Ministry for the Environment
Manatū Mō Te Taiao

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Ministry for Primary Industries
Manatū Ahu Matua

Update on impact analysis for the *Essential Freshwater* Package February 2020

Date Submitted:	28 February 2020	Tracking #: 2020-B-06410	
Security Level	In confidence	MfE Priority:	Non-Urgent

	Action sought:	Response by:
To Hon David Parker, Minister for the Environment	Note	N/A
To Hon Damien O'Connor, Minister of Agriculture	Note	N/A
CC Hon Nanaia Mahuta, Associate Minister for the Environment	Note	N/A

Actions for Ministers' Office Staff	**Return** the signed report to MfE.
Number of appendices and attachments 2	Appendix 1: National impacts of nutrient proposals Appendix 2: How the rate of MFP growth was selected

Ministry for the Environment contacts

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Update on impact analysis for the *Essential Freshwater* Package February 2020

Purpose

1. On 21 November 2019 we provided you with an update on impact analysis for the *Essential Freshwater* package. Following this update, in the week of 9 December 2019 officials met with Minister Parker to discuss the approach. Minister Parker sought further clarification about several matters. This paper provides:
    a. A summary of environmental modelling for nutrients recently produced by NIWA
    b. Further information about matters on which Minister Parker sought clarification:
        i. Assessing the benefits of the *Essential Freshwater* package
        ii. Assuming new technologies and farm systems rather than static models and the value of the "green" premium
        iii. Assumptions being used in agencies' economic modelling
        iv. The peer review process.

Context

2. Ministers will be asked to make decisions on the *Essential Freshwater* package in the first half of 2020. To support these decisions, we intend to produce two key products outlining the impacts of these proposals:
    a. a summary report and slides to use in your conversations with colleagues. This will provide an indication of the scale of the social, economic and environmental benefits and costs of the package as a whole, focussing on the key policy areas.
    b. a regulatory impacts analysis, which will provide more in-depth analysis on the overall impact of the package as a whole as well as the impacts of each of the individual policies (this report will also contribute to the requirements under Section 32 of the Resource Management Act 1991). Much of this work is already included in the interim regulatory impact analysis produced for consultation.
3. The modelling work currently underway will inform both of these products.
4. Officials are preparing a set of slides to present to Ministers O'Connnor and Parker on 6 March 2020 which presents the impact analysis findings to date. This information will be preliminary and only include some of the reports.
5. We intend to provide a more complete set of slides presenting the impact analysis to joint Ministers on 16 March 2020.

Summary of environmental modelling for nutrients by NIWA

6. Environmental modelling is both important to assess the costs and benefits of the *Essential Freshwater* package, and a critical input to the economic modelling which will provide the impacts on sectors, regions and the economy as a whole. This economic modelling is in turn critical to assessing the social impacts and the impacts on Māori.
7. MfE recently received a report from NIWA which estimates:

- the nutrient reduction required to meet current National Policy Statement for Freshwater Management (NPS-FM) 2017 bottom lines for river periphyton, lake total nitrogen, lake total phosphorus and lake and river nitrate toxicity
- the extra nutrient reduction required to meet the Science and Technical Advisory Group's (STAG's) proposed NPS-FM bottom lines for DIN and DRP.

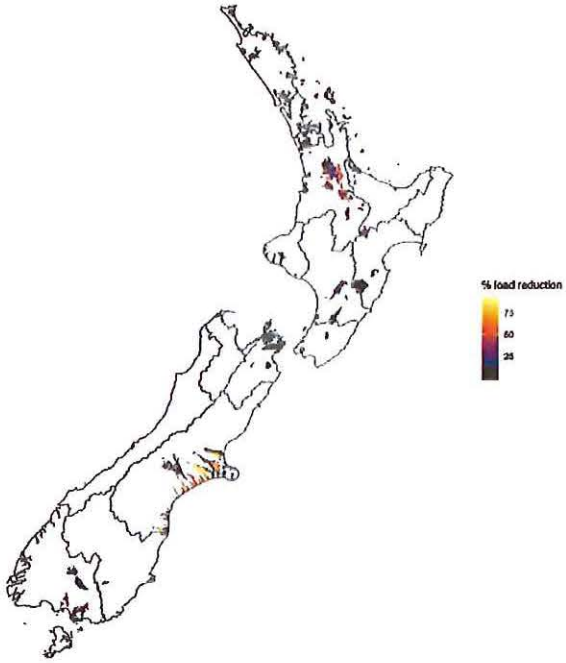
Regional impact of nutrient proposals

8. The maps below show the N and P load reduction under the *Essential Freshwater* package (over and above that required for the NPS-FM 2017). They show that in most parts of the country the nutrient proposals have a modest marginal impact over and above the current NPS-FM 2017 requirements (assuming periphyton is managed to a 20% spatial exceedance criteria). Areas in purple are those that need only small load reductions, while those in yellow need higher load reductions.

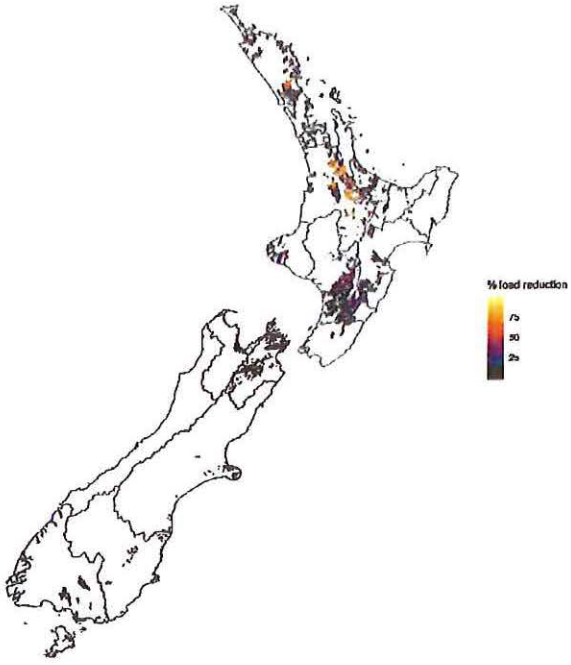
- Nitrogen loads would have to reduce by approximately 3% relative to the baseload under the *Essential Freshwater* package (over and above that required for the NPS-FM 2017). Regionally, the greatest impacts are in Canterbury (9.2%) and Waikato (6.7%).
- Phosphorous loads would have to reduce by approximately 1.7% relative to the baseload under the *Essential Freshwater* package (over and above that required for the NPS-FM 2017). Regionally, the greatest impacts are in Northland, Waikato and Manawatu-Wanganui.[1]
- The overall load reductions required to meet both the NPS-FM 2017 and proposed DIN and DRP bottom lines are larger. Nationally nitrogen loads need to be reduced by 13% and phosphorous by 4%. The largest overall regional load reductions are in Canterbury (41% reduction in nitrogen).

[1] These maps use 20% spatial exceedance. If 10% spatial exceedance is used, then most of the areas where low levels of reductions would be required (dark purple), would not need to reduce nutrient levels (e.g. Manawatu-Wanganui would only require a 0.1% reduction in phosphorous).

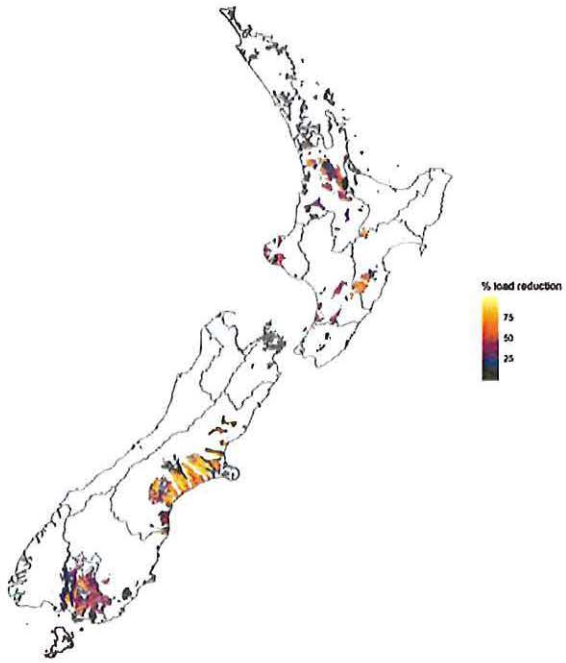
Marginal N load reduction with 20% periphyton



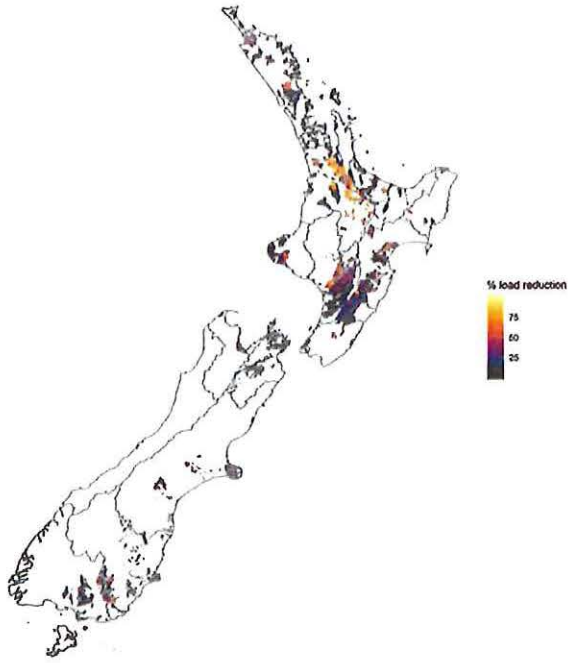
Marginal P load reduction with 20% periphyton



N load reduction with 20% periphyton & DIN



P load reduction with 20% periphyton & DRP



Modelling approach

9. The testing requires assumptions about the level of risk councils will accept that a randomly-chosen site will fail to meet the bottom line for periphyton. This is referred to as "spatial exceedance".

10. We expect that the approaches councils are taking will fall within a range from 10% to 30%. NIWA has already tested two periphyton "spatial exceedance" criteria of 10% and 20%. We have commissioned further work to test a third spatial exceedance criteria of 30%.

11. Officials are reviewing the approaches councils are currently taking to spatial exceedance, and we expect this to be completed by 3 March 2020. The results of this testing may then be used for further economic analysis.

12. A separate NIWA review of the method of estimating the periphyton bottom line found that the approach taken by the Ministry was logical and was based on the best available science, and that our estimates can be improved upon as new monitoring data becomes available. STAG also supported the approach being used.

13. At a national scale the choice between 10% and 20% spatial exceedance criteria has very little impact on the additional nutrient load reduction in the proposed NPS-FM, however, the choice of spatial exceedance criteria significantly affects the size of the nutrient load reduction required to meet the periphyton bottom line contained in the current NPS-FM 2017 (see appendix 1 for further detail).

Further information about matters on which Minister Parker sought clarification

Assessing the benefits of the *Essential Freshwater* package

14. All of the impact analysis projects for the *Essential Freshwater* package will comment on and where possible quantify both the costs and the benefits of the package.

15. There are also two reports MfE has commissioned specifically focussing on the benefits from the Essential Freshwater package. The regulatory impact analysis includes information on the environmental benefits of the package and this will be included in the summary report we are producing to aid your conversations with colleagues.

16. The first will focus on the cumulative impacts and co-benefits of policy interventions in water, climate change and biodiversity (and other policy areas as relevant eg highly productive land and RBNZ capital requirements changes). Particular focus is being given to impacts on rural communities as well as the co-benefits to climate change outcomes from freshwater policy changes, and vice-versa.

17. The second report focusses on identifying and collating the benefits of each of the individual policies, for example downstream benefits of reduced sedimentation of harbours and estuaries.

18. MPI is currently analysing the magnitude of any potential premium for environmentally-friendly product attributes in different markets for different products and how this can be transmitted back through the value chain to producers. In addition, MPI is currently reviewing information on any potential premium for environmentally-friendly products. Officials have also met with Tourism Industry Aotearoa which has provided information on the importance of clean water and the impact of declining water quality on a range of tourism industries. This provides a good narrative as well as some figures about the benefits of good water quality.

The premium from environmentally-friendly production

19. MBIE funds Lincoln University through the Endeavour fund to research premiums for New Zealand products, including "green" premiums. The focus of this work is not specifically on

premiums for water quality, but Lincoln University's Professor Saunders has agreed to provide a synthesis of available information on this topic. MfE has worked with MBIE to commission this work which is due to be delivered in the week ending 7 March 2020.

20. MfE has had discussions with Treasury, MBIE and MPI about the potential for further work on the scope for further work on identifying the value to New Zealand of "green" credentials. A number of questions have been raised in this space including: whether any notional green premium would differ based on the type of product involved (ie commodities vs. products with higher value added); whether a green premium would apply at a firm or country level; and, if there are significant markets where there are barriers to entry from failing to meet minimum environmental standards. We will provide you with further advice on this issues by the end of March 2020.

Assuming new technologies and farm systems rather than static models and the value of the "green" premium

21. In his meeting with officials in mid-December, Minister Parker queried whether the models would use positive assumptions around new technology and whether they would use static assumptions in modelling. Our intention is to use three scenario runs in the CGE modelling, to reflect differences in:

- availability and effectiveness of technology
- rate of adoption of mitigations
- price premium for "green" products.

22. The agencies overseeing the economic impact assessment work (MfE, MPI, Treasury and MBIE) agreed that three scenarios would be used, with varying assumptions about annual growth rates of multifactor productivity ('MFP') distinguishing the scenarios.

23. For the *Essential Freshwater* economic impact assessment three assumptions about MFP growth over the next 30 years (2020 to 2050) will be applied:

    a. MFP increases by 0.25% per annum ('conservative' scenario)
        - In 30 years for the same inputs producers would receive 8% more profit
    b. MFP increases by 1% per annum ('central' scenario)
        - In 3 years for the same inputs producers would receive 35% more profit
    c. MFP increases by 1.75% per annum ('optimistic' scenario)
        - In 30 years for the same inputs producers would receive 70% more profit.

24. The reason we intend to use MFP is that MFP reflects the value added that producers generate after taking account (typically) of the costs of labour, capital and materials they utilise in production. This means it will include: available technology that affects mitigation costs; the proportion of businesses taking advantage of the best available technology; consumers' willingness to pay for different attributes (for example, paying a premium for sustainably-produced goods and services - a "green" premium); and the quality of governing institutions.

25. The NPS-FM provides significant flexibility for councils and communities on: what rules regional councils will set in response to the reforms; and how farmers, consumers and urban residents will respond to the rules put in place by regional councils. Providing a range of costs helps to illustrate the range of costs possible due to this flexibility.

How the rate of MFP growth was selected

26. Officials reviewed a range of reports both agricultural specific and whole of economy, and both domestic and international. As a reasonableness check on the potential for MFP growth in the agricultural sector, we looked to emerging (but not yet commercially applied) technologies (Further information on the approach taken is included in appendix 2).
27. Based on the review of reports on MFP, supported by the estimated impact of new technologies, officials intend to include in the central estimate an MFP increase of 1% per annum.
28. To illustrate the potential impacts, officials intend to present more conservative and more optimistic scenarios. Based on the OECD reviews, it is considered unreasonable to assume a zero or negative MFP growth over the long term, and so a rate of 0.25% per annum has been chosen for the conservative scenario. To prevent bias in the presentation of the figures and ensure that the central scenario is central, the optimistic scenario will use 1.75% per annum.
29. This approach will be discussed with the Freshwater Leaders Group on Monday 2 February.

Assumptions being used in agency's economic modelling

30. For the economic modelling, in addition to the three scenarios set out above, we intend to use two baselines described further below. An important issue for the counterfactuals is how time and environmental degradation will be reflected in the assessment.

Overall approach to the impact assessment

31. Key outputs of the impact assessment will include:
    - Impacts by region and industry focussing on farm profits, farm production and land-use change as a result of having to comply with the most significant proposals in the *Essential Freshwater* package (nutrient bottom lines, sediment bottom lines, *E.coli* for swimming bottom lines and stock exclusion);
    - Impacts on water treatment spending for town/urban populations;
    - Impacts of both of the above on regional GDP and employment;
    - In combination with the social impact work stream, estimates of the impact of the package other than what can be expressed through GDP (for example, population health, quality of life, cultural values);
    - In combination with the Māori impacts project, impacts (economic and well-being) on Māori communities; and
    - Sensitivity results for a given scenario – for example, how would the regional profit impact vary if different assumptions were made about how many estimated kilometres of fencing are currently effective and/or actually in place?

How the scenarios will be reflected

32. The estimated economic impact on rural land users is essentially driven by three key factors:
    a. Estimates of the current pollution load
    b. Estimates of how much the load will have to reduce

(for example a given percentage load reduction is typically expected to lead to an equivalent, matching percentage reduction in nutrient concentration)

c. Estimates of the cost to achieve a given load reduction

(relying on assumptions about how much a given mitigation (or a number of mitigations) reduces the load by (reduced pollution per hectare), how much it costs to implement (cost per hectare), what existing profit is foregone ('opportunity costs' per hectare) and what, if any, new revenue is produced (revenue per hectare)).

33. The three alternative scenarios (conservative, central and upside) will be reflected in the estimates of the cost to achieve the load reduction. For example, if consumers place a high value on sustainable production, the future opportunity cost of moving from unsustainable to sustainable production will be less than otherwise (a premium will be embedded in the sustainable farmer's revenues per hectare, but not the non-sustainable farmer's). Similarly, the cost of implementation will be lower relative to other cases if technology is more advanced (having been developed in response to consumer tastes).

The counterfactuals

34. We will use two baselines, one based on the current environmental situation. The other will be based on the situation once the environmental outcomes required by the NPS-FM 2017 (including impacts on urban wastewater upgrades) are achieved and will also consider the pollution load reductions flowing from the provisions inserted in the Climate Change Response Act 2002 by the Zero Carbon amendment.

35. NIWA's current environmental modelling in relation to dissolved inorganic nitrogen (DIN), periphyton, dissolved reactive phosphorous (DRP) and lakes includes the two baselines.

36. In terms of sedimentation, Landcare Research's analysis uses only one baseline – current loads – and so its cost assessment is relevant only for comparison to 'business as usual'. We are considering how the cost estimates would reduce (if at all) once full compliance with the NPS-FM 2017 is considered (bearing in mind there was no sediment bottom line in the NPS-FM 2017). The Climate Change Response Act is also very relevant for sediment, as increased afforestation is both an important option to reduce sediment loads and an outcome of the recent changes to the Climate Change Response Act.

37. An important issue for the counterfactuals is the level of environmental deterioration if action is delayed.

38. There will need to be assumptions made about how much effect the NPS-FM 2017 will have, both in what the target is (discussed further in the "Summary of NIWA's environmental modelling" section above) and the timeframe for achieving reductions in nutrient loads and subsequent concentrations (discussed below).

Dealing with time and tipping points

39. The economic impact analysis as described above is static, in that the comparisons are between before-reform and after states of the world (for example, the NZIER's computable general equilibrium (CGE) model). However the environment is not static – depending on when you start to mitigate, the required reduction in the pollution load will differ. This matters for the impact assessment. We could assume for example that mitigation begins more or less immediately under the *Essential Freshwater* reforms. However, under the NPS-FM 2017, the timing of actual implementation is less certain and could occur in the distant future (and under the current state mitigation may not occur at all). So we have to have a view about when mitigation will occur under the *Essential Freshwater* reforms as well as both counterfactuals.

40. Officials from MfE, MPI and The Treasury are working with the economic modellers on how

best to capture future environmental states. Critical to this is the time taken to achieve environmental outcomes, the impacts of delaying these benefits and the costs to achieve them.

Peer review process

41. We are in the process of commissioning peer reviews of the overall approach to the economic modelling from Dr Adolf Stroombergen, chief economist at Infometrics, John Ballingall of Sense Partners and Dr Megan Star of Central Queensland University. This will include the methodology used rather than the assumptions or interpretation of results. These peer reviews are due within a week of the delivery of the reports.
42. MfE has also commissioned independent expert peer reviews for each of the reports on the overall impacts of the policies.

MPI analysis

43. MPI has commissioned the following impact analysis to be conducted internally or via external suppliers with results due by mid-March:
    a. Stock exclusion benefits to freshwater stream health through sediment and E.coli reductions. The analysis includes modelling additional stream length fenced, and the extent of pasture retired.
    b. Risk classification for winter grazing determining the susceptibility of contaminants to enter freshwater ways from winter grazing areas based upon several factors such as: slope, climate, soil characteristics and distance to freshwater ways.
    c. National wetland mapping using radiometric data. The wetland mapping project uses a combination of existing radiometric data from mineral exploration and satellite imagery to generate a national map highlighting the wetland extent across New Zealand.
    d. Land use change and intensification analysis based on mapped historic land use changes.
    e. An analysis of the proposed DIN bottom line within the Pukekohe catchment including detailed analysis of vegetable cropping mitigation and land use change.
    f. Farm environment plans – more detailed costings including breakdowns for different elements.

Consultation and Collaboration

44. The Ministry for the Environment and the Ministry for Primary Industries are working together with expert consultancy firms on the assumptions used in our economic modelling. We have also worked with the Treasury and MBIE on the approach to calculating cost curves and a premium for environmentally-friendly production.

Risks and mitigations

45. All modelling work requires numerous assumptions and simplifications to be made. The choices of assumptions and simplifications are open to criticism. We are engaging with experts to try to identify the most robust and reasonable approaches.

Recommendations

46. We recommend that you:

a. **Meet** with officials for further discussion

Yes/No

b. **Agree** that this briefing will be released proactively on the Ministry for the Environment's website once Cabinet decisions have been made

Yes/No

Signature

S9(2)(a)

28-2-20

Hon David Parker
Minister for the Environment **Date**

Hon Damien O'Connor
Minister for Agriculture **Date**

Appendix 1

National impacts of nutrient proposals

The choice between 10% and 20% spatial exceedance criteria has very little impact on the additional nutrient load reduction in the proposed NPS-FM:

- The reduction in nitrogen required by the proposed NPS-FM under the 10% criteria would be 2.7%, while under the 20% criteria it would be 3%.
- For phosphorous under the 10% criteria the reduction required would be 0.8%, while under the 20% criteria it would be 1.6%.

However the choice of spatial exceedance criteria does affect the size of the nutrient load reduction required to meet the periphyton bottom line contained in the current NPS-FM 2017. Therefore the level of spatial exceedance chosen makes a significant difference to the story people may want to tell about the impact of the NPS-FM 2017:

- The reduction in nitrogen required by the NPS-FM 2017 under the 10% criteria would be 18.7%, while under the 20% criteria it would be 7.2%.
- For phosphorous under the 10% criteria the reduction required would be 10.5%, while under the 20% criteria it would be 0.8%.

Appendix 2

How the rate of MFP growth was selected

Officials reviewed a range of reports both agricultural specific and whole of economy, and both domestic and international:

- The OECD estimated MFP growth of approximately 0.5% to 1% per annum for developed countries (average of all industries) since the late 1990s.[2] This estimate does not include detrimental impacts on 'natural capital' and ecosystem services.
- Another OECD report estimated MFP growth of 0.7% per annum for New Zealand and 0.9% for Australia for the period 1986 to 2008. Other OCED countries fell within the range of 0.3% per annum (Spain) to 3.9% per annum (Korea).[3] This study took into account natural capital.
- Statistics New Zealand (Stats NZ) reported that MFP in agriculture increased on average by 2.5% per annum and 0.9% for all measured industry groups over the period 1978 to 2016. This data was not adjusted for composition.
- Stats NZ also published an all sector MFP index that shows an annual average growth rate of 0.4% for the period 1998 to 2016. This data was adjusted for composition.[4]
- The Productivity Commission estimated New Zealand's primary industries (which includes fishing and forestry) MFP growth at 0.9% a year between 1996 and 2018.[5]
- Motu published a study showing MFP in the dairy sector from 2002 to 2012 was negative. Over the same period MFP in the sheep and beef sector was slightly positive. The authors concluded that annual productivity growth in agriculture was positive between 2002 and 2008, but was lacklustre from 2008 to 2012.

Given technology change can reasonably be assumed, the 'central' scenario would be one where producers' costs are reduced by technology change. As a reasonableness check on the potential for MFP growth in the agricultural sector, we can look to emerging (but not yet commercially applied) technologies.

Authors of research papers have identified emerging mitigations which would be effective, if applied, at reducing nitrogen, phosphorous and sediment losses. Their list of emerging mitigations appears to be firmly anchored in existing land management systems, and all the mitigations have been subject to field trials.

The estimated marginal benefit of these emerging technologies was a further nitrogen, phosphorous and sediment load reduction of between 12% and 14%. In other words, if these technologies were available and applied today, the load reduction facing the agricultural sector (and therefore the costs associated with meeting the *Essential Freshwater* bottom lines) would arguably be approximately 12% to 14% lower. If this is spread over a 15 year period it equates to approximately 1% per annum improvement in MFP.

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[2] OECD Compendium of Productivity Indicators. 2019

[3] Brandt, Nicola, Paul Schreyer and Vera Zipperer (2017) Productivity Measurement with Natural Capital. Review of Income and Wealth Series 63, Supplement 1 February 2017.

[4] Department of Statistics. Composition-adjusted productivity in the measured sector.

[5] Nolan, P., R., Pomeroy and G. Zheng. (2019). Productivity by the numbers: 2019. New Zealand Productivity Commission. Available from www.productivity.govt.nz

Based on the review of reports on MFP, supported by the estimated impact of new technologies, officials intend to include in the central estimate an MFP increase of 1% per annum.