

Key Attributes for Water Quality

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How we choose which attributes

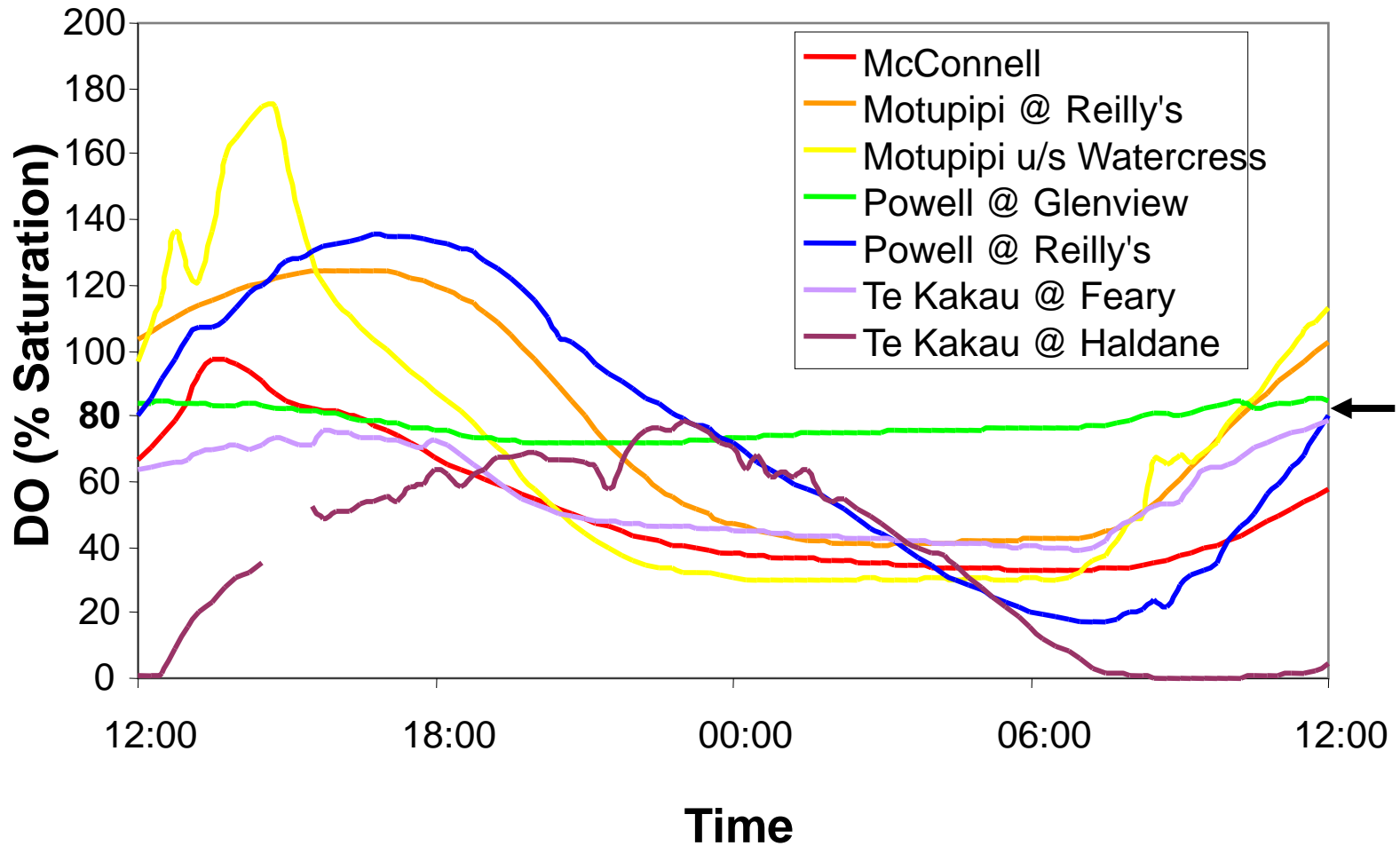
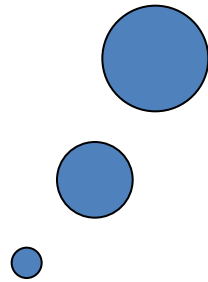
- Significant risk of an adverse effect happening
eg. we are not considering pesticides as an attribute because we think that there is low risk.
- Measureable and analytically valid
- Policy-relevant ie relates to the value at stake
- Cost effective to monitor
- Easily understood
- Data is available

Dissolved Oxygen

- Fundamental for life
- Sensitive species will be absent if concentrations are low
- NPS applies to discharges – no reason it cannot be used to apply to all rivers except near spring sources
- Reduced abundance and death of sensitive species at <6.5 mg/L or 80% saturation
- Many species will die out at <5.0 mg/L or $<60\%$
- Generally a summertime problem
- Affected by discharges of organic material, reduced flow, and nutrients (stimulating plant respiration at night)
- Solution: Shading

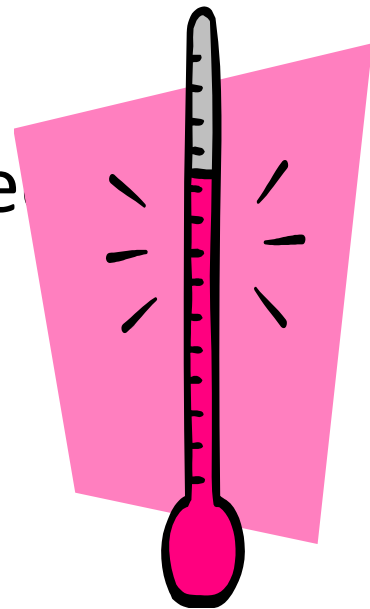


Dissolved oxygen saturation



Temperature for Ecosystem Health

- Widespread issue
- Trout feeding ceases $>18^{\circ}\text{C}$
- Many mayflies, caddisflies and stoneflies disappear at $>21.5^{\circ}\text{C}$
- Fish kills at $>24^{\circ}\text{C}$
- Higher temperatures also adversely affect ammonia toxicity and dissolved oxygen
- Solution: Shading



Stream temperature *cont.*

- Well-shaded streams almost never exceeded the temperature criteria for protecting ecosystem health during the summer.
- Criterion regularly exceeded during summer at sites on small unshaded streams draining developed land (e.g. Waiwhero, Little Sydney, Kikiwa).

Temperature for Swimming



Average daily water temperature for Roding River upstream Hackett from 2003-11

Water clarity

Poor Clarity results in ...

- Bugs not getting enough food (algae)
- Fish not seeing prey (bugs)
- People not seeing fish

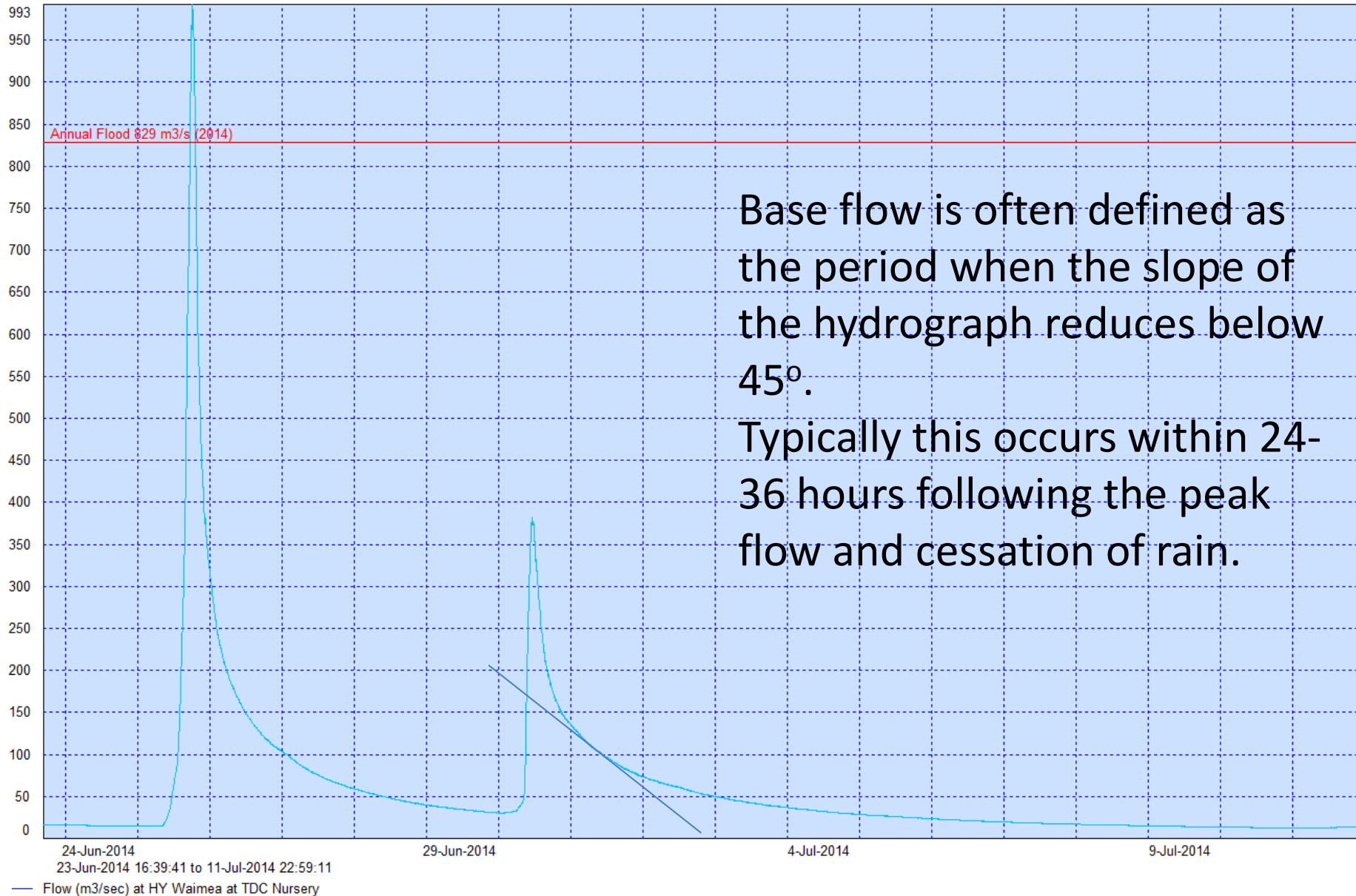
Important at base flow only

Visual = true measure of amenity affect.

Strong relationship with suspended solids and turbidity.



Base Flow



Base flow is often defined as the period when the slope of the hydrograph reduces below 45°. Typically this occurs within 24-36 hours following the peak flow and cessation of rain.

Disease-causing Organisms

Human and Animal Health

Disease Risks From Using Contaminated Water for ...

- Contact recreation
- Household drinking water supplies
- Stock drinking
- Fish and shellfish gathering

Notes:

Contact recreation is anything that brings users in “high” contact with water such as surfing, boating, swimming, washing where there is a reasonable risk that water could be swallowed, inhaled, or come in contact with ears, nose, mucous membranes and cuts in the skin allowing pathogens to enter the body.

Pets who have come into contact with water can spread disease by coming in contact with people (dogs are notorious for seeking out contaminated material and rolling/swimming in it).

Children are more at risk because they do not know to avoid certain waters

What's the problem with bad bugs?

- **eye, ear, nose and throat infections, skin diseases and gastrointestinal disorders.**
- **In most cases, the ill-health effects from exposure are minor and short-lived**

However...

- **the potential for more serious diseases such as Hepatitis A, protozoan infections and salmonellosis cannot be disregarded.**

Notes:

The presence of certain faecal bacteria is almost always associated with the parasites mentioned above (not usually the other way around). That's why we use them as indicator organisms. This means their presence in water is indicative of harmful pathogens. Measurements of harmful, pathogens themselves is difficult or in some cases impossible (ANZECC, 1992).

Contact recreation guidelines are based on an 'acceptable' swimming-associated risk of:

- 8 illnesses per 1000 bathers in freshwater
- 19 illnesses per 1000 for marine water.

Affects on livestock

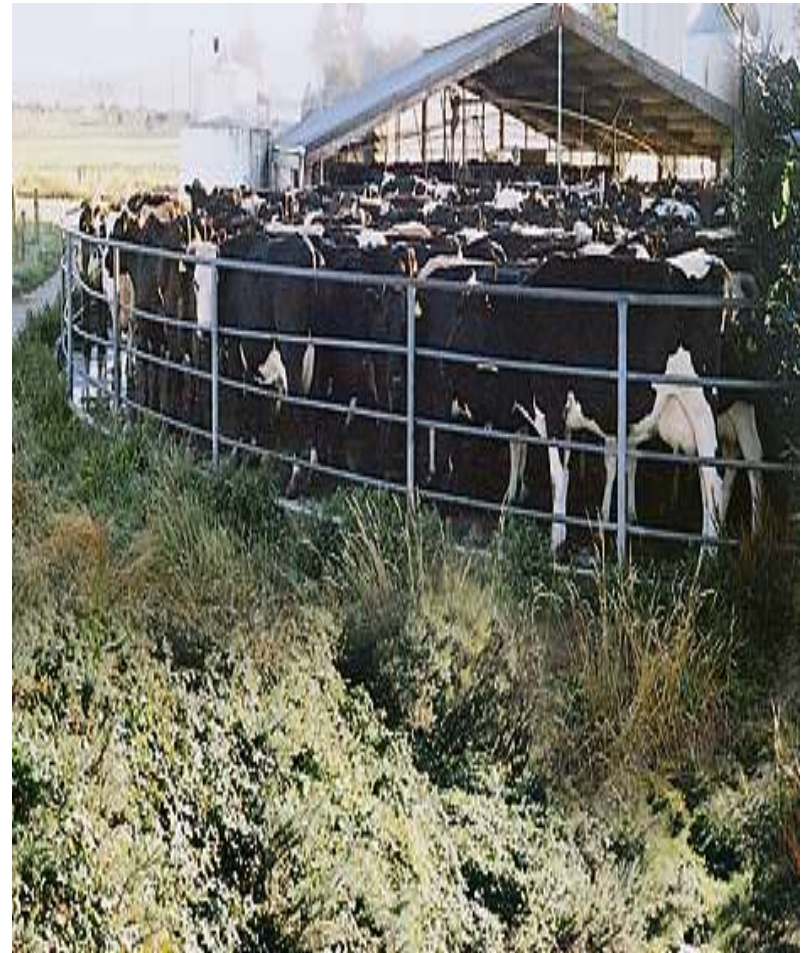
A number of pathogens and parasites can be transmitted by contaminated water to livestock which can lead to:

- **Reduced growth**
- **Morbidity**
- **Mortality**

Notes:

Livestock are more tolerant of disease than humans.

Stock drinking water guidelines have been transgressed on several occasions in several waterways.



Macro-invertebrates



Who cares about the little critters?

Base of the food chain...

- shows up state of the whole ecosystem ... terrestrial and aquatic
- more diverse critters means more fish ... anglers
- very good indicator of the long term effects discharges (integrative)

Slime/ Periphyton

...through high nutrient inputs (along with sunlight and warmer temperatures).

Rivers/streams...

- River bed becomes slippery
- Undesirable odours
- Plant/algae growth can clog stream channels
- Potential algal toxins which can kill some animals

% cover vs. chlorophyll-a



Nutrients

- Nitrate
- Ammonia
- Phosphorus

Flow Regime

- 1. Large floods** (at or above mean annual maximum flow) to maintain channel form, large scale sediment transport, and control encroachment of woody weeds. Flows of more than about ten times the mean flow or 40% of the mean annual maximum flow beginning to move a substantial portion of the river bed.
- 2. Smaller floods and freshes** to flush fine sediment, periphyton and other aquatic vegetation. Usually about 3–6 times the median flow (or 3–6 times the low flow in a highly regulated river)
- 3. Low flows**, the period of minimum wetted habitat availability. The MALF is a potential limiting factor for trout populations and native fish species with generation cycles longer than one year, at least in small rivers where the amount of suitable habitat declines at flows less than MALF .
- 4. Flow recessions**, the median flow is often viewed as providing an approximation of the typical habitat conditions experienced, and able to be utilised, by benthic invertebrates, which in turn may help define carrying capacity for fish and birds populations that feed on invertebrates.
- 5. Flow variability**, at a range of scales. It has been found to be an important predictor of fish community structure in New Zealand rivers and may also provide a stimulus for fish migrations. Flows in the order of 2-4 times the median or preceding base flow have been associated with movement of several fish species in New Zealand.

Toxic Algae (cyanobacteria)



Stream Habitat Score

Variety = high score

Meander

Notes:

Habitat requirements of most of our fish are well known You may have heard me say “the cleanest water in the world will not help a fish in a concrete channel”.

Alteration of the original channel shape, area, depth, or gradient is now not permitted (consent required).

Bed Material

Depth & Width

Bank Shape

Streamside trees

