Akaroa Harbour Settlement Study Areas

Historical Flooding Research and Mapping Project

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Prepared for
Strategy and Planning Group
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by
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Discussed at meeting on January 28, 2008 with:

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Includes:

- *additional information on Duvauchelle received after draft report*
- *analysis of additional rainfall data supplied after draft meeting*
- *minor comments and amendments as per draft meeting*

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1 Introduction

The purpose of the Historical Flooding and Mapping project is to provide Christchurch City Council with information on areas of potential flooding in Akaroa Harbour Basin to contribute to achieving the wider outcome of "strategic direction for the sustainable management of the Akaroa Harbour Basin for the next 20-30 years". The project covered the areas as delineated in the Akaroa Harbour Basin Settlement Study produced by Christchurch City Council and includes:

- Akaroa
- Takamatua
- Robinsons Bay
- Duvauchelle
- Barrys Bay
- French Farm
- Tikao Bay
- Wainui

The Historical Flooding and Mapping project scope is to provide part of the picture of flooding in the Harbour basin by mapping where floods have occurred in the past, and to indicate areas where further more detailed work is warranted to better define the flood hazard.

The main information sources initially identified for the study were historical photographs and memories of long-term residents within the study areas, and the local newspaper, the Akaroa Mail. In addition, Council and Transit records were to be checked, although preliminary enquiries showed that neither of these organisations had kept much in the way of records of flooding. During the research it soon emerged that the best sources of information were the Akaroa Mail articles and residents' memories.

Environment Canterbury (Ecan) supplied rectified aerial photographs of each Settlement area, showing the Settlement Study boundaries and the streams. These photographs were used to create the flooding maps.

1.1 Overview of Methodology

The project used the following methodology:

- Electronically held rainfall records for the area were obtained from NIWA, and used to identify times when very high rainfall had occurred.
- Archived copies of the Akaroa Mail were then checked for each very high rainfall occurrence identified. Note was taken of any relevant article titles, and articles with information on flooding were photographed.
- Key community members with an overview of the whole area were interviewed, and asked for suggestions of other people to interview.
- An article was published in the Akaroa Mail explaining the project and requesting members of the public to contact the researcher if they had information or photographs of flooding. The advertisement accompanying this article was re-run in two further issues of the Akaroa Mail.
- Interviews were conducted with long term residents, including at least one from each settlement area. Interviewees were asked to recall and describe flooding within their area, and to indicate areas of flooding on the aerial photographs. Enlarged copies of photographs were used where necessary. On-site examinations were conducted in some cases to identify culverts, bridges and other details too small to identify on the aerial photographs.
- Further interviews were conducted with other people that they recommended and to fill in details of flooding on specific properties.
- The Akaroa Mail archive was re-examined for any additional flooding episodes remembered by individuals that had not already been identified using the high rainfall index.
- Maps were created for all major flooding events where sufficient information was available. At least one map was produced for each Settlement Study area to show flooding patterns.
- An assessment was made of the accuracy of each map based on the number of independent

sources used to provide the information.

- An assessment of the frequency and the likely re-occurrence of the event was made based on the rainfall level and any other events which had contributed to the flooding.
- A draft copy of the report was circulated to project staff in Christchurch City Council, Ecan and Tonkin and Taylor, and a meeting was held to gather comments to prepare the final version of the report.
- After the draft meeting, Ecan staff supplied additional rainfall data for Akaroa dating back to 1894, and including cumulative storm totals. Further checking was carried out to see if this identified any additional flooding.

1.2 Document Format

The following sections of this document give

- more detailed information on the methodology used for the research including creating the rainfall index and checking the Akaroa Mail, and an overview of the interviews conducted.
- a description of the main rain events that are known to have caused flooding.
- a description of each settlement followed by a map and photographs showing each flooding event where sufficient detail has been amassed . Each flooding event is followed by an assessment of the causes, known frequency any corrective action taken, comments on probable re-occurrence and accuracy of the map.
- a general description of the problem areas in each settlement area is given after the details of the flooding events.
- Appendix A gives details of every rainstorm event examined.
- Appendix B is a copy of the publicity given to the study in the Akaroa Mail.
- Appendix C names all the contributors who were interviewed for the study.

2 Rainfall index

The purpose of analysing rainfall records first, was to narrow down the search through many years of the Akaroa Mail to those issues most likely to contain information about flooding. NIWA provides a climate database on its website http://cliflo.niwa.co.nz, with rainfall records available in electronic format, including two from collection sites within the Akaroa harbour basin. The complete set of records from these two sites was downloaded from the start of record keeping until the end of October 2007, allowing for a quick and efficient analysis of the dates when heavy rain had fallen in the area.

2.1 Examining rainfall records

The rainfall records available from NIWA are taken from collection sites at the northern end of the Onawe Peninsula, and at Rue Lavaud Akaroa.

2.1.1 Onawe

The Onawe dataset starts on 2 Jan 1934, giving over 73 years of rainfall data up to the end of October 2007. The record is very complete with few missing days; of a total of 26,966 days since the start of the data set, 26,920 days had rainfall data recorded, only 46 were missing.

2.1.2 Rue Lavaud Akaroa

Collections have taken place at Rue Lavaud since 2 December 1977, giving nearly 30 years of data up to the end of October 2007 The Akaroa record has quite a few gaps in it; of a total of 10,926 days since the start of the dataset 10,794 days had rainfall data recorded but 132 were missing.

2.1.3 Other personal records

Many farmers and other private individuals take regular rainfall readings, and about 20 people from properties right across the Peninsula send their data through to Hugh Wilson, the manager of the Hinewai Reserve. However, these readings are sent through as monthly totals rather than daily

readings, and they are all handwritten, so of limited direct value to this study and time consuming to analyse. Personal daily rainfall records kept by two local residents, John Roe in Takamatua and Des McSweeney in Aylmers Valley, were partially examined and discussed. Frustratingly, in both cases, key dates were missing from their data when they had been away, illustrating a further problem with private data records. Data from some of these collection points has been digitised by Christchurch City Council staff and was supplied after the draft report meeting, but added little information to what was already known.

Hugh himself has taken rainfall readings at the Hinewai reserve house since 1988 and at a skyline rain gauge on Brocherie Flat since 1994. Hugh's observation is that the rainfall at the skyline is typically 2.5 times that taken at sea level. A number of other people spoken to commented on the great degree of variability in rainfall measurements in different areas at the same altitude, even places quite close by. As a general rule, rain levels taper off toward the north end of the harbour.

2.1.4 Stanley Park Akaroa

After the draft report meeting, Ecan supplied data from the Meteorological Service taken at Stanley Park (Armstrong Crescent) in Akaroa. This record runs from 1894 until 1995, although there are a number of gaps in it. In addition, Graham Harrington from the Asset and Network Planning unit of Christchurch City Council supplied a cumulative index based on the total rainfall of each storm (adding all the daily rainfall totals between 0 readings) from this data. The research was not extended back to 1894 on receipt of the Meteorological Service data, but both the raw data and the cumulative index were used as a cross check on the earlier work to assess whether additional flooding events could be found.

2.2 Determining exceptional rain levels

The NIWA data was examined to find out what rainfall levels could be considered exceptional and therefore most likely to cause flooding. The number of days when rainfall exceeded thresholds of 90mm, 50mm and 25mm was aggregated, giving the following results:

	Total days	Days over 90mm	%	Days over 50mm	%	Days over 25mm	%
Onawe	26920	19	0.07%	118	0.44%	551	2.05%
Akaroa	10794	17	0.16%	78	0.72%	238	2.20%

This summary shows that the rainfall in Akaroa is often much higher than at Onawe; Akaroa had nearly as many days with over 90mm of rain but in under half the number of days recorded.

A comparison was then made of the average of the Akaroa and Onawe data for the years where they overlapped to ascertain how good a predictor the Onawe data would be for Akaroa, because for the majority of the study, the Onawe data would be the only available rainfall index.

	Onawe	Akaroa
Average	2.46	2.75
Standard deviation	6.97	8.9

This showed that rainfall at Akaroa was on average higher than Onawe and with a greater degree of variability. The correlation between Onawe rainfall and Akaroa rainfall was calculated at .83

The rainfall for both collection stations was graphed, and showed that when there is very heavy rain, it more often results in a huge deluge in Akaroa, although sometimes the reverse is true, and rainfall at Onawe is much heavier.

The conclusion from this analysis was that because of its generally lower rainfall, and the degree of difference between the two collection points, the threshold level at which Onawe rainfall data would be useful for exploring whether major flooding events could have occurred elsewhere in the harbour would need to be set relatively low.

2.3 Setting the Rainfall index threshold

An initial search was then made in the archived copies of the Akaroa Mail to see what rainfall level at Akaroa itself generated flooding reports. All of the 17 days with a Rue Lavaud rainfall over

90mm were checked to see if flooding at Akaroa had been reported. This showed that the minimum rainfall level at Akaroa that generated a flooding report was 120mm in a single day; no days when rainfall was less than this had resulted in a flooding report since 1977.

The corresponding rainfall days for Onawe were then examined to see what levels had fallen at Onawe when Akaroa had experienced 120mm of rain. This showed that Onawe falls could have been as low as 50mm when Akaroa had 120mm of rain.

Consequently, it was decided to take a conservative approach initially, and to check the Akaroa Mail for a flooding story each time that rainfall at Onawe had exceeded 50mm on a single day.

3 Checking the Akaroa Mail

The Akaroa Mail has been published continuously since 1876, with a short break of 2 months before the present editor, Michael de Hamel, took over the paper in 1985. The paper has generally been of a very high standard, apart from in the period just before Michael de Hamel took it over, when reporting was of a lower quality and very few photographs were published. For a few years in the late 1970s and early 1980s stock photographs were re-used, so whenever flooding and storms were reported the photograph used was the same one – a picture of the sea coming over at Duvauchelle. Since Michael de Hamel took over, the paper has been much better, like it was in earlier times. The Akaroa Musem has a full archived set of the Akaroa Mail with almost every issue since the paper began. Only two issues (May 1934 and April 1962) that would have been useful to read were missing from the Akaroa Museum set. Other archived partial sets of the Akaroa Mail are held by the Christchurch City Library, the MacMillan Brown library at the University of Canterbury, and the National Library. Unfortunately, the same issues were missing from these collections as well.

A complete list of Akaroa Mails checked is given in Appendix A, “Complete List of Rainstorm Events”. Notes were taken of any articles with specific mention of flooding and they were photographed for future reference.

3.1 Rainfall index checks

In total 107 issues of the Akaroa Mail were specifically checked, based on the rainfall index using the Niwa data back to 1934. This included the 17 days where rainfall in Akaroa had exceeded 90mm and all other days when rainfall at Onawe was at or exceeded 50mm, and a scattering of days where rain was just below the 50mm mark but had persisted for several days in succession (Note that although there were 118 days on which over 50mm was recorded at Onawe, some of these occurred as part of the same rain storm on successive days, so the list of rain fall events to be checked was slightly lower.) Of the 107 days checked, 65 had an article about the rain and 23 of these articles were about flooding in areas covered by the Settlement study.

At the end of the study, a further 8 rainfall events were checked based on the Meteorological Service data from Stanley Park. This included checking the highest rainfall now known about, the storm in June 1895, two additional storms with rainfall of over 90mm in Akaroa prior to 1977 that had not been triggered by the Onawe data threshold of 50mm and 5 storms where the cumulative storm total was greater than 200mm, but had not triggered the Onawe 50mm threshold.

These additional checks revealed that in 1895 there was some flooding in Akaroa, but nothing as great as later floods such as in 1936. This is probably due to the town being less built up at that time, and with less reclaimed land. The other storm that resulted in flooding which was not been identified from the Onawe data was in May 1945. This storm included 2 consecutive days of rain of over 90mm. Of the 5 storms where cumulative rain was over 200mm but no individual day was greater than 90mm, no flooding was reported, suggesting that it is heavy rain in a single burst rather than cumulative rain over several days that is generally responsible for flooding.

3.2 Further checking post interviewing

After interviewing residents, some further checking was carried out of months and years when people had remembered flooding events that were not already on the identified list. This proved generally fruitless, probably because old memories are not good when it comes to remembering specific dates.

3.2.1 Tsunami checking

Two tsunami struck the Akaroa area in the early 1960s. The first of these was on May 24 1960. A

full report of this was given on the front page of the Akaroa Mail as there was flooding in several places. The second tsunami on 28/29 March 1964 was much smaller and although the surges were of note, flooding was only reported in Takamatua.

4 Interviewing

A total of 42 interviews were conducted with local residents, including community members holding key positions of responsibility and long term residents of the various settlement areas.

4.1 Key Community Members

Initial interviews were conducted with three key community members to get an overview of the flooding potential of the small settlements. These key community members included Ken Paulin, the former County Engineer, Liz Haylock the Civil Defence Welfare co-ordinator and Liz Carter, currently the Community Board Advisor for Banks Peninsula Wards and for many years the Council Administrator for Akaroa.

Near the end of the process Kim Stewart, current chief of the Akaroa Fire Brigade, was interviewed, but the interview focussed specifically on Kim's extensive knowledge of the 2002 flood in Akaroa rather than a general overview.

4.1.1 County Engineer

The notes taken during the interview with Ken Paulin are included here in full, because they have proved a useful assessment of the situation on the Peninsula during subsequent research.

Ken Paulin was the Akaroa County engineer from 1971 to 1989 and then the Banks Peninsula District Council Works and Services manager from 1989 to 1996. Since retiring from his full time position with the Council he has worked as a project engineer in the Akaroa ward.

Ken provided information about changes and improvements in construction methods during his time at the Council, comments on his experience with flooding in each of the Settlement Study areas, and a list of further people to approach.

Engineering changes

Ken recalled that more problems in the Akaroa area had been caused by land slips resulting from heavy rainstorms than flooding. He attributed the number of slips in the 1970s to changes in farming practices at the time. As the use of motorised vehicles for farming replaced horses, farmers cut many tracks into the hillsides and these changed the natural drainage patterns, channelling water back to the public roads and causing slips.

Ken also felt that since 1971 most flooding had occurred in conjunction with high tides, and that works to improve storm water disposal had reduced the amount of flooding occurring in Akaroa. Flooding from the creeks and streams generally occurred now when there is debris washed down by heavy creek levels that then blocked under bridges. This was the cause of the flooding in Akaroa in 2002, and since that storm a committee had been formed to monitor streams for potential debris and to keep them free of this to minimise blockage potential. The type of debris that could be washed down in a storm and cause blockage problems was: barbecues etc left lying around on the stream banks from summer when water levels were lower, willows, and ornamental bridges.

Personal recollections

The major events that Ken recalled in Akaroa were:

- La Claire subdivision (Hempleman Drive) slip which he attributed to a road being built over a seepage area and giving way after wet winters. Corrective action was taken by removal of fill above the slip area, and the upper part of Hempleman drive was closed.
- Flooding from Walnut creek along Rue Jolie south and Beach road as far as the waterfront shops nearly to Church street, which went into the shops.He felt that problems with Walnut creek had been addressed, as it did not flood in 2002.
- Flooding in Rue Balguerie including the back of the old Presbyterian Manse.
- Flooding of Rue Lavaud from the Grehan Valley Stream around the Grand Hotel.
- Flooding of the Bowling green area. This he attributed to stormwater pipes under Rue

Brittan being insufficient to cope and the amount of surface water draining from L'Aube Hill.

- Flooding on the corner of Rue Balguerie and Muter Street. This he attributed to inadequate household stormwater drainage in Watson street, which lead to drainage through properties below in Muter street and then some ponding at the bottom at the junction with Rue Balguerie, but he was unsure of the last time when this occurred.

Ken's comments on the other areas in the harbour basin were:

- Takamatua - the main problem is that the steep Old French road drains to a channel running along the back street of the beach front baches, but that this is not monitored adequately, and that drains at this area of the baches need improving.
- Robinsons Bay - It is hard to keep the culverts that empty into the bay open because they are constantly being silted up by the tide. He thought there had been problems with flooding at the houses along the waterfront.
- Duvauchelle - in the past there have been slips above the Hotel and flooding through the old sale yard. The streams along the golf course are now being kept well.
- Barry's Bay - Ken was unsure about flooding here, but there is a drain that comes down the valley road, and flooding here is likely to be tide related.
- French Farm - Ken did not recall problems here, and felt that the streams drained "smartly" into the harbour (in contrast with Robinsons Bay).
- Tikao - Ken did not recall flooding problems here, which he attributed to the steep terrain.
- Wainui – the whole south end of Wainui has been affected by slips. There are no houses on the two sections at the end due to slips. There has been some flooding in the baches near the sea front because of willows blocking the stream that meanders down the valley from the YMCA property. Problems at Wainui should be solveable by managing these willows as the steep beach means that there is good fall from the streams into the sea and it is not troubled by high tides.

4.1.2 Civil Defence Welfare Co-ordinator

Liz Haylock has been the Welfare co-ordinator for Civil Defence since 1983. Liz provided information about the history, structure, management and record keeping of Civil Defence and her personal recollections of flooding events.

Liz recalled that prior to the 1990s, the government devolved responsibility to local councils. Hence Civil Defence in this area was run by the local council and had no independent structure until about 1992. Any records kept by Civil Defence such as log books and diaries of particular events would be held as part of Council Records. Liz Carter would be able to help divine what might exist and where.

The Council first developed a proper plan for Civil Defence in 1990. The Civil Defence co-ordinators for this area since then have been:

- Jed Foley
- Paddy Stronach
- Mark Shadbolt
- Winston McKean
- Rory Redmayne (current)

(Later information obtained from Ecan indicated that the local Akaroa Council had varying degrees of responsibility for Civil Defence until it was amalgamated into Banks Peninsula District Council in 1989, who in turn contracted out much of its civil defence role to the Canterbury Regional Council.)

4.1.3 Council Administrator

Liz Carter has been the Council Administrator for the Akaroa area working for the Akaroa County Council since 1987, and subsequently Banks Peninsula District Council. Since the amalgamation with Christchurch City her role is Community Board Advisor for the Banks Peninsula wards. Her husband, Geoff Carter, is a former employee of the Post Office and has worked in the Akaroa Service Centre since 1993. The Carters were called out during the 2002 storm and ran the call

centre assisting with evacuations. Liz Carter could not identify that any Civil Defence records were held by the Council. She did identify that the Banks Peninsula District Council had kept a storm damage file.

Liz confirmed that the Akaroa Streams Maintenance committee (formed after the 2002 flood) is still operational, and is now managed by Owen Southen. The last inspection was carried out in December 2006 in conjunction with CCC and Ecan staff, along the four main streams running through Akaroa. A letter was sent in January 2007 to all property owners along these streams advising of the need to keep the banks free of refuse and firewood, clear overhanging and fallen vegetation and the requirements for structures over streams.

The Carters have lived in Duvauchelle since 1985 and provided detailed information about Duvauchelle flooding in 1986.

4.2 Interviewing Residents

4.2.1 Akaroa Mail Article

A full page article describing the Historic Flooding and Mapping project was printed in the Akaroa Mail on Friday November 30 2007, prior to contact being made with long term residents asking for their assistance. This proved very useful, partly in eliciting information from members of the public that would not otherwise have been contacted, and also because those who were contacted were fully aware of what the project was about. A paid advertisement explaining the project was run in the same issue, and in the two following issues on December 14, 2007 and December 28, 2007. A copy of the article and advertisement are included in Appendix B.

4.2.2 Residents interviewed

In addition to the key community members already described interviews were conducted with local residents, including at least one person from each Settlement Study Area. It was found necessary to interview more people than originally planned, because most people's recollections were limited to the immediate vicinity of their own property, or, if they had been involved with relief work, the area that they had manned during the flood. A complete list of the people interviewed is given in Appendix C.

The information from each interview was recorded in a set of interview notes and key information summarised in this report under each settlement area. Residents who provided photographs were also asked to sign a release sheet giving permission for the photographs to be used and reproduced by Christchurch City Council in reports related to its flooding research. Some of the photographs were copied by scanning and some supplied as digital images. Other photographs (particularly older ones) were not removed from residents houses, but re-photographed to provide an image adequate for research purposes.

4.2.3 Common points

Similar points were made by a number of people interviewed, these being:

- Small streams on the Peninsula can turn rapidly into powerful raging torrents. Many people commented on the incredible noise made by rocks grinding in these torrents, and showed examples of rocks that have been shifted by the streams, including large boulders.
- Generally even these raging torrents stay within their banks and it is often blockages under bridges that cause them to burst out.
- Flood water quickly drains away as soon as the rain stops or blockages are cleared. Floods do not pond and stay around like they do on the Plains.
- Photographs record the flood levels as seen at the time, but not necessarily at the highest point. Furthermore, as water recedes so quickly on the Peninsula, and photographs tend to be taken after rather than during the main "emergency" period, they are not necessarily as good a guide to the extent of flooding as the recollections are.
- Obtaining photographs proved difficult. Quite a number of people had taken photographs of flooding at the time, but now had no idea where they were or would have to search through boxes in sheds and attics to find them. Those people who did have photographs

accessible were very happy to share them.

- Slips caused by heavy rain have been more problematic on the Peninsula than inundation flooding. Slips tend to happen more after there has been heavy rain for a number of days when the clay is saturated. A single heavy rain on dry ground will tend to "bounce" off.
- Variability of rainfall in different areas. People who have collected rainfall records over the years like to compare notes with others also taking records, and comment on the great degree of variability from one bay to another. In general it seems that the closer to the harbour heads, the greater the rainfall, confirming the findings from the rain records themselves that the falls at Akaroa are on average higher than those at Onawe. At the head of the harbour and a low altitude, Onawe itself receives relatively little rain.
- Several interviewees commented that it is the amount of rain in the upper parts of the catchments that is more responsible for flooding than rain in the valleys themselves.
- Rain coming from a north easterly tends to hit the Akaroa side of the harbour more heavily. Rain coming from the west and south affects the Wainui and Barrys Bay side more.

4.3 Tales of Banks Peninsula

An extensive collection of memories from different Peninsula bays was published in 1990 to commemorate Akaroa's 150th year with the title *"Tales of Banks Peninsula 1940-1990"*. Unfortunately this book lists neither its sources or even its authors. However, it did reveal some information on flooding, the main recollections being of the 1960 tsunami (then referred to as a tidal wave) at various places and the Wahine storm.

5 Council and Transit records

Very little information about flooding has been recorded over the years by government agencies, so these records added little to the overall knowledge of events. However, the following section describes the files that were produced in response to requests and the relevant information found in them.

5.1 Records from Banks Peninsula District Council

Liz Carter identified that there were no specific records on flooding held by the Akaroa County Council or the Banks Peninsula District Council, and could think of no way of finding out this information. The Storm Damage file that she did identify was supplied by Council Archivist, Brian Saunders.

This file, RD37, was opened in 1/1/1999, but the first correspondence that appears in it is after the October 2000 storm. Relevant information found in this file included:

- A letter from the management of Club Lavaud (on the main road into Akaroa just before the corner into Rue Lavaud) requesting improvements to the culvert and piping near the building. This letter (dated 31 October 2000) mentions that it is the second time water damage has occurred to the building in 5 years, but no details as to when this has occurred.
- The file also contained road condition reports and media releases from 19 November 2002 to 22 September 2005. No flooding was referred to in any of these reports, which mainly dealt with road closures due to snow and ice.

Also supplied was information on landslide damage caused to the Lighthouse Road in July 1994 and to the Ngaio Point slide in the Big Snow August 1992. (This area is above the state highway and now referred to as Ngaio Grove). Both of these storm events had already been identified.

The file also contained a schedule of flood damage repairs from the 1994 storm. The only one within the Settlement Study area was the Lighthouse Road slip.

The file on the Akaroa Streams Maintenance committee, now held by Owen Southen, was also examined, but this contained no further detail on the floods themselves.

5.2 Transit records

Transit was formed in 1989 and has kept records of flood damage to the state highways since. Prior to that no records exist. Barry Stratton supplied Part 2 of the Transit file SH/11/0/15 "Flood Damage Canterbury" which dates back to 7 September 2000. Unfortunately Part 1 could not be

located in the Recall storage facility and hence has not been examined.

Part 2 contained some information on two storms since 2000 which have caused flood damage to State Highway 75. These were in October 2000 and January 2002. In October 2000 there were a number of slips on the road between Hilltop and Barry's Bay, but no specific record of flooding. This does not mean there was no flooding, just that it did not require significant enough cleanup to merit an entry in the file. In January 2002 there were washouts at Archdalls road in Robinsons Bay and the Long Bay road above Akaroa. There was also flooding from the Takamatua river and surface debris needed to be cleared. There was also a copy of an article from the Christchurch Press (presumably, but not labelled as such) describing the damage in Akaroa and flooding at Bon Accord backpackers on Rue Lavaud.

6 Rain storm events

A complete list of all the rain storm events considered during the preparation of this report is given in Appendix A.

6.1 Rainstorm events known to have caused flooding

This following table lists all the storms from the complete list that have been found to cause flooding in Settlement Study areas. Rainfall figures for Akaroa prior to 1978 have been obtained from the Stanley Park data, and from 1978 onwards from the Rue Lavaud data. Highlighted floods are mapped later in the report.

Table 1 Storm Events known to have caused flooding

Year	**Month Day**	**Rainfall at Onawe**	**Rainfall at Akaroa**	**Study Areas flooded**	***Storm name / Comments***
1934	May 4 5	 60.5 57.7 21.3	 59.7 169.9 60.7	Akaroa	*May 1934*
1936	February 7 8 9 10	 21.6 10.4 75.7 12.2	 16.0 13.7 192.0 31.5	Akaroa	*Feb 8/9 1936* Te Ara encyclopedia of New Zealand lists worst cyclone to hit New Zealand in 20th century on 2/3 February in North Island
1936	February 20 21	 43.2 82.8	 96.0 297.9	**Akaroa** Takamatua	*Feb 20/21 1936* Presume related to earlier tropical cyclone, Caused a huge flood in Akaroa
1945	May 18 19 20 21	 1 34.5 42.2 39.1	 7.6 120.7 110.0 89.9	Akaroa	*May 1945* Extensive flooding in Southern Akaroa and fron the Balguerie stream. Slips in other areas but no flooding reported
1962	April 15 16 17	 13 109.5 22.9	 11.2 91.7 14.2	Akaroa	*April 1962* Very high winds. Akaroa Mail missing, so very little information, but remembered by fishermen

Year	Month Day	Rainfall at Onawe	Rainfall at Akaroa	Study Areas flooded	*Storm name /* Comments
1963	April 19 20 21	 45.7 57.9 19.6	 36.6 74.7 43.2	Akaroa	*April 1963* Recreation Ground
1963	July 3 4 5 6	 5.8 32.3 47 41.1	 7.9 30.7 71.1 68.6	Akaroa	*Early July 1963* Aylmers creek flooded Beach road Selwyn Ave Upper Balguerie road
1963	July 14 15 16 17	 43.9 35.8 39.6 17.8	 97.5 62.0 72.4 38.1	Akaroa Takamatua? Duvauchelle Robinsons	*mid July 1963* Rue Lavaud from Waeckerle bridge to Rue Grehan, Rue Balguerie, Percy Street, lower Balguerie creek, Walnut Place, Beach Road, slip behind Gaiety
1963	December 20 21	 147.3 217.2	 4.6 116.1	**Barrys Bay** French Farm Tikao Bay	*Christmas 63*. Extensive damage on Peninsula, but Barry's Bay only settlement area where flooding reported in paper. There was also flooding at French Farm and Tikao according to memory. Started as a north easterly then turned southerly with very high winds
1968	April 10 11 12	 29.5 205.7 73.9	 41.1 167.6 59.9	Akaroa **Duvauchelle** Barry's Bay **French Farm**	*Wahine* Extreme rain and very high winds lead to flooding in the western side of the harbour. There was flooding at Beach Road Akaroa from sea surges and a high tide. This was an easterly cyclone, but seems to have come from the south in the Akaroa harbour
1973	August 6 7 8	 63.4 70.2 9.7	 156.5 144.8 31.3	Akaroa	*August 1973* High winds Akaroa streets awash Akaroa Museum flooded Torrents from Stanley Park
1974	August 23 24	 16.8 87.2	 15.5 133.8	Akaroa	*August 1974* Beach road and most problems from Slips
1975	June 14 15 16	 18.9 54.8 48.7	 32.3 176.3 106.9	Akaroa	*June 1975* Muter Street drain Beach road from Walnut creek

Year	Month Day	Rainfall at Onawe	Rainfall at Akaroa	Study Areas flooded	*Storm name* / Comments
1975	August 19 20 21	 23.6 47.5 77.4	 14.7 54.5 94.4	Akaroa Duvauchelle Wainui	*August 1975* Strong Southwesterly. Akaroa awash in low areas Picture of sea over wall in Duvauchelle Massive slips in Wainui
1976	August 27 28 29	 53.8 53.4 28	 51.2 40.2 72.7	Akaroa	*August 1976* Hempleman drive slip. The amount recorded at Hickory Bay at a high level stations was 340mm. Locals remember a storm around this time with 14 inches in 12 hours, and this may be it.
1977	July 3 4 5	 80.8 111.6 9.7	 59.3 103.6 53.1	Akaroa Duvauchelle	*July 1977* Strong Southwesterly winds Beach road flooded by sea Akaroa Museum +Gallery flooded
1978	July 8 9 10	 97.5 61.4 15.5	 121 67.4 14.4	Akaroa	*July 1987* Beach Road from rain Other Akaroa streets
1981	August 25 26 27	 42.3 30.7 39.8	 48.2 18 78.8	**Akaroa**	*August 1981* Balguerie Stream Rue Lavaud
1986	March 13	 78.5	 90	**Duvauchelle**	*March 1986* Golf course flood
1986	August 22 23 24	 10.8 48 56.8	 21.5 120 110.4	Duvauchelle	*August 1986* A culvert blocked at Duvauchelle, otherwise places outside the settlement study. Jack Woodleys slip in Takamatua
1992	August 27 28 29	 63.6 70.3 56.4	 110.3 46.5 42.3	Akaroa **Duvauchelle** **Tikao Bay** **Wainui**	*Big Snow* This storm is best remembered for the snow that blocked the roads, but in the lower areas it fell as heavy rain. There were also very strong sea surges causing flooding on the Western side of the harbour
1994	July 26 27 28	 36.7 138.8 35.6	 44.8 198.1 41.5	**Akaroa** **Takamatua** **Robinsons**	*Lighthouse road slip* Caused the Lighthouse road slip about Akaroa and extensive flooding

Year	Month Day	Rainfall at Onawe	Rainfall at Akaroa	Study Areas flooded	*Storm name /* Comments
2000	October 12 13	 61.7 99.6	 64 33	**Barrys Bay** **Duvauchelle** Tikao Bay **Wainui**	*Lyttelton Marina Storm* Extreme high winds were the problem as much as rain, bringing down many trees and causing slips.*(Rainfall at Akaroa sourced from Des McSweeney as missing from Niwa record)*
2002	January 12 13	 38.3 66.8	 55.5 143.5	**Akaroa** **Takamatua**	*January 2002* Localised heavy rain over the Akaroa Catchment, particularly the northern part of town

6.2 Completeness of list

The list of rainstorm events that have caused flooding given above should be read with the understanding that some flooding events may have not been identified by the study due to the limitations of the methodology. These limitations include:

- reliance on rainfall records from only two collection points in the harbour.
- use of Akaroa Mail reports which are quite variable depending on the editor at the time, and other competing newsworthy events - certainly during the 1970s and 1980s some fairly major flooding events received minimal reporting.
- use of personal memories which can blur different flooding events and confuse times.

The primary method used in the study was to identify days with exceptionally high rainfall, and then examine the issue of the Akaroa Mail subsequent to that rainfall to see if there was a flood report.

The secondary method was to gather additional information on flooding and more detail from personal interviews. This was less systematic than the primary method; the flood events identified by the interviews depended very much on who was approached and what they remembered, and was naturally skewed to more recent events.

To assess the degree to which the primary methodology may have missed flooding events the complete list was reviewed to see how many of the floods listed had been identified by other methods than the rainfall indexed Akaroa Mail checks. This showed that three were detected using other methods. The August 1981 flood in Akaroa was identified solely because of a resident's dated photographs. Two others in early July 1963 and mid July 1963 were identified while skimming all the issues of the Akaroa Mail in the early 1960s looking for tsunami information, and then matched up with a resident's memory.

Later in the project when the additional data from Stanley Park was provided by Ecan and the cumulative storm information provided by Graham Harrington, seven additional storms within the 73 year study period were checked. These included two additional storms with an Akaroa rainfall of more than 90mm and five with a cumulative rainfall of over 200mm. Although all of these storms rated a mention in the Akaroa Mail, only three of them had resulted in serious flooding, these being a storm in May 1945 with over 90mm of rain in one day, and the two episodes already identified in July 1963.

This suggests that most flooding, certainly in the built up areas, has been identified by the primary methodology; only 1 flooding episode out of 24 has been identified purely by chance. This was the flood in Akaroa in August 1981. Furthermore, none of the storms with a cumulative total of over 200mm but no single day over 90mm in Akaroa or 50mm in Onawe resulted in a flooding event. This suggests that the major storms that have caused flooding have probably been identified using the methodology of looking for single high rainfall days.

6.2.1 Under-reporting in rural areas

The major cause of under-reporting is probably that little may have been remembered or recorded in the Akaroa Mail about flooding in open farmland as opposed to residential or other high use

areas. For example, much has been remembered and photographed about flooding on the Duvauchelle Golf Course because this is a high use recreational area where flooding causes significant damage. Had the Golf Course still be pastureland, little of the flooding would have been of note.

7 Flooding events

The remaining sections of the report describe flooding in each Settlement Area on an area by area basis, working around the harbour anticlockwise from Akaroa to Wainui. A specific description and map is given of at least one flooding event in each Settlement Area, and more are given where sufficient information to produce a maps was available, with the focus on more recent events. After the detailed maps there is a summary of the problem spots in each Settlement Area.

7.1 Base Aerial maps

The flooding information was overlayed on the rectified aerial photographs supplied by Ecan. These photographs covered much larger areas than the valley floors where flooding has usually occurred, so the maps given in this report are cropped down to include just the areas where flooding is mapped.

7.1.1 Streams

The Ecan photographs had stream beds superimposed on them as blue lines. During the course of the research it was found that these are often inaccurately located, and include some streams that do not exist while omitting others that do, especially “rain creeks” that appear during high rainfall. Where more accurate information has been gathered during the flooding research, the maps have been amended to show this, with incorrect stream beds struck through with diagonal lines, and more accurate stream beds redrawn in green. Where interviewees commented that whole streams marked did not exist, these have been struck through with diagonal lines, and no replacement stream is shown. In some cases the lower part of a stream has been struck through because it doesn’t exist, but the upper part is still shown in blue because it is not known whether it exists or not.

Occasional “rain creeks” are drawn in brown. However, no comprehensive attempt has been made to remap and check all the stream beds shown on the maps; only the very obvious have been amended, or ones with a direct relevance to flooding discussed with interviewees.

7.1.2 Blocked culverts to sea

Where blocked culverts to the sea have been a contributing factor or a persistent problem, they are marked on the maps with a brown block-shaped arrow.

7.1.3 Flooding

The information used to create the maps has been taken from Akaroa Mail articles and interviews with residents, with some limited backup from photographs.

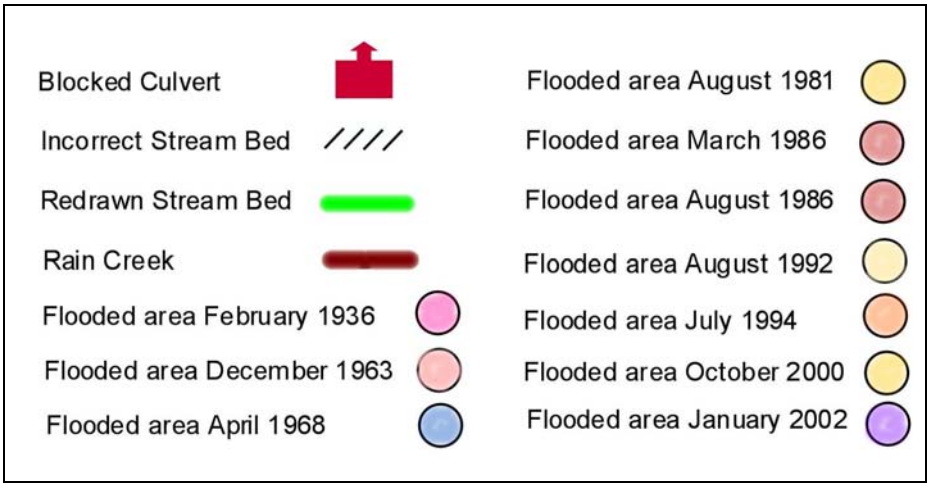
The shading on each map shows areas that have been indicated as inundated. A different colour of shading has been used for each year of flooding.

During times of extreme rainfall the streams rise dramatically in their beds but unless they have actually broken out of their bed significantly this has not been mapped. For each of the flooding events mapped it can be assumed that the streams have risen to the top of their beds and may also have broken out to a minor level causing some damage to gardens or overflowing into paddocks. However, without interviewing every property owner along the stream paths there is no way of discovering the extent of this type of minor bank burst. Hence shading on the maps is only done where bank bursts have been described by residents interviewed or in articles in the Akaroa Mail. In residential areas, this will include most places where property was actually affected, but in farmland only major flooding has been identified.

7.1.4 Map Key

The following gives a key to the maps:

Figure 1 Map Key



7.1.5 Photographs

Where photographs of flooding have been obtained, then appear after the corresponding map. Points of note are identified on the maps, and the maps and photographs should be examined in conjunction with each other.

7.2 Assessment

After each flooding event map there is an assessment of the factors that influenced the particular flooding event, an estimate of the accuracy of the information mapped, a list of any known corrective action that has been taken since the flooding event and some lay comments on the likelihood of re-occurrence.

7.2.1 Causes

Factors that influenced the particular flooding event include rainfall levels and any special circumstances such as slips or blockages.

7.2.2 Known Frequency

An estimate has been given of the number of times a similar or worse flooding event is known to have occurred during the 73 year study period. Readers should bear in mind the comments made above on the completeness of the list of rainstorm events; it is likely that some flooding events have been missed or under-reported, particularly in the more rural areas.

7.2.3 Corrective Action

Any known improvements to drainage, bridges etc is noted.

A report on the Akaroa Stormwater Catchments conducted by GHD Consultants for the Asset and Network Planning unit of Christchurch City Council is occurring in parallel to this report, and is likely to recommend (and result in) improvements to the stormwater drainage in the Akaroa Township.

7.2.4 Lay comments on likelihood of re-ocurrence

Where possible some comments have been made on the likelihood of the flood event recurring. This is based upon comparing the flooding event with the other similar flooding events that have been identified during the period of covered by the study, and taking into account any corrective actions that are known to have been taken subsequently.

7.2.5 Accuracy scoring

Accuracy of the maps has been rated as follows:

- **Accurate and Comprehensive** Given when the map has been built up using multiple sources, each of which has been very sure of their information, or was based on a thorough written description in the Akaroa Mail, and appears to be a *reasonably but not necessarily totally* complete picture of the flooding.
- **Accurate but not Comprehensive** Given when the information is based on a single source who has been clear about their information, but may be limited to knowledge of specific areas.
- **Sketchy** Given when information is based on sources that do not all agree with each other or when it appears to only give a small part of the flooding extent.

The shading of areas on the maps has been based upon a combination of memories and accounts given in the Akaroa Mail. It is therefore difficult to assess how accurate each map is with a metre figure. If the data is superimposed on 1m contour maps (as currently proposed by Tonkin and Taylor), it may be more possible to assess the accuracy and adjust shading boundaries to match the contour lines.

The following sections of the report now present the flooding information on an area by area basis.

8 Akaroa

Akaroa has suffered more from flooding than any of the other Settlement Study areas. This is probably because it is much more built up, meaning that the effect of flooding is more memorable and newsworthy than the flooding of farm paddocks, but also because in the northern part of the town, (usually the worst affected area) the land is reclaimed, making drainage to the sea more difficult.

Table 2 Interviewees providing information for Akaroa were:

Ken Paulin	Works and Services Manager, BPDC
Liz Haylock	Civil Defence Welfare Co-ordinator
Peter Haylock	Civil Defence Warden
Lou Walker	Retired builder and resident near Recreation ground
Alan Reid	Former resident and fisherman
Eric Ryder	Proprietor of Grand Hotel
Jan Shuttleworth	Former resident of Rue Balguerie
Richard Stewart	Chemist
Ruth Jones	Resident of Muter Street
Cheryl Jenkins	Woodills Road resident
Kim Stewart	Fire Brigade chief
Harold and Barbara Surtees	Grehan valley residents
Lynda Wallace	Museum Director
Jessie Mould	Elderly resident and historian
Barry Brownie	Long term resident
Ted McNabb	Long term resident and former Fire Brigade chief

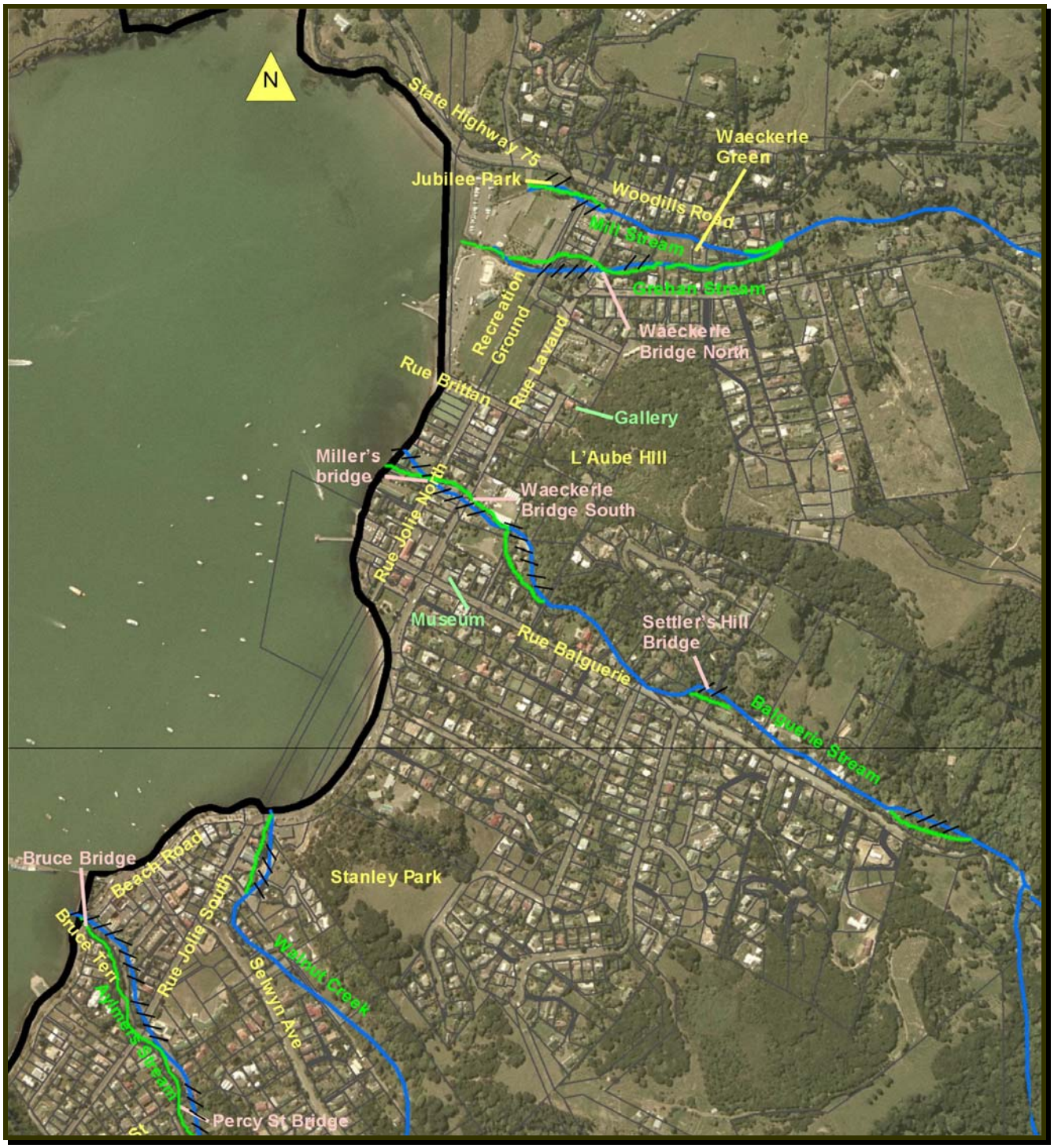
8.1 Streams

There are four major streams in Akaroa. Working from north to south these are:

- Grehan Valley Stream. Unusually, the stream draining the Grehan Valley forks into two branches at the upper end of Woodills Road, and these branches then drain separately to the sea. This may be natural, or the northern branch may be a race created by early pioneer Jacob Waeckerle who built the town's first flour mill beside it. It is now known as the Mill branch of the stream. The Mill stream runs behind the houses on Woodills Road along the north side of Waeckerle Green, crosses Rue Lavaud between the Grand Hotel and the Waeckerle's cottage and then runs to the sea alongside Club Lavaud and Jubiliee park. The southern branch, known as the Grehan stream and taking the bulk of the water, runs along the south side of Waecklerle Green and crosses Rue Lavaud under the northern Waeckerle bridge beside the police station and flows to the sea alongside the skate park.
- Balguerie Stream. The stream draining the Balguerie valley runs along the north side of Rue Balguerie weaving between the houses, crosses Rue Lavaud under the southern Waeckerle bridge between the Akaroa petrol station and Bon Accord backpackers and then Rue Jolie North under Miller's bridge. Both the Waeckerle bridges are listed by the New Zealand Historic Places Trust as Category II structures.
- Walnut Creek. This small stream drains the area south of Stanley Park and runs below Selwyn Avenue and Rue Jolie behind the Gaiety Theatre. It crosses Beach Road in a culvert.
- Aylmer's valley creek. The stream draining Aylmer's valley runs through Akaroa behind the houses on Percy Street and then alongside Bruce terrace. It crosses Beach road at Aylmer's bridge (also known as the Bruce bridge). This bridge also has a Category II listing with the New Zealand Historic Places Trust. This creek does not have a recent history of flooding.

The following map gives an overview of Akaroa showing the streams, major street names and other points of interest to assist with understanding the following sections. More details of places which have flooded are given in each individual flooding map, but the street names are not repeated to avoid clutter.

Figure 2 Akaroa Overview Map



8.2 Known flooding

The following table lists all the flooding events in Akaroa that have been identified during the research and indicates the part of the town in which flooding occurred. A question mark indicates that flooding is likely to have happened in a particular location given the general description of the event given in the Akaroa Mail, but there is no definite information to confirm this.

Table 3 Known flooded areas in Akaroa

Year	Month Day	Unspecified	Woodills road	Recreation ground	Waeckerle Bridge North	North Rue Lavaud	South Rue Lavaud	Museum area	Rue Balguerie	Balguerie stream	Rue Jolie North	Beach Road	Walnut Creek	William St Percy Sty	Aylmers Creek
1934	4-5 May	X													
1934	26 Sep	X													
1936	9 Feb			X	X	X									
1936	20-21 Feb			X	X	X	X	X	X	?	X			X	X
1945	18-21 May				X	X		?	X	?	X	X	X	X	X
1962	15-17 Apr											X			
1963	19-21 Apr			X											
1963	14-15 Jul		X	X	X	X	X	X	X	?	?	X	X	X	
1968	10-12 Apr											X			
1973	6-7 Aug			?	?	?		X	X	?		X	X		
1974	16-17 Aug											X			
1975	Jun 14 15 16							?	X			X	X		
1975	19-21 Aug		X	X	X	X	X	?	X	?	X	X			
1976	27-28 Aug											X			
1977	3-4 Jul					Gallery*		X	X	?		X			
1978	8-10 Jul											X	X		
1981	25-27 Aug				X	X			?	X					X
1992	27-29 Aug											X			

Year	Month Day	Unspecified	Woodills road	Recreation ground	Waeckerle Bridge North	North Rue Lavaud	South Rue Lavaud	Museum area	Rue Balguerie	Balguerie stream	Rue Jolie North	Beach Road	Walnut Creek	William St Percy Sty	Aylmers Creek
1994	26-28 Jul			X	X	X	X	X	X		X				
2002	11-12 Jan		X	X	X	X	X	X	X		X				

** On July ¾ 1977 it was the Gallery in Rue Pompallier behind Rue Lavaud that also flooded*.

In addition, the tsunami in 1960 also breached Akaroa, coming over the Recreation Ground as far Rue Lavaud and flooding the gardens.

8.3 Flooding Event February 1936

The most severe flood ever experienced in Akaroa appears to have been in February 1936. This occurred about two weeks after a cyclone listed by Te Ara the Encyclopedia of New Zealand as the worst cyclone to hit New Zealand in the 20th century. There is a very detailed write up of this flood in the Akaroa Mail, and a number of photographs have also been sourced, allowing this flood to be used as a baseline against which to measure all subsequent floods in Akaroa.

The Akaroa Mail report entitled “Torrential Rain” stated that rain had been an all-time record, with 9.5 inches (241mm) falling in 6.5 hours and a total fall during the storm of 14.6 inches (370.84mm), over 2 days. In a later article (October 8, 1963) the Meteorological Office confirmed that there had been 96mm on February 19, 1936 and 297.9mm on February 20. This is nearly twice as much rain as the recent 2002 storm. The areas flooded appear to be similar to those that flooded in the most recent 2002 storm, but with the water being even deeper. Exactly the same spots caused the trouble, with the water bursting its banks from the Grehan Stream at the Waeckerle Bridge (then called Hennings Bridge), the Balguerie stream bursting out by Rue Jolie (then Kingstons Place) and water also flowing down Rue Balguerie, flooding Mrs. Manson’s (now known as the Press House). The shops along Rue Lavaud to McCaughans garage (where the supermarket is now) were only saved from flooding by sandbagging. In addition there was flooding in William Street, but interestingly no mention is made of flooding in Beach Road, or even at the Gaiety Theatre in lower Rue Jolie. The report of this storm is all about the rain; there does not appear to have been a lot of wind or damage to boats, which is probably why there was not a major problem along Beach Road. Descriptions include knee deep water around the Secondary School, cars being towed through Rue Lavaud by lorries, logs and milk cans floating down Rue Lavaud, lots of houses being flooded in Rue Jolie North and Rue Balguerie, shops being protected by sandbags in Rue Lavaud and a big lake from the Rue Jolie North bridge to the Recreation ground.

Two weeks earlier there had also been very heavy rain of 232mm (Akaroa Mail figure, 192mm Met Office figure) and the creek had overflowed at the Hennings bridge, flooding Lavaud Street, the Recreation Ground and the frontage of St. Patricks Church. The Akaroa Mail considered that this earlier storm had cleared the creek banks of debris, and had it still been lying about the flooding from the second storm would have been even more extensive. The reclaimed land around the Recreation Ground was not as extensive as it is now, so the area to be drained was less and the fall required on the drains not so great.

Figure 3 Akaroa North February 1936

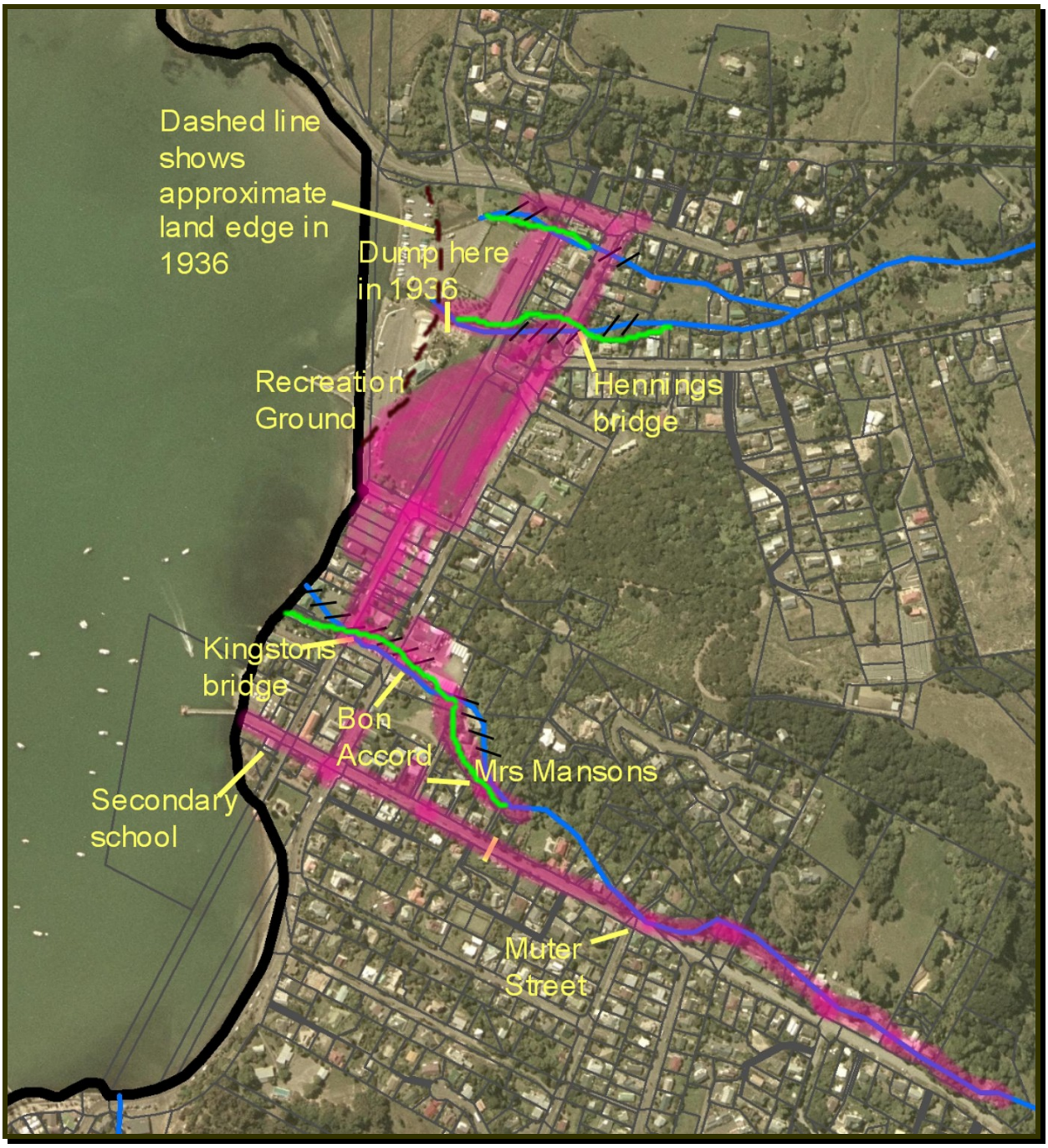
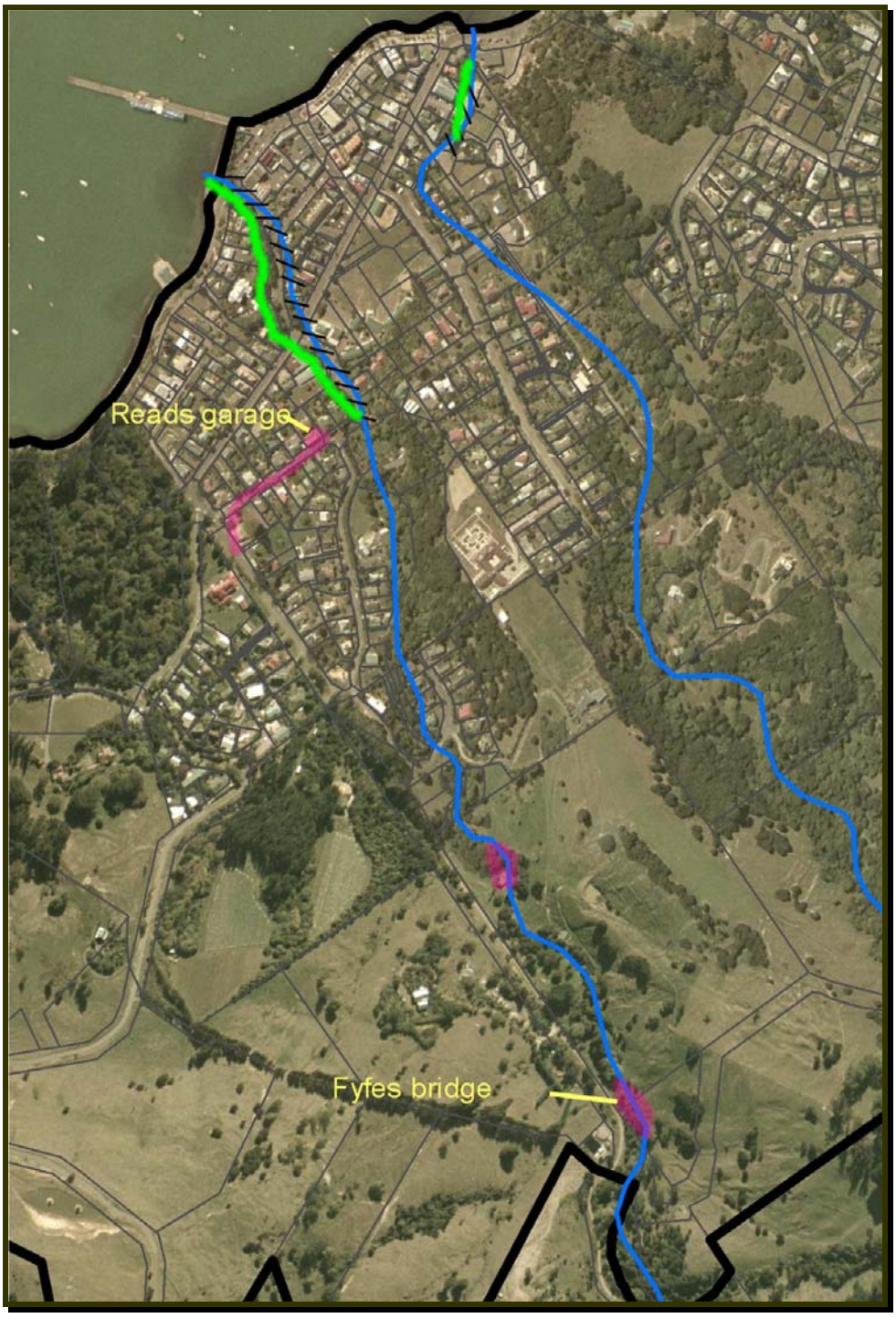


Figure 4 Akaroa South February 1936



Photographs of the 1936 floods were provided independently by brother and sister Alan Reid and Ruth Jones, and were from the collection of their father, Jack Reid, a well known Akaroa identity, now deceased. Ruth thought that the photographs had been taken by Jack's mother. Jack had labelled them in his album as February circa 1935, but they clearly tie up with the Akaroa Mail description of the flood in 1936.

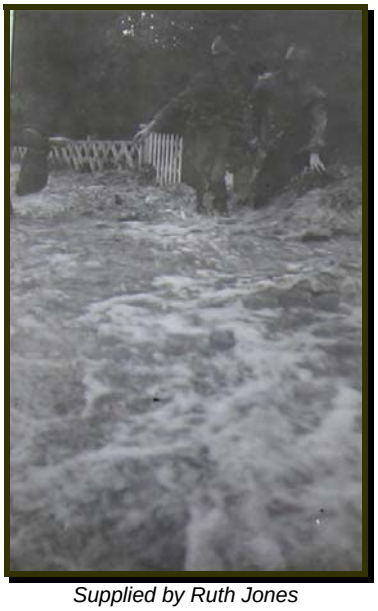
Figure 5 Photographs of North Akaroa February 1936

Supplied by Alan Reid

North Rue Lavaud with water pouring through Hennings Bridge (now known as the northern Waeckerle's bridge) The building opposite is Mon Desir. Mon Desir still exists, but has a very different façade. Further along one of the small cottages still stands, as does the Grand Hotel, the last building on the left.

Supplied by Ruth Jones

Bells Truck outside the Mon Desir window opposite Hennings bridge.



Supplied by Ruth Jones

Rue Lavaud opposite Hennings Bridge showing Hennings fence (now known as The Poplars).

Supplied by Ruth Jones

Rue Lavaud further south opposite the Recreation Ground corner. The white structure is the old Fire Bell tower, which stood where the Petanque court is now.

Supplied by Ruth Jones

Rue Lavaud/Rue Balguerie corner outside Bells shop, now the Turenne Dairy. The large building at the back is the Metropole Hotel where the supermarket is today. The small building to the left of the Turenne is McCaughan's garage mentioned in the Akaroa Mail.

Table 4 Event Assessment

Causes	***Extreme Rain*** Feb 21 96.0 Feb 22 297.9
Known Frequency	*This is probably the worst flood in Akaroa since the town started in 1840, but similar floods (probably not quite as deep) have occurred in 1945, 1963 and 2002.*
Corrective Action	*Improvements were made to the Grehan Stream fork in Woodills road, and an overflow pipe installed under the northern Waeckerle bridge.*

Lay comments on probable re-occurrence	*The rainfall is the highest on any single day since the records began in 1894. However, the flooding pattern is very similar or a little higher than in 2002 and 1963. Since 1936 more land reclamation has been done on the Recreation Ground making drainage more difficult, and the area around the Grehan Stream fork has been built up.*
Map Accuracy **High**	***Accurate and Comprehesive*** *Based on a very comprehensive write up in Akaroa Mail. Most locations referenced are still identifiable, the flooding pattern is very similar to the recent 2002 flood and theMail story is backed up by photographs.*

8.4 Flooding Event August 1981

The Akaroa Mail reports that at the height of the storm in August 1981 debris was caught in a fence in the Selwyn Avenue/Rue Jolie stream flooding properties alongside in Rue Jolie. Water nearly flowed through a house that had caught fire the previous autumn. There was also flooding at the Grehan Stream bridge near Mon Desir, opposite the northern Waeckerle bridge. The article was very brief and does not state whether flooding extended into the Recreation Ground and no mention is made of problems with the Balguerie stream. However, reporting in the Akaroa Mail was at its poorest at this time, and photographs of the Balguerie stream in flood dated September 1981 were supplied by Jan Shuttleworth whose brother lived at Blythcliffe at the time. The flooding was in the garden of his neighbours, the Chaney's and Caldwells. Jan Shuttleworth had no further information on this storm, such as whether the flood had affected the Museum. This flood was only picked up because of Jan Shuttleworth's photographs, not by the rainfall indexes. It appears to have been an unusual flood; Margaret Chaney who still owns part of the property stated that the stream did not break its banks here in either 1994 or 2002.

Figure 6 Akaroa August 1981

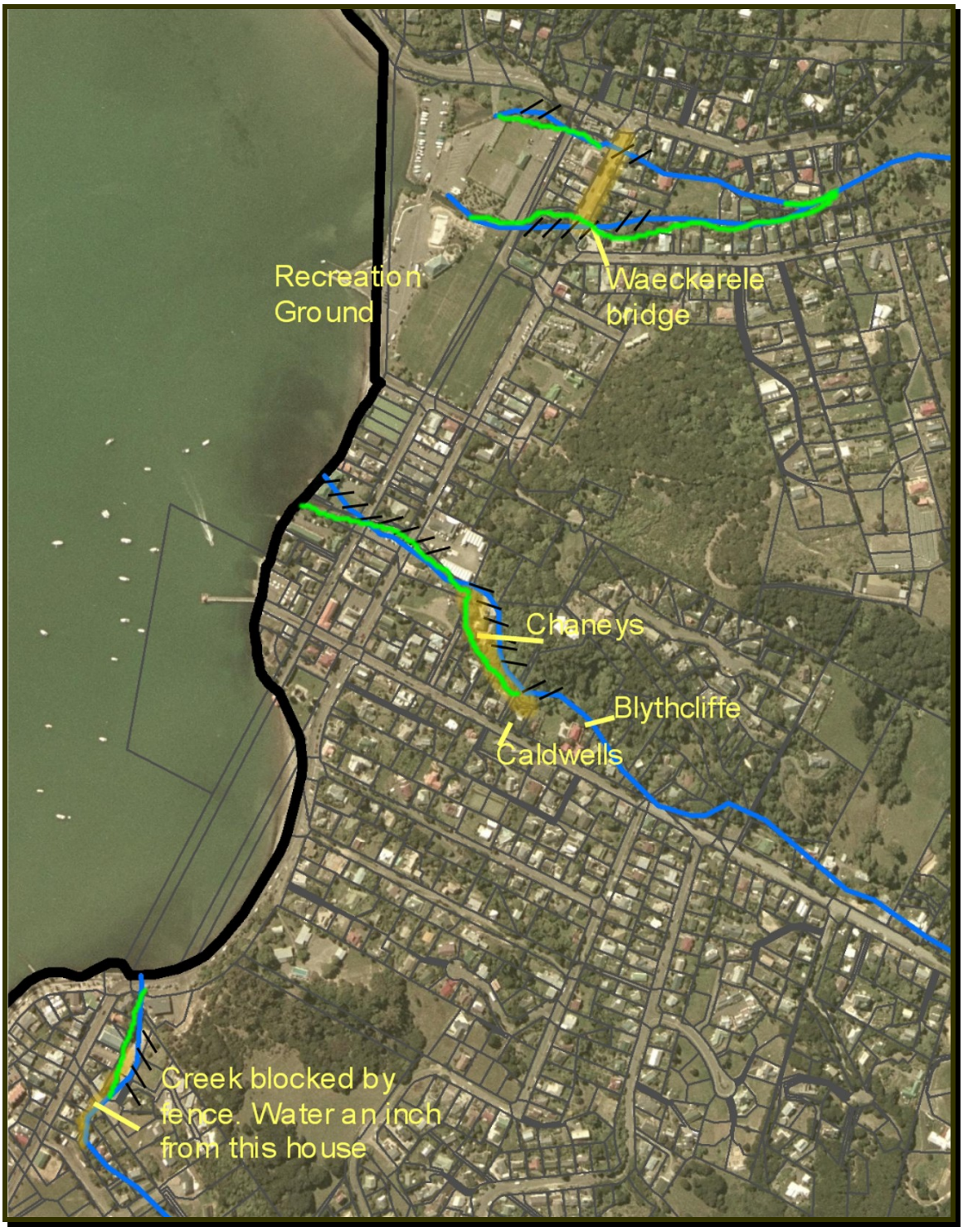


Figure 7 Photographs of Balguerie Stream August 1981

Looking from the garden to the Chaney's house

Supplied by Jan Shuttleworth

Supplied by Jan Shuttleworth

Looking from the Chaney garden to BP meats

Supplied by Jan Shuttleworth

Supplied by Jan Shuttleworth

Balguerie creek at Caldwells house

Supplied by Jan Shuttleworth

Table 5 Event Assessment

Causes	***Wet year/month and persistent heavy rain over several days, Blockage in Walnut Creek***
Known Frequency	*The southern branch of the Grehan stream has broken its banks at least 8 times during the study period.* *Walnut creek has broken 5 times during the study period* *How often the Balguerie stream has broken at the Chaney property is unclear, but it did not do this in either 1994 or 2002, so the flood in this garden may be very unusual. It may have happened in 1936 and again in 1945 when houses in Rue Balguerie flooded, but this may have also been caused by water running down Rue Balguerie.*
Corrective Action	*Improvements have been made to Walnut Creek as this also did not flood in either 1994 or 2002.*
Lay comments on probable re-occurrence	*The Grehan stream is likely to break again, but it is unlikely that the flooding in the Chaney garden will occur as shown in the photographs unless there is a major slip or blockage.*
Map Accuracy **Sketchy**	***Sketchy*** *Write up in the Akaroa Mail is very brief and photographic evidence limited to one place. Flooding may well have been more extensive.*

8.5 Flooding Event July 1994

The July 1994 storm is best remembered for causing a major slip on the Lighthouse Road that threatened at least one house below. This was very expensive to fix, and the Council has an extensive file on the slip assessment and recovery options.

However, there was also extensive flooding caused in northern Akaroa by this storm, mainly from the troublesome northern Waeckerle's bridge over the Grehan Stream in Rue Lavaud. Flooding was similar but not as extensive as in 2002. Yew cottage on the corner of Rue Brittan and Rue Jolie North was evacuated The problems in Rue Balguerie seem to have been caused by storm drains overflowing and failing to cope. There was no problem in southern Akaroa with Walnut Creek or Beach road.

Figure 8 Akaroa July 1994

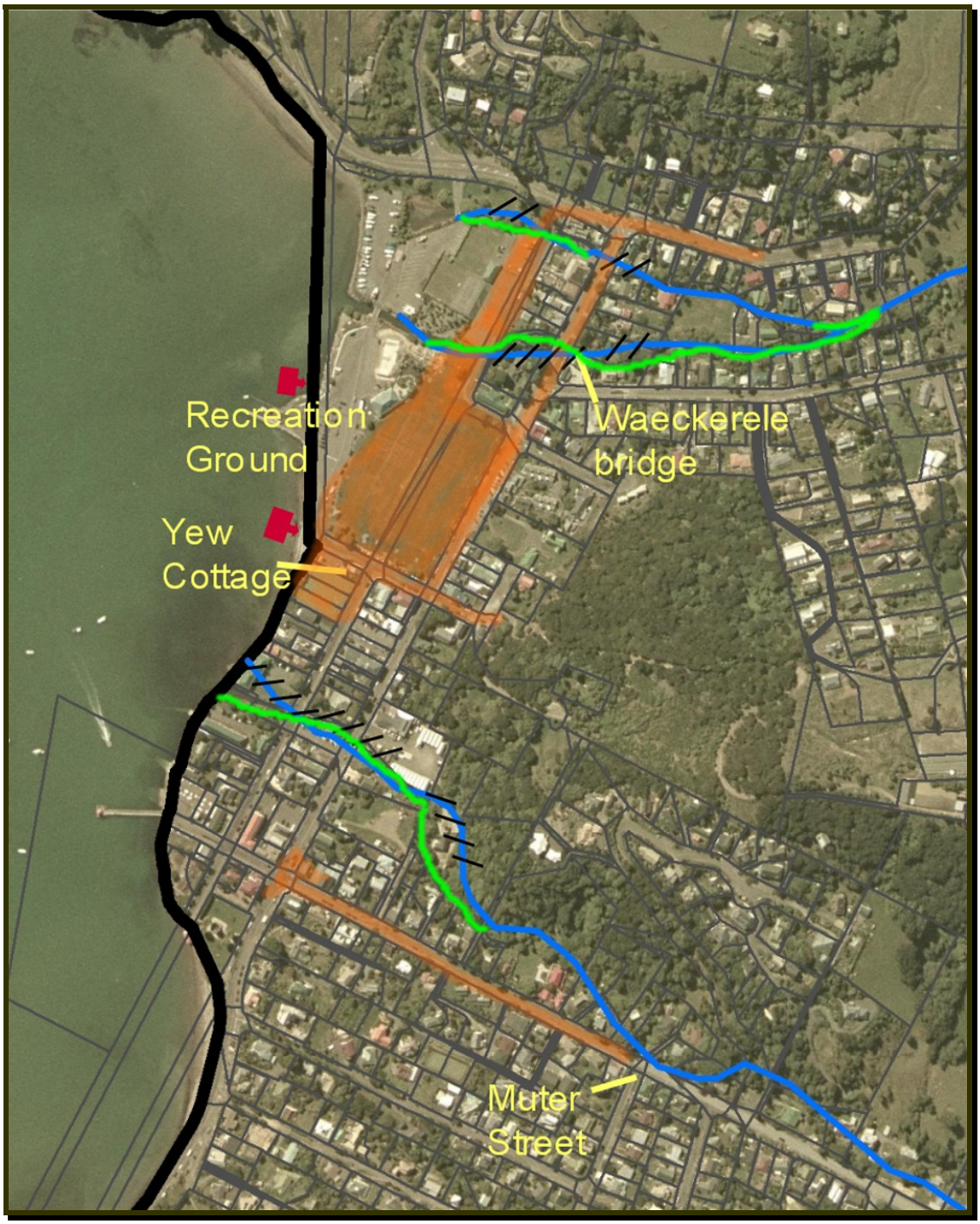
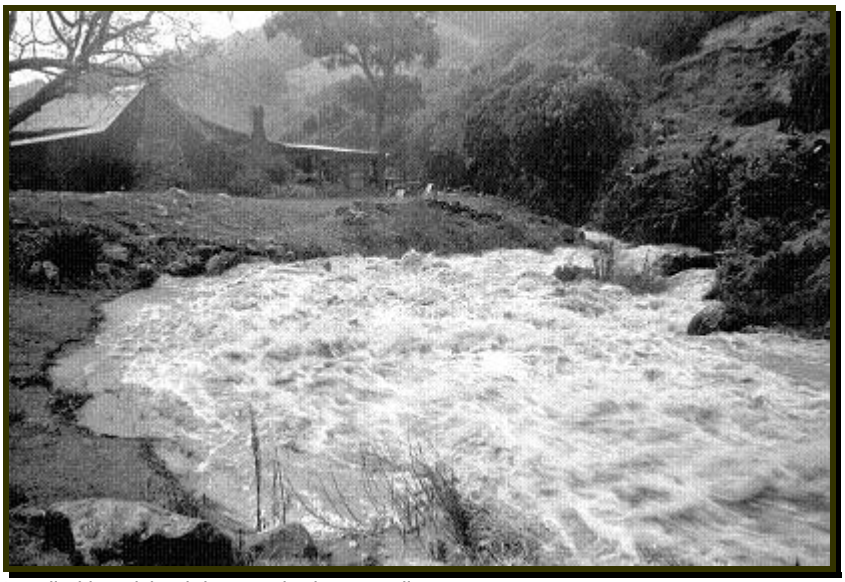


Figure 9 Photograph of Rue Lavaud/Rue Balguerie corner 1994

Water streaming down Rue Balguerie and flooding Rue Lavaud. It also ran into the back of the Museum.

Supplied by Michael de Hamel, Akaroa Mail



The Grehan stream much higher up at Tree Crop Farm outside the Settlement study area.

Supplied by Michael de Hamel, Akaroa Mail

Table 6 Event Assessment

Causes	**Extreme Rain** July 26 44.8 July 27 198.1 July 28 41.5
Known Frequency	*Rainfall at Akaroa at or about the same level or more has occurred 7 times in the study period.* *The Grehan stream has broken at the northern Waeckerles bridge 8 times during the study period.*
Corrective Action	*None identified*

Lay comments on probable re-occurrence	*Comparable or worse events during the 73 year study period are twice in February 1936, and then again in 1945, 1963 and 2002. This level of flooding is likely to occur again unless improvements are made to the drainage at Rue Brittan and the Recreation Ground and under the northern Waeckerle bridge.*
Map Accuracy High	***Accurate and Comprehensive***

8.6 Flooding Event January 2002

There was much more severe flooding in Akaroa in January 2002, on the night of the 11th and early morning on the 12th when both the Grehan Stream and the Balguerie stream overflowed. The Fire Brigade and Council were alerted in the early hours of the morning of the 12th (approximately 2:00am) by Eric Ryder at the Grand Hotel. There were four main problem areas, all in the north part of Akaroa.

In Woodills Road the Grehan stream had broken its banks at the point where it forks. Water flooded the gardens and entered at least two, possibly three, houses near this point. Woodills Road was also being flooded by water coming down the road from the hill and from a side creek near the milk depot.

In Rue Lavaud the Grehan branch of the Grehan stream was flowing over the road at the Waeckerle bridge near the police station. From here water was flooding down Rue Lavaud and onto the Recreation Ground. Culverts in Rue Brittan were not coping either and large amounts of water were streaming down from L'Aube Hill. It overflowed again at the bridge by the tennis courts.

In Rue Jolie North the bridge below Miller's property was also blocked with a large uprooted tree. Water was filling the garden of the Miller property and running down Rue Jolie toward the Recreation Ground.

In Settler's Hill Road just before the Balguerie corner the water broke over the bridge flooding the corner. Further along Rue Balguerie the torrent undermined the bank and footpath opposite Muter Street and ran down Rue Balguerie. Water was coming up through the storm drains in Rue Balguerie and running down the road into Rue Lavaud. Water ponded behind the Museum, eventually flooding the theatre and lower display area, coming through from the house behind, (currently Heartlands).

Rue Lavaud at the town entrance, the Recreation ground road and the Settlers Hill road were all closed.

Residents were evacuated from properties in upper Woodills road, Club Lavaud, the ground floor of the Grand Hotel, Yew cottage and Bon Accord backpackers. The elderly woman evacuated from Yew Cottage was sitting on her bed and was covered in water up to her waist.

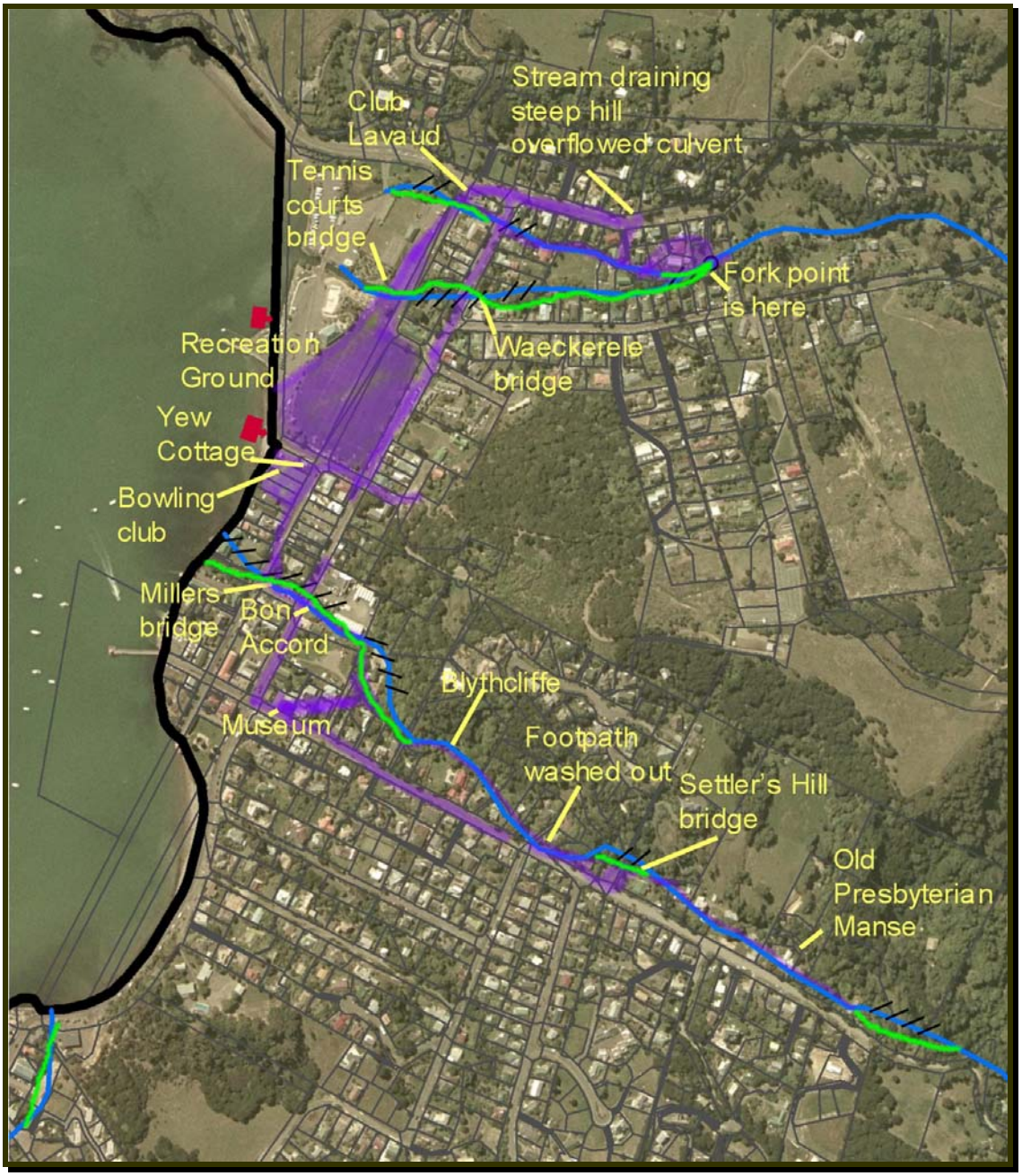
The fence in the garden of the Miller property and along Rue Jolie North was cut to allow the water to flow instead of backing up, and eventually a digger was authorised to clear the bridge, at which point the stream returned to its bed, and this area of Rue Jolie North quickly drained. The north Waeckerle bridge eventually cleared also.

A Civil Defence Adverse event was declared before the afternoon high tide, but by this stage the worst of the rain and flooding was over and drainage coped during the second high tide, with flood water rapidly receding.

Unfortunately the Akaroa Mail editor was away when this flooding occurred, so the write up in the following paper was minimal. A better article was in the Christchurch Press, but apart from describing the evacuation of Bon Accord backpackers it provided little information on the flooding.

The local wisdom is that the flooding was extreme because rainfall in the upper Akaroa catchment was very high. This is probably the case because the rainfall in Akaroa itself (143.5mm) was lower than during the 1994 flood (198mm), and similar rainfalls in 2003 and 2007 have caused no problems. Unfortunately Hugh Wilson's skyline rain gauge at Hinewai overflowed, so no accurate measurement can be obtained from that, although it does indicate how severe the rain was higher up. There may be other farmers who have taken rain measurements at higher altitudes, but attempts to source these have not been made.

Figure 10 Akaroa January 2002



By the time the following photographs were taken by Jan Shuttleworth the water had receded considerably. The water was probably up to window level at Yew Cottage shown below during the height of the flood; Kim Stewart, the Fire Brigade chief, described the occupant as being waist deep in water when sitting on her bed, and Lou Walker described a Fulton Hogan employee, Philip Kingston, standing in waist deep water trying to clear the Rue Brittan culvert pipe.

Figure 11 Photographs of North Akaroa January 2002

Looking across Rue Brittan and Recreation Ground to Rue Lavaud.

Supplied by Jan Shuttleworth

Yew Cottage, Rue Jolie and Recreation Ground behind. The water was probably up to the windows at the height of the flooding.

Supplied by Jan Shuttleworth

Bowling club Pavilion.

Supplied by Jan Shuttleworth

Bowling green looking to Rue Jolie.

Supplied by Jan Shuttleworth

Rue Jolie North taken from Yew Cottage looking south. At the height of the flood the whole street back to Miller's bridge over the Balguerie stream bridge was under water.

Balguerie stream from Miller's Bridge on Rue Jolie north looking to the Miller property on the north bank. Earlier when the bridge was blocked water was flooding over the bridge and into the garden of the Miller house shown. This picture is taken after the blockage was cleared and the stream had returned to its bed.

Supplied by Jan Shuttleworth

Balguerie stream from Miller's Bridge on Rue Jolie North looking to the Shepherd property on Rue Lavaud. Flattened plants show where the stream had broken its bank to flood onto Rue Jolie earlier and flooded Rue Jolie via Miller's garden and part of the fence cut by the Fire Brigade to release the water.

Supplied by Jan Shuttleworth

Balguerie Stream along Rue Balguerie opposite Muter Street showing footpath washed away. At the height of the flood water would have been flowing onto the street.

Supplied by Jan Shuttleworth

Balguerie Stream in Blythcliffe garden, Feijoa tree beside stream bank and debris showing highest water mark.

Balguerie Stream in Blythcliffe garden. Feijoa tree has now washed away.

Table 7 Event Assessment

Causes	***Extreme Rain*** ***Streams blocked by debris*** *January 12 55.5* *January 13 143.5*
Known Frequency	*The Grehan stream has broken at the Waeckerle bridge 8 times during the study period, flooding Rue Lavaud north and the Recreation Ground.* *The Balguerie stream has broken at Rue Jolie North 5 times* *There have been problems in Rue Balguerie 9 times* *There have been at least 9 times during the study when rainfall levels at Akaroa have been at comparable or higher levels, but only four other times (February 1936 twice, May 1945 and July 1963) when there was a similar level of flooding.*
Corrective Action	*The Akaroa Stream Maintenance committee has worked with property owners to keep stream banks free of debris.*
Lay comments on probable re-occurrence	*Akaroa has experienced this level of flooding 5 times during the study period. Although work to keep streams clear of debris is useful, unless improvements are also made to the northern Waeckerle bridge and drainage around the Recreation Ground and Rue Brittan, this type of flood is likely to happen again.*
Map Accuracy **High**	***Accurate and Comprehensive*** *This flood is relatively recent and a number of people have been interviewed.*

8.7 Sea surges

Akaroa can also be affected by strong sea surges. There was flooding during the Big Snow storm of 1992 in Akaroa along Beach road caused by the strong surges and also in the Wahine storm.

8.8 Summary of Problem areas

The main problem area in Akaroa has always been at the northern end of the town.

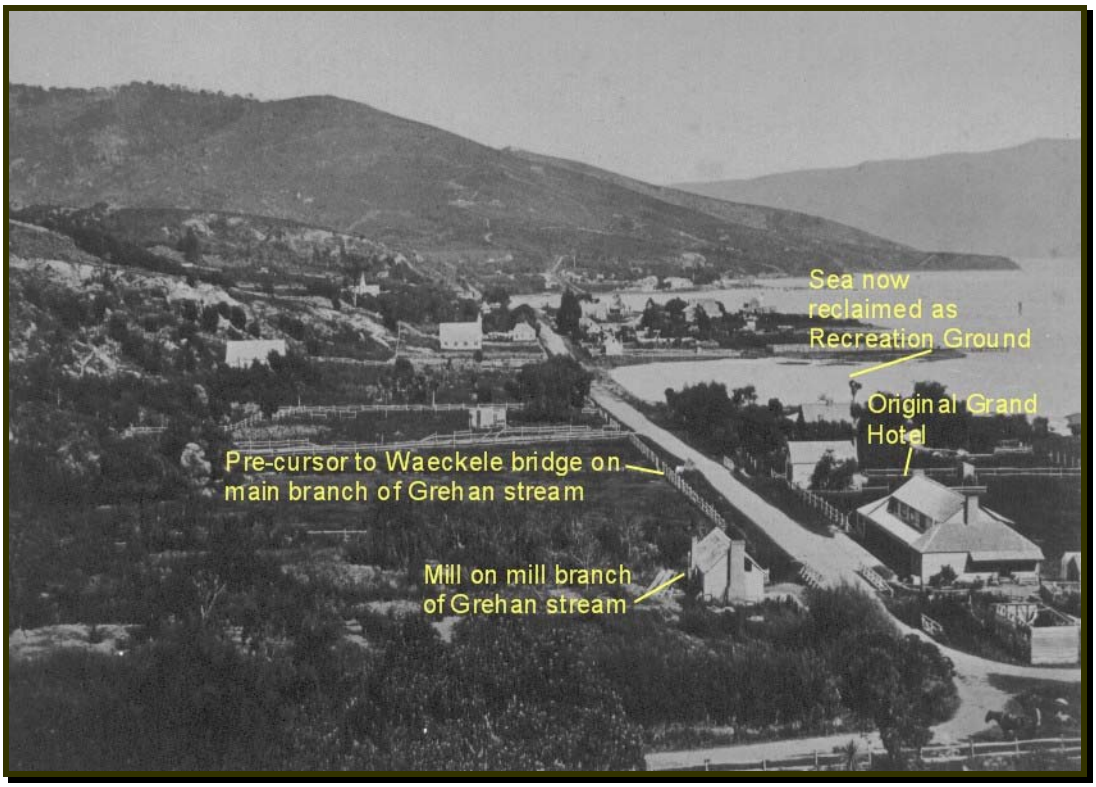
8.8.1 Recreation Ground

The Recreation Ground is reclaimed land, and hence drainage of this area is more difficult. It has flooded and ponded so many times in the past that shallow winter ponding on the ground alone

was neither newsworthy or memorable, but just part of the normal experience of Akaroa.

The following early photograph is included to show north Akaroa before any land reclamation took place.

Figure 12 Akaroa circa 1867 showing the sea occupying the area now reclaimed as the Recreation Ground



Photograph from Akaroa Museum collection catalogue number 1103

Recent work to improve drainage of the Recreation Ground means that it no longer ponds in normal rain conditions, but the whole area including Rue Brittan and the corner of Rue Brittan and Rue Jolie still floods if the nearby Grehan stream breaks its banks. High tides exacerbate the problem of drainage from the reclaimed land, which has been extended several times over the years, with new drains connecting to the old drains and consequently getting too low at the outflow points

8.8.2 Inadequacy of drainage in Rue Brittan and sea outflows

The outstanding problem in the area now seems to be the inadequacy of the storm water pipes in Rue Brittan, which must cope with a large watershed from L'Aube hill as well as any overflow if the Grehan stream bursts its banks. The following photographs show these problem areas as explained by Lou Walker, who has been a builder in Akaroa all his life, and has owned, lived and worked at the properties opposite the Recreation Ground for many years. These properties now house the Ce La Vie restaurant and the Ca Bouge clothing store.

Figure 13 Inadequate drainage in Rue Brittan

Supplied by Suky Thompson

Photograph shows the L'Aube Hill access road where it joins Rue Pompallier between the Recycling depot and the Gallery.

There is a drain below the rose bush of an adequate size, but during heavy rain the water flowing from L'Aube hill mainly comes down the L'Aube hill road, misses the drainage channel, fails to enter the drain and instead runs down Rue Brittan.

Supplied by Suky Thompson

These two photographs show the drain on the corner of Rue Brittan and Rue Lavaud. The Recycling shed on Rue Pompallier can be seen in the background.

Supplied by Suky Thompson

The grating on this drain blocks up with sticks and leaves during heavy rain, effectively reducing the total flow of the drain by about half, so more water pours onto lower Rue Brittan from here.

Figure 14 Blocked outfalls

Supplied by Suky Thompson

The outfall from Rue Brittan follows the line of the beach and so fills up with sand, reducing the outflow.

Supplied by Suky Thompson

This picture and the following close-up show the outfall of a drain that runs from the Gallery (formerly the Power House) in Rue Pompallier across the Recreation Ground to the sea. The drain starts as a brick arch that used to drain the water from the Pelton Wheel at the Power House. Originally the Recreation Ground ended at the edge of what is now the grass area.

As it was extended over the years to create the present car park, the brick drain was extended with a concrete pipe, and the result is that the outfall to the sea is too low.

Supplied by Suky Thompson

This is a close up of the drain outfall shown above. It was taken during dry weather and at low tide, but the slimy puddle shows that the drain does not flow well.

8.8.3 Northern Waeckerle's bridge

There are two identical bridges on Rue Lavaud known as the Waeckerle's bridges because they were built in 1879 during Waeckerle's time as Mayor of Akaroa and have his name embossed on them. They are both Category II structures listed by the New Zealand Historic Places Trust. The southern branch of the Grehan stream has burst over the northern Waeckerle bridge on Rue Lavaud on several occasions (at least 7 found during the course of this research). When this happens the flood waters flow down the street toward Rue Brittan and over the Recreation Ground.

A blockage in 1936 broke the railings shown here on the upper side of the bridge. These were only replaced in 1999 with funding from the Parkinson Trust. An extra overflow pipe below the bridge is also thought to have been installed after the 1936 floods, but as can be seen, is often blocked with silt and debris reducing its effectiveness.

Figure 15 Waeckerle bridge on Grehan Stream

Supplied by Suky Thompson

The upper side of the Northern Waeckerle bridge. The buildings across the street are Mon Desir (painted pink) and the historic cottage and Grand Hotel, which can also be seen in the 1936 flooding picture taken at this bridge.

Supplied by Suky Thompson

This pipe is an overflow drain for the stream at the bridge shown above and runs parallel to the stream bed to give the bridge extra capacity. It was probably constructed after the 1936 flood. As shown here, its effectiveness is limited because it is partially blocked.

8.8.4 Grehan Stream Fork, Woodills Road

Up stream the point where the Grehan stream forks below Woodills Road is also a trouble spot. Several residents remember the area before the houses were built, and recall it being generally marshy and waist deep in water during times of flooding. The houses were built in the 1970s. Whether drainage improvements or recognition of this as a flood prone area was taken into account at the time has not been established. However, most of the houses are raised on piles and only suffered minor interior flooding in the 2002 flood.

The fork does have a concrete retaining structure built to separate the two branches. Lou Walker thought that this had been built after the 1936 flood. At that time there would only have been one house in the area, a cottage dating to the 1880s and fronting onto Woodills road.

8.8.5 Balguerie Stream

The Balguerie Stream is prone to trouble in several places and can flood properties in Rue Balguerie.

The stream has broken its bank at least once and possibly more often in the section between Settlers Hill and the Rue Jolie Bridge. It has overflowed at the Settlers Hill bridge, opposite Muter

Street and in the Chaney garden. There has been flooding of the lower properties in Rue Balguerie including the property known as Mrs. Mansons (now the Press House) and the Museum.

The Balguerie stream crosses Rue Lavaud under the southern Waeckerle's bridge. The water does not ever seem to have broken over the bridge here although it has got very high.

A more troublesome spot is the next bridge (Miller's Bridge) at Rue Jolie North, where the stream has broken over on several occasions and then the water flowed along the street toward the Recreation Ground to meet the water coming from Rue Brittan. In 1945 this bridge collapsed and had to be replaced.

8.8.6 Rue Balguerie

Rue Balguerie itself can also be flooded with running surface water. The storm drains in the street can fail to cope and the drain on the corner of Muter Street which takes stormwater overflow from properties on the lower side of Watson street can also overflow. Water running down Rue Balguerie can flood the Museum, and may also be responsible for the flooding of the houses at the lower end of the street.

8.8.7 Walnut creek and lower Rue Jolie South

In the past Walnut creek running below Selwyn Avenue and the lower part of Rue Jolie South has overflowed or been blocked in extreme rain. When the Gaiety Theatre was restored there was much evidence of flooding underneath it. However, improvements to the drainage in this area seem to be working because it did not flood in either July 1994 or January 2002.

8.8.8 Beach Road

Beach Road, along the beach itself, the shops and further along to the Glen, is subject to sea surges rather than flooding from streams or rain. The last time Beach road did suffer was in 1992 was when there were extremely high sea surges. In the past when Walnut Creek overflowed there was also some flooding along the shop fronts in Beach Road.

8.8.9 William Street and Percy Street

Many years ago there are also records of Aylmers stream breaking its banks, and of flood waters in William street and Percy street. In 1961 a major slip on the hill above (on the other side of Aylmer's Valley Road) caused flooding in this area. However, flooding in this area has not reoccurred in more recent years, such as 1994 and 2002.

9 Takamatua

Takamatua tends to be affected by the same torrential rainstorms as Akaroa, with the records showing flooding at Takamatua in 1936, 1994 and 2002. The effects are not nearly so pronounced in Takamatua both because it is not built up and also because the water drains more quickly. Takamatua does not seem to be affected by sea storm surges in the same way as parts of Akaroa, probably because it is more sheltered from southerly storms by the Children's Bay headland.

Table 8 Interviewees who provided information for Takamatua were:

Ken Paulin	Works and Services Manager, BPDC
Bruce Morton	Former building inspector and Takamatua resident
John Roe	Resident and collector of rainfall data
Neil Fraser	Farmer above Frasers bridge
David Thurston	Bells Road resident
Pru Downes	Main road resident

The main floods remembered in Takamatua were in 1994 and 2002. However, one resident, Bruce Morton, had also heard about extensive flooding in about 1965. This would probably have been the storm in 1963, although the Akaroa Mail did not report problems in Takamatua. Alternatively Bruce may have been remembering or have heard of the earlier tsunami damage, as this comment was a recollection in the commemorative book "Tales of Banks Peninsula, 1940-1990"

> *"In 1962 a tidal wave after an earthquake swept over the flat in Takamatua bringing flotsam up as far as the main road and putting 12"-18" of salt water in one house" Tales of Banks Peninsula 1940-1990*

The date of 1962 given in this recollection is probably incorrect as the biggest tsunami was in May 1960 and there was another smaller tsunami on March 28/29 1964 which the Akaroa Mail reported as flooding the killing shed on the Takamatua waterfront.

9.1 Flooding Event July 1994

Takamatua did suffer from some flooding in the winter storm of 1994. John Roe, who records rainfall daily in Takamatua was away for a few days during this period, but noted a total rainfall of 228.6mm of rain by Wednesday 27 July on his return. This compares with Akaroa's 284.4.

The areas affected in 1994 were the houses along the beach front, the Valley Road which was flooded from Fraser's bridge at the Old Le Bons Track to at least as far as Kotlowski Road. The water flows out from the Fraser's bridge and then back into the stream at two points before Kotlowski Road. One resident interviewed, Neil Fraser (who lives further up the valley with a good view of the whole floor and out to the sea) stated that the paddocks down by the main road and to the sea near the old killing shed flood regularly, but none of the other interviewees mentioned this. There was also conflicting information about the extent of the flooding around the houses on Old French road, which may depend on what time the flooding was seen. Similarly, it has been difficult to assess the extent to which water flows down the Valley Road, which may be because it disappears quickly after the rain eases.

Figure 16 Takamatua July 1994

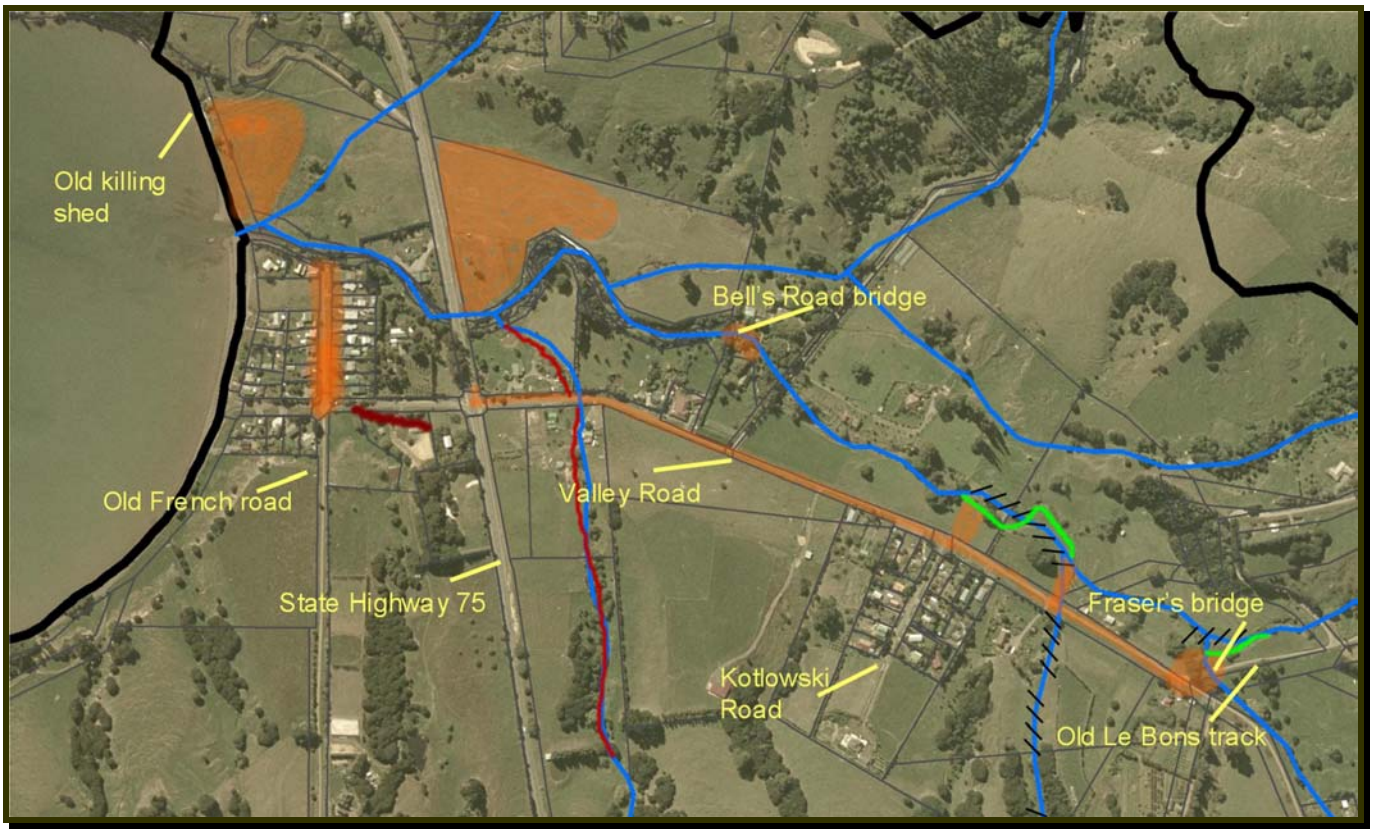
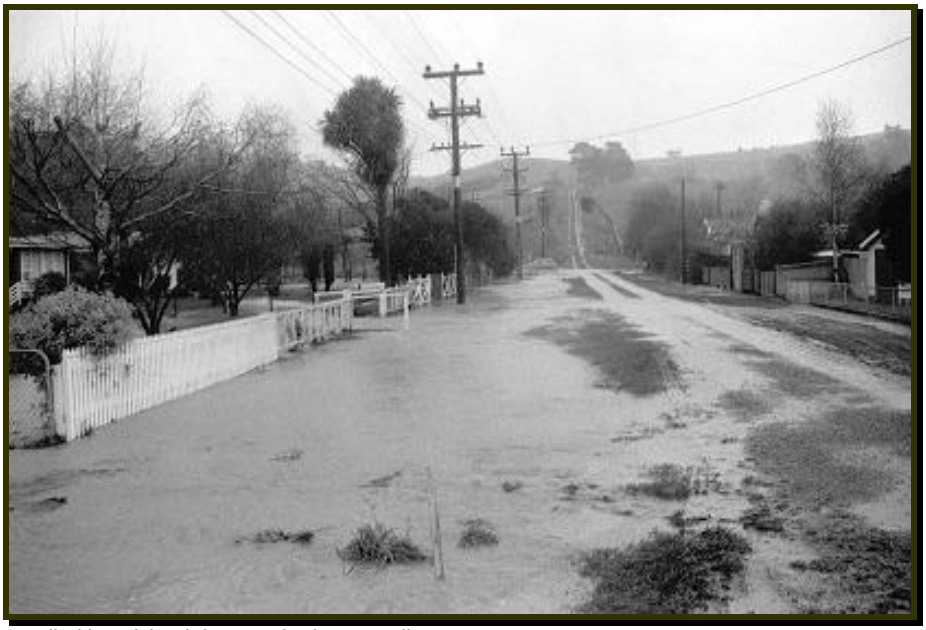


Figure 17 Photographs of Takamatua July 1994

Flooding around houses in Old French road,

Supplied by Michael de Hamel, Akaroa Mail

Supplied by Michael de Hamel, Akaroa Mail



Looking up Old French Road where water has come from

Supplied by Michael de Hamel, Akaroa Mail

Table 9 Event Assessment

Causes	***Extreme Rain***
Known Frequency	*Rainfall at or about the same level has occurred at Onawe 6 times in the study period and at Akaroa 7 times in the study period. Similar flooding has happened in Takamatua about 4 times in the 73 years studied, including 2002.*
Corrective Action	*None identified*
Lay comments on probable re-occurrence	*As no corrective action appears to have been taken, this is likely to recur.* *Problems could be lessened in Takamatua with improved drainage in Old French Road and at Frasers Bridge.*
Map Accuracy **Sketchy**	***Sketchy*** *Conflicting stories as to whether flooding inundated the paddock*

	areas and the extent of flooding in the residential area at Old French Road.

9.2 Flooding Event January 2002

Takamatua flooded again in 2002 in a similar pattern to 1994. Two residents mentioned that a slip higher up the valley had dammed the creek, and that when this gave way there was a huge rush of water which caused some additional damage. The map below shows additional flooding from the Bells Road bridge, and also over Prue Downes property near the stream loop. Dave Thurston who described the flooding from Bells Road bridge was away during the 1994 storm, so it may be that this also flooded similarly then. A bridge over the stream at Thurstons was washed away during this storm, as the stream rose to the top of its bank (but not over it). Prue Downes felt that the 2002 flood at the stream bend on her property was a one-off caused by a blockage from a tree that had been just felled in the neighbour's property. Transit recorded that there had been flooding requiring cleanup on the State Highway at the Takamatua river, although residents again had conflicting information about this.

Neil Fraser who had identified flooding in the paddocks north of Prue Downes property and by the killing shed north of the Old French Road houses was away in 2002, so whether these paddocks flooded is unclear. No other residents have mentioned it.

Figure 18 Takamatua January 2002

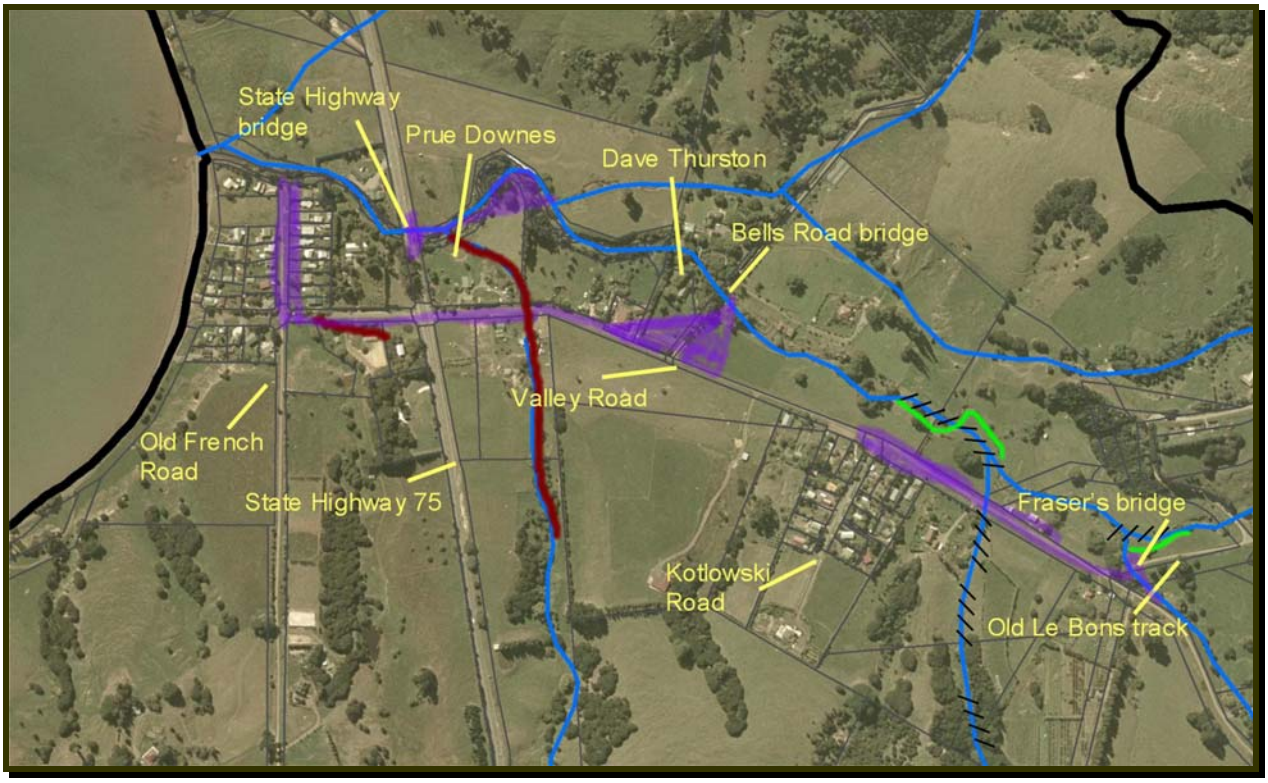


Table 10 Event Assessment

Causes	***Extreme Rain*** ***Slip higher up stream*** ***Debris in stream***
Known Frequency	*Rainfall at or about the same level has occurred at Onawe 6 times in the study period.* *Similar flooding has happened in Takamatua about 4 times in the 73 years studied.*
Corrective Action	*None identified, except that the Thurston bridge has been raised, but this was not a flood point.*
Lay comments on	*As above, this type of flooding is likely to happen again unless*

probable re-occurrence	*improvements are made to drainage at the Old French Road and at Frasers Bridge. Residents could be made more aware of the need to keep stream banks clear of debris.*
Map Accuracy **Moderate**	***Accurate and but not Comprehensive*** *Several residents have been interviewed, but the extent of flooding in the paddocks near the highway is unclear*

9.3 Summary of Problem Areas

The main problems at Takamatua are with the residential settlement below Old French Road and Fraser's Bridge where the Old Le Bons track joins the valley road.

9.3.1 Lower Old French Road

Water comes down the hill along the Old French Road and through the paddocks and ponds around the houses, particularly in Old French Road because there is inadequate drainage to the main stream.

9.3.2 Fraser's bridge and Bells Road bridge

The creek can also burst its banks higher up the valley at the corner of the Old Le Bons Track and the Valley road at the Fraser's bridge. Water then runs down the Takamatua Valley Road before mostly returning to the creek bed before Kotlowski road.

Problems have also been experienced further down the stream at the Bells Road bridge, and again having burst its banks the water flows across the paddocks to the Valley road.

9.3.3 State Highway bridge

The very flat paddocks on either side of Highway 75 are also subject to flooding, and the main road can become inundated for brief periods around the bridge.

10 Robinsons Bay

The parts of Robinsons Bay within the Study area that are prone to flooding are all on the valley floor. No interviewees mentioned flooding in the Archdalls Road, Ngaio Grove or Ngaio Point settlements, although there have been some major slips in some of these areas over the years, especially along the State highway.

Table 11 Interviewees who provided information for Robinsons Bay were:

Ken Paulin	Works and Services Manager, BPDC
Paddy Stronach	Former resident of Tizzards road
Peter Haylock	Farms hay paddocks on the flats
Dianne Carson and Sue Church	Residents of flood prone area on valley floor
Alan Reid	Resident of School road at the time and his father (now deceased) then lived in one of the cottages by the beach

10.1 Flooding Event July 1994

The most recent flooding event in Robinson's Bay was in July 1994. Paddy Stronach attributed the main problem to the sheer volume of rain that fell. Contributing factors were a blocked culvert on School Road which meant that the water from above ran down the road rather than draining down the hill, and a blocked culvert in the ditch that runs along the north side of the valley road. While community members were trying to unblock this culvert a slip occurred above School Road sending a torrent of water down the temporary rain creek. Further up the valley a slip in the Tizzards Road stream (outside the Study area) caused the stream to break its banks at the 5th bridge and torrent down Tizzards Road. At the bottom of Tizzards Road it flooded across the Valley road toward the Pavitt cottage. The Pavitt cottage did not flood. It is probably worth noting that this cottage has stood since 1857. Further down the valley, the stream broke its banks above Dianne Carson's house and flooded across the paddocks surrounding the front of her house. Dianne recalls the water being about ½ a metre deep along her driveway. The three houses at the corner of the Valley Road and the Main Road were not flooded, due to sandbagging along the fences.

Figure 19 July 1994 Robinsons Bay

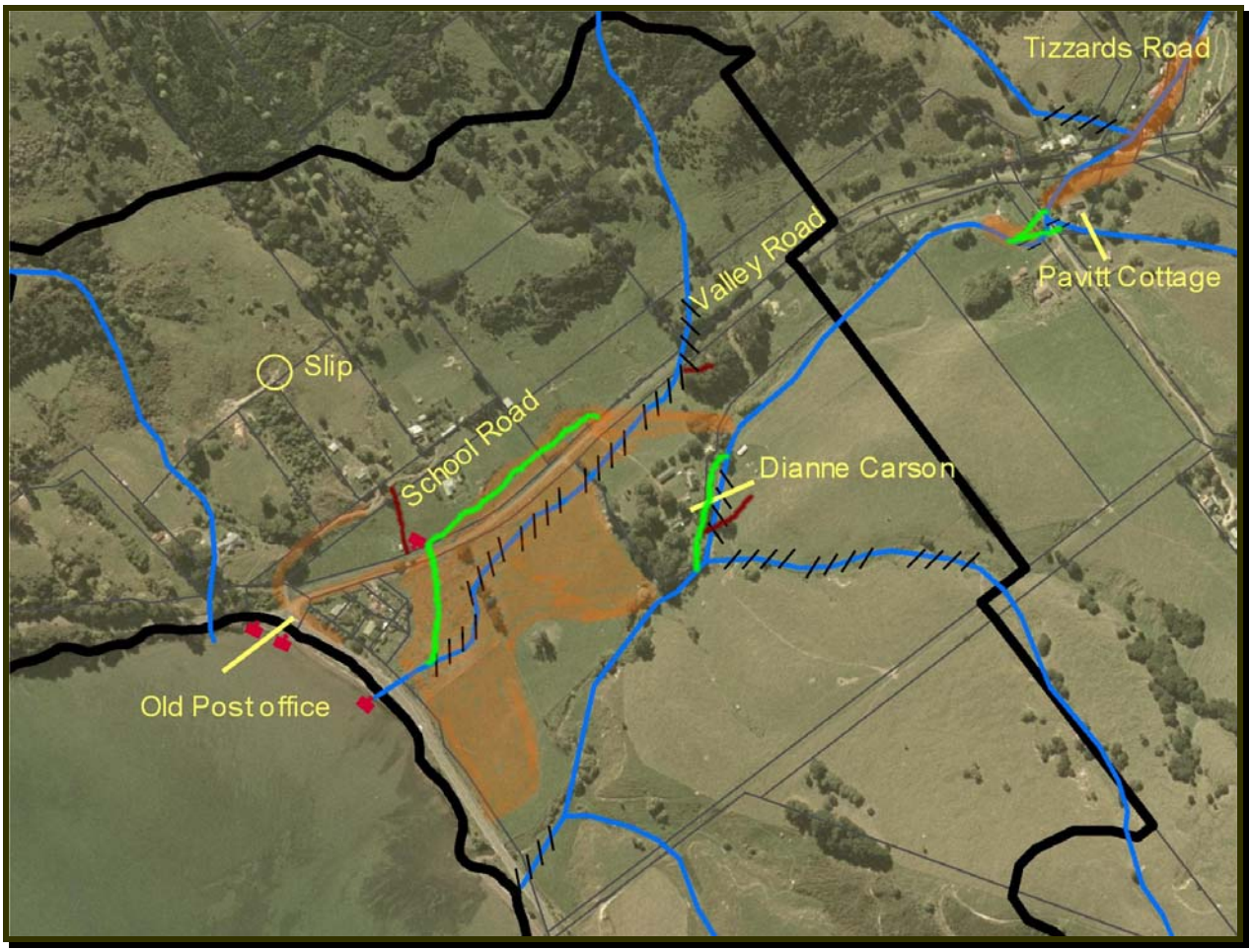


Figure 20 Photographs Robinsons Bay July 1994

Robinsons Valley Stream behind Dianne Carson's house during 1994 floods. Stream has overflowed normal banks, and broken out here, but returned to its bed by the time this picture was taken.

Supplied by Sue Church, Dianne Carson's daughter

Table 12 Event Assessment

Causes	***Extreme Rain*** ***Blocked Culverts*** ***Slips*** ***Poor outflow to sea***
Known Frequency	*Rainfall at or about the same level has occurred at Onawe 6 times in the study period and at Akaroa 7 times in the study period. Robinsons Bay has flooded before in the early 1980s, according to two residents, but memories of this event are sketchy. However, no records exist in the Akaroa Mail of regular flooding at Robinsons Bay, and there were no problems in 2002. There was flooding at Robinsons Bay in 1963, but this was on the main highway due to a blocked culvert. There was also flooding a few days after the Wahine storm when a slip came away high up and sent water down the Valley road. It seems that Robinsons Bay has probably flooded about 3 times to this extent during the study period, although under-reporting is likely in this predominantly rural valley.*
Corrective Action	*None identified*
Lay comments on probable re-occurrence	*Rainfall at or about this level has occurred 7 times at Akaroa since the start of the study period and 5 times at Onawe. Robinsons Bay continues to suffer from poor drainage into the sea, so this type of flooding is likely to occur again occasionally.*
Map Accuracy **High**	***Accurate and Comprehensive*** *A relatively recent event, several residents consulted, and information is consistent.*

10.2 Summary of Problem Areas

The main problem in Robinsons Bay is caused by poor outflow to the sea.

10.2.1 Culverts

As identified by Ken Paulin and by local residents, Robinson's Bay has a constant problem with the culverts at the northern end that drain into the sea being blocked by debris. The drop from the valley into the sea is very shallow and these drains block with seaweed and other debris.

Partially blocked culvert at beach opposite Old Post Office and houses.

Supplied by Suky Thompson

Experimental Whitebait traps in main stream bed just above the State Highway bridge.

Supplied by Suky Thompson

Residents are currently concerned that four structures recently erected in the main stream bed by the University of Canterbury research on whitebait breeding could form a major blockage of the stream during a future flooding event. This is probably where flooding occurred in 1963 as the Akaroa Mail describes flooding on the main Highway near Mr. E.L. Williams gate.

10.2.2 Houses on main highway

Although Ken Paulin thought that the houses along the main road were prone to flooding, residents said that they have never actually flooded and certainly didn't in 1994. However, they are very low lying with a creek running behind them. Along the east side of the Main Highway there is often ponding by the Old Post office building caused by poor drainage.

11 Duvauchelle

The main part of Duvauchelle is prone to flooding both from the two creeks that run down and from the sea surges when high tide and high wind conditions occur. The creeks are known as the Showground creek and Pawson's stream which comes through the Golf Course.

There are also problems along the Onawe flat road because of poor drainage.

Table 13 Interviewees who provided information for Duvauchelle were:

Ken Paulin	Works and Services Manager, BPDC
Paddy Stronach	Civil Defence coordinator in 1992
Beverley Broad	Resident of Onawe Flat
Ruth Jones	Family owned a home at Onawe Flat
Denise and Pip Cummings	Run a shop at the Old Post Office in Duvauchelle
Vern Shadbolt	Owner of the Saleyard building
Huntly Marshall	Duvauchelle resident
Liz and Geoff Carter	Residents of the Post office when it flooded
Barry Brownie	Long time golf club member
Tony Rhodes	Long time golf club member
Ray Skinner	Former proprietor of Bay View garage and long time golf club member
Phillip Kingston	Former proprietor of Duvauchelle hotel and then heavy machinery driver for Serco and then Fulton Hogan

11.1 Flooding Event Wahine Storm April 1968

The Akaroa Mail reported serious flooding at Duvauchelle during the Wahine storm. Areas flooded included the State Highway between the Hotel and the Hall, and then further along from the Pawsons Valley stream right along to the Council Yard. The creek had broken its banks and was threatening the Shop and the Post Office. There was also extensive flooding on the new golf course and all the bridges were washed away. The report does not say whether there was flooding at Onawe Flat, but given the strong winds that accompanied this storm this seems very likely as there were tidal surges.

Figure 21 Wahine storm April 1968 Duvauchelle

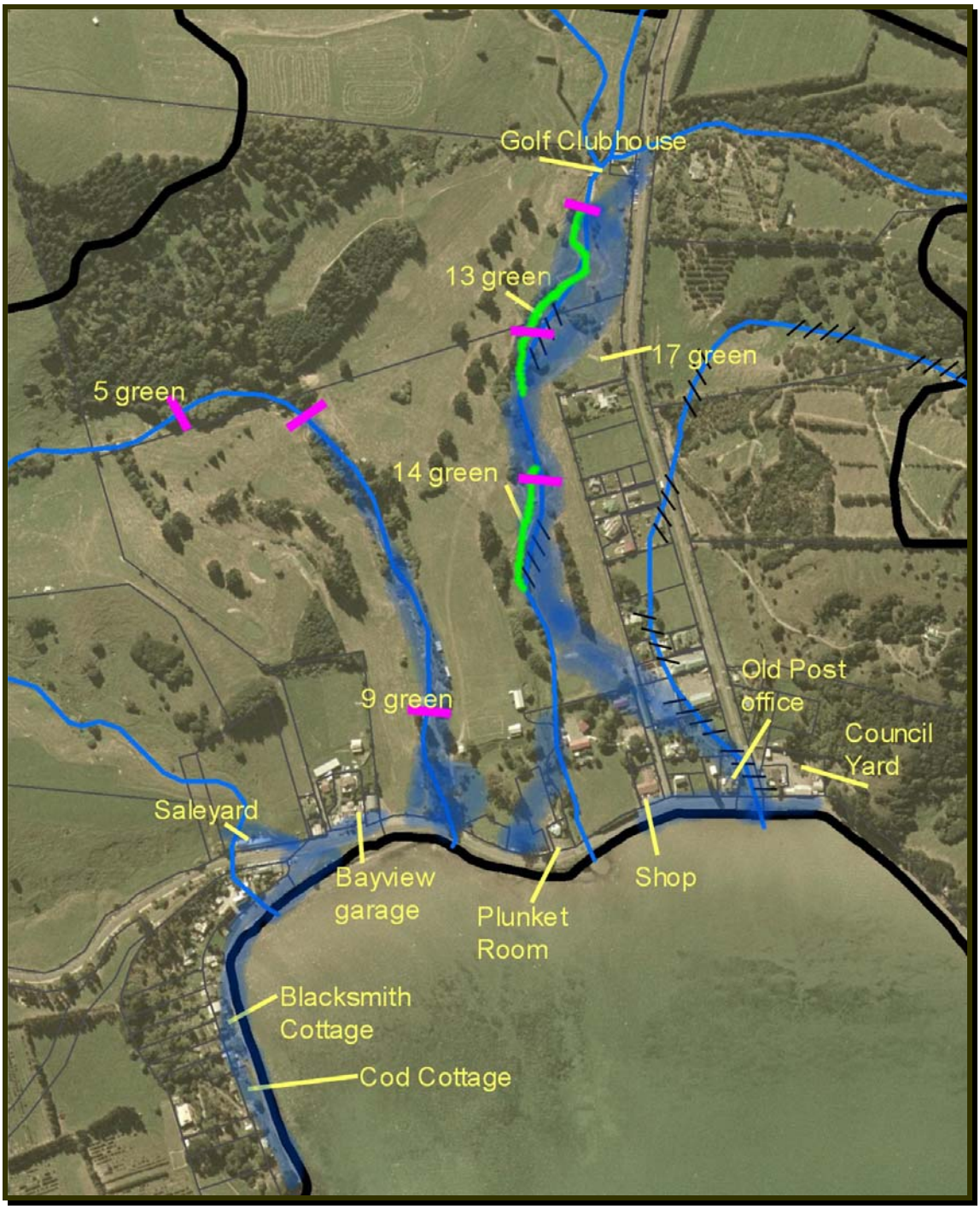


Table 14 Event Assessment

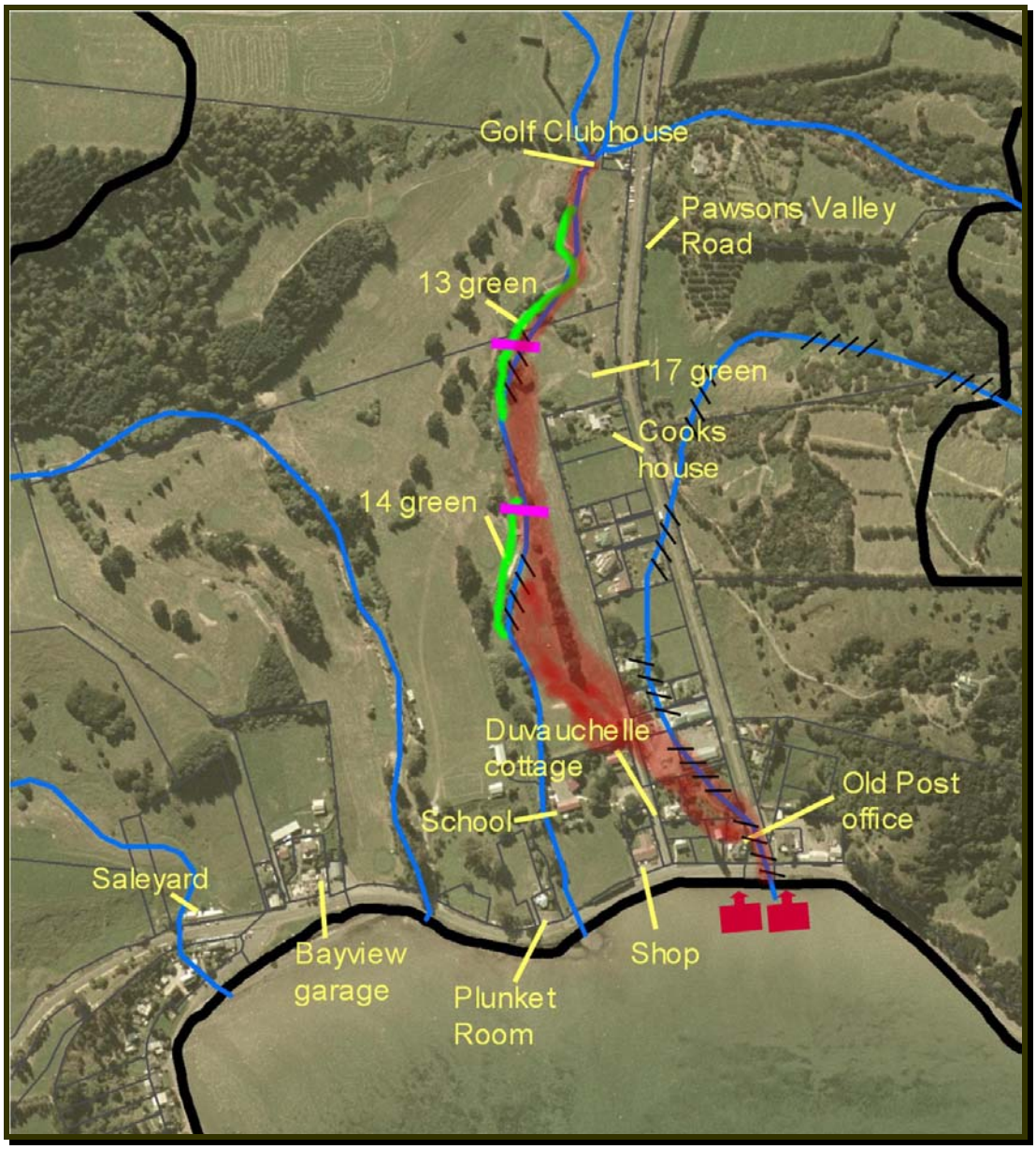
Causes	***Extreme Rain*** ***Culverts blocked by high tide and debris*** ***Extreme wind***
Known Frequency	*The Wahine storm is the worst on record in Akaroa for its combination of both extreme wind, rain and tides.*
Corrective Action	*Improvements have been made to drainage at the Saleyard, along Pawsons Valley Road and on the School road.*
Lay comments on probable re-occurrence	*This was the second highest rain recorded at Onawe, the highest being at Christmas 1963. However, the problem of culverts at the*

	sea blocking and the streams bursting their banks have not yet been solved.
Map Accuracy **High**	***Accurate and Comprehensive*** *Good write up in Akaroa Mail and concurs with several residents memories*

11.2 Flooding Event March 1986

In heavy rain in March of 1986 the Post Office in Duvauchelle flooded overnight. This event is remembered vividly by Liz and Geoff Carter who were living in the building at the time. The problem during this storm was caused by a huge log which first got stuck at the irrigation dam beside the clubhouse and then, when the dam broke, blocked the bridge on the 13th green sending the water all down the fairway, ending up behind the school. Rubbish against the fence deflected the torrent from the school, but the grounds would have been flooded. The water flowed on through the grounds of Duvauchelle cottage and then through the Post Office. The problem was then exacerbated by blocked culverts at the sea.

Figure 22 March 1986 Duvauchelle



Photographs of the 1986 flooding in Duvauchelle were provided by Ray Skinner and Barry Brownie.

Figure 23 Duvauchelle Golf Course March 1986

Looking down the Golf Course, this shows the full torrent and the 17th bridge still intact.

Supplied by Ray Skinner

This is the log that broke the bridge, sitting where the stream in flood had deposited it a few hours earlier according to Barry Brownie. Photograph taken during the clean up a few hours later.

Supplied by Barry Brownie

Looking from the 13th green down the fairway towards the sea. The extent of the flooding can be seen

Supplied by Barry Brownie

Looking up the golf course towards the Cooks house. The stream is in its bed rather than the flood path.

Supplied by Barry Brownie

Looking back to the Club House about 16 hours after the flooding event

Supplied by Ray Skinner

Table 15 Event Assessment

Causes	***Moderate Rain*** ***Blockage in stream*** ***Culverts blocked***
Known Frequency	*This storm was not one the biggest the Peninsula has known, neither in terms of a single rainfall nor in terms of several days of rain. The event was mainly caused by a log blocking the dam and then the bridge on the Golf Course stream. However, flooding through the Post Office also happened in the Wahine storm. The Golf Course was fairly new when the Wahine storm occurred and has flooded at least 5 times since.*
Corrective Action	*The Golf Course dam is no longer in use. Improvements to culverts in School Road by Duvauchelle cottage*
Lay comments on probable re-occurrence	*If Pawsons stream blocks high on the course, the water is likely to take this path, but improved drainage may help, although problems still exist with drainage to the sea in Duvauchelle*
Map Accuracy **High**	***Accurate and Comprehensive*** *Based on information from several people*

11.3 Flooding Event July 1986

Further flooding at the Golf Course occurred some time later in the 1980s. The date has been identified as most likely to be in July 1896, when the Akaroa Mail reported flooding in Duvauchelle caused by blocked culverts. This time the main problem was caused by water flowing down the stream from the hillside opposite the clubhouse and the culverts in Pawsons Valley Road failing to cope. Since this flood the culverts along Pawsons Valley Road have been greatly improved. The extent of the flooding on the Golf Course during this storm has not been ascertained, but it did not flood down through the Post Office again.

Figure 24 Pawsons Road July 1986

Looking down the Golf Course from Pawsons Valley Road. This picture was identified as taken in the late 1980s in the evening, and seems most likely to be in July 1986 when more problems were caused by the Pawsons Valley road culverts.

Supplied by Ray Skinner

Pawsons Valley road opposite the Golf Club entrance and looking toward the sea. Water draining from the hillside is flooding across road towards Golf Course and down to sea. Also likely to be July 1986; photograph taken about 5:00pm and car lights are on.

Supplied by Ray Skinner

Table 16 Event Assessment

Causes	***Moderate Rain*** ***Culverts inadequate***
Known Frequency	*This storm was not one the biggest the Peninsula has known, either in terms of a single rainfall or in terms of several days of rain. The event was mainly caused by inadequate culverts on Pawsons Valley Road.*
Corrective Action	*Major improvements to the culverts in Pawsons Valley Road have*

	been done.
Lay comments on probable re-occurrence	*Unlikely due to improved drainage in Pawsons Valley Road.*
Map Accuracy **Sketchy**	***Sketchy*** *Based on information from two people, but unclear as to how far flooding extended into the Golf Course.*

11.4 Flooding Event Big Snow August 1992

Sea surges caused major flooding at Onawe flat, and the Jones family with their small children and baby living at what is now called the Blacksmith Cottage were kept supplied with food by family dashing in between surges, and eventually moved out. During the storm sea surges meant access was only possible between wave breaks. The Duvauchelle wharf was washed away by the sea surges of this storm. (Note that this wharf has subsequently been rebuilt in its original position. It is pictured separately from the flooding map to avoid compressing the flooding map scale).

Figure 25 Big Snow August 1992 Duvauchelle

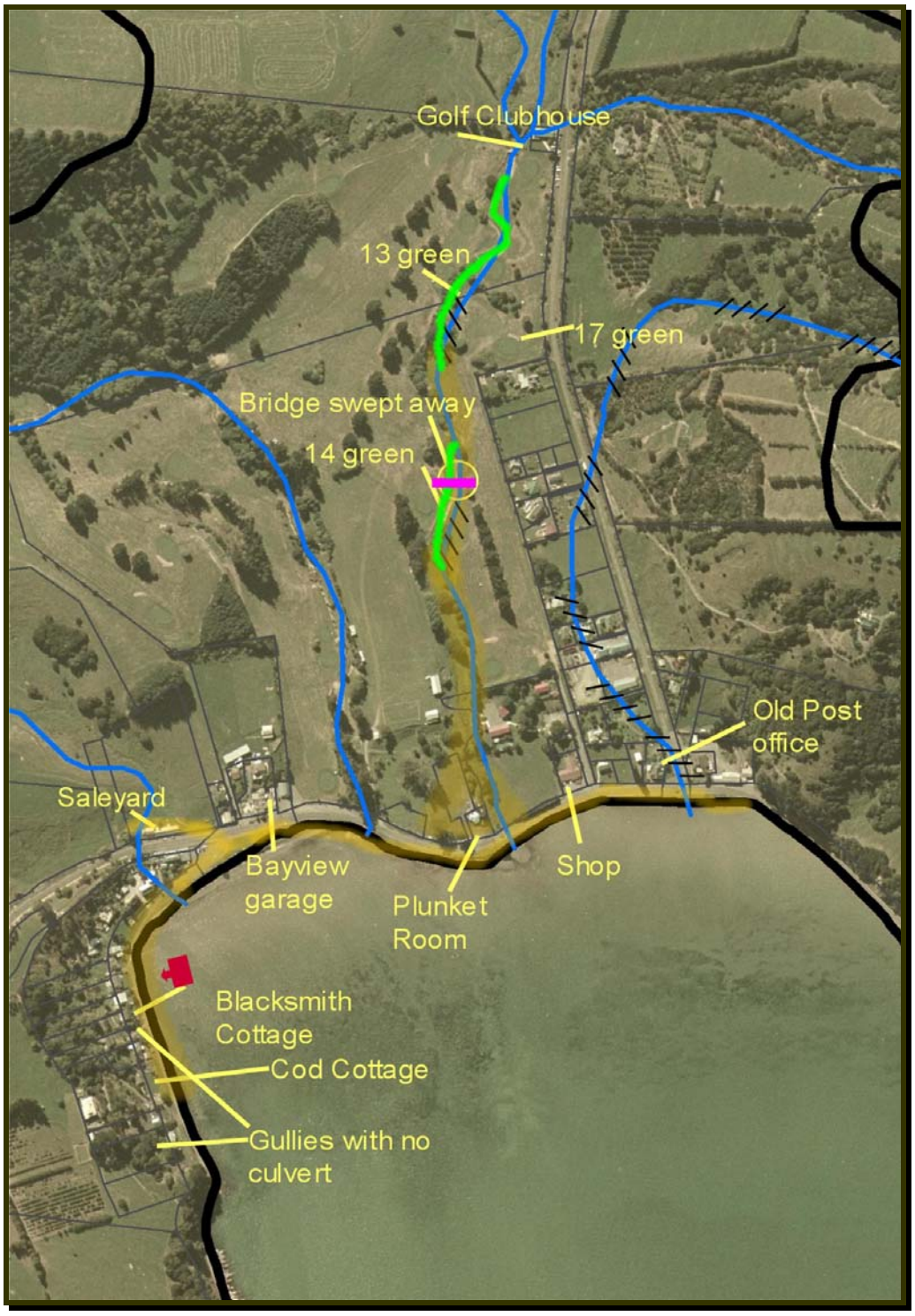


Figure 26 Duvauchelle Wharf

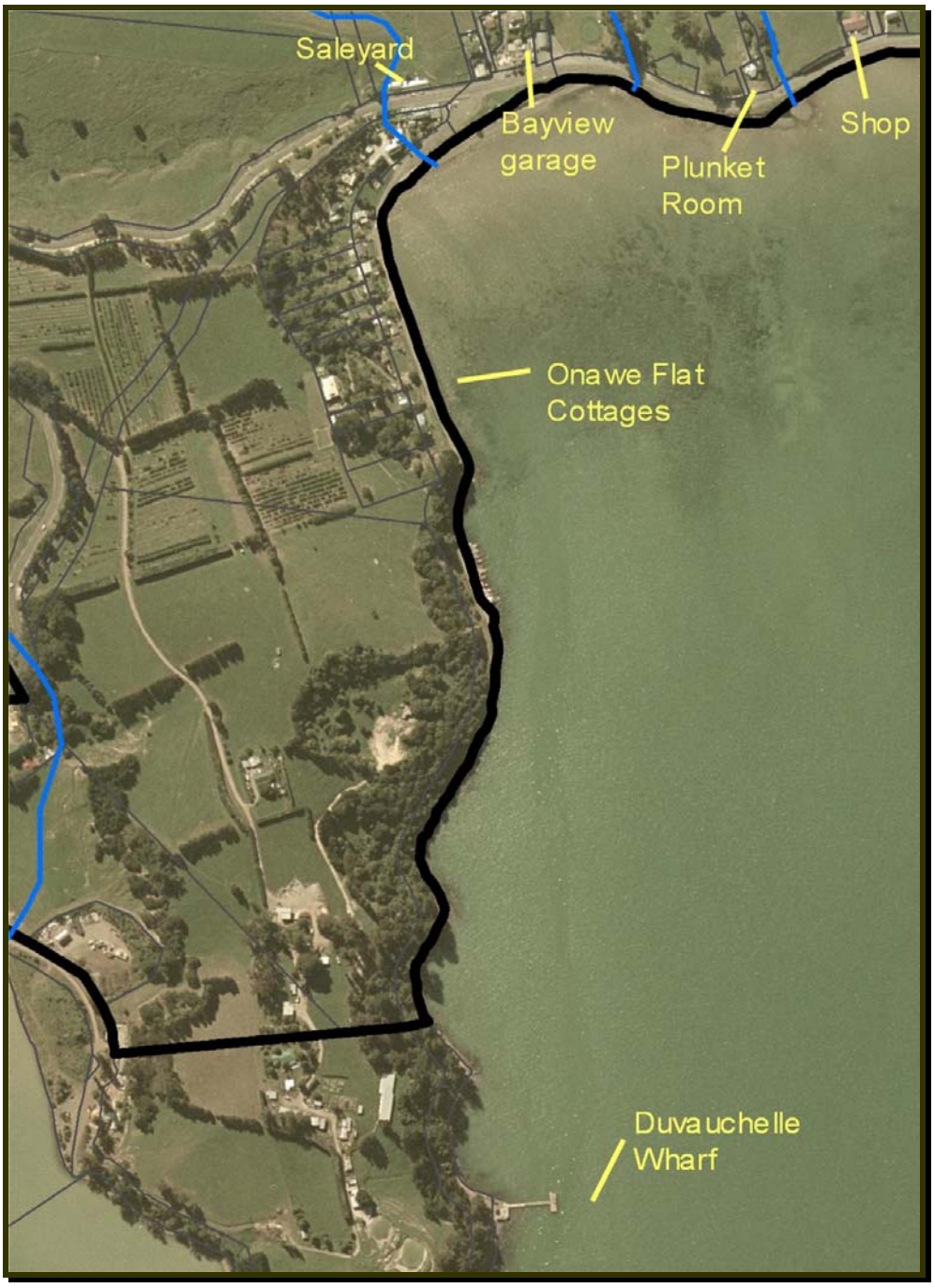


Figure 27 Photograph of Duvauchelle in Big Snow 1992

Taken in the front garden of the first house along the Onawe Flat road after the motel units.

Taken by Wally Saggers, Supplied by Michael de Hamel, Akaroa Mail

Figure 28 Stock photograph of sea surge at Duvauchelle

This photograph of a sea surge at Duvauchelle was reprinted in the Akaroa Mail several times when there was rain or storm news for the area during the Vine editorial years prior to Michael de Hamel taking over the paper. The first time it appeared is probably 22 August 1975. It is reprinted again here to show how the sea can behave.

Photograph from archive copy of Akaroa Mali, 4 July 1981 held at Akaroa Museum

Table 17 Event Assessment

Causes	***Sea surges*** ***Heavy Rain*** ***High wind***

Known Frequency	*Minor sea surges can occur during winter storms and put some water onto the road. Major sea surges that cause serious flooding have happened on at least the the following occasions: April 1962, Wahine Storm, August 1975, July 1992, October 2000, and probably also Christmas 1963 as there were heavy sea surges then.* *The 1992 precipitation fell as very heavy snow on higher ground and as rain lower and was combined with very high sea surges, which hit the southern and western sides of the Peninsula. The storm was not as severe as the Wahine cyclone or the storm of April 1962. Sea surges and wind storms have not been the focus of this study, so the number of them that have occurred is not known.*
Corrective Action	*None identified*
Lay comments on probable re-occurrence	*This storm seems to have been exceptional for its combination of heavy snow fall and heavy seas, but the same type of flooding could occur during a heavy rain and heavy sea episode, and there appear to have been at least 6 of these during the study period.*
Map Accuracy **Moderate**	***Accurate but not Comprehensive*** *This storm is well remembered for its heavy snow, and memories of the flooding are strong too. However, there is some doubt as to whether the Pony Paddock flooded during this storm or 1994. Also some doubt as to whether the Saleyard flooded this year, and the extent of flooding along the main road.*

11.5 Flooding Event October 2000

As well as Onawe Flat, the road outside the garage was flooded. This was remembered by Pip Cummings who drove from flooded Barry's Bay to Duvauchelle school to collect his children. He was able to make the journey.

Information on what happened higher up the streams is sketchy at this stage.

Figure 29 October 2000 Duvauchelle

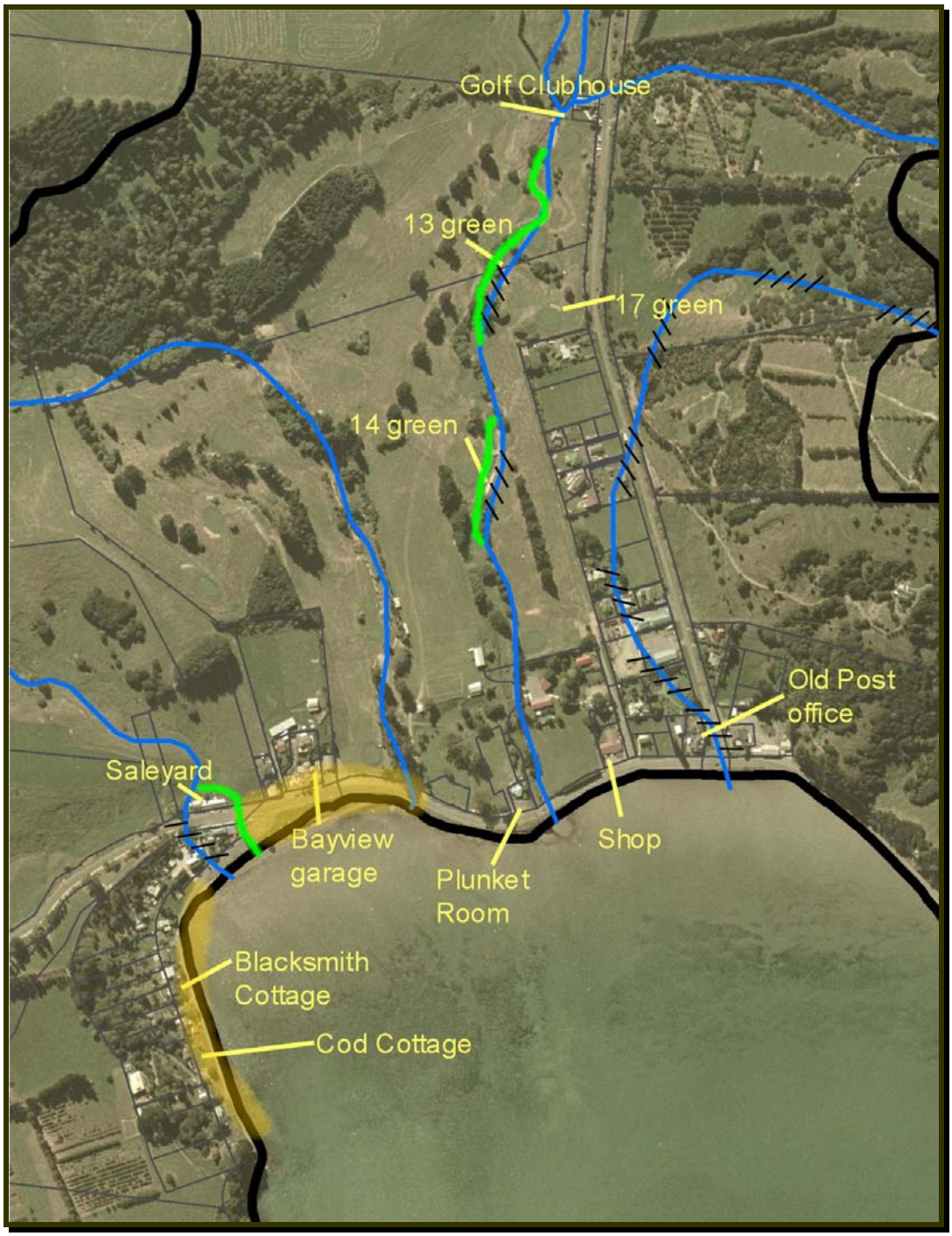


Table 18 Event Assessment

Causes	***Extreme rain and very high wind***
Known Frequency	*5 times during study period of 73 years at least*
Corrective Action	*None identified*
Lay comments on probable re-occurrence	*The October 2000 storm event had extremely high winds and brought down many trees, although it is not thought to be as bad a storm as the Wahine. Rainfall was much less and wind was remembered as less. Similar flooding is likely; storms with this level of rain and wind have occurred a number of times during the study period. There are still outstanding problems with drainage at Onawe Flat and the coastal area at the head of the harbour will always be susceptible to flooding from sea surges.*
Map Accuracy Moderate	***Accurate but not Comprehensive*** *Cummings gave good descriptions of the flooding on the road. Whether the Show Ground stream flooded higher up is not established at this stage.*

11.6 Summary of Problem Areas

11.6.1 State Highway from Hotel to Council Yard

The State Highway has flooded on a number of occasions at low points between the Hotel and the Council Yards. This has usually been caused by a combination of extreme rain and high tide and wind. Keeping the culverts that drain to the sea along the Duvauchelle waterfront clear is a major problem, and blocked culverts have been blamed for flooding problems. The culvert opposite the Old Post office has a flap door, but this cannot open very far because of another concrete structure in front of it, presumably both attempts to prevent the culverts from blocking, but in themselves also greatly restricting water flow out of the pipe during a major storm.

11.6.2 Golf Course

This has flooded several times and the bridges have been washed away on a number of occasions. Many of the problems have started at the Golf Course irrigation dam on Pawsons Stream beside the clubhouse. When this has broken a large flood has gone down the Golf Course, such as in March 1986 when the dam was blocked by a rogue log which then released and travelled downstream, ending up on the course itself. Since the last flood in the early 2000s the dam has not been re-instated.

11.6.3 Pawsons Valley Road

This used to flood from the stream coming down on the east side opposite the Golf Club house. In 1986 water flooded from the road onto the Golf Course. However, major improvements have been made to the culverts along this road since them, which has reduced the flooding risk.

11.6.4 Showgrounds Pony Paddock

The part of the Showground closest to the main road is known as the Pony paddock, This has flooded, probably in 1994, but the Plunket rooms that stand at the end of it have never been flooded inside.

11.6.5 Old Post Office

If Pawsons stream on the Golf course breaks its banks at the 13th green, the path it takes to the sea is through the Old Post office. The problems are compounded by the culverts at the sea side being blocked by debris. There are two culverts on the other side of the road from the Post Office. One stands well proud of the sea, the other currently appears to be nearly blocked.

11.6.6 Bayview Garage

The low lying area around the garage has flooded on a number of occasions.

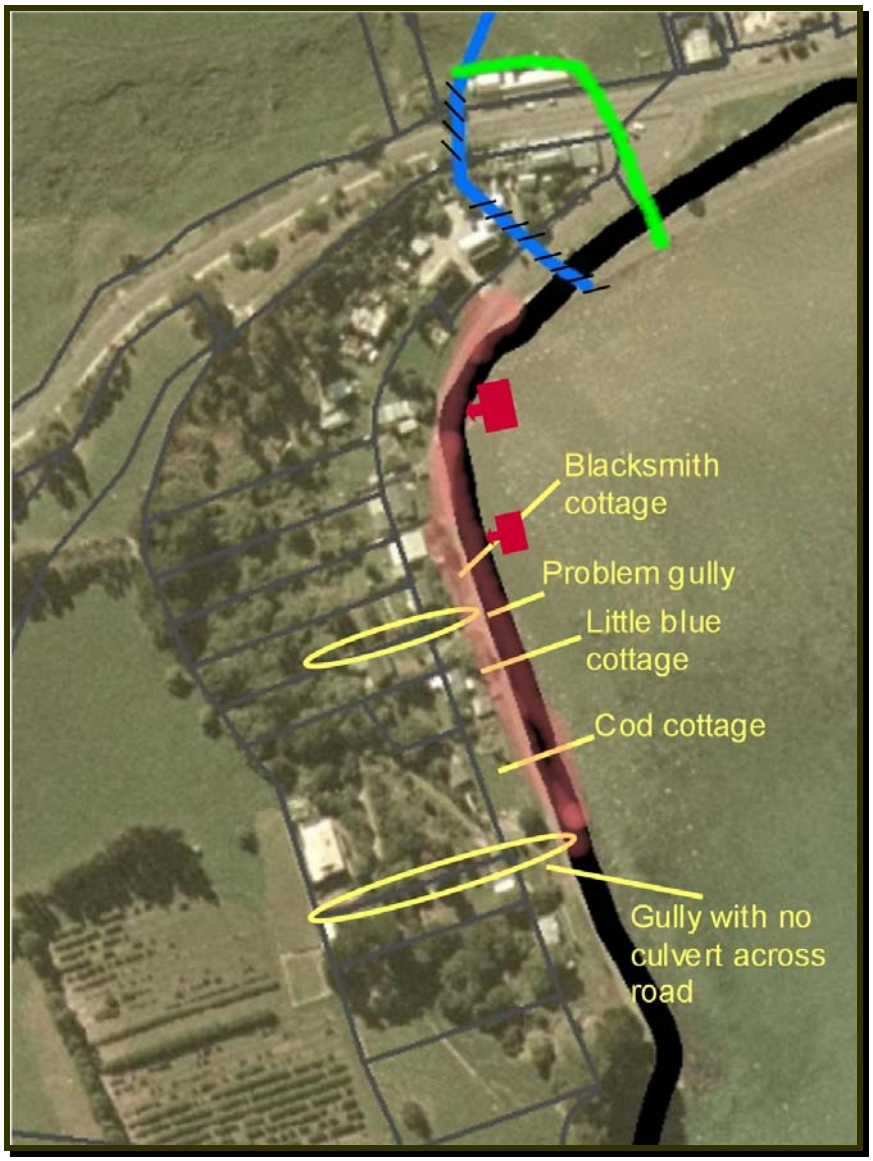
11.6.7 Saleyards

The Saleyards used to flood regularly in the past, but new drainage has been in place since the early 1990s and it hasn't flooded since.

11.6.8 Onawe Flat

Onawe flat floods frequently. The problems here are caused by both heavy rain and high tides and sea surges. A lot of water comes down from the Protea farm above the flat, and drains via two gullies. The gully to the north of Blacksmith cottage has no culvert across the road to the sea. There used to be one, but when the Duvauchelle sewage system was installed in the 1980s the sewer pipe crossed the culvert and it ceased to exist. Now the area floods every time there is heavy rain, with ponding in front of the cottages trapped behind the road, because the culverts at the end of the ditch get continuously blocked by shells and sand washed up by the sea. Particular problem areas are the Cod Cottage, the Little Blue cottage (which was flooded with sewage recently) and the Blacksmith cottage. The following map shows these problem areas, as described by Beverly Broad.

Figure 30 Onawe Flat problem areas



Onawe Flat also flooded during the 1960 tsunami.

12 Barrys Bay

The parts of Barrys Bay within the Study area prone to flooding are all on the valley floor. No interviewees mentioned flooding elsewhere in the valley. However, over the years there have been numerous slips higher up on State Highway 75, outside the study area.

Table 19 Interviewees who provided information for Barrys Bay were:

Ross Curry	Farmer in Barry's Bay
Denise and Pip Cummings	Residents of Barry's Bay who experienced property flooding in 2000
Colin Slade	Former owner of Half Moon Cottage
Des Heath	Current owner of Half Moon Cottage

Barry's Bay has been flooded on at least four occasions during the 73 years of this study. These include the storm at Christmas 1963, the following year in 1964, during the Wahine storm in 1968 and more recently during the storm in October 2000. The most dramatic was in the Christmas 1963 storm.

Barrys Bay was not affected by flooding in either 1994 or 2002

12.1 Flooding Event Christmas 1963

Ross Curry has farmed in Barry's Bay since 1970 and before that lived high in the Grehan Valley above Akaroa with a good view of Barry's Bay. The most serious flooding in Barry's Bay was in the storm just before Christmas in 1963. Ross remembers seeing the scars left by landslips in Barry's Bay clearly from his home in Grehan valley, and that Arthur Stewarts piggery had been completely destroyed and filled up with stones and the Cheese factory flooded. Many other people have mentioned the sight of these slips as well.

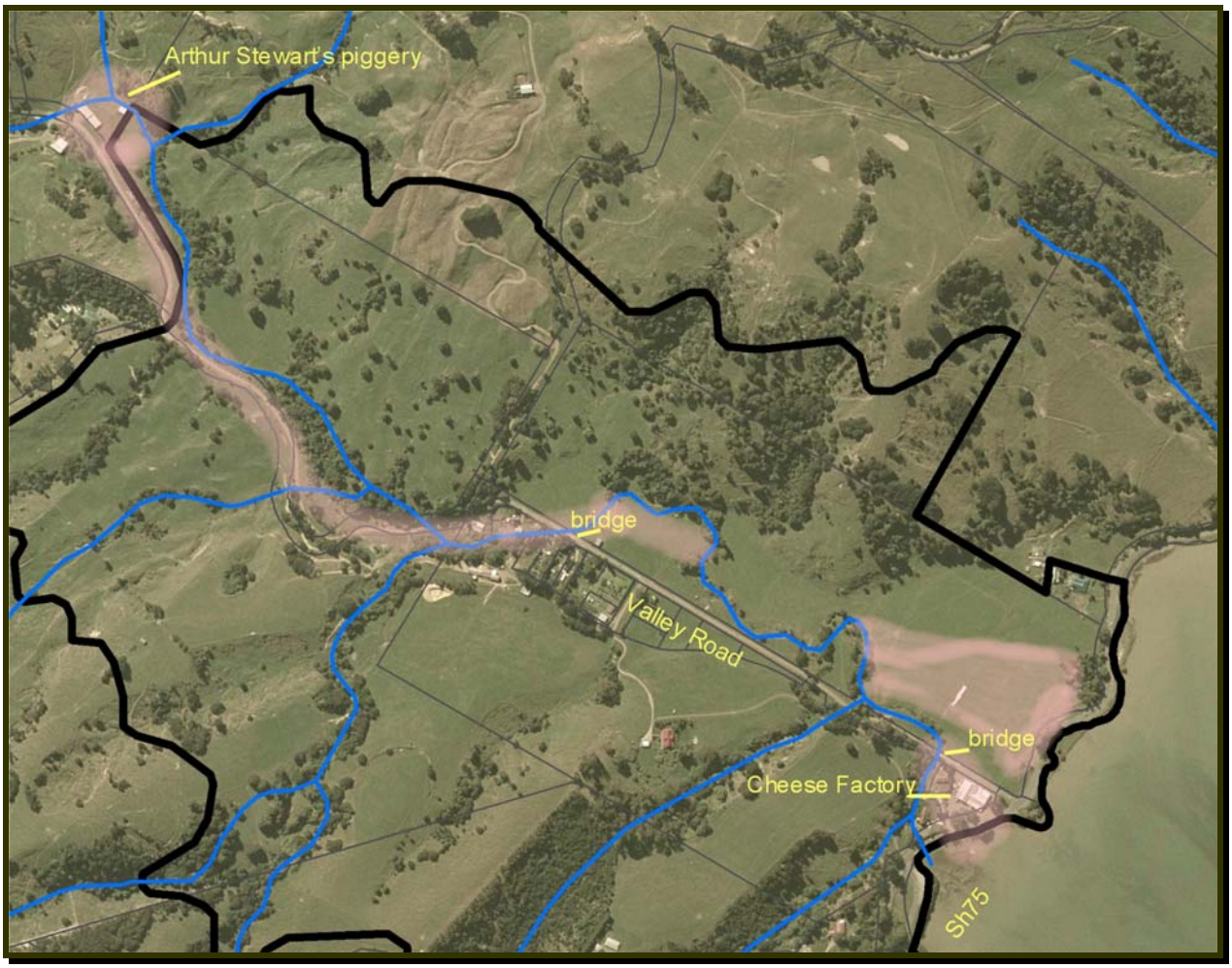
This is corroborated by the extensive report on this storm in the Akaroa Mail, which describes the damage at Barry's Bay thus:

> *"there had been a lot of land movement about Mr. Arthur Stewart's home piling debris into the creek which had changed its course and flowed down the road. Both bridges had been destroyed…."*
>
> *"At Barry's Bay the rampaging creek waters flowed round into the Barry's Bay Dairy Factory, depositing silt and rubbish inside the building, and causing damage to the stainless steel whey drain."*
>
> *"The valley itself presented a scene of havoc, one observer on Saturday counting at least sixteen large slips both from the Highway and the Summit Road sides for the full depth of the valley. The sea in Barry's Bay on Saturday was stained a rich red-brown." Akaroa Mail 24/12/63 "Heavy damage to district roading."*

Some time later following this flood, Ross Curry's uncle (who then owned the property) built a stop bank at the point lower down where the creek had overflowed to prevent the creek from flooding over again. Improvements had been to the creek below the bridge at the Cheese factory, with a cut being made in the concrete wall to allow flood waters to escape to the sea without flooding the factory. This was probably after the Wahine storm in 1968, as the cheese factory flooded again then.

> *"the flat area at Barry's Bay around the vicinity of the factory was flooded when the creek came over its banks and the paddocks were covered with a thick layer of silt" Akaroa Mail 17/4/1968 "Heavy stock and property losses Aftermath of Gale on Banks Peninsula"*

Figure 31 Christmas 1963 Barry's Bay



No photographs of the Christmas 1963 floods in Barry's Bay have been sourced.

Table 20 Event Assessment

Causes	***Extreme rain*** ***Extreme Slips***
Known Frequency	*4 times during study period of 73 years at least, but this was by far the worst time with the slips standing out in people's memories as extreme*
Corrective Action	*Stop Bank in valley and flood release in Cheese Factory bridge have been done since this flood.*
Lay comments on probable re-occurrence	*Unlikely to this degree* *The Christmas 1963 storm was the highest rainfall recorded at Onawe since records began. Improvements at the Cheese Factory bridge seem to be working and sending the runoff towards the sea rather than the factory, so although the valley is likely to flood again, the factory is less so.*
Map Accuracy **High**	***Accurate and Comprehensive*** *Ross Curry's account and that in the Akaroa Mail concur. Although it is clear from the records that one of the bridges damaged was by the Cheese Factory, but not which the other bridge was, so an assumption is made that it is the bridge by the houses.*

12.2 Flooding Event October 2000

Barry's Bay was very badly hit by this violent storm.. The problems were lower down in the valley than in 1963. The rainfall was much less and there weren't the slips higher up the valley. This time the main problem seems to have been caused by fallen willow trees that blocked the stream path causing it to back up below the stop bank. There was also flooding at the Cummings garden and garage and through the neighbours garden, but not in the houses. The Cheese Factory did not flood in this storm because the water flowed through the cut in the concrete wall at the bridge.

Figure 32 October 2000 Barry's Bay

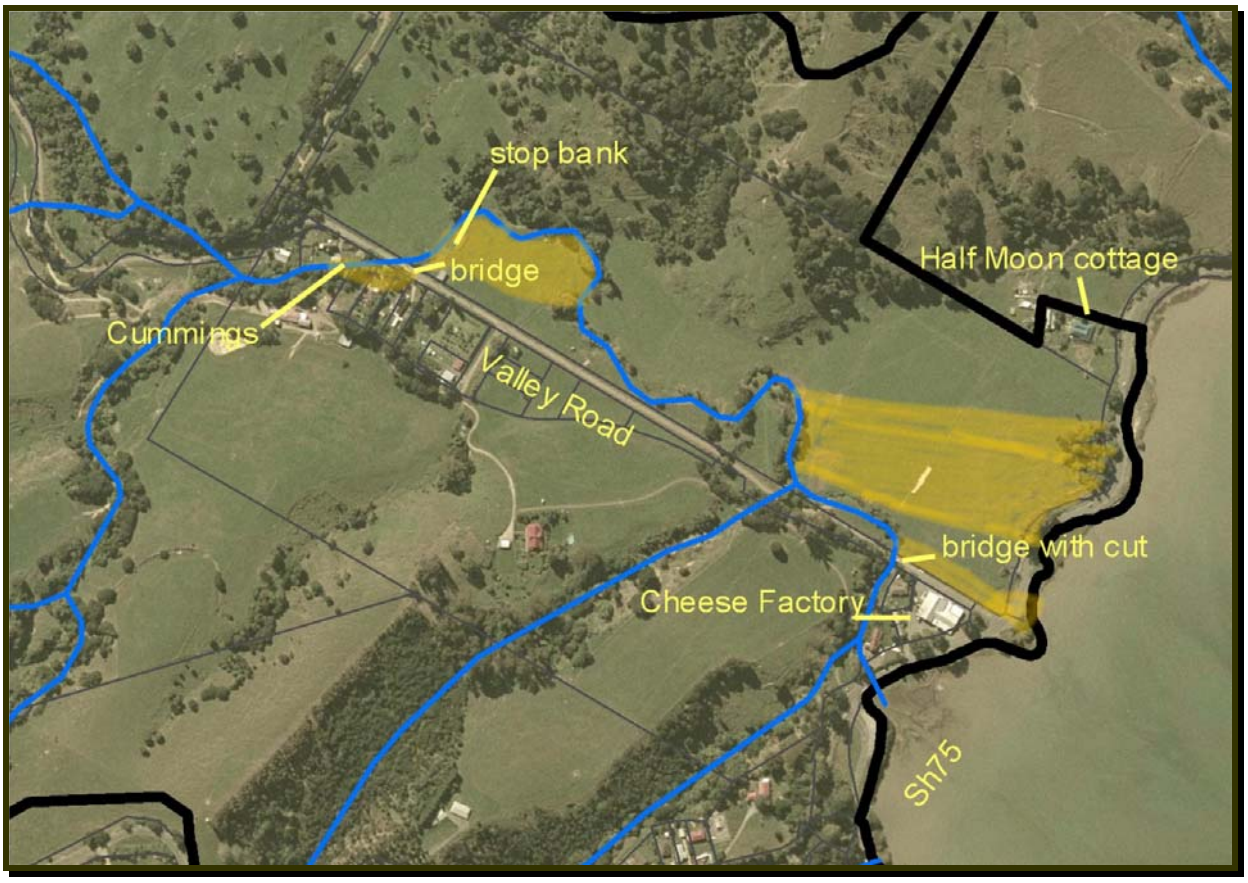
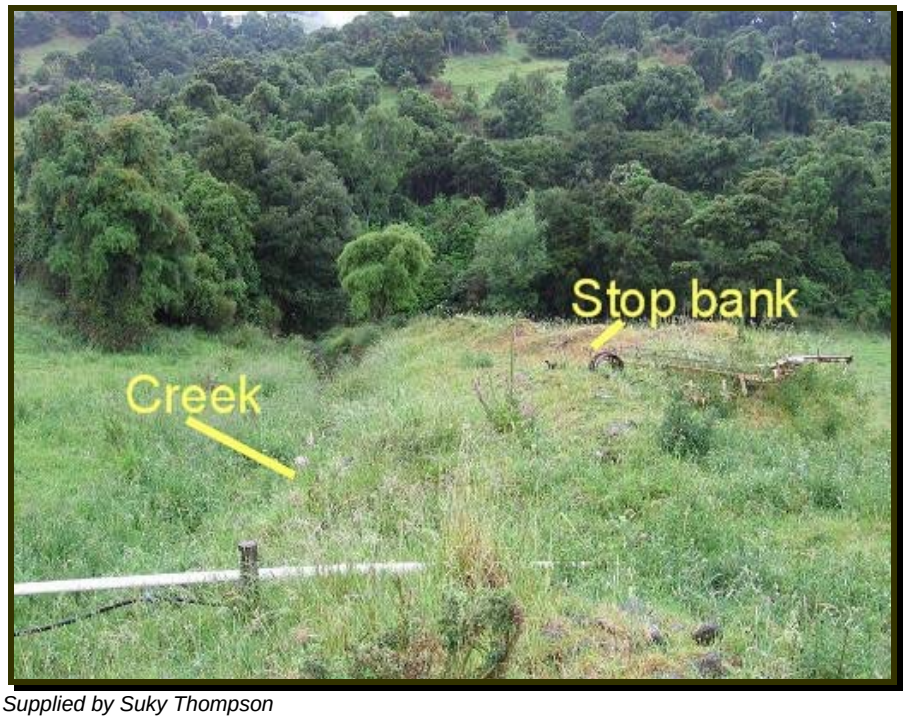


Figure 33 Photographs Barrys Bay October 2000

Stream torrent over stop bank. Fallen willows on far right.

Supplied by Ross Curry



The same stream in bed by stop bank during normal flow.

Supplied by Suky Thompson

Table 21 Event Assessment

Causes	***Extreme rain and wind*** ***Fallen willows blocking creek***
Known Frequency	*4 times during study period of 73 years at least.*
Lay comments on probable re-occurrence	*The October 2000 storm had extremely high winds and brought down many trees, although it is not thought to be as bad a storm as the Wahine. Rainfall was much less and wind was remembered as less too. However, storms of this ferocity have occurred at least 5*

	times during the study period. The gardens of the houses near the stream above the stop bank are likely to flood again in the future.
Map Accuracy **High**	***Accurate and Comprehensive*** *Ross Curry and the Cummings gave good descriptions of the flooding. Colin Slade and Des Heath confirmed that low lying Half Moon cottage had not flooded.*

12.3 Summary of Problem areas

12.3.1 Valley floor near Cheese factory

The Cheese factory used to flood, but after the storms in the 1960s (probably after Wahine) a cut was made in the concrete wall at the bridge beside the factory and this allows flood water to release across the paddock rather than flooding the factory. It seemed to work during the flooding in October 2000.

Figure 34 Release path near Cheese Factory

Break in concrete wall by Cheese factory bridge appears to work in releasing excess water here rather than through the factory

Supplied by Suky Thompson

12.3.2 Half way up valley near houses

The stream has flooded the gardens and outbuildings of these houses (labelled Cummings on the maps) on at least two occasions, and tends to break its banks and flood the paddocks across the road where a stop bank has been built (although it is not always sufficient).

12.3.3 Half Moon Cottage

Checks with residents of the low lying Half Moon Cottage indicate that this has not flooded, although there has been some very minor flooding through the workshop building at the back due to culverts blocked.

13 French Farm

Records and memories only record French Farm being flooded by the Christmas 1963 storm and the Wahine storm, the strongest the Peninsula has experienced since European settlement began. The bay is well protected from Southerly storm sea surges, but did suffer some minor coastal flooding during the 1960 tsunami.

Table 22 Interviewees who provided information for French Farm were:

Ken Paulin	Works and Services Manager, BPDC
Vern Shadbolt	Retired Farmer and resident near waterfront since 1946

Vern Shadbolt, whose family have farmed in the area for several generations said that he had been brought up with the belief that French Farm is worst hit by storms that begin as Southerlies and then veer to the West, and that the devastation of the Wahine storm upheld that view. (Note that although the Wahine storm may have blown from the south when it hit Akaroa Harbour, it was a tropical cyclone, not a Southerly).

13.1 Flooding Event Wahine Storm April 1968

The Akaroa Mail describes French Farm after the Wahine storm as follows:

> *"The flat at French Farm presented a desolate picture with water and silt covering large areas. A big bluegum near Mr. V.S. Shadbolts had crashed across the road and broken all the telephone lines. The valley road near Mr. H. Harris was blocked, the bridge at this point being washed out.*
>
> *On the flat Mr. T. J. Brocherie had to manhandle his milk cans across the creek to a neighbours vehicle to get the milk to the factory.*
>
> *Mr. V. Shadbolt reported measuring 12 inches of rain in the 24 hours to 8am Thursday" Akaroa Mail 17/4/1968 "Heavy Stock and Property Losses"*

Figure 35 Wahine Storm French Farm

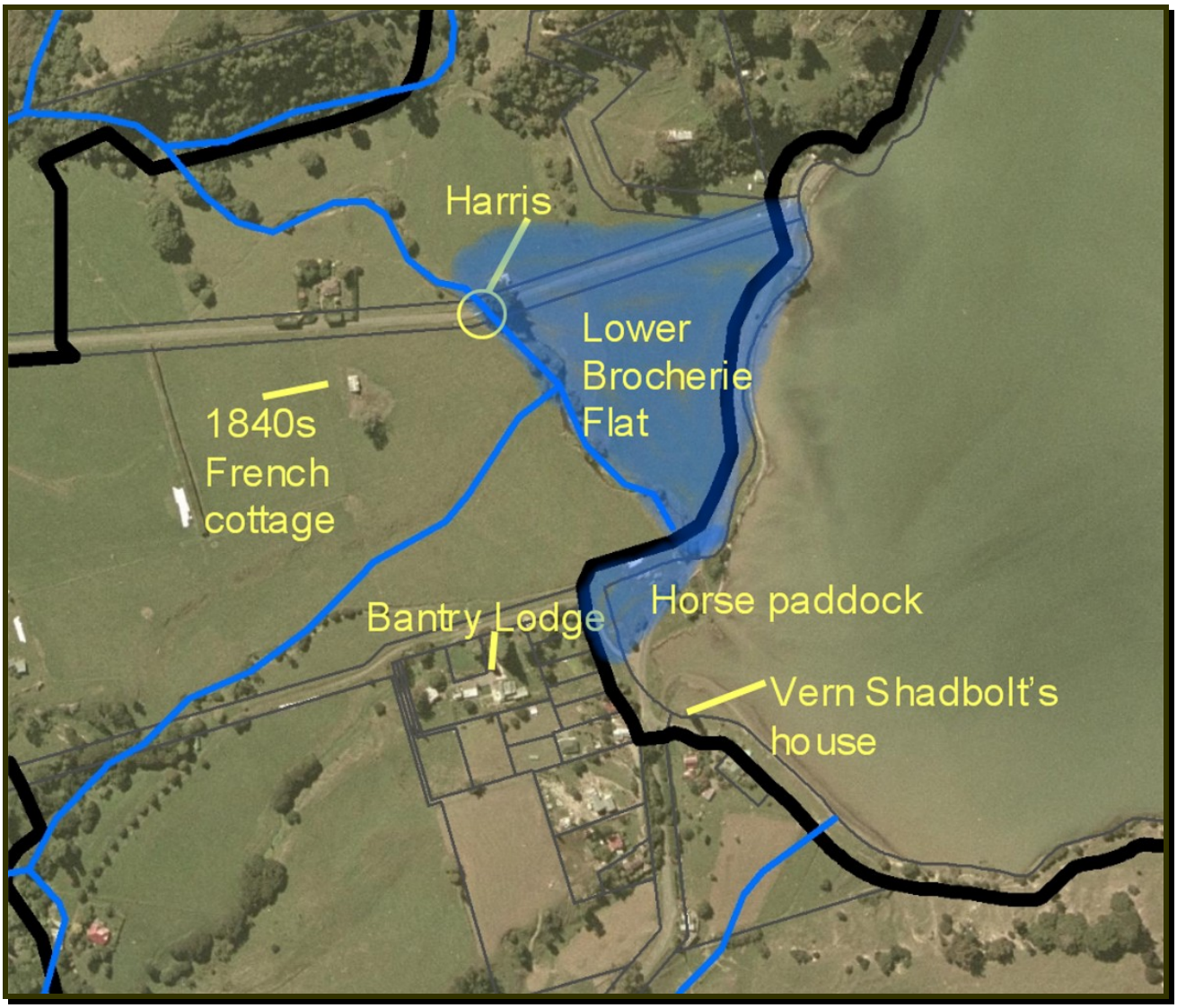


Table 23 Event Assessment

Causes	***Extreme Rain*** ***Extreme wind causing fallen trees***
Known Frequency	*In general, the Wahine storm is the worst on record for its combination of both extreme wind, rain and tides, but French Farm was hit by a similar level of deluge at Christmas in 1963 when similar flooding occurred. French Farm has flooded twice to this level during the study period.*
Corrective Action	*The French Farm stream is now routed differently and not so much water is channelled into the Horse paddock area near Bantry Lodge.*
Lay comments on probable re-occurrence	*This was the second highest rain recorded at Onawe, the highest being at Christmas 1963. However, the real devastation in French Farm was caused by wind.*
Accuracy **Moderate**	***Accurate but not Comprehensive*** *Clear write up in Akaroa Mail. Vern Shadbolt quoted in the Akaroa Mail was interviewed and has good memories of the lower valley. However information would be improved by also interviewing Terence Brocherie who was also quoted in the Akaroa Mail at the time. The precise location of the horse paddock is also not clear.*

13.2 Tsunami

Vern supplied this photograph of French Farm in the 1960 Tsunami.

Figure 36 French Farm in 1960 Tsunami and during normal conditions

Supplied by Vern Shadbolt

Supplied by Suky Thompson

13.3 Summary of Problem Areas

13.3.1 Lower Brocherie Flat

Vern also stated that although French Farm is not prone to flooding, the lower Brocherie Flat paddock from the stream to the beach has flooded twice, once in Christmas 1963 and again in the Wahine storm in 1968. In the Christmas 1963 storm Vern recorded 14" (355.6mm) of rain starting at midday. This accords with the figure at Onawe. He described the floods as a torrent of water from the stream rather than ponding and said that it drains quickly when the rain stops. During the Wahine storm the flood was up to waist level in his horse paddock. Vern Shadbolt's house itself has never been flooded (it is the closest one to the sea).

13.3.2 Bantry Lodge/Horse paddock area

The path of the stream was changed in 1960 when the road under the bridge was made. Before that it used to exit to the sea further to the south and snake around the Bantry Lodge road and there was often flooding around the Bantry lodge flat, but that doesn't happen anymore.

14 Tikao

Very steep Tikao Bay is not prone to flooding except for one property down on the waterfront. However the narrow topography does make it particularly susceptible to sea surges.

Table 24 Interviewees who provided information for Tikao Bay were:

Ken Paulin	Works and Services Manager, BPDC
Ian and Ally Telfer	Long term residents

The information on Tikao Bay was mainly sourced from Ian and Ally Telfer. Ian Telfer has known the bay since 1955 and Ian and Ally retired to live permanently in the house in 1998. The creek in Tikao runs adjacent to their house, and behind the house is a wetland area which can fill with water after heavy rain.

14.1 Flooding Event Tikao Bay Big Snow August 1992

The sea surges during the storm in August 1992 were particularly strong, sufficiently so that the Tikao Bay boating club keeps a picture of the flooding hung in the clubrooms. The sea surges went on for the entire day, and the waves broke up over the grassy parking area, and water ponded in the garden of one low lying bach which has the stream running through its front garden.

Figure 37 Tikao Bay August 1992

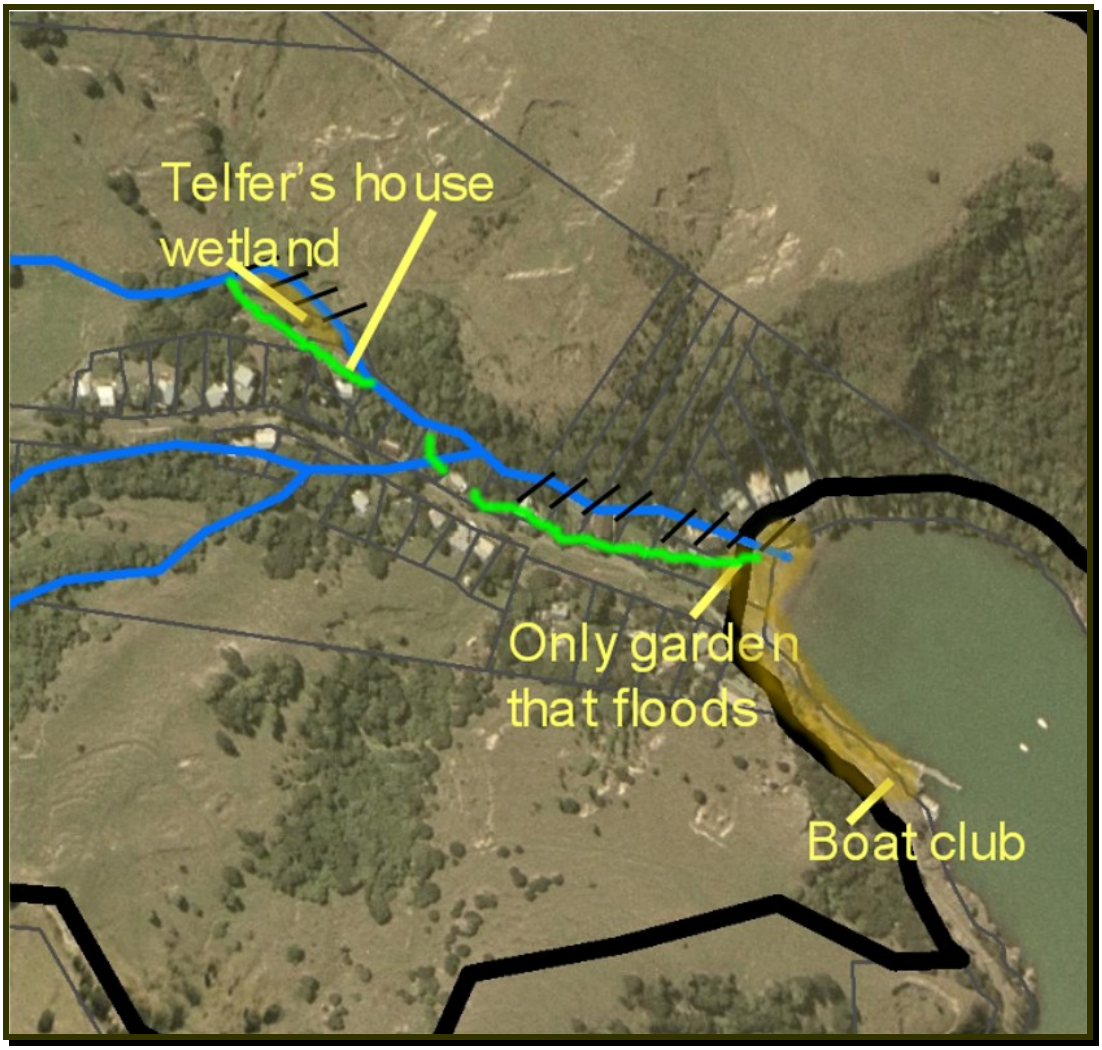
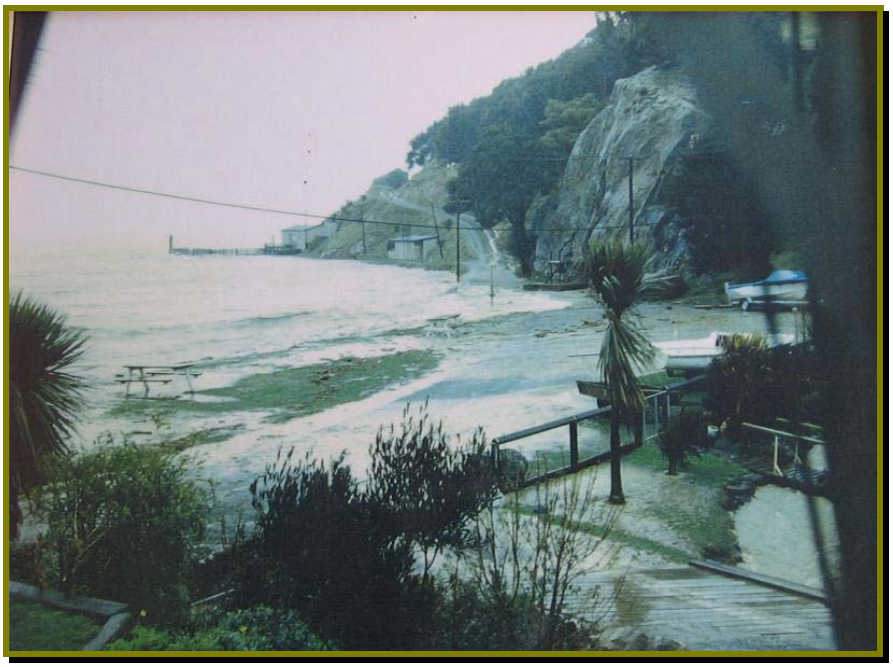


Figure 38 Photograph Tikao Bay August 1992



Photograph in the Tikao Bay clubrooms looking from gardens to boat club at start of wharf.

Photograph hangs in Tikao Bay Boat club

Tikao during normal conditions taken from the boat club.

Supplied by Suky Thompson

Table 25 Event Assessment

Causes	***Heavy Rain*** ***High wind*** ***Prolonged Sea surges***
Known Frequency	*High Sea surges at Tikao have occurred in at least 3 of the storms that have occurred during the 73 years of this study, and probably Wahine as well. This is probably the second worst.*
Corrective Action	*None Identified*
Lay comments on probable re-occurrence rrence	*There are likely to be sea surges of this intensity again, but the damage caused and problems are minimal at Tikao*

Map Accuracy **High**	***Accurate and Comprehensive*** *The situation at Tikao is fairly simple and the Telfers were very clear about exactly where flooding occurred. Their information concorded with Ken Paulin's experience. Tikao bay has never been mentioned in any Akaroa Mail articles.*

14.2 Summary of Problem Areas

The Telfers had mainly seen problems with flooding at Tikao caused by heavy tidal surges. Because of the narrow topography of the bay, during certain conditions the sea can pull back almost out of the bay and then surge forward. This can carry on for several hours, and the sea will then come over the sea wall and flood the parking area. If combined with heavy rain, this can lead to flooding of one garden in Tikao, number 69. This type of flooding occurred in Christmas 1963, in August 1992 and in October 2000. The Telfers were not in Tikao during the Wahine storm so were unsure about this one.

15 Wainui

Flooding at Wainui is also mainly due to sea surges.

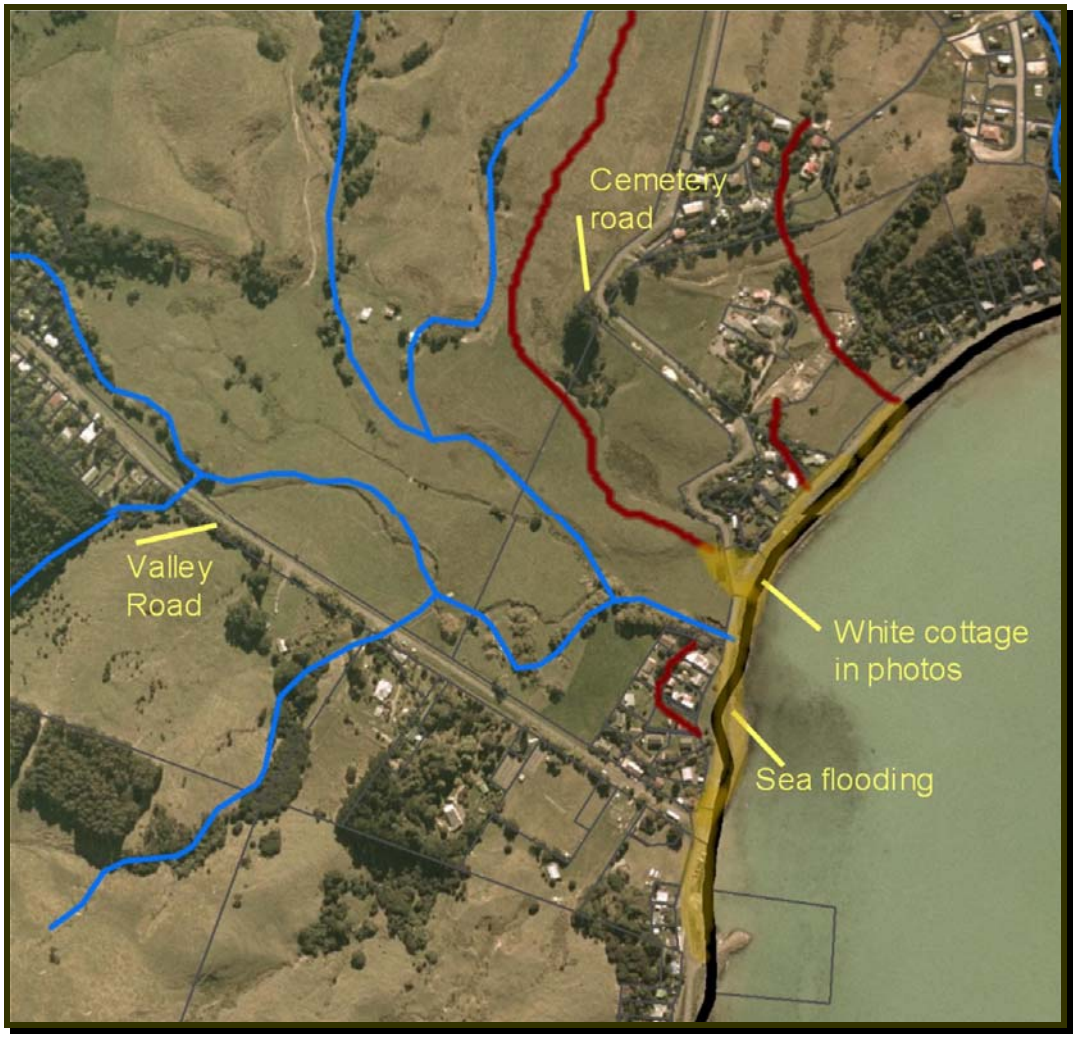
Table 26 Interviewees who provided information for Wainui were:

Ken Paulin	Works and Services Manager, BPDC
Ted Robinson	Former Building Inspector and long term resident of Wainui
Gary Simes	Farmer and long term resident of Wainui
Phillip Kingston	Driver with Serco and Fulton Hogan

Ken Paulin felt that Wainui was well drained and much less prone to flooding than Robinsons Bay or Duvauchelle. There have been some very serious slips in Wainui, and there are two sections which cannot be built on. Ken felt that there were a few sections along the waterfront prone to sea surges, and that the creek coming down the main valley from the YMCA had flooded behind the houses due to blocking by willows.

Ted Robinson provided more information for Wainui, including photographs and a video of flooding mainly due to sea surges during the August 1992 storm. Ted has had a house in Wainui since 1980 and been a permanent resident since 1991. He was the Building Inspector with Banks Peninsula District Council until retiring shortly prior to the amalgamation. Gary Simes who has lived in Wainui since 1966 confirmed Ted's comments.

15.1 Flooding Event Wainui Big Snow August 1992



Ted Robinson supplied the following photographs of the sea surges and subsequent flooding during the Big Snow storm of August 1992. He also supplied a video, now converted to DVD and provided with this report. The DVD shows the power of the storm far more graphically than the still photographs.

Figure 39 Photographs of Wainui Big Snow August 1992

This cottage on the corner of Cemetery Road is the worst affected by flooding.

Supplied by Ted Robinson, Taken by Ed Nicholls

The same cottage with a view from inside the garden.

Supplied by Ted Robinson, Taken by Ed Nicholls

The same cottage during normal conditions.

Supplied by Suky Thompson

The sea coming right across the road.

Supplied by Ted Robinson, Taken by Ed Nicholls

Sea debris across Wainui main road after storm surges.

Supplied by Ted Robinson, Taken by Ed Nicholls

Road and grass verge normally.

Picture also shows sections in distance below the pine plantation cannot be built on because of land instability.

Supplied by Suky Thompson

Table 27 Event Assessment

Causes	***Sea surges*** ***High Wind***
Known Frequency	*This storm brought very heavy snow on higher ground and rain lower. This was combined with very high sea surges which hit the southern and western sides of the Peninsula. There have been at least 6 storms during the 73 years studied with very high sea surges, although this one seems to have been the second or third worst in Wainui.*
Corrective Action	*None Identified*
Lay comments on probable re-occurrence	*This storm seems to have been exceptional for its combination of heavy snow fall and heavy seas. Gary Simes thought only the Wahine storm was worse. This type of sea surge flooding is likely to occur again.*
Map Accuracy **High**	***Accurate and Comprehensive*** Both interviewees in Wainui agreed on area flooded

15.2 Flooding event – low lying areas

The following map shows the low lying areas around the Valley Road that are prone to flooding in heavy rain. These include an area along the main creek, and the old school grounds (now the community hall). Gary Simes mentioned that the community had always had trouble with the septic tank drainage at the old school because the land was so low lying with poor drainage. No date has been given to this map because clear dates when this flooding occurred have not been identified. They may have flooded as recently as 2002.

Figure 40 Wainui low lying areas

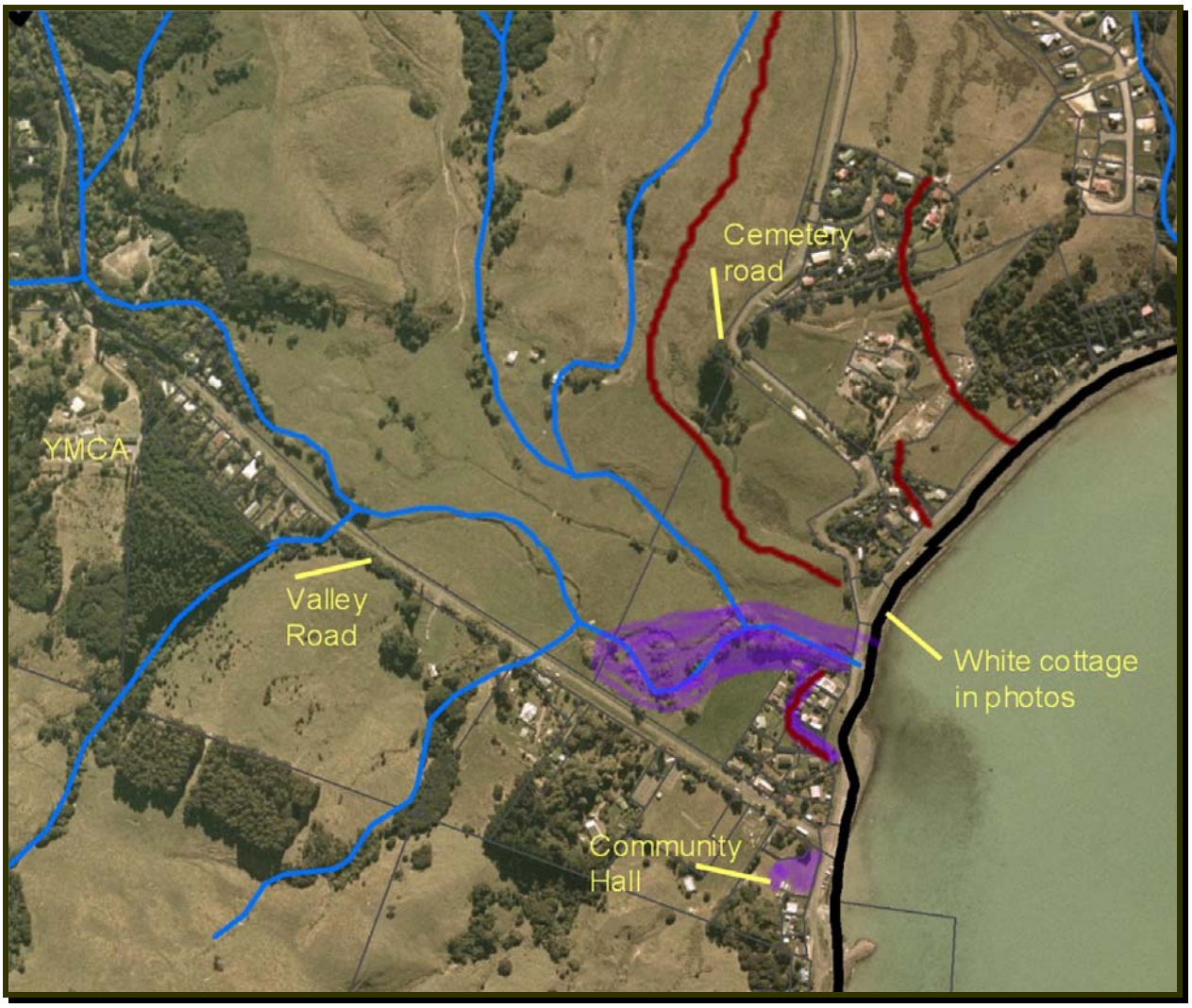


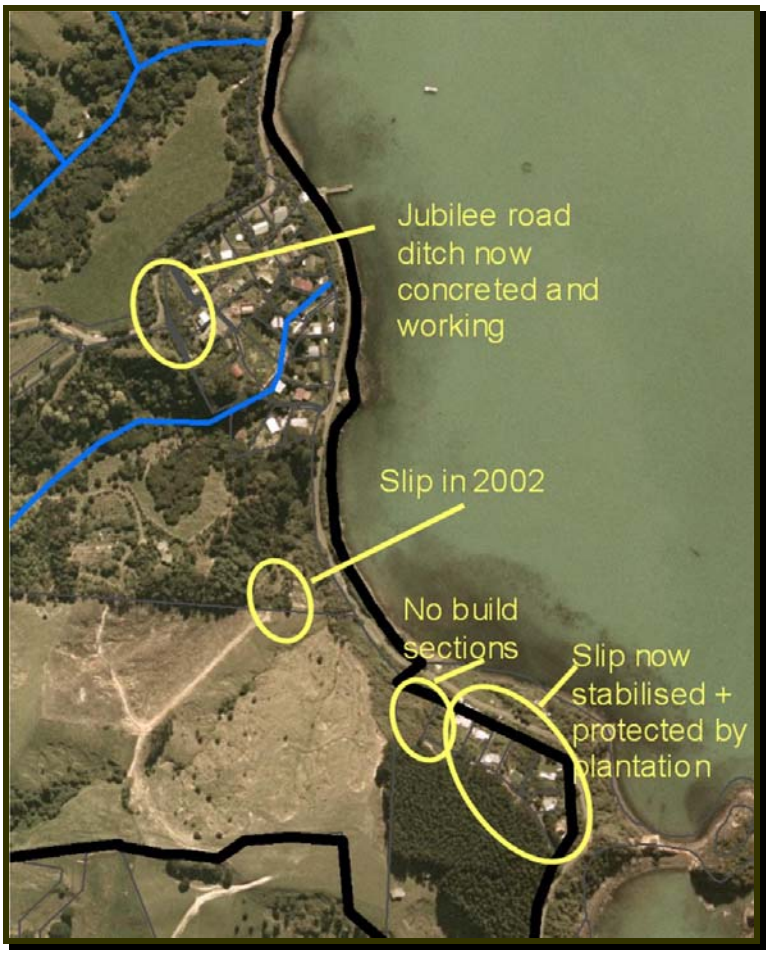
Table 28 Event Assessment

Causes	***Low Lying areas***
Known Frequency	***Not known***
Corrective Action	***None identified***
Lay comments on probable re-occurrence	*Likely as these areas have been troublesome over the years and no corrective action to improve drainage has been identified.*
Map Accuracy	*Would be useful to walk around the area with property owner*

15.3 Other trouble spots

The following map shows where the major slip in Wainui occurred, and also the location of the ditch which Ted Robinsons felt had been improved and no longer caused trouble.

Figure 41 South Wainui trouble spots



15.4 Summary of Problem Areas

15.4.1 Waterfront between Valley Road and Cemetery Road

The area most subject to sea surges is between the slipway by Wainui Valley Road and Cemetery Road. Ted Robinson provided photographs and film footage of the sea surges in 1992. Gary Simes felt that the 1992 storm was the second most severe he had seen, the Wahine storm being worse. However, a combination of high tides and a winter southerly could throw rocks up onto the road by the slipway and this happened every 5 years or so. Phillip Kingston remembered the damage as more extensive in October 2000 than in 1992.

15.4.2 Low lying areas around Valley Road

There are low lying areas around the Valley Road near the waterfront that are prone to flooding. Ted thought that one of these areas had flooded in 2002, but Gary was not so sure about this.

15.4.3 Jubilee Road houses

Further south an area by the Jubilee Road has also suffered from flooding from a poorly functioning ditch in the past. However, Ted felt that this had been sorted out now because the ditch had been concreted and now drained adequately.

15.4.4 Cape Three Points slip

The most dramatic event in Wainui was a huge slip in August 1975 on some recently zoned and subdivided land above Cape Three Points. Gary Simes who had sold the land provided photographs of the houses slipping down the hill, and the subsequent planting of pines behind them. Two of these sections have been declared no build areas, and the pine plantation protects the houses that are there. The land that slipped had been covered in thick gorse before Gary

cleared it to make pasture and grow sheep turnips. He had no idea that it would slip and the sections were considered safe for building. This and the similar Hempleman drive slip show how fickle the Peninsula slopes can be, especially during times of prolonged rain. Gary Simes remembered the that the rain in August 1975 was much heavier in Wainui than in 1992, but the sea surges were less.

16 More detailed work warranted

The following areas may merit further investigation:

- Stream paths – to correct the paths of the streams and establish where rain creeks exist. This would be a major exercise, but in terms of understanding the drainage patterns of the area is probably the most important, given the inaccuracy of the current information.
- Accuracy of maps – the original brief requested that the accuracy of maps be given to a number of metres. While the shaded areas on the maps are as accurately drawn as possible given the information supplied by the interviewees and the reports in the Akaroa Mails, it has not been possible to assess the accuracy of each with a metre figure. Because the flood waters tend to drain very quickly, the flood height remembered, reported or photographed is very dependent on the time the witness observed it. Nor do the aerial photographs have sufficient clarity to mark down to the metre level. Increased accuracy could be obtained by revisiting the mapping exercise after the shaded areas have been superimposed on 1m contour maps by Tonkin and Taylor.
- Corrective Action – to examine Council files and talk further with the retired engineer Ken Paulin about improvements to drainage that may have resolved problems.
- Beach Road Akaroa - to find out more about where flooding occurred in this area in the 1970s.
- Takamatua – to find out more about flooding on the flat areas with further interviews.
- French Farm – to interview Terence Brocherie and find out further about Wahine storm.
- Wainui – to sort out how often the valley paddocks flood.

Appendix A Complete list of Rainstorm events identified

This table includes all dates checked against the Akaroa Mail. Initially all days where rainfall at Onawe was over 50mm, and all dates where rainfall was over 90mm in Akaroa since the start of the Niwa data in December 1977 were used as an index into the Akaroa Mail. Later in the research after the Metereological service from Stanley Park (going back to 1894) was obtained, all days with rainfall over 90mm at Akaroa were checked as well as all storms with a cumulative rainfall of over 200mm. (These storms are indicated as cumulative storms in the table below). The rainfall at Akaroa is taken from the Metereological service station at Stanley Park from 1895 to the end of 1977. From 1978 to 2007 Akaroa data is taken from the Niwa station in Rue Lavaud.

Year	Day/ Month	Rainfall at Onawe	Rainfall at Akaroa	Akaroa Mail report	Settlements in study area flooded
1895	25/26 June	n/a	163.2 178.1	Tuesday June 25, 1895. "The Weather" Reports flooding outside Mail office (Walnut Creek) and Bank corner. Creeks in higher flood than for years Friday June 28, 1895. "The Weather" Reports unprecedented rain but creeks flowing as banks being kept clear of timber Tuesday July 2, 1896 "The Weather" Peninsula coping well despite unprecedented rain levels Friday July 12 1896 "The Weather and its effects" reports the habour being frozen over, people leaving their homes, a slip in Rue Balguerie. Lake Ellesmere very high. Nothing much on floods Tuesday July 16 "The Weather" reports easing off, thaw, great loss of stock, no loss of human life	
1934	4/5 May	60.5 57.7	59.7 169.9	Issue of paper missing Next issue Fri 15/5/34 has "The trail of the storm" "The Little River flood repairing the damage" also says that rain wasn't heavy elsewhere Later reports mention disastrous floods in May 1934 with 6" rain in 12 hours Mentions a flood but no details	Akaroa Wainui
1934	1 July	98.8	7.6	Heavy fall of snow but no floods	
1934	26 Sept	186.4	105.9 35.3	Fri 28/9/34 "Heavy fall of rain over 5.5 inches in two days" Tue 2/10/34 "A season of heavy rain"	Akaroa
1935	27/6	54.9	20.6	Fri 28/6/35 "Heavy rain and gale" but no flood	
1936	22/1	54.6	2.8	Fri 24/1/36 "A cloud burst" no flood	
1936	9/2	75.7	192.0	Tue 11/2/36 "The weather a heavy downpour 7.5 inches in one day" Hennings creek overflowed and was running into Lavaud St, flooded the Recreation Ground and Catholic School. (Hennings creek is the Grehan Stream, Catholic School was outside St. Patricks). Met office in later article (8 October 1963) gives the figure for this	Akaroa

Year	Day/ Month	Rainfall at Onawe	Rainfall at Akaroa	Akaroa Mail report	Settlements in study area flooded
				day as 192mm.	
1936	20/21 2	43.2 82.8	96.0 297.9	Fri 21/2/36 “Torrential Rain” Tue 25/2/36“Hennings Creek” Tue 25/2/36“Aftermath of Storm”9.5” of rain in 6.5 hours” Hennings creek flooded. Water on Rec ground 3’ to 4’ deep Houses in Rue Jolie and Rue Lavaud evacuated Balguerie stream broke banks at Mr. Geo Phillips. Flooded Mrs. Mansons house and McCaughans garage. Knee deep by post office and bank. Higher up surrounded Jacobson house. Rise in creek about 8’. Shops in Rue Lavaud prevented flooding with blockading doorways. Heaviest flooding and rain in memory of residents at the time. 3’ to 4’ feet across Lavaud street. Cars had to be towed by lorries. Aylmers creek also broke banks and Fyfe’s bridge carried away. Fyfes left their home. Water from hospital flowed down William street and flooded Reads garage	Akaroa Takamatua
1936	3/3	53.3	58.7	Fri 6/5/36 more rain noted but no floods	
1936	9/10 3	49.5 63.5	52.8 72.4	Fri 13/3/36 “Holmes bay bridges 7 washed away in floods”	
1936	31/8 1/9	55.4 32.3	0.0 20.8	No Mention	
1936	1/12	53.3	49.0	Fri 4/12/36 notes heaviest fall in a wet November was Monday last but no floods	
1937	17/5	62	59.4	Tue 18/5/37Heavy rain noted but no flood	
1938	12/13/14 6	 58.7 27.9	63.2 71.4 30.5	Tue 14/6/38 “The weather: heavy southerly gale” no floods	
1939	21/6	50.3	52.1	No Mention	
1939	6-9/7	15.7 109.5 20.1 24.6	14.0 65.5 14.2 24.1	Tue 13/7/39 “Heavy rain at Akaroa”	
1940	14-15/1	29.7 58.2	34.5 86.6	Tue 16/1/40 “Heavy rain 4 3/4 inches in two days”	

Year	Day/ Month	Rainfall at Onawe	Rainfall at Akaroa	Akaroa Mail report	Settlements in study area flooded
1940	6-7/9	32.8 63.5	64.5 93.0	Tue 10/9/40 “The weather over six inches in two days”	
1941	17-20/3	26.7 69.9 74.7 57.9	12.4 82.8 96.0 109.0	Fri 21/3/41 “The weather: a heavy fall of rain” No floods, but slip at Robinsons mentioned and road diverted. “the new formation on Robinsons Bay hill has slipped away at Ormes gate and traffic has to be diverted onto the old road.	
1941	14-20 / 8	39.9 52.8 20.3 85.3 2.8 45.7 15.2	66.8 103.6 32.5 212.3 8.9 80.5 39.1	Fri 22/8/41 “Clearing the roads” Big slip between Barry’s Bay and French Farm. Slips on the road at Greens Point	
1942	25-27/5	111.8 94 26.7	83.1 22.6 19.8	Fri 29/5/42 mentions historic tree lost but no flood in Mondays gale	
1943	13-14/7	7.1 48.5	150.9 59.9	Friday 16/7/43 “Weather Records” Late floods did no damage Cumulative storm	
1944	30/4 – 3/5	18.5 102.9 37.3 20.3	15.2 57.9 23.1 9.7	No Mention	
1944	16 – 23/12	73.2 0 0 57.7 15.5 1.5 11.2	59.2 12.4 3.8 0.0 1.8 0.0 9.9	High rainfalls noted but no flooding article	
1945	21/22 2	39.4	47.0	No Mention	

Year	Day/ Month	Rainfall at Onawe	Rainfall at Akaroa	Akaroa Mail report	Settlements in study area flooded
		73.7	126.5		
1945	18-21/5	1 34.5 42.2 39.1	7.6 120.7 110.0 89.9	Tue 22/05/45 “Storm Does Extensive Damage” Three main creeks break banks. Slip in Aylmers valley takes out Read’s bridge (William/Percy Intersection) and washes away bridge. Water runs down Rue Jolie south flooding the houses at the bottom, especially Davis (now Drapery) and garage (probably next door). Rue Jolie North bridge collapses. Hennings creek not too bad, but floods Jennings House (the Poplars) North Rue Lavaud by St. Patricks underwater due to drains overflowing, but not Recreation Ground. Waeckerle Creek (Mill Stream) did no damage	Akaroa
1945	8-9/8	67.3 31.2	168.1 71.1	No Mention	
1946	24-26/9	109.2 16.5 70.6	98.8 7.9 57.4	Fri 27/9/46 “The Weather Heavy Rainstorm Duvauchelle heaviest”	
1947	10/1	109.2 16.5 70.6	57.2 0.0 11.2	14/1/47 “Heavy rainstorm”	
1947	2/10	51.8	41.7	No Mention	
1949	12/8	70.4	0.0	No Mention	
1951	10/2	67.6	89.4	Tue 13/2/51 “Friday’s heavy rain”	
1951	1-2/4	27.9 141.7	32.8 115.6	Tue 3/4/51 “Slips on many peninsula roads” “milkman delayed byslips”	
1951	20-23/10	10.7 58.4 55.1 17.8	 0.0 4.8 40.1	Wed 24/10/51 “Unfavourable weather” Bad weather at labour weekend but no floods	
1952	8/10	56.6	0.0	No Mention	
1952	27/11 - 2/12	22.1 44.5 16.5 6.1 5.1	40.4 91.2 17.8 7.6 3.6	Cumulative storm Friday December 5, 1952 “Little Flood Damage” Roads escaped damage except for problems with upper Pawsons and Pipers	
		48.8	66.0		

Year	Day/ Month	Rainfall at Onawe	Rainfall at Akaroa	Akaroa Mail report	Settlements in study area flooded
		48.8	66.0		
1953	27/3-31/3	10.4 8.6 31.8 24.4 6.9	18.5 13.2 51.1 24.1 6.6	Cumulative storm Tuesday April 14, 1953 “Storm Damage, Terrific Gale Lashes Peninsula” Main damage is wind related to fishing boats, trees down, power out. Spray blew onto Recreation ground and Camping Ground at Akaroa	
1953	18-19/8	21.1 50.5	11.9 35.3	No Mention	
1954	19-20/5	41.7 57.2	39.4 62.2	Fri 21/5/54 “Heavy rain power failure” reported for previous Tuesday but no floods	
1954	15-16/8	72.4 68.8	74.9 94.5	Tue 17/8/54 “The Storm, Roads blocked”	
1956	2-4/10	5.3 27.7 21.1	9.9 54.6 20.6	Cumulative Storm No Mention of Flooding, but reports on need to keep culverts clear in this and next issue	
1957	7-8/3	43.7 75.2	40.1 79.5	“Storm battered power system” seems mostly damage to power lines, not flooding	
1957	16-20/5	17.8 4.8 62 85.1 29	49.5 10.7 88.4 78.7 21.1	“Storm water town problem” “Inspection of beach road slip”	
1959	4-8/5	18.8 62 41.9 40.4 12.2	15.0 40.6 43.7 54.4 29.2	Fri 8/5/59 “Extensive damage to roads” Sea flooded over highway in Barry’s Bay No other flooding in settlement areas	Barrys Bay
1959	14-18/5	14 3.8 0 16	62.0 20.3 27.4 32.5	Cumulative Storm Tuesday May 19,1959 “Weather Bent on setting a record” but no mention of flooding in this or subsequent issue. Wet spell was after a drought	

Year	Day/ Month	Rainfall at Onawe	Rainfall at Akaroa	Akaroa Mail report	Settlements in study area flooded
		16 17	32.5 16.0		
1961	17-21/7	19.8 79.8 41.9 20.1 8.9	16.5 89.4 64.8 44.5 11.9	No Mention	
1961	5-9/8	47.8 11.4 10.9 3 8.6	108.0 32.3 35.1 0.0 42.9	Cumulative Storm Tuesday August 8, 1961 Big slip on Percy Street that came down from Helps property and and went as far as Bruce Terrace. Tuesday August 15, 1961 “New Culvert Across Road” Slip had caused problem at Percy Street and Aylmers road junction. Probably some flooding from this.	Akaroa Percy Street
1962	15-17/4	13 109.5 22.9	11.2 91.7 14.2	Akaroa Mail from this date is missing from Akaroa Museum and also from Macmillan Brown collection. Later issues refer to heavy storm damage 29/5/07 “Sympathy in storm loss” Federated Farmers branch expresses sympathy for those who lost stock etc in the severe storm in mid april 1962/6/07 “Storm repairs” – from the April storm –has holes in Beach road, blocked sewer at Presbyterian manse, new pipe at Rue Charbonnier, new kerb and channel in William st, Refuse and pruning removed from Britomart reserve and Beach road, tennis courts and Service station and block culverts in Beach road cleared.	Akaroa – Beach road
1962	31/5- 2/6	22.4 50.3 0.5	1.3 9.7 62.0	No mention	
1963	19-21/4	45.7 57.9 19.6	36.6 74.7 43.2	23/4/1963 “Heavy rain at weekend” Akaroa recreation ground flooded	Akaroa – Recreation ground
1963	3-6/7	5.8 32.3 47 41.1	7.9 30.7 71.1 68.6	Tue 9 July 1963 “Roads blocked with slips after heavy rains” rain fell the week before *Note: Rainfall is below the 50mm Onawe threshold, but article seen in Akaroa Mail, also giving rainfall figures* Aylmers creek flooded Beach road Selwyn Ave Upper Balguerie road	Akaroa

Year	Day/ Month	Rainfall at Onawe	Rainfall at Akaroa	Akaroa Mail report	Settlements in study area flooded
1963	14-17/7	43.9 35.8 39.6 17.8	97.5 62.0 72.4 38.1	Tue July 16 1963 “Flooding,slips from torrential rainfall” rain fell the weekend before Fri July 19 1963 “Akaroa recovers from effects of heavy downpour” Flooded Rue Lavaud from Waeckerle Bridge to Rue Brittan, Rue Balguerie, Percy Street, Lower Rue Balguerie Creek, Robinsons Bay, Duvauchelle Hall. Month total was already at 469mm. slip behind Gaiety, Beach road *Note: Rainfall is below the 50mm Onawe threshold, but article seen in Akaroa Mail, also giving rainfall figures*	Akaroa
1963	20-21/12	147.3 217.2	4.6 116.1	Tue 24/12/63 “Heavy damage to district roading” 11” at Barrys Bay and bridge destroyed. Drop outs and slips at Wainui + near Wainui wharf. Slip in Barry’s Bay at Arthur Stewart’s house changed creek course and its ran down road. Bridges destroyed at Barry’s Bay. Dairy factory flooded No damage at Akaroa 17/7/64 “Priority fixed for flood repair scheme”	Barrys Bay
1964	10/7	52.3	23.9	No mention	
1964	8-9/8	107.2 25.7	55.4 29.0	“Bridges damaged in storm, Roads blocked” worst damage at French Farm and Barry’s bay Bridge washed away at Dairy factory that had been damaged in Christmas 1963 storm was washed away	Barrys Bay
1965	31/1 1/2	15.7 57.7	18.0 91.2	Heavy rain noted but no floods	
1967	7/1	65	106.7	“Torrential rain storms on Banks Peninsula” no floods	
1968	10-12/4	29.5 205.7 73.9	41.1 167.6 59.9	“Heavy stock and property losses Aftermath of Gale on Banks Peninsula” Wahine Storm Akaroa – beach road flooded mostly it seems from sea rather than creeks. Duvauchelle also sea and creeks, Houses in the area had water to floorboards. Golf course water up to ninth green. A foot of water covered the small bridge to the fourth tee and the fourth and seventh greens were underwater. Water on main road from Post office to hotel. Barry’s Bay – “the flat area at Barry’s Bay around the vicinity of the factory was flooded when the creek came over its banks and the paddocks were covered with a thick layer of silt” Debris washed onto main road by sea mostly it seems at Duvauchelle, Barrys Bay, Robinsons Bay, French Farm and Wainui	Akaroa Duvauchelle Barrys Bay French Farm

Year	Day/ Month	Rainfall at Onawe	Rainfall at Akaroa	Akaroa Mail report	Settlements in study area flooded
				French Farm – flat at French farm covered in water	
1969	24-26/4	33.8 4.1 10.7	47.5 13.5 20.3	"Drought broken by heavy rain" but no floods recorded 6.6 inches in one day according to Aka Mail of 7/8/73	
1970	4/7	52.6	53.3	Heavy rain mentioned but no problems	
1971	4/6	52.6	38.1	Heavy rain recorded and a few slips but no mention of floods. No pic	
1973	6-7/8	63.4 70.2	156.5 144.8	"Heaviest rain for years in Akaroa" Flooded museum from blocked runaway in Rue Balguerie, Beach road torrents from Stanley Park Feb 1936 282mm in one day reckoned heaviest ever	Akaroa
1974	16-17/4	22.3 135.5	20.3 105.0	No Mention	
1974	23-24/8	16.8 87.2	15.5 133.8	"Rain brings many slips on Peninsula roads"	
1975	29/1	55.7	51.5	No Mention	
1975	13/3	55.6	76.8	"Storm on the Peninsula" no floods	
1975	14-16/6	18.9 54.8 48.7	176.3 106.9	27/27 "Water black after rain" referring to weekend of 14-16/6	
1975	19-21/8	23.6 47.5 77.4	14.7 54.5 94.4	"Rain storm brings floods-cuts road" more than 163mm in Akaroa Akaroa streets flooded with low lying areas being up to 6" deep. A Garage workshop in Rue Jolie flooded (probably opposite Gaiety). Slip at Beach Road	Akaroa Duvauchelle
1976	8/7	56.7	51.0	No Mention	
1976	27-29/8	53.8 53.4 28	51.2 40.2 72.7	"More than 72 hours of rain" Slip at Beach road, streets of Akaroa awash, pot holes on Beach road 170mm at Akaroa, 200 at Okains Bay, 340 at Hickory Bay – possibly a skyline measurement? Hempleman drive slip Locals remember 355mm in 12 hours. The amount recorded at Hickory Bay was 340	Akaroa

Year	Day/ Month	Rainfall at Onawe	Rainfall at Akaroa	Akaroa Mail report	Settlements in study area flooded
				which may be where this comes from.	
1977	5/6	73.4	54.9	No Mention	
1977	27-29/6	15.8 36.5 72.5	15.9 25.7 66.4	Fri Jul 1 1977 mentions heavy rain at Queens Birthday weekend	
1977	3-4/7	80.8 111.6	59.3 103.6	"Peninsula slips and flooding" Sea came over and flooded Beach Road. Akaroa Museum and Akaroa Gallery flooded. Bridge below Mt. Vernon on Rue Balguerie/Purple peak road intersection washed away	Akaroa
1977	31/12	60.8	46.8	No Mention (but no paper till late Jan)	
1978	17/18/19/ 20/21/22 April	28.3 16.8 9.1 38.6 45.1 18.3	54.2 57 12.5 58.2 48.8 47.4	"Akaroa water still not right" about discolouration of water supply after heavy rain	
1978	8/9/10 July	97.5 61.4 15.5	121 67.4 14.4	"A 48 hour downpour" Flooding in Beach road	Akaroa
1979	25/8	55.5	70.4	"Heavy rain" No floods	
1980	3 Jan	117.6	110.8	No but strong southerly on Jan 17 mentioned	
1980	1/2/3 March	3.6 33.6 34.8	11 63.9 90.4	No floods, but "Akaroa has 157mm rain"	
1980	5/6	69.5	65.2	No Mention	
1981	14-15/6	47.1 72.8	54 73	No Mention	
1981	25-27 /8	42.3 30.7 39.8	48.2 18 78.8	4/9/81 "Storm rain leaves heavy silt" Walnut creek overflowed due to blockage. Waeckerle's bridge on Grehan Stream overflowed	Akaroa
1982	24-27/10		49.2 36.5	No Mention	

Year	Day/ Month	Rainfall at Onawe	Rainfall at Akaroa	Akaroa Mail report	Settlements in study area flooded
		68.7 63 14.3 35.1	36.5 21.5 32 0		
1983	19/5	61.8	40.6	"Akaroa Harbour lashed by storm" says Akaroa has 147mm of rain in 5 days no floods	
1983	1-2/7	31.2 79.2	34.2 10.2	No 15/7/83 article about Hempleman drive and council spending money on flood damage "Sections in subdivision may be built on"	
1984	14/1	55.8	43.2	"Showery weather at Duvauchelle show" but not floods	
1984	18/3	57	24.5	No Mention	
1984	25/5	66.4	61.8	No article, but picture of flooding in Friday June 1 84	
1986	13/3	78.5	90	No Mention	
1986	31/3	56.8	31	No Mention	
1986	7/8 July	78.5 37.9	111.9 70.1	Fri July 18 1986 "Rain damage to road" and pictures. Some flooding at Duvauchelle, otherwise Little Akaloa and Pigeon Bay	Duvauchelle
1986	22/23/24 August	10.8 48 56.8	21.5 120 110.4	Fri 29/08/1986 "$1/4 million damage cost Slips and dropouts, Hempleman drive had more trouble, but nothing mentioned about flooding	
1986	26/11	72.4	71.5	No Mention	
1989	27/8	53.5	47.5	No Mention	
1989	23/10	76.2	50.7	No Mention	
1990	23/24/25 August	13.1 71.1 25.5	20.6 89.7 74.8	"Wet month. No damage"	
1991	19 July	61.1	92.9	No Mention	
1992	9 July	64.8	106.8	No mention but article about "not a level playing field at Rec ground". Spoof showing a hide on flooded Rec ground	
1992	27/28/29 August	63.6 70.3 56.4	110.3 46.5 42.3	Big Snow "Long term effects from last week's big storm" Flooding in Beach road due to sea surge. Pictures of flooded Onawe Flat road	Akaroa Duvauchelle Tikao Wainui

Year	Day/ Month	Rainfall at Onawe	Rainfall at Akaroa	Akaroa Mail report	Settlements in study area flooded
1993	25 September	44.7	94.3	No Mention	
1993	22-24/12	12.4 52.8 37.4	15.9 38.4 66.4	No Mention	
1994	20/2	54.6	33.8	No Mention	
1994	12-13/5	56.2 32.7	41 22.3	No Mention	
1994	26/27/28 July	36.7 138.8 35.6	44.8 198.1 41.5	“Storm damage may go over 1./2 millions” 29 July 94 “Slip will leave big scar” on Akaroa 12/8/94 Big story + the Lighthouse road slip Club Lavaud flood Down Rue Lavaud Old French road	Akaroa Takamatua Robinsons Bay
1999	14/12	56.6	38.5	No Mention	
2000	14 March	40.2	100.1	No Mention	
2000	19/20 August	88.9 18.7	184.2 41.8	No mention “Slips showing after Rain” in 8/9/2000 issue	
2000	11/9	60.3	33.6	No mention	
2000	12-13/10	61.7 99.6	Data missing	Lyttelton Marina storm, also known as October 2000 storm Photos of story, but nothing on flooding, more on damage	Barrys Bay Duvauchelle
2002	12/13 January	38.3 66.8	55.5 143.5	25/01/02 “The big cleanup of Akaroa” Flooded back of Museum – Jan Shuttleworth thought this came through the roof.	Akaroa Takamatua
2002	19/11	59.8	51.7	No Mention	
2003	7/8 April	49.7 17.2	134.3 49.8	No Mention	
2003	29 September	40.5	111.6	No Mention	
2006	4/10	56.8	Data missing 78.4 (following day)	No Mention	

Year	Day/ Month	Rainfall at Onawe	Rainfall at Akaroa	Akaroa Mail report	Settlements in study area flooded
2006	30/10	54.5	Data missing 42.5 (following day)	No Mention	
2006	21/12	51	59	Boat washed ashore but no flooding	
2007	31 July	48.5 9.2	0 123.2	No mention	

Appendix B Akaroa Mail information

The following article informing the local community of the flooding research project was published in the Akaroa Mail on Friday November 30, 2007

An Akaroa Mail photograph from 1994 shows water flowing down Rue Balguerie and across Rue Lavaud.

Suky Thompson checks what the water depth was during the 1994 rainfall.

Researcher looking into deep water

It is not actually gumboots and galoshes that Suky Thompson needs for a research project on flooding around Akaroa Harbour basin, but photographs and stories.

She's working on the subject as a consultant to the Christchurch City Council, as part of the development of its Akaroa Harbour Small Settlements study.

"They identified that there are no Council records on where and when floods have happened" she said.

"An appeal is being made to the public to help collate this knowledge so that the Council can better manage and plan for the area."

To get her project underway Suky has been looking at rainfall records, which are available since 1934 at Onawe and from Rue Lavaud in Akaroa since 1977, to build up a list of dates on which there when there has been exceptionally high rainfall.

"These high rainfall dates are then being used as an index to the archive copies of The Akaroa Mail stored at the Akaroa Museum, to see whether the high rainfall led to a big enough flood to make a story in the paper."

In 1994, for example, there was a high rainfall event – and this led Suky to the photographs printed here of flooding in Rue Lavaud and at Takamatua during the 'big slip' storm of July that year.

The rain on that occasion set off a slip above Lighthouse Road which became national news when it threatened to sweep down on the southern end of Akaroa.

Photographs were rarely used in the newspaper before 1985, and Suky is particularly keen to see any photographs that were perhaps taken during the "Wahine" storm of April 1968 or after two exceptionally heavy rainfall deluges on December 21 and 22 of 1963.

That December 22 rainfall of 1963 – recorded as 217.2mm at Onawe – was the highest ever recorded at the site, and had been preceded by 147.3mm the day before.

The Wahine storm rainfall was the second-highest total, with 205.7mm on a single day.

"Older residents are asked to dredge their memories for flooding during those storms" Suky said.

There may have also been other storms or events which caused flooding in the area.

Other dates on which exceptional rainfall is know to have ocurred were in September 1934, on April Fools Day in 1951, in April 1974, August 1976, August 2000 and April 2003.

One of the problems that Suky has found is that rainfall may vary considerably from place to place, with Akaroa town usually getting much more than Onawe. On January 12 and 13 2002 Akaroa received 143.5mm of rain, while Onawe recorded a much more moderate 66.8mm.

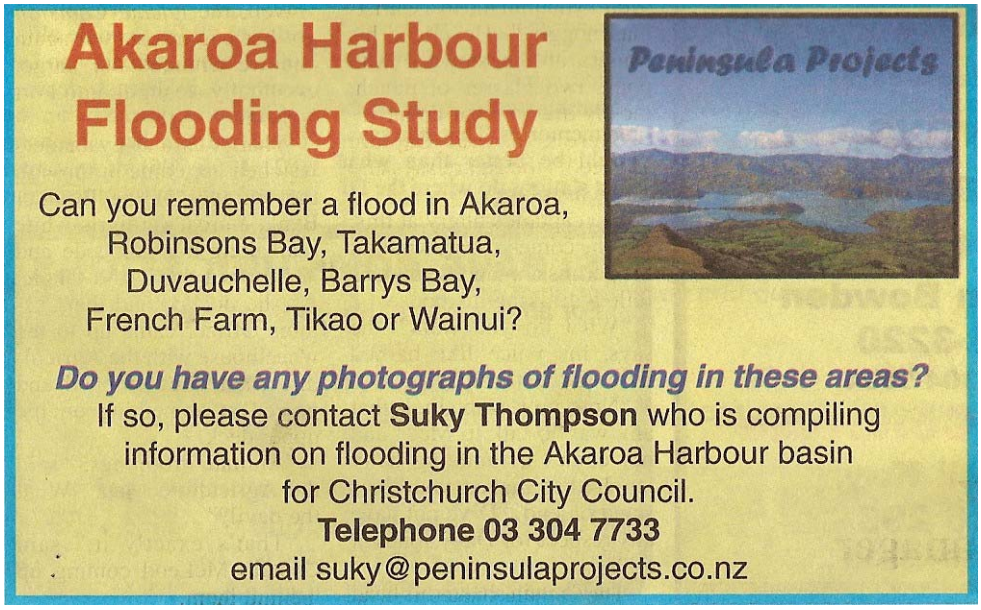
"Given that the records at Onawe are not that good as a predictor of the rainfall in other parts of the harbour, and also that flooding can depend on the ability of streams and culverts to free flow, as well as the height of the tide, residents' memories are particularly important to fill in the real story."

She'd also be interested in seeing rainfall records from other locations around Akaroa Harbour.

Suky can be contacted by telephone on Akaroa 304 7733 or by email at suky@peninsulaprojects.co.nz or by post at 59 Tizzards Road, Robinsons Bay, RD1, Akaroa.

Some of the worst flooding during the 1994 flooding was at Takamatua.

The following advertisement was printed in the same issue and the two subsequent issues:



Appendix C Residents interviewed

The following table lists all the residents who have been interviewed and assisted with the study. Each resident is listed under the study area that they provided information for, so some residents appear more than once in the list. In addition to those listed, Ken Paulin the former Akaroa County Engineer and Banks Peninsula Works and Services Manager provided information on all the areas. Those people who contacted the researcher directly as a result of the Akaroa article and advertisements are indicated with an asterisk.

Table 29 Residents interviewed

Study Area	Name	Reason for interview	Photos supplied
Akaroa	Jan Shuttleworth	Long term resident with photographs	Y
	Lew Walker	Long term resident in several flood prone areas and builder	Y
	Liz Haylock	Civil Defence Welfare Co-ordinator	
	Peter Haylock	Civil Defence warden in both 1994 and 2002 floods	
	Eric Ryder	Proprietor of Grand Hotel and Community board member	
	Des McSweeney	Farmer in Aylmers Valley and collector of rainfall records. Submission on settlement study commented on rainfall records	
	Alan Reid*	Responded to Akaroa Mail article. Supplied early photographs from his father's collection and resident of Akaroa and Robinsons Bay	Y
	Ruth Jones*	Responded to Akaroa Mail article. Supplied early photographs from her father's collection. Long term Akaroa resident	Y
	Richard Stewart	Long term resident and proprietor of pharmacy near flood prone area	
	Cheryl Jenkins	Resident of Woodills road evacuated in 2002	
	Harold and Barbara Surtees	Streamside dwellers of upper Grehan valley	
	Lynda Wallace	Museum Director since 2002	
	Jessie Mould	Elderly resident and historian	
	Barry Brownie	Long term resident	
	Ted McNabb	Long term resident and former Fire Brigade chief	
	Steve Lowndes	Former Museum director (no separate notes)	
	Margaret Chaney	Resident of property flooded in 1981 (no separate notes)	
	Kim Stewart	Long term resident and Akaroa Fire Brigade member since 1985, currently Brigade chief	
Takamatua	Bruce Morton	Long term resident and former building inspector	
	John Roe	Long term resident and collector of rainfall data	
	Pru Downes	Owner of low lying property on Highway corner	
	David Thurston	Resident of property on Bells Road	
	Neil Fraser	Retired farmer with property near bridge that floods on Old Le Bons track	
Robinsons Bay	Paddy Stronach	Long term resident and active with Civil Defence	
	Dianne Carson and Sue Church	Long term residents of property in flood prone area	Y
	Alan Reid	Former resident	Y
	Fran Anderson	Resident of house on main road (no separate	

		notes – just checked if her house flooded)	
Duvauchelle	Liz and Geoff Carter	Council Civil Defence staff. Long term residents of Duvauchelle	
	Huntly Marshall	Long term resident and Council contractor for earthmoving for many years	
	Beverly Broad*	Responded to Akaroa Mail article. Resident of Onawe flat	
	Vern Shadbolt	Owner of Saleyard property	
	Paddy Stronach	Pony paddock information	
	Barry Brownie	Long time golf club member	Y
	Tony Rhodes	Long time golf club member (no separate notes-marked map with Barry)	
	Nic Craw	Resident of Pipers valley (no separate notes)	
	Ray Skinner	Duvauchelle golf course	Y
	Philip Kingston	Machinery driver for Serco and Fulton Hogan	
Barrys Bay	Ross Curry	Long term resident and farmer	Y
	Denise and Pip Cummings	Owners of flood prone property	
	Colin Slade	Former owner of Half Moon cottage	
	Des Heath	Current owner of Half Moon cottage (no separate notes just asked if house flooded)	
French Farm	Vern Shadbolt	Long term resident on waterfront	
Tikao Bay	Ian and Ally Telfer	Long term residents	Y
Wainui	Ted Robinson	Long term resident and former building inspector	Y
	Gary Simes	Long term resident, and owner of property that slipped. Photos not included in report as not of flooding	Y
	Philip Kingston	Machinery driver for Serco and Fulton Hogan	

(Note that in most cases a separate file was created for each major interview to record the comments. However, people who were only briefly contacted by phone to see if their property had ever flooded, or who took part in an interview with someone else are indicated as not having a separate set of notes taken, but their comments noted in a combined file.)

Other residents who were suggested as useful to interview, but who have not been included:

Wainui	Jeanette and Don Walker	Long term residents, also owners of the Cheese Factory for many years	
	John Hutchinson	Long term resident and owner of low lying property in Wainui	
Barrys Bay	Eric Harrington	Long term resident	
Takamatua	Bob Orr	Pictured in photo of 1994 flooding	
	Murray Walker	Dave Thurston's neighbour	
Akaroa	Frank Helps	Over 90 years old and very active with a good memory	
General	Trevor Bond	Fulton Hogan boss. May have records and photos	
Akaroa	Owen Southern	Has file on Akaroa 2002 flood	
	Fire Brigade records		