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**To:** Mary-Anne Baker  
**From:** Anna Madarasz-Smith  
**Date:** 02/03/2021  
**Subject:** ESTUARINE TRIGGER LEVELS FOR PC9  
**File Ref:**  
**CC:** Sandy Haidekker; Jeff Smith

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Good morning,

Please find following relevant information on the trigger levels for the Waitangi and Ahuriri/Te Whanganui-a-Orotū estuaries proposed for PC9.

### **Background**

The National Policy Statement for Freshwater Management (NPS-FM) requires Hawke's Bay Regional Council to set policies and limits that ensures that natural and physical resources are managed in a way that prioritises;

- 1) the health and well-being of the water bodies and freshwater ecosystems;
- 2) the health and needs of people; and
- 3) the ability for people and communities to provide for their social, economic and cultural well-being now and in the future.

The National Policy Statement refers to all freshwater, **and** to the extent that they are affected by freshwater, to receiving environments (which may include estuaries and the wider coastal marine area) (section 1.5).

### **Plan Change 9 - TANK**

During Plan Change 9 preparations, the effects of land-use and freshwater quality on the Waitangi and Ahuriri/Te Whanganui-a-Orotū estuarine systems have been considered. This is consistent with Policy 3 of the NPS-FM (2020) which requires that freshwater is managed in such a way that considers the effects of the use and development of land on a whole-of-catchment basis, including the effects on the receiving environment.

As such, the limits for the lowland urban streams have been set bearing in mind the direction, and to some degree magnitude, of change required for the benefit of the downstream receiving environment of the estuary.

### **Current state**

The current state of the Waitangi and Ahuriri/Te Whanganui-a-Orotū for a variety of values has been described in Madarasz-Smith (2013); Madarasz-Smith et al. (2016); and Madarasz-Smith and Shanahan (2020).

These reports have highlighted that bacteria, sediment and nutrient levels, and the presence of a marine bioinvasive species are contributing to poor outcomes for the estuaries.

A recent Bayesian network model developed for the Parliamentary Commissioner for the Environment has been applied to Hawke's Bay estuaries (Bulmer and Hewitt, 2020). This modelling has highlighted that the Ahuriri/Te Whanganui-a-Orotū has:

- high to very high nitrogen concentrations
- moderate suspended sediment concentrations
- moderate to high sediment mud content, and
- moderate sediment metal concentrations.
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The Waitangi Estuary had:

- high nitrogen concentrations
- a wide range of suspended sediment concentrations
- high to very high mud content, and

- moderate sediment metal concentrations.

Please note that this model does not consider phosphorus concentrations.

As a result, the model predicted a probability of low or very low ecosystem function exceeding 50% for these estuaries. The model indicated that reductions in suspended sediments, mud, metals and nitrogen were likely to result in improvements in estuarine condition and function. The probability of these outcomes can be calculated depending on the level of reductions.

### Proposed approach

Estuaries are the downstream receiving environments for the freshwater drainage system, and as such can be sensitive to the cumulative catchment load of contaminants. The proposed trigger levels provide an indication of the 'state' that should be targeted for estuarine water quality, and sediment quality and quantity for the TANK estuaries.

Due to the functioning of freshwater and estuarine systems, it is not possible at this stage to set instream limits that will provide for a known estuarine concentration downstream. This is due to instream and in-estuary attenuation, flux and transformation of constituents as they are processed through the system. For this reason, a simple 1:1 relationship cannot be predicted for reductions of estuarine contaminant concentrations. That is, that a reduction by 20% of contaminant *x* upstream will not necessarily result in a reduction of the contaminant *x* by 20% in the estuary.

However, when contaminants from the catchment are available in concentrations that contribute to low ecosystem outcomes for the downstream estuarine environment, it is likely that a meaningful reduction will contribute to a directional change in the estuary, although the magnitude of this change will need to be assessed through ongoing monitoring (see Implementation and on-going monitoring).

Hawke's Bay Regional Council have proposed estuarine water quality and sediment quality and quantity trigger levels that set a target for instream reductions. The targets have been set as triggers rather than limits as the relationship between these precise values and strict ecological outcomes is unclear. It provides a direction of change, and an indication of magnitude while providing for further refinement (in any direction) based on monitoring information.

Proposed trigger levels for key attributes for the TANK estuaries were developed using a combination of approaches such as external literature and guidelines (e.g. Estuarine Trophic Index, ANZECC, etc), or by statistical assessment of current water quality in Hawke's Bay estuaries. These are detailed in Madarasz-Smith (2018).

### Nutrient concentrations versus nutrient loads

Trigger values for nutrients can be expressed as either concentrations in overlying waters or as catchment loads. While nutrient concentrations present a snapshot of what the system is experiencing at a point in time, they can be misleading in areas where uptake is high and eutrophication symptoms are present. In these cases, overlying nutrient concentrations can be low due to the uptake by plants.

Nutrient loads can also provide a relationship with interactions such as land use, management, slope and soil type. High nutrient mobilisation is known to be linked with high rainfall events, however the data to support accurate, catchment specific nutrient load information over such events (rather than typical base flows) is relatively young. Therefore, as part of the implementation of the plan, modelling of nutrients including data from higher flow events is recommended in order to refine nutrient concentration or develop nutrient load trigger values over time.

### Sediment attributes

Sediment is a key stressor in the Waitangi and Ahuriri/Te Whanganui-a-Orotū estuaries. SedNet modelling has indicated significant increases in sediment load compared to pre-human estimates:

*Table 1: Sediment load estimates from SedNet (Smith et al., 2020)*

Catchment	Current Modelled Sediment Load (t/yr)	Pre-human Load (as a percentage of current)
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Ahuriri	42,336	19%
Ngaruroro	624,297	32%
Tutaekuri	328,485	27%
Karamu	30,212	24%

Sediment mud content has been proposed as the measurement attribute for sediment delivery to the estuaries as there is an extensive evidence base linking the composition of estuarine sediments to macrofaunal community composition and benthic health.

Similar to nutrients, sediment load triggers may be developed over time once automated sampling is able to provide more accurate measurement of sediment catchment loss over a variety of climatic conditions.

### Implementation and on-going monitoring

A key component of the success of the proposed approach to meeting objectives for estuarine health will be in the on-going monitoring of estuarine water and sediment quality and quantity. This will provide important information on the intervention to outcome relationship and provide feedback on any further upstream management that may be required to achieve desired estuarine outcomes.

Kind regards

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