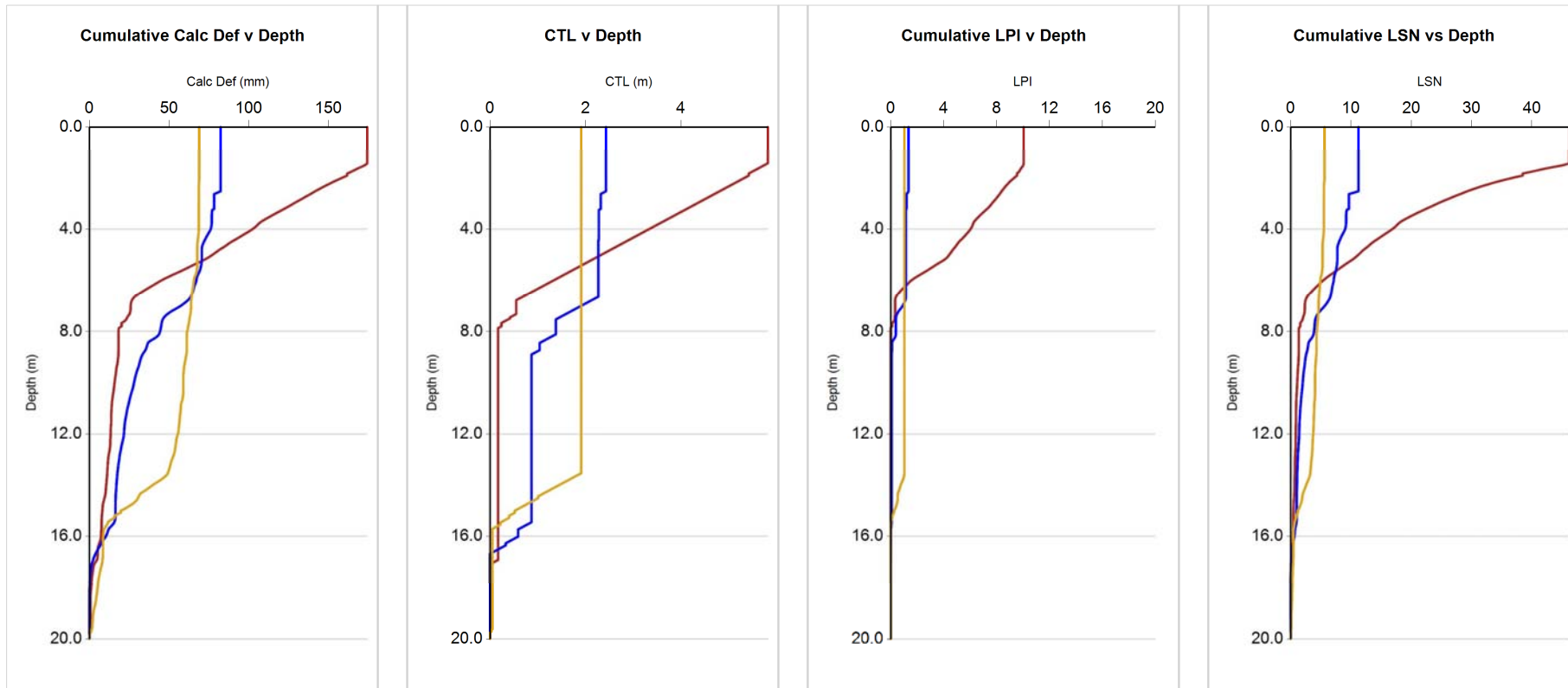
(Assumed predrill values)

CPT Name	Database ID	Investigation Date	Event and PGA	Magnitude	PGA (g)	GWD (m)	Trigger Method	Settlement Method	Pre-drill Depth (m)	Qc (MPa)	Fs (MPa)	γ (kN/m³)
INPUT: CPT-ARN-09	9	5/13/2011	CHCH Sept, UoC PGA	7.1	0.1918	2.0897	IB	ZRB	1.2	2	0.01	18

S - Calculated deformation (mm) CTL - Cumulative Thickness of Liquefaction (m) LPI - Liquefaction Potential Index LSN - Liquefaction Severity Number CT - Crust Thickness (m)

OUTPUT:	69	1.9	1	6	13.6
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<p>Tonkin & Taylor Environmental and Engineering consultants V1.1</p>	CLIENT, PROJECT EQC Data analysis of increased vulnerability to liquefaction for the Canterbury Earthquake Sequence	LOCATION Christchurch	DATE 3/4/2013
	TITLE Case Study CPT - Red Zone, TC3, TC2	JOB NUMBER 52020.0200	ANALYSED JLSS CHECKED PAGE Figure D2.C

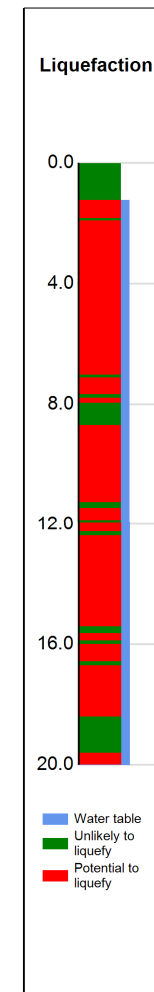
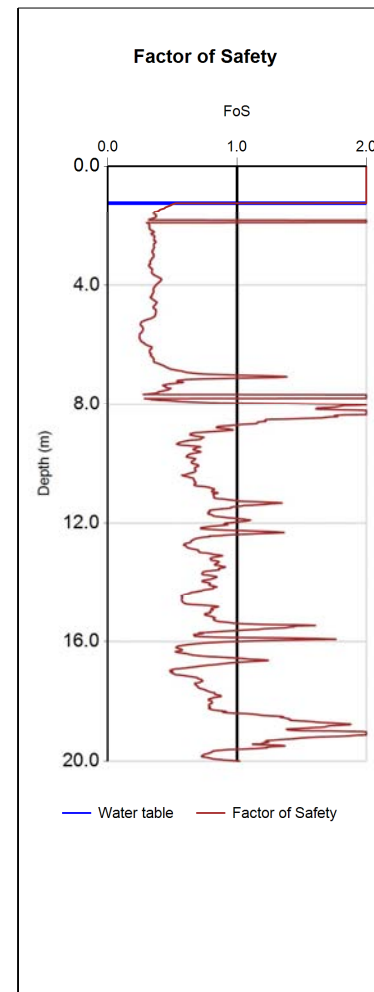
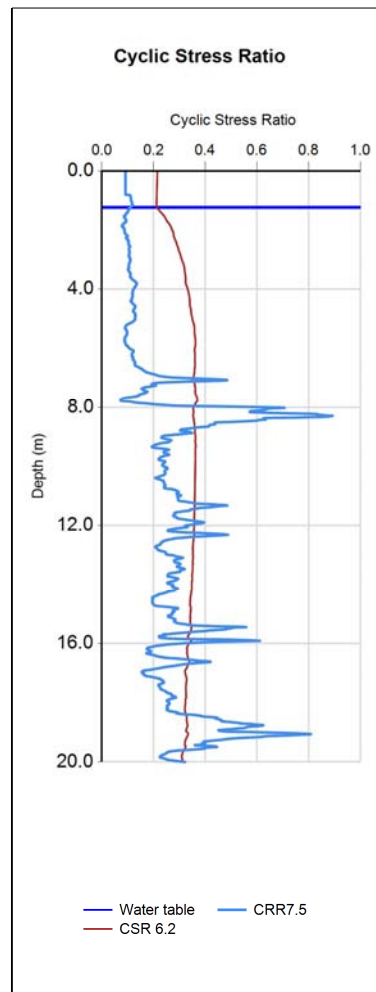
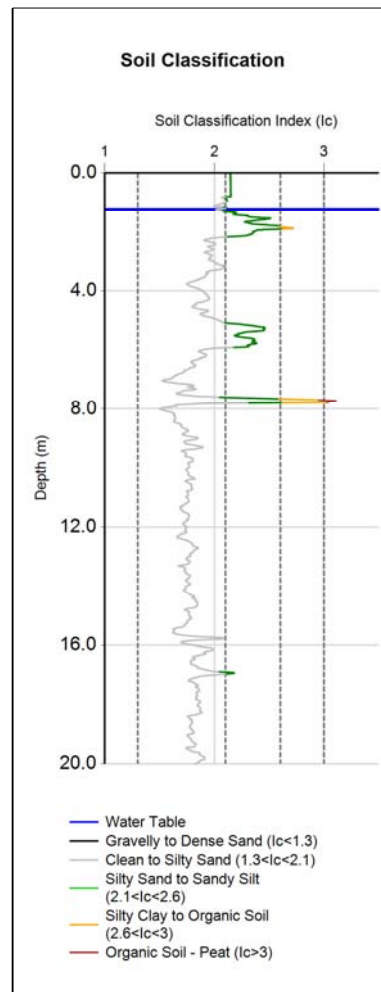
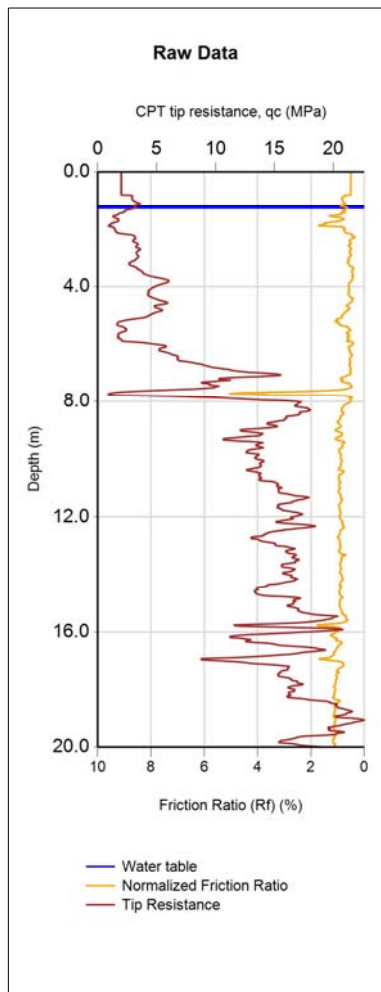


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(Assumed predrill values)

CPT Name	Database ID	Investigation Date	Event and PGA	Magnitude	PGA (g)	GWD (m)	Trigger Method	Settlement Method	Pre Drill Depth (m)	Qc (MPa)	Fs (MPa)	γ (KN/m ³)
CPT-BEX-13	165	11/4/2010	CHCH Sept, UoC PGA	7.1	0.1823	1.4262	IB	ZRB	0.8	2	0.01	18
CPT-ARN-26	26	5/12/2011	CHCH Sept, UoC PGA	7.1	0.1806	2.514	IB	ZRB	1.2	2	0.01	18
CPT-ARN-09	9	5/13/2011	CHCH Sept, UoC PGA	7.1	0.1918	2.0897	IB	ZRB	1.2	2	0.01	18

 Tonkin & Taylor Environmental and Engineering consultants V1.1	CLIENT, PROJECT EQC Data analysis of increased vulnerability to liquefaction for the Canterbury Earthquake Sequence	LOCATION Christchurch	DATE 3/4/2013
	TITLE Case Study CPT - Red Zone, TC3, TC2	JOB NUMBER 52020.0200	ANALYSED JLSS CHECKED PAGE Figure D2.D



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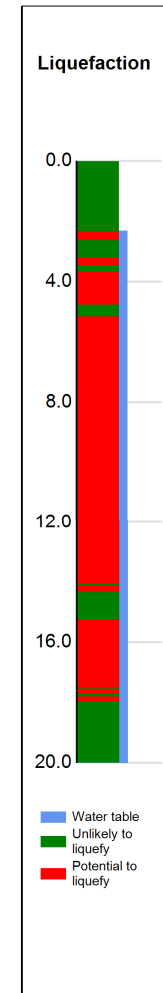
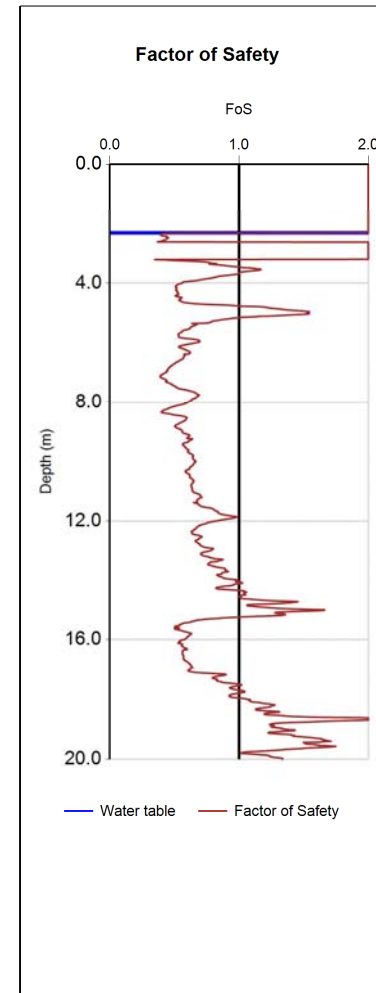
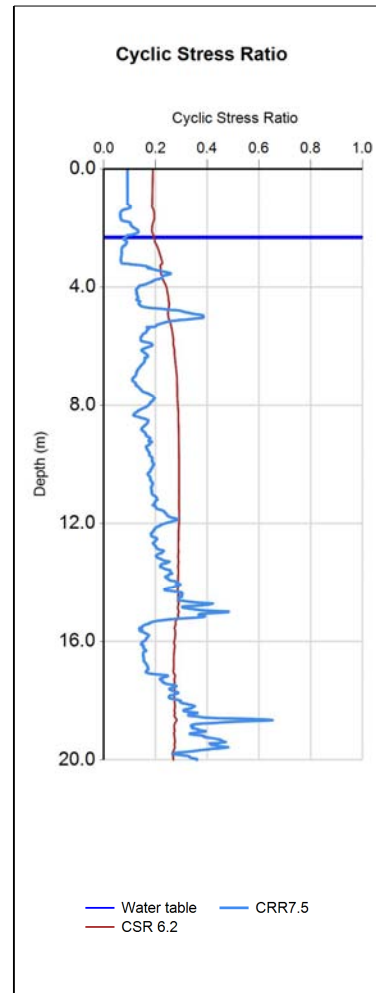
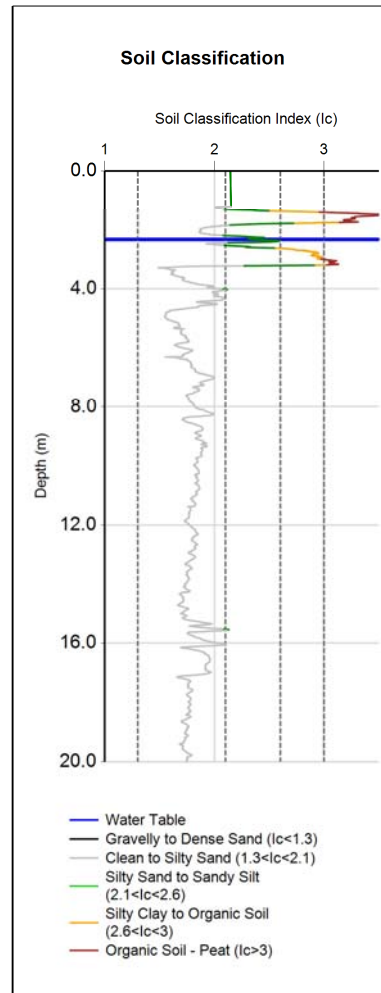
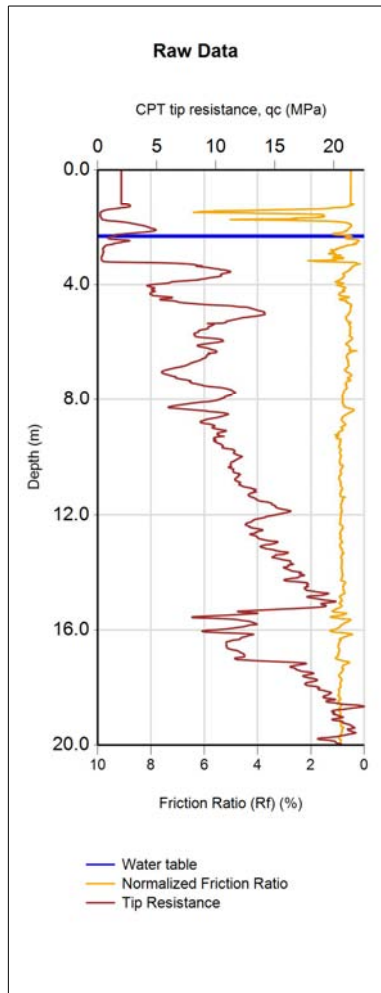
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CPT Name	Database ID	Investigation Date	Event and PGA	Magnitude	PGA (g)	GWD (m)	Trigger Method	Settlement Method	Pre-drill Depth (m)	Qc (MPa)	Fs (MPa)	γ (kN/m³)
INPUT: CPT-BEX-13	165	11/4/2010	CHCH Feb, UoC PGA	6.2	0.5084	1.2339	IB	ZRB	0.8	2	0.01	18

S - Calculated deformation (mm) CTL - Cumulative Thickness of Liquefaction (m) LPI - Liquefaction Potential Index LSN - Liquefaction Severity Number CT - Crust Thickness (m)

OUTPUT:	307	15.5	39	62	1.3
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<p>Tonkin & Taylor Environmental and Engineering consultants V1.1</p>	CLIENT, PROJECT	EQC Data analysis of increased vulnerability to liquefaction for the Canterbury Earthquake Sequence	LOCATION	Christchurch	DATE	3/4/2013
	TITLE	Case Study CPT - Red Zone, TC3, TC2	JOB NUMBER	52020.0200	ANALYSED	JLSS
			CHECKED		PAGE	Figure D3.A

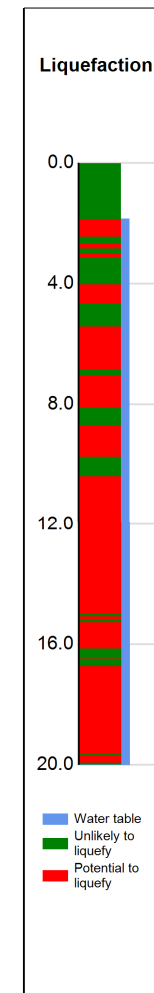
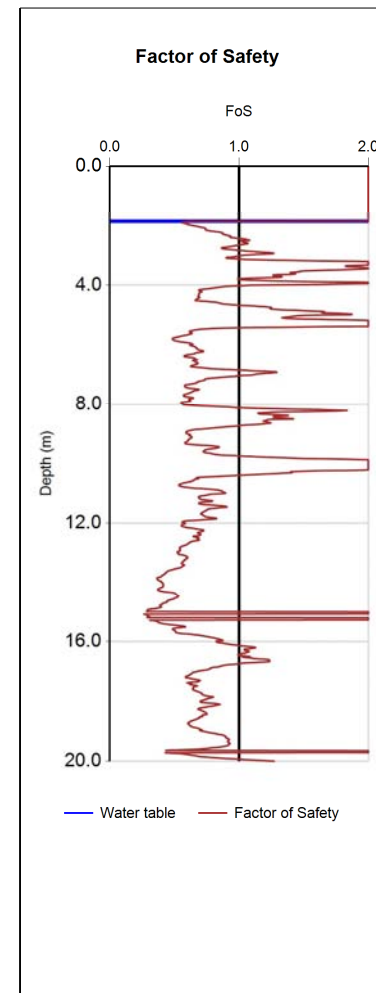
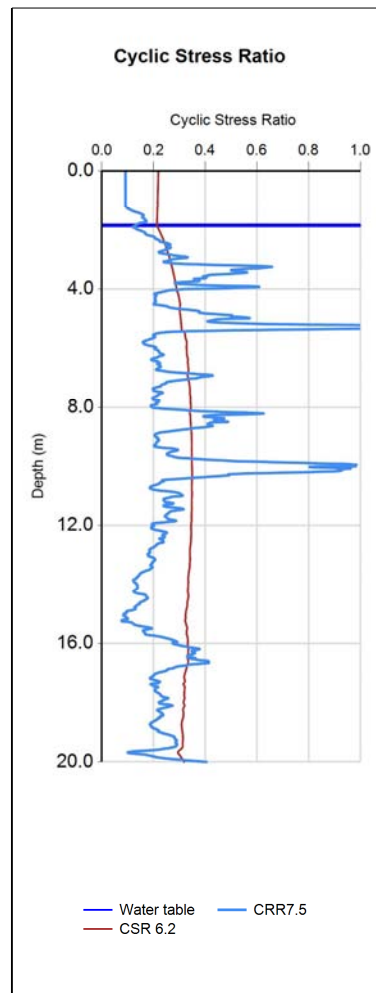
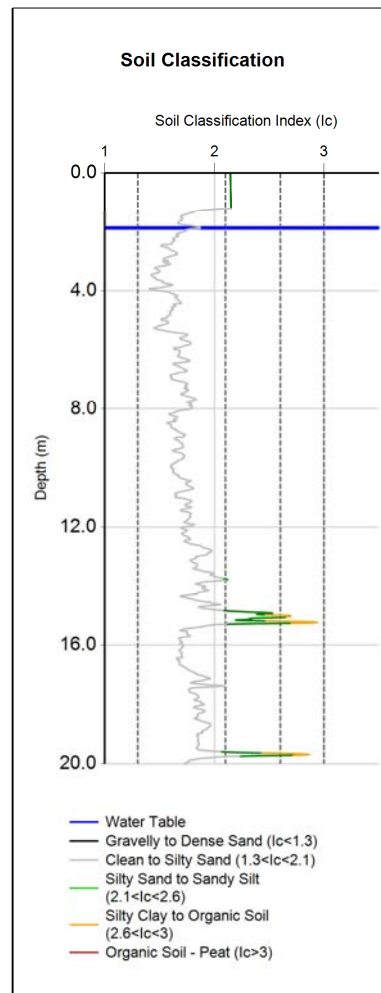
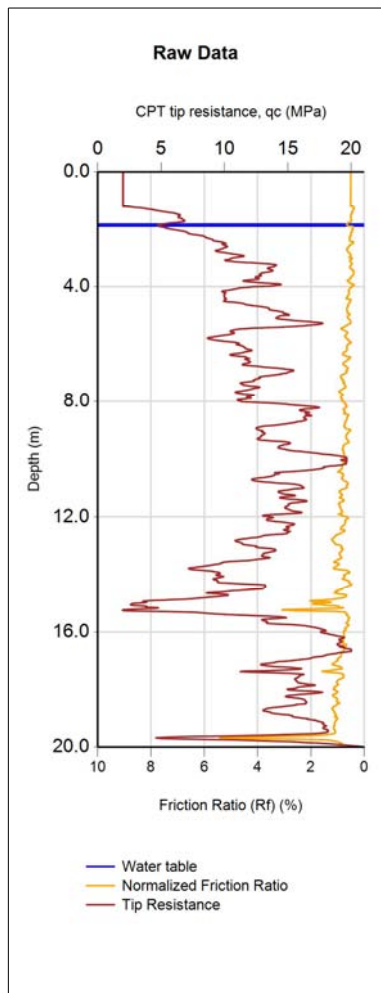


Surcharge used.

(Assumed predrill values)

CPT Name	Database ID	Investigation Date	Event and PGA	Magnitude	PGA (g)	GWD (m)	Trigger Method	Settlement Method	Pre-drill Depth (m)	Qc (MPa)	Fs (MPa)	γ (kN/m³)
INPUT: CPT-ARN-26	26	5/12/2011	CHCH Feb, UoC PGA		6.2	0.4496	IB	ZRB	1.2	2	0.01	18
OUTPUT: S - Calculated deformation (mm)	267	CTL - Cumulative Thickness of Liquefaction (m)	13.3	LPI - Liquefaction Potential Index	24	LSN - Liquefaction Severity Number	35	CT - Crust Thickness (m)	2.4			

<p>Tonkin & Taylor Environmental and Engineering consultants V1.1</p>	CLIENT, PROJECT	EQC Data analysis of increased vulnerability to liquefaction for the Canterbury Earthquake Sequence	LOCATION	Christchurch	DATE	3/4/2013
	TITLE	Case Study CPT - Red Zone, TC3, TC2	JOB NUMBER	52020.0200	CHECKED	JLSS
					PAGE	Figure D3.B

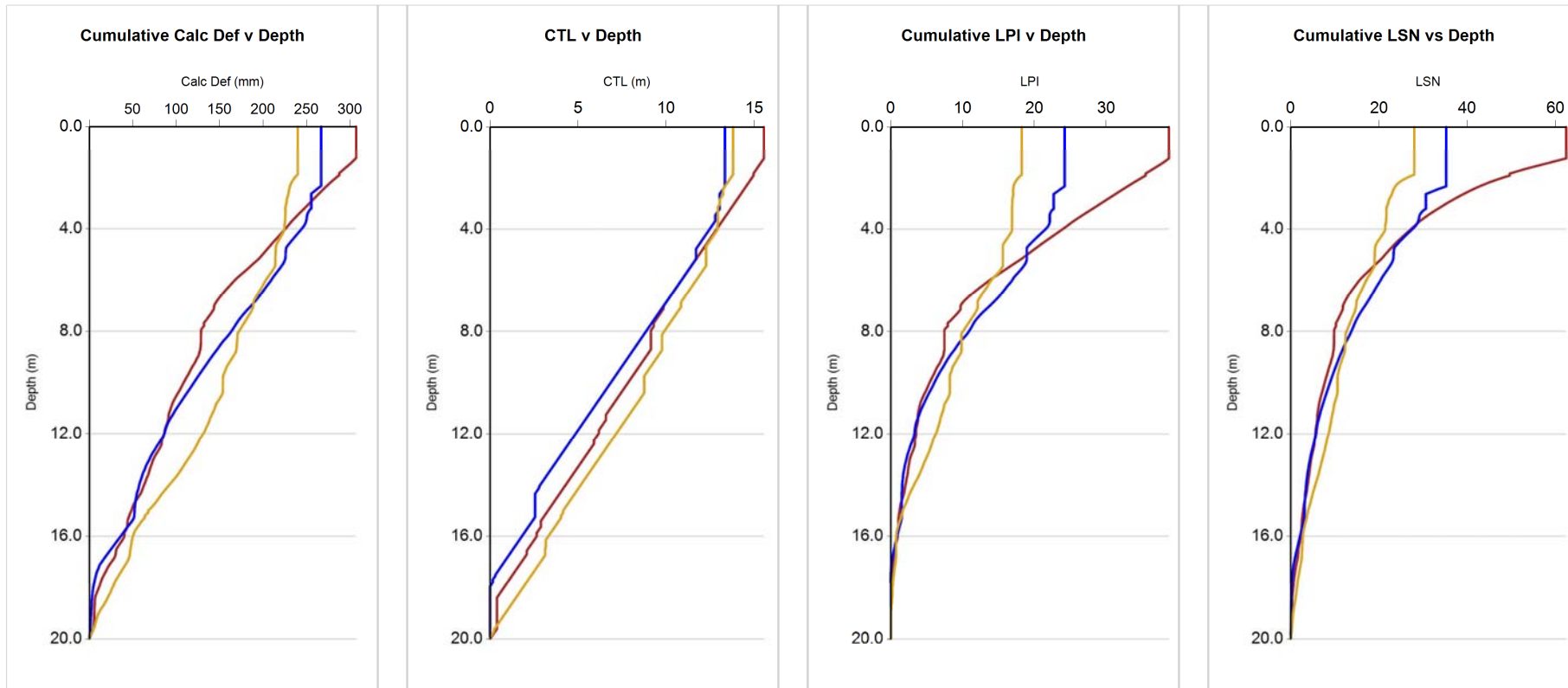


Surcharge used.

(Assumed predrill values)

CPT Name	Database ID	Investigation Date	Event and PGA	Magnitude	PGA (g)	GWD (m)	Trigger Method	Settlement Method	Pre-drill Depth (m)	Qc (MPa)	Fs (MPa)	γ (kN/m³)
INPUT: CPT-ARN-09	9	5/13/2011	CHCH Feb, UoC PGA		6.2	0.5177	IB	ZRB	1.2	2	0.01	18
S - Calculated deformation (mm) CTL - Cumulative Thickness of Liquefaction (m) LPI - Liquefaction Potential Index LSN - Liquefaction Severity Number CT - Crust Thickness (m)												
OUTPUT:	240		13.8				18		28		2	


<p>Tonkin & Taylor Environmental and Engineering consultants V1.1</p>	<p>CLIENT, PROJECT</p> <p>EQC Data analysis of increased vulnerability to liquefaction for the Canterbury Earthquake Sequence</p>	<p>LOCATION</p> <p>Christchurch</p>	<p>DATE</p> <p>3/4/2013</p>
	<p>TITLE</p> <p>Case Study CPT - Red Zone, TC3, TC2</p>	<p>JOB NUMBER</p> <p>52020.0200</p>	<p>ANALYSED</p> <p>JLSS</p>
			<p>CHECKED</p> <p>PAGE Figure D3.C</p>

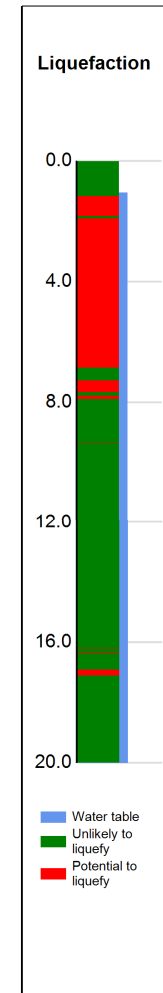
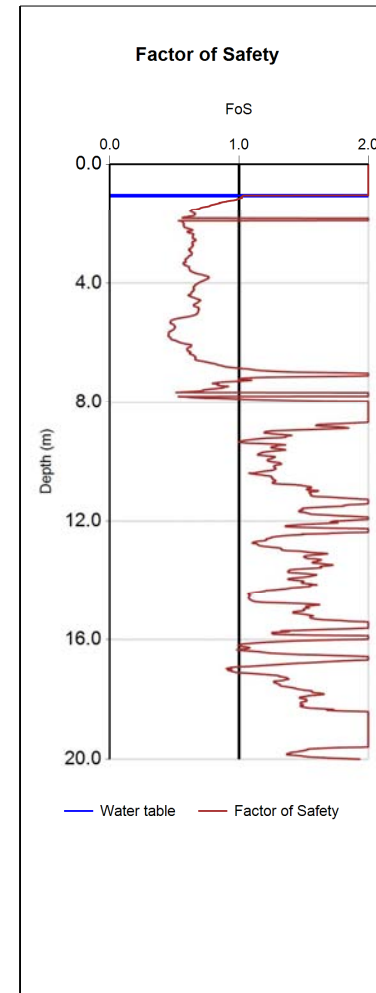
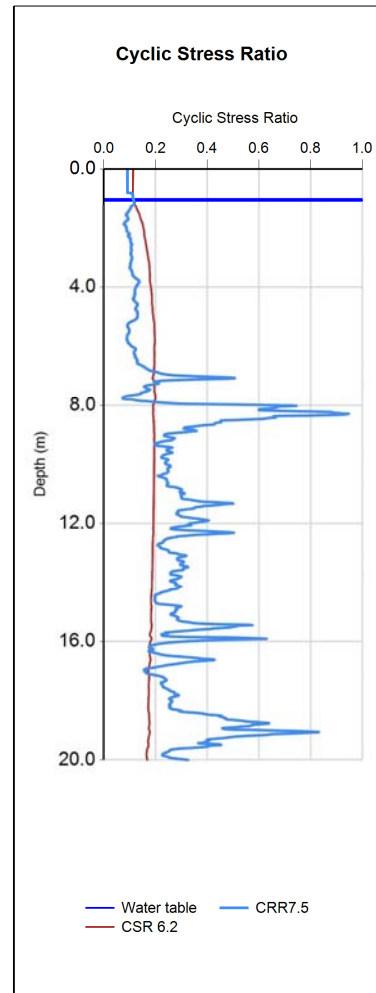
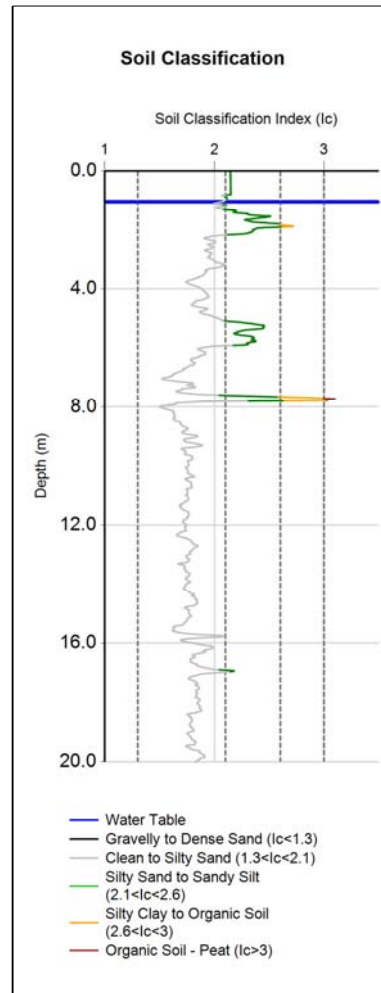
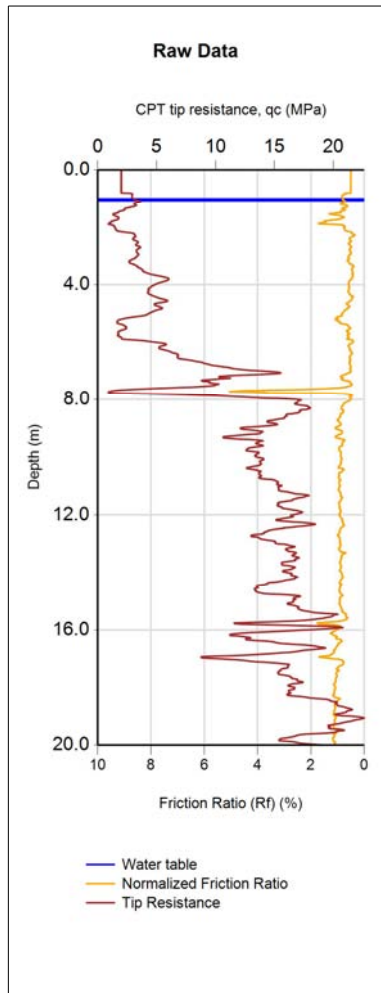


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(Assumed predrill values)

CPT Name	Database ID	Investigation Date	Event and PGA	Magnitude	PGA (g)	GWD (m)	Trigger Method	Settlement Method	Pre Drill Depth (m)	Qc (MPa)	Fs (MPa)	γ (KN/m ³)
CPT-BEX-13	165	11/4/2010	CHCH Feb, UoC PGA	6.2	0.5084	1.2339	IB	ZRB	0.8	2	0.01	18
CPT-ARN-26	26	5/12/2011	CHCH Feb, UoC PGA	6.2	0.4496	2.3234	IB	ZRB	1.2	2	0.01	18
CPT-ARN-09	9	5/13/2011	CHCH Feb, UoC PGA	6.2	0.5177	1.8618	IB	ZRB	1.2	2	0.01	18

 Tonkin & Taylor Environmental and Engineering consultants V1.1	CLIENT, PROJECT EQC Data analysis of increased vulnerability to liquefaction for the Canterbury Earthquake Sequence	LOCATION Christchurch	DATE 3/4/2013
	TITLE Case Study CPT - Red Zone, TC3, TC2	JOB NUMBER 52020.0200	ANALYSED JLSS CHECKED PAGE Figure D3.D

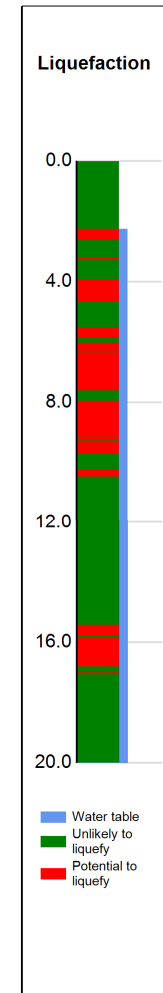
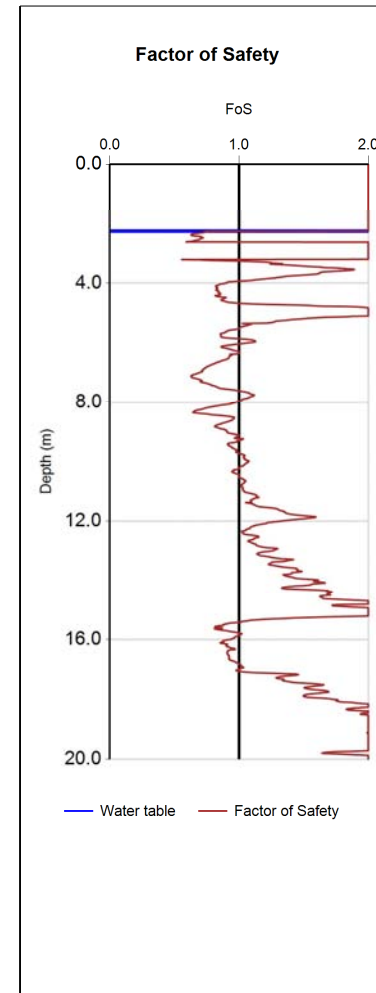
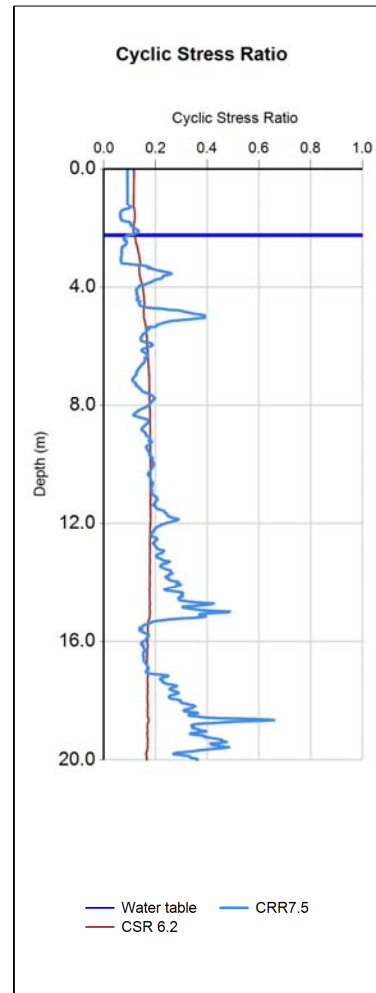
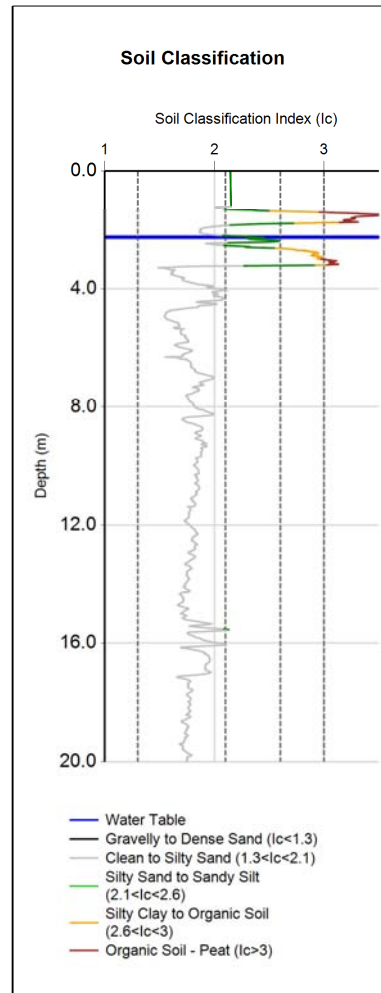
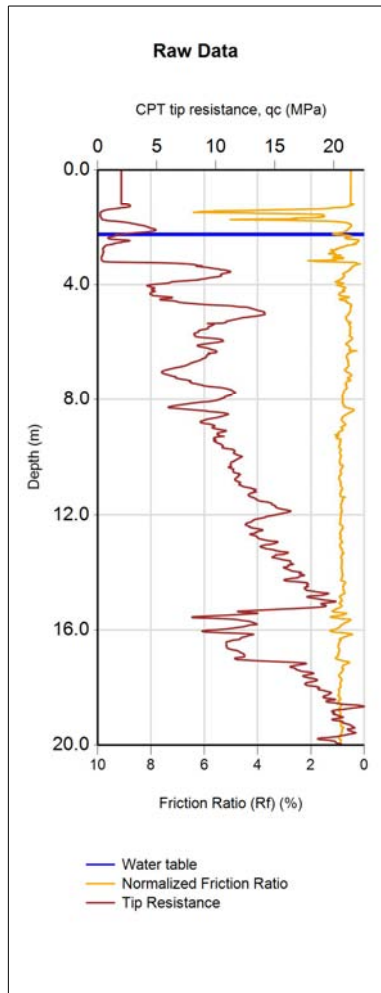


Surcharge used.

(Assumed predrill values)

CPT Name	Database ID	Investigation Date	Event and PGA	Magnitude	PGA (g)	GWD (m)	Trigger Method	Settlement Method	Pre-drill Depth (m)	Qc (MPa)	Fs (MPa)	γ (kN/m³)	
INPUT: CPT-BEX-13	165	11/4/2010	CHCH June, UoC PGA		6.2	0.2692	1.0481	IB	ZRB	0.8	2	0.01	18
OUTPUT: S - Calculated deformation (mm)	193	CTL - Cumulative Thickness of Liquefaction (m)	6.3	LPI - Liquefaction Potential Index	17	LSN - Liquefaction Severity Number	55	CT - Crust Thickness (m)	1.3				

<p>Tonkin & Taylor Environmental and Engineering consultants V1.1</p>	<p>CLIENT, PROJECT</p> <p>EQC Data analysis of increased vulnerability to liquefaction for the Canterbury Earthquake Sequence</p>	<p>LOCATION</p> <p>Christchurch</p>	<p>DATE</p> <p>3/4/2013</p>
	<p>TITLE</p> <p>Case Study CPT - Red Zone, TC3, TC2</p>	<p>JOB NUMBER</p> <p>52020.0200</p>	<p>ANALYSED</p> <p>JLSS</p> <p>CHECKED</p> <p>PAGE Figure D4.A</p>

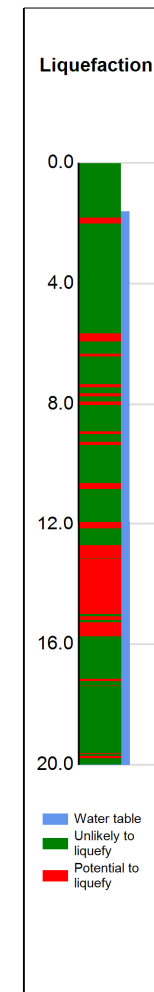
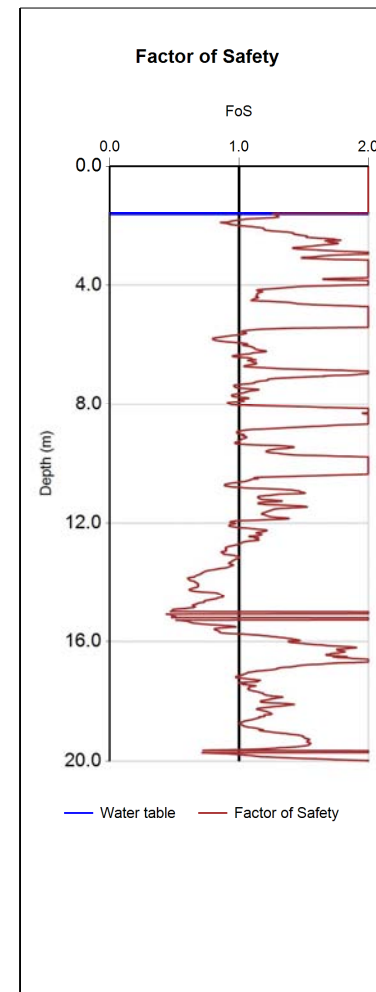
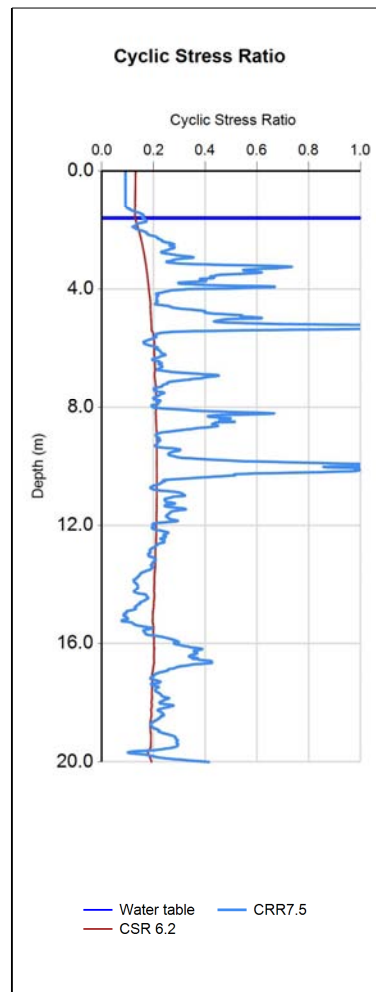
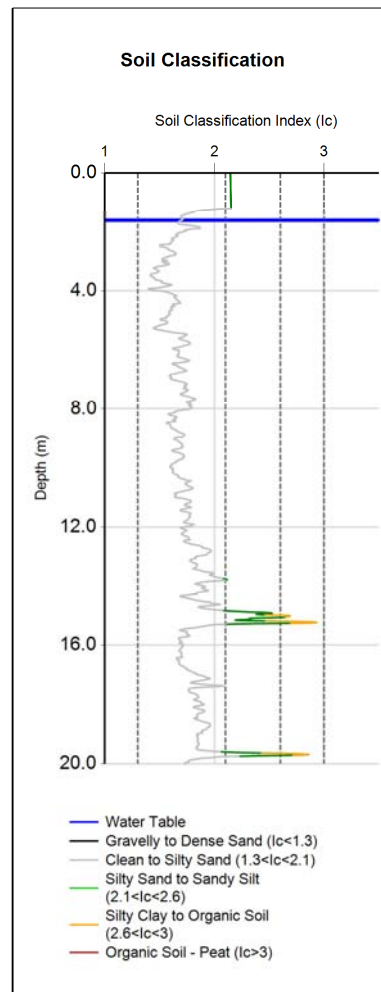
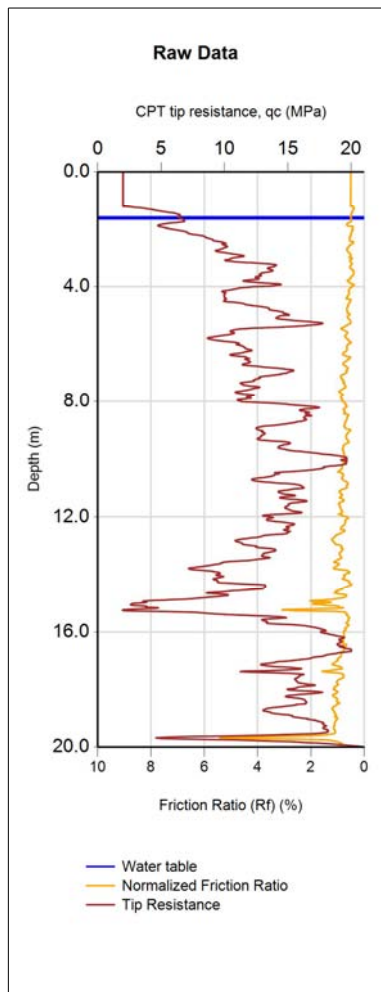


Surcharge used.

(Assumed predrill values)

CPT Name	Database ID	Investigation Date	Event and PGA	Magnitude	PGA (g)	GWD (m)	Trigger Method	Settlement Method	Pre-drill Depth (m)	Qc (MPa)	Fs (MPa)	γ (kN/m³)
INPUT: CPT-ARN-26	26	5/12/2011	CHCH June, UoC PGA	6.2	0.2774	2.2585	IB	ZRB	1.2	2	0.01	18
S - Calculated deformation (mm) CTL - Cumulative Thickness of Liquefaction (m) LPI - Liquefaction Potential Index LSN - Liquefaction Severity Number CT - Crust Thickness (m)												
OUTPUT:	138		6.3		5			22	2.4			

<p>Tonkin & Taylor Environmental and Engineering consultants V1.1</p>	<p>CLIENT, PROJECT</p> <p>EQC Data analysis of increased vulnerability to liquefaction for the Canterbury Earthquake Sequence</p>	<p>LOCATION</p> <p>Christchurch</p>	<p>DATE</p> <p>3/4/2013</p>
	<p>TITLE</p> <p>Case Study CPT - Red Zone, TC3, TC2</p>	<p>JOB NUMBER</p> <p>52020.0200</p>	<p>ANALYSED</p> <p>JLSS</p>
			<p>CHECKED</p> <p>PAGE Figure D4.B</p>



Surcharge used.

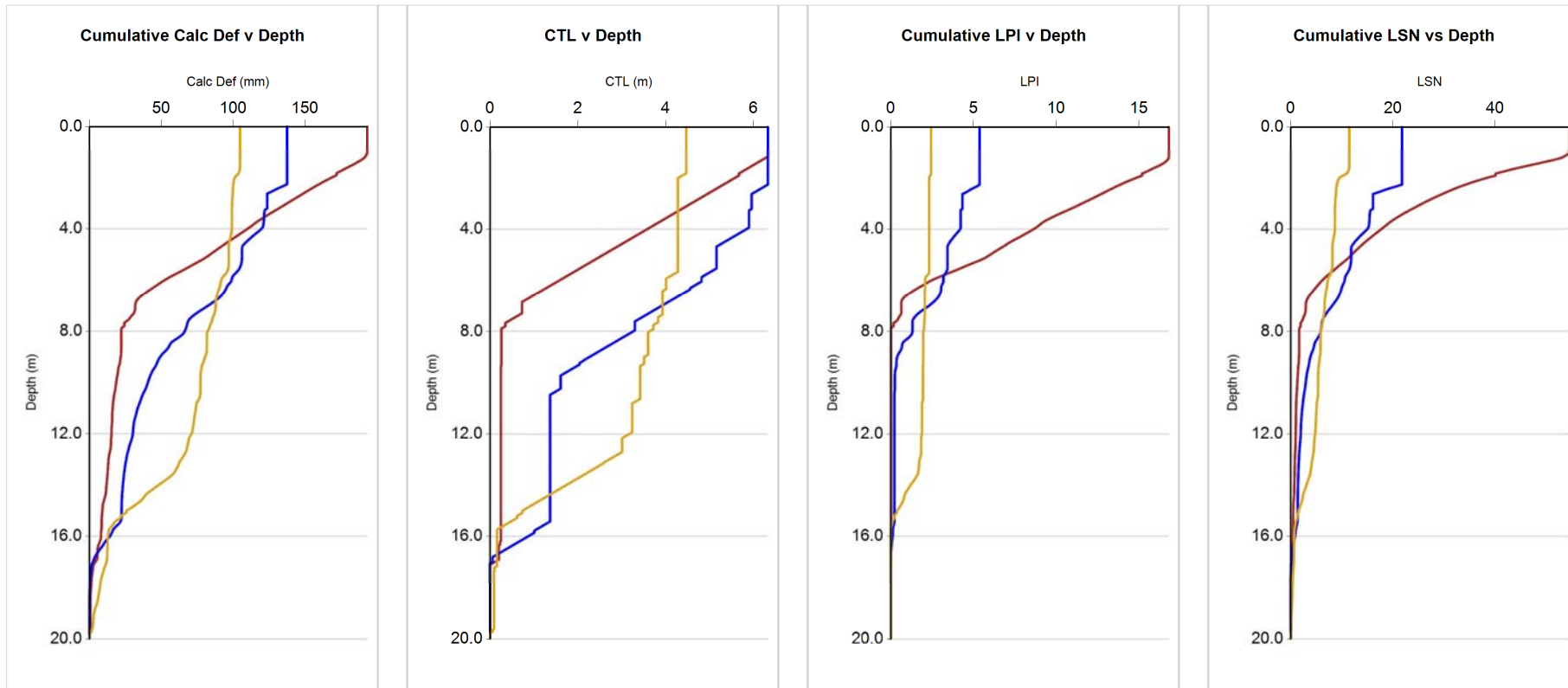
(Assumed predrill values)

CPT Name	Database ID	Investigation Date	Event and PGA	Magnitude	PGA (g)	GWD (m)	Trigger Method	Settlement Method	Pre-drill Depth (m)	Qc (MPa)	Fs (MPa)	γ (kN/m³)
INPUT: CPT-ARN-09	9	5/13/2011	CHCH June, UoC PGA	6.2	0.3098	1.6066	IB	ZRB	1.2	2	0.01	18

S - Calculated deformation (mm) CTL - Cumulative Thickness of Liquefaction (m) LPI - Liquefaction Potential Index LSN - Liquefaction Severity Number CT - Crust Thickness (m)

OUTPUT:	105	4.5	2	11	1.9
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<p>Tonkin & Taylor Environmental and Engineering consultants V1.1</p>	CLIENT, PROJECT	EQC Data analysis of increased vulnerability to liquefaction for the Canterbury Earthquake Sequence	LOCATION	Christchurch	DATE	3/4/2013
	TITLE	Case Study CPT - Red Zone, TC3, TC2	JOB NUMBER	52020.0200	ANALYSED	JLSS
			CHECKED		PAGE	Figure D4.C

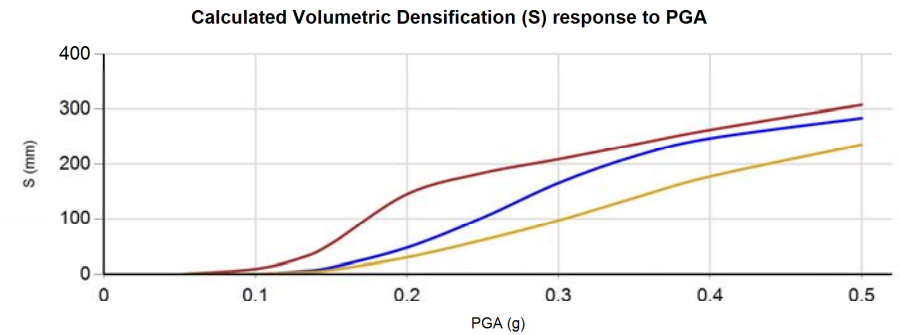
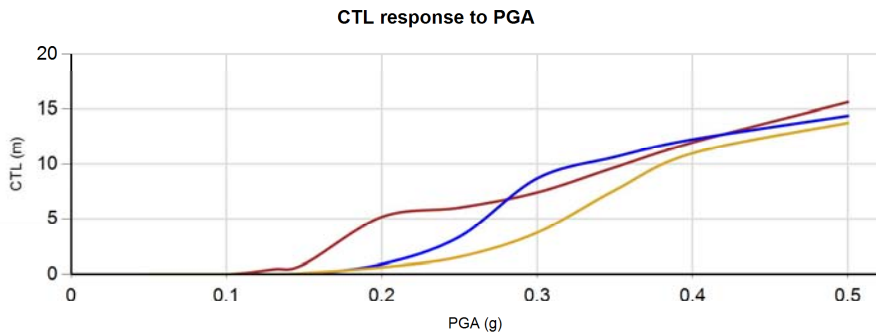
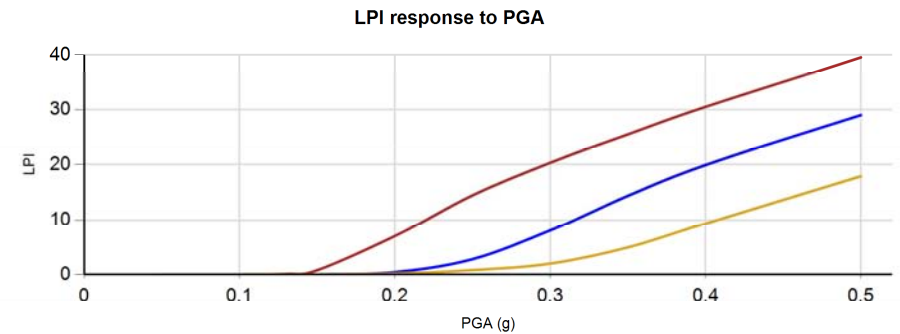
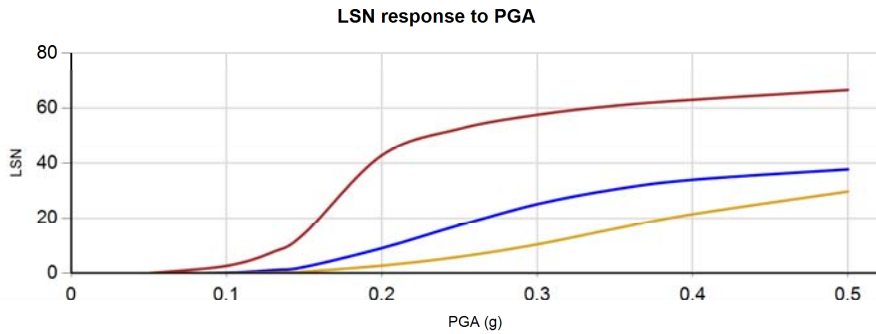


Surcharge used.

(Assumed predrill values)

CPT Name	Database ID	Investigation Date	Event and PGA	Magnitude	PGA (g)	GWD (m)	Trigger Method	Settlement Method	Pre Drill Depth (m)	Qc (MPa)	Fs (MPa)	γ (KN/m ³)
CPT-BEX-13	165	11/4/2010	CHCH June, UoC PGA	6.2	0.2692	1.0481	IB	ZRB	0.8	2	0.01	18
CPT-ARN-26	26	5/12/2011	CHCH June, UoC PGA	6.2	0.2774	2.2585	IB	ZRB	1.2	2	0.01	18
CPT-ARN-09	9	5/13/2011	CHCH June, UoC PGA	6.2	0.3098	1.6066	IB	ZRB	1.2	2	0.01	18

 <p>Tonkin & Taylor Environmental and Engineering consultants V1.1</p>	<p>CLIENT, PROJECT</p> <p>EQC Data analysis of increased vulnerability to liquefaction for the Canterbury Earthquake Sequence</p>	<p>LOCATION</p> <p>Christchurch</p>	<p>DATE</p> <p>3/4/2013</p>
	<p>TITLE</p> <p>Case Study CPT - Red Zone, TC3, TC2</p>	<p>JOB NUMBER</p> <p>52020.0200</p>	<p>ANALYSED</p> <p>JLSS</p> <p>CHECKED</p> <p>PAGE Figure D4.D</p>



Surcharge used.

(Assumed predrill values)

CPT Name	Database ID	Investigation Date	Event and PGA	Magnitude	PGA (g)	GWD (m)	Trigger Method	Settlement Method	Pre Drill Depth (m)	Qc (MPa)	Fs (MPa)	γ (KN/m³)
CPT-BEX-13	165	11/4/2010	CHCH June, UoC PGA	6.2	0.2692	1.0481	IB	ZRB	0.8	2	0.01	18
CPT-ARN-26	26	5/12/2011	CHCH June, UoC PGA	6.2	0.2774	2.2585	IB	ZRB	1.2	2	0.01	18
CPT-ARN-09	9	5/13/2011	CHCH June, UoC PGA	6.2	0.3098	1.6066	IB	ZRB	1.2	2	0.01	18