Healthy Rivers PLAN FOR CHANGE | Wai Ora HE RAUTAKI WHAKAPAIPAI

Draft for discussion purposes

Report No. HR/TLG/2015-2016/6.3

Integrated Assessment Two: Achieving water quality for swimming, taking food and healthy biodiversity. Assessment of Scenario 1 steps 10%, 25% and 50% from case 1 of modelling round two.

This report was commissioned by the Technical Leaders Group for the Healthy Rivers Wai Ora Project

The Technical Leaders Group approves the release of this report to Project Partners and the Collaborative Stakeholder Group for the Healthy Rivers Wai Ora Project.

Signed by: 

Date: 1 March 2016

Integrated Assessment Two: Achieving water quality for swimming, taking food and healthy biodiversity. Assessment of Scenario 1 steps 10%, 25% and 50% from case 1 of modelling round two.

1 March 2016

Liz Wedderburn and Antoine Coffin on behalf of the Technical Leaders Group

Preface

The Healthy Rivers Wai Ora plan change project (the project) aims to update the Waikato Regional Plan in order to help restore and protect the health and wellbeing of the Waikato and Waipa rivers. The plan change seeks to reduce, over time, the levels of sediment, bacteria and nutrients (nitrogen and phosphorus) entering water bodies (including groundwater). A key driver of the project is the Vision and Strategy for the Waikato River. The Vision and Strategy identifies the objective of the restoration of water quality within the Waikato River, so that it is safe for people to swim in and take food from over its entire length[1].

The Integrated Assessment (IA) is a key input into the project, providing an assessment of the environmental, social, cultural and economic impacts of the water quality scenarios modelled[2]. This work was led by Dr Liz Wedderburn (Portfolio Leader - Agri Policy & Principal Scientist, AgResearch) and Antoine Coffin (Te Onewa Consultants), from the Technical Leaders Group.

Development of Integrated Assessment Framework

An initial workshop was held on 1 December 2014[3] to discuss the prosperous communities and social impact assessment for the project. It was attended by IA leads Liz Wedderburn and Antoine Coffin, as well as Dr Bryce Cooper (General Manager – Strategy, NIWA) as Chair of the Technical Leaders Group, Julie Meade Rose (Social and Environmental Ltd, Bruce Small (AgResearch), and Jacqueline Henry and Emma Reed (Waikato Regional Council).

The outcome of this workshop was a preliminary assessment framework, and identification of data sources for the IA. The framework was based on the values identified by the Collaborative Stakeholder Group (CSG). The workshop also identified key elements of the IA including the need for baseline information, and that the outcomes of testing water quality scenarios using a set of indicators would be provided to the CSG for consideration.

Indicators

The draft environmental, social and economic indicators were developed through a series of workshops with the CSG[4] from February to April 2015, led by Liz Wedderburn. A sub-group of the CSG (Ruth Bartlett, Charlotte Rutherford, Gwyneth Verkerk and Sally Davis) met with Liz Wedderburn in May 2015 to further develop an Integrated Assessment framework that considered the Policy Selection Criteria, the indicators identified at CSG9, the Waikato Progress Indicators and the Waikato River Authority report card. At CSG13, CSG decided on the following list of indicators:

Environmental

- Regional Ecological Monitoring of (wadeable) Streams (REMS which includes MCI, clogginess (Macrophytes), stream habitat)
- Riparian (effective for land-use) - Pareparenga o te wai (Riparian margin – access and acceptability)
- Wetland (unique habitat protected)

[1] Te Ture Whaimana o te Awa o Waikato – The Vision and Strategy for the Waikato River
[2] See Doole, G. et al (2015). Economic modelling report- first round scenarios DM#3483793 and 2nd round scenarios DM#3564910
[3] Prosperous communities workshop notes December 2014. DM#3237973
[4] Integrated Assessment CSG history (summary) DM#3499887

Social

- Vibrant Resilient Communities
- Employment (with an emphasis on type, variety and diversity of jobs)
- Infrastructure (reliable, affordable to consumers, investment/reinvestment risk - only covers energy, waste and water)
- Recreation use (including access and safety)

Economic

- Net Value Add $m (Regional GDP with sector breakdown)
- Net International Exports $m (Waikato regional contribution to national exports)
- Net Employment (Modified Employee Count or MEC) (Total value of employment)

The Mātauranga Māori indicators were developed through a separate process, led by Antoine Coffin. The details of this process are contained in a separate report[5].

Mātauranga Māori (Cultural)

- Waitemata (water clarity)
- Te Rere (flow)
- Paemakariri (temperature)
- He kai pai (edible food)
- Te nui o nga kai i te wai (abundance of fish species – koura)
- Nga tarukino me nga ika rawaho i te wai (presence of pest weeds and fish)
- Matauranga ki nga wai kaukau (Knowledge of swimming places)
- Au Putea (economic benefit of water)

Baseline

The baseline provides a reference from which to assess each of the indicators based on the scenario outputs. A baseline of quantitative and qualitative data and trends were prepared for each of the indicators. Both published and unpublished sources were used to provide the most up to date information. The ecological data were provided by Dr John Quinn (Chief Scientist - Freshwater and Estuaries, NIWA) from the Technical Leaders Group, the social indicators data by Beat Huser (Waikato Regional Council), Bruce Small and members of the CSG sectors[6], and the baseline economic data by Dr Garry McDonald (Economist, Market Economics Ltd).

Assessment process

An expert panel was used to carry out the assessment. The purpose of the expert panel workshops was to bring together a range of expertise and knowledge to evaluate the results of the scenario modelling against the baseline information. The panel would then produce a narrative for each indicator and a trend for any change showing direction (either positive, negative or no change) and magnitude (i.e. a minor or more significant effect/change). The requirement was for the panel to use data where possible but due to timeframe constraints, to generally provide best professional judgement. A report was prepared for each of round one and round two scenario modelling assessments.

Process

A panel was convened comprising Liz Wedderburn, Jacqueline Henry, John Quinn, Wendy Boyce (Consultant), Emma Reed and Antoine Coffin. The panel met on Friday 28 August 2015 to consider the first round of economic modelling outputs. Using the baseline information, the panel assessed the model outputs against each indicator, and a draft narrative and trends were recorded.

[5] See Te Onewa Consultants (2015). Mātauranga Māori Knowledge Networks DM#3504062
[6] Relevant data was provided by representatives of the horticulture, tourism, and energy sectors.

A sub-group of CSG members, formed at the CSG13 meeting and comprising Sally Davis, Trish Fordyce, Stephen Colson, Jason Sebestian, Gwyneth Verkerk, George Moss, Weo Maag, James Bailey, Alastair Calder, James Houghton, and Al Fleming[7], met with the panel on 15 September 2015 to finalise the first round IA. At this workshop a new indicator 'Vibrant Resilient Communities' was developed, after CSG identified a gap at their meeting on 8 September 2015.

The panel re-convened on 23 September 2015 to assess the outputs of the second round of modelling, for the 10, 25, 50 and 100% steps for Scenario 1[8].

Outputs

This report sets out the Integrated Assessment of scenario modelling round two and should be read in conjunction with the two reports summarising the baseline information (Baseline Report) and scenario modelling round one (Integrated Assessment One: assessment of scenarios from modelling round one)

Introduction

This report summarises information about the potential social, environmental, cultural and economic impacts if policy was put into place to restore and protect the Waikato and Waipa rivers for swimming, taking food and healthy biodiversity. This is known as Scenario 1, with steps being taken to achieve 10, 25 and 50% of progress towards achieving the water quality targets and limits.

Structure

The report is divided up into four categories:

1. Social
2. Environmental
3. Economic
4. Mātauranga Māori .

Each category has several key pieces of information to guide decisions about the Healthy Rivers Wai Ora (HRWO) project. These indicators are chosen because they provide a measurable snapshot of the current situation in the Waikato catchment and surrounds. The next column contains the percentage step or distance toward achieving Scenario 1 that would be achieved. Columns 3 and 4 make an assessment in words and numbers about the effect of the modelled outputs on this indicator.

Some important points about this report

The indicators were based on what people value about the Waikato catchment, as well as the ways they use the land and rivers (waikatoregion.govt.nz/csgdocs). They were also based on what the community said they wanted taken into account by the Collaborative Stakeholder Group (CSG) as the policy was designed. This is also known as the policy selection criteria). For example, the acceptability of the policy to the community will focus the policy designers on achieving sound principles of allocation, recognition of effort already made and ensuring those contribute to the problem contribute to the solution in the right proportions (waikatoregion.govt.nz/policyselectioncriteria).

NB:

The Integrated Assessment does not take into account timeframes for each scenario. Therefore the severity of effects on the indicators should be read not as intensity of change but as direction and degree of change. Any significant change required may be ameliorated by the policy instruments that are chosen and how they are implemented (i.e. over a longer timeframe).

[7] See Integrated Assessment CSG history (summary) DM#3499887
[8] Doole, G. et al (2015). Healthy Rivers Wai Ora Economic modelling report-2nd round scenarios DM#3564910

The Integrated Assessment panel acknowledge that the issue of climate change, and potential carbon trading or tax regimes will have a significant effect on the profitability of particular sectors. The risks and likely anticipated effects of climate change have been considered as part of this assessment. These events are recognised through the benefits such as greater diversity of employment, and environmental resilience achieved through enhanced biodiversity.

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Social Indicators

Vibrant and Resilient Communities

Indicator	Steps	Impact of the Scenario at each step upon this indicator	Trend (scale 1 – 5)[i]
Vibrant Resilient Communities	**10%**	The Upper FMU has the highest level of impact in terms of jobs losses. That impacts most particularly on Tokoroa and the surrounding areas, which has existing high levels of deprivation and so a change will have a compounding effect for that community. There is an immediate effect on job losses in the Upper FMU, given that this is the smallest step towards Scenario 1. Almost all reductions are in dairy with employees between 18-40 years being important to some parts of the industry. Having a loss in the working age population has a negative effect on the resilience of a community. Sheep and beef and forestry experience some gains in job numbers in the Upper FMU. The Waipa FMU overall has negligible loss in jobs. The losses are seen mainly in dairy product manufacturing and agricultural and forestry support, which may have a rural town impact. There is a gain in sheep, beef and grain job numbers. This indicates a low level of shift between jobs in different industries rather than a loss from the Waipa FMU to other areas. The Lower and Middle FMUs both have a medium level of impact in terms of job losses. This may impact negatively more in the Lower FMU as it has a lower employee count to start with.	↓3
	25%	There is a more gradual change between the 10% and 25% steps in terms of cost and loss in profit. There is a steeper change between the 10% and 25% steps in terms of job loss in the Upper FMU, and is less pronounced in the Middle FMU. There is a lower level of change between the 10% and 25% steps in terms of job loss in the Lower and Waipa FMU. The Upper FMU has the highest level of impact in terms of jobs losses. That impacts most particularly on Tokoroa and the surrounding areas, which has existing high levels of deprivation and so a change will have a compounding effect for that community. The Waipa FMU has the lowest level of impact in terms of job losses. This may may mean in a lower level of impact on the towns of Te Kuiti, Otorohanga and Waitomo and the surrounding areas, which already have existing high levels of deprivation. The Lower and Middle FMUs both have a medium level of impact in terms of job losses. This may impact negatively more in the Lower FMU as it has a lower number of MECs to start with. In the Upper FMU between the 10% and 25% steps there is a change in the sheep and beef job numbers from +27 to -182.	↓3.5

	50%	There is a steeper change between the 25% and 50% steps in terms of cost and loss in profit. There is a steeper change between the 25% and 50% steps in terms of job losses only in the Lower FMU. The Upper FMU has the highest level of impact in terms of jobs losses. That impacts most particularly on Tokoroa and the surrounding areas, which has existing high levels of deprivation and so a change will have a compounding effect for that community. The Waipa FMU has the lowest level of impact in terms of job losses. This would expect to result in a lower level of impact on the towns of Te Kuiti, Otorohanga and Waitomo and the surrounding areas, which already have existing high levels of deprivation. The Lower and Middle FMUs both have a medium level of impact in terms of job losses. This may be felt more in the Lower FMU as it has a lower number of MECs to start with.	↓3.5
	100%	The loss of MEC is reported as a loss relative to the baseline, so each absolute number of job losses needs to be considered as a proportion of the existing number of jobs. The Middle FMU has a much larger employee base than the other FMUs, so a decrease in jobs for the Upper, Lower and Waipa FMUs will mean those communities may be more severely impacted than a similar number of jobs lost from the Middle FMU. Scenario 1 has the greatest impact in terms of community vibrancy and resilience because it implies a sudden change. From a social perspective time and support reduces the negative social impacts and assists people to make transition. Support could be, for example, research and development grants, land purchases, funding, extension, advice, business development grants, education and training initiatives or infrastructure subsidies. Support measures become critical to assist the change and reduce unintended negative consequences. Communities that are already in decline, will be more affected by a decrease in jobs, which influence population decline and can have the flow on effect of a loss of key services such as schools, healthcare, stores and shops. Providing levels of service and infrastructure relies on having a large enough rateable population base. Working age population brings employment and children to an area. The dairy industry is the most affected by the number of job losses in scenario 1, and people 18-40 years being important to some parts of the industry. So a loss in this sector may impact on this working age population in the area. This is especially so in the Upper FMU. How close a community gets to a tipping point will depend on how close it is now. Some communities may experience increased vibrancy associated with recreation and related business opportunities, for example Karāpiro or Ngāruawahia.	↓4

Employment

Employment (with an emphasis on type, variety and diversity of jobs)	**10%**	The employment situation is much as it currently is. Because the required shift is not so large, there is less incentive to innovate. The greatest impact will be felt by communities in the upper Waikato, as this area has higher nitrogen leaching rates, and accordingly is the area most targeted for mitigations. There will be some lesser impact on lower Waikato communities, with minimal effects in the central areas. Primarily dairy and horticulture job losses. Overall little change in diversity of employment in the catchment.	↓1
	25%	Continued trend for greater job losses in upper Waikato. Affecting dairy farming, horticulture but also sheep, beef and grain. Overall little change in diversity of employment in the catchment.	↓1
	50%	Continued trend for greater job losses in upper Waikato. Affecting dairy farming, horticulture but also sheep, beef and grain. Overall little change in diversity of employment in the catchment.	↓1
	100%	Employment in non-forestry primary industries, particularly dairy farming, would decrease substantially under this step. This would affect the type and number of jobs in these sectors, with many of the job losses affecting low-skilled workers who may struggle to find work elsewhere without retraining. The magnitude of the change for the dairy industry means there would be a flow-on effect for the primary service sectors and other services within the economy. There would be a large regional loss of jobs in these sectors. Depending on the policy approach, this may have a large negative effect on these sectors, which may in turn lead to migration out of the region and force people to look for work elsewhere. However, balancing this is the possibility that adaptation and mitigation within industries could lead to innovation and opportunities for new types of employment. The model shows a major shift towards forestry. An increase in employment in forestry, and wood and paper manufacturing, would result in an increase in the numbers of people working in these industries. This may balance migration out of the region to some extent, and provide jobs for people from industries that have been adversely affected. The transition to forestry would take place over 60 to 70 years – taking into account successive waves of forestry planting, as dairy is gradually replaced, and the lag time as trees are planted and mature. The central FMU would experience different effects to the other FMUs, due to its predominantly urban population and focus on manufacturing and processing jobs. There may be little overall change in the diversity of jobs in the catchment. Despite showing a large loss of jobs, the model doesn't show where new jobs are created. Net change in jobs would not necessarily be negative. It also doesn't account for innovation and change over time. It is anticipated that phased land use changes will buffer the impact of changes in employment for people and communities, and allow them to innovate. It is possible that the impact from the loss of dairy jobs will be reduced over time, as people are re-employed in other sectors. Existing and ongoing land use changes in the northern part of the catchment, primarily due to urbanisation, are already having an impact on employment patterns, which will probably be hastened by this step. The substantial decrease in horticulture would result in a reduction in number and diversity of jobs in this sector for the region.	↓4.5

Infrastructure

Infrastructure (reliable, affordable to consumers, investment/reinvestment risk)	**10%**	Overall, the impact of this step on the reliability and affordability of water and river-related infrastructure would be minimal. It is not likely to be practicable to provide incremental improvements to existing wastewater treatment plants to match the nominated incremental improvement targets. Constructing new treatment plants with higher technical specifications may be the only option if further improvements are required, which would bring significant unplanned costs. Most plants are operating at their technical capacity. All treatment plants have existing resource consent conditions and review clauses, and this is the appropriate mechanism to use to change discharge conditions.	–
	25%	The impact expected for this step is some reduction in the reliability and affordability of the various water infrastructure for consumers and communities. Specific points relevant to this step are: • electricity generation – no change • flood protection – slight improvement • industrial point discharges and municipal wastewater treatment plants – slight negative trend • stormwater (diffuse discharge) – unknown • community water supply – slight improvement.	↓1
	50%	Specific points relevant to this step are: • electricity generation – no change • flood protection – slight improvement • industrial point discharges and municipal wastewater treatment plants – negative trend • stormwater (diffuse discharge) – unknown • community water supply – slight improvement.	↓1
	100%	Costs to the urban centres and the rural areas may be more equitable under this step, because mitigations would be required for both point source municipal and commercial, and diffuse source rural contaminants. Urban municipal point sources would have to take into account the constraints of council planning timeframes, such as those set by the 10 year long-term plans. Affordability for communities would decrease, as job losses combine with increased costs. Upgrades required to wastewater treatment and stormwater infrastructure will create particular affordability issues for some communities. The upgrades to infrastructure are managed through the resource consent process. Costs for these upgrades are passed on to consumers and rate payers. In the case of public infrastructural upgrades, the level and allocation of funding is decided through council long term planning processes, involving assessment of benefits, costs and affordability.	↓2

		Land-use change to reach this step is likely to affect hydroelectricity generation negatively, by reducing flows and affecting reliability. There is a possibility that this step will impact on the industry's international competitiveness. Flood protection on the other hand, will benefit from these same changes to flows.	

Recreation

Recreation use (including access and safety)	**10%**	No change in recreation use. 2 breaches of clarity attribute limit may have localised effect.	—
	25%	No change in recreation use. 2 breaches of clarity attribute limit may have localised effect.	—
	50%	No change in recreation use. 6 breaches of clarity attribute limit may have localised effect	—
	100%	Access will depend on how riparian areas are managed, when fences and buffers are included as mitigations. It will be important to plan for and factor into any mitigation, such as shifts in land use, the requirement for access and the need to enable it, for example by providing gates, stiles, boat ramps etc. One possible mechanism, which is already used, is to place covenants providing access on the land. Overall, there may not be much change to access, but there are opportunities to increase the accessibility of the rivers' margins if these margins are used for reserves. This will require explicit policy and agency by local government and landowners to enable access, and possibly some investment. There are also different rules relating to riparian margins for rivers with differing bed depths, and there is a need to understand the distribution of rivers with bed widths of greater than 3 metres throughout the region. The beds of these broader rivers are government owned and generally have esplanade strips. These could form the basis of a network of accessible river margins. Riparian planting also increases bank stability, which increases safety for recreational and other users.	↑2

Environmental Indicators

Regional Ecological Monitoring of Streams (REMS)

Regional Ecological Monitoring of Streams (Animals, insects and plant life in rivers and streams - which includes MCI, Clogginess (Macrophytes), stream habitat))	**10%**	Fencing of streams is mostly complete for dairy already and about 50 % for drystock. Setbacks (5m) exist for about 3/4 of fenced streams on dairy but not in significant amounts for drystock. This will mean a modest increase in MCI, little in the upper Waikato, less in the mid and lower Waikato and more in the Waipa. Stock exclusion will reduce grazing on macrophytes, and depending on the state of the riparian environment there may be an increase in shade which will reduce macrophyte growth. Overall not much net change in macrophytes (clogginess). The effect is only in small tributaries.	↑1
	25%	The total area of constructure wetlands is 2390 (compared to existing wetland of 15,500 ha and historic 202,600 ha area). So the created wetland area would represent a 15% increase on the low baseline but only 1.2% of the historic level). At 10%, 25% and 50% of Scenario 1 are predicted to increase the current baseline by 3, 5, 12% respectively. More setbacks for drystock at this step will result in slightly greater in MCI, little in the upper Waikato, less in the mid and lower Waikato and more in the Waipa. There are edge of field mitigations in the forms of wetlands that will support greater macroinvertebrate communities. Increasing stock exclusion beyond that achieved at the 10% step will reduce grazing on macrophytes, depending on the state of the riparian environment there may be an increase in shade which will reduce macrophyte growth. Overall not much net change in macrophytes (clogginess). Effect only in small tributaries.	↑2
	50%	Further increases in setbacks for drystock at this stage will result in slightly greater MCI, little in the upper Waikato, less in the mid and lower Waikato and more in the Waipa. There are more edge of field mitigations (wetlands), that will support greater macroinvertebrate communities. Bunds and wetlands help at peak flow by reducing overall flow, which benefits MCI. Increasing stock exclusion will reduce grazing on macrophytes, depending on the state of the riparian environment there may be an increase in shade which will reduce macrophyte growth. Overall not much net change in macrophytes (clogginess). Effect only in small tributaries.	↑2

	100%	The suggested result of this step is for an increased MCI and decreased 'clogginess' caused by macrophytes. There would be an increase in stream habitat but will ultimately be no net change for fish and eel populations. Depending on the timeframes to achieve the step, not much change in eel population will occur short term, as habitat will only increase slowly as vegetation grows. This step may affect sediment as banks change from grass to vegetation. The factors affecting this indicator represent ecological health for iwi, which is expressed in terms of increasing mauri of water bodies.	↑5

Pareparenga o te wai/Riparian margins

Pareparenga o te wai/Riparian margins (The banks of rivers, streams and lakes - effective for land-use)	**10%**	Dairy accord streams are almost complete, so the scope for improvement is in the non-accord and drystock streams. All of the change in riparian is for dairy farms at this step. Same for buffers.	↑2
	25%	Half of the drystock fencing is completed between the 10% and 25% steps.	↑2
	50%	Two thirds of drystock fencing required for the scenario is completed by this step. Only small increase in buffers for drystock below this step.	↑2
	100%	Effective riparian management is an important consideration for all land based sectors and is required to achieve the attribute targets for this step. This step requires significant fencing but may need to include different management options, suitable to the land and farm types. Riparian buffers provide benefits for biodiversity, aesthetics and ecological corridors as well as increasing customary resources. The fencing of waterways with large buffers may increase the public perception of accessible space adjacent to waterways. Inputs to the model include fencing and grass buffers but not planting for revegetation. Limited benefit for biodiversity unless native vegetation can recolonise naturally or property owner chooses to plant natives. Assume that buffer and fence occur at the same time, because in practice this is what farmers would do rather than fence for stock exclusion and later move the fences to create a buffer. As a matauranga Māori indicator, the riparian margin also plays an important role in the acceptability of a place to swim. This indicator assumes that bank stability, safe water access and native vegetation including customary resources will enhance this indicator. In this scenario	↑4

		a number of mitigations such as buffers and fencing are employed at an early stage thus providing immediate enhancement of pareparenga o te wai. The key difference is the pareparenga takes into account the retention of pasture outside the fenced area which is more accessible for swimming than a re-vegetated strip. Therefore for scenarios (10%, 25% and 50%) as a matauranga Māori indicator, the scores could be slightly higher at 3 for each scenario.	

Wetland

Wetland (unique habitat protected)	**10%**	Very small increase in wetland area (465 Ha), about 15% of the total area required to achieve this step.	↑0.5
	25%	Still a relatively small increase overall (723 Ha).	↑0.5
	50%	The area in wetlands represented a 10% increase on existing area. By this step about 80% of the wetlands to achieve scenario 1 would be constructed.	↑1
	100%	This represents a 16% increase on current wetland area, and a 1.2% increase of historic total area. This step would require significant collaboration between farmers, and include restoration of previously drained areas. Forestry can dry out small wetlands but the increase in wetland area would be effective for nitrogen and load to come. Increase in base flow and more even base flow as a result of more wetlands would have significant benefits through increased biodiversity, increased customary resources, increased sense of identity and increased food sources.	↑2

Economic Indicators

Value Add

Value Add (proxy for Regional GDP with sector breakdown)

10%

Industry	% change in Value Added (relative to baseline)
Horticulture	-1.8
Sheep, beef, and grain	1.2
Dairy farming	-4.6
Forestry	4.2
Other primary	0.0
Agriculture and forestry support	-1.8
Meat and meat product manufacturing	0.9
Dairy product manufacturing	-4.4
Wood and paper manufacturing	1.6
Other manufacturing	-0.1
Utilities	0.0
Construction	0.1
Wholesale and retail trade	-0.1
Transport	-0.2
Professional/administrative services	-0.1
Local and central government	0.0
Other services	-0.2
Total relative to baseline	-0.6

The overall effect on Value Add in the region is relatively small, but still negative. The largest effect is felt in the losses in the dairy farming and processing sectors. The biggest gain comes from the forestry industry.

↓1

25%

Industry	% change in Value Added (relative to baseline)
Horticulture	-2.7
Sheep, beef, and grain	-1.2

↓2

Dairy farming	-6.3
Forestry	4.8
Other primary	0.0
Agriculture and forestry support	-2.2
Meat and meat product manufacturing	0.6
Dairy product manufacturing	-5.9
Wood and paper manufacturing	1.6
Other manufacturing	-0.2
Utilities	-0.1
Construction	0.1
Wholesale and retail trade	-0.2
Transport	-0.3
Professional/administrative services	-0.2
Local and central government	-0.5
Other services	-0.3
Total relative to baseline	-0.9

The overall effect on Value Add in the region is relatively small, with a loss of less than one percent. The largest effect is felt in the losses in the dairy farming and processing sectors. The biggest gain comes from the forestry industry.

50%

Industry	% change in Value Added (relative to baseline)
Horticulture	-9.0
Sheep, beef, and grain	-4.2
Dairy farming	-8.0
Forestry	4.2
Other primary	0.2
Agriculture and forestry support	-2.2
Meat and meat product manufacturing	0.6
Dairy product manufacturing	-6.6
Wood and paper manufacturing	1.6
Other manufacturing	-0.3
Utilities	0.5
Construction	-0.5

↓2

Wholesale and retail trade	-0.4
Transport	-0.3
Professional/administrative services	0.7
Local and central government	-0.5
Other services	-0.5
Total relative to baseline	-1.2

The overall effect is a reduction in Value Add in the region, however it is relatively small. The largest effect is felt in the losses in Horticulture, dairy farming and processing sectors, losses in the value added also occur from sheep and beef . The biggest gain comes from the forestry and associated processing industries.

100%

Value added for the Waikato region decreases by 3.0%, with a significant impact on Horticulture 40.5% Value added for Waikato dairy farming decreases by 15.1% and for sheep and beef by 16.2%. These impacts are felt throughout all the FMUs. The large reduction in Horticulture will have flow on impacts for local domestic supply of leafy greens that will be felt throughout New Zealand.

Land values may decrease due to reduced opportunities. Dairy farms are often highly leveraged and are highly indebted. Any changes that flow onto the banking sector due to repayment defaults will impact on exchange rates and other sectors. Sheep and beef farms typically have lower levels of debt than dairy farms, and decreases in land value would decrease the equity levels. Land equity is especially relied on to offset lower cashflow in drystock farming compared to higher cashflow dairy farming.

With such decreases in the agricultural sectors, the declines in smaller rural towns will accelerate as people move away to seek other opportunities.

Industry	% change in Value Added (relative to baseline)
Horticulture	-40.5
Sheep, beef, and grain	-16.2
Dairy farming	-15.1
Forestry	5.3
Other primary	0.2
Agriculture and forestry support	-3.5
Meat and meat product manufacturing	-1.3
Dairy product manufacturing	-11.9
Wood and paper manufacturing	1.8
Other manufacturing	-0.5

↓5

Utilities	0.2
Construction	-0.3
Wholesale and retail trade	-0.9
Transport	-0.8
Professional/administrative services	0.7
Local and central government	-1.8
Other services	-1.3
Total relative to baseline	-3.0

International exports

International Exports (proxy for Waikato regional contribution to national exports)	**10%**	Total loss of $110m of net international exports, relative to the baseline, in the Waikato region. This total includes a loss of $139m in dairy product manufacturing and gains of $14m in meat and meat product manufacturing, and $15m in wood and paper manufacturing in the Upper Waikato.	↓1
	25%	Total loss of $163m of net international exports, relative to the baseline, in the Waikato region. This total includes a loss of $184m in dairy product manufacturing and gains of $8m in meat and meat product manufacturing, and $17m in wood and paper manufacturing in the Upper Waikato.	↓2
	50%	Total loss of $192m of net international exports, relative to the baseline, in the Waikato region. This total includes losses of $205m in dairy product manufacturing, and $9m in horticulture. Gains are made in wood and paper manufacturing ($15m) and in meat and meat product manufacturing ($8m).	↓2
	100%	Total loss of $406m of net international exports, relative to the baseline, in the Waikato region. This total includes losses of $370m in dairy product manufacturing, $29m in horticulture, and $20m from meat and meat product manufacturing. Gains are only made in the forestry ($3m) and wood and paper manufacturing ($18m) exports. The large impact on dairy product manufacturing is mostly in the mid Waikato FMU, and some in the Waipa, due to the location of processing plants. The horticulture impact is mostly occurring in the Lower Waikato FMU.	↓5

Employment

Employment (MEC)
(proxy for Total value of employment)

10%

Industry	% change in employment (Modified Employee Counts) (relative to baseline)
Horticulture	-1.9
Sheep, beef, and grain	1.2
Dairy farming	-5.1
Forestry	4.2
Other primary	0.0
Agriculture and forestry support	-1.4
Meat and meat product manufacturing	0.8
Dairy product manufacturing	-3.7
Wood and paper manufacturing	2.2
Other manufacturing	-0.1
Utilities	-0.1
Construction	0.1
Wholesale and retail trade	-0.2
Transport	-0.2
Professional/administrative services	-0.1
Local and central government	-0.2
Other services	-0.1
Total relative to baseline	-0.5

The largest impact from employment loss is in dairy farming, and the majority of this loss occurs in the Upper Waikato FMU. Similarly the largest gain is in forestry in the Upper Waikato.

↓1

25%

Industry	% change in employment (Modified Employee Counts) (relative to baseline)
Horticulture	-2.5
Sheep, beef, and grain	-1.5
Dairy farming	-6.6
Forestry	4.7
Other primary	-0.0
Agriculture and forestry support	-2.0
Meat and meat product manufacturing	0.5
Dairy product manufacturing	-4.9

↓2

Wood and paper manufacturing	2.4
Other manufacturing	-0.1
Utilities	-0.2
Construction	0.1
Wholesale and retail trade	-0.3
Transport	-0.2
Professional/administrative services	-0.2
Local and central government	-0.4
Other services	-0.3
Total relative to baseline	-0.9

The largest impact from employment loss is in dairy farming, and the majority of this loss occurs in the Upper Waikato FMU. Similarly the largest gain is in forestry in the Upper Waikato.

50%

Industry	% change in employment (Modified Employee Counts) (relative to baseline)
Horticulture	-5.1
Sheep, beef, and grain	-1.3
Dairy farming	-7.3
Forestry	4.2
Other primary	0.1
Agriculture and forestry support	-2.1
Meat and meat product manufacturing	0.5
Dairy product manufacturing	-5.5
Wood and paper manufacturing	2.2
Other manufacturing	-0.2
Utilities	0.6
Construction	-0.5
Wholesale and retail trade	-0.4
Transport	-0.3
Professional/administrative services	0.5
Local and central government	-0.6
Other services	-0.4
Total relative to baseline	-1.1

The largest impact from employment loss is in dairy farming, and the majority of this loss occurs in the Upper Waikato FMU. Similarly the largest gain is in forestry in the Upper Waikato. Dairy product manufacturing, especially in the Mid FMU, and horticulture, especially in the

↓2.5

		Lower Waikato FMU suffer from significant job losses.	
	100%	Total employment count for the Waikato region decreases by 2.3%. The largest percentage employment decreases are felt in horticulture, dairy farming, and dairy processing. With more people employed in dairy farming than the other sectors that are impacted, this is where the majority of job losses are. There are also significant losses in sheep, beef and grain and supporting industries. The impacts are felt throughout all the FMUs; unskilled labour will be most affected. The largest employment sectors in the Waikato region are health and education (in 'other services'), wholesale and retail trade, and business and finance services. These largest employment sectors are relatively unaffected compared to primary industries. There will be rural population decrease and job losses. Population changes (in both number and age structure) in smaller towns will have a significant impact on rates and ability to pay, and impact on community services.	↓5

Industry	**% change in employment (Modified Employee Counts) (relative to baseline)**
Horticulture	-12.2
Sheep, beef, and grain	-6.3
Dairy farming	-11.4
Forestry	5.1
Other primary	0.2
Agriculture and forestry support	-3.2
Meat and meat product manufacturing	-1.2
Dairy product manufacturing	-9.9
Wood and paper manufacturing	2.5
Other manufacturing	-0.5
Utilities	0.4
Construction	-0.2
Wholesale and retail trade	-1.1
Transport	-0.8
Professional/administrative services	0.4
Local and central government	-1.9
Other services	-1.2
Total relative to baseline	-2.3

Cultural Indicators

Waitematā

Waitematā (water clarity) – currently an attribute	**10%**	Water clarity begins to improve across all FMUs.	↑1
	25%	Water clarity improves across all FMUs.	↑2
	50%	Water clarity improves across all FMUs.	↑3
	100%	Clarity in this scenario will improve as mitigations are employed over time however modelling indicates potentially 11 breaches of the scenario limits. These are predominantly in the same specific catchments as the 25% and 50% scenarios, upper, mid and lower Waikato FMUs. It is expected that water clarity would achieve the B band in most places. The number of breaches generally increases where mitigation options are limited.	↑4

Te Rere

Te Rere (flow) – measures in cumecs at monitoring stations / effects from expert panel	**10%**	Having sufficient water to swim in and reducing high and low flows for all steps is expected to remain static and not be affected by the reductions of the contaminants themselves. It is expected afforestation and edge of field mitigations will decrease the variability of flow, particularly during small to medium sized storm events. The introduction of wetlands for this step servicing some 360,000ha will have some effects on base flow, that is, less variability and an increase in base flow.	—
	25%		—
	50%		—
	100%		—

Paemakariri

Paemakariri (temperature) – measured across the monitoring network / effects from expert panel Survey (in tributaries)	**10%**	The expectations and familiarity of contemporary swimmers frequenting warmer ocean waters, geothermal pools and public swimming pools will be different to traditional expectations of cooler temperatures found in rivers, lakes and spring fed pools.	↑0.5
	25%	The temperature of water is affected by exposure to sunlight. Shading of water bodies, particularly tributary streams will see a small decrease in temperature. For each of the steps (10%, 25%, 50% and 100%) a gradual but minimal improvement is proposed.	↑0.75
	50%	This step includes land use change (conversion to forestry, and riparian management) that will result in a reduction in water temperature at those places. Temperature is also a stressor of native fauna, therefore lower temperatures are an improvement in ecosystem health. Generally, the expectation is afforestation and shading vegetation will reduce temperature in tributaries especially streams where water is shallower and narrow and that and this will have flow some on effect on the main stem.	↑0.75
	100%		↑1

He kai pai

He kai pai (edible food) – E.coli measured but food standards not reported	**10%**	In this step E.coli levels reduce. However, there are 37 breaches of the limits set at 95th percentile for E. coli (whereas for median E. coli no breaches at all) (Upper Waikato remains A, Tributaries min B, Middle Waikato Main stem B, lower stem C, Lower Waikato C). While the limits for E.coli have 37 breaches in the model, there is likely to be an improvement or decrease in E.coli through de-intensification, afforestation, and mitigations. There are minimal breaches in steps (10%, 25% and 50%). E.coli monitoring and modelling involves significant uncertainty regarding resident times in hydro-lakes, urban point sources, and off the grid point discharge sources. Kai collected in contemporary times from the catchments is cooked, reducing risk of human health risk from E.coli and other pathogens. Therefore the improvements in E.coli will likely improve perceptions of risk to human health. As the steps become more stringent it is proposed there is a gradual improvement in this indicator. This indicator does not include or consider effects of heavy metals such as arsenic, mercury, zinc and copper that may come from both natural (geothermal) and industrial/urban waste sources. Heavy metals, particularly concentrated in sediment (Ohakuri) and reduced nutrients may reduce the release of heavy metals in anoxic stratified water.	—
	25%		↑1
	50%		↑2.5
	100%		↑3

Te nui o ngā kai i te wai

Te nui o ngā kai i te wai (abundance of fish species – koura) – monitored as part of Regional Ecological Monitoring Survey (in tributaries)	**10%**	It is expected that numbers and distribution of koura may increase slightly as a result of 10% Scenario 1 riparian management and afforestation. This scenario increases food complexity and habitat variation that enhances resilience and places for koura to hide from predators.	↑1
	25%	It is expected that numbers and distribution of koura may increase slightly as a result of 25% Scenario 1 riparian management and afforestation. This scenario increases food complexity and habitat variation that enhances resilience and places for koura to hide from predators.	↑1
	50%	It is expected that numbers and distribution of koura may increase as a result of 50% Scenario 1 riparian management and afforestation. This scenario increases food complexity and habitat variation that enhances resilience and places for koura to hide from predators.	↑2
	100%	In this step fish species have the potential to increase in number. There are a number of factors that affect the abundance of fish, including predation, food, barriers to migration, and water quality attributes (dissolved oxygen, pH, turbidity, ammonia, temperature). Reductions in the 4 contaminants may have varying impacts on particular species. Tuna are a very resilient species and can live in degraded environments but like piharau and inanga are sensitive to barriers to migration. Koura are more sensitive to sediment, and inanga are quite sensitive to a range of factors. For this indicator koura has been focussed on as an indicator species. They have a wide distribution in water body types (lakes, river, and streams) and are sensitive to turbidity and clogginess and thrive in natural riparian margins. It is expected that numbers and distribution of koura may increase as a result of Scenario 1 (100%) riparian management and afforestation. This scenario increases food complexity and habitat variation that enhances resilience and places for koura to hide from predators.	↑2

Ngā tarukino me ngā ika rawaho i te wai

Ngā tarukino me nga ika rawaho i te wai (presence of pest weeds and fish)	**10%**	There is no expected change in pest weed and pest fish populations as a result of afforestation and shading from revegetation on riparian margins. These measures would take some time to provide shading and effect on pest weeds.	—
	25%	There is no expected change in pest weed and pest fish populations as a result of afforestation and shading from revegetation on riparian margins. These measures would take some time to provide shading. These measures would take some time to provide shading and effect on pest weeds.	—
	50%	There is no expected change in pest weed and pest fish populations as a result of afforestation and shading from revegetation on riparian margins. These measures would take some time to provide shading and effect on pest weeds.	—
	100%	This negative indicator assumes that the presence of pest plants and fish are an indicator of poor water health, from a cultural perspective. This scenario will have minimal impacts on the presence of pest weeds and fish (i.e. won't reduce their numbers). There is expected to be some reduction of pest weeds that are affected by shading from afforestation and riparian management (that includes planting). The scenario has not considered riparian planting, however this is expected to occur in some instances as part of restoration programmes. Pest fish such as carp, catfish, gambusia and rudd are very resilient to a range of water quality characteristics. This scenario is not expected to see reductions in their number. There is expected to be some reduction of pest weeds and watercress in tributaries that are affected by shading from afforestation and riparian management (that includes planting) and further decreases as a result of nutrient reductions.	↑2

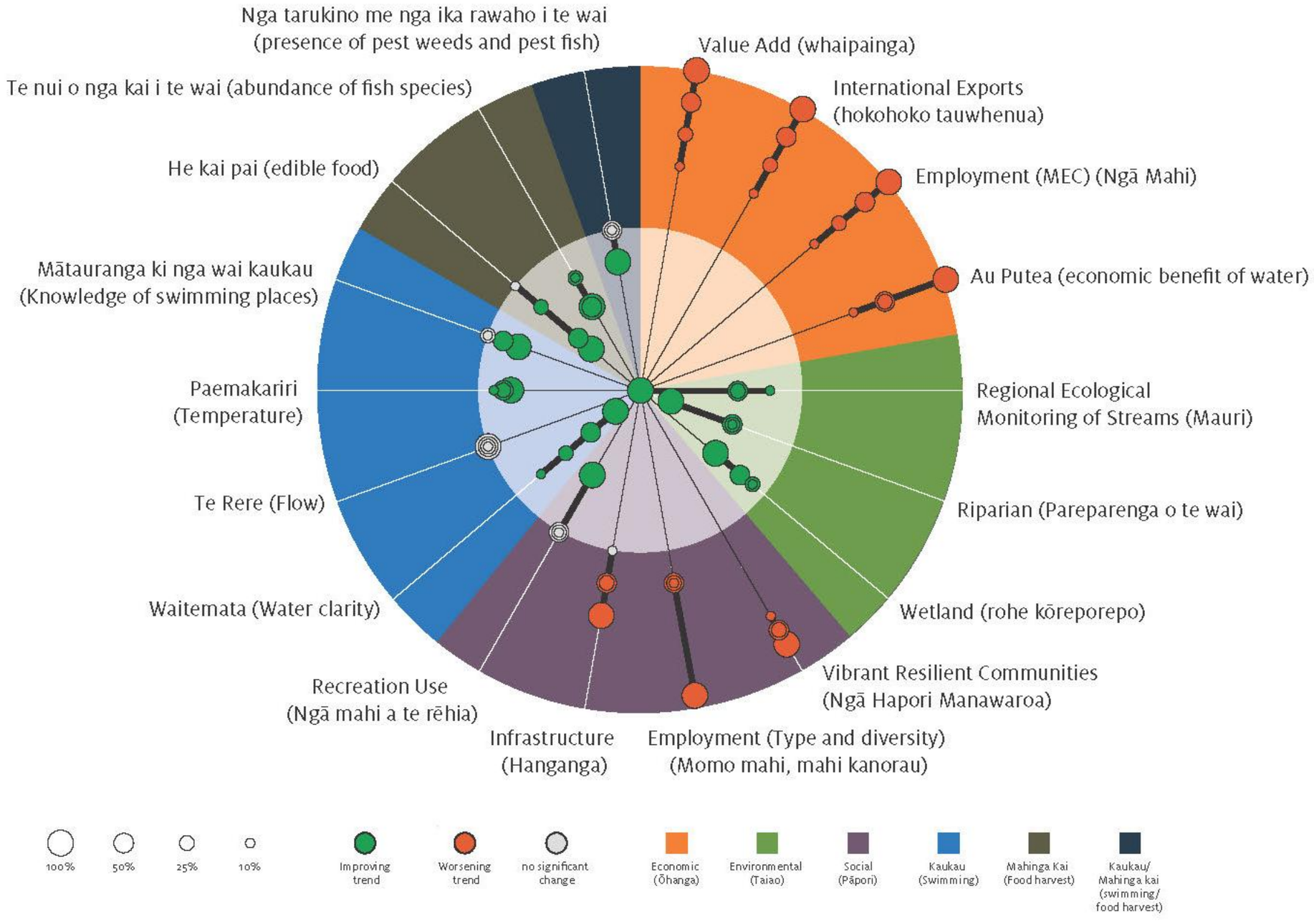
Mātauranga ki ngā wai kaukau

Mātauranga ki ngā wai kaukau (Knowledge of swimming places) – information currently held by River Iwi	**10%**	This indicator assesses the change in the River Iwi knowledge of swimming places, this being knowledge of the location of swimming places, knowledge of access to the swimming places, knowledge of the history of that place, and the ability to pass on knowledge. The assessment of changes in knowledge requires detail of personal, whanau, hapu, Iwi and collective knowledge, therefore assessment within the timeframe and scope of this project is unlikely to be achieved. Knowledge of swimming places can potentially be improved and increased as a result of improved water quality, particularly as these places are more accessible for swimming. In particular, by improving clarity (safety) and reducing E.coli (perceptions of health) this will improve the opportunity to go to swimming places and therefore sharing of knowledge can occur The higher frequency of swimming will facilitate the improvements in knowledge and the passing of knowledge. It is also expected that the awareness generated from the focus on swimmability will facilitate discussion and research. This indicator is likely to be significantly improved by factors outside the scope of Healthy Rivers, these being availability and access to knowledgeable people, dedicated learning programmes and restoration projects and ongoing research and data collection.	—
	25%		—
	50%		↑.5
	100%		↑2

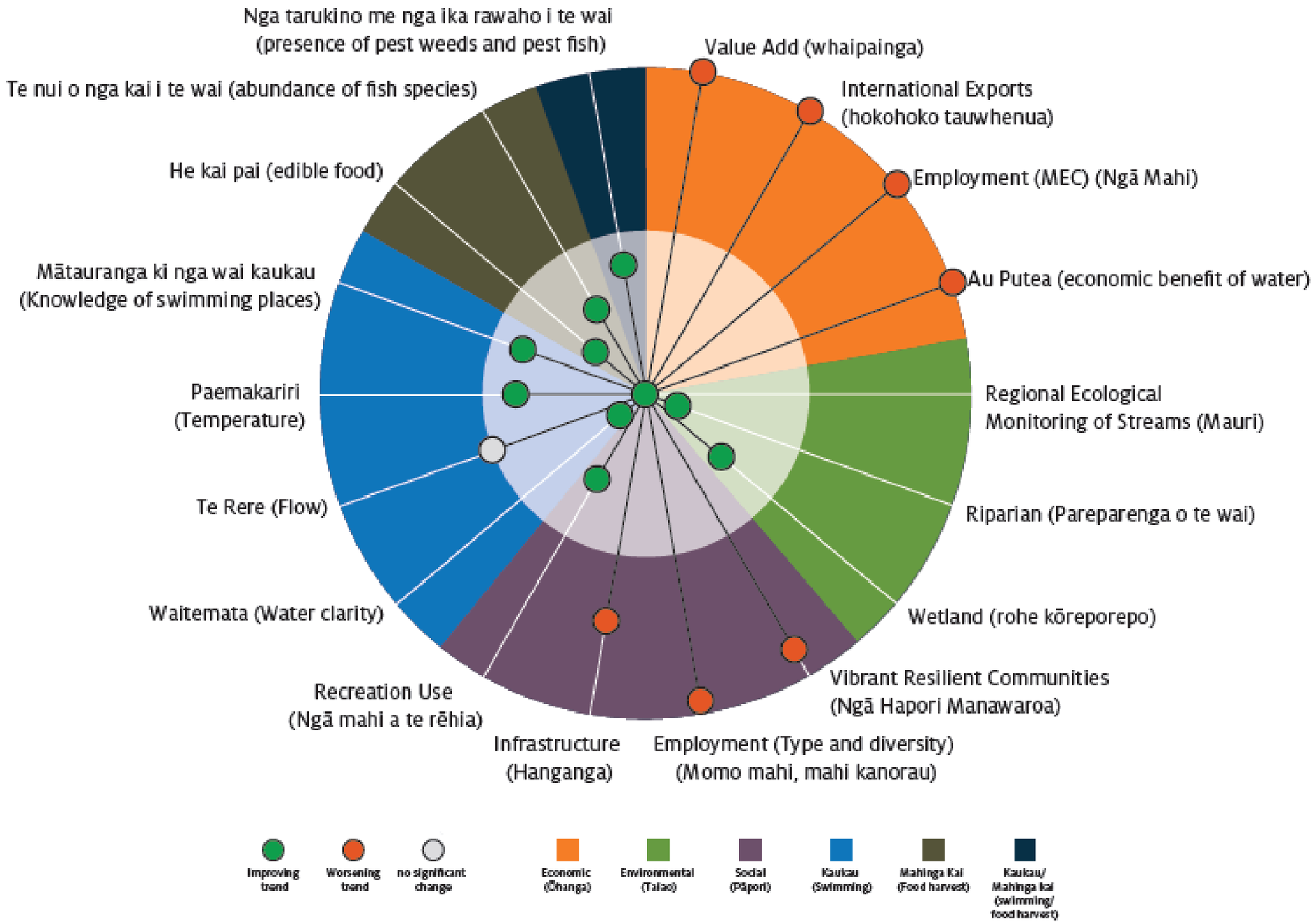
Au Putea

Au Putea (economic benefit of water) – can measure effects in employment and profit from sectors and industries and on farm cost in economic model	**10%**	This indicator focuses on the economic effects of changes in land-use, particularly on Maori landholdings that significantly rely on agriculture, forestry, horticulture activities and future geothermal energy production. Under this scenario there would be land-use change (afforestation) and decreases in land-use intensity. These result in significant impacts on value and employment. As the scenarios become more stringent the trends for this indicator gradually decline. See the employment and added value indicators for the full impact. Whilst there is expected to be some increases in forestry (which has low labour force requirements) and value added industries such as pulp and paper, these would occur after some time (maturity of forestry for harvest). There will be significant reductions in other primary sectors; horticulture and fruit growing, sheep and beef, dairy and this in turn will affect benefits to beneficial owners. There will be some reductions in energy production but it is unclear the scale of effect on geothermal energy production in the future.	↓2
	25%		↓3
	50%		↓3
	100%		↓5

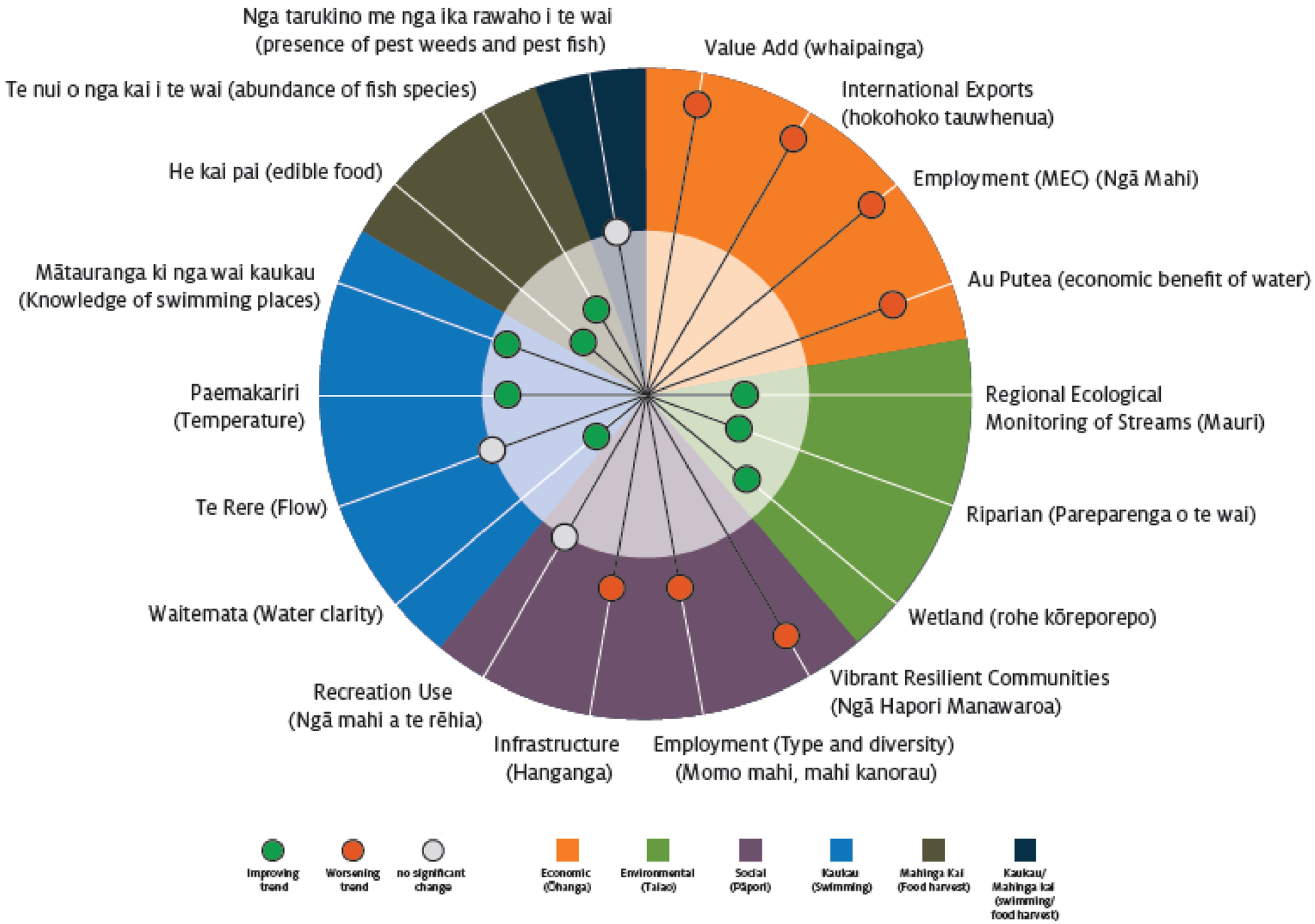
Trends wheel for Scenario 1 – combined steps 10%, 25%, 50% and 100%



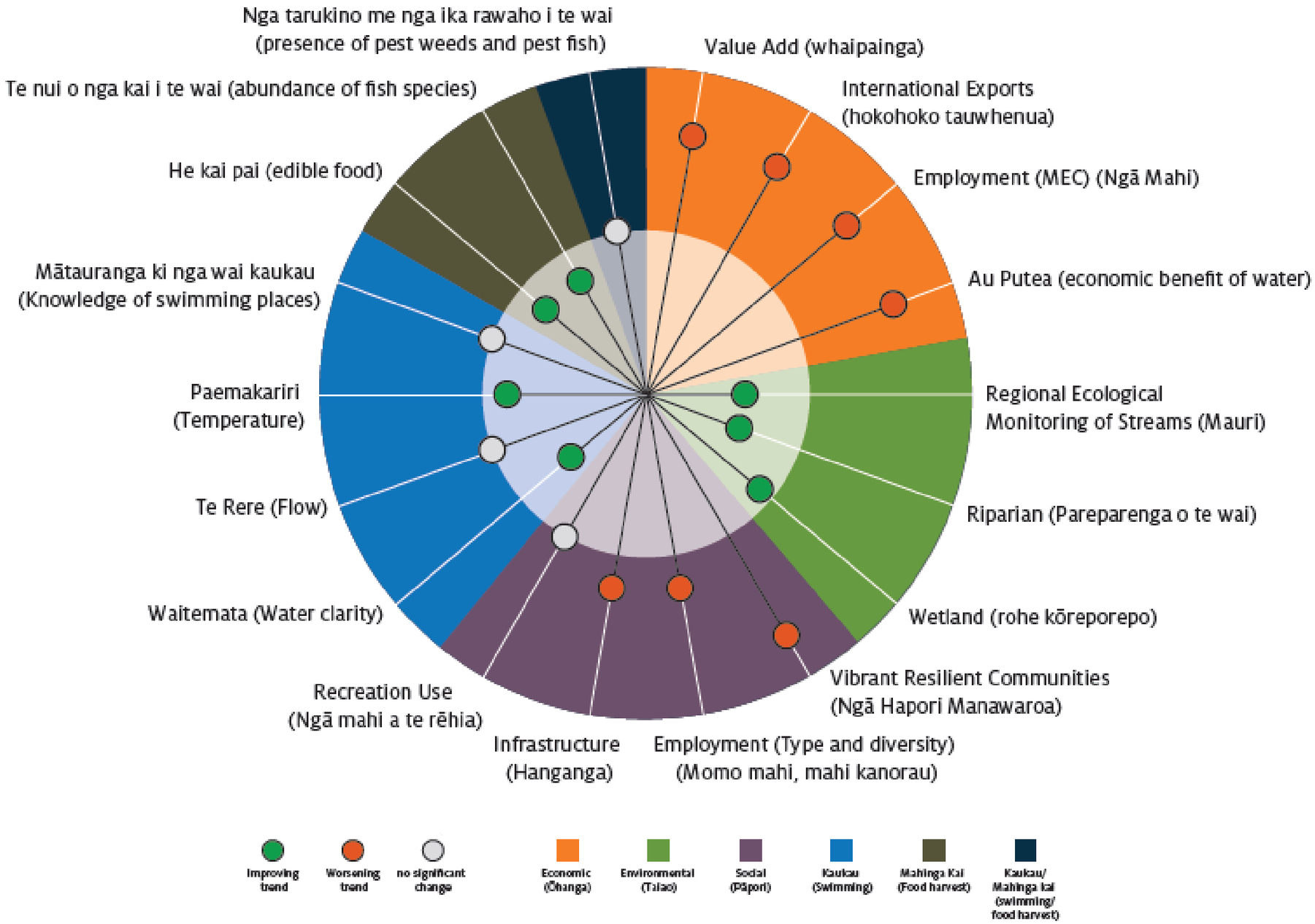
Trend wheel Scenario 1 – 100%


Nga tarukino me nga ika rawaho i te wai
(presence of pest weeds and pest fish)
Value Add (whaipainga)
Te nui o nga kai i te wai (abundance of fish species)
International Exports
(hokohoko tauwhenua)
He kai pai (edible food)
Employment (MEC) (Ngā Mahi)
Mātauranga ki nga wai kaukau
(Knowledge of swimming places)
Au Putea (economic benefit of water)
Paemakariri
(Temperature)
Regional Ecological
Monitoring of Streams (Mauri)
Te Rere (Flow)
Riparian (Pareparenga o te wai)
Waitemata (Water clarity)
Wetland (rohe kōreporepo)
Recreation Use
(Ngā mahi a te rēhia)
Vibrant Resilient Communities
(Ngā Hapori Manawaroa)
Infrastructure
(Hanganga)
Employment (Type and diversity)
(Momo mahi, mahi kanorau)
Improving trend
Worsening trend
no significant change
Economic (Ōhanga)
Environmental (Taiao)
Social (Pāpori)
Kaukau (Swimming)
Mahinga Kai (Food harvest)
Kaukau/ Mahinga kai (swimming/ food harvest)

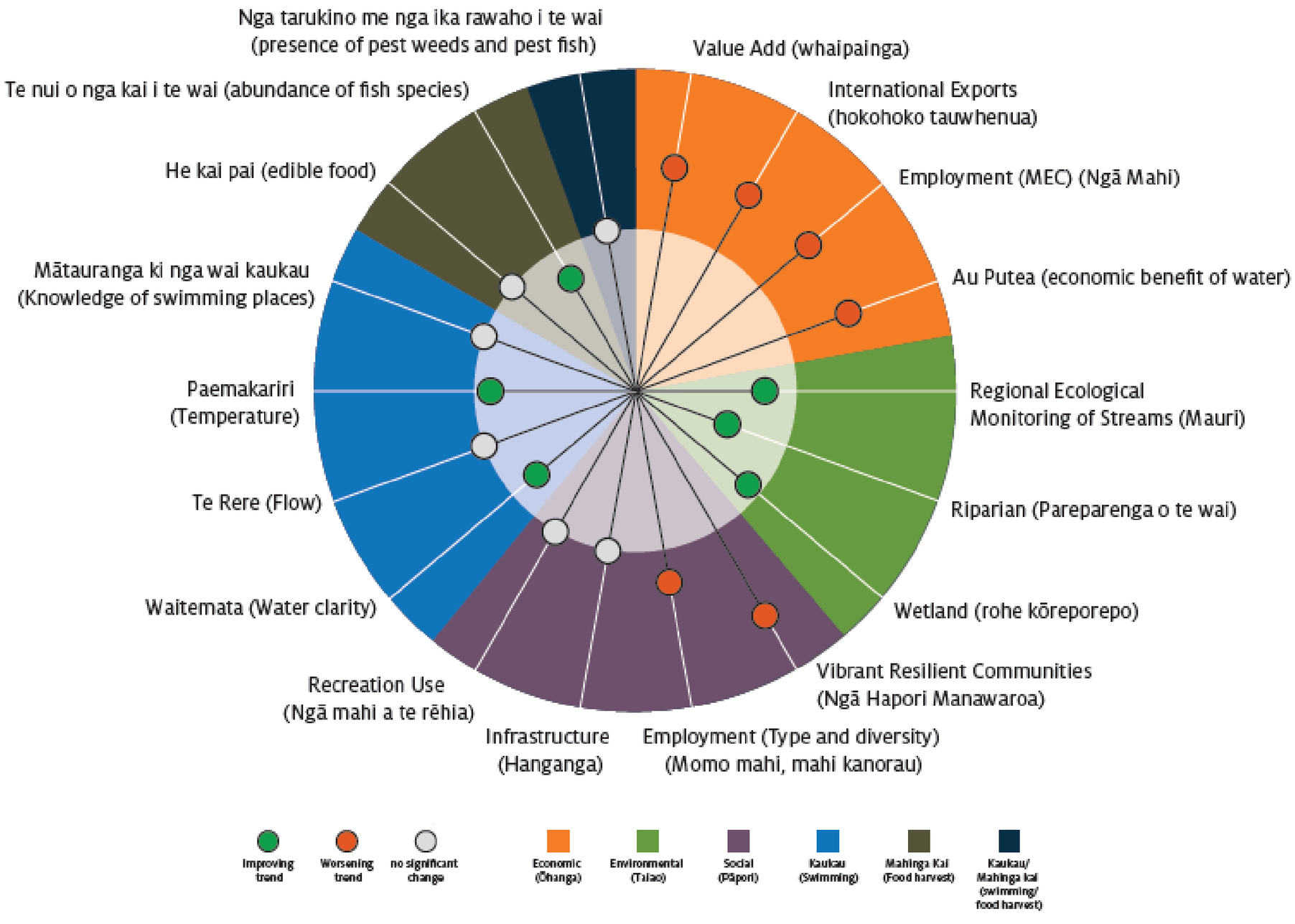
Trend wheel Scenario 1 – 50%



Trend wheel Scenario 1- 25%



Trend wheel Scenario 1 – 10%



Scenario Trend Summary: Trend of Indicator for the impact of activities to achieve the scenario attribute states

Key (scale 1 – 5) ↑ Improving ↓ Worsening — No change	Social				Environmental			Swimming/ Mahinga Kai
	Vibrant Resilient Communities	**Employment (with an emphasis on type, variety and diversity of jobs)**	**Infrastructure (reliable, affordable to consumers, investment/reinvestment risk - only covers energy, waste and water)**	**Recreation use (including access and safety)**	**Regional Ecological Monitoring of Streams (REMS which includes MCI, Clogginess (Macrophytes), stream habitat)**	**Riparian (effective for land-use)**	**Wetland (unique habitat protected)**	**Nga tarukino me nga ika rawaho i te wai (presence of pest weeds and fish)**
Direction of change in relation to Baseline	10% ↓3 25% ↓3.5 50% ↓3.5 100% ↓4	10% ↓1 25% ↓1 50% ↓1 100% ↓4.5	10% — 25% ↓1 50% ↓1 100% ↓2	10% — 25% — 50% — 100% ↑2	10% ↑1 25% ↑2 50% ↑2 100% ↑5	10% ↑2 25% ↑2 50% ↑2 100% ↑4	10% ↑0.5 25% ↑0.5 50% ↑1 100% ↑2	10% — 25% — 50% — 100% ↑2

	Kaukau (Swimming)				Mahinga Kai		Economic			
	Waitemata (water clarity)	**Te Rere (flow)**	**Paemakariri (temperature)**	**Matauranga ki nga wai kaukau (Knowledge of swimming places)**	**Te nui o nga kai i te wai (abundance of fish species – koura)**	**He kai pai (edible food)**	**Au Putea (economic benefit of water)**	**Value Add**	**International Exports**	**Employment MEC**
Direction of change in relation to Baseline	10% ↑1 25% ↑2 50% ↑3 100% ↑4	10% — 25% — 50% — 100% —	10% ↑0.5 25% ↑0.75 50% ↑0.75 100% ↑1	10% — 25% — 50% ↑0.5 100% ↑2	10% ↑1 25% ↑1 50% ↑2 100% ↑2	10% — 25% ↑1 50% ↑2.5 100% ↑3	10% ↓2 25% ↓3 50% ↓3 100% ↓5	10% ↓1 25% ↓2 50% ↓2 100% ↓5	10% ↓1 25% ↓2 50% ↓2 100% ↓5	10% ↓1 25% ↓2 50% ↓2.5 100% ↓5

[i] 1 being the lowest level of change and 5 being the highest level of change.