

Part Two

PROJECT REPORTS

1903-1990

A summary and archive reference for each of the major engineering works, and unique minor works, which in total form the Hutt River Flood Control Scheme.

Refer to figures in Appendix A for the location of the works. Project reports are indicated by the prefix "PR".

Table of Contents : Project Reports

No.	Date	Description	Page
1.	1901-03	Scheme for Conserving the Hutt River	167
2.	1906	Gear Island protective works contract	169
3.	1933	Stopbank raising Moera section	170
4.	1956-57	Stopbank raising Pipe Bridge to Ewen Bridge	173
5.	1959-60	Melling Diversion Cut - First Stage	175
6.	1960-61	Melling Diversion Channel - Second Stage	178
7.	1960-61	Stopbank raising - Ewen Bridge to Melling	179
8.	1962-64	New stopbank and stopbank raising north of Melling Bridge	181
9.	1964	Melling Diversion Cut - Third Stage	182
10.	1964	Stopbank raising Melling Road to Mills Road	183
11.	1964-65	Haywards Settlement stopbank construction	184
12.	1964-65	Whakatiki Street to Maoribank stopbanking	185
13.	1966-69	Whakatiki Street to Heretaunga Golf Club stopbank	186
14.	1965-66	Flattening stopbank slope at Hutt Valley High School	187
15.	1966-67	Stopbank construction at the drainage channel near Gibbons Street	188
16.	1966-71	Channel realignment between Trentham Memorial Park and the Silverstream Bridge	190
17.	1967	Channel alignment - Hudson Avenue	193
18.	1967	Hutt road channel realignment	194
19.	1968, 1981-83	Totara Park stopbanks	195
20.	1969	Stopbank construction - Boulcott to Mabey Road	197
21.	1971-73	Model study of the River Mouth	198
22.	1972	Maoribank Reserve drainage channel	199
23.	1972	Regrading drainage channel - Clouston Park to Ebdentown Road	200
24.	1972	Regrading the stopbank - Boulcott Golf Club	201
25.	1972	Stopbank reshaping south of Melling Station	202
26.	1972-73	Okoutu Stream (Black Creek) Auxiliary Stopbank	203
27.	1976	Hutt Valley main sewer river crossing Silverstream	204
28.	1980-81	Protection of State Highway 2 Embankment at Te Marua	206
29.	1980-81	Stokes Valley Stream outlet stopbank reconstruction	208
30.	1981-86	Wellington Golf Club - Heretaunga - river control works	210
31.	1981-87	Maoribank groynes and planting programme	211
32.	1981//1988	Protection of stopbank and river bank Alicetown	212
Project Reports			165

			Page
33.	1981, 1989	Te Marua river metal extraction	213
34.	1983-84	Parkdale subdivision stopbank and associated protection works	214
35.	1983/1984	Concrete cycle track facility	216
36.	1983/84	Te Marua Golf Club private works for bank stabilisation and protection	218
37.	1984	Stopbank repair at Woollen Mills (Moera)	219
38.	1984-86	Bank stabilisation trial - Estuary section	220
39.	1984-89	Totara Park bank protection and stabilisation	222
40.	1984, 1990	Pomare Bridge protection and bank stabilisation	223
41.	1984-present	Okoutu Stream outlet improvements	225
42.	1985-86	Bank stabilisation at the Ewen Bridge	226
43.	1985-87	Bank stabilisation - Harcourt and Haukaretu parks	229
44.	1985-88	Stopbank repairs at Croft Grove	231
45.	1985-88	Upper Hutt Bypass - river works	233
46.	1989	Ewen Bridge area temporary stabilisation works	236
47.	1989	Tree removal and stopbank reinstatement at Ewen Park/Melling Reserve	237
48.	1990	Croft Grove point to Black Creek Outlet bench construction and rip-rap placement	239
49.	1985-89	Twin Bridges debris fences, Gillespies Road bank protection and Akatarawa Bridge protection	241
50.	1987-89	Kennedy-Good Bridge protection works	242
51.	1984-87	Trentham Memorial Park bank protection work	243
52.	1984-89	Belmont (right bank) bank protection work	244
53.	1984	Manor Park Golf Course river berm and bank protection	245
54.	1928-1987	Recorded annual extraction volumes Hutt River 1928-1987	246

PROJECT REPORT 1

SCHEME FOR CONSERVING THE HUTT RIVER

Stopbanking from Section 38 at Boulcott to the Harbour

The first stopbanks built by the Hutt River Board, in response to a disastrous flood in 1898. They ran from Boulcott to the Harbour on the left (east) bank and from Melling to the Harbour on the right (west) bank.

Date: 1901-03

Plan Number: Rivers Control Series 13/21/1 and 2

File: Hutt River Board Minutes (held at LHCC Memorial Library)

Location: Refer Appendix A, figures 2-4

Historical Chainage - S/B C/L
Right Bank 0 mi 0 ch to 1 mi 26 ch
Left Bank 0 mi 0 ch to 3 mi 30 ch

Current River Traverse - river C/L:
Right Bank 2020 m to 4034 m
Left Bank 350 m to Boulcott

Reason for Initiation: In 1898 the largest flood for 38 years caused loss of life and major damage in the Boroughs of Lower Hutt and Petone. Public pressure brought about the election in 1899 of a new Hutt River Board which immediately commenced the process of making the Lower Hutt residential area safe from flooding. An engineering consultant was selected on the basis of his previous flood control work in Geraldine, South Canterbury and within months a "Scheme For Conserving The Hutt River" was placed before the Board. The Scheme involved stopbanking on the present stopbank alignment (except for the left bank section rebuilt to accommodate the approaches to the current Melling Bridge), from just south of the present Melling Station to the Petone Stopbank on the right (west) bank and from Hathaway Avenue to Seaview Road on the left bank. The design capacity of the proposed floodway is not recorded, but was probably the estimated discharge of the 1898 flood plus freeboard.

The original proposal showed the right bank stopbank passing to the west of Gear Island (now the Shandon Golf Course) to leave it unprotected and Petone protected only by its own stopbank. Following strong representation from Petone the Hutt River Board was forced to delay and revise this portion of the work to include Gear Island. In order to protect the island it was necessary to block off the branch of the river to the west of the island, at additional cost. Most of the stopbank construction was carried out from 1901-03. Gear Island was protected by a stopbank extension built separately in 1906 and in the same year the Fourth Hutt Bridge was replaced allowing the completion of the Scheme construction.

Design Capacity: Not recorded. Plans show the use of a varying freeboard (between 4 ft (1.2 m) and 7 ft (2.13 m)) above the "largest known flood" - probably the larger flood (of two) in 1898.

Designer: Laing-Meason and Fulton

Construction: John Thomas Jones, Pleasant Point

Supervision: Laing-Meason

Construction Standards: Not recorded

Construction Materials: Shingle from adjacent river beaches was used because of its availability, proximity and ease of excavation by the methods of the day. It is evident that the Engineers considered the river gravels to be adequate for stopbank filling because a well graded material (reasonable fines content) was available.

Construction Equipment: Photographs show horse and dray teams carried gravels to the stopbank and provided compaction by hoof and wheel trafficking. Loading was by hand shovel. One photograph also shows demountable, gravel filled trays being lifted from the drays and tipped using a steam engine. The material was then presumably spread by hand.

Cash Flow:

1901	£400
1902	£9924
1903	£3926

Subsidy: Application declined.

Comments: Cross sections of the original stopbanks are shown on the following plans for later stopbank raising works:

HRB 31/4: Stopbank Raising, Pipe Bridge to Hutt Bridge (Ewen Bridge)

HRB 107: Stopbank Raising, Melling Bridge to Pipe Bridge

HRB 120: Stopbank Raising, Melling to Mills Street

PROJECT REPORT 2

GEAR ISLAND PROTECTIVE WORKS CONTRACT

A stopbank and associated works to protect Gear Island from flooding in the Hutt River

Date: 1906

Plan Reference: Plans identified as RC 13/5 (Wellington Regional Council Rivers Department)

File: HRB Minutes (held in LHCC Memorial Library)

Location: Refer Appendix A, figure 3.
Historical Chainage - S/B C/L
Right Bank 1 mi 26 ch to 2 mi 05 ch
Current River Traverse - river C/L:
Right Bank 1036 m to 2020 m

Reason for Initiation: The stopbank was the final section of the first Hutt River stopbanking Scheme. Refer Project Report 1.

The already completed section of stopbank was continued downstream from Wakefield Street on the current 1990 stopbank alignment to the Estuary Bridge. Drainage from the Dead Arm of the Hutt River (old western channel) blocked off in 1901, was provided by a triple barrel concrete culvert under Waione Street. The culvert is still functioning.

Design Capacity: Not recorded. Plans show 7 ft (2.13 m) above the "largest known flood" - probably the larger flood (of two) in 1898.

Designer: Meason and Fulton

Construction: John Thomas Jones, Pleasant Point

Supervision: Meason

Construction Standards: Not recorded

Construction Materials: As for the 1901-03 works, shingle from adjacent river beaches was used because of its availability, proximity and ease of excavation by the methods of the day.

It is evident that the Engineers considered the river gravels to be adequate for stopbank filling because a well graded material (reasonable fines content) was available.

Construction Equipment: Although construction methods for this work are not recorded it is assumed that the horse and dray teams used to construct the original stopbank were used again here to carry gravels to the stopbank and provide compaction by hoof and wheel trafficking. The drays were loaded by hand.

Subsidy: None

Comments: Refer also to Plan Nos RC 13/21/1, 13/21/2.

PROJECT REPORT 3

STOPBANK RAISING MOERA SECTION

Stopbank raising on the left bank only at Moera

Date:	1933
Plan Number:	HRB 33/2
File:	SSPHRB6 (Engineer's file)
Location:	Refer Appendix A, figure 3. Historical Chainage - S/B C/L: Left Bank 1 mi 00 ch to 1 mi 29 ch Current River Traverse - river C/L: Left Bank 1350 m to 1980 m
Reason For Initiation:	<p>Although the first Hutt River stopbanks (1901-03) were never breached by flood waters, floods in 1915 and 1931 came close to overtopping the banks. Although few technical records from this period survive, it appears certain that the early Hutt River Board intended to protect Hutt residents against the maximum possible flood.</p> <p>A scheme to raise the original stopbanks was proposed in 1931, based on providing a freeboard of 4 ft (1.2 m) above the 1931 flood. It was found necessary to raise the stopbanks from the Estuary Bridge to the Hutt (Ewen) Bridge by 1 to 2 ft (300-600 mm).</p> <p>The work carried out in 1933 represented only about 1/4 of the 1931 proposal. At the request of the Unemployment Board the Hutt River Board reluctantly modified their proposals so that they could be undertaken by hand. It is assumed that the most appropriate section was selected for the first stage. It is not clear why the work was not continued. Possible reasons are Hutt River Board disinterest and the easing of the depression.</p>
Design Capacity:	1931 flood (approx 59,000 cusec (1666 cumec)) level + 4 ft (1.2 m) freeboard.
Designer:	Seaton Sladden and Pavitt
Construction:	Unemployed Relief Workers
Supervision:	Seaton Sladden and Pavitt
Construction Standards:	No construction details are recorded.
Construction Materials:	Graded river gravels from Jorgensen's bend, then a closed bend in the river, and now the outlet channel of the Okoutu Stream (Black Creek). This material was used because of its availability, proximity and ease of excavation by hand. It is evident that the Engineer considered the river gravels to be adequate for stopbank filling because a well graded material (reasonable fines content) was available.
Construction Equipment:	The Engineer's records refer to four horse and dray teams which, as for earlier constructions, would have been loaded by hand and were probably also unloaded by hand on this job.

Compaction was probably expected to be effected by hoof and wheel trafficking. However, it is not known to what degree benching and stripping of topsoil and vegetation were carried out.

Cash Flow: Not recorded

Subsidy: Unemployment Board paid wages only.

Comments: Cross sections of the original stopbank raising proposal are shown on Plan No. HRB 31/4, from which Plan No. HRB 33/2 was derived.

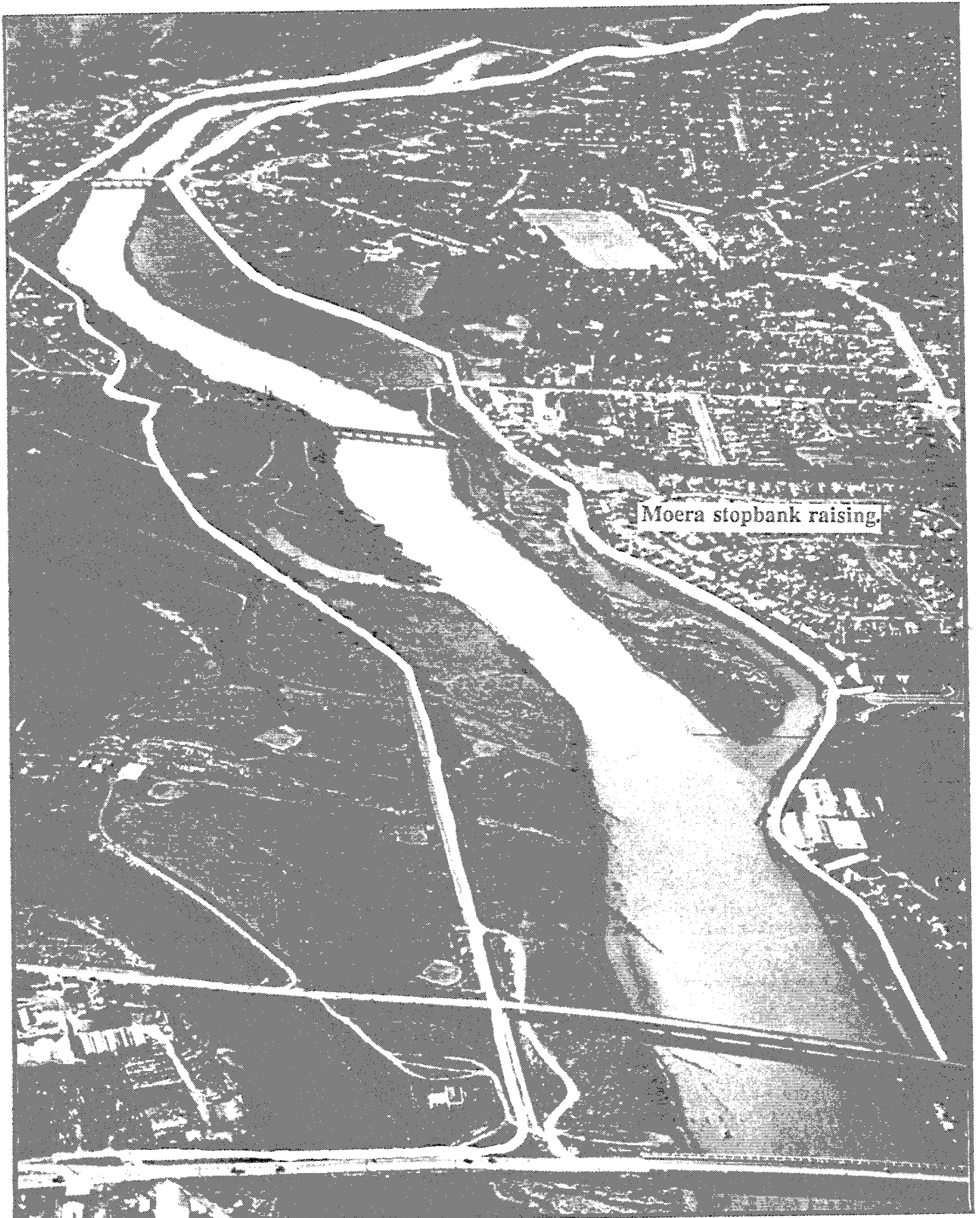


Plate 90: 1956 photo showing the extent of the original stopbanking.

PROJECT REPORT 4

STOPBANK RAISING PIPE BRIDGE TO EWEN BRIDGE

Date:	1956-57
Plan Number:	HRB 48/3
File:	SSPHRB72
Location:	Refer Appendix A, figure 2-3. Historical Chainage - S/B C/L: Right Bank 0 mi 50 ch to 2 mi 06 ch Left Bank 0 mi 48 ch to 2 mi 04 ch Current Traverse - river C/L: Right Bank 830 m to 3105 m Left Bank 800 m to 3140 m
Reason for Initiation:	This stopbank raising work was the first stage in the Hutt River Flood Control Scheme of the 1950s jointly promoted by the Public Works Department and Hutt River Board, and by the Local Councils affected. Refer to Chapter 6 and Archive Table 16.
Design Capacity:	100,000 cusecs (2825 cumecs) with 2 ft (600 mm) freeboard.
Designer:	Seaton Sladden and Pavitt
Construction:	Mr A C Willis with Gaynor Transport Ltd and Olsen Earthworks Ltd
Supervision:	Seaton Sladden and Pavitt
Construction Standards:	Construction was to the standard Seaton Sladden and Pavitt specification (see file 72). This required: <ol style="list-style-type: none">(1) Compaction in horizontal layers not exceeding 12 inches (300 mm) loose depth.(2) Each layer separately consolidated as evenly and densely as possible by operating and distributing construction plant.(3) Top and batter of the existing embankment to be scarified.
Construction Materials:	The Contractor's letter of intention submitted with the tender indicates the intention to use material from the Public Works Dept quarry at Gracefield (probably weathered greywacke). Shingle from the River at Melling was also to be used but "reserved for wet or soft spots in foundations and for keeping access roads open.". Ministry of Works files refer to removal of material from the Ministry of Works Gracefield Quarry for stopbank construction, free of charge.
Construction Equipment:	From the tender, the following list of plant was to be on site during the works: Caterpillar diesel traxcavator, Carryall 6.5 cu. yd, 8-9 ton roller, 5, 6 and 8 yd trucks, Grader, Tracked loaders/dozers
Cash Flow:	1956 £17,000 1957 £40,869
Subsidy:	1 for 1
Comments:	Land claims of £28,777 incl. solicitors, etc.

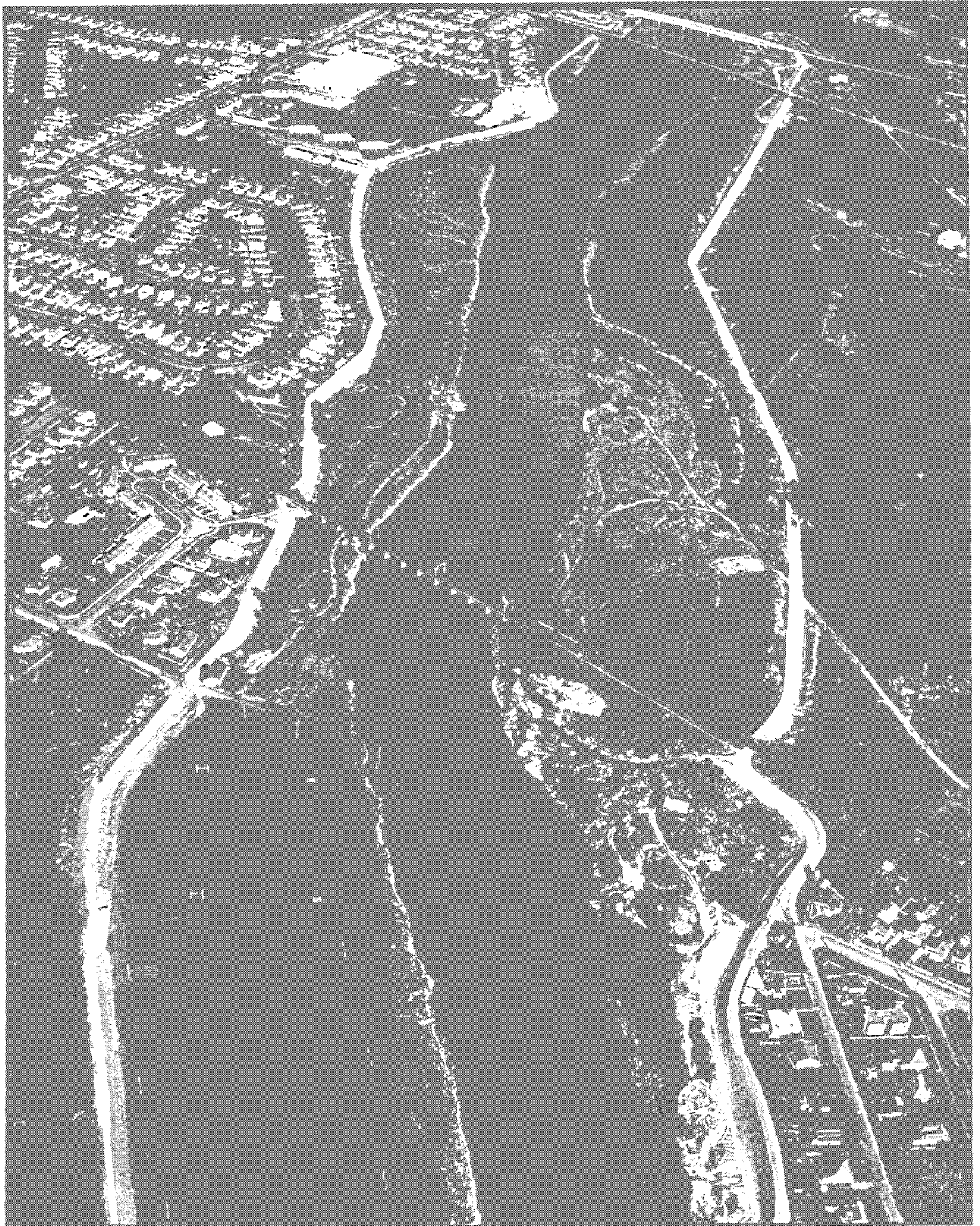


Plate 91: 1956 stopbank works in progress.

PROJECT REPORT 5

MELLING DIVERSION CUT : FIRST STAGE

A realignment of the Hutt River at Melling to remove an incised S bend

Date: 1959-60
Plan Number: HRB 102
File: SSPHRB17
Location: Refer Appendix A, figure 4.

Historical Chainage - S/B C/L:
Right Bank 2 mi 77 ch to 3 mi 7.5 ch
Left Bank 3 mi 11 ch to 3 mi 20.5 ch

Current River Traverse - river C/L:
4500 m to 5000 m

Reason for Initiation: This work was a pilot cut, 50 ft (15 m) wide, on the western side of the proposed 1904 "Ultimate River Alignment". The cut was first proposed in 1940, following the 1939 flood, but could not be made until LHCC had replaced the Melling suspension bridge with a bridge that spanned the full waterway on the Ultimate Channel Alignment.

The cut was proposed because of:

- (1) Erosion on the outsides of the two bends and the ongoing cost of protection, described by the Hutt River Board Chairman as a cost which "...probably ran into tens of thousands of pounds." Evening Post 25 November 1953.
- (2) Danger to the stopbank.
- (3) The need to comply with the "Ultimate Channel Alignment".
- (4) To reduce flood levels.
- (5) To allow the free movement of bedload through the river system and so prevent aggradation upstream of Melling.

A preliminary plan for the Melling Cut was put to the Board by its Engineer in 1951 - refer to Plan No. HRB 89. The Engineer noted that the channel downstream of the Melling Bridge had been deepened and increased in capacity over many years by planned shingle extraction and river training, however, a steep bed gradient through and immediately above the proposed cut area indicated a very large volume of shingle "perched" above the Melling "S" bend. The Engineer believed that an immediate opening of a full width cut would allow massive shingle movement downstream during a flood, with a possible serious reduction in the capacity of the downstream section.

From an *Evening Post* article, 2 December 1953, the river bank, presumably east bank immediately downstream of the Melling (suspension) Bridge approach, was eroded to within feet of the stopbank.

From an *Evening Post* article, 8 December 1953, the Hutt River Board Engineer considered that a significant threat of flooding existed - probably from stopbank breaching. He therefore proposed that the cut proceed in stages, starting with a relatively high level pilot cut, to place some control on shingle movement and allow assessment of the extent to which deposition would occur in the abandoned channel areas.



Plate 92: 1955 Flood showing the restriction formed by the Melling bend.

Design Capacity: The minimum considered necessary based on the experience of scour induced diversion development.

Designer: Seaton Sladden and Pavitt

Construction: M L Daly, 138 Martin Square, Upper Hutt

The pilot cut was made through an S bend upstream of the position of the present Melling Bridge. It was intended that the pilot cut, once made, would deepen sufficiently over two to three years to dewater the general area and enable the main cut to be completed more easily. Excavations through the downstream portion of the cut were made in a solid clay. A Public Works Department representative commented that "The material is mostly toughish clay and it seems essential either to excavate gullets through the cuts well below low water level or to loosen the bottom of the cuts with explosives, these would probably have to be shot several times at intervals." T H Nevins, 22 December 1958 (MOW file 96/298000)

The cut was delayed for about two years after the completion of the new Melling Bridge to enable the formalities of legal closure of the old Melling Road (approach to the old bridge) to be made, and the old bridge to be removed.

Excavated clay was trucked to Taita and spread in a low area to the west of Taita Drive, near Mabey Road. Gravels were stockpiled for later use in filling the old river channel.

During the contract an additional 25 ft width was added to the cut. Five thousand cu. yd of this material was stockpiled on site. Three thousand cu. yd was removed to fill at Taita Drive. A netted boulder weir was built at the apex of the eastern S bend to encourage deposition of bed material and filling of the old channel.

Supervision: Seaton Sladden and Pavitt

Construction Equipment: Not recorded, however, an old photograph in Ministry of Works File 96/298000 shows a dragline excavating one portion of the pilot cut, apparently in gravel.

Cash Flow: 1959
£9,500
1960
£3,142
Land purchase of £10,238 required

Subsidy: 1 for 1

PROJECT REPORT 6

MELLING DIVERSION CHANNEL : SECOND STAGE

Widening of the Melling Diversion Cut

Date:	1960-61
Plan Number:	HRB 102 and 113
File:	SSPHRB17
Location:	Refer Appendix A, figure 4. Historical Chainage - S/B C/L: Right Bank 2 mi 77 ch to 3 mi 7.5 ch Left Bank 3 mi 11 ch to 3 mi 20.5 ch Current River Traverse - river C/L: 4500 m to 5000 m
Reason for Initiation:	<p>The pilot cut, opened as Stage One of the Melling Diversion Cut, was to have been left to develop for two to three years. However, the decision was made within about one year to widen the cut because of:</p> <ol style="list-style-type: none">(1) The slow rate of siltation of the old channel.(2) Difficulty in maintaining the weir (built in the old channel to promote siltation). <p>The channel was widened a further 60 ft (18.2 m) to make a total width of 135 ft (41 m).</p> <p>Excavated material was deposited in the old channel upstream of the weir.</p>
Design Capacity:	N/A
Designer:	Seaton Sladden and Pavitt
Construction:	V A Draper and Company Ltd
Supervision:	Seaton Sladden and Pavitt
Construction Materials:	22,000 cu. yd removed
Construction Equipment:	Not recorded: probably Dragline.
Cash Flow:	1960 £2,000 1961 £2,118
Subsidy:	1 for 1

PROJECT REPORT 7

STOPBANK RAISING - EWEN BRIDGE TO MELLING

Raising of the original stopbanks, built 1901-03 to conform to the Hutt River Flood Control Scheme of 1945

Date: 1960-61

Plan Number: HRB 107, HRB 75

File: SSPHRB56

Location: Refer Appendix A, figure 3-4.

Historical Chainage - S/B C/L:
Right Bank 2 mi 4.7 ch to 2 mi 71.0 ch
Left Bank 2 mi 7.3 ch to 2 mi 57.7 ch

Current River Traverse - river C/L:
Right Bank 3060 m to 4370 m
Left Bank 3060 m to 4200 m

Reason for Initiation: Part of the 1950s Scheme Review works.

Design Capacity: 100,000 cusecs (2825 cumecs), plus 2 ft (600 mm) freeboard.

Designer: Seaton Sladden and Pavitt

Construction: R Seville Ltd

Supervision: Seaton Sladden and Pavitt

Construction Standards: Standard SSP Specification (see file SSPHRB56) and Project Report 4.

Construction Method: The work included raising of stopbanks, construction of reinforced concrete flood walls upstream of the Ewen Bridge and extension of stormwater pipes. New r.c. walls on the east and west banks were built to Plan No. HRB 75.

East Bank:

Low stone wall 55 m long from Ewen Bridge to car park. R.C. flood wall to varying height alongside old wall. R.C. toe wall to retain city side of stopbank up to Melling Bridge.

West Bank:

New r.c. wall 90 m long alongside old wall. On the east bank, from 2 mi 48 ch to 2 mi 70 ch, the stopbank was moved toward the river by between 20 ft and 80 ft (6 to 25 m) to permit the extension of Rutherford Street from Queens Drive through to Daly Street.

Construction Materials: West Bank:

2 mi 09 ch to 2 mi 64 ch - 28,000 cu. yd site material (silt and shingle)
2 mi 64 ch to 2 mi 71 ch - 4,000 cu. yd "rotten rock"

East Bank:

2 mi 15.68 ch to 2 mi 23.27 ch - 3,900 cu. yd silt and shingle
2 mi 23.27 ch to 2 mi 36 ch - 8,000 cu. yd rotten rock

2 mi 36 ch to 2 mi 46.75 ch - 5,000 cu. yd rotten rock
2 mi 46.75 ch to 2 mi 55.91 ch - 9,000 cu. yd silt and shingle
2 mi 72.92 ch to 3 mi 2.34 ch - 2,800 cu. yd silt and sand

Plant Used: Euclid S-7 motorscraper (ref: letter 29/4/60 from Clyde Engineering to Seaton Sladden and Pavitt)

Cash Flow:	1960	£22,100
	1961	£27,908

Subsidy: 1 for 1

PROJECT REPORT 8

NEW STOPBANK AND STOPBANK RAISING NORTH OF MELLING BRIDGE

Raising of the existing stopbank from Taita to Fraser Park and new stopbanking from Fraser Park to Mabey Road

Date: 1962-64

Plan Number: HRB 117

File: SSPHRB96

Location: Refer Appendix A, figure 5

Historical Chainage - S/B C/L:
Left Bank 5 mi 10 ch to 7 mi 31.5 ch and extension to 4 m 55 ch

Current River Traverse - river C/L:
Left Bank 8,050 m to 11,620 m

Reason for Initiation: In 1944 a low stopbank was built by the Public Works Department on behalf of the Department of Housing to protect the Taita Housing Block. Construction of housing in the block was just commencing. The original stopbank was built of river gravels, generally on the existing stopbank alignment, but slightly further inland in parts. It appears from file correspondence and reports that the bank and earthworks for the housing block were in part designed to block a potential overflow path from the river onto the valley floor, possibly near the present intersection of Taita Drive and High Street. The bank was later raised to 6 ft (1.83 m) above the gradient of the 1948 flood (47,000 cusecs (1327cumecs)) and extended 300 ft (91 m) further south. In 1962 the stopbank was again raised by about 2 ft (600 mm) as part of the Hutt Scheme Review and was extended south to vicinity of Mabey Road.

Design Capacity: 100,000 cusecs (2825 cumecs)

Designer: Seaton Sladden and Pavitt

Construction: V A Draper and Company Ltd

Supervision: Seaton Sladden and Pavitt

Construction Standards: Standard SSP Specification, see Project Report 4.

Construction Materials: 5 mi 10 ch to 7 mi 31.5 ch
Borrowed fill from river berm - 20,000 cu. yds
Other borrowed fill - 63,000 cu. yds
(referred to in the specification as being available "from the hill face alongside Pomare Railway Station..").

5 mi 10 ch to 4 mi 55 ch
Borrowed fill from river berm - 22,000 cu. yds
Other borrowed fill - 10,800 cu. yds

Construction Equipment: Loader, 2 x D6 dozers, 3 trucks - 6 cu. yd no record of roller

Cash Flow:

1962	£54,000
1963	£8,000
1964	£698
Land acquisition of	£7,000

Subsidy: 1 for 1

PROJECT REPORT 9

MELLING DIVERSION CUT - THIRD STAGE

Widening of the Melling Diversion Cut to design width

Date: 1964

Plan Number: HRB 102, 113, 133

File: SSPHRB17

Location: Refer Appendix A, figure 4.
Historical Chainage - S/B C/L:
2 mi 77 ch to 3 mi 7 ch
Current River Traverse - river C/L:
4500 m to 5000 m

Design Capacity: 100,000 cusecs (2825 cumecs)

Designer: Seaton Sladden and Pavitt

Construction: V A Draper and Company Ltd

Supervision: Seaton Sladden and Pavitt

Construction Materials: 25,000 cu. yds of material was removed from the downstream of the two bends and placed as fill in the Mills Road stopbank raising and in filling the old channel. The total bottom width of the channel was then 205 ft (62 m).

It is probable that the cut was carried out in order to win material to completely close the old channel, and to remove tough clay from an apparently limited area: it appears that the upstream pilot cut was in gravels and developed with less requirement for excavation.

Construction Equipment: 17RB and 19RB draglines - 0.75 cu. yd. Four trucks.

Cash Flow: £5507

Subsidy: Not recorded but probably 1:1 as for stages one and two, and other Scheme Review Works.

PROJECT REPORT 10

STOPBANK RAISING MELLING ROAD TO MILLS ROAD

Raising of the original (1901) stopbank to meet Scheme Review standards

Date: 1964

Plan Number: HRB 120

File: SSPHRB109

Location: Refer Appendix A, figure 4

Historical Chainage - S/B C/L:
Left Bank 3 mi 4 ch to 3 mi 19 ch

Current River Traverse - river C/L:
Left Bank 4650 m to 4950 m

Reason for Initiation: Scheme Review works

Design Capacity: 100,000 cusecs (2825 cumecs), plus 2 ft (600 mm) freeboard.

Designer: Seaton Sladden and Pavitt

Construction: V A Draper and Company Ltd

Supervision: Seaton Sladden and Pavitt

Construction Standards: Not retained on file. However, it is assumed that a standard specification was used. See Project Report 4.

Construction Materials: Cut and fill from existing stopbank, 1,200 cu. yds. Borrowed fill from stage 3 of the Melling Diversion Cut (ref: letter E M Sladden to District Commissioner of Works 11/12/63) 8,200 cu. yds.

Plant Used: Not recorded

Cash Flow: £5,400

Subsidy: 1 for 1

PROJECT REPORT 11

HAYWARDS SETTLEMENT STOPBANK CONSTRUCTION

Extension of an existing stopbank to protect Ministry of Works housing in the Haywards Settlement

Date:	1964-65
Plan Number:	HRB 106
File:	SSPHRB73
Location:	Refer Appendix A, figure 5. Historical Chainage: Not given. Current River Traverse - river C/L: Right Bank 11,500 m to 12,820 m
Reason for Initiation:	Construction of stopbanks was proposed by the Ministry of Works in 1958 to protect a planned extension to the Ministry of Works housing area at the Haywards Settlement. The proposed stopbank was to be a northern extension to an existing stopbank, built by the Ministry of Works, protecting the earlier southern housing block. In 1961 it was proposed by the District Commissioner of Works that the Hutt River Board should "... embody (the stopbank) in the existing stopbank system and share in the cost of the work ..." and this was agreed by the Board. The financial basis for this agreement is not recorded.
Design Capacity:	According to a personal comment by E M Sladden (Engineer to the Hutt River Board) dated 10/9/70, on the above file, the stopbank was built with 3 ft 6 in (1.05 m) freeboard above the (recorded) grade line of the (70,000 cusec) 1939 flood. There is no record as to why the design capacity of 100,000 cusecs, then the standard for other parts of the Hutt River Scheme, was not used. However there is a comment on file that due to river bed lowering since the (70,000 cusec) 1939 flood the channel capacity at Haywards would exceed 70,000 cusecs. It is noted that the northern section of the Haywards stopbank is over a metre higher than the stopbank at the mouth of the Stokes Valley Stream, which was designed in 1980 for a one metre freeboard above a 2124 cumec (75,000 cusec) discharge.
Designer:	Seaton Sladden and Pavitt
Construction:	C A Willis
Supervision:	Seaton Sladden and Pavitt
Construction Standards:	SSP Specification - refer Project Report 4
Construction Materials:	Approved clay or rotten rock obtained from either Horokiwi Quarries Ltd or from the Lower Hutt City Council refuse tip at Wingate.
Construction Equipment:	Caterpillar D6 bulldozer, 3 cu. yd Euclid loader, Case 450, Caterpillar 966 loader, Trucks (6 cu. yd)
Cash Flow:	£30,600
Subsidy:	1 for 1

PROJECT REPORT 12

WHAKATIKI STREET TO MAORIBANK STOPBANKING

Construction of a new stopbank from the street now known as Masefield Street to Maoribank: and the first stage of the Scheme Review in the Upper Valley. Originally known as the Whakatiki Street to Maoribank Stopbanking, but extending from present day Masefield Street to Maoribank

Date: 1964-65

Plan Number: HRB 118
Other relevant plans:
HRB 129 - Diversion Channels
HRB 167 - Maoribank Drainage Channel
HRB 161 - Regrading Drainage Channel, Clouston Park to Ebdentown Road
HRB 144 - Stopbank Construction at Drainage Channel near Gibbons Street

File: SSPHRB111

Location: Refer Appendix A, figure 8-9.

Historical Chainage - S/B C/L:
Left Bank 12 m 70 ch to 15 m 16 ch

Current River Traverse - river C/L:
Left Bank 19,870 m to 24,200 m

Reason for Initiation: Scheme Review Works

Design Capacity: 100,000 cusec (2825 cumecs), + 2 ft (600 mm) freeboard

Designer: Seaton Sladden and Pavitt

Construction: Green and McCahill Contractors Ltd

Supervision: Seaton Sladden and Pavitt

Construction Materials: The stopbank was constructed of river gravel, with a clay capping 1 ft (300 mm) thick and a 6 in (150 mm) topsoil layer. Compaction standards are not recorded. Materials were obtained from the diversion channel opposite Hudson Avenue (124,000 cu. yds), from the drainage channels (8,000 cu. yds), and included clay capping (over river shingle), 27,500 cu. yds and topsoil, 13,700 cu. yds.

Construction Machinery: 38RB dragline, 2 DW21 motorscrapers of 22.5 cu. yd capacity

Cash Flow:

1964	£46,850
1965	£22,854
Miscellaneous items	£5342

Subsidy: 2 Government to 1 local share

PROJECT REPORT 13

WHAKATIKI STREET TO HERETAUNGA GOLF CLUB STOPBANK

Second stage of stopbank construction for the upper valley section of the Hutt River Scheme from the street now known as Masefield Street to the Wellington Golf Club. Originally known as the "Heretaunga Golf Club to Whakatiki Street Stopbank", but extended south from the present day Masefield Street

Date:	1966-69
Plan Number:	HRB 124
File:	112
Location:	Refer Appendix A, figure 7-8. Historical Chainage - S/B C/L: Left Bank 11 m 5 ch to 12 m 70 ch Current River Traverse - river C/L: Left Bank 17,250 m to 19,870 m
Reason for Initiation:	Scheme Review Works
Design Capacity:	100,000 cusec (2825 cumecs), plus 2 ft (600 mm) freeboard
Designer:	Seaton Sladden and Pavitt
Construction:	Green and McCahill Contractors Ltd
Supervision:	Seaton Sladden and Pavitt
Construction Standards:	SSP Specification - see Project Report 4.
Construction Materials:	"... approved clay and rotten rock ..." supplied by Downer and Company Ltd from a site on the Moonshine Road approximately 400 m beyond the Moonshine Bridge (178,000 cu. yds); from drainage channel excavations (43,000 cu. yds); from "... near the end of Whakatiki Street.." (8,000 cu. yds) spoil - type unrecorded - previously dumped at the site.
Plant Used:	Not recorded but probably as for the previous Upper Hutt stopbank contract.
Cash Flow:	1966 \$54,550 1967 \$31,600 1968 \$69,300 1969 \$2,000 \$30,154 paid in land compensation
Subsidy:	2 Government for 1 local share

PROJECT REPORT 14

FLATTENING STOPBANK SLOPE AT HUTT VALLEY HIGH SCHOOL

Flattening of the city side slope of the stopbank adjacent to the Hutt Valley High School

Date: 1965-66

Plan Number: HRB 141

File: SSPHRB116

Location: Refer Appendix A, figure 3
Historical Chainage - S/B C/L
Left Bank 1 m 39 ch to 1 m 65 ch
Current River Traverse - river C/L
Left Bank 2160 m to 2600 m

Reason for Initiation: The stopbank through this area had originally been built with 1.5:1 batters. The 1950s Scheme Review called for all batters to be 3:1 on the river face and 2:1 on the outer face (where feasible).

Design Capacity: N/A

Designer: Seaton Sladden and Pavitt

Construction: W G Kells Ltd

Supervision: Seaton Sladden and Pavitt

Construction Standards: Not retained

Construction Materials: 4,900 cu. yds of "approved clay or rotten rock"

Construction Equipment: Not recorded

Cash Flow: \$2865

Subsidy: Not recorded

PROJECT REPORT 15

STOPBANK CONSTRUCTION AT THE DRAINAGE CHANNEL NEAR GIBBONS STREET

An auxiliary stopbank to improve outlet conditions for the drainage channel discharging at Gibbons Street. Pipes under the main stopbank had been laid previously under the main stopbank construction contract

Date: 1966-67

Plan Number: HRB 144

File: SSPHRB120

Location: Refer Appendix, figure 8
Historical Chainage; not assigned
Current River Traverse - river C/L
Left Bank 21,320 m to 21,640 m

Reason for Initiation: Part of Scheme Review works.

Design Capacity: To the 100,000 cusec flood level of the main stopbanks.

Designer: Seaton Sladden and Pavitt

Construction: Green and McCahill Contractors Ltd

Supervision: Seaton Sladden and Pavitt

Construction Materials: Cut to fill from existing channel 1,600 cu. yds. Borrowed fill (unspecified but probably river gravel) 18,700 cu. yds. Material (unspecified but probably clay) over channel slopes 500 cu. yds. Topsoil 1500 cu. yds

Construction Equipment: Not recorded

Cash Flow: \$8025 in 1966
\$2800 in 1967

Subsidy: Not recorded but probably 2:1 as for the main stopbanks.

PROJECT REPORT 16

CHANNEL REALIGNMENT BETWEEN TRENTHAM MEMORIAL PARK AND THE SILVERSTREAM BRIDGE "The Silverstream Cut"

Realignment of the river channel and training works, from the Wellington Golf Club to the Silverstream Bridge. Part of the Upper Valley Flood Control Scheme

Date:	1966-71
Plan Number:	HRB 148, HRB 155
File:	SSPHRB127
Location:	Refer Appendix A, figure 7 Current River Traverse - river C/L 14,600 m to 17,360 m
Reason for Initiation:	<p>During the 1950s a proposal to extend the Western Hutt Motorway (State Highway 2) beside the Hutt River, north of the Silverstream Bridge, was considered in conjunction with the proposed River Control Scheme. A road alignment west of the Hutt River up to the Moonshine Bridge and east of the River to Maoribank (as now in place) was proposed and land for the scheme was purchased by the National Roads Board.</p> <p>At that time, the Hutt River through the Upper Valley, was generally in private ownership, and was not controlled according to any specific scheme. Localised bank stabilisation and river training works were carried out by the Public Works Department and Hutt River Board, mainly on behalf of the Upper Hutt Borough Council and private landowners. The risk of flooding was recognised and was dealt with in part by small, private stopbanks which appear to have been constructed to mainly prevent scour and deposition.</p> <p>The Public Works Department had begun the purchase of land for the Upper Hutt section of the Hutt River Scheme in 1947, making provision to acquire sections in Newton Street (west of Shakespeare Street and upstream of the Moonshine Bridge). The Newton Street subdivision had proved to be seriously floodable, despite a stopbank built by the developer at its upstream end.</p> <p>In the early 1960s it was expected that the State Highway 2 River Road would be extended within a short time and provision for it had therefore been included in the Upper Valley Scheme works. Preliminary river straightening and training works, the "Silverstream Cut", were carried out concurrently with the commencement of stopbank construction between Maoribank and Masefield Street, as scheme works.</p>
Design Capacity:	To match the hydraulics of the adjoining reaches.
Designer:	Seaton Sladden and Pavitt
Construction:	Hired plant - various contractors
Supervision:	Seaton Sladden and Pavitt
Comments:	The work involved straightening the river, which lay in an inverted "S" swinging toward the Wellington Golf Club in the east and then crossing over to lie against the Western Hills upstream of the Silverstream Bridge. The river works, carried out by the Hutt River Board and subsidised by the National Roads Board placed the river in its "Ultimate Controlled Alignment", an alignment established by the Hutt River Board in 1952.

The works involved excavation of a design channel of trapezoidal cross section, removal of gravels to fill old meanders; and bank protection. Bank protection was achieved by retards formed from about eight tethered 2 tonne concrete blocks, perpendicular to the channel centre line. The retards held down wire cables to which willow poles and fascines were tied. "Boulsters" i.e., stone filled netting "sausages" were also used for weighting the willow fascines.

The "Silverstream Cut" survived in a reasonably functional although deteriorated form until 1984, when it was replaced by the River Works for the Upper Hutt Bypass, refer Project Report 45. Significant deterioration occurred between 1970 and 1984 due to:

- (1) Heavy river attack in the years 1976 to 1982.
- (2) Lack of maintenance funding from the National Roads Board (and consequently the Wellington Regional Water Board/Wellington Regional Council who were not prepared to commit regional funds if the principal beneficiary (National Roads Board) was not prepared to contribute) following the end of the previously agreed maintenance period in 1976.
- (3) A lesser degree of siltation in old meanders than expected, causing a diversion of high velocity flood flows through and around bank protection works with consequent damage to these works.
- (4) Removal of gravel from the old channel by the Ministry of Works and Development for road filling.

In 1984 the designers of the Upper Hutt Bypass River Works revised the philosophy, of river stabilisation between Maoribank and Silverstream and the original works on the right bank were completely replaced. Remnants of the left bank works remain.



Plate 93: Closing the channel to direct water through the first stage, Nov 1969.

Evening Post neg. C11328.

Construction Materials: 1110 concrete blocks; 30,000 cu. yds of gravel stockpiled for State Highway 2 upgrading south of Silverstream; 33,000 cu. yds of gravel stockpiled in the old channel for later use in the proposed motorway north of Silverstream; excavation of unsuitable material, probably silt and sand, stockpiled on Wellington Golf Club land near the river.

Cash Flow: \$11,283 in 1966/67
\$15,653 in 1967/68
\$31,462 in 1968/69
\$43,282 in 1969/70
\$75,416 in 1970/71

Subsidy: 2 Government (SC and RCC) to 1 local share on 45 percent of the cost of the works. The remaining 55 percent funded by the National Roads Board with no local share levied.



Plate 94: Aerial view of the combined first and second stages of the Silverstream Cut.

PROJECT REPORT 17

CHANNEL ALIGNMENT - HUDSON AVENUE

Date: 1967

Plan Number: HRB 150

File: SSPHRB132

Location: Refer Appendix A, figure 8
Current River Traverse - river C/L
22,050 m to 22,640 m approximately
(from opposite Willow Grove to opposite Ebdentown Road)

Reason for Initiation: The cut was carried out through a central shingle bar to divert the River away from a point of attack on the left bank. Erosion at this point was threatening the stopbank opposite Hudson Ave.

Designer: Seaton Sladden and Pavitt

Construction: Feast Contractors Ltd

Supervision: Seaton Sladden and Pavitt

Construction Materials: 34,250 cu. yds of shingle excavated and placed in low areas in the river bed on the river side of the stopbank (left bank). Forty-eight concrete blocks salvaged and replaced.

Cash Flow: \$7695

Subsidy: Not recorded.

PROJECT REPORT 18

EASTERN HUTT ROAD CHANNEL REALIGNMENT

Realignment of the Hutt River channel south of Stokes Valley for construction of the Eastern Hutt Road

Date: 1967

Plan Number: HRB 142 (not found)

File: SSPHRB118

Location: Refer Appendix A, figure 6
Current River Traverse approximately 12,000 m to 12,200 m

Reason for Initiation: Construction of the four lane extension of the Eastern Hutt Road from Pomare to Stokes Valley required an encroachment of some 20 ft (6 m) into the Hutt River.

Designer: Seaton Sladden and Pavitt

Constructed By: Camerons Carrying Company Ltd

Supervised By: Seaton Sladden and Pavitt

Construction: The river channel was realigned 20 ft (6 m) toward the Manor Park Golf Course, with excavation of 15,700 cu. yds of gravel from the right bank. Although it is not recorded, it is probable that the excavated material was used in filling under the new road.
Bank protection was constructed, including placement of quarry forkings on the left bank, 24 ch (480 m) of willow and cable protection (probably on both banks) and 20 tethered concrete blocks.

Construction Equipment: Not recorded

Cash Flow: \$6200 in March 1967

Subsidy: No record

PROJECT REPORT 19

TOTARA PARK STOPBANKS

The Totara Park stopbanks, constructed in three stages, commencing in 1968, 1981 and 1983 respectively

- Dates:** Stage I 1968, Stage II 1981, Stage III 1983.
- Plan Number:** Stage I plans in Upper Hutt City Council Files 323/3/160
Stage II Truebridge Callendar Beach Ltd 73/10
Stage III refer Truebridge Callendar Beach Ltd
- File:** WRWB 8/7/13 and UHCC Files 323/3/160
- Location:** Refer Appendix A, figure 9

Current River Traverse - river C/L
Stage I 22,440-23,140 m
Stage II 23,140-24,680 m
Stage III 24,680-25,230 m
- Reason for Initiation:** Stage one construction, from the western (downstream) end to the Maoribank Bend was constructed by the Totara Park Development Company, designed by Rayward and Gilkison Ltd (surveyors and consultants to the developers) to meet the requirements on the subdivisional development by the Hutt County Council which included: "Production of a satisfactory assurance from the Hutt River Board that the work (the company) proposes to carry out along the east and south boundaries of the property will be sufficient to protect from flooding the area comprised in the scheme plan to the same extent as the case on the south side of the Hutt River."
- Design Capacity:** 100,000 cusec (2825 cumecs)
- Construction:** The Hutt County Council was requested by Truebridge Callendar Beach Ltd to accept a bond on uncompleted stopbank works in October 1968 and in turn requested that the Hutt River Board "... provide an assurance that the areas are adequately protected from flooding." The Hutt River Board provided a plan (copy held on file Wellington Regional Water Board 8/7/13) showing the area considered to be protected (by this stopbank) against the 100,000 cusec flood and indicated that the stopbank would be taken over as soon as topsoiling and grassing were complete. The area considered to be protected encompassed the whole of Totara Park as now existing. A file note contained on the Hutt County Engineer's files, dated 30/10/68 states that "... a stopbank would be required at the top end to stop a flood sweeping through the entire subdivision ...", however, this does not appear to have been communicated to the Hutt River Board.
- The Hutt River Board was asked to "... clarify the situation with respect to the stopbank ..." in November 1971. At this time the stopbank ran from the Maoribank Bridge to the western (downstream) end of Totara Park, but was not complete from a point 22 ch (440 m) west of Totara Park Road. The Hutt River Board's response is not recorded.
- Plans for construction of a stopbank on the eastern side of Totara Park (to protect an eastward expansion of the development) were presented to the Wellington Regional Water Board for approval in 1977. At this time, as a result of a recent computer study of channel hydraulics the Wellington Regional Water Board noted that a portion of the existing bank might have to be raised.

This was later confirmed and the raising was incorporated into the new stopbank construction contract.

The eastern stopbank was raised in two sections. The first, incorporating raising of 200 m of existing bank and construction of 300 m of new bank was built in 1981. The cost of raising the existing bank was carried by the Wellington Regional Water Board. The remaining 550 m section was built in 1983. By agreement between the Wellington Regional Water Board, Upper Hutt City Council and Totara Park Developments Ltd the cost was met in full by the Wellington Regional Water Board and Upper Hutt City Council (with Soilcon subsidy) as it was accepted that Totara Park Development Ltd had insufficient funds to meet construction costs.

Designer: Stage I, Rayward and Gilkison
Stage II, Truebridge, Callender, Beach
Stage III, Truebridge, Callender, Beach

Construction: Not recorded

Construction Standards: Not recorded

Cash Flow: Stage I not recorded
Stage II included \$19300 from Wellington Regional Water Board
Stage III Wellington Regional Council \$30,275/Upper Hutt City Council
\$60,550/NWASCA \$19,937
Totara Park Developments are to repay \$61,500 in 1992.

PROJECT REPORT 20

STOPBANK CONSTRUCTION - BOULCOTT TO MABEY ROAD

Construction of a new stopbank from the Boulcott Golf Club to a point opposite Tennyson Avenue, to meet the existing stopbank completed in 1964. Local opposition to the loss of views in the Stellin Street area resulted in the omission of the section south of the Film Unit

Date:	1969
Plan Number:	HRB 125
File:	SSPHRB117
Location:	Refer Appendix A, figure 4-5 Historical Chainage - S/B C/L Left Bank 3 m 32 ch to 4 m 55 ch Current River Traverse - river C/L Left Bank 5660 m to 7340 m
Reason for Initiation:	This was the last section of stopbank to be built in the lower valley, probably because the area was considered to be at lower risk from flooding than previously stopbanked areas. This area was at the southern end of a stretch of bank referred to as the "terraces" , being a length of higher river banks between historic overflow points at Taita and Boulcott. The stopbank was designed and built in accordance with the Hutt River Board's Hutt River Scheme.
Design Capacity:	100,000 cusec, plus 2 ft freeboard
Designer:	Seaton Sladden and Pavitt
Construction:	Hired plant
Supervision:	Seaton Sladden and Pavitt
Construction Standards:	Draft construction specification held on File SSPHRB117. This requires compaction in 6 in (150 mm) layers, minimum of 12 passes with a 4.5 tonne (minimum) sheepsfoot roller, clay or rotten rock, where used, to be placed at optimum moisture content.
Construction Materials:	From draft specification the materials to be used as filling would be "... approved clay or rotten rock..." obtained from either Horokiwi Quarries Ltd or from the Lower Hutt City Council Refuse Tip at Wingate.
Construction Equipment:	Caterpillar D6 bulldozer, 3 cu. yd Euclid loader, Case 450, Caterpillar 966 loader, Trucks (6 cu. yd)
Cash Flow:	\$30,600
Subsidy:	1 Government share for 1 local share

PROJECT REPORT 21

MODEL STUDY OF THE RIVER MOUTH

Date: 1971-73

File: SSPHRB114

Location: Refer Appendix, figure 2

River mouth, principally concerned with the reach downstream of the Estuary Bridge.

Reason for Initiation: The principal objective of the model study was to determine the limits of reclamation that could be permitted on the western side of the river without increasing the flood level in the Waiwhetu Stream.

Refer letter from E M Sladden to Dr H P Thorpe, Ministry of Works and Development Central Laboratories, 2 August 1971.

The study was carried out by the Ministry of Works and Development Central Laboratories at a cost of approximately \$8000.

PROJECT REPORT 22

MAORIBANK RESERVE DRAINAGE CHANNEL

Construction of the open perimeter drain around Maoribank Park

Date: 1972

Plan Number: HRB 167

File: SSPHRB165

Location: Refer Appendix A, figure 9
Current River Traverse - river C/L
Left Bank 23,450 m to 24,000 m

Reason for Initiation: The drain was required to discharge stormwater from the Maoribank Park and from the growing residential area of Maoribank. It is not recorded why this drain was not constructed at the time of stopbank construction, 1964-67, but it is possible that the requirement for the Hutt County Council to improve drainage from the hillsides and flats above Maoribank Park, refer to Project Report 23, prompted a review of drainage in the Maoribank area.

Design Capacity: Not recorded

Designer: Seaton Sladden and Pavitt

Constructed by: G G Wilkie and P Corrigan

Supervised by: Seaton Sladden and Pavitt

Construction Standards: Not recorded

Construction Materials: 4,350 cu. yd of material excavated, 1,250 cu. yd of topsoil placed 6 in (150 mm) thick on batters, twin 42 in concrete culverts with flap-gates constructed under stopbank.

Plant Used: Not recorded

Cash Flow: \$7948

Subsidy: Not recorded

PROJECT REPORT 23

REGRAIDING DRAINAGE CHANNEL - CLOUSTON PARK TO EBDENTOWN ROAD

Date: 1972

Plan Number: HRB 161

File: SSPHRB130

Location: Refer Appendix A, figure 9

Historical Chainage - S/B C/L
Left Bank 14 m 13.5 ch to 14 m 39 ch

Current River Traverse - river C/L
Left Bank 22,500 m to 23,000 m

Reason for Initiation: The drainage channel was lowered by 3 ft (900 mm) at the upstream end to conform to the invert level of a new 72 in (1.83 m) Upper Hutt City Council stormwater pipe from the Maoribank area (south of Fergusson Drive).

Design Capacity: Not recorded

Designer: Seaton Sladden and Pavitt

Construction: John McLachlan Ltd

Supervision: Seaton Sladden and Pavitt

Construction Standards: Not recorded

Construction Materials: 6 in (150 mm) layer of "rotten rock" in channel batters

Cash Flow: \$8535

Subsidy: Apportionment of costs not recorded

PROJECT REPORT 24

REGRADE THE STOPBANK - BOULCOTT GOLF CLUB

Lowering the stopbank in the Boulcott Golf Course from Ariki Street to Hathaway Avenue

Date: 1972

Plan Number: HRB 168 (held on file HRB 182)

File: SSPHRB182

Location: Refer Appendix A, figure 4

Historical Chainage - S/B C/L
Left Bank 3 m 44 ch to 3 m 66 ch

Current River Traverse - river C/L
Left Bank 5,360 m to 5,750 m

Background: Correspondence on the Engineer's general file, dated 1931, records permission granted to James Stellin, property developer, to lower the stopbank at Troon Crescent, Lower Hutt, to 18 in (450 mm) above the adjoining terraces (a lowering of approx 4 ft (1.2 m)).

The "Boulcott Farm" subdivision was built in two stages with the first part (Frys Lane) constructed in 1928 . Troon Crescent extended along what is now Hathaway Avenue to meet the stopbank where it ends at the Terrace. (Note that half the subdivision is built below the Terrace). Prior to the construction of the stopbanks the area between Military Road and Ariki Street had been known as the Boulcott overflow and was the entry to the top of the Black Creek or Second River. The stopbanks had been continued to Military Road in order to close the Boulcott Overflow. It is not known why the stopbank grade finished 5-6 ft. above the terrace level other than to allow the northern area to act as an overflow spillway and so ensure the integrity of the banks, should a super design event occur.

Stellin, who was an energetic property developer throughout the Wellington and Hutt Valley area, had been pressuring the Hutt River Board since the mid-1920s to allow the removal of the stopbank and had enlisted the support of Lower Hutt City Council. The Hutt River Board resisted this pressure until the 1931 flood was measured at 3 ft 2 in below the top of the bank.

Reason for Initiation: As part of the Scheme upgrading the existing banks were to be strengthened and regraded to the 100,000 cusec + 2 ft. flood profile. In this area the stopbank was lowered by 1 ft 9 in to 3 ft 6 in to establish a top width of 10 ft (3 m), with 3:1 batters.

Design Capacity: N/A

Constructed by: G G Wilkie and P Corrigan

Supervised by: Seaton Sladden and Pavitt

Construction Standards: Not recorded

Construction Materials: 2,100 cu. yd excavation, 400 cu. yd topsoil

Cash Flow: \$4550

Subsidy: Not recorded

PROJECT REPORT 25

STOPBANK RESHAPING SOUTH OF MELLING STATION

Date: 1972

Plan Reference: HRB 170

File: 185

Location: Refer Appendix A, figure 4
Historical Chainage - S/B C/L
Right Bank 2 m 49 ch to 2 m 69 ch
Current River Traverse - river C/L
Right Bank 3935 m to 4350 m

Reason for Initiation: The existing stopbanks from the Melling Railway Station south for approximately 400 m had been left on a 1.2:1 batter so as not to encroach on an area leased to a shingle crushing plant. Material from the reconstruction of State Highway 2 had been stockpiled at the site for berm and stopbank upgrading, and was used to flatten the batters to 3:1.

Design Capacity: N/A

Designer: Seaton Sladden and Pavitt

Construction: John McLachlan Ltd

Supervision: Seaton Sladden and Pavitt

Construction Standards: Not recorded

Construction Materials: 5,750 cu. yds of material from improvements to State Highway 2. Type of material not known, but likely to have been rotten rock and clay.

Cash Flow: \$3958

Subsidy: Not recorded

PROJECT REPORT 26

OKOUTU STREAM (BLACK CREEK) AUXILIARY STOPBANK

Construction of the auxiliary stopbank at the Okoutu Stream
(Black Creek) outlet channel

Date: 1972-73

Plan Number: HRB 164

File: SSPHRB162

Location: Refer Appendix A, figure 3.

Current River Traverse - river C/L
Left Bank 1,950 m to 2,120 m

Reason for Initiation: The stopbank was constructed to reduce the effect on the Okoutu Stream of high water levels in the Hutt River and thus to reduce ponding behind the main stopbank in floods of the magnitude of the 1939 flood. The backwater effect of the Ava Bridge was recognised as affecting the Okoutu Stream outlet.

Design Capacity: ". to 1939 flood level ." (Evening Post, 27/11/72)

Designer: Seaton Sladden and Pavitt

Construction: John McLachlan Ltd

Supervision: Seaton Sladden and Pavitt

Construction Standards: Not known - work carried out by hired plant supervised by Seaton Sladden and Pavitt

Construction Materials: Imported filling, type unknown, 2,200 cu. yd

Construction Equipment: TD8 bulldozer, E211 motorscraper, Grader, H65 loader, H90 loader, 6 cu. yd trucks, Dragline - for stream clearing

Cash Flow:

1972	\$ 6,223
1973	\$ 3,287

Subsidy: Not approved for subsidy

PROJECT REPORT 27

HUTT VALLEY MAIN SEWER RIVER CROSSING - SILVERSTREAM

Date:	1976
Plan Numbers:	Hutt Valley Drainage Board Plans A1-3064 to A1-3076 WRC Plans HR2208, HR2224
File:	Now held by Lower Hutt City Council
Location:	Refer Appendix A, figure 6. Current River Traverse - river C/L Left Bank 14,208 m
Reason for Initiation:	<p>The main sewer from Upper Hutt previously crossed the river via a siphon attached to the old railway bridge, which was located at approximately this point. (The Silverstream Rail Enthusiasts' line at the entry to the Silverstream Landfill is part of the old line north of the old bridge.) Vacuum conditions were maintained in the siphon by a vacuum pumping station. Replacement of the siphon was proposed because:</p> <ol style="list-style-type: none">(1) The siphon and pumping station gave continual trouble, resulting in frequent discharges of raw sewage into the river at a location regularly used by the public.(2) The Railways Department had given notice of its intention to relocate the bridge.(3) Replacement of the sewer main could be expected at some time because of the anticipated development of Upper Hutt.
Design Capacity:	N/A
Designer:	Odlin, Sowry and Company
Construction:	Olsen Earthworks Ltd
Supervision:	Odlin, Sowry and Company
Construction Method:	<p>A previous seismic survey of the Hutt River showed that bedrock at the northern end of Taita Gorge rose close to river level. The site chosen for the crossing allowed the sewer to be founded on rock. Additionally, there was sufficient space on the eastern side of the river to permit diversion of the Eastern Hutt Road during construction.</p> <p>The construction area was coffer dammed to allow dry working conditions. The structure was built on a keyed tidy slab and consist of a number of pipes covered with reinforced, post-tensioned concrete.</p>
Construction Materials:	Coffer dam of cohesive clays, and site backfilled with river gravels on completion.

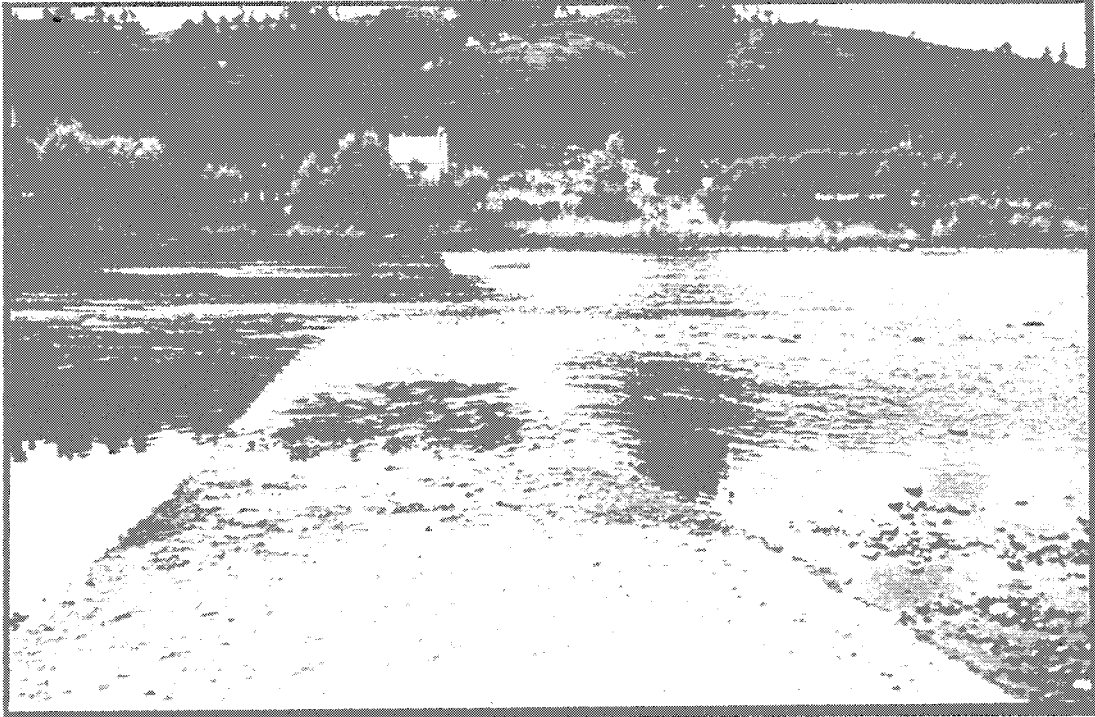


Plate 95: The sewer crossing looking west to east 1989.

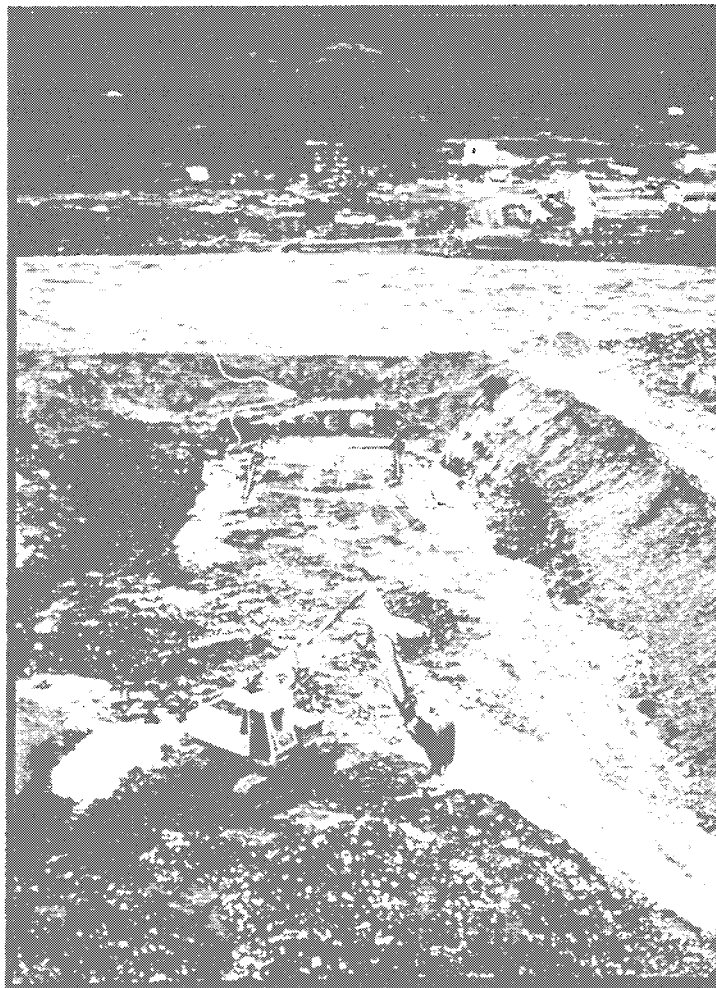


Plate 96: Construction of the sewer crossing 1976. Note the bed depth above the structure.

PROJECT REPORT 28

PROTECTION OF STATE HIGHWAY 2 EMBANKMENT AT TE MARUA

Date: 1980-81

Plan Number: No plans held by Wellington Regional Council

File: WRC File 8/7. Main files held in Ministry of Works and Development archives.

Location: Refer Appendix A, figure 10.
Current River Traverse - river C/L
Left Bank 29,270 m to 29,450 m

Reason for Initiation: In the late 1970s the State Highway 2 Bridge over the Mangaroa River was replaced, with an accompanying realignment of some ½ km of highway.

Design Capacity: To 100 year flood level.

Designer: Ministry of Works and Development Wellington District Office

Constructed By: Ministry of Works and Development Trentham Residency

Supervision: Ministry of Works and Development

Construction: The objective was to achieve a low cost but effective bank facing and toe protection. This was done by laying a rip-rap toe to the embankment up to normal water level, with a chequer board pattern of concrete blocks cabled together and anchored to deadmen. The spaces between the blocks were filled with large stones, and the top of the batter was planted.

Construction Materials: Rip-rap, concrete blocks and plants.

Cash Flow: Not known

Subsidy: Funded by National Roads Board

Comments: River metal extraction upstream, and associated bank protection assisted to reduce river attack against the embankment. Attack on the bank by the Hutt River is also reduced by the action of the outflowing Mangaroa River immediately upstream.



Plate 97: Hutt River bed south of the Mangaroa confluence at the start of highway construction. The river flowed against the highway before the diversion.

PROJECT REPORT 29

STOKES VALLEY STREAM OUTLET STOPBANK RECONSTRUCTION

Reconstruction of the Stokes Valley Stream Outlet Dividing
Stopbank in conjunction with stream upgrading works

Date: 1980-81

Plan Reference: WRC series A1-6935 and various amended and annotated plans held by the Rivers Department

File: Wellington Regional Water Board 8/36, 8/36/1

Location: Refer Appendix A, figure 6
Current River Traverse - river C/L
Left Bank 12,200 m to 12,500 m

Reason for Initiation: In 1980 the Wellington Regional Water Board commenced a contract to improve the capacity of the Stokes valley Stream, following major residential property damage from flooding in December 1976. During the works the existing dividing stopbank at the Stokes Valley Stream exit, built by the Hutt River Board to improve outlet conditions, was to be raised to 1 m above the grade line of the 2124 cumec (75,000 cusec) flood. This flood was established by the Wellington Regional Water Board in 1976 to be the 100 year return period flood in the Hutt River below the Whakatiki River, and the design flood for future scheme works.

Immediately before stopbank construction commenced a flood in the Hutt River severely eroded the existing stopbank, necessitating its reconstruction before the raising could continue.

Design Capacity: 2124 cumec(75000 cusecs)

Designer: Wellington Regional Water Board

Construction: Feast Contractors Ltd - earthworks
Wellington Regional Water Board - bank protection

Supervision: Wellington Regional Water Board

Construction Materials: A mixture of river gravels and clay. Approximately $\frac{2}{3}$ by volume was river gravel taken from the Hutt River by scraper, and $\frac{1}{3}$ was clay from a cutting in George Street, Stokes Valley.

Construction Equipment: Bulldozer, Scrapers, Trucks

Cash Flow: \$26,500 (stopbank and protection work only)

Subsidy: 1:1 on 60 percent. Remainder paid by Lower Hutt City Council



Plate 98: Stokes Valley Stream dividing stopbank 1982.

PROJECT REPORT 30

WELLINGTON GOLF CLUB - HERETAUNGA - RIVER CONTROL WORKS

Date: 1981-86

Plan Numbers: HR3114, HR3198, HR3222, HR3224

Files: 8/7, 8/7/2

Location: Refer Appendix A, figure 7
Current River Traverse - river C/L
Left Bank 15,940 m to 17,430 m

Reason for Initiation: Prevention of active erosion and stabilisation of the Silverstream Cut.

Design Capacity: N/A

Designer: Wellington Regional Water Board/Wellington Regional Council

Constructed By: Wellington Regional Water Board/Wellington Regional Council

Supervision: Wellington Regional Water Board/Wellington Regional Council

Construction: The left bank of the river adjacent to the Wellington Golf Club was stabilised with standard design debris fences and willow plantings. These were subsequently removed and replaced with rip-rap as part of the Upper Hutt Bypass Riverworks Contract.

In addition, the golf club made arrangements with local contractors to dump an estimated 30,000 cu. m of fill (including bricks, demolition material, concrete blocks, asphalt and clayey basecourse) in a depression on golf club land outside the course boundaries. River gravels had previously been mined from this area at the club's instigation.

Cash Flow: Not known

PROJECT REPORT 31

MAORIBANK GROYNES AND PLANTING PROGRAMME

Date: 1981-87

Plan Number: HR3116

File: 8/7

Location: Refer Appendix A, figure 9.
Current River Traverse - river C/L
Left Bank 23,930 m to 24,220 m

Reason for Initiation: During the May 1981 flood a 1.5 ha area was eroded, in effect bringing the river bed to within the line of the stopbank foundation.

Design Capacity: N/A

Designer: Wellington Regional Council

Construction: PEP (Project Employment Programme - Department of Labour) labour and Wellington Regional Council

Supervision: Wellington Regional Council

Construction Standards: Following the 1981 flood two groynes were constructed of 10 tonne concrete blocks on foundation mattresses. Planting between the groynes was carried out.

The blocks had not been cabled together and nor had the second groyne been tied into the southern stopbank. During a flood in December 1982 some of the blocks were pushed out of position on both groynes, with some erosion occurring around the inside end of the second groyne. The leading edge of the upstream mattress was rolled back on to itself. The cost to complete the groynes and repair the damage was approximately \$20,000.

The upstream of the two groynes was removed as part of the Upper Hutt Bypass construction. Part of these works involved construction of debris fences through the willow planting to protect the planting. Ongoing maintenance of the mattresses and willows has continued.

Cash Flow: 1983/1984 \$20,000 (programmed)
1984/1985 \$4,000
1985/1986 Nil
1986/1987 Minor

PROJECT REPORT 32

PROTECTION OF STOPBANK AND RIVER BANK, ALICETOWN

Date: 1981/1988

Plan Number: No plan

File: 8/7/1

Location: Refer Appendix A, figure 3.
Current River Traverse - river C/L
Right Bank 2550 m to 2750 m

Reason For Initiation: Even though the Hutt River below Ewen Bridge is shaped by the influence of the tidal cycle and salt water intrusion the flow velocities during floods still cause scour and erosion of the banks. At approximately 350 m south of the Ewen Bridge the river turns to the right and in the vicinity of Buckley and Montague Streets has developed a deep thalweg close to the right bank. In March 1981 this reach was identified as a high risk area requiring a more substantial berm between the stopbank and river. Derelict wooden groynes (built by the Hutt River Board c. 1924) remain in place but now have no discernable effect in arresting bank erosion.

Design Capacity: Not Applicable

Designer: Wellington Regional Council

Constructed by: Wellington Regional Council

Supervised by: Wellington Regional Council

Construction: The existing berm was only sufficiently wide to allow a tractor to pass between the stopbank toe and river bank. This berm was widened to 5-7 m by adding and consolidating a working bench of fill (obtained free of charge from local contractors).

Cash Flow: Not known

Comments: The intention was that this work be the first stage of a three stage programme. Subsequent work was to involve installation of prefabricated groynes made from telegraph poles and the planting of suitable plant species on the riverbank. If rock or rubble was available free, then this was to be placed at the toe of the bank. The estimated cost of this work was \$6,000 (March 1981), including the planting over this reach of river.

In preparation for future work to be done along this section concrete blocks are stored locally. The cost to date of block purchase has been \$15,000 (1987/1988) and \$9,000 (1988/1989).

PROJECT REPORT 33

TE MARUA RIVER METAL EXTRACTION

Date: 1981, 1989

Plan Number: HR4042, HR4048, HR4050

File: 8/7/18, N/3/10/4

Location: Refer Appendix A, figure 10
Current River Traverse - river C/L 29,536 m to 29,998 m

Reason For Initiation: For extraction of accumulated river gravels and re-direction of river flows so as to minimise erosion of river banks on Teasdale property on the true right bank and the Te Marua Golf Club on the true left bank upstream of the confluence of the Hutt and Mangaroa rivers.
Debris fences were also constructed to offer protection to the banks

Design Capacity: N/A

Designer: Wellington Regional Council

Constructed By: Wellington Regional Council, with hired plant

Supervised By: Wellington Regional Council

Construction: In 1980/81 an estimated 48,000 cu. m of river gravel was removed, on trucks working in combination with bulldozers and motorscrapers. Again in 1988/89 29,000 cu. m was extracted.
A number of associated works (mostly construction of debris fences and plantings) have been carried out over a period of time in conjunction with the extraction.

Materials Used: Extensive use of willow plantings to offer bank protection

Cash Flow: 1980-81 \$6,000
1988-89 \$16,000
(figures based on information from files)

PROJECT REPORT 34

PARKDALE SUBDIVISION STOPBANK And Associated Protection Works

Date:	1983-84
Plan Number:	Plans held on file
File:	WRWB 8/7/18, 8/7/19
Location:	Refer Appendix A, figure 9. Current River Traverse Left Bank, cross sections 2560 to 2590
Reason for Initiation:	<p>In 1976 following recently completed investigations into flood levels in the Hutt River the proposed Parkdale Subdivision was found to be at risk from flooding at 100 year return period frequency. After site investigations for the proposed new bridge over the Hutt River to the Akatarawa Valley the Wellington Regional Water Board advised that flood levels should be revised upwards for safety and that stopbanking would definitely be required to protect the subdivision.</p> <p>In 1979, after further investigation and final design of the bridge, the Wellington Regional Water Board advised the height of stopbank required. This was over 3 m at its greatest height, immediately upstream of the bridge. By agreement with the Upper Hutt City Council, stopbank design and construction were carried out by the Council and protection was designed and built by the Wellington Regional Water Board/Wellington City Council.</p>
Design Capacity:	Designed to computed flood profile for a 48,600 cusec (1,400 cumec) flood, plus 0.5 m freeboard, plus allowance for log rafts on the Akatarawa Bridge.
Designer:	Wellington Regional Council - hydraulics, bank protection Upper Hutt City Council - earthworks, drainage
Construction:	Regan - earthworks, drainage Wellington Regional Council - bank protection
Supervision:	Upper Hutt City Council, Wellington Regional Council
Construction Standards:	Fill placed in 200 mm thick layers within 2 percent of optimum moisture content. Not less than 6 passes of a suitable sheepsfoot roller.
Construction Materials:	<p>The stopbank was built with highly weathered clay material extracted from a hillside cut on the Mangaroa Hill Road.</p> <p>Bank protection consisted of a chequer board pattern of tethered concrete blocks as toe scour protection in the river, woven plastic fabric anchored into the face of the bank as erosion protection, and willow planting.</p>
Construction Equipment:	Plant for compaction was a 12 tonne sheepsfoot roller.
Cash Flow:	\$150,000 stopbank and drainage; \$70,000 bank protection.
Subsidy:	40 percent on Wellington Regional Council share. Total subsidy approximately \$33,000.

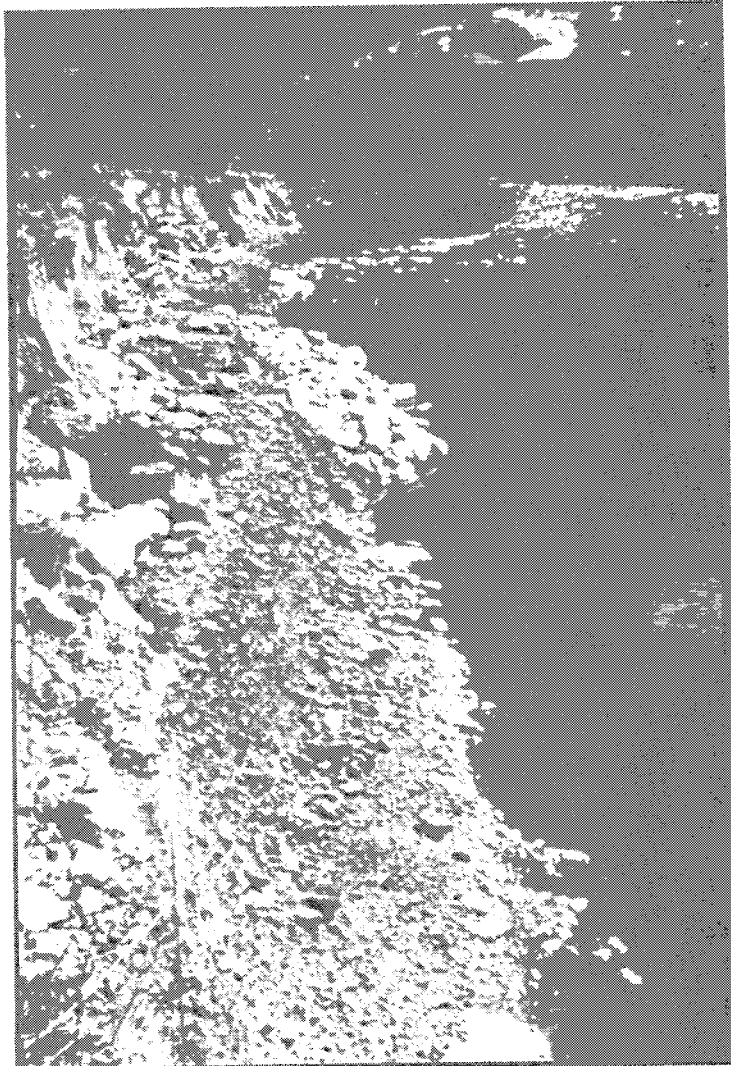


Plate 99: Erosion of the Parkdale river reserve 1983.

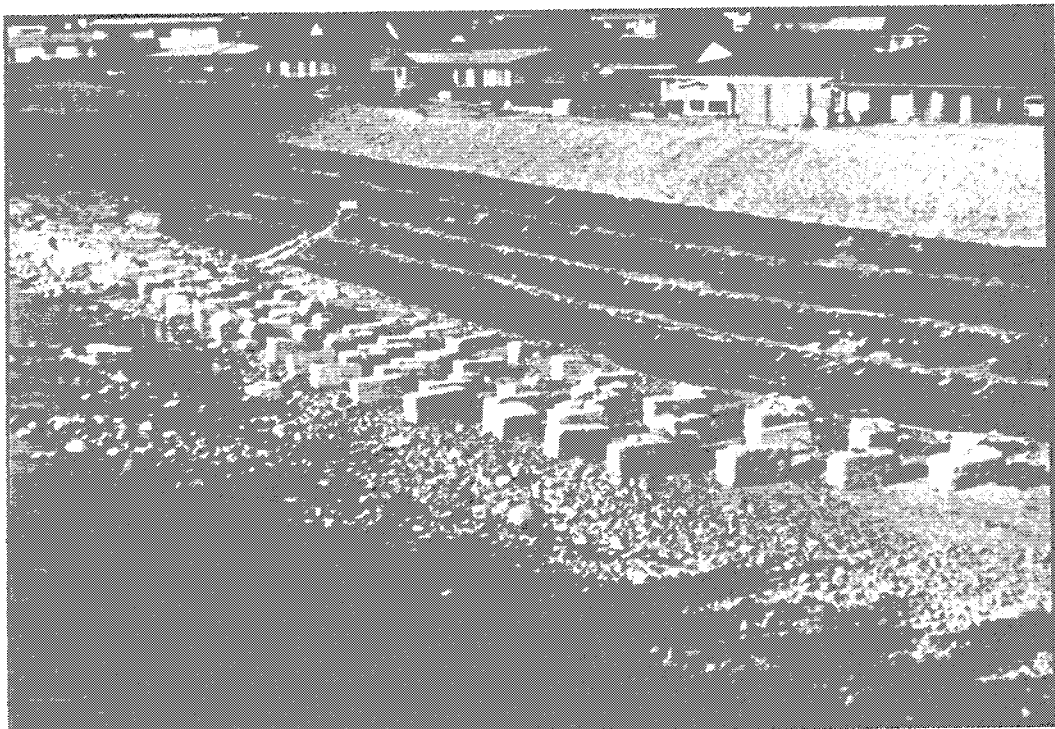


Plate 100: Stopbank and stabilisation works on completion 1984.

PROJECT REPORT 35

CONCRETE CYCLE TRACK FACILITY

Date: 1983/1984

Plan Number: Not held by Wellington Regional Council

File: 8/7

Location: Refer Appendix A, figure 3-5.
Current River Traverse - river C/L
Left Bank 6,800 m to 11,520 m

Reason For Initiation: To provide high quality public access, particularly for use by cyclists, while at the same time minimising damage to an existing stopbank.

Design Capacity: N/A

Designer: Wellington Regional Council

Constructed By: PEP (Project Employment Programme) labour

Supervised By: PEP Co-ordinator

Construction: The cycle track begins at Kennedy-Good Bridge on the left and runs on top of the stopbank as far as Pomare Bridge (river distance 6,800 m to 11,320 m) then under Pomare bridge and along the toe of the stopbank to the main road (river distance 11,320 m to 11,520 m). The track is 1 m wide, formed of unreinforced concrete.

Cash Flow: In the order of \$300,000 with Wellington Regional Council share being approximately \$100,000

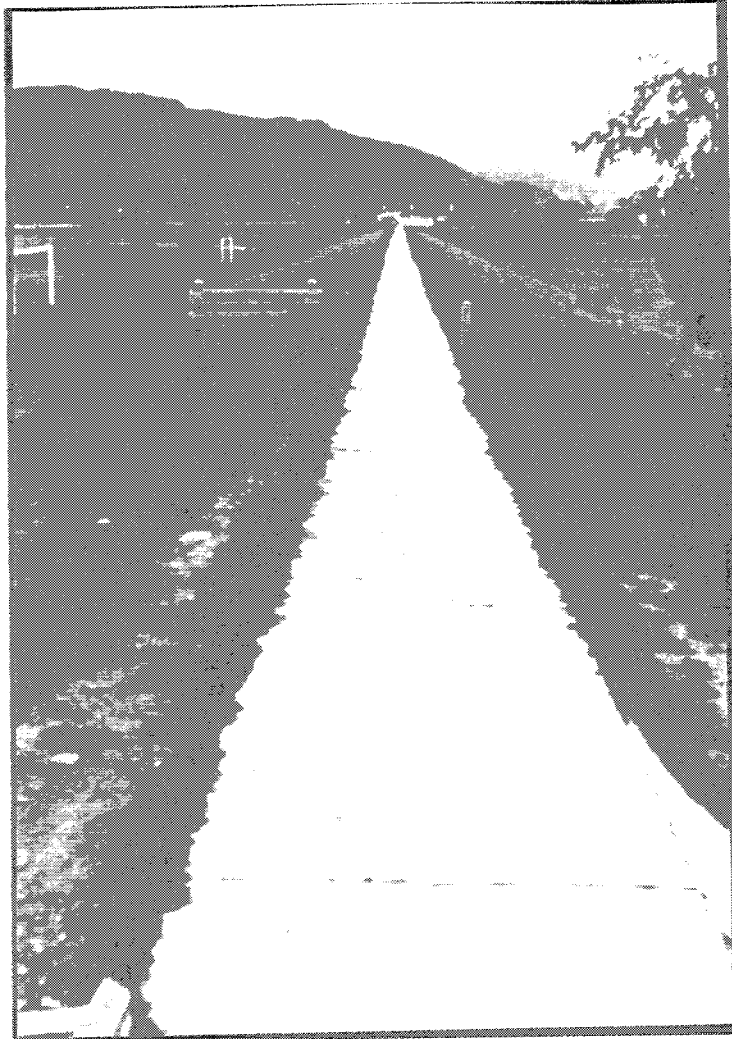


Plate 101: Cycle track at Fraser Park.

PROJECT REPORT 36

TE MARUA GOLF CLUB PRIVATE WORKS FOR BANK STABILISATION AND PROTECTION

Date: Since 1983/84

Plan Number: N/A

File:

Location: Refer Appendix A, figure 10
Current River Traverse - river C/L
Left Bank 30,048 m to 31,102 m

Reason For Initiation: To minimise the effects of erosion of the riverbanks and subsequent loss of golf club fairways

Design Capacity: N/A

Designer: Te Marua Golf Club, with assistance from Wellington Regional Council staff

Constructed By: Voluntary labour from the membership of the Te Marua Golf Club

Supervised By: Te Marua Golf Club

Construction: Extensive use of willow plantings as necessary along reach. Bank protection consisting of tyres, concrete blocks, debris arrestors and willows over the reach 30,431 m to 30,561 m. A large debris groyne at or about 30,700 m in behind the Club's Pro Shop.

Materials Used: Willows, railway irons, cable, tyres, concrete blocks and poles.

Cash Flow: Unknown, as done as a private work with next to no labour costs.

Subsidy: Not applicable

Comments: It is also planned at the time of writing to remove a substantial island of gravel over the reach 30,694 m to 30,954 m. The objective is to direct the river away from an alignment hard against the left bank. This work will be done by the Te Marua Golf Club with overall supervision by Wellington Regional Council. The cost sharing will be between the golf club and the property opposite on the right bank belonging to the Teasdale family.

PROJECT REPORT 37

STOPBANK REPAIR AT WOOLLEN MILLS (MOERA)

Experimental stopbank repair at Randwick Woollen Mills, immediately downstream of Okoutu Stream (Black Creek) mouth

Date: 1984

Plan Number: No plan

File: WRC 8/7/1

Location: Refer Appendix A, figure 2.
Current River Traverse - river C/L
Left Bank 1,150 m to 1,180 m

Reason for Initiation: This was an experimental work, to test the durability of limestone rip-rap from a Wairarapa quarry. The work involved stabilisation of the toe of a section of stopbank immediately downstream of the Okoutu Stream mouth, where the stopbank protrudes into the river. Large blocks of concrete rubble were dumped in deep water below low tide level, with limestone rip-rap (median diameter 0.5 to 0.6 m) placed on the existing stopbank.

Design Capacity: 2,140 cumec

Designer: Wellington Regional Council

Construction: Wellington Regional Council

Supervision: Wellington Regional Council

Construction Materials: See above

Construction Equipment: Supply by truck from Wairarapa. Placement by long-reach digger.

Cash Flow: \$9000

Subsidy: 35 percent

PROJECT REPORT 38

BANK STABILISATION TRIAL - ESTUARY SECTION

Location : river banks at Sladden Park

- Date:** 1984-86
- Plan Reference:** Plans held on file.
- File:** WRC 8/7/1
- Location:** Refer Appendix A, figure 3
Current River Traverse - river C/L
Right Bank 1660 m to 2000 m
- Reason for Initiation:** Wave lap erosion in the lower river had been recognised as a problem as early as the late 1920s. As willows could not be established in this area the Hutt River Board experimented with grasses and various types of armouring.
- In 1982 it had become apparent that upgrading of existing bank protection works was required and that bank protection in place, and in use in other parts of the river were unsuitable. This was because:
- (1) Plants generally used for soil stabilisation do not tolerate the salt water entering this section.
 - (2) Existing bank protection relied heavily on dumped rubble, which was aesthetically unpleasant to the increasing numbers of recreational users of the river berms.
- The purpose of the trial was to investigate the effectiveness of several methods of stabilising river banks in this estuarine reach. These were:
- (1) Rebuilding old "boom groynes" (i.e., timber pile and cross-members) remaining from Hutt River Board works.
 - (2) Placement of rip-rap.
 - (3) Weighted filter cloth placed as a soil surface stabiliser.
 - (4) Weighted filter cloth placed in conjunction with salt tolerant native reed plantings.
 - (5) Planting of native reed and other native species without filter cloth.
- It was intended that the results of the trial would be used in stabilising and beautifying up to 6 km of river bank in the tide-affected zone; predominantly downstream of the Ewen Bridge. A major factor in the trial was the attempt to establish a durable plant cover in the inter-tidal zone with species which would not (by reason of invasiveness or otherwise) become a nuisance.
- Designer:** Wellington Regional Council
- Constructed By:** Wellington Regional Council
- Supervised By:** Wellington Regional Council
- Construction Standards:** Not relevant

Construction Materials: Rip-rap, reinstatement of "boom groynes" (timber groynes built by the Hutt River Board in 1927-28, UV stabilised polypropylene filter cloth, salt tolerant native plants.

Cash Flow: \$50,000

Subsidy: 60 percent

Comment: The trial has demonstrated that native plants can be established in the upper part of the intertidal zone (and higher), but generally in sheltered areas of limited extent only. The usefulness of exotic plants is yet to be gauged quantitatively.

PROJECT REPORT 39

TOTARA PARK BANK PROTECTION AND STABILISATION

Date:	1984-1989
Plan Number:	No specific plans pertaining to this work but for general design of debris fences refer WRC Plans HR316, HR3158.
File:	8/5, 8/7/2, 8/7/14
Location:	Refer Appendix A, figure 9 Current River Traverse - river C/L reach 20,840 m to 22,800 m
Reason For Initiation:	Predominantly as part of protection works for the Upper Hutt Bypass Construction. To offer protection to the bypass road on the left bank and protection against bank erosion on the right bank.
Design Capacity:	N/A
Designer:	Wellington Regional Council
Constructed By:	Wellington Regional Council
Supervised By:	Wellington Regional Council
Construction:	1986/87 Right Bank (21,240 m to 21,570 m) - 6 permeable groynes and extension of debris fences 1986/87 Right Bank (21,995 m to 22,385 m) - 5 permeable groynes and extension of debris fences 1986/87 Left Bank (22,500 m to 22,700 m) - 4 permeable groynes and debris fences 1986/87 Right Bank (22,700 m to 22,800 m) - 2 permeable groynes and debris fences 1987/88 Left Bank (20,840 m to 21,943 m) - supplementary rock rip-rap 1987/88 Right Bank (21,140 m to 21,240 m) - 1 debris fence and 2 permeable groynes to strengthen and extend existing work 1987/88 Right Bank (21,843 m to 21,943 m) - install 3 groynes at the end of some existing debris fences 1988/89 Left Bank (22,500 m to 22,700 m) - Erosion occurred about permeable groynes and debris fences with resulting willow loss. Batter banks and plant willows.
Cash Flow:	1984/1985 \$3,000 1985/1986 \$13,000 1986/1987 \$43,000 1987/1988 \$94,000 1988/1989 \$43,000 1989/1990 \$11,000 (to 31/3/90)
Subsidy:	Carried out as part of the River Works Agreement.

PROJECT REPORT 40

POMARE BRIDGE PROTECTION AND BANK STABILISATION

Date:	1984, 1990														
Plan Number:	HR2142, HR2166, HR2262, HR2270. No plans relating to maintenance works.														
File:	8/7, 8/7/4/5, N/3/10/2, N/3/12/6														
Location:	Refer Appendix A, figure 6 Current River Traverse - river C/L Left Bank 11,076 m to 11,708 m														
Reason For Initiation:	<p>The Pomare rail bridge over the Hutt River is located at a significant bend in the river. The main channel normally aligns itself with the left bank posing a constant threat to the bridge and stopbank. Historically work in the Region has consisted of maintenance with willow and poplar plantings, construction of wooden and concrete deflectors and cross blading in order to redirect the main channel.</p> <p>A substantial area of river berm was removed by the January 1980 flood. As a result 20,000 cu. m of fill was placed to reinstate the river alignment away from the Taita stopbank. Low cost protection works were subsequently constructed. A fresh in the river on 13/14 September 1988 caused a 15 m width of river berm and protection works to be eroded away affecting a 200 m length and leaving a raw vertical bank.</p>														
Design Capacity:	Protection works - 100 year flow, 2075 cumecs														
Designer:	Wellington Regional Council														
Constructed By:	Maintenance carried out by Wellington Regional Council														
Supervised By:	Morrison Cooper Ltd														
Construction:	Proposed Works Contract 1001 - Construction of four rock groynes on the left bank of the Hutt River in the vicinity of the Pomare Rail Bridge. The formation of groyne cores using <i>in situ</i> materials, the placing of filter aggregates over the core and the placing of an outer rip-rap "skin".														
Contract Materials:	<p>Part Contract 130 - Supply of 5,425 tonnes of grade B and 1,016 tonnes of grade C rock from Pongaroa in the Wairarapa. Gradings defined by Wellington Regional Council standard rip-rap grading curves.</p> <p>Contract 130A - Supply of 6,000 tonnes of grade C rock by Mintech New Zealand out of Collingwood.</p>														
Cash Flow:	<table><tr><td>1984/1985</td><td>\$3,000</td></tr><tr><td>1985/1986</td><td>\$9,000</td></tr><tr><td>1986/1987</td><td>\$18,000</td></tr><tr><td>1987/1988</td><td>\$2,000</td></tr><tr><td>1988/1989</td><td>\$20,000</td></tr><tr><td>1989/1990</td><td>\$288,000 (to 31/3/90)</td></tr><tr><td>1989/1990</td><td>\$448,000 (1/4/90 to 30/6/90) rock supply only</td></tr></table> <p>Total estimated costs, including overheads for the Pomare Groynes Project, is \$ 1,500,000</p>	1984/1985	\$3,000	1985/1986	\$9,000	1986/1987	\$18,000	1987/1988	\$2,000	1988/1989	\$20,000	1989/1990	\$288,000 (to 31/3/90)	1989/1990	\$448,000 (1/4/90 to 30/6/90) rock supply only
1984/1985	\$3,000														
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1989/1990	\$448,000 (1/4/90 to 30/6/90) rock supply only														

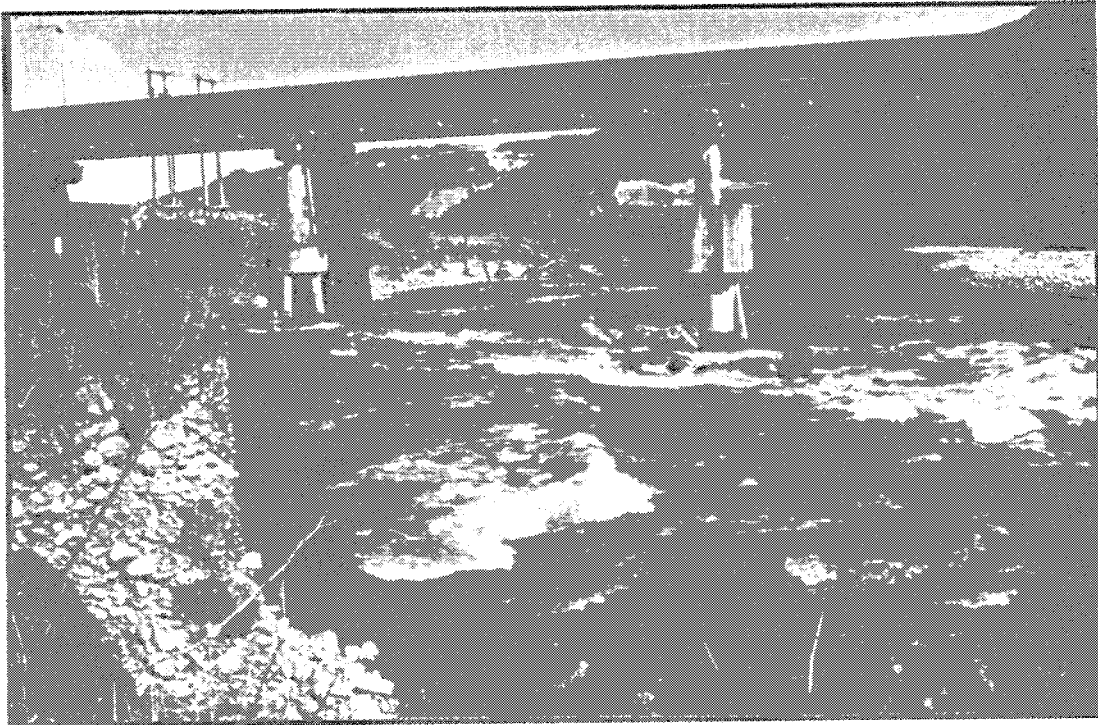


Plate 102: Pomare bank erosion. The eastern stopbank at the head of the Taita housing estate can be seen in the background.

Subsidy:

New Zealand Railways contribution of \$100,000-\$300,000, depending on assessed degree of security. Not yet known.

PROJECT REPORT 41

OKOUTU STREAM (BLACK CREEK, LOWER HUTT) OUTLET WORKS UPGRADING

Replacement of the outlet (stopbank) culvert, excavation of the river berm outlet channel and reconstruction and strengthening of the outlet channel auxiliary stopbank

- Date:** 1984-present
- Plan Number:** Held on file WRC 8/7/1
- File:** WRC 8/7/1, N/3/10/2
- Location:** Refer Appendix A, figure 3
Current River Traverse - river C/L
Left Bank 1325 m to 1970 m
- Reason for Initiation:** The replacement of the (1903) stopbank outlet culverts, the improvement of the conveyance of the outlet channel within the river berm, and the consequential strengthening of the auxiliary stopbank which protects the outlet from moderate river stages, were recommendations of the Lower Hutt City Council commissioned review of the Black Creek stormwater system.
- Culvert Replacement:** In 1985 Lower Hutt City Council replaced the two original cast in situ concrete culverts with a single barrelled precast concrete culvert and flapgate structure. It was the original intention to seal and leave the 1903 culverts beneath the stopbank. The culverts were found to be in a deteriorated condition and both were later removed by the Wellington Regional Council in 1988.
- Culvert Design and Construction:** Refer LHCC and WRC 8/7/1
- 1903 Culvert Replacement:** Wellington Regional Council - refer WRC N/3/10/2
- Auxiliary Stopbank:** The auxiliary stopbank at the outlet of the Okoutu Stream, constructed in the 1920s to provide relief to the stream outlet during rises in the Hutt River, was by the early 1980s seen to be inadequately protected from river erosion. Although the remnants of the timber groynes remained, reerected after the extraction for the New Zealand Railways eastern duplication in 1927, these provided no effective erosion control. Bank erosion, principally by wave lap, was advancing and was threatening to remove part of the auxiliary stopbank.
- Construction:** Silty fill from the New Zealand Railways' workshops site was brought in to raise, widen and extend the dividing bank to approximately River Distance 1350 m (at the present stream mouth). The material was dumped and allowed to consolidate for 18 months. The central stream channel was enlarged with cuttings stockpiled for use in the auxiliary stopbank. Rip-rap was placed on the Hutt River side of the extension to stabilise the toe of the bank. Two tonne concrete blocks and large blocks of concrete rubble were placed or dug into the river bed (as appropriate) below low tide level.
- Design and Construction:** Wellington Regional Council

Cash Flow: 1984-85 \$ 87,000 culvert construction and channel excavation
1985-86 \$101,000 \$51,000 auxiliary stopbank, \$50,000 culvert construction
1986-87 \$32,000 auxiliary stopbank
1987-88 \$70,000 1903 culvert removal
1988-89 \$25,000 1903 culvert removal

Subsidy: 35 percent. Cost sharing of 1:1 with Lower Hutt City Council for works within the stopbank.

PROJECT REPORT 42

BANK STABILISATION AT THE EWEN BRIDGE

A maintenance work to protect the stopbank and bridge approaches upstream of the Ewen Bridge

Date: 1985-86

Plan Number: Plans held on file WRC 8/7/1

File: WRC 8/7/1

Location: Refer Appendix A, figure 3.
Current River Traverse - river C/L
Left Bank 3150 m to 3230 m

Reason for Initiation: This work was to fill and stabilise an eroded section of the left bank, upstream of the Ewen Bridge, which was threatening to undermine:

- (1) The concrete flood wall (part of the stopbank system).
- (2) The Ewen Bridge approaches.
- (3) Access to the adjacent Lower Hutt City Council river bank car park.

Design Capacity: 2140 cumecs(75000 cusecs)

Designer: Wellington Regional Council

Construction: Wellington Regional Council, with hired plant.

Supervision: Wellington Regional Council

Construction Standards: Compaction to staff engineer's direction

Construction Materials: Rock was dumped into the river on its angle of repose up to 0.3 m above high tide level to bring the bank to a desired line. The bank above was built up from compacted clay taken from a road cutting in Normandale. The bottom 2 m of clay was protected with turf slabs, secured with plastic windbreak cloth and anchored wires. Poplar poles were planted during filling.

Construction Equipment: Sheepsfoot roller towed by tracked machine

Cash Flow: \$40,000



Plate 103: Reinstatement of the eastern bank, Ewen Bridge 1985.



Plate 104: Ewen Bridge left bank stabilisation 1986.

PROJECT REPORT 43

BANK STABILISATION - HARCOURT AND HAUKARETU PARKS

A scheme work to stop erosion at Harcourt and Haukaretu Parks

Date: 1985-87

Plan Number: Plans held on file

File: WRC 8/7/2

Location: Refer Appendix A, figure 9.
Current River Traverse - river C/L
Left Bank 24 370 m - 25,200 m

Reason for Initiation: The Wellington Regional Council was requested by the Upper Hutt City Council and Hutt Valley Drainage Board to remedy bank erosion on the left bank of the Hutt River alongside Harcourt Park and Haukaretu Park. The erosion was threatening the riverside road within the park and the Hutt Valley Drainage Board sewer.

Design Capacity: N/A

Designer: Wellington Regional Council

Constructed by: Wellington Regional Council

Supervised by: Wellington Regional Council

Construction: A variation of the railway iron breastwork used by the HRB at Hudson Avenue and at other locations to prevent the erosion of the foundation of an otherwise stable bank formation.

Construction Materials: Two rows of railway irons were driven along the bank, parallel to the river. To these were tied willow poles and netting which retained gravel infill, with provision to accommodate scour.

Cash Flow: \$147,000 in equal shares by Wellington Regional Council, Upper Hutt City Council and Hutt Valley Drainage Board

Subsidy: \$42,000 being 30 percent of Wellington Regional Council and Upper Hutt City Council contribution

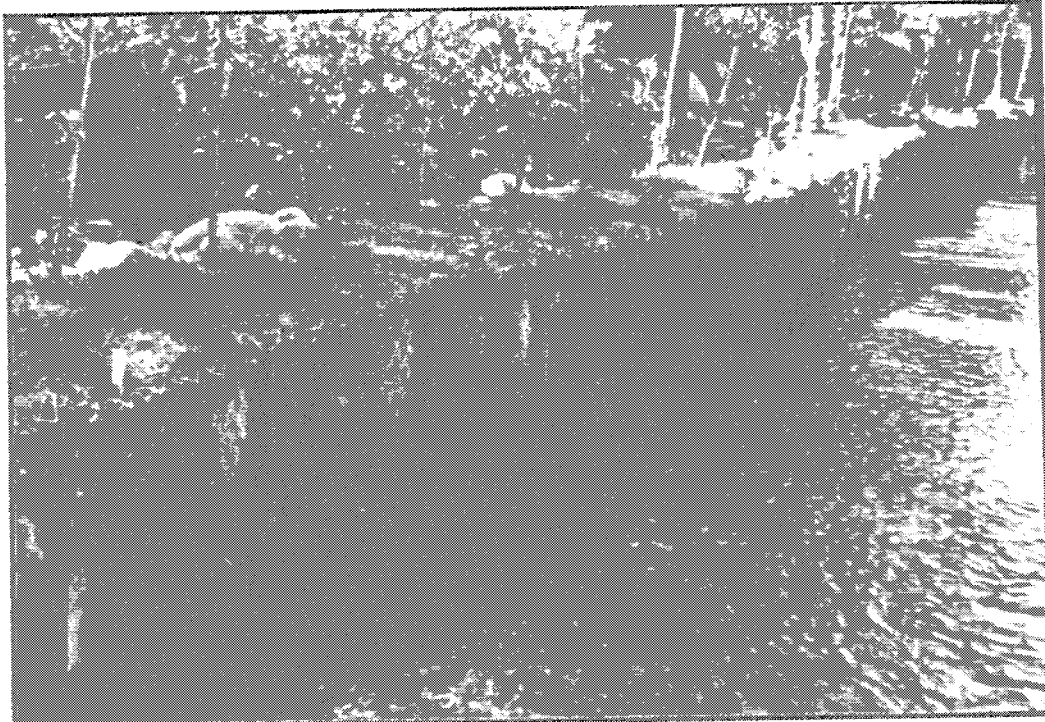


Plate 105: Harcourt Park toe stabilisation 1985.



Plate 106: Harcourt Park toe stabilisation 1989.

PROJECT REPORT 44

STOPBANK REPAIRS AT CROFT GROVE

Date: 1985-88

Plan Number: Plans held on files.

File: WRC 8/7/1, N/3/10/2

Location: Refer Appendix A, figure 2.
Current River Traverse - river C/L
Left Bank 870 m to 1150 m

Reason for Initiation: Damage to banks in the estuarine section of the river, primarily by a combination of high flows and wave action, had been apparent for some years. At Croft Grove erosion was encroaching on and undermining the stopbank toe.

Design Capacity: 2140 cumecs

Designer: Wellington Regional Council

Construction: Wellington Regional Council

Supervision: Wellington Regional Council

Construction Materials: The eroded areas were filled with large blocks of rubble below low water level and above this with rip-rap (median diameter 0.3 m) to form a 3 m wide bench 1 m above high tide. The stopbank was refaced with soil and grassed. The work was done in two stages which were approximately:
870 m to 1080 m in 1985-86
1080 m to 1150 m in 1987-88

Cash Flow: 1985-86 \$42,000
1986-87 \$7,000
1987-88 \$27,000

Subsidy: 30 percent

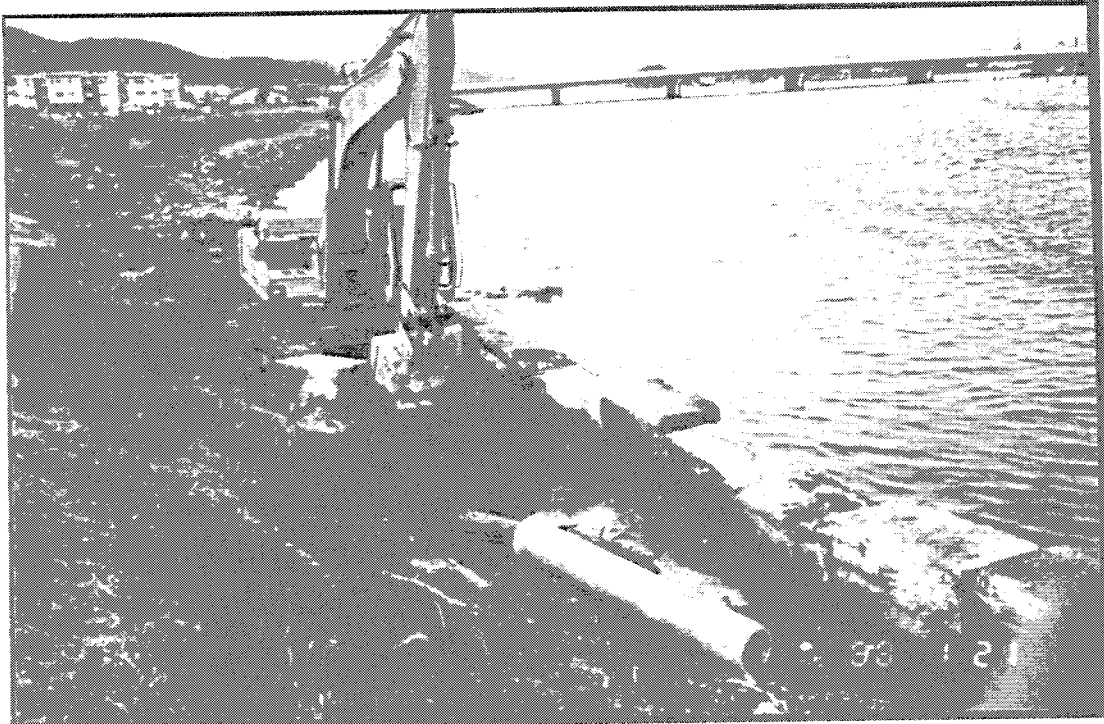


Plate 107: Croft Grove excavation of unsuitable stopbank toe 1988.

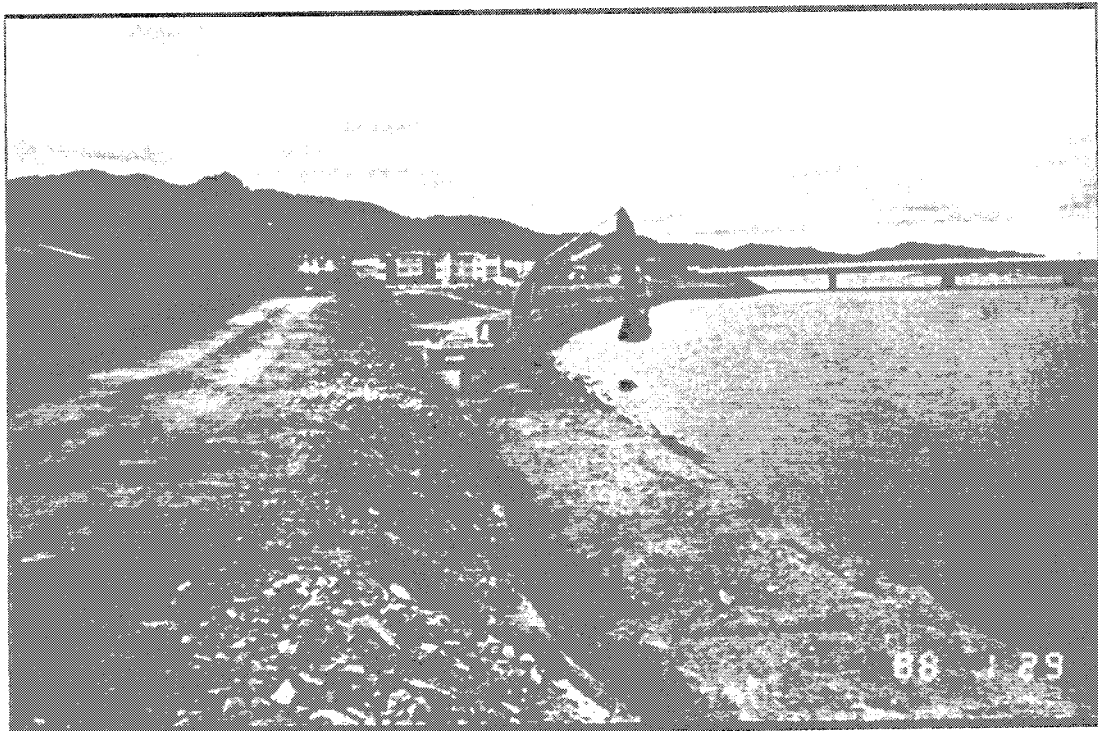


Plate 108: Croft Grove reconstruction of stopbank 1988.

PROJECT REPORT 45

UPPER HUTT BYPASS - RIVER WORKS

River realignment and training works in conjunction
with the Upper Hutt Bypass Road

- Date:** 1985-88
- Plan Number:** MWD plans held under WRC Rivers Control 9 and 10 series.
- File:** WRC 8/7/14, N/60/2/1. Refer Upper Hutt Bypass River Works Report
- Location:** Refer Appendix A, figure 7-9
Current River Traverse - river C/L
14,600 m to 18,900 m and 20,800 m to 24,200 m
- Reason for Initiation:** Construction of a motorway extension on the banks of the Hutt River north of Silverstream to bypass Upper Hutt had been considered since the late 1940s. From 1966 to 1971 channel realignments and training works were carried out by the Hutt River Board on behalf of the National Roads Board in preparation for the proposed road construction.

Because of the deteriorated state of existing river training works, and due to the need to make adequate provision for protection of the Bypass Road a new river training scheme was designed by the M.W.D.
- Previous Work:** Refer Project Report 16.
- Construction:** In 1985 the Ministry of Works and Development and Upper Hutt City Council commenced construction of the Upper Hutt Bypass Road and associated River Works.

The River Works were designed to maintain the channel in a stable meander pattern of dimensions (width, wavelength, etc.) calculated to approximate the River's natural pattern. The pattern was reinforced with rock at the outsides of bends and by retards and willow planting in other places.

Works south of the Moonshine Bridge were carried out by the Ministry of Works and Development and works north of Gibbons Street were the carried out by the Upper Hutt City Council. Costs were shared by the Upper Hutt City Council, National Roads Board and Wellington Regional Council.
- Design Capacity:** Roadway at 20 year return period flood level, Protection works designed for 100 year return period (2124 cumec) flood, with detailed provisions for ongoing maintenance.
- Designer:** Road Works:
Ministry of Works and Development for MWD section 14,600 m to 18,900 m
Upper Hutt City Council for UHCC section 20,800 m to 24,200 m
- Construction:** Ministry of Works and Development section 14,600 m to 18,900 m
Upper Hutt City Council section 20,800 m to 24,200 m
Wellington Regional Council - for all willow planting and retards

Supervision:

By party responsible for construction

Cash Flow:

Capital cost of River Works \$3,043,000 shared by the National Roads Board and Upper Hutt City Council

Annual maintenance commitment of \$(1988)93,000 from the Wellington Regional Council for 25 years.

Cost sharing agreement for "Disaster Damage".

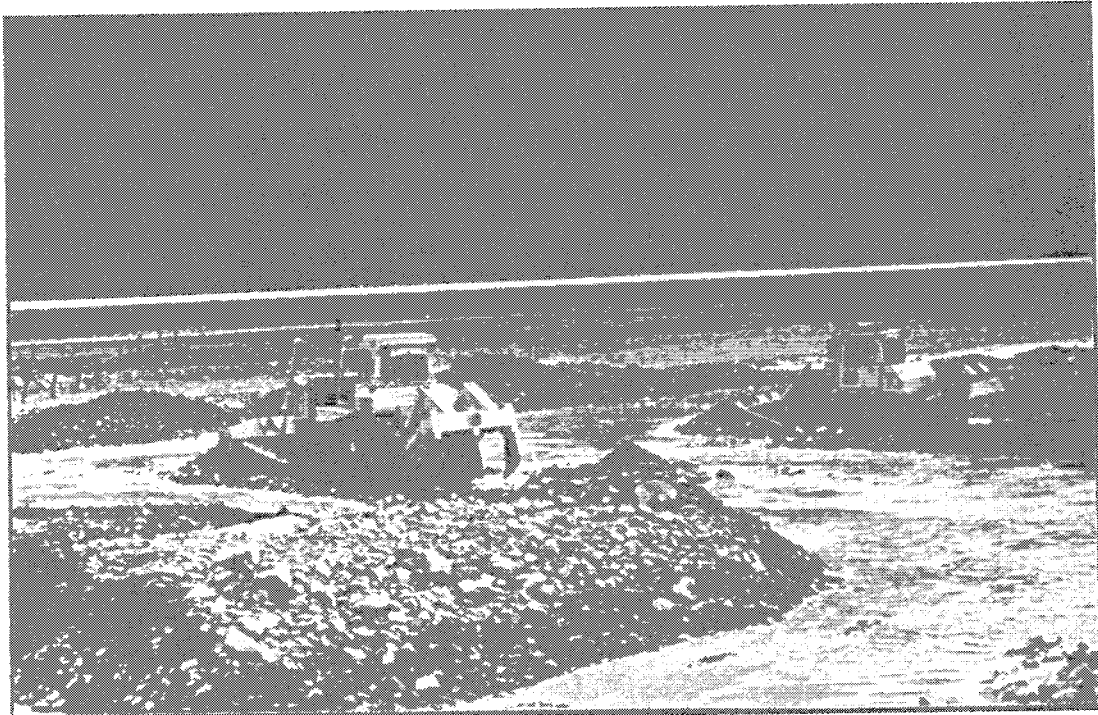


Plate 109: Upper Hutt Bypass River Works - establishment of meander pattern.

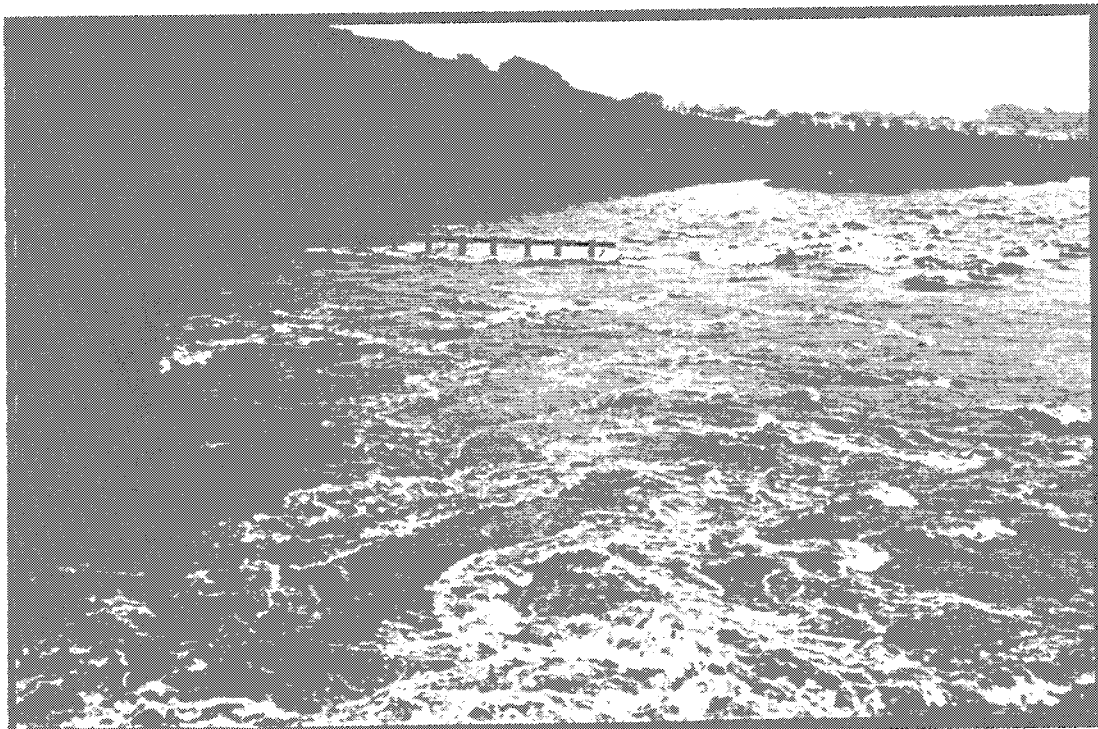


Plate 110: Upper Hutt Bypass - Maoribank deflector and river wall 1989.

PROJECT REPORT 46

EWEN BRIDGE AREA - TEMPORARY STABILISATION WORKS

Date:	1989
Plan Number:	No plan
File:	N/3/10/2, N/3/13/18, N/3/13/22
Location:	Refer Appendix A, figure 3 Current River Traverse - river C/L 3,165 m to 3,605 m
Reason For Initiation:	This work originates out of the Channel Management Report commissioned for the Ewen Bridge Gateway Study and was identified as urgent works required as a temporary measure to complement existing works and prevent potential loss of the bank and remaining berm by high velocity flood flows.
Design Capacity:	N/A
Designer:	G and E Williams Consultants Limited
Constructed By:	Wellington Regional Council
Supervised By:	Wellington Regional Council
Construction:	Left Bank Protection - 3,265 m to 3,320 m Clearing of existing bank batter, bank shaping utilising river gravels from exposed beach opposite Andrews Avenue Lower Hutt, placement of 50 lineal metres of rock lining on the left bank immediately downstream from the riverbank car park. Right Bank Protection - 3,165 m to 3,605 m Construction of two timber groynes on the western bank opposite Andrews Avenue. Located downstream of another timber groyne which was constructed in the 1920s. In addition to the timber groynes, rock was placed in the area. Eight rock snub groynes proposed to be constructed between the timber groynes and the Ewen Bridge.
Construction Materials:	Left Bank - 1,000 tonnes of Grade B rip-rap from Pongaroa in the Wairarapa and as specified in Contract 130. Right Bank - Eight timber poles and 3,200 tonnes of rock as above.
Cash Flow:	1989/1990 \$240,000 (to 31/3/90)
Comments:	Much of the rock placed will be reused once a permanent solution to bank protection has been implemented.

PROJECT REPORT 47

TREE REMOVAL AND STOPBANK REINSTATEMENT AT EWEN PARK/MELLING RESERVE

Date: 1989

Plan Number: HR2272 Plan held in Rivers cabinets

File: N/3/10/2

Location: Refer Appendix A, figure 4
Current River Traverse - river C/L
Left Bank 4,492 m to 4,585 m

Reason For Initiation: To remove the silver poplars growing on a steep riverside edge of the left stopbank in the Ewen Park area (upstream of Melling Bridge) The poplar stands were preventing maintenance and posing a risk to stopbank stability.

Design Capacity: N/A

Designer: Wellington Regional Council

Constructed By: Wellington Regional Council, with hired plant

Supervised By: Wellington Regional Council

Construction: After removal of the silver poplars the stopbank was reinstated by benching and placement of imported fill with compaction by roller.

Construction Standards: All testing of material and construction was carried out by Material Advisory Services.
A "New Zealand Heavy" compaction test was carried out on the source material to establish the optimum number of roller passes.
Materials Testing and Advisory Services tested compaction at a number of locations and found an average of 98.4 percent of maximum dry density.

Materials Used: The cleared site was reinstated with quarry overburden from Firths Quarry at Belmont.
The existing stopbank material was silty with a substantial amount of construction rubble. This necessitated extensive cut back with 3,294 cubic metres of fill being placed.
Material from the site clearing operation was used as topsoil with no additional topsoil required to be imported.

Cash Flow: \$ 29,000

Subsidy: N/A

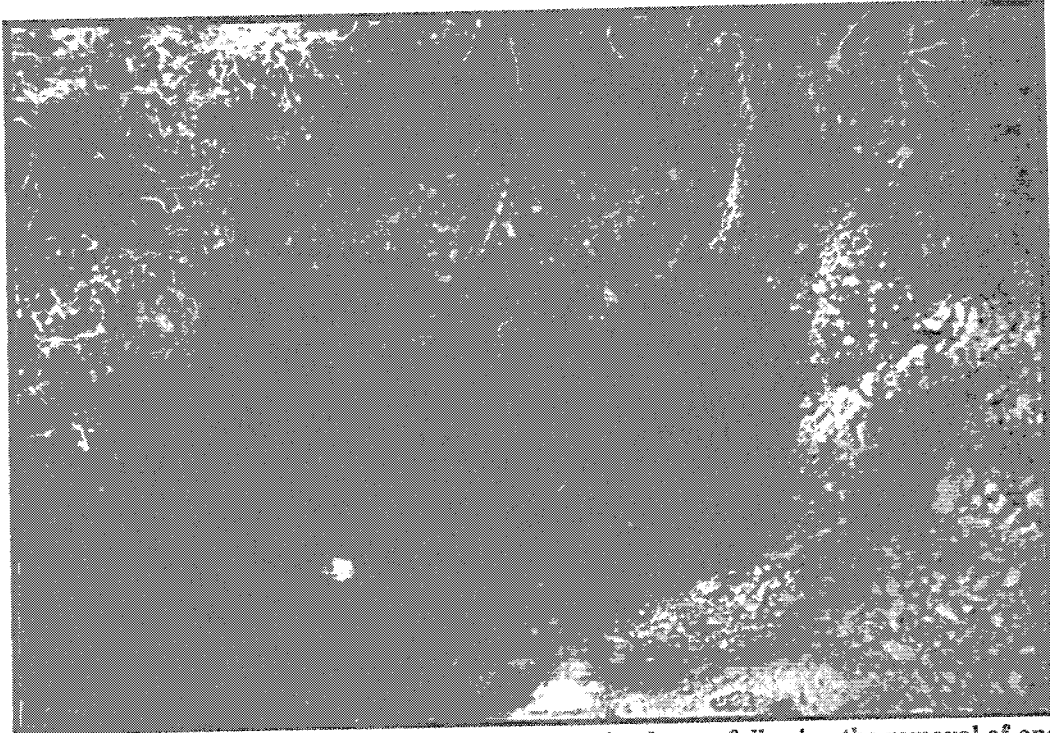


Plate 111: Melling Stopbank. Exposure of the stopbank core following the removal of one willow stump.

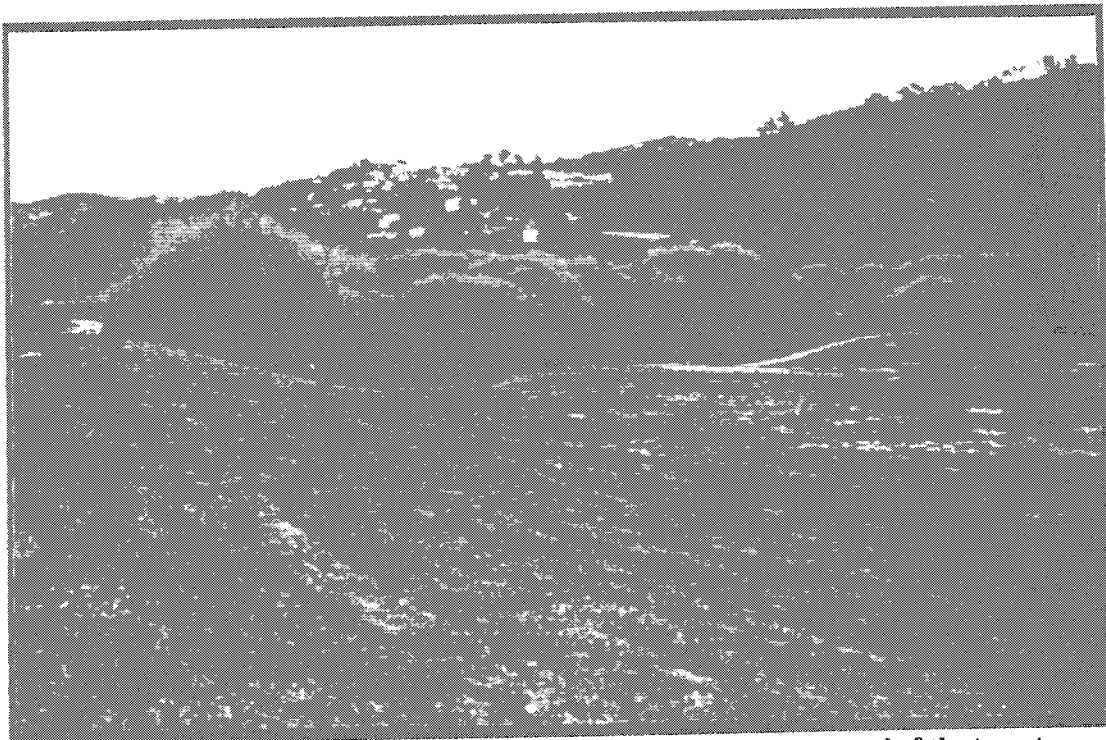


Plate 112: Melling Stopbank. Reconstruction of the bank after the removal of the tree stumps.

PROJECT REPORT 48

CROFT GROVE POINT TO BLACK CREEK OUTLET BENCH CONSTRUCTION AND RIP-RAP PLACEMENT

Date:	1990
Plan Number:	HR2274
File:	N/3/10/2
Location:	Refer Appendix A, figure 2 Current River Traverse - river C/L Left Bank 1,148 m to 1,334 m
Reason For Initiation:	<p>The left (east) stopbank from Estuary Bridge to Black Creek outlet is vulnerable to attack since there is little or no berm protecting the stopbank from flood water.</p> <p>The flow constriction at the Woollen Mills point (Cross Section No. 0130, 1,173 m) causes substantial increases in flow velocity. Scour depths adjacent to the stopbank near this point are up to 6 m below mean tide level.</p> <p>Prior to this work the situation was exacerbated by a steep batter which was in a bad state of repair and could not be maintained.</p>
Design Capacity:	Top of bench and rip-rap at 2-5 year flood level
Designer:	Wellington Regional Council
Constructed By:	Wellington Regional Council, with hired plant
Supervised By:	Wellington Regional Council
Construction:	<p>Rip-rap and concrete blocks were placed around the point in 1984 - refer Project Report 37 - but the river had since scoured under the concrete blocks creating an unstable overhang. The limestone rip-rap used was also not considered sufficiently durable to remain.</p> <p>The section from Estuary Bridge to the downstream side of the point at 1,173 m was benched and rip-rapped early 1988. This project completed the reach to the Black Creek outlet with secure, durable rip-rap and reinstated and repaired the stopbank to facilitate proper maintenance, and provided a bench to further protect the stopbank toe in the reach upstream of the point.</p>
Construction Materials:	<p>Grade A and B rock as specified in Contract 130 (Supply of Rock Rip-rap). Rip-rap grades to Wellington Regional Council standard rip-rap specification. Rip-rap placed in three distinct zones of grade A, B and mixture of A and B rock. Rip-rap used : Grade A - 1200 tonne, Grade B - 2300 tonne.</p> <p>Rip-rap was placed on rock fill (1,400 cu. m) imported from Winstone's Quarry. Overburden (600 cu. m) was trucked in and used in reinstating the stopbank.</p> <p>TENSAR reinforcing mesh was used over a 60 m length of the stopbank</p>

to protect the lower 2.25 m of the stopbank toe giving protection up to R.L 2.6 m which is above the "100 year flood" at this location.

Cash Flow: 1989/90 \$223,000 (to 31/3/90)

Subsidy: N/A

Comments: Also refer to Project Report Nos 37, 44

PROJECT REPORT 49

TWIN BRIDGES DEBRIS FENCES, GILLESPIES ROAD BANK PROTECTION AND AKATARAWA BRIDGE PROTECTION

Date: 1985-1989

Plan Number: Refer to files

File: 8/5, 8/7/2, 8/7/18

Location: Refer Appendix A, figure 9
Current River Traverse - river C/L 26,720 m to 27,100 m

Reason For Initiation: Twin Bridges - An area of established willows was being attacked by moderate flows in the Hutt River. A secondary river channel was forming through the area and posing an erosion threat to a significant riverbank at the rear of residential properties along Bridge Road.

Gillespies Road - In response to a letter from a local resident. Local erosion of esplanade reserve on right bank upstream of bridge over Hutt River at Akatarawa.

Akatarawa Bridge Protection - Local protection works

Design Capacity: N/A

Designer: Wellington Regional Council

Constructed By: Wellington Regional Council

Supervised By: Wellington Regional Council

Construction: Twin Bridges - Construction of four debris fences across the secondary channel along with some layering of large willows. Followed by additional willow plantings with a more vigorous species in the season following construction.

Construction Materials: Twin Bridges - Debris fences constructed of driven railway irons at 3 m centres 4 wire ropes per fence.

Cash Flow:

Twin Bridges:	
1987/1988	\$4,000
1988/1989	\$3,000
Gillespies Road:	
1985/1986	\$1,000
1986/1987	\$5,500
Akatarawa Bridge:	
1986/1987	\$3,000

Comments: These works were undertaken as part of the River Control, Mabey Road Operations programme of works.

PROJECT REPORT 50

KENNEDY-GOOD BRIDGE PROTECTION WORKS

Date:	1987-1989
Plan Number:	No plans
File:	8/5
Location:	Refer Appendix A, figure 4 Current River Traverse - river C/L Left Bank 6,610 m to 7,250 m
Reason For Initiation:	<p>The Hutt River channel at this location widens and the bed slope flattens resulting in river metal deposition and misalignment of the channel. To correct this, regular cross blading has been required at an estimated cost in the order of \$100,000 in 4 years.</p> <p>In October 1986 a fresh in the river caused considerable bank erosion with large bands of willows being attacked over a 200 m reach. Subsequent cross blading received adverse publicity and so a more permanent solution was sought.</p>
Design Capacity:	N/A
Designer:	Wellington Regional Council
Constructed By:	Wellington Regional Council
Supervised By:	Wellington Regional Council
Construction:	Involved extension of the width of the existing willow band and establishing willows in the river bed. Willow plantings are protected by 20 debris fences (nominally 15 m long, constructed of driven railway irons at 3 m spacings with 4 strands of wire rope).
Cash Flow:	1987/88 \$16,000 1988/89 \$24,000
Comments:	<p>The function of the debris fences is to offer protection to the establishing willows and will not be required once sufficient growth has occurred.</p> <p>These works were undertaken as part of the Rivers Control, Mabey Road Operations programme of works.</p>

PROJECT REPORT 51

TRENTHAM MEMORIAL PARK - BANK PROTECTION WORK

Date: 1984-87

Plan Number: No specific plan pertaining to this work, but for general design of debris fences refer WRC plans HR3156, HR3158.

File: 8/7/2

Location: Refer Appendix A, figure 7
Current River Traverse - river C/L
Left Bank 17,596 m to 18,583 m

Reason For Initiation: Some bank protection work was done in this reach prior to the commencement of construction for the Upper Hutt Bypass Road in 1985. This was followed by Upper Hutt Bypass River Works in 1986/87.

Design Capacity: N/A

Designer: Wellington Regional Council

Constructed By: Wellington Regional Council

Supervised By: Wellington Regional Council

Construction: Left Bank (17,596 m to 17,920 m) - This reach is the beach adjacent to the outlet of the Trentham Memorial Park outlet drain. Existing fences were re-erected and any gaps filled in. Four new debris fences were erected.

Left Bank (18,260 m to 18,583 m) - This was the first beach on the left bank and downstream of the Moonshine Bridge. Eleven debris fences were erected.

All fences were of a standard design with railway irons at 3 m spacings and four strands of wire rope. Fences were constructed at 45 degrees to the river centre line (facing downstream).

Cash Flow:

1984/1985	\$9,000
1985/1986	\$ Nil
1986/1987	\$ 12,000

Subsidy: Carried out as part of the Hutt River subsidised works, maintenance and repairs.

PROJECT REPORT 52

BELMONT (RIGHT BANK) BANK PROTECTION WORK

Date: 1984-1989

Plan Number: N/A

File: 8/7

Location: Refer Appendix A, figure 5
Current river Traverse - river C/L
Right Bank 6,100 m to 8,430 m

Reason For Initiation: Over this reach of the Hutt River from 600 m downstream to 1500 m upstream of Kennedy-Good Bridge there has been substantial urban development.

Downstream of the residential development in the vicinity of Owen Street (7380 m to 8190 m) there are large areas of berm predominantly used for recreation purposes.

Upstream of Owen street area State Highway 2 is close to the river with little berm as a buffer.

The Hutt River main channel is hard against the riverbanks at a number of locations along the reach. Protection against bank and berm erosion has been done as preventative maintenance.

Design Capacity: N/A

Designer: Wellington Regional Council

Constructed By: Wellington Regional Council

Supervised By: Wellington Regional Council

Construction: Predominantly willow and poplar plantings, with some small areas of fill.

Cash Flow:

1984/1985	\$2,000
1985/1986	\$16,000
1986/1987	\$15,000
1987/1988	\$34,000
1988/1989	\$25,000
1989/1990	\$20,000 (to 31/3/90)

PROJECT REPORT 53

MANOR PARK GOLF COURSE - RIVER BERM AND BANK PROTECTION

Date: 1984

Plan Number: No relevant plans

Files: 8/7, 8/7/1

Location: Refer Appendix A, figure 6
Current River Traverse - river C/L
Right Bank 13,430 m to 13,660 m

Reason For Initiation: Continuing bank erosion along the river berm was highlighted by a fresh in November 1983 in which approximately 300 m of bank (up to 2 m high) was affected with up to 3 m of lateral erosion. Willow trees were also lost.

Design Capacity: N/A

Designer: Wellington Regional Council

Constructed By: Wellington Regional Council

Supervised By: Wellington Regional Council

Construction: Works involved battering of the river bank, construction of debris fences, toe protection and plantings. General riverbank erosion protection involved planting of willows in a band nominally 20 m wide throughout susceptible areas.

Cash Flow: 1984/1985 \$14,000

PROJECT REPORT 54

RECORDED ANNUAL EXTRACTION VOLUMES HUTT RIVER 1928-1987

The following pages copy a Wellington Regional Council report identifying the location of the sources of river shingle on the Hutt River for the period 1928-1987. The sites are also marked on the Historical Works location plans, figures 2 to 10, Appendix A using the same notations.

Sources prior to 1928 are referred to in Archive Tables 9 to 11, "Explanation of the Shingle Resource", and in figure 22, "Log of Extraction Activity, Estuary to Belmont, 1900 - 1955".

Refer to the Wellington Regional Council Rivers Department for sources after 1987.



THE WELLINGTON REGIONAL COUNCIL

COPY

22 February 1988
File: 8/7/3/4 (ajw:160)
cc 8/7/10
8/28

GRAVEL EXTRACTIONS FROM THE HUTT RIVER 1928-1987

Gravel Extractions - for each company are shown on the following pages. The positions of the companies have been shown on the Series of the Lower Hutt Valley aerials (1-9) with red half circles - Plan No. 304, 1985. Ref Aerials Filed 8A/68. Firth returns from 1980 specify a point of removal as their licence covers an extensive reach of the river. These have been shown on the same aerial prints with pink 120° segment and numbered as shown on the forms. 11R 2256

An aerial photo reference number for each company appears at the bottom of the page.

References used:

Hutt River Board Files	54,155
Wellington Regional Council Files	2/3/2
	8/7/9/2
	8/7/10
	8/28
	86

- Shingle Removal Schedules
+ 1963-1979 summary included in schedule files.
- WRC Chief Engineer's Report 1974-84.

COPY

SHINGLE EXTRACTION (IN M³) 1

	Butt-Petone Shingle Supplies (Gear Is.)	White's Line Shingle Co. To MS Ltd	Bognuda Arkans Blythe Harsden St.	Rivers, Sand Single - total for 4 sites	Deaper	Wellington Concrete Pipe Co.	P.V.D. (Site Unknown)	Unaccounted for	Yearly Total
1928/29				12,671				78,122	90,793
1929/30				11,815				84,674	96,489
1930/31				37,570				19,712	57,282
1931/32			5,501	33,988		5,038		19,344	63,871
1932/33			2,116	3,739		2,372		33,611	41,838
1933/34			3,377	8,214		5,474		18,679	25,744
1934/35	1,491		4,198	19,664		7,271		8,579	41,203
1935/36	7,413		7,157	25,051		7,745		6,934	54,300
1936/37	7,327		14,338	20,864		10,008		7,014	59,551
1937/38	5,094	535	13,751	20,395		20,811		26,930	87,516
1938/39	11,575	6,307	14,484	28,215		25,214		12,350	98,145
1939/40	8,406	18,173	17,790	31,171		30,202		15,007	120,749
1940/41	5,655	11,692	11,874	22,318		14,221		12,885	78,645
1941/42	5,446	8,701	14,426	28,073		11,919		12,553	81,118
1942/43	7,158		25,155	33,621	5,848	18,423		9,123	99,328
1943/44	6,148		20,523	45,961	3,463	22,470	43,388	13,473	155,426
1944/45	9,522		29,127	29,841	3,463	14,978	32,409	17,378	136,718

Aerial
Photo
Reference

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COPY

SHINGLE EXTRACTION (IN M³) 2

	MES Ltd	Bognuda Marsden Street	RSS Mills Road	River Sand & Shingle Walling	River Sand & Shingle Belmont	Sand Supplies	Central Sand & Shingle Road	Bognuda Mabe Road	Butt Petone Taita	V A Draper & Co.	RSS Butt	Egim Concrete Pipe	Roads Metal	PMD	Wreck- atiki Misc	Yearly Total
1945/46	639	12362	528	3538	22977		2883	15691	17160		3537	10757		2006	10185	102263
1946/47	2625	7078	6232	2479	16774		16700	9580	6689	4218	5798	4622			8967	91763
1947/48	1499	6844	6122	666	15153		16598	12727	4762	6944	7735	8850		1953	1595	91448
1948/49	2251	7773	5263		19589		13867	11209	3523	2128	8040	12320			12028	97991
1949/50	2314	7854	7821	89	17802		16288	11106	4155	6471	5217	11512			6602	97231
1950/51	1962	7527	7389	5832	16192		17666	12278	4077	6418		17582			2205	99128
1951/52	1924	9472	7749	4344	19246		29636	15321	3312	9490	3587	19841			2051	126173
1952/53)																130693
1953/54)																
1954/55)																
1955/56)																
1956/57)																
1957/58)																
1958/59)																
1959/60	2021		14253	12933	52642	26649	28250	13150	18079	2021		16066	4314	2366	11444	204820
1960/61	945		19488	9372	58982	29277	24535	15695	25698	677		20739	3574	1323	13715	224139
1961/62			20628	13468	75283	21345	25077	12050	32246			25384	1514		12679	240401
1962/63			12083	8516	86413	24920	30546	11533	36629	5795		19519	1179		15232	252786

Upper Valley

Aerial Photo Ref. (2) (3) (4) (5) (5) (6) (6) (6) (7) (7) (8)

COP

SHINGLE EXTRACTION (IN M³) 3

	River Shingle & Sand	Sand Supplies	Central Sand & Shingle	Bognura Adams & Rhythe Mabe Road	Hutt Petone Shingle Supplies Taita	V A Draper & Co.	Wgm Concrete Pipe Co.	Road Metals	Donner Silverstream to 1970 then Upper Hutt	Misc.	Yearly Total
1963/64	128,004	29,093	36,074	8,692	32,936	3,648	27,163	3,182		1,101	282,803
1964/65	105,574	26,311	37,056	10,720	43,405	3,772	38,145	73	50,938	272	319,340
1965/66	69,132	19,392	27,809	8,961	49,276	845	41,289	23,827	29,751	297	286,025
1966/67	28,972	17,210	22,430	9,385	25,745		33,927	24,755	26,704	297	195,771
	To Firth 1979 to v a syndicate										
1967/68				198,546) North of					47,674	75	246,295
1968/69				160,049) Silverstream					50,734	62	210,845
1969/70				177,321) Bridge					56,198	45	233,564
1970/71				228,292) Haretanga					50,646	86	279,024
1971/72				193,169) Golf Course					34,353	6,583	234,105
1972/73				190,188) Totara Park				Webb Sand Supplies Houth	36,215	115	226,518

Aerial
Photo
Reference

(5) (6) (6) (6) (6) (6) (7) (8)

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SHINGLE EXTRACTION (IN M³) 4

	River Shingle & Sand Supplies	Central Sand & Shingle	Rognath Adams & Elythe Mabey Road	Hutt Petone Shingle Supplies Taita	V A Draper & Co.	Wgun Concrete Pipe Co.	Road Metals	Downer Silverstream to 1970 then Upper Hutt	Makaitiki	Misc.	Yearly Total
1973/74	59,794	8,587	11,705			38,414	67,113	52,377		242	237,232
1974/75	41,922	6,077	9,445			5,675	65,641	57,116			185,876
1975/76	51,219						56,531	44,283			152,033
1976/77	29,143						52,106	32,775			114,024
1977/78	67,207						46,835	31,397			145,439
1978/79	32,497						45,464	32,016			109,977
1979/80	FIRKH 31,308						39,473	22,468			93,249

Upper Valley +9

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Aerial Photo Reference

Upper Valley

SENGLE EXTRICATIONS (IN \$'S)

expansion of Fifth Barrages from Belmont

	WEBB	FIFTH Barrage	YARDY Total	BENNY* Bridge	Belmont School	Belmont Beach	Kennedy Good Bridge	Golf Club	Certified Beach	Peet Office Beach	Memorial Park	Avallon	Oxydite Quarry	Mulling St	Ovan	Barraxat	Connoly Street	Balta Drive	Melky Road	Liverton Road	Pusare Beach	Walon Beach	SILVER-streem Bridge	Tonona Park	Decorated For
1980/81	54,295	89,311	175,267		10,184			20,022	3,250	15,604	15,028	1,614										20,237			35,938
1981/82	58,566	94,941	184,960	2,687	25,463			10,398	5,819	15,604	17,584	4,895										27,272	1,046		
1982/83	48,229	60,655	145,265																				4,899	14,650	
1983/84	44,289	92,536	175,389	4,396	5,856					11,445		17,118			9,865		14,387	11,274	725			1,888			21,111
1984/85	38,417	60,538	161,289			8,495			4,747	5,825		6,239		3,687	7,089				2,386			746			30,177
1985/86	37,025	36,213	118,231	6,389					8,577	1,668				337											
1986/87	34,760	53,235	108,260		7,879	1,514			4,346	4,601		3,000	6,400	825								7,298			

Amical Photo Reference (1) Upper Valley

(1) No. 1 (5) No. 4 (5) No. 3 (5) No. 5 (5) No. 2 (4) No. 2 (3) No. 1 (2) No. 1 (5) No. 6 (7) No. 3 (6) No. 1 (6) No. 2 (6) No. 3 (5) No. 1 (7) No. 2 (6) No. 1 (7) No. 1 (6) No. 1 (7) No. 1 (9) Valley No. 1