Strategy and Planning Committee Agenda
9 February 2022

Meeting will be held electronically and livestreamed
Link to: Otago Regional Council YouTube Channel

Members:

Cr Gretchen Robertson, Co-Chair	Cr Carmen Hope
Cr Kate Wilson, Co-Chair	Cr Gary Kelliher
Cr Hilary Calvert	Cr Michael Laws
Dr Lyn Carter	Cr Kevin Malcolm
Cr Michael Deaker	Cr Andrew Noone
Mr Edward Ellison	Cr Bryan Scott
Cr Alexa Forbes	

Senior Officer: Sarah Gardner, Chief Executive

Meeting Support: Dianne Railton, Governance Support

09 February 2022 10:00 AM - 12:00 PM

Agenda Topic — Page

This paper informs Council about the on-line measurement technology and its use in the environmental monitoring network operated by the ORC Environmental Monitoring team. The paper further gives an insight into future prospects for using on-line measurement technology.

This paper is provided for TAG to report to Strategy and Planning Committee on progress towards finalising the required science for the Manuherekia catchment.

7.3 LWRPGG UPDATE

A verbal update will be provided by members of the LWRP Governance Group.

8. CLOSURE

Otago Regional Council

Minutes of a meeting of the Strategy and Planning Committee held in the Council Chamber on Wednesday 10 November 2021 at 1:00PM

Membership

Cr Gretchen Robertson	*(Co-Chair)*
Cr Kate Wilson	*(Co-Chair)*
Cr Hilary Calvert	
Dr Lyn Carter	
Cr Michael Deaker	
Mr Edward Ellison	
Cr Alexa Forbes	
Cr Carmen Hope	
Cr Gary Kelliher	
Cr Michael Laws	
Cr Kevin Malcolm	
Cr Andrew Noone	
Cr Bryan Scott	

Welcome

Chairperson Wilson welcomed Councillors, members of the public and staff to the meeting at 1:00 pm. Staff present included Sarah Gardner (Chief Executive), Nick Donnelly (GM Corporate Services), Gwyneth Elsum (GM Strategy, Policy and Science), Gavin Palmer (GM Operations), Dianne Railton (Governance Support), Anita Dawe (Manager Strategy, Policy and Science), Kyle Balderston (Team Leader Urban Growth and Development), Sylvie Leduc (Senior Strategic Analyst), Anne Duncan (Manager Strategy), Sarah Harrison (Scientist - Air Quality) and Hugo Borges (Scientist - Lakes).

1. APOLOGIES

Resolution: Cr Wilson Moved, Cr Hope Seconded:
That the apologies for Dr Lyn Carter and Cr Deaker be accepted.
MOTION CARRIED

2. PUBLIC FORUM

No public forum was held.

3. CONFIRMATION OF AGENDA

Resolution: Cr Wilson Moved, Cr Robertson Seconded
Cr Wilson requested a change to the agenda, and that the items 7.3 Housing Bottom Lines and 7.4 RPS Summary of Decisions Requested, be reordered to allow them to be discussed first under Matters for Consideration, due to the availability of the Manager Policy and Planning.
MOTION CARRIED

4. CONFLICT OF INTEREST

No conflicts of interest were advised.

5. CONFIRMATION OF MINUTES

Resolution: Cr Wilson Moved, Cr Hope Seconded
That the minutes of the meeting held on 13 September 2021 be received and confirmed as a true and accurate record.
MOTION CARRIED

6. ACTIONS

The status report on the resolutions of the Strategy and Planning Committee was reviewed.

7. MATTERS FOR CONSIDERATION

7.3. Housing Bottom Lines

The report was provided to amend the Partially Operative Regional Policy Statement (RPS) by inserting 'Housing Bottom Lines' for Dunedin and Queenstown, in accordance with the National Policy Statement for Urban Development 2020 (NPSUD). Kyle Balderston (Team Leader Urban Growth & Development) and Gwyneth Elsum (GM Strategy, Policy & Science) were present to speak to the report and respond to questions.

Resolution SP21-120: Cr Calvert Moved, Cr Malcolm Seconded
That the Strategy and Planning Committee:

1) ***Notes*** *the report.*
2) ***Notes*** *amendments to the Partially Operative RPS 2019 (modification to Schedule 6: Housing Capacity) by the insertion of the Housing Bottom Lines for Dunedin and Queenstown urban environments that can occur immediately.*
3) ***Notes*** *that the relevant District Plan's will also be amended subsequently without a Schedule 1 Process.*

MOTION CARRIED

7.4. RPS Summary of Decisions Requested

The report was provided to release of the Summary of Decisions Requested (SoDR) in relation to the proposed Otago Regional Policy Statement 2021 (pORPS) for further submissions. Kyle Balderston, Anita Dawe (Manager Policy & Planning) and Gwyneth Elsum (GM Strategy, Policy & Science) were present to speak to the report and respond to questions. Kyle Balderston spoke to the RPS Summary of Decisions PowerPoint presentation, which included graphs and details on submissions received. Ms Dawe said that a hearing date is set down for early February 2022 and those parties who wish to join, have done so. Ms Elsum advised that for further information, the RPS page on the ORC website is kept updated.

Resolution SP21-121: Cr Wilson Moved, Cr Hope Seconded

That the Strategy and Planning Committee:

*1) **Notes** this report.*

MOTION CARRIED

7.1. Otago Lakes Strategic Plan – Scope

The report was provided for the Committee to agree on the brief and scope of the study relating to an Otago Lakes Strategic Plan, as requested by Council on 26 May 2021. Sylvie Leduc (Senior Strategic Analyst), Anne Duncan (Manager Strategy) and Gwyneth Elsum (GM Strategy, Policy & Science) were present to speak to the report and respond to questions. Ms Leduc advised that she is aware there is a lot of work being done in the great lakes, and she has spoken to those who are managing the great lakes, including Dr Marc Schallenberg, a researcher from the University of Otago. She said that this is an early scoping brief and initially has only consulted with statutory bodies but is aware of other groups. Ms Elsum advised that a consultant will undertake this initial work due to staff being committed to other work. There was lengthy discussion on the brief and scope.

Resolution SP21-122: Cr Malcolm Moved, Cr Hope Seconded

That the Strategy and Planning Committee:

*1) **Approves** the proposed brief and scope of the project associated to the Council's resolution made on 26 May 2021, requesting a scoping study for an Otago Lakes Strategic Plan.*

MOTION CARRIED

7.2. Air Quality Knowledge Gaps

The Data and Information Committee requested on 8 September 2021 that a report on areas of concern regarding potential knowledge gaps regarding Otago's air quality be brought to the Strategy and Planning Committee. Sarah Harrison (Air Quality Scientist) and Gwyneth Elsum (GM Strategy, Policy & Science) were present to speak to the report and respond to questions. During discussion Ms Elsum advised that the Air Plan is being reviewed in Year 2 of the Long-term Plan. Cr Forbes asked about monitoring and Ms Harrison advised that this is required as part of the NES. She said that data for airsheds will be available soon and once analysed, will be reported on early next year.

Resolution SP21-123: Cr Noone Moved, Cr Malcolm Seconded

That the Strategy and Planning Committee:

*1) **Notes** this report.*

MOTION CARRIED

Cr Calvert left the meeting at 2:44 pm and returned at 2:45pm

Cr Hope left the meeting at 2:52 pm.

7.5. TAG Report
Cr Kelliher declared a potential conflict and sat back from the table for this item.

The paper was provided for TAG to report to Strategy and Planning Committee on progress towards finalising the required science for the Manuherekia catchment. Gwyneth Elsum (GM Strategy, Policy & Science) was present to speak to the report and respond to questions.

Cr Hope returned to the meeting at 2:57 pm.

Resolution SP21-124: Cr Calvert Moved, Cr Noone Seconded
That the Strategy and Planning Committee:

*1) **Notes** this report.*
MOTION CARRIED

Cr Kelliher returned to the table.

7.6 LWRP GOVERNANCE GROUP UPDATE
Cr Noone, Cr Robertson and Mr Ellison provided a verbal update of work undertaken by the LWRP Governance Group, which has included a comprehensive review of every report on water and reviewing legislative requirements. Mr Ellison said the group is not critiquing, but providing oversight and gaining a level of confidence and understanding.

8. CLOSURE
There was no further business and Chairperson Wilson declared the meeting closed at 3:15pm.

_________________________ __________________
Chairperson Date

ACTION REGISTER – STRATEGY AND PLANNING COMMITTEE AS OF 9 FEBRUARY 2022

Meeting Date	Item	Status	Action Required	Assignee/s	Action Taken	Due Date
01/12/2020	P&S1885 ORC Role in South Dunedin/Harbourside Adaptation collaboration with DCC	Completed	Progress collaboration with DCC to deliver the South Dunedin/Harbourside natural hazards adaptation programme as in Option 3 and report back to Council.	Chairperson	**26/01/2021** Date to be set for initial meeting between Chair Noone, Mayor Hawkins and staff. **6/05/2021** Chair Noone advised he had spoken with DCC Mayor Hawkins who is waiting on a formal position from Councillors **12/07/2021** That Chair Noone formally write to DCC requesting a discussion held on the action point South Dunedin Harbourside Adaptation Programme **4/08/2021** Chair Noone wrote to the DCC and a meeting has been scheduled in the Mayor's office on Tuesday 31 August, which Cr Noone, Sarah Gardner and Gavin Palmer will attend. **2/02/2022** Chair Noone, Sarah Gardner and Gavin Palmer met with Mayor Hawkins and CEO Ms Graham on 14/09/2021 and discussed the appointment of a Joint Programme Manager. It was agreed this role would have responsibility to report to both Councils to keep Governance informed going forward. A report to Council on 27/10/2021 advised the appointment of Jonathan Rowe, as Joint Programme Director. Jonathan Rowe provided a report to Council on 24/11/2021.	28/02/2021
13/10/2021	SPS2159 Otago Greenhouse Gas (GHG) Profile Update	Completed	Delegate to the Chair, writing a letter to appropriate Ministers to seek clarification and consideration of issues based on the Otago Greenhouse Gas paper October 2021 that is being presenting to Otago; and invite representatives to meet with Council. **RES SP21-118**	Chairperson	**2/02/2022** Chair Noone sent a letter to Hon James Shaw, highlighting concerns about the 'five metre tree rule' causing the exclusion of the large areas of land when calculating sequestration.	30/11/2021
10/11/2021	SPS2162 Otago Lakes Strategic Plan – Scope	Assigned	Procure the services of a consultant to carry out the scoping study – Stage 1. **RES SP21-122**	General Manager Strategy, Policy and Science		31/03/2022

7.1. Real Time Data

Prepared for: Strategy and Planning Committee

Report No. SPS2164

Activity: Governance Report

Author: Eike Breitbarth, Manager Environmental Monitoring

Endorsed by: Gwyneth Elsum, General Manager Strategy, Policy and Science

Date: 9 February 2022

PURPOSE

[1] This paper informs Council about the on-line measurement technology and its use in the environmental monitoring network operated by the ORC Environmental Monitoring team. The paper further gives an insight into future prospects for using on-line measurement technology.

EXECUTIVE SUMMARY

[2] The ORC maintains a sophisticated environmental monitoring program. Measurements of flood warning relevant data such as river level/flow and rain fall provide the core of the on-line monitoring program. Further essential services include groundwater level, water quality, air quality, and climate monitoring, which have been integrated into the hydrology network. These areas are being expanded to fulfil the Council's obligations to the National Policy Statement – Fresh Water Management (NPS-FM) 2020 and increasing stakeholder interests in the region. Reliable, up to data are made available to the public in the form of an on-line platform and are available for rapid decision-making processes for public safety and health.

RECOMMENDATION

That the Committee:

*1) **Notes** this report.*

BACKGROUND

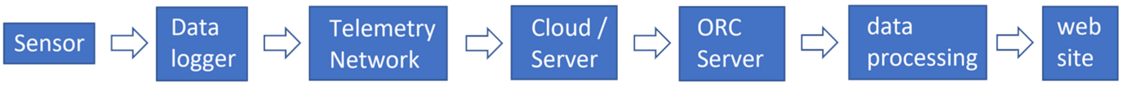
On-line measurements

[3] On-line measurements are essential to provide up-to-date information of critical parameters such as river level for the flood warning system. The on-line environmental monitoring network of the ORC includes surface water hydrology (water level and flow), ground water (level and water quality), surface water quality, rain fall, air quality, as well as the trophic lake buoys. Further, manual measurements and samplings are carried out to calibrate on-line systems and as part of the state of the environment monitoring (SoE) and scientific projects. This includes sampling of biodiversity (including fish diversity) and biological monitoring parameters such as periphyton, coliform bacteria, nutrients and other water quality parameters. The Environmental Monitoring team currently maintains a hydrological network of 274 sites.

[4] On-line monitoring is often referred to as "real-time" monitoring and especially for flood monitoring, data availability needs to be accurate and current. However, some limitations do apply. While some on-line sensors and systems deliver instantaneous

results, others require a certain time for the measurement process. Further, data need to be transferred from the point of measurement to the ORC databases and processed to be presented in a format that is understandable to the public via the ORC website (Water Info) or other platforms for access. Depending on the parameter and site, data are sent as bundles from the measurement site through our data network on set time intervals (e.g. 5min, 15min, 1hr).

[5] The basic set-up and data flow of the ORC on-line measurement systems is as follows (simplified):



Please see table 1 in attachment and the data processing section below for further information.

Telemetry and data processing:

[6] The telemetry system is the core of the monitoring network and provides the data transfer from the measurement system or sensor through mobile or satellite networks. See Fig. 1 for a schematic overview.

[7] Generally, a measurement site consists of a power supply (mostly solar with backup batteries), a data logger, and the actual measurement device (e.g. a level sensor). For critical sites that are part of the flood warning system, duplicate sensors as well as telemetry systems are installed (Fig. 2). A range of logger types are used, with HyQuest and NIWA loggers (both for satellite and mobile network communications) being the main brands. The two data loggers will then communicate via separate mobile networks (different providers) or have a satellite connection as a backup. Further, the ORC is now using Low Range (LoRa) systems to transfer data from remote measurement sites that are even without satellite reception to nearby points from where data are transferred to a satellite network.

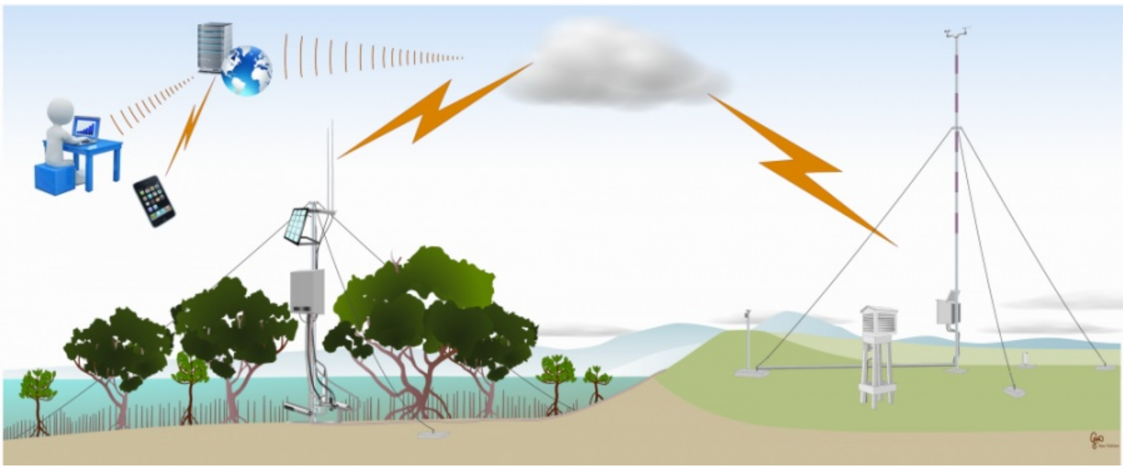


Fig.1: Illustration of field monitoring stations (aquatic, soil on left – atmospheric on the right) and telemetric data transfer via cloud and server systems to the end user). Image by NIWA.

Fig.2: Left: An ORC logger box containing two completely independent telemetry systems for a flood warning network site. The blue HyQuest iRIS logger on the left communicates data from a bubbler water level sensor (green box in the middle – see text below for further information) via a cell phone network, while the dark grey NIWA NEON logger is a satellite device that is connected to a bridge mounted radar. Both systems have independent solar power supplies and back-up batteries.
Right: The Manuherekia monitoring site above Falls Dam.

Surface water level and rainfall measurements – water flow information and flood warning system

[8] All ORC hydrographic sites measure water level and not flow. Water flow is then calculated from the level readings based on a "rating curve" which is derived from manual flow measurements taken throughout the range of river levels experienced at the monitoring site, i.e. a certain water level corresponds to a certain flow. Once the rating curve is established these calculations are done automatically as part of the data processing in the ORC system to produce continuous flow values. The rating curve is specific to each individual monitoring site as it is affected by many physical parameters in the river channel at site and by the characteristics of the catchment. The relationship of level and flow often is not static and can shift significantly over time as environmental conditions change. For example, as the riverbed changes during flooding situations, aquatic biota build-up on the bed, or even kids building dams during the school holidays. Thus, verification measurements are done frequently by hand-held or towed flow meters to maintain an accurate rating curve, which at low flow scenarios can be as often as every 5 days or even every 3 days during extreme low flow. This process cannot be automated for the dynamic riverbeds in Otago and thus is labour intensive, especially during summer low flow (Fig. 3). On the other extreme, e.g. during a flood situation, or also in inaccessible terrain, the high flow measurements are verified by deploying gauging instruments during helicopter flights (heli-gauging, Fig. 3). Protocols for this have been specifically developed by the Environmental Monitoring team and are internationally recognised. Internal and external intercalibration exercises are carried out to ensure highest data quality and accuracy.

Fig.3: River flow gaugings.
Left hand pictures: preparation for helicopter gauging with a kayak mounted acoustic doppler current profiler (ADCP) and view from helicopter during gauging operation (with Emily Olson and Jono Young, method developed by Paul Hannah).
Right hand image: Tim Harrex conducting a manual river gauging using a FlowTracker.

Measuring water level using bubblers, pressure sensors, and radar level sensors

[9] The ORC uses a range of systems to measure water level in rivers. As with telemetry, at critical flood monitoring sites two independent systems are used as backups. The best "gold standard" method of river level measurement is to use what is known as an up-down encoder mounted in a stilling well. This method requires significant investment in infrastructure on site and is often only found at some of the older sites. In more recent times the standard set up has changed to utilising a submerged pressure sensor in combination with a bubbler system or radar. The quality of data from these instruments has been improving over time and has proved to be reliable and accurate. The pressure sensor (also pressure transducer) detects the water pressure above its location. The sensor sends the pressure information via a cable to the data logger and the water level of the river can be determined from this information as described above. A bubbler system is quite different and consists of a land-based unit that measures the amount of pressure required to push an air bubble out of a small opening in an underwater pressure line into the water body. The higher the water level above the opening, the more pressure is required to push the bubble out (Fig. 4 + 5). Both technologies are well established and have been in use for some time. A modern addition is a radar level sensor, mounted on a bridge or cantilevered arm, with integrated battery power supply and telemetry communications (Fig. 4).

Fig. 4: Schematic of a bubbler system (YSI, on the left), pressure sensor/vented pressure tranducer (middle, here Seametrics PT2X pressure and temperature sensor, also commonly used for groundwater applications), and a Waterwatch radar sensor mounted of the Dart River bridge (right).

Fig. 5: Example of recently installed new flow site on the Rees River at Invincible that will provide better flood warning for the community in Glenorchy.
a. installation in progress by Emily Olson, Jono Young, Tim Harrex, Nick Boyens (not in picture).
b. completed river installation. The instruments are submerged into the river through the steel tube that is anchored to the rock. The site has no cell phone reception and too much bush coverage to obtain good satellite coverage.
Thus the team has installed the new NIWA LoRA IoT links to transmit multiple signals from the water level sensor site (c. and e.) in the bush to the logger and satellite modem out in the open (d. and f.).

<u>Measuring rain:</u>

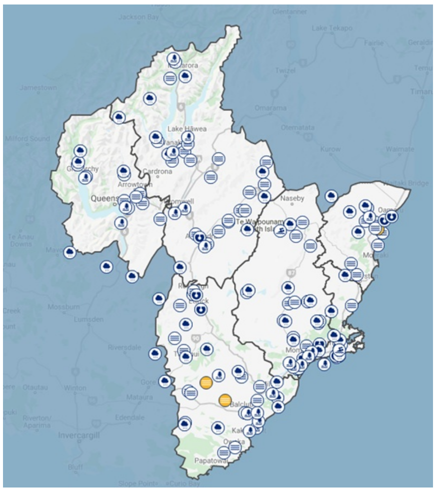
[10] Rainfall data are an essential component in the flood warning network, provide accurate local data for catchments and tie into flood prediction modelling. They are also used to calibrate the rain radars from Met Service. Field sites are equipped with tipping bucket rain sensors or also more recently with weighing principle rain gauges, which are basically a high precision balance weighing amounts of rain per unit time (Fig. 6). In addition, simple manual rain collectors verify rain data collected in the field. All rainfall sites (32 in total) are telemetered. Some alpine sites cannot be accessed in winter and data remain unverified as tipping bucket rain gauges cannot measure snow fall. However, the new weighing gauges can measure solid precipitation through the use of heating elements. The Environmental Monitoring team is also scoping out the possibility of installing snow depth sensors in the future. These will aid to estimate snow fall and melt effects on the catchment.

Fig. 6: Tipping bucket rain sensor being serviced by Wayne Worth. There is a new rain gauge at Lauder Basin in the Dunstan Mountains. This is the ORCs highest rain gauge station at an elevation of about 1550m. The set-up includes a tipping bucket rain gauge and also the first weighing principle gauge (PreciBal 3 from HyQuest) of the ORC. Access to the site is by a 2 hour, 4WD trip each way in addition to the travel time on sealed roads or by helicopter.

Data transmission and processing

[11] Most sensors are set to record every 5 minutes, some groundwater probes and temperature loggers record data every 15 minutes. Generally, the data loggers are set to communicate every 60 minutes. These then send the data via mobile phone or satellite networks to a server platform for environmental monitoring managed a dedicated service provider (Hydrotel). Currently data from there are still transferred to another interface associated with our previous data management software (Hilltop), from where data are processed and then displayed on the ORC Water Info Website (Fig. 7). With changing to the Aquarius platform this is changing to a direct data feed from Hydrotel into Aquarius and onto the Aquarius Webportal. With some data analysis steps involved, the approximate time difference between the Hydrotel platform and data display on the website (available to the public) is an additional 20 minutes. The maximum total delay from the time of measurement at site to public display in graph or summary table format is 1 hour 20 minutes (see also notes in end of paper for detailed information). With the change to the new Aquarius web portal, there are less steps in the process of getting the data to the website so the time delay will be cut down.

[12] If necessary, the Neon and IRIS data loggers can have their communication rates changed remotely from the office. In winter, when there can be issues with batteries not recharging enough during the day, the communication rate tends to be changed to 120 minutes. This is then changed back if a weather event is predicted. In those cases, the communication rates at key flood sites are changed to 30 minutes. It is important to note, that while the first data points of the data pack transferred every 30 minutes will be up to 30 minutes old, also the newest up to date data point is transferred and has a maximum age of 5 minutes (depending on the sensor settings). Data can then also be viewed in directly Hydrotel for faster access and the communication to the flood phone is directly off Hydrotel, updating every 15 minutes. Further, in a flood event a combination of data flows (river level, rain fall, rain radar) from a network of sites in the affected area, as well as predictive modelling along with the experience of the flood monitoring officer are used to make informed decisions. See also Attachment, Table 1.



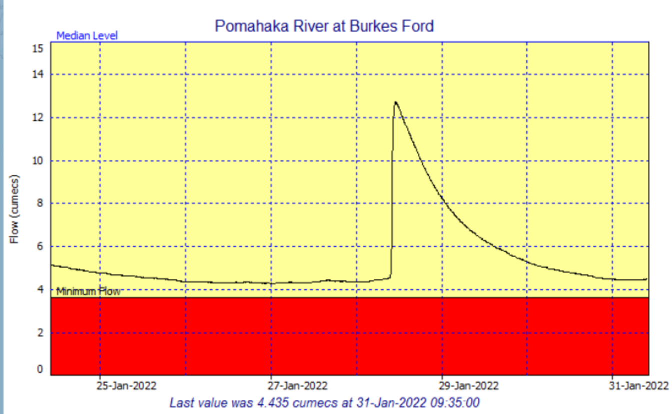


Fig. 7: Water Info map (left) – here showing three low flow alerts (yellow). Example of flow alert (approaching minimum flow setting) at the Pomahaka River at Burkes Ford (right) and effect of short rain event on flow levels during 28 Jan 2021.

https://www.orc.govt.nz/managing-our-environment/water/water-monitoring-and-alerts

Groundwater monitoring

[13] Of the 45 groundwater sites maintained by the Environmental Monitoring team, 23 to date are telemetered State of the Environment (SoE) sites that are equipped with pressure level sensors (Fig 4) deployed inside the groundwater bore. These sites, e.g. in South Dunedin, are an essential component of environmental monitoring for public safety as well as to understand changing groundwater levels in context of sea level rise, resource use and climate change. In the future, on-line water quality and further physicochemical measurements (pH, Nitrate, conductivity, pH) in groundwater bores will help to get a better understanding of the dynamics in groundwater quality. Nitrate concentrations in groundwater for example, receive growing attention due potential risk for public health when groundwater is used as a drinking water source. Data from other regions show that Nitrate concentrations in groundwater can exceed drinking water standards. Nitrate concentrations in groundwater can be highly dynamic after heavy rain events and river intrusions into aquifers. Such information cannot be obtained with quarterly manual sampling for ground water quality. Similar to installations in rivers, optical sensors can be used to measure Nitrate in groundwater reliably and at high accuracy (see water quality section below and Fig. 8). Likewise, systems are available for on-line detection of coliform bacteria and both provide a required barrier and data for informed decision making and treatment processes to comply with drinking water standards.

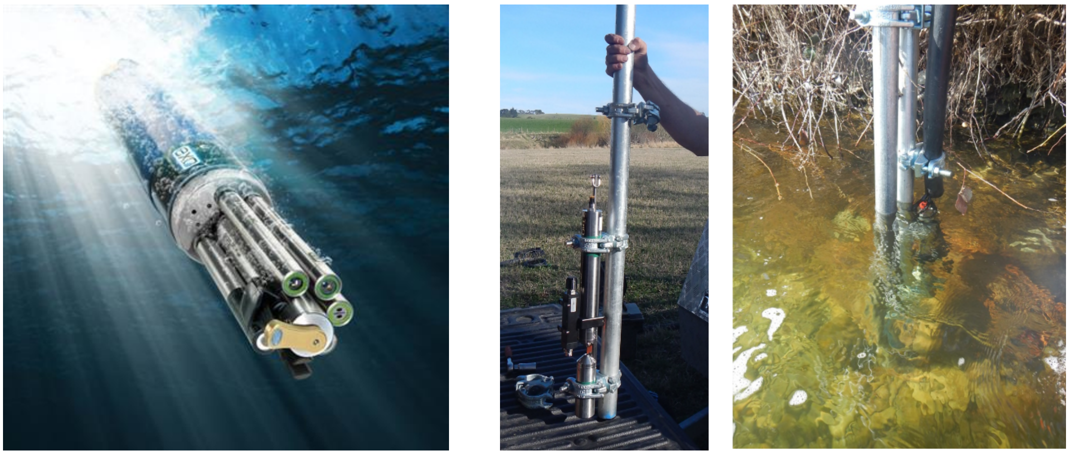
Water Quality:

[14] The ORC is monitoring a range of water quality parameters and is in the process of rolling out a wider network of telemetered on-line monitoring sites in this sector as well. For river, lake, and ecosystem health, classic water quality and physicochemical parameters of interest are turbidity, oxygen, pH, temperature, coliform bacteria, algae including cyanobacteria, and nutrients such as nitrate and phosphate. The Council is mandated to measure these for different reasons, including contact recreation in summer (direct public health effects), ecosystem health, source water protection for drinking water (direct and long-term public health effects), and information on land use effects.

[15] Of the parameters aforementioned, temperature, oxygen, and in only three sites Nitrate, are currently measured on-line. Temperature and oxygen are so called master variables for ecosystem functioning and e.g. fish survival, and thus also receive frequent interest by the press. The values show the state of water quality, which can degrade due to eutrophication (by high nutrient input), high sediment and organic matter loads (turbidity), and lead to algae and cyanobacteria blooms and/or fish kills.

[16] Thus, there is a strong interest and also mandate by the 2020 NPS-FM to increase the monitoring of these parameters, and the future perspective is to move from a water quality sampling scheme to an on-line sensor-based system. Taking the hydrographic river level and flow measurements as an example, an extensive on-line monitoring network provides the ORC and the public with up-to-date information on the state of the environment and alert in case of changing conditions that can affect public health

and safety. Furthermore, on-line sensors are a much more cost effective way to collect environmental data, as after the instrument purchase and installation the main costs are in the maintenance and not the actual measurement itself (see Fig. 8 as examples). Manual water quality sampling and lab analysis will remain to be important for sensor calibration and are likely to be continued on the similar frequencies as to date (e.g. monthly during site maintenance visits), but like with the on-line water quantity measurements the on-line water quality sensors provide a continuous monitoring of the water bodies and thus detect dynamics and peaks of critical parameters such as oxygen and nitrate, which allow for informed decision making for public health and are missed in low frequency manual sampling.



<u>Fig. 8:</u> Water quality sensors.
Left: YSI Exo – a multiparameter sensor measuring, e.g. pH, conductivity, temperature, oxygen, turbidity, including an automatic brush cleaner.
Middle: TriOS optical sensor for measuring Nitrate and organic matter – also including an automatic brush cleaner – mounted on scaffolding pipe for river installation.
Right: Optical Nitrate sensor installed in the Kakanui river.

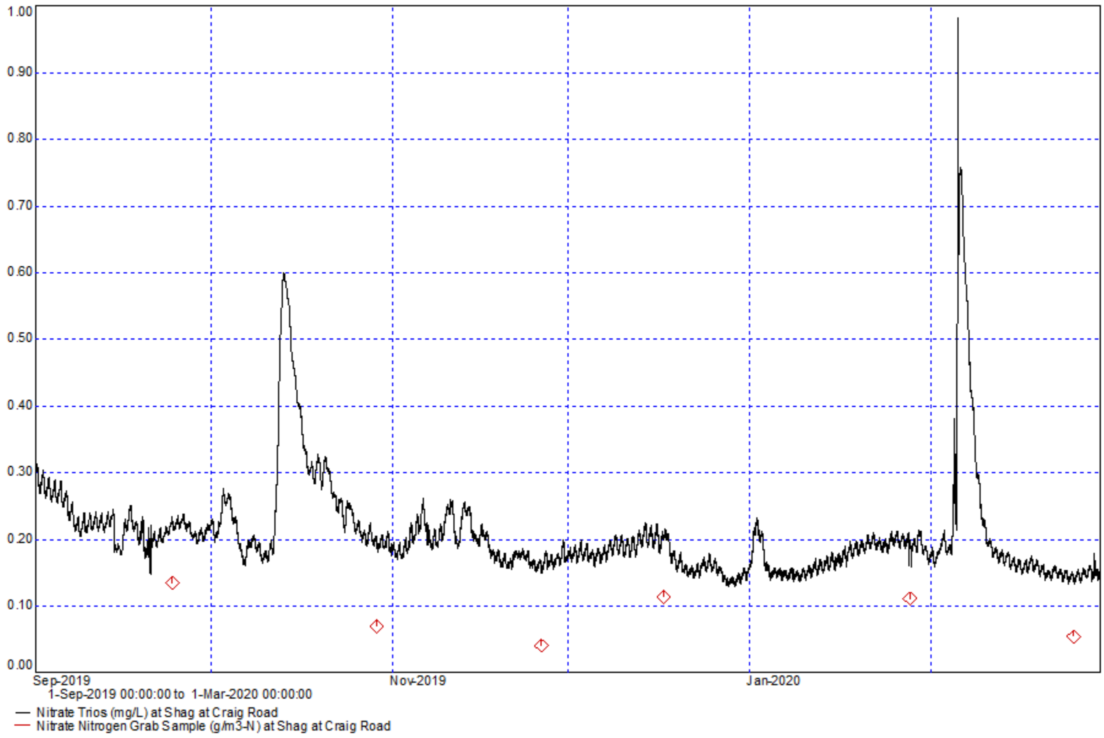


Fig. 9: Example data - 4 months of continuous Nitrate measurements at Craig Rd., Shag River.

Fig. 10: Water quality sensors.
Left: Oxygen sensor in mounting bracket during maintenance work (cleaning). Middle: manual cleaning of oxygen sensor installed in field.
Right: field installation of water quality sensors in a protective steel tube.

Air quality:

[17] The ORC is mandated to monitor air quality and provide the data to the public. Air quality is measured at eight sites across Otago (Alexandra, Arrowtown, Mosgiel and Central Dunedin, Balclutha, Milton, Clyde, and Cromwell), with a new site in Wanaka currently being under construction. Air quality has received increasing public attention due to effects of poor air quality on respiratory health. To date, the ORC monitoring has focussed on monitoring airborne particles from home heading (fire), vehicle traffic, and to some extent industrial contributions. Particles of 10µm size or larger are measured (PM10) and new instruments also measure the size fraction of 2.5µm or larger (PM 2.5). For this, air is drawn into the monitor from an intake on the roof of the unit and

analysed (Fig. 11). The ORC does not monitor Sulphur Dioxide SO_2 from industrial and maritime ship emissions, or gases, such as Nitrous Oxide (NOx) from e.g. vehicle emissions and Methane CH_4 from e.g. agricultural emissions.

[18] PM10 and PM2.5 air quality is monitored at permanently installed air quality sites, along with parameters such as air temperature, relative humidity, wind speed, and wind direction. Installations are inside monitoring units or, as now preferred, portacom buildings for robustness, safety, and ease of maintenance. All data are telemetered and made available to the public through the ORC and LAWA websites.

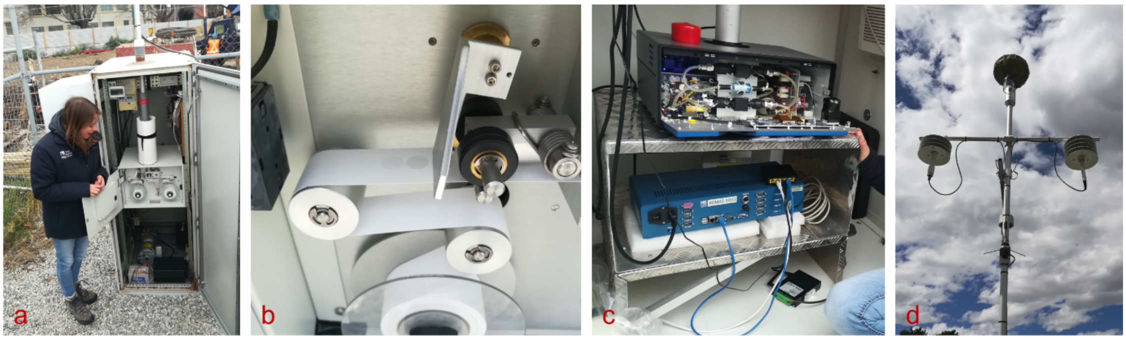


Fig. 11: a: Dunedin air-quality site (currently in progress to be shifted to new location and upgraded to a portacom building) with Lauren Hunter explaining the set-up.
b: Inside of BAM1020 air quality monitor showing accumulated PM10 particles on filter tape.
c. Inside of the Teledyne T640X optical monitoring system measuring PM10 and PM 2.5.
d: Air monitoring intake on roof of air monitoring station, including meteorological instruments for air temperature, relative humidity, wind speed, and wind direction.

System maintenance

[19] On-line sensor systems operate autonomously and are designed to deliver data automatically over their expected lifespan. A common conception might be that once the systems are installed and produce data, they would do so without further work required. However, on-line sensor systems need to be serviced and calibrated during regular site visits. These site maintenance visits are essential for maintaining the sensor reliability, performance, and data quality to ensure that data collected are accurate, robust and meet national and international standards (NEMS, ISO, WMO, etc). From a workload perspective, a detailed national method is used to calculate work time required per monitoring site, which depends on the complexity and technical outfitting of the site along with its location. One field technician can service about 10 environmental monitoring sites, depending on their outfitting. While some sites can be accessed via tracks from nearby roads, a wider number are located in very remote environs and travel times can include travel of several hours one-way via 4WD tracks or even require helicopter access. Aspects such as automatic cleaning of sensors and systems, long time calibration stability of e.g. optical sensors for water quality, as well as remote diagnostics play an increasing role in reducing the in person servicing requirements and thus operational costs.

DISCUSSION

Summary and future perspectives:

[20] The use of on-line systems in environmental monitoring is continuously developing. From a business perspective, using on-line systems has a significant advantage of a high frequency data supply with relatively small operating costs compared to discrete sampling and laboratory analysis. Like for other regional councils and organisations such as NIWA and Met Service, high frequency measurements of on-line systems allow for rapid detection of changes, data use in up-to-date predictive modelling, and informed decision making. Weather predictions, meteorological warnings, and flood prediction and monitoring, rely on continuous data input from environmental on-line monitoring systems.

River level and flow:

[21] The ORC flood warning system and general river level/flow monitoring will benefit greatly by installation of further low-cost radar systems (e.g. Waterwatch sensors, Fig. 4). Bridge mounted systems such as velocity image analysis sensors or higher end radar sensors also measuring surface water speed may add to the system. However, while becoming part of monitoring systems in Europe and the US, in New Zealand velocity image analysis and radar-based surface flow measurements have their limitations considering the complex and changing riverbeds and potential interference from strong wind effects on the water surface experienced here. Thus, deriving actual flow information from level sensors and manual flow gaugings to build rating curves as described above will remain an essential part of the monitoring work in Otago. The Environmental Monitoring team is currently investigating the use of surveillance/monitoring cameras to assist in river low flow monitoring at the Lindis river confluence. Cameras are also used by e.g. Horizons Council, Northland Council, NIWA and Environment Canterbury, and in regions with risks of flash flooding.

Water Quality:

[22] The NPS-FM 2020 and the deriving Land and Water plan will require an intensification of State of the Environment (SoE) monitoring for water quality. It should be the long-term goal, to extend the ORC on-line monitoring network for water quality in a similar way as for the established river level and flow monitoring, which would allow for high frequency data provision on water quality in rivers, lakes and groundwater to the public and stakeholders at reasonable operating costs. Parameters such as Nitrate, algae, and cyanobacteria can all be measured with optical sensors that are robust and designed for remote on-line field monitoring. For this, the ORC is also expanding its lake monitoring program with installing further lake monitoring buoys in Lake Wakatipu and Lake Wanaka, as well as investigating the use of smaller buoys for surface water monitoring in other lakes across the region (see Fig. 12). Discrete water sampling and laboratory analysis will provide reference measurements used for sensor calibrations. Marine buoys and systems for estuarine monitoring are being considered, with marine buoys potentially also providing data on wave height and direction.

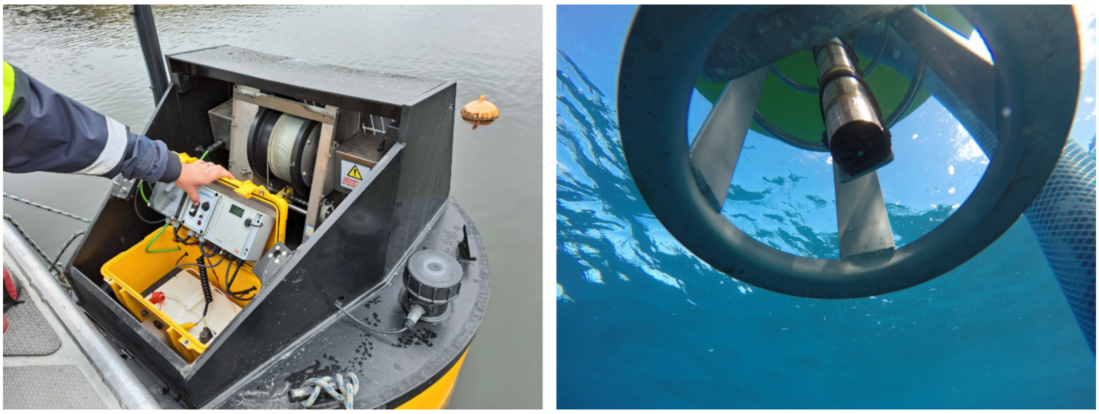


Fig. 12: Profiling buoy on Lake Hayes during maintenance (left).
Example of surface water monitoring buoy for lakes and estuaries – seen from below (photo by Sealink)

[23] Intriguingly, Auckland Council, as well as the City of Copenhagen, also use a predictive model to warn for potential contamination of surface water by Coliform bacteria and Enterococci in marine waters, that utilises environmental data such as turbidity, conductivity, etc. from the environmental monitoring network of the region (https://www.safeswim.org.nz/). An approach like this significantly reduces the risk to the public, as the current contact recreational sampling program carried out seasonally by the ORC, where water quality information and potential warnings to public health can only be made available to the public after laboratory analysis, and a delay of approximately 24 hours, and only a limited number for public sites that are sampled 1x/week. In addition, Coliform bacteria can be measured with on-line analysers, which can be installed at strategic locations to ground truth the system in a similar manner as done with rain sensors for the Met Service rain radars, resulting in predictive modelling. An application of such a system to also derive bacterial contamination across the monitoring network would need to be developed, but once established would allow for greater in-depth information of water quality in Otago. Together with on-line monitoring at high-frequency and good spatial resolution would have great implications for the SoE monitoring as required by the NPS-FM 2020, recreational activities, as well as risk analysis in context of source water protection for drinking water.

Climate and Air Quality:

[24] The ORC Air Quality network is continuously being upgraded to improve the set-up with portacoms and improved equipment such as the combined PM10 and PM2.5 monitors. Prospects in the future may include using the portacoms for additional information to inform the public about the air quality monitoring program. Furthermore, future programs should also include monitoring of relevant contaminants and gases such as Sulphur oxides (SOX), Nitrous Oxides (NOx), Carbon Dioxide (CO2) and Methane (CH4), all of which can be easily measured with on-line sensors and depending on location (e.g. port, industry such as fertilizer plants, high traffic inner city area) are highly relevant to public health. See Fig. 13 for examples.

Fig. 13: Left: Wellington inner city air-quality monitoring portacom, which is also used as a display for public information.
Right: inner city air-quality monitoring station in Gothenburg (Sweden) including gas measurements for Nitrous Oxides (NOx).

[25] Naturally, air quality monitoring is tied in with climate monitoring when looking at atmospheric parameters such as wind, relative humidity and temperature as well as climate relevant gases such as Carbon Dioxide (CO_2) and Methane (CH_4). Further, atmospheric information with data on rainfall and soil moisture are key parameters that are relevant for agricultural use as well as climate research and monitoring. See Fig. 14 for the installation of a soil moisture probe along with rain sensors.

Fig. 14: Left: Soil moisture probe being installed.
Right: Same site, showing the rain sensors and telemetry system (with Nick Boyens). The area is fenced off from stock and accidental damage by farming vehicles.

OPTIONS

[26] This report is a noting paper for information only.

CONSIDERATIONS

Strategic Framework and Policy Considerations

[27] Nil

Financial Considerations

[28] Nil

Significance and Engagement Considerations

[29] Nil

Legislative and Risk Considerations

[30] Nil

Climate Change Considerations

[31] See summary text

Communications Considerations

[32] Nil

NEXT STEPS

[33] Nil

ATTACHMENTS

1. Real Time Data Table 1 [**7.1.1** - 4 pages]

Table 1: ORC environmental monitoring and telemetry system response and longing times

River Water Level:	Reading characteristics	Comment	Minimum logging rate for NEMS compliance	ORC log rate	Comment
Dry Pressure transducer (Bubbler)	Instantaneous	May be averaged over 10-60 seconds prior to time stamp	5 min	5 min	
Up/down encoder	Instantaneous	Need stilling well and may be averaged over 10-60 seconds prior to time stamp	5 min	5 min	
Vented Pressure transducer	Instantaneous	May be averaged over 10-60 seconds prior to time stamp	5 min	5 min	
Absolute Pressure transducer (non-vented)	Instantaneous		5 min	5 min	Non-telemetered, requires site visit to collect data
Radar	Instantaneous	May be averaged over 10-60 seconds prior to time stamp	5 min	5 min	to complement flood warning system, completely independent power supply and telemetry
Groundwater Level:					
Vented Pressure transducer	Instantaneous	May be averaged over 10-60 seconds prior to time stamp	15 min	5 min	
Absolute Pressure transducer (non-vented)	Instantaneous		15 min	5 min/15 min	Non-telemetered, requires site visit to collect data

Table 1 continued: ORC environmental monitoring and telemetry system response and longing times

Water quality parameters:	**Reading characteristics**	**Comment**	**Minimum logging rate for NEMS compliance**	**ORC log rate**	**Comment**
Individual sensors (eg Dissolved Oxygen, Nitrate etc)	Instantaneous – 1 minute	May be averaged over 10-60 seconds prior to time stamp	15 min	5 min	
Water Temperature	Instantaneous		15 min	5 min	
Hobo temperature logger	Instantaneous				Non-telemetered, requires site visit to collect data
Multi-parameter sondes	Instantaneous		15 min	15 min	Usually not telemetered and log rate restricted by battery capacity
Rainfall:					
Tipping bucket rain gauge	after each bucket tipping		1 min	5 min/1 min	Currently transitioning from 5 min logging to 1 min or bucket tip event type logging
Weighing rain gauge			1 min	1 min	New system, first weighing rain gauge now installed in Dunstan Mountains

Table 1 continued: ORC environmental monitoring and telemetry system response and longing times

Air Quality:					
Wind Speed/Direction	Instantaneous			60 min	
Air Temperature	Instantaneous			15min	
PM10 BAM1020	Hourly			60 min	
PM2.5 / PM10 T640X	Every minute / average over hour			60 min	
Soil Moisture:					
Soil water content			15 min	15 min	

Notes:

Data flow for website graphs:

Sensor records every 5 minutes -> Logger on site communicates and sends data to Hydrotel every 60 minutes -> Data transferred to Hilltop Hydrotel file -> Data transfer from Hydrotel.hts to Telemetry.Hts every 10 minutes at XX:X7 -> Data transferred from Telemetry.hts to WaterInfo.hts every 10 minutes at XX:X9 -> Image created for graph every 10 minutes at XX:X0 -> Azureship graphs sends graphs to the website every 10 minutes at XX:X7

Approx. 20 minutes from data coming in to Hydrotel to getting to webgraphs. Max 1 hour 20 minutes behind collection of first data point in sent data bundle.

Data flow for website summary tables:

Sensor records every 5 minutes -> Logger on site communicates and sends data to Hydrotel every 60 minutes -> Data transferred to Hilltop Hydrotel file -> Data transfer from Hydrotel.hts to Telemetry.Hts every 10 minutes at XX:X7 -> Alarmist reads Telemetry.hts file every 3 minutes -> Creates Alets.xml -> Azureship Alerts sends summary table last data points to website every 10 minutes at XX:X7.

Approx. 15 minutes for data coming into Hydrotel to website summary tables. Max 1 hour 15 minutes behind collection of first data point in sent data bundle.

7.2. TAG Update

Prepared for:	Strategy and Planning Committee
Report No.	SPS2204
Activity:	Governance Report
Author:	Gwyneth Elsum, General Manager Strategy, Policy and Science
Endorsed by:	Sarah Gardner, Chief Executive
Date:	9 February 2022

PURPOSE

[1] For TAG to report to Strategy and Planning Committee on progress towards finalising the required science for the Manuherekia catchment.

EXECUTIVE SUMMARY

[2] At its meeting on 25 August 2021, Council resolved "that the Technical Advisory Group (TAG) be requested to provide regular reports to the Strategy and Planning Committee on progress towards finalising the required science for the Manuherekia catchment".

[3] Attached to this paper (Attachment 1) is the third report to the Strategy and Planning Committee from TAG.

RECOMMENDATION

That the Committee:

1) ***Notes** this report.*

BACKGROUND

[4] TAG was established in early 2019 with the purpose of the TAG to support the Otago Regional Council and Manuherekia Reference Group ("MRG") with science and technical advice for the Manuherekia Catchment.

[5] TAG is made up of the following members:

a. Aukaha
b. Department of Conservation
c. Fish & Game
d. Omakau Area Irrigation Company
e. Otago Water Resource Users Group
f. Otago Regional Council

[6] All members can nominate one representative except for ORC which can nominate two. ORC also provides the Chair and secretariat services.

[7] TAG met regularly throughout 2019, 2020 and the first half of 2021 (a total of 16 meetings). At these meetings, TAG reviewed technical studies to do with the Manuherekia and provided advice. A TAG representative also participated in meetings of the Manuherekia Reference Group.

[8] Since the Council meeting on 25 August 2021, at which minimum flows for the Manuherekia were considered, TAG met again on:

a. 23 September 2021
b. 18 October 2021
c. 22 November 2021
d. 16 December 2021 (virtually)

[9] Minutes of the October 2021 meeting are attached to this paper (Attachment 2).

CONSIDERATIONS

Strategic Framework and Policy Considerations

[10] The activities of TAG are consistent with the following ORC roles as articulated in the Strategic Directions:

- Monitor and investigate the health of Otago's ecosystems.
- Provide the best available information on Otago's ecosystems.
- Monitor and investigate the health of Otago's fresh and coastal water, and the region's soil resources.
- Provide the best available information on Otago's water, land and coastal resources.

[11] The NPSFM requires regional councils to set limits for resources use. Rules for restrictions on allowed takes (minimum flows) and discharges to achieve environmental flows are required to be set as rules in the new Land and Water Plan. The limits need to be consistent with the NPSFM 2020 framework and Te Mana o te Wai hierarchy of obligations.

[12] ORC has committed to the Minister for the Environment to notify a new fit-for-purpose Land and Water Plan by December 2023.

Financial Considerations

[13] Funding of TAG's activities or any further work the Group may advise ORC to undertake have not been budgeted for this financial year.

Significance and Engagement Considerations

[14] Not applicable.

Legislative and Risk Considerations

[15] Not applicable.

Climate Change Considerations

[16] Not directly applicable.

Communications Considerations

[17] Not applicable.

NEXT STEPS

[18] TAG is meeting again in February and early March 2022 and will report back to the Strategy and Planning Committee at its next scheduled meeting in April 2022.

ATTACHMENTS

1. TAG Report FEB 22 [**7.2.1** - 3 pages]
2. FINAL Minutes Manuherekia TAG 18.10.21 [**7.2.2** - 3 pages]

TAG Report to ORC Council

Strategy & Planning Committee February 2022

Otago Regional Council

www.orc.govt.nz

Strategy and Planning Committee 2022.02.09

Overview

- On 25 August 2021 Council resolved to:
  - *"that the Technical Advisory Group (TAG) be requested to provide regular reports to the Strategy and Planning Committee on progress towards finalising the required science for the Manuherekia catchment".*
- This constitutes TAG's third report to Council.
- This report contains an update as to the end of January 2022 on progress against the agreed work programme.
- All timeframes in this report are subject to no further work, other than that currently underway, needing to be commissioned.

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Review inventory of science undertaken

- Establish a list, seek access to and use of all relevant technical work undertaken from member organisations and key stakeholders
- TAG role: Seek relevant technical work undertaken from member organisations and key stakeholders
- Expected Timeframe: Early – Mid October 2021

Complete

TAG members to establish a criteria for assessing 'ecological health'

- Establish criteria for 'ecological health' from a science perspective
- TAG role: Provide technical expertise and work together to establish criteria
- Expected Timeframe: Mid – Late October 2021

Draft criteria developed & reviewed by TAG members. Feedback to be incorporated at next TAG meeting.

Analysis of inventory

- Carry out a gaps analysis of the inventory and assess relative criticality of technical work undertaken including where peer review is desired
- TAG role: Provide advice to ORC on gaps, criticality and any requirements for peer review
- Expected Timeframe: November 2021

Complete

Review of flow scenarios against criteria

- ORC to undertake analysis of flows for range of scenarios up to 3000l/s
- TAG will assess each flow scenario against the agreed 'ecological health' criteria
- TAG role: To review and provide comment on analysis undertaken by ORC against established criteria
- Expected Timeframe: January / February 2022

Scheduled early March 2022

Final report to Council

- Final report to Council will contain the output of each of the above steps in the work programme
- TAG role: Input into final report to Council
- Expected Timeframe: March 2022

Expected to be completed in time for April Committee Meeting

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Strategy and Planning Committee 2022.02.09

Manuherikia [Manuherekia] Technical Advisory Group (TAG)
Minutes of meeting held Monday 18 October 2021
10:00am – 2:00pm
Dunstan Meeting Room, Otago Regional Council, Dunedin

Present:
Gwyneth Elsum (ORC - Chair)
Matt Hickey (OWRUG)
Ian Hadland (Fish & Game)
Korako Edwards (Aukaha)
Richard Allibone (ORC)
Pete Ravenscroft (ORC)
Amanda Keach (ORC - secretariat)

Via Teams:
Roger Williams (OAIC)
Jacob Williams (DOC)

1. **Welcome & apologies**
There were no apologies.

2. **Confirm minutes of previous meeting 23.09.21**
The minutes of the previous meeting held 23.09.21 were approved.

3. **Establish criteria for assessment of ecosystem health**
Richard spoke to his Manuherekia Flow Process powerpoint (circulated to the group following the meeting).

Richard highlighted in regard to minimum flow requirements, the NPS-FW objective that is required to be met is 2.1(a)
- First, the health and well-being of waterbodies and freshwater ecosystem

Richard's presentation stated this requires ecosystems to be considered, not just a certain species. An end point for the minimum flow is needed, only relating to ecological health. It needs to be demonstrated that the species selected for modelling include a range of trophic levels so that ecosystem processes are being considered.

It was discussed that water quality can drive ecosystem health outcomes and that we need to take care with attributing ecosystem health outcomes solely to flow. ORC staff are to bring the proposed water quality targets (based on the NPSFM attributes regime) for the Manuherikia FMU to TAG to aid in this assessment at February meeting.

Accrual time was also discussed as it is well understood that the time between flushing events can significantly drive periphyton communities (including diatoms) and therefore the ecosystem response. Accrual is proposed to be included in the ecosystem criteria.

The criteria process for assessing ecosystem health has two parts, the habitat side and the additional ecosystem processes that could be considered. The aim is to establish the criteria to assess against from a science perspective.

It was agreed to have criteria at all trophic levels if possible.

Discussion was had regarding the origins of the diatom habitat curve used in the habitat modelling and how much weight it should be given in representing the primary trophic level. The following issues were raised:

1. That the curve although titled as for diatoms is only for a section of the diatom community namely thin films and slimes. There will be other diatom species not represented by the curve present in the Manuherikia.
2. That diatoms are only a component of the other primary producers that are likely to be present in the Manuherikia.
3. Most habitat curves (e.g., the fish and macroinvertebrate curves) relied on for flow setting have published data supporting their use documenting how the curve was developed and for what species. There does not appear to be published data for the diatom curve.
4. The habitat preference curve for diatoms suggests they are not present in velocities less than 0.6 m^3/s which doesn't appear to be supported by field observations in the Manuherikia or velocity preferences in other publications.

The issues raised above could not be addressed at the meeting.

The group summarised the discussion in to two parts:

1. Species selected for habitat modelling
2. Habitat retention as a percentage compared to habitat available at MALF

A separate document was drafted summarising the discussion which requires the group to finalise and agree on at the meeting in November. This will form the criteria against which assessment will be made.

For clarity TAG need to know the allocation regime ORC has adopted for the Manuherikia as it has an impact on the categories in the habitat table.

Fish passage

If passage is provided for large trout, then there will be passage for all fish species because large trout require deeper water for passage than all other species in the Manuherikia. Ryders have done a report which MCG are expected to release. Base depths will be explained in the reports that have been completed.

Actions:

I. Matt Hickey and/or Richard Allibone to look at accrual measure offline
II. Water quality in terms of NPSFM bands to be discussed at February meeting. Rachel O to be invited to discussion.
III. Ian to circulate to the group the info he has on fish passage from the Lindis
IV. Pete to source temperature thresholds for select species
V. ORC staff to provide the allocation regime used for the Manuherikia.
VI. It was agreed the current diatom curve would need further review and discussion by the group to determine whether it is fit for purpose

4. Review inventory of science undertaken

Discussion was had regarding the inventory of science undertaken. A separate document was drafted and the headings for the table of inventory were agreed on. TAG members to start populating table offline and this will be reviewed at the November meeting.

5. Next meeting

A meeting will be needed in November (date tba) to cover:

- Cawthron to give update re: invertebrate drift study before criteria is set
- Criteria for drift
- Criteria for accrual measure
- Review of Diatom curve
- Review list of inventory of science undertaken

February meeting:

At the February meeting where an assessment against the criteria is made the following information will need to be available:

- Water quality including temperature
- Water quantity
- Habitat - produce traffic light risk matrix from criteria table
- Fish passage
- Allocation regime used for the Manuherikia

Meeting closed 2.00pm.