
Diminution of Value Methodologies for Increased Flooding Vulnerability, Increased Liquefaction Vulnerability, and Increased Liquefaction Vulnerability (Compromised Crust) for Crown-owned Properties in the Residential Red Zone (with Known Severe Lateral Spreading Vulnerability)

FEBRUARY 2018

(A) INTRODUCTION

1 This paper describes the methodologies used on behalf of the Earthquake Commission (**EQC**) to assess the diminution of value (**DoV**) of residential land or property that has resulted from:

1.1 Increased Flooding Vulnerability (**IFV**);

1.2 Increased Liquefaction Vulnerability as a result of ground surface subsidence (**ILV**) damage; and

1.3 Increased Liquefaction Vulnerability as a result of compromised crust caused by extensive stretching and ground cracking (**ILV_{cc}**) damage;

to residential land with severe lateral spreading vulnerability¹ in the Residential Red Zone where the land is now owned by the Crown and the land claim has been assigned to Land Information New Zealand (**LINZ**) (**Crown RRZ Claims**).

2 EQC's valuers are satisfied, as a matter of valuation judgement, that the application of the methodologies in accordance with the valuation process set out in this paper has enabled the robust assessment of the total DoV to property and land caused by IFV, ILV and ILV_{cc} land damage to the portfolio of Crown RRZ Claims with severe lateral spreading vulnerability and is consistent with applicable valuation standards and practice.

3 The methodologies described in this paper are developed from the methodologies previously developed by EQC's valuers for IFV and ILV land damage, and the approach adopted to assess the DoV attributable to each form of damage separately and when combined. This report should therefore be read in conjunction with the other DoV methodologies papers prepared by EQC's valuers and referred to in this paper.

4 This paper is organised under the following headings:

4.1 **Background** – provides background to the development of DoV methodologies, the forms of increased vulnerability damage to be assessed, and the assessment approach taken for Crown RRZ Claims;

4.2 **Engineering advice** – describes the engineering advice received from EQC's expert engineering advisors, Tonkin + Taylor (**T+T**) on the practical implications of IFV, ILV and ILV_{cc} damage to residential land with pre-existing severe lateral spreading vulnerability;

4.3 **Defining the valuation outcome sought**– describes EQC's instructions to EQC's valuers on the DoV to be assessed;

4.4 **Assumptions** – describes legal and valuation assumptions made in relation to the DoV assessment;

4.5 **Determination of undamaged value** – describes the approach taken to assessing the undamaged value of either the property (land and buildings) or

¹ Severe lateral spreading vulnerability has been assessed as the property being vulnerable to greater than 500 mm of lateral movement in a 1 in 500 year level of shaking earthquake event.

land, assuming full knowledge of the pre-existing severe lateral spreading vulnerability of the land; and

- 4.6 **Assessment of DoV** – describes the approach taken to assessing the DoV for properties with one or more of IFV, ILV and ILV_{CC} land damage using adapted versions of the DoV methodologies previously adopted for properties with IFV and/or ILV land damage.
- 5 EQC’s valuers principally responsible for this report, and the development of the DoV methodologies for IFV and/or ILV land damage, are:
- 5.1 Dave Townsend FNZIV, FPINZ, a registered valuer who works for his own company and has been involved in the valuation and property consultancy industry for the past 36 years. Dave is a contractor to, and advises, EQC on a range of valuation matters. Working as a contracted Lead Valuer with EQC often involves working with and advising local valuers in the event of specific land value issues that arise throughout New Zealand;
 - 5.2 Ken Blucher FPINZ, ANZIV a registered valuer who has over 35 years’ valuing experience. Based in Wellington, he is a Director at Darroch Limited and has a wealth of experience with respect to EQC claims, compensation work, disposal of surplus Crown properties and Treaty settlements acting on behalf of the Crown. Ken also advises clients on various legislative matters, specifically relating to rating. Ken has been a key member of the valuation team assisting EQC with property and valuation policy advice in Christchurch since September 2010 through to the current day. He is currently Valuation team leader with respect to the assessment of properties with IFV and ILV; and
 - 5.3 Chris Bridges ANZIV, SPINZ, a Christchurch-based registered valuer with over 35 years’ experience in valuation and property advice. Chris manages his own company, and provides valuation advice to EQC on a range of matters. He is a key member of the team that has developed the methodology for DoV valuation.

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(B) BACKGROUND

(B1) Purpose

- 6 The purpose of this paper is to explain the development of a methodology to determine what, if any, reduction or diminution of value (**DoV**) of certain properties in the Residential Red Zone has resulted from:
- 6.1 Increased Flooding Vulnerability (**IFV**);
 - 6.2 Increased Liquefaction Vulnerability as a result of ground surface subsidence (**ILV**) damage; and
 - 6.3 Increased Liquefaction Vulnerability as a result of compromised crust caused by extensive stretching and ground cracking (**ILV_{cc}**) damage.
- 7 This paper applies only to Residential Red Zone properties with known severe lateral spreading vulnerability, that is, properties that have been identified as having greater than 500 mm of lateral stretching expected at 500 year return period levels of shaking.² This includes all properties with ILV_{cc} damage.
- 8 EQC's engineering advice is that the severe lateral spreading vulnerability of these properties existed prior to the Canterbury earthquake sequence and has not increased as a result of the earthquakes for a given shaking level. While seismicity has increased as a result of the earthquakes, with the result that higher shaking levels are expected in more frequent events, this is not due to any physical change to the insured land. The increase in seismicity used for design purposes, together with greater knowledge about the potential impacts of severe lateral spreading vulnerability, has however altered how land may be used for residential development in Christchurch in practice.
- 9 In particular, there are currently no practical ways of mitigating lateral spreading for most properties with severe lateral spreading vulnerability on an individual property basis. Area-wide lateral spreading mitigation measures in the form of perimeter treatment works would be required. Absent those works, there is no standard MBIE ground improvement or foundations in the MBIE Guidance (2015) that can be economically used to support a residential building.
- 10 EQC has instructed EQC's valuers that different assumptions are required to assess the DoV attributable to natural disaster damage for properties with known severe lateral spreading vulnerability than those that apply to properties with IFV and/or ILV land damage to land that is otherwise capable of supporting a standard MBIE foundation in accordance with the MBIE Guidance.
- 11 The methodology and this paper reflect a combination of valuation, legal and engineering advice provided to EQC.

(B2) Increased vulnerability damage

- 12 The Canterbury earthquake sequence has resulted in certain types of land damage that may not severely impact the owner's present ability to use the land, but that have made the land more vulnerable to certain future natural disaster events.

² T+T *Increased Liquefaction Vulnerability due to Compromised Crust from the Canterbury Earthquake Sequence: Assessment Methodology and Practical Implications* (December 2017) at p 6.

13 These types of land damage result largely from the lowering of ground levels. This change in turn has increased the land's vulnerability to future natural disasters, namely flooding and liquefaction damage in the event of another significant earthquake. These types of land damage have been classified as:

13.1 Increased Flooding Vulnerability (**IFV**); and

13.2 Increased Liquefaction Vulnerability (**ILV**).

14 ILV land damage has been defined and assessed by EQC as increased vulnerability to liquefaction as a result of ground surface subsidence. However, the vulnerability of land to liquefaction damage in future earthquakes may also have increased as a result of physical changes to land caused by extensive stretching and cracking of the land such that existing crack-repair methodologies are insufficient to reinstate the crust to pre-earthquake conditions. This form of cracking damage has been defined as ILV_{CC} damage.

(B3) Diminution of value methodologies

15 Ordinarily, EQC does not settle land claims by reference to any DoV of land damaged by a natural disaster. Rather, it settles such claims based on the estimated cost of repair. However, IFV and ILV damage have led to the need to consider settling claims by reference to the DoV of the property caused by the damage to the land resulting from the earthquakes.

16 Methodologies for assessing DoV resulting from each of IFV and ILV damage where they occur separately or together have already been developed. These are as set out in the reports:

16.1 For IFV land damage:

(a) *Diminution of Value Methodology for Increased Flooding Vulnerability* (updated March 2015), which is used in circumstances where the pre-earthquake house remains in place; and

(b) *Diminution of Value Methodology for Increased Flooding Vulnerability (for where the residential building has been or will be rebuilt)* (October 2016);

(together the **IFV DoV Methodologies**);

16.2 For ILV land damage:

(a) *Diminution of Value Methodology for Increased Liquefaction Vulnerability (for properties with residential building in place)* (May 2016); and

(b) *Diminution of Value Methodology for Increased Liquefaction Vulnerability (for where with residential building has been or will be rebuilt)* (November 2016):

(together the **ILV DoV Methodologies**);

16.3 For properties with both IFV and ILV land damage, *Diminution of Value Methodology for properties with both Increased Flooding Vulnerability and Increased Liquefaction Vulnerability* (November 2016);

(the **IFV and ILV DoV Methodologies**).

- 17 In the context of EQC's settlement policy for IFV land damage, the High Court confirmed that DoV is an available basis of settlement in appropriate circumstances. Accordingly, the IFV and ILV DoV Methodologies are being used by EQC in appropriate circumstances as the basis of settlement of IFV and ILV damage claims.
- 18 Each of the IFV and ILV DoV Methodologies assume that the damaged property was and remains suitable for residential use with and without the IFV and/or ILV land damage.

(B4) Statutory context – Earthquake Commission Act 1993

- 19 EQC provides statutory insurance for residential buildings and land (where the buildings have private fire insurance), for damage resulting from a natural disaster. The scope of the cover is set out in the Earthquake Commission Act 1993 (the **EQC Act**).
- 20 As regards land, EQC covers the land on which the house is situated, 8m around the house (and any appurtenant structures such as sheds), the main access way (up to 60m from the house) and land supporting that access way.
- 21 EQC provides building cover, in general, up to \$100,000 (plus GST) for each earthquake event. There is no equivalent fixed cap for land cover. Instead, EQC insures the land up to a maximum amount, being the value of the smaller of certain areas, which will typically be the area of the land damaged or lost, or the minimum lot size for an equivalent residential purpose under the District Plan applicable to the property.
- 22 EQC may settle both land and building claims, up to the maximum amount, by way of payment, replacement or reinstatement at its discretion. In the past, EQC has settled land claims either by payment or reinstatement. Where it settles by payment, the payment has been calculated by reference to the cost of reinstatement or repair (subject to that amount not exceeding the maximum amount). Where land has been "lost", for example by landslip, EQC has paid the maximum amount, being generally the value of the area of land lost.
- 23 In the case of IFV and ILV, rather than paying the cost of repairing the land, another option is for EQC to pay a claimant DoV of the property resulting from the land damage. The High Court has confirmed that DoV may be a more appropriate measure of the claimant's true loss in certain circumstances.

(B5) Assessment approach

- 24 The properties identified by T+T that have known severe lateral spreading vulnerability are all located in the Residential Red Zone. Most of these properties are now owned by the Crown, after the former owners accepted Crown offers to purchase the land and associated buildings and assigned the benefit of the EQC land insurance claims to the Crown. These properties are referred to by EQC as the "**Crown RRZ Claims**".
- 25 EQC has asked EQC's valuers to adopt an assessment approach that:

- 25.1 enables EQC's valuers to determine the total DoV to either land or property (land and associated buildings) caused by ILV_{CC} and IFV and ILV land damage due to the Canterbury earthquake sequence to the portfolio of Crown RRZ Claims; and
 - 25.2 is consistent with applicable valuation standards and practice.
- 26 Given this, EQC's valuers have therefore considered mass appraisal techniques that may result in some "over" and "under" assessments of DoV on a specific property level, but which in aggregate produce a robust and accurate total DoV assessment for the portfolio of Crown RRZ Claims.

(C) ENGINEERING ADVICE REGARDING SEVERE LATERAL SPREADING VULNERABILITY

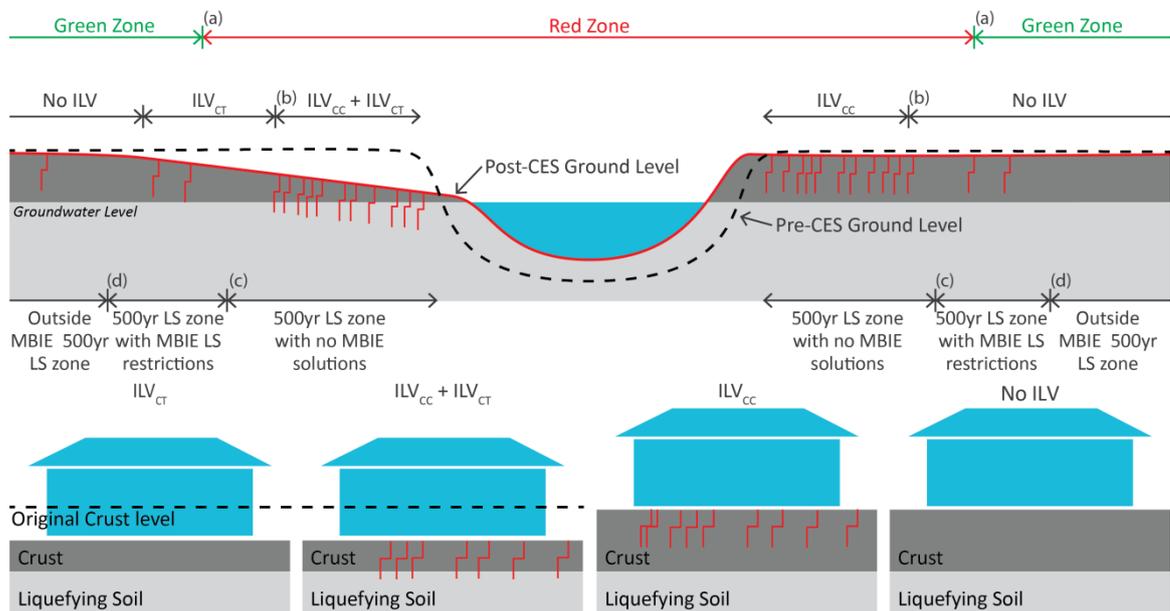
27 T+T, EQC’s engineering advisors, have provided a report to EQC on properties with severe lateral spreading vulnerability and ILV_{CC} damage: T+T *Increased Liquefaction Vulnerability due to Compromised Crust from the Canterbury Earthquake Sequence: Assessment Methodology and Practical Implications* (December 2017) (the **Compromised Crust Report**).

28 ILV_{CC} land damage is defined by T+T as:³

a physical change to residential land as a result of extensive stretching and ground cracking in the CES, such that existing individual crack repair methodologies are insufficient to reinstate the crust to pre-CES conditions, adversely affecting the use and amenity that would otherwise be associated with the land by materially increasing the vulnerability of that land to liquefaction damage in future earthquakes.

29 ILV_{CC} land damage has occurred in areas within zones that are predicted to experience severe lateral spreading at 500 year return period levels of earthquake shaking. The exact boundaries of those zones are not known, and cannot be determined with precision based on existing science. However, the presence of ILV_{CC} land damage itself indicates that the land is vulnerable to severe lateral spreading.

30 T+T illustrate this with the following diagram (in which ILV_{CT} refers to ILV land damage, and LS refers to lateral spreading).



31 T+T have advised that the potential for lateral spreading in Canterbury in future earthquake events has not increased as a result of physical changes to land that occurred as a result of the Canterbury earthquake sequence. Accordingly, this hazard pre-existed the Canterbury earthquakes (and was responsible for much of the damage to the affected properties). Equally, T+T advise that it cannot be

³ T+T *Increased Liquefaction Vulnerability due to Compromised Crust from the Canterbury Earthquake Sequence: Assessment Methodology and Practical Implications* (December 2017) at 1.

assumed that the potential for lateral spreading has materially decreased as a result of the Canterbury earthquake sequence.

32 The confirmed presence of severe lateral spreading vulnerability affects the practical implications of ILV_{CC} land damage, as well as increased liquefaction vulnerability due to crust thinning (*ILV land damage*). In summary, T+T's advice in the Compromised Crust Report is that:

32.1 in areas with severe lateral spreading vulnerability, there are no practical ways of providing lateral spreading mitigation measures on an individual property basis apart from potentially a few exceptions which would typically be the higher value properties (i.e., the cost of ground improvement and the accompanying foundations exceed \$300,000, which is greater than the property land value for most of the residential Red Zone properties);

32.2 in these areas, area-wide lateral spreading mitigation measures in the form of perimeter treatment are required before MBIE standard foundation solutions could be used;

32.3 with perimeter treatment:

- (a) rebuilding of residential buildings on land improved by the perimeter treatment works could be undertaken in a practical way in accordance with MBIE Guidance, as with other TC3 land;
- (b) the implications of ILV land damage or ILV_{CC} land damage would be those set out in: T+T *Practical Implications of Increased Liquefaction Vulnerability Report* (November 2016) (the **Practical Implications Report**) and the Compromised Crust Report;

32.4 if severe lateral spreading is not addressed, Tonkin + Taylor have advised that ILV and ILV_{CC} land damage have more limited practical implications for the property than would be the case if the severe lateral spreading was not present. In summary:

- (a) if severe lateral spreading is not triggered, which is likely to be the case for most properties with ILV_{CC} damage in earthquakes for 25 year return period levels of shaking, the implications of ILV and ILV_{CC} damage for the risk of future land damage and house damage will be the same as if the property was not vulnerable to severe lateral spreading;
- (b) if severe lateral spreading is triggered, which is likely to be the case in a 100 year return period and higher levels of earthquake shaking, the land damage and house damage that would be caused by severe lateral spreading would be very severe and any increase in liquefaction vulnerability due to ILV or ILV_{CC} damage would be negligible (that is, immaterial);
- (c) the severe lateral spreading hazard causes significant constraints for building on the land. There are no standard MBIE foundation solutions that can be used to build on the land. The deep ground improvement required to address the severe lateral spreading hazard is unlikely to be practical, given the cost of the works, but in

any event would completely address the liquefaction vulnerability and remediate all ILV and ILV_{CC} damage.

- 33 The Compromised Crust Report has been reviewed by engineers engaged by LINZ, Aurecon. Aurecon and T+T have confirmed that their joint view is that:
- 33.1 the pre-existing potential for lateral spreading has not practically changed for a given seismicity as a result of the Canterbury earthquakes;
 - 33.2 the pre-existing potential for lateral spreading of the Residential Red Zone (which has not become any worse as a result of the land damage caused by the Canterbury earthquakes) is the only hazard that results in not being able to practically build in parts of the Residential Red Zone – where several lateral spreading is expected at 1 in 500 year levels of earthquake shaking; and
 - 33.3 in areas with severe lateral spreading potential for future earthquakes, the practical implications of ILV land damage and ILV_{CC} damage are reduced, except for the risk of future land damage (and house damage, where the pre-earthquake building remains in place) where severe lateral spreading is not triggered at lower levels of earthquake shaking.
- 34 EQC's valuers have relied upon this advice, together with advice from T+T as to potential alternative uses of land with known severe lateral spreading vulnerability, in preparing this paper.

(D) DEFINING THE VALUATION OUTCOMES SOUGHT

- 35 The objective of this methodology is to provide, for each parcel of insured land that has ILV_{CC} damage and any IFV and ILV damage, a dollar value for the DoV of the property resulting from that damage. The methodology has been implemented in a manner that is intended to assure that it, in aggregate, produces a robust and accurate total DoV assessment for the portfolio of Crown RRZ Claims in known severe lateral spreading areas.
- 36 More specifically, the objective is to assess the **discount** from the price that would have been paid for a **property or land**, as at **the day of the earthquake** but with **full knowledge** about the vulnerability of the land to **severe lateral spreading**, that would be agreed between a **willing buyer and willing seller** because of the **specified physical change** to the land, with full knowledge of the change and its impact on the vulnerability of the land to flooding and liquefaction, the costs of repair options, and advice from competent and **reasonable advisors** recommending any course of action.
- 37 The key elements of this objective can be broken down as follows:
- 37.1 **Discount:** EQC is not attempting to assess the value of the property or land, or all changes in value after the earthquake; EQC is only assessing the change in value resulting from certain physical land changes. The total change to the property or land value may reflect impacts for uncertainty, stigma, externalities, etc. which need to be disregarded.
- 37.2 **Property or Land:**⁴
- (a) *Where the pre-earthquake house remains on the land:* The DoV is that of the **property** (insured land and relevant improvements, including chattels), to the extent that it arises from the combined effect of ILV_{CC} damage and any IFV and/or ILV damage to land insured by EQC. While in this context EQC is assessing the DoV in order to settle claims of damage to land only (the insurance of residential buildings and personal property being separate), the damage to the land affects the value of both the land and the relevant buildings on it, including the chattels normally included in the sale of the relevant buildings. This is because they are also directly affected by the increased vulnerability represented by the combined effect of ILV_{CC} damage and any IFV and/or ILV damage. Accordingly, the financial loss to an insured person as a result of the land damage includes the impact of that damage on both the value of the land itself and the relevant improvements on the land;
- (b) *Where the pre-earthquake house has been or will be rebuilt:* The DoV is that of the insured **land**, to the extent that it arises from the combined effect of ILV_{CC} damage and any IFV and/or ILV damage to land insured by EQC. Where the house that existed prior to the earthquakes is either not capable of being, or will not be, repaired as

⁴ The approach taken to determine whether the pre-earthquake house has been or will be rebuilt for Crown RRZ Claims is described in EQC *Explanatory Notes for EQC Residential Land Settlement for Residential Red Zone – Part 1: Flat Land (Excluding Known Severe Lateral Spreading Areas)* (November 2017) at [148]–[148].

a result of the earthquakes, damage to the land does not affect the value of that building, but only the value of the land.

- 37.3 **The day of the earthquake:** The DoV is assessed as at 4 September 2010, the date of the first earthquake in the Canterbury earthquake sequence.
- 37.4 **Full knowledge of lateral spreading vulnerability:** The DoV is assessed as the discount from the value of the property or land that takes account of full knowledge of the pre-existing lateral spreading vulnerability of the land. This assumption requires an adjustment to be made to the pre-earthquake value of the property or land to take account of the impact of lateral spreading vulnerability on the use and enjoyment of the land. The reasons for this assumption are discussed in more detail in Part (D) of this paper.
- 37.5 **Willing buyer and willing seller:** The objective is still to determine, as much as possible, what value would be attributed to the physical damage in an open market transaction.
- 37.6 **Specified physical change:** EQC is assessing the DoV that results from physical changes to the land, specifically the combined effect of Compromised Curst and any IFV and/or ILV damage. The engineering assessment of the physical change and the practical implications of that physical change, is being carried out by EQC's engineers, T+T.
- 37.7 **Full knowledge:** The market participants are taken to have full knowledge of the physical changes caused by the earthquake sequence and their impacts (other than on value), including therefore the pre-earthquake vulnerability of the land to flooding and liquefaction damage. This does not entail full knowledge of every detail regarding the land, changes, repair options and costs etc., but rather the level of detail a reasonable buyer and seller would obtain from relevant experts.
- 37.8 **Reasonable advisors:** EQC compensates for loss as a direct result of land damage; it does not compensate for regulatory changes made following the earthquakes (e.g. decisions regarding the maintenance of services in the Red Zone). However, an assessment of the DoV may reflect future steps that a property owner may reasonably wish to take as a result of the change to the land.

38 Aspects of the above are elaborated on in the assumptions section, below.

One DoV assessed for the Canterbury earthquake sequence

- 39 The EQC Act responds to damage caused by each natural disaster event separately. However, as the valuation of a DoV for the combined effect of ILV_{CC} and any IFV and/or ILV damage is a difficult exercise, involving the application of valuation judgement based on limited market information, EQC's valuers consider that it is necessary to value the effect of all ILV_{CC} land damage, and any IFV and/or ILV damage caused by the entire Canterbury earthquake sequence. Due to the variable and often insignificant change from one event to another, this provides a truer measure of the loss of amenity and value from before to after the Canterbury earthquake sequence. This is because, in general, the change across the sequence will be larger and the loss of value more confidently and accurately identified.

- 40 Further, in the context of ILV damage and ILV_{CC} land damage, an assessment of DoV across the entire Canterbury earthquake sequence is necessary because the engineering assessment of ILV is also based on the changes across the entire sequence. This is predominantly because the engineering assessment of ILV damage is based on a manual application of engineering judgement taking into account highly complex information, which is not feasible to undertake separately for each earthquake.
- 41 Accordingly, the valuation of DoV for the combination of ILV_{CC} damage and any IFV and/or ILV damage will be undertaken to reflect the discount in value arising from ILV_{CC} damage and any IFV and/or ILV damage caused over the full Canterbury earthquake sequence. The apportionment of the DoV to specific earthquake events is a matter for EQC, and does not form part of this paper.

(E) ASSUMPTIONS (LEGAL AND VALUATION)

42 This methodology is based on a range of legal and valuation assumptions. EQC's legal advisors and valuers currently consider that assumptions will need to be made in relation to matters listed below. These assumptions are valid and appropriate at the time that valuations for Canterbury earthquake damage are completed, and given the nature of the land insurance provided under the EQC Act. The assumptions are as follows.

Date of valuation

43 The DoV is to be assessed as at 4 September 2010.

Willing buyer and willing seller

44 The DoV is based on the standard valuation assumption that the value is the exchange value between a willing, but not anxious, seller and a willing, but not anxious, buyer.

Basis of valuation

45 For the IFV and ILV DoV Methodologies, the value immediately before the September earthquake was the market value of the insured property or land, for which reasonable comparable market indicators are available.

46 For the reasons given below, it is not appropriate to use the market value of the insured property or land immediately prior to the September earthquake as the undamaged value of the property or land for properties with severe lateral spreading vulnerability. That is because EQC is satisfied that the value of the property prior to the Canterbury earthquake sequence did not reflect full knowledge of the pre-earthquake vulnerability of the land to severe lateral spreading, with the result that standard MBIE ground improvements and foundations cannot be used to economically build on the land in the absence of area-wide works.

47 Instead, a market value of the property that takes account of the pre-existing severe lateral spreading vulnerability will be assessed as the starting point of an assessment of the discount attributable to ILV_{CC} damage and any IFV and/or ILV damage (i.e., the undamaged value of the property).

Insurance

48 The IFV and ILV DoV Methodologies proceed on the assumption that insurance will be generally available for properties affected by IFV and ILV damage (in the case of land where the pre-earthquake house has been or will be rebuilt, this assumption applies once any new residential building is built on the land). If the assumption is incorrect in relation to a specific property, this will be considered further.

49 For reasons given below, it is not appropriate to assume that the properties with severe lateral spreading vulnerability will be suitable for residential development in accordance with MBIE Guidance. However, it will be assumed that appropriate insurance to support the assumed future highest and best use of the property will be available, on reasonable commercial terms. This is discussed further in Section (E) of this paper.

Finance

50 The IFV and ILV DoV Methodologies also assumed that finance to purchase a residential property (including a rebuilt residential building) or residential land will be available on normal terms for any property for which insurance is available.

- 51 For properties with severe lateral spreading vulnerability, it is assumed that finance would be available on normal terms for such development activities as are required to support the assumed highest and best use of the property.

DoV to only reflect ILV_{CC}, IFV and ILV damage

- 52 One of the most important assumptions is that the DoV will be the reduction in value resulting only from physical changes to that residential land assessed by EQC as having caused any ILV_{CC} damage and any IFV and/or ILV damage. This assumption is made to ensure that EQC is compensating customers for only natural disaster damage that is covered under the EQC Act.

- 53 The DoV will not therefore reflect any changes in vulnerability to flooding or liquefaction resulting from external changes or effects, whether as a result of the earthquakes or otherwise. Equally it will not reflect changes in value due to increased knowledge of pre-existing vulnerability as against increased vulnerability due to the earthquake damage. For example:

53.1 *Operational services:* It will not consider loss of value attributable to whether the property or land has, and will continue to have, operational services such as roading, telephone, sewerage etc. For example, the fact that the Council has decided that it will not maintain services in the Residential Red Zone to the same level as before the earthquakes, is not something that EQC will compensate for. For the purposes of assessing the value of the undamaged property at its highest and best use, EQC's valuers have assumed that services are generally available to the boundary.

53.2 *Neighbouring properties:* Any effect from the earthquakes on neighbouring properties will be disregarded (in the sense that the valuation impact of being in a neighbourhood of dwellings that suffered earthquake damage will not be taken into account).

53.3 *Short term temporary stigma:* Any short to medium-term stigma arising from the earthquakes that may temporarily affect property or land values will be disregarded.

53.4 *Non-insured land:* EQC is making an insurance payment to claimants for loss in value of the property or land resulting from damage to the insured land. To the extent the property or land includes land that is not insured, the DoV EQC is assessing will not include any DoV resulting from the damage to that uninsured land.

53.5 *Vulnerability not caused by physical changes to the insured land:* Natural disaster damage under the EQC Act is limited to physical damage to the insured residential land. Accordingly, any increase in flooding or liquefaction vulnerability resulting from other changes – such as changes in seismicity – which are unrelated to a physical change to the land are not included.

53.6 *Changes in regulatory and building practice:* In relation to ILV and ILV_{CC} damage, EQC understands that, since the Canterbury earthquake sequence, the increased seismicity in the region and increased awareness of the vulnerability to liquefaction have led to changes in building regulations and practices. These changes have resulted in more extensive geotechnical testing and more robust foundation designs being required in areas that are vulnerable to liquefaction. These are not changes that arise from the physical

damage to the land, and therefore will not be compensated for. However, the practical implications of the ILV and ILV_{CC} damage to the land will be assessed in light of current regulation and practice.

- 54 For land with severe lateral spreading vulnerability, this assumption has an additional importance compared to other properties. That is because it is important that the DoV does not reflect changes in value due to increased knowledge of pre-existing vulnerability to severe lateral spreading, which has not increased as a result of changes to residential land caused by the Canterbury earthquake sequence, including how that vulnerability is in practice addressed under current regulation and practice.
- 55 This assumption affects the value of the property that is to be discounted to reflect natural disaster damage, and the assessment of the implications of ILV_{CC} damage and any IFV and/or ILV damage. In particular, in order to ensure that the DoV does not include loss of value caused by the increased knowledge of the pre-existing vulnerability to lateral spreading, a value of the pre-earthquake property adjusted to reflect the vulnerability of the land to severe lateral spreading damage will be assessed:
- 55.1 where the pre-earthquake house has been or will be removed, a value of the land will be assessed that reflects that the standard MBIE ground improvement or foundation solutions cannot be economically used to support residential use of the land, absent area wide works;
- 55.2 where the pre-earthquake house has not been and will not be removed, a value of the property will be assessed that reflects that the current building may be occupied (as lateral spreading vulnerability does not give rise to any other practical or legal impediment to inhabit the dwelling) but that the standard MBIE ground improvement or foundation solutions cannot be economically used to support residential use of the land, absent area wide works, in the event that work requiring a consent is undertaken, including redevelopment of the land.
- 56 This is discussed further in Section (F) of this paper.

(F) DETERMINATION OF UNDAMAGED VALUE OF PROPERTY

(F1) Introduction

- 57 EQC has instructed EQC's valuers to assess the DoV attributable to ILV_{CC} damage and any IFV and/or ILV damage as the discount, as at the date of the earthquake, from the price that would have been paid for the property or land with full knowledge about the vulnerability of the land to severe lateral spreading. The reasons for this assumption are described in Part (D) of this paper.
- 58 For land that is not subject to known severe lateral spreading vulnerability, EQC adopts the market value of the property or land as at the date of the earthquake as the best evidence for the undamaged value of the relevant property or land.
- 59 EQC's valuers are satisfied that the pre-earthquake market value of the property did not reflect full knowledge about the vulnerability of the land to severe lateral spreading. In particular, there did not appear to be any engineering advice that would preclude the land's suitability for residential development. There is no evidence that the pre-earthquake market value reflected anything other than an understanding that the land and buildings were suitable for residential use and development. That is, there is no evidence that:
- 59.1 it was understood that the land affected by ILV_{CC} damage was subject to severe lateral spreading vulnerability; or
 - 59.2 residential construction was restricted in these areas, even where specific geotechnical engineering advice was sought and obtained.
- 60 Accordingly, EQC has instructed EQC's valuers to determine, for use as a starting point in the DoV assessment, a methodology to adjust the value of the property or land, as at the date of the earthquake, to reflect full knowledge about the vulnerability of the land to severe lateral spreading.
- 61 In developing this methodology, EQC's valuers have been asked to assume that:
- 61.1 the market value of the property generally reflected full knowledge of the vulnerability of the land to various natural hazards, other than its severe lateral spreading vulnerability;
 - 61.2 the adjustment is solely to reflect the known vulnerability of the property to severe lateral spreading. No account is to be taken of the properties' vulnerability to other natural hazards, including flooding and liquefaction damage.
- 62 The purpose of these assumptions is to enable an assessment of the reduction in the pre-earthquake value of the property that is attributable to full knowledge of the implications of severe lateral spreading vulnerability. Put another way, it asks the question: what is the value of the property as at the date of the earthquakes if the only change from its market value was full knowledge of the property's severe lateral spreading vulnerability.

(F2) Determination of unadjusted pre-earthquake value

- 63 Pre-earthquake values have been assessed using conventional mass appraisal valuation techniques based on indexation of the most recent rating valuations, in

force as at 3 September 2010, and adjusting the resulting valuations to reflect the insured area of land. Since the majority of dwellings had been demolished before the valuations were carried out, EQC's valuers relied on the historical information available as at 3 September 2010.

(F3) Adjusted value of land subject to severe lateral spreading vulnerability

64 To adjust the value of the property or land, as at the date of the earthquake, to reflect full knowledge of the vulnerability of the land to severe lateral spreading, it is necessary to assess:

64.1 the likely highest and best use of the land with full knowledge of the vulnerability of the land to severe lateral spreading; and

64.2 the appropriate adjustment required to the pre-earthquake value of the land that reflects that highest and best use.

65 The highest and best use of the land is residential, if the land is capable of economic residential development. If residential development of the land is not possible, land will still have a value for some alternative use, albeit a lesser value. EQC's valuers consider that land in this category can be further divided into the following areas of highest and best use:

65.1 **Lot aggregation:** aggregation with existing residential properties either not subject to known severe lateral spreading vulnerability or properties with known severe lateral spreading vulnerability where the pre-earthquake residential building does not require rebuilding due to earthquake damage; and

65.2 **Alternative land use:** alternative land use, likely non-residential in at least the medium term.

66 Preliminary work was also undertaken on whether area-wide perimeter treatment works could be economically undertaken in some areas of the Residential Red Zone. If such works could be undertaken, this would enable residential buildings to be constructed on the land using standard MBIE Guidance foundations. EQC understands from LINZ that, in fact, no such works are currently anticipated as being undertaken in the Residential Red Zone.

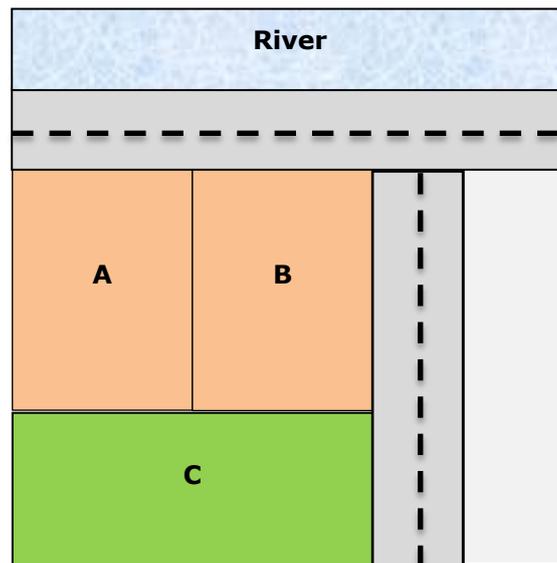
67 EQC considers that, based on the information currently available to it, it is not appropriate to assume that perimeter treatment works would be undertaken in any part of the Residential Red Zone. This is because:

67.1 to be viable in a context outside of a government scheme, perimeter treatment schemes would require the sale of all land subject to severe lateral spreading to a single developer or for each property owner to agree to participate (in addition, for some schemes public land would be required). There would therefore be a material hold out risk for any private scheme not backed by a compulsory acquisition option;

- 67.2 the civil works required to undertake perimeter treatment schemes are very expensive. In the preliminary analysis undertaken by T+T for the purposes of the valuation exercise, drawing on earlier work completed in the Red Zone:⁵
- (a) the estimated costs of civil works for the schemes in most areas of the Red Zone exceeded the combined pre-earthquake value of the insured land;
 - (b) in the five areas where the estimated costs of civil works for the schemes did not exceed the combined pre-earthquake value of the land, the cost of works in most cases approached 60 to 70% of the pre-earthquake land value;
- 67.3 the estimate of the cost of civil works is uncertain, as it is dependent on design considerations that are difficult to fully implement in a hypothetical context;
- 67.4 in addition to civil costs, any developer would have to take into account enabling work costs such as reinstatement of buried services, as well as financing and developer risk margins. Any developer is likely to apply a significant risk margin to the project, given the risks associated with the investment. This would further reduce the number of areas in the Residential Red Zone that could be considered for viable area-wide works, if not eliminate all areas altogether;
- 67.5 even if perimeter treatment works were economically viable, a developer could choose to use existing site boundaries and services (i.e., a Brownfields development) or redevelop completely the affected area (i.e., a Greenfields development). Attributing the total value of the development after perimeter treatment works are undertaken to pre-earthquake properties is therefore challenging, and would require a number of simplifying assumptions to be made, many of which may not reflect the real-world consequences of development; and
- 67.6 there are no current plans by the Government or land owners to undertake such works.
- 68 Accordingly, EQC's valuers have been instructed to disregard participation in an area-wide works scheme as a viable highest and best use of land in the Residential Red Zone. If further information becomes available indicating the viability of such schemes in any particular area of the Red Zone, this assumption can be revisited.
- 69 The remaining categories of highest and best use are discussed further below.
- Lot Aggregation**
- 70 In the absence of area-wide works, the highest and best use of land with known lateral spreading vulnerability is sale to an adjacent owner as additional yard space or to allow future subdivision of their existing lot. This is most readily achieved for Residential Red Zone properties that adjoin Green Zone properties or other Red Zone properties that are outside areas known to have severe lateral spreading vulnerability.

⁵ T+T *Darfield Earthquake 4 September 2010 Geotechnical Land Damage Assessment & Reinstatement Report – Stage 2 Report* (2010) and T+T *Kaiapoi Red Zones – Engineering Feasibility of Potential Land Uses – Stage 1 Report* (2016).

71 An example of lot aggregation, is set out in the figure below.



- 72 In this example, both Lot A and Lot B are known to have severe lateral spreading vulnerability, and front the river. Lots A and B adjoin Lot C, which is outside the area of severe lateral spreading vulnerability. Lots A and B can be aggregated with Lot C to form a larger property.
- 73 Depending on location and proximity to properties outside of areas of known severe lateral spreading vulnerability, various options may be available to aggregate properties together. The most optimal (highest likely value) instances are situations where a single lot with known severe lateral spreading vulnerability can be aggregated with an adjacent lot without known severe lateral spreading vulnerability. This provides the ability to build multiple houses on the property without known severe lateral spreading vulnerability, utilising the additional land from the property with known severe lateral spreading vulnerability as yard. Additional benefit may accrue in cases where a property without known severe lateral spreading vulnerability is set back from the river, and is able to secure river frontage through amalgamation with a river front lot.
- 74 In some cases up to 2 – 3 lots may be required in order to allow aggregation with a site without known severe lateral spreading vulnerability to provide an effective building platform.
- 75 Lot aggregation is therefore viable for reasonably small clusters of properties but is not a solution available for all properties with severe lateral spreading vulnerability. The market for this land is more limited and relies on the willingness of adjoining owners to purchase the adjoining land to form a larger 'lifestyle' lot with a higher value. For the purposes of assessing a discount, it therefore necessary to assume a willing buyer and willing seller.
- 76 The value of the land with known severe lateral spreading vulnerability can be determined by removing the notional building site to assume that the land is used for peripheral land. This is a conventional valuation technique, reflecting the well-

established valuation principle that parts of a residential section may have different per square metre rates based on utility.

77 Typically analysis of vacant land identified that around 60% - 70% of the site value is contained in the building platform area with the remainder relating to the balance land. Typically the balance land rates range from 10% to 50% of the land rate associated with the building platform depending on size and nature of the additional land.⁶ The percentage will vary depending on:

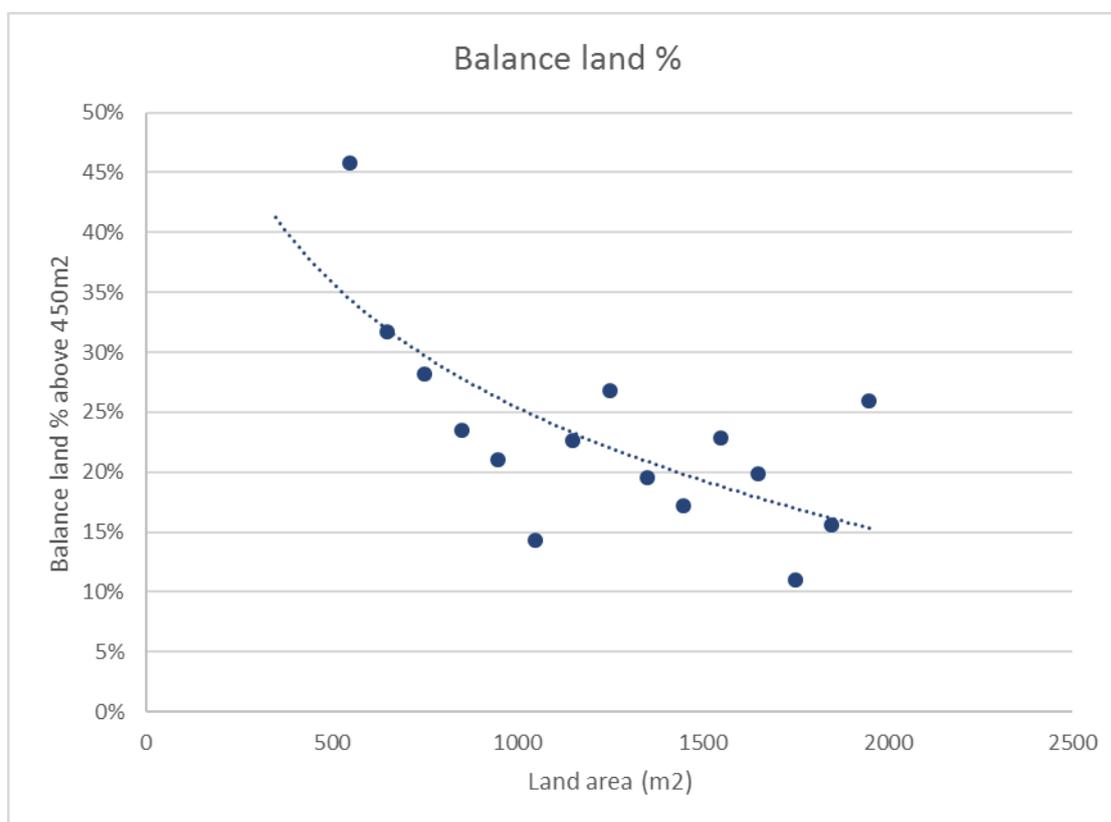
77.1 the scale of the land being added;

77.2 the overall shape of the amalgamated lot;

77.3 the contour of the land; and

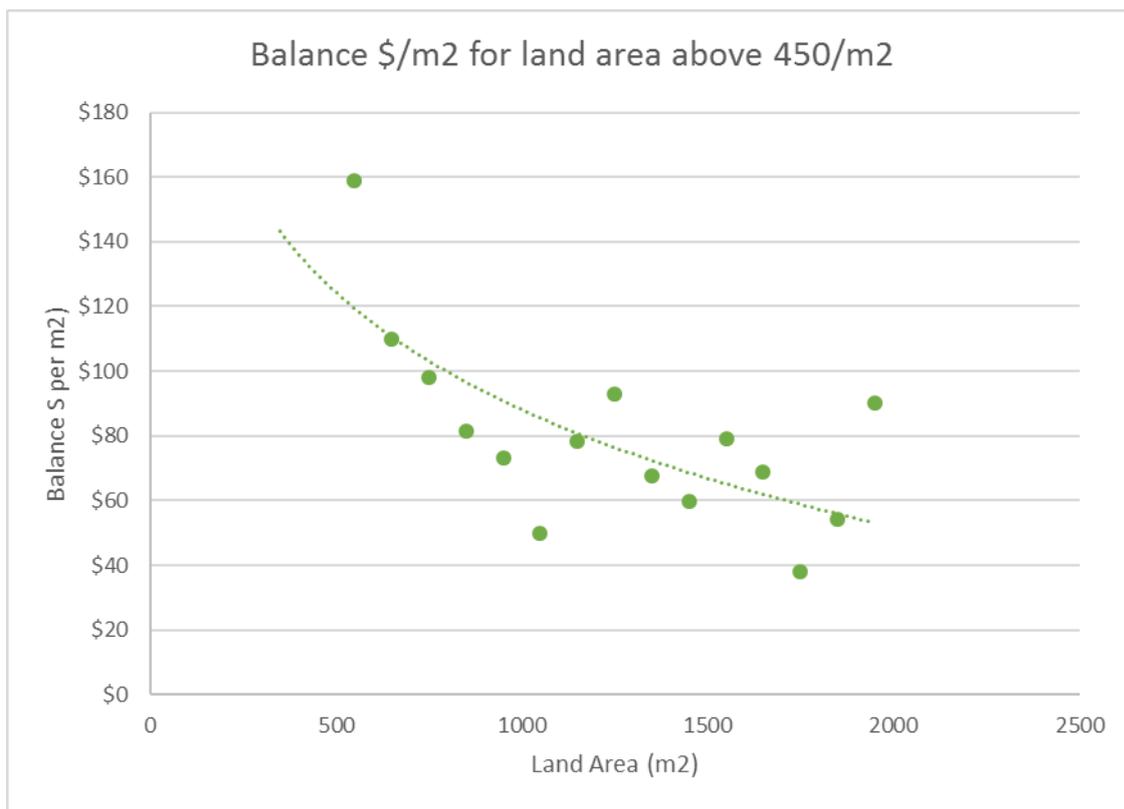
77.4 any desirable attributes added: e.g. riverside access or reserve outlook.

78 As a cross-check against this analysis, EQC's valuers analysed the relationship between lot size and value for Red Zone properties subject to Crown RRZ Claims. Properties were grouped into ranges of lot size (e.g., between 501 and 600 m²). For each grouping, the median pre-earthquake value was calculated. The difference between this value and the median value of sections in the 401 to 500 m² range, as indicative of the standard minimum residential lot size of 450 m², was calculated, and a per square metre rate for the "additional land" above 450 m² determined. The per square metre value of the additional land was considered as a proportion of the per square metre value of 450 m². This relationship is shown in the graph below.



⁶ See the discussion in *ILV DoV: Pre-Earthquake Value of Unrepaired Land: Guidance Note* (October 2017).

- 79 The best fit trend curve shows a decreasing rate per square metre as the size increases, diminishing beyond 1200 square metres within a range of between 15% and 20% of the land value rate of a minimum residential lot.
- 80 EQC's valuers also considered the value of excess land in terms of absolute dollar rates per square metre for land above the minimum lot size. This is shown in the graph below. The rate per square metre flattens out to approximately \$65 per square metre, which is above the per square metre rate that developers have paid for deferred or land bank investment. The maximum discount for aggregated lots should not be greater than the rate that might reasonably be paid for such land by a party with no motive for extending or protecting an unaffected land holding – that is, for a party that wished to put the land to alternative use.



- 81 The analysis is consistent with the results of the analysis completed by Colliers International in their report on the value of marginal land in Kaiapoi.⁷ The Colliers analysis considered the possibility of Red Zone land being amalgamated with neighbouring Green Zone land, by undertaking analysis of residential subdivisions in the Waimakariri District and Christchurch City. In the Wigram Skies subdivision, involving smaller sites, this indicated a marginal utility value for the additional land of 20% - 23% of the base residential site value rate. For larger sites in the Preston Downs subdivision, a marginal utility value of between 10% - 21% was found. It is noted that the lower percentages occurred when the additional area rose over twice the base site area: essentially where minimum lot sizes were combined.
- 82 EQC's valuers consider that for standard lots, these discounts are consistent with their own analysis discussed in paragraphs 78 – 80, above. In cases where positive

⁷ Colliers International *Valuation Consultancy Report: WDC Residential Red Zone – Marginal Land Kaiapoi, The Pines Beach and Kairaki* (May 2016) at 13 to 14.

factors such as river frontage exist, a lesser discount is likely to be warranted. This is a factor that the Colliers report did not consider.

83 In considering the approximate discount, consideration was also given to the specific attributes of red zone properties including:

83.1 own transferable certificate of title with ability to trade into the future

83.2 serviced site with own access and road frontage;

83.3 possibility of immediate residential subdivision on aggregation via boundary adjustment; and

83.4 more uniform shape.

84 Based on the range of aggregated lot options, EQC's valuers consider it appropriate to adopt a range of discount figures depending on the attributes of the lot to be aggregated. These are:

84.1 Standard Lot: 75% discount from pre-earthquake land value.

84.2 Good Lot: 70% discount from pre-earthquake land value. These lots will provide river views or improved shape to the lots they are aggregated with.

84.3 Superior Lot: 65% discount from pre-earthquake land value. As for good lots, but with good subdivision potential (i.e., it may be possible to build an additional building on the lot the land is aggregated with, once aggregation occurs).

84.4 Elite Lot: 60% discount from pre-earthquake land value. As for good lots, but with imminent subdivision potential, excellent shape, corner position or river views.

85 For example, for a lot with an assessed pre-earthquake value of \$180,000:

- Standard site with no outstanding attributes:

$\$180,000 @ 25\% = \$45,000$ Adjusted undamaged value

- Site with desirable attributes:

(A) Provides new composite site with river frontage

$\$180,000 @ 30\% = \$54,000$ Adjusted undamaged value

(B) Provides new composite potential subdivision

$\$180,000 @ 35\% = \$63,000$ Adjusted undamaged value

86 EQC's valuers have assumed that sites where the pre-earthquake building was required to be rebuilt due to earthquake damage can be aggregated with properties that are not known to have severe lateral spreading vulnerability within the Green Zone or Red Zone, or with properties that do have known severe lateral spreading vulnerability but where the pre-earthquake building does not require to be rebuilt

due to earthquake damage. For such properties, given the limitations on building, the value of aggregation is lower. Accordingly, EQC's valuers have adopted two discount figures:

86.1 Standard Lot: 80% discount from pre-earthquake land value.

86.2 Good Lot: 75% discount from pre-earthquake land value. These lots will provide river views or improved shape to the lots they are aggregated with.

Alternative Use

87 In situations where, due to lateral spreading risk, the land is not suited to residential development, alternative uses may be considered for the land including:

87.1 temporary accommodation;

87.2 storage;

87.3 long term hold or land banking;

87.4 grazing or cropping; and

87.5 reserve use.

88 T+T's advice is that, given the slab foundation design associated with standard industrial or box retail premises, these are no more resilient to lateral spreading than standard MBIE foundations recommended for residential development. Accordingly, the potential commercial or industrial use of land with known severe lateral spreading vulnerability is limited. A description of the limitations that apply to these sites is set out in **Appendix A** to this methodology.

89 Other uses such as grazing, storage or reserve use involve far less intensive uses with consequently significantly lower base values.

90 EQC's valuers consider there is a minimum price that the market would determine for this land. While storage or grazing may provide short term options, the price point for this land (at \$5 - \$10 psm) arguably sets a market price that is too low for land within an urban environment, even for land subject to known severe lateral spreading vulnerability. There will always be purchasers available who have a risk appetite and are willing to purchase and hold land long term in the hope that new technology or ongoing development within areas known to have severe lateral spreading vulnerability will present future opportunities for building.

91 In considering this alternative use, consideration has been given to land rates for 'undeveloped' land throughout Christchurch. Sales information provided by Telfer Young provides good background to transactions which occurred prior to September 2010 as summarised below:

Address	Suburb	Zone	Sale Date	Sale Price (ex GST)	Purchaser	Area (ha)	Rate/m ²
40 Johns Road	Belfast	Rural 3	1/07/2005	\$9,376,178	Yaldhurst Village	25.96	\$36.12
420 Marshland Road	Marshland	Rural 3	1/08/2005	\$858,000	Foodstuffs	4.13	\$20.76
125 Philpotts Road	Mairehau	Rural 3	25/08/2005	\$1,100,000	Jdml Holdings Limited	5.76	\$19.10
18 Murphys Road	Halswell	Rural 2	9/09/2005	\$1,620,000	Yan Li	8.00	\$20.25
317 Prestons Road	Marshland	Rural 3	14/09/2005	\$550,000	Tipple Family	2.60	\$21.19
441 Prestons Road	Marshland	Rural 3	8/11/2005	\$1,000,000	CDL	4.94	\$20.23
393 Prestons Road	Marshland	Rural 3	1/12/2005	\$1,100,000	CDL	4.41	\$24.96
395 Prestons Road	Marshland	Rural 3	15/12/2005	\$1,595,000	CDL	5.32	\$29.95
414 Prestons Road	Marshland	Rural 3	1/02/2006	\$4,000,000	CDL	11.09	\$36.06
432 Prestons Road	Marshland	Rural 3	2/02/2006	\$4,650,000	CDL	13.71	\$33.92
West Melton	Gainsborough	Living 1 & 2	1/04/2007	\$8,500,000	Selwyn District Council/R Hughes	49.27	\$17.25
155 Mairehau Road	Marshland	Rural 3	1/10/2007	\$3,500,000	CDL	8.20	\$42.68
139 Mairehau Road	Marshland	Rural 3	1/10/2007	\$2,415,000	CDL	7.10	\$34.01
81 Mairehau Road	Marshland	Rural 3	1/10/2007	\$6,000,000	CDL	18.51	\$32.42
119 Mairehau Road	Marshland	Rural 3	1/10/2007	\$3,715,000	CDL	10.90	\$34.08
330 Styx Mill Road	Casebrook	Rural 3	7/11/2007	\$11,050,000	Independent Producers Limited	21.86	\$50.54
18 Murphys Road	Halswell	Rural 2	1/08/2008	\$2,100,000	Fulton Hogan	8.00	\$26.25
266 Highsted Road	Casebrook	Rural 3	17/11/2010	\$755,000	Camick Investments Ltd	2.08	\$36.27

- 92 There was a period of significant growth and activity from 2005 – 2007. During this period significant tracts were purchased in areas such as Marshlands, Casebrook and Halswell and, in addition, new stages in existing subdivisions were being actively marketed. Following the Global Financial Crisis in 2007, due to a significant drop in demand for sections, transactions for block land practically ceased. At that time, a stock pile of land already held by developers, exacerbated this issue. Land purchased for redevelopment leading up to September 2010 typically ranged from \$17 to \$50 psm. These levels therefore establish peak level prices for land of this nature.
- 93 These sales were generally for raw land with limited access and relatively undeveloped services, often on the fringe of Christchurch city. Land contouring, formation of roads and infrastructure, and separate titling was required before any building could occur on this land. The development of this land also attracted development and council levies.
- 94 In comparison, land in the Residential Red Zone tends to be in more established areas of Christchurch with a developed network of infrastructure available and liability with respect to development already prepaid but offset by the known vulnerability to severe lateral spreading.
- 95 EQC's valuers consider that the location of undeveloped land at the fringe of the city, with limited access and relatively undeveloped services, and the current limitations on use of land with known vulnerability to severe lateral spreading, although different, are of similar scale in effect on land use and therefore value. In each case, there is no practical potential for immediate residential development, and the land is held for alternative use but with a value given to its potential for long-term future development. Consideration of raw land rates provides a minimum base price for smaller parcels which cannot be built on and are available for alternative use.
- 96 Based on an example land price of \$170,000 for say a 700 sqm site this produces a rate of \$243 psm. Applying a discount of 85% produces a per square metre rate of \$36 psm, whereas applying a discount of 80% produces a per square metre rate of \$48 psm.
- 97 Based on the available evidence, EQC's valuers consider that a discount of 85% is appropriate for alternative use land. This reflects a value towards the mid to upper end of indicative sales values for block land. In some cases where the site is particularly desirable, a lower adjustment of 80%, representing the high end of values for block land, may be adopted.

(F4) Adjusted value of properties subject to severe lateral spreading vulnerability

- 98 Where the pre-earthquake residential building does not require rebuilding due to earthquake damage, the highest and best use of the property will be to continue to use the residential building and associated land for residential purposes.
- 99 The value of the land and associated building will reflect that the property can continue to be occupied without immediate costs being incurred but with restrictions on future use, and with an ongoing vulnerability to severe lateral spreading, and the associated land and building damage that would be caused in a future significant earthquake. That is, the owner of the residential building is unlikely to be able to obtain building consent to demolish and rebuild the residential building or carry out major renovations, such as extending the footprint of the building.
- 100 EQC's valuers considered that the value of the improvements is generally linked to their expected economic life. A large, modern home built to current standards can be inhabited without need for alteration for many years to come. As such, the owner is not immediately affected by the restriction that the home cannot be rebuilt or extended. However, a small, older dwelling on a large site is more likely to require upgrading or enlarging in the short to medium future.
- 101 EQC's valuers have considered two options, set out below, to determine the value of properties where the residential building does not require to be rebuilt due to earthquake damage on land that is known to have severe lateral spreading vulnerability.

Option 1 – Market approach

- 102 The "market approach" involves calculating a deduction to the pre-earthquake property value to reflect that a property owner cannot rebuild or extend the residential building, given the known severe lateral spreading vulnerability.
- 103 EQC's valuers used evidence from properties subject to terminating leases, or leases with restrictions on altering the improvements to assess the appropriate discount. The extent of discount is likely to vary depending upon the age, design and current amenity provided along with ongoing uncertainty of future changes that can be made to the property. In cases where a modern house offers ongoing amenity with little need for change then the discount is far less pronounced. The main risk is being unable to rebuild where a total loss occurs.
- 104 Recent arbitrations concerning a number of properties in Waikawa Bay, Marlborough, which contain older baches situated on land subject to ground leases, collated significant information from markets around New Zealand on properties in this position. The leases provide for ongoing occupation, but due to the steep contoured land and relative instability, typically have restrictions to prevent lessees from altering the residential buildings. While these properties rarely sell, the discount can be observed from the ground lease rental payable on review.
- 105 EQC's valuers analysed the data using a "traditional approach" and a "classical approach":
- 105.1 Under the classical approach, ground leases are compared to other ground leases that have been fixed in the market. Adjustments are made for differences in factors such as physical attributes, location, lease terms size, planning considerations, and general market movements in value over time;

105.2 Under the traditional approach, ground leases are assessed based on a percentage of the land value. Adjustments are made for differences in factors discussed at paragraph 105.1 above. The percentage to be applied is affected by the value range, term of lease, frequency of reviews, rights to compensation and any restrictions imposed by the lease.

106 EQC's valuers considered that the classical approach was most appropriate as it directly answers the question as to what a prudent lessee would pay to occupy the site, though relies on having sufficient market transactions of a comparable nature.

107 Based on this analysis, a reduction in value of around 30 to 35% was observed for sites where there are restrictions on alteration of the residential building. While this discount was observed in areas with attractive features, such as coastal access, there is no reason to expect the proportionate reduction in value associated with limitations on future use to be different in areas without those features.

108 For properties where the residential building remains in place in areas of known severe lateral spreading vulnerability, discounts may range from 15 to 30% depending on the nature of the house. EQC's valuers proposed to adopt a 25% discount to the pre-earthquake value across the portfolio given the lack of accurate information regarding the condition and utility of houses prior to September 2010.

Option 2 –Income approach

109 As an alternative the 'income approach' provides a useful check as it benchmarks the value from an investment perspective. The 'income approach' involves calculating the estimated market rent that could be charged for the residential building and land, used as an investment property. The capitalisation rate can be analysed from market evidence, though this needs to be adjusted upwards to reflect the restrictions on extending or rebuilding the dwelling.

110 For houses in fair to poor condition the 'added value' may be appropriately determined by adding a minimum of 5 years of income to the value of the land.

Sold 1/04/2010 \$270,000 Gross **Built** 1940's

Method 2 - Income approach			
Based on analysis of pre-2010 house sales, typical gross returns are 5.5% - 6.5%.			
A 1.5% higher allowance was adopted for these restrictions			
Rent	\$300	50 Wks (allowing for typical 2 week vacancy period)	\$15,000 pa
Capitalised @		7.5% gross return	\$200,000
Modified Pre quake value		Adopt	\$200,000

(G) ASSESSMENT OF DOV ATTRIBUTABLE TO ILV_{CC} DAMAGE AND ANY IFV AND/OR ILV DAMAGE

(G1) Introduction

- 111 The methodologies developed by EQC's valuers to assess the DoV attributable to IFV and/or ILV land damage each utilises matrices that enable the consistent identification of percentage adjustments for the extent of the particular practical implications of those types of damage. The percentage adjustments for different aspects of the practical implications of the damage are added together to produce a total percentage adjustment. This is then applied to the undamaged value of the property or land to produce a resulting DoV, which is then reviewed to ensure that, as a matter of valuation judgement, it is an appropriate figure for the property.
- 112 For properties with both IFV and ILV land damage, the percentage adjustments for the practical implications of each form of damage are combined using the Combination Matrix described in the IFV and ILV DoV Methodologies report.
- 113 EQC's valuers have considered the application of the matrices and percentage adjustments to properties and land that are subject to known severe lateral spreading vulnerability, given the engineering advice received about the practical implications of ILV_{CC} damage and any IFV and/or ILV damage to properties and land in this category.
- 114 In undertaking this exercise, EQC's valuers have sought to ensure consistency between the approach to the adjusted undamaged value of the property and land, and the discounts to be applied. That is, they have assessed the practical implications of ILV_{CC} damage and any IFV and/or ILV damage on the highest and best use of the property or land assumed for the purposes of determining the adjusted undamaged value.

**(G2) Properties where the residential building has been or will be removed
*ILV and ILV_{CC} land damage***

- 115 DoV attributable to ILV and ILV_{CC} land damage will be assessed using the ILV DoV Methodology (Residential Building has been or will be removed). Adjustments will be made to the methodology to account for the particular circumstances of land subject to known severe lateral spreading vulnerability.
- 116 In the absence of area-wide works to address severe lateral spreading vulnerability, T+T's engineering advice is that any increase in liquefaction vulnerability due to ILV land damage or ILV_{CC} damage is limited to an increase in the vulnerability of the residential land to land damage in a future earthquake that does not trigger severe lateral spreading. T+T have advised that it is likely that severe lateral spreading will not be triggered in a 25 year return period earthquake, but will be triggered in a 100 year return period earthquake. It is not possible to identify with precision or confidence the level of earthquake shaking between these events at which severe lateral spreading will be triggered.
- 117 In events where severe lateral spreading is not triggered, T+T's engineering advice is that:
- 117.1 the practical implications for ILV land damage are as described for land not subject to severe lateral spreading vulnerability in the Practical Implications Report; and

- 117.2 the practical implications for ILV_{CC} land damage are essentially the same as those described for ILV land damage. As ILV_{CC} damage is another way in which land's vulnerability to liquefaction-related damage can increase, the implications of ILV_{CC} damage can be described using the same severity and change in severity classifications developed for ILV land damage and described in the Practical Implications Report.
- 118 As described in detail in the Compromised Crust Report, T+T have reviewed all properties or land identified as having ILV_{CC} damage and assessed the 1 in 25 year level of shaking and 1 in 100 year level of shaking pre-earthquake and post-earthquake severity classifications and change in severity classifications. Where the property or land has suffered both ILV land damage and ILV_{CC} damage, T+T have provided a combined assessment of the increase in liquefaction vulnerability due to both mechanisms.
- 119 The ILV DoV Methodology (Residential Building has been or will be removed) contains adjustments for changes to liquefaction vulnerability at both 100 and 25 year return periods of earthquake shaking. For land that has known severe lateral spreading vulnerability, adjustments to reflect the 100 year return period level of shaking are inappropriate, given the engineering advice that the implications of ILV and ILV_{CC} damage are immaterial at those levels of shaking.
- 120 However, there will be practical implications of ILV and ILV_{CC} land damage in less than 100 year return period levels of shaking. In the ILV DoV Methodology (Residential Building has been or will be removed), the adjustments necessary to reflect these practical implications were considered in two scenarios:
- 120.1 where a residential building will be rebuilt on the affected land (at paragraphs [176] to [180] of the Methodology);
- 120.2 where the only land affected will not be directly under or around a residential building, because the land directly under and surrounding the building will be remediated (at paragraphs [109] to [205] of the Methodology).
- 121 As in both the aggregated lot and alternative use scenarios for land with known severe lateral spreading vulnerability, the land will not be used as a building platform, EQC's valuers consider that it is appropriate to apply the adjustments previously developed where land affected will not be directly under or around a residential building.
- 122 These are set out at paragraph [205] of the ILV DoV Methodology (Residential Building has been or will be removed) and are set out below:
- 122.1 No change: 1.5% (to reflect the existence of an increase in vulnerability in levels of earthquake shaking between 100 and 25 year return periods);
- 122.2 None or Minor change: 2.25%;
- 122.3 Minor change: 3%;
- 122.4 Minor or Major Change: 6.5%;
- 122.5 Major Change: 10%.

123 For the reasons set out in the ILV DoV Methodology (residential building has been or will be removed), these adjustments incorporate recognition of the increase in vulnerability at frequencies below 100 year return periods levels of shaking).

IFV land damage

124 Severe lateral spreading does not affect the vulnerability of land to flooding. However, the implications of IFV land damage will depend on the assumption made as to the highest and best use of the land.

125 Properties may either:

125.1 have a residential use when aggregated with other adjoining parcels of land with an existing residential use; or

125.2 have an alternative use.

126 In both cases, the parcel being assessed will not have a residential building situated on it. Accordingly, a percentage adjustment must be selected to reflect that a building platform will not be affected by the flooding.

127 EQC's valuers have considered the appropriate percentage discounts to adopt in each case.

128 In the case of both aggregated lots and alternative use, there is no directly applicable Flood Profile from the standard IFV DoV Methodologies. Instead, it is necessary to apply valuation judgement to assess the equivalent level of severity of exacerbated flooding on use of land as yard (aggregated lots) or alternative use properties, having regard to the lower valuation base of those uses.

129 For aggregated lots, the use is similar to land considered in the standard IFV DoV Methodologies, in that the land is to be aggregated with a residential property as a larger yard. Taking the uses of such land and the likely market impact of exacerbated flooding into account, EQC's valuers generally consider that use of Code 2 for Step 1 in the IFV DoV Methodologies will produce appropriate discounts to reflect the severity of the increase. Flood Profile 2 is described as "*most of site affected excluding building platform*".⁸ Other steps in the IFV DoV Methodologies will generally be applied using the automated model developed by T+T.

130 For alternative use lots, the potential uses of the land are different from those considered in the standard IFV DoV Methodologies. Further, because of the lower value base, EQC's valuers consider that the impact of IFV land damage may in severe cases be more significant as a percentage of the total value for alternative use sites than for equivalent residential land. That is because, in assessing the adjustment to the pre-earthquake value of the land, EQC's valuers have assumed that the alternative lots have a broad range of non-residential uses. If the land is subject to severe flooding, particularly in frequent events such as a 10% AEP event, the land value will reflect considerably more constrained uses.

131 Accordingly, EQC's valuers consider that a modification to the IFV DoV Methodologies is necessary for alternative use land where the exacerbated flooding

⁸ *Diminution of Value Methodology for Increased Flooding Vulnerability (for where the residential building has been or will be rebuilt)* (October 2016) at [303]–[304].

has a more significant depth change, and the property becomes newly vulnerable at more frequent events. The following percentage adjustments have been adopted:

No frequency impact	No frequency adjustment or Exacerbated flood depth is less than 0.3 m except where property now vulnerable at 10% AEP (previously vulnerable at 1% AEP).	Apply standard IFV DoV percentage adjustments (adopting Flood Profile 2, as for aggregated lots).
Moderate frequency impact	Exacerbated flood depth less than 0.3 and property now vulnerable at 10% AEP (previously vulnerable at 1% AEP) or Exacerbated flood depth is greater than 0.3 m and property now vulnerable at 2% AEP (previously vulnerable at 1% AEP)	15%
Moderate to major frequency impact	Exacerbated flood depth is between 0.3 m and 0.5 m and property now vulnerable at 10% AEP (previously vulnerable at 2% AEP)	20%
Significant frequency impact	Exacerbated flood depth is greater than 0.3 m and property now vulnerable at 10% AEP (previously vulnerable at 1% AEP) or Exacerbated flood depth greater than 0.5 m and property now vulnerable at 10% (previously vulnerable at 2% AEP).	30%

- 132 The above categories can be more simply described, in terms of the Step 2 and Step 3 codes used in the IFV DoV Methodologies, as follows:

		Frequency Code			
		0	1	2	3
Exacerbated Flood Depth	1	<i>Standard Matrix Percentage Discounts</i>			15%
	2		15%	20%	30%
	3		15%	30%	30%

- 133 The percentage adjustments in the above table will be applied in place of the percentage adjustments in the standard IFV DoV Methodologies, where applicable.
- 134 EQC's valuers consider that this is an issue specific to flooding vulnerability, which can have more severe frequency impacts than liquefaction vulnerability. Accordingly, no adjustment is required to the ILV DoV Methodologies for alternative use land.

ILV_{CC} damage and IFV and/or ILV damage

- 135 The Combination Matrix will be applied as set out in the IFV and ILV DoV Methodologies for properties with ILV_{CC} damage and IFV and/or ILV damage.

(G3) Properties where the residential building remains in place

- 136 As set out in Section (F3), where the pre-earthquake residential building does not require to be rebuilt due to earthquake damage, the highest and best use of the property will be to continue to use the residential building and associated land for residential purposes, until such time as it becomes necessary to obtain building consent to repair or rebuild the building.

ILV and ILV_{CC} land damage

- 137 DoV attributable to ILV and ILV_{CC} land damage will be assessed using the ILV DoV Methodology (residential building remains in place). The ILV DoV Methodologies will be applied to the combined severity and change in severity classifications for ILV and ILV_{CC} land damage, for the reasons described above.

- 138 As discussed above, ILV and ILV_{CC} damage only have practical implications for the property where severe lateral spreading is not triggered. Accordingly, for the reasons given above, only the adjustments for increased vulnerability at 25 year return period levels of shaking (incorporating recognition of the increase in vulnerability at frequencies below 100 year return periods levels of shaking) will be used. These are set out at paragraph [357] of the ILV DoV Methodology (residential building remains in place) and are set out below:

138.1 No change: 2% (to reflect the existence of an increase in vulnerability in levels of earthquake shaking between 100 and 25 year return periods);

138.2 None or Minor change: 3%;

138.3 Minor change: 4%;

138.4 Minor or Major Change: 8%;

138.5 Major Change: 12%.

139 In addition, the Step 3 Construction Type Allowance will be implemented in addition to these percentage discounts.⁹

IFV land damage

140 DoV attributable to IFV land damage will be assessed using the IFV DoV Methodology that applies where the residential building remains in place.

141 EQC's valuers have considered whether any adjustment is required to the methodology and matrices in the DoV methodology to reflect the limited rebuilding rights for properties where no perimeter treatment works are undertaken. They consider that no adjustment is appropriate, as there are only limited implications of IFV land damage on rebuilding.

142 ILV_{CC} damage and IFV and/or ILV damage The Combination Matrix will be applied as set out in the IFV and ILV DoV Methodologies for properties with ILV_{CC} damage and IFV and/or ILV damage.

⁹ As explained at paragraphs 109 – 114 of *Implementation of Diminution of Value Methodologies for Increased Flooding Vulnerability and/or Increased Liquefaction Vulnerability for Crown-owned Properties in the Residential Red Zone (without Severe Lateral Spreading Vulnerability)* (November 2017) and at paragraph 183 of the *Explanatory notes for EQC residential land settlement for Residential Red Zone – Flat Land (Excluding Known Severe Lateral Spreading Areas)* (December 2017).

APPENDIX A – ALTERNATIVE USE OF LAND IN THE RESIDENTIAL RED ZONE

- 1 The highest and best use of land in the Residential Red Zone is residential, if the land is capable of economic development.
- 2 However, if residential development of the land is not possible, land will still have a value for some alternative use. EQC's valuers consider that another highest and best use is "alternative land use", likely non-residential in at least the medium term.
- 3 EQC has obtained advice from T+T regarding the types of buildings that could be erected on that land.

Requirements for non-habitable structures in areas with severe lateral spreading vulnerability

- 4 Under section 17 of the Building Act 2004, all building work must comply with the Building Code, to the extent required by the Act, whether or not a building consent is required in respect of that building work.
- 5 It is most likely that the types of buildings that could be practically erected on alternative use land would be smaller non-habitable structures.

Importance Level 1 Structures

- 6 Non habitable structures, such as garages, sheds and barns (whether temporary or permanent, movable or immovable structures and any structure intended for occupation by people, animals, machinery, or chattels) are classed as Importance Level 1 (IL1) structures.
- 7 Clause A3 of the Building Code defines IL1 structures as buildings posing low risk to human life or the environment, or a low economic cost, should the building fail. These are typically small non-habitable buildings, such as sheds, barns, and the like, that are not normally occupied, though they may have occupants from time to time.
- 8 Irrespective of whether a non-habitable building requires a building consent, they need to be designed and constructed to achieve certain performance expectation requirements under the Building Code. IL1 structures only need to be designed to meet ULS requirements under the Building Code (which are primarily about life safety) for 100 year return period levels of earthquake shaking, whereas IL2 structures (i.e. houses) need to meet both ULS and SLS requirements (which are about amenity as well as life safety) at 500 and 25 year return period levels of earthquake shaking respectively.
- 9 In order to be able to build IL1 structures on land with severe lateral spreading vulnerability and meet the Building Code ULS performance requirements, the foundations of the structures, or the structures themselves would need to be sufficiently robust to be able to resist being pulled apart, even if the land beneath the foundations stretches in the order of 500mm to 1500mm (the range of lateral stretch expected to occur at ULS levels of earthquake shaking over a 10 m distance). Without a sufficiently robust foundation or structure, the foundation or structure could be pulled apart and the structure may collapse.
- 10 Foundations for a non-habitable structure would need to be specifically designed, as there are no standard solutions for foundations in severe lateral spreading zones. Generally, the larger the building footprint, the greater the contact area between the building footprint and the ground surface, and therefore the greater the stretching

forces applied to the foundations as a result of severe lateral spreading. A structure with a small building footprint (i.e. a 3m x 3m garage) would not need as robust foundation to hold it together as a larger building footprint (i.e. a 9m x 9m garage).

- 11 T+T has indicated the foundation requirements and costs for non-habitable structures of a range of sizes:

Structure size	Foundation type required	Increased cost factor compared to a conventional 100mm thick concrete slab foundation
3m x 3m	Probably TC2	Approximately 1.5 – 3
6m x 6m	Lighter end of TC3	Approximately 3 – 6
9m x 9m	Heavier duty TC3	Approximately 6 – 10
12m x 12m	Foundation systems start to become impractical	

- 12 For rectangular footprints, the orientation of the building is important – e.g. for a 9m x 6m building, if the 9m side is oriented parallel to a river, then the foundations would be more in the order of what is required for 6m x 6m building, but if the 9m side is oriented perpendicular to the river, then the foundations would be more in the order of what is required for 9m x 9m building.

Other structures

- 13 Certain types of structures are not classified as IL1 and therefore would not need to meet the ULS requirements of the building code. These include structures such as shipping containers.