# Freshwater Science and Technical Advisory Group:

# Meeting 1 priority paper compilation

| | | | |
|---|---|---|---|
| Paper Author | Various | Classification | **See below** |

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|---|---|---|---|
| Meeting date | 18 & 19 October 2018 | Agenda item (number) | 4, 6, 11, 12, 13, 15 |

Paper summary:

| **Agenda item (number)** | **Paper title** | **Classification - confidential yes/no?** | **Page** |
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| 4 | Terms of Reference | No | 2 |
| 6 | The Freshwater NPS NOF – 1 page summary | No | 12 |
| 11 | The intervention logic behind the NPSFM | Yes | 13 |
| 12 | Past criteria used to develop attributes | Yes | 15 |
| 13 | Ecosystem Health Framework: "CawRpt_3194_Freshwater ecosystem health framework report 21 Sep 2018" (Executive summary) | No | 18 |
| 15 | Sediment summary | Yes | 19 |

# TERMS OF REFERENCE

# FOR THE FRESHWATER SCIENCE AND TECHNICAL ADVISORY GROUP

October 2018

Version 1

Status: DRAFT

Document: TP 10133284

## 1. Purpose of the Document

This document defines the draft Terms of Reference (TOR) for the Freshwater Science and Technical Advisory Group (the Group). The document provides:

- contact details of key Water Taskforce staff for freshwater policy development,
- information on the role of the Group and standards of conduct (Appendix 1),
- Confidentiality Undertaking to be signed by all Group members (Appendix 2), and
- Conflict of Interest declaration (Appendix 3).

## 2. Contacts for Freshwater Science and Technical Advisory Group members

**Director**

- Martin Workman –Director – Water. Email: Martin.Workman@mfe.govt.nz

**Managers**

- Lucy Bolton – Manager Freshwater Policy - Responsible manager for the Group. Email: Lucy.Bolton@mfe.govt.nz
- Jo Burton - Manager Freshwater Policy. Email: Jo.Burton@mfe.govt.nz

**Freshwater Science and Technical Advisory Group Secretariat**

- Jennifer Price – Senior Analyst. Email: Jennifer.price@mfe.govt.nz

## 3. Background

The Water Taskforce is comprised of officials from the Ministry for the Environment (MfE), the Ministry for Primary Industries (MPI) and other central and regional government organisations. The Water Taskforce continue to work on freshwater policy development, including the National Policy Statement for Freshwater Management (Freshwater NPS). Since early 2018, the Water Taskforce have been examining options for broad and narrow reform of the Freshwater NPS and on furthering the guidance available on the Freshwater NPS. To inform advice to Ministers on these matters, the Ministries are building a scientific evidence base for freshwater policy options. The Ministries recognise that external groups are important and valuable to explore and test approaches and to advise on science and policy work. It is intended that the Group will continue to oversee the science evidence for freshwater policy development, including National Objective Framework (NOF) attributes, as requested by the Ministries throughout 2018-2020.

In addition, Cabinet recently agreed to establish a new Freshwater Leaders Group. This group will be appointed by Ministers to test freshwater policy as it is developed. Cabinet has also agreed to establish Kahui Wai Māori as a key forum for engagement with Māori on freshwater issues.

## 4. Purpose of the Freshwater Science and Technical Advisory Group

The purpose of the Group is to support officials with science and technical advice on the Water Taskforce work programme, as requested by the Water Taskforce officials, throughout 2018 - 2020. The Group will have a role in ensuring the interpretation of the science for policy development is accurate and help improve protocols to better manage incorporating science into the policy process.

While the Group may wish to engage with the Freshwater Leaders Group and Kahui Wai Māori these groups are to be considered separate and one cannot direct or commission work from the

others. Group Members are not expected to provide advice directly to other groups internal or external to the Water Taskforce in their capacity as members of the Freshwater Science and Technical Advisory Group.

## 5. Freshwater Science and Technical Advisory Group Membership

The Group membership includes respected individuals with expertise in data, science and technical matters related to freshwater and estuarine water quality and processes. Members are selected to represent a breadth of expertise across freshwater disciplines and from a range of organisations.

The Group members for 2018- 2020 (the Members) are:

- Ken Taylor (Agresearch) (Chair)
- Dr Adam Canning (Figh & Game NZ)
- Dr Bev Clarkson (Landcare Research)
- Dr Bryce Cooper (NIWA)
- Dr Clive Howard-Williams (NIWA)
- Dr Chris Daughney (GNS)
- Dr Dan Hikuroa (University of Auckland)
- Graham Sevicke-Jones (Environment Southland)
- Prof. Ian Hawes (University of Waikato)
- Prof. Jenny Webster-Brown (University of Canterbury, Lincoln University)
- Dr Joanne Clapcott (Cawthron Institute)
- Dr Jon Roygard (Horizons Regional Council)
- Dr Marc Schallenberg (University of Otago)
- Dr Mike Joy (Victoria University of Wellington)
- Rawiri Smith (Kahungunu ki Wairarapa)
- Prof. Russell Death (Massey University)

Water Taskforce officials may amend the Group membership and co-opt expertise for particular meetings at their sole discretion.

## 6. Objective and Scope

The Group will:

- Have a solid understanding of the fundamental purpose of the Freshwater NPS and the guiding principles of attribute development
- Advise on scientific evidence for freshwater policy development by:
    - reviewing science that underpins Freshwater NPS NOF attributes and other freshwater policy options
    - identify any gaps in the science
    - improving the NOF attribute development process
    - improving protocols to better manage incorporating science into the policy process
    - providing overarching scientific advice and guidance as it relates to freshwater policy development
- Contribute to science and technical related guidance for councils to implement the Freshwater NPS
- Provide science advice on issues raised in public submissions on proposed Appendix 2 attributes and wider freshwater policy.

Final decisions on policy advice, working with Ministers, management and provision of funding, budgets and financial aspects of the programme and the management of procurement processes remain the sole responsibility of the Ministries and not the Group.

## 7. Meetings

Face to face Group meetings will be one or two days long, held in Wellington, with catering provided. The secretariat will endeavour to organize meetings on a day that suits most Members. Members are asked to keep the secretariat informed if they are unavailable for particular dates. If a Member is unavailable for a meeting they may provide advice on a topic via email – preferably prior to the meeting.

Face to face meetings will be held at least 6 times per calendar year. If required additional meetings will be held on an ad hoc basis, these meetings may be face to face or held via telephone/video conference.

The deliberations of the group will be recorded as meeting minutes and with the agreement of the Chair made available publically on the Ministry for the Environment website, to increase transparency.

## 8. Tasks and Conduct

The Chair has the following roles and responsibilities:

a) Set meeting agendas, with the assistance of the secretariat, and approve meeting minutes;
b) Chair meetings, encouraging and modelling open communication where all members contribute effectively;
c) Determine, with assistance from the Water Taskforce managers, what action is appropriate if a member has a potential conflict of interest; and
d) Seek written approval from the Water Taskforce before incurring any expenditure or financial commitment on behalf of the Group.

All Group members have the following roles and responsibilities:

a) Make every effort to attend each meeting and report anticipated absences to the Secretariat;
b) Prepare adequately prior to each meeting, review any papers provided prior to meetings and participate actively in meetings, contributing to actions when agreed;
c) Bring matters of significance to the attention of the Group and use professional perspectives to undertake analysis or prepare advice as required;
d) Contribute to email discussion amongst the Group about relevant technical issues;
e) Approve minutes of meetings;
f) Comply with the Standards of Conduct in Appendix 1;
g) Complete the Confidentiality Undertaking in Appendix 2 and return it to the secretariat; and
h) Complete the conflict of interest declaration form in Appendix 3 and return it to the secretariat.

## 9. Role of Water Taskforce staff

Officials from the Water Taskforce will:

- lead all administrative actions associated with the smooth operation of the Group including:
  - leading communication with the Group
  - organising meetings, including catering and arranging reimbursement of travel expenses for non-government members
  - distributing papers to Members prior to meetings and minutes after the meeting.

## 10. Remuneration and reimbursement of expenses

The Freshwater Science and Technical Advisory Group operates on an 'in kind' basis. No remuneration is payable to members:

- where members are employees of central government their employer is responsible for meeting all cost associated with their membership on the Group
- for university and non-central government employees or members not in paid employment, all reasonable travel costs will be paid for by the Ministry for the Environment. The Ministry for the Environment will, as a general rule, book all accommodation and travel for members. Where members book their own accommodation or travel, that person is entitled to have to have the actual and reasonable costs of Expenses for travel and accommodation (Expenses) reimbursed by MfE, if:
  - MfE has given prior written consent to the Supplier incurring the Expense;
  - the Expense is charged at actual and reasonable cost; and
  - the claim for Expenses is supported by GST receipts.

## 11. Confidentiality

It is a pre-condition of membership on the Group that each Member sign the Confidentiality Undertaking attached at Appendix 2.

## 12. Conflict of Interest

The Freshwater Science and Technical Advisory Group members will be asked to formally declare real or possible conflicts of interest with the development of freshwater policy (see Appendix 3). This includes current or future services they may commercially offer to the Water Taskforce. These will be noted in the members records and will be reviewed and accepted by the Water Taskforce Manager responsible for the Group.

Disclosure of interest can be:

- Self-initiated
- Raised by the Water Taskforce
- Raised by other members

Members should operate on the understanding that "if in doubt, disclose the interest". The Water Taskforce Manager responsible for the Group will decide if there is a relevant interest and determine appropriate action.

# Appendix 1 to The Freshwater Science and Technical Advisory Group Terms of reference:

## The Freshwater Science and Technical Advisory Group Standards of Conduct

All members are expected to adhere to the following principles:

**Conflicts of interest**

A conflict of interest will occur when a member's private interest interferes, or appears to interfere, with an issue that faces the Group. A conflict of interest will also occur when there is a possibility that a benefit may apply to a sector, industry or organisation that they represent. A conflict of interest may be real or perceived.

Any situation that involves or may be expected to involve any real or potential conflict of interest must be declared immediately to the Water Taskforce Manager responsible for the Group, as soon as the conflict arises, using the form in Appendix 3.

At the discretion of the Water Taskforce, members may participate in discussions about issues in which they have declared a conflict of interest.

**Confidentiality and media**

In order for the Group to operate effectively, members must maintain the confidence of the group, including maintaining confidentiality of matters discussed at meetings, and any information or documents provided to the group. Water Taskforce staff will identify whether Information provided to the Group is confidential. With the agreement of the Chair, members and observers may share information about the business of the Group.

Where information is already in the public domain (through no fault of a member or observer), the confidentiality requirements do not apply to that information.

Where information is not already public;

1. The Chair may seek agreement from the Water Taskforce for the Group to release a media statement.
2. A Member may only participate in a media interview or public statement about the business of the Group if they have obtained the prior written approval of the Water Taskforce.

All members must sign the Confidentiality Undertaking using the form in Appendix 2.

**Privacy Act 1993**

Members must at all times comply with the requirements of the Privacy Act 1993 and keep information about identifiable individuals confidential.

**Official Information Act 1982**

All information provided to the Group or by the Group to the Secretariat will be treated as official information under the Official Information Act 1982 and, subject to the requirements of that Act, may be released to the public if there are no grounds for withholding it.

If the Water Taskforce is considering releasing information about Group meetings or Group-authored documents under the Official Information Act 1982, the Water Taskforce will consult with the person who provided the information before making a final decision on release. If that person cannot be located, the Water Taskforce will consult with the Chair on behalf of that person.

**Corporate opportunities**

Members must not exploit any opportunity that is discovered through access to information within the Group for their own personal gain or that of any industry, sector or organisation that they represent.

**Respect for others**

Members and observers will treat each other and the opinions of others with respect at all times. Members will not take unfair advantage of anyone through manipulation, concealment, abuse of privileged information, misrepresentation of material facts or any other unfair dealing practices.

**State Services Standards of Integrity and Conduct**

State servants have statutory demands under the State Services Standards of Integrity and Conduct. In the case of any conflict between the obligations outlined there and the ones in this document, those of the Standards and Integrity of Conduct shall preside.

# Appendix 2 to The Freshwater Science and Technical Advisory Group Terms of reference:

## Confidentiality Undertaking

Membership of the Freshwater Science and Technical Advisory Group

I, _____

1. Agree and undertake as a condition of membership, we will:

   a) be discreet and keep confidential all information provided to members of the Freshwater Science and Technical Advisory Group (the "Information");

   b) not, other than as required by law, disclose or discuss the Information with any person who is not:

      - employed by the Water Taskforce, or otherwise a part of the Crown; or
      - an officer, employee or authorised agent of the Water Taskforce;

      without the prior written consent of the Water Taskforce Manager responsible for the Group ;

   c) not use any Information to gain personal advantage or for the benefit of any person or organisation;

   d) in particular, but without limitation, not discuss any Information with any member of the public and media or submit articles for publication or dissemination outside the Crown without the prior authorisation of the Water Taskforce;

   e) take all reasonable care to ensure that all Information in my possession is kept secure and we will immediately return, destroy or otherwise deal with such Information as directed by the Water Taskforce.

2. I acknowledge that:

   (a) I will continue to honour the promises I make in signing this Undertaking until the Information in question becomes publicly available, or until the Water Taskforce gives written approval for the disclosure or use of particular Information.

**Signature:** _____

# Appendix 3 to Freshwater Science and Technical Advisory Group terms of reference:

## Conflict of Interest declaration form

An actual conflict of interest arises in a situation where a candidate's private interest interferes or appears to interfere with an issue that faces the Freshwater Science and Technical Advisory Group (the Group). Perceived or potential conflicts of interest exist in situations where a candidate of the Group, a family member or a close personal relation has private interests that interfere or appear to interfere with an issue that faces the Group.

A conflict of interest arises in a situation where there is a possibility that a benefit may apply to a sector, industry or organisation that a candidate may represent.

| | |
|---|---|
| Name: | |
| ☐ I declare that there are no conflicts of interest could compromise my objectivity, judgement, integrity or ability to perform the responsibilities of the Group. | |
| ☐ I declare the following situation(s) that would cause a conflict of interest to exist | |
| Please describe how this conflict of interest will be managed: | |
| ☐ I declare the following situation(s) that may be perceived as a conflict of interest | |

| |
|---|
| |
| Please describe how this conflict of interest will be managed: |

Date:

Signed:

# The Freshwater NPS - National objectives framework

To manage fresh water the Freshwater NPS introduced a national objectives framework which can broadly be thought of as a **Values – Freshwater Objectives – Limit setting – methods** cascade.

The framework firstly requires councils to establish what values apply to the freshwater bodies in their region. This must include the **two compulsory national values of ecosystem and human health**, plus any other national or local values the community identifies.[1] Councils must then establish freshwater objectives for those values. Freshwater objectives should ensure that those aspects (attributes) of water quality relevant to the values are maintained or improved.

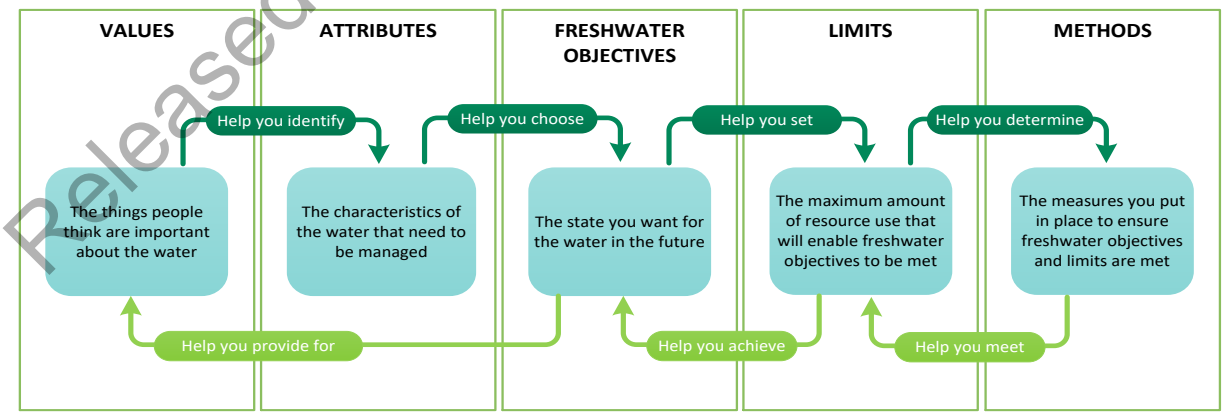
**Freshwater objectives** must be set using every attribute in Appendix 2 of the NPS (as they are all linked to the two compulsory values), and any other attributes which are appropriate for supporting the full range of values the community holds for water bodies in their region [2]. Freshwater objectives describe the intended environmental state of fresh water that would provide for a value, conveyed by the attribute states A–D. Freshwater objectives must be set at a level that ensures water quality is either maintained (set at current state) or improved (better than current state)

**Limits** on resource use must then be established that will achieve the freshwater objective. A limit is the maximum amount of 'resource use' that is possible, while still meeting the freshwater objective over time. Resource use is often thought of as a 'water take' (consumptive use) or 'discharge allowance' (assimilative capacity of the water body to absorb nitrogen).

However it can also be any other kind of resource use, eg, stock access to water, grazing on certain types of land, or urban greenfield developments. Restricting these things eg, by a requirement to fence stock out of water, restricting grazing on critical source areas, or requiring a minimum percentage of permeable ground cover is setting a limit on resource use to achieve desired water outcomes (the freshwater objective).

**Methods (including rules)** must be established in the plan to ensure the limit is applied to resource users. Regional plan rules tell users what can and cannot be done with water and assist in avoiding over-allocation. Other methods (not rules) can incentivise change. Figure 1 summarises the framework concept and how limits fit in to it.

**Figure 1: The Freshwater NPS framework from values to methods**




[1] This includes the 'national values' in Appendix 1 and any others identified by the community

[2] The NPS acknowledges the Appendix 2 is not a complete list and councils will need to establish other attributes

# The intervention logic behind the NPSFM

The purpose of this paper is to prompt discussion about the intervention logic behind the NPSFM and what it does/ doesn't do – both in a theoretical/technical sense as well as in practice. This is intended to underpin future discussions about the best option for managing a stressor – whether that's an NPSFM attribute or something else.

Key messages:

a. At its core, the **NPSFM operates by driving regional planning to constrain resource users (i.e. negative constraints on resource use** activities that impact on water quality).

b. **This is a simplified description of the intervention logic intended to prompt discussion, there are other elements not included here** – e.g. monitoring requirements generate information, which in turn can influence how people behave and support Environmental Reporting (and potentially future policy development). The below is completely up for debate!

c. **Attributes in the NPSFM are always an option**. But we should consider A) what the NPSFM does/doesn't do, B) what we want regional councils and communities to do, and C) what's the best way to get them to do it?

d. In practice, **the NPSFM can clearly motivate actions without requiring them in a technical sense** (e.g. regional councils commit funding and do clean-ups, etc). **But is it the most effective mechanism for doing so?** What about funding, monitoring and Environmental Reporting, NESs, planning standards, Waste Minimisation Act regulations, more fundamental reform (**anything goes – if we are clear about the intervention logic we want to employ, we can discuss what other mechanisms exist/should exist**)?

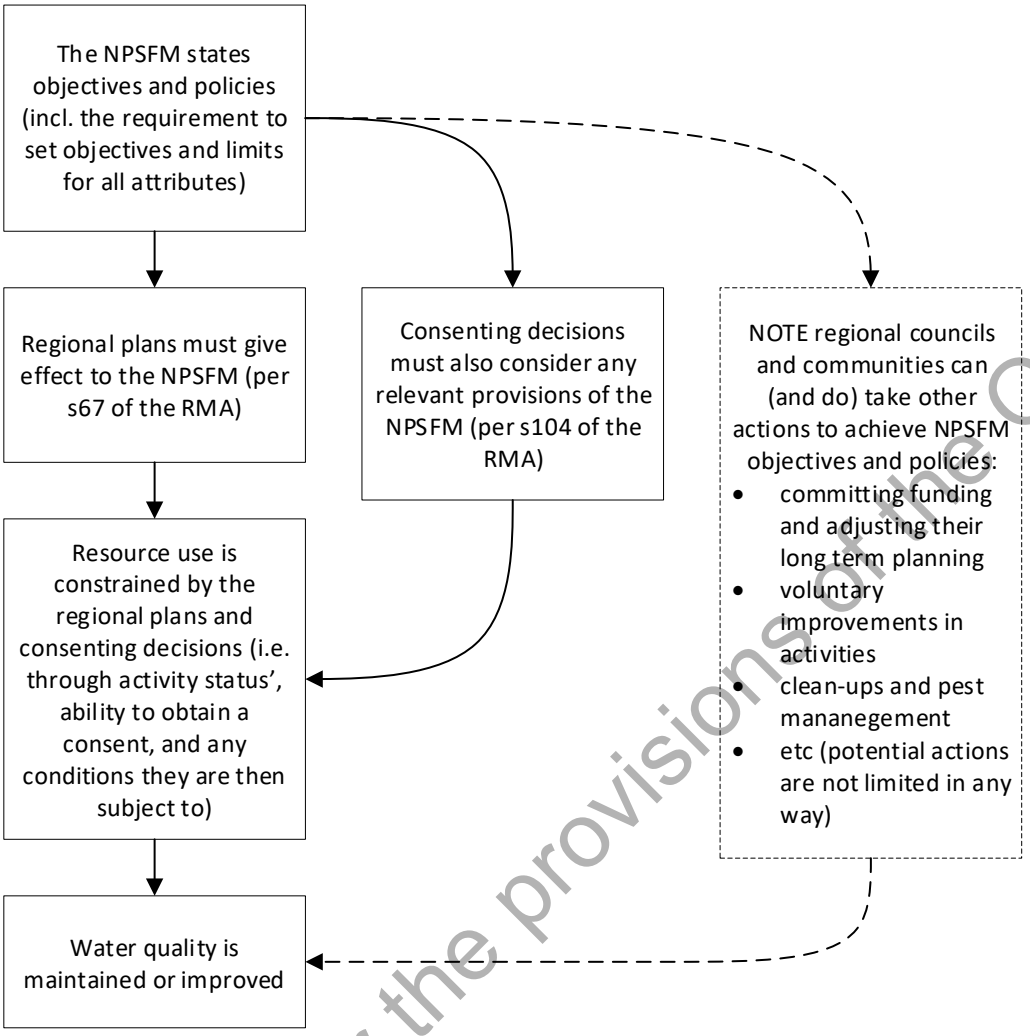



**Figure 1: Example intervention logic behind the NPSFM**

# Past criteria used to develop attributes, and what to do with them?

The purpose of this paper is to outline criteria that were used to develop existing attributes, and discuss what their relevance is for policy development and whether they are still fit for purpose.

Key messages:

a. The attribute development **criteria described are what we have used in the past, but not necessarily what we have to use going forward**.

b. **Are useful criteria missing?** For example, can we assess potential attributes for:
    a. Priority or importance (e.g. if key aspects of ecosystem health are currently not managed, or there is a risk of irreversible harm);
    b. Efficacy (i.e. of a NPSFM attribute to manage that particular attribute);
    c. etc?

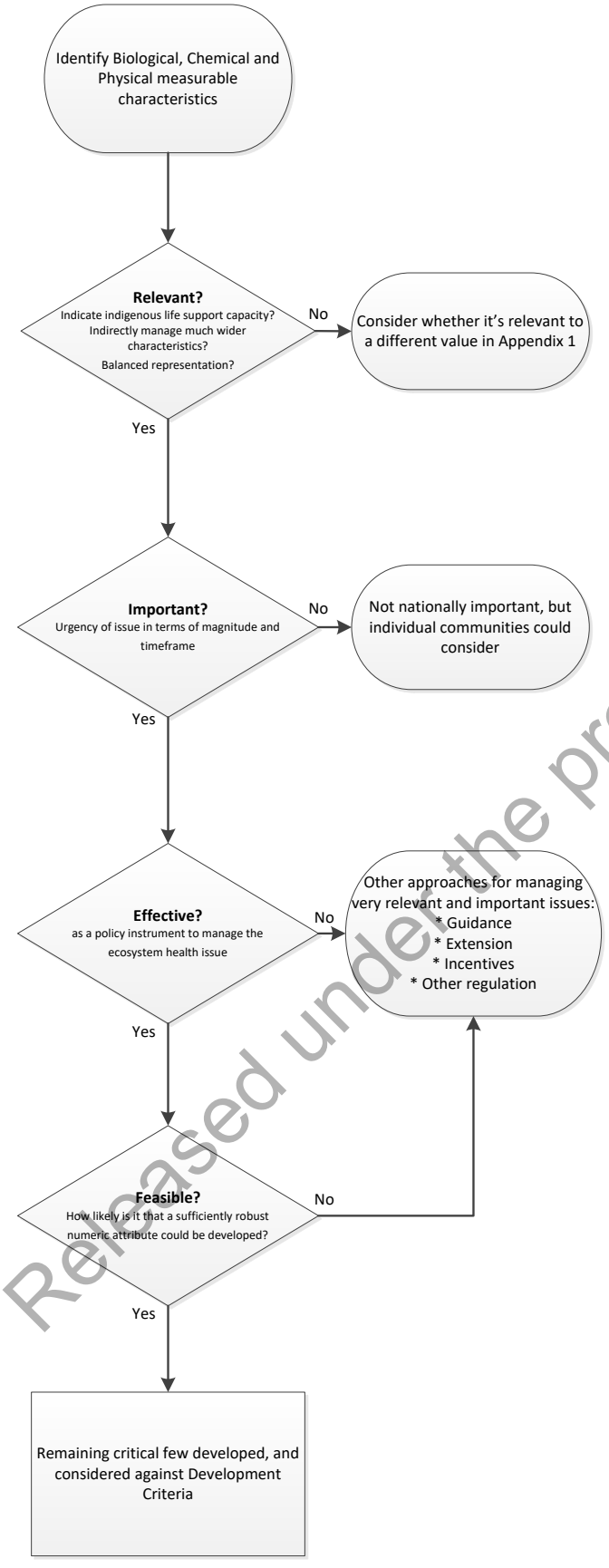
    Other criteria have been tested with the previous Science Review Panel, and are included in the flow chart at the end of this document.

c. It is completely **up to the group to decide what criteria to apply and how** – the main thing is to think about why the criteria are there, and whether this affects your advice/how the Ministers will receive your advice.

d. The NPSFM and **attributes are a means to an end, there may be better means available**. We need an accurate understanding of the NPSFM's intervention logic – please refer to discussion about the NPSFM's intervention logic.

| Past criteria | Points for discussion |
|---|---|
| **1. Link to the National Value**<br>a. Is the attribute required to support the value?<br>b. Does the attribute represent the value? | • Purpose is to make it clear to regional councils and communities what impact a measurable characteristic is having - e.g. on their ability to swim, the health of the fauna living in the stream, etc?<br>• To some extent this is not problematic for attribute development and will be clear/satisfied in most cases? |
| **2. Measurement and band thresholds**<br>a. Are there established protocols for measurement of the attribute?<br>b. Do experts agree on the summary statistic and associated time period?<br>c. Do experts agree on thresholds for the numerical bands and associated band descriptors? | • Purpose is to support community discussions about where they want to set objectives by describing the impact on values in an accessible way.<br>• Fundamentally, the band thresholds are a subjective value judgment about when something changes, and there are risks (as well as benefits) to this approach.<br>• Established thresholds and, as well as expert opinion is valuable for reaching consensus, but are there other approaches attributes could take?<br>• Note this does have an implications for Objective A2, requiring councils to at least 'maintain' water quality – we are considering options to address risks with bands approach. |
| **3. Relationship to limits and management**<br>a. Do we know what to do to manage this attribute?<br>b. Do we understand the drivers associated with the attribute?<br>**c.** Do quantitative relationships link the attribute state to resource use limits and/or management interventions? | • Purpose is to assess whether the NPSFM's intervention logic will work. The relationship to resource use is critical for the current NPSFM intervention logic to work (i.e. enabling regional councils to limit resource use in order to achieve a specific outcome).<br>• Acknowledge attribute sit on a continuum, with some more closely related to resource use, and other closer to the state of the ecosystem health. As long as they tell us something about water quality and values like ecosystem health, then they should be managed – the issue is whether an attribute will be an effective way to do that.<br>• We should consider other options (e.g. difficulties/disagreements with how to address MCI is a useful case study for this). |
| **4. Evaluation of current state of the attribute on a national scale**<br>a. What do we know about the current state of the attribute at a national scale?<br>**b.** Is there data of sufficient quality, quantity and representativeness to assess the current state of the attribute on a national scale? | • Purpose is to help us give Minister's complete and convincing advice. Although impact testing is not necessary for a policy to work – the intervention logic may be OK regardless. But it is critical when advising Ministers and convincing them to make changes.<br>• For example, if we are asking Minister's to do X, can we describe what will happen as a result?<br>• If we don't know, how do we proceed in the face of uncertainty? We will never know everything, and there are consequences if we don't act in a timely manner. |
| **5. Implications of including the attribute in the NOF**<br>**a.** Do we understand/can we estimate the extent (spatial), magnitude, and location of failures to meet the proposed bottom line for the attribute on a national scale? | • As above, suggest discussing together. |

## Other criteria tested with the previous Science Review Panel




Matrix of water body type, and aspects to be managed

Biology, Physicochemical, Physical Habitat, Hydrology
* Rivers
* Lakes
* Wetlands
* Groundwater

1. how **relevant** the attribute is to Ecosystem Health

Ecosystem = biological communities and their physical and chemical environment, interacting as a system

NPS objective: "safeguard the **life-supporting capacity, ecosystem processes** and **indigenous species** including their associated ecosystems, of fresh water"

***NPS Appendix 1***: "in a healthy freshwater ecosystem **ecological processes** are maintained, there is a range of **diversity of indigenous flora and fauna**, and there is **resilience** to change"

2. the **importance** and urgency of the issue that the attribute would manage

- Irreversible
- Cumulative
- Large in scale or pervasive [e.g. nationally, or affects a number of regions],
- Increasing in scale and/or distribution, especially if it is accelerating
- Able to tip a system over a threshold into another (worse) state

To date, the PCE has used these criteria to identify **nutrients**, **sedimentation** and **longfin eel** communities as important freshwater ecological issues.

3. how **effective** would using Appendix 2 be to manage the issue?

Appendix 2 influences Councils to set *objectives* and **limits** (to resource use) for the specified attributes. This:
- manages cumulative effects
- is more efficient, and provides greater certainty for consent applicants
- helps to justify placing restrictions on resource use

Works best where the link to resource use and/or management actions is understood. There are a range of other management approaches available.

4. **feasibility**; ease (science sufficiency) for developing a robust numeric attribute

NOF Guiding Principles. How easy will it be to develop:
* Measurement and band thresholds
* Relationship to limits and management
* Understand current state nationally, including failures of bottom lines
* Quantify Socio-economic impacts of managing attribute and bottom lines

# Freshwater Biophysical Ecosystem Health Framework

Joanne Clapcott, Roger Young, Jim Sinner, Mahuru Wilcox, Richard Storey, John Quinn, Chris Daughney, Adam Canning

## EXECUTIVE SUMMARY

This report describes a proposed framework for the integrated assessment of the biophysical ecosystem health of fresh waters in Aotearoa New Zealand. The Ministry for the Environment commissioned the framework to help freshwater managers meet their monitoring and reporting requirements, in particular, under the National Policy Statement for Freshwater Management 2017 and the Environmental Reporting Act 2015.

We undertook a series of workshops and a critique of existing frameworks and relevant literature to identify the key requirements for developing and implementing a framework for Aotearoa New Zealand. The purpose of the framework was defined as: To provide a consistent approach for assessing biophysical ecosystem health of fresh waters, enabling central and local government, communities and individuals to gauge the maintenance and improvement of ecosystem health. A healthy freshwater ecosystem has ecological integrity when it can maintain its evolving structure and function over time in the face of external stress. A consistent assessment of ecological integrity requires reference benchmarks.

The proposed framework has five core components that together provide an integrated assessment of ecological integrity. These include: aquatic life, physical habitat, water quality, water quantity and ecological processes.

Performance attributes of the framework include: consistent (has broad application across fresh waters), representative (integrates multiple components), robust (is informed by science), informative (is easily understood), flexible (suits varied application) and scalable (can be modified for reach- to national-scale assessments).

Application of the framework requires knowledge of the suitability of its component indicators and their appropriate benchmarks, as well as of methods for data aggregation, harmonisation and integration, and reporting. This report provides an example of how component indicators can be identified for river health assessments, but further effort is recommended to develop a 'toolbox' for resource managers. Further recommendations for framework application include: development of conceptual models to illustrate the core components and indicator links to management options, development of best practice guidelines for data analysis and reporting (including pilot analysis of existing data at multiple spatial scales), as well as communicating with resource managers throughout any subsequent policy process.

Finally, although the proposed ecological integrity framework is biophysical and based on 'western' science, it could be a helpful complement to a kaupapa Māori approach, along with other tools and approaches such as the Cultural Health Index, to support iwi to identify their values, aspirations and subsequent indicators for fresh water. We recommend further consideration of how this biophysical approach can be used to contribute to a holistic picture of fresh water that also reflects other cultural, social, economic and environmental values.

# Sediment attribute discussion primer

**Purpose of the brief**

1. Provide policy context on the sediment attribute development programme
2. Describe generally the work done to date and the sediment expert working group
3. Outline the advice we seek from you
4. Provide summary information on the classification systems and research methods used

**Attached documents**

- Collated sections of the relevant reports that provide more detail on the development of attribute classification systems and ecological thresholds research methods
- The entire Stage 2 draft report; we do not expect you to read this, but it is available to you **in confidence** if you would like to examine anything further

**Themes of advice we will seek over the next few meetings**

- The strength of evidence for the proposed attribute classification systems
- The appropriateness of the research methods used in the programme, including the integration of multiple lines of evidence
- The strength of evidence for the proposed bottom-line attribute thresholds and evidence base for potential attribute bands
- Approaches to assess the potential impacts of implementing sediment attribute regulation

**Objectives for this meeting**

1. At this meeting, we intend to cover at least the attribute classification systems as well as one specific aspect of regulatory impact assessment
2. Ideally, we will also cover methods used to date; if this is not possible given time constraints, methods will be the primary topic for the next meeting



**Sediment and the National Policy Statement for Freshwater Management**

Sustainable management of freshwater resources to safeguard "the life-supporting capacity of air, water, soil, and ecosystems" is one of the core purposes of the Resource Management Act (RMA). The National Policy Statement – Freshwater Management (NPSFM) provides further direction and requires regional councils, through their regional plans, to set freshwater objectives that provide for freshwater values, and to set limits and management actions to achieve those objectives. The National Objectives Framework (NOF) further defines attributes that assist regional councils in setting freshwater objectives and justifiable policies (including limits) for achieving these. The NPSFM includes both ecosystem health and human health for recreation as compulsory national values that Regional Councils must ensure freshwater bodies provide.

There is ample evidence that suspended and deposited sediment are among the greatest pressures on freshwater and estuarine biodiversity, habitat availability, ecosystem function, and overall features of

ecosystem health. In-stream sediment also affects the national value of human health for recreation[3] as well as other in-stream and extractive values described in the NPS-FM. Policy reviews of the NPSFM and New Zealand Coastal Policy Statement identify persistent challenges councils face in effective management of erosion and sediment generation. Therefore, we have procured research to support the development of sediment attributes.

## Overview of the sediment attribute programme

### Work to date

The sediment attribute programme started in 2016 and incorporated two stages. The first stage focused on the development of an attribute classification system to account for natural "reference state" variation in sediment "environmental state variables" that cause ecological impacts, and the second focused on development of sediment indicator thresholds for the ecosystem health value.

Stage 1 consisted of the following main components (all reports published on our website)[4]:

1. Collation and exploration of sediment ESV data and ecological health (macroinvertebrate and fish) metrics
2. Literature review of the ecological impacts of sediment environmental state variables (ESVs)
3. Assessment of the relationships between in-stream sediment loading and sediment ESVs and their variation across catchments as well as relationships between ESVs to consider whether any are redundant or unnecessary
4. Field research and development of sediment-specific macroinvertebrate species sensitivity analysis methods and metrics
5. Development of a classification system to differentiate rivers according to reference state variation in sediment ESVs

Stage 2 investigated biological responses to gradients of sediment ESVs and proposed bottom-line thresholds for deposited and suspended fine sediment ESVs for inclusion in the NOF. We note that the Stage 2 report is still in draft form.

### Stakeholder involvement

A sediment expert group of researchers and council scientific staff contributed to the development of the research programme and evaluated research outputs. Most recently, in November 2017, they provided conclusions on the overall suitability of the Stage 2 results. Their overall recommendation was to advance policy development using the work to date while providing suggestions for future work to improve the quality of the evidence base.

We also convene a working group of council policy staff from the Resource Managers' Group to discuss sediment-related policy implications.



[3] Where regional councils have set in-stream thresholds related to long-term sediment indicator values, visual clarity is the most frequently used indicator, and thresholds are explicitly linked to recreation.

[4] 1. Literature review of fine sediment effects on freshwaters and the relationship of environmental state to sediment loads; 2. Stage 1 analysis of relationship between sediment loads and in-stream sediment indicators; 3. Stage 1b proposed classification for suspended sediment attribute; 4. Stage 1b. proposed classification for deposited sediment attribute

We will be discussing the proposed sediment attributes, and other sediment-related policy options, with the Freshwater Leaders Group, Kahui Wai Maori, and other stakeholders.

**Work in process**

1. We are procuring research to provide further evidence for sediment attribute development
2. We are procuring analysis to assess potential implications of implementing the proposed bottom-line thresholds including
    a. assessment of load reductions required to meet proposed thresholds
    b. avenues to reach the load reduction requirements
    c. the costs and co-benefits of the various mitigations and changes necessary to meet load reduction requirements

**Advice we seek from you at this meeting**

**Broad themes**

For the first meeting, we would like your feedback on two over-arching issues, and we hope that you will be able to reach summary conclusions at least about the first:

1. The strength of evidence for the proposed attribute classification systems
2. The adequacy of methods used for Stage 2 research components and their integration

In addition, we have a specific question on regulatory impact testing we would like to cover.

**Specific questions**

We have several specific questions that should help to open and facilitate the conversation.

1. In relation to the attribute classification systems:

- How strong do you consider the evidence for the climate-based source of flow classification for suspended sediment?
- Do you consider the indicator "offset" proposed for the suspended sediment classification system warranted given the evidence provided?
- How strong do you consider the evidence for the reference-state classification for deposited sediment?
- From an environmental management perspective, is it problematic that the suspended and deposited sediment attribute classification systems have different framings – one being source of flow and one being predicted reference state?

2. In relation to regulatory impact testing:

- Where does existing evidence best suit catchment case studies for regulatory impact assessment along the lines described above given our objective to focus on catchments with primary erosion/sediment generation pressures from a. forestry, b. urban infrastructure and development, and c. connections to estuaries (one case study each).

3. In relation to the adequacy of methods used and their integration:

- How suitable are the range of methods used for determining ecological impact thresholds?

- To what extent is the comparability of evidence produced using these methods conducive to determining ecological impact thresholds?
- How well do you think the integration of evidence dealt with input data inconsistency/incomparability?
- How could the challenges related to evidence comparability be overcome more effectively?

**High-level summary information to inform your response**

1. ***Proposed attribute classification systems (collated text from the stage 2 draft report)***

**Overview of attribute classification**

The purpose of a classification system is to account for the natural variation in deposited and suspended sediment measures along rivers and across the country due to factors such as geology, soils, channel and catchment slope and climate. Some of the key drivers of natural state variation differ between deposited sediment and suspended sediment. Deposited sediment cover of the streambed can vary substantially between reaches along rivers with changes in local (reach scale) river characteristics (e.g., stream slope and power), whereas suspended sediment is relatively insensitive to these factors. This required different approaches to the classification systems: suspended sediment classification was derived from simpler analysis of data to characterise natural state variation whereas the deposited sediment classification required a modelling approach that accounted for local river influences to predict natural levels of deposited fine sediment percentage cover at every stream reach.

**Suspended sediment classification system**

80-90 suspended sediment reference sites where identified from approximately 800 water quality sites, using newly developed criteria and catchment landcover areas (LCDB4), and used to characterise natural state variation of three sediment measures – namely total suspended sediment (TSS), visual clarity and turbidity.

The absolute levels and variation in median natural state suspended sediment measures were relatively low (e.g., turbidity at natural state sites varied 6-fold, most sites ranging between 0.4 and 2.2 NTU. Furthermore, because the focus of the project was limited to defining bottom-line thresholds (C/D bands), the observed variation natural state of suspended sediment was much lower than anticipated bottom-line threshold values informed by a literature search. For turbidity, we expected the lowest C/D band threshold would be medians between 5 and 7 NTU, compared to natural state variation of site median values (0.4-2.2 NTU).

Differentiation of reference site suspended sediment measures by climate class suggested that aggregate 'warm' River Environment Classification (REC) climate class, on average, have up to 1 NTU higher median turbidity values compared to reference sites from 'cool' REC climates. We therefore recommend a potential +1 NTU offset for warm climate classes. This is largely a pragmatic

recommendation based on few reference sites, but is also consistent with modelled reference state measures of suspended sediment (McDowell et al. 2013)[5].

**Deposited sediment classification system**

A boosted regression tree (BRT) model, trained with deposited sediment data from 2,022 reference sites spread across New Zealand, was used to predict natural state (i.e., sediment state without or little human influence) for all stream segments of the national river network. Across all stream segments, the model predicted a 'national' median deposited sediment cover of 13% for the hypothetical natural state of streams in New Zealand. It also predicted that 75% of all stream segments in New Zealand would have <30% sediment cover in their hypothetical natural state while the remaining 25% of stream segments have >30% sediment cover.

We explored the grouping of sediment natural state predictions using Classification and Regression Trees (CART) and River Environment Classification classes. The CART identified 9 sediment classes with a statistically significant difference in mean sediment values. These classes were pragmatically combined into three classes: 1) <30% sediment cover ('hard-bottom streams with low-medium sediment levels'), 2) 30-60% sediment cover ('hard-bottom streams with high sediment levels') and 3) >60% sediment cover ('soft-bottom streams'). The three classes are recommended for attribute band application, and the BRT model predictions are recommended for the assignment of stream segments into each class.

***2. Research methods used (MFE-provided synthesis summary)***

The table below provides a high-level overview of primary - not exhaustive - methods used in each project component and indicative (not exhaustive) datasets.

| Project component | Analysis | Datasets |
|---|---|---|
| Sediment loading to ESVs (Stage 1a) | For predicting sediment rating curves at any river site:<br>1. Random Forest (RF) regression models (4);<br>2. Analysis of variance with source of flow as predictor<br><br>For relationship between sediment loading and deposited sediment indicators:<br>1. Linear regression<br>2. Boosted regression tree (BRT) modelling | 1. NRWQN dataset;<br>2. LAWA;<br>3. New Zealand Freshwater Fish Database (NZFFD);<br>4. Regional council data (from data request);<br>5. CRI-held data<br>6. Fieldwork data;<br>7. REC<br>8. LCDB 3 |
| Suspended sediment (SS) attribute | 1. Identify "reference state" river reaches per land cover definitions; | 1. Water quality data: NRWQN; SOE; Project Stage 1 findings/data |

[5] McDowell RW, Snelder TH, Cox N, Booker DJ, Wilcock RJ 2013. Establishment of reference or baseline conditions of chemical indicators in New Zealand streams and rivers relative to present conditions. Marine and Freshwater Research 64(5): 387-400

| | | |
|---|---|---|
| classification system (Stage 1b) | 2. Statistical analyses of relationships between land cover and SS indicators to assess reference state variation | 2. Land cover: LCDB v4.1<br>3. Freshwater classification: REC |
| Deposited sediment (DS) attribute classification system (Stage 1b) | 1. BRT modelling to predict reference DS state nationwide<br>2. Classification and regression tree (CART) analysis using REC to derive reference state DS groupings | 1. Water quality: SOE; NRWQN; Project stage 1; regional councils; new data collection; sediment-MCI project data; NZFFD<br>2. Freshwater classification: REC; Freshwater Environments of New Zealand (FENZ)<br>3. Land cover: LCDB 3 |
| Macroinvertebrates (MI) – DS (Stage 2) | 1. Quantile Regression - link each MI indicator to DS to calculate effect levels<br>2. BRT – relate MI indicators to DS and other stressors and environmental variables<br>3. Gradient forest – relate MI taxa abundance to DS and other variables | 1. Water quality and MI indicators: SOE; NRWQN; Project Stage 1; LAWA; |
| Macroinvertebrates – SS (Stage 2) | 1. Quantile regression and linear regression to define subsidy/stress thresholds and effects levels related to species sensitivity distributions | 1. Water quality and MI indicators: NRWQN and also SOE |
| Fish – DS and SS (Stage 2) | 1. Covariance and linear regression modelling to relate sediment indicators to land cover and fish presence/absence. | 1. Fish: NZFFD<br>2. Water quality indicators: NRWQN; SOE<br>3. Freshwater classification: REC; LCDB 3 |

***3. Integration of multiple lines of evidence (collated text from the stage 2 draft report)***

The researchers used multiple lines of evidence to derive proposed bottom-line attribute thresholds:

1. The results of analyses conducted in Stage 2
2. Literature effects thresholds for suspended and (to a lesser extent) deposited sediment
3. Existing regulatory guidelines for managing the effects of sediment (mainly suspended sediment)

The diagram below shows how these components were included in the Stage 2 work.

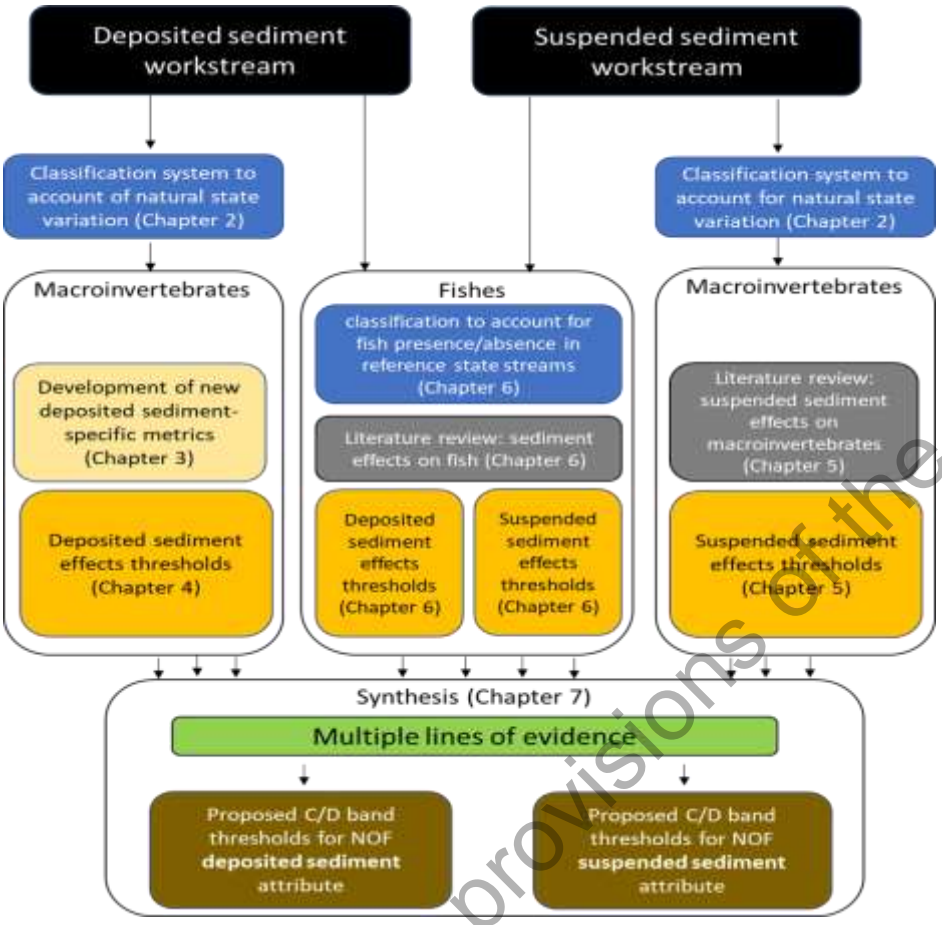



**Figure 2: Summary of the workflow of the Stage 2 sediment threshold project, illustrating the major components of the chapters, and how these contributed to the final proposed C/D band thresholds for suspended and deposited sediment attributes.**

The multiple lines of evidence from the 3 workflows were synthesised (green box above) using expert opinion to generate the final proposed NOF C/D band thresholds for the suspended and deposited attribute tables.