

Friends Of Paekakariki Streams

Wainui Catchment

Status Report

Draft Version 3

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for the Friends Of Paekakariki Streams

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## Table of Contents

Report purpose.....	3
Hydrology.....	3
Landcover.....	5
Water quantity.....	7
Flow readings.....	7
Water use.....	8
Paekakariki Water Supply.....	8
Underground water.....	9
Past extractions.....	9
Recreational use.....	10
Water quality.....	12
Nutrients/Contaminants.....	12
Faecal.....	13
Point source pollution.....	14
Biological.....	15
Fish.....	15
Macroinvertebrates.....	17
Fish passage.....	18
Barriers.....	18
Wellington Road Queen Elizabeth Park bridge.....	18
Queen Elizabeth Park old paddle pond weir.....	18
Te Puka Stream weir.....	18
Te Puka Stream State Highway 1 culvert.....	18
Te Puka Stream West State Highway 1 culvert.....	18
Wainui Stream State Highway 1 culvert.....	18
Impediments.....	19
Flooding.....	20
Extent.....	20
Risks to the community.....	21
Instream interventions.....	23
Gravel extractions.....	23
Stream mouth cutting.....	23
Future developments.....	24
Transmission Gully motorway.....	24
Exotic forest clearance.....	24
Restocking Perkins farm.....	24
Marginal Strips reserved.....	24
Paekakariki Water Supply consent operation.....	24
Housing development pressure on minimum flows.....	25
Climate Change.....	25
References.....	26
Appendices.....	27

## **Report purpose**

This report aims to set out some basic information about the status of the Wainui catchment and its streams that flow into Paekakariki. It provides available information on a range of resource attributes of the stream and their current state. The report also outlines likely expected future developments and their potential impacts on the catchment and its streams.

It is hoped that this report can provide a resource for any discussions about the current and future use and management of the streams. The Author welcomes any constructive feedback and notification of any further available information that can add to the usefulness of this report for all.

## **Hydrology**

The Wainui catchment comprises about 784 hectares. It rises from sea level to its highest point at Mt Wainui at 722 metres over a distance of about 5.6 km. It is a moderately short catchment that is susceptible to short duration rainfall events. The upper third is steep hills and covered in regenerating native forest. The middle third is steep hills covered in exotic forest and farmland. The lower third is alluvial outwash fans, flatter depositional areas, and sand dunes dissected by the outlet to the sea.

It flows through the southern end of the Queen Elizabeth Park and enters the sea north of the Surf Lifesaving Club.

It is one of three catchments in Paekakariki. The Waikakariki Stream drains under Paekakariki Hill Road, past the motels, and under Ames St, entering the sea south of Beach Road. The Lookout catchment is rather dry, entering the sea south of the Fishermans Table restaurant.

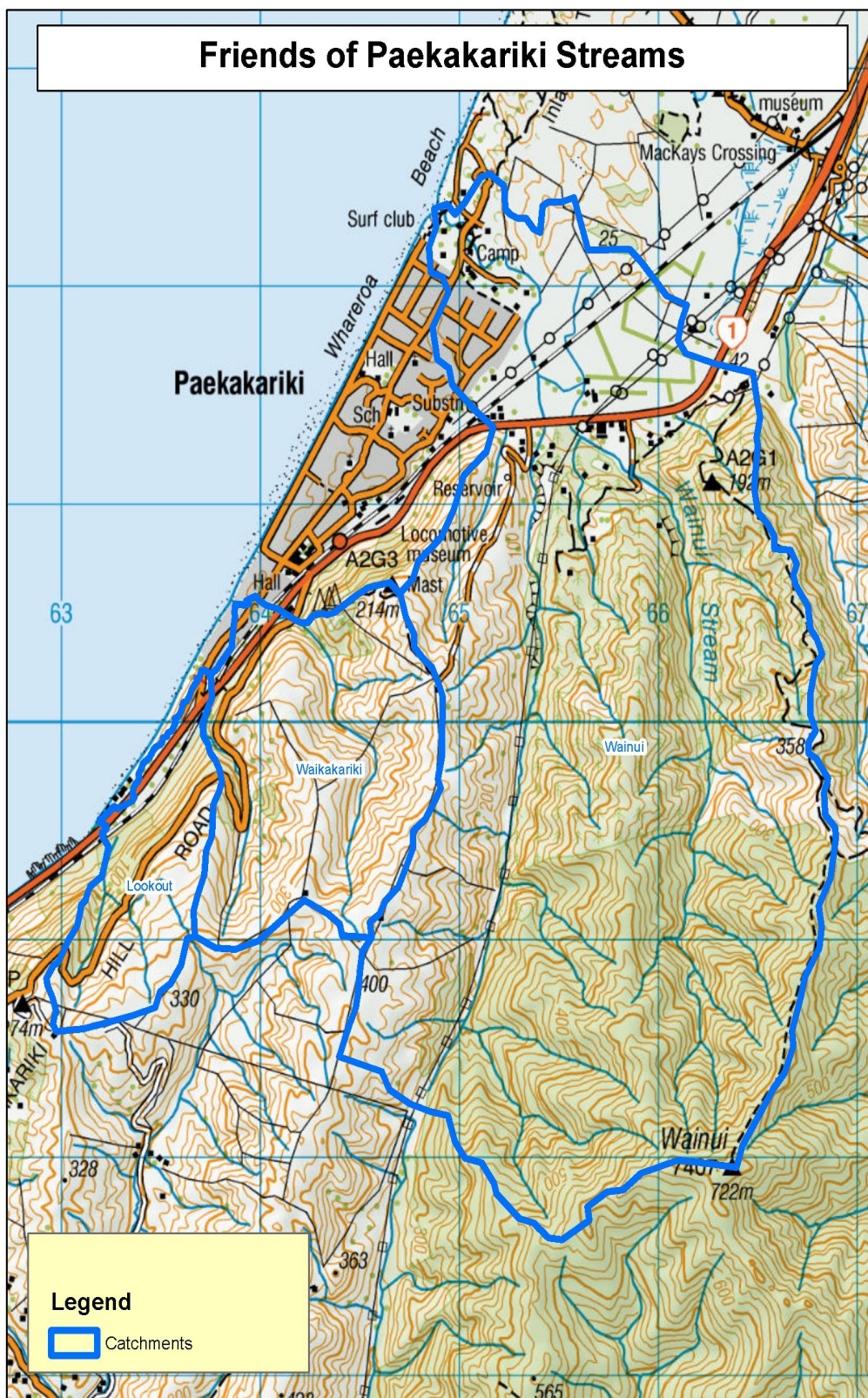


Figure 1: Paekakariki catchments

## Landcover

Landcover comprises primarily native forest, pasture, and exotic forest:

<b>Landcover</b>	<b>Catchment percentage</b>
Native forest	37
Grassland	30
Exotic forest	26
Cropland	3
Residential	3
Scrubland	1

*Table 1: Wainui catchment landcover*

### Riparian Landcover

The only remaining indigenous cover is at the top of the catchment.

Replanting with indigenous cover has been progressing at the bottom of the catchment within the Queen Elizabeth Park and the motorcamp.

Recently fenced stream margins below SH1 present the opportunity to restore riparian indigenous vegetation on what was pastureland.



Figure 2: Landcover in the Wainui catchment(from LandCover DataBase V3)

## Water quantity

### Flow readings

Significant variation occurs during the year and as flows move downstream past the KCDC intake, and as flows percolate down into the unconfined aquifer.

Years 1975- 1998	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual Mean
Min	19	14	11	15	28	33	33	33	20	33	29	24	42
Mean	55	43	47	56	73	91	99	91	84	95	75	81	75
Max	148	98	199	141	175	177	164	142	181	189	200	238	105

Table 2: Wainui Stream above the KCDC intake. 1975-1998 Mean Monthly and Yearly Flows (L/sec) (KCDC 2000)

Date	Wainui above KCDC intake	Wainui below KCDC intake	Wainui @ SH1	Te Puka @ SH1	Beach
16/04/98	16	-	7	10	14
28/01/99	29	4	1	3	24
12/02/99	18	6	1	1.6	16
14/04/99	14	0.5	0	4	11
02/03/00	16	11	0.5	3	8
27/02/01	12	5	0	0	2
14/03/03	-	-	-	5	-
Median (ex nulls)	16	5	0.75	3	12.5

Table 3: Kapiti Coast Low Flow Program Gauging Results (L/Sec) (KCDC 2000)(GW 2014)



## **Water use**

There are several water extractions that impact on surface flows in the Wainui Stream.

### ***Paekakariki Water Supply***

Paekakariki water supply utilises a surface water extraction from 3 locations at Wainui Stream upper intake above SH1 that has been in operation since 1942, a bore near SH1 since 2003, and a bore behind the old car yard since 2013. The allowed extraction was for 1624 m<sup>3</sup>/day from the upper intake since 2000, and 964 m<sup>3</sup>/day from the bore since 2004, making a total of 2588 m<sup>3</sup>/day from both sources. WRC Consents 990209 (WRC 2000) and 040122 (WRC 2004).

The initial 2000 consent officers report considered “there will be at times adverse effects on the flow of the Wainui Stream from this abstraction.” “At times of little to no flow in the Wainui Stream, the bed of the stream below SH1 does contain water but it is largely stagnant” “demand management is in place for the Paekakariki community where year round sprinkler and garden watering bans are required. There is also an active leak detection and investigation programme established.” “this abstraction does have the potential to cause an adverse effect on the aquatic life of the stream.” “low flow monitoring of the Wainui Stream will continue as part of the Regional Council's ongoing gauging This will provide a greater level of information on the effect of the abstraction during the term of the consent”(WRC 2000)

The later 2003 consent (which promptly increased the abstraction by over 50%) officers report considered “Under average flow conditions there is little or no flow in the Wainui Stream in the vicinity of the water treatment plant.” “pumping may extend the period that sections of the stream are dry or cause the stream to lose flow to groundwater further upstream than currently occurs.”(WRC 2004)

In 2013 a new consent was issued for a new bore, and the old bore and intake. KCDC applied to take up to 2,160m<sup>3</sup>/day (24 hours/day) and 788,400m<sup>3</sup>/year (365 days/year), as a combined maximum water take from any combination of the three takes. This was a small reduction in the allowable take. KCDC stated that during dry periods of the years, at a point just downstream of the intake point, the volume of water in the Wainui Stream is not sufficient to maintain surface flow and all flow is within the permeable gravel/sand layers beneath the bed.  
(GW 2013a)



## ***Underground water***

In 2003 a bore was constructed that extracts from near the pumpstation at a depth of 10-12 metres from an unconfined aquifer that ranges in depth from 5-61 metres deep.?????

## ***Past extractions***

Village residences – in the early days of subdivision in the 1960's several residences in the Tilley Rd and Te Miti St area had bores to water gardens.

Sang Sue Gardens – utilised two bores for domestic/shop use, and vegetable irrigation. These 2007 consents appear to have expired/lapsed.

QEP Paddle pond – beside the motorcamp there is a derelict weir and pumphouse. This was used some years ago to fill a paddle boat pond in Queen Elizabeth Park for recreational use.

## Recreational use

The Paekakariki community and visitors enjoy a close connection with the lower reach of the Wainui Stream. Specific recreational contact occurs at several places along the lower Wainui Stream.



*Tame eels fed at the motorcamp*



*Children playing in the stream opposite the motorcamp playground*



*Children playing in the stream-mouth within Queen Elizabeth Regional Park*

# Water quality

## Nutrients/Contaminants

Time	Zinc (Dissolved)	Copper Dissolved (Lab)	Chromium Dissolved (Lab)	Field pH	DO (%S)	Temp
4/10/2006	0.002	0.0006	<0.000500	7.2	95.8193	12
14/03/2007	<0.00100	<0.000500	<0.000500	6.9	84	14
30/07/2007	<0.00100	0.0008	<0.000500	6.8	94.1	11.1
19/12/2007	0.0016	0.0013	<0.000500	6.9	65.9	14.4
23/06/2008	<0.00100	0.00098	<0.000500	6.91	59.9	13.3
8/08/2008	0.0054	0.0015	<0.000500	6.99	62.7	12.1
29/04/2009	<0.00100	0.00062	<0.000500	7.17	96.7	15
24/09/2009	0.002	0.0008	<0.000500	7.67	121.1	8.2
30/11/2009	<0.00100	0.0006	<0.000500	8.13	78.6	13
24/05/2010	<0.00100	<0.000500	<0.000500	7.73	100.4	13.5
17/08/2010	<0.00100	0.0007	<0.000500	7.22	92	11.1
30/09/2010	0.0012	0.0009	<0.000500	7.01	101.9	12.1
18/04/2011	0.0011	<0.000500	<0.000500	7.28	111.1	10.1
11/07/2011	0.0015	0.0006	<0.0005	6.7	94.2	11.4
16/07/2012	0.001	0.001	<0.0005	7.05	104	11.9
17/11/2012	<0.001	<0.0005	<0.0005	7.26	150.6	13.1
15/10/2013	0.0017	0.001	< 0.0005	7.26	96.6	11.2
31/10/2013	<0.001	0.0005	< 0.0005	7.02	99.5	13

Table 4: Water quality readings upstream of Haumia St stormwater

Other regular samples are taken from the Haumia St stormwater and from the KCDC water take. Some samples have been taken during Transmission Gully investigations.

## **Faecal**

### General E Coli levels

#### **Wainui Stream Paekakariki water supply intake**

KCDC monitor the water quality of Wainui Stream at the water supply intake significantly upstream from the treatment plant near SH1. They monitor pH, turbidity, Temperature, Faecal coliforms, and E. coli. Readings for the period 5/1/2012 – 24/12/13 were examined (KCDC 2013).

E. coli. normally ranged from <1 – 770.

During a rain event it rose to 3,200.

#### **Wainui Stream at Haumia St stormwater outlet**

KCDC monitor the Haumia St stormwater outlet wet weather flows and the upstream and downstream and other water quality.

Readings for the period 4/10/2006 – 4/12/2013 were examined (KCDC 2014)

See Appendix 2 for readings

E. coli. from the upstream Wainui catchment normally ranged from 120 – 93,000

E. coli. from the Haumia St stormwater outlet normally ranged from 220 – 56,000

E. coli. downstream from the Haumia St stormwater outlet normally ranged from 100 – 80,000 indicating some dilution of effects.

#### **River mouth**

KCDC in recent years have monitored the Wainui Stream at its mouth because this is an area that is frequented by children on the beach playing in the stream.

See Appendix 2. for readings.

Faecal Coliform ranged from 58 to 180.

#### **Grazing stock effects**

Since stock were removed from the Perkins Farm on August 28 2013, significant changes in water quality have been observed.

<b>Period</b>	<b>Upstream - wet weather flows</b>	<b>Upstream - dry weather flows</b>
4/10/2006 – 28/8/2013 (stocked)	120-93,000	870-2,200
29/8/2013 – 4/12/2013 (destocked)	220-1,100	250

*Table 5: Wainui Stream E Coli readings for Wainui Stream upstream of the Haumia St stormwater discharge*

### **2013 Controversy**

In March 2013, Massey University trainee students working under Stan Abbott monitoring the Wainui Stream found very high E. coli levels in the stream ranging from 689 - >2419 when the “action required” level was 550. KCDC erected warning signs and the residents became concerned.

Since then with stock removal from the farm upstream the levels have reduced to acceptable levels with the exception of duck faecal contamination in the lower reaches.

### ***Point source pollution***

There are two point source pollution sites, Haumia and Horomona St stormwater discharges. The Haumia St discharge is monitored by KCDC – see Appendix 2 Site O column. The pollution is not much different to that from stock on the farmland and dilution reduces it significantly in the stream due to mixing. Now that the stock have been removed the KCDC stormwater needs attention.

## Biological

### Fish

Fish records are mainly held in the NIWA national freshwater fish database (FWFD). Some other records appear in various theses, reports and studies.

The NIWA FWFD records show that no surveys have been undertaken in the upper Wainui Stream. It records the following:

Reach	Section	Year	Species
Lower Wainui	Motorcamp	1984	Redfin bully, shortfinned eel koura, giant kokopu
Lower Wainui	Motorcamp	2002	Redfin bully, common bully, shortfinned eel, giant kokopu, torrentfish, longfinned eel
Lower Wainui	Motorcamp	2005	Koura, giant kokopu, common bully
Te Puka	Above SH1	2007	Longfinned eel, koara, redfin bully
Te Puka	Motorcamp	2002	Longfinned eel, redfin bully, koura
Te Puka	Pines	2002	Longfinned eel, banded kokopu, redfin bully, inidentified eel, shortfinned eel
Te Puka	Upper pines	2007	Redfin bully, longfinned eel, koaro
Te Puka	Top	2007	Koaro, longfined eel

*Table 6: Wainui catchment fish occurrences – NZ Freshwater Fish Database*

Atkinson 2008 found shortfinned eel, longfinned eel, giant kokopu, redfin bully, and common bully below the Te Puka Stream weir, and only longfinned eel and redfin bully above. The conclusion was that shortfinned eel, giant kokopu and common bully were not able to pass the Te Puka Stream weir. When compared with the FWFD it records no giant kokopu and common bully above the weir, and only one shortfinned eel in 2002 despite 5 survey points.

The Transmission Gully Technical Report #9 (Boffa Miskell 2011) found only koaro, red fin bully, longfinned eel. These were repeated in the evidence of Vaughan Keesing. The distribution was as follows:

Species	Te Puka Upper	Te Puka Mid	Te Puka Lower
Longfinned eel	1	1	9
Koaro	3	10	4
Redfin bully	0	9	26

*Table 7: Te Puka Stream fish distribution*



Mike Joy found there were many koaro in the upper catchment and longfin eels, in the lower catchment there were giant kokopu and both species of eels, giant bully, redfin and common bully. (Joy 2014)

Longfinned eel are regularly fed by locals and visitors beside the motor camp and are something of an attraction.

Numerous giant kokopu have been observed in the lower reaches adjoining the motorcamp.

Electric fishing by Mike Joy beside the motorcamp in 2014 found eel, torrentfish, inanga and shrimps.

Longfinned Eel, Giant Kokopu, Torrentfish, Koaro and Redfin Bully are all classified as “At risk” threat status. (DOC 2014)

Spawning at the stream-mouth has not been surveyed or recorded (Taylor & Kelly 2001)

# Macroinvertebrates

## Appendix 9.H Macroinvertebrate Data

SEV Macroinvertebrate List	Te Puka upper			Te Puka mid			Te Puka lower		
	TE-U(a)	TE-U(b)	TE-U(c)	TE-M(a)	TE-M(b)	TE-M(c)	TE-L(a)	TE-L(b)	TE-L(c)
<b>SEV Version 8.2</b>									
<b>Ephemeroptera</b>									
Acanthophobia	r	r	r			r	r	r	r
Aenictopus	r	r	r			r	r	r	r
Austroclima						r			
Colobyriscus				c	c	c	c	c	c
Deleatidium	r	r	r	va	va	va	va	va	va
Ichnybotus									r
Masutulus									
Neocleptelia							r	c	r
Nesozelus	c	r			r	r	r		
Zephlebia sp		r	r	r			r		
<b>Trichoptera</b>									
Aoteapsyche	r			a	a	r	r	r	r
<b>Scaraeoptera</b>									
<b>Custachaeidae</b>									
Crynoscilla				r		r			
Cryphocrella									
Melicopsyche		c			c	c	r	r	r
Hydrobiosella	c	r	c	r	a	c	c	a	a
Hydrobiosis sp.							r	r	r
<b>Oeconesidae</b>									
Olinga	r			va	a	va	va	a	a
Orthopsyche		a	c				a	c	r
Plectrocnemia	r		r	c		r	c		
Polylectropus									
Psilochorema				r	c	c	a	r	c
Pycnocentris						c			
Pycnosentroides				na	va	a	a	a	a
Tetrasica									
<b>Stenoptera</b>									
Acroperla									r
Austroperla	c	r							
Spaniocerca		c							
Stenoperla	r	r	r	r	c	r	a	r	a
Telandobius	r	c							
Zelandoperla	a	c	r	r	c	r	c		r
<b>Hemiptera</b>									
<b>Coleoptera</b>									
Elmidae	c			a	va	va	a	a	a
Ptilodactylidae	r		r		r				
<b>Udonata</b>									
Andropedochloa									
<b>Neuroptera</b>									
<b>Isopoda</b>									
Hydrochila							r		r
Austrosimulium									
Eriopterini	c	c	c	c	a	a	a	a	c

Table 8: Te Puka Stream macroinvertebrates

## **Fish passage**

### **Barriers**

There are six man-made barriers to fish passage, which have been documented several times over the years but nothing has been done to remove the barriers. The significant surveys are Aiken 2008, Atkinson 2008 (Barrier surveys in years 2006 & 2008), and Greater Wellington 2013.

### **Wellington Road Queen Elizabeth Park bridge**

This is a large box culvert under the Wellington Road extension into Queen Elizabeth Park. It is owned by DOC and managed by Greater Wellington regional council.

### **Queen Elizabeth Park old paddle pond weir**

This is a small weir beside the motor camp in Queen Elizabeth Park. It is owned by DOC and managed by Greater Wellington regional council. It was previously constructed to supply water to a paddle boat pond in the Park with the help of adjoining pumpstation. It appears to be built on top of army camp building rubble from WWII. It needs assessment and Greater Wellington appear to have assessed it but the results are not to hand.

### **Te Puka Stream weir**

This is a river flow measurement weir. It is generally considered to be operated by Kiwirail but this can not be confirmed with anyone. It comprises a weir with three flow measurement devices in the form of a level gauge, downstream depth recorder and upstream depth recorder. They all feeding a telemetry device.

It was constructed by Kiwirail in the 1960's and flow gauges were subsequently added by NZTA (Perkins 2014)

It is not consented because it was constructed prior to any consen requirement (GW 2014)

### **Te Puka Stream State Highway 1 culvert**

This is a State Highway triple box culvert owned by NZTA. Only two section contains the stream in normal flow, while the third section only flows during times of flood and is normally used for stock passage under SH1.

### **Te Puka Stream West State Highway 1 culvert**

This is a State Highway round culvert owned by NZTA with a steep gradient.

### **Wainui Stream State Highway 1 culvert**

This is a State Highway round culvert owned by NZTA. It has a large drop on the downstream side. As a condition of the Transmission Gully motorway consents, NZTA is required to remove this fish passage barrier to improve instream habitat upstream as mitigation for adverse effects in the upper Te Puka Stream caused by construction of the motorway.

Examination of a stream long-section for the reach shows that this culvert is perched above the

natural gradient of the streambed. It needs lowering significantly, to restore a natural stream gradient that is not subject to downstream scouring and upstream disappearing instream flows.

This also necessitates lowering the streambed upstream as it is also perched and encourages the absence of surface flow in this reach, restricting fish passage.

### Overall priorities

The documented priority for removals and any relevant comments are:

Barrier	Priority	Comment
Wellington Road Queen Elizabeth Park bridge	High	Lip below.
Paekakariki Motorcamp weir	High	Barrier in low and high flows
Te Puka Stream weir	Medium	Inhibits passage of 3 species – Shortfinned eel, Giant kokopu and Common bully – despite REC predictions (Atkinson 2008)
Te Puka Stream State Highway 1 culvert	Medium	Lip below and weir above
Te Puka Stream West State Highway 1 culvert	Low	---
Wainui Stream State Highway 1 culvert	Low	Undercut height 1 metre. Was considered too expensive to remove (Aiken 2008) (NZTA required to remove as part of TG resource consents)

Table 9: Fish passage barriers surveyed

### Impediments

There are several impediments that change the natural character of the stream and are also an impediment to fish passage. They are all beside the motor camp and are thought to be remnants of WWII army camp building rubble. They are a jumble of concrete blocks in the streambed. They detract from the natural character of the stream and raise the bed level above the natural level, reducing instream flows at times of low flow, raising flood levels, and reducing the capacity of the stormwater system that drains to them.

# Flooding

## Extent

Much of the lower Wainui Stream catchment is prone to flooding as the flows from the hill country start to spread out dropping sediment, and then meander through the dune belt to the sea. State Highway 1 and the railway line form artificial barriers that encourage surface ponding.

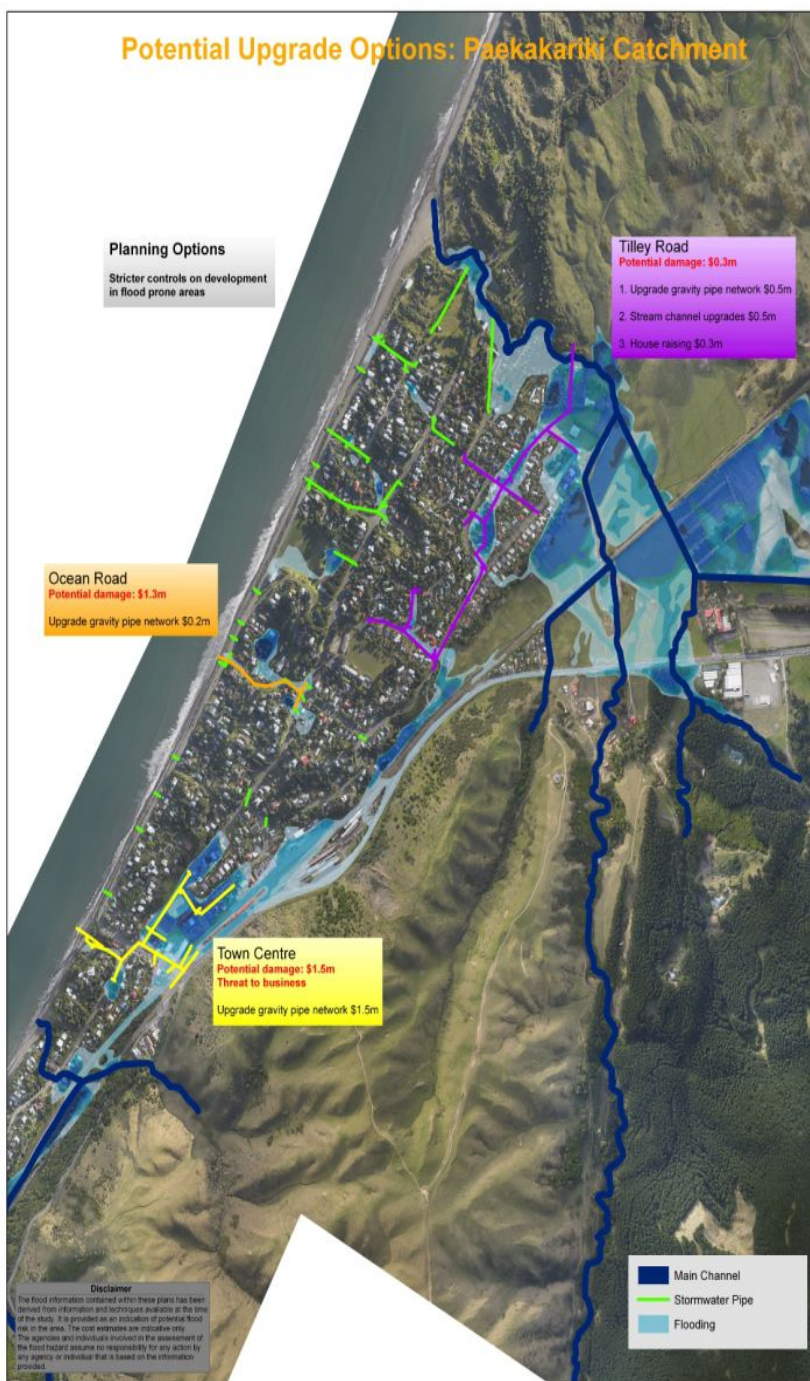


Figure 3: Paekakariki catchment map (KCDC 2012a)

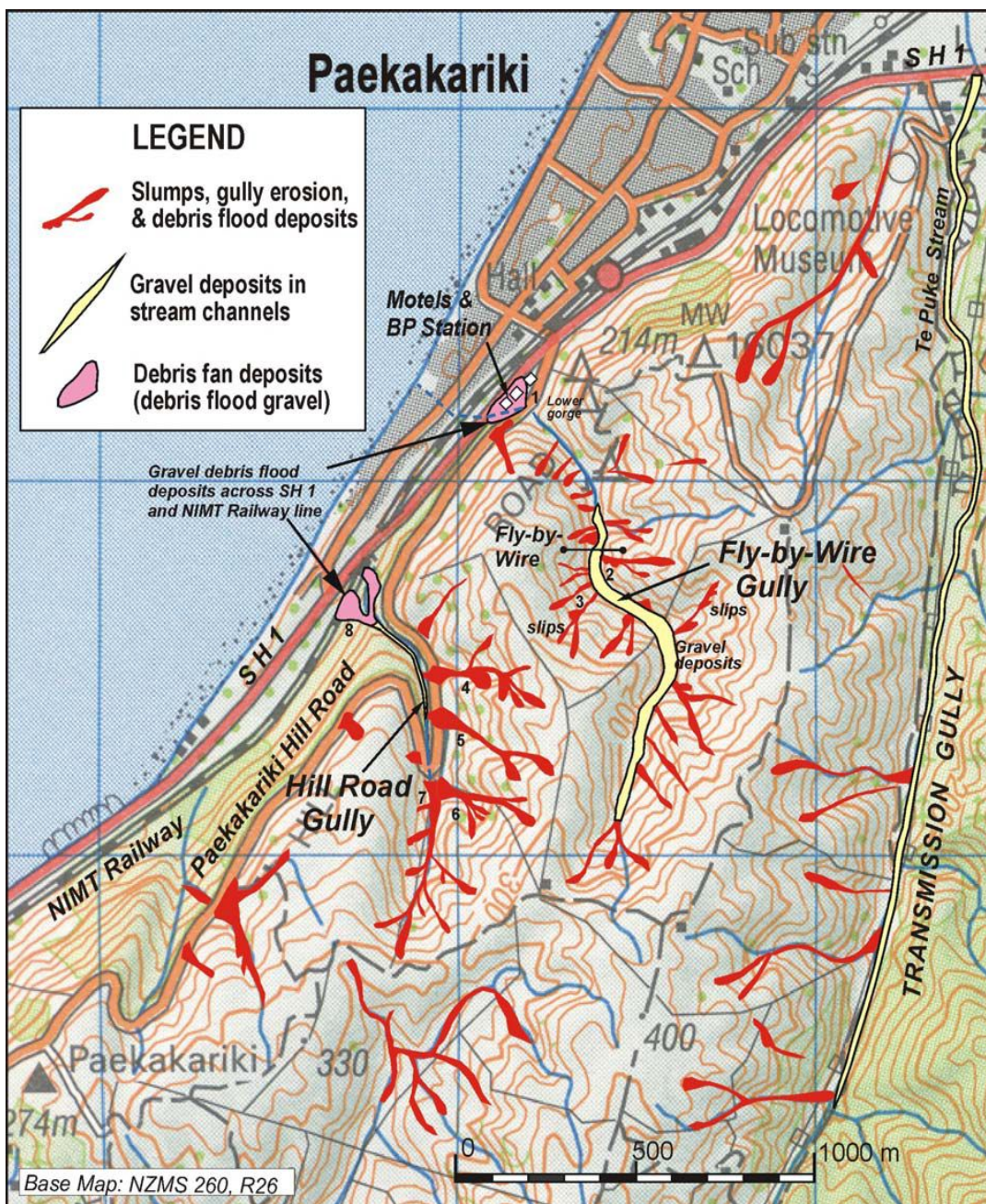


## Risks to the community

There are three main flooding risks to the Paekakariki and wider community:

- State Highway 1
- Railway line
- Tilley Road north residences

The flooding risks are from surface runoff and sediment that is carried by them that creates “debris floods” and chokes up streambeds. The runoff is a particular problem when high intensity rainfall events arrive from the north or northwest as the terrain in the upper catchment faces these weathers. Floods are exacerbated if there has been a dry period beforehand, which is often a problem with the denuded farmland that exists at present. This farmland contains slumps and gully erosion that are generating significant sediment in the Te Puka Stream subcatchments.



*Figure 4: Sediment sources originating in 2003(GNS 2003)*

#### State Highway 1

The State Highway is threatened by surface flooding from the main Wainui Stream branch where a restricted capacity culvert that is perched too high ponds floodwaters upstream that appear to flow over the State Highway in extreme events. This will be a KCDC problem in the future as they are due to inherit this length of road from NZTA as a result of the SH1 realignment.

#### Railway line

The railway line is threatened by a small bridge on the Te Puka Stream that has limited capacity and is prone to sediment build-up that restricts capacity.

#### Tilley Road north residents

The Tilley Road north residents are at risk for two reasons; restricted downstream channel capacity, and a high stopbank that encourages flooding of properties rather than protecting them. The downstream channel capacity is restricted by WWII rubble and a derelict weir raising the bed above its natural level and restricting peak flows.



## Instream interventions

### **Gravel extractions**

There have been consented gravel extractions on Te Puka Stream in the past, typically after flood events that have deposited large quantities of gravel and reduced flood protection to infrastructure and houses.

Often large quantities were removed above SH 1 and distributed over the adjoining land.

Currently the only consent for extraction is to KCDC in the Te Puka Stream above the Railway.

KCDC intend to apply for an gravel extraction consent below the railway and near the Tilley Rd north houses.

### **Stream mouth cutting**

Under the Regional Coastal Plan – Regional Rules there is a rule that permits cutting the Wainui Stream outlet in certain circumstances (Greater Wellington 2000).

“Rule 30 River and stream mouth cutting, provides for the Wainui Steam mouth to be cut as a permitted activity provided it complies with the following conditions:

- (1) The foreshore is not disturbed to a depth greater than 1 metre below the natural water table or to a width greater than 5 metres.
- (2) Subject to the exception stated below, the activity shall not prevent public access to and along the foreshore past the site of the cutting operation. This condition shall not apply to any restrictions on access arising from water flowing in any new outlet channel.
- (3) No contaminants shall be released to land or water from equipment being used for the cutting operation, and no refuelling may take place on any area of foreshore or seabed.
- (4) All material excavated shall be retained within the active beach system.
- (5) All equipment and materials used for the cutting operation shall be removed from the site on completion of the operation.
- (6) (Not applicable in this case)
- (7) The activity shall comply with the general standards listed in [section 14.1](#).

Table 7.1 Trigger levels for river and stream mouth cutting in accordance with rules 30 and 34

Wainui Stream	Erosion	When the channel outlet within the coastal marine area migrates either south of or 60 metres north of the end of the pole retaining structure
	Flooding	When the stream mouth closes or the distance between the timber bridge deck (approximately 50 metres upstream) is less than 1.5 metres in normal flow at low tide

This is often not exercised despite the trigger level under the timber bridge deck being reached.

## **Future developments**

Numerous future developments will present negative and positive effects on the Wainui Stream catchment.

### ***Transmission Gully motorway***

The construction of Transmission Gully motorway will result in:

- , A major culvert over Wainui Stream.
- , A large bridge over Te Puka stream above the ford in the Te Puka Stream gorge.
- , Major modifications to the upper Te Puka Stream channel.
- , Significantly increased runoff that will be offset to some extent by replanting required on the extensive western slopes of the Te Puka Stream.
- , Increased contaminants runoff from the additional length of highway within the catchment.
- , Removal of the current SH1 Wainui Stream culvert fish passage barrier.

### ***Exotic forest clearance***

The foothills contain much exotic forestry planting that is near harvesting. Most are on Class VIIe land and should not be replanted. Some are within the catchment used to supply water to Paekakariki. Harvesting with disturb fragile steep soils and increase flooding and sediment in the streams. Replanting with exotic forestry will perpetuate a continued cycle of soil disturbance and deforestation leading to ongoing increased flooding and sediment in the streams and reduced quality water supply.

### ***Restocking Perkins farm***

NZTA have purchased Perkins farm and destocked it. This has resulted in significant reduction in faecal coliform contamination and sediment in the streams. Any restocking will introduce significant faecal coliform contamination and sediment in the streams unless all streams are fenced.

### ***Marginal Strips reserved***

When NZTA dispose of any land they are required to reserve from any sale or lease/licence 20 metre wide marginal strips along streams that are 3 metres wide at fullest flow without overtopping banks. They would be owned by DOC after any disposal. The community needs to ensure that these transfer to DOC and are increased in width where appropriate. See Appendix 1 for the indicative extent of these.

### ***Paekakariki Water Supply consent operation***

The 2013 granting of this consent renewal without community input leaves a gap in our understanding of our urban water use effects on our Wainui Stream. There is the opportunity for our Council to manage its consent and our use of water in a way that minimises times of low flow. There is an opportunity for our community to better understand the negative connection between our urban water supply and the volume of water in the Wainui Stream.

### ***Housing development pressure on minimum flows***

Any additional housing in the village will increase the take of water from Wainui Stream at times of low flow. This will adversely impact our threatened fish, while reducing the amount of water residents will have available, and increasing restrictions on water use.

### ***Climate Change***

There is a Climate Change group in the village that is considering the effects of climate change on Paekakariki. This group considers that the likely effects on the Wainui Stream catchment are:

- ~ Increased flooding – larger floods and more often
- ~ Reduced minimum flows – more likely for instream values to suffer from low flows
- ~ Increased sea storm surge – waves coming inland and higher water and flood levels

## References

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# Appendices

## Appendix 1 Marginal Strips required to be reserved



## Appendix 2 KCDC water quality readings

### Wainui Stream at Haumia St outlet ecoli water quality readings - 2006-2013

Date	E-coli	Site	Date	E-coli	Site	Date	E-coli	Site	Date	E-coli
4/10/2006	860	O	4/10/2006	8000	DS	4/10/2006	6300	BL	-	-
-	-	O	-	-	DS	-	-	BL	14/02/2007	870
14/03/2007	3300	O	14/03/2007	11000	DS	14/03/2007	6200	BL	-	-
30/07/2007	1400	O	30/07/2007	7600	DS	30/07/2007	2800	BL	-	-
-	-	O	-	-	DS	-	-	BL	18/12/2007	2200
19/12/2007	93000	O	19/12/2007	29000	DS	19/12/2007	80000	BL	-	-
23/06/2008	5500	O	23/06/2008	1900	DS	23/06/2008	3500	BL	-	-
8/08/2008	120	O	8/08/2008	220	DS	8/08/2008	100	BL	-	-
29/04/2009	1000	O	29/04/2009	4700	DS	29/04/2009	1000	BL	-	-
24/09/2009	1100	O	24/09/2009	6400	DS	24/09/2009	2600	BL	-	-
30/11/2009	4200	O	30/11/2009	3600	DS	30/11/2009	4000	BL	-	-
24/05/2010	900	O	24/05/2010	3300	DS	24/05/2010	1700	BL	-	-
17/08/2010	500	O	17/08/2010	56000	DS	17/08/2010	600	BL	-	-
30/09/2010	3200	O	30/09/2010	11000	DS	30/09/2010	3100	BL	-	-
18/04/2011	2600	O	18/04/2011	9000	DS	18/04/2011	3000	BL	-	-
11/07/2011	150	O	11/07/2011	900	DS	11/07/2011	260	BL	-	-
16/07/2012	800	O	16/07/2012	1500	DS	16/07/2012	1900	BL	-	-
17/11/2012	350	O	17/11/2012	2400	DS	17/11/2012	738	BL	-	-
-	-	O	-	-	DS	-	-	BL	14/03/2013	1800
15/10/2013	1100	O	15/10/2013	5600	DS	15/10/2013	3800	BL	-	-
31/10/2013	220	O	31/10/2013	4300	DS	31/10/2013	280	BL	-	-
-	-	O	-	-	DS	-	-	BL	4/12/2013	250
25/06/14	320	O	25/06/14	12000	DS	25/06/14	1100	BL	-	-0

### Wainui Stream Mouth - 2014

Date	Faecal coliform
26/02/14	66
25/03/14	98
02/05/14	180
27/05/14	58