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MEMO

TO	Friends of Waiwhetu Stream
COPIED TO	George Bowman, Alistair Allan
FROM	Hannah Jägvik, Bryce Warner
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Mapping Pools, Runs and Riffles to Assist in Improving Fish Habitat in Waiwhetu Stream

Purpose of Memo

1. To inform the Friends of Waiwhetu Stream and Flood Protection of the results of a stream survey so they may use it to help improve fish habitat in the future.

2. To provide a reach-surveying methodology for small streams that can be replicated or used as a reference for similar activities.

Background

Since the removal of Cape Pondweed from the stream, the Waiwhetu has been able to flow more freely and much of the fine sediment accumulated due to the weed has since been washed away. The natural streambed is now exposed and native fish species such as inanga and kōkopu have been identified. Surveying activities were undertaken to provide a foundation for improving the fish habitat even further.

Variance to Original Scope of Work

The results from this investigation were to be compared to a survey conducted by the 2013/2014 summer students. However, the 2014 survey seems to have had a slightly different scope. It identifies a lot more features such as birds, fish, detritus and erosion but the pool/run/riffle count and vegetation survey are not extensive nor detailed enough for comparison purposes. For example, 13 features are identified as 'pools and riffles' but which is which is not distinguished. Additionally, the methodology could not be found so any comparison would prove futile. The 2014 survey is included as an attachment nonetheless.

Methodology

Three activities were carried out along the stream from the downstream end of the Naenae concrete channel to the Bell Road Bridge. These included mapping the size and location of pools, runs and riffles; identifying aquatic and streamside vegetation; and measuring water depth incrementally along the stream. When conducting the survey, one person walked in the stream in waders and one walked along the bank in order to have two different points of view at all times.

Pools, Runs and Riffles

Riffles are easy to identify visually, as the water is shallow, fast-moving and the surface is broken with a distinctive rippled effect. Many pools and runs were also identified visually because small floating debris on the surface of pools were still, or the velocity was such that the reach had to be classified as a run.

Some reaches were more difficult to classify as a pool or run, so a table from Queensland Government's Macroinvertebrate Sampling Field Sheet (recommended by Evan Harrison – GWRC Senior Environmental Scientist) was used in these cases (Table 1). The depth was measured with a 1 m metal ruler while standing in the stream. The velocity was measured by holding the ruler on the surface of the water and manually counting the number of seconds it took for a submerged particle to travel from the upstream end to the downstream end. Only submerged particles were utilised as surface particles were more susceptible to wind effects.

Table 1. Table used to identify pools and runs on the Waiwhetu when it was not immediately obvious.

The Velocity:Depth Table to Identify Stream Habitat Types

(V:D>0.032 = riffle, <0.0124 = pool, in between = run)

(P = Pool, R = Riffle)

Try to avoid sampling "marginal" habitats

VELOCITY (m sec^{-1})

DEPTH (cm)	0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5
5	P	run	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
10	P	P	run	run	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
15	P	P	run	run	run	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
20	P	P	P	run	run	run	run	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
25	P	P	P	P	run	run	run	run	run	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
30	P	P	P	P	run	run	run	run	run	run	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
35	P	P	P	P	P	run	run	run	run	run	run	run	R	R	R	R	R	R	R	R	R	R	R	R	R	R
40	P	P	P	P	P	run	run	run	run	run	run	run	run	R	R	R	R	R	R	R	R	R	R	R	R	R
45	P	P	P	P	P	P	run	run	run	run	run	run	run	run	run	R	R	R	R	R	R	R	R	R	R	R
50	P	P	P	P	P	P	P	run	run	run	run	run	run	run	run	run	run	R	R	R	R	R	R	R	R	R
55	P	P	P	P	P	P	P	run	run	run	run	run	run	run	run	run	run	run	R	R	R	R	R	R	R	R
60	P	P	P	P	P	P	P	P	run	run	run	run	run	run	run	run	run	run	run	run	R	R	R	R	R	R
65	P	P	P	P	P	P	P	P	P	run	run	run	run	run	run	run	run	run	run	run	run	R	R	R	R	R
70	P	P	P	P	P	P	P	P	P	run	run	run	run	run	run	run	run	run	run	run	run	run	run	R	R	R
75	P	P	P	P	P	P	P	P	P	P	run	run	run	run	run	run	run	run	run	run	run	run	run	run	run	R
80	P	P	P	P	P	P	P	P	P	P	run	run	run	run	run	run	run	run	run	run	run	run	run	run	run	run
85	P	P	P	P	P	P	P	P	P	P	P	run	run	run	run	run	run	run	run	run	run	run	run	run	run	run
90	P	P	P	P	P	P	P	P	P	P	P	P	run	run	run	run	run	run	run	run	run	run	run	run	run	run
95	P	P	P	P	P	P	P	P	P	P	P	P	run	run	run	run	run	run	run	run	run	run	run	run	run	run
100	P	P	P	P	P	P	P	P	P	P	P	P	P	run	run	run	run	run	run	run	run	run	run	run	run	run

Once a digital GIS layer mapping pools, runs and riffles had been created, potential sites to add riffles were identified. Points along the stream were added where there was more than 200 metres between consecutive riffles. A visit to these sites determined whether they were suitable. Some sites were eliminated because the water was too deep or slow-moving, or they were on private land therefore had no areas nearby to store stones if need be. Sites were deemed 'excellent' if they were shaded or the water was particularly shallow and fast-moving.

Ideally, 100 metres would be used as a cutoff because as much diversity as possible in channel characteristics is desired. For now, 200 metres is sufficient to test the riffle-creating process and in future more can be added if it is successful. Downstream of Wainui Road was not considered because tidal influence would make it difficult to make riffles permanent, and the deeper water would increase the amount of cobbles required. Adding larger boulders downstream of Wainui Road would be worth considering in the future.

Stream Depth

Stream depth was measured in the centre of the primary flow of the channel and also in noticeable outlying pools. A 1 m measuring stick was used to measure in approximately 10 m increments or wherever there were noticeable differences in bed levels (such as in pools, riffles, or velocity changes). The centre of the channel was chosen as to give a representative view of the entire channel section. On site, depth was recorded on a custom Fulcrum GIS application – *Stream Depth App*.

Vegetation

Examples of streamside vegetation classes can be seen in Figures 1 through 4. Note the streamside vegetation was only surveyed one-dimensionally i.e. the depth of vegetation was not considered, just the occurrence of it on the stream banks. On site, several A3 maps of the stream were used to draw on the streamside vegetation and pools, runs and riffles. A digital version of this was then created in GIS (attached).

Figure 1. Example of young/ recently planted natives.

Figure 2. Example of mature natives.

Figure 3. Example A of exotic vegetation.

Figure 4. Example B of exotic vegetation.

Aquatic vegetation was recorded at each depth measurement point as being surface, subsurface or not present. Only plants longer than 5 cm were counted to narrow the results of the survey and provide a more representative view of the major aquatic vegetation types. Examples can be seen in Figures 5 and 6.

Figure 5. Surface aquatic vegetation.

Figure 6. Subsurface aquatic vegetation (causing a riffle).

Results

Pools, Runs and Riffles

The following statistics were gathered. See maps for a visual representation.

- Length surveyed = 5.5 km
- 57 pools (41 spanning the entire cross-section and 16 beside a run / only extending across part of the stream)
- Longest pool = 45 m
- 60 runs covering 4.87 km (89% of length surveyed)
- Longest run = 450 m
- 29 riffles (including 2 caused by aquatic vegetation) covering 0.56 km (10% of length surveyed)
- Longest riffle = 60 m
- Number of new riffle sites proposed = 9

Except for those caused by vegetation, the substrate of riffles was mostly stones and cobbles. Pools and runs had a substrate of sand or silt with aquatic vegetation sometimes present.

Stream Depth

Stream depth varied significantly along the measured length. A minimum of 120 mm was measured at a riffle between Burnside Street and Lockett Street, and several depths over 1000 mm were measured in larger pools. Depth measurements are represented as points and should be interpreted as only an average of the local stream bed.

Depths over 1000 mm were marked as 1000+, so true depths above this level are unknown. It should also be noted that downstream of survey marker XS33 the tidal influence was noticeable. Depth measurements were continued to the Wainuiomata Road Bridge, but discontinued shortly thereafter. GWRC flow data is presented in the depth maps.

Vegetation

See maps to identify the extent of both streamside and aquatic vegetation.

Of the 691 aquatic survey points, 23% had both subsurface and surface macrophytes, and an additional 14% had subsurface vegetation only. Aquatic vegetation was most prominent south of Cleary Street, and although this may be partially attributed to an update in the capture app, large stretches of stream bed were devoid of vegetation in the upstream stretches of the Waiwhetu*. The primary surface-breaking vegetation was a species of watercress, and subsurface vegetation was a combination of potamogetans, grasses, and other aquatic weeds.

*An update in the GIS application between survey days was performed to create an improved method of capture between macrophyte types. All instances of aquatic vegetation were recorded above Cleary St but whether they were surface or sub-surface was not. A modification to the app, post-survey, has allowed for density to be recorded in future surveys.

Tidal Influence

The lower reaches of the Waiwhetu are susceptible to tidal influence. GWRC hydrologists have noted tidal flows as far upstream as Whites Line road. The presence of pools, riffles, and runs below Whites Line road will depend on the changing tides, and thus the methods used in this survey may only be applicable to areas outside of tidal influence.

Due to an increasingly silty bed, zero visibility, and increasing tidal influence, the depth and aquatic macrophyte survey was not completed below the Wainuiomata Bridge.

Fish Presence

Inanga presence was noted heavily in sections below the weir south of Rossiter Avenue. A large concentration was encountered between Malone Rd and Avon St. There were some upstream of the St Ronans Ave weir, but at magnitudes fewer than concentrations downstream. Six eels were noted in sections upstream and downstream of the weirs between the three survey days, although there may have been repeated sightings.

Recommendations

This document can be used in order to standardise the method of surveying pools, riffles and runs for small, non-tidal streams. It will also be useful for improving fish habitat, as some new sites for riffles have been identified.

Attachments

- 8-page PDF of 2014 survey
- 14-page PDF of pools/runs/riffles and vegetation survey
- 6-page PDF of stream depth survey
- 2-page PDF of new sites for riffles

Prepared by:

Hannah Jägvik
Student Engineer
Flood Protection

Bryce Warner
Student Engineer
Flood Protection