



**Tonkin & Taylor**

## **Appendix G: Main earthquakes - graphs and analysis**

**ENVIRONMENTAL AND ENGINEERING CONSULTANTS**

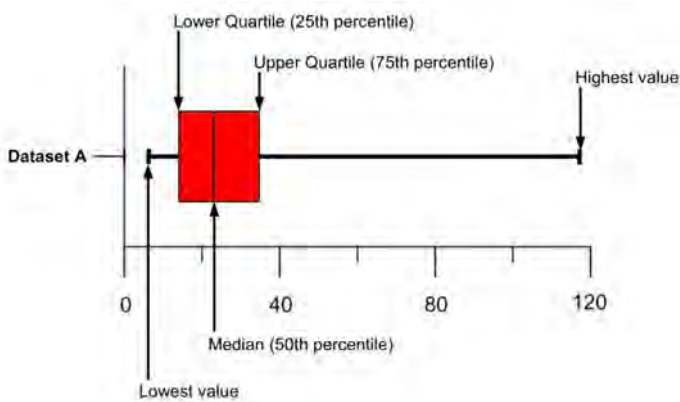


## Figure Index

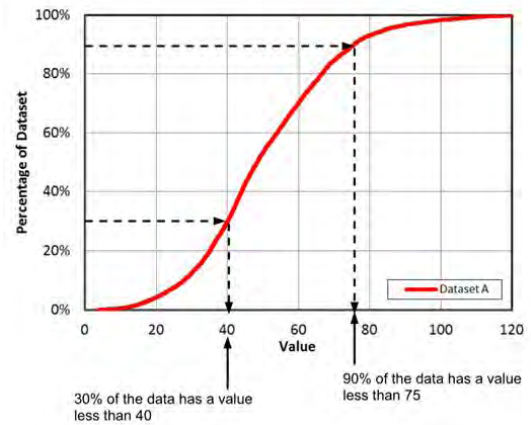
FIGURE	Graph Type	FIGURE No
Land and Dwelling Damage Correlations	Bubble Plot	G1
Earthquake Related Elevation Change (Incremental)	Cumulative Frequency	G2
Earthquake Related Elevation Change (Cumulative)	Cumulative Frequency	G3
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## KEY

Box and Whisker Plots



Cumulative Frequency Plot



### LEGEND

#### Liquefaction and Lateral Spreading Observation Category

	1	No observed ground cracking or ejected liquefied material
	2	Minor ground cracking but no observed ejected liquefied material
	3	No lateral spreading but minor to moderate quantities of ejected material
	4	No lateral spreading but large quantities of ejected material
	5	Moderate to major lateral spreading; ejected material often observed
	6	Severe lateral spreading; ejected material often observed

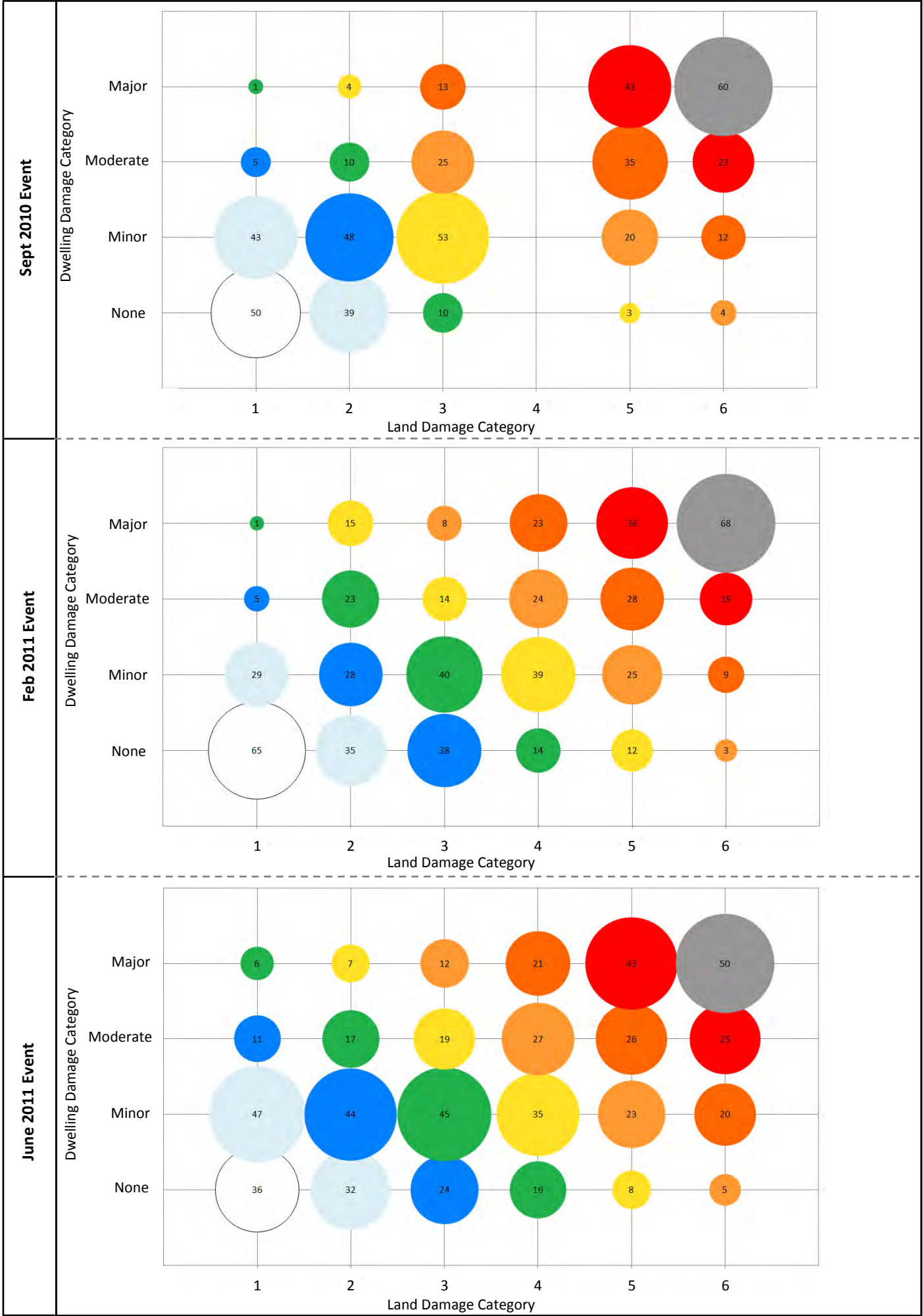
#### Dwelling Damage Category

	None
	Minor
	Moderate
	Major

Refer to Figure A9 for diagrams and a full description.

To avoid plotting seven sets of results for the different mechanisms of foundation damage, the worst foundation damage severity is taken for each LDAT inspection and is referred to as a 'Dwelling Damage Category'.

### Land and Dwelling Damage Correlations



Note: The values in the bubbles on the graphs are in percentages. For each of the graphs, the percentage values tally vertically (in each land damage category) to 100%

Figure G1

## Earthquake Related Elevation Change (Incremental)

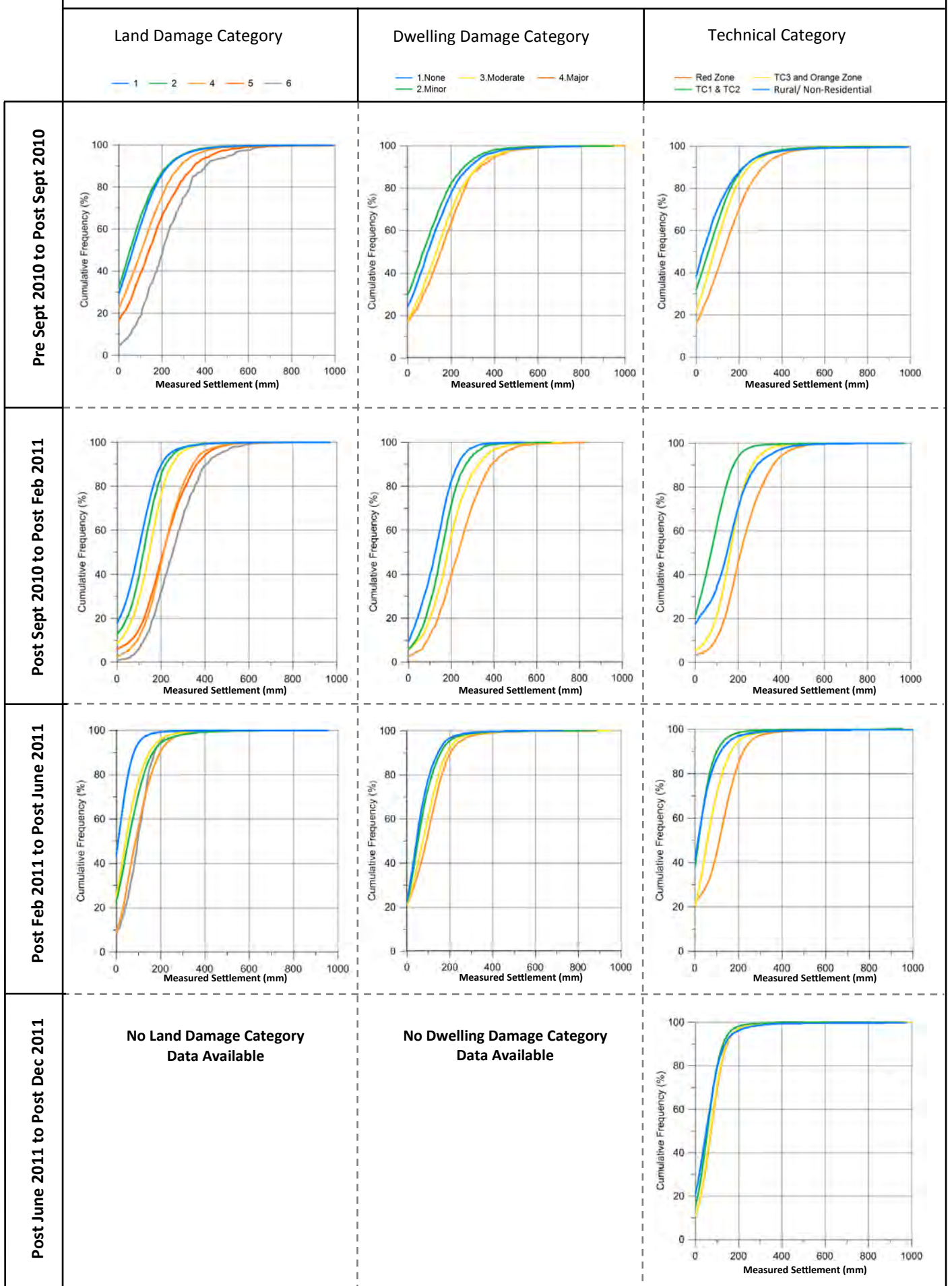


Figure G2

## Earthquake Relate Elevation (Cumulative)

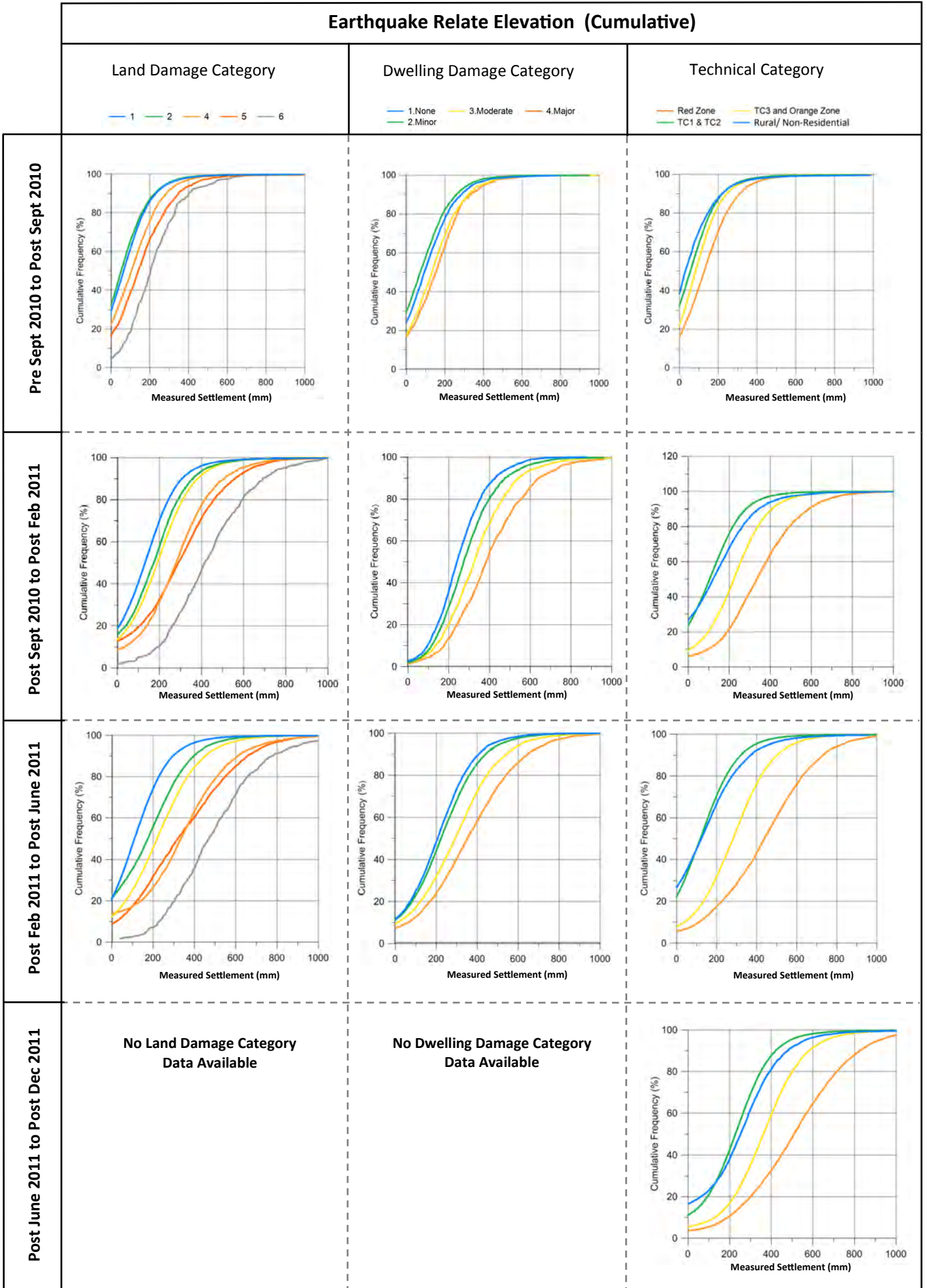


Figure G3

**Relationship between Calculated Settlement Indicator and Liquefaction Related Elevation Change (UoC PGA)**

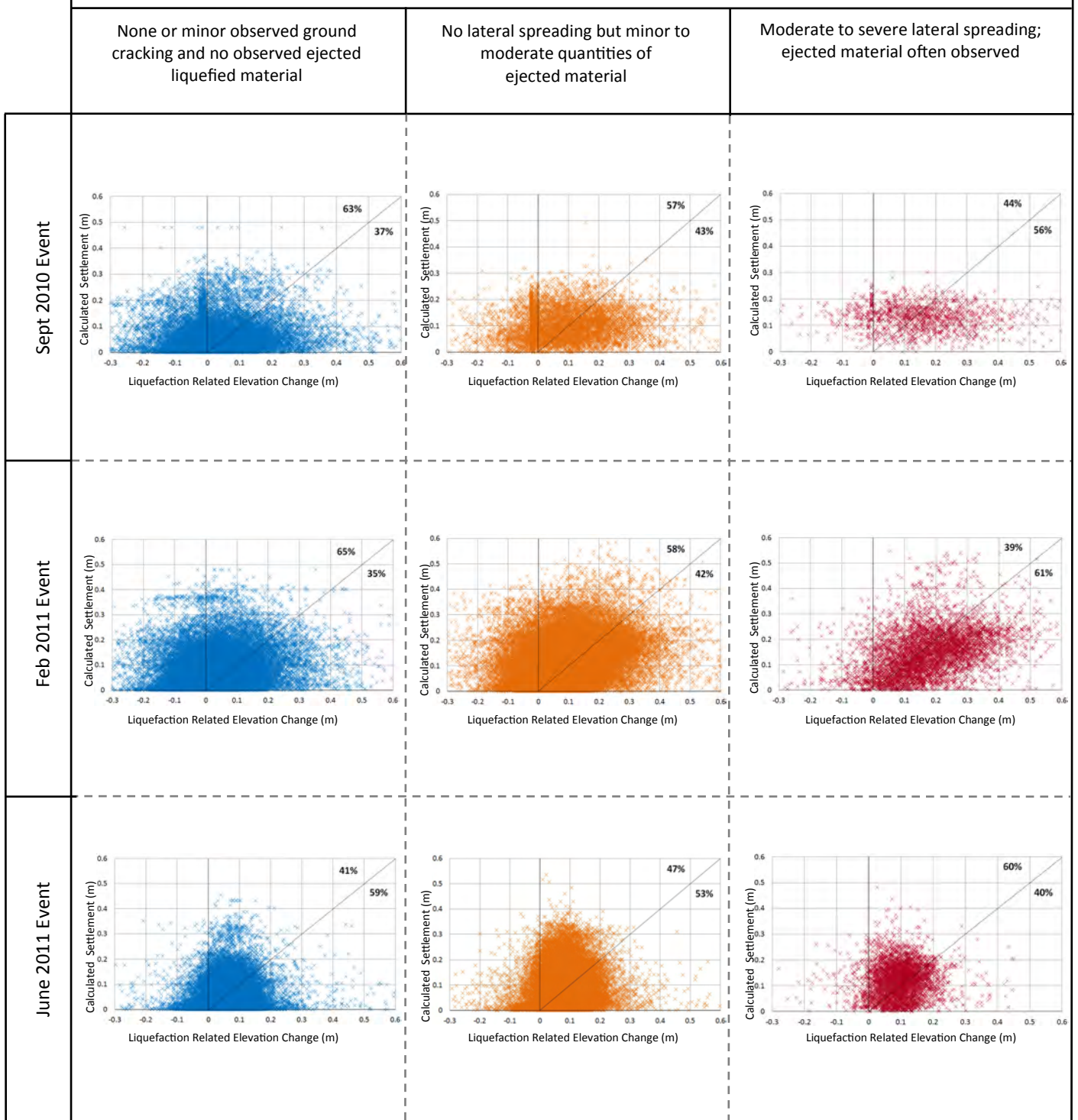


Figure G4

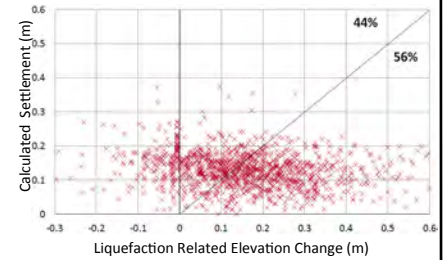
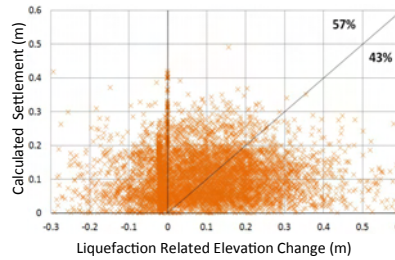
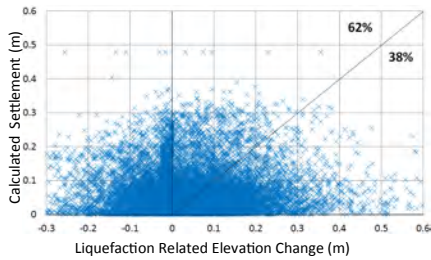
**Relationship between Calculated Settlement Indicator and Liquefaction Related Elevation Change (Cornell PGA)**

None or minor observed ground cracking and no observed ejected liquefied material

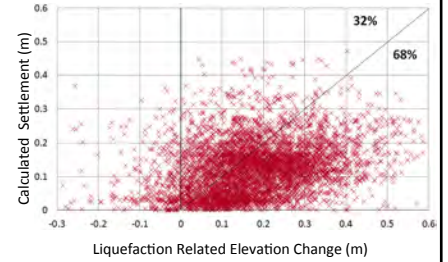
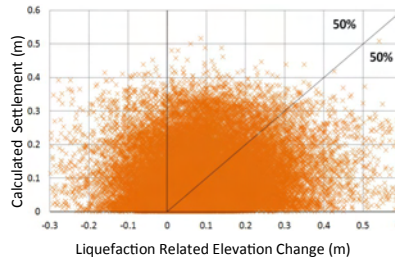
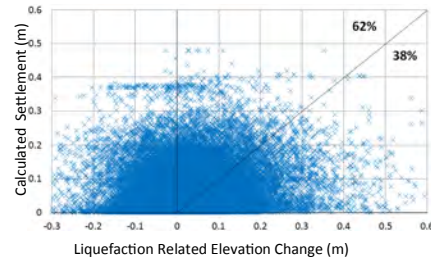
No lateral spreading but minor to moderate quantities of ejected material

Moderate to severe lateral spreading; ejected material often observed

Sept 2010 Event



Feb 2011 Event



June 2011 Event

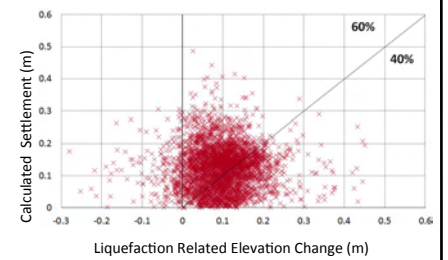
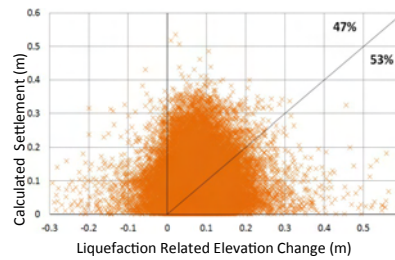
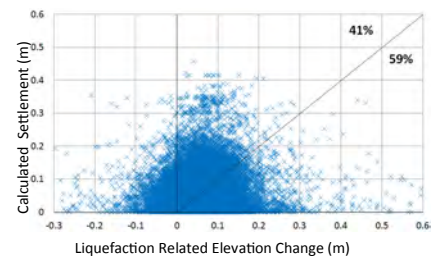


Figure G5



### Calculated Settlement Indicator based on UoC PGA Distribution

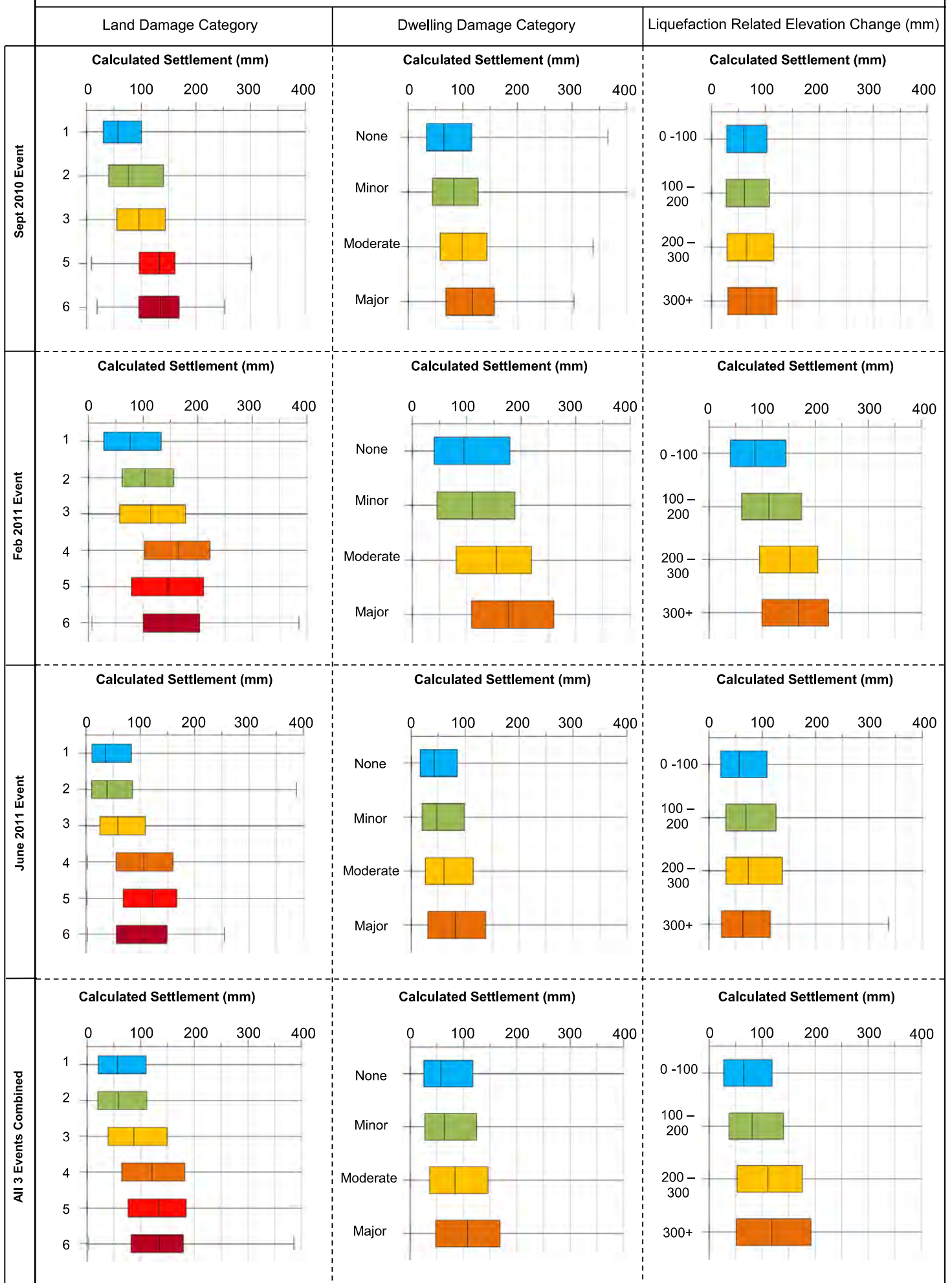


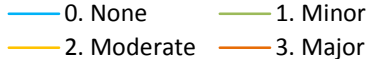
Figure G6

### Calculated Settlement Indicator based on UoC PGA Distribution

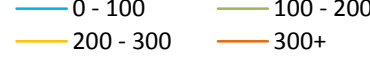
Land Damage Category



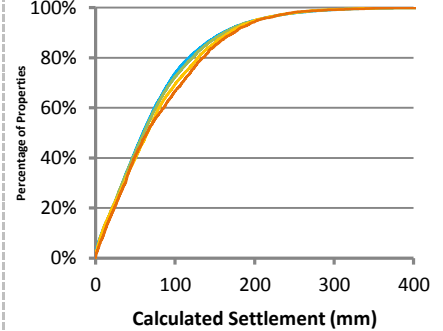
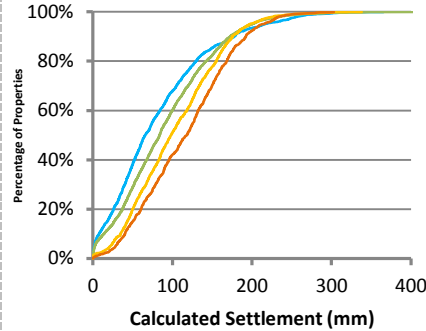
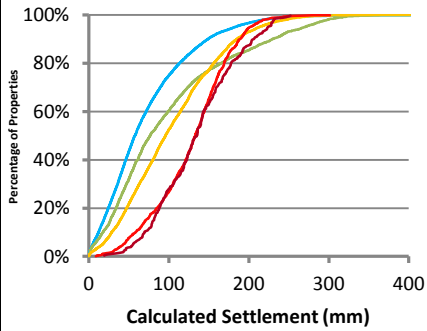
Dwelling Damage Category



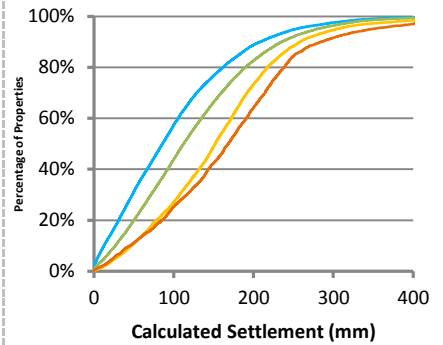
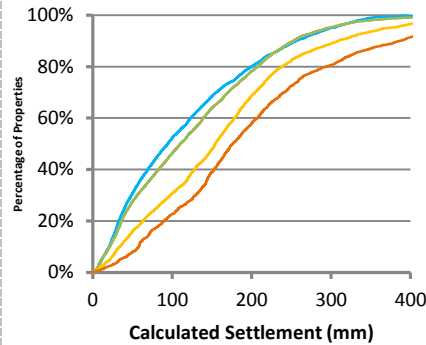
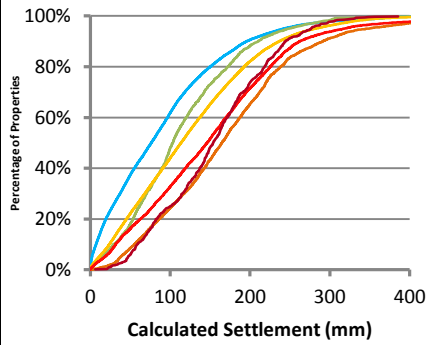
Liquefaction Related Elevation Change (mm)



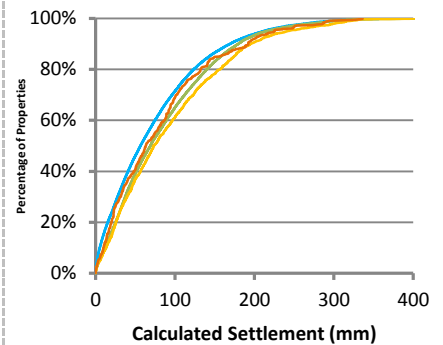
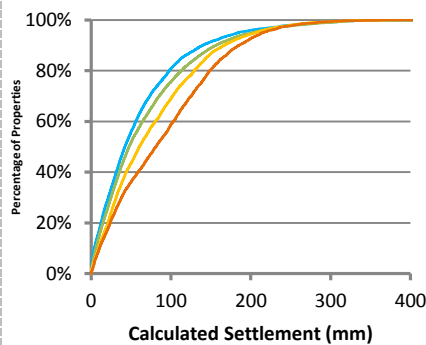
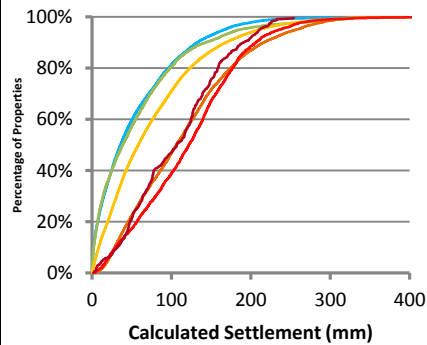
Sept 2010 Event



Feb 2011 Event



June 2011 Event



All 3 Events Combined

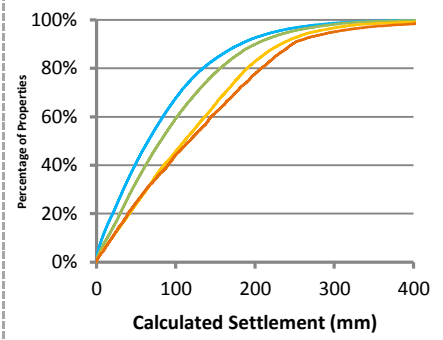
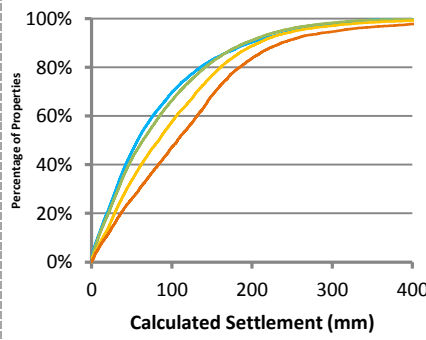
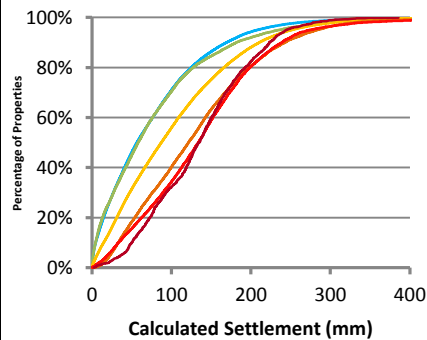


Figure G7

### Calculated Settlement Indicator based on Cornell PGA Distribution

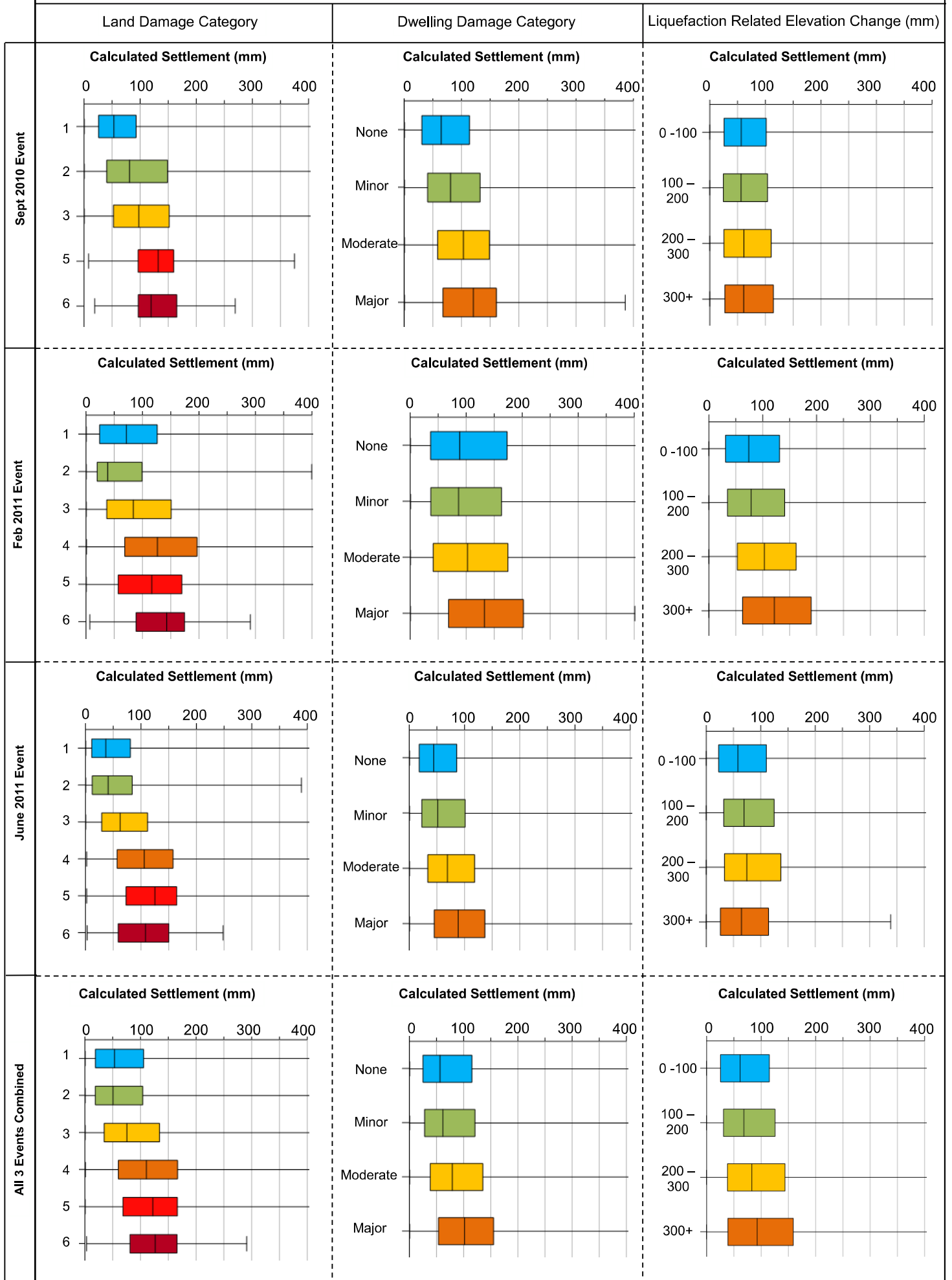


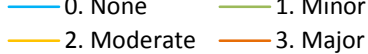
Figure G8

### Calculated Settlement Indicator based on Cornell PGA Distribution

Land Damage Category



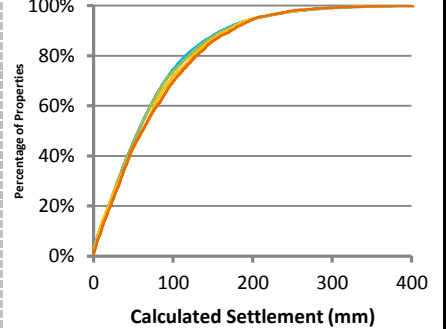
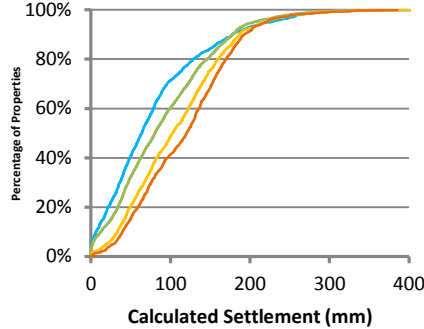
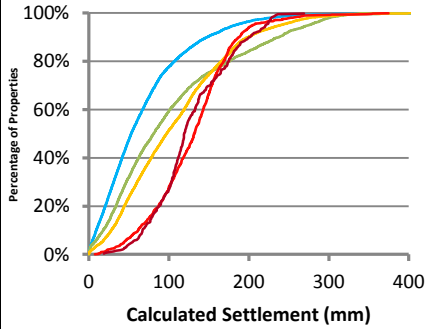
Dwelling Damage Category



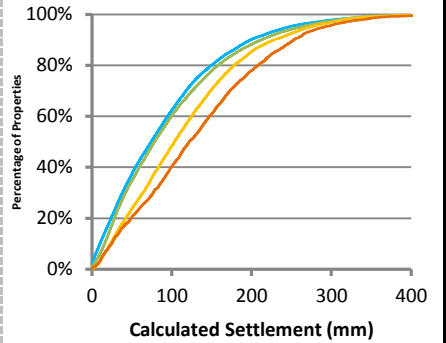
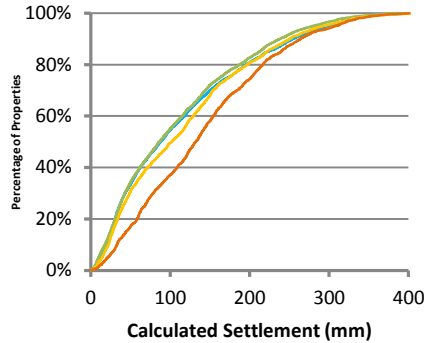
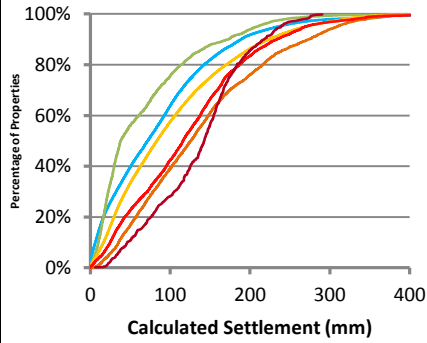
Liquefaction Related Elevation Change (mm)



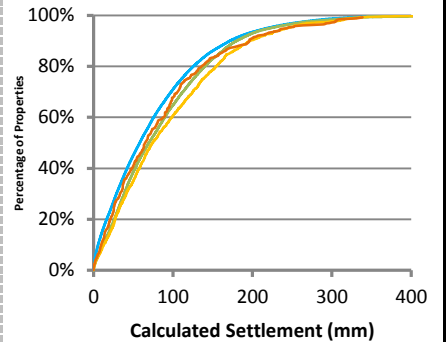
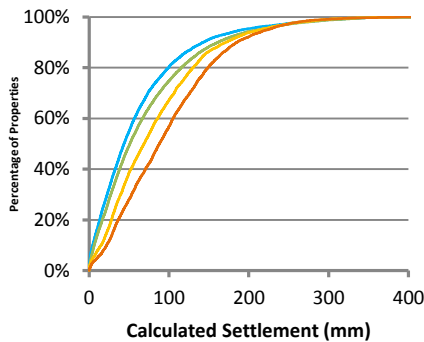
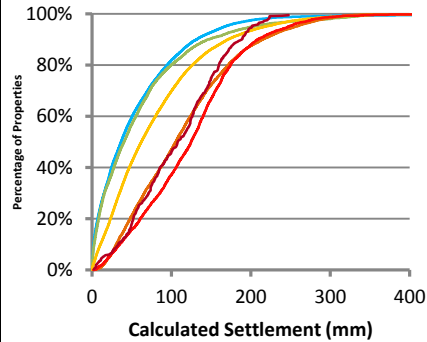
Sept 2010 Event



Feb 2011 Event



June 2011 Event



All 3 Events Combined

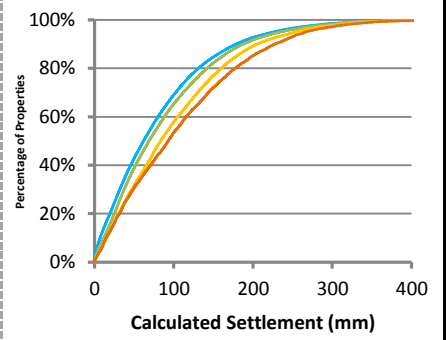
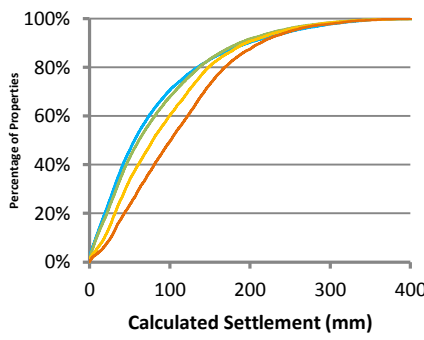
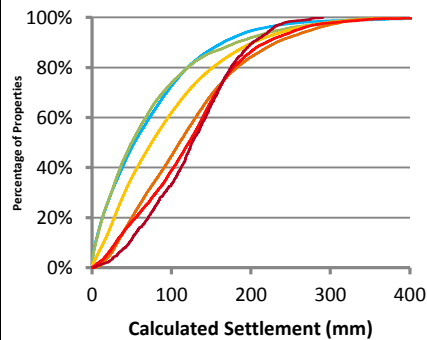


Figure G9

### LPI based on UoC PGA Distribution

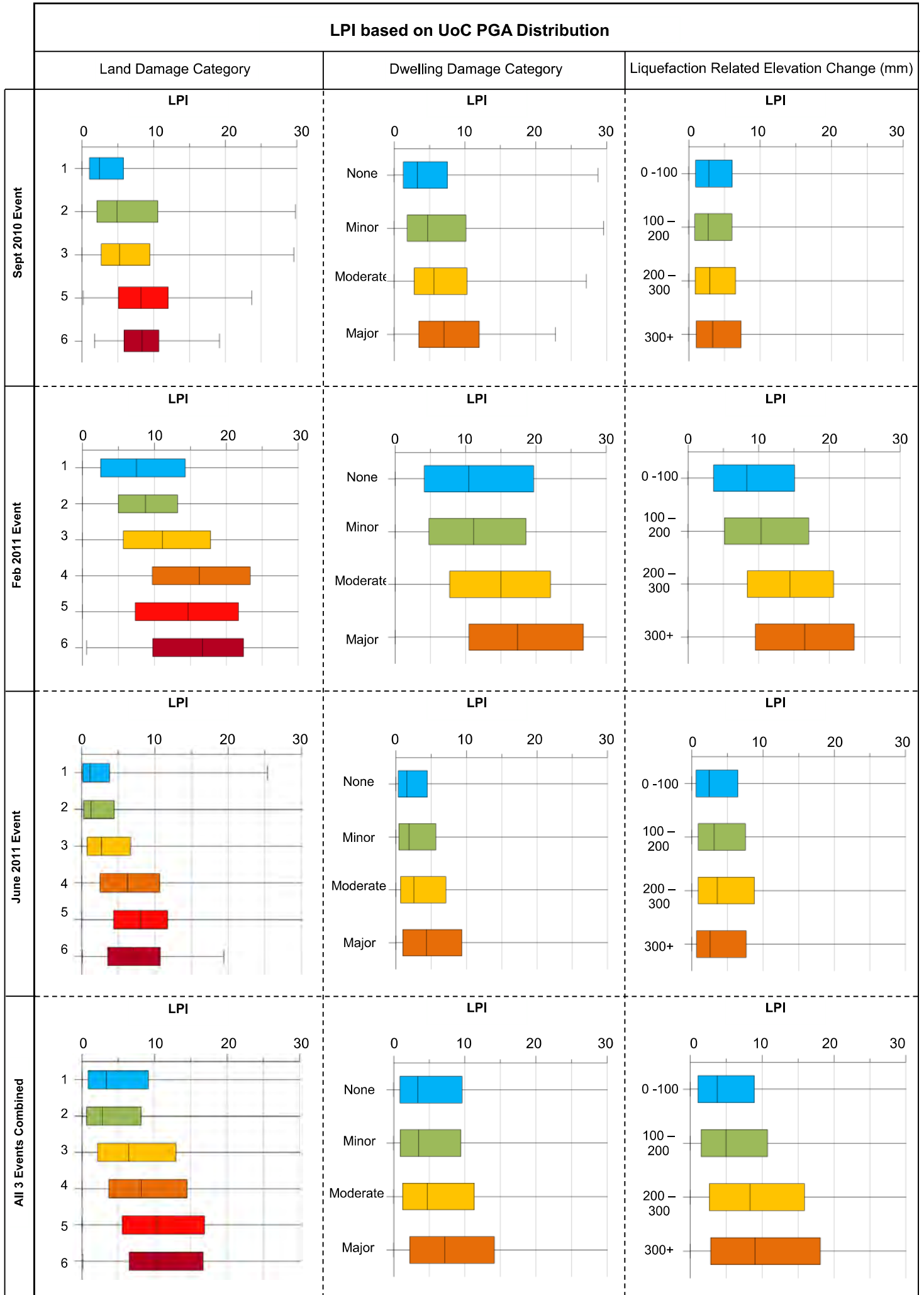


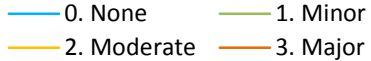
Figure G10

### LPI based on UoC PGA Distribution

Land Damage Category



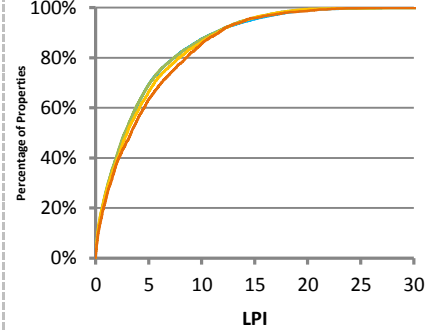
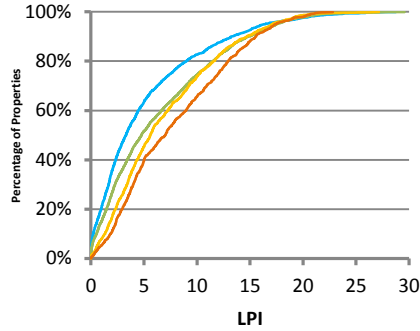
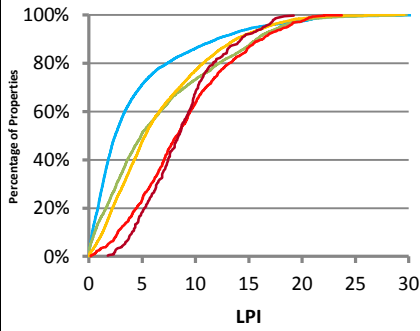
Dwelling Damage Category



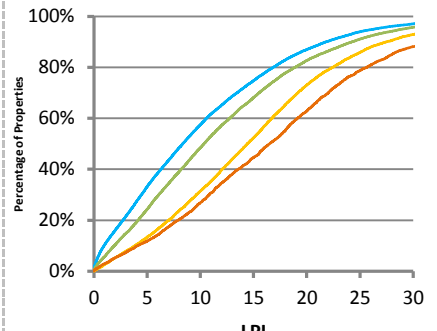
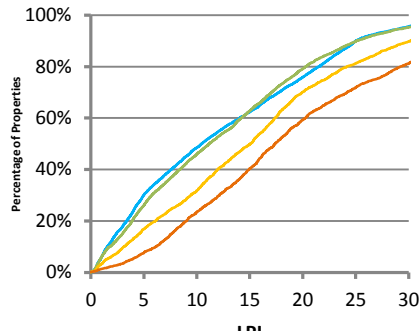
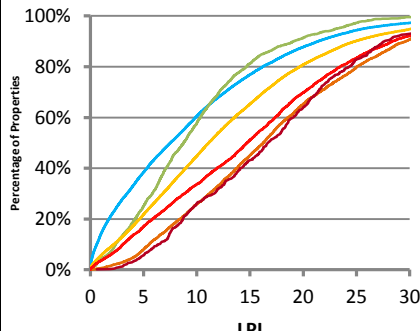
Liquefaction Related Elevation Change (mm)



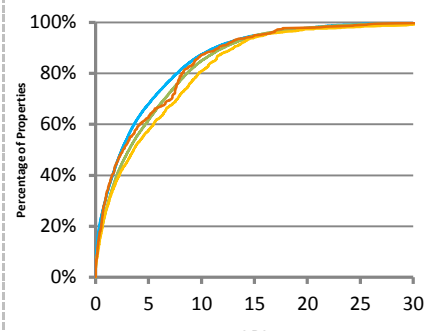
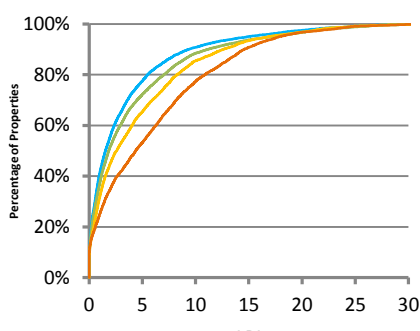
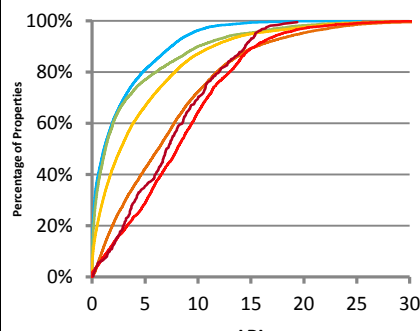
Sept 2010 Event



Feb 2011 Event



June 2011 Event



All 3 Events Combined

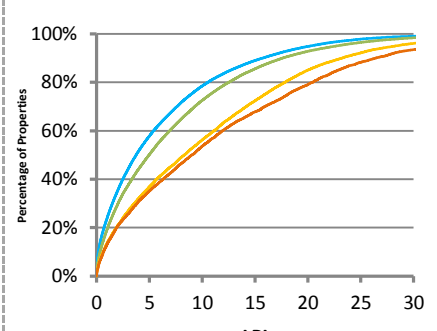
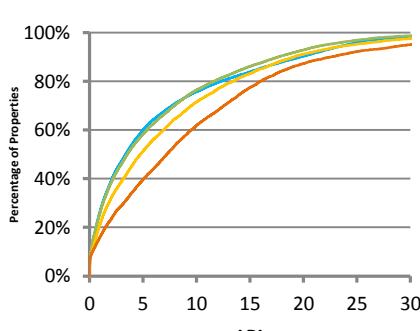
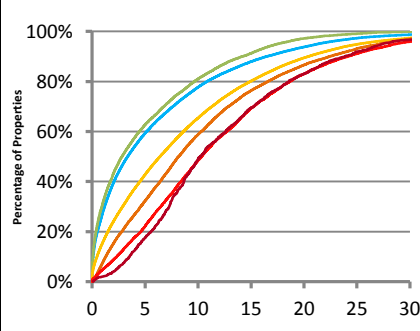


Figure G11

### LPI based on Cornell PGA Distribution

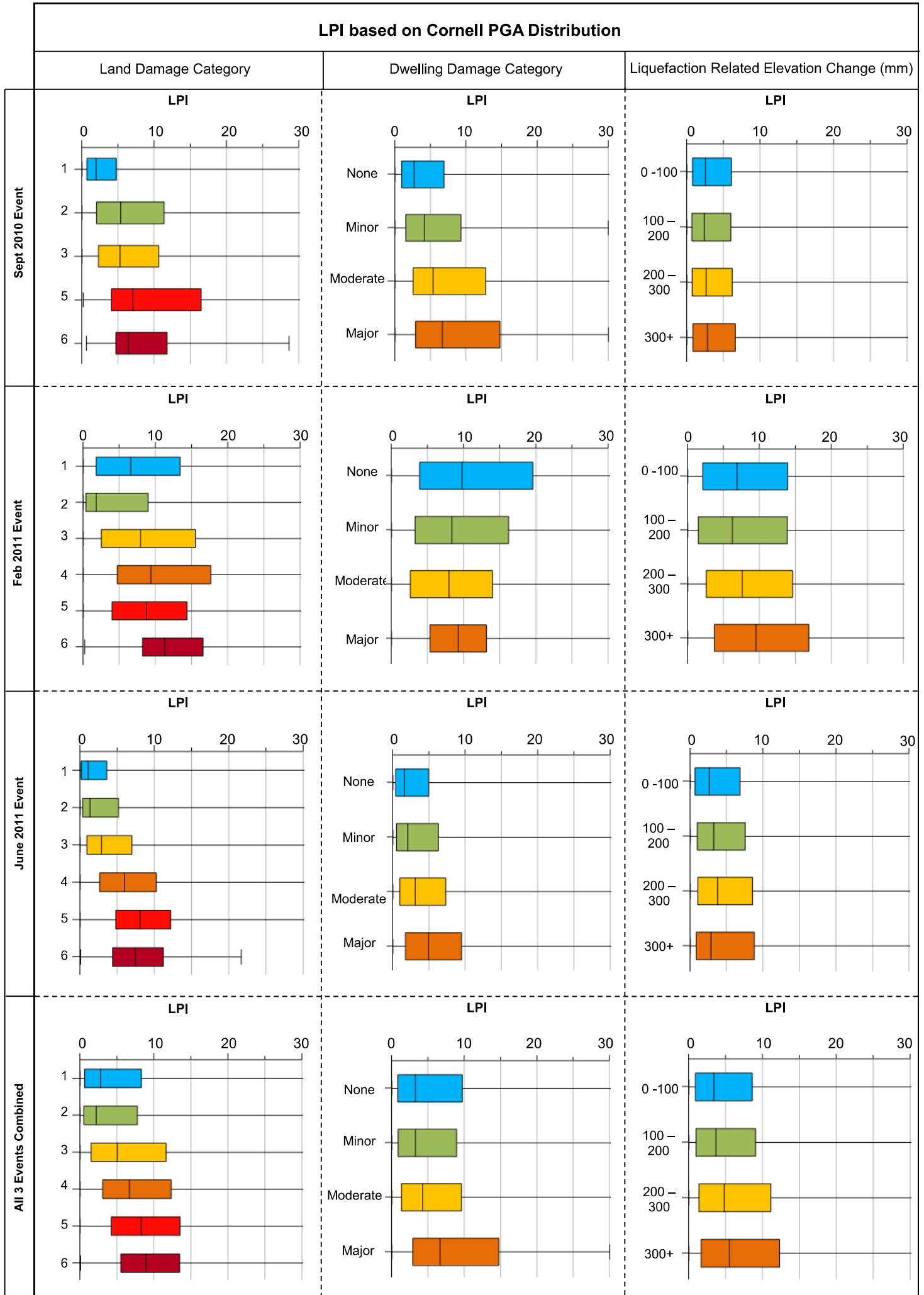


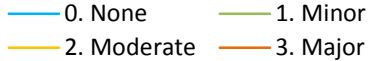
Figure G12

### LPI based on Cornell PGA Distribution

Land Damage Category



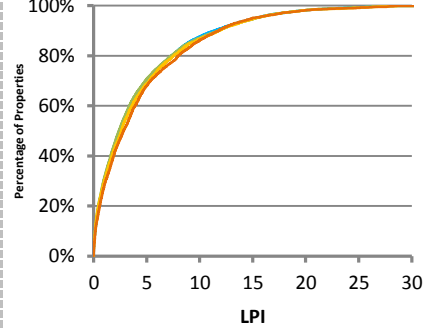
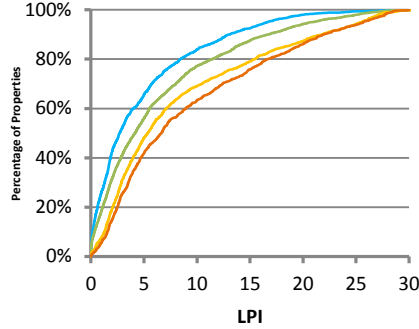
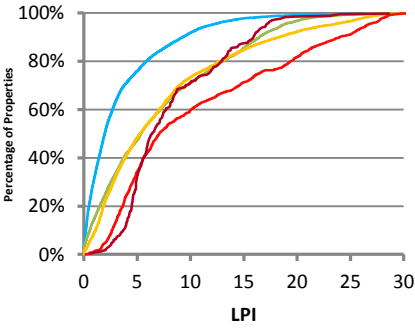
Dwelling Damage Category



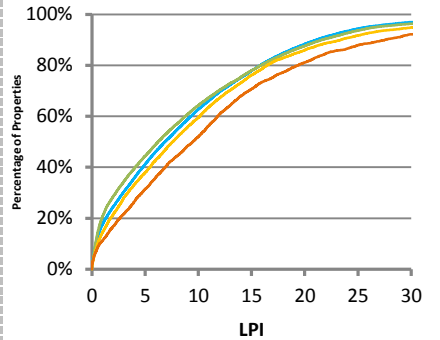
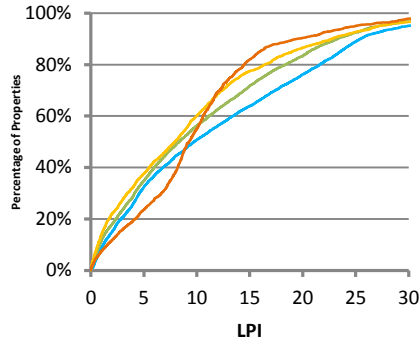
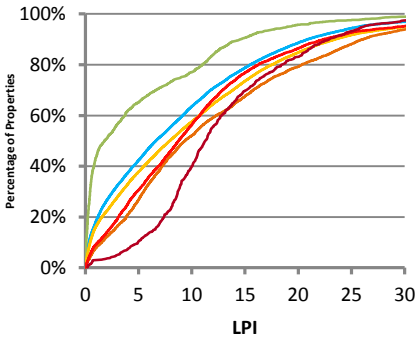
Liquefaction Related Elevation Change (mm)



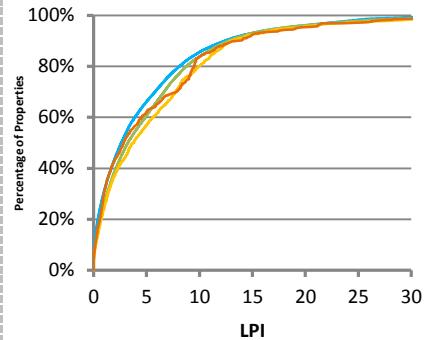
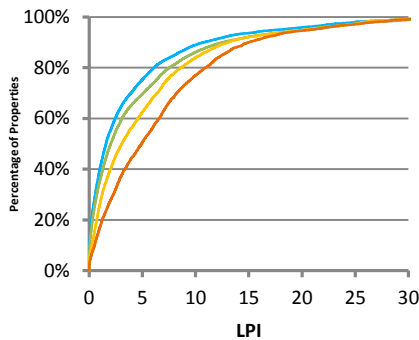
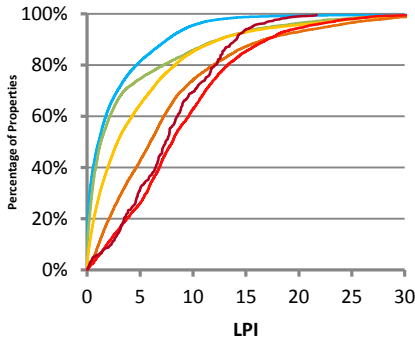
Sept 2010 Event



Feb 2011 Event



June 2011 Event



All 3 Events Combined

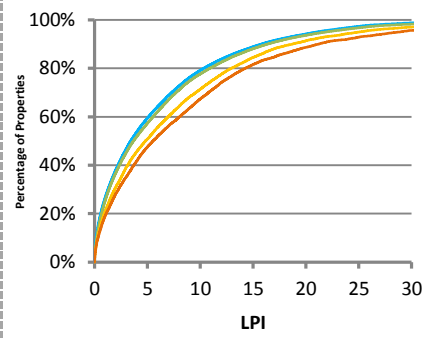
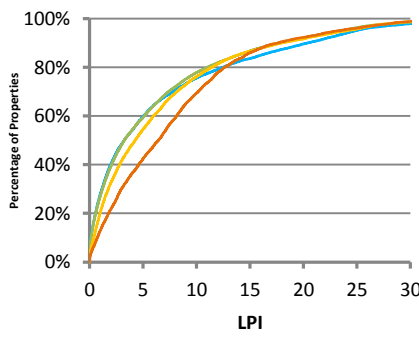
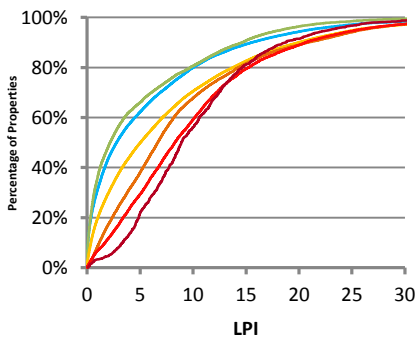


Figure G13



### LSN based on UoC PGA Distribution

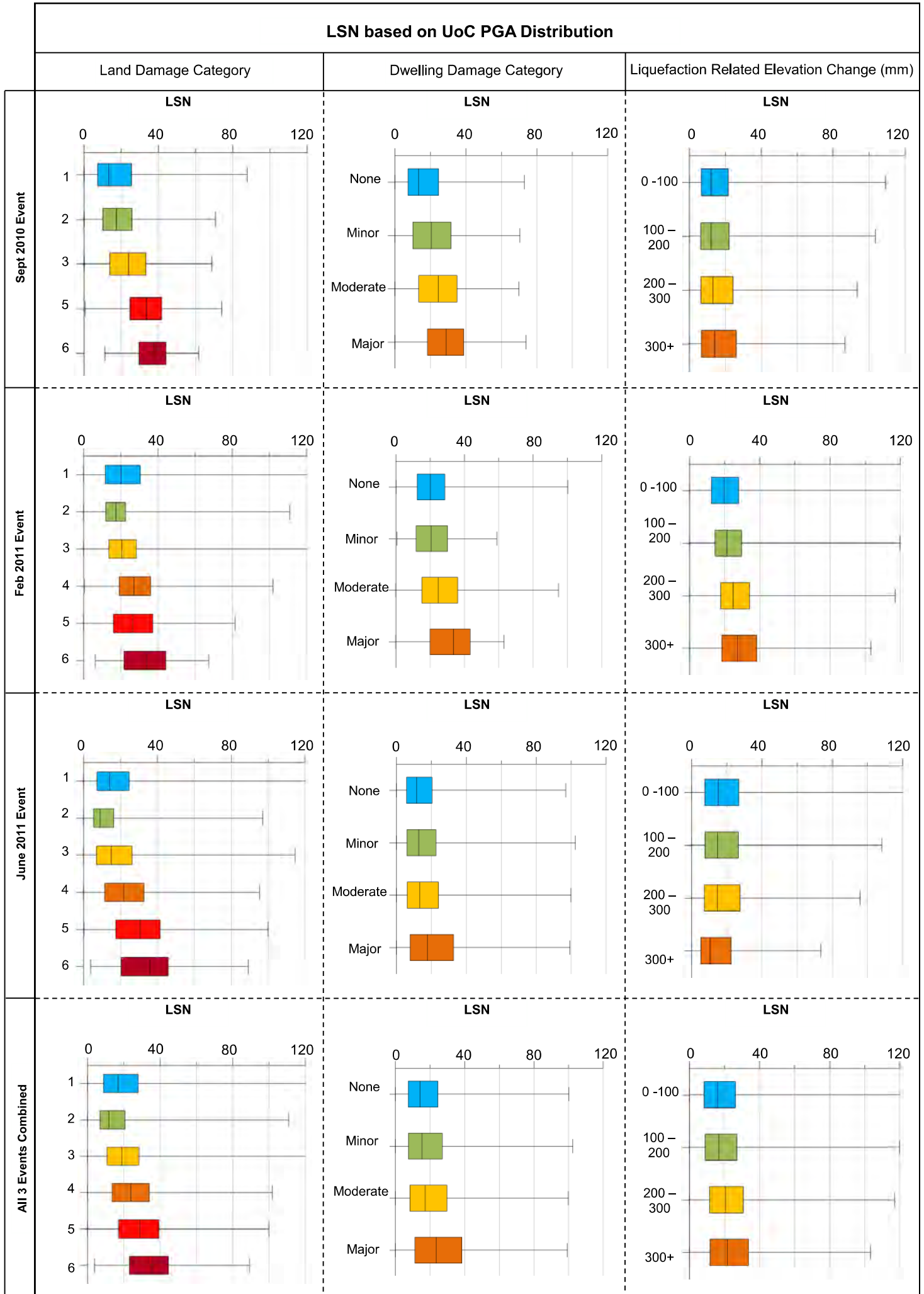


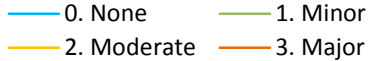
Figure G14

### LSN based on UoC PGA Distribution

Land Damage Category



Dwelling Damage Category



Liquefaction Related Elevation Change (mm)

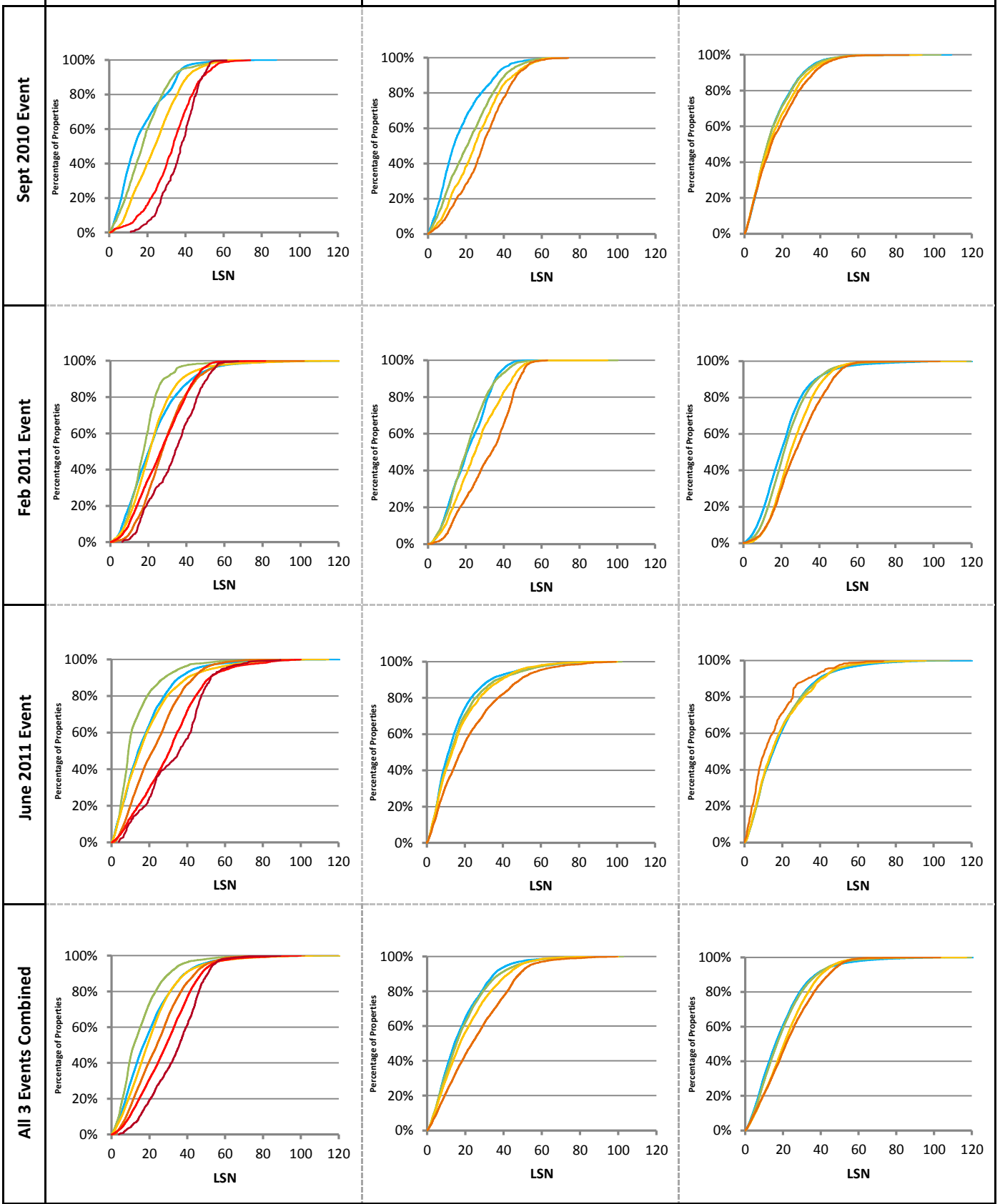


Figure G15

### LSN based on Cornell PGA Distribution

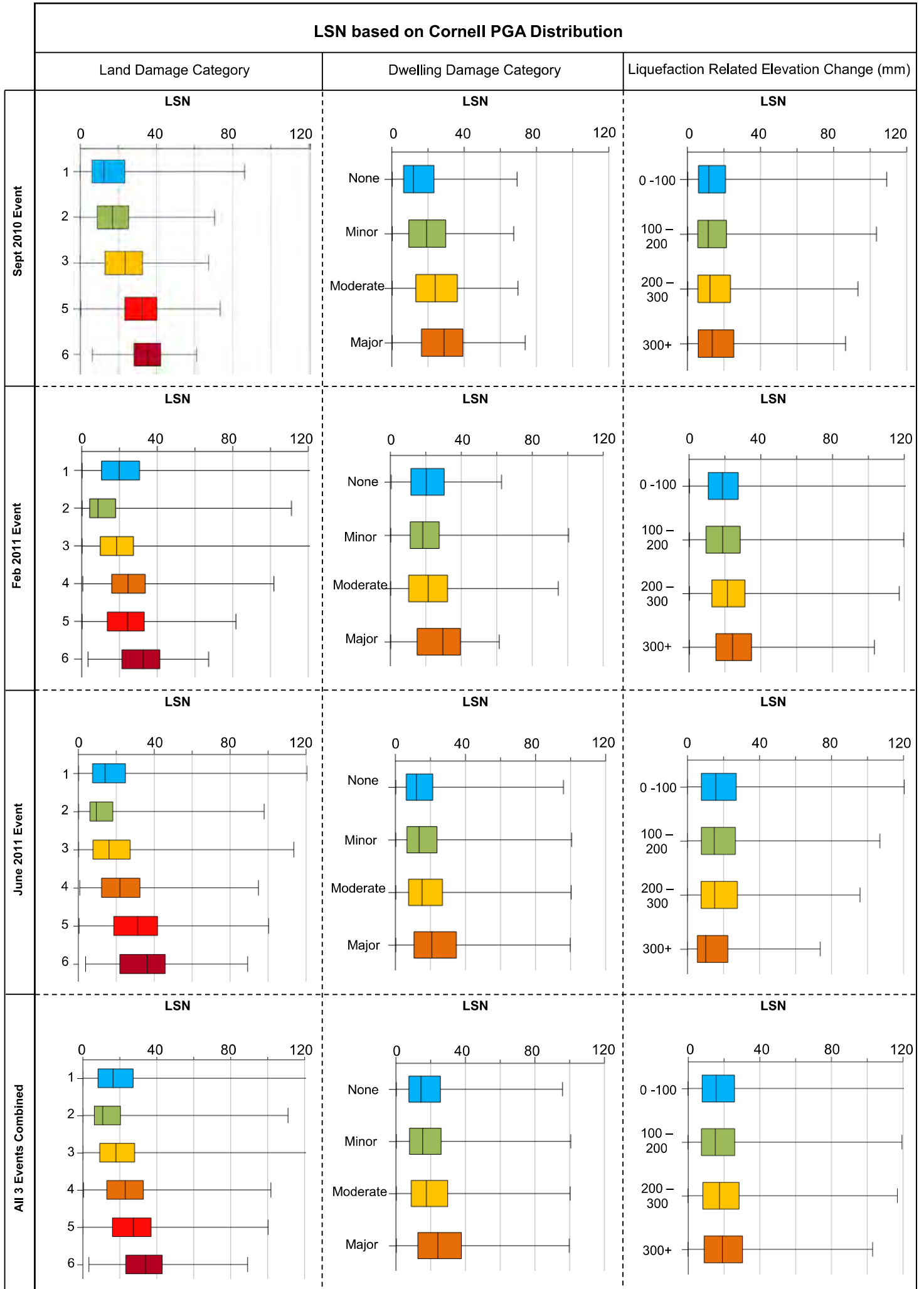
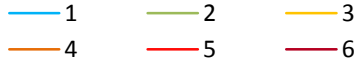


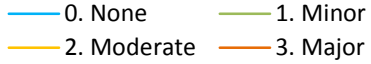
Figure G16

### LSN based on Cornell PGA Distribution

Land Damage Category



Dwelling Damage Category



Liquefaction Related Elevation Change (mm)

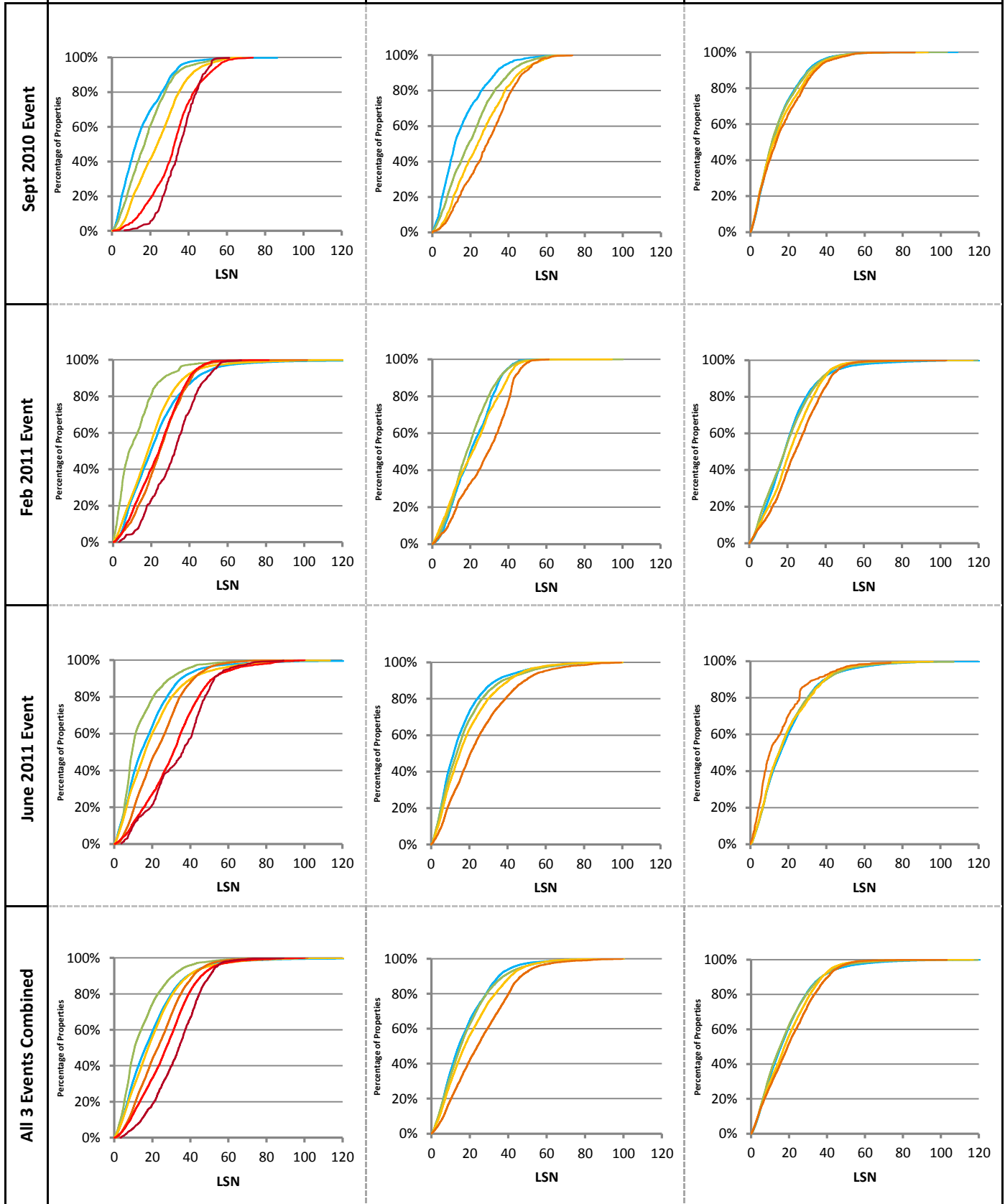


Figure G17

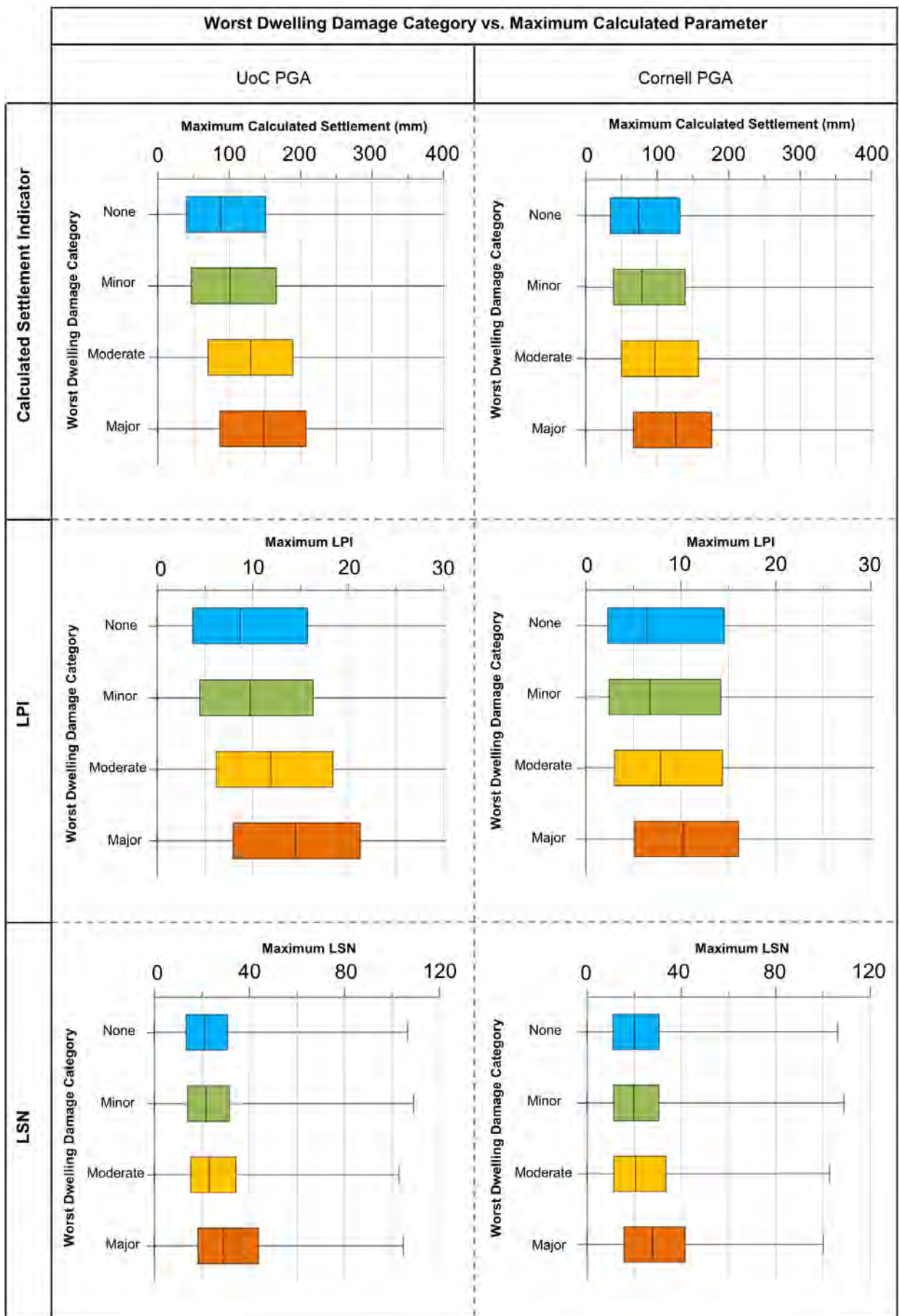


Figure G18

**Worst Dwelling Damage Category vs. Maximum Calculated Parameter**

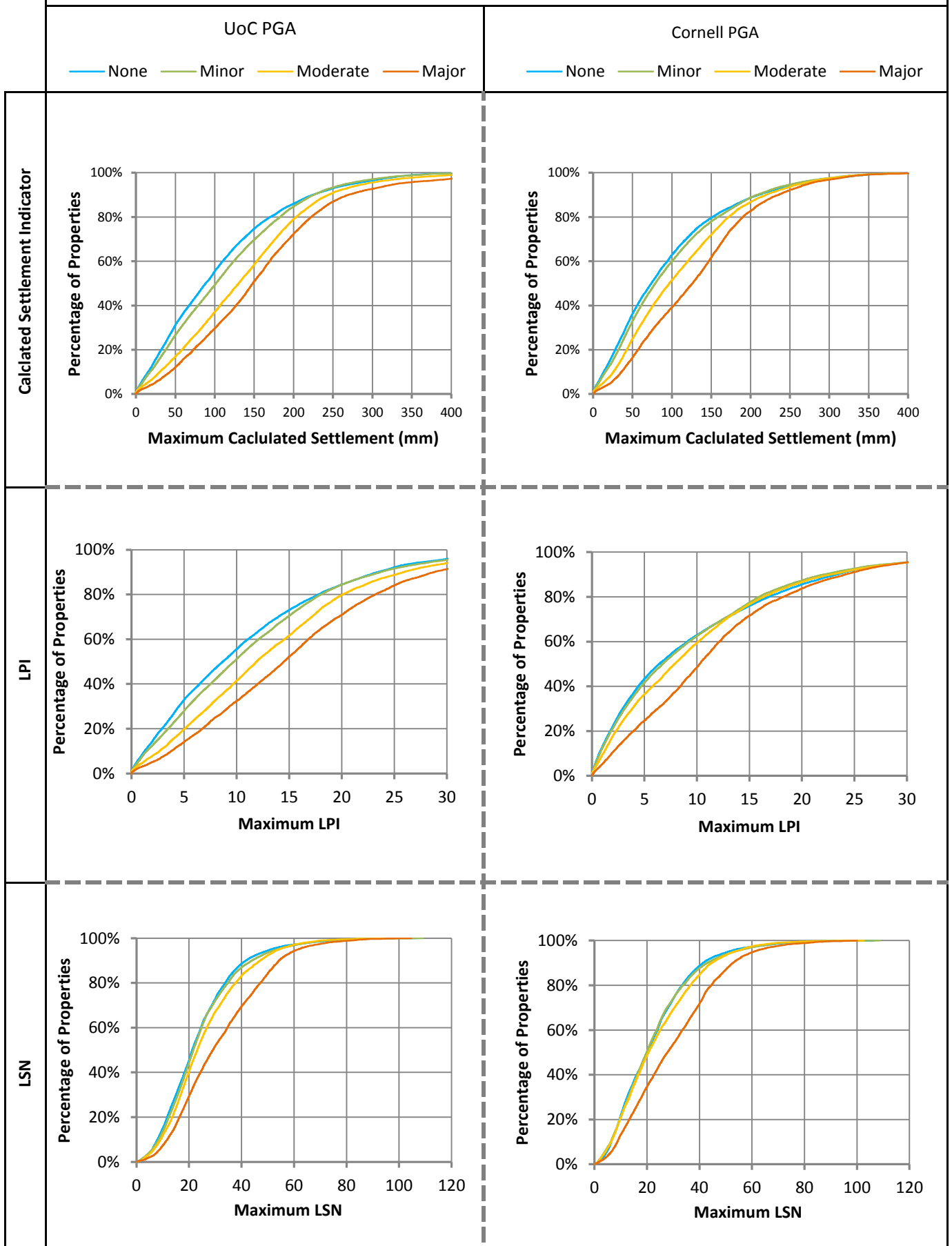


Figure G19