RESIDENTIAL RED ZONE

Interim Land Clearance Treatment Methodology – Version 1.1
Prepared for Canterbury Earthquake Recovery Authority

27 November 2012

Boffa Miskell

Land Information New Zealand
Toitū te whenua

CERA
Canterbury Earthquake Recovery Authority

Document Quality Assurance

Bibliographic reference for citation: Boffa Miskell Limited 2012. *RESIDENTIAL RED ZONE: Interim Land Clearance Treatment Methodology – Version 1.1*. Report prepared by Boffa Miskell Limited for Canterbury Earthquake Recovery Authority.		
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Status: Version 1.1	Revision / version: Version 1.1 Minor text amendments only	Issue date: 27 November 2012 Re-issue date: 29 July 2014

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Template revision: 20120608 0000

File ref: C11109_011f_Land_Clearance_Treatment_Report_20140729

ACKNOWLEDGEMENTS:

Boffa Miskell acknowledges discussions and input from the following people:

- Dr Colin Meurk, Landcare Research - Manaaki Whenua
- Davina McNickel, Team Leader - Contaminated Sites, Environment Canterbury
- Dr Jan Kupec, Chief Geotechnical Engineer, Canterbury Earthquake Recovery Authority
- John O'Dea, Commercial Manager – Infrastructure, Canterbury Earthquake Recovery Authority
- Mathew Clark, Canterbury Earthquake Recovery Authority
- Jeremy Barr, Land Information New Zealand
- Mike Gillooly, Christchurch City Council
- Tom Parsons, Hydraulic Engineer, GHD
- Craig Thompson, Waimakariri District Council
- Rakihia Tau (jnr), Te Awheahwe Ru Whenua
- Aaron Rice Edwards, Te Awheawhe Ru Whenua
- Dr Te Maire Tau, Ngāi Tahu Research Centre (Canterbury University)
- Craig Pauling, Canterbury Earthquake Recovery Authority
- Takerei Norton, Te Runanga o Ngāi Tahu (TRONT)
- Helen Brown, New Zealand Historic Places Trust (NZHPT)

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1.0 Executive Summary

1.1 This report has been prepared to assist with decision making regarding interim land clearance treatment options on Crown-owned residential red zone properties.

CERA's objectives for interim land clearance treatment are practicable clearance, retention of amenity and ecological values where practical, and the implementation of secure, safe, cost effective and easily maintained areas. Interim land clearance treatment options should not impinge or hinder any future land use or remediation.

The key outcomes of this document are to map interim land clearance treatment options for Crown-owned properties in the residential red zone and generally describe the work required to implement the suggested interim land clearance treatment options.

1.2 Determination and advice for interim or future residential red zone land uses or end states is not included within the scope of this report.

Community consultation has not been undertaken to inform this report. CERA shall determine any consultation strategies relating to land clearance treatment options.

1.3 Figure 1 in *Part 3.0 Report Area Location,* displays the extent of residential red zone considered in this report. The report does not consider the Port Hills residential red zone properties.

1.4 A number of assumptions and limitations have been included in the report, these include:

- The report only applies to those properties where the purchase offer from the Crown has been accepted and does not include road reserves, reserves, parks, or commercial properties
- Each residential red zone property has not been individually surveyed by CERA or its agents to inform this report. Specific sites will be visited during the block clearance phase of Crown-owned properties.
- Information gathered by community, academic, local authorities and other professional groups may be included in a future revision of the report if the information is relevant, in a consistent format and within the scope of interim land clearance treatment options.
- The report has been prepared based on the proposed phasing of CERA's Residential Red Zone Crown-owned Property Clearance Project for Crown-owned properties.
- Where information has been supplied by third parties in the form of GIS data, reports and maps, it has not been verified and is assumed to be correct.

1.5 Interim land clearance treatment options, were informed by the following data:

- LiDAR data
- Aerial photographs
- Cadastral boundaries
- Properties settled with the crown
- Soil types

- Groundwater levels
- Geotechnical information
- Existing infrastructure locations
- Contaminated land locations
- Protected and significant tree and street tree locations
- Waterway locations
- Heritage items and sites
- Community facility locations

And considered the following issues:

- Flood prone areas, flood protection and surface flooding
- Current and potential amenity values
- Biodiversity protection and enhancement
- Ongoing maintenance cost and logistics
- Safety and security concerns.

1.6 Six interim land clearance treatment options have been determined by analysis and sample ground checking of the information and issues listed. The interim land clearance treatment options suggested are:

- Treatment Area 1 - Grassland
- Treatment Area 2 – Riparian Buffer Areas
- Treatment Area 3 – Dune
- Treatment Area 4 – Estuarine Edge
- Treatment Area 5 – Wet Areas
- Treatment Area 6 – No Clearance Treatment

The general works required for each interim clearance treatment area are described in Section 6.0, and locations shown on maps included in Appendix 1. Note that the Interim Land Clearance Treatment Report only applies to Crown-owned properties. The maps do not show individual properties that are privately owned to protect the privacy of those individuals.

A Vegetation Retention Methodology has been developed separately, and is included in Appendix 5. In summary this recommends the retention of indigenous trees and shrubs, and the retention of tall trees (>4 or >6 metres depending on the area) throughout the residential red zone

Treatment options for residential red zone/green zone boundaries are also discussed in Section 6.0.

Cultural heritage advice was sought from Te Rūnanga o Ngāi Tahu (TRONT) and the New Zealand Historic Places Trust (NZHPT). This advice has assisted in the development of protocols for accidental discovery of recorded and unrecorded Maori and European archaeological sites in the residential red zone areas. In addition to this Te Rūnanga o Ngāi Tahu provided guidance for the development of options for environmental and ecological enhancements in the residential red zone (attached as Appendix 4). Existing

recorded archaeological sites in the residential red zone areas have been identified and listed in Section 7.0 of this report and locations are mapped in *Appendix 1: Recorded Archaeological Sites.*

1.7 Recommendations in the report include:

- The proposed interim land clearance treatment options, alongside the Vegetation Retention Methodology, are adopted and incorporated into CERA policy.
- Interim and temporary land use options which are consistent with the interim land clearance treatment options described are considered in an appropriate policy and planning framework.
- CERA in conjunction with local consenting authorities, determine the consent requirements to implement the proposed interim land clearance treatment options.
- Further work is needed to develop site specific works specifications and schedules through trial block clearances for the interim land clearance treatment options. These templates should assist to define the scope and quantum of work required for the clearance and clearance treatment of Crown-owned individual blocks.
- Maintenance and weed control specifications and management programmes need to be prepared for each interim clearance treatment option.
- Identifying test blocks for each interim clearance treatment option to assess efficiency and cost effectiveness of the recommended clearance work implementation, including monitoring and a review of the test bock works.
- A further revision of this report may be considered if information supplied by third parties such as community groups, scientists/academics, local authorities and other professional groups is relevant, in a consistent format and within the scope of interim land clearance treatments.
- An archaeological desktop assessment is recommended, unless previous authorities have been granted by NZHPT or previous archaeological assessments have been undertaken. The intention of the desktop assessment is to identify archaeological potential of properties in the residential red zone.

2.0 Introduction

2.1 This report has been commissioned to provide options and advice to CERA (Canterbury Earthquake Recovery Authority) and to guide interim land clearance treatment options in the residential red zone.

2.2 CERA's objectives for interim land clearance treatment are practicable clearance, retention of amenity and ecological values where practical, and the implementation of secure, safe, cost effective and easily maintained areas.

2.3 The interim land clearance treatment options should not hinder or impinge upon any future use or remediation of the Crown-owned residential red zone land.

2.4 Key outcomes of this report are:

- To map the residential red zone areas and show locations of interim land clearance treatment options.
- Recommend interim land clearance treatment options for the Crown-owned properties within the residential red zone. The report identifies interim land clearance treatment areas, and generally describes the works required to implement the suggested interim clearance treatment options.

2.5 This report includes:

- Confirmation of the extent of area to which this report applies
- Assumptions and limitations
- Interim land clearance treatment considerations
- Interim land clearance treatment areas
- Cultural heritage accidental discovery and archaeological sites protocols
- Recommendations

2.6 The scope of this report does not include determination and advice for interim or future residential red zone land uses or end states.

2.7 This report should be read in conjunction with the Residential Red Zone Vegetation Retention Methodology prepared by Boffa Miskell.

3.0 Report Area Location

3.1 The area covered by this report includes all residential red zone areas as at 24 August 2012. The report does not apply to red zone properties on the Port Hills.

3.2 Refer to Figure 1 below for residential red zone extent.

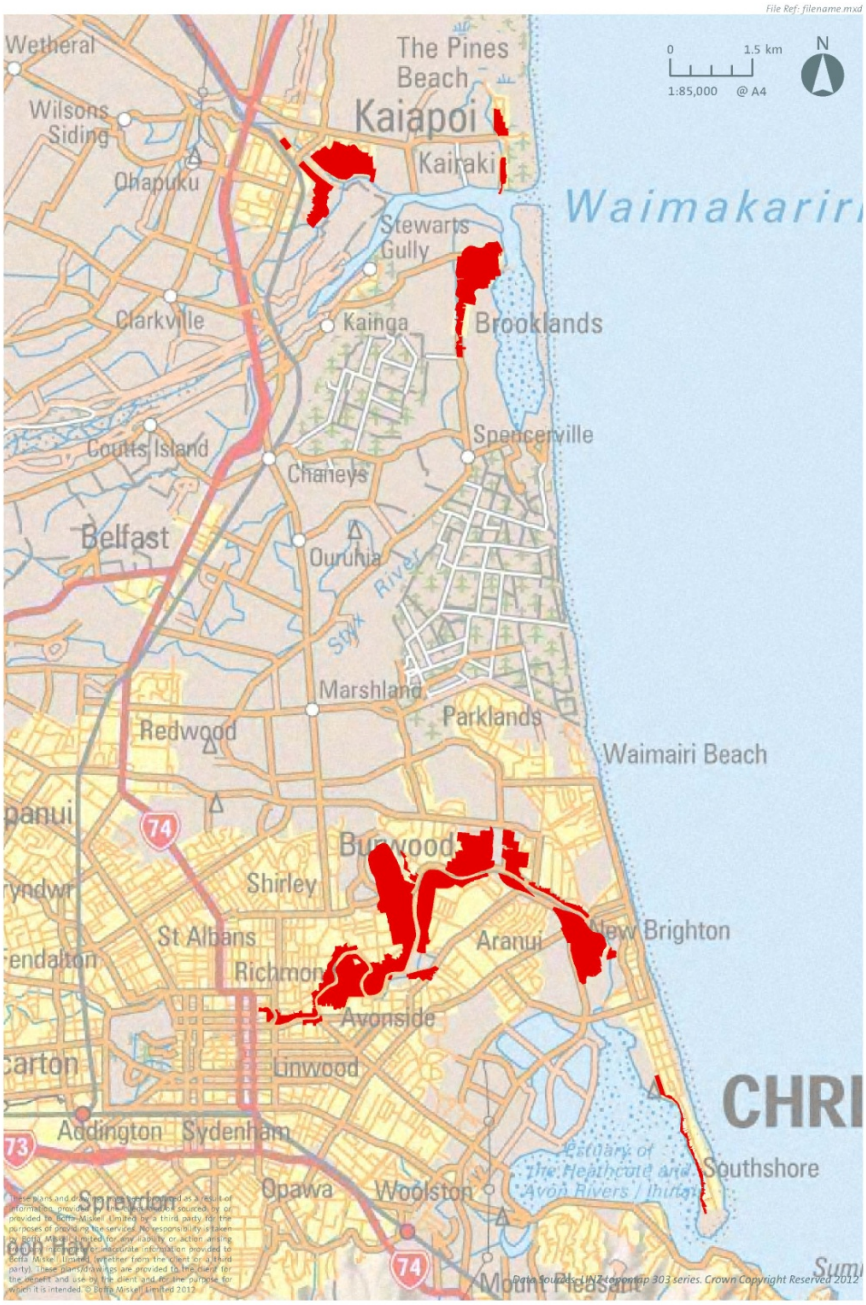

Figure 1: Residential Red Zone Extent

4.0 Assumptions and Limitations

4.1 This report only applies to the properties within the residential red zone where the Crown purchase offer has been accepted. Proposed interim land clearance treatment options are mapped on a block by block basis and information on whether the Crown offer has been accepted by individual property owners is not included.

4.2 The report and interim clearance treatment options described do not apply to the following areas within the residential red zone:

- local authority reserves and parks
- road reserves
- commercial properties
- or any other areas not included in the residential red zone Crown purchase offer as at 24 August 2012.

4.3 This report is prepared on the basis that residential red zone properties have not been individually surveyed by CERA or its agents to inform this report. Specific sites will be visited during the block clearance phase of CERA's Crown-owned property clearance project. A GIS computer programme has been predominantly used to review layers of information relating to the residential red zone. Site visits and ground checking have been undertaken in limited circumstances.

4.4 It is anticipated that some outcomes from survey work done by various community groups, academics, scientists, local authorities and other professional groups interested in the clearance and management of the residential red zone may be incorporated into the interim treatment options. Knowledge and information gathering from these groups has commenced although the exact content of the survey work and suitability of the information gained is still to be established and clarified.

4.5 The owners of properties within the residential red zone are at varying stages of negotiation with the Crown and insurers and access to all properties is not possible.

We understand the phasing of CERA's Residential Red Zone Crown-owned property clearance project to be as follows:

- Phase 1 - Acquisition: Agreement with property owners and the Crown for the sale and transfer of the property to the Crown.
- Phase 2 – Built Structure Clearance: The disconnection of all utilities and the removal of all built structures and foundations.
- Phase 3 – Block Clearance: Removal of garden vegetation (other than that defined in the Vegetation Retention Methodology), shared driveways, residual boundary fences, aggregation of individual properties and conversion to open space areas.
- Phase 4 – Infrastructure Clearance: Removal of redundant public infrastructure, including roads, pedestrian paths, utility infrastructure and implementation of any future land use decisions.

4.6 The advice from this report is to be implemented in Phase 3 – Block Clearance of the Crown-owned property clearance project. Works and design associated with Phase 4 of

the Crown-owned property clearance project may necessitate amendments to this report.

4.7 Where information has been supplied by third parties in the form of GIS data, reports and maps, it has not been verified and is assumed to be correct.

5.0 Interim Land Clearance Treatment Considerations

Introduction

In ascertaining options for proposed interim land clearance treatment in the residential red zones a number of layers of information were considered.

Some information does not directly influence the locations and extent of the proposed treatment areas, but provides information on specific items or areas within the residential red zone. These specific items and areas may impact interim land clearance treatment works and have been identified on the interim land clearance treatment maps.

We have used the ARCGIS computer programme to view and analyse information layers. A geographic information system (GIS) is a system designed to capture, store, manipulate, analyse, manage, and present all types of geographical data. In simple terms, GIS is the merging of cartography, statistical analysis, and database technology that integrates, stores, edits, analyses, shares, and displays geographic information for informing decision making.

Site visits to the residential red zone have been undertaken throughout the project to ground check data that has been reviewed in the ARCGIS computer programme. Predominantly, our ground checking work has been to review the location of surface water and poor draining areas, existing vegetation and soil conditions on cleared sites.

LiDAR

5.1 Using GIS we have been able to undertake analysis of LiDAR data taken above Christchurch in May 2011. From the data we have been able to generally review the land elevation or ground level within the residential red zone after the September 2010 and February 2011 earthquakes.

We have also been able to generally review the change in land elevation or ground level in the residential red zone by analysing the data from May 2011 against previous LiDAR data that was collected above Christchurch in 2003.

LiDAR (light detection and ranging) is an optical remote sensing technology that can measure the distance to, or other properties of a target by illuminating the target with light, often using pulses from a laser. In this case the LiDAR data was gained from an aircraft that was equipped with the necessary technology to gather such data. The work from May 2011 was carried out by AAM Group and is freely available to use under its Creative Commons Licence.

LiDAR data is processed to give an accurate computer model which includes information such as terrain, vegetation and structure heights.

5.2 The LiDAR data supplied was collected before the significant earthquake events on 13 June 2011 and 23 December 2011. In discussion with Dr Jan Kupec, CERA Chief Geotechnical Engineer, we confirmed that the major changes to land elevation occurred in the September and February events and the effects from the June and December events in 2011 were relatively minor. The changes in land elevation and

ground level shown by the LiDAR data collected in May 2011 is considered relevant for analysis of possible interim land clearance treatment options.

We have reviewed the "Canterbury Earthquakes 2010 and 2011 – Land Report as at 29 February 2012", prepared by Tonkin and Taylor for the Earthquake Commission. The ground elevation information and maps shown in this report correspond to the data we have analysed and reviewed.

The Canterbury Earthquakes 2010 and 2011 – Land Report as at 29 February 2012 can be downloaded and viewed from the following webpage:

http://canterbury.eqc.govt.nz/news/reports

5.3 The land elevation and change in land elevation information derived from the LiDAR data are attached as maps in *Appendix 2 – Land Elevation and Change in Land Elevation Maps.*

5.4 When displayed in map form, the land elevation and change in land elevation data indicates the areas within the residential red zone that may be susceptible to localised flooding or ponding when considered with groundwater and soil information.

5.5 Data gained from LiDAR has also been used to establish approximate vegetation height in the preparation of the Vegetation Retention Methodology for the residential red zone.

Aerial Photographs

5.6 In addition to the LiDAR information discussed previously, we have used aerial photographs to analyse properties in the residential red zone.

5.7 As well as the aerial images available through Google Earth and Maps, we have used aerial photos with a resolution of 0.1 metres taken on 24 February 2011 by NZ Aerial Mapping for the Christchurch Response Centre (CRC) and sourced from Koordinates.com/Land Information New Zealand.

5.8 The aerial photos taken on 24 February 2011 show damage from the 22 February 2011 earthquake. In the context of the residential red zone, the aerials are useful when considering ground elevation information from LiDAR. Land damage such as localised flooding and silt from liquefaction is visible.

5.9 The aerial photos also provide a visual record of land use in and around the residential red zone. For example, not all land within the residential red zone in Brooklands and Kaiapoi is built up. Large areas of land have a rural setting and are used for grazing. The extent of these areas can be easily established by viewing the aerial images.

5.10 Aerial photos have also been used as a tool to check information layers as displayed by the GIS computer programme. For example, for this report we have reviewed the positions of protected trees and waterways using aerial photographs.

Cadastre/Properties Settled with the Crown

5.11 Cadastre data, along with the residential red zone boundary, define which residential properties are within the residential red zone. Data such as property boundaries and easements is included with cadastral information.

5.12 We are able to use this information as a base for mapping interim land clearance treatment options using the property and road reserve boundaries to define 'blocks' of clearance treatment areas.

5.13 Cadastre information is Land Information New Zealand authored data. The information detailing which properties have been settled with the Crown has been provided by CERA.

Soils

5.14 We have analysed soil maps for the residential red zone areas. The soil map data reviewed was prepared by Landcare Research - Manaaki Whenua and provided to Boffa Miskell in GIS file format by Environment Canterbury.

5.15 Although the soil structure and strata/horizon has altered in localised sites throughout the residential red zone due to the effects of earthquake phenomena such as liquefaction, consideration of the broad/wide scale soil types in the residential red zone is important for understanding generalised relationships between damage, drainage, and vegetation.

5.16 A range of different soil classification types exist throughout the residential red zone. A brief summary of the soil types, and their drainage characteristics, is:

Pines Beach and Kairaki – Sandy Raw Soils that generally have well drained characteristics.

Kaiapoi East – Typical Sandy Recent Soils and Typical Orthic Gley Soils that have well drained and imperfect drainage characteristics respectively.

Kaiapoi, South of the Kaiapoi River – Mottled Weathered Fluvial Recent Soils that have imperfect draining characteristics.

Brooklands – predominantly Sandy Raw Soils with well drained characteristics.

Southshore – Sandy Raw Soils with well drained characteristics.

Avon Corridor, City/Richmond to the Avonside and Dallington Loops – predominantly Weathered Fluvial Recent Soils close to the river, with Mottled Weathered Fluvial Recent Soils further away from the river edge, with well drained and imperfect draining characteristics respectively.

Avon Corridor, Dallington, Burwood, Avondale, Bexley and New Brighton South of QEII Park – predominantly Typical Recent Gley Soils which have poor draining characteristics. An area of Saline Recent Gley Soils that also have poor draining characteristics underlies part of Bexley. An area of Weathered Fluvial Recent and Mottled Weathered Fluvial Recent Soils with free and imperfect draining characteristics underlies part of Avondale.

Avon Corridor, New Brighton - Sandy Raw Soils with well drained characteristics.

The various soil areas outlined are shown in *Appendix 3 – Residential Red Zone Soil Maps.*

5.17 Soil type and its drainage characteristics should be considered as contributing factors to standing water and localised flooding on properties within the residential red zone.

5.18 This is confirmed by observations made on site. Standing or ponding water and localised flooding has been observed after rainfall in parts of the Avonside Loop, Dallington, adjacent to Horseshoe Lake in Burwood, Avondale, New Brighton south of QEII Park adjacent to the former Kate Sheppard Rest Home, Bexley and Kaiapoi East.

After the significant rainfall on 12 – 14 August 2012, widespread surface flooding was observed in these areas. These areas generally have poorly draining soils, as described above in *Section 5.16*.

5.19 Soil type/landform and drainage characteristics are therefore important in determining interim land clearance treatment options. While most areas analysed should be able to support a simple grassland treatment, some specific areas, such as the steep sand dunes in Pines Beach and low lying poor draining areas, will require alternative interim clearance treatment options.

5.20 We have also reviewed the historic 'Black Maps', which are freely available from the Christchurch City Council website. The Black Maps are a historical record displaying general plant community types and land conditions in Christchurch prior to early European settlement.

While the Black Maps are not accurate when compared to modern digital mapping methods, when considered with current soil maps the information displayed gives historical context and an indication of the natural state of land in the residential red zone prior to European settlement and development.

5.21 The *Christchurch Otautahi Indigenous Ecosystems Maps and Vegetation Species Lists* prepared and published by Lucas Associates, et al, is another source of information that builds upon the information from the Black Maps and soil maps. They are derived from historic and remnant vegetation, and provide an insight to the indigenous plant species that would have grown in many of the residential red zone areas prior to urbanisation. This information has also been considered in the preparation of the vegetation retention methodology and interim land clearance treatment options.

Flood Prone Areas, Flood Protection and Surface Flooding

5.22 Flooding is a risk in the residential red zone due to subsidence in the level of land as a result of the earthquakes. Many areas within the residential red zone are now at a considerably lower level than prior to the earthquakes, when compared to adjacent waterways. Existing rivers, streams and waterways may overtop or break banks, flooding into residential red zone areas. Accordingly, the potential for inundation is an important consideration.

5.23 In June 2012 the Christchurch City Council prepared a Situation Analysis Document for *Flood Risk Arising from the Canterbury Earthquakes*. The situation analysis notes that the existing temporary flood banks in the Lower Avon area have so far performed adequately in 'moderate' tests of the protection system, including rainfall and tidal events. (We note that the temporary flood banks also appear to have performed satisfactorily during the rainfall on 12 – 14 August 2012).

5.24 The situation analysis states that the temporary stop bank systems in the Lower Avon will be retained, monitored and maintained until the Crown-owned residential red zone areas are cleared.

Following future use decisions being made, stop bank locations in the residential red zone may be altered and moved further back from the banks of the Avon. We understand that future options for possible flood protection and stop bank locations are being designed by the Christchurch City Council.

5.25 For the purposes of this report, it is assumed that the existing stop banks will be retained in their current positions. Accordingly, the interim land clearance treatment options and locations described and mapped in this report may need to be amended when future

flood protection design options are completed and confirmed. The suggested clearance treatment options will not cause additional issues if stop banks are relocated at a later date.

5.26 Surface flooding/ponding in a number of residential red zone properties has been observed during ground checking and site visits after rainfall.

In some areas, such as parts of Bexley, Horseshoe Lake at Burwood and New Brighton south of QEII Park adjacent to the former Kate Sheppard Rest Home and East Kaiapoi surface water has been observed extending across property boundaries to form larger areas of localised flooding. Examples of this localised surface-water ponding are shown in Figures 2-5. These areas have similar characteristics of low land elevation, additional subsidence in land elevation as a result of the earthquakes (in many cases the residential blocks are lower lying than adjacent streets), shallow groundwater levels and predominately poor draining soils. In many of these areas simple grassland treatment is unfeasible and alternative interim land clearance treatment options may be proposed.

Figure 2: Surface flooding extending across property boundaries – 189 New Brighton Road, Burwood, 3 August 2012

Figure 3: Surface flooding extending across property boundaries – 1 and 3 Waitaki Street, Bexley, 3 August 2012

5.27 Surface flooding/ponding that is confined to individual residential red zone properties with demolished houses has also been observed during ground checking and site visits after rainfall. Again many of these properties are in areas that have low land elevation, land subsidence, shallow ground water and predominately poor draining soil characteristics. However, as well as some residential blocks lying lower than adjacent streets, we observed that the condition and form of the land left after demolition works is also a contributing factor to ponding we have observed. Often the area of a property that was occupied by a house is lower than surrounding ground levels and has been compacted by machinery used for demolition works and the resulting hollow fills with water.

As part of the interim clearance treatment works, grading, earthworks and shaping is suggested to ensure that the cleared blocks remain as free as possible of surface water. Refer to *Section 6, Proposed Interim Land Clearance Treatment Areas* for further description.

Figure 4: Surface flooding contained within property boundaries – 77 Sewell Street, Kaiapoi, 6 August 2012

Figure 5: Surface flooding contained within property boundaries – 150 Kingsford Street, Burwood, 3 August 2012

Groundwater

5.28 From the site visits and ground checking we have undertaken there is evidence that in some specific locations, shallow ground water levels, in combination with surface flooding/ponding, ground elevation and poor drainage would make a simple grassland treatment unfeasible.

5.29 These areas include parts of Bexley, New Brighton south of QEII Park adjacent to the former Kate Sheppard Rest Home and adjacent to Horseshoe Lake in Burwood. The LiDAR data indicates these areas are predominantly located where ground levels have dropped significantly as a result of the earthquakes (in the range of 0.5 to 1.2 metres in localised areas).

5.30 The Canterbury Earthquakes 2010 and 2011 – Land Report as at 29 February 2012, prepared by Tonkin and Taylor for the Earthquake Commission contains a summary on groundwater levels on a suburb by suburb basis. The groundwater level information discussed in the land report corresponds to the general observations we have made throughout the residential red zone.

Geotechnical

5.31 We met and discussed the proposed interim land clearance treatment project with Dr Jan Kupec, CERA Chief Geotechnical Engineer. We confirmed with Dr Kupec at the meeting that LiDAR data taken in May 2011 is sufficient for the analysis and consideration of interim land clearance treatment options in the residential red zone.

5.32 Aside from the obvious land changes, such as change in land elevation and lateral spread, there are no underlying geotechnical factors that should influence interim clearance treatment options such as grassland or wetland planting.

Existing Infrastructure

5.33 Existing infrastructure including stormwater, wastewater, potable water, roading, telecommunications, street lighting and above and underground power lines have been considered in the analysis of the interim land clearance treatment options for the residential red zone.

5.34 We have received data from the Christchurch City Council and Waimakariri District Council showing the locations of public utility stormwater, wastewater and potable water lines. We have not been able to gain power line data from Orion or telecommunications data. This data will need to be sourced from the service providers prior to CERA's Phase 3 and 4 works.

5.35 As stated in CERA's Residential Red Zone Property Clearance Programme Standard Operating Procedures, as part of Phase 2 Built Structure Clearance, all services within Crown-owned residential red zone properties are to be removed within the property and capped at the property boundary.

It is assumed that all services will be removed from residential properties prior to the commencement of Phase 3 Block Clearance and implementation of interim land clearance treatment options.

5.36 The 4th Phase of CERA's Crown-owned property clearance project includes the removal of redundant public Infrastructure including roads, pedestrian paths and utility

infrastructure (such as stormwater, wastewater, power, street lighting and telecommunications).

Decisions regarding which infrastructure is redundant are still to be made. We understand that the disestablishment of public infrastructure shall be negotiated between CERA, Christchurch City Council, Waimakariri District Council and various service providers.

For the purposes of this report we assume the current public infrastructure will remain in place until future decisions are made regarding disestablishment. When infrastructure such as stormwater drainage and roading is disestablished, amendment to the interim land clearance treatment areas may be required and in specific locations further design may be required.

Contaminated Land

5.37 Contaminated land data has been provided by Environment Canterbury. The data provided shows 'HAIL' (Hazardous Activities and Industries List) sites in the residential red zone. HAIL sites are shown on the interim land clearance treatment option maps. Refer to *Appendix 1 – Interim Land Clearance Treatment Area Maps.*

5.38 The Ministry for the Environment website notes that *"The Hazardous Activities and Industries List (HAIL) is a compilation of activities and industries that are considered likely to cause land contamination resulting from hazardous substance use, storage or disposal. The HAIL has grouped similar industries together which typically use or store hazardous substances that could cause contamination if these substances escaped from safe storage, were disposed of on the site, or were lost to the environment through their use. The HAIL is intended to identify most situations in New Zealand where hazardous substances could cause, and in many cases have caused, land contamination."*

Refer to the Ministry for the Environment website for more information on HAIL sites: http://www.mfe.govt.nz/issues/hazardous/contaminated/hazardous-activities-industries-list.html

5.39 The issue of contaminated land has been discussed with Davina McNickel, Environment Canterbury Team Leader for Contaminated Sites. From this it has been established that:

- Under the National Environmental Standard, earthworks or clearance of HAIL sites may trigger a requirement for testing for levels of contamination. This will generally occur when clearing or earthworks in an area become larger than a standard size single residential property.
- In normal circumstances a resource consent would be required for this work; however, CERA may apply, or may have already applied for a global consent that covers work in all HAIL areas in the residential red zone.
- Different levels of contamination are acceptable for open space/green field areas compared to residential areas and other development. As residential properties purchased by the Crown are cleared and become an open space, the allowance for contamination levels is likely to be higher than if the areas were retained or redeveloped as residential areas.

5.40 Environment Canterbury has also undertaken preliminary testing of land in the Horseshoe Lake area north of Liggins Street, to determine if there is risk to human health from the demolition of houses. The testing was not detailed enough to evaluate risk to health from long term use of the site. The site tested has a history of horticultural use and contains A10 HAIL sites.

Samples for the tested area were analysed for a range of heavy metals and persistent organochlorine pesticides. While some samples indicated a presence of these, it was the opinion of Brett Mongillo, Environment Canterbury Principal Contaminated Sites Advisor, that it would be highly unlikely that stockpiling, sorting and processing of Christchurch area earthquake demolition debris within the Horseshoe Lake subdivision would result in the contamination of that material.

5.41 HAIL sites in the residential red zone include unverified, verified, investigated and partially investigated sites. Recorded HAIL sites occurring within the residential red zone include:

- A10 - Persistent pesticide bulk storage or use including sport turfs, market gardens, orchards, glass houses or spray sheds
- A17 - Storage tanks or drums for fuel, chemicals or liquid waste
- A18 - Wood treatment or preservation including the commercial use of anti-sapstain chemicals during milling, or bulk storage of treated timber outside
- D3 - Metal treatment or coating including polishing, anodising, galvanising, pickling, electroplating, or heat treatment or finishing using cyanide compounds
- E4 - Commercial concrete manufacture or commercial cement storage
- E5 - Coal or coke yards
- F3 - Engine reconditioning workshops
- F4 - Motor vehicle workshops
- F7 - Service stations including retail or commercial refuelling facilities
- G3 - Landfill sites
- G4 - Scrap yards including automotive dismantling, wrecking or scrap metal yards
- G5 - Waste disposal to land (excluding where biosolids have been used as soil conditioners)
- G6 - Waste recycling or waste or wastewater treatment

5.42 Depending on the level of contamination on tested sites, treatment of the contaminated land may be required. A possible scenario is that former land fill sites may need to be capped before any interim land clearance treatment options can be advanced. Another scenario is that HAIL sites in 'Wet Area' treatment areas may need specific treatments, due to inundation by water, that may not be required in other interim clearance treatment areas

5.43 We suggest that a procedure for testing and determining the consents required to manage HAIL sites/contaminated land in the residential red zone needs to be developed by CERA, Environment Canterbury, Christchurch City Council and the Waimakariri District Council. Once the appropriate level of testing HAIL sites is determined, further design options to adequately treat land contamination may need to be investigated by CERA.

5.44 We envisage that any specific treatment of contaminated sites within the residential red zone will need to be completed prior to interim land clearance treatment options being implemented.

Protected, Significant and Street Trees

5.45 GIS data layers were sourced from the Christchurch City Council and Waimakariri District Council that show the locations of protected, significant and street trees. This information has been used for the preparation of this report and the Vegetation Retention Methodology.

5.46 Many of the significant and street trees are located in road reserves, parks and reserves. These areas are outside the scope area of this report and the Vegetation Retention Methodology. We note that these will need to be considered during Phase 4 – Infrastructure Clearance. Where protected and significant trees do occur in residential properties within the residential red zone, they are shown on the interim land clearance treatment option maps. Refer to *Appendix 1 – Interim Land Clearance Treatment Area Maps.*

5.47 Refer to the Vegetation Retention Methodology prepared by Boffa Miskell for information regarding the retention of protected and significant trees.

Waterways

5.48 The location of waterways such as streams, creeks, open drains, and rivers has been considered as part of the interim clearance treatment option work. Waterway data in GIS format has been supplied by Christchurch City Council and Waimakariri District Council

5.49 As previously discussed in this section, flooding and standing water are wider issues within the residential red zone.

5.50 The locations of lesser known streams, creeks and open drains are is an important part of the analysis of possible interim land clearance treatment areas. A specific riparian buffer treatment for residential red zone land adjacent to waterways is discussed in *Section 6.0* of this report.

Heritage Items and Sites

5.51 There are few Maori or European heritage items and sites in the residential red zone listed by the Christchurch City Council and Waimakariri District Council and registered by the New Zealand Historic Places Trust (NZHPT).

5.52 In order to gain a comprehensive understanding of the cultural landscape and the layers of historic settlement in the residential red zone areas, we actively engaged Te Rūnanga o Ngāi Tahu (TRONT) and the New Zealand Historic Places Trust (NZHPT) to confirm items and areas of cultural significance to Ngāi Tahu. *Appendix 4 – Areas of Cultural Significance to Ngāi Tahu in the Christchurch Residential Red Zones* is a scoping document that outlines areas of significance to Ngāi Tahu and discusses aspirations for the future of the resid*ential red zone areas.*

*Section 7 of this report responds to the cultural areas and recorded archaeo*logical sites identified in the scoping report. Advice on accidental discovery during clearing and clearance treatment works and specific treatment advice for recorded sites is included.

5.53 The following properties in the residential red zone are listed in the Waimakariri District Council and Christchurch City Council City district and city plans as being heritage items. *(Figure 6)*

The listed heritage items are shown on the interim land clearance treatment option maps. Refer to *Appendix 1 – Interim Land Clearance Treatment Area Maps.*

Policy on the treatment of the listed heritage items needs to be confirmed by CERA, New Zealand Historic Places Trust, Christchurch City Council and Waimakariri District Council.

WDC/CCC Plan ID	Site Address	Name	NZHPT Register Number	Legal Description
H016	52 Sewell Street, Kaiapoi	Cottage	3757 Cat II	Pt RS 320
H021	14 Beswick Street, Kaiapoi	House	3819 Cat II	Lot 4 DP 23453
H029	56 Sewell Street, Kaiapoi	Old St Paul's Manse	5431 Cat II	Lot 3 DP 5089
H102	56 Cass Street, Kaiapoi	Cherryvale	n/a	Lot 1 DP 56058
600	11 Retreat Road, Christchurch	MED Substation	n/a	Lot 1 DP 30333
468	73 River Road, Christchurch	Single Storey Villa	n/a	Lot 1 DP 5722

Figure 6: CCC and WDC Heritage Listed items in the residential red zone

5.54 As stated in the '*Assumptions and Limitations'* section of this report, information gathered by community groups, scientists, academics, local authorities and other professional groups may be included in a future revision of this report.

Depending upon the exact content of the survey work and suitability of the information supplied, other heritage areas or items that are not officially listed that could be retained may become known. These may include:

- Individual significant trees
- Groups of significant trees or vegetation
- Gardens with heritage or historic value

5.55 Information from any group is yet to be completely gathered, formalised into a database, or analysed. Guidelines have been provided to the Avon Otakaro Network on the best format to collect data in order for it to be considered for interim land clearance treatment. A further revision of this report may be considered if the information supplied is relevant and is within the scope of interim land clearance treatment options.

Biodiversity and Sites of Ecological Value

5.56 None of the sites of specific ecological value (e.g., 'Ecological Heritage' or 'Vegetation and Habitat' sites) listed within the Christchurch City or Waimakariri District Plans are within the residential red zone.

5.57 There are, however, a number of Ecological Heritage sites adjacent to residential red zone areas listed in the Christchurch City Plan, including:

- Waimakariri River to South Brighton Spit
- Pūharakekenui/Styx River mouth, Brooklands
- Waikākāriki/Horseshoe Lake

- Ōruapaeroa/Travis Wetland
- Cockayne Reserve
- Te Ihutai / Avon-Heathcote Estuary

5.58 No 'Vegetation and Habitat' sites listed in the Waimakariri District Plan are adjacent to residential red zone areas.

5.59 Other areas identified as 'natural features' in the Christchurch City Plan that are adjacent to residential red zone areas also have values as habitat for biodiversity. These include:

- Ōtākaro/Avon River
- Pūharakekenui/Styx River
- Waitākiri/Bottle Lake Reserve
- Te Huinga Manu Wildlife Refuge
- Te Riu o Te Aika Kawa/Brooklands Lagoon

5.60 These sites and their associated ecological values have been taken into account during the development of the Interim Land Clearance Treatment Methodology. It is also noted that the above sites, including the Ōtākaro/Avon River and Estuary (Te Ihutai), were used and regarded as highly prized mahinga kai areas and utilised for food and resource gathering. Taonga species traditionally gathered from these areas included tuna (eel), inanga (whitebait), waikōura (freshwater crayfish), kanakana (lamprey eel), and pūtakitaki (paradise duck). Customary activities in these areas continue today and Ngāi Tahu communities are particularly interested in maintaining the integrity of these habitats.

5.61 Biodiversity values occur to varying degrees in the gardens of the residential red zone. In order to retain the key elements of these values the Vegetation Retention Methodology (attached as Appendix 5) recommends the retention of indigenous trees and shrubs throughout the residential red zone and retention of tall exotic trees. This vegetation provides habitat for a range of indigenous and introduced wildlife.

5.62 The proposed interim land treatment options will not adversely affect the ecological values of the residential red zone areas. Furthermore, the proposed interim land clearance treatment options may enhance habitat and biodiversity adjacent to these areas of high value through removal of weed species and retention and planting of indigenous vegetation.

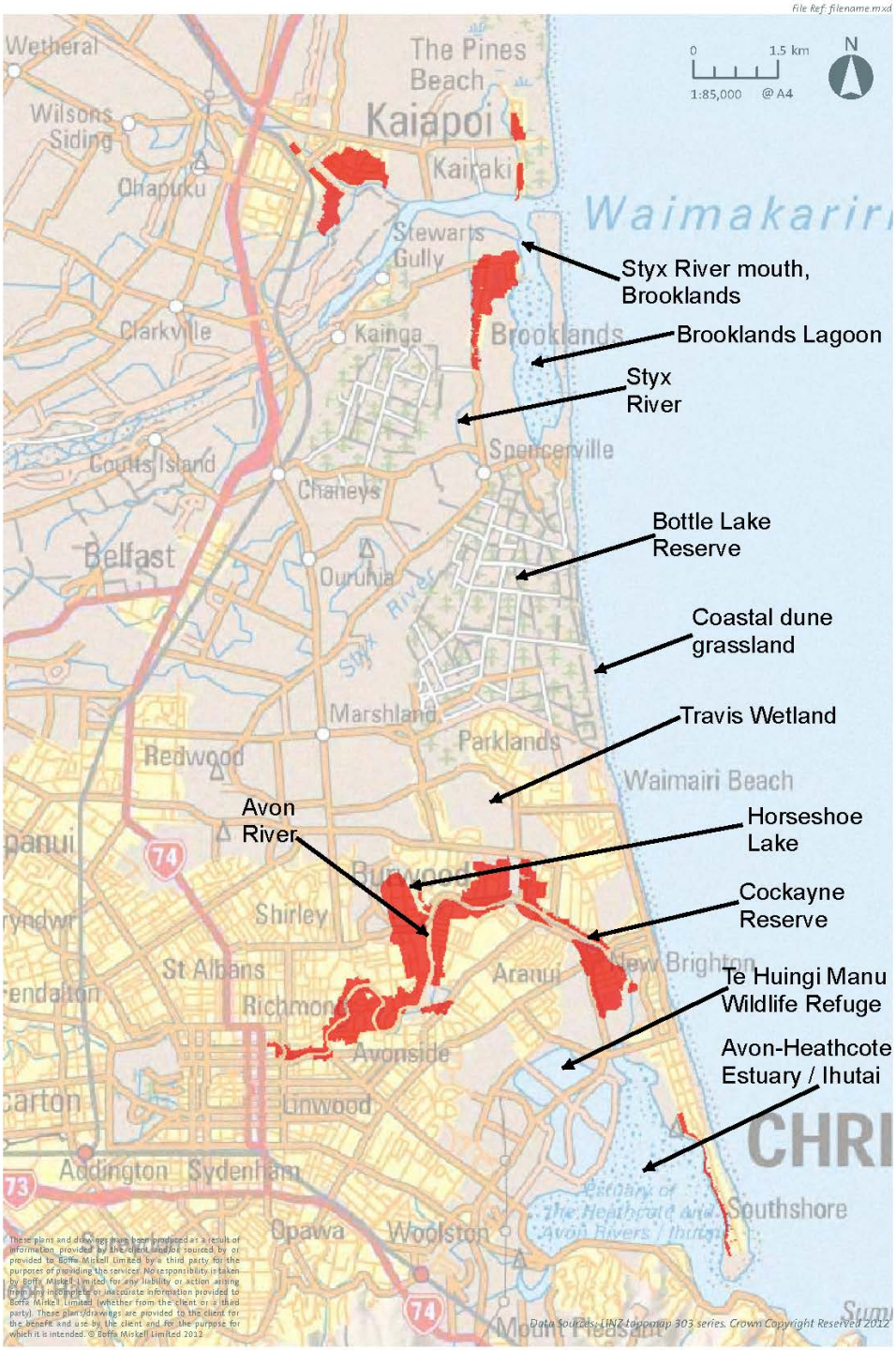

Figure 7: Ecological Heritage Sites and Natural Features in the vicinity of the Residential Red Zone.

Community Facilities

5.63 The location of community facilities within and adjacent to the residential red zone including recreation facilities, parks and reserves, walkways, schools have been analysed. These facilities are not included in the scope of this report, but we have reviewed the various locations in relation to the residential red zone properties.

Amenity

5.64 The amenity value of the interim land clearance treatment options for the residential red zone has been considered. 'Amenity' is a subjective matter, however the 'cleared' appearance of residential red zone is important, particularly those areas that are located in close proximity to remaining green zone areas.

5.65 Many residents who occupy properties in green zone areas adjacent to the residential red zone are currently living with significant disruption to their lives and will continue to do so for years to come. Where highly visible from green zone areas, interim clearance treatment of the Crown-owned residential red zone needs to be aesthetically pleasing and well maintained.

5.66 Areas immediately proximal to occupied residences should be tidy, but more distal sites – behind the tidy border may be allowed to develop and regenerate – partly to provide undisturbed areas for wildlife, to allow natural regeneration to occur and to avoid higher maintenance costs. Alternative approaches to vegetation maintenance, such as sheep-grazing, could be considered.

Ongoing Maintenance

5.67 Ongoing maintenance of the Crown-owned residential red zone areas after clearance of structures and hard surfaces has been considered. The labour requirement and cost involved in maintaining the cleared Crown-owned residential red zone properties will be significant.

5.68 Maintenance tasks will likely include weed control, mowing, and care of retained vegetation.

5.69 As discussed in point 5.67, alternative approaches to maintaining the Crown-owned residential red zone may assist in providing cost effective maintenance options. A more intensive maintenance regime will be required in interim clearance treatment areas (particularly grassland areas) adjacent to residential green zone areas. Where Crown-owned residential red zone areas are more isolated and less visible to adjacent occupied residential areas, sheep grazing should be considered as a low cost maintenance option.

Some of the proposed interim clearance treatment areas described in Section 6.0 of this report includes planting as a partial treatment option. While the upfront costs for planting and initial maintenance will likely be more a simple grassland treatment, the maintenance cost reduces over time as the planting establishes.

5.70 Maintenance requirements for the interim land clearance treatment areas will also be determined by the interim use of the land. Maintenance strategies for specific sites will need to be confirmed when interim uses are confirmed.

Weed Control and Risk

5.71 Weed risk is greatest where maintenance in the form of mowing or grazing does not occur, including riparian buffer areas and within other interim clearance treatment areas where patches of vegetation are retained or planted.

5.72 For these areas a monitoring and control regime should be scheduled. Further site specific specification of the monitoring and controls may be required to establish the frequency and quantum of weed control work required for individual areas.

5.73 The Canterbury Weed Calendar, included as an appendix to the Vegetation Retention Methodology, attached as Appendix 5 of this report, identifies weed species that need to be monitored in the Canterbury region. In addition to the species noted in the Weed Calendar, the following species have particular potential to threaten biodiversity restoration in the residential red zone urban setting. Greater awareness and control of these species may be required:

- *Acer psuedoplanatus* – sycamore
- *Cotoneaster* species
- *Crataegus monogyna* - hawthorn
- *Hedera helix* - ivy
- *Ilex aquifolium* – holly
- Palm species
- *Prunus* species
- *Rubus fruticosus* - blackberry
- *Taxus baccata* – yew
- *Tradescantia fluminensis* – wandering jew

5.74 In wetland/wet areas *Salix* species (willow) and *Iris pseudacorus* (yellow flag iris) are particular weed threats that will need to be monitored.

5.75 In the dune and estuarine areas *Ulex europaeus* (gorse), *Cytisus* species (broom) and *Chrysanthemoides monilifera* (boneseed) are particular weed threats that will need to be monitored.

Safety and Security

5.76 Safety and security of residents living adjacent to and still living in the residential red zone have been considered. We have reviewed the Ministry of Justice *National Guidelines for Crime Prevention though Environmental Design in New Zealand – part 1: Seven Qualities of Safer Places.*

There are four key CPTED (Crime Prevention through Environmental Design) principles described in the guidelines that have relevance to the interim land clearance treatment options for the residential red zone:

- Surveillance – people are present and can see what is going on.
- Access Management – methods are used to attract people and vehicles to some places and restrict them from others.

- Territorial Reinforcement – clear boundaries encourage community 'ownership' of the space.
- Quality Environments – good quality, well maintained places attract people and support surveillance.

The guidelines also describe seven qualities that characterise well designed, safer places:

- Access: Safe Movement and Connections - Places with well defined routes, spaces and entrances that provide for convenient and safe movement without compromising security.
- Surveillance and Sightlines: See and be Seen - Places where all publicly accessible spaces are overlooked, and clear sightlines and good lighting provide maximum visibility.
- Layout: Clear and Logical Orientation - Places laid out to discourage crime, enhance perception of safety and help orientation and wayfinding.
- Activity Mix: Eyes on the Street - Places where the level of human activity is appropriate to the location and creates a reduced risk of crime and a sense of safety at all times by promoting a compatible mix of uses and increased use of public spaces.
- Sense of Ownership: Showing a Space is Cared For - Places that promote a sense of ownership, respect, territorial responsibility and community.
- Quality Environments: Well Designed, Managed and Maintained Environments - Places that provide a quality environment and are designed with management and maintenance in mind to discourage crime and promote community safety in the present and the future.
- Physical Protection: Using Active Security Measures - Places that include necessary, well designed security features and elements.

The qualities of *Surveillance and Sightlines, Sense of Ownership: Showing a Space is Cared For, Quality Environments: Well Designed, Managed and Maintained Environments,* and *Physical Protection, Using Active Security Measures* are particularly relevant to the proposed interim land clearance treatment options.

5.77 Casual surveillance of the residential red zone from neighbouring green zone areas is a factor that may assist in improving security and safety in the residential red zone.

5.78 Maintenance of Crown-owned residential red zone land is discussed in *Section 6.0* of this report. Sense of ownership by surrounding communities and ensuring that the land is well maintained are key issues in retaining an acceptable level of amenity, safety and security.

5.79 Continuous groups of low and concealing vegetation and other structures create cover and 'hiding' opportunities. Vegetation that is retained should not inhibit observation of red zone areas by neighbouring residents, the Police or security contractors. However, where observation is not required, natural regeneration may be encouraged to enhance wildlife values.

5.80 Retention of large amounts of low planting, grasses and groundcovers also provides fuel for fire, which is a consideration that CERA and the New Zealand Fire Service have

already identified and are managing. Sheep grazing to reduce fire risk may be an appropriate vegetation management tool in places.

5.81 Refer to the Vegetation Retention Methodology prepared by Boffa Miskell for information regarding the vegetation retention.

6.0 Proposed Interim Land Clearance Treatment Options

Introduction

6.1 Proposed interim clearance treatment options have been assigned to Crown-owned land in the residential red zone land based on the considerations outlined in the previous section of this report.

6.2 Based on our analysis the physical environment of much of the residential red zone will support a grassland treatment. This treatment is based on retention of some existing vegetation including some trees and shrubs as well as lawns undisturbed by demolition works.

6.3 Grassland treatment meets the CERA objectives of practicable clearance, retention of amenity and ecological values where practical, and the implementation of secure, safe and cost effectively maintained areas.

6.4 Through analysis, areas have been identified that will not support a simple grassland treatment and alternative treatment options are recommended. Specific soil condition, locations, drainage and standing water are predominant factors in determining alternative treatment options.

6.5 The proposed interim land clearance treatment options proposed are:

- Treatment Area 1 - Grassland
- Treatment Area 2 – Riparian Buffer Areas
- Treatment Area 3 – Dune
- Treatment Area 4 – Estuarine Edge
- Treatment Area 5 – Wet Areas
- Treatment Area 6 – No Clearance Treatment
- Residential Red Zone/Green Zone Edge Treatment Options

The following subsections generally describe the work required in each treatment area as block clearances are completed.

6.6 It is noted that future implementation of all treatment area types will include the retention of vegetation as outlined in the Vegetation Retention Methodology. In summary this includes the retention of indigenous trees and shrubs throughout the residential red zone and retention of tall exotic trees (>4 or >6 metres depending on the area).

6.7 Cultural Heritage Treatment requirements are outlined in *Section 7.0* of this report.

Treatment Area 1 – Grassland

INTRODUCTION

6.8 Treatment Area 1 is the predominant proposed treatment type in the residential red zone.

6.9 A grassland treatment option of cleared residential blocks adequately meets CERA's objective of retaining amenity value and ecological values where possible, while still enabling security, safety and maintenance. In terms of potential interim uses, grassed surfaces offer a number of versatile options.

6.10 Impervious surfaces currently constitute an estimated 50-60% of the residential red zone (based on a visual analysis of aerial photos). These comprise houses, garages, sheds, driveways and paved areas. The remainder of the land is in lawn and garden.

6.11 The 50-60% of hard surface will become managed grassland. The lawn will remain as grassland. Some of the garden area, which includes herbaceous borders and other garden plantings, will become grassland and the indigenous trees and shrubs and tall exotic trees will remain (as defined in the Vegetation Retention Methodology, Appendix 5).

6.12 The interim land clearance treatment options have the potential to:

- Improve water quality in local waterways. Rainwater will infiltrate straight to ground and be filtered through the soil prior to reaching any surface waterways (other than during periods of surface water flooding when the water may drain to the street and into remaining infrastructure).
- Assist in flood management in the Avon River catchment through slower movement of water from the red zone into the adjacent waterways.
- Provide additional habitat for animal species that inhabit parks and gardens. Some food sources will be removed through removal of herbaceous vegetation and exotic shrubs, but the overall increase in open grassland, reduction in human disturbance and the retention of indigenous trees and shrubs, and tall exotic trees may increase the abundance of existing animal species. This may also encourage visitation by other bird species, such as bellbirds.
- Reduce the diversity of herbaceous vegetation and exotic shrubs, but correspondingly increase the proportion of indigenous plants particularly with specific plantings in the wet areas, estuarine edge and dune areas.
- Improve the connectivity between above and below ground ecosystems.

6.13 Development of the cleared residential blocks of Crown-owned land as grassland will not limit any interim land use or future development options in those particular areas.

TREATMENT AREA 1 LOCATIONS

6.14 Grassland is proposed as the interim clearance treatment to a large number of areas within the residential red zone, including areas in the suburbs of:

- Richmond
- Avonside
- Dallington

- Wainoni
- Avondale
- Burwood
- New Brighton
- Bexley
- Southshore
- Brooklands
- Kaiapoi
- Pines Beach
- Kairaki

6.15 Refer to *Appendix 1 – Interim Land Clearance Treatment Area Maps* for Treatment Area 1 locations.

SURFACE FLOODING AND PONDING

6.16 As part of CERA's objectives for safety and security, residential properties should be kept free of standing water for health and safety reasons. As stated in *Section 5 Interim Land Clearance Treatment Considerations*, surface flooding and ponding has been observed in various locations in the residential red zone during periods of heavy rainfall.

6.17 Due to the low lying land, high water table and poor draining soil characteristics of many of the residential red zone areas some surface flooding and ponding is inevitable during periods of significant rainfall (such as those that occurred on 12 – 14 August 2012). Water that stands for an extended period of time may impact on the viability of grassed areas. To help to reduce the length of time surface water stands on the residential properties, areas that are to be grassed should either be free draining, or where not free draining, be graded towards drainage infrastructure where possible.

6.18 It needs to be noted however that grading cleared blocks towards an adjacent road reserve or drainage infrastructure can only be considered a temporary measure. It is also acknowledged that the stormwater infrastructure in the residential red zone has been compromised by earthquake damage.

We understand that until the future of public infrastructure, such as roads and stormwater drainage, is determined the issue of surface flooding cannot be completely resolved. As decisions are made, design options for the drainage of wider areas within the residential red zone will be considered.

6.19 As previously discussed in this report, there are a number of contributing factors to surface flooding and ponding of water in the residential red zone. The condition and form of the land left after demolition works is a contributing factor to ponding that can be controlled and mitigated. The grade and height of land in relation to adjacent streets can also be mitigated to a certain extent.

Hollows and depressions left in individual properties after demolition works could be filled to minimise ponding and lower lying blocks may be able to be filled and graded towards stormwater drainage infrastructure.

6.20 The extent of filling and grading is difficult to accurately quantify from the wide scale analysis undertaken for this project. Until all of the houses and structures are removed, the extent of subsidence on individual properties is unknown.

TREATMENT AREA 1 WORKS

6.21 It is anticipated that the interim land clearance treatment options will be implemented as part of CERA's Residential Red Zone Crown-owned property clearance project, Phase 3 Block Clearance work.

Prior to Phase 3 work commencing, all services/utilities within Crown-owned residential red zone properties are to be removed and disconnected, with built structures and foundations removed.

Generally, prior to the implementation of interim land clearance treatment options, Phase 3 work will include removal of garden vegetation (other than vegetation to be retained, as per the criteria of the Vegetation Retention Methodology), shared driveways, other paved areas, swimming pools and residual boundary fences and aggregation of individual properties.

In addition to retained vegetation, remaining lawn areas that have not been impacted by demolition works should be retained. Retention of these lawn areas within the wider grassland treatment option will minimise the need for further works.

6.22 The following works will generally be required to implement the interim clearance treatment grassland option:

- Removal of any further hard objects in areas to be grassed, such as stumps, garden walls, etc should be removed and recycled as appropriate.
- Many properties have a significant coverage of aggregate that is a remnant of concrete slab foundations. In most situations the aggregate could be easily covered with a suitable depth of topsoil material (100 to 150mmm depth) without significantly altering the surface profile of the subject property. In fewer situations, the top layer (100 to 150mm depth) of existing aggregate may need to be scraped and removed from the subject site and replaced with topsoil. This may mean that the aggregate is moved to other locations within the block that is being cleared to fill holes and depressions.
- Minor earthworks, grading and screening the top layer of soil may be required for the filling of hollows and depressions and should be carried out to reduce ponding of surface water during rainfall. Where required, grading and levelling should fall levels towards adjacent streets and stormwater drainage infrastructure where possible. Screening of the top layer of soil is carried out to remove as much foreign material, such as left over demolition debris, rocks, etc, as possible.
- It is possible 'topsoil' material for filling and grading works described above may be able to be reused from the land remediation works required for residential TC3 properties. This may be preferable to purchasing or acquiring soil from other locations such as new subdivision developments. Any soil gained from TC3 properties for use within the residential red zone would need to be checked for contamination.
- Following grading and screening of the soil surface of a cleared block, grass seeding should proceed. Two suggested options for applying seed to cleared blocks are direct drilling and hydroseeding. Both methods have advantages and limitations:

Direct Drilling:

Application Method:

Application of grass seed at 15 grams per square metre by direct drilling machine into exposed topsoil/subsoil areas.

Advantages:

Cost effective, a good option for when larger areas are cleared.

Disadvantages:

Irrigation required on establishment (unless carried out in spring or autumn), seed may not take if high winds occur before establishment, effectiveness less on poor soils, and difficult to use machinery in small areas.

Practicality:

Not practical to apply in small areas due to size of machinery and likely uneven ground levels. Practical in large open areas where the ground is relatively level.

Effectiveness:

Effective after approximately 6 weeks establishment period. Possibly less effective in areas affected by liquefaction silt.

Cost:

Approximately $1.50 per square metre install price.[1]

Maintenance:

Irrigation required on establishment (unless carried out in spring or autumn).

Hydroseeding:

Application Method:

Application of wood fibre hydroseeding mixture with grass seed, tackifiers, soil stabilisation and dust reduction additives, over area of exposed topsoil/subsoil.

Advantages:

Hydroseed mix is effective in providing dust mitigation until grass establishes and can be applied to poorer topsoil.

Disadvantages:

Irrigation required on establishment (unless carried out in spring or autumn).

Practicality:

Practical to apply in small and large areas and unusual shapes.

Effectiveness:

Hydroseed mix effective after approx 6 hrs and grass effective after 6 weeks.

Cost:

[1] Cost estimates above are subject to scale/quantity of works and are to be used as a guide only. Cost estimates above do not include earthwork, grading, screening, or maintenance costs such as mowing, weed control or irrigation.

Approximately $1.80 per square metre install price.[1]

Maintenance:

Irrigation required on establishment (unless carried out in spring or autumn).

Alternatively, a hydroseed application that includes rubber fibre in the application mix is available. This mix can provide dust mitigation for up to a year if not disturbed by vehicles. Irrigation requirements are also less than a regular hydroseed mix, with the rubber mix being viable for up to a year. Remnant rubber fibre, and its impact on the land the mix has been applied to, is an issue that needs to be considered prior to specification and use. Approximate cost of this method is also higher at approximately $2.00 per square metre.

- Hand broadcasting of seed could be considered in small areas that have minimal ground disturbance.
- Irrigation of the seeded areas may be required depending on the season that the work is carried out. Watering of newly seeded grassed areas will be required during summer. The method and design of irrigation needs to be established on a block by block basis, but could include temporary systems and the use of water trucks.
- Other works, that are particular to specific sites, such as the protection of springs or wells, may be required. Any additional treatment required to protect and isolate springs and well will depend on their location and condition. Some may be able to be left untreated, others may require buffer fencing or planting. Potential use of wells for water supply for use in the interim clearance treatment areas would need to be discussed and approved with Environment Canterbury.

  We note that while the interim land clearance treatment option plans show well and bore locations, not all actual locations are known, recorded and mapped.
- Maintenance of grassed areas will also be required. A limited maintenance regime may be required for land that might be grazed. A more intensive maintenance regime may be required for areas that need to be mowed and may include litter collection and weed control.
- We envisage that grazing would be light grazing by sheep. Other animals such as goats and cattle are not considered as suitable as sheep, due to the damage they may cause retained vegetation.
- Grazing of residential red zone land, however, must not result in the degradation of adjacent waterways.

6.23 The exact scope and quantum of works required for grassing each cleared block will vary. Specifying and scheduling the required works for each site specific block is beyond the scope of this report, but should be considered as the next step in documenting interim land clearance treatment works in the residential red zone.

Treatment Area 2 - Riparian Buffer

INTRODUCTION

6.24 Treatment Area 2 –Riparian Buffer are the same as those shown in the Vegetation Retention Methodology. Refer to *Appendix 1 – Interim Land Clearance Treatment Area Maps for* Treatment Area 2 locations.

6.25 The Riparian Buffer areas provides for a 5m wide buffer zone along Crown-owned property boundaries with a stream or waterway.

6.26 Retaining vegetation adjacent to waterways is an option that adequately meets CERA's objective of retaining amenity value and ecological values where possible, while still enabling security, safety and maintenance.

6.27 Retention of vegetation along the margins of waterways will not impinge any future development of those particular areas. In addition to bank stabilisation and reducing sediment transportation into waterways, the retention of vegetation in the buffer areas shown on the plans will also help retain some ecological and biodiversity values, of the existing riparian margins along waterways.

6.28 The primary purpose of the Riparian Buffer is to provide protection to streams and waterways from clearance and ongoing works.

6.29 Notwithstanding the demolition and clearance contractor's obligations to CERA and local government authorities to provide sediment and erosion control, retention of vegetation in the buffer areas will help to stabilise banks and reduce the potential for runoff and sediment to enter waterways.

6.30 The *Ngāi Tahu Freshwater Policy Statement 1999* sets objectives for improving water quality, water quantity and the protection of the mauri of freshwater and natural habitats within the Ngāi Tahu's tribal takiwā. The measures proposed above provide for the active protection of Ngāi Tahu values for the future enhancement of habitat, improvement of water quality and availability of mahinga kai species.

TREATMENT AREA 2 LOCATIONS

6.31 Treatment Area 2 areas occur throughout the residential red zone.

6.32 There are some specific locations where the Riparian Buffer areas have been made larger than 5 metres wide. These include:

- Crown-owned properties on New Brighton Road, Burwood, on the northeast side of Horseshoe Lake where it joins the Avon River.
- Crown-owned properties adjacent to the northwest corner of the ANZAC Drive, New Brighton Road roundabout.
- Crown-owned properties on the eastern side of Brooklands, that are situated on higher dune areas close to the Brooklands Estuary.

The areas where the buffer has been increased beyond 5 metres are for site specific reasons. The first two examples listed above include concentrations of protected and well established vegetation adjacent to waterways. The third area includes properties that are situated on the edge of dunes. The larger buffer area and retention of vegetation is proposed to minimise degradation to the dunes.

TREATMENT AREA 2 WORKS

6.33 The following works will generally be required to implement the riparian buffer option:

- All vegetation within the 5 metre setback from a residential red zone property boundary adjoining a stream or waterway shall be retained, except for weed species as specified in the Vegetation Retention Methodology.
- Some grassing or planting work may be required within Riparian Buffer areas where structures to be removed as part of the demolition and clearing work protrude into the buffer.
- Maintenance of vegetation within the buffer areas will also be required. A maintenance programme primarily focussed on weed control and litter collection, but also care of any new planting or grassing, will be required.

Treatment Area 3 - Dune

INTRODUCTION

6.34 Dune treatment zones have been located in areas of sandy raw soils on Crown-owned land that are adjacent to dunes in reserve management. Dune areas are buffered by existing vegetated dunes. Specific treatments have been selected in these areas in order to establish vegetation on the very dry sandy soils and to complement adjacent vegetation and residential amenity.

TREATMENT AREA 3 LOCATIONS

6.35 Dune treatment is proposed in parts of:

- Pines Beach
- Southshore

6.36 Only one small block of dune treatment is defined at Pines Beach. The boundary of the treatment area was derived from mapped soil types, existing vegetation and adjacent land use. At Pines Beach and Kairaki, the soils of the residential red zone are all classified as sandy raw soils. These are well drained soils comprising almost entirely of sand. However the soils on the flatter land in these areas are mapped to contain Burwood sandy loams, a mottled sandy recent soil with imperfect drainage that includes clays amongst the sand dominated profile. This is reflected in the vegetation observed in these areas, with highly drought tolerant species such as marram grass and woody weeds on the sloping dune areas and common exotic pasture / grassland species on the flatter land. The treatment zone boundaries therefore reflect this difference, with grassland treatment (Treatment Area 1) using drought tolerant grass species covering most of Pines Beach and Kairaki, and dune treatment (Treatment Area 3) on the sloping faces. The boundaries also account for whether the neighbouring land included housing or just vegetated duneland.

6.37 At Southshore the dune treatment area extends from approximately 130 metres south of Tern Street south to Spit reserve (at the end of Stilt Lane). There is existing dune vegetation in Spit Reserve, at the southern end of Southshore, as well as between the residential red zone boundary and the estuary.

TREATMENT AREA 3 WORKS

6.38 At Pines Beach we recommend planting the block of dune treatment with marram grass. Marram grass dominates the adjacent dunes, along with pine trees and woody exotic shrubs (such as broom). Marram will provide quick cover and minimise wind erosion. Consideration was given to planting indigenous duneland species in this 0.5 hectare block. However this would require a high level of management to establish the indigenous species and to control the rapidly colonising exotic species from the neighbouring duneland.

6.39 At Southshore grassing and nodes of indigenous shrubland are recommended to reflect indigenous shrubland dune planting and adjoining residential gardens. A drought resistant grass mix (using the species listed in Treatment Area 1 "drought prone, low fertility, sand based soil areas") should be used. Indigenous shrubland species could include Ngāio, cabbage trees and akekake and others consistent with nearby CCC and community plantings.

6.40 Maintenance of dune treatment areas will also be required. A maintenance programme primarily focussed on weed control and litter collection, but also care of any new planting or grassing will be required.

Treatment Area 4 – Estuarine Edge

INTRODUCTION

6.41 The estuarine edge treatment is in Southshore and lies on generally dry sandy raw soils between the estuary to the west and residential green zone land to the east. Estuarine edge interim clearance treatment areas have a direct boundary with the estuary.

The dune systems and estuarine edge of Southshore were traditional settlement sites for Ngāi Tahu communities. This included the mahinga kai site (Te Karoro Karoro) and wāhi tapu (Te Kai a Te Karoro) (as described in Appendix 4). Treatment therefore needs to reflect both the nature of these features and values associated with the surrounding area.

TREATMENT AREA 4 LOCATIONS

6.42 This area extends south from Godwit Street to 130 metres south of Tern Street, adjacent to the estuary edge. To the north the residential red zone is in grassland treatment, as a road separates it from the estuary edge. To the south is the dune treatment area.

TREATMENT AREA 4 WORKS

6.43 Grassing and nodes of indigenous shrubland are recommended for Crown-owned land to reflect natural estuarine riparian species and the adjoining residential gardens. Relatively substantial grassing will be required in places where large houses, structures and impermeable surfaces dominate the land area in the red zone. A drought resistant grass mix (using the species listed in Treatment Area 1 "drought prone, low fertility, sand based soil areas") should be used. Indigenous shrubland species could include salt marsh ribbonwood at the estuary edge, ngāio, cabbage trees and akekake and others consistent with nearby CCC and community plantings.

6.44 Maintenance of estuarine edge areas will also be required. A maintenance programme focused on primarily weed control and litter collection, but also care of any new planting or grassing will be required.

Treatment Area 5 – Wet Areas

INTRODUCTION

6.45 These areas are close to the Avon River, the ground elevation has dropped since the earthquakes and they are observed to be consistently wet or to have the groundwater very close to the surface during winter months. Having standing water for prolonged periods creates a risk of contamination to the public and animals and also provides potential mosquito breeding grounds, if the standing waters persist in the warmer spring and summer months.

6.46 Large amounts of fill would be required to elevate this land sufficiently to avoid ponding, and work by heavy machinery is limited in such wet conditions. Grassing is unlikely to be successful on this wet land.

6.47 We recommend treatment of Crown-owned land through planting with indigenous wetland species.

TREATMENT AREA 5 LOCATIONS

6.48 Wet area treatment is proposed in three areas:

- Bexley, adjacent to the river
- New Brighton, south of QEII and adjacent to the site of the Kate Sheppard Rest Home
- Burwood, adjacent to the controlled outlet of Horseshoe Lake

TREATMENT AREA 5 WORKS

6.49 In Bexley we recommend planting with wetland indigenous species that are already present in the lower Avon River. These species will establish relatively easily, have tolerance for a range of hydrological conditions and provide habitat for indigenous fauna.

6.50 We recommend planting oioi, raupō, *Schoenoplectus tabernaemontani* and Juncus at the edge of the wettest areas. Once established these species will spread into ponded areas. *Carex secta, C. virgata*, toetoe, harakake / flax and tī kōuka / cabbage trees should then be planted in adjacent damp areas. All plants should be sourced locally. Drier parts could be left to regenerate naturally and managed with light sheep grazing in summer. Weed control will be required to remove any species that threaten the establishing indigenous plants or the nearby Cockayne Reserve and habitats of the lower Avon.

6.51 At New Brighton, south of QEII and adjacent to the site of the Kate Sheppard Rest Home, a combination of wetland planting and natural wetland regeneration is recommended. *Juncus pallidus* has been observed re-establishing in the area already, in lawns and through gaps in driveways. It is expected that the vegetation that dominates the reserve land to the west would establish quickly at the site, but some planting will be required to reduce ponding, particularly adjacent to remaining residential areas. Other rushes *Juncus edgareae, J, australis* and *J sarophorus* should be considered.

6.52 At Burwood, in the area adjacent to the controlled outlet of Horseshoe Lake, site specific wetland planting is recommended to reduce ponding alongside natural regeneration.

6.53 Aside from earthworks directly associated with the demolition and removal of houses, earthworks and disturbance of ground should be minimised in Treatment Area 5.

6.54 Maintenance of wet areas will also be required. A maintenance programme focused on primarily weed control and litter collection, but also care of any new planting will be required.

6.55 Light summer sheep grazing could control rank grass growth and not adversely affect the plantings once established. Restricted access may promote use of this habitat by wetland birds.

Treatment Area 6 – No Clearance Treatment

INTRODUCTION

6.56 There are a few areas in the residential red zone where due to existing land conditions, there is no requirement for CERA to undertake interim land clearance treatment works on Crown-owned land.

TREATMENT AREA 6 LOCATIONS

6.57 These areas are located in Brooklands and Kaiapoi. No treatment areas are shown in *Appendix 1 – Interim Land Clearance Treatment Area Maps*

6.58 To the east of Courtney Drive in Kaiapoi and on the west side of Brooklands adjacent to the Styx River, large sections of land within the residential red zone are currently used for grazing. This use could continue without any additional interim land clearance work from CERA.

6.59 There are a few structures such as sheds and fences that exist in the areas proposed as Treatment Area 6. These may be kept for use with the grazing land. If CERA chooses to remove any structure in a no clearance treatment area, the land should be reinstated to pasture to match the existing surrounding land use.

6.60 Existing fencing in the no clearance treatment areas may need to be rationalised to enable future grazing or other use.

6.61 In the northeast corner of Brooklands the residential red zone covers an area that is a river flat (close to where the Styx River exits into the Brooklands Lagoon and joins the Waimakariri River). No clearance treatment work is required in this area.

TREATMENT AREA 6 WORKS

6.62 Although no specific clearance treatment work needs to be implemented, management, monitoring, and maintenance of the existing grazing areas will need to be continued. Maintenance works may include weed control, fence maintenance and other works associated with the care of stock.

Residential Red Zone/Green Zone Boundary Treatment Options

INTRODUCTION

6.63 Using the ARCGIS computer programme we have identified where residential red zone properties border residential green zone properties. These edge locations are where there is no separating feature such as a road, waterway or reserve/park.

6.64 Treatment of Crown-owned land on the edge identified between the residential red zone and green zone properties is an important part of the interim land clearance treatment proposal and meeting CERA's objectives of retaining amenity value and enabling security and safety.

EDGE TREATMENT OPTION LOCATIONS

6.65 Red zone/green zone property boundaries occur in all affected suburbs except Brooklands and Kairaki. The locations of red zone/green zone property boundaries are shown in *Appendix 1 – Interim Land Clearance Treatment Area Maps.*

CPTED – CRIME PREVENTION THROUGH ENVIRONMENTAL DESIGN

6.66 As discussed in Section 5.0 of this report, CPTED principles have been considered in the analysis of interim clearance treatment options for the residential red zone. The qualities of *Surveillance and Sightlines, Sense of Ownership: Showing a Space is Cared For, Quality Environments: Well Designed, Managed and Maintained Environments* are particularly relevant to the interim clearance treatment of residential red zone that border green zone areas.

6.67 Where residential red/green zone boundaries are currently defined by solid 1.8 metre high boundary fences or walls, consideration needs to be given to altering or replacing the existing with lower fencing (1.0 to 1.2 metres) or fencing that is visually permeable. This will help to improve sightlines and casual observation from neighbouring green zone residences.

The introduction of lower or visual permeable fences will also reduce areas along residential red zone/green zone boundaries that are concealed and isolated.

6.68 Retention of vegetation along residential red zone/green zone boundaries should not hinder sightlines and casual observation from neighbouring green zone properties. On a location by location basis, planting of appropriate vegetation should be considered to help soften the interface between red zone and green zone properties. Community groups could be actively involved in planting in these areas to help foster a sense of ownership.

6.69 Residential red zone/green zone boundaries need to be well maintained. Any vegetation should be kept pruned and tidy, lawns regularly mowed, litter collected and graffiti removed quickly.

6.70 Some areas of the residential red zone have isolated locations such as adjacent to Horseshoe Lake and in Bexley and physical fencing and gate barriers may need to be installed as security measures.

EDGE TREATMENT WORKS

6.71 The following works will generally be required to implement the edge treatment options:

- Where agreed between the neighbouring green zone property owner and CERA, alteration of residential red zone/green zone solid 1.8m high boundary fences and walls to lower (1.0 to 1.2 metres high) or visually permeable fences.
- We note that there may be specific locations along the red zone/green zone boundaries that require repair or replacement of retaining structures. These situations will need to be assessed on a case by case basis.
- Retention and planting of suitable vegetation along residential red zone/green zone boundaries. Plant stock for additional planting could be transplanted from other locations within the residential red zone. Suitable locations for additional planting should be assessed on a block by block basis as they are cleared. Retention and transplanting of vegetation shall be as per the Vegetation Retention Methodology attached as *Appendix 5*.
- Maintenance of residential red zone/green zone borders will be required. A higher level of maintenance may be required for these areas, including mowing, pruning and care of vegetation, litter collection, graffiti removal and weed control.

RESIDENTIAL RED ZONE FENCING

6.72 For varying security reasons, parts of the Crown-owned residential red zone areas that have had interim clearance treatment options implemented will need to be fenced. At this initial stage of block clearance, this may be limited to individual blocks, but may increase to wider areas as block clearance work advances.

We anticipate that fence and gate locations will change as interim land clearance treatment options are implemented.

We have not mapped any fence or gate locations for the residential red zone. One reason for this is that the order in which the blocks will be cleared is not yet known due to the Crown purchase and settlement process and insurance issues.

When the sequence for block clearance is better understood fencing maps may be able to be produced.

Potential interim land use within the residential red zone may also influence fencing locations.

6.73 For interim land clearance treatment we suggest that an appropriate fence type is a simple rural style, 1.2m high post and 5 wire fence.

7.0 Cultural Heritage Accidental Discovery and Archaeological Sites Protocol

Accidental Discovery Protocol

PURPOSE

7.1 This protocol recognises the importance of cultural / archaeological material to both Aotearoa/New Zealand, as set out in the statutory requirements of the Historic Places Act 1993, and to Ngāi Tahu represented by Kaitiaki Ngāi Tahu Papatipu Rūnanga. This protocol sets out the particular procedures that must be followed in the event that archaeological sites, koiwi (human remains) or taonga (Māori artefacts) are accidentally discovered.

THE HISTORIC PLACES ACT 1993

7.2 An archaeological site is defined in the Historic Places Act 1993 (the HPA) as any place associated with pre-1900 human activity, including shipwrecks, where there is evidence relating to the history of New Zealand that can be investigated using archaeological methods.

7.3 If you wish to do any work that may affect an archaeological site you must obtain an authority from the New Zealand Historic Places Trust (NZHPT) before you begin. This work could include, amongst other things:

- Invasive geo-tech investigations
- Earthworks for road construction
- Earthworks for relocation of buildings or structures, creation of accessways, etc.
- Earthworks for landscaping,
- Trenching for stormwater management, and waste disposal
- Quarrying building demolition or removal.

7.4 It is an offence to do work that may affect an archaeological site without a written authority from the NZHPT.

7.5 Refer to *Part 7.23* of this report for description of procedure for applying for archaeological authorities for activities affecting recorded archaeological sites in the Canterbury residential red zone areas.

IDENTIFYING ARCHAEOLOGICAL SITES

7.6 For Maori archaeological sites the largest and most obvious site types are pa, pits and terraces. However, evidence may be of a smaller nature, in the form of bones, shells, charcoal, burnt stone etc; a midden is an archaeological rubbish tip, in which many of these items can be found consolidated together. Evidence of disturbance of a midden can be a scattering of shell across a wide area; this can be confusing if it is near a beach. Pieces of obsidian or chert, together with stone tools, may also be recovered.

7.7 In later sites of European origin artefacts such as bottle glass, iron/metal, crockery etc. may be found, or evidence of old foundations, wells, drains or similar structures. Burials/koiwi tangata may be found from any period.

7.8 Some examples include:

- Shell midden
- Discolored soils indicating burning or cooking
- Animal bone
- Historic pottery on a roadside scrape
- Shell midden uncovered in road scraping

PROCEDURES

7.9 Prior to ground investigation work commencing on Crown-owned land, the field team shall be briefed on the likely nature of cultural and historic artefacts in the area, and on this procedure.

7.10 If any suspected archaeological material is uncovered, all work within 10m of the discovery shall stop immediately.

7.11 The project manager, including any sub-consultants and sub-contractors, is required to keep confidential all discoveries.

7.12 The project manager is responsible for on-site safety and may from time to time need to restrict access, for the safety of all parties.

7.13 The project manager is responsible for ensuring the New Zealand Historic Places Trust NZHPT is advised of an accidental discovery. The project manager is also responsible for ensuring iwi are advised of the find and provided an opportunity to participate in decision-making.

7.14 The project manager shall coordinate the response as follows:

- In the event of the discovery of any taonga/artefacts advise the New Zealand Historic Places Trust (NZHPT) of the discovery
- Seek direction from the NZHPT archaeologist or Maori Heritage Adviser on the appropriate consent process in accordance with the requirements of the Historic Places Act (1993).
- Work with the iwi representatives to ensure that the appropriate steps are taken to make the site culturally safe,
- Works affecting the archaeological site shall not resume until the New Zealand Historic Places Trust and iwi are satisfied that the site has been identified, the find recorded, and cultural protocols appropriately observed.

7.15 If any artefacts are to be removed from a find site the Ministry for Culture and Heritage will be advised to ensure that the correct procedures under the Protected Objects Act 1975 are adhered to.

7.16 Any media statements in relation to this protocol will be prepared with the assistance of iwi and only after discussions between the project manager and iwi.

7.17 Canterbury's former wetland areas contain archaeological material preserved as a result of anaerobic conditions. Typically these remains are extremely fragile and susceptible to

rapid decay in the event of any changes in environment, so usually require specialist attention. Finds can include (but are not limited to) wooden artefacts such as adze handles, weapons or horticultural implements and woven flax, or artefacts made from organic materials such as gourds.

7.18 Where wooden or organic artefacts are found in wetlands areas:

- Finds should remain, where possible, in-situ until professional advice has been obtained;
- In the event that items are inadvertently removed from their original context, the project manager shall ensure the organic material is kept wet by being placed in a suitable storage container filled with water;
- Work in that location shall cease until such time that the NZHPT and iwi are comfortable that work can resume;
- The project manager shall obtain specialist conservation services and advice from an appropriate specialist, such as a wet wood conservator, to ensure the survival and appropriate conservation treatment of the artefact;
- The Ministry of Heritage and Culture will also be notified in accordance with the statutory requirements of the Protected Objects Act 1975; and
- The project manager shall be responsible for all transportation and conservation costs that may be incurred.

KOIWI TANGATA/HUMAN REMAINS

7.19 As soon as practicable after the project manager has given notice to the appropriate iwi representatives that koiwi have been discovered, iwi representatives will inspect the site and advise whether they wish to undertake any cultural ceremonies at the site. The project manager will arrange access.

7.20 If iwi wish to undertake such ceremonies, the iwi representative will make the necessary arrangements for these ceremonies to occur at the site as soon as possible. Once these ceremonies are completed iwi representatives, will inspect the skeletal remains. An Archaeologist should record the details of the koiwi, the site of discovery, and any other relevant facts and will make these records available to iwi and the police if required.

7.21 If the discovery area is found to contain an archaeological site, approvals must be obtained from the New Zealand Historic Places Trust (NZHPT) to permit the removal of koiwi. If the koiwi are Maori, and the police and or coroner have no uncertainty or suspicion about the koiwi, the iwi representatives will then gather up the koiwi and remove them from the site. In the event that the police and/ or coroner have any uncertainty or suspicion about the koiwi, they are responsible for making any records they require and for any koiwi that they remove from the site.

7.22 If the koiwi are Maori and the police and/ or coroner remove only part of the koiwi, the iwi representative will arrange removal of the remaining koiwi. If the koiwi are non-Maori, the police and or the coroner will be responsible for removing any remaining exposed Koiwi.

ADVICE TO ALL CONTRACTORS/SITE WORKERS/OWNERS - IF IN DOUBT, STOP AND ASK; TAKE A PHOTO AND SEND IT TO THE NEW ZEALAND HISTORIC PLACES TRUST

ACCIDENTAL DISCOVERY CONTACT DETAILS		
NZHPT Archaeologist	027 688 9741	**archaeologistcw@historic.org.nz**
NZHPT Southern Regional Office	(03) 363 1880	**information@historic.org.nz**
NZHPT Māori Heritage Advisor	027 249 3604	**mhadvisorcw@historic.org.nz**
Kaitiaki Rūnanga **Mahaanui Kurataiao Ltd (MKT)**	03 377 4374	**admin@mkt.co.nz**
NZ Police (Christchurch Central)	(03) 363 7400	
Ministry for Culture and Heritage (MCH)	Phone: +64 4 499 4229	

Figure 8: Accidental Discovery Contact Details

ACCIDENTAL DISCOVERY PROCEDURES	
Artefact Find	**Koiwi Tangata/Human Remains Discovery**
Immediately stop work.	Immediately stop work
Find site is cordoned off	Find site is cordoned off
Contractor manager to advise CERA	Contractor manager to advise CERA
Project manager advises NZHPT and co- ordinates site inspection.	Project manager advises NZHPT and co-ordinates site inspection.
Project manager contacts all iwi representative groups.	Project manager contacts all iwi representative groups.
Iwi representatives are provided the opportunity to inspect the site and advise on appropriate protocols to be followed	Project manager advises NZHPT and Christchurch or Kaiapoi Police Station.
Project manager to contact the Ministry for Culture and Heritage if artefacts are removed from the find site.	Christchurch or Kaiapoi Police Station in coordination with the Coroner will analyze the remains to determine if it is a crime scene.
Work recommences once NZHPT and iwi are satisfied that correct procedures have been followed.	If the remains are not associated with a crime then the iwi representatives will determine how the remains will be reinterred.
	Iwi representatives will be provided sufficient time to perform appropriate rituals and customary practices.
	The project manager will contact the Ministry for Culture and Heritage if artefacts are removed from the find site.
	Work recommences once NZHPT and iwi are satisfied that correct procedures have been followed.

Figure 9: Accidental Discovery Procedures

Recorded Archaeological Sites - Archaeological Authority Process

RECORDED SITES IN THE RESIDENTIAL RED ZONE AREAS

7.23 The New Zealand Archaeological Association (NZAA) Site Recording Scheme, the national system for recording information on archaeological sites, identifies a number of recorded archaeological sites within Canterbury's residential red zone areas. The site types vary from burials/cemetery, to middens and ovens, to cottages homesteads and wells. The Historic Places Act 1993 makes it unlawful for any person to destroy damage or modify the whole or any part of an archaeological site without the prior authority of the New Zealand Historic Places Trust. Activities affecting the following recorded archaeological sites will require an authority from the New Zealand Historic Places Trust.

7.24 NZAA Recorded Archaeological Sites within the residential red zone areas area listed below. Refer to *Appendix 6 – Recorded Archaeological Sites* for mapped locations.

NZAA_ID	NAME	DESCRIPTION	SITE FEATURE
M35/291		Midden	Midden
M35/298		Burials	Burial
M35/25		Oven/Midden	Midden, Oven (intact)
M35/498	Arawa	A 19th century house site.	Building - cottage
M35/494	Broome Farm	The homestead from Broome Farm.	Building - homestead
M35/495	Shannon Lodge	The site of a 19th century house.	Building - homestead, House floor/ site
M35/496		A 19th century cottage.	Building - cottage
M35/497		A 19th or early 20th century cottage.	Building - cottage, House floor/ site
M35/582		Site of Harry Pannell's home.	Building
M35/598		Site of a 19th century house, depicted on DP 270 (1878).	House floor/ site
M35/601	Riversleigh stables	Site of 19th century outbuildings, possibly stables, for large house formerly at 306-308 Avonside Drive - depicted on DP 61 (1875), DP 1313 (1896).	Unclassified
M35/602		Site of a 19th century house, depicted on DP 49 (1875), DP 1313 (1897); CT21/23.	House floor/ site
M35/600	Riversleigh	Site of 19th century house, depicted on DP 61 (1875), DP 1313 (1896), DP 6209 (1921); CT176/197.	House floor/ site
M35/441		An 1870s cottage.	Building - cottage
M35/614		Artesian well, depicted on DP 12017 (1941).	Well
M35/612		Artesian well, as depicted on DP 12017 (1941).	Well
M35/613		Artesian well, as depicted on DP 12017 (1941).	Well
M35/615		Site of former scouring sheds.	Tannery
M35/609		Artesian well, as depicted on DP 12017 (1941).	Well
M35/634	Cherry Vale Homestead and Cherry Orchard	Cherry Vale Homestead and Cherry Orchard. 1890s homestead believed to be still standing at 56 Cass St, Kaiapoi.	Unclassified
M35/610		Artesian well, as depicted on DP 12017 (1941).	Well
M35/611		Artesian well, as depicted on DP 12017 (1941).	Well
M35/608		Artesian well, as depicted on DP 12017 (1941).	Well
M35/607		Artesian well, as depicted on DP 12017 (1941).	Well

M35/631	Avebury House	Site of pre-1900 house, as depicted on DP 1504 (1899).	House floor/ site
M35/570		Site of a 19th century house.	Building
M35/700		Part of a 19th century homestead.	Building
M35/697		The site of a 19th century house.	Artefact - historic, Building
M35/732		Site of a 19th century building.	Building

Figure 10: Recorded Archaeological Sites – Residential Red Zone

LEGAL OBLIGATIONS

7.25 Under the Historic Places Act 1993, an archaeological site is defined as any place associated with pre-1900 human activity, where there is material evidence relating to the history of New Zealand. It is unlawful for any person to destroy, damage or modify the whole or any part of an archaeological site without the prior authority of the NZ Historic Places Trust. This is the case regardless of the legal status of the land on which the site is located, whether the activity is permitted under the District or Regional Plan or whether a resource consent, designation or building consent has been granted. The Historic Places Act provides for substantial penalties for unauthorized damage or destruction.

MITIGATION/AUTHORITY CONDITIONS

7.26 If an authority/authorities are granted, conditions will be imposed such as a mandatory 14 day stand-down period for appeals to the consent and measures for mitigating impacts. In the case of M35/319 and M35/298 the NZHPT will likely seek direction from Ngāi Tahu Rūnanga as to appropriate protocols and procedures to be observed, these matters will be addressed in the Maori values assessment MVA component to the authority application.

7.27 It is likely that the NZHPT will require an archaeological authority, assessment, and monitoring of excavations (archaeological/cultural) for activities affecting the above sites.

8.0 Recommendations

The following recommendations are made regarding interim land clearance treatment options for Crown-owned land in the residential red zone:

8.1 The interim land clearance treatment options and the Accidental Discovery Protocol (ADP) for clearance works described in this methodology are adopted and incorporated into CERA policy to provide the basis for the future implementation of interim clearance treatment options on Crown-owned cleared residential red zone blocks.

8.2 Interim and temporary land use options that are consistent with the interim land clearance treatment options described in this methodology, are considered in an appropriate policy and planning framework.

8.3 CERA, in conjunction with local consenting authorities, determine the consent requirements to implement the proposed interim land clearance treatment options.

8.4 Site specific specifications and schedules are developed through trial block clearances for the implementation of each interim clearance treatment option. The template specifications can be used as base documents to help determine the scope and quantum of work required for the clearance and implementation of interim clearance treatment options. The works for each treatment option that have been generally described in Section 6.0 of this report should be included in the template specifications.

8.5 Site specific maintenance and weed control specifications and management programmes should be prepared for each interim clearance treatment option.

8.6 'Test' blocks for each interim land clearance treatment option are identified and essentially used as trial blocks to assess how easily, efficiently and cost effectively the interim clearance treatment option can be implemented and what the challenges are associated with the physical works. The test blocks should be monitored over a set period of time to ascertain the success of the interim clearance treatment works.

8.7 Lessons learned from the test blocks can be applied to later block clearances to ensure the most efficient and cost effective method of implementation is being carried out. We suggest that after the completion of clearance works in the test block, the implementation of each treatment type is reviewed and adjusted if required.

8.8 Implementation of interim land clearance treatment options on the selected test blocks should also be used as an opportunity to train and up skill the operators and workers carrying out the clearance and clearance treatment works.

8.9 As discussed in this report, it is understood that a number of community groups, scientists, academics and other professional groups have been coordinating surveys of some residential red zone properties for varying information, including the identification significant vegetation and other items they worthy of protection and retention, vegetative cover and emergent species (including some weed species).

If the information surveyed is relevant, supplied to CERA in a consistent format and is within the scope of interim land clearance treatment options, a further revision of this report that refers to the survey information may be considered.

Further information from local authorities, in addition to the data already sourced as part of the preparation of this methodology, may also be considered if the information is

relevant, within the scope of interim land clearance treatment options and will assist in the clearance treatment and maintenance of the residential red zone.

As discussed in the Vegetation Retention Methodology, it is anticipated that some of the information that may be supplied (especially relating to the site survey of large and significant trees and heritage information) may help improve the accuracy of important vegetation to be retained.

8.10 In order to determine the need for an archaeological authority under the Canterbury Earthquake (Historic Places Act) Order 2011, an archaeological desktop assessment is recommended, unless previous authorities have been granted by NZHPT or previous archaeological assessments have been undertaken. The intention of the desktop assessment is to identify archaeological potential through consideration of the following: geomorphology, historic land use, current land modification, nature of extant structures (i.e. deep foundations).

8.11 It is noted that the above recommendations are based on initial consultation with New Zealand Historic Places Trust. Two key documents that have informed the recommendations in this report are the Ngāi Tahu Freshwater Policy (Te Rūnanga o Ngāi Tahu 1999), Te Whakatau Kaupapa (Tau et al 1990). These reports outline Ngāi Tahu values as they pertain to wahi tapu/wahi taonga, water quality, mahinga kai, ecology, mauri and a traditional and contemporary cultural practices around land, rivers and sea in the Canterbury region.

8.12 It is recommended that Ngāi Tahu values and relationships particularly those of Te Ngāi Tuahuriri Rūnanga and Te Hapū o Ngāti Wheke (Rāpaki) are addressed and processes considered for their participation in future planning for the residential red zone areas. For further detail refer to Appendix 4.

9.0 References

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Te Whakatau Kaupapa (1990). *Te Maire Tau, Anake Goodall, David Palmer Rakihia Tau, Ngāi Tahu Resource Management Strategy for the Canterbury Region*

Tonkin and Taylor (2012). *Canterbury Earthquakes 2010 and 2011 – Land Report as at 29 February 201.2* Report Prepared by Tonkin and Taylor Ltd for the Earthquake Commission.

10.0 Data Sources

Dataset	Source	Author
LiDAR	Christchurch City Council	AAM Group
Post Quake Aerial Photos	Koordinates.com/Land Information New Zealand	NZ Aerial Mapping
Properties settled with Crown	CERA	NSG GIS NZ
Cadastre (with rate unit reference)	Boffa Miskell NASBOX	Land Information New Zealand
Soils	Ecan	Landcare Research
Historical 'black maps'	Christchurch City Council	Christchurch City Council
Flood prone areas	Christchurch City Council	Christchurch City Council
Ground Water Levels	EQC	Tonkin and Taylor
Protected trees	Christchurch City Council and Waimakariri District Council	Christchurch City Council and Waimakariri District Council
Street trees / Significant Trees	Christchurch City Council and Waimakariri District Council	Christchurch City Council and Waimakariri District Council
Waterways - piped/open	Christchurch City Council and Waimakariri District Council	Christchurch City Council and Waimakariri District Council
Stormwater	Christchurch City Council and Waimakariri District Council	Christchurch City Council and Waimakariri District Council
Wastewater	Christchurch City Council and Waimakariri District Council	Christchurch City Council and Waimakariri District Council
Potable water	Christchurch City Council and Waimakariri District Council	Christchurch City Council and Waimakariri District Council
Community and recreation facilities	Christchurch City Council and Waimakariri District Council	Christchurch City Council and Waimakariri District Council
Parks and Reserves	Christchurch City Council and Waimakariri District Council	Christchurch City Council and Waimakariri District Council
Heritage items	New Zealand Historic Places Trust/Ngāi Tahu/Christchurch City Council	New Zealand Historic Places Trust/Ngāi Tahu/Christchurch City Council
Ecological heritage sites	Christchurch City Council	Christchurch City Council
Contaminated Land	Environment Canterbury	Environment Canterbury

Appendix 1: Interim Land Clearance Treatment Area Maps

Appendix 2: Land Elevation and Change in Land Elevation Maps

Appendix 3: Residential Red Zone Soil Maps

Appendix 4: Areas of Cultural Significance to Ngāi Tahu in the Christchurch Residential Red Zones

Appendix 5: Vegetation Retention Methodology

Appendix 6: Recorded Archaeological Sites