

WATERWAYS MONITORING REPORT 2021

Introduction

Various classes and projects have carried out water quality monitoring on campus since 1979. However, previous monitoring has often been sporadic and the data collected was scattered across different groups within UC. This prompted the creation of the 2018 Water Quality Monitoring Framework (WQMF), which produced a standardised monitoring program to track changes to streams on campus.

The WQMF and a GEOG309 report prepared for the Sustainability Office in 2021 identified several key parameters for long-term monitoring (Figure 1). The first round of sampling following this framework was carried out in October 2021 across six sites throughout Okeover stream; this will be repeated every three months in subsequent years. While there are reasonable quantities of existing data on the ecology of the Okeover, most of the other crucial parameters have data from only a few years.

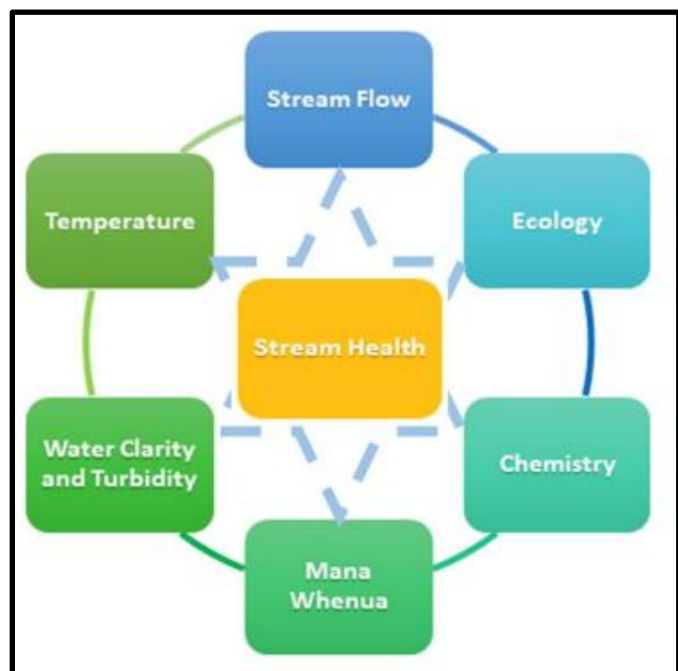


Figure 1: Stream health monitoring framework as proposed in a GEOG309 report (2021), by UC students J. Bird, J. McMecking, R. Painter, Z. Shadbolt, and Blake Woods.

Stream Flow

Adequate stream flow is important for water quality, as it impacts other parameters such as turbidity and dissolved oxygen. Stream flow is measured as the volume of water (m^3) that flows through a stream every second. In 2021, flow along the stream increased from $0.013 \text{ m}^3/\text{s}$ in the headwaters to $0.088 \text{ m}^3/\text{s}$ by the greenhouses on the edge of campus, likely as water outlets from air conditioning etc. empty into the Okeover.

Temperature

Temperature controls a number of important aspects, including what can live in a stream and how fast things grow. Temperatures below 20°C are ideal, while Okeover has consistently remained at an average of 15°C since 2000.

Water Clarity and Turbidity

Turbidity describes how much suspended solids are in the water, which affects both visibility for aquatic animals and the beauty of the water. It is measured in NTUs, with water above 5 NTUs being barely noticeably cloudy. Turbidity has decreased from 1.5-2.4 NTUs in 2002 to 0.67-2.05 NTUs in 2021.

Chemistry

Dissolved oxygen

Oxygen is essential for fish, eels and insects to survive. Dissolved oxygen can be measured via what percentage of the water is oxygenated; typically, healthy systems contain at least 80% dissolved oxygen. Dissolved oxygen has fluctuated between 70-90% since 2010, although all these measurements were taken during the day when dissolved oxygen is likely to be higher due to photosynthesising algae.

Heavy metals

Urban streams are often polluted with heavy metals that runoff from surrounding roofs, roads and other impermeable surfaces. In high concentrations, heavy metals can impair the growth of or kill aquatic life. Previous sampling in 2009 revealed copper exceeded threshold value while lead and zinc were below threshold values. Heavy metal samples were collected in October 2021 and are currently being processed for both total and dissolved heavy metal contaminants.

Table 1: Total concentrations of heavy metals in Okeover stream in 2009, averaged across 13 sites, compared to baseline thresholds according to a 90% protection level as suggested by Environment Canterbury's Land and Water Regional Plan (2019).

Trace element	Threshold values (µg/L)	Actual sampled values (µg/L) in 2009
Copper	1.8	5.55
Lead	5.6	0.41
Zinc	15	7.64
Cadmium	0.4	Undetectable

Ecology

A diverse collection of macroinvertebrates - insects, beetles and other creepy-crawlies - call streams their home. Some macroinvertebrates can survive in poor stream conditions whereas others require pristine conditions to survive. These differences in pollution sensitivity allow us to assess stream health by monitoring the presence of different species. For example, in a healthy stream we would expect to find pollution sensitive species, while a degraded stream will likely be dominated by pollution tolerant species.

The pollution tolerance of the macroinvertebrates present is summarised by the Macroinvertebrate Community index (MCI), which ranges from <90 (severe pollution) to >130 (pristine). Based on this index, the water quality in Okeover has very slightly improved since 1979 (Figure 1); however, this is consistently below the threshold for severe pollution set in the National Policy Statement for Freshwater Management (2020). Unfortunately, these results fail to meet the biodiversity target set in the 2019-2024 UC Biodiversity Plan; to increase in-stream MCI values from scores representing a moderately polluted stream to ones suggesting mild pollution.

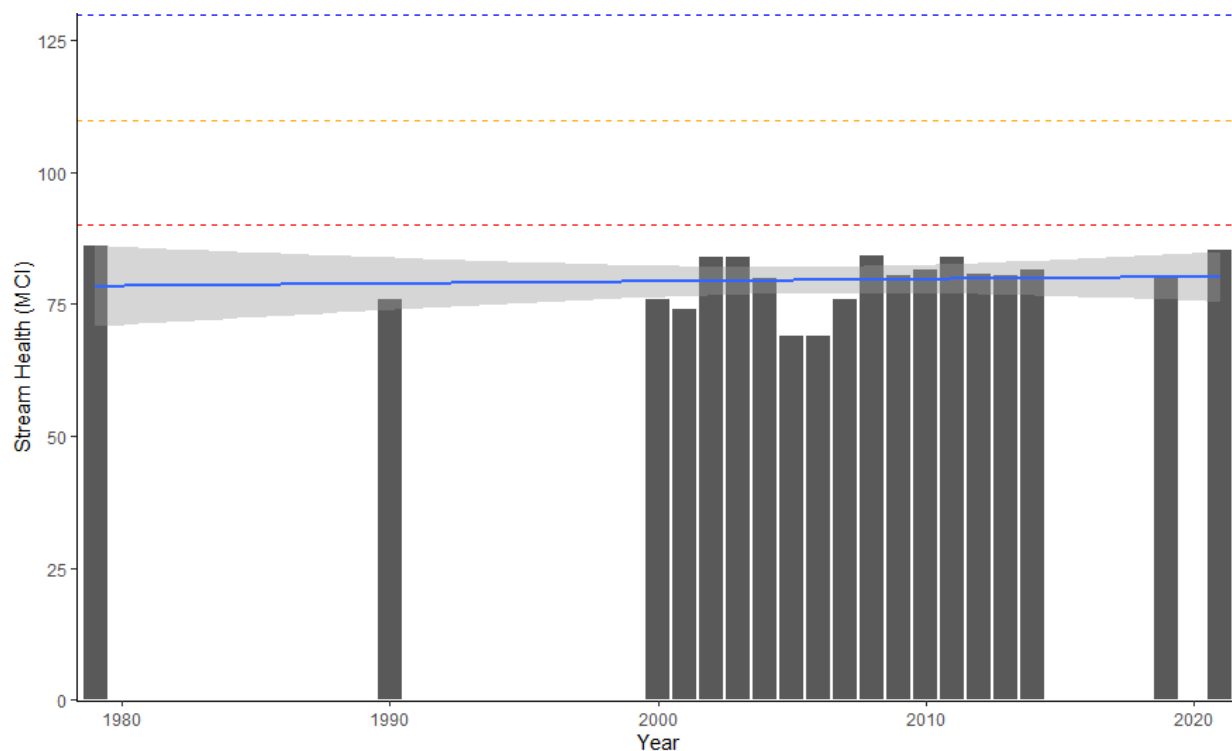


Figure 2: Average MCI scores taken across six sites in Okeover Stream, University of Canterbury, from 1979 to 2021. The red, orange and blue dashed lines represent threshold values for pollution categories (<90 = severe pollution, ≥90 and <110 = moderate pollution, ≥110 and <130 = mild pollution, ≥130 = pristine conditions) as outlined in the National Policy Statement for Freshwater Management (2020). Gaps between bars represent years where data was not available.



Figure 3: Macroinvertebrates found within Okeover stream, University of Canterbury, 2021. *Polycentropodidae polyplectropus*, a free-living caddis fly (left) and *Conoesucidae Pycnocentria*, a cased caddis fly (right).

Summary and next steps

While physical conditions in the stream may be adequate, current data suggests poor aquatic life within the Okeover stream. However, current gaps in the data restrict our ability to assess long term trends in water quality. Over time, consistent monitoring of the parameters described above will fill these gaps and provide a better picture of the health of Okeover stream.

Specifically, the following improvements will be made:

- Installation of grab samples throughout Okeover to collect samples during storm events, particularly to monitor changes in heavy metal levels during the ‘first flush’ of heavy rain.
- Installation of long-term dissolved oxygen and temperature loggers to capture maximum and minimum values over time, which better represent stressors on aquatic life.
- Begin testing water samples for *E. coli*.