Appendix M: Classification Process for Properties that do not Qualify for ILV but are Materially Vulnerable to Liquefaction

M1 Introduction

The outcome of the ILV assessment process resulted in two data sets, these being:

- Properties that qualify for ILV (i.e. properties which have satisfied both *Criterion 1* and Criterion 2)[1]; and
- Properties that do not qualify for ILV (i.e. properties which have not satisfied either *Criterion 1* and/or *Criterion 2*)[1]

The two data sets are spatially shown in Figure M1.1.

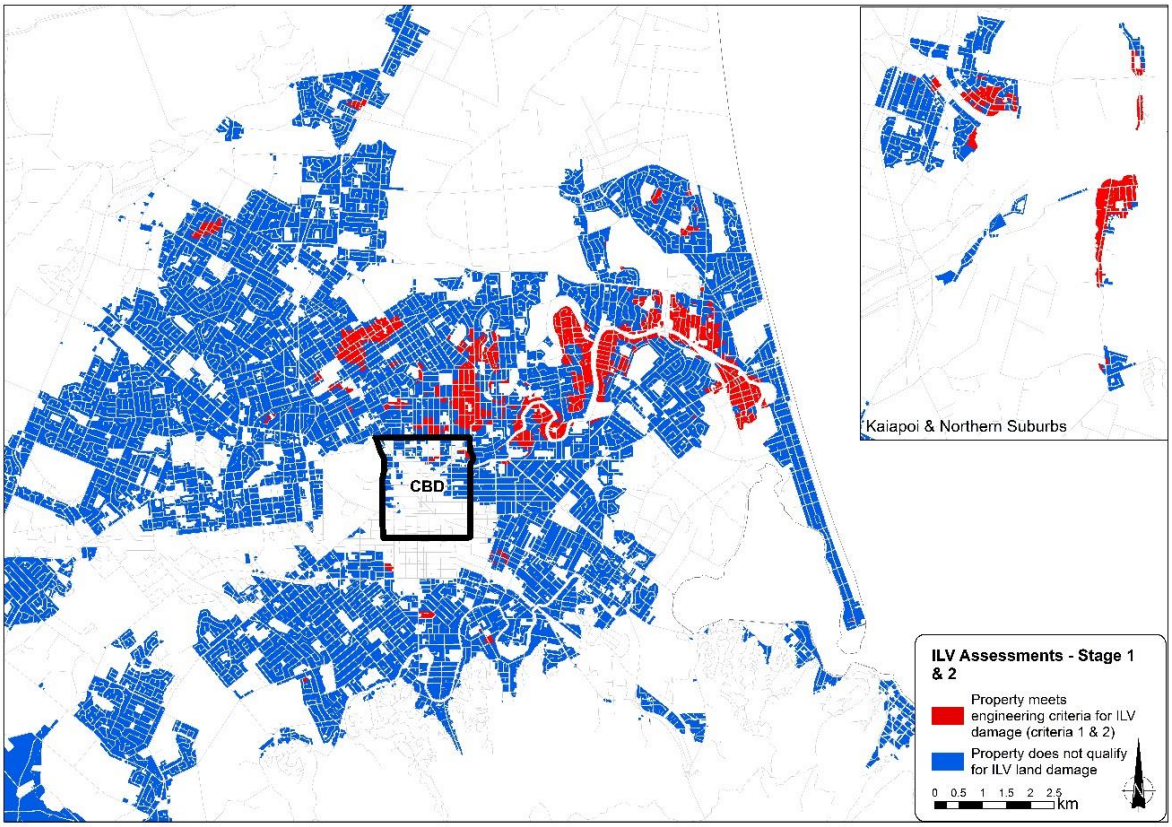

Figure M1.1: ILV assessment results after the completion of the Stage 2 process. Note the white areas on the map represent the non-urban and non-residential land in Christchurch.

Table M1.1 below shows the categorisation of ILV land damage following Stage 2 qualifications divided into their respective TC1, TC2, TC3 and residential Red Zone areas.

[1] *Criterion 1* and *2* are defined in Section 2 of the Report.

Table M1.1: ILV Land Damage Qualification following Stage 2 by MBIE Technical Category and CERA Residential Red Zone

Technical Category	ILV assessment results following the completion of the Stage 2 Process	
	Number of properties which qualify for ILV	Number of properties which do not qualify for ILV
TC1	0	23,267
TC2	510	80,512
TC3	4,386	23,466
Red Zone	5,021	2,228
Total	9,917	129,473

The property counts are based on the QPID database (maintained by Quotable Value Ltd) which existed at the time of the CES. The number of properties/QPIDs does not necessarily represent the number of claims.

For properties that do not qualify for ILV, these can be further classified as follows:

- **Properties materially vulnerable to liquefaction (LV)**: where the residential land has a material vulnerability to liquefaction damage after the CES, at M6 0.3g levels of earthquake shaking (i.e. satisfy *Criterion 1)*. However the vulnerability of the residential land to liquefaction damage in future earthquakes has not materially increased at up to M6 0.3g levels of earthquake shaking as a result of ground surface subsidence of the land caused by the CES (i.e. does not satisfy *Criterion 2)*; and
- **Properties not materially vulnerable to liquefaction (NV)**: where the residential land does not have a material vulnerability to liquefaction damage after the CES at M6 0.3g levels of earthquake shaking (i.e. it does not satisfy *Criterion 1)*.

M1.1 Purpose and Outline

During the Stage 1 ILV assessment process (refer to Section 9 of the Report) the NV and LV status were not recorded for the Stage 1 properties that did not qualify for ILV. However during the Stage 2 ILV assessment process, the NV and LV classifications for properties that did not qualify for ILV was recorded.

The classification of properties, which did not qualify for ILV, as NV and LV was undertaken for the purpose of assisting EQC when communicating with property owners whose land may have had material liquefaction related damage as a result of the CES, but did not qualify for ILV land damage.

Therefore, the purpose of this appendix is to document the process which was used for classifying the properties which do not qualify for ILV into NV and LV classifications. This appendix outlines the process and then the results from the assessment process.

M2 NV and LV Classification Process

The classification of properties as NV and LV was undertaken in 3 steps as shown in the flow chart in Figure M2.1 and described in the following sections. The classification approach summarised in Figure M2.1 was only carried out on properties that did qualify for ILV during the Stage 1 assessment process. During the Stage 2 assessment process the NV and LV classifications were recorded for each Stage 2 property.

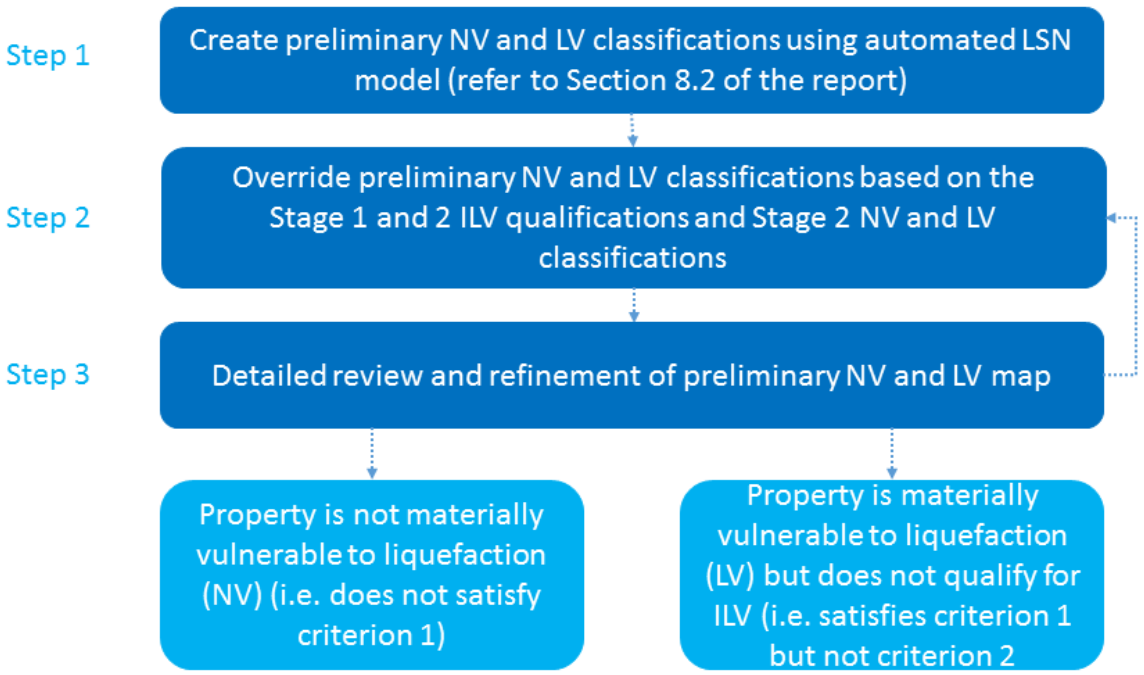

Figure M2.1: Approach to classifying non-ILV properties as NV and LV.

M2.1 Step 1: Create Preliminary NV and LV Map using the Automated Estimation of LSN Values

In this step a preliminary NV and LV map was created by classifying all residential flat land parcels not qualifying for ILV as either NV or LV based on the estimated property LSN values obtained from the automated ILV model (discussed in Section 8.2 of the Report). The indicator value used to determine if a property was NV or LV for this was the same as was used in the ILV assessment process (i.e. those properties with an automated LSN value of 16 or greater were given a preliminary classification of LV, while those properties with an automated LSN value of less than 16 were given a preliminary classification as NV).

M2.2 Step 2: Override Preliminary NV and LV Classifications Based on the Stage 2 NV, LV and ILV Classifications

In addition to the process described Step 1, all of the Stage 2 properties that were manually assessed during the Stage 2 ILV assessment as not qualifying for ILV were classified as NV or LV using the approach set out in Sections 8, 9 and 10 of the Report.

The results from the Stage 2 assessment were then overlaid on the results from the automated estimation of LSN values described in Step 1 to produce a combined NV, LV and ILV map. The results of the combined NV, LV and ILV map showed that in most areas, there was generally close alignment between the results from the estimated LSN values obtained from the ILV model (refer to Section M2.1) and the Stage 2 manual results.

In a small number of areas the Stage 2 assessment suggested that the results from the estimated property LSN values should be over-ridden. In such cases adjacent Stage 1 properties which were not qualified for ILV were identified as requiring a potential manual review of the preliminary NV or LV classification. These areas were highlighted on the map for further consideration during the detailed review, as discussed in Step 3 (refer to Section M2.3).

The automated NV and LV map was then manually overridden by the Stage 2 Assessments with NV and LV classifications.

M2.3 Step 3: Detailed Review and Refinement of the Preliminary NV and LV Map

As part of the manual assessment process the combined NV, LV and ILV map was reviewed by a team of engineers. Particular attention was given to the boundaries between NV, LV and ILV properties and properties adjacent to the properties which were assessed using the Stage 2 ILV assessment process. Information used for the detailed review and refinement of the combined NV and LV map is listed in Section 5 of the Report.

Using the information above, engineering judgement was used to determine whether or not a property should be classified as NV or LV in accordance with the *engineering criteria* set out in Section 2.4 of the Report, the objectives in Section 2.6 of the Report and the assumptions set out in Section 6 of the Report. In order to be classified as LV, the engineers undertaking the assessment would determine that, on the balance of probabilities, the property satisfied *Criterion 1.*

The results of this detailed review were entered directly in to a GIS database using an online mapping tool created specifically for this purpose.

A final review was then undertaken by a senior technical review team using three comparison maps, which showed the NV and LV classifications overlaid with the following information:

- Map 1 – September 2010 PGA contours and September 2010 land damage (refer to Figure K1.5 in **Appendix K**);
- Map 2 – February 2011 PGA contours and February 2011 land damage (refer to Figure K1.6 in **Appendix K**); and
- Map 3 – TC1, TC2, TC3 and Red Zone map (refer to Figure K1.1 in **Appendix K**).

M2.3.1 Review of Maps 1 and 2

For properties identified as NV where:

- Minor-to-moderate or moderate-to-severe land damage was mapped in the September 2010 and February 2011 events; and
- The levels shaking were less than M6 0.3g for those events;

reviews were undertaken to understand why those properties were not classified as LV. Often this was because either the mapped land damage was minor (confirmed by detailed review of the aerial photography) and was not considered material or the mapped land damage was as a result of lateral spreading.

Similarly for properties identified as LV where:

- None-to-minor land damage was mapped in the September 2010 and February 2011 events; and
- The levels shaking were greater than M6 0.3g for those events;

reviews were undertaken to understand why those properties were not classified as NV. There were not many properties in this category. For properties where this did occur, typically the estimated PGA values were found to be less certain and potentially over estimating the levels of ground shaking that actually occurred.

M2.3.2 Review of Map 3

In a similar manner, TC2 properties classified as LV and TC3 properties classified as NV were also manually reviewed to check whether this was appropriate.

In the case of the LV classification of the TC2 properties, the main reasons for this is the observed land damage indicators and the geotechnical data indicated that these properties are materially vulnerable to liquefaction. Most of those properties are located in the north eastern suburbs of Christchurch.

In the case of the NV classification of the TC3 properties, the main reasons for this is the geotechnical data, the land damage maps and the aerial photography demonstrate that these areas are not materially vulnerable to liquefaction damage at M6 0.3g levels of ground shaking. Most of the observed liquefaction related damage in these areas is caused by levels of ground shaking which were greater than M6 0.3g or is attributable to lateral spreading.

As part of the review process, the NV and LV classification of some properties assessed as not qualifying for ILV was changed from NV to LV and vice versa. This did not occur frequently and was typically restricted to boundary areas of NV & LV properties.

M3 Results

The spatial distribution of NV and LV properties is shown in Figure M3.1. When comparing this figure to Figure M1.1, it can be seen that a significant number of properties that did not qualify for ILV in the northern, central, eastern and southern areas of Christchurch, have been classified as LV.

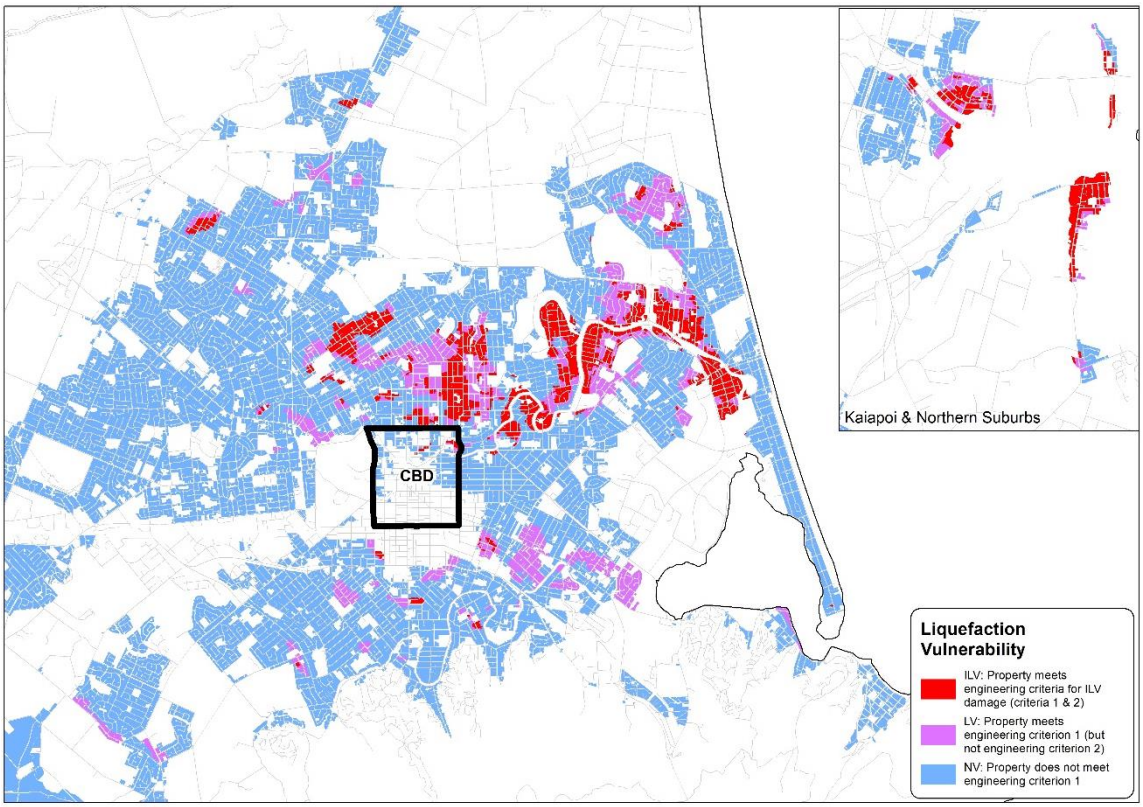

Figure M3.1: ILV assessment results after the completion of Stage 2 also showing the NV and LV properties. Note the white areas on the map represent the non-urban and non-residential land in Christchurch.

Table M3.1 shows the categorisation of NV, LV and ILV results divided into their respective TC1, TC2, TC3 and residential Red Zone areas.

Table M3.1: NV, LV and ILV classification by MBIE Technical Category and CERA Residential Red Zone

Technical Category	Number of properties which qualify for ILV	Number of properties materially vulnerable to liquefaction (LV)	Number of properties not materially vulnerable to liquefaction (NV)
TC1	0	0	23,267
TC2	510	1,867	78,645
TC3	4,386	9,693	13,773
Red Zone	5,021	1,272	956
Total	9,917	12,832	116,641

The property counts are based on the QPID database (maintained by Quotable Value Ltd) which existed at the time of the CES. The number of properties/QPIDs does not necessarily represent the number of claims.