Rationale for Schedule 15 standards and Schedule 16 limits

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1. State of water quality in Otago

The recent State of the Environment Report (ORC, 2012) identifies three water quality issues significantly affecting a number of the Region's river and lake systems:

- Nutrient enrichment of the water, which can cause nuisance biological growth (green filamentous algae in rivers and algal blooms in lakes)
- Too much sediment in the waterways which can cause decreased clarity, have direct and indirect impacts on aquatic life and allow bacteria to persist.
- Faecal contamination of the water, posing a health risk to swimmers and other water users.

The ORC SOE Reports (ORC 2006, 2012) also identified that water quality is continuing to decline in many rivers, particularly in areas of intensive farming. ORC studies (catchment specific investigations) have shown that agricultural non point source pollution is a key contributor to nutrient pollution.

2. Water quality standards

This proposed plan change is based around the values our regional community places on our rivers and lakes.

2.1 Setting water quality standards.

By using available data, ORC has been able to recommend local limits for Otago Rivers and also assess whether applying the guideline values (i.e. ANZECC, NZ Periphyton and microbiological water quality) is appropriate at a local scale. These standards define the environmental bottom line beyond which values will be lost or compromised.

When proposing standards ORC took a pragmatic approach focused around key factors such as:

- Do the standards maintain or improve water quality?
- Do the standards meet the current water plan objectives?
- Are the targets achievable?
- When will the standards apply?

And practically,

- Are the standards fair and reasonable for land managers?
- Are there options available to land managers to reduce their impacts on receiving water where rivers currently fail to meet the standards?

2.2 Otago's river and lake values.

The key to the proposed standards is the protection of the values our regional community places on our rivers and lakes. The main values of concern are:

- Recreational values
- Angling values
- Ecosystem values
- Food gathering values
- Cultural values

2.3 When should water quality standards and discharge limits apply?

Consideration for when quality standards and specific discharge limits and/or rules should apply was targeted at the following:

- When the rivers and lakes are used for values identified.
- When values identified are at most risk from contaminants entering a water body
- When land managers can manage their discharges to water.

2.4 When are river and lake values at most risk from contaminants entering a water body?

Some values are more sensitive than others while others are flow dependant or even relative to season. Below are some of the main values associated with Otago's water bodies with some context around the most important times of year for them and the key contaminants that affect them.

2.4.1 Contact recreation

Season and river flow are relevant considerations when applying water quality standards for the protection of contact recreation.

Primary contact recreation, such as swimming, is most likely to occur during the warmest months of the year and when clarity is high (>1.6m). The 2003 Microbiological Water Quality Guidelines, define the bathing season as follows: "the bathing season will vary according to location, but will generally extend from 1 November to 31 March."

In rivers, primary contact recreation is much less likely to occur during periods of high river flow. Standards should apply when the river flow is at or below median flow.

2.4.2 Angling

The majority of river angling tends to occur from October to April in lowland rivers and November to May in our backcountry rivers. Most angling occurs at lower river flows (ie. below median flow). Lake angling is year round in the larger lakes.

- High levels of suspended sediments can have a direct detrimental effect on trout, through direct physical abrasion effect of gill rakers and gill filaments. Deposited fine sediment may also impact on the availability of suitable benthic habitat for trout spawning and macroinvertebrates, which generally represent a significant proportion of trout diet in rivers. (Hay *et al.*, 2006).

- Excessive periphyton biomass and cover has detrimental effects on benthic habitat quality and macroinvertebrate communities. It also impacts negatively on the angling experience, as clumps of algae tangle in fishing line/lures, and excessive algae growth is unsightly (Biggs, 2000).

Minimising sediment input during times of high flow, keeping nutrient levels to point that prevents excessive algal proliferation and maintaining clarity at or below median flow are considered the key values for maintaining angling values.

2.4.3 Ecosystem values

Ecosystems are a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit. These include physical, habitat and species characteristics.

Minimising sediment input during times of high flow and keeping nutrient levels to a point that prevents algal proliferation during normal or low flows are the key values for maintaining ecosystem health.

2.4.4 Food Gathering

The mahika kai custom of producing or procuring food resources from a range of resources throughout the region on a seasonal basis is a fundamental basis of the traditional economy. Maintenance of the custom and knowledge associated with the natural resource is governed by lore. Transfer from one generation to the next of the cumulative knowledge is tied to practical use and management of the mahika kai resource. The water resources of the Otago region provide mahika kai directly, provide ecosystem support for mahika kai species, and support other significant mahika kai environments, for example forest and coastal areas.

Food gathering is provided for by maintaining the abundance and productivity of mahika kai species, keeping bacteria levels low, minimising sediment input during times of high flow and keeping nutrient levels to point that prevents excessive algal proliferation at or below median flow.

2.5 Nutrients

2.5.1 Rivers

The New Zealand Periphyton Guidelines (Biggs 2000) provides recommendations on nutrient standards to control periphyton growth. The recommendations are based on a model predicting the maximum periphyton biomass based on descriptors of the hydrological regime and nutrient availability.

The hydrological regime is represented by a parameter called 'mean days of accrual', which is the average time between two flood events. The flood events are characterised as a river flow over three times the median flow (3* median). This flow level is a general indicator of a flood that will start to initiate "periphyton scour", ie. That can reset the periphyton biomass to a very low level. Otago catchments were classified as either short accrual (i.e less than 30 days between flood events), long accrual (i.e more than 30 days between flood events), and upper Clutha (i.e. upper catchment tributaries of Lakes Wanaka, Wakatipu and Hawea of exceptional good water quality)

Bigg's work highlights that periphyton proliferation is most likely at low flows and that excessive concentration of N and P at these times may cause problems for ecosystem, recreation and angling values. ORC have recommended applying the NNN and DRP standards at lower river flows (ie. at or below median flow) as this is the time when controlling nutrient concentrations is most critical for instream values as well as the most practical time for land mangers to control drainage discharges. The guidelines proposed (Biggs, 2000) were the starting point when setting N and P standards.

The proposed standard for nitrite nitrate nitrogen (NNN) for short accrual (i.e less than 30 days between flood events) catchments of Otago is 0.444 mg/l and is based on ANZECC, it is higher than the 0.295 mg/l proposed by Biggs (2000). It was considered unrealistic to use the 0.295 mg/l guideline due to N being readily available due to higher rainfall, saturated soils and high N leaching. As P is the limiting nutrient in most of these catchments it was considered reasonable to be more stringent on P and relax the NNN standard slightly.

McDowell et al, (2011) supported targeting P rather than N in the Pomahaka catchment. Wilcock *et al.*, 2007 noted that where there is a key indication of a single, limiting nutrient (e.g. P), it would be sensible to focus on managing that nutrient without neglecting controls on the other macronutrient (eg. N).

The proposed standard for dissolved reactive phosphorus (DRP) for long accrual catchments (i.e more than 30 days between flood events) is 0.01 mg/l, which is higher than the 0.006 mg/l proposed by Bigg's (2000). In Otago most of the catchments in this area have historically been graded as having very good water quality (SoE 2006 and 2011) , by expecting these rivers to meet a DRP concentration of 0.01 mg/l for 80% of samples taken below median flow we expect to maintain existing good water quality.

The proposed standards in the Upper Clutha are more stringent at 0.03 mg/l NNN and 0.005 mg/l DRP, to protect the exceptional water quality of the upper Clutha.

2.5.2 Lakes

Total nitrogen (TN) and total phosphorus (TP) are usually the metrics of choice in enclosed systems where nutrient recycling may be significant, such as lakes and estuaries (Burns *et al.*, 1999).

The trophic status of lakes is commonly assessed using a combination of four parameters, as recommended in the Protocol for Monitoring New Zealand Lakes and Reservoirs (Burns *et al.* 1999): TP and TN concentration in the water column form part of the assessment.

ORC have defined the water quality standards for Group 4 as that corresponding to the approximate mid point of the eutrophic scale as defined in Burns *et al.* (2000). The water quality standards for Group 5 correspond to the approximate mid point of the oligotrophic scale as defined in Burns *et al.* (2000).

2.6 Water Quality Standards for Otago's Rivers and Lakes:

Table 1 provides a summary of water quality standards that will apply as 80th percentiles. In rivers they will apply when flows are at or below median flow (that is, 80% of samples taken at normal flow should comply with these standards) and in lakes 80% of all samples should comply.

Table 1: Proposed Water Quality Standards for Otago's River and lakes (Schedule 15)

	NNN mg/l	TN mg/l	DRP mg/l	TP mg/l	NH4 mg/l	E Coli cfu/100ml
Group 1 (more flushing flows)	0.444		0.026		0.1	260
Group 2 (fewer flushing flows)	0.075		0.01		0.1	260
Group 3 (Upper Clutha)	0.03		0.005		0.01	10
Group 4 (small lakes)		0.55		0.033	0.1	126
Group 5 (large lakes)		0.1		0.005	0.01	10

These standards are set at a level that is designed to protect the values of Otago's rivers and lakes for contact recreation, angling, ecosystem and food gathering. The standards are designed to maintain water quality where it is good and enhance it where it is poor.

3 Discharges

3.1 When are rivers at most risk from contaminants entering a water body?

Consideration needs to be given to how and when nutrients or contaminants enter water bodies. Generally there are two types of discharges in the rural environment:

- Intermittent discharges through poor practice or high flow events.
- Continuous or consistent discharges through seepage or drainage.

3.2 Intermittent Discharges

ORC identified the following as having significant effects on water bodies though they occur intermittently.

- Sediment input during high flows. Sourced from stock access to stream banks causing slumping and exposed soils.
- Sediment input through pugging. Pugging causes sediment input at all flows but is exacerbated in high flows.
- Sediment input from exposed soils. Sourced mainly from:
    1. ploughing steep or rolling ground with no consideration for buffer strips or swales that run during rain events;
    2. winter strip grazing; and
    3. clearing forestry with poor management strategies.
- Effluent or irrigation run-off entering water. Source being poor management practice including a lack of infrastructure for deferred irrigation.
- Nitrogen entering water. Source being high intensity farming, winter feed grazing, poor effluent management.

ORC has taken a pragmatic approach to these intermittent inputs and rather than putting number limits on them they are covered under specific rules (either prohibited or permitted activities).

3.3 Continuous or discharges that occur during normal or low flow (i.e. below or at median flow)

Inputs that enter water bodies on a more continuous basis from drainage or during times of low flow (i.e. irrigation run-off) can appropriately be targeted with specific limits.

Contaminated drainage to a water body from a drain or irrigation run-off during normal or low flow (i.e. at or below median flow) can have significant effects, particularly if the contaminant levels are high and the stream flow is low.

It is proposed that specific limits for contaminants that are related to the values discussed earlier for Otago rivers are set at the point they discharge to a water body, or leave an owners boundary or control (i.e. enter a scheduled drain or another parties water race).

Limits are proposed for NNN, DRP, ammoniacal nitrogen (NH_4^+) and *Escherichia coli*. These limits are applicable during normal or low flow (i.e. at or below median flow) as this is the time when the discharges are likely to have the greatest effect on the values for rivers outlined earlier.

3.4 Managing discharges from land.

ORC acknowledges there are times when controlling run-off from a property becomes almost impossible, especially during and shortly after significant rain events. However, as identified earlier there are practical management practices that can significantly reduce impacts during these times.

ORC have recommended applying the discharge standards at lower river flows (i.e. at or below median flow) as this is the most critical time to protect instream values as well as the most practical time for land mangers to control drainage discharges

3.5 Discharge standards.

Schedule 16 discharge concentrations are higher than those in Schedule 15 to recognize the nature of farm drainage and the assimilative capacity of rivers and streams. The overriding principle is to control limiting nutrients, keep effluent out of waterways and maintain low bacteria concentrations. ORC believes that the proposed standards in conjunction with the prohibited and permitted rules will protect the values of Otago's rivers and lakes.

Table 2 provides a summary of water quality discharge standards that will apply when flows are at or below median flow.

Table 2: Proposed Discharge Standards for Otago's River and lakes (Schedule 16)

	NNN	DRP	NH4	E Coli
	mg/l	mg/l	mg/l	cfu/100ml
Group 1 (more flushing flows)	3.6	0.045	0.2	550
Group 2 (fewer flushing flows)	1	0.035	0.2	550
Group 3 (Upper Clutha)	1	0.035	0.2	550
Group 4 (small lakes)	1	0.035	0.2	550
Group 5 (large lakes)	1	0.035	0.2	550

These proposed limits are set at an achieveable level (AgResearch, 2011) that is designed to protect the values of Otago's rivers and lakes for contact recreation, angling, ecosystem and food gathering at or below median flow. The limits are intended to maintain water quality where it is good and enhance it where it is poor.

Sampling results indicate that where discharges exceed these values it can usually be linked to a poor management practice or to high flow events following rainfall (Schedule 16 won't apply during high flows). Both prohibited and permitted rules have been written to target activities that are known to contribute significant nutrient loads during high rainfall events. If management practices are employed to ensure all farm discharges meet schedule 16 limits at times of normal flow, and activities that contribute nutrient loads during high rainfall are managed, there would be a net benefit to river water quality.

4 References

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- Kakanui (2012)
- Waianakarua (in progress)
- Tuakitoto (in progress)
- Shag (in progress)
- Lysimeter (in progress)