Peterborough Village (Pita Kaik) has been identified as a neighbourhood centre within the Central City of Christ church following the devastating earthquakes of 2010 and 2011. The high levels of damage within the Peterborough Village community have meant that there is a need to significantly redevelop the area. Due to zoning, in which the community has been almost entirely zoned as TC3, coupled with the complex geomorphological

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The City of Christchurch experienced a series of earthquakes from September 2010, well into mid 2011. Of these, the 6.3 magnitude earthquake of February 22, 2011 was the most devastating, resulting in widespread damage and loss of life (Canterbury Earthquake Recovery Authority, 2011). For a number of months following the February earthquake the Central City was cordoned off, including that of the Peterborough Village community. Peterborough Village lies between Colombo Street and Barbadoes Street, and from Salisbury Street to the Avon River/Otakaro (Figure 1).

Figure 1: Outline of Peterborough Village (Courtesy of Di Lucas).

The community suffered severe damage from the earthquake with the land considerably prone to liquefaction thus resulting in widespread destruction to houses and buildings.

Peterborough Village, prior to the earthquake, was a vibrant mixed-use community of residential and business. 2006yal

St Mary's Stream historically rose from a spring that was located in the grounds of the old Saint Mary's Church presbytery, hence its name. From here it meandered south towards the Avon River/Otakaro, before tracking north-east along beside the river and eventually emptying into it at the Salisbury-Barbadoes corner (Figure 2).

Figure 2

Figure 3: Sketch into the Avon River/ Otakaro at Madras Street (Source: Christchurch Online, n.d.).

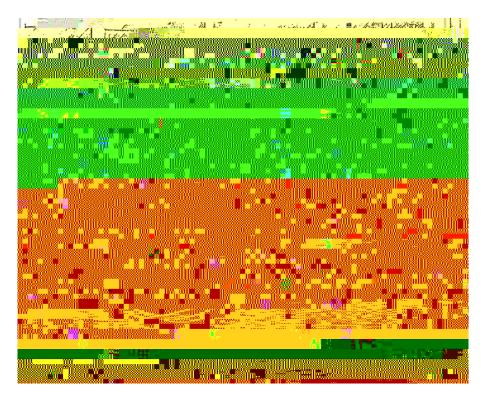


Figure 4 (Source: Di Lucas).

The stream remained exposed along this course for many years, with development occurring around it (Figure 5).



Figure 5 was photographed from the vicinity of the Manchester-Kilmore corner in 1905, only 3 years before it was demolished to make way for the 1909 Halswell Stone

Figure 7: Corsers Stream in Christchurch functions as a true environmental asset and an effective drainage system (Source: Watts & Greenaway, n.d.).

Daylighting describes the deliberate exposure of some or all of a previously covered river, creek or stormwater drainage (Pinkharm, 2000). Daylighting projects can restore perennial or occasionally ephemeral waterways as well stormwater culverts that run with water only during wet weather. Such projects have been undertaken throughout the world, notably the Cheonggyecheon River in Seoul and various streams in Zurich, Switzerland. There are many different reasons to daylight a culverted stream or storm drain, which generally leads to a number of interrelated environmental, economic and social benefits (Table 2) (Gerson et al, 2005).

Table 2: Daylighting streams: the environmental, economic and social benefits.

Issue/subject

	funds be used for daylighting activities (Bicknell & Gan, 1997)?
	Who will maintain the project?
	Daylighting may raise liability and regulation issues for site owners and those adjacent to it, as outlined in Pinkharm (2001, 8).
TECHNICAL	Daylighting projects can raise questions about the site and situation, the inputs from the watershed, the channel design, the stream-bank and floodplain, and the project logistics.

As seen, daylighting can provide a multitude of benefits, however most projects also face a variety of challenges.

Daylighting has been proposed as part of the Peterborough Village rebuild to recognise St Mary's **Stream and enhance green spaces. Perhaps the most obvious option is daylighting the 1859 path of** St Mary's Stream, **although the fact that this flows through private land has been raised as an issue.** 

Another option that has been considered is the daylighting of a stream along another route, for example along the length of the stormwater culvert that runs down Manchester Street, into which St. Mary's Stream was originally piped (personal communication, Di Lucas, Landscape Architect at Lucas)

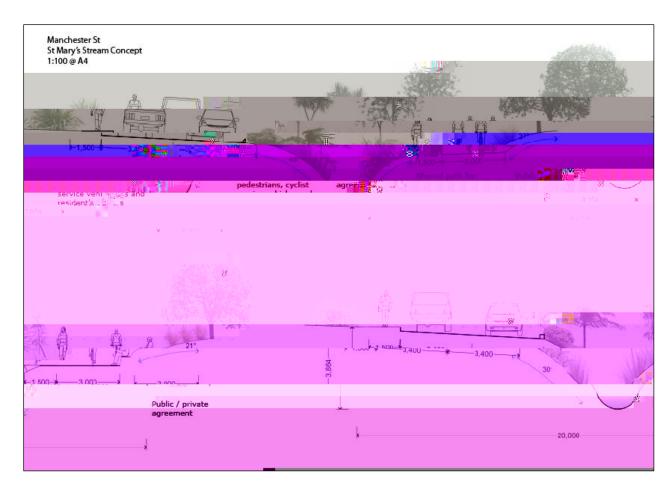


Figure 9: A draft design for the daylighting of a stream down Manchester Street, including a shared path on the eastern side of the street (Courtesy of Di Lucas).

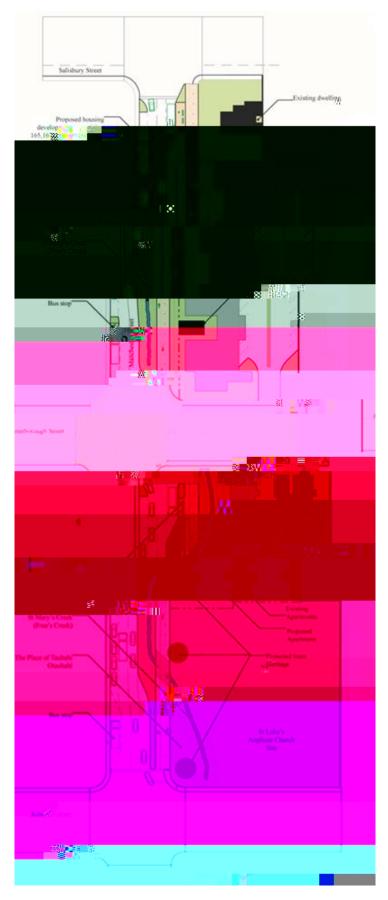
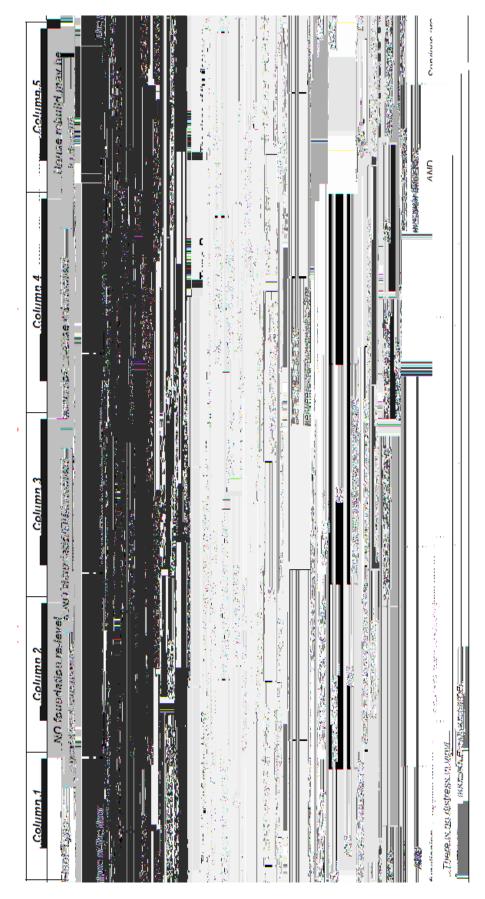


Figure 10: Conceptual design of the stream down Manchester Street. (Courtesy of Di Lucas)



Table 4: Oriteria for floor or foundation repair or rebuilding. This provides an indication of the typical types of foundation damage associated with particular building structures (Department of Building and Housing, 2012).



This suggests that through appropriate site specific testing the most suitable foundation options for rebuilds in the area can be determined. These consist of deep pile foundations, lightweight structrues with shallow foundations and ground remediation techniques (Table 5 & Appendix 1) (Department of Building and Housing, 2012)

Table 5: Possible Foundation Types for TC3 Land, such as Peterborough village, and the constraints associated with each option (Department of Building and Housing, 2012).

Within the three foundation typologies suggested for TC3 zoning, there are a number of variations (e.g. different designs of pile or shallow foundations). This means that there is a certain level of flexibility with different foundation choices, but economic and structural feasibility must also be considered. Suggestions for flexible construction of foundations have included ideas such as the sharing of foundations for two or more houses as a stability and cost-saving measure (personal communication, Di Lucas, Landscape Architect at Lucas Associates, March 7, 2012). While potentially an effective means of creating group collaboration and combining resources within the community, the structural feasibility of such ideas also needs to be considered. As an example; the creation of foundation-sharing would require the installation of heavy fire-walls between two or more homes, creating difficulties for the use of potentially more affordable, lightweight foundations (personal communication, Dave Brunsdon, Engineering Consultant at Kestrel Group, May 6, 2012).

Discussion of rehabilitation of homes is a theme commonly experienced wirdable, lightweig

As a result of exposing streams, or employing ground remediation foundation techniques, there is a need to explore options for land-sharing agreements. A land-share agreement, or land readjustment, describes a situation in which two or more parties enter into a legal agreement to merge their land titles in order to facilitate the building of structures, or better utilisation of land across all titles. The joint title can then be managed by the individuals themselves, a supervisory trust or a body corporate. Although collective participation into a land-share agreement can lead to increased economic management of the assets, this can lead to a reduction in sovereignty.

Land share agreements originated in post-World War II Germany, with subsequent spread to Japan

The purpose of this research is to investigate how viable the options are for post-earthquake recovery in Peterborough Village?

- 1. What opportunities exist for stream restoration and how might this be facilitated?
- 2. What are the options for foundation rebuilding in relation to land within Peterborough Village?
- 3. What different types of land-share agreements exist and what are the resident's perspectives associated with these?

In order to gain an understanding of the issues within Peterborough Village, and the possibilities for the future, extensive background research was undertaken in relation to streams, land sharing and foundations. This involved a combination of background reading, consultation with the Peterborough Village (Pita Kaik) Community committee, retrieving information from community locals, and a number of interviews with professionals in the required fields.

A focus group was held to facilitate community discussion and retrieve opinions about the range of options explored through background research. This was advertised twice through the Peterborough Village community group email list, and at a seminar about community co-housing held in the Villag

## 5.2.3 Ceramic footpath

The option of a ceramic footpath was debated among participants. While some thought that it was a "lovely idea" and would be a good back-up if daylighting did not go ahead, others believed that it would depreciate property values as potential buyers might not wish to buy a house that obviously had a historic underground stream next to it, especially as considerable earthquake damage was seen to occur near historic streams. Other focus group members felt that a less permanent

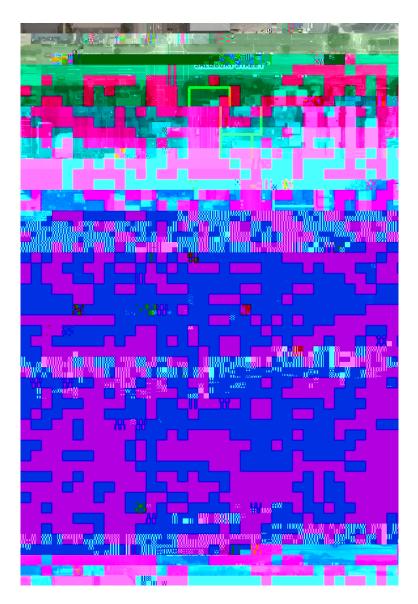


Figure 14: Properties required to be purchased by the Council to allow for the daylighting of a stream along the eastern length of Manchester Street.

Land values, not including property values, totalled a cost of \$3,088,000. Although it is likely that land not employed for stream purposes could be sold-on, this still represents a considerable cost to the Council.

## 5.2.5 Council does not purchase land

The majority of participants believed that if the council did not purchase the land, daylighting would be too difficult to achieve. This was due to the uncertainty and issues around working with other landowners and reconfiguring properties as discussed by Pinkharm (2001). One respondent stated, "The whole question is just too big for me to understand. I don't know what the ramifications are, the property title, and the legal ownership it's a bit of a minefield."

Additionally, all members stated they were not able to contribute some of the costs of daylighting a stream, particularly if this stream did not run through or near their property. They stated that they had "bigger priorities" and could not "be bothered with a fight" and many did not believe that their

insurance pay-out would allow them to do so anyway. Some indicated they would be more likely to contribute to stream daylighting if evidence indicated that this would reduce liquefaction and earthquake-related damage. Still, most believed it was the Council's responsibility to create and maintain the urban stream.

### 5.2.6 Daylighting in Pita Kaik

In this sense it appears that the only possibility for daylighting in Peterborough Village will result from the Council purchasing such land. Despite this, the cost of doing so is substantial. However, such an option may be considered by the council if the community makes a collaborative decision to create streams in their area, and are seen to be proactively working together on this. There is potential that the possibility of this may be enhanced by the presence of a stormwater culvert that is in need of replacement, and thus it could be argued that daylighting this would be cheaper and more beneficial in the long-term than replacing the pipe (Watts & Greenaway, n.d.). However, this would still require a significant land purchase by the Council.

In any case, while the earthquake has presented opportunities for exposing streams in Peterborough Village, it has also placed considerable pressure on public and private funds, consequently reducing the feasibility for such opportunities to go ahead. Nevertheless, there appears to be considerable backing from the community for exposure of a stream within Peterborough Village, and further discussion between the council and community should be facilitated.

#### 5.3.1 Advice

Participants of the focus group had been given a range of advice

# 5.3.5 Foundations in Pita Kaik

Feelings and o

This research has investigated three key areas that relate to the multi-faceted recovery of Peterborough Village following the Canterbury earthquakes. These areas include stream exposure, foundation repair and land sharing techniques. Research was conducted through extensive literature review, discussion with related experts and the use of a focus group to gain an understanding of the positionality of residents in relation to the key themes. Key areas of redevelopment identified in the research included the daylighting of historic streams, the rebuilding of homes with earthquakesuited foundations and potential for the sharing of land titles. Options received particularly well by the community included stream daylighting or the development of a swale in the area, the use of lightweight or tilt foundations alongside collective ground remediation and the potential emergence of more cross lease arrangements in the area. Despite this, our research found that due to the **nature of Ch**ristchurch's recovery, many redevelopment opportunities are tied to government agencies or protocols, and require local-government or expert support to be viable. From these findings, we can conclude that when considering the redevelopment of Peterborough Village, in depth conversations about responsibility and opportunity need to be held between Christchurch City Council, CERA and the Peterborough Village Community. Additionally, residents would benefit from a greater understanding of the process of individual home rebuilding, especially in relation to foundations and soil dynamics. Finally, it was found that there needs to be a change in perception of the concept of land sharing, not only at the individual level but also at the commercial level. This study was limited by the short time frame available and the complex nature of the issues at hand. Of further benefit to the Peterborough Village community would be an extension of this study in collaboration with the wider community, the council and appropriate experts.

It can be seen that there are a number of viable options for the redevelopment of Peterborough Village. This viability, however, depends on the ability and willingness of government organisations to become involved in particular projects, as well as the meeting of complex regulations and codes in relation to particular aspects of the community. As a result of the ongoing nature of the redevelopment of both Christchurch and Peterborough Village, there is a need to recognize that this project is of an open ended nature and has an opportunity to extend into the future of both Peterborough Village and Christchurch as a whole.

To Smon Kingham and Eric Pawson- your carefully considered advice and wisdom throughout this project was greatly appreciated. Di Lucas and Mark McKnight, thank you for your patience and guidance and for the constant flow of emails! Thank you also to the following people: Robert Watts for your wealth of knowledge regarding the uncovering of streams; Michael Fisher for explaining the Council's role in the rebuild; Dave Brunsdon and Rob Logie for your engineering expertise. Also, thank you to David Moore, Graham Harrington and Robert Watson for information regarding streams and stormwater in Peterborough Village.

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<ul> <li>containment by ground reinforcement or curtain walls</li> <li>drainage using stone columns or earthquake drains "</li> </ul>
"Type 1 - Densified raft (ie, re-compacted soil or replacement fill; also dynamic compaction or rapid impact compaction).
Type 2 - Stabilised crust (ie, cement mixed soils, either by excavate and replace or insitu mixing).  Type 3 - Deep soil mixing (ie, soil mixed or jet grouted columns).
Type 4 - Stone columns.
Type 5 - Low mobility grout columns.
Some or all of these methods may require a resource consent. In particular, noise and vibration effects should be considered."  (DBH, 2012, p. 53)

weight wall cladding, and with regular plan layouts.

Due to the range and different combinations of future vertical land settlement and lateral spreading (stretch) on TC3 sites, careful consideration needs to be given to the selection of surface structure options." (DBH, 2012, p. 66)

- modified NZS3604 light-weight platform. Capable of withstanding moderate differential vertical settlement from liquefaction at SLSIevels (ie, corresponding to minor

- What would you describe as your main ties to Peterborough Village? (E.g. financial, family, home ownership...)
- Did you feel well informed by the Peterborough Village community group with regard to the community submission to the City Central Plan, and able to participate in this?
- Do you feel well informed in general about the central city plan and rebuild?
- Do you have a mortgage?
- Do you have insurance that covers earthquake damage?
- Will your insurance pay-out be enough for you to rebuild your home/workplace in the way that you wanted or needed to?
- Do you wish your land had been red-zoned? Why?

- Do you like the idea of a stream through Peterborough Village?
  If a stream were to be 'exposed' within the Village would you prefer for it to be located where the historical stream was situated (refer to the blue line on Figure 1)



