

Appendix C: Case Histories - Marina District

Case History:

Site: Marina District
Location: Marina District, California
Earthquake: 1989 Loma Prieta Mw 6.9
PGA: 0.16 g (USGS PP1551-F, Zhang et al. 2002)
Ground Elevation: 1.36 m (SF Datum - USGS PP1551-F)
Water table: -1.60 m (SF Datum - USGS PP1551-F)
CPT: All CPTs Latitude 37.801436 Longitude -122.4462
Source: USGS CPT Data Map (<https://earthquake.usgs.gov/research/cpt/data/>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

USGS (1990). Open File Report 90-253. Effects of The Loma Prieta Earthquake on The Marina District San Francisco, California)

USGS (1992). Professional Paper 1551-F. The Loma Prieta, California, Earthquake of October 17, 1989-Marina District – Strong Ground Motion and Ground Failure.

Zhang, G., Robertson, P.K., and Brachman, R.W.I. (2002). Estimating Liquefaction induced ground settlements from CPT for level ground. Canadian Geotechnical Journal.

USGS Earthquakes Hazard CPT Data Map. Retrieved from <https://earthquake.usgs.gov/research/cpt/data/>

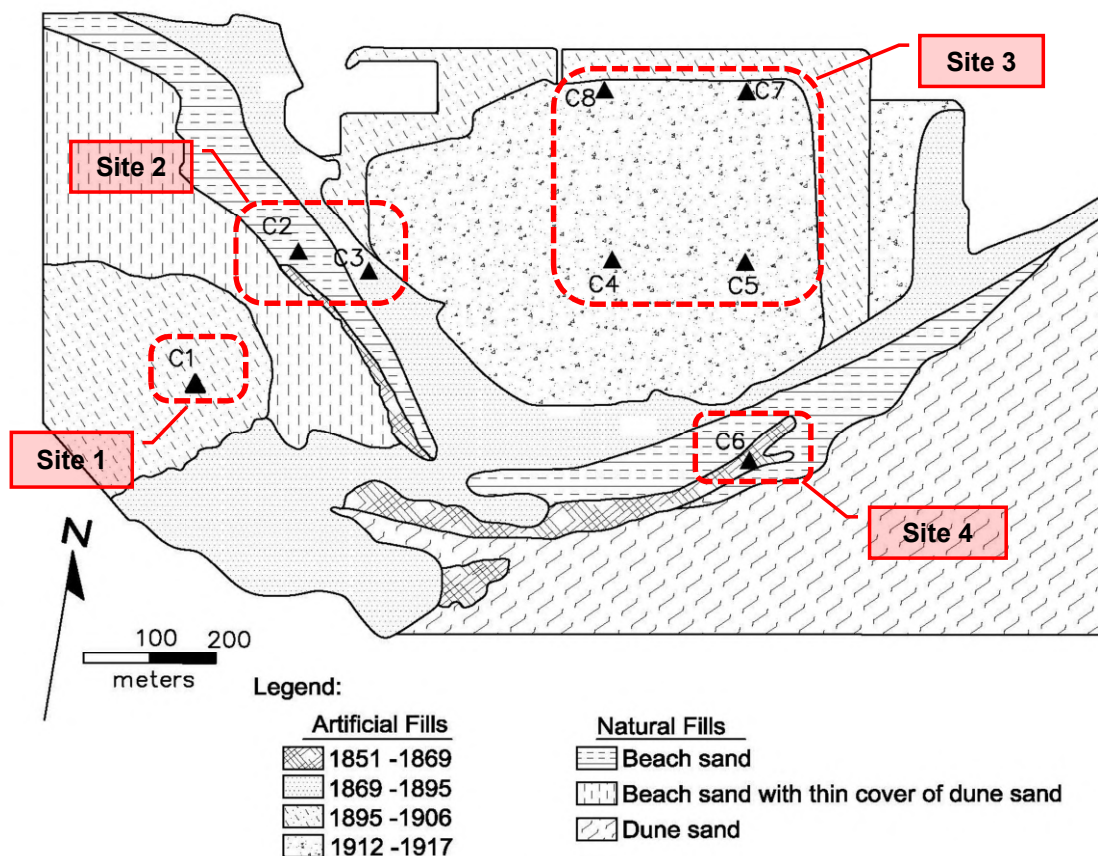
Case History:

Site: Marina District
Location: Marina District, California
Earthquake: 1989 Loma Prieta Mw 6.9
PGA: 0.16 g (USGS PP1551-F, Zhang et al. 2002)
Ground Elevation: 1.36 m (SF Datum - USGS PP1551-F)
Water table: -1.60 m (SF Datum - USGS PP1551-F)
CPT: All CPTs Latitude 37.801436 Longitude -122.4462
Source: USGS CPT Data Map (<https://earthquake.usgs.gov/research/cpt/data/>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology

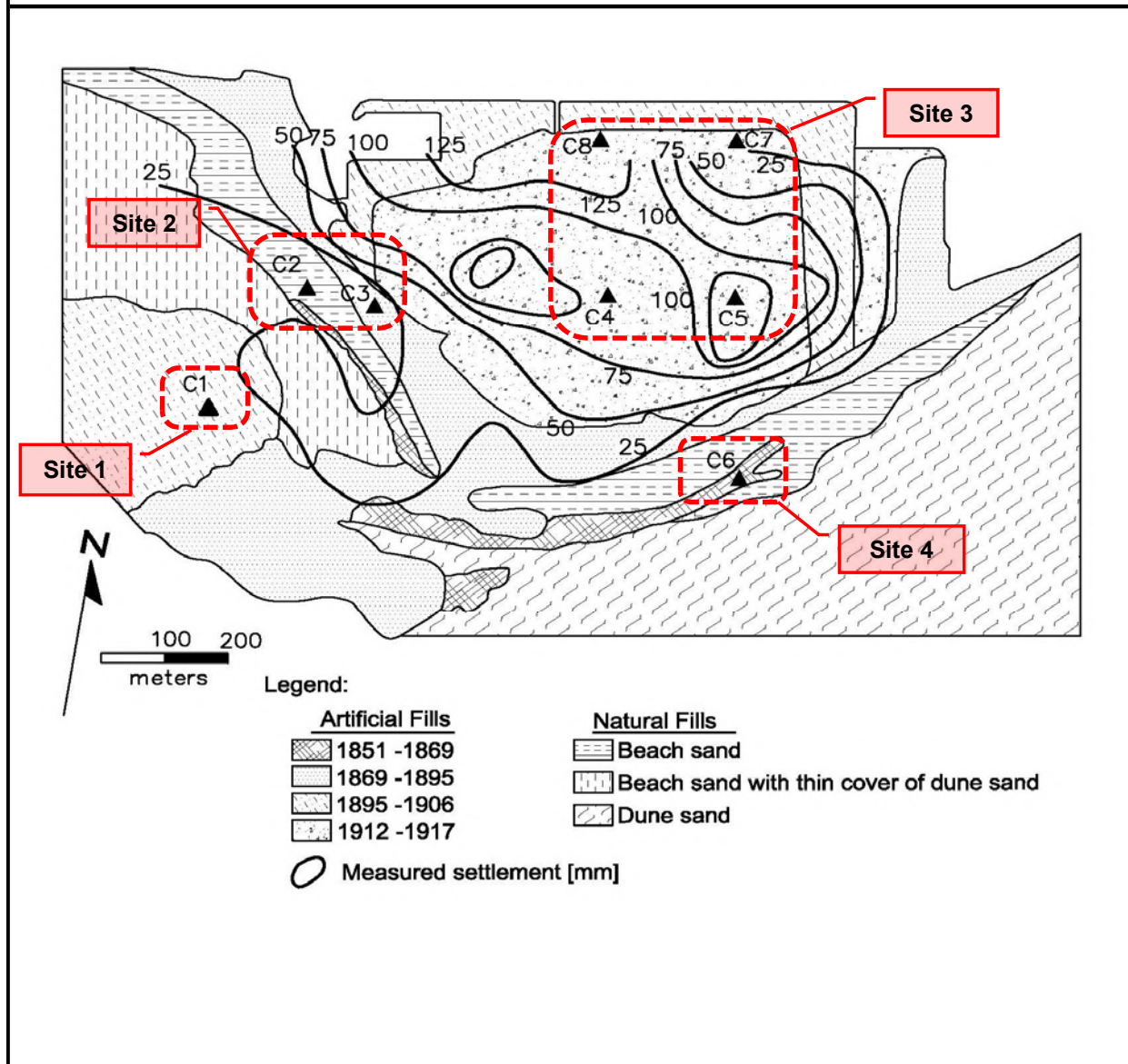
Case History:

Site: Marina District
Location: Marina District, California
Earthquake: 1989 Loma Prieta Mw 6.9
PGA: 0.16 g (USGS PP1551-F, Zhang et al. 2002)
Ground Elevation: 1.36 m (SF Datum - USGS PP1551-F)
Water table: -1.60 m (SF Datum - USGS PP1551-F)
CPT: All CPTs Latitude 37.801436 Longitude -122.4462
Source: USGS CPT Data Map (<https://earthquake.usgs.gov/research/cpt/data/>)

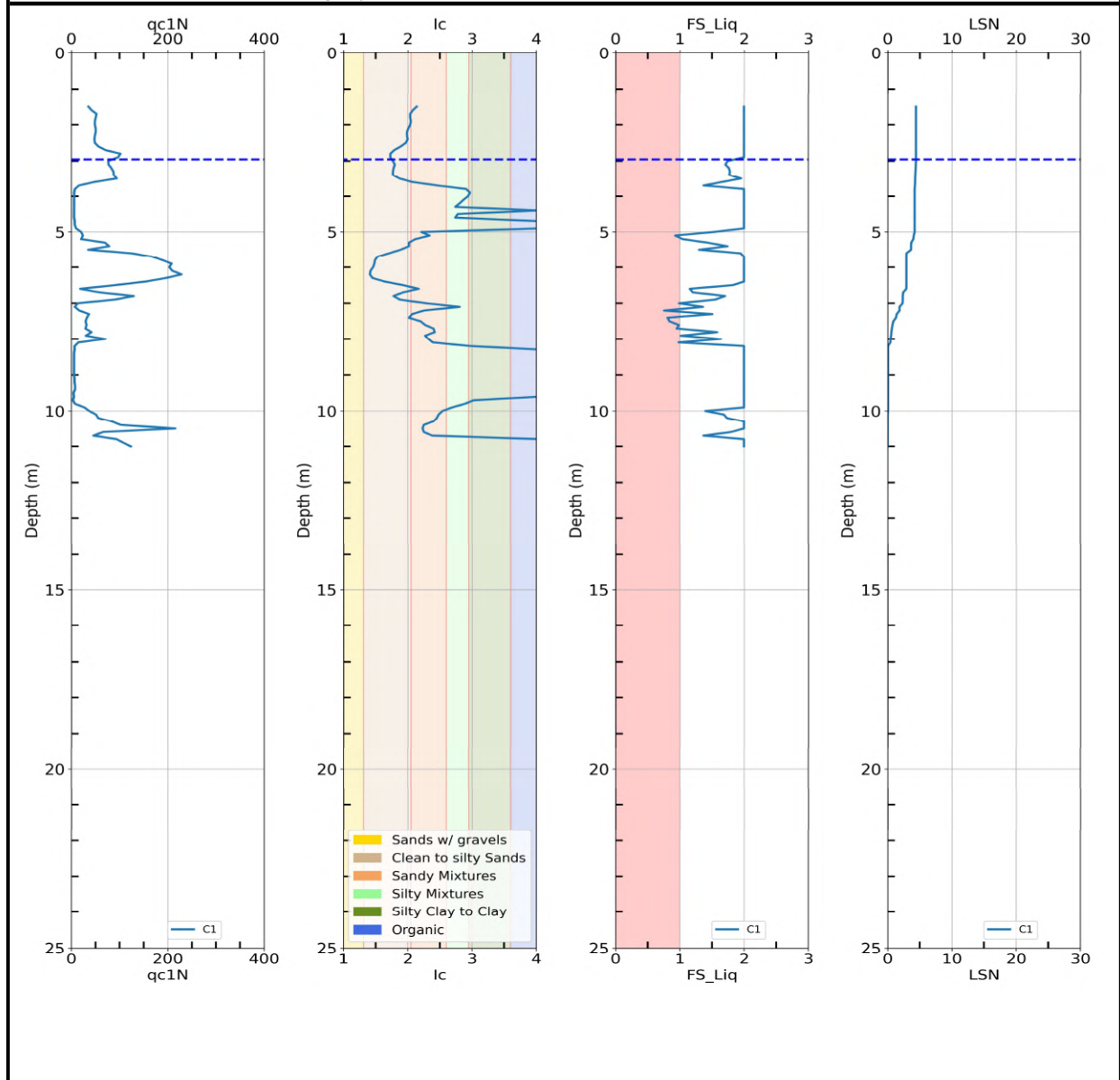
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Free-Field Ground Settlement Measurement

Case History: MD-S1
Site: Marina District, Site 1
Location: Marina District, California
Earthquake: 1989 Loma Prieta Mw 6.9
PGA: 0.16 g (USGS PP1551-F, Zhang et al. 2002)
Ground Elevation: 1.36 m (SF Datum - USGS PP1551-F)
Water table: -1.60 m (SF Datum - USGS PP1551-F)
CPT: C1 Latitude 37.801436 Longitude -122.4462
Source: USGS CPT Data Map (<https://earthquake.usgs.gov/research/cpt/data/>)
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014

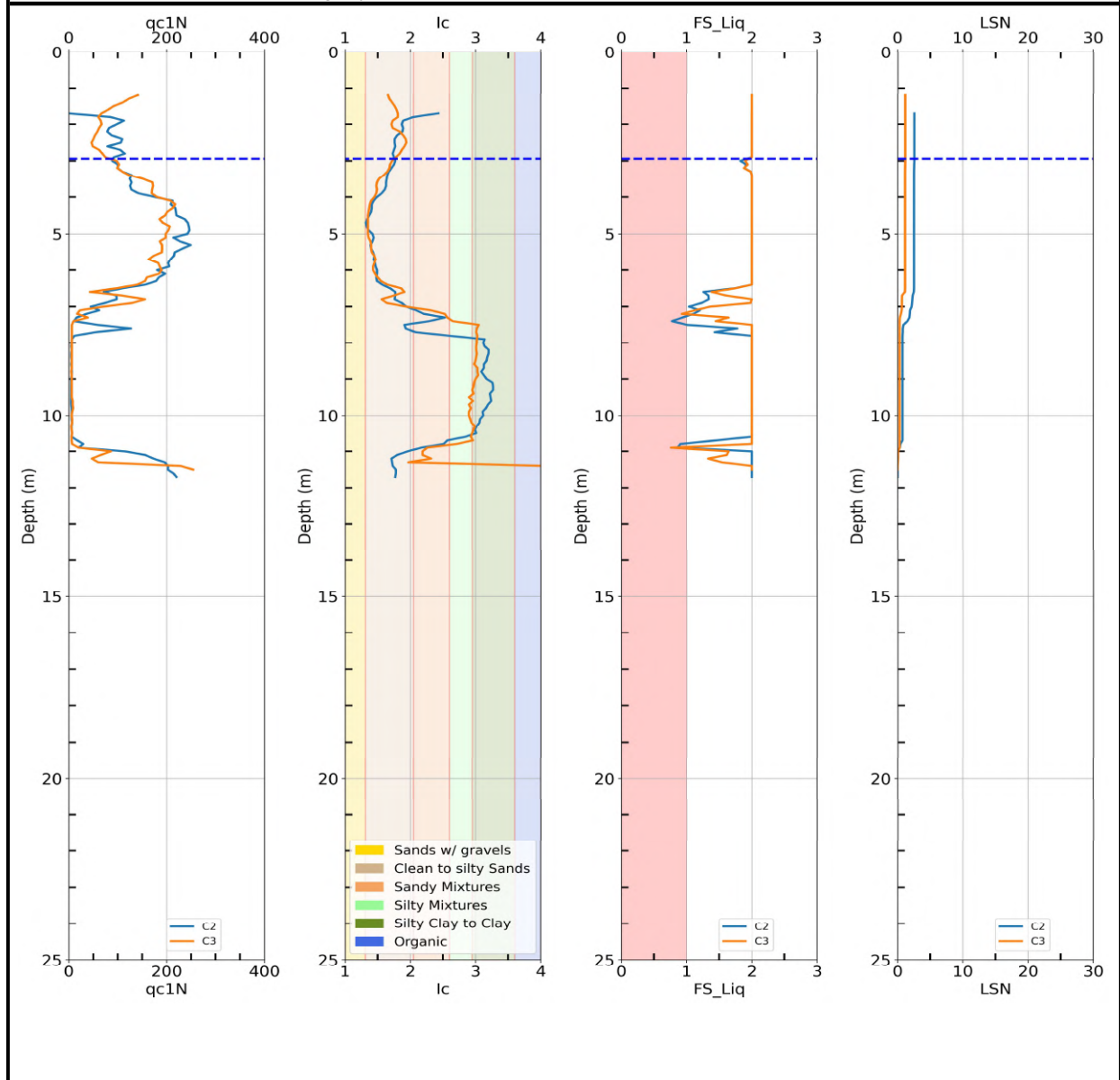


Case History: MD-S2
Site: Marina District, Site 2
Location: Marina District, California
Earthquake: 1989 Loma Prieta Mw 6.9
PGA: 0.16 g (USGS PP1551-F, Zhang et al. 2002)
Ground Elevation: 0.80 m (SF Datum - USGS PP1551-F)
Water table: - 2.14 m (SF Datum - USGS PP1551-F)
CPT: C2, C3 Latitude 37.803521 Longitude -122.4449
Source: USGS CPT Data Map (<https://earthquake.usgs.gov/research/cpt/data/>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

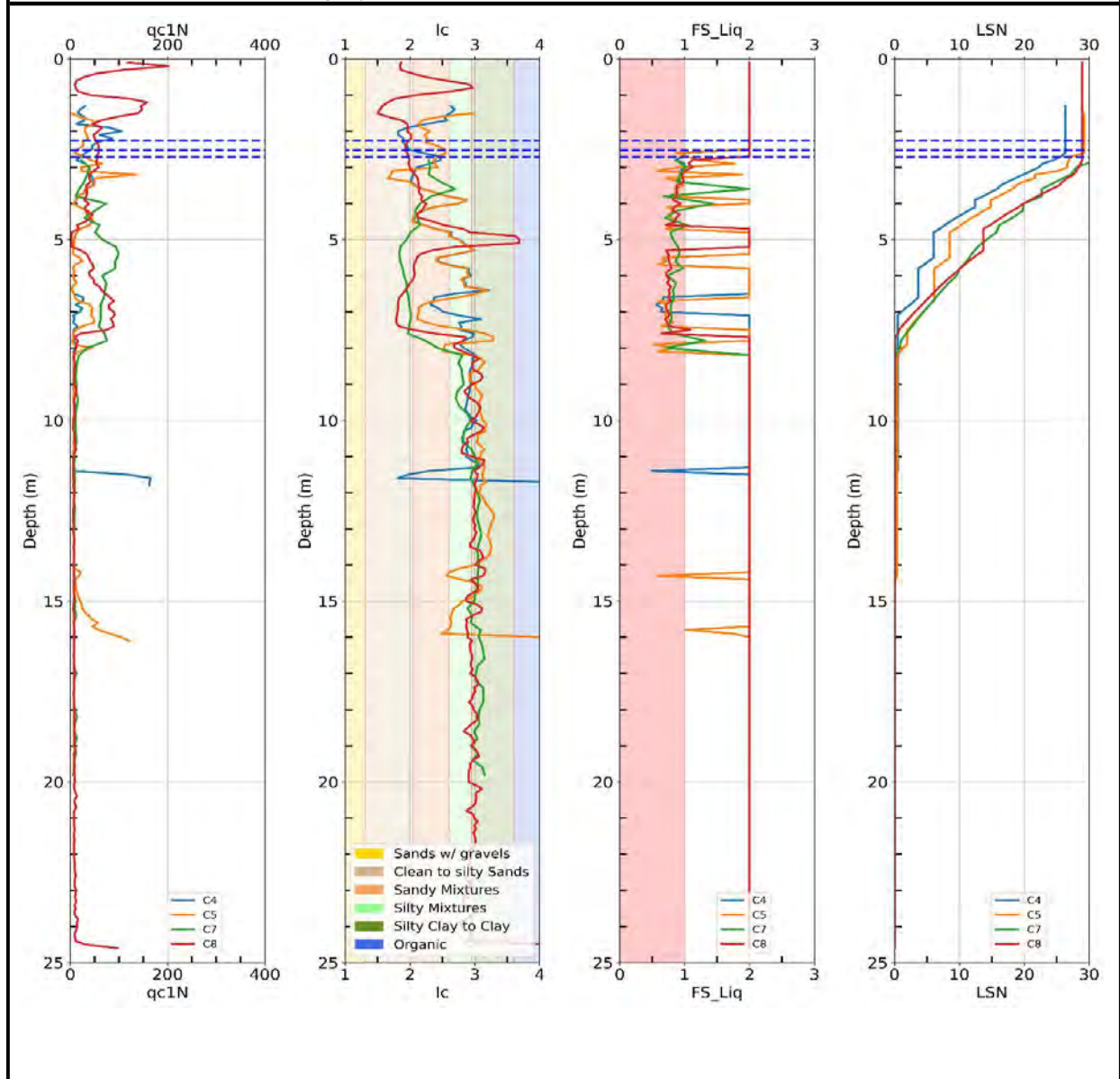


Case History: MD-S3
Site: Marina District, Site 3
Location: Marina District, California
Earthquake: 1989 Loma Prieta Mw 6.9
PGA: 0.16 g (USGS PP1551-F, Zhang et al. 2002)
Ground Elevation: 0.80 m (SF Datum - USGS PP1551-F)
Water table: - 2.14 m (SF Datum - USGS PP1551-F)
CPT: C4 - C8 Latitude 37.803521 Longitude -122.4449
Source: USGS CPT Data Map (<https://earthquake.usgs.gov/research/cpt/data/>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

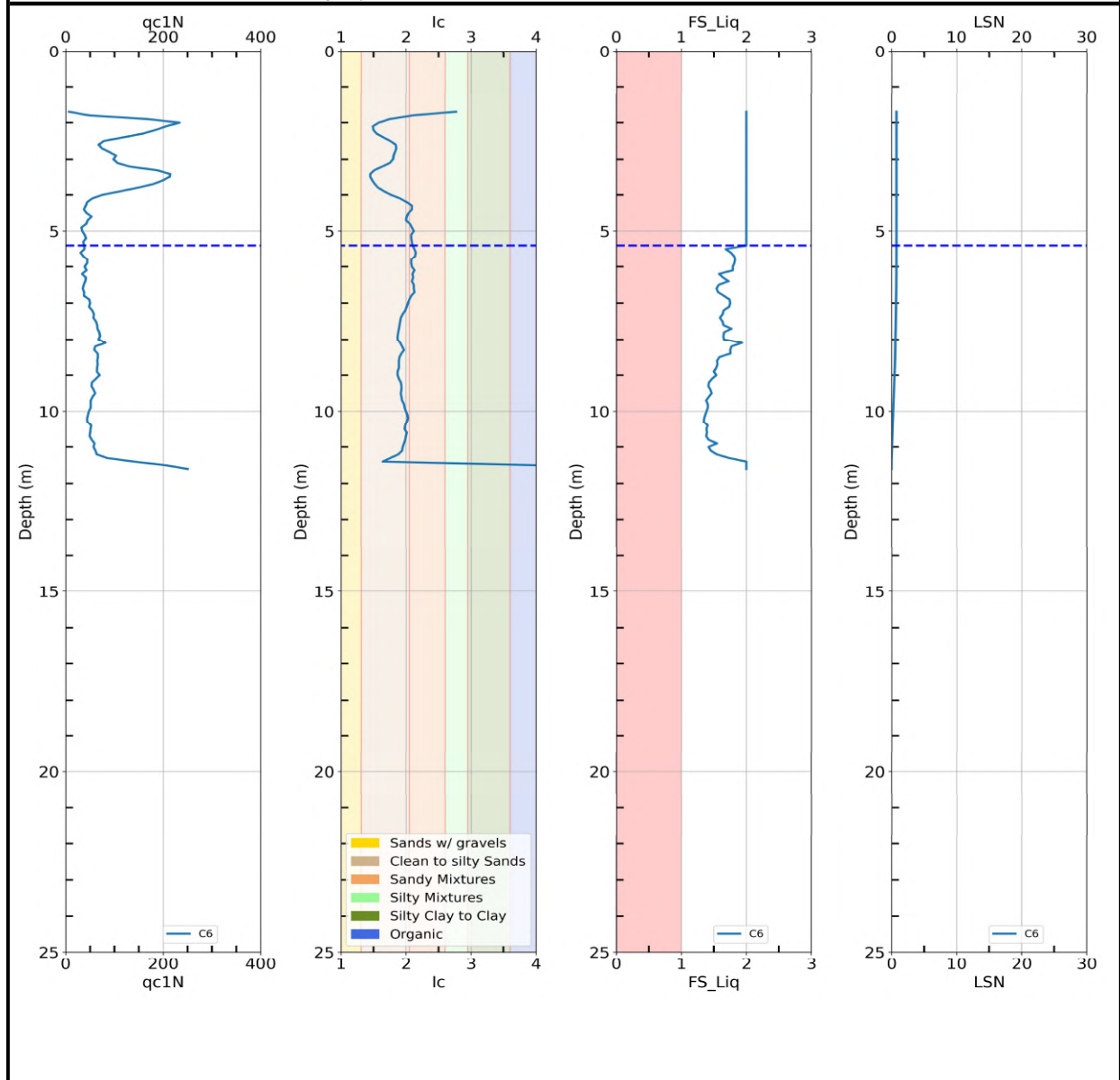
Ic Robertson, 2009

LSN van Ballegooy et al., 2014



Case History: MD-S4
Site: Marina District, Site 4
Location: Marina District, California
Earthquake: 1989 Loma Prieta Mw 6.9
PGA: 0.12 g (USGS PP1551-F, Zhang et al. 2002)
Ground Elevation: 5.40 m (SF Datum - USGS PP1551-F)
Water table: 0 (SF Datum - USGS PP1551-F)
CPT: C6 Latitude 37.801516 Longitude -122.4365
Source: USGS CPT Data Map (<https://earthquake.usgs.gov/research/cpt/data/>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Appendix D: Case Histories - Treasure Island

Site:	Treasure Island			
Location:	Treasure Island, California			
Earthquake:	1989 Loma Prieta	Mw	6.9	
PGA:	0.16 g (Fire station EW Comp. [PP1551-B])			
Ground Elevation:	3.0 m avg. above MLLW (PP1551-A, B)			
Water table:	1.6 m avg. above MLLW (PP1551-A, B)			
CPT:	All CPTs	Latitude	37.827606	Longitude -122.3683
Source:	ENGEO (Project 7091.000.005 [2019] and Personal Communication [2020])			

Site: Treasure Island

Location: Treasure Island, California

Earthquake:	1989 Loma Prieta	Mw	6.9
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PGA: 0.16 g (Fire station EW Comp. [PP1551-B])

Ground Elevation: 3.0 m avg. above MLLW (PP1551-A, B)

Water table: 1.6 m avg. above MLLW (PP1551-A, B)

CPT:	All CPTs	Latitude	37.827606	Longitude	-122.3683
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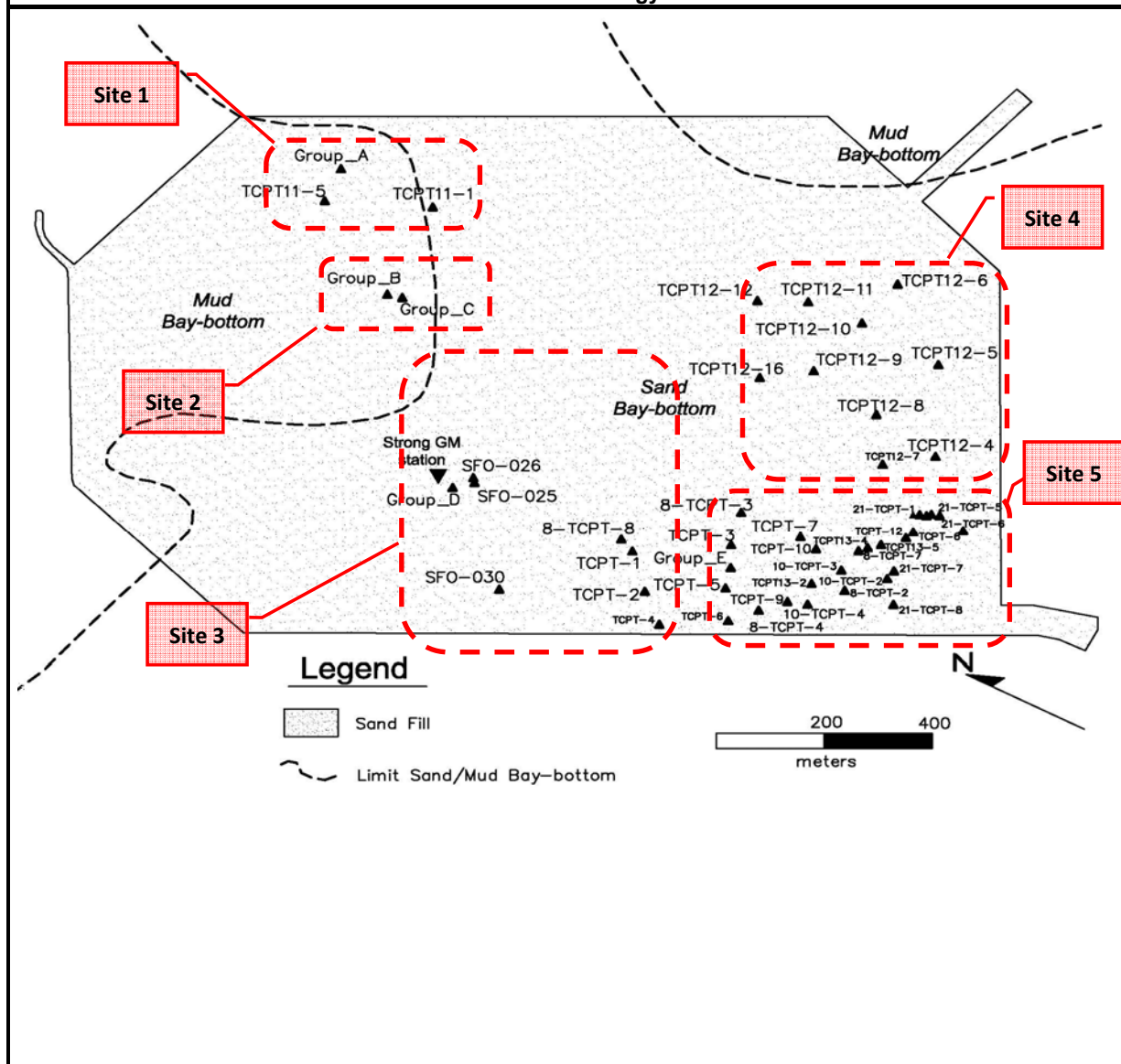
Source: ENGEO (Project 7091.000.005 [2019] and Personal Communication [2020])

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Robertson, 2009

van Ballegooy et al., 2014

Surficial Geology



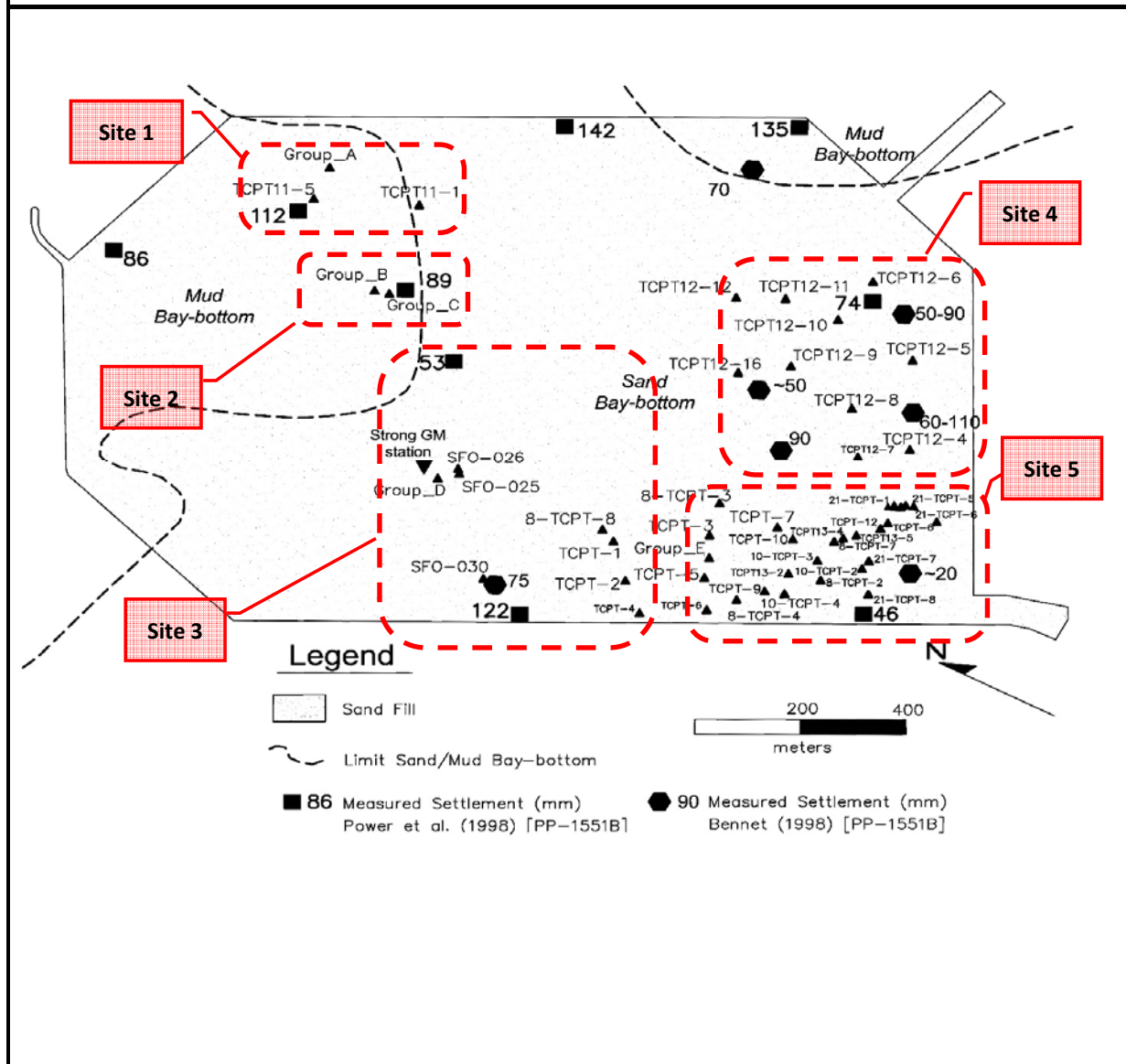
Site:	Treasure Island			
Location:	Treasure Island, California			
Earthquake:	1989 Loma Prieta	Mw	6.9	
PGA:	0.16 g (Fire station EW Comp. [PP1551-B])			
Ground Elevation:	3.0 m avg. above MLLW (PP1551-A, B)			
Water table:	1.6 m avg. above MLLW (PP1551-A, B)			
CPT:	All CPTs	Latitude	37.827606	Longitude -122.3683
Source:	ENGEO (Project 7091.000.005 [2019] and Personal Communication [2020])			

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Robertson, 2009

LSN van Ballegooy et al., 2014

Free-Field Ground Settlement Measurement

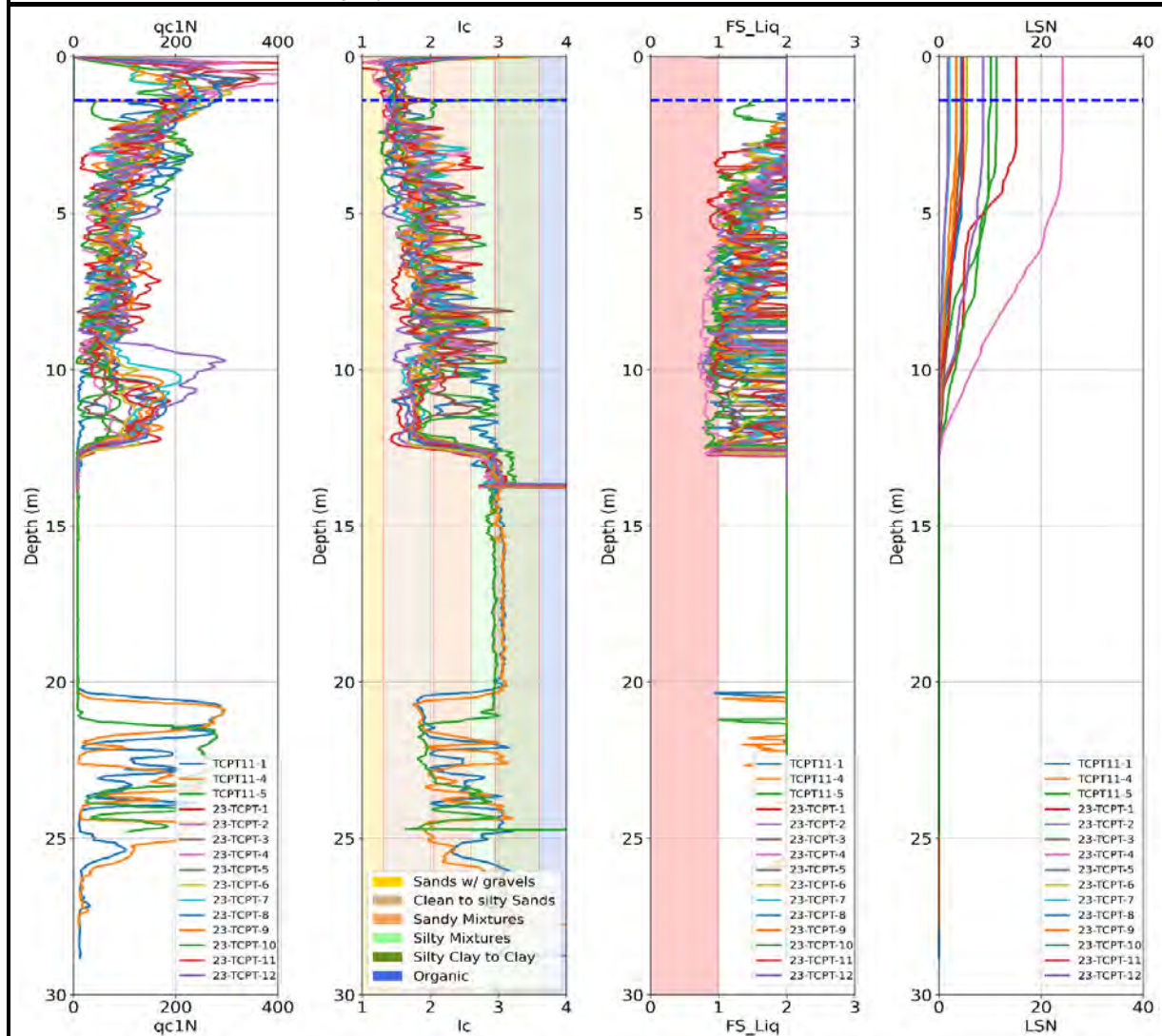


Case History: TI-S1
Site: Treasure Island
Location: Treasure Island, California
Earthquake: 1989 Loma Prieta Mw 6.9
PGA: 0.16 g (Fire station EW Comp. [PP1551-B])
Ground Elevation: 3.0 m avg. above MLLW (PP1551-A, B)
Water table: 1.6 m avg. above MLLW (PP1551-A, B)
CPT: Site 1 Latitude 37.827606 Longitude -122.3683
Source: ENGEO (Project 7091.000.005 [2019] and Personal Communication [2020])

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

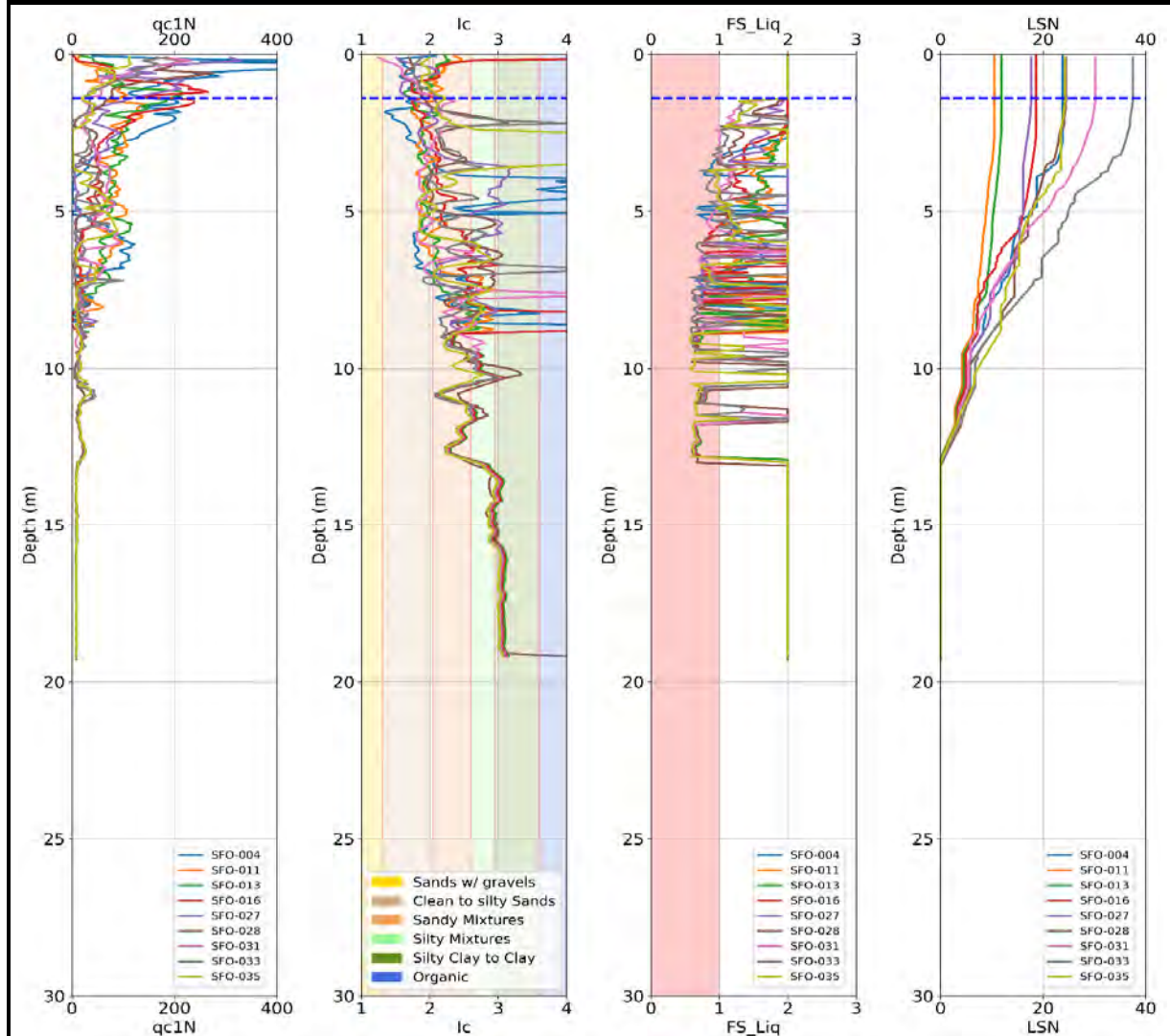


Case History: TI-S2
Site: Treasure Island
Location: Treasure Island, California
Earthquake: 1989 Loma Prieta Mw 6.9
PGA: 0.16 g (Fire station EW Comp. [PP1551-B])
Ground Elevation: 3.0 m avg. above MLLW (PP1551-A, B)
Water table: 1.6 m avg. above MLLW (PP1551-A, B)
CPT: Site 2* Latitude 37.8275 Longitude -122.3707
Source: USGS CPT Data Map (<https://earthquake.usgs.gov/research/cpt/data/>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014



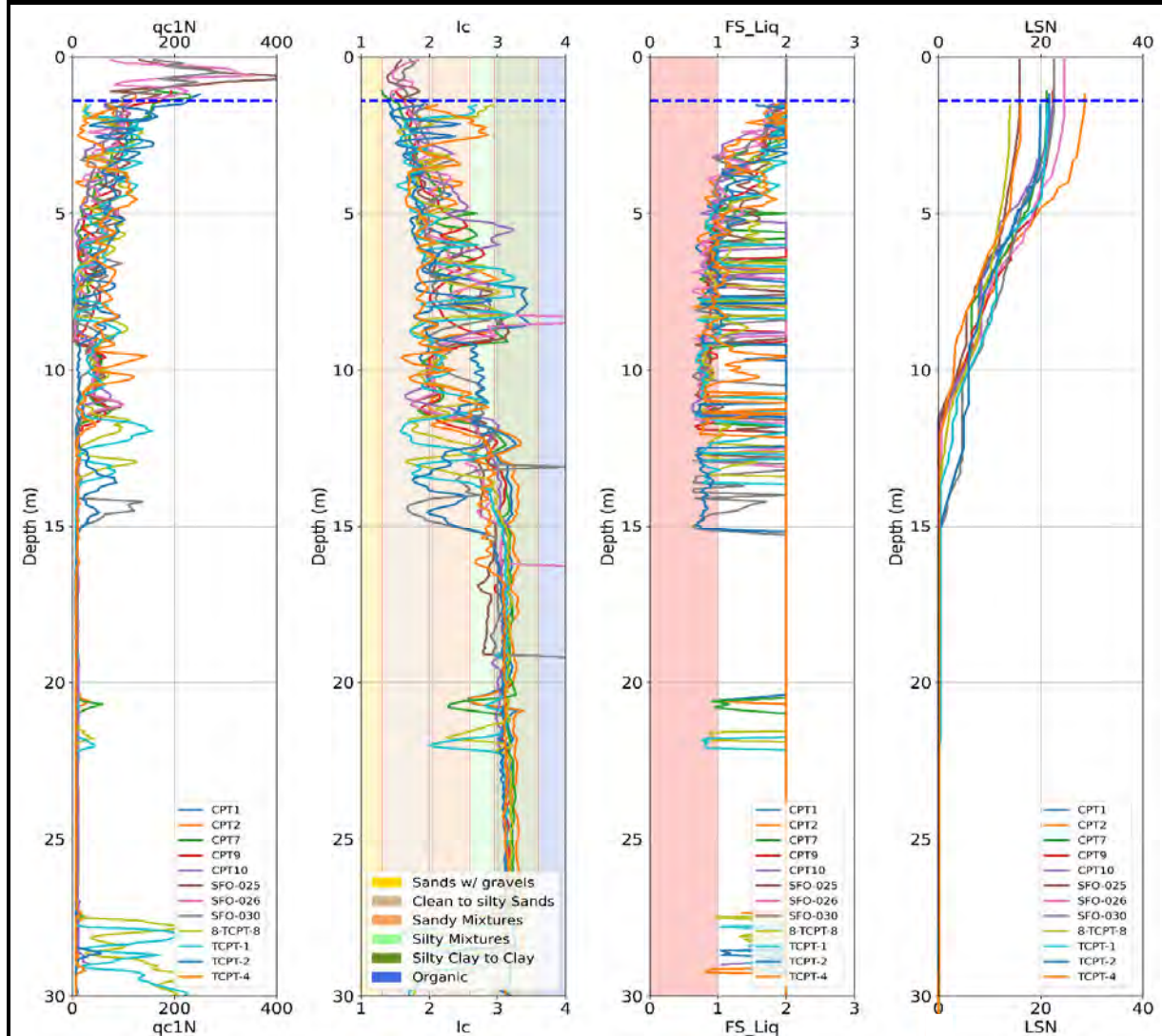
* After the termination depth of CPTs SFO-004, 011, 013, 016, 031, 033, 035 CPT data from CPT SFO-027 was added so that the liquefiable materials between 10 m and 15 m was captured

Case History: TI-S3
Site: Treasure Island
Location: Treasure Island, California
Earthquake: 1989 Loma Prieta Mw 6.9
PGA: 0.16 g (Fire station EW Comp. [PP1551-B])
Ground Elevation: 3.0 m avg. above MLLW (PP1551-A, B)
Water table: 1.6 m avg. above MLLW (PP1551-A, B)
CPT: Site 3* Latitude 37.824806 Longitude -122.374
Source: Next-Generation Liquefaction Database (<http://www.nextgenerationliquefaction.org/>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

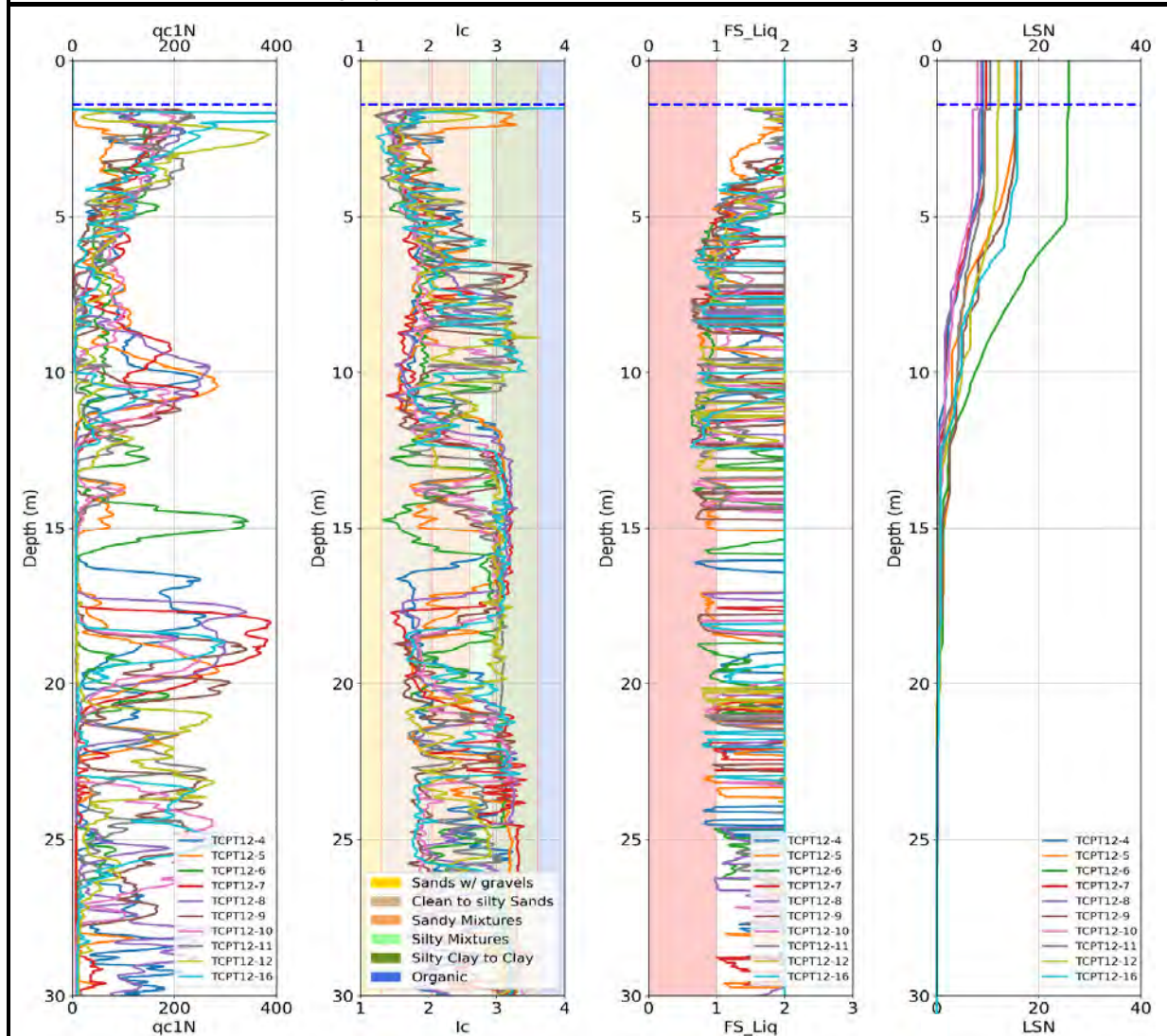
LSN van Ballegooy et al., 2014



* After the termination depth of CPT2 (10.3 m) data from CPT1 was added so that potentially deeper liquefiable materials were captured

Case History: TI-S4
Site: Treasure Island
Location: Treasure Island, California
Earthquake: 1989 Loma Prieta Mw 6.9
PGA: 0.16 g (Fire station EW Comp. [PP1551-B])
Ground Elevation: 3.0 m avg. above MLLW (PP1551-A, B)
Water table: 1.6 m avg. above MLLW (PP1551-A, B)
CPT: Site 4 Latitude 37.818221 Longitude -122.3686
Source: ENGEO (Project 7091.000.003 [2019])

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014

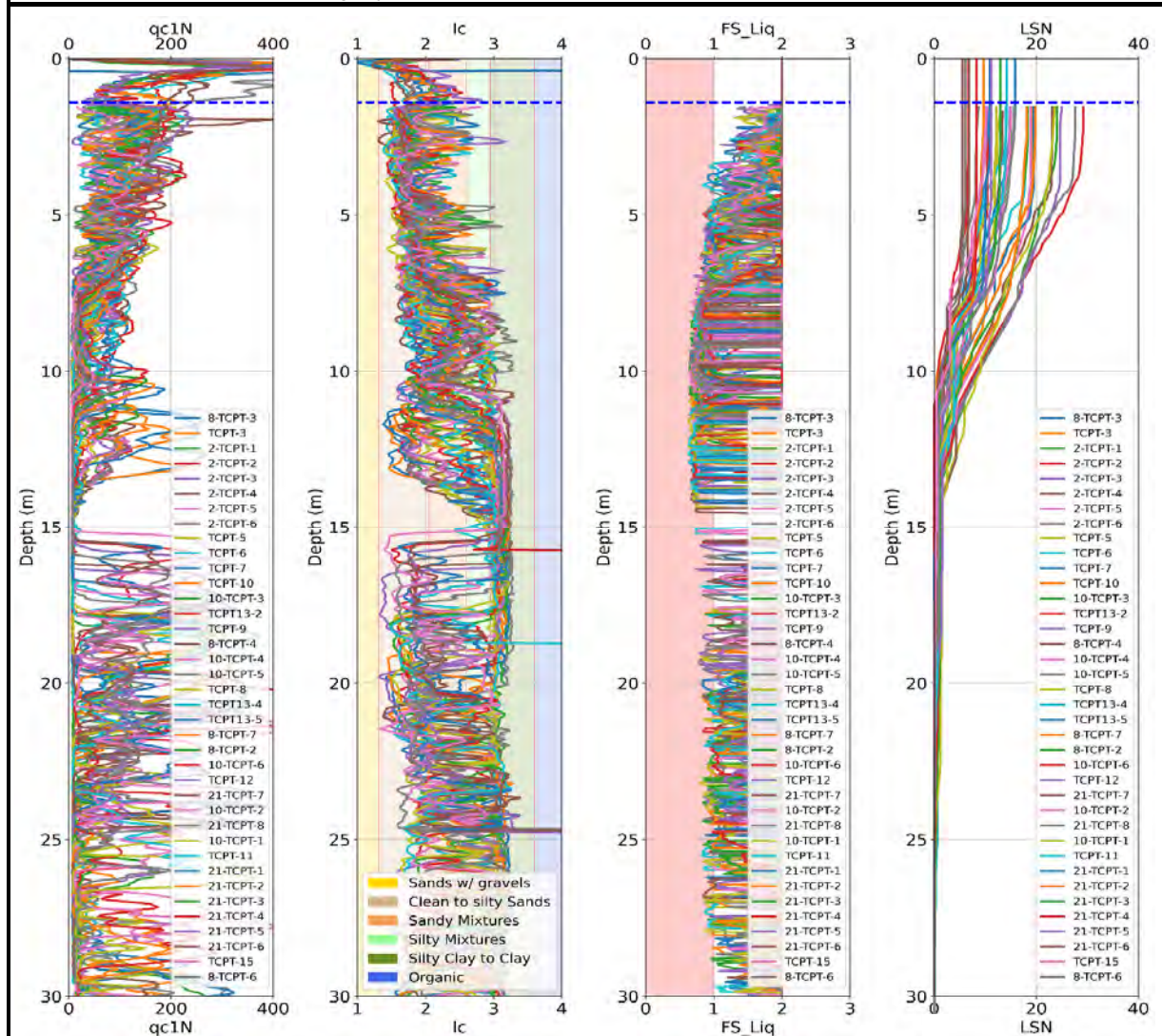


Case History: TI-S5
Site: Treasure Island
Location: Treasure Island, California
Earthquake: 1989 Loma Prieta Mw 6.9
PGA: 0.16 g (Fire station EW Comp. [PP1551-B])
Ground Elevation: 3.0 m avg. above MLLW (PP1551-A, B)
Water table: 1.6 m avg. above MLLW (PP1551-A, B)
CPT: Site 5 Latitude 37.820556 Longitude -122.3716
Source: ENGEO (Projects 7091.000.000 [2015], 7091.000.003 [2019], Personal communication [2020])

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014



Appendix E: Case Histories - Wufeng

Case History:

Site: Wufeng
Location: Wufeng, Taiwan
Earthquake: 1999 Chi-Chi Mw 7.6
PGA: 0.79 g (EW direction [Lee et al. 2001])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0 m avg. below ground surface (Juang et al. 2013 / Chu et al. 2004)
CPT: All CPTs Latitude 24.064574 Longitude 120.69565
Source: Chu et al. 2004

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

Chu et al. 2004. PEER Documentation of Soil Conditions at Liquefaction Sites from 1999 Chi-Chi, Taiwan Earthquake

Lee, Ishihara, Chen and Chu 2011 Liquefaction Induced Ground Failures Caused by Strong Ground Motion

Juang et al. 2013_Simplified procedure for estimation of liquefaction-induced settlement and site-specific probabilistic settlement exceedance curve using cone penetration test (CPT)

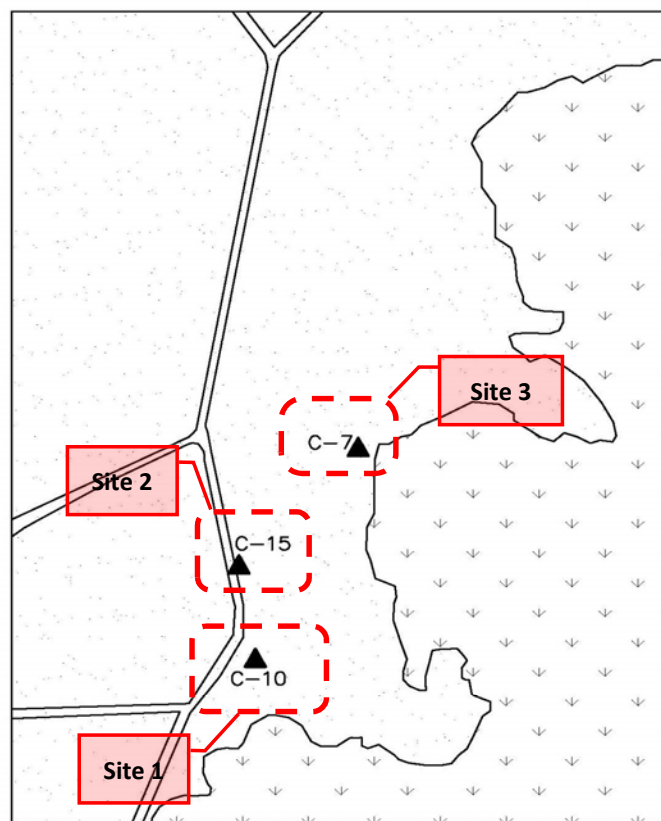
Case History:

Site: Wufeng
Location: Wufeng, Taiwan
Earthquake: 1999 Chi-Chi Mw 7.6
PGA: 0.79 g (EW direction [Lee et al. 2001])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0 m avg. below ground surface (Juang et al. 2013 / Chu et al. 2004)
CPT: All CPTs Latitude 24.064574 Longitude 120.69565
Source: Chu et al. 2004

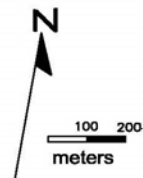
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

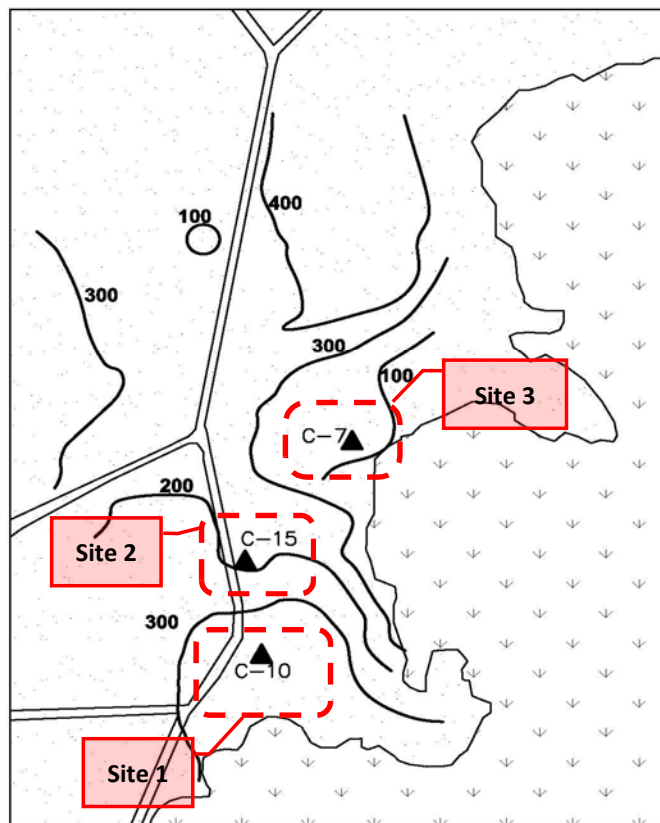
Surficial Geology**Legend**

- Back-fill and Silty Sand
- Western Foothills



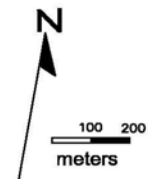
Case History:**Site:** Wufeng**Location:** Wufeng, Taiwan**Earthquake:** 1999 Chi-Chi Mw 7.6**PGA:** 0.79 g (EW direction [Lee et al. 2001])**Ground Elevation:** 0 m Datum: ground surface**Water table:** 1.0 m avg. below ground surface (Juang et al. 2013 / Chu et al. 2004)**CPT:** All CPTs

Latitude 24.064574 Longitude 120.69565

Source: Chu et al. 2004**qc1N, FS_{Liq} (PL = 50%)** Boulanger and Idriss, 2014; Robertson and Wride 1998/2009**Ic** Robertson, 2009**LSN** van Ballegooy et al., 2014**Free-Field Ground Settlement Measurement****Legend**

- Back-fill and Silty Sand
- Western Foothills

200 Measured Settlement [mm]

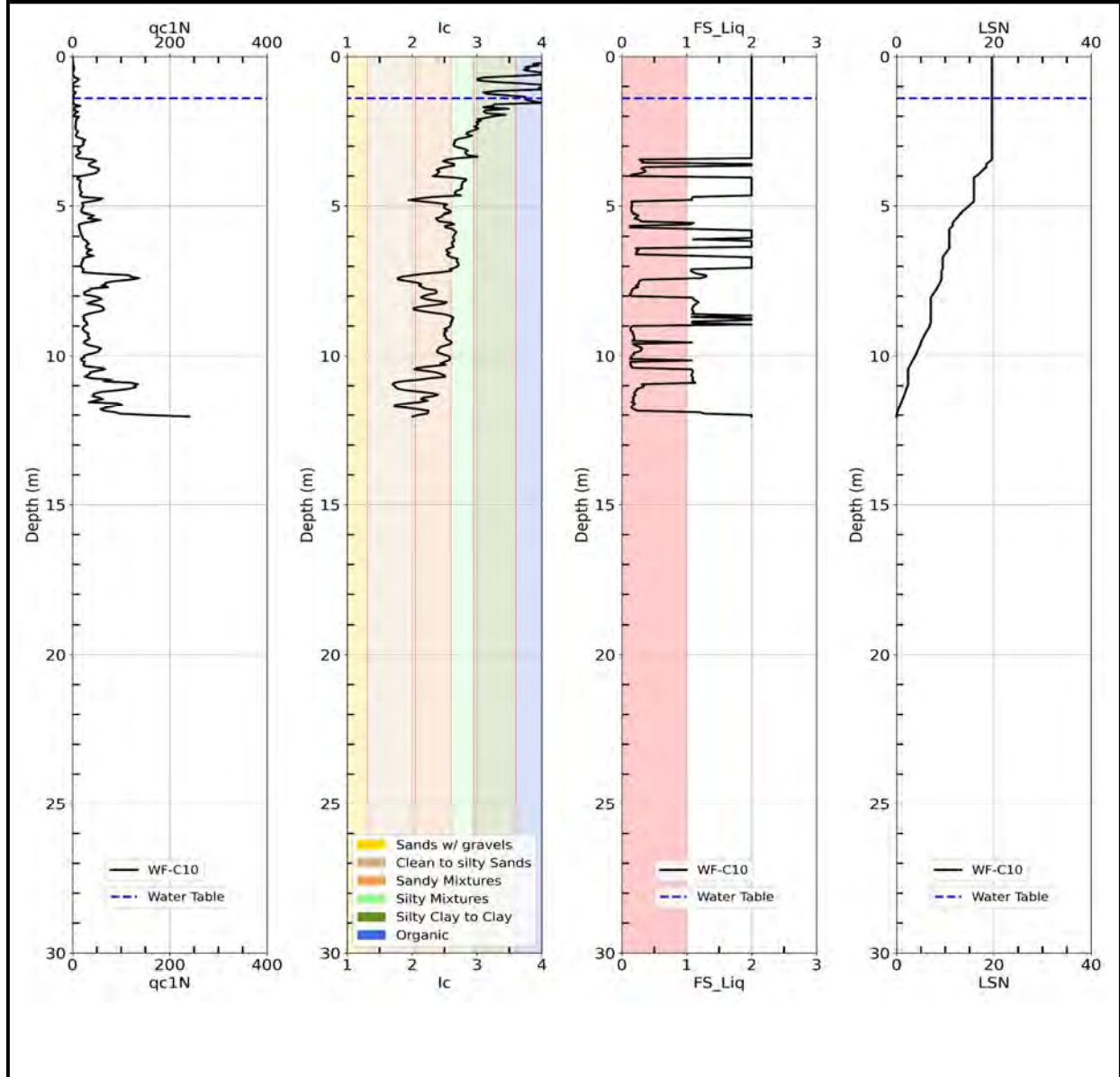


Case History: WU-S1
Site: Wufeng
Location: Wufeng, Taiwan
Earthquake: 1999 Chi-Chi Mw 7.6
PGA: 0.79 g (EW direction [Lee et al. 2001])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.40 m avg. below ground surface (Juang et al. 2013 / Chu et al. 2004)
CPT: WF-C10 Latitude 24.053582 Longitude 120.69677
Source: Chu et al. 2004

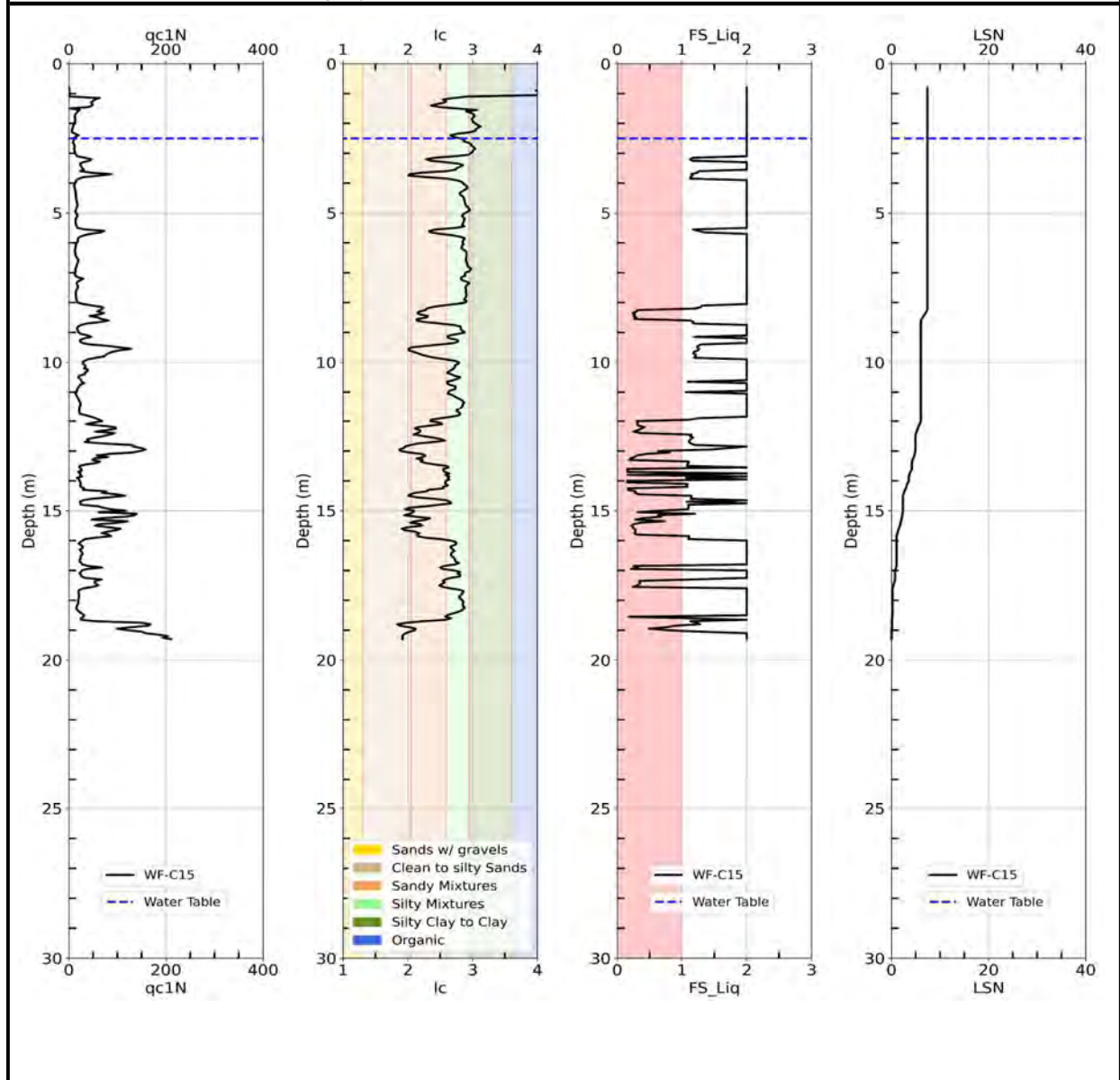
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

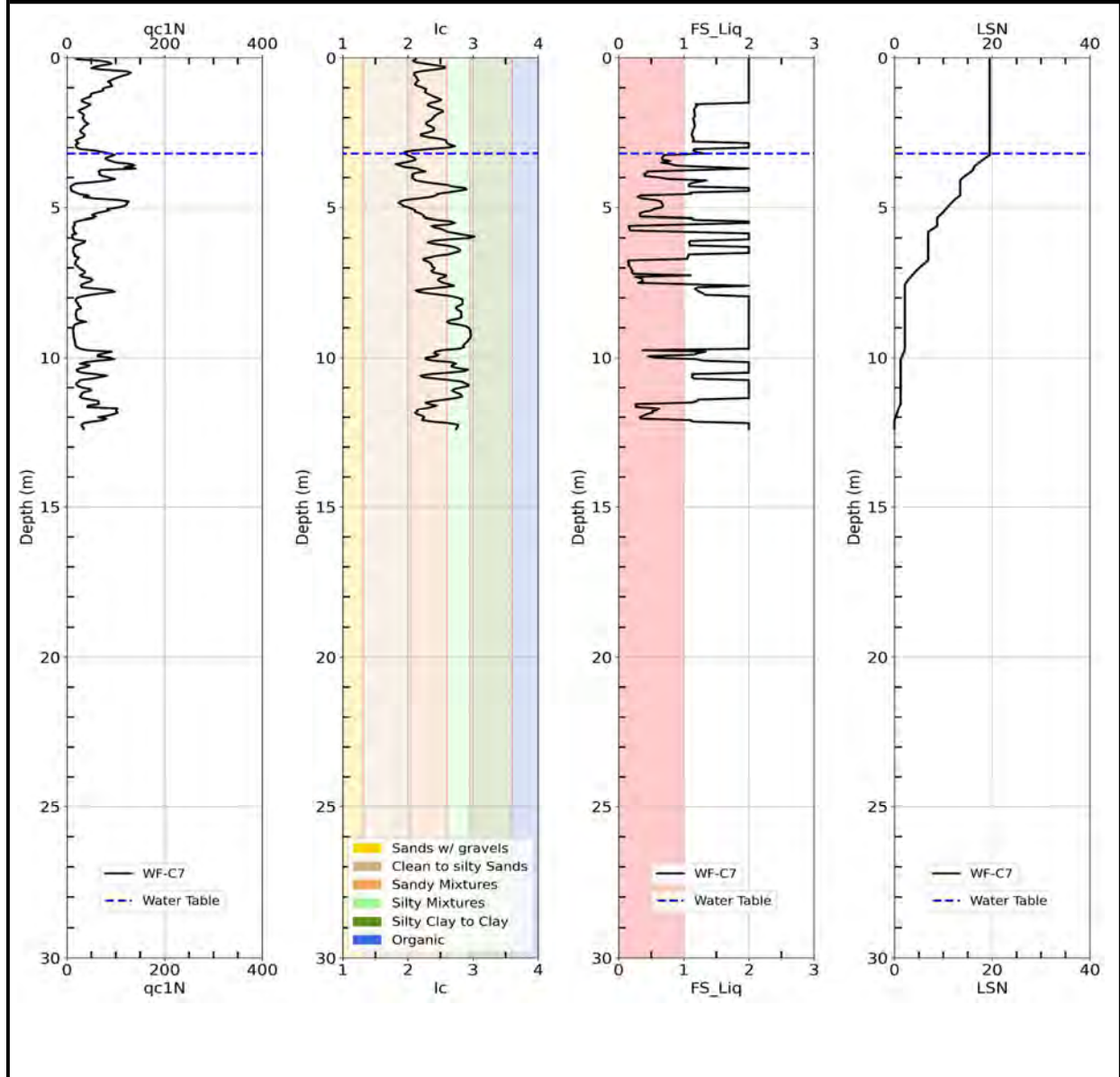


Case History:	WU-S2
Site:	Wufeng
Location:	Wufeng, Taiwan
Earthquake:	1999 Chi-Chi Mw 7.6
PGA:	0.79 g (EW direction [Lee et al. 2001])
Ground Elevation:	0 m Datum: ground surface
Water table:	2.5 m avg. below ground surface (Juang et al. 2013 / Chu et al. 2004)
CPT:	WF-C15 Latitude 24.056137 Longitude 120.69621
Source:	Chu et al. 2004
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014



Case History: WU-S3
Site: Wufeng
Location: Wufeng, Taiwan
Earthquake: 1999 ChiChi Mw 7.6
PGA: 0.79 g (EW direction [Lee et al. 2001])
Ground Elevation: 0 m Datum: ground surface
Water table: 3.2 m avg. below ground surface (Juang et al. 2013 / Chu et al. 2004)
CPT: WF-C7 Latitude 24.05949 Longitude 120.69936
Source: Chu et al. 2004

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Appendix F: Case Histories - Yuanlin

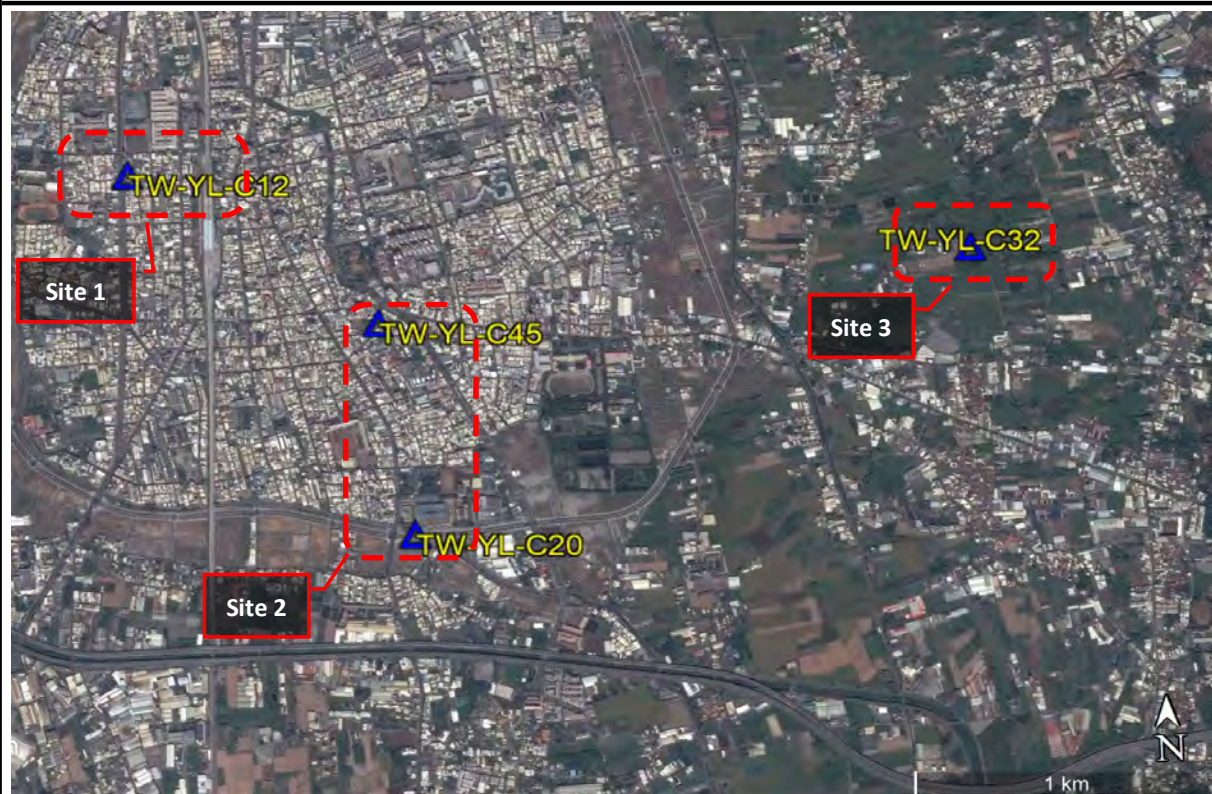
Case History:

Site: Yuanlin
Location: Yuanlin, Taiwan
Earthquake: 1999 Chi-Chi Mw 7.6
PGA: 0.19 g (EW direction [Juang et al. 2013])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.7-2.30 m avg. below ground surface (Chu et al. 2004)
CPT: All CPTs Latitude 23.959917 Longitude 120.57039
Source: Chu et al. 2004

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

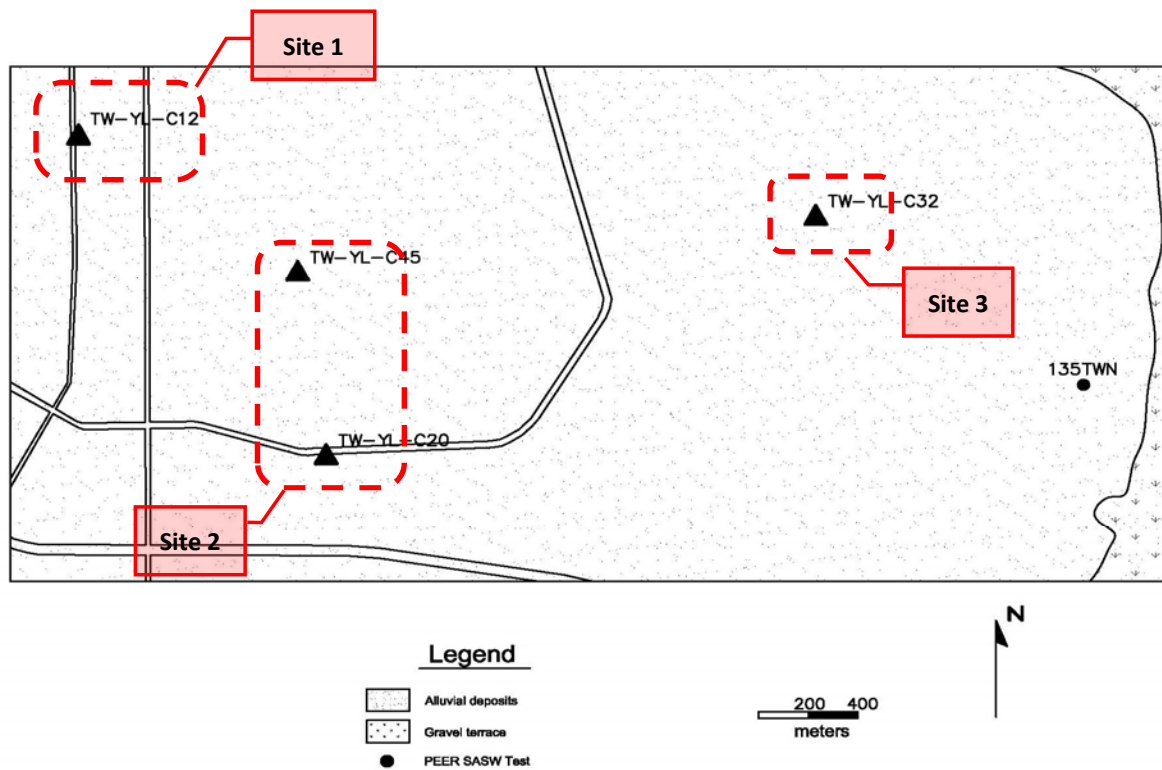
lc Robertson, 2009

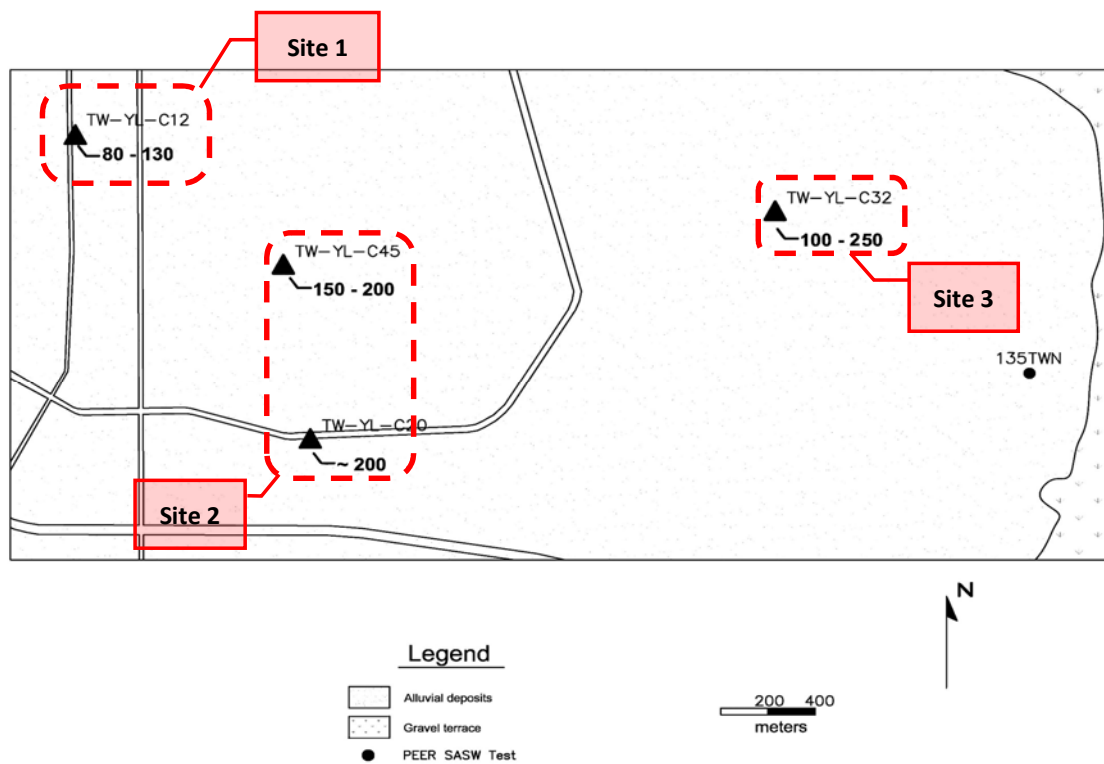
LSN van Ballegooy et al., 2014

Site Plan View**References:**

Chu et al. 2004. PEER Documentation of Soil Conditions at Liquefaction Sites from 1999 Chi-Chi, Taiwan Earthquake

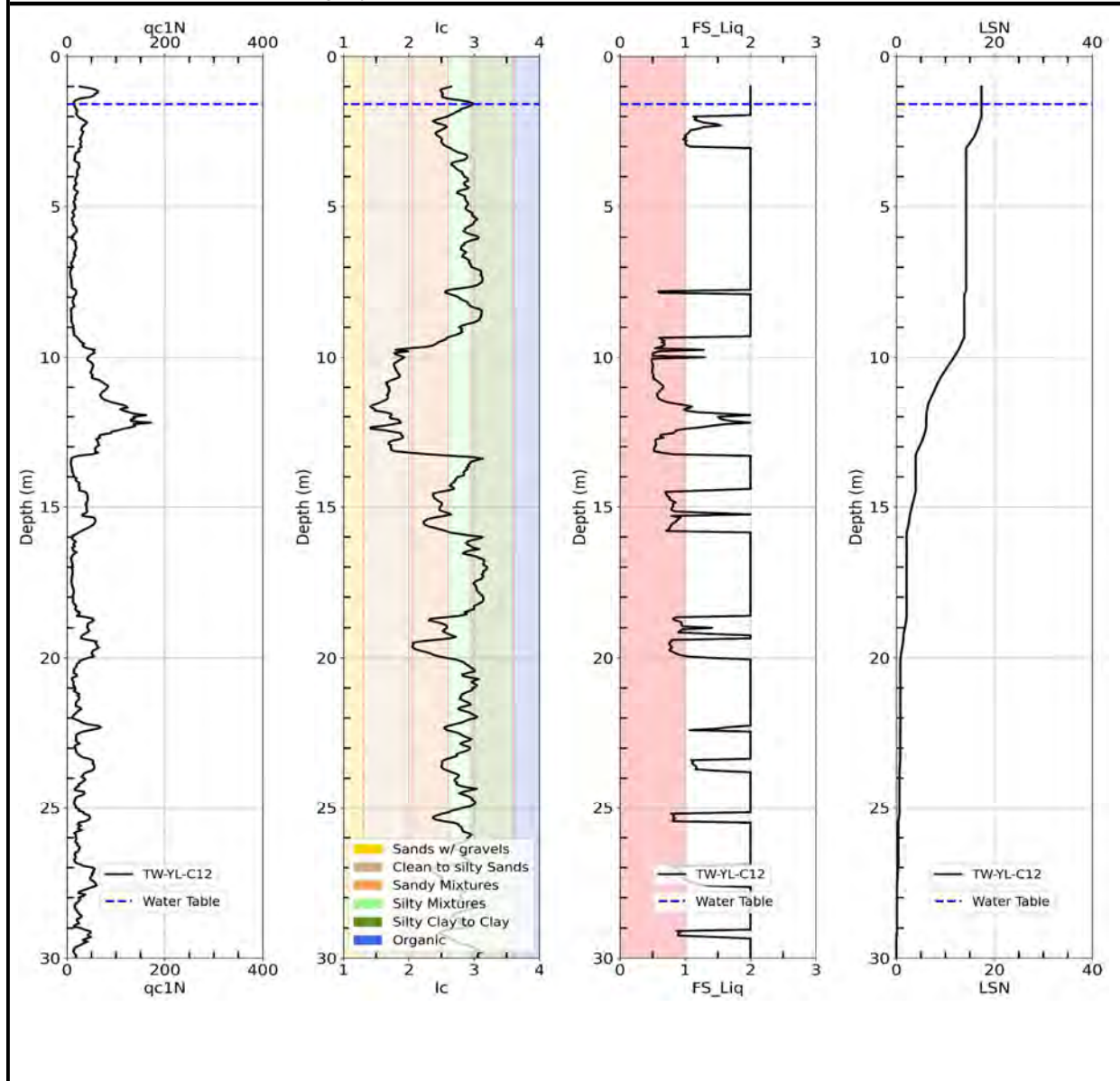
Juang et al. 2013_Simplified procedure for estimation of liquefaction-induced settlement and site-specific probabilistic settlement exceedance curve using cone penetration test (CPT)

Case History:**Site:** Yuanlin**Location:** Yuanlin, Taiwan**Earthquake:** 1999 Chi-Chi Mw 7.6**PGA:** 0.19 g (EW direction [Juang et al. 2013])**Ground Elevation:** 0 m Datum: ground surface**Water table:** 0.7-2.30 m avg. below ground surface (Chu et al. 2004)**CPT:** All CPTs Latitude 23.959917 Longitude 120.57039**Source:** Chu et al. 2004**qc1N, FS_{Liq} (PL = 50%)** Boulanger and Idriss, 2014; Robertson and Wride 1998/2009**Ic** Robertson, 2009**LSN** van Ballegooy et al., 2014**Surficial Geology**

Case History:**Site:** Yuanlin**Location:** Yuanlin, Taiwan**Earthquake:** 1999 Chi-Chi Mw 7.6**PGA:** 0.19 g (EW direction [Juang et al. 2013])**Ground Elevation:** 0 m Datum: ground surface**Water table:** 0.7-2.30 m avg. below ground surface (Chu et al. 2004)**CPT:** All CPTs Latitude 23.959917 Longitude 120.57039**Source:** Chu et al. 2004**qc1N, FS_{Liq} (PL = 50%)** Boulanger and Idriss, 2014; Robertson and Wride 1998/2009**Ic** Robertson, 2009**LSN** van Ballegooy et al., 2014**Free-Field Ground Settlement Measurement**

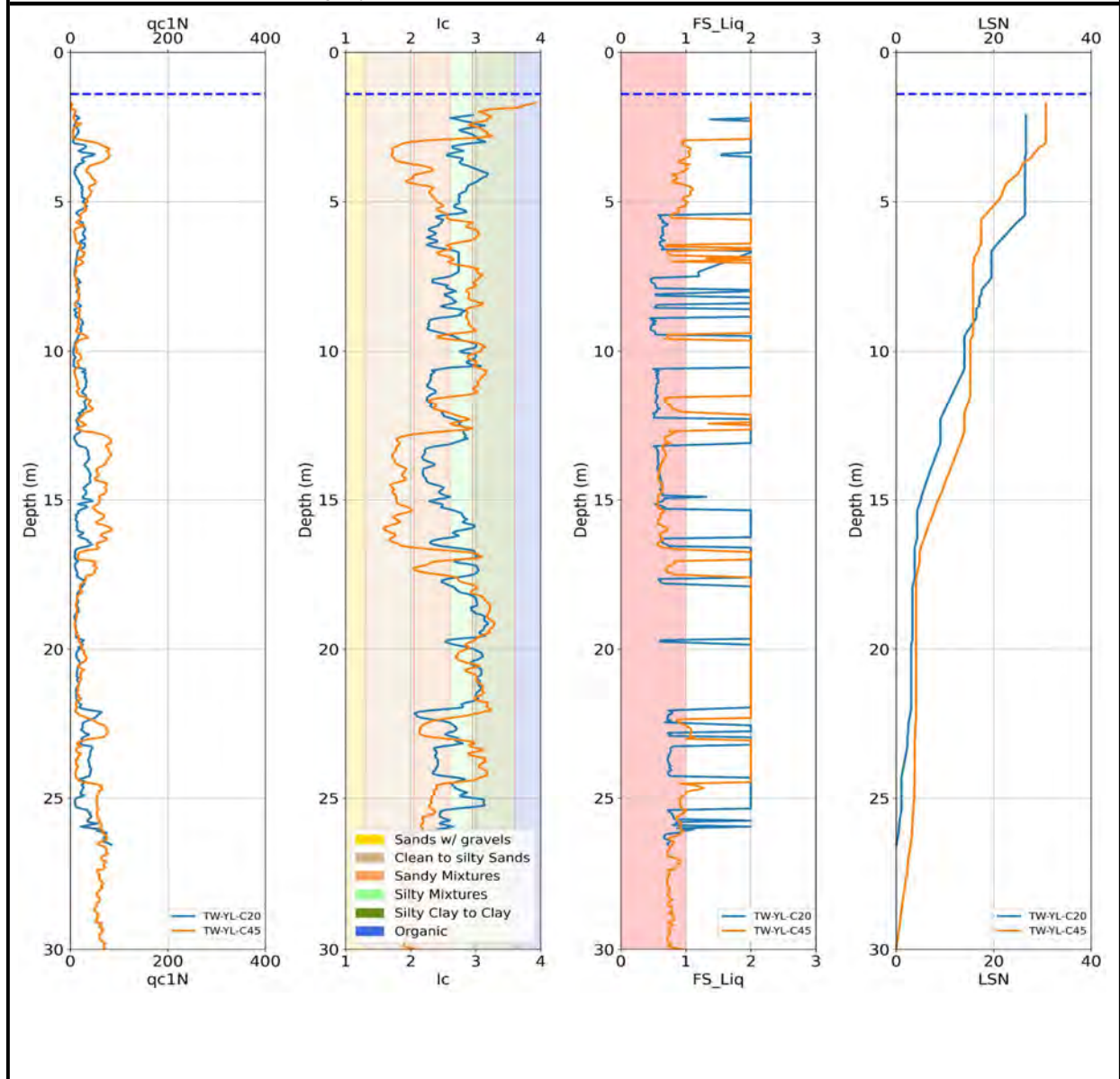
Case History: YU-S1
Site: Yuanlin
Location: Yuanlin, Taiwan
Earthquake: 1999 Chi-Chi Mw 7.6
PGA: 0.19 g (EW direction [Juang et al. 2013])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.60 m avg. below ground surface (Juang et al. 2013 / Chu et al. 2004)
CPT: YL-C12 Latitude 23.9614 Longitude 120.5669
Source: Chu et al. 2004

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



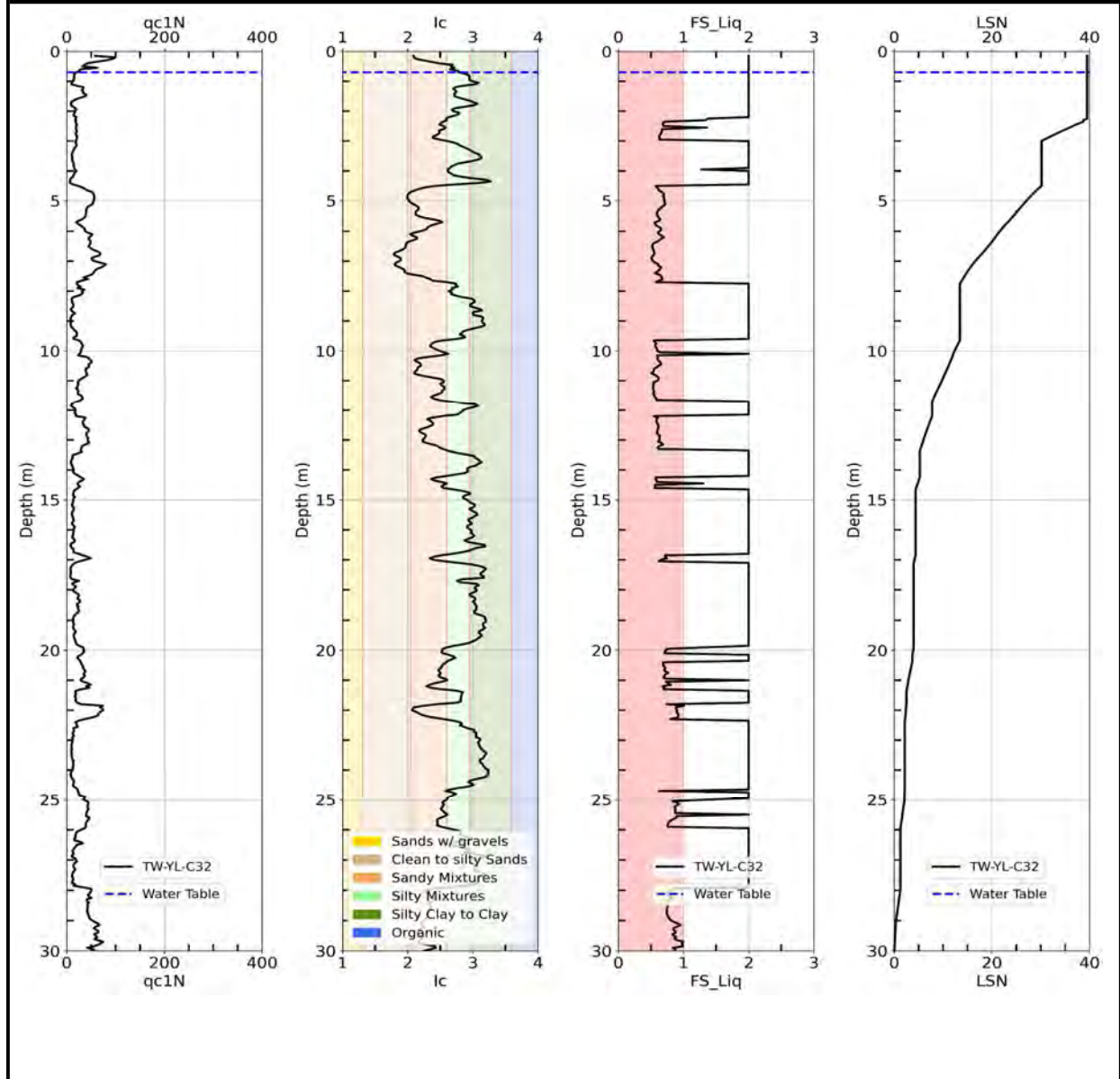
Case History: YU-S2
Site: Yuanlin
Location: Yuanlin, Taiwan
Earthquake: 1999 Chi-Chi Mw 7.6
PGA: 0.19 g (EW direction [Juang et al. 2013])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.40 - 2.30 m avg. below ground surface (Juang et al. 2013 / Chu et al. 2004)
CPT: YL-C20, YL-C45 Latitude 13.9487 Longitude 120.5764
Source: Chu et al. 2004

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: YU-S3
Site: Yuanlin
Location: Yuanlin, Taiwan
Earthquake: 1999 Chi-Chi Mw 7.6
PGA: 0.19 g (EW direction [Juang et al. 2013])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.70 m avg. below ground surface (Juang et al. 2013 / Chu et al. 2004)
CPT: YL-C32 Latitude 23.9579 Longitude 120.5957
Source: Chu et al. 2004

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Appendix G: Case Histories - CentrePort

CentrePort, 2013 Cook Strait Earthquake

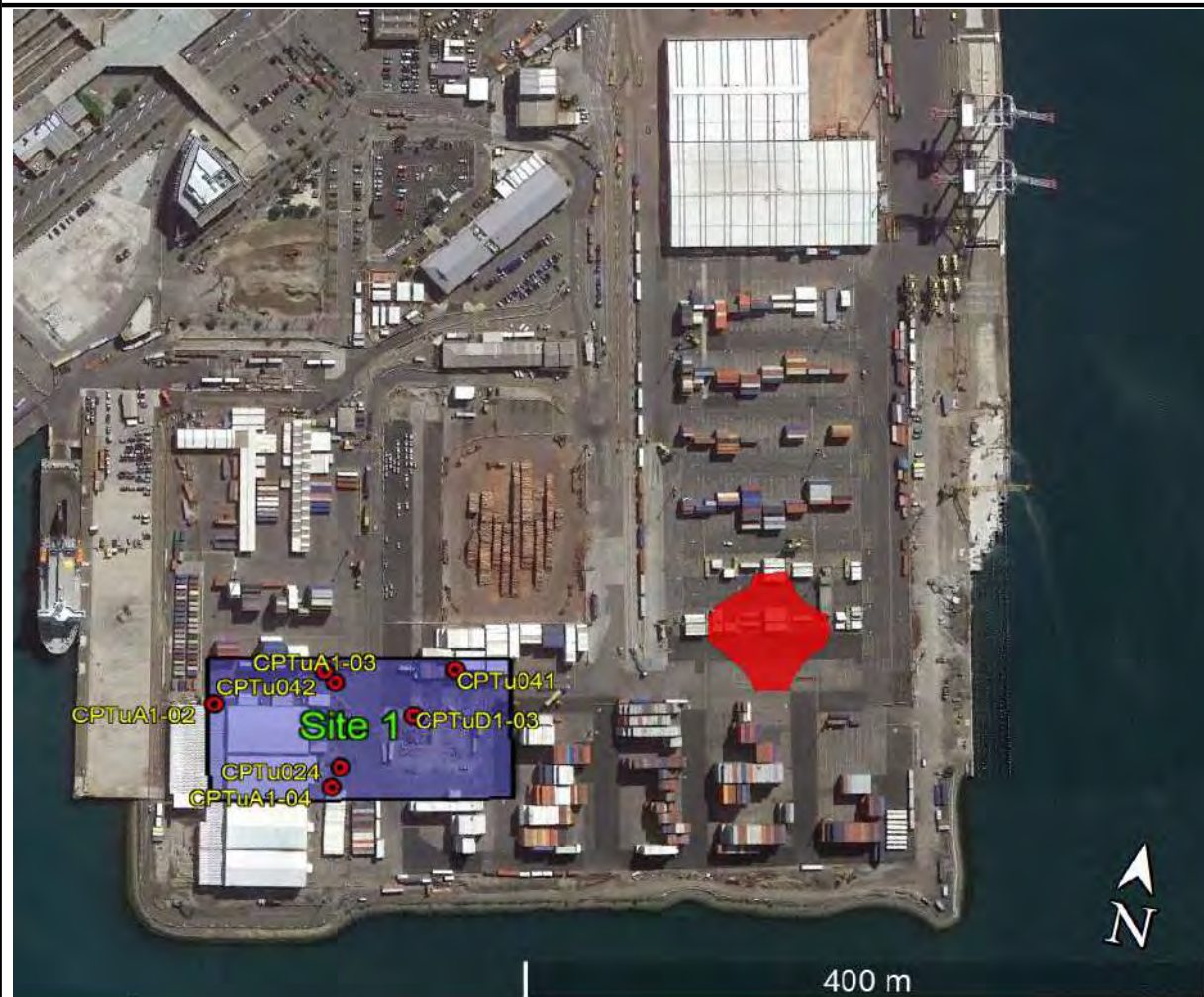
Case History:

Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2013 Cook strait Mw 6.6
PGA: 0.22 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakal et al. 2020a)
Water table: 2.7 - 3.5 m avg. below ground surface (Dhakal et al. 2020a)
CPT: Site 1 Latitude -41.28058 Longitude 174.78465
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

lc Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

Dhakal et al. 2020a. Geotechnical characterization and liquefaction evaluation of gravelly reclamations and hydraulic fills (Port of Wellington, New Zealand)

Dhakal et.al. 2020b. Liquefaction assessment of reclaimed land at CentrePort, Wellington

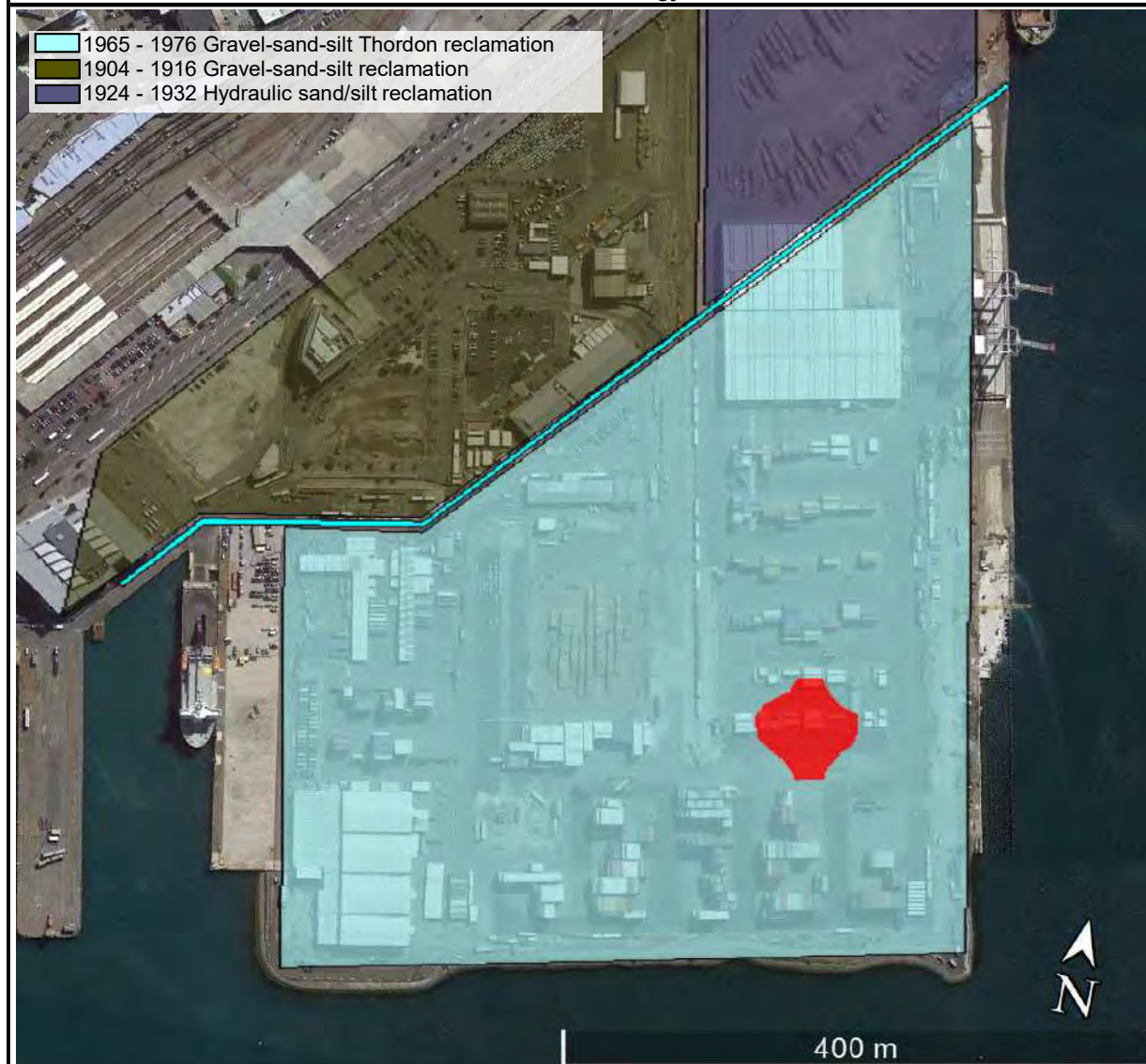
Case History:

Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2013 Cook strait Mw 6.6
PGA: 0.22 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakal et al. 2020a)
Water table: 2.7 - 3.5 m avg. below ground surface (Dhakal et al. 2020a)
CPT: Site 1 Latitude -41.28058 Longitude 174.78465
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology

Case History:

Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2013 Cook strait Mw 6.6
PGA: 0.22 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakal et al. 2020a)
Water table: 2.7 - 3.5 m avg. below ground surface (Dhakal et al. 2020a)
CPT: Site 1 Latitude -41.28058 Longitude 174.78465
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

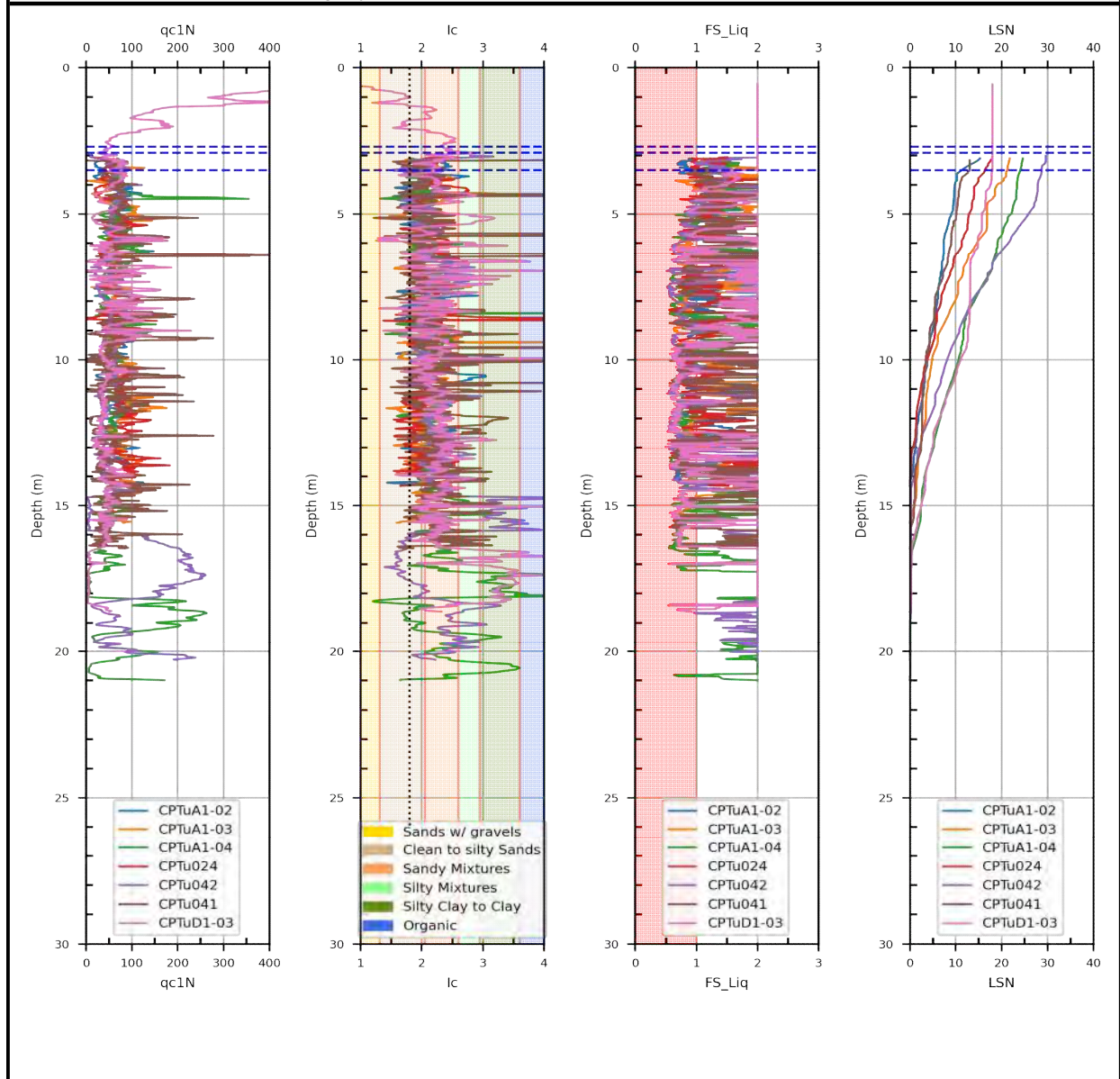
Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Free-Field Ground Settlement Measurement

Case History: CP-CS13-S1
Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2013 Cook strait Mw 6.6
PGA: 0.22 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakal et al. 2020a)
Water table: 2.7 - 3.5 m avg. below ground surface (Dhakal et al. 2020a)
CPT: Site 1 Latitude -41.28058 Longitude 174.78465
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



CentrePort, 2013 Lake Grassmere Earthquake

Case History:

Site: CentrPort
Location: CentrePort, Wellington
Earthquake: 2013 Lake Grassmere Mw 6.6
PGA: 0.15 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakal et al. 2020a)
Water table: 2.5 - 4.1 m avg. below ground surface (Dhakal et al. 2020a)
CPT: All Latitude -41.28058 Longitude 174.78465
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

lc Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

Dhakal et al. 2020a. Geotechnical characterization and liquefaction evaluation of gravelly reclamations and hydraulic fills (Port of Wellington, New Zealand)

Dhakal et.al. 2020b. Liquefaction assessment of reclaimed land at CentrePort, Wellington

Case History:

Site: CentrPort
Location: CentrePort, Wellington
Earthquake: 2013 Lake Grassmere Mw 6.6
PGA: 0.15 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakal et al. 2020a)
Water table: 2.5 - 4.1 m avg. below ground surface (Dhakal et al. 2020a)
CPT: All Latitude -41.28058 Longitude 174.78465
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

lc Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology

Case History:

Site: CentrPort
Location: CentrePort, Wellington
Earthquake: 2013 Lake Grassmere Mw 6.6
PGA: 0.15 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakal et al. 2020a)
Water table: 2.5 - 4.1 m avg. below ground surface (Dhakal et al. 2020a)
CPT: All Latitude -41.28058 Longitude 174.78465
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

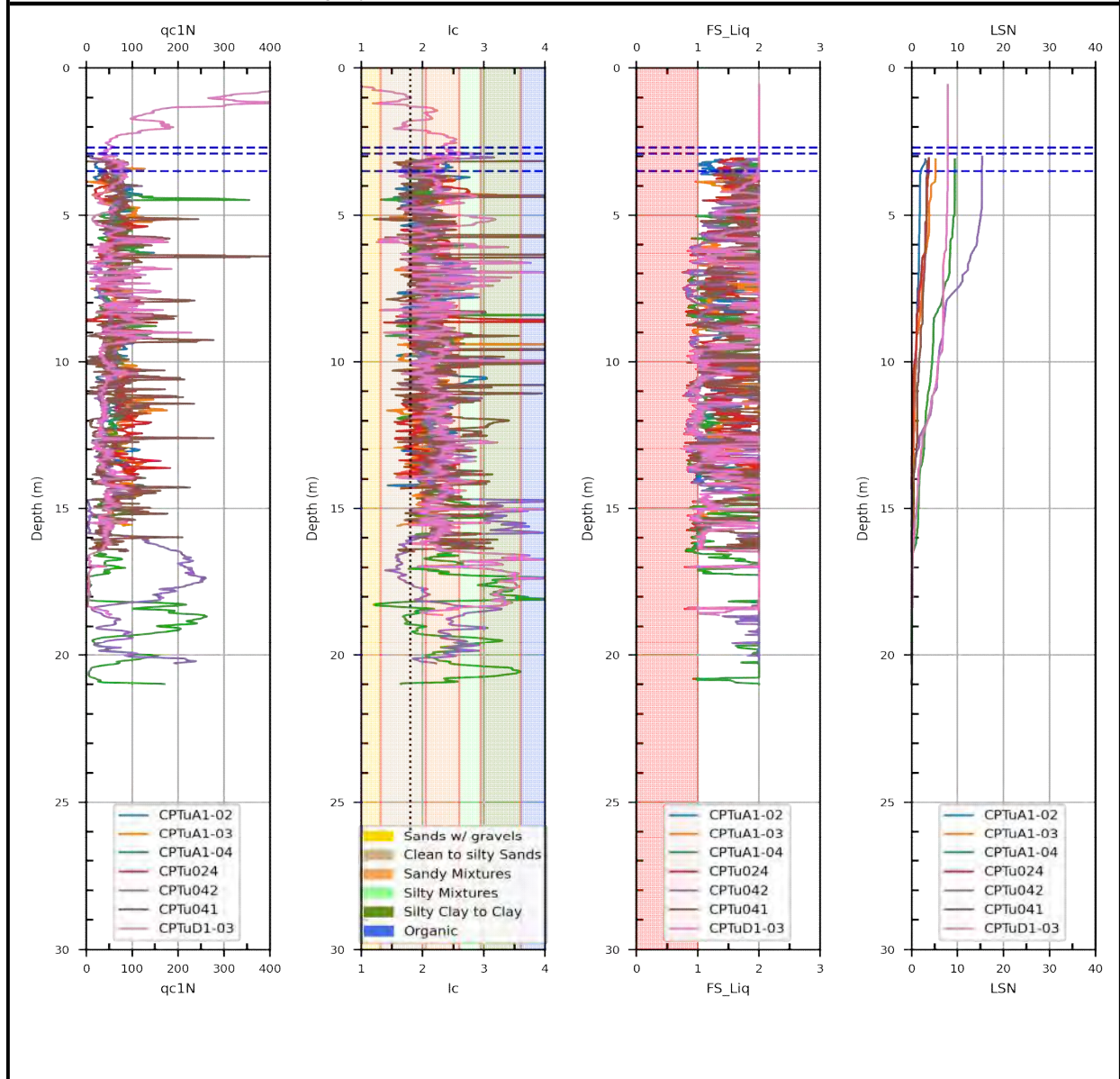
lc Robertson, 2009

LSN van Ballegooy et al., 2014

Free-Field Ground Settlement Measurement

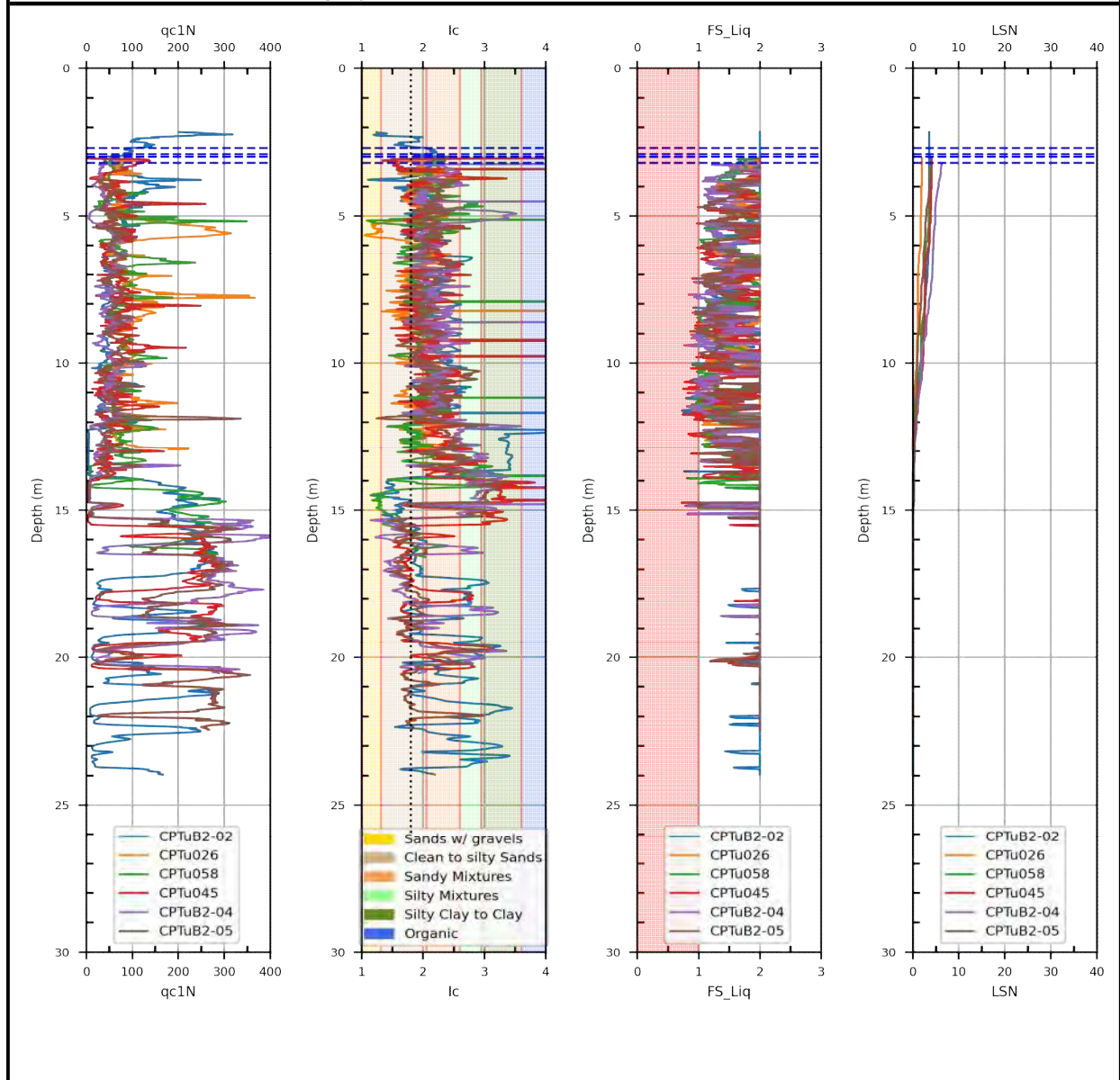
Case History: CP-LG13-S1
Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2013 Lake Grassmere Mw 6.6
PGA: 0.15 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakal et al. 2020a)
Water table: 2.7 - 3.5 m avg. below ground surface (Dhakal et al. 2020a)
CPT: Site 1 Latitude -41.28058 Longitude 174.78465
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



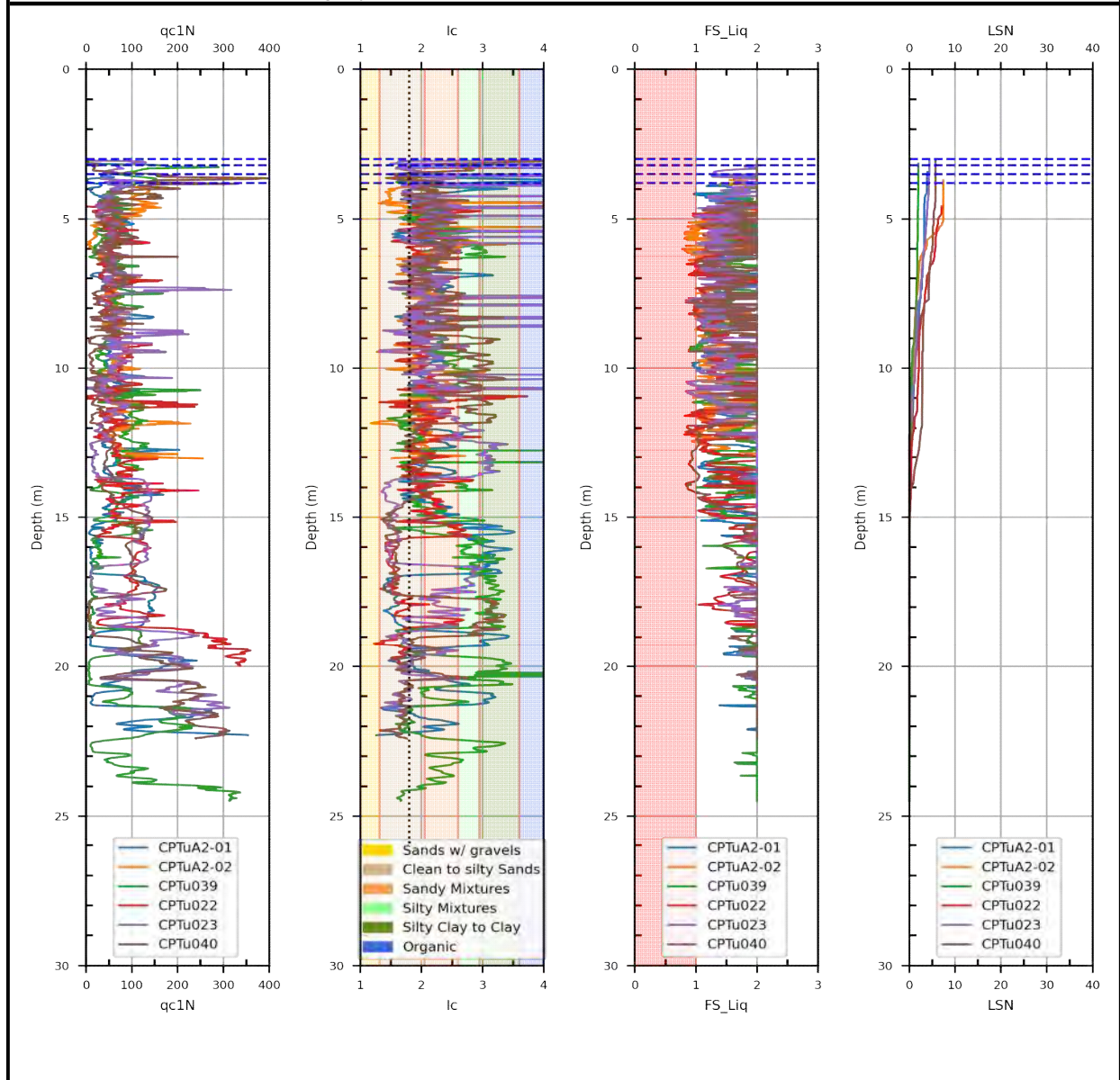
Case History: CP-LG13-S2
Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2013 Lake Grassmere Mw 6.6
PGA: 0.15 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakal et al. 2020a)
Water table: 2.7 - 3.0 m avg. below ground surface (Dhakal et al. 2020a)
CPT: Site 2 Latitude -41.27934 Longitude 174.78622
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



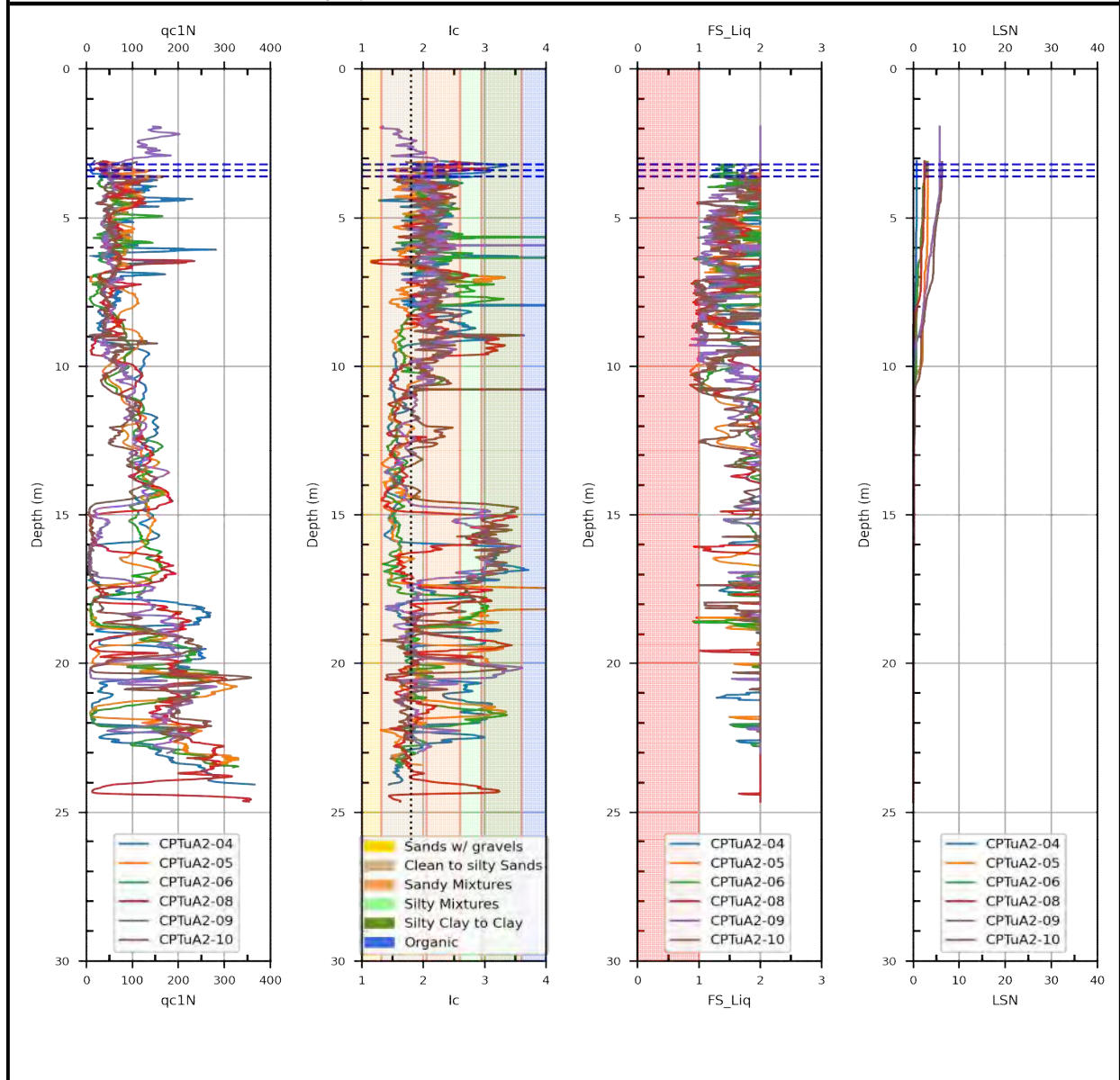
Case History: CP-LG13-S3
Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2013 Lake Grassmere Mw 6.6
PGA: 0.15 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakal et al. 2020a)
Water table: 3.2 - 3.8 m avg. below ground surface (Dhakal et al. 2020a)
CPT: Site 3 Latitude -41.27998 Longitude 174.78754
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



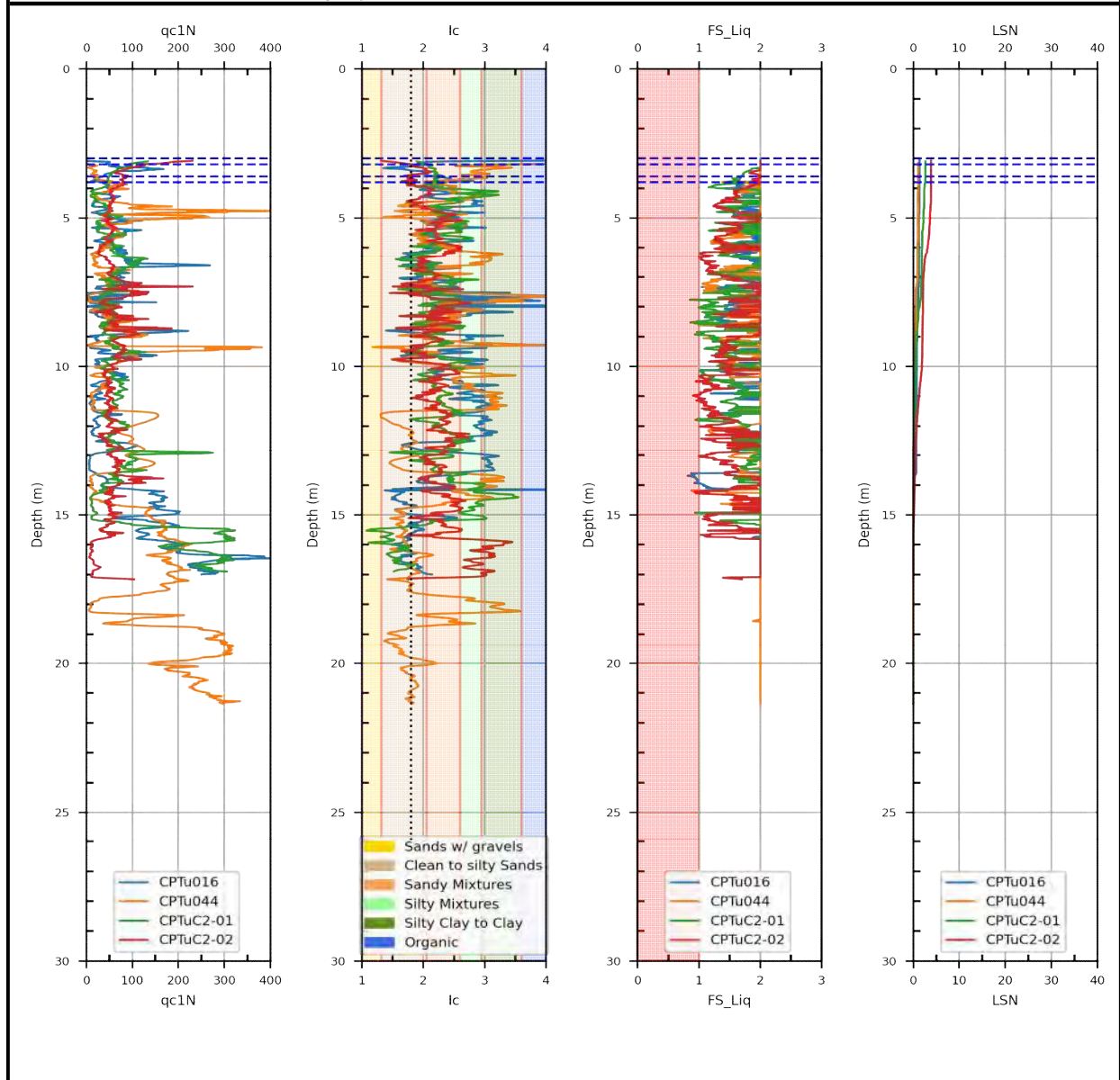
Case History: CP-LG13-S4
Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2013 Lake Grassmere Mw 6.6
PGA: 0.15 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakal et al. 2020a)
Water table: 3.2 - 3.6 m avg. below ground surface (Dhakal et al. 2020a)
CPT: Site 4 Latitude -41.27883 Longitude 174.78803
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



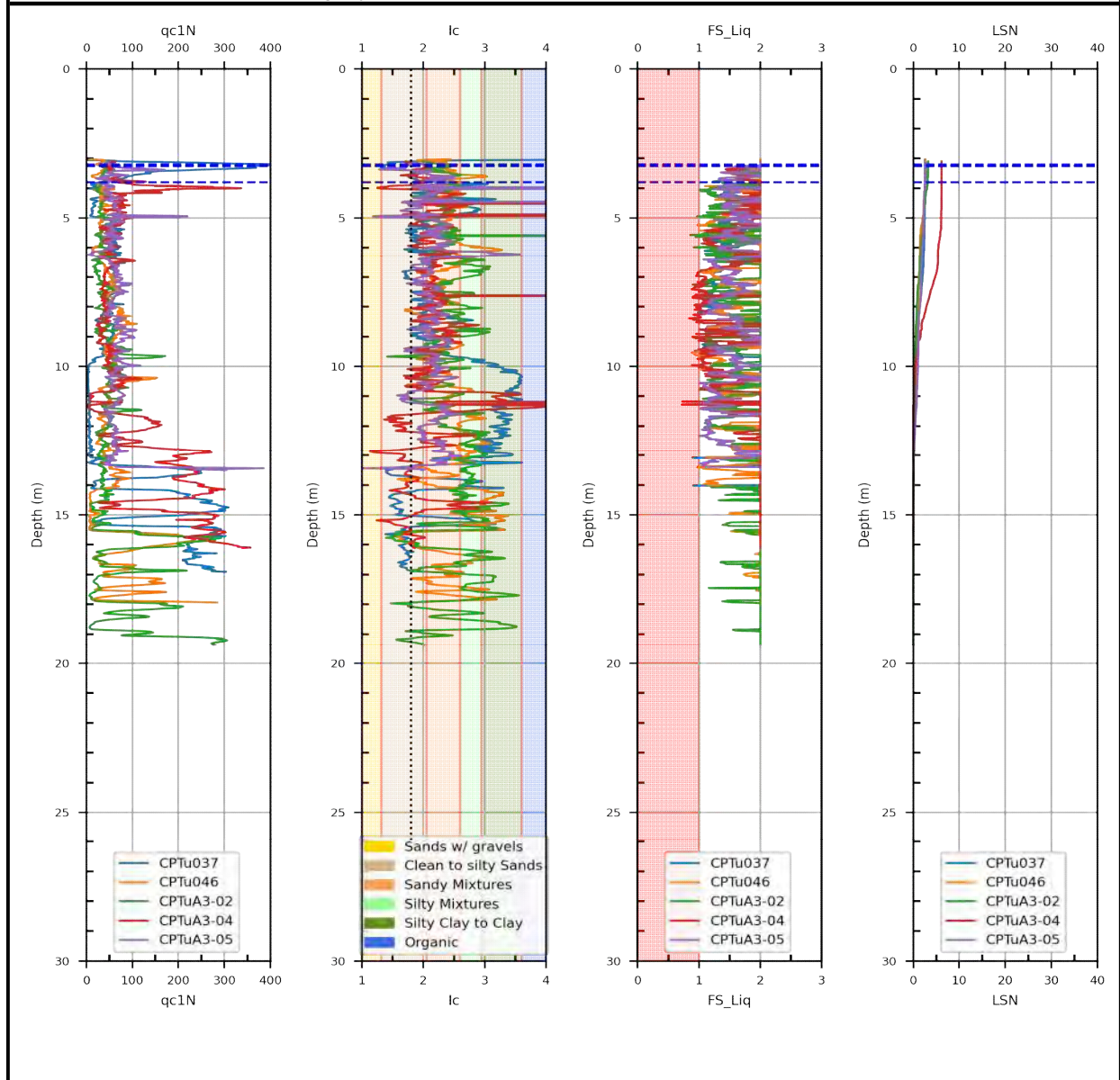
Case History: CP-LG13-S5
Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2013 Lake Grassmere Mw 6.6
PGA: 0.15 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakal et al. 2020a)
Water table: 3.0-3.8 m avg. below ground surface (Dhakal et al. 2020a)
CPT: Site 5 Latitude -41.27792 Longitude 174.78782
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



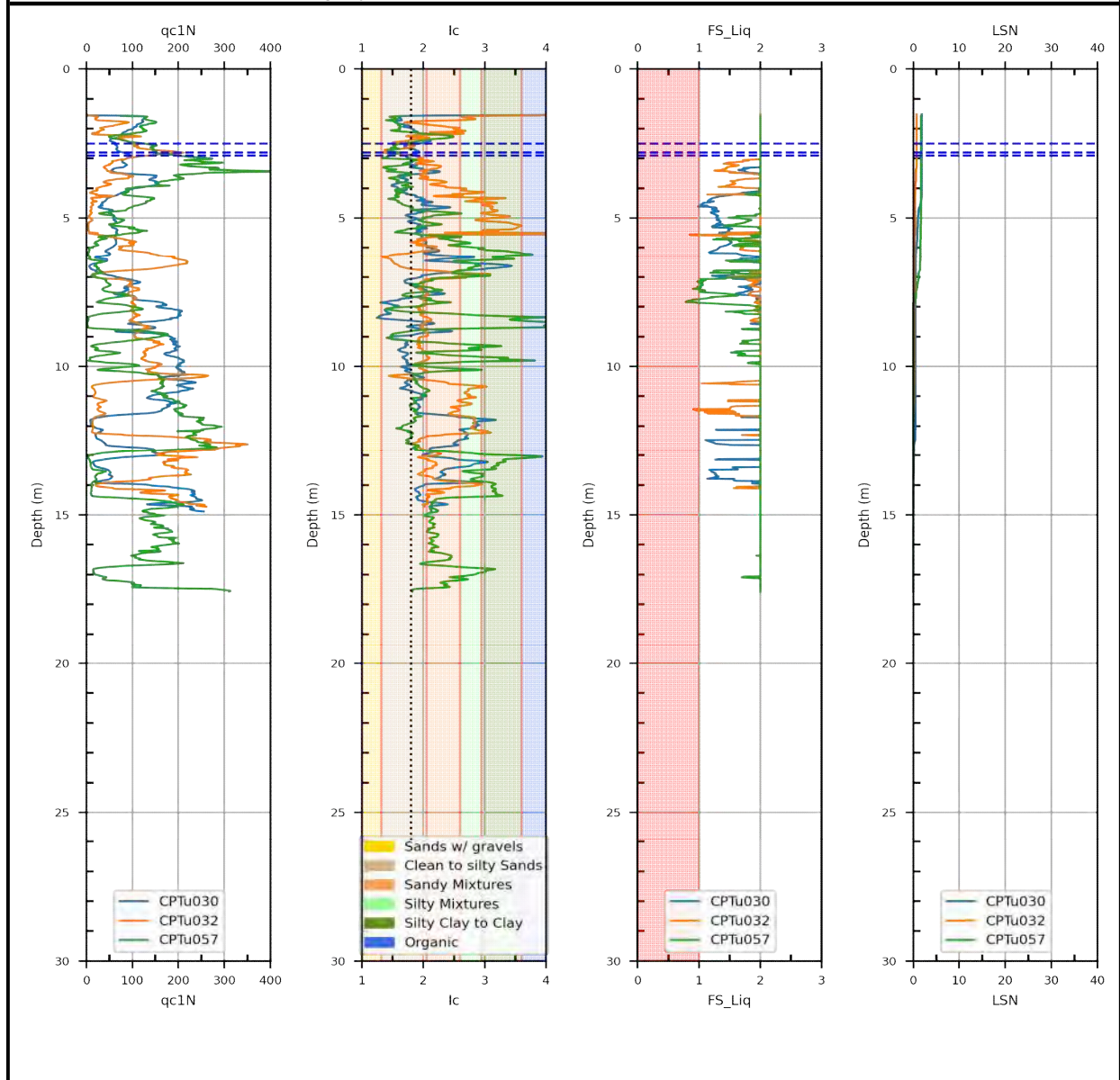
Case History: CP-LG13-S6
Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2013 Lake Grassmere Mw 6.6
PGA: 0.15 g (CPLB Station. [Dhakai et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakai et al. 2020a)
Water table: 3.2-3.8 m avg. below ground surface (Dhakai et al. 2020a)
CPT: Site 6 Latitude -41.27826 Longitude 174.78604
Source: Dhakai et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



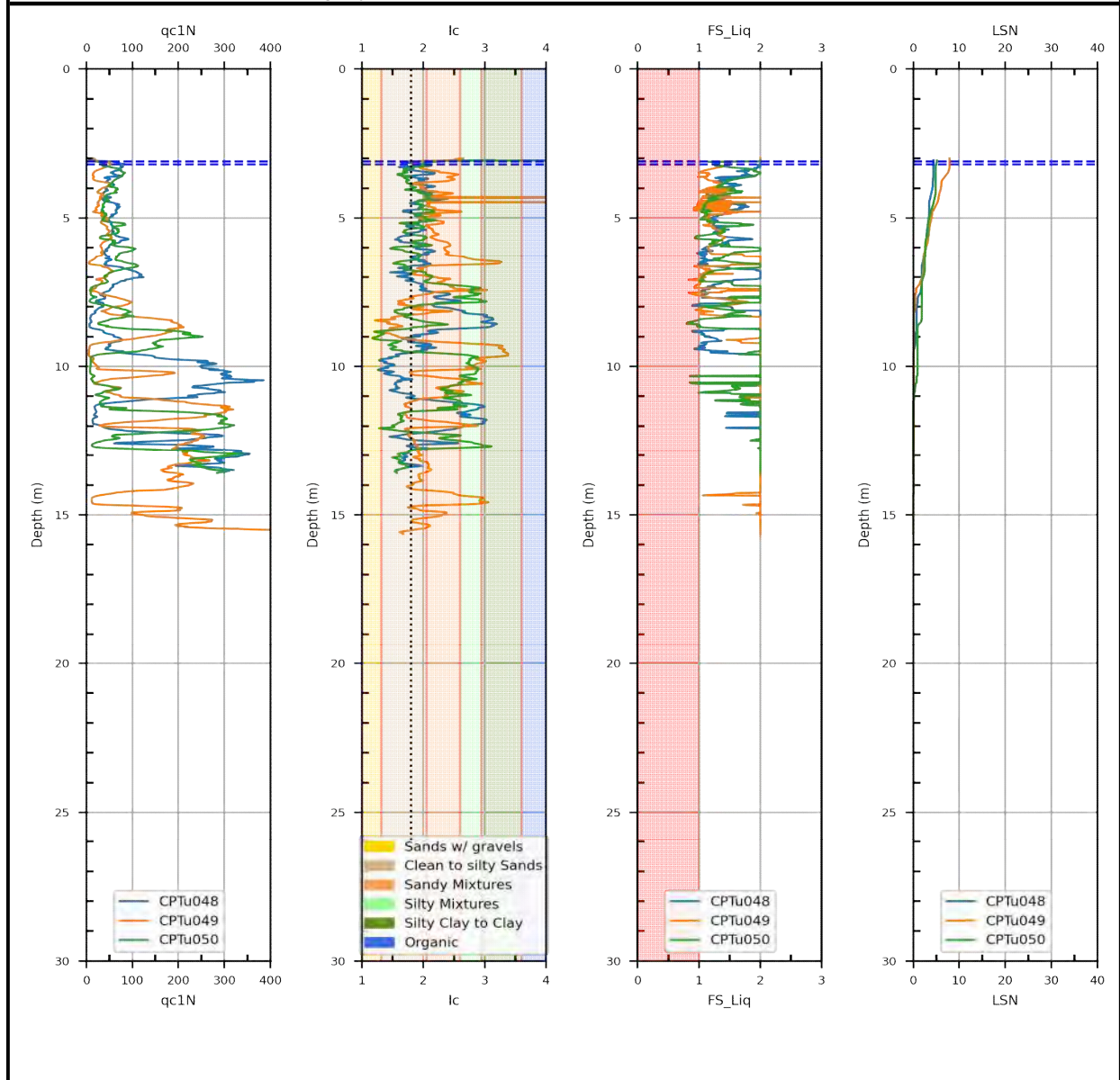
Case History: CP-LG13-S7
Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2013 Lake Grassmere Mw 6.6
PGA: 0.15 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakal et al. 2020a)
Water table: 2.5-2.9 m avg. below ground surface (Dhakal et al. 2020a)
CPT: Site 7 Latitude -41.27894 Longitude 174.78262
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



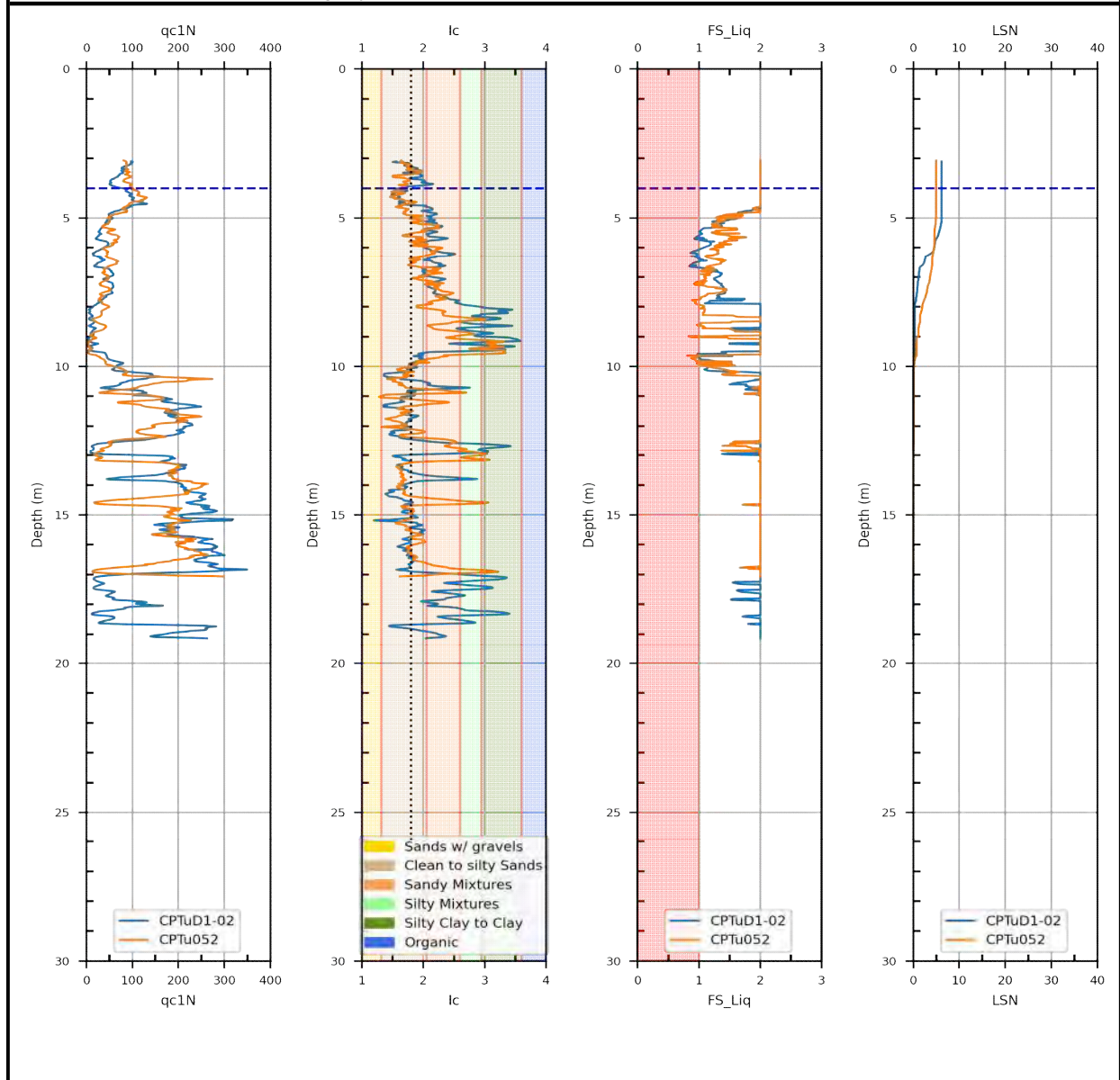
Case History: CP-LG13-S8
Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2013 Lake Grassmere Mw 6.6
PGA: 0.15 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakal et al. 2020a)
Water table: 3.1-3.2 m avg. below ground surface (Dhakal et al. 2020a)
CPT: Site 8 Latitude -41.27844 Longitude 174.78403
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



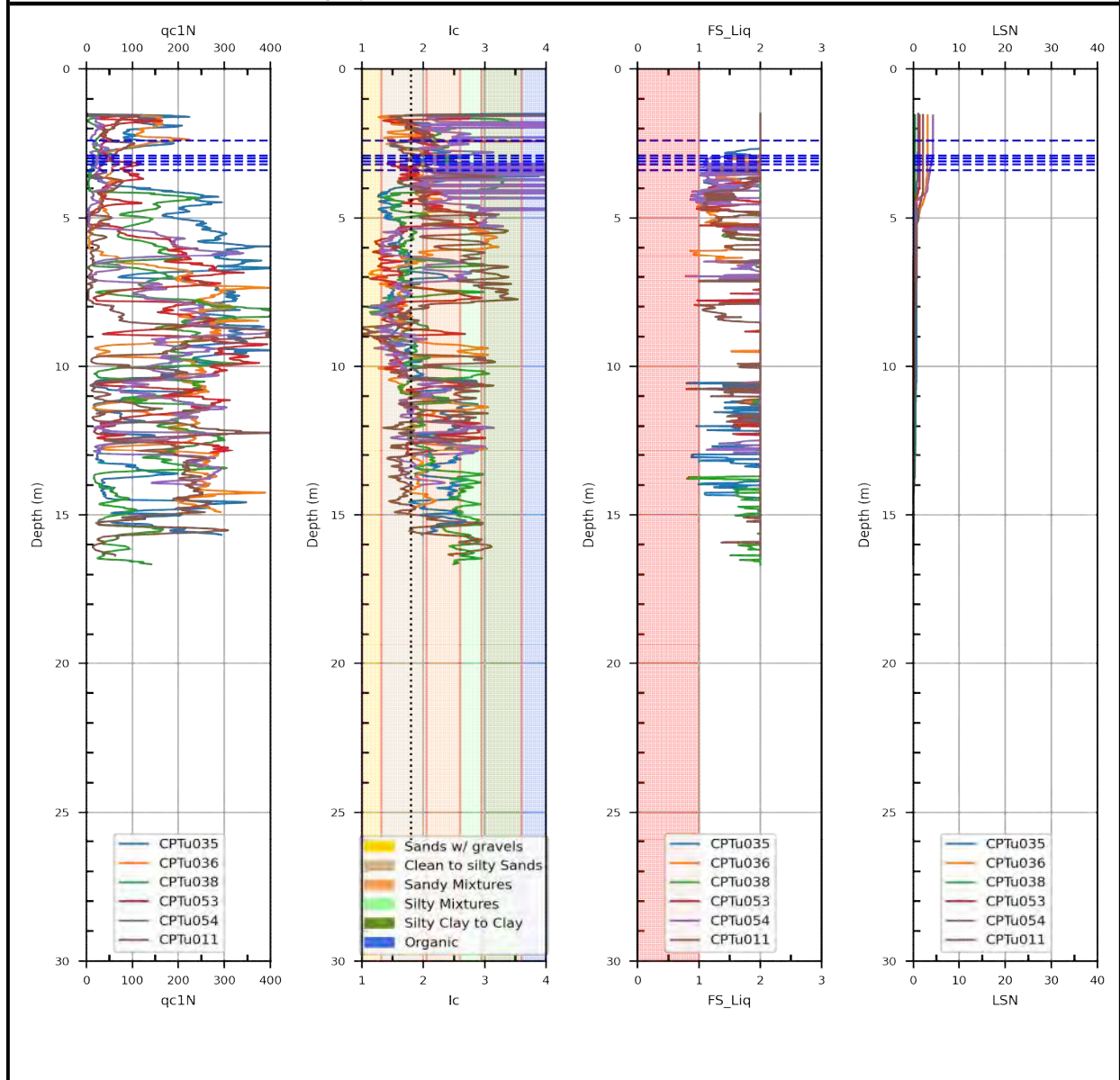
Case History: CP-LG13-S9
Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2013 Lake Grassmere Mw 6.6
PGA: 0.15 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakal et al. 2020a)
Water table: 4 m avg. below ground surface (Dhakal et al. 2020a)
CPT: Site 9 Latitude -41.27713 Longitude 174.78633
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: CP-LG13-S10
Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2013 Lake Grassmere Mw 6.6
PGA: 0.15 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakal et al. 2020a)
Water table: 2.4-3.4 m avg. below ground surface (Dhakal et al. 2020a)
CPT: Site 10 Latitude -41.27647 Longitude 174.78522
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014

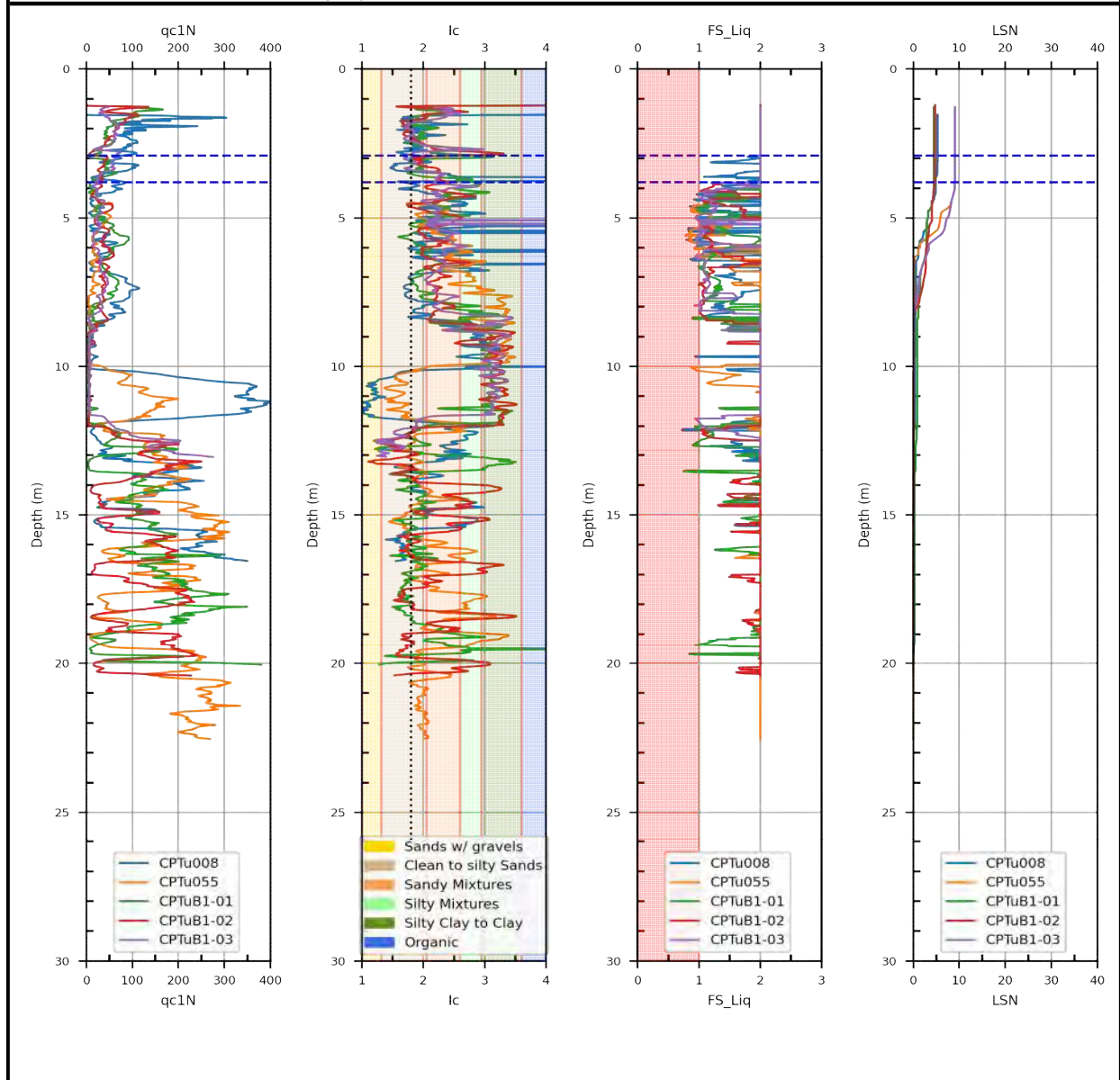


Case History: CP-LG13-S11
Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2013 Lake Grassmere Mw 6.6
PGA: 0.15 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0m Datum: ground surface (Dhakal et al. 2020a)
Water table: 3.0-3.8 m avg. below ground surface (Dhakal et al. 2020a)
CPT: Site 11 Latitude -41.27505 Longitude 174.78758
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

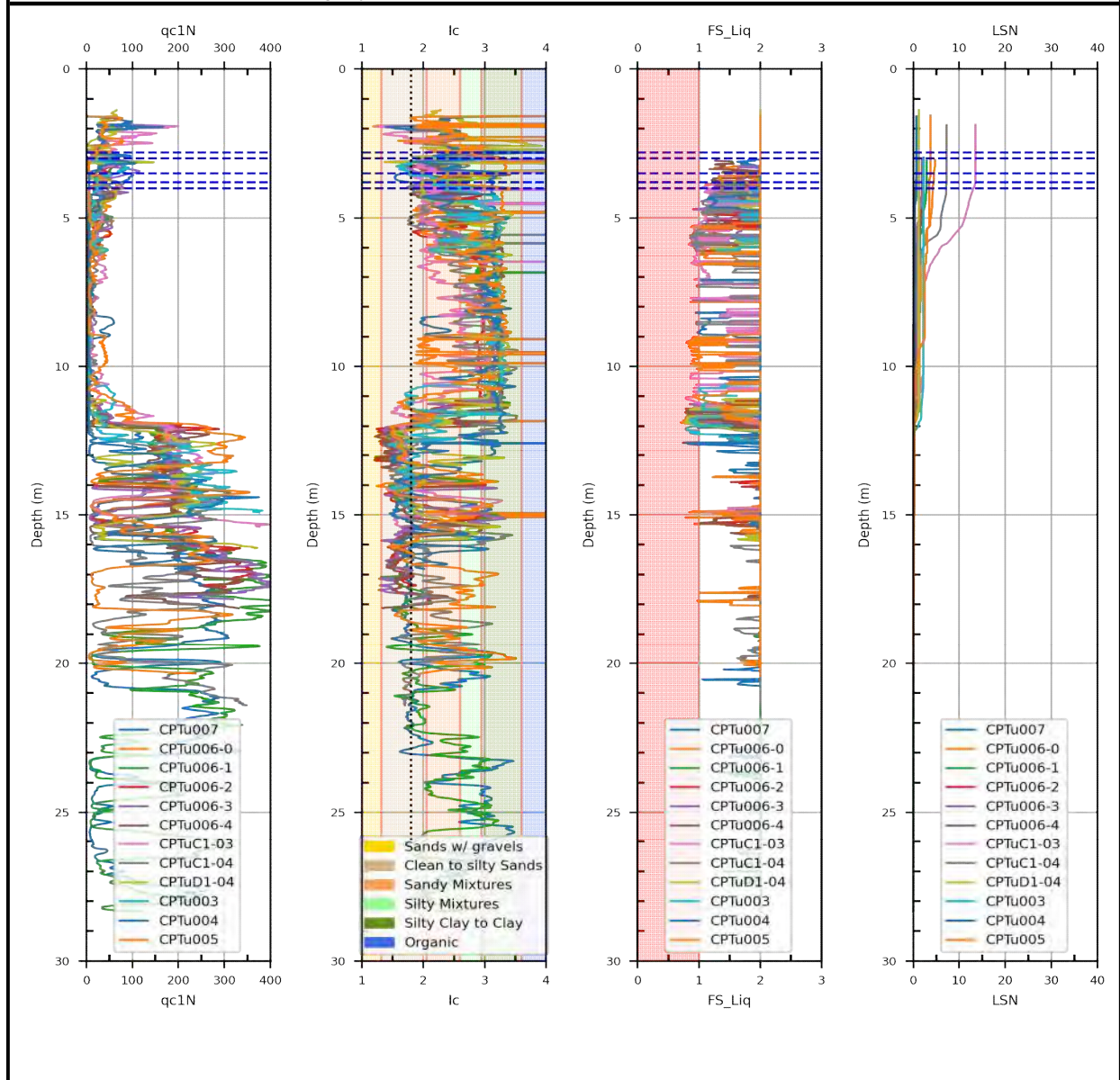


Case History: CP-LG13-S12
Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2013 Lake Grassmere Mw 6.6
PGA: 0.15 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0m Datum: ground surface (Dhakal et al. 2020a)
Water table: 2.8-4.0 m avg. below ground surface (Dhakal et al. 2020a)
CPT: Site 12 Latitude -41.27237 Longitude 174.78733
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

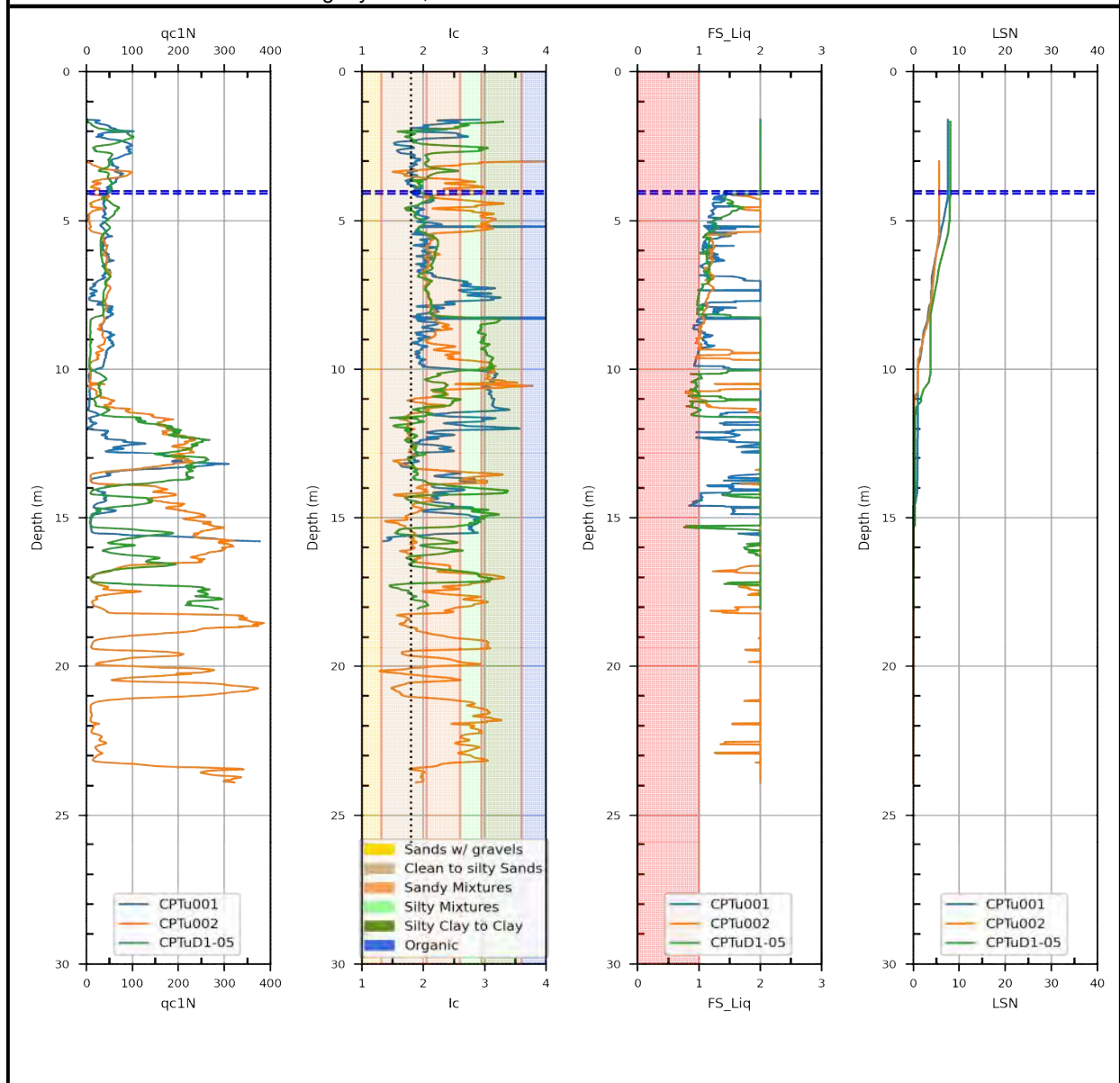
Ic Robertson, 2009

LSN van Ballegooy et al., 2014



Case History: CP-LG13-S13
Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2013 Lake Grassmere Mw 6.6
PGA: 0.15 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0m Datum: ground surface (Dhakal et al. 2020a)
Water table: 4.0-4.1 m avg. below ground surface (Dhakal et al. 2020a)
CPT: Site 13 Latitude -41.269 Longitude 174.78647
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



CentrePort, 2016 Kaikoura Earthquake

Case History:

Site: CentrPort
Location: CentrePort, Wellington
Earthquake: 2016 Kaikoura Mw 7.8
PGA: 0.25 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakal et al. 2020a)
Water table: 2.5 - 4.1 m avg. below ground surface (Dhakal et al. 2020a)
CPT: All Latitude -41.28058 Longitude 174.78465
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

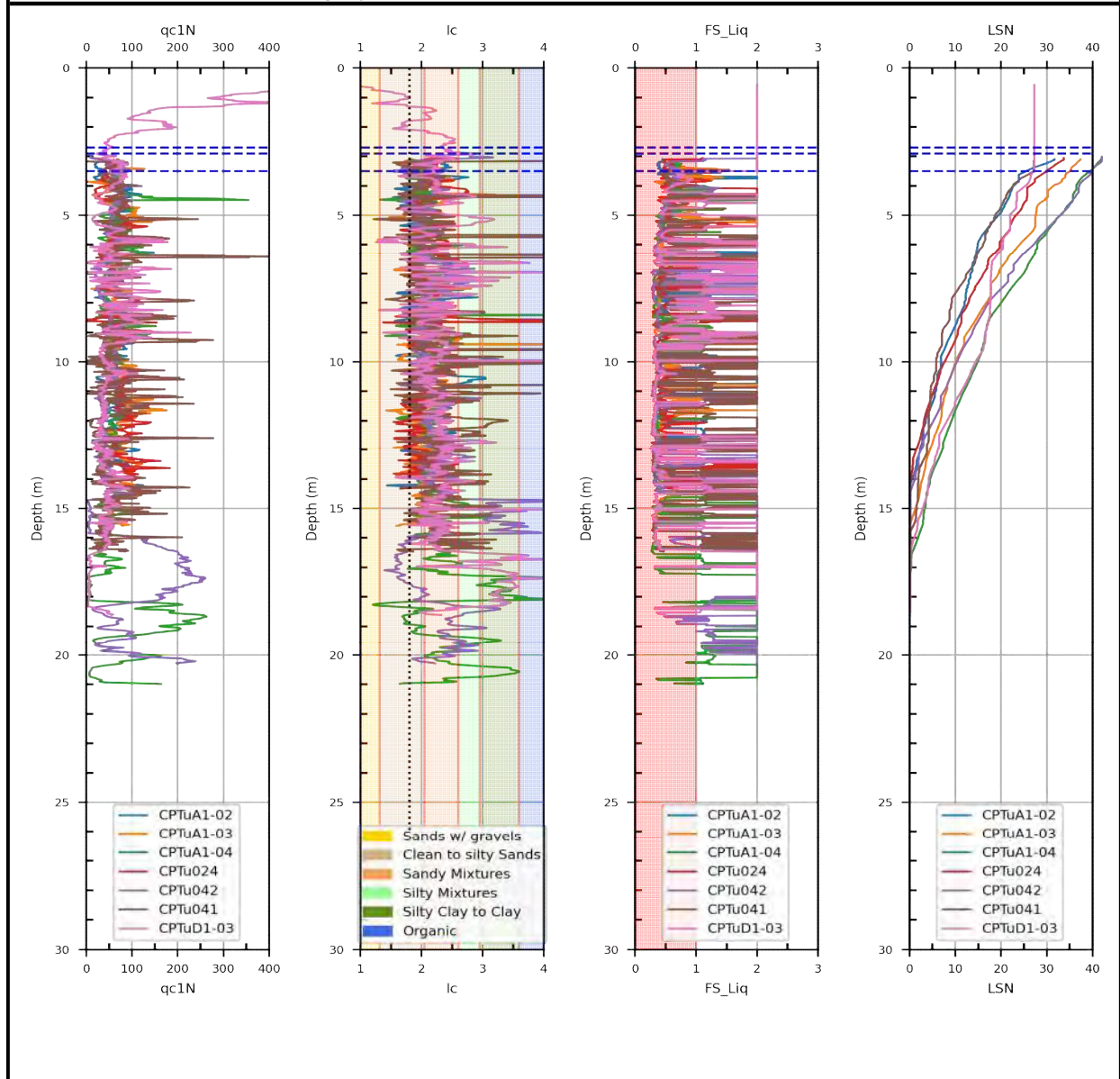
lc Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology

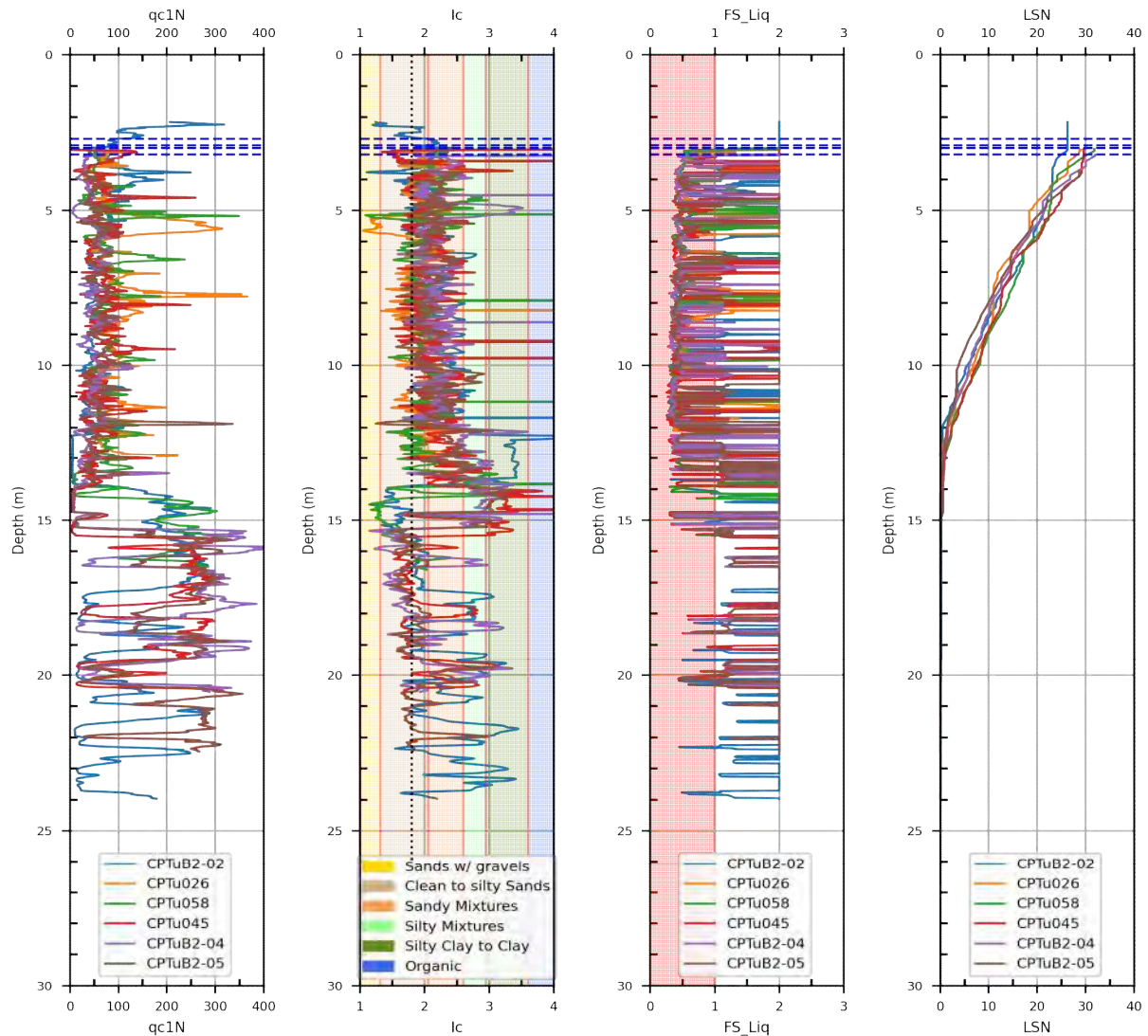
Case History: CP-K16-S1
Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2016 Kaikoura Mw 7.8
PGA: 0.25 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakal et al. 2020a)
Water table: 2.7 - 3.5 m avg. below ground surface (Dhakal et al. 2020a)
CPT: Site 1 Latitude -41.28058 Longitude 174.78465
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



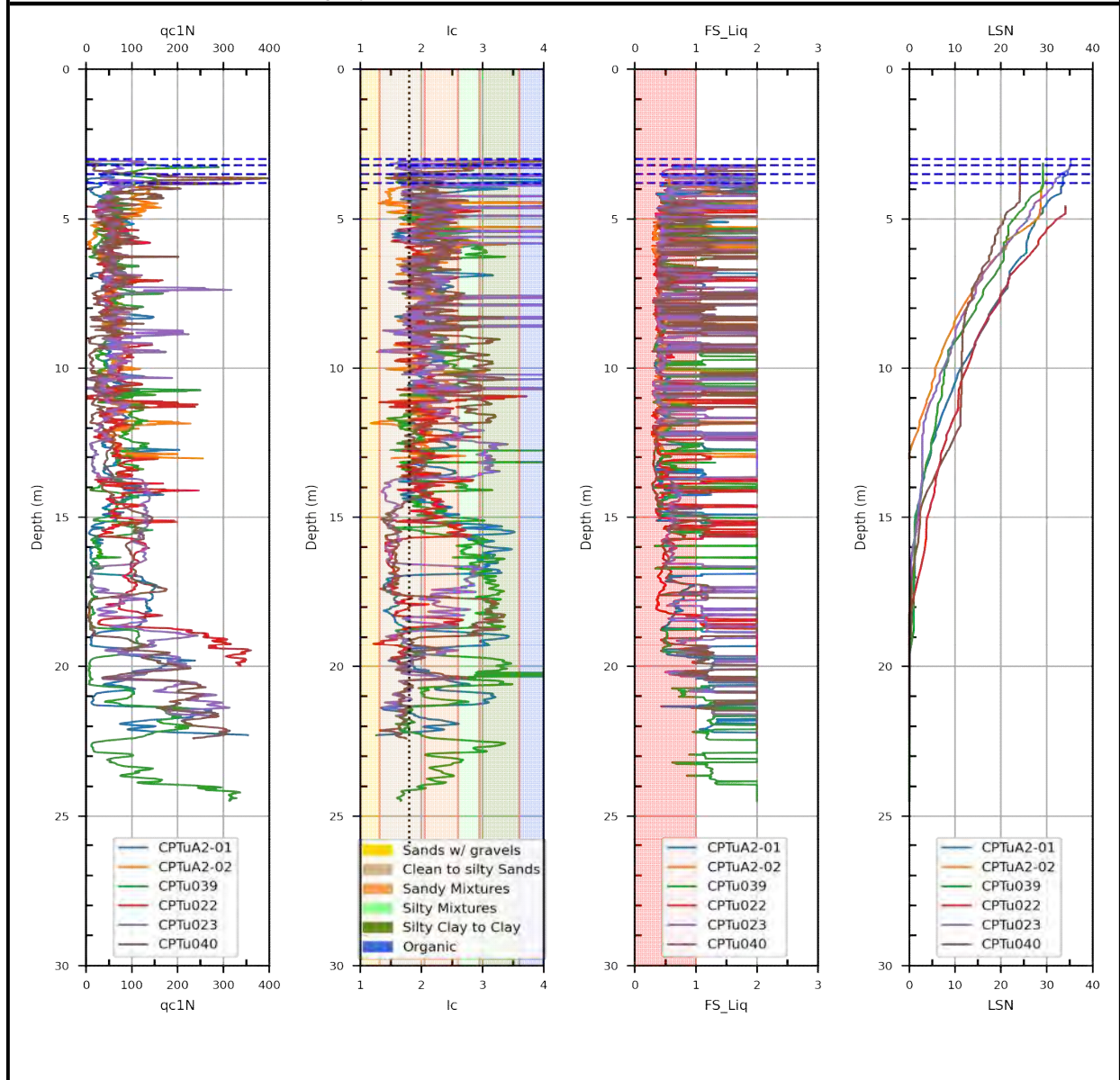
Case History: CP-K16-S2
Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2016 Kaikoura Mw 7.8
PGA: 0.25 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakal et al. 2020a)
Water table: 2.7 - 3.0 m avg. below ground surface (Dhakal et al. 2020a)
CPT: Site 2 Latitude -41.27934 Longitude 174.78622
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



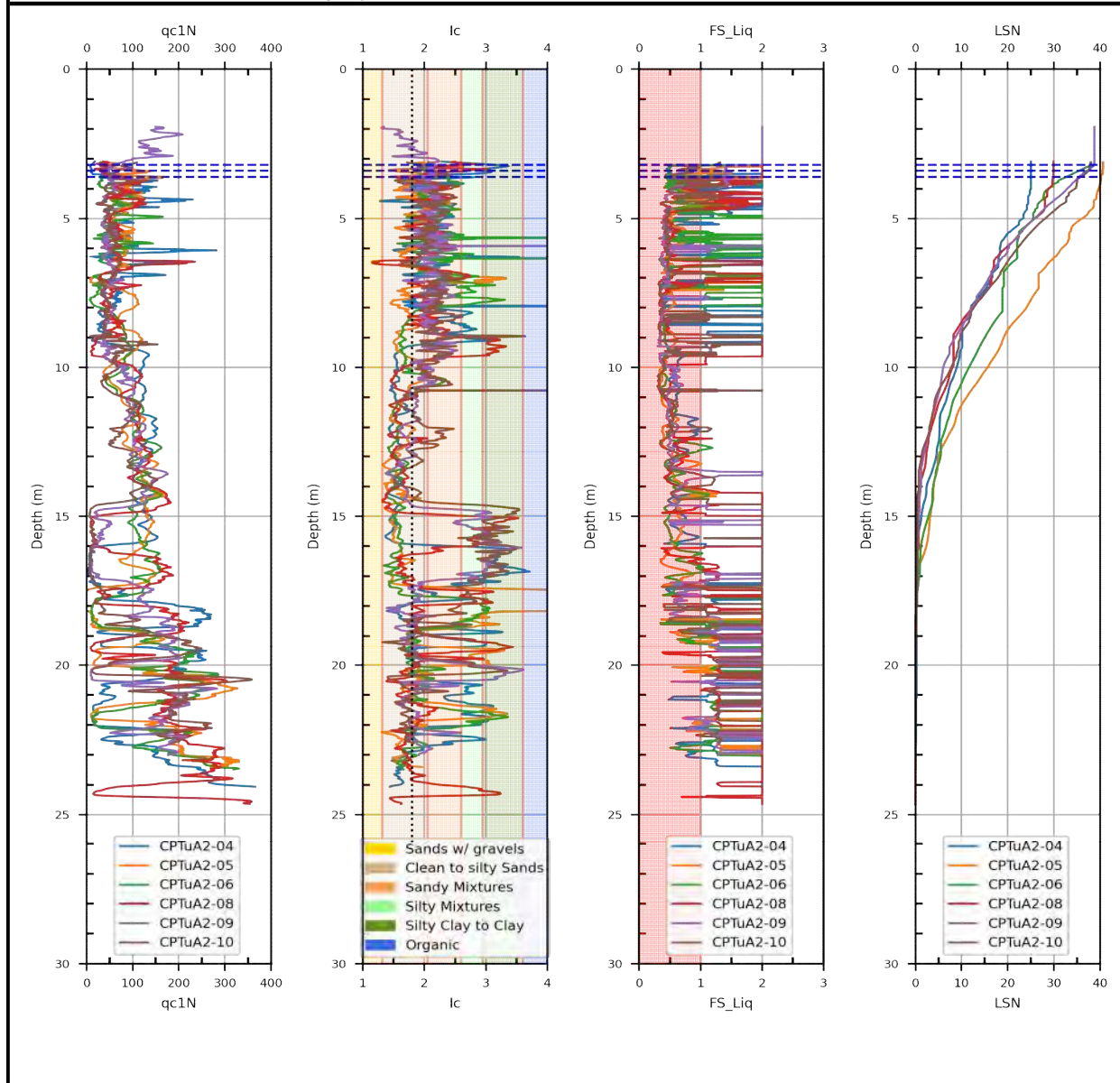
Case History: CP-K16-S3
Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2016 Kaikoura Mw 7.8
PGA: 0.25 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakal et al. 2020a)
Water table: 3.2 - 3.8 m avg. below ground surface (Dhakal et al. 2020a)
CPT: Site 3 Latitude -41.27998 Longitude 174.78754
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



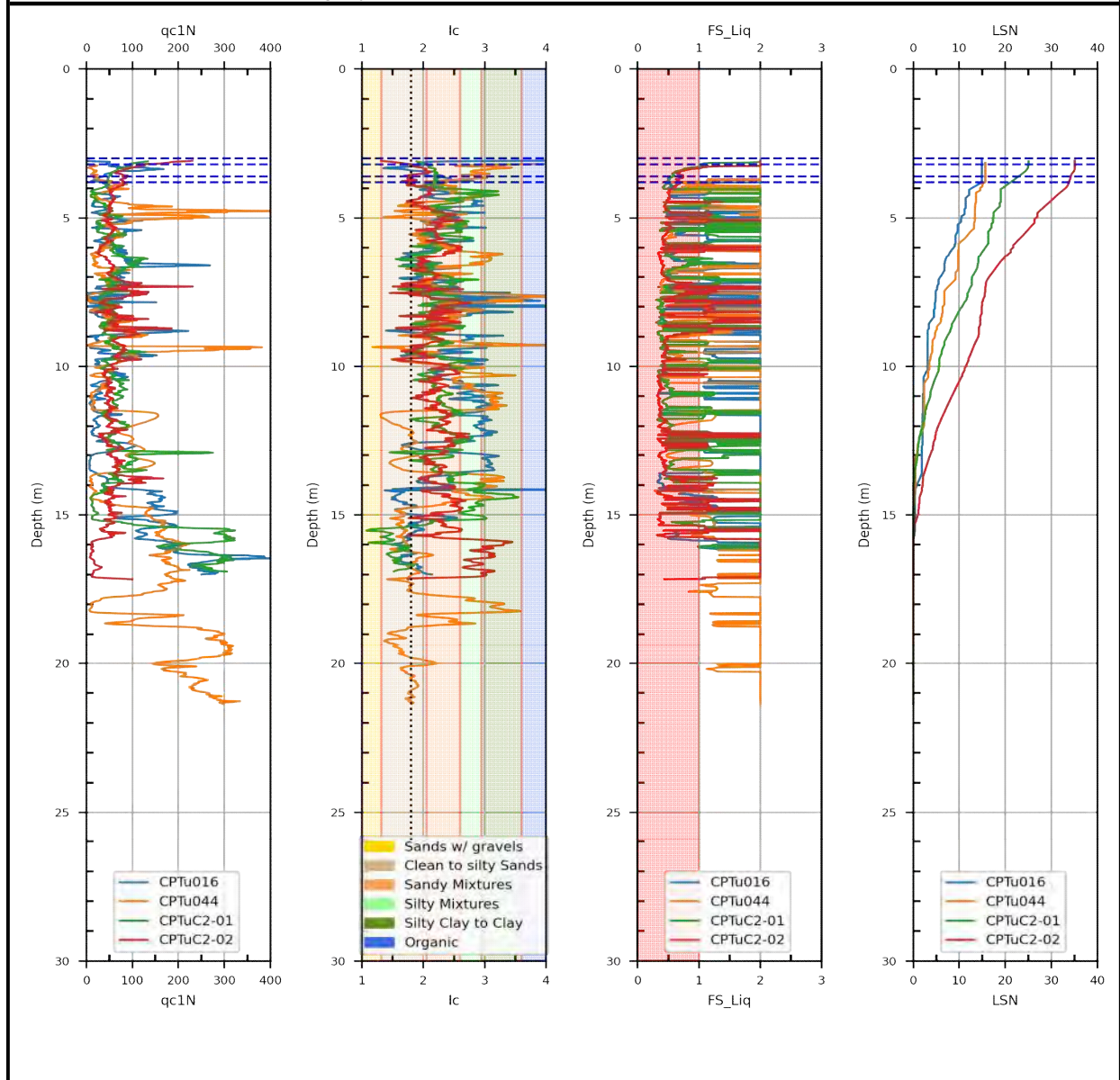
Case History: CP-K16-S4
Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2016 Kaikoura Mw 7.8
PGA: 0.25 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakal et al. 2020a)
Water table: 3.2 - 3.6 m avg. below ground surface (Dhakal et al. 2020a)
CPT: Site 4 Latitude -41.27883 Longitude 174.78803
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



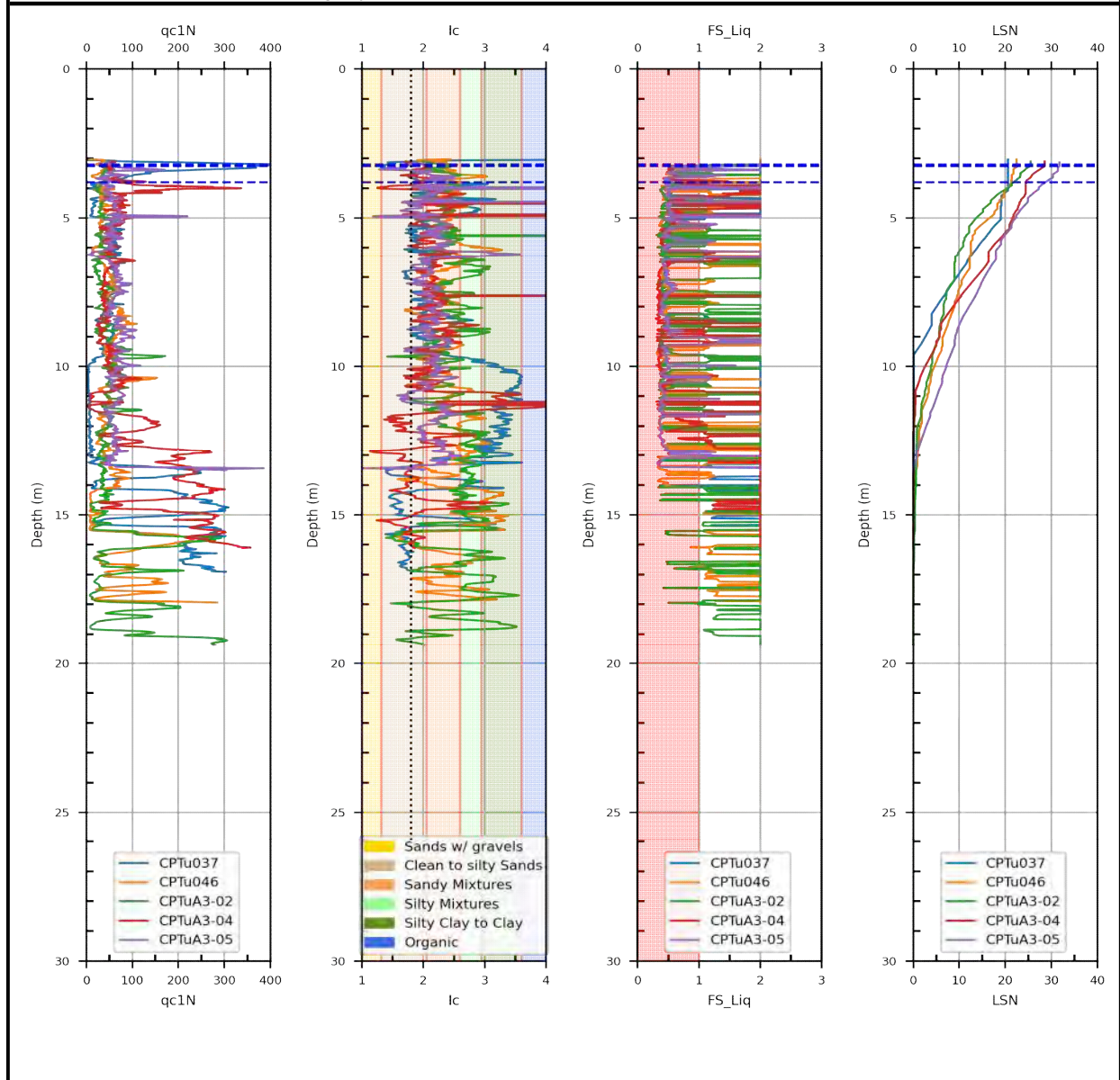
Case History: CP-K16-S5
Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2016 Kaikoura Mw 7.8
PGA: 0.25 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakal et al. 2020a)
Water table: 3.0-3.8 m avg. below ground surface (Dhakal et al. 2020a)
CPT: Site 5 Latitude -41.27792 Longitude 174.78782
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



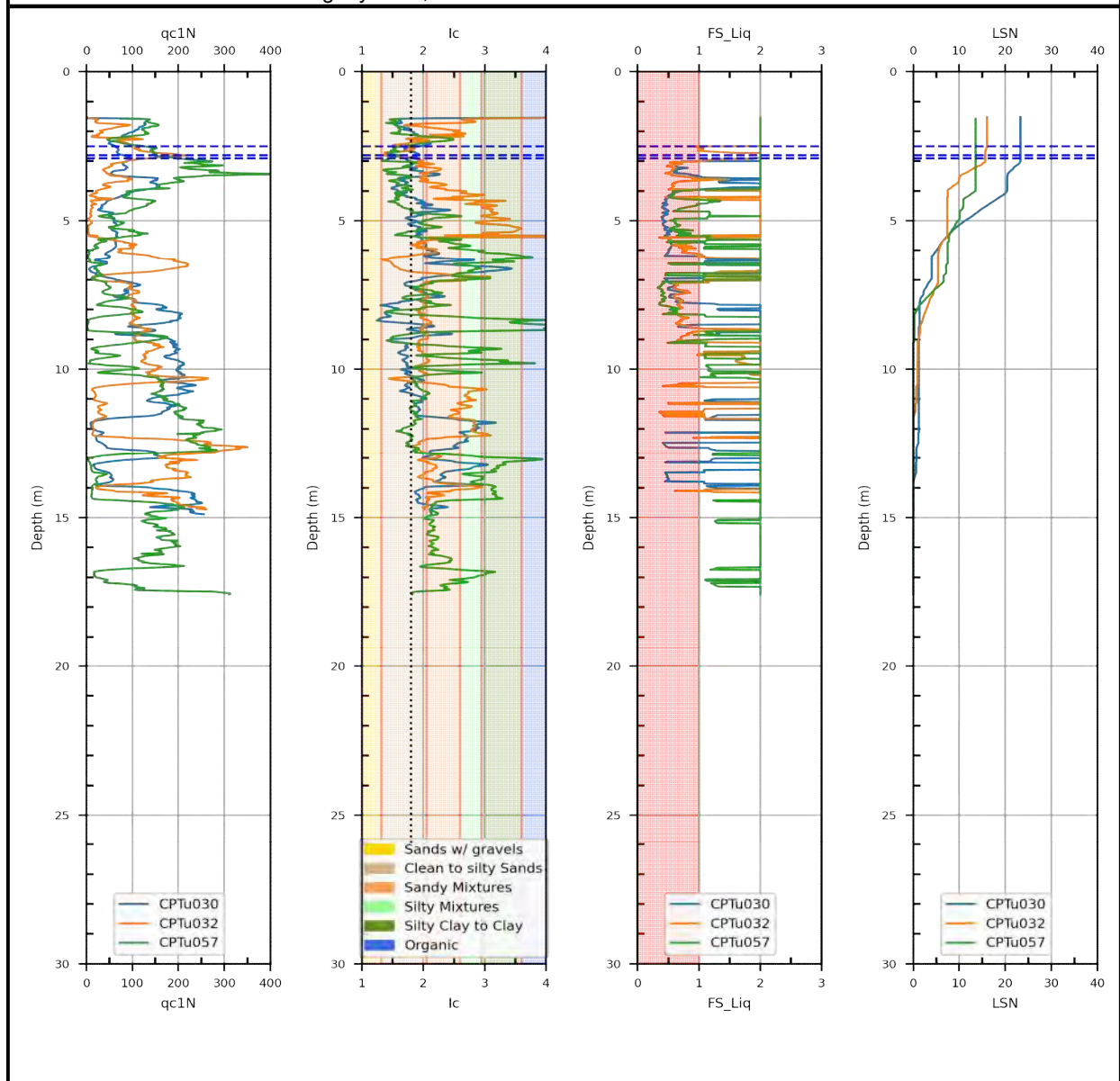
Case History: CP-K16-S6
Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2016 Kaikoura Mw 7.8
PGA: 0.25 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakal et al. 2020a)
Water table: 3.2-3.8 m avg. below ground surface (Dhakal et al. 2020a)
CPT: Site 6 Latitude -41.27826 Longitude 174.78604
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



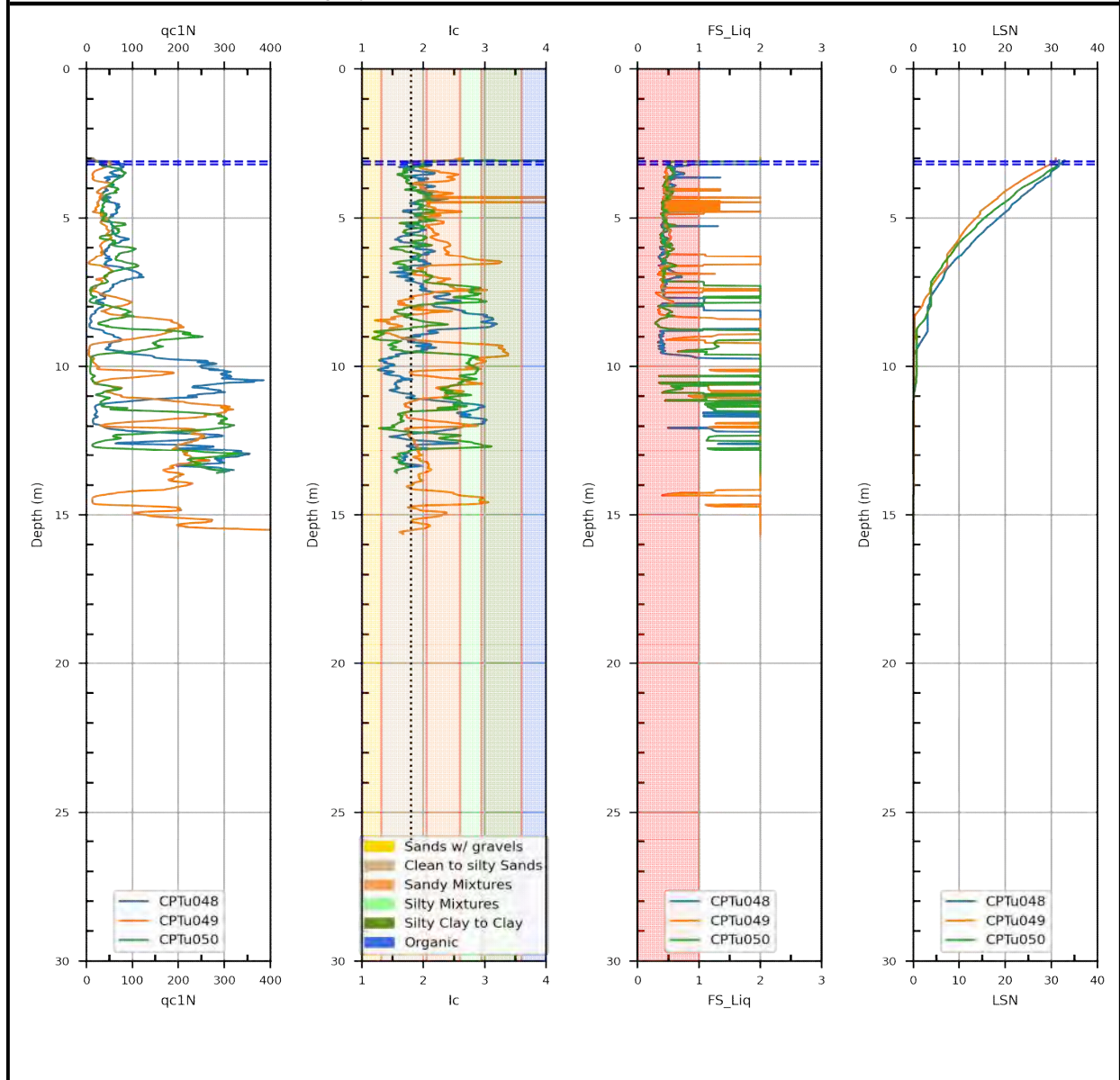
Case History: CP-K16-S7
Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2016 Kaikoura Mw 7.8
PGA: 0.25 g (CPLB Station. [Dhakai et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakai et al. 2020a)
Water table: 2.5-2.9 m avg. below ground surface (Dhakai et al. 2020a)
CPT: Site 7 Latitude -41.27894 Longitude 174.78262
Source: Dhakai et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



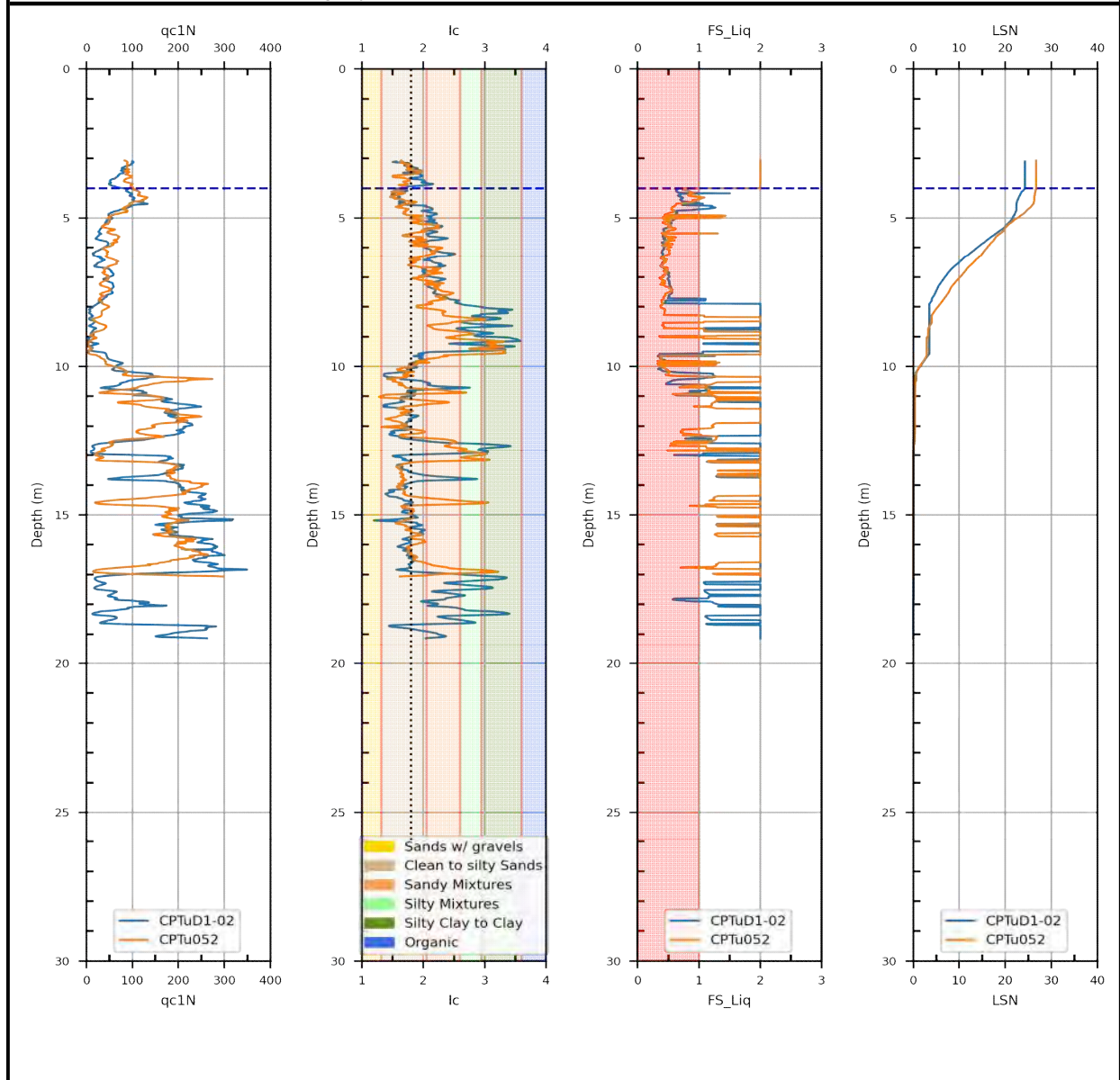
Case History: CP-K16-S8
Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2016 Kaikoura Mw 7.8
PGA: 0.25 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakal et al. 2020a)
Water table: 3.1-3.2 m avg. below ground surface (Dhakal et al. 2020a)
CPT: Site 8 Latitude -41.27844 Longitude 174.78403
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



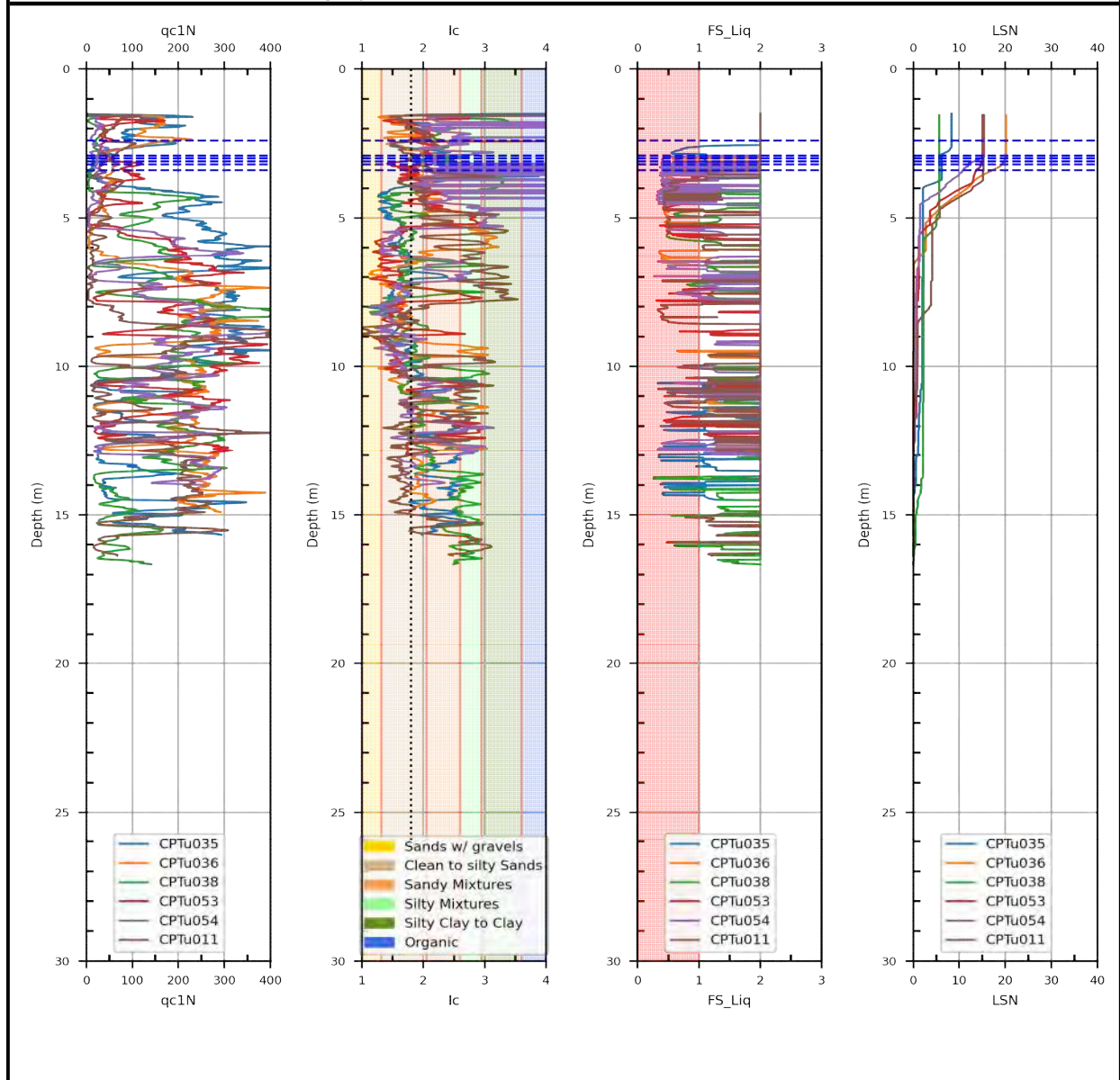
Case History: CP-K16-S9
Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2016 Kaikoura Mw 7.8
PGA: 0.25 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakal et al. 2020a)
Water table: 4 m avg. below ground surface (Dhakal et al. 2020a)
CPT: Site 9 Latitude -41.27713 Longitude 174.78633
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: CP-K16-S10
Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2016 Kaikoura Mw 7.8
PGA: 0.25 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0 m Datum: ground surface (Dhakal et al. 2020a)
Water table: 2.4-3.4 m avg. below ground surface (Dhakal et al. 2020a)
CPT: Site 10 Latitude -41.27647 Longitude 174.78522
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014

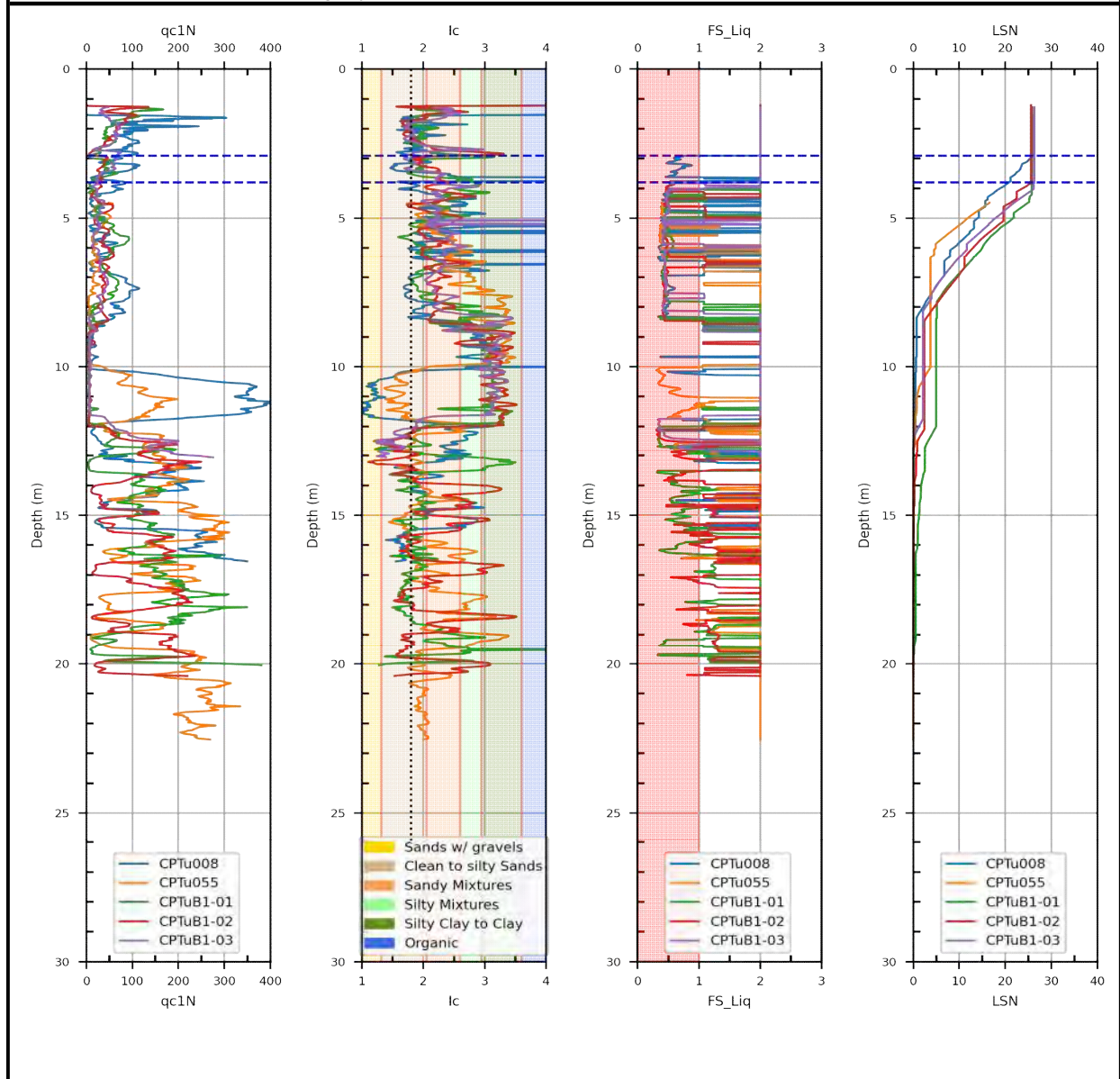


Case History: CP-K16-S11
Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2016 Kaikoura Mw 7.8
PGA: 0.25 g (CPLB Station. [Dhakai et al. 2020b])
Ground Elevation: 0m Datum: ground surface (Dhakai et al. 2020a)
Water table: 3.0-3.8 m avg. below ground surface (Dhakai et al. 2020a)
CPT: Site 11 Latitude -41.27505 Longitude 174.78758
Source: Dhakai et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

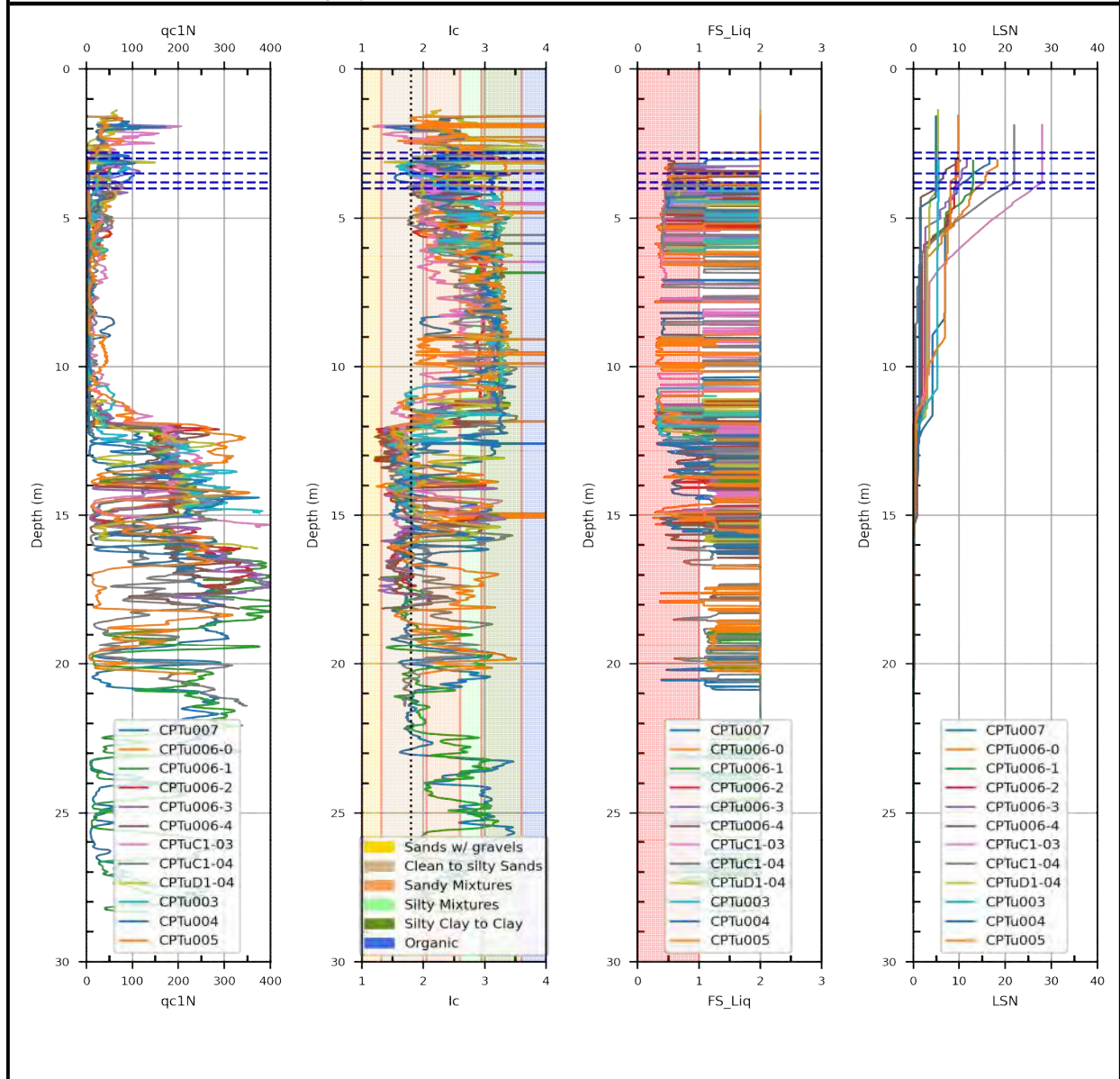


Case History: CP-K16-S12
Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2016 Kaikoura Mw 7.8
PGA: 0.25 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0m Datum: ground surface (Dhakal et al. 2020a)
Water table: 2.8-4.0 m avg. below ground surface (Dhakal et al. 2020a)
CPT: Site 12 Latitude -41.27237 Longitude 174.78733
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

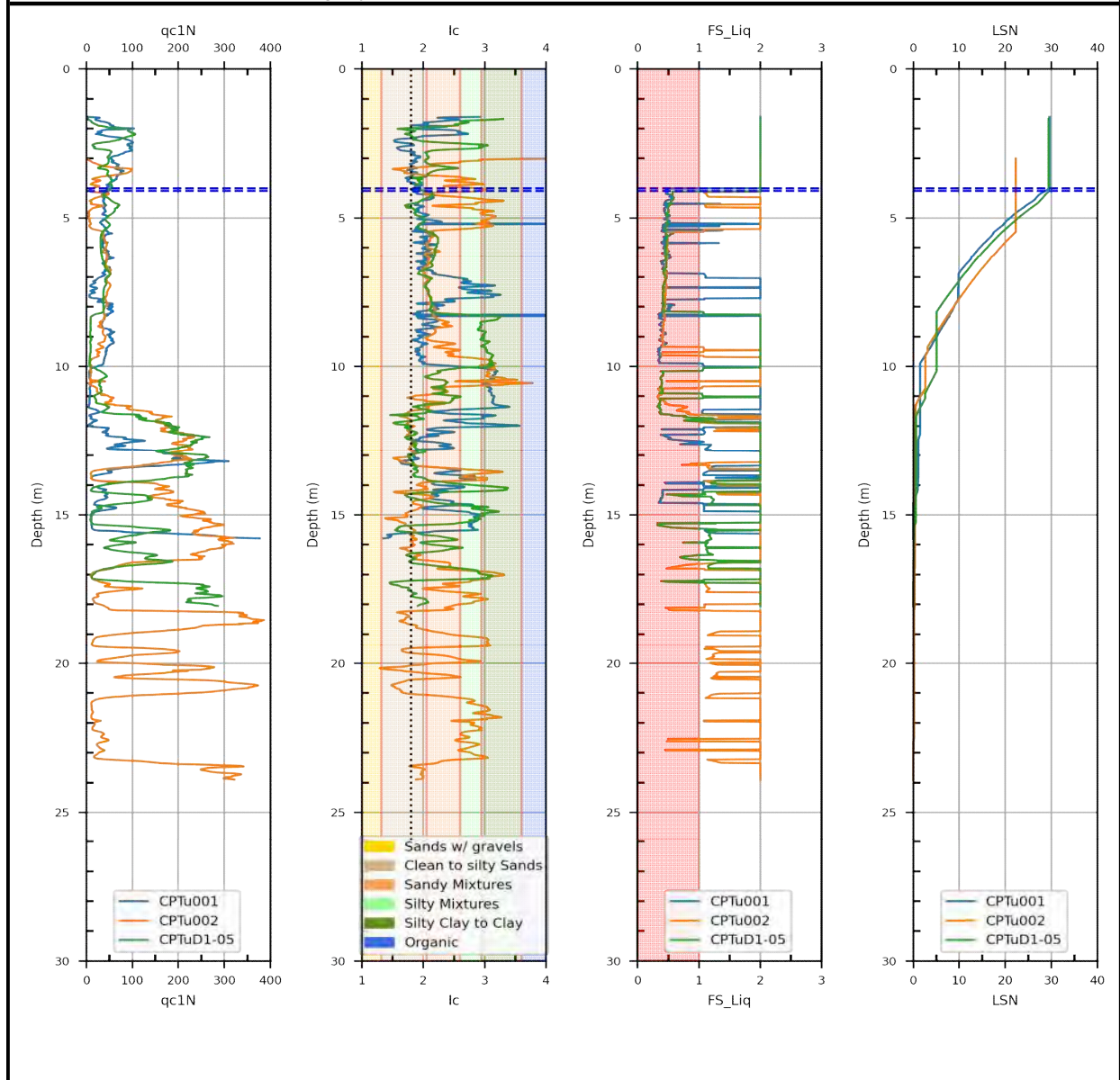
Ic Robertson, 2009

LSN van Ballegooy et al., 2014



Case History: CP-K16-S13
Site: CentrePort
Location: CentrePort, Wellington
Earthquake: 2016 Kaikoura Mw 7.8
PGA: 0.25 g (CPLB Station. [Dhakal et al. 2020b])
Ground Elevation: 0m Datum: ground surface (Dhakal et al. 2020a)
Water table: 4.0-4.1 m avg. below ground surface (Dhakal et al. 2020a)
CPT: Site 13 Latitude -41.269 Longitude 174.78647
Source: Dhakal et al. (2020a, 2020b)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Appendix H: Case Histories – Christchurch

Avondale Playground

Case History:

Site: Avondale Playground (N° 1)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2-7.1
PGA: 0.18-0.40 g (Bradley's median estimate. [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.4 -2.0 m avg. below ground surface (Token and Taylor 2013)
CPT: All CPTs Latitude -43.5081 Longitude 172.6872
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

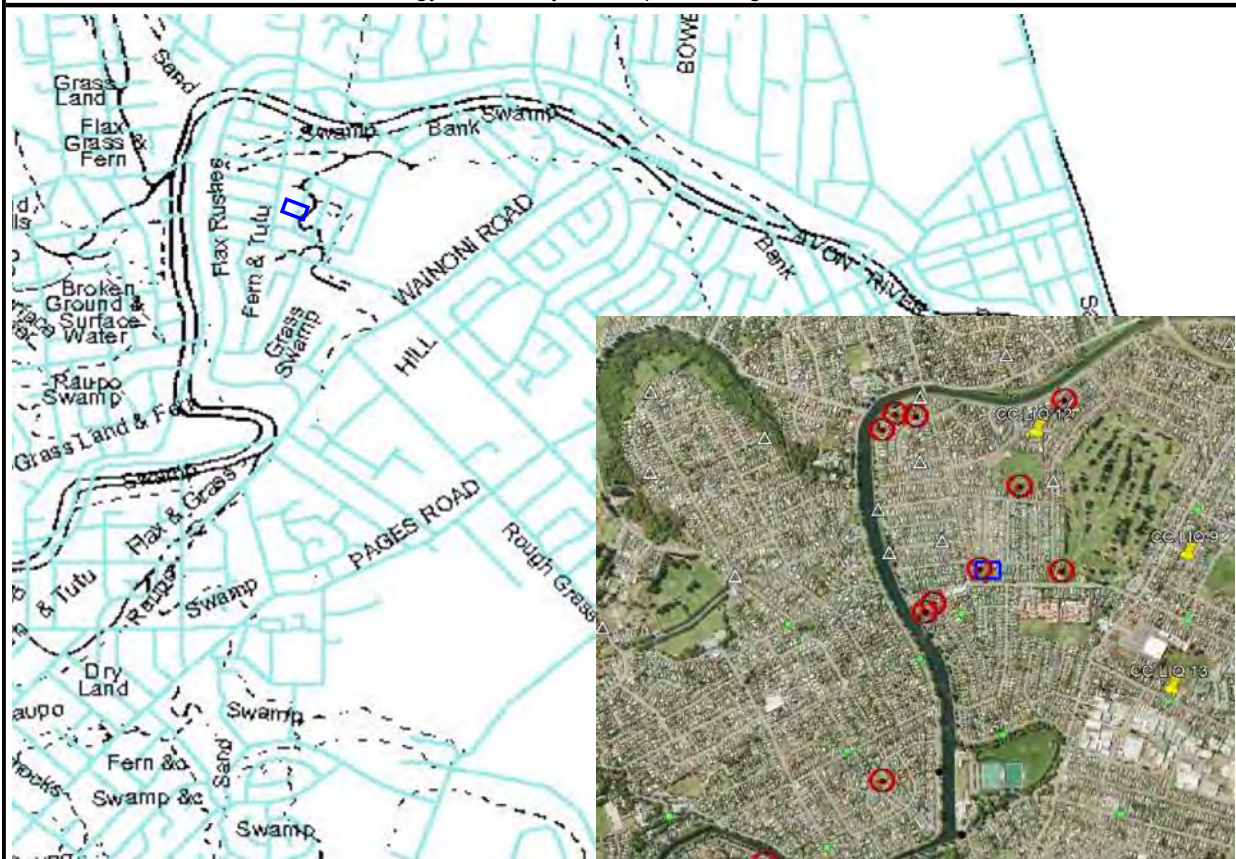
LSN van Ballegooy et al., 2014

Site Plan View**References:**

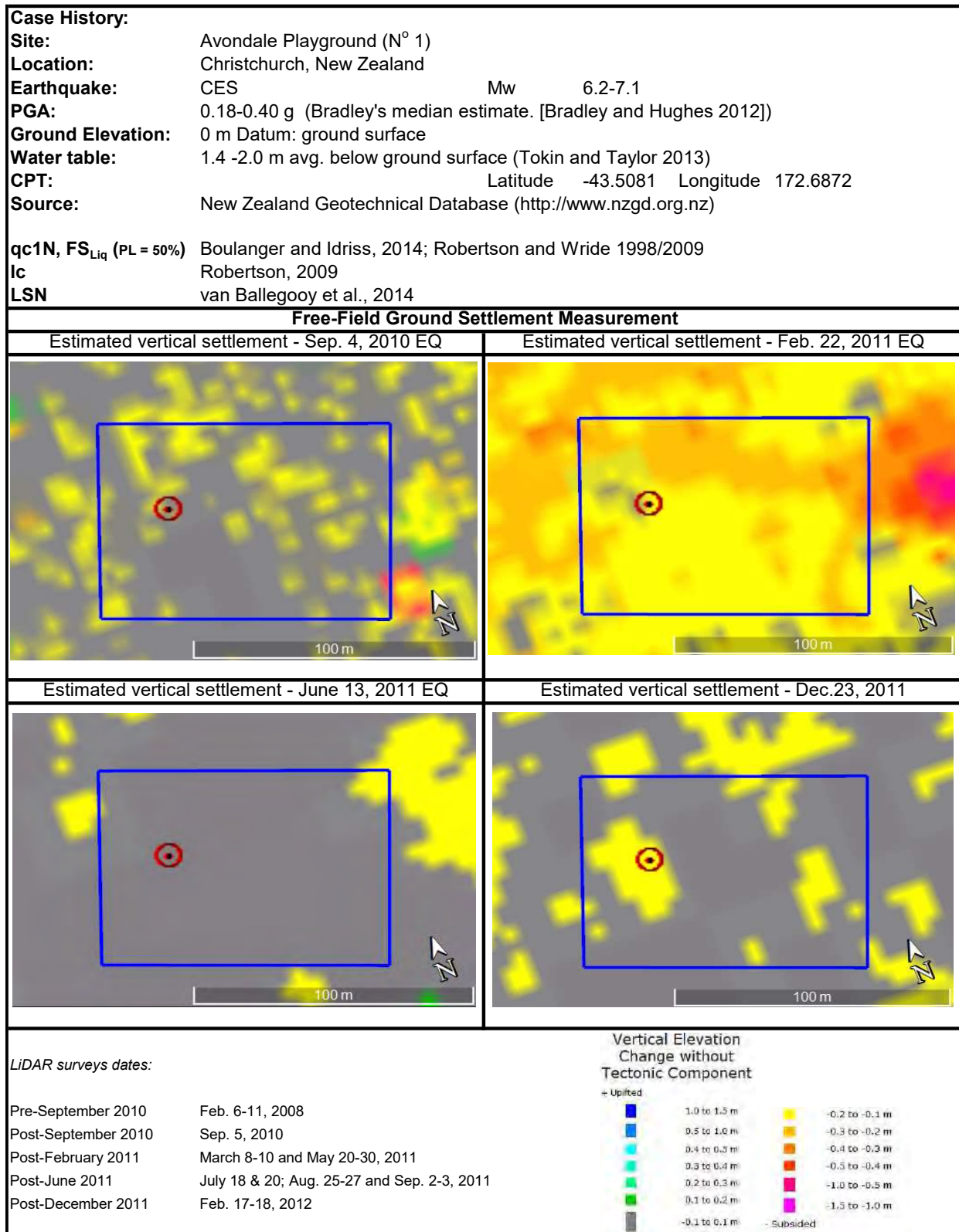
New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:**Site:** Avondale Playground (N° 1)**Location:** Christchurch, New Zealand**Earthquake:** CES Mw 6.2-7.1**PGA:** 0.18-0.40 g (Bradley's median estimate. [Bradley and Hughes 2012])**Ground Elevation:** 0 m Datum: ground surface**Water table:** 1.4 -2.0 m avg. below ground surface (Token and Taylor 2013)**CPT:** Latitude -43.5081 Longitude 172.6872**Source:** New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)**qc1N, FS_{Liq} (PL = 50%)** Boulanger and Idriss, 2014; Robertson and Wride 1998/2009**lc** Robertson, 2009**LSN** van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

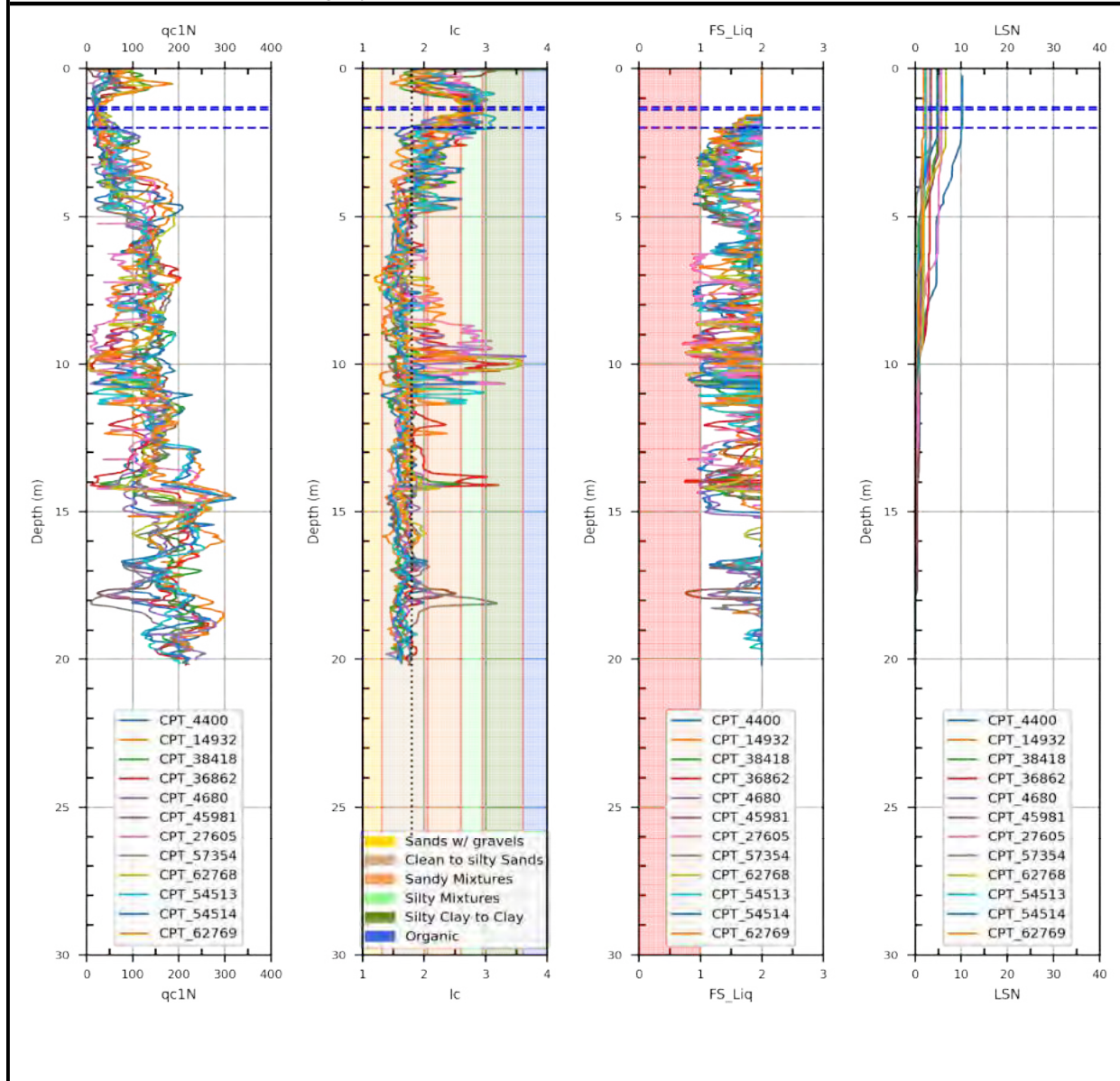


Case History:	
Site:	Avondale Playground (N° 1)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2-7.1
PGA:	0.18-0.40 g (Bradley's median estimate. [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	1.4 -2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	Latitude -43.5081 Longitude 172.6872
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
	



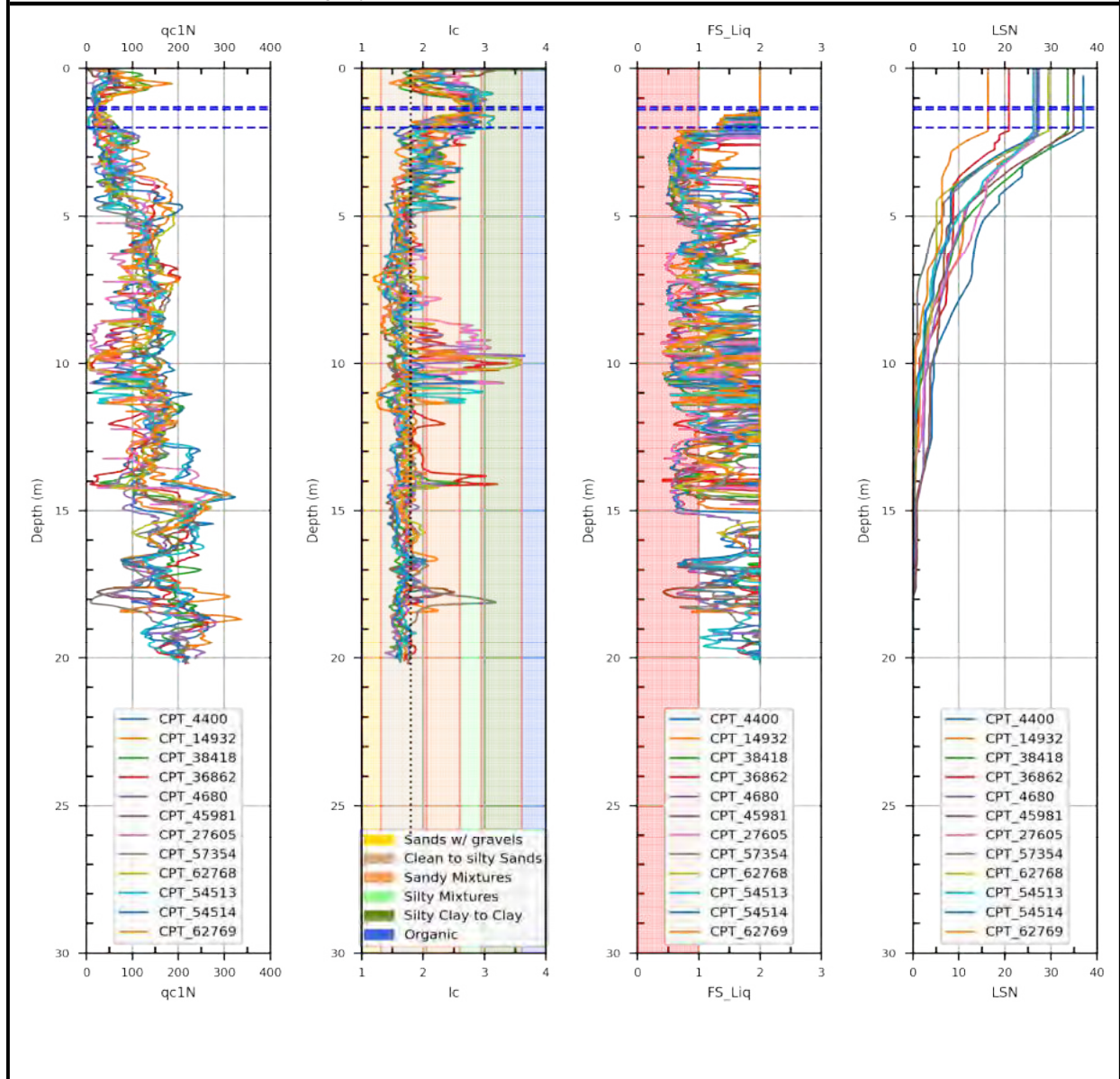
Case History: Ch-S1
Site: Avondale Playground (N° 1)
Location: Christchurch, New Zealand
Earthquake: 2010 Darfield Mw 7.1
PGA: 0.18 g (Bradley's median estimate. [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.6 -2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5081 Longitude 172.6872
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



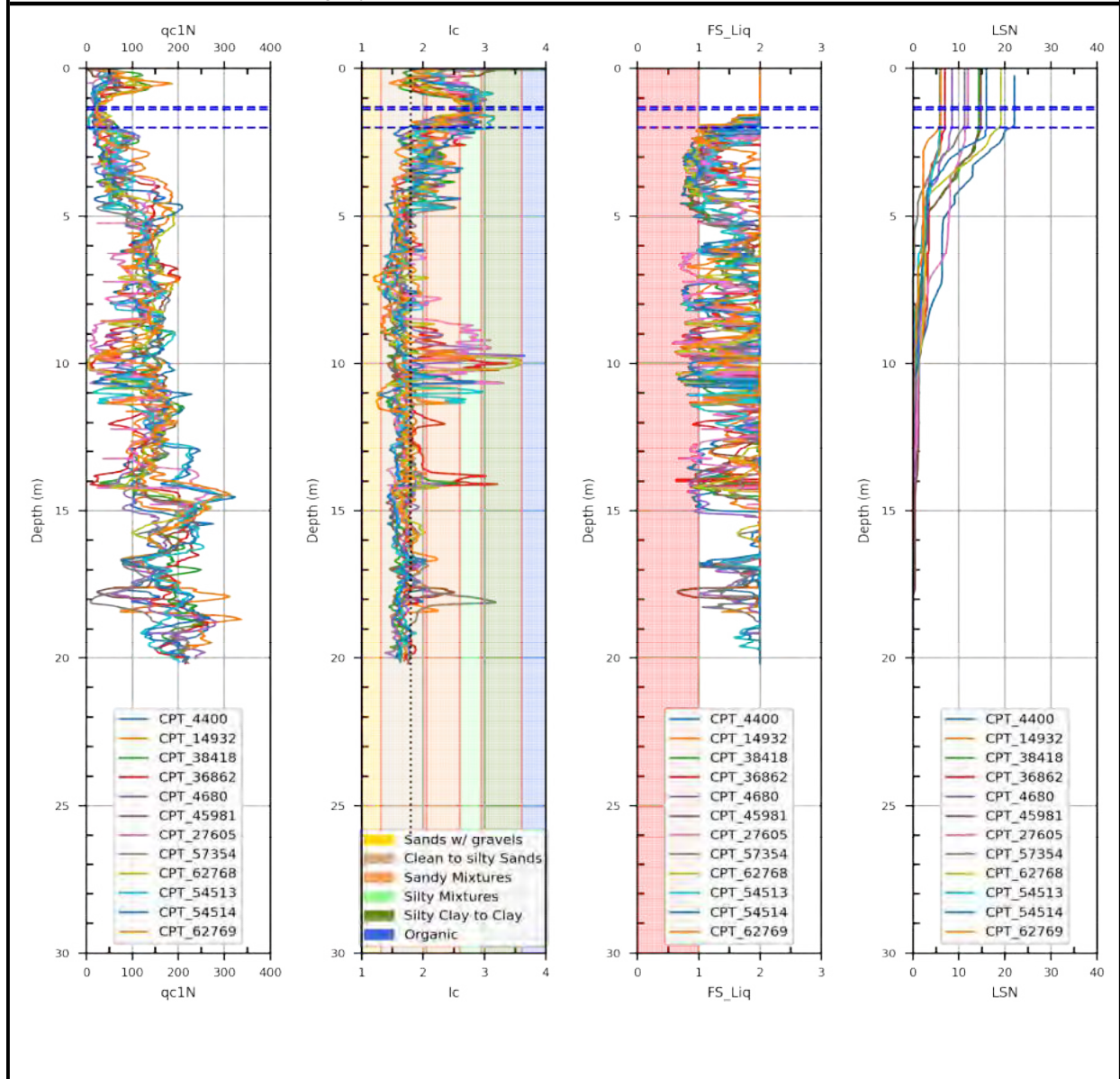
Case History: Ch-S2
Site: Avondale Playground (N° 1)
Location: Christchurch, New Zealand
Earthquake: 2011 Christchurch Mw 6.2
PGA: 0.40 g (Bradley's median estimate. [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.6 -2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5081 Longitude 172.6872
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S3
Site: Avondale Playground (N° 1)
Location: Christchurch, New Zealand
Earthquake: 2011 June Mw 6.2
PGA: 0.26 g (Bradley's median estimate. [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.6 -2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5081 Longitude 172.6872
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



Marblewood Reserve

Case History:

Site: Marblewood Reserve (N° 2)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2-7.1
PGA: 0.13g - 0.24g (Bradley's median estimate. [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0 -1.10 m avg. below ground surface (Tokin and Taylor 2013)
CPT: Latitude -43.4945 Longitude 172.6015
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

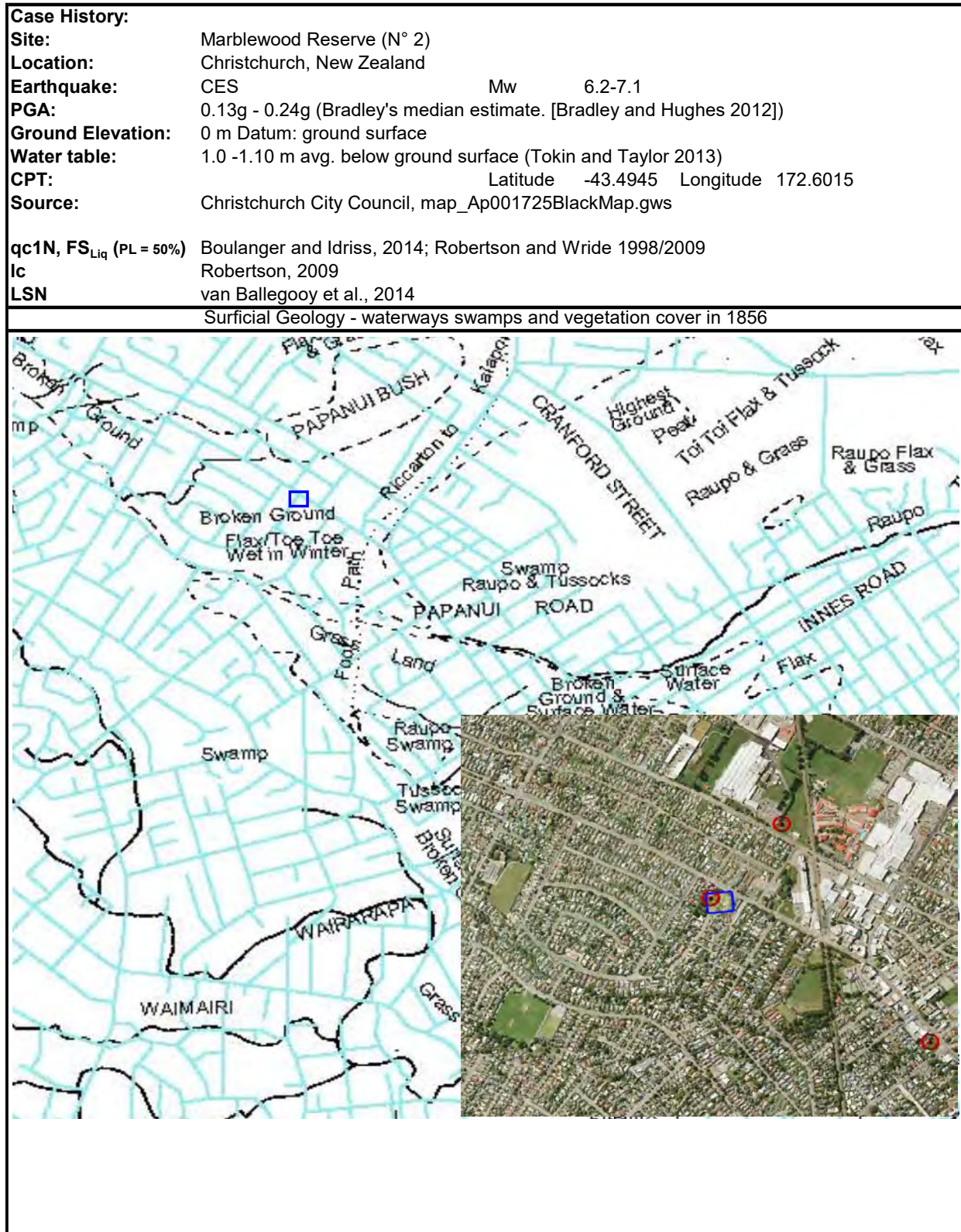
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

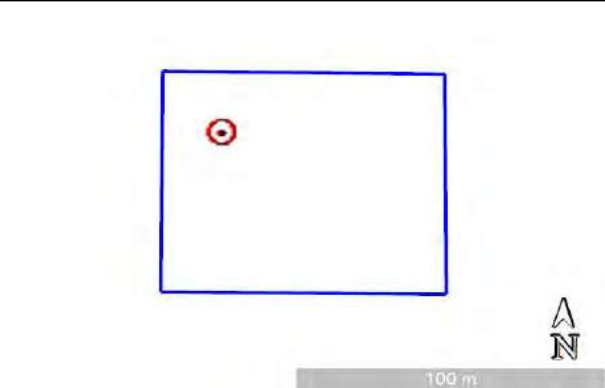
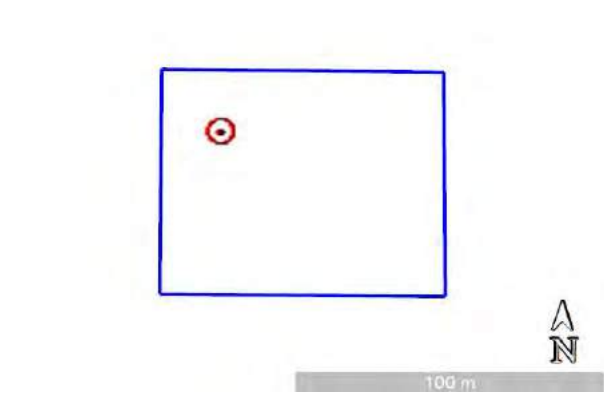
Ic Robertson, 2009

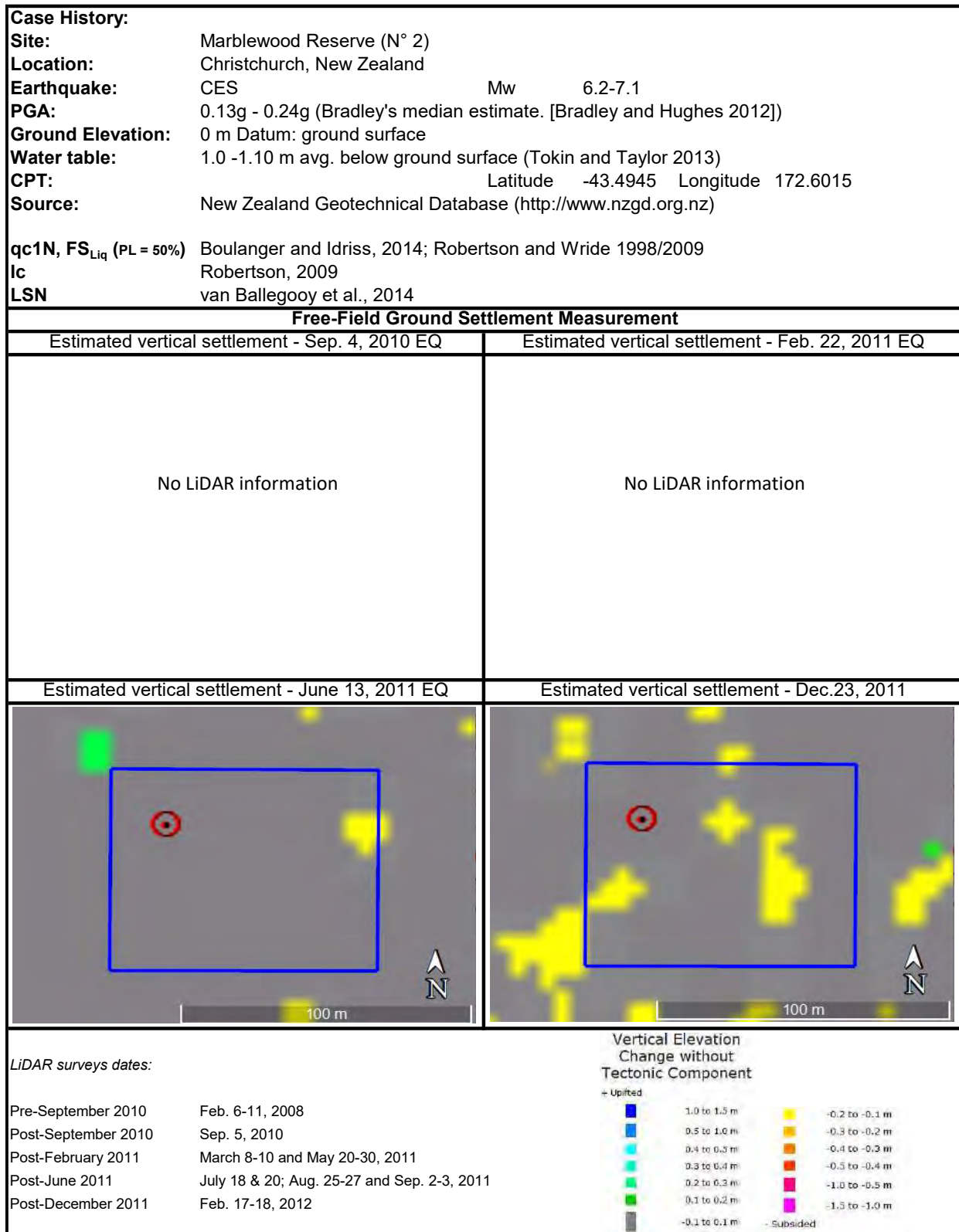
LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)



Case History: Site: Marblewood Reserve (N° 2) Location: Christchurch, New Zealand Earthquake: CES Mw 6.2-7.1 PGA: 0.13g - 0.24g (Bradley's median estimate. [Bradley and Hughes 2012]) Ground Elevation: 0 m Datum: ground surface Water table: 1.0 -1.10 m avg. below ground surface (Tokin and Taylor 2013) CPT: Latitude -43.4945 Longitude 172.6015 Source: New Zealand Geotechnical Database (http://www.nzgd.org.nz) qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009 Ic Robertson, 2009 LSN van Ballegooy et al., 2014	
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
	

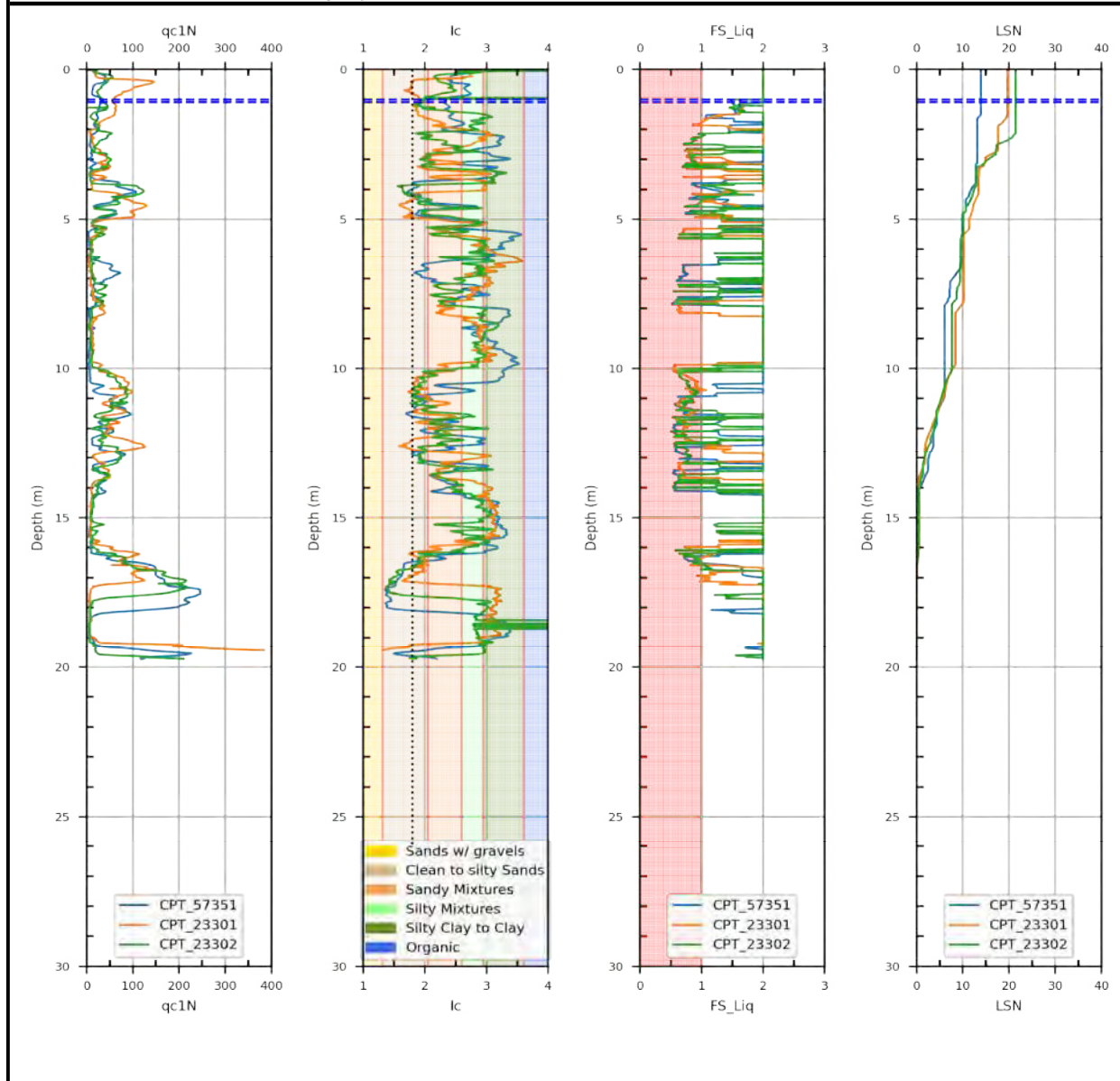


Case History: Ch-S4
Site: Marblewood Reserve (N° 2)
Location: Christchurch, New Zealand
Earthquake: 2010 Darfield Mw 7.1
PGA: 0.22g (Bradley's median estimate. [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0 -1.10 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4945 Longitude 172.6015
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

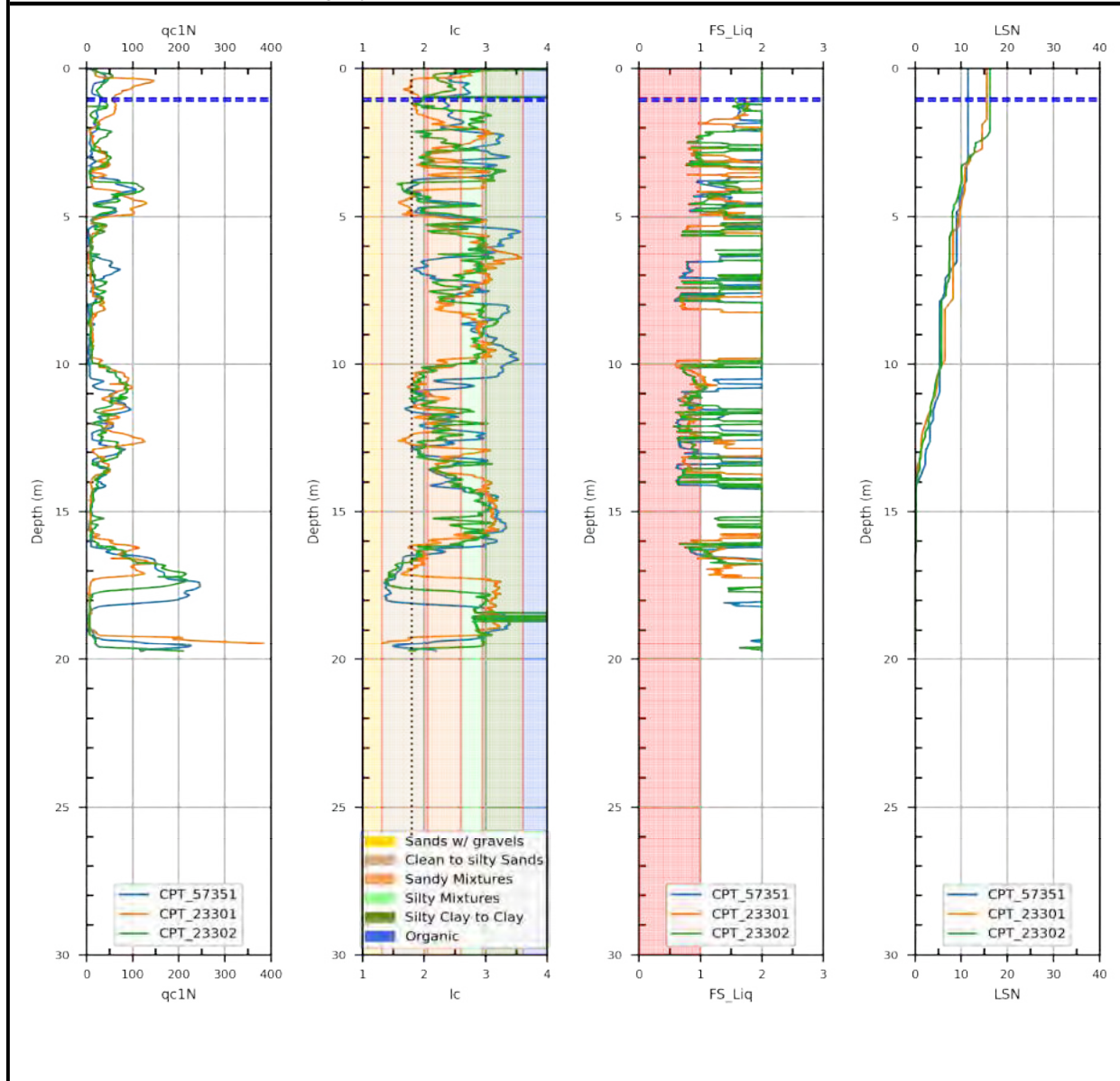


Case History: Ch-S5
Site: Marblewood Reserve (N° 2)
Location: Christchurch, New Zealand
Earthquake: 2011 Christchurch Mw 6.2
PGA: 0.24g (Bradley's median estimate. [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0 -1.10 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4945 Longitude 172.6015
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

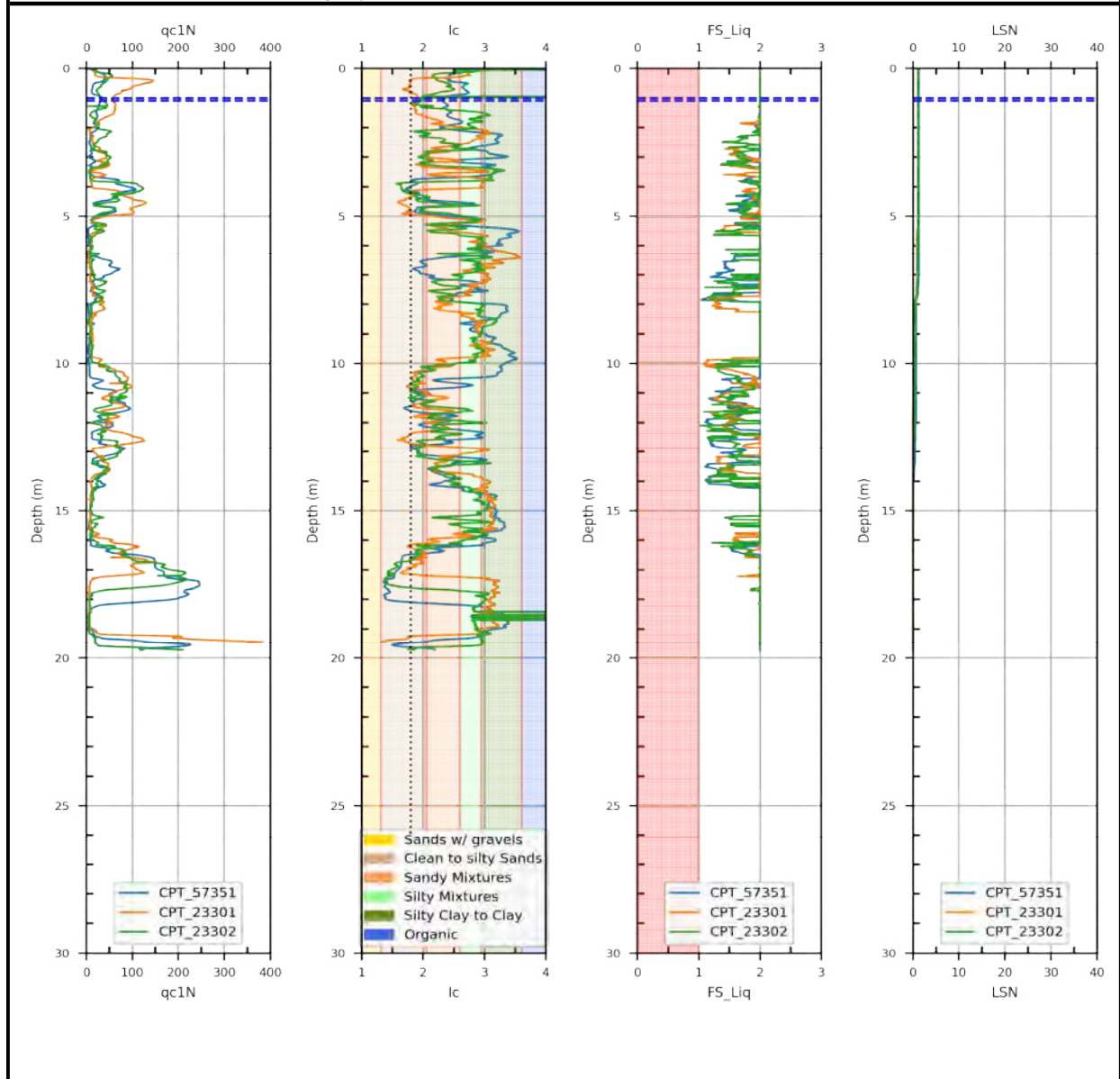
Ic Robertson, 2009

LSN van Ballegooy et al., 2014



Case History: Ch-S6
Site: Marblewood Reserve (N° 2)
Location: Christchurch, New Zealand
Earthquake: 2011 June Mw 6.2
PGA: 0.13g (Bradley's median estimate. [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0 -1.10 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4945 Longitude 172.6015
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Harrington Park

Case History:

Site: Harrington Park (N°3)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.17g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5344 Longitude 172.5903
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

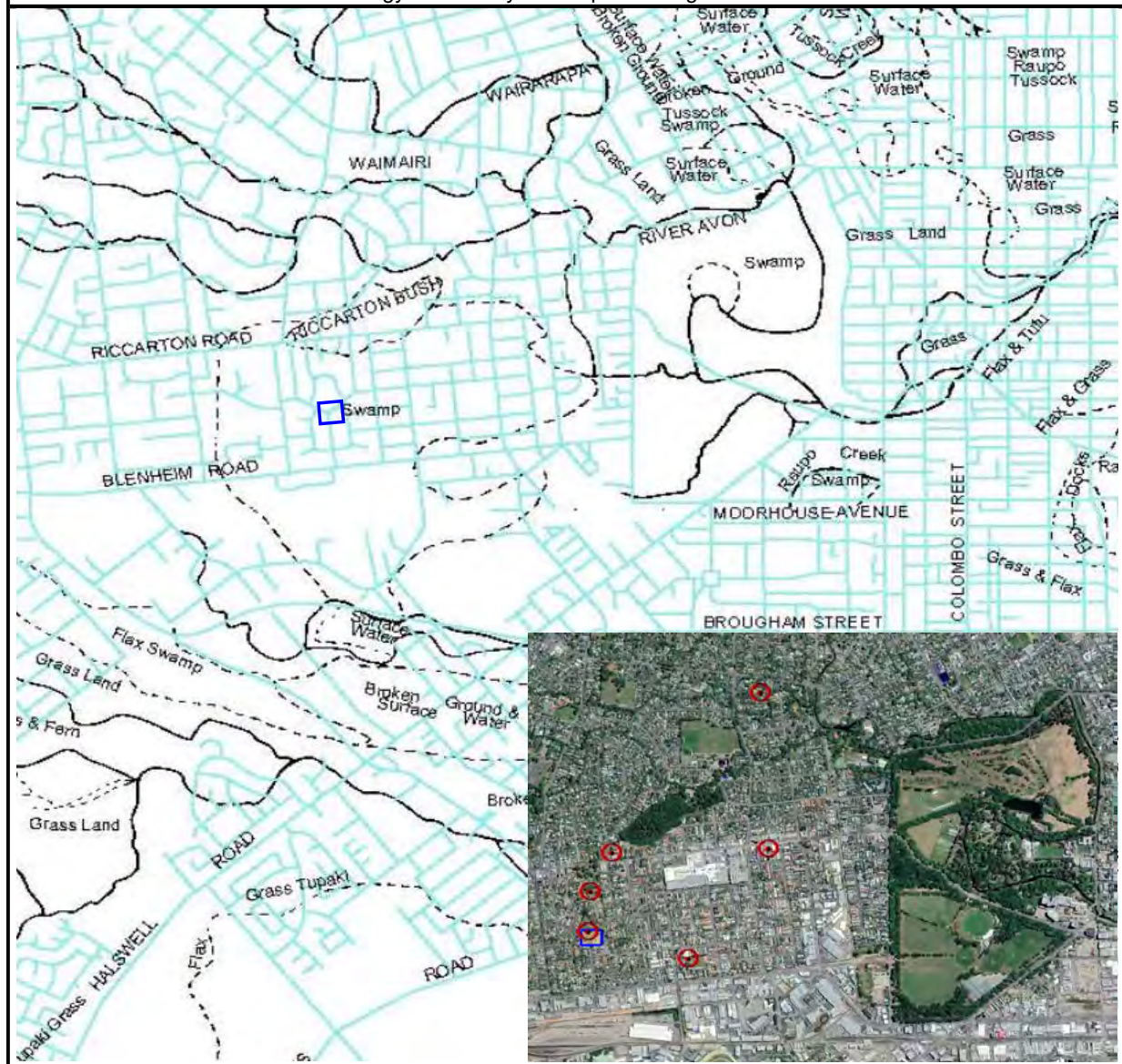
LSN van Ballegooy et al., 2014

Site Plan View**References:**

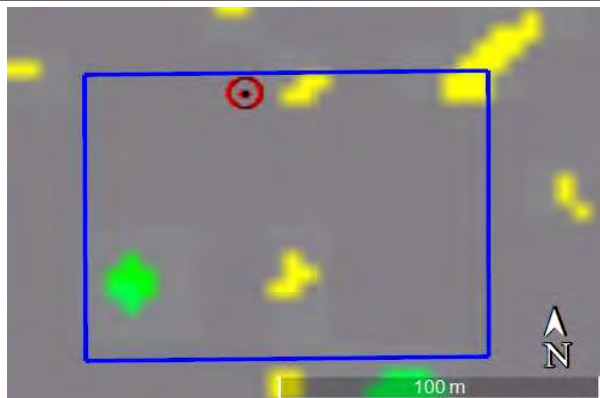
New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:**Site:** Harrington Park (N°3)**Location:** Christchurch, New Zealand**Earthquake:** CES Mw 6.2 - 7.1**PGA:** 0.17g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])**Ground Elevation:** 0 m Datum: ground surface**Water table:** 2.0 m avg. below ground surface (Tokin and Taylor 2013)**CPT:** Latitude -43.5344 Longitude 172.5903**Source:** Christchurch City Council, map_Ap001725BlackMap.gws**qc1N, FS_{Liq} (PL = 50%)** Boulanger and Idriss, 2014; Robertson and Wride 1998/2009**lc** Robertson, 2009**LSN** van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

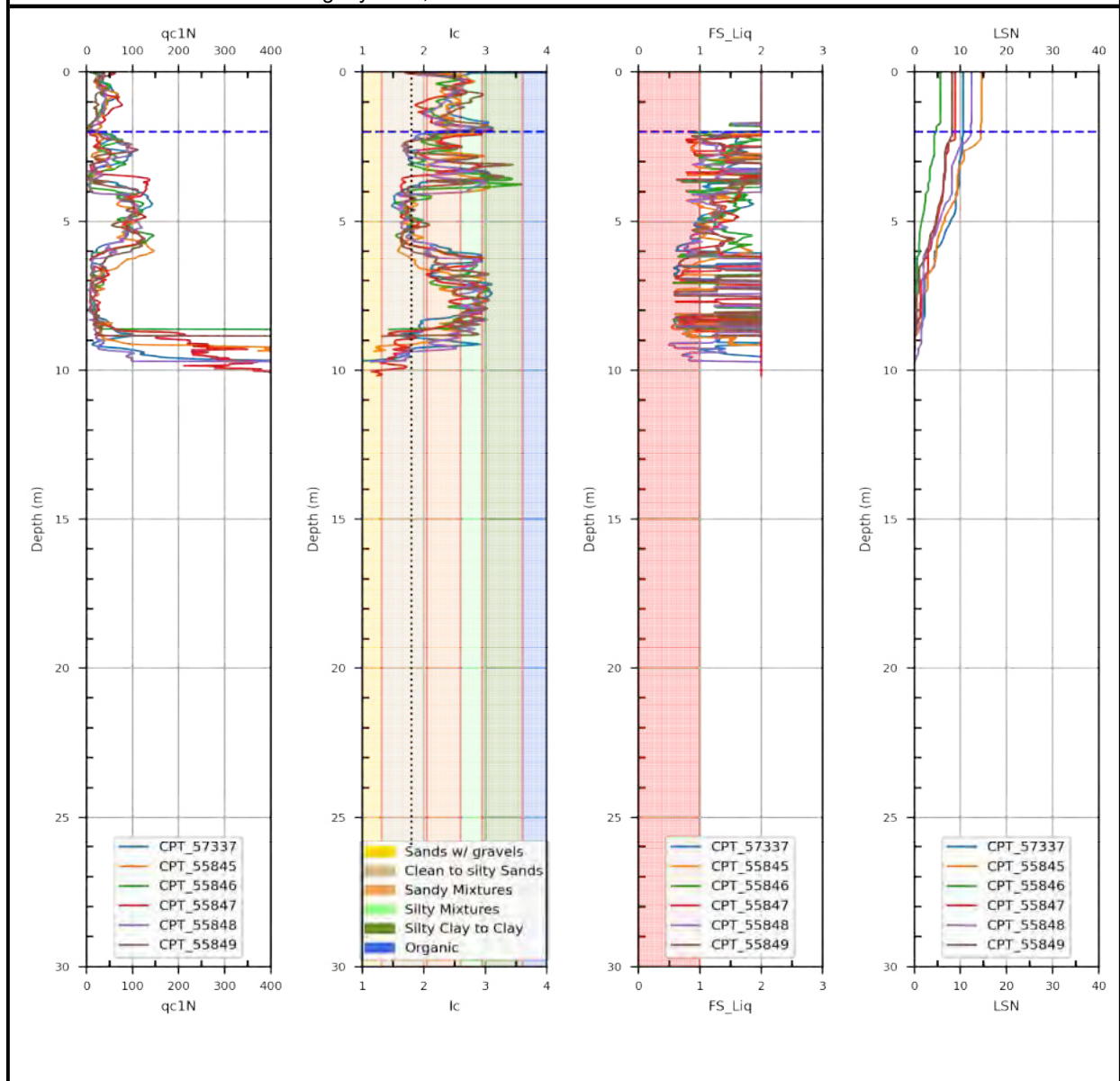


Case History: Site: Harrington Park (N°3) Location: Christchurch, New Zealand Earthquake: CES Mw 6.2 - 7.1 PGA: 0.17g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012]) Ground Elevation: 0 m Datum: ground surface Water table: 2.0 m avg. below ground surface (Tokin and Taylor 2013) CPT: Latitude -43.5344 Longitude 172.5903 Source: New Zealand Geotechnical Database (http://www.nzgd.org.nz) qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009 Ic Robertson, 2009 LSN van Ballegooy et al., 2014	
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
No aerial photo available	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	No aerial photo available
	

Case History:	
Site:	Harrington Park (N°3)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.17g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	Latitude -43.5344 Longitude 172.5903
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Free-Field Ground Settlement Measurement	
Estimated vertical settlement - Sep. 4, 2010 EQ	Estimated vertical settlement - Feb. 22, 2011 EQ
No LiDAR data available	No LiDAR data available
Estimated vertical settlement - June 13, 2011 EQ	Estimated vertical settlement - Dec.23, 2011
	No LiDAR data available
LiDAR surveys dates:	
Pre-September 2010	Feb. 6-11, 2008
Post-September 2010	Sep. 5, 2010
Post-February 2011	March 8-10 and May 20-30, 2011
Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011
Post-December 2011	Feb. 17-18, 2012
Vertical Elevation Change without Tectonic Component	
+ Uplifted	
	1.0 to 1.5 m
	0.5 to 1.0 m
	0.4 to 0.5 m
	0.3 to 0.4 m
	0.2 to 0.3 m
	0.1 to 0.2 m
	-0.1 to 0.1 m
	-0.2 to -0.1 m
	-0.3 to -0.2 m
	-0.4 to -0.3 m
	-0.5 to -0.4 m
	-1.0 to -0.5 m
	-1.5 to -1.0 m
- Subsided	

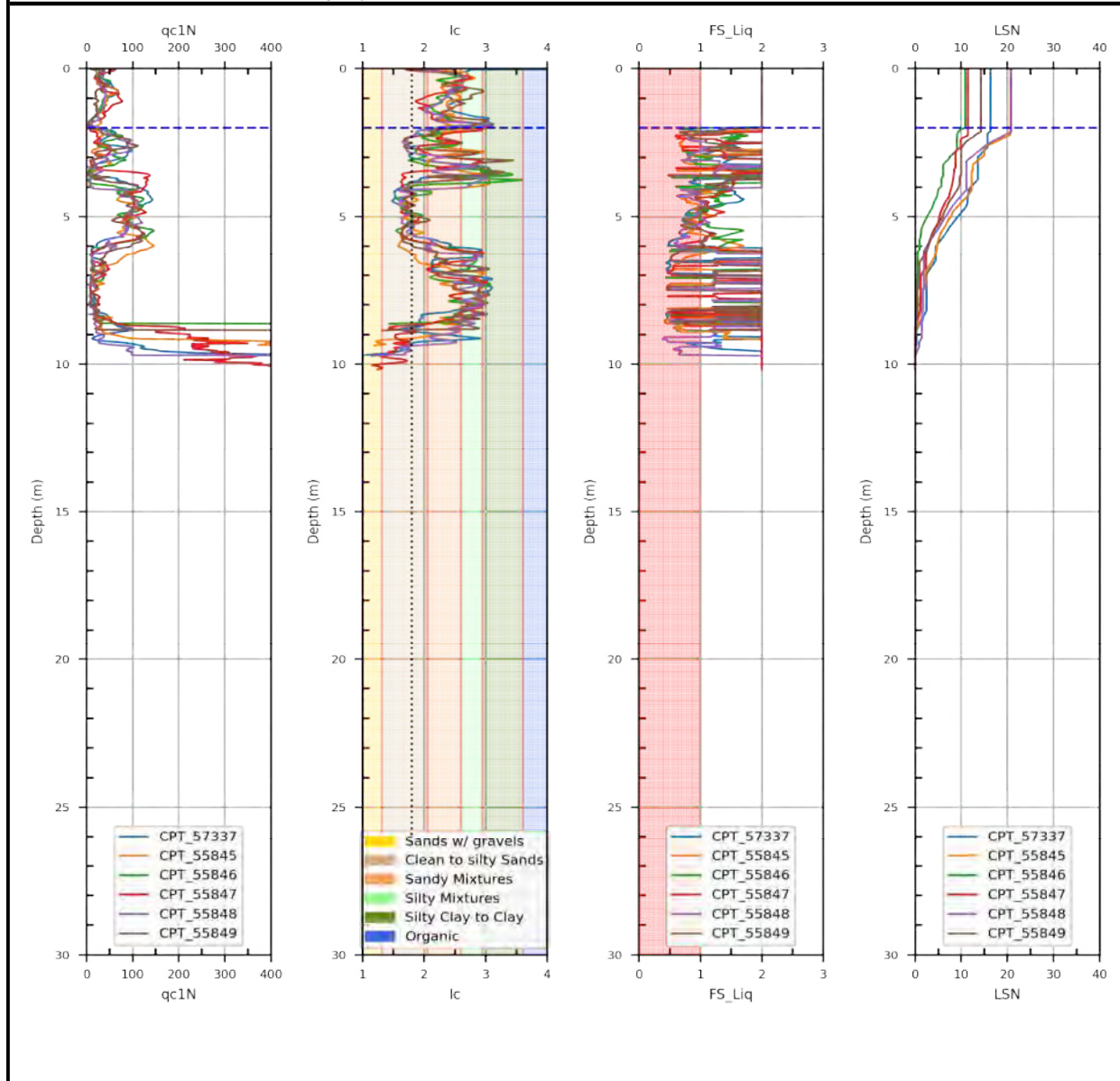
Case History: Ch-S7
Site: Harrington Park (N°3)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.22g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5344 Longitude 172.5903
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



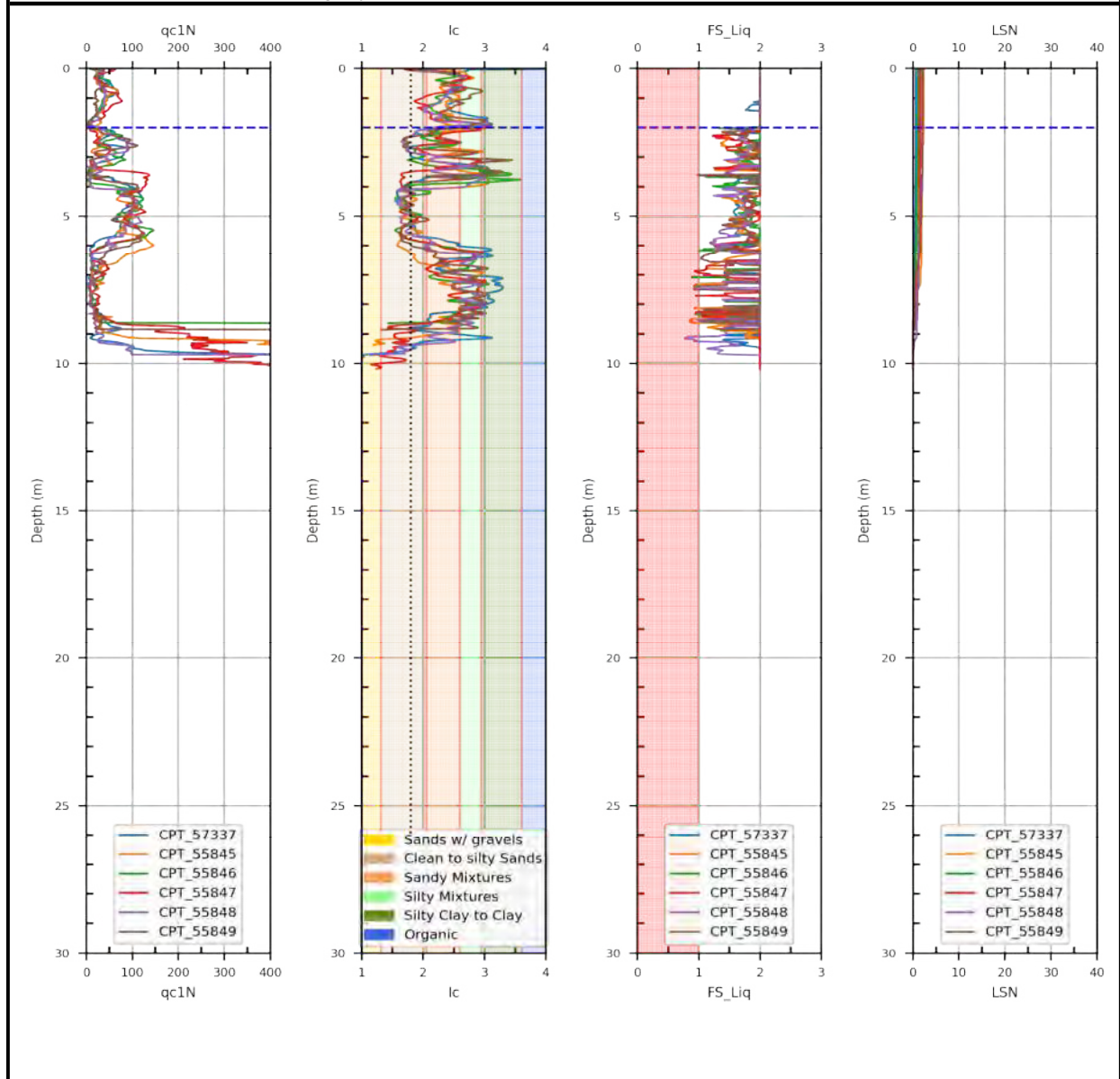
Case History: Ch-S8
Site: Harrington Park (N°3)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5344 Longitude 172.5903
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S9
Site: Harrington Park (N°3)
Location: Christchurch, New Zealand
Earthquake: Jun-11 Mw 6.2
PGA: 0.0.17g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5344 Longitude 172.5903
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



Wharenui School

Case History:

Site: Wharenui School (N°4)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.36g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.8-1.6 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5361 Longitude 172.5976
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

Site: Wharenui School (N°4)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.36g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.8-1.6 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5361 Longitude 172.5976
Source: Christchurch City Council, map_Ap001725BlackMap.gws

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

lc Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

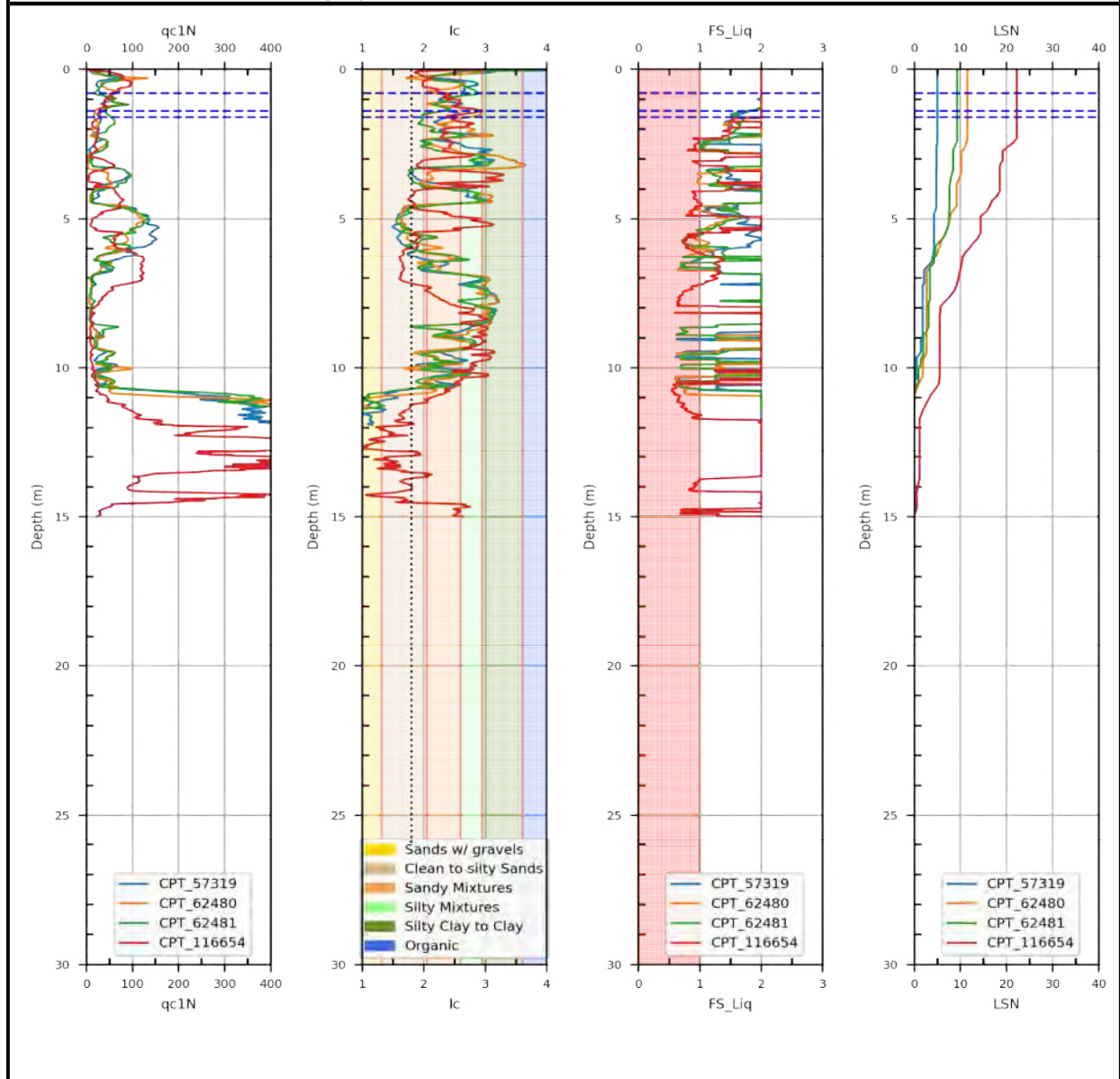


Case History: Site: Wharenui School (N°4) Location: Christchurch, New Zealand Earthquake: CES Mw 6.2 - 7.1 PGA: 0.18g - 0.36g (Bradley's median estimate [Bradley and Hughes 2012]) Ground Elevation: 0 m Datum: ground surface Water table: 0.8-1.6 m avg. below ground surface (Tokin and Taylor 2013) CPT: All CPTs Latitude -43.5361 Longitude 172.5976 Source: New Zealand Geotechnical Database (http://www.nzgd.org.nz) qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009 lc Robertson, 2009 LSN van Ballegooy et al., 2014	
Ejecta Patterns	
Aerial photography taken on September 5, 2010 No aerial photo available	Aerial photography taken on February 24, 2011 
Aerial photography taken on June 14-15, 2011 	Aerial photography taken on December 24, 2011 No aerial photo available
	

Case History:											
Site:	Wharenui School (N°4)										
Location:	Christchurch, New Zealand										
Earthquake:	CES Mw 6.2 - 7.1										
PGA:	0.18g - 0.36g (Bradley's median estimate [Bradley and Hughes 2012])										
Ground Elevation:	0 m Datum: ground surface										
Water table:	0.8-1.6 m avg. below ground surface (Tokin and Taylor 2013)										
CPT:	All CPTs Latitude -43.5361 Longitude 172.5976										
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)										
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009										
Ic	Robertson, 2009										
LSN	van Ballegooy et al., 2014										
Free-Field Ground Settlement Measurement											
Estimated vertical settlement - Sep. 4, 2010 EQ	Estimated vertical settlement - Feb. 22, 2011 EQ										
No LiDAR data available	No LiDAR data available										
Estimated vertical settlement - June 13, 2011 EQ	Estimated vertical settlement - Dec.23, 2011										
	No LiDAR data available										
LiDAR surveys dates: <table> <tr> <td>Pre-September 2010</td><td>Feb. 6-11, 2008</td></tr> <tr> <td>Post-September 2010</td><td>Sep. 5, 2010</td></tr> <tr> <td>Post-February 2011</td><td>March 8-10 and May 20-30, 2011</td></tr> <tr> <td>Post-June 2011</td><td>July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011</td></tr> <tr> <td>Post-December 2011</td><td>Feb. 17-18, 2012</td></tr> </table>		Pre-September 2010	Feb. 6-11, 2008	Post-September 2010	Sep. 5, 2010	Post-February 2011	March 8-10 and May 20-30, 2011	Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011	Post-December 2011	Feb. 17-18, 2012
Pre-September 2010	Feb. 6-11, 2008										
Post-September 2010	Sep. 5, 2010										
Post-February 2011	March 8-10 and May 20-30, 2011										
Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011										
Post-December 2011	Feb. 17-18, 2012										
Vertical Elevation Change without Tectonic Component + Uplifted  -0.2 to -0.1 m (yellow) -0.3 to -0.2 m (orange) -0.4 to -0.3 m (red-orange) -0.5 to -0.4 m (red) -1.0 to -0.5 m (magenta) -1.5 to -1.0 m (dark magenta) - Subsided											

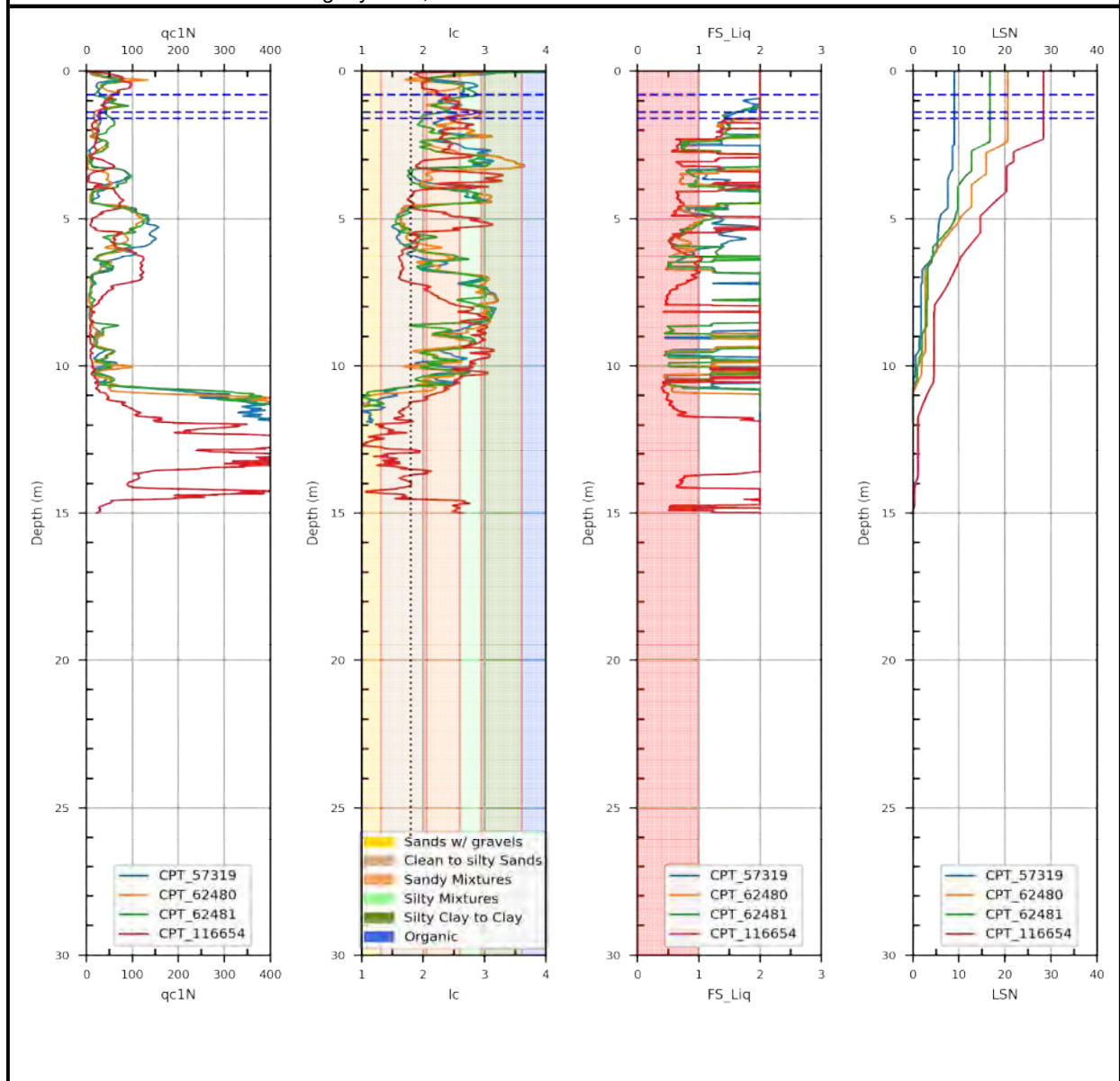
Case History: Ch-S10
Site: Wharenui School (N°4)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.22g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.8-1.6 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5361 Longitude 172.5976
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



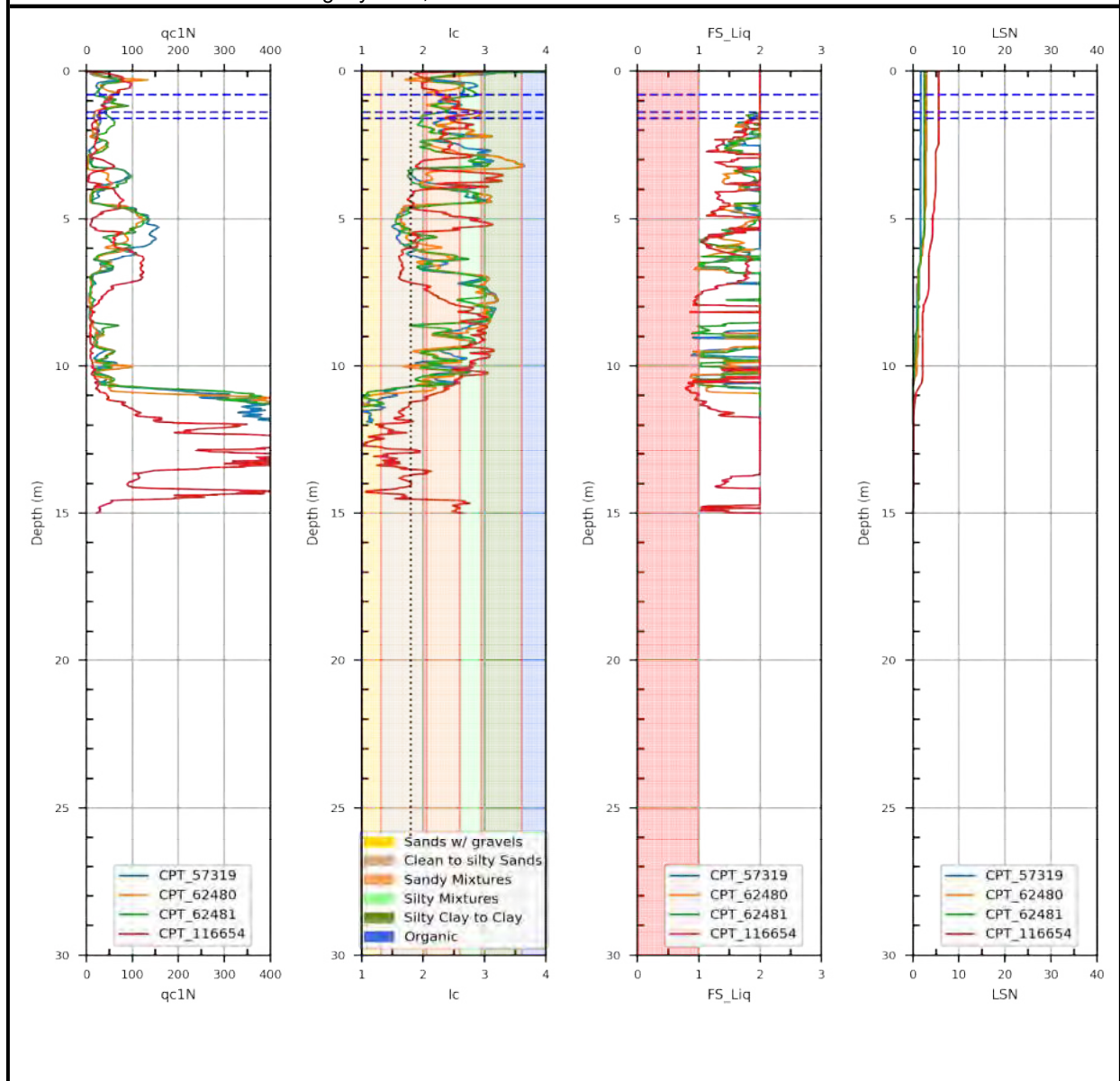
Case History: Ch-S11
Site: Wharenu School (N°4)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.36g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.8-1.6 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5361 Longitude 172.5976
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S12
Site: Wharenui School (N°4)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.17g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.8-1.6 m avg. below ground surface (Token and Taylor 2013)
CPT: All CPTs Latitude -43.5361 Longitude 172.5976
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



Cobra Reserve

Case History:

Site: Cobra Reserve (N°5)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.15g - 0.35g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.1-2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5701 Longitude 172.5639
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

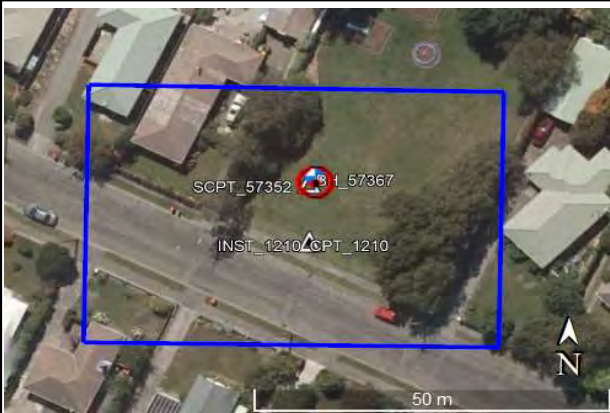
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

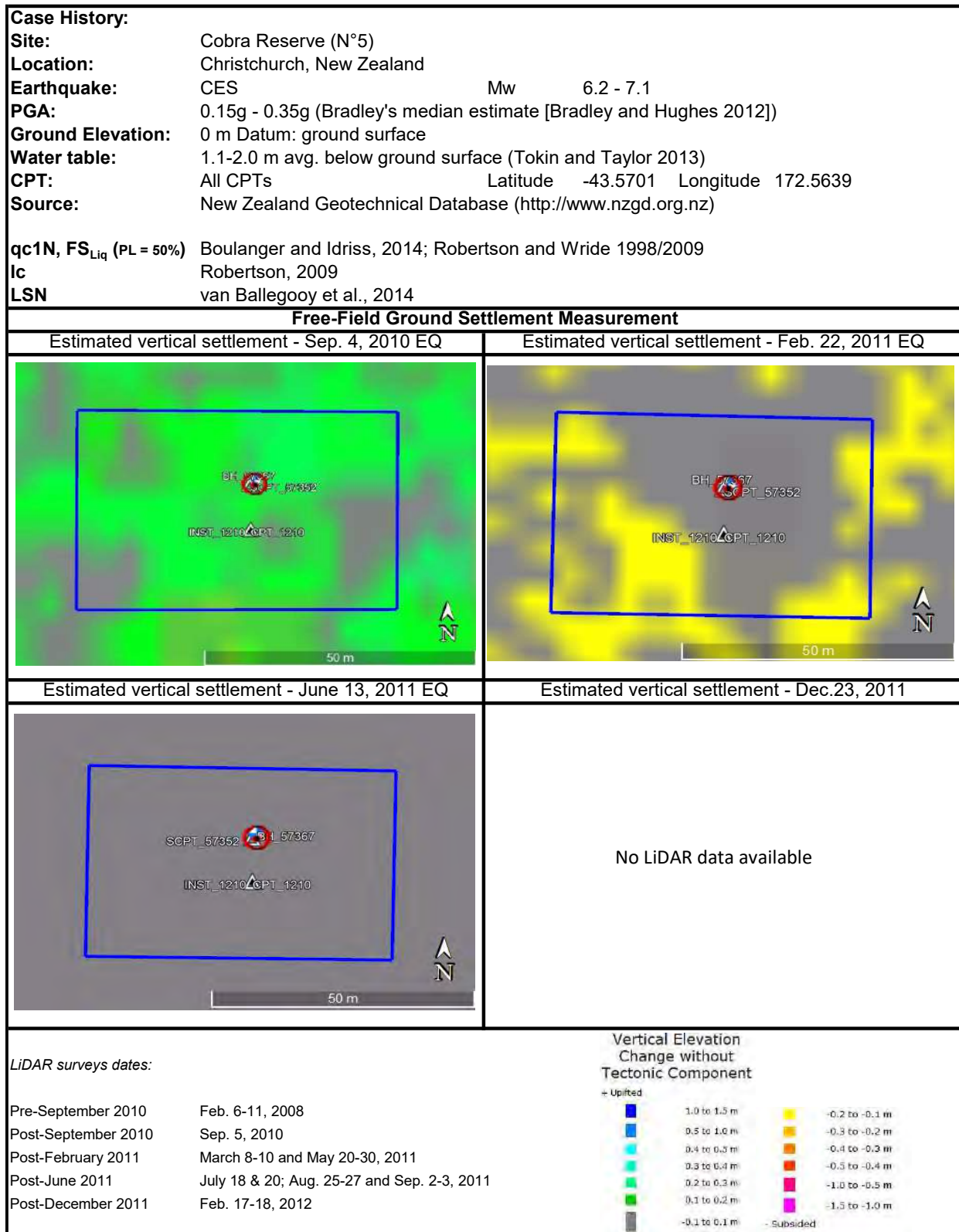
Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

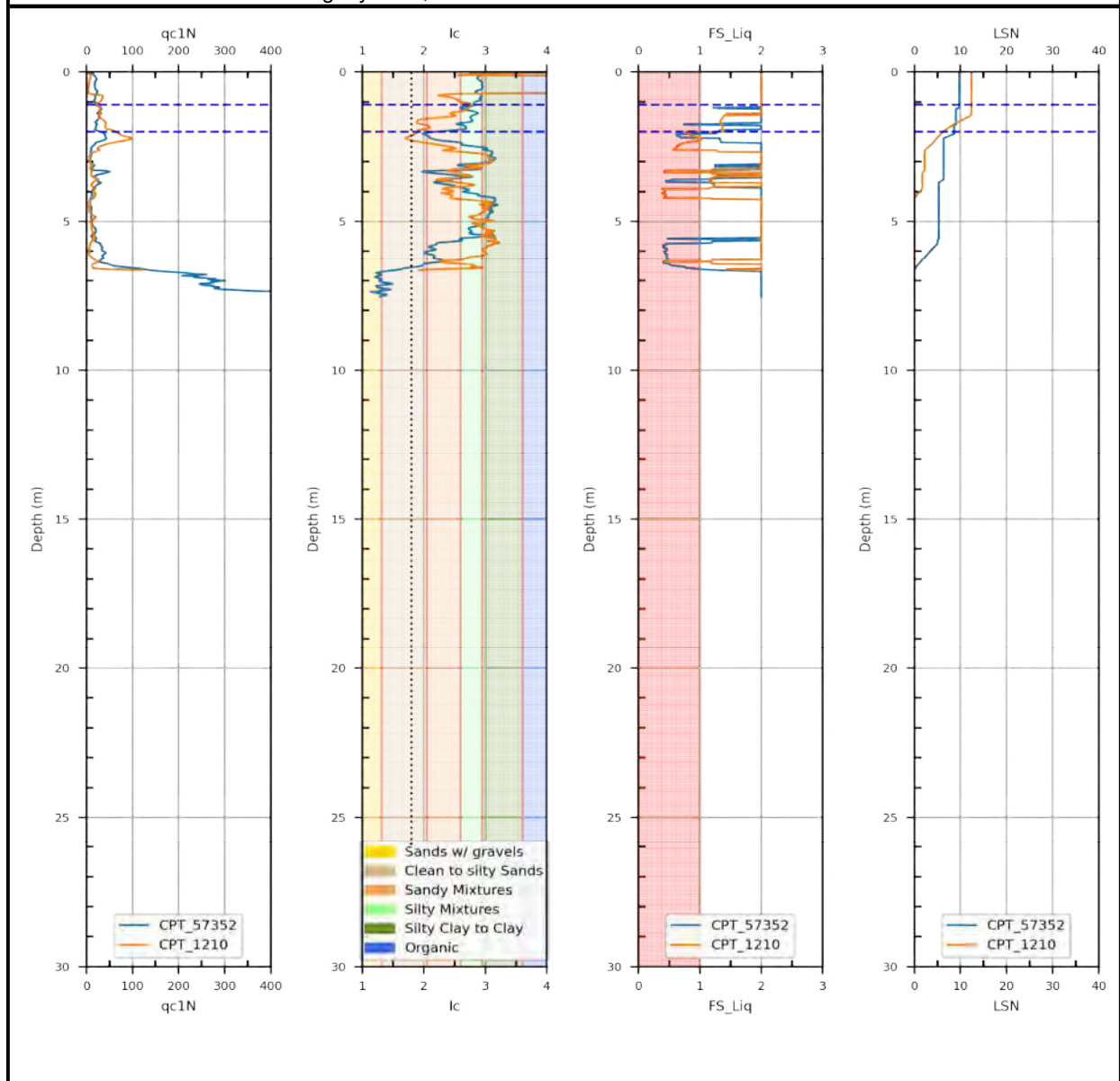
New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:	
Site:	Cobra Reserve (N°5)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.15g - 0.35g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	1.1-2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5701 Longitude 172.5639
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
No aerial photo available	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
No aerial photo available	No aerial photo available
	



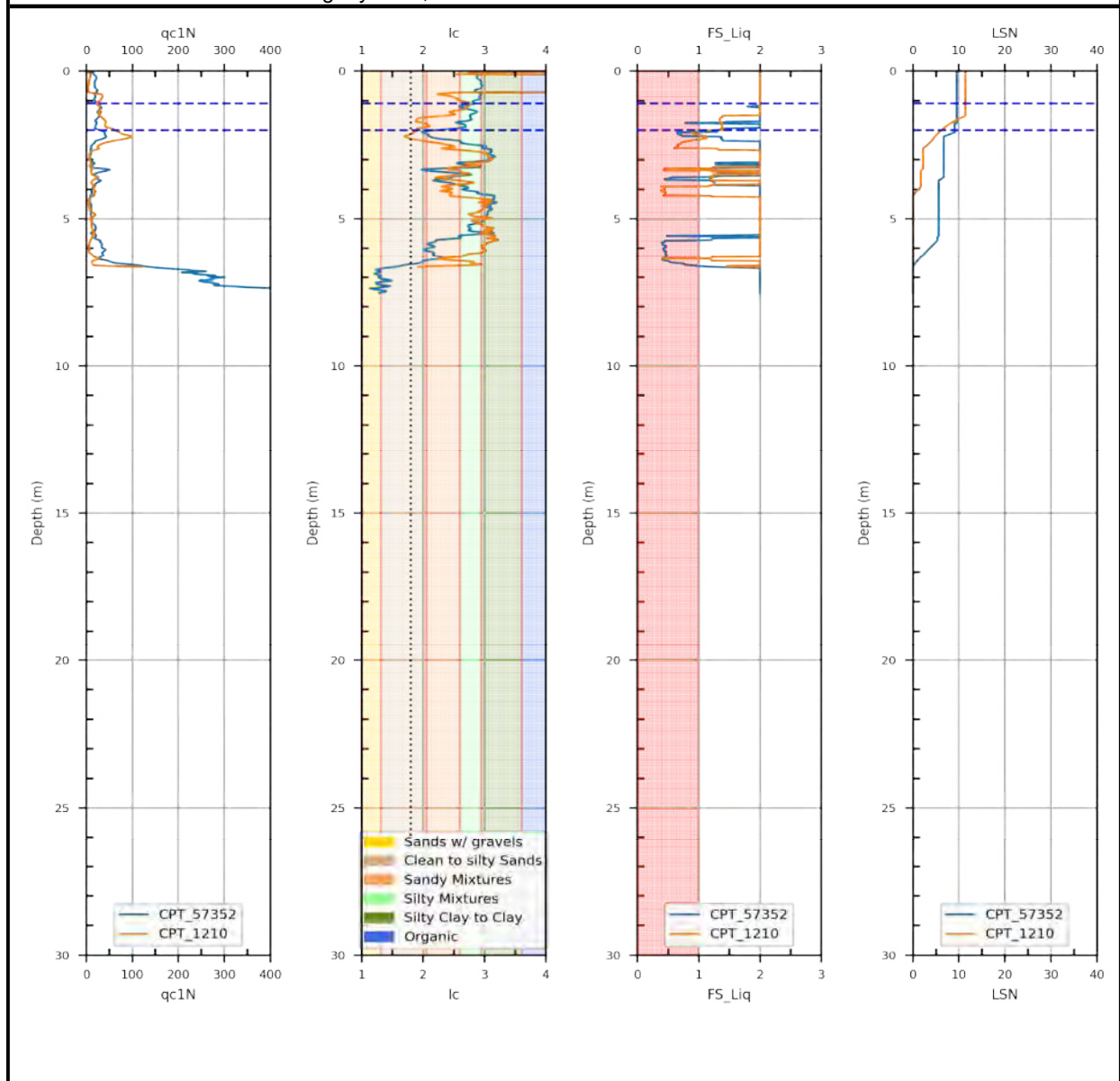
Case History: Ch-S13
Site: Cobra Reserve (N°5)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.28g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.1-2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5701 Longitude 172.5639
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



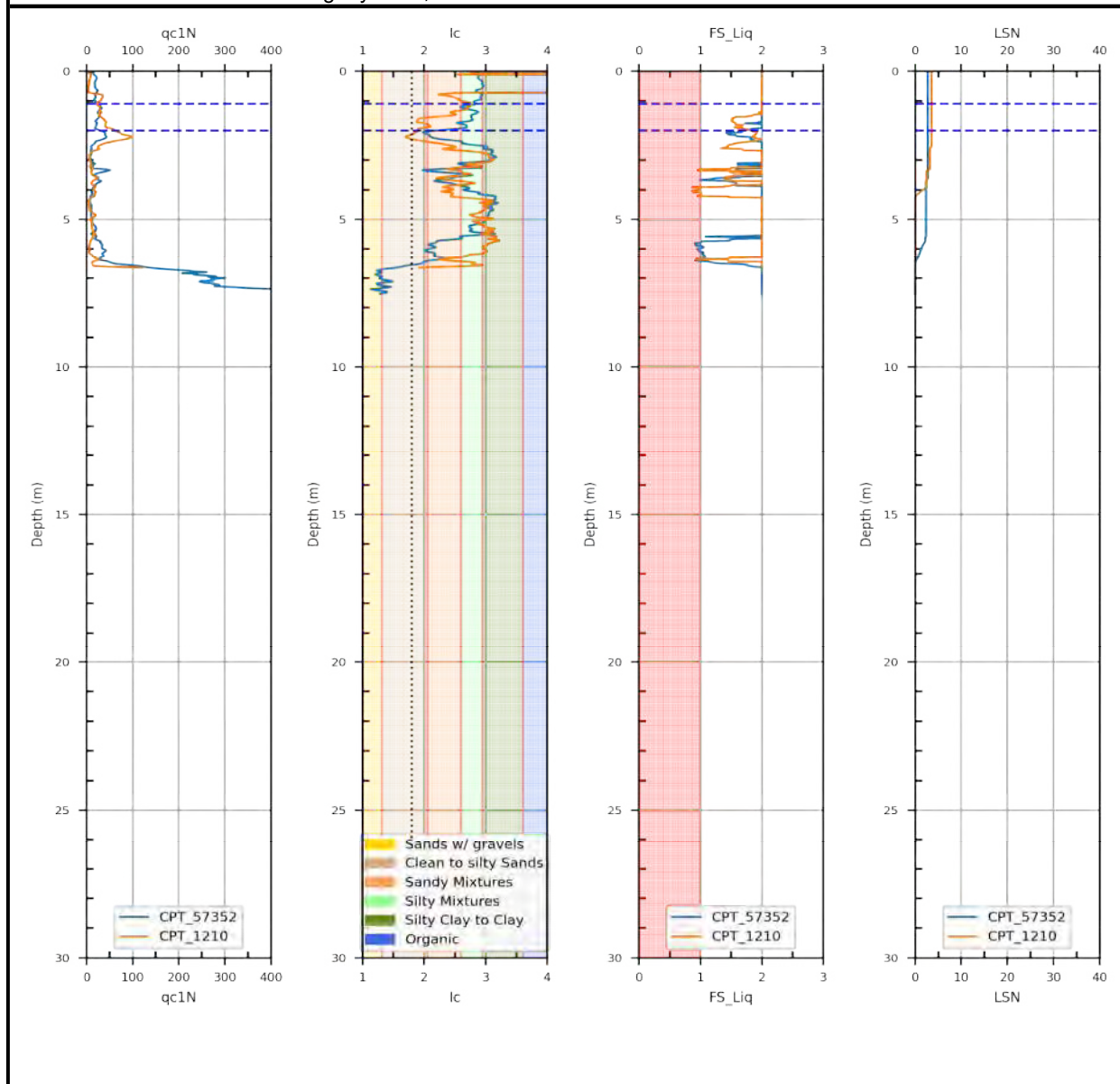
Case History: Ch-S14
Site: Cobra Reserve (N°5)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.35g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.1-2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5701 Longitude 172.5639
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S15
Site: Cobra Reserve (N°5)
Location: Christchurch, New Zealand
Earthquake: Jun-11 Mw 6.2
PGA: 0.15g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.1-2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5701 Longitude 172.5639
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Langdons Road

Case History:

Site: Langdons Roads (N°6)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.13g - 0.22g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.6 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4922 Longitude 172.6049
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

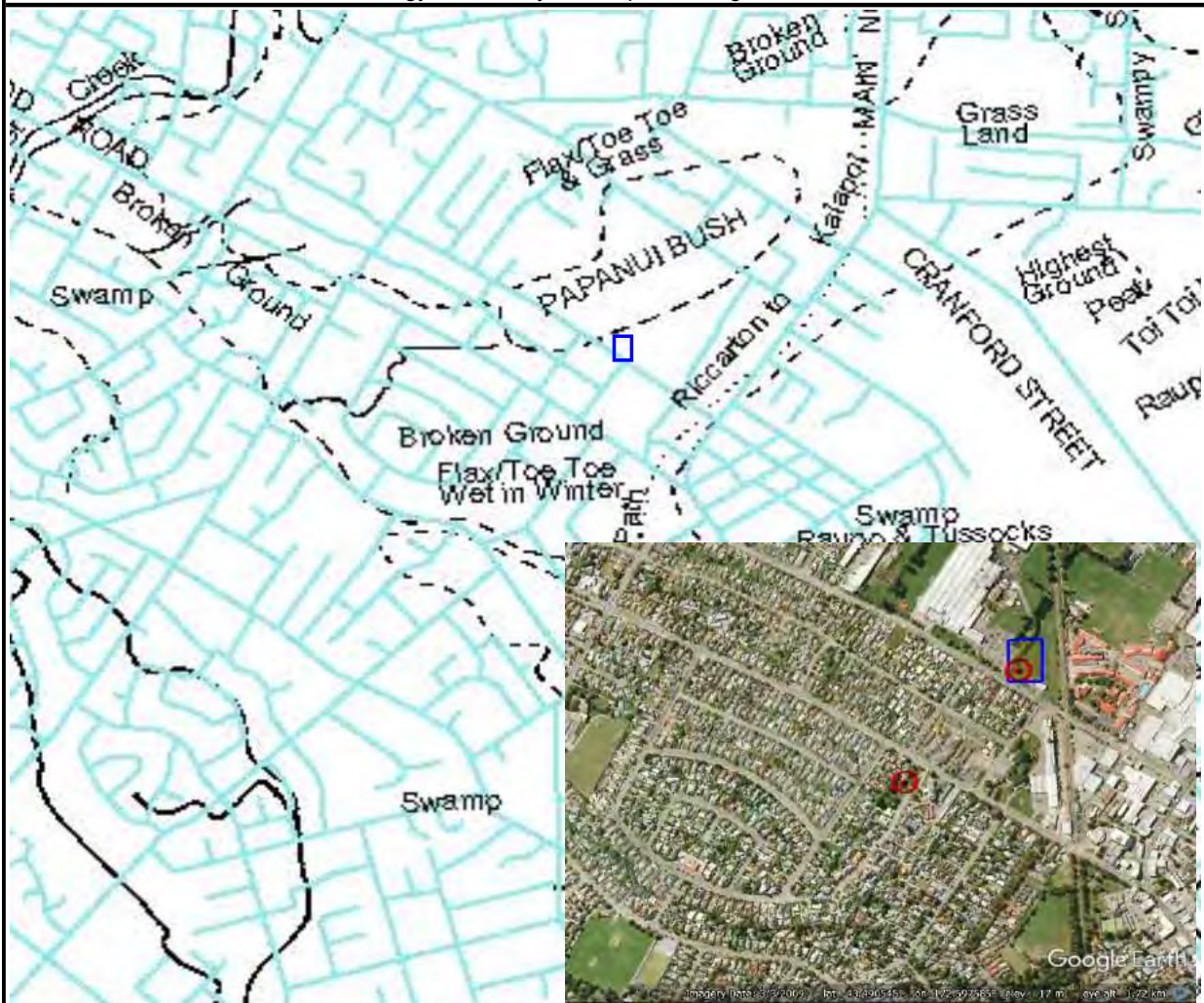
Site: Langdons Roads (N°6)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.13g - 0.22g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.6 m avg. below ground surface (Tokin and Taylor 2013)
CPT: Latitude -43.4922 Longitude 172.6049
Source: Christchurch City Council, map_Ap001725BlackMap.gws

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856



Case History:	
Site:	Langdons Roads (N°6)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.13g - 0.22g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	2.6 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	Latitude -43.4922 Longitude 172.6049
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
No aerial photo available	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	No aerial photo available
	

Case History:

Site: Langdons Roads (N°6)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.13g - 0.22g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.6 m avg. below ground surface (Tokin and Taylor 2013)
CPT: Latitude -43.4922 Longitude 172.6049
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

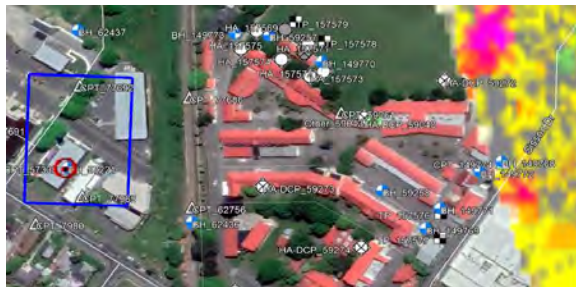
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

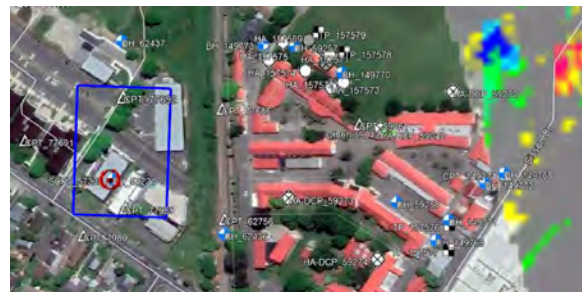
LSN van Ballegooy et al., 2014

Free-Field Ground Settlement Measurement

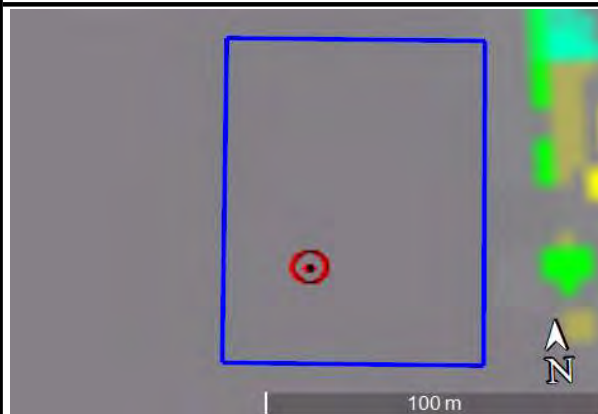
Estimated vertical settlement - Sep. 4, 2010 EQ



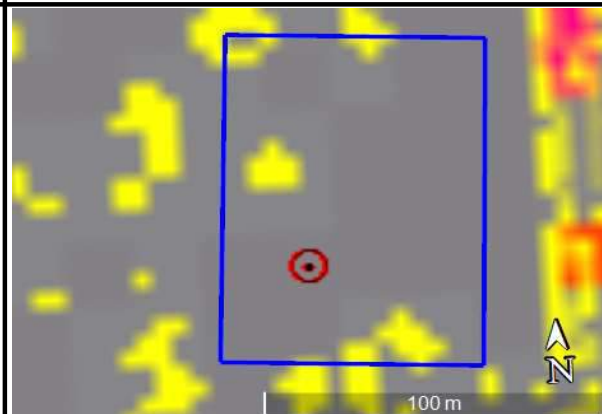
Estimated vertical settlement - Feb. 22, 2011 EQ



Estimated vertical settlement - June 13, 2011 EQ



Estimated vertical settlement - Dec.23, 2011

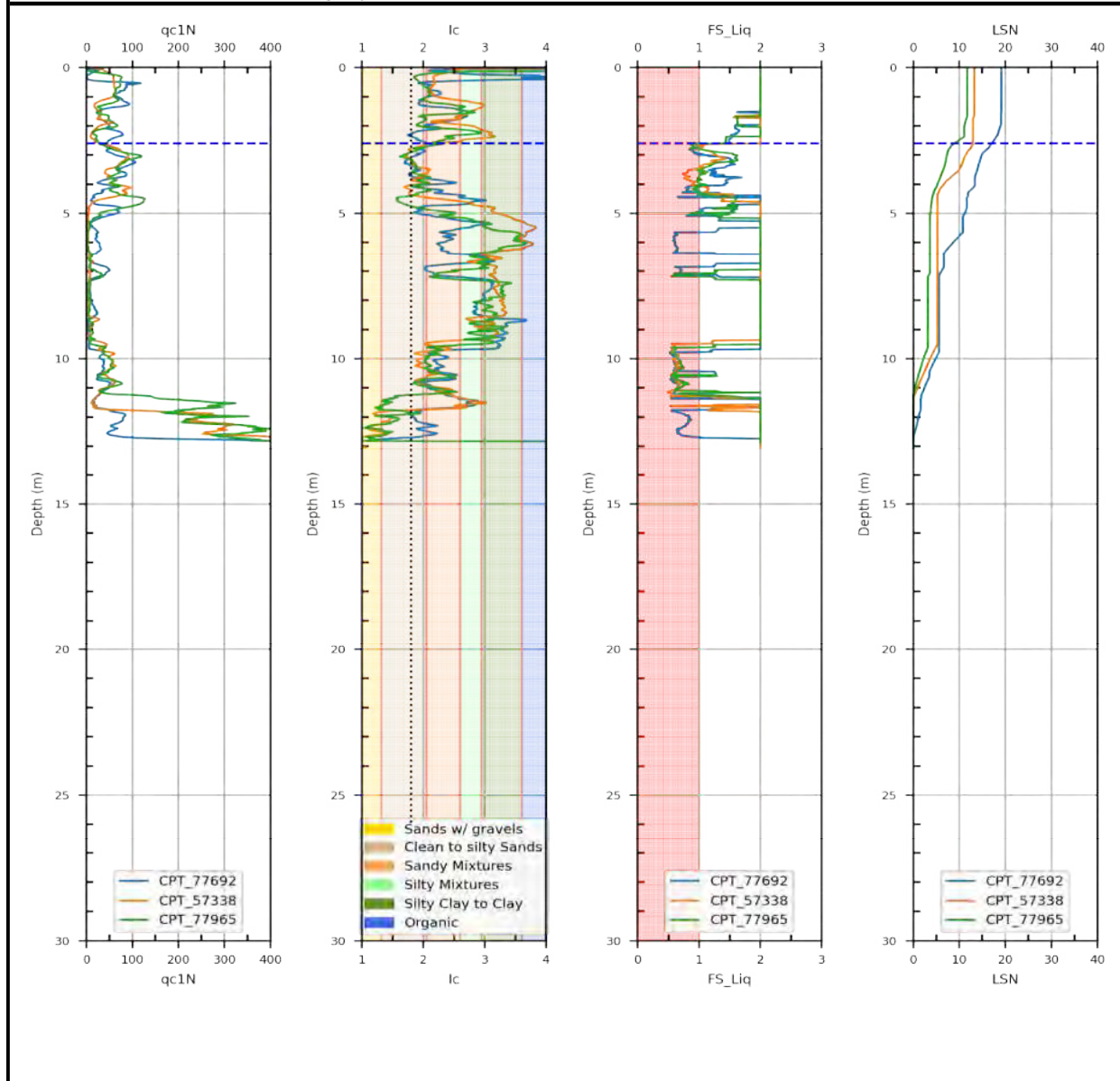
**LiDAR surveys dates:**

Pre-September 2010	Feb. 6-11, 2008
Post-September 2010	Sep. 5, 2010
Post-February 2011	March 8-10 and May 20-30, 2011
Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011
Post-December 2011	Feb. 17-18, 2012

Vertical Elevation Change without Tectonic Component

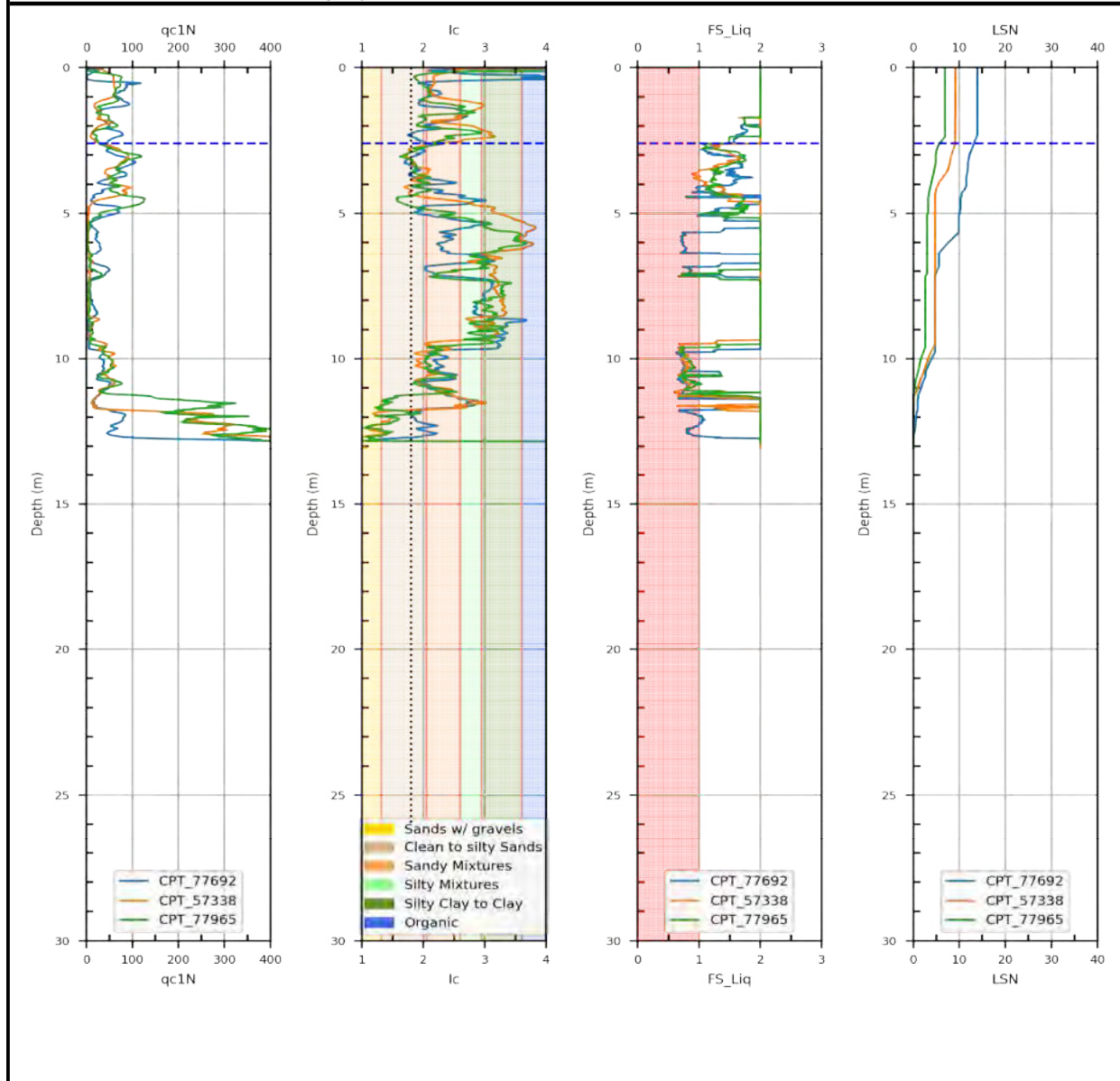
Case History: Ch-S16
Site: Langdons Roads (N°6)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.22g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.6 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4922 Longitude 172.6049
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



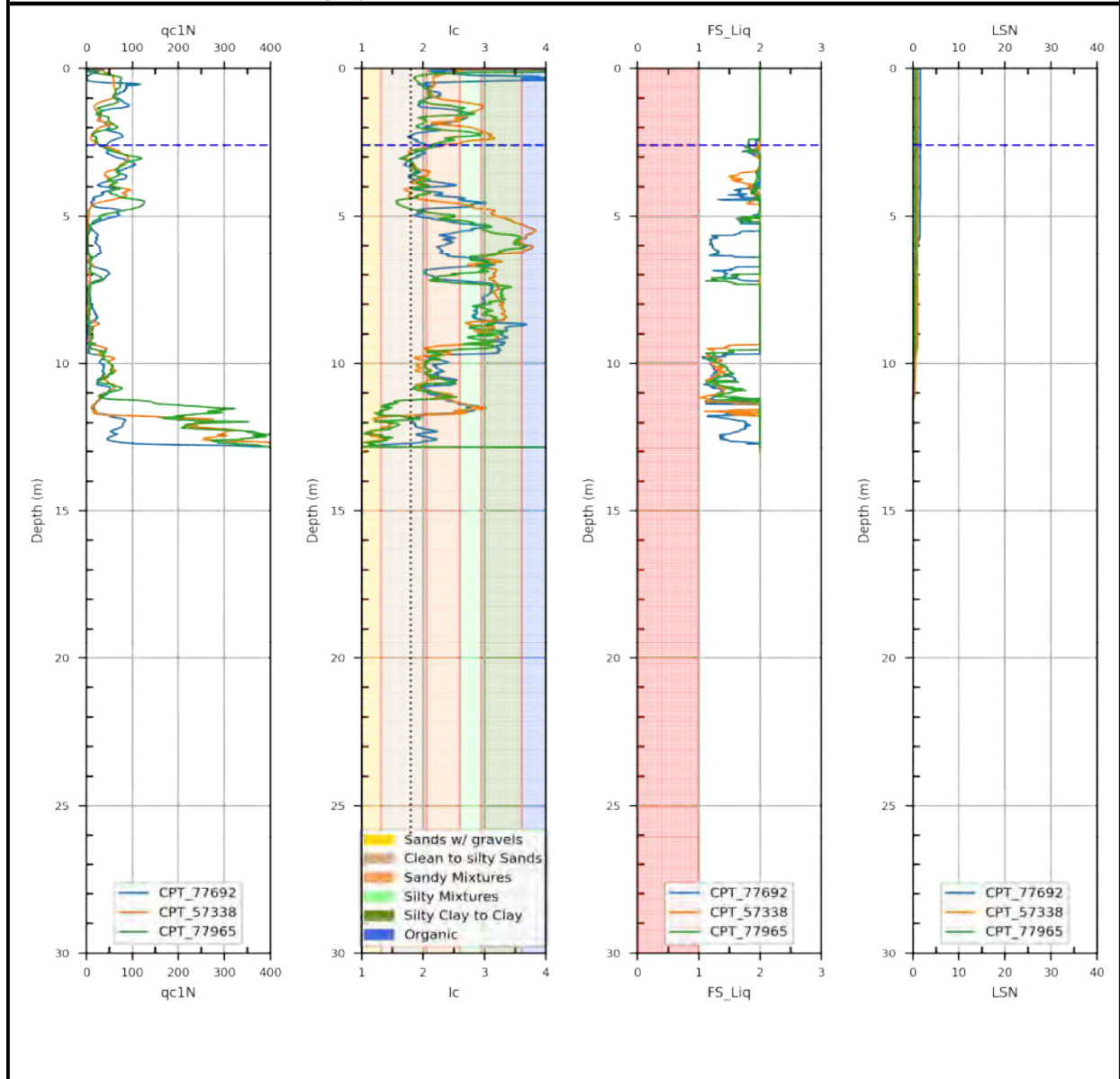
Case History: Ch-S17
Site: Langdons Roads (N°6)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.22g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.6 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4922 Longitude 172.6049
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S18
Site: Langdons Roads (N°6)
Location: Christchurch, New Zealand
Earthquake: Jun-11 Mw 6.2
PGA: 0.13g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.6 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4922 Longitude 172.6049
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Meadow Street

Case History:

Site: Meadow Street (N°7)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.14g - 0.25g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.6-2.6 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4921 Longitude 172.6193
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

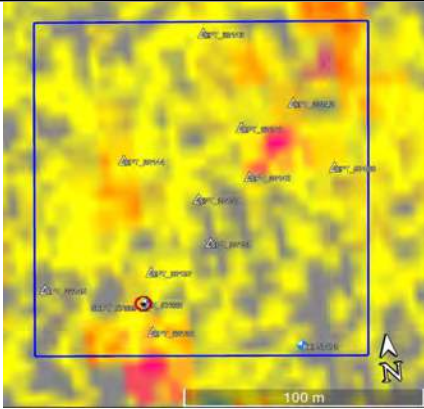
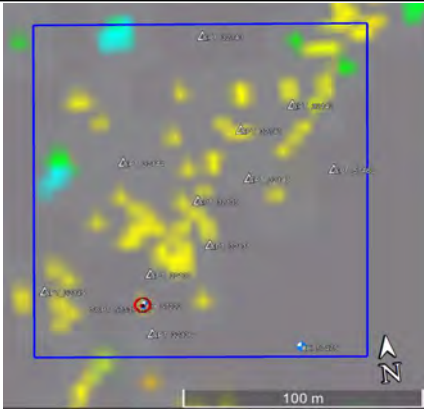
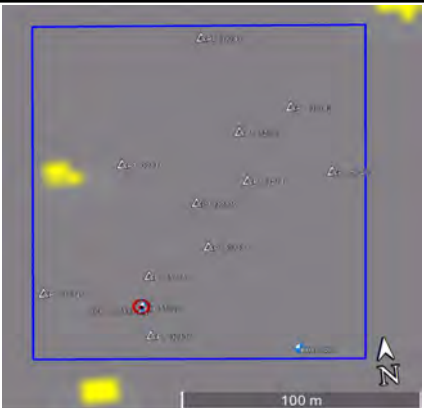
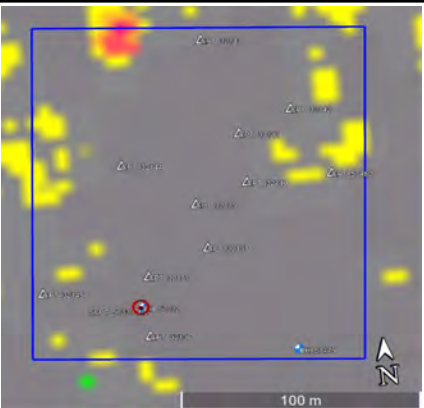
Site:	Meadow Street (N°7)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.14g - 0.25g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	0.6-2.6 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	Latitude -43.4921 Longitude 172.6193
Source:	Christchurch City Council, map_Ap001725BlackMap.gws

Robertson, 2009

Surficial Geology - waterways swamps and vegetation cover in 1856

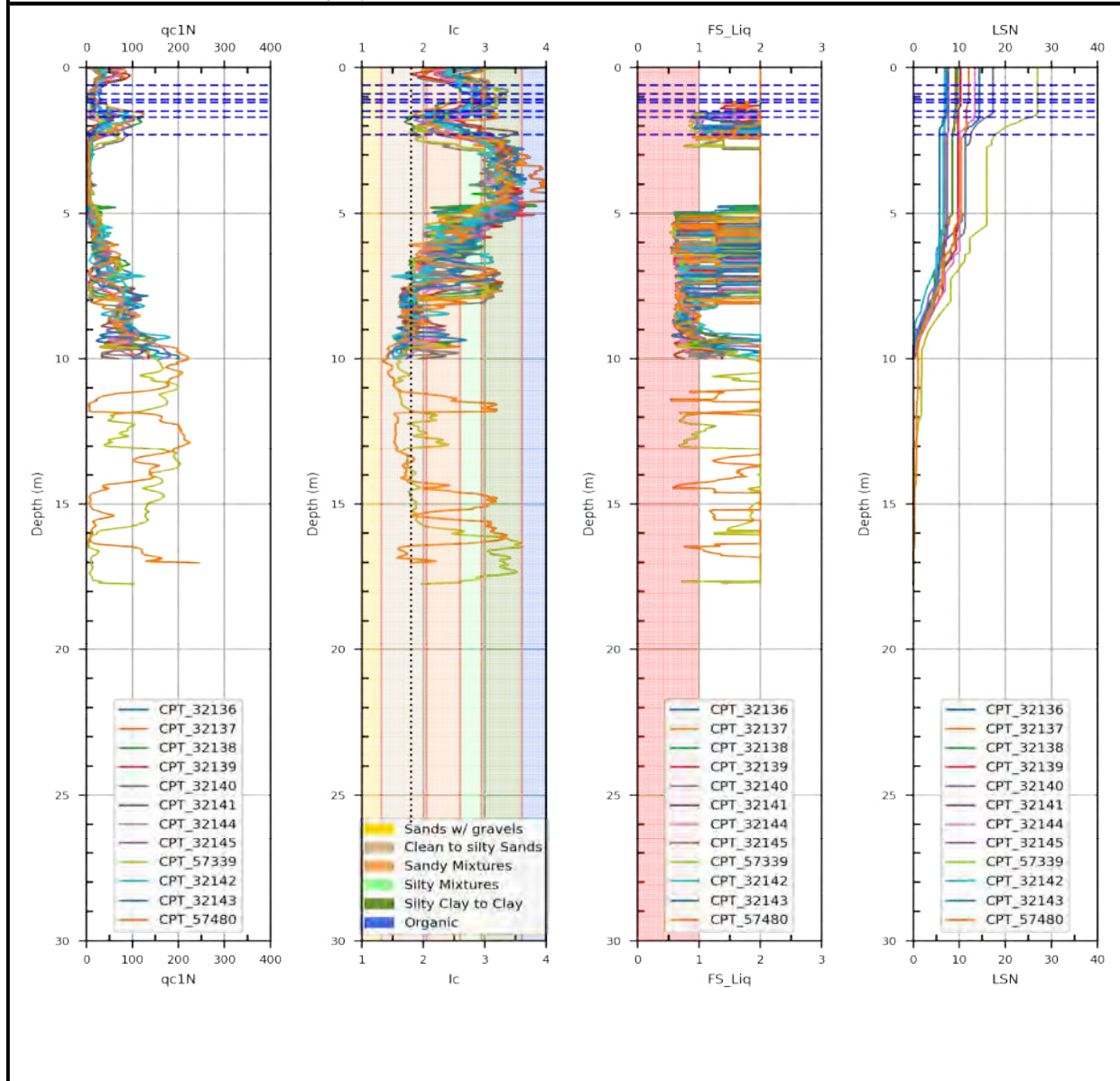


Case History: Site: Meadow Street (N°7) Location: Christchurch, New Zealand Earthquake: CES Mw 6.2 - 7.1 PGA: 0.14g - 0.25g (Bradley's median estimate [Bradley and Hughes 2012]) Ground Elevation: 0 m Datum: ground surface Water table: 0.6-2.6 m avg. below ground surface (Tokin and Taylor 2013) CPT: All CPTs Latitude -43.4921 Longitude 172.6193 Source: New Zealand Geotechnical Database (http://www.nzgd.org.nz) qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009 lc Robertson, 2009 LSN van Ballegooy et al., 2014	
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	No aerial photo available
  Ministry of Civil Defence & Emergency Management Te Kaitiaki Whakamānau  CERA Canterbury Earthquake Recovery Authority  EQC EARTHQUAKE COMMISSION Kaitiaki Takekōwhiri  TT Tonkin & Taylor	

Case History:	
Site:	Meadow Street (N°7)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.14g - 0.25g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	0.6-2.6 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.4921 Longitude 172.6193
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Free-Field Ground Settlement Measurement	
Estimated vertical settlement - Sep. 4, 2010 EQ	Estimated vertical settlement - Feb. 22, 2011 EQ
	
Estimated vertical settlement - June 13, 2011 EQ	Estimated vertical settlement - Dec.23, 2011
	
LiDAR surveys dates: Pre-September 2010 Feb. 6-11, 2008 Post-September 2010 Sep. 5, 2010 Post-February 2011 March 8-10 and May 20-30, 2011 Post-June 2011 July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011 Post-December 2011 Feb. 17-18, 2012	
Vertical Elevation Change without Tectonic Component + Uplifted - Subsided 	

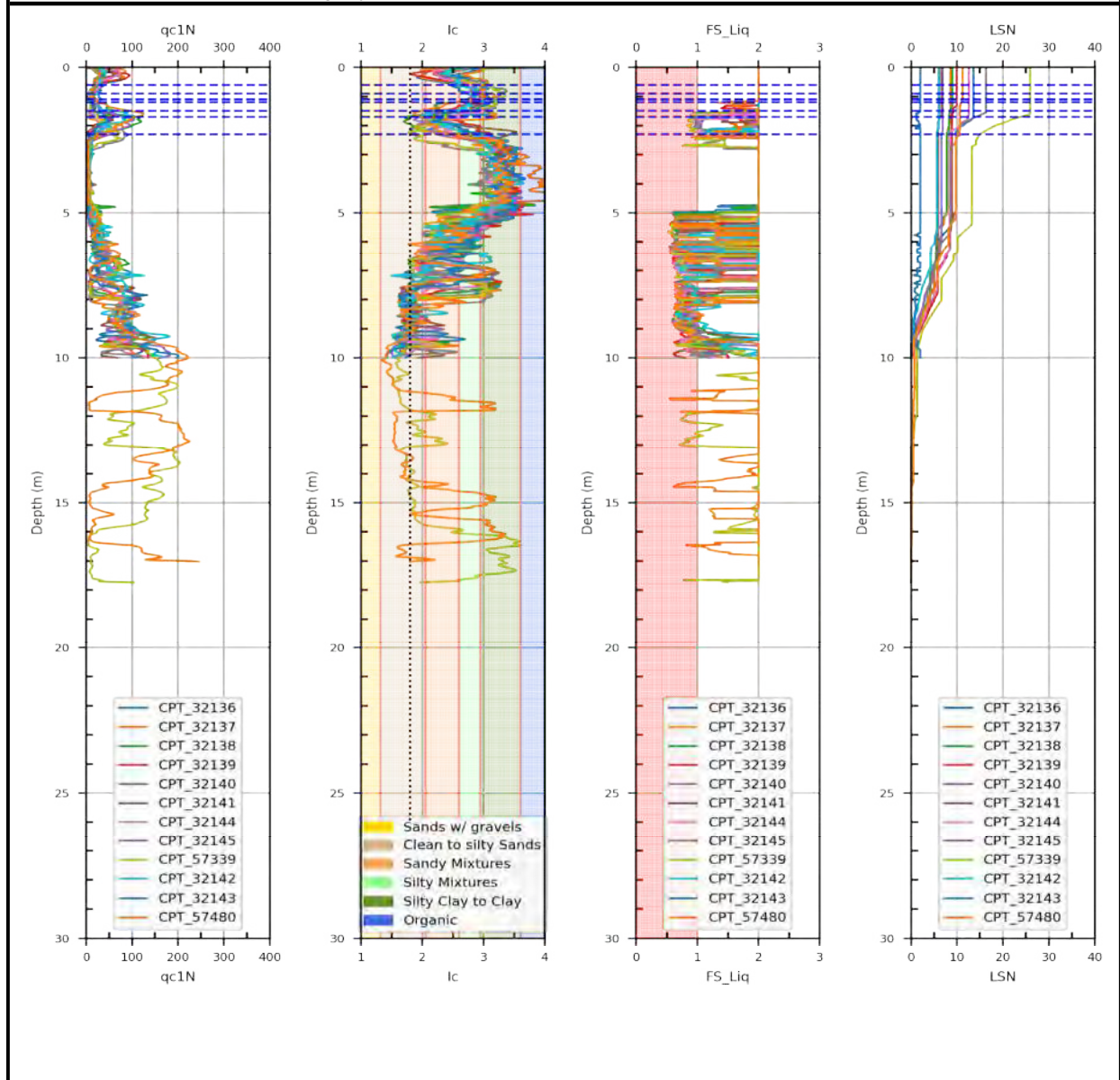
Case History: Ch-S19
Site: Meadow Street (N°7)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.21g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.6-2.6 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4921 Longitude 172.6193
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



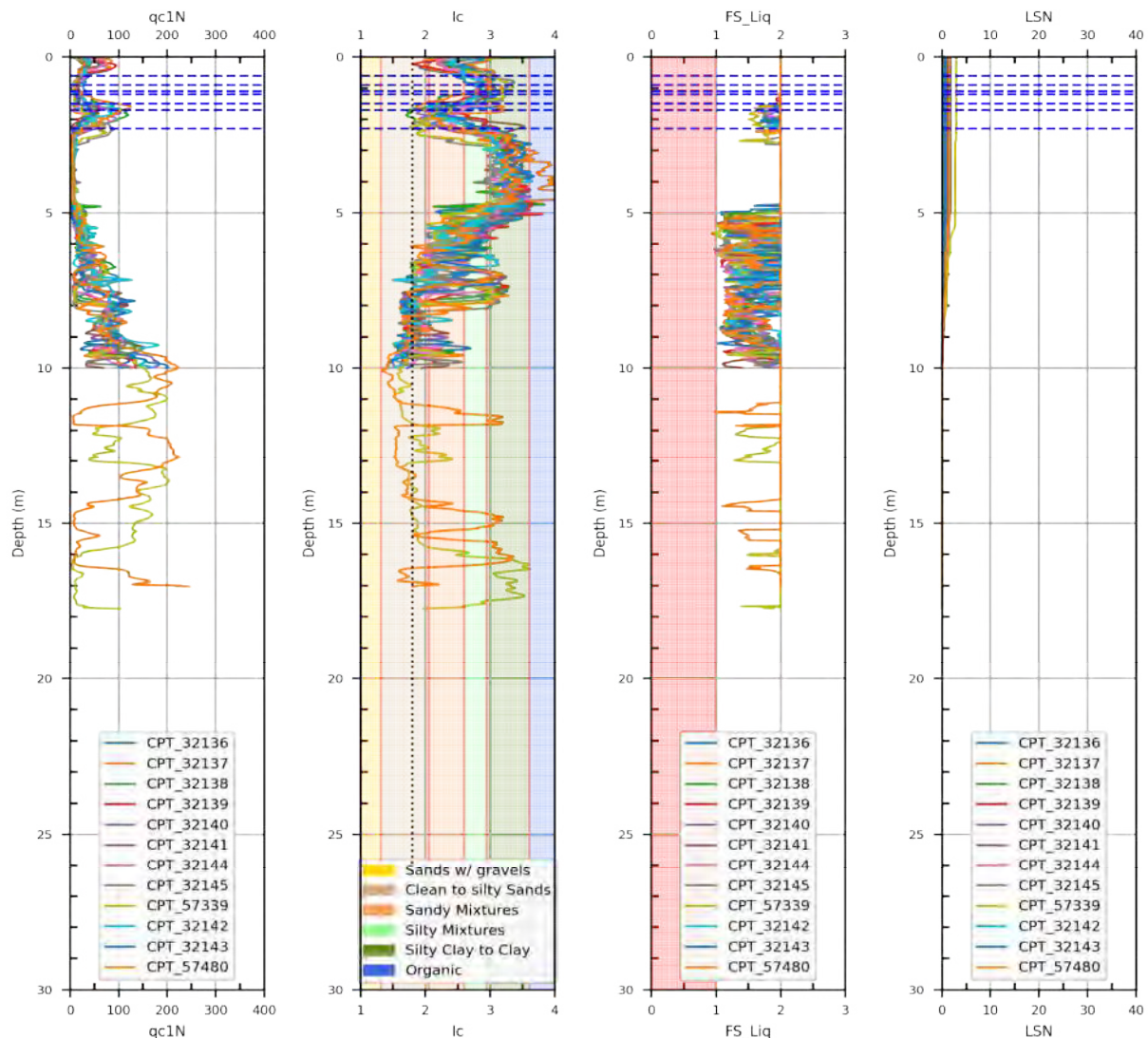
Case History: Ch-S20
Site: Meadow Street (N°7)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.25g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.6-2.6 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4921 Longitude 172.6193
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S21
Site: Meadow Street (N°7)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.14g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.6-2.6 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4921 Longitude 172.6193
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



St. Albans Catholic School

Case History:

Site: St. Albans Catholic School (N°8)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.1 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5072 Longitude 172.6291
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

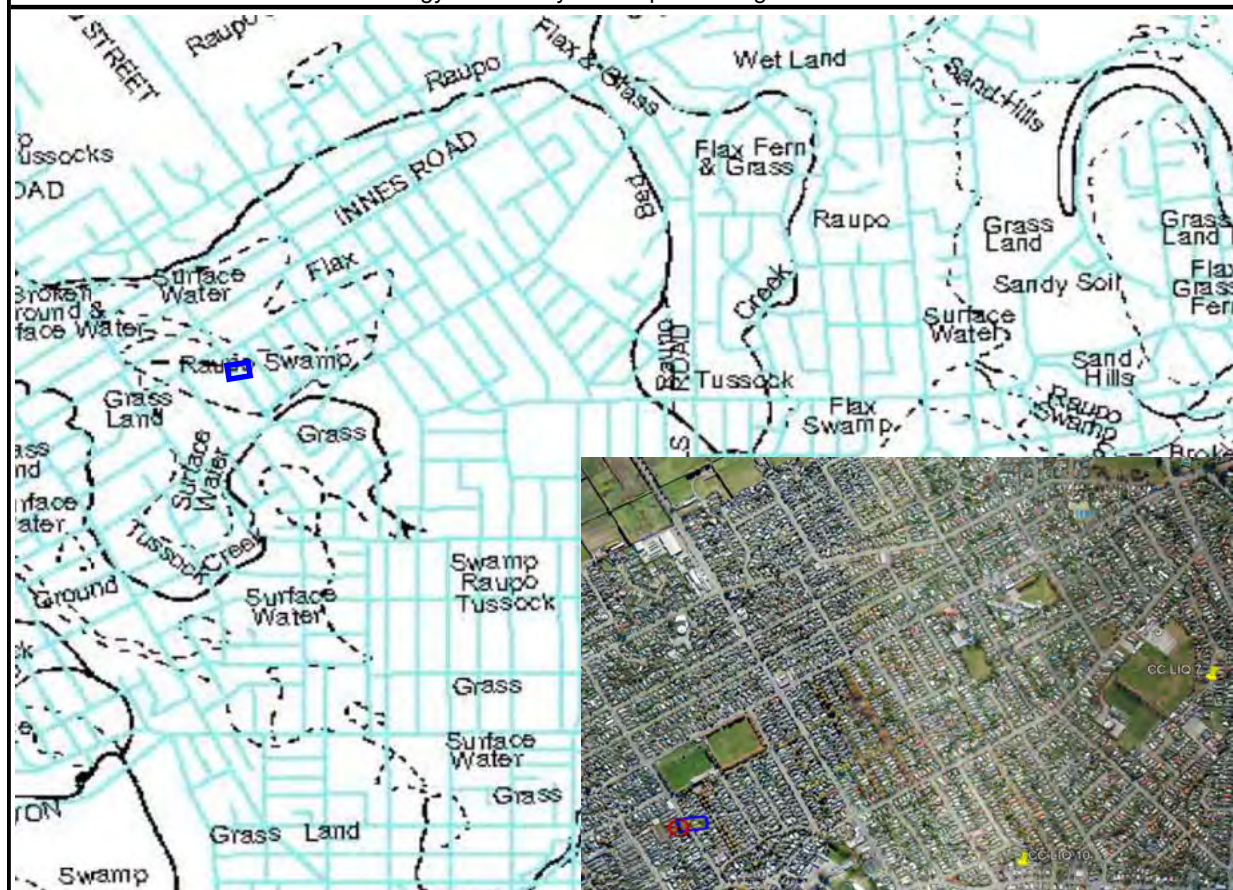
Site: St. Albans Catholic School (N°8)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.1 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5072 Longitude 172.6291
Source: Christchurch City Council, map_Ap001725BlackMap.gws

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

lc Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856



Case History:

Site: St. Albans Catholic School (N°8)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.1 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5072 Longitude 172.6291
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

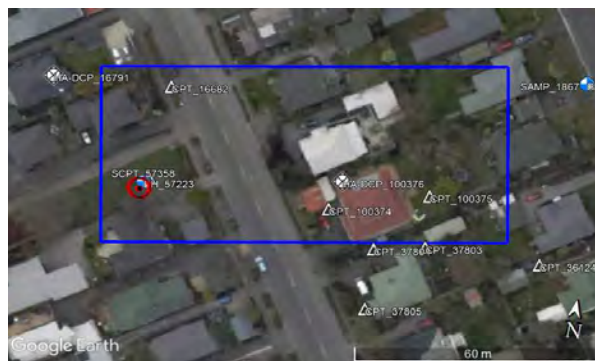
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

lc Robertson, 2009

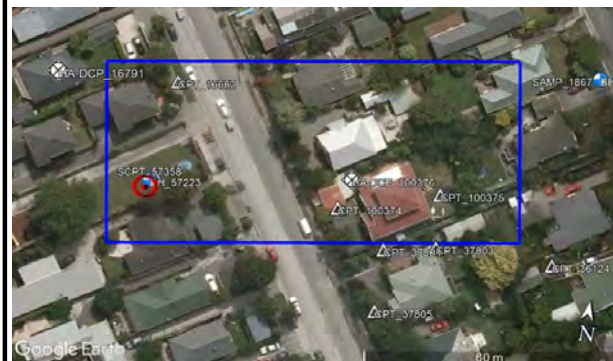
LSN van Ballegooy et al., 2014

Ejecta Patterns

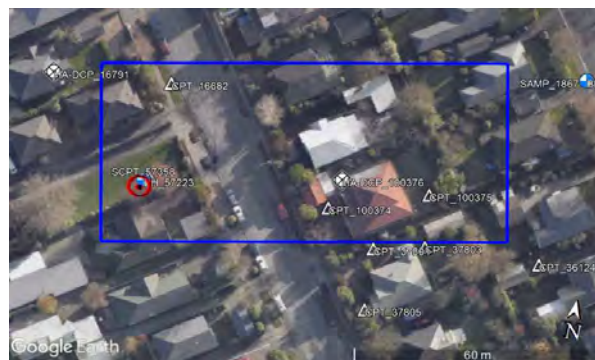
Aerial photography taken on September 5, 2010



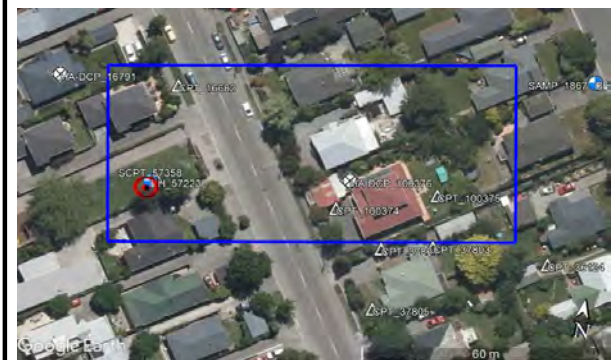
Aerial photography taken on February 24, 2011



Aerial photography taken on June 14-15, 2011



Aerial photography taken on December 24, 2011



Ministry of Civil Defence
& Emergency Management
Te Kaitiaki Whakamānau



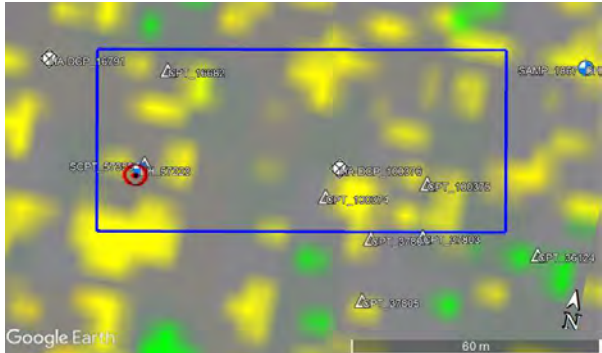
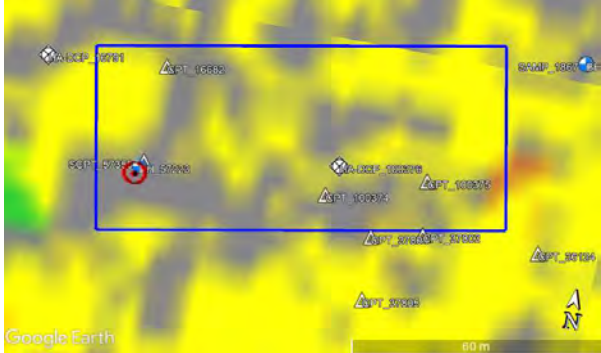
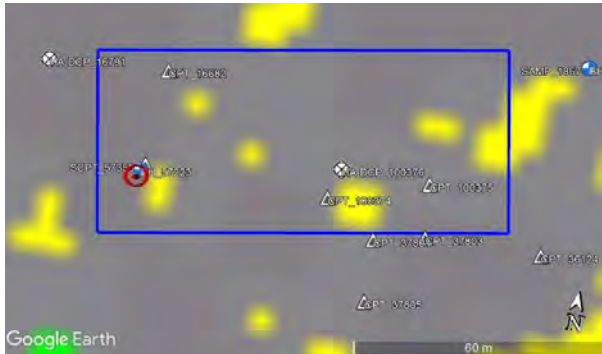
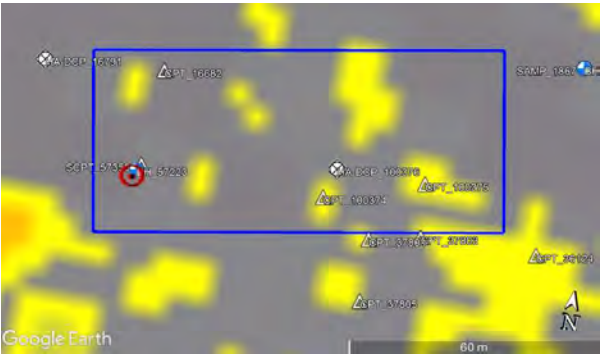
Canterbury Earthquake
Recovery Authority



EARTHQUAKE COMMISSION
Kaitiaki Takekōwhiri

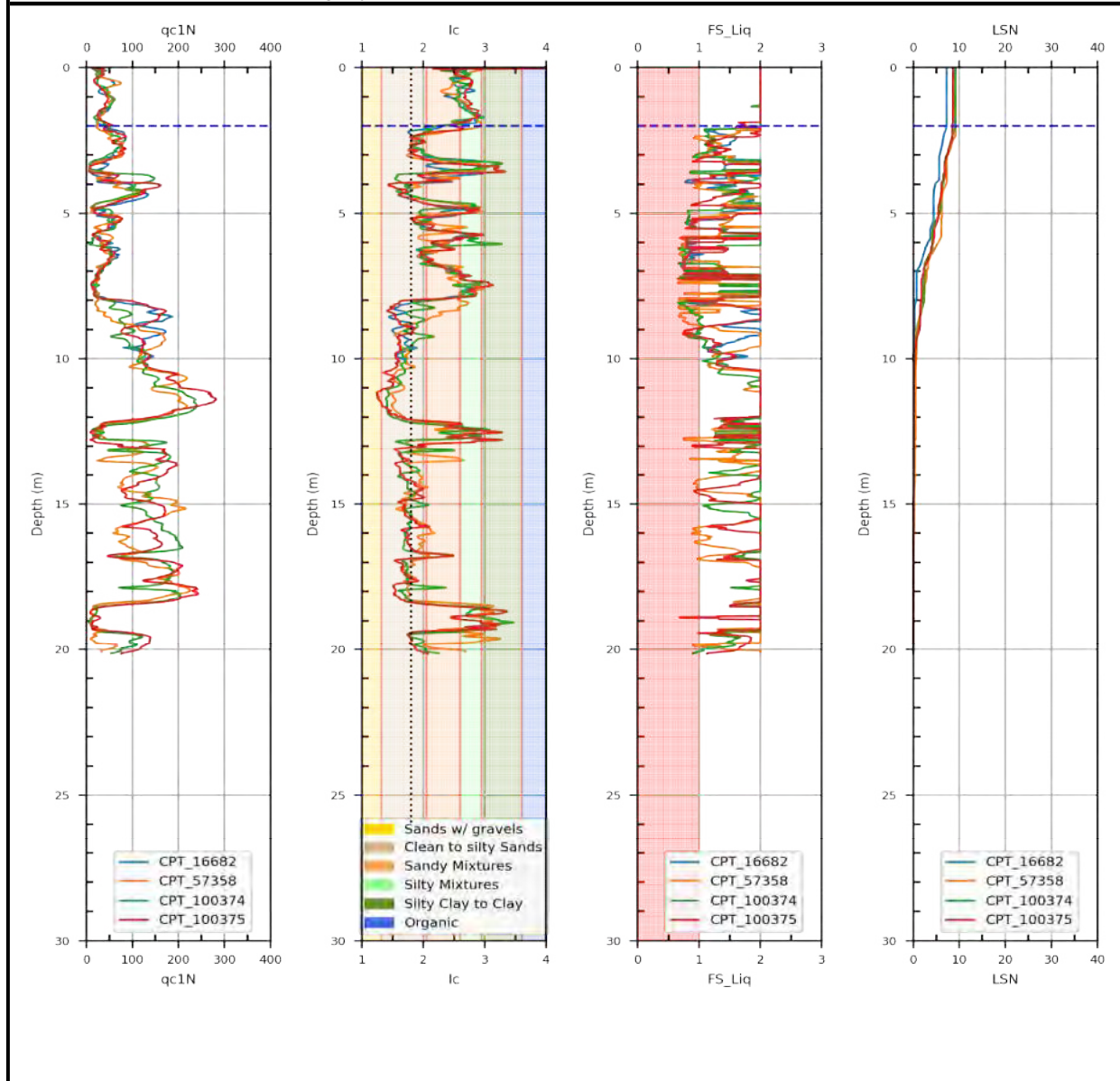


Tonkin & Taylor

Case History:	
Site:	St. Albans Catholic School (N°8)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.18g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	2.1 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5072 Longitude 172.6291
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Free-Field Ground Settlement Measurement	
Estimated vertical settlement - Sep. 4, 2010 EQ	Estimated vertical settlement - Feb. 22, 2011 EQ
	
Estimated vertical settlement - June 13, 2011 EQ	Estimated vertical settlement - Dec.23, 2011
	
LiDAR surveys dates: Pre-September 2010 Feb. 6-11, 2008 Post-September 2010 Sep. 5, 2010 Post-February 2011 March 8-10 and May 20-30, 2011 Post-June 2011 July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011 Post-December 2011 Feb. 17-18, 2012 Vertical Elevation Change without Tectonic Component + Uplifted - Subsided 1.0 to 1.5 m 0.5 to 1.0 m 0.4 to 0.3 m 0.3 to 0.4 m 0.2 to 0.3 m 0.1 to 0.2 m -0.1 to 0.1 m -0.2 to -0.1 m -0.3 to -0.2 m -0.4 to -0.3 m -0.5 to -0.4 m -1.0 to -0.5 m -1.5 to -1.0 m	

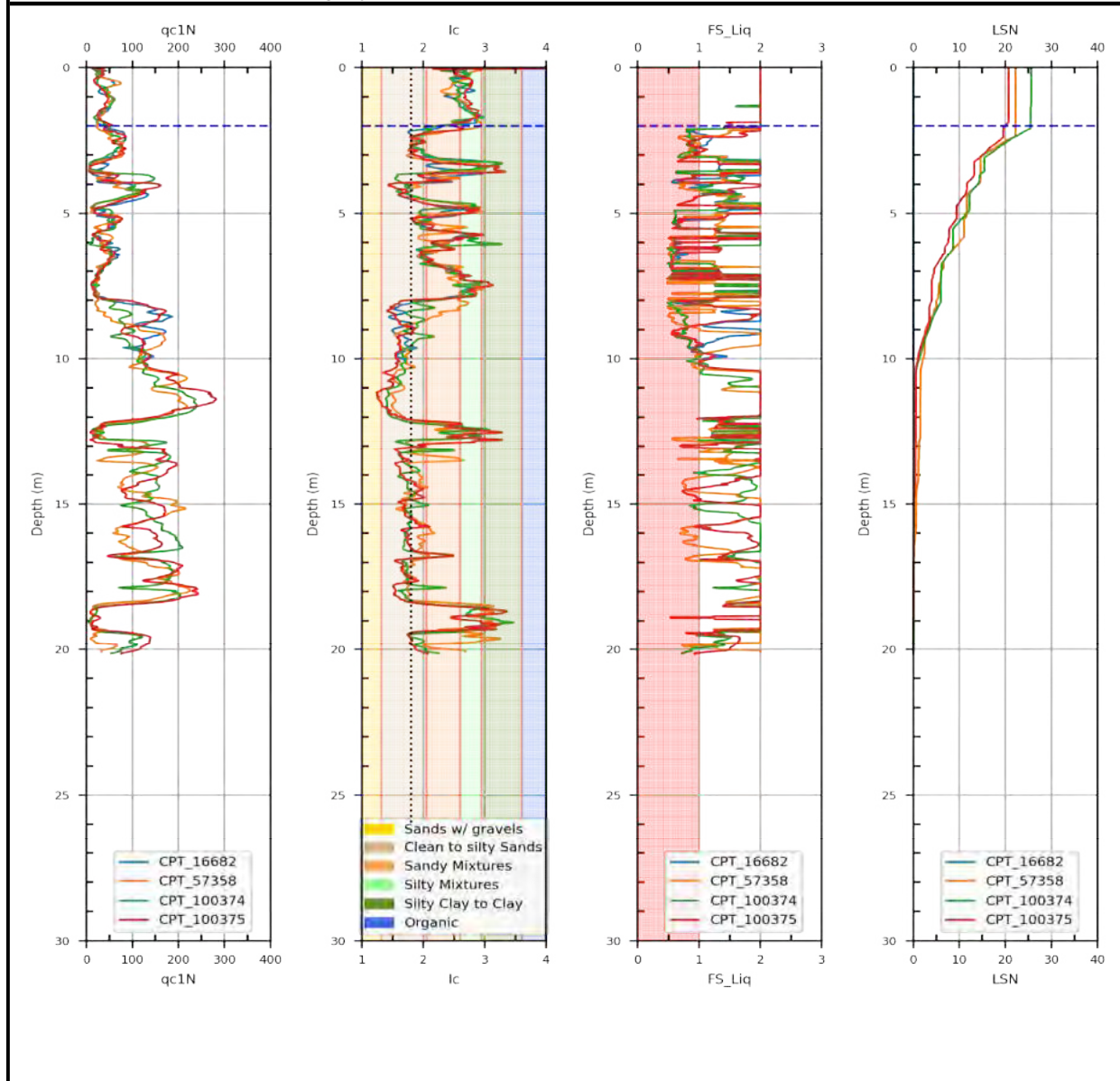
Case History: Ch-S22
Site: St. Albans Catholic School (N°8)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.21g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.1 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5072 Longitude 172.6291
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



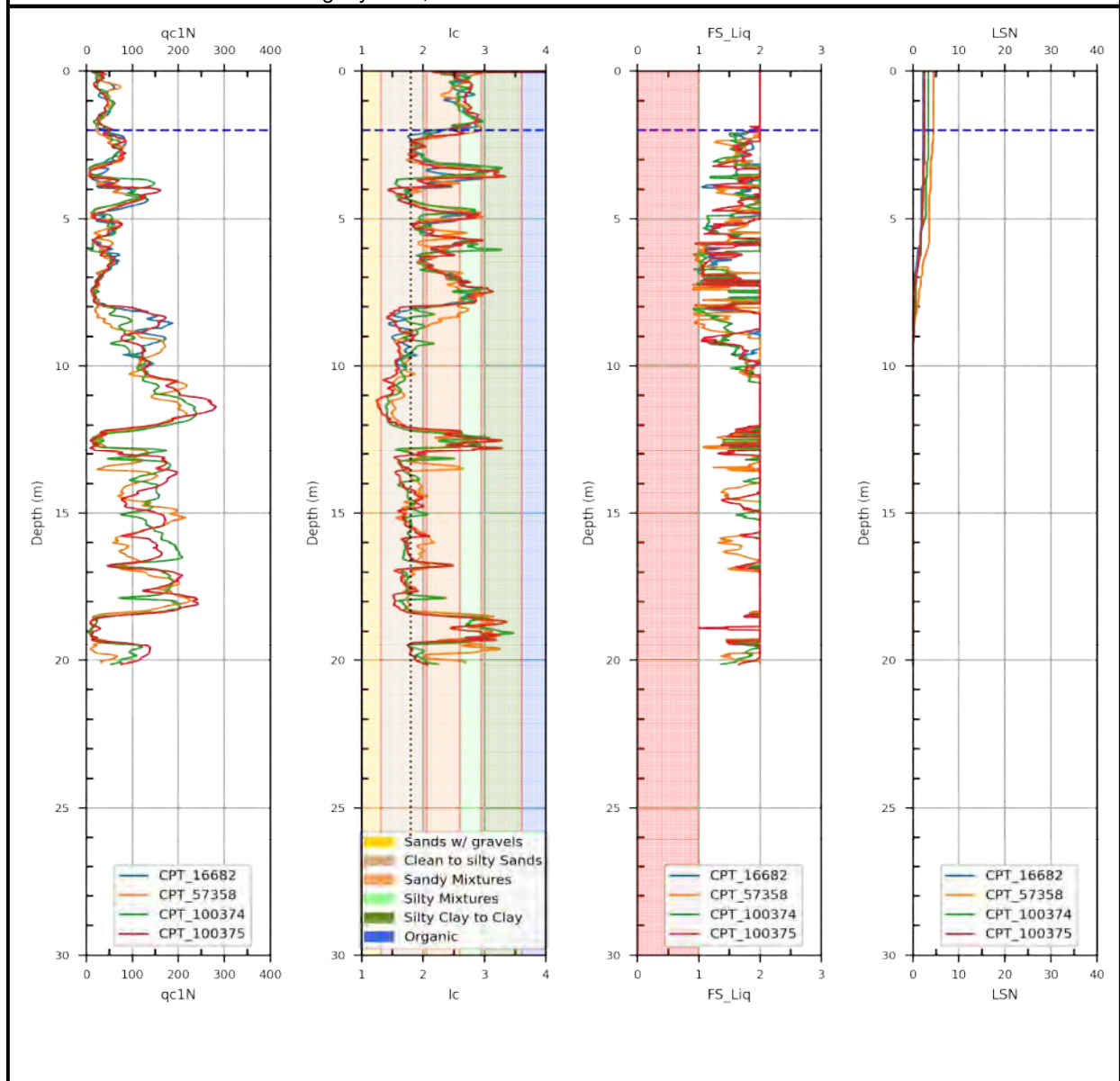
Case History: Ch-S23
Site: St. Albans Catholic School (N°8)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.1 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5072 Longitude 172.6291
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S24
Site: St. Albans Catholic School (N°8)
Location: Christchurch, New Zealand
Earthquake: Jun-11 Mw 6.2
PGA: 0.18g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.1 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5072 Longitude 172.6291
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Heaton Normal Intermediate School

Case History:

Site: Heaton Normal Intermediate School (N°9)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.17g - 0.32g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.7m - 2.1 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5106 Longitude 172.6149
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

Site: Heaton Normal Intermediate School (N°9)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.17g - 0.32g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.7m - 2.1 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5106 Longitude 172.6149
Source: Christchurch City Council, map_Ap001725BlackMap.gws

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

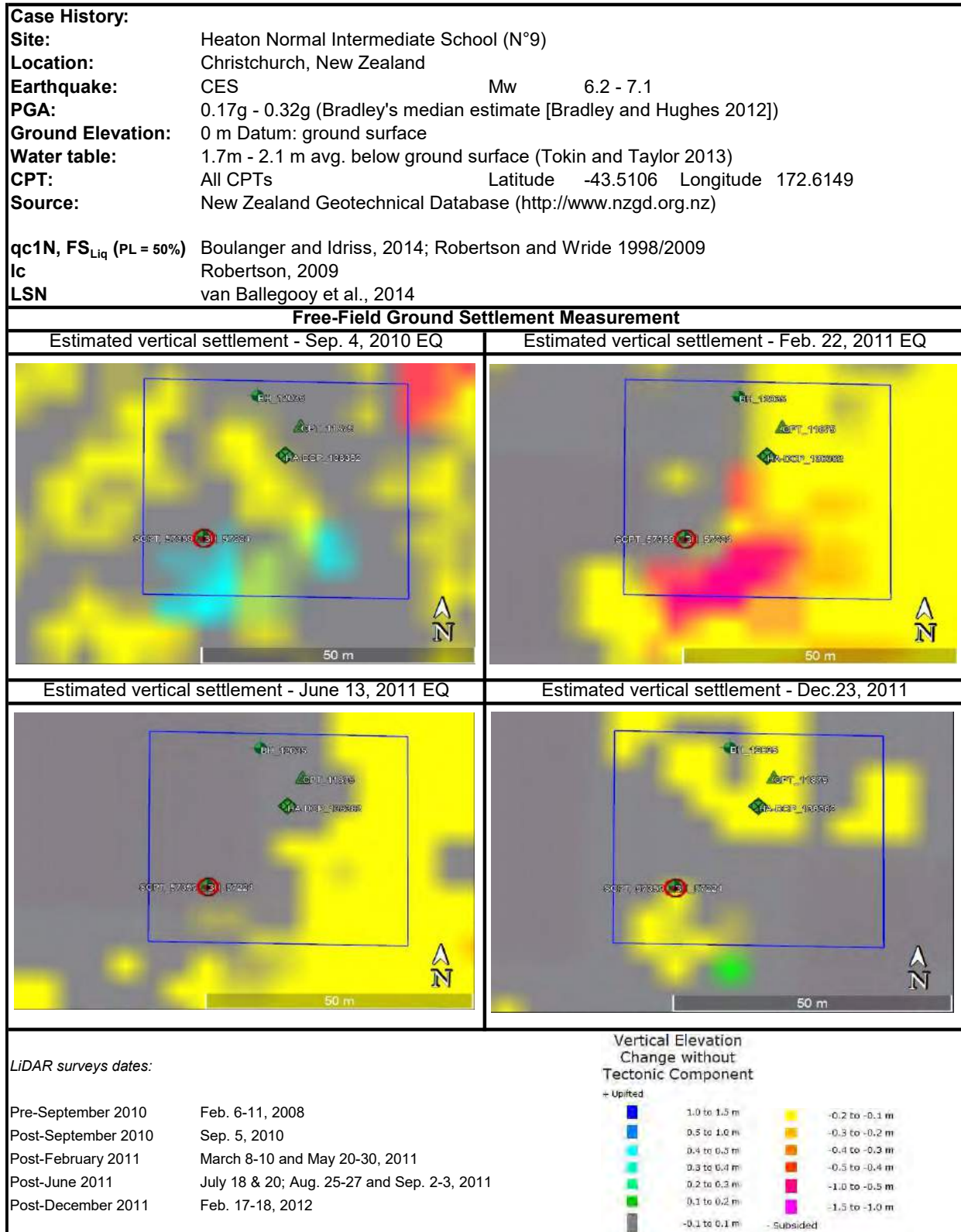
lc Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

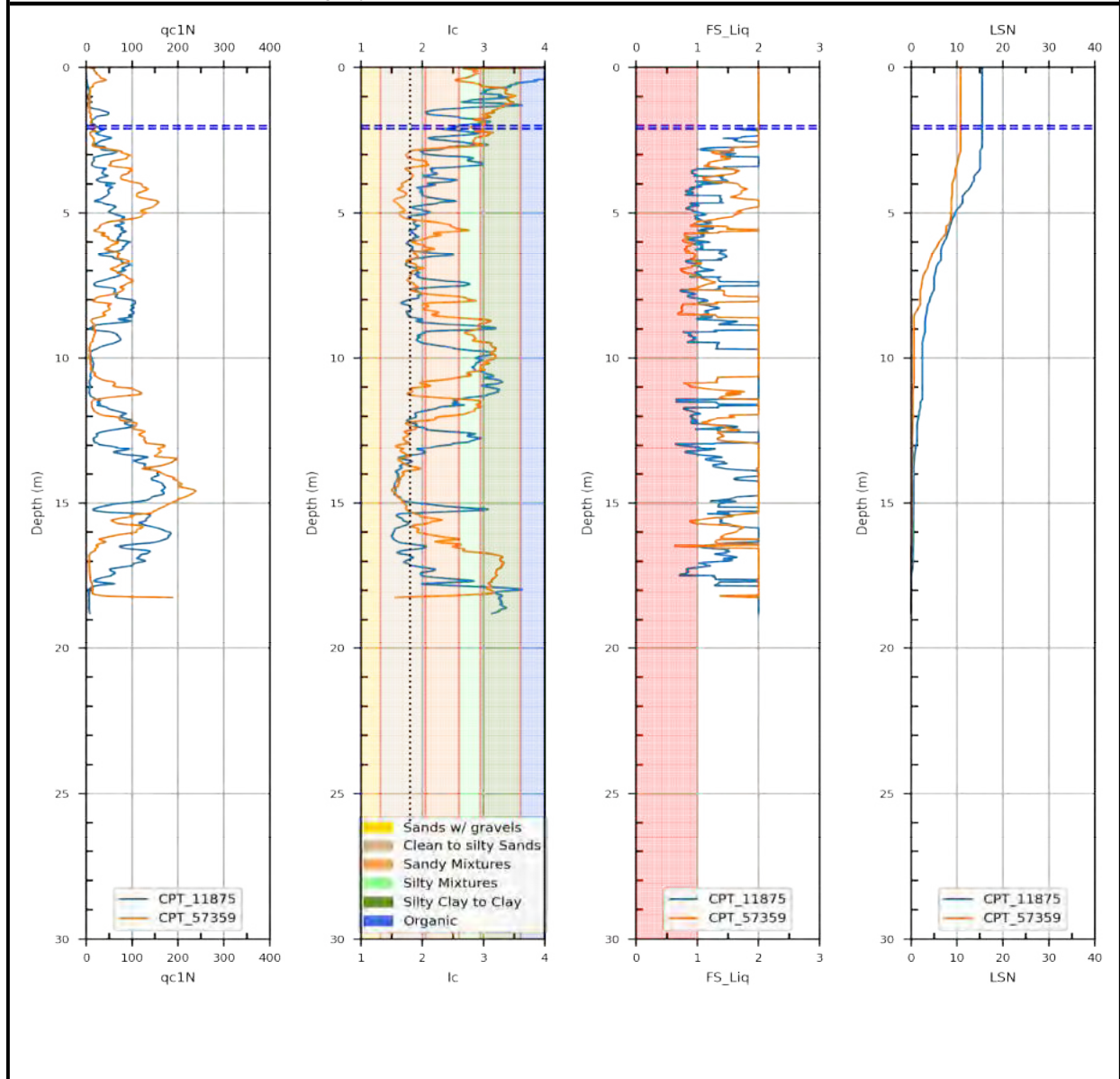


Case History:	
Site:	Heaton Normal Intermediate School (N°9)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.17g - 0.32g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	1.7m - 2.1 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5106 Longitude 172.6149
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	
Aerial photography taken on February 24, 2011	
Aerial photography taken on June 14-15, 2011	
Aerial photography taken on December 24, 2011	
	



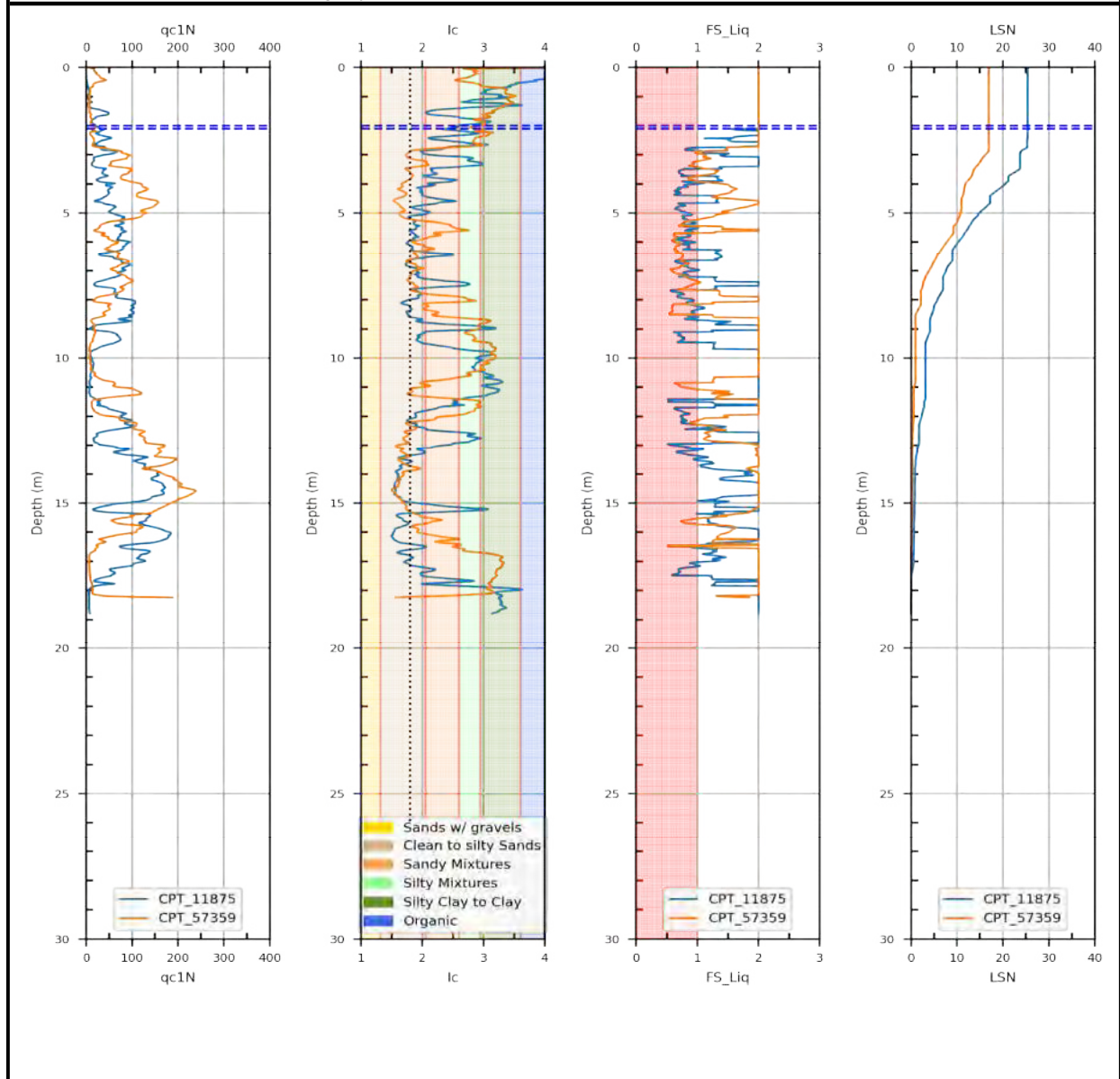
Case History: Ch-S25
Site: Heaton Normal Intermediate School (N°9)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.21g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5106 Longitude 172.6149
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



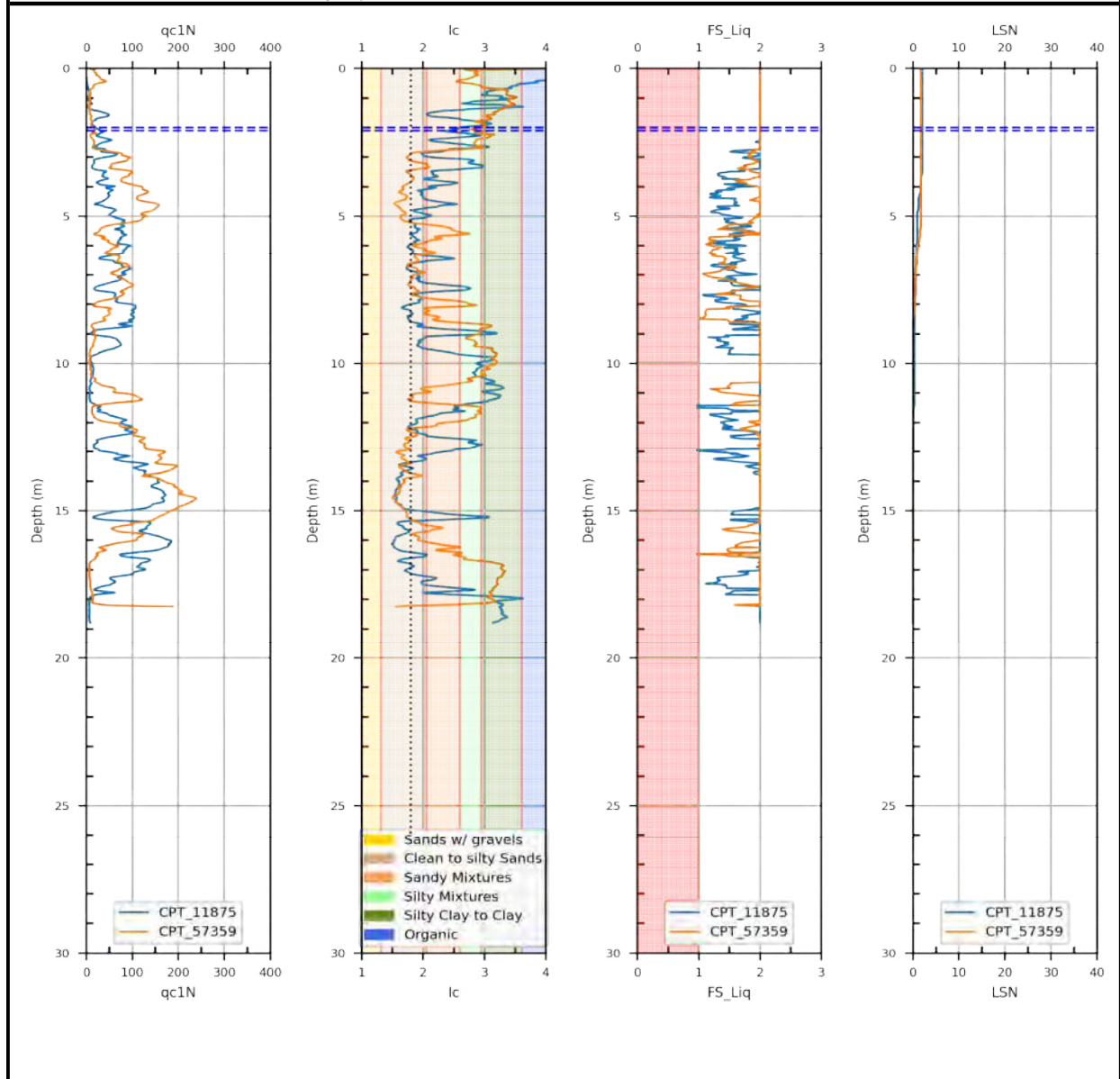
Case History: Ch-S26
Site: Heaton Normal Intermediate School (N°9)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.32g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5106 Longitude 172.6149
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S27
Site: Heaton Normal Intermediate School (N°9)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.17g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5106 Longitude 172.6149
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Kaiwara Reserve

Case History:

Site: Kaiwara Reserve (N°10)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.19g - 0.46g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5715 Longitude 172.6081
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

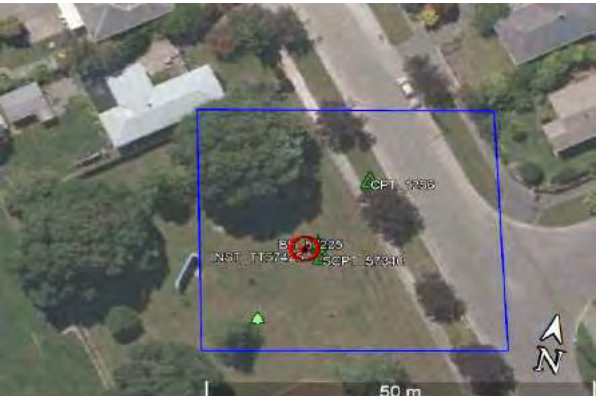
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

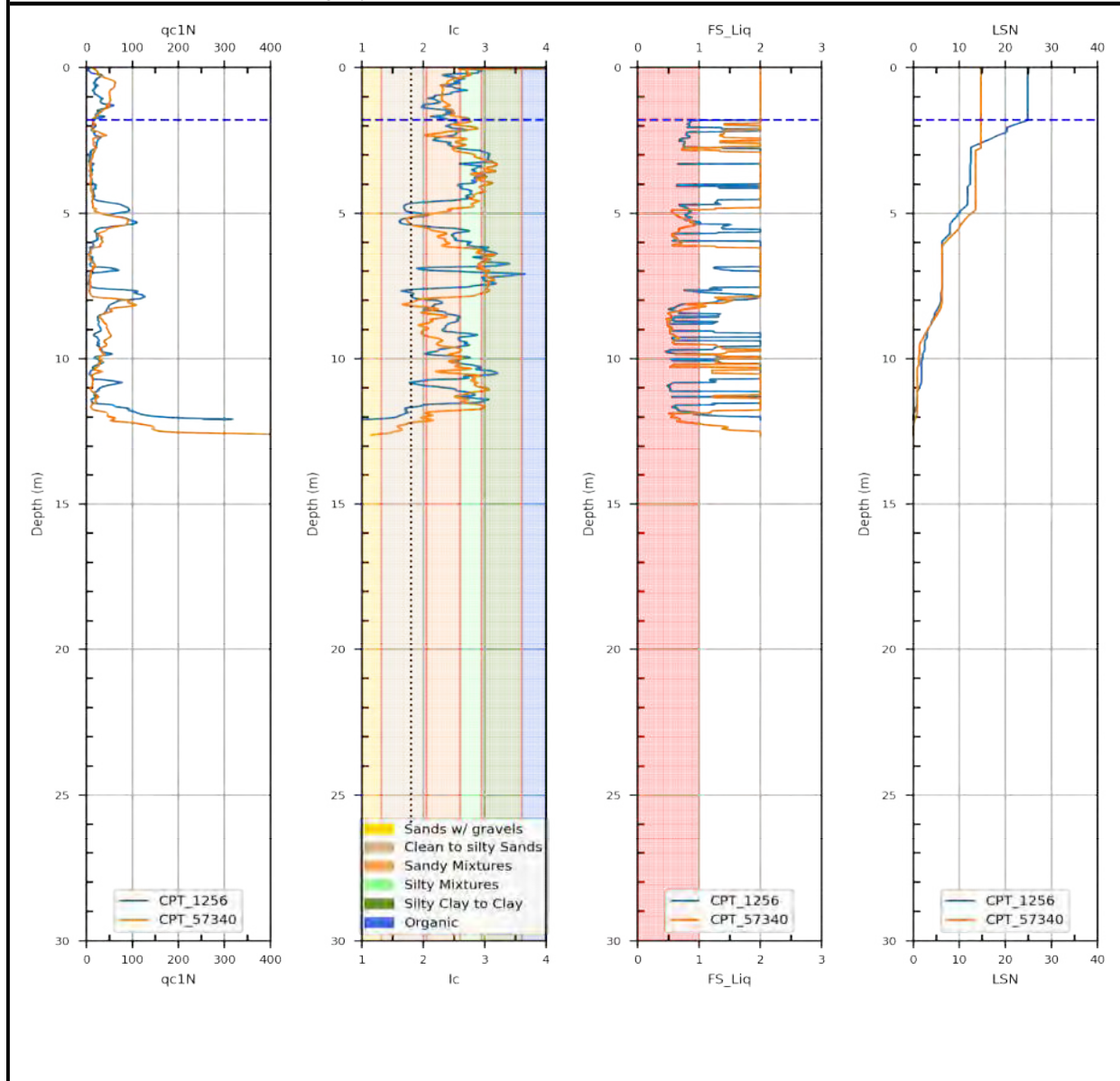
New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History: Site: Kaiwara Reserve (N°10) Location: Christchurch, New Zealand Earthquake: CES Mw 6.2 - 7.1 PGA: 0.19g - 0.46g (Bradley's median estimate [Bradley and Hughes 2012]) Ground Elevation: 0 m Datum: ground surface Water table: 1.8 m avg. below ground surface (Tokin and Taylor 2013) CPT: All CPTs Latitude -43.5715 Longitude 172.6081 Source: New Zealand Geotechnical Database (http://www.nzgd.org.nz) qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009 lc Robertson, 2009 LSN van Ballegooy et al., 2014	
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
Aerial photo not available	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
Aerial photo not available	
	

Case History:	
Site:	Kaiwara Reserve (N°10)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.19g - 0.46g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	1.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5715 Longitude 172.6081
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Free-Field Ground Settlement Measurement	
Estimated vertical settlement - Sep. 4, 2010 EQ	Estimated vertical settlement - Feb. 22, 2011 EQ
LiDAR data not available	LiDAR data not available
Estimated vertical settlement - June 13, 2011 EQ	Estimated vertical settlement - Dec.23, 2011
	LiDAR data not available
LiDAR surveys dates:	
Pre-September 2010	Feb. 6-11, 2008
Post-September 2010	Sep. 5, 2010
Post-February 2011	March 8-10 and May 20-30, 2011
Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011
Post-December 2011	Feb. 17-18, 2012
Vertical Elevation Change without Tectonic Component	
+ Uplifted	
	1.0 to 1.5 m
	0.5 to 1.0 m
	0.4 to 0.3 m
	0.3 to 0.4 m
	0.2 to 0.3 m
	0.1 to 0.2 m
	-0.1 to 0.1 m
	-0.2 to -0.1 m
	-0.3 to -0.2 m
	-0.4 to -0.3 m
	-0.5 to -0.4 m
	-1.0 to -0.5 m
	-1.5 to -1.0 m
- Subsided	

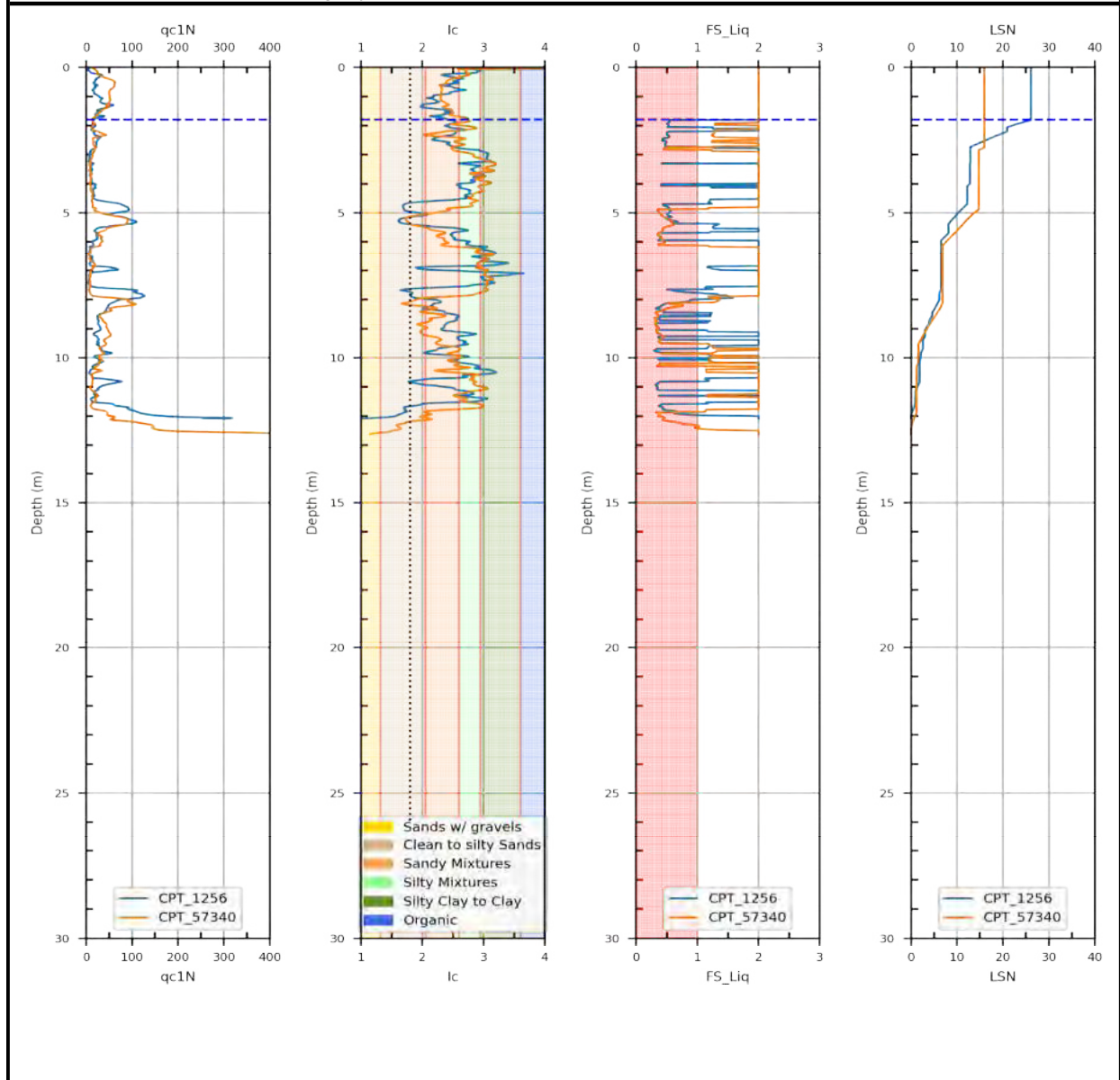
Case History: Ch-S28
Site: Kaiwara Reserve (N°10)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.25g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5715 Longitude 172.6081
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



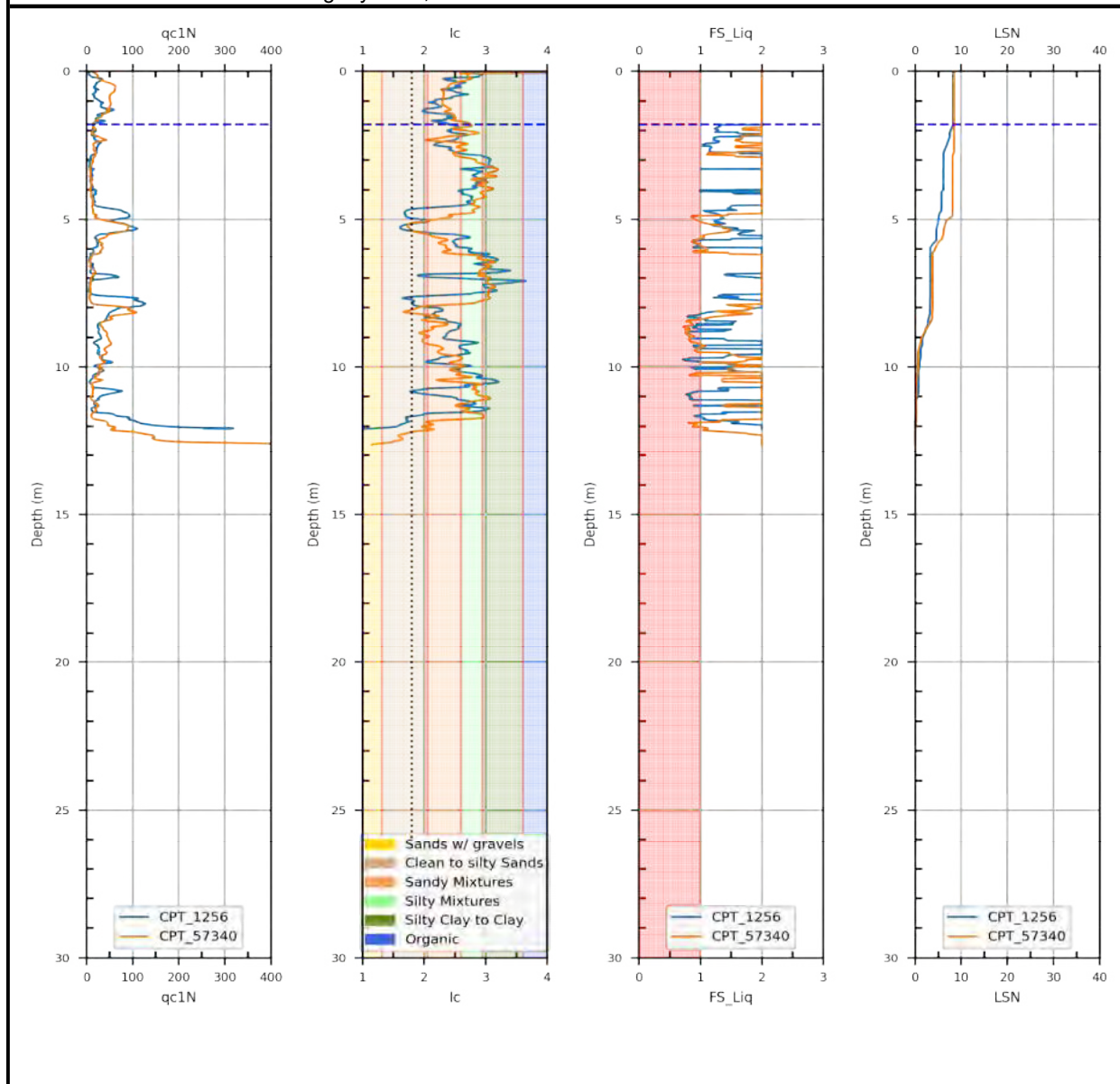
Case History: Ch-S29
Site: Kaiwara Reserve (N°10)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.46g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5715 Longitude 172.6081
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S30
Site: Kaiwara Reserve (N°10)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.19g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5715 Longitude 172.6081
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



15 Cresselly Place

Case History:

Site: 15 Cresselly Place (N°11)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.23g - 0.55g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5568 Longitude 172.6522
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

Site: 15 Cresselly Place (N°11)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.23g - 0.55g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5568 Longitude 172.6522
Source: Christchurch City Council, map_Ap001725BlackMap.gws

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856



Site:	15 Cresselly Place (N°11)		
Location:	Christchurch, New Zealand		
Earthquake:	CES	Mw	6.2 - 7.1
PGA:	0.23g - 0.55g (Bradley's median estimate [Bradley and Hughes 2012])		
Ground Elevation:	0 m Datum: ground surface		
Water table:	2.0 m avg. below ground surface (Tokin and Taylor 2013)		
CPT:	All CPTs	Latitude	-43.5568 Longitude 172.6522
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)		

qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc	Robertson, 2009
LSN	van Ballegooy et al., 2014

Ejecta Patterns

Aerial photography taken on September 5, 2010

Aerial photo not available

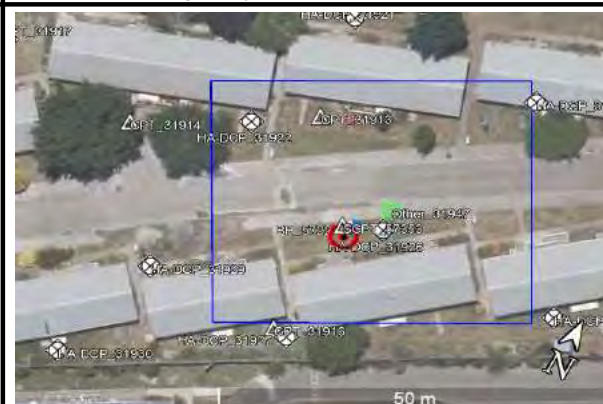
Aerial photography taken on February 24, 2011



Aerial photography taken on June 14-15, 2011

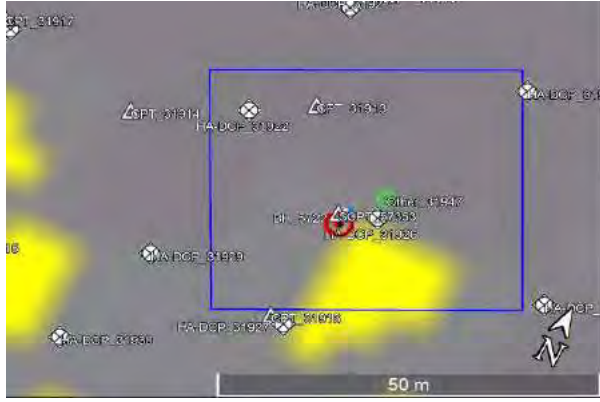
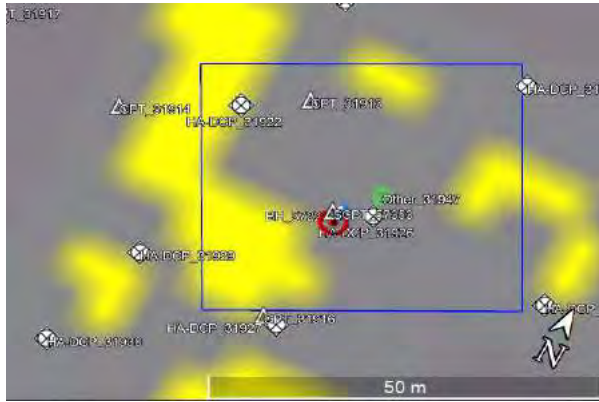


Aerial photography taken on December 24, 2011



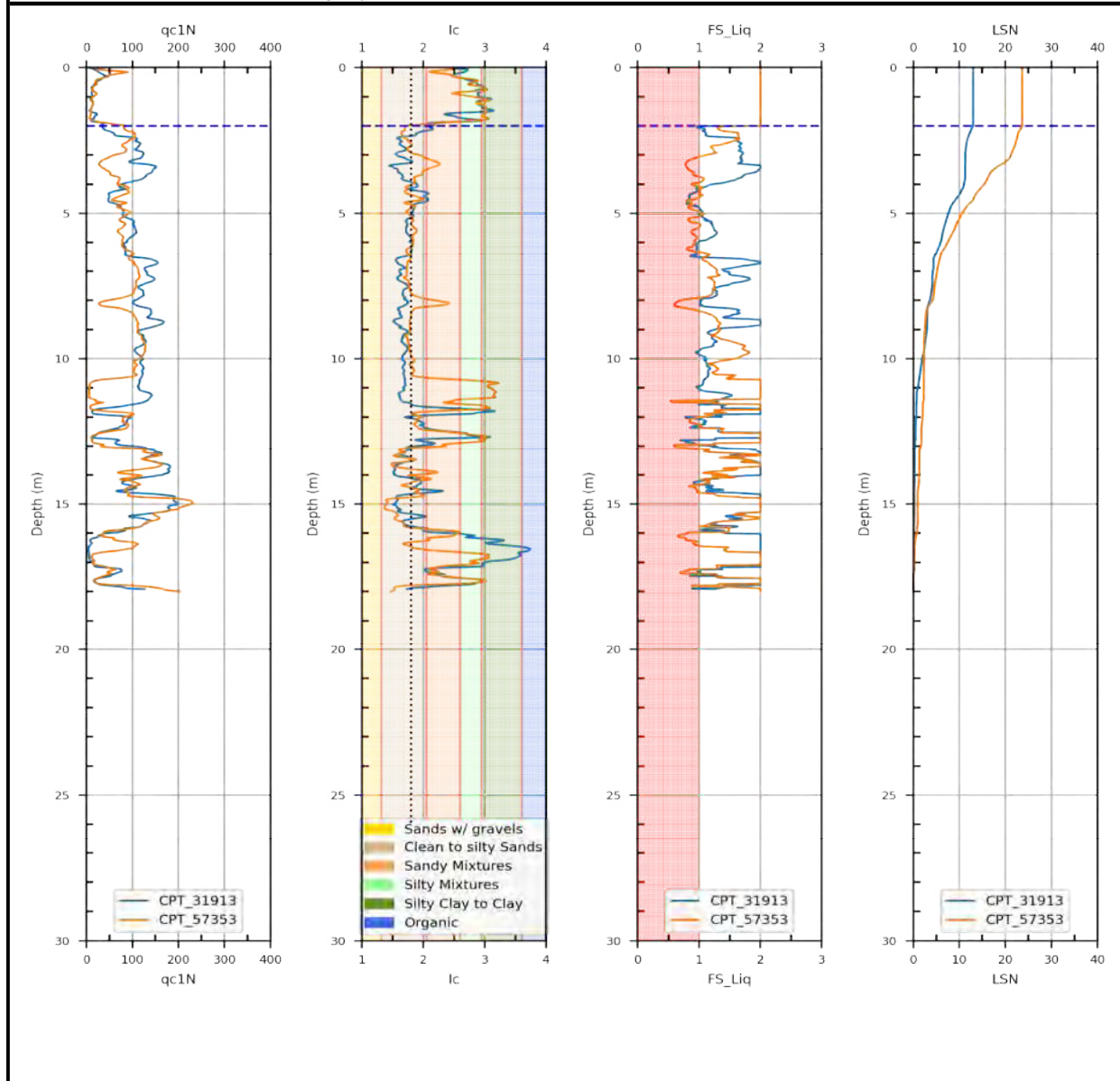
**Ministry of Civil Defence
& Emergency Management**
Te Kaitiaki Whakamanatanga



Case History:											
Site:	15 Cresselly Place (N°11)										
Location:	Christchurch, New Zealand										
Earthquake:	CES Mw 6.2 - 7.1										
PGA:	0.23g - 0.55g (Bradley's median estimate [Bradley and Hughes 2012])										
Ground Elevation:	0 m Datum: ground surface										
Water table:	2.0 m avg. below ground surface (Tokin and Taylor 2013)										
CPT:	All CPTs Latitude -43.5568 Longitude 172.6522										
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)										
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009										
Ic	Robertson, 2009										
LSN	van Ballegooy et al., 2014										
Free-Field Ground Settlement Measurement											
Estimated vertical settlement - Sep. 4, 2010 EQ	Estimated vertical settlement - Feb. 22, 2011 EQ										
LiDAR data not available	LiDAR data not available										
Estimated vertical settlement - June 13, 2011 EQ	Estimated vertical settlement - Dec.23, 2011										
											
LiDAR surveys dates: <table> <tr> <td>Pre-September 2010</td><td>Feb. 6-11, 2008</td></tr> <tr> <td>Post-September 2010</td><td>Sep. 5, 2010</td></tr> <tr> <td>Post-February 2011</td><td>March 8-10 and May 20-30, 2011</td></tr> <tr> <td>Post-June 2011</td><td>July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011</td></tr> <tr> <td>Post-December 2011</td><td>Feb. 17-18, 2012</td></tr> </table>		Pre-September 2010	Feb. 6-11, 2008	Post-September 2010	Sep. 5, 2010	Post-February 2011	March 8-10 and May 20-30, 2011	Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011	Post-December 2011	Feb. 17-18, 2012
Pre-September 2010	Feb. 6-11, 2008										
Post-September 2010	Sep. 5, 2010										
Post-February 2011	March 8-10 and May 20-30, 2011										
Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011										
Post-December 2011	Feb. 17-18, 2012										
Vertical Elevation Change without Tectonic Component <table> <tr> <td> 1.0 to 1.5 m 0.5 to 1.0 m 0.4 to 0.3 m 0.3 to 0.4 m 0.2 to 0.3 m 0.1 to 0.2 m -0.1 to 0.1 m </td> <td> -0.2 to -0.1 m -0.3 to -0.2 m -0.4 to -0.3 m -0.5 to -0.4 m -1.0 to -0.5 m -1.5 to -1.0 m - Subsided </td> </tr> </table>		1.0 to 1.5 m 0.5 to 1.0 m 0.4 to 0.3 m 0.3 to 0.4 m 0.2 to 0.3 m 0.1 to 0.2 m -0.1 to 0.1 m	-0.2 to -0.1 m -0.3 to -0.2 m -0.4 to -0.3 m -0.5 to -0.4 m -1.0 to -0.5 m -1.5 to -1.0 m - Subsided								
1.0 to 1.5 m 0.5 to 1.0 m 0.4 to 0.3 m 0.3 to 0.4 m 0.2 to 0.3 m 0.1 to 0.2 m -0.1 to 0.1 m	-0.2 to -0.1 m -0.3 to -0.2 m -0.4 to -0.3 m -0.5 to -0.4 m -1.0 to -0.5 m -1.5 to -1.0 m - Subsided										

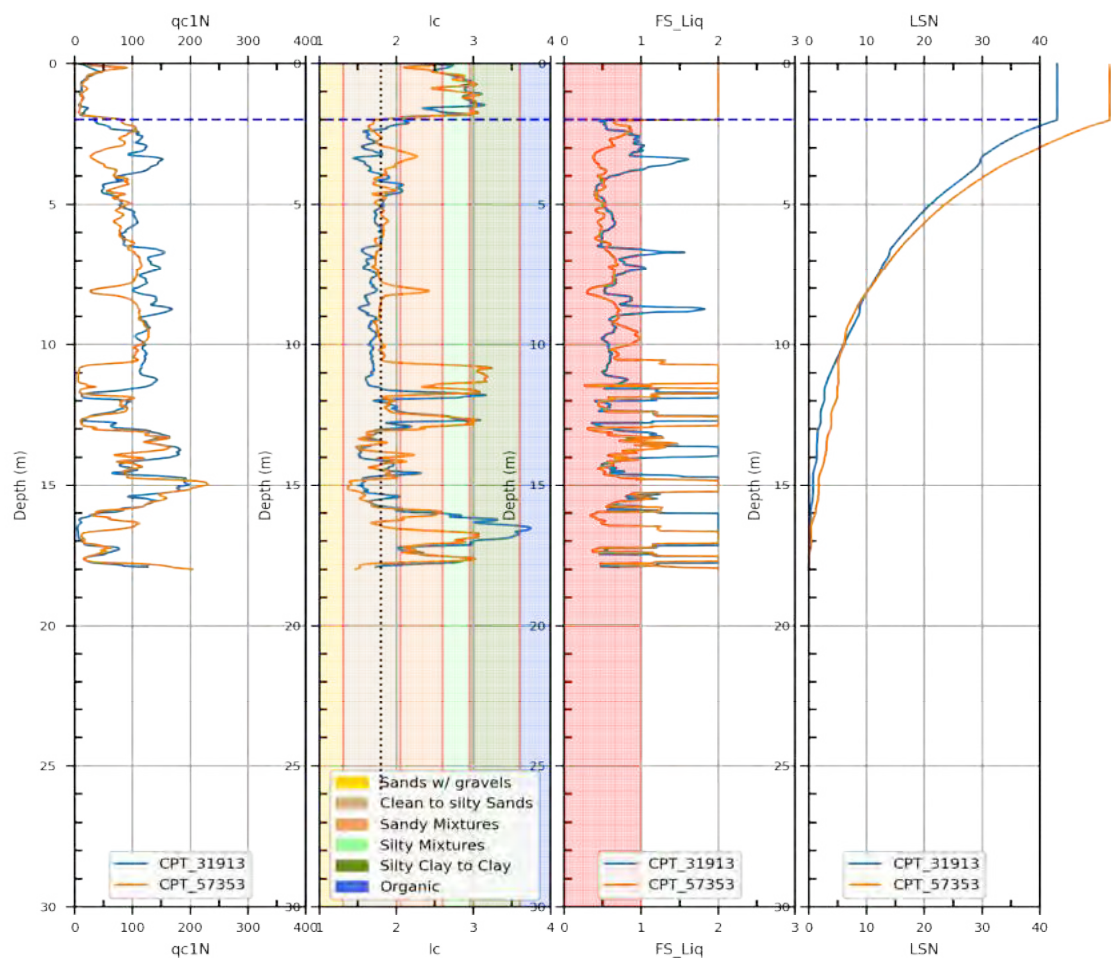
Case History: Ch-S31
Site: 15 Cresselly Place (N°11)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.23g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5568 Longitude 172.6522
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



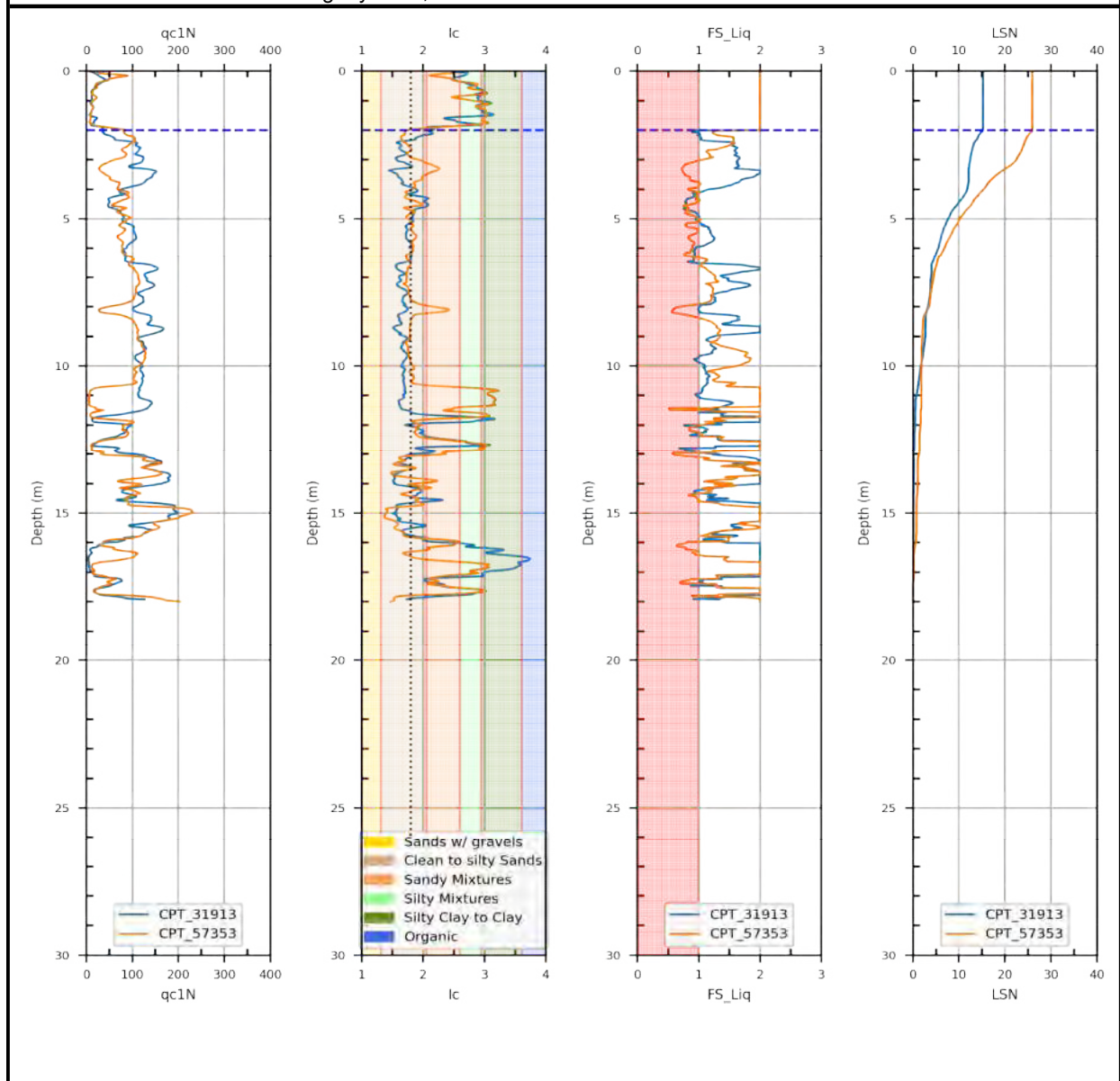
Case History: Ch-S32
Site: 15 Cresselly Place (N°11)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.55g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5568 Longitude 172.6522
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S33
Site: 15 Cresselly Place (N°11)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.29g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5568 Longitude 172.6522
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Brougham Street

Case History:

Site: Brougham Street (N°12)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.22g - 0.46g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0 - 1.7 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5472 Longitude 172.6375
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

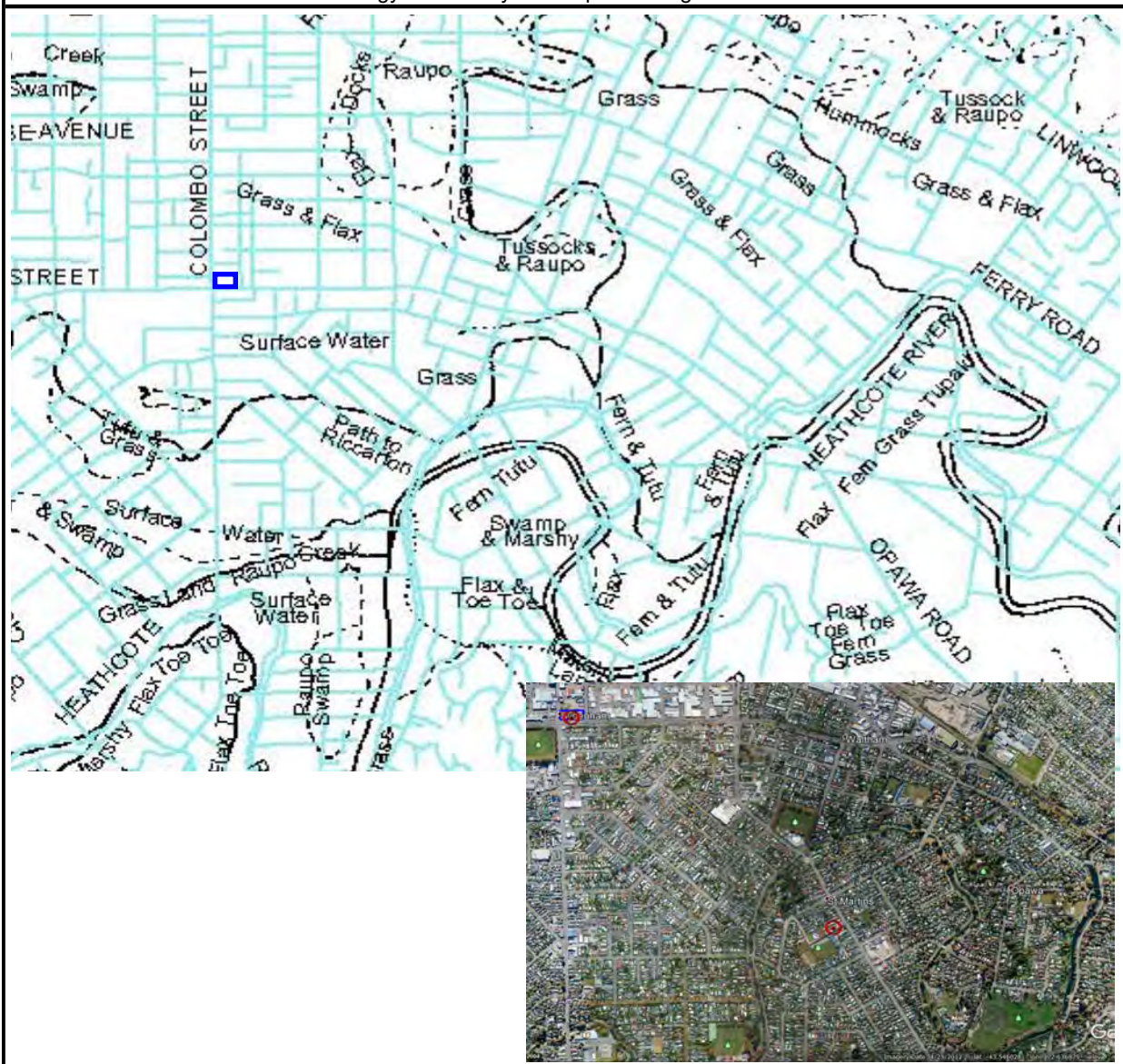
LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:**Site:** Brougham Street (N°12)**Location:** Christchurch, New Zealand**Earthquake:** CES Mw 6.2 - 7.1**PGA:** 0.22g - 0.46g (Bradley's median estimate [Bradley and Hughes 2012])**Ground Elevation:** 0 m Datum: ground surface**Water table:** 1.0 - 1.7 m avg. below ground surface (Tokin and Taylor 2013)**CPT:** All CPTs Latitude -43.5472 Longitude 172.6375**Source:** Christchurch City Council, map_Ap001725BlackMap.gws**qc1N, FS_{Liq} (PL = 50%)** Boulanger and Idriss, 2014; Robertson and Wride 1998/2009**lc** Robertson, 2009**LSN** van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856



Site:	Brougham Street (N°12)			
Location:	Christchurch, New Zealand			
Earthquake:	CES	Mw	6.2 - 7.1	
PGA:	0.22g - 0.46g (Bradley's median estimate [Bradley and Hughes 2012])			
Ground Elevation:	0 m Datum: ground surface			
Water table:	1.0 - 1.7 m avg. below ground surface (Tokin and Taylor 2013)			
CPT:	All CPTs	Latitude	-43.5472	Longitude 172.6375
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)			

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Robertson, 2009

LSN van Ballegooy et al., 2014

Ejecta Patterns

Aerial photography taken on September 5, 2010

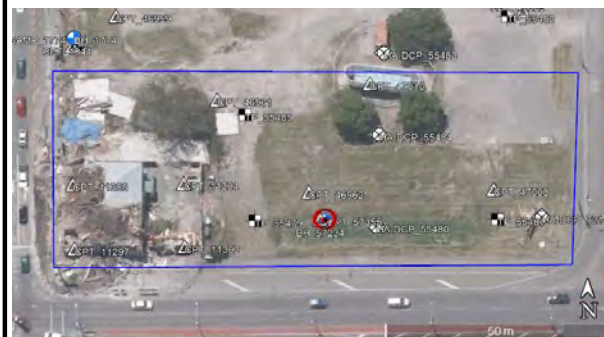
Aerial photography taken on February 24, 2011

Aerial photo not available



Aerial photography taken on June 14-15, 2011

Aerial photography taken on December 24, 2011



**Ministry of Civil Defence
& Emergency Management**
Te Kaitiaki Whakamanatanga

CERA
Canterbury Earthquake
Recovery Authority

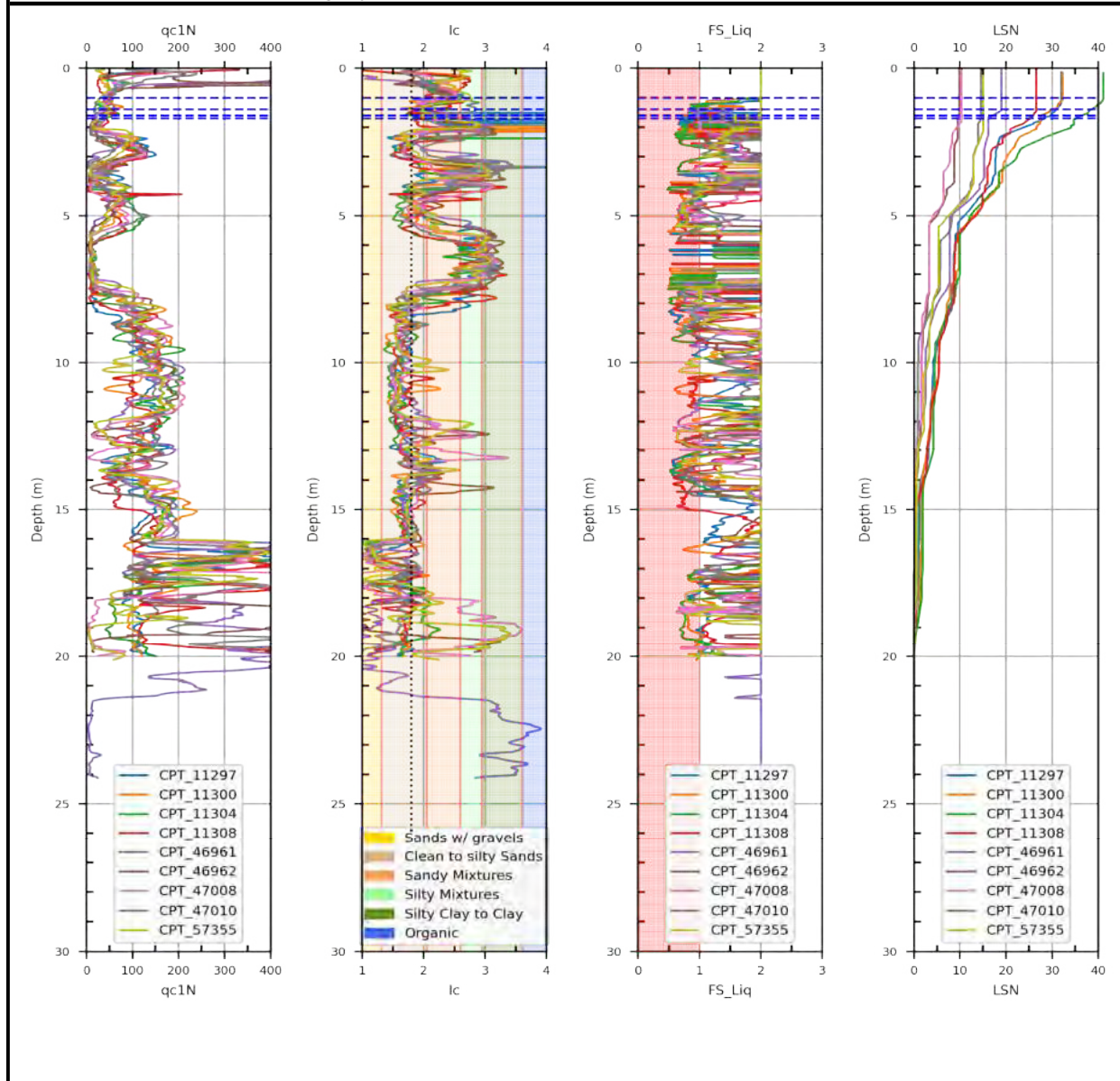
EQC
EARTHQUAKE COMMISSION



Tonkin & Taylor

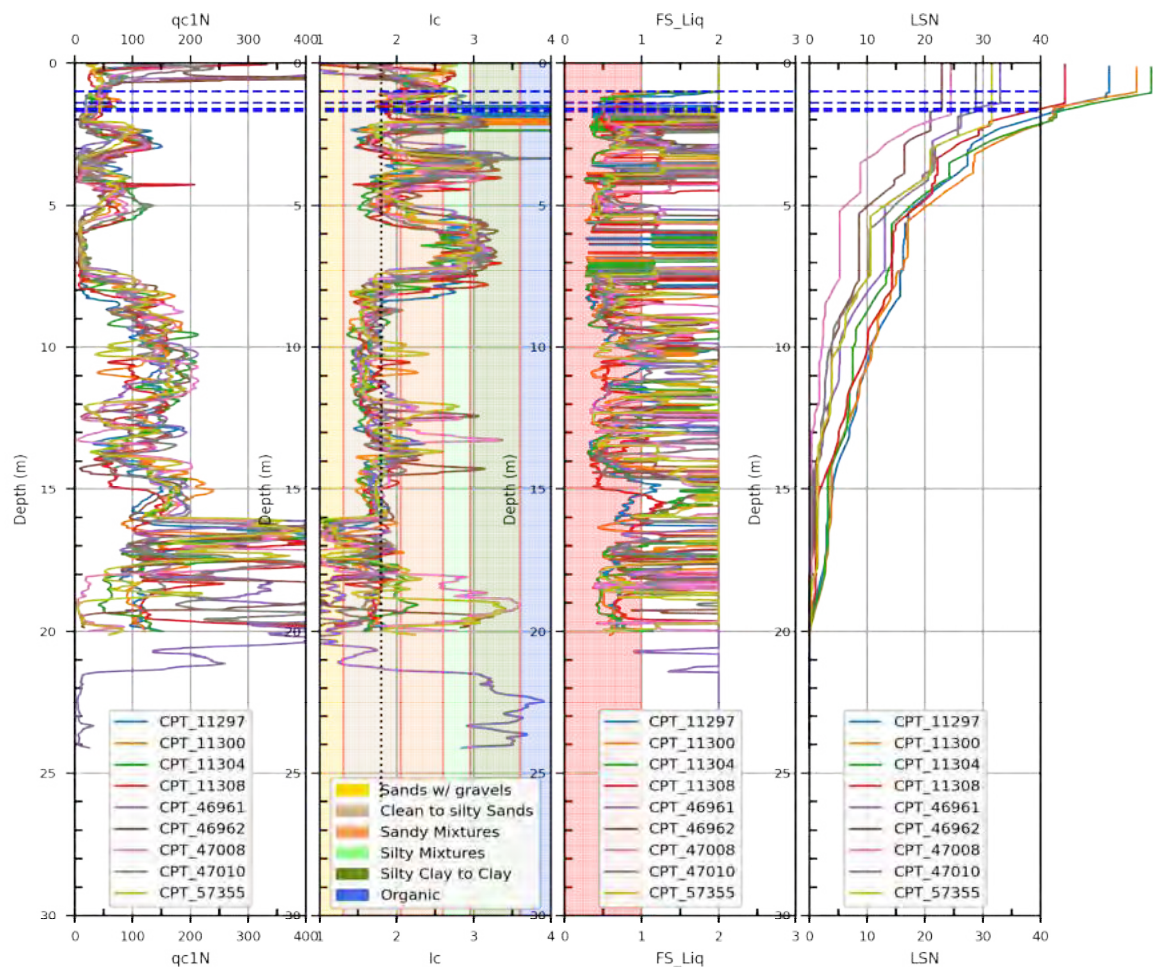
Case History: Ch-S34
Site: Brougham Street (N°12)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.22g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5472 Longitude 172.6375
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



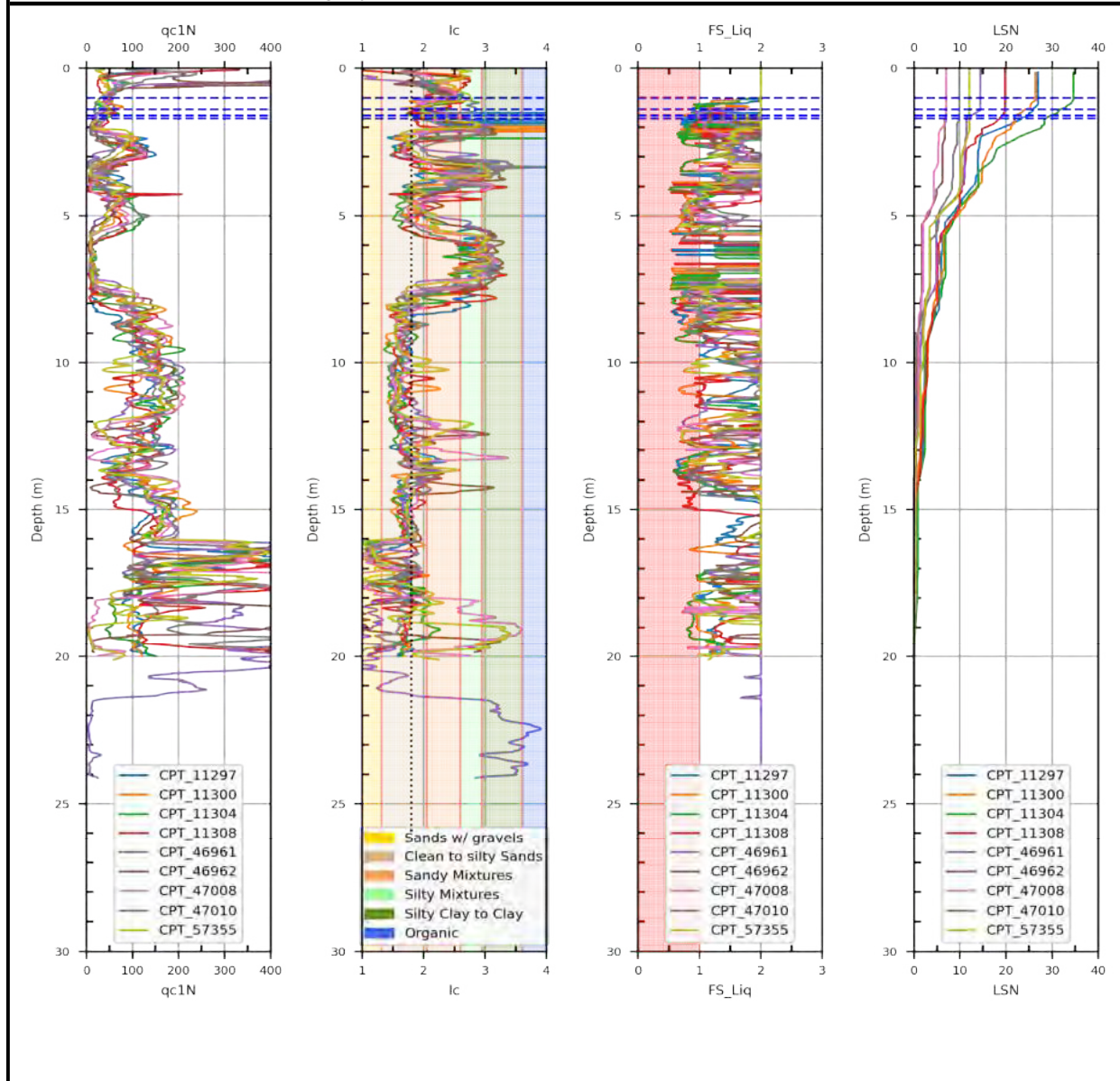
Case History: Ch-S35
Site: Brougham Street (N°12)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.46g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5472 Longitude 172.6375
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S36
Site: Brougham Street (N°12)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.24g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5472 Longitude 172.6375
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Palinurus Road

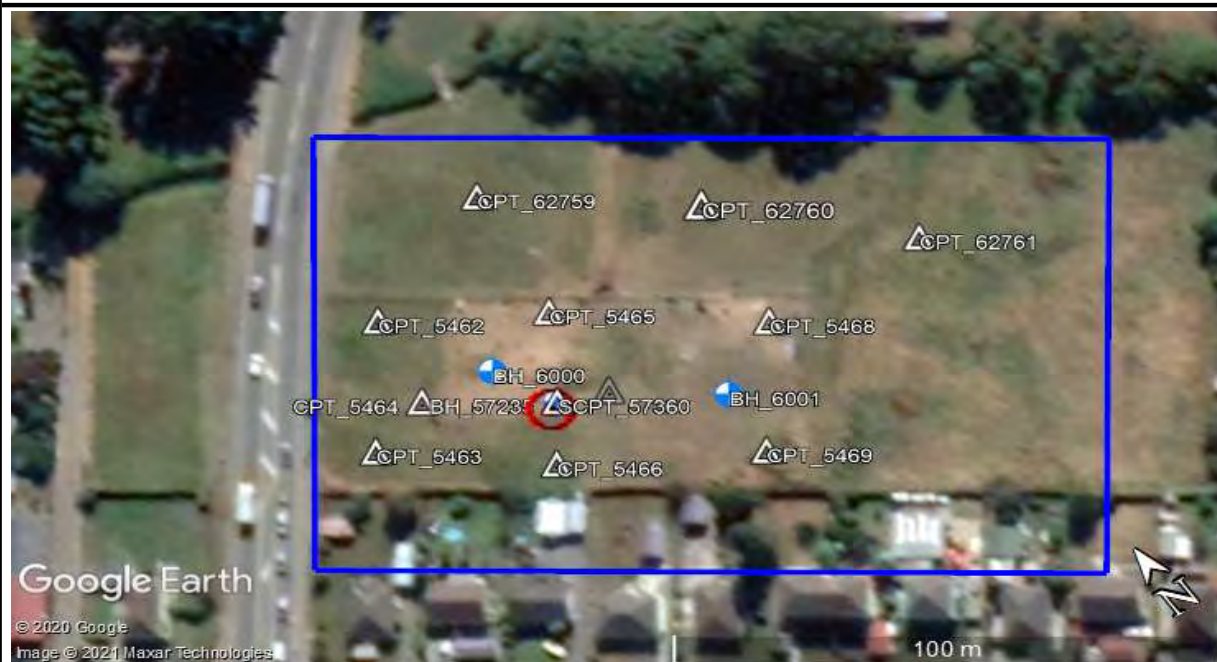
Case History:

Site: Palinurus Road (N°13)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.24g - 0.68g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.2 - 1.4 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5513 Longitude 172.6882
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

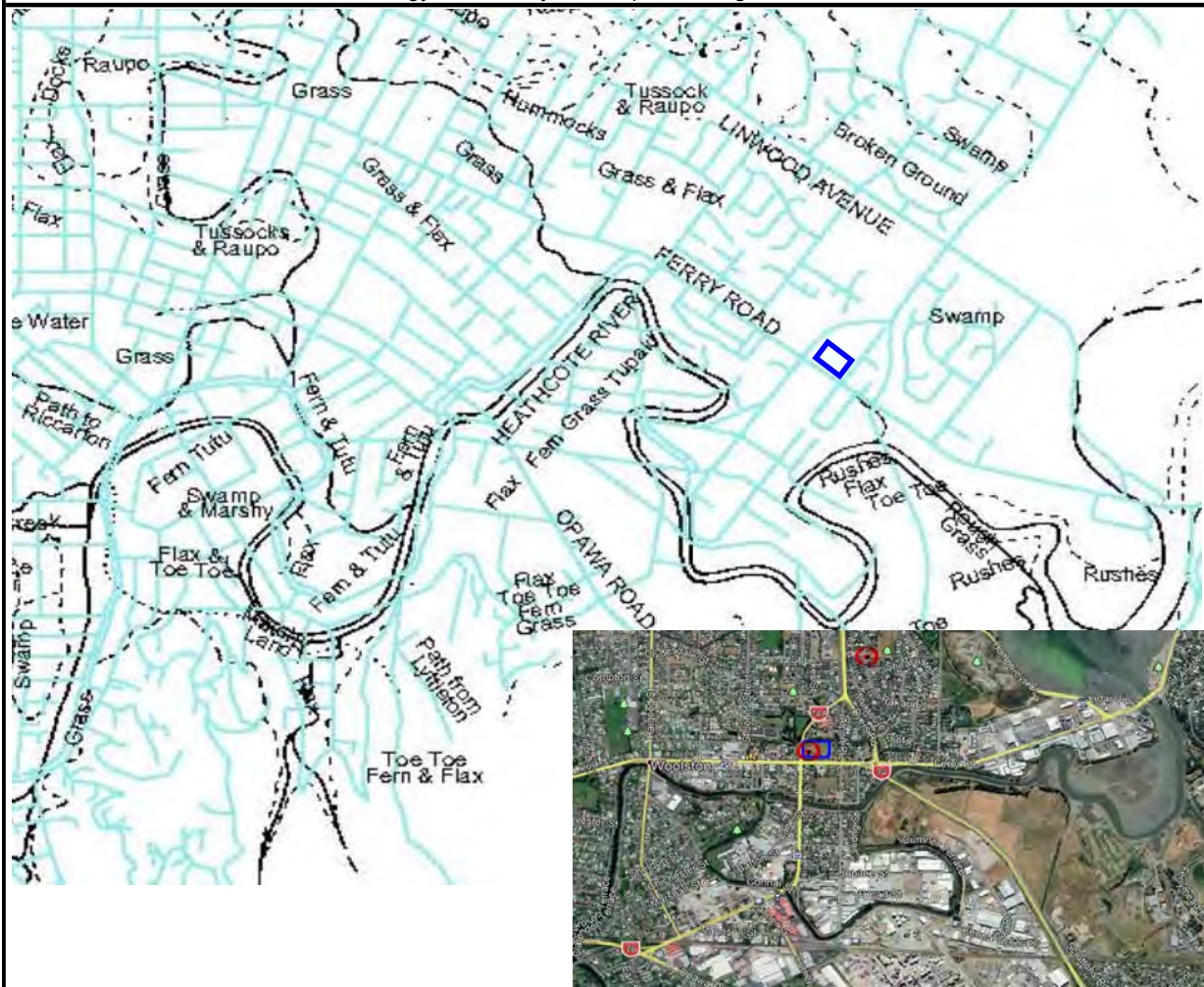
Site: Palinurus Road (N°13)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.24g - 0.68g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.2 - 1.4 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5513 Longitude 172.6882
Source: Christchurch City Council, map_Ap001725BlackMap.gws

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

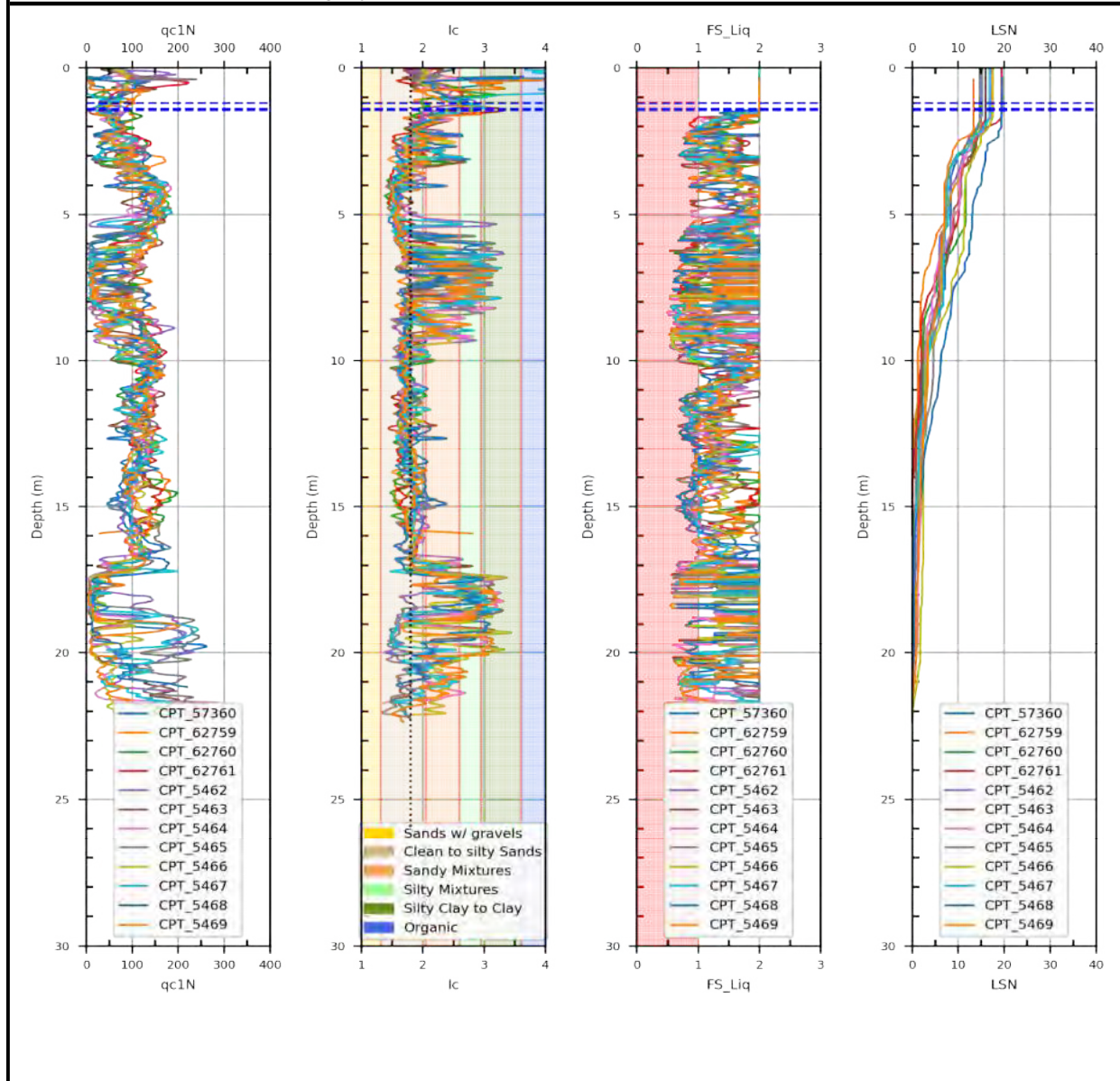


Case History:	
Site:	Palinurus Road (N°13)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.24g - 0.68g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	1.2 - 1.4 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5513 Longitude 172.6882
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
Aerial photo not available	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
	

Case History:	
Site:	Palinurus Road (N°13)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.24g - 0.68g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	1.2 - 1.4 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5513 Longitude 172.6882
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Free-Field Ground Settlement Measurement	
Estimated vertical settlement - Sep. 4, 2010 EQ	Estimated vertical settlement - Feb. 22, 2011 EQ
LiDAR data not available	LiDAR data not available
Estimated vertical settlement - June 13, 2011 EQ	Estimated vertical settlement - Dec.23, 2011
	
LiDAR surveys dates:	
Pre-September 2010	Feb. 6-11, 2008
Post-September 2010	Sep. 5, 2010
Post-February 2011	March 8-10 and May 20-30, 2011
Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011
Post-December 2011	Feb. 17-18, 2012
Vertical Elevation Change without Tectonic Component	
+ Uplifted	
	1.0 to 1.5 m
	0.5 to 1.0 m
	0.4 to 0.3 m
	0.3 to 0.4 m
	0.2 to 0.3 m
	0.1 to 0.2 m
	-0.1 to 0.1 m
- Subsided	
	-0.2 to -0.1 m
	-0.3 to -0.2 m
	-0.4 to -0.3 m
	-0.5 to -0.4 m
	-1.0 to -0.5 m
	-1.5 to -1.0 m

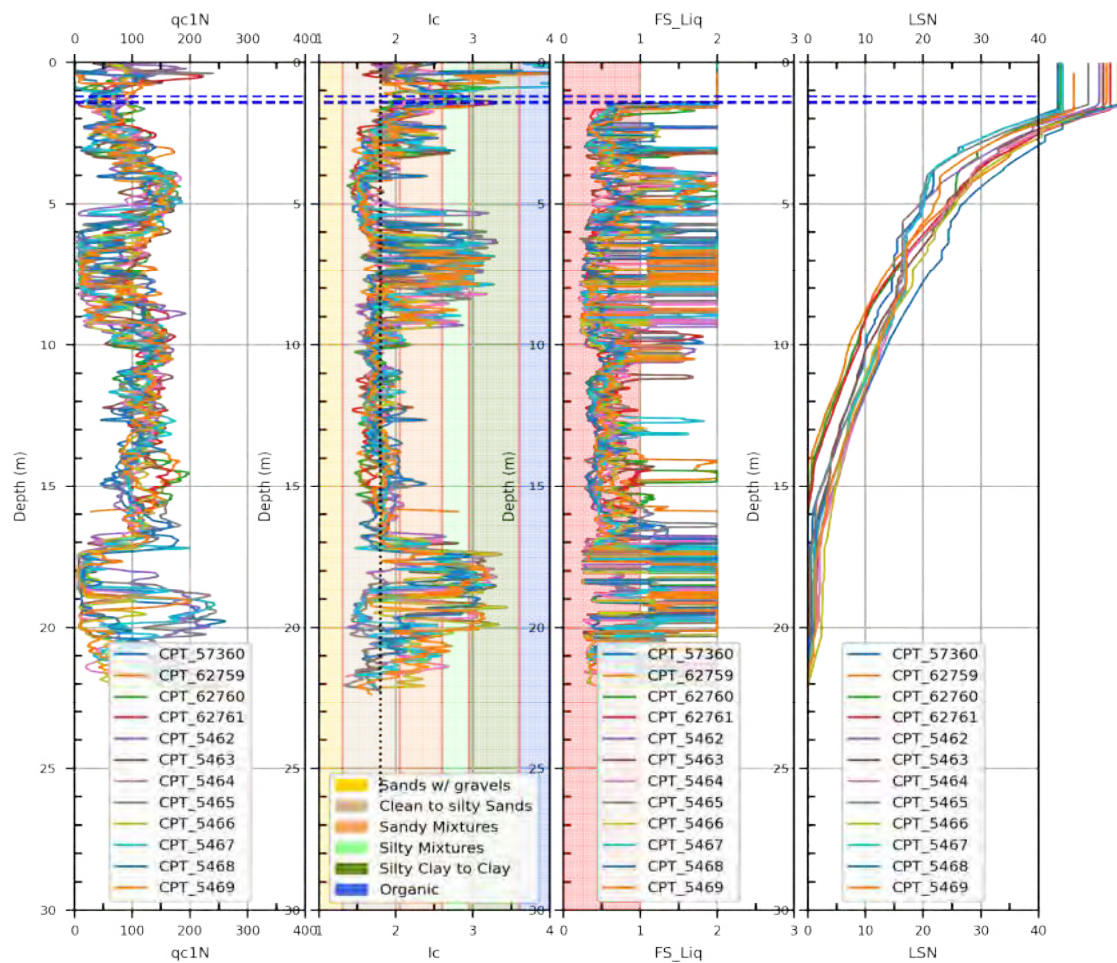
Case History: Ch-S37
Site: Palinurus Road (N°13)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.24g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.2 - 1.4 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5513 Longitude 172.6882
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



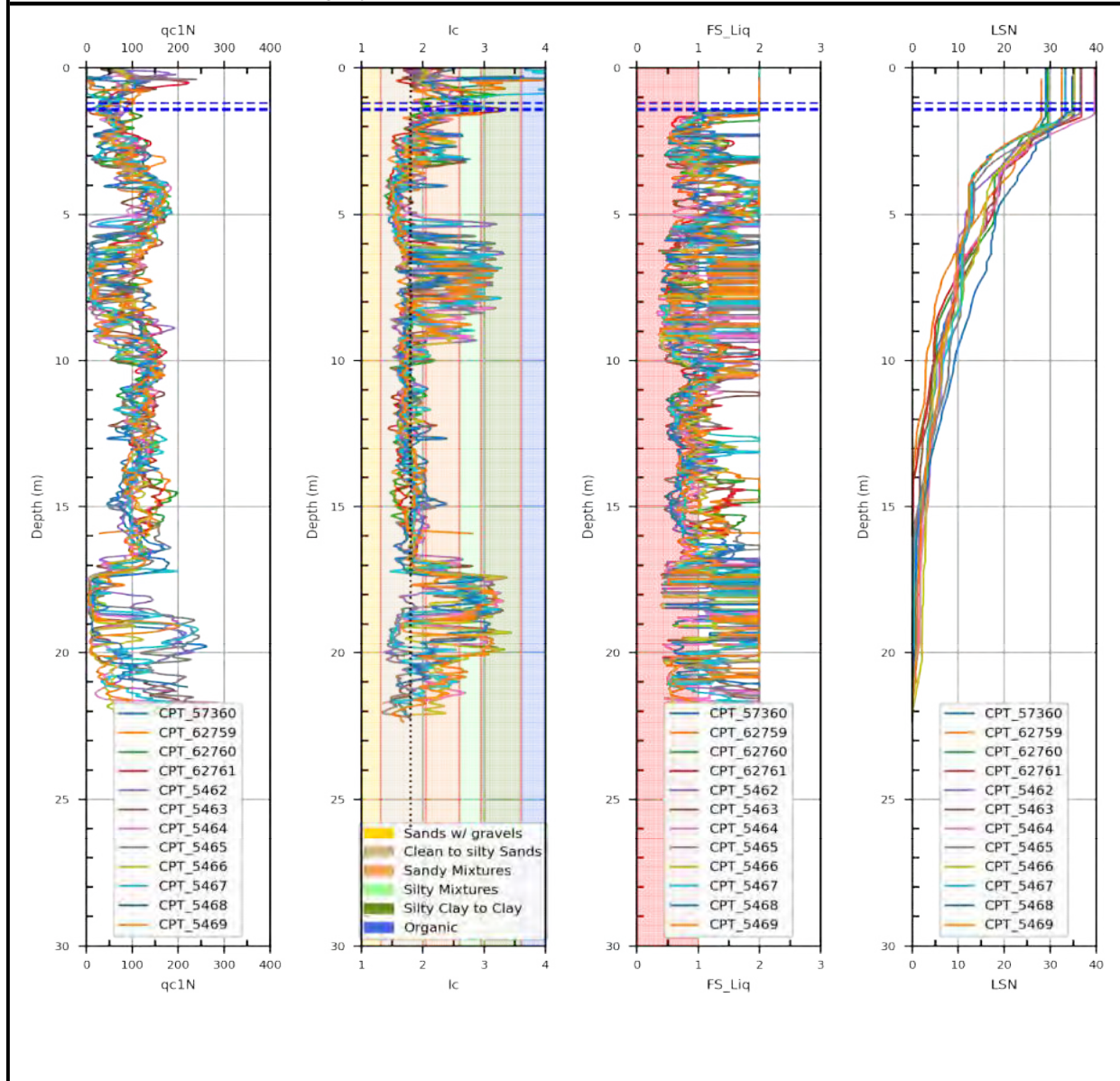
Case History: Ch-S38
Site: Palinurus Road (N°13)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.68g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.2 - 1.4 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5513 Longitude 172.6882
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S39
Site: Palinurus Road (N°13)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.42g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.2 - 1.4 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5513 Longitude 172.6882
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Ti Rakau Reserve

Case History:

Site: Ti Rakau Reserve (N°14)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.23g - 0.68g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0 - 3.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5488 Longitude 172.6954
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

Site: Ti Rakau Reserve (N°14)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.23g - 0.68g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0 - 3.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5488 Longitude 172.6954
Source: Christchurch City Council, map_Ap001725BlackMap.gws

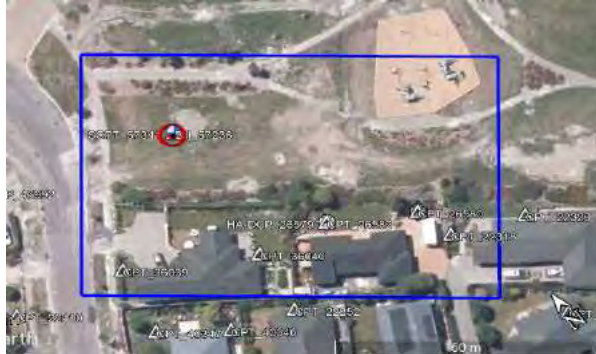
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

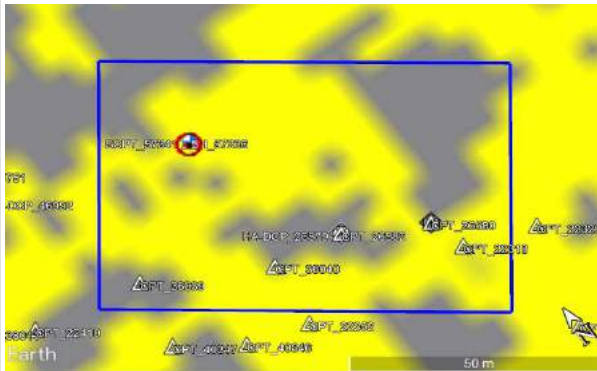
lc Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

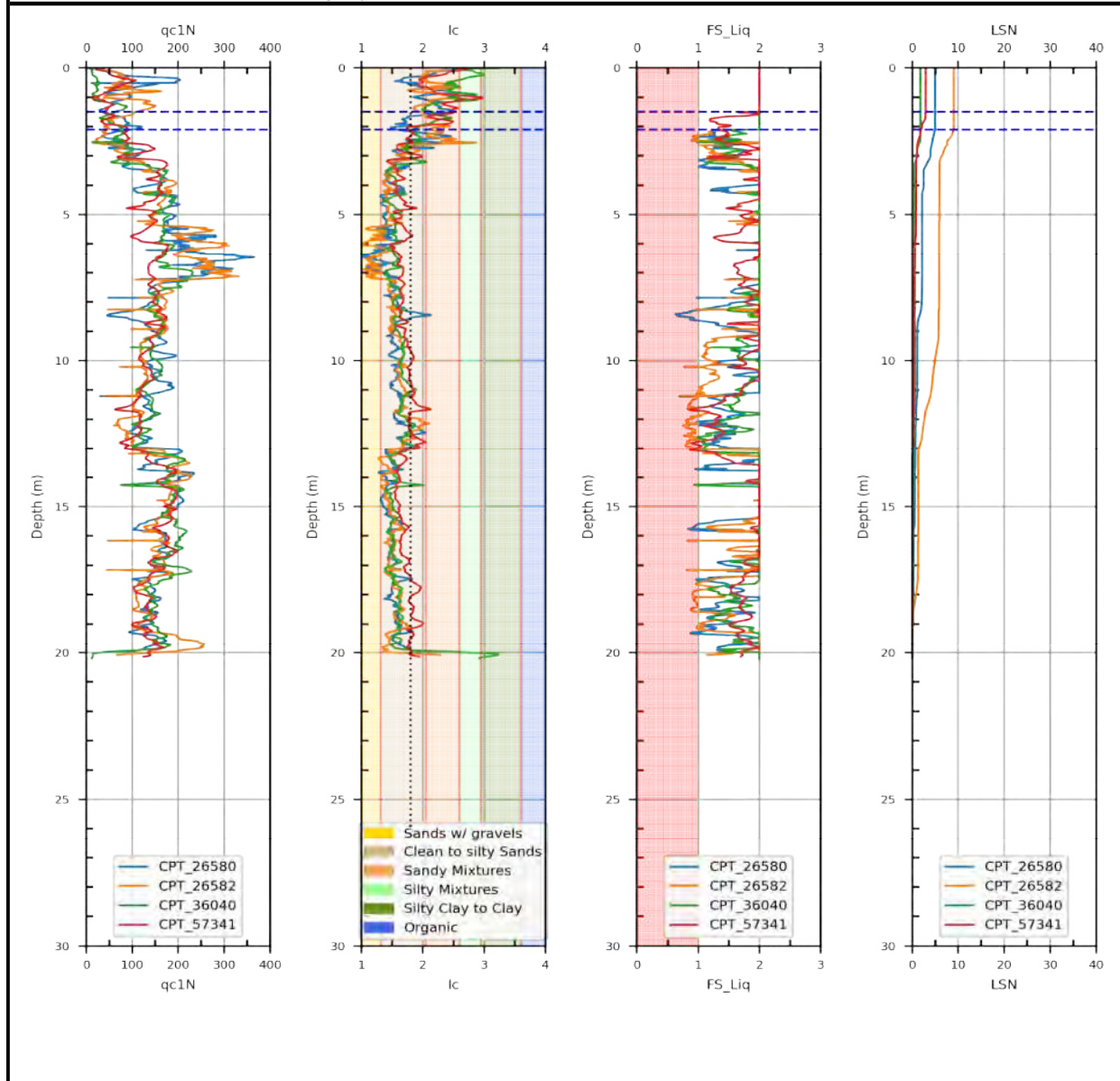


Case History: Site: Ti Rakau Reserve (N°14) Location: Christchurch, New Zealand Earthquake: CES Mw 6.2 - 7.1 PGA: 0.23g - 0.68g (Bradley's median estimate [Bradley and Hughes 2012]) Ground Elevation: 0 m Datum: ground surface Water table: 1.0 - 3.8 m avg. below ground surface (Tokin and Taylor 2013) CPT: All CPTs Latitude -43.5488 Longitude 172.6954 Source: New Zealand Geotechnical Database (http://www.nzgd.org.nz) qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009 Ic Robertson, 2009 LSN van Ballegooy et al., 2014	
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
Aerial photo not available	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
	

Case History:	
Site:	Ti Rakau Reserve (N°14)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.23g - 0.68g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	1.0 - 3.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5488 Longitude 172.6954
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Free-Field Ground Settlement Measurement	
Estimated vertical settlement - Sep. 4, 2010 EQ	Estimated vertical settlement - Feb. 22, 2011 EQ
LiDAR data not available	LiDAR data not available
Estimated vertical settlement - June 13, 2011 EQ	Estimated vertical settlement - Dec.23, 2011
	
LiDAR surveys dates:	
Pre-September 2010	Feb. 6-11, 2008
Post-September 2010	Sep. 5, 2010
Post-February 2011	March 8-10 and May 20-30, 2011
Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011
Post-December 2011	Feb. 17-18, 2012
Vertical Elevation Change without Tectonic Component	
+ Uplifted	
 1.0 to 1.5 m	 -0.2 to -0.1 m
 0.5 to 1.0 m	 -0.3 to -0.2 m
 0.4 to 0.3 m	 -0.4 to -0.3 m
 0.3 to 0.4 m	 -0.5 to -0.4 m
 0.2 to 0.3 m	 -1.0 to -0.5 m
 0.1 to 0.2 m	 -1.5 to -1.0 m
 -0.1 to 0.1 m	- Subsided

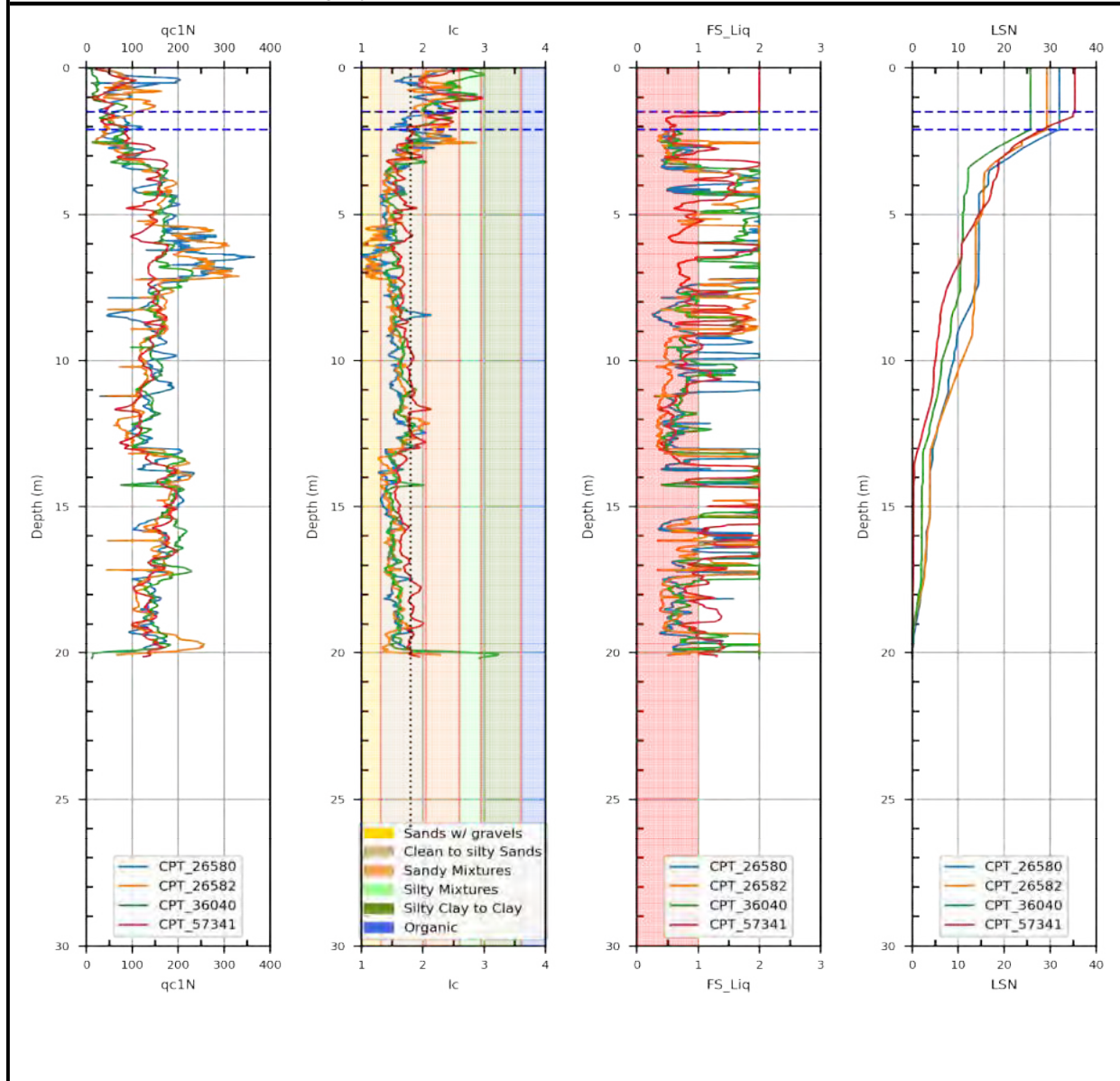
Case History: Ch-S40
Site: Ti Rakau Reserve (N°14)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.23g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0 - 3.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5488 Longitude 172.6954
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



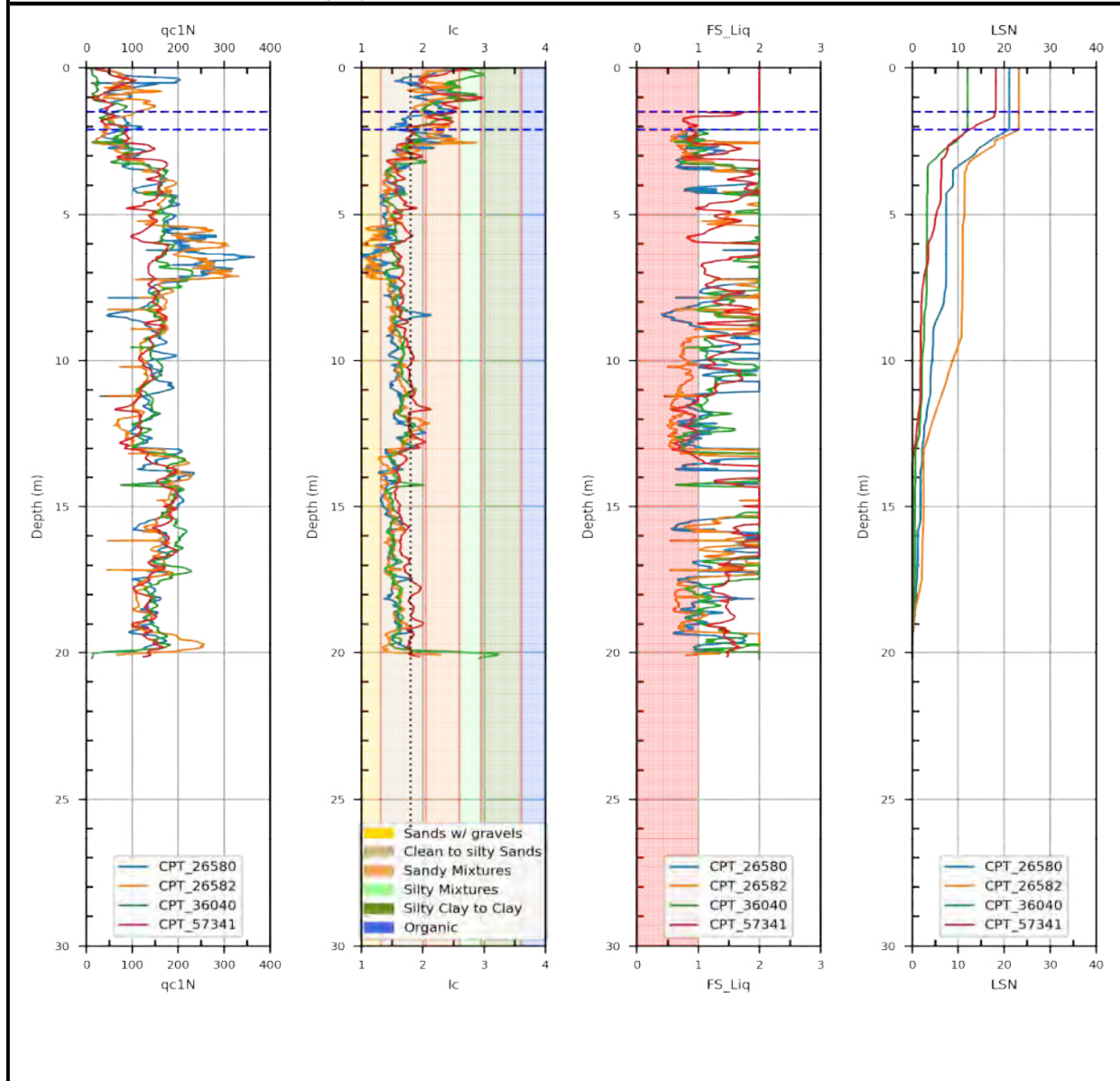
Case History: Ch-S41
Site: Ti Rakau Reserve (N°14)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.68g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0 - 3.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5488 Longitude 172.6954
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S42
Site: Ti Rakau Reserve (N°14)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.43g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0 - 3.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5488 Longitude 172.6954
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Avondale Park

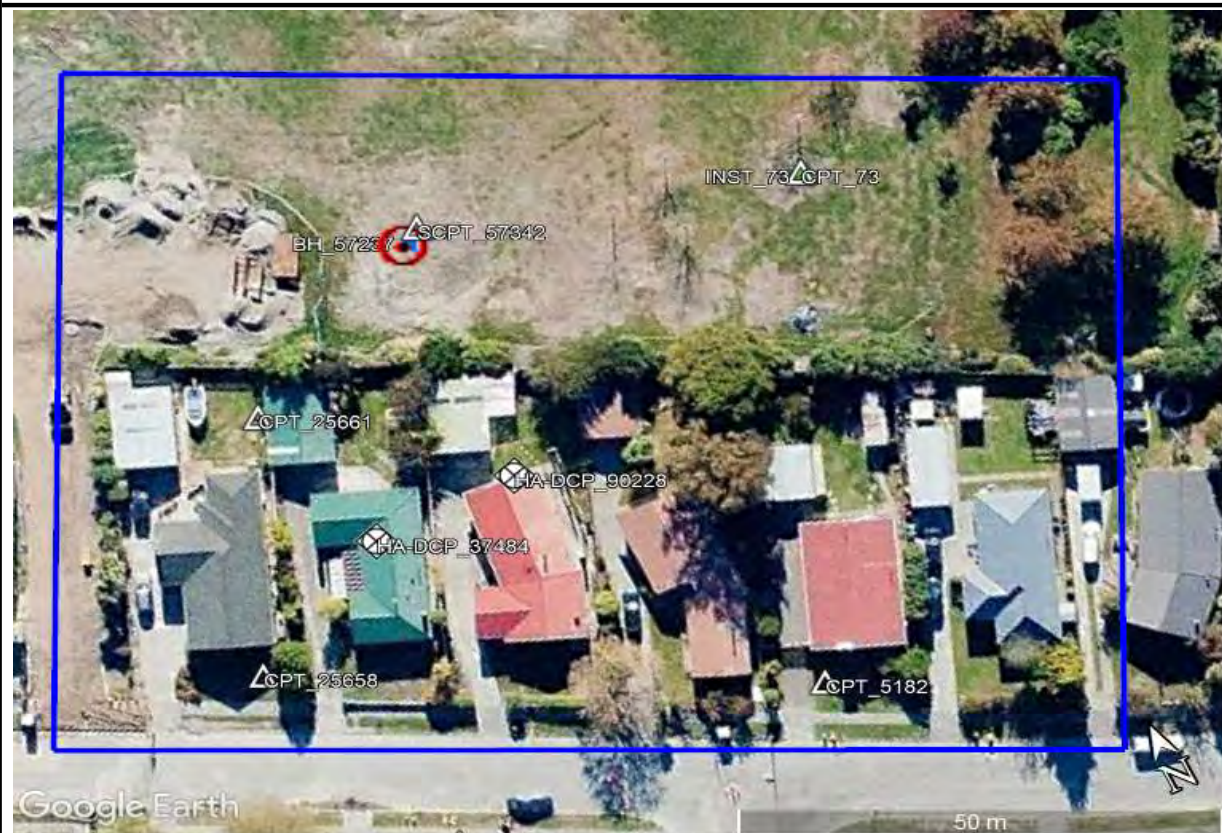
Case History:

Site: Avondale Park (N°15)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.37g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.6 - 2.1 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5055 Longitude 172.6908
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

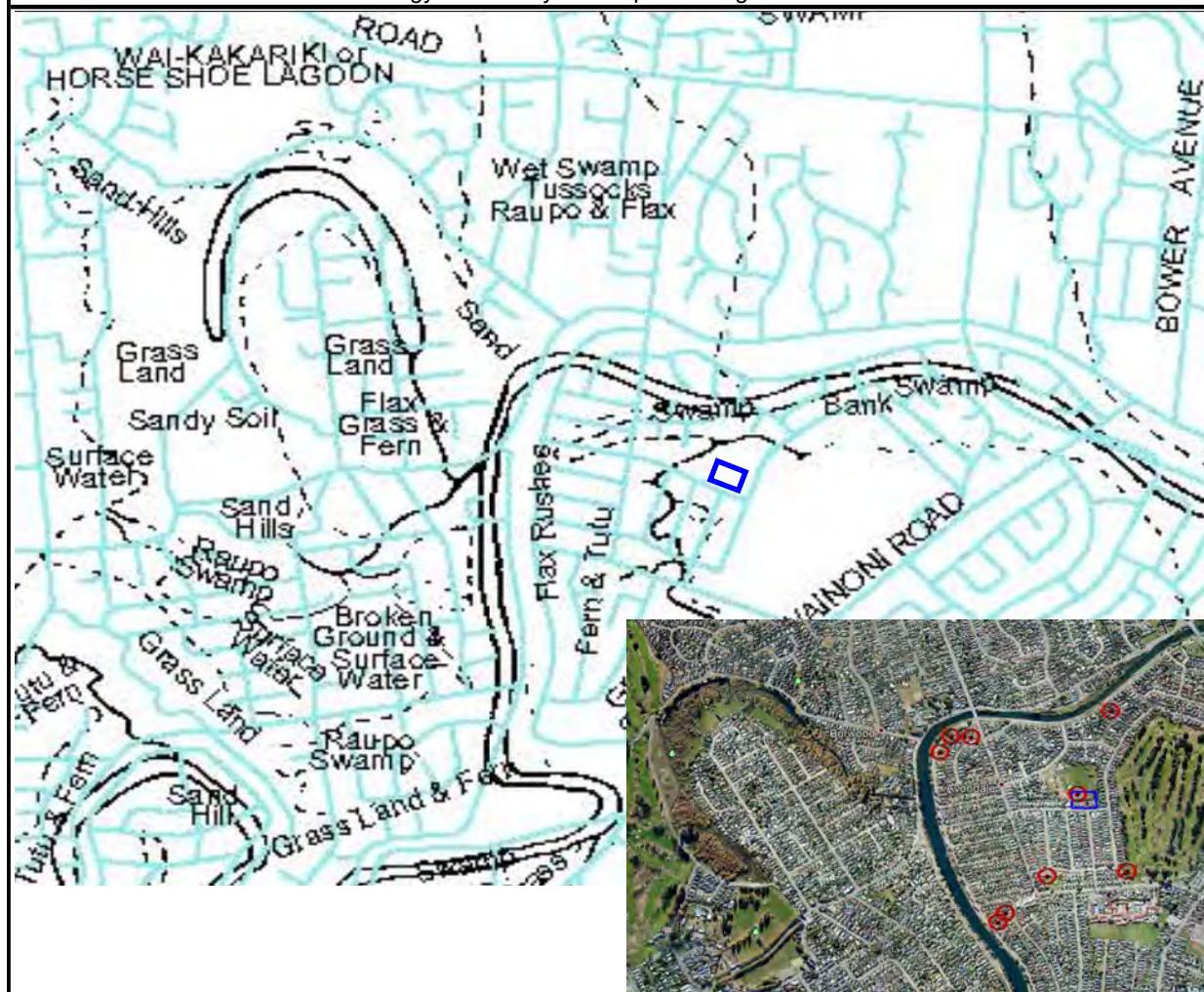
Site: Avondale Park (N°15)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.37g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.6 - 2.1 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5055 Longitude 172.6908
Source: Christchurch City Council, map_Ap001725BlackMap.gws

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856



Case History:

Site: Avondale Park (N°15)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.37g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.6 - 2.1 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5055 Longitude 172.6908
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

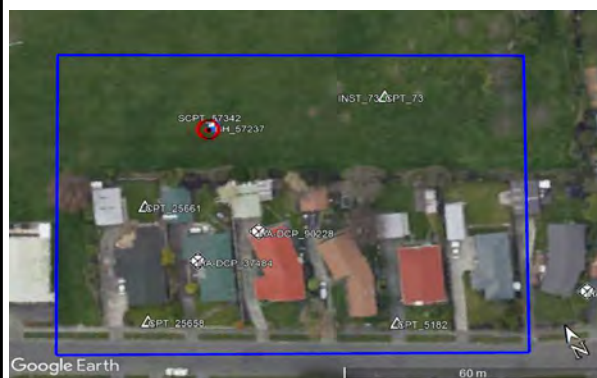
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Ejecta Patterns

Aerial photography taken on September 5, 2010



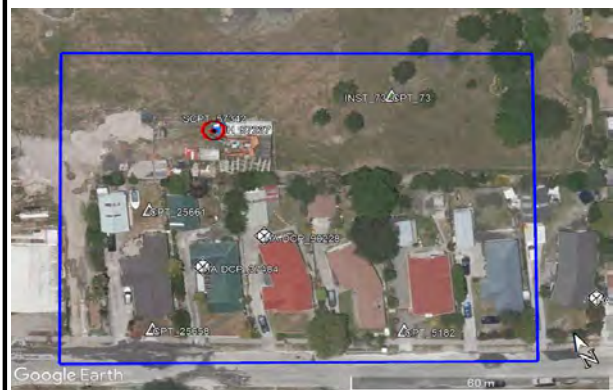
Aerial photography taken on February 24, 2011



Aerial photography taken on June 14-15, 2011

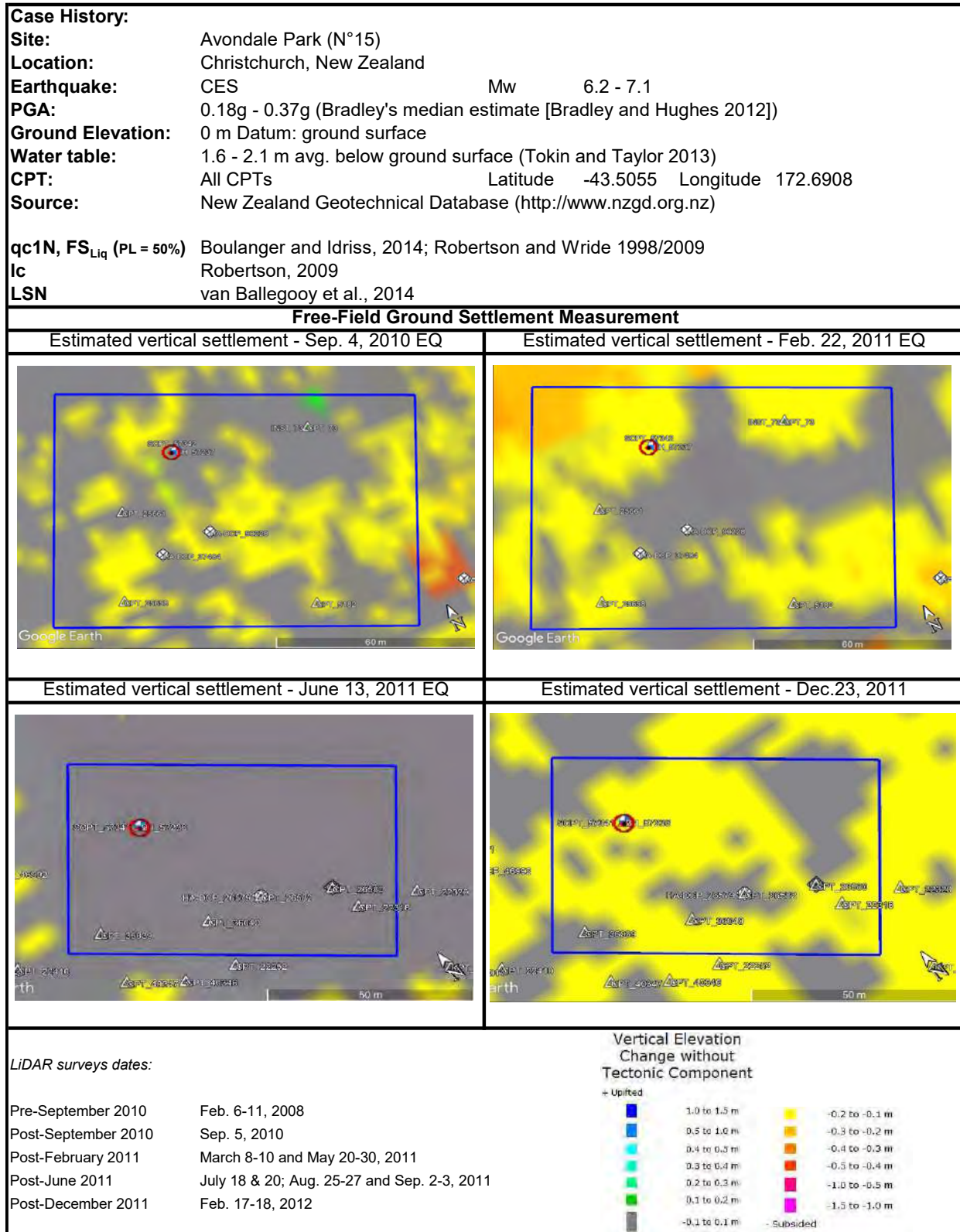


Aerial photography taken on December 24, 2011



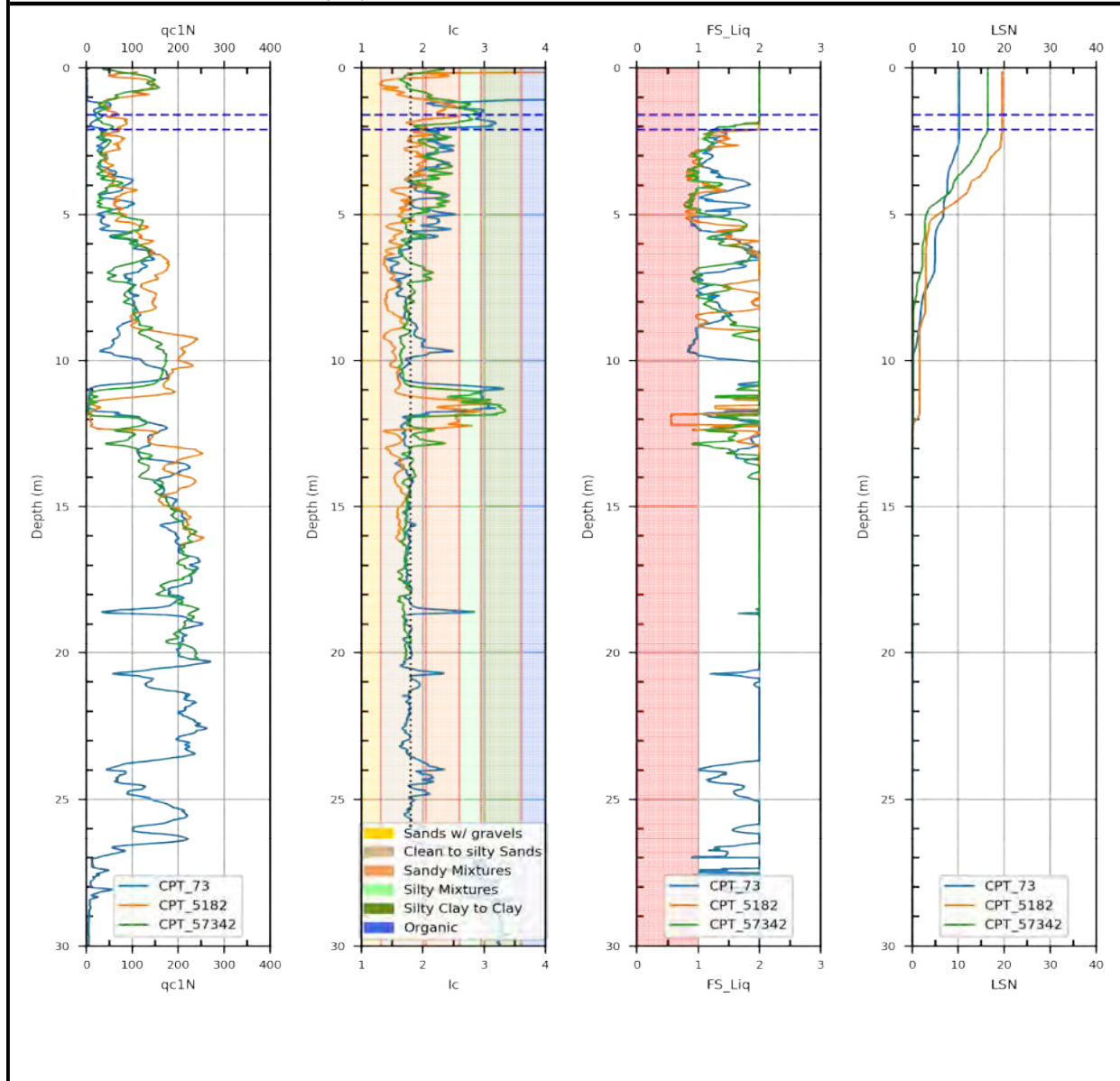
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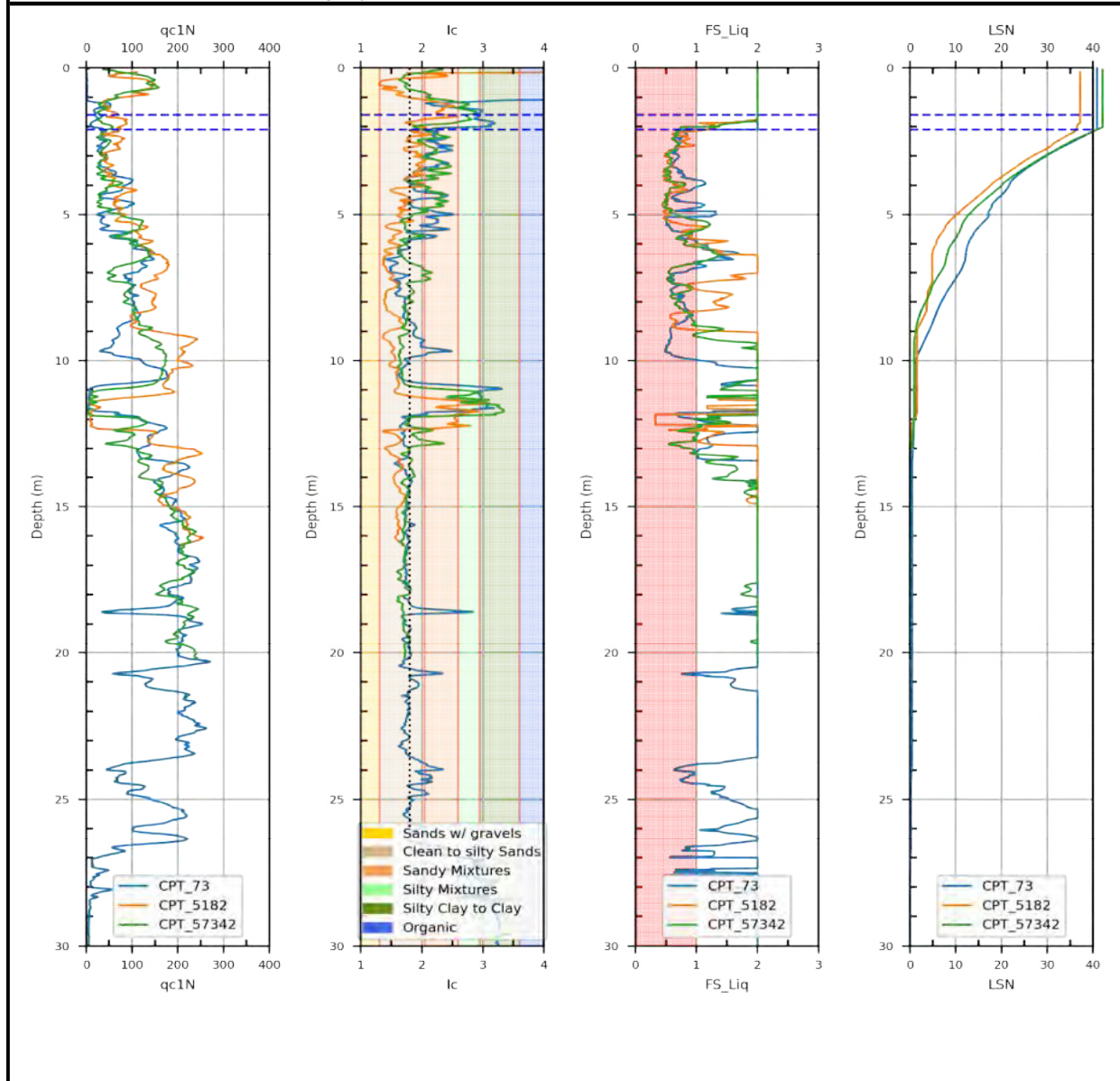
Case History: Ch-S43
Site: Avondale Park (N°15)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.18g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.6 - 2.1 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5055 Longitude 172.6908
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



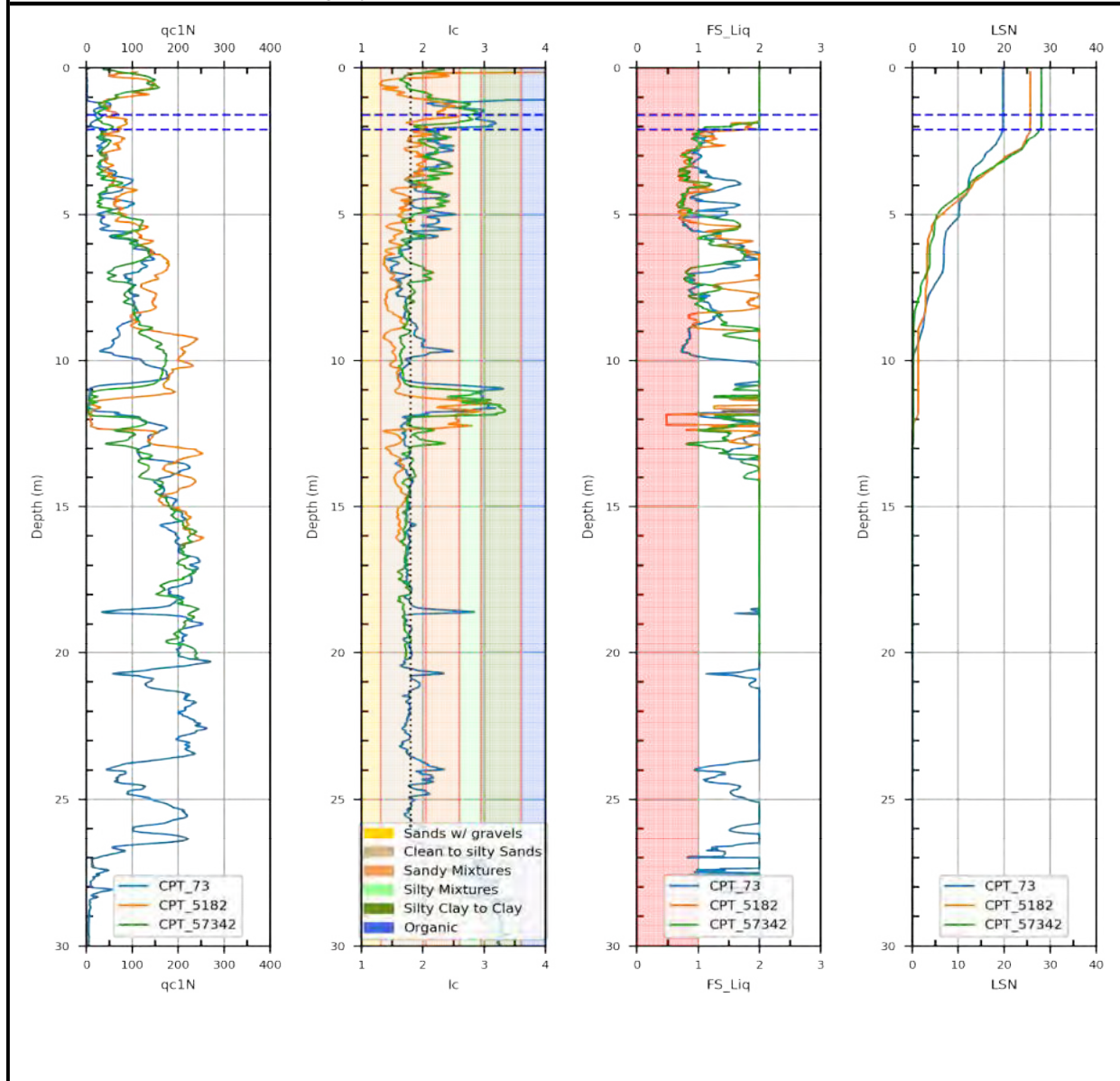
Case History: Ch-S44
Site: Avondale Park (N°15)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.37g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.6 - 2.1 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5055 Longitude 172.6908
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S45
Site: Avondale Park (N°15)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.25g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.6 - 2.1 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5055 Longitude 172.6908
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Rawhiti Domain

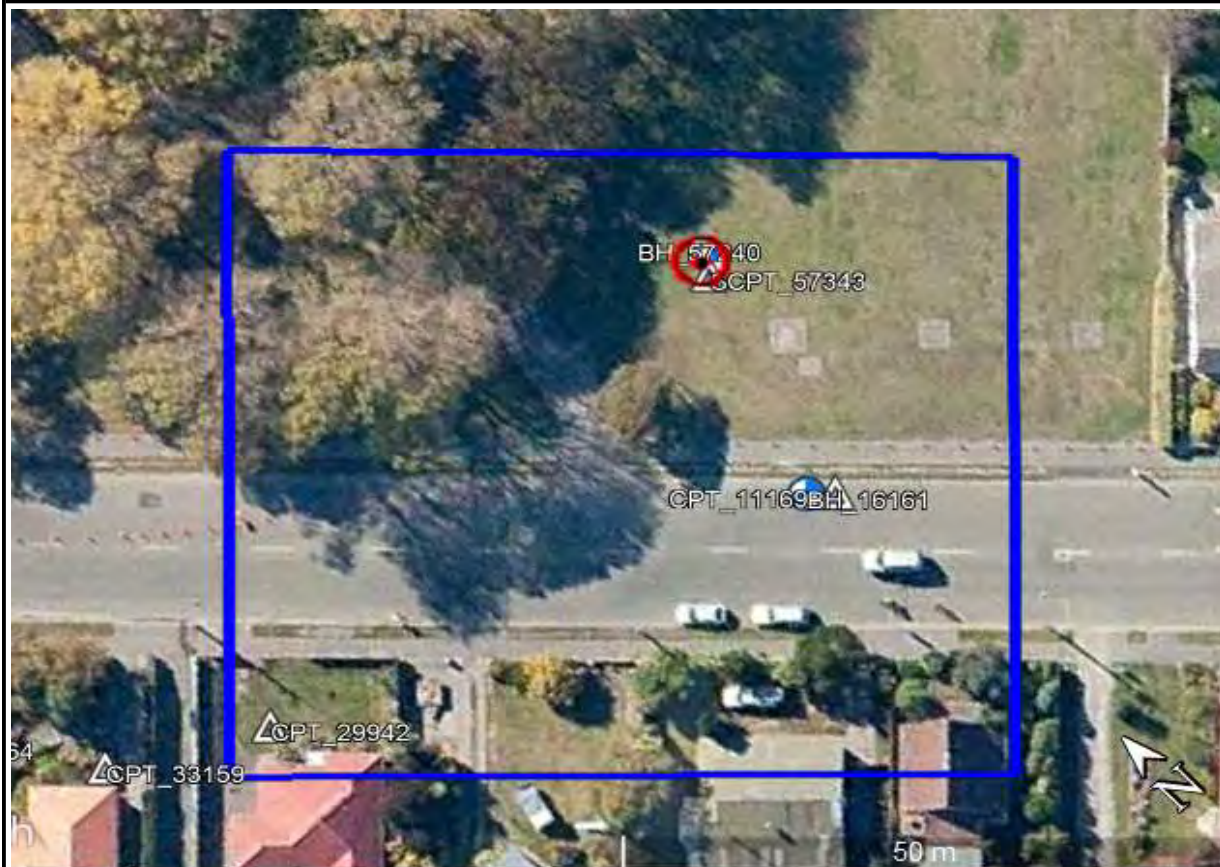
Case History:

Site: Rawhiti Domain (N°16)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.52g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.3 - 2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5067 Longitude 172.7214
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

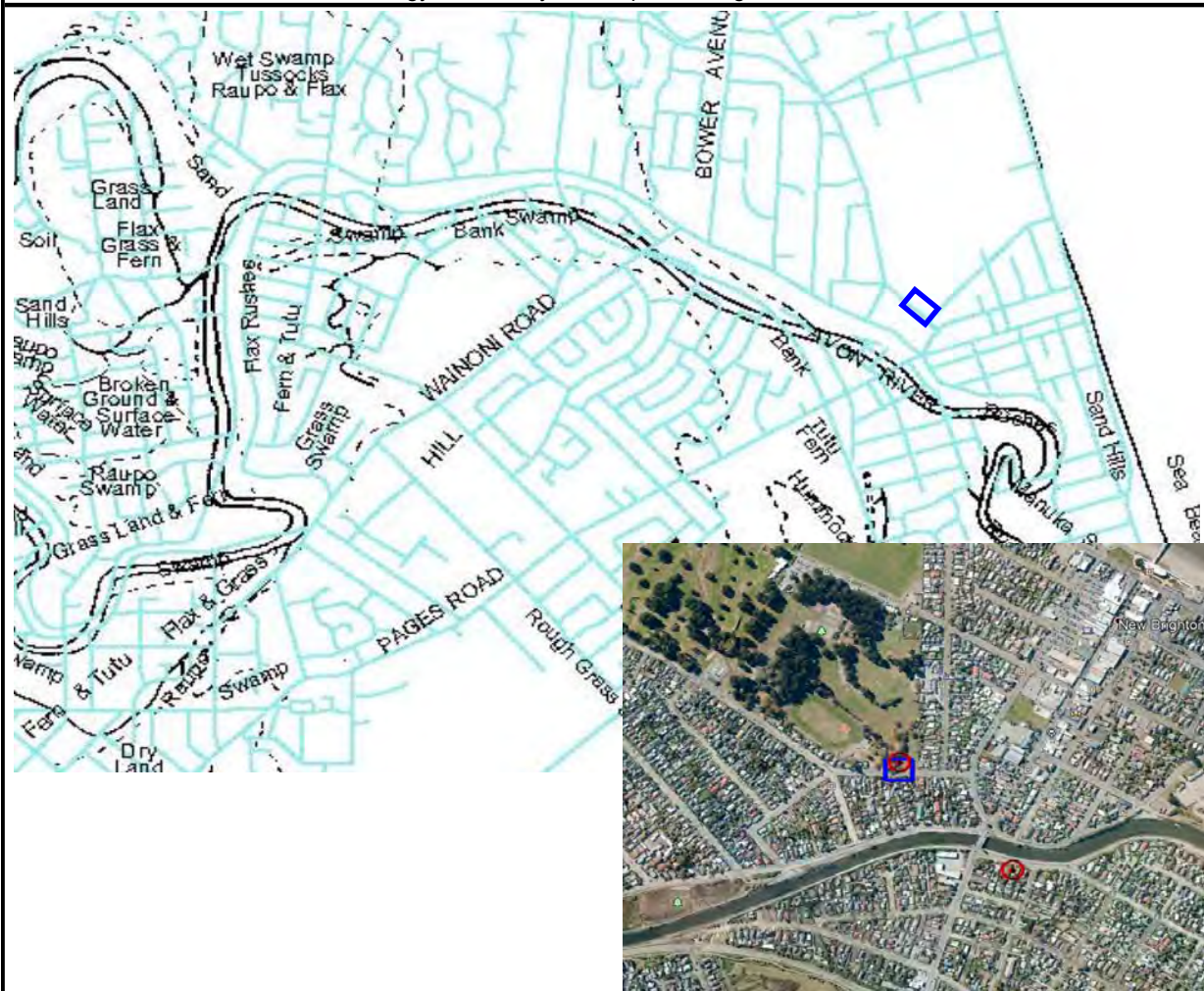
Site: Rawhiti Domain (N°16)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.52g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.3 - 2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5067 Longitude 172.7214
Source: Christchurch City Council, map_Ap001725BlackMap.gws

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

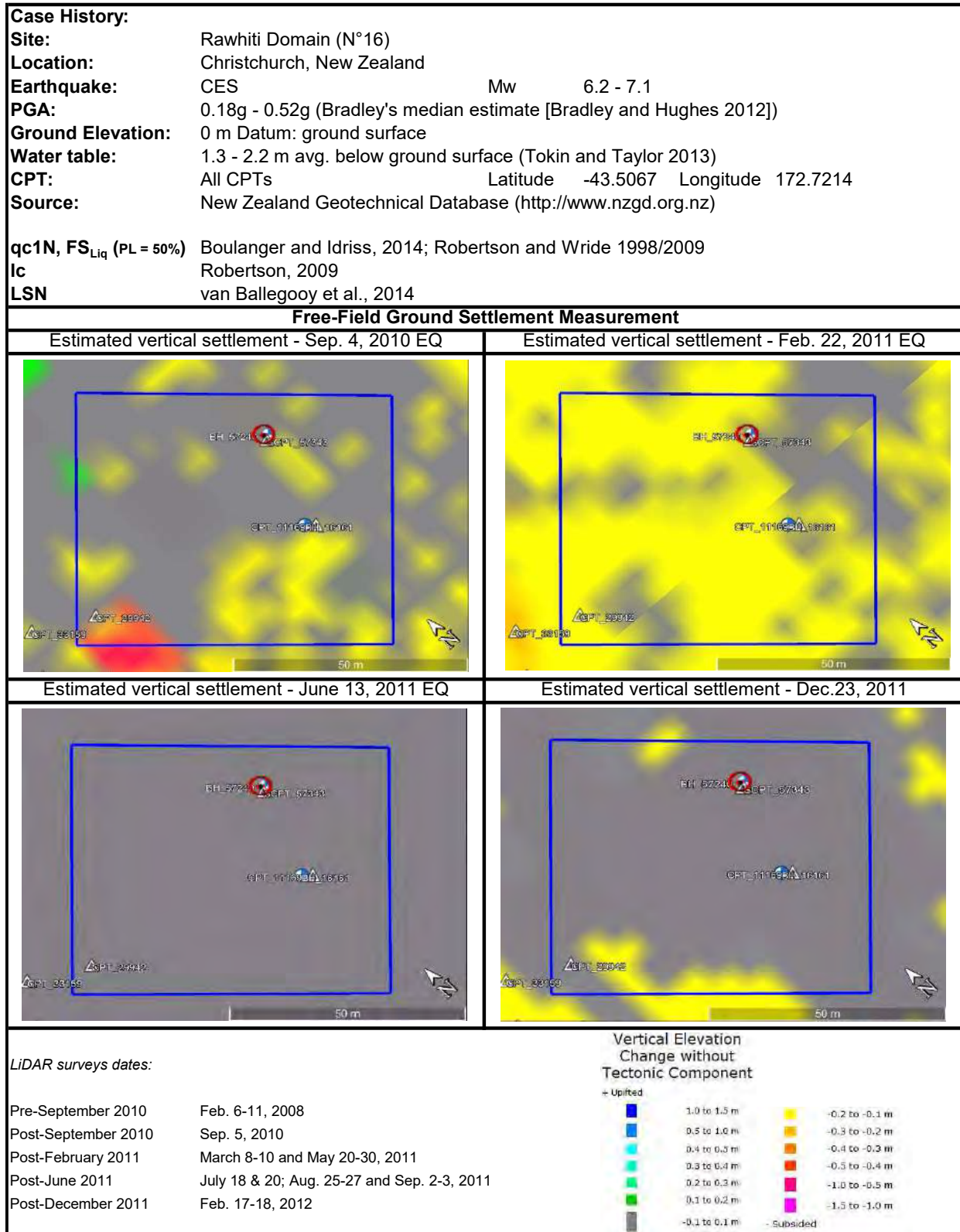
Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

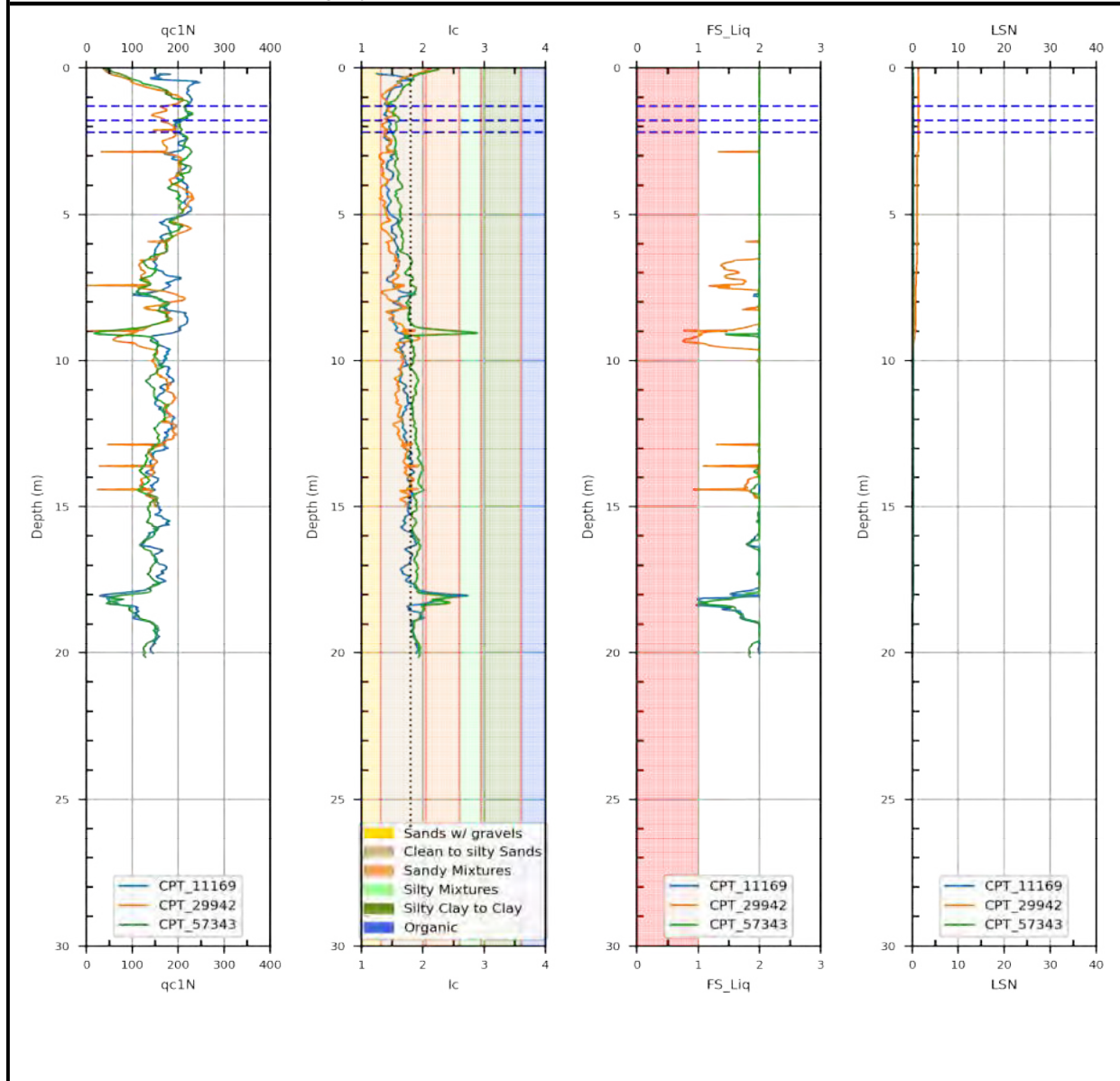


Case History:	
Site:	Rawhiti Domain (N°16)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.18g - 0.52g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	1.3 - 2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5067 Longitude 172.7214
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
	



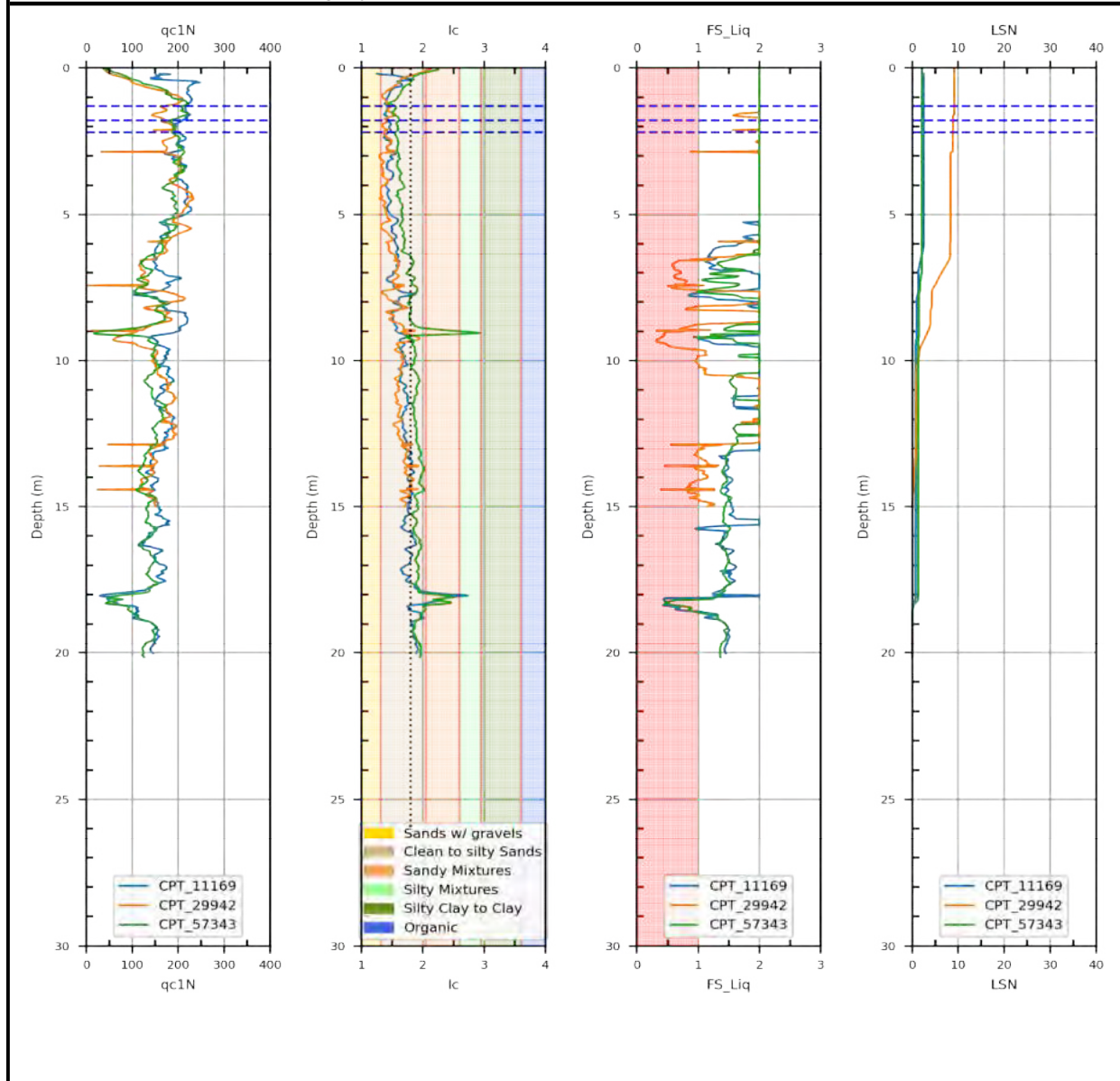
Case History: Ch-S46
Site: Rawhiti Domain (N°16)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.18g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.3 - 2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5067 Longitude 172.7214
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



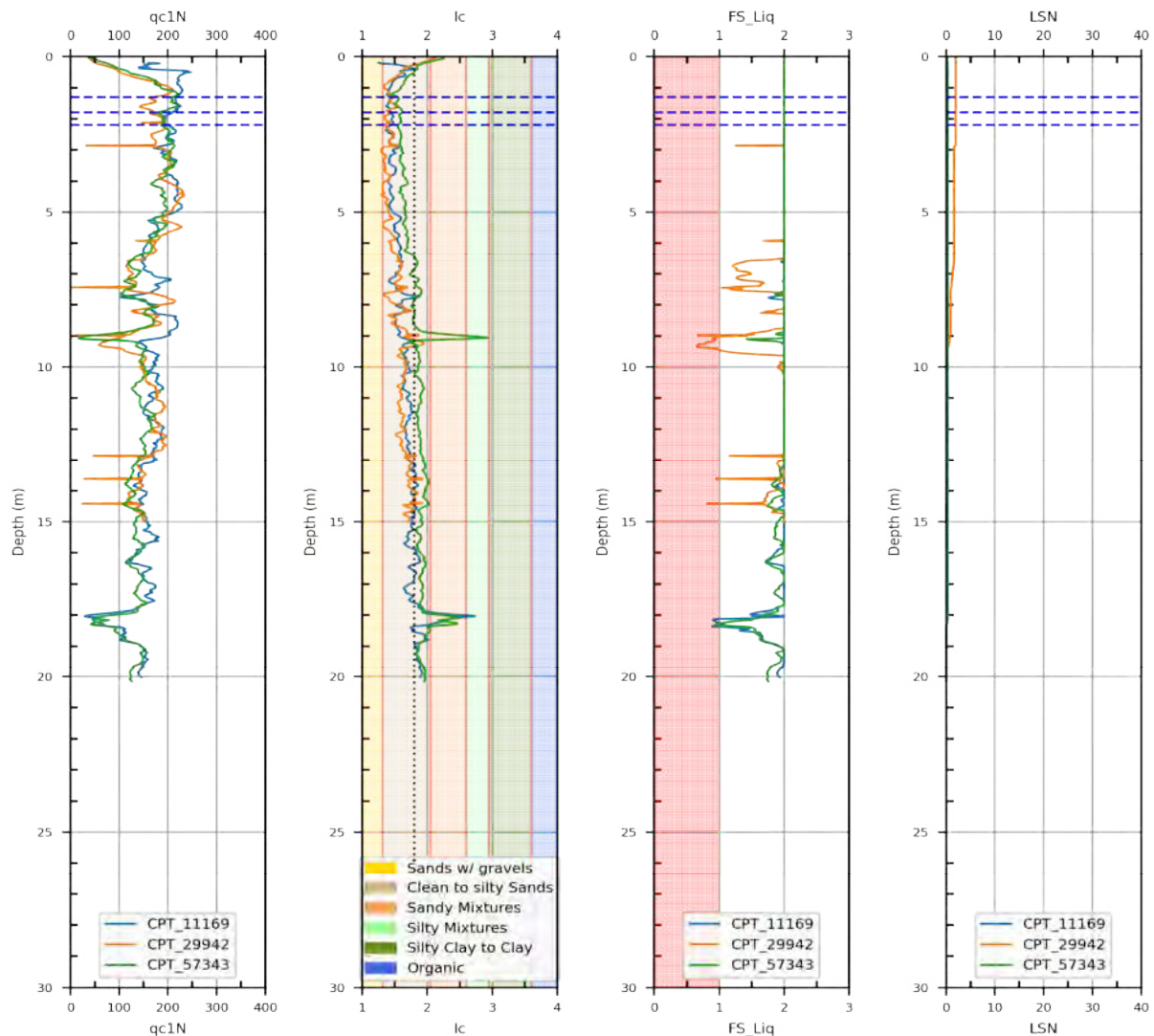
Case History: Ch-S47
Site: Rawhiti Domain (N°16)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.52g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.3 - 2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5067 Longitude 172.7214
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S48
Site: Rawhiti Domain (N°16)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.25g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.3 - 2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5067 Longitude 172.7214
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



455 Papanui Road

Case History:

Site: 455 Papanui Road (N°17)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.15g - 0.27g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.7 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5 Longitude 172.6101
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

Site: 455 Papanui Road (N°17)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.15g - 0.27g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.7 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5 Longitude 172.6101
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Ejecta Patterns

Aerial photography taken on September 5, 2010



Aerial photography taken on February 24, 2011



Aerial photography taken on June 14-15, 2011



Aerial photography taken on December 24, 2011



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Case History:

Site: 455 Papanui Road (N°17)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.15g - 0.27g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.7 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5 Longitude 172.6101
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

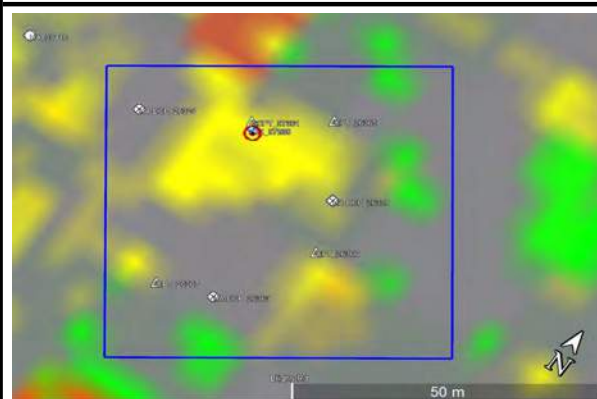
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

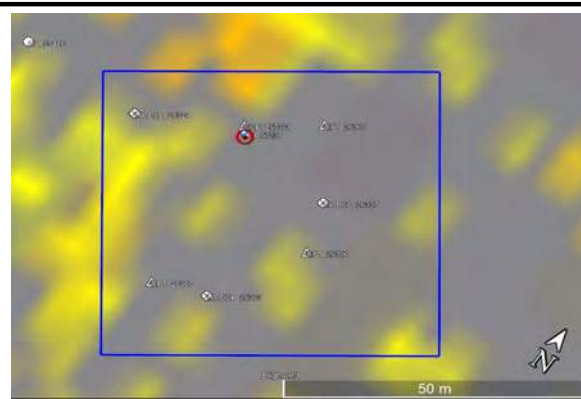
LSN van Ballegooy et al., 2014

Free-Field Ground Settlement Measurement

Estimated vertical settlement - Sep. 4, 2010 EQ



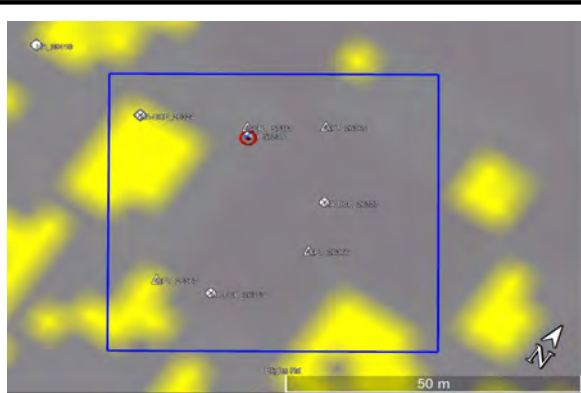
Estimated vertical settlement - Feb. 22, 2011 EQ



Estimated vertical settlement - June 13, 2011 EQ



Estimated vertical settlement - Dec.23, 2011

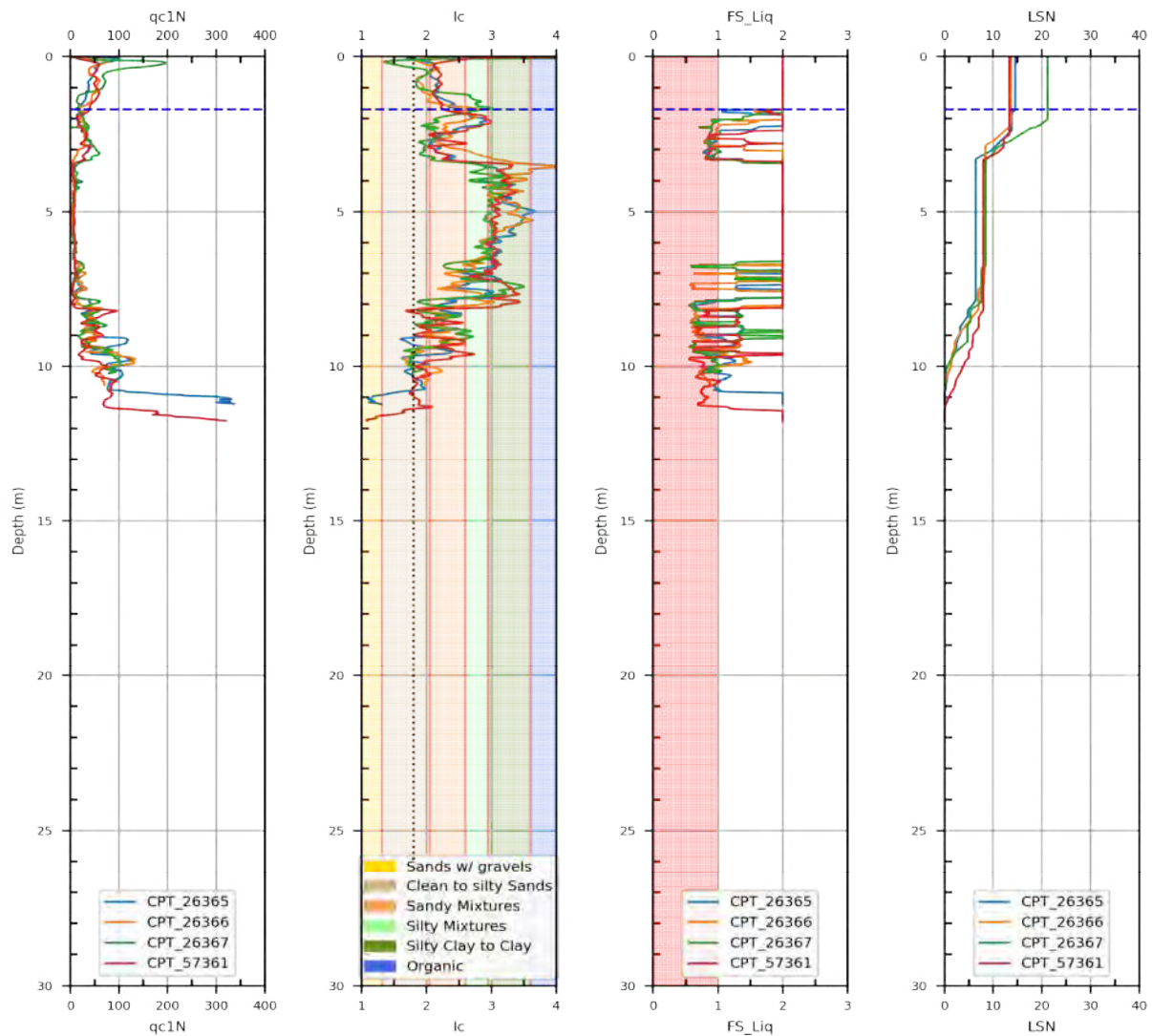
**LiDAR surveys dates:**

Pre-September 2010	Feb. 6-11, 2008
Post-September 2010	Sep. 5, 2010
Post-February 2011	March 8-10 and May 20-30, 2011
Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011
Post-December 2011	Feb. 17-18, 2012

Vertical Elevation Change without Tectonic Component

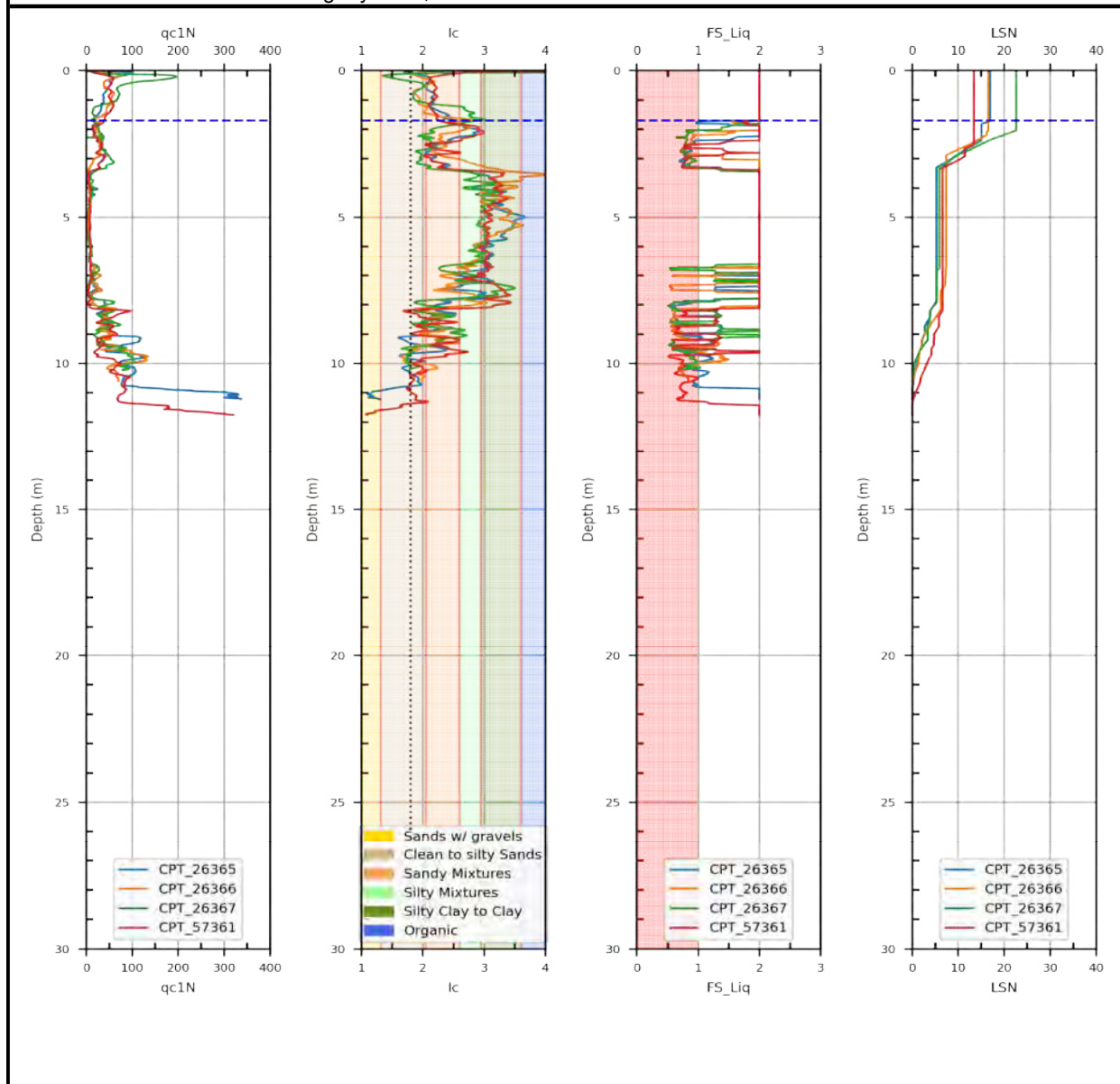
Case History: Ch-S49
Site: 455 Papanui Road (N°17)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.21g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.7 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5 Longitude 172.6101
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



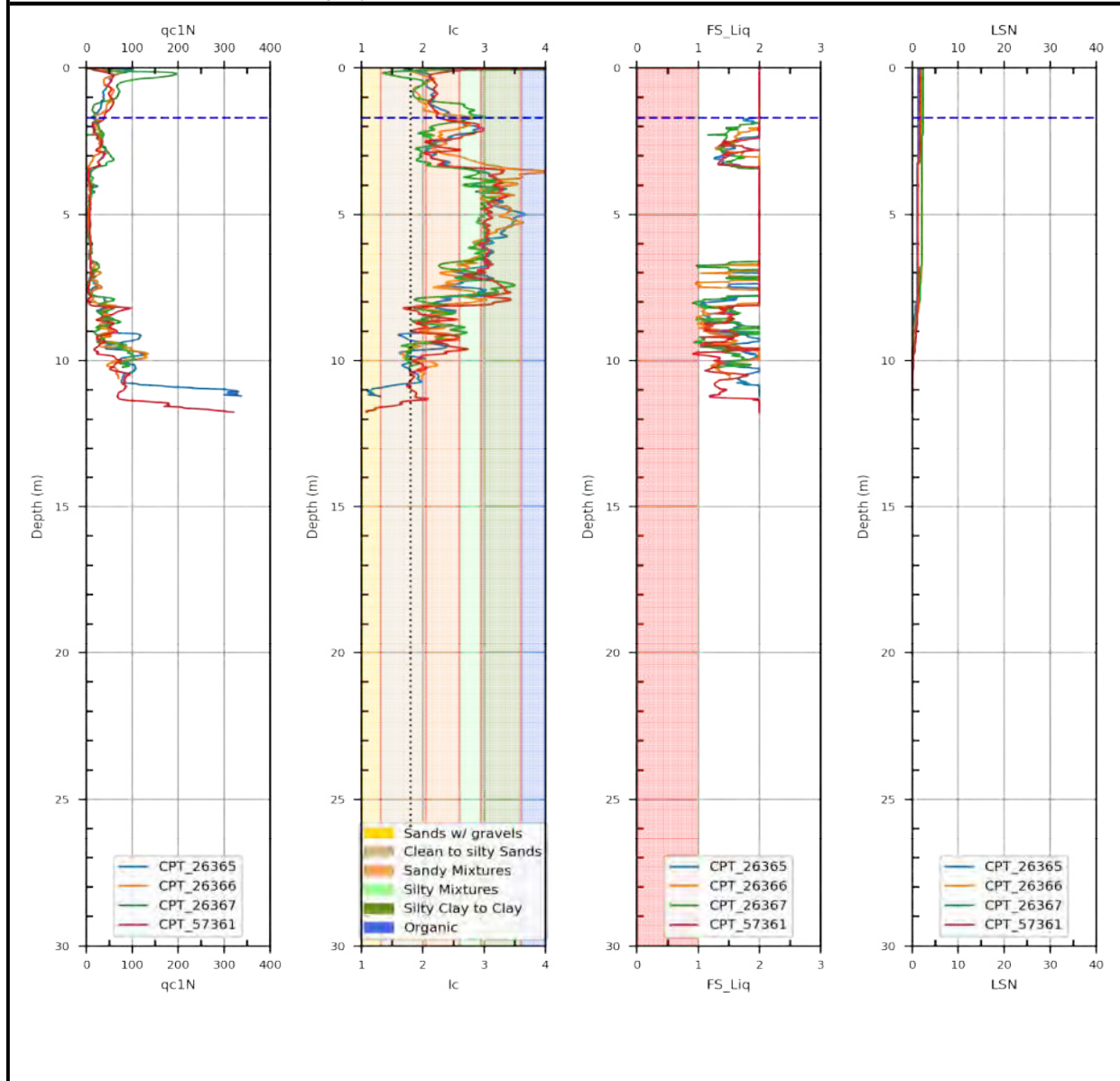
Case History: Ch-S50
Site: 455 Papanui Road (N°17)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.27g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.7 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5 Longitude 172.6101
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S51
Site: 455 Papanui Road (N°17)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.15g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.7 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5 Longitude 172.6101
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



Rydal Reserve

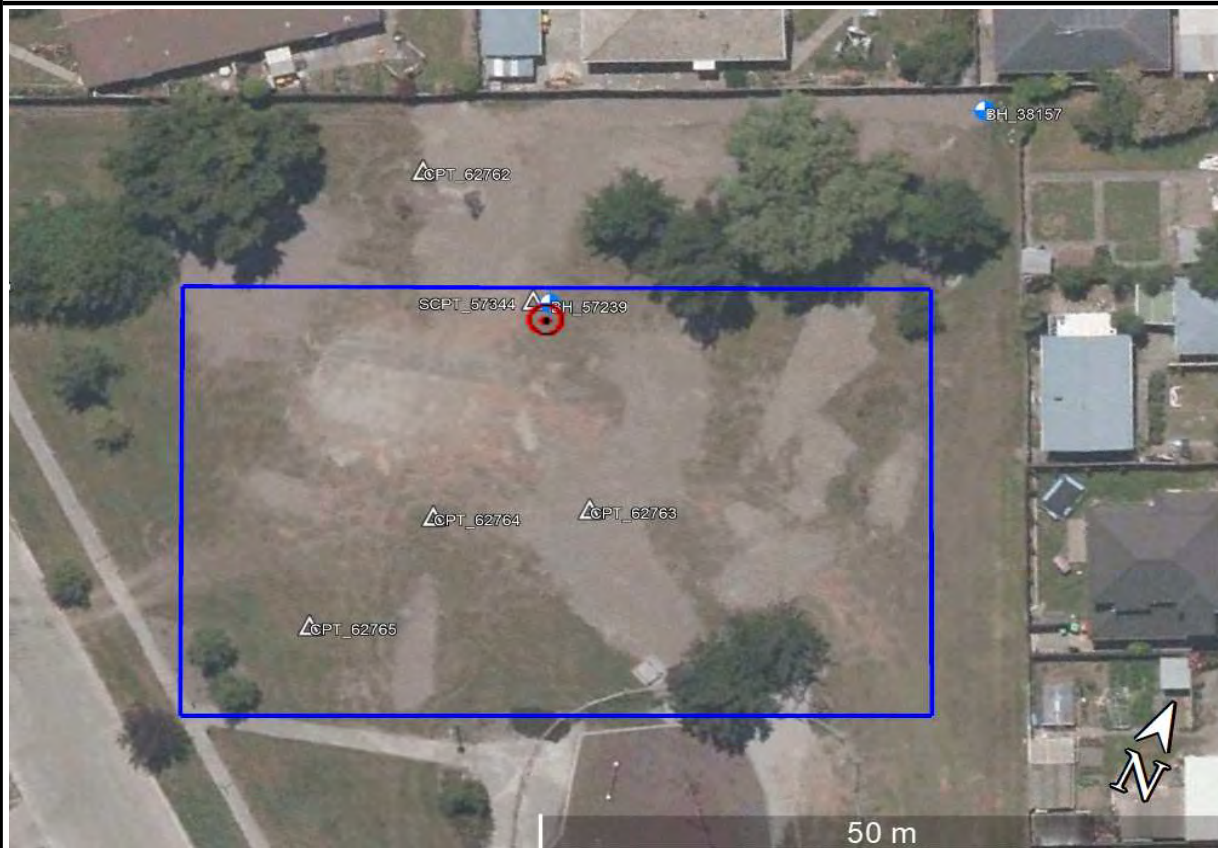
Case History:

Site: Rydal Reserve (N°18)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.19g - 0.44g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.5 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5659 Longitude 172.6086
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

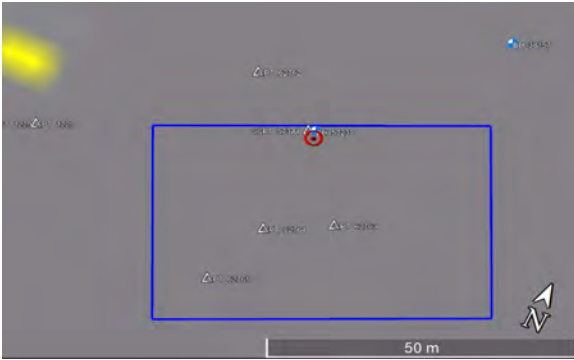
Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

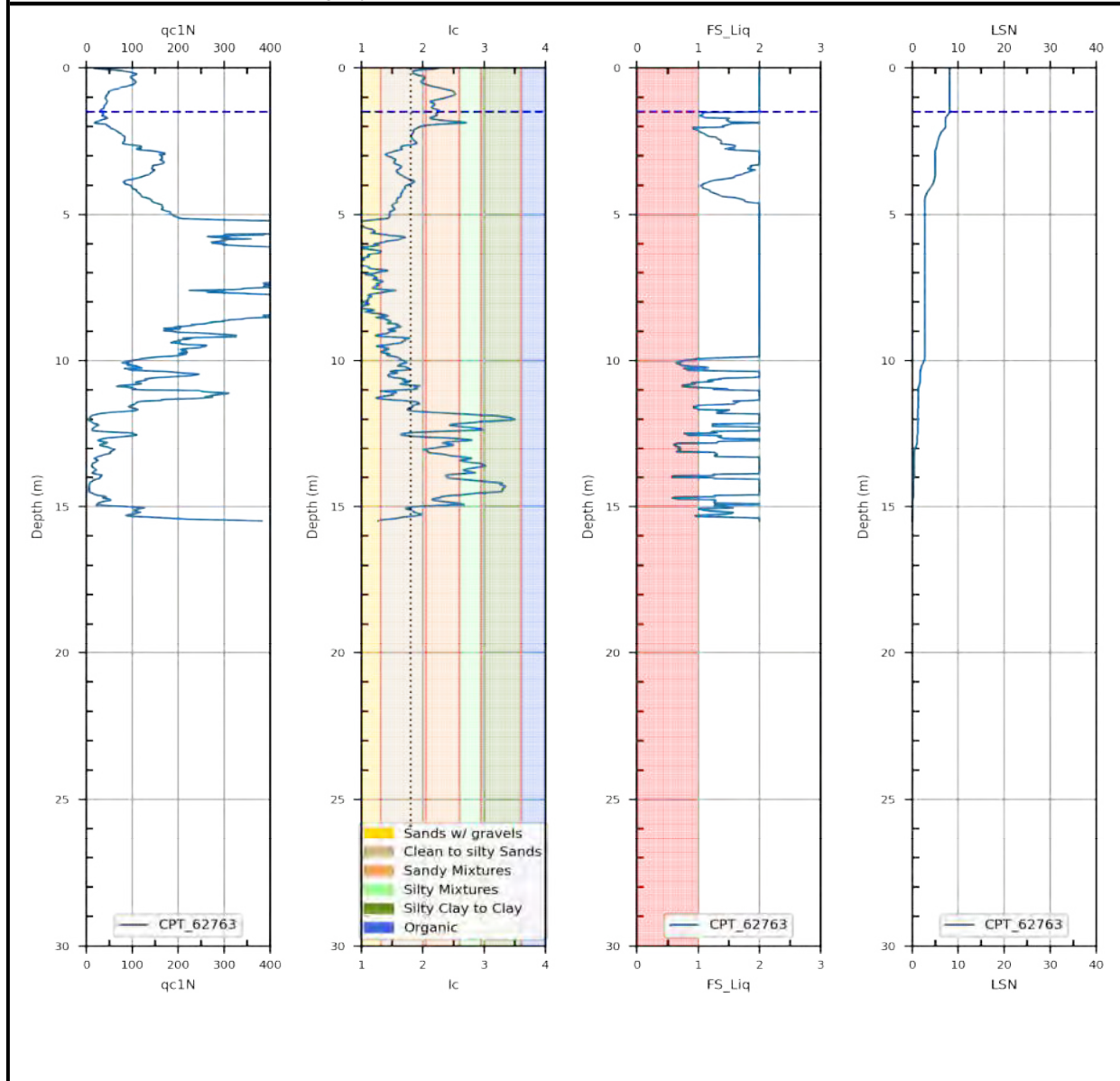
New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History: Site: Rydal Reserve (N°18) Location: Christchurch, New Zealand Earthquake: CES Mw 6.2 - 7.1 PGA: 0.19g - 0.44g (Bradley's median estimate [Bradley and Hughes 2012]) Ground Elevation: 0 m Datum: ground surface Water table: 1.5 m avg. below ground surface (Tokin and Taylor 2013) CPT: All CPTs Latitude -43.5659 Longitude 172.6086 Source: New Zealand Geotechnical Database (http://www.nzgd.org.nz) qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009 lc Robertson, 2009 LSN van Ballegooy et al., 2014	
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
No aerial photo available	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
No aerial photo available	
	

Case History:	
Site:	Rydal Reserve (N°18)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.19g - 0.44g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	1.5 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5659 Longitude 172.6086
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Free-Field Ground Settlement Measurement	
Estimated vertical settlement - Sep. 4, 2010 EQ	Estimated vertical settlement - Feb. 22, 2011 EQ
No LiDAR data available	No LiDAR data available
Estimated vertical settlement - June 13, 2011 EQ	Estimated vertical settlement - Dec.23, 2011
	No LiDAR data available
LiDAR surveys dates:	
Pre-September 2010	Feb. 6-11, 2008
Post-September 2010	Sep. 5, 2010
Post-February 2011	March 8-10 and May 20-30, 2011
Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011
Post-December 2011	Feb. 17-18, 2012
Vertical Elevation Change without Tectonic Component	
+ Uplifted	
	1.0 to 1.5 m
	0.5 to 1.0 m
	0.4 to 0.3 m
	0.3 to 0.4 m
	0.2 to 0.3 m
	0.1 to 0.2 m
	-0.1 to 0.1 m
	-0.2 to -0.1 m
	-0.3 to -0.2 m
	-0.4 to -0.3 m
	-0.5 to -0.4 m
	-1.0 to -0.5 m
	-1.5 to -1.0 m
- Subsided	

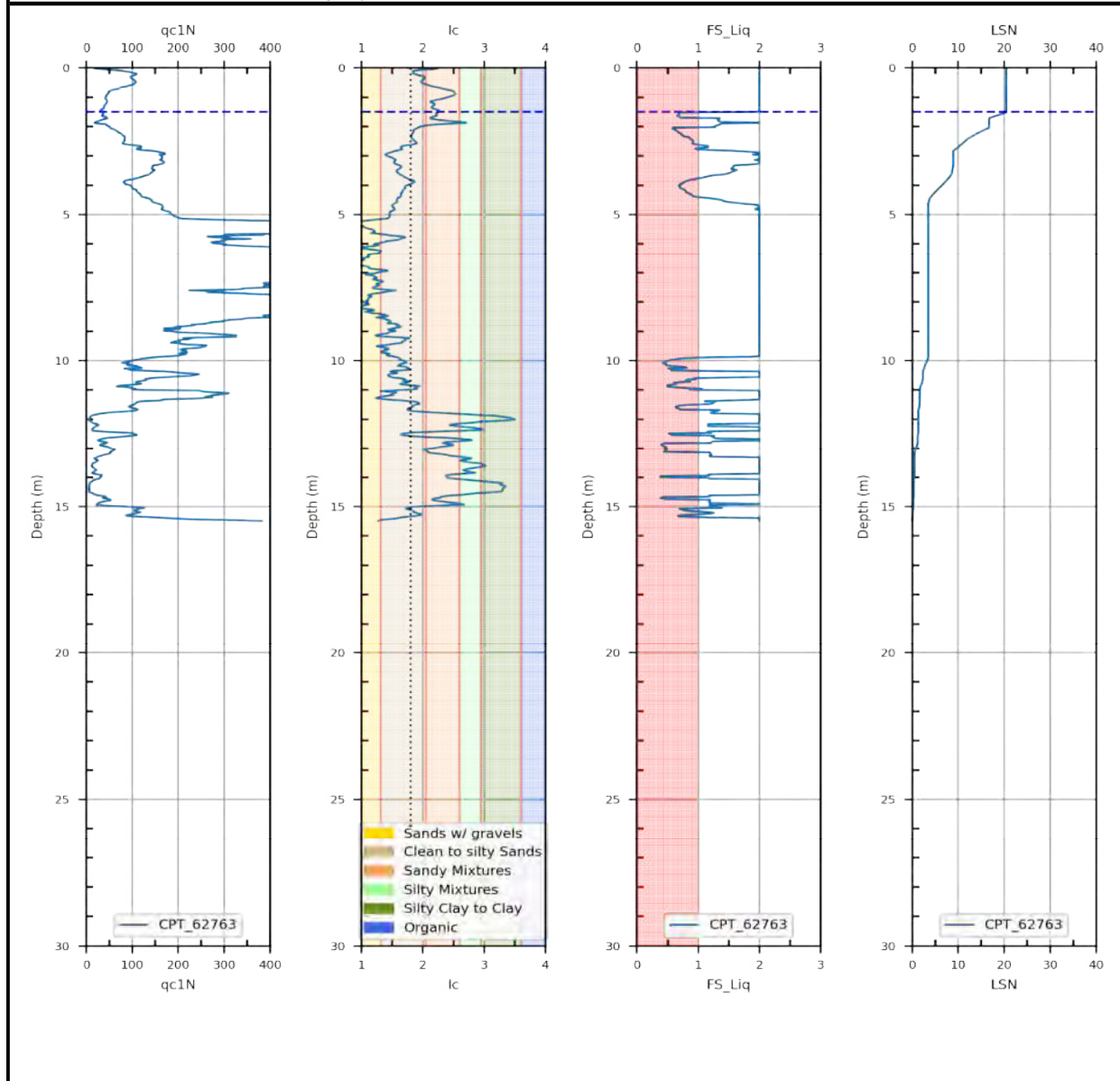
Case History: Ch-S52
Site: Rydal Reserve (N°18)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.24g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.5 m avg. below ground surface (Tokin and Taylor 2013)
CPT: CPT 62763 Latitude -43.5659 Longitude 172.6086
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



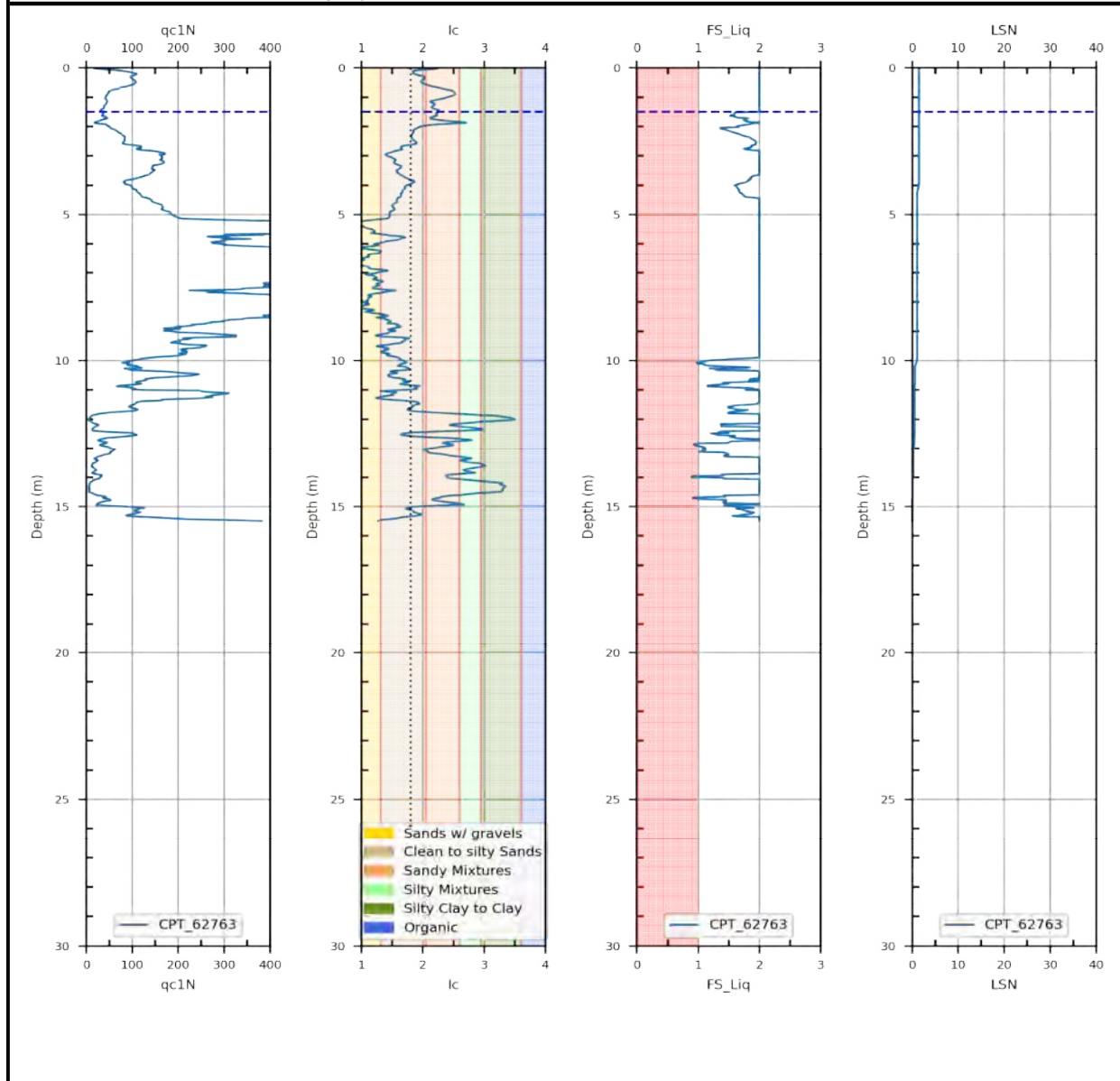
Case History: Ch-S53
Site: Rydal Reserve (N°18)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.44g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.5 m avg. below ground surface (Tokin and Taylor 2013)
CPT: CPT 62763 Latitude -43.5659 Longitude 172.6086
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S54
Site: Rydal Reserve (N°18)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.19g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.5 m avg. below ground surface (Tokin and Taylor 2013)
CPT: CPT 62763 Latitude -43.5659 Longitude 172.6086
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



St. Teresa School

Case History:

Site: St. Teresa's School (N°19)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.17g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0 m - 1.2m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5299 Longitude 172.5921
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

lc Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

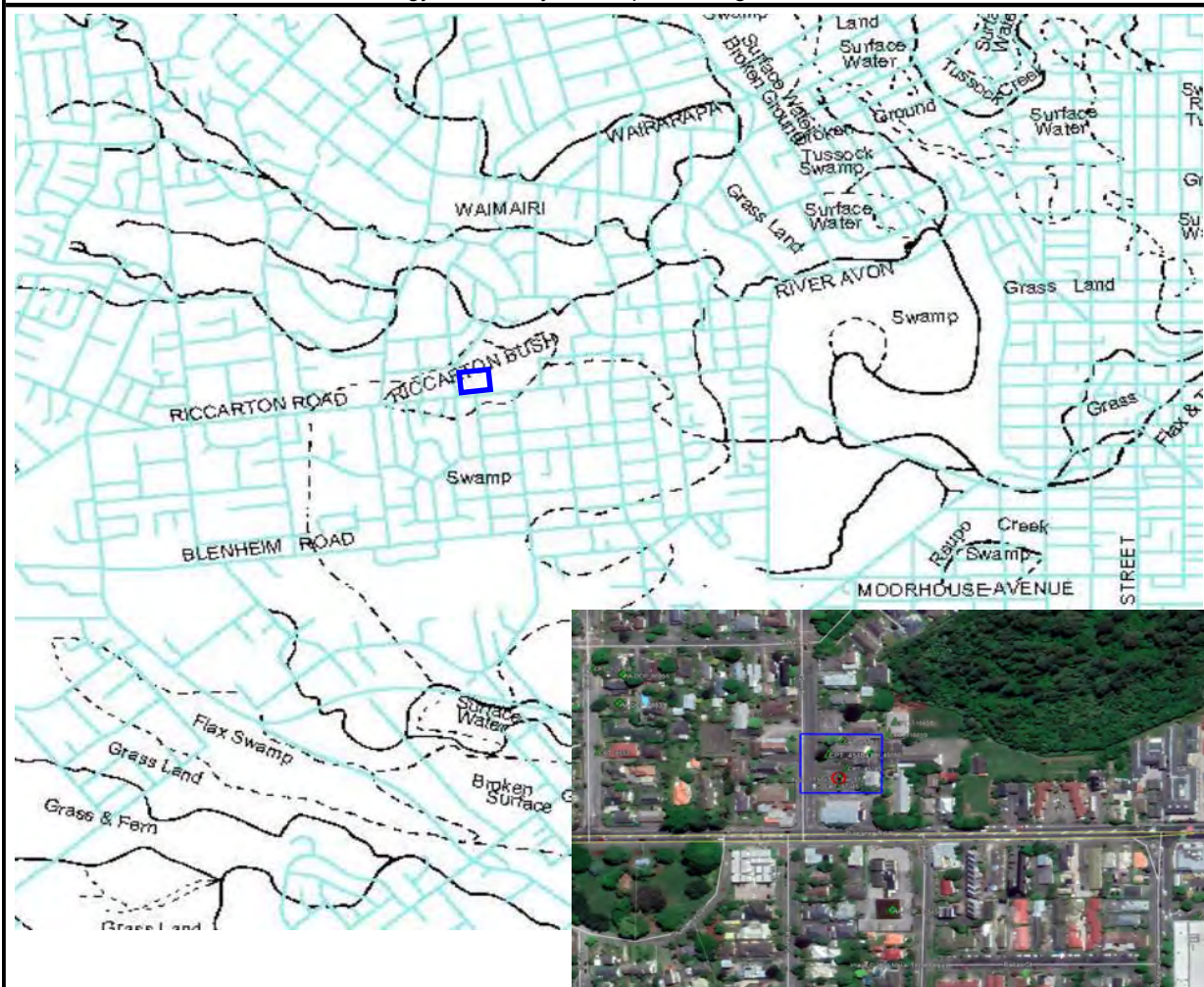
Site: St. Teresa's School (N°19)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.17g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0 m - 1.2m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5299 Longitude 172.5921
Source: Christchurch City Council, map_Ap001725BlackMap.gws

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

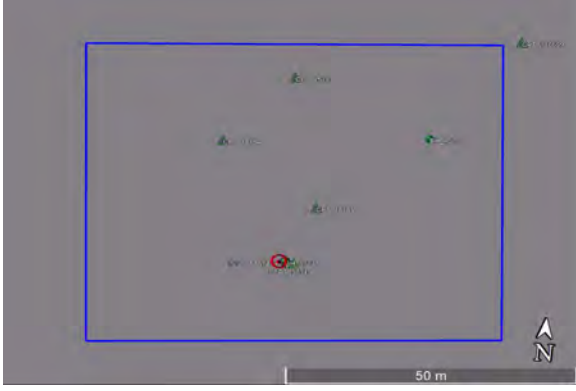
lc Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

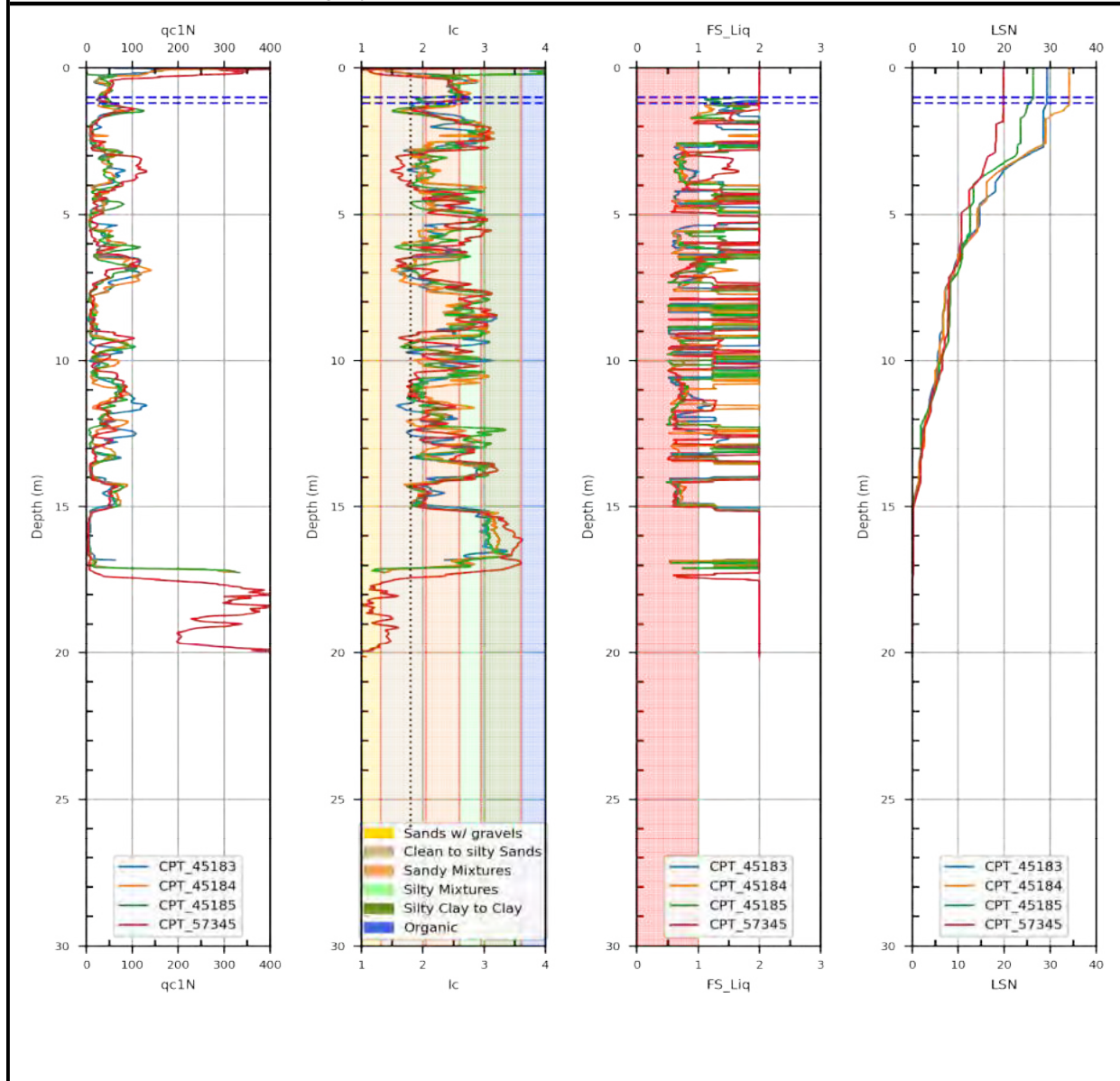


Case History: Site: St. Teresa's School (N°19) Location: Christchurch, New Zealand Earthquake: CES Mw 6.2 - 7.1 PGA: 0.17g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012]) Ground Elevation: 0 m Datum: ground surface Water table: 1.0 m - 1.2m avg. below ground surface (Tokin and Taylor 2013) CPT: All CPTs Latitude -43.5299 Longitude 172.5921 Source: New Zealand Geotechnical Database (http://www.nzgd.org.nz) qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009 Ic Robertson, 2009 LSN van Ballegooy et al., 2014	
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
No aerial photo available	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	No aerial photo available
	

Case History:											
Site:	St. Teresa's School (N°19)										
Location:	Christchurch, New Zealand										
Earthquake:	CES Mw 6.2 - 7.1										
PGA:	0.17g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])										
Ground Elevation:	0 m Datum: ground surface										
Water table:	1.0 m - 1.2m avg. below ground surface (Tokin and Taylor 2013)										
CPT:	All CPTs Latitude -43.5299 Longitude 172.5921										
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)										
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009										
Ic	Robertson, 2009										
LSN	van Ballegooy et al., 2014										
Free-Field Ground Settlement Measurement											
Estimated vertical settlement - Sep. 4, 2010 EQ	Estimated vertical settlement - Feb. 22, 2011 EQ										
No LiDAR data available	No LiDAR data available										
Estimated vertical settlement - June 13, 2011 EQ	Estimated vertical settlement - Dec.23, 2011										
											
LiDAR surveys dates: <table> <tr> <td>Pre-September 2010</td><td>Feb. 6-11, 2008</td></tr> <tr> <td>Post-September 2010</td><td>Sep. 5, 2010</td></tr> <tr> <td>Post-February 2011</td><td>March 8-10 and May 20-30, 2011</td></tr> <tr> <td>Post-June 2011</td><td>July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011</td></tr> <tr> <td>Post-December 2011</td><td>Feb. 17-18, 2012</td></tr> </table>		Pre-September 2010	Feb. 6-11, 2008	Post-September 2010	Sep. 5, 2010	Post-February 2011	March 8-10 and May 20-30, 2011	Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011	Post-December 2011	Feb. 17-18, 2012
Pre-September 2010	Feb. 6-11, 2008										
Post-September 2010	Sep. 5, 2010										
Post-February 2011	March 8-10 and May 20-30, 2011										
Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011										
Post-December 2011	Feb. 17-18, 2012										
Vertical Elevation Change without Tectonic Component <table> <tr> <td> ↑ Uplifted 1.0 to 1.5 m 0.5 to 1.0 m 0.4 to 0.3 m 0.3 to 0.4 m 0.2 to 0.3 m 0.1 to 0.2 m -0.1 to 0.1 m </td> <td> ↓ Subsided -0.2 to -0.1 m -0.3 to -0.2 m -0.4 to -0.3 m -0.5 to -0.4 m -1.0 to -0.5 m -1.5 to -1.0 m </td> </tr> </table>		↑ Uplifted 1.0 to 1.5 m 0.5 to 1.0 m 0.4 to 0.3 m 0.3 to 0.4 m 0.2 to 0.3 m 0.1 to 0.2 m -0.1 to 0.1 m	↓ Subsided -0.2 to -0.1 m -0.3 to -0.2 m -0.4 to -0.3 m -0.5 to -0.4 m -1.0 to -0.5 m -1.5 to -1.0 m								
↑ Uplifted 1.0 to 1.5 m 0.5 to 1.0 m 0.4 to 0.3 m 0.3 to 0.4 m 0.2 to 0.3 m 0.1 to 0.2 m -0.1 to 0.1 m	↓ Subsided -0.2 to -0.1 m -0.3 to -0.2 m -0.4 to -0.3 m -0.5 to -0.4 m -1.0 to -0.5 m -1.5 to -1.0 m										

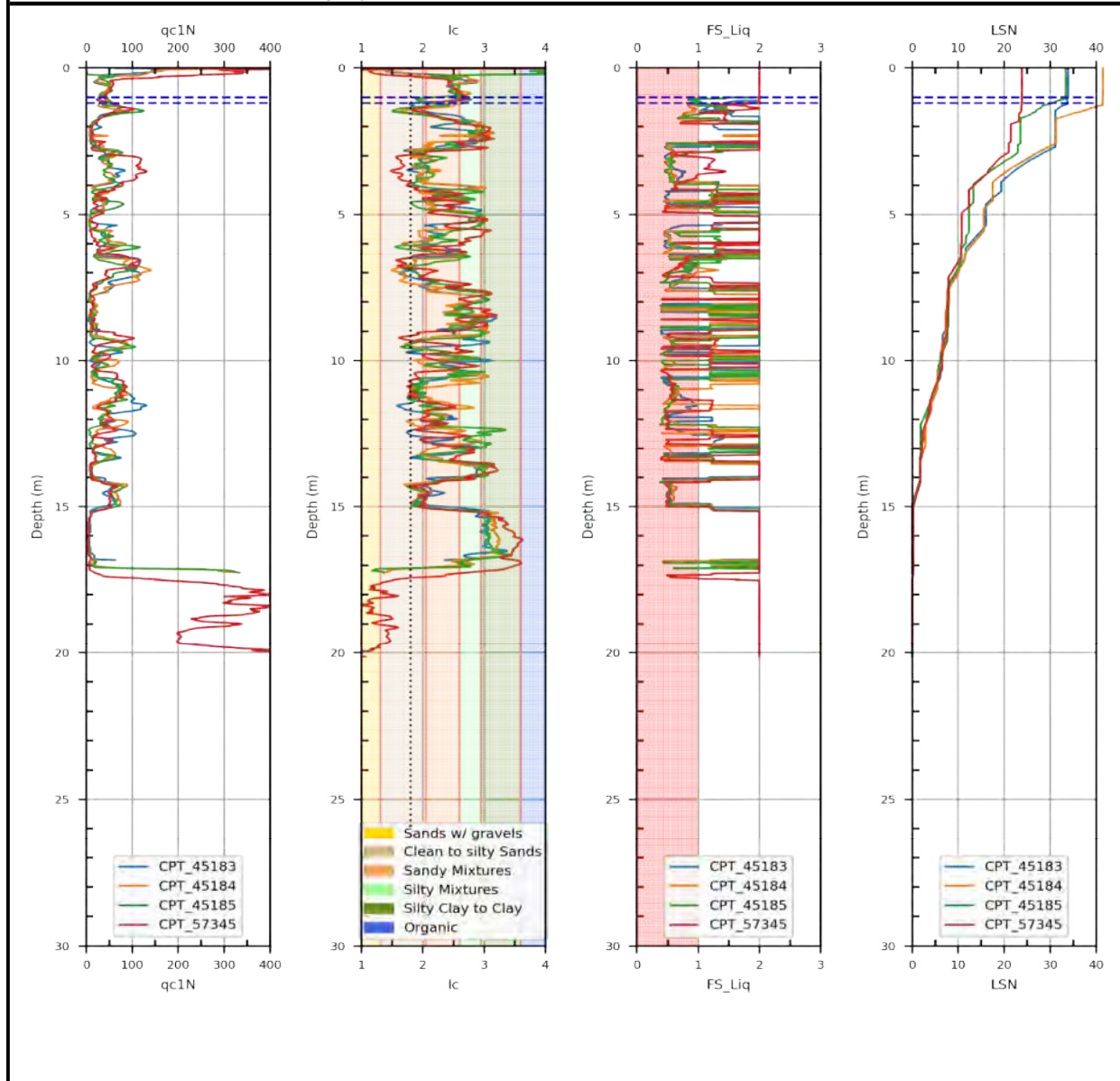
Case History: Ch-S55
Site: St. Teresa's School (N°19)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.22g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0 m - 1.2m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5299 Longitude 172.5921
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



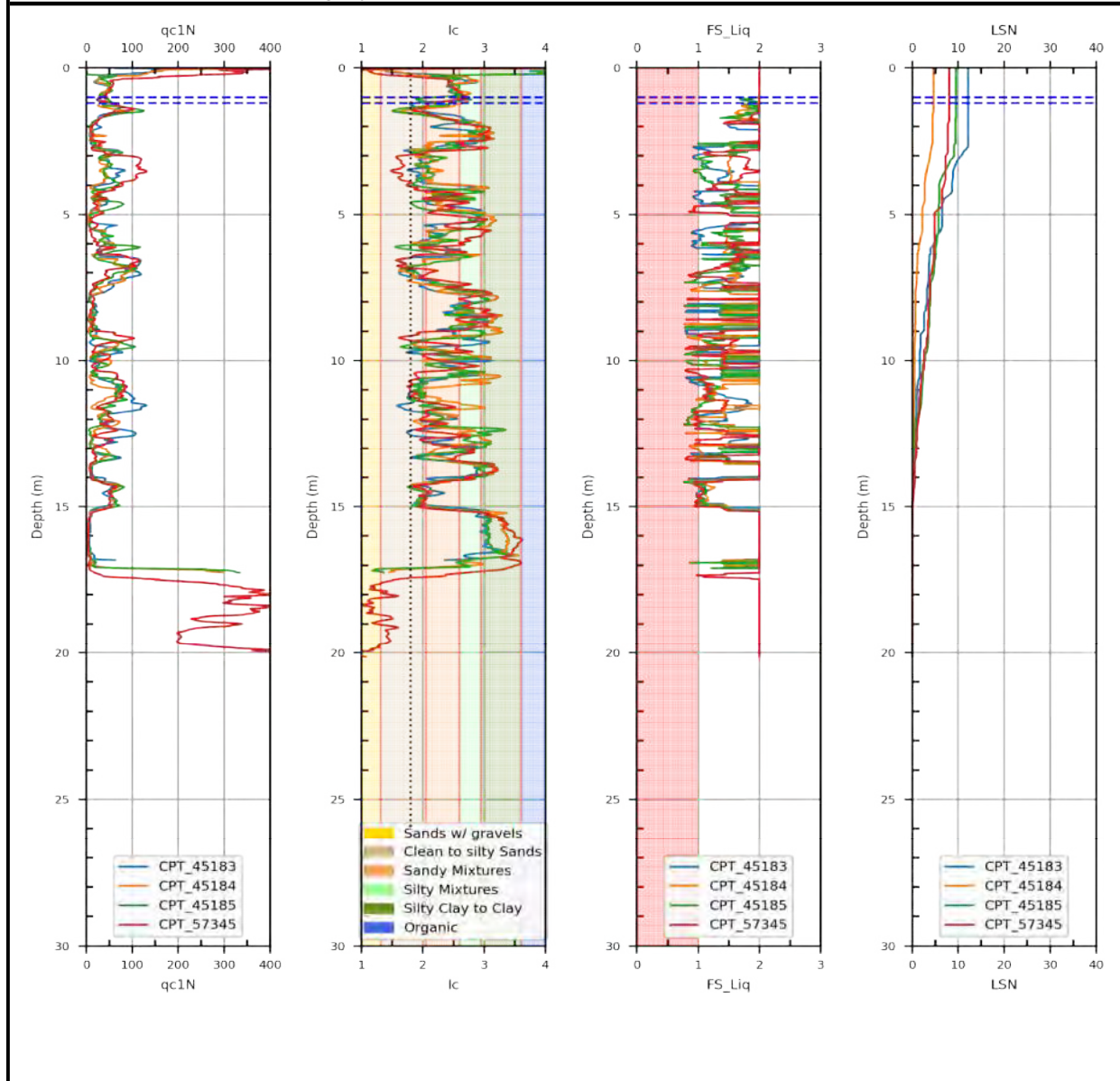
Case History: Ch-S56
Site: St. Teresa's School (N°19)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0 m - 1.2m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5299 Longitude 172.5921
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S57
Site: St. Teresa's School (N°19)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.17g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0 m - 1.2m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5299 Longitude 172.5921
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Sabina Playground

Case History:

Site: Sabina Playground (N°20)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0 m - 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5043 Longitude 172.6607
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

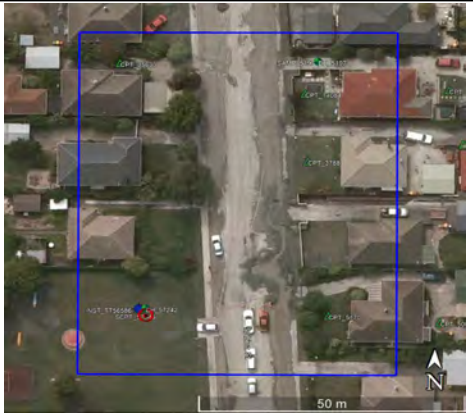
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

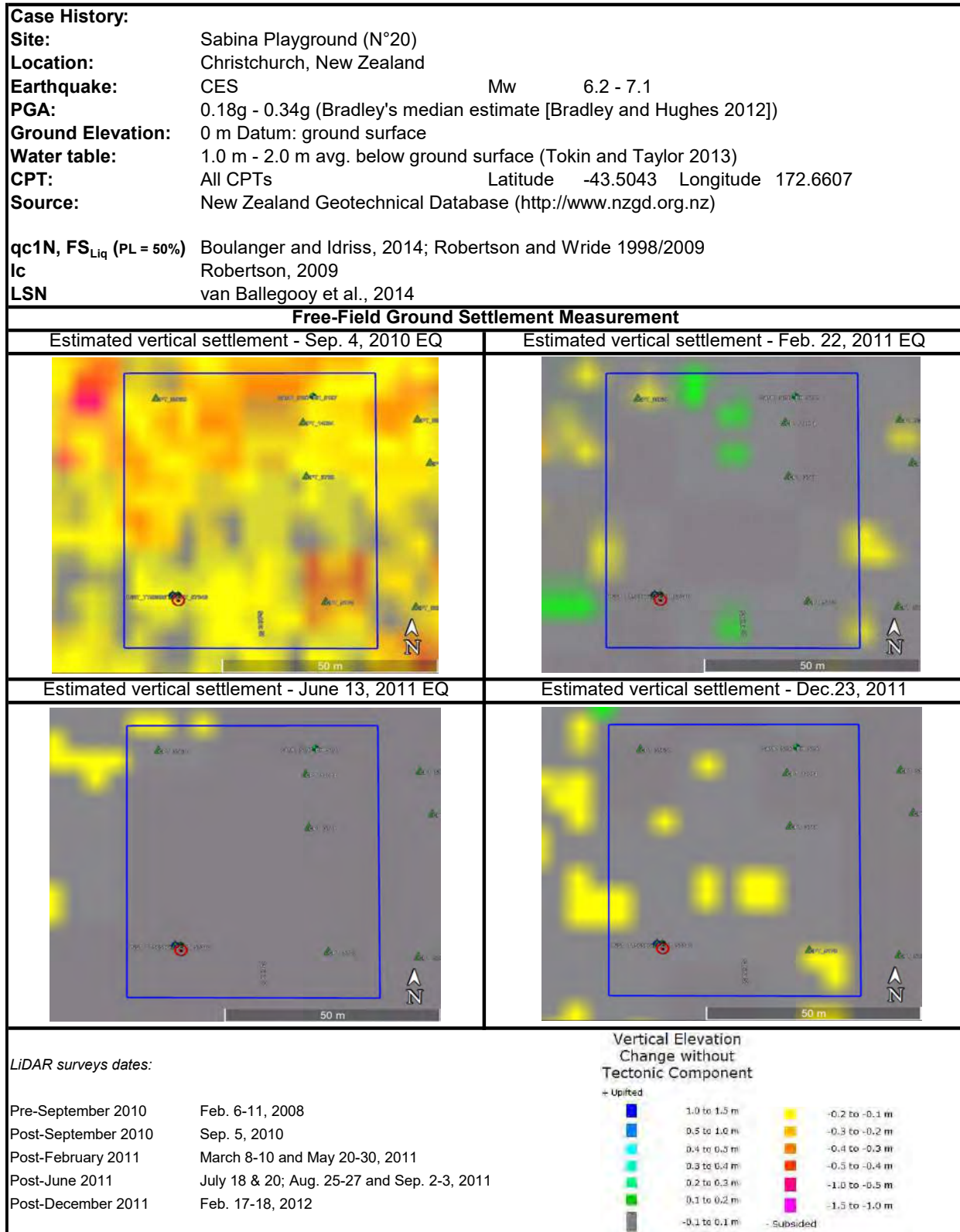
Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

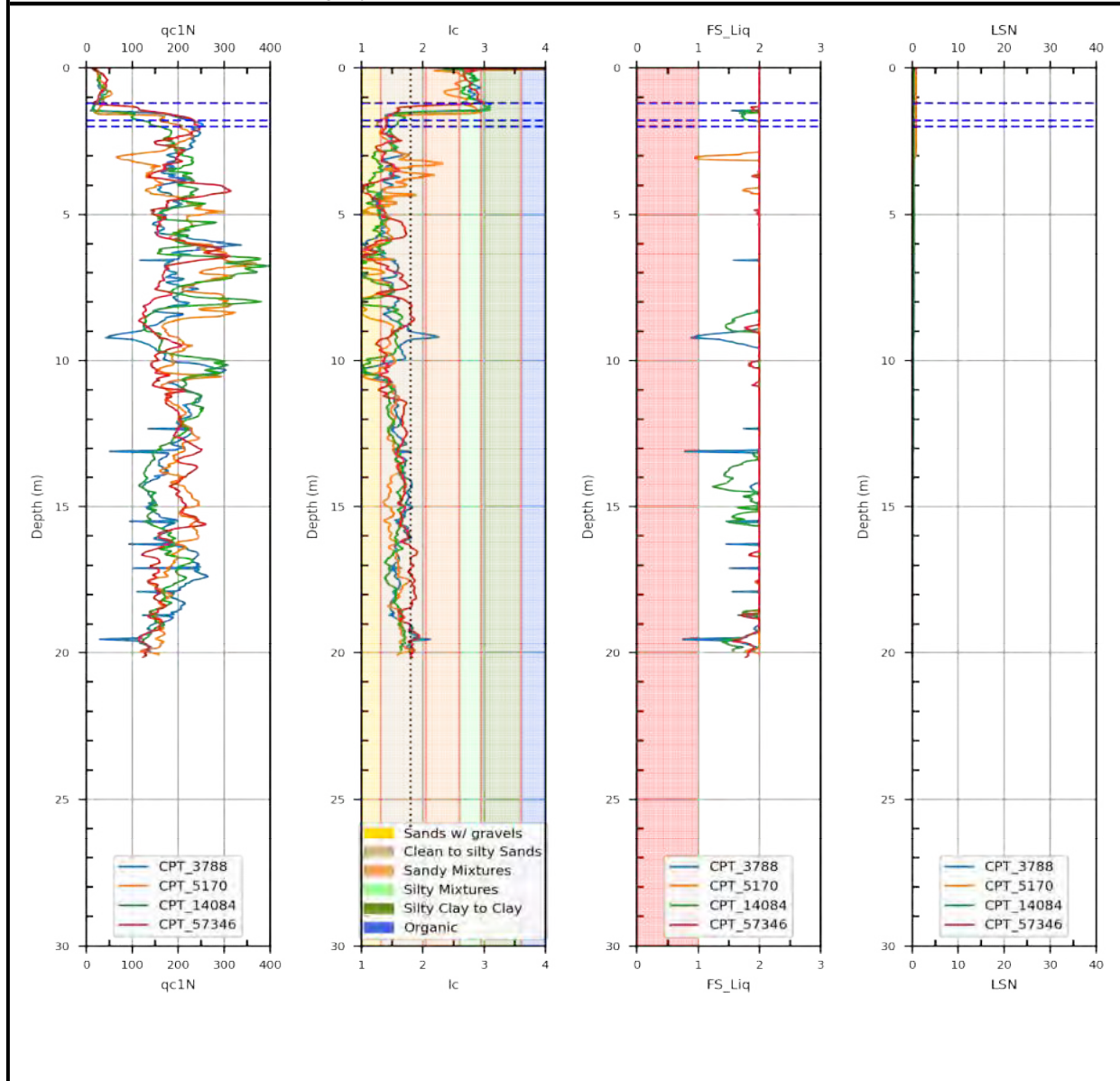
New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:	
Site:	Sabina Playground (N°20)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.18g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	1.0 m - 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5043 Longitude 172.6607
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
	



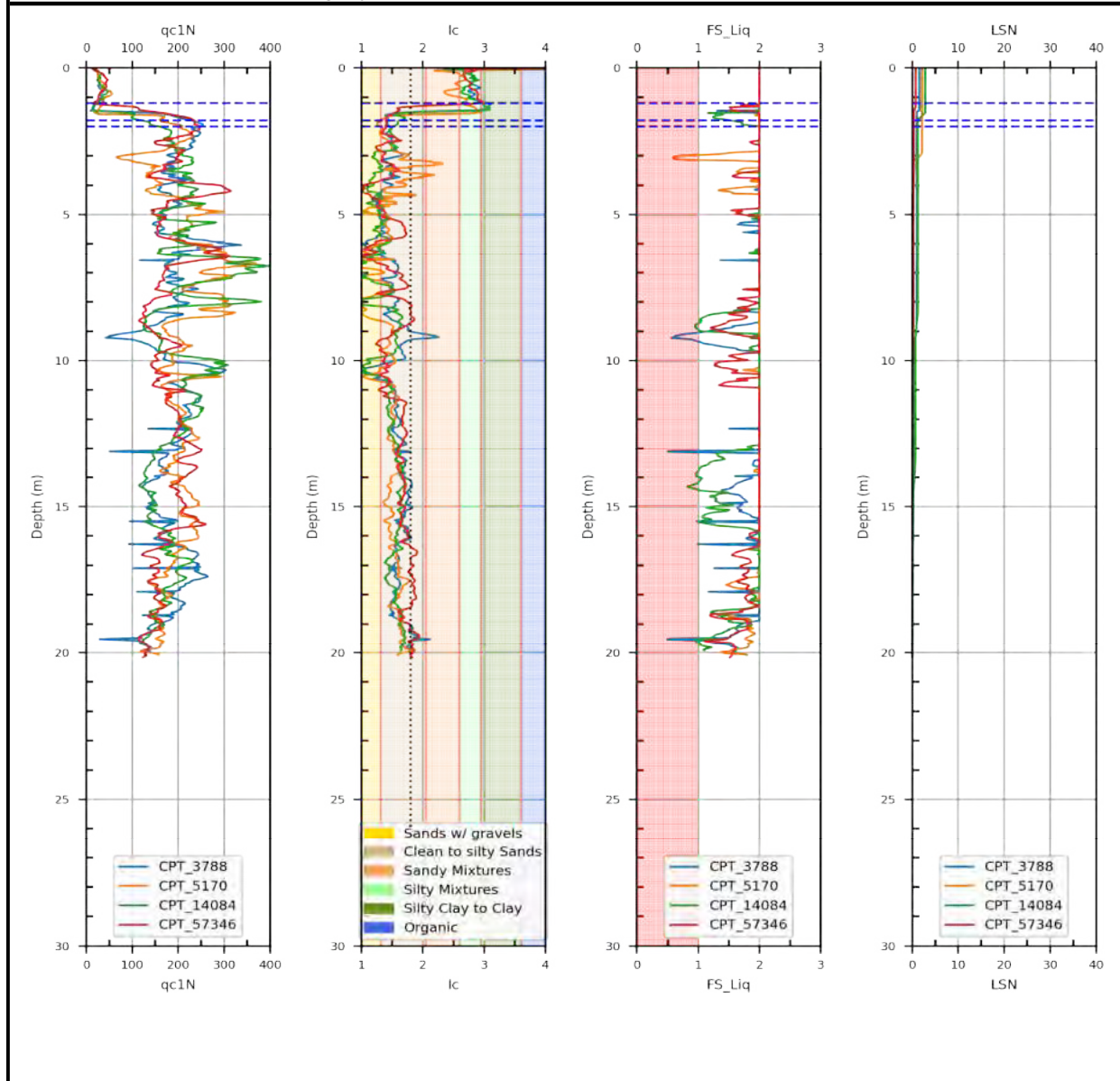
Case History: Ch-S58
Site: Sabina Playground (N°20)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.18g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0 m - 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5043 Longitude 172.6607
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



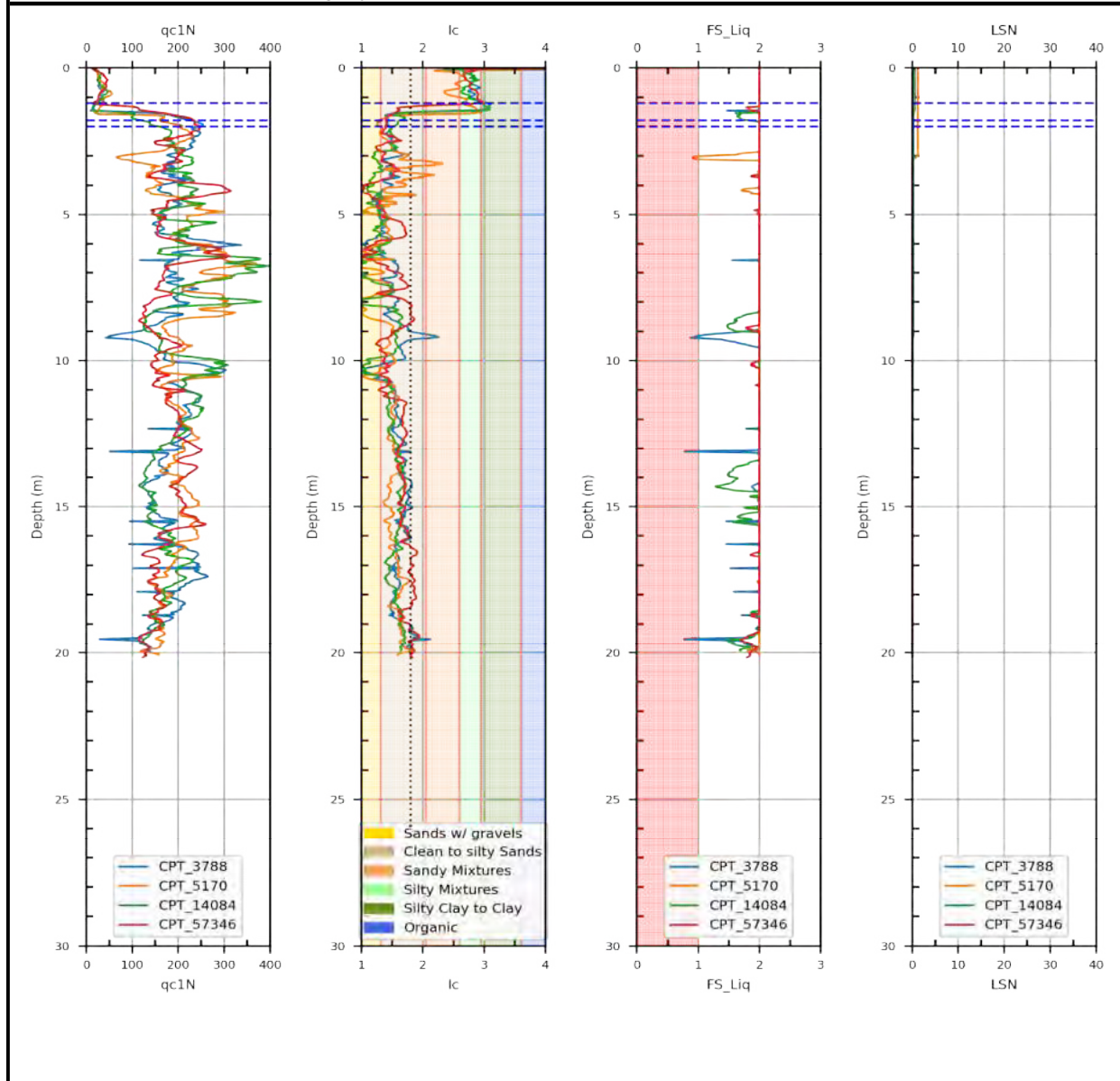
Case History: Ch-S59
Site: Sabina Playground (N°20)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0 m - 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5043 Longitude 172.6607
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S60
Site: Sabina Playground (N°20)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.20g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0 m - 1.2m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5043 Longitude 172.6607
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



Carisbrooke Playground

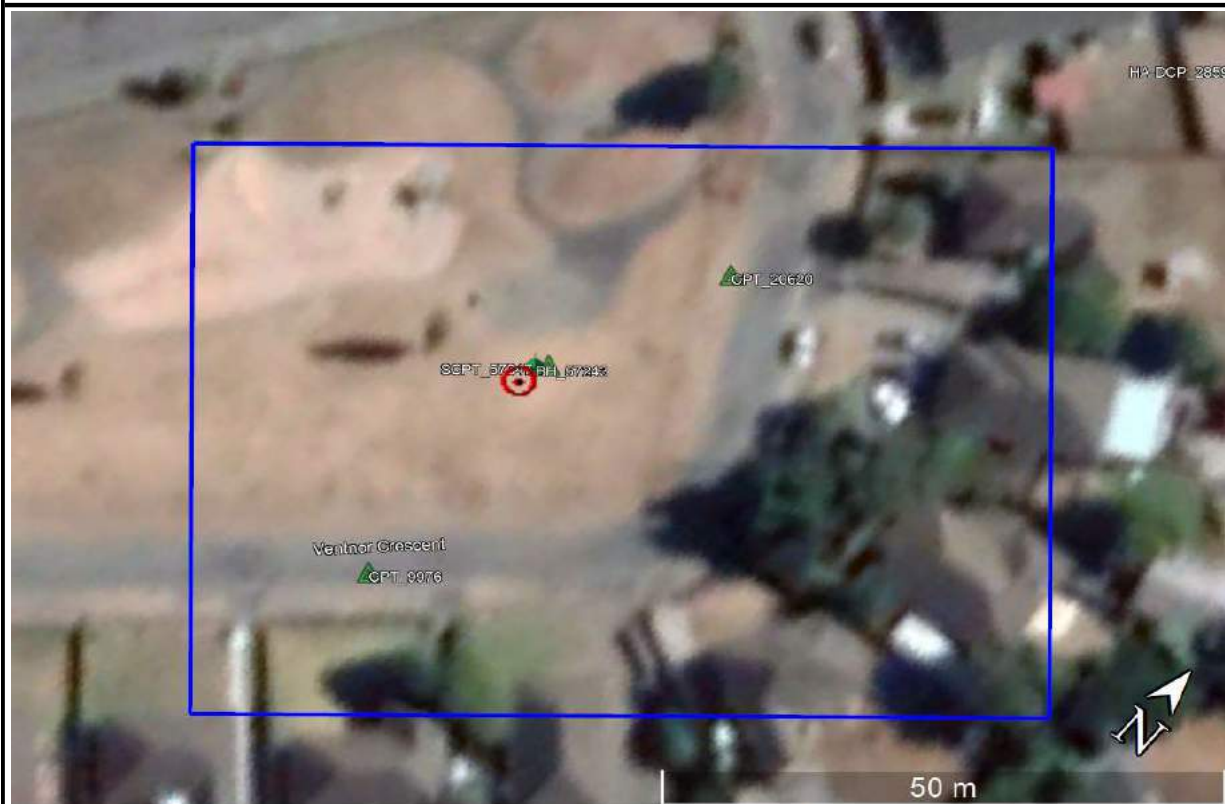
Case History:

Site: Carisbrooke Playground (N°21)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.46g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.3 m - 2.9 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5108 Longitude 172.7099
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

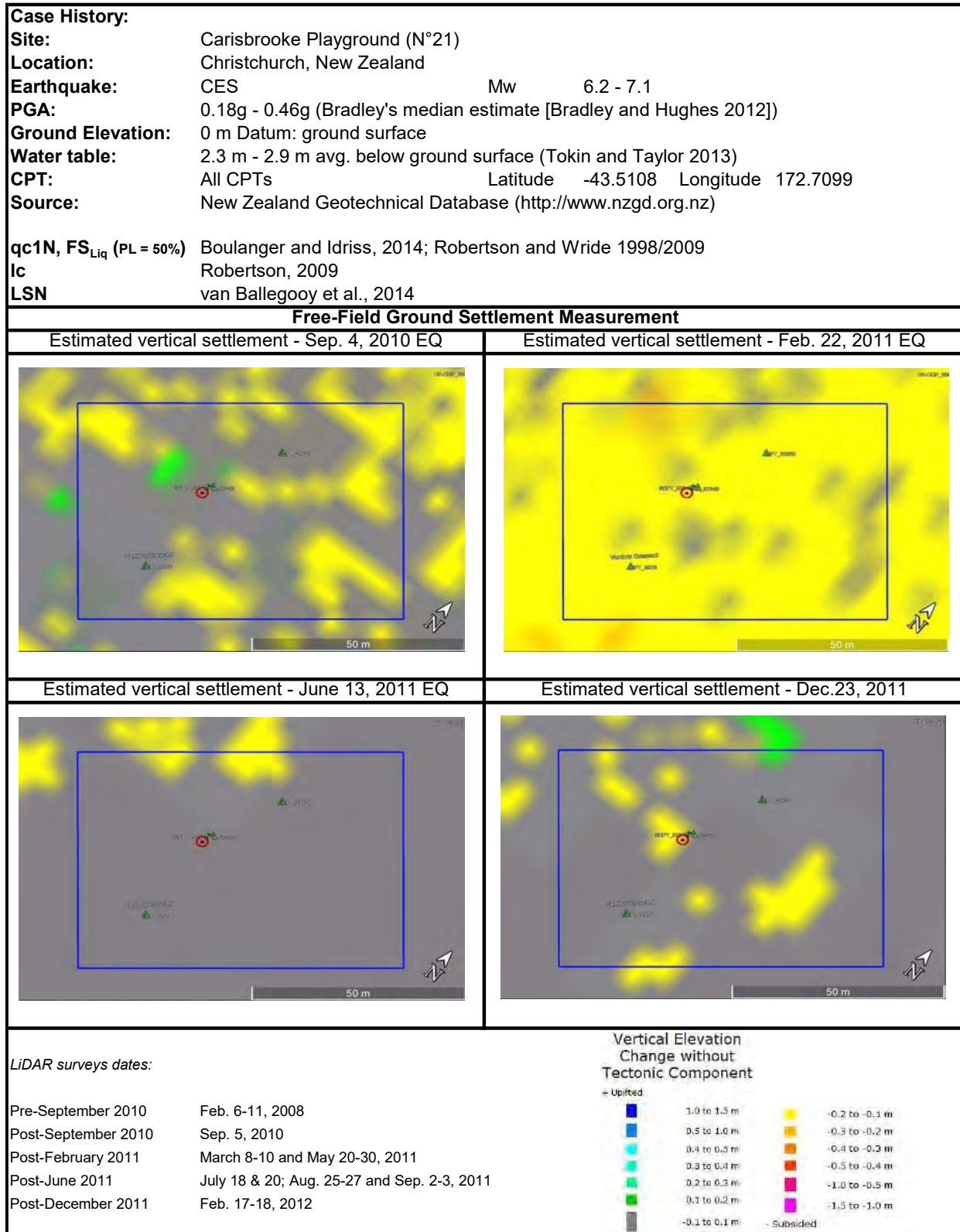
Site:	Carisbrooke Playground (N°21)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.18g - 0.46g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	2.3 m - 2.9 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5108 Longitude 172.7099
Source:	Christchurch City Council, map_Ap001725BlackMap.gws

Robertson, 2009

Surficial Geology - waterways swamps and vegetation cover in 1856

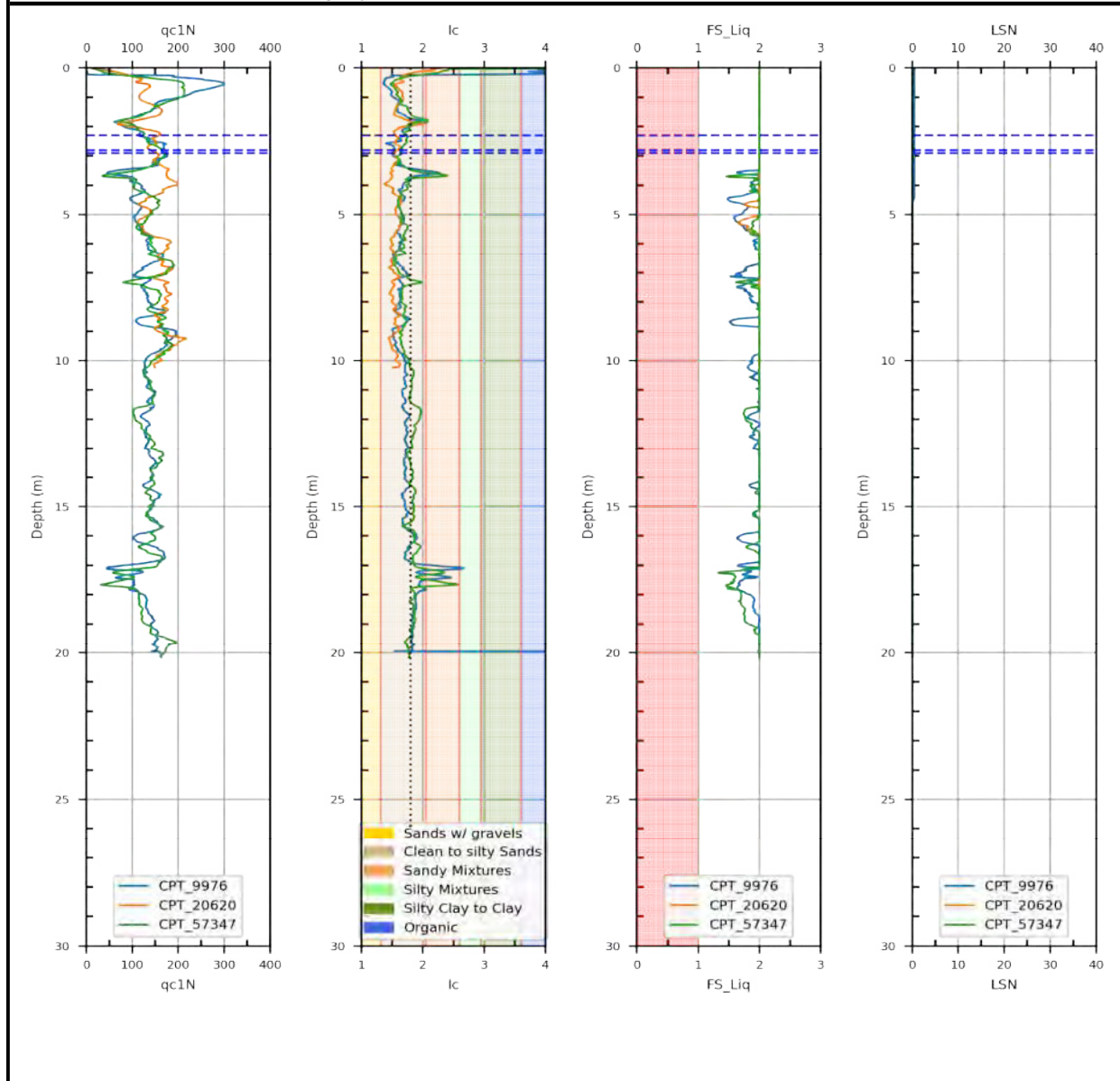


Case History:	
Site:	Carisbrooke Playground (N°21)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.18g - 0.46g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	2.3 m - 2.9 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5108 Longitude 172.7099
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
	



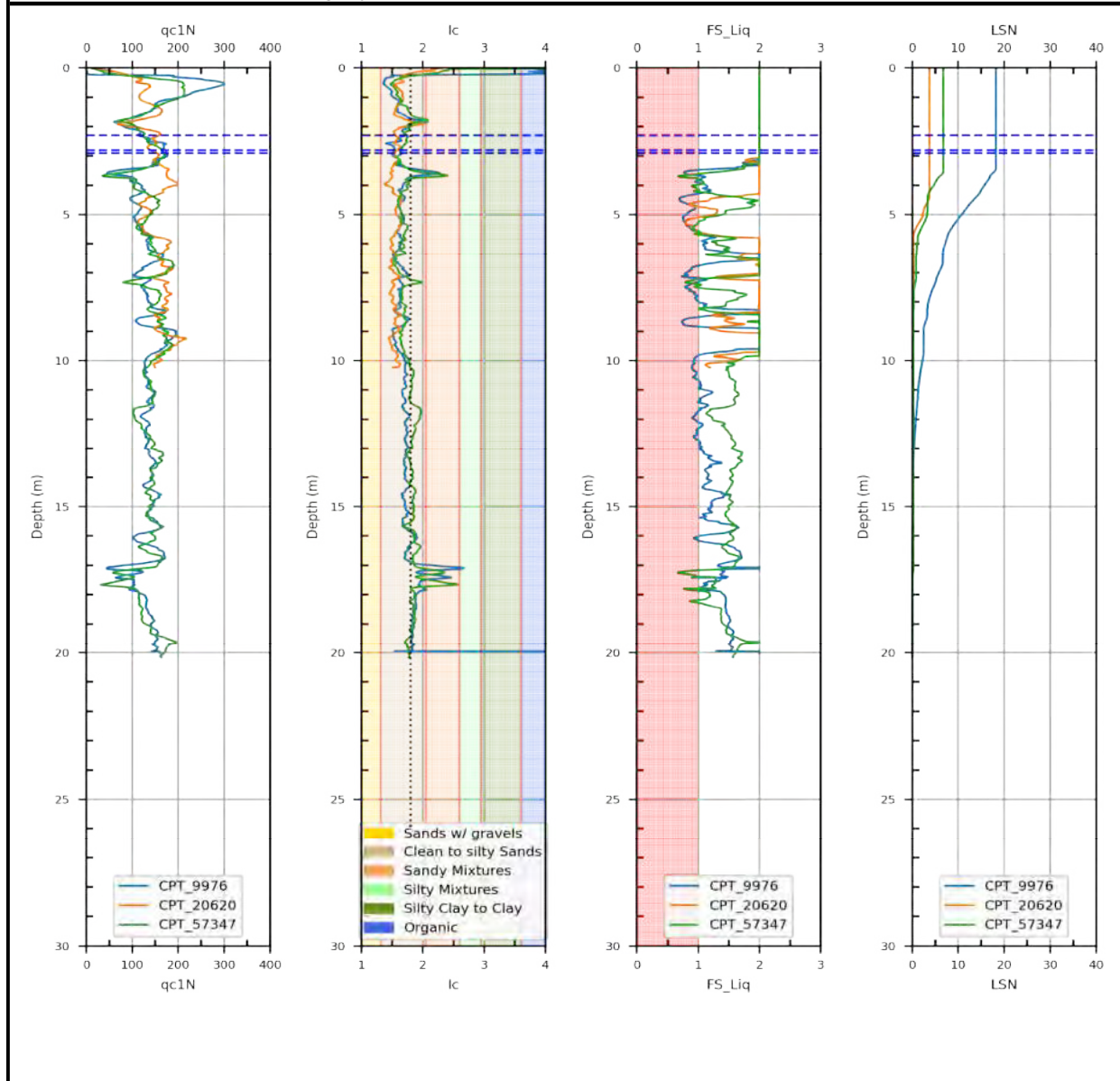
Case History: Ch-S61
Site: Carisbrooke Playground (N°21)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.18g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.3 m - 2.9 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5108 Longitude 172.7099
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



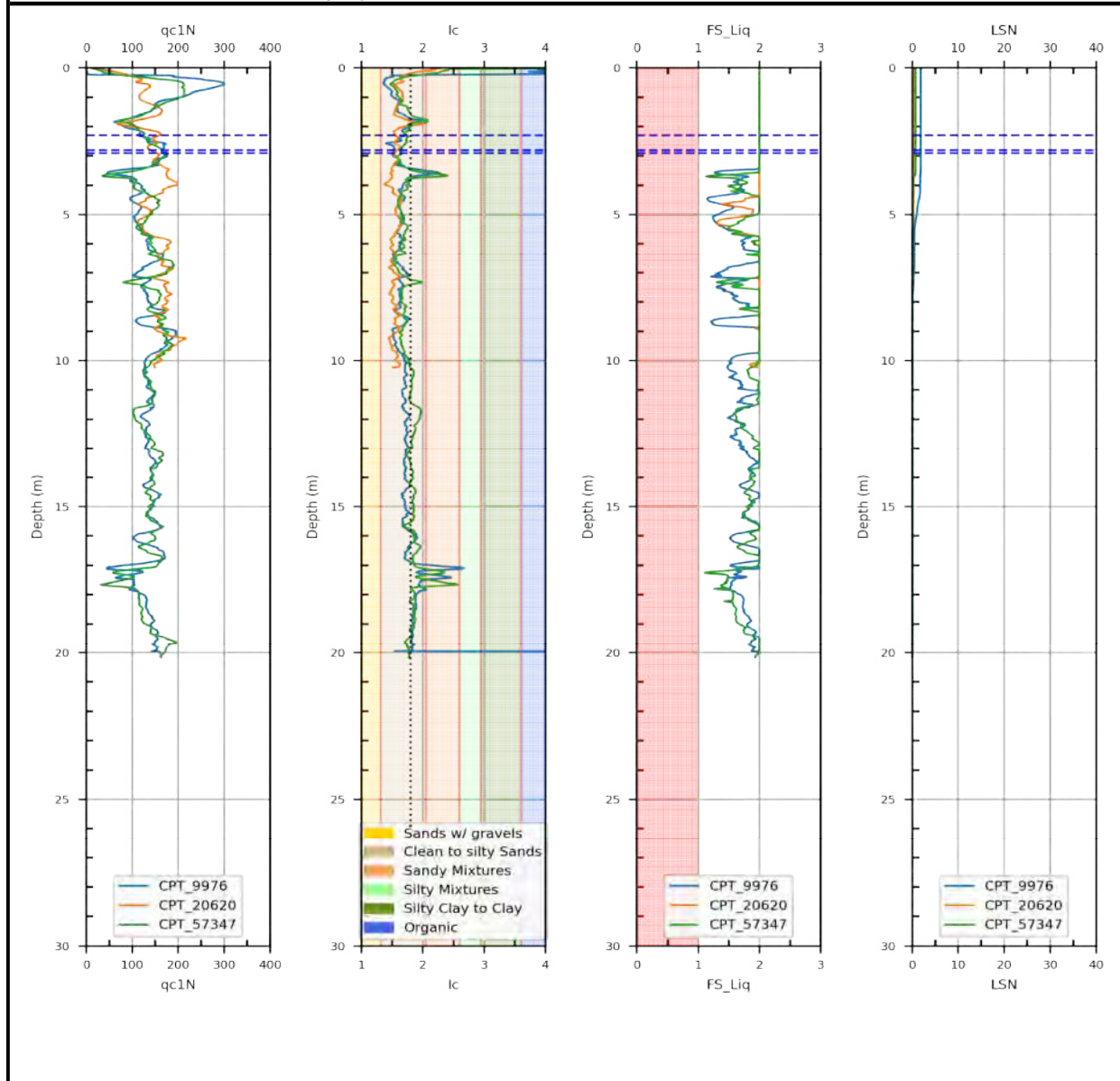
Case History: Ch-S62
Site: Carisbrooke Playground (N°21)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.46g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.3 m - 2.9 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5108 Longitude 172.7099
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S63
Site: Carisbrooke Playground (N°21)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.28g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.3 m - 2.9 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5108 Longitude 172.7099
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



20 Corhampton Street

Site:	20 Corhampton Street (N°22)		
Location:	Christchurch, New Zealand		
Earthquake:	CES	Mw	6.2 - 7.1
PGA:	0.18g - 0.48g (Bradley's median estimate [Bradley and Hughes 2012])		
Ground Elevation:	0 m Datum: ground surface		
Water table:	1.8 m - 2.0 m avg. below ground surface (Tokin and Taylor 2013)		
CPT:	All CPTs	Latitude	-43.5116 Longitude 172.7114
Source:	Christchurch City Council, map_Ap001725BlackMap.gws		

Robertson, 2009

Surficial Geology - waterways swamps and vegetation cover in 1856

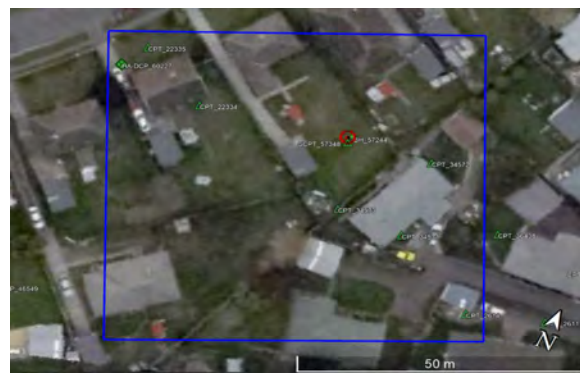


Site:	20 Corhampton Street (N°22)		
Location:	Christchurch, New Zealand		
Earthquake:	CES	Mw	6.2 - 7.1
PGA:	0.18g - 0.48g (Bradley's median estimate [Bradley and Hughes 2012])		
Ground Elevation:	0 m Datum: ground surface		
Water table:	1.8 m - 2.0 m avg. below ground surface (Tokin and Taylor 2013)		
CPT:	All CPTs	Latitude	-43.5116 Longitude 172.7114
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)		

qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc	Robertson, 2009
LSN	van Ballegooy et al., 2014

Ejecta Patterns

Aerial photography taken on September 5, 2010



Aerial photography taken on February 24, 2011



Aerial photography taken on June 14-15, 2011



Aerial photography taken on December 24, 2011



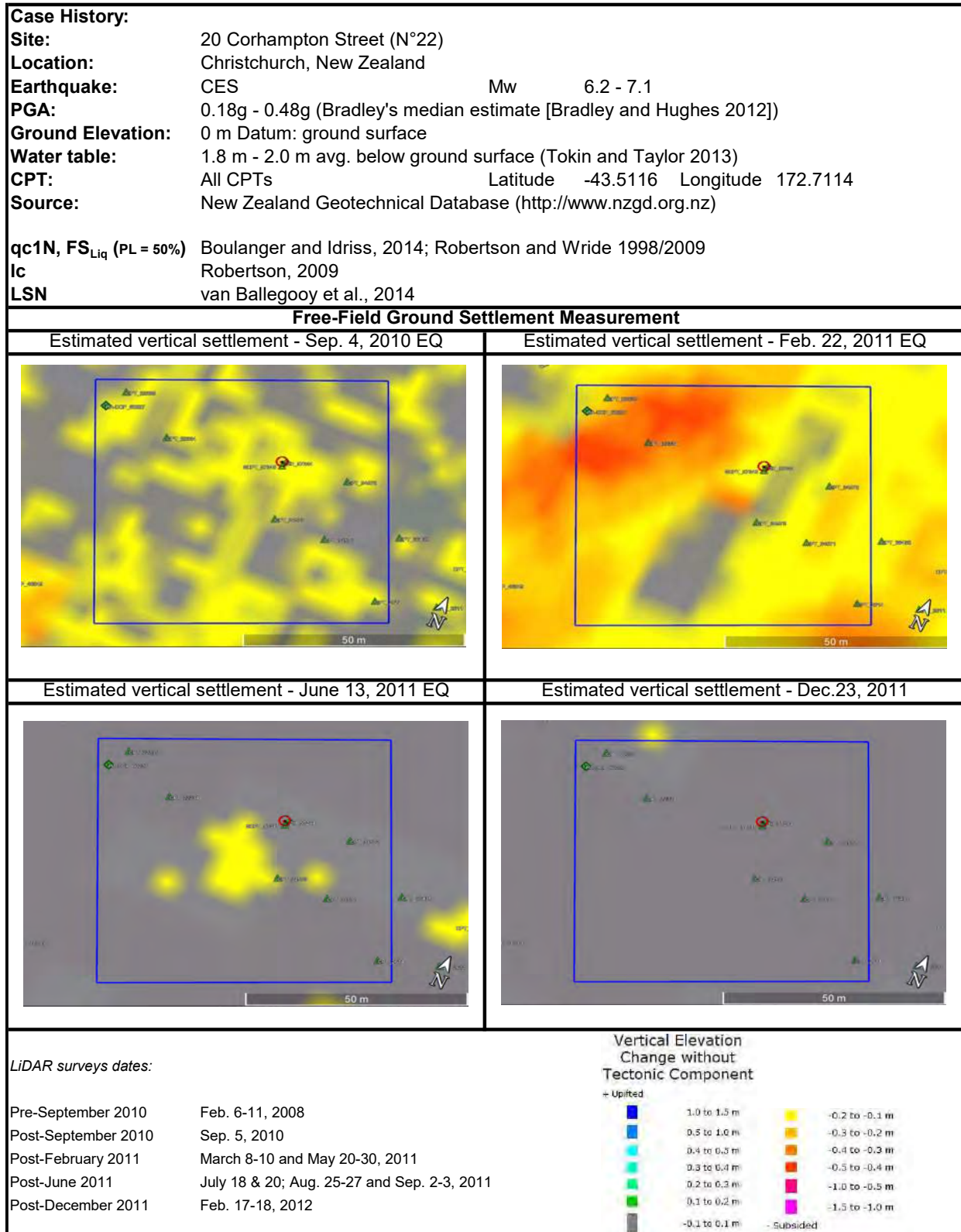
Ministry of Civil Defence
& Emergency Management
Te Kāwai Whakamāramaru

CERA 
Canterbury Earthquake
Recovery Authority

EQC
EARTHQUAKE COMMISSION
KONINKRIJK DER NEDERLANDEN

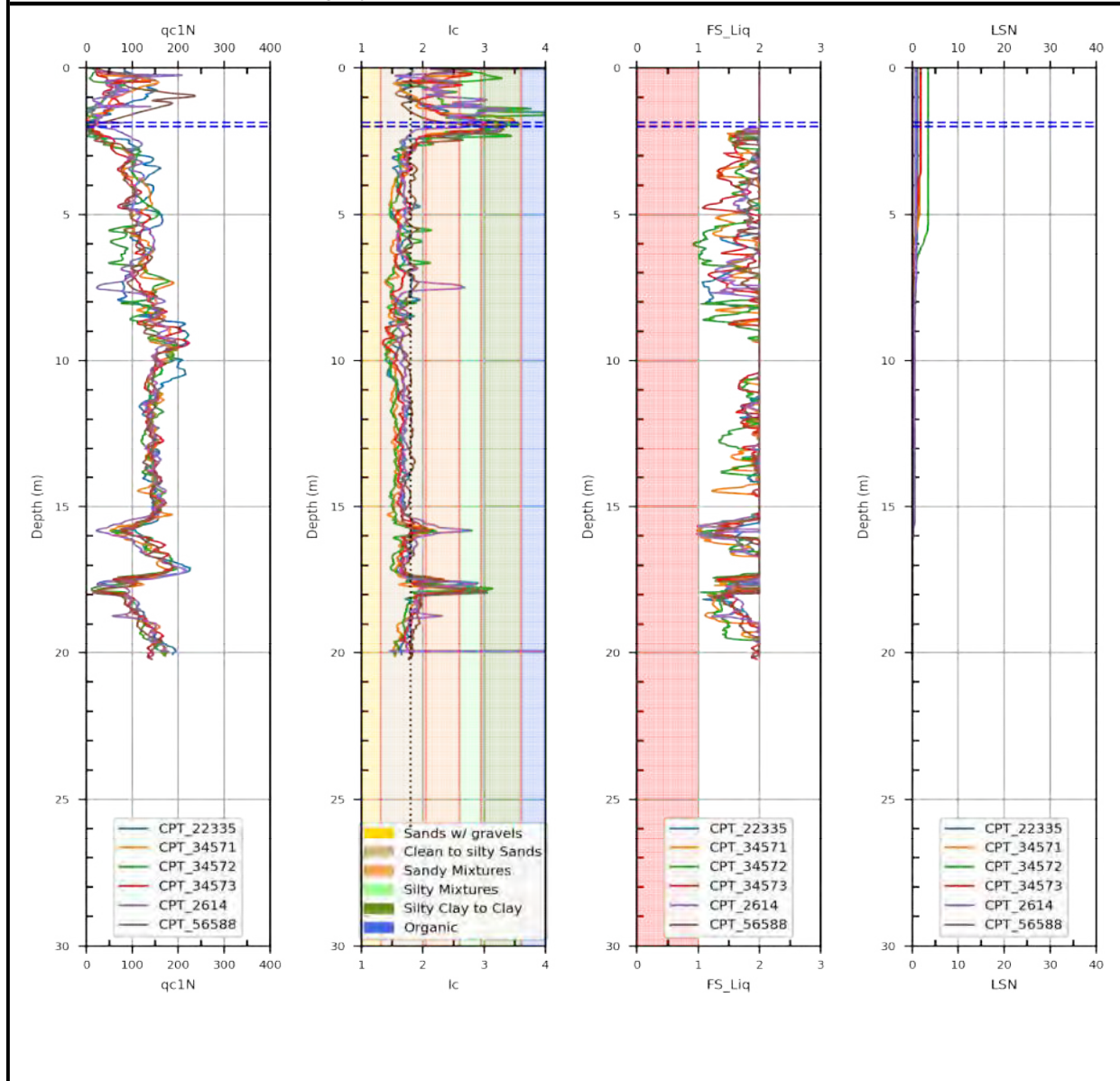


Tonkin & Taylor



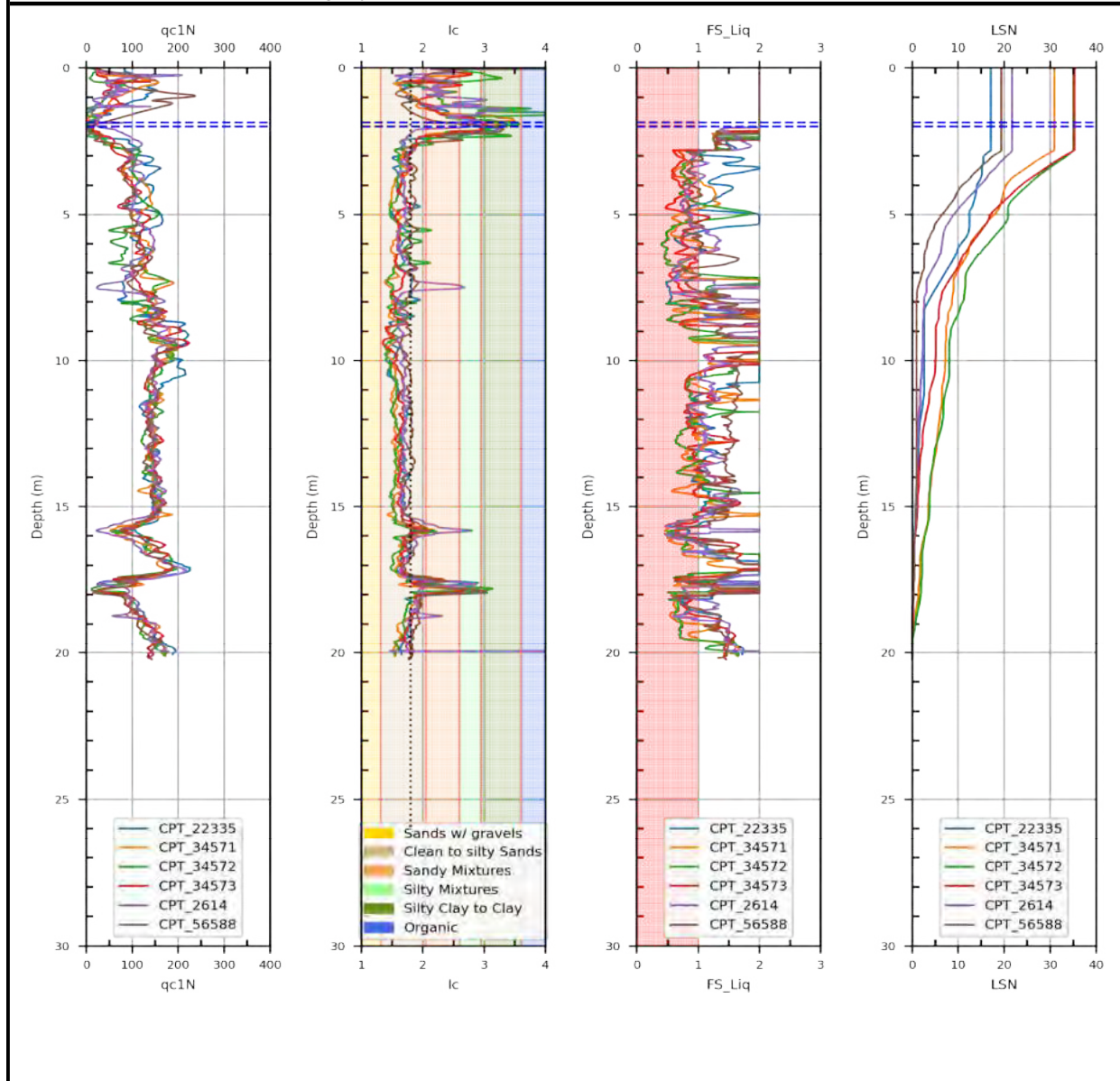
Case History: Ch-S64
Site: 20 Corhampton Street (N°22)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.18g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.8 m - 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5116 Longitude 172.7114
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



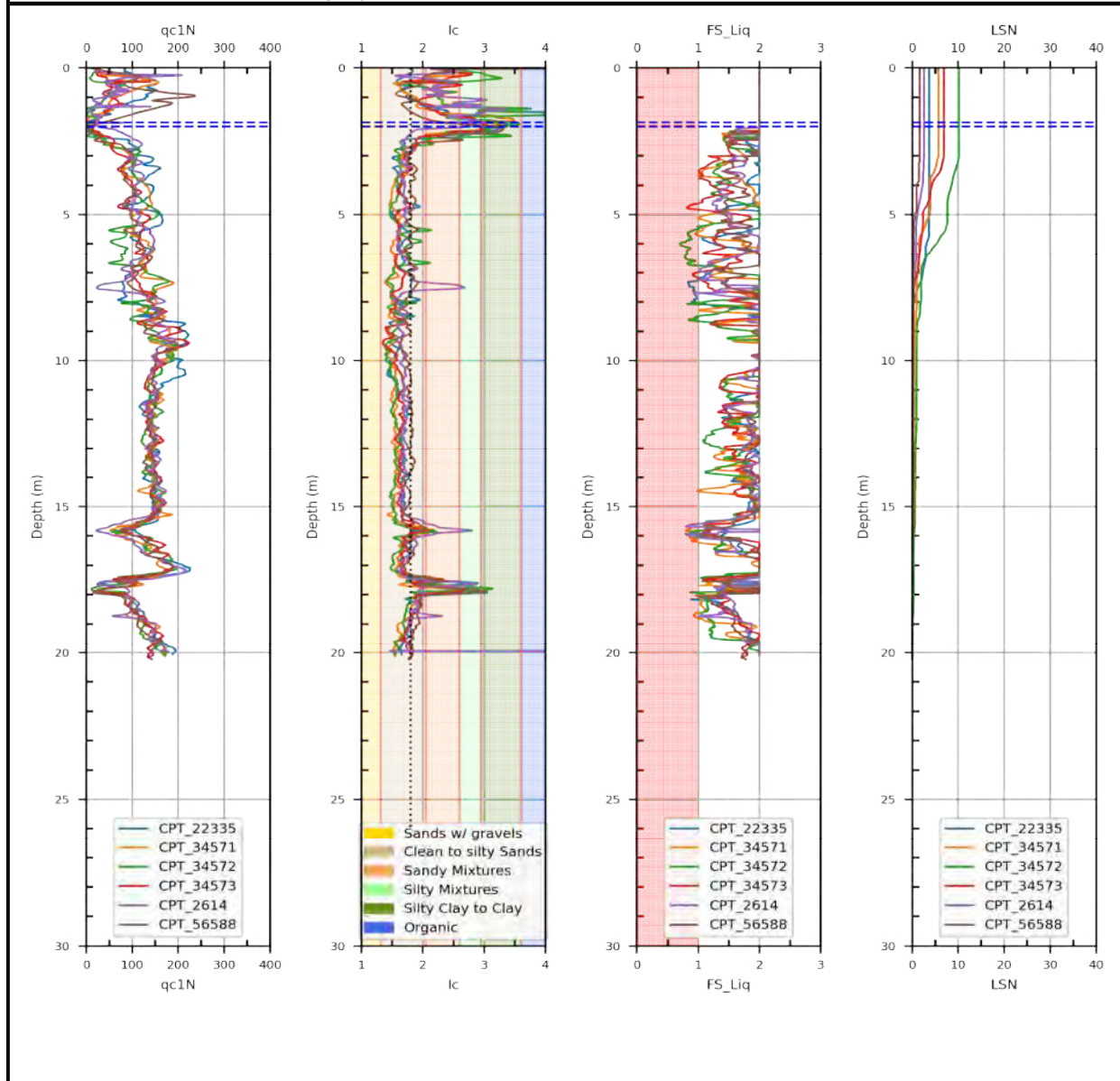
Case History: Ch-S65
Site: 20 Corhampton Street (N°22)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.48g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.8 m - 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5116 Longitude 172.7114
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S66
Site: 20 Corhampton Street (N°22)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.28g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.8 m - 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5116 Longitude 172.7114
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



50 Eureka Street

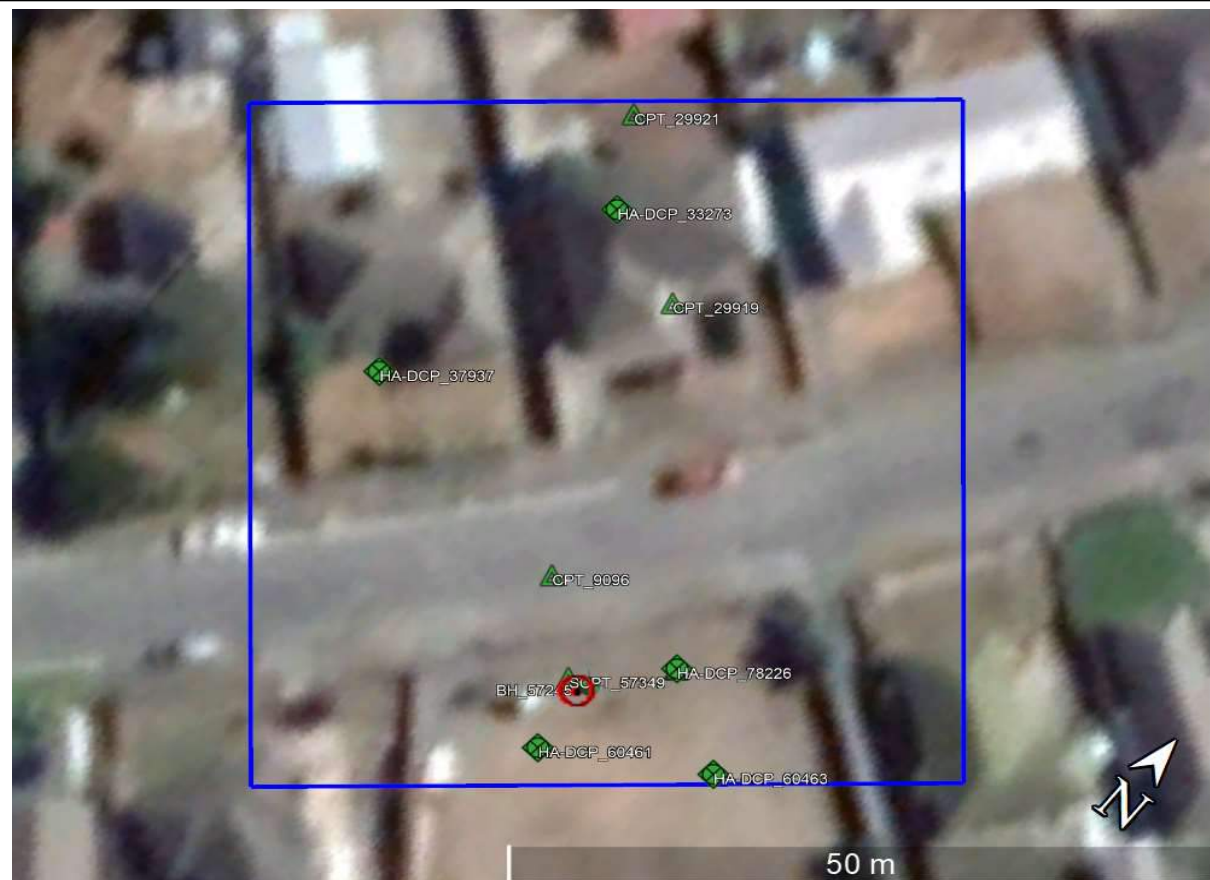
Case History:

Site: 50 Eureka Street (N°23)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.43g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5093 Longitude 172.7065
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

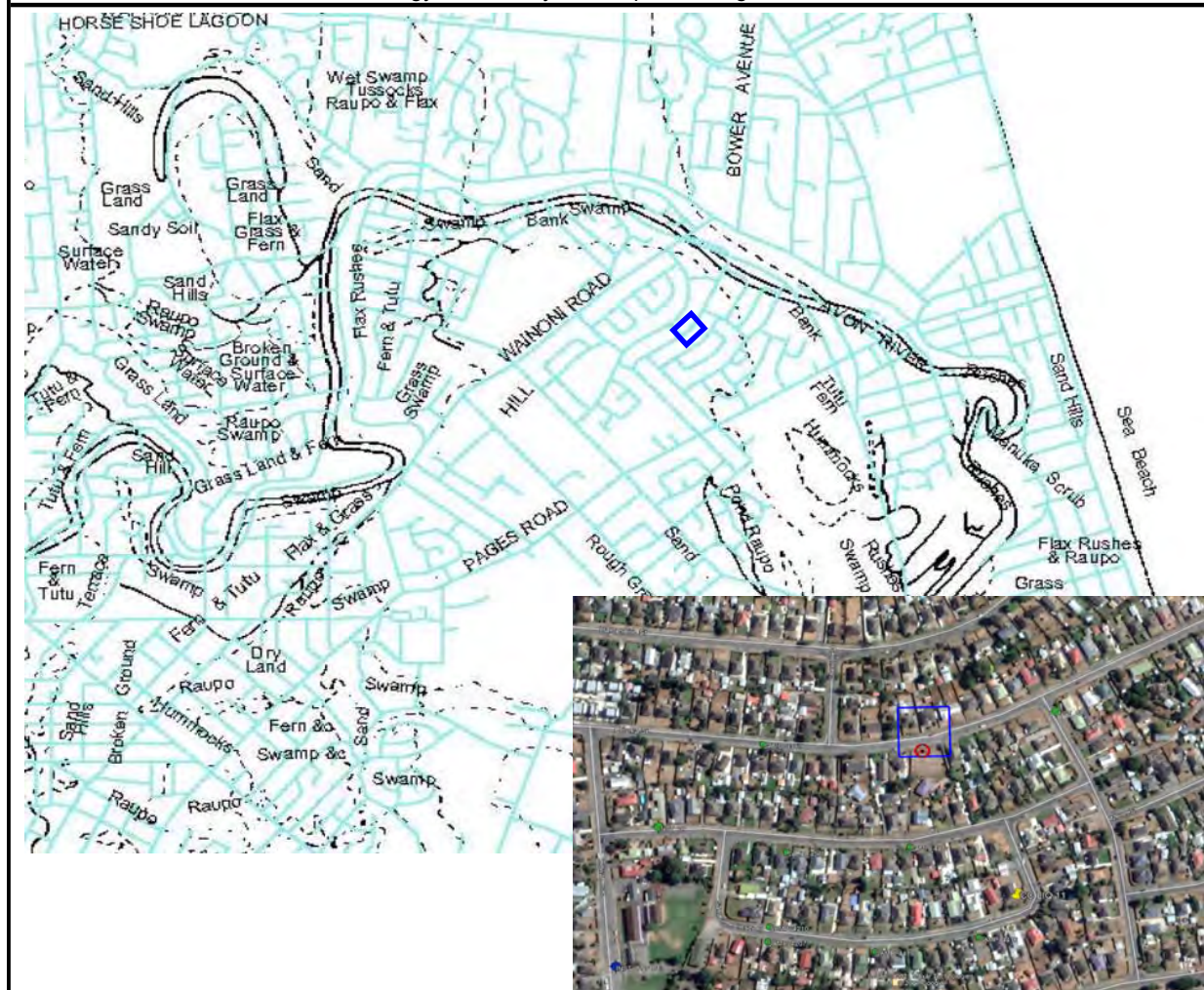
LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:**Site:** 50 Eureka Street (N°23)**Location:** Christchurch, New Zealand**Earthquake:** CES Mw 6.2 - 7.1**PGA:** 0.18g - 0.43g (Bradley's median estimate [Bradley and Hughes 2012])**Ground Elevation:** 0 m Datum: ground surface**Water table:** 2.0 m avg. below ground surface (Tokin and Taylor 2013)**CPT:** All CPTs Latitude -43.5093 Longitude 172.7065**Source:** Christchurch City Council, map_Ap001725BlackMap.gws**qc1N, FS_{Liq} (PL = 50%)** Boulanger and Idriss, 2014; Robertson and Wride 1998/2009**lc** Robertson, 2009**LSN** van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856



Case History:

Site: 50 Eureka Street (N°23)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.43g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5093 Longitude 172.7065
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

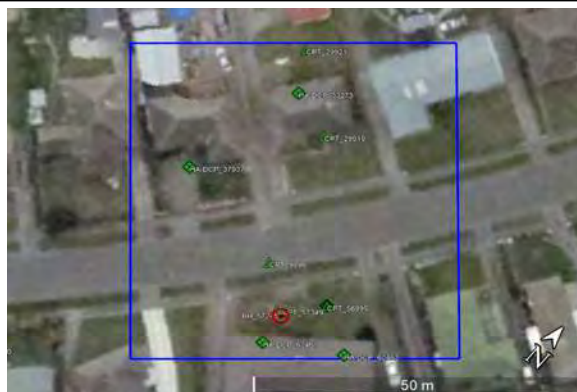
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Ejecta Patterns

Aerial photography taken on September 5, 2010



Aerial photography taken on February 24, 2011



Aerial photography taken on June 14-15, 2011



Aerial photography taken on December 24, 2011



Ministry of Civil Defence
& Emergency Management
Te Kaitiaki Whakamānau



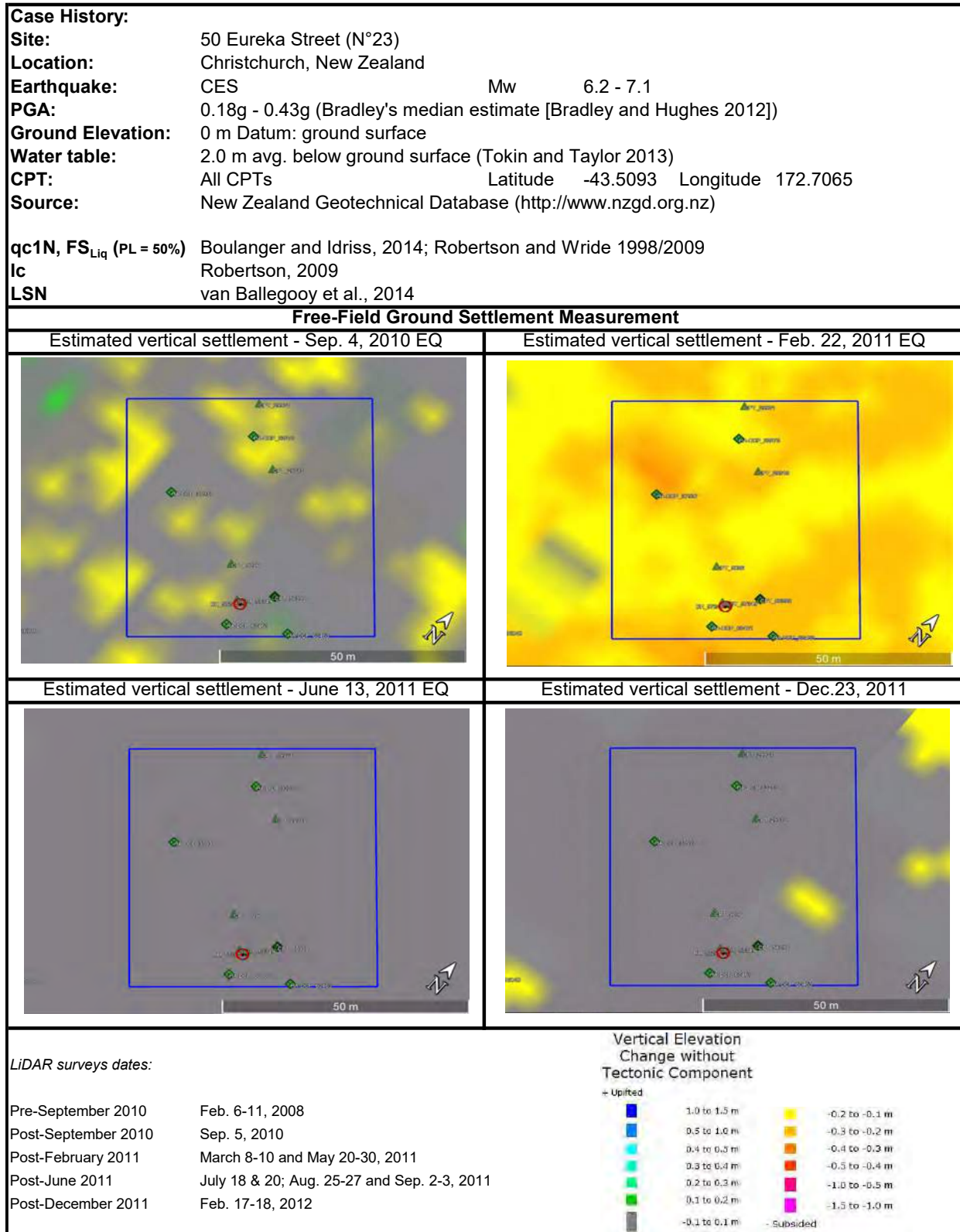
Canterbury Earthquake
Recovery Authority



EARTHQUAKE COMMISSION
Kaitiaki Takekōwhiri

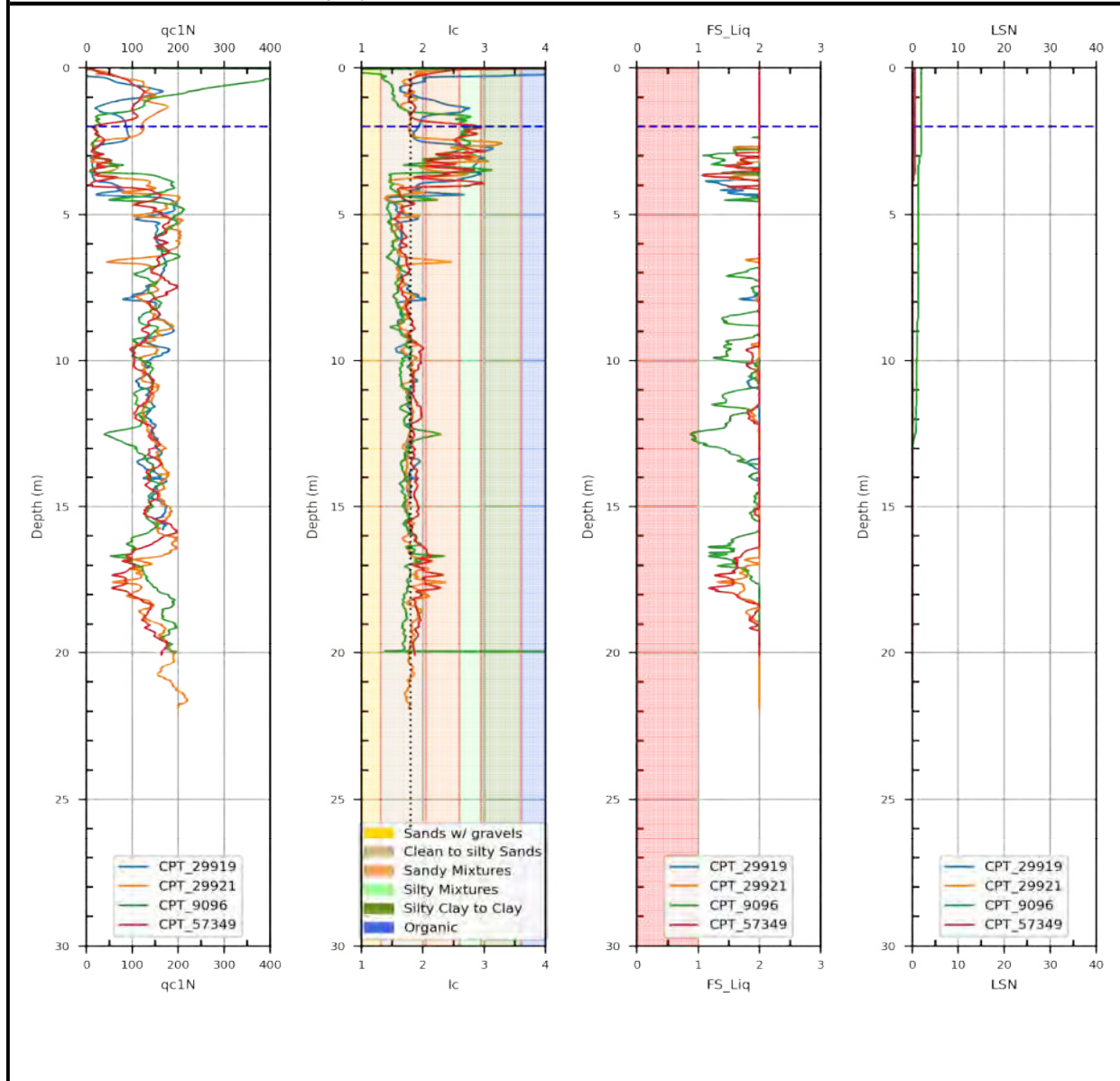


Tonkin & Taylor



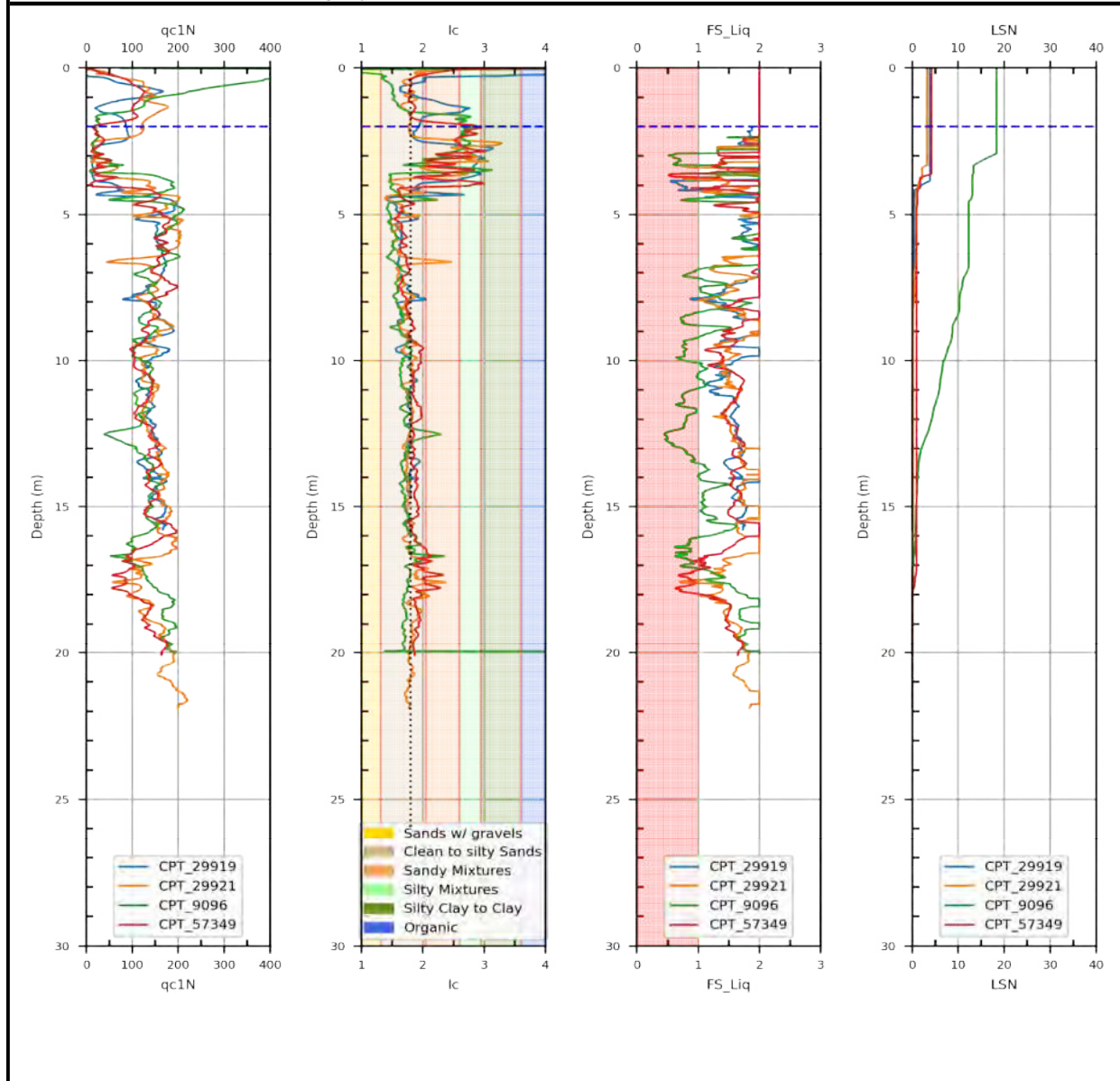
Case History: Ch-S67
Site: 50 Eureka Street (N°23)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.18g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5093 Longitude 172.7065
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



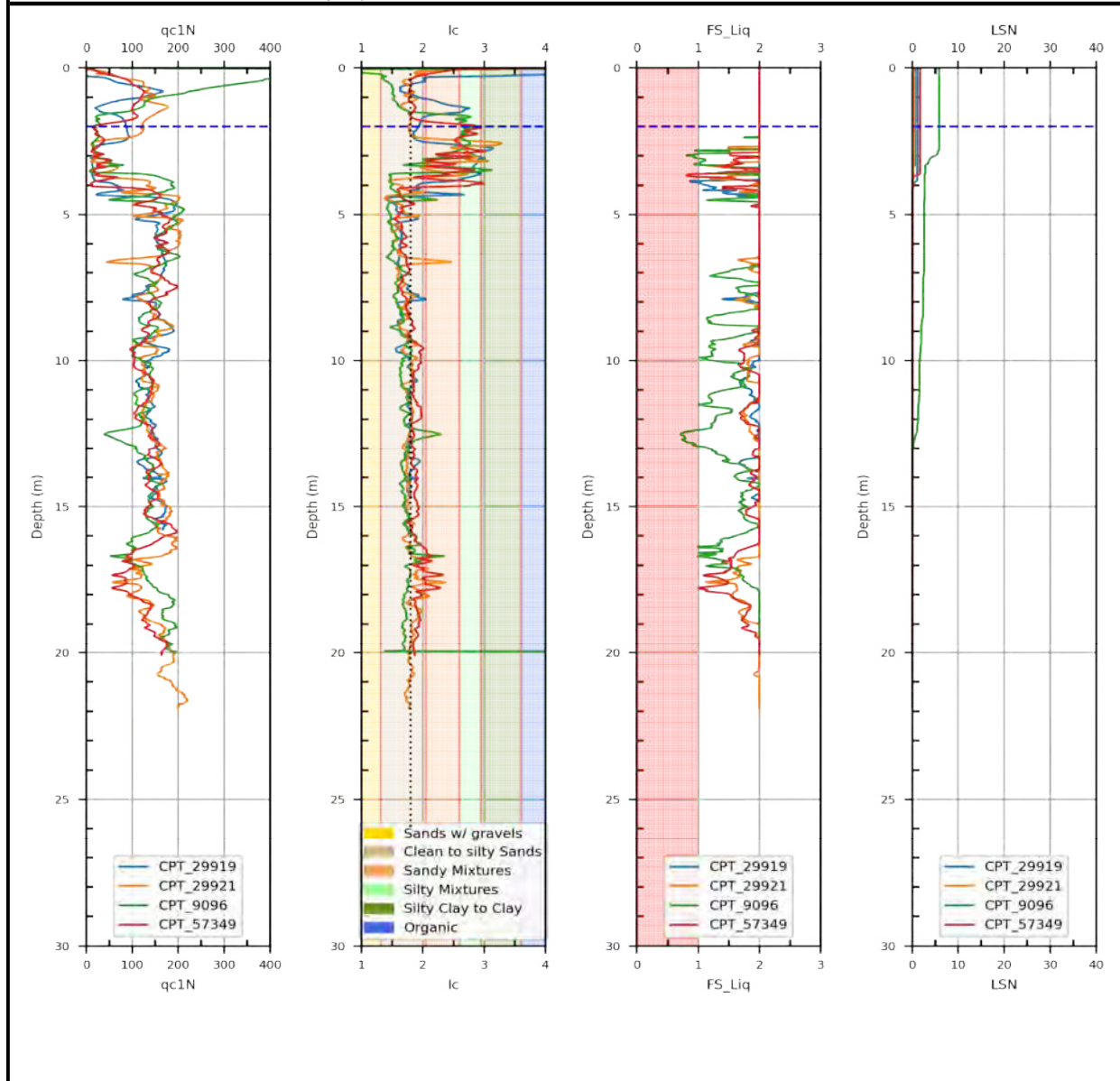
Case History: Ch-S68
Site: 50 Eureka Street (N°23)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.43g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5093 Longitude 172.7065
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S69
Site: 50 Eureka Street (N°23)
Location: Christchurch, New Zealand
Earthquake: Jun-11 Mw 6.2
PGA: 0.27g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5093 Longitude 172.7065
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



29 Charles Street

Case History:

Site: 29 Charles Street (N°24)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.22g - 0.52g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.9 m - 1.1 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5432 Longitude 172.6576
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

Site: 29 Charles Street (N°24)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.22g - 0.52g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.9 m - 1.1 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5432 Longitude 172.6576
Source: Christchurch City Council, map_Ap001725BlackMap.gws

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

lc Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856



Case History: Site: 29 Charles Street (N°24) Location: Christchurch, New Zealand Earthquake: CES Mw 6.2 - 7.1 PGA: 0.22g - 0.52g (Bradley's median estimate [Bradley and Hughes 2012]) Ground Elevation: 0 m Datum: ground surface Water table: 0.9 m - 1.1 m avg. below ground surface (Tokin and Taylor 2013) CPT: All CPTs Latitude -43.5432 Longitude 172.6576 Source: New Zealand Geotechnical Database (http://www.nzgd.org.nz) qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009 Ic Robertson, 2009 LSN van Ballegooy et al., 2014	
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
No aerial photo available	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
	

Case History:

Site: 29 Charles Street (N°24)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.22g - 0.52g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.9 m - 1.1 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5432 Longitude 172.6576
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

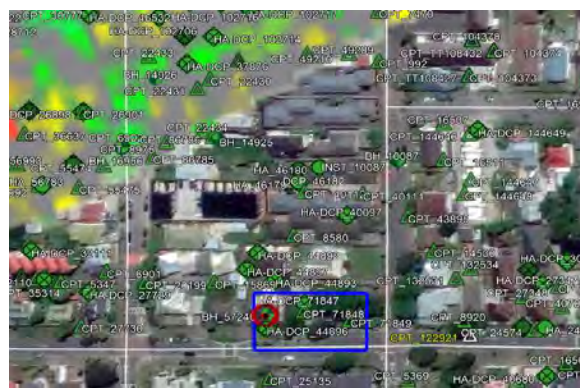
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Free-Field Ground Settlement Measurement

Estimated vertical settlement - Sep. 4, 2010 EQ



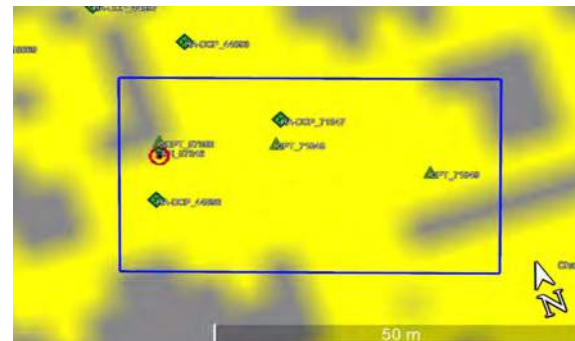
Estimated vertical settlement - Feb. 22, 2011 EQ



Estimated vertical settlement - June 13, 2011 EQ



Estimated vertical settlement - Dec.23, 2011



LiDAR surveys dates:

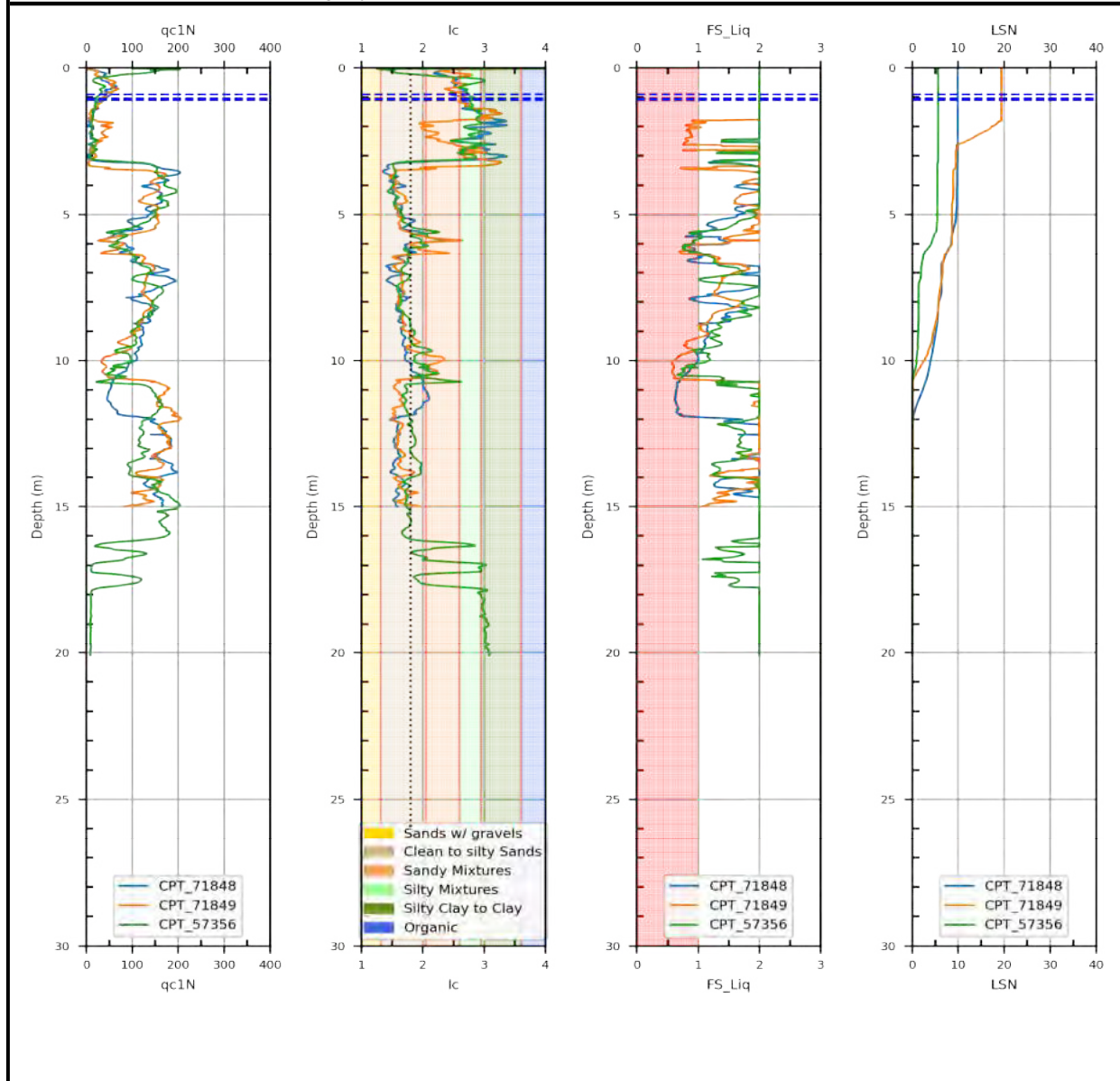
Pre-September 2010	Feb. 6-11, 2008
Post-September 2010	Sep. 5, 2010
Post-February 2011	March 8-10 and May 20-30, 2011
Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011
Post-December 2011	Feb. 17-18, 2012

Vertical Elevation Change without Tectonic Component



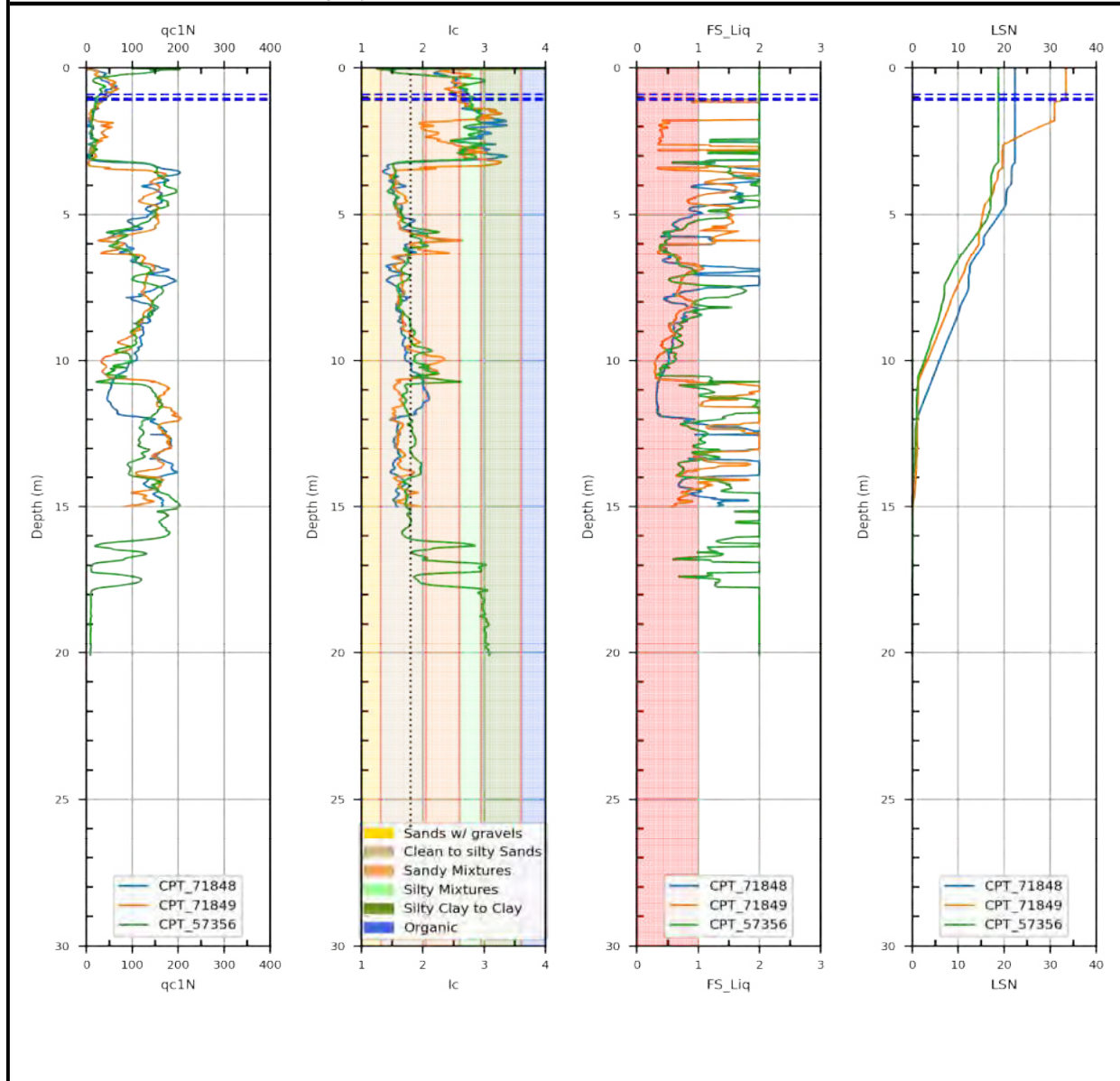
Case History: Ch-S70
Site: 29 Charles Street (N°24)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.22g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.9 m - 1.1 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5432 Longitude 172.6576
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



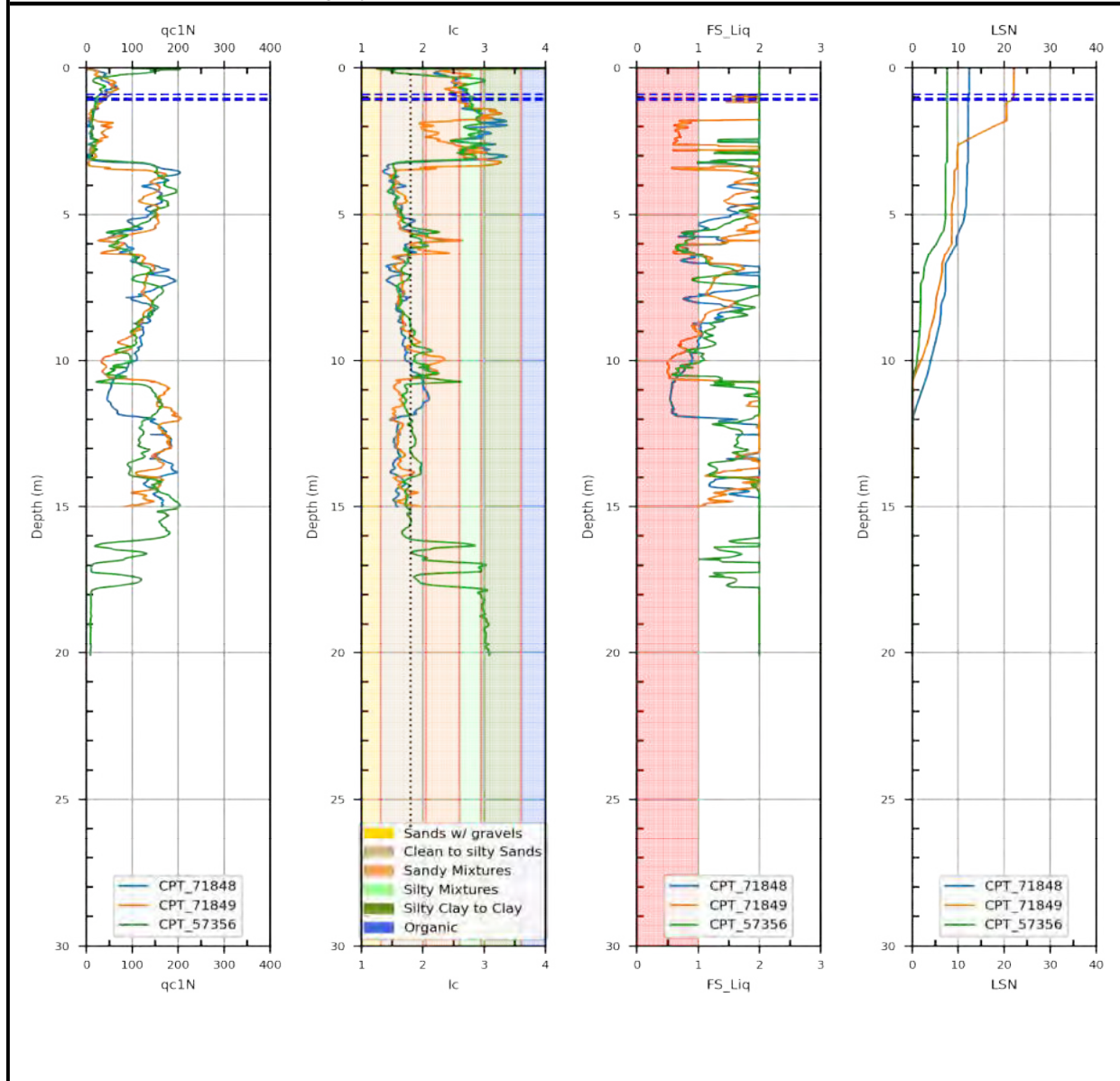
Case History: Ch-S71
Site: 29 Charles Street (N°24)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.52g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.9 m - 1.1 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5432 Longitude 172.6576
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S72
Site: 29 Charles Street (N°24)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.30g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.9 m - 1.1 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5432 Longitude 172.6576
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



59 Osborne Street

Case History:

Site: 59 Osborne Street (N°25)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.23g - 0.54g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5446 Longitude 172.6595
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

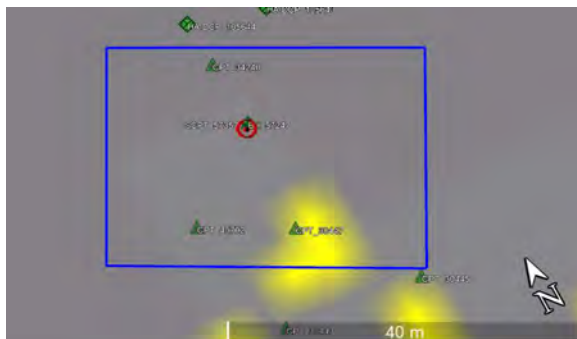
Site:	59 Osborne Street (N°25)		
Location:	Christchurch, New Zealand		
Earthquake:	CES	Mw	6.2 - 7.1
PGA:	0.23g - 0.54g (Bradley's median estimate [Bradley and Hughes 2012])		
Ground Elevation:	0 m Datum: ground surface		
Water table:	2.0 m avg. below ground surface (Tokin and Taylor 2013)		
CPT:	All CPTs	Latitude	-43.5446 Longitude 172.6595
Source:	Christchurch City Council, map_Ap001725BlackMap.gws		

Robertson, 2009

Surficial Geology - waterways swamps and vegetation cover in 1856

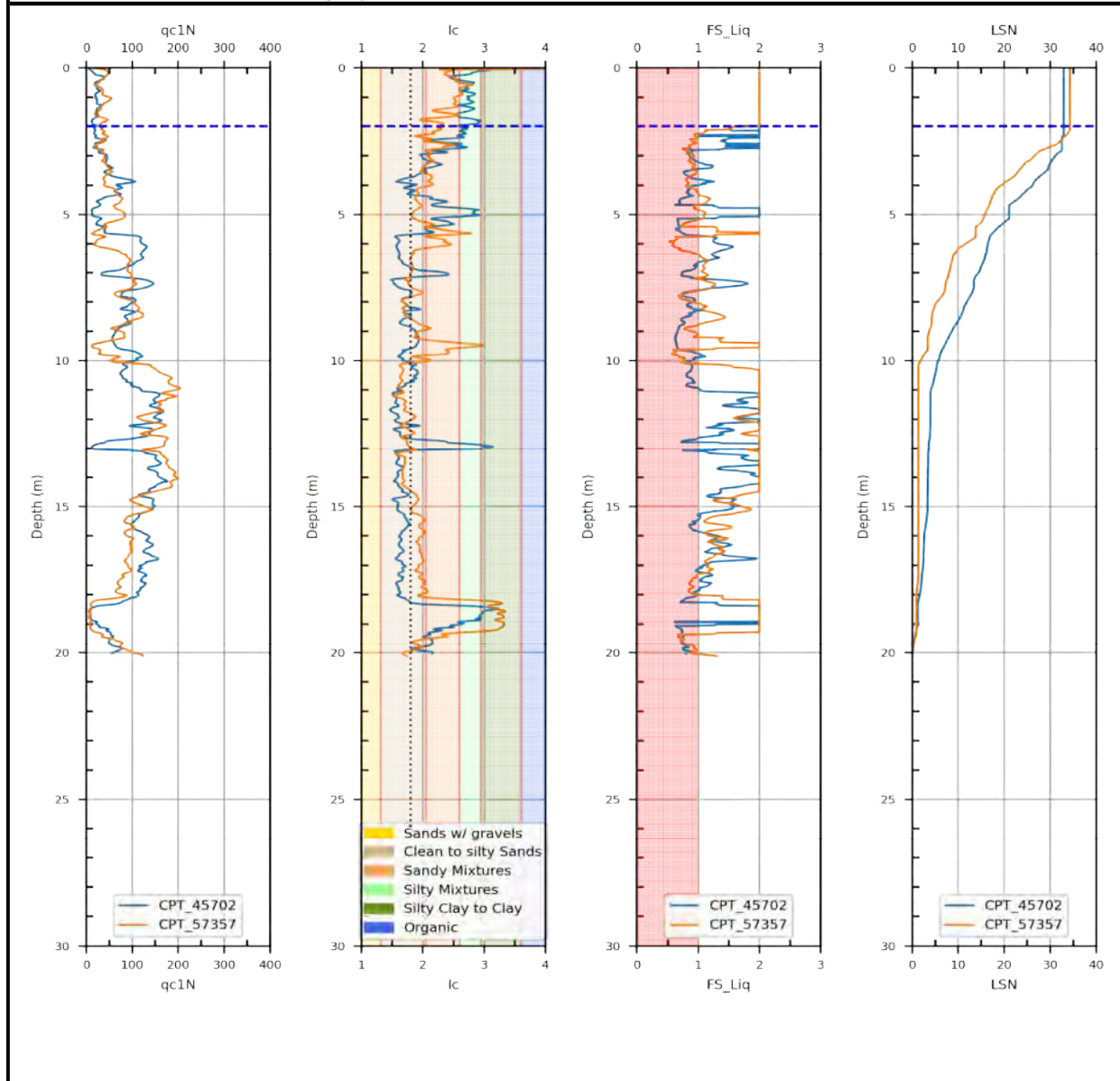


Case History: Site: 59 Osborne Street (N°25) Location: Christchurch, New Zealand Earthquake: CES Mw 6.2 - 7.1 PGA: 0.23g - 0.54g (Bradley's median estimate [Bradley and Hughes 2012]) Ground Elevation: 0 m Datum: ground surface Water table: 2.0 m avg. below ground surface (Tokin and Taylor 2013) CPT: All CPTs Latitude -43.5446 Longitude 172.6595 Source: New Zealand Geotechnical Database (http://www.nzgd.org.nz) qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009 lc Robertson, 2009 LSN van Ballegooy et al., 2014	
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
No aerial photo available	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
	

Case History:	
Site:	59 Osborne Street (N°25)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.23g - 0.54g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5446 Longitude 172.6595
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Free-Field Ground Settlement Measurement	
Estimated vertical settlement - Sep. 4, 2010 EQ	Estimated vertical settlement - Feb. 22, 2011 EQ
No LiDAR data available	No LiDAR data available
Estimated vertical settlement - June 13, 2011 EQ	Estimated vertical settlement - Dec.23, 2011
	
LiDAR surveys dates:	
Pre-September 2010	Feb. 6-11, 2008
Post-September 2010	Sep. 5, 2010
Post-February 2011	March 8-10 and May 20-30, 2011
Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011
Post-December 2011	Feb. 17-18, 2012
Vertical Elevation Change without Tectonic Component	
+ Uplifted	
	1.0 to 1.5 m
	0.5 to 1.0 m
	0.4 to 0.3 m
	0.3 to 0.4 m
	0.2 to 0.3 m
	0.1 to 0.2 m
	-0.1 to 0.1 m
	-0.2 to -0.1 m
	-0.3 to -0.2 m
	-0.4 to -0.3 m
	-0.5 to -0.4 m
	-1.0 to -0.5 m
	-1.5 to -1.0 m
- Subsided	

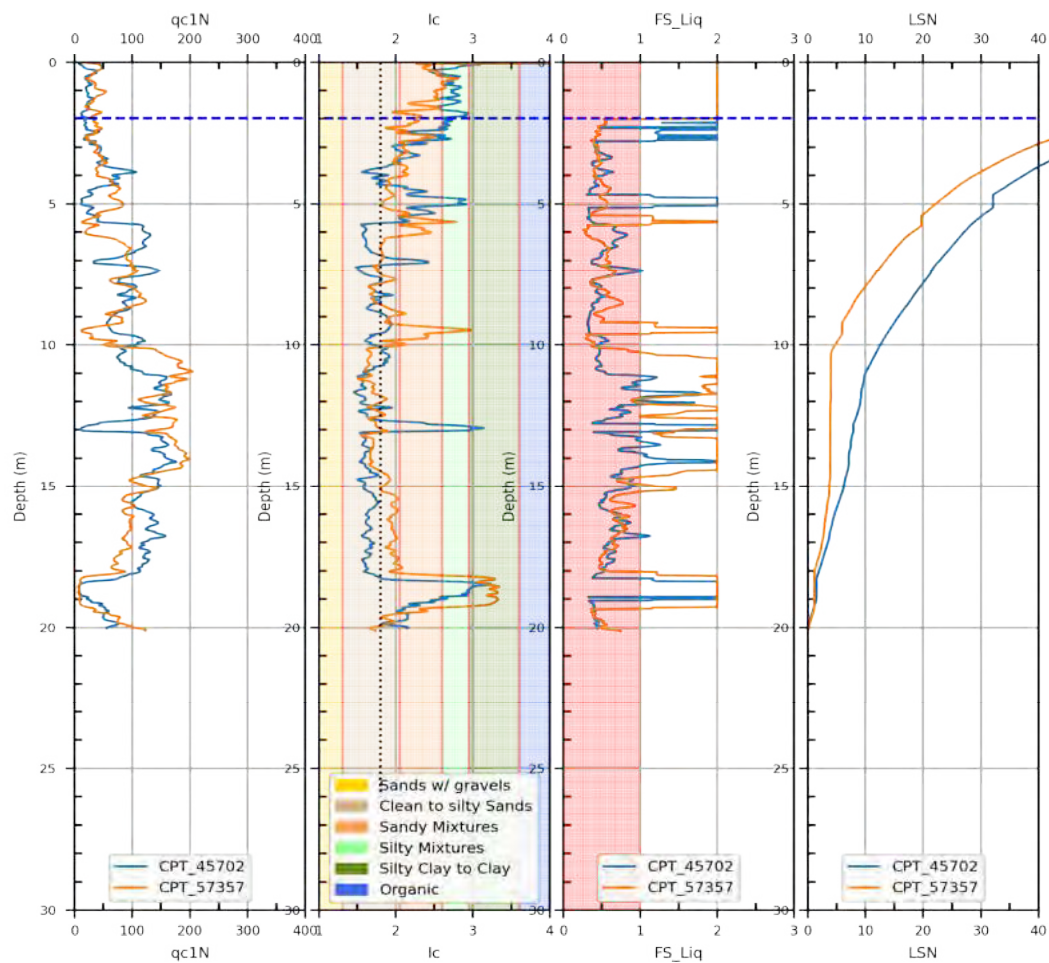
Case History: Ch-S73
Site: 59 Osborne Street (N°25)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.23g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5446 Longitude 172.6595
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



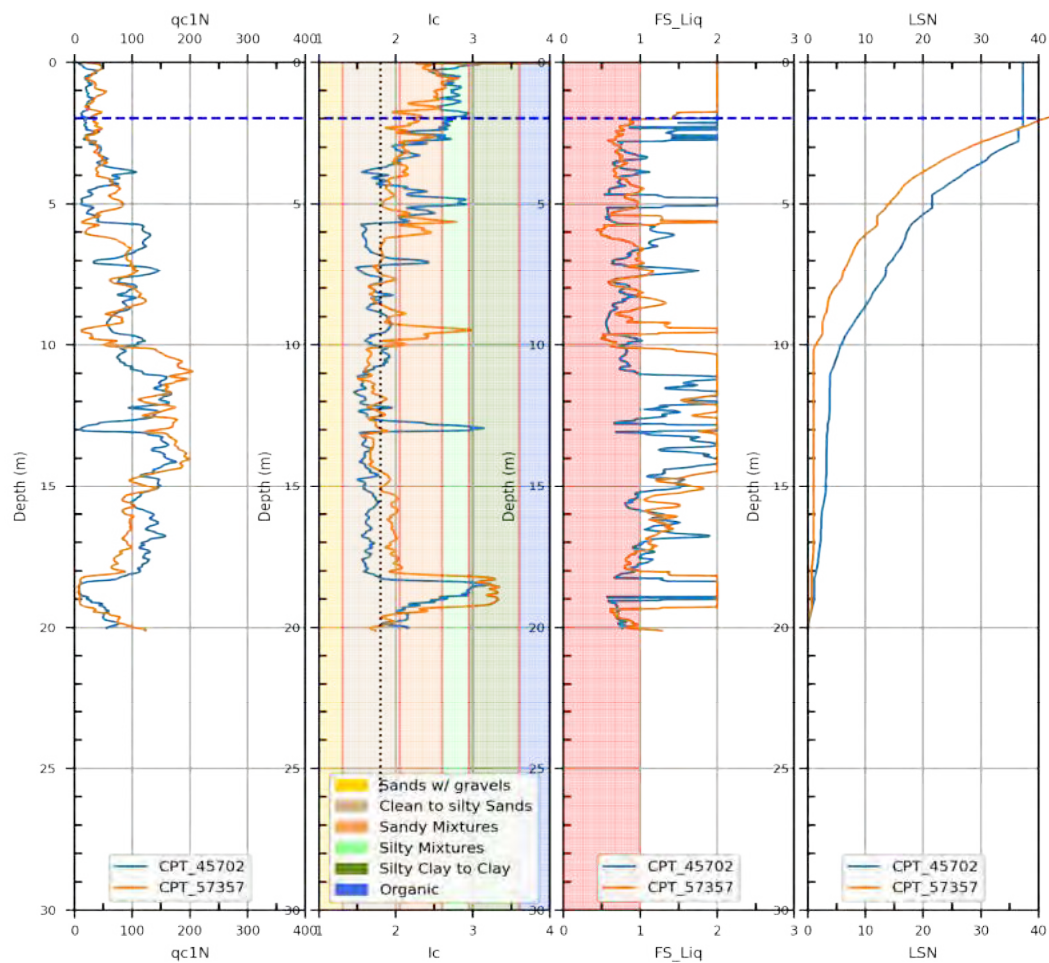
Case History: Ch-S74
Site: 59 Osborne Street (N°25)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.54g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5446 Longitude 172.6595
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S75
Site: 59 Osborne Street (N°25)
Location: Christchurch, New Zealand
Earthquake: Jun-11 Mw 6.2
PGA: 0.31g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5446 Longitude 172.6595
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



North New Brighton School

Case History:

Site: North New Brighton School (N°26)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.20g - 0.64g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.60 m - 2.2 avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4952 Longitude 172.7181
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

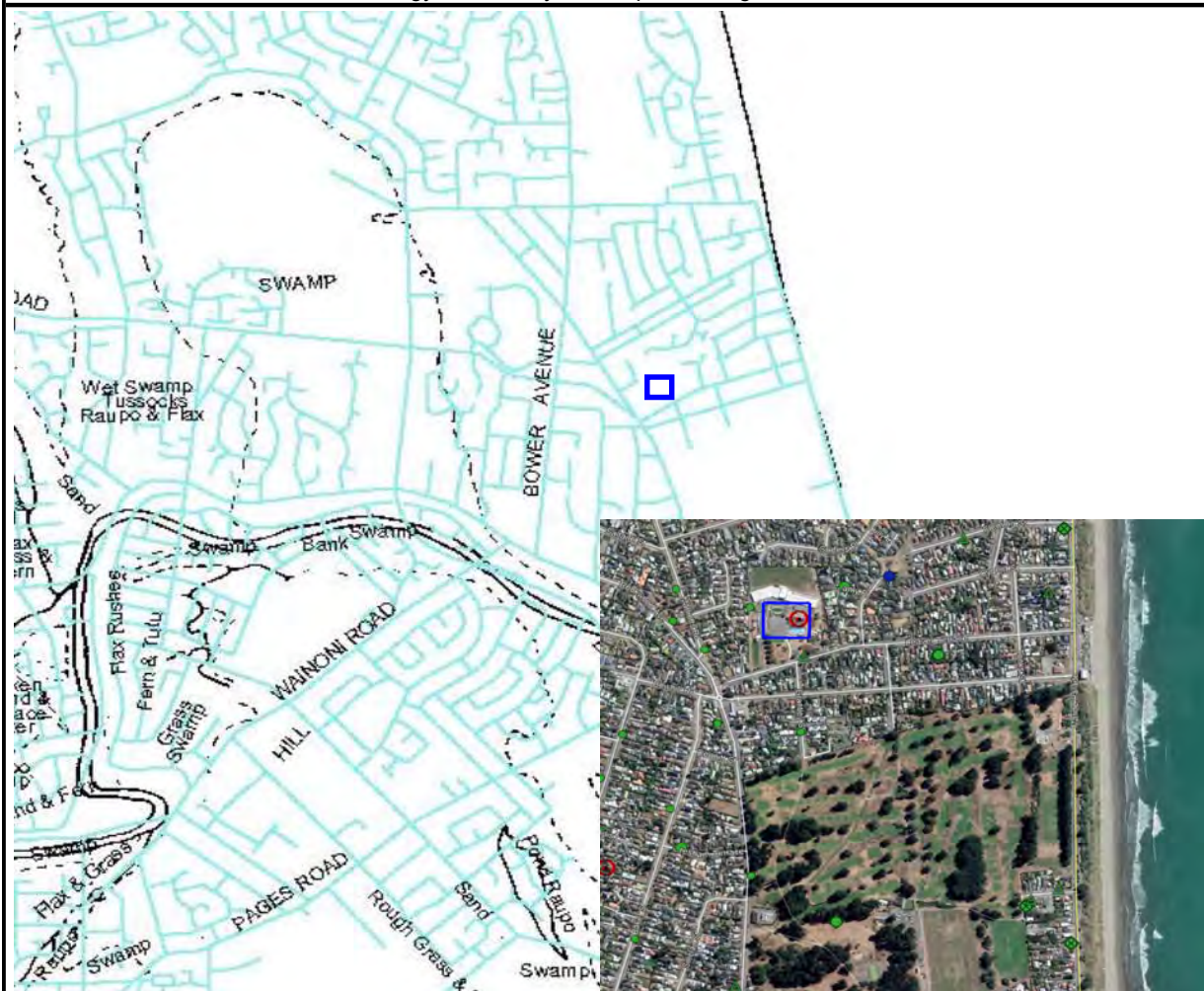
Site: North New Brighton School (N°26)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.20g - 0.64g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.60 m - 2.2 avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4952 Longitude 172.7181
Source: Christchurch City Council, map_Ap001725BlackMap.gws

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856



Site:	North New Brighton School (N°26)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.20g - 0.64g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	1.60 m - 2.2 avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.4952 Longitude 172.7181
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Robertson, 2009

LSN van Ballegooy et al., 2014

Ejecta Patterns

Aerial photography taken on September 5, 2010



Aerial photography taken on February 24, 2011



Aerial photography taken on June 14-15, 2011



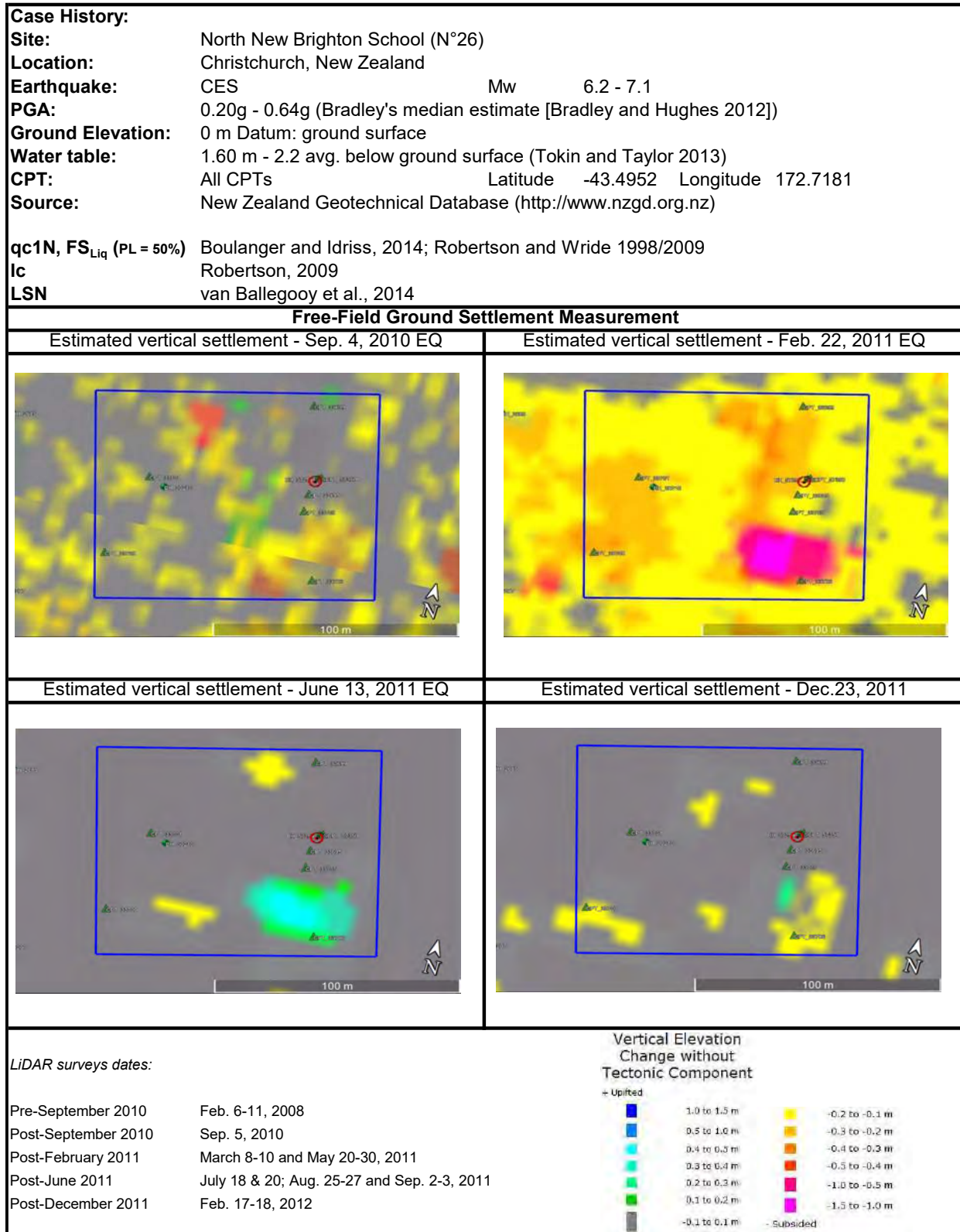
Aerial photography taken on December 24, 2011

No aerial photo available



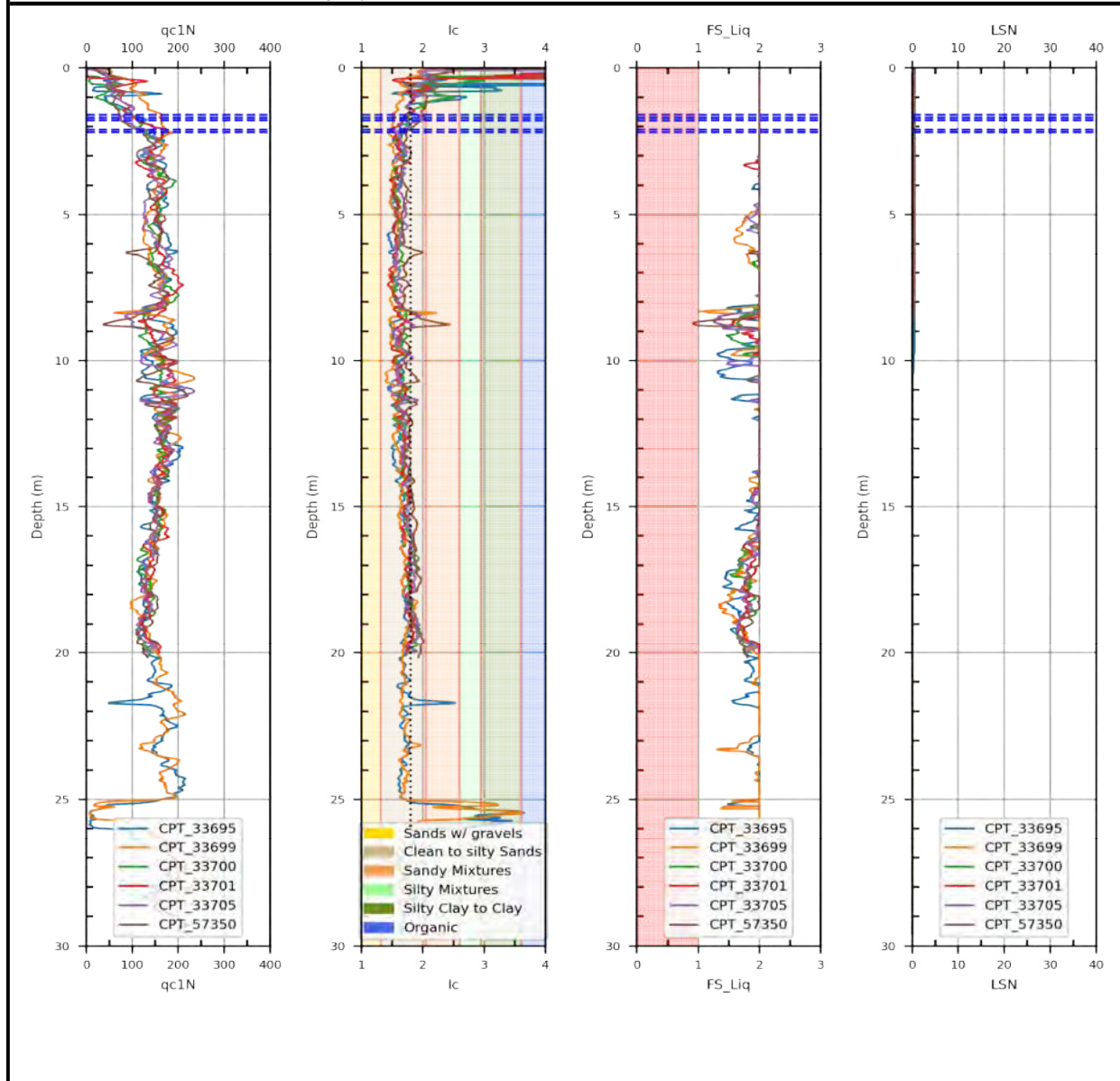
Ministry of Civil Defence
& Emergency Management
Te Kāhau Whakamāramaru





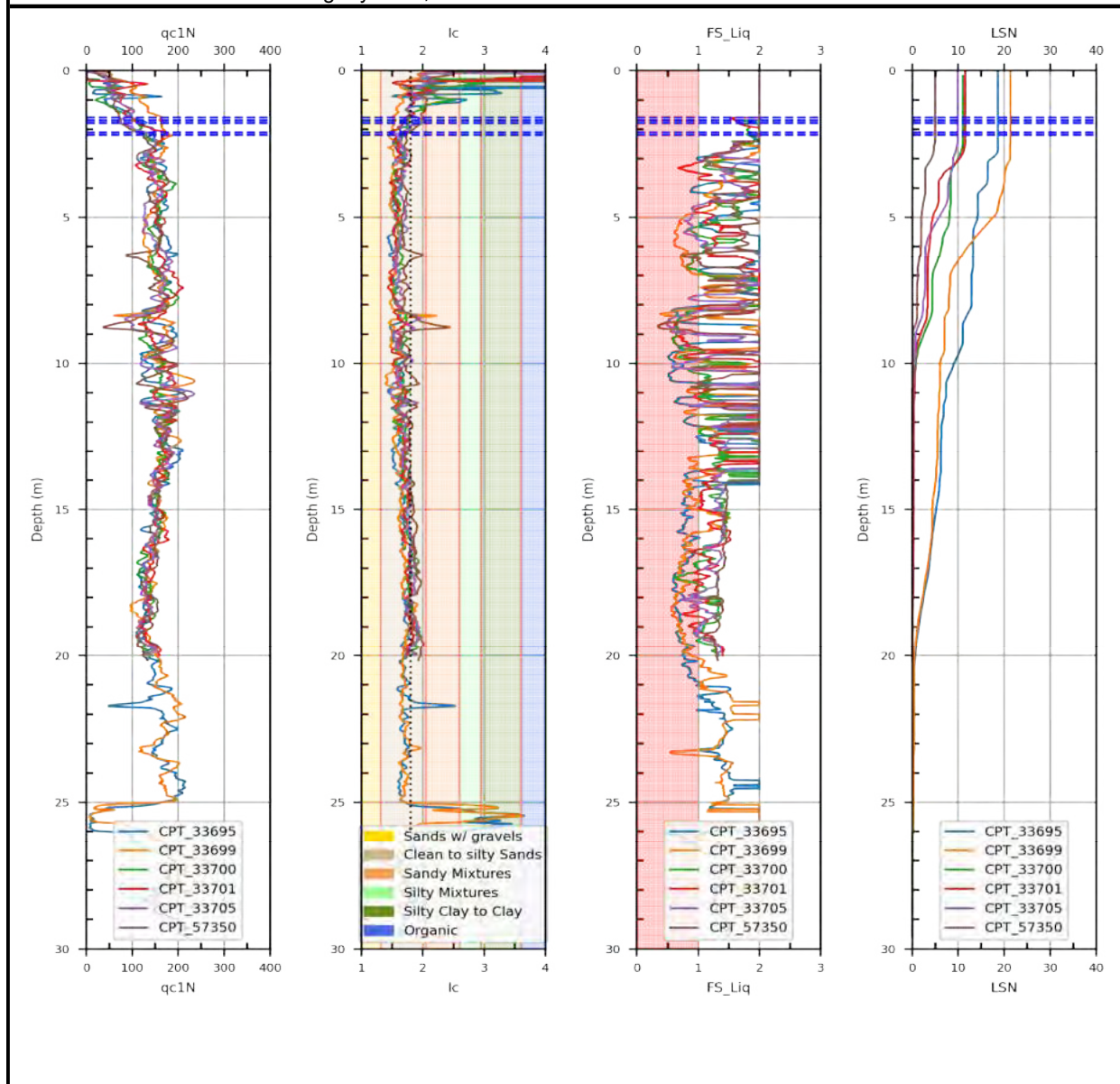
Case History: Ch-S76
Site: North New Brighton School (N°26)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.20g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.60 m - 2.2 avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4952 Longitude 172.7181
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



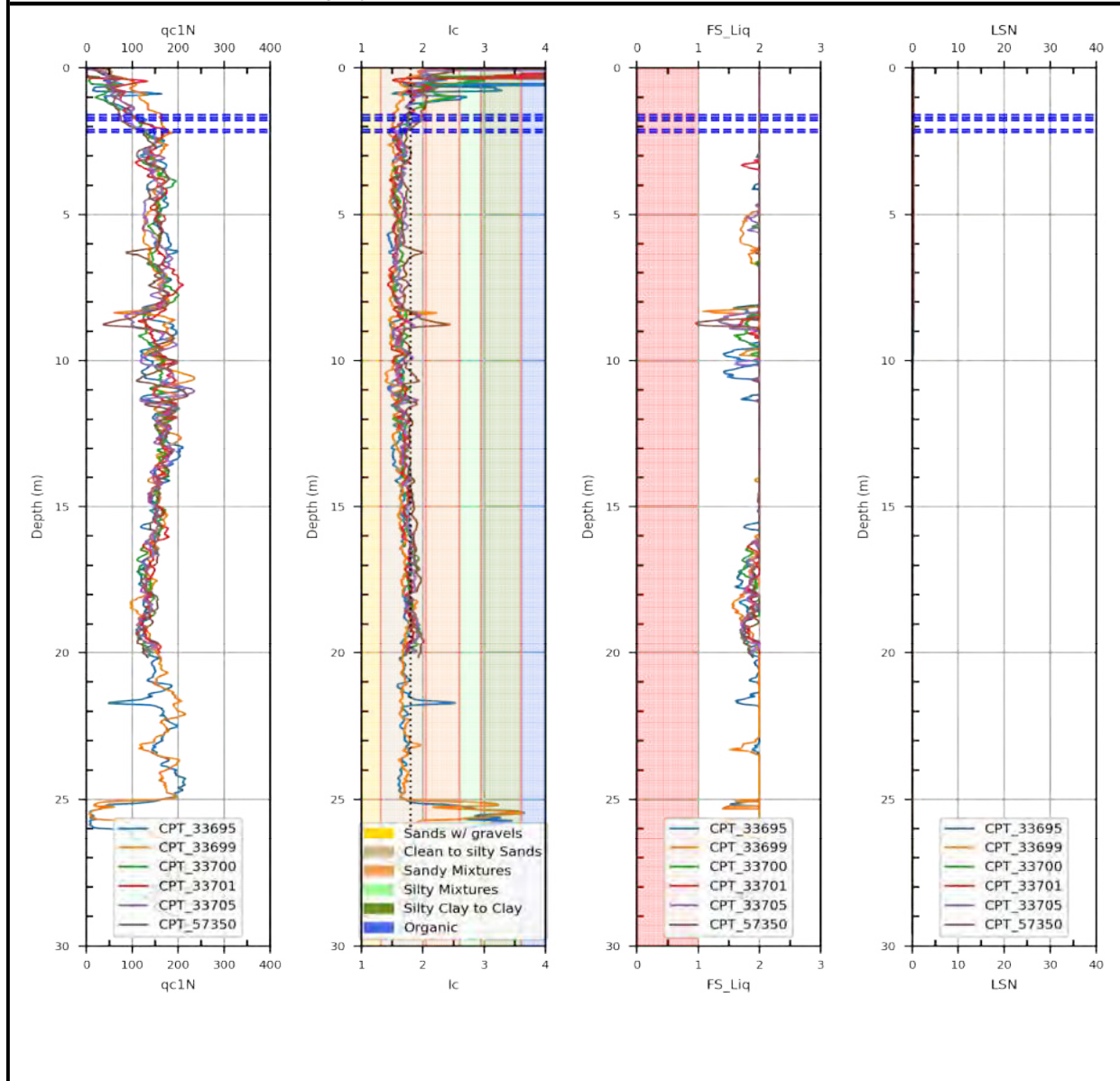
Case History: Ch-S77
Site: North New Brighton School (N°26)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.64g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.60 m - 2.2 avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4952 Longitude 172.7181
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S78
Site: North New Brighton School (N°26)
Location: Christchurch, New Zealand
Earthquake: Jun-11 Mw 6.2
PGA: 0.21g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.60 m - 2.2 avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4952 Longitude 172.7181
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



578 Barbadoes Street

Case History:

Site: 578 Barbadoes Street (N°27)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.21g - 0.39g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.10 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.513 Longitude 172.6461
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

lc Robertson, 2009

LSN van Ballegooy et al., 2014

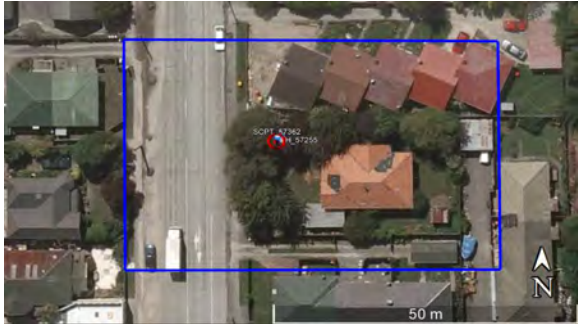
Site Plan View**References:**

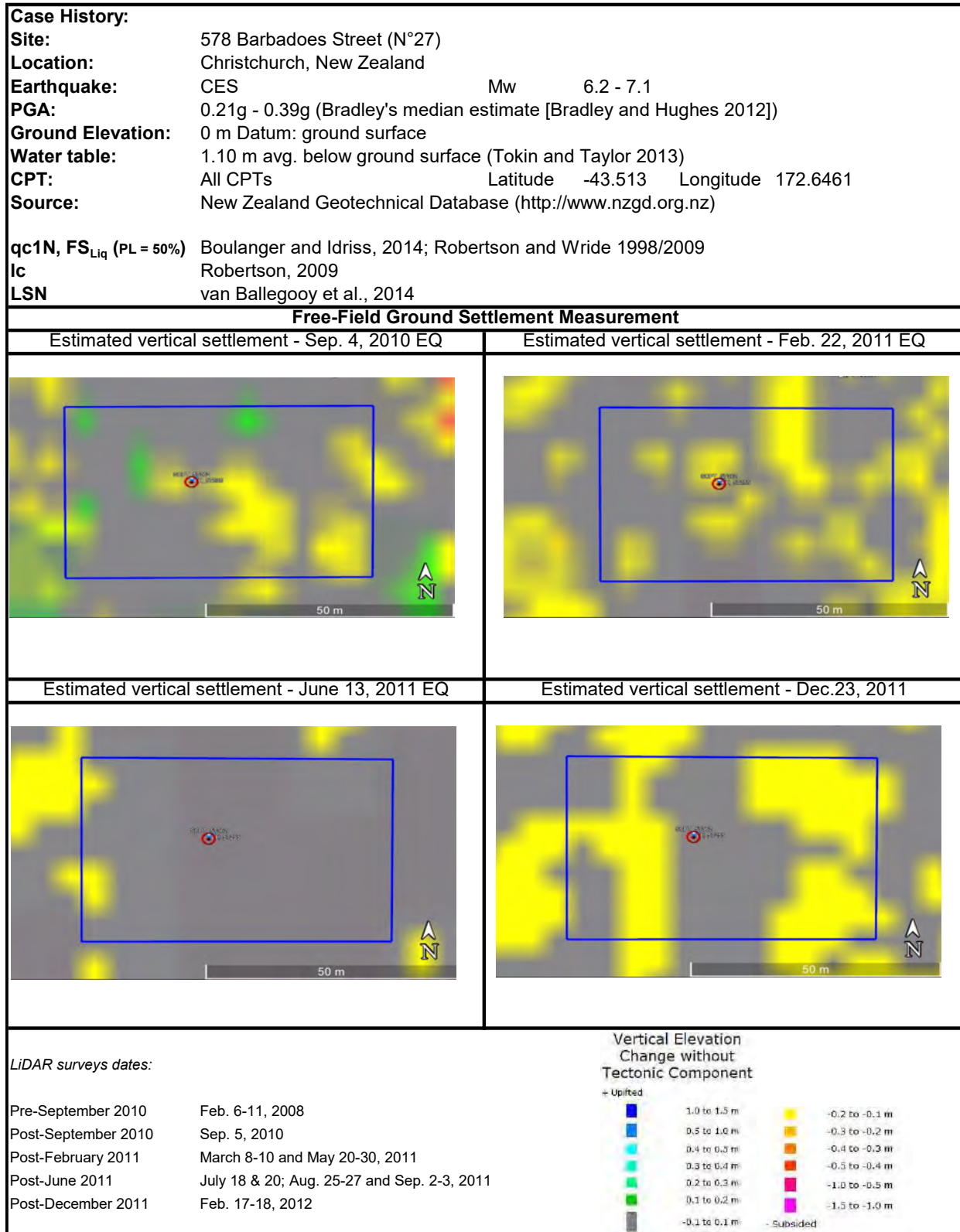
New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:**Site:** 578 Barbadoes Street (N°27)**Location:** Christchurch, New Zealand**Earthquake:** CES Mw 6.2 - 7.1**PGA:** 0.21g - 0.39g (Bradley's median estimate [Bradley and Hughes 2012])**Ground Elevation:** 0 m Datum: ground surface**Water table:** 1.10 m avg. below ground surface (Tokin and Taylor 2013)**CPT:** All CPTs Latitude -43.513 Longitude 172.6461**Source:** Christchurch City Council, map_Ap001725BlackMap.gws**qc1N, FS_{Liq} (PL = 50%)** Boulanger and Idriss, 2014; Robertson and Wride 1998/2009**lc** Robertson, 2009**LSN** van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

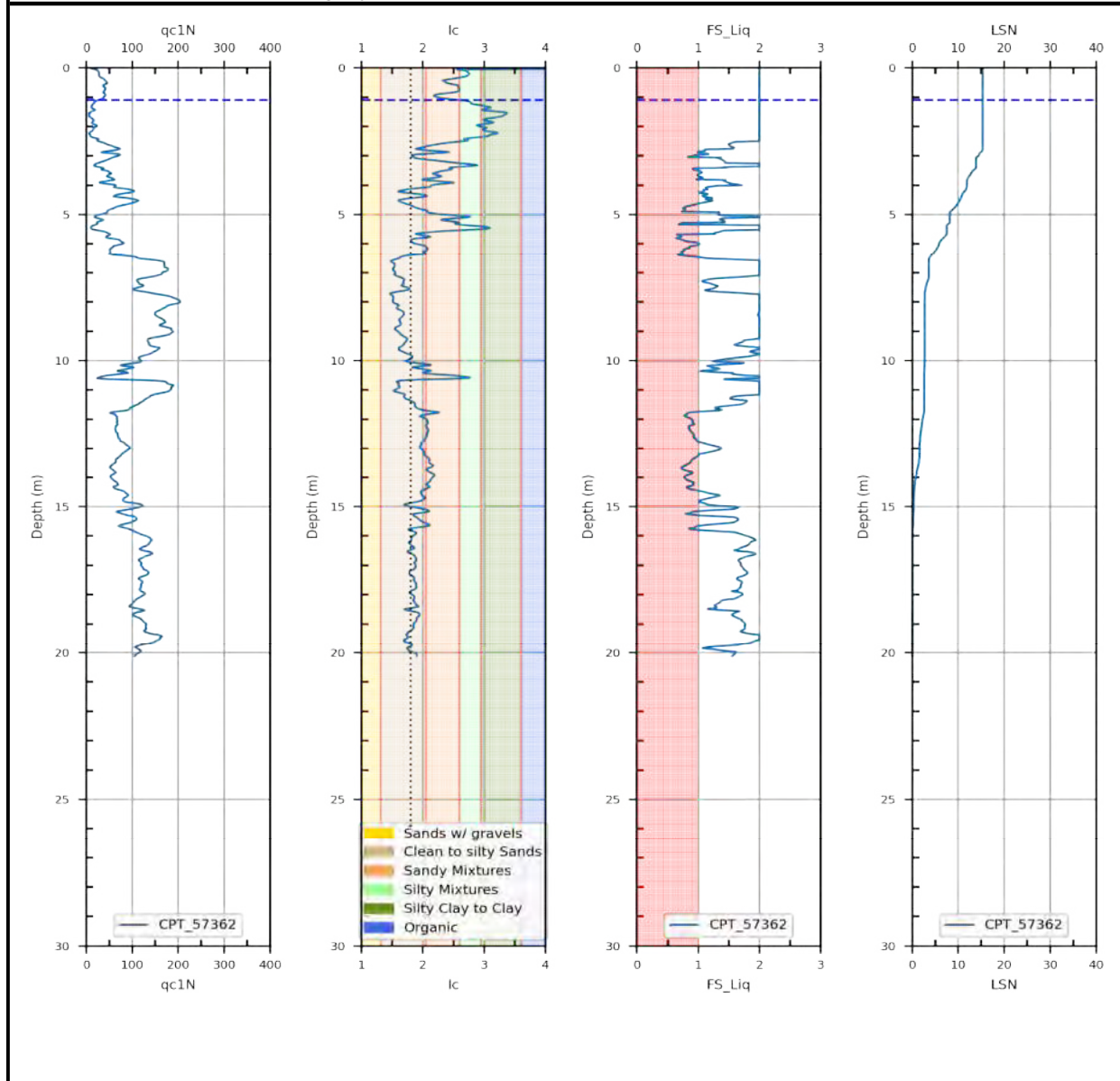


Case History: Site: 578 Barbadoes Street (N°27) Location: Christchurch, New Zealand Earthquake: CES Mw 6.2 - 7.1 PGA: 0.21g - 0.39g (Bradley's median estimate [Bradley and Hughes 2012]) Ground Elevation: 0 m Datum: ground surface Water table: 1.10 m avg. below ground surface (Tokin and Taylor 2013) CPT: All CPTs Latitude -43.513 Longitude 172.6461 Source: New Zealand Geotechnical Database (http://www.nzgd.org.nz) qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009 Ic Robertson, 2009 LSN van Ballegooy et al., 2014	
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
  Ministry of Civil Defence & Emergency Management Te Kaitiaki Whakaminatanga   	



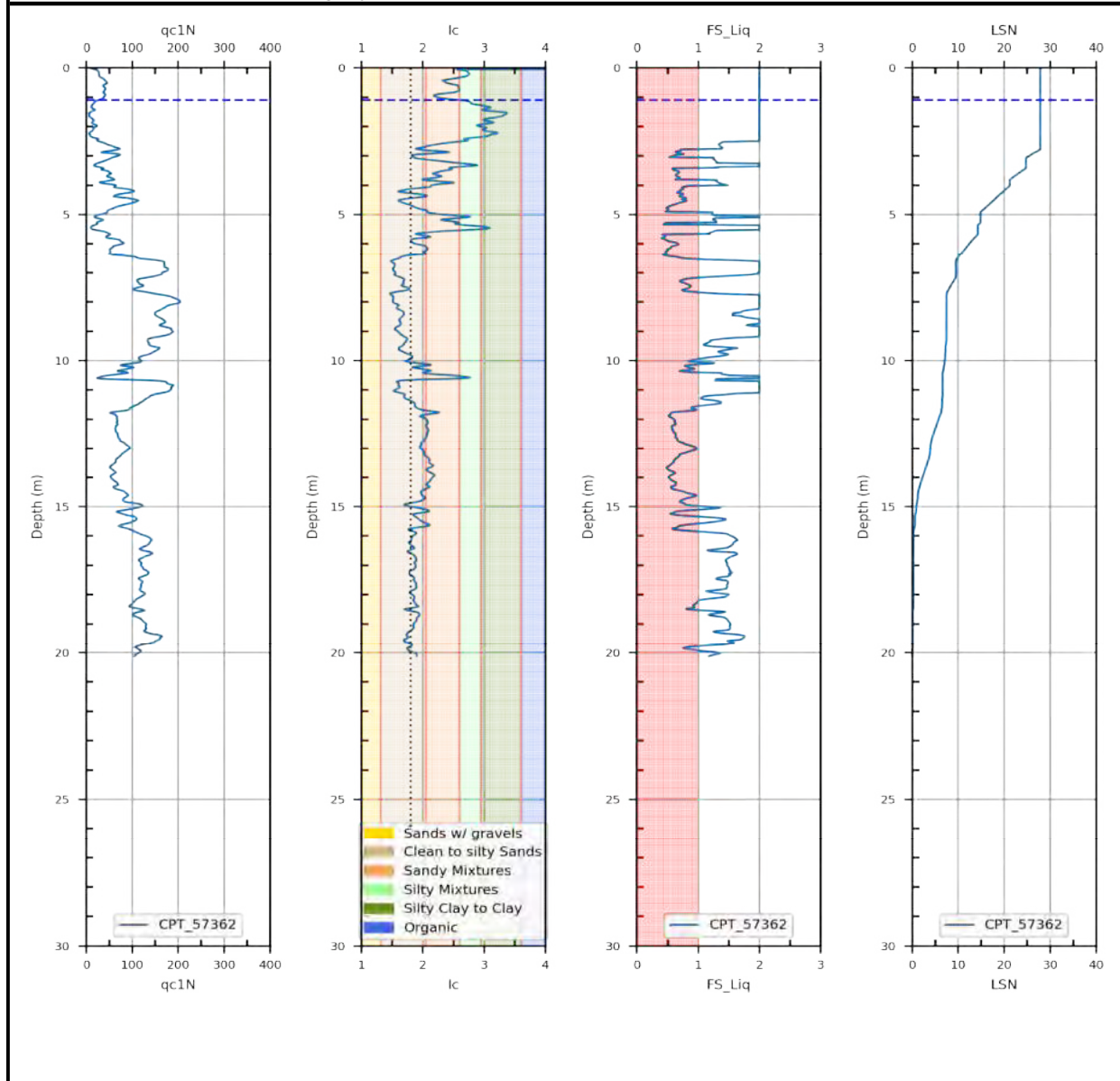
Case History: Ch-S79
Site: 578 Barbadoes Street (N°27)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.21g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.10 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.513 Longitude 172.6461
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



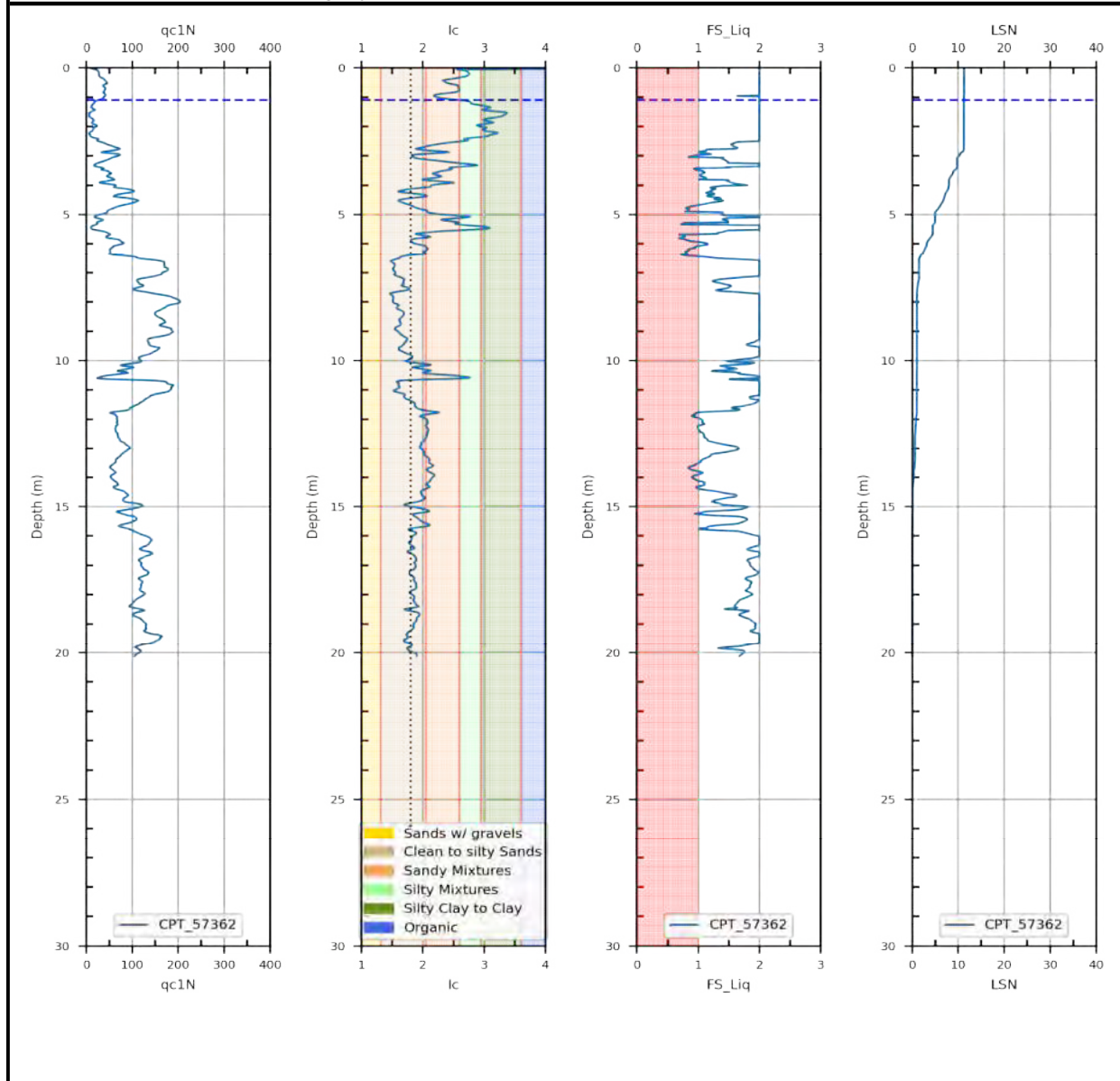
Case History: Ch-S80
Site: 578 Barbadoes Street (N°27)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.39g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.10 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.513 Longitude 172.6461
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S81
Site: 578 Barbadoes Street (N°27)
Location: Christchurch, New Zealand
Earthquake: Jun-11 Mw 6.2
PGA: 0.22g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.10 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.513 Longitude 172.6461
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Normans Road/Papanui Road

Case History:

Site: Normans Road / Papanui Road (N°28)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.21g - 0.30g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 3.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5061 Longitude 172.6157
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

Site: Normans Road / Papanui Road (N°28)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.21g - 0.30g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 3.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5061 Longitude 172.6157
Source: Christchurch City Council, map_Ap001725BlackMap.gws

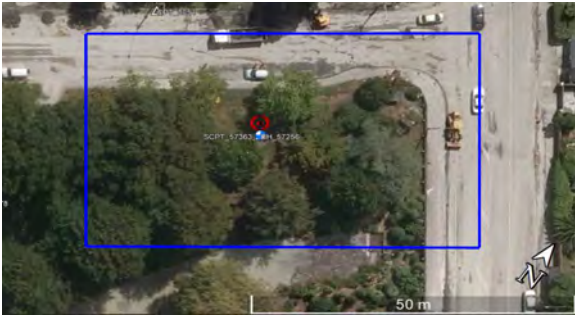
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

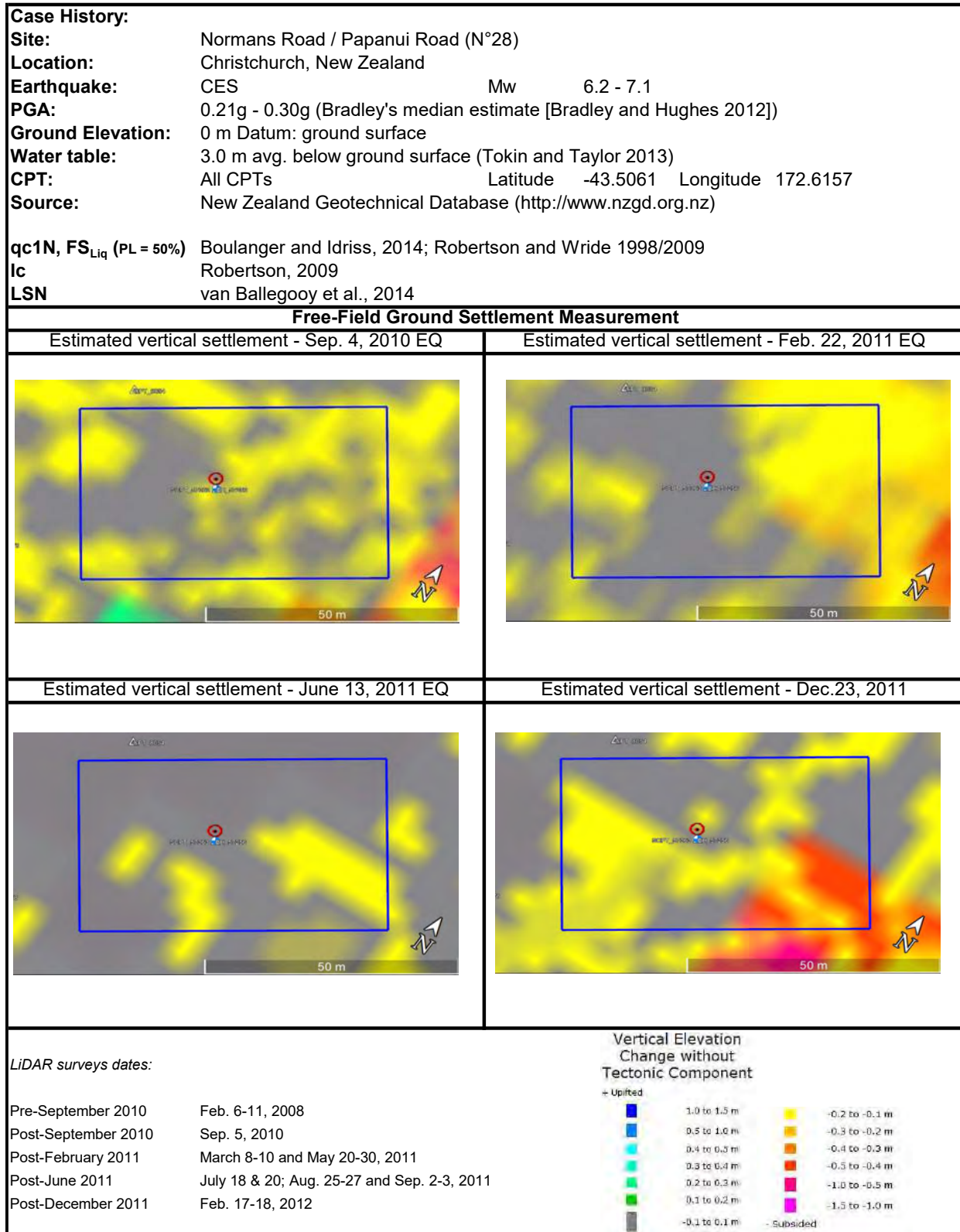
lc Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

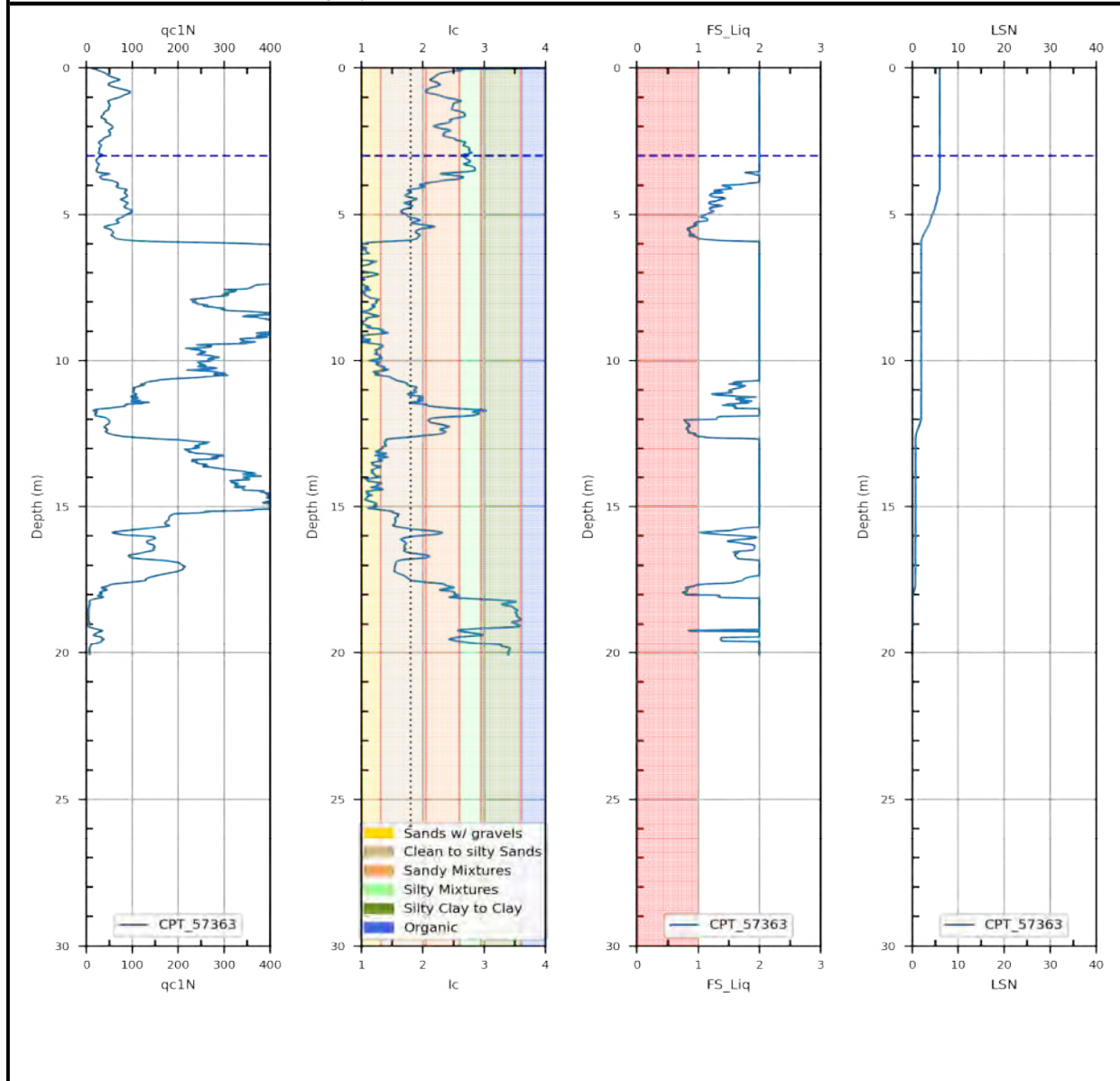


Case History:	
Site:	Normans Road / Papanui Road (N°28)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.21g - 0.30g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	3.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5061 Longitude 172.6157
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
	



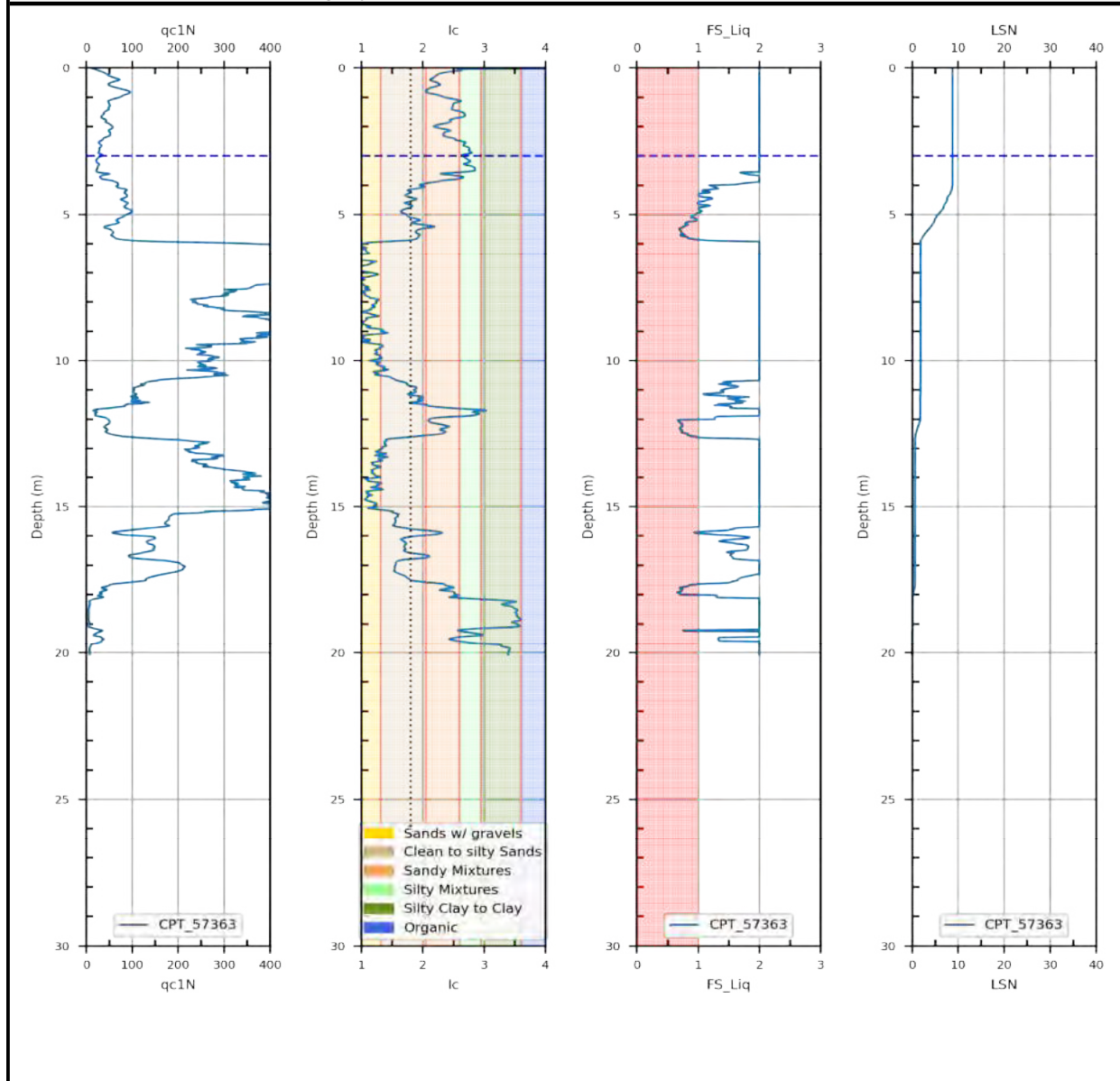
Case History: Ch-S82
Site: Normans Road / Papanui Road (N°28)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.21g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 3.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5061 Longitude 172.6157
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



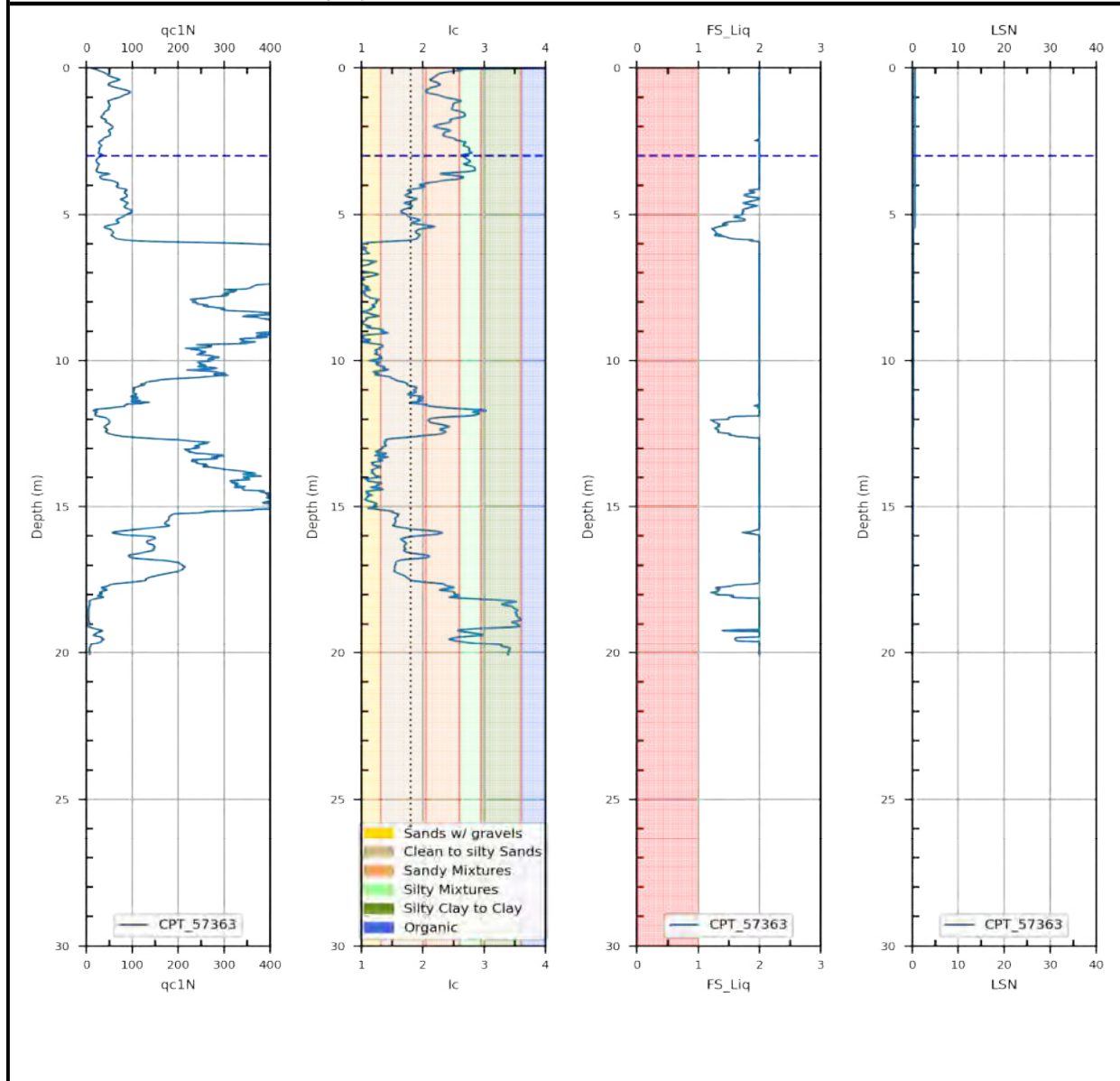
Case History: Ch-S83
Site: Normans Road / Papanui Road (N°28)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.30g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 3.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5061 Longitude 172.6157
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S84
Site: Normans Road / Papanui Road (N°28)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.16g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 3.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5061 Longitude 172.6157
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Hillmorton High School

Case History:

Site: Hillmorton High School (N°29)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.39g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5562 Longitude 172.5933
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

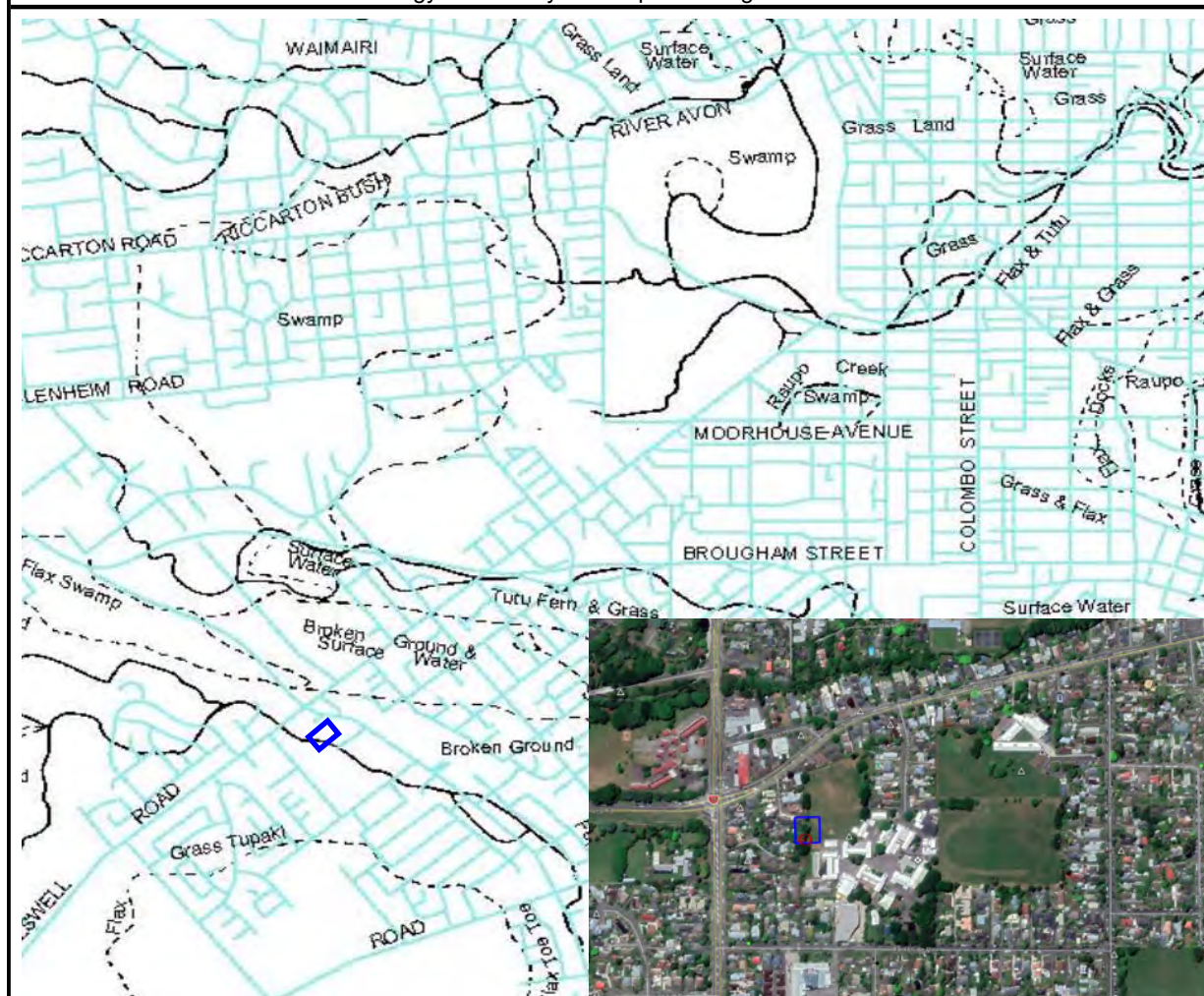
Site: Hillmorton High School (N°29)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.39g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5562 Longitude 172.5933
Source: Christchurch City Council, map_Ap001725BlackMap.gws

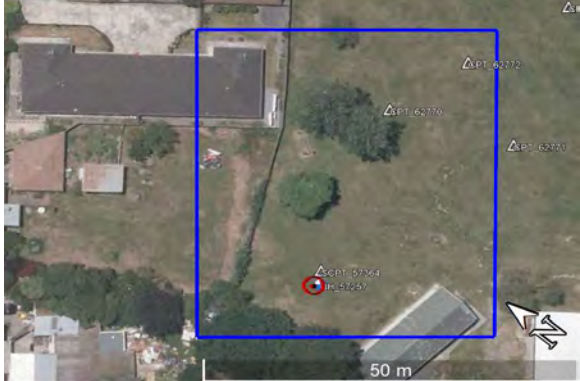
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

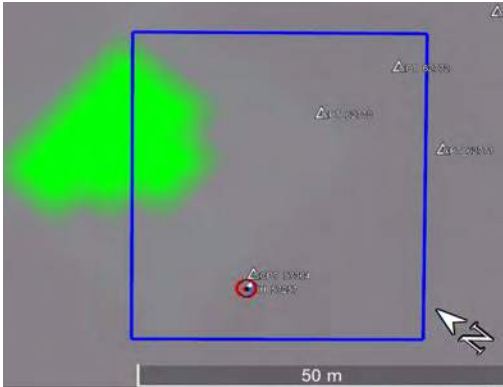
lc Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

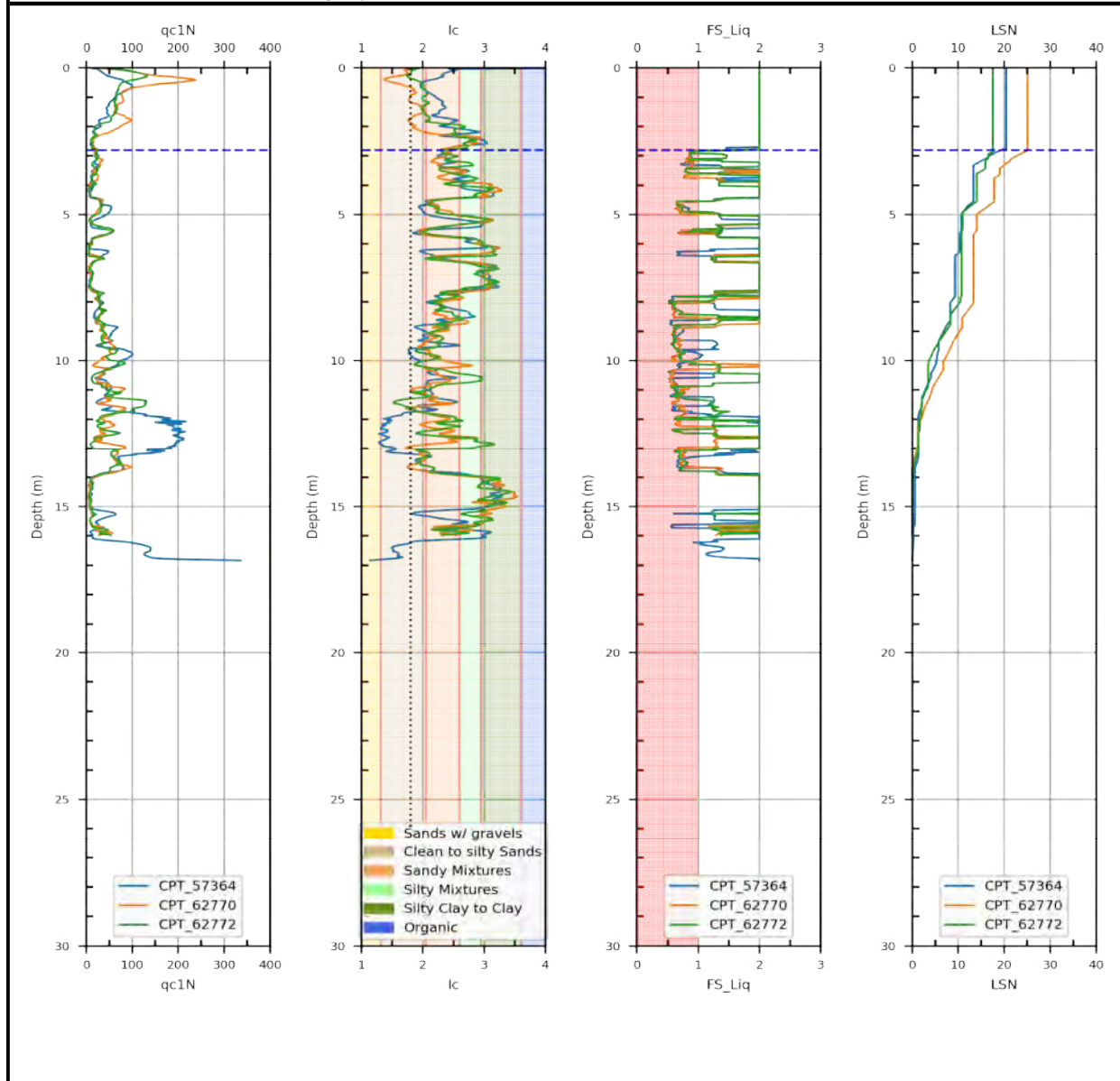


Case History:	
Site:	Hillmorton High School (N°29)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.18g - 0.39g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	2.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5562 Longitude 172.5933
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
No aerial photo available	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
	

Case History:															
Site:	Hillmorton High School (N°29)														
Location:	Christchurch, New Zealand														
Earthquake:	CES Mw 6.2 - 7.1														
PGA:	0.18g - 0.39g (Bradley's median estimate [Bradley and Hughes 2012])														
Ground Elevation:	0 m Datum: ground surface														
Water table:	2.8 m avg. below ground surface (Tokin and Taylor 2013)														
CPT:	All CPTs Latitude -43.5562 Longitude 172.5933														
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)														
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009														
Ic	Robertson, 2009														
LSN	van Ballegooy et al., 2014														
Free-Field Ground Settlement Measurement															
Estimated vertical settlement - Sep. 4, 2010 EQ	Estimated vertical settlement - Feb. 22, 2011 EQ														
No LiDAR data available	No LiDAR data available														
Estimated vertical settlement - June 13, 2011 EQ	Estimated vertical settlement - Dec.23, 2011														
	No LiDAR data available														
LiDAR surveys dates: <table> <tr> <td>Pre-September 2010</td><td>Feb. 6-11, 2008</td></tr> <tr> <td>Post-September 2010</td><td>Sep. 5, 2010</td></tr> <tr> <td>Post-February 2011</td><td>March 8-10 and May 20-30, 2011</td></tr> <tr> <td>Post-June 2011</td><td>July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011</td></tr> <tr> <td>Post-December 2011</td><td>Feb. 17-18, 2012</td></tr> </table>		Pre-September 2010	Feb. 6-11, 2008	Post-September 2010	Sep. 5, 2010	Post-February 2011	March 8-10 and May 20-30, 2011	Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011	Post-December 2011	Feb. 17-18, 2012				
Pre-September 2010	Feb. 6-11, 2008														
Post-September 2010	Sep. 5, 2010														
Post-February 2011	March 8-10 and May 20-30, 2011														
Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011														
Post-December 2011	Feb. 17-18, 2012														
Vertical Elevation Change without Tectonic Component <table> <tr> <td>1.0 to 1.5 m</td><td>-0.2 to -0.1 m</td></tr> <tr> <td>0.5 to 1.0 m</td><td>-0.3 to -0.2 m</td></tr> <tr> <td>0.4 to 0.3 m</td><td>-0.4 to -0.3 m</td></tr> <tr> <td>0.3 to 0.4 m</td><td>-0.5 to -0.4 m</td></tr> <tr> <td>0.2 to 0.3 m</td><td>-1.0 to -0.5 m</td></tr> <tr> <td>0.1 to 0.2 m</td><td>-1.5 to -1.0 m</td></tr> <tr> <td>-0.1 to 0.1 m</td><td>- Subsided</td></tr> </table>		1.0 to 1.5 m	-0.2 to -0.1 m	0.5 to 1.0 m	-0.3 to -0.2 m	0.4 to 0.3 m	-0.4 to -0.3 m	0.3 to 0.4 m	-0.5 to -0.4 m	0.2 to 0.3 m	-1.0 to -0.5 m	0.1 to 0.2 m	-1.5 to -1.0 m	-0.1 to 0.1 m	- Subsided
1.0 to 1.5 m	-0.2 to -0.1 m														
0.5 to 1.0 m	-0.3 to -0.2 m														
0.4 to 0.3 m	-0.4 to -0.3 m														
0.3 to 0.4 m	-0.5 to -0.4 m														
0.2 to 0.3 m	-1.0 to -0.5 m														
0.1 to 0.2 m	-1.5 to -1.0 m														
-0.1 to 0.1 m	- Subsided														

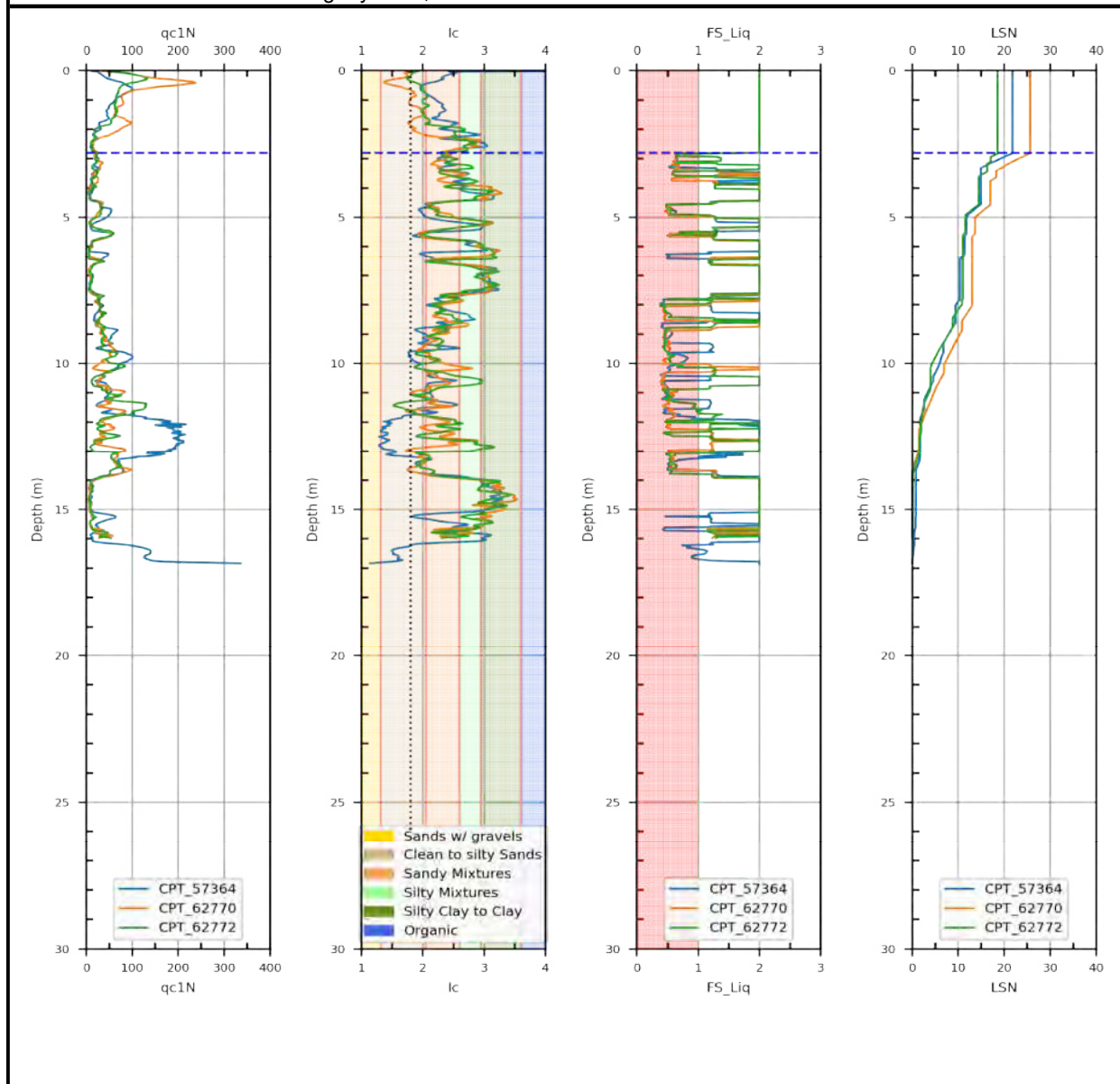
Case History: Ch-S85
Site: Hillmorton High School (N°29)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.24g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5562 Longitude 172.5933
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



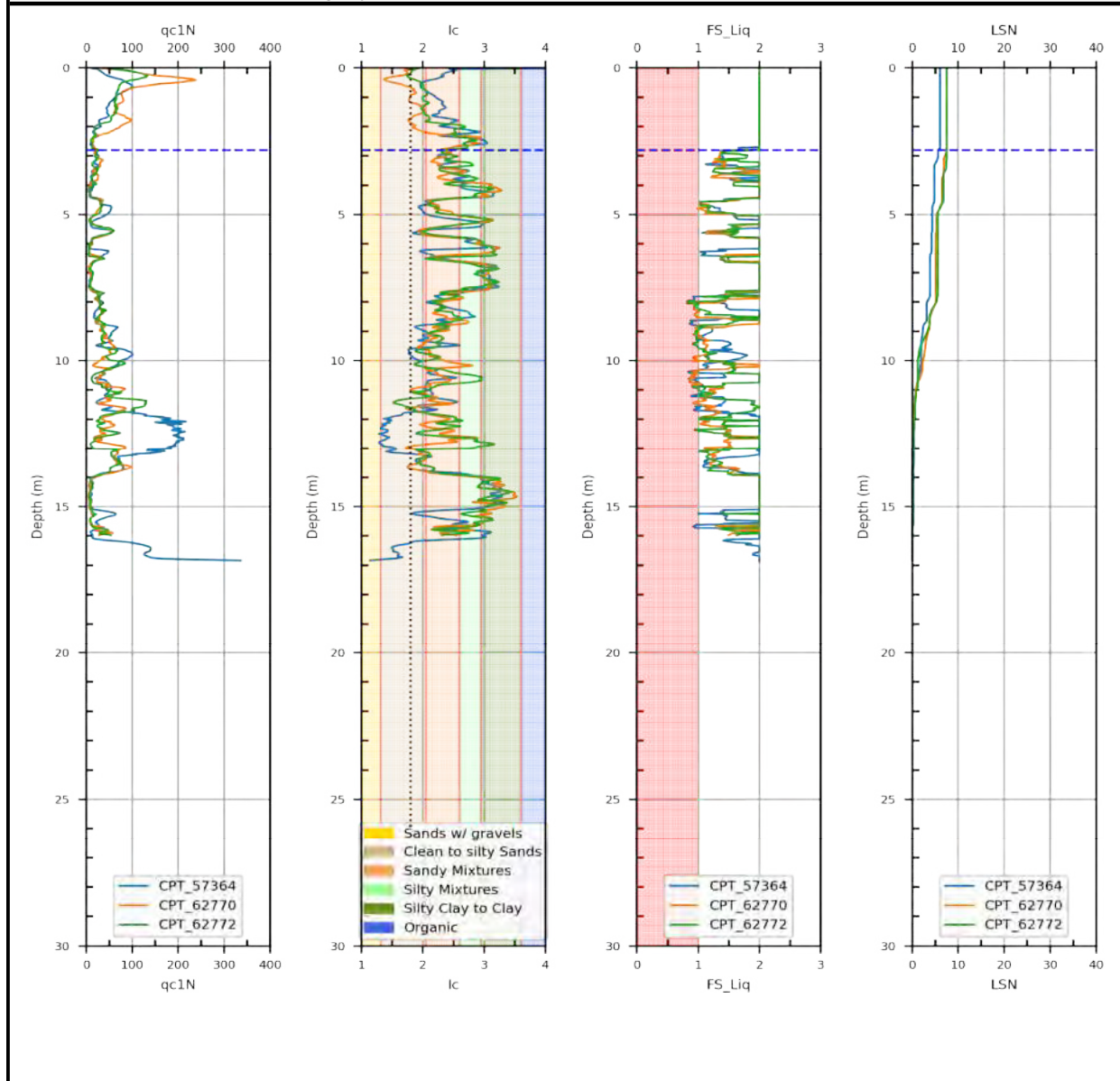
Case History: Ch-S86
Site: Hillmorton High School (N°29)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.39g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5562 Longitude 172.5933
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S87
Site: Hillmorton High School (N°29)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.18g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5562 Longitude 172.5933
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Hillsborough Park

Case History:

Site: Hillsborough Park (N°30)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.25g - 0.63g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.8 m - 1.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5606 Longitude 172.6731
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

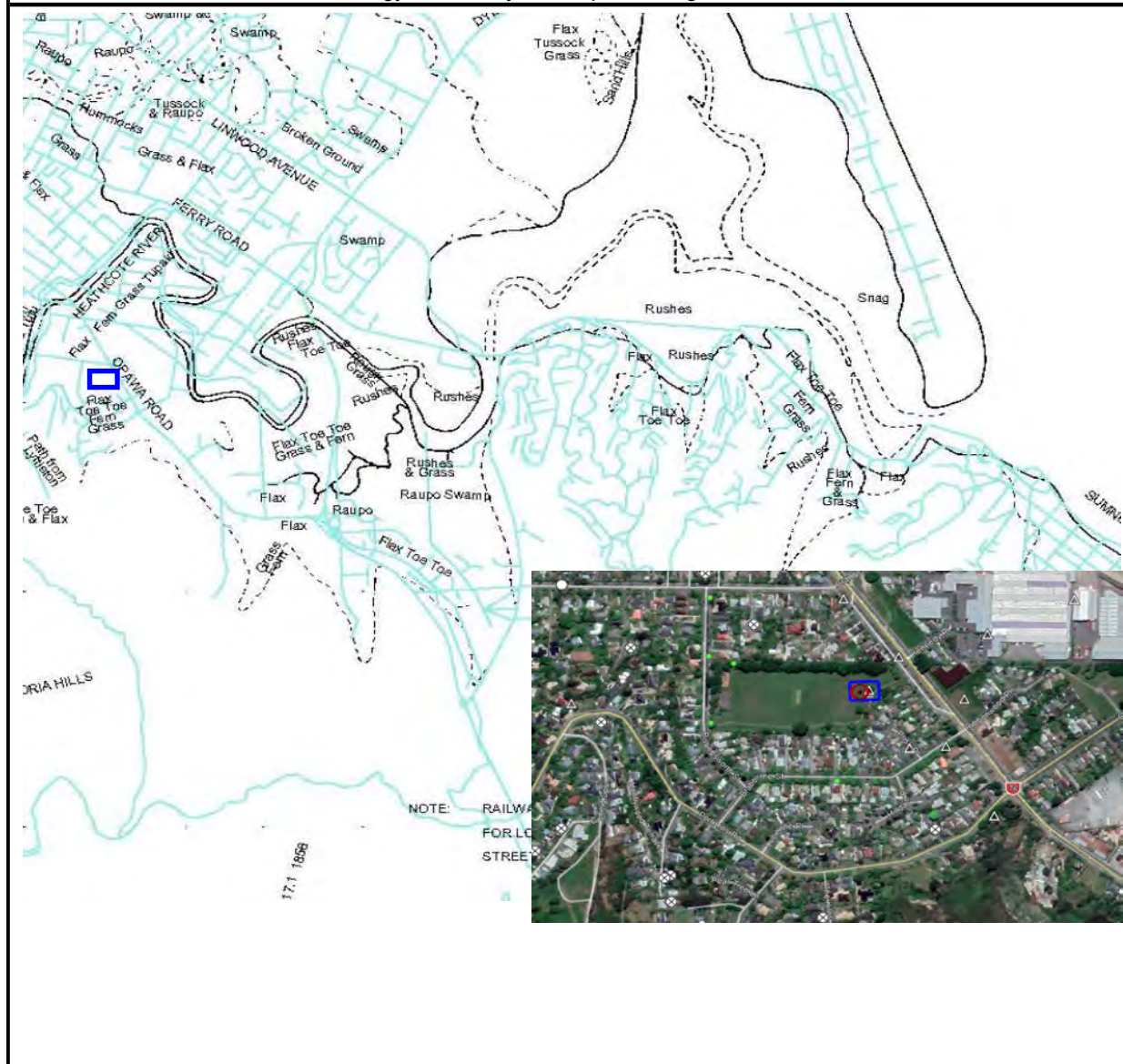
Site: Hillsborough Park (N°30)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.25g - 0.63g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.8 m - 1.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5606 Longitude 172.6731
Source: Christchurch City Council, map_Ap001725BlackMap.gws

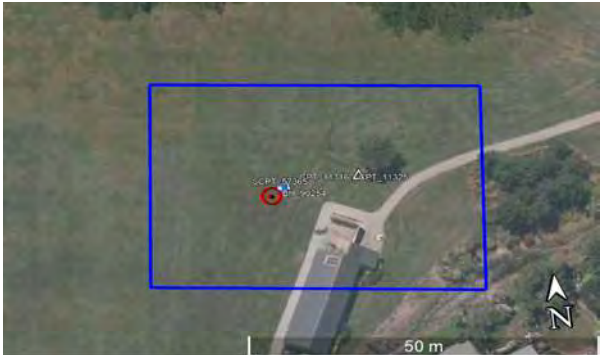
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

lc Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

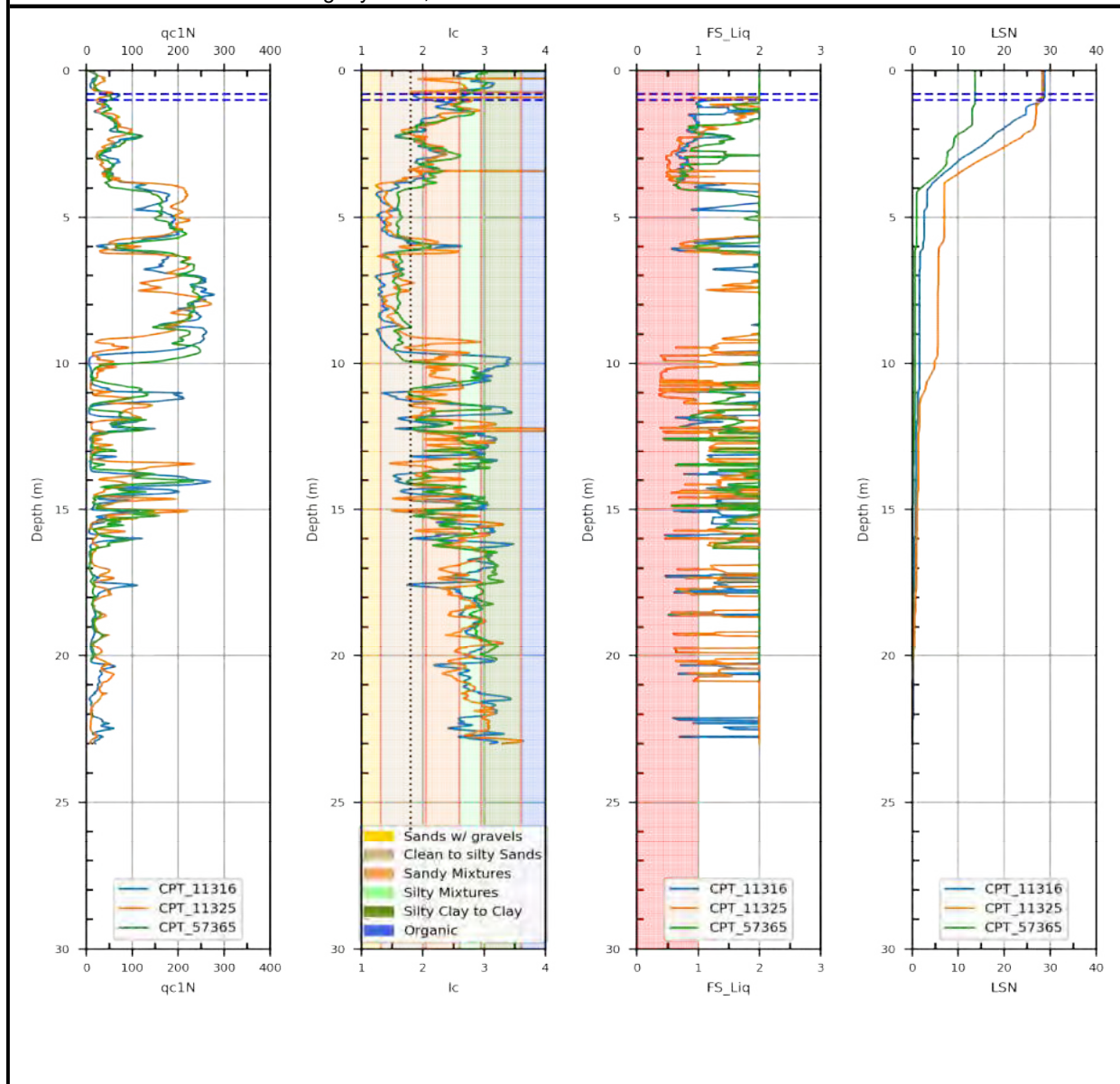


Case History:	
Site:	Hillsborough Park (N°30)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.25g - 0.63g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	0.8 m - 1.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5606 Longitude 172.6731
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
No aerial photo available	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
	

Case History:	
Site:	Hillsborough Park (N°30)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.25g - 0.63g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	0.8 m - 1.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5606 Longitude 172.6731
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Free-Field Ground Settlement Measurement	
Estimated vertical settlement - Sep. 4, 2010 EQ	Estimated vertical settlement - Feb. 22, 2011 EQ
No LiDAR data available	No LiDAR data available
Estimated vertical settlement - June 13, 2011 EQ	Estimated vertical settlement - Dec.23, 2011
	
LiDAR surveys dates:	
Pre-September 2010	Feb. 6-11, 2008
Post-September 2010	Sep. 5, 2010
Post-February 2011	March 8-10 and May 20-30, 2011
Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011
Post-December 2011	Feb. 17-18, 2012
Vertical Elevation Change without Tectonic Component	
+ Uplifted	
	1.0 to 1.5 m
	0.5 to 1.0 m
	0.4 to 0.5 m
	0.3 to 0.4 m
	0.2 to 0.3 m
	0.1 to 0.2 m
	-0.1 to 0.1 m
	-0.2 to -0.1 m
	-0.3 to -0.2 m
	-0.4 to -0.3 m
	-0.5 to -0.4 m
	-1.0 to -0.5 m
	-1.5 to -1.0 m
- Subsided	

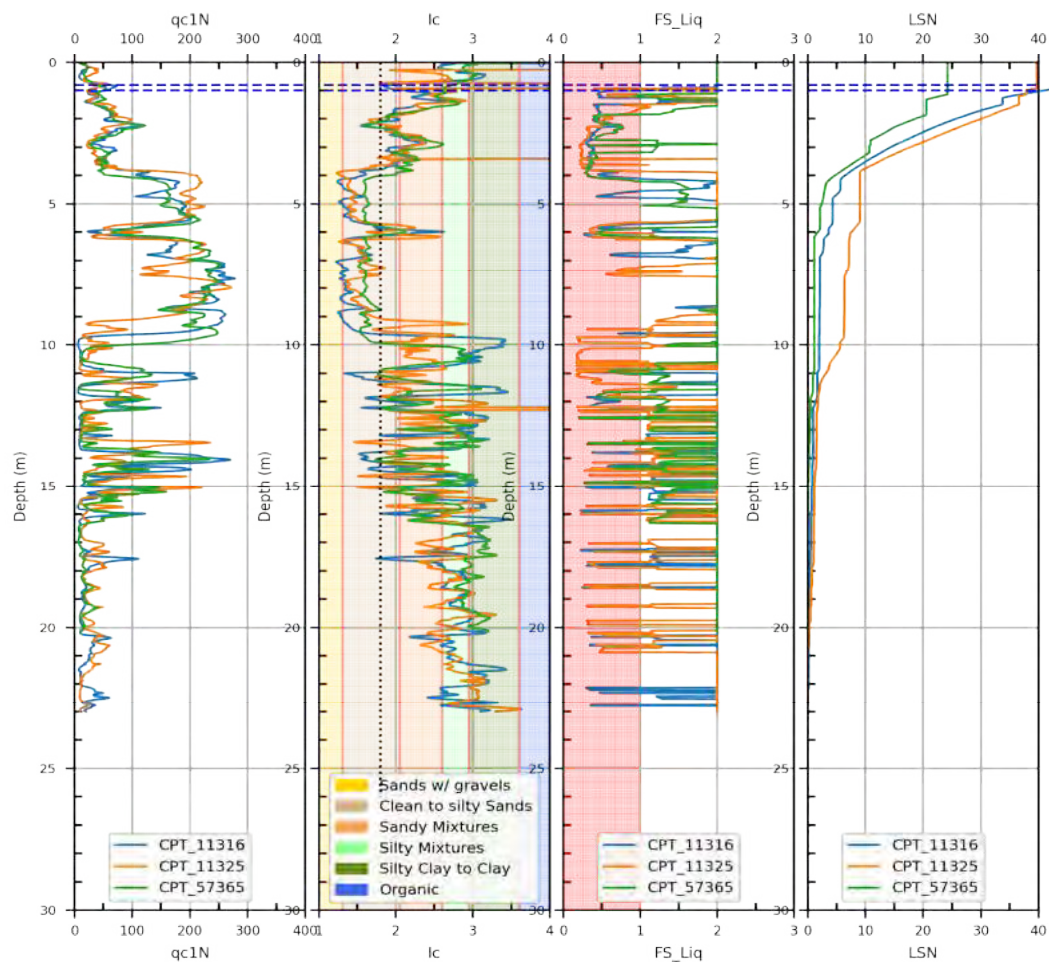
Case History: Ch-S88
Site: Hillsborough Park (N°30)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.25g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.8 m - 1.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5606 Longitude 172.6731
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



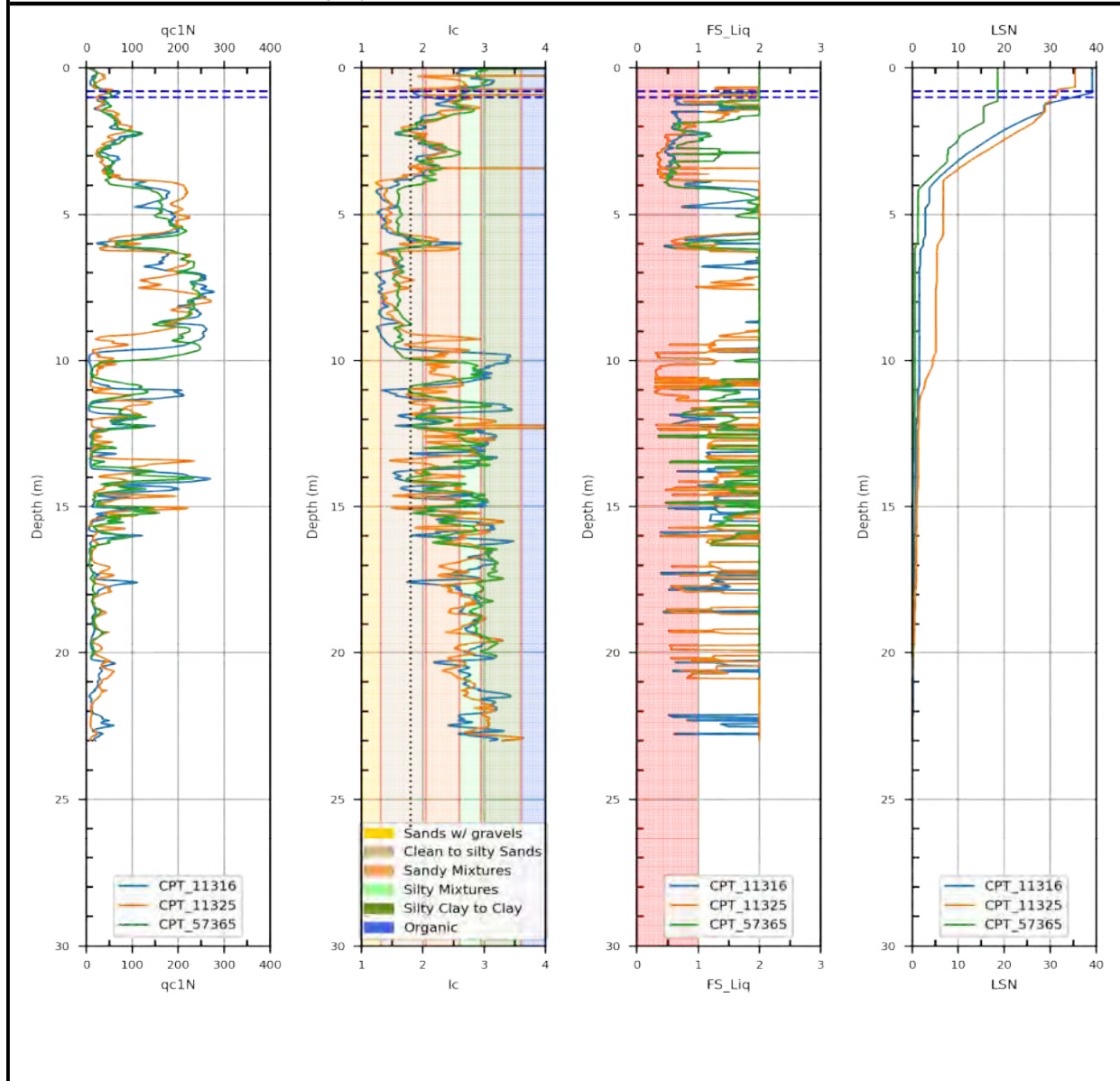
Case History: Ch-S89
Site: Hillsborough Park (N°30)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.63g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.8 m - 1.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5606 Longitude 172.6731
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S90
Site: Hillsborough Park (N°30)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.63g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.8 m - 1.0 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5606 Longitude 172.6731
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



Shirley Intermediate School

Case History:

Site: Shirley Intermediate School (N° 31)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6 - 7.1
PGA: 0.19g - 0.38g (Bradley's median estimate. [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2 - 2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5104 Longitude 172.66199
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

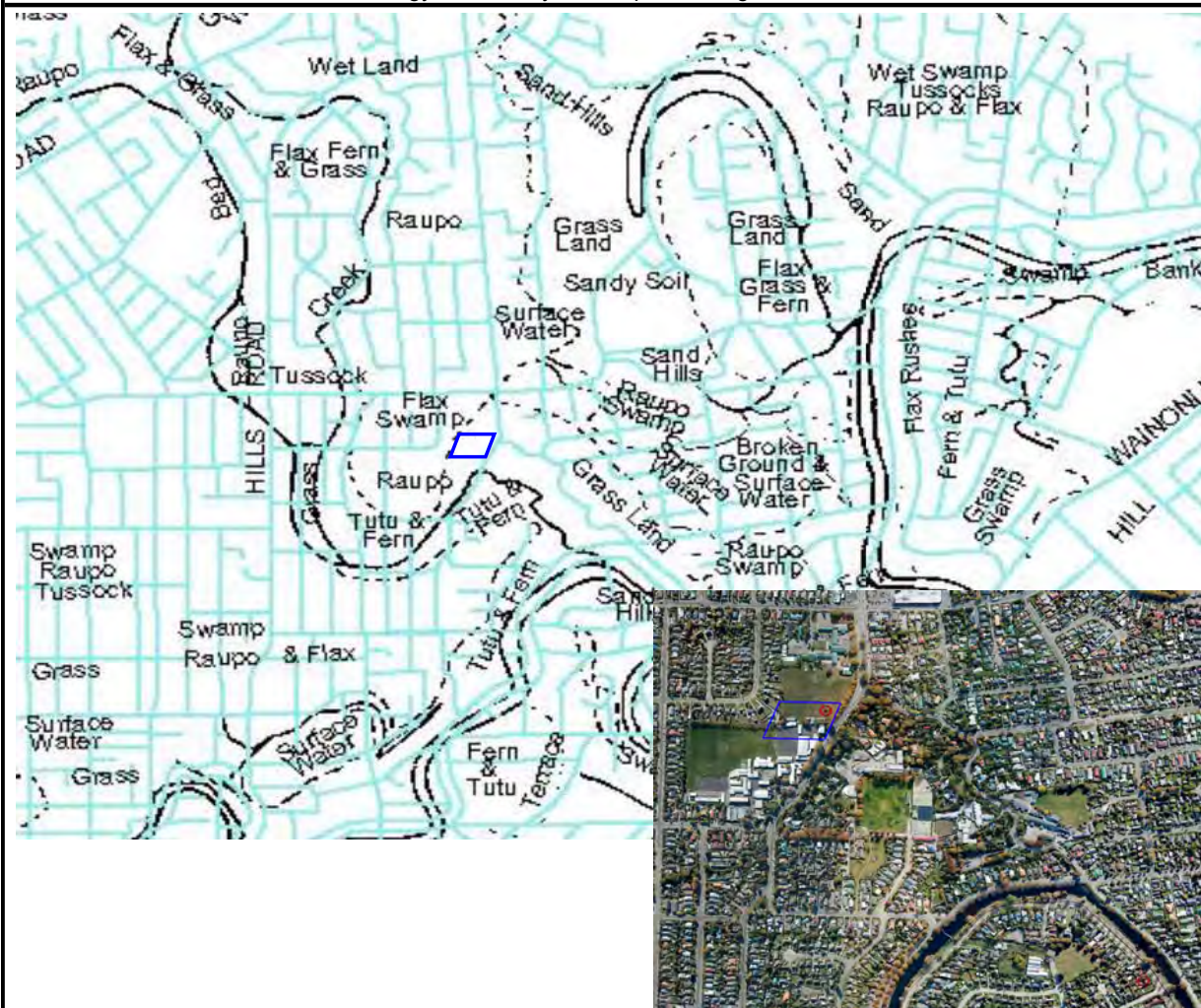
LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:**Site:** Shirley Intermediate School (N° 31)**Location:** Christchurch, New Zealand**Earthquake:** CES Mw 6 - 7.1**PGA:** 0.19g - 0.38g (Bradley's median estimate. [Bradley and Hughes 2012])**Ground Elevation:** 0 m Datum: ground surface**Water table:** 2 - 2.2 m avg. below ground surface (Tokin and Taylor 2013)**CPT:** Latitude -43.5104 Longitude 172.66199**Source:** Christchurch City Council, map_Ap001725BlackMap.gws**qc1N, FS_{Liq} (PL = 50%)** Boulanger and Idriss, 2014; Robertson and Wride 1998/2009**Ic** Robertson, 2009**LSN** van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856



Case History:**Site:** Shirley Intermediate School (N^o 31)**Location:** Christchurch, New Zealand**Earthquake:** CES Mw 6 - 7.1**PGA:** 0.19g - 0.38g (Bradley's median estimate. [Bradley and Hughes 2012])**Ground Elevation:** 0 m Datum: ground surface**Water table:** 2 - 2.2 m avg. below ground surface (Tokin and Taylor 2013)**CPT:** All CPTs Latitude -43.5104 Longitude 172.66199**Source:** New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)**qc1N, FS_{Liq} (PL = 50%)** Boulanger and Idriss, 2014; Robertson and Wride 1998/2009**Ic** Robertson, 2009**LSN** van Ballegooy et al., 2014**Ejecta Patterns**

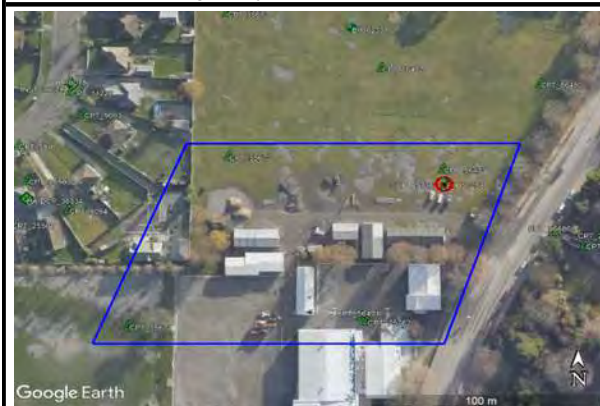
Aerial photography taken on September 5, 2010



Aerial photography taken on February 24, 2011

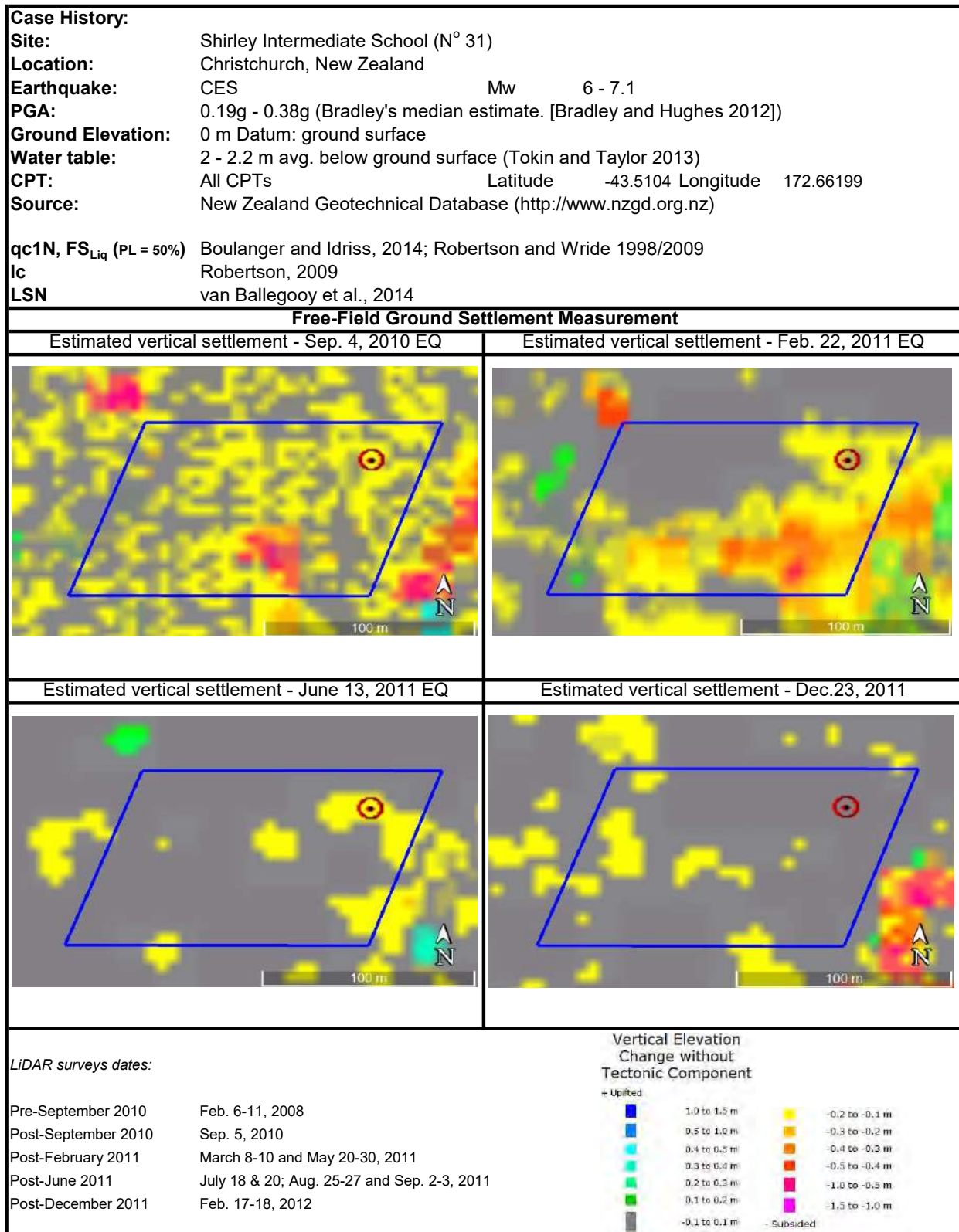


Aerial photography taken on June 14-15, 2011



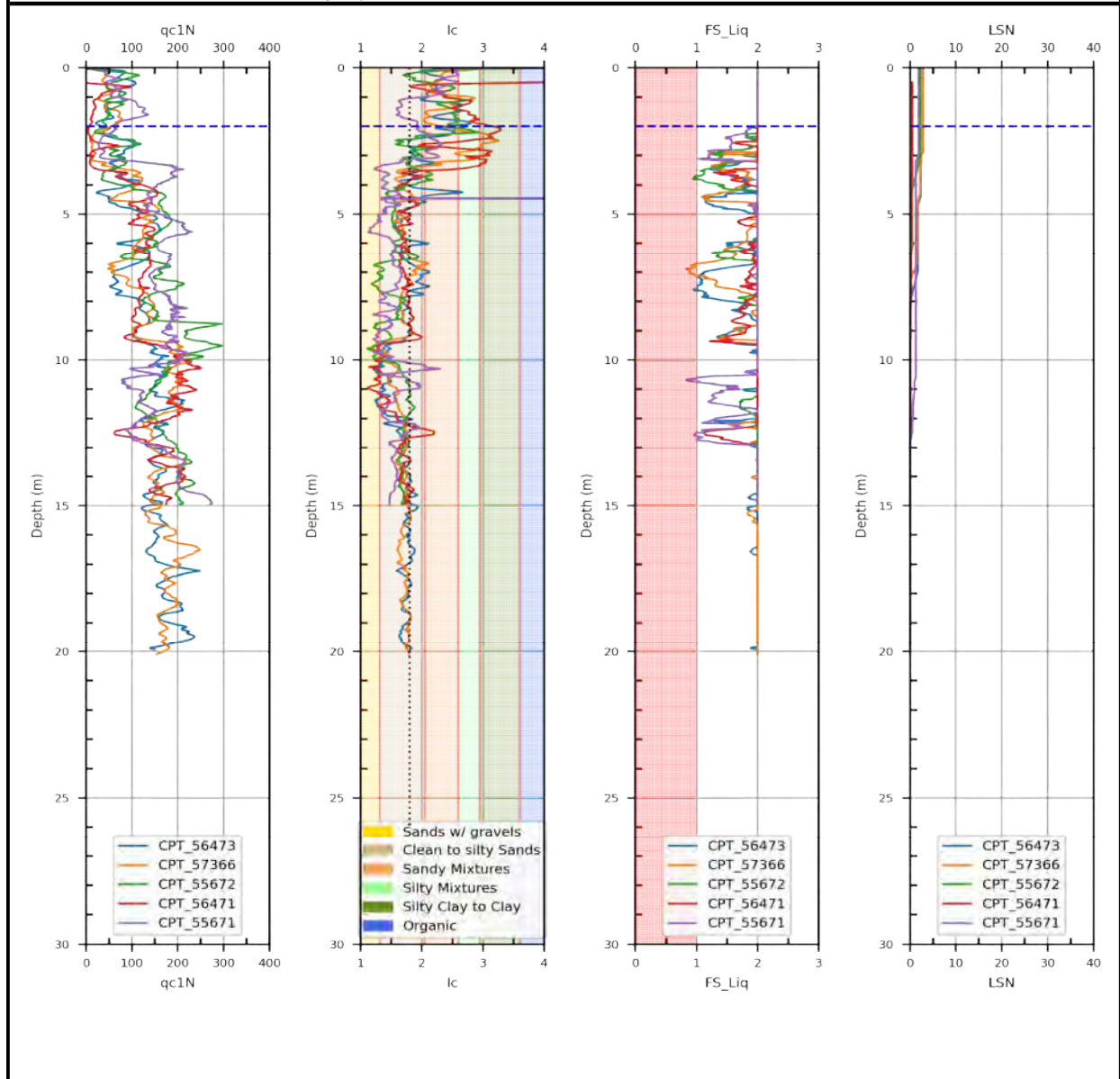
Aerial photography taken on December 24, 2011

**Ministry of Civil Defence
& Emergency Management**
Te Kaitiaki Whakamanatanga**CERA**
Canterbury Earthquake
Recovery Authority**EQC**
EARTHQUAKE COMMISSION
Kaitiaki Takekōwhiri**Tonkin & Taylor**



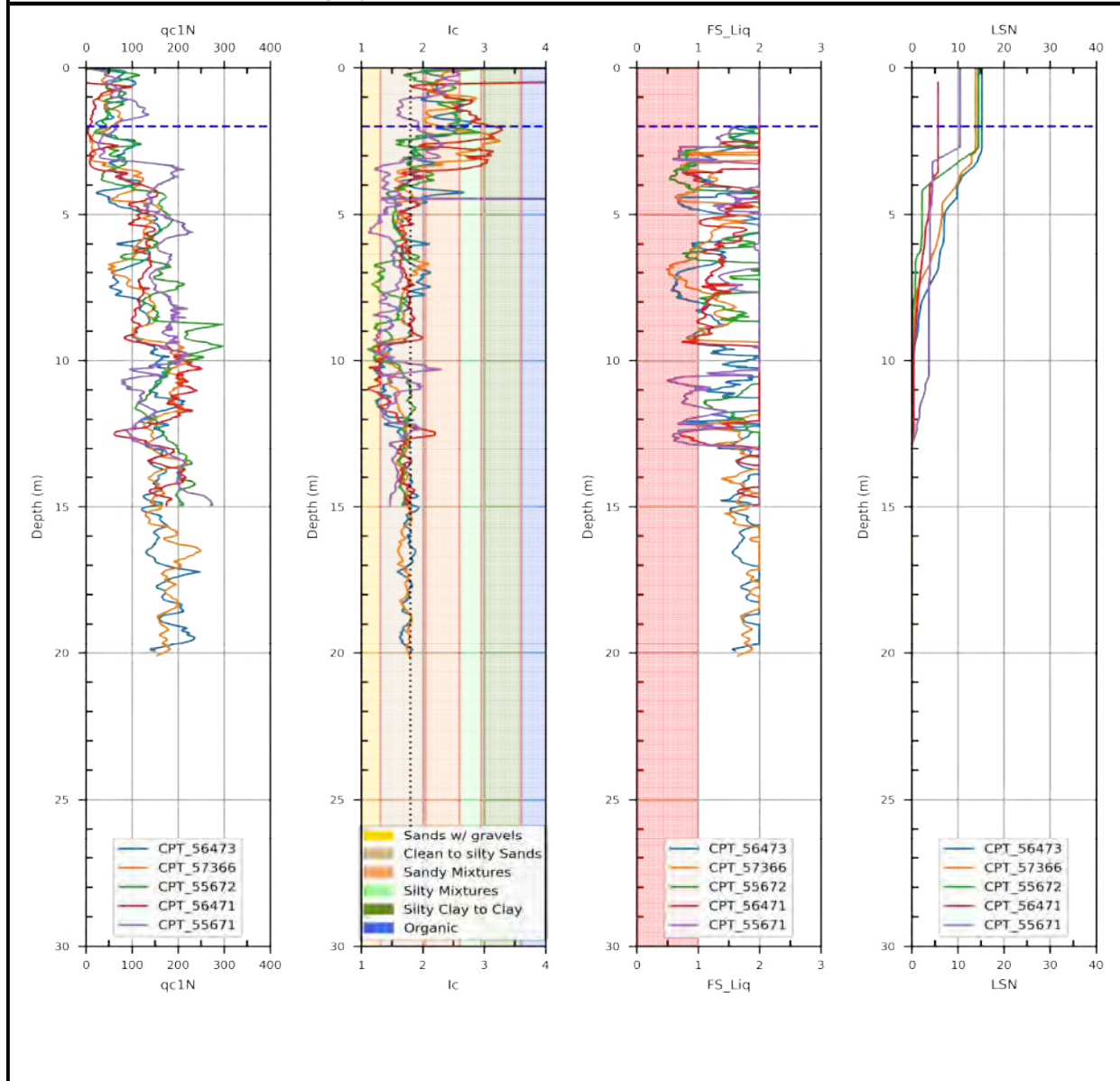
Case History: Ch-S91
Site: Shirley Intermediate School (No 31)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.19g (Bradley's median estimate. [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2 - 2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5104 Longitude 172.66199
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



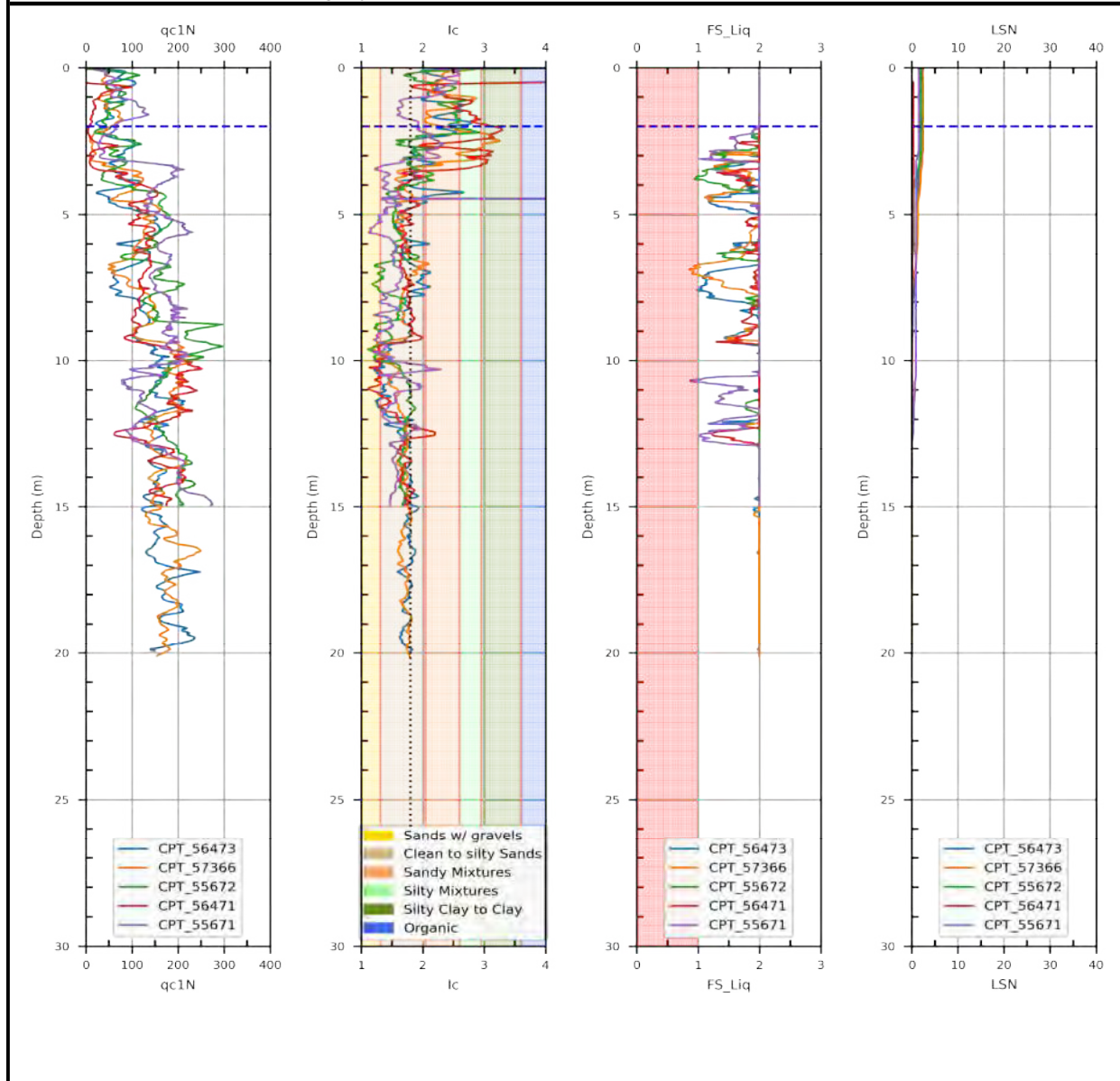
Case History: Ch-S92
Site: Shirley Intermediate School (No 31)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.38g (Bradley's median estimate. [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2 - 2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5104 Longitude 172.66199
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S93
Site: Shirley Intermediate School (No 31)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.22g (Bradley's median estimate. [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2 - 2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5104 Longitude 172.66199
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



200 Cashmere Road

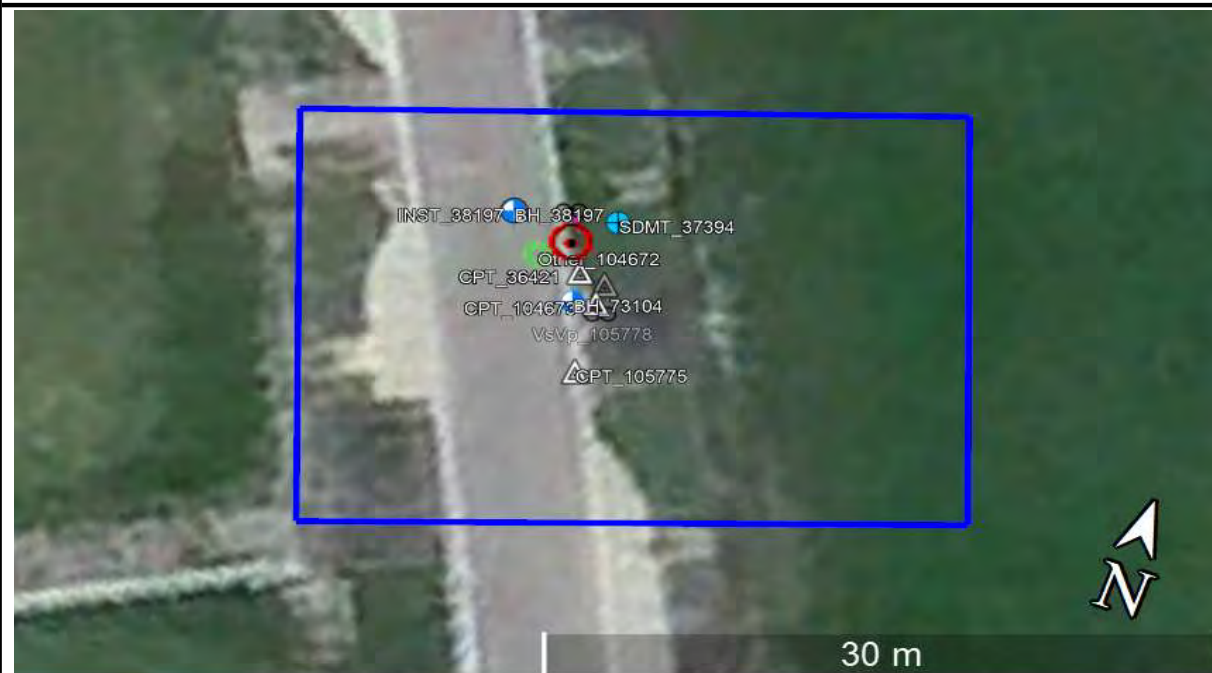
Case History:

Site: 200 Cashmere Road (N°33)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.19g - 0.46g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5726 Longitude 172.6081
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

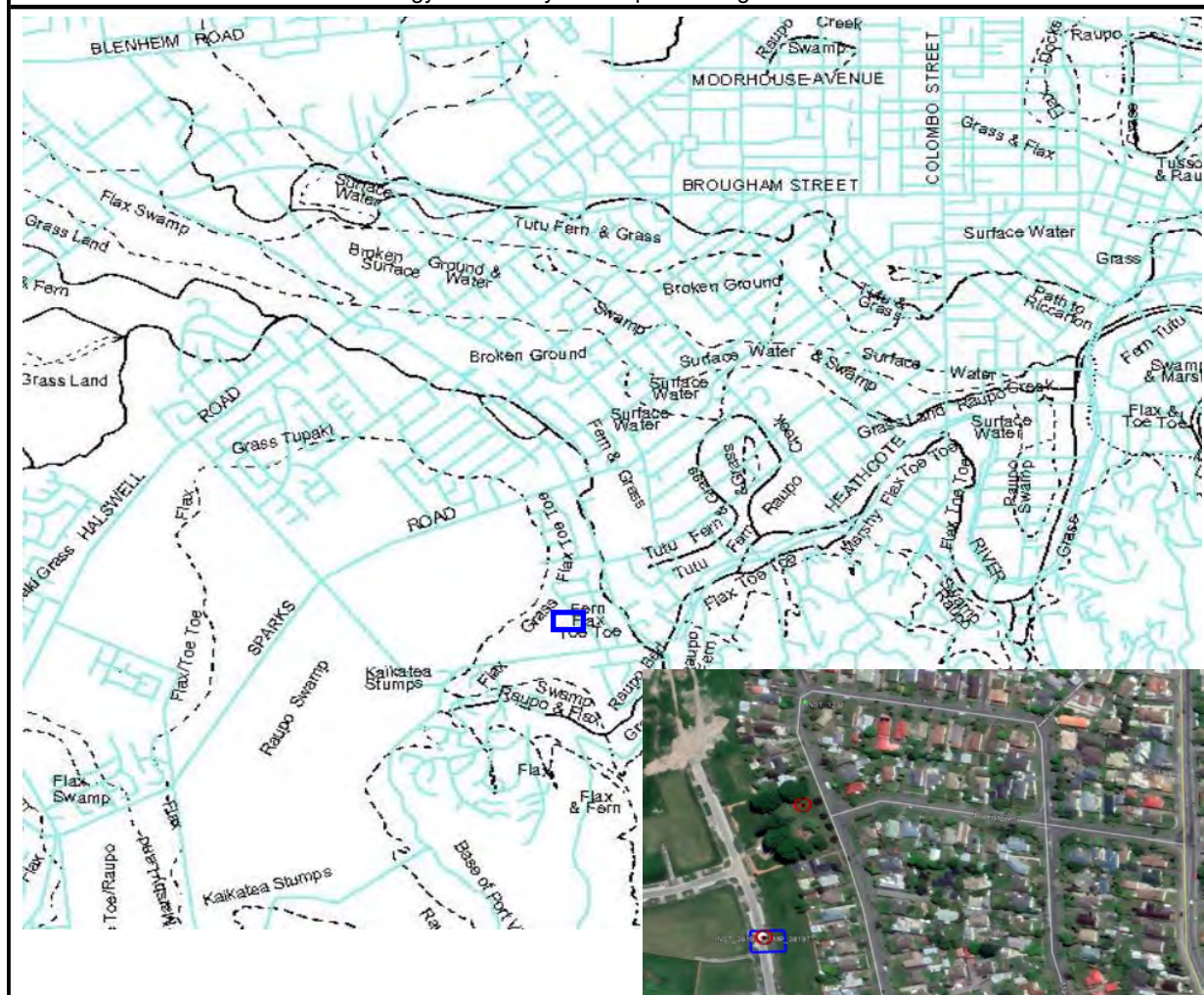
Site: 200 Cashmere Road (N°33)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.19g - 0.46g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5726 Longitude 172.6081
Source: Christchurch City Council, map_Ap001725BlackMap.gws

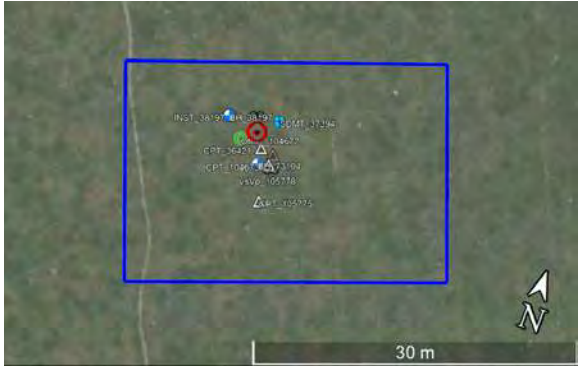
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

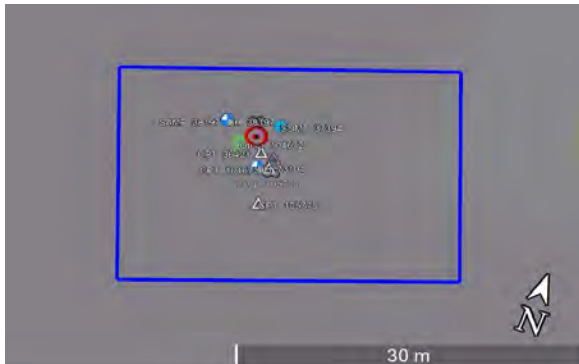
lc Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

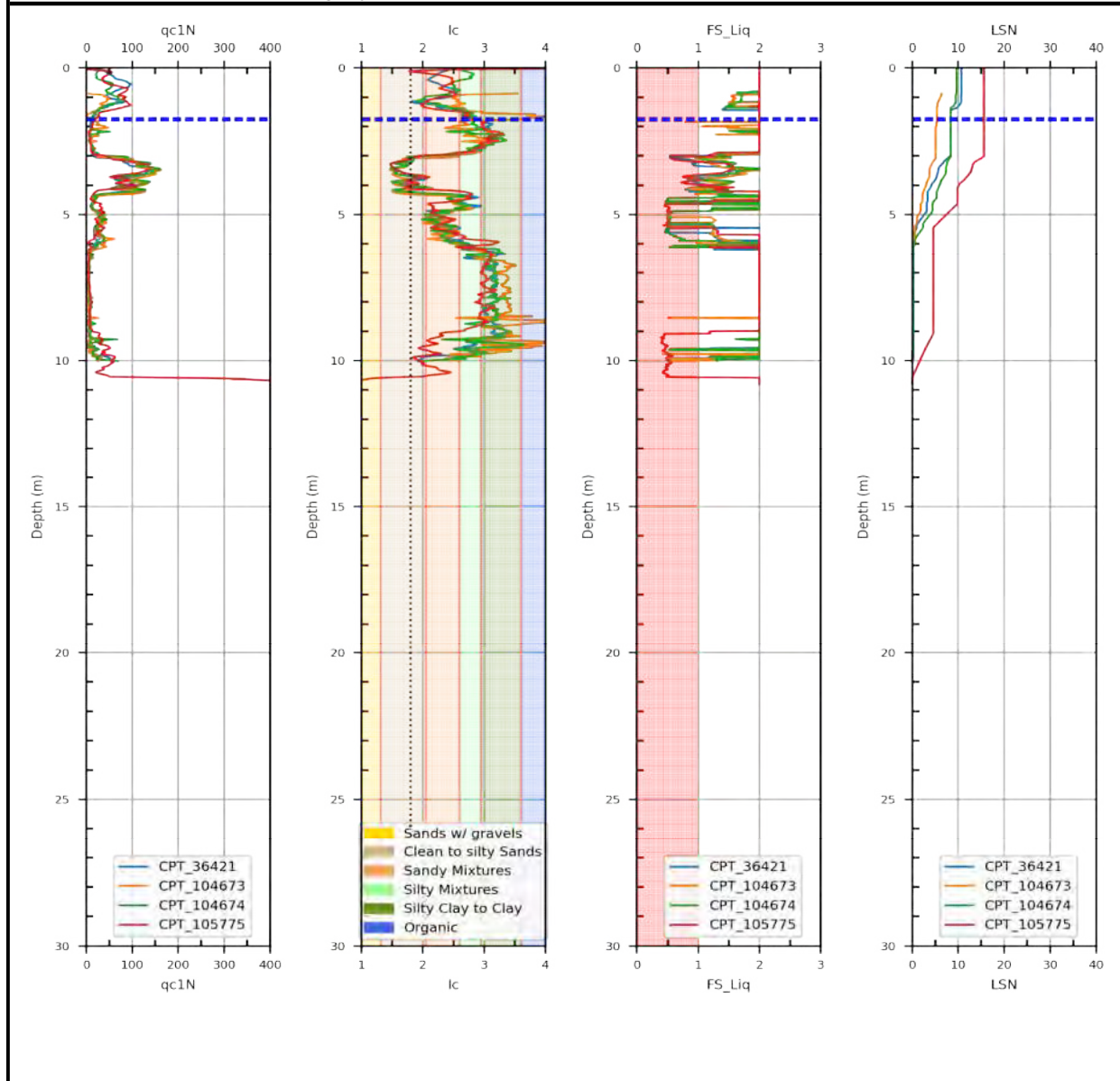


Case History: Site: 200 Cashmere Road (N°33) Location: Christchurch, New Zealand Earthquake: CES Mw 6.2 - 7.1 PGA: 0.19g - 0.46g (Bradley's median estimate [Bradley and Hughes 2012]) Ground Elevation: 0 m Datum: ground surface Water table: 1.8 m avg. below ground surface (Tokin and Taylor 2013) CPT: All CPTs Latitude -43.5726 Longitude 172.6081 Source: New Zealand Geotechnical Database (http://www.nzgd.org.nz) qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009 Ic Robertson, 2009 LSN van Ballegooy et al., 2014	
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
No aerial photo available	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
No aerial photo available	
	

Case History:	
Site:	200 Cashmere Road (N°33)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.19g - 0.46g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	1.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5726 Longitude 172.6081
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Free-Field Ground Settlement Measurement	
Estimated vertical settlement - Sep. 4, 2010 EQ	Estimated vertical settlement - Feb. 22, 2011 EQ
No LiDAR data available	
Estimated vertical settlement - June 13, 2011 EQ	Estimated vertical settlement - Dec.23, 2011
	No LiDAR data available
LiDAR surveys dates:	
Pre-September 2010	Feb. 6-11, 2008
Post-September 2010	Sep. 5, 2010
Post-February 2011	March 8-10 and May 20-30, 2011
Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011
Post-December 2011	Feb. 17-18, 2012
Vertical Elevation Change without Tectonic Component	
+ Uplifted	
	1.0 to 1.5 m
	0.5 to 1.0 m
	0.4 to 0.3 m
	0.3 to 0.4 m
	0.2 to 0.3 m
	0.1 to 0.2 m
	-0.1 to 0.1 m
- Subsided	
	-0.2 to -0.1 m
	-0.3 to -0.2 m
	-0.4 to -0.3 m
	-0.5 to -0.4 m
	-1.0 to -0.5 m
	-1.5 to -1.0 m

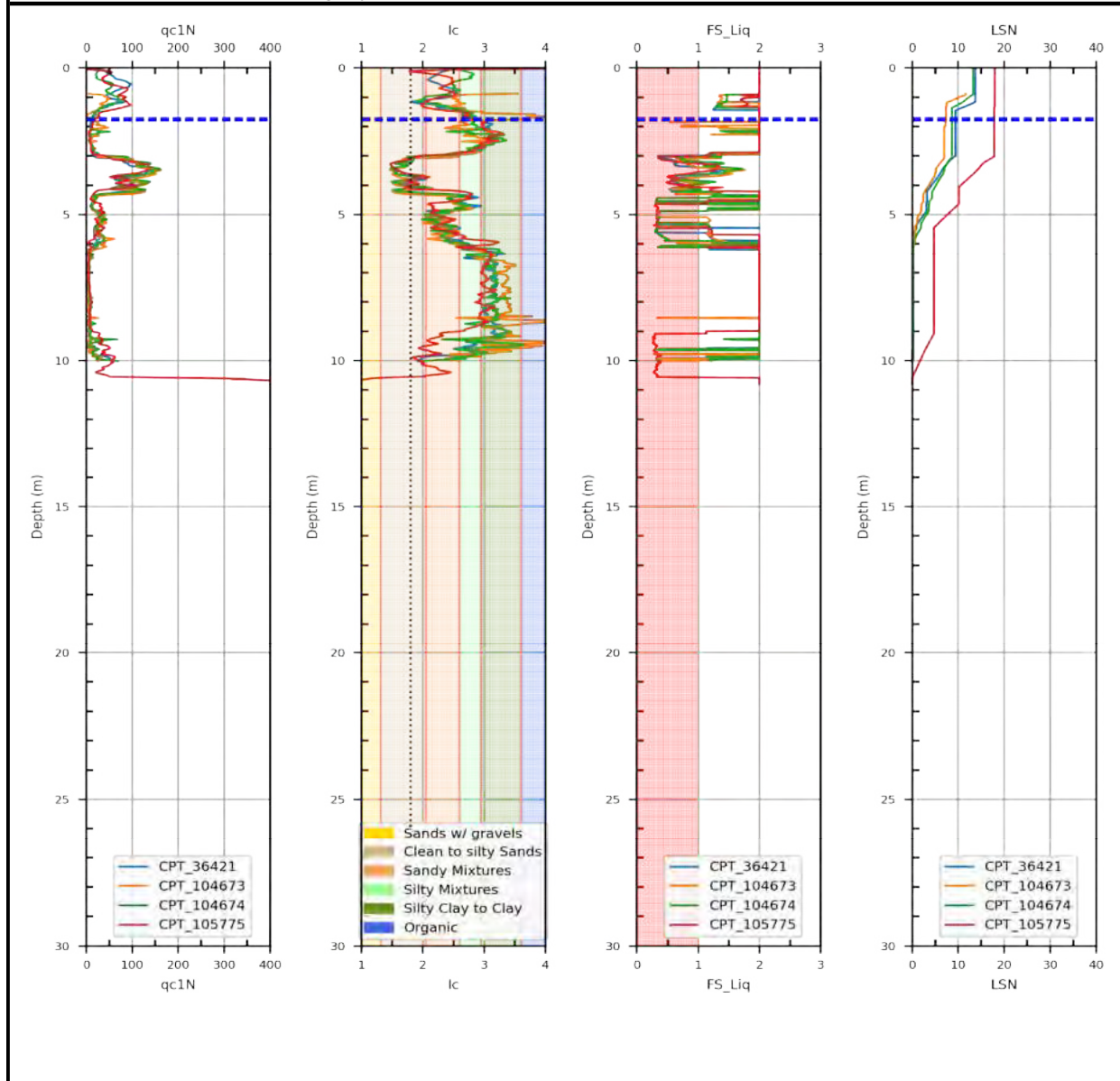
Case History: Ch-S94
Site: 200 Cashmere Road (N°33)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.25g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5726 Longitude 172.6081
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



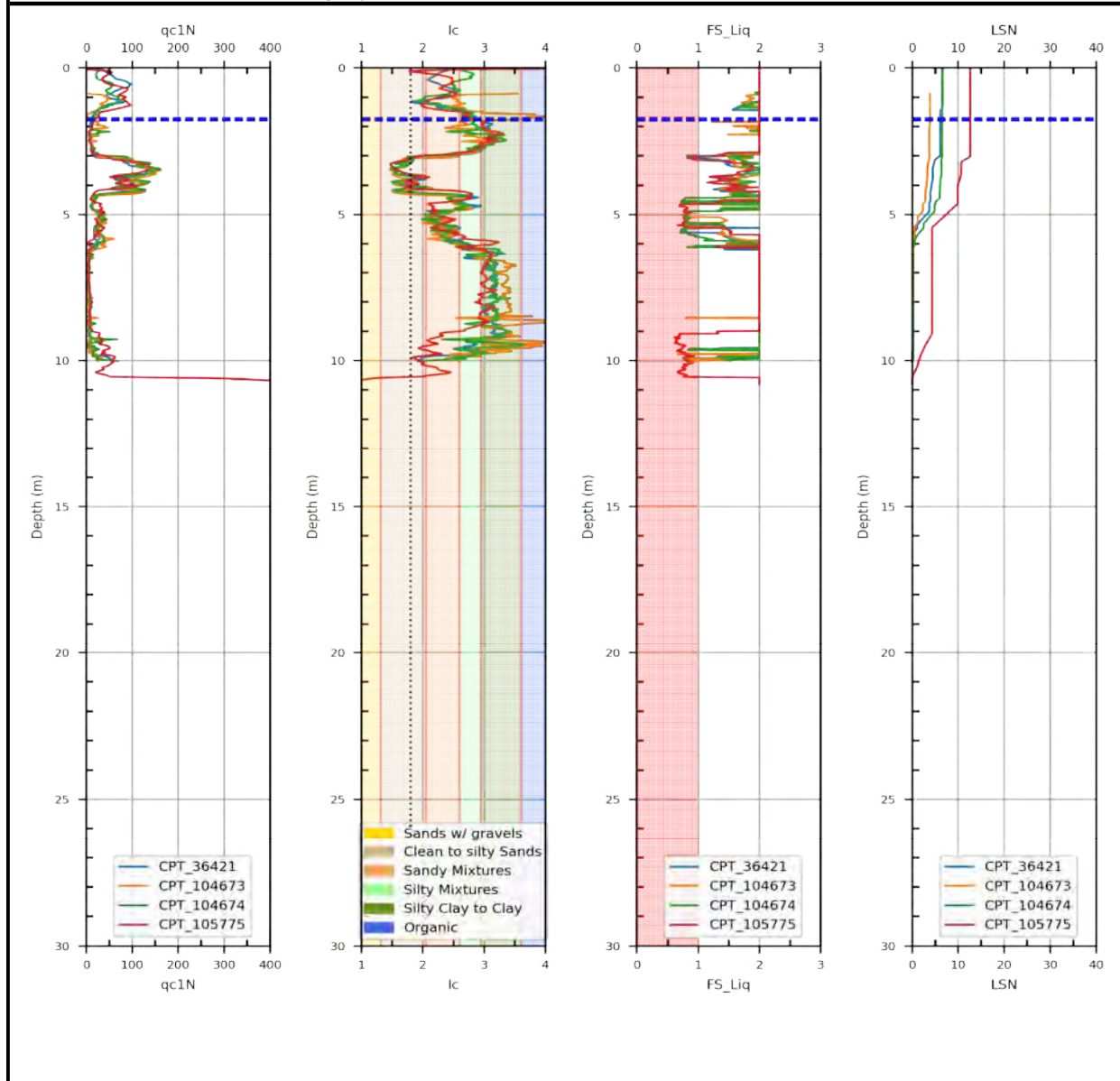
Case History: Ch-S95
Site: 200 Cashmere Road (N°33)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.46g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5726 Longitude 172.6081
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S96
Site: 200 Cashmere Road (N°33)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.19g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5726 Longitude 172.6081
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Gainsborough Reserve

Case History:

Site: Gainsborough Reserve (N°34)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.43g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.9 m - 2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5636 Longitude 172.6019
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

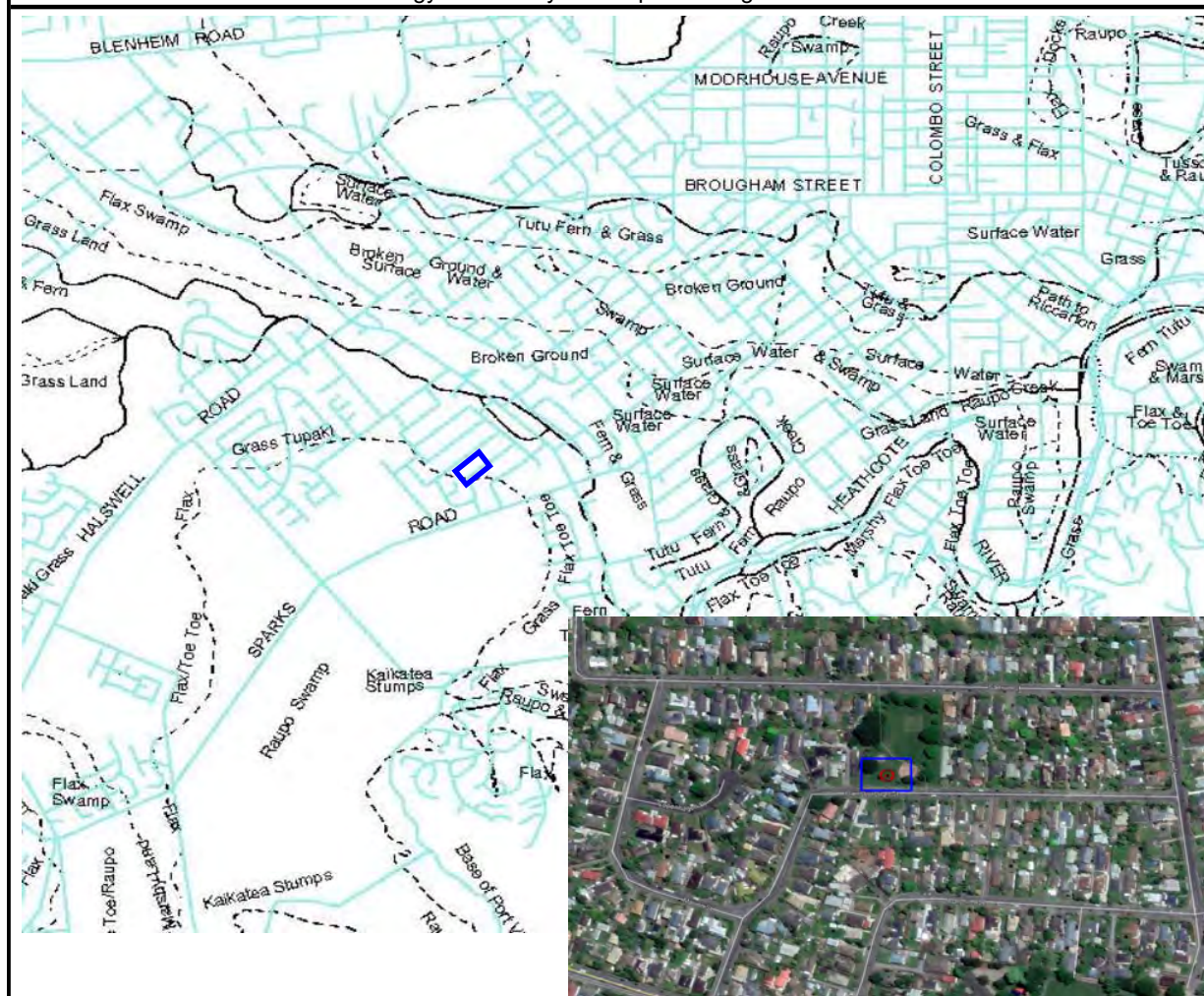
Site: Gainsborough Reserve (N°34)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.43g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.9 m - 2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5636 Longitude 172.6019
Source: Christchurch City Council, map_Ap001725BlackMap.gws

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

lc Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

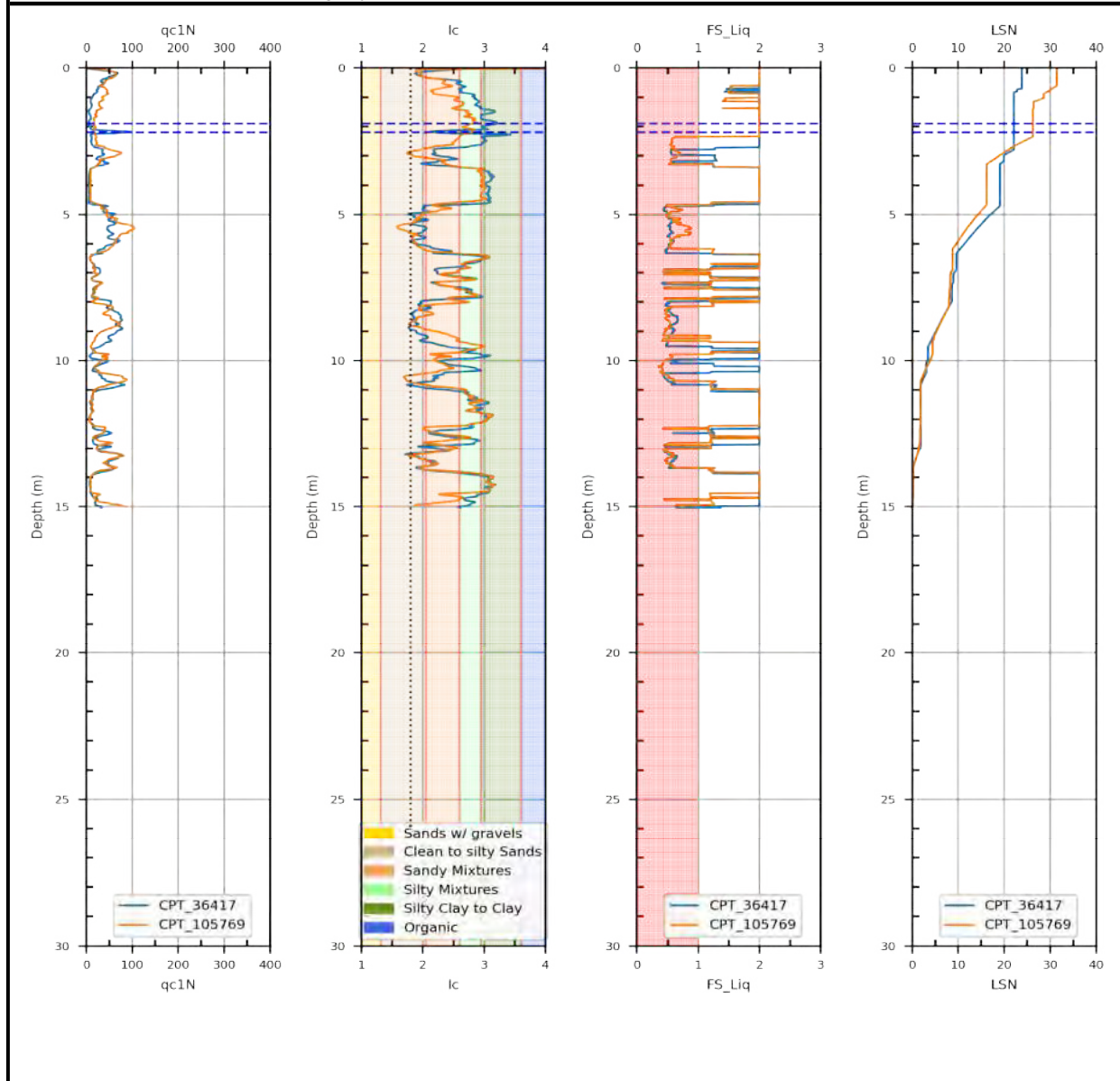


Case History:	
Site:	Gainsborough Reserve (N°34)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.18g - 0.43g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	1.9 m - 2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5636 Longitude 172.6019
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
No aerial photo available	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
No aerial photo available	No aerial photo available
	

Case History:	
Site:	Gainsborough Reserve (N°34)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.18g - 0.43g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	1.9 m - 2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5636 Longitude 172.6019
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Free-Field Ground Settlement Measurement	
Estimated vertical settlement - Sep. 4, 2010 EQ	Estimated vertical settlement - Feb. 22, 2011 EQ
No LiDAR data available	No LiDAR data available
Estimated vertical settlement - June 13, 2011 EQ	Estimated vertical settlement - Dec.23, 2011
	No LiDAR data available
LiDAR surveys dates:	
Pre-September 2010	Feb. 6-11, 2008
Post-September 2010	Sep. 5, 2010
Post-February 2011	March 8-10 and May 20-30, 2011
Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011
Post-December 2011	Feb. 17-18, 2012
Vertical Elevation Change without Tectonic Component	
+ Uplifted	
	1.0 to 1.5 m
	0.5 to 1.0 m
	0.4 to 0.5 m
	0.3 to 0.4 m
	0.2 to 0.3 m
	0.1 to 0.2 m
	-0.1 to 0.1 m
	-0.2 to -0.1 m
	-0.3 to -0.2 m
	-0.4 to -0.3 m
	-0.5 to -0.4 m
	-1.0 to -0.5 m
	-1.5 to -1.0 m
- Subsided	

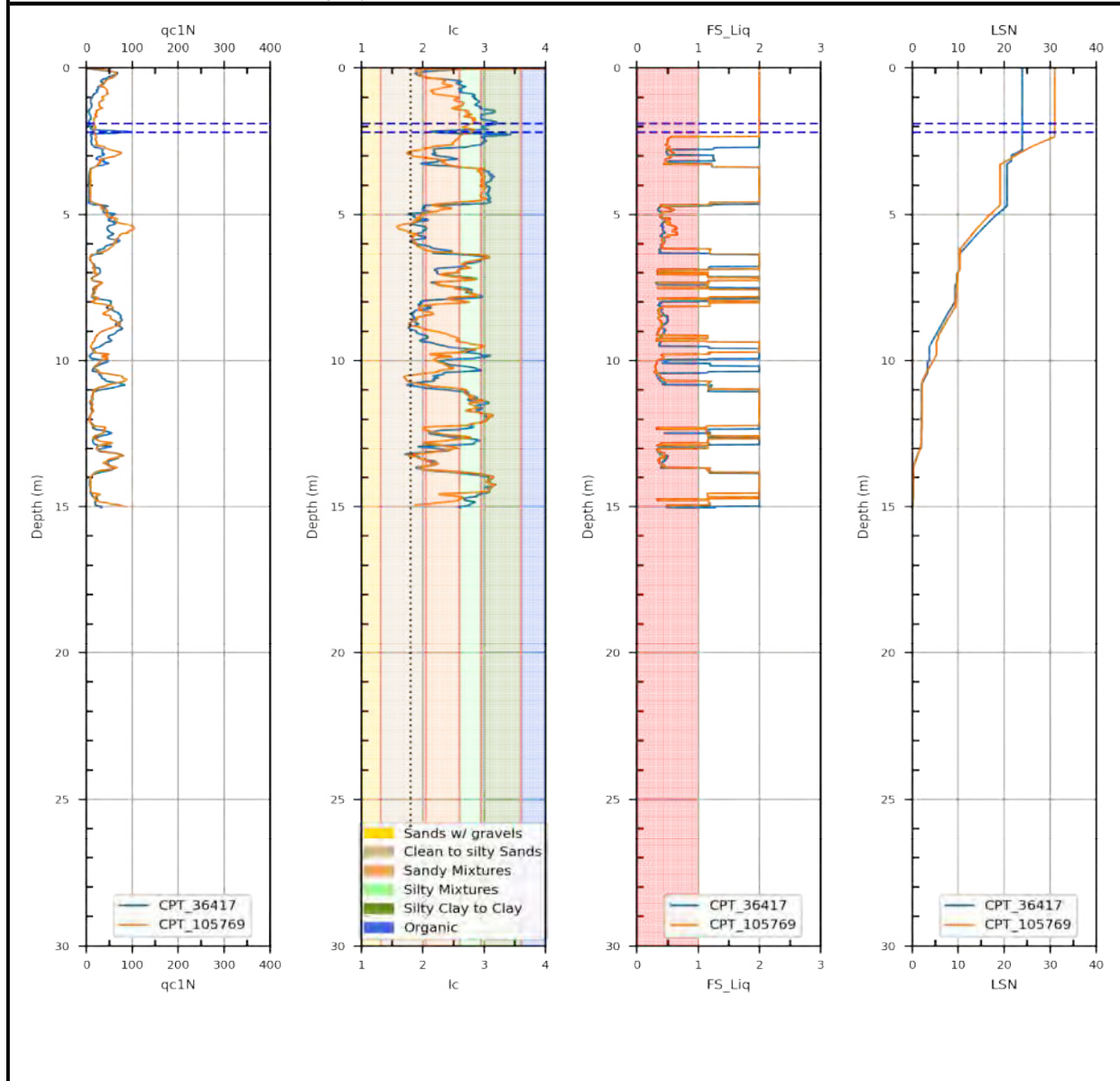
Case History: Ch-S97
Site: Gainsborough Reserve (N°34)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.25g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.9 m - 2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5636 Longitude 172.6019
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



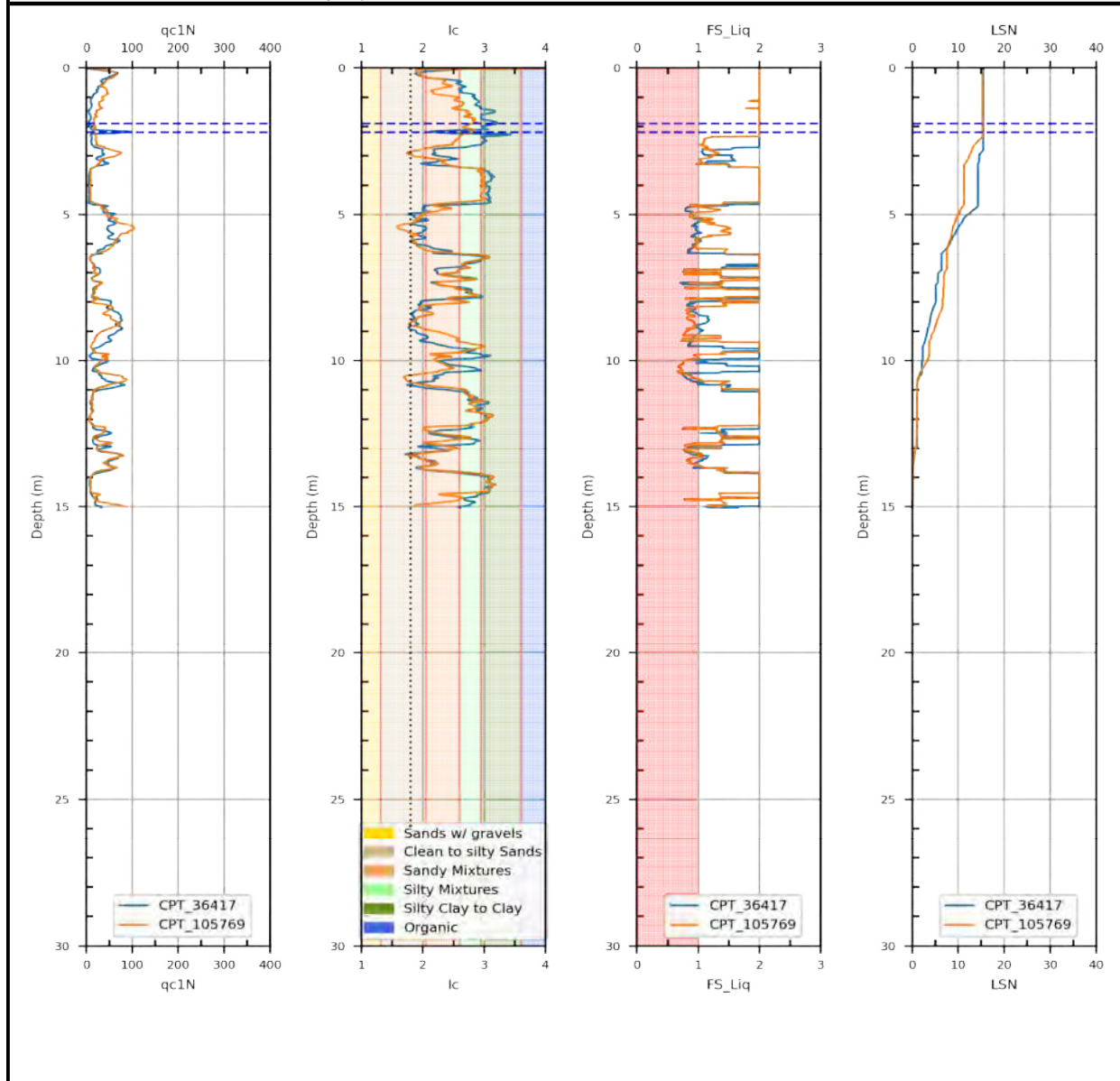
Case History: Ch-S98
Site: Gainsborough Reserve (N°34)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.43g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.9 m - 2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5636 Longitude 172.6019
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S99
Site: Gainsborough Reserve (N°34)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.18g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.9 m - 2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5636 Longitude 172.6019
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



71 Somerfield Street

Case History:

Site: 71 Somerfield Street (N°35)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.22g - 0.45g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.3 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5605 Longitude 172.6307
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

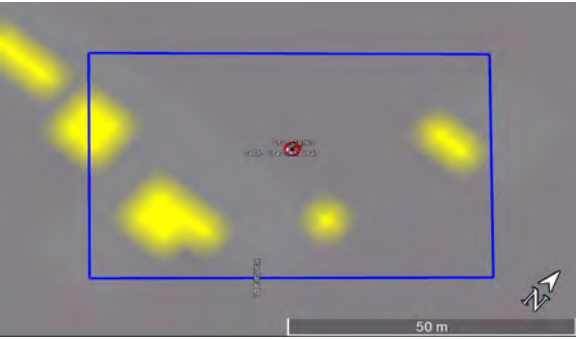
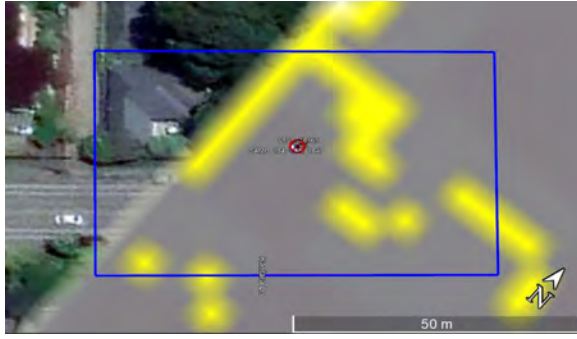
New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:**Site:** 71 Somerfield Street (N°35)**Location:** Christchurch, New Zealand**Earthquake:** CES Mw 6.2 - 7.1**PGA:** 0.22g - 0.45g (Bradley's median estimate [Bradley and Hughes 2012])**Ground Elevation:** 0 m Datum: ground surface**Water table:** 2.3 m avg. below ground surface (Tokin and Taylor 2013)**CPT:** All CPTs Latitude -43.5605 Longitude 172.6307**Source:** Christchurch City Council, map_Ap001725BlackMap.gws**qc1N, FS_{Liq} (PL = 50%)** Boulanger and Idriss, 2014; Robertson and Wride 1998/2009**lc** Robertson, 2009**LSN** van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

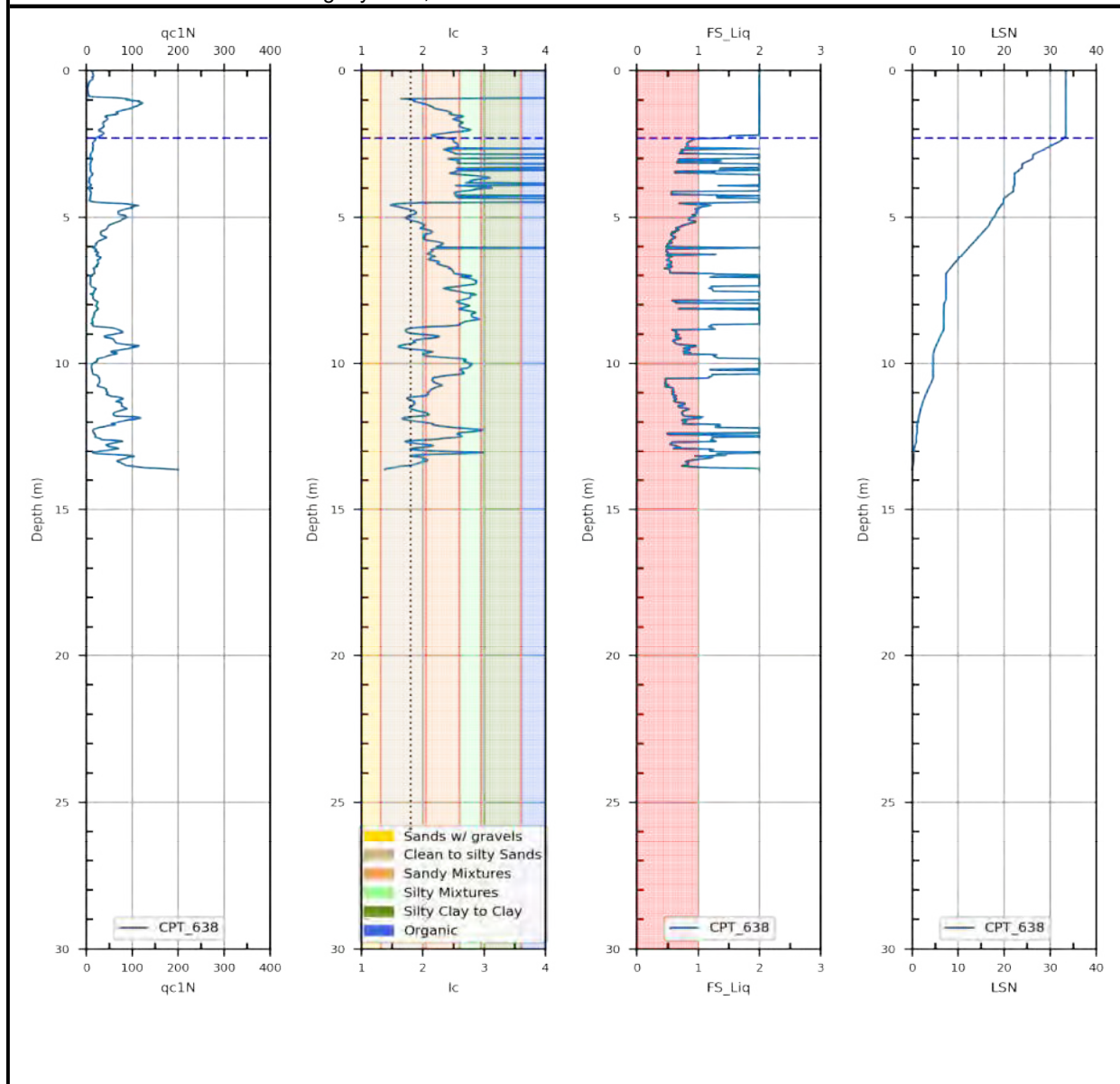


Case History:	
Site:	71 Somerfield Street (N°35)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.22g - 0.45g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	2.3 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5605 Longitude 172.6307
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
No aerial photo available	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
	

Case History:															
Site:	71 Somerfield Street (N°35)														
Location:	Christchurch, New Zealand														
Earthquake:	CES Mw 6.2 - 7.1														
PGA:	0.22g - 0.45g (Bradley's median estimate [Bradley and Hughes 2012])														
Ground Elevation:	0 m Datum: ground surface														
Water table:	2.3 m avg. below ground surface (Tokin and Taylor 2013)														
CPT:	All CPTs Latitude -43.5605 Longitude 172.6307														
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)														
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009														
Ic	Robertson, 2009														
LSN	van Ballegooy et al., 2014														
Free-Field Ground Settlement Measurement															
Estimated vertical settlement - Sep. 4, 2010 EQ	Estimated vertical settlement - Feb. 22, 2011 EQ														
No LiDAR data available	No LiDAR data available														
Estimated vertical settlement - June 13, 2011 EQ	Estimated vertical settlement - Dec.23, 2011														
															
LiDAR surveys dates: Pre-September 2010 Feb. 6-11, 2008 Post-September 2010 Sep. 5, 2010 Post-February 2011 March 8-10 and May 20-30, 2011 Post-June 2011 July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011 Post-December 2011 Feb. 17-18, 2012															
Vertical Elevation Change without Tectonic Component + Uplifted <table border="0"> <tbody> <tr> <td>1.0 to 1.5 m</td><td>-0.2 to -0.1 m</td></tr> <tr> <td>0.5 to 1.0 m</td><td>-0.3 to -0.2 m</td></tr> <tr> <td>0.4 to 0.3 m</td><td>-0.4 to -0.3 m</td></tr> <tr> <td>0.3 to 0.4 m</td><td>-0.5 to -0.4 m</td></tr> <tr> <td>0.2 to 0.3 m</td><td>-1.0 to -0.5 m</td></tr> <tr> <td>0.1 to 0.2 m</td><td>-1.5 to -1.0 m</td></tr> <tr> <td>-0.1 to 0.1 m</td><td>- Subsided</td></tr> </tbody> </table>		1.0 to 1.5 m	-0.2 to -0.1 m	0.5 to 1.0 m	-0.3 to -0.2 m	0.4 to 0.3 m	-0.4 to -0.3 m	0.3 to 0.4 m	-0.5 to -0.4 m	0.2 to 0.3 m	-1.0 to -0.5 m	0.1 to 0.2 m	-1.5 to -1.0 m	-0.1 to 0.1 m	- Subsided
1.0 to 1.5 m	-0.2 to -0.1 m														
0.5 to 1.0 m	-0.3 to -0.2 m														
0.4 to 0.3 m	-0.4 to -0.3 m														
0.3 to 0.4 m	-0.5 to -0.4 m														
0.2 to 0.3 m	-1.0 to -0.5 m														
0.1 to 0.2 m	-1.5 to -1.0 m														
-0.1 to 0.1 m	- Subsided														

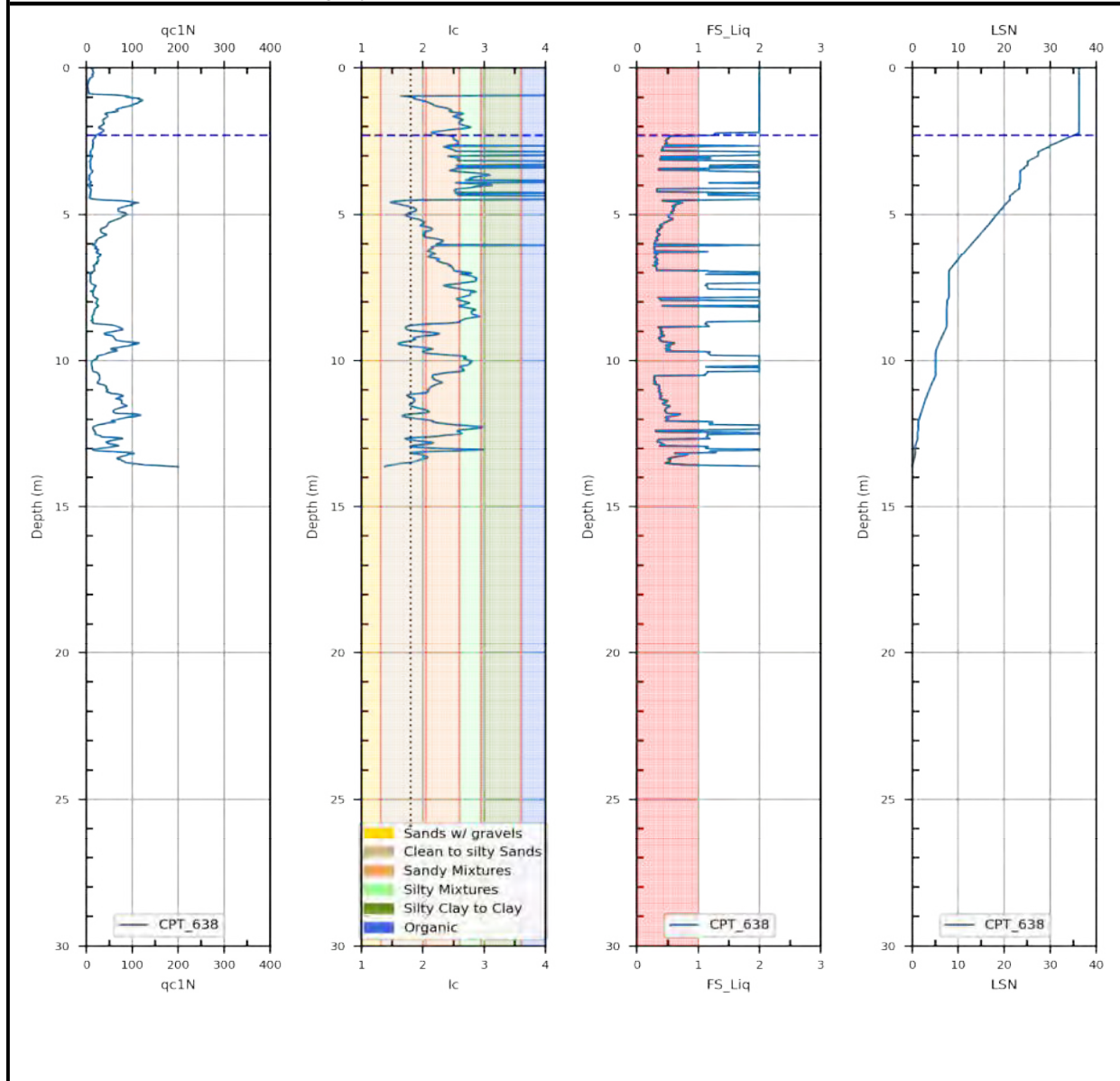
Case History: Ch-S100
Site: 71 Somerfield Street (N°35)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.23g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.3 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5605 Longitude 172.6307
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



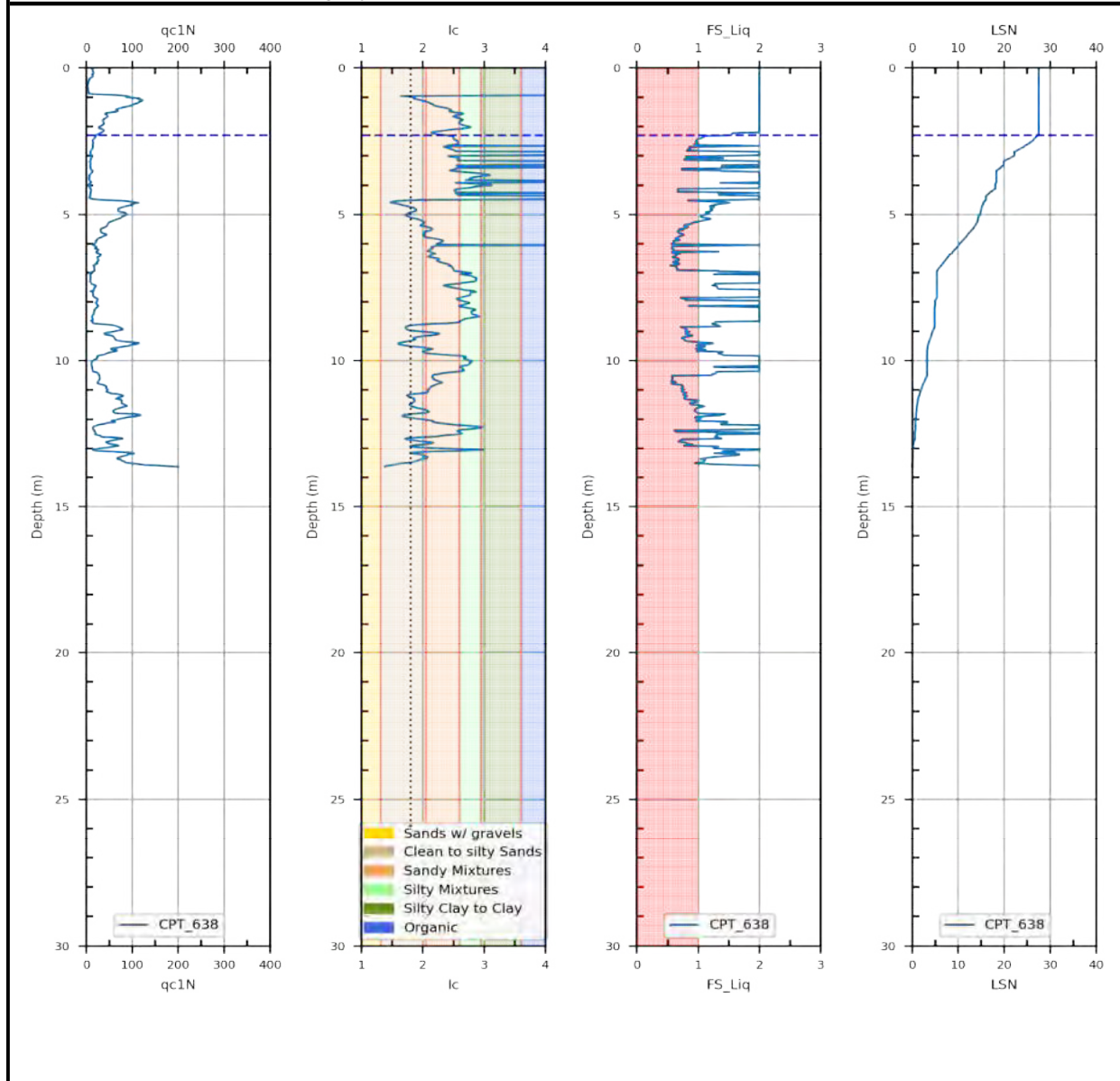
Case History: Ch-S101
Site: 71 Somerfield Street (N°35)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.45g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.3 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5605 Longitude 172.6307
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S102
Site: 71 Somerfield Street (N°35)
Location: Christchurch, New Zealand
Earthquake: Jun-11 Mw 6.2
PGA: 0.22g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.3 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5605 Longitude 172.6307
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Paeroa Reserve

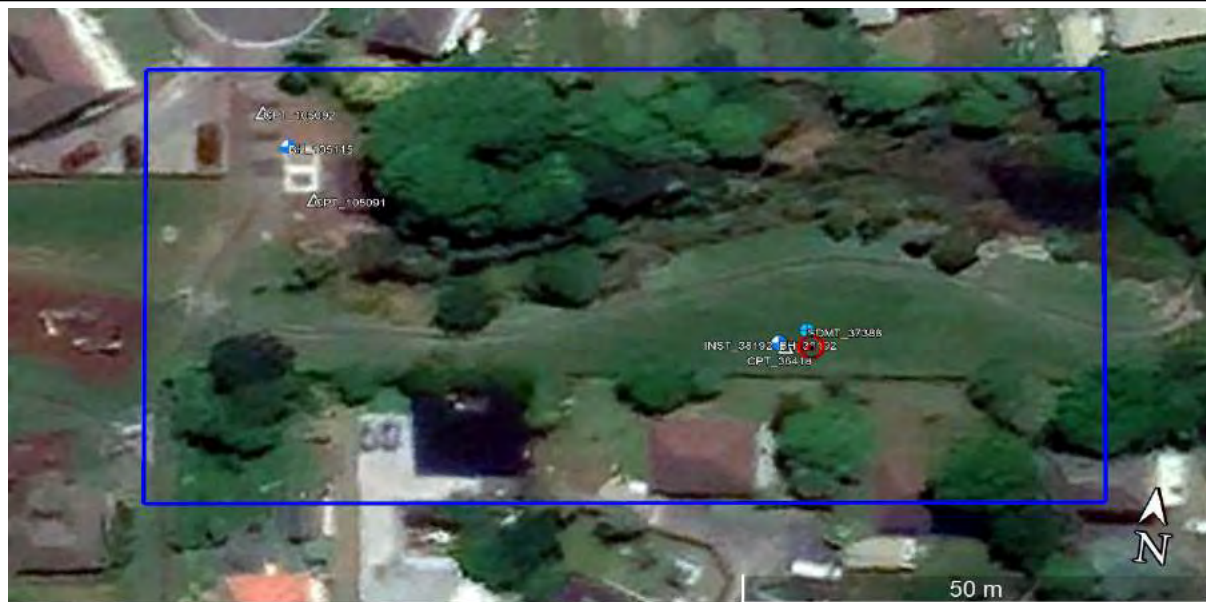
Case History:

Site: Paeroa Reserve (N°37)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.17g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5321 Longitude 172.5905
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

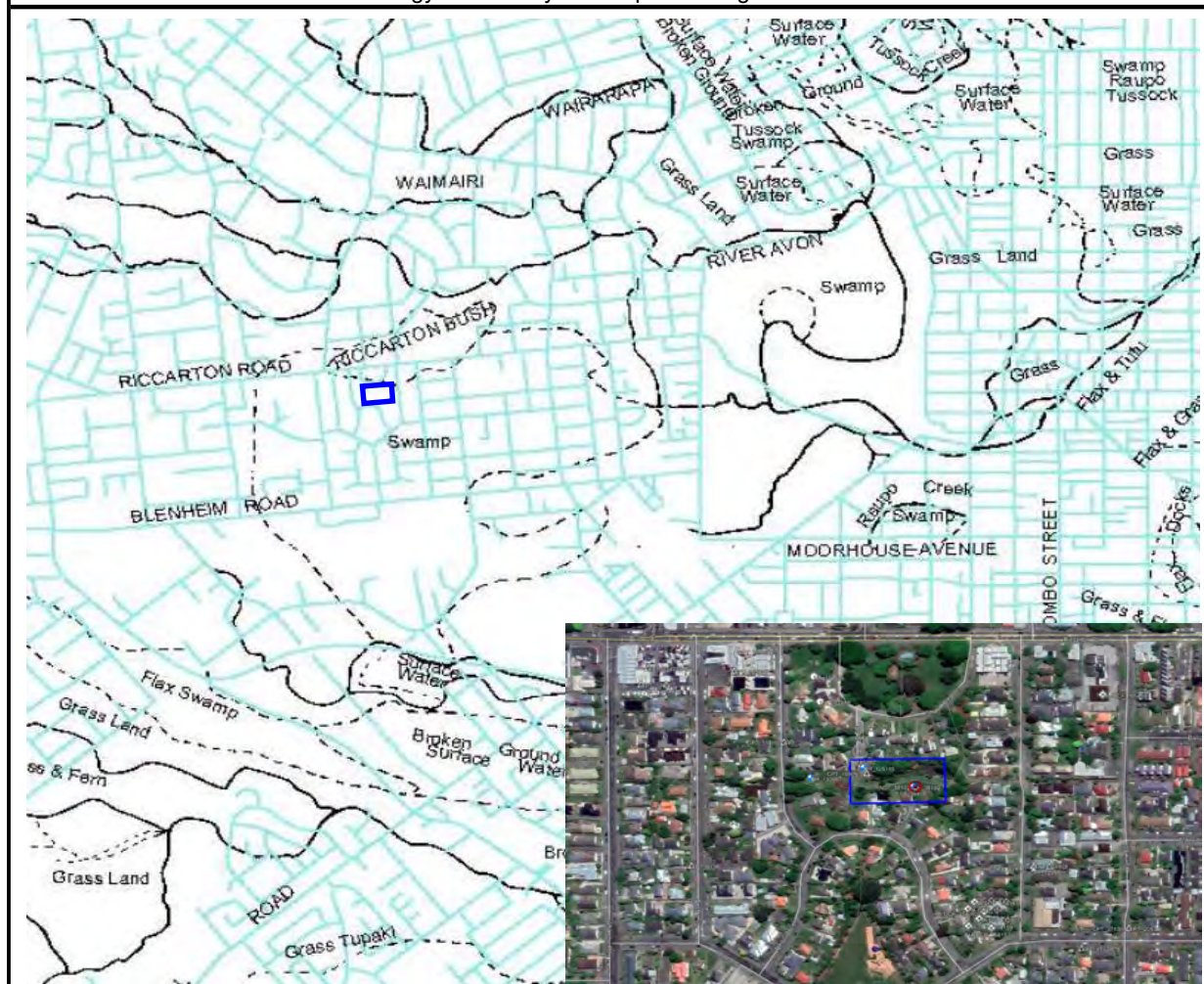
Site: Paeroa Reserve (N°37)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.17g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5321 Longitude 172.5905
Source: Christchurch City Council, map_Ap001725BlackMap.gws

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

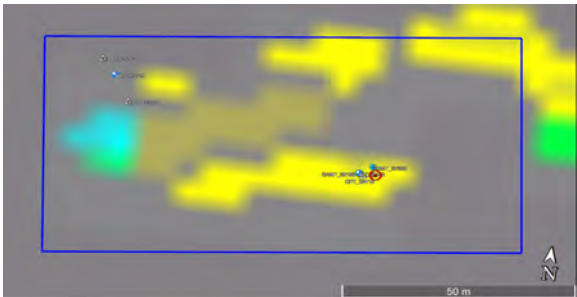
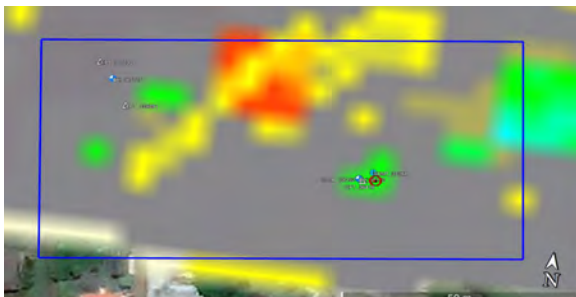
Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

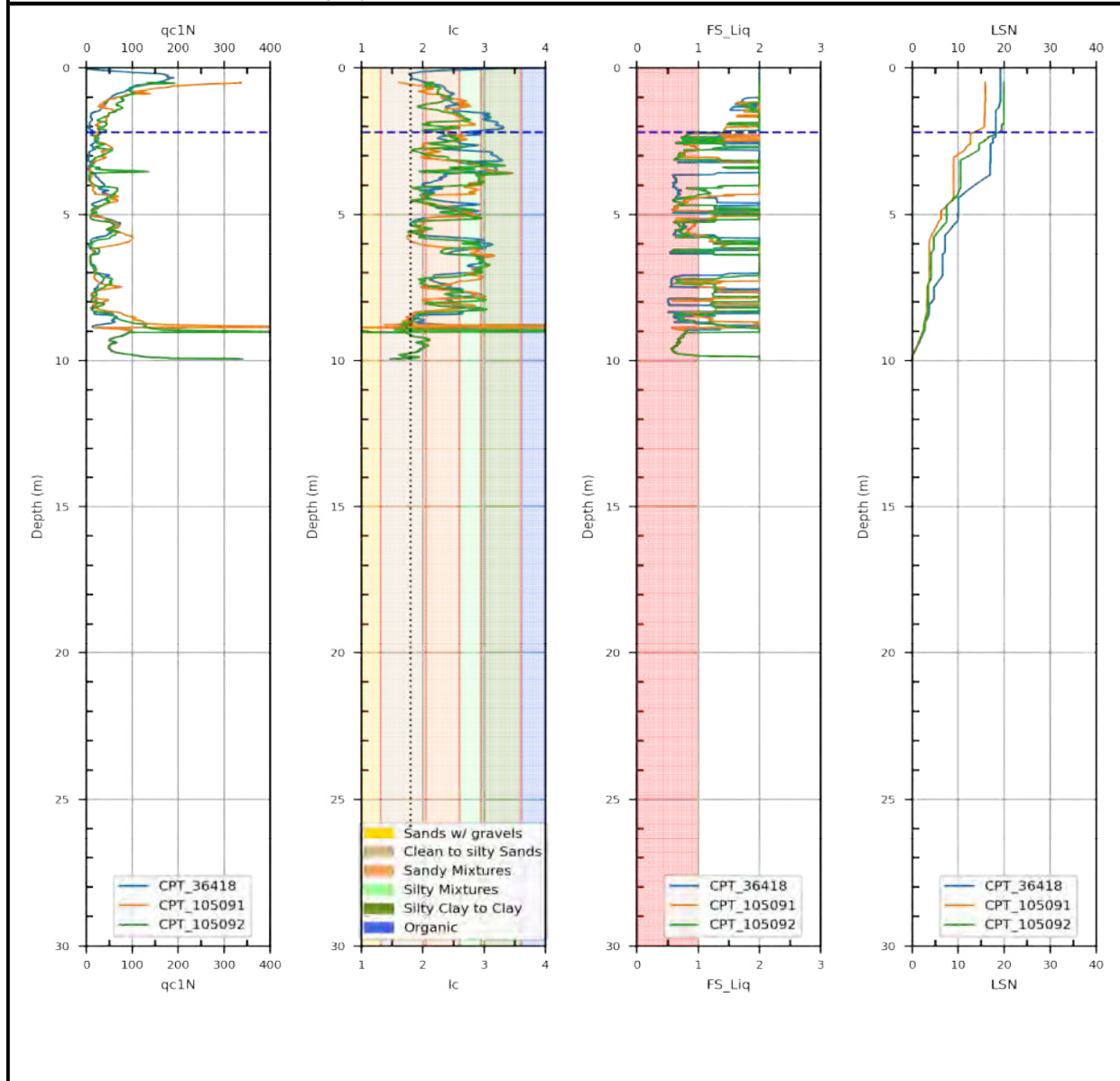


Case History:	
Site:	Paeroa Reserve (N°37)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.17g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5321 Longitude 172.5905
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
No aerial photo available	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	No aerial photo available
	

Case History:	
Site:	Paeroa Reserve (N°37)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.17g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5321 Longitude 172.5905
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Free-Field Ground Settlement Measurement	
Estimated vertical settlement - Sep. 4, 2010 EQ	Estimated vertical settlement - Feb. 22, 2011 EQ
No LiDAR data available	No LiDAR data available
Estimated vertical settlement - June 13, 2011 EQ	Estimated vertical settlement - Dec.23, 2011
	
LiDAR surveys dates:	
Pre-September 2010	Feb. 6-11, 2008
Post-September 2010	Sep. 5, 2010
Post-February 2011	March 8-10 and May 20-30, 2011
Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011
Post-December 2011	Feb. 17-18, 2012
Vertical Elevation Change without Tectonic Component	
+ Uplifted	
1.0 to 1.5 m	-0.2 to -0.1 m
0.5 to 1.0 m	-0.3 to -0.2 m
0.4 to 0.5 m	-0.4 to -0.3 m
0.3 to 0.4 m	-0.5 to -0.4 m
0.2 to 0.3 m	-1.0 to -0.5 m
0.1 to 0.2 m	-1.5 to -1.0 m
-0.1 to 0.1 m	- Subsided

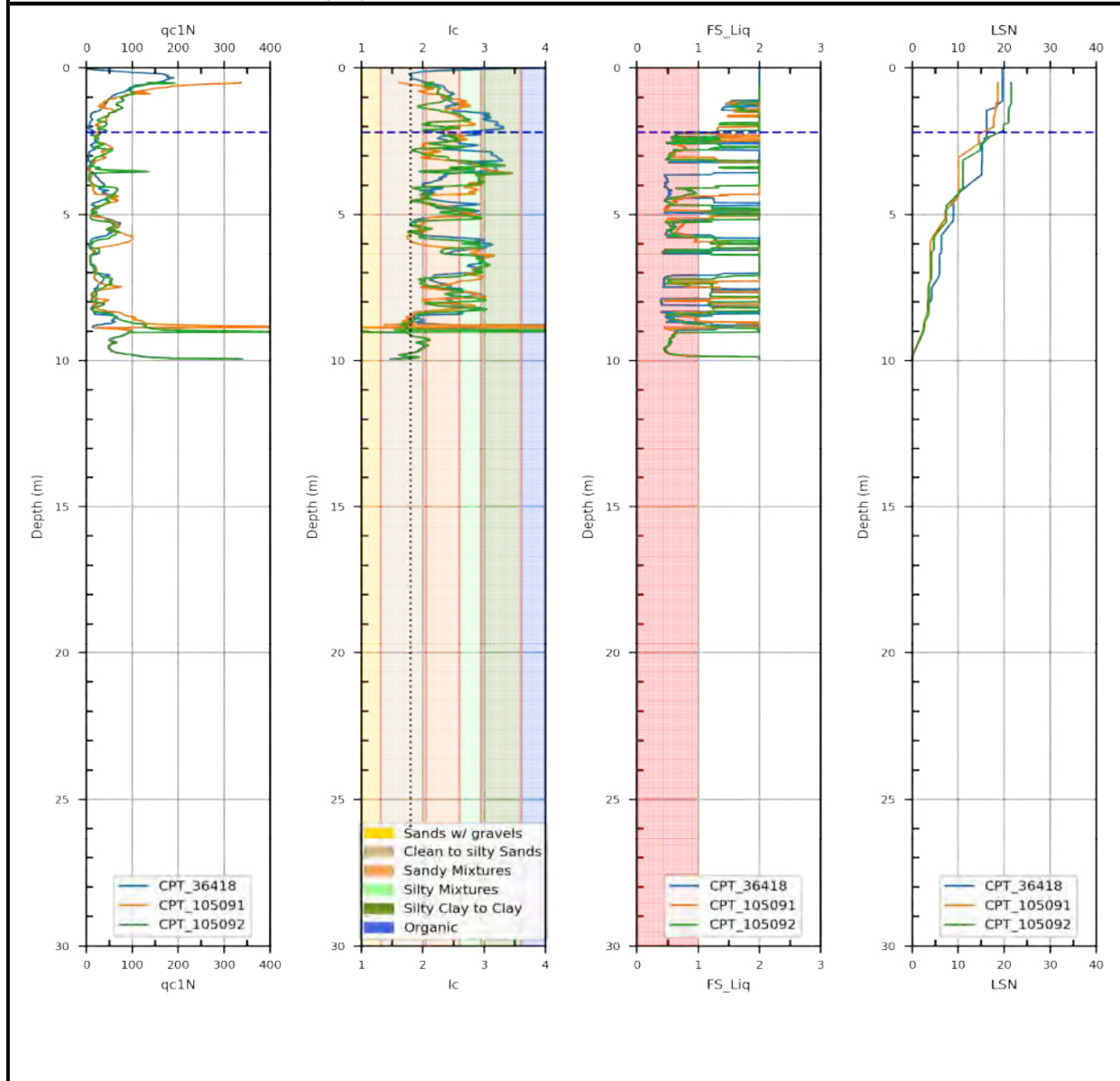
Case History: Ch-S103
Site: Paeroa Reserve (N°37)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.22g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5321 Longitude 172.5905
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



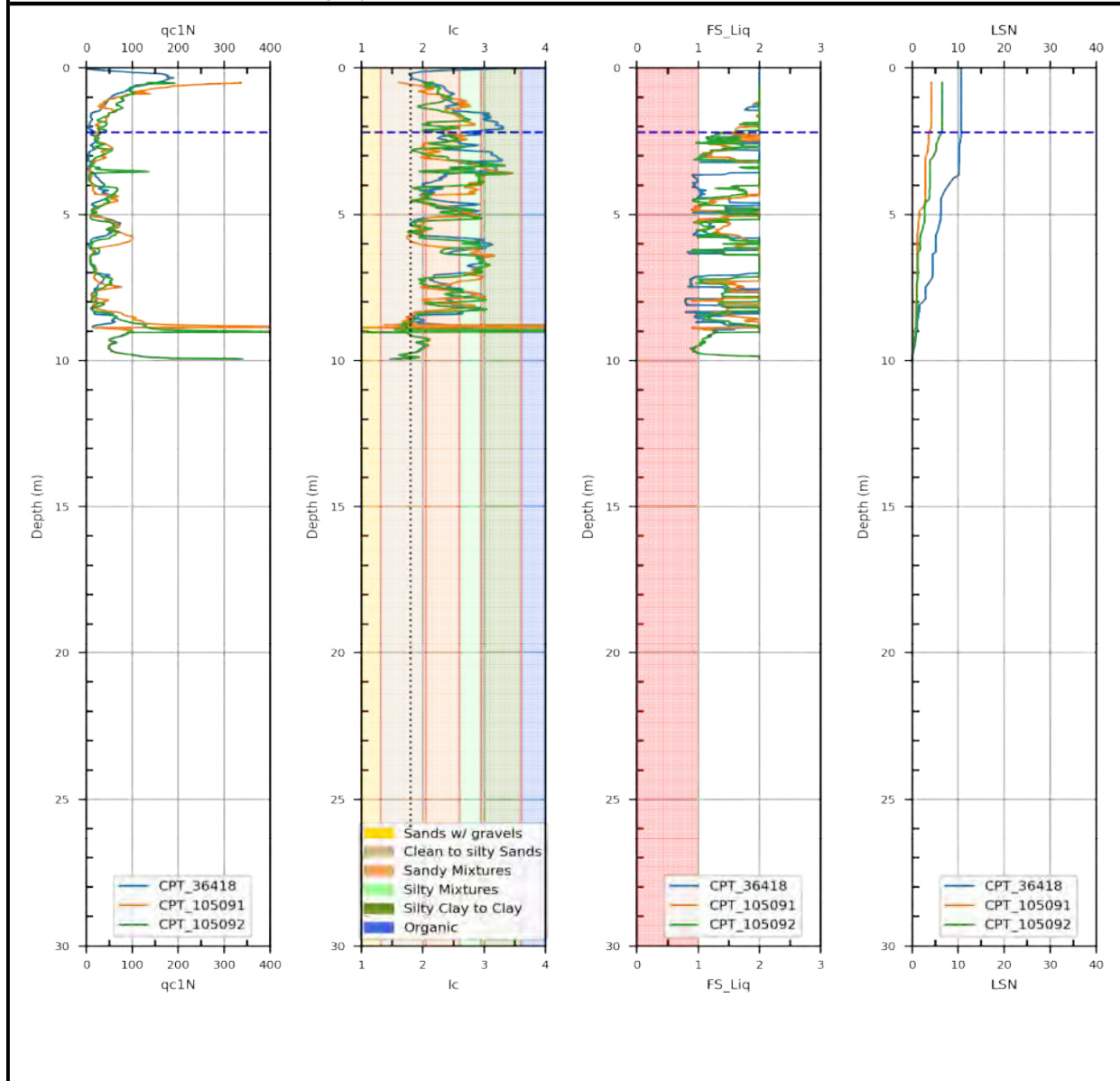
Case History: Ch-S104
Site: Paeroa Reserve (N°37)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5321 Longitude 172.5905
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S105
Site: Paeroa Reserve (N°37)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.17g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5321 Longitude 172.5905
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



85 Riccarton Road

Case History:

Site: 85 Riccarton Road (N°38)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.37g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5298 Longitude 172.6037
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

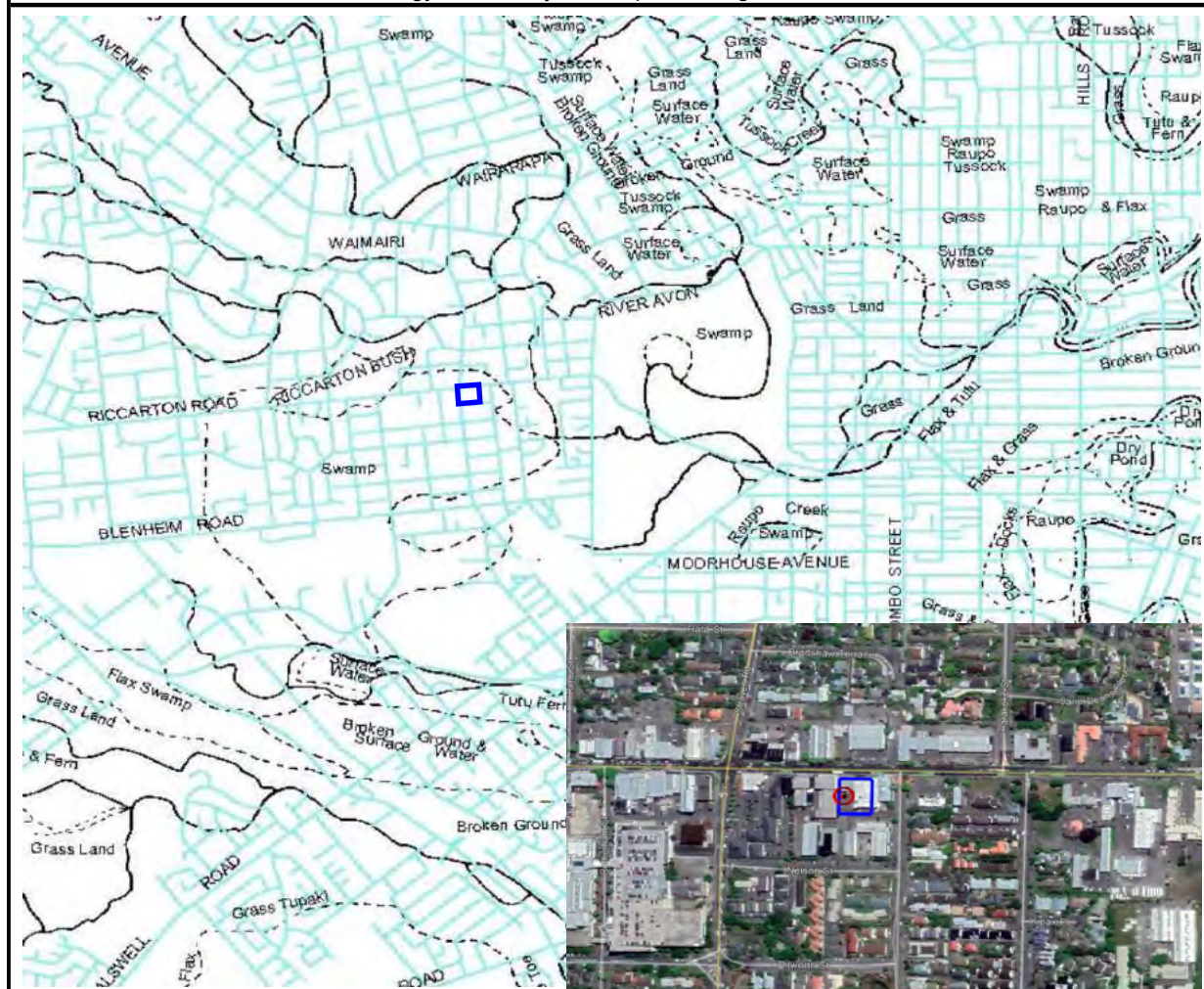
Site: 85 Riccarton Road (N°38)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.37g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5298 Longitude 172.6037
Source: Christchurch City Council, map_Ap001725BlackMap.gws

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

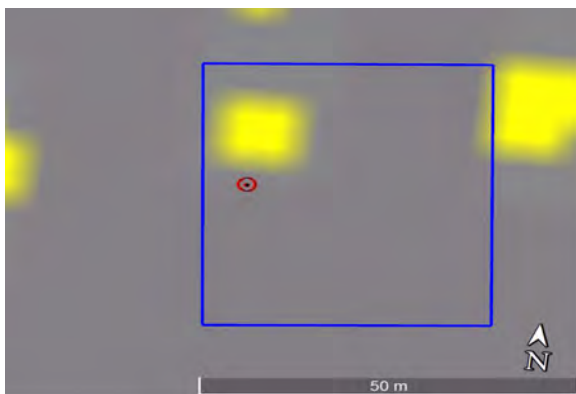
lc Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

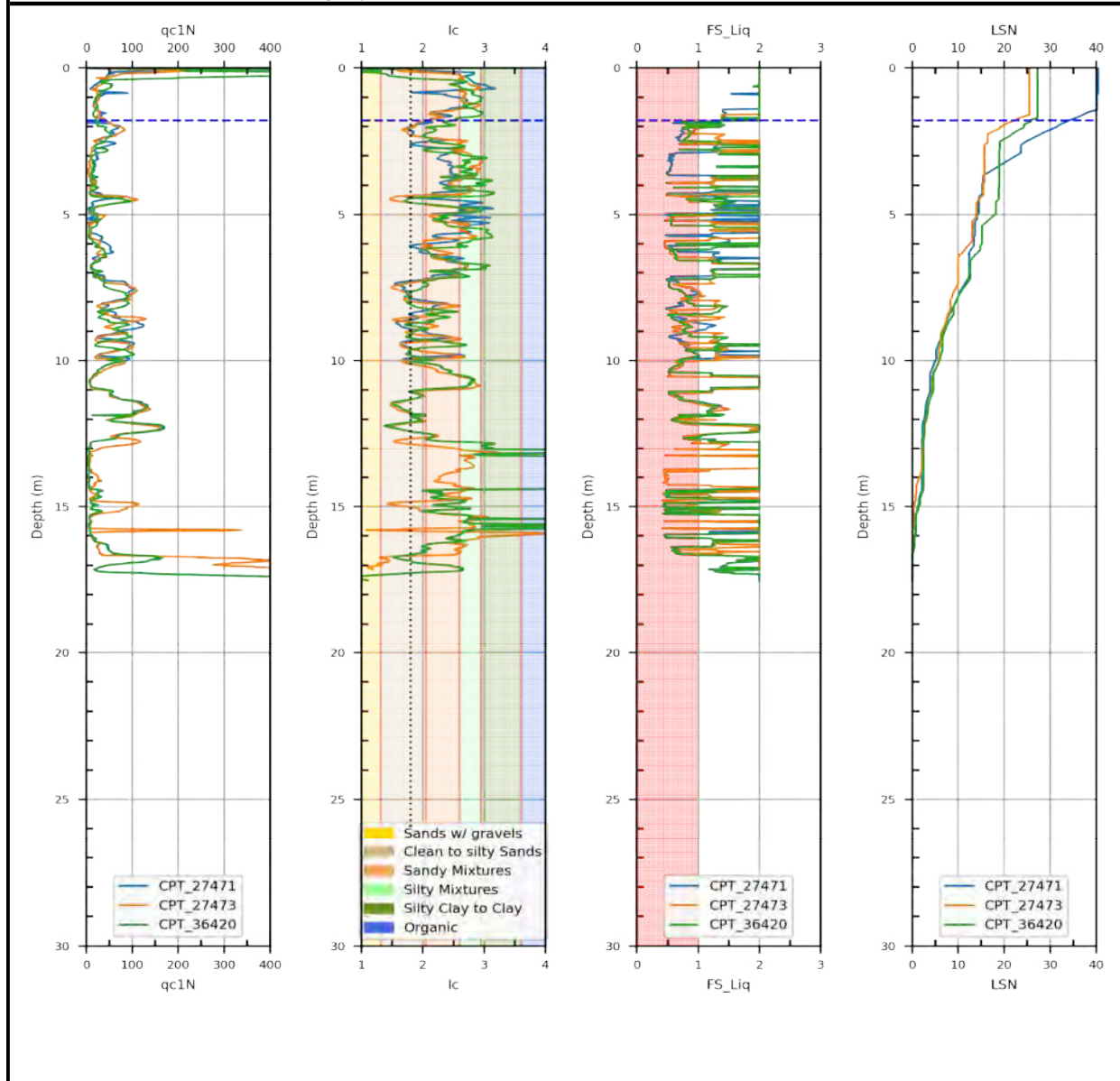


Case History:	
Site:	85 Riccarton Road (N°38)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.18g - 0.37g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	1.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5298 Longitude 172.6037
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
No aerial photo available	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
	

Case History:	
Site:	85 Riccarton Road (N°38)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.18g - 0.37g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	1.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5298 Longitude 172.6037
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Free-Field Ground Settlement Measurement	
Estimated vertical settlement - Sep. 4, 2010 EQ	Estimated vertical settlement - Feb. 22, 2011 EQ
No LiDAR data available	No LiDAR data available
Estimated vertical settlement - June 13, 2011 EQ	Estimated vertical settlement - Dec.23, 2011
	No LiDAR data available
LiDAR surveys dates:	
Pre-September 2010	Feb. 6-11, 2008
Post-September 2010	Sep. 5, 2010
Post-February 2011	March 8-10 and May 20-30, 2011
Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011
Post-December 2011	Feb. 17-18, 2012
Vertical Elevation Change without Tectonic Component	
+ Uplifted	
	1.0 to 1.5 m
	0.5 to 1.0 m
	0.4 to 0.3 m
	0.3 to 0.4 m
	0.2 to 0.3 m
	0.1 to 0.2 m
	-0.1 to 0.1 m
	-0.2 to -0.1 m
	-0.3 to -0.2 m
	-0.4 to -0.3 m
	-0.5 to -0.4 m
	-1.0 to -0.5 m
	-1.5 to -1.0 m
- Subsided	

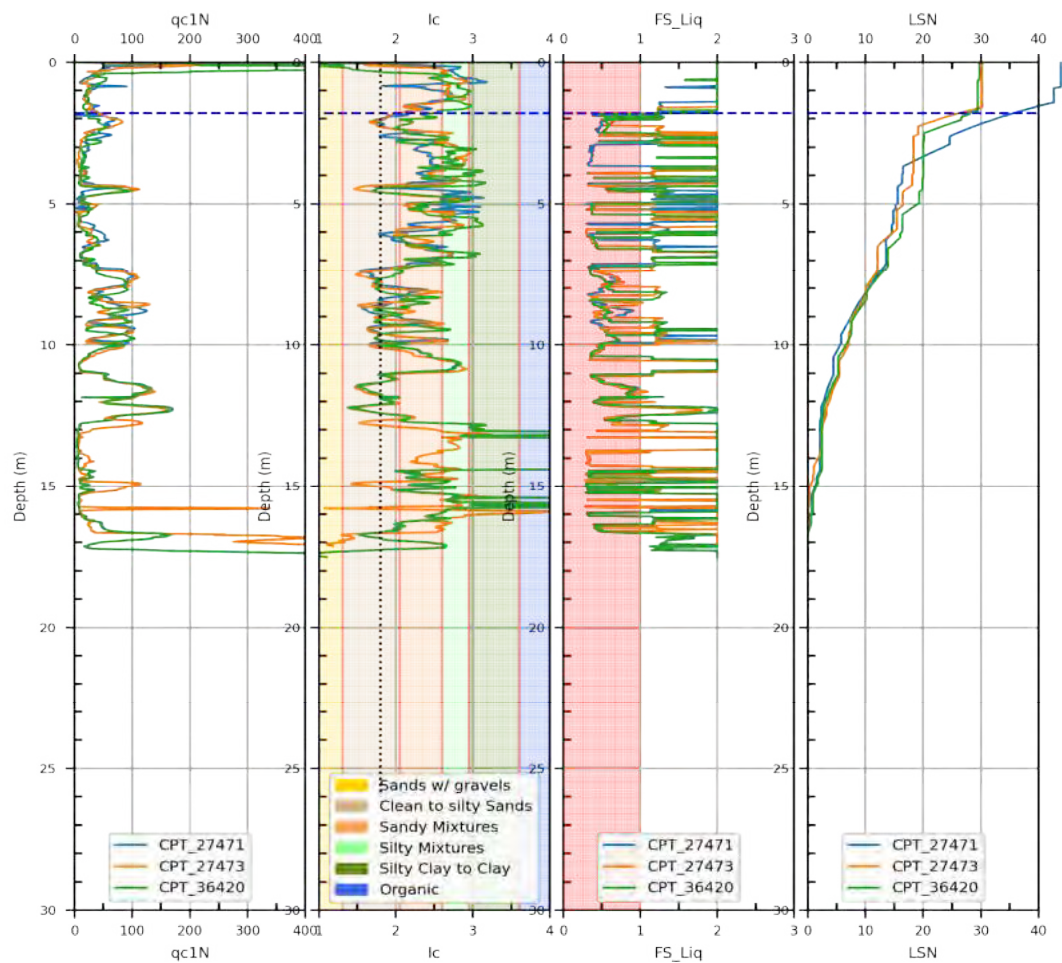
Case History: Ch-S106
Site: 85 Riccarton Road (N°38)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.21g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5298 Longitude 172.6037
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



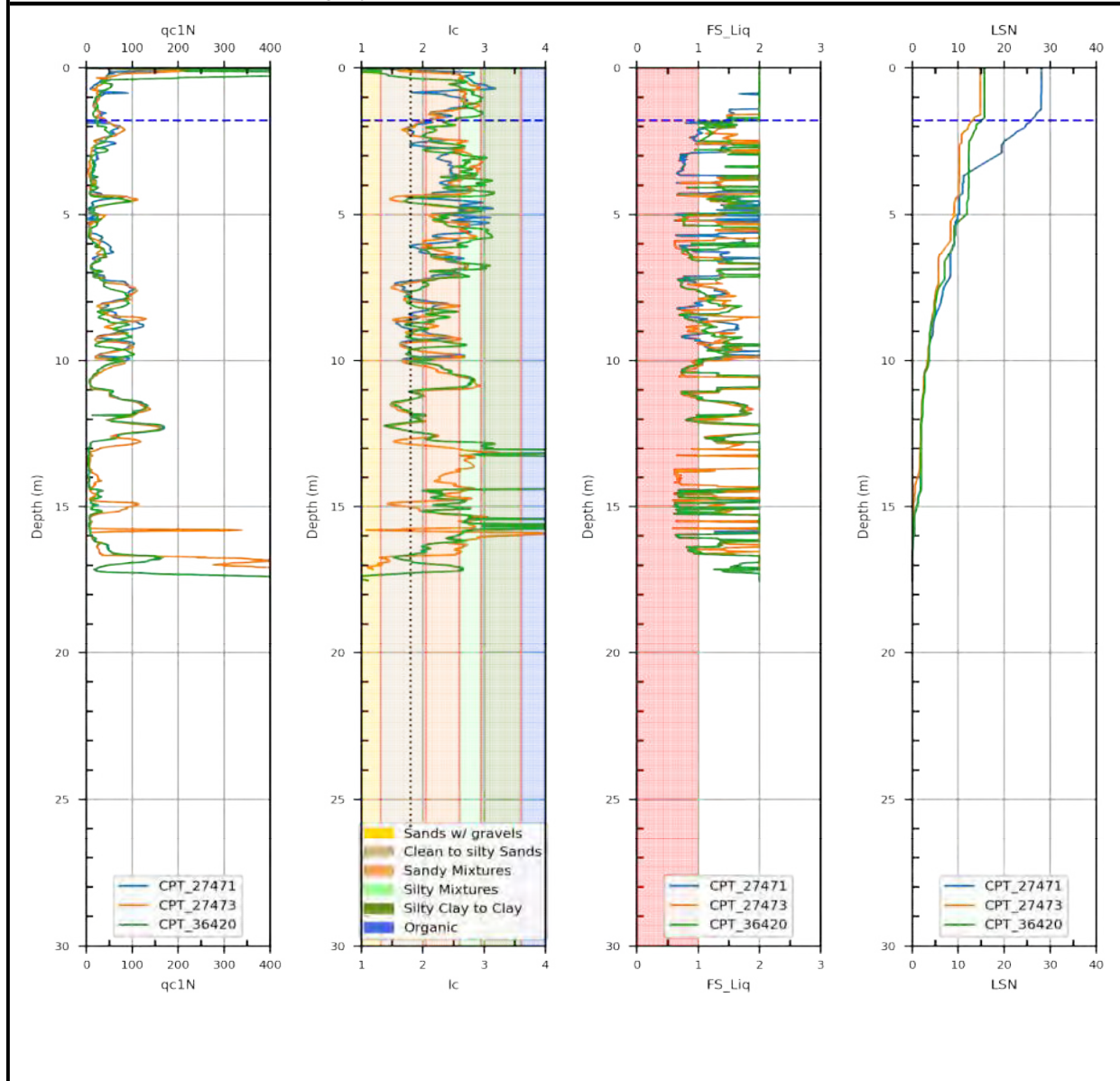
Case History: Ch-S107
Site: 85 Riccarton Road (N°38)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.37g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5298 Longitude 172.6037
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S108
Site: 85 Riccarton Road (N°38)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.18g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.8 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5298 Longitude 172.6037
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



121 Bower Avenue

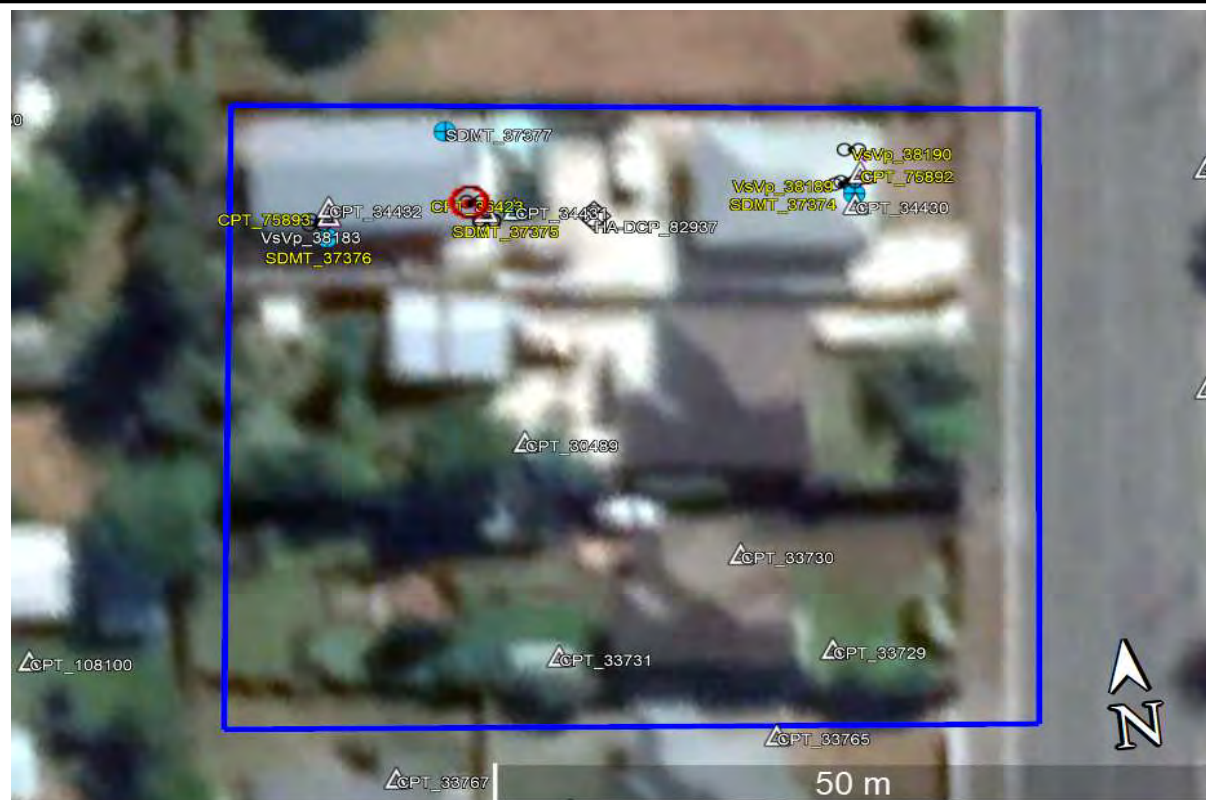
Case History:

Site: 121 Bower Avenue (N° 39)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.42g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.8 - 1.9 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.49895 Longitude 172.70979
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

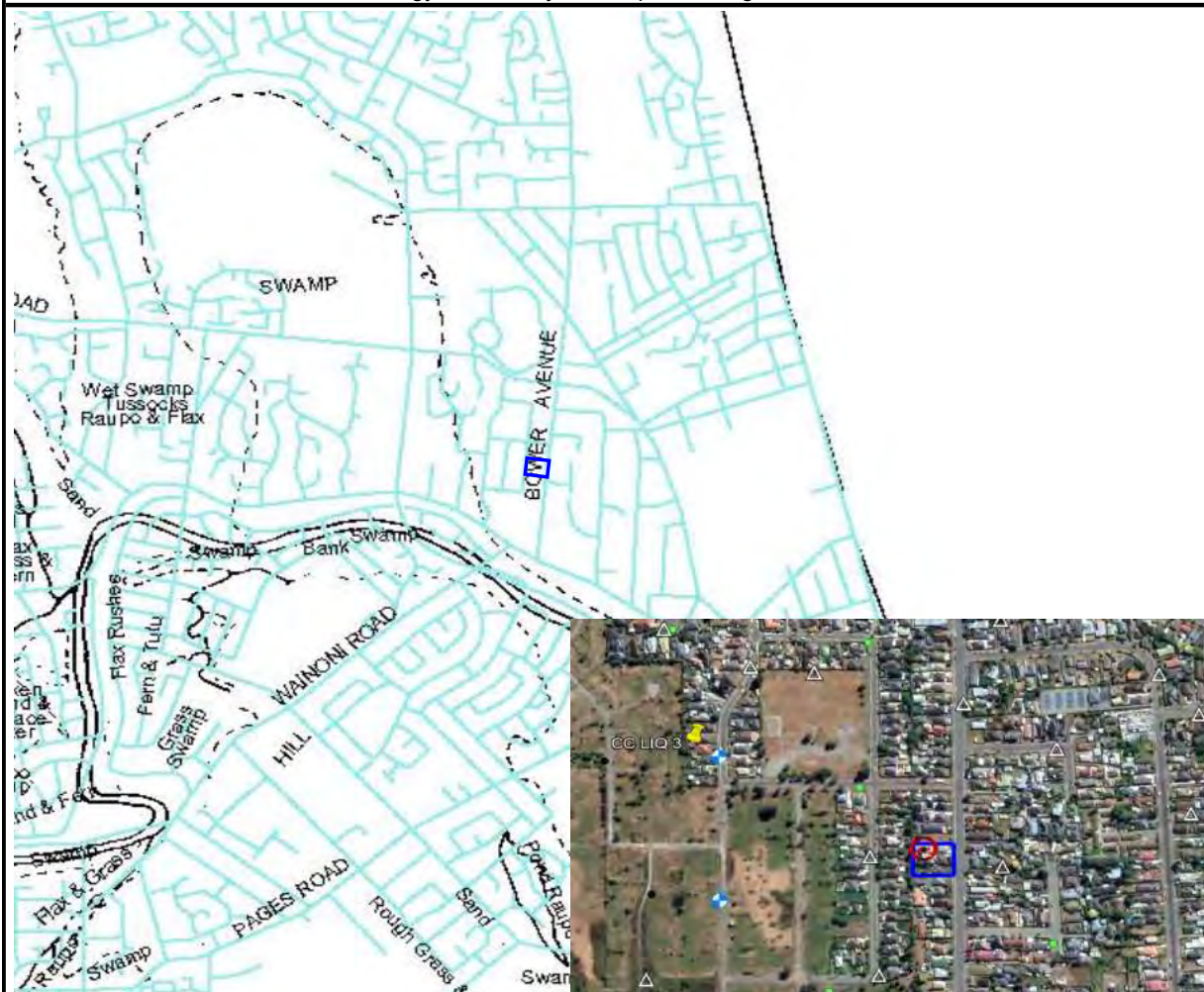
Site: 121 Bower Avenue (N° 39)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.42g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.8 - 1.9 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.49895 Longitude 172.70979
Source: Christchurch City Council, map_Ap001725BlackMap.gws

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856



Case History:

Site: 121 Bower Avenue (N^o 39)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.42g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.8 - 1.9 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.49895 Longitude 172.70979
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

lc Robertson, 2009

LSN van Ballegooy et al., 2014

Ejecta Patterns

Aerial photography taken on September 5, 2010



Aerial photography taken on February 24, 2011



Aerial photography taken on June 14-15, 2011

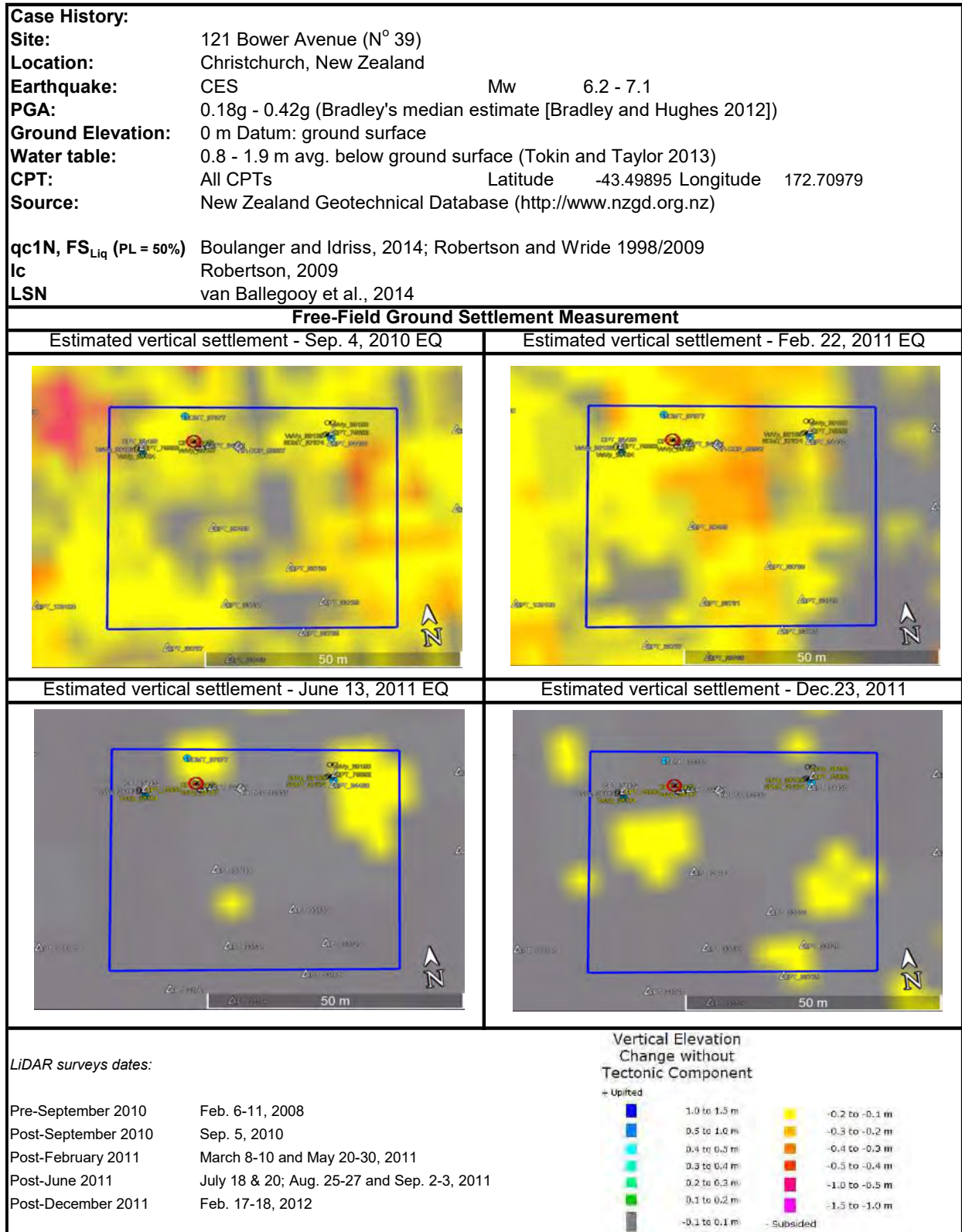


Aerial photography taken on December 24, 2011



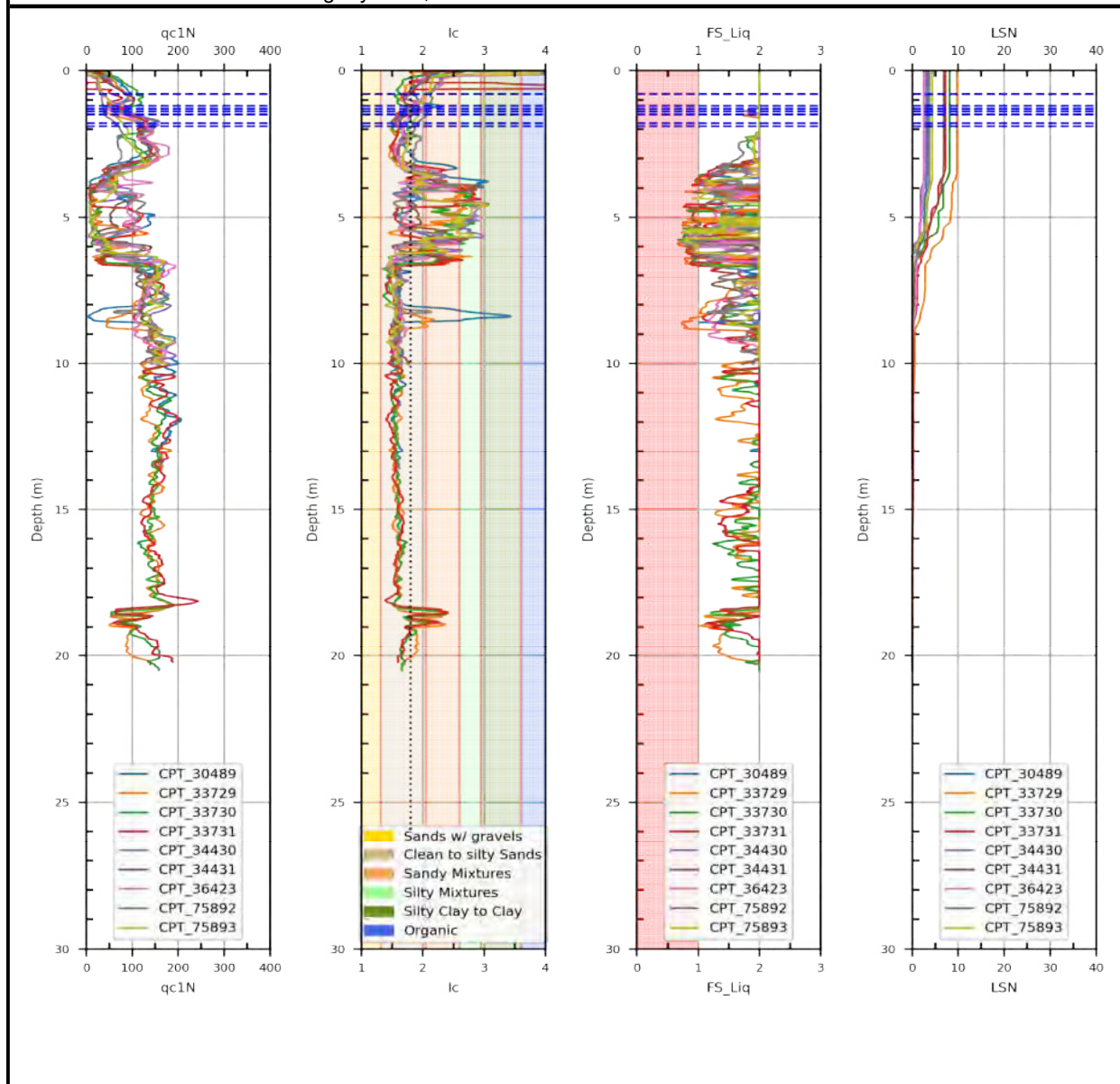
Ministry of Civil Defence
& Emergency Management
Te Kaitiaki Whakamānau





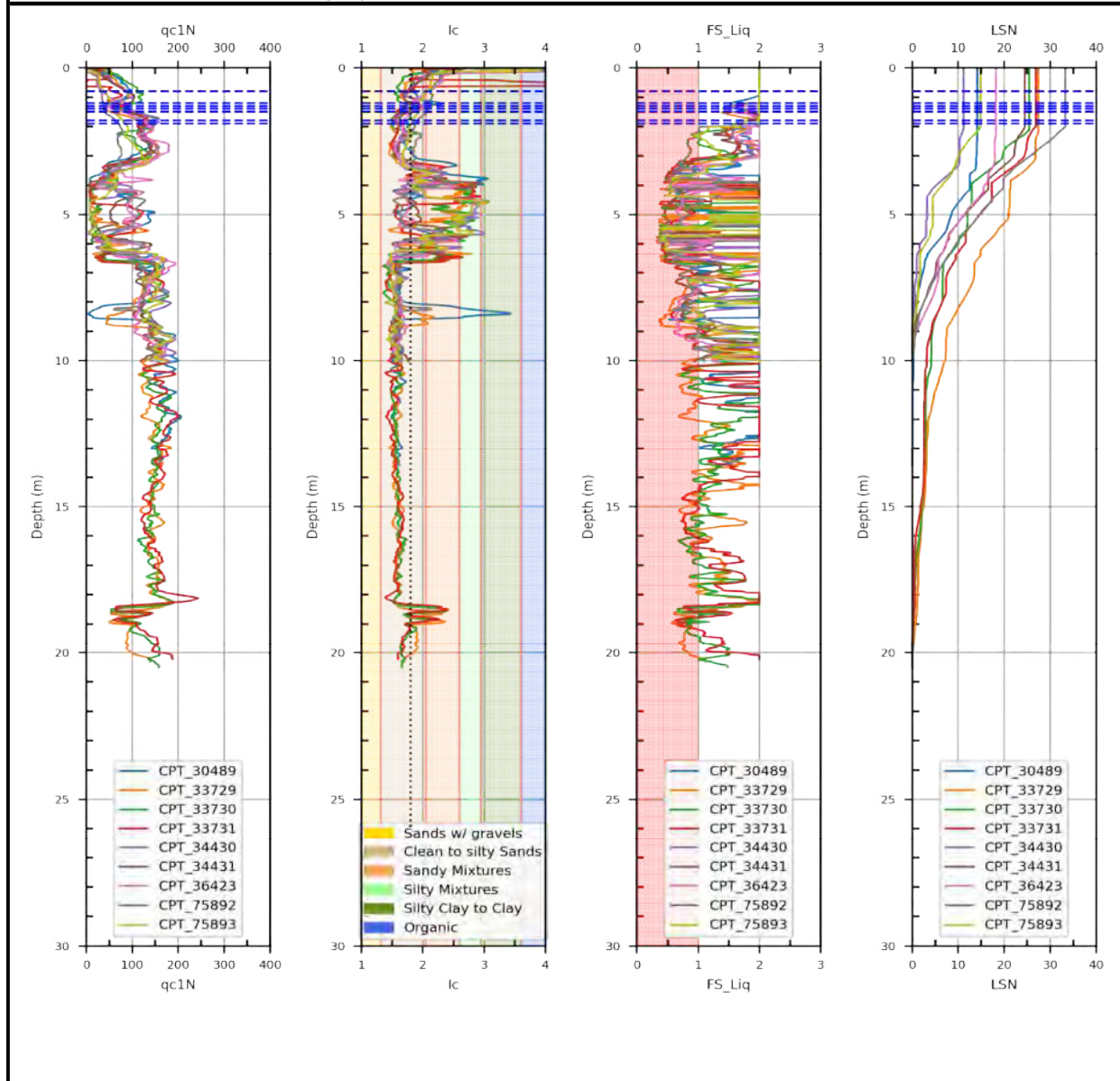
Case History: Ch-S109
Site: 121 Bower Avenue (N° 39)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.8 - 1.9 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.49895 Longitude 172.70979
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



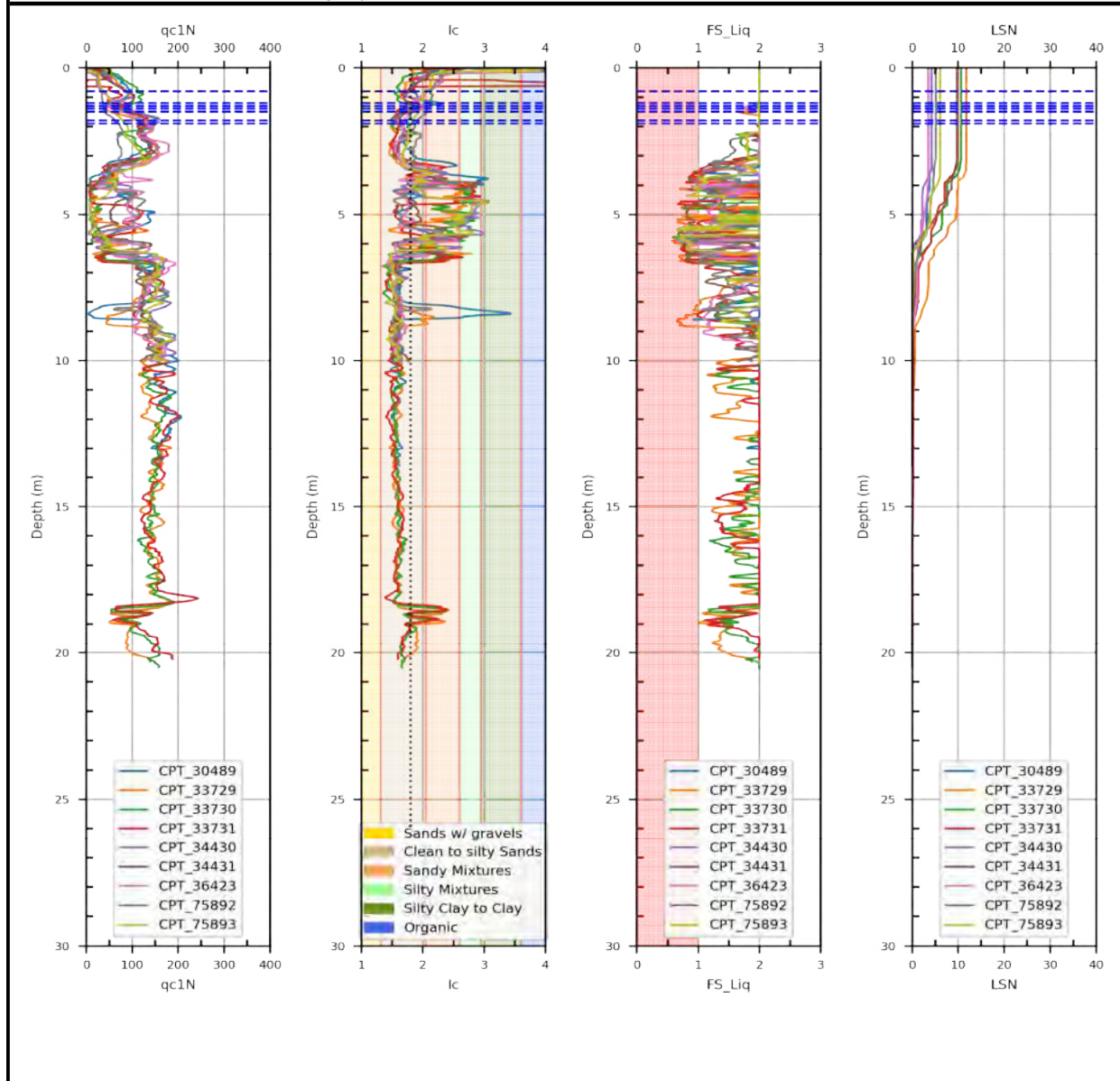
Case History: Ch-S110
Site: 121 Bower Avenue (N° 39)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.42g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.8 - 1.9 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.49895 Longitude 172.70979
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S111
Site: 121 Bower Avenue (N° 39)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.24g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.8 - 1.9 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.49895 Longitude 172.70979
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



31A Ardrossan Street

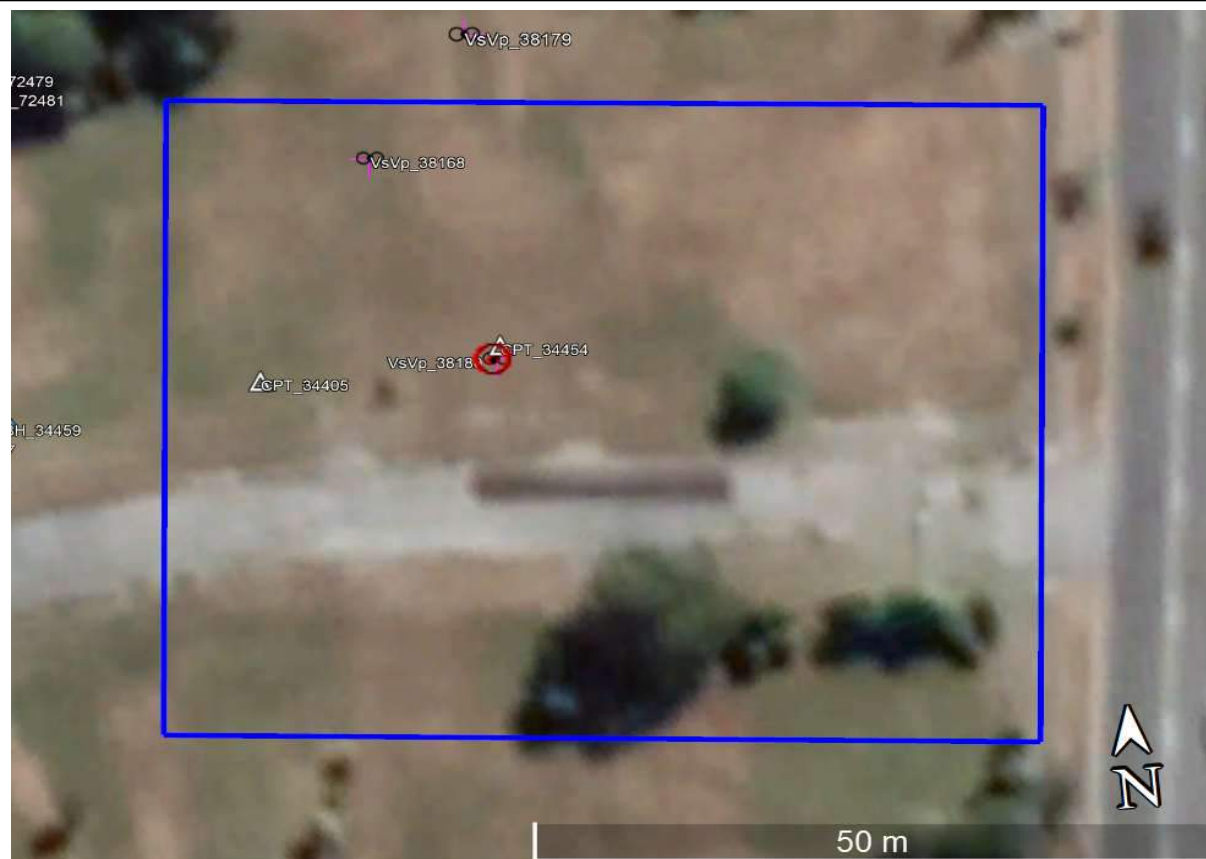
Case History:

Site: 31A Ardrossan Street (Site 4) (N°45)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.36g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5015 Longitude 172.6871
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Site:	31A Ardrossan Street (Site 4) (N°45)		
Location:	Christchurch, New Zealand		
Earthquake:	CES	Mw	6.2 - 7.1
PGA:	0.18g - 0.36g (Bradley's median estimate [Bradley and Hughes 2012])		
Ground Elevation:	0 m Datum: ground surface		
Water table:	2.2 m avg. below ground surface (Tokin and Taylor 2013)		
CPT:	All CPTs	Latitude	-43.5015 Longitude 172.6871
Source:	Christchurch City Council, map_Ap001725BlackMap.gws		

Robertson, 2009

Surficial Geology - waterways swamps and vegetation cover in 1856



Case History:

Site: 31A Ardrossan Street (Site 4) (N°45)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.36g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5015 Longitude 172.6871
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

lc Robertson, 2009

LSN van Ballegooy et al., 2014

Ejecta Patterns

Aerial photography taken on September 5, 2010



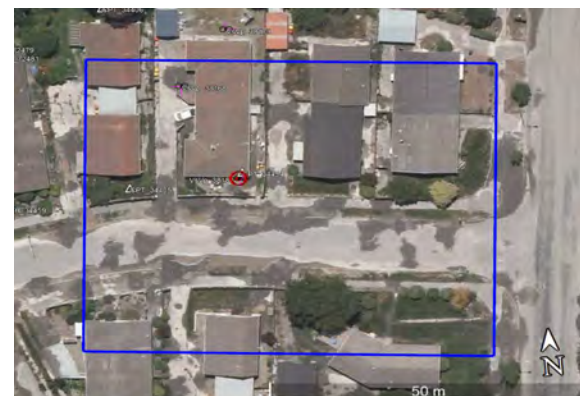
Aerial photography taken on February 24, 2011



Aerial photography taken on June 14-15, 2011

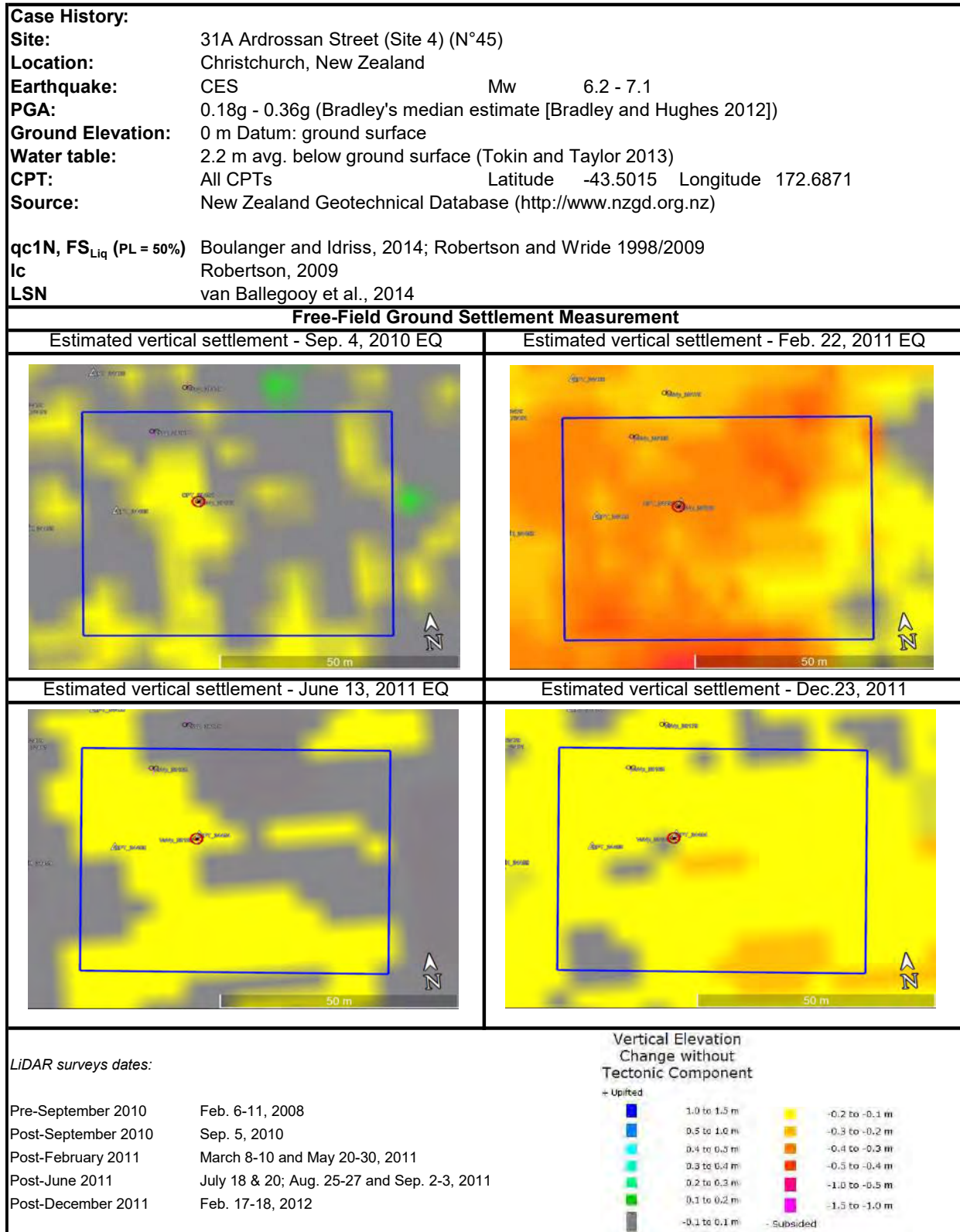


Aerial photography taken on December 24, 2011



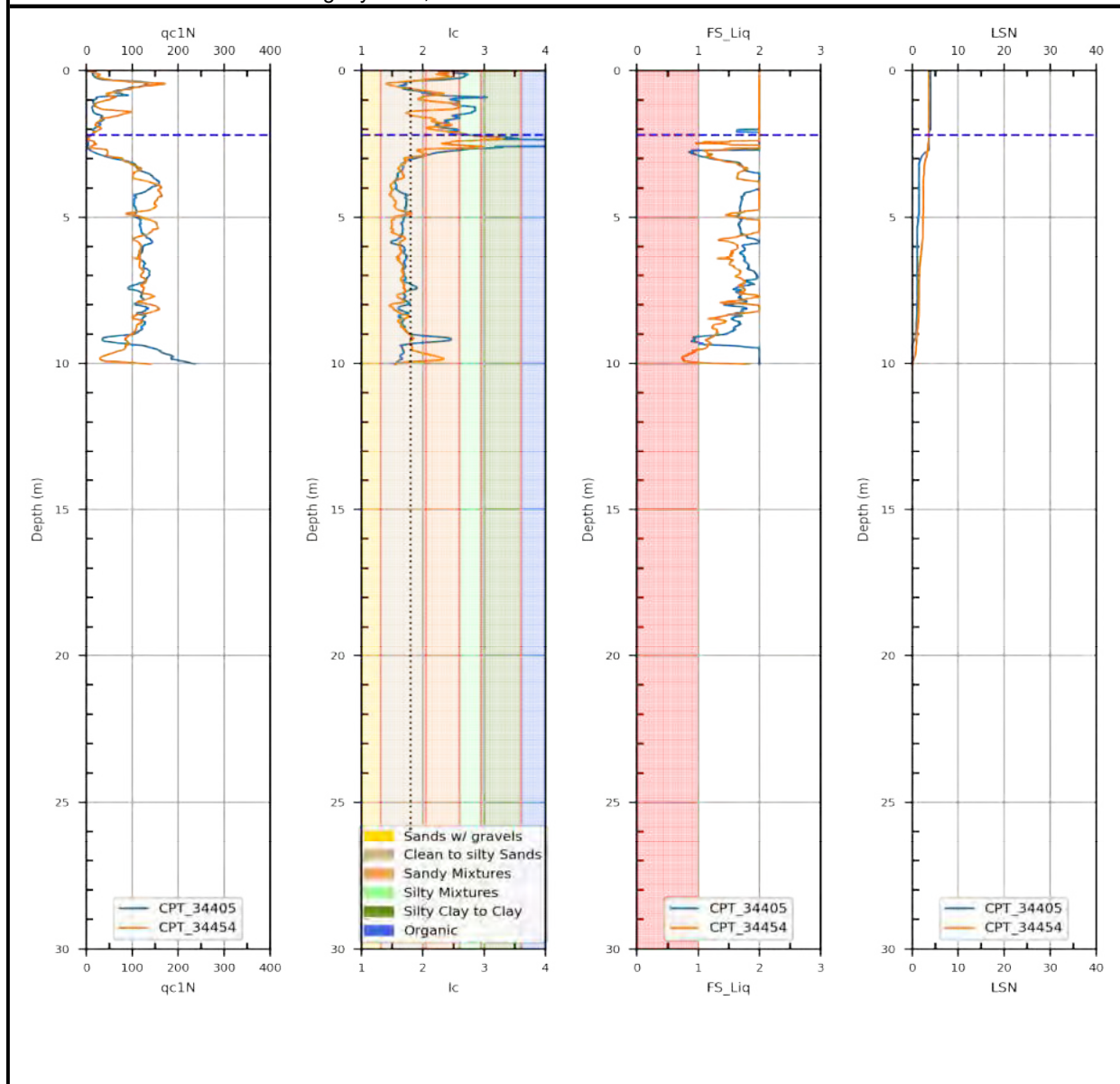
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Te Kaitiaki Whakamānau





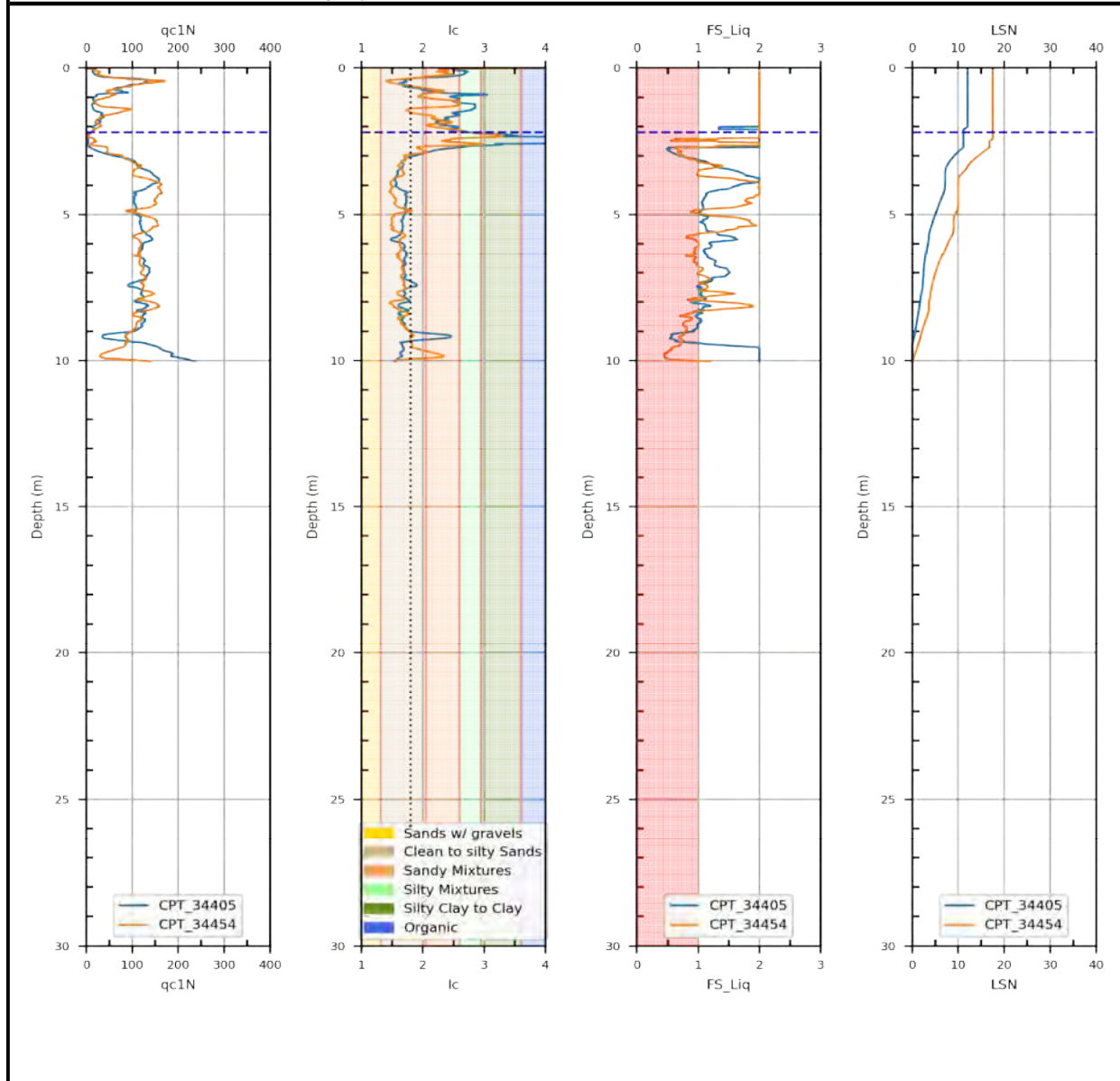
Case History: Ch-S112
Site: 31A Ardrossan Street (Site 4) (N°45)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.21g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5015 Longitude 172.6871
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



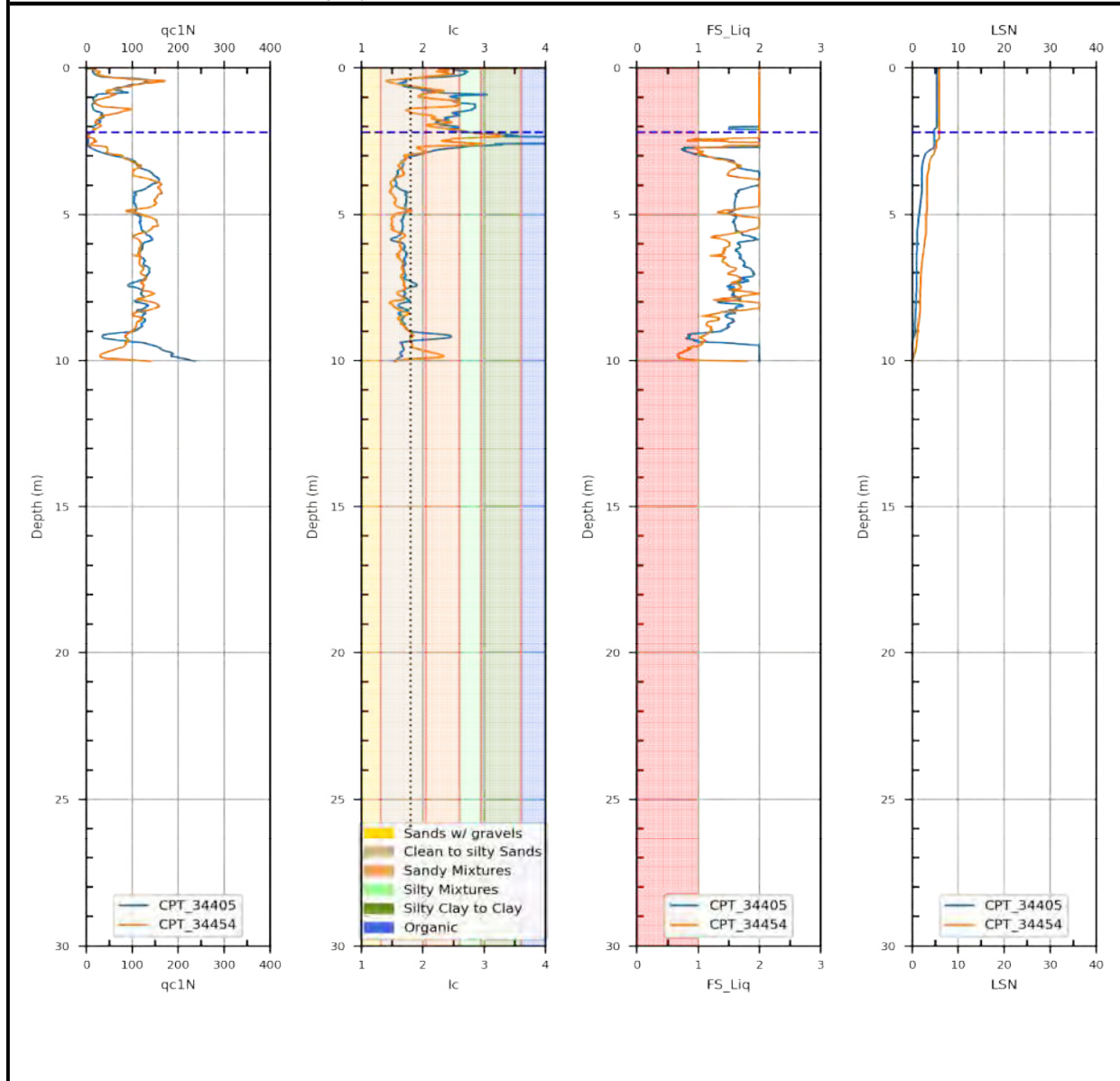
Case History: Ch-S113
Site: 31A Ardrossan Street (Site 4) (N°45)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.37g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5015 Longitude 172.6871
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S114
Site: 31A Ardrossan Street (Site 4) (N°45)
Location: Christchurch, New Zealand
Earthquake: Jun-11 Mw 6.2
PGA: 0.18g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.2 m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5015 Longitude 172.6871
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



59 Cardrona Street

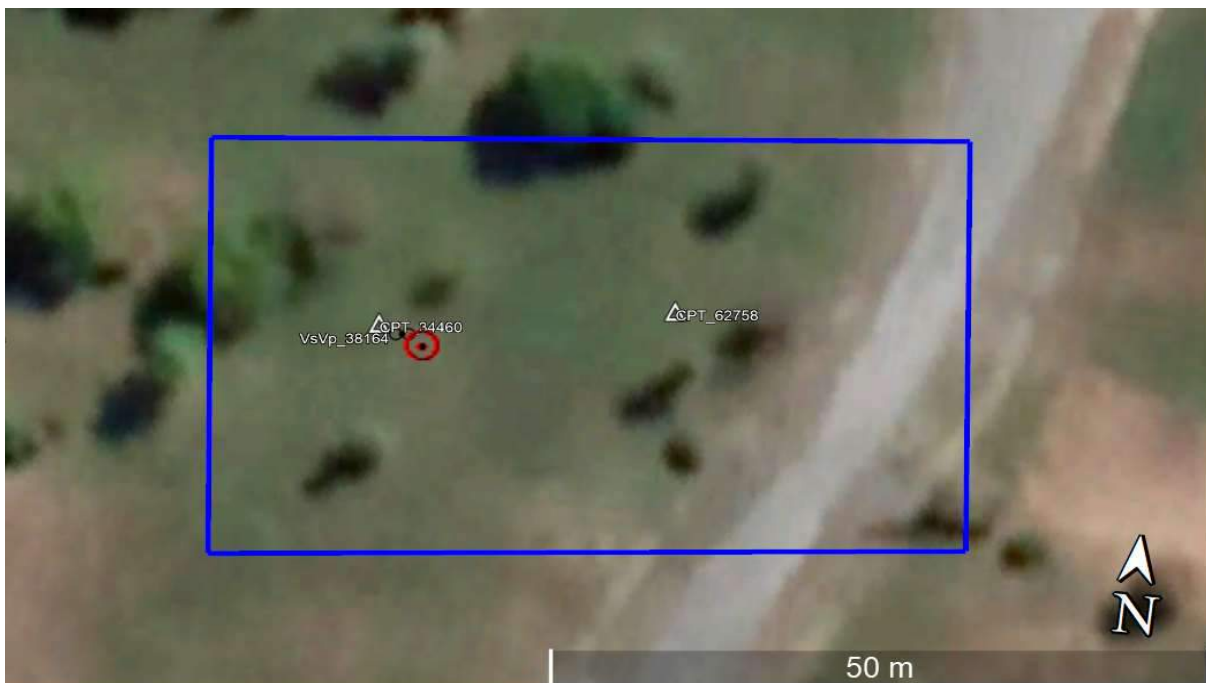
Case History:

Site: 59 Cardrona Street (Site 3) (N°48)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.19g - 0.40g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.90m - 1.1m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5088 Longitude 172.6843
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

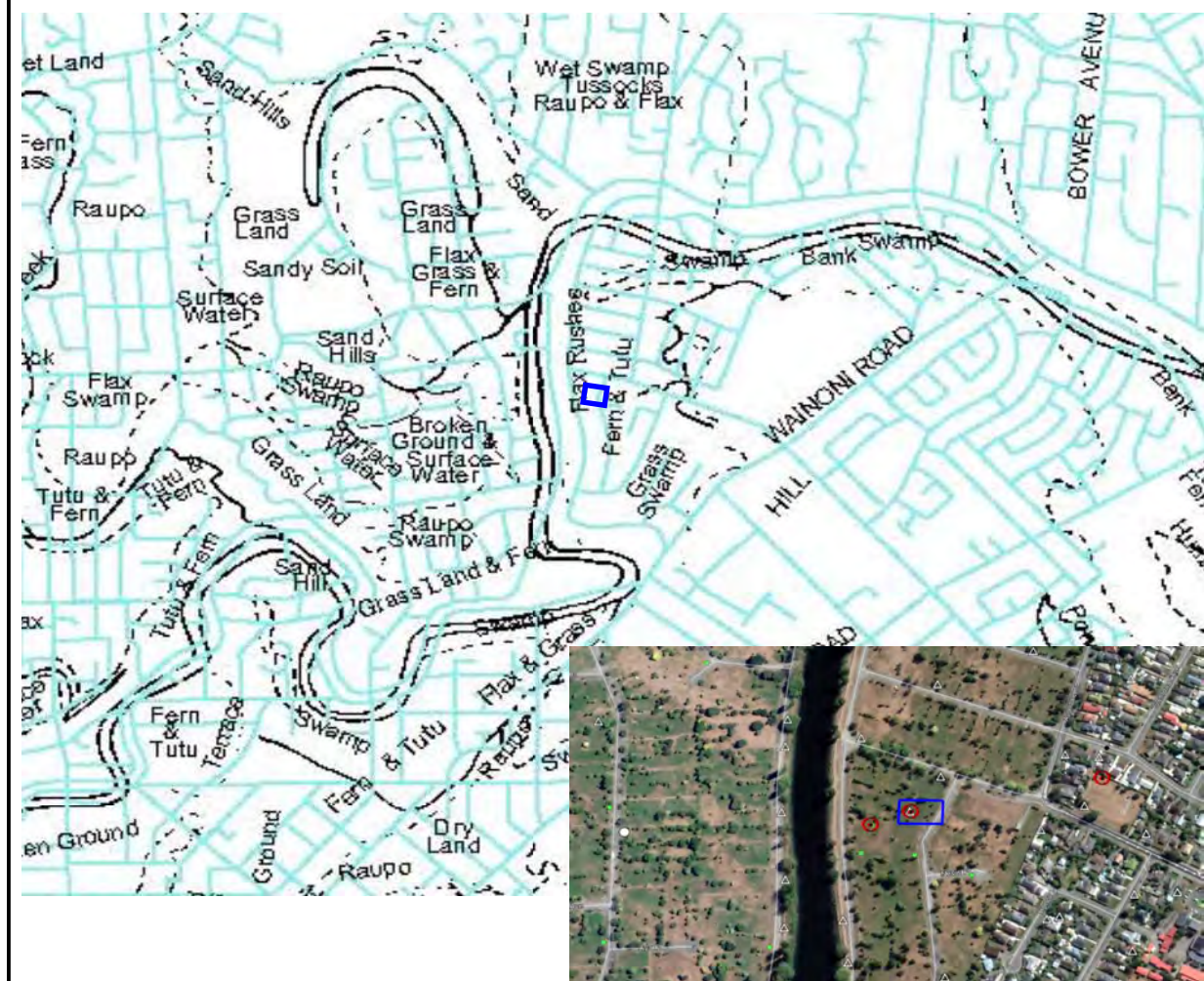
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

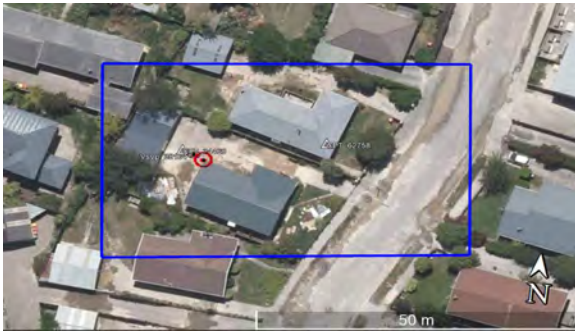
Ic Robertson, 2009

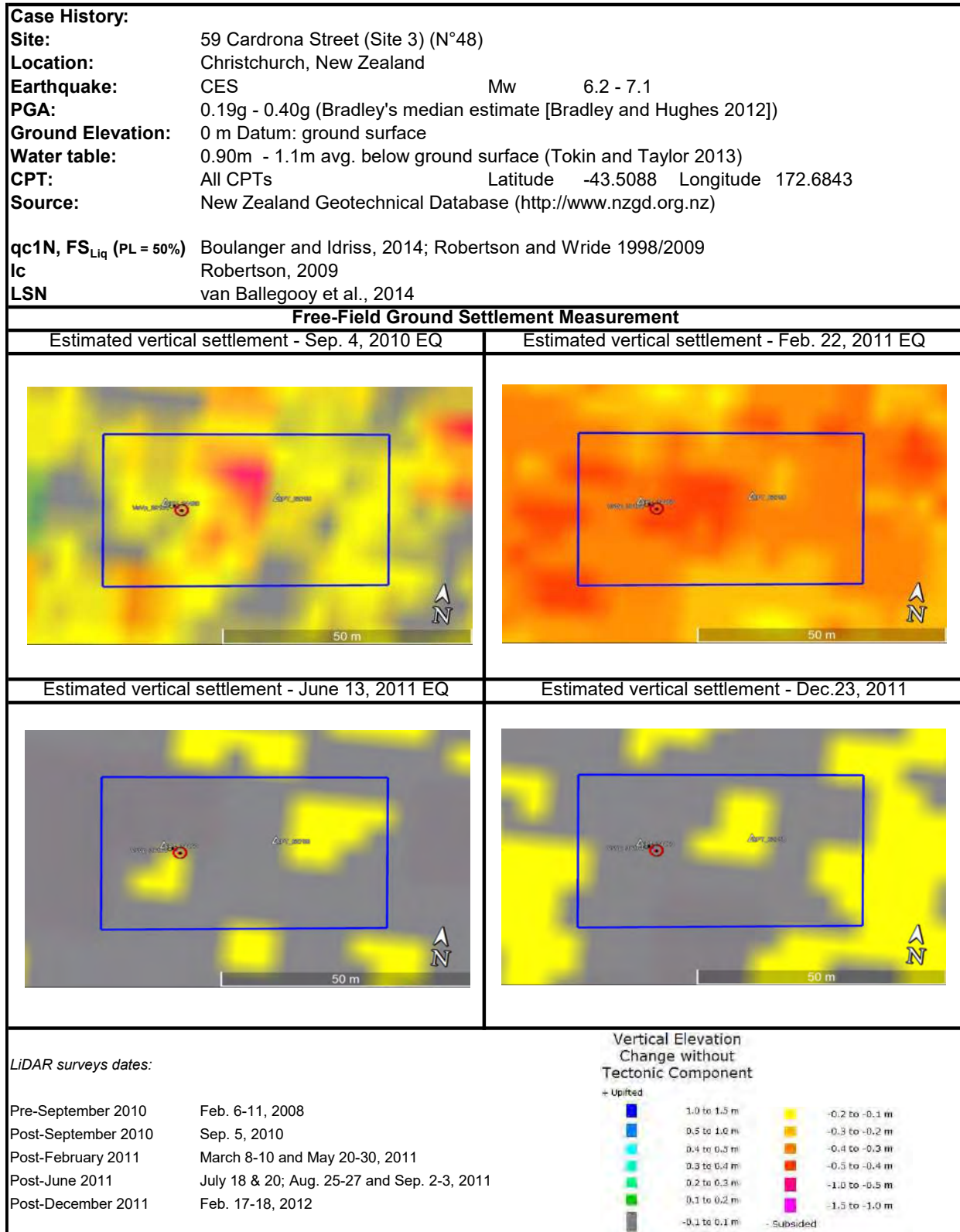
LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

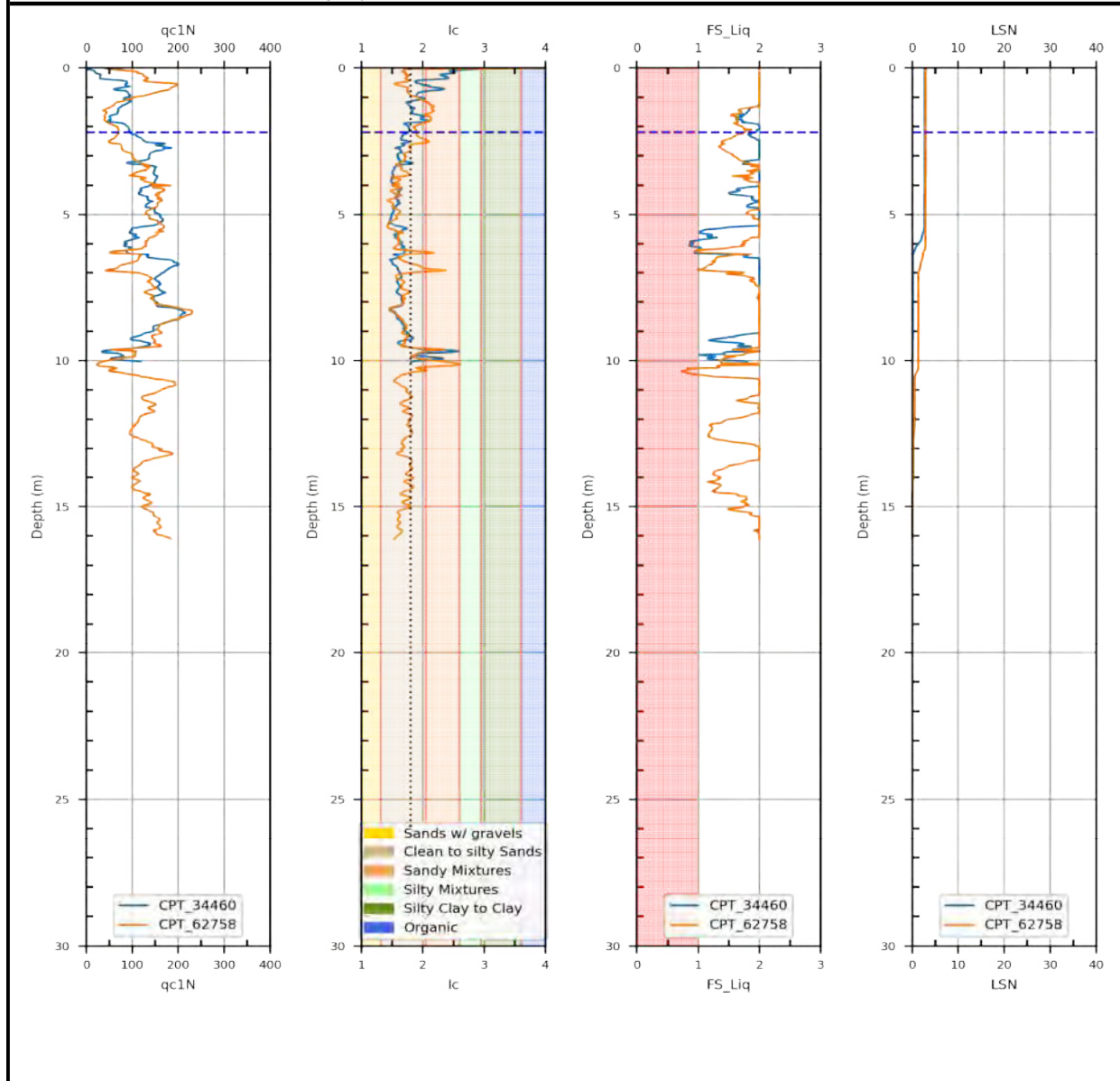


Case History: Site: 59 Cardrona Street (Site 3) (N°48) Location: Christchurch, New Zealand Earthquake: CES Mw 6.2 - 7.1 PGA: 0.19g - 0.40g (Bradley's median estimate [Bradley and Hughes 2012]) Ground Elevation: 0 m Datum: ground surface Water table: 0.90m - 1.1m avg. below ground surface (Tokin and Taylor 2013) CPT: All CPTs Latitude -43.5088 Longitude 172.6843 Source: New Zealand Geotechnical Database (http://www.nzgd.org.nz) qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009 Ic Robertson, 2009 LSN van Ballegooy et al., 2014	
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
  Ministry of Civil Defence & Emergency Management Te Kaitiaki Whakamārama  CERA Canterbury Earthquake Recovery Authority  EQC EARTHQUAKE COMMISSION Kaitiaki Takekōwhiri  TT Tonkin & Taylor	



Case History: Ch-S115
Site: 59 Cardrona Street (Site 3) (N°48)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.21g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.90m - 1.1m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5088 Longitude 172.6843
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



1/19 Chardale Street

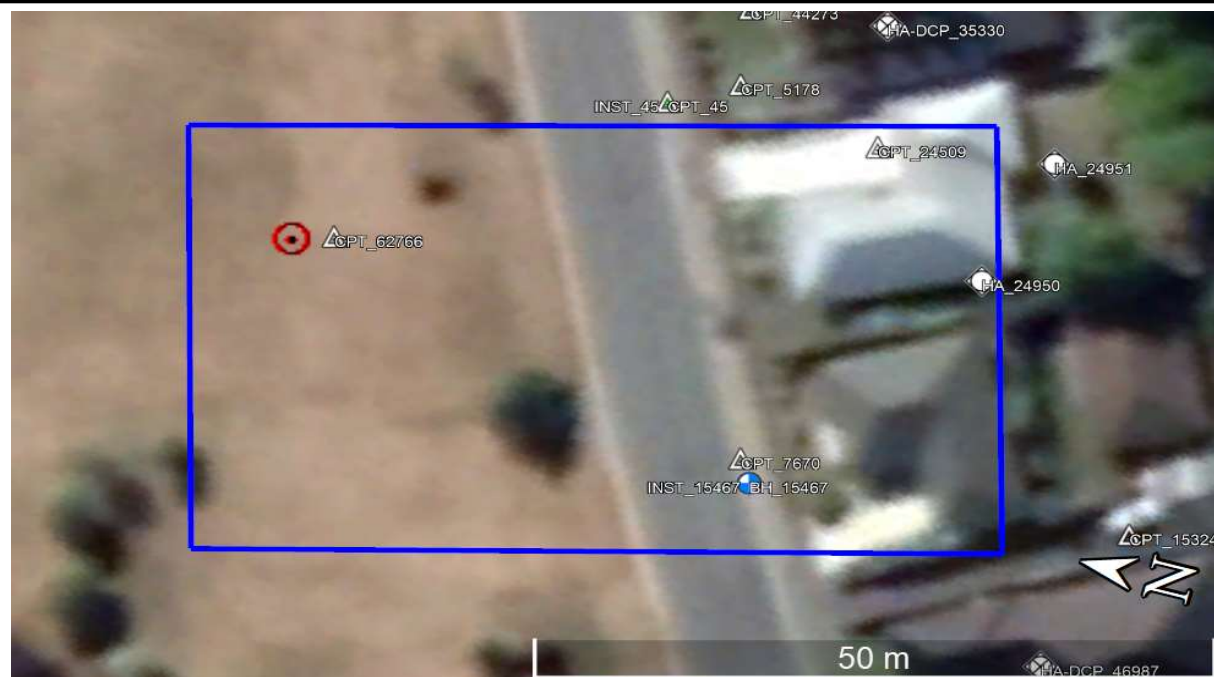
Case History:

Site: 1/19 Chardale Street (N°49)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.17g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.8m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5028 Longitude 172.6946
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

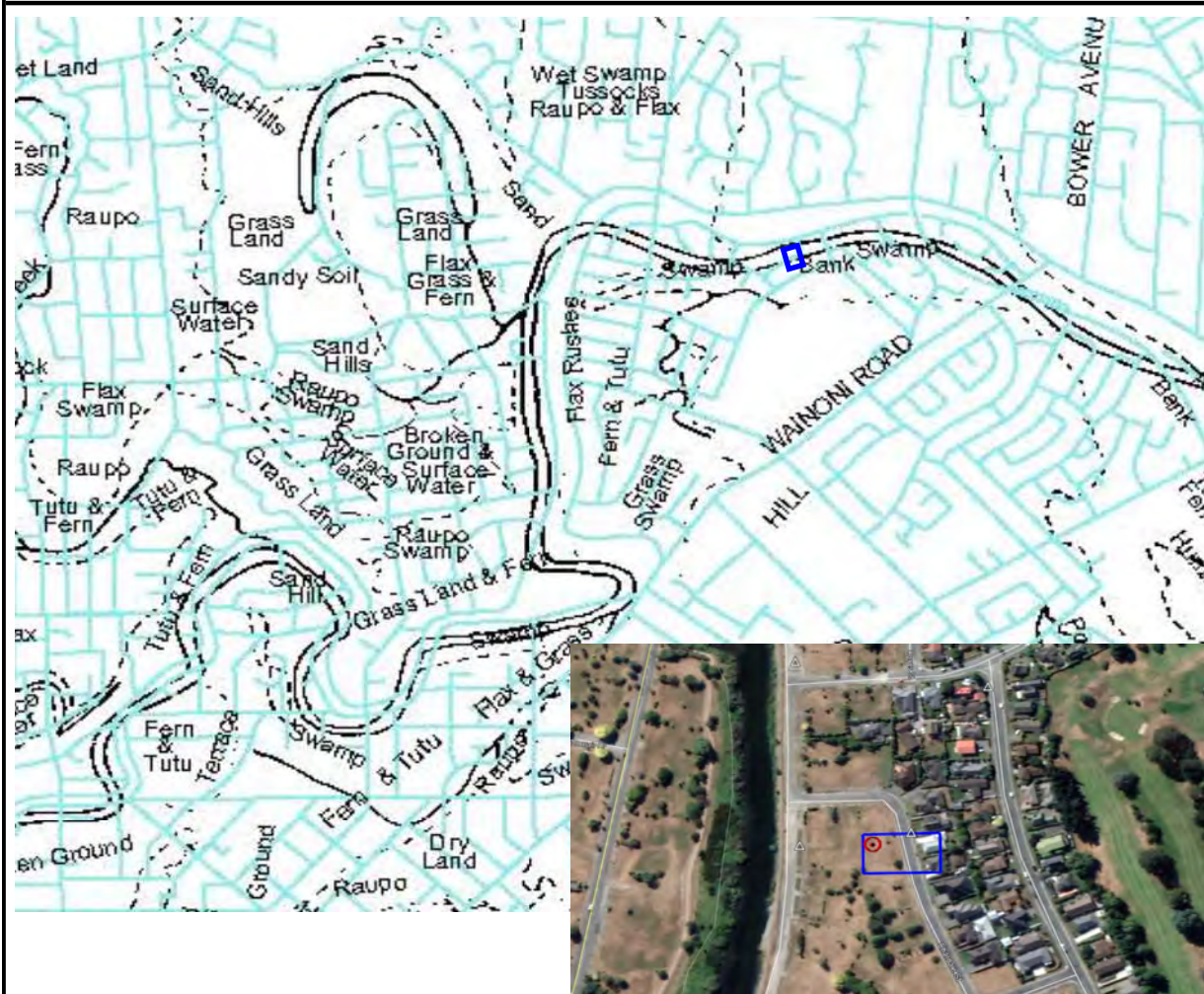
LSN van Ballegooy et al., 2014

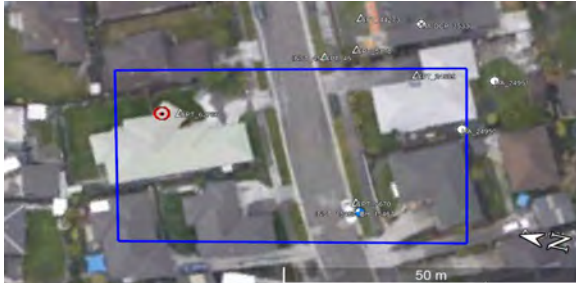
Site Plan View**References:**

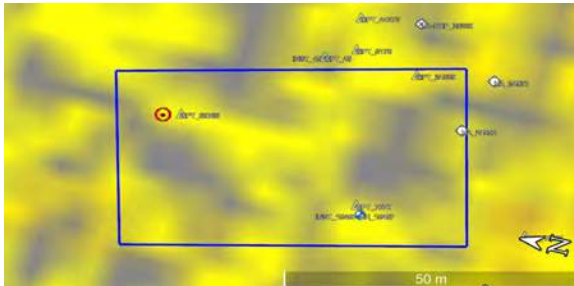
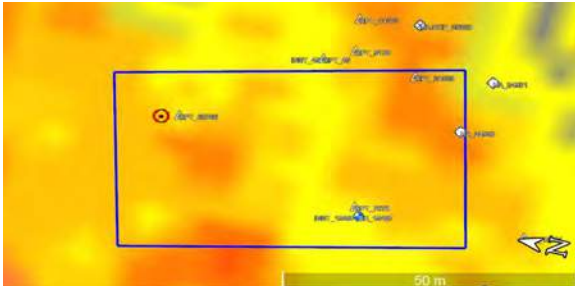
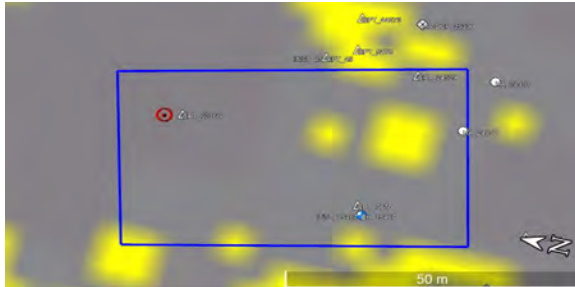
New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:**Site:** 1/19 Chardale Street (N°49)**Location:** Christchurch, New Zealand**Earthquake:** CES Mw 6.2 - 7.1**PGA:** 0.17g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])**Ground Elevation:** 0 m Datum: ground surface**Water table:** 1.8m avg. below ground surface (Tokin and Taylor 2013)**CPT:** All CPTs Latitude -43.5028 Longitude 172.6946**Source:** Christchurch City Council, map_Ap001725BlackMap.gws**qc1N, FS_{Liq} (PL = 50%)** Boulanger and Idriss, 2014; Robertson and Wride 1998/2009**lc** Robertson, 2009**LSN** van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

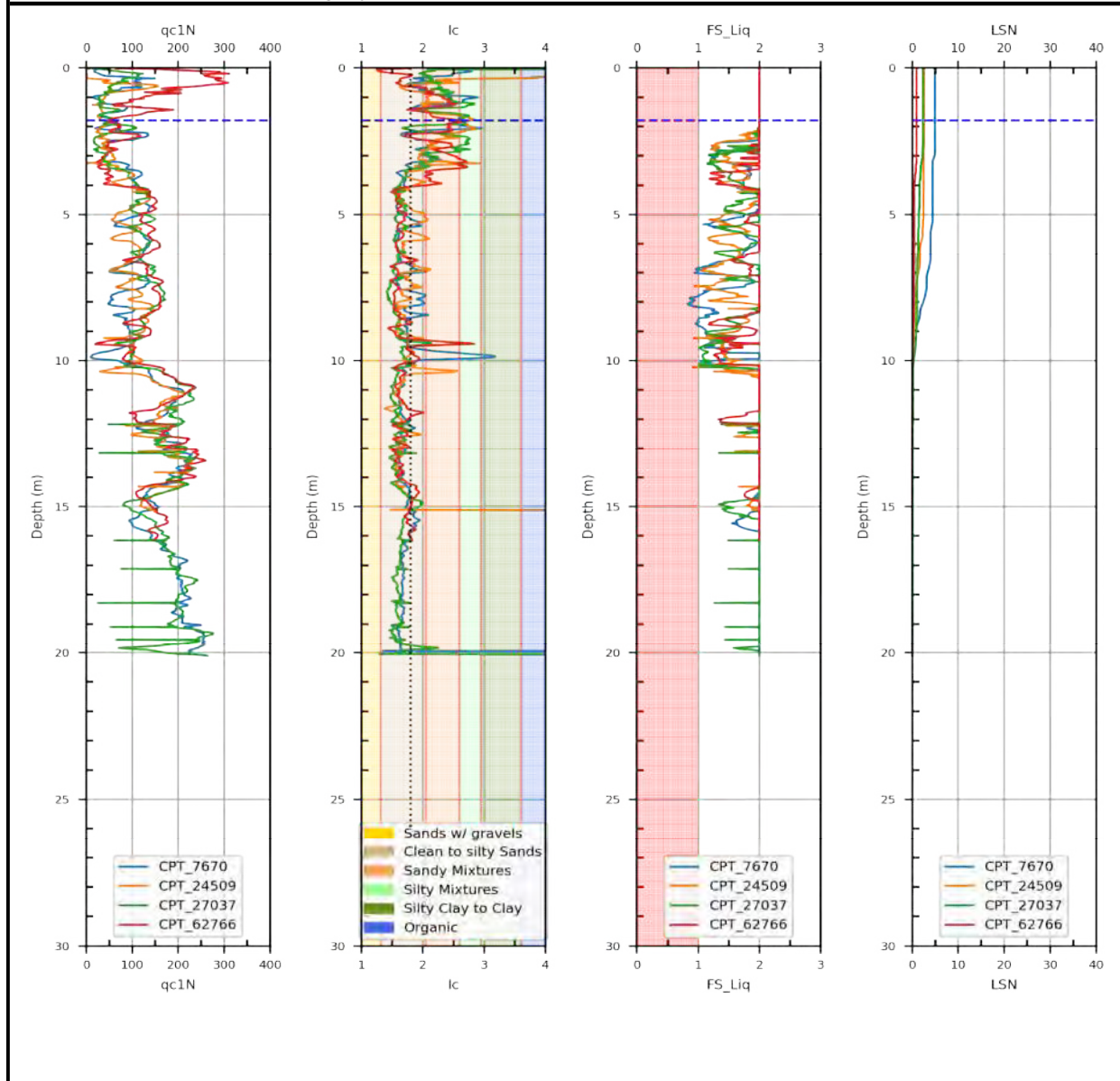


Case History: Site: 1/19 Chardale Street (N°49) Location: Christchurch, New Zealand Earthquake: CES Mw 6.2 - 7.1 PGA: 0.17g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012]) Ground Elevation: 0 m Datum: ground surface Water table: 1.8m avg. below ground surface (Tokin and Taylor 2013) CPT: All CPTs Latitude -43.5028 Longitude 172.6946 Source: New Zealand Geotechnical Database (http://www.nzgd.org.nz) qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009 lc Robertson, 2009 LSN van Ballegooy et al., 2014	
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
	

Case History:	
Site:	1/19 Chardale Street (N°49)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.17g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	1.8m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5028 Longitude 172.6946
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Free-Field Ground Settlement Measurement	
Estimated vertical settlement - Sep. 4, 2010 EQ	Estimated vertical settlement - Feb. 22, 2011 EQ
	
Estimated vertical settlement - June 13, 2011 EQ	Estimated vertical settlement - Dec.23, 2011
	
LiDAR surveys dates:	
Pre-September 2010	Feb. 6-11, 2008
Post-September 2010	Sep. 5, 2010
Post-February 2011	March 8-10 and May 20-30, 2011
Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011
Post-December 2011	Feb. 17-18, 2012
Vertical Elevation Change without Tectonic Component	
+ Upheld	
	1.0 to 1.5 m
	0.5 to 1.0 m
	0.4 to 0.3 m
	0.3 to 0.4 m
	0.2 to 0.3 m
	0.1 to 0.2 m
	-0.1 to 0.1 m
	-0.2 to -0.1 m
	-0.3 to -0.2 m
	-0.4 to -0.3 m
	-0.5 to -0.4 m
	-1.0 to -0.5 m
	-1.5 to -1.0 m
- Subsided	

Case History: Ch-S116
Site: 1/19 Chardale Street (N°49)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 7.1
PGA: 0.17g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.8m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5028 Longitude 172.6946
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



31 Landy Street

Case History:

Site: 31 Landy Street (N°51)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.19g - 0.45g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.6m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5148 Longitude 172.6785
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Site:	31 Landy Street (N°51)		
Location:	Christchurch, New Zealand		
Earthquake:	CES	Mw	6.2 - 7.1
PGA:	0.19g - 0.45g (Bradley's median estimate [Bradley and Hughes 2012])		
Ground Elevation:	0 m Datum: ground surface		
Water table:	1.6m avg. below ground surface (Tokin and Taylor 2013)		
CPT:	All CPTs	Latitude	-43.5148 Longitude 172.6785
Source:	Christchurch City Council, map_Ap001725BlackMap.gws		

Robertson, 2009

Surficial Geology - waterways swamps and vegetation cover in 1856



Case History:

Site: 31 Landy Street (N°51)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.19g - 0.45g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.6m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5148 Longitude 172.6785
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

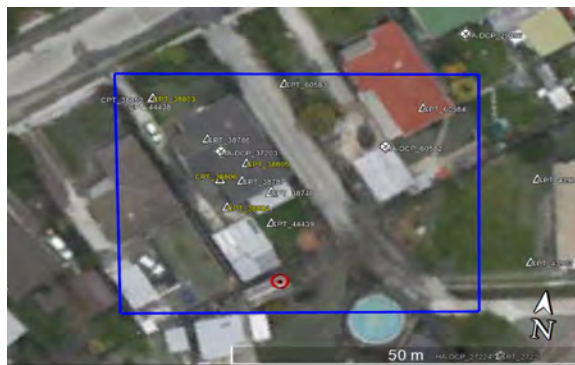
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Ejecta Patterns

Aerial photography taken on September 5, 2010



Aerial photography taken on February 24, 2011



Aerial photography taken on June 14-15, 2011

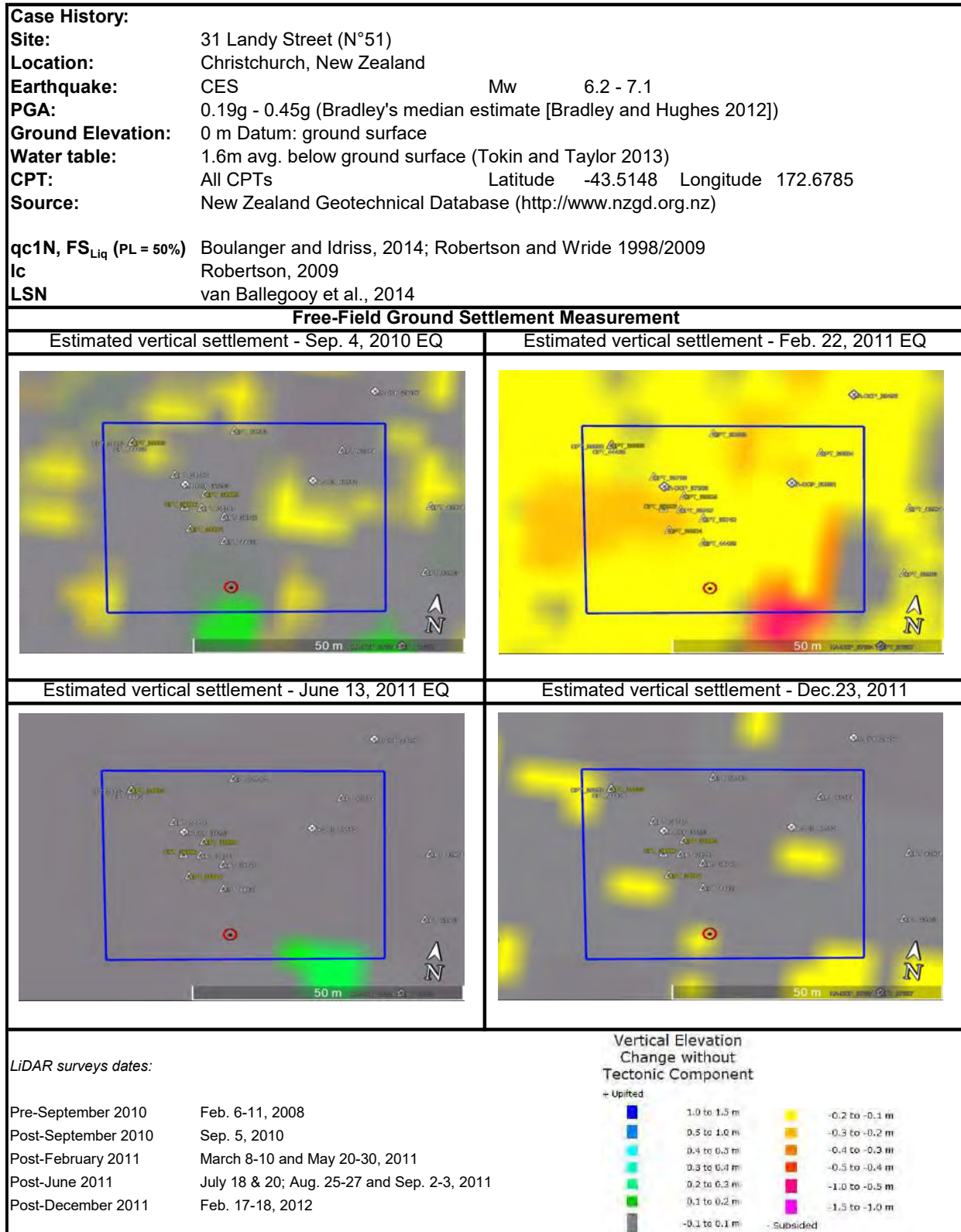


Aerial photography taken on December 24, 2011



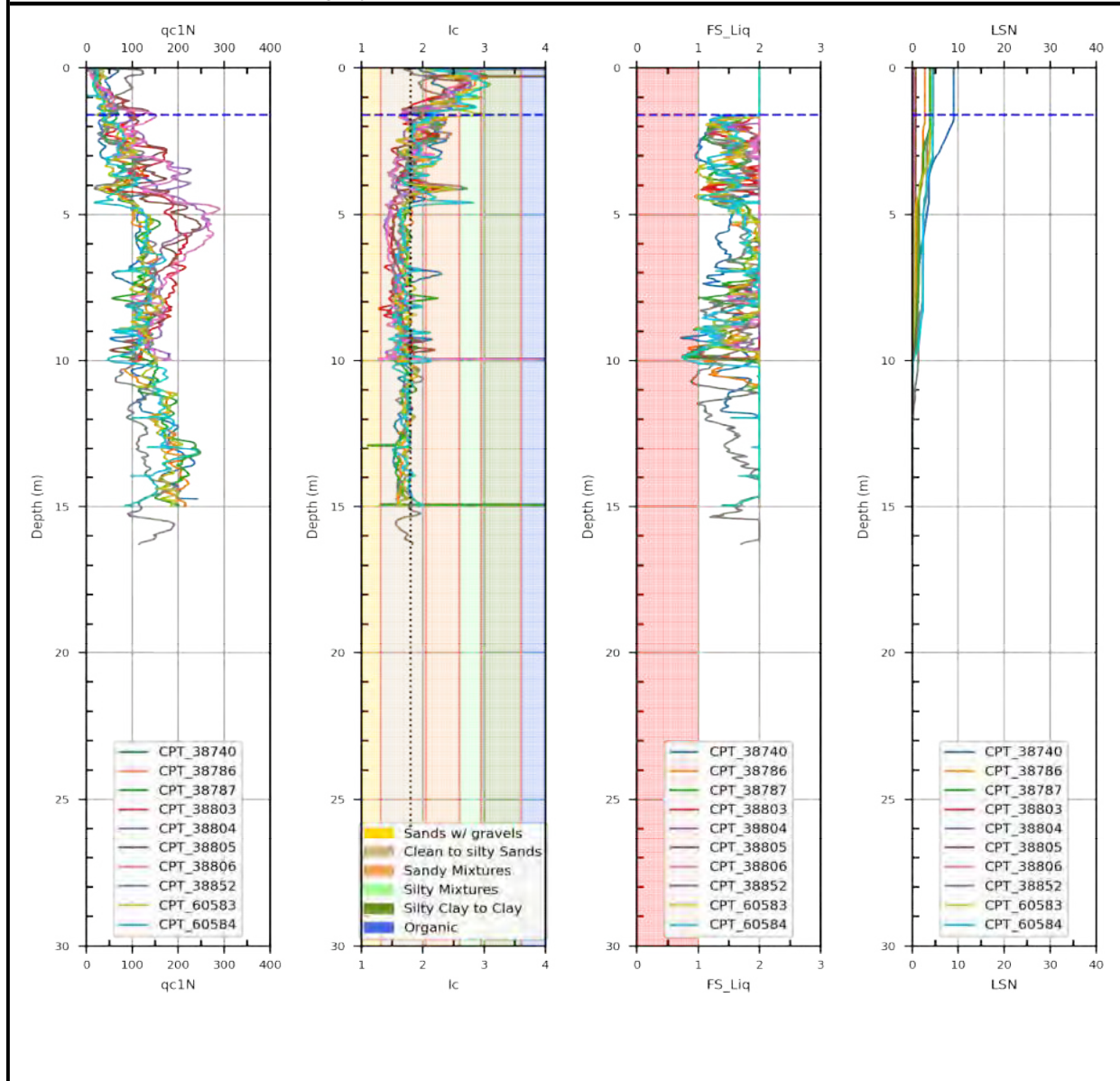
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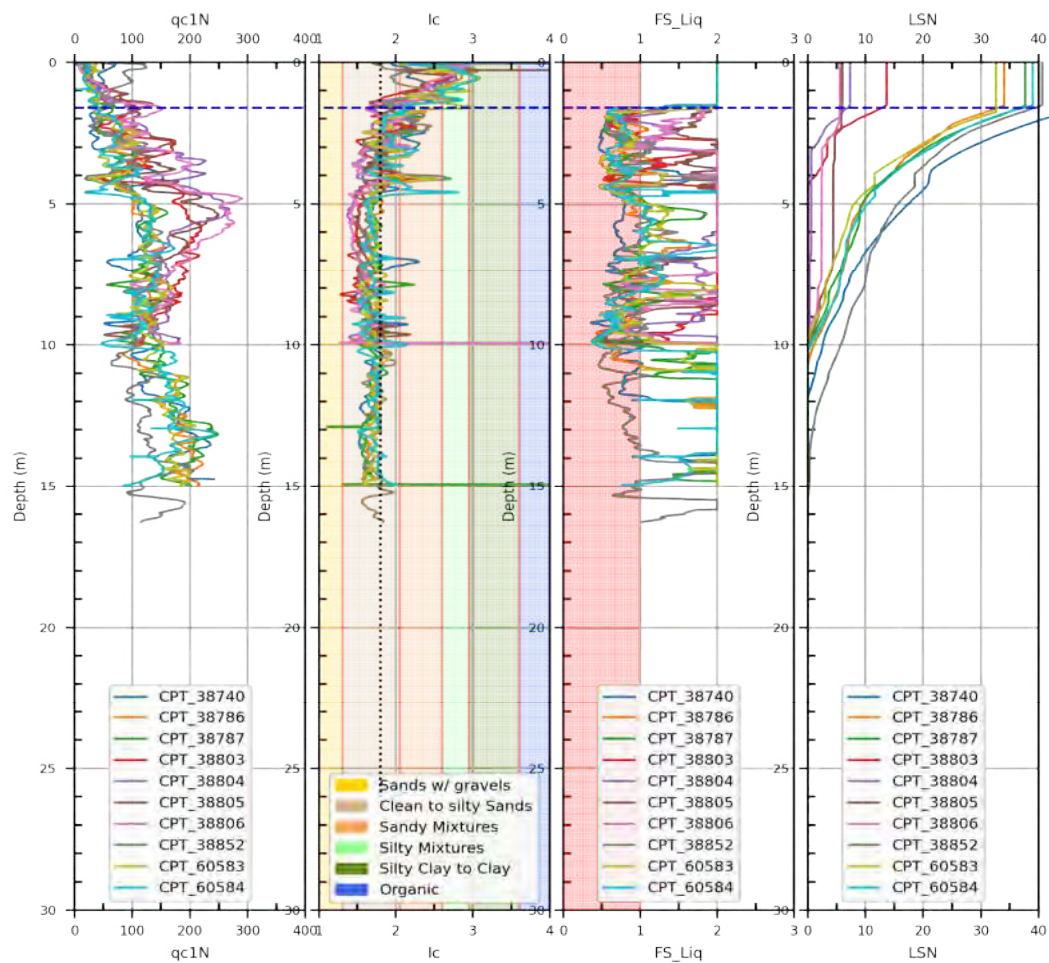
Case History: Ch-S120
Site: 31 Landy Street (N°51)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 6.2 - 7.1
PGA: 0.19g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.6m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5148 Longitude 172.6785
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



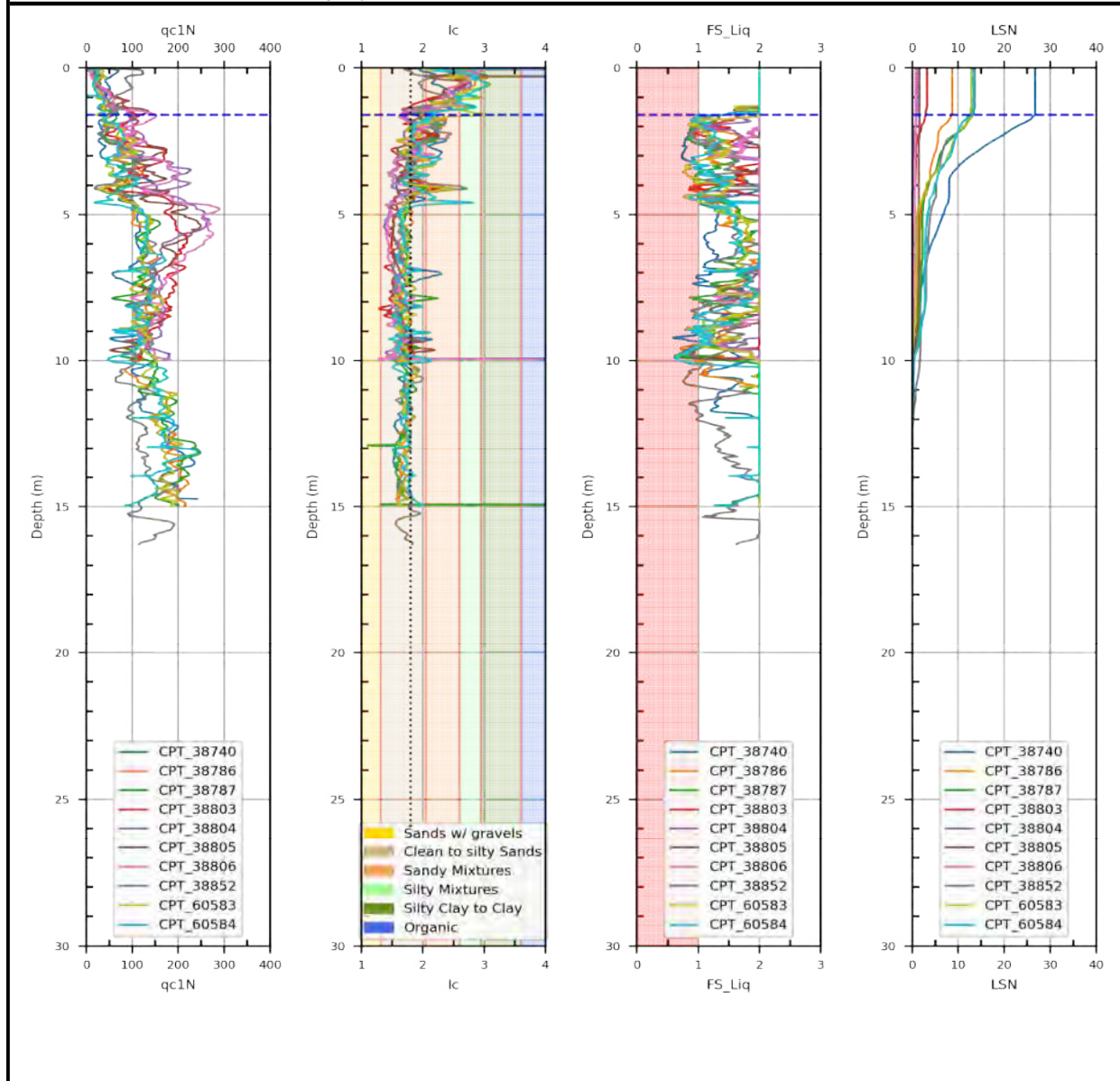
Case History: Ch-S121
Site: 31 Landy Street (N°51)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.45g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.6m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5148 Longitude 172.6785
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S122
Site: 31 Landy Street (N°51)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.27g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.6m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5148 Longitude 172.6785
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



68 Niven Street

Case History:

Site: 68 Niven Street (N°52)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.40g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.5m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5093 Longitude 172.6911
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

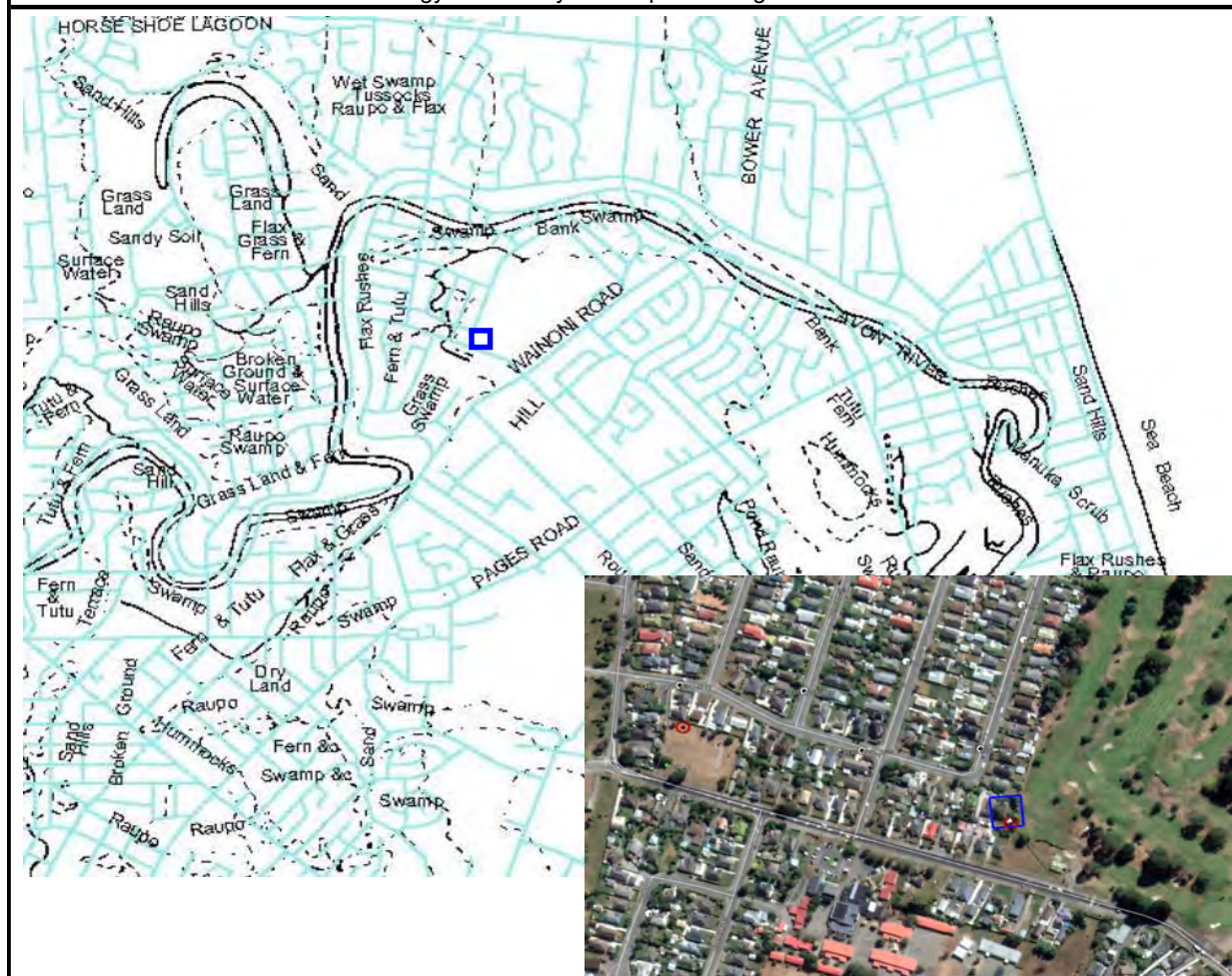
Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

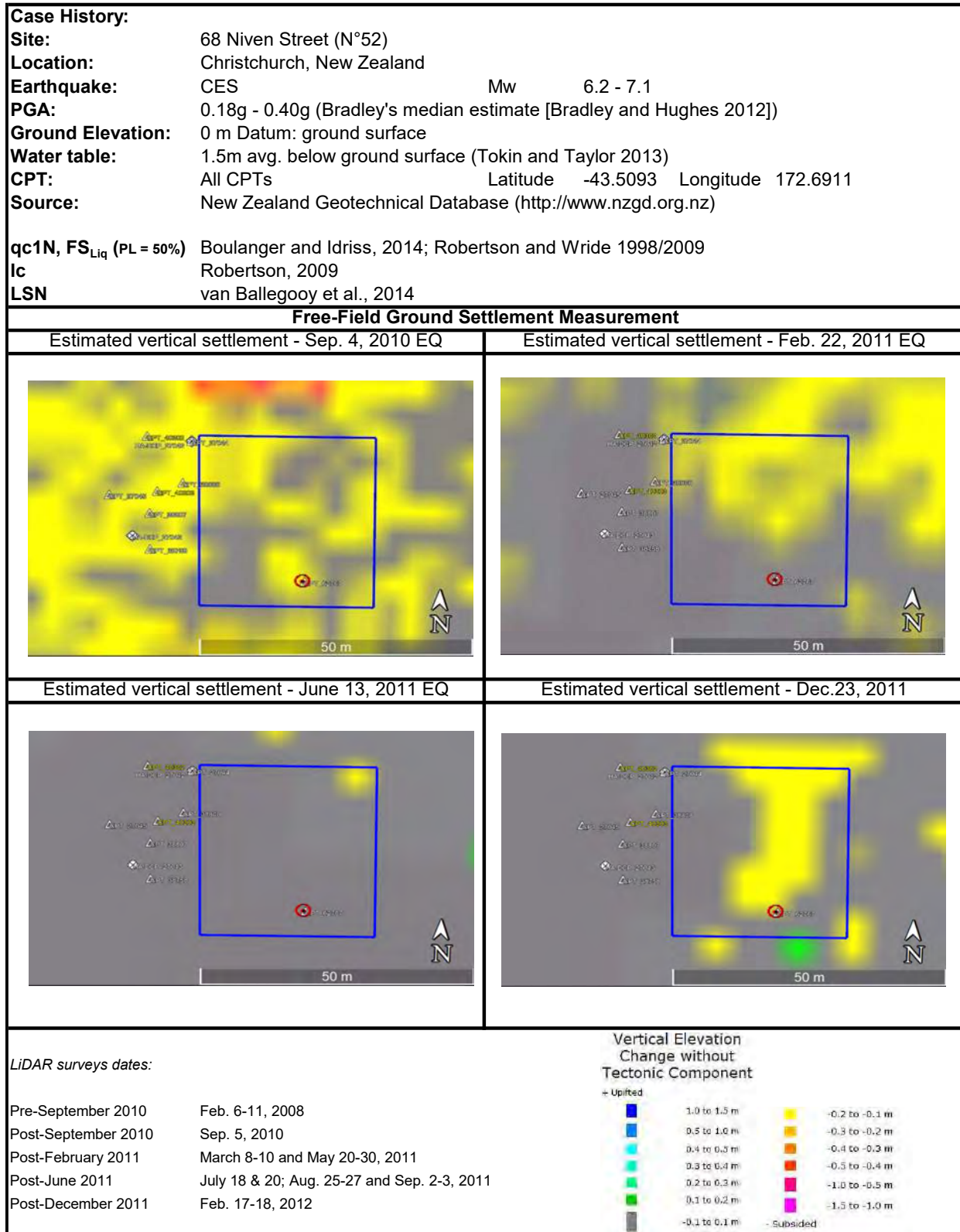
Site:	68 Niven Street (N°52)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.18g - 0.40g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	1.5m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5093 Longitude 172.6911
Source:	Christchurch City Council, map_Ap001725BlackMap.gws

Robertson, 2009

Surficial Geology - waterways swamps and vegetation cover in 1856



Case History:	
Site:	68 Niven Street (N°52)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.18g - 0.40g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	1.5m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5093 Longitude 172.6911
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
	



↓ Subsided

-0.2 to -0.1 m

-0.3 to -0.2 m

-0.4 to -0.3 m

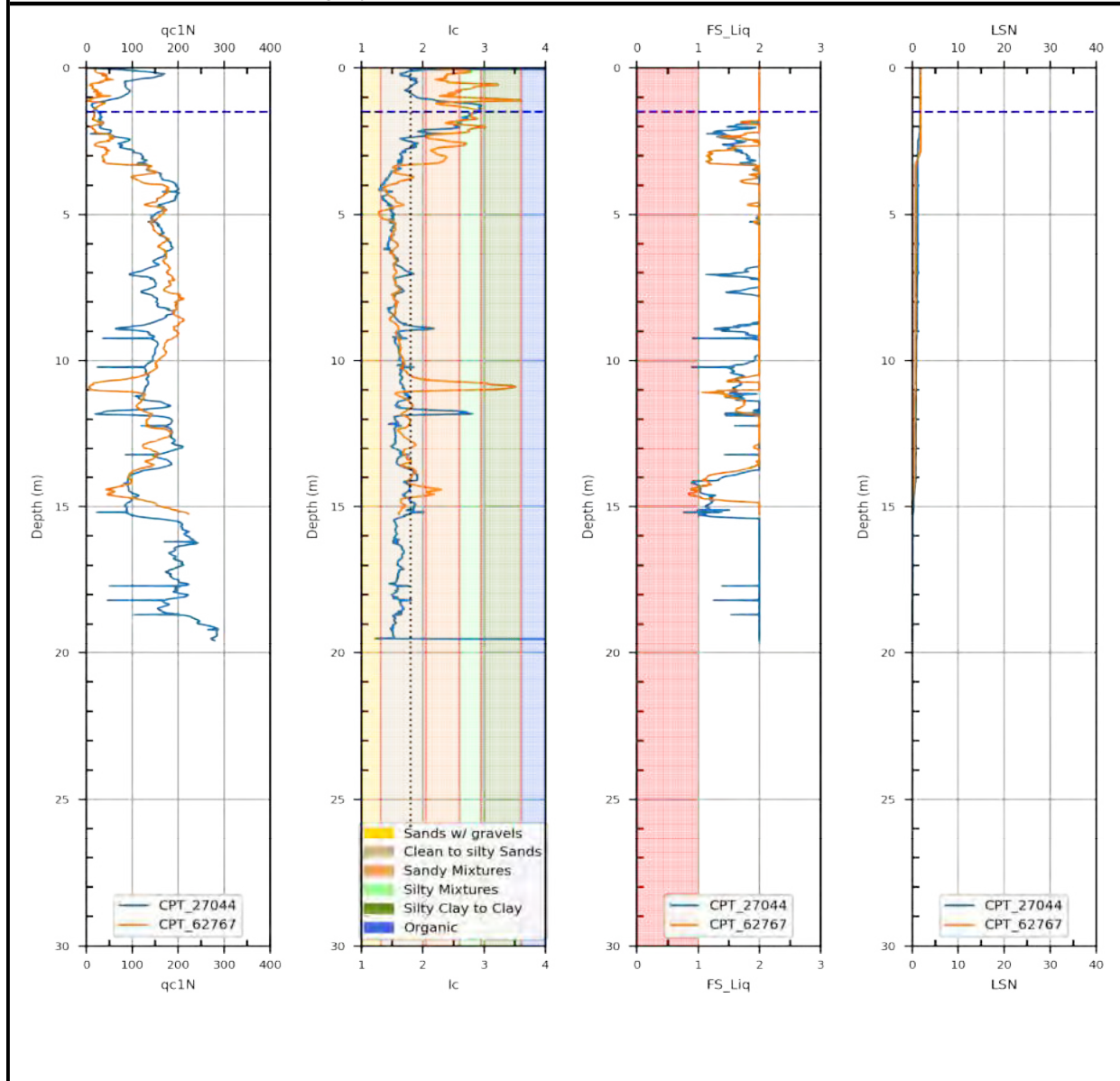
-0.5 to -0.4 m

-1.0 to -0.5 m

 -1.5 to -1.0 m

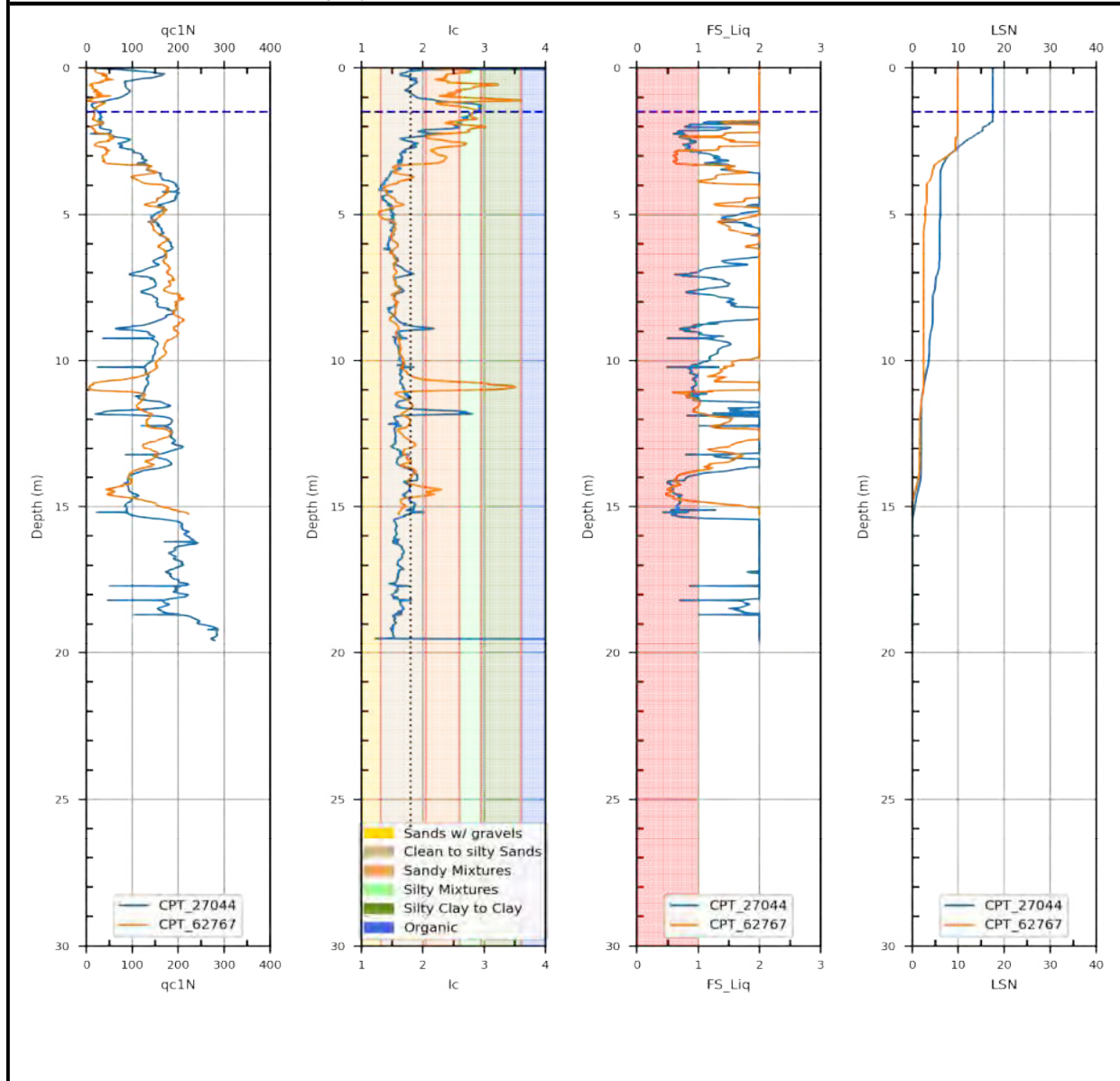
Case History: Ch-S123
Site: 68 Niven Street (N°52)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 6.2 - 7.1
PGA: 0.18g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.5m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5093 Longitude 172.6911
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



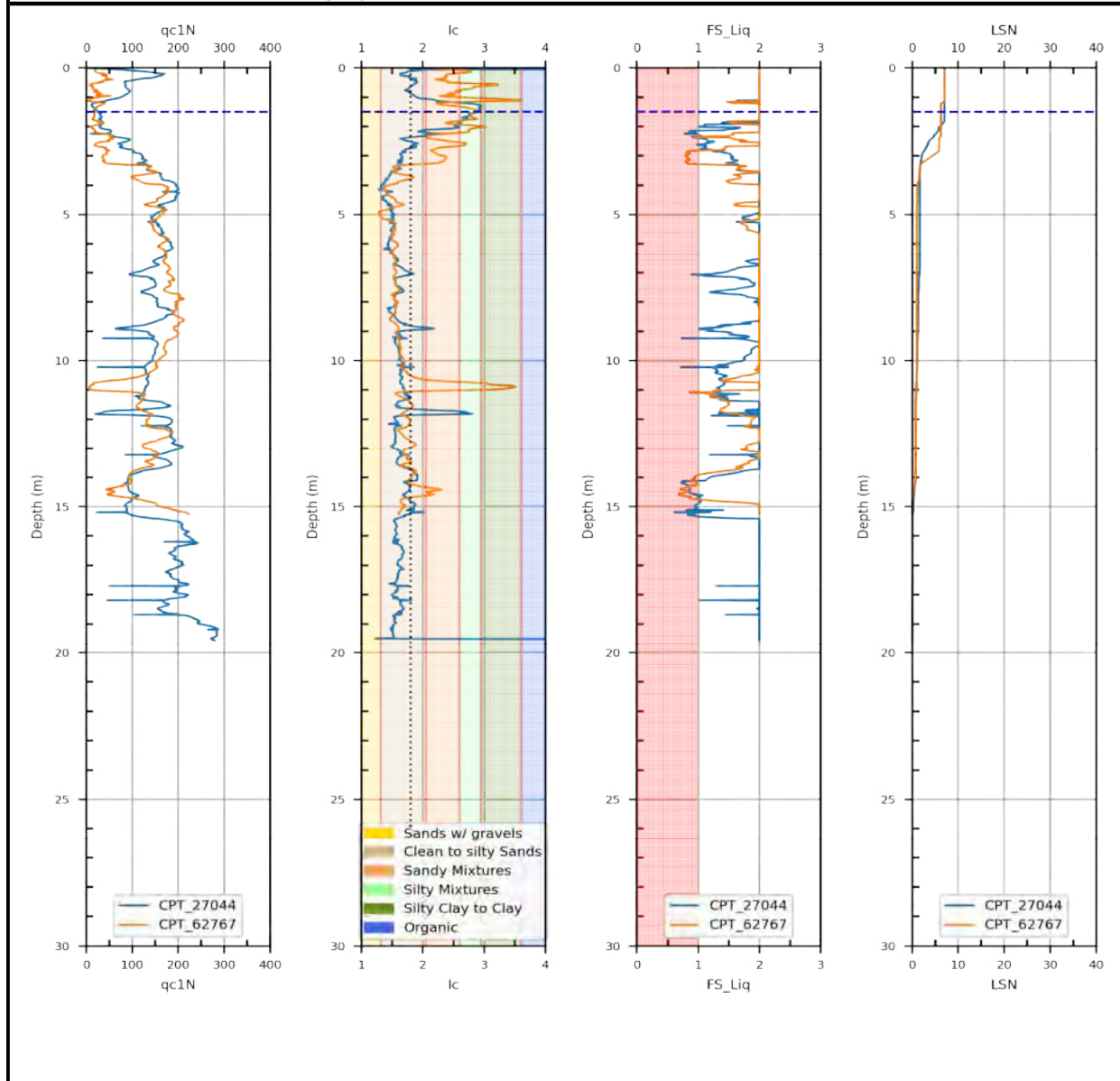
Case History: Ch-S124
Site: 68 Niven Street (N°52)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.40g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.5m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5093 Longitude 172.6911
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S125
Site: 68 Niven Street (N°52)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.27g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.5m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5093 Longitude 172.6911
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



137c Palmers Road

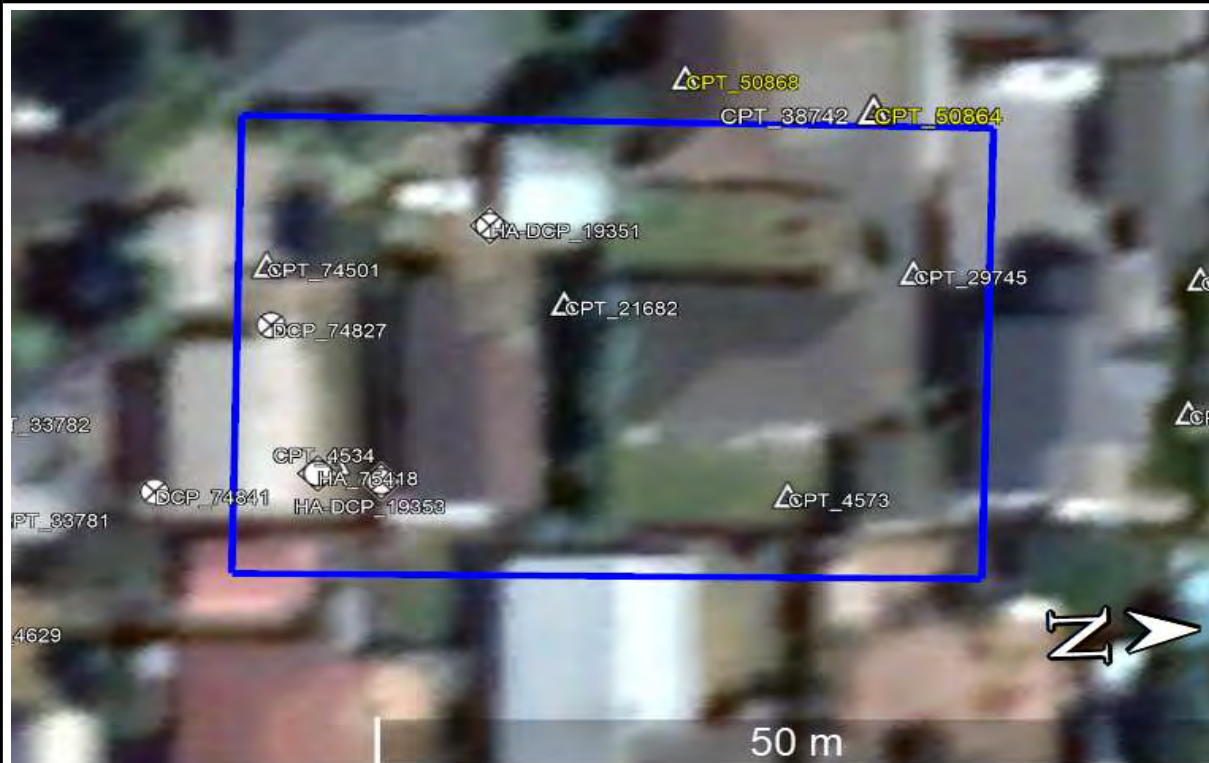
Case History:

Site: 137c Palmers Road (N°53)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.47g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5022 Longitude 172.7147
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

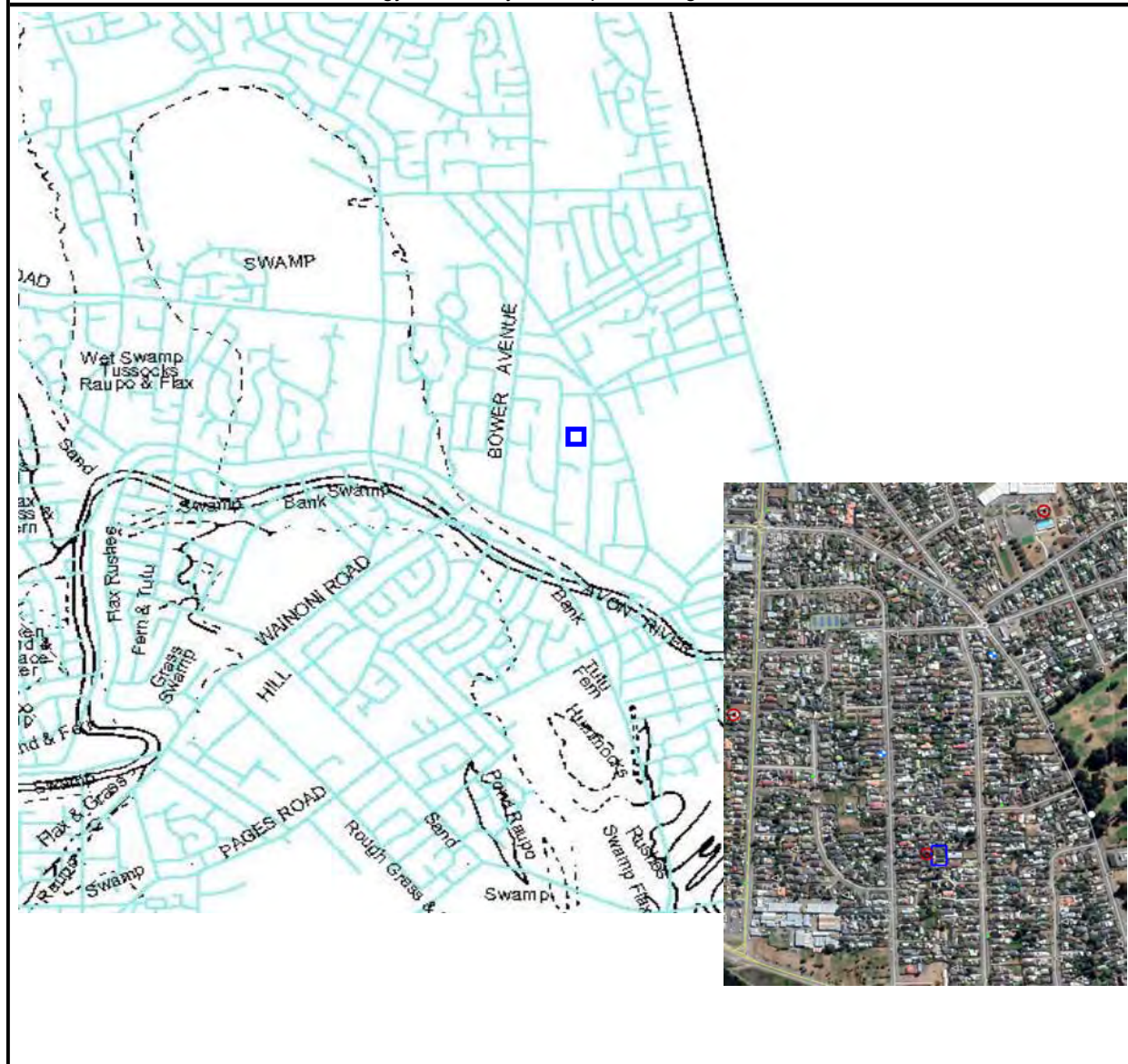
Site: 137c Palmers Road (N°53)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.47g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5022 Longitude 172.7147
Source: Christchurch City Council, map_Ap001725BlackMap.gws

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

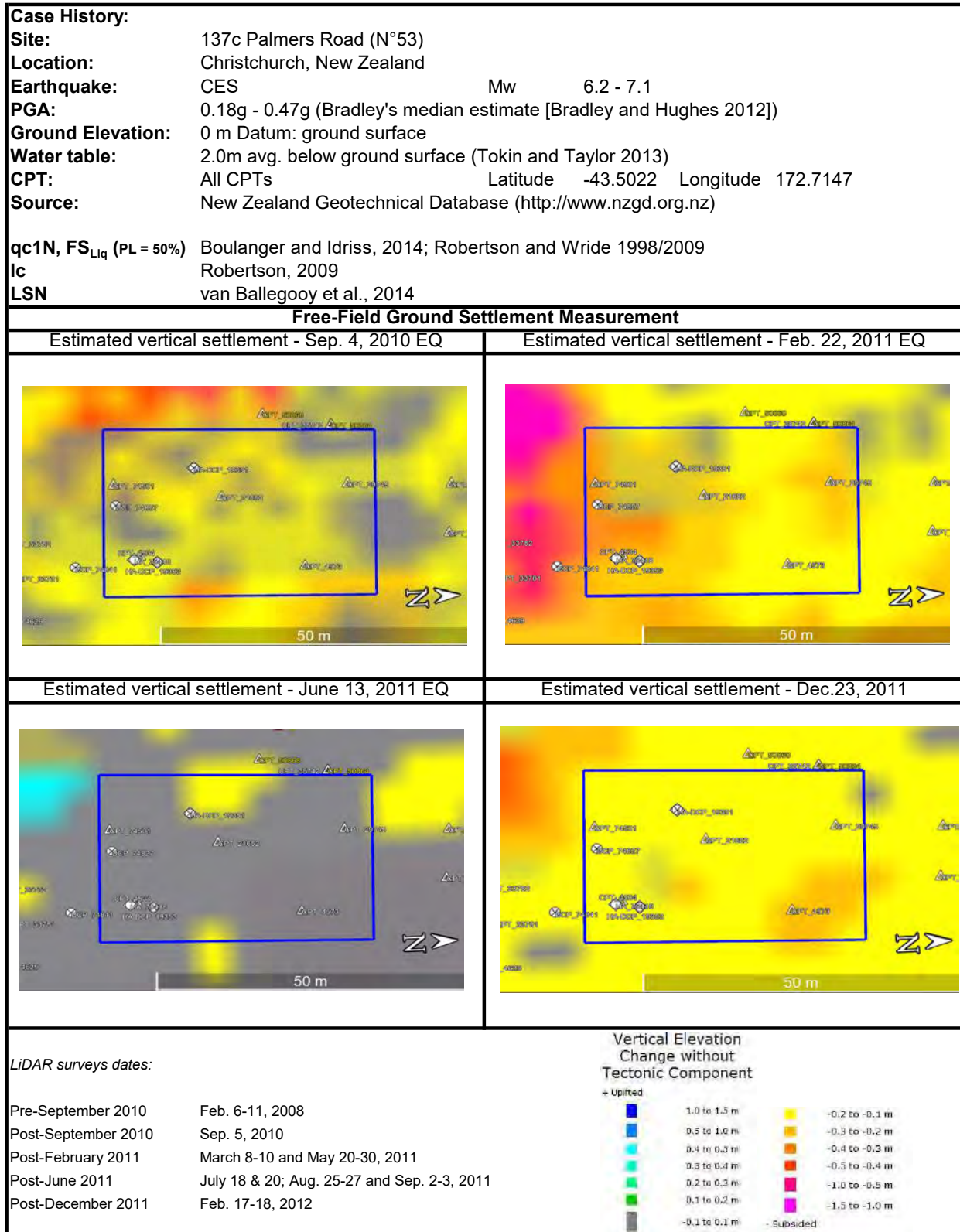
lc Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

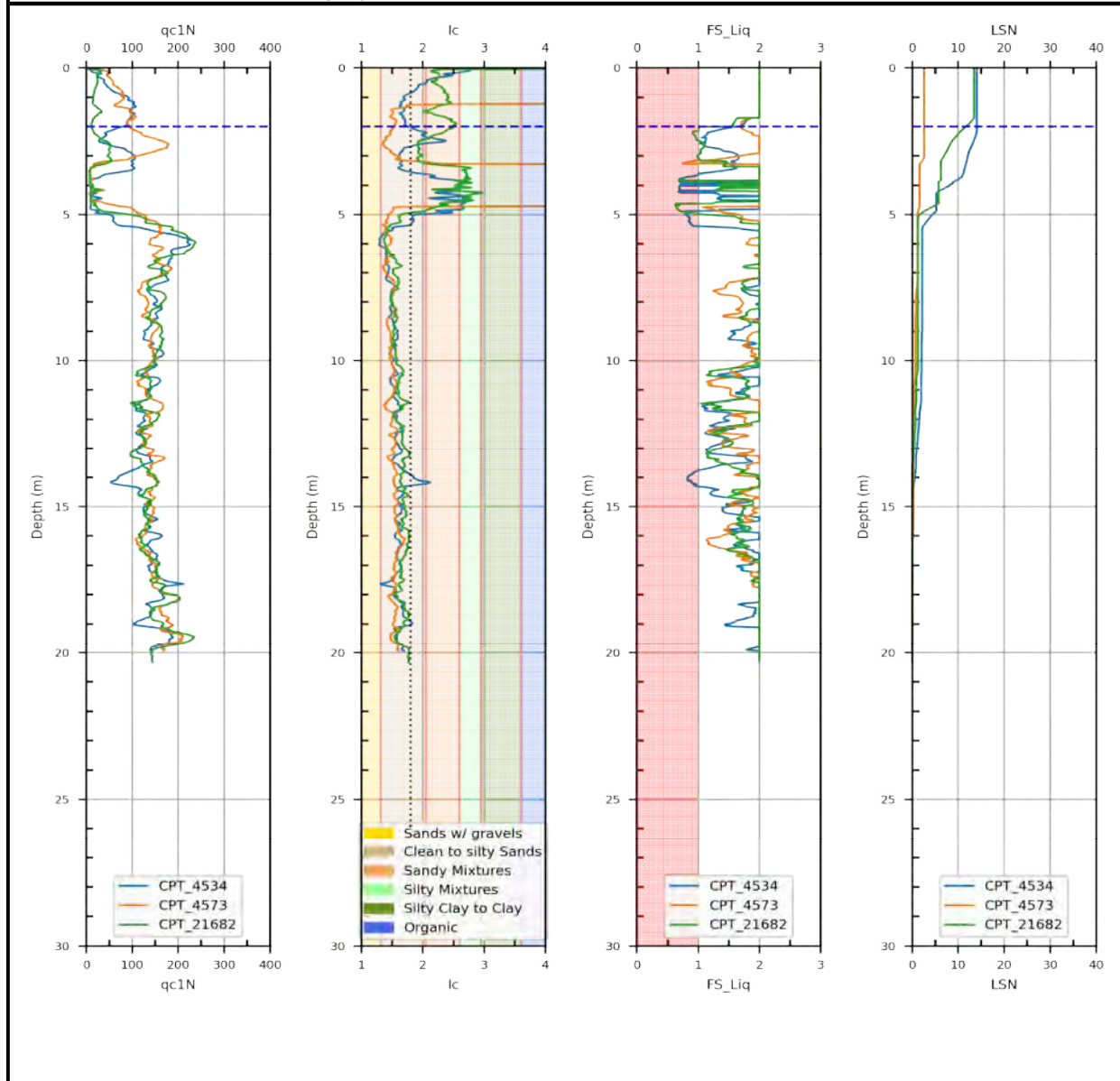


Site:	137c Palmers Road (N°53)		
Location:	Christchurch, New Zealand		
Earthquake:	CES	Mw	6.2 - 7.1
PGA:	0.18g - 0.47g (Bradley's median estimate [Bradley and Hughes 2012])		
Ground Elevation:	0 m Datum: ground surface		
Water table:	2.0m avg. below ground surface (Tokin and Taylor 2013)		
CPT:	All CPTs	Latitude	-43.5022 Longitude 172.7147
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)		



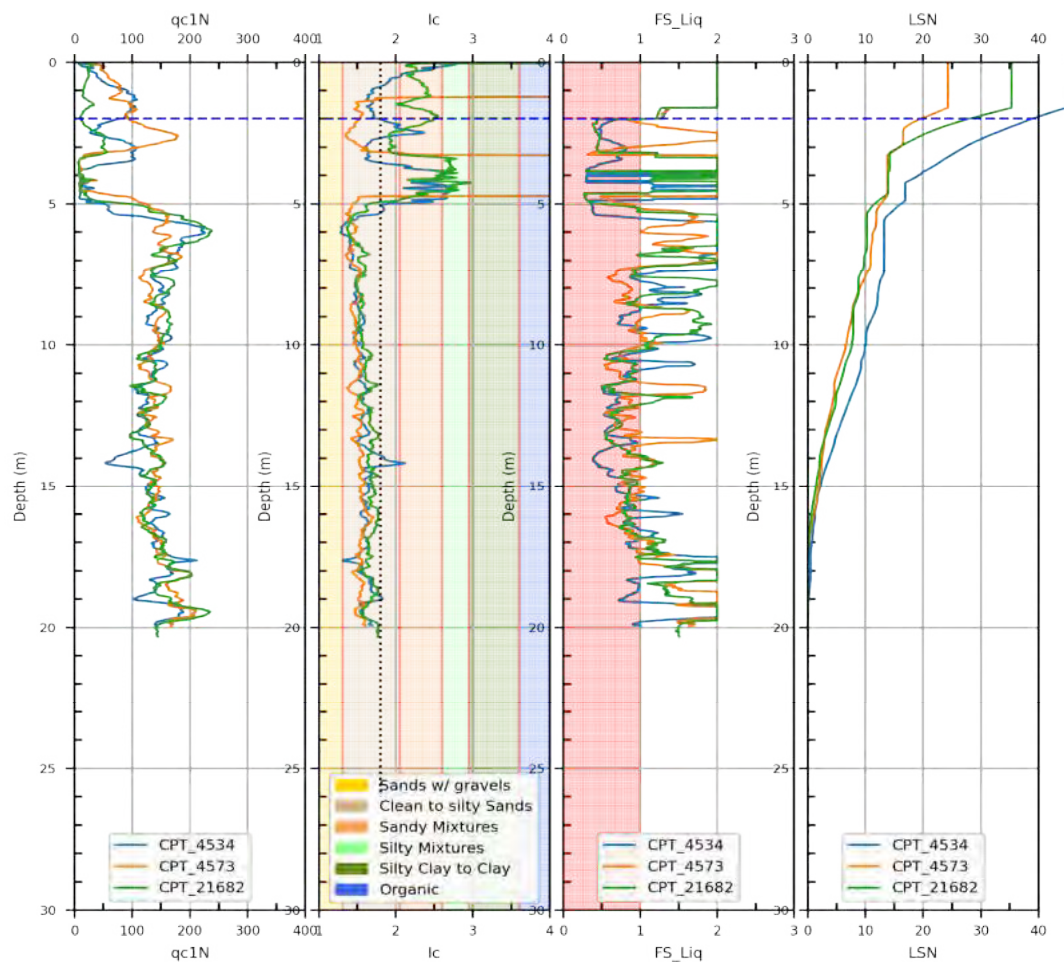
Case History: Ch-S126
Site: 137c Palmers Road (N°53)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 6.2 - 7.1
PGA: 0.18g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5022 Longitude 172.7147
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



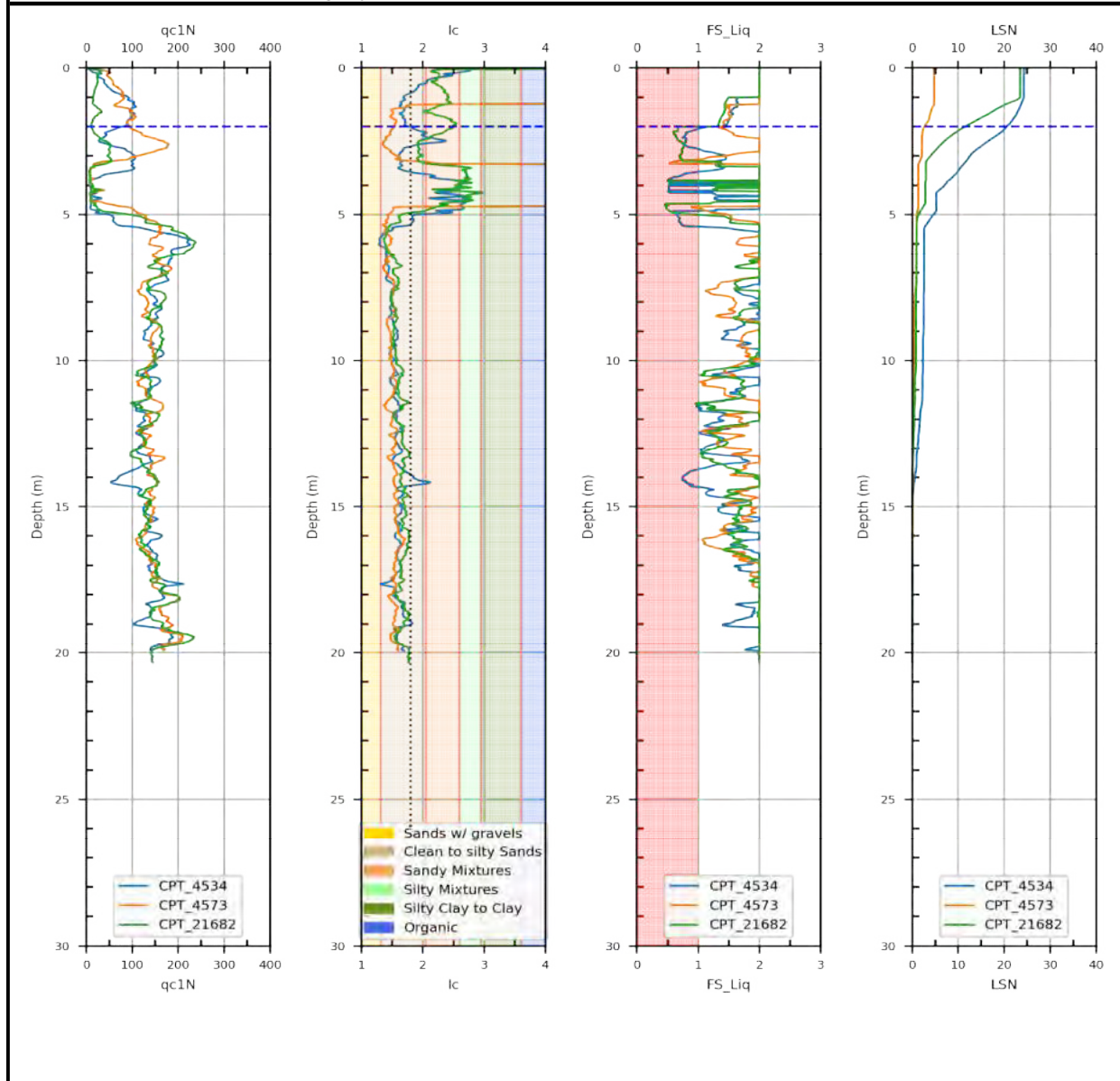
Case History: Ch-S127
Site: 137c Palmers Road (N°53)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.47g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5022 Longitude 172.7147
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S128
Site: 137c Palmers Road (N°53)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.24g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5022 Longitude 172.7147
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



513 Pages Road

Site:	513 Pages Road (N°54)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.18g - 0.49g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	0.8m -1.0m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5128 Longitude 172.712
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)

Case History:

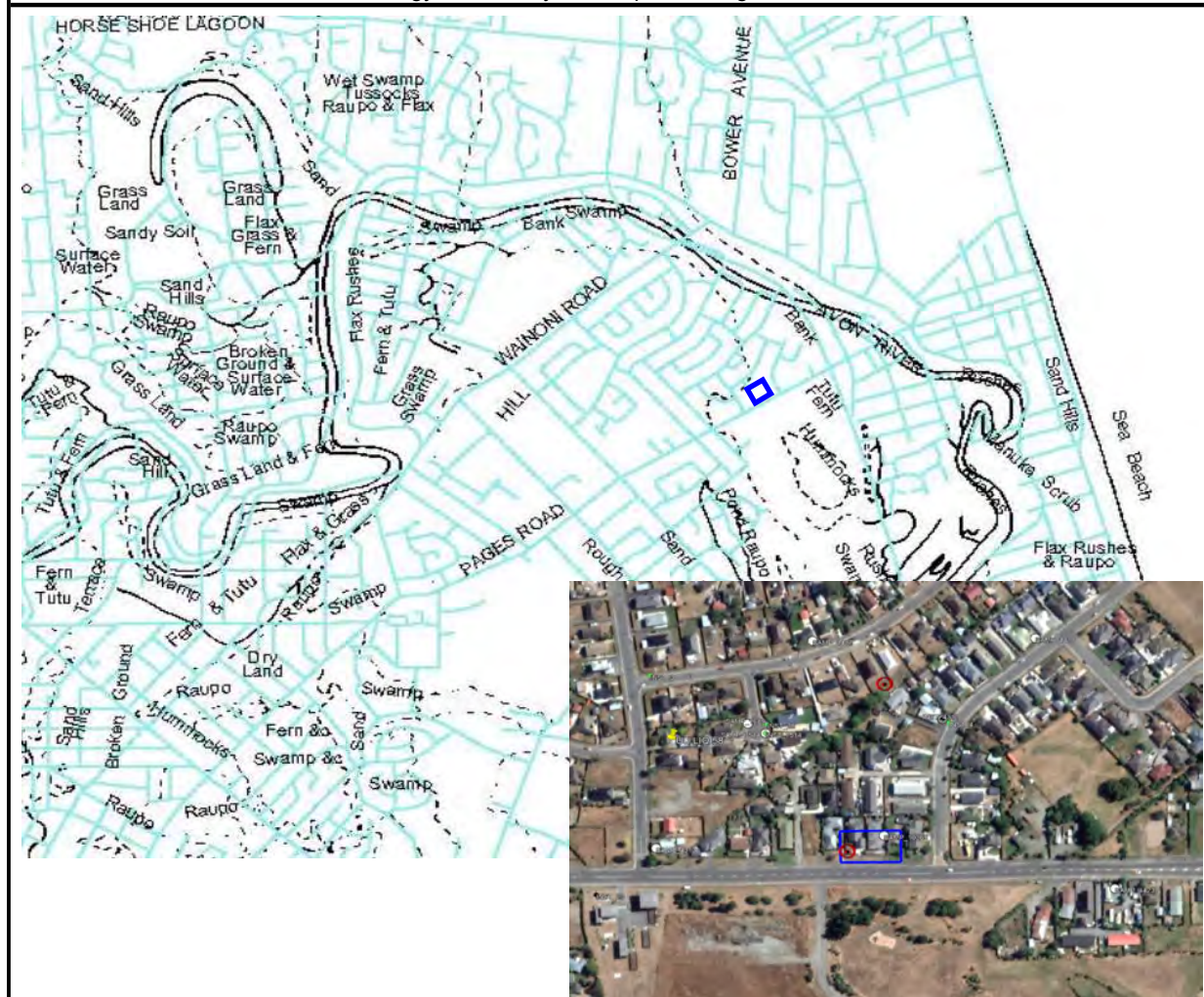
Site: 513 Pages Road (N°54)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.49g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.8m -1.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5128 Longitude 172.712
Source: Christchurch City Council, map_Ap001725BlackMap.gws

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

lc Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856



Case History:

Site: 513 Pages Road (N°54)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.49g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.8m -1.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5128 Longitude 172.712
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Ejecta Patterns

Aerial photography taken on September 5, 2010



Aerial photography taken on February 24, 2011



Aerial photography taken on June 14-15, 2011



Aerial photography taken on December 24, 2011



Ministry of Civil Defence
& Emergency Management
Te Kaitiaki Whakamānau



Case History:

Site: 513 Pages Road (N°54)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.49g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.8m -1.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5128 Longitude 172.712
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

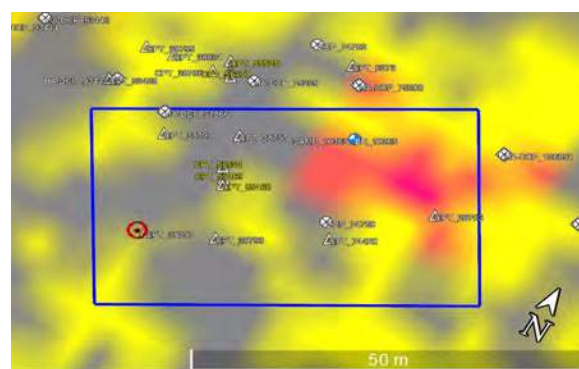
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

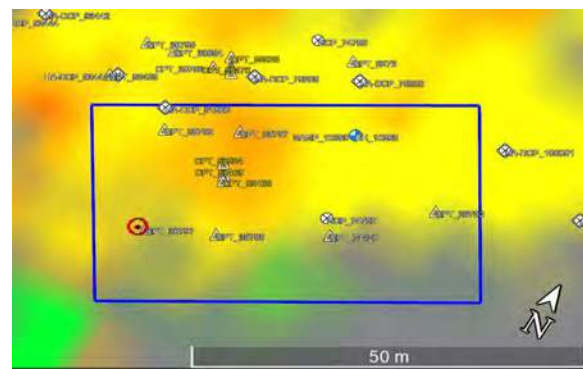
LSN van Ballegooy et al., 2014

Free-Field Ground Settlement Measurement

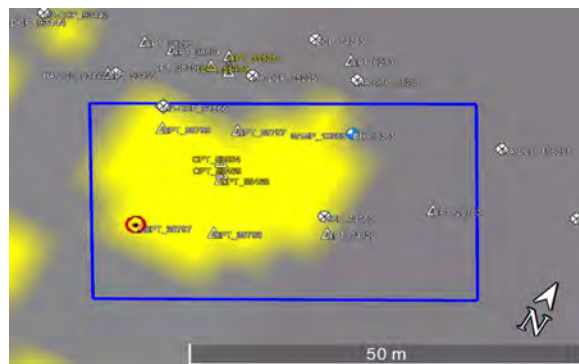
Estimated vertical settlement - Sep. 4, 2010 EQ



Estimated vertical settlement - Feb. 22, 2011 EQ



Estimated vertical settlement - June 13, 2011 EQ



Estimated vertical settlement - Dec.23, 2011

**LiDAR surveys dates:**

Pre-September 2010	Feb. 6-11, 2008
Post-September 2010	Sep. 5, 2010
Post-February 2011	March 8-10 and May 20-30, 2011
Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011
Post-December 2011	Feb. 17-18, 2012

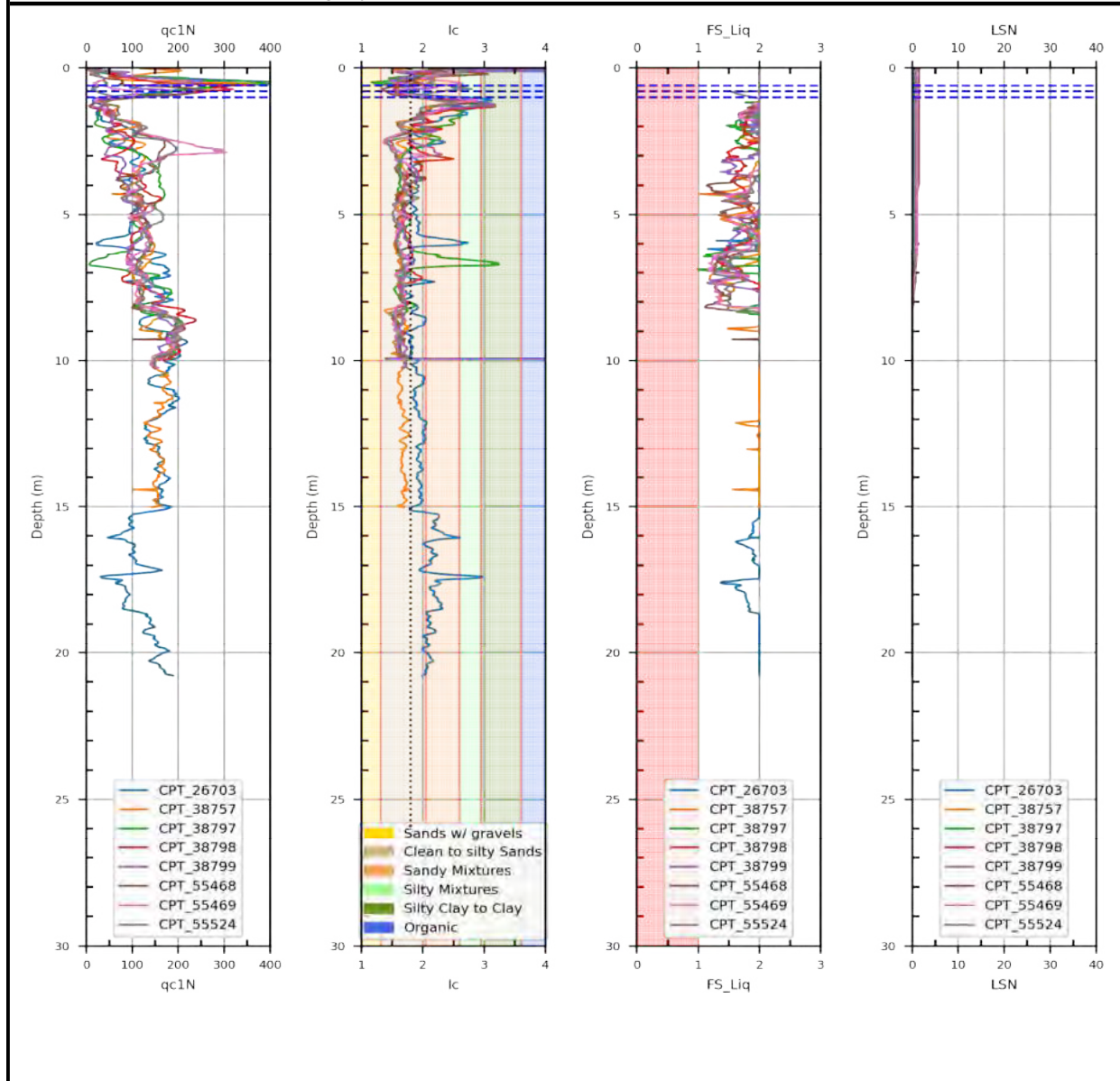
Vertical Elevation Change without Tectonic Component

+ Uplifted



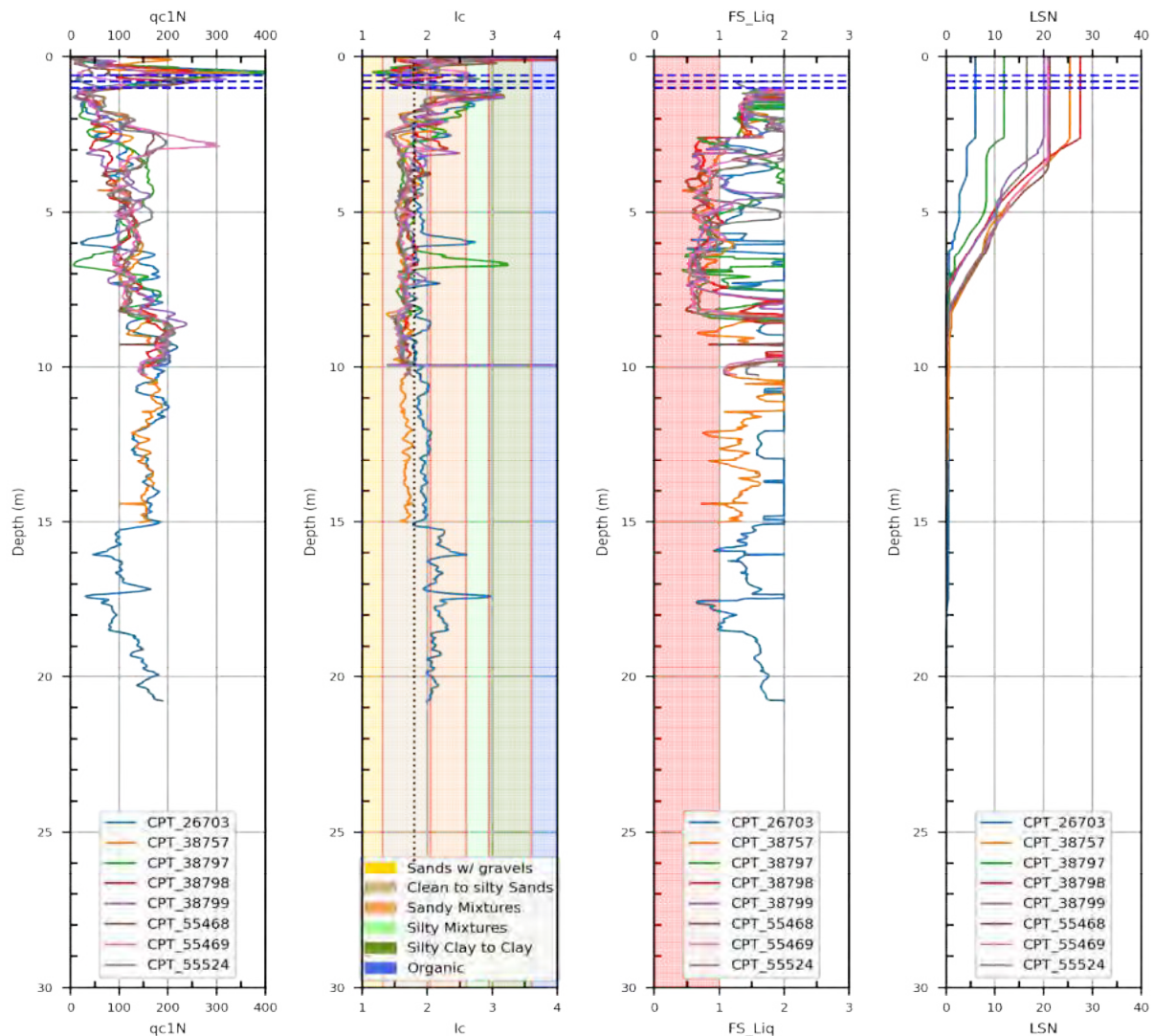
Case History: Ch-S129
Site: 513 Pages Road (N°54)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 6.2 - 7.1
PGA: 0.18g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.8m -1.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5128 Longitude 172.712
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



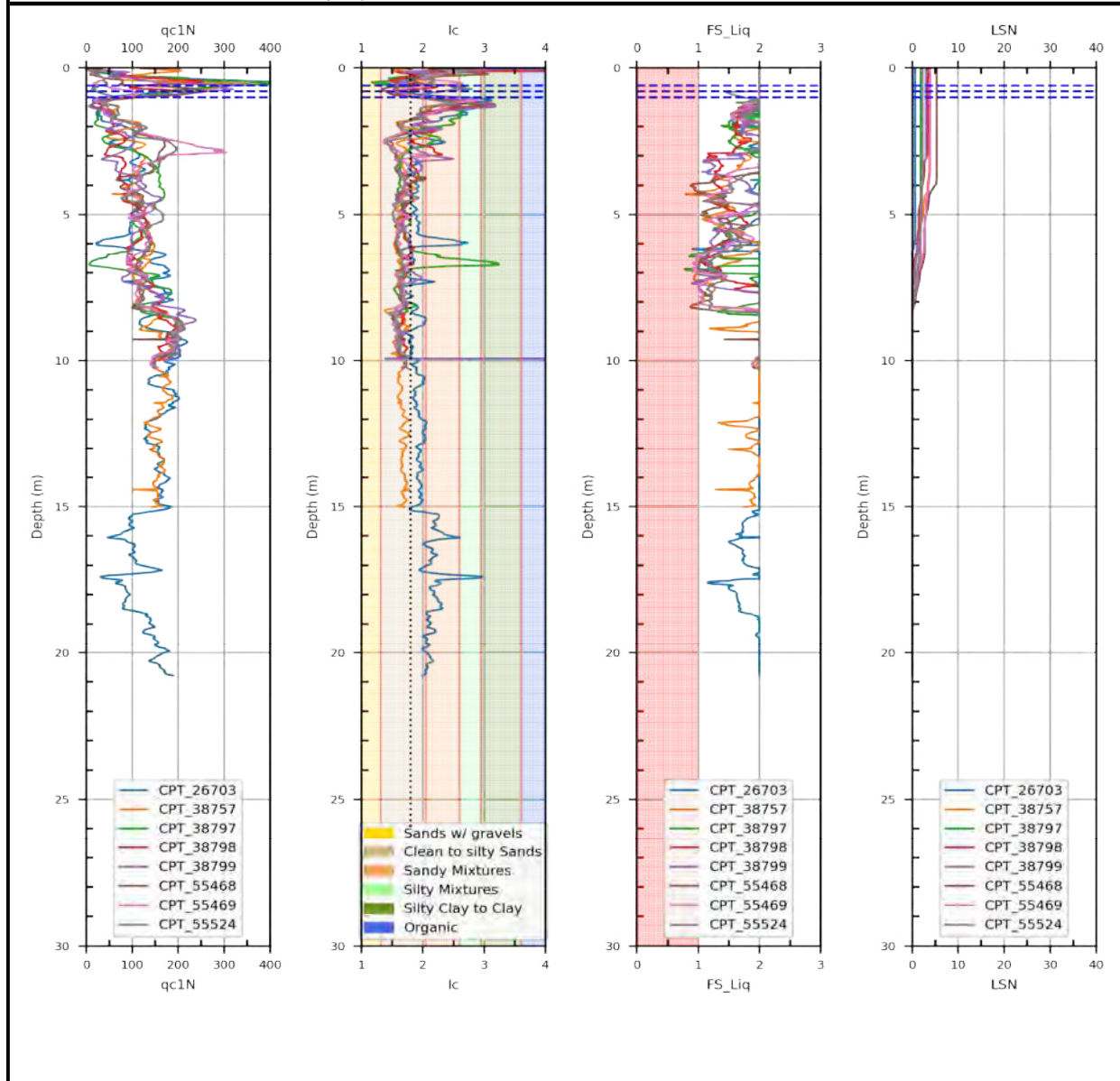
Case History: Ch-S130
Site: 513 Pages Road (N°54)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.49g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.8m -1.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5128 Longitude 172.712
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S131
Site: 513 Pages Road (N°54)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.28g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 0.8m -1.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5128 Longitude 172.712
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



CC LIQ1 Vivian Street

Case History:

Site: CC_LIQ1_Vivian_St (N°56)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.17g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.5m -2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4964 Longitude 172.6900
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

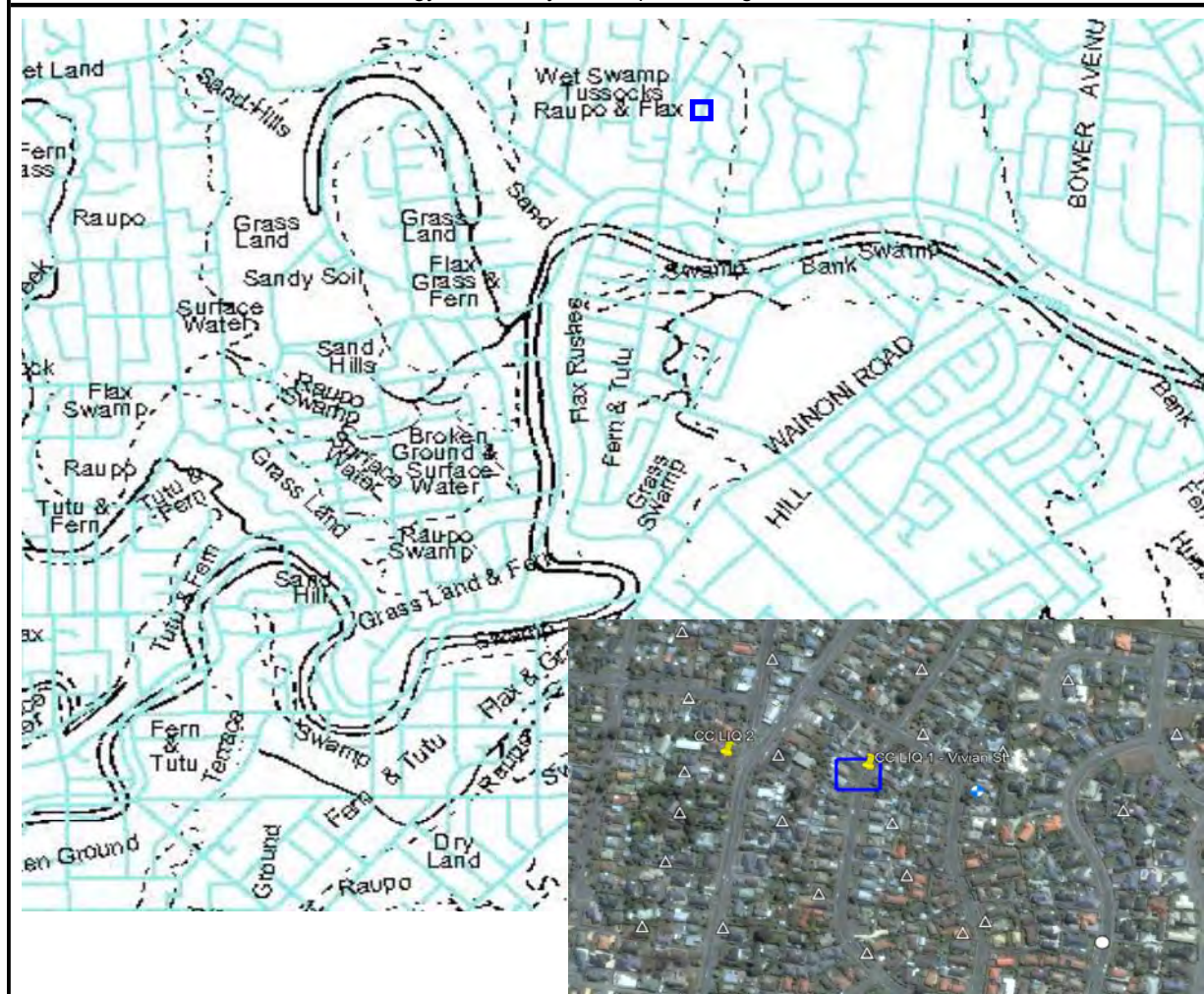
LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:**Site:** CC_LIQ1_Vivian_St (N°56)**Location:** Christchurch, New Zealand**Earthquake:** CES Mw 6.2 - 7.1**PGA:** 0.17g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])**Ground Elevation:** 0 m Datum: ground surface**Water table:** 1.5m -2.0m avg. below ground surface (Tokin and Taylor 2013)**CPT:** All CPTs Latitude -43.4964 Longitude 172.6900**Source:** Christchurch City Council, map_Ap001725BlackMap.gws**qc1N, FS_{Liq} (PL = 50%)** Boulanger and Idriss, 2014; Robertson and Wride 1998/2009**lc** Robertson, 2009**LSN** van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856



Case History:

Site: CC_LIQ1_Vivian_St (N°56)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.17g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.5m -2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4964 Longitude 172.6900
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Li} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

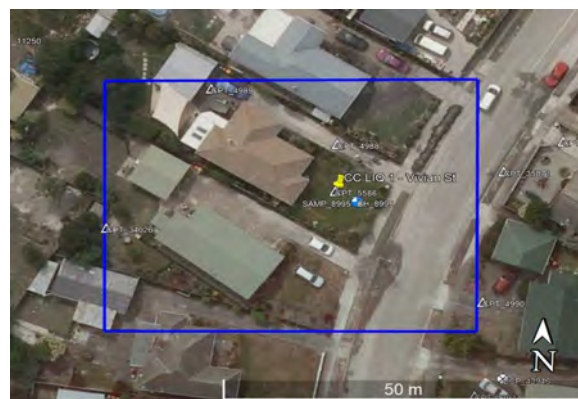
LSN van Ballegooy et al., 2014

Ejecta Patterns

Aerial photography taken on September 5, 2010



Aerial photography taken on February 24, 2011



Aerial photography taken on June 14-15, 2011



Aerial photography taken on December 24, 2011

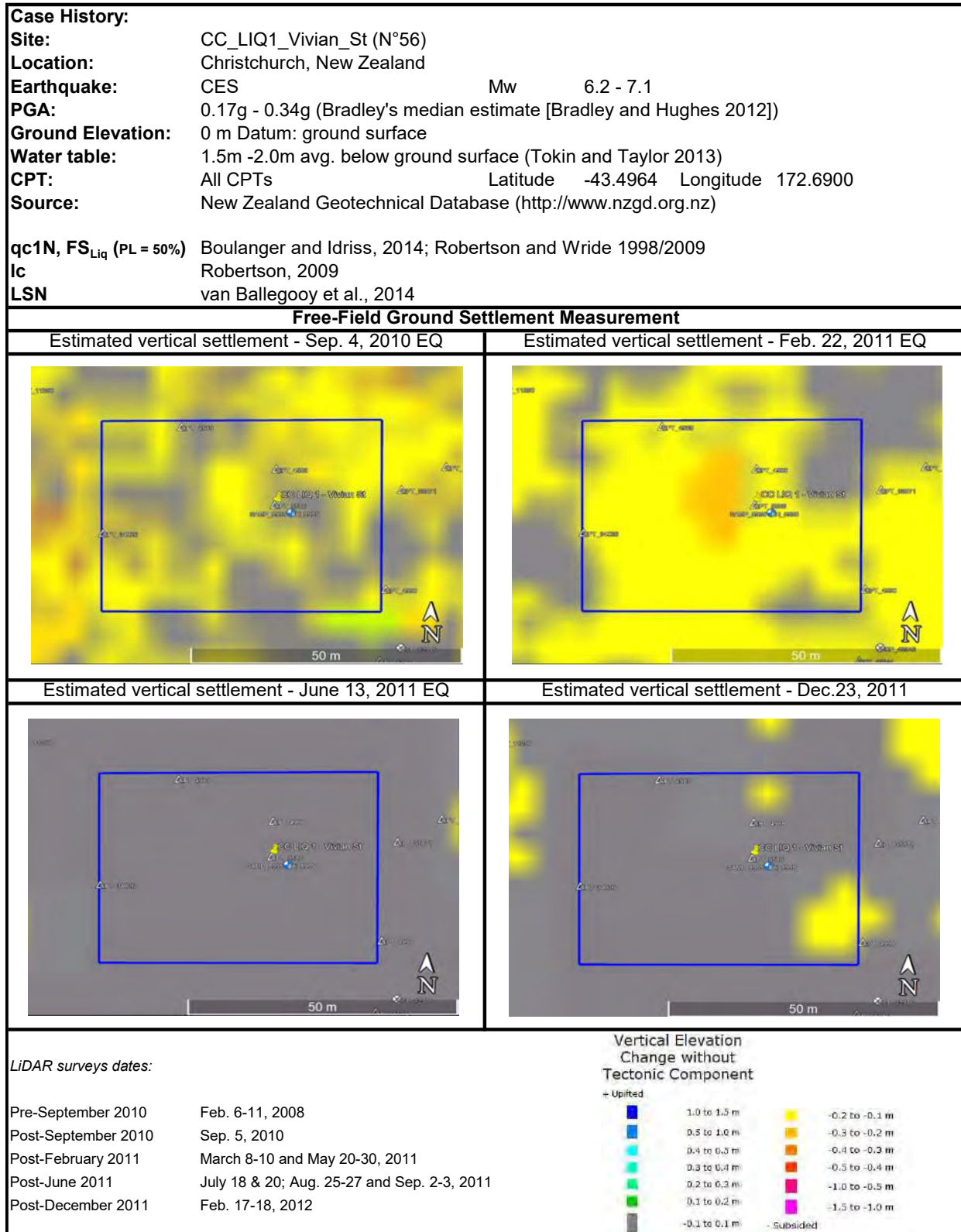


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CERA
Canterbury Earthquake
Recovery Authority

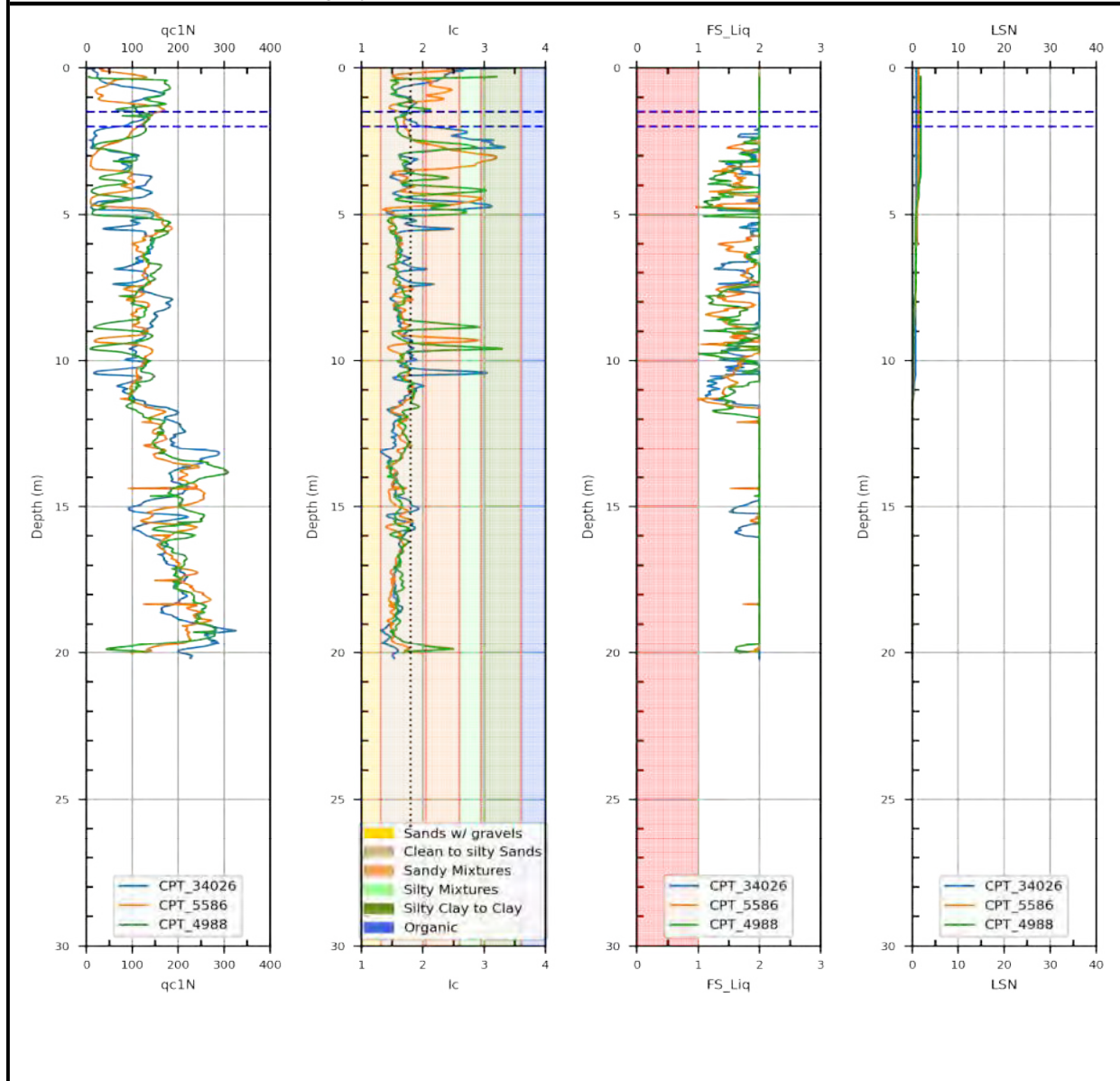
EQC
EARTHQUAKE COMMISSION
Kaitiaki Takekōwhiri

TT
Tonkin & Taylor



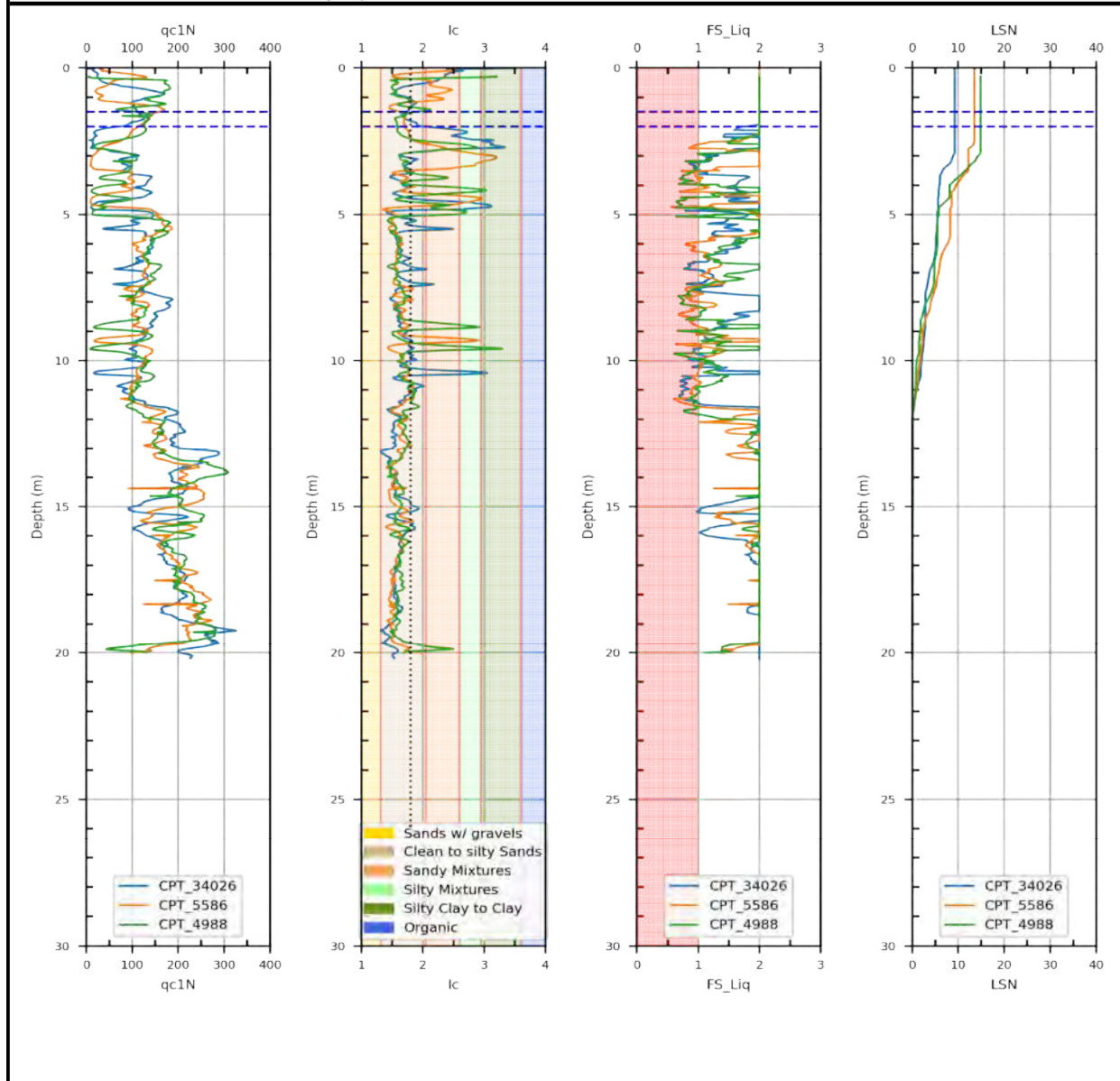
Case History: Ch-S132
Site: CC_LIQ1_Vivian_St (N°56)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 6.2 - 7.1
PGA: 0.17g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.5m -2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4964 Longitude 172.6900
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



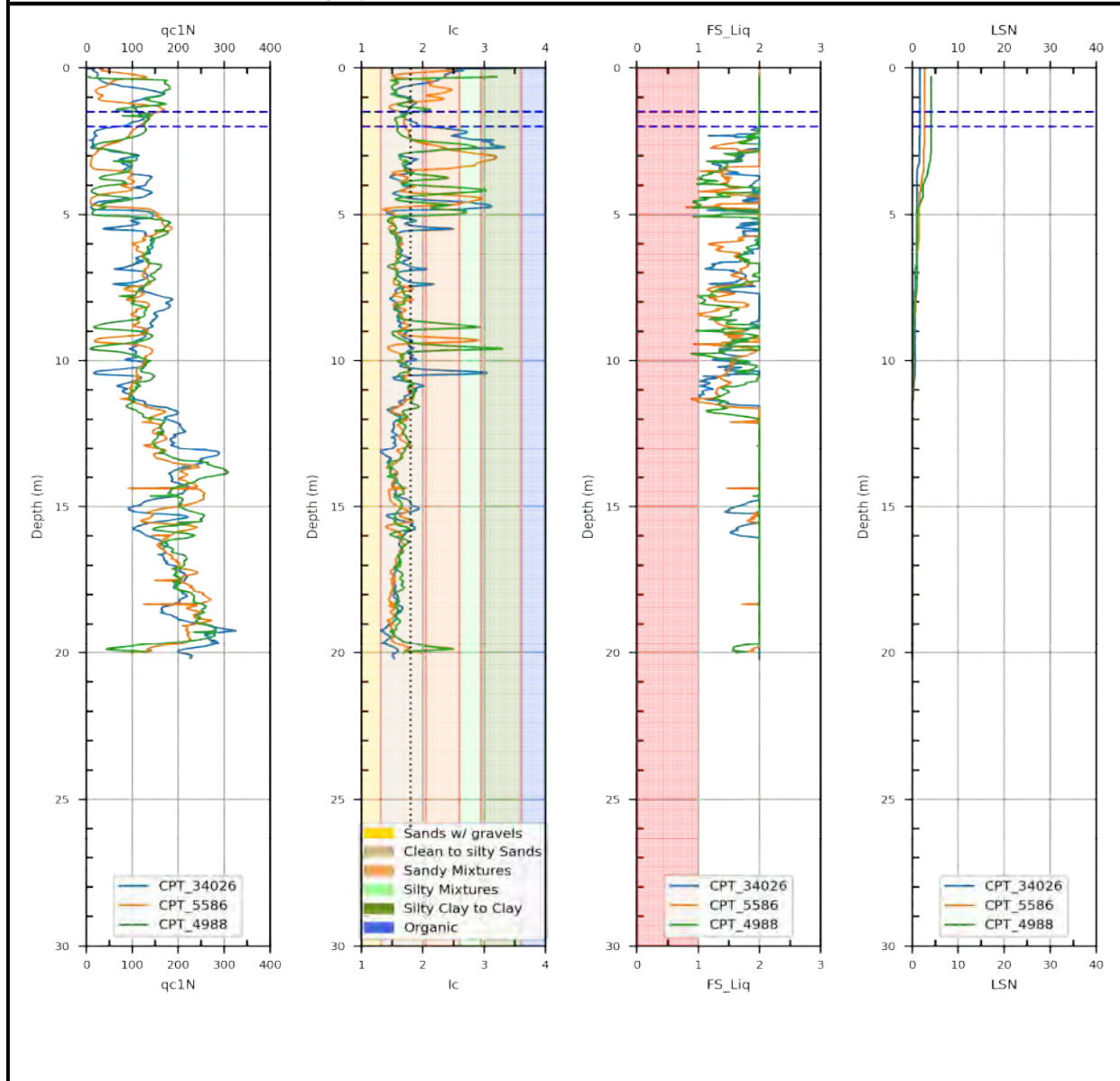
Case History: Ch-S133
Site: CC_LIQ1_Vivian_St (N°56)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.5m -2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4964 Longitude 172.6900
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S134
Site: CC_LIQ1_Vivian_St (N°56)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.23g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.5m -2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4964 Longitude 172.6900
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



CC LIQ2 Parnwell St & Basset St

Case History:

Site: CC LIQ2 Parnwell St & Bassett St (N°57)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4963 Longitude 172.6880
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Site:	CC LIQ2 Parnwell St & Bassett St (N°57)		
Location:	Christchurch, New Zealand		
Earthquake:	CES	Mw	6.2 - 7.1
PGA:	0.18g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])		
Ground Elevation:	0 m Datum: ground surface		
Water table:	2.0m avg. below ground surface (Tokin and Taylor 2013)		
CPT:	All CPTs	Latitude	-43.4963 Longitude 172.6880
Source:	Christchurch City Council, map_Ap001725BlackMap.gws		

Robertson, 2009

Surficial Geology - waterways swamps and vegetation cover in 1856



Case History: Site: CC LIQ2 Parnwell St & Bassett St (N°57) Location: Christchurch, New Zealand Earthquake: CES Mw 6.2 - 7.1 PGA: 0.18g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012]) Ground Elevation: 0 m Datum: ground surface Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013) CPT: All CPTs Latitude -43.4963 Longitude 172.6880 Source: New Zealand Geotechnical Database (http://www.nzgd.org.nz) qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009 Ic Robertson, 2009 LSN van Ballegooy et al., 2014	
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
  Ministry of Civil Defence & Emergency Management Te Kaitiaki Whakamānau  CERA Canterbury Earthquake Recovery Authority  EQC EARTHQUAKE COMMISSION Kaitiaki Takekōwhiri  TT Tonkin & Taylor	

Case History:

Site: CC LIQ2 Parnwell St & Bassett St (N°57)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4963 Longitude 172.6880
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

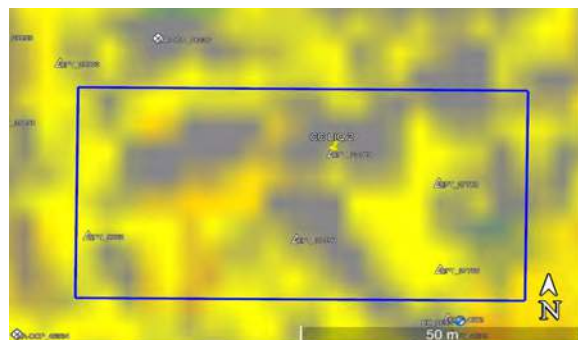
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

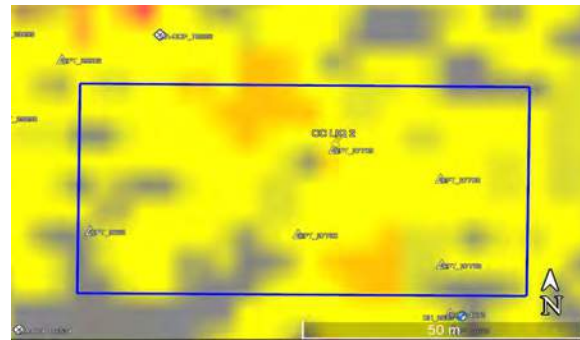
LSN van Ballegooy et al., 2014

Free-Field Ground Settlement Measurement

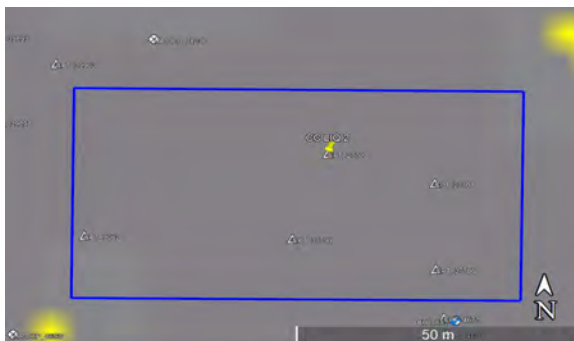
Estimated vertical settlement - Sep. 4, 2010 EQ



Estimated vertical settlement - Feb. 22, 2011 EQ



Estimated vertical settlement - June 13, 2011 EQ



Estimated vertical settlement - Dec.23, 2011

**LiDAR surveys dates:**

Pre-September 2010	Feb. 6-11, 2008
Post-September 2010	Sep. 5, 2010
Post-February 2011	March 8-10 and May 20-30, 2011
Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011
Post-December 2011	Feb. 17-18, 2012

Vertical Elevation Change without Tectonic Component

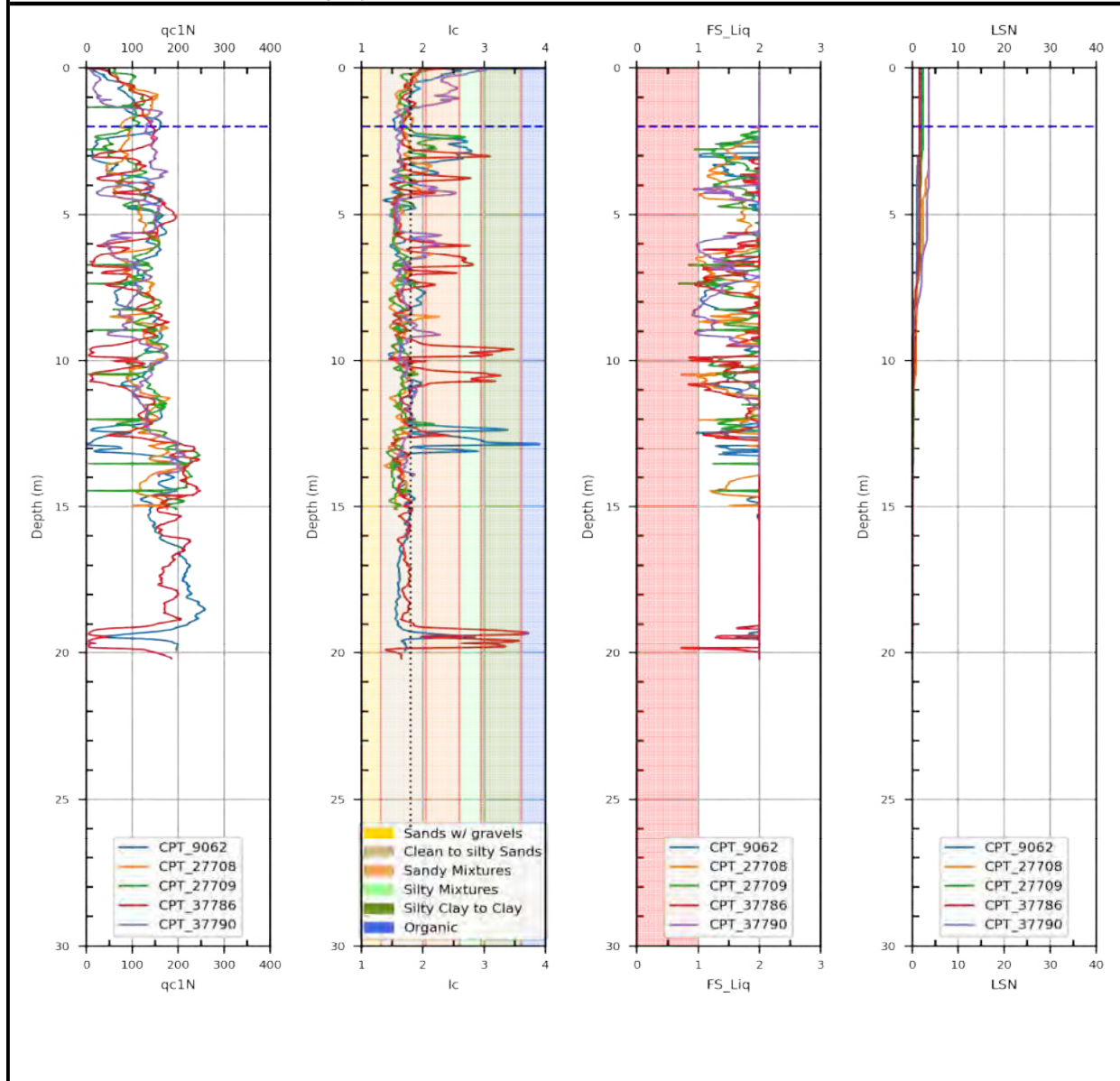
+ Uplifted



1.0 to 1.5 m	-0.2 to -0.1 m
0.5 to 1.0 m	-0.3 to -0.2 m
0.4 to 0.3 m	-0.4 to -0.3 m
0.3 to 0.4 m	-0.5 to -0.4 m
0.2 to 0.3 m	-1.0 to -0.5 m
0.1 to 0.2 m	-1.5 to -1.0 m
-0.1 to 0.1 m	- Subsided

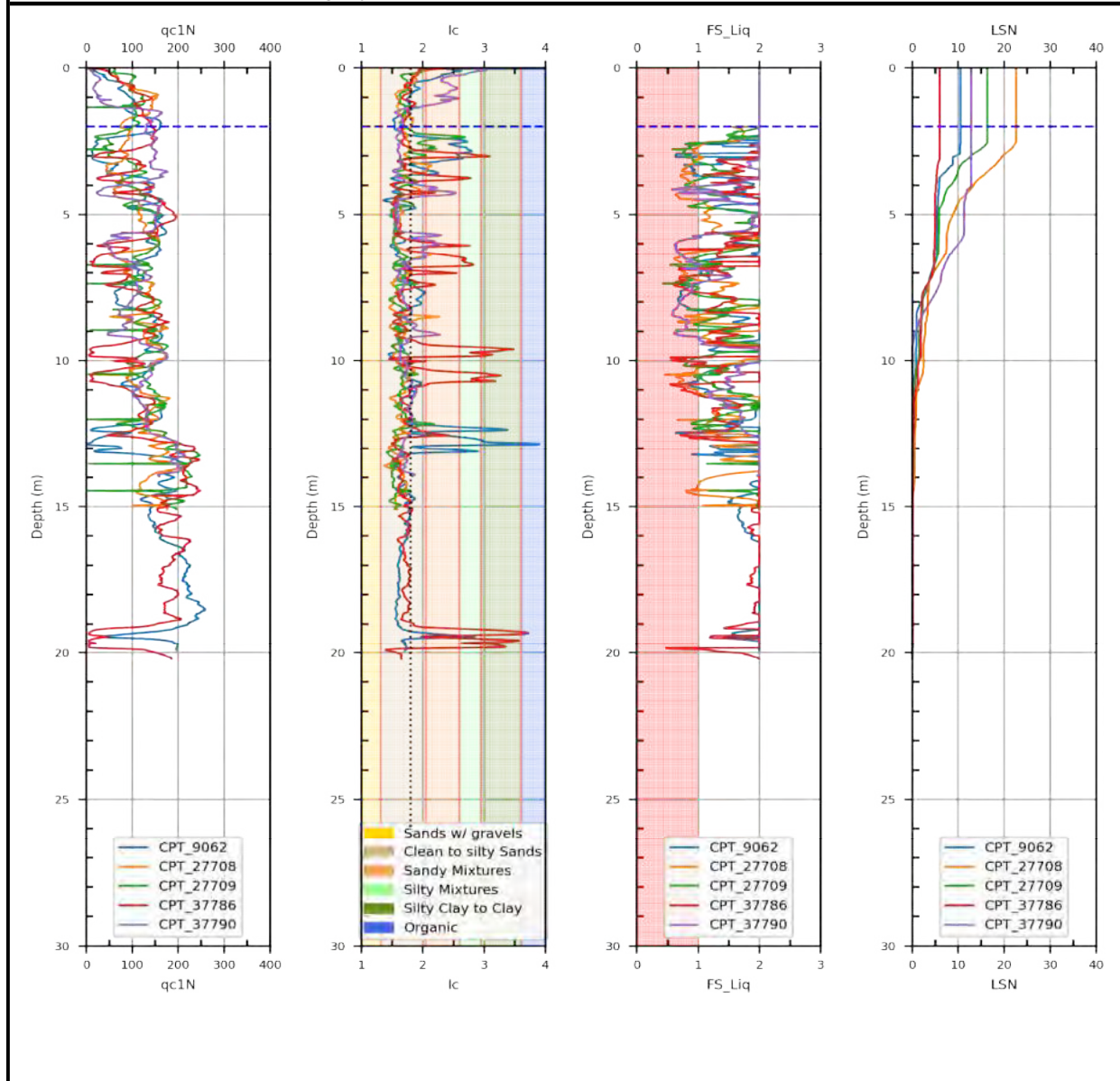
Case History: Ch-S135
Site: CC LIQ2 Parnwell St & Bassett St (N°57)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 6.2 - 7.1
PGA: 0.18g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4963 Longitude 172.6880
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



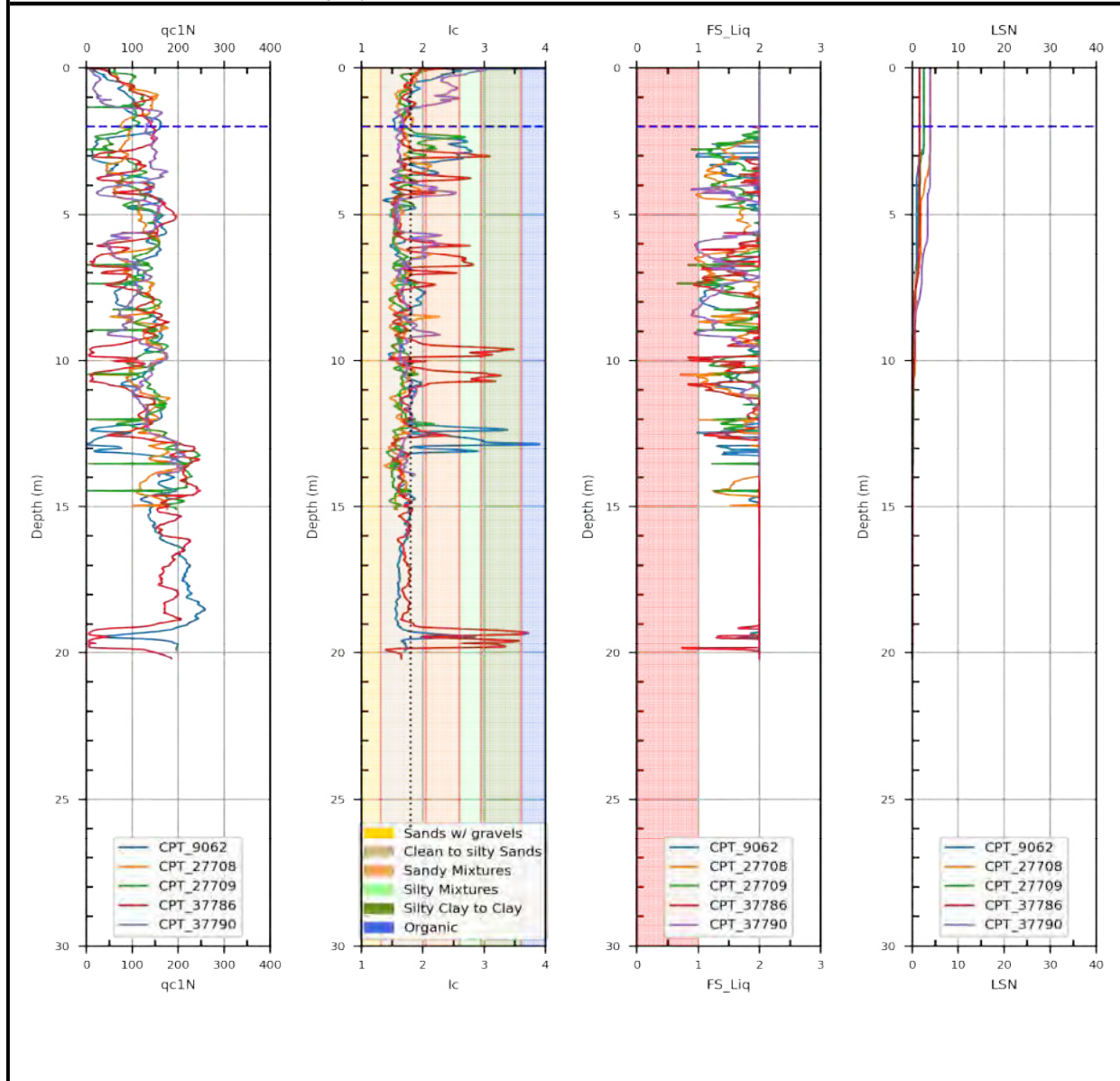
Case History: Ch-S136
Site: CC LIQ2 Parnwell St & Bassett St (N°57)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.22g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4963 Longitude 172.6880
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S137
Site: CC LIQ2 Parnwell St & Bassett St (N°57)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.23g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.5m -2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4964 Longitude 172.6900
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



CC LIQ3 Wattle Dr

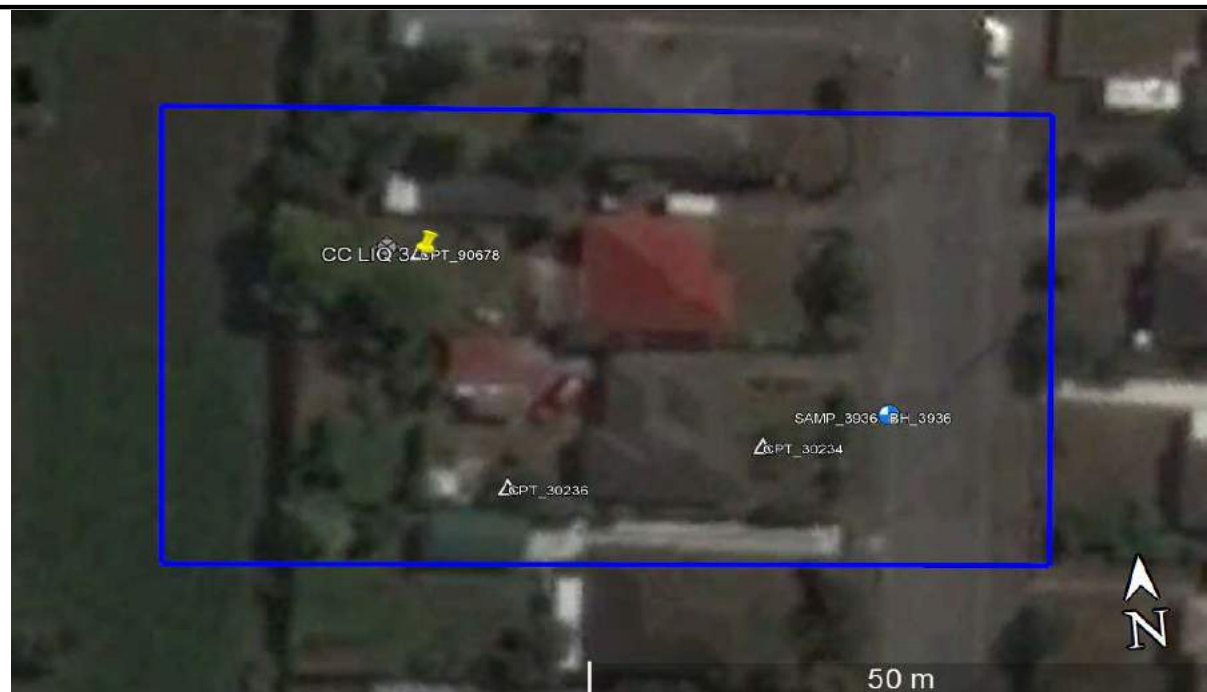
Case History:

Site: CC LIQ3 Wattle Dr (N°58)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.17g - 0.38g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4973 Longitude 172.7062
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

lc Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

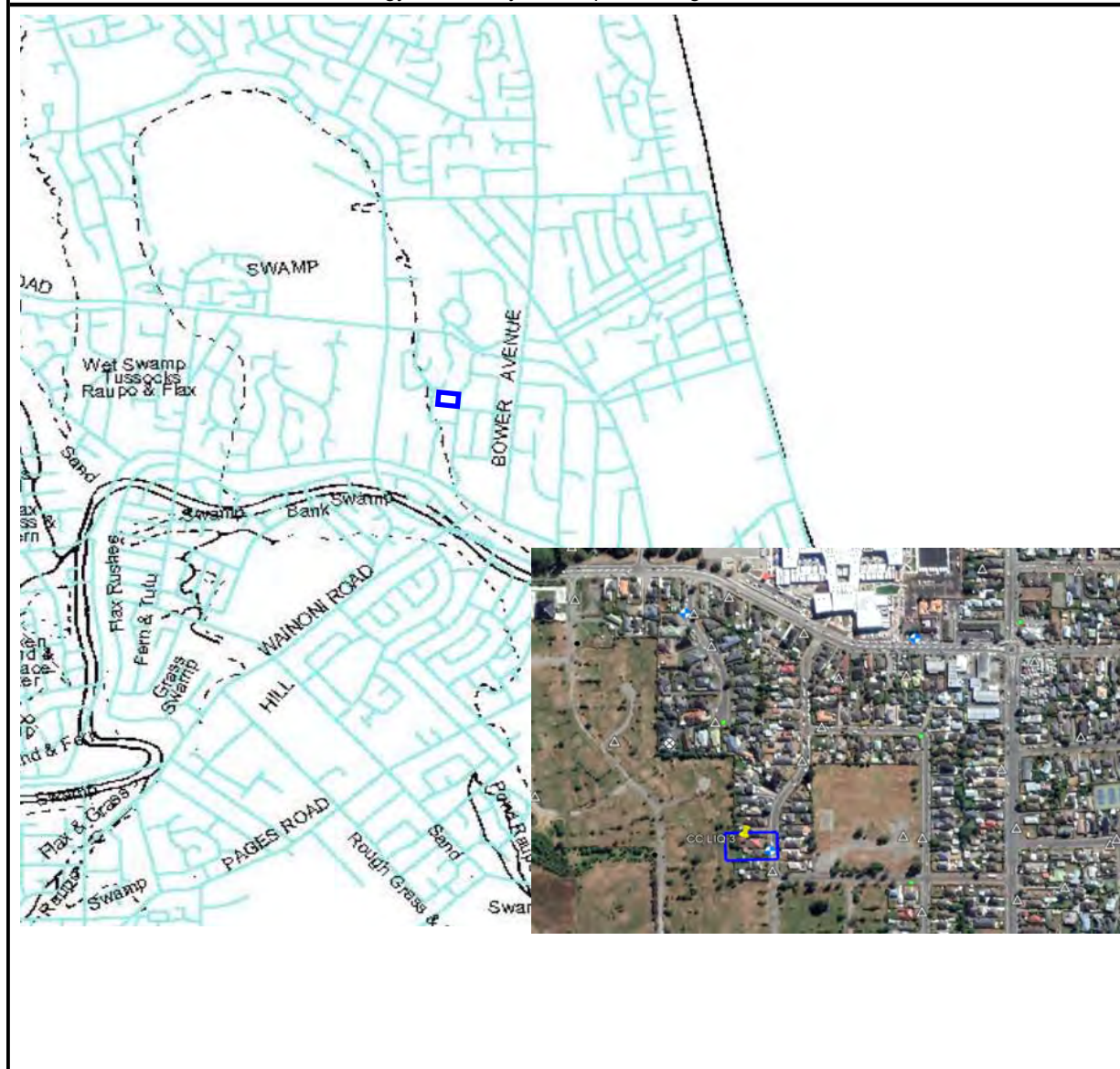
Site: CC LIQ3 Wattle Dr (N°58)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.17g - 0.38g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4973 Longitude 172.7062
Source: Christchurch City Council, map_Ap001725BlackMap.gws

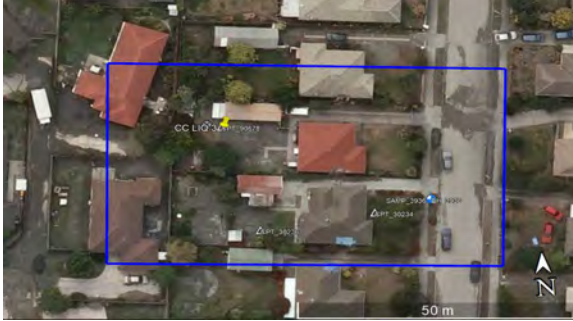
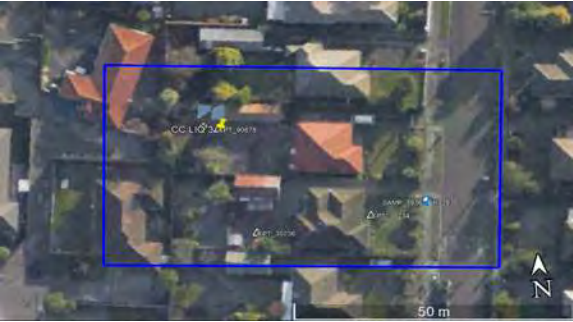
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

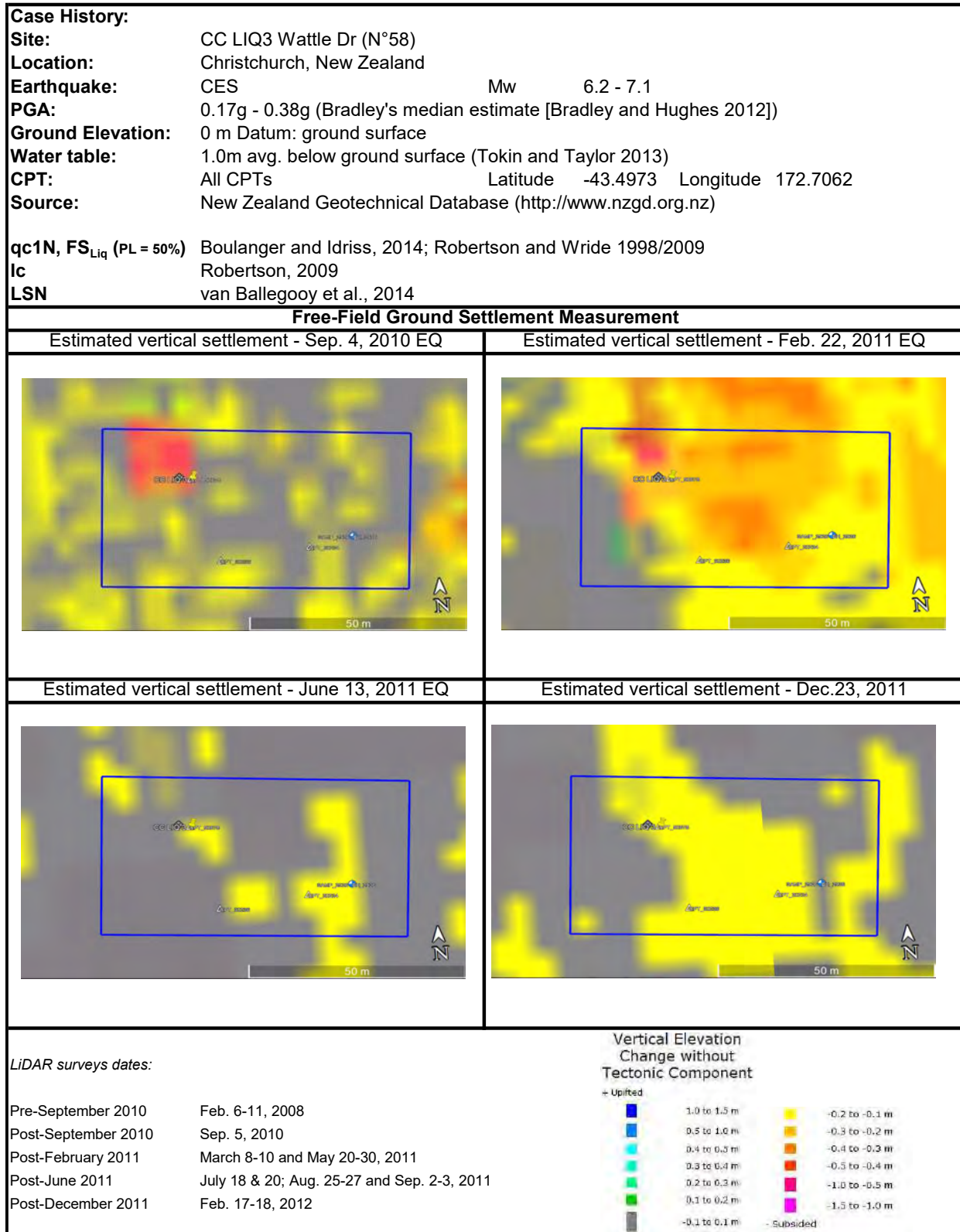
lc Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

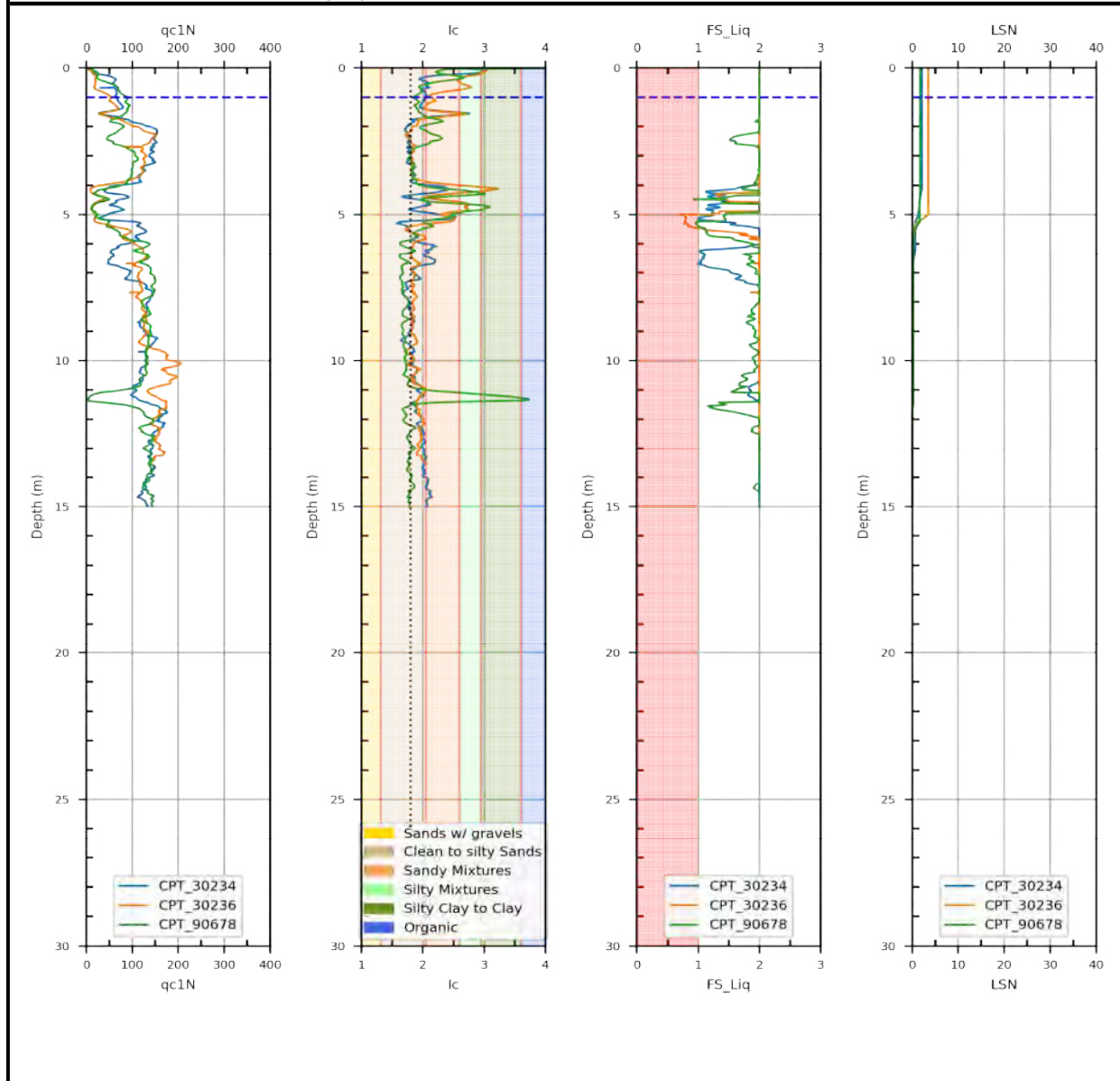


Case History: Site: CC LIQ3 Wattle Dr (N°58) Location: Christchurch, New Zealand Earthquake: CES Mw 6.2 - 7.1 PGA: 0.17g - 0.38g (Bradley's median estimate [Bradley and Hughes 2012]) Ground Elevation: 0 m Datum: ground surface Water table: 1.0m avg. below ground surface (Tokin and Taylor 2013) CPT: All CPTs Latitude -43.4973 Longitude 172.7062 Source: New Zealand Geotechnical Database (http://www.nzgd.org.nz) qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009 Ic Robertson, 2009 LSN van Ballegooy et al., 2014	
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
	



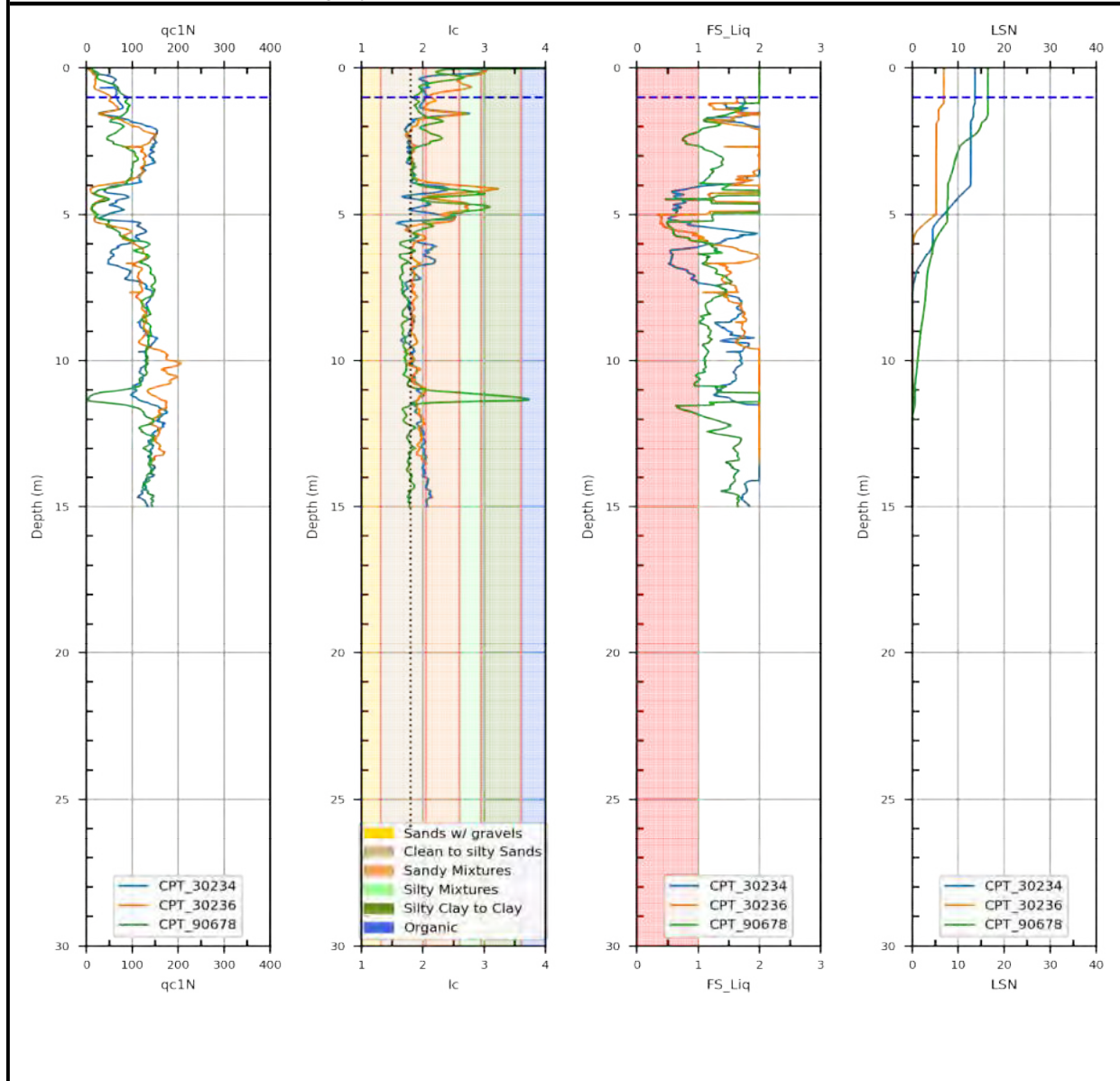
Case History: Ch-S138
Site: CC LIQ3 Wattle Dr (N°58)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 6.2 - 7.1
PGA: 0.17g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4973 Longitude 172.7062
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



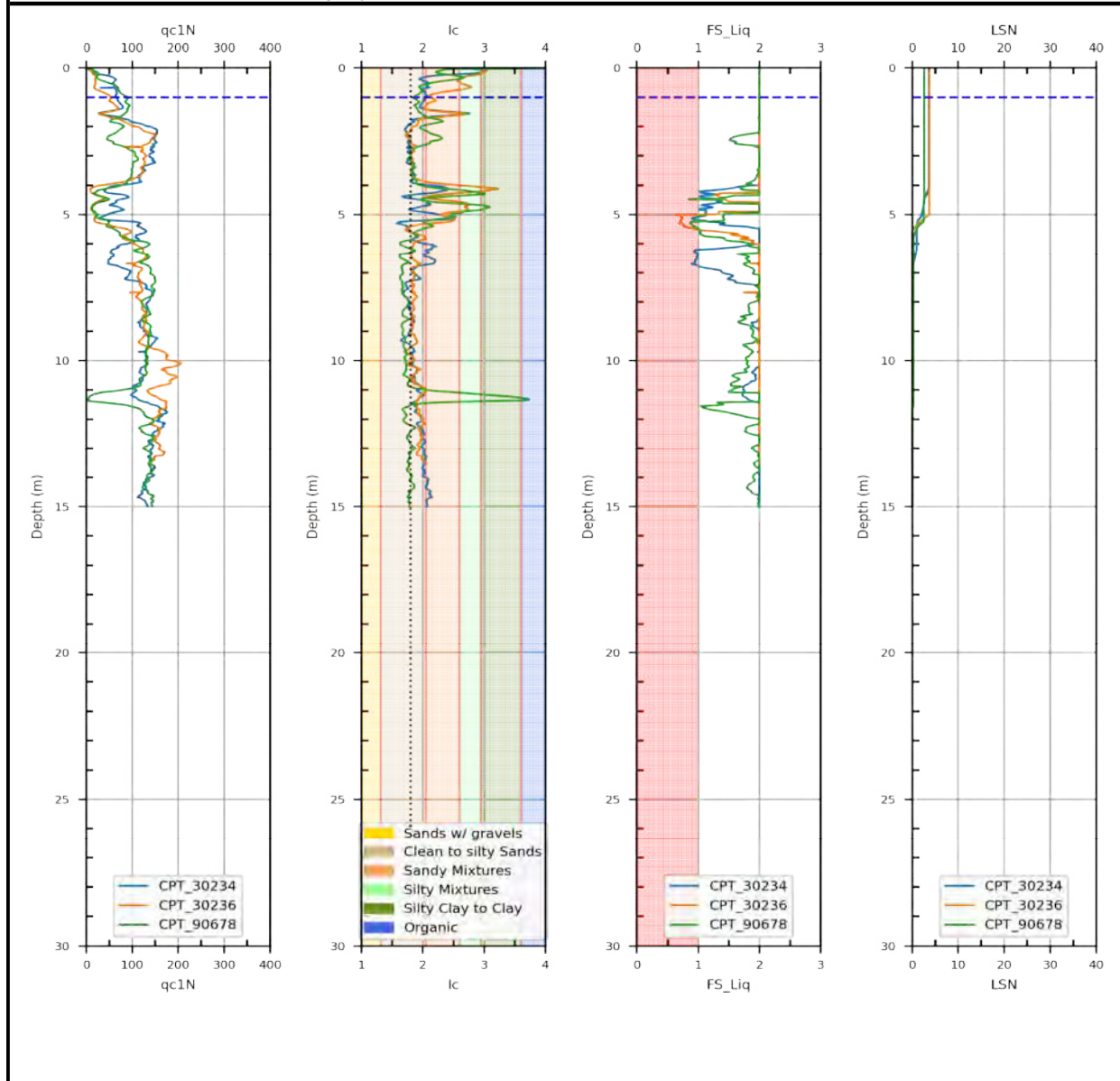
Case History: Ch-S139
Site: CC LIQ3 Wattle Dr (N°58)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2
PGA: 0.38g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4973 Longitude 172.7062
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S140
Site: CC LIQ3 Wattle Dr (N°58)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2
PGA: 0.24g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4973 Longitude 172.7062
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



CC LIQ4 Bower Avenue

Site:	CC LIQ4 Bower Avenue (N° 59)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.18g - 0.47g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	1.0m - 2.2m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.4926 Longitude 172.71149
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)

Site: CC LIQ4 Bower Avenue (N° 59)

Location: Christchurch, New Zealand

Earthquake:	CES	Mw	6.2 - 7.1
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PGA: 0.18g - 0.47g (Bradley's median estimate [Bradley and Hughes 2012])

Ground Elevation: 0 m Datum: ground surface

Water table: 1.0m - 2.2m avg. below ground surface (Tokin and Taylor 2013)

CPT:	All CPTs	Latitude	-43.4926	Longitude	172.71149
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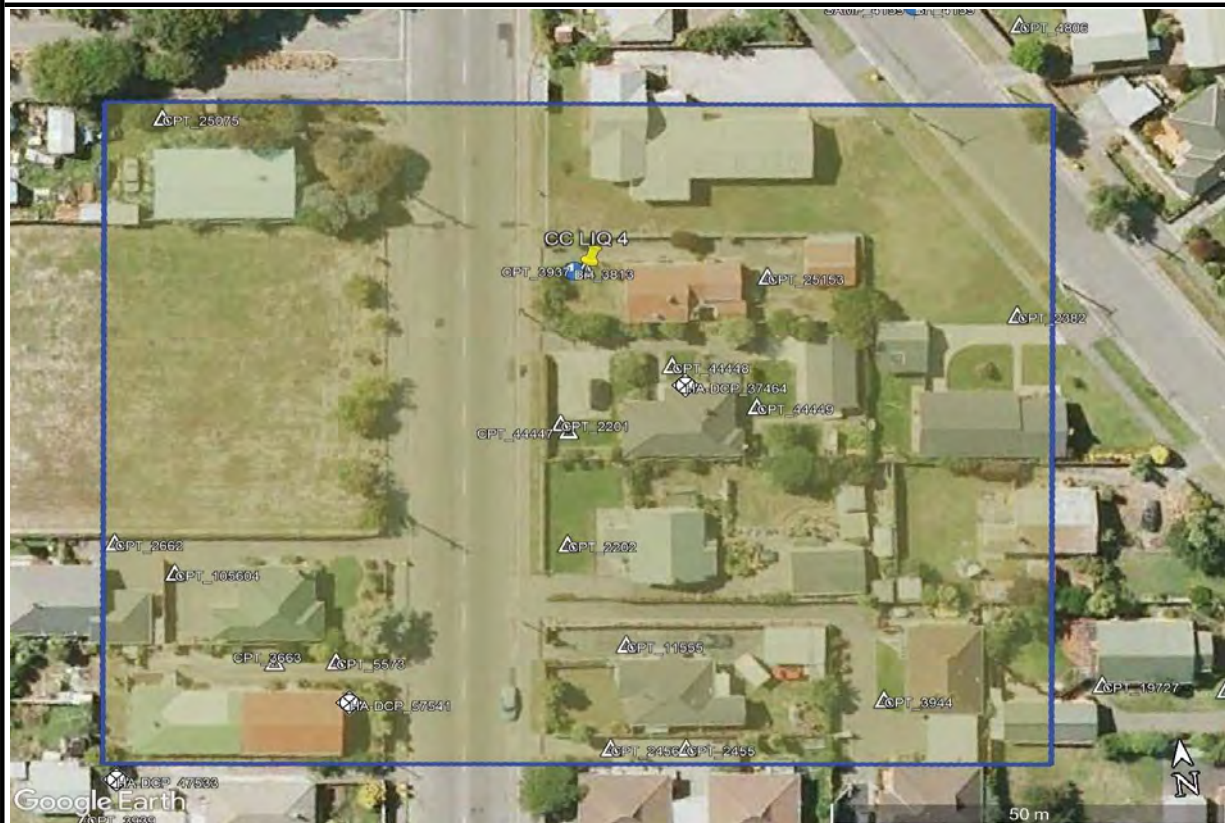
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View



References:

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

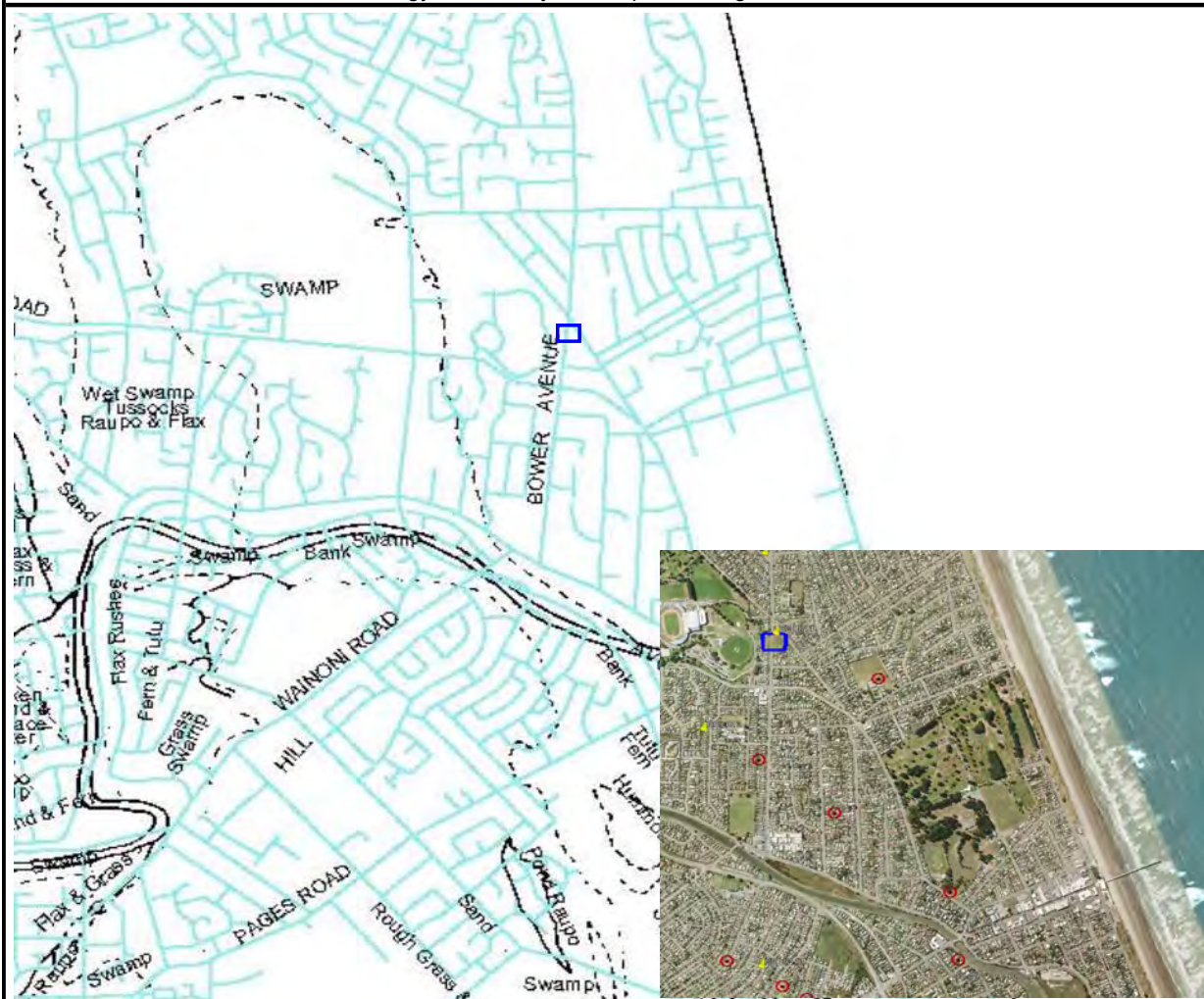
Site: CC LIQ4 Bower Avenue (N° 59)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.47g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0m - 2.2m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4926 Longitude 172.71149
Source: Christchurch City Council, map_Ap001725BlackMap.gws

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

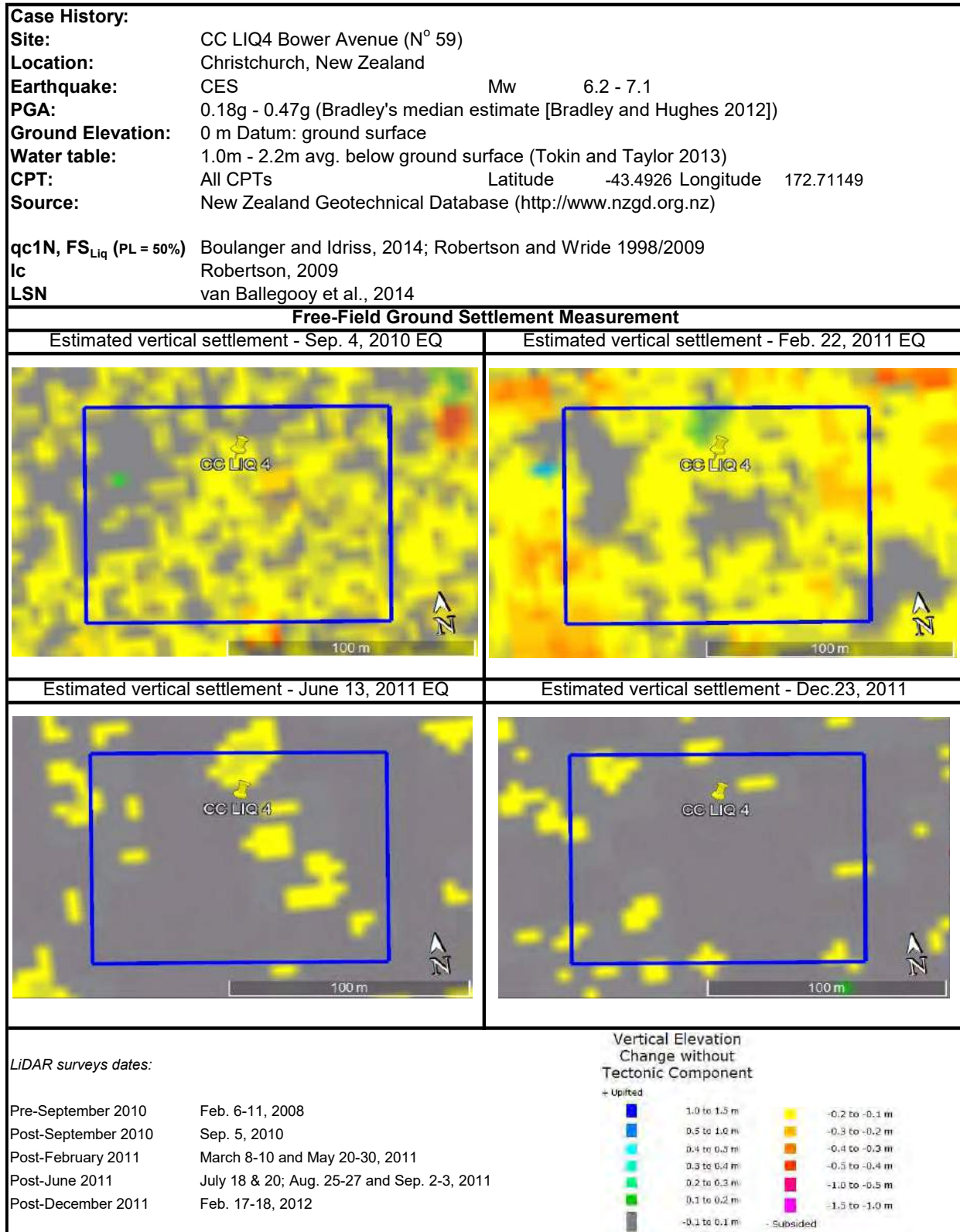
lc Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

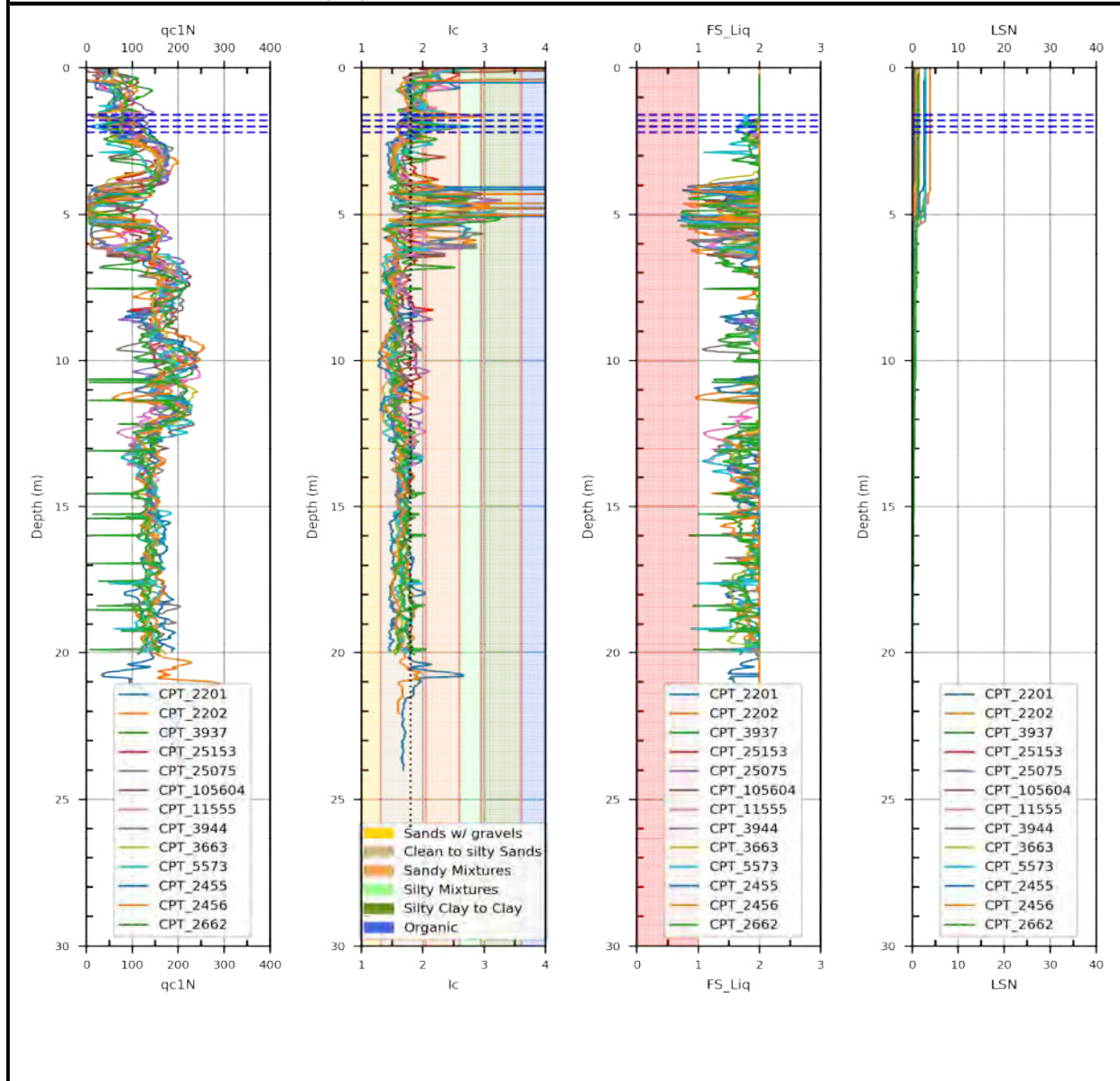


Case History:	
Site:	CC LIQ4 Bower Avenue (N° 59)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.18g - 0.47g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	1.0m - 2.2m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.4926 Longitude 172.71149
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
	



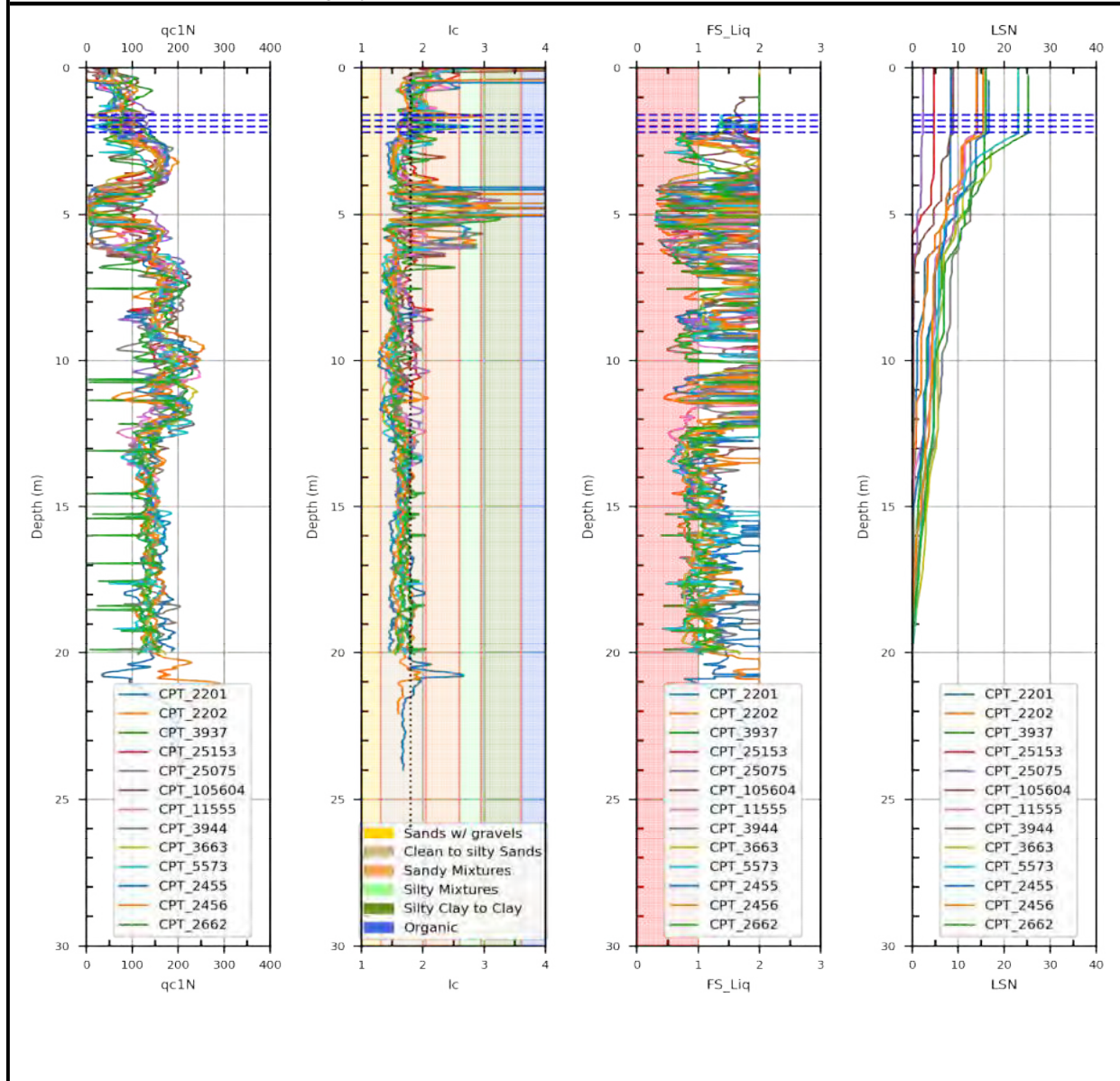
Case History: Ch-S141
Site: CC LIQ4 Bower Avenue (N° 59)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 6.2 - 7.1
PGA: 0.18g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0m - 2.2m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4926 Longitude 172.71149
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



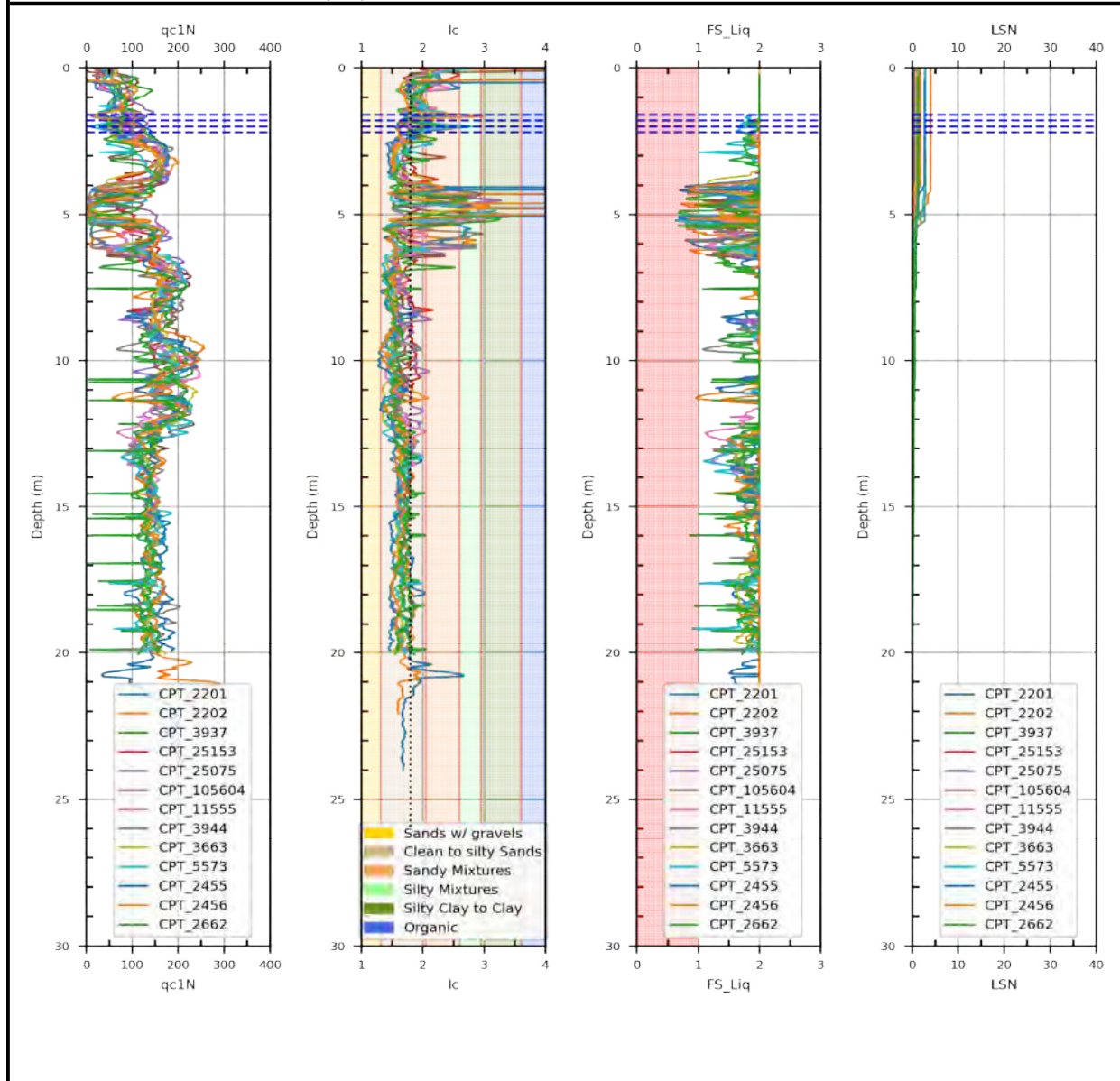
Case History: Ch-S142
Site: CC LIQ4 Bower Avenue (N° 59)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2 - 7.1
PGA: 0.47g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0m - 2.2m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4926 Longitude 172.71149
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S143
Site: CC LIQ4 Bower Avenue (N° 59)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2 - 7.1
PGA: 0.22g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0m - 2.2m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4926 Longitude 172.71149
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



CC LIQ5 Pinewood Avenue

Case History:

Site: CC LIQ5 Pinewood Ave (N° 60)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.44g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.48833 Longitude 172.71127
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

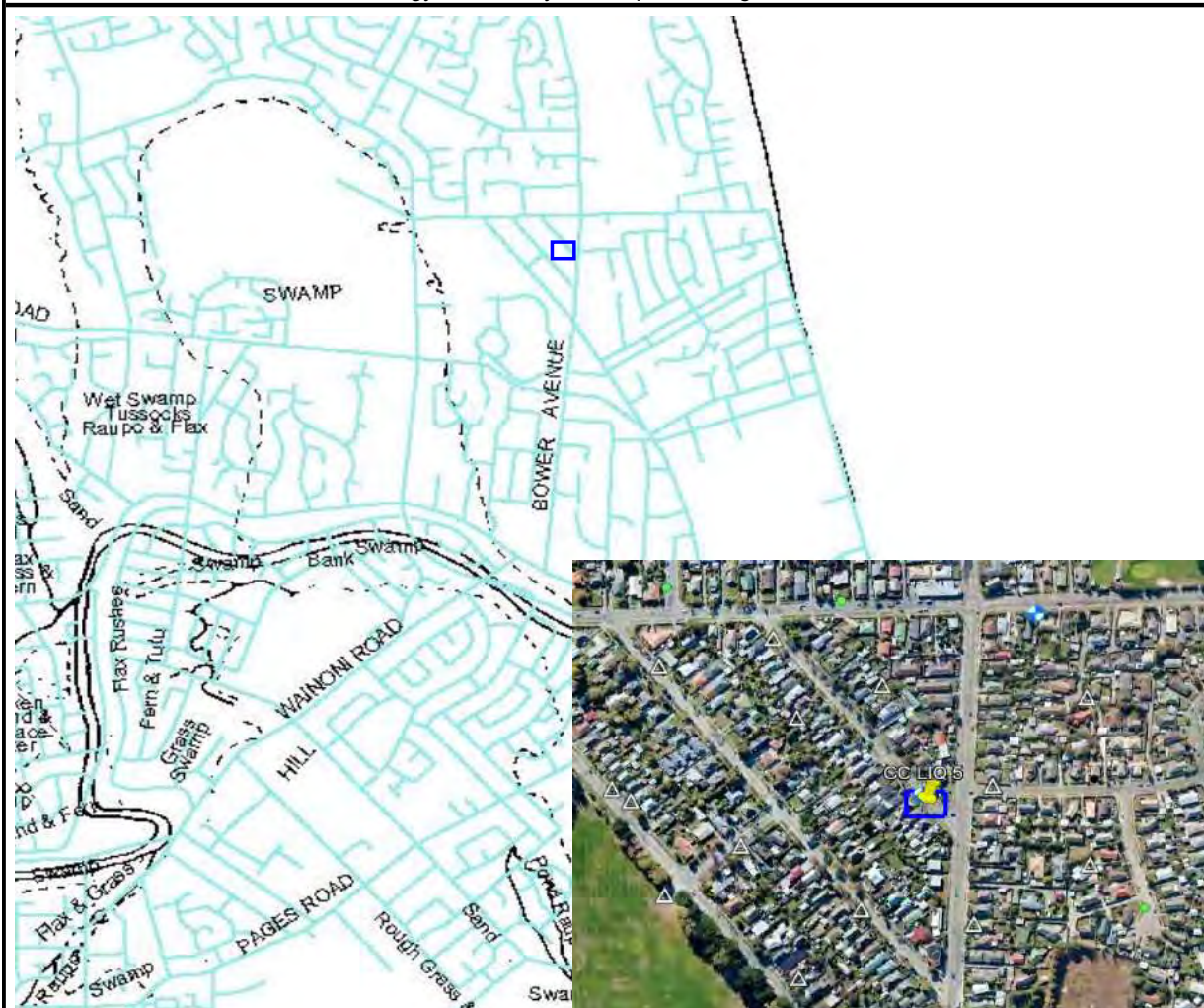
Site: CC LIQ5 Pinewood Ave (N° 60)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.44g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.48833 Longitude 172.71127
Source: Christchurch City Council, map_Ap001725BlackMap.gws

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

lc Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856



Case History:

Site: CC LIQ5 Pinewood Ave (N° 60)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.44g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.48833 Longitude 172.71127
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

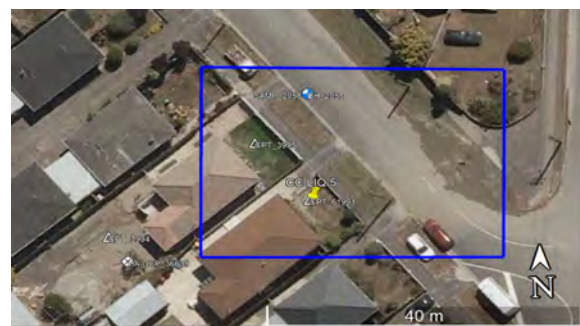
LSN van Ballegooy et al., 2014

Ejecta Patterns

Aerial photography taken on September 5, 2010



Aerial photography taken on February 24, 2011



Aerial photography taken on June 14-15, 2011

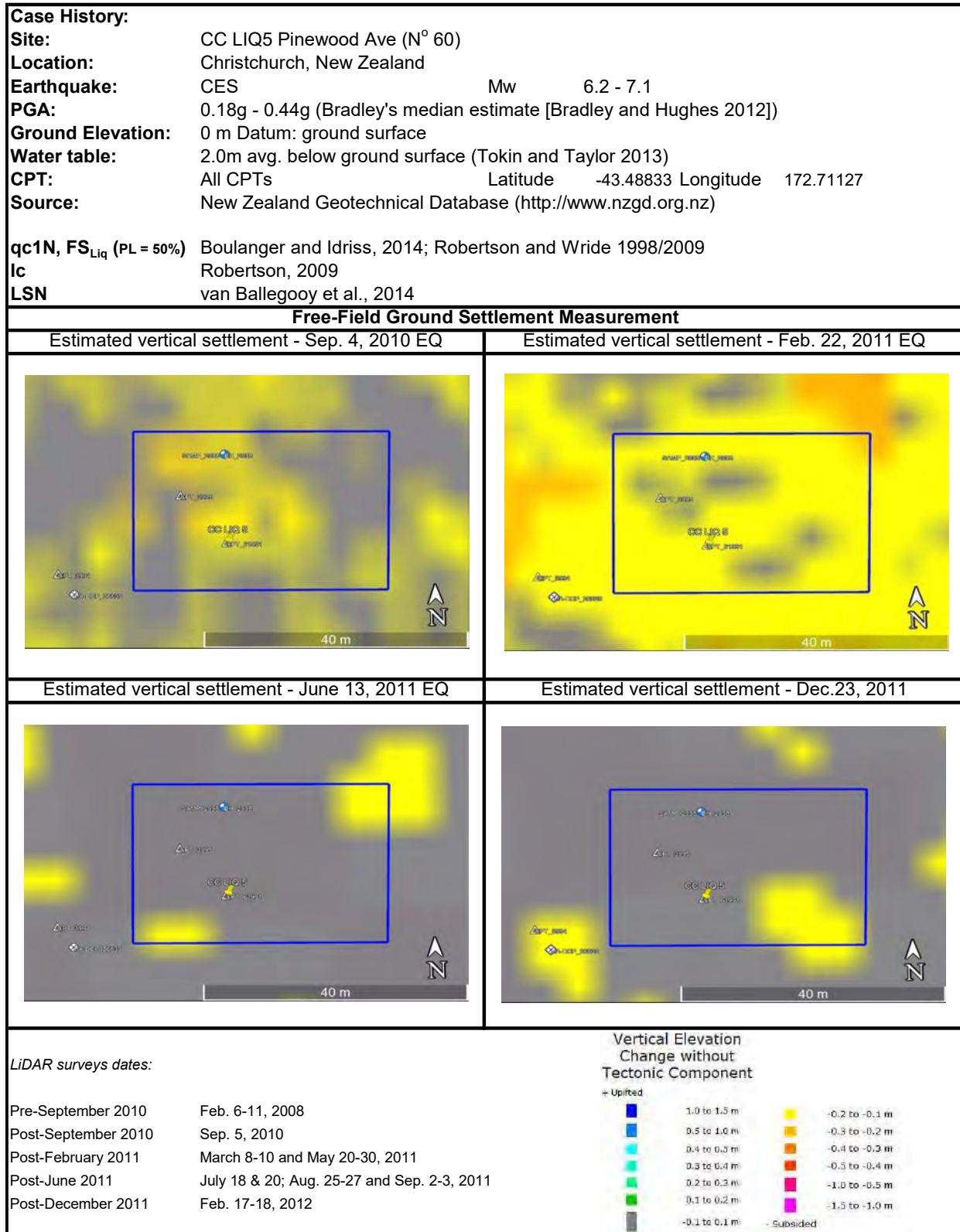


Aerial photography taken on December 24, 2011



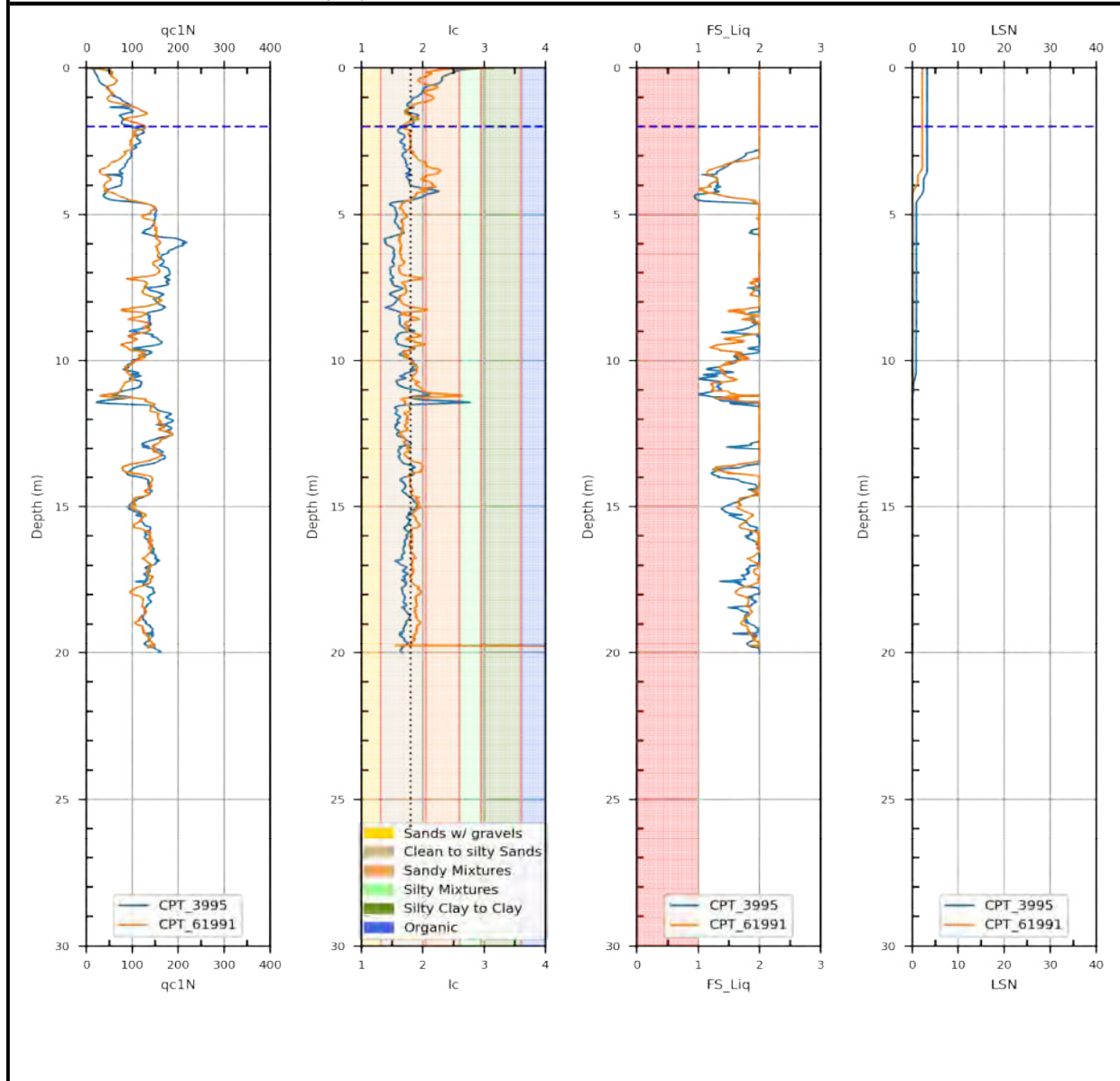
Ministry of Civil Defence
& Emergency Management
Te Kaitiaki Whakamānau





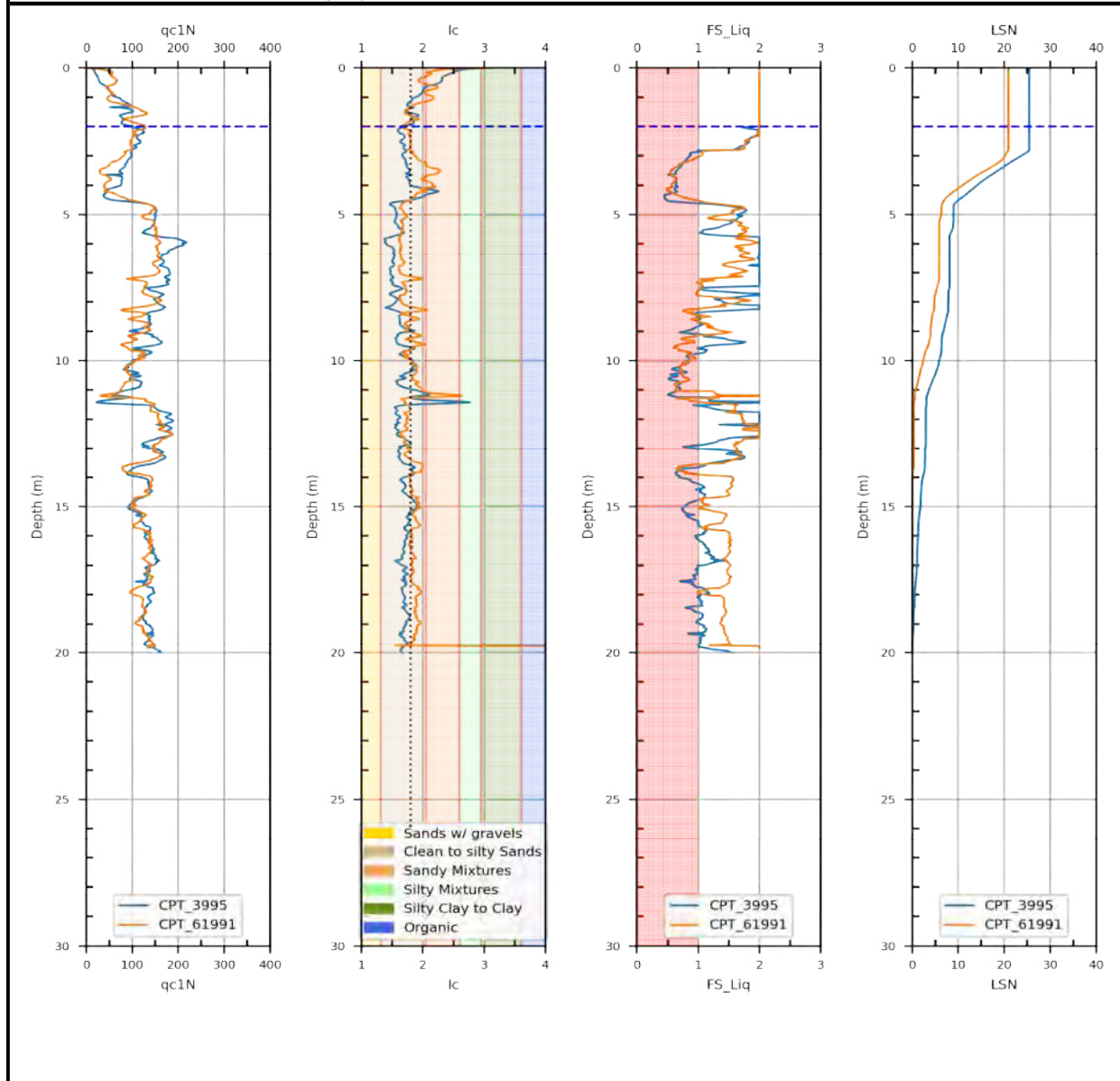
Case History: Ch-S144
Site: CC LIQ5 Pinewood Ave (Nº 60)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 6.2 - 7.1
PGA: 0.18g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.48833 Longitude 172.71127
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S145
Site: CC LIQ5 Pinewood Ave (Nº 60)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2 - 7.1
PGA: 0.44g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.48833 Longitude 172.71127
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014

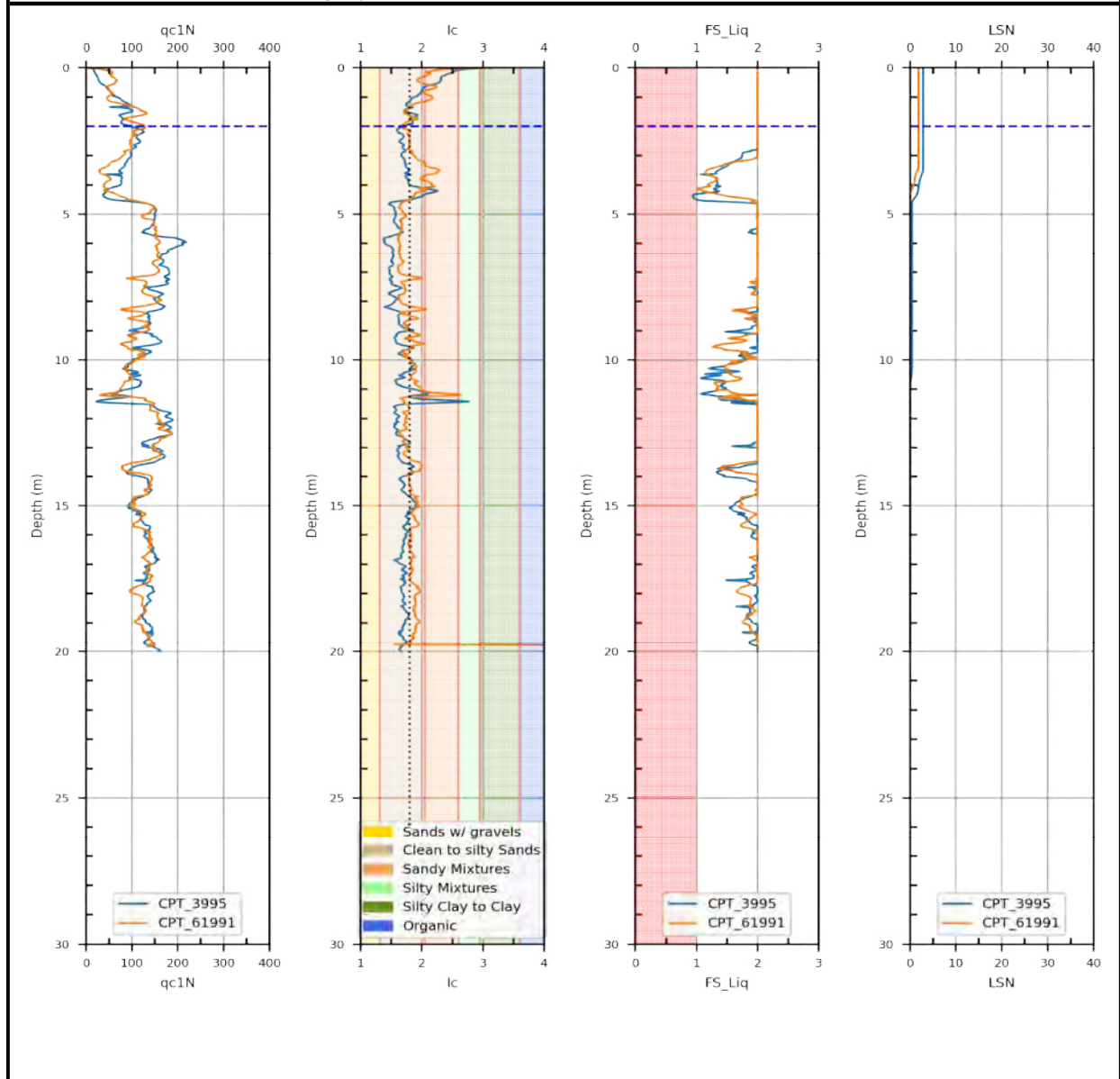


Case History: Ch-S146
Site: CC LIQ5 Pinewood Ave (Nº 60)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2 - 7.1
PGA: 0.21g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.48833 Longitude 172.71127
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014



CC LIQ7 Vangelis Ln. & Fernbrook Pl.

Case History:

Site: CC LIQ7 Vangelis Ln & Fernbrook PI (N° 61)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.19g - 0.33g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.5m - 2.2m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.50149 Longitude 172.65016
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

lc Robertson, 2009

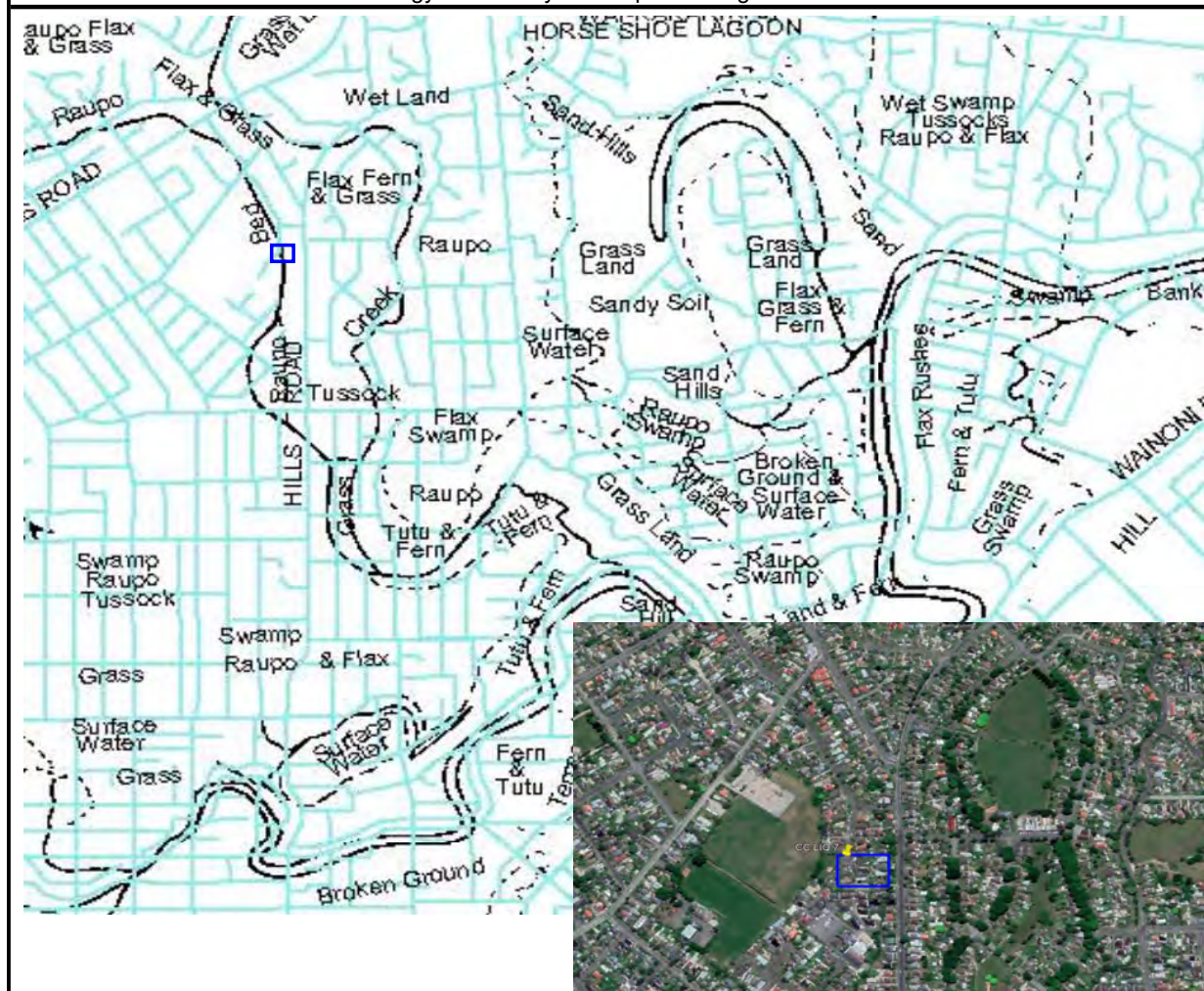
LSN van Ballegooy et al., 2014

Site Plan View**References:**

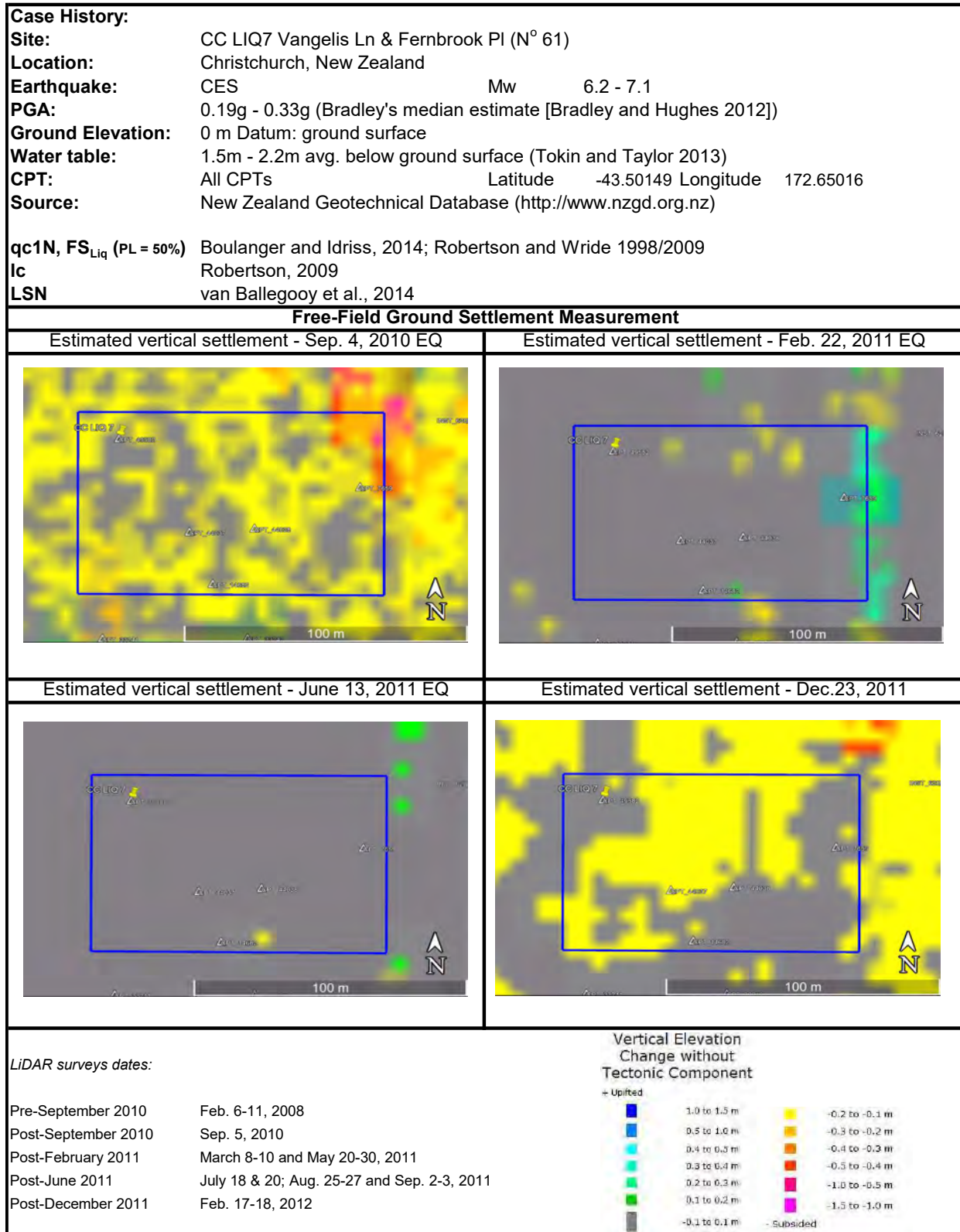
New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:**Site:** CC LIQ7 Vangelis Ln & Fernbrook PI (N° 61)**Location:** Christchurch, New Zealand**Earthquake:** CES Mw 6.2 - 7.1**PGA:** 0.19g - 0.33g (Bradley's median estimate [Bradley and Hughes 2012])**Ground Elevation:** 0 m Datum: ground surface**Water table:** 1.5m - 2.2m avg. below ground surface (Tokin and Taylor 2013)**CPT:** All CPTs Latitude -43.50149 Longitude 172.65016**Source:** Christchurch City Council, map_Ap001725BlackMap.gws**qc1N, FS_{Liq} (PL = 50%)** Boulanger and Idriss, 2014; Robertson and Wride 1998/2009**lc** Robertson, 2009**LSN** van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

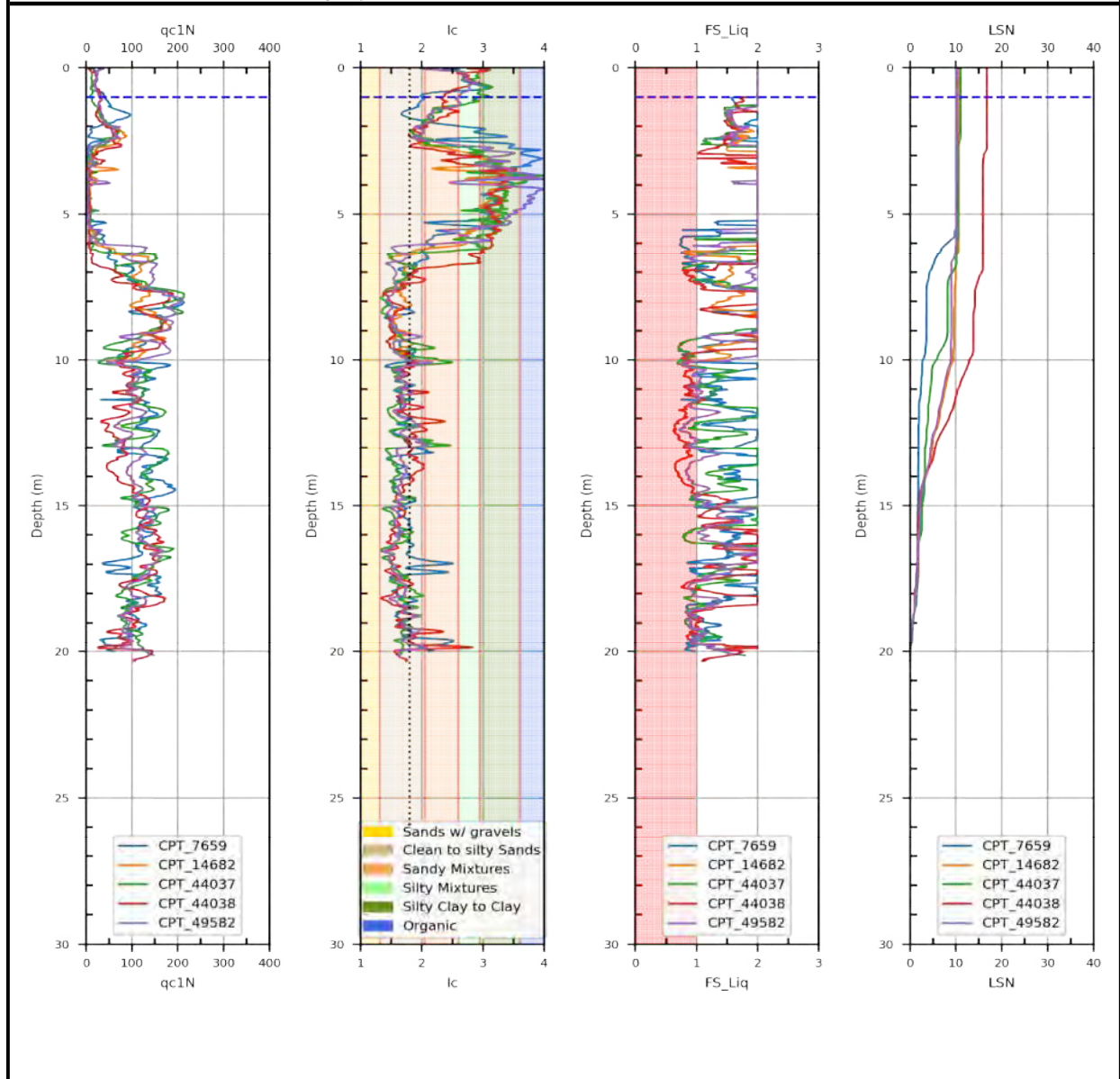


Case History: Site: CC LIQ7 Vangelis Ln & Fernbrook PI (N ^o 61) Location: Christchurch, New Zealand Earthquake: CES Mw 6.2 - 7.1 PGA: 0.19g - 0.33g (Bradley's median estimate [Bradley and Hughes 2012]) Ground Elevation: 0 m Datum: ground surface Water table: 1.5m - 2.2m avg. below ground surface (Tokin and Taylor 2013) CPT: All CPTs Latitude -43.50149 Longitude 172.65016 Source: New Zealand Geotechnical Database (http://www.nzgd.org.nz) qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009 Ic Robertson, 2009 LSN van Ballegooy et al., 2014	
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
  Ministry of Civil Defence & Emergency Management <i>Te Kaitiaki Whakamānau</i>  CERA Canterbury Earthquake Recovery Authority  EQC EARTHQUAKE COMMISSION <i>Kaitiaki Takekōwhiri</i>  Tonkin & Taylor	



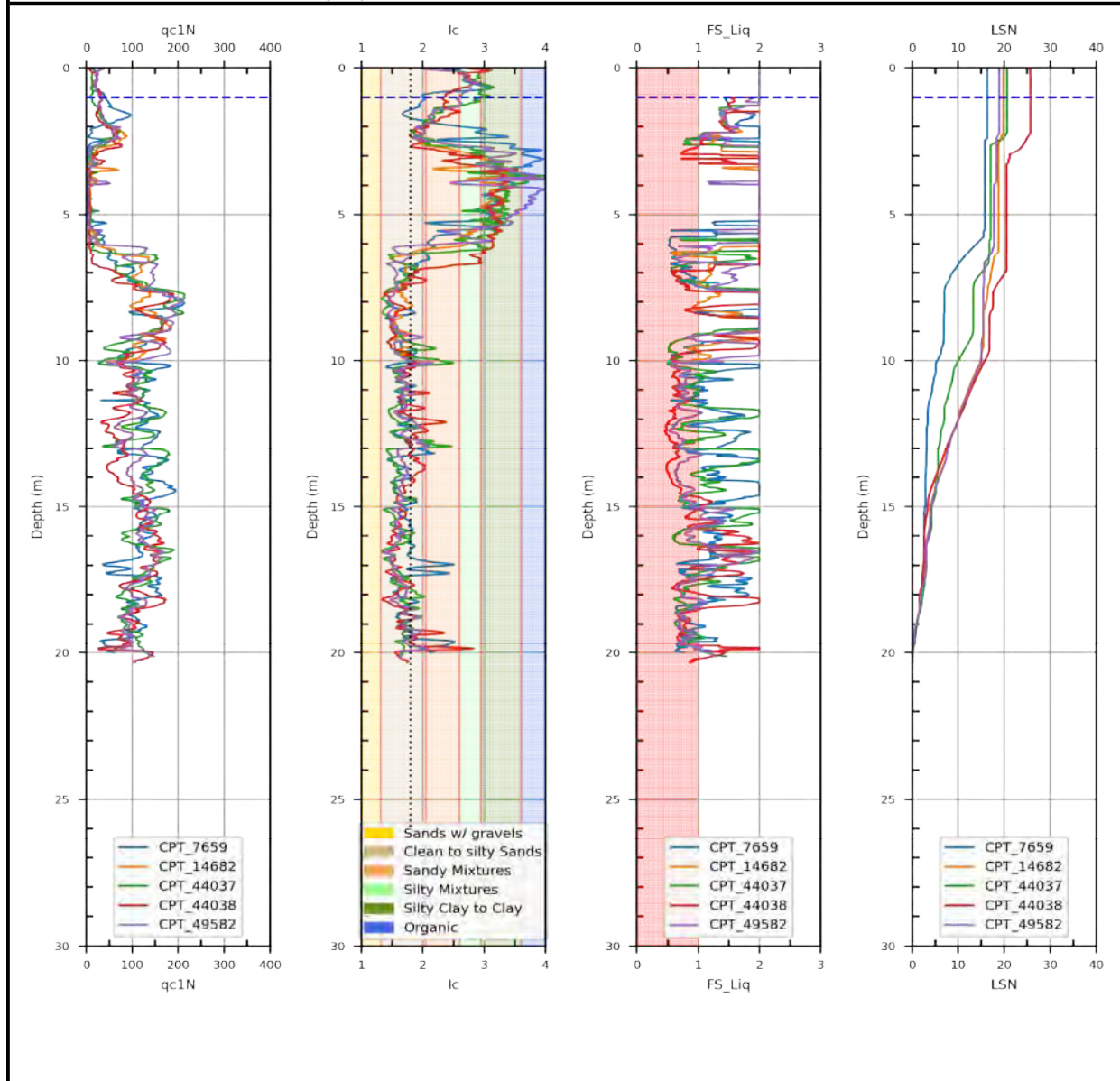
Case History: Ch-S147
Site: CC LIQ7 Vangelis Ln & Fernbrook PI (N° 61)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 6.2 - 7.1
PGA: 0.19g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.5m - 2.2m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.50149 Longitude 172.65016
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



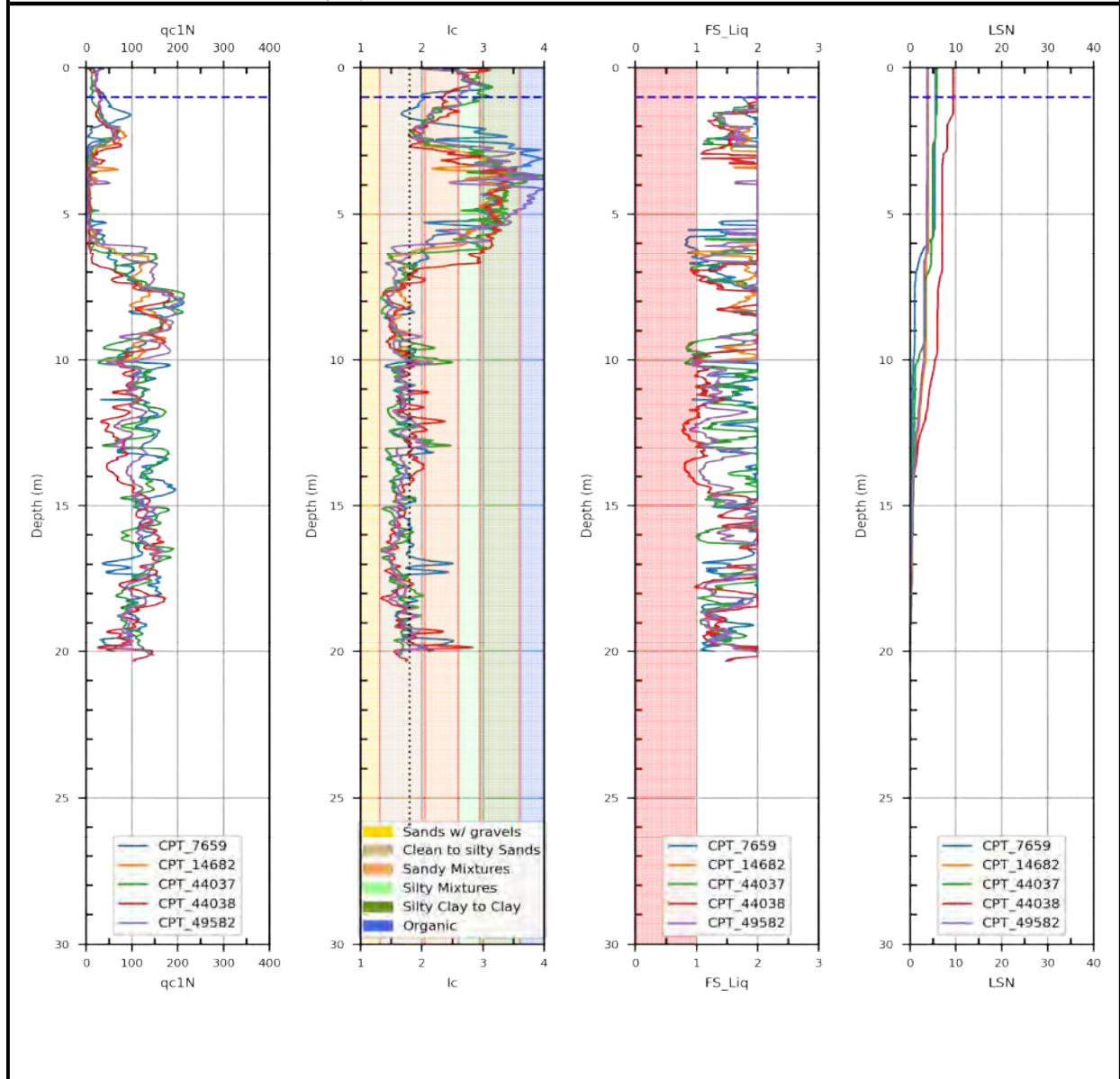
Case History: Ch-S148
Site: CC LIQ7 Vangelis Ln & Fernbrook PI (N° 61)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2 - 7.1
PGA: 0.33g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.5m - 2.2m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.50149 Longitude 172.65016
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S149
Site: CC LIQ7 Vangelis Ln & Fernbrook PI (N° 61)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2 - 7.1
PGA: 0.19g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.5m - 2.2m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.50149 Longitude 172.65016
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



CC LIQ8 Travis County Dr

Site:	CC LIQ8 Travis County Dr (N ^o 62)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.17g - 0.35g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.4894 Longitude 172.69168
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)

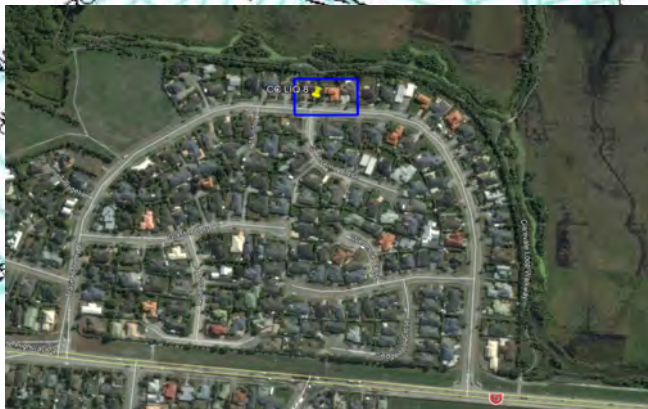
LSN van Ballegooy et al., 2014

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

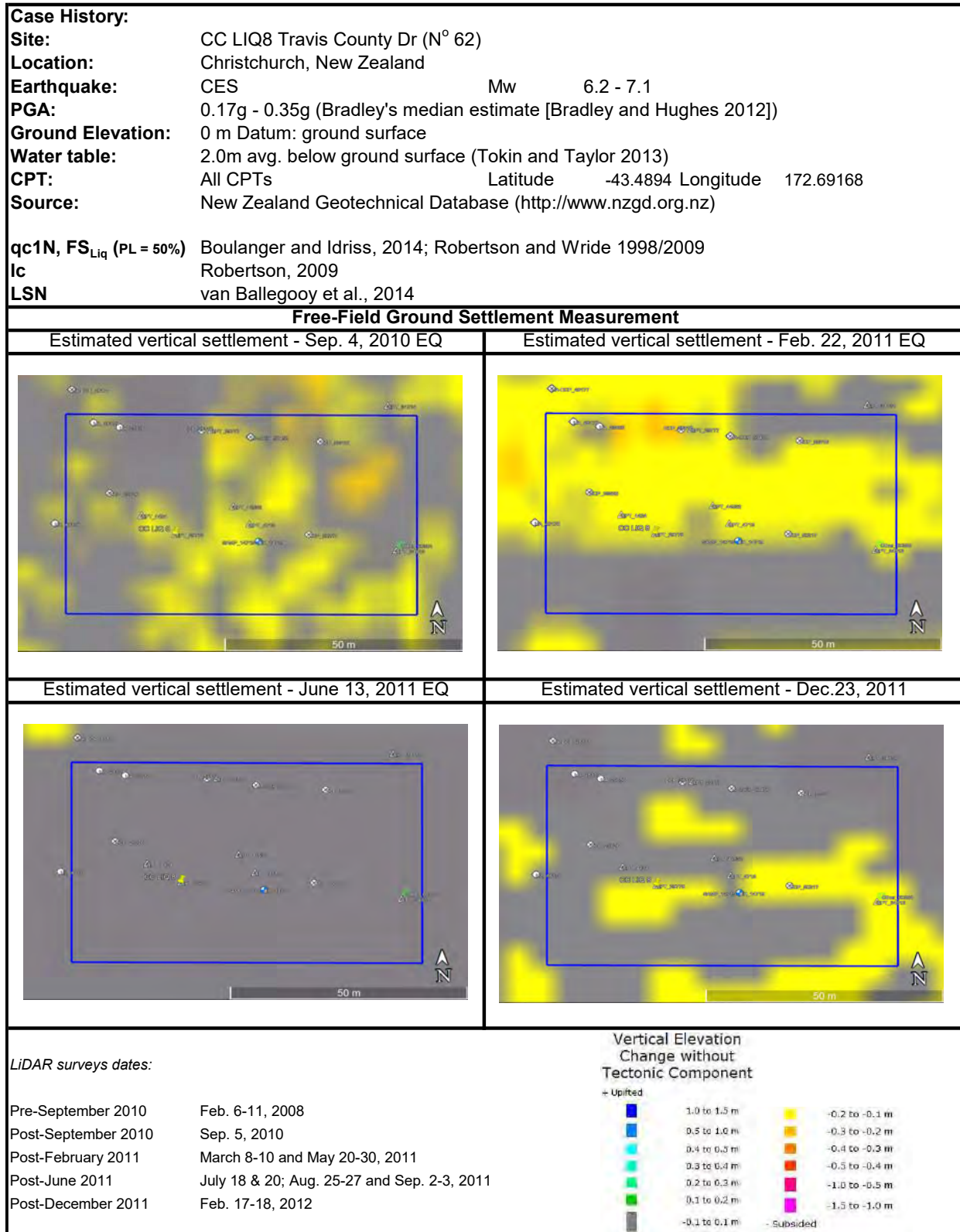
Site:	CC LIQ8 Travis County Dr (N ^o 62)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.17g - 0.35g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.4894 Longitude 172.69168
Source:	Christchurch City Council, map_Ap001725BlackMap.gws

Robertson, 2009

Surficial Geology - waterways swamps and vegetation cover in 1856

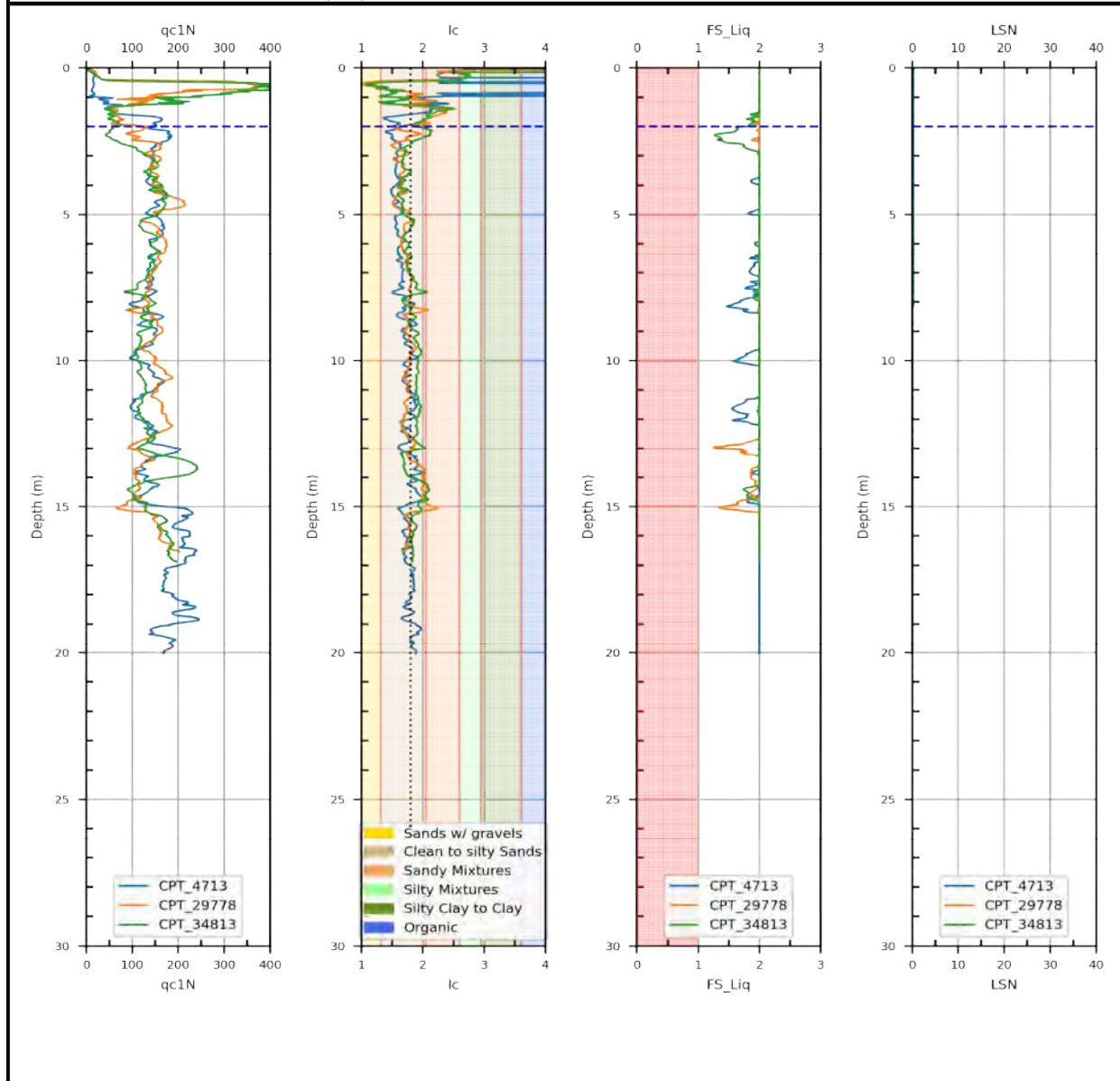


Case History:	
Site:	CC LIQ8 Travis County Dr (N° 62)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.17g - 0.35g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.4894 Longitude 172.69168
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
	



Case History: Ch-S150
Site: CC LIQ8 Travis County Dr (N° 62)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 6.2 - 7.1
PGA: 0.17g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4894 Longitude 172.69168
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014

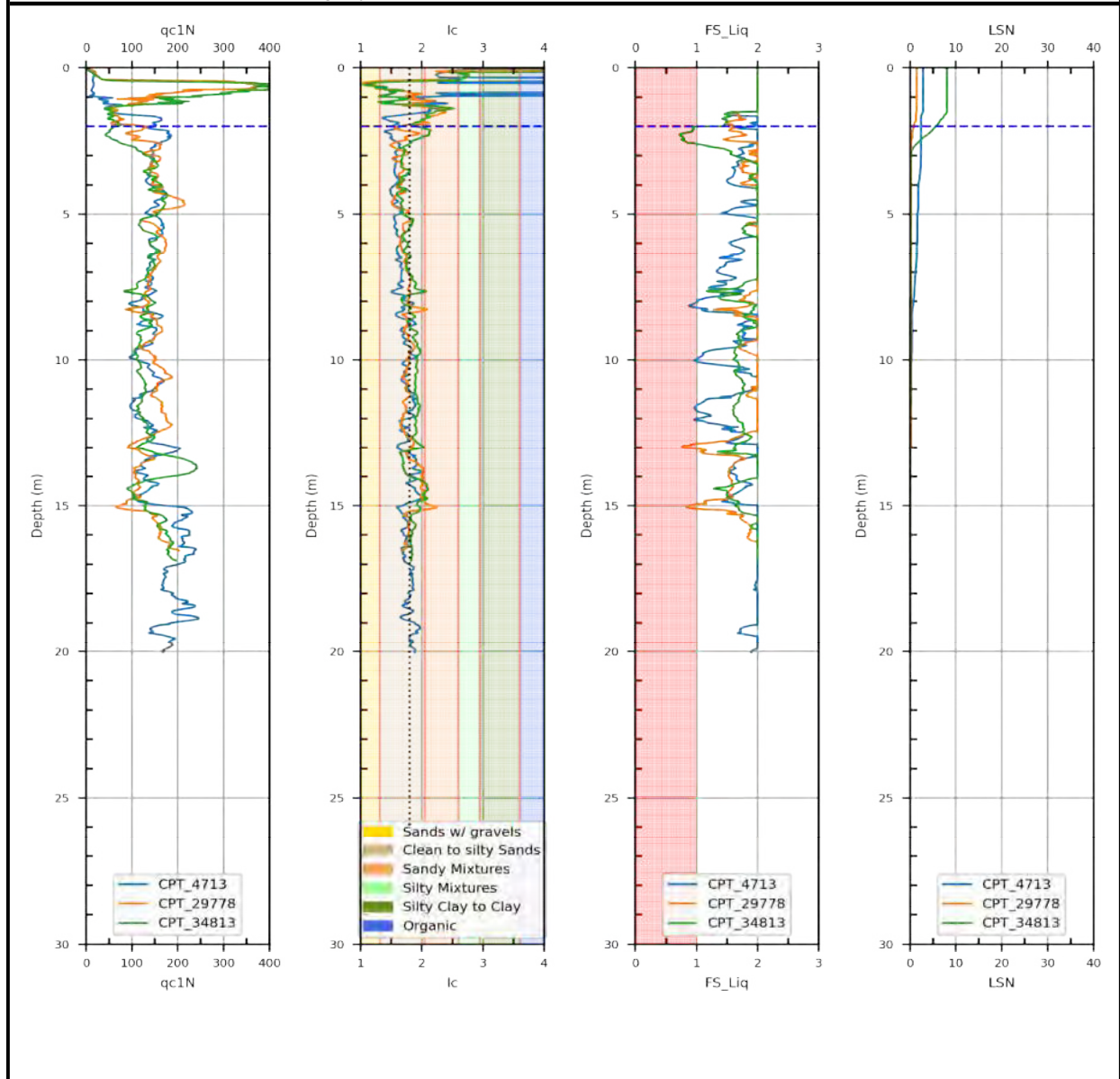


Case History: Ch-S151
Site: CC LIQ8 Travis County Dr (N° 62)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2 - 7.1
PGA: 0.35g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4894 Longitude 172.69168
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

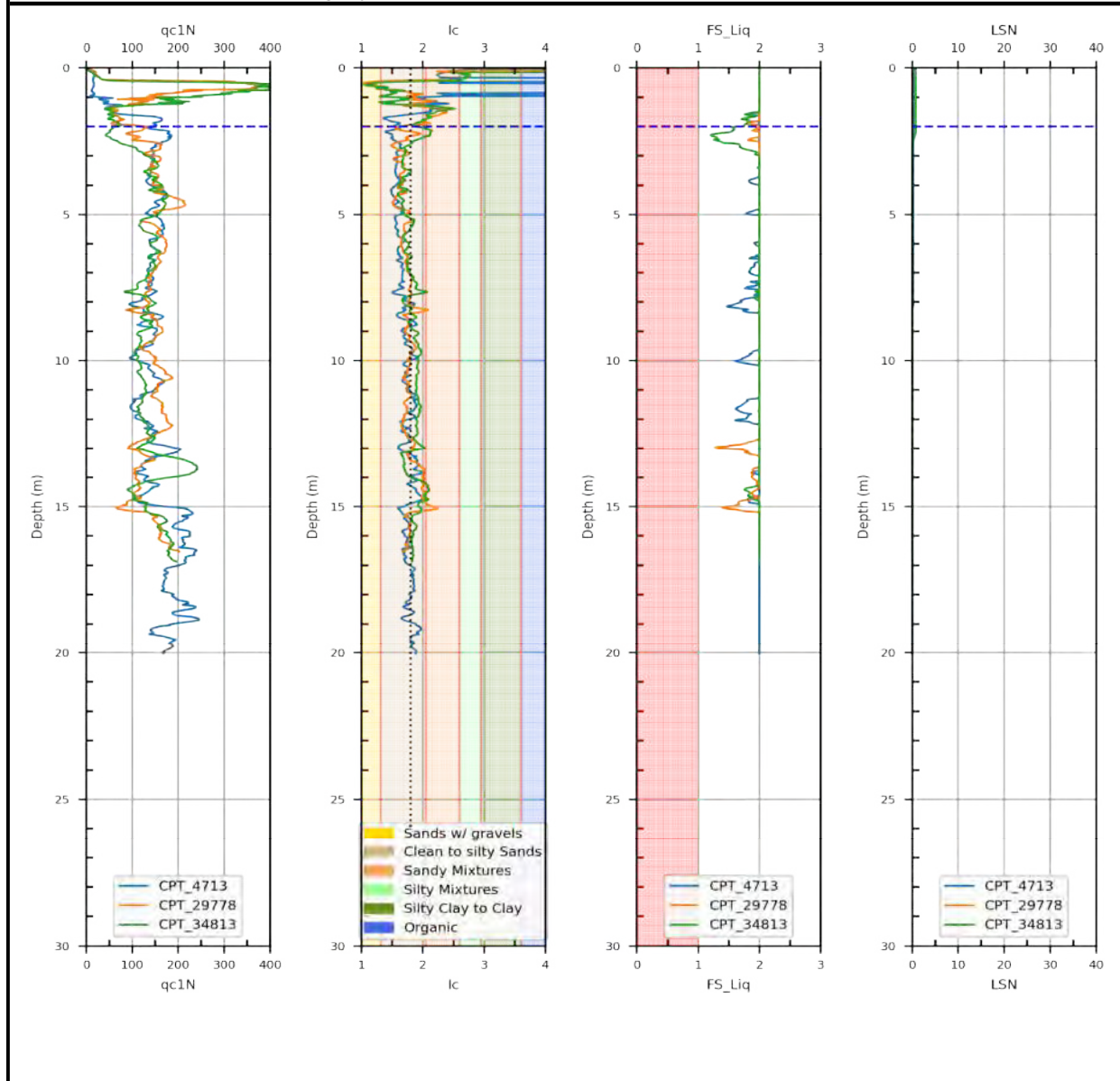
Ic Robertson, 2009

LSN van Ballegooy et al., 2014



Case History: Ch-S152
Site: CC LIQ8 Travis County Dr (N° 62)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2 - 7.1
PGA: 0.21g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.4894 Longitude 172.69168
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



CC LIQ9 Aldershot Street

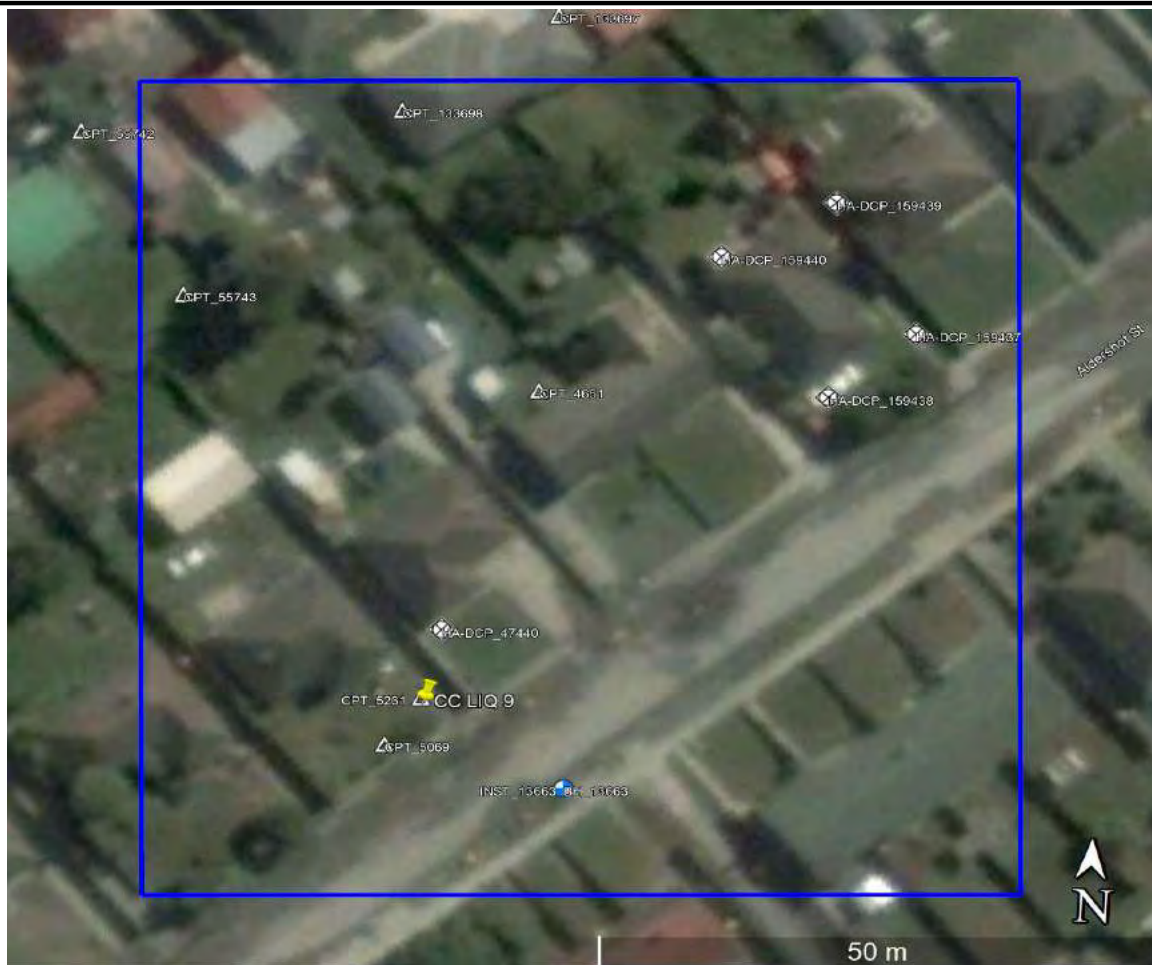
Case History:

Site: CC LIQ9 Aldershot St (N° 63)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.42g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.3m - 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.51058 Longitude 172.69706
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

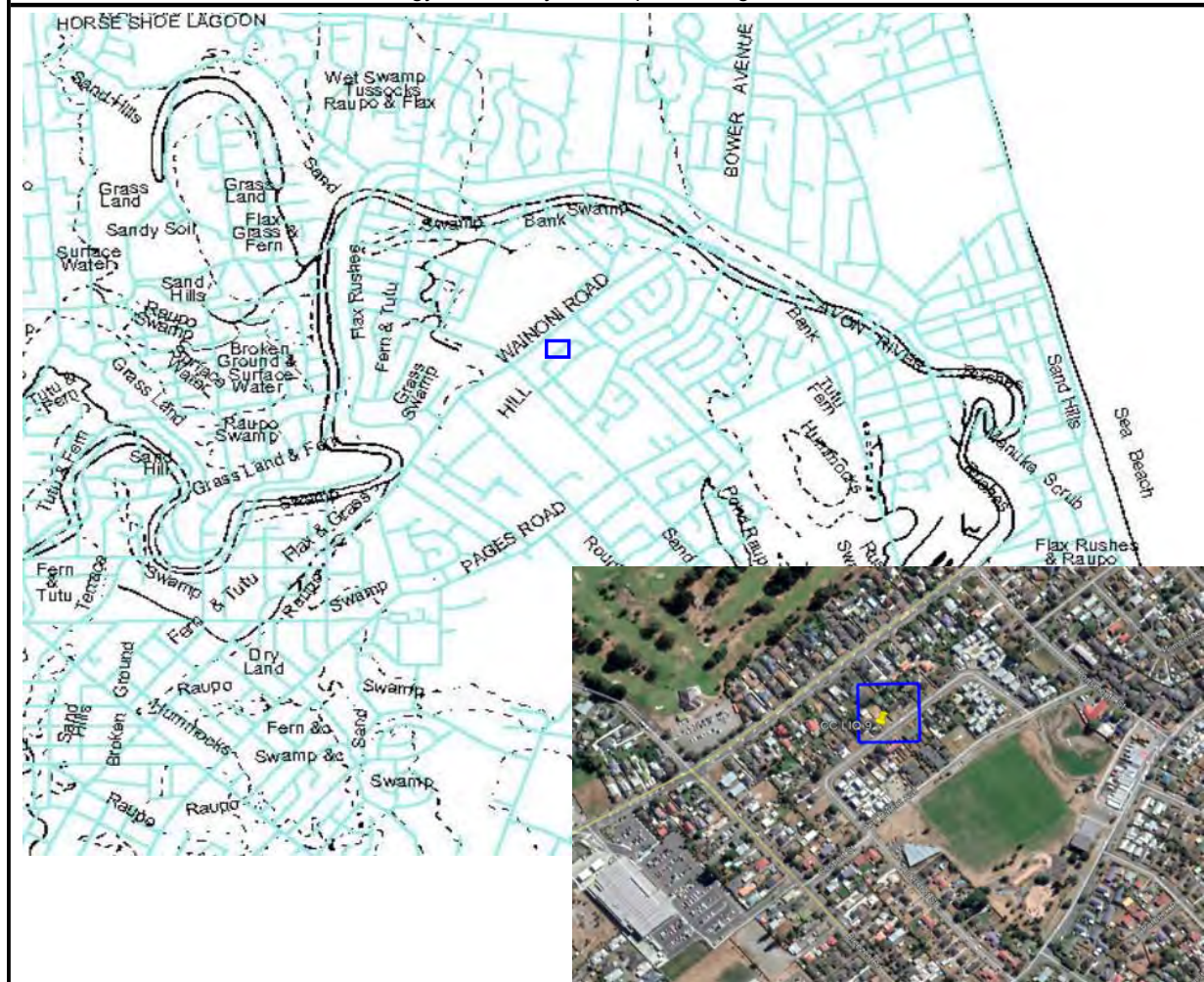
LSN van Ballegooy et al., 2014

Site Plan View**References:**

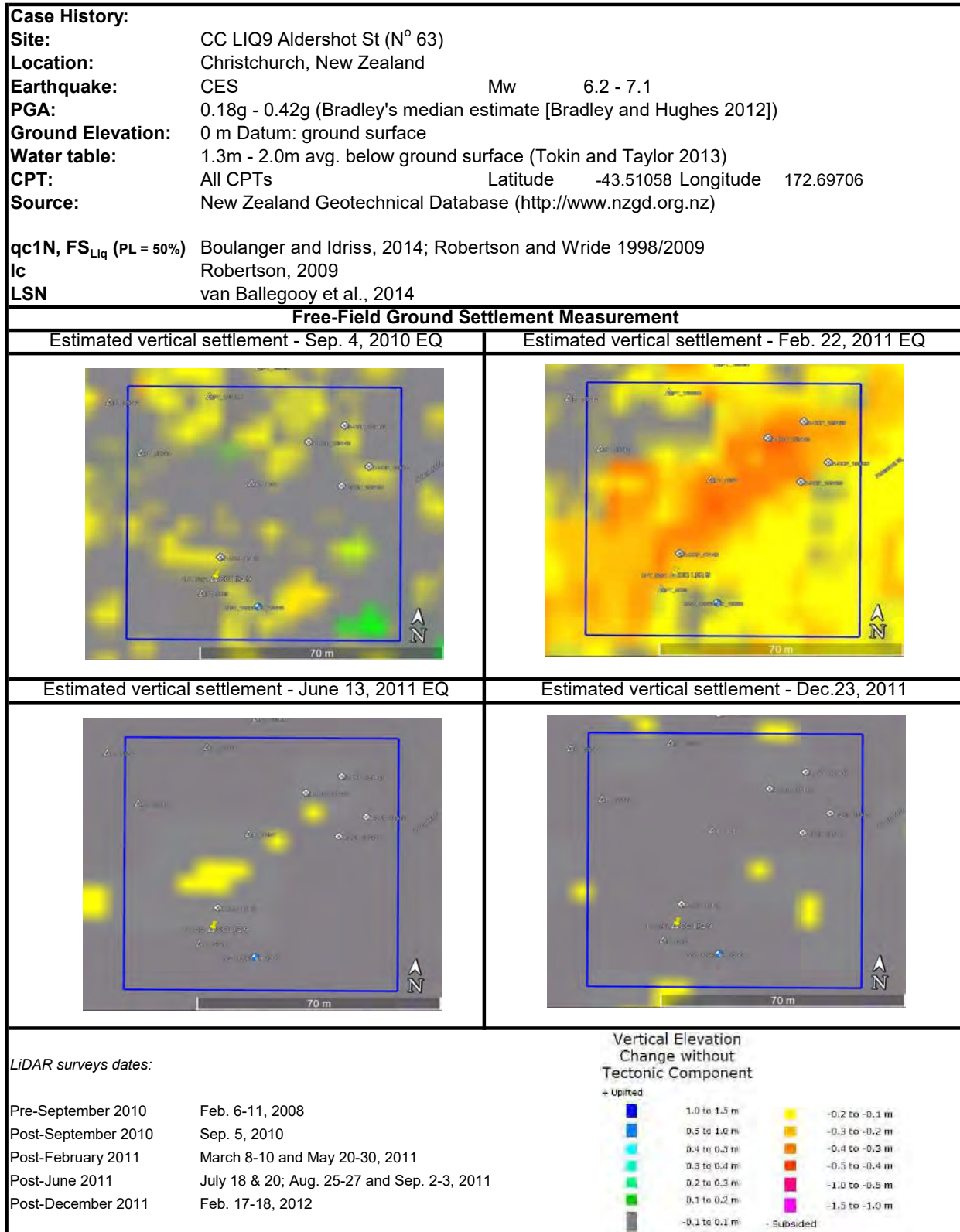
New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:**Site:** CC LIQ9 Aldershot St (N° 63)**Location:** Christchurch, New Zealand**Earthquake:** CES Mw 6.2 - 7.1**PGA:** 0.18g - 0.42g (Bradley's median estimate [Bradley and Hughes 2012])**Ground Elevation:** 0 m Datum: ground surface**Water table:** 1.3m - 2.0m avg. below ground surface (Tokin and Taylor 2013)**CPT:** All CPTs Latitude -43.51058 Longitude 172.69706**Source:** Christchurch City Council, map_Ap001725BlackMap.gws**qc1N, FS_{Liq} (PL = 50%)** Boulanger and Idriss, 2014; Robertson and Wride 1998/2009**lc** Robertson, 2009**LSN** van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

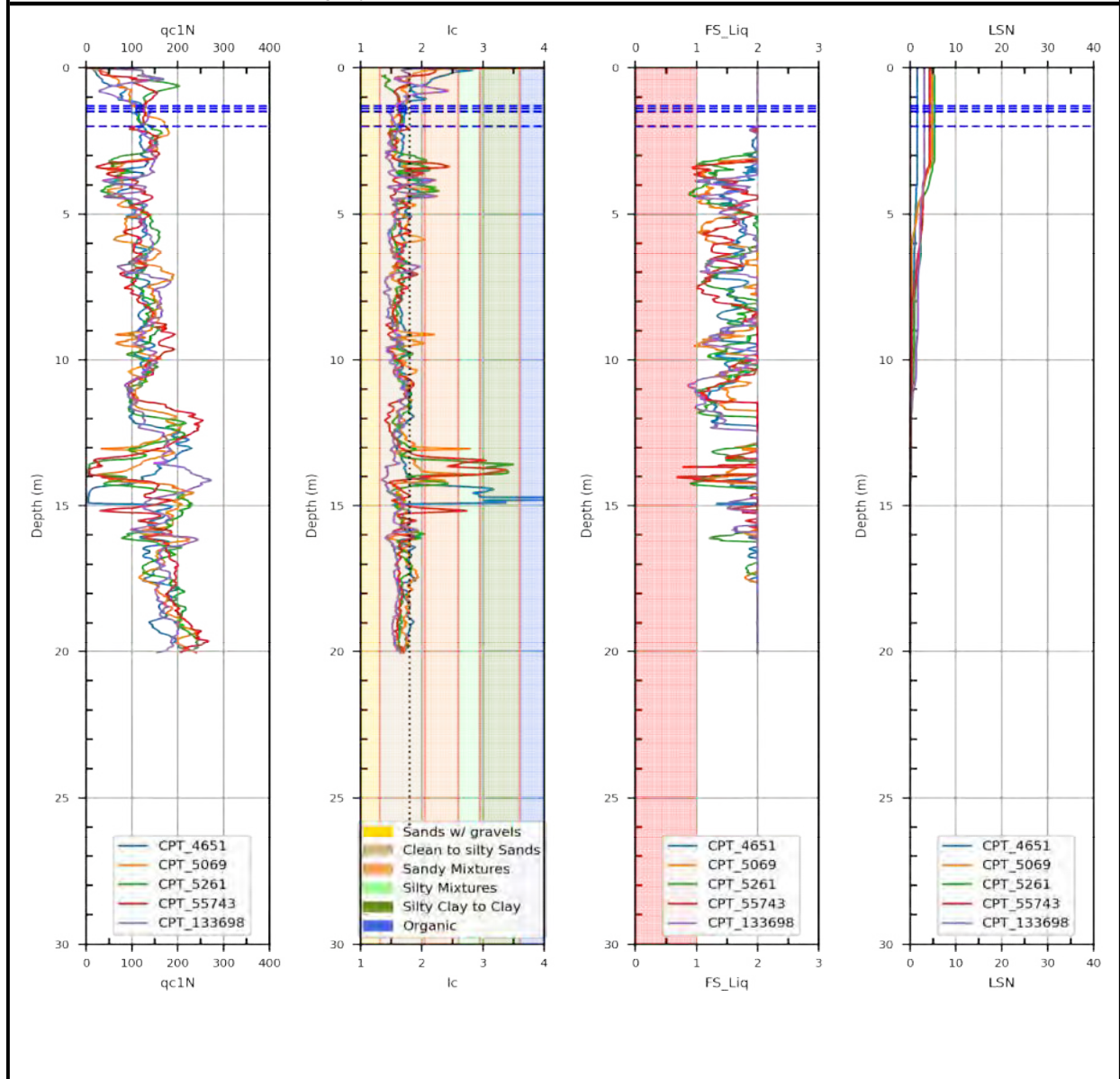


Case History:	
Site:	CC LIQ9 Aldershot St (N° 63)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.18g - 0.42g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	1.3m - 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.51058 Longitude 172.69706
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	
	
Aerial photography taken on February 24, 2011	
	
Aerial photography taken on June 14-15, 2011	
	
Aerial photography taken on December 24, 2011	
	
	



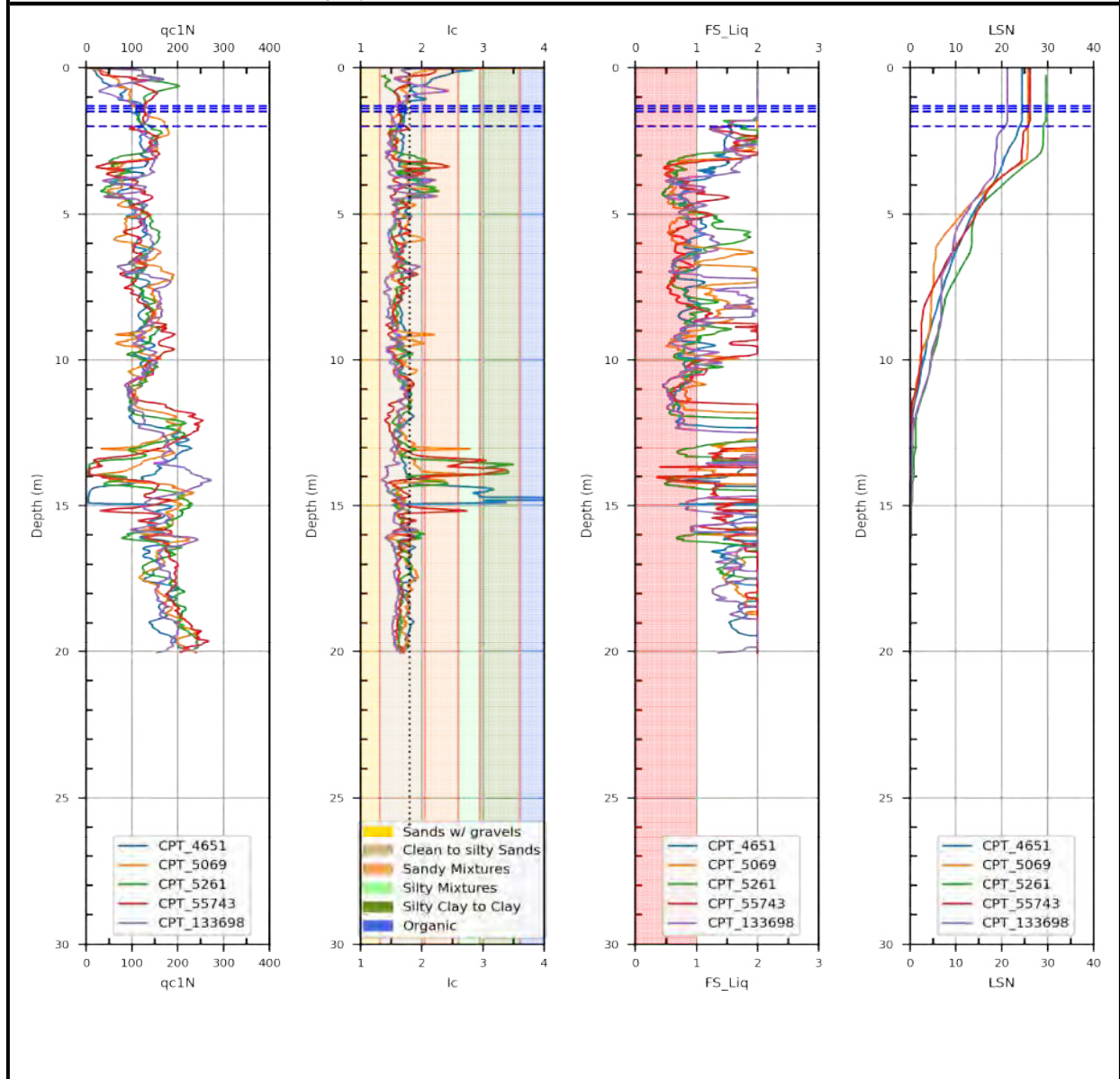
Case History: Ch-S153
Site: CC LIQ9 Aldershot St (N° 63)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 6.2 - 7.1
PGA: 0.18g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.3m - 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.51058 Longitude 172.69706
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



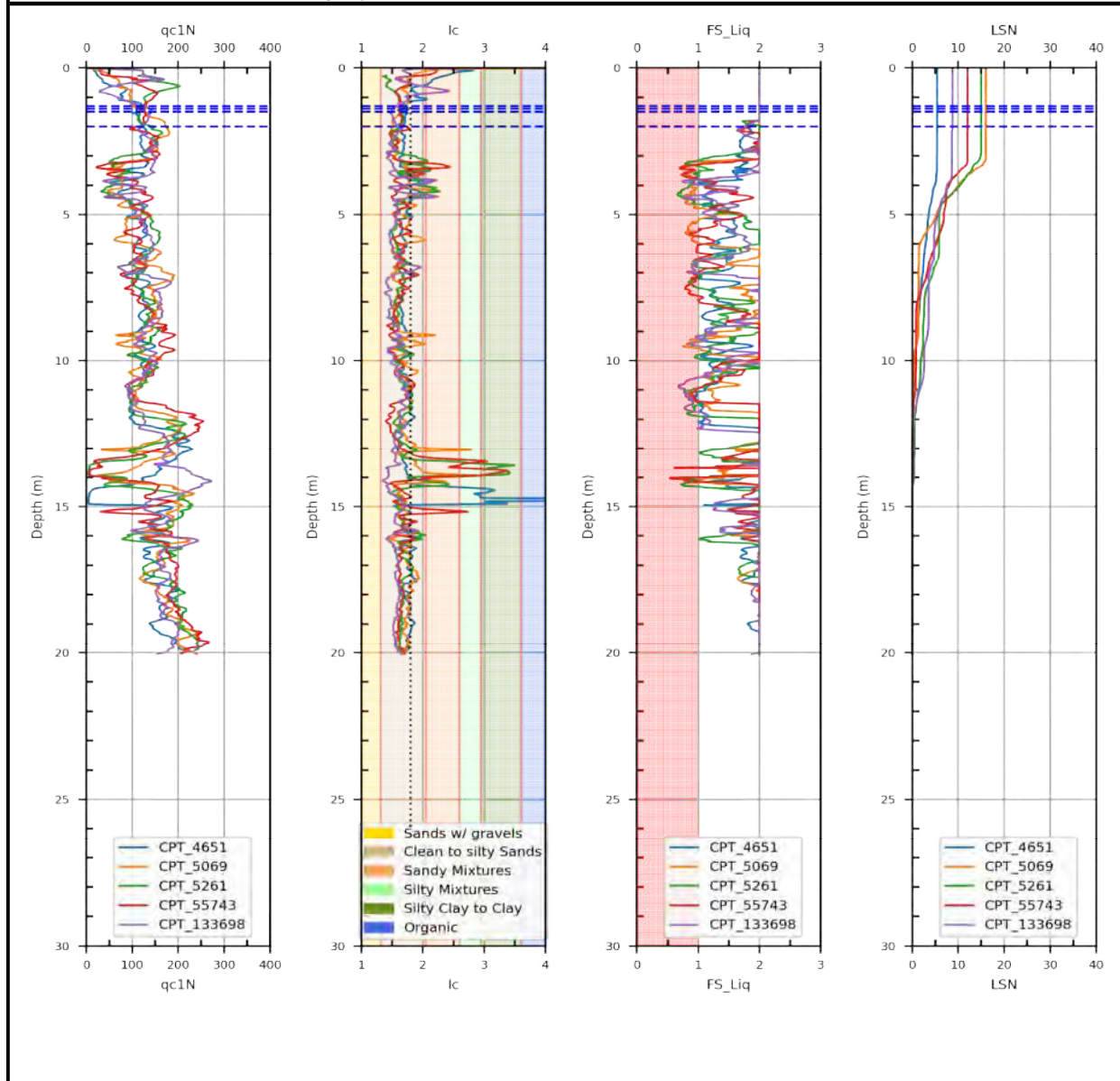
Case History: Ch-S154
Site: CC LIQ9 Aldershot St (N° 63)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2 - 7.1
PGA: 0.42g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.3m - 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.51058 Longitude 172.69706
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S155
Site: CC LIQ9 Aldershot St (N° 63)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2 - 7.1
PGA: 0.28g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.3m - 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.51058 Longitude 172.69706
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



CC LIQ10 Warrington Street

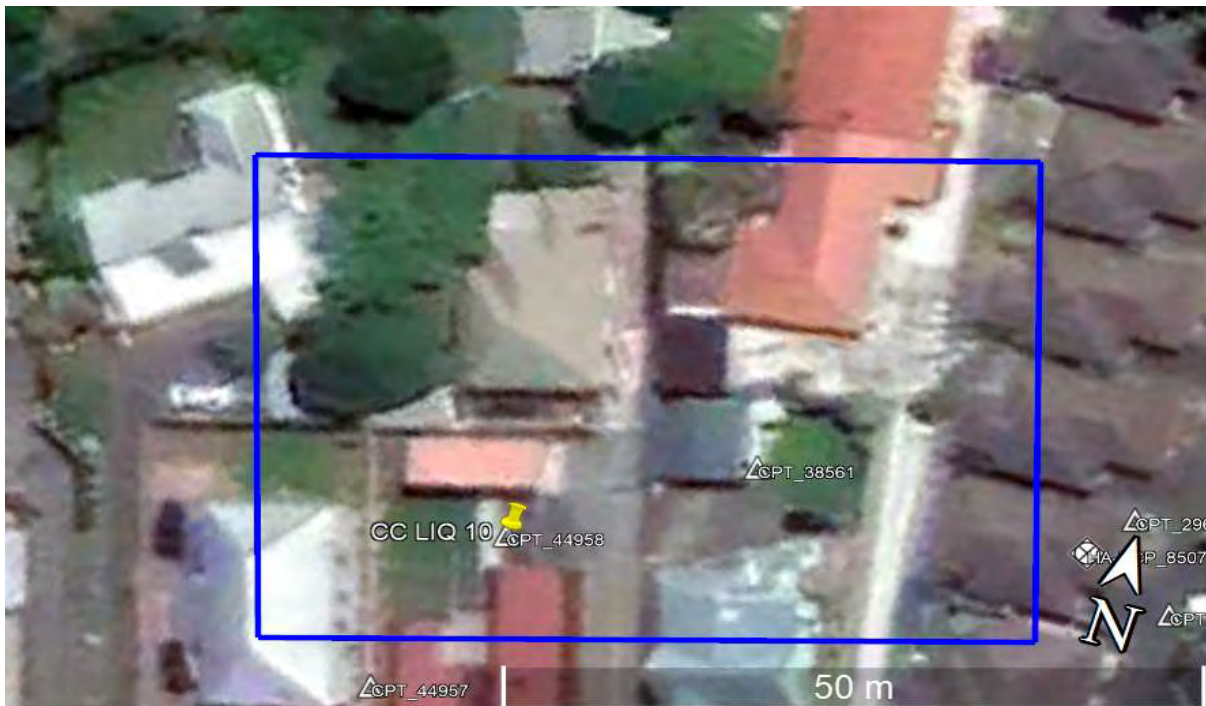
Case History:

Site: CC LIQ10 Warrington St (N° 64)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.20g - 0.36g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.50803 Longitude 172.64311
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

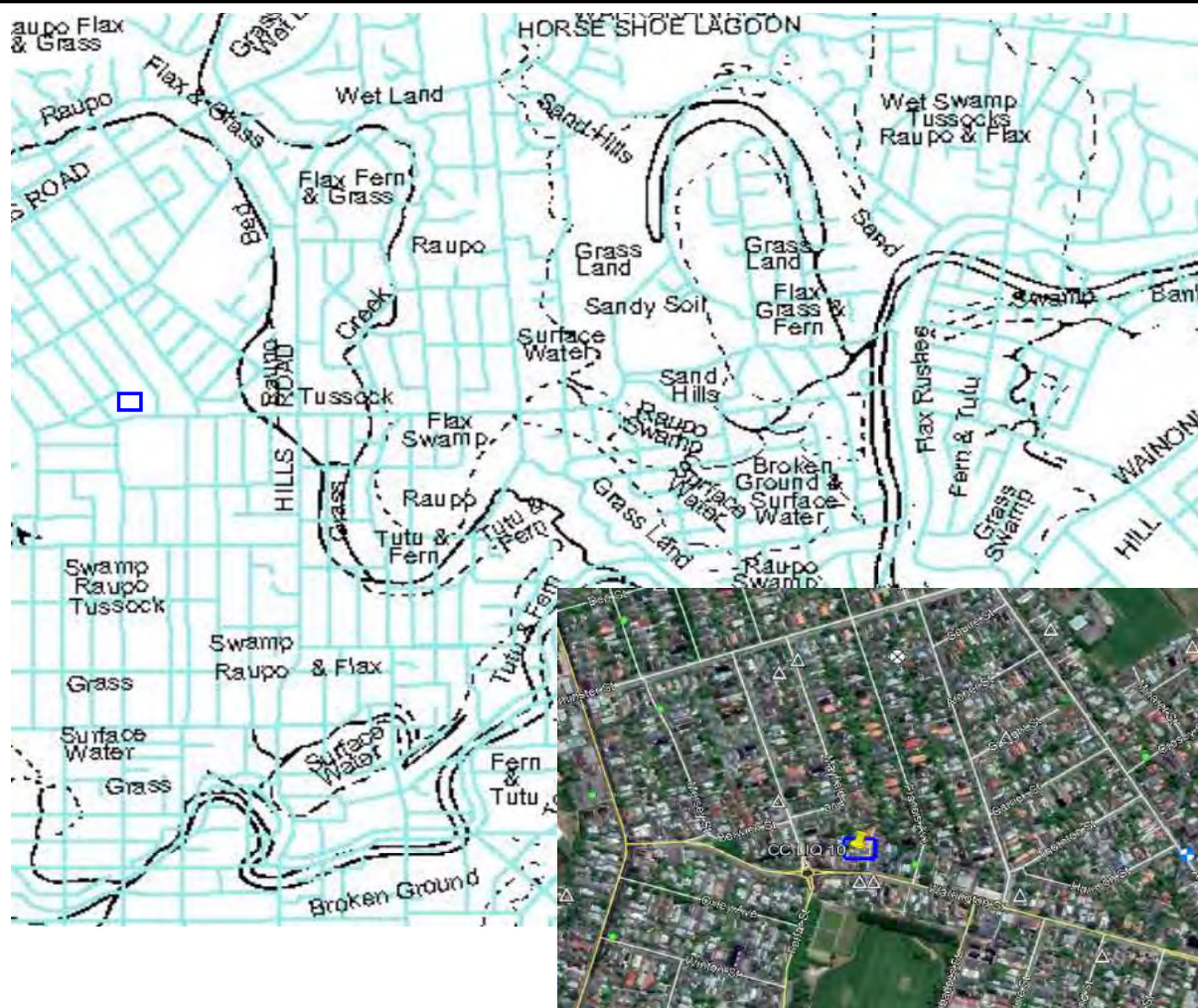
LSN van Ballegooy et al., 2014

Site Plan View**References:**

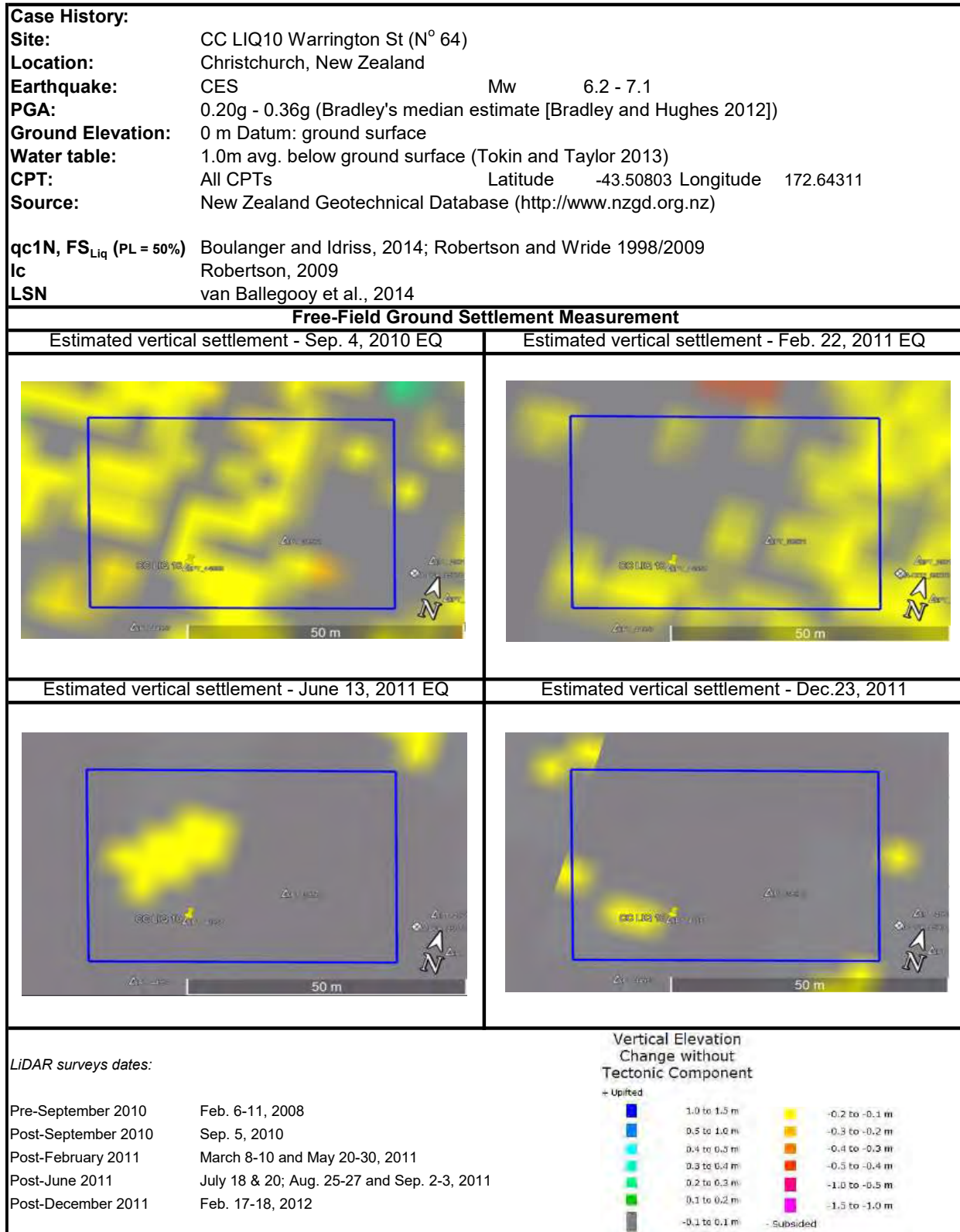
New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:**Site:** CC LIQ10 Warrington St (N° 64)**Location:** Christchurch, New Zealand**Earthquake:** CES Mw 6.2 - 7.1**PGA:** 0.20g - 0.36g (Bradley's median estimate [Bradley and Hughes 2012])**Ground Elevation:** 0 m Datum: ground surface**Water table:** 1.0m avg. below ground surface (Tokin and Taylor 2013)**CPT:** All CPTs Latitude -43.50803 Longitude 172.64311**Source:** Christchurch City Council, map_Ap001725BlackMap.gws**qc1N, FS_{Liq} (PL = 50%)** Boulanger and Idriss, 2014; Robertson and Wride 1998/2009**lc** Robertson, 2009**LSN** van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

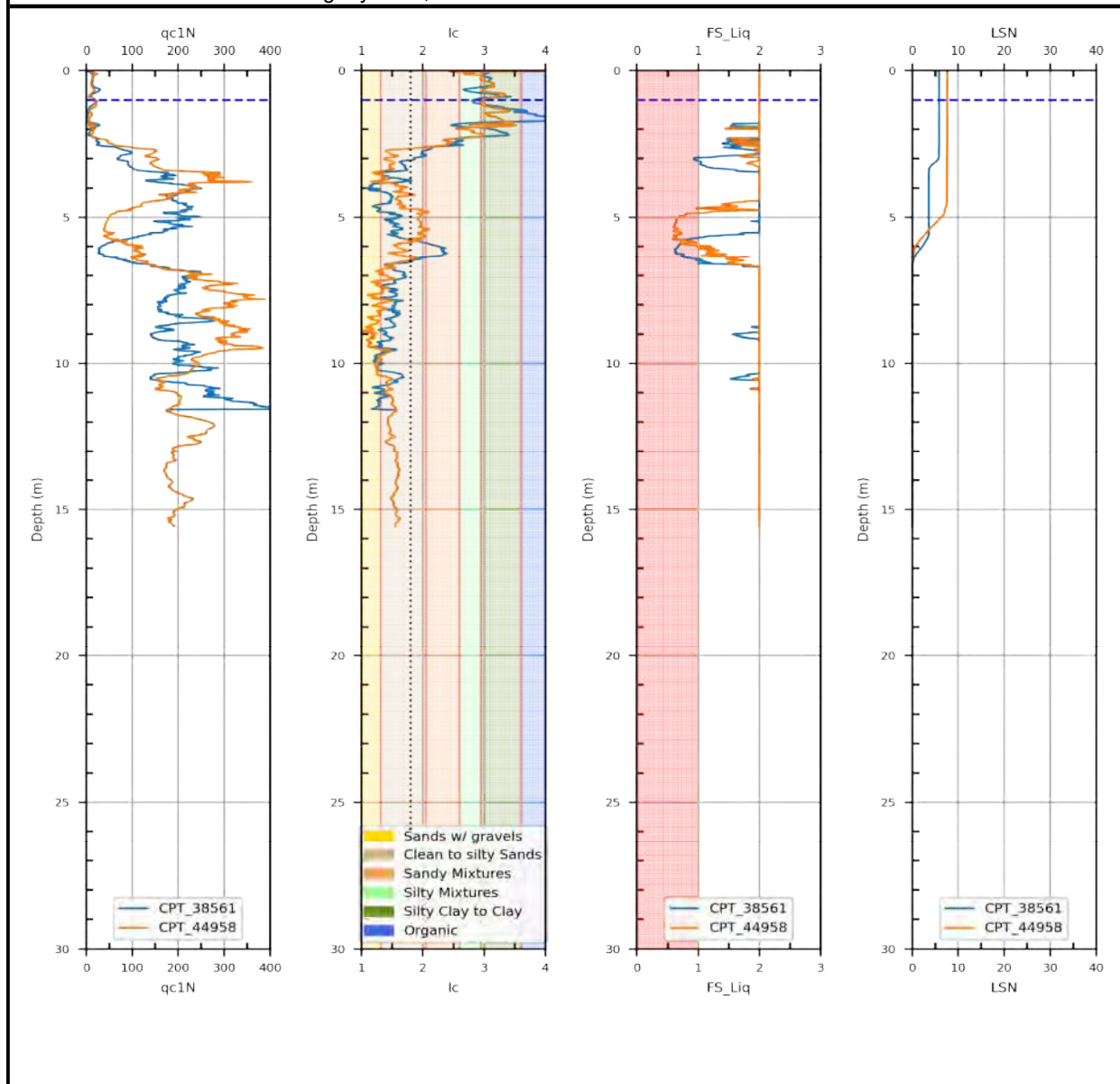


Case History: Site: CC LIQ10 Warrington St (N° 64) Location: Christchurch, New Zealand Earthquake: CES Mw 6.2 - 7.1 PGA: 0.20g - 0.36g (Bradley's median estimate [Bradley and Hughes 2012]) Ground Elevation: 0 m Datum: ground surface Water table: 1.0m avg. below ground surface (Tokin and Taylor 2013) CPT: All CPTs Latitude -43.50803 Longitude 172.64311 Source: New Zealand Geotechnical Database (http://www.nzgd.org.nz) qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009 lc Robertson, 2009 LSN van Ballegooy et al., 2014	
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
  Ministry of Civil Defence & Emergency Management Te Kaitiaki Whakamārama  CERA Canterbury Earthquake Recovery Authority  EQC EARTHQUAKE COMMISSION Kaitiaki Takekōwhiri  TT Tonkin & Taylor	



Case History: Ch-S156
Site: CC LIQ10 Warrington St (N° 64)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 6.2 - 7.1
PGA: 0.21g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.50803 Longitude 172.64311
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014

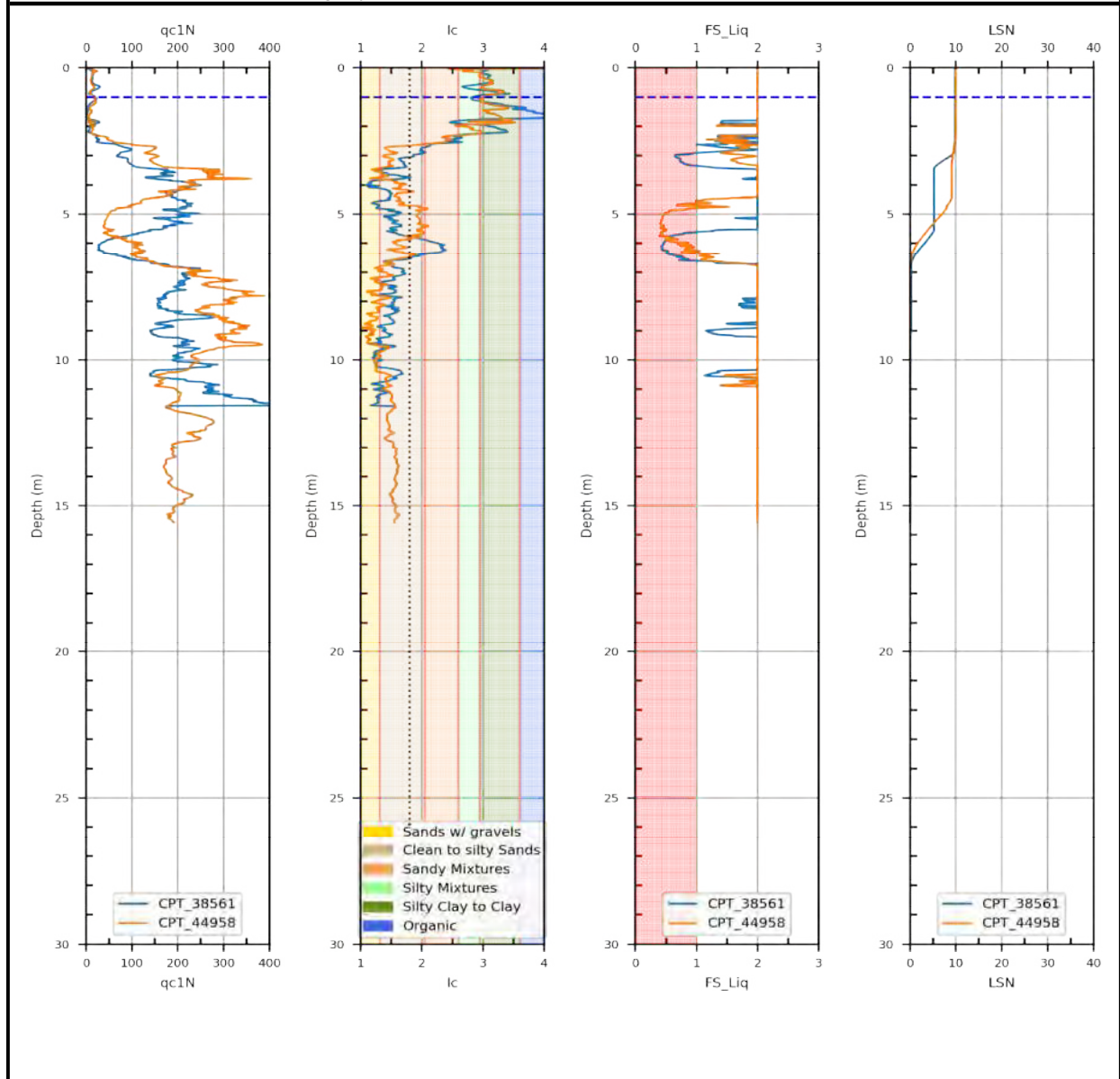


Case History: Ch-S157
Site: CC LIQ10 Warrington St (N° 64)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2 - 7.1
PGA: 0.36g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.50803 Longitude 172.64311
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

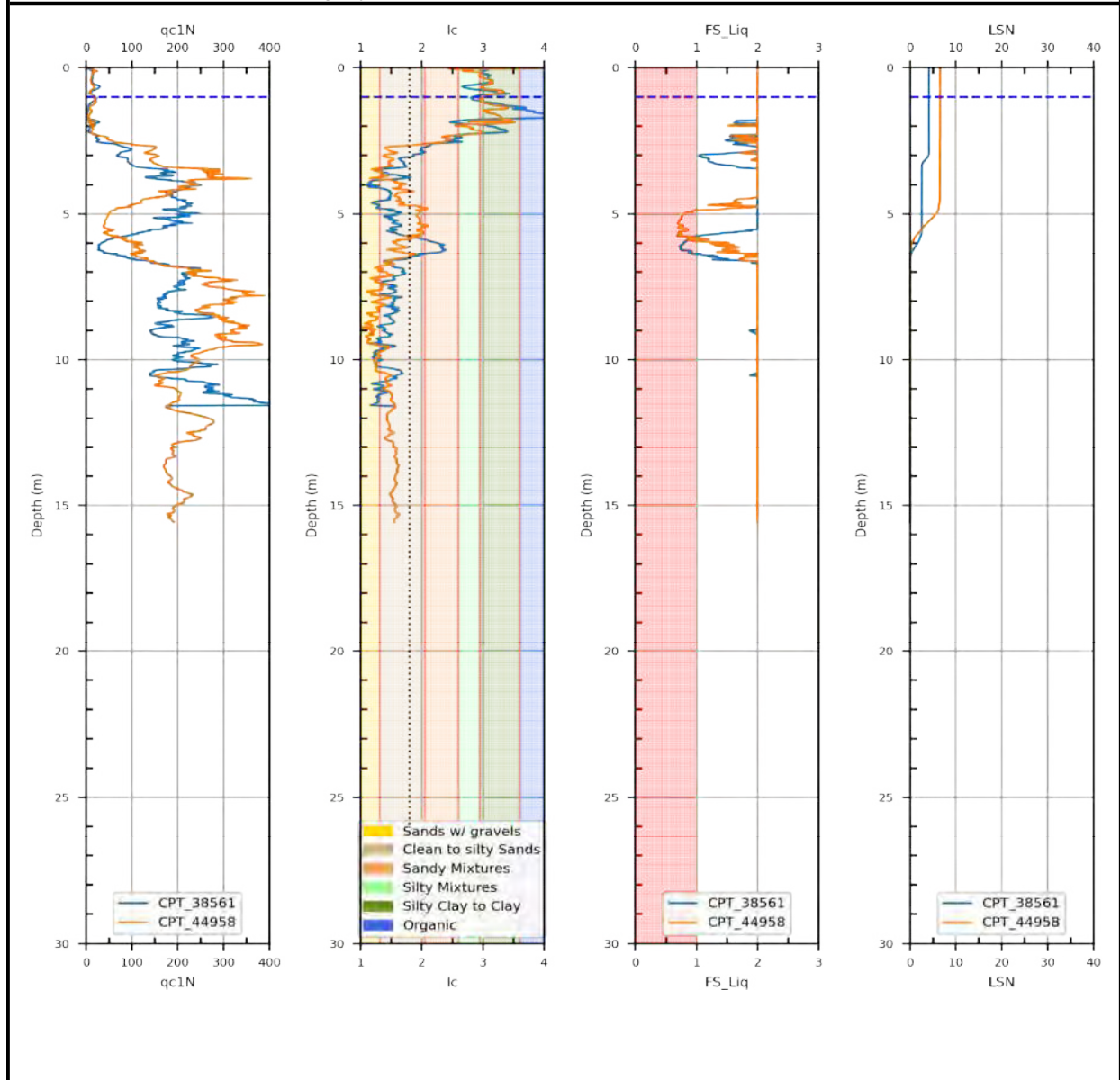


Case History: Ch-S158
Site: CC LIQ10 Warrington St (N° 64)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2 - 7.1
PGA: 0.20g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.50803 Longitude 172.64311
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014



CC LIQ11 Sandown Cres

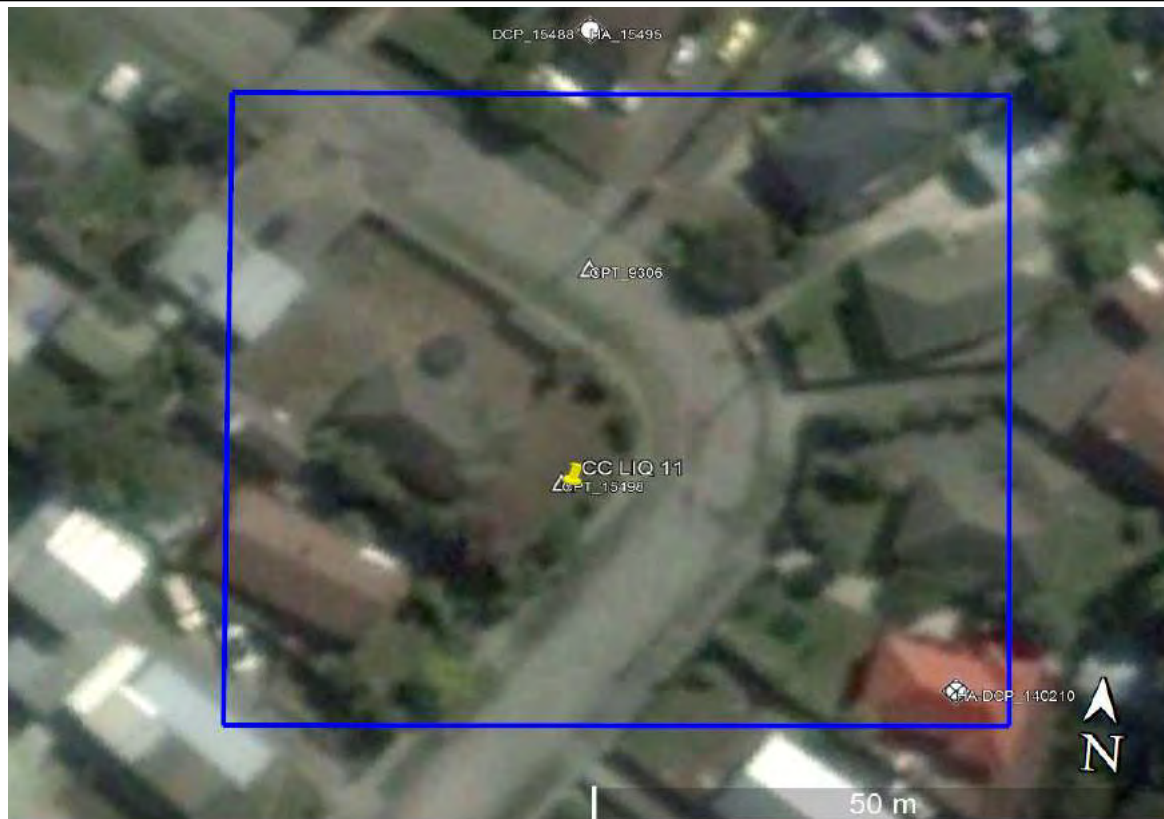
Case History:

Site: CC LIQ11 Sandown Cres (N° 65)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.45g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.8m-2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.50992 Longitude 172.70848
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

lc Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

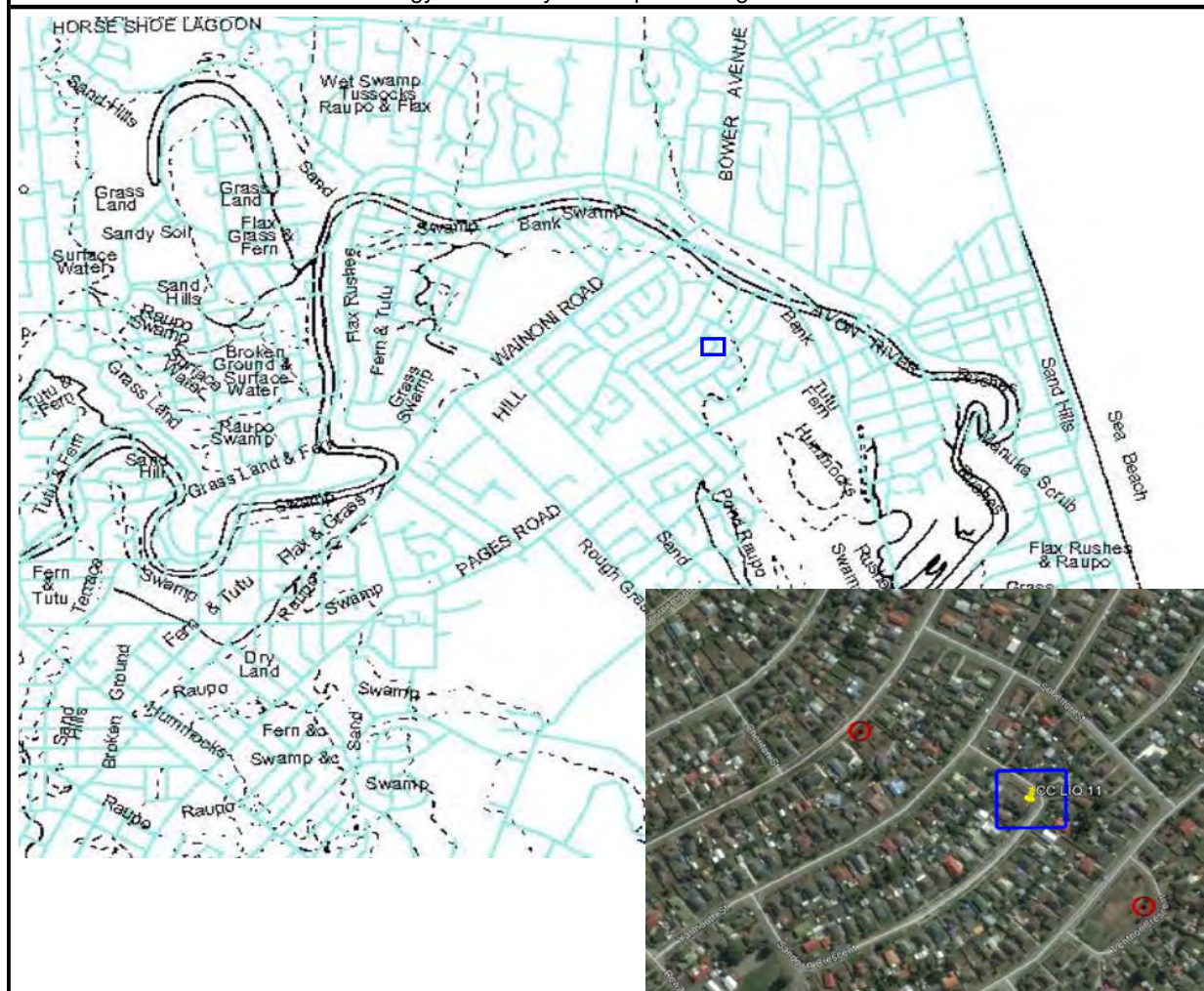
Site: CC LIQ11 Sandown Cres (N° 65)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.45g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.8m-2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.50992 Longitude 172.70848
Source: Christchurch City Council, map_Ap001725BlackMap.gws

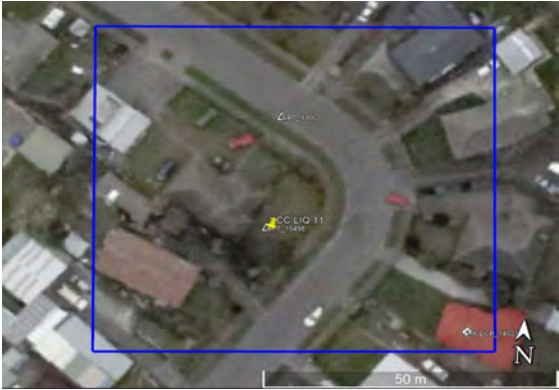
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

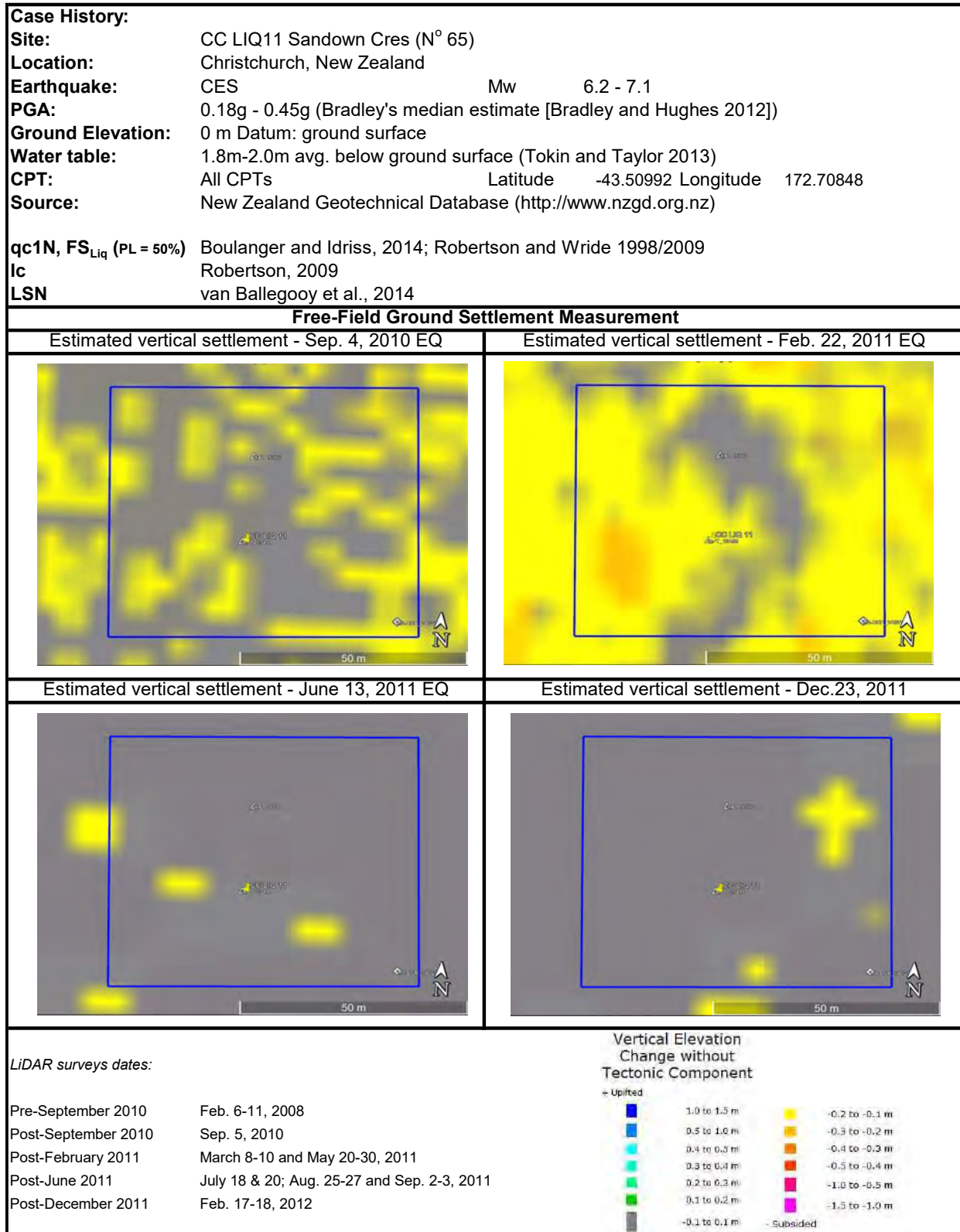
lc Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

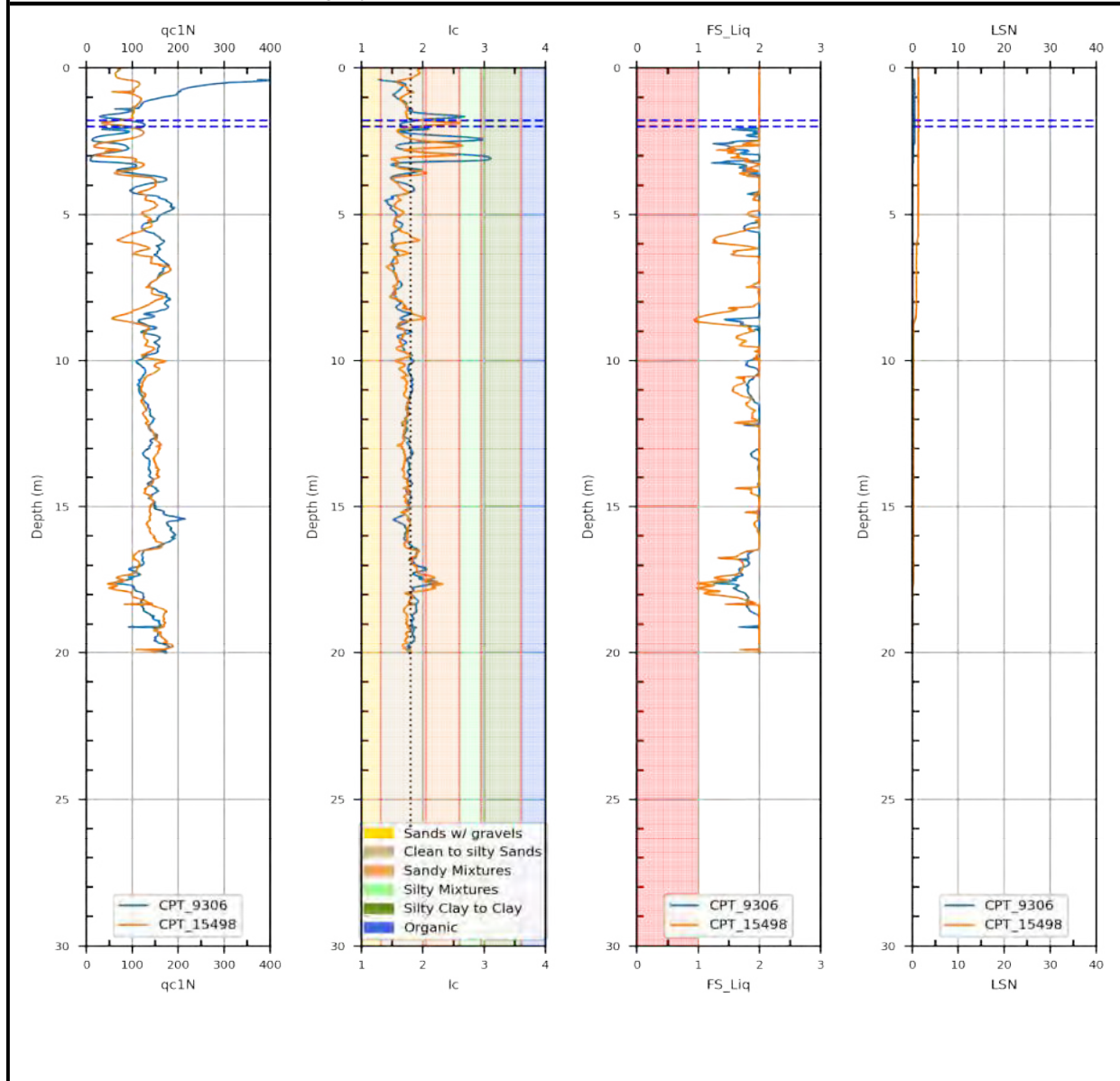


Case History:	
Site:	CC LIQ11 Sandown Cres (N° 65)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.18g - 0.45g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	1.8m-2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.50992 Longitude 172.70848
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
	



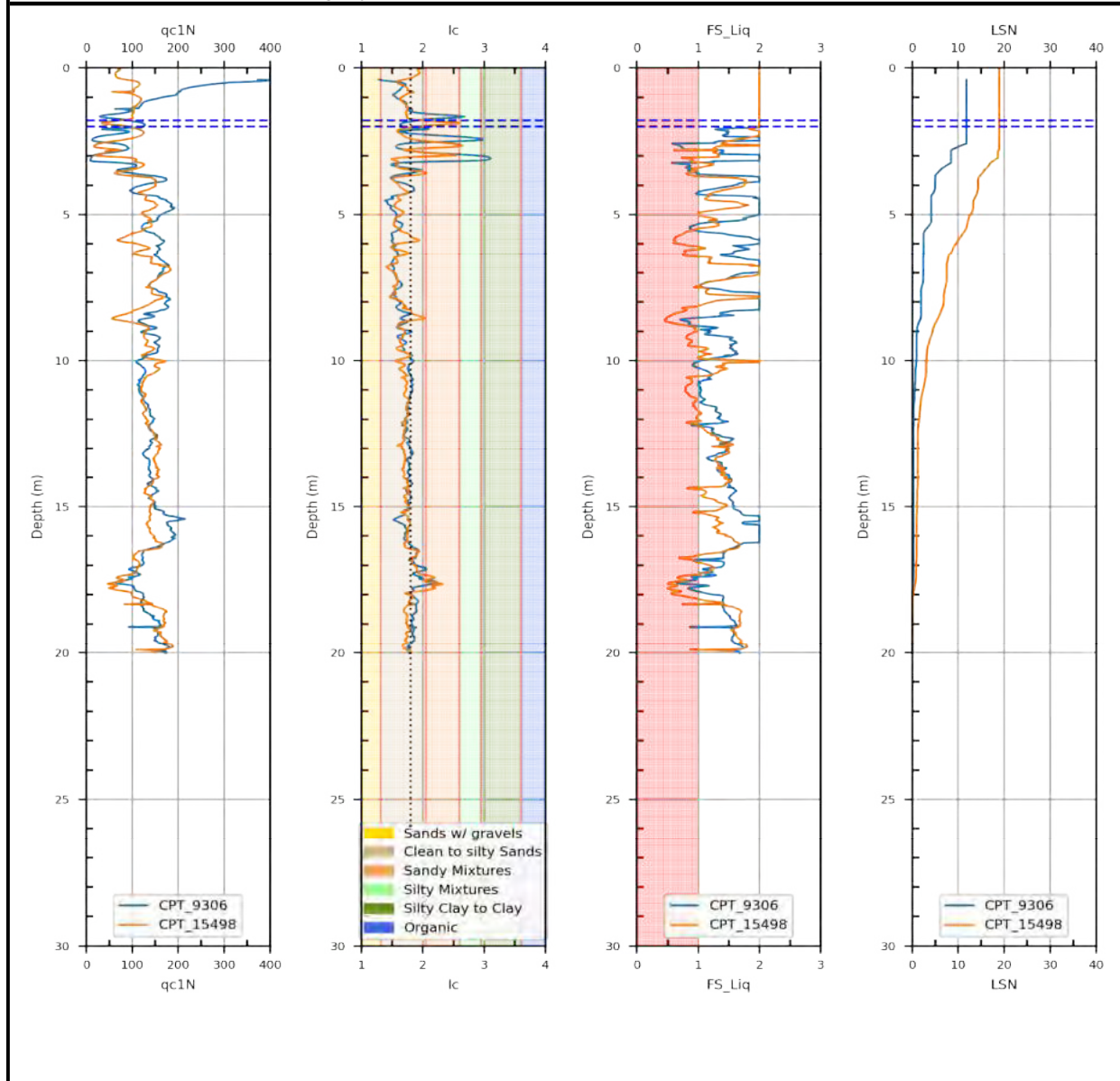
Case History: Ch-S159
Site: CC LIQ11 Sandown Cres (N^o 65)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 6.2 - 7.1
PGA: 0.18g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.8m-2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.50992 Longitude 172.70848
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S160
Site: CC LIQ11 Sandown Cres (N^o 65)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2 - 7.1
PGA: 0.45g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.8m-2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.50992 Longitude 172.70848
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014

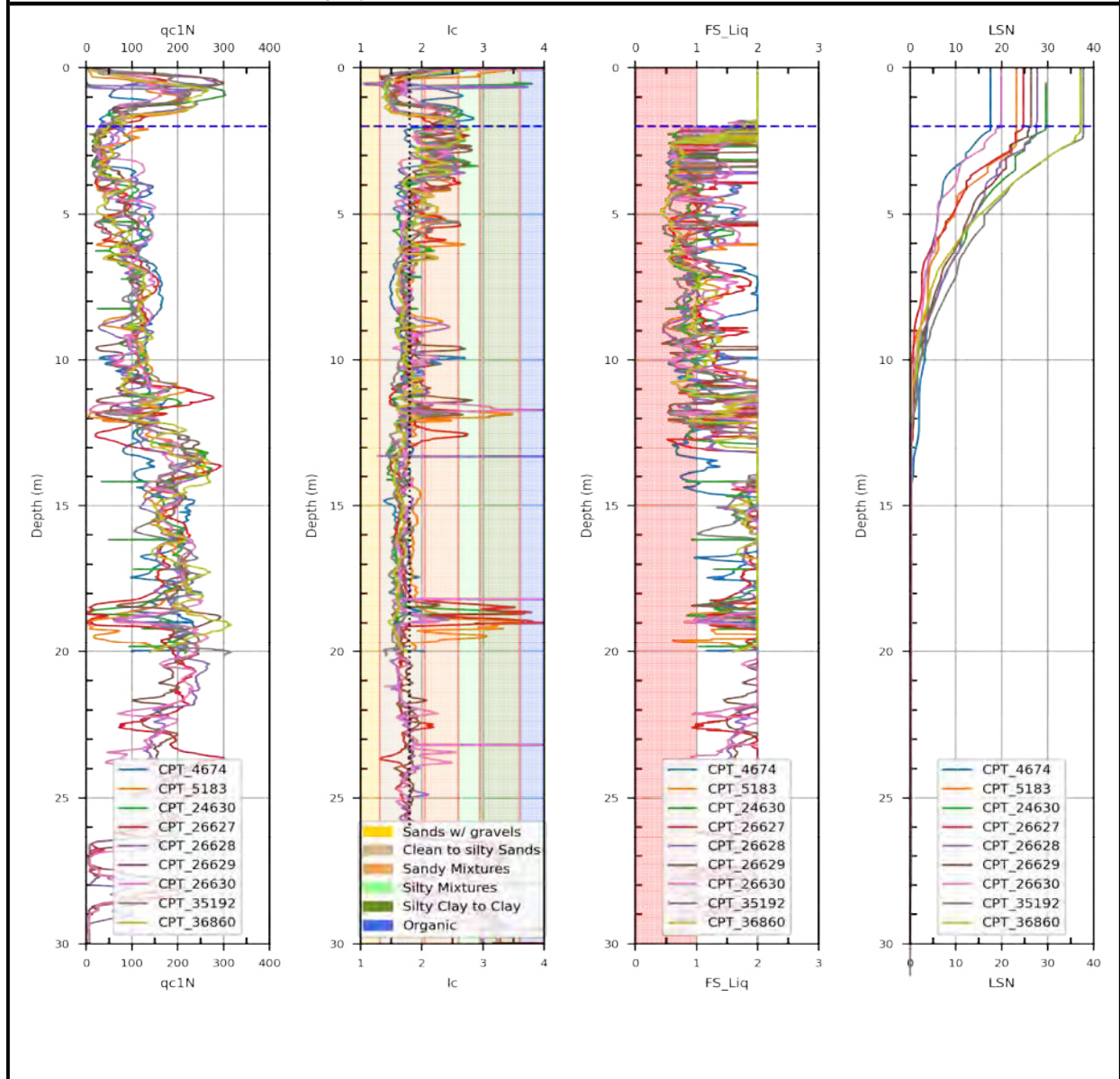


Case History: Ch-S161
Site: CC LIQ11 Sandown Cres (N^o 65)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2 - 7.1
PGA: 0.27g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.8m-2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.50992 Longitude 172.70848
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014



CC LIQ12 Hunt Ln

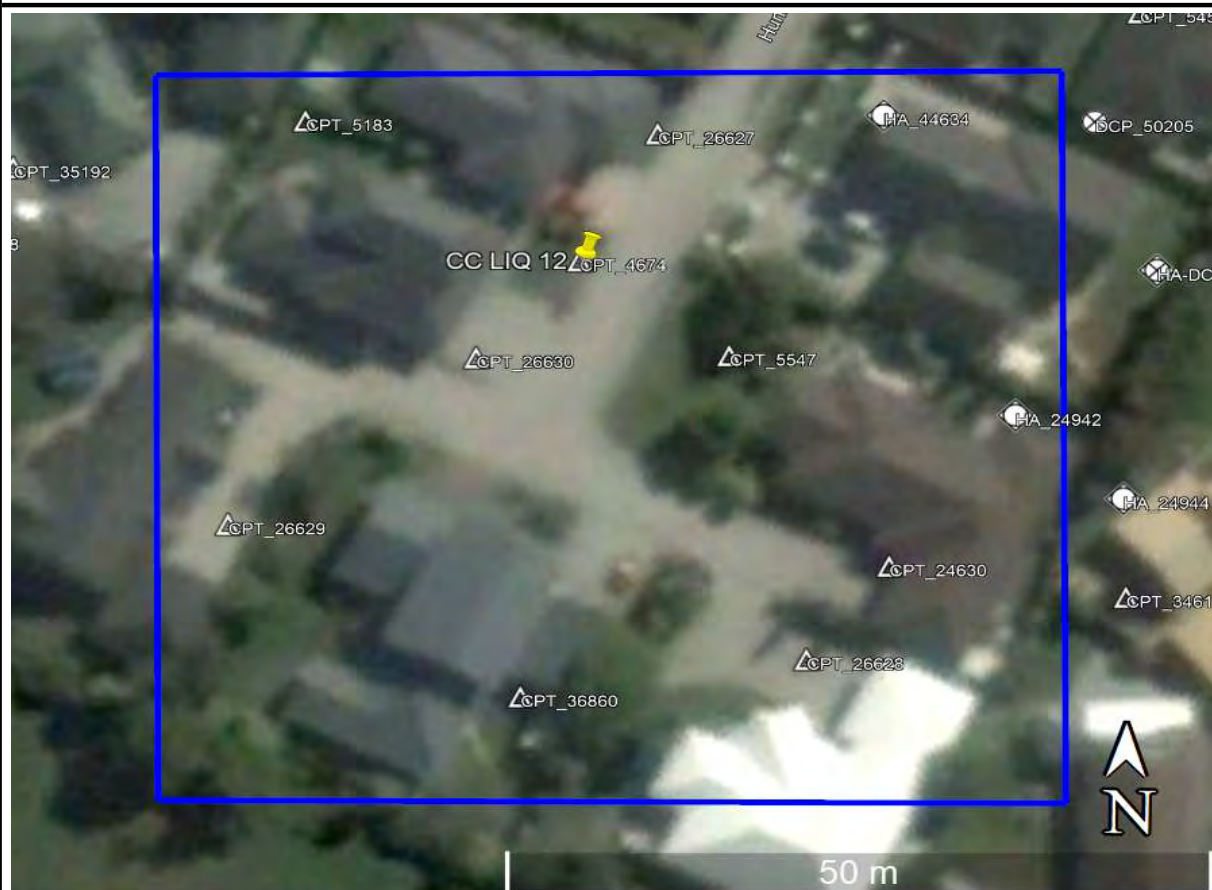
Case History:

Site: CC LIQ12 Hunt Ln (N° 66)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.36g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.50395 Longitude 172.69215
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

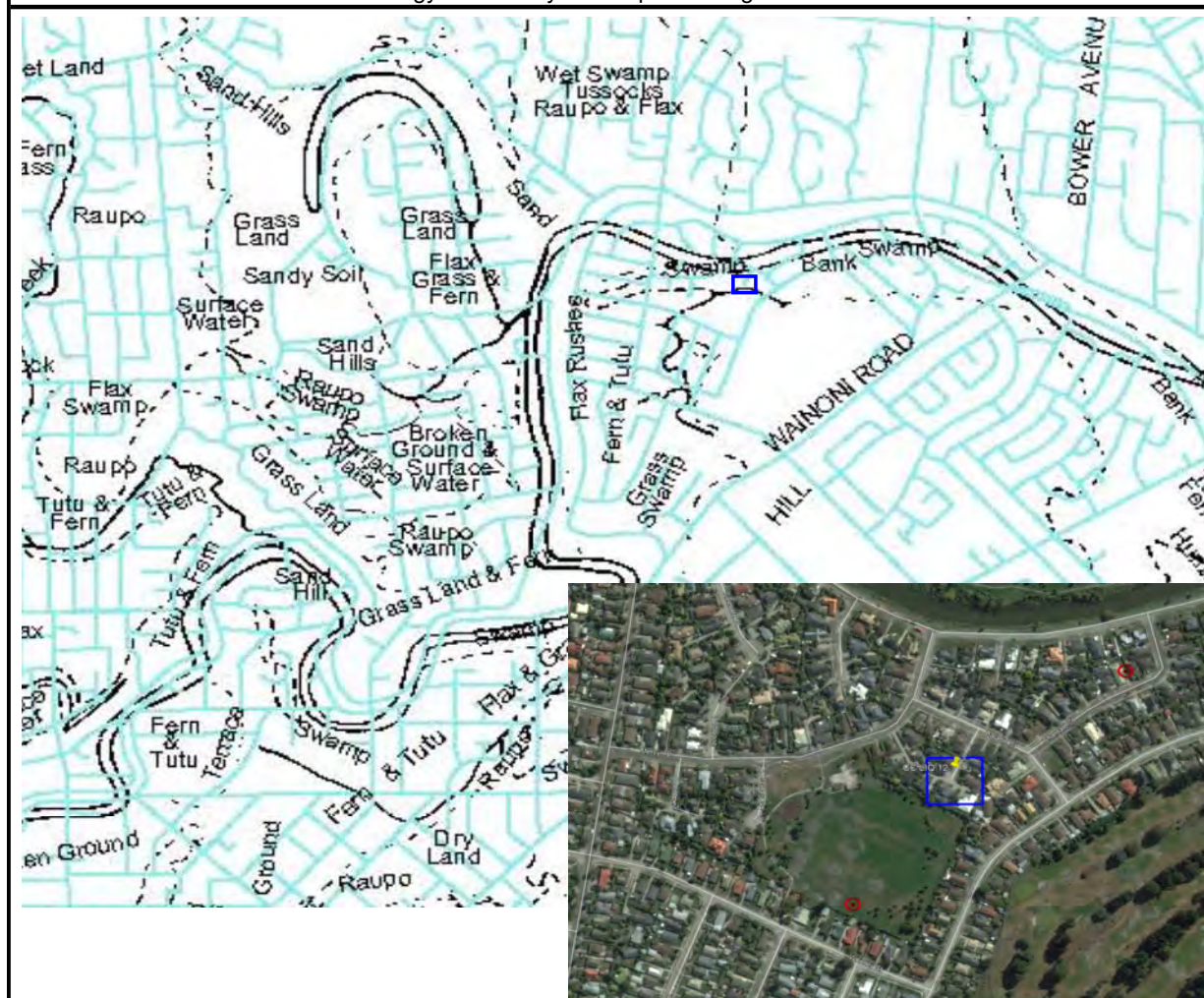
LSN van Ballegooy et al., 2014

Site Plan View**References:**

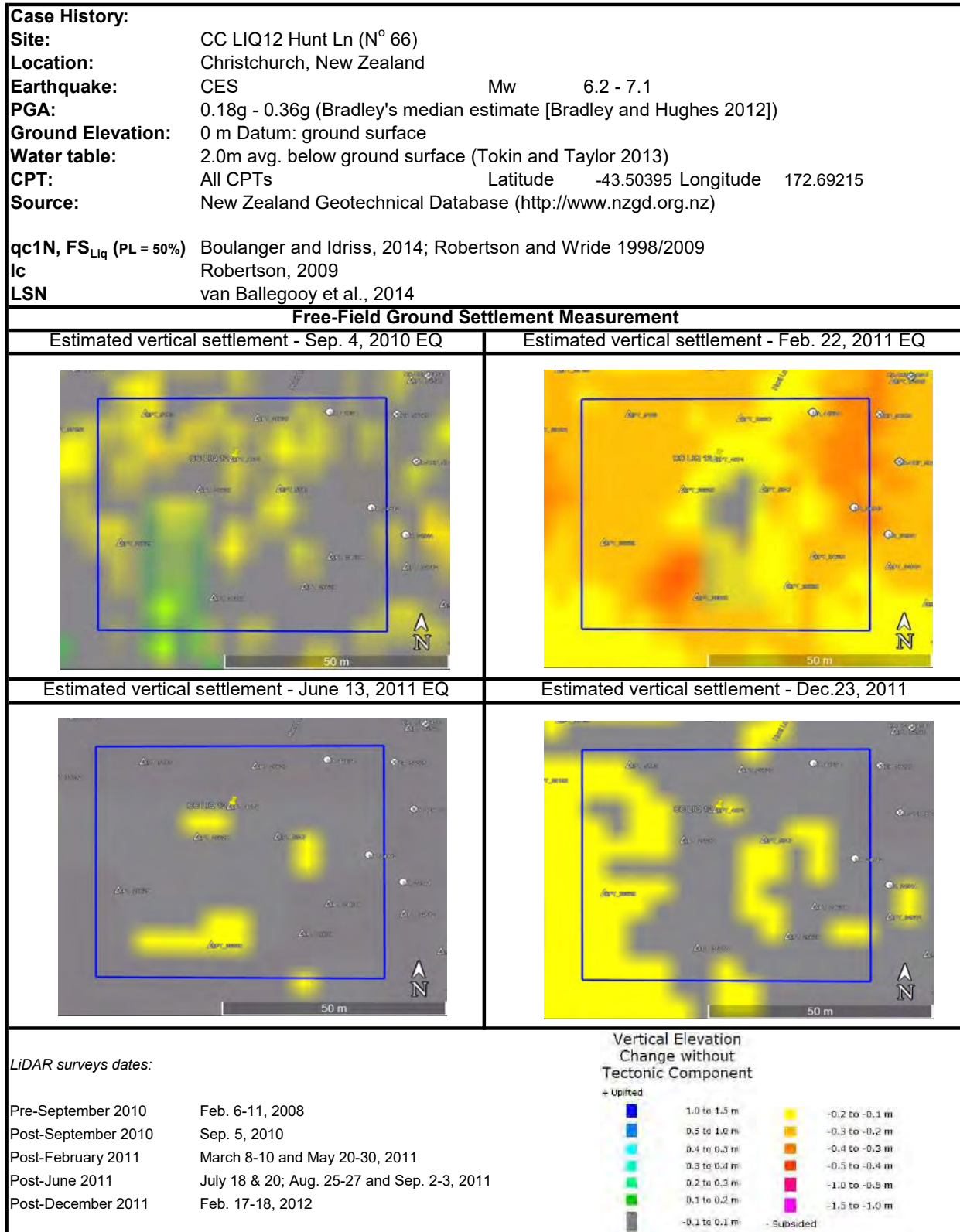
New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:**Site:** CC LIQ12 Hunt Ln (N° 66)**Location:** Christchurch, New Zealand**Earthquake:** CES Mw 6.2 - 7.1**PGA:** 0.18g - 0.36g (Bradley's median estimate [Bradley and Hughes 2012])**Ground Elevation:** 0 m Datum: ground surface**Water table:** 2.0m avg. below ground surface (Tokin and Taylor 2013)**CPT:** All CPTs Latitude -43.50395 Longitude 172.69215**Source:** Christchurch City Council, map_Ap001725BlackMap.gws**qc1N, FS_{Liq} (PL = 50%)** Boulanger and Idriss, 2014; Robertson and Wride 1998/2009**lc** Robertson, 2009**LSN** van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

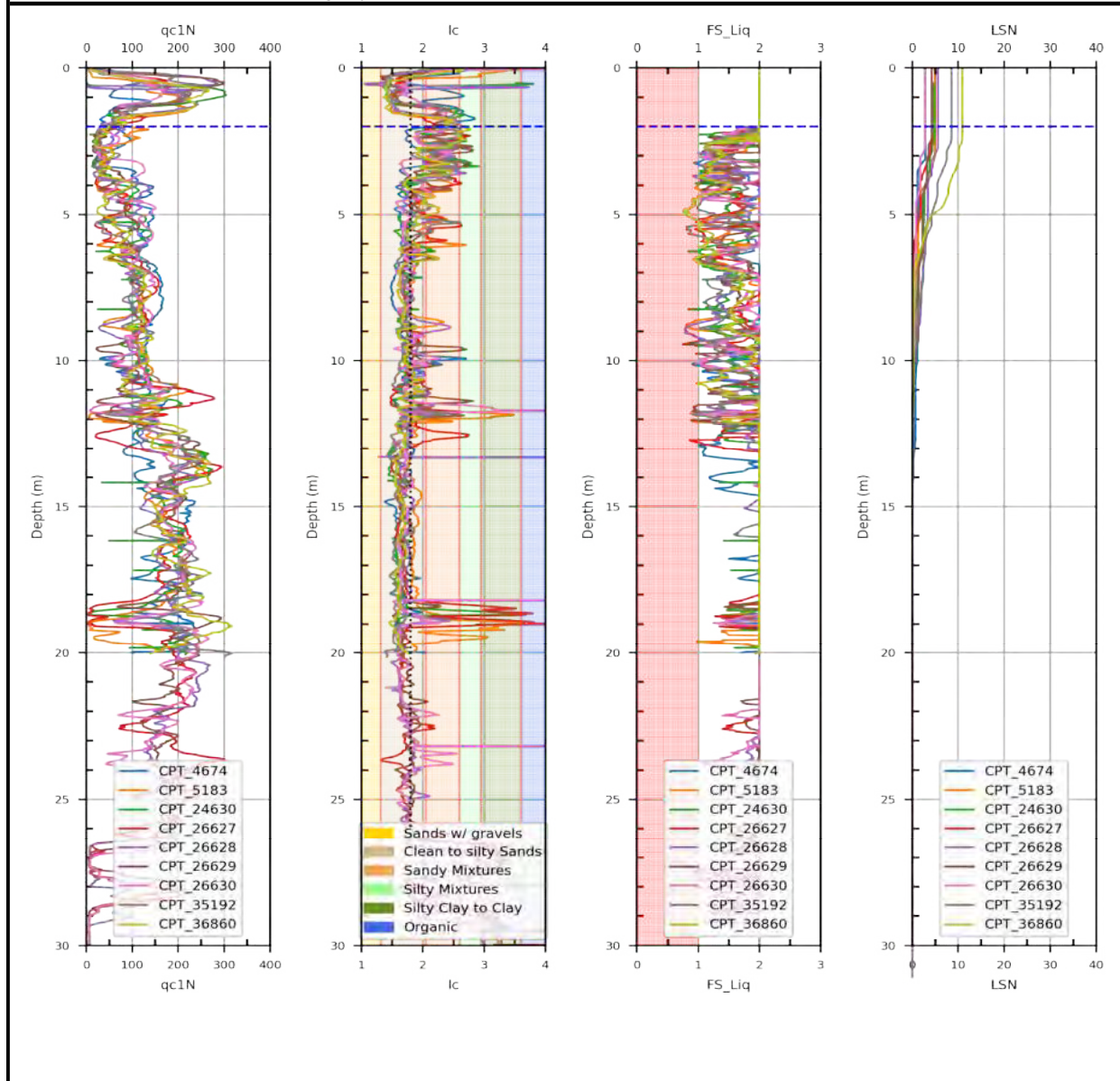


Case History:	
Site:	CC LIQ12 Hunt Ln (N° 66)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.18g - 0.36g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.50395 Longitude 172.69215
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
	



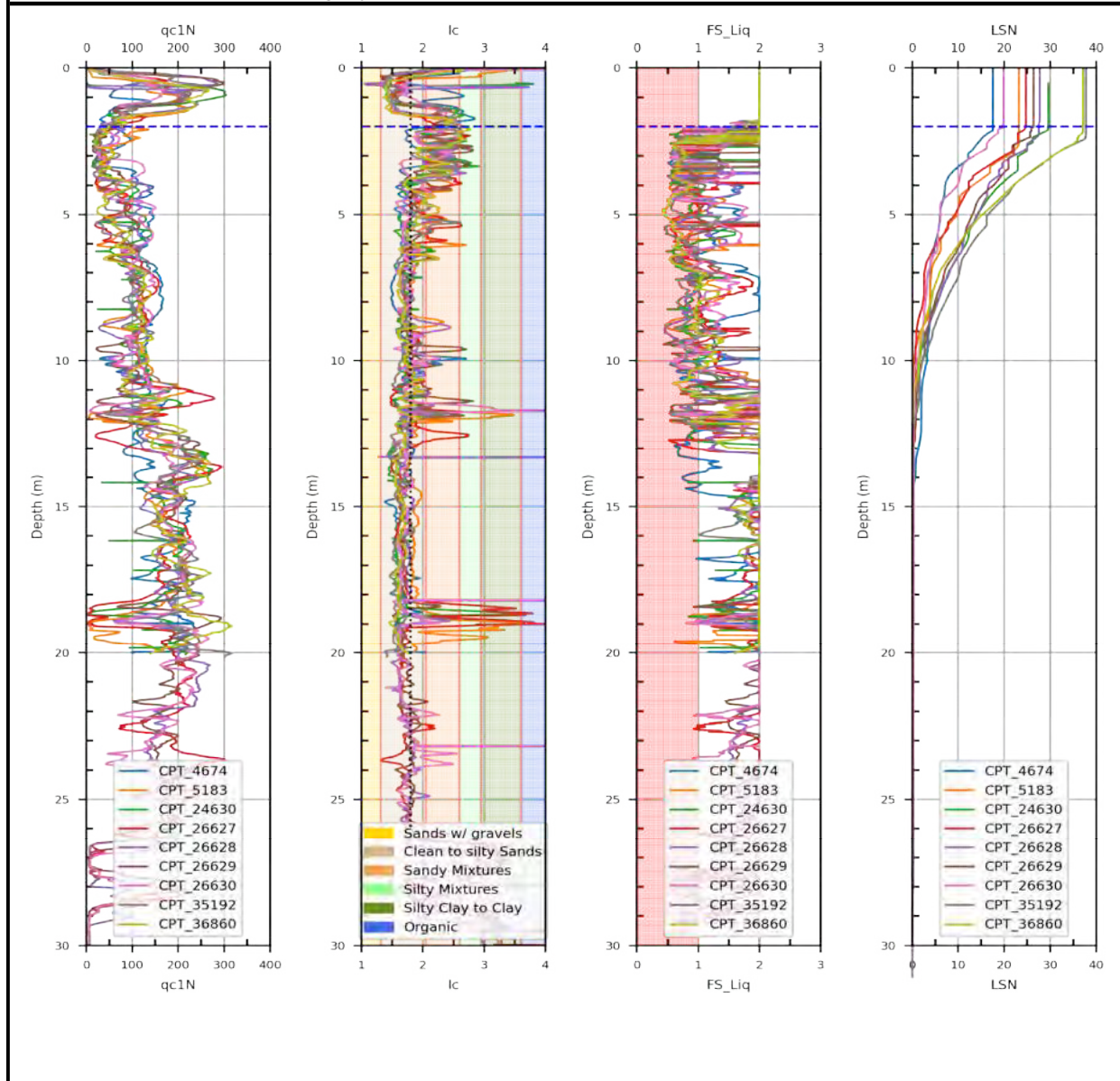
Case History: Ch-S162
Site: CC LIQ12 Hunt Ln (N° 66)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 6.2 - 7.1
PGA: 0.18g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.50395 Longitude 172.69215
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



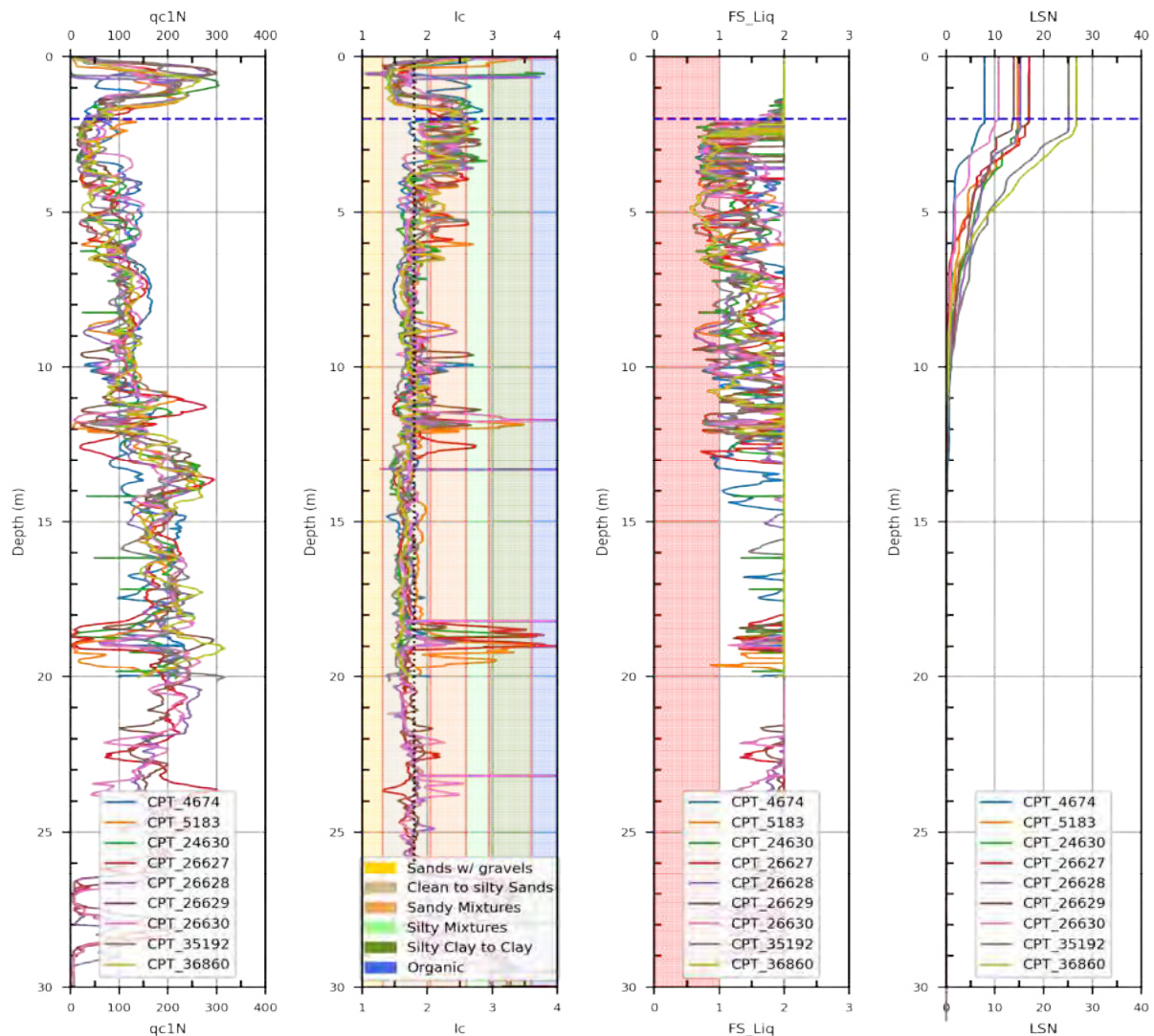
Case History: Ch-S163
Site: CC LIQ12 Hunt Ln (N° 66)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2 - 7.1
PGA: 0.36g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.50395 Longitude 172.69215
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S164
Site: CC LIQ12 Hunt Ln (N° 66)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2 - 7.1
PGA: 0.25g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.50395 Longitude 172.69215
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



CC LIQ13 Shortland Street

Case History:

Site: CC LIQ13 Shortland St (N° 67)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.19g - 0.47g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5154 Longitude 172.69367
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

Site: CC LIQ13 Shortland St (N° 67)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.19g - 0.47g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5154 Longitude 172.69367
Source: Christchurch City Council, map_Ap001725BlackMap.gws

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856



Case History:

Site: CC LIQ13 Shortland St (N° 67)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.19g - 0.47g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5154 Longitude 172.69367
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

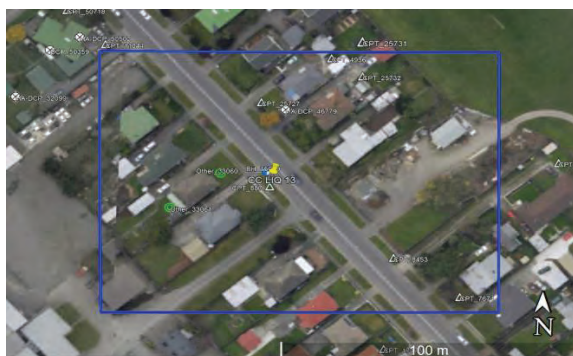
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

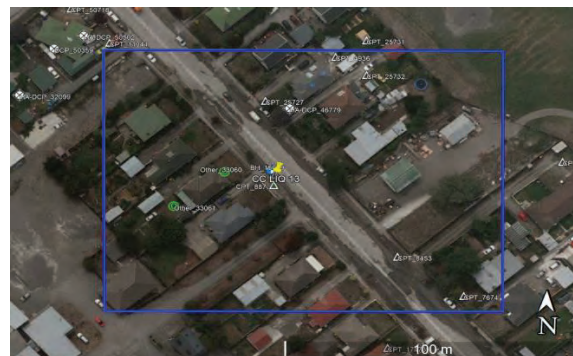
LSN van Ballegooy et al., 2014

Ejecta Patterns

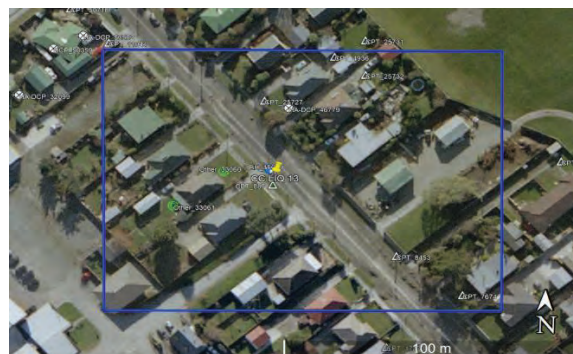
Aerial photography taken on September 5, 2010



Aerial photography taken on February 24, 2011



Aerial photography taken on June 14-15, 2011



Aerial photography taken on December 24, 2011



Ministry of Civil Defence
& Emergency Management
Te Kaitiaki Take Kōwhiri



Case History:

Site: CC LIQ13 Shortland St (N° 67)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.19g - 0.47g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5154 Longitude 172.69367
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

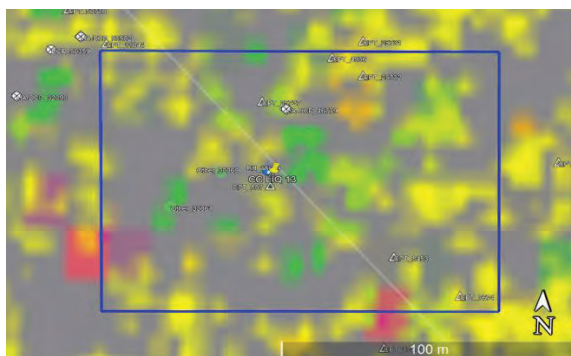
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

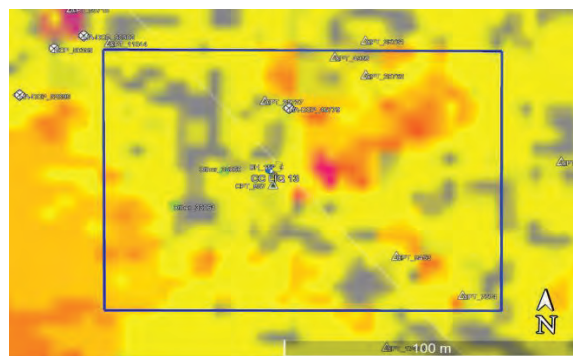
LSN van Ballegooy et al., 2014

Free-Field Ground Settlement Measurement

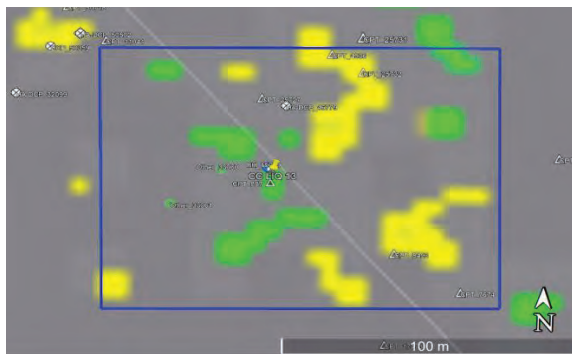
Estimated vertical settlement - Sep. 4, 2010 EQ



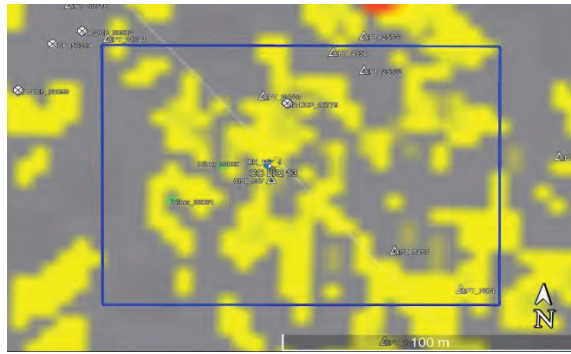
Estimated vertical settlement - Feb. 22, 2011 EQ



Estimated vertical settlement - June 13, 2011 EQ



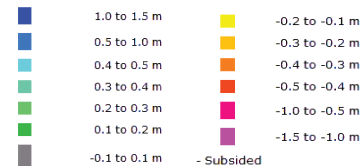
Estimated vertical settlement - Dec.23, 2011

**LiDAR surveys dates:**

Pre-September 2010	Feb. 6-11, 2008
Post-September 2010	Sep. 5, 2010
Post-February 2011	March 8-10 and May 20-30, 2011
Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011
Post-December 2011	Feb. 17-18, 2012

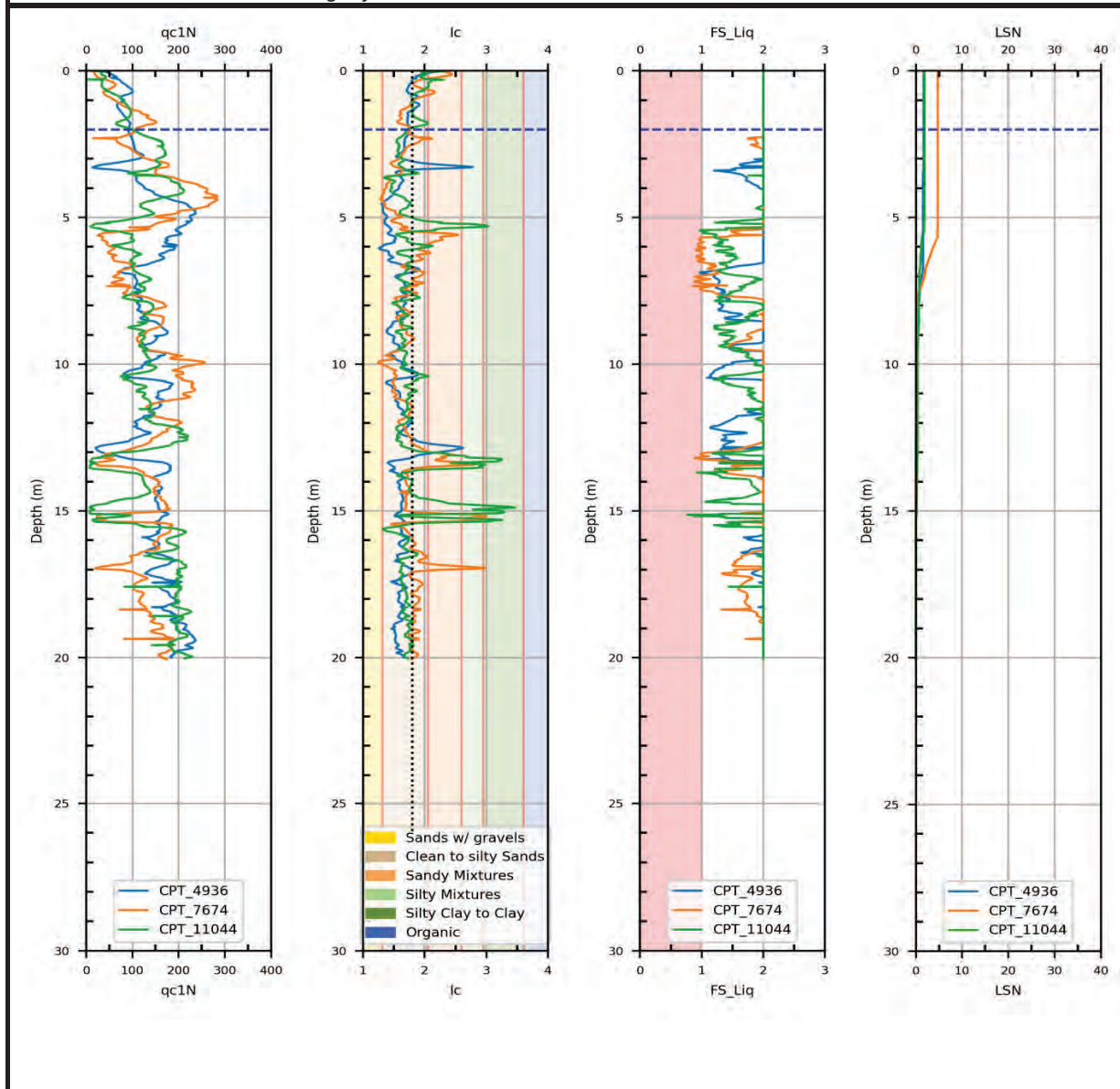
**Vertical Elevation
Change without
Tectonic Component**

+ Uplifted



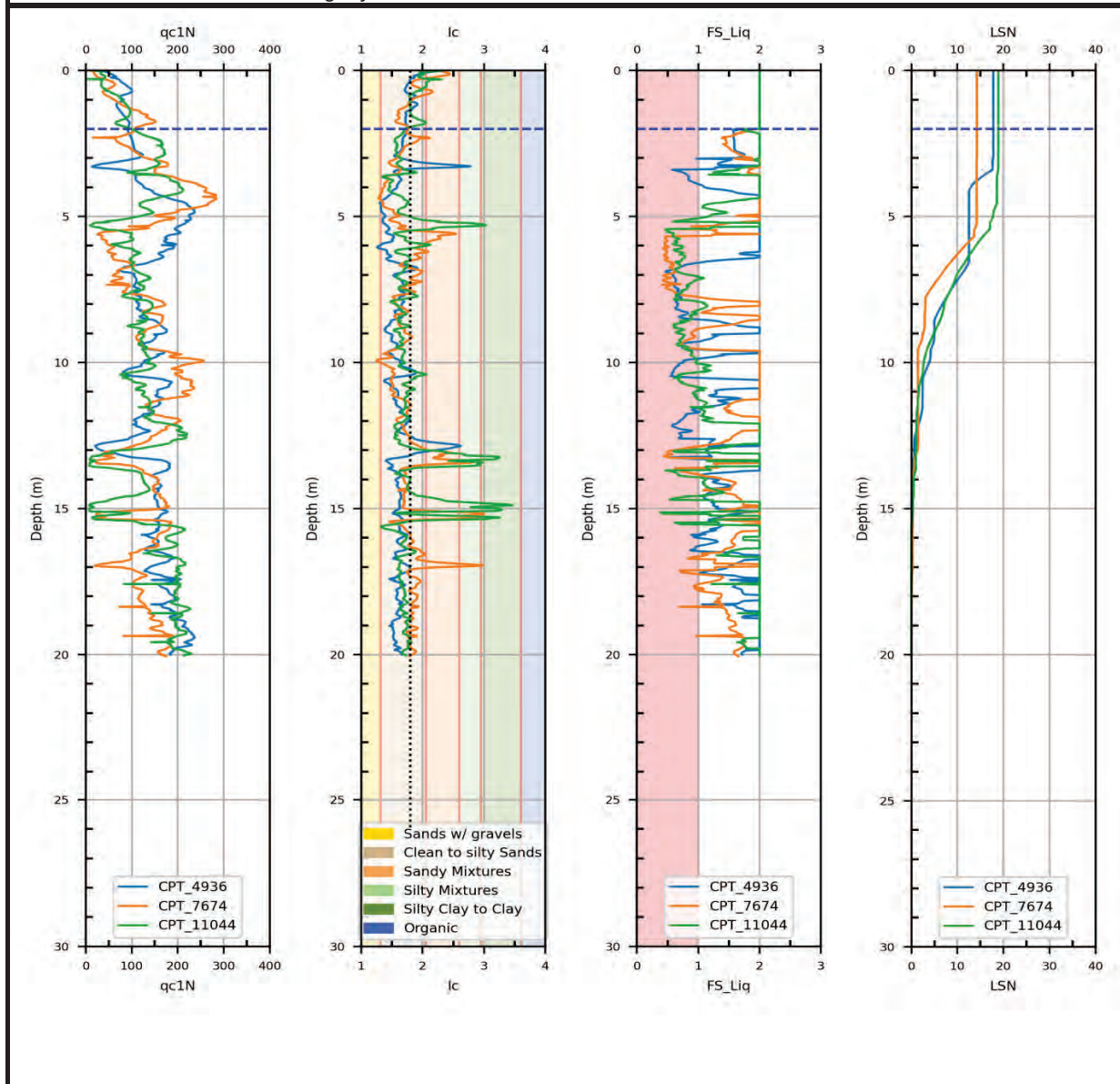
Case History: Ch-S165
Site: CC LIQ13 Shortland St (N^o 67)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 6.2 - 7.1
PGA: 0.19g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5154 Longitude 172.69367
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



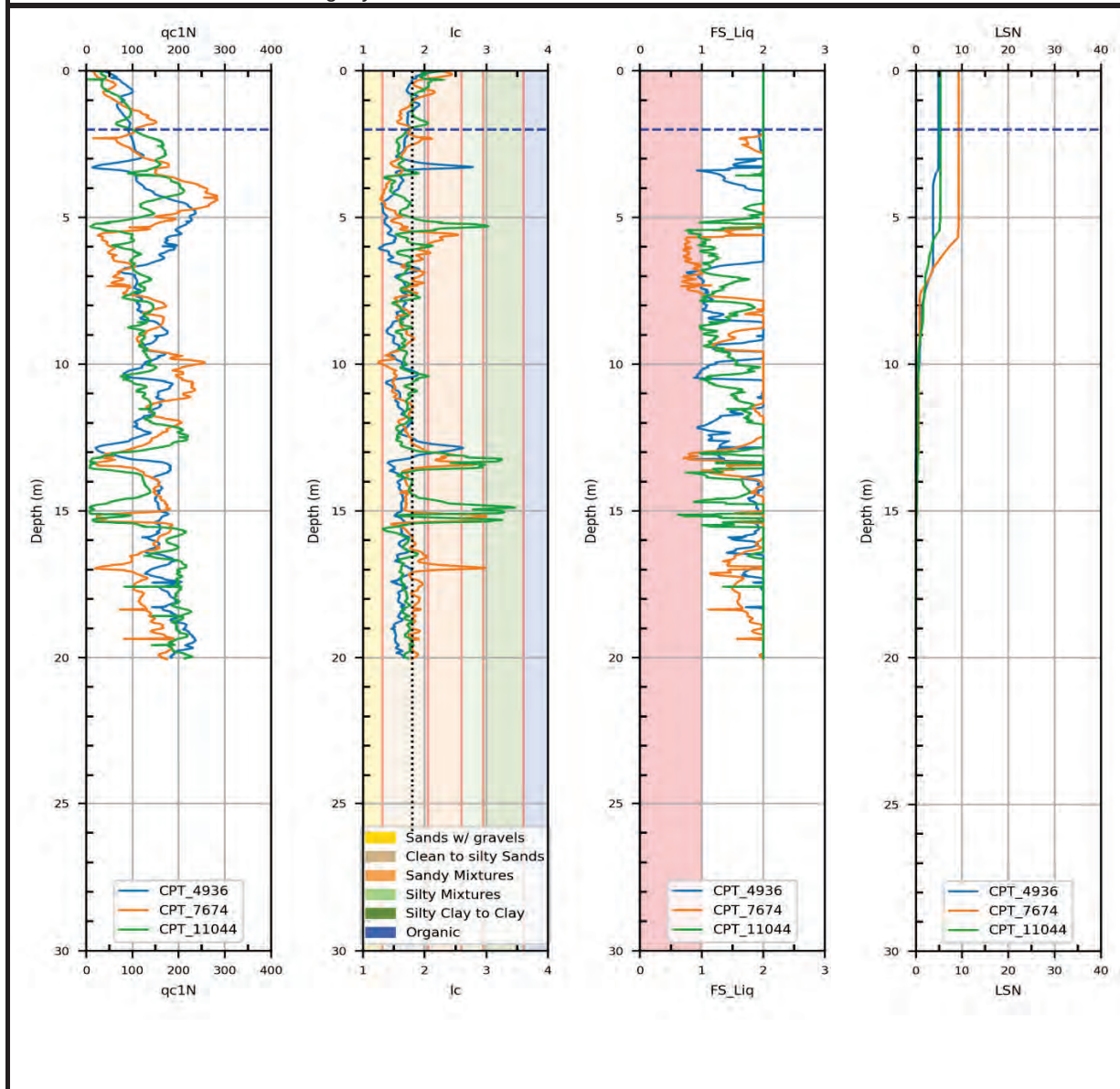
Case History: Ch-S166
Site: CC LIQ13 Shortland St (N^o 67)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2 - 7.1
PGA: 0.47g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5154 Longitude 172.69367
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S167
Site: CC LIQ13 Shortland St (N^o 67)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2 - 7.1
PGA: 0.29g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5154 Longitude 172.69367
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



CC LIQ15 Shirley Primary School

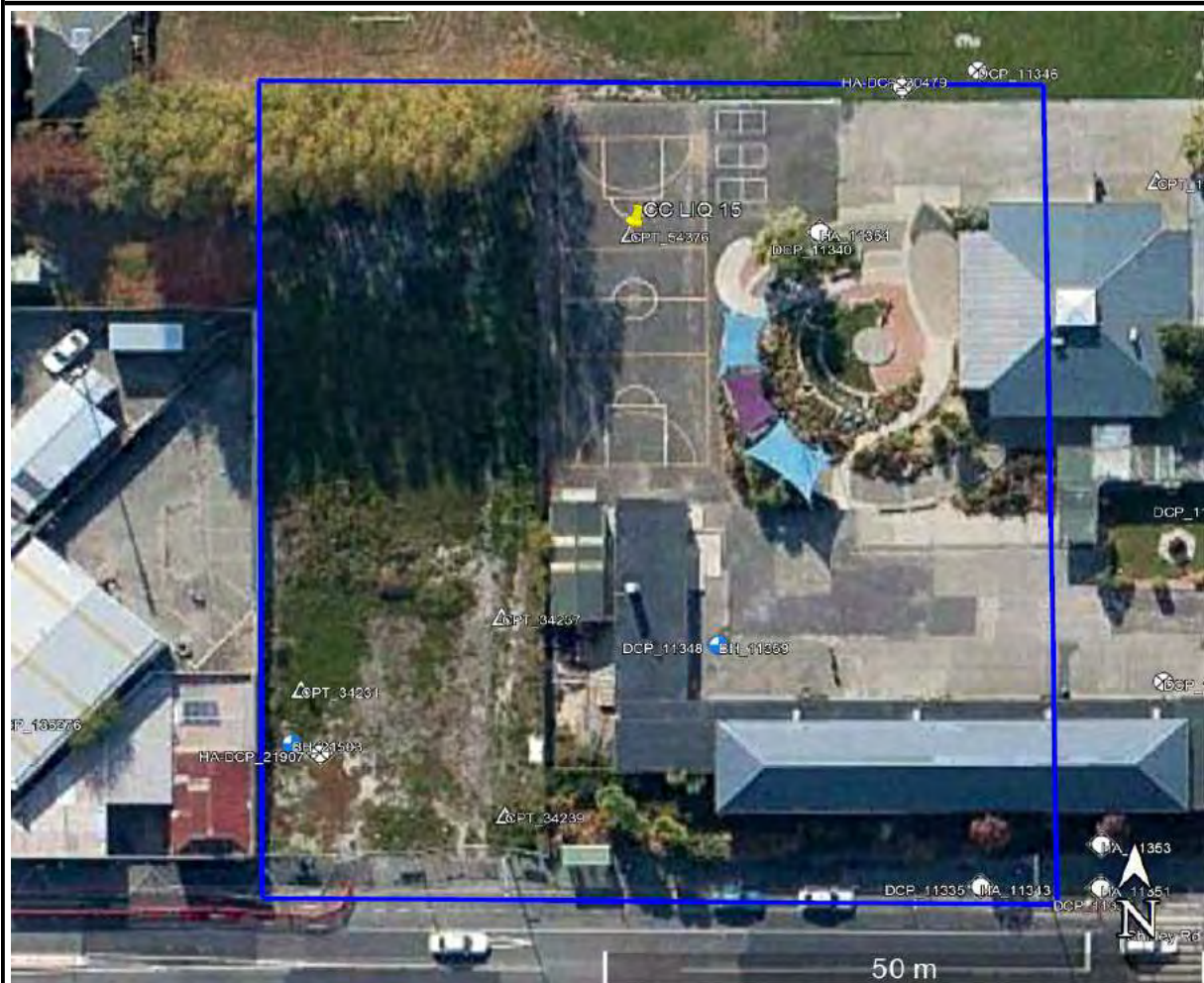
Case History:

Site: CC LIQ15 Shirley Primary School (N° 68)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.20g - 0.36g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.50748 Longitude 172.65307
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

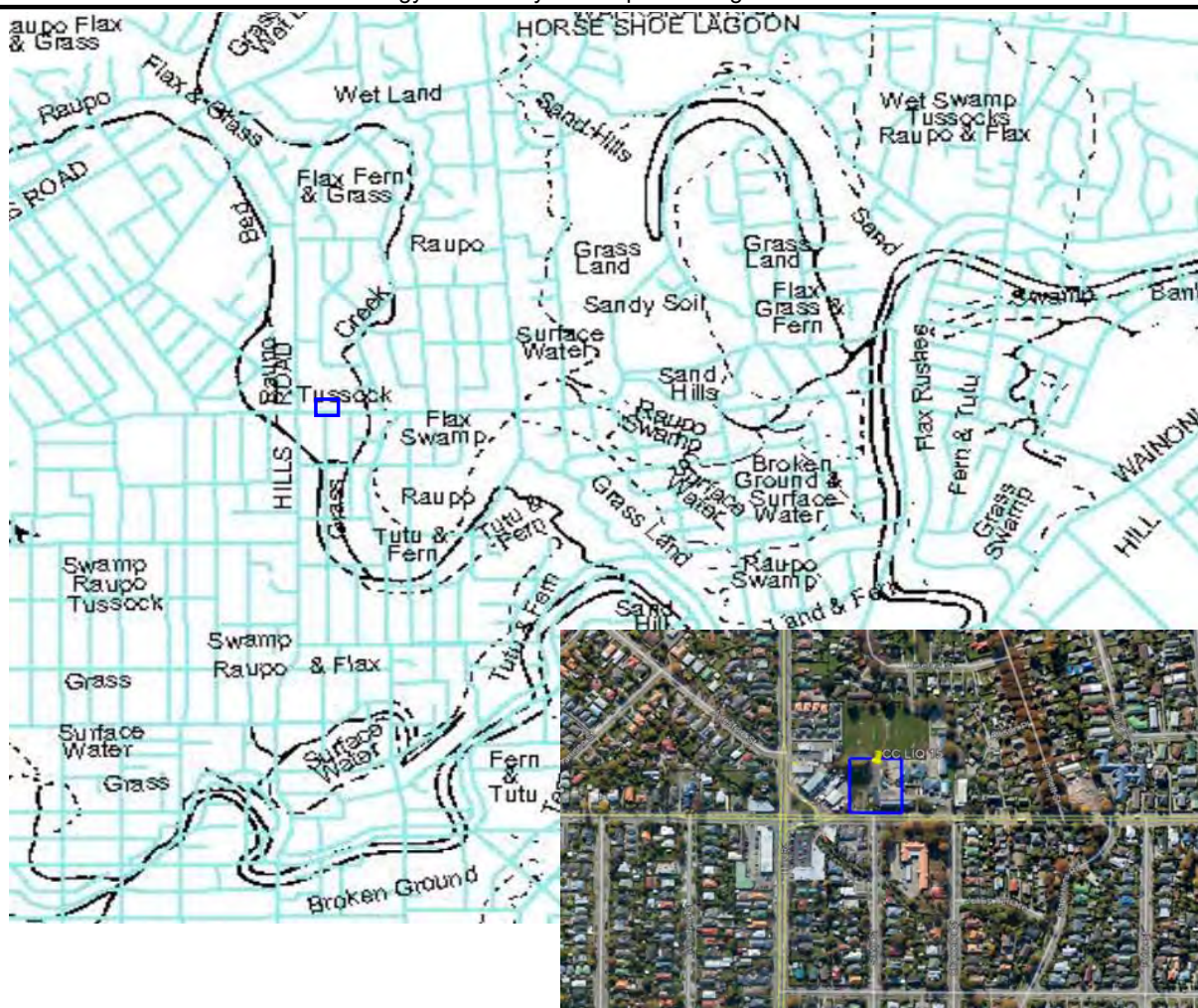
LSN van Ballegooy et al., 2014

Site Plan View**References:**

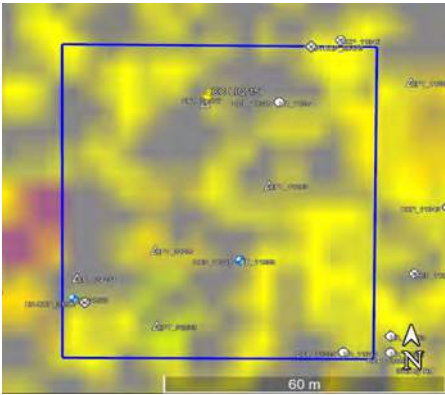
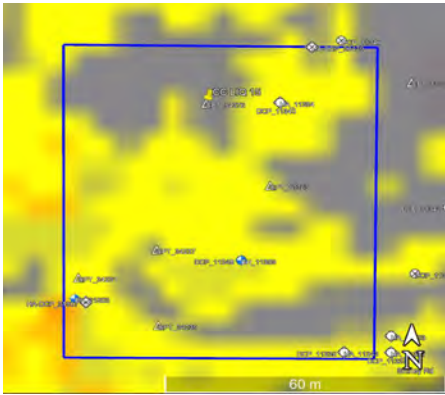
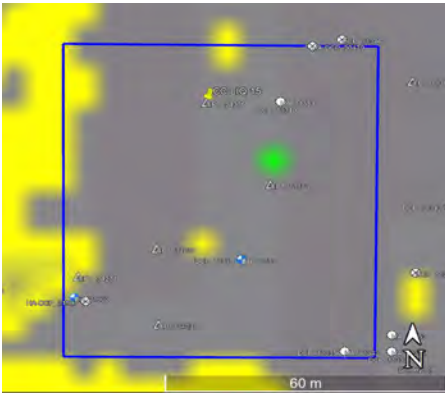
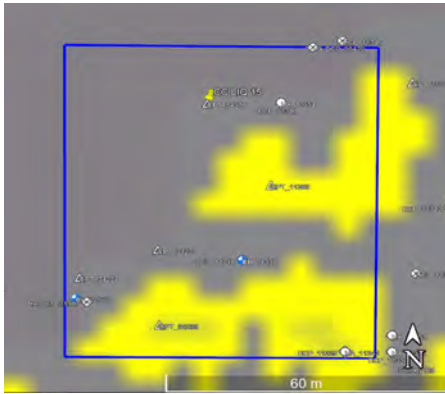
New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:**Site:** CC LIQ15 Shirley Primary School (N° 68)**Location:** Christchurch, New Zealand**Earthquake:** CES Mw 6.2 - 7.1**PGA:** 0.20g - 0.36g (Bradley's median estimate [Bradley and Hughes 2012])**Ground Elevation:** 0 m Datum: ground surface**Water table:** 2.0m avg. below ground surface (Tokin and Taylor 2013)**CPT:** All CPTs Latitude -43.50748 Longitude 172.65307**Source:** Christchurch City Council, map_Ap001725BlackMap.gws**qc1N, FS_{Liq} (PL = 50%)** Boulanger and Idriss, 2014; Robertson and Wride 1998/2009**lc** Robertson, 2009**LSN** van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

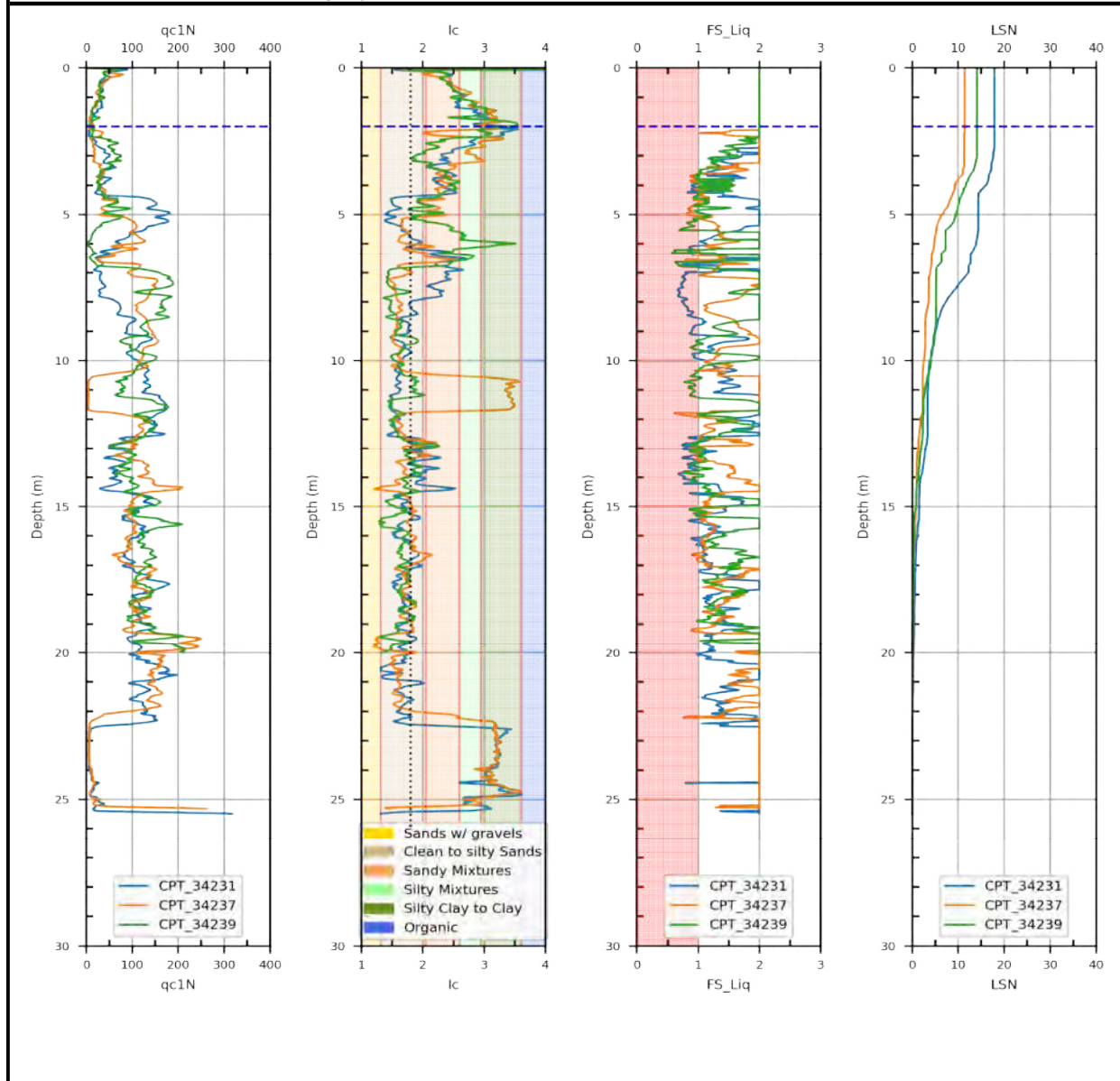


Case History:	
Site:	CC LIQ15 Shirley Primary School (N° 68)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.20g - 0.36g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.50748 Longitude 172.65307
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
	

Case History:											
Site:	CC LIQ15 Shirley Primary School (N° 68)										
Location:	Christchurch, New Zealand										
Earthquake:	CES Mw 6.2 - 7.1										
PGA:	0.20g - 0.36g (Bradley's median estimate [Bradley and Hughes 2012])										
Ground Elevation:	0 m Datum: ground surface										
Water table:	2.0m avg. below ground surface (Tokin and Taylor 2013)										
CPT:	All CPTs Latitude -43.50748 Longitude 172.65307										
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)										
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009										
Ic	Robertson, 2009										
LSN	van Ballegooy et al., 2014										
Free-Field Ground Settlement Measurement											
Estimated vertical settlement - Sep. 4, 2010 EQ	Estimated vertical settlement - Feb. 22, 2011 EQ										
											
Estimated vertical settlement - June 13, 2011 EQ	Estimated vertical settlement - Dec. 23, 2011										
											
LiDAR surveys dates: <table> <tr> <td>Pre-September 2010</td><td>Feb. 6-11, 2008</td></tr> <tr> <td>Post-September 2010</td><td>Sep. 5, 2010</td></tr> <tr> <td>Post-February 2011</td><td>March 8-10 and May 20-30, 2011</td></tr> <tr> <td>Post-June 2011</td><td>July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011</td></tr> <tr> <td>Post-December 2011</td><td>Feb. 17-18, 2012</td></tr> </table>		Pre-September 2010	Feb. 6-11, 2008	Post-September 2010	Sep. 5, 2010	Post-February 2011	March 8-10 and May 20-30, 2011	Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011	Post-December 2011	Feb. 17-18, 2012
Pre-September 2010	Feb. 6-11, 2008										
Post-September 2010	Sep. 5, 2010										
Post-February 2011	March 8-10 and May 20-30, 2011										
Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011										
Post-December 2011	Feb. 17-18, 2012										
Vertical Elevation Change without Tectonic Component 1.0 to 1.5 m 0.5 to 1.0 m 0.4 to 0.3 m 0.3 to 0.4 m 0.2 to 0.3 m 0.1 to 0.2 m -0.1 to 0.1 m -0.2 to -0.1 m -0.3 to -0.2 m -0.4 to -0.3 m -0.5 to -0.4 m -1.0 to -0.5 m -1.5 to -1.0 m - Subsided + Uplifted - Subsided											

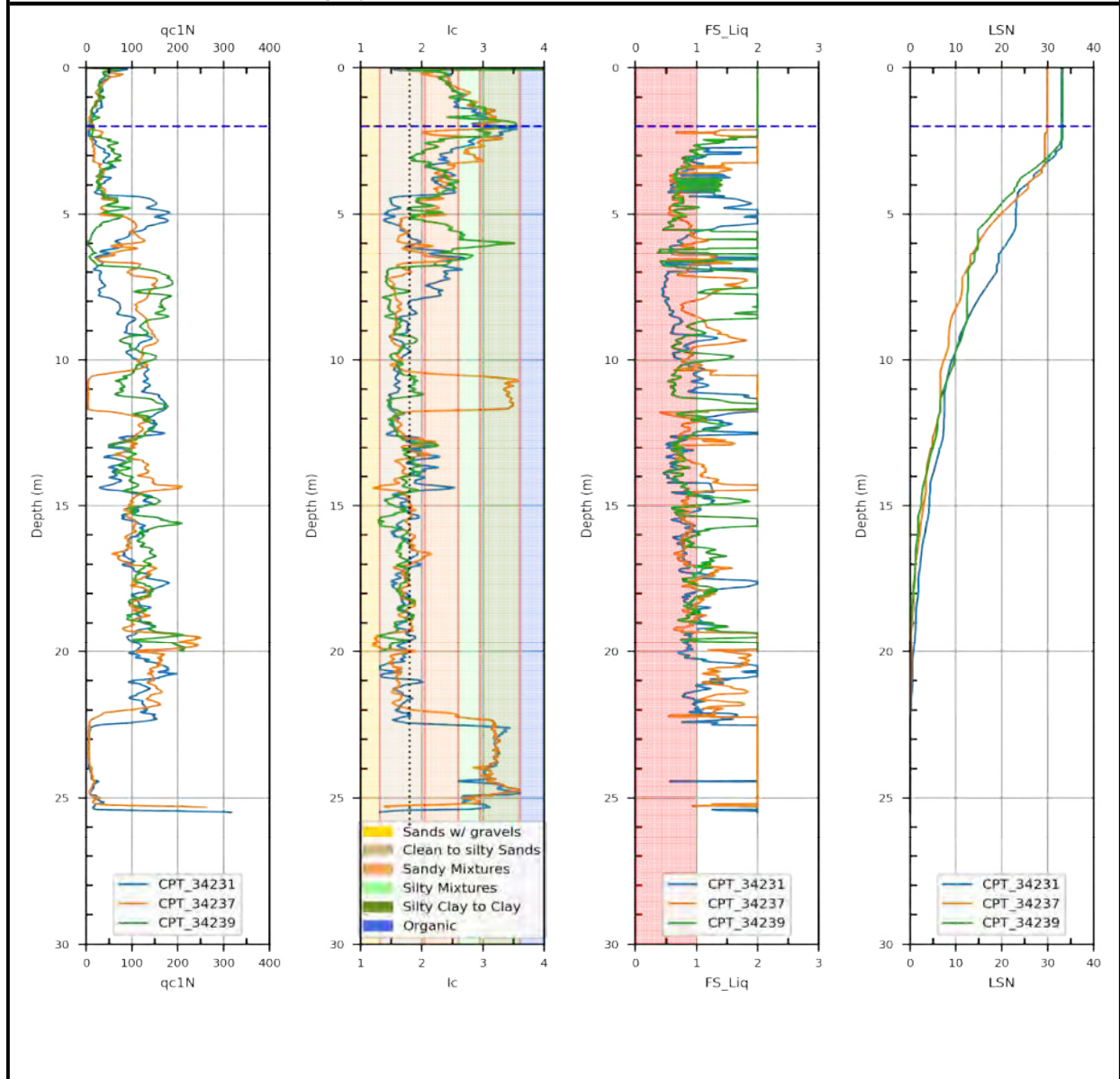
Case History: Ch-S168
Site: CC LIQ15 Shirley Primary School (N° 68)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 6.2 - 7.1
PGA: 0.20g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.50748 Longitude 172.65307
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



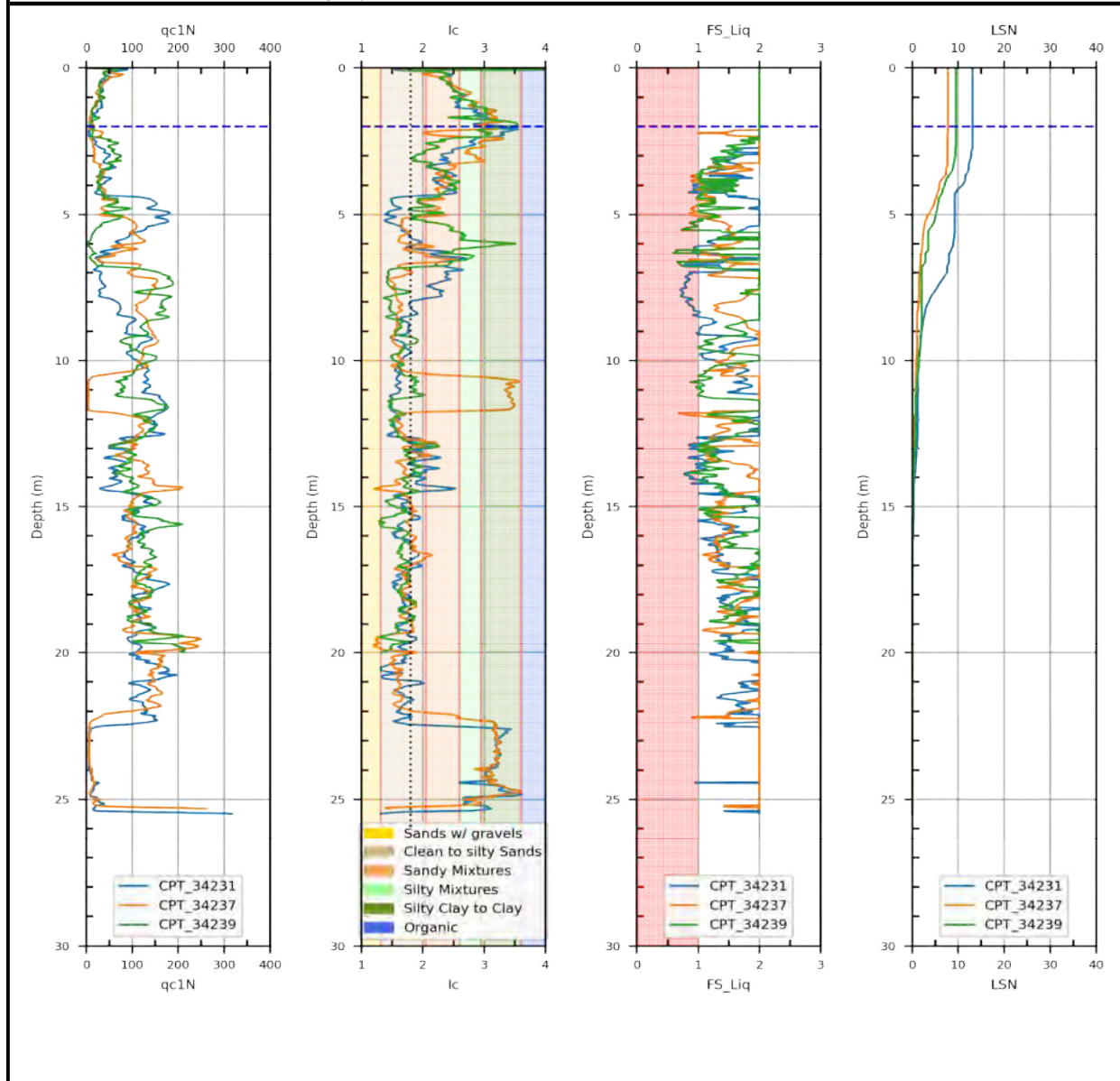
Case History: Ch-S169
Site: CC LIQ15 Shirley Primary School (N° 68)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2 - 7.1
PGA: 0.36g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.50748 Longitude 172.65307
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S170
Site: CC LIQ15 Shirley Primary School (N° 68)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2 - 7.1
PGA: 0.21g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.50748 Longitude 172.65307
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



CC LIQ17 Biderford Pl

Case History:

Site: CC LIQ17 Bideford PI (N° 69)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.19g - 0.43g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5125 Longitude 172.67507
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

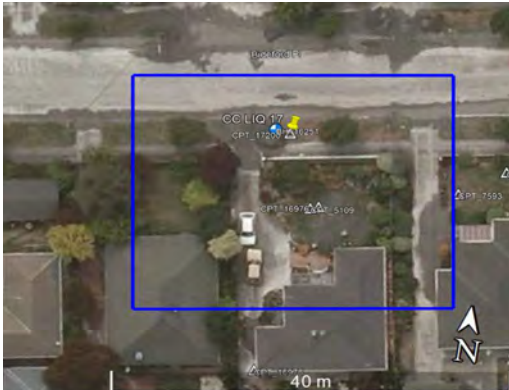
Site Plan View**References:**

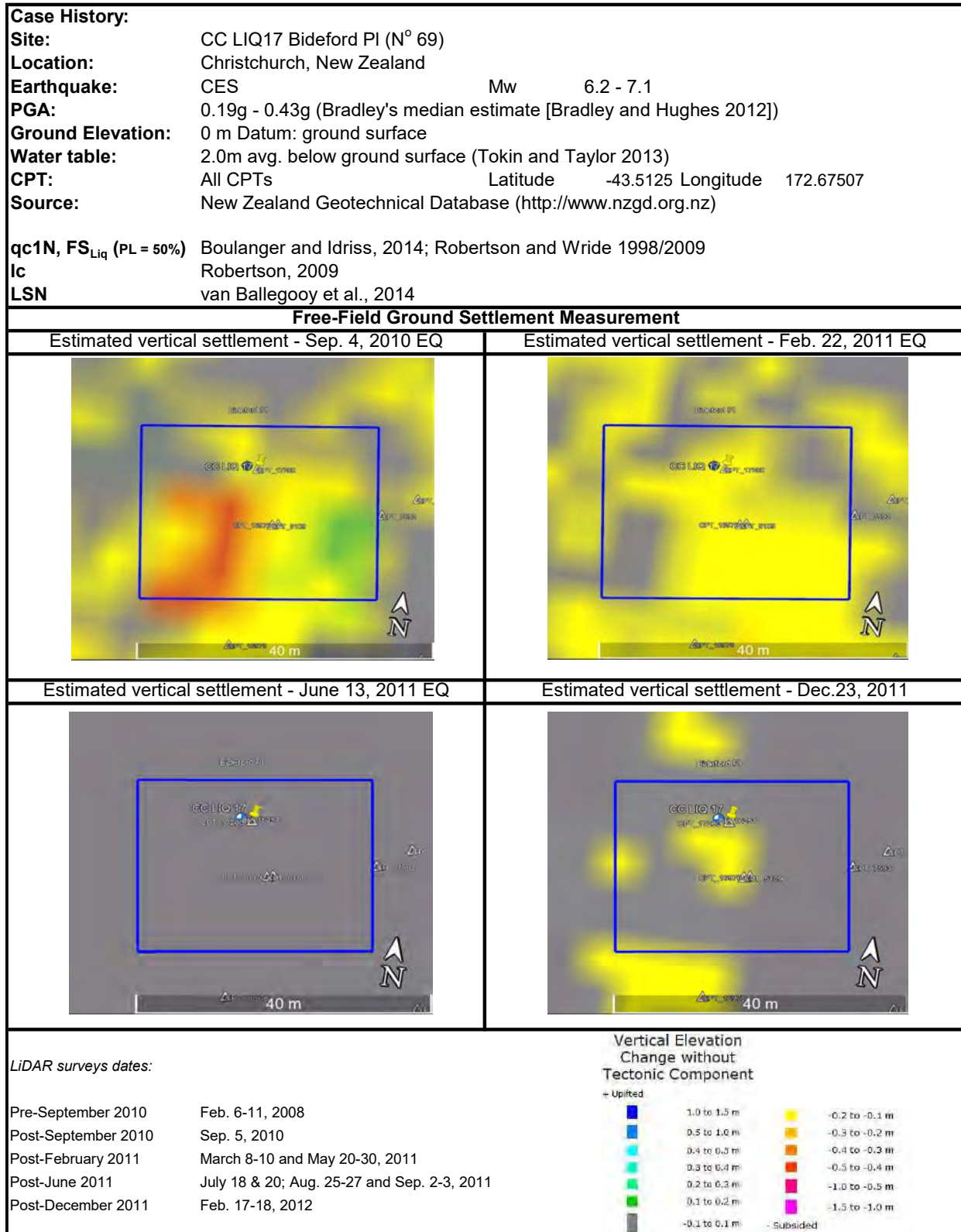
New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:**Site:** CC LIQ17 Bideford PI (N° 69)**Location:** Christchurch, New Zealand**Earthquake:** CES Mw 6.2 - 7.1**PGA:** 0.19g - 0.43g (Bradley's median estimate [Bradley and Hughes 2012])**Ground Elevation:** 0 m Datum: ground surface**Water table:** 2.0m avg. below ground surface (Tokin and Taylor 2013)**CPT:** All CPTs Latitude -43.5125 Longitude 172.67507**Source:** Christchurch City Council, map_Ap001725BlackMap.gws**qc1N, FS_{Liq} (PL = 50%)** Boulanger and Idriss, 2014; Robertson and Wride 1998/2009**lc** Robertson, 2009**LSN** van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

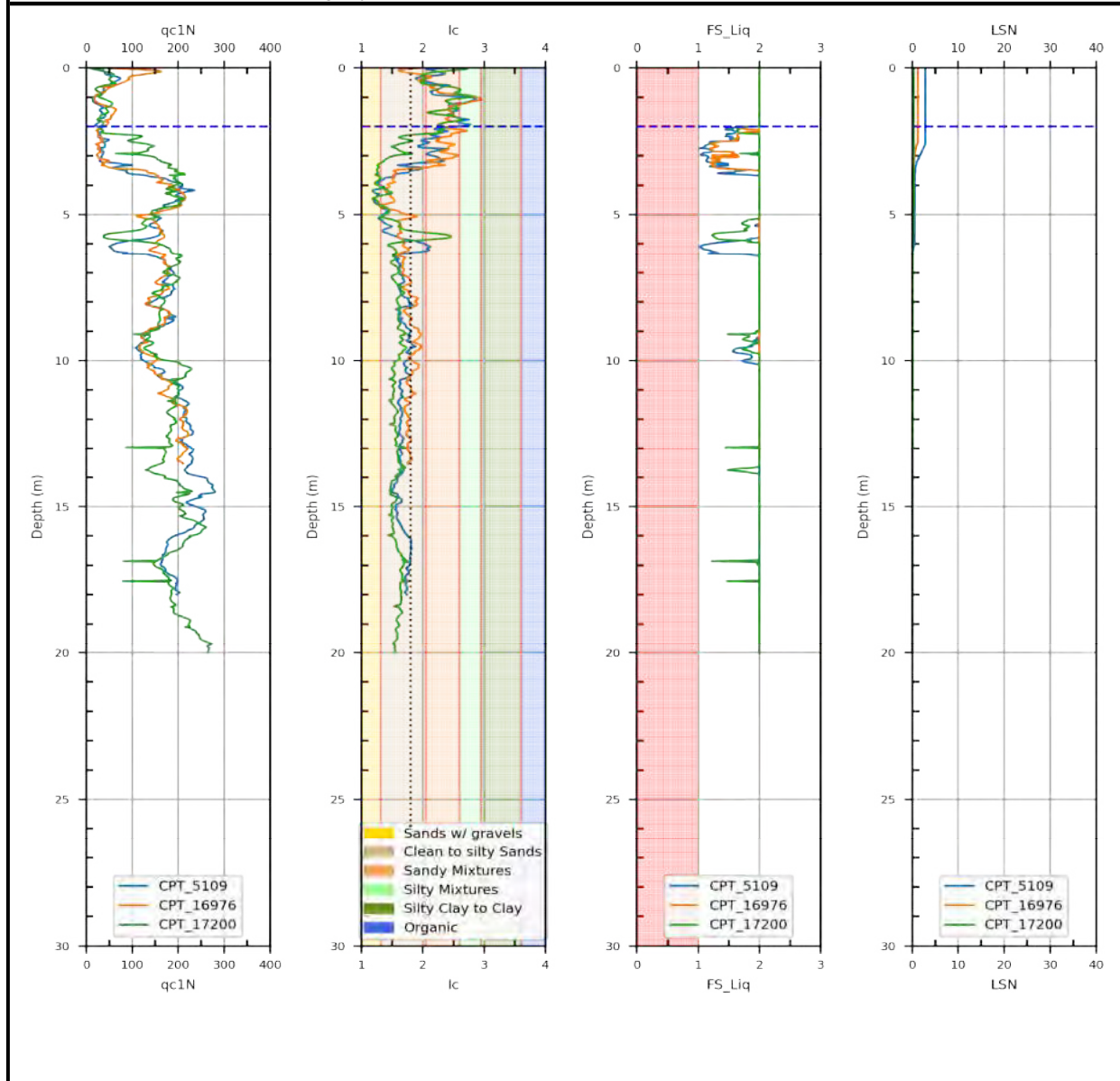


Case History:	
Site:	CC LIQ17 Bideford PI (N° 69)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.19g - 0.43g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.5125 Longitude 172.67507
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	
	
Aerial photography taken on February 24, 2011	
	
Aerial photography taken on June 14-15, 2011	
	
Aerial photography taken on December 24, 2011	
	
	



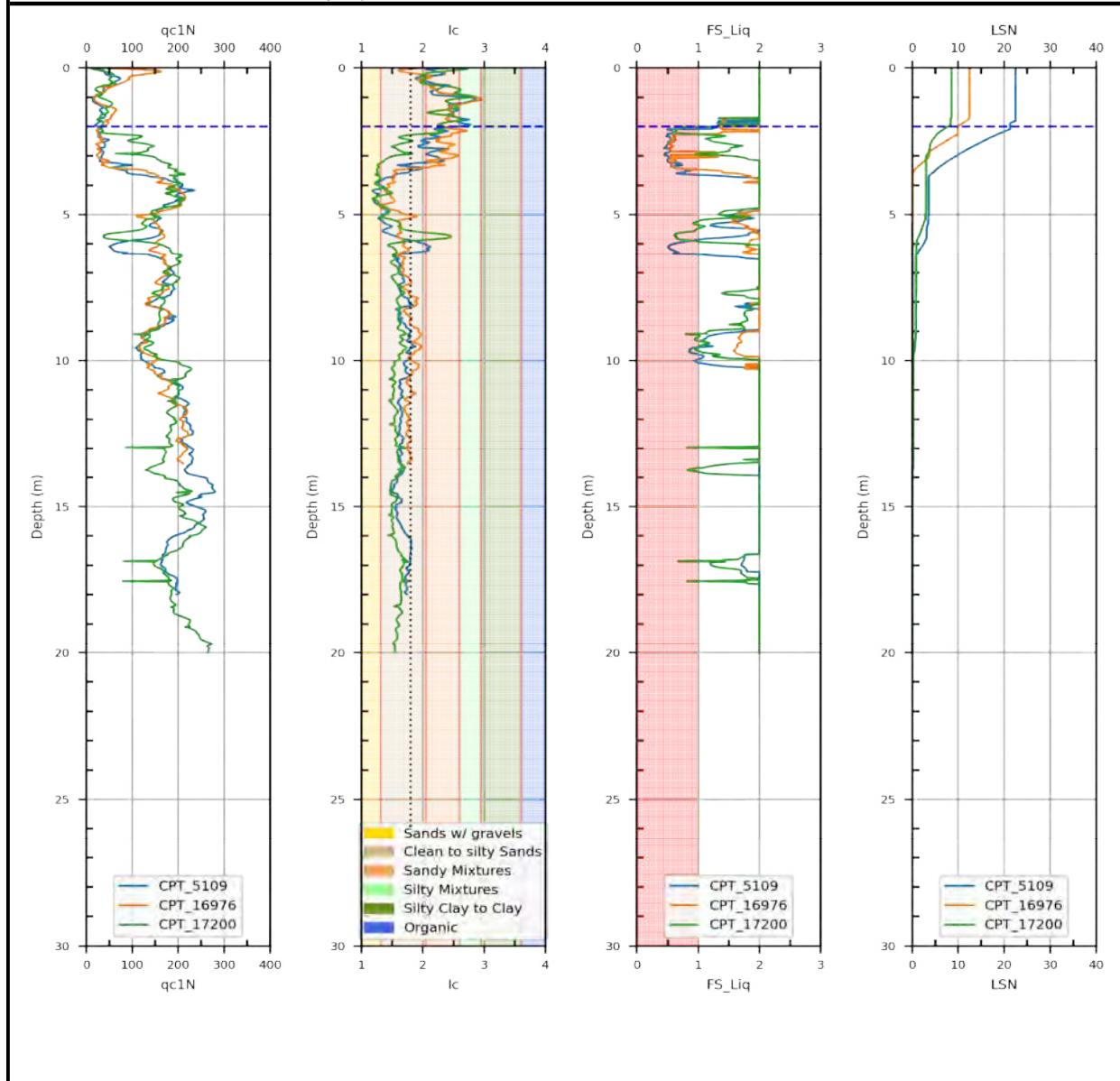
Case History: Ch-S171
Site: CC LIQ17 Bideford PI (N° 69)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 6.2 - 7.1
PGA: 0.20g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5125 Longitude 172.67507
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



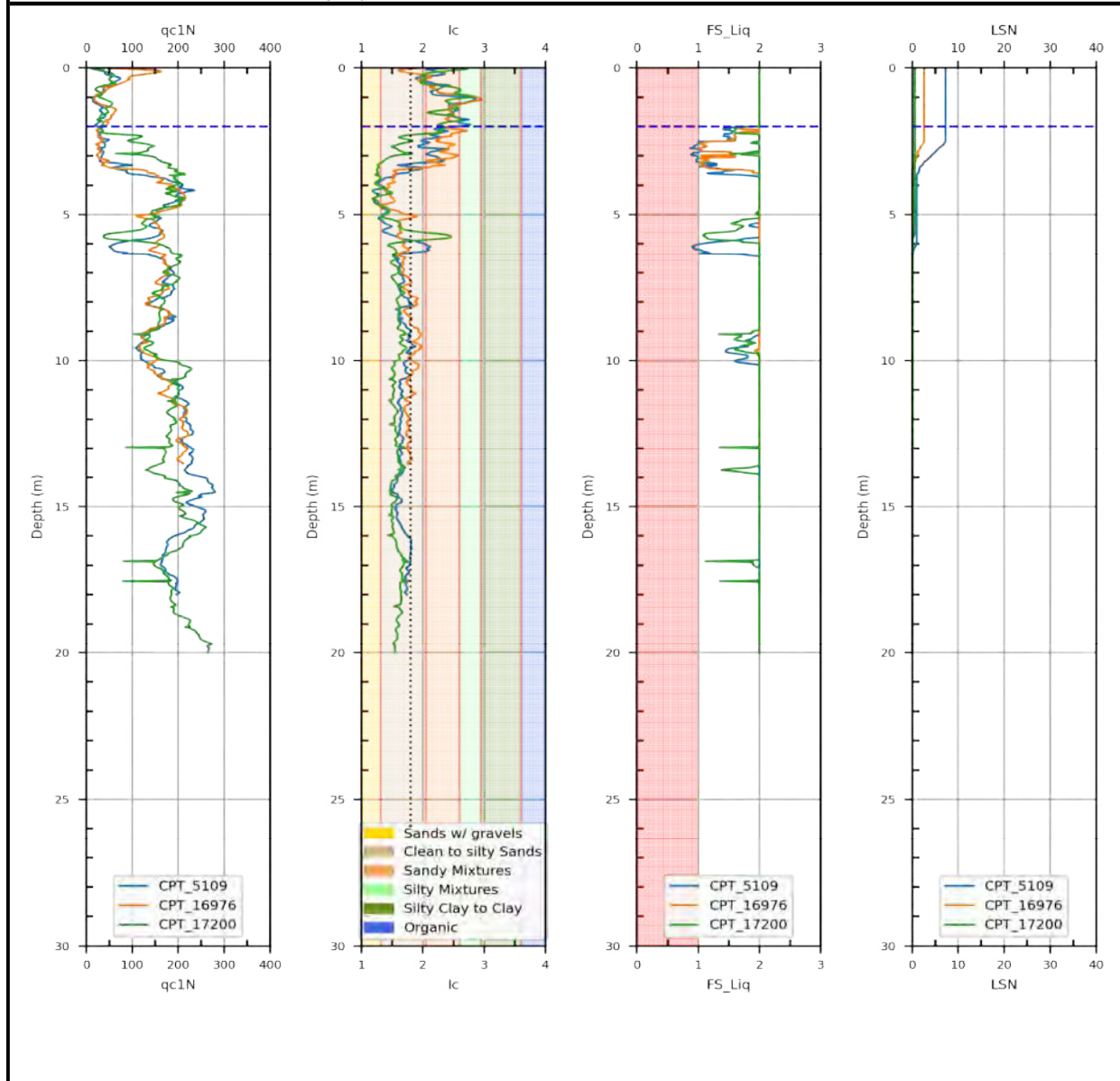
Case History: Ch-S172
Site: CC LIQ17 Bideford PI (N° 69)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2 - 7.1
PGA: 0.36g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5125 Longitude 172.67507
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S173
Site: CC LIQ17 Bideford PI (N° 69)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2 - 7.1
PGA: 0.21g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.5125 Longitude 172.67507
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



CC LIQ25 Dunarnan Street

Case History:

Site: CC LIQ25 Dunarnan St (N° 70)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.21g - 0.53g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.5m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.52227 Longitude 172.67599
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

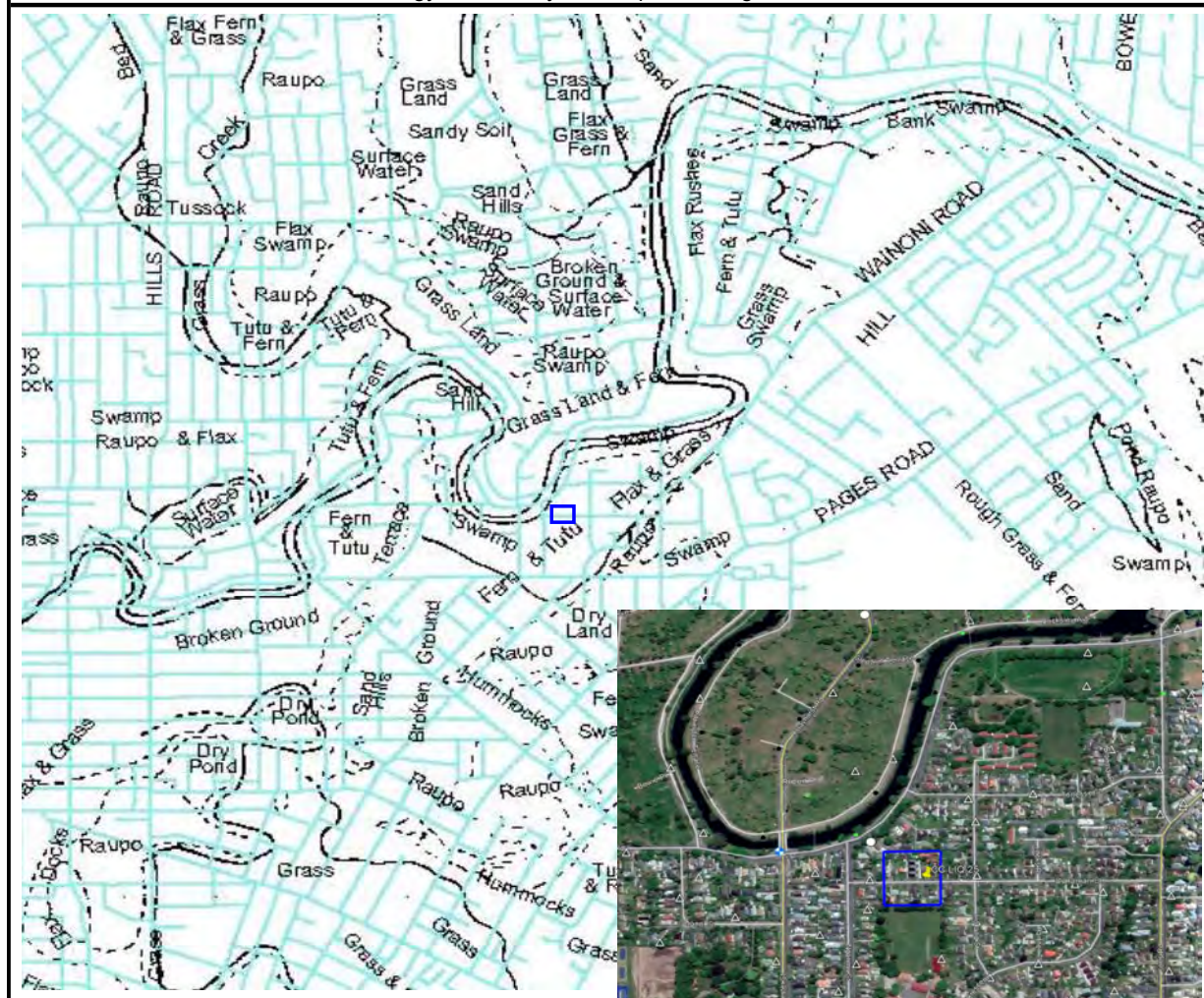
Site Plan View**References:**

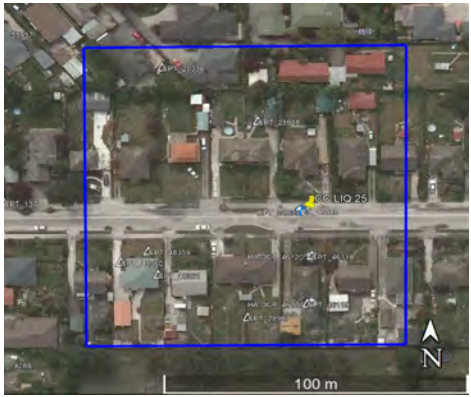
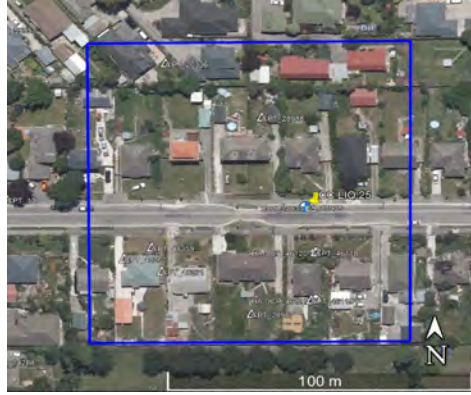
New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Site:	CC LIQ25 Dunarnan St (N ^o 70)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.21g - 0.53g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	2.5m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.52227 Longitude 172.67599
Source:	Christchurch City Council, map_Ap001725BlackMap.gws

Robertson, 2009

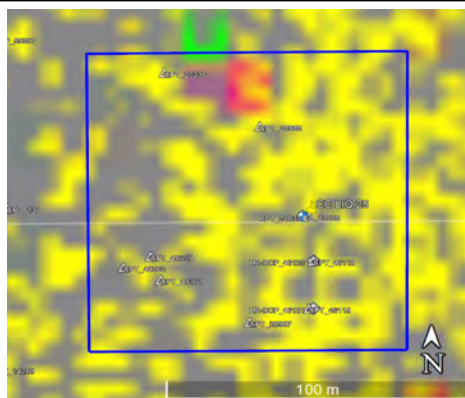
Surficial Geology - waterways swamps and vegetation cover in 1856



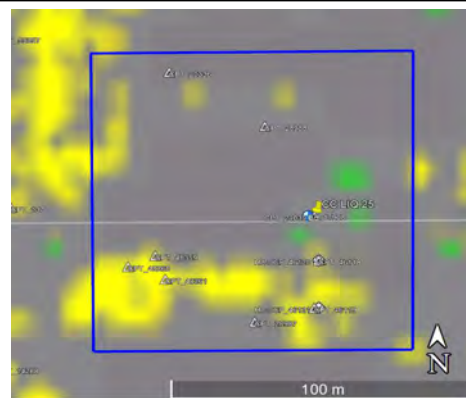
Case History:	
Site:	CC LIQ25 Dunarnan St (N° 70)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.21g - 0.53g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	2.5m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.52227 Longitude 172.67599
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	
	
Aerial photography taken on February 24, 2011	
	
Aerial photography taken on June 14-15, 2011	
	
Aerial photography taken on December 24, 2011	
	
	

Case History:**Site:** CC LIQ25 Dunarnan St (N° 70)**Location:** Christchurch, New Zealand**Earthquake:** CES Mw 6.2 - 7.1**PGA:** 0.21g - 0.53g (Bradley's median estimate [Bradley and Hughes 2012])**Ground Elevation:** 0 m Datum: ground surface**Water table:** 2.5m avg. below ground surface (Tokin and Taylor 2013)**CPT:** All CPTs Latitude -43.52227 Longitude 172.67599**Source:** New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)**qc1N, FS_{Liq} (PL = 50%)** Boulanger and Idriss, 2014; Robertson and Wride 1998/2009**Ic** Robertson, 2009**LSN** van Ballegooy et al., 2014**Free-Field Ground Settlement Measurement**

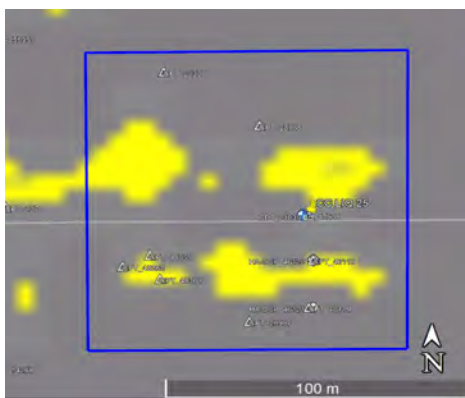
Estimated vertical settlement - Sep. 4, 2010 EQ



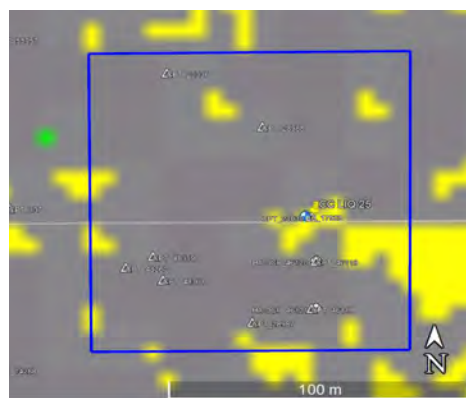
Estimated vertical settlement - Feb. 22, 2011 EQ



Estimated vertical settlement - June 13, 2011 EQ



Estimated vertical settlement - Dec.23, 2011

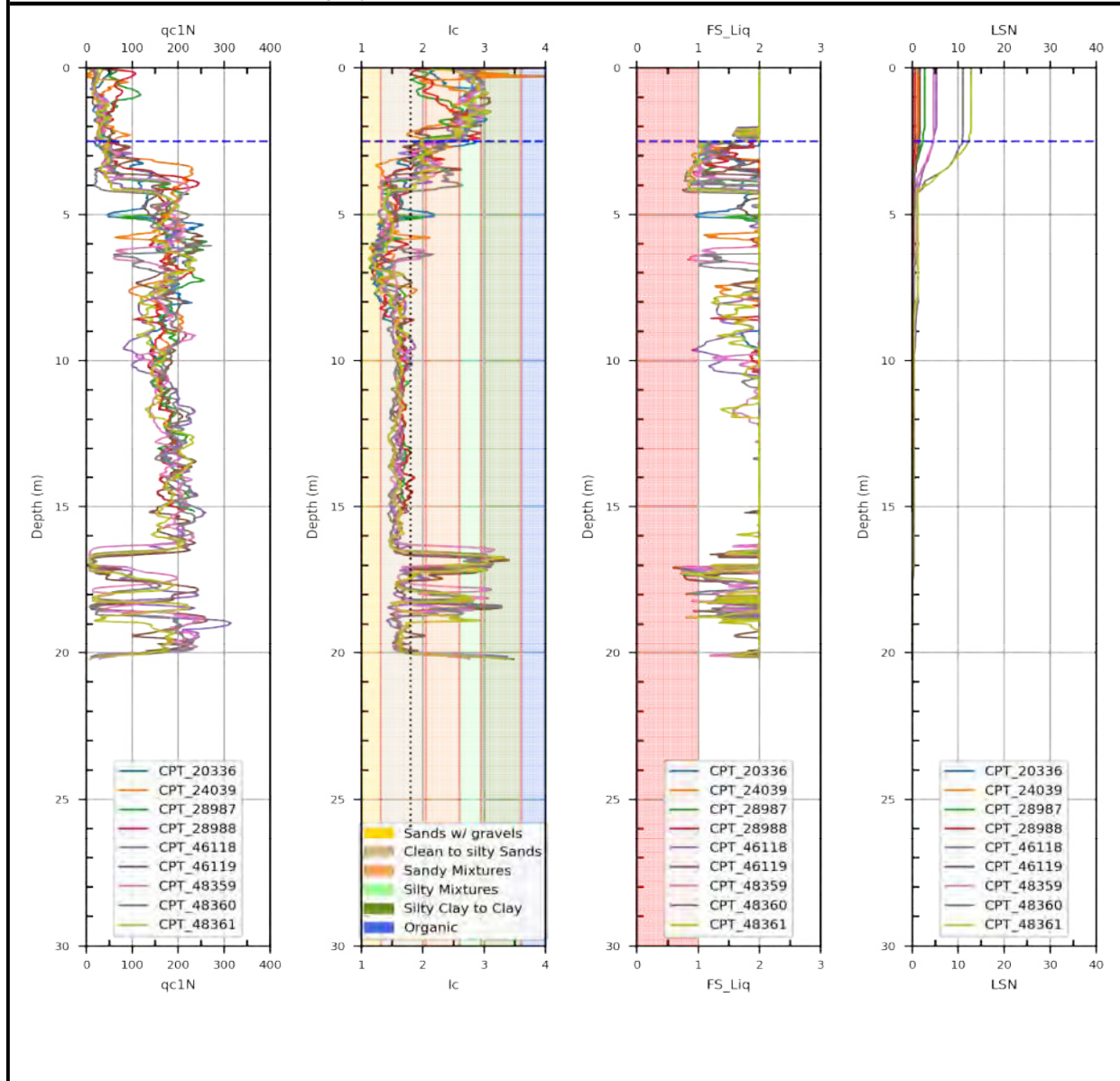
**LiDAR surveys dates:**

Pre-September 2010	Feb. 6-11, 2008
Post-September 2010	Sep. 5, 2010
Post-February 2011	March 8-10 and May 20-30, 2011
Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011
Post-December 2011	Feb. 17-18, 2012

Vertical Elevation Change without Tectonic Component

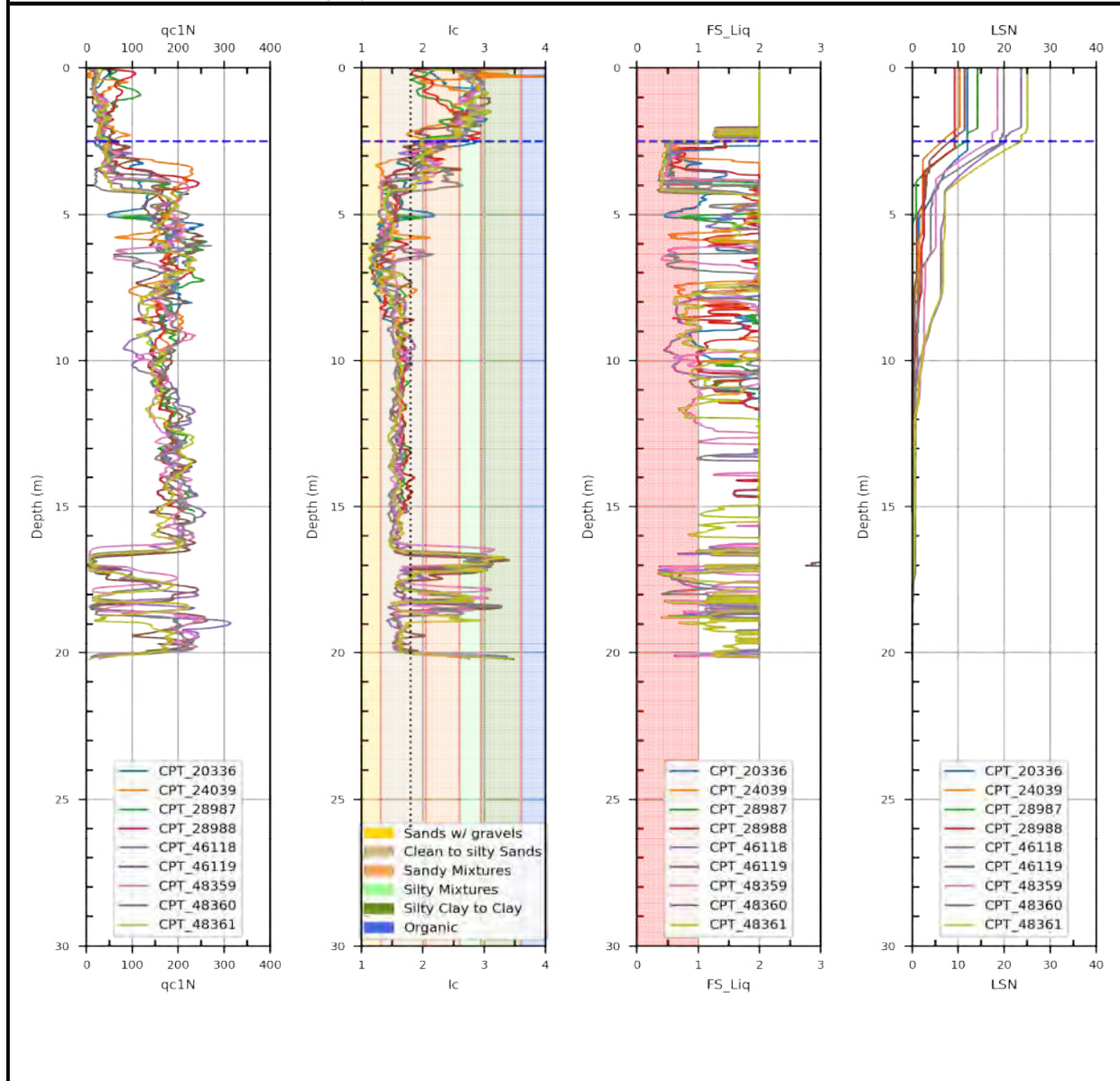
Case History: Ch-S174
Site: CC LIQ25 Dunarnan St (N° 70)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 6.2 - 7.1
PGA: 0.21g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.5m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.52227 Longitude 172.67599
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



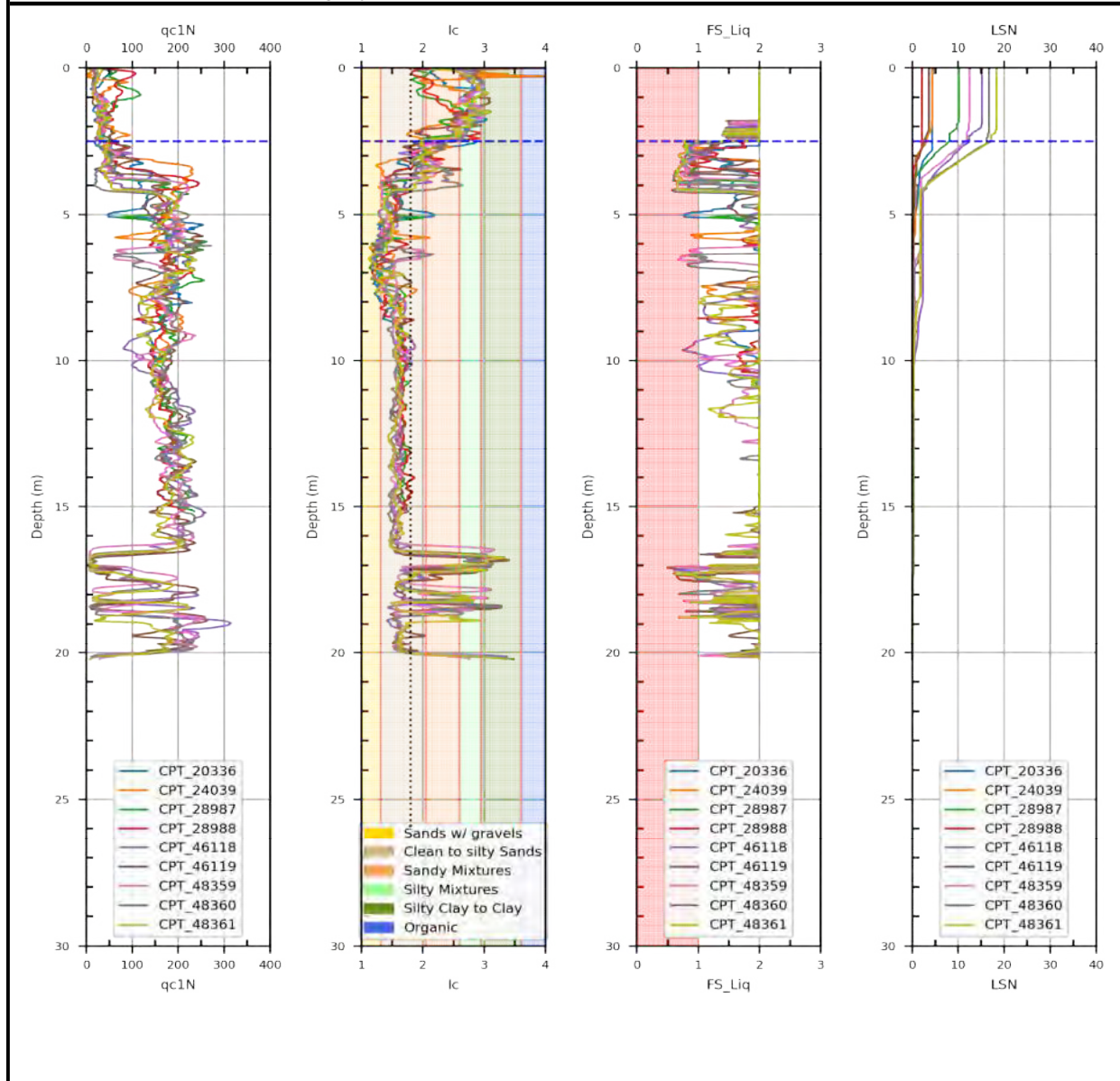
Case History: Ch-S175
Site: CC LIQ25 Dunarnan St (N° 70)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2 - 7.1
PGA: 0.53g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.5m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.52227 Longitude 172.67599
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S176
Site: CC LIQ25 Dunarnan St (N° 70)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2 - 7.1
PGA: 0.31g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.5m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.52227 Longitude 172.67599
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



CC LIQ28 Mark Treffers Dr.

Case History:

Site: CC LIQ28 Mark Treffers Dr (N° 71)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.43g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.5m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.49112 Longitude 172.70878
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

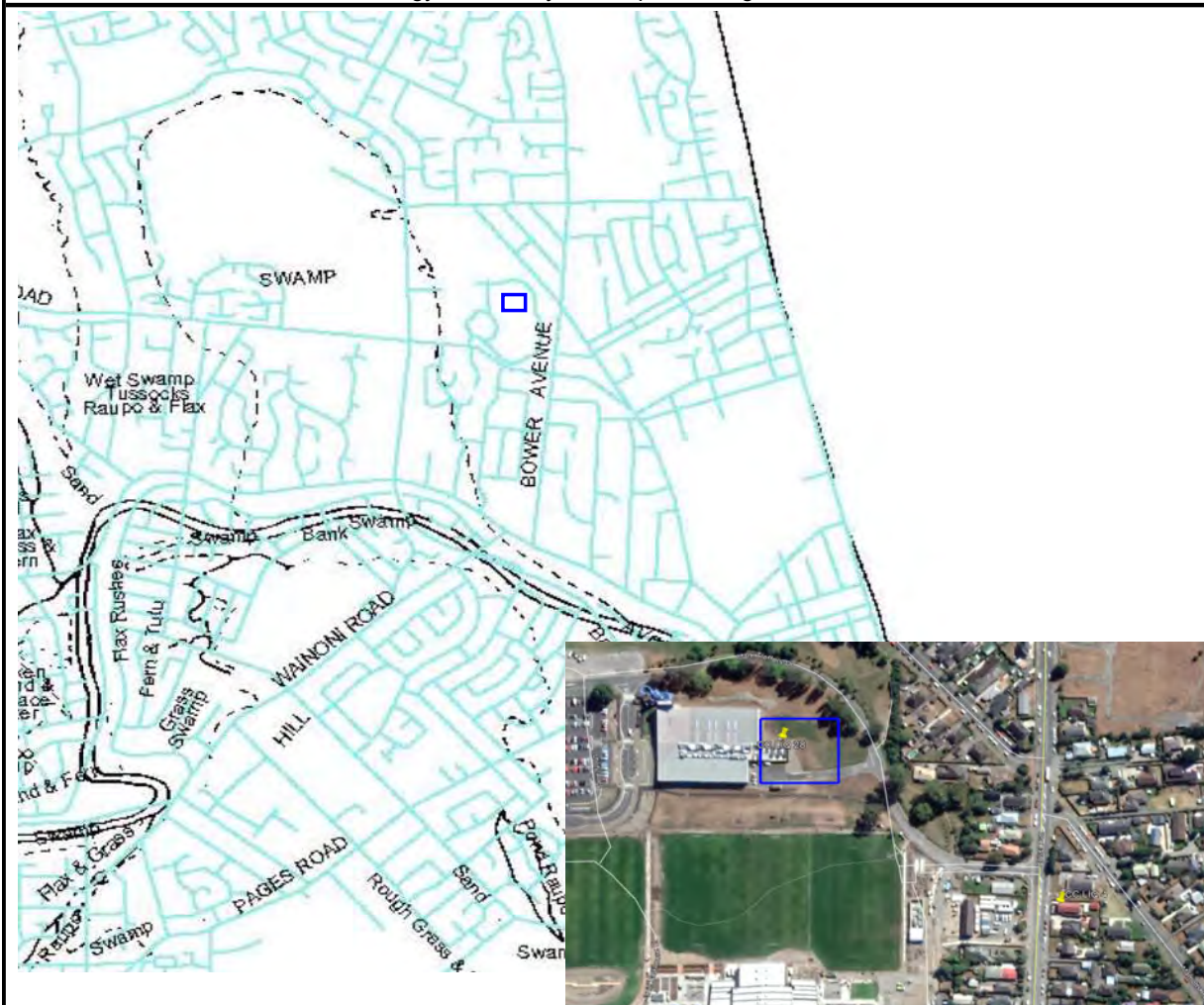
Site: CC LIQ28 Mark Treffers Dr (N° 71)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.43g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.5m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.49112 Longitude 172.70878
Source: Christchurch City Council, map_Ap001725BlackMap.gws

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

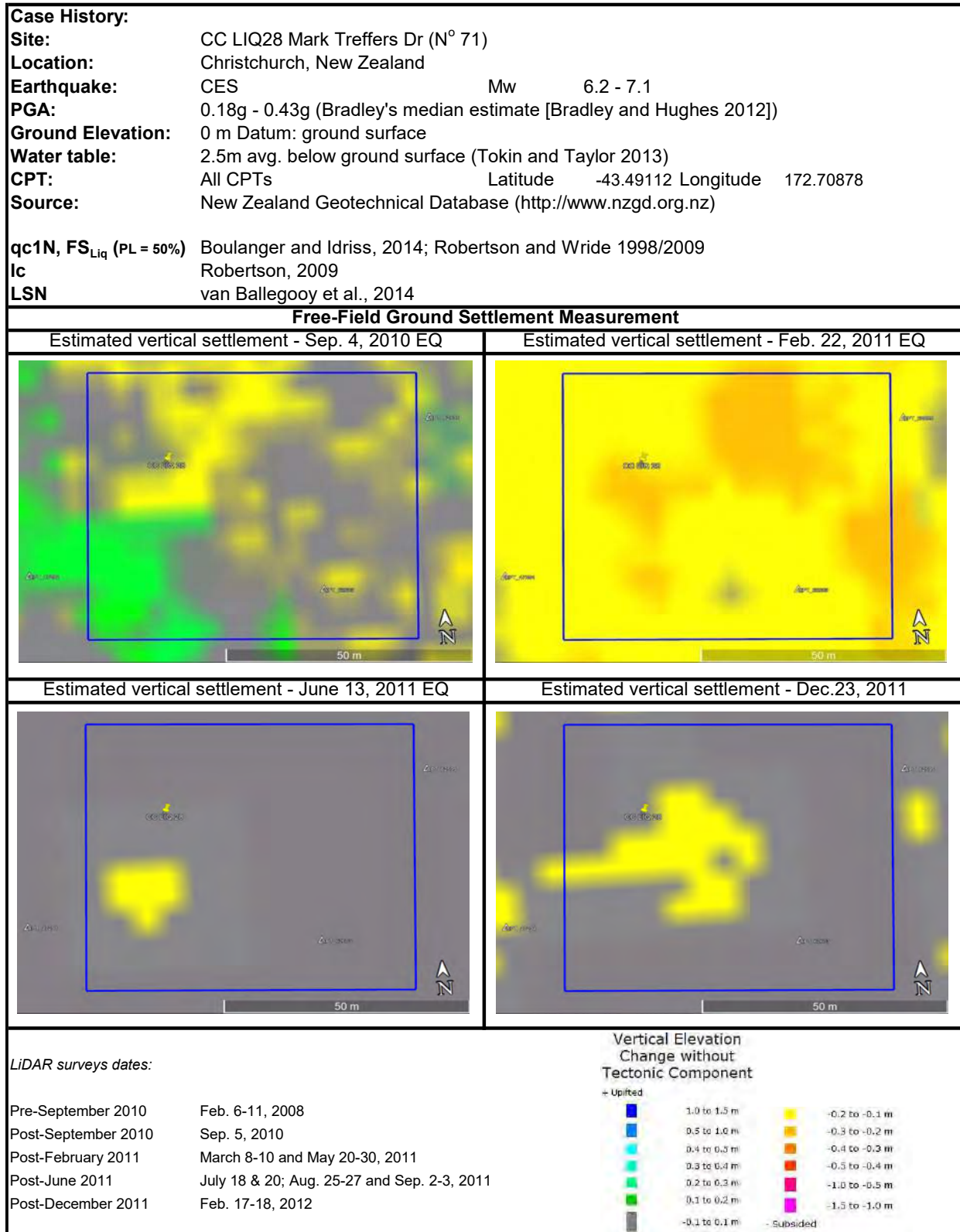
lc Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

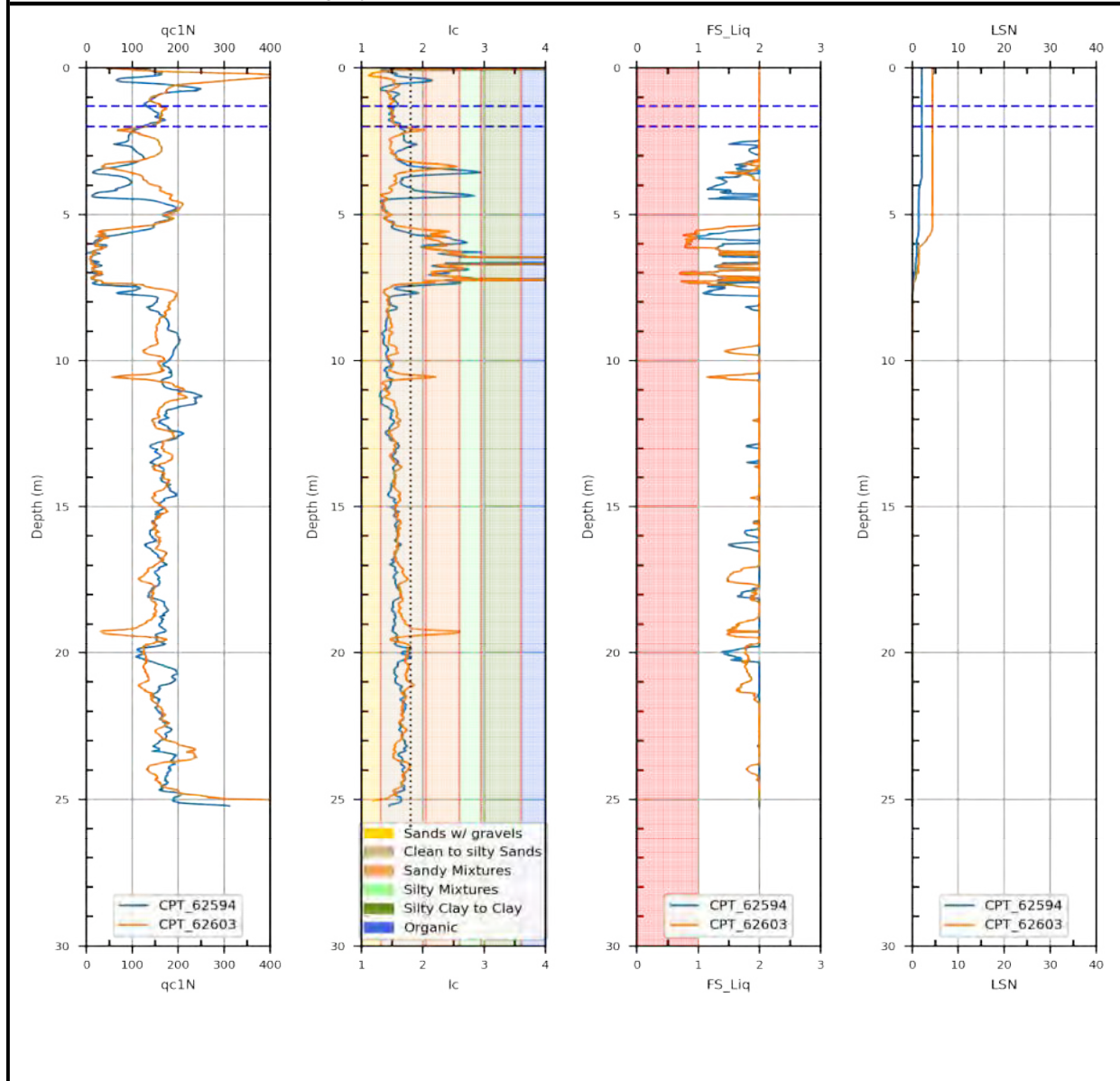


Case History:	
Site:	CC LIQ28 Mark Treffers Dr (N° 71)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.18g - 0.43g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	2.5m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.49112 Longitude 172.70878
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
	



Case History: Ch-S177
Site: CC LIQ28 Mark Treffers Dr (N° 71)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 6.2 - 7.1
PGA: 0.18g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.5m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.49112 Longitude 172.70878
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014

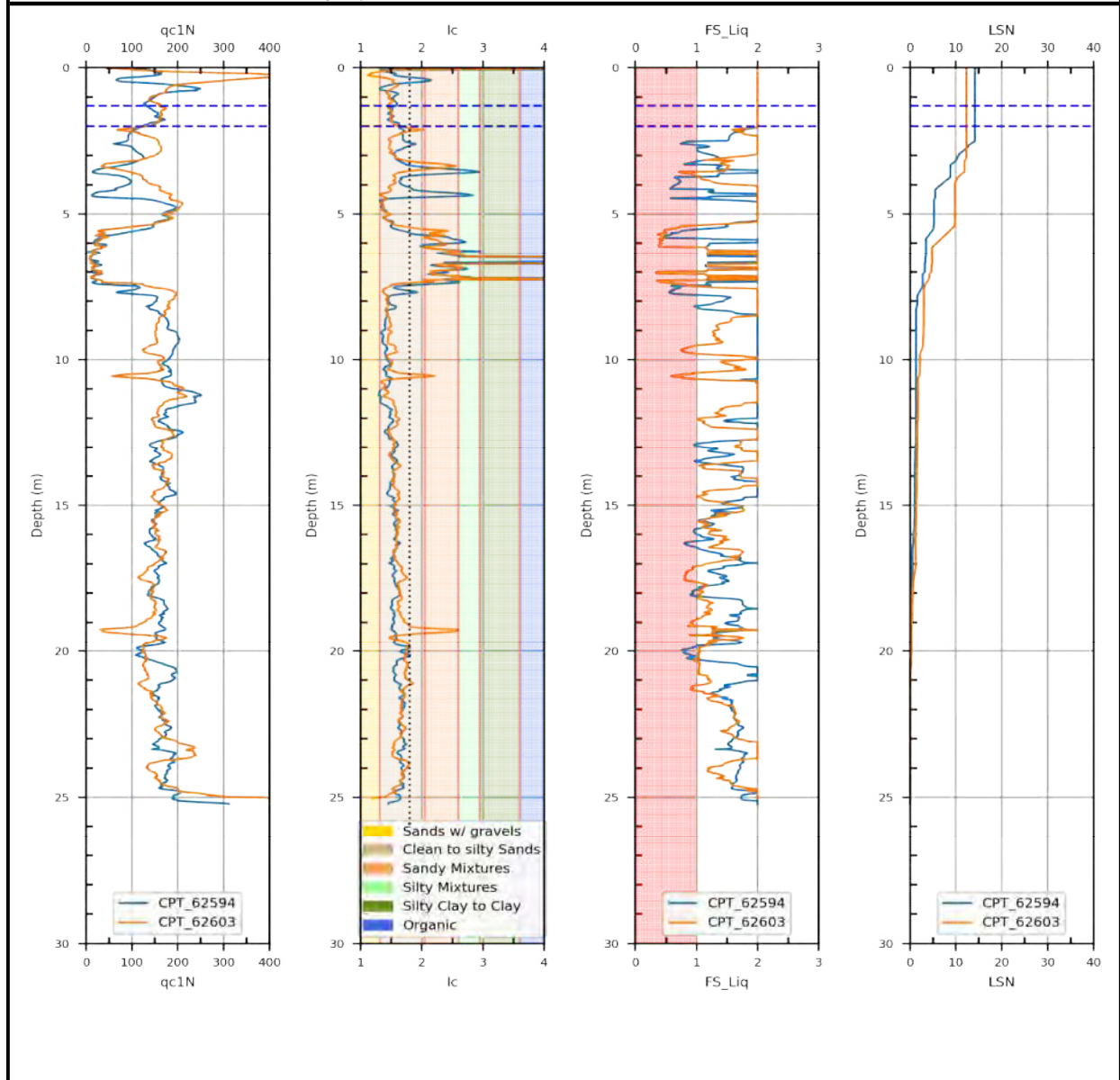


Case History: Ch-S178
Site: CC LIQ28 Mark Treffers Dr (N° 71)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2 - 7.1
PGA: 0.43g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.5m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.49112 Longitude 172.70878
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

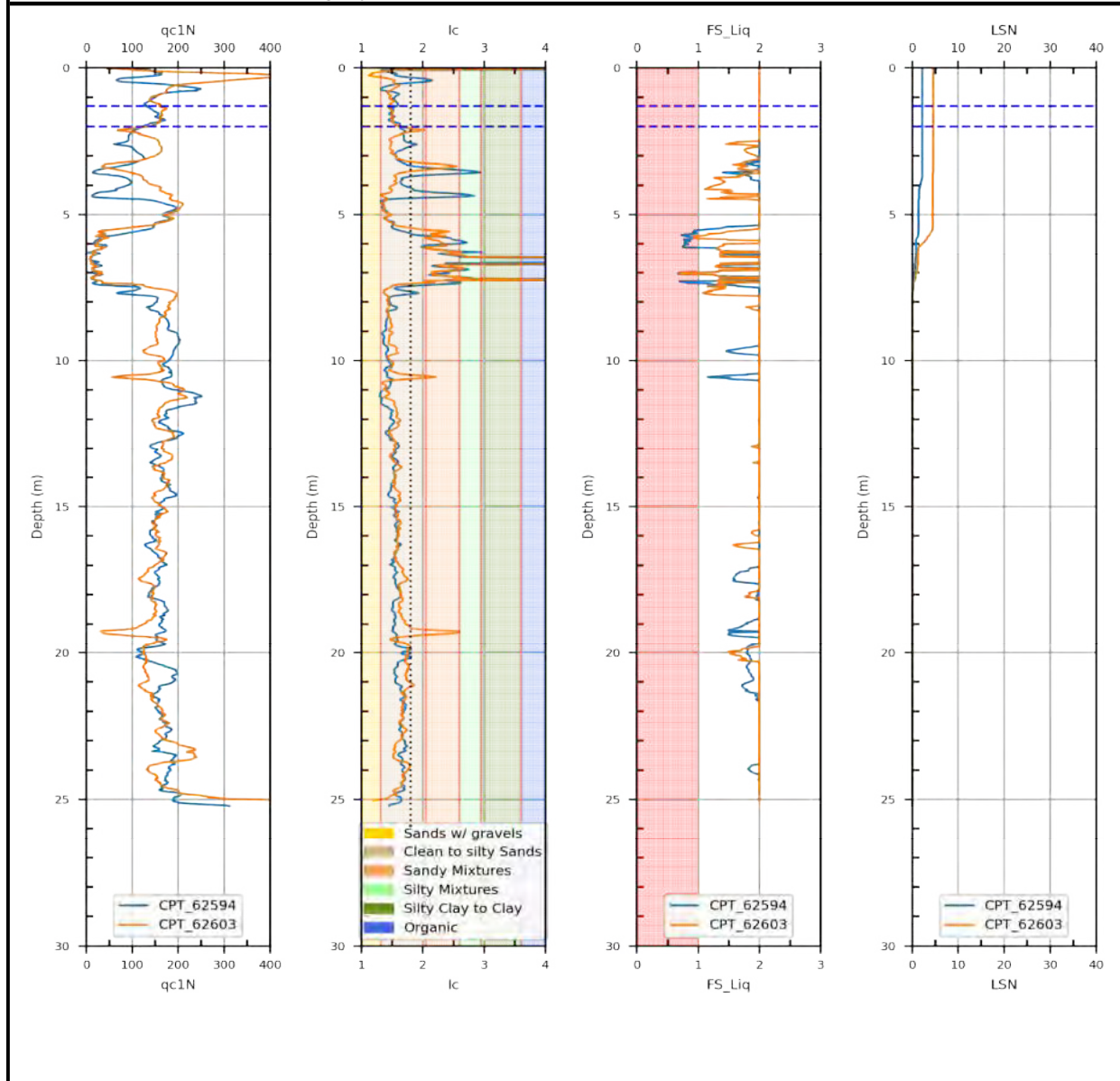
Ic Robertson, 2009

LSN van Ballegooy et al., 2014



Case History: Ch-S179
Site: CC LIQ28 Mark Treffers Dr (N° 71)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2 - 7.1
PGA: 0.22g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.5m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.49112 Longitude 172.70878
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



CC LIQ35 Shirley Boys High School

Case History:

Site: CC LIQ35 Shirley Boys High School (N° 72)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.20g - 0.39g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.51101 Longitude 172.65968
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

lc Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Site:	CC LIQ35 Shirley Boys High School (N° 72)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.20g - 0.39g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.51101 Longitude 172.65968
Source:	Christchurch City Council, map_Ap001725BlackMap.gws

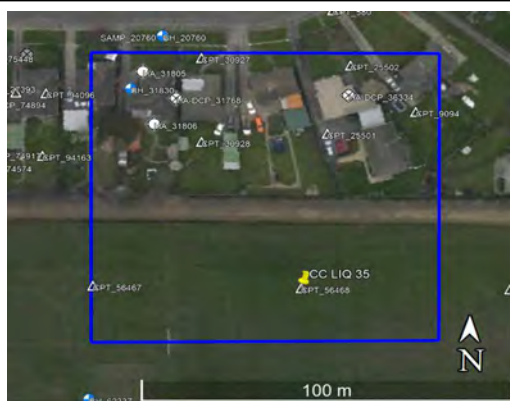
Robertson, 2009

Surficial Geology - waterways swamps and vegetation cover in 1856



Case History:**Site:** CC LIQ35 Shirley Boys High School (N° 72)**Location:** Christchurch, New Zealand**Earthquake:** CES Mw 6.2 - 7.1**PGA:** 0.20g - 0.39g (Bradley's median estimate [Bradley and Hughes 2012])**Ground Elevation:** 0 m Datum: ground surface**Water table:** 2.0m avg. below ground surface (Tokin and Taylor 2013)**CPT:** All CPTs Latitude -43.51101 Longitude 172.65968**Source:** New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)**qc1N, FS_{Liq} (PL = 50%)** Boulanger and Idriss, 2014; Robertson and Wride 1998/2009**Ic** Robertson, 2009**LSN** van Ballegooy et al., 2014**Ejecta Patterns**

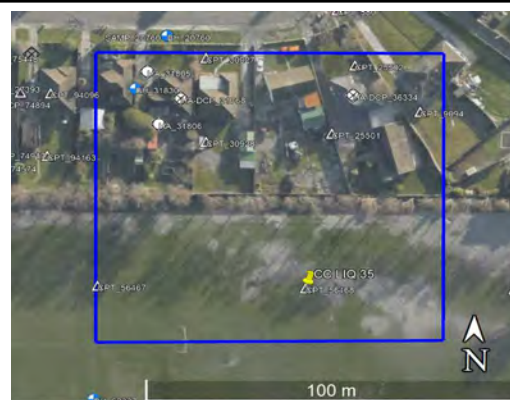
Aerial photography taken on September 5, 2010



Aerial photography taken on February 24, 2011

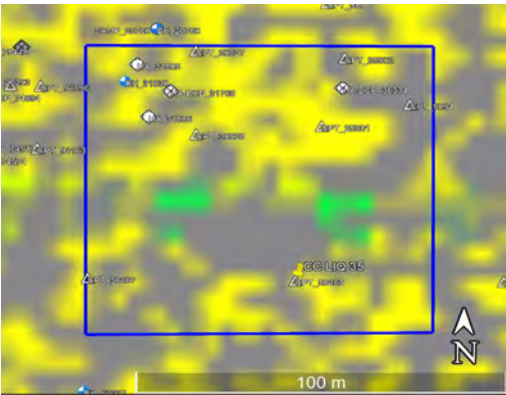
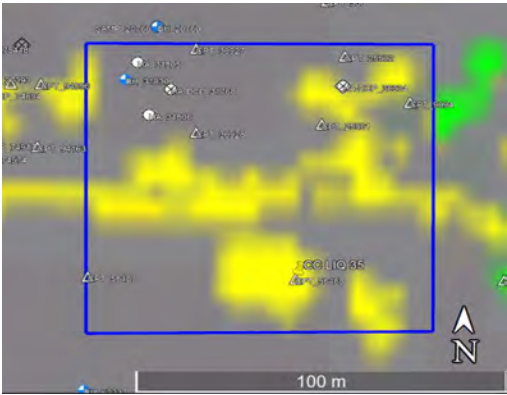
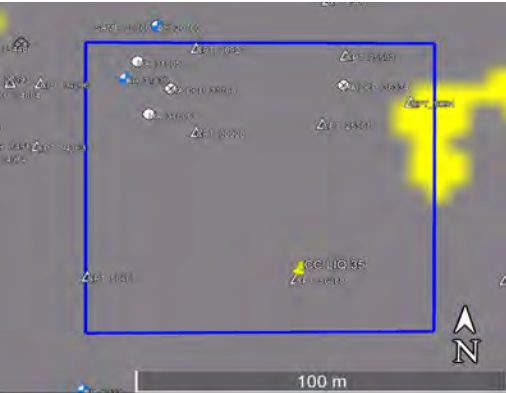
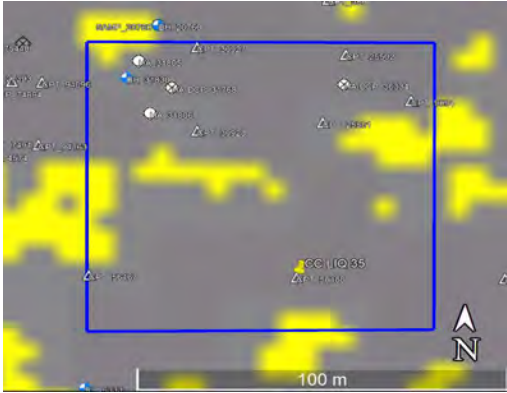


Aerial photography taken on June 14-15, 2011



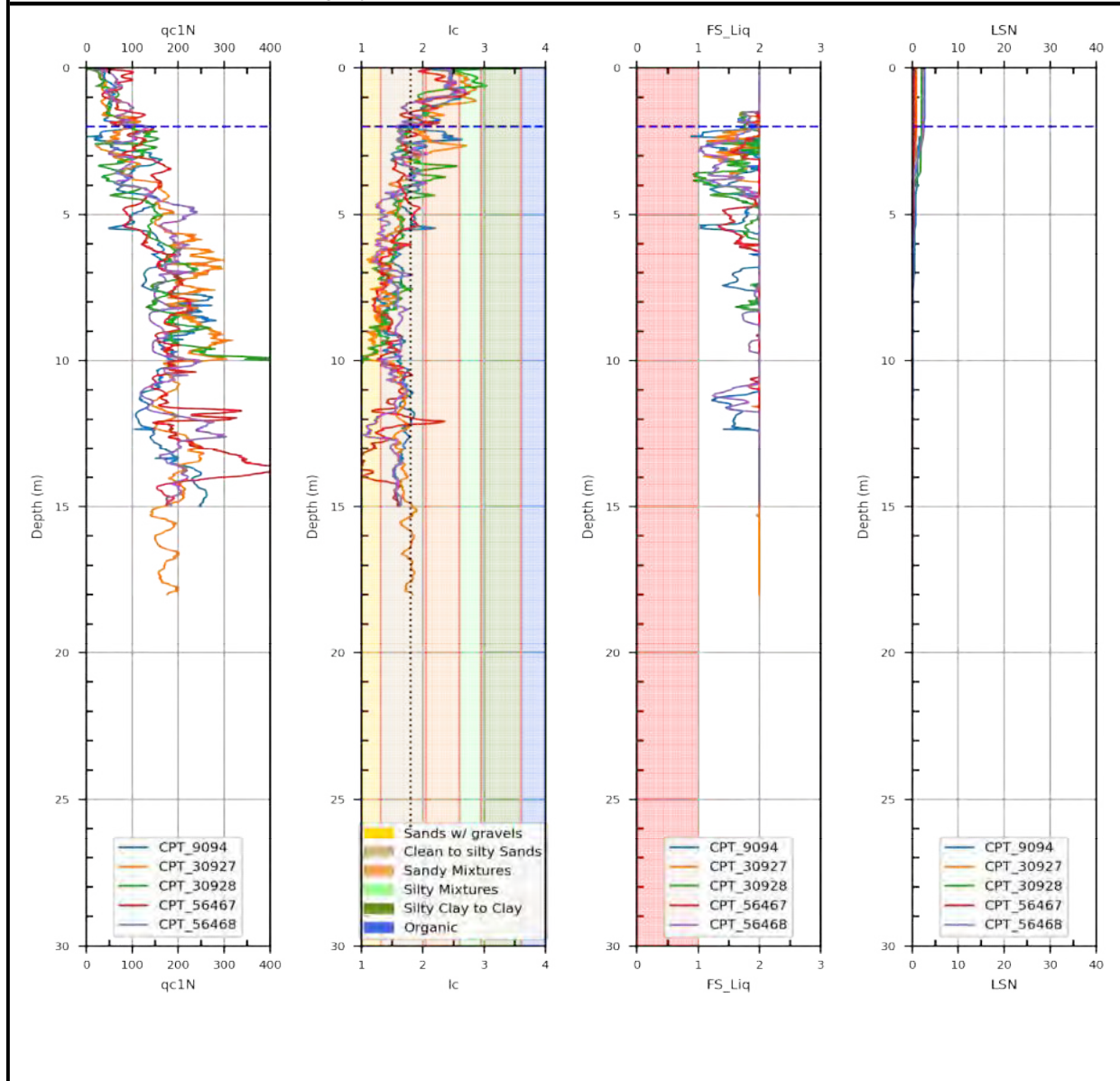
Aerial photography taken on December 24, 2011

**Ministry of Civil Defence
& Emergency Management**
Te Kaitiaki Whakamānau**CERA**
Canterbury Earthquake
Recovery Authority**EQC**
EARTHQUAKE COMMISSION
Kaitiaki Whakamānau**TT**
Tonkin & Taylor

Case History:											
Site:	CC LIQ35 Shirley Boys High School (N° 72)										
Location:	Christchurch, New Zealand										
Earthquake:	CES Mw 6.2 - 7.1										
PGA:	0.20g - 0.39g (Bradley's median estimate [Bradley and Hughes 2012])										
Ground Elevation:	0 m Datum: ground surface										
Water table:	2.0m avg. below ground surface (Tokin and Taylor 2013)										
CPT:	All CPTs Latitude -43.51101 Longitude 172.65968										
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)										
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009										
Ic	Robertson, 2009										
LSN	van Ballegooy et al., 2014										
Free-Field Ground Settlement Measurement											
Estimated vertical settlement - Sep. 4, 2010 EQ	Estimated vertical settlement - Feb. 22, 2011 EQ										
											
Estimated vertical settlement - June 13, 2011 EQ	Estimated vertical settlement - Dec. 23, 2011										
											
LiDAR surveys dates: <table> <tr> <td>Pre-September 2010</td><td>Feb. 6-11, 2008</td></tr> <tr> <td>Post-September 2010</td><td>Sep. 5, 2010</td></tr> <tr> <td>Post-February 2011</td><td>March 8-10 and May 20-30, 2011</td></tr> <tr> <td>Post-June 2011</td><td>July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011</td></tr> <tr> <td>Post-December 2011</td><td>Feb. 17-18, 2012</td></tr> </table>		Pre-September 2010	Feb. 6-11, 2008	Post-September 2010	Sep. 5, 2010	Post-February 2011	March 8-10 and May 20-30, 2011	Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011	Post-December 2011	Feb. 17-18, 2012
Pre-September 2010	Feb. 6-11, 2008										
Post-September 2010	Sep. 5, 2010										
Post-February 2011	March 8-10 and May 20-30, 2011										
Post-June 2011	July 18 & 20; Aug. 25-27 and Sep. 2-3, 2011										
Post-December 2011	Feb. 17-18, 2012										
Vertical Elevation Change without Tectonic Component <table> <tr> <td> ↑ Uplifted 1.0 to 1.5 m 0.5 to 1.0 m 0.4 to 0.3 m 0.3 to 0.4 m 0.2 to 0.3 m 0.1 to 0.2 m -0.1 to 0.1 m </td><td> 0.2 to -0.1 m -0.3 to -0.2 m -0.4 to -0.3 m -0.5 to -0.4 m -1.0 to -0.5 m -1.5 to -1.0 m ↓ Subsided </td></tr> </table>		↑ Uplifted 1.0 to 1.5 m 0.5 to 1.0 m 0.4 to 0.3 m 0.3 to 0.4 m 0.2 to 0.3 m 0.1 to 0.2 m -0.1 to 0.1 m	0.2 to -0.1 m -0.3 to -0.2 m -0.4 to -0.3 m -0.5 to -0.4 m -1.0 to -0.5 m -1.5 to -1.0 m ↓ Subsided								
↑ Uplifted 1.0 to 1.5 m 0.5 to 1.0 m 0.4 to 0.3 m 0.3 to 0.4 m 0.2 to 0.3 m 0.1 to 0.2 m -0.1 to 0.1 m	0.2 to -0.1 m -0.3 to -0.2 m -0.4 to -0.3 m -0.5 to -0.4 m -1.0 to -0.5 m -1.5 to -1.0 m ↓ Subsided										

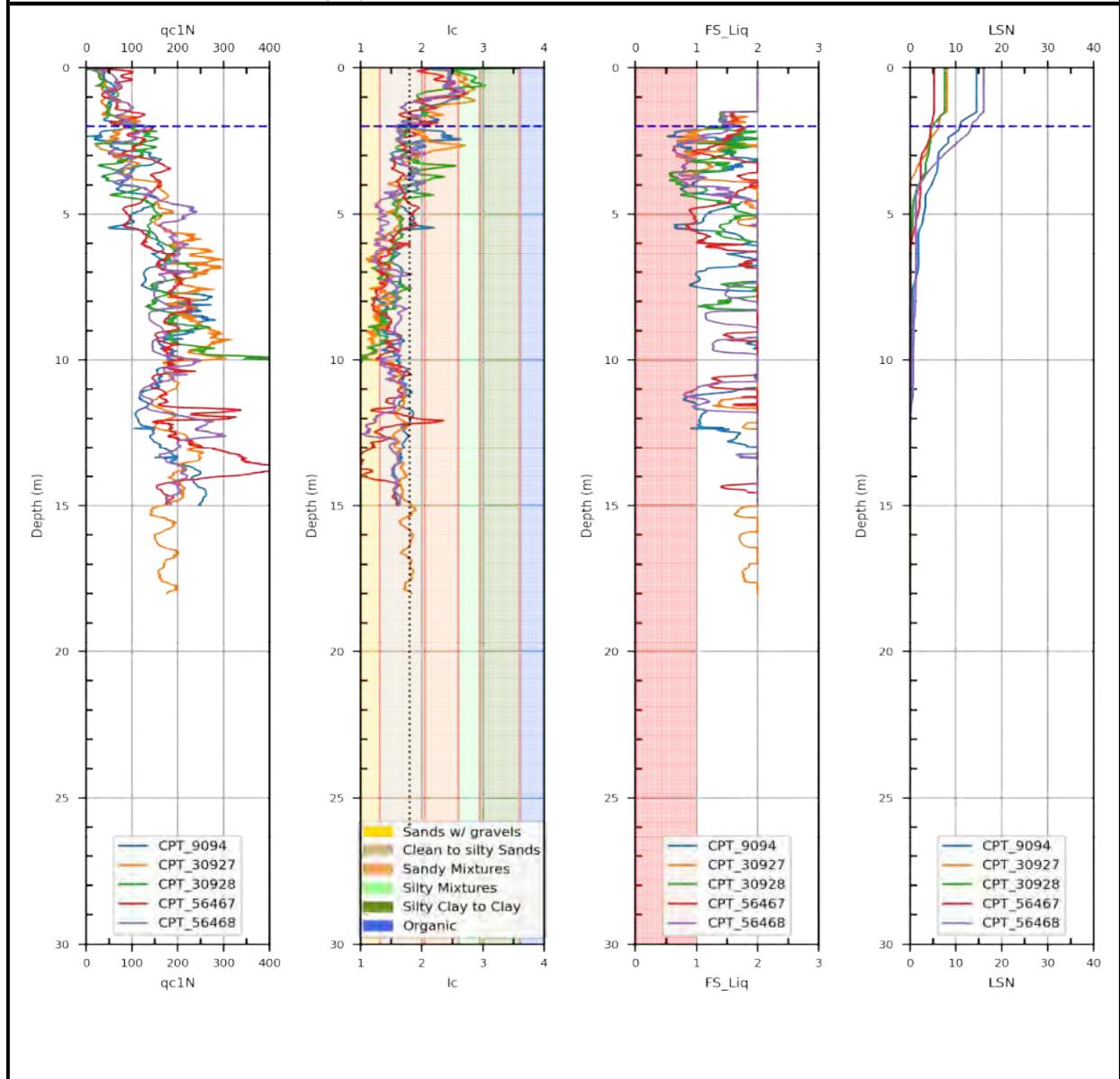
Case History: Ch-S180
Site: CC LIQ35 Shirley Boys High School (N° 72)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 6.2 - 7.1
PGA: 0.20g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.51101 Longitude 172.65968
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



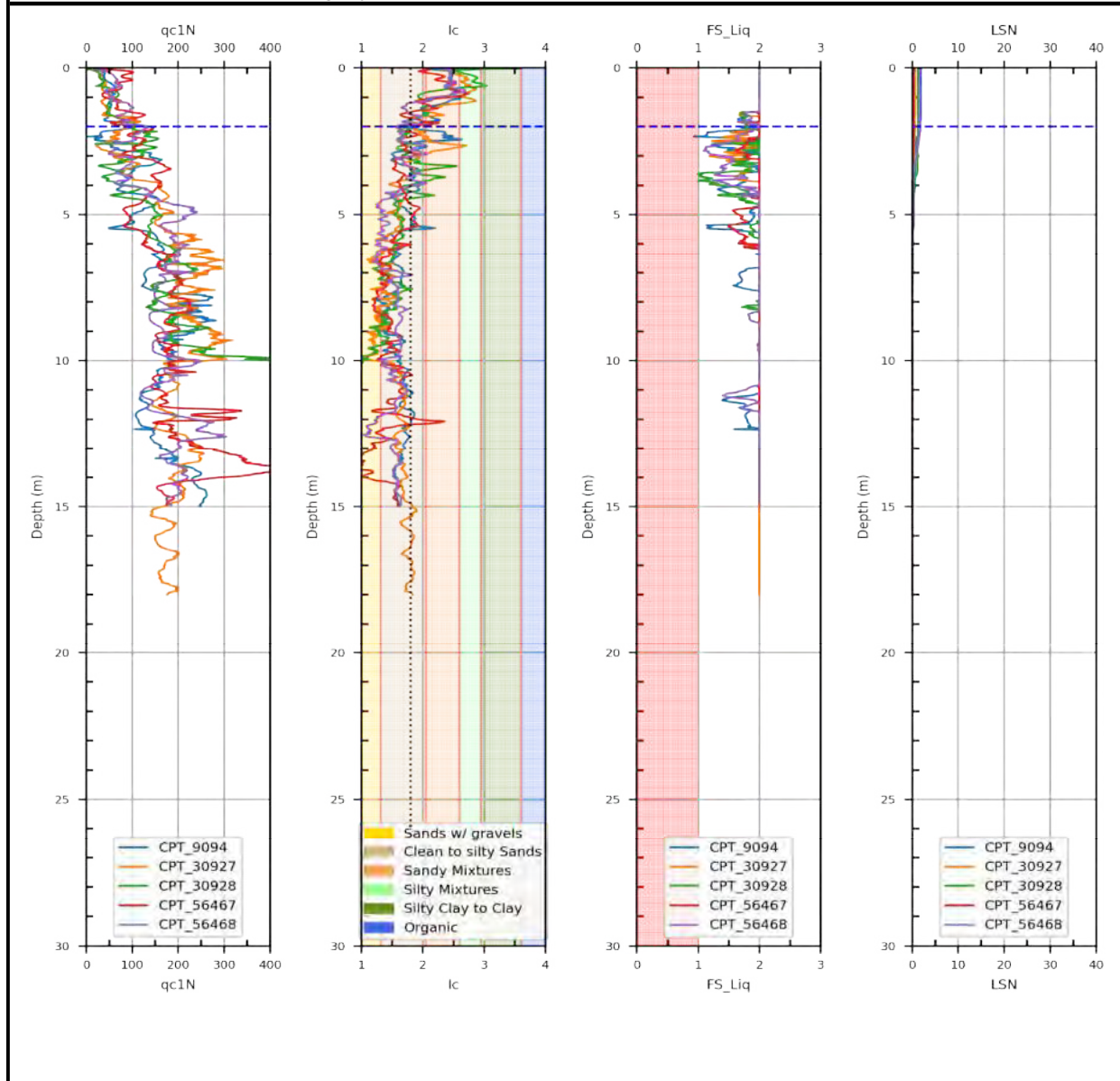
Case History: Ch-S181
Site: CC LIQ35 Shirley Boys High School (N° 72)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2 - 7.1
PGA: 0.39g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.51101 Longitude 172.65968
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S182
Site: CC LIQ35 Shirley Boys High School (N° 72)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2 - 7.1
PGA: 0.22g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.51101 Longitude 172.65968
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



CC LIQ67 Rudds Road

Site:	CC LIQ67 Rudds Rd (N° 73)			
Location:	Christchurch, New Zealand			
Earthquake:	CES	Mw	6.2 - 7.1	
PGA:	0.21g - 0.63g (Bradley's median estimate [Bradley and Hughes 2012])			
Ground Elevation:	0 m Datum: ground surface			
Water table:	2.0m avg. below ground surface (Tokin and Taylor 2013)			
CPT:	All CPTs	Latitude	-43.52776	Longitude 172.68672
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)			

Site: CC LIQ67 Rudds Rd (N° 73)

Location: Christchurch, New Zealand

Earthquake:	CES	Mw	6.2 - 7.1
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PGA: 0.21g - 0.63g (Bradley's median estimate [Bradley and Hughes 2012])

Ground Elevation: 0 m Datum: ground surface

Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)

CPT:	All CPTs	Latitude	-43.52776	Longitude	172.68672
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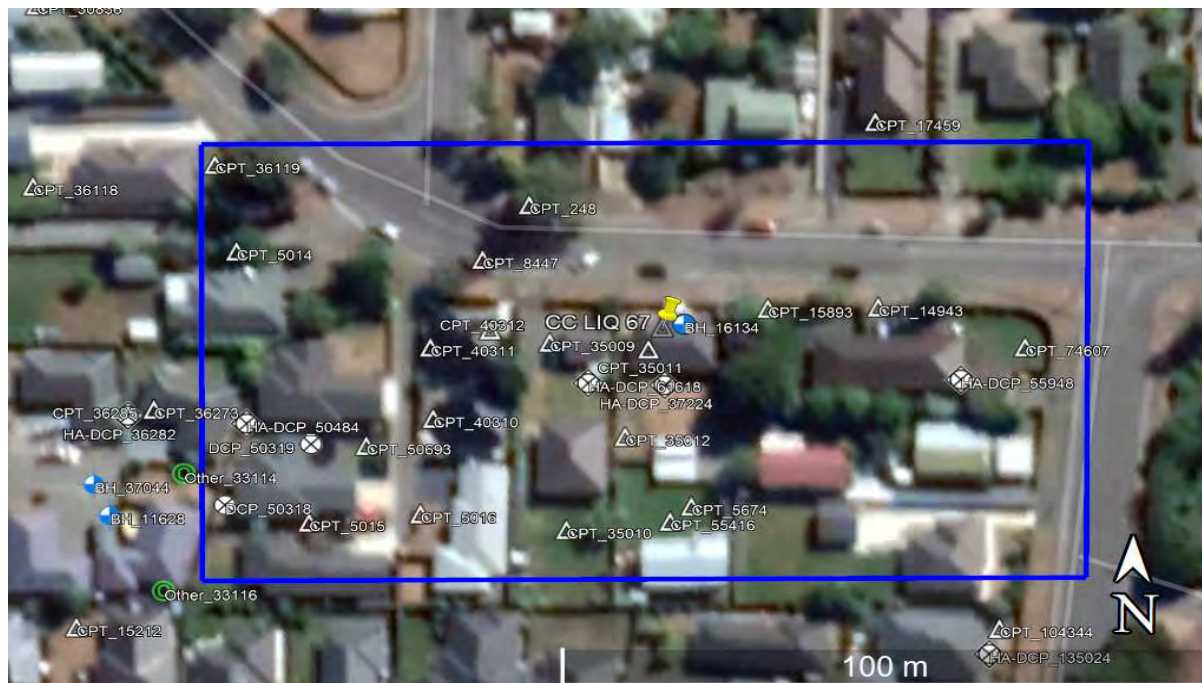
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View



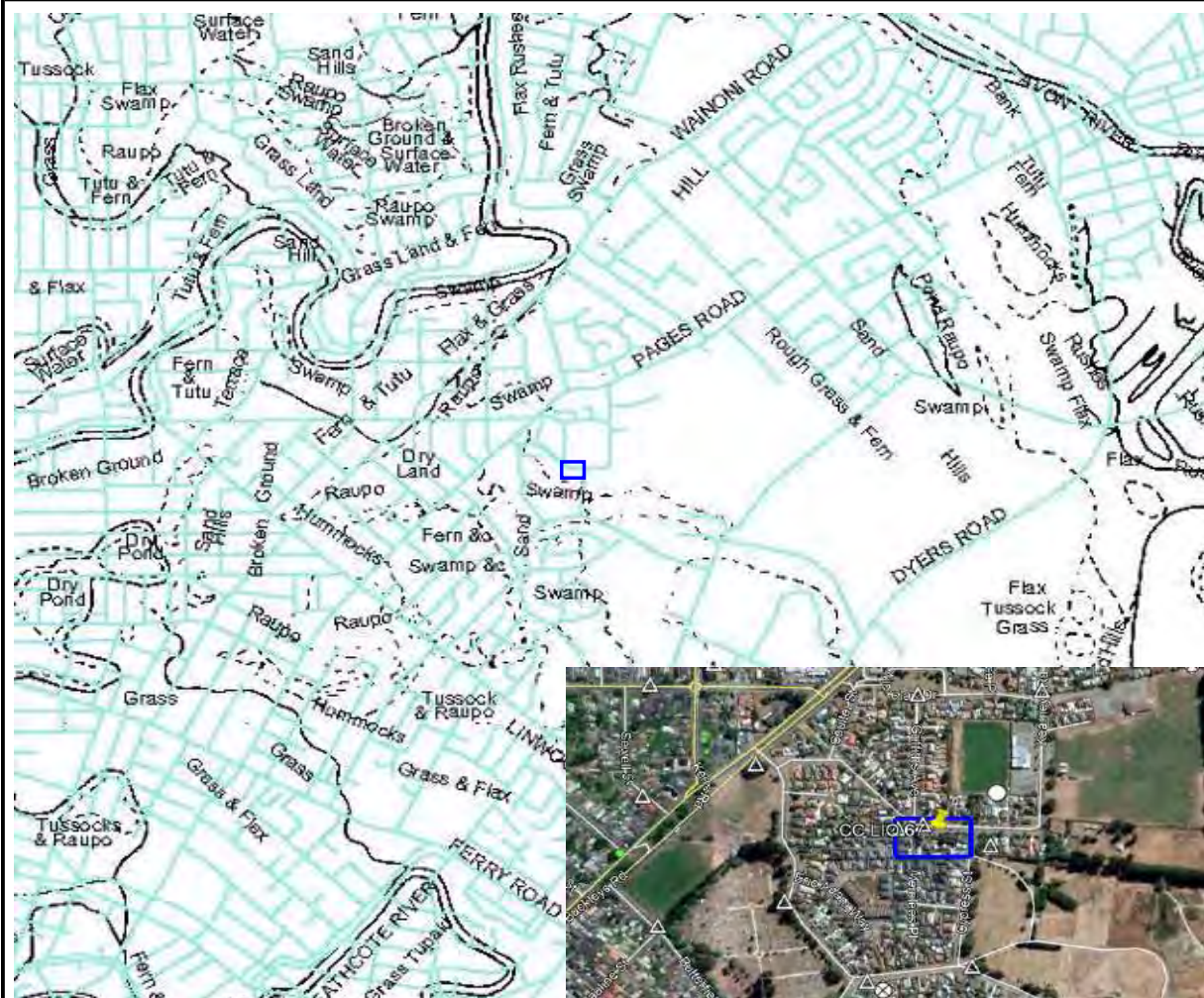
References:

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Site:	CC LIQ67 Rudds Rd (N° 73)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.21g - 0.63g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.52776 Longitude 172.68672
Source:	Christchurch City Council, map_Ap001725BlackMap.gws

Robertson, 2009

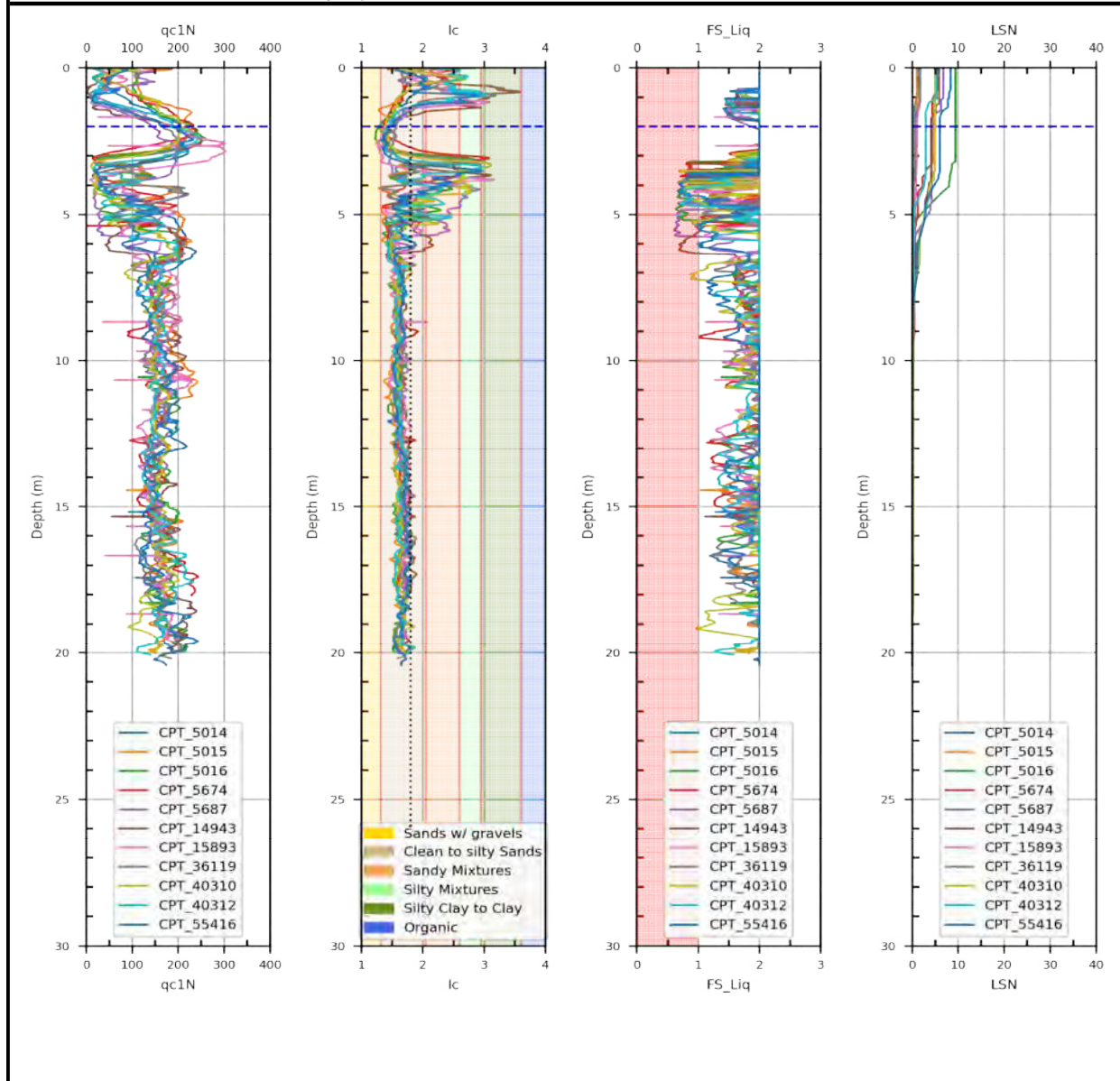
Surficial Geology - waterways swamps and vegetation cover in 1856



Case History: Site: CC LIQ67 Rudds Rd (N° 73) Location: Christchurch, New Zealand Earthquake: CES Mw 6.2 - 7.1 PGA: 0.21g - 0.63g (Bradley's median estimate [Bradley and Hughes 2012]) Ground Elevation: 0 m Datum: ground surface Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013) CPT: All CPTs Latitude -43.52776 Longitude 172.68672 Source: New Zealand Geotechnical Database (http://www.nzgd.org.nz) qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009 Ic Robertson, 2009 LSN van Ballegooy et al., 2014	
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
  Ministry of Civil Defence & Emergency Management <i>Te Kaitiaki Whakamānau</i>  CERA Canterbury Earthquake Recovery Authority  EQC EARTHQUAKE COMMISSION <i>Kaitiaki Raukawa</i>  Tonkin & Taylor	

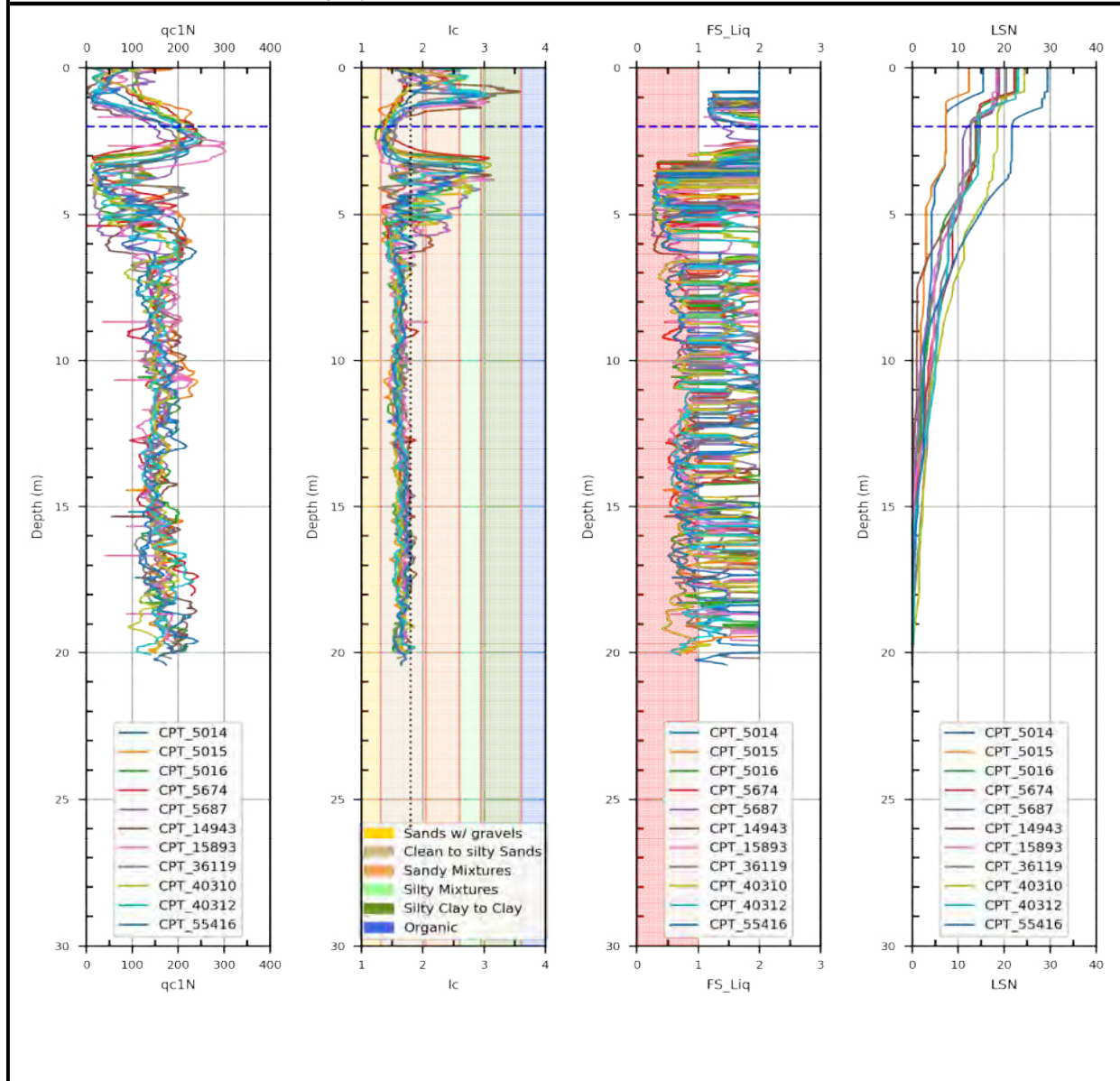
Case History: Ch-S183
Site: CC LIQ67 Rudds Rd (N° 73)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 6.2 - 7.1
PGA: 0.21g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.52776 Longitude 172.68672
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



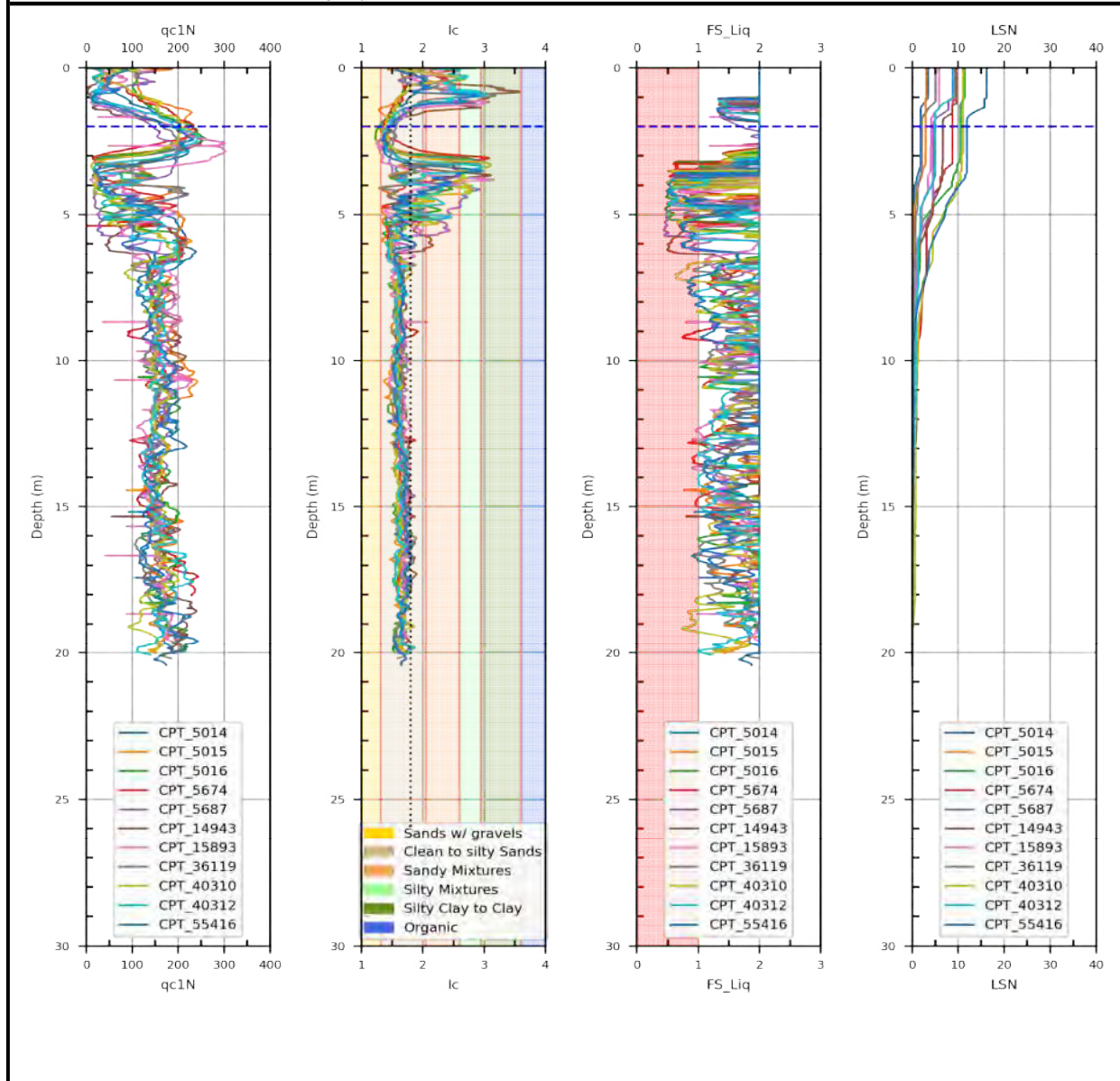
Case History: Ch-S184
Site: CC LIQ67 Rudds Rd (N° 73)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2 - 7.1
PGA: 0.63g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.52776 Longitude 172.68672
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S185
Site: CC LIQ67 Rudds Rd (N° 73)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2 - 7.1
PGA: 0.36g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.52776 Longitude 172.68672
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



CC NOLIQ37 Kensington Avenue

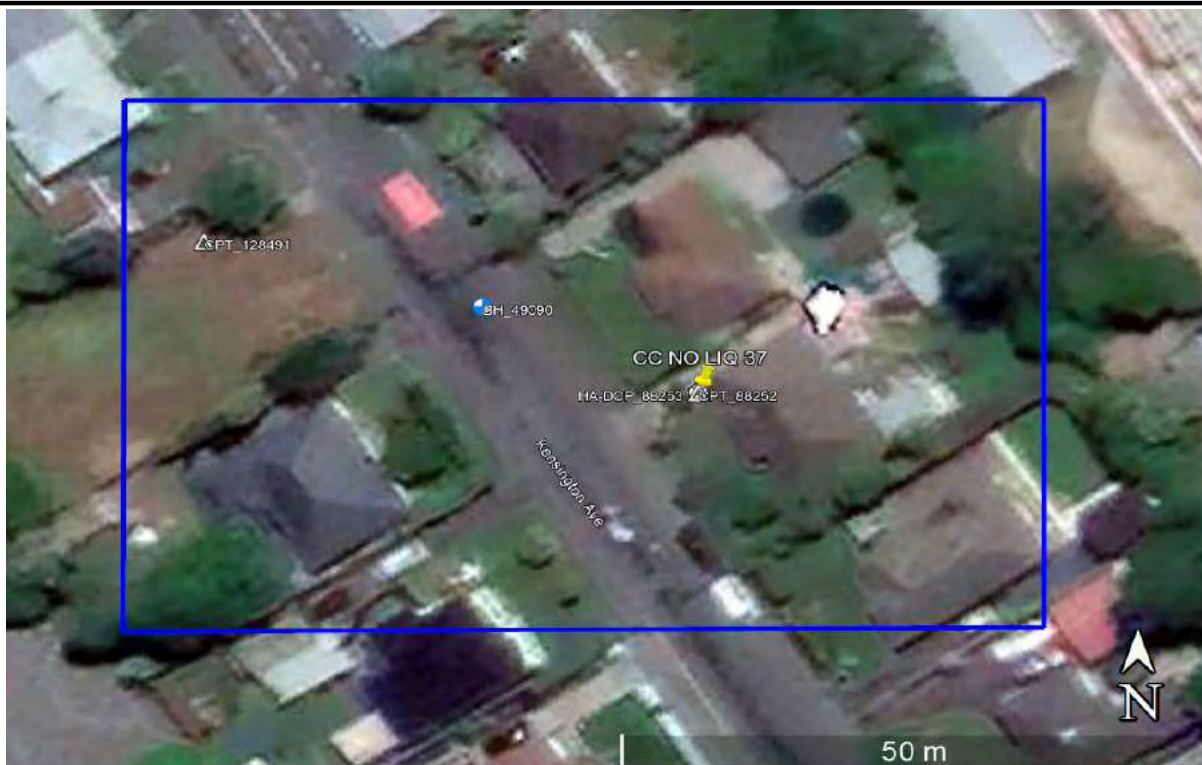
Case History:

Site: CC NOLIQ37 Kensington Ave (N° 74)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.20g - 0.32g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.49963 Longitude 172.64067
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

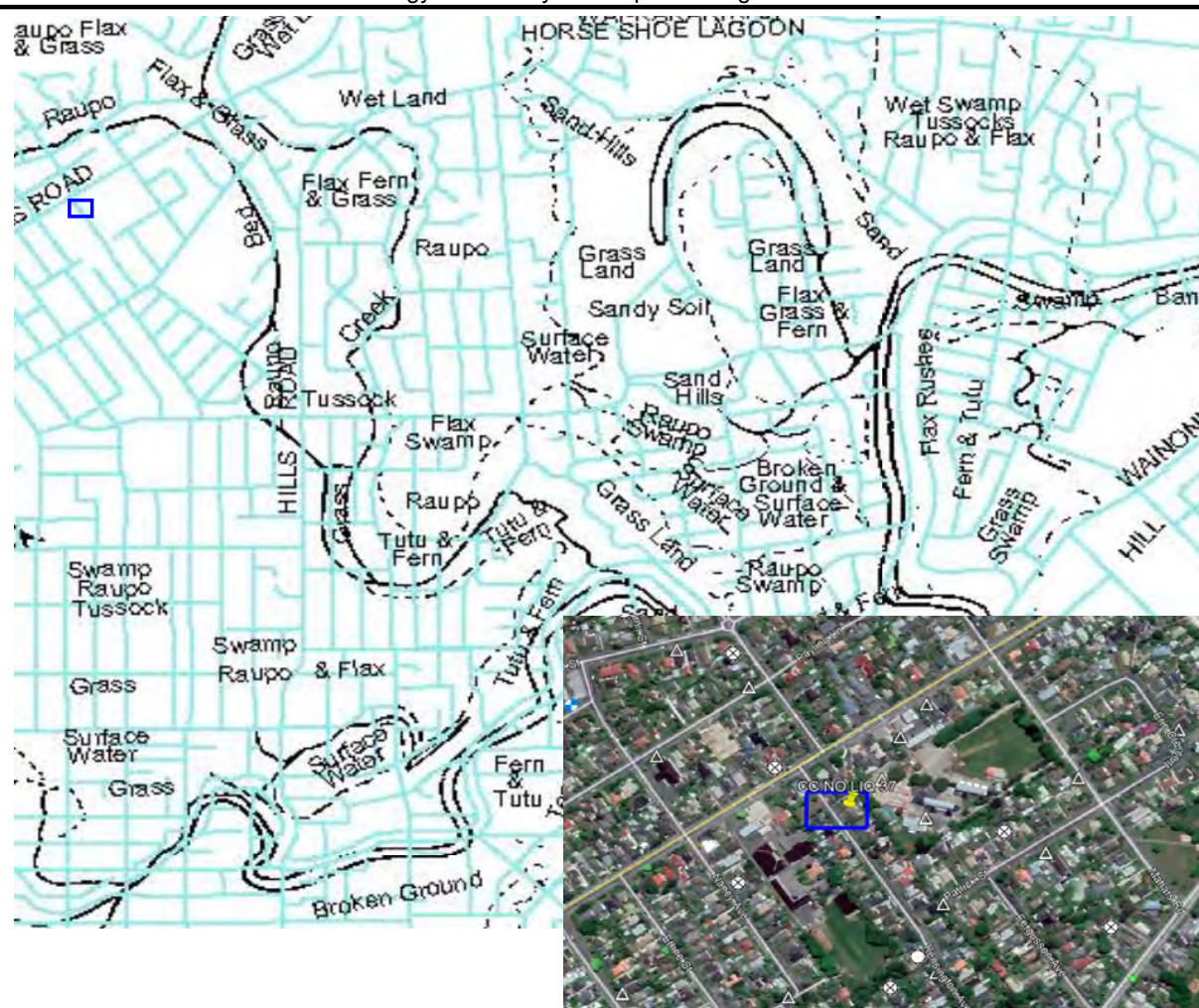
LSN van Ballegooy et al., 2014

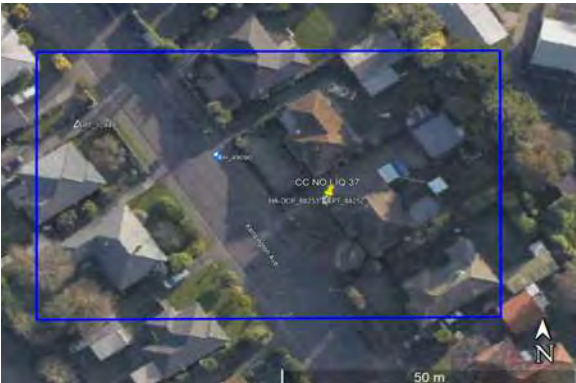
Site Plan View**References:**

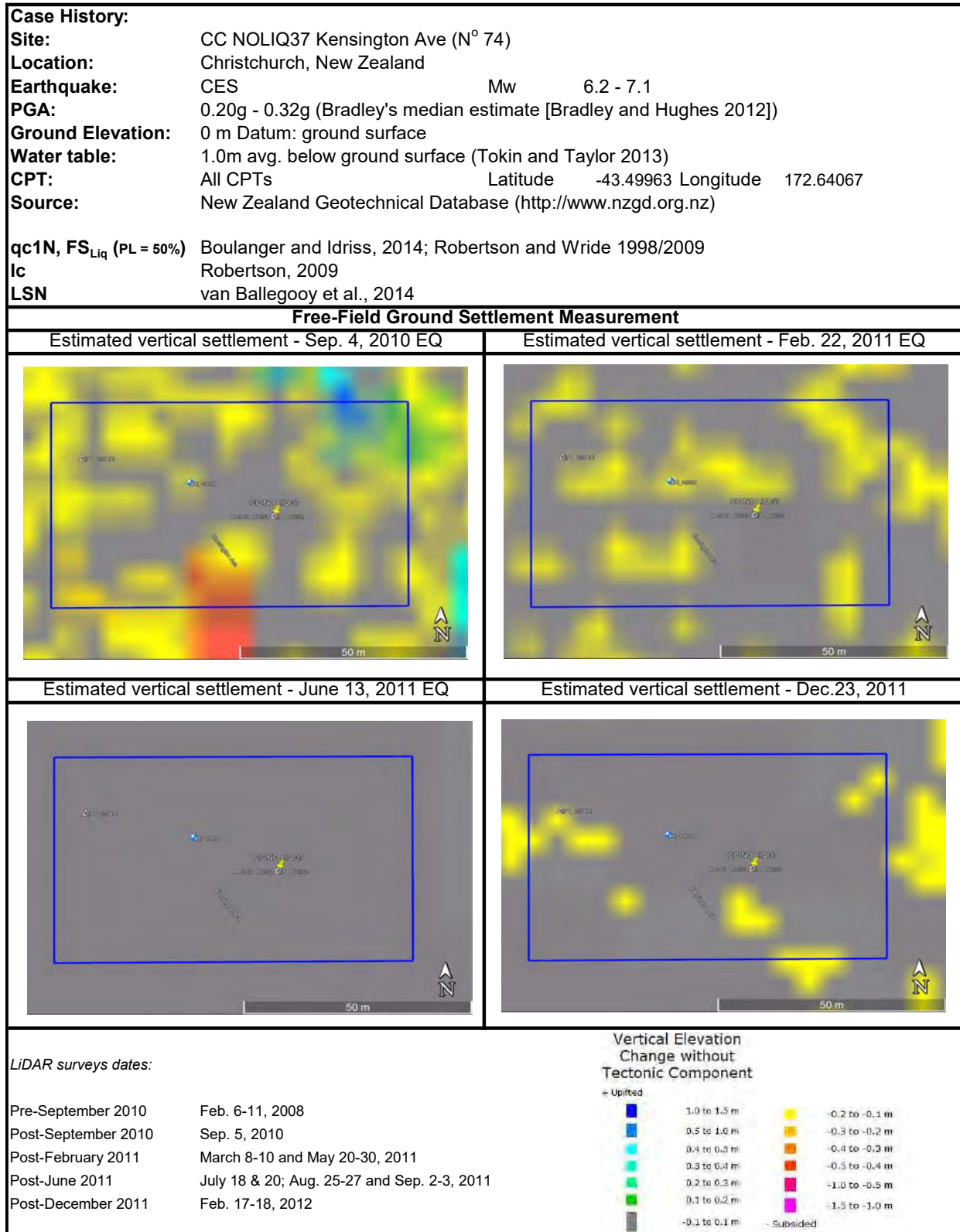
New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:**Site:** CC NOLIQ37 Kensington Ave (N° 74)**Location:** Christchurch, New Zealand**Earthquake:** CES Mw 6.2 - 7.1**PGA:** 0.20g - 0.32g (Bradley's median estimate [Bradley and Hughes 2012])**Ground Elevation:** 0 m Datum: ground surface**Water table:** 1.0m avg. below ground surface (Tokin and Taylor 2013)**CPT:** All CPTs Latitude -43.49963 Longitude 172.64067**Source:** Christchurch City Council, map_Ap001725BlackMap.gws**qc1N, FS_{Liq} (PL = 50%)** Boulanger and Idriss, 2014; Robertson and Wride 1998/2009**lc** Robertson, 2009**LSN** van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856



Case History:	
Site:	CC NOLIQ37 Kensington Ave (N ^o 74)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.20g - 0.32g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	1.0m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.49963 Longitude 172.64067
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
	

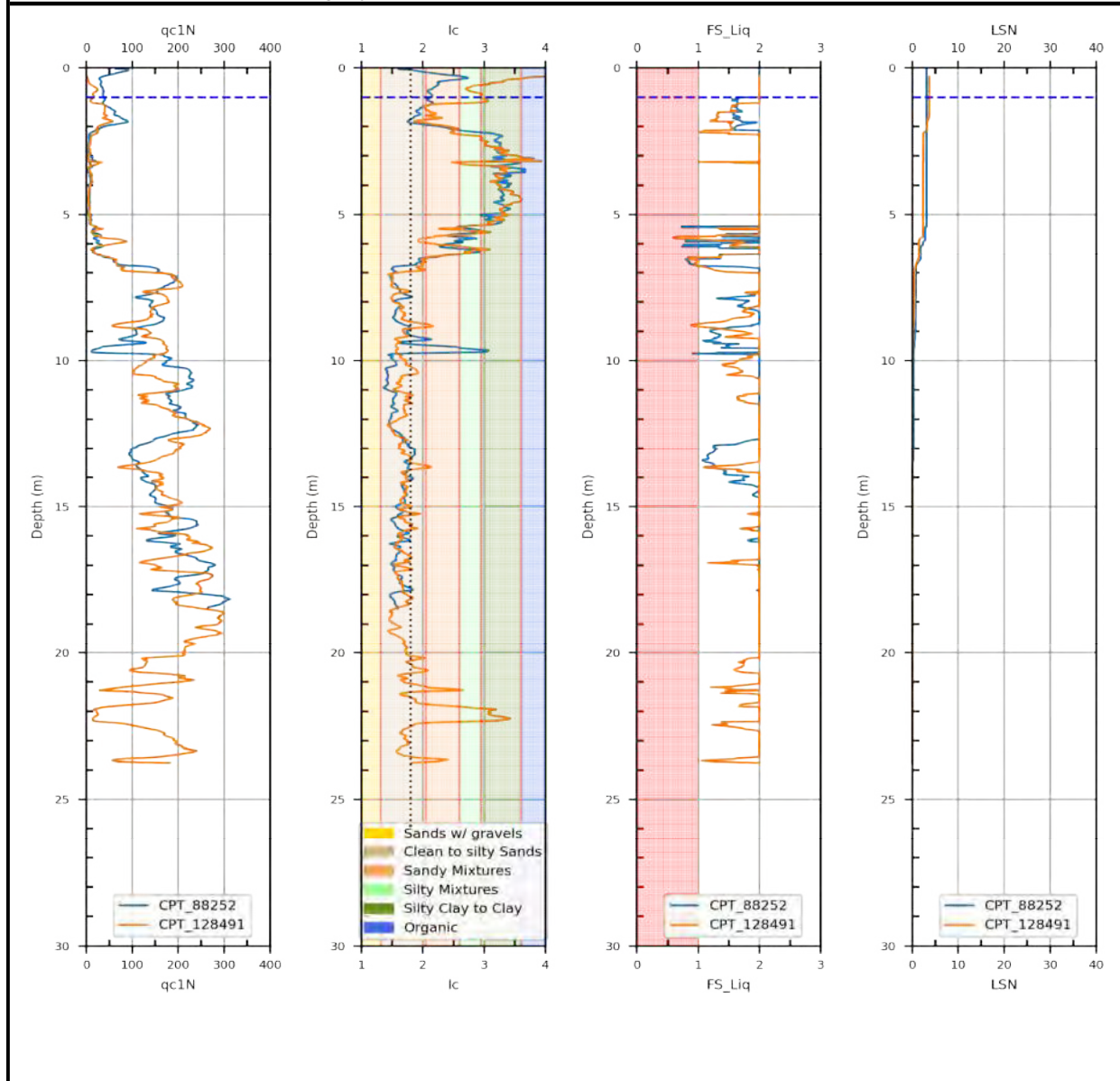


Case History: Ch-S186
Site: CC NOLIQ37 Kensington Ave (N^o 74)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 6.2 - 7.1
PGA: 0.20g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.49963 Longitude 172.64067
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

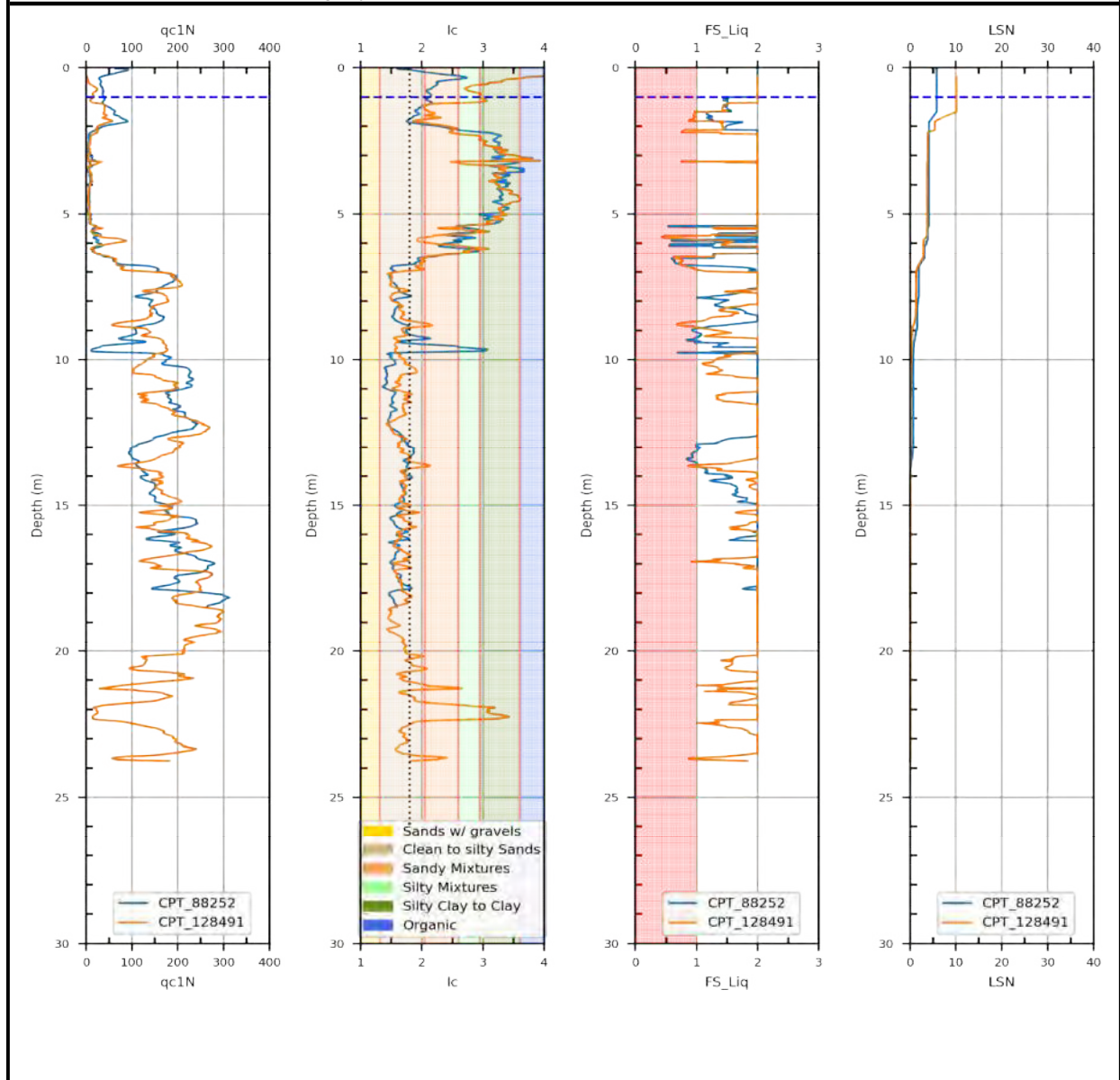


Case History: Ch-S187
Site: CC NOLIQ37 Kensington Ave (N° 74)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2 - 7.1
PGA: 0.32g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.49963 Longitude 172.64067
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

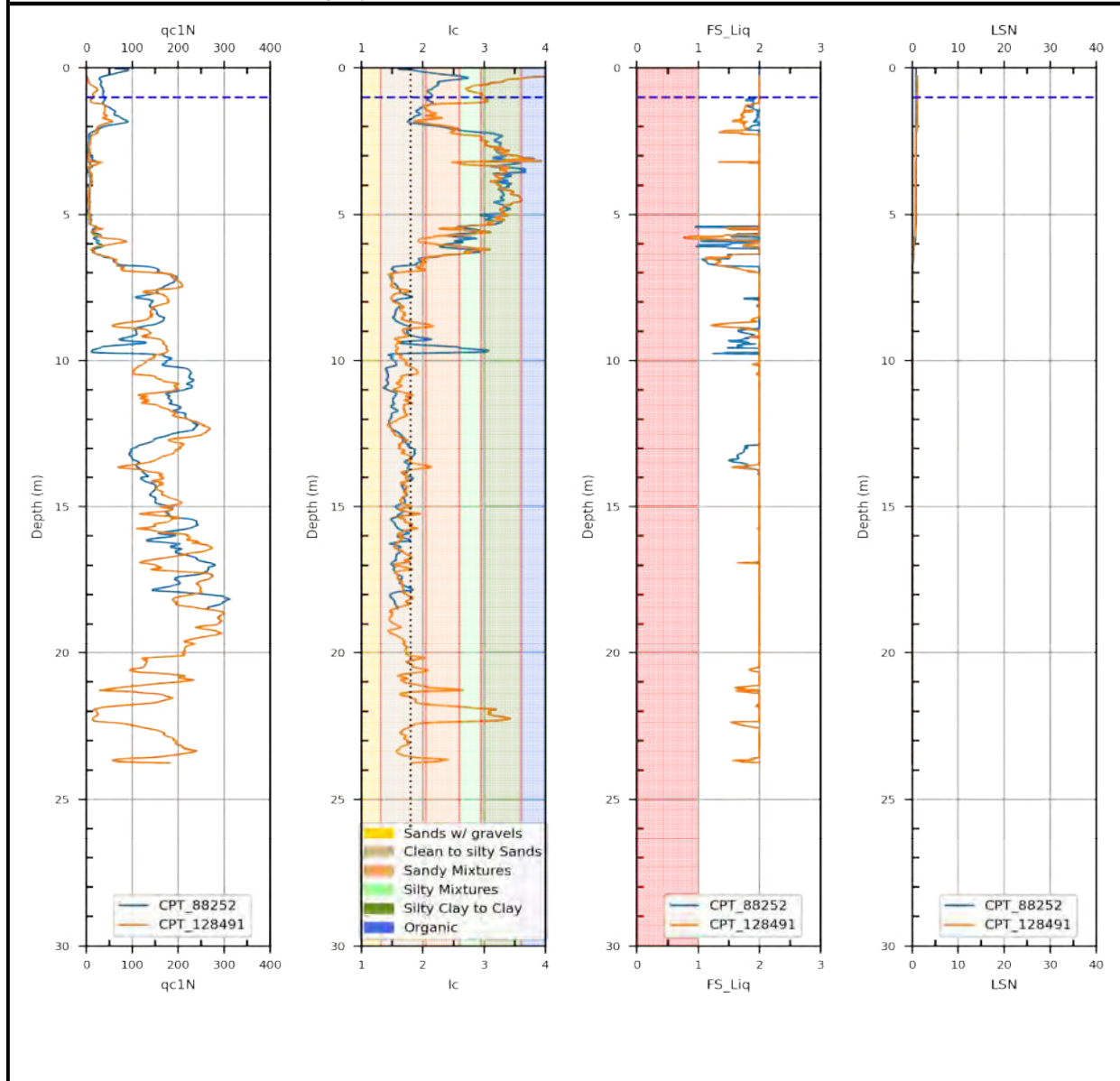
Ic Robertson, 2009

LSN van Ballegooy et al., 2014



Case History: Ch-S188
Site: CC NOLIQ37 Kensington Ave (N° 74)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2 - 7.1
PGA: 0.18g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.49963 Longitude 172.64067
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



CC NOLIQ39 Lakewood Dr.

Case History:

Site: CC NOLI39 Lakewood Dr (N° 75)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.5m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.49244 Longitude 172.68368
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

lc Robertson, 2009

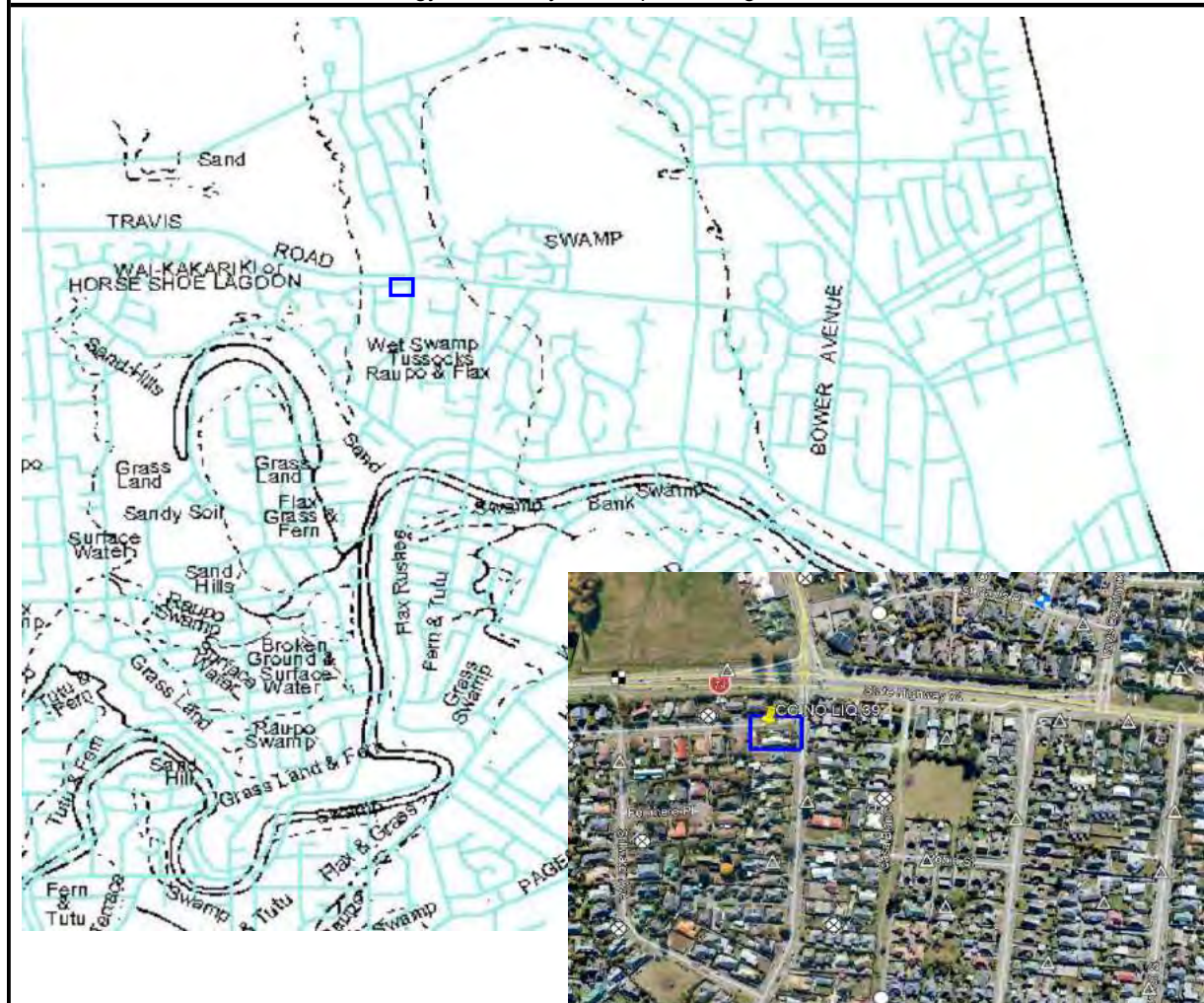
LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:**Site:** CC NOLIQ39 Lakewood Dr (N° 75)**Location:** Christchurch, New Zealand**Earthquake:** CES Mw 6.2 - 7.1**PGA:** 0.18g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])**Ground Elevation:** 0 m Datum: ground surface**Water table:** 2.5m avg. below ground surface (Tokin and Taylor 2013)**CPT:** All CPTs Latitude -43.49244 Longitude 172.68368**Source:** Christchurch City Council, map_Ap001725BlackMap.gws**qc1N, FS_{Liq} (PL = 50%)** Boulanger and Idriss, 2014; Robertson and Wride 1998/2009**lc** Robertson, 2009**LSN** van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856



Case History:

Site: CC NOLIQ39 Lakewood Dr (N° 75)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.18g - 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.5m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.49244 Longitude 172.68368
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

lc Robertson, 2009

LSN van Ballegooy et al., 2014

Ejecta Patterns

Aerial photography taken on September 5, 2010



Aerial photography taken on February 24, 2011



Aerial photography taken on June 14-15, 2011



Aerial photography taken on December 24, 2011

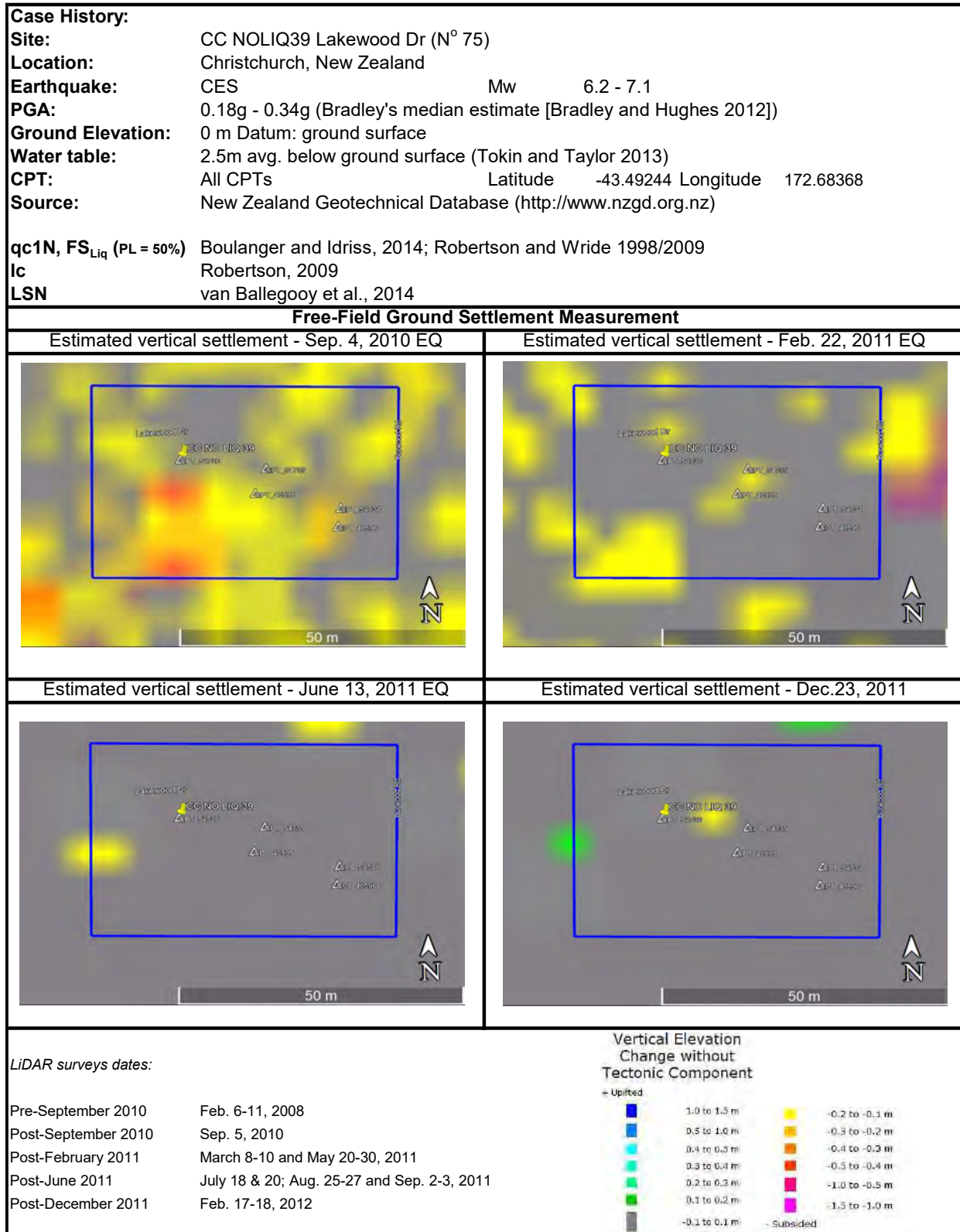


Ministry of Civil Defence
& Emergency Management
Te Kaitiaki Whakamanatanga

CERA
Canterbury Earthquake
Recovery Authority

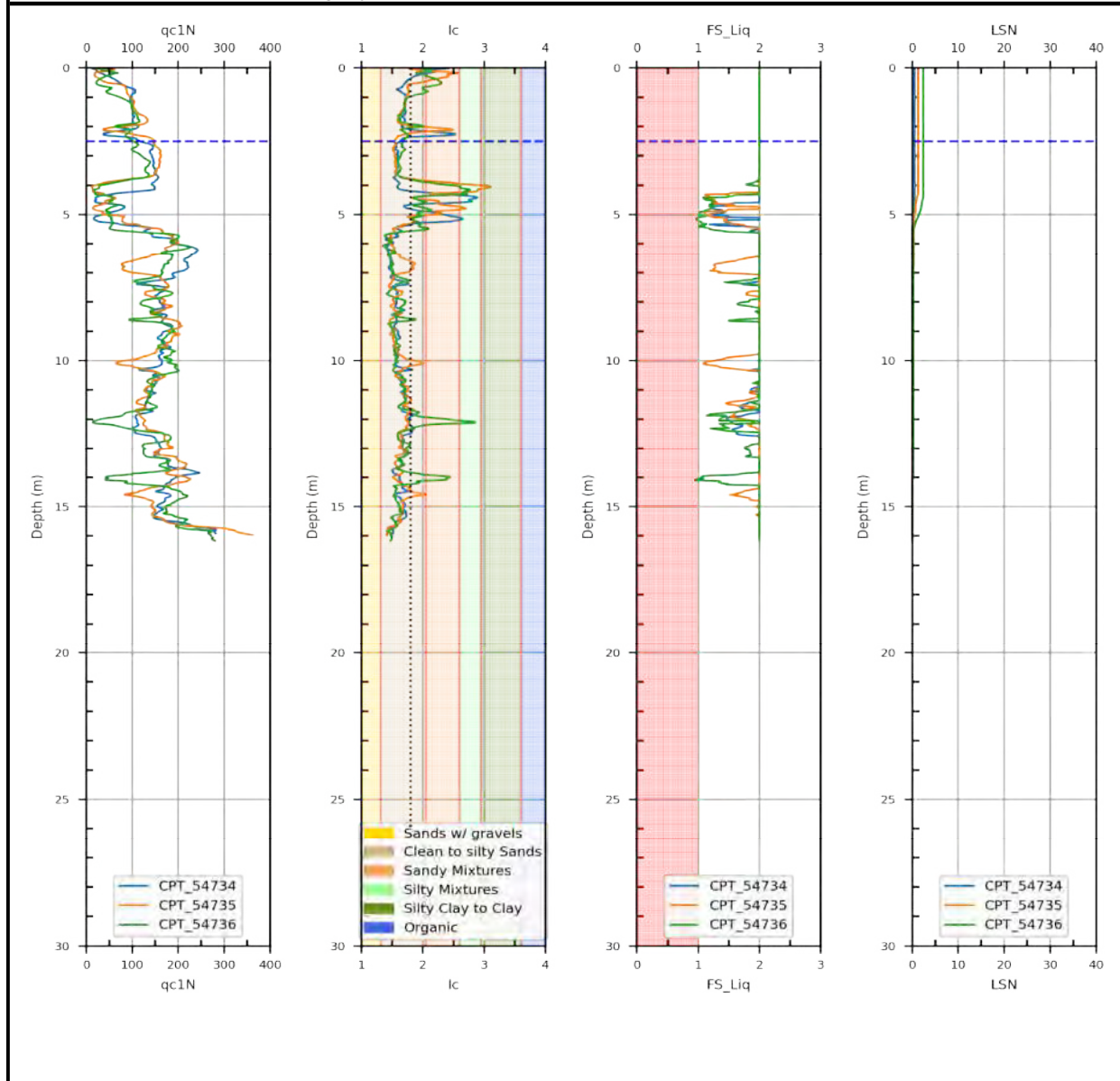
EQC
EARTHQUAKE COMMISSION
Kaitiaki Take Kōwhiri

TT
Tonkin & Taylor



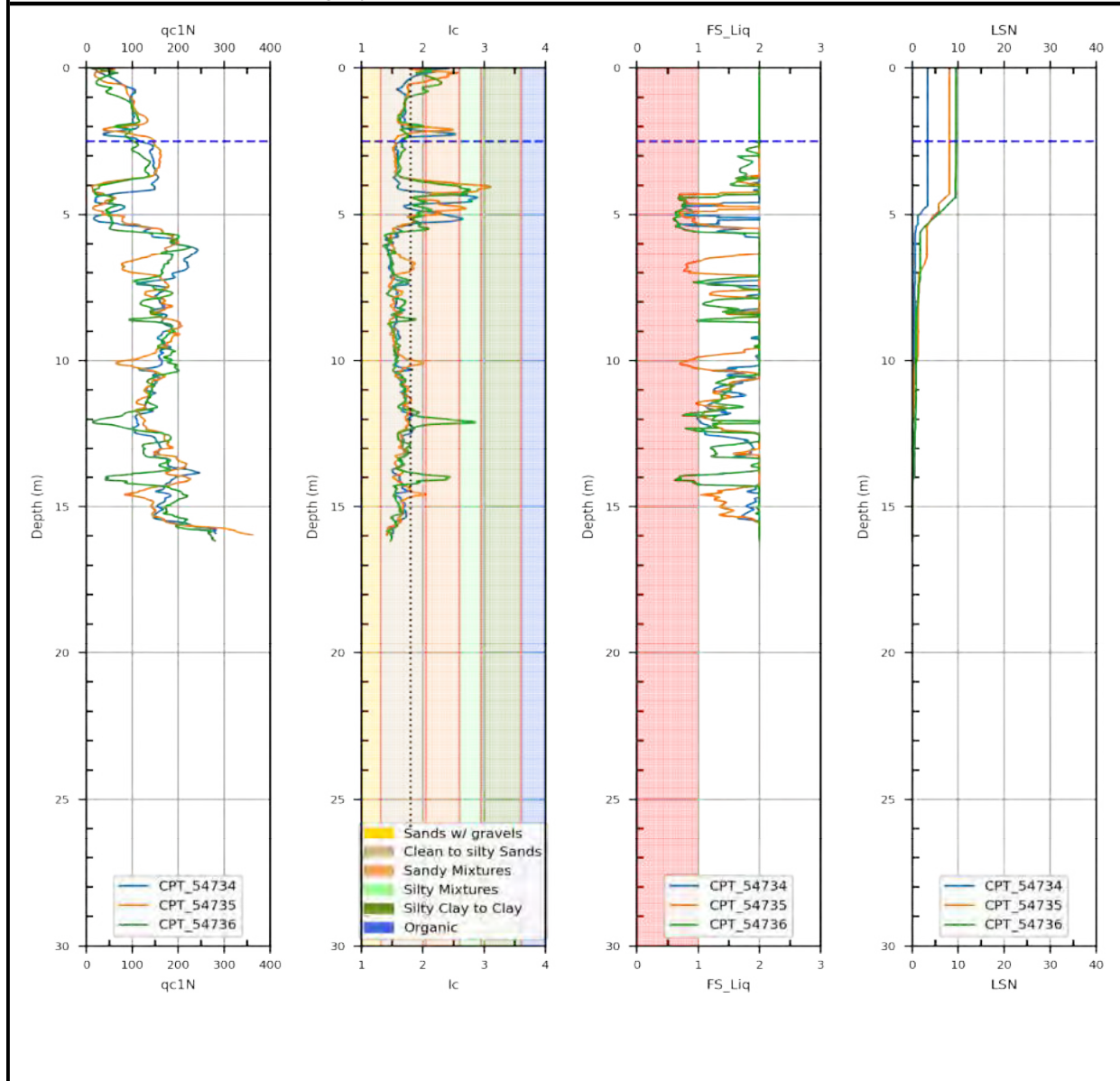
Case History: Ch-S189
Site: CC NOLIQ39 Lakewood Dr (N° 75)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 6.2 - 7.1
PGA: 0.18g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.5m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.49244 Longitude 172.68368
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



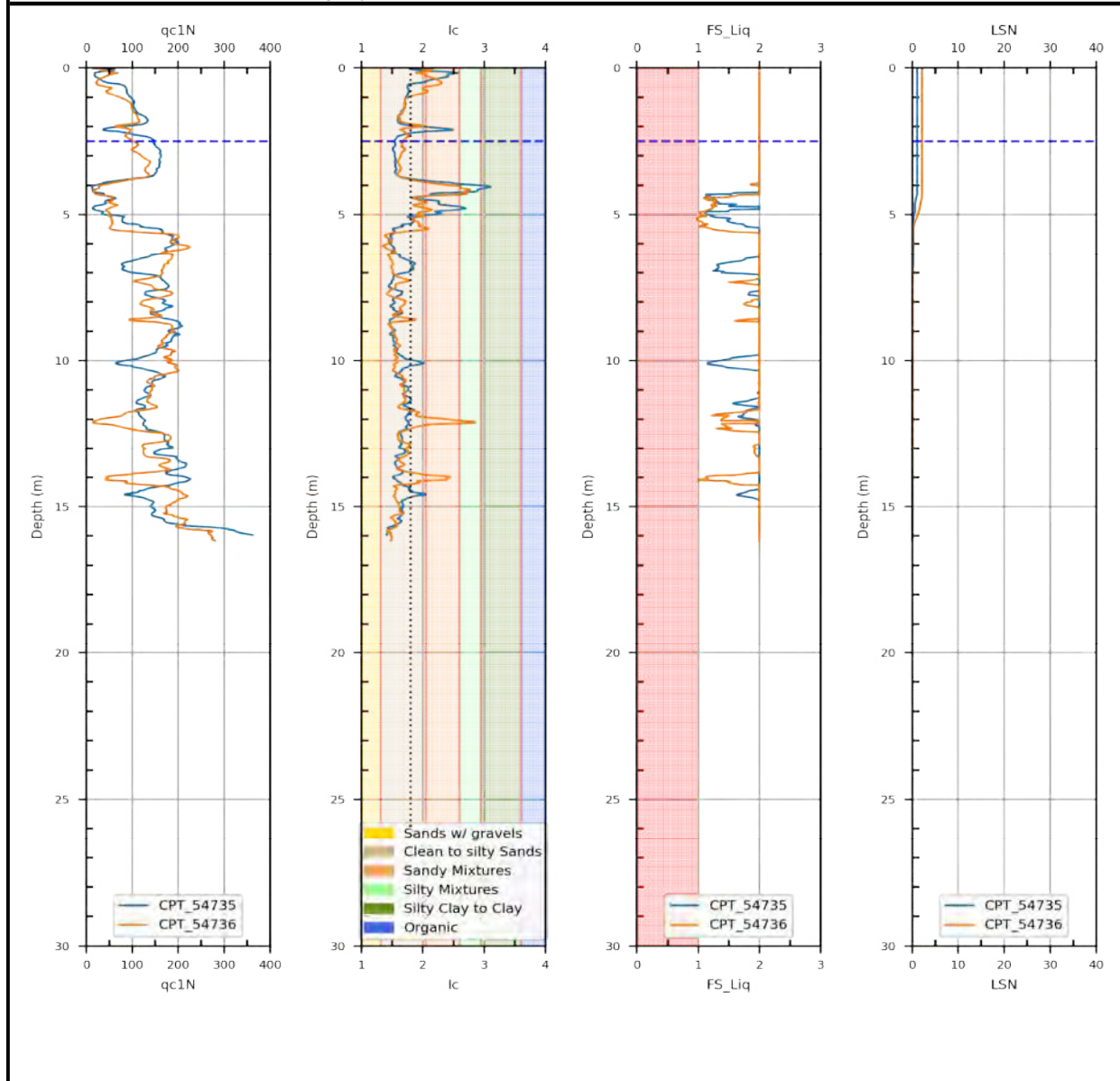
Case History: Ch-S190
Site: CC NOLIQ39 Lakewood Dr (N° 75)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2 - 7.1
PGA: 0.34g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.5m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.49244 Longitude 172.68368
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S191
Site: CC NOLIQ39 Lakewood Dr (N° 75)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2 - 7.1
PGA: 0.21g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.5m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.49244 Longitude 172.68368
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



CC NOLIQ40 Tonks Streets

Case History:

Site: CC NOLIQ40 Tonks St (N° 76)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.19g - 0.56g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.49375 Longitude 172.7245
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:

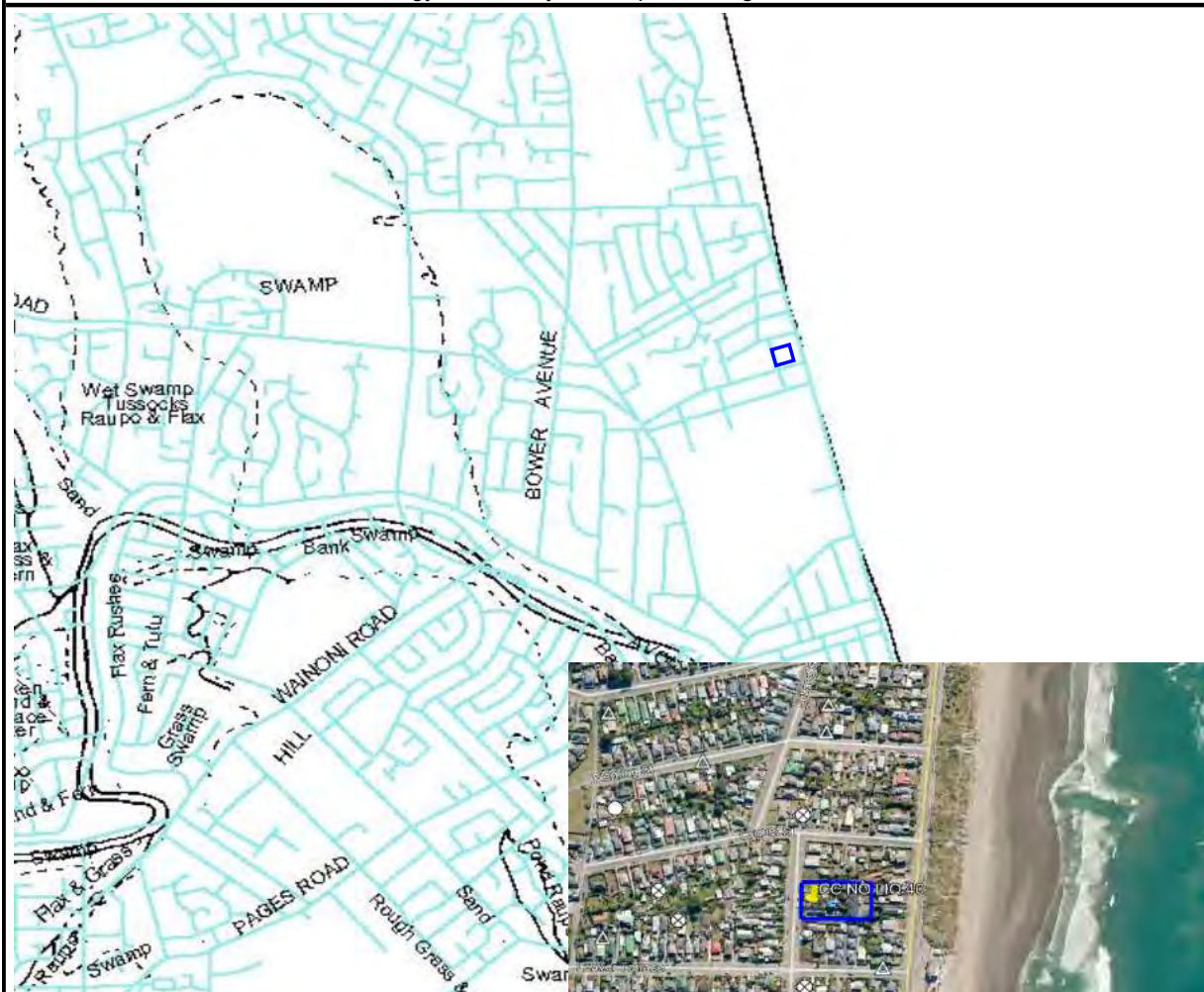
Site: CC NOLIQ40 Tonks St (N° 76)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.19g - 0.56g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.49375 Longitude 172.7245
Source: Christchurch City Council, map_Ap001725BlackMap.gws

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

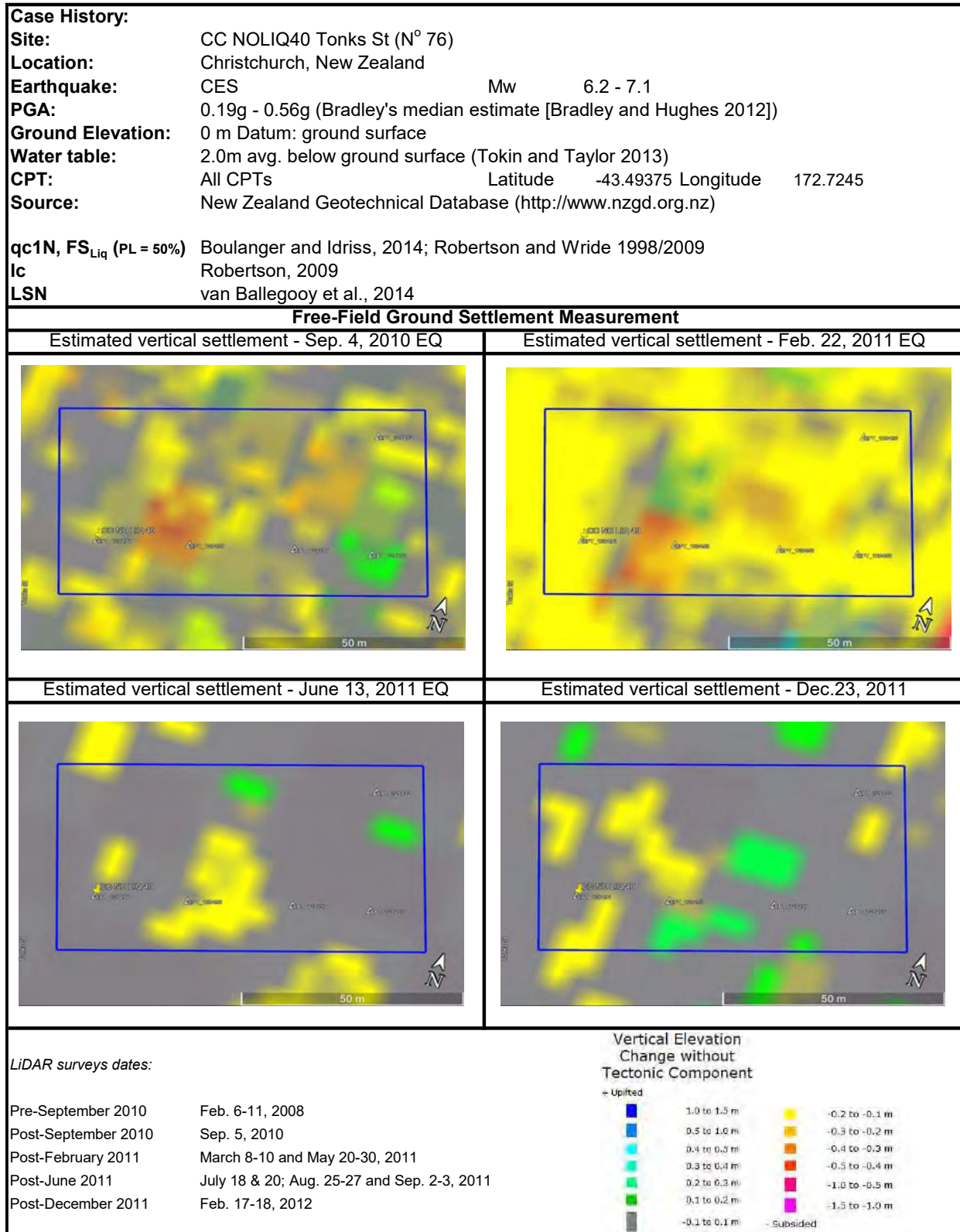
Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856



Case History:	
Site:	CC NOLIQ40 Tonks St (N° 76)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.19g - 0.56g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.49375 Longitude 172.7245
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
	

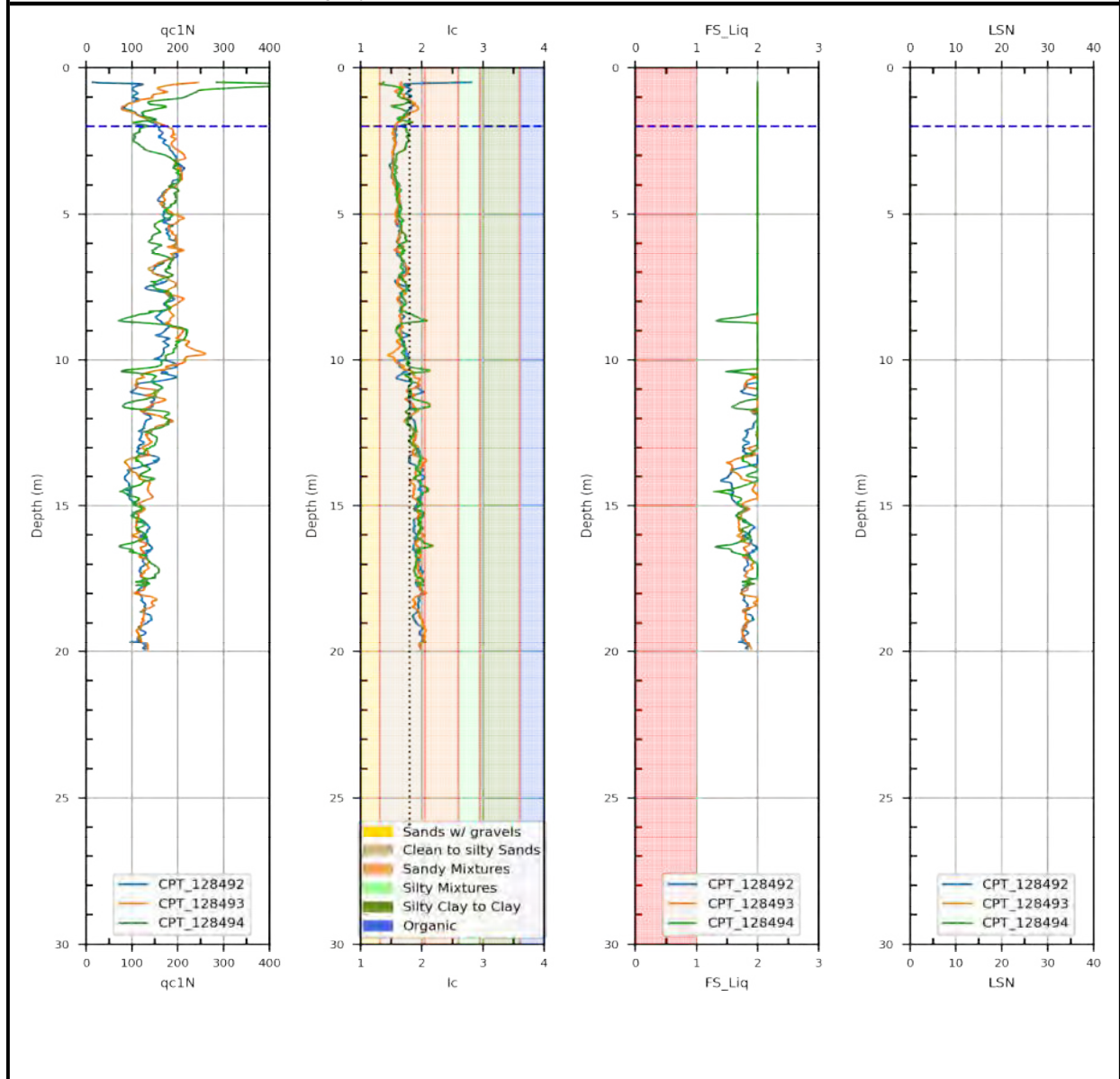


Case History: Ch-S192
Site: CC NOLIQ40 Tonks St (N° 76)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 6.2 - 7.1
PGA: 0.19g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.49375 Longitude 172.7245
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

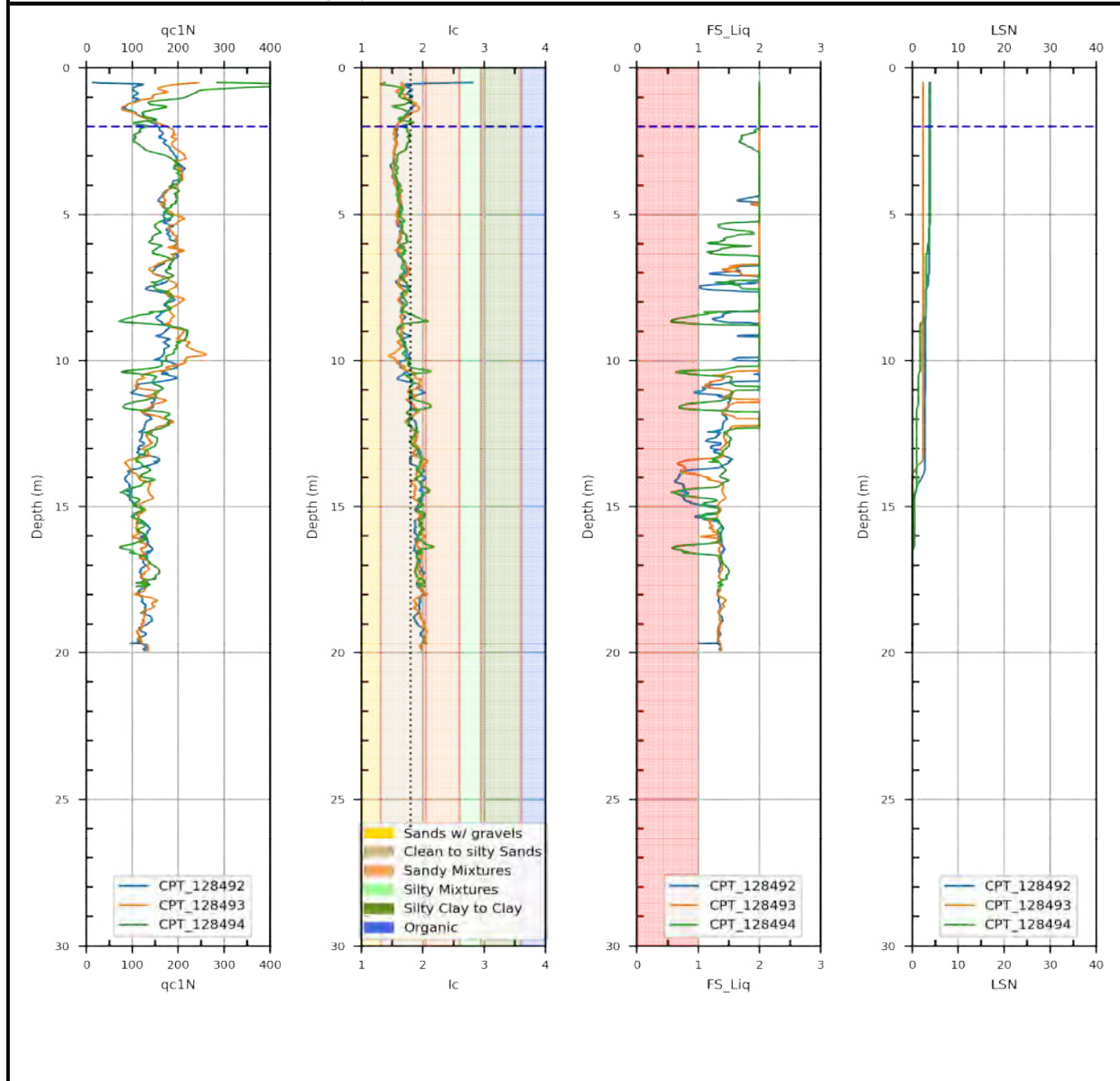
Ic Robertson, 2009

LSN van Ballegooy et al., 2014

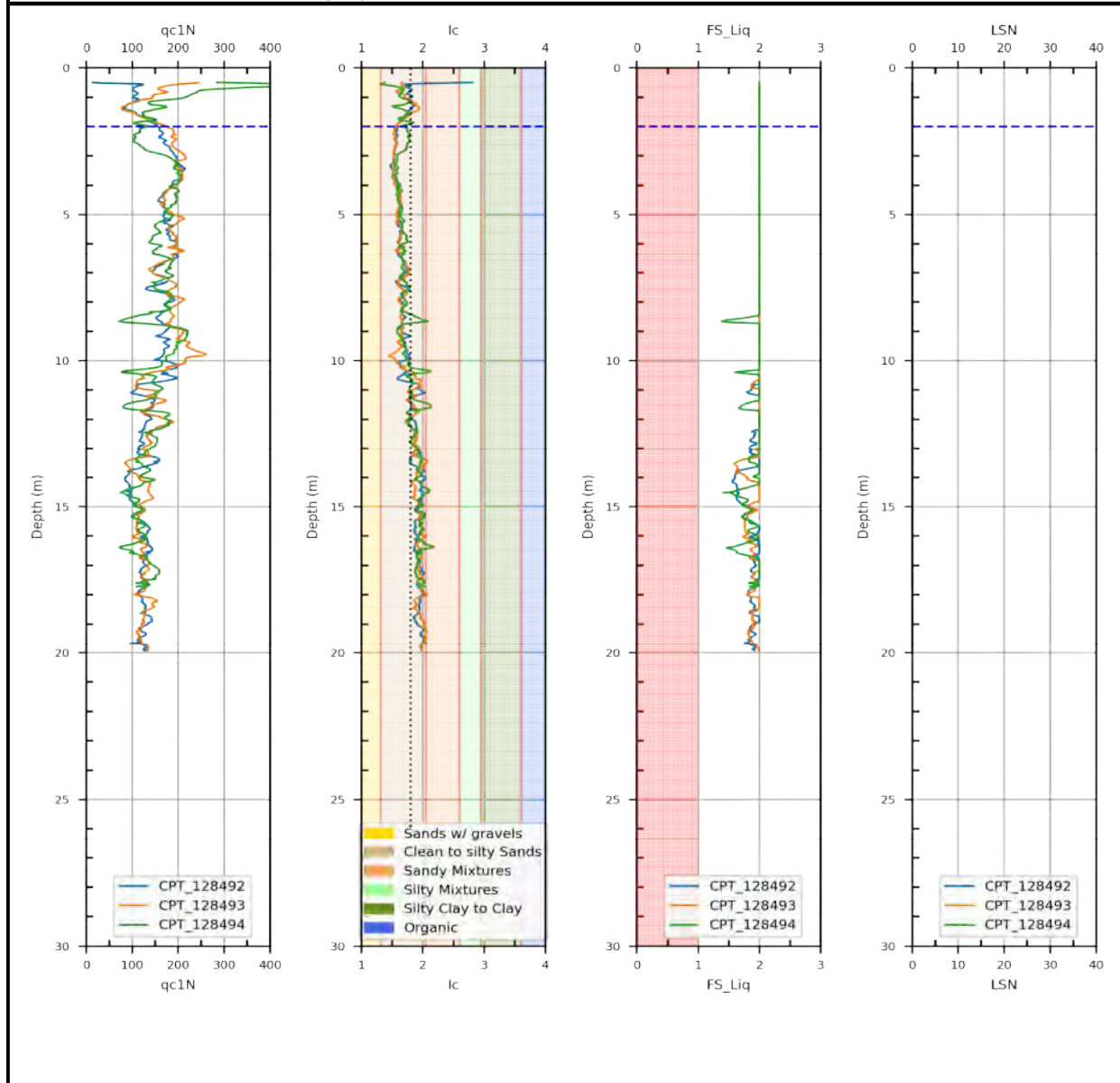


Case History: Ch-S193
Site: CC NOLIQ40 Tonks St (N° 76)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2 - 7.1
PGA: 0.56g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.49375 Longitude 172.7245
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
lc Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S194
Site: CC NOLIQ40 Tonks St (N° 76)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2 - 7.1
PGA: 0.22g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.0m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.49375 Longitude 172.7245
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



CC NOLIQ42 Armagh Street

Case History:

Site: CC NOLIQ42 Armagh St (N° 77)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.22g - 0.46g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.5m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.52901 Longitude 172.64868
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

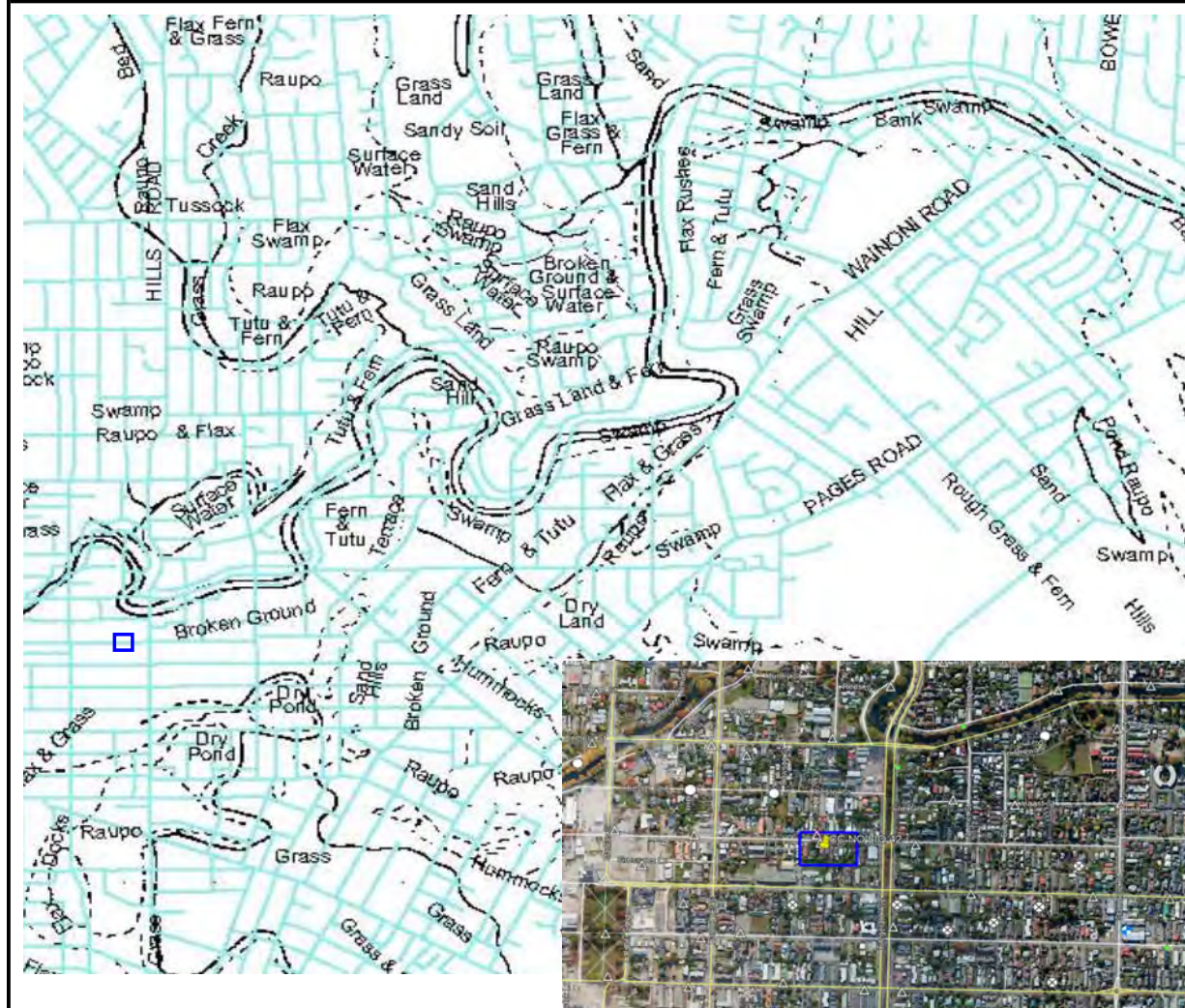
LSN van Ballegooy et al., 2014

Site Plan View**References:**

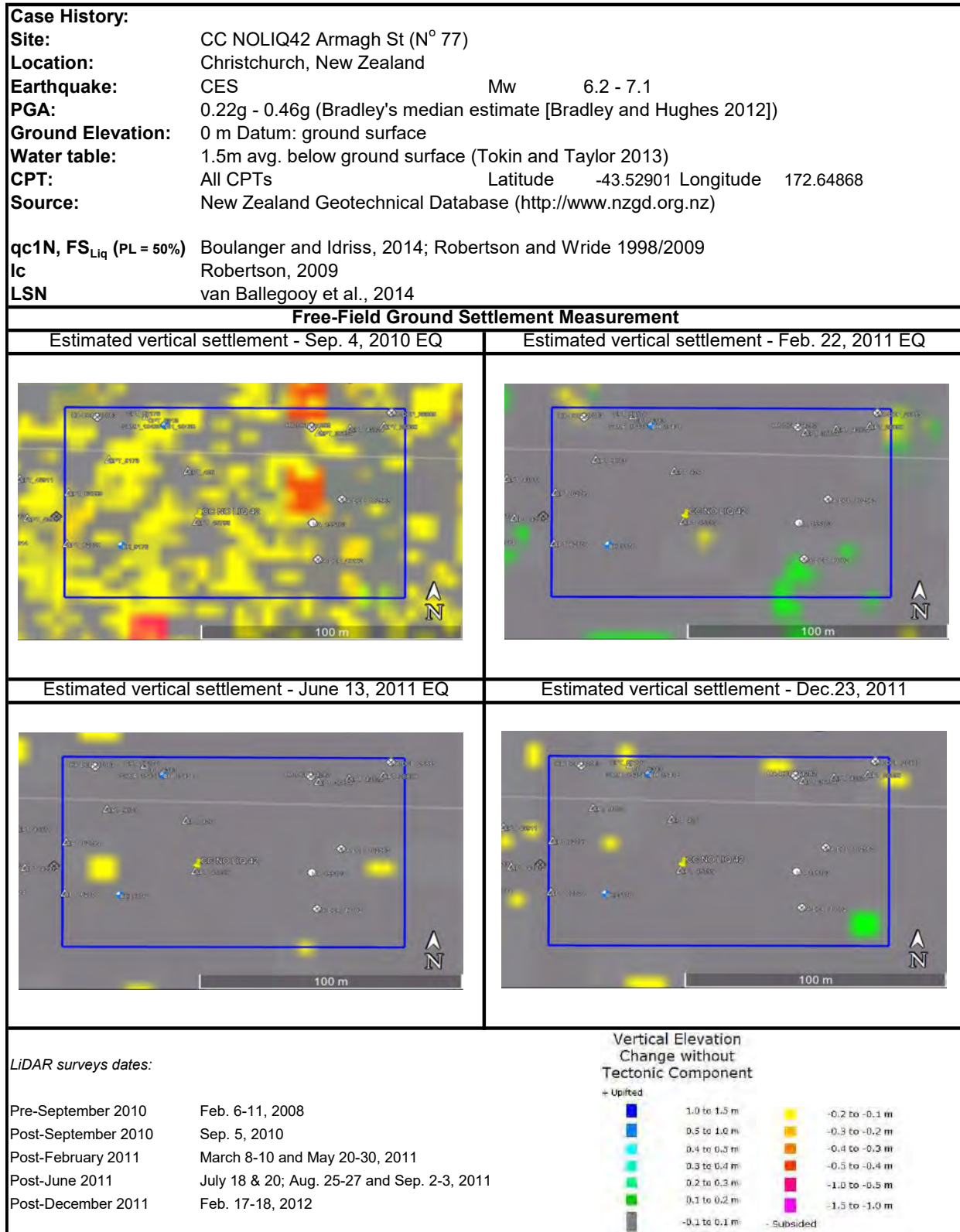
New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

Case History:**Site:** CC NOLIQ42 Armagh St (N° 77)**Location:** Christchurch, New Zealand**Earthquake:** CES Mw 6.2 - 7.1**PGA:** 0.22g - 0.46g (Bradley's median estimate [Bradley and Hughes 2012])**Ground Elevation:** 0 m Datum: ground surface**Water table:** 1.5m avg. below ground surface (Tokin and Taylor 2013)**CPT:** All CPTs Latitude -43.52901 Longitude 172.64868**Source:** Christchurch City Council, map_Ap001725BlackMap.gws**qc1N, FS_{Liq} (PL = 50%)** Boulanger and Idriss, 2014; Robertson and Wride 1998/2009**lc** Robertson, 2009**LSN** van Ballegooy et al., 2014

Surficial Geology - waterways swamps and vegetation cover in 1856

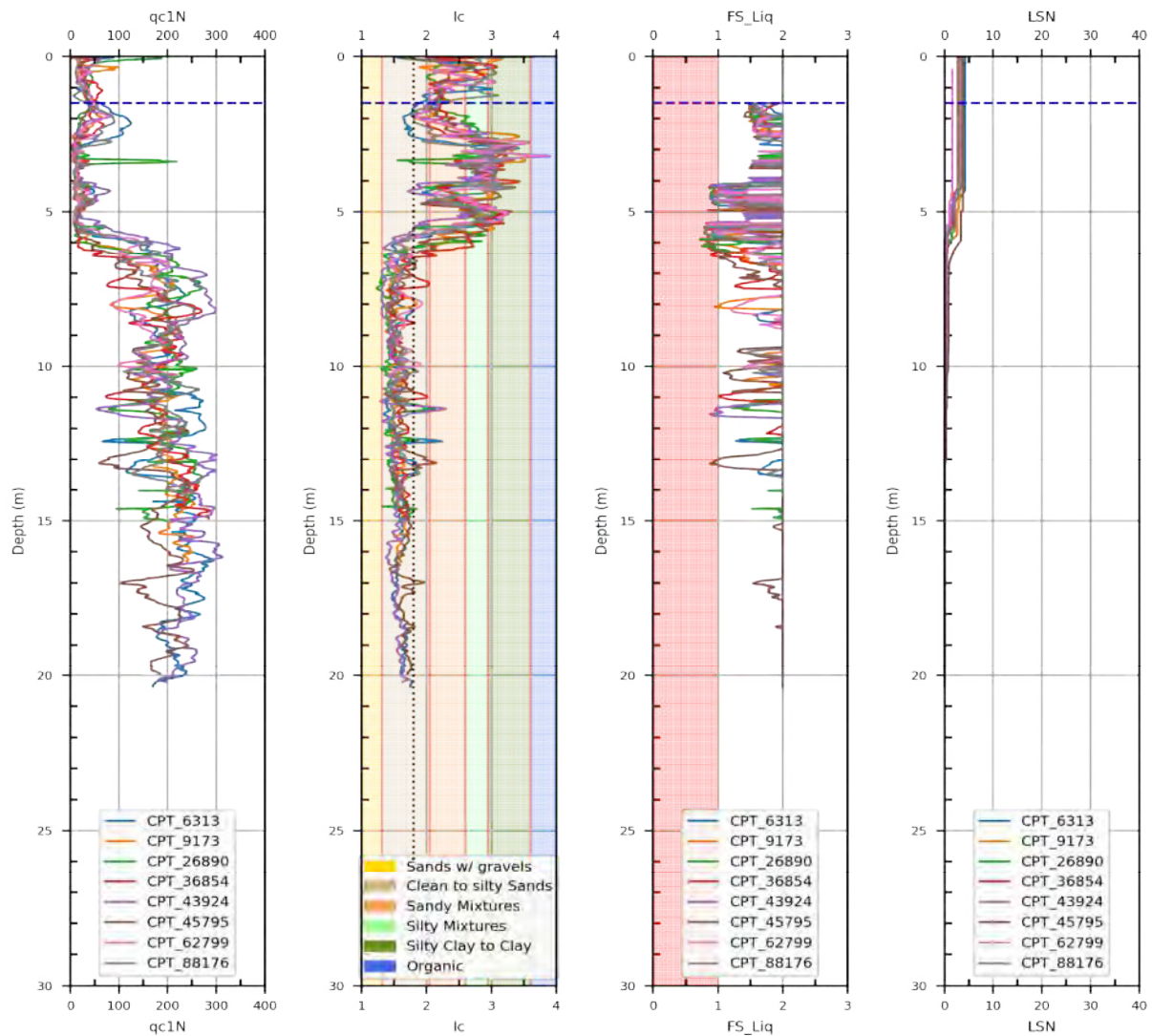


Case History: Site: CC NOLIQ42 Armagh St (N ^o 77) Location: Christchurch, New Zealand Earthquake: CES Mw 6.2 - 7.1 PGA: 0.22g - 0.46g (Bradley's median estimate [Bradley and Hughes 2012]) Ground Elevation: 0 m Datum: ground surface Water table: 1.5m avg. below ground surface (Tokin and Taylor 2013) CPT: All CPTs Latitude -43.52901 Longitude 172.64868 Source: New Zealand Geotechnical Database (http://www.nzgd.org.nz) qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009 Ic Robertson, 2009 LSN van Ballegooy et al., 2014	
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
  Ministry of Civil Defence & Emergency Management Te Kaitiaki Whakamānau  CERA Canterbury Earthquake Recovery Authority  EQC EARTHQUAKE COMMISSION Kaitiaki Takekōwhiri  TT Tonkin & Taylor	

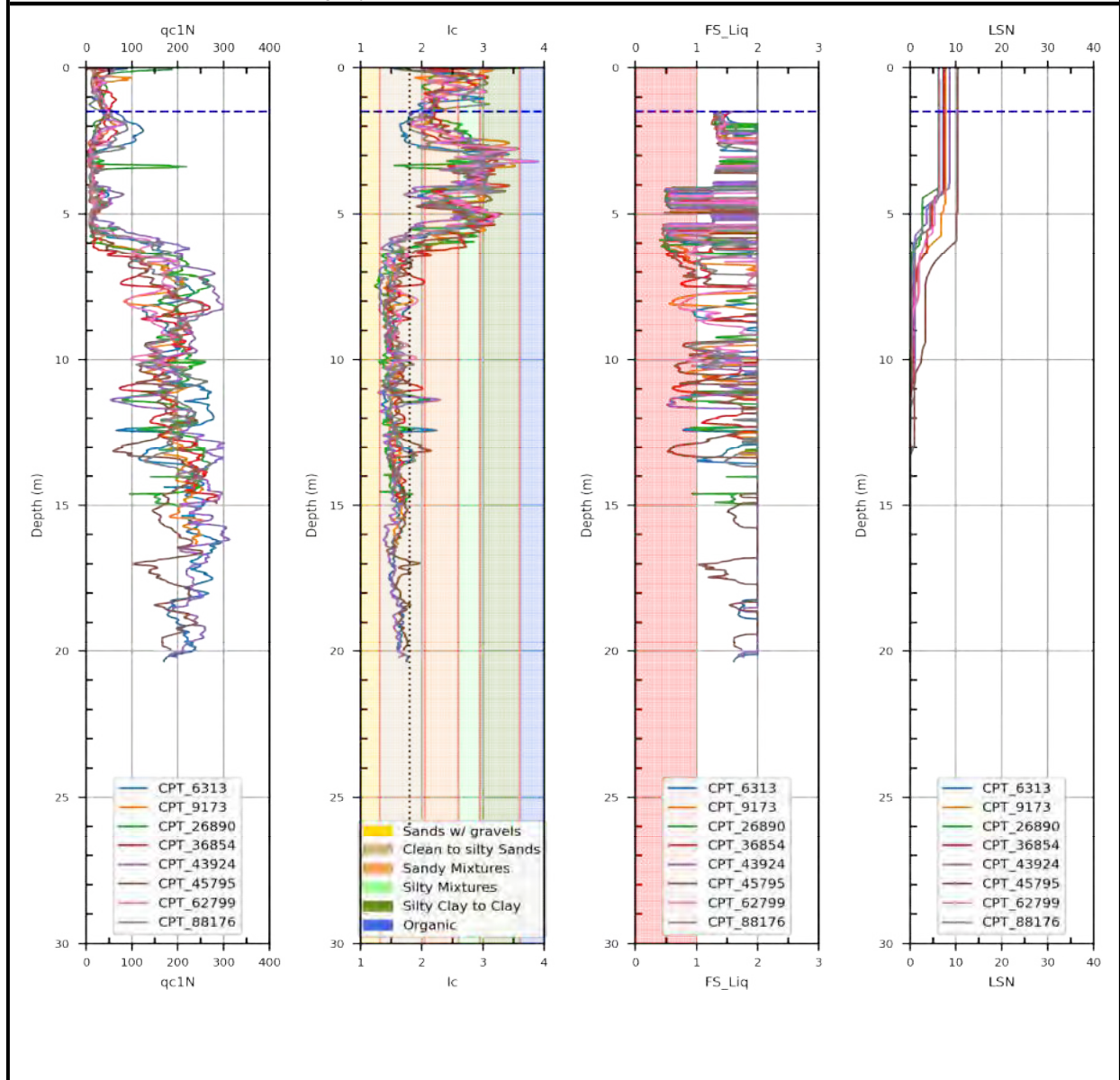


Case History: Ch-S195
Site: CC NOLIQ42 Armagh St (N° 77)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 6.2 - 7.1
PGA: 0.22g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.5m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.52901 Longitude 172.64868
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014

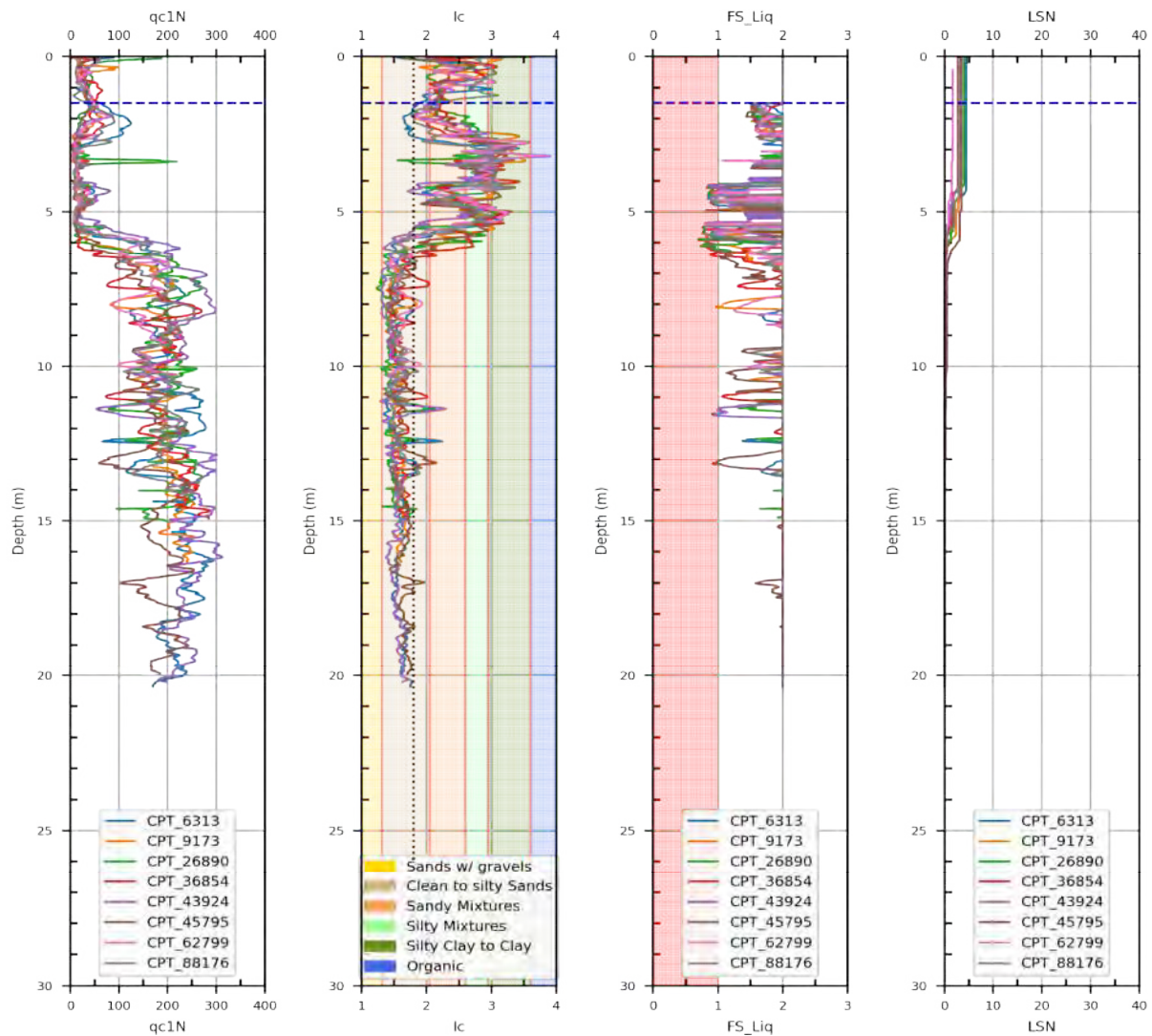


Case History: Ch-S196
Site: CC NOLIQ42 Armagh St (N° 77)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2 - 7.1
PGA: 0.46g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.5m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.52901 Longitude 172.64868
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)
qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: Ch-S197
Site: CC NOLIQ42 Armagh St (N^o 77)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2 - 7.1
PGA: 0.26g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 1.5m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.52901 Longitude 172.64868
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



CC NOLIQ43 Keers Road

Case History:

Site: CC NOLI43 Keers Rd (N° 78)
Location: Christchurch, New Zealand
Earthquake: CES Mw 6.2 - 7.1
PGA: 0.21g - 0.63g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.5m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.52652 Longitude 172.68082
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

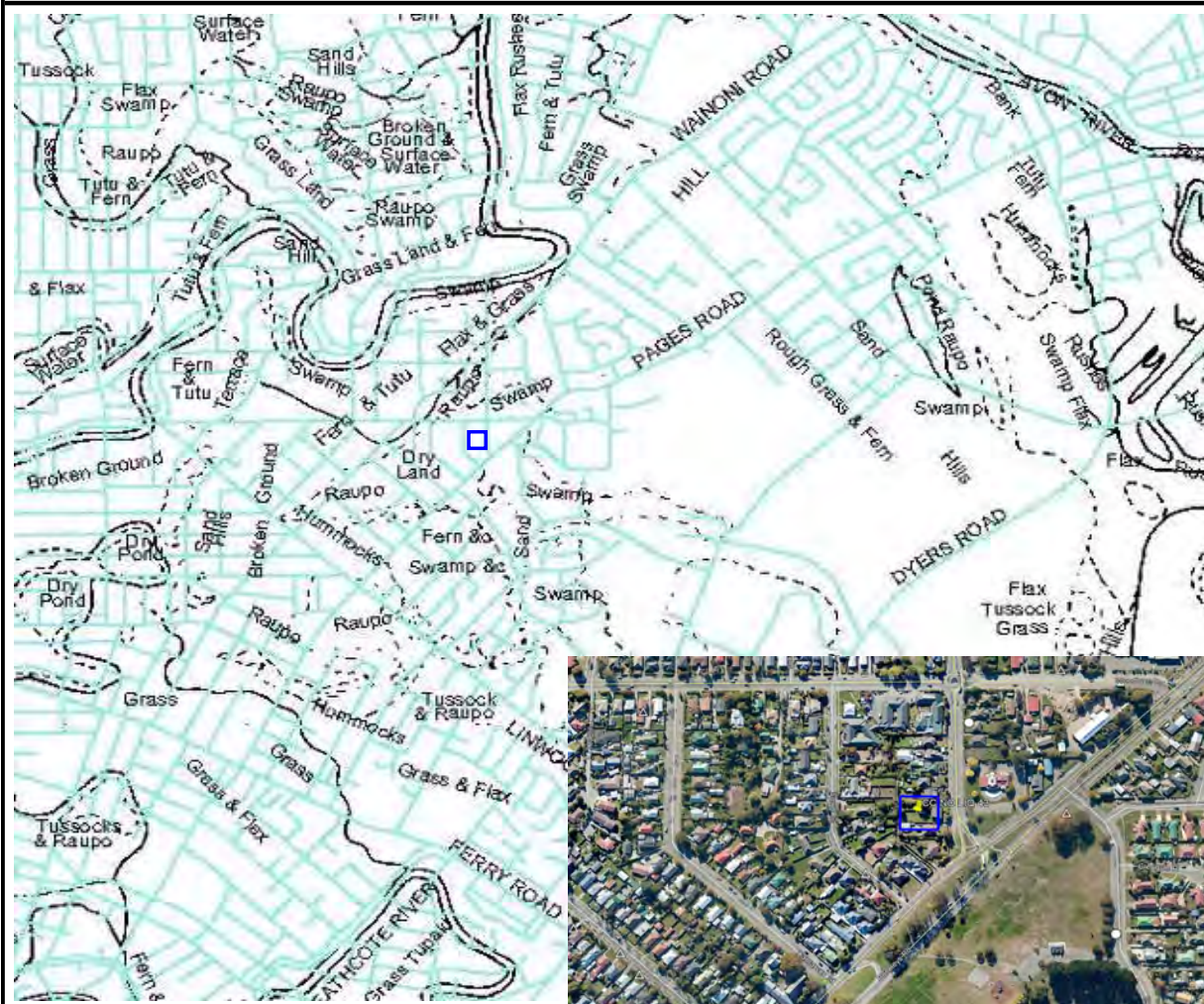
Site Plan View**References:**

New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

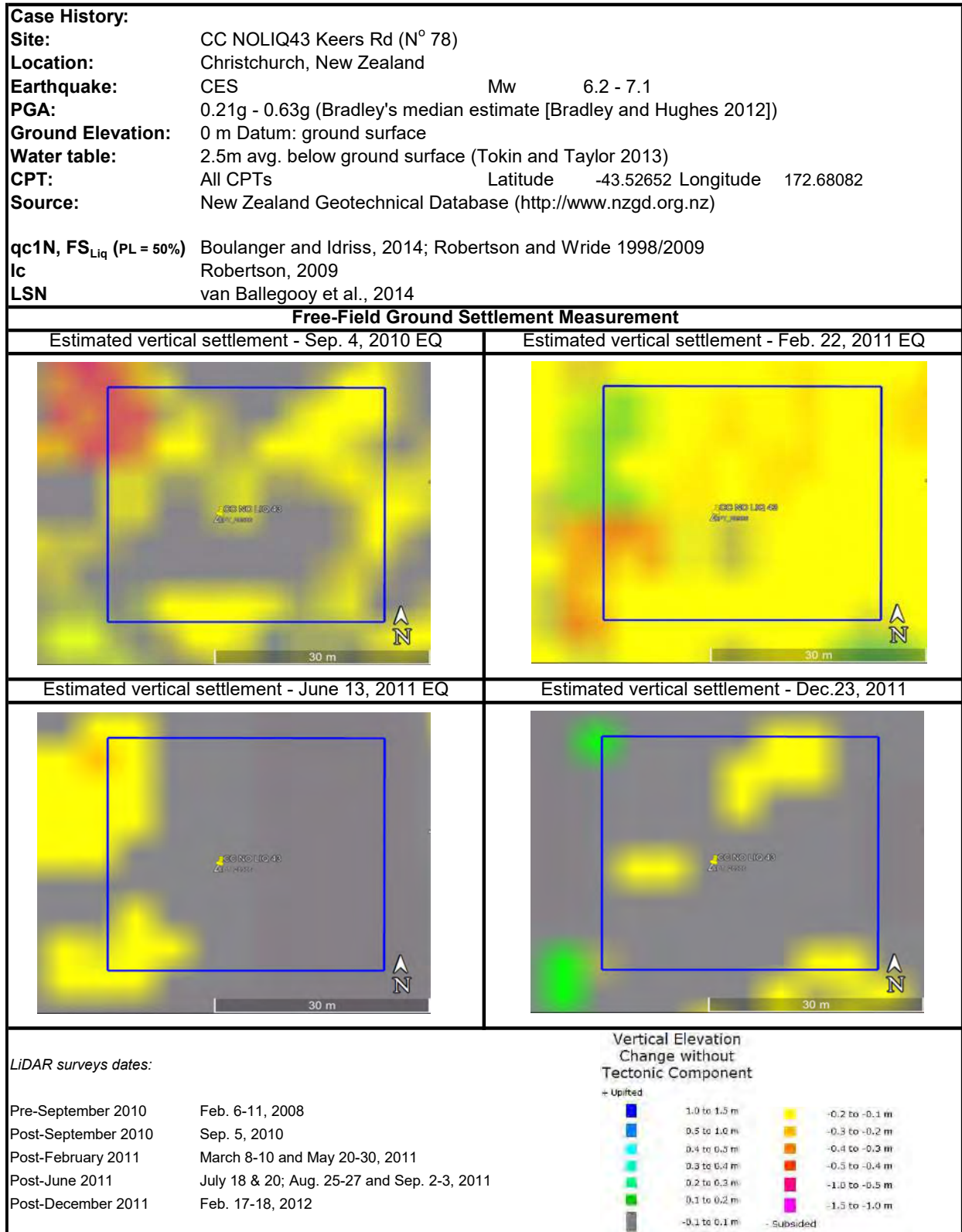
Site:	CC NOLIQ43 Keers Rd (N ^o 78)			
Location:	Christchurch, New Zealand			
Earthquake:	CES	Mw	6.2 - 7.1	
PGA:	0.21g - 0.63g (Bradley's median estimate [Bradley and Hughes 2012])			
Ground Elevation:	0 m Datum: ground surface			
Water table:	2.5m avg. below ground surface (Tokin and Taylor 2013)			
CPT:	All CPTs	Latitude	-43.52652	Longitude 172.68082
Source:	Christchurch City Council, map_Ap001725BlackMap.gws			

Robertson, 2009

Surficial Geology - waterways swamps and vegetation cover in 1856



Case History:	
Site:	CC NOLIQ43 Keers Rd (N° 78)
Location:	Christchurch, New Zealand
Earthquake:	CES Mw 6.2 - 7.1
PGA:	0.21g - 0.63g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation:	0 m Datum: ground surface
Water table:	2.5m avg. below ground surface (Tokin and Taylor 2013)
CPT:	All CPTs Latitude -43.52652 Longitude 172.68082
Source:	New Zealand Geotechnical Database (http://www.nzgd.org.nz)
qc1N, FS_{Liq} (PL = 50%)	Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic	Robertson, 2009
LSN	van Ballegooy et al., 2014
Ejecta Patterns	
Aerial photography taken on September 5, 2010	Aerial photography taken on February 24, 2011
	
Aerial photography taken on June 14-15, 2011	Aerial photography taken on December 24, 2011
	
	

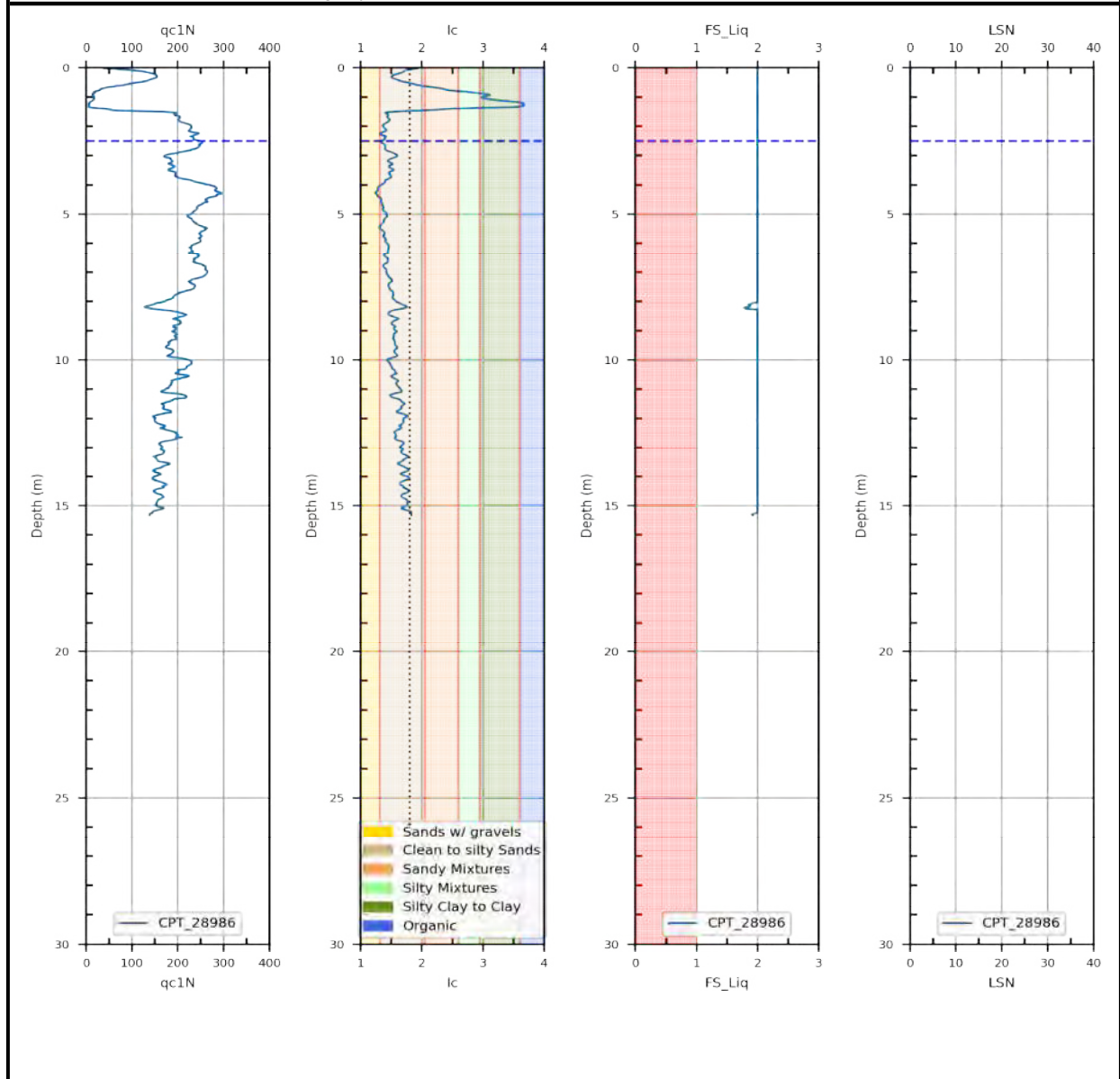


Case History: Ch-S198
Site: CC NOLI43 Keers Rd (N° 78)
Location: Christchurch, New Zealand
Earthquake: Darfield 2010 Mw 6.2 - 7.1
PGA: 0.21g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.5m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.52652 Longitude 172.68082
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

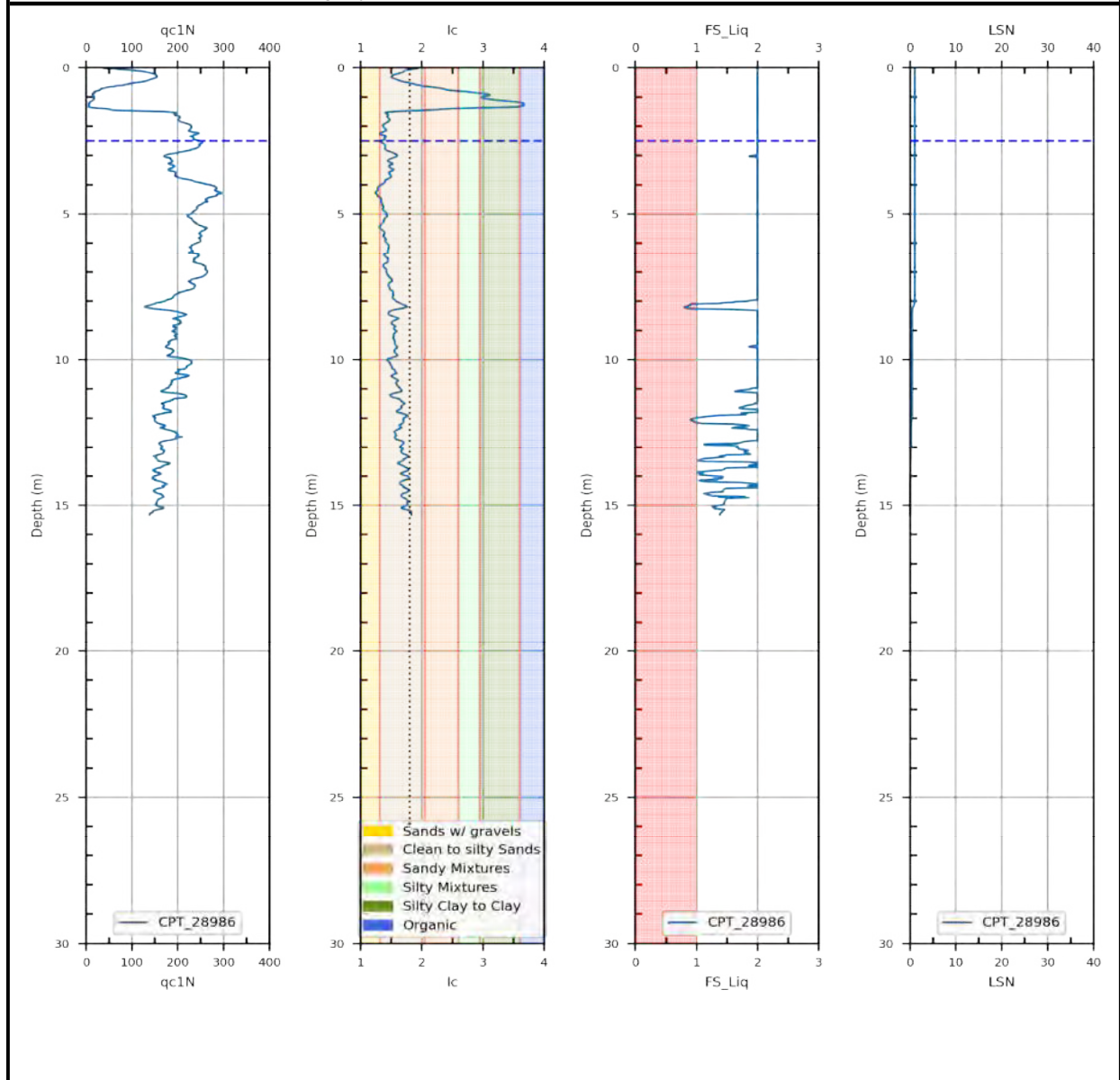


Case History: Ch-S199
Site: CC NOLIQ43 Keers Rd (N° 78)
Location: Christchurch, New Zealand
Earthquake: Christchurch 2011 Mw 6.2 - 7.1
PGA: 0.63g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.5m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.52652 Longitude 172.68082
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

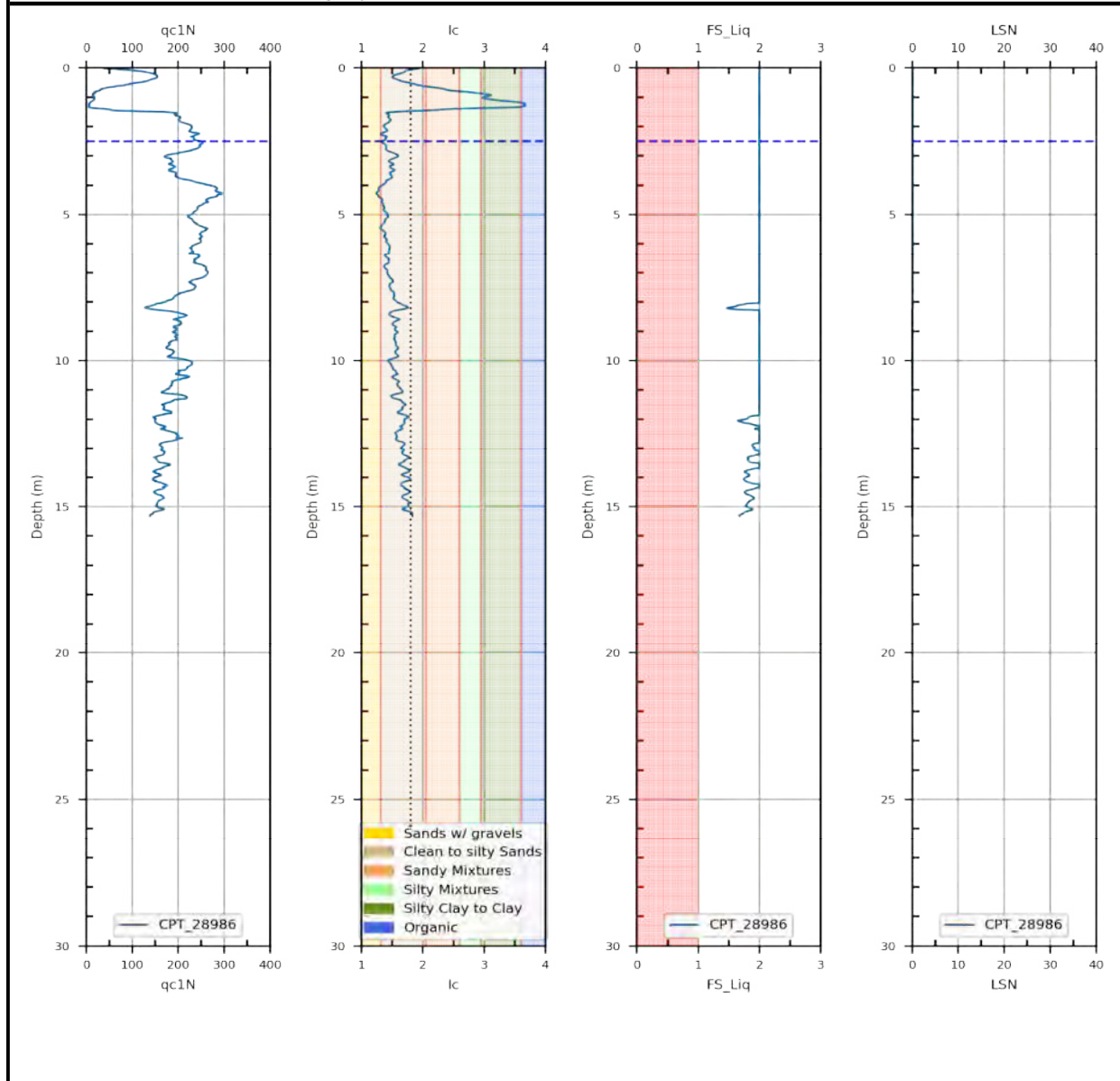
Ic Robertson, 2009

LSN van Ballegooy et al., 2014



Case History: Ch-S200
Site: CC NOLI43 Keers Rd (N^o 78)
Location: Christchurch, New Zealand
Earthquake: June 2011 Mw 6.2 - 7.1
PGA: 0.35g (Bradley's median estimate [Bradley and Hughes 2012])
Ground Elevation: 0 m Datum: ground surface
Water table: 2.5m avg. below ground surface (Tokin and Taylor 2013)
CPT: All CPTs Latitude -43.52652 Longitude 172.68082
Source: New Zealand Geotechnical Database (<http://www.nzgd.org.nz>)

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Appendix I: Case Histories - Urayasu

Case History:

Site: Takasu Kaihin Park
Location: Urayasu, Japan
Earthquake: 2011 Tohoku Mw 9.1
PGA: 0.20 - 0.27 g (Cox et al. 2013)
Ground Elevation: 0m, Ground surface
Water table: 0.5 - 2.4 m below ground surface (Cox et al. 2013)
CPT: All CPTs Latitude 35.632 Longitude 139.919
Source: Katsumata and Tokimatsu, 2012

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Site Plan View**References:**

Cox et.al. 2013_Liquefaction at Strong Motion Stations and in Urayasu City during the 2011 Tohoku-Oki Earthquake

Katsumata and Tokimatsu (2012). Relationship between seismic characteristics and liquefaction damages of Urayasu City induced by the 2011 great east Japan earthquake.

Tokimatsu et al. (2012). Geotechnical problems in the 2011 Tohoku pacific earthquake

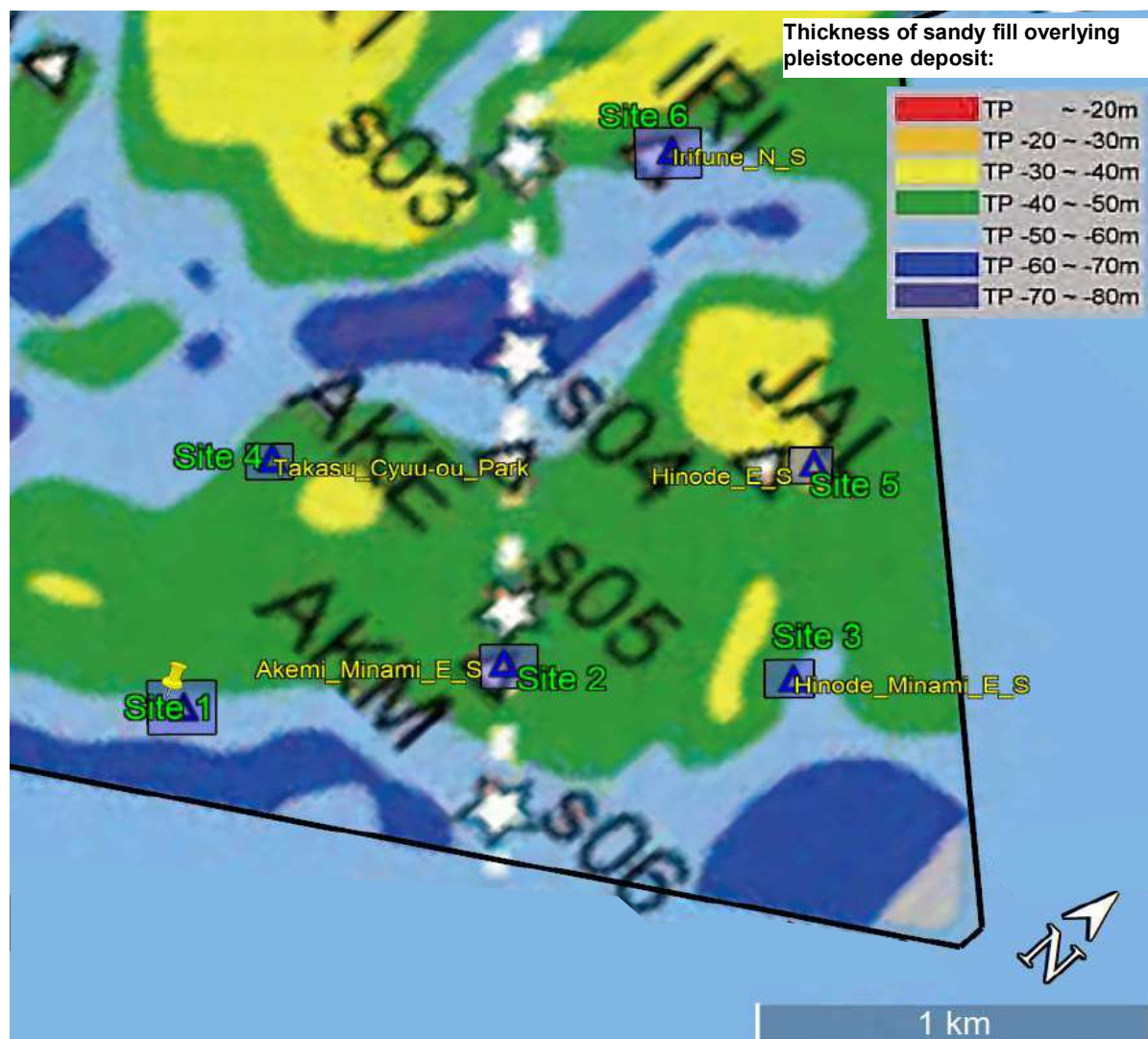
Case History:

Site: Takasu Kaihin Park
Location: Urayasu, Japan
Earthquake: 2011 Tohoku Mw 9.1
PGA: 0.20 - 0.27 g (Cox et al. 2013)
Ground Elevation: 0m, Ground surface
Water table: 0.5 - 2.4 m below ground surface (Cox et al. 2013)
CPT: All CPTs Latitude 35.632 Longitude 139.919
Source: Katsumata and Tokimatsu, 2012

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Surficial Geology

Case History:

Site: Takasu Kaihin Park
Location: Urayasu, Japan
Earthquake: 2011 Tohoku Mw 9.1
PGA: 0.20 - 0.27 g (Cox et al. 2013)
Ground Elevation: 0m, Ground surface
Water table: 0.5 - 2.4 m below ground surface (Cox et al. 2013)
CPT: All CPTs Latitude 35.632 Longitude 139.919
Source: Katsumata and Tokimatsu, 2012

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009

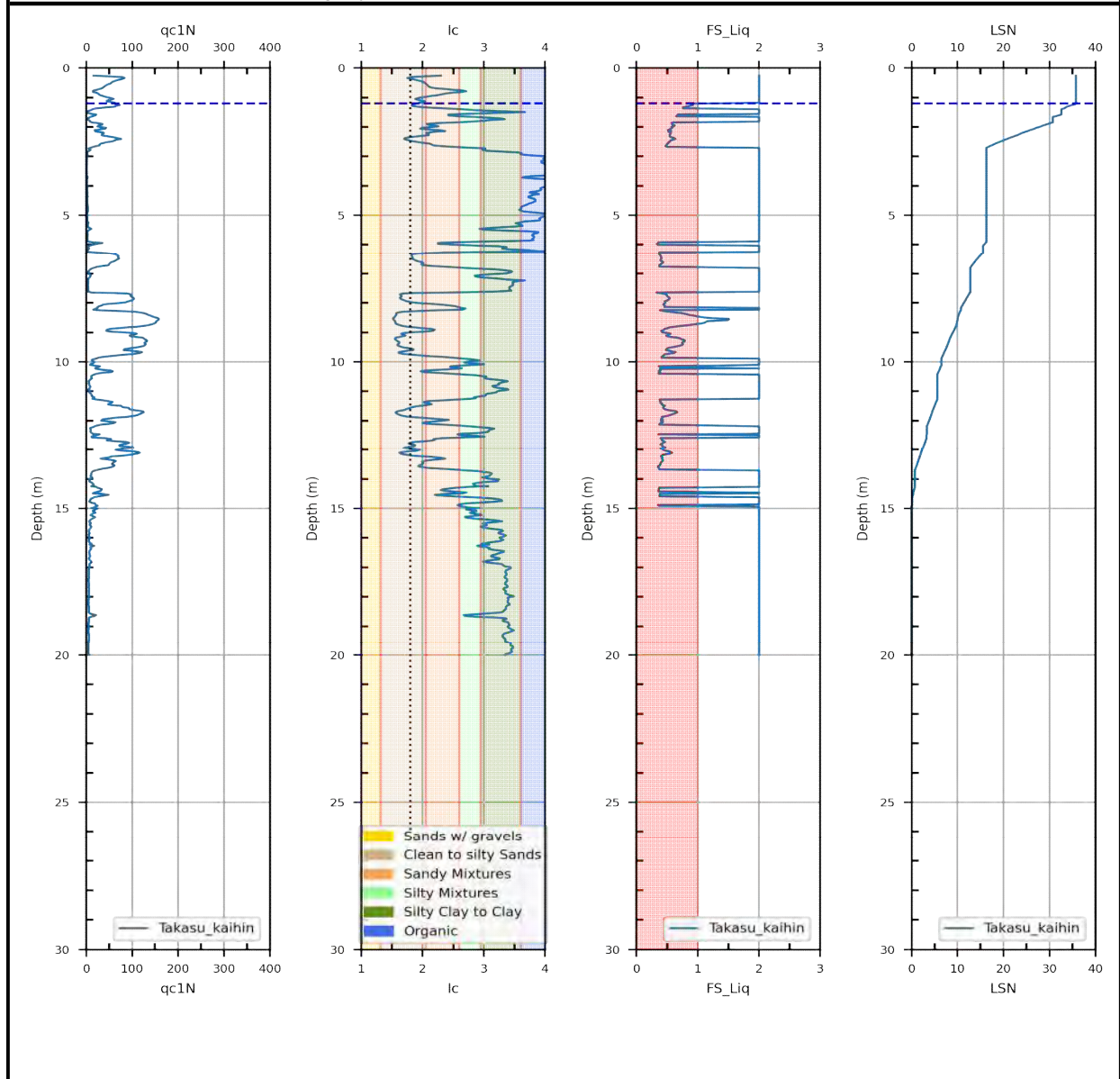
Ic Robertson, 2009

LSN van Ballegooy et al., 2014

Free-Field Ground Settlement Measurement

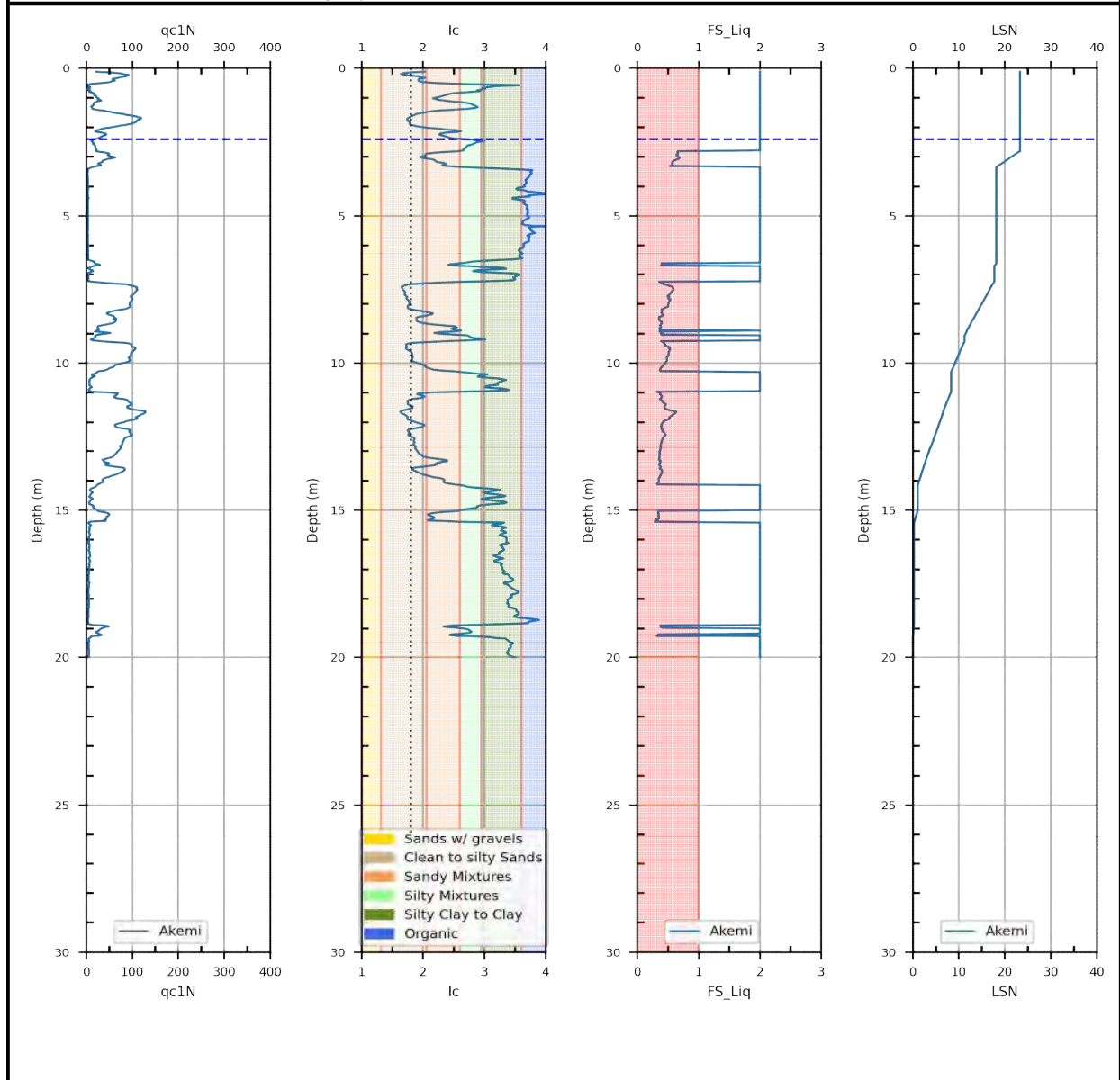
Case History: UR-S1
Site: Takasu Kaihin Park
Location: Urayasu, Japan
Earthquake: 2011 Tohoku Mw 9.1
PGA: 0.22 g (Cox et al. 2013)
Ground Elevation: 0m, Ground surface
Water table: 1.2 m below ground surface (Cox et al. 2013)
CPT: Takasu_Kaihin_Park Latitude 35.632 Longitude 139.919
Source: Katsumata and Tokimatsu, 2012

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



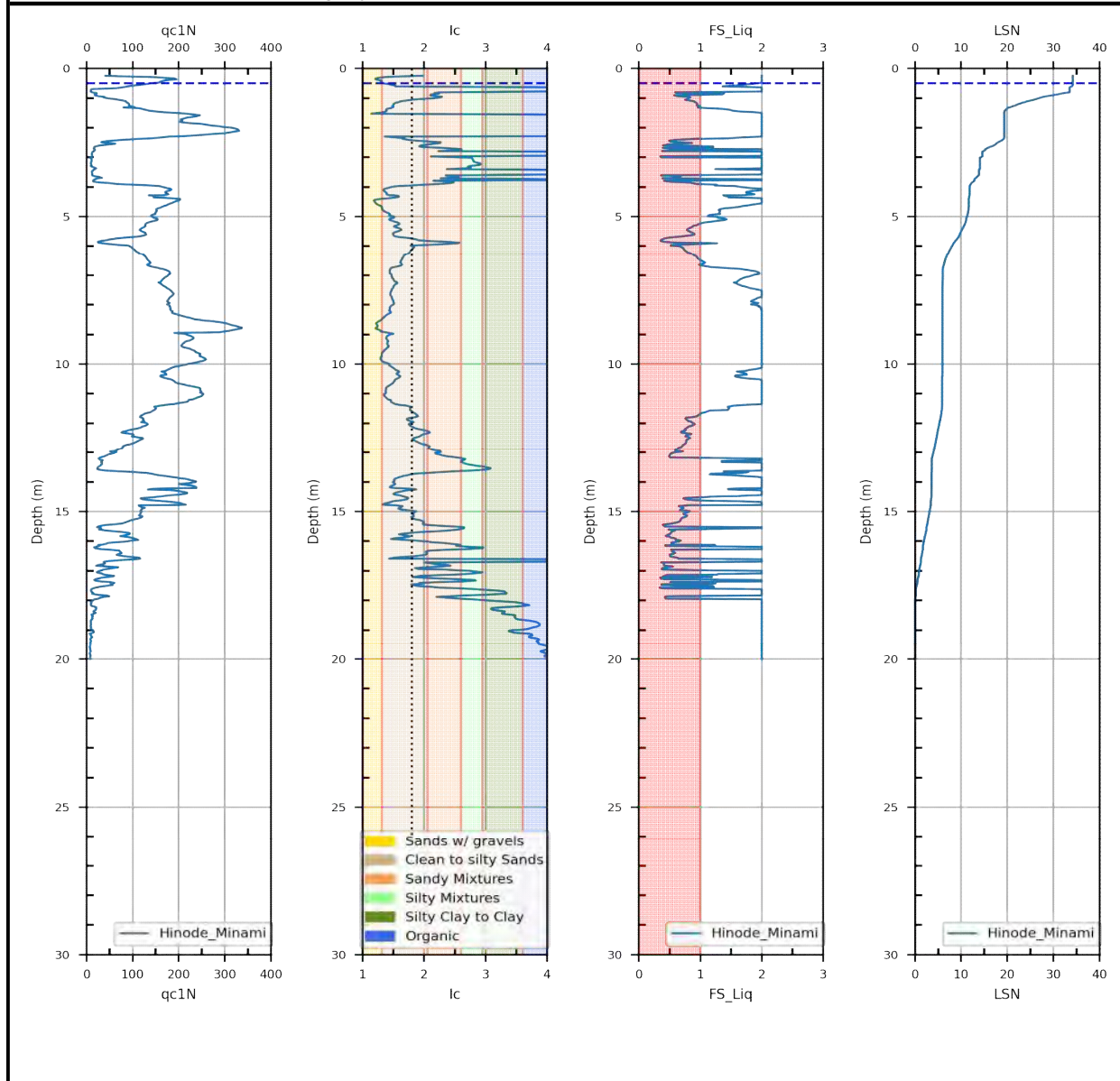
Case History: UR-S2
Site: Akemi Minami ES
Location: Urayasu, Japan
Earthquake: 2011 Tohoku Mw 9.1
PGA: 0.27 g (Cox et al. 2013)
Ground Elevation: 0m, Ground surface
Water table: 2.4 m below ground surface (Cox et al. 2013)
CPT: Akemi_Minami_E_S Latitude 35.6379 Longitude 139.924
Source: Katsumata and Tokimatsu, 2012

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



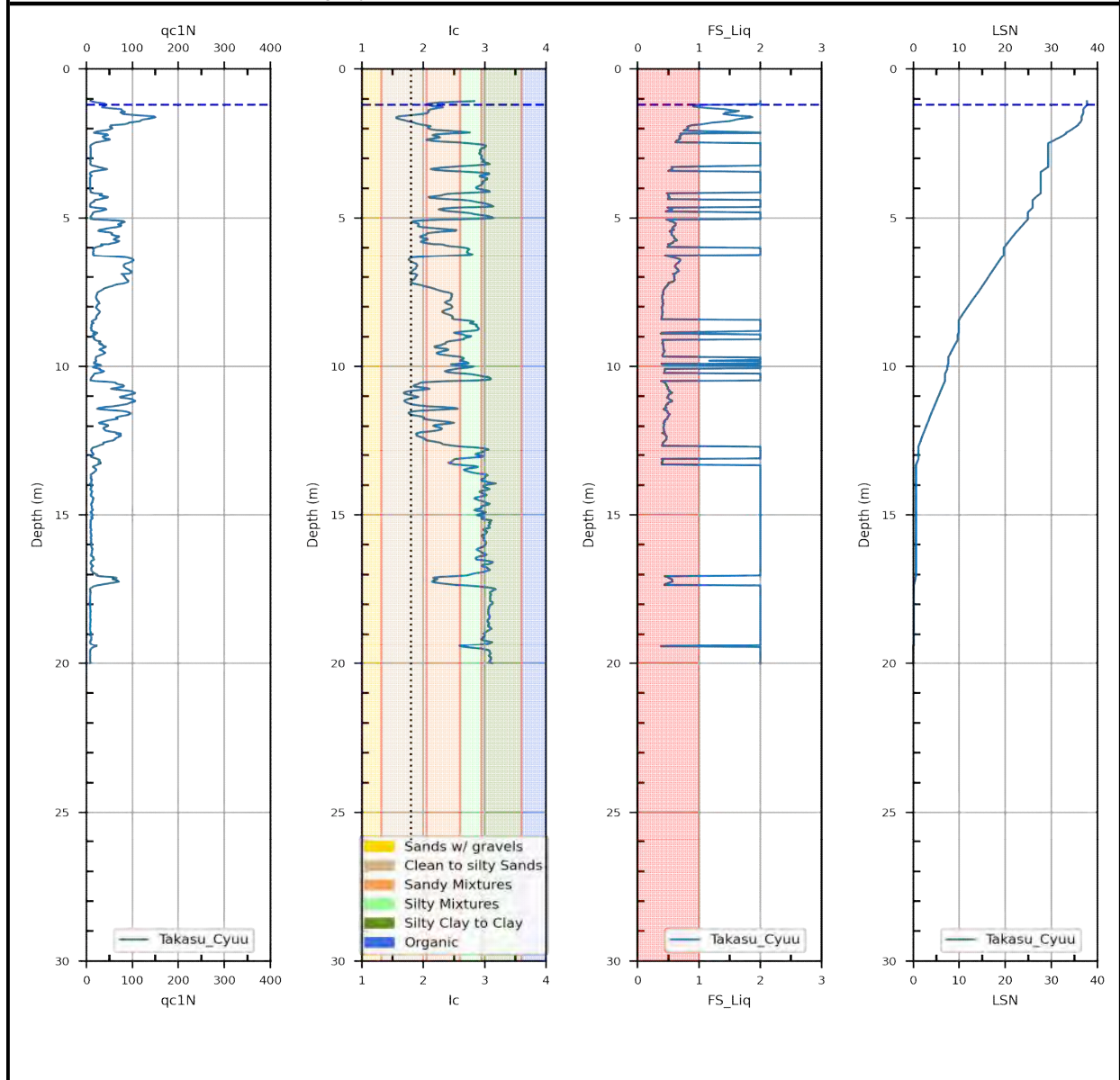
Case History: UR-S3
Site: Hinode Minami
Location: Urayasu, Japan
Earthquake: 2011 Tohoku Mw 9.1
PGA: 0.20 g (Cox et al. 2013)
Ground Elevation: 0m, Ground surface
Water table: 0.5 m below ground surface (Cox et al. 2013)
CPT: Hinode_Minami_E_S Latitude 35.6424 Longitude 139.93
Source: Katsumata and Tokimatsu, 2012

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



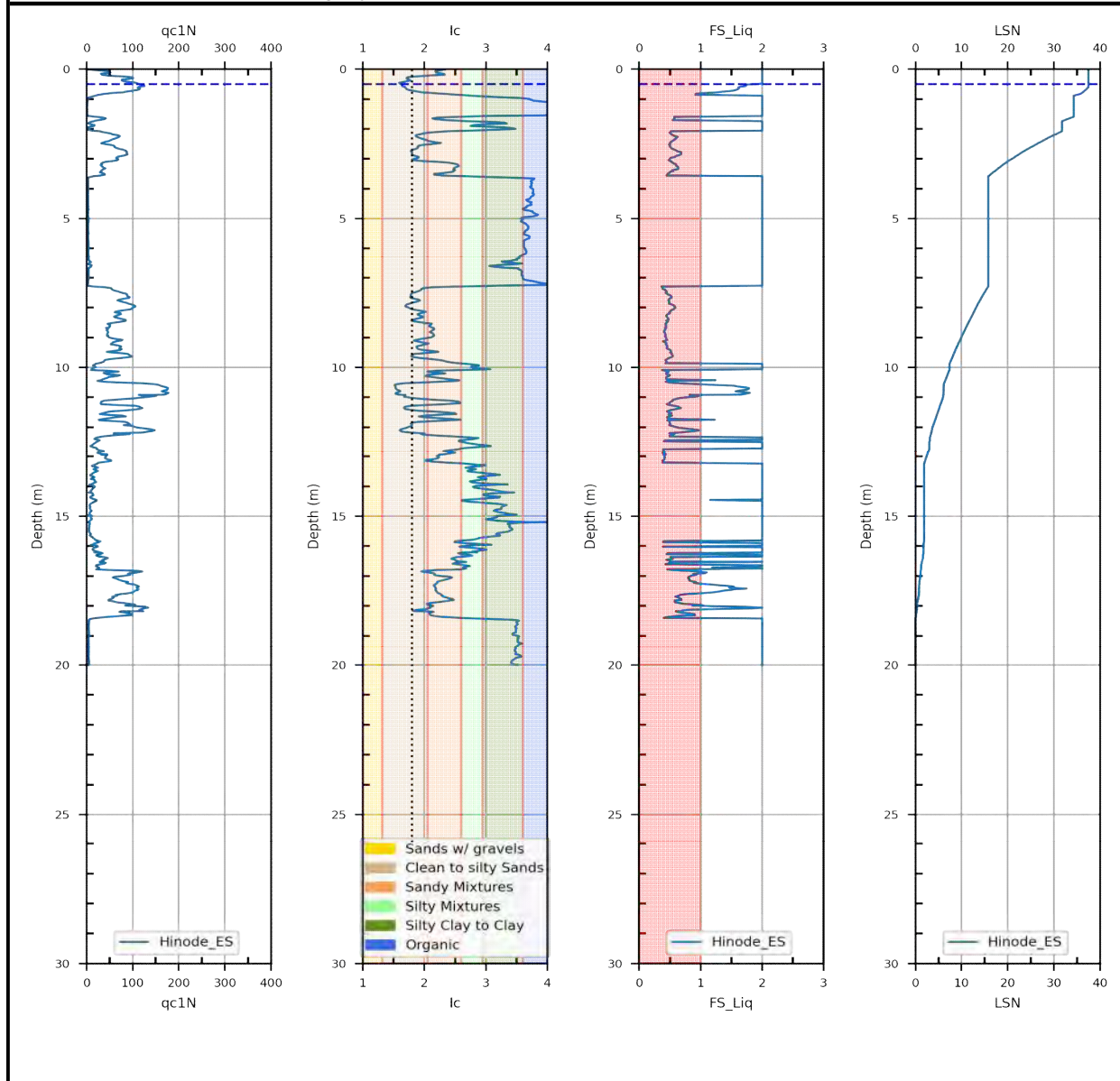
Case History: UR-S4
Site: Takasu Cyuu-ou Park
Location: Urayasu, Japan
Earthquake: 2011 Tohoku Mw 9.1
PGA: 0.21 g (Cox et al. 2013)
Ground Elevation: 0m, Ground surface
Water table: 1.2 m below ground surface (Cox et al. 2013)
CPT: Takasu_Cyuu-ou_Park Latitude 35.6378 Longitude 139.915
Source: Katsumata and Tokimatsu, 2012

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: UR-S5
Site: Hinode ES
Location: Urayasu, Japan
Earthquake: 2011 Tohoku Mw 9.1
PGA: 0.20 g (Cox et al. 2013)
Ground Elevation: 0m, Ground surface
Water table: 0.5 m below ground surface (Cox et al. 2013)
CPT: Hinode_E_S Latitude 35.6465 Longitude 139.926
Source: Katsumata and Tokimatsu, 2012

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014



Case History: UR-S6
Site: Irifune
Location: Urayasu, Japan
Earthquake: 2011 Tohoku Mw 9.1
PGA: 0.26 g (Cox et al. 2013)
Ground Elevation: 0m, Ground surface
Water table: 2.0 m below ground surface (Cox et al. 2013)
CPT: Irifune_N_S Latitude 35.6496 Longitude 139.917
Source: Katsumata and Tokimatsu, 2012

qc1N, FS_{Liq} (PL = 50%) Boulanger and Idriss, 2014; Robertson and Wride 1998/2009
Ic Robertson, 2009
LSN van Ballegooy et al., 2014

