

Focusing Aotearoa New Zealand's environmental reporting system

November 2019



Parliamentary Commissioner for the Environment

Te Kaitiaki Taiao a Te Whare Pāremata

This report has been produced pursuant to subsections 16(1)(a) to (c) of the Environment Act 1986. The Parliamentary Commissioner for the Environment is an independent Officer of Parliament, with functions and powers set out in the Environment Act 1986. His role allows an opportunity to provide Members of Parliament with independent advice in their consideration of matters that may have impacts on the environment.

This document may be copied provided that the source is acknowledged. This report and other publications by the Parliamentary Commissioner for the Environment are available at pce.parliament.nz

Parliamentary Commissioner for the Environment

Te Kaitiaki Taiao a Te Whare Pāremata
PO Box 10-241, Wellington 6143
Aotearoa New Zealand

T 64 4 471 1669
F 64 4 495 8350
E pce@pce.parliament.nz
W pce.parliament.nz

November 2019

ISBN

978-0-947517-16-8 (print)
978-0-947517-17-5 (electronic)

Photography

Cover images: Oamaru by Timo, Flickr; Hawke's Bay by Phillip Capper, Flickr; Ninety Mile Beach from pxhere.com.
Section header fern images by Bernard Spragg, Flickr.

Focusing Aotearoa New Zealand's environmental reporting system

November 2019



Parliamentary Commissioner for the Environment

Te Kaitiaki Taiao a Te Whare Pāremata

Acknowledgements

The Parliamentary Commissioner for the Environment is indebted to a number of people who assisted him in conducting this review. Special thanks are due to Anna Hooper, who led the project, supported by Grant Blackwell, Penny Fairbrother, Peter Lee and Andrew McCarthy.

The Commissioner wishes to thank staff at the Ministry for the Environment and Stats NZ for the considerable time and effort they spent helping him and his team understand New Zealand's environmental reporting system.

The Commissioner is grateful to all regional and unitary councils for their assistance, in particular, Greater Wellington Regional Council for the secondment of a staff member to help with the preparation of this report.

The Commissioner would also like to acknowledge the following organisations for their time and assistance:

- Department of Conservation
- Local Government New Zealand
- Manaaki Whenua – Landcare Research
- Ministry for Primary Industries
- Ministry of Business, Innovation and Employment
- National Institute of Water and Atmospheric Research
- Productivity Commission
- The Treasury.

Finally, the Commissioner wishes to thank the following individuals for reviewing earlier drafts of the report:

- Anne-Gaelle Ausseil
- Kirsty Johnston
- Jean Le Roux
- Emily Revell
- Conal Smith.

Contents

Overview	3
Tirohanga whānui	9
1 How we come to be where we are	15
2 The purpose of environmental reporting	19
3 The state of environmental data and knowledge	21
4 National-level environmental reporting	45
5 Environmental reporting system and wellbeing	75
6 Recommendations	83
7 Appendices	89
References	95



Overview

Under the Environmental Reporting Act 2015, I am given the discretion to “report on an environmental report and the processes that produced it.” Strictly speaking, it is not a discretion that needed to be spelt out in the Act. The terms of the Environment Act 1986, which established the office of the Parliamentary Commissioner for the Environment, are quite wide enough to invite my scrutiny of environmental reporting. But since the inception of the Act, my predecessor and I have at times commented on the reports brought down in its name. Some of our commentaries have been quite detailed.

When *Environment Aotearoa 2019* was published earlier this year, I was able to dash off a brief congratulatory note to the Government Statistician and the Secretary for the Environment. The congratulations were genuine – the report represented a real step forward in producing a state of the environment report that was neither an indigestible doorstop nor a report about everything. It focused on priority issues in a format that was readily able to support, as the report noted, “an open and honest conversation about what we have, what we are at risk of losing, and where we can make changes.”

The reason my note was brief, however, was because I had decided to conduct a thorough review of the reporting system. A review seemed timely because we have now completed one full cycle of domain reports followed by a synthesis report. My review does not, however, stop at the narrow boundaries of the Act. New Zealand’s environmental reporting system didn’t begin with the Act. It was, rather, designed to draw on existing data and knowledge, often generated for reasons quite separate from supporting a national environmental reporting system.

To say that we have designed a national environmental reporting system would be to overstate its coherence. It has been more a case of cobbling together what we have to hand, trying to solicit the willing engagement of a wide range of stakeholders and putting the hat around to try to plug some of the many gaps.

If there is one thing that stands out from the first cycle of reports, it is the extent of what we *don’t* know about what’s going on with our environment. To some extent, that finding should come as no surprise. Understanding the world we inhabit is a work in progress and allocating resources to push back the boundaries of our ignorance will always involve making choices about how to expend scarce resources.

However, the blind spots in our environmental reporting system don't represent conscious choices to collect data or undertake research in some fields rather than others. Rather, they represent the unplanned consequences of a myriad choices over decades. Ours has been a passive system that has harvested whatever data is there and done the best it can to navigate what's missing.

The fact that we enacted an environmental reporting statute that seems very orderly and structured with regular domain and synthesis reports didn't change the essentially passive, opportunistic nature of our reporting. A conscious choice was made to make do with what there was. In my judgment, what there is, is clearly inadequate.

We hear a lot about living in an information age. We are assured that even traditional industries like agriculture, forestry and fishing rely on information to survive in an increasingly competitive and resource-scarce world. But when we try to find out what's happening on our land or what's happening to our water, there are huge gaps.

The last survey of land cover in New Zealand was undertaken in the summer of 2012/2013. We are now almost in the summer of 2019/2020. I don't think anyone would seriously argue that investors or policymakers should take decisions on the basis of seven-year-old data – too much happens in seven years. Land use can change even more quickly than land cover, warranting regular monitoring. However, New Zealand has no robust, comprehensive and nationally representative land use map, let alone one that is regularly updated. Current estimates are an amalgam of data derived from a variety of sources and proxies.

This is what a passive approach to reporting has meant in practice. There are costs and they are not just environmental – they have real consequences for the economy and for society. How can we make economically efficient or socially fair environmental rules if we can't measure authoritatively what's happening to the physical resource base on which our wellbeing ultimately depends?

Having said all that, this review does not propose any fundamental upheavals. It continues the incrementalism that has marked previous efforts to improve our environmental reporting. While amendments to the Act are proposed, they are in the nature of refinements. They include:

- a clearer purpose
- a longer interval between full state of the environment (or synthesis) reports
- expanding the reporting framework to include drivers and outlooks
- a refocusing of domain reports as commentaries on themes, based on those used in *Environment Aotearoa 2019*
- a requirement for Ministers to respond to state of the environment (or synthesis) reports
- some minor adjustments to the respective roles of the Government Statistician and the Secretary for the Environment.

But the essential architecture of the Act, including, most importantly, the statutory independence of the Government Statistician and the Secretary for the Environment responsible for issuing the reports, is preserved.

In some ways, the most important recommendations in this report are those that relate to the prioritising and gathering of data in a consistent way. Despite attempts over more than two decades, no agreement has ever been reached on a set of core environmental indicators. This has to happen. Consistent and authoritative time series coupled with improved spatial coverage are essential if we are to detect trends. Only then will we be able to judge confidently whether we are making progress or going backwards – and get a handle on whether costly interventions are having an effect.

Achieving a genuinely comprehensive national reporting system entails engaging players at many levels, particularly regional councils who are responsible for some of the most important monitoring that takes place under the Resource Management Act 1991.

Beyond the acquisition of high-quality data, we need to be able to interpret what it might be telling us. That means having expertise to hand that can make sense of it. One of the most significant recommendations I am making is the establishment, under the Act, of a standing science advisory panel to advise the Secretary for the Environment on the preparation of theme-based commentaries.

These commentaries would replace the current domain reports. They would, to use a piece of jargon, be of ‘variable geometry’ – in other words, rather than stick slavishly to pre-determined headings, their scope and length would be determined by existing or emerging issues that require attention. The panel would also need to advise on the preparation of regular state of the environment (synthesis) reports and further research, monitoring and data needs.

The panel’s role would be advisory. It would be for the Secretary for the Environment to appoint the panel and, jointly with the Government Statistician, publish the commentaries and state of the environment reports in the exercise of their independent reporting function. Again, this recommendation follows incrementally from an innovation developed for the production of the most recent synthesis report, for which a senior science team was assembled to assist with the report writing.

While the environmental reporting system is led by the Secretary for the Environment and the Government Statistician, its foundation ultimately lies in the knowledge base that our society has developed. There are two very important, but very different, sources of knowledge that need to inform environmental reporting.

One is the output of our science system. New Zealand does some very good environmental science – and, according to the Organisation for Economic Co-operation and Development, we devote a larger share of our public good science investment to the environment than any other member country. For all that, not all is well.

The first cycle of reports under the current Act has identified many knowledge gaps. I am not confident that there is a coherent basis for our national investment in environmental science. I am particularly concerned that there is no mechanism that links the ongoing demand environmental reporting makes for an understanding of complex ecological processes that evolve over decades, and a science funding system that is constantly searching for innovation, impact and linkages to the ever-changing demands of business and society.

The other source of knowledge is that embedded in mātauranga Māori – the traditional knowledge of this land's original settlers. For the 600-odd years before the arrival of Europeans, mātauranga Māori represents the only human record we have of the environment of these islands and their surrounding waters. For that reason alone, it is of immense importance. Given how much we do not know, we can ill afford to disregard this traditionally curated knowledge. The importance of making this a complementary part of future state of the environment reporting has already been acknowledged. It now needs to be deepened.

It is also important that in collecting data of any kind to inform reporting, due emphasis is given to information that is useful to Māori. As I note in section four, it is not hard to make the case that if the Treaty of Waitangi commits the Crown to protecting certain taonga (which include many environmental resources), then gathering information about their state is an important responsibility.

When I set out on this investigation, the Government was in the process of announcing its commitment to prioritise public spending by accounting for its contribution to wellbeing. By including natural capital as a key pillar, the Government has recognised the importance of maintaining the natural environment for both current wellbeing and that of future generations.

Explicitly recognising that wellbeing depends on a range of factors and directing public spending to the factors that 'matter most' is a welcome development. But implementing this approach in practice places considerable demands on the underlying evidence base.

If the purpose of public spending is to support wellbeing, then policymakers need an improved understanding of the linkages between wellbeing and those aspects of life (such as environmental quality) that contribute to it. Establishing these linkages requires research, but as this report makes clear for the environmental domain, the data required to undertake this research is not always available.

Similarly, if the Government is to assess risks to the wellbeing of future generations, it will require an understanding of how the natural environment is changing, as well as knowledge about how it may change in future. The extent to which natural resources can be safely depleted in pursuit of building up other desirable assets is at the heart of a longstanding debate about what 'sustainable development' entails. But again, the existing evidence base is insufficient to allow us to gauge the risks we may be running.

Previous Investment Statements have focused almost exclusively on the Crown's portfolio of built and financial assets with relatively little attention devoted to the natural environment. Similarly, Statements on the Long-Term Fiscal Position shed little light on the potential risks that environmental degradation poses to the Government's finances.

The Treasury is well aware of these issues and has identified data gaps as a barrier to further progress. The shortcomings of the environmental indicators of future wellbeing were apparent in the Living Standards Framework Dashboard published late last year. The absence of comprehensive and authoritative environmental data stands in the way of making good links between the state of the environment and wellbeing. Without a serious investment in data – and work on how it can then be incorporated into the wellbeing framework – references to the environmental pillar of wellbeing risk remaining as placeholders. I have decided to offer some thoughts on how to make progress in a separate report next year.

Mention of 'serious investment' brings me to a final observation. It costs money to improve our knowledge base and collect data. The absence of such data can prove to be very costly if the policies we make (or don't make) turn out to be ill-conceived. But we should resist the temptation to see more money as the only answer to the problems environmental reporting faces. Investments have to be focused and choices have to be made. That requires judgment and expertise.

For me, the most fundamental imperative is to ensure that the agencies responsible for environmental reporting assemble the skills needed to prioritise and interpret the data and research they commission. The next most important imperative is to ensure that those skills are deployed leading the development of a more comprehensive, nationally coordinated environmental monitoring system based on core indicators assembled from consistently and reliably collected data.

If that can be achieved, the case for investing in various knowledge and data gaps can then be more confidently made. My full set of recommendations can be found at the end of the report. If adopted, I am confident we can evolve from the current treadmill of reporting (based on the largely passive harvest of data we happen to have) to reports and commentaries that draw on comprehensive time-series data to identify meaningful trends and help focus our stewardship of the environment in the right places.



Simon Upton

Parliamentary Commissioner for the Environment



Tirohanga whānui

I raro i te Ture Pūrongo Taiao 2015, ka whai au i taku hiahia ki te “pūrongo mō te pūrongo taiao me ngā hātepe nāna i whakaputa ai.” Kia tika rā, ehara i te mea me āta whakaatuhia te hiahia i roto i te Ture. Ko ngā kupu o te Ture Taiao 1986, i whakatūria ai te tari o te Kaitiaki Taiao o Te Whare Paremata, he whānui tonu kia tonu mai i taku whakatātare i te pūrongo taiao. Engari mai i te tīmatanga o te Ture, kua kōrero māua ko tōku tōmua i ētahi wā mō ētahi o ngā pūrongo i puta mai i runga i tana ingoa. Kua tino whai taipitopito ētahi o ā māua kōrerorero.

I te tānga o *Environment Aotearoa 2019* i te tīmatanga o tēnei tau, i āhei au te tuhi atu i te tuhinga whakamihi poto ki te Kaitiaki Kāwanatanga me te Hēkeretari mō te Taiao. He pono ngā whakamihi – e tohu ana te pūrongo i te tino ahu whakamua ki te whakaputa i te pūrongo taiao ehara i te aukati kūaha tē nakunaku, i te pūrongo rānei mō ngā mea katoa. Ka arotahi ki ngā take matua ki te hōputu e taea wawe te tautoko, pēnei i tā te pūrongo, “he kōrerorero tuwhera me te pono mō ngā mea kei a mātou, ngā mea ka ngaro pea, ā, me panoni ki hea.”

Heoi anō, ko te take he poto taku tuhinga, nā te mea i whakatau au ki te whakahaere i te arotake o te pūnaha pūrongo. Kua tae te wā mō te arotake nā te mea kua oti i a mātou te hurihanga kohura kotahi o ngā pūrongo tauwāhi i whāia ai e te pūrongo kōtuitui. Heoi āno, kāore taku arotake e oti ki ngā rohenga whāiti o te Ture. Kāore te pūnaha pūrongo taiao o Aotearoa e tīmata i taua Ture. I hoahoa kētia hei whakamahi i te raraunga me te mātauranga pūmau, i whakaputaina mō ngā take motuhake i te tautoko i te pūnaha pūrongo taiao ā-motu.

Ki te kī kua hoahoa mātou i te pūnaha pūrongo taiao ā-motu ka whakamahi i te pipiri. Ko te mea kē he kohikohi i ngā mea kei a mātou, e whakamātau ana ki te tono i te whai wāhi pai ki te whānuitanga o ngā hunga whaipānga me te tuku i te pōtae ki te puru i ētahi o ngā tiriwā maha.

Mēnā tērā tētahi mea e kōrae ana i te hurihanga tuatahi o ngā pūrongo, koia te whānui o ngā mea kāore mātou i te mōhio e pā ana ki ngā nekeneke o te taiao. Tērā pea, ehara pea i te mea ohorere taua kitenga. Ko te māramatanga ki te ao e noho nei tātou he mahi a haere tonu ana, ā, kei roto i te tohatoha rauemi ki te whakawātea i ngā rohenga kōwhiringa mō te whakapau rauemi ongeonge.

Heoi anō, kāore ngā wāhi tē kitea i roto i te pūnaha pūrongo taiao e tohu i ngā kōwhiringa ki te kohi raraunga, ki te tīmata rangahau rānei i ētahi rohe, kaua ko ētahi atu. Engari, he tohu o ngā whakaaweawe mahere kore o ngā kōwhiringa maha i roto i ngā tekau tau. He pūnaha hāngū i hauhake i te raraunga i reira, ā, kua kaha whakaterere i ngā mea e ngaro ana.

Kāore te meka i whakamana tātou i te ture pūrongo taiao kua āta nahanaha, kua āta whakatakatoria, e panoni i te āhuatanga tino hāngū me te angitu o tō tātou pūrongo. He mea āta kōwhiri te whakamahi i ngā mea i a tātou. Ki a ōku nei whakaaro, he tino takarepa ngā mea kei a tātou.

Ka rite tonu tā tātou rongo i te kōrero he wā mōhiohio tēnei. E whakaahurutia tātou ahakoa e whakawhirinaki ana ngā ahumahi pērā i te ahuwheua, ngāherehere me te hī ika ki te mōhiohio ki te whakarauora i roto i te ao e kaha whakataetae ana, he iti te rauemi. Engari ka whakamātau tātou kia kite he aha ngā nekeneke i runga i tō tātou whenua, i tō tātou wai rānei, he angotanga nui rawa.

Ko te rūri whakamutunga o te uhi whenua ki Aotearoa i whakahaeretia i te raumati o 2012/2013. Kua tata tātou ki te raumati o 2019/2020. Kāore au e whakaaro ana ka taupatupatu tūturu me whakatau ngā kaiwhakarato moni, ngā kaihanganga kaupapa here rānei, i runga i te raraunga e whitu ngā tau – he maha rawa ngā mahi i ngā tau e whitu. Ka tere ake te rerekē o te whakamahi whenua i te huhi whenua, nā reira e tautoko ana i te aroturuki riterite. Heoi anō, kāore he mahere whakamahi whenua e tōtōpū ana, e whānui ana, ā e tohu ana i te motu, hāunga tētahi e whakahoutia riterite ana. Ko ngā whakatau tata onāiane he whakaemitanga o te raraunga i tangohia mai i ngā mātāpuna me ngā rīwhi rerekē.

Pēnei ana te tikanga o te whakamahi o te huarahi hāngū ki te pūrongo. He utu, ā, ehara i te utu taiao noa iho – he whakaaweawe tūturu mō te ōhanga me te hāpori. Me pēhea tātou e hanga i ngā tikanga taiao māia, mātika ā-pāpori rānei mēnā kāore e taea e tātou kia mana te inehua i ngā nekeneke ki te pūtake rauemi ōkiko e whakawhirinaki ai tō tātou hauora?

Hāunga tērā, kāore tēnei arotake e marohi he tino heihei. Ka whakahaere tonu i te paku nekehanga i tohua ai ngā whakamātau ki te whakapai ake i tō tātou pūrongo taiao. Ahakoa kua marohitia ētahi menemana ki te Ture he whakamahine noa iho. Tae atu atu ki:

- he whāinga mārāma
- he whakatā roa ake i waenganui i ngā pūrongo whānui mō te āhua o te taiao (kōtuitui rānei)
- e whakawhānui ana i te anga pūrongo ki te tāpiri i ngā kaikōkiri me ngā anganga
- he arotahi anō i ngā pūrongo whaitua hei kōrerorero ki ngā kaupapa, e whai ana i ērā i whakamahia ki *Environment Aotearoa 2019*
- he herenga kia whakautu ngā Minita ki ngā pūrongo mō te āhua o te taiao (kōtuitui rānei)
- ko ētahi paku whakarerekētanga ki ngā tūnga hāngai o te Kaitata Kāwanatanga me te Hēkeretari mō te Taiao.

Engari ko te tino anga o te Ture, tae atu ana ki, he mea nui rawa, te motuhaketanga o te Kaitatau Kāwanatanga me te Hēkeretari mō te Taiao e noho haepapa ana ki te whakaputa i ngā pūrongo, e whakapūmautia ana.

Ki tētahi whakaaro, ko ngā tūtohi matua i roto i tēnei pūrongo rongo ko ērā e pā ana ki te whakaarotau me te kohikohi i te raraunga ki te ara ōrite. Ahakoa ngā whakamātau mō neke atu i te rua tekau tau, kāore rawa i whakaritea he whakaaetanga ki te huinga paetohu taiao iho. Me mahi tēnei. Ko ngā rārangitanga wā ōrite whaimana i te taha o te uhi ātea pai ake he waiwai mēnā ka kite tātou i ngā ia. I taua wā anake ka āhei tātou te whakawā ngākau titikaha mēnā e ahu whakamua ana, e hoki whakamuri ana rānei – me te mōhio mēnā e puta mai ana te whakaaweawe i ngā wawao utu nui.

E taea ana te whakatutuki i te pūnaha pūrongo rongo whānui ā-motu mēnā ka whai wāhi ngā kaiwhakauru ki ngā taumata maha, ina koa ngā kaunihera ā-rohe e noho haepapa ana mō te aroturuki tino nui e whakamahia i raro i te Ture Whakahaere Rauemi 1991.

I tua atu i te whiwhi ki te raraunga kounga, me āhei tātou te whakamārama he aha te tikanga. Nā reira, me whai pūkenga tātou hei whakamārama. Ko tētahi o ngā tino tūtohi e whakaputa ana au ko te whakatū, i raro i te Ture, o te paewhiri tohu pūtaiao pūmau ki te tohutohu i te Hēkeretari mō te Taiao mō te whakaritenga o ngā kōrerorero whai kaupapa hoki.

Ka whakakapi ēnei kōrerorero i ngā pūrongo rongo whaitua onāiane. Ka pēnei, hei whakamahi i te kupu ā-kaupapa, he 'āhuahanga rerekē' – arā, kau e whai noa i ngā upoko kua whakaritea kētia, ko te whānui me te roa ka whakaritea i runga i ngā take onāiane, e puta mai ana rānei, me tiro. Me tohutohu te paewhiri mō te whakarite i ngā pūrongo rongo riterite mō te āhua o te taiao (kōtuitui rānei) me ētahi atu hiahia rangahau, aroturuki, raraunga hoki.

He tohutohu te tūnga o te paewhiri. Mā te Hēkeretari mō te Taiao e whakatū i te paewhiri, ā, i te taha o te Kaitatau Kāwanatanga, tā i ngā kōrerorero me ngā pūrongo mō te āhua o te taiao i te whakamahinga o tō rātou mahi pūrongo rongo motuhake. Waihoki, e paku whai ana tēnei tūtohi i muri i te auahatanga i whakawhanaketia mō te whakaputanga o te pūrongo rongo kōtuitui tata i whakaemihia ai te tira pūtaiao matua ki āwhina ki te tuhi pūrongo rongo.

Ahakoa e ārahina te pūnaha pūrongo rongo taiao e te Hēkeretari mō te Taiao me te Kaitatau Kāwanatanga, ko tōna pūtake ko te pūtake mātauranga i whakawhanaketia e tō tātou hapori. E rua ngā mātāpuna hira, engari tino rerekē, o te mātauranga hei whakamōhio i te pūrongo rongo taiao.

Ko tētahi ko te putanga o te pūnaha pūtaiao. He tino pai ētahi o ngā pūtaiao taiao i mahia e Aotearoa – ā, e ai ki te Whakahaere mō te Mahi Tahi Ōhanga me te Whakawhanake, e tuku ana tātou i te wāhi nui rawa o tō tātou whakangao pūtaiao painga tūmatanui ki te taiao i tō tētahi atu motu mema. Ahakoa tērā, kāore i te pai te katoa.

Ko te hurihanga tuatahi i raro i te Ture onāiane i whakamōhio i ētahi tiriwā mātauranga. Kāore au i te ngākau titikaha he pūtake mārama mō tō tātou whakangao ki te pūtaiao taiao. E tino māharahara ana au kāore he pūrere e tūhono ana i te hiahia haere tonu a te pūrongo taiao mō te māramatanga o ngā hātepe mātai hauropi tuatini kua whanake i ngā tekau tau me te pūnaha pūtea pūtaiao e rite tonu ana te rapu mō te auahatanga, whakaaweawe me ngā tūhono ki ngā pōrearea e panoni tonu ana o te pakihi me te hapori.

Ko tētahi atu mātāpuna mātauranga koinā e noho ana i roto i te mātauranga Māori – te mātauranga tuku iho o ngā tāngata whenua o tēnei whenua. Mō te āhua 600 rau tau i mua i te taenga mai o te Pākehā, ko te mātauranga Māori te mauhanga anake kei a tātou mō te taiao o ēnei motu me ngā moana tata. Mō taua take anake, he mea hira. I runga i ngā mea kāore tātou i te mōhio, kāore e taea e tātou te waiho i tēnei mātauranga i tukuna ihotia ai. Kua mōhiotia he mea nui kia whakauru i tēnei hei wāhanga tautoko mō te pūrongo taiao mō te āhua anamata. Me whakahōhono ake.

He mea nui hoki mēnā e kōhi ana i te raraunga, ahakoa he aha te raraunga, hei whakamōhio i te pūrongo, me tika te whakanui i te mōhiotia e whai take ana ki a ngāi Māori. Pērā i taku kōrero i te wāhanga tuawhā, ehara i te uaua ki te whakapae mēnā e noho haepapa te Karauna ki te whakahaumarua i ētahi taonga i raro i te Tiriti o Waitangi (kei roto ētahi rauemi taiao), nā reira ko te kōhi mōhiotia mō tō rātou āhua he takohanga nui.

I te wā i tīmata au ki te ketuketu, i te pānui te Kāwanatanga i tana takohanga ki te whakaarotau utu tūmatanui mā te kaute i tana tautoko i te oranga. Mā te tāpiri i te moni tōpū taiao hei poumanawa, i kite te Kāwanatanga i te hira o te pupuri i te taiao māori mō te orana onāiane me tō ngā whakatipuranga anamata.

Mā te kite mārama e whakawhirinaki ana te oranga i te whānui o ngā āhuatanga, ā, ko te whakaahu i te pūtea tūmatanui ki ngā āhuatanga ‘tino hira’ he whakawhanaketanga pai. Engari ko te whakatakoto i tēnei ara ka tuku i ngā pōrearea nui ki te pūtake taunaki.

Mēnā ko te take o te utu tūmatanui ko te tautoko i te oranga, me mārama ake ngā kaihanganga kaupapa here ki ngā tūhono i waenganui i te hauora me aua āhuatanga o te tauoranga (pērā i te kōunga taiao) e tāpae ai. Ki te parākiri i ēnei tūhono ka hiahia te rangahau, engari pērā i te whakamārama a tēnei pūrongo mō te whaitua taiao, kāore i te wātea te raraunga e hiahia ana ki te tīmata i tēnei rangahau i ngā wā katoa.

Waihoki, ki te aromatawai te Kāwanatanga i ngā tūraru ki te oranga o ngā whakatipuranga anamata, ka hiahia te māramatanga e pēhea ana te panoni o te taiao māori, tae atu ki te mātauranga e pēhea e panoni ai ā muri ake nei. Ko te takiwātanga e āhei ana te whakapau haumarua i ngā rauemi taiao i te whāinga ki te hanga i ētahi atu rauemi i matenuitia kei te manawa o te taupatu roa e pā ana ki te āhua o te ‘whakawhanake toitū’. Engari, ko te pūtake taunaki onāiane kāore he rawaka kia inehua tātou i ngā tūraru kei runga i a tātou.

Ko ngā Tauākī Whakangao tōmua tata ki te katoa o te arotahi ki te kohinga Karauna o ngā rauemihanga me te ahumoni me te tiro iti noa nei ki te taiao māori. E pēnei ana ngā Tauākī mō te Āhuetanga Ahumoni Karioi, kāore e tino whakamārama i ngā tūraru torohū e puta mai ai ki ngā pūtea Kāwanatanga i te tūkinu taiao.

E tino mōhio ana Te Tai Ōhanga ki ēnei take, ā, kua whakamōhio i ēnei tiriwā raraunga hei ārai ki te ahu whakamua. Ko ngā ngoikoretanga o ngā paetohu taiao mō te oranga anamata i kitea i roto i te Paetohu Anga Paerewa Tauoranga i tāngia i te mutunga o tērā tau. Ka tū te korenga raraunga taiao whānui, whaimana hoki, hei aukati i te ara tūhono i waenganui i te āhua o te taiao me te oranga. Ki te kore e kaha whakangao ai ki te raraunga – me te mahi me pēhea e whakauru ai ki te anga oranga – tērā te tūraru pea e noho tonu ngā whakapuakanga ki te pou taiao o te oranga hei kaupapa hua kore. Kua whakatau au ki te tuku i ētahi whaaakro me pēhea e ahu whakamua i roto i tētahi pūrongo ā tērā tau.

Nā te whakahua i te ‘whakangao kaha’ i tae au ki taku kitenga whakamutunga. Ka whakapau moni ki te whakapai ake i tō tātou pūtake mōhiohio me te kōhi raraunga. He nui rawa te utu mō te korenga o taua raraunga mēnā kāore i āta whakaarohia ngā kaupapa here e hanga ai tātou (kāore e hanga ai rānei). Engari kei whakawaia tātou kia whakaaro ko te moni anake te whakautu ki ngā āwangawanga o te pūrongorongo taiao. Me arotahi ngā whakangao, me kōwhiri ngā kōwhiringa. Me whai i te whakawākanga me te mātanga.

Mōku ake, ko te kaikōkiri tino taketake ko te whakatūturu ko ngā tari e noho haepapa ki te pūrongorongo taiao ka whakaemi i ngā pūkenga e hiahiatia ana ki te whakaarotau me te whakamārama i te raraunga me te rangahau e hoko ai rātou. Ko te kaikōkiri i tua atu i tēnā ko te whakatūturu ka tukuna aua pūkenga hei ārahi i te whakawhanaketanga o te pūnaha aroturuki taiao mahi tahi ā-motu ka puta mai i ngā paetohu i whakaemihia i te kohinga raraunga ōrite, pono hoki.

Mēnā ka ea tēnei, ka ngākau titikaha te whakapae kia whakangao ki ngā tūmomo mātauranga me ngā tiriwā raraunga. Ko te huinga whānui o aku tūtohi ka kitea ki te mutunga o te pūrongo. Mēnā i whakaūngia, E ngākau titikaha ana au ka āhei tātou te whanake mai i te tikeikei onāiane mō te pūrongorongo (i puta mai i te hauhake āhua hāngū o te raraunga i a tātou) ki ngā pūrongo me ngā kōrerorero e hāngai ana ki te raraunga rārangitanga wā me te āwhina kia arotahi tō tātou tiaki i te taiao ki ngā wāhi tika.



Simon Upton

Te Kaitiaki Taiao a Te Whare Pāremata

1



How we come to be where we are

New Zealand has produced two large, comprehensive state of the environment reports in 1997 and 2007. These were one-off snapshots that tried to provide an overall picture of the health or otherwise of the physical environment on which our wellbeing depends. Back then, New Zealand was the only Organisation for Economic Co-operation and Development (OECD) country without a legislated mandate to report on the environment.

This changed in 2015 with the enactment of the Environmental Reporting Act (the Act). The Act organises environmental reporting around a pragmatic division of the subject material into five environmental domains. Each is to be reported on regularly – six-monthly domain reports followed by a three-yearly synthesis report designed to provide “a diagnosis of the health of our environment”.¹

In the words of *Environment Aotearoa 2019*, the synthesis report is designed “to help us step inside and view our environment as a whole, in all its complexity”.² *Environment Aotearoa 2019* represents the most ambitious attempt to date to describe the state of our environment, while focusing attention on the key issues that require considered and sustained attention.³

To get around the constraints of the five domains, the 2019 synthesis report developed the idea of themes to pull much of the same material together. The information was arranged according to five key themes:

- biodiversity and ecosystems
- land use
- pollution
- marine resources
- climate change.

¹ Parliamentary Commissioner for the Environment (PCE), 2016, p.6.

² Ministry for the Environment (MfE) and Stats NZ, 2019, p.7.

³ The first synthesis report, *Environment Aotearoa 2015*, was published just prior to the Act coming into force.

Further, to provide “a focus on what matters”, priority issues were identified. To qualify as a priority issue, four criteria were used:

- spatial extent and scale
- magnitude of change
- irreversibility and lasting effects of change
- impact on things New Zealanders value (e.g. effect on culture, recreation, health and economy).⁴

Combined, these criteria provide good reasons for identifying particular concerns.

A full suite of reports has now been produced under the Act. However, there is no small irony in the fact that one of the most significant achievements of these reports is the acknowledgement that the data needed to do comprehensive and robust environmental reporting is woefully uneven.

The account of the pressures on our environment, the changes those pressures are bringing about, and the consequential impacts are severely limited by a chronic lack of data. Yet if we are to focus on what matters, we need reporting that is going to tell us whether a specific problem is improving or deteriorating.

The lack of quality data should come as no surprise. Cabinet was assured in 2013 that the Act would “not impose any requirement on local government, individuals, businesses or central government agencies to produce data that does not already exist” and would draw on existing available data.⁵ Existing data was known at the time to be inadequate. The result is that we now have a full suite of reports that have documented numerous data and knowledge gaps.

A summary of my predecessor’s advice

In establishing a national environmental reporting system in 2015, the Government had the benefit of significant advice tendered by my predecessor, Dr Jan Wright. Dr Wright delivered her own recommendations for environmental reporting in a 2010 report titled *How clean is New Zealand? Measuring and reporting on the health of our environment*. She made a submission on the Bill that was finally enacted in 2015, and then commented on the two pilot reports (*2014 Air domain report* and *Environment Aotearoa 2015*) produced in the spirit of the Act.

I think it is appropriate to commence this review with a brief summary of her advice, since it remains valid today and provides a good basis against which to review the system.

On the purpose of an environmental reporting system, Dr Wright had this to say:

“The purpose of state of the environment reporting [should] be to inform the public and decision-makers of the current state and long-term trends in the environment. It should identify and explain environmental issues, including their causes and location, and contain conclusions about their significance.”⁶

⁴ MfE and Stats NZ, 2019, p.10.

⁵ Office of the Minister for the Environment, 2013a, paragraph 65(8).

⁶ PCE, 2016, p.42.

Or, as she stated when commenting on the first air domain report, it is about delivering:

“a diagnosis of the health of our environment to help us decide what to worry about the most, and what to worry about the least – to get beyond the reactionary and the fashionable”.⁷

The need to prioritise was a consistent theme. There is a need to ensure that what is collected is relevant to the issues that matter, as “‘the sky is the limit’ when it comes to measuring our environment”.⁸

Dr Wright proposed five criteria to judge the pertinence of an issue⁹ – by assessing whether it is:

- irreversible
- cumulative – building up over time
- large in scale or pervasive
- increasing or even accelerating in scale and/or distribution
- likely to tip a natural system over a threshold into another state.

High-quality environmental data collection using standardised methods was central to Dr Wright’s 2010 report. She called for a solid foundation that required improvements to the underlying data system by rationalising, streamlining and standardising environmental statistics at both the regional and national levels.¹⁰

The use of information was always at the centre of her focus. She noted that before we can make any decisions about the seriousness of issues or what we should do about them, we need to understand the state of our environment and how that may be changing. If the causes are natural, we may need to find a way to adapt, whereas if the causes are human-induced, we may wish to intervene. The same information can help determine if any such interventions have been effective. Environmental data (particularly time series) can help us determine if this is the case.

Finally, Dr Wright stressed that the environmental reporting system needed to be trusted. That requires independence, accountability and technical capability. Clear roles and a mandate are required to ensure environmental reporting is not a stop-start process. The organisations involved in the process also need to have the capacity to carry out the required work.¹¹

The advice provided by Dr Wright remains relevant in the context of current calls to improve the environmental reporting system. Dr Wright made no mention of te ao Māori and how environmental reporting might embrace it. By contrast, I have made what I hope is a meaningful attempt to include this important aspect.

⁷ PCE, 2015b, p.5.

⁸ PCE, 2010, p.40.

⁹ PCE, 2010, pp.19–20. Note that the five prioritisation criteria are physical and measurable. PCE, 2016, pp.27–28.

¹⁰ PCE, 2010, p.39.

¹¹ PCE, 2010, p.31.

2



The purpose of environmental reporting

Being clear about why we are reporting on the state of the environment is of fundamental importance for anyone trying to review how well we are doing it. But the Environmental Reporting Act 2015 is unhelpful in this regard. It simply states: “The purpose of this Act is to require regular reports on New Zealand’s environment.”¹ It immediately begs the question: why do we need regular reports? And what are these reports supposed to achieve?

New Zealand’s environmental reporting legislation is not unique in not clearly stating why regular reports should be produced. For example, the Australian legislation does not include a purpose provision at all. The Environment Protection and Biodiversity Conservation Act 1999 simply requires five-yearly national reports on the state of the environment.²

However, recent state of the environment reports from Australia and other jurisdictions have described their purpose, stressing the need for an evidence base to support decision making.

For example, the *Australia State of the Environment Report 2016* states that its purpose is to:

“provide all Australians with authoritative information on the state of the environment [and] provide the Australian public, the Australian Government and other decision-makers responsible for managing our environment with an assessment of how effectively the Australian environment is being managed and what the key national environmental issues are.”³

¹ Environmental Reporting Act 2015, s3.

² Section 516B of the Environment Protection and Biodiversity Conservation Act simply states:

(1) The Minister must cause a report on the environment in the Australian jurisdiction to be prepared in accordance with the regulations (if any) every 5 years. The first report must be prepared by 31 December 2001.

(2) The report must deal with the matters prescribed by the regulations.

(3) The Minister must cause a copy of the report to be laid before each House of the Parliament within 15 sitting days of that House after the day on which he or she receives the report.

https://www.legislation.gov.au/Details/C2018C00440/Html/Volume_2.

³ Jackson et al., 2017, p.1.

Similarly, *The European Environment – State and Outlook 2015* states that it provides:

“a comprehensive assessment of the European environment’s state, trends and prospects, and places it in a global context. It informs European environmental policy implementation between 2015 and 2020, and analyses the opportunities to modify existing policies (and the knowledge used to inform those policies) in order to achieve the European Union’s 2050 vision of living well within the limits of the planet.”⁴

Dr Jan Wright suggested that environmental reporting’s “primary purpose should be to help New Zealanders to assess different concerns about the environment, and thus to improve the way we manage and protect it.”⁵

The most recent synthesis report, *Environment Aotearoa 2019*, put it more memorably when it talked of providing “evidence to enable an open and honest conversation about what we have, what we are at risk of losing, and where we can make changes.”⁶

Put simply, reports need to do more than inform. They need to provide a reliable evidence base to enable us to assess the effectiveness of our policies and management practices.

In my view, New Zealand’s Environmental Reporting Act should clearly state the actual purpose of environmental reporting – that is, to enable New Zealanders and decision-makers at all levels to know what impact we are having on the environment. It should be amended to read as follows:

The purpose of this Act is to require authoritative reporting on New Zealand’s environment that describes:

- the drivers of change;
- the pressures on natural and physical resources;
- the current state of the environment;
- how the state of the environment has changed, and the impacts the changes have had;
- how the state of the environment may change in the future, and the impacts those changes are likely to have –

to enable the evidence-based analysis and decision making needed to achieve effective stewardship of the environment.

However, it is important to emphasise that environmental reports are *not* the place to record judgements made about the effectiveness of policies. Instead, they set the stage for that debate, which cannot occur if there is not a trusted source of information to rely on.⁷

⁴ European Environment Agency, 2015, paragraph 1.

The 2050 vision of “living well within the limits of the planet” is set out in the EU’s 7th Environment Action Programme (European Union, 2014).

⁵ PCE, 2016, p.10.

⁶ MfE and Stats NZ, 2019, p.7.

⁷ To date, *Our land 2018* and *Environment Aotearoa 2019* have provided a trusted source of information to inform the Government’s recent policy proposals – *Action for healthy waterways and Valuing highly productive land*. See MfE, 2019b, and Ministry for Primary Industries (MPI) and MfE, 2019.



3

The state of environmental data and knowledge

Anything we wish to say about the state of New Zealand's environment depends on the data we have collected and the knowledge we possess to interpret it. This chapter discusses the state of that data and knowledge and the system that produces it.

A largely fragmented system

Information on the state of the environment is currently gathered by a wide range of organisations, including the local government sector, central government agencies, Crown Research Institutes (CRIs), consultants and industry.

Many of these organisations have a legislative responsibility to monitor different aspects of New Zealand's environment (see box 3.1), but they do so for a variety of different reasons. For example, monitoring of the environment supports a range of activities, including:

- reporting on the state of the environment
- policy development and implementation
- monitoring the effectiveness of plans and policies
- informing resource consent processes
- assessing regulatory compliance
- supporting operational decision making.

Box 3.1: Legislative requirements for monitoring the natural environment

The monitoring of aspects of the natural environment is required under several pieces of legislation. The following list is not exhaustive, but highlights some of the key requirements.

The **Resource Management Act 1991** (the RMA) has some high-level monitoring requirements:

Section 35(2)(a) requires local authorities to monitor “the state of the whole or any part of the environment of their region or district—

- (i) to the extent that is appropriate to enable the local authority to effectively carry out its functions under this Act; and
- (ii) in addition, by reference to any indicators or other matters prescribed by regulations made under this Act, and in accordance with the regulations”.

The relevant regulation-making power is in section 360(1)(hk) and (hl) of the RMA, which provides for the Governor General to make regulations:

“(hk) prescribing, for the purposes of section 35(2) and (2AA),—

- (i) indicators or other matters by reference to which a local authority is required to monitor the state of the environment of its region or district:
- (ia) matters by reference to which monitoring must be carried out:
- (ii) standards, methods, or requirements applying to the monitoring, which may differ depending on what is being monitored:
- (hl) requiring local authorities to provide information gathered under sections 35 and 35A to the Minister, and prescribing the content of the information to be provided and the manner in which, and time limits by which, it must be provided”.

However, no regulations have ever been made under these provisions. This is all the more surprising given that there has been a fair bit of tinkering with the wording of these clauses. The latter (hk) was inserted into the RMA by the **Resource Management (Simplifying and Streamlining) Amendment Act 2009**, then amended by the **Resource Management Amendment Act 2013**, and then amended again by the **Resource Legislation Amendment Act 2017**. One wonders what the purpose of all this drafting activity was if it was never intended to be used.

In addition, National Environmental Standards published under section 43 of the RMA have more specific monitoring requirements. For example, the National Environmental Standards for Air Quality require regional councils to conduct compliance monitoring, specify where monitoring must occur, and specify the acceptable monitoring methods and equipment. Other National Environmental Standards (Sources of Human Drinking Water, Plantation Forestry, and Assessing and Managing Contaminants in Soil to Protect Human Health) also make reference to monitoring.

Several other pieces of legislation require various agencies to monitor specific aspects of New Zealand's environment, for a variety of purposes. For example, monitoring is required under the **Fisheries Act 1996** for compliance purposes (i.e. to see if people are obeying the law). Similarly, the monitoring required under the **Exclusive Economic Zone and Continental Shelf (Environmental Effects) Act 2012** is also compliance focused.

The **Biosecurity Act 1993** requires regional councils to monitor pests (see section 13), and the **Conservation Act 1987** requires Fish and Game New Zealand to monitor fish and game populations and their habitats (see section 26Q). In addition, the Department of Conservation (DOC) undertakes monitoring as part of its wider planning and management role under section 17A of the Conservation Act 1987. Furthermore, the Director General of DOC can collect or commission the collection of information (see section 53(2)(c)).

Similarly, the Government Statistician can collect, with the written approval of the Minister, information concerning any "classes of official statistics". The specified classes cover the "physical environment" and the "condition of land" (see sections 14(d) and 4(e,j) of the **Statistics Act 1975**).¹

In addition, the **Hauraki Gulf Marine Park Act 2000** and the **Waitakere Ranges Heritage Area Act 2008** require placed-based monitoring.

Some Treaty of Waitangi legislation also includes a focus on information-gathering and monitoring work, which could provide a platform to monitor impacts on cultural values. For example, the **Nga Wai o Maniapoto (Waipa River) Act 2012** and the **Waikato-Tainui Raupatu Claims (Waikato River) Settlement Act 2010** both give the iwi the right to discuss and agree priorities for monitoring with relevant local authorities.

Finally, environmental monitoring also takes place under the auspices of several international agreements to which New Zealand is a party. For example, New Zealand's greenhouse gas inventory is produced each year as part of New Zealand's obligations under the United Nations Framework Convention on Climate Change.² Similarly, as a signatory to the Convention on Biological Diversity, New Zealand is "as far as possible and as appropriate" required to "monitor, through sampling and other techniques, the components of biological diversity".³

¹ For example, the Government Statistician can require local authorities to provide financial information using two surveys – the local authority financial statistics and the quarterly local authority statistics questionnaires.

² MfE, 2019a.

³ United Nations, 1992, Article 7.

While current legislation provides central government with some of the tools it needs to ensure that monitoring is done thoroughly and consistently, the monitoring requirements in the Resource Management Act 1991 (RMA) – the cornerstone of New Zealand’s environmental legislation – lack specificity.⁴ In the absence of direction, this has resulted in variable practice.

While the RMA allows the Government to impose some requirements on monitoring (including to achieve better standardisation), it cannot be used to require monitoring that is outside the scope of local authorities’ functions and powers under that Act. For example, they could not be used to require monitoring of the marine environment beyond the 12-nautical-mile limit.

Several of the other pieces of legislation require various agencies to monitor specific aspects of the environment, for a variety of purposes. But the information is being collected using a wide range of methodologies and systems, so it is not easy to collate. To deliver a truly comprehensive regime, this mosaic of requirements needs to be overhauled.

Significant data and knowledge gaps bedevil our understanding

New Zealand’s broader environmental system also suffers from significant data and knowledge gaps which bedevil our understanding. This is in stark contrast to areas such as the economy, where we are much more reliably informed.⁵ While measuring a vast and complex natural environment is challenging, it is also true that historically, measuring economic indicators has been viewed as a higher priority. People have felt less urgency about measuring the environment and natural resources that have appeared to be ‘free’ and seemingly unlimited.

Data gaps and **knowledge gaps** are different things. Data gaps relate to deficiencies in the current environmental monitoring regimes that mean we have insufficient data to accurately describe pressures, state and impacts. Knowledge gaps relate to our inability to make meaningful sense of what the data we have gathered might be telling us, or indeed, where we may need additional data.

Data is gathered for all sorts of purposes. Environmental reporting is just one of them. Data involves measurement – for example, the temperature of air or water, or the abundance of particular species.⁶ In an environmental context, data that can shed light on the state of things, any trends and what is causing them will be particularly useful.

⁴ Note that while more specific monitoring requirements exist under the National Environmental Standards, they are narrow in scope.

⁵ The economic indicators published by Stats NZ are characterised by a high degree of temporal and geographic detail. Estimates of the size of the economy are made on a quarterly basis and are disaggregated by industry as well as the key sources of expenditure. In addition, estimates of economic activity in each of New Zealand’s regions are published annually.

⁶ Note that data can also come from modelling.

The value of *raw data* depends on how it is used. To be useful for reporting, raw data needs to be processed into *statistics* that meet certain quality standards. A statistic that provides particular insights into a relevant environmental problem will often be referred to as an *indicator* – it *indicates* something valuable to aid our interpretation of what is going on.

For example, New Zealand has limited data regarding concentrations of fine particulate matter (PM_{2.5}). Current monitoring of PM_{2.5} is limited in both temporal and geographic coverage despite the public health impacts.⁷

Sometimes our **knowledge** of complex biophysical processes is limited. The poorer our understanding of fundamental processes, the harder it is to know what data to gather and whether the data we are gathering is indicating anything significant. As a result, it is difficult to improve our understanding.

As recently as June this year the Government's Freshwater Science and Technical Advisory Group called for urgent work to fill the identified knowledge gaps that currently constrain our ability to effectively manage freshwater and the health of freshwater ecosystems.⁸ Unfortunately, the need for urgent work goes far beyond freshwater.

Fundamental knowledge gaps around soil health, including the factors that affect soil structure and functioning under different land uses, are particularly worrisome – soil is one of our greatest natural assets, and it is also a non-renewable resource.⁹ Without the necessary information to assess the effectiveness of management practices and determine whether or not we are sustainably managing this precious resource, we risk losing it altogether.¹⁰

New Zealand's diverse and distinctive land invertebrate fauna is another example. To date, 22,000 arthropod species have been described. However, at least that number again is still awaiting identification. Approximately 80 per cent of these species are found nowhere else in the world. Incomplete understanding of our native biota combined with scant data (which is often distributed across multiple databases in various agencies) poses great challenges for New Zealand's biosecurity services and their frontline staff, who need to be very familiar with local flora and fauna to be able to spot alien specimens.¹¹

⁷ MfE and Stats NZ, 2018a, p.63.

⁸ Freshwater Science and Technical Advisory Group, 2019, pp.47–49.

⁹ MfE and Stats NZ, 2018b, p.109.

¹⁰ Soil literally takes tens of thousands of years to form. See <https://soilsmatter.wordpress.com/2013/08/29/soil-formation>.

¹¹ Note that fewer than 20% of identified endemic species have adequate scientific descriptions. See <https://www.landcareresearch.co.nz/science/plants-animals-fungi/animals/invertebrates/systematics> and Goldson et al., 2015.

Invertebrate communities are just one example of serious gaps in both data and knowledge relating to New Zealand's biodiversity. Yet our very identity as 'Kiwis' is intrinsically linked with our natural biodiversity, and most if not all of us view the ability to access and immerse ourselves in nature as our birthright.



Source: denisbin, Flickr

Figure 3.1: There are significant data and knowledge gaps relating to the condition and state of Aotearoa New Zealand's ecosystems and biodiversity. This is despite our national identity as 'Kiwis' being intrinsically linked to our native biodiversity.

A similar situation exists in the marine environment. Marine biodiversity is poorly understood, and we have only a limited understanding of the impact our various activities are having on our marine ecosystems. Current fisheries management systems have a single-species focus and rarely take into account the effects of fishing on the wider ecosystem. For example, ecosystem changes due to fishing and climate change are rarely explicitly included in the single-species fisheries management carried out in New Zealand.



Source: Anna Barnett, Flickr

Figure 3.2: Monitoring New Zealand’s marine environment is both challenging and expensive but crucial to improving our understanding of marine ecosystems. Current data and knowledge gaps relating to the marine environment make it difficult to assess the impact of activities such as fishing, and the pressures caused by a changing climate.

Other key knowledge gaps relate to the cumulative and cascading impacts of climate change, including uncertainty around the role of climate change in terms of exacerbating existing pressures and subsequent secondary impacts.

A lack of knowledge regarding the impact of changes in the environment on mātauranga Māori and cultural values is another significant gap. For a discussion of these issues, see ‘Giving voice to te ao Māori’ in section four.

Many of the data and knowledge gaps mentioned above have been documented in the domain and synthesis reports published to date under the Environmental Reporting Act 2015. The latest synthesis report – *Environment Aotearoa 2019* – alone lists many significant data and knowledge gaps (table 3.1).

Table 3.1: Data and knowledge gaps mapped against the priority issues (as identified in *Environment Aotearoa 2019*).

Biodiversity and ecosystems	
Data gaps - Limited monitoring coverage of lakes by regional authorities. - Ecosystems and species: - limited surveying of New Zealand's marine environment - conservation status of many marine species cannot be assessed - terrestrial invasive species (location, number of species).	Knowledge gaps - There is incomplete knowledge of the condition of: - freshwater ecosystems, habitats and invertebrate communities - remaining wetlands - large rivers and biology of groundwater systems. - Impact of climate change on native species and biodiversity.
Changes to vegetation and impact on soil and water quality	
Data gaps - Timely measure of land cover.* - Nationally consistent measure of land use to link local activities to local changes.* - Limited number of monitoring sites that measure erosion. * Although not specifically mentioned as gaps under this particular issue, measures of land use and land cover can provide important contextual information.	Knowledge gaps - Impact of removing vegetation on: - the flow of ecosystem services from native vegetation - te ao Māori and sites of cultural importance (e.g. impact of increased sedimentation on customary fishing sites). - Attribution of erosion between natural (e.g. earthquakes) and human-induced processes. - Inability to assess management effectiveness of mitigation strategies (e.g. riparian planting). - Impact of climate change on erosion and related processes.
Urban growth and impact on versatile land and biodiversity	
Data gaps Timely measure of land cover.	Knowledge gaps Impact of land fragmentation and productivity of lifestyle blocks.
Water quality in farming areas	
Data gaps - National datasets for some variables relating to ecosystem health (including deposited sediment, dissolved oxygen and algal biomass). - National database or map of farm management practices to explain water quality. - Nationally consistent measure of land use to link local activities to local changes. - Limited monitoring of contaminants like <i>E.coli</i> in New Zealand lakes. - Limited monitoring of emerging contaminants (e.g. pesticides and pharmaceuticals).	Knowledge gaps - Impact of water pollution on: - the health of ecosystems - te ao Māori. - Interacting and cumulative effects of water pollution and other pressures on ecosystem health. - Impact of specific land management practices on water quality. - Attribution of water quality trends between natural and human activities. - Hydrological information regarding pollutant flows.

Environmental quality in urban areas

Data gaps

- Limited spatial coverage of monitoring sites in urban areas.
- Lack of monitoring of land and soil.
- Lack of time-series datasets for some pollutants.
- No coverage of new issues (e.g. indoor air quality) and emerging contaminants in fresh water and on land.

Knowledge gaps

- Impact of pollution on:
 - ecosystems
 - cultural values.
- Cumulative impact of multiple pollutants and other pressures (e.g. habitat modification).

Water extraction and impact on freshwater ecosystems

Data gaps

- The actual quantity of water taken from all our rivers, lakes and groundwater.
- Total amount of water stored in aquifers that is potentially available for use.

Knowledge gaps

- Impact of low flows on:
 - mātauranga Māori and cultural values
 - habitats and ecosystems.
- Cumulative impacts of reduced water flow and pollution on water quality.
- The effects of projected climate change on the flow of water in rivers and aquifers.

Fishing and the health of marine ecosystems

Data gaps

- About half of our fish stocks have too little information to reliably assess their stock status.

Knowledge gaps

- Marine biodiversity is poorly understood due to limited information:
 - marine species have yet to be discovered and identified
 - information on characteristics and extent of marine habitats is lacking.
- Commercial fish stock assessments do not account for interactions between different species and their environment.
- Impact of fishing activities on:
 - mātauranga Māori and cultural values
 - marine ecosystems (e.g. impact of seabed trawling on seabed habitats).

Greenhouse gas emissions

Knowledge gaps

- Understanding of how global emissions will change in the future.
- Information on the relative strengths of different carbon sources and sinks.
- Understanding of global tipping points.

Climate impacts

Knowledge gaps

- Understanding of how global emissions will change in the future and projected impacts of increasing greenhouse gas concentrations.
- Information on cumulative and cascading impacts (e.g. how flooding affects local communities and built infrastructure).

In summary, pervasive data and knowledge gaps bedevil our understanding of key environmental issues. The first cycle of reporting has documented many such gaps. What is now needed is a major push to progressively fill those data gaps that stand between us and a better understanding of New Zealand's key environmental issues.

The limited availability of time-series data

The limited availability of time-series data that enables us to track the trajectory of issues over time is another shortcoming of the broader system of environmental information.

For example, while time-series data exists for the quality of groundwater, rivers and lakes, as well as the concentration of particulate matter in the air, the duration of any trends reported at the national level varies considerably (between 5 and 20 years).

In some cases, trends are not reported at all. This may be for a number of reasons, such as a shortage of data points from which to derive a meaningful trend, or poor quality or low accuracy data, including data collected on an inconsistent basis.

For instance, there is currently a lack of consistent time-series data relating to actual water takes. Changes in river flow regimes as a result of water abstraction can have a detrimental impact on river ecology and habitats. Low river flows may also compromise the provision of other benefits associated with the maintenance of in-stream flows (e.g. recreation).

While there is generally more time-series data relating to water quality, the absence of time-series data for water takes complicates the process of attributing changes in environmental quality to a particular cause. Robust time-series data on water takes provides a better understanding of the underlying causes behind water quality trends, which can be used to identify and develop effective management interventions.

Similarly, there is a lack of time-series data for soil erosion due to the absence of a comprehensive national monitoring programme. Erosion can lead to the degradation of soil quality resulting in reduced primary sector productivity, sediment loading of waterways and estuaries, and damage to infrastructure. Time-series data could provide a better understanding of the impact of land-use activities and the ability of specific management practices to either mitigate or accelerate erosion rates.¹²

This shortcoming of the broader system makes reporting on New Zealand's environment more challenging. Indeed, *Environment Aotearoa 2019* notes: "The timeframes used throughout the report are largely dictated by the data that is available. Where possible, data is used to highlight significant periods of change."¹³

¹²While current trends should not be interpreted as future forecasts, they can provide important insights into what the future may hold if current patterns of environmental degradation continue and current pressures persist.

¹³MfE and Stats NZ, 2019, p.7.

By contrast, reporting of economic data is more comprehensive. This is reflected in differences in the length and consistency of time-series datasets for key macroeconomic, social and environmental indicators, as illustrated in figure 3.3. While many economic indicators, including gross domestic product (GDP), have historical data dating back to the 1950s or earlier, the coverage of many environmental indicators is limited to much more recent time frames. Some of the longest time series that exist for environmental data have been gathered because of commitments New Zealand has made under international treaties.¹⁴

Given that many of the environmental problems we face have been decades in the making and that for nearly 30 years we have had the RMA, which makes specific reference to cumulative effects that arise over time.¹⁵ It is astonishing that we have so little data on trends over time.

By definition, it takes time to assemble time series. If we start collecting data today, it may be a decade or more before we can confidently judge whether the issue being monitored is getting better or worse.¹⁶ Every year that we delay the collection of data in an area identified as a significant gap, we commit New Zealand to flying blind in that area.

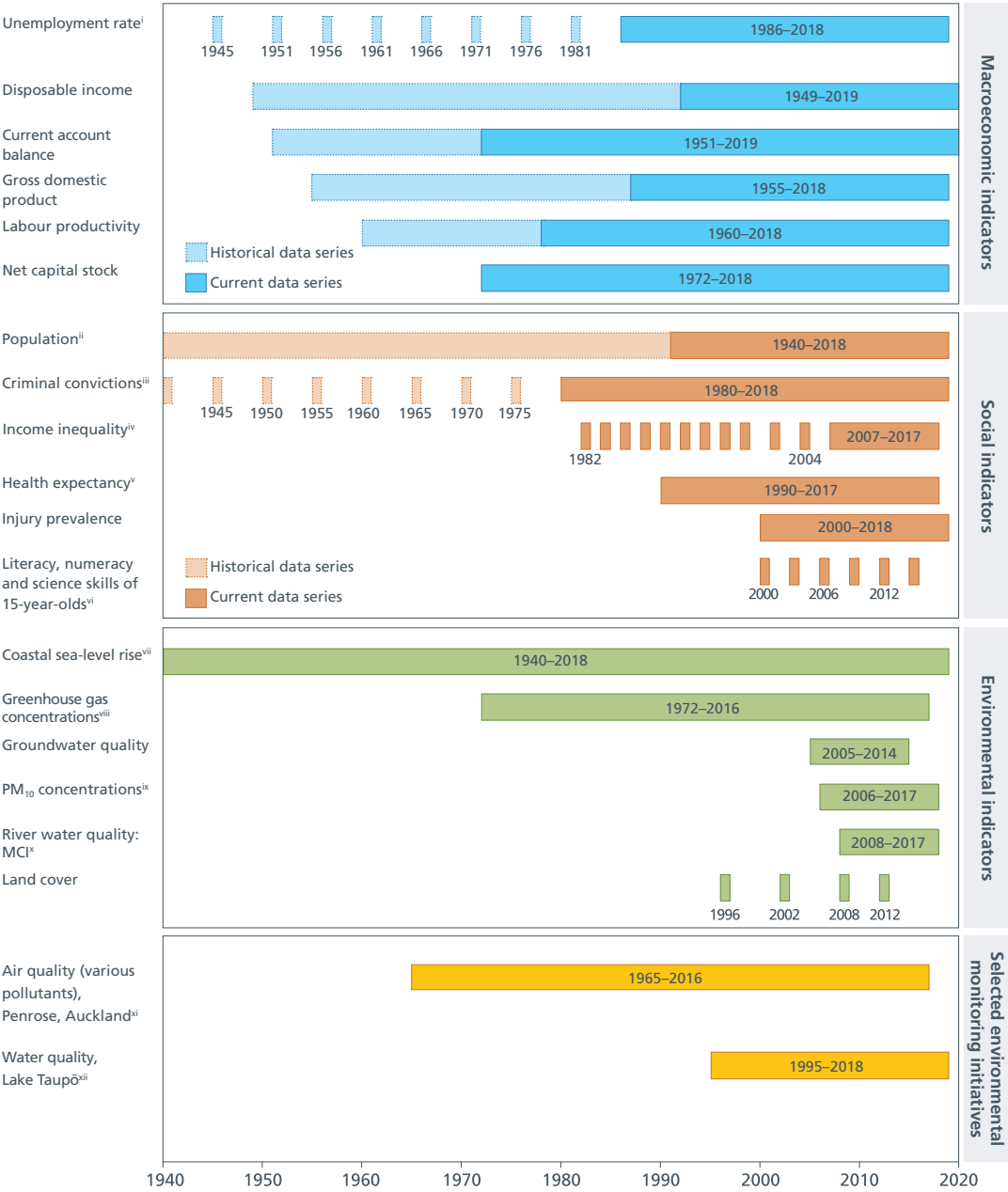
A lack of time series in respect of some environmental pressure points could be costing us dearly in terms of poorly designed policies or irreversible damage.¹⁷

¹⁴For example, New Zealand has comprehensive and consistent time-series data relating to human-induced greenhouse gas emissions and removals since 1990. This dataset has been collected to fulfil reporting requirements under the United Nations Framework Convention on Climate Change and the Kyoto Protocol.

¹⁵Section 3, Resource Management Act 1991.

¹⁶For example, for the purposes of reporting on New Zealand's environment, Stats NZ uses time series with at least six consecutive years of good quality data. See http://archive.stats.govt.nz/browse_for_stats/environment/environmental-reporting-series/environmental-indicators/Home/About.aspx.

¹⁷A lack of national time-series data for environmental indicators is also a result of inconsistent methods for data collection and analysis being used by many organisations. This can hinder the collation, standardisation and analysis of data to provide a national picture. However, individual monitoring programmes can have consistent time-series data for relatively long periods, as illustrated by the Auckland air quality and Lake Taupō monitoring examples in figure 3.3.



Source: Stats NZ unless otherwise specified

Figure 3.3: Comparison of the temporal coverage and time-series consistency of selected key macroeconomic, social and environmental indicators.

Note: Historical and current data series may not be directly comparable due to differences in data collection practices, methodological compilation and revisions.

ⁱ Historical data series begins in 1896.

ⁱⁱ Historical data series begins in 1840.

ⁱⁱⁱ Historical data series begins in 1855.

^{iv} Stats NZ data published by Ministry of Social Development.

^v Global Burden of Disease Study, Institute of Health Metrics and Evaluation.

^{vi} Programme for International Student Assessment (PISA), Ministry of Education.

^{vii} Data series begins in 1901.

^{viii} Greenhouse gas concentrations measured by the National Institute of Water and Atmospheric Research (NIWA) at Baring Head. Baring Head is part of a global network of stations for determining trends in greenhouse gas concentrations. Carbon dioxide measurements began in 1972, while measurements of methane and nitrous oxide began in 1989 and 1996 respectively.

^{ix} PM₁₀ refers to airborne particulate matter less than 10 micrometers in diameter.

^x Macroinvertebrate community index.

^{xi} Auckland Council.

^{xii} Waikato Regional Council.

Lack of consistency

When data is collected, attempts to construct a national-level picture can be thwarted because of inconsistencies in:

- what is measured
- why it is measured
- when and where it is measured
- how it is measured
- how the data is stored
- how the data is analysed and reported.

For example, regional councils monitor the bacteria *Escherichia coli* (*E. coli*) as an indicator of faecal contamination and public health risks. However, councils differ in what, where, when and how they monitor, and how they analyse and report the information (see appendix one for further details). This creates challenges when aggregating and synthesising data to produce an indicator that is consistent and nationally representative.¹⁸



Source: Tom Kay, NZ Landcare Trust, Flickr

Figure 3.4: Collecting samples of invertebrates is regularly used to indicate the functioning and health of streams. However, the use of inconsistent methods to collect and analyse this and other data poses challenges for building a national picture of freshwater quality. While work to improve consistency is ongoing, better leadership and resourcing are needed to make meaningful progress.

¹⁸Over the years, NIWA has been contracted on a regular basis to collate and analyse water quality data using time-consuming data cleaning and processing techniques to address differences in definitions and collection and measurement techniques, where possible. For example, see Larned et al., 2018.

Similarly, soil quality monitoring remains patchy and inconsistent. Not all regional councils and unitary authorities collect soil quality data.¹⁹ Further, the list of soil quality chemical analyses and approaches for classifying soils varies significantly between councils.²⁰ So, it is not possible to tell where around the country soils are in good condition and where further attention may need to be focused.

Further, regional councils, the Department of Conservation (DOC), Manaaki Whenua – Landcare Research and the Ornithological Society of New Zealand all carry out bird monitoring on public and private land using different methods.²¹ Although these different methods are used for a reason (i.e. some methods are more suited to particular types of habitat), the result is that it is not possible to build a consistent and up-to-date picture of the distribution and abundance of birds across the country.

A regional council-led initiative called National Environmental Monitoring Standards (NEMS) aims to “ensure consistency in the way environmental monitoring data is collected and handled throughout New Zealand”.²² The initiative was formally established in 2011, when it received initial funding from MfE.²³

At the outset, the focus of this initiative was the development of standards for continuously measured hydrological data such as rainfall and water levels. This initial tranche of work was followed by the development of standards for continuously measured water quality parameters, with later phases focusing on the development of standards for discrete water quality, air quality and soil data. To date, 15 different standards and several codes of practice have been developed, and several more are currently under development.²⁴

¹⁹When surveyed, Gisborne, West Coast, Otago and Nelson councils did not monitor soil quality (Cavanagh et al., 2017, p.16).

²⁰Cavanagh with co-authors reported that councils used a combination of sources for determining soil classification. Further, the basic soil quality chemistry analyses were highly variable between councils and over time. For details, see Cavanagh et al., 2017, pp.22, 28–29.

²¹DOC outlines a variety of bird inventory and monitoring methods on its website (www.doc.govt.nz/our-work/biodiversity-inventory-and-monitoring/birds). As an example, DOC and many regional councils use 5 minute bird counts to estimate the relative abundance of bird populations across an 8 × 8 km grid on public conservation land as part of its Tier 1 monitoring programme (Hartley and Greene, 2012). However, this is not appropriate for all types of habitats, e.g. wetlands, where a census-type method to determine the actual numbers of birds is used (Cheyne, 2017). Manaaki Whenua – Landcare Research hosts the citizen science New Zealand Garden Bird Survey each year (<https://www.landcareresearch.co.nz/science/plants-animals-fungi/animals/birds/garden-bird-surveys>), while the Ornithological Society has carried out two systematic surveys across the whole country, using different methods again (Ray and McArthur, 2019).

²²See www.nems.org.nz/about-nems.

²³Raelene Mercer, NEMS Project Manager, pers. comm., July 2019.

²⁴The national environmental monitoring standards that have been developed to date are: rainfall recording, water level, open channel flow measurement, rating curves, water meter data, water temperature recording, dissolved oxygen, turbidity recording, soil water measurement, water quality part 1 (groundwater quality data), water quality part 2 (river water quality data), water quality part 3 (lake water quality data), water quality part 4 (coastal water quality data), quality code schema, glossary (see <http://www.nems.org.nz/documents/>). The standards have been developed at an approximate cost of \$990,000 (cash funding from MfE and Envirolink grants) and an estimated \$2.63 million of in-kind funding (primarily from regional councils) (Raelene Mercer, NEMS Project Manager, pers. comm., July 2019).

Initially, some councils resisted adopting the standards on account of additional costs or the need for operational changes or staff training. Within the water quality field there was also a reluctance to break the continuity of existing long-term datasets. This resistance has subsided, giving place to 'support in principle'.²⁵ However, the 2018 survey demonstrated that uptake rates still differed significantly between the various standards.²⁶

One of the barriers to more rapid progress (including the development of new standards and updating of current documents) is the lack of a reliable long-term funding stream. But the most significant limiting factor is reported to be the availability and capacity of technical experts.²⁷ Development of NEMS requires extensive input from relevant experts. These are usually knowledgeable senior personnel who already have demanding full-time roles within their respective organisations.

In addition to the challenges described above, current monitoring networks are not necessarily representative of the entire country. This is because monitoring is often undertaken by local authorities who, not surprisingly, monitor in areas that are of local and regional importance.²⁸

Differences in resourcing and capability across local authorities have led to further patchy geographical coverage.²⁹ Generally, regional councils and unitary authorities with a smaller ratepayer base have less extensive monitoring networks (for further illustration of this point, see appendix two).

Data accessibility remains challenging

Another challenge is data accessibility. While many local authorities make their environmental data publicly available, the degree of accessibility varies between them. Some have almost all their data available on their websites (e.g. Auckland Council) while others display none of it (e.g. West Coast Regional Council).

Attempts to pull regional council and unitary authority state of the environment data together have resulted in the development of an online portal called Land, Air, Water Aotearoa (LAWA).³⁰ It displays environmental data and information gathered by these organisations, and in doing so aims to connect communities with the environment.

²⁵ 100% of respondents supported NEMS in principle, and 96% of respondents have adopted or are striving to achieve practices and processes that are aligned to the standard (NEMS, 2018).

²⁶ Note that in many cases there has not been uptake because the parameter in question is not measured by the council themselves, e.g. water meter data that is collected by a third party on behalf of consent holders (Abi Loughnan, EMaR National Project Manager, pers. comm., September 2019).

²⁷ Jeff Watson, NEMS Steering Group Chair, pers. comm., July 2019.

²⁸ For example, confidence of predictions (or in technical terms, degree of extrapolation) was assessed for the national river network using available data. The patterns observed reflected the high density of sampling carried out near more populated regions. See Booker and Whitehead, 2018, for details.

²⁹ Further, New Zealand lacks several important classification systems, e.g. for lakes, groundwater and estuaries. Without these we can't tell if sites are properly situated and monitoring networks are adequately representative.

³⁰ <https://www.lawa.org.nz>.

The LAWA website is a major achievement of the Environmental Monitoring and Reporting (EMaR) initiative, led by the 16 regional and unitary councils, the Ministry for the Environment (MfE) and Cawthron Institute. This initiative was established in 2014 and aims to “provide integrated regional and national environmental data collection networks and widely accessible reporting platforms”.³¹

However, only certain datasets and indicators are displayed on LAWA. This is largely because LAWA requires nationally consistent datasets. LAWA has been developed ‘topic by topic’ with priority being placed on topics that have the most complete nationally consistent datasets, and wide public interest. Currently, LAWA contains topics that present information on air quality, freshwater quality and quantity, land cover and swimming water quality. A topic on groundwater quality is in the process of being developed, but further topics (such as estuarine health, terrestrial biodiversity and soil health) are all dependent on future resourcing and funding arrangements.³²

It is important to note here that while LAWA has been a success in terms of being a good communication tool for delivering environmental information to the public, there is limited ability to download the actual datasets from LAWA. This means that accessibility of underlying data remains an issue, especially for those who need it in a certain way for certain purposes (including national environmental reporting).

Although progress has been made with EMaR and NEMS, they are far from producing seamlessly consistent data across the country. The initiatives appear to be held together by the dedication of a small number of committed individuals rather than solid, strategic determination at all levels of government. In the absence of a concerted sense of urgency, coordination and funding at the national level, progress is likely to be a halting and arduous affair.

Another hindrance to the accessibility of data is the proprietary nature of some of the information gathered. For example, CRIs may charge for access to data and information.³³ Also, industry data collected on private properties is wrapped in privacy issues. In a number of cases, the datasets are not easily accessible due to proprietary ownership arrangements.³⁴ As these issues limit both access and interpretability of information, there has been limited use of this type of data for national-level environmental reporting.

³¹ Abi Loughnan, EMaR National Project Manager, pers. comm., June 2019. The EMaR initiative has a governance group, executive steering group, project office and project delivery teams.

³² At the time of writing, funding secured for the 2019/20 financial year amounts to around \$360,000, while the projected expenditure for the same year is around \$510,000 (Abi Loughnan, EMaR National Project Manager, pers. comm., June 2019).

³³ For example, information on stream networks requires permission to access, as it is linked to river reaches and is part of the River Environment Classification provided by NIWA.

³⁴ For example, AgriBase is a national spatial database that holds information on approximately 142,000 current New Zealand farms. It provides some information on land-use class and stocking rates. However, as this database is administered by a private company,ASUREQuality, the database is proprietary, and various users need to pay to use this information. See <https://asurequality.com/our-solutions/agribase>.

Attempts to increase accessibility of environmental data have resulted in the development of several reporting platforms.³⁵ These platforms have been developed for a variety of purposes, pulling environmental data from a range of data sources, some of which overlap. For example, some platforms have an environmental-economic focus (e.g. System of Environmental-Economic Accounting), while others focus on wellbeing (e.g. the Living Standards Framework and Indicators Aotearoa New Zealand).

Collectively, they all suffer from the same general lack of fundamental knowledge and data, as well as the irregular nature of the underlying data collection. Together they help create a somewhat confusing and overlapping landscape of reporting platforms.

The way we fund data

The way we fund the collection of environmental data at a national level suffers from at least three main problems:

- a preference for funding exciting, novel research ahead of the collection of essential underpinning data
- the stagnation of datasets due to a lack of proper maintenance
- a lack of secure, ongoing funding for important new datasets.

A preference for exciting novel research over essential underpinning data

The collection of much data has its roots in a data collection world that was once dominated by government departments. For example, the Department of Scientific and Industrial Research and the Pollution Advisory Council had a legislated mandate to collect information.³⁶ The establishment of CRIs and the move to fund research at arm's length (firstly through the Foundation for Research, Science and Technology, and subsequently through a variety of funds administered by the Ministry of Business, Innovation and Employment (MBIE) meant that there was no dedicated 'purchaser' of the data needed for environmental reporting.³⁷

Many information sources and information collection initiatives suffer from a lack of a commitment to maintaining them in the long term. The contestable nature of even long-term research funding has made it hard to maintain a commitment to collecting essential underpinning data, particularly when there is pressure to demonstrate novelty and innovation.

³⁵These are in addition to the national-level environmental reporting platform.

³⁶The Department of Scientific and Industrial Research was established in 1926, and the Pollution Advisory Council was established in 1953. See sections 5(1,2) of the Scientific and Industrial Research Act 1926 and section 14 of the Waters Pollution Act 1953.

³⁷The contestable funding system run by the Foundation for Research, Science and Technology and other purchasers created competition between providers for limited government funds (McGuinness Institute, 2009, p.5).

For example, MBIE administers a variety of research funds, including the \$58 million per annum Endeavour Fund.³⁸ These funds are approved for short funding periods (typically three to five years).³⁹ All research proposals submitted to be funded under the Endeavour Fund are assessed against an excellence criterion first. This criterion stipulates that research should be well designed, involve risk and/or novelty, and leverage additional value from wider research. In addition, particular regard is paid to whether the proposed research progresses and disseminates new knowledge and is ambitious in terms of scientific risk, technical risk, novelty and/or innovative approaches. Only proposals that have been assessed as “having sufficient quality” against the excellence criterion are then assessed against an impact criterion.⁴⁰

It is hard for organisations to justify gathering essential underpinning data in the face of these relentlessly boundary-pushing criteria. CRIs have been expected to maintain data collection from broad funding platforms like the infrastructure component of the Strategic Science Investment Fund (SSIF), in which it is just one claim on a static pool of resources subject to constantly growing demands.⁴¹ Alternative sources of funding, including the programmes component of the SSIF, are contestable and evaluated against a scientific excellence criterion.

Yet while ambition and novelty may be crowd pleasers, underpinning data is crucial as it forms the foundation for innovation. Neglect through funding pressures over the years has led to the fragmentation of some very important datasets. Some of these datasets and associated monitoring programmes have either been discontinued or are subject to increasingly tenuous funding arrangements.

³⁸See <https://gazette.govt.nz/notice/id/2018-go4196>.

³⁹The Endeavour Fund consists of two components. The Smart Ideas investment mechanism provides funding for a term of two or three years, while the Research Programmes investment mechanism provides funding for a term between three and five years. <https://www.mbie.govt.nz/science-and-technology/science-and-innovation/funding-information-and-opportunities/investment-funds/endeavour-fund/>.

⁴⁰See <https://gazette.govt.nz/notice/id/2018-go4196>.

⁴¹The SSIF consists of two components. The SSIF Programmes fund provides funding to enable organisations to undertake long-term research programmes. The SSIF Infrastructure fund provides funding to enable access to research technology, infrastructure and Nationally Significant Collections and Databases. For details, see <https://www.mbie.govt.nz/science-and-technology/science-and-innovation/funding-information-and-opportunities/investment-funds/strategic-science-investment-fund/>.



Source: Brian, Flickr

Figure 3.5: One of NIWA's sites for monitoring water quality is on the Hutt River Te Awakairangi.

The origin and funding of the National Institute of Water and Atmospheric Research (NIWA) National River Water Quality Network provides an example. The network provides a depiction of river water quality by recording measurements of key physical, chemical and biological variables across New Zealand's rivers. It enables reporting on both the state of river water quality and trends in these variables over time.

In 1989, NIWA's predecessor organisation, the Department of Scientific and Industrial Research, set up 77 sites on 35 rivers for the purposes of river water quality monitoring. NIWA, the Department's successor, continued to maintain this river network.

However, about ten years ago, evolving organisational priorities necessitated the re-allocation of resources, which has been at the expense of this river monitoring network. The monitoring of some of the original 77 sites was subsequently handed over to regional councils. In some cases, original sites were replaced by council-run sites nearby. From the original set of 77 national sites, NIWA now operates between 40 and 50 sites.⁴²

Another example is NIWA's National Lakes Water Quality Monitoring Programme. The monitoring network was established in 1992 with the aim of assessing the condition of New Zealand's lakes and tracking changes over time. Coverage consisted of 22 lakes monitored nationwide. However, monitoring was discontinued in 1998 due to a lack of demand for monitoring results coupled with the absence of an effective means of disseminating the data.⁴³

⁴²The National River Water Quality Network is currently funded from the Infrastructure Strategic Science Investment Fund. Also note that regional and district councils currently monitor water quality at over 1,000 river sites (Scott Larned, NIWA, pers. comm., August 2019).

⁴³Note that councils currently monitor about 150 lakes (Scott Larned, NIWA, pers. comm., August 2019).

Stagnation of datasets due to a lack of proper maintenance

Tenuous funding arrangements have also affected several databases. For example, Land Environments of New Zealand is a spatial classification that maps landscape variation. It was produced by overlaying 15 individual datasets (characterising climate, soils and topography). After the classification was developed in 2002–2003, the funding dried up, posing challenges for maintaining the viability of the database over time.⁴⁴

Some long-standing databases and collections have been lucky enough to be considered 'nationally significant' and receive national funding. A list of 25 nationally significant collections and databases was established in 1992 and has remained unchanged ever since.⁴⁵ MBIE is currently reviewing the Government's investment in scientific collections and databases, but no conclusions about a final set of the databases to be funded were available at the time of writing.

It should be noted that existing funding arrangements for these databases and collections do not account for inflation. This can create significant challenges for agencies attempting to maintain the viability of these databases over time.⁴⁶

Lack of secure, ongoing funding for important new datasets

Any new datasets that have been created since the 1992 list are reliant on interested agencies having to 'put the hat around' to drum up resources to make occasional data harvests, as they do not receive any dedicated national funding.

A country reliant on primary industries and tourism for much of its income needs to know what is happening on the land.⁴⁷ This includes understanding how the land cover (the types of vegetation and other features that cover the land) is evolving. It also includes understanding how the land is currently used, how it was used in the past, and what land use changes mean in terms of benefits and pressures. Comprehensive and up-to-date information about land cover and land use would seem to be indispensable to an economy like ours.

⁴⁴Fraser Morgan, Manaaki Whenua – Landcare Research, pers. comm., August 2019.

⁴⁵The Government (through MBIE) provides \$19 million of funding per year to the 25 nationally significant collections and databases. The list of these collections and databases was identified in 1992. See www.mbie.govt.nz/science-and-technology/science-and-innovation/funding-information-and-opportunities/investment-funds/strategic-science-investment-fund/funded-infrastructure/nationally-significant-collections-and-databases.

⁴⁶For example, the New Zealand Land Resource Inventory (NZLRI) is a spatially explicit database that maps physical factors deemed to affect land use (e.g. rock type, slope, vegetation cover and erosion). The funding allocated for ongoing maintenance and management has never been inflation adjusted, so is now considerably lower in real terms. Furthermore, funding for significant data updates of the NZLRI also largely ceased in the mid-1990s, effectively resulting in a stagnant database (James Barringer, Manaaki Whenua – Landcare Research, pers. comm., August 2019).

⁴⁷In 2017, agriculture's share of total GDP was 4.6%, while tourism's share was 6.0% (Stats NZ, 2018a, 2018b).

However, that is not how it is treated. National surveys of Aotearoa New Zealand's land cover were carried out in 1996, 2002, 2008 and 2012.⁴⁸ Further, long-term funding remains an issue, as the land cover database does not receive any dedicated funding. This is deeply concerning given that tracking land cover changes over time and understanding the resulting pressures is imperative. This warrants much more frequent updates of the land cover database.

Similarly, New Zealand has no robust, comprehensive and nationally representative dataset that characterises New Zealand's land use and how this is changing spatially and temporally. Current estimates are cobbled together from data derived from a variety of sources and proxies.⁴⁹ Finally, New Zealand's soil database (S-map) also suffers from patchy geographical coverage and a lack of secure funding.⁵⁰



Source: Andrew Cooper, Wikimedia Commons

Figure 3.6: Land use changes often occur quickly, warranting regular monitoring. However, despite being a land-based economy, New Zealand has no robust, comprehensive and nationally representative land use map, let alone one that is regularly updated. Current estimates are an amalgam of data derived from a variety of sources and proxies.

⁴⁸Most recently, a survey of New Zealand's land cover was carried out in the summer of 2018/19. This survey will inform the latest update of the land cover database (LCDB5), which is planned for release in 2020. The funding needed for the one-off update (LCDB5) has been provided by MfE, MPI and DOC as a three-way partnership on the basis that it is a gap that needs to be urgently filled. Long-term funding is still an issue. Hopes are held for MBIE's currently ongoing review of the Nationally Significant Databases (MfE officials, pers. comm., July 2019 and John Dymond, Manaaki Whenua – Landcare Research, pers. comm., October 2019).

⁴⁹The land cover and land use indicators in *Our Land 2018* required the compilation of different datasets held by seven different agencies. See MfE and Stats NZ, 2018b, pp.104–105 (Table 3).

⁵⁰As of August 2019, S-map had four funding sources: Manaaki Whenua – Landcare Research's Strategic Science Investment Fund; the successful NextGen S-map research programme funded from MBIE's contestable Endeavour Fund for five years (2016–2021); commercial licensing fees (S-map is proprietary for commercial use); and contributions from regional councils and Envirolink grants. However, a proposed Envirolink advice grant for soil mapping for S-map has recently been turned down, making this funding source no longer available for the smaller councils to tap into. To date, contributions from regional councils and Envirolink grants, with a little support from Manaaki Whenua, have been the primary source of funding for additional mapping. The other two sources have been used for related science/research (Endeavour Fund) and database maintenance/operations (commercial licensing fees). As of August 2019, the S-map coverage of New Zealand was 35%, including 64% of the land capable of multiple land uses (LUC 1–4: horticulture, arable cropping, pastoral grazing, tree crops and production forestry) (Linda Lilburne, Manaaki Whenua – Landcare Research, pers. comm., August 2019).

Sorting out who funds what

In summary, while New Zealand's current science system is focused on innovative and leading-edge research, it is difficult (if not impossible) to effectively undertake such research without the solid foundational knowledge needed to ground our understanding. As such, national-level environmental reporting must somehow be linked to New Zealand's science system.

The usefulness of environmental datasets is dependent on their ability to provide a consistent and representative measure of environmental phenomena over a prolonged period. This allows for a better understanding of relationships between variables of interest (e.g. dominant land use and water quality) and trends over time as well as the setting of research priorities and any management interventions. The absence of a long-term commitment and increasingly tenuous funding arrangements for maintaining important datasets poses significant challenges for their usefulness.

Diversification of funding sources could enhance the security of funding arrangements and make the system more resilient. This could be achieved through greater use of the 'beneficiary pays' principle, which would ensure those organisations that benefit from a particular dataset contribute to the cost of provision (e.g. the establishment and maintenance of monitoring networks). While such an arrangement could be considered more equitable from a distributional perspective, it may also act to strengthen funding arrangements by reducing the burden placed on any single data provider. Co-funding arrangements would allow multiple providers to derive benefits from a dataset while contributing towards a commensurate share of the cost.⁵¹

When we look at other areas, different levels of the government contribute. For example, while national roads are funded by central government, local roads are jointly funded by local and central government.⁵² This reflects the fact that different roads confer benefits to different groups of users.

Earlier this year, the Productivity Commission reviewed the funding and financing of local government and recommended that the "benefit principle" should be used to guide central government funding of local government activities.⁵³

Environmental data has both regional (local) and national benefits. It can be used for national-level reporting on the state of the environment as well as for informing resource consent processes and supporting operational decision making at a regional level.

⁵¹ The benefit principle is a well-established economic principle that requires those who benefit from, or cause the need for, a service to contribute towards a proportionate share of the costs of provision.

⁵² Central government policies that subsidise local roads take account of the rating base of territorial authorities in setting the level of subsidy. See Productivity Commission, 2019, p.64.

⁵³ "The benefit principle should be used to test whether a funding contribution from central government is justified. If benefits from local government activities yield significant national benefits, then central government should fund a share commensurate with those benefits." See Productivity Commission, 2019, p.182.

Since environmental data has both regional (local) and national benefits, one suggestion could be that both central and local government should contribute to the cost of information-gathering initiatives and the cost of standardising data collection practices to ensure consistency of environmental data across all organisations.

While a dedicated working group may be best placed to determine the exact contribution from each, local government could focus on filling the data and knowledge gaps that are within the scope of local authorities' functions and powers under the RMA, while central government could focus on the remainder.

A further benefit of dedicated funding allocations is that nationally important indicators and datasets would have long-term certainty.⁵⁴

New Zealand's challenges are not unique

New Zealand's challenges are not unique. Similar obstacles have been identified in our nearest neighbour, Australia. The Australian system also suffers from a degree of fragmentation, with devolution of responsibilities between local, state and federal governments.

Lack of agreement on data and information standards and data collection protocols between these different levels of government and other agencies makes national aggregation and reporting difficult. The complexity of the environment means that management objectives are highly specific to the local management context. This makes specifying environmental information requirements, at the national level in particular, very difficult.⁵⁵

Neither is the Australian system immune from short-termism in funding, which does not encourage enduring information systems. As in New Zealand, environmental information is often viewed as having lower priority compared to other demands and is often collected on a project- and purpose-driven basis.⁵⁶

The Netherlands provides an example of a country that has developed a comprehensive and high-quality information base. Environmental information is underpinned by a strong scientific evidence base drawing on the expertise of both government departments and specialist research institutes. This collaborative approach is reflected in both the scope of the available information and depth of analysis.

Innovative methods of disseminating and displaying the information base have also been developed. This includes the development of an online atlas that integrates a diverse array of spatially referenced datasets to provide an overview of environmental quality in a particular area.⁵⁷

⁵⁴For example, economic and social statistical collections are funded from baseline allocations, which provide long-term certainty. GDP and social wellbeing statistics derived from Stats NZ's General Social Survey are good examples of these funding arrangements.

⁵⁵Van Dijk et al., 2014.

⁵⁶Van Dijk et al., 2014.

⁵⁷Further, environmental reports provide a means of disseminating environmental information to the general public and for evaluating environmental policy (OECD, 2015).

In summary

New Zealand's broader environmental data and knowledge system is largely fragmented, with many providers gathering environmental information for a variety of purposes. The resulting gaps relate to multiple issues, as documented in *Environment Aotearoa 2019*. A "shortage of reliable and nationally uniform data" was also mentioned by the OECD in 2017.⁵⁸

By way of specific example, the Auditor-General's recent report *Managing freshwater quality: Challenges and opportunities* noted that a lack of representative monitoring of New Zealand's rivers and the use of inconsistent methods to collect and analyse data were key difficulties for building a national picture of freshwater quality.

While these issues are well known, and work to address them is ongoing, the Auditor-General pointed out that better leadership is needed to make meaningful progress. He recommended that MfE and Stats NZ should lead work with regional councils to achieve greater consistency in the monitoring and analysis of freshwater quality information.⁵⁹ Further, urgent additional work on nationally consistent methods for monitoring compulsory freshwater values was called for by the Government's Freshwater Science and Technical Advisory Group.⁶⁰

It is notable that the majority of known data and knowledge gaps relate to matters that local government is already required to monitor to some degree. It makes sense for that work to be done in a consistent way, and central government should be given the tools to ensure that happens going forward.

Finally, it should be acknowledged that a significant number of monitoring gaps relate to issues that central government should take responsibility for. That is not happening, partly due to a lack of legislative requirement for monitoring,⁶¹ and partly because of a lack of clarity about which organisations are responsible for monitoring which aspects of the environment.⁶²

However, standardisation and improved clarity about who does what may not be enough. Funding may also be needed. All in all, the division of labour and the fair distribution of costs should be consciously agreed and assigned as part of a national strategy.

⁵⁸The OECD noted that shortage of data remained "particularly acute in such key environmental policy areas as waste management and biodiversity protection" (OECD, 2017, p.110).

⁵⁹Controller and Auditor-General, 2019.

⁶⁰The five biophysical components that contribute to freshwater ecosystem health are water quality, water quantity, habitat, aquatic life and ecological processes. The group also called for guidance on the design of systems for data generation and analysis (including system design, data collection, storage and analysis, and reporting protocols), and applied science to describe what is required to lift ecosystem health to meet community objectives and support adaptive management (Freshwater Science and Technical Advisory Group, 2019, p.7).

⁶¹Land cover is one such example.

⁶²For example, freshwater quality monitoring is currently undertaken by both NIWA and regional councils. Similarly, both MPI and DOC are involved in monitoring the distribution of invasive species.

4



National-level environmental reporting

Reflections on the current system

A 'passive harvest'

When the Environmental Reporting Act was passed in 2015, it was made clear that reporting would draw only on existing and available data.

The July 2013 Cabinet paper proposing the environmental reporting regime spelt out clearly that the proposed legislation would not “impose any requirement on local government, individuals, businesses or central government agencies to produce data that does not already exist.”¹

The Cabinet paper added that

“national-level environmental reporting will draw on existing available data and that any data gaps will be addressed over time, either collaboratively, via procurement, through the Minister’s power to regulate under section 360 of the RMA, or through Ministerial decisions about priorities for investment in official statistics by central government agencies.”²

Further, “neither officials nor the PCE have powers to require that new information is generated.”³

This determination to avoid raising any expectations about collecting new information was carried into the Environmental Reporting Act 2015, which states that the Secretary for the Environment and the Government Statistician are not required to include in domain and synthesis reports “information that cannot be obtained by using reasonable efforts.”⁴

For whatever reason, the system appears to have been designed to make do with whatever information happened to be available and makes no commitment to gather anything more. A reporting system is only as good as its weakest link. With many links missing and no mechanism to fill them, New Zealand’s environmental reporting system falls well short of providing policymakers with the evidence they need to make informed decisions.

¹ Office of the Minister for the Environment, 2013a, paragraph 65(8).

² Office of the Minister for the Environment, 2013a, paragraph 65(9).

³ Office of the Minister for the Environment, 2013a, paragraphs 24 and 65(8).

⁴ See sections 8(3) and 11(3) of the Environmental Reporting Act 2015.

Domain and synthesis reports and their frequency

The current environmental reporting system requires the production of regular reports.⁵ Under the Environmental Reporting Act 2015, the Secretary for the Environment and the Government Statistician must produce a synthesis state of the environment report every three years. Between synthesis reports, a report on one of five environmental domains specified in the Act must be produced every six months (domain reports). The five domains are:

- air
- atmosphere and climate
- freshwater
- land
- marine.

While the Act organises the environment into five domains, the real world is not so neatly divided into separate silos. In reality, these domains are all interrelated. While officials have produced a succession of domain reports, this siloed approach has made it difficult to present the information in a manner that allows the reader to fully grasp the magnitude and scope of some of our most pressing environmental issues.



Source: NelsonNZ, Flickr

Figure 4.1: The Environmental Reporting Act 2015 splits the natural world into five separate domains – air, atmosphere and climate, freshwater, land, and marine. However, nature does not neatly divide into separate silos. Rather, everything is interrelated.

⁵ Notably, the Act does not describe what constitutes a 'report'. The term has been interpreted to mean a published written document.

It is not clear why six months was chosen as the interval between domain reports. The departmental report on the Bill provided in 2015 simply stated that six-monthly intervals meant that “each domain will be reported on at three-yearly intervals”, which in turn “aligns well with the synthesis report, which is also produced at three-year intervals.”⁶

The rationale for requiring a synthesis report every three years is similarly unclear – the official reason given in 2015 was that “three years aligns with the average interval internationally.”⁷ However, most of the key environmental issues that concern us have developed over lengthy time frames and are unlikely to be remedied in short order. Furthermore, there are often long lag times between policy interventions and physical changes in the environment. Producing a state of the environment report like *Environment Aotearoa 2019* every three years risks fairly repetitive reporting.

The most frequently stated reasons I have encountered for having six-monthly reports are a desire to ensure that some aspect of the environment is always in the limelight and the need to generate a constant and steady workload for a team.⁸ In theory, this enables reporting agencies to build and retain capability and avoid a ‘boom and bust’ cycle, but it has not been borne out in practice.⁹

I am uneasy with the idea that the reporting cycle should be driven by worries about the need to constantly keep reminding policymakers and the public that reporting exists. While regular attention to aspects of the environment is desirable, it can be achieved without a statutorily prescribed cycle of domain reports.

In practice, six-monthly reporting has put MfE and Stats NZ staff on a never-ending treadmill of report preparation and production.¹⁰ It requires them to spend too much time tinkering with and repackaging old information, instead of developing new indicators, undertaking analyses and gathering new insights to improve future reporting.

⁶ MfE and Statistics New Zealand, 2015, p.25.

⁷ MfE and Statistics New Zealand, 2015, p.24.

⁸ Indeed, the 2015 departmental report on the Bill stated: “From a resourcing perspective it is a workable timeframe, provided that the report does not require a comprehensive update encompassing many or all data sets. Instead, the focus will be on presenting an integrated picture of the pressures, state and impacts of the environment as a coherent whole, particularly in respect to those elements that cut across domains, such as biodiversity.” See MfE and Statistics New Zealand, 2015, pp.24–25.

⁹ The data on staff retention suggests that the theory does not match the reality. On average, Stats NZ has ten staff contributing to environmental reporting at any one time. Average tenure of environmental reporting staff has been about two years. Similarly, MfE has 30 staff contributing to environmental reporting at any one time. Of the 30 staff, two thirds have a tenure of one year or less, and one third have a tenure of two to three years (MfE and Stats NZ officials, pers. comms, August 2019).

¹⁰ Reports published to date have taken about 18 months to produce, with three reports simultaneously in different stages of production, requiring sustained effort from about ten Stats NZ staff and about 30 MfE staff at any one time (MfE and Stats NZ officials, pers. comms, October 2019).

Reporting framework

The Environmental Reporting Act requires both domain and synthesis reports to be based on a pressure-state-impact (PSI) framework.¹¹ In fact, when first proposed to Cabinet in July 2013, the framework for reporting was only going to include the **state** of domains (including changes in state over time) and the **pressures** driving changes in state.¹²

The scope of reporting was expanded in a subsequent Cabinet paper of October 2013, which proposed the inclusion of **impacts** on the basis that “impact indicators put information about the state of the environment into context.” Answering these ‘so what?’ questions about the environment would “better inform the public about the significance of the state of the environment” and allow New Zealanders to “engage in debate about what the management objectives for our environment should be.”¹³

In addition, the October 2013 Cabinet paper emphasised the importance of significance, statistical rigour and the evidence for causal links. In fact, these criteria were proposed as the three criteria for selection of pressure, state and impact topics.¹⁴

Despite the emphasis placed on impact indicators by the Cabinet paper, fewer than one seventh of environmental indicators used to date characterise impacts, while more than half describe the state of various environmental issues (figure 4.2). This may reflect the relative ease of measuring biophysical characteristics of the environment and changes over time.

By contrast, measuring the resulting impacts on ecological integrity, public health, the economy, te ao Māori, culture and recreation is more complex.¹⁵ In addition, establishing causal links, as emphasised by the Cabinet paper, is not a straightforward task. It often requires monitoring initiatives to be supplemented by the development of targeted research investigations.

¹¹ See sections 8 and 11 of the Act.

¹² Office of the Minister for the Environment, 2013a, paragraph 27.

¹³ Office of the Minister for the Environment, 2013b, paragraphs 4 and 5, see also paragraphs 16–24, and 41.

¹⁴ Office of the Minister for the Environment, 2013b, paragraphs 21–24.

¹⁵ Under the Act, domain and synthesis reports are required to describe the following impact categories: ecological integrity, public health, the economy, te ao Māori, and culture and recreation. See sections 8(1) and 11(1) of the Environmental Reporting Act.

Environmental reporting indicators

By indicator category, across all environmental reports

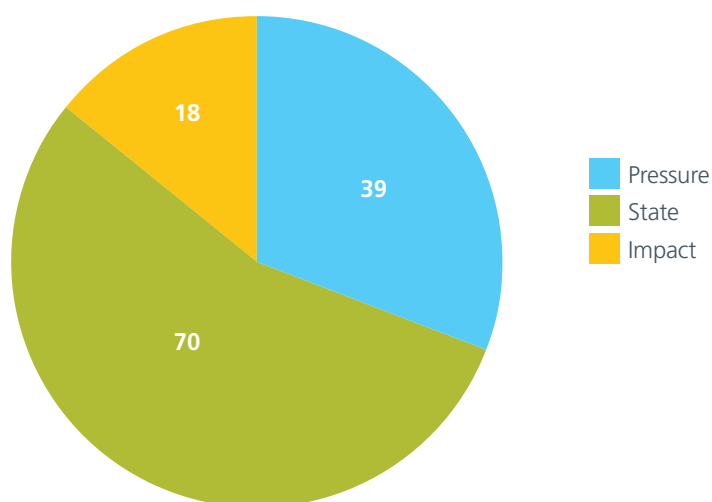


Figure 4.2: Out of the 127 environmental indicators developed to date, more than half describe environmental *states*, while fewer than a third describe *pressures* and fewer than one seventh characterise *impacts*.

This PSI framework is a truncated version of the internationally accepted drivers-pressure-state-impact-response (DPSIR) framework. This framework recognises a chain of causal links from driving forces (or drivers), through to human-induced pressures on the state of the environment, to impacts and the deployment of responses aimed at mitigating the potential impacts of those pressures.

The full DPSIR framework is circular. It assists users to close the loop by identifying responses to address the drivers and pressures, through to determining whether those responses have achieved the desired changes. By contrast, the truncated PSI version is linear, and has the potential to lead to somewhat shuttered thinking (figure 4.3).

Given that one of the aims of the 2015 Environmental Reporting Act was to place the process beyond immediate political control, the omission of responses from the environmental reports is appropriate. As the 2013 Cabinet paper stated, reporting on policy (including assessment, evaluation or commentary on the effectiveness of policy responses) “in a way that is perceived as politically neutral” may be difficult.¹⁶ I agree with this conclusion.

However, the decision to leave drivers out of the framework is harder to justify. The 2013 Cabinet papers introducing the environmental reporting framework were silent on the subject of drivers.

¹⁶It was envisaged, however, that the reporting on impact measures will help to “have a conversation about what the management objectives for the environment might be and, once management objectives are determined, whether the environmental management system as a whole is delivering outcomes” (Office of the Minister for the Environment, 2013b, paragraph 30).

Drivers are overarching factors – such as population or economic growth – that, through changes in production and consumption, exert pressures on the environment at large.¹⁷ Understanding the links between drivers and pressures is complex. But leaving them out denies us important context for specific pressures.¹⁸ As we seek to build a wellbeing framework for allocating fiscal resources and examining the effectiveness of policies (see section five), being able to link social and economic trends with environmental pressures will become increasingly important.

Truncated PSI framework



Full DPSIR framework

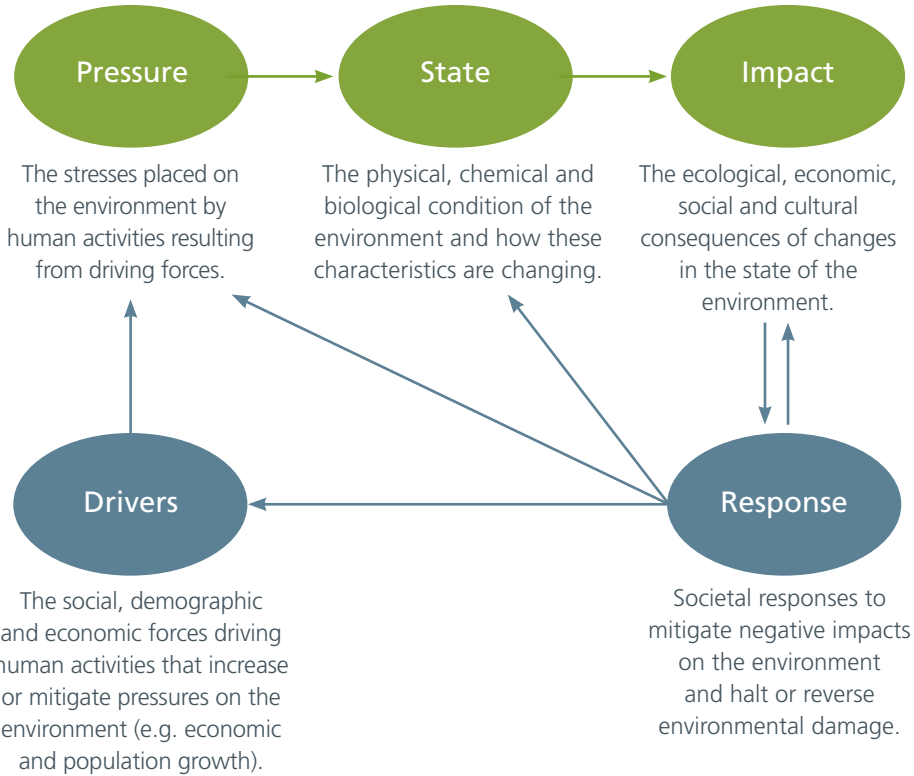


Figure 4.3: The Environmental Reporting Act requires reporting to be based on a pressure-state-impact (PSI) framework, which is a truncated version of the internationally accepted drivers-pressure-state-impact-response (DPSIR) framework for reporting on environmental issues.

¹⁷Growth in population and material consumption have a huge bearing on environmental outcomes and are the subject of meticulous measurement. Stats NZ already holds information about both population and economic activity.
¹⁸European Environment Agency, 1999.

Environmental reporting topics

The scope of reporting on the state of New Zealand's environment is further defined by environmental reporting topics, which are categorised as relating to either pressures, states or impacts.¹⁹ These topics are at the core of environmental reporting in New Zealand. Their purpose is to identify "key areas of interest for each domain, help create consistency across domains [and] help ensure continuity of information over time".²⁰

The topics are currently set out in regulations. The use of regulations was intended to strike a balance between flexibility and certainty. On the one hand, there may be a genuine need to update them from time to time. This was the reason given in the 2015 departmental report on the Bill, which emphasised "the dynamic nature of both the environment and our knowledge of it" as the reason for the likely need to change these topics over time. As a result, "it was not regarded as appropriate to set these topics in primary legislation."²¹

On the other hand, the topics should not be able to be changed too easily, because that could result in the exclusion of controversial issues or information for political reasons.

Regulations can of course be changed by executive fiat. My predecessor, Dr Jan Wright, specifically advised against the use of regulations, noting that:

"topics should not be set in regulations because regulations are made by Ministers. Topics should be chosen independently of the Government of the day to avoid the opportunity for political interference."²²

As it turns out, the Environmental Reporting (Topics for Environmental Reports) Regulations 2016 have not been changed since they were promulgated in 2016.

It should also be noted here that both the Environmental Reporting Act and the regulations specify te ao Māori as one of the impact topics to be covered in reports.²³ Having a Māori world view dealt with only as an impact topic is in stark contrast with the more holistic approach that te ao Māori presents. The difficulty this creates for giving due weight to mātauranga Māori is a further issue that needs to be considered. For further discussion of this issue, see 'Giving voice to te ao Māori' below.

¹⁹The topics to be covered in synthesis and domain reports are set by regulation under section 19(1) of the Environmental Reporting Act. See Environmental Reporting (Topics for Environmental Reports) Regulations 2016 (<http://www.legislation.govt.nz/regulation/public/2016/0127/latest/DLM6855401.html>).

²⁰Further, the topics are also considered to bridge the gap between an environmental domain (set in the Act) and a statistic (set by the Government Statistician) (MfE and Stats NZ, 2016, p.4).

²¹MfE and Statistics New Zealand, 2015, p.8.

²²In addition, despite my predecessor's advice, the list of 'pressure' topics includes natural processes and physical conditions alongside human activities – e.g. physical form of the land environment. However, natural processes and physical conditions provide "explanatory context, not a 'pressure' that we can influence" (PCE, 2015a, pp.3–4).

²³See sections 8(1) and 11(1) of the Environmental Reporting Act and section 10 of the Environmental Reporting (Topics for Environmental Reports) Regulations 2016.

Environmental indicators

The Environmental Reporting Act 2015 specifies that environmental indicators (or “statistics”) should be used for reporting on the various topics.

However, as environmental reporting has been set up to draw on existing and available data, it is inevitable that only existing indicators (or ones that can be easily constructed from available data) will be used for reporting. Given that New Zealand’s environmental reporting system is currently just a ‘passive harvester’ of information, data availability has played a big part in selecting current indicators (figure 4.4).²⁴ While developing new indicators is harder and requires investment, they may be more relevant to an issue.

Source of environmental reporting indicators

Across all environmental reports, by organisation

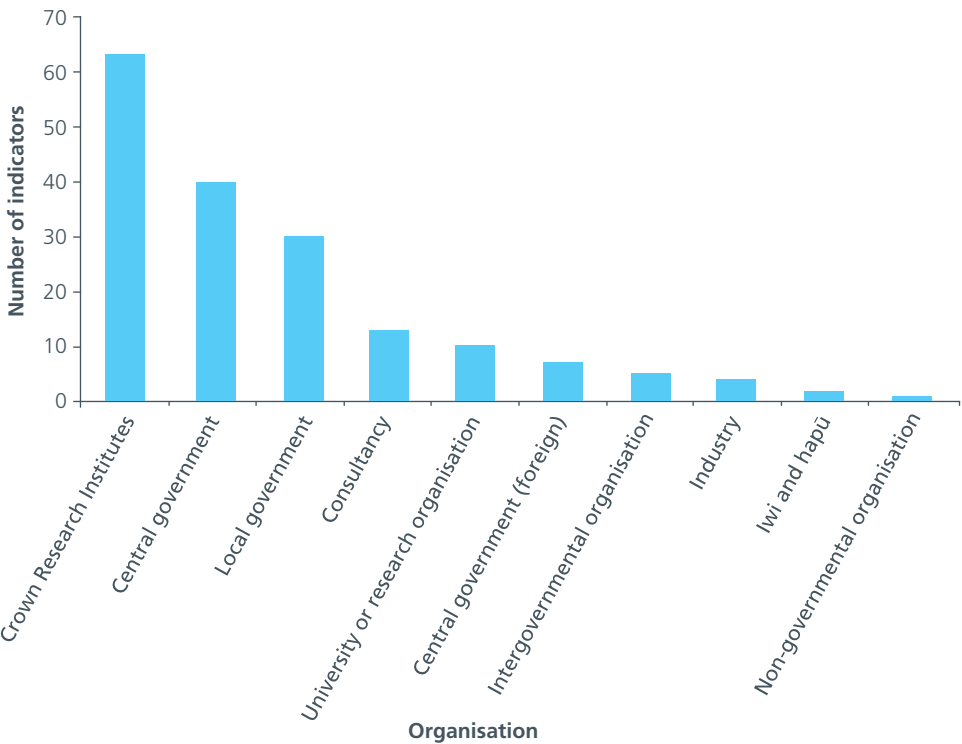


Figure 4.4: New Zealand’s environmental reporting system is currently just a ‘passive harvester’ of information – it simply collates existing environmental data from many organisations.²⁵

²⁴Indeed, the 127 environmental indicators currently used for environmental reporting have been selected largely because they were available and also met Stats NZ’s data quality criteria (as opposed to having been purposefully selected or designed because they are the best ones for the job at hand).

²⁵Note that indicators compiled from multiple data sources have been categorised against each of their respective provider categories, resulting in the multiple recording of some indicators in figure 4.4. Indicators that have been reproduced across multiple reports have only been categorised once unless previous versions of the indicator have differed significantly in terms of content or presentation.

Further, as discussed in the previous section, the quality of the underlying evidence base poses significant challenges for reporting. Inconsistencies in data collection and analysis alongside patchy spatial and temporal coverage can thwart attempts to develop robust environmental indicators and construct a national-level picture.²⁶

The choice of environmental indicators is critical for meaningful reporting. The Government Statistician (in consultation with the Secretary for the Environment) ultimately decides which indicators should be included in each report.²⁷ All environmental indicators published to date have been assessed using the six data quality criteria (relevance, accuracy, timeliness, coherence and consistency, accessibility, and interpretability).²⁸

The independence of the Government Statistician, and the rigour that surrounds the publication of environmental indicators, provides a vital source of quality assurance that contributes to public trust in the reporting.

However, I am reminded that my predecessor was insistent that indicators should primarily be chosen on the basis of their *direct relevance* to issues of pressing importance, noting that they must be accurate enough to give a true insight into the issue.²⁹

While data quality is important, it should not be treated as an absolute. Not all data needs to be of ‘gold standard’ to be included, provided any limitations are clearly stated. Differing levels of data quality are already provided by Stats NZ when assessing and reporting the quality of the data underpinning environmental indicators.³⁰ In addition, body of evidence material (which includes insights from scientific papers, reports and other forms of evidence) provides a way of including information in the report (e.g. as case studies) when the data does not meet the Stats NZ standards for an environmental indicator.³¹

²⁶Time-consuming ‘data cleaning’ and sophisticated analysis are usually required to collate and standardise data to address some of the inconsistencies and construct a national picture. Extrapolation and modelling are often needed to compensate for the non-representative nature of the monitoring networks and gaps in geographical coverage. Sometimes, however, the gaps are so large and the data quality is so poor that it is not possible to construct a consistent national picture. The actual freshwater takes indicator is one such example (Stats NZ officials, pers. comm., August 2019).

²⁷Section 14 of the Environmental Reporting Act prescribes how indicators (“statistics”) are to be selected. It refers to the Government Statistician following “best practice principles and protocols” and deciding on “procedures and methods”. In practice, this requires environmental reporting to follow the guidelines and requirements prescribed by the Principles and Protocols for Producers of Tier 1 Statistics. http://archive.stats.govt.nz/about_us/who-we-are/home-statisphere/tier-1/principles-protocols.aspx.

²⁸MfE and Stats NZ, 2017a, pp.27–31.

²⁹See PCE, 2016, pp.18, 44.

³⁰When assessing and reporting data quality, Stats NZ ranks data accuracy (high or medium; low accuracy is not accepted for use) and data relevance (direct, partial or indirect relevance to one of the environmental reporting topics). See http://archive.stats.govt.nz/browse_for_stats/environment/environmental-reporting-series/environmental-indicators/Home/About.aspx.

³¹For example, indicators on tuatara populations and seed production were proposed for *Our Atmosphere and Climate 2017*. After the data was assessed by Stats NZ as not meeting the standards for environmental indicators, this information was included as case studies (MfE and Stats NZ, 2017b, pp.38–39).

Reporting products

Over the years, domain and synthesis reports have often been accompanied by a range of complementary products, including media releases, infographics and videos, summary reports, web pages displaying environmental indicators, and underlying datasets. Having a range of diverse products is a good idea as they suit different audiences. For example, media releases and summary reports are well suited to busy policymakers, while underlying datasets may be useful for consultants and researchers who want to do their own analysis.³²

The indicator web pages hosted by Stats NZ are a good resource as they provide more detailed and technical information about environmental indicators than reports, along with comments about the underlying data and collection methods. The web pages also link to the data service hosted by MfE – this allows users to download underlying datasets to interrogate them, along with associated metadata and data quality information.³³

Streamlining and focusing the environmental reporting system

This section outlines ways to streamline and further improve the environmental reporting system.

Further developing the online reporting platform

As mentioned above, an online platform (the indicator web pages hosted by Stats NZ and the data service hosted by MfE) has already been developed as one of the environmental reporting products.

Further developing this existing online platform makes sense given its advantages for accessibility and ease of use. Another advantage is the ability to display graphs and maps interactively. The interactive maps in particular enable users to drill down into locations of interest. Specific and timely information presented in an interactive way is an essential input into decision making, so regular updates are important.³⁴

The frequency of updating will depend on the indicator. For example, the status of a species according to its threat of extinction (the New Zealand Threat Classification System) is unlikely to change over a short time period and will likely therefore be updated on a less frequent basis. By contrast, updates for indicators that demonstrate high levels of variability and have immediate implications for either environmental or human health should occur more frequently. Examples of these indicators include those that measure concentrations of pollutants and contaminants in the environment.

³²In addition, media play an important role as a 'delivery vehicle' to help convey key messages.

³³While a range of complementary products has been developed, they are housed across multiple websites, as New Zealand lacks a dedicated environmental reporting portal. By contrast, the Australian 2016 national state of the environment report has a dedicated portal (<https://soe.environment.gov.au>).

³⁴Many information users we have talked with during the investigation commented that, of the various reporting products, the indicator web pages and accompanying data are of most value to them, as they are only interested in specific issues or locations.

Further, the timing of the updates does not need to be linked to the deadlines for the production of future commentaries and reports. Rather, it should be determined by the availability of new data and its immediate usefulness. Regular updates can also provide a useful 'alert' system, if indicators (and any trends) are reported against meaningful benchmarks in a timely fashion. Ideally this should act as a trigger and lead to actions being taken to ensure that any relevant limits are not exceeded.

An important distinction needs to be made here between environmental significance and statistical significance. Statistical significance depends simply on statistical detectability, and may not tell us much about the environmental significance of the observed patterns.³⁵ Judging environmental significance requires meaningful benchmarks relating to ecosystem health, as well as information about the impacts of any observed changes. So, it is the environmental significance that matters most and should be the emphasis of any reporting.

The online platform should provide *the* authoritative source of information when it comes to reporting on New Zealand's environment. While other reporting platforms exist, the national-level environmental reporting platform should serve to highlight any apparent contradictions and provide an independent 'sense check'. It needs to be authoritative so that we can shift the debate away from non-constructive arguments over the facts to constructive dialogue about ways to deal with the issues.

Replacing domain reports with theme-based commentaries

While providing timely updates of environmental indicators is important for decision making, written commentaries are needed to go a step further in helping make sense of the data and indicators. New Zealanders are entitled to be informed about the state of their environment, the seriousness of any problems and where trends are taking us. New Zealand's environmental reporting system therefore needs to provide robust and reliable interpretation to increase the value and impact of environmental indicators.

The six-monthly domain reports currently provide a place to draw out any relationships between various indicators within the domain and provide some interpretation by referring to the wider body of evidence. However, the interpretation is currently focused within the boundaries of the specified domain.³⁶

It is important that the structure of the reporting system does not constrain its ability to effectively report on the issues that matter. Focusing the interpretation of environmental issues within the artificial confines of a single domain will often result in an incomplete picture. For example, erosion is a change in the state of the land and a pressure on freshwater and coastal habitats, so the discussion of the erosion-sedimentation issue belongs in the land, freshwater and marine 'domains'.³⁷

³⁵For further discussion regarding issues around statistical significance and environmental relevance, refer to Martínez-Abraín, 2008.

³⁶Section 11 of the Environmental Reporting Act sets out what each domain report 'must' include, and this is limited to information on 'the domain' in the spotlight. While the legislation does not prevent the inclusion of additional information, this has tended not to happen in practice.

³⁷Similarly, ocean acidification is a major impact of climate change, but it is also a change in the state of the ocean and a pressure on marine biodiversity. So the ocean acidification issue spans two domains – atmosphere and climate, and marine.

To step outside the constraints imposed by domains, *Environment Aotearoa 2019* identified five overarching themes. These are a promising alternative to the domains, since each of them looks beyond single domains to the whole interconnected system of New Zealand's environment and allows for a cross-domain commentary.³⁸

The five themes identified in *Environment Aotearoa 2019* are:

- our ecosystems and biodiversity
- how we use our land
- pollution from our activities
- how we use our freshwater and marine resources
- our changing climate.

In my view, these themes, as opposed to the domains, should form the basis of New Zealand's environmental reporting system. They should guide the development of regular state of the environment reports (see below) and form the basis of the theme-based commentaries between state of the environment reports. With some amendment, I believe they are sufficiently broad and all-encompassing to be stated on the face of the Environmental Reporting Act.

To this end I would suggest refinements to the five themes as follows:

- land
- freshwater and marine environment
- biodiversity and ecosystem functioning
- pollution and waste
- climate change and variability.

Unlike reporting of data and indicators, which need to be rigorously standardised, these commentaries do not need to follow a rigid format. Different issues are likely to demand attention at different times and in varying degrees of detail. Their format needs to be flexible and adapted to the needs of the issues. This will allow emerging issues to be more easily incorporated.

Commentaries should also help interested readers to get a better understanding of the bigger picture, by providing science-based interpretation and relevant background for any observed changes across environmental indicators. It would be useful for such commentaries to draw out the links between various environmental indicators and provide broader context obtained from scientific papers, reports and other forms of evidence. The commentaries do not need to be constrained by artificial boundaries but should link thematic areas where it is appropriate to do so. For example, a commentary on a key land-based issue like erosion would also likely draw on information gathered for the biodiversity, freshwater and marine themes.

³⁸Interestingly, the five themes used in *Environment Aotearoa 2019* mirror the language of the five 'direct drivers' used by the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). The five direct drivers are: invasive alien species, land use and land cover change, pollution, natural resource overexploitation, and climate change and variability (IPBES, 2018).



Source: Phillip Capper, Flickr

Figure 4.5: Erosion is a change in the state of the land and a pressure on freshwater and coastal habitats. So a commentary on this key land-based issue would likely draw on information gathered for several themes – such as land, biodiversity, freshwater and marine.

The length and frequency of these commentaries should be driven by need and the complexity of the task at hand. They should not be linked to a rigid six-month cycle. Rather, key issues emerging under each theme should receive appropriate commentary at the appropriate time. However, at a minimum, each theme should be commented on at least once in every interval between successive state of the environment reports.

Retaining regular state of the environment reports

Regular state of the environment reports should remain one of the key components of New Zealand's environmental reporting system. Such reports should be published in addition to the theme-based commentaries. State of the environment reports should cover all the themes, provide an overall picture of our environment, and be the vehicle for bringing environmental issues to the attention of New Zealanders.

Future state of the environment reports should continue to take a truly cross-cutting approach and be structured by priority environmental issues, in line with the five overarching themes. The preparation of *Environment Aotearoa 2019* provides a useful basis to work from.

Physical and measurable criteria should be used to identify the priority environmental issues within each of the themes. In addition to commenting on New Zealand's priority issues, state of the environment reports can provide a place to comment on any emerging issues and issues of high interest to the public. This will help ensure that New Zealand's reporting system has a wide audience and maintains a connection with the general public.

Priority environmental issues identified in the state of the environment reports should also provide a focus for further research and monitoring. Over time this will ensure that more information is gathered and a fuller picture can be presented in future state of the environment reports.

Based on overseas examples and discussions with various experts, I have come to the conclusion that producing state of the environment reports every three years is too frequent. A report every six years feels more appropriate. Six years has the benefit of aligning with the cycle of general elections. Reports could be released in November or early December of the year of an election or alternatively, 12 months earlier.

Expanding the reporting framework

In addition to reporting on pressures, states and impacts, future state of the environment reports should report on drivers and outlooks.

The significance of drivers has already been discussed above. One way to report on drivers in future state of the environment reports could be to include a separate chapter on drivers to provide context for the rest of the report. This chapter could examine the overarching factors that create pressures on environmental systems and any trends in these and, where possible, draw connections between these drivers and specific pressures and states. This would be in line with the approach employed in Australia in its 2011 and 2016 national state of the environment reports.³⁹

In addition, future state of the environment reports should also provide outlooks for priority environmental issues. A state of the environment report cannot provide a perspective on the seriousness of different environmental issues without looking forward. Discussions about potential future states and impacts could be based on the key factors that are likely to have the greatest influence on future states and trends.

It is important that outlooks are based on the current understanding of how environmental systems have reacted to pressures in the past and how they might continue to change if these pressures persist. Future scenarios could be provided to facilitate informed decision making about the New Zealand environment. A straightforward way to incorporate a look forward is to do what Australia does – each chapter in Australia's state of the environment report ends with an outlook section.⁴⁰

Replacing topics with themes

As mentioned above, the Environmental Reporting (Topics for Environmental Reports) Regulations 2016 have not been changed since they were promulgated in 2016. This is perhaps unsurprising, since the topics are couched so broadly as to encompass almost any issue. However, the lack of change might also suggest that the need for flexibility was overstated.

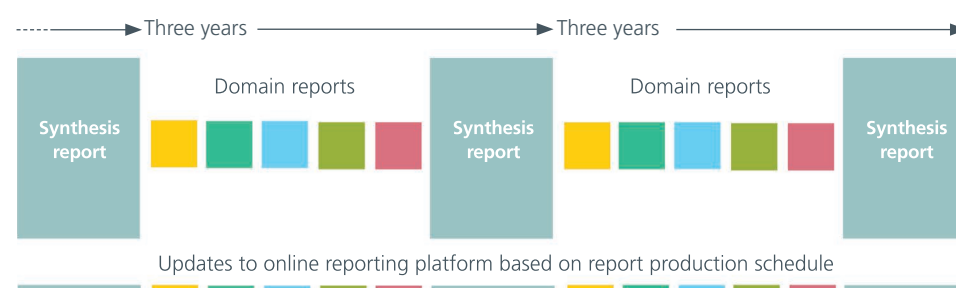
³⁹For example, see <https://soe.environment.gov.au/how-why/how-report-written>.

⁴⁰For example, see <https://soe.environment.gov.au/theme/inland-water>.

In my view, the five overarching themes proposed above should instead form the basis of New Zealand's environmental reporting system and should be specified in the Act. Specifying the themes in the Act provides certainty for future environmental reporting and, as Dr Wright urged, would further secure the independence of the reporting system.

If this is done, the current regulation-making power can be dispensed with. The breadth of the themes and their overarching nature (looking beyond single domains to the whole interconnected system of New Zealand's environment) will provide the necessary flexibility to focus on those environmental issues that are most pressing at any given time (see figure 4.6).

Current reporting system



Proposed reporting system

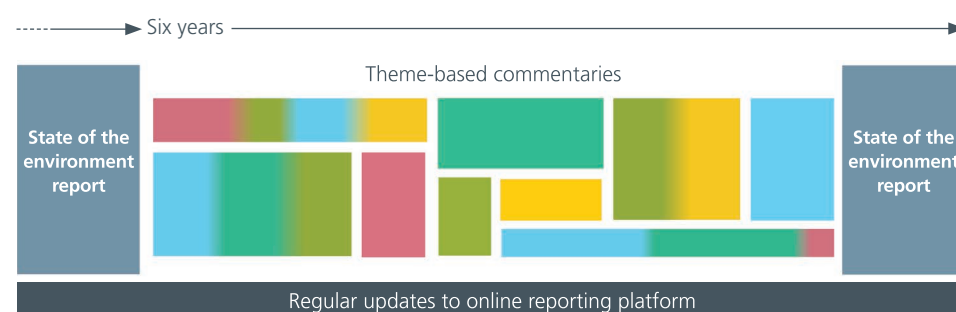


Figure 4.6: Conceptual diagram of the current and proposed environmental reporting systems. Domain reports under the current system are confined to a single area (represented here by discrete single-coloured blocks). By contrast, the proposed commentaries do not need to be constrained by artificial boundaries and could bring together data and other forms of evidence, as needed, from one or more themes or areas (represented here by multi-coloured blocks of different sizes). Their timing would be determined by the complexity of the task at hand. The existing online platform would need to be further developed to provide timely and regular updates, which should be disconnected from the deadlines for the production of commentaries and reports.

From passive to active information gathering

If environmental reporting is going to better enable evidence-based analysis and decision making, the current system needs to shift from being an opportunistic passive harvester of data that just happens to have been collected, to one that sets about systematically generating the data that is needed to address the key environmental issues of concern to New Zealanders.

This involves development of a more comprehensive, nationally coordinated environmental monitoring system. This initiative should include:

- the development of a dedicated set of core environmental indicators for the purposes of national environmental reporting, along with –
- the design of a national-level monitoring network, and –
- the development, specification and mandating of consistent data collection standards.

This will ensure New Zealand has a comprehensive and representative national monitoring system with a standardised and consistent approach to collecting, managing and analysing data.

The development of a more comprehensive, nationally coordinated environmental monitoring system should be led by MfE drawing on input from a standing science advisory panel (see below) and Stats NZ, as well as suitable experts from local government, central government agencies (such as DOC and the Ministry for Primary Industries (MPI) and CRIs.

Developing a dedicated set of core environmental indicators is a critical initiative.⁴¹ However, this project need not start from scratch. Several efforts have been undertaken in the past, but none has made it to the stage of actual implementation.⁴² It is time this happened.

There are likely to be two parts to this work:

1. A list of current indicators that we know should continue to be produced.
2. A more comprehensive list that includes:
 - a. indicators that require improvements in coverage and/or quality
 - b. new indicators.

The core environmental indicators should become a key part of the environmental reporting. The online platform should provide a 'home' for these indicators to be displayed and regularly updated with new data.

⁴¹The core environmental indicators will need to be built on a pool of supporting data that will be wider than the indicators themselves.

⁴²Examples of the past efforts include the Environmental Performance Indicators Programme, which ran from 1996 until 2002, and the *Environment domain plan*, which was published in 2013 and never implemented (PCE, 2010, p.12; Statistics New Zealand et al., 2013). In addition, Dymond and Ausseil (2019) undertook a gap analysis of the land-based environmental reporting indicators with a focus on land. Further, a suite of indicators that relate to New Zealand's wellbeing is currently being developed by Stats NZ (see Stats NZ, 2019). The United Nations Framework for the Development of Environmental Statistics (FDES) also provides useful information on the potential scope of what could be measured, an organising structure to guide collection of data, and a comprehensive list of statistics and indicators (United Nations Statistics Division, 2013).

Further, once the dedicated set of core environmental indicators has been developed, it should be set out in regulations under the Environmental Reporting Act. This will provide certainty.

Following this, the Government Statistician (drawing on input from the Secretary for the Environment) should be required to collect the data to construct and regularly update the core environmental indicators. Consistent, long-term monitoring and reporting of a dedicated set of core environmental indicators will ensure that New Zealand has reliable time-series information that can tell us whether environmental issues of importance are improving or deteriorating.

Once the core environmental indicators have been developed, and underpinning data needs have been identified, monitoring networks then need to be designed to improve spatial coverage.⁴³

Further, data collection standards should be specified to ensure a consistent and standardised approach. This, in turn, should lead to efficiencies, streamlined reporting and an improved ability to construct a consistent national picture.

MfE should be leading this work, drawing on input from a standing science advisory panel and Stats NZ, as well as suitable experts from local government, central government agencies (such as DOC and MPI) and CRIs.

Once data collection standards have been specified, they should be made publicly available. Further, the Secretary for the Environment and the Government Statistician should ensure that the standards are implemented within a set time frame – I would propose five years.

Importantly, the development of a more comprehensive, nationally coordinated environmental monitoring system needs to be explicitly resourced to bring to an end two decades of inconclusive discussions and indecisiveness. The funding and resourcing for this initiative is likely to be more resilient and secure if diversified. A contribution from a variety of organisations makes sense from that point of view. But of course, the fair distribution of costs (including of those between central and local government) will need to be determined.

Shifting away from being an opportunistic passive harvester of data that just happens to have been collected, and developing a comprehensive, nationally coordinated environmental monitoring system as described above, will ensure that New Zealand's system is focused and streamlined and sets about systematically generating the data that is needed to address the key environmental issues of concern to New Zealanders.

⁴³The designed monitoring networks should then be compared against existing monitoring networks to assess where the gaps are.

Who should do what?

Current arrangements

Under the Environmental Reporting Act, the Secretary for the Environment and the Government Statistician are tasked with regularly producing state of the environment reports. The Act requires these two officials to act independently of any Minister of the Crown and ensure that reports are fair and accurate.⁴⁴ In this way the reporting role is kept at arm's length from the Government of the day.

Section 14 of the Environmental Reporting Act describes the roles of the Government Statistician and the Secretary for the Environment.

The Government Statistician and Stats NZ

The Government Statistician and Stats NZ play a crucial role in the development of reports by selecting indicators that suitably represent each topic as a key early step in the reporting process. The Government Statistician and Stats NZ (in consultation with the Secretary for the Environment and MfE), ultimately decide which indicators should be included in each report.

The MfE and Stats NZ *Good practice guide for environmental reporting* says Stats NZ's key roles in the reporting process "include:

- applying the customer-focus model to developing reporting products
- assessing the measures from a statistical perspective and ensuring the methodologies are coherent
- quality assurance of data
- ensuring all sufficient metadata is available
- statistical testing of trends
- ensuring release protocols are followed."⁴⁵

In addition to the above, Stats NZ checks the consistency of all reporting products, ensuring not only that the statistics are correct, but that they are fairly and accurately represented whenever quoted.

⁴⁴See sections 15 and 16 of the Environmental Reporting Act.

⁴⁵MfE and Stats NZ, 2017a, p.9.

Under the Act, decisions about the procedures and methods for providing statistics used in reports are made by the Government Statistician.⁴⁶ In making those decisions, the Government Statistician is required to follow best practice protocols, and to be satisfied that the statistics will “accurately represent the topic they purport to measure”.⁴⁷ Environmental reporting adheres to the Principles and Protocols for the Producers of Tier 1 statistics.⁴⁸ The principles and protocols include a list of data quality criteria and guidance around the release of data to ensure equal access at first release.⁴⁹

Both the Government Statistician and the Secretary for the Environment have an explicit duty to act independently of any Minister of the Crown and are required to ensure that reports are “fair and accurate”.⁵⁰ In addition, the independence of the Government Statistician is protected more generally by section 15 of the Statistics Act 1975. I consider that the particular status of the Government Statistician lends powerful reinforcement to the independence that is being sought.

The combined effect of these provisions is that reporting is largely immunised from political considerations (although currently Ministers can still control what topics are reported on through the regulation-making power described above).

The Secretary for the Environment and Ministry for the Environment

The roles of the Secretary for the Environment and MfE are loosely defined under the Act. With Stats NZ taking a lead on determining what will be measured and how data will be processed, MfE assumes something of an environmentally knowledgeable facilitation role, currently bridging the gap between the perspectives and capacities of data providers, experts and the needs of Stats NZ.⁵¹

The MfE and Stats NZ *Good practice guide for environmental reporting* says MfE’s key roles in the reporting process “include:

- relationship management with data providers, experts, and peer reviewers
- advising on the science underlying the selection and methodology of measures
- procuring, receiving, and managing data
- providing scientific analysis.”⁵²

Thus far, data procurement has generally been managed by MfE.⁵³

⁴⁶See section 14(4) of the Environmental Reporting Act.

⁴⁷See section 14(3) of the Environmental Reporting Act.

⁴⁸These protocols have been developed for economic, social and environmental statistics that are deemed to be essential to government decision making and are of high public interest. See Statistics New Zealand, 2007, pp.2–3, 16.

⁴⁹While these principles and protocols are sound, their practical implementation sometimes poses difficulties because to date, environmental indicators have been released at the same time as domain and synthesis reports. Strict embargo conditions have made it difficult for journalists to cover environmental reporting in an in-depth manner (Dacia Herbulock, Science Media Centre, pers. comm., September 2019). For details about information releases and embargoes, see <https://www.stats.govt.nz/about-us/legislation-policies-and-guidelines/information-releases-embargoes-and-sanctions>.

⁵⁰See sections 15 and 16 of the Environmental Reporting Act.

⁵¹When the Environmental Reporting Act was passed, new appropriations were given to Stats NZ and PCE. However, MfE received no additional funding, despite needing to source data and commission analysis from a range of external providers. If the environmental reporting system is to be of value for New Zealand, it must be resourced well enough to do the job.

⁵²MfE and Stats NZ, 2017a, p.9.

⁵³To date, much of the data procured has been funded separately from environmental reporting. For example, freshwater data was procured and funded by MfE’s Water Directorate (MfE officials, pers. comm., October 2019).

The task of harvesting data from various data suppliers comes with a number of challenges. To date, data has generally been procured manually and on a one-off basis (e.g. for a specific report). In addition, time-consuming ‘data cleaning’ is usually required as part of the effort to collate and standardise data in order to construct a national picture. Further, methodological changes can make it difficult to get a good handle on whether things are getting better or worse from report to report.⁵⁴

In an attempt to address some of these challenges, CRIs have often been contracted to collate and make sense of the data.⁵⁵ Despite these efforts, problems can still arise during the quality assurance process managed by Stats NZ.⁵⁶ When this happens, Stats NZ staff need to go back to the CRI and/or data provider (often through MfE staff) to seek clarification and/or ask for extra analysis. In the past, poor data procurement specifications have led to the need for multiple clarifications, which is a time-consuming business. For that reason, recent discussions between MfE and Stats NZ have led to an arrangement that gives Stats NZ an equal role in data procurement.⁵⁷

The scope of domain and synthesis reports to date has been determined by MfE staff in consultation with experts.⁵⁸ When data relating to each environmental indicator has been selected and assessed to the satisfaction of the Government Statistician, the narrative explaining and interpreting the findings has typically been drafted by MfE staff, technical advisors, science experts and contracted technical writers.⁵⁹

The division of responsibilities between MfE and Stats NZ has made report production a somewhat fraught affair with significant overlap between the two agencies. While MfE has mainly been responsible for shaping the headline issues and the report’s narrative, design and presentation, and report publication, both agencies have been responsible for articulating insights and key findings. In addition, both agencies have been responsible for checking consistency and accuracy – with Stats NZ leading the consistency checking of indicator statistics in the reports and MfE leading consistency checking of the body of evidence material.

⁵⁴For example, trend assessment methodologies used to establish water quality trends have changed between *Environment Aotearoa 2015* and *Environment Aotearoa 2019* due to improvements in statistical procedures.

⁵⁵NIWA has been contracted on a regular basis to collate and analyse water quality data. For example, see Larned et al., 2018.

⁵⁶For example, metadata is often lacking (description, history, variable detail and definition, methodologies).

⁵⁷Stats NZ officials, pers. comm., April 2019.

⁵⁸Note that Stats NZ staff attended the meetings with technical experts and had their say in the selection of environmental indicators.

⁵⁹For example, the writing of *Environment Aotearoa 2019* involved a process of iterative exchanges between an external writer and the science panel. Note that the approach to writing reports has varied over the years.

Adjusting responsibilities in line with the proposed changes to reporting

The Government Statistician and Stats NZ

The recent arrangement to give Stats NZ an equal role in data procurement represents an improvement in the current procurement process. However, I question the wisdom of not having the “lead agency for government-held data” managing the data procurement process for core environmental indicators. Making Stats NZ responsible for routine data procurement related to these core environmental indicators would also align well with the new role of the Government Statistician as the Government’s Chief Data Steward.⁶⁰

Of course, deciding *what* data to procure involves scientific expertise, understanding of the monitoring system design and judgements about the usefulness of collecting some types of data rather than others. This is why the development of a dedicated core set of environmental indicators for the purposes of national environmental reporting becomes so important.

Making judgements about what that core set needs to embrace is squarely within the expertise of MfE. But once the dedicated core set of environmental indicators has been agreed and developed, Stats NZ should be responsible for routine data procurement to support the ongoing process of updating the core indicators and maintaining the associated online platform. The expertise of Stats NZ in ensuring robust methodologies is critical for ensuring that the procured data is of good quality and can be confidently used.⁶¹

In addition, from a technical angle there are a number of initiatives that need to be implemented for the platform to provide timely and regular updates of environmental indicators. For example, data collection needs to be standardised across providers to ensure data is collected and recorded in a consistent way.

Automated systems also need to be set up to allow data to be uploaded or extracted from data providers and stored and managed appropriately.⁶² Furthermore, updated datasets need to be analysed and statistical outputs (graphs, tables) produced using specialist statistical software. This will enable efficient analysis and reduce the potential for error associated with the manual handling and manipulation of large datasets.⁶³

⁶⁰In 2017, the Government Statistician was designated as the Government Chief Data Steward, and Stats NZ as the lead agency for government-held data. “As the lead for data, Stats NZ’s role is to facilitate. [They are] supporting government agencies to build their capability and manage the data they hold as a valuable strategic asset.” See <https://www.stats.govt.nz/about-us/data-leadership>.

⁶¹For example, due to poor data quality, lack of standardisation and patchy geographical coverage, the actual freshwater takes data will not be used to produce an indicator for the upcoming *Our Fresh Water 2020* report, despite having been procured (Stats NZ officials, pers. comm., August 2019).

⁶²Note that automatic data retrieval directly from regional council servers was trialled in 2019. This is a promising start. Further, Stats NZ could assist other organisations with the co-design of upgrades to key IT infrastructure and systems to enable automation and customised data requests. This will ensure appropriate storage and management of data, as well as timely processing of data.

⁶³Stats NZ is in the process of building a standardised code system to enable efficient handling and analysis of large datasets.

Stats NZ, as the “lead agency for government-held data”, is well placed to take a leading role in implementing procedures for automated data handling and analysis and other technical initiatives to further develop the online platform. Several tools and initiatives are currently being developed, including a data investment framework.⁶⁴

To this end, Stats NZ should work with the data providers and draw on MfE staff and experts as needed. While Stats NZ has a high level of ‘data literacy’, ongoing capability building in the field of environmental data will be highly beneficial.

It is important that the production of the theme-based commentaries and state of the environment reports is kept at arm’s length from the Government of the day. The Environmental Reporting Act already requires the Government Statistician and the Secretary for the Environment to act independently of any Minister of the Crown.⁶⁵ This should continue.

In addition, the Government Statistician and Stats NZ should retain an approval function of future commentaries and reports. I envisage that this function would be similar to the current responsibilities of checking indicator statistics, specifically:

- checking the accuracy and consistency of any statistics used in commentaries and reports
- providing advice to ensure the relevant interpretation does not overstep the bounds of what can be meaningfully drawn from these statistics.

The Secretary for the Environment and Ministry for the Environment

In my view, the Secretary for the Environment and MfE, as the stewards for New Zealand’s environment, should be responsible for producing the theme-based commentaries and state of the environment reports. In doing so, they should maintain a team whose role it is, working with a standing science advisory panel (see below), to ensure ongoing production of commentaries and state of the environment reports.

As mentioned above, the frequency of these commentaries should not be linked to a rigid six-month cycle. Rather, it should be determined by the complexity of the task at hand. Further, commentaries and reports do not need to be published on the same day as the updates to the online platform.⁶⁶

As stated above, I believe that Stats NZ should be responsible for the routine data procurement for core environmental indicators. However, this does not preclude MfE from ad hoc procurement of data or research to inform the body of evidence material.⁶⁷

⁶⁴Stats NZ is currently developing several tools to help manage data as a valuable strategic asset. Relevant tools and initiatives include consistent data standards, a data stewardship framework, data capability hub, data investment framework and data strategy and roadmap. See <https://www.stats.govt.nz/about-us/data-leadership>.

⁶⁵See section 15 of the Environmental Reporting Act.

⁶⁶This should alleviate any practical challenges arising from the current arrangements, which see environmental indicators (subject to Tier 1 protocols) released at the same time as domain and synthesis reports. As the timing of the commentaries would be flexible under the proposed system, they could be released once the indicators have been updated. This arrangement would leverage the flexibility afforded by the proposed framework while still being supported by robust principles and protocols that help ensure the national reporting system is an authoritative source of robust information. Note that a degree of coordination between MfE and Stats NZ would still be required.

⁶⁷Note that any data procured and included for environmental reporting needs to meet the data quality standards.

In addition, MfE should be responsible for leading the development of a dedicated core set of environmental indicators for the purposes of national environmental reporting. The project to develop these core indicators should also include design of a national monitoring network as well as development of standardised methodologies for collecting data. This project will require collaboration to ensure the necessary scientific expertise and understanding of monitoring system design.

In preparing this report I have encountered a fear that discontinuing domain reports would lead to a ‘boom and bust’ cycle in which intense activity prior to the release of a report is followed by inactivity for much of the intervening period. A stop-start approach to reporting like this, it is said, could undermine institutional knowledge and expertise. I consider that such fears are unfounded.

In the interval between state of the environment reports, MfE staff will need to produce at least five commentaries, drawing on the advice of a standing science advisory panel (see below). In addition, leading the development of a dedicated core set of environmental indicators for the purposes of national environmental reporting is no small task.

While this work needs to start urgently, it is likely to take a couple of years to complete and implement. Furthermore, the interval between the publication of state of the environment reports should be an ideal time to prioritise and close major data and knowledge gaps, and undertake critical work to help address data challenges and improve consistency.

The Environmental Reporting Act already requires the Secretary for the Environment and the Government Statistician to act independently of any Minister of the Crown and ensure that reports are fair and accurate.⁶⁸ This should continue. In this way the reporting role is kept at arm’s length from the Government of the day.

A standing science advisory panel

For the production of *Environment Aotearoa 2019* the Secretary for the Environment was assisted by a senior science team. A science advisory panel of this type should be formally constituted under the Environmental Reporting Act as one of the ways the environmental reporting system is guaranteed a measure of independence. There are good precedents for the establishment of expert panels of this kind.⁶⁹

⁶⁸See sections 15 and 16 of the Environmental Reporting Act.

⁶⁹For example, the Animal Welfare Act 1999 includes two different expert advisory committees that make recommendations and advise on a variety of matters, including areas requiring further research. In addition, the Psychoactive Substances Act 2013 has an expert advisory committee to evaluate various products, with regard to the results of trials. The Environmental Protection Authority Act 2011 has a Māori Advisory Committee, which provides advice and assistance to the Environmental Protection Authority.

The role of the standing science advisory panel should be to advise the Secretary for the Environment on the:

- timing and focus of the theme-based commentaries
- environmental issues that should be given priority in state of the environment reports
- further research, monitoring and data needed to provide robust and comprehensive reporting.

In my view the panel should consist of five members whose collective expertise enables them to span the five overarching themes (discussed above). The senior science team established for the preparation of *Environment Aotearoa 2019* worked well and provides a useful starting point.

As the panel needs to provide scientific advice, panel members should have wide-ranging knowledge as well as significant scientific expertise in their respective fields. Most importantly, they need to know where expertise lies in the wider science community. In addition, panel members need to be impartial (i.e. not an advocate for any third-party organisations or their own research), collaborative (i.e. work to the common goal of producing the best commentary or report possible) and good science communicators.

The Secretary for the Environment should alone be responsible for appointing the members of the panel. This will ensure the panel is kept at arm's length from the Government of the day. The panel also needs to be adequately resourced to do its job.

Having the panel work closely with MfE should ensure that any advice is also cognisant of the wider environmental policy context and is relevant from a policy perspective. It will also widen the technical capability available for the agencies to draw on.⁷⁰

Giving voice to te ao Māori

In the preparation of *Environment Aotearoa 2019*, significant efforts were made to acknowledge the importance of te ao Māori, the Māori world view. The report states that te ao Māori “has an important place in environmental reporting in New Zealand and is intended to be a significant voice” in the report.⁷¹ While acknowledging that the Māori voices are not as strong as they could be, Māori researchers and practitioners were asked to comment on the “relevance of the nine [key] issues to mātauranga Māori, kaitiakitanga, and other cultural values”.⁷²

The attempt to incorporate the Māori world view appears to have borne most fruit in terms of impacts. Notably, the transformation of land use, the degradation of water quality and urban pollution are all identified as compromising cultural health and identity.⁷³

⁷⁰In the past, seconding scientists to the environmental reporting team at MfE was a useful way of increasing capability on a report-per-report basis.

⁷¹MfE and Stats NZ, 2019, p.6.

⁷²MfE and Stats NZ, 2019, p.10.

⁷³MfE and Stats NZ, 2019, pp.39, 61–62, 70.

To the extent that Māori are able to use state of the environment reports as evidence of environmental quality, they are likely to value them. It will be important going forward to ensure that issues of environmental concern to Māori are the subject of proper data collection. It is not hard to make the case that if the Treaty of Waitangi commits the Crown to protect certain taonga, then gathering information about their state is an important responsibility.

A number of things could be done to make future reports more relevant to a Māori audience. In particular, a way needs to be found to connect environmental issues with *place*. A people that sees itself as being of the land – literally tangata whenua – is likely to be more interested in actual places and sites of importance than national averages. The use of place-based case studies to illustrate the national-level issues being focused on could add richness to future reports.

Similarly, the existing online platform for environmental reporting could be expanded to include interactive maps that show actual places, boundaries and sites of importance. It will be important to ensure that Māori retain control of sensitive information, but if a bottom-up approach is taken (i.e. ensuring permission by Māori is granted), this information would be used for case-study purposes.

Case studies could also help underscore the interconnectedness of the physical, cultural and spiritual world as understood by Māori. The idea of *mauri*, and the environment as an organic, living entity, is a holistic one that struggles to emerge from the highly differentiated indicators that drive what is a science-based reporting system. Many non-Māori New Zealanders would also probably welcome a way to describe a more holistic account of ecological functioning that sits uneasily with whatever concepts – issues, themes, domains – have been used to simplify highly complex systems.

Mātauranga Māori

A separate question involves the extent to which the environmental reporting system should actually seek to embrace mātauranga Māori as part of its data and knowledge base.

Mātauranga Māori is the body of knowledge that has been generated and transmitted orally over many generations since the first Polynesians arrived in Aotearoa. The accumulated knowledge represents sustained and often extremely subtle observations. In the same way that Māori regard themselves as connected to and a part of the land, the knowledge that has been accumulated is often strongly related to place. It is the knowledge base that enabled Māori to manage their areas and sustainably use resources.

That knowledge would have been hard-won from the experience of settling and having to learn to live in a previously uninhabited land. For the 600-odd years before the arrival of Europeans, mātauranga Māori represents the only human record we have of the environment of these islands and their surrounding waters. For that reason alone, it is of immense importance. And it can be of highly practical contemporary importance (see box 4.1).

Box. 4.1: Contemporary use of mātauranga Māori**Pūrākau**

For mātauranga Māori to be passed down orally, several mechanisms were used to ensure the information was transmitted wholly and accurately. One way was through pūrākau (stories).

An example of mātauranga Māori passed down in pūrākau through the generations is the story of the Waitepuru stream in Matatā, Eastern Bay of Plenty. Dr Daniel Hikuroa retells the story to emphasise the use of observational information to make decisions on where to build marae.

The stream is referred to as a taniwha (in the form of a ngārara, lizard). The head, body and legs lie in the headwaters of the stream and the tail in the Rangitāiki Plains. It is said that the tail flicks from side to side.

The taniwha is used to signal the danger associated with the stream. Hikuroa explains that from a scientific perspective it is hard to understand a lizard being a sign of danger, but through a mātauranga Māori lens it makes sense.

“After large flood events, the channel in the headwaters maintained its location, whereas the channel on the low-lying section often changed its course. Over the course of many centuries therefore, the unconfined low-lying stream section moved back and forth from side to side.”⁷⁴

Thus the reference to a taniwha in the form of a ngārara has multiple meanings. It represents “an understanding of the physical geomorphology of the stream and its behaviour ... as well as acting as a warning of the inherent danger that the stream poses.”⁷⁵

When two debris flows smashed into Matatā in 2005, although a number of houses were destroyed, no marae were impacted.

Maramataka

The maramataka is a way to manage resources based on observations of the moon’s phases, movement of stars, tides and length of day and night.⁷⁶ In particular, the maramataka indicates when to harvest or collect certain types of kai, either cultivated or uncultivated.

It is more specific than seasonal cycles and details more accurate activities, for example, what day not to harvest kūmara. The maramataka is place-based and specific to an area.

⁷⁴Hikuroa, 2018, p.7.

⁷⁵Hikuroa, 2018, p.7.

⁷⁶Roberts et. al., 2006.



Source: Bernard Spragg, Flickr

Figure 4.7: Mātauranga Māori can be used for environmental monitoring. For example, Tūhoe have observed declines in kererū (wood pigeon) abundance in Te Urewera since the beginning of the 1900s.⁷⁷

There are, however, two problems. In the first place, mātauranga is itself at risk. Much knowledge has been lost or disregarded through colonisation, urbanisation and the loss of connection to place. This disconnection continues to be exacerbated by other regulations, policies and processes of local and central government.⁷⁸

Individuals that have mātauranga of a place are connected with that place physically and through whakapapa. Those who manage their use of resources in a place are practising kaitiakitanga. For kaitiaki to be able to manage the environment within te ao Māori, they need to be connected with the land. Where that connection has been broken or weakened, it must first be rebuilt. This will take time and cannot happen without the support of local government agencies and others charged with the management of the places involved.

Secondly, if mātauranga is generated in a place by kaitiaki, there is a question whether it is appropriate to have it rolled up into a national reporting system. Neither MfE nor Stats NZ, as government departments, are a part of te ao Māori. It is not appropriate for them to make decisions on the inclusion, value and acknowledgement of mātauranga. It is for Māori to offer it, and that will have to be on their terms. A place-based sharing of traditional knowledge probably makes more immediate sense with those institutions and agencies whose monitoring and research work is closer to people who are embedded in places.

⁷⁷Lyver et al., 2008.

⁷⁸Lyver et al., 2019.

However, given the significant gaps that exist in our current science-based description of the biophysical world in Aotearoa New Zealand and our uncertainty about so many connectivities and interdependencies in the ecological web, it seems intuitively unwise to deny ourselves access to any knowledge. Mātauranga is a precious record that can provide us with something complementary to the ecological connectedness that we assert – but frequently lack the data to describe.

In saying that, there have been attempts to incorporate contemporary mātauranga into a framework that will allow kaitiaki to monitor their places. For example, cultural health indicators have been developed for freshwater and coastal areas by Ngāi Tahu, Te Tau Ihu, Otago, Ngāti Kōwhiri, Ngāti Kere hapū and Ngāti Toa Rangitira. These regimes are relatively new and represent an innovative way of attempting to integrate mātauranga Māori and science together.

Initiatives like this are not limited to Māori. NIWA and some regional councils are working on the development of a national freshwater monitoring citizen science database that will allow citizens to record and store data in a consistent way. Bottom-up initiatives such as these are likely to give people living close to important environmental assets a sense of ownership that a national state of the environment reporting system cannot do.

This review is not the place to try to prescribe the way national-level agencies should seek to treat mātauranga. This is something MfE and Stats NZ need to pursue with Māori, building on the experience of *Environment Aotearoa 2019*.⁷⁹ Similarly, regional councils should continue to engage with their relevant iwi and hapū and develop relationships that provide the opportunity for Māori to connect to their places and monitor what is important to them.⁸⁰ Western science and mātauranga are complementary and will be used by Māori where they can add value.

Who should respond to state of the environment reports?

To date, state of the environment reports have been required to address pressures, states and impacts, but have stopped short of reporting on 'responses'. The Environmental Reporting Act is silent about the *response* component of the DPSIR framework.

It is appropriate that responses are not included in environmental reports themselves. Commentary on the effectiveness or adequacy of policy settings leaves the realm of data behind and enters the world of policy debate. Policy responses reflect political choices and are inevitably controversial. If the environmental reporting system is to be a trusted source of information, it is best kept at arm's length from controversy.

⁷⁹Note that MfE plans to progress te ao Māori development through an advisory group – but may use an existing forum if there is a commonality of expertise needed (MfE officials, pers. comm., September 2019).

⁸⁰There are legal mechanisms that could be used to support this. For example, under the RMA, iwi can request to have an agreement with local councils (refer sections 58L to 58U of the RMA). Outside of this, many regional councils have processes in place to support whānau, hapū and iwi to connect to place. However, these can always be improved by ensuring other council regulations, policies and procedures do not continue to disconnect them.

But that does not mean that the outputs of our environmental reporting system should not be responded to. On the contrary, if the purpose of such a system is, as I have suggested, to provide authoritative reporting on New Zealand's environment to enable evidence-based analysis and decision making, then we must expect a debate. If trends are headed in the wrong direction, questions should be asked about the effectiveness of our policy responses. The question is, by whom?

There are several possibilities – none of them mutually exclusive.

Civil society

The first respondents in a democracy should be civil society in its widest definition. Ordinary citizens, businesses, non-governmental organisations, community groups and elected officials both national and local are all stakeholders in the health of our environment. A robust debate rooted in impeccable reporting should be the best response we can hope for. But the debating power of those who seek to respond is not equal. There are vested interests. There is conflict between public and private goods. The risk is that they who shout loudest – or can tap the deepest pocket – will prevail. So is there a need for an arm's length commentary?

Parliamentary Commissioner for the Environment

This is where my role as Parliamentary Commissioner for the Environment comes in. Uniquely, New Zealand has created an office designed to give the environment a 'voice'. Under the current Environmental Reporting Act, the Commissioner has a discretionary role to "report on an environmental report and the processes that produced it."⁸¹

In truth, the Commissioner did not need this statutory discretion since the terms of the Environment Act 1986 are more than wide enough to encompass any regular or one-off environmental reporting that may be carried out – whether or not it is under a statutory instrument.⁸²

The history of the provision goes back to a much earlier debate about who should conduct environmental reporting itself. The original proposal was for reporting to be led by the Commissioner. The Commissioner at the time examined the pros and cons, noting that actually carrying out the reporting function could affect the independence of the office and would certainly have significant resourcing implications.⁸³

High-quality environmental reporting requires all the resources of a national statistical agency and the huge array of expertise that can be coordinated by a central government ministry such as MfE. The decision to have these agencies run the reporting system was in my view the right one.

⁸¹Section 18 of the Environmental Reporting Act 2015.

⁸²Section 16 of the Environment Act 1986.

⁸³PCE, 2011.

The discretionary nature of section 18 of the Environmental Reporting Act 2015 is the somewhat anaemic relic of that debate. The statutory independence of the Commissioner is of paramount importance, and leaving the power to comment discretionary is consistent with that. But in my view the Commissioner should be one of the people who comments on the adequacy of policies in the light of environmental reports.⁸⁴ Now that environmental reporting is firmly established, I for one intend to do so. In a sense, this report is one such response.

Relevant Ministers

Other key players well placed to respond are Ministers. Keeping politicians at arm's length from the production of state of the environment reports is a key element of the Environmental Reporting Act's design.⁸⁵

Section 7(2) of the Environmental Reporting Act requires that "As soon as is reasonably practicable after the Secretary and the Government Statistician have published a synthesis report, the Ministers must jointly present the report to the House of Representatives." However, there is no requirement to do anything further, or provide a formal response to the findings of the report.

A response from the Government could help formally close the loop by addressing the drivers and pressures that are responsible for any environmental degradation.

One way to achieve this would be to require the responsible Minister (likely to be the Minister for the Environment) to provide a formal response on behalf of the Government to the findings of the state of the environment reports within six months of the report being released.

For any issues (or concerning trends), this formal response may include comment on:

- what policies and initiatives *currently* exist
- what *new* policies and initiatives are proposed or planned
- what policy analysis the Government proposes to undertake to identify any other policies and initiatives that are needed.

Requiring a formal response from the Government is not unique. For example, in Victoria, Australia, reports on the state of the environment of Victoria are prepared by the Commissioner for Environmental Sustainability. In Victoria, once a report on the state of the environment is prepared, it is submitted to the Minister, who "must cause a copy of a Report on the State of the Environment of Victoria to be laid before each House of the Parliament within 10 sitting days" of receiving it.⁸⁶ Within 12 months of the report being laid before each House of Parliament, the Minister must provide a statement of the Government's response to any recommendations made in the state of the environment report.⁸⁷

⁸⁴Commentaries could also cover the effectiveness of current on-the-ground management practices.

⁸⁵The Act requires both the Secretary for the Environment and the Government Statistician to act independently from any Minister for the Crown. See section 15 of the Environmental Reporting Act.

⁸⁶See section 17(4) of the Commissioner for Environmental Sustainability Act 2003 (Australia).

⁸⁷See section 17(5) of the Commissioner for Environmental Sustainability Act 2003 (Australia).

5



Environmental reporting system and wellbeing

Environmental data is not collected for the sake of it. We collect data about the natural environment for the same reason that we collect data about the economy, the education system, or people's health: these things matter for our wellbeing.

This idea is central to the current Government's approach to fiscal policy, the essence of which is that public spending should be prioritised according to its likely impacts on wellbeing. In short, the Government should focus on those things that matter the most for its citizens, both present and future.

Explicitly recognising that wellbeing depends on a range of factors, including environmental quality, social connections and safety, as well as more conventional economic factors, is a welcome development. But putting this philosophy into action in day-to-day policymaking requires a great deal of information.

New Zealand's environmental reporting system will require considerable investment if it is to provide sufficient information to enable policymakers to evaluate and prioritise public policy with wellbeing in mind.

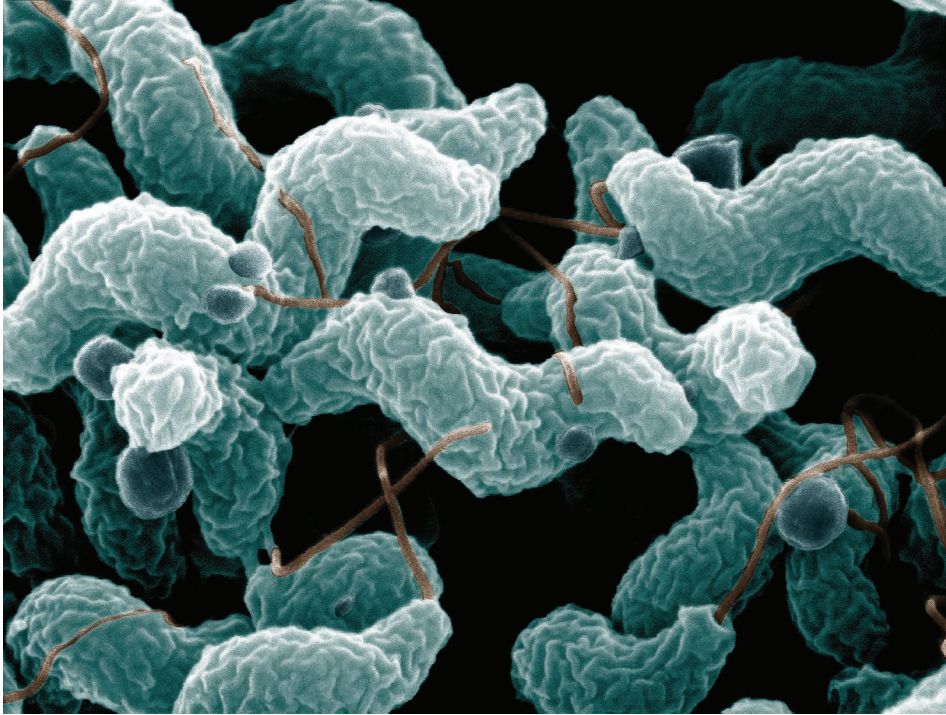
The link between the natural environment and wellbeing

There is an increasing awareness amongst New Zealanders that the natural environment is fundamental to their wellbeing. The relationship makes intuitive sense. A clean environment supplying air, water and food that is uncontaminated will support healthy lives. Degrading and polluting the natural environment undermines and jeopardises our own wellbeing now and into the future.

The link between the environment and wellbeing is often most visibly highlighted when acute disease or discomfort is linked to environmental degradation. Threats to human health often provide the most potent reminders of our dependence on the natural environment.

For example, in August 2016, a large campylobacteriosis outbreak occurred in Havelock North due to faecal contamination of the town's drinking water supply. It was estimated that 5,500 of the town's 14,000 residents became ill with the water-borne disease. Furthermore, up to four deaths were associated with the outbreak.

The total social and economic costs resulting from the campylobacteriosis outbreak, excluding loss of life, have been estimated at around \$21 million. These costs related to lost productivity due to sick leave, lost leisure time, the household inconvenience of having to boil water and the necessity of buying bottled water.¹



Source: Wikimedia Commons

Figure 5.1: Campylobacter infection, or campylobacteriosis, is an infectious disease caused by Campylobacter bacteria (shown here). The Havelock North outbreak provided a potent reminder of our dependence on the natural environment.

Clear recognition of the link between the environment and wellbeing in a case like this illustrates the twofold importance of environmental reporting, as reporting provides insight into the health of the environment and, in turn, our own wellbeing.

Unfortunately, despite some recognition of the link between the environment and wellbeing, it is yet to be consistently embedded in the policy process. This may be, in part, because the relationship between wellbeing and the environment is rarely as direct as it was in the case of the Havelock North outbreak. More often, the links are less well-understood and the nature of the harm cumulative over time rather than dramatic.

¹ Moore et al., 2017.

The use of environmental data: an application to fiscal policy

In 2018, the Government announced an alternative approach to fiscal policy – one that explicitly places the wellbeing of New Zealanders – current and future – at the core of decisions about how fiscal resources are allocated. More recently, the Government has proposed that the Public Finance Act be amended so that consideration of wellbeing becomes a formal part of the annual budget process.²

Four key ideas lie at the heart of this wellbeing approach. The first is that those aspects of our lives where improvements would contribute the most to wellbeing (e.g. education, health, income, environment, housing) should be those where public spending is targeted.³ The second is that the wellbeing of future generations should be considered alongside that of the current generation when decisions about public spending are made. The third is that cost-benefit analysis, along with a set of complementary tools, should be used to select the initiatives that might drive the greatest improvement in the ‘things that matter most’ at the least cost.⁴ The fourth is that the success of these initiatives should be rigorously assessed following their implementation to establish what works and what we can learn from experience.

Establishing what aspects of life make the greatest contributions to wellbeing and directing public resources to initiatives that are likely to be the most cost-effective is a welcome development. It represents a serious attempt to ensure that policy development is informed by evidence, can be demonstrated to be in the public interest, and improves value for money as perceived by the public at large.

However, the proposed approach is also one that requires a great deal more information than the traditional policy process relies on. Fragmented environmental data and a lack of knowledge about the functioning of biophysical systems also have implications for other policy functions. How can we prioritise action on problems we cannot properly describe? How can we assess future risks when we do not have a reliable idea of the way trends have evolved up to now?

Prioritising what we do

If public money is to be spent according to its potential contribution to wellbeing, then policymakers need to know something about the relative contribution of different aspects of life to wellbeing. For example, how much would New Zealanders value an incremental improvement in education outcomes relative to an equivalent improvement in environmental quality?

² Parliamentary Counsel Office. 2019. Public Finance (Wellbeing) Amendment Bill. <http://www.legislation.govt.nz/bill/government/2019/0173/latest/LMS254601.html>.

³ In a speech in 2019, the Minister of Finance stated: “The Budget priorities have been developed on the basis of a wellbeing analysis. We have looked at the evidence to assess where we have the greatest opportunities to make a difference to New Zealanders’ wellbeing and we have focused our efforts on those opportunities” (Robertson, 2019, p.8).

⁴ The 2019 Treasury guidance for agencies preparing budget bids states: “You will need to provide a fit-for-purpose CBA [cost-benefit analysis] for all initiatives, with a focus on identifying and quantifying impacts of initiatives to support a wellbeing analysis and providing a well-evidenced and robust intervention logic, rather than focussing on factors such as return on investment (RoI) or benefit-cost ratio.” (Treasury, 2018a, p.14).

Understanding the links between environmental quality, other constituents of wellbeing, and wellbeing itself is a pre-condition for prioritising public policy according to ‘what matters most’.

If policymakers do not have access to information highlighting the multiple sources of value that the environment provides, they can hardly be expected to prioritise spending to protect it. Empirical research is required to provide evidence of the links between environmental quality and wellbeing. But this work is itself reliant on the availability of environmental data. Researchers will find it difficult to determine the contribution of environmental quality to wellbeing if the data and knowledge gaps outlined in section three are not addressed.

Forward-looking risk assessment

Maintaining the natural environment is critical for current wellbeing, but also for ensuring the wellbeing of future generations. The extent to which natural resources can be safely depleted in pursuit of building up other desirable assets is at the heart of a long-standing debate about what ‘sustainable development’ entails.⁵ Any deterioration in the availability or quality of natural assets will restrict the development pathways available to future generations, as well as limiting their ability to meet their needs.

In practice, the risks that environmental degradation pose for the wellbeing of future generations have been difficult to incorporate in the forward-looking documents that the Treasury is required to produce.

Previous Investment Statements have focused almost exclusively on the Crown’s portfolio of built and financial assets. Despite their importance for future wellbeing – and the fact that a significant proportion remains in Crown ownership – relatively little attention has been directed towards the natural environment.⁶ Similar issues are relevant for the Statements on the Long-Term Fiscal Position, despite the risk that environment degradation poses to the Government’s finances.⁷

The Treasury is well aware of these issues, but highlights data gaps as a key barrier to further progress. The shortcomings of the environmental indicators of future wellbeing that have been included in the Living Standards Framework Dashboard are one illustration of this issue (see box 5.1). Further, in the 2016 Statement on the Long-Term Fiscal Position, the Treasury stated: “In particular, resource management could be improved by building a better evidence base to assess the state of our natural resources, the value derived from them, rate of change, and return on investments.”⁸

⁵ There are essentially two variants: Strong sustainability is characterised by a non-declining stock of natural capital, and weak sustainability is characterised by a non-declining stock of all capital. It acknowledges that, in certain cases, there may be some degree of substitutability between different capital stocks. For example, see PCE, 2002, pp.34–35.

⁶ That said, the 2018 edition did discuss the implications that the Living Standards Framework might have for future Investment Statements. It included a section – entitled “Pursuing distant horizons” – that examined how natural capital could be incorporated (The Treasury, 2018b, pp.67–82).

⁷ For example, on the revenue side of the ledger, lost soil productivity or water degradation will impinge on the profitability of several of New Zealand’s key primary sectors, and on the tax revenues that flow from them. On the spending side, adapting to the disruptions likely to result from climate change – rising sea levels and more frequent extreme weather events, for example – is likely to place significant demands on government accounts.

⁸ The Treasury, 2016, p.48.



Source: Jeff Hitchcock, Flickr

Figure 5.2: One way the natural environment contributes to the wellbeing of New Zealanders is by providing a setting for recreational activities. Environmental reporting can provide insight into the health of the environment and, in turn, our own wellbeing.

Box 5.1: The Living Standards Framework Dashboard: an illustration of poor-quality environmental data

The Living Standards Framework (LSF) Dashboard uses six indicators to capture information on the state of the natural environment: biodiversity and genetic resources, climate regulation, natural hazard regulation, soil quality, drinking water quality and waste generation. According to the Treasury, these were initially prioritised based on their relationship to “future wellbeing, investment required to develop the indicator, policy relevance, sensitivity to change and current investment.”⁹

The natural environment module of the LSF Dashboard has several notable shortcomings. First, it is not clear that the environmental indicators that have been selected are those that relate most strongly to future wellbeing. For example, despite their likely importance for future generations, no indicators of abiotic resource depletion (i.e. minerals, energy carriers, soils), the loss of land to urbanisation or the drawdown of fossil water stocks are included in the LSF Dashboard.

Second, it is not clear which environmental asset some of the indicators relate to. For example, does the waste generation indicator relate to the depletion of New Zealand’s abiotic resources (that are used in the production of products that eventually become waste) or to the loss of undeveloped land that is associated with the construction of landfills?

Third, the indicators that have been chosen to describe each of the environmental assets of interest are not always well suited. For example, the proportion of people with access to drinking water that meets all standards is a very questionable proxy for freshwater quality. Access to drinking water of a particular quality often depends just as much on investments in treatment facilities as it does on the state of the underlying water resource.

Finally, even if the six indicators included in the LSF Dashboard did reflect the six outcomes that relate most strongly to future wellbeing and were all good indicators, it is not clear that they are the only important things that need to be measured. While the Indicators Aotearoa New Zealand (IANZ) data platform is seen as the basis for populating the LSF Dashboard in the future, it is currently plagued by extensive data gaps. As of September 2019, only 9 of the 24 natural capital indicators contained in IANZ were populated with data.¹⁰

⁹ The Treasury, 2018c, p.37.

¹⁰ Stats NZ, 2019.

Beyond environmental data: what else might be required?

The availability of timely and accurate environmental data is essential for effective policy design and evaluation. Policymakers need to know something about where environmental damage is taking place, how quickly it is occurring and what is causing it. In short, the environmental data gaps identified in section three represent a real barrier to the implementation of the Government's wellbeing approach.

But while improved environmental data is a necessary condition for the implementation of the Government's wellbeing approach, it may not be sufficient.¹¹ If public spending is to be allocated according to its likely contribution to wellbeing, then the process needs to be supported by an improved understanding of the links between the aspects of life that constitute wellbeing. This is particularly the case for the environment, which not only contributes directly to wellbeing but also is a key driver of other important aspects, such as income, employment, health and cultural identity.

Policymakers also need a means to compare the gains and losses of competing policy proposals across the various 'things that matter most'. This has traditionally been the domain of cost-benefit analysis that relies on being able to value environmental services in monetary terms to provide a basis for comparisons. However, many environmental goods and services are not traded in markets – valuing them relies on methods that can be expensive and involve considerable uncertainty (e.g. willingness-to-pay surveys or choice experiments).

Questions about the appropriateness of using monetary values for the environment, and the feasibility of alternative analytical approaches that use environmental data directly to support policymaking, need to be addressed if the environment is to be more than a placeholder in the current approach to constructing wellbeing budgets.

Understanding how environmental data and indicators can be better used in policy processes to support improvements to current and future wellbeing risks being left in the too-hard basket. For that reason, I plan to produce a sequel to this report to examine these issues in greater depth.

¹¹The OECD states: "Well-being policy makes new demands on the evidence base, and the research response will take time to build. Much of the evidence will be generated outside of government departments, and perhaps even New Zealand itself, so evidence demands must be stated clearly, and communicated effectively. Signalling a long-term commitment to using well-being evidence will enable actors within the evidence pipeline to invest in the long-term resources needed to meet these demands" (OECD, 2019, p.96).

6

Recommendations

Recommended amendments to the Environmental Reporting Act 2015:

1. I recommend that the Government prepares a Bill to amend the Environmental Reporting Act 2015 as follows:

a. Amend the purpose clause to read:

The purpose of this Act is to require authoritative reporting on New Zealand's environment that describes:

- the drivers of change;
- the pressures on natural and physical resources;
- the current state of the environment;
- how the state of the environment has changed, and the impacts the changes have had;
- how the state of the environment may change in the future, and the impacts those changes are likely to have –

to enable the evidence-based analysis and decision making needed to achieve effective stewardship of the environment.

b. Retain regular state of the environment (synthesis) reports but produce them every six years, with the first state of the environment (synthesis) report produced in 2025.

c. Require state of the environment (synthesis) reports to include drivers and outlooks (in addition to pressures, states and impacts).

d. Require state of the environment (synthesis) reports to include commentary on five overarching themes:

- land
- freshwater and marine environment
- biodiversity and ecosystem functioning
- pollution and waste
- climate change and variability.

These themes should replace the Environmental Reporting (Topics for Environmental Reports) Regulations 2016. The current regulation-making power should also be dispensed with.

e. Replace domain reports with theme-based commentaries that meet the following requirements:

- Producing such commentaries should be mandatory.
- They should be produced in the interim between state of the environment (synthesis) reports, but not to a fixed timetable.
- Their frequency should be largely determined according to the availability of new information.
- Their subject matter should be able to cover more than one thematic area where it is appropriate to do so.
- At a minimum, each theme should form the basis for a commentary at least once in the interval between state of the environment (synthesis) reports.
- The length of these commentaries should be determined by the complexity of the task at hand.

f. Adjust the responsibilities of the Secretary for the Environment and the Government Statistician:

- The Secretary for the Environment should be responsible for producing both the state of the environment (synthesis) reports and the theme-based commentaries.
- The Government Statistician should have an approval function in respect of both the state of the environment (synthesis) reports and the theme-based commentaries.

g. Establish a standing science advisory panel:

- A standing science advisory panel should be established, with the role of providing independent, expert advice (both on request and on its own initiative) to the Secretary for the Environment on:
 - the timing and focus of the theme-based commentaries
 - the environmental issues that should be given priority in state of the environment (synthesis) reports
 - further research, monitoring and data needed to provide robust and comprehensive reporting.
- The Secretary for the Environment should be responsible for appointing the members of the standing science advisory panel.

h. Provide for a shift from passive to active information gathering:

- Define a set of core environmental indicators and provide for the core indicators to be set out in regulations.
- The Government Statistician (with input from the Secretary for the Environment) should then be required to collect the data needed to construct and regularly update the core environmental indicators.

i. Add a requirement for the Government to provide a formal response to the state of the environment (synthesis) reports:

Require the responsible Minister (likely to be the Minister for the Environment) to provide a formal response on behalf of the Government to the findings of state of the environment (synthesis) reports within six months of the report being released.

For any issues (or concerning trends) this formal response may include comment on:

- what policies and initiatives *currently* exist
- what *new* policies and initiatives are proposed or planned
- what policy analysis the Government proposes to undertake to identify any other policies and initiatives that are needed.

Recommendations that do not require amendments to the Environmental Reporting Act 2015:

2. Adjust the role of the Government Statistician:

The Government Statistician should be responsible for:

- the routine procurement of data needed to construct the core environmental indicators
- the further development and maintenance of the online environmental reporting platform
- implementing procedures for automated data handling and analysis.

3. Adjust the role of the Secretary for the Environment:

The Secretary for the Environment should be responsible for:

- appointing the members of the standing science advisory panel
- seeking and considering advice from the panel
- producing state of the environment (synthesis) reports and theme-based commentaries
- the procurement of research and any other evidence required to provide broader context
- leading the development of the dedicated set of core environmental indicators.

4. Develop a comprehensive environmental monitoring system:

The Minister for the Environment should task his or her officials with leading the development of a comprehensive, nationally coordinated environmental monitoring system.

This work should draw on input from the standing science advisory panel and Stats NZ, as well as suitable experts from local government, central government agencies and Crown Research Institutes.

In particular:

- a comprehensive and representative national monitoring network should be designed and implemented to ensure systematic, coordinated and consistent monitoring across the country
- the development of a nationally coordinated monitoring system should be properly resourced
- a standardised and consistent approach to collecting, managing and analysing data should be developed, made publicly available and made mandatory.

Once the data collection standards have been set, the Secretary for the Environment and the Government Statistician should be required to see that they are implemented within five years.

5. Develop a nationally mandated strategy to progressively fill in known data gaps:

The Minister for the Environment and the Minister of Statistics should jointly task their officials with leading the development and implementation of a nationally mandated strategy to ensure that environmental data gaps in relation to key environmental issues are progressively filled.

In particular:

- the data gaps documented in the domain and synthesis reports published to date should be prioritised
- past efforts (e.g. *Environment domain plan 2013*) should provide a starting point
- existing initiatives (e.g. data investment framework) should be leveraged
- suitable experts from local government, central government agencies and Crown Research Institutes should be involved
- the division of labour and the fair distribution of costs between different levels of government should be consciously agreed and assigned
- the Secretary for the Environment and the Government Statistician should be required to report within 12 months on progress and see that the strategy is implemented.

6. Bridge knowledge gaps:

The Minister for the Environment and the Minister of Research, Science and Innovation should jointly task their officials to report within 12 months on the best way to link New Zealand's environmental reporting system with the science system to ensure that key knowledge gaps are incrementally closed.

7. Allocate dedicated resourcing:

The Minister of Finance, together with the Minister for the Environment and the Minister of Statistics, should determine the investment required to deliver the recommended improvements to New Zealand's environmental reporting system, the fair distribution of costs between central and local government and the time frame over which a multi-year funding proposal would need to extend to deliver them.

The investment case should cover:

- a comprehensive, nationally coordinated environmental monitoring system, including the development of a dedicated set of core environmental indicators and the design and maintenance of the necessary monitoring networks
- a standardised and consistent approach to collecting, managing and analysing data
- a nationally mandated strategy to ensure that known environmental data gaps are progressively filled
- the development and maintenance of a fit-for-purpose national online reporting platform
- the maintenance of a standing science advisory panel and the preparation of theme-based commentaries and regular state of the environment reports.



Appendices

Appendix 1: Inconsistencies galore

Indicators of faecal contamination are a prime example of data that is collected by different providers and for different reasons, resulting in datasets that are difficult to collate or compare due to multiple layers of inconsistencies.

When data is collected for different reasons

Escherichia coli (*E. coli*) is considered the most specific indicator of faecal contamination in freshwater because it is “nearly always found in high numbers in the gut of humans and warm blooded animals”.¹

Most, if not all, regional councils collect *E. coli* data. However, they collect it for two different reasons:

- to inform the public of the suitability of various freshwater locations for swimming
- to assess the state of water quality in various fresh waterways.

As a result, two different monitoring networks or programmes are run:

1. A recreational water quality programme designed to inform the public of the suitability of various locations for swimming or other forms of recreation involving primary contact with the water.
 - Site selection is based on knowledge of popular swimming sites.
 - Sites are generally sampled weekly, but only over the summer months (December–March).
 - Ministry for the Environment (MfE) and Ministry of Health microbiological water quality guidelines specify two trigger values that guide management responses:
 - A sample > 260 and ≤ 550 colony-forming units per 100 millilitres (cfu/100 ml) triggers an ‘alert level’ that requires increased monitoring and investigation of source.
 - A sample > 550 cfu/100 ml triggers an ‘action level’ that requires public warnings as well as increased monitoring and investigation of source.²

¹ Perrie et al., 2012, p.133.

² MfE and Ministry of Health, 2003.

2. A rivers and streams state of the environment programme designed to assess the state of water quality in various fresh waterways.
 - Sites are generally chosen to represent major land uses and human activities, as well as the natural diversity of rivers and streams.
 - Sites are sampled monthly over the entire year.
 - Results may be assessed against the National Policy Statement for Freshwater Management (national bottom lines),³ regional plan targets and/or the ANZECC and ARMCANZ (2000)⁴ guideline value of ≤ 100 cfu/100 ml.⁵

When data is collected by different providers

Inconsistencies also occur due to the differences in specific approaches taken by different monitoring agencies. These inconsistencies can occur at all levels, including planning and design, field sampling, analysis and reporting. To illustrate, some of the major issues related to recreational water quality monitoring are outlined below.⁶

Site selection

Different councils select sites based on different rationales. For example:

- Environment Canterbury bases site selection on general knowledge of popular recreation sites – both those used for swimming as well as those used primarily for boating and/or fishing (a secondary contact activity as opposed to swimming, which is a primary contact activity).
- Auckland Council selects sites based on a risk matrix, which includes site use, the type of activity generally undertaken (i.e. primary versus secondary contact activities), contamination risk (including confidence in the data) and cultural significance.
- Greater Wellington Regional Council, in consultation with Regional Public Health and local authorities, selects sites based on knowledge of popular swimming sites.

There is no standard protocol for site selection, and councils often lack a formal procedure for site selection, with many relying on anecdotal information of where the most popular spots are.

Sampling frequency and duration

While most sites are sampled weekly, there are some exceptions, and the length of the monitoring season varies between regions. For example:

- Auckland Council monitors weekly from 1 November to 31 March (approx. 22 weeks)

³ MfE, 2017.

⁴ Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ), 2000.

⁵ Perrie et al., 2012, p.20.

⁶ Information sourced from Bolton-Ritchie et al., 2013.

- Greater Wellington Regional Council monitors fortnightly from 1 December to 31 March (approx. 18 weeks)
- Environment Canterbury monitors weekly from mid-November to early March (approx. 15 weeks).⁷

Indicator type

In freshwater, *E. coli* is the preferred indicator. For coastal environments (saltwater), enterococci are the preferred indicator. Historically there has been some uncertainty when it comes to estuaries and brackish waters. For example:

- Environment Canterbury monitors both *E. coli* and enterococci, and bases its analyses and results on the worst result
- Auckland Council uses enterococci in tidal streams, but *E. coli* in coastal lagoons
- Northland Regional Council monitors enterococci and faecal coliforms.

However, a draft coastal guideline recently completed by NIWA now sets out clear guidance on brackish water, which agencies should be adopting as best practice going forward.

Sample collection and rainfall

The MfE and Ministry of Health guidelines are relatively precise about where in a waterway samples should be taken, at what depth they should be collected, and procedures for ensuring samples are not contaminated by the collector. However, there is currently no National Environmental Monitoring Standard specifically for recreational water quality sampling, and differences in sampling techniques likely still occur. For example, collection of samples can be done by hand or by using what is called a 'mighty grabber'.

Whether or not to sample during rainfall events probably remains the principle area of difference in practice between councils. Many councils agree that sampling regimes should not be biased to exclude rainfall events, yet the Taranaki Regional Council routinely avoids monitoring sites during rainfall events (i.e. it will delay monitoring if a rainfall event happens to occur on the regular sampling day).

Further, what constitutes a rainfall event differs between councils. For example, Auckland Council uses 20 millimetres in 24 hours, whereas Hawke's Bay Regional Council uses 10 millimetres in 24 hours.

Analytical methods

The MfE and Ministry of Health guidelines specify several approved analytical methods – the two most popular being the:

- Enterolert™/Colilert™ test, which measures the most probable number (MPN) – used by Auckland Council and Environment Canterbury
- membrane filtration method, which counts colony-forming units (CFUs) – used by Greater Wellington Regional Council.⁸

⁷ Greater Wellington Regional Council officials, pers. comm., August 2019.

⁸ MfE and Ministry of Health, 2003.

Currently it is unclear whether one method is more appropriate than the other, nor is it known whether historical data is able to be correlated and combined with new data should a council change methods.

Further, there are known testing issues – different laboratories can get different results from the exact same sample, and even the same laboratory can deliver inconsistent results.

Analysis and reporting

As noted above, sample results can be reported individually or used to calculate a Suitability for Recreation Grade (SFRG), made up of two components – a Microbial Assessment Category (MAC) and a Sanitary Inspection Category (SIC).⁹ However, in recent years there has been a move to drop the SIC component and just report the MAC. Currently Land, Air, Water Aotearoa (LAWA) bases the overall bacterial risk of a site on the MAC.¹⁰

Possibly the area of most contention is how to deal with the influence of rainfall-related data at freshwater sites (note that rainfall does not tend to have the same effect on coastal sites, so the following only applies to freshwater sites).

Some councils (e.g. Taranaki Regional Council) have effectively excluded the influence of rainfall, as they only sample in dry weather. Other councils, including Environment Canterbury and Greater Wellington Regional Council, have developed their own processes to derive both a 'dry weather grade' as well as an 'all weather grade' to reveal the influence and additional risk of recreating in or immediately following a rainfall event.¹¹

Even the process for including or excluding wet weather data can differ.¹² For example, Greater Wellington Regional Council only includes data collected during river flow conditions at or below three times the median flow. Whereas Environment Canterbury uses a more subjective approach where science staff assess results against peak flows and water clarity to decide whether or not to exclude the data point.

In Greater Wellington Regional Council publications designed for the general public (i.e. report cards), only the dry weather grades are published – the rationale being that people are unlikely to swim in poor weather, so a dry weather grade better represents the actual times that people are more likely to be swimming. Yet for the same sites, LAWA displays the 'all weather' grades.

Where wet weather results are reported, some councils may provide rainfall averages to provide context for their results, and some may also report the percentage of samples exceeding the guideline that are related to rainfall events.

⁹ MfE and Ministry of Health, 2003.

¹⁰ LAWA, 2018.

¹¹ Greater Wellington Regional Council, 2017, p.7.

¹² Greater Wellington Regional Council officials, pers. comm., August 2019.

Appendix 2: Regional council monitoring network density

Information on the number of sites sourced from the relevant councils. Note that this table only displays data for selected types of monitoring – particularly those that are more aligned with traditional state of the environment monitoring networks.

Table A2.1: North Island

	Northland Regional Council	Auckland Council	Waikato Regional Council	Bay of Plenty Regional Council	Gisborne District Council	Hawke's Bay Regional Council	Taranaki Regional Council	Horizons Regional Council	Greater Wellington Regional Council
Population (percentage of NZ total) ⁱ	179,100 (4%)	1,695,900 (35%)	468,800 (10%)	305,700 (6%)	49,100 (1%)	165,900 (3%)	119,600 (2%)	243,700 (5%)	521,500 (11%)
Land area km ² (percentage of NZ total) ⁱⁱ	12,498 (5%)	4,938 (2%)	23,902 (9%)	12,071 (5%)	8,386 (3%)	14,137 (5%)	7,254 (3%)	22,220 (8%)	8,049 (3%)
Population density (population/km ²)	14	343	20	25	6	12	16	11	65
2018 rates revenue \$ (000) ⁱⁱⁱ	20,915	1,715,225	85,034	39,570	55,154	19,323	9,478	40,648	122,788
# air quality sites	3	10	8	16	1	3	1	2	6
# river/stream SOE sites (WQ) ^{iv}	73	42	120	50	47	75	13	142	45
# river/stream SOE sites (ecological) ^v	70	72	265	118	81	75	59	74	60
# lakes monitored	27	5	38	12	1	5	1	15	5
# groundwater quality sites	32	9	90	47	57	74	24	35	66
# soil quality sites	30	141	151	70	0	86	20	41	118

Note: Percentage figures have been rounded.

ⁱ Data source <http://nzdotstat.stats.govt.nz/wbos/Index.aspx?DataSetCode=TABLECODE7501&ga=2.9010229.1001763861.1565214417-328979220.1557453910> [data extracted 3 October 2019].

ⁱⁱ Data source www.localcouncils.govt.nz/lcip.nsf/wpg_URL/Profiles-Councils-by-Type-Index.

ⁱⁱⁱ Data source www.localcouncils.govt.nz/lcip.nsf/wpg_URL/Profiles-Councils-by-Type-Index.

^{iv} Refers to sites that are monitored for physiochemical variables, usually monthly – note some of these sites may also be monitored for ecological health (i.e. macroinvertebrates and other biological variables).

^v Refers to sites that are monitored for ecological health (i.e. macroinvertebrates), usually once or twice annually – note some of these sites may also be monitored for physiochemical variables.

Table A2.2: South Island

	Tasman District Council	Nelson City Council	Marlborough District Council	Environment Canterbury	West Coast Regional Council	Otago Regional Council	Environment Southland
Population (percentage of NZ total) ^{vi}	52,100 (1%)	51,900 (1%)	46,600 (1%)	624,200 (13%)	32,600 (1%)	229,200 (5%)	99,100 (2%)
Land area km ² (percentage of NZ total) ^{vii}	9,616 (4%)	424 (0.2%)	10,458 (4%)	44,508 (17%)	23,244 (9%)	31,209 (12%)	31,195 (12%)
Population density (population/km ²)	5	122	4	14	1	7	3
2018 rates revenue \$ ('000) ^{viii}	71,018	62,163	62,886	97,624	4,180	20,909	15,682
# air quality sites	1	4	1	11	1	7	4
# river/stream SOE sites (WQ) ^{ix}	26	30	34	141	37	106	60
# river/stream SOE sites (ecological) ^x	26	30	50	183	32	36	94
# lakes monitored	0	1	0	42	3	8	7
# groundwater quality sites	11	0	14	329	28	51	34
# soil quality sites	35	15	96	300	0	0	19

Note: Percentage figures have been rounded.

^{vi} Data source <http://nzdotstat.stats.govt.nz/wbos/Index.aspx?DataSetCode=TABLECODE7501&ga=2.9010229.1001763861.1565214417-328979220.1557453910> [data extracted 3 October 2019].

^{vii} Data source www.localcouncils.govt.nz/lcip.nsf/wpg_URL/Profiles-Councils-by-Type-Index.

^{viii} Data source www.localcouncils.govt.nz/lcip.nsf/wpg_URL/Profiles-Councils-by-Type-Index.

^{ix} Refers to sites that are monitored for physiochemical variables, usually monthly – note some of these sites may also be monitored for ecological health (i.e. macroinvertebrates and other biological variables).

^x Refers to sites that are monitored for ecological health (i.e. macroinvertebrates), usually once or twice annually – note some of these sites may also be monitored for physiochemical variables.

Key to tables A2.1 and A2.2

	Denotes a unitary authority responsible for all activities in the region	
	= High density of monitoring sites compared to other regions	For air quality: at least 1 site per 2,000km ² For river water quality: at least 1 site per 200km ² For river ecology: at least 1 site per 150km ² For lakes: at least 1 lake per 1,000km ² For groundwater quality: at least 1 site per 250km ² For soil quality: at least 1 site per 100km ²
	= Moderate density of monitoring sites compared to other regions	For air quality: 1 site per 2,000–5,000km ² For river water quality: 1 site per 200–300km ² For river ecology: 1 site per 150–300km ² For lakes: 1 lake per 1,000–3,000km ² For groundwater quality: 1 site per 250–550km ² For soil quality: 1 site per 100–200km ²
	= Low density of monitoring sites compared to other regions	For air quality: less than 1 site per 5,000km ² For river water quality: less than 1 site per 300km ² For river ecology: less than 1 site per 300km ² For lakes: less than 1 lake per 3,000km ² For groundwater quality: less than 1 site per 550km ² For soil quality: less than 1 site per 200km ²
	= No monitoring sites	



References

- Bolton-Ritchie, L., Greenfield, S., Madarasz-Smith, A., Milne, J., Stevenson, M. and Walker, J. 2013. *Recreational water quality: A practitioner's discussion on the limitations of the 2003 national guidelines*. Report No. RM 16-57. Napier: Hawke's Bay Regional Council. <https://www.hbrc.govt.nz/assets/Document-Library/Publications-Database/4876-Recreational-Water-Quality-A-Practitioners-Discussion-on-the-Limitations-of-the-2003-National-Guidelines-2013.pdf> [Accessed 12 August 2019].
- Booker, D. and Whitehead, A. 2018. Inside or outside: Quantifying extrapolation across river networks. *Water Resources Research* 54(9): 6983–7003.
- Cavanagh, J., Munir, K., McNeil, S., and Stevenson, B. 2017. *Review of soil quality, including trace elements, state of the environment monitoring programme*. Lincoln: Landcare Research. Prepared for Hawke's Bay Regional Council. <http://envirolink.govt.nz/assets/Envirolink/Reports/1757-HBRC226-Review-of-soil-quality-and-trace-element-State-of-the-Environment-monitoring-programmes.pdf> [Accessed 9 October 2019].
- Cheyne, J. 2017. *Australasian bittern (matuku) and spotless crane (puweto) survey: Eastern and southern wetlands Wairarapa Moana*. Wellington: Greater Wellington Regional Council. <http://www.gw.govt.nz/assets/Biodiversity/GWRC-Bittern-Report-Spring-2017.pdf> [Accessed 4 October 2019].
- Controller and Auditor-General. 2019. *Managing freshwater quality: Challenges and opportunities*. Wellington: Controller and Auditor-General. <https://oag.govt.nz/2019/freshwater-quality/docs/freshwater-quality.pdf> [Accessed 30 September 2019].
- Dymond, J. and Ausseil, A.-G.E. 2019. An ecosystem services approach to choosing environmental indicators for state of environment reports. *New Zealand Science Review* 75(2–3): 43–51.
- European Environment Agency (EEA). 1999. *Environmental indicators: Typology and overview*. Technical report No 25. Copenhagen: EEA. <https://www.eea.europa.eu/publications/TEC25> [Accessed 12 August 2019].
- European Environment Agency (EEA). 2015. *About SOER 2015*. Copenhagen: EEA. <https://www.eea.europa.eu/soer-2015/about/about-soer-2015> [Accessed 3 October 2019].

- European Union. 2014. *General Union environment action programme to 2020: Living well, within the limits of our planet*. Luxembourg: Publications Office of the European Union. <https://publications.europa.eu/en/publication-detail/-/publication/1d861dfb-ae0c-4638-83ab-69b234bde376> [Accessed 15 October 2019].
- Freshwater Science and Technical Advisory Group. 2019. *Freshwater Science and Technical Advisory Group: Report to the Minister for the Environment*. Wellington: MfE. <https://www.mfe.govt.nz/sites/default/files/media/Fresh%20water/freshwater-science-and-technical-advisory-group-report.pdf> [Accessed 10 October 2019].
- Goldson, S.L., Bourdôt, G.W., Brockerhoff, E.G., Byrom, A.E., Clout, M.N., McGlone, M.S., Nelson, W.A., Popay, A.J., Suckling, D.M. and Templeton, M.D. 2015. New Zealand pest management: Current and future challenges. *Journal of the Royal Society of New Zealand* 45(1): 31–58.
- Greater Wellington Regional Council (GWRC). 2017. *Is it safe to swim? Recreational water quality monitoring results for 2016/17*. Wellington: GWRC. <http://www.gw.govt.nz/assets/Our-Environment/Environmental-monitoring/Environmental-Reporting/Recreational-Water-Quality-Annual-Report-2017FINAL.pdf> [Accessed 3 October 2019].
- Hartley, L. and Greene, T. 2012. *Birds: Incomplete counts – five-minute bird counts*. Christchurch: Department of Conservation. <https://www.doc.govt.nz/globalassets/documents/science-and-technical/inventory-monitoring/im-toolbox-birds-incomplete-five-min-counts.pdf> [Accessed 10 October 2019].
- Hikuroa, D. 2018. *Mātauranga Māori – The ūkaipō of knowledge in New Zealand*. Policy Briefing 1/2018. Auckland: University of Auckland. <https://cdn.auckland.ac.nz/assets/auckland/arts/our-research/research-institutes-centres-groups/ppi/policy-briefings/maatauranga-maori.pdf> [Accessed 9 October 2019].
- Intergovernmental and Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). 2018. *Summary for policymakers of the regional assessment report on biodiversity and ecosystem services for Asia and the Pacific of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services*. Bonn: IPBES. https://www.ipbes.net/system/tdf/spm_asia-pacific_2018_digital.pdf?file=1&type=node&id=28394 [Accessed 13 August 2019].
- Jackson, W.J., Argent, R.M., Bax, N.J., Bui, E., Clark, G.F., Coleman S., Cresswell, I.D., Emmerson, K.M., Evans, K., Hibberd, M.F., Johnston, E.L., Keywood, M.D., Klekociuk, A., Mackay, R., Metcalfe, D., Murphy, H., Rankin, A., Smith, D.C. and Wienecke, B. 2017. *Australia state of the environment 2016: Overview*. Canberra: Australian Government Department of the Environment and Energy. <https://soe.environment.gov.au/sites/default/files/soe2016-overview-launch-version328feb17.pdf?v=1488792535> [Accessed 13 August 2019].
- Land, Air, Water Aotearoa (LAWA). 2018. *Factsheet: What do the swim icons mean?* 12 February 2018. <https://www.lawa.org.nz/learn/factsheets/what-do-the-swim-icons-mean/> [Accessed 4 October 2019].

Larned, S., Whitehead, A., Fraser, C., Snelder, T. and Yang, J. 2018. *Water quality state and trends in New Zealand rivers: Analyses of national data ending in 2017*. NIWA client report no. 2018347CH. Christchurch: NIWA. <https://www.mfe.govt.nz/sites/default/files/media/Fresh%20water/water-quality-state-and-trends-in-nz-rivers.pdf> [Accessed 16 August 2019].

Lyver, P.O.B., Taputu, T.M., Kutia, S.T. and Tahi, B. 2008. Tūhoe Tuawhenua mātauranga of kererū (*Hemiphysalis novaezealandiae novaezealandiae*) in Te Urewera. *New Zealand Journal of Ecology* 32(1): 7–17.

Lyver, P.O.B., Timoti, P., Davis, T. and Tylianakis, J.M. 2019. Biocultural hysteresis inhibits adaptation to environmental change. *Trends in Ecology & Evolution* 34(9): 771–780.

Martínez-Abraín, A. 2008. Statistical significance and biological relevance: A call for a more cautious interpretation of results in ecology. *Acta Oecologica* 34(1): 9–11.

McGuinness Institute. 2009. *A history of government-funded science 1865–2009. Background report to Report 9: Government-funded science under the microscope*. Wellington: McGuinness Institute. <http://www.mcguinnessinstitute.org/wp-content/uploads/2016/08/Project-2058-Report-9a-Web.pdf> [Accessed 10 October 2019].

Ministry for the Environment (MfE). 2017. *National policy statement for freshwater management 2014*. Wellington: MfE. <https://www.mfe.govt.nz/publications/fresh-water/national-policy-statement-freshwater-management-2014-amended-2017> [Accessed 23 October 2019].

Ministry for the Environment (MfE). 2019a. *About New Zealand's Greenhouse Gas Inventory*. Wellington: MfE. <https://www.mfe.govt.nz/climate-change/state-of-our-atmosphere-and-climate/new-zealands-greenhouse-gas-inventory/about-new> [Accessed 2 September 2019].

Ministry for the Environment (MfE). 2019b. *Action for healthy waterways: A discussion document on national direction for our essential freshwater*. Wellington: MfE. <https://www.mfe.govt.nz/publications/fresh-water/action-healthy-waterways-discussion-document-national-direction-our> [Accessed 5 October 2019].

Ministry for the Environment (MfE) and Ministry of Health. 2003. *Microbiological water quality guidelines for marine and freshwater recreational areas*. Wellington: MfE. <https://www.mfe.govt.nz/sites/default/files/microbiological-quality-jun03.pdf> [Accessed 2 October 2019].

Ministry for the Environment (MfE) and Statistics New Zealand. 2015. *Departmental report on the Environmental Reporting Bill 2014*. Wellington: MfE and Statistics New Zealand. https://www.parliament.nz/resource/en-NZ/51SCLGE_ADV_00DBHOH_BILL12994_1_A422639/0fdc955f04b88f24e07faf93769a71f31e230fcf [Accessed 10 October 2019].

Ministry for the Environment (MfE) and Stats NZ. 2016. *Topics for environmental reporting*. Wellington: MfE and Stats NZ. https://www.mfe.govt.nz/sites/default/files/media/Environmental%20reporting/topics-for-environmental-reporting_0.pdf [Accessed 13 August 2019].

Ministry for the Environment (MfE) and Stats NZ. 2017a. *Good practice guide for environmental reporting*. Wellington: Stats NZ. <https://www.stats.govt.nz/methods/good-practice-guide-for-environmental-reporting> [Accessed 13 August 2019].

Ministry for the Environment (MfE) and Stats NZ. 2017b. *New Zealand's Environmental Reporting Series: Our atmosphere and climate 2017*. Wellington: MfE and Stats NZ.

Ministry for the Environment (MfE) and Stats NZ. 2018a. *New Zealand's Environmental Reporting Series: Our air 2018*. Wellington: MfE and Stats NZ.

Ministry for the Environment (MfE) and Stats NZ. 2018b. *New Zealand's Environmental Reporting Series: Our land 2018*. Wellington: MfE and Stats NZ.

Ministry for the Environment (MfE) and Stats NZ. 2019. *New Zealand's Environmental Reporting Series: Environment Aotearoa 2019*. Wellington: MfE and Stats NZ.

Ministry for Primary Industries (MPI) and Ministry for the Environment (MfE). 2019. *Valuing highly productive land: A discussion document on a proposed national policy statement for highly productive land*. Wellington: MPI. <https://www.mpi.govt.nz/dmsdocument/36624/direct> [Accessed 2 September 2019].

Moore, D., Drew, R., Davies, P. and Rippon, R. 2017. *The economic costs of the Havelock North August 2016 waterborne disease outbreak*. Wellington: Sapere Research Group Ltd. https://www.health.govt.nz/system/files/documents/publications/havelock_north_outbreak_costing_final_report_-_august_2017.pdf [Accessed 13 August 2019].

National Environmental Monitoring Standards (NEMS). 2018. *Uptake survey: Summary of responses and comments*. Wellington: NEMS.

Office of the Minister for the Environment. 2013a. *Environmental Reporting Bill Cabinet paper*. 31 July 2013. Wellington: MfE. <https://www.mfe.govt.nz/sites/default/files/environmental-reporting-bill-cabinet-paper.pdf> [Accessed 15 October 2019].

Office of the Minister for the Environment. 2013b. *Environmental Reporting Framework Cabinet paper*. 16 October 2013. Wellington: MfE. <https://www.mfe.govt.nz/sites/default/files/environmental-reporting-framework-cabinet-paper.pdf> [Accessed 15 October 2019].

Organisation for Economic Co-operation and Development (OECD). 2015. *OECD environmental performance reviews: The Netherlands*. Paris: OECD Publishing. <https://www.oecd-ilibrary.org/docserver/9789264240056-en.pdf?expires=1569559358&id=id&accname=oid044683&checksum=268A8221FE1E534C568B3DF1DBFE3CE1> [Accessed 27 August 2019].

Organisation for Economic Co-operation and Development (OECD). 2017. *OECD environmental performance reviews: New Zealand 2017*. Paris: OECD Publishing. <https://www.oecd-ilibrary.org/docserver/9789264268203-en.pdf?expires=1565913417&id=id&accname=oid044683&checksum=B328BCF66FAD791CEDE9E33575BB820C> [Accessed 16 August 2019].

Organisation for Economic Co-operation and Development (OECD). 2019. *OECD economic surveys: New Zealand 2019*. Paris: OECD Publishing. <https://www.oecd-ilibrary.org/docserver/b0b94dbd-en.pdf?expires=1570053839&id=id&accname=oid044683&checksum=261A09751F24574745BAC64CD0AC3641> [Accessed 27 August 2019].

Parliamentary Commissioner for the Environment (PCE). 2002. *Creating our future: Sustainable development for New Zealand*. Wellington: PCE.

Parliamentary Commissioner for the Environment (PCE). 2010. *How clean is New Zealand? Measuring and reporting on the health of our environment*. Wellington: PCE.

Parliamentary Commissioner for the Environment (PCE). 2011. *Measuring up: Environmental Reporting. Discussion document submission*. Wellington: PCE.

Parliamentary Commissioner for the Environment (PCE). 2015a. *Environmental reporting regulations: Submission to the Minister for the Environment and the Minister of Statistics*. Wellington: PCE.

Parliamentary Commissioner for the Environment (PCE). 2015b. *The state of air quality in New Zealand: Commentary by the Parliamentary Commissioner for the Environment on the 2014 Air Domain Report*. Wellington: PCE.

Parliamentary Commissioner for the Environment (PCE). 2016. *The state of New Zealand's environment: Commentary by the Parliamentary Commissioner for the Environment on Environment Aotearoa 2015*. Wellington: PCE.

Perrie A., Morar S., Milne J.R. and Greenfield S. 2012. *River and stream water quality and ecology in the Wellington region: State and trends*. Publication No. GW/EMI-T-12/143. Wellington: Greater Wellington Regional Council. <http://www.gw.govt.nz/assets/Our-Environment/Environmental-monitoring/Environmental-Reporting/River-and-Stream-Water-Quality-and-Ecology-SoE-report.pdf> [Accessed 12 August 2019].

Productivity Commission. 2019. *Local government funding and financing: Draft report*. Wellington: Productivity Commission. https://www.productivity.govt.nz/assets/Documents/21e9d8fde3/ProdCom_Draft-report_Local-government-funding-and-financing-v5.pdf [Accessed 12 August 2019].

Ray, S. and McArthur, N. 2019. *New Zealand bird atlas handbook*. Blenheim: Wildlife Management International Ltd. <https://birdatlas.co.nz/assets/dc2b79d2d0/New-Zealand-Bird-Atlas-Handbook-version-2.pdf> [Accessed 4 October 2019].

Roberts, M., Weko, F. and Clarke, L. 2006. *Maramataka: The Maori moon calendar*. Research report No. 283. Lincoln: Lincoln University. https://researcharchive.lincoln.ac.nz/bitstream/handle/10182/155/aeru_rr_283.pdf?sequence=3&isAllowed=y [Accessed 13 August 2019].

Robertson, G. 2019. *Applying a wellbeing approach to the public financing system*. Speech to the Institute of Public Administration New Zealand (IPANZ). 21 February 2019. https://ipanz.org.nz/Attachment?Action=Download&Attachment_id=150280 [Accessed 4 October 2019].

- Statistics New Zealand. 2007. *Principles and protocols for producers of Tier 1 statistics*. Wellington: Statistics New Zealand. http://archive.stats.govt.nz/about_us/who-we-are/home-statisphere/tier-1/principles-protocols.aspx [Accessed 8 October 2019].
- Statistics New Zealand, Ministry for the Environment (MfE) and Department of Conservation (DOC). 2013. *Environment domain plan 2013: Initiatives to address our environmental information needs*. Wellington: Statistics New Zealand. http://archive.stats.govt.nz/browse_for_stats/environment/environmental-economic-accounts/environment-domain-plan.aspx [Accessed 9 October 2019].
- Stats NZ. 2018a. *National accounts (industry production and investment): Year ended March 2017*. Wellington: Stats NZ. [https://www.stats.govt.nz/information-releases/national-accounts-industry-production-and-investment-year-ended-march-2017#targetText=In%20the%20year%20ended%20March,\(up%20from%2052%20percent\)](https://www.stats.govt.nz/information-releases/national-accounts-industry-production-and-investment-year-ended-march-2017#targetText=In%20the%20year%20ended%20March,(up%20from%2052%20percent)) [Accessed 2 October 2019].
- Stats NZ. 2018b. *Tourism satellite account: 2018*. Wellington: Stats NZ. <https://www.stats.govt.nz/information-releases/tourism-satellite-account-2018> [Accessed 2 October 2019].
- Stats NZ. 2019. *Ngā Tūtohu Aotearoa – Indicators Aotearoa New Zealand. Wellbeing data for New Zealanders: Natural capital*. Wellington: Stats NZ. <https://wellbeingindicators.stats.govt.nz/en/natural-capital/> [Accessed 27 September 2019].
- The Treasury. 2016. *He Tirohanga Mokopuna – 2016 Statement on the Long-Term Fiscal Position*. Wellington: The Treasury. <https://treasury.govt.nz/sites/default/files/2016-11/tfs-16-htm.pdf> [Accessed 27 September 2019].
- The Treasury. 2018a. *Budget 2019: Guidance for agencies*. Wellington: The Treasury. <https://treasury.govt.nz/sites/default/files/2018-12/budget19-guidance.pdf> [Accessed 27 September 2019].
- The Treasury. 2018b. *He Puna Hao Pātiki: 2018 Investment Statement*. Wellington: The Treasury. <https://treasury.govt.nz/sites/default/files/2018-03/is18-hphp-wellbeing.pdf> [Accessed 27 September 2019].
- The Treasury. 2018c. *Our people our country our future: Living standards framework: Background and future work*. Wellington: The Treasury. <https://treasury.govt.nz/sites/default/files/2018-12/lstf-background-future-work.pdf> [Accessed 27 September 2019].
- United Nations Statistics Division (UNSD). 2013. *Framework for the development of environmental statistics (FDES 2013)*. Series M No. 92. New York: UNSD. <https://unstats.un.org/unsd/environment/FDES/FDES-2015-supporting-tools/FDES.pdf> [Accessed 12 August 2019].
- United Nations. 1992. *Convention on Biological Diversity*. <https://www.cbd.int/doc/legal/cbd-en.pdf> [Accessed 27 September 2019].
- van Dijk, A., Mount, R., Gibbons, P., Vardon, M. and Canadell, P. 2014. Environmental reporting and accounting in Australia: Progress, prospects and research priorities. *Science of the Total Environment* 473–474: 338–349.

