

APPENDIX 1

FLOOD EVENTS:24 APRIL 1990-27 JUNE 2002

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FLOOD EVENTS 1990-2002

Note: Record *not* complete – only Greymouth Evening Star (GES) searched. West Coast Times, Westport News, The Press, and technical reports not searched. Not all issues of the GES were readily available at the time of writing, due to GES office renovations, and some papers missing. See text for references other than Greymouth Evening Star.

Date: 24 April 1990.

Flood Damage: Surface flooding in Westport and on SH67 around Little Wanganui. Rivers rose but didn't cause any trouble.

Source: GES 24/04/90.

Date: 11-12 December 1990

Flood Damage: Flooding in McDonald's Creek near Lake Mapourika, scoured away the bank and a power pole. Surface flooding and minor slips in South Westland. Waiho River came within 0.5m of the bridge deck. Haast and Whataroa rivers reached 'small flood' levels and the Hokitika River was in a 'medium fresh'.

Rainfall: Haast 251mm in 2 days, Hokitika 144mm, Geymouth 45.9mm, Moana 90mm in 24hrs.

Slip Damage: See Appendix 3.

Source: GES 12/12/90.

Date: 7 January 1991.

Flood Damage: Waiho River high, threatened southern approach to SH6 bridge. Glacier access road closed due to flooding. Tourists were cleared from the valley so as not to get trapped by floodwaters. Haast River undercutting bank at Clarke's Bluff reduced SH6 to a single lane.

Slip Damage: See Appendix 3.

Rainfall: Franz Josef Glacier 319mm in 24hrs.

Source: GES 08/01/91.

Date: 23 January 1991.

Flood Damage: All river levels in the region were up. No damage reported.

Source: WCRC Hydrological data.

Date: 28-30 January 1991.

Flood Damage: State of Civil Emergency (Westland District) declared on the 28th, 20 houses and 100 people were evacuated from the Kaniere - Arthurstown - Woodstock area, as low lying areas were inundated from the Hokitika River. Kaniere was the worst affected – backup water flooded areas never before flooded in living memory. 10 homes in Kaniere were flooded and 7 in Arthurstown. Severe surface flooding in Hokitika as

pumps were unable to cope with backup water in the stormwater system. Hokitika isolated as floodwaters cut SH6 at the Totara River (22m gap scoured out), and at the Greyhound Tavern – Arahura River area. River protection works damaged on the Arahura and other rivers. Possibly the largest flood in the Hokitika River in the last 100 years. Widespread surface flooding on highways and country roads throughout region. Many roads closed by slips. Nearly 100 people evacuated from Franz Josef Glacier township as the Waiho River overtopped the south bank and came very close to taking the bridge out. People evacuated from the motor-camp, Gateway Motel, and two houses. Water was lapping the SH6 bridge and poured over the southern stopbank. The SH6 bridge was closed and water was across the glacier access road. Flood waters crossed SH6 at Bullock's Creek, Havelock Creek, Jacobs River and the Mahitahi River.

Slip Damage: See Appendix 3.

Rainfall: Kokatahi 580mm, South Westland 600mm, Hokitika 146mm in 24hrs

Source: GES 28/01/91, 29/01/91, 30/01/91. Lovell 1991.

Date: 1 February 1991.

Flood Damage: Flooding for the third time in a week. Grey District and northern Westland most affected. Hokitika River rose at a rate of 1m per hour. Estimated that several \$100 000 of damage occurred in the Hokitika Valley during this series of floods. Crooked River flooded farmland. Creek behind the Brunner Lodge flooded and disrupted power supplies. Bridge approaches were washed out at Brown's Creek on the Inchbonnie – Rotomanu Road.

Slip Damage: See Appendix 3.

Wind Damage: Power lines brought down.

Lightning Damage: Power supplies blown.

Rainfall: Rotomanu-Styx area 200mm in 24hrs, 44mm in 1hr.

Source: GES 01/02/91.

Date: End of July – Start of August 1991.

Flood Damage: Two washouts near railway track at Dobson station and at Wallsend. Caused by overflowing culvert, backing up against the Grey River. Around 20m length of bank was washed out to a depth of 2m, although the track itself was not threatened.

Source: GES 08/08/91.

Date: 8-9 August 1991.

Flood Damage: Widespread surface flooding around Greymouth and Runanga, especially at Coal Creek. Blocked culvert flooded road between Taylorville and Stillwater. Washout near the top of the Lewis Pass. Numerous slips on roads in area. Farm at the southern end of Lake Peorua flooded – landslip blocked river leading into lake.

Slip Damage: See Appendix 3.

Wind Damaged: Widespread damage to power supplies.

Lightning Damage: Widespread damage to power supplies.

Source: GES 08/08/91, 09/08/91, 10/08/91.

Date: 11 September 1991.

Flood Damage: South Westland rivers rose, but no damage reported.
Source: GES 11/09/91.

Date: 16 October 1991.
Flood Damage: Hokitika River was high but no damage reported.
Rainfall: Heavy persistent rain.
Source: GES 16/10/91.

Date: 19 October 1991.
Flood Damage: Bell Dam near Dillmanstown burst. 40m section of SH73 washed out east of Dillmanstown, and scoured down to a depth of 8m.
Rainfall: Heavy overnight rain.
Source: GES 19/10/91.

Date: 30 December 1991.
Flood Damage: Flash flood in Hector resulted in house being evacuated for the second time in two days. Water went through 8 houses. Intense rain washed debris into a culvert, blocking it, and caused flooding which threatened 20 house near the beach. SH67 closed due to flooding and slips.
Slip Damage: See Appendix 3.
Source: GES 31/12/91.

Date: 24 February 1992.
Flood Damage: Although rivers south of Hokitika reached a 'good fresh' no damage recorded, as rivers were low before rain fell.
Slip Damage: See Appendix 3.
Rainfall: 50-80mm in the Alps overnight.
Source: GES 24/02/92.

Date: 17 March 1992.
Flood Damage: Temporary Bridge at Slatey Creek on Atarau Rd washed out when the Creek flooded. Localised flooding. Karamea River reached 2yr flood level, Grey River in a fresh.
Wind Damage: Gale force winds and thunderstorms.
Rainfall: Heavy overnight.
Source: GES 17/01/92.

Date: 28 March 1992.
Flood Damage: Ikamatua-Atarau Road closed due to washed out bridge approaches.
Rainfall: Heavy rain on the 28th.
Slip Damage: See Appendix 3.
Source: GES 30/03/92.

Date: 10 August 1992.
Flood Damage: Grey River running at highest level since floodwall became operational. At Kamaka, Stewart's farm suffered flooding an about 20m of bank erosion. Extreme

surface flooding in region, although only minor floods in the rivers south of the Grey. In Blaketown surface flooding occurred as water backed up through the stormwater system and also from possible seepage through the floodbank.

Rainfall: Styx Saddle 770mm, Haast 206mm Moana 150mm Arahura 90mm Greymouth 90mm in 24hrs.

Source: GES 10/08/92, 11/08/92.

Date: 26 August 1992.

Flood Damage: Surface flooding around region. Surface flooding on SH6 and SH7 in the Coal Creek area. Minor surface flooding in creeks north of Hokitika, but major rivers caused no trouble. Some water on the Arnold Valley Road. Avalanche closed SH6 at Candy's Creek in the Otira Gorge.

Source: GES 26/08/92, 27/08/92.

Date: 8 October 1992.

Flood Damage: Haast River in full flood – Whitebaiter was drowned.

Source: GES 08/10/92.

Date: 29-30 December 1992.

Flood Damage: Hokitika and Whataroa rivers rose but not to dangerous levels.

Slip Damage: See Appendix 3.

Rainfall: Hokitika Catchment 260mm in 18hrs.

Source: GES 29/12/92, 30/12/92.

Date: 7 January 1993.

Flood Damage: Surface flooding in Greymouth at road works near Victoria Park Raceway – 30cm deep. Streets garages and back yards flooded, and footpaths washed out. Ponding in Blaketown and creeks bank high but didn't overflow.

Rainfall: Heaviest downpour since the 'Wahine Storm'. 1 in 20 year event in Greymouth (Mel Sutherland GDC). 55mm in 1½ hours and 81.5mm total on the 7th.

Source: GES 08/01/93, 12/01/93 (letters to editor).

Date: 19 January 1993.

Flood Damage : '2 year flood' in the Grey River. Significant but not serious (Richard Stocker, WCRC.)

Slip Damage: See Appendix 3.

Rainfall: Tropical Storm 326mm in ranges overnight.

Source: GES 19/01/93.

Date: 22 January 1993.

Flood Damage: Rail bridge at Rocky Creek underwater after heavy rain, and road bridge threatened (SH73). Floodwater from Griffins Creek flowed down road.

Rainfall: Heavy overnight.

Source: .GES 22/01/93, 23/01/93.

Date: 26 January 1993.

Flood Damage: Second storm in a week. SH6 and SH73 closed due to flooding and slips. Heavy surface flooding at Havelock Creek and between Whataroa bridge and Lake Wahapo. Bridge approach scouring at Kakapotahi and river bank erosion along the Arahura Valley Road. Surface flooding on much low-lying farmland and minor surface flooding in Greymouth around Shakespeare Street and Boundary Street.

Slip Damage: See Appendix 3.

Wind Damage: Power supplies cut in Blaketown. Trees brought down.

Rainfall: 173mm in 18hrs in Grey Catchment (80mm in previous weeks' storm), Haast 120mm and Whataroa 140mm (inferred 24hrs period) compared to 242mm and 27mm in the previous storm. 53.7mm in Greymouth in 24hrs.

Source: GES 26/01/93.

Date: 5 February 1993.

Flood Damage: Flooding closed Rotomanu-Jacksons Road, SH73 flooded between Jacksons and Griffins Creek. Surface flooding on Pines Straight at Fairdown. Minor surface flooding in Greymouth. Hokitika rose to 3m.

Wind Damage: Strong winds but only minor damage.

Slip Damage: See Appendix 3.

Rainfall: Haast 284mm, Hokitika back country 237mm, Greymouth 55.8mm in 24hrs.

Source: GES 05/02/93.

Date: 13-14 June 1993.

Flood Damage: Major flooding in the Buller District. Buller River levels highest since 1970's. Buller discharged $7\,800\text{m}^3\text{s}^{-1}$, peaking at 5:23pm and coinciding with high tide. Westport sandbagged, Buller Gorge road (SH6) under 2m of water in places, and the lower Buller Gorge closed on the 13th and 14th. River flowing at very fast and full of logs. Car was swept into the river 20km west of Murchison. Most farmers along the Buller shifted stock to higher ground. Surface flooding closed streets in Westport - Stormwater backed up in the town as the Buller River rose. At Excelsior Road the Buller River "had been through the property three times in 12 years but this was the worst". Around Westport, flooding and scouring occurred at Nine Mile, McKenna's Road and Excelsior Road, and the approaches to Scott's Bridge suffered minor damage. In Greymouth, extensive surface flooding occurred around Victoria Park, and sections of road were washed away at Nimmo Park. Horses had to be evacuated from the Omoto Racecourse stables – some stables were half filled with water. The Grey River peaked at its highest level since 1988: At Dobson it was 2.1m above normal with a flow of $3\,400\text{m}^3\text{s}^{-1}$. This was described as an annual flood.

Slip Damage: See Appendix 3.

Source: GES 14/06/93.

Date: 6 October 1993.

Flood Damage: Hokitika River topped its banks at several places and flooded Kokatahi-Kowhitirangi Road. Ross was isolated for 4hrs when the Whataroa River cut across the road (SH6) to the north of the town, and Harold Creek flooded the road to the south: 30cm of fast flowing water in both cases. SH6 also blocked at Havelock Creek, and at

Black Creek (South of Bruce Bay). The Arahura River breached its banks, flooding paddocks on the south bank and flowing behind the Greyhound Tavern. Creek flooding around the Rotomanu area, and some slight scouring of roads in the Buller.

Slip Damage: See Appendix 3.

Rainfall: Cropp River 687mm, Styx River 523mm Franz Josef and Whataroa 418mm in 24hrs.

Source: GES 06/10/93.

Date: 2-3 December 1993.

Flood Damage: Karamea River burst its banks and flooded 3 upper Arapito properties. Roads and farms cut off but no serious damage. Surface flooding on several West Coast roads but no major damage. Some minor surface flooding in Greymouth.

Slip Damage: See Appendix 3.

Source: GES 03/12/93.

Date: 5–6 January 1994.

Flood Damage: Largest flood in the Grey River since 1988. Grey peaked at 300mm below September 1988 level (6.224m at Dobson). Richmond Hotel evacuated at 1:30am – flood waters came up through the road but did not enter the premises. Some surface flooding around houses in Nelson Quay in Cobden. 1m of water covered SH6 at Coal Creek. Flood waters closed SH7 at the Stillwater underpass and SH6 around the Inangahua Junction and township area.

Slip Damage: See Appendix 3.

Lightning Damage: Severe electrical storm in Blaketown and a lightning strike burnt down the Snowflake Icecream factory at Coal Creek Flat.

Source: GES 05/01/94, 06/01/94.

Date: 8-12 January 1994.

Flood Damage: Considerable damage around the region after several days of stormy weather. Four houses in Stafford, Awatuna, Arahura and Chesterfield were inundated after torrential rain. Extensive damage occurred to roads in the region due to flooding, washouts and slips. Streets in Hokitika were closed as deep surface flooding affected the town – streets were pumped for 14hrs. Washout occurred on Gillans Road and the Stafford Road was severely scoured. SH6 between Greymouth and Hokitika was open but marginal due to the Arahura River flooding the road near the Greyhound Tavern. North of Ross, SH6 was closed for 3hrs as the Totara River overflowed, and between Haast and Wanaka 5 bridges were washed out, closing the road for 3 weeks: The Little Hononhu bridge approaches were washed out. Flooding closed the Rotomanu-Bell Hill road. Range Creek flooded parts of Cobden and in Greymouth, the floodgate was used at Anzac Park. The repair bill for West Coast highways was put at \$500 000, and \$75 000 for Grey District roads. The Waiho River shifted from the north to the south side of the channel, causing extensive erosion. The Dillmanstown power station was knocked out of action by a combination of rain, wind and a lightning strike, leaving Hokitika and South Westland without power for 48hrs.

Slip Damage: See Appendix 3.

Wind Damage: Damage to Dillmanstown Power Station.

Lightning Damage: Damage to Dillmanstown Power Station.

Rainfall: Hokitika 210mm, Hokitika Gorge 863mm over weekend (523mm on Saturday, 340mm on Sunday).

Source: GES 10/01/94, 11/01/94, 12/01/94.

Date: 16-17 January 1994.

Flood Damage: Soldier was swept away and drowned whilst attempting to cross the swollen Taipo River, during army exercises.

Source: GES 24/01/94.

Date: 22-24 January 1994.

Flood Damage: Surface flooding in Whataroa Domain, and SH6 between Haast Pass and Fox Glacier closed by surface flooding. For the third time in a month, SH6 washed out at Thirsty Culvert. Havelock Creek Bridge buried under tonnes of debris. Lake Wahapo flooded the highway to a depth of 0.5m. Whataroa River rose 2m above normal and the Haast River rose 1m. The Grey River was swollen but no damage reported.

Slip Damage: See Appendix 3.

Source: GES 22/01/94, 24/01/94.

Date: 7-8 November 1994.

Flood Damage: Widespread flooding. The Buller River peaked at 10.7m at Te Kuha, 8.7m above normal on the 8th. The Grey peaked at 5m (3.8m above normal) at Dobson on the 7th. The Hokitika and Taramakau rivers were also high. Taramakau River broke through farmland and threatened the Moana-Inchbonnie Road. Over 50m of bank erosion occurred. Emergency flood protection works were required. Flooding closed SH6 at Inangahua Junction (water 1.5m deep on road), and at Haast. SH73 closed by flooding at Lake Misery at the top of Arthur's Pass.

Slip Damage: See Appendix 3.

Wind Damage: Gale force winds in Greymouth (62-74kmh).

Rainfall: In 56 hrs to 9:00am on the 7th, Hokitika 589mm, Styx 565mm, Haast 296mm, Franz Josef 216mm, Paparoa Range 120mm, Inangahua Landing 159mm.

Source: GES 07/11/94, 08/11/94, 14/12/94.

Date: 21-23 November 1994.

Flood Damage: Buller hardest hit. 4 houses evacuated in Seddonville. First Civil Defence emergency in Buller District since the Inangahua earthquake in 1968. Mokihinui River rising against a 3m tide and entered 4 houses. Buller River peaked at 10.7m at Te Kuha. SH6 closed by floodwaters at Hawk's Crag in the Buller Gorge – 0.5m of water over the road, and between Inangahua Junction and Inangahua Camp. The Grey River peaked at 6m (at Dobson). Floodwaters from the Grey River closed SH7 at the Stillwater underpass, and SH6 at Wingham Park was marginal. Surface flooding in low parts of Greymouth and Cobden as the floodgates were not in place. Power was cut in the Inchbonnie-Rotomanu area when the Crooked River washed out a pole. At Omoto Racecourse, 20 horses had to be evacuated – water was to the top of the stables. 600mm of water in bars under administration stand, 500mm in totaliser, 50mm in tearooms. Just north of Whataroa, Dodinski's house and 2 cars were caught by a sudden rise in water

levels, and the lower end of Scally Street was impassable. Approaches to Diedrich's Creek bridge were washed out, and the Kokatahi –Kowhitirangi Road was closed to all traffic as the Hokitika and Kaniere rivers overflowed their banks. Sections of road on the south of the Waitaha River were washed away, and power at Okarito was cut when a pole was washed away.

Source: GES 21/11/94, 22/11/94, 23/11/94.

Date: 18-19 March 1995.

Flood Damage: Rivers around Hokitika and Ross were up, but no flood damage of any serious nature.

Wind Damage: High winds caused most damage. At Ross, telephones and power were cut as lines got tangled in high winds.

Lightning Damage: Lightning blew fuses at Kokatahi, Stafford and Awatuna.

Source: GES 19/03/95.

Date: 28 March 1995.

Flood Damage: Oparara Rd closed after sections of road were washed out by intense localised rain. Culverts buried by debris.

Slip Damage: See Appendix 3.

Source: GES 28/03/95.

Date: 26 September 1995.

Flood Damage: Grey River 4m above normal, Buller 6m above normal. No damage reported.

Slip Damage: See Appendix 3.

Rainfall: 200mm in three days.

Source: GES 26/09/95, 27/09/95.

Date: 13 December 1995.

Flood Damage: South Westland badly affected. Northern approach to Waiho River bridge washed out (SH6). Paringa River stayed at peak flow for 24hrs – hadn't happened since 1982. All South Westland rivers were in flood, the Waiho being in 'full flood'. Large floods in the Whataroa and Waitangi-taona rivers. Surface flooding closed SH6 at Whataroa, and at the bridge approaches to the Waitangi-taona River. Many slips on the road.

Slip Damage: See Appendix 3.

Rainfall: Fox Glacier 592mm, Franz Josef 568mm, Paringa 508.5mm in 24hrs..

Source: GES 13/12/95, 14/12/95.

Date: 29 December 1995.

Flood Damage: Surface flooding near Haast at Solitude Creek caused four cars to go off the road.

Source: GES 29/12/95.

Date: August 1996.

Flood Damage: Sea flooding at Rapahoe camping ground.

Source: GES 29/03/98.

Date: 1-2 October 1996.

Flood Damage: Washout of Midland Rail line between Rotomanu and Inchbonnie (40km south of Greymouth). Many roads affected by surface flooding around Lake Brunner, especially in the Te Kinga-Inchbonnie area. Power pole washed out at Docherty's Creek (near Franz Josef), cut power to area.

Wind Damage: Trees blown through power lines in Greymouth and South Westland cutting power. Roofs blown off, windows broken, cars damaged by flying debris. Bus shelter in Greymouth blown down.

Slip Damage: See Appendix 3.

Rainfall: Hokitika 81.8mm in 15hrs.

Source: GES 02/10/96, 03/10/96.

Date: 7 October 1996.

Flood Damage: Green Beach isolated by floodwaters, hindering search for 3 missing fishermen (Boat wrecked at sea and washed up on beach). No flood damage reported

Source: GES 08/10/96.

Date: 13 October 1996.

Flood Damage: Civil Defence on alert in Grey and Buller Districts. Karamea River rose to 5.5m (12yr return period). Water didn't enter homes or businesses, but flooded many back roads in the area – some to a depth of 2m (roads closed). Much farmland in Karamea area flooded – mainly due to ponding. In Grey District, flooding (and slips) did \$40 000-60 000 worth of damage. SH6 at Baker's Creek near Barrytown scoured out. No road closures despite damage.

Slip Damage: See Appendix 3.

Other Damage: Rough sea at Rapahoe cutting into beach threatened properties.

Rainfall: 24 hr recordings: Moana 128mm, Karamea 68mm, Greymouth 67.7mm, Hokitika 100mm.

Source: GES 14/10/96.

Date: 20 November 1996.

Flood Damage: German tourist had to be rescued from the flooded Fox River (near Punakaki). Creeks in the region were flooded.

Source: GES 20/11/96.

Date: 11-12 February 1997.

Flood Damage: On the 11th, water entered the Paroa Primary School (closing it), a motel unit at Paroa Hotel, and the garage of the store. This was due to a combination of torrential rain and the mouth of Saltwater Creek being blocked by sandbar that built up over summer. Paroa School remained closed on the 12th as floodwater damaged the pump motor, leading to a risk of sewage contamination from the septic tanks. Two properties were evacuated at Coal Creek and SH6 was closed in this area due to 40cm of water covering the road. The Rotomanu School was closed because of surface flooding: flooding also closed the Blackball-Atarau Road and the Stillwater Moana Road. Power

supplies were cut to Haupiri and Moonlight as a pole was washed out. Heavy scouring of the approaches to the Haupiri bridge. A truck drilling in the Grey River bed was submerged. The Grey River peaked at 5m above normal at Dobson, 2m below the crest of the floodwall; was the third largest flood in the Grey since September 1998.

Morrison's Bridge over the Otira River was closed as a pier was knocked 4m downstream and lowered 4m in height. Water in the Blaketown Lagoons rose 2m above normal height – floodgates at Preston's Road, Waterwalk Road, and Tarry Creek were put in place as a precaution.

Slip Damage: See Appendix 3.

Rainfall: Greymouth 109.9mm in 24hrs (9:00am 10th – 9:00am 11th).

Source: GES 11/02/97, 12/02/97, 13/02/97.

Date: 20 May 1997.

Flood Damage: Heavy rain recorded in South Westland and surface flooding on several roads.

Slip Damage: See Appendix 3.

Source: GES 20/05/97.

Date: 15-16 December 1997.

Flood Damage: Grey River highest since September 1998. Grey River peaked at 6.825m at Dobson. Kaiata residents evacuated. Water 0.5m deep through a house at Omotumotu Creek. SH7 closed by flooding at Stillwater, and a washout at Springs Junction. Large stock losses occurred in the Grey Valley. At Stillwater, a farmer lost most of his pigs: Pastures covered in thick silt. Many stopbanks breached. In Greymouth the floodwall saved the town from major river flooding. Shops flooded by surface flooding – some parts of the town weren't connected to the pump stations. Surface flooding in Boundary, Werita, Mackay and Tainui Streets. Storm water system struggled to get rid of surface water. Some residents had to be evacuated, as water surrounded homes. Greymouth residents had to boil water. Surface flooding in Nelson Quay, Cobden. At Coal Creek houses were flooded. Flood debris on top of the stables at Omoto Racecourse. Claimed to be the highest since 1930s. SH73 between Kumara and Rocky Point reduced to a single lane in several places by surface flooding, and SH6 closed at Brown's Creek (Inangahua Junction), Hawk's Crag and Wingham Park, because of flooding.

Slip Damage: See Appendix 3.

Rainfall: Greymouth 98.8mm overnight.

Source: GES 16/12/97, 17/12/97.

Date: 20 December 1997.

Flood Damage: Rivers in the Arthur's Pass National Park area rose quickly. Runners were trapped in the Deception River and had to stay overnight until the river dropped.

Source: GES 22/12/1997.

Date: 15-18 February 1998.

Flood Damage: SH6 closed at Franz Josef – Waiho River at dangerously high levels. Deck of bridge covered in silt. River rose just above stopbank.

Rainfall: Franz Josef-170mm in 6hrs.

Source: GES 18/02/98.

Date: 6-9 March 1998.

Flood Damage: Extensive surface flooding and road closures in the Grey District and Westland. Extreme care was needed on SH6 between Fox Glacier and Haast because of severe surface flooding particularly bad south of Whataroa. Welshman's Road near Shantytown closed – an Armco culvert was washed out. Bridge approaches at Taramakau Settlement washed out. Water on the Kumara-Inchbonnie Road. The old Christchurch Road between Arahura and Turiwhati closed due to wash outs and slips. Roads in the Kowhitirangi area badly affected by flooding. 60m long section of SH69, 1km north of Inangahua slumped out of line on the morning of the 8th. Around Jackson's to Taramakau, Kowhitirangi-Kokatahi, and Paringa many creeks overflowed, depositing debris over roads and paddocks. The Waitagi-taona River rose to the top of the stopbanks causing around \$50 000 of damage. The Grey and Hokitika rivers reached 'first alarm' levels.

Slip Damage: See Appendix 3.

Rainfall: Collier's Creek 567mm, Haast 403.5mm in 3 days. Greymouth 107.4mm in 24hrs. Paringa 451mm in 4 days.

Source: GES 07/03/98, 09/03/98, 10/03/98.

Date: 29 March 1998.

Flood Damage: Tail end of Cyclone Yali. SH6 south of Fox Glacier closed for about 2hrs due to flooding. Most flood damage due to sea flooding. At Ngakawau one house had 1m of seawater through it, and the Rapahoe camping ground was flooded "*The water came up much further than it did last time in August 1996*"

Slip Damage: See Appendix 3.

Wind Damage: Roofs blown off, windows blown out over much of the region. Power out in Greymouth, Cronadun and Runanga by falling trees cutting lines and poles blown over.

Source: GES 31/03/98.

Date: 1-3 July 1998.

Flood Damage: Atarau Rd between Ikamatua and Blackball closed after a culvert washed out. On the 2nd the Buller River peaked at 9.942m at Te Kuha. The Grey River rose to 5.441m at Dobson: SH6 closed at Lyell due to washout, and at Inangahua Junction due to flooding; closed for 12 hours. SH6 north of Fox reduced to a single lane after a washout. Water and mud entered houses at Hector – runoff from a slip entered half a dozen houses (3rd time in last 6 years in one house). Erosion threatened to breach the main Taramakau stopbank that stops it from flowing directly into the Grey River catchment via Lake Brunner.

Slip Damage: See Appendix 3.

Rainfall: Greymouth 118.5mm in 24 hrs to 9:00am on the 1st.

Source: GES 01/07/98, 02/07/98, 03/07/98.

Date: 30 July 1998.

Flood Damage: Localised downpour in Greymouth coincided with high tide in Greymouth and glutted drain outlets.

Lightning Damage: Electrical storm in Hokitika. No damage reported.

Rainfall: Hokitika 75.5mm in 24hrs.

Source: GES 30/07/98.

Date: 20 October 1998.

Flood Damage: Widespread in Grey and Buller Districts. In Kaiata three houses in Lichfield Street and Golf Links Road were inundated with water and mud seepage. SH7 closed for 12hrs at the Stillwater underpass and at Kaiata. SH6 closed at Wingham Park, and at Inangahua Junction. Flooding closed SH67 between Mokihinui and Seddonville. The floodwall saved Greymouth from certain flooding. The barriers were put in position at Preston's Road and Waterwalk Road, and Mawhera Quay and Richmond Quay were closed. The Grey River at Dobson reached 6.825m (15-20 year return event). The river rose 1m in 15mins. At Omoto Pump Station, a caravan and motorbike were lost in the floodwaters. The Karamea River broke its banks and in Karamea, Aripito, and Umere area 7 homes were flooded, and a total of 66 residents were evacuated. Worst flooding in Karamea for 10 years.

Sources: GES 20/10/98.

Date: 27-29 October 1998.

Flood Damage: Serious flooding. Seddonville, Karamea and Harihari worst affected. The Poerua River burst its banks and flooded a farmhouse near Harihari. A family of 3 had to be rescued by jet boat. Several bridge approaches in the area were washed out. On the south side of the Poerua River, houses were threatened, and a farm bridge collapsed into the river. Two cars were washed away but were later retrieved. In the Buller District, a state of Civil Defence emergency was declared. Houses were evacuated at Seddonville, and Aripito. A total of 200 residents were evacuated from their homes. The Karamea River peaked at 5.946m (same as last weeks' flood), and second highest since 1977. Surface flooding occurred around Westport. The road to Karamea (SH67) closed due to surface flooding, and slips. The Buller River reached the road level at Hawkes Crag in the Buller Gorge, and at Murchison reached the highest level in 30 years. At Inangahua Junction 900mm of water flooded SH6. Army and Red Cross called in to help clean up. 12 houses in Seddonville, and 3 in Aripito flooded for the second time in 2 weeks – fences, driveways and races were destroyed. Estimated costs of the two flood in one week was \$1.7 million.

Slip Damage: See Appendix 3.

Wind Damage: Trees down, closed Aorangi Reserve Road.

Rainfall: Harihari 180mm in 13½ hours (40mm in last 1½ hours). In the Buller only 50mm of the predicted 150-200mm fell.

Source: GES 27/10/98, 28/10/98, 29/10/98.

Date: 1 November 1999.

Flood Damage: Heavy rain washed debris down from Mt Adams landslide, covering McKenzie's farm in silt and debris. 20% of farm taken out of production. Flood water

and debris breached some stopbanks and threatened 10 more farms downstream. Waiho River rose rapidly after a local 'cloudburst' but no damage reported.

Slip Damage: See Appendix 3.

Source: GES 02/11/99.

Date: 24-25 January 2000.

Flood Damage: Greymouth bore the brunt of storm- localised bands of intense rain in previous 24hrs. At the corner of Alexander Street /Murray Street surface flooding was up to window level of parked cars, and elderly residents were evacuated from this area. Heavy surface flooding in other parts of the town as the stormwater system could not cope with the rainfall. Saltwater Creek burst its banks and flooded the Paroa Hotel carpark and isolated Shantytown. Flash flood in Karoro – rail tracks washed out in this area. Most damage done by landslides in Greymouth.

Slip Damage: See Appendix 3.

Wind Damage : Tornadoes north of Hokitika – seen from Cobden, Blaketown, Rapahoe and Serpentine.

Rainfall: Greymouth – 70mm in 2hrs, 162.6mm in 24hrs. Arthur's Pass 164mm in 24hrs.

Source: GES 24/01/00, 25/01/00.

Date: 4-5 May 2000.

Flood Damage: Whakapohai River in fresh, cut in to north bank below state highway bridge exposing old rubbish dump.

Source: GES 05/05/00.

Date: 30 September 2000.

Flood Damage: Relentless floodwaters at the head of the Poerua River. Erosion of bank caused a 20m x 4m calf shed to drop into the river. Trouble began with the Mt Adams landslide the previous year. 21 floods since – much damage to farm and fences (Note: this is assumed to be McKenzie's farm, although the paper doesn't identify it).

Slip Damage: See Appendix 3.

Source: GES 30 /09/00.

Date: 7-9 October 2000.

Flood Damage: Karamea, Buller and Grey rivers all exceeded 1st stage flood warning levels at least once over the weekend. Old grandstand at Omoto Racecourse flooded, also flooding of farm land around Stillwater. Farmers moved stock to higher ground.

Karamea River peaked at 4.363m on 7th.

Source: GES 09/10/00.

Date: 28 December 2000.

Flood Damage: Grey and Karamea Rivers up high. Floodwall gates lowered into position in Greymouth. Surface flooding in Greymouth. Washout closed SH6 at Robinson's Creek. Civil Defence in Westland on alert – Waiho River high.

Slip Damage: See Appendix 3.

Rainfall: Greymouth 56mm overnight, Franz Josef ~ 130mm in 12-18hrs.

Source: GES 28/12/00.

Date: 6 February 2001.

Flood Damage: Turiwhati Creek burst its banks, blocking SH73.

Slip Damage: See Appendix 3.

Source: GES 07/02/01.

Date: 20-22 November 2001.

Flood Damage: Rivers high in Westland. Several warning levels reached. No flood damage reported but slip damage in Greymouth occurred.

Slip Damage: See Appendix 3.

Source: .GES 22/11/01.

Date: 5-6 December 2001.

Flood Damage: .Waiho River very high after heavy rain on the 5th. River lapped the underside of the SH6 bridge. Grey and Buller River reached alarm levels. No major problems reported.

Slip Damage: See Appendix 3.

Rainfall: Franz Josef 160mm in 24hrs, South Westland 500-800mm in 7 days.

Source: .GES 06/12/01.

Date: 7 December 2001.

Flood Damage: Intense rain partially responsible for a landslide that blocked Doherty's Creek . When dam breached creek flooded downstream area.

Rainfall: 659.5mm in 18 days at nearby Rapahoe

Slip Damage: See Appendix 3.

Source: GES 10/12/01.

Date: 12 December 2001.

Flood Damage: Flooding and erosion in the Hokitika and Poerua rivers. Main trouble was again at McKenzie's farm on the Poerua at the base of Mt Adams, and at several farms on the south bank of the Hokitika River between Kaniere and Hokitika.

Rainfall: Continuous and heavy over the last few weeks.

Source: GES 12/12/01.

Date : 2-3 January 2002.

Flood Damage: Surface flooding in Greymouth and Westport. Approached to the SH6 bridge at Waiho River washed out. All rivers rose and fell rapidly. Considerable damage to roads and bridges up and down the coast. Waiho and Totara river valleys worst affected. At Franz Josef, Waiho Bridge approaches (SH6), were washed out on the 3rd.

Waiho River eroded the south bank and threatened Holiday Park. Waiho River peaked at 7.078m. Considerable bank erosion and farmland lost along Poerua and Hokitika Rivers.

Slip Damage: See Appendix 3.

Rainfall: 200mm in 3 days over much of the region. 236mm overnight at Franz Josef.

Source: GES 03/01/02, 04/01/02.

Date: 19-20 March 2002.

Flood Damage: Many creeks jumped channels and flooded roads in the Rotomanu and Haupiri area. \$50 000-70 000 damage to roads in this area. SH6 in the Buller Gorge closed due to flooding. Civil Defence warning in Karamea although no major problems eventuated. Little Wanganui School evacuated. SH67 to Karamea closed due to flooding at Tidal Creek, and surface flooding of roads around Karamea, Urmere, Arapito and Glasseye Roads. Also flood damage to roads around Punakaiki.

Rainfall: Intense in the Rotomanu-Haupiri area.

Source: GES 21/03/02.

Date: 13 June 2002

Flood Damage: Houses in Torea St, Granity were flooded by a swollen creek

Source: The Press 29/06/02.

Date: 27 June 2002

Flood Damage: Six houses evacuated in Granity. The Fire Service had to pump some houses dry. Some of the Torea St properties flooded by a swollen creek on the 13th were affected again. Floodwaters scoured the Ngakawau-Westport rail line, pushed debris across SH67.

Slip Damage: See Appendix 3).

Source: The Press 29/06/02.

APPENDIX 2

GLACIER BURST EVENTS

APPENDIX 2

Glacier Burst Events

1920's. (Day/Month/Year unknown.)

In his book 'A Glacier Crumbles', Frank Alack recorded that in the 1920's, house-sized blocks of ice were floating down the Waiho River. (G.E.S. 20/12/65).

Note: Searches have failed to find copies of Alack's book to expand on details.

1949 (Day/Month unknown)

"In 1949 another ice fall was recorded but it was much inferior to either the 1920's fall and the 1965 fall; a natural lake was formed in front of the terminal face and absorbed most of the fallen ice". (Source: G.E.S. 20/12/65)

19 December 1965

Note: Imperial units in original article converted to metric here.

"Flooding occurred in the Waiho River after a huge block of ice fell off the Franz Josef Glacier. The ice fall was approximately 305m long, 30m deep and 91m wide (832 650m³) and weighing more than 2 000 000 tonnes. The ice fall was attributed to torrential rain in the area – during the 16th – 17th, over 279mm fell at Franz Josef. After the rain the flooded river lifted the ice on the 18th. The subsidence of the river on the 19th, allied with the pressure build up in the crevasses would have caused the fall.

The river changed into a huge sea of ice chunks, right from the terminal face of the glacier to the river mouth 16km away (G.E.S. 20/12/65). The ice extended right across the riverbed and up to 30m high in the bush on the valley sides (G.E.S.21/12/65). The ice changed the course of the Waiho River, making it flow over enormous rocks and produced a waterfall 12m high (G.E.S. 20/12/65). Experts were staggered by the amount of aggradation in the Waiho Gorge. "They feel that it is impossible for it (the rock debris) to have all come from the visible areas, and a theory which is being adopted is that a great proportion of the debris came from beneath the glacier itself (G.E.S.22/12/65). The Chief Park Ranger estimated the valley floor rose 9.1m, 800m downstream from the terminal face to the parking area, a distance of 2km. Mr W. Sara, of the Geological Division, D.S.I.R., said that sometime previously a lot of rock came down on the western side of the glacier and would have been pushed down by the ice". (G.E.S. 22/12/65)

Sara (1968) provided more technical details of this event.

Note: The glacier had been advancing at 1.6m/day for a number of weeks prior to the ice fall. (Source: Benn 1990)

2 June 1985

“At about 1100 h on 2 June we observed the development of a stream on the glacier’s true left margin, at the level of the study site, between ice and the glacial moraine. Within minutes, the stream grew from non-existence into a steep torrent which was discoloured due to its high sediment load. The torrent cut down into the ice face and undercut the marginal portions of the glacier. Blocks of ice broke off and were carried away down the torrent. The torrent abated sometime in the evening of 2 June. The torrent had eroded away a portion of the glacier margin approximately 50m wide and about 25m deep, and deposited a bed of coarse sediment. The depth of eroded ice is a lower bound because the depth of the stream-deposited sediment is unknown. The glacier margin was eroded for several hundred metres downstream. The volume of ice lost through this fluvial ablation was thus in the order of 50 000m³. This quantity of ice is equivalent to over 100mm of surface melt when averaged over the trunk portion of the glacier.

The cascade was probably a crevasse outburst flood, similar to one which occurred on 19 December 1965 and was described by Sara (1968). Rain and meltwater were stored in the crevasses above the icefall until sufficient pressure was built up for the water to burst out”. (Source: Marcus, Moore and Owens 1985).

December 1995

Small glacier burst deposited about 250 000m³ in the upper Waiho valley. Much of the sediment was composed of very large boulders. (Source: Turnbull 1998 *in* McSaveney and Davies 1998).

APPENDIX 3

**CHRONOLOGICAL HISTORY OF LANDSLIDE EVENTS IN THE WEST COAST
REGION: 5 NOVEMBER 1867-27 JUNE 2002.**

APPENDIX 3

CHRONOLOGICAL HISTORY OF LANDSLIDE EVENTS IN THE WEST COAST REGION

Note:

The following chronology of events was compiled by initially extracting details from Benn (1990), where the information in that report was focussed on flood events. Landslide details were collected peripherally to flood details; landslides commonly occur during flood events, and are often the cause of flooding, as in landslide dammed lakes. Further research of the original source information quoted in that volume may reveal more landslide details. The dates given below relate to the duration of the recorded flood events, and unless otherwise stated, the landslides listed are from Benn (1990). The record is far from complete as no specific project to establish such an inventory has yet been undertaken. Nonetheless it is the most comprehensive list gathered to date, compiled from information sources readily available at the time of writing. It was considered appropriate to compile such an inventory to compliment the flood and earthquake hazard inventories already recorded by the WCRC (Benn 1990, Benn 1992). It thus goes some way in filling in gaps of knowledge in regards to landslide event frequency, location and damage caused. Rainfall generated events up until January 1990 are from Benn (1990) unless otherwise stated. From December 1990, references are provided.

Rainfall Generated Landslides

Date: 5-6 November 1867.

Cause: Rain (unsettled for days).

Effects: Many slips along the Greymouth –Arnold road.

Date: 12-26 May 1870.

Cause: Rain (rained for two weeks).

Effects: Many slips around Inangahua. Roads blocked for days.

Date: 26-29 September 1874.

Cause: Rain (heavy for 48hrs).

Effects: Large slip at Maori Chief Mine (Charleston) totally destroyed the crushing plant.

Date: 20 November 1874.

Cause: Rain.

Effects: At Jones' Flat, two slips filled in a water race.

Date: 13 November 1886.

Cause: Rain.

Effects: Severe damage in Taramakau district as a result of slips (and floods). Slip at Rocky Point covered the road for 40m, carried away telegraph lines and knocked others out of line.

Date: 30 November 1897.

Cause: Rain.

Effects: Slip on Hokitika River embankment caused the whole wharf structure to be washed away.

Date: 12-14 June 1921.

Cause: Rain (140mm at Greymouth in 48hrs).

Effects: Slips on road and rail at Omoto. No serious damage.

Date: 1 March 1922.

Cause: Rain (very heavy in the Karamea area- 'cloud burst').

Effects: Slips on road and elsewhere in Aripito area.

Date: 22 September 1925.

Cause: Rain (two weeks of rain in Buller).

Effects: Roads around Westport and Buller blocked by slips and washouts. Westport completely isolated.

Date: 4-5 December 1925.

Cause: Rain (305mm at Otira overnight. Heavy rain over rest of region).

Effects: Many slips in country areas - most damage by floodwaters and washouts.

Date: 1-11 December 1925.

Cause: Rain (152mm at Otira in 24hrs).

Effects: Large slip at Aickens caused serious damage to Midland Railway line.

Date: 8-9 May 1926.

Cause: Rain (Heavy in high country, 55mm at Greymouth in 24hrs).

Effects: Several slips between Kaimata and Moana disorganised road and rail services.

Date: 30 -31 October 1926.

Cause: Rain (a week of wet weather).

Effects: Slips blocked roads in Westland and considerable damage to road in the Buller Gorge (SH6).

Date: 8 October 1928.

Cause: Rain (4 days of wet weather).

Effects: Slips on road at Harihari (SH6) in several places.

Date: 6 November 1929.

Cause: Rain ('cloud burst' in Crushington area).

Effects: Much slipping in Crushington area. Minor damage to roads.

Date: December 1929.

Cause: Rain (several hours of intense rain then a 'cloud burst').

Effects: A large slip near Norris Hill, 10km from Westport. No slip damage reported.

Date: 7-10 October 1930.

Cause: Rain (4 days of heavy rain over whole region. 125mm at Greymouth in 3 days).

Effects: Large slip >2 300 m³ damaged hydro construction work at Kaimata. Many slips in the Westport area. Millerton Mine work halted due to six slips on the road to it.

Date: 20 January 1931.

Cause: Rain (167mm at Otira in 24hrs).

Effects: Otira Gorge road blocked by slips. Other roads similarly affected.

Date: 3 April 1931.

Cause: Rain (heavy over whole region. Tiroroa-330mm/Greymouth -75mm in 24hrs).

Effects: Many roads blocked by slips. At Tiroroa a slip killed a man, by severing his leg.

Date: 29 January 1932.

Cause: Rain (exceptionally heavy).

Effects: In district surrounding Greymouth, many roads blocked by slips.

Date: 31 January 1932.

Cause: Rain (heavy over whole region).

Effects: Numerous slips around Karamea blocked roads.

Date: 15-16 July 1933.

Cause: Rain (Torrential over whole region. 263mm at Hokitika in 48 hrs)

Effects: Many roads in Grey District damaged by slips (and washouts).

Date: 17 April 1934.

Cause: Rain.

Effects: Landslide dammed creek at Poerua (near Inchbonnie). Dam burst and caused severe damage to rail bridge approaches, cutting a breach 6m long and 3m deep in ten minutes.

Date: 20 February 1935.

Cause: Rain (Hokitika - 233mm in 24hrs/ Greymouth - 114mm in 36hrs).

Effects: Slips (and washouts) caused severe road damage throughout the West Coast.

Date: 20 March 1935.

Cause: Rain (Torrential in Millerton area).

Effects: Large slip in Ngakawau area covered road bridge to a depth of 6m and the railway to a depth of 3.6m. Traffic disorganised for several days.

Date: 10-12 October 1936.

Cause: Rain (NW storm, high wind, heavy rain).

Effects: Extensive slipping in Grey District blocked many roads. Many slips on road between Inangahua and Lyell.

Date: 8-9 January 1938.

Cause: Rain (Greymouth - 77mm in 48hrs/ Arthurs Pass - 91mm in 24hrs).

Effects: Slips (and washouts) blocked many main roads. Train ran into slip at Omoto causing much damage to rolling stock. Numerous slips (and washouts) on roads in Buller.

Date: 14 February 1938.

Cause: Rain (Otira - 27mm in 2hrs).

Effects: New traffic bridge at Goat Creek (about 400m east of Otira), covered to handrails with boulders brought down off the mountainsides. Whole creek bed was raised to this new level for 180m.

Date: 21 March 1938.

Cause: Rain (Greymouth - 44mm in 2hrs/ Greymouth -178mm in 4 days).

Effects: Roads throughout Grey District blocked by slips. At Omoto, one slip around 11 500m³. Many landslides and slips in in Greymouth. At Kumara, a miner was killed when "a fall of earth" crushed him.

Date: 13-14 April 1938.

Cause: Rain (Torrential).

Effects: Slips blocked several roads in the Grey Valley.

Date: 28-29 May 1938.

Cause: Rain (Greymouth - 51mm in 24hrs).

Effects: Several slips blocked roads in the Dunollie area.

Date: 11-12 January 1939.

Cause: Rain (Greymouth - 29mm in 24 hrs).

Effects: Five slips on the Midland Line between Aratika and Kaimata. Damage generally slight.

Date: 26-27 February 1940.

Cause: Rain (Almost 2 months of continual rain over whole region).

Effects: One of the most extensive slips in the history of the Midland Rail line at Jackson's. Completely obliterated road and rail for 40m and 60m respectively. Both the rail bridge and road culvert at Nellies Creek were buried by slips. Slips (and washouts) were prevalent in other parts of the area and throughout Westland. Lewis Pass blocked by slips (and washouts).

Date: 17-18 October 1940.

Cause: Rain (Greymouth - 57mm in 11hrs/ Rewanui - 102mm over night)

Effects: Extensive slip over rail line to Rewanui Mine. Slip on Granity – Millerton road interrupted traffic.

Date: 3 February 1941.

Cause: Rain (Greymouth - 93mm-12hs/Rewanui-191mm-24hrs/Otira 214mm-24hrs)

Effects: Serious blockages of roads and rail – several slips on the Midland line and extensive slips on roads throughout region.

Date: 4-8 April 1942.

Cause: Rain (Greymouth – 235mm in 6 days/Karangarua – 24mm in 24hrs).

Effects: Numerous slips on roads throughout region. Slips on Rewanui rail line stopped coal production from the Liverpool State Mine. In South Westland, roads severely damaged by slips. In Buller, Westport to Murchison roads also damaged by slips.

Date: 5 May 1942.

Cause: Rain (Heavy over whole region. Greymouth - 69mm in 24hrs).

Effects: Slips on rail line between Stillwater and Brunner, and on SH6 at Twelve Mile.

Date: 12-13 July 1942.

Cause: Rain (Greymouth – 160mm in 24hrs/Rewanui – 296mm in 24hrs).

Effects: Small slips around Greymouth. Slips blocked roads in many places around the Grey District. Midland line also affected by slips. Several coalmines idle due to slips on their rail lines. Buller Gorge road (SH6) blocked by slips.

Date: 23-24 October 1942.

Cause: Rain (Greymouth – 229mm in 3 days/Otira - 300mm in 24hrs)

Effects: Numerous roads blocked by slips and washouts. No serious damage.

Date: 5-6 March 1943.

Cause: Rain (Jacksons Bay/Haast area – 229mm 36 hrs).

Effects: Several large slips in Jackson Bay area. No mention of damage attributable to slips.

Date: 17-19 September 1943.

Cause: Rain (Greymouth - 220mm in 9days. Heavy rain over whole region)

Effects: Large slip blocked the Brunnerton rail line.

Date: 12 November 1943.

Cause: Rain (Otira – 178mm in 24hrs. Heavy rain around main divide area).

Effects: Slips blocked the Otira Gorge road (SH73) and the Lewis Pass road (SH7).

Date: 1-19 January 1944.

Cause: Rain (after long dry spell).

Effects: Numerous slips on Midland Rail line and SH73, effectively blocking all traffic. Most slips occurred between Jackson's and Otira. Rail closed for 6 days.

Date: 2-3 February 1944.

Cause: Rain (Greymouth – 144mm/24hrs. Torrential throughout region).

Effects: Serious damage to Midland Rail line. Slips in similar locations, and of similar dimensions to previous event. Rail traffic again disrupted.

Date: 10 February 1944.

Cause: Rain (Rewanui – 163mm in 24hrs. Greymouth – 89mm in 24hrs).

Effects: Slips again on the Midland line disrupted rail traffic. Slips on rail line in Buller Gorge. Train ran into slip 20km from Westport, losing 13 wagons of coal. Slips blocked several roads in the area.

Date: 29 July 1944.

Cause: Rain.

Effects: Buller Gorge road (SH6) blocked by several slips.

Date: 15 December 1944.

Cause: Rain (Rewanui – 213mm in 24hrs. Greymouth – 59mm in 24hrs).

Effects: In Grey Valley, slips occurred on some rail tracks leading to coal mines, halting mining operations.

Date: 13 January 1945.

Cause: Rain (Reefton – 83mm in 48 hrs).

Effects: Slips blocked roads around the Reefton area.

Date: 3 February 1945.

Cause: Rain (Westport – 76mm overnight).

Effects: Several slips on Karamea Bluff road (SH67).

Date: 1 February 1946.

Cause: Rain.

Effects: Slips on Midland Rail line at Nellies Creek near Otira.

Date: 12-13 August 1946.

Cause: Rain (Otira – 190mm in 24 hrs).

Effects: Numerous slips on the rail line between Inangahua and Reefton, and on the Midland line at Nellies Creek near Otira. Slips also blocked the Otira Gorge road (SH73) and the Lewis Pass (SH7) road for a short period.

Date: 27-28 November 1946.

Cause: Rain (Waiuta – 58mm/Totara Flat – 83mm in 24hrs. Reefton – 59mm over night).

Effects: Slips (and washouts) damaged Midland Rail line near Otira.

Date: 26-27 December 1947.

Cause: Rain (Jackson Bay – 138mm/Whataroa – 149mm/Otira – 198mm in 24hrs).

Effects: Slips blocked roads around the Inchbonnie area.

Date: 16 January 1948.

Cause: Rain (heavy showers throughout region).

Effects: A large rock fell on rail line between Dunollie and Runanga damaging the central line. A few small slips on roads in Grey Valley – Inangahua area, but no disruption to traffic.

Date: 5-6 October 1949.

Cause: Rain (Otira – 307mm/Kaniere – 222mm/Downerton - 263mm in 24hrs).

Effects: Otira Gorge road (SH73) and Lewis Pass road (SH7) blocked by slips.

Date: 25-26 December 1949.

Cause: Rain ('cloud burst near Granity).

Effects: Large stones off hillside at Granity fell on houses below causing serious damage.

Date: 10 January 1950.

Cause: Rain (Greymouth – 51mm in 12hrs/57mm in 24hrs).

Effects: Two slips on SH6 in Otira Gorge, and slips occurred on other roads.

Date: 25-26 May 1950.

Cause: Rain (Otira – 412mm in 24hrs/813mm in 4 days. Reefton – 254mm in 4 days).

Effects: Numerous slips in Otira Gorge blocked SH6 for several weeks. Slips were widespread throughout the region.

Date: 23 July 1950.

Cause: Rain (Inchbonnie – 211mm/Kokatahi – 196mm/Kaniere – 270mm in 24hrs).

Effects: A large slip at Aratika where the Midland Rail line skirts the Kaimata Dam.

Date: 28 December 1950.

Cause: Rain (Whataroa – 267mm in 48hrs/Greymouth – 114mm in 24hrs).

Effects: Several slips (and washouts) on roads in South Westland.

Date: 17-18 January 1951.

Cause: Rain (Otira – 211mm/Karoro 107mm in 24hrs).

Effects: SH6 (Otira Gorge) blocked by slips. No serious damage reported.

Date: 28-29 November 1951.

Cause: Rain (Otira – 159mm in 24hrs).

Effects: Roads throughout the West Coast suffered from slips but no serious damage reported.

Date: 25 June 1952.

Cause: Rain (Otira – 127mm in 24hrs).

Effects: Slips on several roads around region but no serious damage reported.

Date: 26 March 1953.

Cause: Rain (Whataroa 432mm in 10 hrs).

Effects: Slips on several roads in South Westland and traffic interrupted.

Date: 29-30 April 1953.

Cause: Rain

Effects: Some roads impassable due to slips (and floodwaters). At Nikau a house invaded by water and thick silt up to 20cm deep.

Date: 24 November 1953.

Cause: Rain (Kowhitirangi – 114/Haast – 103mm in 24hrs).

Effects: Road to Jackson Bay blocked by slips (and washouts).

Date: 31 January 1955.

Cause: Rain (Whataroa - 178mm overnight/Greymouth – 38mm during the day).

Effects: Slips closed the Midland Rail line near Aickens and the Otira Gorge for 5 hours.

Date: 16-19 February 1955.

Cause: Rain (Greymouth – 229mm in 5 days/Inangahua – 90mm in less than 48 hrs).

Effects: Slips blocked road between Inangahua Junction and Westport and between Inangahua Junction and Lyell (SH6). Buller Gorge road (SH6) blocked by slips at Husband Hill. Slips also caused trouble on the road to Karamea (SH67), and the Lewis Pass road (SH7). Otira Gorge road (SH73) cut by many slips. On the night of the 18th, the rail car ran into a slip in the Buller Gorge – no injuries.

Date: 26-27 February 1955.

Cause: Rain: (Greymouth – 139mm in about 48 hrs).

Effects: Widespread serious slip damage. SH6 at Costellos' Hill (south of Charleston), Meybille Bay, White Horse Hill, and in Buller Gorge blocked by slips. All rail services to coast cut by slips (and flooding). Major slip near Kaimata left the Midland Line suspended: Slips removed part of the line at Aratika and covered the line at Aickens and at Omoto. Slips caused serious damage to the Cascade Mine at Denniston – buildings and equipment were buried and over 11km of fluming leading to the mine was carried away by slips.

Date: 13 October 1957.

Cause: Rain (Greymouth – 93mm in 24hrs).

Effects: About half of the road width between Taylorville and Brunner slipped into the Grey River, completely destroying three culverts.

Date: 5-28 November 1957.

Cause: Rain (Greymouth – 178mm in a week).

Effects: Slips (and flooding) closed roads and rail links in the Blackball and Ngahere area. Rail line between Ngahere and Matai affected by slips. A slip 100m long occurred on the Haupiri Road near Nelson Creek – removed quickly.

Date: 4-5 December 1957.

Cause: Rain (Karoro – 63mm in 8hrs).

Effects: A number of slips blocked the Midland Rail line between Otira and Aickens for a short period.

Date: 14 December 1957.

Cause: Rain (Greymouth – 29mm in 24hrs).

Effects: A slip blocked the Midland Rail line between Otira and Aickens for a short period.

Date: 26-28 December 1957.

Cause: Rain (intense over whole region).

Effects: On 27th, landslide completely blocked the Otira River – dammed up within minutes and breached on the 28th. Much flood damage to township when dam burst. SH73 through Otira Gorge blocked for 5 months due to slip and flood damage. Large debris slide at Candy's Bend destroyed the highway, and at Goat Creek the road bridge was buried under gravel.

Date: 12-13 January 1958.

Cause: Rain

Effects: More slips in Otira Gorge on SH6, in some places the road slipped completely away. A slip crossed the road at Fourteen Mile (SH6 near Barrytown) and damaged the approaches to Baker's Bridge, but road remained open.

Date: 14-15 February 1958.

Cause: Rain (Greymouth – 152mm in 6 hrs).

Effects: Many slips in Greymouth-Cobden area: Mud and silt from slips deposited over a wide area in this area. Slips also destroyed a number of sheds and damaged two houses.

Date: 10 March 1958.

Cause: Rain (Paringa/South Westland – 357mm in 36.5hrs).

Effects: SH6 in South Westland closed for many days because of slips, especially in the Mt Hercules area, where substantial slips occurred.

Date: 13 March 1958.

Cause: Rain (heavy rain continued from previous event over whole region)

Effects: Mud (mudslide) came down from hills above Greymouth railway station as temporary streams flowed down slip scars from previous event. At Mitchells several slips caused much damage to a number of houses and cars (3 cars buried). Rail lines at Otira were blocked by slips (and floods) in six places, as were a number of roads throughout the region.

Date: 8-10 May 1958.

Cause: Rain (Greymouth – 121mm/Blackball – 126mm/Karoro – 91mm in 24hrs).

Effects: Major slip that damaged houses at Mitchells was re-activated – several new slips covered the road in this area. New slips in the Lake Poerua area blocked the Midland Rail line between Poerua and Rotomanu, and between Rocky Point and Nellie's Creek. Rail line to Rewanui was blocked by slips. On the 8th, the road the Karamea (SH67) was blocked by slips.

Date: 28 May 1958.

Cause: Rain (Storm of cyclonic force).

Effects: Midland Rail line cut by slips at Rocky Creek, and at Reefton Saddle, a slip blocked the entrance to the Tawhai Rail Tunnel.

Date: 30 May 1958.

Cause: Rain (Continuation of above storm).

Effects: More damage to the Tawhai Rail Tunnel when embankment subsided and knocked tracks out of line.

Date: 12 December 1958.

Cause: Rain.

Effects: Slip blocked SH6 at Candy's Bend in the Otira Gorge.

Date: 28-30 January 1960.

Cause: Rain (Greymouth - 30mm in 24hrs. Intense electrical storm in South Westland).

Effects: Large slip completely blocked Haupiri River in the gorge. Dam was about 6m high – river backed up for considerable distance before overtopping and breaching.

Date: 7-10 November 1961.

Cause: Rain (Otira – 203mm/Fox – 152mm/Greymouth – 33mm in 24 hrs).

Effects: Slip demolished a span of the bridge leading to the Liverpool State Coal Mine, halting production until it was repaired. Large Slip blocked road (SH67) just south of Karamea. SH6 in the Buller Gorge, Costello's Hill and Cobden Quarry cut by slips (and floodwaters). Buller Gorge rail line cut by slips.

Date: 21 January 1962.

Cause: Rain (Karoro – 80mm in 24hrs).

Effects: Slip at Candy's Bend blocked SH6 in the Otira Gorge for a short period.

Date: 27-28 March 1963.

Cause: Rain (Otira – up to 355mm in 24 hrs).

Effects: Serious slipping (and flooding) on roads throughout the region especially in the Otira Gorge (SH73) and the Weheka Hills (SH6) between the Glaciers. Slips blocked the Midland Rail line between Greymouth and Christchurch.

Date: 6-9 November 1963.

Cause: Rain (Greymouth – 101mm in 36hrs/Blackball – 100mm in 24hrs)

Effects: Large slip at Roiden's Creek closed the Lewis Pass road (SH7). About 2000 tonnes of material had to be removed from the road.

Date: 7-9 January 1964.

Cause: Rain (8 days of incessant rain over region).

Effects: Slips on Karamea Bluff road (SH67) – not closed. Slips closed SH6 in Otira Gorge for a short time. Small slip covered the Rewanui rail line but not closed.

Date: 14-15 January 1964.

Cause: Rain (Inchbonnie – 576mm in 13 days. Days of rain over whole region).

Effects: Moana – Mitchells road near Arahura Gold Dredge covered by slips.

Date: 22 January 1964.

Cause: Rain (glaciers – 78mm/Greymouth – 51mm/Hokitika – 35mm in 24hrs).

Effects: Buller Gorge road (SH6) closed by slips at Dublin Terrace.

Date: 24-25 March 1964.

Cause: Rain (Greymouth - 41mm/Karoro – 43mm in 24 hrs).

Effects: Slips blocked Buller Gorge railway 28km west of Inangahua, and blocked SH73 in the Otira Gorge for a short period.

Date: 12-14 May 1964.

Cause: Rain (Otira – 338mm in 27hrs/Karoro – 27mm in 5hrs).

Effects: 5 major slips on Otira Gorge road (SH73) – most serious at Reid's Falls where tons of rock/debris/water shattered the timber half bridge reducing road width to 1.7m. Many slips on road between Stillwater and Ngahere (SH7, remained open). Four slips covered SH6 between Ten Mile and Twelve Mile (Greymouth – Westport road).

Date: 6 August 1964.

Cause: Rain (figures unknown at the time of writing).

Effects: Largest slip recorded on the Rewanui branch rail line leading to the Mt Davy coal mine, on the east side of Rewanui railway station. Slip blocked the creek which dammed up considerably before breaching through and returning to normal.

Date: 13-15 March 1965.

Cause: Rain (Paringa – 610mm in about 48 hrs).

Effects: A huge landslide near Lake Moeraki, and in the Weheka Hills several slips and a washout blocked SH6.

Date: 21-24 February 1966.

Cause: Rain (Greymouth – 170mm in 36 hrs).

Effects: Slip on SH6 at Meybille Bay about 150-230m³. Slip only just cleared away when another occurred just north of Fox River closing SH6 again. This slip was around 300-380m³. SH6 closed by slip at Dublin Terrace in the Buller Gorge – debris came down from 45m up the hillside and covered the road with about 4 600-6 000m³ of material.

Date: 26-27 April 1966.

Cause: Rain (Greymouth – 164mm/Westport – 63/Inangahua – 51mm in 24hrs).

Effects: Slip closed SH7 between Coal Creek and Wingham Park. Many slips in Greymouth – one in Freyberg Terrace left a house overhanging. Material from under the house slid down the hill and rested against a house in Rochfort Street below it. Slip in Ashmore Avenue (Cobden) blocked a drain. Slips also occurred in Lydia Street and Arnott;s Heights. Slip at Liverpool No. 3 Mine badly damaged a conveyer belt, and a slip closed the Buller Gorge railway near Rahui.

Date: 2-3 November 1966.

Cause: Rain (Karoro – 37mm in 24hrs).

Effects: A few minor slips on the road (SH6) at Franz Josef.

Date: 24-25 January 1967.

Cause: Rain (Paringa – 528mm in 72 hrs/Fox Gl. – 136mm/Harihari – 145mm in 24hrs).

Effects: Slip of about 1 500m³ blocked SH6 at Whataroa River bridge, and a slip blocked the rail line at Rewanui.

Date: 30 January 1967.

Cause: Rain (Haast – 165mm in 24hrs).

Effects: Slips (debris and gravel) caused blockages to SH6 at Moeraki Bluff between Paringa and Moeraki. At Boulder Creek, debris and rocks diverted the creek further to the north and across the main road.

Date: 15-16 February 1967.

Cause: Rain (Karoro – 36mm in 24hrs. Moderate rainfall over region).

Effects: Slips cut SH6 at Waikukupa River (Haast highway) for an hour, and in Buller Gorge between Inangahua and Murchison. SH73 blocked by slips in Otira Gorge at Deception Point and Kelly's Creek.

Date: 10-12 March 1967.

Cause: Rain (Blackball 175mm in 24hrs/Hokitika – 166mm in 48hrs).

Effects: Upper and Lower Buller Gorges (SH6) closed due to slips.

Date: 7-9 April 1967.

Cause: Rain (Harihari – 172mm/Kaniere – 171mm/Greymouth – 118mm in 24 hrs).

Effects: Slips closed the Mitchells-Kumara road. Minor slips on SH6 at Fox River and in the Buller Gorge, and on SH73 in the Otira Gorge. Both highways remained open.

Date: 26-27 April 1967.

Cause: Rain (stormy weather for a week).

Effects: Slips closed SH6 at Clarke's Bluff, south of Lake Wahapo, between Inangahua Junction and Westport (Buller Gorge), and at Solitude Stream between Haast township and the pass. Slips also blocked the road between Tiroroa and Rahui, the Lewis Pass (SH7) near the summit, and the Midland Rail line at Deception Point near Otira.

Date: 2-4 July 1967.

Cause: Rain (Franz Josef – 254mm in 22hrs/Inangahua – 76mm).

Effects: A few minor slips in the Buller Gorge.

Date: 16-17 November 1967.

Cause: Rain (Greymouth – 222mm in 12 days. 12 days successive rain over region).

Effects: Telecommunications cut by a slip at Deception Point.

Date: 17-18 January 1968.

Cause: Rain (Greymouth – 54mm overnight).

Effects: Numerous minor slips closed the Blackball – Brunner road for a couple of days.

Date: 29 February 1968.

Cause: Rain (heavy overnight rain).

Effects: Several slips blocked the Midland Rail line in the Jackson's-Aickman's area. Near Mitchell's a large slip (and washouts) closed the road.

Date: 9-10 April 1968.

Cause: Rain (the 'Wahine Storm')

Effects: Many slips in Greymouth, Cobden and Runanga. Mudflow (water and silt) wrote off the Brighton Coal Mine, as it swept away all buildings and plant. Rail way severely damaged by slips in the Ahaura – Totara Flat area. All of rail track at the end of the Kaimata Tunnel slipped into the Grey River.

Date: 6 May 1968.

Cause: Rain (Greymouth – 31mm/Karoro – 29mm in 24hrs).

Effects: Slips produced by the April event were re-activated although little damage reported.

Date: 11-13 August 1968

Cause: Rain (Greymouth - 69 mm in 24hrs.)

Effects: Upper and lower Buller Gorges closed due to slips – probably re-activation of Inangahua Earthquake slips. A number of slips in the Lake Wahapo area but roads remained open.

Date: 22-23 October 1968.

Cause: Rain (Otira – 201mm/Milford Sound – 220mm/Greymouth – 51mm).

Effects: Minor slips on road and rail links in the Grey District – cleared quickly. Rain re-activated Inangahua Earthquake slip at the Cascade Mine and blocked Cascade Creek. Creek backed up and flooded mine causing considerable damage to plant (\$2 000). Bins, compressor electric pumps and other equipment lost.

Date: 28-30 October 1968.

Cause: Rain (peak of a stormy week, beginning above).

Effects: Many roads around Westport cut by slips (and floodwaters), as were rail links.

Date: 13 April 1969.

Cause: Rain (Inchbonnie – 168mm in 24hrs).

Effects: Country roads in the Grey District affected by minor slips.

Date: 15-16 June 1969.

Cause: Rain.

Effects: Slips on Blackball-Taylorville road but remained open.

Date: 6-8 September 1969.

Cause: Rain (Fox Glacier. – 297mm/Franz Josef – 341mm/Harihari – 267mm in 24 hrs)

Effects: Major slip at junction of Hokitika and Whitcombe rivers covered the water level recording site and completely blocked the river. Many roads throughout Westland closed by slips (and floods).

Date: 9-10 March 1970.

Cause: Rain.

Effects: Slips halted traffic in the upper Buller Gorge.

Date: 28-31 August 1970.

Cause: Rain (Grey Catchment – 152mm in 6 days/Hokitika – 122mm in 24hrs).

Effects: Slips blocked rail links in the Otira Gorge, at Aicken's Railway Station (Midland Rail line) and between Greymouth and Westport. Slips also closed roads in the Buller Gorge (SH6) and the Westport – Cape Foulwind road.

Date: 17 September 1970.

Cause: Rain (prolonged period).

Effects: Most major highways affected by slips and flooding). Lower Buller Gorge (SH6) closed by slips and floods.

Date: 2-3 October 1971.

Cause: Rain.

Effects: Reactivated massive slip from the 1968 Inangahua Earthquake and blocked Buller River in Upper Gorge. River took two days to breach dam – flood washed away machinery at Coal Creek culvert, and Bailey Bridge at Ohika (nui?) was submerged.

Source: Johnston 1971.

Date: 7-8 October 1972.

Cause: Rain (Karoro – 325mm in 3 days).

Effects: Two large slips closed SH7 in the upper Totara Valley and at Stillwater.

Date: 2-3 October 1973.

Cause: Rain (heavy in South Westland).

Effects: Major slip blocked SH6 between Grave Creek and Breccia Creek (near Haast), and a smaller slip blocked the road near Fox Glacier.

Date: 14-15 April 1974.

Cause: Rain (torrential –short lived rain storm).

Effects: Slips occurred over much of the Coast. Three people were killed and one was injured, as they were caught in mudslide at Lake Daniels, near the Lewis Pass.

Date: 19-24 July 1974.

Cause: Rain.

Effects: Massive slip in the Buller Gorge at Wales Creek reduced traffic to a single lane.

Date: 24 February 1975.

Cause: Rain (heavy rain for 2 days in Weheka Hills).

Effects: Slips on SH6 in the Weheka Hills between the glaciers.

Date: 29-31 March 1975.

Cause: Rain (Westport – 80mm/Buller Gorge – 130mm/Greymouth – 108mm in 24hrs)

Effects: SH6 (Lower Buller Gorge road) covered by many slips – Westport to Inangahua section closed for 36 hours. Slips (and washouts) also closed SH6 between Greymouth and Westport, and damaged SH7 between Reefton and Springs Junction. Extensive slips in the Weheka Hills (SH6) reduced traffic to a single lane at Hende's Creek bridge.

Date: 2 April 1975.

Cause: Rain (Mai Mai –177mm in 24hrs).

Effects: Otira Gorge road (SH73) blocked by numerous slips and washouts.

Date: 26-27 January 1976.

Cause: Rain.

Effects: Small slips on SH6 between Westport and Greymouth and on SH73 in the Otira Gorge.

Date: 6 December 1976.

Cause: Rain (Greymouth – 58mm in 24hrs).

Effects: A slip on the Ten Mile Valley road.

Date: 27-28 December 1976.

Cause: Rain (Greymouth – 139mm in 24hrs).

Effects: Slip at Omoto reduced traffic to single lane.

Date: 18-19 January 1977.

Cause: Rain (Greymouth – 150mm in 24hrs).

Effects: Slips blocked the Midland Rail line at Kaimata, and the rail line between Tiroroa and Westport.

Date: 3 May 1977.

Cause: Rain.

Effects: Milton Road (Greymouth) had up to 30cm of rock debris and wood deposited across it, being brought down from the hillside above.

Date: 18-20 January 1978.

Cause: Rain (Greymouth - 114mm in 24hrs).

Effects: Minor slips hindered traffic on SH6 between Hokitika and Haast.

Date: 26-29 March 1978.

Cause: Rain (Haast- 61mm/Greymouth 91mm in 24hrs).

Effects: South Westland isolated by slips in the Weheka Hills and at the Gates of Haast (SH6). SH73 cut by slips west of Jackson's.

Date: 13-14 April 1978.

Cause: Rain (Greymouth – 210mm in 12hrs).

Effects: SH6 north and south of Greymouth blocked by slips (and flooding). Numerous slips cut rail links. Sawyers Creek blocked by a large slip, dammed up and flooded large area of Greymouth.

Date: 12-13 May 1978.

Cause: Rain.

Effects: Minor slips on roads and Rail in the Otira area. Slips near Fox Glacier caused most trouble on roads.

Date: 14 October 1978.

Cause: Rain (Paringa - 140mm in 24hrs.)

Effects: Major slips blocked SH6 at the Gates of Haast and at the Haast Pass summit. At Knights Point (Near Lake Maporika) slips reduced traffic to a single lane.

Date: 6-7 May 1979.

Cause: Rain (2 days of heavy rain).

Effects: SH67 closed by slips, as was SH6 at Meybille Bay (Buller), and at Knights Point (South Westland).

Date: 1 October 1979.

Cause: Rain (Otira – 175mm/Franz Josef – 182mm/Fox Glacier – 187mm in 24hrs).

Effects: Minor slips closed some highways throughout the region for a short period.

Date: 3 December 1979.

Cause: Rain (Otira – 254mm overnight/Upper Mai Mai – 110 in 24hrs).

Effects: Major slips in a 1.5km stretch of road closed SH6 between Ninety Foot Falls and the Gates of Haast. Hills on either side of the Gates of Haast bridge slid into the river. Slips also blocked the Otira Gorge road (SH73) and the Buller Gorge rail line.

Date: 21 May 1980.

Cause: Rain (Otira – 152mm/Franz Josef – 105mm/Fox Glacier – 100mm in 24hrs).

Effects: Minor slips on SH73 at Bluff Creek, 6km west of Otira but road remained open.

Date: 15-18 August 1980.

Cause: Rain.

Effects: Slips blocked SH6 at Mt Hercules and at Ninety Foot Falls near Haast.

Date: 28 November 1980.

Cause: Rain.

Effects: Numerous Westland roads covered by slips. Slips covered SH7 at Omoto, and SH6 at Ten Mile – remained open.

Date: 21 March 1981.

Cause: Rain (Kaniere – 135mm in 1.5hrs).

Effects: Dorothy Falls Road (Lake Kaniere) closed by slips.

Date: 29 April 1981.

Cause: Rain (Otira – 79mm/Hokitika – 72mm/Greymouth – 39mm in 24 hrs).

Effects: Minor slip damage in the Buller region – slips occurred around the Deep Creek area near Inangahua, and many slips reported from the Inangahua Junction and Ngakawau areas. Flood in Deep Creek was attributed to landslide dammed lakes (from the Inangahua Earthquake), breaching: a wall of water came down the creek damaging the road bridge, then a second wall of water 15 minutes later took the whole bridge away.

Date: 20 September 1981.

Cause: Rain.

Effects: Minor slips in the Kaimata area and near Cobden Quarry – No road or rail damage.

Date: 3-6 October 1981.

Cause: Rain (Otira – 197mm in 24 hrs).

Effects: Midland Rail line blocked by slips between Kaimata and Kotuku. “*Many disruptive slips in the area*”.

Date: 22-23 January 1982.

Cause: Rain (Otira - 104mm in 24hrs).

Effects: Slip closed SH73 in the Otira Gorge. Massive slip at Goat Creek almost totally buried the road bridge.

Date: 26-27 January 1982.

Cause: Rain (Otira – 252mm in 24hrs).

Effects: SH6 closed by numerous slips between Haast and the Glaciers. Slips closed SH73 near Deception Point.

Date: 10-12 March 1982.

Cause: Rain (Franz Josef – 350mm in 13hrs and 650mm in 3 day total).

Effects: Numerous slips closed Haast Pass (SH6).

Date: 20 May 1982.

Cause: Rain (Otira – 80mm in 6hrs and 127mm in 24 hrs).

Effects: Slips affected SH6 south of Whataroa – no serious damage.

Date: 2 December 1982.

Cause: Rain (Greymouth - 84mm in 24hrs).

Effects: Numerous slips in Greymouth. Slip on Cobden Hill blocked SH6; SH7 and the Midland Rail line were also blocked by slips.

Date: 25 December 1982.

Cause: Rain.

Effects: Midland Rail line blocked by slips and washouts in three places between Jackson's and Otira.

Date: 9-10 March 1983.

Cause: Rain (Haast – 181mm/Franz Josef – 148mm/Hokitika – 44mm in 24hrs).

Effects: Slip debris at Bullock Creek near Fox Glacier closed SH6.

Date: 14-15 April 1983.

Cause: Rain (Karamea – 120mm in 24hrs).

Effects: Slips blocked SH6 at Twelve Mile (between Greymouth and Westport) for a short period.

Date: 10 July 1983.

Cause: Rain (Upper Mai Mai - 210mm in 24hrs).

Effects: SH6 closed by subsidence at Meybille Bay, and Upper Buller Gorge reduced to a single lane.

Date: 20-22 October 1983.

Cause: Rain (Otira – 264mm/Franz Josef – 122mm/Greymouth – 62mm in 24hrs).

Effects: Slips closed SH6 at Meybille Bay, and further slips occurred at Rocky Point on SH73.

Date: 17-18 October 1984.

Cause: Rain (Greymouth – 60mm in 24hrs).

Effects: Minor slips on country roads throughout Westland. Slip closed SH73 at Jackson's.

Date: 19-20 December 1984.

Cause: Rain (Okarito – 235mm/Franz – 123mm/Fox Glacier – 145mm in 24hrs).

Effects: Slips closed SH73 at Rocky Point between Jackson's and Kumara.

Date: 14-20 January 1987.

Cause: Rain (Several days of wet weather).

Effects: Slips caused major disruption to transport routes. SH6 closed by slips between Cascade Point and the Ohikanui River and reduced traffic to a single lane between Greymouth and Westport. SH73 closed by slips at Rocky Creek (buried the bridge), Candy's Bend and Bluff Creek. Slips cancelled all trains between Greymouth and Christchurch. On the 20th a major slip destroyed half the Windy Point rail tunnel in the Buller Gorge.

Date: 28-29 January 1987.

Cause: Rain (Rain on already wet catchments).

Effects: Slips blocked SH6 at Red Jacket Creek near Punakaiki. Windy Point rail tunnel again blocked by slips.

Date: 3-4 February 1987.

Cause: Rain (Haast – 110mm/Lake Moeraki – 127mm/Franz J. – 126mm in 24hrs).

Effects: Huge slip nearly killed a man sleeping in a hut in the Copeland River valley. Slip was between 400-500m long and carried the hut into the Copeland River. Buller Gorge rail again closed by slips at Windy Point Tunnel.

Date: 19-20 May 1988.

Cause: Rain (prolonged heavy rain after driest April on record).

Effects: Numerous slips throughout region – 3 slips cut the Westport to Greymouth rail line.

Date: 25 July 1988.

Rain: (Greymouth – 131m in 3 days).

Effects: Rockslide closed SH73 in the Otira Gorge.

Date: 13-14 September 1988.

Cause: Rain (steady rain for 3 days on already saturated catchments).

Effects: Numerous slips throughout region. Slips the SH73 in the Otira Gorge. Slip at Rewanui Mine buried a hut, killing the caretaker. A large slip 300m east of Cobden closed SH7 as it completely blocked the road.

Date: 4-5 October 1988.

Cause: Rain (Falls of over 100mm during night common throughout region).

Effects: Slip closed the Mitchells-Greenstone road for a short period. Slip on the Waipuna road (stayed open). Slip near Inangahua Junction closed the road and SH6 was closed by a slip near Lyell bridge for 3 hours. A small slip on SH6 between Punakaiki and Westport reduced traffic to a single lane.

Date: 28-29 March 1989.

Cause: Rain (Fox Glacier – 122mm/Franz Josef – 110mm).

Effects: Numerous slips throughout the region. Slips closed SH6 in the Weheka Hills between the glaciers and cut telecommunications in the area.

Date: 6-8 March 1989.

Cause: Rain (heavy rain over whole region).

Effects: Minor slips in South Westland and a minor slip in Greymouth on the approach to the Cobden Bridge.

Date: 15-16 December 1989.

Cause: Rain (Cropp River – 627mm/Crooked River – 37mm in about 1.5 days).

Effects: Slip blocked SH6 at Ten Mile, and slips at the Gates of Haast. Minor slips on SH73 in the Otira Gorge. Small rock falls on SH7 at Kamaka and the Greymouth side of the Cobden bridge – both roads remained open.

Date: 28 –29 December 1989.

Cause: Rain (Haast – 215mm/ Franz Josef – 84mm)

Effects: SH6 blocked by numerous slips in the Otira Gorge. Slips on the road between Nine Mile and Kamaka.

Date: 14-16 January 1990.

Cause: Rain

Effects: Minor slips on SH6 between Greymouth and Westport and on SH7 between Kamaka and on the Greymouth side of the Cobden Bridge.

Date: 12 December 1990.

Cause: Rain (Haast – 251mm in 2 days, Hokitika 144mm/Greymouth – 45.9mm/Moana – 90mm in 24hrs).

Effects: Minor slips in South Westland.

Source: Greymouth Evening Star 12/12/90.

Date: 7-9 January 1991.

Cause: Rain (South Westland – 319mm in 24hrs).

Effects: Slips occurred on Franz Josef access road, and slips on SH6 at Clarke's Bluff reduced traffic to a single lane.

Source: Greymouth Evening Star 8/1/91, 9/1/91.

Date: January 1991 (Approx. Timing).

Cause: Rain.

Effects: Slip off Mt Te Kinga blocked Lake Poerua river outlet (see 9 August 1991 event for more details).

Source: Greymouth Evening Star 10/8/91

Date: 1 February 1991.

Cause: Rain (Crooked River - 200mm in 24hrs and 44mm in 1hr. More than twice average January rainfall over the region. Hokitika – 555mm – highest since January 1866).

Effects: Greenstone-Mitchell's road closed by two slips – narrowly missed people in a car. Westport earthquakes occurred earlier in the week.

Source: Greymouth Evening Star 1-2/2/91

Date: 7 August 1991.

Cause: Rain.

Effects: Slips closed SH6 and SH7 for short periods. Slip in the Lewis Pass, and debris on road at Kamaka (SH7). Slips on SH6 in the upper Buller Gorge near Iron Bridge, and in the lower Buller Gorge.

Source: Greymouth Evening Star 8-9-10/8/91.

Date: 9 August 1991.

Cause: Rain.

Effects: Continued slipping of landslide from the above event dams and blocks the Lake Poerua outlet at the side of Mt Te Kinga. Don Bills, the local farmer, thinks the main slide came down in heavy rains in January 1991. Backup water floods farm.

Source: Greymouth Evening Star 10/8/91.

Date: 19-20 August 1991.

Cause: Rain.

Effects: Slips on the 19th closed SH6 in the Buller Gorge near the Inangahua Earthquake slip. About 10 000m³ covered the roadway. Further slips occurred overnight.

Source: Greymouth Evening Star 19-20/8/91.

Date: 22 December 1991.

Cause: Rain (heavy for several days).

Effects: Debris flow at Little Wanganui subdivision. Occurred at 4:00a.m. Block of sandstone about 2 500m³ broke away from main cliff with intersection of secondary cliff. Resulting debris flow flattened bush on the talus slope below and individual boulders (up to 1m diameter) rolled to the base of the slope.

Source: Power and Anderson 1992.

Date: 30 December 1991.

Cause: Rain (localised downpour in Granity/Hector area, 50mm in a very short time)

Effects: Slip blocked SH67, 20km north of Hector, stranding hundreds of holidaymakers in the Karamea area. The slip also damaged the Hector and Nakawau water supplies, contaminating them for two days.

Source: Greymouth Evening Star 31/12/91.

Date: 24 February 1992.

Cause: Rain (50-80mm in Alps overnight).

Effects: SH6 at Lake Ianthe reduced to a single lane due to overnight slip.

Source: Greymouth Evening Star 24/2/92.

Date: March 1992.

Cause: Rain

Effects: Karamea River blocked by slips

Source: W.C.R.C. File 951000.

Date: 30 March 1992

Cause: Rain.

Effects: Minor slips in the Otira Gorge. Lake Coleridge earthquake occurred later in the day – not considered responsible for slips.

Source: Greymouth Evening Star 30-31/3/92.

Date: 29-30 December 1992.

Cause: Rain (Hokitika catchment – 260mm in 18hrs).

Effects: Slip damaged the Callery footbridge – hit the anchor point. Rockfall closed the access road to Fox Glacier.

Source: Greymouth Evening Star 29-30/12/92.

Date: 19 January 1993.

Cause: Rain (Tropical Storm – 326mm in ranges overnight).

Effects: SH73 road bridge and Midland Line rail bridge buried under 3 000m³ of shingle at Rocky Creek, and Griffins Creek (between Jackson's and Kumara) was diverted across SH73 by a slip (i.e. debris flow across road). Slips also closed SH6 at Havelock Creek and in the Weheka Hills between the glaciers.

Source: Greymouth Evening Star 19/1/93.

Date: 26 January 1993.

Cause: Rain (Haast – 120mm/Whataroa –140mm in 24hrs, coupled with 242mm and 227mm the previous week, Havelock Creek catchment – 173mm in 18hrs).

Effects: Slips closed SH73 and SH6. Rockfall in Otira Gorge (SH73) above Wallace's Ridge closed road, and slips at Mt Hercules, Harihari, Kiwi Jacks, and the Haast Pass closed SH6.

Source: Greymouth Evening Star 26/1/93.

Date: 5 February 1993.

Cause: Rain (Haast – 284mm/Hokitika backcountry – 237mm in 24hrs).

Effects: Rock slip on SH6 at Breccia Creek near Haast and small slips on the Fox Glacier access road.

Source: Greymouth Evening Star 5/2/93.

Date: 1 March 1993.

Cause: Rain.

Effects: Slips on the Fox Glacier access road trapped tourists.

Source: Greymouth Evening Star 1/3/93.

Date: 14 June 1993.

Cause: Rain (Buller area - 200+mm, Haast - 300mm, Grey Valley – 181mm in 24hrs).

Effects: Slumping on SH67 near the Mohikinui end of Karamea Bluffs, and rockfalls on the bluff road. Minor slips on the road to Denniston.

Source: Greymouth Evening Star 14/6/93.

Date: 6 October 1993.

Cause: Rain (Styx River – 533mm/Franz Josef – 418mm in 24hrs. Cropp River Basin 800mm in 1 day).

Effects: “*Trail of debris, slips, scouring*” SH6 closed between Haast and Hokitika overnight due to slips, debris and scouring. Slips and rockfalls elsewhere.

Source: Greymouth Evening Star 6/10/93.

Date: 3 December 1993.

Cause: Rain (Greymouth – 49.6mm in 24hrs)

Effects: Minor slips on West Coast roads. No major problems.

Source: Greymouth Evening Star 3/12/93.

Date: 5 January 1994.

Cause: Rain (Collier's Creek - 231mm/Inangahua – 171mm/Waipuna – 129mm in 24hrs).

Effects: 70m long slip closed SH6 at Seventeen Mile between Greymouth and Westport, and slips closed SH7 between Greymouth and Reefton.

Source: Greymouth Evening Star 5/1/94.

Date: 9-10 January 1994

Cause: Rain (Hokitika – 210mm over weekend/Hokitika Gorge – 523mm on Saturday & 340mm on Sunday)

Effects: Numerous slips throughout region. Slip covered rail line at Arahura. Slip blocked SH73 at Reid Falls in the Otira Gorge. SH6 closed by slips at Brewery Hill and Fourteen Mile, between Fox Glacier and Haast. SH6 between Haast and Wanaka closed for three weeks due to slips (and flood damage). Many slips on roads around Lake Brunner, Taramakau Settlement, and Mitchell's. In Greymouth a slip on Power Road in Greymouth came down between two houses, and a slip on Eassons Hill closed Alexander Street. Minor slips occurred around Cobden Hill (SH6) and at the Greymouth side of the Cobden Bridge at Auto Diesels (SH6-7 intersection).

Source: Greymouth Evening Star 9-10-11/1/94.

Date: 23-24 January 1994.

Cause: Rain.

Effects: Slip closed Franz Josef Glacier access road, trapping 5 vehicles in the flooded Waiho valley. SH6 blocked at Havelock Creek – bridge buried under 1000s of tonnes of gravel, and by slips at Pivot Creek and Wilson's Creek – bridge at Pivot Creek buried under 2m of gravel.

Source: Greymouth Evening Star 24/1/94.

Date: 7 November 1994.

Cause: Rain (Hokitika – 589mm/Styx – 565mm/Haast – 296mm/ Inangahua Landing – 159mm in 56 hrs).

Effects: Minor slipping caused minimal damage to roads in the region. Slip on Haupiri Road.

Source: Greymouth Evening Star 7/1/94.

Date: 22 November 1994.

Cause: Rain (Prolonged period of heavy rain- 3rd heavy rain warning in a week).

Effects: Despite wide spread flood damage, slip damage was minimal. Slip took out power pole at Okarito.

Source: Greymouth Evening Star 21-22/11/94.

Date: 23 February 1995.

Cause: Rain (“*substantial localised downfall*”).

Effects: Several landslips in the Nikau/Hector area. At least two houses damaged and the road was closed for 24hours due to slip material from several gullies

Source: Lowe 2001.

Date: 28 March 1995.

Cause: Rain (heavy showers for a week).

Effects: Oparara Road closed as culverts were buried with debris from creeks draining hillsides (and washouts).

Source: Greymouth Evening Star 28/3/95.

Date: 7 September 1995.

Cause: Rain (Greymouth – 107.5mm in 24hrs).

Effects: Major slipping at properties in Lydia Street in Greymouth, adjacent to Grandjeans Creek

Source: Lowe 2001.

Date: 26 September 1995.

Cause: Rain (Harihari –200mm in 3 days).

Effects: Slip on SH7 at Kamaka, and SH73 blocked by fallen trees at Kumara.

Source: Greymouth Evening Star 26-27/9/95.

Date: 13 December 1995.

Cause: Rain (Fox Glacier – 592mm/Franz Josef – 568mm/Paringa - 508.5mm in 24hrs).

Effects: Slips closed SH6 at Boulder Creek (near Paringa), on the Fox Hills, and at Whataroa and Haast. Slip on the Fox Hills took out the power lines.

Source: Greymouth Evening Star 13-14/12/95.

Date: 1-2 October 1996.

Cause: Rain (Hokitika 81.8mm in 24hrs).

Effects: Slips closed SH73 at Yorky's Point in the Otira Gorge and at Rocky Point, and a slip partially blocked SH7 at Kamaka. Train was derailed by a slip between Rotomanu and Moana.

Source: Greymouth Evening Star 2/10/96, 3/10/96.

Date: 13 October 1996.

Cause: Rain (Moana 128mm, Karamea 68mm, Greymouth 67.7mm, Hokitika 100mm in 24hrs).

Effects: Three small slips on road between Eight Mile and Twelve Mile. Slips and flooding caused \$40 000-60 000 damage to roads in the Grey District.

Source: Greymouth Evening Star 14/10/96.

Date: 11 – 13 February 1997.

Cause: Rain (Greymouth - 109.3mm/Rapahoe – 160mm/Otira – 257mm in 24hrs).

Effects: Rotomanu School closed due to debris brought down by floodwaters, and debris on the road between Rotomanu and Inchbonnie. SH6 between Greymouth and Westport

down to single lane due to slips. Significant slips occurred in the Ten Mile Valley off the Coast Road.

Source: Greymouth Evening Star 11-12-13/2/97.

Date: 20 May 1997.

Cause: Rain (heavy in South Westland).

Effects: Slip blocked SH6 at Mt Hercules.

Source: Greymouth Evening Star 20/5/97.

Date: 15-16 December 1997.

Cause: Rain.

Effects: Mudslide at Blackball destroyed a house: lady swept outside and under the floor boards – received a broken leg. Husband struggled out of debris to rescue her. Slip at 23 Lydia Street, Greymouth damaged land, garage and paths.

Source: Hannon and Seddon Ltd 1999 (Letter to the WCRC). Greymouth Evening Star 16/12/96.

Date: December 1997.

Cause: Rain (Heavy).

Effects: Landslip closed car park at Franz Josef Glacier.

Source: Greymouth Evening Star 29/12/97.

Date: 28 December 1997.

Cause: Rain (Heavy).

Effects: Rockfalls closed Franz Josef Glacier access road – rockfalls occurred on a landslip near the car park.

Source: Greymouth Evening Star 29/12/97.

Date: 6-9 March 1998.

Cause: Rain (Colliers Creek –567mm/Haast – 403.5mm in 3 days/Paringa – 451mm in 4 days/Greymouth - 107.4mm in 24hrs).

Effects: Major slip damage to roads throughout the region. Worst affected area was on SH73 between Turiwhati and Donegals: Every creek in this stretch filled with gravel and overflowed - 8km section of road closed between Friday (6th) and Sunday (8th) as much of it was covered in shingle brought down by the creeks off the hillsides – gravel 1.5m deep over Grahams Creek bridge. 60m long section of SH69, 1km north of Inanagahua slumped out of line. The Old Christchurch Road between Turiwhati and Arahura was closed due to slips and washouts. Much damage to farms with creeks depositing debris over paddocks.

Source: Greymouth Evening Star 7 –9 –10/3/98.

Date: 29 March 1998.

Cause: Rain (Tail end of Cyclone Yali).

Effects: Slips blocked SH73 at Kelly's Creek and Nellies Creek; " *Around 500 cubic metres of debris covered the road with another 200 cubic metres blocking part of the*

high way at nearby Rocky Creek". Rockfall closed the highway at Candy's Creek in the Otira Gorge

Source: Greymouth Evening Star 30/5/98, 31/5/98.

Date: 1-2 July 1998.

Cause: Rain (Greymouth – 118mm in 24hrs).

Effects: Slip restricted traffic to single lane on SH7 in Grey Valley. Slips also closed two sections of SH67 north of Hector, reduced traffic to single lane on SH73 at Rocky Point. Mud flow (runoff from a landslide) entered half a dozen houses at Hector – 7mm of mud in houses. Third time in last 6 years in one house.

Source: Greymouth Evening Star 1-2/7/98.

Date: 20 October 1998.

Cause: Rain (heavy for days).

Effects: Slips closed SH67 in the Karamea Bluffs.

Source: Greymouth Evening Star 20/10/98.

Date: 27 –29 October 1998.

Cause: Rain (Harihari – (180mm in 13.5hrs (40mm in last hour), 50mm in Buller area).

Effects: SH67 closed by slips at Nikau/Granity, Mokihinui and Karamea Bluffs. Slips on SH67 near Mohikinui but road remained open. SH73 closed by slips near Rocky Point. Slip on SH6 at Windy Point – remained open.

Source: Greymouth Evening Star 27-28-29/10/98.

Date: February 1999.

Cause: Rain.

Effects: Slip at 23 Lydia Street reactivated. House had to be evacuated.

Source: Hannon and Seddon Ltd 1999 (Letter to WCRC).

Date: 1 November 1999.

Cause: Rain.

Effects: Debris flow in Poerua River valley. Heavy rain washed debris off Mt Adams landslide: 20% of McKenzie's farm taken out of production by silt and rubble on paddocks. Trees and rubble brought down the valley damaged river protection works and threatened 10 farms downstream, as well as the highway bridge. Rick Lowe (West Coast Regional Council), estimated 2 000 000m³ of slip material had moved from the landslide in the last month.

Source: Greymouth Evening Star 2/11/99.

Date: 17 November 1999.

Cause: Rain (Haast lowlands – 149mm/Haast mountains – 450mm in 24hrs).

Effects: 2 slips on SH6 at Evan's Creek and the neck of Haast Pass.

Source: Greymouth Evening Star 17/11/99.

Date: 24 January 2000.

Cause: Rain (Greymouth – 162.6mm in 24hrs).

Effects: Substantial slips in the southern part of Greymouth. Large slip at the back of Arnott's Heights (Grandjeans Creek): Slip several hundred metres long and 10-15m wide. Threatened house at No. 45. Slip initiated further downhill then regressed towards the house. Grandjeans Creek totally blocked and dammed, causing creek to flow across Perotti Park. Three small slips in Freyberg Terrace, and many others in hillside streets. Greymouth man lucky to escape – in his car and caught in a landslide that carried him and the car 50m downhill, on the first bend at Milton Road. House demolished at Lake Kanieri on the 24th – small hill behind house slipped and pushed the house 10m, wrecking it.

Source: Lowe 2001, Geotech Consulting Ltd 2000, Greymouth Evening Star 25/1/00.

Date: 24 February 2000.

Cause: Rain (Colliers – 352mm in 3 days).

Effects: Landslide demolished a section of a house at Lake Kanieri.

Source: Lowe 2001.

Date: 27 July 2000.

Cause: Rain (Heavy overnight).

Effects: Large rocks tumbled down and shut the two main highways out of Greymouth. SH73 between Otira and Jacksons was closed and rockfalls closed the Otira Gorge (SH73). *“An excessive amount of rock had come down onto the road between Candy's Bend and Starvation Point...Torrential rain caused the slipping.”* A large slip blocked SH6 near Granity Creek, and two major slips blocked SH6 through the Buller Gorge.

Source: Greymouth Evening Star 27/7/00, 28/7/00.

Date: 30 September 2000.

Cause: Rain.

Effects: Slip in Whitcombe Valley above the Colliers Swing bridge.

Source: Greymouth Evening Star 30/9/00.

Date: 27-28 December 2000.

Cause: Rain (Franz Josef 130mm in 12-18hrs).

Effects: Slip closed SH6 at Diana Falls (Haast Pass).

Source: Greymouth Evening Star 28/12/00.

Date: 6 February 2001.

Cause: Rain.

Effects: Turiwhati Creek burst its banks and a debris flow covered the road (SH73).

Source: Greymouth Evening Star 7/2/01

Date: 22 November 2001.

Cause: Rain (Greymouth – 116mm in 24hrs and 360+mm in 8 days).

Effects: Section of SH6 on Cobden Hill slipped, sending debris onto railway line below.

Source: Greymouth Evening Star 22/11/01.

Date: 5-6 December 2001.

Cause: Rain (South Westland - 500 to 800mm in 7 days/ Franz Josef – 160mm in 24hrs).

Effects: Large slip blocked SH6 at Knights Point. Slip blocked SH73 at Turiwhati.

Source: Greymouth Evening Star 6/12/01.

Date: 2-3 January 2002.

Cause: Rain (Greymouth 56mm in 24hrs – much fell during spectacular thunderstorm overnight, Arthurs Pass area –200mm in first 3 days of January.)

Effects: Massive landslide at Langridge's farm at Taramakau Settlement. Slip began around 1 000m up Mt Smart and lasted less than 10 seconds, covering 350m of the farm. Lost stock and 4ha of land. The farm was saturated with 800-900mm in December and a further 600mm in the two days before the slip. Large slip in the Totara River valley threatened road below – started 200m up slope. Slip closed SH73 between Jackson's and Kumara.

Source: Greymouth Evening Star 2-3-4/1/02.

Date: 27 June 2002.

Cause: Rain (described as a 'cloud burst' in northern Buller).

Effects: Police evacuated 9 houses along Back Road (Granity), when heavy rain caused a slip to open up the hillside, diverting flood waters into the back of the properties. A couple of small slips flowed across the Millerton Road, and flood waters deposited debris across SH67.

Source: The Press 28/06/02, 29/06/02.

Earthquake Generated Landslides

Date: 1 September 1888.

Cause: North Canterbury Earthquake.

Effects: Landsliding in the Otira Gorge.

Source: Cowan 1989.

Date: 22 February 1913.

Cause: Westport Earthquake (M>5, MM7).

Effects: Many slips in the Buller Gorge. Slips may have caused a tsunami in the Buller – Karamea area. "*A number of coastal landslides were reported as a result of the earthquake and these may have induced the tsunami, which was restricted to 85km of coast*" (de Lange and Healy 1986). Hendersen (1937) observed a small slip-dammed lagoon in Drysdale Creek, a small tributary of Larry's Creek, near Reefton and concluded it was probably caused by the Westport Earthquake.

Source: Benn 1992 (see original sources in that report).

Date: 9 March 1929.

Cause: Arthur's Pass Earthquake (M7.1, MM8).

Effects: Many very large slips throughout region. SH73 in Otira Gorge blocked by many slips, and rockfalls at Pegleg Creek. The road between Pegleg Creek and Otira

extensively damaged – large sections of edge of the zig-zag road collapsed. Large boulders, many tonnes in weight left impact marks on road where they hit.

Source: Benn (1992), Yang, (1992), Paterson (1996).

Date: 16 June 1929.

Cause: Murchison (Buller) Earthquake (M7.6, MM10-11 in epicentral region).

Effects: Severe slips throughout region, especially in the upper Buller Catchment (now in Tasman District). Many rivers (including major rivers such as the Buller and its tributaries) blocked by slips forming earthquake dammed lakes. Many of these subsequently breached causing post earthquake flood problems. A total of 17 people killed by slips in the Buller and Tasman Districts. In the Buller District 3 large slips killed 6 people in the Maruia River valley and a miner was killed by a falling roof at the Cardiff Coal Mine near Seddonville. A major debris flow occurred at the present site of the Little Wanganui subdivision, near Karamea. A large rotational slip at Whitecliffs near Karamea may have been responsible for a 2.5m high tsunami at Karamea and Farewell Spit (de Lange and Healy 1986). Hillsides around Reefton collapsed, as did the road to Dee Hill. Slips blocked the Blackball – Greymouth road near the cemetery, and there were many slips in the Nelson Creek area. Roof collapses occurred in the Liverpool Mine and Jame's Mine and minor coal falls occurred in the Blackball Mine. At Cobden Quarry 60 000 –100 000 tonnes of rock fell and was thrown nearly 100m. Gravel faces at old mine sites at Kumara collapsed. Large slips occurred on the Stafford Road near Hokitika.

Source: Benn 1992.

Date: 23 August 1943.

Cause: Arthurs Pass Earthquake (M5.5 - 6, MM7)

Effects: Numerous slips around the Otira area.

Source: Benn 1992.

Date: 10 May 1962.

Cause: Westport Earthquake (M5.9+, MM Unknown).

Effects: Slips at Omoto.

Source: Benn 1992.

Date: 24 May 1968.

Cause: Inangahua Earthquake (M7.1, MM10)

Effects: Hundreds, possibly thousands of slips throughout region. Buller District and Buller Gorge severely affected. All roads around Inangahua blocked by slips. Slip killed a person at Whitecliffs in the Buller Gorge. Massive slip blocked the Buller River 3km upstream from Lyell. Material came down from 600m on south side and deposited 50m high up north side, completely blocking the river and forming a large lake. Lake breached next day causing little flood damage. This slip totally destroyed road (SH6) and rail links through the gorge. Falling boulder hit and disabled a locomotive on the Midland line at Deception Point, and numerous slips blocked the line between Kokiri and Moana. Slips also blocked the rail lines between Hokitika and Ross, and the Rewanui line.

Source: Benn 1992.

Date: 29 January 1991.

Cause: Westport Earthquakes (M6 and M6.1. Two distinct shocks).

Effects: Major slip (80m long) blocked SH6 at Tiroroa, along with numerous slips in the Buller Gorge. Slips occurred on the Blackball – Stillwater road and in the Taramakau area. Power and Anderson (1992) record rock falls at Little Wanganui – a slab of rock between 2-5m³ fell from near the top of the cliff above Nikau Heights. Largest intact blocks about 1 x 0.6m rolled downslope further than smaller blocks.

Source: Benn 1992, Power and Anderson 1992.

Date: 15 February 1991.

Cause: Westport Earthquake (M5.8).

Effects: Minor rockfalls in the Buller Gorge.

Source: Benn 1992.

Other or Unknown Generation of Landslides

Date: 1908 (Day-Month unknown).

Cause: “*Spontaneous*” (Hendersen 1937)

Effects: Landslide on the south bank of the Buller River, at Lyell completely dammed the river for more than a day.

Source: Hendersen 1937.

Date: 1930 (Day-Month unknown)

Cause: Unknown.

Effects: Landslide blocked Callery River for a day. When dam breached it caused an extremely high flood at Franz Josef and river channel problems. No rain or earthquake recorded.

Source: Davies and Scott 1997.

Date: 1930's (Day, Month, Year unknown).

Cause: Goldminer undercutting talus slope.

Effects: Small shallow slip on talus slope at Little Wanganui subdivision area.

Source: Power and Anderson 1992.

Date: 1947 (Day and month unknown).

Cause: Unknown.

Effects: Portion of cliff at Little Wanganui subdivision broke off at the southern end – now forms the talus slope at the southern end of the cliff.

Source: Power and Anderson 1992.

Date: 1982 (Day, Month, Year unknown).

Cause: Unknown.

Effects: First in a series of major slips to affect Mt Adams (noted by Mrs McKenzie – long time resident near the mountain).

Source: Greymouth Evening Star 26/8/97.

Date: 28 July 1995.

Cause: Ground subsidence due to weight of mine overburden.

Effects: Over burden from the Wellman Creek Coal Mine caused the ground to subside, causing a huge quantity of overburden material to suddenly collapse. Material seriously polluted Wellman Creek and Inangahua River.

Source: WCRC Resource Consent File 94-001.

Date: August 1996.

Cause: Subsidence and ridge top failure

Effects: Landslides associated with ridge top failure in the Doherty Creek coal mining area (Strongman No.2).

Source: Yetton (1999).

Date: 23 August 1997.

Cause: Unknown (An earthquake of M5.1 was recorded in Blenheim – not sure of influence)

Effects: Major slip on the face of Mt Adams. Silt build up in the Poerua River was very rapid, swamping a tractor.

Source: Greymouth Evening Star 26/6/97.

Date: 25 August 1997.

Cause: Unknown.

Effects: Another slip on Mt Adams – larger than one above. *“A lot of trees and debris are stopped at the gorge...fortunately the narrow gorge governs the flow and slows things down”* (Rick Lowe, Operations Manager, WCRC). Mrs McKenzie from the farm below Mt Adams said slips had been coming down the mountain for about a month.

Source: Greymouth Evening Star 26/8/97.

Date: 1997 – July 1998.

Cause: Unknown.

Effects: Strongman No.2 mine plan notes rockfalls and flooding within mine drives.

Source: Yetton 1999.

Date: 27(?) August 1998.

Cause: Combination of factors.

Effects: Large rockfall in Strongman Mine No.2 panel *“ ..due to the size of the fall, the disruption to the surface was considerable, particularly along the escarpment of Doherty’s Creek... ”*.

Source: Yetton 1999.

Date: 23-25 September 1998.

Cause: Rain and past mining activities induced debris flow.

Effects: Landslide formed a dam and blocked Doherty Creek on the 23rd – 24th (estimated at least 300 000m³), and burst on the 25th. Caused much damage to channel of Doherty Creek and Ten Mile Creek. Destroyed culvert across Doherty Creek including access to United Mine loading bin. Destruction of Harrison and Party Mine's loading facilities at Doherty Creek. Minor secondary landslides generated as result of toe undercutting in Doherty Creek.

Source: Yetton 1999.

Date: 6 October 1999.

Cause: Unknown.

Effects: Massive rock avalanche on Mt Adams in the Poerua River valley. 10-15 million m³ fell from 1800m up the mountain. Debris blocked river by forming a dam 100m high and impounding a lake 1200m long and 80m deep, with volume of 5-7 million m³. Dam breached 6 days later and a state of civil emergency put in place for several hours. Considerable damage to McKenzie's Farm, but little else. Rain and three small earthquakes had occurred in the previous days, although these were not recorded at the actual time of failure.

Source: Hancox *et al.* 1999, 2000, Greymouth Evening Star 6-7/10/99.

Date: 10 August 2000.

Cause: Unknown.

Effects: A single rock, about the size of a football, fell in the Otira Gorge (SH73), killing a construction worker. The accident happened in what was thought to be one of the least likely, and safest places, on the section of road between Candy's Bend and Reid's Falls. The rock fall was independent of construction work activities.

Source: The Press 12/8/2000, Greymouth Evening Star 19/5/2001.

Date: 18 May 2001.

Cause: Unknown.

Effects: Large boulder fell down Otira Gorge (SH6) at Reid Falls and hit a car, demolishing the car's rear end and narrowly missing a child in the back seat.

Source: Greymouth Evening Star 19/5/01.

Date: 7 December 2001.

Cause: Rain (659.5mm in 18 days at nearby Rapahoe) and previous mine activities.

Effects: Very large slip (1000s of tonnes) opposite Spring Creek Coal Mine. Blocked Seven Mile Creek, and roads to other mines were closed. Slip on SH6 between Nine Mile and Ten Mile reduced traffic to a single lane. *"The prolonged wet spell is thought to have been a contributing factor in the fall, along with past mining operations dating back to Armstrong and Party from the 1920s...The rain ...coupled with the periodic spontaneous combustion of the outcrop barriers of the old mines over may years has lead to long term slope stability problems in the area. A large lateral crack at the top of the cliff was observed two years ago and this is the area from where the material has detached"*.

Source: Greymouth Evening Star 10/12/2001.

APPENDIX 4

LIQUEFACTION EVENTS

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1913 Westport Earthquake.

Liquefaction at:

- Cape Foulwind. 27km from epicentre. Fairless and Berrill (1984).

1929 Murchison Earthquake.

Liquefaction at:

- Three Channel Flat, Inangahua. 23km from epicentre (Berrill *et al.* 1988).
- Keoghan's Farm, Sergeants Hill, Westport. 45km from epicentre (Berrill *et al.* 1988.)
- Little Wanganui. 41km from epicentre (Berrill *et al.* 1988.
- Karamea School. 54km from epicentre (Berrill *et al.* 1988).
- Kongahu Estuary, Karamea. 54km from epicentre (Berrill *et al.* 1988).
- Arapito, Karamea. 52km from epicentre (Berrill *et al.* 1988.)
- Four Rivers Plain, Murchison. 4km from epicentre (Berrill *et al.* 1988.)
- Greymouth Lagoon. 114km from epicentre (Berrill *et al.* 1988).
- Blaketown residence. Cracks 1.2m wide in backyard, water and mud poured in up to 30mm deep in backyard. Precise location unknown (GES 17/6/1929, Benn 1992).
- Paroa residence. Crack in backyard-fountain 6m high. Precise location not known (GES 18/6/1929, Benn 1992).
- Greenstone River. 122km from epicentre. Curious circular rings in mud reported (sand boils). Greenstone river shot 1-1.2m high (GES 20.6.1929, Benn 1992). Significant case as it was the most distant recorded from the Murchison earthquake epicentre - ~19km further south than the Grey Lagoon example (Benn 1992).

- Orowaiti River (near Westport). At Palmer's Farm, cracks in the ground, and in some places ground dropped 300mm or more, with water was being forced up through the cracks (Palmer 1970).

1968 Inangahua Earthquake.

Liquefaction at:

- Three Channel Flat. 10km from epicentre (Berrill *et al.* 1988).
- Nixon's Farm. 12km from epicentre (Berrill *et al.*1988).
- Inwood's Farm, Inangahua. 11km from epicentre (Berrill *et al.* 1988).
- Walker's Flat, Buller Gorge. 12-15km from epicentre (Berrill *et al.*1988)
- O'Conner's Farm, Westport. 30km from epicentre (Berrill *et al.*1988).
- Durkin's Farm, Westport. 32km from epicentre (Berrill *et al* 1988).
- Reedy's Farm, Westport. 33km from epicentre (Berrill *et al.* 1988).
- Kilkenny Park, Westport. 34km from epicentre (Berrill *et al.* 1988).
- Keoghan's Farm, Westport. 29km from epicentre (Berrill *et al.* 1988).
- Ross's Farm, Browns Rd, Inangahua. Near the milking shed, jets of water coming up through ground, nearly 2m high (Benn 1992).

1991 (January) Westport Earthquake

Liquefaction at:

- Nine Mile Beach, Charleston . Sand boils and cracks along beach. Subsidence of beach, especially around large driftwood logs, leaving the logs perched on pedestals of sand (Benn 1992).

APPENDIX 5

SELECTION OF INL DATABASE REPORTS ON CLIMATIC HAZRDS

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SELECTION OF INL DATABASE REPORTS ON CLIMATIC HAZARDS.

Hailstorms

THE PRESS, 27 FEB 2001, Edition 1, Page 4.

Hail sees herons take flight early

By: MADGWICK Paul

The birds have flown early from New Zealand's only white heron colony, near Whataroa, after a hailstorm last month killed 21 chicks.

THE DOMINION, 11 NOV 1997, Edition 2, Page 12.

Plane still missing

SEARCHERS in south Westland found no sign yesterday of a Cessna plane and its pilot, last seen at a Canterbury airfield on Saturday. Searchers said he probably began flying back to his base at Haast; a light plane was seen trying to climb above a southerly hail storm south of the Haast River on Saturday afternoon.

Thunderstorms and Lightning Strike.

STUFF — THE PRESS — WEST COAST — 12 SEP 2000

Telecom fixes phones hit by lightning

By PAUL MADGWICK

The last batch of phones blown out by last week's violent lightning storm on the West Coast have been reinstated.

Telecom contractor Connectel had to get reinforcements from Wellington and Christchurch to cope with about 200 outages, mainly in Hokitika and South Westland. One lightning strike in Hokitika was so violent it split the pillar next to a cable cabinet and melted some of the copper wiring, said Telecom spokeswoman Lisa-Marie Richan. Electricity supplies in the same areas were also cut by a succession of lightning storms on Wednesday and Thursday, and the Hokitika tornado in between. Electronet assets manager Rodger Griffiths said the succession of problems left 934 customers between Arahura and Franz Josef Glacier without electricity for up to six hours on several occasions. All supplies were restored on Friday.

Strong Winds and Tornadoes

*NEW ZEALAND HERALD — news — general — Mar 28 2001
12:11PM*

Tornado targets West Coast township

7.30 am - By BOB COTTON and ALISON HORWOOD

A tornado swept through a small town on the West Coast of the South Island early this morning ripping the roofs off houses, destroying sheds and garages, and cutting power. No one was seriously hurt when the twister hit Cobden, just north of Greymouth, about 4 am, but many were shocked and shaken by the storm, which a police spokesperson said came completely out of the blue.

THE PRESS, 17 JAN 2001, Edition 1, Page 4.

Tornado-like wind leaves Hokitika residents reeling

By: MADGWICK Paul

Several Hokitika businesses were shut and two people were injured when a wet wind storm cut a swathe of damage through the town. The unseasonably cold and sudden gust at about 8.25am yesterday was so fierce some people thought a tornado had hit the town. The wind peeled off part of the roof on the historic Renton Hardware building, exposing two floors of stock to extensive water damage. A house also lost its roof, and sheets of iron and signs were lifted off several other buildings in and around the central business district.

THE PRESS, 8 SEP 2000, Edition 2, Page 3.

Tornado tears path through Hokitika

By: MADGWICK Paul

The tornado hit during a period of squally weather with thunder and lightning and very heavy rain. It was followed by a heavy dumping of hail.

THE PRESS, 8 SEP 2000, Edition 2, Page 3.

Tornado tears path through Hokitika

By: MADGWICK Paul

Hokitika residents were still shaking last night after a tornado ripped through parts of the town, lifting roofs and spinning debris 200m to 300m in the air. Witnesses watched in awe as the twister zig-zagged off the sea and across the Hokitika River towards town about 3.45pm. It tore off at least four roofs and flipped a truck and trailer along the way. Police said it was a miracle no-one was hurt in the havoc.

THE PRESS, 26 JAN 2000, Edition 2, Page 4.

Twisters whip up Coast

GREYMOUTH -- Mother Nature has provided the West Coast with a rare display.

At least five tornadoes were observed from the north of Greymouth south towards Hokitika. All were formed out at sea. Two lasted mere minutes, another headed to South Beach and passed over houses without causing damage. A larger twister entertained motorists and residents at Serpentine before also dissipating.

THE EVENING POST, 16 MAR 1998, Edition 1, Page 2.

Twisters damage township

A mini-tornado caused damage in the West Coast township of Runanga, 8km northeast of Greymouth, yesterday morning. Police said some "small twisters" were seen in one street at 6am. A garage was smashed, trees were uprooted and a glasshouse was smashed. -

Drought

THE PRESS, 19 FEB 2002, Edition 1, Page 4.

Making hay while the sun shines

The West Coast is browning up under a summer of warm temperatures and little rainfall. Tank-water supplies in country areas are drying up, and lawns usually lush with summer rain are starting to burn. Spare milk tankers from Hokitika have been booked with fresh water deliveries to parched rural areas, while the army came to the rescue in Nelson Creek last week when several house tanks ran dry.

THE PRESS, 21 AUG 2001, Edition 1, Page 7.

Friday switch-on for Greymouth water

The Grey District Council will throw the switch on Greymouth's new water supply at a function on Friday. The council has spent \$2.4 million shifting the intake and pipeline from a tidal area of the Grey River to an upstream site at Coal Creek to avoid the saltwater intrusion which has been tainting the town's drinking water. The council fast-

tracked the project when salt levels skyrocketed during a period of low river levels in March.

THE PRESS, 26 MAR 2001, Edition 2, Page 3.

Kaiata man dies collecting water near Greymouth

By: RUSH Christine

Greymouth's water shortage has claimed its first victim after a man gathering water was swept down the Grey River.

THE PRESS, 13 MAR 2001, Edition 1, Page 6.

Faulty, salty water for Greymouth taps

By: MADGWICK Paul

A decent rainfall is needed to beat water-quality problems with the Greymouth town supply as the West Coast endures its driest summer since 1891.

THE DOMINION, 9 MAR 2001, Edition 2, Page 3.

Tankers cart water on West Coast

WATER carters are working overtime as the West Coast basks in one of its driest spells recorded. Greymouth weather recorder Phil Forrest has records dating back to 1891, but none can match the 245 millimetres of rain recorded so far this year. At this stage last year, 607mm had fallen.

Wildfires

THE PRESS, 28 MAR 2002, Edition 2, Page 10.

Rural fire caution

Canterbury and the West Coast are drying out, prompting calls of caution from the regional rural fire committee chairman, Tim Sheppard. The fire risk in scrub had been extreme for some time throughout Canterbury and the West Coast, while readings for grass were medium to high on the West Coast and in Canterbury, and medium to low in South Canterbury.

THE PRESS, 19 FEB 2002, Edition 1, Page 4.

Making hay while the sun shines

The West Coast is browning up under a summer of warm temperatures and little rainfall. With the fire danger rising, rural firefighters have been watching out for flare-ups from a fire that burned through 5ha of scrub in the Coal Creek area on Saturday. Because the ground was so dry the fire was burning 30cm below the surface in places.

THE PRESS, 21 JAN 2000, Edition 1, Page 6.

Fire ban looms for Coast

By: CHRISTIAN Peter

The West Coast looks likely to face a complete fire ban from today even if forecast rain did fall overnight. Rural fire officer Alan Flux said yesterday that the region was facing its driest season on record, and fire danger levels in the Inangahua and Grey Valleys were now extreme. "The district has already experienced 63 rural fires this season, more than Canterbury, Nelson, and Marlborough combined." Mr Flux said that, even if it did rain, as much as 75mm was needed to make any impact. Also of concern was that February was normally the region's driest month, and if the present hot weather continued into that month the region the place would be drier than a chip.

THE PRESS, 1 DEC 1998, Edition 2, Page 4.

Dry weather brings work for firefighters on West Coast

Members of the Cobden Volunteer Fire Brigade battle a blaze on the banks of the Grey River near the Greymouth Harbour entrance. Members of the brigade had their Westland Anniversary holiday cut short yesterday morning as they fought the well-established driftwood and bush fire.

THE PRESS, 7 JAN 1997, Edition 1, Page 4.

Fire ban likely on Coast

GREYMOUTH -- A fire ban may be introduced on the West Coast if the dry weather continues. Yesterday's fire risk ranged from moderate for southern parts to between high and very high in north Westland and Buller. The region has had little rain since before Christmas, and the long-range forecast is for continued fine weather.