Appendix 2: Waterway low flows

Includes:

1. Memo re: *River flows for fish passage*

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SUBJECT	River flows for fish passage

Overview

An understanding of the flow regime in a number of streams on the Kapiti Coast is required so that the 10th and 90th percentile flows can be derived for fish passage design.

There are two catchments in the general vicinity that have an instrumental record; the Waitohu Stream, and the Mangaone Stream. However, nine of the 11 catchments have no instrumental record. Therefore, synthetic records were generated for these sites by scaling the flow record from the most appropriate adjustment flow monitoring site.

Using the synthetic records, the 10th and 90th percentile flows were derived for all of the catchments shown in Table 2.

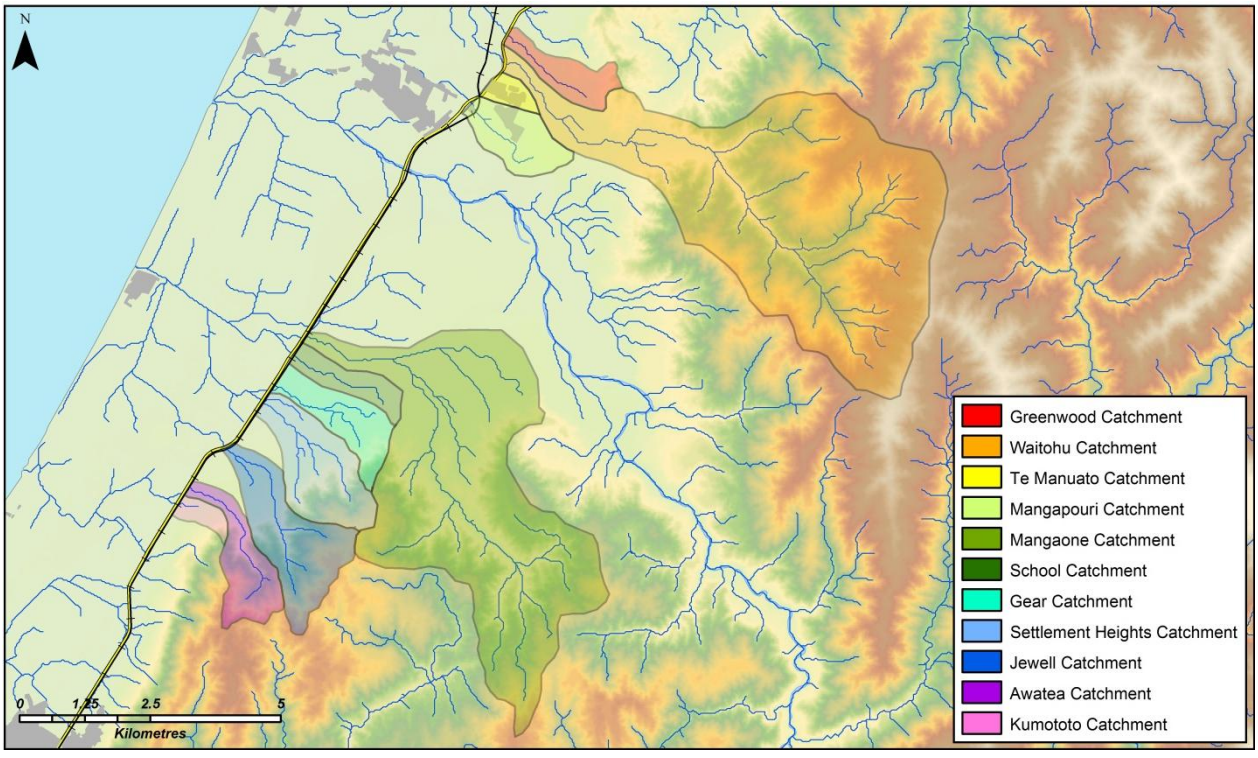

Figure 1 Location of the study catchments.

Introduction

NZTA are developing and upgrading roading infrastructure on the Kapiti Coast. This new infrastructure has the potential to affect the local hydrology and consequently the local fish habitat (Figure 1). Therefore, an understanding of the flow regimes, particularly the expected low and high flows (the lowest 30 (10^{th} percentile) and highest 30 days (90^{th} percentile)), is required for fish passage design.

Methodology

To obtain the upper and lower limits for fish passage the following methodology was adopted. This is consistent with the guidelines in *Fish passes – design, dimensions and monitoring* (DVWK, 2002).

1) Obtain and review the Mangaone Stream, Waitohu Stream and Otaki River flow records. Determine which is the most appropriate for the streams that have no instrumental record.

2) Scale this flow record to the nine streams adjusting as a function of differences in Mean Annual Flood (MAF) obtained from the REC (River Environment Classification). This approach includes consideration of the effects of both area and rainfall variability across the catchment.

3) Derive the 10^{th} and 90^{th} percentiles to use as the lower at upper flows in the fish passage design.

Results

Flow Data

Analysis of the flow statistics from the REC (River Environment Classification) for the Mangaone, Waitohu streams and the Otaki River as well as the other nine catchments was undertaken (Table 1). The Mangaone flow parameters appear to be more similar to the nine smaller catchments than both the Otaki River and Waitohu Stream. Both the Otaki River and Waitohu Stream have higher specific MAF's (m^3/km^2) and higher specific runoff values. This is expected as the headwaters of the catchments are at significantly higher elevation, and through orographic enhancement receives considerably more and heavier rainfall. The Mangaone Stream has a lower specific MAF and lower runoff values. Its flow regime is less biased by heavy rainfall occurring in the ranges.

Table 1 Statistics of the catchments of interest. Note that this data, including the catchment areas, is based on the REC.

	Area (km²)	Runoff (mm/yr)	MAF (m³/s)	Specific MAF (m³/s/km²)
Otaki Catchment	341.1	2773	1143.6	3.35
Waitohu Catchment	24.3	1103	44.8	1.84
Mangaone Catchment	19.0	684	26.8	1.41
Kumototo Catchment	0.9	585	1.2	1.33
Awatea Catchment	2.9	585	3.2	1.10
Jewell Catchment	4.2	585	4.3	1.02
Settlement Heights Catchment	3.4	624	3.6	1.06
Gear Catchment	2.1	670	2.3	1.10
School Catchment	1.7	711	2.0	1.18
Mangapouri Catchment	1.9	463	2.0	1.05
Greenwood Catchment	1.8	329	1.5	0.83
Te Manuao Catchment	There is no REC data available for this catchment			

MAF = Mean Annual Flood

Scaling

The Mangaone Stream is considered the more suitable record for scaling to produce synthetic flow records for the nine other catchments (the Waitohu record will be used for the Waitohu catchment). The Mangaone Stream recorder is situated upstream of the State Highway and study site. Thus, the record needs to be scaled to account for the area between the recorder and the study site (9.2 to 19.02km²) (Figure 2). This synthetic record for the Mangaone Stream was then used to scale each of the study sites using the ratio of the two MAFs to allow for consideration of both differences in area and precipitation.

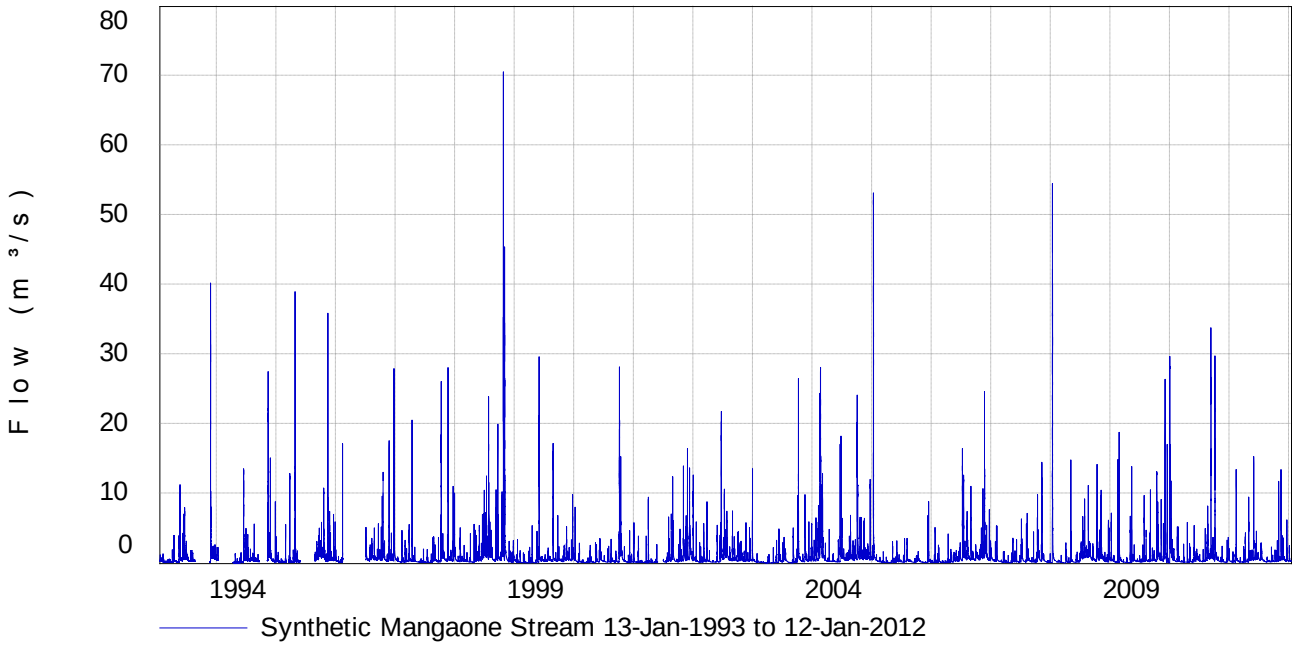

Figure 2 Flow record for the Mangaone Stream at Ratanui scaled to the State Highway.

Fish Passage Design

Using the synthetic records the 10th and 90th percentiles were determined. These figures relate to the upper and lower flows needed to design for fish passage. Table 2 shows these figures for each of the catchments.

Table 2 Flows for fish passage design

	10th percentile (m^3/s)	90th percentile (m^3/s)	10th percentile (l/s)	90th percentile (l/s)
Waitohu Catchment	2.06	0.22	2060	223
Mangaone Catchment	1.30	0.19	1296	187
Kumototo Catchment	0.06	0.01	57	8
Awatea Catchment	0.15	0.02	154	22
Jewell Catchment	0.21	0.03	206	30
Settlement Heights Catchment	0.18	0.03	176	26
Gear Catchment	0.11	0.02	113	16
School Catchment	0.01	0.01	95	14
Mangapouri Catchment	0.01	0.01	99	14
Greenwood Catchment	0.07	0.01	71	10

Constraints

Many of the catchment boundaries extend slightly below the State Highway. As the REC values relate to the whole reach, the values provided in this report are likely to be slightly conservative i.e. slightly higher than expected.

Also, nine of the 11 catchments are essentially local streams at low elevation. Consequently, rainfall in these catchments is likely to be significantly less than in the Mangaone. The use of scaled flow records, based on the flow regimes of Mangaone Stream, will also result in slightly conservative design, i.e. slightly higher design flows than will actually be experienced.

References

DVWK (2002). Fish passes – Design, dimensions and monitoring. FAO, United Nations.