Ministry for the Environment
Manatū Mō Te Taiao

PO Box 10362, Wellington 6143
Website: www.mfe.govt.nz
Freephone: 0800 499 700

20-D-01649

s9(2)(a)

s9(2)(a)

Thank you for your email of 27 August 2020 requesting the following under the Official Information Act 1982 (the Act):

> *I understand that MfE has approached NIWA, particularly Scott Larned, concerning the development of nutrient criteria (nitrogen and/or phosphorus) for the National Policy Statement for Freshwater Management.*
>
> *1. I request all communications between MfE staff and NIWA, including Scott Larned, concerning NIWA giving advice and/or undertaking work to develop nutrient criteria (nitrogen and/or phosphorus) for the National Policy Statement for Freshwater Management.*
>
> *These communications should include emails, and their attachments, texts, meeting notes and minutes, and other records of communications.*
>
> *2. I request copies of any project scoping documents, tendering documents, and other documents setting out the actual or planned work and/or advice concerning the development of nutrient criteria by NIWA.*
>
> *3. I request all communications and associated documentation between MfE staff and DairyNZ staff, in the last 4 months (1st May to present) relating to the development of nutrient criteria by NIWA.*

On 4 September 2020, the Ministry for the Environment (the Ministry) contacted you to clarify the date range for the first two parts of your request. You confirmed that any relevant communications in the scope of the request should be from 1 November 2019 to the date of your request (27 August 2020). You also confirmed the request related to the National Policy Statement for Freshwater Management 2020 (NPS-FM 2020), rather than any previous iteration.

The Ministry has identified 13 documents in scope of your request, as listed in the attached document schedule. For 10 documents information has been withheld under the following sections of the Act:

- 9(2)(a) to protect the privacy of natural persons, including that of deceased natural persons.
- 9(2)(i) enable a Minister of the Crown or any public service agency or organisation holding the information to carry out, without prejudice or disadvantage, commercial activities

One document has been withheld in full under the following section of the Act:

- 9(2)(b)(ii) to protect information where the making available of the information would likely unreasonably to prejudice the commercial position of the person who supplied or who is the subject of the information.

In terms of section 9(1) of the Act, I am satisfied that, in the circumstances, the withholding of this information is not outweighed by other considerations that render it desirable to make the information available in the public interest.

The remaining two documents are released in full.

In respect of part three of your request, we found no in scope correspondence between the Ministry and DairyNZ in the requested timeframe. Therefore, that part of the request is refused under section 18(e), as it does not exist.

You have the right to seek an investigation and review by the Office of the Ombudsman of my decision to withhold information relating to this request, in accordance with section 28(3) of the Act. The relevant details can be found on their website at: www.ombudsman.parliament.nz.

Please note that, due to the public interest in our work, the Ministry publishes responses to requests for official information on our OIA responses page shortly after the response has been sent.

If you have any queries about this, please feel free to contact our Executive Relations team: ministerials@mfe.govt.nz.

Yours sincerely

Hayden Johnston
Acting Director, Water and Land Use Policy

Document schedule

Document no.	Document date	Content	Decisions	OIA sections applied
1	13 January 2020	Contract: Draft contract – NIWA essential freshwater support – to NIWA	Released in part	9(2)(a) 9(2)(i)
2	13 January 2020	Email: Contract for review and signing	Released in part	9(2)(a)
3	21 January 2020	Contract: FULLY EXECUTED CONTRACT – NIWA contract for sediment nutrient and ad-hoc support 2001234	Released in part	9(2)(a) 9(2)(i)
4	27 May 2020	Email: Potential to extend contract	Released in part	9(2)(a)
5	10 June 2020	Email: Re_signed contract variation	Released in part	9(2)(a)
6	10 June 2020	Contract: Variation to Contract 23184 (NIWA – ad hoc support)	Released in full	--
7	15 June 2020	Email: RE_Draft scope of work – DRP	Released in part	9(2)(a) 9(2)(i)
8	22 June 2020	Email: RE_Approved scope of work	Released in part	9(2)(a)
9	22 June 2020	Scoping document: Scope of Work under Contract 23184_data exploration and next steps for DRP analysis	Released in part	9(2)(i)
10	30 June 2020	Memo: Memo – DRP classification	Released in full	--
11	2 July 2020	Email: RE_DRP update	Released in part	9(2)(a)
12	20 July 2020	Email: RE_DRP classification memo	Released in part	9(2)(a)
13	--	Brochure: NIWA – Capability and Pricing Table	Withheld in full	9(2)(b)(ii)

Document 1 redacted

Support for Essential Freshwater package
Contract Reference number:

Part A: Parties and Execution

The Parties

The Sovereign in Right of New Zealand, acting by and through the Secretary for the Environment **(Ministry)**

National Institute of Water & Atmospheric Research Ltd (Company No. 550957) **(Supplier)**

The Contract

Agreement

The Ministry and the Supplier are party to a head agreement entered into in 2017 for the supply of science and research services to the Ministry on an ad hoc basis.

This Contract is subject to the terms of the Head Agreement.

The Ministry appoints the Supplier to deliver the Services described in this Contract and the Supplier accepts that appointment. This Contract sets out the Parties' rights and obligations.

The documents forming this Contract are:

1. **Part A:** Parties and Execution
2. **Part B:** Contract Details and Description of Services
3. **Part C:** Contract Terms and Conditions (Schedule 5 to the Head Agreement)
4. Any other Attachments to Part B or Part C.

How to read this Contract

5. Any Supplier terms and conditions do not apply.
6. Clause numbers refer to clauses in Part C unless the context requires otherwise.
7. Words starting with capital letters have a special meaning. The special meaning is stated in the Definitions section at clause 20 (Part C).

Acceptance

In signing this Contract each Party acknowledges that it has read and agrees to be bound by it.

For and on behalf of the **Ministry**:		For and on behalf of the **Supplier**	
_____ (signature)		_____ (signature)	
name:	Martin Workman	**name:**	
position:	Director, Water Directorate	**position:**	
date:		**date:**	

Commented [SF1]: For NIWA

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Part B: Contract Details and Description of Services

Start Date	17 January 2020		**Reference Part C clause 1**
End Date	1 June 2020		**Reference Part C clause 1**

Contract Managers Reference Part C clause 5		**Ministry's Contract Manager**	**Supplier's Contract Manager**
	Name:	Jo Burton	TBD
	Title / position:	Manager, Water Directorate	
	Address:	Environment House, 23 Kate Sheppard Place, Thorndon, Wellington 6011	
	Phone:	022 066 1645	
	Email:	Jo.burton@mfe.govt.nz	

Commented [SF2]: NIWA please fill this in.

Contract Owners Reference Part C clause 6.5 and 14.1		**Ministry's Contract Owner**	**Supplier's Contract Owner**
	Name:	Martin Workman	Scott Larned
	Title / position:	Director, Water Directorate	Manager – Freshwater Research
	Address:	Environment House, 23 Kate Sheppard Place, Thorndon, Wellington 6011	NIWA Christchurch 10 Kyle St, Riccarton, Christchurch 8011
	Phone:		s 9(2)(a)
	Email:	Martin.workman@mfe.govt.nz	s 9(2)(a)

Commented [SF3]: NIWA, please correct if this is wrong.

Addresses for Notices Reference Part C clause 19		**Ministry's address**	**Supplier's address**
	For the attention of:	Jo Burton	[Contract Owner or senior manager]
	c.c. Contract Manager	As above	
	Delivery address:	Environment House, 23 Kate Sheppard Place, Thorndon, Wellington 6011	
	Postal address:	PO Box 10362, Wellington 6143	

Supplier's Approved Personnel Reference Part C clause 6		**Approved Personnel**
	Name:	See the DoS
	Position:	
	Specialisation:	

Commented [SF4]: Legal – we would like to have named personnel for the fixed deliverable projects (sediment + impact review) BUT NOT for the rest of the contract. I have stated this in the DOS but haven t specified it here.

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Supplier's Approved Subcontractor Reference Part C clause 6		Approved Subcontractor
	Name:	Cawthron Institute Limited
	Address:	88 Hallifax Street East, Nelson, 7010
	Specialisation:	Freshwater environment and ecology

Description of Services

Context

This Contract relates to the delivery of the Essential Freshwater policy package. The Water Directorate currently requires the delivery of several disparate projects related to National Policy Statement – Freshwater Management attribute development, and it anticipates the need will arise for a significant amount of additional water quality, flow, and GIS analyses approaching final policy decision on the Essential Freshwater policy package. Therefore, the Ministry wishes to develop a single contracting mechanism that will meet currently identified needs as well as support meeting future needs that it anticipates will arise and have short turnaround times.

This contract will therefore meet existing scoped needs for attribute development. It will also provide a mechanism for Ministry staff, through a single focal point, to task experts in specific domains with discrete analyses or related support (potentially including workshop or meeting attendance) on relatively short notice.

Description of Services (DoS)

This contract is to deliver two sets of services: 1.) scoped needs to support attribute development, and 2.) ad-hoc analysis and support needs expected to arise.

1.) Attribute development

Tasks 1-4 relate to Out of Scope, and Task 5 relates to nutrient attribute development.

Out of Scope

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Out of Scope

Out of Scope

Out of Scope

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Out of Scope

Task 5 – Nutrient attribute development – Out of Scope

s 9(2)(a)

2.) **Ad hoc analysis and support needs**

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The Supplier will provide expert analysis and support on an 'as required' basis to enable the Ministry to provide timely advice to Ministers and internal management on the Essential Freshwater proposals. The Ministry anticipates that ad hoc analysis and support needs will arise in relation to a range of Essential Freshwater proposals.

The Ministry and the Supplier will discuss and agree in advance the Scope of Work required by the Ministry for each ad hoc analysis or support task. This Scope of Work will include the specific deliverables, timeframes, estimated hours, and approved personnel for the delivery of each task. The Scope of Work will be recorded in an email or letter from the Ministry's Contract Manager to the Supplier's Contract Manager (or the primary point of contact identified below) before the Supplier's Approved Personnel will commence work on the Scope of Work.

For the avoidance of doubt, each written Scope of Work will be deemed a Variation in accordance with clause 19.1 of Part C to this Contract.

Deliverables

The Supplier will deliver the Services in accordance with the requirements detailed in the Milestone table below:

#	Milestone	Milestone Activities	Deliverable	Performance Standards	Due date
1.	Out of Scope				
2.	Out of Scope				
3.	Out of Scope				

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4.	Out of Scope				
5.	Out of Scope				
6.	Ad hoc analysis and support	Ad hoc analysis and support as required by the Ministry's Contract Manager (and as confirmed in writing by Scope of Work – see Dos)	Meets the requirements detailed in the Scope of Work and is to the reasonable satisfaction of the Ministry's nominated contact person	Per Performance Standards below	Ongoing throughout Contract Term with specific timeframes for delivery of any ad hoc advice and support confirmed in writing in Scope of Work

Performance standards

The Supplier will deliver the Services (including the Deliverables) in accordance with the Performance Standards detailed below:

1. The Services (including any Deliverables) provided under this Contract must meet or exceed the industry/environmental standards or independently audited accreditations.
2. The Services (including any Deliverables) provided will:

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- be developed and delivered in an environmentally and socially responsible manner;
- be the result of a professional, comprehensive investigation consistent with best practice business standards;
- contribute to a constructive working relationship between the Ministry and other suppliers or contractors that the Supplier may be working in conjunction with to deliver the requirements of this Contract; and
- Adhere to the science quality principles stated below.]

3. All documents produced by the Supplier must conform to the Ministry's standards of good writing and presentation as set out in the Ministry's style guide, a copy of which can be provided by the Ministry upon request.
4. Electronic copies of documents provided in the performance of the Services must be formatted in MSWord and PDF. The Supplier must advise the Ministry in advance of any material imported from another software program to ensure that the Ministry can easily access and edit such material.
5. Unless otherwise agreed by the Ministry, all geospatial data will be provided as shapefiles.
6. In performing the Services, the Supplier must ensure any written material, advice proffered and oral communication undertaken, is performed in accordance with the following performance standards:
   - factually correct, evidence-based and accurate;
   - clear and concise;
   - grammatically correct English;
   - delivered to the Ministry by the due dates;
   - the result of careful consideration of all relevant information;
   - meets all legislative requirements; and
   - is to the reasonable satisfaction of the Ministry's Contract Manager.
7. Performance reports are to be provided by the Supplier on a frequency and format to be agreed between the Parties.

Science Quality Principles

1 The Ministry must be confident that all science information used to inform policy development is relevant, objective, reliable, transparent, independent and robust.

2 To help achieve this aim the Ministry requires the Supplier, as a research provider, to meet adequate standards for ensuring the quality of science information. In particular, peer review processes, the primary mechanism for ensuring the quality of science information, are efficient and cost-effective.

3 The Supplier will comply with the following principles for science quality:

(a) *Relevant* – scientific research must be relevant to questions being addressed.

(b) *Objective* – Scientific methods must be used in the collection and analysis of data, and science processes must be free of undue non-scientific influences and considerations. Data must be obtained from credible and reliable sources; data collection and analyses must be accurate and unbiased.

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(c) *Reliable* – Methods and models used to produce science information must be verified and validated to the extent necessary to demonstrate that they are reliable.

(d) *Transparent* – One of the prerequisites for trust and credibility in science information is that it must be seen as being provided by neutral processes that operate independently of politics, financial interests and advocacy. This is primarily achieved by ensuring that all science processes are transparent and open to scrutiny.

(e) *Independent* – Peer review is the most accepted and reliable process for independent assessment of the quality of science information. The use of objective and transparent peer review as the principle quality assurance method enhances the confidence of the community (including scientists, resource managers, tangata whenua, stakeholders and the public) in the findings presented in science reports.

(f) *Standardised peer review processes*, designed to ensure that science information meets the quality criteria specified in these Performance Standards, must be established and implemented for all science information that is intended or likely to inform policy development decisions.

(g) *Robust* – Science information must stand up to the challenges of relevance, accuracy, objectivity, reproducibility, integrity and lack of bias. This includes the evaluation and reporting of uncertainty and risk.

Contract Management Plan

Attribute development Tasks 1-4

Out of Scope

Attribute development Tasks 5

Out of Scope

Ad hoc analysis and support

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The Ministry's Contract Manager must direct the Supplier to undertake any Scope of Work arising from the ad hoc analysis and support component of the DoS. Individual analysts from the Ministry will coordinate with the Ministry's Contract Manager, as well as the Supplier's Project Manager, to develop the Scope of Work.

Scopes of Work will include brief information on the following themes:

- Description of the Ministry's analytical or support need;
- Primary contact person for the Scope of Work from the Ministry and the Supplier;
- Analysis or support the Supplier will provide;
- Approved Personnel (if any) and their hourly rates;
- Price for delivery of services based on agreed resource estimates for given Supplier Personnel and disbursements.
- Anticipated timeframes for delivery;
- Progress meeting and/or check-in points.

Supplier invoices will be checked against these agreed Scopes of Work.

Given the anticipated short timeframes of requests, the Ministry will endeavour to give as much advance notice as possible to the Supplier in order to ensure the Supplier is able to manage existing workloads and deliver the ad hoc analysis and support component of the Contract.

The Supplier may choose not to accept ad-hoc analysis and support components if it is unable to meet the Ministry's required deadlines for delivery of the services. In these circumstances the Supplier will alert the Ministry as soon as possible that it will be unable to complete a proposed or agreed Scope of Work.

In the event that key Personnel become unavailable during delivery of Milestones/Deliverables 1-5 or 6 for reasons out of the control of the Supplier, the Supplier and the Ministry will discuss a revised timeframe for delivery of the specific Task(s) or revisions to the Scope(s) of Work with the Ministry.

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Data Reference Part C Clause 12	Environmental Reporting Act 2015	Not applicable
	Raw Input Data	**Ministry Licensed Data:** The observed deposited sediment dataset provided to he Supplier will be published as part of the Environmental Reporting programme for 2020. Results from analyses using these data should cite the dataset as "Clapcott J, Casanovas P, Doehring K 2019. Indicators of freshwater quality based on deposited sediment and rapid habitat assessment. Prepared for Ministry for the Environment. Cawthron Report No. 3402". The data themselves may not be published.
		Supplier Data: None
		Third Party Data: None
	Metadata	None
	Standards	See Performance Standards
	Analysis	See DoS
	Final Output Data	The Ministry intends to publish outputs of his Contract under CC4.0 Licence.

Supplier's Conflict of Interest Declaration Reference Part C Clause 9	I, [name of Supplier's signatory] have made diligent inquiry whether the National Institute of Water and Atmospheric Research has any actual, potential or perceived Conflict of Interest were it to provide the Services described in this Contract and I have disclosed any actual, potential or perceived Conflict of Interest and how it will be managed below: The Supplier warrants that as at the Start Date to the best of its knowledge after making reasonable enquiry it has no actual potential or perceived Conflict of Interest in providing the Services or entering into this Contract.
	Proposed Conflict of Interest management plan (if applicable): [If any actual, potential or perceived Conflict of Interest, describe how you propose to manage it or insert 'Not applicable'.]

Commented [SF5]: NIWA, for you

Supplier's Reporting Obligations Reference Part C Clause 2.4 + 11.6	Report to:	Type of report	Due date
	Contract Manager	See Contract Management Plan	See Contract Management Plan
Supplier's Meeting Obligations Reference Part C clause 2.4	Meeting Type:	See Contract Management Plan above	

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CHARGES: The following section sets out the Charges. Charges are the total maximum amount payable by the Ministry to the Supplier for delivery of the Services. Charges include ***Fees***, and where agreed, ***Expenses*** and ***Daily Allowances.*** The Charges for this Contract are set out below.

Fees **Reference Part C** **Clause 3**	The Supplier's Fees will be calculated as follows: **Milestones for Attribute Development Tasks in the Contract (Milestones/Deliverables 1-5)** Fixed Milestone payments of the amounts set out in the Milestones table in the Invoices section below up to a total maximum of s 9(2)(i) excluding GST. **Hourly Fee Rate for Ad Hoc Analysis and Support aspects of the Contract (Milestone/Deliverable 6)** The Supplier's Fees will be calculated based on actual hours worked at the Hourly Fee Rates for Personnel set out in the Scope(s) of Work, up to a total maximum of s 9(2)(i) excluding GST. Rates for Personnel will be provided in the Scope(s) of Work and will align with the Science Panel approved rates as shown in the Attachment. If the Supplier reaches the total Contract maximum without completing the Scope of Work, the Supplier is required to complete the Scope of Work without further payment, unless otherwise agreed in writing.
Expenses **Reference Part C** **Clause 3**	**Actual and reasonable — general Expenses** The Ministry will pay the Supplier actual and reasonable Expenses for travel and meeting attendance incurred in delivering the Services up to a total maximum amount of s 9(2)(i) excluding GST provided that: a. the Ministry has given prior written consent to the Supplier incurring the Expense in a Scope of Work b. the Expense is charged at actual and reasonable cost, and c. the claim for Expenses is supported by GST receipts.
Invoices **Reference Part C** **Clause 3**	The Supplier must send the Ministry an invoice for the Charges at the following times: **Milestone/Deliverables 1-5** On the following dates subject to completion of Milestones for the Out of Scope aspects of this Contract.

Deliverable/ Milestone	Due date	Amount due (exc GST)
1	31 January 2020	s 9(2)(i)
2	31 January 2020	s 9(2)(i)

Commented [SF6]: Legal, NIWA s science panel memo has rates per personnel "level" so that "principal scientist" gets more than "GIS analyst"

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	3	31 January 2020	s 9(2)(i)
	4	31 January 2020	s 9(2)(i)
	5	31 January 2020	s 9(2)(i)

Milestone/Deliverable 6

At the end of the month, for Services delivered during that mon h for the Ad Hoc Analysis and Support (Milestone/Deliverable 6) aspects of this Contract.

Tax invoices Reference Part C Clause 3		**Ministry's address**
	For the attention of:	Accounts Payable
	Email:	accounts.payable@mfe govt nz
	CC Contract Manager:	Jo Burton
		Supplier's Invoicing Details
	Supplier's GST Number:	059-456-466
	Email (for e-copy of Ministry's remittance advice):	[insert Supplier s email address for invoice p poses]

Commented [SF7]: NIWA, check this.

Commented [SF8]: NIWA

Insurance Reference Clause 12 of the Head Agreement	It is the Supplier's responsibili y to ensure its risks of doing business are adequately covered, whether by insura ce o otherwise. At a minimum, he Supp ier m st hold the type and levels of insurance specified in clause 12.1 of he Head Agre ment.
Special Terms	**Part C: Contrac Terms and Conditions of is Contract is amended as follows:** None

Attachments Reference 'Contract documents' descr bed at Part A and Par C clause 20.2	Science Panel approved hour y ra es (NIWA - Capability and Pricing Table.pdf)

From: Stephen Fragaszy
To: s 9(2)(a)
Subject: Contract for review and signing
Date: Monday, 13 January 2020 3:10:21 pm
Attachments: image001.png
Draft contract - NIWA essential freshwater support - to NIWA.docx
NIWA - Capability and Pricing Table.pdf

Hi Paul and Doug,

This contract is finally ready following full legal review. I have also included the hourly pricing schedule from the Science Panel (we made mention of it previously but now the table is included for the sake of clarity). Please let me know if you have any requested changes. And if not, this is ready for your signature.

Regards,

Stephen Fragaszy – Senior Policy Analyst – Freshwater Policy – Water Directorate
Ministry for the Environment – Manatu Mo Te Taiao
Telephone: s 9(2)(a) Email: stephen.fragaszy@mfe.govt.nz Website: www.mfe.govt.nz
23 Kate Sheppard Place, Thorndon, Wellington 6143

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Manatū Mō Te Taiao

Making Aotearoa New Zealand the most liveable place in the world
Aotearoa – he whenua mana kura mō te tangata

Document 3 redacted

Support for Essential Freshwater package

Contract Reference number:

Part A: Parties and Execution

The Parties

The Sovereign in Right of New Zealand, acting by and through the Secretary for the Environment **(Ministry)**

National Institute of Water & Atmospheric Research Ltd (Company No. 550957) **(Supplier)**

The Contract

Agreement

The Ministry and the Supplier are party to a head agreement entered into in 2017 for the supply of science and research services to the Ministry on an ad hoc basis.

This Contract is subject to the terms of the Head Agreement.

The Ministry appoints the Supplier to deliver the Services described in this Contract and the Supplier accepts that appointment. This Contract sets out the Parties' rights and obligations.

The documents forming this Contract are:

1. **Part A:** Parties and Execution
2. **Part B:** Contract Details and Description of Services
3. **Part C:** Contract Terms and Conditions (Schedule 5 to the Head Agreement)
4. Any other Attachments to Part B or Part C.

How to read this Contract

5. Any Supplier terms and conditions do not apply.
6. Clause numbers refer to clauses in Part C, unless the context requires otherwise.
7. Words starting with capital letters have a special meaning. The special meaning is stated in the Definitions section at clause 20 (Part C).

Acceptance

In signing this Contract each Party acknowledges that it has read and agrees to be bound by it.

For and on behalf of the **Ministry**:		For and on behalf of the **Supplier**:	
M. Workman (signature)		M. P. Bruce (signature)	
name:	Martin Workman	**name:**	Michael Bruce
position:	Director, Water Directorate	**position:**	Regional Manager - Hamilton
date:	21/1/20	**date:**	17-01-2020

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Part B: Contract Details and Description of Services

Start Date	17 January 2020	Reference Part C clause 1
End Date	1 June 2020	Reference Part C clause 1

Contract Managers Reference Part C clause 5		Ministry's Contract Manager	Supplier's Contract Manager
	Name:	Jo Burton	Dr Paul Franklin
	Title / position:	Manager, Water Directorate	Freshwater Ecologist
	Address:	Environment House, 23 Kate Sheppard Place, Thorndon, Wellington 6011	NIWA Hamilton, Gate 10 Silverdale Road, Hillcrest, Hamilton 3216
	Phone:	022 066 1645	s 9(2)(a)
	Email:	Jo.burton@mfe.govt.nz	s 9(2)(a)

Contract Owners Reference Part C clause 6.5 and 14.1		Ministry's Contract Owner	Supplier's Contract Owner
	Name:	Martin Workman	Neale Hudson
	Title / position:	Director, Water Directorate	Manager – Freshwater & Estuaries
	Address:	Environment House, 23 Kate Sheppard Place, Thorndon, Wellington 6011	NIWA Hamilton, Gate 10 Silverdale Road, Hillcrest, Hamilton 3216
	Phone:		s 9(2)(a)
	Email:	Martin.workman@mfe.govt.nz	s 9(2)(a)

Addresses for Notices Reference Part C clause 19		Ministry's address	Supplier's address
	For the attention of:	Jo Burton	Paul Franklin
	c.c. Contract Manager	As above	Freshwater Ecologist
	Delivery address:	Environment House, 23 Kate Sheppard Place, Thorndon, Wellington 6011	NIWA Hamilton, Gate 10 Silverdale Road, Hillcrest, Hamilton 3216
	Postal address:	PO Box 10362, Wellington 6143	PO Box 11115, Hamilton, 3251

Supplier's Approved Personnel Reference Part C clause 6		Approved Personnel
	Name:	See the DoS
	Position:	
	Specialisation:	

		Approved Subcontractor

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Supplier's Approved Subcontractor Reference Part C clause 6	**Name:**	Cawthron Institute Limited
	Address:	88 Hallifax Street East, Nelson, 7010
	Specialisation:	Freshwater environment and ecology

Description of Services

Context

This Contract relates to the delivery of the Essential Freshwater policy package. The Water Directorate currently requires the delivery of several disparate projects related to National Policy Statement – Freshwater Management attribute development, and it anticipates the need will arise for a significant amount of additional water quality, flow, and GIS analyses approaching final policy decisions on the Essential Freshwater policy package. Therefore, the Ministry wishes to develop a single contracting mechanism that will meet currently identified needs as well as support meeting future needs that it anticipates will arise and have short turnaround times.

This contract will therefore meet existing scoped needs for attribute development. It will also provide a mechanism for Ministry staff, through a single focal point, to task experts in specific domains with discrete analyses or related support (potentially including workshop or meeting attendance) on relatively short notice.

Description of Services (DoS)

This contract is to deliver two sets of services: 1.) scoped needs to support attribute development, and 2.) ad-hoc analysis and support needs expected to arise.

1.) Attribute development

Tasks 1-4 relate to Out of Scope, and Task 5 relates to nutrient attribute development.

Out of Scope

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Out of Scope

Out of Scope

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Out of Scope

Out of Scope

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2.) Ad hoc analysis and support needs

The Supplier will provide expert analysis and support on an 'as required' basis to enable the Ministry to provide timely advice to Ministers and internal management on the Essential Freshwater proposals. The Ministry anticipates that ad hoc analysis and support needs will arise in relation to a range of Essential Freshwater proposals.

The Ministry and the Supplier will discuss and agree in advance the Scope of Work required by the Ministry for each ad hoc analysis or support task. This Scope of Work will include the specific deliverables, timeframes, estimated hours, and approved personnel for the delivery of each task. The Scope of Work will be recorded in an email or letter from the Ministry's Contract Manager to the Supplier's Contract Manager (or the primary point of contact identified below) before the Supplier's Approved Personnel will commence work on the Scope of Work.

For the avoidance of doubt, each written Scope of Work will be deemed a Variation in accordance with clause 19.1 of Part C to this Contract.

Deliverables

The Supplier will deliver the Services in accordance with the requirements detailed in the Milestone table below:

#	Milestone	Milestone Activities	Deliverable	Performance Standards	Due date
Out of Scope					

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Out of Scope

Out of Scope

6.	Ad hoc analysis and support	Ad hoc analysis and support as required by the Ministry's Contract Manager (and as confirmed in writing by Scope of Work – see DoS).	Meets the requirements detailed in the Scope of Work and is to the reasonable satisfaction of the Ministry's nominated contact person	Per Performance Standards below	Ongoing throughout Contract Term with specific timeframes for delivery of any ad hoc advice and support confirmed in writing in Scope of Work

Performance standards

The Supplier will deliver the Services (including the Deliverables) in accordance with the Performance Standards detailed below:

1. The Services (including any Deliverables) provided under this Contract must meet or exceed the industry/environmental standards or independently audited accreditations.
2. The Services (including any Deliverables) provided will:

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- be developed and delivered in an environmentally and socially responsible manner;
- be the result of a professional, comprehensive investigation consistent with best practice business standards;
- contribute to a constructive working relationship between the Ministry and other suppliers or contractors that the Supplier may be working in conjunction with to deliver the requirements of this Contract; and
- Adhere to the science quality principles stated below.]

3. All documents produced by the Supplier must conform to the Ministry's standards of good writing and presentation as set out in the Ministry's style guide, a copy of which can be provided by the Ministry upon request.
4. Electronic copies of documents provided in the performance of the Services must be formatted in MSWord and PDF. The Supplier must advise the Ministry in advance of any material imported from another software program to ensure that the Ministry can easily access and edit such material.
5. Unless otherwise agreed by the Ministry, all geospatial data will be provided as shapefiles.
6. In performing the Services, the Supplier must ensure any written material, advice proffered and oral communication undertaken, is performed in accordance with the following performance standards:
   - factually correct, evidence-based and accurate;
   - clear and concise;
   - grammatically correct English;
   - delivered to the Ministry by the due dates;
   - the result of careful consideration of all relevant information;
   - meets all legislative requirements; and
   - is to the reasonable satisfaction of the Ministry's Contract Manager.
7. Performance reports are to be provided by the Supplier on a frequency and format to be agreed between the Parties.

Science Quality Principles

1 The Ministry must be confident that all science information used to inform policy development is relevant, objective, reliable, transparent, independent and robust.

2 To help achieve this aim the Ministry requires the Supplier, as a research provider, to meet adequate standards for ensuring the quality of science information. In particular, peer review processes, the primary mechanism for ensuring the quality of science information, are efficient and cost-effective.

3 The Supplier will comply with the following principles for science quality:

(a) *Relevant* – Scientific research must be relevant to questions being addressed.

(b) *Objective* – Scientific methods must be used in the collection and analysis of data, and science processes must be free of undue non-scientific influences and considerations. Data must be obtained from credible and reliable sources; data collection and analyses must be accurate and unbiased.

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(c) *Reliable* – Methods and models used to produce science information must be verified and validated to the extent necessary to demonstrate that they are reliable.

(d) *Transparent* – One of the prerequisites for trust and credibility in science information is that it must be seen as being provided by neutral processes that operate independently of politics, financial interests and advocacy. This is primarily achieved by ensuring that all science processes are transparent and open to scrutiny.

(e) *Independent* – Peer review is the most accepted and reliable process for independent assessment of the quality of science information. The use of objective and transparent peer review as the principle quality assurance method enhances the confidence of the community (including scientists, resource managers, tangata whenua, stakeholders and the public) in the findings presented in science reports.

(f) *Standardised peer review processes*, designed to ensure that science information meets the quality criteria specified in these Performance Standards, must be established and implemented for all science information that is intended or likely to inform policy development decisions.

(g) *Robust* – Science information must stand up to the challenges of relevance, accuracy, objectivity, reproducibility, integrity and lack of bias. This includes the evaluation and reporting of uncertainty and risk.

Contract Management Plan

Out of Scope

Ad hoc analysis and support

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The Ministry's Contract Manager must direct the Supplier to undertake any Scope of Work arising from the ad hoc analysis and support component of the DoS. Individual analysts from the Ministry will coordinate with the Ministry's Contract Manager, as well as the Supplier's Project Manager, to develop the Scope of Work.

Scopes of Work will include brief information on the following themes:

- Description of the Ministry's analytical or support need;
- Primary contact person for the Scope of Work from the Ministry and the Supplier;
- Analysis or support the Supplier will provide;
- Approved Personnel (if any) and their hourly rates;
- Price for delivery of services based on agreed resource estimates for given Supplier Personnel and disbursements.
- Anticipated timeframes for delivery;
- Progress meeting and/or check-in points.

Supplier invoices will be checked against these agreed Scopes of Work.

Given the anticipated short timeframes of requests, the Ministry will endeavour to give as much advance notice as possible to the Supplier in order to ensure the Supplier is able to manage existing workloads and deliver the ad hoc analysis and support component of the Contract.

The Supplier may choose not to accept ad-hoc analysis and support components if it is unable to meet the Ministry's required deadlines for delivery of the services. In these circumstances, the Supplier will alert the Ministry as soon as possible that it will be unable to complete a proposed or agreed Scope of Work.

In the event that key Personnel become unavailable during delivery of Milestones/Deliverables 1-5 or 6 for reasons out of the control of the Supplier, the Supplier and the Ministry will discuss a revised timeframe for delivery of the specific Task(s) or revisions to the Scope(s) of Work with the Ministry.

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Data Reference Part C Clause 12	**Environmental Reporting Act 2015**	Not applicable
	Raw Input Data	**Ministry Licensed Data:** The observed deposited sediment dataset provided to the Supplier will be published as part of the Environmental Reporting programme for 2020. Results from analyses using these data should cite the dataset as "Clapcott J, Casanovas P, Doehring K 2019. Indicators of freshwater quality based on deposited sediment and rapid habitat assessment. Prepared for Ministry for the Environment. Cawthron Report No. 3402". The data themselves may not be published.
		Supplier Data: None
		Third Party Data: None
	Metadata	None
	Standards	See Performance Standards
	Analysis	See DoS
	Final Output Data	The Ministry intends to publish outputs of this Contract under CC4.0 License.

Supplier's Conflict of Interest Declaration Reference Part C Clause 9	I, Michael Bruce have made diligent inquiry whether the National Institute of Water and Atmospheric Researchhas any actual, potential or perceived Conflict of Interest were it to provide the Services described in this Contract and I have disclosed any actual, potential or perceived Conflict of Interest and how it will be managed below: The Supplier warrants that as at the Start Date to the best of its knowledge after making reasonable enquiry it has no actual potential or perceived Conflict of Interest in providing the Services or entering into this Contract.
	Proposed Conflict of Interest management plan (if applicable): Not applicable

Supplier's Reporting Obligations Reference Part C Clause 2.4 + 11.6	**Report to:**	**Type of report**	**Due date**
	Contract Manager	See Contract Management Plan	See Contract Management Plan

Supplier's Meeting Obligations Reference Part C clause 2.4	**Meeting Type:**	See Contract Management Plan above

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CHARGES: The following section sets out the Charges. Charges are the total maximum amount payable by the Ministry to the Supplier for delivery of the Services. Charges include ***Fees***, and where agreed, ***Expenses*** and ***Daily Allowances.*** The Charges for this Contract are set out below.

Fees
Reference Part C
Clause 3

The Supplier's Fees will be calculated as follows:

Milestones for Attribute Development Tasks in the Contract (Milestones/Deliverables 1-5)

Fixed Milestone payments of the amounts set out in the Milestones table in the Invoices section below up to a total maximum of s 9(2)(i) excluding GST.

Hourly Fee Rate for Ad Hoc Analysis and Support aspects of the Contract (Milestone/Deliverable 6)

The Supplier's Fees will be calculated based on actual hours worked at the Hourly Fee Rates for Personnel set out in the Scope(s) of Work, up to a total maximum of s 9(2)(i) excluding GST. Rates for Personnel will be provided in the Scope(s) of Work and will align with the Science Panel approved rates as shown in the Attachment.

If the Supplier reaches the total Contract maximum without completing the Scope of Work, the Supplier is required to complete the Scope of Work without further payment, unless otherwise agreed in writing.

Expenses
Reference Part C
Clause 3

Actual and reasonable – general Expenses

The Ministry will pay the Supplier's actual and reasonable Expenses for travel and meeting attendance incurred in delivering the Services up to a total maximum amount of s 9(2)(i) excluding GST provided that:

a. the Ministry has given prior written consent to the Supplier incurring the Expense in a Scope of Work
b. the Expense is charged at actual and reasonable cost, and
c. the claim for Expenses is supported by GST receipts.

Invoices
Reference Part C
Clause 3

The Supplier must send the Ministry an invoice for the Charges at the following times:

Milestone/Deliverables 1-5

On the following dates subject to completion of Milestones for the Out of Scope Out of Scope aspects of this Contract.

Deliverable/ Milestone	Due date	Amount due (exc GST)
1	31 January 2020	s 9(2)(i)
2	31 January 2020	

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3	31 January 2020	s 9(2)(i)
4	31 January 2020	
5	31 January 2020	
Total Fixed Cost of Milestone/Deliverables 1-5		

Milestone/Deliverable 6

At the end of the month, for Services delivered during that month for the Ad Hoc Analysis and Support (Milestone/Deliverable 6) aspects of this Contract.

Hourly Fee Rates for Personnel set out in the Scope(s) of Work, up to a total maximum of s 9(2)(i) excluding GST.

Expenses

At the end of the month, for Services delivered during that month for Supplier's actual and reasonable Expenses for travel and meeting attendance incurred in delivering the Services up to a total maximum amount of s 9(2)(i) excluding GST provided the Ministry has given prior written consent as set out in Expenses – References Part C Clause 3.

Tax invoices Reference Part C Clause 3		**Ministry's address**
	For the attention of:	Accounts Payable
	Email:	accounts.payable@mfe.govt.nz
	CC Contract Manager:	Jo Burton
		Supplier's Invoicing Details
	Supplier's GST Number:	059-456-466
	Email (for e-copy of Ministry's remittance advice):	remittances@niwa.co.nz
	CC Contract Manager:	Dr Paul Franklin s 9(2)(a)

Insurance Reference Clause 12 of the Head Agreement	It is the Supplier's responsibility to ensure its risks of doing business are adequately covered, whether by insurance or otherwise. At a minimum, the Supplier must hold the type and levels of insurance specified in clause 12.1 of the Head Agreement.
Special Terms	**Part C: Contract Terms and Conditions of this Contract is amended as follows:** None

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Attachments Reference 'Contract documents' described at Part A and Part C clause 20.2	Science Panel approved hourly rates (NIWA - Capability and Pricing Table.pdf)

Document 4 redacted

From: Stephen Fragaszy
To: s 9(2)(a)
Subject: Potential to extend contract?
Date: Wednesday, 27 May 2020 12:38:55 pm
Attachments: image001.png

Hi Paul,

I hope you and your family are doing well these days and you're relishing the return to schools. I took last Monday off and all the parents were grinning like clowns around dropoff. The kids were wondering why we were so happy and dancing for joy!

We may be interested in extending the ad-hoc support contract until 31 July and adding some money to it. This is just a heads-up because I'm not certain yet, but I just wanted to let you know in case that was problematic for you.

The things we may want to undertake include freshwater quality data collation/exploration/next steps scoping (Out of Scope and DRP) and something on Out of Scope. I would not be leading any of those pieces of work, hence why I can't say if we will or won't be doing them (or give much detail). My role would just be to make sure the contract lists for them to be done if the managers decide to progress them and NIWA have staff availability to do them.

We're in the end of the financial year period where things can be complicated project-wise, so I just want to try and get the contract variation done now to give us flexibility down the road. Let me know if you have any questions other than about what the specific work would be – I would be decidedly unhelpful on that issue. Otherwise, hope you're hanging in there alright.

Regards,

Stephen Fragaszy – Senior Policy Analyst – Freshwater Policy – Water Directorate
Ministry for the Environment | Manatu Mo Te Taiao
Telephone: s 9(2)(a) | Email: stephen.fragaszy@mfe.govt.nz Website: www.mfe.govt.nz
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Document 5 redacted

From: Stephen Fragaszy
To: s 9(2)(a)
Subject: Re: signed contract variation
Date: Wednesday, 10 June 2020 10:15:37 am
Attachments: image001.png

It should be today or tomorrow at the latest. Jen price has the draft for review and ought to send it on soon.

From: Paul Franklin s 9(2)(a)
Sent: Wednesday, June 10, 2020 9:31 AM
To: Stephen Fragaszy <Stephen.Fragaszy@mfe.govt.nz>
Subject: RE: signed contract variation

Hi Stephen,

No worries. As long as we have the paperwork, that's all that matters!

The sooner you can get the scope to us the better at this time of year. Once I've seen it I'll get back to you with what we can do.

Cheers,
Paul

From: Stephen Fragaszy <Stephen.Fragaszy@mfe.govt.nz>
Sent: Monday, 8 June 2020 3:28 PM
To: Paul Franklin <s 9(2)(a) >
Subject: signed contract variation

Hi Paul,

Sorry it took a while to get you this signed off, but here's the variation.

I hope to get you a rough scope of work by tomorrow COP for DRP work as discussed previously (data collation and exploration, description of feasibility for environmental classification based on natural variability, and high level scope for next steps to develop potential ecological thresholds based on that classification system – the scope should include estimate timeframe and cost for the work).

Please shout (once you've seen the draft scope of work) if you anticipate facing troubles doing the work on time given constraints - we would need the draft and invoice on 30 June and could have some back and forth afterwards, but the bulk should be done by then.

Regards,
Stephen Fragaszy – Senior Policy Analyst – Freshwater Policy – Water Directorate
Ministry for the Environment – Manatu Mo Te Taiao
Telephone: s 9(2)(a) Email: stephen.fragaszy@mfe.govt.nz Website: www.mfe.govt.nz
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****

Dr Paul Franklin
Freshwater Ecologist

s 9(2)(a)
National Institute of Water & Atmospheric Research Ltd (NIWA)
Gate 10 Silverdale Road Hillcrest Hamilton New Zealand
Connect with NIWA: niwa.co.nz Facebook LinkedIn Twitter Instagram

Document 6 redacted

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Contract Variation – SERVICES

Contract Variation 1

Buyer: The Ministry for the Environment

Supplier: NIWA

Contract: Support for Essential Freshwater package

Contract reference number: 23184

Contract dated: 21/1/2020

Variation

The Buyer and the Supplier are Parties to the Contract.

The Parties agree to vary the Contract. The scope of the Variation is set out in the attached Schedule of Changes. The Variation is effective from the Effective Date stated in the Schedule of Changes.

Subject to the changes made by this Variation the terms and conditions of the Contract remain in effect.

Words used but not defined in this Variation have the same meaning as they do in the Contract.

Acceptance

Signed for and on behalf of the **Buyer**:

Electronically signed by Annabelle Ellis

Signature

Name: Annabelle Ellis

Position: Acting Director, Water

Date: 08/06/2020

Signed for and on behalf of the **Supplier**:

Signature

Name: Michael Bruce

Position: Regional Manager - Hamilton

Date: 29-05-2020

Schedule of Changes

Effective Date: 29 May 2020

Changes

Changes to Schedule 1

1. Change to End Date

1.1 The End Date as stated in Schedule 1 is amended to 30 June 2020

Document 7 redacted

From: s 9(2)(a)
To: Stephen Fragaszy
Subject: RE: Draft scope of work - DRP
Date: Monday, 15 June 2020 12:54:06 pm
Attachments: image001.png

Hi Stephen,

That only amounts to just over half a day, so it's not going to make a vast difference. We'll just try and fit it to what's there.

It is going to be difficult to answer your step 2 without actually looking at the different datasets to know what their coverage etc is like, which is exactly what we've just adjusted the scope to not do as there's not sufficient time in the next 2 weeks. There are obviously several datasets referred to in s 9(2)(a) report, but nowhere does he actually give you any information to evaluate them in terms of their suitability for what you're looking at next (number of sites, location, length/frequency of records etc). The reality is likely to be that we can make something from the current data, but extensive data collection would get you a better result!

As soon as we have the finalised scope, send it through and we can get things underway.

Cheers,
Paul

From: Stephen Fragaszy <Stephen.Fragaszy@mfe.govt.nz>
Sent: Monday, 15 June 2020 12:21 PM
To: Paul Franklin <s 9(2)(a) >
Subject: RE: Draft scope of work - DRP

Hi Paul,

I checked and saw we have s 9(2)(i) left on the contract and not s 9(2)(i) Is that a problem for this scope of work? Apologies – I should have checked contract value left more thoroughly up front.

We've accepted all changes and added in step 2 something along the lines of "recommend whether this work can be carried out with current data or needs extensive collation/collection".

Regards.

Stephen Fragaszy – Senior Policy Analyst – Freshwater Policy – Water Directorate
Ministry for the Environment – Manatū Mo Te Taiao
Telephone: s 9(2)(a) Email: stephen.fragaszy@mfe.govt.nz Website: www.mfe.govt.nz
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From: Paul Franklin s 9(2)(a)
Sent: Friday, 12 June 2020 4:10 PM
To: Stephen Fragaszy <Stephen.Fragaszy@mfe.govt.nz>
Cc: Jennifer Price <Jennifer.Price@mfe.govt.nz>
Subject: RE: Draft scope of work - DRP

Hi Stephen & Jen,

Please see attached for a proposed revised scope for this DRP work stream. Please let me know if you have any questions or queries regarding what we are suggesting is achievable here.

Kind regards,
Paul

From: Stephen Fragaszy <Stephen.Fragaszy@mfe.govt.nz>
Sent: Friday, 12 June 2020 1:05 PM
To: Paul Franklin s 9(2)(a)
Cc: Jennifer Price <jennifer.price@mfe.govt.nz>
Subject: RE: Draft scope of work - DRP

Hi Paul,

Given time limitations, and that our objective for this piece of work is to set ourselves up better next financial year, your approach makes perfect sense. Please do re-draft along those lines.

Regards,
Stephen Fragaszy – Senior Policy Analyst – Freshwater Policy – Water Directorate
Ministry for the Environment – Manatu Mo Te Taiao
Telephone: s 9(2)(a) Email: stephen.fragaszy@mfe.govt.nz Website: www.mfe.govt.nz
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From: Paul Franklin s 9(2)(a)
Sent: Friday, 12 June 2020 12:29 PM
To: Stephen Fragaszy <Stephen.Fragaszy@mfe.govt.nz>
Subject: RE: Draft scope of work - DRP

Hi Stephen,

Apologies for the delay in getting back to you on this one but I needed to take a look at what was in the STAG supplementary report and then have a discussion with a few people here as to how we think we can be helpful in the time we have available.

If you have the chance this afternoon it would be good to have a quick chat about the scope please.

Broadly, our thoughts are that it's not going to be practical to collate and review the various different datasets that have obviously been used for Appendix 6 in the time we have available now.

What I propose is that we essentially limit the scope to Part 2 (the 'next steps' outline) and incorporate the data review as one of those next steps. We can at least identify the possible datasets that should be reviewed and the key characteristics that we would want to evaluate with respect to trying to figure out their suitability for developing a spatial classification (I don't think any of that info is in Adam's report so we'd need to get hold of all the data to do it ourselves). We can also highlight some possible avenues for exploring spatial classifications depending on the outcomes of the data review and in light of what s 9(2)(a) has already done. We'd also obviously still address next steps for then evaluating ecological thresholds in light of what s 9(2)(a) has already done.

Hopefully that all makes sense, but I thought it would be useful to discuss before re-drafting the scope to match what we think is realistic in the next 2 weeks.

Cheers,
Paul

From: Stephen Fragaszy <Stephen.Fragaszy@mfe.govt.nz>
Sent: Thursday, 11 June 2020 9:26 AM
To: Paul Franklin s 9(2)(a)
Subject: Draft scope of work - DRP

Hi Paul,

Here you go. Apologies we've been slow on this. I still have to confirm the total value remaining, but it's quite close to s 9(2)(i). Please let me know about the feasibility of this through a tracked change response. There are also 2 places where I've left comment boxes for you to fill (personnel and rates per Science Panel agreement). Thanks very much, and hope you're keeping well.

Regards,
Stephen Fragaszy – Senior Policy Analyst – Freshwater Policy – Water Directorate
Ministry for the Environment – Manatū Mo Te Taiao
Telephone: s 9(2)(a) Email: stephen.fragaszy@mfe.govt.nz Website: www.mfe.govt.nz
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Dr Paul Franklin
Freshwater Ecologist

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Document 8 redacted

From: Stephen Fragaszy
To: s 9(2)(a)
Subject: RE: Approved scope of work
Date: Monday, 22 June 2020 9:52:25 am
Attachments: image001.png

Hi Paul,

Thanks for this and good to know – all filed now.

Regards,
Stephen Fragaszy – Senior Policy Analyst – Freshwater Policy – Water Directorate
Ministry for the Environment – Manatu Mo Te Taiao
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From: Paul Franklin s 9(2)(a)
Sent: Wednesday, 17 June 2020 4:39 PM
To: Stephen Fragaszy <Stephen.Fragaszy@mfe.govt.nz>
Subject: RE: Approved scope of work

Hi Stephen,

Just to confirm that we accept the scope of work and will commence with the work. Sorry for the delay in getting back to you, I had to wait on a manager to agree that I could accept it!

Cheers
Paul

From: Stephen Fragaszy <Stephen.Fragaszy@mfe.govt.nz>
Sent: Monday, 15 June 2020 2:43 PM
To: Paul Franklin <Paul.Franklin@niwa.co.nz>
Subject: Approved scope of work

Hi Paul,

Here is the Scope of Work for DRP analysis that has been approved on our end. Please confirm if this scope of work is acceptable to you. If so, it can commence.

Regards,
Stephen Fragaszy – Senior Policy Analyst – Freshwater Policy – Water Directorate

Ministry for the Environment – Manatu Mo Te Taiao
Telephone: s 9(2)(a) Email: stephen.fragaszy@mfe.govt.nz Website: www.mfe.govt.nz
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Gate 10 Silverdale Road Hillcrest Hamilton New Zealand
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Scope of Work under Contract 23184

Description of MfE support need: Data exploration and next steps for dissolved reactive phosphorus (DRP) analysis

Primary contacts: Stephen Fragaszy for MfE and for NIWA, Amy Whitehead

Support the Supplier will provide:

This scope of work is to scope potential next steps to develop in-stream thresholds (NPS-FM attribute bot om lines and bands) for DRP incorporating environmental classification systems and based on ecological effects thresholds.

This consists of the following steps:

1. Identify available national datasets of in-stream water quality data for DRP and th r relevant variables that affect it. This includes datasets produced for Environment Aotearoa and Our Freshwater 2020, as well as other available datasets, e.g. those used in Appendix 6 of the Science nd Technical Advisory Group's supplementary report[1].
2. Describe the characteristics of the datasets that must be evaluated to determine their potential suitability for developing a national environmental classification system for DRP. R commend, as far as possible given the work undertaken in step 1, whether the w rk can feasibly be pr gressed with existing collated data and/or additional data that can be collated relatively quick y f om Regional Councils, or if extensive data collation and/or collection would be needed.
3. Describe potential avenues to develop an environmental classification system. This should include consideration of the understanding gained in Ap endix 6 of the Sci nce and Technical Advisory Group's supplementary report.
4. Describe at a high level the research and nalytical scope needed to develop and test the robustness of a potential environmental classification system and the eco ogical thresholds related to them for DRP.

Deliverable: Provide a technical memo ou lining the pote tial next steps and scope of work.

Supplier Approved Personnel and hour y rates:

Amy Whitehead, Paul Franklin (oth Level 3)

Task total value – up to S 9(2)(i) .

Timeframes for del very:

1. 30 June 2020

Progress meetings: At the r u t of the Ministry, 1 meeting (remote) of 30 minutes or less the week of 22 June and following delivery of he outputs.

1 - https://www.mfe.govt.nz/publications/fresh-water/freshwater-science-and-technical-advisory-group-supplementary-report

Document 10 redacted

Memo

From	**Amy Whitehead, Paul Franklin**
To	Stephen Fragaszy
Date	30 June 2020
Subject	Contract 23184: Task 11 – DRP attribute development scoping

This technical memo outlines potential steps for developing in-stream thresholds (NPS-FM attribute bottom lines and bands) for dissolved reactive phosphorus (DRP) that are based on ecological effects thresholds and incorporate environmental classification systems. The memo is divided into four sections that cover the following steps:

1. Identify available national datasets of river DRP and other ecological variables that are affected by DRP (i.e., ecological response variables). This includes datasets produced for Environment Aotearoa and Our Freshwater 2020, as well as other available datasets, e.g. those used in Appendix 6 of the Science and Technical Advisory Group's supplementary report[1], (hereafter STAG Appendix 6)
2. Describe the characteristics of the datasets that must be evaluated to determine their potential suitability for developing a national environmental classification system for DRP. Recommend, as far as possible given the work undertaken in step 1, whether the work can feasibly be progressed with existing collated data and/or additional data that can be collated relatively quickly from Regional Councils, or if extensive data collation and/or collection would be needed.
3. Describe potential avenues to develop a environmental classification system. This should include consideration of the understanding gained in STAG Appendix 6 of the Science and Technical Advisory Group's supplementary report.
4. Describe at a high level the research and analytical scope needed to first develop and test the robustness of a potential environmental classification system and then assess potential relationships between DRP and ecological response variables.

1. Availability of national datasets

1.1. Nationally available DRP and ecological response data

A water quality dataset was compiled by NIWA in 2018 for national-scale analyses of river water quality state and trends (Larned et al. 2018). These analyses enable the New Zealand Ministry for the Environment (MfE) and Statistics New Zealand to inform policy development and meet their requirements for national environmental reporting on the freshwater domain under the Environmental Reporting Act 2015. The data used for these analyses came from regional council state-of-the- environment (SoE) monitoring programmes and NIWA's National River Water Quality Network (NRWQN).

This dataset contains DRP records for 1048 sites, typically measured monthly, from November 1976 to July 2018, although the length and monitoring frequency of the data record varies between sites. There were 876 sites with sufficient DRP data to be included in the 2013-2017 state analyses, based on site inclusion rules (Larned et al. 2018). DRP monitoring sites are geographically spread across most of New Zealand (Figure 1) and cover almost all of the classes within the River Environment Classification (Figure 2), one of

1 - https://www.mfe.govt.nz/publications/fresh-water/freshwater-science-and-technical-advisory-group-supplementary-report

several existing classifications that group New Zealand river reaches by their environmental characteristics (Snelder and Biggs 2002). However, these monitoring sites are not completely representative of the environment when compared to the national river network, with several cases of under- and over-representation amongst some REC classes. For example, DRP monitoring sites are under-represented in catchments characterised by cold, extremely wet climates (Climate: CD, CW), mountain-fed rivers (Source of flow: M), sedimentary lithology (Geology: HS, SS), native vegetation (Landcover: IF, T, S) or low order, steep streams (Network position: LO; Valley landform: HG). In contrast, these monitoring sites are over-represented in cool lowland catchments (Climate: CD, CW; Source of Flow: L) dominated by volcanic acidic or alluvial geology (Geology: VA, Al), pastoral or urban landcover (Landcover: P, U) or higher order, low gradient rivers (Network position: MO, HO; Valley landform: LG).

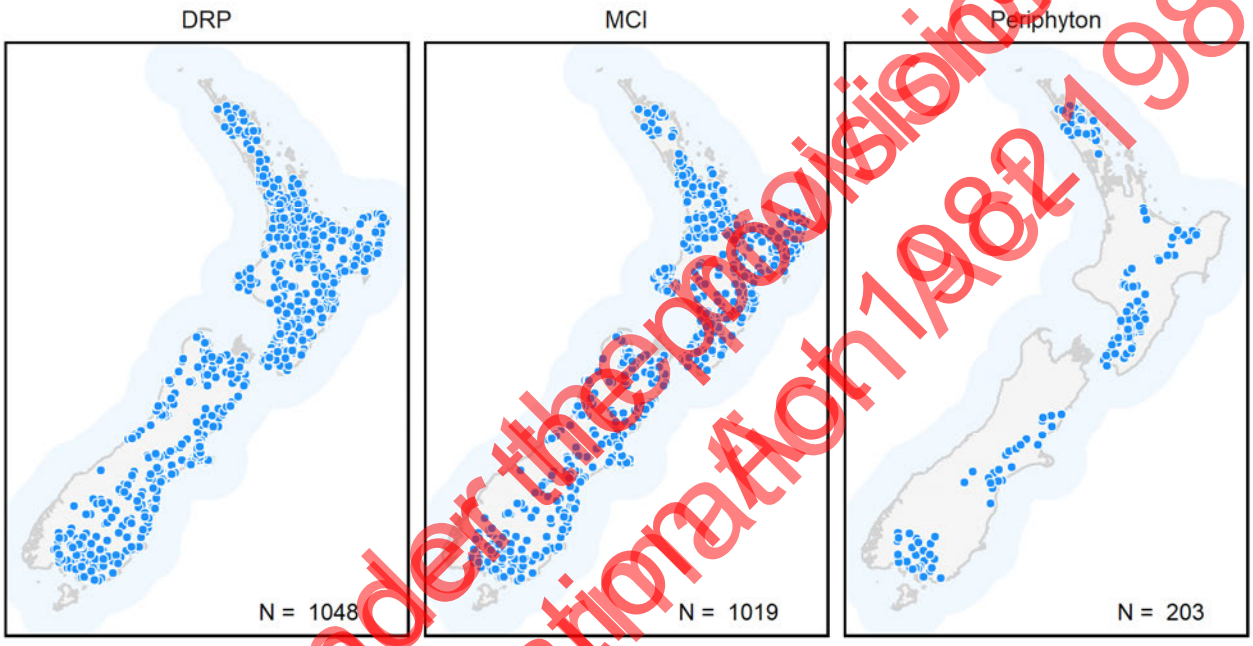

Figure 1. Location of river water quality monitoring sites with raw data available for DRP, MCI and periphyton in the datasets used in Larned et al. (2018) and Kilroy et al (2019). The number in the lower right of each panel corresponds to the number of sites available for each variable.

Macroinvertebrate and periphyton metrics (e.g., MCI scores, periphyton biomass and cover), which may be used as ecological response variables for DRP attribute states, can be derived using data from regional councils and NIWA river monitoring programmes. All regional councils and NIWA undertake macroinvertebrate monitoring, and six regional councils and NIWA currently monitor periphyton. MCI scores from macroinvertebrate monitoring (1019 sites; January 1990 to June 2018) and periphyton (203 sites; Mar 2008 to June 2018; chlorophyll *a* and weighted composite cover) data were collated as part of data analyses by Larned et al. (2018) and Kilroy et al. (2019). The periphyton data from NIWA's national river water quality network (NRWQN) were not combined with the regional council data in the Kilroy et al. (2019) dataset due to methodological differences. The MCI scores in the Larned et al. (2018) dataset were supplied by the regional councils and were not corrected as per Clapcott et al (2017b). The Larned et al. (2018) dataset does not include a full time series of raw macroinvertebrate data.

The geographic and environmental distribution of sites used for the macroinvertebrate monitoring network is very similar to that of the water quality network, with many sites contributing to both datasets (Figure 1, Figure 2). In contrast, periphyton data are restricted to six regional councils, with some classes of climate (WD), geology (VB) and landcover (W, U) either under-represented or not represented within this dataset.

Fish occurrence and abundance records are available from NIWA's New Zealand Freshwater Fish Database (NZFFD; Richardson 2008). NZFFD records are typically converted to presence-absence data as abundances are strongly influenced by fishing methods and are spatially biased towards certain catchments and regions of the country (Franklin et al. 2019). Most NZFFD sites have only been sampled once, meaning that assessment of temporal patterns in fish communities is impossible. In addition, most records are unlikely to be associated with concurrent measurements of DRP.

Figure 2: The distribution of River Environment Classification (REC) classes across all segments in the digital river network and at monitoring sites for water quality (DRP & MCI) and periphyton. Similarities in the distributions shown in the two histograms in each panel provide an indication of the degree to which environmental variation across the monitoring sites represents environmental variation across the New Zealand river network; complete representativeness would be indicated by exact matches between the histograms.

Modelled predictions for DRP, periphyton (chlorophyll-*a* and weighted composite cover), MCI and fish are also available for the entire national river network (Crow et al. 2014; Kilroy et al. 2019; Whitehead 2019). Random forest models were used to generate the predictions using the five-year current state datasets derived by Larned et al (2018) and Kilroy et al. (2019) and spatial data corresponding to predictor variables available from the REC geodatabase (see Section 0 for more details). While there are uncertainties associated with modelled predictions, they currently provide our best estimates of water quality and ecological responses at unmeasured sites.

While we did not have access to the data analysed in STAG Appendix 6 for the preparation of this memo, the appendix has some metadata concerning data sources and data processing (Table 1). These data represent a compilation of data from regional council SoE and NRWQN monitoring sites (e.g., Clapcott et al 2017b; Matheson et al. 2016), fish data from the NZFFD and regional or small research datasets with limited environmental representation (e.g., Biggs 2000; Clapcott et al. 2010). The macroinvertebrate data from Clapcott et al (2017b) were standardised to a common taxonomic level prior to calculating a range of macroinvertebrate metrics and may, therefore, provide additional information to that contained within the Larned et al. (2018) MCI dataset. Further investigation is needed to assess the spatial and temporal resolution, and environmental representativeness, of these datasets and their suitability for assessing stressor-response relationships with DRP.

Table 1. Summary of datasets used in Appendix 6 of the STAG supplementary report to inform the derivation of DRP criteria, including the number of sites (where available), the spatial distribution and the source of the response data. Adapted from STAG Appendix 6.

Response	Metric	Number of sites	Spatial distribution	Data source
Water quality	Measured DRP	Not reported	National	(Clapcott et al. 2017b; LAWA)
	Modelled DRP	River network*	National	(Larned et al. 2017)
Periphyton	Chlorophyll *a*	981	Hawkes Bay, Horizons, Greater Wellington, Canterbury, Southland, NRWQN	(Matheson et al. 2016)
	Chlorophyll *a*	30	National	(Biggs 2000)
Macroinvertebrates	MCI, QMCI, ASPM	1851	National	(Clapcott et al. 2017b)
	MCI	963	Lower North Island	(Death et al. 2015)
Fish	Fish index of biotic integrity (F-IBI)	2922	Unknown	NZFFD
	Modelled fish assemblage O/E	River network*	National	(Canning 2018)
Ecosystem processes	Ecosystem respiration Gross primary production Cotton decay	83	Bay of Plenty, Canterbury, Southland	(Clapcott et al. 2010)

* Modelled predictions available for all ~590,000 reaches on the digital river network.

1.2. Nationally available environmental data for predicting DRP

The principal source of spatial environmental data for New Zealand rivers and their catchments is the REC geodatabase (https://www.niwa.co.nz/freshwater-and-estuaries/management-tools/river-environment-classification-0). This database includes the digital river network and catchment boundaries that have been used as the spatial framework for random forest models of river water quality state (e.g., Whitehead 2019). The digital network represents New Zealand's rivers as ~590,000 segments (bounded by upstream and downstream confluences) and their corresponding catchments. Each segment in the digital network has a unique identifier, the nzsegment number. The links between each nzsegment and its catchment, between adjacent nzsegments and between adjacent catchments facilitate analyses of upstream-downstream connectivity and the accumulation of catchment characteristics in the downstream direction.

In addition to the digital network, the REC geodatabase contains spatial data layers describing the climate, topography, geology, vegetation, infrastructure and hydrology of New Zealand. These spatial data are used to link each nzsegment to many attributes that describe the environmental characteristics of the segment and its catchment. Catchment land cover in the REC geodatabase is derived from the national Land Cover Database (LCDB4) which differentiates 32 categories based on analysis of satellite imagery from 2012 (lris.scinfo.org.nz). Descriptions of catchment regolith are derived from the Land Resources Inventory (LRI) including interpretations of the LRI categories made by Leathwick et al. (2003). Additional variables for each segment have been derived from national-scale hydrological modelling (e.g., Booker and Snelder 2012). Environmental data associated with the digital river network have previously been used to develop national-scale predictions of DRP (Larned et al. 2017; Unwin et al. 2010; Whitehead 2019), with predictor variables describing aspects of geography, topography, climate, flow, geology and landcover selected based on their predicted mechanistic or correlative relationships with water quality.

Two environmental classification systems are also available on the digital river network: the River Environment Classification (REC; Snelder et al. 2010) and Freshwater Environments of New Zealand (FENZ; Leathwick et al. 2010). Both classifications group river reaches based on their environmental similarities but were derived using different approaches. The REC is a rule-based top-down classification that groups and classifies river reaches at six hierarchical levels that correspond to 'controlling environmental factors': climate, topography, geology, land cover, network position and valley landform. The REC is based on scientific understanding of the way the controlling factors cause patterns in physical and associated biological characteristics in rivers (Snelder and Biggs 2002). In contrast, FENZ is a data-driven hierarchical classification that clusters environmental variables based on their ability to maximise explanation of species turnover in site-based biological data (Leathwick et al. 2011). FENZ used continuous environmental data that described aspects of the local and upstream climate, topography, hydrology, and landcover of a reach, as well as factors affecting upstream-downstream connectivity. The number of river classes increases as you move down the hierarchical levels of both the REC and FENZ classifications.

2. Required characteristics of DRP and environmental and ecological datasets

Development of a national environmental classification system for DRP requires a national dataset of measured DRP that is representative of the natural spatial and temporal variation in DRP across New Zealand. Here, natural variation refers to variation that is controlled by natural factors such as climate and geology. Ideally, such a dataset would come from long-term systematic data collection in reference sites that proportionally represent all geographic and environmental regions of New Zealand. Regional datasets are unlikely to sufficiently cover the range of environmental conditions across the country. In some instances, it may be necessary to use modelled data where measured data are not available. For example, modelled values may be required to parameterise relationships between DRP and ecological responses if both variables are not measured concurrently (Franklin et al. 2019; STAG Appendix 6) or for making national-scale predictions across the entire river network (Kilroy et al. 2019).

The SoE water quality dataset (Larned et al. 2018) meets the criterion of a large national-scale dataset, with 1048 sites with DRP records from 1976 to 2018 across most geographic and environmental regions. However, as discussed in Section 1, this dataset over-represents lowland, modified environments and contains few reference sites. Despite the limitations, this dataset provides the best available long-term dat of instream DRP measurements in New Zealand. An additional two years of data will now be available fo many of these SoE monitoring sites, although it is unlikely that this additional information woul suffici ntly alter site-based water quality statistics, particularly if using long-term medians or percentiles. Therefore, collating these data for the purposes of developing an environmental classification of DRP is probably unnecessary.

Many of the environmental predictor data likely to be important for predicting DRP h ve already been mapped to the digital river network and exist within the REC geodatabase and other GIS atabases held by NIWA, MfE and others. Other environmental variables considered important for eveloping an environmental classification of DRP, specifically those that relate to soils (S-Map; L lburne et al. 2012 and recent landcover (LCDB5), may require some pre-processing to develop predic ors that characterise local and upstream catchment conditions on the river network. Partially automat d procedures exist for developing such layers but will require some additional time to complete.

Careful consideration also needs to be given to the appropriate DRP and ecological response metrics to use for calculating site-specific reference conditions (and subsequ ntly stressor-respo se relationships). Water quality variables naturally vary over time, with different aspects of ecosystem health potentially impacted differently by temporal variation at a given site. Franklin et a (2019) used all available data to calculate long-term site medians for their assessment of sediment but acknowledged that this did not consider the potential impacts of temporal trends within the da aset. In compar son estimates of MCI reference condition were based on five-year site media to ensure that va e coincided with the available landcover predictors (Clapcott et al. 2017a). Such an approach may be appropriate for DRP but may reduce the number and spatial coverage of sites avai able for analysis, particularly if following the strict site inclusion rules used in Larned et al (2018). Long- erm trends have been identified in the available DRP dataset, although these vary in direction and m gnitude both spa ially and between time periods (Larned et al. 2018). It is difficult to assess *a priori* how the presence of such trends might affect the development of an environmental classification and the estimation of r ference conditions.

3. Potential avenues for develo i g a national environmental classification system

Water quality is expected to natural vary across the landscape due to natural differences in the environment (e g., geology, c imate, topography, etc). Environmental classifications provide a mechanism for characte ising this variati n and generalising it across landscapes in order to predict effects and guide managem n actions (Tadaki et al. 2014). They can provide important context for understanding the current state of a site and likely natural or "reference" condition in the absence of anthropogenic dis u b nce, with refe ence conditions useful as a benchmark against which to make ecological assessments and s t management objectives (Hawkins et al. 2010; Stoddard et al. 2006). Two general approaches h ve been used to predict reference conditions within environmental classes: *a priori* classifica ions based on natural environmental settings, and models that use continuously variable environm ntal attributes as inputs (Hawkins et al. 2010). In both cases, data describing the reference condition may come from historical information, minimally-disturbed or least-disturbed sites that represent natural or near-natural conditions or estimates from all available monitoring sites across a gradient of anthropogenic disturbance in a model-based approach (Hawkins et al. 2010; Stoddard et al. 2006). Given that reference sites are rare and often not represented across all environmental gradients, model-based approaches are often used to estimate reference conditions by resetting anthropogenic disturbance to zero (e.g., Clapcott et al. 2017a; Franklin et al. 2019; McDowell et al. 2013).

We propose that the first step in developing an environmental classification for DRP is to develop a robust conceptual model of the likely relationships between DRP levels and controlling environmental factors. This conceptual model should draw on existing literature and discussions with experts, and consider DRP under both natural conditions and anthropogenic conditions (i.e., at sites of intensive human activities). The conceptual model should then be used to guide the development of an appropriate environmental classification for DRP. This classification could be based on an existing classification of New Zealand river (e.g., REC, FENZ) or use a data-driven approach to develop a new classification specific to DRP.

3.1. Existing classification approach

Previous analyses of the national-scale SoE monitoring dataset have identified factors relating to climate, topography, geology and landcover in the upstream catchment as important predictors of median DRP (Figure 3a; Larned et al. 2017; Snelder et al. 2018; Unwin et al. 2010; Whitehead 2019). Whitehead (2019) found that median DRP typically declined with increasing slope and elevation, particle size (a measure of the mean catchment particle size of regolith), pasture, bare ground and rainfall but increased with increasing temperature. It should be noted, however, that the predictor variables included in this analysis were selected from a suite of variables commonly used for modelling water quality and ecological responses in New Zealand rivers (e.g., Larned et al. 2017; Leathwick et al. 2011; Unwin et al. 2010) and were not specifically chosen for DRP. Therefore, other environmental variables that may have a more direct influence on DRP should also be considered for inclusion in future DRP-specific analyses. For example, the underlying lithology of the catchment will likely influence the supply of phosphorus, with higher DRP concentrations typically associated with phosphorus-rich rock types (Eden and Parfitt 1992). Soil characteristics, such as phosphorus retention, drainage and soil age and weathering, may also be important (Parfitt et al. 2005), with leaching via subsurface flow paths and groundwater also potentially influencing instream DRP concentrations (Dymond et al. 2013; McDowell et al. 2020; Parfitt et al. 2005). Instream sediment can also be a source of DRP, with bioavailability linked to instream pH levels (Wilcock et al. 2020).

Previous analyses have indicated that the estimated reference condition for DRP is elevated within the Volcanic Acidic (VA) class of the REC (McDowell et al. 2013; STAG Appendix 6). However, the variation in reference condition DRP within the VA class appeared to be higher than that within other geology classes, particularly in the Cool Wet Lowland class. The VA geology class is an amalgamation of eight geology top rock categories (Snelder et al. 2010), with median DRP from the Larned et al. (2018) current state dataset varying between these geology types (Figure 3b). Similar patterns of high variability within the VA class have also been noted for measures of periphyton in some regions (Kilroy et al. 2020a). Therefore, we recommend that development of an environmental classification for DRP should consider a finer categorisation of geology than that included in the REC. This could include the categorical geology layers described by the New Zealand Land Resource Inventory database (LRI; Lynn et al. 2009) or continuous variables that represent mineral concentrations in surface rocks using values derived from the data associated with the Land Environments of New Zealand classification (LENZ; Leathwick et al. 2002).

Previous estimates of water quality reference conditions in New Zealand have classified monitoring sites based on the climate, topography-geology (CTG) classes of the REC (Franklin et al. 2019; McDowell et al. 2013). Where necessary, CTG classes with few sites were either removed or aggregated using hierarchical clustering prior to estimating reference conditions to ensure sufficient data and reduce the number of potential management classes. Reference conditions were then estimated from models of water quality and landcover (as a surrogate for anthropogenic disturbance) within each aggregated CTG class, by setting anthropogenic disturbance to zero based on the method of Dodds and Oakes (2004).

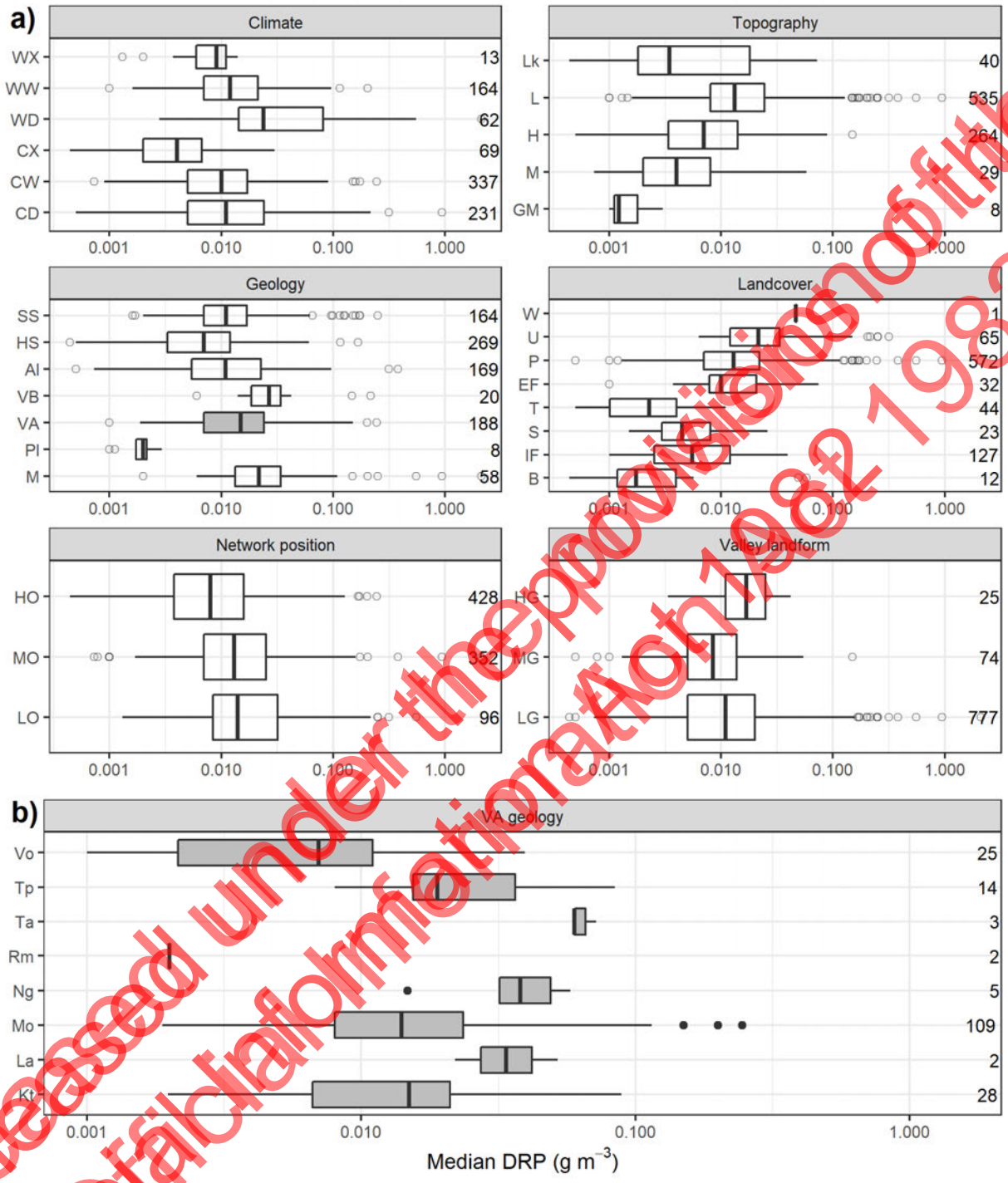

Figure 3 Median DRP within a) each class of the River Environment Classification (REC) and b) each of the top rock types that make up the Volcanic Acidic (VA) geology class (highlighted in grey in the top panel). DRP data are five-year site medians (2013-2017) from Larned et al (2018) and represent current state rather than reference conditions. The number of sites is indicated for each class, with the x axes shown on a $\log_{10}$ scale. REC classes as defined by Snelder et al (2010), with rock type definitions from Lynn et al (2009). Vo – Lavas and welded ignimbrites; Tp – Taupo and Kaharoa breccia and pumiceous alluvium; Ta – Tarawera tephra; Rm – Rotomahana mud; Ng – Ngauruhoe tephra; Mo – Ashes older than Taupo ash; La – Lahar deposits; Kt – Kaharoa and Taupo ashes.

Using the REC as the underlying environmental classification is advantageous as it captures much of the broadscale variation across the New Zealand river network and is already used for setting water quality limits under the NOF. However, it may not sufficiently capture the main drivers of natural DRP concentrations, particularly with respect to geology and soils, as noted above. The relationship between DRP and alternative existing environmental classifications (e.g., FENZ) could also be explored using a similar approach to that proposed for the REC above. Some previous analyses of water quality and ecological responses have also explored relationships within regional council boundaries, with varying explanatory power (e.g., Clapcott et al. 2017a; STAG Appendix 6). While not strictly an environmental classification, such an approach can help partition variation in geographic space and potentially improve model performance. We do not recommend this approach for classifying DRP as the driving environmental predictors are unlikely to align with territorial boundaries.

3.2. Data-driven classification approach

Alternatively, a data-driven approach could be used to derive a DRP-specific environmental classification, incorporating continuous environmental predictors and grouping sites based on their environmental similarities. First, the importance of potential environmental predictor variables of DRP could be assessed using a flexible regression model technique, such as random forests (RF) or boosted regression trees (BRT), that can accommodate non-linear and complex relationships. Second, an environmental classification would be defined by aggregating sites based on the important predictors of DRP identified above (excluding anthropogenic stressors) using hierarchical clustering (or a similar technique). This approach is similar to that used to develop the LENZ and FENZ classifications (Leathwick et al. 2002, 2010, 2011) but would provide a classification specific to DRP. Finally, reference conditions could be estimated using regression models within each class as described above.

It is difficult to state *a priori* which method of developing an environmental classification will provide the best fit for the national DRP dataset. Therefore, we suggest that any future analysis should explore using existing environmental classifications (e.g., REC, FENZ) and developing a data-driven classification specifically for DRP. Methods for identifying which environmental classification best describes patterns in DRP are outlined in Section 4.

4. Developing and testing the robustness of a potential environmental classification system and ecological thresholds for DRP

MfE has requested that we set out a possible pathway for progressing the DRP attribute development that considers the discussion points laid out in the STAG supplementary report Appendices 6 and 7. Below we propose a framework for this process with a view to establishing credible and legitimate DRP limits that take into account natural spatial variations in DRP state. There is a dependency between Step 3 (derivation of ecological thresholds) and the outcomes of Step 2 (development of the DRP spatial classification). Recommendations for Step 3 are also caveated by the fact that we have not had access to the datasets used for the analyses presented in Appendix 6 of the STAG supplementary report and insufficient information on those datasets is presented in Appendix 6 to evaluate their suitability for applying within a DRP environmental classification system.

4.1. Develop conceptual models

In order to effectively inform management decisions, both researchers and decision makers need to consider that the generation of scientific information is salient (relevant and timely), credible (authoritative, believable, and trusted), and legitimate (developed via a process that considers the values and perspectives of all relevant stakeholders; Cash et al. 2003; Cook et al. 2013). We suggest that the framework depicted in **Figure 4** could provide a robust, transparent and reproducible process for deriving attribute band thresholds for DRP for the NOF.

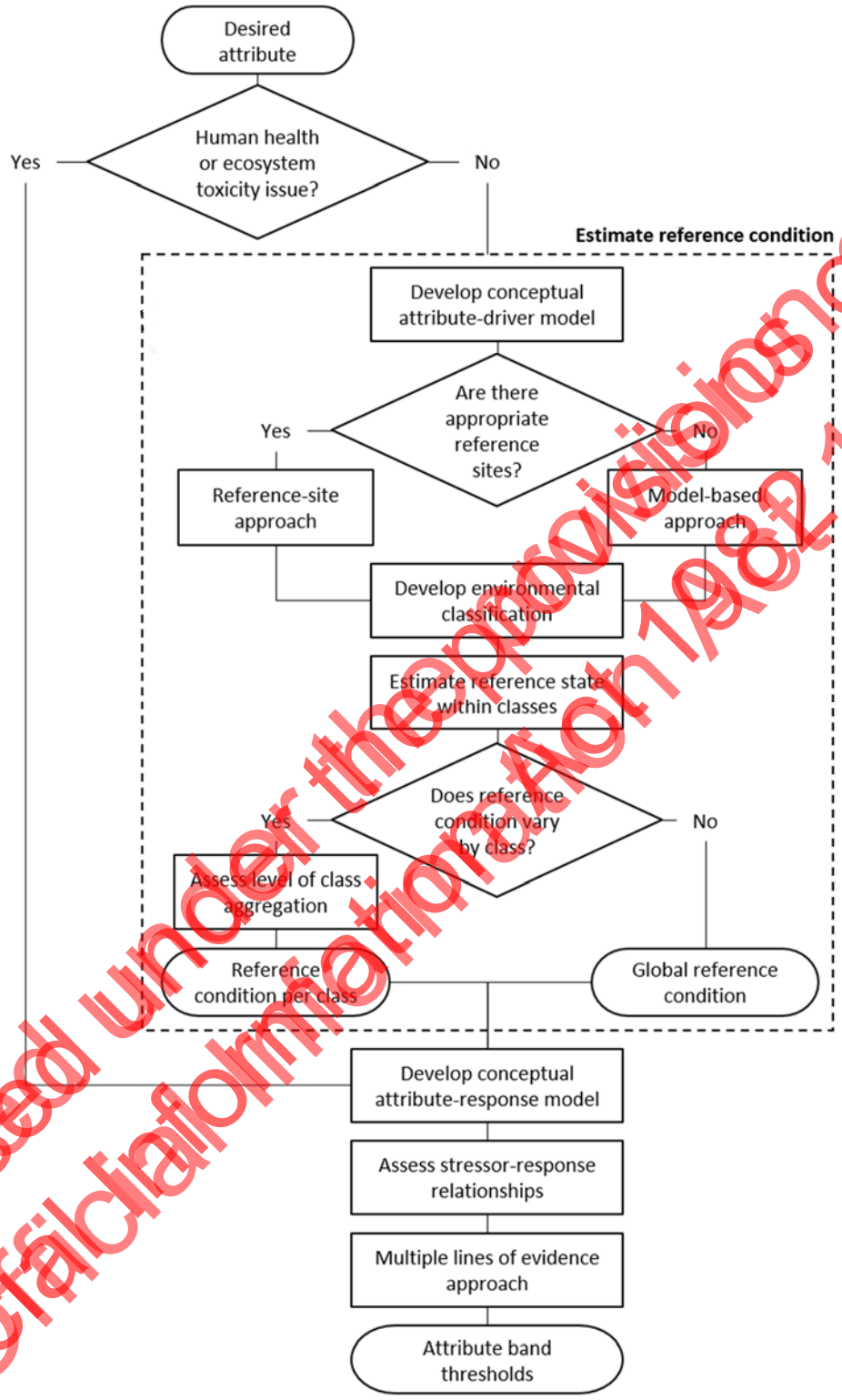

Figure 4. Potential framework for identifying attribute band thresholds under the National Objectives Framework. Development of an environmental classification is one small piece of a larger body of work that requires engagement and support from both researchers and decision makers throughout the process. This framework aligns closely with the approach taken by Franklin et al. (2019) and allows for the potential to use either a global reference condition or multiple reference conditions based on the environmental classification to inform development of the attribute band thresholds.

Under this framework, we suggest that the initial step requires the development of two conceptual models; the first describing the likely environmental drivers of DRP under both natural and current landscape settings in New Zealand to inform the environmental classification and the second outlining our understanding of the mechanistic relationships between DRP and ecological health indicators to identify potential stressor-response relationships. These conceptual models should be based on known relationships in the literature and expert advice. At this stage, ensuring that there is consensus amongst stakeholders on the relationships in the conceptual models will help build legitimacy around the process.

4.2. Develop environmental classifications and estimate reference conditions

The second step centres on the development of the environmental classification and derivation of the associated reference conditions, with the environmental driver-attribute conceptual model used as the basis for identifying appropriate environmental data. We suggest that development of a potential environmental classification for DRP should follow similar guiding principles to those used to develop the sediment state classification for estimating sediment reference conditions (Franklin et al. 2019; adapted below for DRP).

1. The classification should achieve a balance between simplicity, hence ease of use, and sensitivity to changes in the DRP status of streams.
2. The classification should be (a) based on the key geomorphological and climatological variables that drive instream DRP concentrations; and (b) also be based on observed DRP data, hence capture real differences in the DRP characteristics of rivers.
3. The classification should group stream segments at a spatial resolution reflecting likely changes in the geomorphological and climatological variables driving DRP concentrations.
4. Estimates of reference condition within all regions of New Zealand should result in NOF management bands — hence management targets — that are achievable.

Franklin et al. (2019) also suggested that the sediment state classification should build on existing river classification systems used in New Zealand, particularly those that have been used to inform catchment policy and management. However, we noted in Section 3 that existing classifications may not be suitable for DRP and we encourage exploration of both existing classifications and alternative classifications derived using a data-driven approach. Regardless of the approach (existing classification or data-driven) used to develop an environmental classification for DRP, it is likely that the resulting classifications will be hierarchical and have several potential levels of class aggregation that could be used to estimate reference conditions for DRP.

Quantitative approaches will be required to compare the ability of potential classifications to estimate reference conditions of DRP as well as comparing the effects of different levels of class aggregation on potential management outcomes (e.g. numbers and magnitude of 'unders' and 'overs'). Franklin et al. (2019) approached this problem by developing models of reference conditions for each potential class aggregation level, using information-theoretic approaches to find the most parsimonious model that balanced model complexity and simplicity. They also compared estimates of reference condition within each class to measured values from reference sites within that class (defined as >90% native vegetation, 0% urban, <5% exotic vegetation) and from all sites within the class. These checks provided an assurance that estimates of reference conditions were realistic. In addition, they also assessed how estimates of median reference state changed as classes were aggregated to identify potential biases at higher levels of aggregation. The classification strength statistic could also provide evidence for the most appropriate level of aggregation by comparing variation within and between classes (Van Sickle 1997; Van Sickle and Hughes 2000). However, we acknowledge that the selection of the "best" classification and the final level of aggregation will require a trade-off between the statistical complexity and the number of classes that can

practically be managed. This will ultimately require some level of normative decisions, with transparency required to ensure that it is clear where such decisions have been made throughout the process.

4.3. Identify and evaluate stressor-response relationships

In the context of DRP attribute development, stressor-response relationships refer to bivariate relationships between DRP levels (concentrations or loads) and ecological responses. These relationships may be based on causal inferences that are supported by "process understanding" (i.e., information about the biophysical processes by which stressors elicit responses). Alternatively, they may be based p imarily on statistical correlations with little process understanding. Examples of the former include positive relationships between DRP concentration and algal biomass and growth, which reflects the physiological processes of cellular uptake, biomolecule synthesis and tissue accrual through cell replication (Bothwe l 1985; Hill and Fanta 2008). Examples of the latter include positive relationships betw en electrical conductivity and periphyton biomass; the mechanism(s) controlling these relatio hips have not been determined (Kilroy et al. 2020b). In cases where a stressor response relationship is poorly supported by process understanding, there is a risk of spurious relationships (i.e., both th stressor and response variables are causally related to a third variable, but not to each oth r). For example, negative relationships between dissolved silicate concentrations and macroinvertebrate bas d ecological health metrics have been reported, but in these cases, non-toxic silicate and the macro nvertebra e met ic were likely correlated with an unmeasured toxicant (Berger et al. 2017). To reduce th s risk correlative relationships should at least be consistent with general knowledge of governing processes, as indicated in Step 1.

There are a wide range of ecological response variables for which quantitative relationships with DRP could be developed. However, the discussion below focu es on four classes of response variables listed in Table 1; variables in these classes are in use or und consideration for u rient criteria development for New Zealand rivers: periphyton biomass, macroinvertebrate commu ity metrics, fish community metrics and ecosystem metabolism.

Where possible, measured natio al- cale ecological esponse data from across a gradient of measured DRP concentrations records are pref rable for assessing s ressor-response relationships. The available national-scale monitoring datasets fo periphyton, macroinvertebrates and fish generally meet these criteria, although spatial and temporal biases are pre ent for some metrics. For example, the periphyton datasets held by NIWA represent the est available data from regional council monitoring for chlorophyll-*a* and weighted composite cove (C. Kilroy, *pers. omm.*). However, they are only available from six regional councils and the efore may be spati lly and environmentally biased in a national context. Based on the number of periphyton sites reported in STAG Appendix 6 (Table 1), it appears that data may be available for additional s es that potentially cover a wider environmental gradient. Similarly, additional data from individual research stud es may also help to fill some gaps for macroinvertebrates as described in STAG Appendix 6. However, the patial and temporal ranges of these data are currently unclear and require fur her investigation i these ecological health responses are considered important with respect to DRP.

The shapes of he stressor-response relationships will vary depending on the traits of the response o ganism the magnitude, frequency and duration of exposure to the stressor, and the potential influence of other confounding factors (Larned and Schallenberg 2019). However, a range of analytical techniques are available o plore these different stressor-response relationships and develop understanding about potential ecological thresholds. Careful evaluation of the available ecological response data will be required o identify the most appropriate analytical technique for each dataset. However, previous research identifying stressor-response relationships, including studies deriving NOF thresholds for other attributes (e.g., Clapcott et al. 2017b; Franklin et al. 2019; Snelder et al. 2013), may serve as a useful first step for identifying potential analytical techniques and likely stressor-response relationship shapes. However, it will be important to also consider how the outputs of dissimilar statistical techniques might be combined to

develop attribute bands and bottom lines, particularly if their estimates range by an order-of-magnitude or more.

4.4. Combine multiple lines of evidence

Assessment of potential stressor-response relationships in Step 3 may result in multiple lines of evidence that need to be reconciled in order to develop attribute bands and bottom lines. The generation of multiple pieces of evidence of different types is common in environmental assessments. Often none of the multiple estimates available completely represent the attribute value, but each provides evidence regarding its true value (Suter et al. 2017). To determine the best-supported attribute bands there must be consideration of the relative strengths or weaknesses of the analyses used to derive the lines of evidence. The strongest single line of evidence could be used as the basis for developing attribute bands or outputs could be combined using a weighted or unweighted average. Use of a formal framework for evaluating lines of evidence can provide greater transparency and reproducibility relative to ad hoc weighing of evidence (Suter et al. 2017). The multiple lines of evidence approach inevitably involves a degree of normative decisions. However, use of a standardised framework can help to minimise the risk of biased or arbitrary outcomes. A key benefit of a formal multiple lines of evidence approach is that it allows incorporation of all relevant and reliable evidence, including expert knowledge. It can also increase the defensibility and transparency of the process and outcomes by demonstrating that all evidence has been considered. This approach was successfully employed by Franklin et al. (2019) for evaluating and combining multiple lines of evidence to derive sediment attribute thresholds.

In summary, we suggest that the proposed framework (**Figure 4**) and steps outlined above could form the basis of future work towards deriving attribute band thresholds for DRP under the NOF. It is likely that such a process would be somewhat iterative, as refinement to potential environmental classifications and associated levels of aggregation alter reference condition estimates and influence within-class stressor-response relationships. However, we feel that it provides a methodology for developing a robust and transparent process. We welcome the opportunity to discuss this memo and the proposed framework in more detail.

5. Acknowledgement

Many thanks to Cathy Kilroy, Doug Booker and Rick Stoffels for providing technical advice and Scott Larned for a thorough review.

6. References

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Document 11 redacted

From: Stephen Fragaszy
To: s 9(2)(a)
Subject: RE: DRP update
Date: Thursday, 2 July 2020 10:06:45 am
Attachments: image001.png

Great, thanks. I'll give our accounts payable a heads up.

Stephen Fragaszy – Senior Policy Analyst – Freshwater Policy – Water Directorate
Ministry for the Environment – Manatu Mo Te Taiao
Telephone: s 9(2)(a) Email: stephen.fragaszy@mfe.govt.nz Website: www.mfe.govt.nz
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From: Paul Franklin s 9(2)(a)
Sent: Thursday, 2 July 2020 10:04 AM
To: Stephen Fragaszy <Stephen.Fragaszy@mfe.govt.nz>
Subject: RE: DRP update

Hi Stephen,

I've just spoken to Amy and she is expecting to get the report to you by the end of today. Apologies for the last minute nature of it, but it's that time of year!

I've also just spoken to our Project Coordinator and she will ensure that the invoice is sent out before the end of today (4pm ish) also.

If you've got any questions please give me a call on my mobile s 9(2)(a) as I'm not in the office today.

Cheers,
Paul

From: Stephen Fragaszy <Stephen.Fragaszy@mfe.govt.nz>
Sent: Thursday, 2 July 2020 9:17 AM
To: Paul Franklin <s 9(2)(a) >
Subject: RE: DRP update

Hi Paul,

I just want to check in on this – you'll still be getting me the invoice and a draft/final shortly today, right? Please give me a call if something has arisen or you have a question on this.

Regards,
Stephen Fragaszy – Senior Policy Analyst – Freshwater Policy – Water Directorate
Ministry for the Environment – Manatu Mo Te Taiao
Telephone: s 9(2)(a) Email: stephen.fragaszy@mfe.govt.nz Website: www.mfe.govt.nz
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From: Paul Franklin <s 9(2)(a) >
Sent: Monday, 29 June 2020 4:35 PM
To: Stephen Fragaszy <Stephen.Fragaszy@mfe.govt.nz>
Cc: Amy Whitehead <s 9(2)(a) >
Subject: RE: DRP update

Hi Stephen,

Okay, will do. We will make sure it doesn't go beyond 2 July to save us having to tackle those FY contracting issues!

Cheers,
Paul

From: Stephen Fragaszy <Stephen.Fragaszy@mfe.govt.nz>
Sent: Monday, 29 June 2020 4:33 PM
To: Paul Franklin <s 9(2)(a) >
Cc: Amy Whitehead <s 9(2)(a) >
Subject: RE: DRP update

Hi Paul,

Sounds good and please let me know if you're not able to meet tomorrow COB (with invoice at the same time) as we have contracting FY issues to deal with if it goes beyond 2 July.

Regards,
Stephen Fragaszy – Senior Policy Analyst – Freshwater Policy – Water Directorate
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From: Paul Franklin <s 9(2)(a) >
Sent: Monday, 29 June 2020 3:48 PM
To: Stephen Fragaszy <Stephen.Fragaszy@mfe.govt.nz>
Cc: Amy Whitehead s 9(2)(a)
Subject: DRP update

Hi Stephen,

I hope all is good with you and that you had a good weekend. I just wanted to send you a quick update through to let you know that Amy is hopefully on tra to have an initi l dr ft of the memo on the DRP ready for internal review today. Assuming that gets tu ned around fairly qu ckly nd doesn't come up with any major issues (which it shouldn't!), then we'll h pefully be able t ge a draft memo to you by the end of the tomorrow. If there are any delays in the reviewing process (which 'm not currently expecting), we'll definitely have something to you before the end of the week.

In terms of invoicing, we'll figu e out how many hou Amy has spent up to the end of tomorrow and get the invoice sent out for that time ASAP.

Cheers,
Paul

Dr Paul Franklin
Freshwater Ecologist

s 9(2)(a)
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Document 12 redacted

From: s 9(2)(a)
To: Stephen Fragaszy
Cc: s 9(2)(a)
Subject: RE: DRP classification memo
Date: Monday, 20 July 2020 2:28:13 pm
Attachments: image001.png

Kia ora Stephen,
Thanks for the update. Happy to discuss those points and potential pathways forward when you are ready a your end.
Nga mihi
Amy

From: Stephen Fragaszy <Stephen.Fragaszy@mfe.govt.nz>
Sent: Monday, 20 July 2020 1:31 PM
To: Amy Whitehead s 9(2)(a)
Cc: Paul Franklin s 9(2)(a)
Subject: RE: DRP classification memo

Hi Amy,

I've had a chance to review this memo now, and I think it outline a very clear path forward with a few potential options to consider on our end. Figure 4 is particularly helpful to conceptualise the big picture and how the various components could take us through the process.

We won't get back in touch for a few weeks at least (we're solely focused on drafting for the time being), but I think the first step will be to discuss a few pieces that I've understood to be some of these potential project scoping options:

Out of Scope

If we choose to progress this work, I won't be leading it from our end. But I would likely be supporting whoever is, so I'd set up an initial call to get things rolling.

Regards,
Stephen Fragaszy – Senior Policy Analyst – Freshwater Policy – Water Directorate
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From: Amy Whitehead s 9(2)(a)
Sent: Thursday, 2 July 2020 4:14 PM
To: Stephen Fragaszy <Stephen.Fragaszy@mfe.govt.nz>
Cc: Paul Franklin s 9(2)(a)
Subject: DRP classification memo

Kia ora Stephen,

Please find attached a memo outlining potential steps for developing in-stream thresholds for dissolved reactive phosphorus (DRP) based on an environmental classification and ecological effects thresholds as scoped by MfE.

We look forward to discussing the contents of this memo, particularly with respect to how it could be developed into a future work programme for deriving attribute values for DRP.

Nga mihi nui
Amy

Dr Amy Whitehead
Freshwater Ecologist

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