

Te Pūrongo ā-Tau 2022

Annual Report



Ka tiaki, ka whakapiki hoki a ESR i te oranga o te tangata e noho ana ki Aotearoa.

ESR protects and enhances the wellbeing of people living in New Zealand.

He Pūtaiao, He Tāngata

Impact for Māori / Mātauranga Māori



Tautohua DETECT

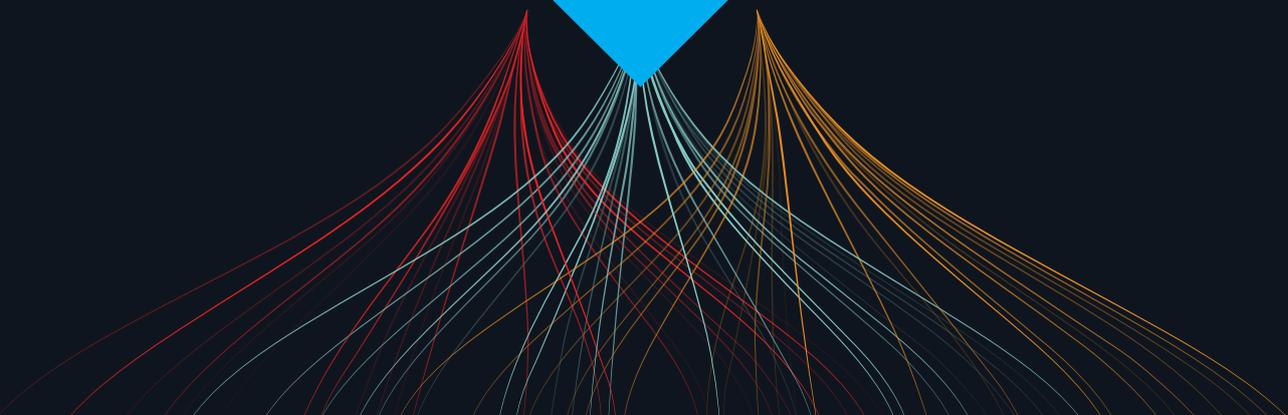
IDENTIFY emerging issues by recognising the interconnection between people, animals, plants and their shared environment

Tiakina PROTECT

KEEPING communities healthy and safe by delivering comprehensive and connected wellbeing outcomes

Tūhonotia CONNECT

PARTNERSHIPS that facilitate a whole system approach to wellbeing



Ngā Ihirangi

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Front cover: We are working with Ngāti Toa Rangatira (Porirua) to create a long-term marine-based monitoring strategy of the Awarua o Porirua coastline. Photo: Jenny Ralston

Presented to the House of Representatives pursuant to section 17 of the Crown Research Institutes Act 1992.

The Institute of Environmental Science and Research Limited (ESR) is a Crown research institute. It was incorporated in June 1992 and is wholly owned by the New Zealand Government. The two shareholding Ministers appoint a Board of Directors to govern the organisation. ESR has science facilities in Auckland, Wellington (Porirua and Wallaceville) and Christchurch.

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Te Tirohanga a te Heamana me te Tumu Whakarae

Chair and Chief Executive's overview

I orea te tuatara ka puta ki waho¹

The transformative science leadership provided by the Institute of Environmental Science and Research (ESR) has kept Aotearoa New Zealand safe, well and prosperous through challenging times.

We are proud to present ESR's 2021/22 Annual Report. It records our achievements and outcomes for the year against the plans and objectives set out in our Statement of Corporate Intent 2021–2026.

Our dedicated **OneESR** team make transformative science possible. Several of our people have been recognised this year with national or international awards. We are proud of the dedication, spirit and professionalism of all our people to deliver outstanding contributions in a challenging year. Our science leadership in genomics, wastewater and data science has provided the science-based insights necessary for New Zealand to implement effective responses to COVID-19. This has kept people safe, enabled positive economic performance and opened borders without causing Aotearoa's health system to collapse.

We have continued to push the boundaries in science excellence to reduce drug harm, and, with the creation of Lumi™, we have implemented a world-first frontline tool to help reduce drug harm and support drug intervention. ESR's ground-breaking forensic science software, STRmix™ celebrates its 10th anniversary continuing to demonstrate the value of this service to the global forensic community. These are but a few of the many transformative science initiatives ESR has delivered over the past year.

Seeking to build Te Tiriti o Waitangi based excellence

ESR is early in its journey of building Te Tiriti o Waitangi based excellence, but is committed to ensuring that, as a science institution, the research and services it delivers is in accordance with Te Tiriti. To build capacity and capability, we continue to invest in our Māori impact

strategy, **He Pūtaiao, He Tāngata** to allow us to deliver greater partnership understanding and approaches. As an organisation, being able to build meaningful connections with iwi partners is important for fostering and growing opportunities for co-design that will advance Māori wellbeing and capability through iwi-centric solutions.

Through our He Wai Māpuna research programme, our iwi and mana whenua partners are shaping this programme of work to deliver iwi-based solutions. This approach allows ESR to accept the gift of mātauranga into ESR's mahi so it can deliver benefit and impact with and for iwi.

Growing ESR's partnerships and collaborations

Our commitment to collaborative synergies in the New Zealand science system and our ability to generate added value through transformative science and long-term collaborations was further recognised through our successful bid with the University of Otago to establish and co-host the new Infectious Diseases Research Platform. This initiative builds on our enduring collaborations with the University of Otago. The platform will signal the start of a new and exciting chapter for New Zealand to combat infectious diseases, reduce health inequities and further lift responsiveness to current and emerging health, food and environmental risks.

Our partnership with GNS Science to successfully launch the ESR–GNS Workday platform is a first in New Zealand and may become the model for integrated enterprise resource planning amongst Crown research institutes (CRIs). We look forward to reaping the benefits of this integrated enterprise resource planning system that will increase efficiencies, improve integration and internal and external collaboration.

ESR has also been a keen champion of the increased CRI collaboration through pan-CRI initiatives such as

¹ *This well-known whakataukī or 'proverb' speaks to the importance of adaptability, perseverance and creative thinking to find solutions. This is relevant as ESR seeks to create and deliver point of need science solutions that are needed for communities. Translated, it reads: "A problem is solved by continuing to find solutions".*

improving Māori data sovereignty practices, implementing 24/7 information technology security monitoring and progressing sustainability initiatives. These science and business practice workstreams are essential to achieving increased value and impact across the research, science and innovation (RSI) system.

ESR's long-standing partnership with the Pūhoro STEM Academy continues to strengthen and grow. We signed a memorandum of understanding with Pūhoro, the first CRI to do so. This recognises ESR as a national partner to further the Academy's programme of bringing science to rangatahi, developing and inspiring them to be active participants in the fields of science, technology, engineering, mathematics and mātauranga. We look forward to advancing the aims of Pūhoro of building tomorrow's world-class Māori science leaders.

We are expanding our national and international collaborations to continue supporting national research and government priorities. Our commitment to reducing health inequities extends to our work with the Ministry of Foreign Affairs and Trade and UNICEF in the Pacific Islands to urgently address water quality, sanitation and nutritional needs. We are supporting a pan-CRI initiative to develop a Pacific environmental exposure assessment to investigate and assess potential climate change risks.

Future ready

Preparing for the challenges and opportunities that lie ahead requires adaptability, perseverance and creative thinking. This is relevant as ESR seeks to elevate its performance through strategic partnerships and investment that will shape its future direction and delivery for greater frontline responsiveness to combat the effects of a changing climate on infectious diseases, food security and biomonitoring.

Our Board welcomed the appointment of three new members: Justine Gilliland, Dr Melissa McLeod and Dr Matt Glenn. Their expertise, experience and contributions will be invaluable as ESR continues to evolve as an agile and adaptable science organisation. We also farewelled Richard Gill, who served as ESR's Board director for the past six years. The Board and Senior Leadership Team extend their

thanks and appreciation to Richard for his expertise in science, technology and innovation that has been influential in helping ESR grow its innovative thinking and ambition to achieve more for Aotearoa New Zealand's people.

ESR is actively contributing to delivering on the Government's aspirations for a refreshed and resilient RSI system. As discussions and decisions evolve, it is timely to remember that cutting-edge genomic, wastewater and forensic toolkits would not have been developed and in place without the governance structures to allow for informed risk taking and decision making. External research and operational funding was not yet committed to these investment areas and the tools would not have been 'demand ready' without the Board backing forward investment decisions.

The Board also continues to be highly engaged and supportive of reform that ensures the RSI system is as effective as it can be. Our world-class scientists deserve the best laboratories, ongoing collaborative opportunities and enterprise support systems to continue delivering their transformative research excellence. The proposed reinvestment in the Kenepuru Science Centre is long overdue and is crucial to building on ESR's community-based mātauranga and science collaborations.

We remain committed to ESR being an innovative and customer-focused organisation, delivering creative and collaborative solutions to the health, wellbeing and environmental challenges facing Aotearoa New Zealand. We thank our iwi and mana whenua partners, key science partners and community collaborators, government agencies and ministers for their continued engagement and support.



Denise Church QSO **Chair**



Peter Lennox **Chief Executive Officer**

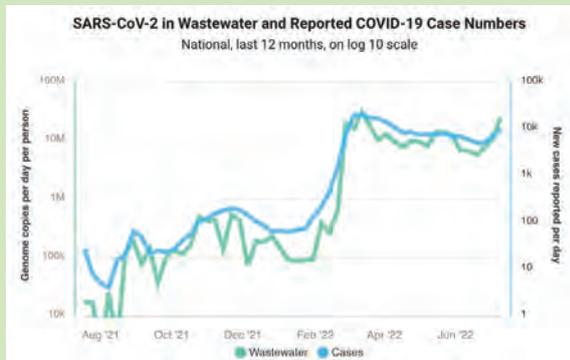
He kōrewhatanga – te arotake o te tau

At a glance – the year in review

We have grown our organisational capabilities and transformative science to create, develop and generate applied science solutions to meet the needs of New Zealand’s people, communities and economy. This year, ESR has further lifted its science and organisational capabilities, as well as national and international collaborations. Below are some examples of the work we have delivered.



21,000+
COVID-19 samples sequenced



8,179
COVID-19 wastewater samples tested and epidemiologically analysed for COVID-19 national surveillance, including a COVID-19 wastewater testing results dashboard

Delivered daily epidemiological reports as well as weekly genomics insights reports

and wastewater reports for the national surveillance of COVID-19 to support the Government’s response efforts

34%

of staff took part in te reo Māori training online

1,309 news media mentions on

genomics, infectious disease, public health surveillance, wastewater, forensics and influenza with a cumulative potential reach of more than 26 million people

The first CRI to sign an MoU in December 2021 with Pūhoro STEM Academy

to grow our science offering for rangatahi and taura Māori in science, technology, engineering, mathematics and mātauranga from high school through to tertiary study

We sequenced the genomes of

5,417
pathogenic species

Successfully establishing a genomics database of pathogens of interest will be key to providing insights and intelligence to support further research and future health and environment regulatory functions.

Funding received and a formalised arrangement in place with the University of Otago to co-host the new **Infectious Diseases Research Platform**



More than 1.6 kg nitrate per day (nearly 584 kgs of nitrate in 12 months) removed by an in-stream denitrifying woodchip bioreactor in South Canterbury

We continue to be recognised for our science and mahi to deliver on significant research priorities, such as infectious diseases, antimicrobial resistance and growing our genomics capability across health, food and water sciences.



Provided science learning workshops to 280 rangatahi Māori at 6 wānanga, across 4 locations around Aotearoa through Pūhoro STEM Academy

349

science staff – 309 in FY21

Appointed as a Ministry of Health drug checking service provider in November 2021 to further reduce drug harm



Established 2 new field trials in Bromley and Wainui (South Island) to study how New Zealand's native vegetation could improve water quality and sustainable land use by reusing biowaste to mitigate environmental contaminants. The Wainui field trial is co-funded by Christchurch City Council

45%

success rate for external research funding bids

ESR's top five co-published science publications relate to **COVID-19** (3), **AMR** (1) and **microplastics** (1) according to the Web of Science

Implemented



a joint ESR-GNS enterprise resource platform, a first in New Zealand, which will deliver increased efficiencies, better integration and improved collaboration internally and externally

90+ global organisations use **STRmix™ forensic software**

20% plus scientists

participated in science innovation workshops to build innovation capability

18 international groundwater collaborations

WE DELIVERED 10 FOOD PROJECTS to the Ministry for Primary Industries and 12 to the New Zealand Food Safety Science and Research Centre on current and emerging food risks in Aotearoa New Zealand

Te whakanui i ā mātou kaimahi

Celebrating our people

Our dedicated scientists are committed to delivering excellence in their work. They are recognised for their outstanding science contributions that underpin the value of ESR's work for the benefit of Aotearoa New Zealand.



Photo: Bronwyn Humphries

Te whakanui i tō mātou hiranga ā-pūtaiao

Celebrating our science excellence

ESR has worked hard to assemble science teams that are amongst the world's best, led by some of the best science leaders in their respective fields of genomics, bioinformatics, forensics, social, radiation, epidemiology, virology, drug chemistry and toxicology, environmental science and food safety.

During the year, our scientists have continued to make significant contributions to improving public health, forensic science and the environment, as evidenced by the following national and international recognition.



Dr Stephen Cordiner New Zealand Science Individual / Lifetime Achievement Awards

Dr Stephen Cordiner (retired) was ESR's Forensic Service Centre's manager. He won one of the Individual/Lifetime Achievement Awards. Throughout his career, Stephen harnessed forensic science to achieve impact for communities around New Zealand. Stephen's career spanned the crossroads as forensic science transitioned into the highly technical discipline we recognise today.

He has been at the forefront of many major forensic science developments, helping to make the justice system underpinned by robust, impartial science for fairer outcomes. In particular, he has been a leader in implementing DNA technology.



Dr SallyAnn Harbison appointed as a Fellow of the Academy of the Royal Society Te Apārangī

Dr SallyAnn Harbison was appointed as a Fellow of the Academy of the Royal Society Te Apārangī. This achievement recognises her outstanding thought leadership and significant contribution to forensic science and distinction in research both in New Zealand and internationally.

SallyAnn is recognised internationally for providing casework-ready, accredited science for the justice sector derived from her research activities. She is currently researching next-generation sequencing for use in forensic applications.



Dr Sarah Jefferies and her multi-agency team recognised in the Royal Society Te Apārangī Research Honours

The prestigious Liley Medal has been awarded to a multi-agency team led by ESR Public Health expert, Dr Sarah

Jefferies, for a landmark paper analysing the impact of New Zealand's initial response to the COVID-19 pandemic.

The award, part of the Royal Society Te Apārangi Research Honours, is presented for a piece of outstanding work that is internationally recognised and a leading contributor to health research in New Zealand. It highlights the national and global significance of the highly cited epidemiological study that was published in the *Lancet Public Health* in October 2020.

The study considered the impact of the initial interventions during the first wave of COVID-19 on critical outcomes like health equity and highlighted vital considerations for the management of future pandemic responses. The award highlights the importance of a world-class surveillance system informing epidemiological research to better understand the pandemic and plan for the future.



Dr Sue Huang appointed an honorary professorship from the University of Auckland

In December 2021, Dr Sue Huang was appointed an honorary professorship from the University of Auckland for her sizable contribution to advancing public health through science and influenza research. Sue is a virologist, the principal investigator (PI) for the WellKiwis (ie, SHIVERS-

III) study. She is also the PI for SHIVERS-I and SHIVERS-II and the Director of the World Health Organization National Influenza Centre at ESR.

The joint ESR / Hutt Valley District Health Board WellKiwis team received an award for their innovation.



Dr Joep de Ligt made an Honorary Fellow of the University of Otago

This award acknowledges Dr Joep de Ligt's leadership in genomics and bioinformatics, the significant contributions of ESR's Human Genomics team, and ESR's longstanding collaborations with the university on genomics, phylodynamic, and epidemiology research.

Joep currently co-leads, with the University of Otago², a Genomics Aotearoa project that will implement and assess genome graph methods for improved variant detection across all organisms covering both large (human-scale) and small (microbial-scale) genomes to better understand biological functions in New Zealand populations.

Making genome graph methodology publicly accessible will contribute to understanding human health, as well as supporting primary industry, and research on the country's environmental issues.

² *Genome graphs | Genomics Aotearoa (genomics-aotearoa.org.nz).*



Enteric, Environmental and Food Virology Team awarded New Zealand Science Team of the Year

The New Zealand Science Awards were held online in December 2021. The award is for the team that has made an outstanding contribution through their research, engagement and/or other activity that has advanced New Zealand's economic, environmental, social or cultural wellbeing.

Led by **Dr Joanne Hewitt**, ESR's 'wastewater testing team' has been recognised as providing a crucial line of defence in New Zealand's COVID-19 response.

Building on over 20 years' experience studying viruses, such as poliovirus and norovirus in wastewater, the team undertook research in August 2020 to detect COVID-19 in wastewater with an eight-week sampling pilot at sites throughout New Zealand. One year later, the programme expanded to cover 26 sites before further extending to test up to 335 samples each week from 173 locations throughout the country. The team's experience was crucial to the rapid development and remarkable sensitivity of the testing.



Dr Miles Benton New Zealand Science Early Career Researchers awards

Dr Miles Benton, formerly a senior bioinformatician with ESR's Human Genomics Group, won one of the Early Career Researchers awards. This award is given for making an outstanding contribution to the values and purpose of their entity through their research and engagement with colleagues, partners, and wider community (nationally or globally).

Miles is an expert in new generation DNA/RNA sequencing technology that offers rapid and powerful applications in environmental monitoring, food safety monitoring, human genome sequencing and more. He has collaborated with researchers around the world to make this powerful capability more widely affordable. This has enabled faster and more accurate clinical diagnoses to help improve the health and wellbeing of communities.



Dr Rishi Pandey and Dr Kristin Bohm awarded KiwiNet's Emerging Innovator Programme

ESR's Dr Rishi Pandey and Dr Kristin Bohm are blazing a trail of innovation that caught the attention – and funding – of KiwiNet's Emerging Innovator Programme.

Kristin, a health and environment scientist and environmental biologist, and Rishi, a senior scientist in the Forensic Business Group, are among just 70 other New Zealand scientists to receive this prestigious award.

Kristin was the first ESR scientist to be recognised by KiwiNet's Emerging Innovator Programme earlier this year for her ground-breaking research into recovering products of economic value from human waste, by using the power of insects.

If realised, Kristin's research could help divert the more than 255,000 tonnes of sewage sludge dumped in New Zealand each year. This research is focused on how wastewater sludge can be fed to black soldier fly larvae, which can in turn be used as a source of higher value products like oils, proteins, and biopolymers.

Dr Rishi Pandey also won a KiwiNet Emerging Innovator Award in 2021 for his roadside drug testing projects using biosensing technology. Rishi's award is enabling him to grow as an innovator by supporting the roadside aptamer project he's working on. Aptamers can be used to detect small molecules in a range of medical and environmental contexts in real-time.



Dr Liping Pang New Zealand Hydrological Society Outstanding Achievement in Hydrology Award

The award recognises outstanding contributions to hydrological science in New Zealand, as demonstrated by scientific publications, and/or a person's impact on the management of New Zealand's water resources.

Liping, a science leader in ESR's Groundwater team, is one of just 17 Health Research Council of New Zealand Explorer Grant recipients nationwide. An expert in subsurface microbial transport, Liping has been awarded \$150,000 over two years to carry out research that will reduce the risk of waterborne Legionellosis and inform better water systems design. She is the only recipient of the grant who is from a CRI.



Dr Annette Bolton's first-equal prize for oral presentation at the New Zealand Hydrological Society Awards

Dr Annette Bolton won the prize for her presentation Groundwater Ecosystems: A first look at protozoan diversity in groundwaters of Aotearoa.

Annette is also part of a team of researchers investigating the impact of rising temperatures on child health that received one of 53 grants from the Health Research Council of New Zealand. The funding is part of a \$78.92 million allocation for new and innovative research into some of New Zealand's most pressing health concerns.



Dr Kristin Dyet recognised by the Office of the Prime Minister's Chief Science Advisor

Dr Kristin Dyet was recognised for her expertise in antimicrobial resistance and contributions to the report *Kotahitanga; Uniting Aotearoa against infectious disease and antimicrobial resistance* released in early March 2022.

Antimicrobial resistance has been a key area of interest for the Prime Minister's Chief Science Advisor Professor Dame Juliet Gerrard since she assumed the role in 2018. For Kristin's work to be recognised at this level is a significant achievement and something ESR is proud to celebrate.

As the Prime Minister notes: "I welcome the expert panel's recommendations and thank them for providing a clear path forward for Aotearoa to unite against infectious diseases and antimicrobial resistance."

The Hon. Dr Ayesha Verrall, Minister for Research, Science and Innovation and Dr Kristin Dyet discussed the importance of extending New Zealand's capability to tackle antimicrobial resistance (AMR) and how ESR's AMR expertise and surveillance support this national research priority.



Photo: Nicola Mutch

Te tuku i te kairangi ā-pūtaiao mō Aotearoa

Delivering science excellence for Aotearoa New Zealand

ESR is the Crown research institute that has a critical national role in public health and forensics and a key contributor to environment and biosecurity outcomes. ESR provides scientific leadership and generates policy-ready intelligence to support some of New Zealand's most critical decisions. By applying expertise from our rich array of health, forensic, food, water and radiation services, communities will thrive and prosper.

Our aspiration is that, through innovative and integrated thinking and expertise, ESR's science is at the forefront of attaining the lowest possible burden of crime and drug harm, environmental contamination and infectious diseases in New Zealand.

We deliver for New Zealand in the following impact areas:

<p>Impact for Māori</p> 	<p>ESR's research with Māori has strong alignment with the Tiriti-led approach of Te Pūtahitanga – “genuinely valuing and utilising two of Aotearoa's rich knowledge systems – Western science and mātauranga Māori – so that scientific advice, and the policy that it informs, is relevant and draws from multiple sources of evidence.” (Kukutai T. et. al. (2021). <i>Te Pūtahitanga: A Tiriti-led science-policy approach for Aotearoa New Zealand</i>. Auckland: Ngā Pae o te Māramatanga). We are intentionally investing and working in new ways to connect with iwi and co-design and deliver outcomes that improve the economic, social and wellbeing of Māori.</p>
<p>Healthier communities</p> 	<p>We detect existing and emerging public health and environmental health risks and threats by connecting and analysing data to generate intelligence and solutions to prevent infectious diseases and protect the health and wellbeing of New Zealanders.</p>
<p>Safer communities</p> 	<p>We use the latest advances in forensic and genomic science to increase the effectiveness of forensic science services and research to reduce drug harm and improve equitable justice and wellbeing outcomes. We use our radiation expertise to reduce occupational and medical exposure to radiation, contributing to keeping people safer.</p>
<p>Safer food</p> 	<p>By researching and collaborating with government agencies and food industry partners to detect, trace and eliminate pathogens that cause foodborne disease and other contaminants that may cause harm, we help protect New Zealand's food-based economy and improve public health and economic outcomes.</p>
<p>Cleaner water and environment</p> 	<p>We develop sustainable, long-term options and solutions for fresh water and groundwater resources and explore options for the sustainable use of waste, including radiation compliance, monitoring and testing to protect the environment, enhance public health and keep communities safer.</p>

To address complex challenges and opportunities in an increasingly changing world, we must continue to bring fresh thinking and deliver innovative solutions that will place ESR at the forefront of dual based mātauranga and science solutions for New Zealand now and tomorrow. By effectively using mātauranga and 21st-century science and technological advancements, we continue to evolve ESR's

leadership by pushing and transcending boundaries. Central to ESR's thinking is anticipating where its expertise is needed. The ability to detect emerging issues using innovative mātauranga and science approaches and connect our expertise at the right time and place help us build enduring partnerships to protect New Zealand's people and communities.

Our strategic focus areas

He Pūtaiao, He Tāngata – Valuing and enabling both mātauranga and science drives innovative research solutions that are uniquely New Zealand and that will increase the wellbeing of communities and the environment.

Understanding our value – Growing our innovation and influence through putting our customers, iwi and communities at the core of our mahi, continually improving health, safety and wellbeing outcomes.

Shaping the future of our science – Relevant co-designed transformational research and service delivery that meets the needs of our customers, iwi and communities within the wider science system. Having more articles accepted for publication in renowned science journals.

Increasing our impact – Providing collaborative, prioritised and integrated research that grows innovation, and secures opportunities that deliver better outcomes for our customers, iwi and communities. Understanding how our influence impacts upon New Zealand's economy.

Building our team – Capable and engaged staff, strong, accountable leadership, and clear strategic direction. Being recognised as an employer of choice. Our aim is that ESR's ethnicity and diversity are reflective of New Zealand's societal profile. We are positioned for continued and future success through strong accountable leadership and a healthy work environment as we seek to broaden our workforce talent and embed cultural competency.

Building stronger foundations – Embedding and strengthening our infrastructure, systems and processes by strengthening our collaborative partnerships. Effective business and governance systems, enabling decision-making to be smarter and more impactful in delivering research and science solutions for our customers, iwi and communities.



Our progress over the year

Focus area	What we did	Impact
<p>He Pūtaiao, He Tāngata</p> <p>Understanding our value</p> <p>Shaping the future of our science</p>	<p>Co-designed with Māori and key stakeholders, the new Infectious Diseases Research Platform will ensure a focus on how to remove the barriers to equitable health outcomes. The platform was established in collaboration with the University of Otago and became operational in the first quarter of the new financial year. Co-design, development and delivery are core principles of the platform.</p> <p>The success of this collaboration and platform relies on active participation and partnership. To deliver a coordinated research pipeline, research priorities and topics are co-developed and agreed.</p> <p>Increased the number of co-designed iwi research projects across ESR's impact areas and grew our investment in mātauranga scientists.</p>	<p>To further lift New Zealand's infectious disease responsiveness and capability while meeting our Te Tiriti o Waitangi commitment and delivering equitable solutions that shift the barriers that cause health inequities.</p> <p>Iwi-led solutions to iwi-initiated areas of interest.</p>
<p>He Pūtaiao, He Tāngata</p> <p>Shaping the future of our science</p> <p>Increasing our impact</p> <p>Understanding our value</p>	<p>With the guidance of our Māori Data Leadership Group, we continued to develop ESR's Māori data sovereignty framework for best practice data management approaches that will ensure Māori governance and ownership of data in co-designed research.</p> <p>We are growing artificial intelligence capability in ESR's forensic sciences and further boosting ESR's data science governance, practices and capability. We are developing ESR's <i>Responsible Artificial Intelligence Framework</i>. This will guide and support ESR's artificial intelligence capability and lift data science governance and partnerships to support ESR's future science directions.</p> <p>Extended ESR's genomic capabilities and interlinked science approaches to improve antimicrobial resistance surveillance and emerging infectious disease preparedness.</p> <p>Expanded ESR's wastewater-based epidemiology programme as an early-warning system to support public health surveillance. We developed new methods to speed up its testing to rapidly detect new COVID-19 variants. We are expanding testing to other infectious pathogens.</p> <p>We have started work to replace ESR's health and environment laboratory information systems to meet future public and environmental health needs. ESR's forensic laboratory information systems upgrade is on track to be completed before the end of 2022.</p>	<p>Creating and developing portfolios of Māori-led research while protecting te ao Māori values in research.</p> <p>Effectively addressing complex challenges for communities by ensuring an ethical approach to our science.</p> <p>Smart systems investment to protect communities from infectious diseases.</p>

Focus area	What we did	Impact
<p>He Pūtaiao, He Tāngata</p> <p>Building our team</p>	<p>During the year, we started work to update our He Pūtaiao, He Tāngata strategy by talking to scientists, leadership and support staff across the organisation. Te Tiriti o Waitangi principles remain at the core of our strategy. The updated strategy will identify new actions across ESR's science and operations focused on outcomes and benefits with and for iwi.</p> <p>Reshaped and revitalised ESR's foundational cultural competency programme to build a better understanding of Te Tiriti o Waitangi and its principles. This will better equip staff to meaningfully integrate mātauranga into science for innovative solutions.</p>	<p>Intentionally and actively growing ESR's understanding of te ao Māori and building mātauranga capability and position ESR as an employer of choice.</p>
<p>Understanding our value</p> <p>Increasing our impact</p> <p>Shaping our science</p> <p>Building stronger foundations</p>	<p>We signed a memorandum of understanding with Te Pūhoro STEM Academy in December 2021. We are the first Crown research institute to become a national partner with Pūhoro to support the Academy's aims of developing future science leaders.</p> <p>Established the joint ESR–New Zealand Police Innovation Governance Group in September 2021 promoting greater strategic alignment of justice and health priorities, focusing on innovation to develop applied science solutions for the future while seeking equitable outcomes for Māori.</p> <p>Through the <i>Extending Research Capacity Programme</i>, we are investing in additional roles that will support the attachment or appointment from other universities to fund innovative research and increase strategic collaborations with universities and the wider science community. We recruited three graduate students, one post-doctoral graduate, one doctoral student and one summer intern to support biowaste research, grow ESR's computational and forensic data science capabilities and accelerate ESR's innovation.</p>	<p>Investing in the next generation of Māori mātauranga and science leaders through enduring partnerships.</p> <p>Greater strategic research alignment to deliver frontline solutions.</p> <p>Generate new research and grow future scientists through actively growing national and international collaborations.</p>
<p>Building stronger foundations</p>	<p>We successfully launched Workday, the joint ESR–GNS Science enterprise resource platform for our human resources and finance functions to improve efficiencies and better-integrated planning across ESR's science and operations.</p> <p>Work has started to establish a project management office to support the integrated project planning, investment and decision-making functions that underpin ESR's science.</p> <p>In February 2022, we fast-tracked ESR's sustainability and progressive procurement programme to reduce ESR's carbon footprint further and meet the requirements of the Carbon Neutral Government Programme.</p>	<p>Strengthening ESR's enterprise and organisational resilience and ability to effectively respond to national research priorities.</p>

Ā mātou mahi whakahirahira ā-pūtaiao 2021–22

Our science highlights 2021–22

We use our multi-disciplinary science expertise to take a cohesive, holistic approach to our research and services to support national research priorities. These include tackling antimicrobial resistance, improving the health of water systems in Aotearoa New Zealand, and using our water expertise to inform sustainable land and water use and reduce drug harm. We continued to explore how we can use our water and genomic capabilities to improve New Zealand’s freshwater quality.

We are increasing our thought leadership in genomics and partnering with Māori to detect and address complex issues to help shift barriers that cause inequities in the health, environment and justice sectors.

Through our research, we are pushing science boundaries by integrating our capabilities to support the early detection of issues and risks, which will improve frontline responsiveness, address specific problems and create transformative science.

Many of our research projects aim to create and develop improved or novel testing methods or tools. These will advance workflows, sampling methods for monitoring, detecting and/or validating, and/or expand analysis, intelligence and decision-making for public health, environmental, water, food and forensic sciences.



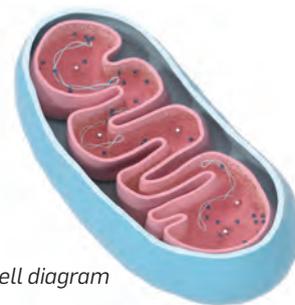
Campylobacter

Highlights from the year include:

- ESR’s cross-platform research project ‘**Pathogenesis of *Campylobacter jejuni* using an intestinal organ-on-a-chip**’ uses state-of-the-art technology to gain new insights into the pathogenesis of *Campylobacter jejuni*. We are the first research organisation in New Zealand to use this technology to investigate this food- and waterborne pathogen that is a leading cause

of foodborne illness here. Until now, our ability to explain and include variations in pathogenicity factors in the epidemiology of the disease in New Zealand has been very limited. We have begun preliminary work on a model for toxicology and pharmacology studies. We also propose using this technology to explore the pathogenesis of New Zealand *Yersinia enterocolitica* strains to further build ESR’s food genomics capability and reduce foodborne illness in New Zealand.

- As part of our **He Wai Māpuna** research, we are working with Ngāti Toa Rangatira (Porirua) to create a long-term successive marine-based monitoring strategy of the Awarua o Porirua coastline. Our ESR kairangahau, who has a background in marine biology, is developing a framework and strategy for collecting mahinga kai and surrounding environmental data. This will help build a rich picture of the pressures that urban infrastructure places on the surrounding taiao and kai resources. Culturally sensitive data remains with Ngāti Toa Rangatira. The He Wai Māpuna project team will look to adapt and apply the framework and methodologies to similar environments in other areas.



Mitochondrial cell diagram

- Our **forensic genomics research** aims to develop new forensic science services using DNA sequencing technologies. A highlight from the year is completing the analysis of over 500 whole mitochondrial genomes from volunteers to establish a New Zealand-relevant population database. We have again increased the use of bioinformatics and computer science to further improve data analysis and interpretation. We aim to expand this new capability to support the analysis of difficult and highly degraded samples and grow ESR’s eDNA capability for biodiversity monitoring. We will ensure that our work aligns with Māori data sovereignty principles and good data governance practices.



Hē Wai Māpuna research programme working with Ngāti Toa Rangitira (Porirua) to create long-term marine-based monitoring of the Awarua o Porirua harbour.

Photos: Jenny Ralston



- The innovative **Lumi™ Drug Scan** Service, jointly developed by ESR and the New Zealand Police, has evolved from a pilot programme to being used nationally to support New Zealand's police officers with drug detection on the frontline. We successfully developed and deployed version 2 of the Lumi™ Drug Scan Service app. As part of the New Zealand Police's approval of the national rollout and launch on 15 June 2022, 150 devices were received, verified and deployed. The research plan for year two of ESR's Digital Forensic Strategic Science Investment Fund programme will focus on artificial intelligence tools and forensic workflows to support justice outcomes and further reduce drug harm.



- Environmental monitoring of **antimicrobial resistance (AMR)** in wastewater is critical to understanding how prevalent AMR is and the role of the environment in transmitting AMR to pathogenic organisms. ESR's Antimicrobial resistance in wastewater Phase II project aims to develop three methods to understand AMR in wastewater, including using metagenomics to identify specific AMR genes present in the environment. This will help build a picture of emerging microbes, antimicrobial drugs, and genes that contribute to or are sources of AMR. AMR is a priority issue, and evaluating its prevalence and changes is important for health surveillance in New Zealand.

- Our three-year long research project, **Novel models of wai and biowaste management for a carbon neutral circular economy – ōhanga āmiomio**, has been co-designed with Māori using tikanga-based wai and biowaste management to reduce biowaste to landfill. We conducted experiments with various organisms to identify their potential for converting biosolids to reduce biological contaminants in water and ecosystems. We demonstrated that black soldier fly larvae can reduce biosolids while producing protein- and fat-rich biomass. This has significant potential to contribute to our vision of a waste-free New Zealand.



- As part of its **groundwater remediation research programme**, ESR's work with experimental woodchip denitrification walls is gaining international attention. ESR's work was presented online at the AGU (Advancing Earth and Space Science) conference in New Orleans, USA, in December 2021. Ongoing monitoring of the shallow groundwater around the permeable reactive barrier is continuing to evaluate nitrate removal performance and estimate the longevity and cost-effectiveness of this technology. Our research into permeable reactive barrier and bioreactor technology continues to generate interest from central government agencies, councils, businesses and landowners.
- To **further reduce drug harm and improve health outcomes**, we are developing new computational methods and capabilities to evaluate the toxicity of harmful chemicals and drugs. This new capability aims to complement existing toxicology tests. We also aim to develop and establish a framework for assessing the drug harm of synthetic cannabinoids or any drugs of interest.

By developing a better understanding, and predicting the interaction of toxic drugs and chemicals on people, animals and the environment, we will support our key stakeholders, including emergency department staff at the operational and policy level.

- Under an **International Atomic Energy Agency (IAEA)** project to enhance radiation emergency preparedness and response in the Caribbean, we carried out a home-based assignment for Jamaica. The main purpose of this project was to develop a preliminary hazard assessment for building a national radiological emergency plan in Jamaica. The methods and processes in our report can be used to support similar hazard assessments in other Caribbean countries. As a result of this work, the IAEA is now engaging ESR to run training workshops in early 2023 in the Caribbean to help other countries in preparing national hazard assessments.



- ESR has long been **leading multi-disciplinary and cross-health agency collaboration in influenza research**. Together with our key partners, the SHIVERS (Southern Hemisphere Influenza and Vaccine Effectiveness Research and Surveillance) research team expanded the influenza research to include COVID-19 in this high-quality longitudinal cohort platform. SHIVERS (also known as WellKiwis) has grown from strength to strength, reaching the milestone of over 3,000 participants, including 600 babies (the WellKiwis Infant study), with the aim of understanding how early flu exposures shape immunity to subsequent flu exposures. We

successfully secured additional funding from the US National Institute of Allergy and Infectious Diseases for the SHIVERS-IV influenza research programme (the WellKiwis household cohort, which is now in its second year). We also received funding from Flu Lab (via the University of Auckland) to understand the impact of border restrictions and other public health measures on disease transmission and the burden of influenza and other respiratory viruses in New Zealand. SHIVERS led coverage in *Nature Communications*, a publication ranked as including 2021 Top 25 COVID-19 articles (*Impact of the COVID-19 nonpharmaceutical interventions on influenza and other respiratory viral infections in New Zealand | Nature Communications*).



- Our collaborative work in the **Pacific Island countries** has been a mixture of developing new partnerships and supporting the Ministry of Foreign Affairs and Trade (MFAT) with disaster relief efforts in Tonga and Kiribati. We completed the five-year-long Healthy Tonga Environments project, aimed at helping the Tongan Ministry of Health build capacity and capability to mitigate health and environmental outcomes. We continued to build on our long-standing relationship with Tonga by developing a water sector policy and related water information management system to further maintain and develop resilient health and environment systems to protect people from day-to-day health risks. We are also working on a pan-CRI initiative to develop the Pacific Environmental Exposure Assessment for the Pacific Islands. This work is a first-stage, integrated investigation and assessment of potential climate change risks and how these will affect the health of people, the environment and animals. Together with MFAT and UNICEF, we have started developing integrated programmes for Micronesia to urgently address water quality, sanitation and nutritional needs.

Te tautoko ā-pūtea i ā mātou mahi pūtaiao

Funding our science

To deliver applied science research and service solutions, as outlined in ESR’s Statement of Core Purpose, we receive funding from the Strategic Science Investment Fund (SSIF) across two research platforms (Human and Environmental Health and Forensic Science).

We also reinvest earnings from key service contracts and commercial activities in significant research programmes as well as the infrastructure that underpins our science capabilities. Additionally, we submit research bids for external funding (such as to the Health Research Council of New Zealand, KiwiNet, and the Ministry of Business, Innovation and Employment’s (MBIE’s) Endeavour and Smart Ideas funds). We also apply for international funding grants through the US National Institutes of Health to fund the SHIVERS research programme.

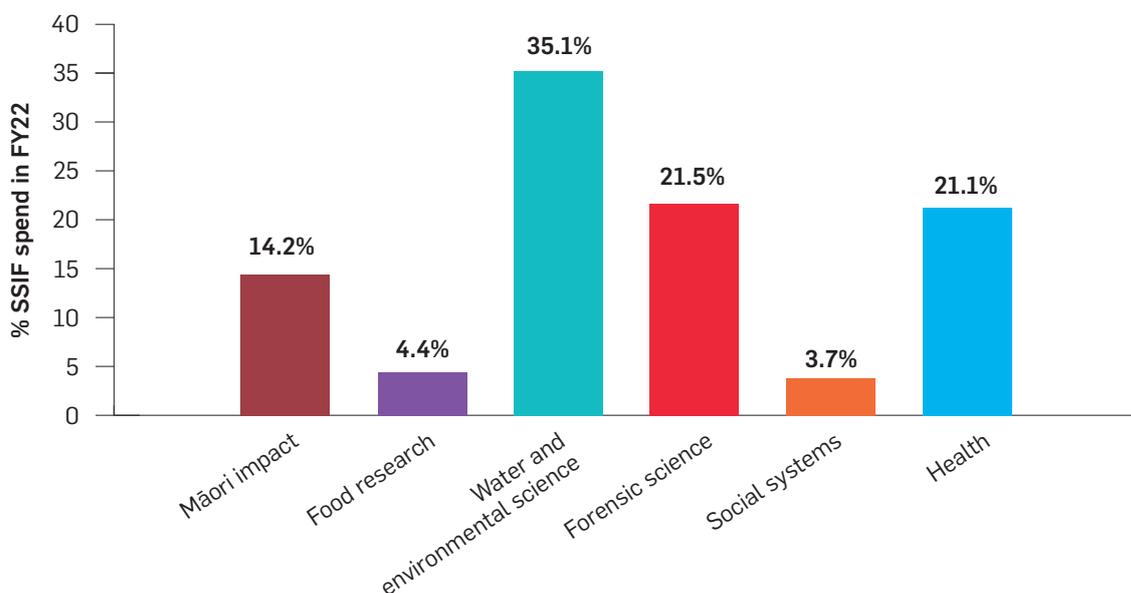
In FY22, we received SSIF funding of \$12.2 million. This funded 28 projects (seven new and 21 continuing projects) across the following research portfolios to support ESR’s current research priorities of mātauranga Māori, genomics, data science, social systems, and point of use testing.

We spent 8.6 percent (just over \$1 million) on 20 Pioneer-funded projects to test proof of concept ideas that could lead to transformative science solutions or new areas of research. In FY22, examples of Pioneer-funded research projects included exploring eDNA methods to monitor freshwater systems, understanding Māori wellbeing, developing rapid diagnostics for respiratory viruses, testing new technology to prevent Legionellosis in engineered water systems and using artificial intelligence for crime scene work and reducing drug harm.

Two Pioneer Fund projects have evolved into new research projects for FY23, which demonstrates the value of this innovation seed fund.

We worked with MBIE during FY22 to reallocate \$1 million of our SSIF funding to ESR’s forensic science platform for FY23. This will support our OneESR research in data science, cross-platform projects and mātauranga Māori. Nearly 18 percent of our new or ongoing research projects now span more than one research platform.

SSIF research funding by portfolio for 2021/22



Our science quality by the numbers



78

Peer reviewed publications

13

Awards received

65 (total)

Co-authored publications (with New Zealand and international collaborators)

38 with ESR and other New Zealand collaborators

9 with ESR, New Zealand and international collaborators

18 with ESR and international collaborators

34

Appointments to national and international committees, panels and groups



Delivering healthier communities

Generating new genomic insights and intelligence to support COVID-19 response efforts



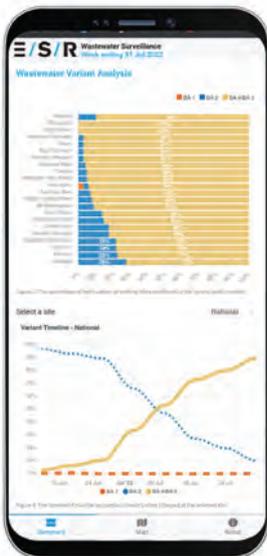
We continue to adapt and optimise our COVID-19 reporting to provide up-to-date insights and intelligence to expand and improve public health surveillance.

ESR has proactively grown the COVID-19 genomics (CGI) insights report to be a collaboration between ESR, Massey University and the universities of Otago and Auckland to provide robust intelligence. Contributors to the CGI report include Dr Jemma Geoghegan from the University of Otago, who won the Te Puiaki Kaipūtaiao Māea Prime Minister’s MacDiarmid Emerging Scientist Prize.

In collaboration with the Ministry of Health, we now have a public-facing dashboard of the CGI report. This step was taken to provide increased publicly accessible information on the genomics surveillance undertaken at the border and in Aotearoa New Zealand communities and hospitals. The number of new variants over the past year has brought into sharp focus the need to continually monitor and inform how SARS-CoV-2 is evolving.

In October 2021, we launched an interactive map and dashboard of COVID-19 wastewater samples tested across the country’s regions. We have evolved our COVID-19 wastewater dashboard to provide additional insights and regional trends on new COVID-19 variants.

The pandemic has transformed the genomics ‘playing field’ here in New Zealand and abroad. ESR continues to advance a vision of a ‘genomics future’ that is well governed, curated and calibrated to the needs and aspirations of communities and other key stakeholders.





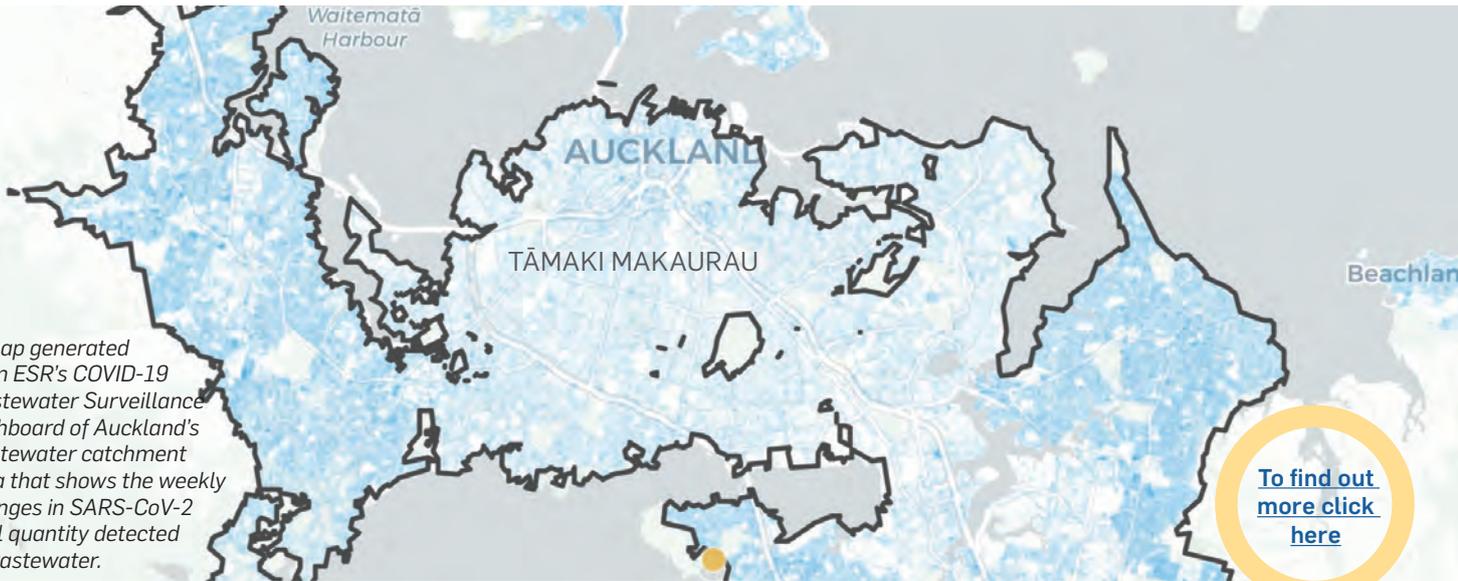
ESR's wastewater epidemiology is vital to help us respond to public health and environmental threats. It is a powerful technique that supports traditional public health surveillance and provides valuable insights into overall community health.

Photo: Andrew Chappell



Delivering healthier communities

How ESR's wastewater-based epidemiology is changing public health surveillance in New Zealand



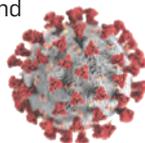
A map generated from ESR's COVID-19 Wastewater Surveillance dashboard of Auckland's wastewater catchment area that shows the weekly changes in SARS-CoV-2 viral quantity detected in wastewater.

To keep people and the environment healthy and safe, we are building an accurate picture of community health to better understand the sources and scope of health and environmental problems.

ESR's wastewater-based epidemiology (WBE) for health and environmental surveillance has been a significant step in helping Aotearoa New Zealand respond quickly and effectively to current and emerging infectious diseases.

The evolution of ESR's WBE programme

Wastewater is full of chemical and biological markers that provide researchers with vital clues into the overall health of specific communities or populations. By analysing wastewater, researchers can build a picture and profile of specific diseases in communities, trends in licit and illicit drug use, and environmental and health pollutants and pathogens, such as antimicrobial resistance and SARS-CoV-2.



WBE is a valuable, powerful technique and approach to complement traditional public health surveillance approaches. It supports and validates existing or observed signals through non-invasive and non-biased data. While WBE cannot provide information on individuals in a community, it helps to overcome some of the challenges

that face traditional health surveillance. This helps create a more accurate picture of the source and scope of the health or environmental problem and what health measures should be implemented to control disease.

In December 2016, ESR's Drugs in Wastewater trial began at two locations. In November 2018, ESR started the national monitoring programme, measuring samples from 37 locations to determine different drug consumption patterns and long-term consumption trends in different areas. The Drugs in Wastewater programme has been so successful that we are working with our key partners to determine the best way to further expand the programme's impact by testing for emerging drugs. This ongoing work, with our key partners, helps to reduce drug harm through coordinated prevention and treatment strategies and strategic, health-based approaches and initiatives to reduce drug harm in communities where drug use is disproportionately high.

With the emergence of the SARS-CoV-2 virus in 2020, WBE began to gain prominence worldwide as an early tracking, detection and forecasting system. We combine traditional laboratory assays and genomics capabilities to build on our pioneering WBE capability. We draw on our broad scientific expertise to provide expert advice based on

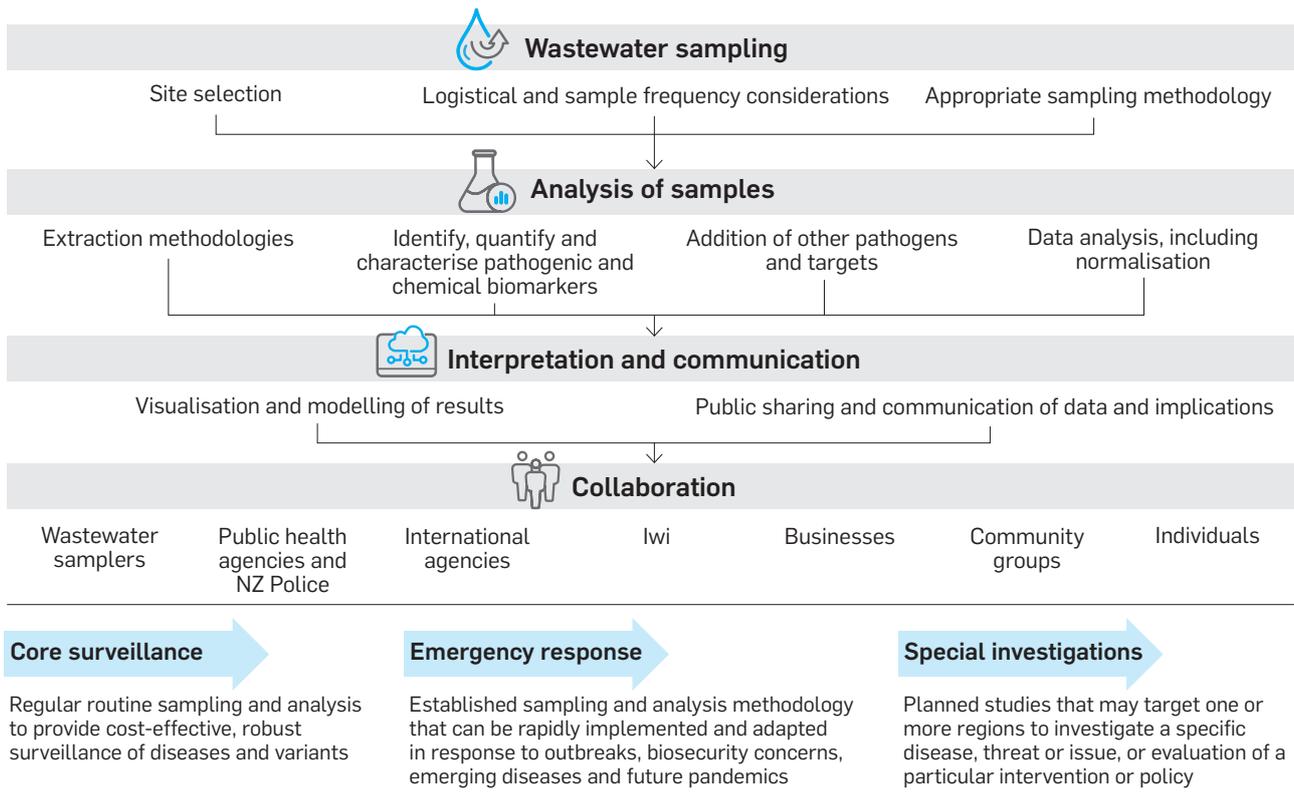


Figure 1: Flow of ESR's wastewater-based epidemiology activities used to inform responses and prevention activities

data generated. This provides an early warning system for communicable disease, generating insights into community transmission and spread. This leadership and detection capability supported New Zealand's COVID-19 response. We developed strategic relationships with councils to test at wastewater treatment plants, allowing us to use the data generated to create dashboards and interactive tools. These are used by the Ministry of Health and various stakeholders for insights to improve health outcomes.

Growing New Zealand's wastewater-based epidemiology capability

We use WBE in three areas: core surveillance, emergency response and special investigations (to evaluate the effectiveness or otherwise of health responses and interventions).

Our WBE programme also ties in with other research projects, particularly antimicrobial research. ESR's scientists are testing wastewater using whole genome sequencing to develop testing tools that will help us better understand antimicrobials, resistance genes and resistant bacteria.

A robust and ethical WBE infrastructure and programme for the future

Our focus is on creating scientifically robust genomic toolkits and tests to expand WBE testing to detect a range of infectious diseases, such as influenza viruses, respiratory

syncytial virus, norovirus and enterovirus. By generating new data, we will be able to gain fresh insights so we can forecast health trends and projections in real-time, like a weather forecast for health.

We aim to work more closely with councils and key stakeholders to explore the potential of expanding WBE so that it is a normal part of wastewater operations. This will help us understand how biomarkers and chemicals are affected by a changing climate and human activities. Routine and ongoing wastewater monitoring will help us form a complete and comprehensive view of current or emerging risks as well as overall population health.

We want to explore how WBE can be used in New Zealand to support future border health surveillance activities. Through early detection, we can alert public health agencies to act promptly through additional screening measures or precautions, further lifting New Zealand's infectious disease responsiveness.

We are also exploring how WBE could be expanded to support future monitoring for persistent organic pollutants and selected chemicals of concern. This will be an important step in developing complementary testing to screen for additional disease biomarkers of public health concern.



Delivering impact for Māori



Delivering healthier communities

Partnership and co-design in shaping Aotearoa New Zealand's future infectious disease responsiveness and readiness

To meet Māori aspirations for health through mātauranga and reduce health inequities, our research and services must be relevant to and inclusive of Māori. We will achieve this through co-governance partnerships to develop a pipeline of research that will provide meaningful, customer-centric solutions for iwi and Māori communities.

"Success will be built on the strengths of the hosts and partners in research and effective implementation in healthcare, policy and community settings, exemplified by the outstanding science-led approach to the pandemic response in Aotearoa and our Pacific realm."

Professor Richard Blaikie, Deputy Vice-Chancellor (Research and Enterprise), University of Otago

A new research platform for public health threats

Following the challenges of the recent COVID-19 pandemic, the Government initiated the formation of the Infectious Diseases Research Platform in December 2021. The platform aims to ensure Aotearoa New Zealand has world-class research capability to support New Zealand's preparedness for current and future infectious disease challenges. ESR and the University of Otago were announced as co-hosts and tasked with developing a platform through a co-design process involving those within the health sector from tāngata Tiriti and tāngata whenua.

The University of Otago and ESR have a long-standing, collaborative partnership. In early 2020, ESR and the

university's scientists successfully set up genomic sequencing of SARs-CoV-2, recognising the need for New Zealand to be ready for and responsive to the then emerging COVID-19 pandemic. Jointly hosting the Infectious Diseases Research Platform marks a significant deepening of ESR's established ties with the University of Otago. Co-hosting the platform will allow both organisations to support national infectious disease research by creating innovative and proactive responses to public health threats, ensuring we

"COVID-19 has highlighted the need to foster collaboration and innovation, and this platform will ensure New Zealand is better prepared for known and emerging infectious disease threats, including future pandemics."

Peter Lennox, Chief Executive, ESR

do not take a one-size-fits-all approach to health. It will also provide new opportunities to strategically influence and improve health and wellbeing outcomes for New Zealand's people.

Co-design to reduce health inequities

Taking a coordinated approach to improving New Zealand's resilience to current and emerging infectious diseases and ensuring the success of the platform includes considering solutions and responses that are fairer for everyone. The platform will support the principles of Te Tiriti o Waitangi ensuring **participation, partnership and protection**.

Appropriate responses to public health threats must reduce health inequities, mitigate economic hardship and maintain confidence and trust through robust scientific research and evidence.



Establishing a new research platform requires extensive and ongoing engagement and collaboration for maximum impact. Reducing inequities and improving wellbeing outcomes for the future are at the forefront of the hosts' and partners' thinking to solve complex challenges and shift the obstacles that cause inequities within New Zealand's society and economy.

Over the past six months, the Infectious Diseases Research Platform has been co-designed with research providers, community leaders and scientists from Māori and Pacific people's organisations, including health providers, through a series of hui. These hui have identified important initial research directions, along with framing that enables partnership. We extend our thanks to everyone who took part.

Community members and researchers both identified several research themes and areas of concern during the co-design process. Many participants were significantly concerned about the disproportionate effects of the pandemic and infectious diseases on Māori and Pacific people's populations.

Another major theme that came out of the co-design process is that research priorities and pipelines must focus on further lifting infectious disease preparedness, mitigating the harm caused by pandemics and preventing future outbreaks of infectious diseases. Partners also want any barriers to participation in things such as immunisation programmes to be identified. They also requested that any

engagement and communications processes necessary to support the platform aims must link with and meet the needs of the communities involved.

The success of the platform relies on active participation and partnership. Both hosts are committed to ensuring vital relationships developed during the establishment phase of the platform continue to be built and nurtured. This will help develop a research pipeline for the platform to explore and allow delivery of valuable customer and user-centric solutions for the research themes and priorities identified through the co-design process. Research priorities and topics will continue to be co-developed and agreed through the lifetime of the platform. The increased focus on co-design with Māori aims to address equity issues and support improved wellbeing outcomes.

Next steps

The significant amount of work to establish the Infectious Diseases Research Platform (engagement, sign-off of research priorities and begin researching), all within less than a year of the funding announcement, is a testament to the commitment of everyone involved.

In the early stages of the platform becoming operational, priority will be given to research to overcome the identified challenges. A primary focus for the hosts and key stakeholders is to further strengthen New Zealand's pandemic and infectious disease preparedness and contribution to global pandemic readiness.



Delivering healthier communities

Growing our clinical genomics and clinical partners to transform clinical diagnostics and healthcare

By improving clinical diagnostic capabilities in healthcare settings, we aim to improve long-term health outcomes, reduce health inequities and create healthier communities.

Science, healthcare and society are in the middle of the next genomics revolution. Genomic technologies allow us to study the entire genetic make-up of organisms. The application of these technologies has become affordable, increasingly accessible and widespread. The benefits of genomics pervade a wide range of sectors. They push boundaries in real-time identification of disease-causing microbes and viruses, diagnosis of rare diseases, cancer prognosis and personalised treatment, through to vaccine production, food safety, water management and environmental monitoring.

Genomic technology and healthcare

Genomic technologies have dramatically changed healthcare internationally and present a huge potential benefit to the health of Aotearoa New Zealand's people and economy. Importantly, they present an opportunity to address equity issues in the health sector by empowering Māori communities and health providers to shape the genomics future for New Zealand.

The genomics work within the COVID-19 pandemic response has helped keep people safe and demonstrated the importance and value of real-time whole genome sequencing to make evidence-based strategic decisions.

Health genomics has several applications, including but not limited to:

- discovering genetic variants that underlie developmental disorders and help in diagnosing rare conditions
- supporting cancer research to understand how cancers develop and to develop treatments
- informing targeted therapies through better understanding the pharmacogenetics and pharmacodynamics of different medicines based on how a person's genetics influence how their bodies respond to certain medicines or therapies

- expanding prenatal testing and diagnosis
- managing infectious diseases.

In New Zealand, we need to improve genomic diagnostic capability and build the infrastructure that will help address health inequities. This will happen by transforming patient healthcare now and in the future.

Exploring new genomic frontiers

At the forefront of ESR's thinking is creating genomic 'tests' that will provide point-of-need solutions in healthcare where they are needed the most and can deliver the greatest benefit and impact in a timely way.

In a healthcare setting, these tests could significantly improve patient outcomes through less invasive diagnostic testing. A single genomic assay (test) can produce data in real-time that can be used to bring different insights when they are needed most. This will give clinicians the ability to make faster diagnoses for various health issues and build genomic diagnostic capability in New Zealand's healthcare settings. We are continuing to work with Wellington Regional Hospital to build a clinical genomics platform. The aim is for New Zealand clinicians to have access to improved tools to interpret clinical genomic data to treat critically ill patients quickly and effectively. The local genomics setup has helped with investigations into potential hospital transmissions of infectious diseases.

We are also working with the Wellington Regional Genetics Lab to consider how genomic technology can be most relevantly applied for patient benefit in clinical genetics, rare genetic diseases and cancer testing, including familial and genetic variants associated with resistance to certain therapies.

Genomics has an important role in reducing health inequities. Co-designed and innovative genomic diagnostic tools, which put the needs and priorities of Māori and Pacific communities at the centre of culturally appropriate healthcare models and genomic solutions, will be critical to overcoming health barriers. Through research alliances with Genomics Aotearoa and the Healthier Lives He Oranga

Hauora National Science Challenge, ESR's human, and wider genomics, teams are involved in several significant collaborative research projects to build New Zealand's genomic capability while reducing health inequities. ESR's Dr Donia Macartney-Coxson (Science Leader Human Genomics) is a member of both the Healthier Lives He Oranga Hauora and Rakeiora (Genomics Aotearoa) Science Leadership Teams, and Dr Joep de Ligt (Senior Science Lead Bioinformatics and Genomics) is a member of the Genomics Aotearoa Science Leadership Team.

Better insights and analyses of data can lead to an increased understanding of the causes of genetic disease and the role of genetics and epigenetics in non-communicable diseases, such as cancers and diabetes.

This will help create targeted health research to improve patient outcomes on how to predict, monitor and treat these diseases more effectively.

Changing personalised healthcare in New Zealand

By sharing new clinical genomic data processing and analysis pipelines, we can expand our collaborations with clinicians and national and international organisations to build capability and capacity across New Zealand. We also want to use our genomic expertise to help lead the development of an ethical genomics framework that supports clinical diagnostics and protects the data of patients in New Zealand.

Science Leader profile Dr Donia Macartney-Coxson

Donia is a people-focused researcher who is passionate about exploring how genomics can help improve health outcomes, reduce health inequities and empower individuals and communities.



ESR's human genomics science leader, Dr Donia Macartney-Coxson, is a geneticist and molecular biologist who first started her career as a laboratory technician at the Plant Breeding Institute in Cambridge, United Kingdom. This formative experience shaped her passion for science and research such that she went to Birmingham University to obtain her Bachelor of Science Honours degree in genetics and doctorate in molecular genetics.

Donia's doctorate focused on plasmids, specifically ones carrying antibiotic resistance and isolated from patients in the burns unit at the local hospital.

After her doctorate, she moved into human disease and did post-doctoral work in lung cancer and obesity research. In 2003, Donia moved to New Zealand to continue obesity and

type 2 diabetes research. Since joining ESR in December 2005, a main focus of her research has been obesity and type 2 diabetes, in particular epigenetics and the role it plays in these complex diseases.

The Human Genomics team has significant expertise in DNA methylation, transcriptomic and small-non-coding RNA. Aspects of the team's work have brought Donia full-circle back to her microbial (doctorate) routes, including collaborations with clinicians to identify the best application of point-of-need genomics for health benefit, for instance, supporting bacterial surveillance and clinical metagenomics at Wellington Regional Hospital.

The Human Genomics team is also currently involved in collaborative research projects with the Wellington Regional Genetics Laboratory, Genomics Aotearoa, the Healthier Lives He Oranga Hauora National Science Challenge, and University of Otago, Wellington.

Donia is excited about the advances in genome sequencing technology that make the applications of point-of-need genomics real, practical and affordable.

Donia says: "It is cool to think that the work you're involved in can lead to better health outcomes. In my job, your brain never turns off and you need to have space and freedom to think. It is creative in a scientific context. I guess the bottom line is that I love this stuff!"



Delivering safer, healthier communities

Building deeper awareness of vaping impacts on health



To keep people and communities safer, it is more important than ever to know what vaping products contain and what the risks and potential long-term health effects are.

Evidence is emerging that vaping is becoming increasingly appealing to younger people, including those who have never smoked before. By providing compelling evidence and insights, we help inform the developing regulatory framework to reduce harm by ensuring that vaping products available in Aotearoa New Zealand meet safety standards.

New Zealand's current vaping environment

The Smokefree Environments and Regulated Products Act 1990 regulates vaping products and smokeless tobacco products in New Zealand. On 11 November 2020, the Smokefree Environments and Regulated Products (Vaping) Amendment Act 2020 (SERPA) came into effect with the staged introduction of a regulatory framework for vaping and smokeless tobacco products.

Before the implementation of SERPA, vaping products in New Zealand were not regulated. Additionally, manufacturers and suppliers could market whatever they wanted without any requirements for quality control testing

of the products' contents. SERPA aims to strike a balance between ensuring vaping products are available and safe for smokers who want to switch to a potentially less harmful alternative while ensuring these products are not marketed or sold to young people.

Integrated and holistic thinking to investigate vaping products

ESR's forensic scientists use multi-disciplinary science approaches to take a holistic view of the links between the justice and health sectors, including in the area of vaping products and harm reduction.

ESR's forensic scientists had the foresight to develop the vaping research *Is there fire behind the smoke?* before the amendment Act was passed. This research was developed to test these unregulated products and investigate their ingredients to highlight any potential safety and harm issues.

The vaping research project is also being supported by ESR's Drug CoLab team. This important cross-functional team was formed in September 2021. The team has wide-ranging and extensive capability with its collective data and toxicology expertise. They provide thought leadership both internally and externally to explore how forensic science can



reduce drug harm and improve health outcomes. Since the project started, we have tested over 200 vaping products purchased from online New Zealand stores.

Our analysis showed that for most vaping products tested the ingredients on the label did not match what was found in the product. The findings highlight a significant number of products on the New Zealand market that have a high percentage of alcohol, microbial contamination and discrepancies in the stated nicotine levels.

A range of toxicants have been reported to be present in vapour including some cancer-causing agents but, in general, at levels much lower than found in cigarette smoke or at levels unlikely to cause harm. These significant safety and health concerns confirm that vaping is not as harmless or as safe as first thought.

We continue to engage with a range of stakeholders, such as the Ministry of Health, the Vaping Regulatory Authority, Māori health providers, university research groups, and the wider smoke-free sector. We will inform the organisations working in the Smokefree 2025 arena and the vaping community in New Zealand of test results and the contents of the products that are vaped. This will help them make evidence-based decisions.

Informing a comprehensive vaping regulatory framework now and in the future

We will continue our market surveillance of vaping products. This includes investigating and analysing nicotine and tobacco metabolites in wastewater. If successful, this data will help us gain more insights on the effect of vaping on community health and extend ESR's wastewater testing capabilities.

We will also explore whether we can use metagenomic approaches in parallel with normal testing techniques. This will help with testing and profiling vaping products and expand our knowledge of the contents of the products being sold on the New Zealand market.

ESR's ongoing testing will be an opportunity to demonstrate if the regulatory system is working, and whether suppliers and manufacturers are indeed complying with regulatory and quality control requirements. Another important aim is to show whether any ongoing quality control improvements have been made in vaping products over the time of the research.

Our leadership in generating new insights and knowledge is critical for informing a comprehensive vaping regulatory framework that protects the health of New Zealand's people now and in the future.





Delivering safer communities

STRmix™ celebrates its 10th anniversary of resolving complex DNA mixtures in forensic casework

'The functionality and power within STRmix™ has grown significantly over the past 10 years. STRmix™ has revealed to us how much information is present in DNA profiles and unlocked what was inaccessible for so long.'

Dr Duncan A Taylor, Forensic Science, South Australia

More than
380,000
cases worldwide since
STRmix™ introduced
Source: Survey 2021

More than
210,000
cases in North America
since STRmix™ introduced
Source: Survey 2021

More than
135,000
cases in Australasia
since STRmix™ introduced
Source: Survey 2021

More than
30,000
cases in Europe since
STRmix™ introduced
Source: Survey 2021

STRmix™ is currently in use in the United States, New Zealand, Australia, the United Kingdom, Ireland, Canada, Finland, Switzerland and Denmark.

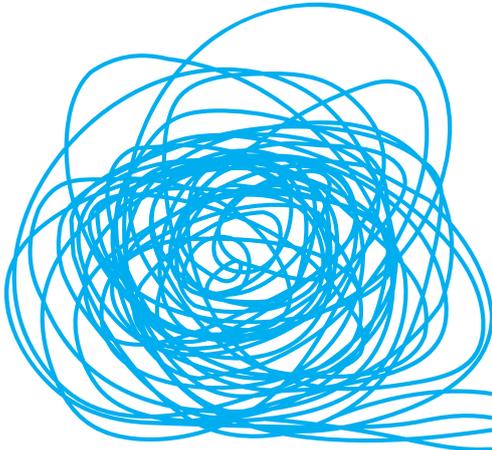


STRmix™ is expert forensic software that can 'unravel' complex DNA mixtures (for example, a DNA profile generated from a crime scene sample containing DNA from more than one person). This allows forensic scientists to provide information to law enforcement and the justice system to infer who may have contributed to the mixture. STRmix™ is a breakthrough for criminal investigations because it can unlock DNA evidence previously considered too complex to interpret.

Celebrating its 10th anniversary of use in live casework, STRmix™ has moved from being a novel technology to more widely used in cases where sophisticated forensic software is needed to resolve mixed DNA profiles.

Developed by ESR's world renowned leaders in the forensic field, STRmix™ uses a fully continuous approach for DNA profile interpretation, to resolve complex DNA mixtures. It is designed to run on a standalone or in a networked environment, without the need for high-speed computing and with the benefits of increasing efficiencies at a lower cost.

Since its introduction in 2012, STRmix™ has proven to be highly effective in helping to develop investigative leads and support exonerations in post-conviction cases by excluding individuals who have been wrongly associated as the source of crime scene. John Buckleton DSc, FRSNZ, principal scientist at ESR and one of the developers of STRmix™, credits the software's popularity with its highly successful track record in resolving low-level, degraded, or mixed DNA samples from multiple contributors.



STRmix™ EMPOWERING FORENSIC SCIENCE.



“STRmix™ has proven to be very effective in producing usable, interpretable, and legally admissible DNA evidence in a wide range of criminal cases worldwide,” John explains.

“It has proven to be particularly effective in resolving violent crime and sexual assault cases, as well as cold cases in which evidence originally dismissed as inconclusive was able to be reexamined.”

Dr Buckleton developed STRmix™ in conjunction with Dr Duncan A Taylor from Australia's Forensic Science SA and Dr Jo-Anne Bright, senior science leader at ESR. Dr Bright has valued the chance to work closely with a growing team and a wide range of international users.

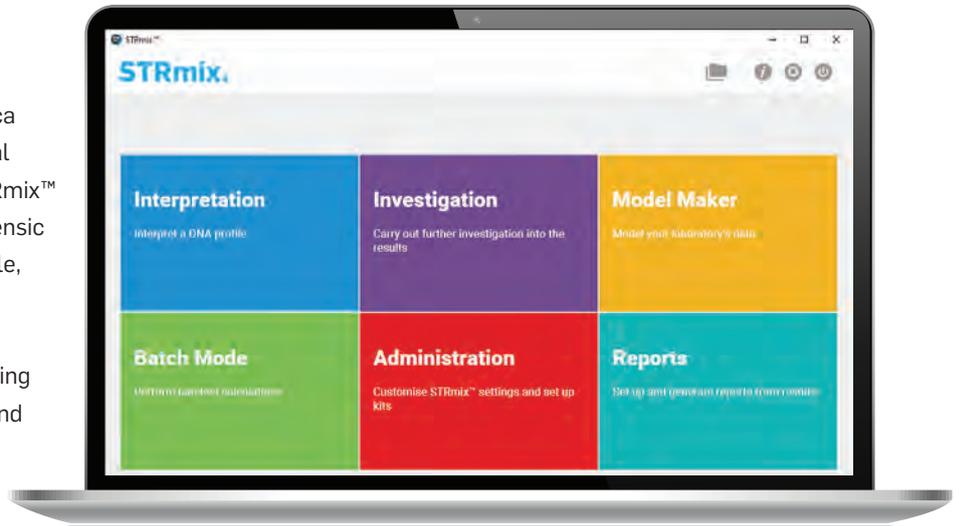
Jo-Anne states, “It’s been really rewarding working so closely with the STRmix™ team members and also getting the opportunity to work with so many people in other laboratories worldwide”.

Nearly 80 percent of certified forensic laboratories in the United States of America including numerous local, state and federal agencies, now routinely use STRmix™. STRmix™ has become the most tested and used forensic software due to its ability to produce usable, interpretable, and admissible DNA results. The STRmix™ team actively supports its users with a wide range of activities including comprehensive training, implementation and validation support, case consultancy and admissibility support.

STRmix™ is currently in use in the United States of America, New Zealand, Australia, the United Kingdom, Ireland, Canada, Finland, Switzerland and Denmark. Surveys conducted by ESR indicate that STRmix™ has been used in at least 380,000 cases worldwide since it was introduced a decade ago. This includes more than 210,000 cases in North America, 30,000 in Europe (including the United Kingdom) and 135,000 in Australasia.

A new version of STRmix™ introduced in October 2021, underwent more than a year of extensive development and testing and contains several new features. These include allowing multiple interpretations to occur simultaneously, the introduction of a batch maker mode and improvements to biological modelling calculations.

Looking to the future, as the forensic community embraces new analytical techniques such as next generation sequencing, the STRmix™ team is looking to formulate suitable models for interpreting such data, as well as the Y-STR (male specific) DNA profiles that are routinely developed during sexual assault investigations.





Delivering safer food

Using genomics to unlock answers for food safety and public health

To increasingly protect the health of Aotearoa New Zealand’s people and safeguard the integrity of New Zealand’s food industry, ESR’s expertise in genomics is helping to close knowledge gaps and create fresh insights into foodborne illnesses.

We aim to build ground-breaking genomic tools and approaches to lower the rates of foodborne illnesses. Through robust and timely evidence and insights to support effective control strategies, we will improve public health and food surveillance.

New Zealand’s increasing yersiniosis infections

The number of notified yersiniosis cases in New Zealand continues to increase (figure 2). Our rates of yersiniosis are also high, compared with other countries.

Yersiniosis is a gastrointestinal disease, commonly associated with stomach pain and diarrhoea but can also cause complications and severe illnesses, especially for those who are very young, elderly or immune-compromised. The disease is predominantly caused by the bacterium *Yersinia enterocolitica*. It is unclear how people are becoming ill from it in New Zealand, but it is most likely due to foodborne sources.

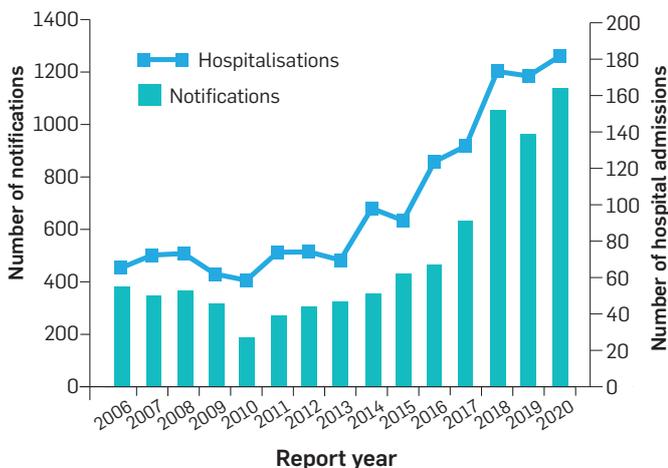


Figure 2: Yersiniosis EpiSurv notifications (line) and NMDS hospitalisations (bar) by year, 2006–2020³

Because New Zealand’s data are limited or outdated, we need new data and insights to explain why an increase in case numbers and hospitalisations is occurring.

Exploring potential equity issues

We do not know the severity of yersiniosis symptoms in some cases or what causes some people to become more ill than others. We know different population groups are also over- or under-represented in case numbers, but we do not know why. For example, Māori have the lowest notified yersiniosis rates in New Zealand, compared with other population groups. We are working with Māori health experts, providers and participants, including other providers, to begin understanding what factors may explain the low notification rates observed, not only for yersiniosis but other enteric diseases.

It is important we identify the main risk factors to answer these questions about increasing infection rates in New Zealand, so we can build a fuller picture of the burden of this disease.

In 2021, we received funding from the Health Research Council of New Zealand to conduct a 36-month-long research project to answer these questions.

Building genomic insights into *Yersinia* and antimicrobial-resistant genes

ESR has developed leading genomics capability in generating and analysing the DNA make-up or the ‘genome’ of pathogens like *Yersinia*. Different strains of *Yersinia* can be obtained from individuals who have been ill and diagnosed with yersiniosis (from their faeces) and from food, water and environmental samples tested as a part of the study (figure 3). Genomics can help us:

- **Improve public health surveillance** – we can compare *Yersinia* genomes from different people to see if they are genetically related, which signals that these people may have had a common source or exposure, like a food product, which can be investigated further.
- **Identify a food or source contributing to illness** – *Yersinia* from foods or other sources may also be genetically related to those found in sick individuals, suggesting a food source may be contributing to illness.

³ Source: New Zealand Food Safety (2021) Annual Report Concerning Foodborne Diseases in New Zealand 2020. Wellington: Ministry for Primary Industries.

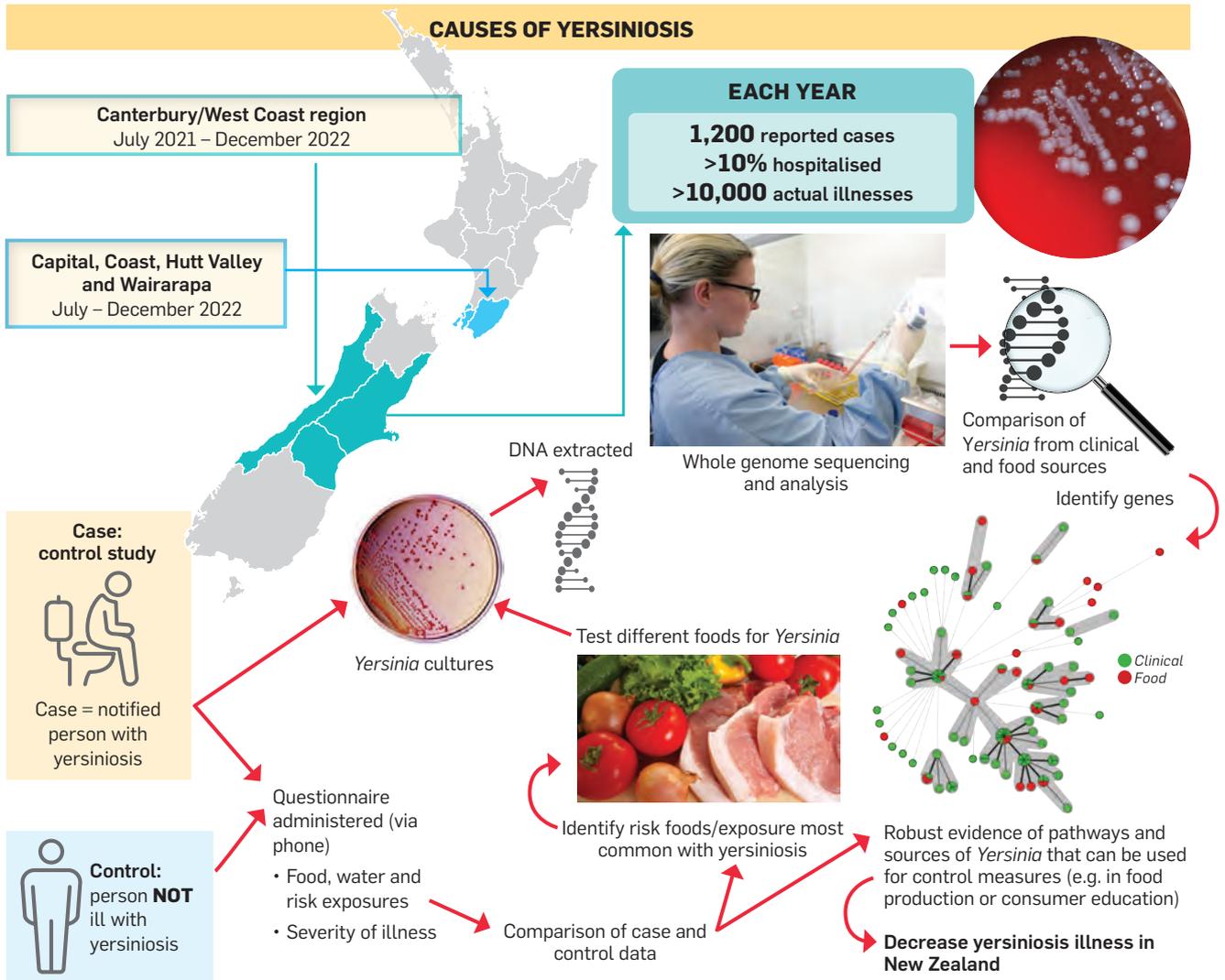


Figure 3: Studying yersiniosis to understand increasing infection rates and identify risk foods and exposures most common in New Zealand⁴

- **Understand Yersinia:** how it causes human disease and identify the types circulating in New Zealand and whether they pose concerns for antimicrobial resistance (AMR).

This study, now in its second year, will help us develop complementary areas of research to combat infectious diseases caused by food pathogens, support AMR research and strengthen New Zealand’s public health surveillance capability.

An integrated approach to food and health surveillance for the future

We take an integrated approach to genomics research to find the connections between human health and environmental and water sources to address the causes of infectious diseases. Genomics is evolving and has revolutionised the way we can identify and track pathogens that cause illness. Integrating genomics into the broader food production chain ultimately helps keep food safe, thereby reducing foodborne disease for all New Zealanders. It also helps protect New Zealand’s food-based economy by

providing food safety assurances, including those required for international market access.

We aim to use our leading genomics expertise and insights to work with key collaborators and partners, particularly within the New Zealand Food Safety Science and Research Centre (NZFSSRC). This will allow the co-design and development of new genomic approaches, tools and data to make genomics accessible and affordable and, ultimately, an integral part of food safety and surveillance in New Zealand.

Creating and sharing new data, knowledge and insights about food pathogens and AMR genes will inform a New Zealand genomic database of pathogens. This will be extremely relevant as we face challenges from a changing climate and manage emerging risks. Our work will also help the Ministry for Primary Industries improve food regulatory frameworks for food to ensure the future integrity of New Zealand’s food.

⁴ Source: Dr Lucia Rivas, personal communication, July 2022.



Delivering cleaner water and environment

Combating pathogens and contaminants in Aotearoa New Zealand's water systems using novel multi-omic tools and technologies



Our ability to investigate, identify and mitigate water pathogens before they become a major issue is crucial for protecting the health of New Zealand's people and improving the long-term sustainability, health and quality of water systems and the environment.

Understanding current and emerging issues by recognising the interconnections between people, animals, plants and their shared environment is essential for preventing infectious diseases and improving sustainable land use practices. Our aim is to create new tools and approaches to develop and provide creative, co-designed and integrated methods for sustainable land use practices and safer groundwater and fresh water.

Water is essential for life. The health of New Zealand's water systems is vital for ensuring the health of people, animals and the environment. Fresh water must be safe for human consumption, shellfish farming, swimming and horticulture. Pathogens and contaminants in water systems

are a major risk to human, animal and environmental health, affecting the longer-term health and quality of New Zealand's water systems. Pathogens, such as *Legionella*, *Cryptosporidium*, *E. coli*, antimicrobial resistance and chemical pollutants threaten the health of groundwater and freshwater systems.

We must develop a fuller picture of existing and emerging pathogens, as well as how human activities (such as changing land use) affect water systems. We also want to increase our understanding of the microorganisms that contribute to healthy water systems. Human and water health are also affected by climate stressors across regions in New Zealand. Being able to identify, understand and remove **emerging contaminants** will be an important capability for managing climate change hazards. Developing tools and new processes for identifying, monitoring, controlling and mitigating these pathogens in groundwater, fresh water and engineered water systems is crucial for keeping people and the environment safe.

Pioneering new genomic approaches to improve groundwater and freshwater

Our current research for both groundwater and fresh water aims to lift our water quality expertise even further through genomics to provide greater benefit and impact for New Zealand.

We are focused on supporting Māori aspirations for managing wai and mahinga kai through our He Wai Māpuna programme. We are funding 10 SSIF water projects in FY23. This includes providing advice on water quality, groundwater mapping and visualisation with a focus on developing solutions that meet community needs.

A significant achievement for ESR is establishing a genomics methodology for sampling groundwater. This work is allowing ESR to be at the forefront of groundwater and fresh water genomics in New Zealand. We are using genomics alongside traditional approaches for testing groundwater systems and sampling groundwater ecosystems. Our research is focusing on identifying and removing emerging contaminants in the future.

This pioneering work is helping to develop a fuller picture of New Zealand's groundwater ecosystems. The research includes looking at how groundwater health is influenced by microbes living in there, environmental contaminants and how changes to the climate and weather patterns influence groundwater health and the diversity of organisms living in groundwater. These toolkits will be essential for setting up an in-line monitoring system to support biomonitoring through eDNA. This is an important early warning system that will help support climate change research.



From the genomic data pipelines that we are creating from baseline data, we aim to build a useable database to help understand regional differences in groundwater systems and detect new organisms, from microbes through to macrofauna living in groundwater. This will help us develop a standard index for groundwater quality, such as the macroinvertebrate community index (MCI index) used for freshwater in New Zealand. The MCI index for fresh water provides a picture of overall surface water quality and health. Although stated as a requirement in the 2020 *National Policy Statement for Freshwater Management*, currently no limits are set for groundwater fauna. We are working to address this through combined taxonomic and eDNA approaches.

We are using metagenomics to improve faecal source tracking for different contamination scenarios. Our research in this area will support iwi as kaitiaki (commercial and non-productive landowners) to keep their communities safe by detecting water quality issues early.

ESR's water scientists have been creating environmentally safe food-grade surrogates and synthetic DNA tracers that mimic pathogens to combat water contamination. Our scientists are collaborating with international researchers to validate proof-of-concept technologies and approaches





Photo: Jenny Ralston

to develop control measures to safely test and mitigate pathogens (such as *Legionella*) in engineered water systems. This research is transformative because new technology and techniques could create new applications for water while mitigating the risk and expense of working with actual pathogens.

Integrated thinking to better support water health

Our genomic data will also support groundwater modelling. We are collaborating with GNS Science and Lincoln Agritech on mapping New Zealand's groundwater wells.

We will be developing new genomic databases of water pathogens to support existing and new research priorities for groundwater, fresh water and wastewater. This includes exploring eDNA applications for biomonitoring and climate-related work. We will also focus on identifying gaps, such

as looking at how stormwater issues should be managed, and how groundwater health affects mahinga kai (food harvested in the wild). By developing new genomic toolkits and eDNA approaches, we aim to generate and interpret genomic sequencing in real-time, which will allow for flexible and faster decision-making about water health.

With new knowledge and technologies, we will help councils and those responsible for managing land to assess water health. This will help shape improved water mitigation strategies and policies for how groundwater and freshwater resources are used and managed in the future.

We also want to develop and deploy more cost-effective denitrification technologies for groundwater remediation. We will explore developing portable genome sequencing devices to be used in field settings to analyse waterways, mahinga kai and crops.



Directional drilling through the permeable reactor barrier at our experimental site at Silverstream Reserve.

Photo: Richard Sutton

WĀHANGA 3 – TĀ MĀTOU KĀRI TAPEKE / PART 3 – OUR SCORE CARD

Ngā inenga mahi

Performance measures

Summary results

Our measures are based on our estimates of a 'usual' year. However, due to ESR's critical role in the COVID-19 response, some of the planned activities have been delayed or deferred. Of the nine measures not achieved (31%), five relate to workstreams that have been deferred to the new financial year. Details are listed below.

Achieved	7
In progress	13
Off-track – not achieved	9

Full year-end results

Develop a customer insights strategy with an action plan to support customer engagement, co-creation, and innovation			
Performance measures	2021/22 target	Comment	Year-end result
Establish and embed methods and systems that enable a pipeline of innovative science ideas to deliver services and products for customers	Achieved	<p>This measure is made up of several workstreams such as ESR's Innovation and Design and Extending Research Capacity programmes.</p> <p>While progress is being made to advance the next steps to commercialising the Lumi™ Drug Scan device, this project is still in its early stages. The project's success will lay the foundation for ESR's commercialisation approach.</p> <p>Initial work started this year to progress the development of ESR's innovation and commercialisation pipeline. However, this is a long-term project that will have a phased approach. The first phase is to develop a commercialisation framework proposal, which involves defining the structure of the pipeline and completing project mapping. Initial scoping work was completed during the year.</p>	In progress
Increase knowledge, understanding and partnering with key government agencies			
Partnerships are demonstrated by collaboration and co-design with Ministry of Health, Ministry for Primary Industries, Plant & Food Research and the New Zealand Police	Participation by each entity in at least one major service and/or product co-design	<p>We are making good progress on genomics co-designed services and projects with the Ministry of Health. Through the joint ESR-New Zealand Police Innovation Governance Group, we are exploring potential projects to support frontline policing.</p> <p>We continue to engage with key stakeholders and collaborators, such as the Ministry for Primary Industries, on potential food genomics projects.</p>	In progress

Māori-led research programmes			
Performance measures	2021/22 target	Comment	Year-end result
Number of iwi partnerships under the He Wai Māpuna programme	5	He Wai Māpuna has five iwi partners located across Aotearoa. They are Ngāti Awa, Ngāti Kahungunu ki Wairarapa, Tauranga Moana (consisting of three local iwi partners), Ngāti Toa Rangatira and Ngāi Tahu.	Achieved
Increasing Māori collaboration and partnership			
Number of co-designed research projects	13	We have co-designed six collaborative research projects this year with iwi in the North Island and South Island. Although COVID-19 has impacted our ability to meet with iwi on the whenua, we have continued to engage with iwi to explore opportunities for co-designed research.	Off track – not achieved
Māori data sovereignty			
Māori data sovereignty programme established and under way	Māori data principles and practices established through Māori Data Leadership Group	This workstream, which is longer-term, consists of two phases. The first is to develop a Māori data sovereignty treaty in practice framework for ESR. The second phase will be implementing the recommendations from the first phase into ESR's operations. The work is being developed in parallel with the pan-CRI approach to developing a Māori data sovereignty policy. During FY22, ESR's external Māori Data Sovereignty Advisory Group has been guiding the design of principles and practices that will inform ESR's data ecosystem and support the ethical use of data to enhance wellbeing.	In progress
Strategic Science Investment Fund (SSIF) funding allocation			
Percentage of SSIF funding allocated to projects led by and/or co-designed with Māori	10% to 12%	ESR has increased its investment in co-designed research projects. The total SSIF funding allocated to these projects during FY22 amounted to 14.2%.	Achieved
Uplifting Data Science and Development Capability			
Number of data scientists employed full-time employee equivalents (FTE)	4 FTE	These highly specialised roles are vital in underpinning ESR's e-infrastructure and science capability in genomics and artificial intelligence. Although recruitment during this period was especially challenging due to the COVID-19 pandemic, we successfully recruited ESR's data science lead at the end of June 2022. This role will shape ESR's future data science governance practices and further lift ESR's data science capability to support its future science direction. As at 30 June 2022, ESR employed four FTE data scientists.	Achieved

Performance measures	2021/22 target	Comment	Year-end result
Research collaboration			
Number of international proposals submitted and accepted	3	During FY22, we submitted and received international funding from St Jude Children's Research Hospital in the United States of America for SHIVERS IV (influenza research).	Off track – not achieved
Overall success rate of external research bids	41%	ESR had a success rate of 45.4%, with \$29.7 million of external bidding that was decided in FY22.	Achieved
Strengthening ties with New Zealand universities			
Number of universities with formalised collaboration arrangements	2	We have one formalised arrangement re the joint ESR-Otago University Infectious Diseases Research Platform. This is a significant achievement for ESR. A second formalised arrangement with the University of Auckland is being finalised.	In progress
Developing ESR's commercialisation approach			
Review ESR's commercialisation approach and make recommendations accordingly	Achieved	We are in the process of developing the foundations for ESR's future commercialisation approach. However, this workstream is dependent on ESR developing a pipeline of fresh innovative research projects. Developing ESR's commercialisation pipeline is the first stage of this long-term workstream. During the year, we focused on building commercialisation capability, including starting to define what ESR's future commercialisation approach could look like based on ESR's previous work with successfully developing STRmix™ and the Lumi™ Drug Scan Service.	Off track – not achieved – deferred to FY23
If recommendations accepted by Senior Leadership Team and Board, commence implementation	Implementation commenced	See above.	Off track – not achieved – deferred to FY23
Upskill ESR's scientists in achieving impact through science commercialisation	At least 20% of science staff have participated in a science innovation workshop	Although COVID-19 lockdowns and alert levels affected the ability to hold in-person workshops, we held virtual workshops to continue upskilling our scientists for innovation and commercialisation. The workshops were well received, and staff feedback was positive.	Achieved
Developing a workforce capability framework to assess workforce skills, development needs and priority areas for investment			
Develop ESR's workforce capability framework	Workforce capability framework developed	Due to the significant HR resource required to support the implementation of the joint ESR-GNS Science Workday business platform, this work has been deferred to FY23.	Off track – not achieved – deferred to FY23

Performance measures	2021/22 target	Comment	Year-end result
ESR employee diversity is reflective of New Zealand society			
Establish employee diversity baseline and monitor	Baseline established	<p>ESR's employee diversity baseline will be fully developed after the joint ESR-GNS Science Workday business platform is fully implemented.</p> <p>However, during the year, ESR started a programme of work to better reflect the diversity of New Zealand's society, to ensure alignment with the Kia Toipoto Gender and Ethnic Pay Action Plan.</p>	<p>Off track – not achieved</p> <p>–</p> <p>deferred to FY23</p>
Cultural capability: Build cultural competency			
Develop and implement Te Pihinga training programme	At least three cohorts have commenced the intensive Te Pihinga training programme	<p>Te Pihinga, an advanced training programme, was started in FY22. However, the COVID-19 pandemic affected the ability of the participants of this inaugural cohort to complete the training course. This programme is being reassessed because the priority is to re-establish ESR's foundational cultural competency training programmes. A progression point of the foundational programme is a level 2 Te Tiriti course that specifically makes a connection for science-based roles with knowledge and understanding of Te Tiriti o Waitangi and its principles.</p>	<p>Off track – not achieved</p>
Percentage of staff who have participated in The Wall Walk™ Māori and the Te Tiriti historical context training	≥ 80%	<p>Due to the impacts of the COVID-19 pandemic and our chosen operating guidelines, both The Wall Walk™ and Te Tiriti training could not be delivered online this financial year.</p> <p>Providers are still establishing the mode of delivery for these programmes. With increased FTE and training not being able to be delivered, the percentage of staff completion has dropped.</p>	<p>Off track – not achieved</p> <p>Wall Walk = 52%</p> <p>Te Tiriti = 33%</p>
Percentage of staff who have participated in introduction te reo courses	≥ 35%	<p>Te reo and tikanga lessons were able to be delivered online during the latter part of the year, with 34% of our permanent staff enrolled in te reo and tikanga lessons.</p>	<p>In progress – 34%</p>
Refresh He Pūtaiao, He Tāngata	Refreshed programme commenced	<p>During the year, we started work to update our He Pūtaiao, He Tāngata strategy by talking to scientists, leadership, and support staff across the organisation. Te Tiriti o Waitangi principles remain at the core of our strategy. The updated strategy will identify new actions across ESR's science and operations focused on outcomes and benefits with and for iwi. We expect to update this strategy by Q2 FY23.</p>	<p>In progress</p>

Performance measures	2021/22 target	Comment	Year-end result
Improving ESR's health and safety processes and procedures			
Health and safety critical risks reviewed and implement management framework	Critical health and safety risk assessment completed and management framework in place	<p>Ensuring our people are kept safe and our work practices prevent harm is of paramount importance. At the end of FY22, we completed 53% of ESR's critical risk control plans. The remaining six critical risk reviews are almost complete. Control plans for all 13 critical risks will be completed in early Q1 FY23.</p> <p>In Q1 FY23, we will allocate risk controls, and an assurance plan and monitoring regime will be put in place to ensure effective, sustainable and enduring risk management.</p>	In progress
Improving the management of staff wellbeing			
Establish and implement ESR's wellbeing strategy	ESR's wellbeing strategy established and implemented	<p>ESR's wellbeing strategy needs to be developed as part of ESR's wider, overarching health, safety and wellbeing (HSW) work plan.</p> <p>We have deferred this workstream to complete the critical health and safety risk control plans, and recruitment of the new HSW team. In addition to four other HSW specialists, a health and wellbeing business partner has been recruited to deliver ESR's health and wellness programme and practices.</p>	Not achieved – deferred to FY23
Deliver Investment Management System			
Investment Management System is delivered and implemented	Investigation completed and implementation under way	We completed the investigation into ESR's Investment Management System. This is now being developed alongside a strategic work programme for FY23.	In progress
Investigate and implement an enterprise resource platform			
Enterprise resource platform implemented	Investigation completed and Implementation under way	Workday was implemented on 07 July 2022.	Achieved
Investigate and identify a replacement laboratory information management system			
A laboratory Information Management system identified and implementation under way	Investigation completed and implementation under way	<p>Renewing this critical infrastructure is vital to ensure diagnostic and analytical capabilities support frontline responsiveness across ESR's health, environment and forensic sciences.</p> <p>We have completed the investigation stages to replace the laboratory information management system to be used in ESR's health and environment laboratories.</p> <p>The upgrade to ESR's forensic laboratory information management system is expected to be completed before the end of 2022.</p>	In progress

Performance measures	2021/22 target	Comment	Year-end result
Improving ESR's strategic business resilience and continuity			
Implement recommendations of the ESR resilience programme	Uplift ESR resilience from level 3 to level 4	ESR's business continuity practices throughout the COVID-19 pandemic have focused on making improvements to strengthen organisational resilience and business continuity management (BCM) and maturity. This work programme started in early 2020 and has seen ESR continue to uplift integrated organisational BCM practices relating to business resilience, coordination, recovery and leadership.	In progress
Review organisational policies to ensure all policies are effective and consistent with our He Pūtaiao, He Tāngata strategic aspirations			
Policies are reviewed and updated	Review of policy structure completed, and four policies reviewed and implemented	We have updated, reviewed and approved 13 priority-1 critical organisational policies. Training on the new policies will be rolled out in early FY23.	In progress
Technology roadmap: Developing a future IT operating model for ESR			
Develop and implement a future information technology (IT) operating model	Operating model implemented	Recent efforts in this area have focused on supporting the Government's COVID-19 response. Future changes to the operational model are dependent on the COVID-19 response demands and the outcome of the CRI review. However, work continues to strengthen systems and ensure resilience. Business cases are being developed to replace the health and forensic laboratory information management systems. This will ensure that ESR's laboratory systems can respond to time critical public health and forensic needs.	In progress
Technology roadmap: Security assessment – strengthening ESR's cyber security maturity			
ESR's cyber security maturing rating is managed or enhanced	Improving against an established baseline	ESR's cyber security maturity and IT infrastructure is being actively managed and monitored, with our focus on strengthening performance for internal and external systems. We have established and implemented a work programme to improve ESR's cyber security maturity as measured against the NIST ⁵ framework (which aligns with <i>New Zealand Information Security Manual</i>). We assess ESR's cyber security maturity against five NIST ⁵ framework criteria. ESR's cyber security maturity has improved overall by 31% against baseline (the average percentage over the five criteria).	Achieved
Information management strategy: Develop an information asset register that provides an enterprise view of how and where information and data are managed, accessed and shared by ESR			
The information asset register supports security and privacy risk assessments and informs the development of a revised disposal authority	Information asset register in place and governance framework across ESR's information and data assets implemented	ESR's scientific information assets were mapped during FY22 to fully inform ESR's information asset register. Availability constraints due to Workday implementation caused interviews for the information assets of ESR administrative and support functions to be delayed to Q1 FY23. The information asset register (a living document) will be submitted for approval in Q1 FY23. A revised information classification scheme has been drafted and consultation is under way. The first release of ESR's information asset register is on track to be delivered in Q1 FY23.	In progress

⁵ The National Institute of Standards and Technology is a non-regulatory federal agency within the US Department of Commerce.

Supplementary performance indicators – results at 30 June 2022

Government priorities	Performance measure	Purpose	FY21 Actual	FY22 Forecast or target	FY22 year-end result
Effective and efficient investment practices	ESR maintains or improves its procurement capability index (PCI) self-assessment score	PCI is an MBIE self-assessment scoring tool for government agencies to self-assess procurement practices and capability annually.	2.19	Between 2.7 and 2.8	2.3 ^a
	<i>Note a: The result for the PCI self-assessment score is based on a calendar year (1 January to 31 December 2021).</i>				
Increasing the diversity and quality of the research, science and innovation workforce, including growing excellence and collaboration in research activity	Number of doctoral theses examined and number of postgraduate students supervised by ESR scientists	Indicates the quality of ESR's scientists.	11	Between 8 and 10	12

Ministry of Business, Innovation and Employment core generic performance indicators

All CRIs report against the following core generic operating measures. These generic performance measures are designed to provide consistency across all CRIs.

Our results are reported at 30 June 2022.

Government priorities	Performance measure	Purpose	Year-end result	Full year 2022 target
Growing investment in research, science and innovation Effective and efficient investment practices	End-user collaboration: Revenue per full-time employee equivalents (FTE) from commercial sources	Domestic and international commercial revenue targets for end-user collaboration (revenue per FTE from commercial sources) and the knowledge exchange indicator (commercial reports per FTE) reflect commercial research activity	\$163,530	\$139,300
	Financial indicators: revenue per FTE	\$ amount of revenue per FTE	\$210,579	\$185,000
	Total commercial revenue	Total commercial revenue	\$86.0m	\$73.0m
Increasing the diversity and quality of the research, science and innovation workforce, including growing excellence and collaboration in research activity	Science quality: impact of science publications ^a	Impact of science publications (measured using web of science citations for the previous calendar year)	4.25	3.8
	Research collaboration: publications with collaborators	These refer to publications we have prepared in collaboration with authors at other New Zealand institutes and/or international authors	65	75
	Technology and knowledge transfer: commercial reports per scientists' FTE	Technology transfer refers to the process of conveying results stemming from scientific and technological research to the marketplace along with associated skills and procedures. It is an intrinsic part of the technological innovation process	0.20	0.36

^a This result is calculated for a calendar year (1 January to 31 December 2021) and reported at 30 June 2022.

He waka eke noa

OneESR

Our performance and reputation as a good employer are underpinned by our commitment to fostering a positive workplace culture and work environment to let our people excel. Creating and providing opportunities for growth and leadership will build a resilient, healthy, agile and diverse organisation that values, energises and rewards its people.

Through our shared values, we empower our people to challenge old ways of thinking. This year we have been reshaping our organisational capabilities to expand our innovation and further embed mātauranga knowledge into our science and mahi.

By investing in and developing our people, we increase ESR's performance and reputation for leadership in science. We employ the principles and practices of equal employment opportunities; a diverse workplace and inclusive culture; and an environment that enables each person to share their views and develop and perform to the best of their ability.

This year we continued to shape our workforce to ensure we plan for and build capabilities that align with ESR's future needs and those of the wider science system to deliver benefit and impact for Aotearoa New Zealand's people.

Our highlights are outlined below.

Building our organisational capability

The Impact Planning Evaluation Network (iPEN) is a pan-CRI collaboration that provides staff with opportunities to develop and build capability in impact planning and evaluation to lift science quality in a CRI context. To date, 84 of our scientists have participated in iPEN training.

We started an initiative aimed at lifting the h-index score of ESR's scientists. The h-index is an author-level metric that measures both the productivity and citation impact of publications. We provided support to our scientists to help them complete and publish scientific papers that will lift their h-index score and profile. Since December 2021, we have had encouraging results of 17 staff as a group that increased their h-index by 9 percent in Google and 12 percent in Scopus.

Initial work started this year to progress the development of ESR's innovation and commercialisation pipeline to deliver services and products for our customers.



ESR's Chief Executive, Peter Lennox, and ESR scientists and staff attended the Love Local Expo at Porirua's Te Rauparaha Arena to highlight the ground breaking science that ESR delivers for Aotearoa. Photo: Grace Lennox



Future focus

Due to the significant HR resources required to support the implementation of the joint ESR–GNS Science Workday business platform, we deferred our wellbeing and workforce capability workstreams to FY23. We are rescoping the work so that our wellbeing strategy aligns with our overarching health, safety and wellbeing programme. ESR is experiencing significant growth and its workforce framework needs to align with its future strategic science direction and cultural and capability requirements.

Supporting our He Pūtaiao, He Tāngata goals

COVID-19 affected our ability to deliver in-person training for a significant time during the year and several of our courses were unable to proceed. We were pleased, however, to continue training for our staff who are learning te reo and tikanga as we worked with suppliers to switch to successful online delivery. This meant we achieved 34 percent of our current permanent staff registering for these lessons. In total, 193 staff participated in te reo and tikanga lessons.

Our inaugural Te Pihinga roopu accelerated cultural capability training course was also unfortunately unable to proceed, because the key elements of noho marae were also affected. Following this disruption, Te Pihinga and its learning outcomes were reviewed. This training is currently on hold.

We are now focusing on establishing a core foundational training framework that provides continuity of courses for staff, and connects new staff to our He Pūtaiao, He Tāngata strategy and training programmes when they join ESR.

Growing our people and culture

We work to promote a thriving and modern workplace and culture that is diverse and inclusive by reflecting Aotearoa New Zealand. We aim to provide people-centred leadership and opportunities for staff growth that will shape and expand ESR’s science capabilities. An inclusive workforce helps shape the science system for the benefit of everyone.

ESR is striving to be an employer of choice for Māori scientists and professionals. Through our investment in and support of the Pūhoro STEM Academy, we have an internship programme to attract young Māori science students to grow and advance Māori science leadership and capability.

During the year, we started refreshing our He Pūtaiao, He Tāngata strategy to identify actions that will create greater space for and impact with Māori. The refreshed strategy aims to build and apply science and business approaches that reflect Te Tiriti o Waitangi principles through:

- building enduring partnerships with iwi through mātauranga-led and mātauranga solutions alongside science
- strengthening co-design and co-governance with Māori in all our areas of impact, such as infectious diseases, data sovereignty, the use of DNA, and removing contamination in wai and kai
- creating the pathways for mātauranga expertise and Māori scientists and researchers to flourish, ensuring the research we undertake better delivers for Aotearoa New Zealand.

In time, this will ensure we are acknowledged as a place where mātauranga thrives alongside science



Our commitment to sustainability

To be an environmentally friendly and sustainable organisation, we need to think and act with our effect on the environment in mind. This requires increasing knowledge across the organisation and having systems in place to support sustainable practices.

Good progress was made on ESR's sustainability work programme. An ESR team is working on how to measure and track the sustainability of ESR's activities. We also started work on refreshing ESR's sustainability initiatives. This includes developing a reinvigorated sustainability policy, based on selected UN Sustainable Development Goals, which commits us to acting and operating in a way that protects and enhances social, environmental,

cultural and economic sustainability. We intend for these to support our business, customers, suppliers, communities and the planet, now and for future generations. ESR is also an active member of the pan-CRI initiative to reduce carbon emissions, a collaborative approach to address the requirements from the Carbon Neutral Government Programme.

Over the next year, we intend to implement both long- and short-term actions and measure the impact of these, refresh the Sustainability Committee. Once goals and sustainable actions are confirmed, the amount of additional resourcing requirements will become clear.



Action plan to reinforce and shape our positive health, safety and wellbeing culture

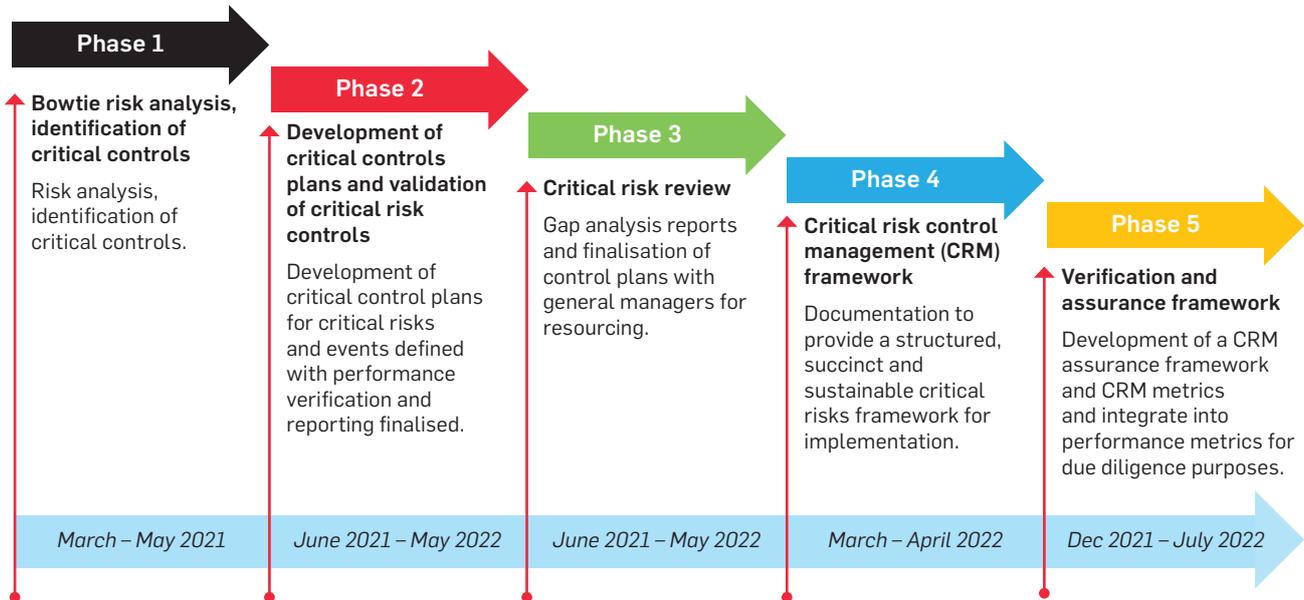


Figure 4: Stages 1-5 of ESR's critical risk control programme

Good leadership and management of our workplace health, safety and wellbeing is essential to support how we manage exposure to risks to keep our people safe, avoid disruption of business activities and provide effective delivery of our science and research.

In 2021, we embarked on an 18-month long critical risk management programme journey. This was an integral part of our risk management work, with a focus on identifying and monitoring performance of critical controls to prevent realising material risks to staff. This programme encompassed a strong visible leadership component and encouraged active engagement and participation of staff across ESR.

To achieve this, we used the critical risk methodology blueprint the International Council on Mining and Metals uses, which is regarded as international good practice.

Using a formal, phased approach, we identified our risks and strengthened opportunities to show our commitment to visible leadership. We engaged with over 90 staff members through individual discussions and virtual or group workshops. This gave staff the opportunity to stay connected across ESR throughout the COVID-19 pandemic by meeting and speaking to colleagues virtually about

shared risks and learnings. This was important because it provided active participation during a time of isolation.

Active participation allowed us to identify and know what our real risks are rather than making assumptions. While we already had many controls in place, we identified improvement opportunities.

In the first phase, we identified 13 critical risks that are defined as events that may cause failure or loss of control. At the end of FY22, we had completed 53 percent of ESR's critical risk control plans. The remaining six critical risk reviews are almost complete.

We then developed control plans for these risks alongside a critical risk assurance process. This enduring process will ensure the future effectiveness and sustainability of managing risk and associated controls.

The second programme of work (phases 6-9) is scheduled to start in October 2022. The focus will be on assigning accountability, improving controls and the enduring risk and operational ownership process, which includes verification and performance reporting.

This work represents a major shift in health, safety and wellbeing leadership and maturity for us as we work to prevent harm and keep our people safe.

Kia noho hei kaituku mahi pai

Being a good employer

We embrace the principles of being a ‘good employer’ that the Human Rights Commission recommends. The summary below shows our activities this year against the seven elements of being a ‘good employer’.

<p>Our leadership, accountability and culture</p>	<p>Our Te Kāpehu Performance Experience programme is based on building a collaborative, high-performing culture. It encourages clear accountability through meaningful performance-development conversations and defined work outputs aligned to business plans and our strategic objectives.</p> <p>We started work on refreshing ESR’s cultural capability programme to ensure ESR’s training and learning opportunities align with its He Pūtaiao, He Tāngata strategy.</p>
<p>Recruitment selection and induction</p>	<p>We are committed to promoting a culture of diversity and inclusion, the elimination of conscious and unconscious bias, and equal employment opportunities. We encourage our people to take advantage of the online courses we provide to address bias in the workplace.</p> <p>Our recruitment and selection processes fosters competencies, values, skills knowledge and experience, backed by appropriate assessment and selection tools, to ensure the best candidate is selected in a fair and equitable manner.</p> <p>We employed additional data scientists, an important move to broaden ESR’s data science and data governance practice as a partnership. Data science is a vital enabler of ESR’s future science direction, ensuring ESR’s data is used to its full value to deliver transformative science for communities across all aspects of ESR’s work.</p>
<p>Employee development, promotion and exit</p>	<p>Te Kāpehu encourages employees’ development by providing clear and achievable progression through building technical skills and behavioural competencies. Our annual science promotions process supports staff career progression. All vacancies are advertised internally to provide career development and advancement opportunities.</p> <p>Employees who leave us can participate in either an online or a face-to-face exit interview. The feedback is consolidated and themed to assess how we can continue to build on areas of strength and improve our working environment.</p> <p>Our online staff learning library ‘Ararau’ was launched. Ararau, offers 80,000 plus online courses to support staff learning and development goals. An analysis will be done to determine the types of activity and training staff are accessing, which will inform future development opportunities and the overall capability programme.</p>
<p>Flexibility and work design</p>	<p>We support and promote flexible working arrangements. This includes flexible hours and working from home or alternative locations, recognising the flexibility required to support family and other obligations, embedding a culture of flexi-work for all staff.</p> <p>We supported parents returning to work by offering part-time and gradual return to full-time work arrangements.</p> <p>We managed our staff to take annual leave in the year it is accrued and encouraged them to manage their hours to maintain wellbeing.</p> <p>We also encourage our staff to take their volunteering day, which aims to support staff who wish to contribute to the wider community through volunteer work.</p>

<p>Remuneration, recognition and conditions</p>	<p>Our Te Kāpehu and remuneration framework ensure staff feel valued, recognised and appropriately rewarded for their contribution.</p> <p>Our job evaluation processes are transparent. We have an annual remuneration review that aims to ensure fairness and transparency across gender, ethnicity and age and promotes pay for performance. If we identify inequities beyond the annual process, we resolve them promptly.</p>
<p>Harassment and bullying prevention</p>	<p>We have zero tolerance of bullying and ensure matters are dealt with promptly and appropriately.</p> <p>Our code of conduct outlines the standards of behaviour we expect of our people, how to deal with unacceptable behaviour (including harassment and bullying) and where to access further information and support if required, including the Employee Assistance Programme.</p> <p>We ensured our people are up to date with our policies and procedures, through induction, presentations at staff meetings and intranet updates.</p> <p>We updated our protected disclosures policy and guidance ensuring alignment with the Public Service Commissioner's 'Speaking up' model standards.</p>
<p>Health and safety environment</p>	<p>We continually improve our health and safety systems and performance to keep staff safe at work. This is supported by our health and safety at work policy statement, associated health, safety and wellbeing (HSW) policies and procedures, and HSW training for all staff.</p> <p>Annual flu immunisation for staff and rapid antigen (RAT) COVID-19 tests are made available to all staff.</p> <p>We started a programme of work to review risks and procedures to develop appropriate health and safety key measures and assurance reporting.</p> <p>We collaborated with WorkSafe New Zealand and other CRIs on the requirements for safe work instruments relating to the hazardous substances regulations. This work is critical as ESR develops its hazard and risk methodology.</p>



ESR's biowaste team established two new field trials in the South Island to study how New Zealand's native vegetation could mitigate environmental contaminants and improve water quality. Photo: Maria J Gutierrez-Gines

Ā mātou kaimahi mā ngā tatauranga

Our people by the numbers

566
employees

increase of 69 over previous year

197

health and safety event notifications in 2021/22**
An increase of 44 from the previous year

**The step-change in health and safety awareness and maturity, together with the importance of reporting near misses, has contributed to this increase.

Over **78%** of ESR staff are engaged in science and research about the same as the previous year

Disability profile NZ European
– **≤1%** Same as previous year

88% of eligible staff are enrolled in KiwiSaver

Increase of 11 percentage points over previous year (77%)

101 (18%) of our staff work part-time

Increase from 85 (17%) of our staff work part-time

5.88 average days lost

due to sickness, accidents, domestic leave. An increase of 0.18 days lost over previous year (5.70 days)

49 promotions, career progressions and redeployments in 2021/22,

including 20 internal secondments and one external secondment. ESR actively seeks to support staff development by promoting staff on merit and providing secondment opportunities

9 years
average length of service

Of our employees, **18%** (19%), have worked with us for five to 10 years. The smallest group, **3%** (5%), have worked with us for more than 30 years, while **22%** (11%) of staff have worked with us for less than one year

44 years average age

decrease from 45 years over previous year

65%

of ESR staff are female

(Higher than the 2022 public service average)

Same as previous year

No gender pay gap

Same as previous year

Ethnicity

NZ European – **56%**

Māori – **3%***

Asian – **17%**

Pacific peoples – **2%**

Other European – **20%**

Middle Eastern, Latin American and

African (MELAA) – **2%**

*Self-identified ethnicity at the time of employment. Workplace attractiveness for Māori and Pacific peoples is a focus area.

8.51% staff turnover

Our annual rolling average turnover based on headcount is 8.51%, **3.22 percentage points higher than the same time last year.** This is 1.99% lower than the most recent State Services Commission Public Service Workforce Data 2021 benchmark of 10.5%



Photo: Bronwyn Humphries

Te Mana Whakahaere me Te Rōpū Kaihautū

Governance and senior leadership team

Our Board

ESR's Board is appointed by the Minister of Science, Innovation and Research. Directors' remuneration is set by shareholding ministers under the fees framework approved by Cabinet.

The Board is responsible for ensuring our governance is purposeful, robust and accountable.

Their responsibilities include acting on behalf of, and being accountable to, the Minister of Research, Science and Innovation, and the Minister of Finance. Our Board fulfils regulatory expectations under the Companies Act 1993, Crown Research Institutes Act 1992, Crown Entities Act 2004 and Public Finance Act 1989, including helping to establish strategic policy.

The Board and its three committees, the Audit and Risk Committee and People, Culture and Performance Committee, Property Development Committee, are supported by our senior leadership team and an independent strategic science advisory panel. The Board and its committee members are subject to ESR's code of conduct.

Denise Church QSO, CFInstD, Chair

Denise Church is a Wellington-based company director and consultant who was appointed as Chair of the ESR Board in July 2015. She is also Chair of Airways New Zealand and serves on the boards of Predator Free Wellington and the Scouts Youth Foundation.



Denise has wide-ranging governance experience, including as Chair of Zealandia, and has held other governance appointments in the health, tertiary education and science sectors. In her consulting practice, Leadership Matters, Denise focuses on strategy and leadership. Denise has also been Chief Executive of the Ministry for the Environment. She holds degrees in zoology, economics, resource management and urban and regional planning.

Professor Cristin Print, Deputy Chair

Professor Cristin Print is a medically qualified biomedical scientist who joined the ESR Board in August 2017. He has a 25-year career in academic medical research and biotechnology, including work in Australia, the United Kingdom and Japan. He is a professor in the University of Auckland's Department of Molecular Medicine and Pathology, where he uses genomic and bioinformatic technologies alongside traditional pathology to better understand human disease.



Cris is currently Chair of the Auckland Regional Tissue Bank's Scientific Advisory Board, a principal investigator in the Maurice Wilkins Centre and leads the Genomics Into Medicine Strategic Research initiative in Auckland.

Kate Thomson

Kate Thomson was appointed to the ESR Board in July 2018. Currently she is the Director Finance, Risk and Digital Solutions at Upper Hutt City Council. Kate was based in Australia working in the engineering and research sectors as a senior executive.



Kate is an experienced senior executive and has held several senior roles in the commercial sector during her career. Kate holds a post-graduate certificate in science and technology and is a graduate of the Australian Institute of Company Directors.

Richard Gill

Richard Gill was appointed to the ESR Board in January 2016. Richard is a technology innovator and serial entrepreneur who has more than 30 years' experience founding and growing high-tech start-ups serving a range of industries, including broadcasting, manufacturing, finance, education, healthcare and water.



Richard has worked extensively in technology development, product conceptualisation, early-stage commercialisation and high-growth execution. He is Board Chair of events technology start-up Blerter. Richard's tenure as a Board member with ESR ended at the end of June 2022.

Dr Andy Shenk

Dr Andy Shenk was appointed to the ESR Board in August 2017. Andy graduated with a doctorate in biological sciences from the University of Delaware, Newark, United States of America. He has had a 30-year career spanning academic research, management and governance in biotechnology and nutrition start-up companies, and senior management in a major corporate.



Andy currently works across many fields of research, development and commercialisation of intellectual property, including early-stage investment in new technologies here in New Zealand and overseas.

Justine Gilliland

Justine Gilliland was appointed to the ESR Board in February 2022. Justine is an independent director and strategy consultant. She is currently on the boards of Manaaki Whenua-Landcare Research; the Agricultural and Marketing Research and Development Trust; and health



provider Tui Ora; and ESR. Justine is the former Chief Executive of Venture Taranaki. Prior to Venture Taranaki, Justine was Deputy Director-General Sector Partnerships and Programmes at the Ministry for Primary Industries, where she led multi-million-dollar investment and research and development programmes, Māori partnerships, regional development, and previously ran the Ministry's research and development and other external grants and funds.

She is also Chair of the Taranaki Toy Library Trust, and a tourism innovation advisory group member. Her consulting work is currently mainly focused on developing offshore wind energy for Aotearoa New Zealand. Justine holds law and arts degrees and has been admitted as a barrister and solicitor of the High Court of New Zealand.

Dr Melissa McLeod

Dr Melissa McLeod was appointed to the ESR Board in February 2022. Melissa is a public health physician and epidemiologist at the University of Otago in Wellington. She teaches postgraduate epidemiology and general public health and brings rich research expertise in Māori health, epidemiology (including quantitative aspects of kaupapa Māori research) and the investigation and elimination of ethnic health inequities in New Zealand.



Melissa has recently been involved in providing expert advice to the PHARMAC review and also sits on the Ministry of Health Bowel Screening Advisory Group.

Dr Matt Glenn

Dr Matt Glenn was appointed to the ESR Board in February 2022. Matt is Chief Executive Officer (CEO) for the Kiwifruit Breeding Centre (KBC), a joint venture between Zespri and the CRI, Plant and Food Research. He was previously CEO at Hill Laboratories, New Zealand's largest private analytical



testing laboratory; and CEO of Robotics Plus, an agricultural automation and robotics start up.

An experienced executive in the technology industry, he holds a doctorate in molecular biology from the University of Leeds, United Kingdom, and held the role of Head of Genomics at Genesis, which included, what was at the time, the largest DNA sequencing facility in the southern hemisphere.

Access to independent professional advice

It may be necessary, from time to time, for directors to seek independent professional advice, either individually or collectively, to help them fulfil their duties and obligations. This advice, with the approval of the Board Chair, is at ESR's expense.

Directors' use of information

No member of the Board of ESR, or any subsidiary, issued a notice requesting to use information received in their capacity as directors that would not otherwise have been available to them.

Directors' development

Directors can access ESR-funded development opportunities to support their practice and ensure ESR maintains strong governance arrangements. The Board had a budget of \$34,000 to cover directors' development. Any such costs are authorised by the Chair or, in the case of the Board Chair, the Chair of the Audit and Risk Committee. During 2021/22, directors attended both face-to-face and online governance development activities. Several directors participated in ESR workshops set up to build cultural competency.

Board activity in 2021/22

In February 2022, the Board welcomed the appointment of three new directors, Melissa McLeod, Justine Gilliland and Matt Glenn. The Board also farewelled Richard Gill on 30 June 2022 acknowledging the outstanding service he had contributed to the governance of ESR since January 2016. During 2021/22, 25 Board and committee meetings were held. Meetings were a mix of in-person across ESR's sites and video conferences. Video conferences were the necessary method of engagement during various movements in COVID-19 levels around the country, and the

Board and management worked together to make these effective and impactful. Where it was possible, directors continued their practice of on-site visits with a health and safety focus.

Directors were actively involved in virtual meetings of the ESR Strategic Science Advisory Panel.

The Board continued with its focus on governance performance and resilience. Building on its learnings from the previous year, the Board undertook a further external 'Board Effectiveness Review' led by Richard Westlake, including survey, discussion and interviews with all directors, the Chief Executive and several senior leadership team members. The review was timed so it included the views of the newly appointed directors. The review identified several ways that the Board could continue to enhance and develop its practices.

Audit and Risk Committee

The objective of this committee is to help the Board in discharging its responsibilities in relation to the oversight of ESR's risk management policies and processes, internal and external audit and control functions, and overseeing financial information for reporting purposes.

Members are:

- Kate Thomson (Chair)
- Denise Church
- Richard Gill
- Justine Gilliland.

People, Performance and Remuneration Committee

The objective of this committee is to help the Board in discharging its responsibilities in relation to overseeing ESR's people and performance strategies, principles and frameworks that support a high-performance culture, including the remuneration of the Chief Executive and ESR staff.

Members are:

- Professor Cristin Print (Chair)
- Denise Church
- Dr Andy Shenk
- Dr Melissa McLeod.

Property Development Committee

The objective of this committee is to help the Board in discharging its responsibilities in relation to overseeing ESR's property developments including ESR's new Kenepuru Science Centre.

Board and Board committee attendance for the year ending 30 June 2022

This table includes attendance by Board committee members only and does not include attendance by other Board members who are not members of the committee.

Total number of meetings attended

Board of Directors	Board meetings (out of 13)	Audit and Risk Committee (out of 4)	People Culture Performance Committee (out of 3)	Property Development (out of 5)
Denise Church	13	4	3	4
Cristin Print	13	n/a	3	n/a
Kate Thomson	13	4	n/a	5
Andy Shenk	13	n/a	3	n/a
Richard Gill	12	4	n/a	4
Justine Gilliland ^a	5/5	1/1	n/a	2/2
Matt Glenn ^a	4/5	n/a	n/a	1/2
Melissa McLeod ^a	5/5	n/a	1/1	n/a

^a From 2 February 2022

Dividends

No dividends have been declared or paid in respect of the 2022 financial year.

Donations

The ESR Group made koha and donations of \$1,324 during the 2022 financial year.

Directors' disclosure of interests

Directors complete a declaration of interests at the start of their appointment. At each Board meeting, the directors are asked to check and update (as necessary) the register of interests declared that the Board secretariat maintains. Declaration of interests is a standing item on the agendas for all Board and Board committee meetings. Any changes to Board members' interests are tabled and reviewed at the opening of every Board meeting.

For Board decisions relating to significant matters, any potential conflict issues are discussed with the Office of the Auditor-General, or independent legal advice is sought with the prior approval of the Board Chair at ESR's expense.

Directors' interests

No director held any interest in the shares of ESR. ESR has funding contracts with the Marsden Fund of the Royal Society Te Āparangi and the Ministry of Business, Innovation and Employment, which are negotiated at arm's length, with appropriate directors' interests being declared.

Except for these contracts, no material contracts involving directors' interests were entered into during, or subsequent to, the period covered by this report. During the financial year, the directors had made the following general disclosures:

Denise Church (Chair)

Director and shareholder, Leadership Matters Limited
Trustee, Scout Youth Foundation, including related appointments to SANZ Trustee Company Limited (Director)
Brookwood Estate Ltd (Director) (Lorna Maisie Eade Memorial Trust)
Te Roto Ltd (Director) (Mathias Paulson Memorial Trust)
Jack and Tui Lucas Trust

Tatum Scout Memorial Trust

Director, Predator Free Wellington Ltd

Chair, Airways NZ

Professor Cristin Print (Deputy Chair)

Professor, Department of Molecular Medicine and Pathology, University of Auckland and lead of the University of Auckland Genomics Into Medicine Research programme

Principal Investigator, Maurice Wilkins Centre

Board member, Cancer Research Trust NZ

Member of the New Zealand eScience Infrastructure Research Reference Group

Chair, Auckland Regional Biobank Scientific Advisory Board (working in the COVID-19 biobanking field in which ESR also works)

Co-leader of Ministry of Business, Innovation and Employment/Genomics Aotearoa Precision Medicine Pathfinder Project (includes collaboration with ESR staff)

Scientific director for solid tumours, Grafton Clinical Genomics

Dr Andrew Shenk

Chief Executive Officer, Auckland UniServices Limited

Director, The Icehouse Limited

Advisor, Matū Fund Limited (until 31 October 2021)

Director, Hop Revolution Limited

Director, Hop Garden Services Limited

Director, Hop Revolution Trading Company Limited

Kate Thomson

Shareholder, Dandaloo Farming Company Limited

Board member, Endangered Species Foundation New Zealand

Director, Finance, Risk and Digital Solutions, Upper Hutt City Council

Richard Gill (term ended 30 June 2022)

Director and shareholder, Richard Gill Limited

Director, Richard Gill Trustees Limited

Director and shareholder, Sumfood Limited

Director and shareholder, InstatData Limited

Consultant, RethinkX Inc

Justine Gilliland

Director, Manaaki Whenua-Landcare Research Ltd

Director, Tui Ora Ltd

Director/trustee, Agricultural and Marketing Research and Development Trust (AGMARDT)

Chair, Taranaki Toy Library Trust

Member, Institute of Directors (and committee member, Taranaki Branch)

Fellow, Royal Society of the Arts (UK)

Member, Economic Development New Zealand

Member, Advisory Group, Tourism Innovation Hub (Tātaki Auckland Unlimited)

Managing director, In Perspective Ltd

Director, Economic Development New Zealand

Member, Transpower Consumer Advisory Panel

Chief Executive, Venture Taranaki Trust

Dr Melissa McLeod

Senior Lecturer, Department of Public Health, University of Otago, Wellington

Fellow, New Zealand College of Public Health Medicine

Director, DRTS Concepts Limited

Director and shareholder, McLeod Medical Services Limited

Trustee, McLeod Family Trust

Dr Matt Glenn

Chief Executive Officer, The Kiwifruit Breeding Centre

Director and shareholder Idea Partners Limited

Director, PlantTech Research Institute

Directors' indemnity

ESR has arranged for directors' and officers' insurance for any act or omission in their capacity as a director of the company.

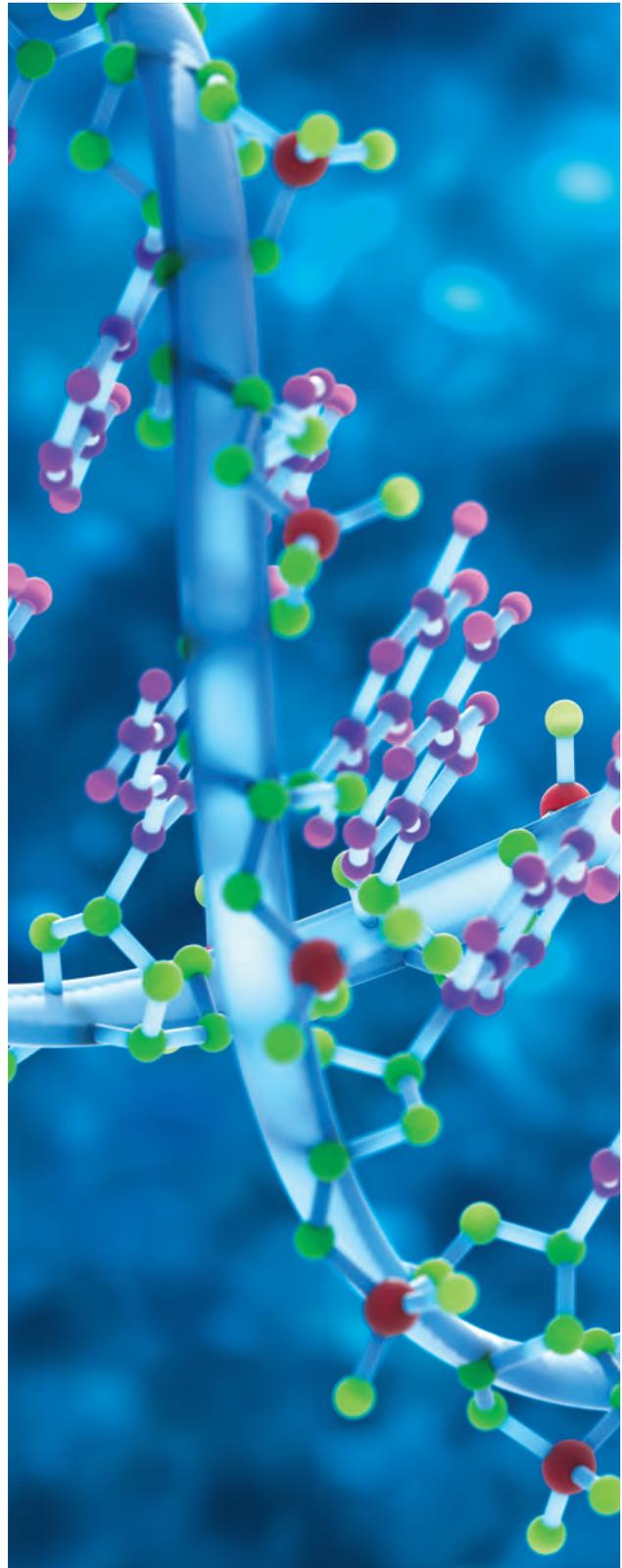
Disclosure of directors' remuneration

Directors' remuneration

The directors who held office in the period of this report and their total remuneration and other directors' remuneration benefits were:

Directors' remuneration

Denise Church (Chair)	\$48,064
Professor Cristin Print (Deputy Chair)	\$32,540
Kate Thomson (Audit and Risk Chair)	\$28,032
Richard Gill	\$26,532
Dr Andrew Shenk	\$26,532
Justine Gilliland	\$10,013
Dr Melissa McLeod	\$10,013
Dr Matt Glenn	\$10,013
Total	\$191,739



Pae Tohutohu Rautaki ā-Pūtaiao

Strategic Science Advisory Panel

ESR's Strategic Science Panel is appointed by ESR's Board of Directors. The main role of the panel is to provide independent, high-level strategic advice to ESR's Board and management relating to ESR's science, research and innovation activities.

This advice helps ESR to identify potential risks or gaps in its activities and to position its science within the context of international best practice, helping to support ESR with delivery of its strategic science aspirations.

The panel also provides comment on the competitiveness and quality of ESR's science activities, with suggestions for improvement and any other science advice as requested by the Board.

Members of the panel during the year consisted of:

- Dr Liz Jazwinska (Chair)
- Professor James Curran
- Dr Kēpa Morgan.

ESR wishes to also thank Dr Ian Elsum for his contributions as a panellist until his departure at the end of August 2021.

Member profiles

Dr Elizabeth Jazwinska, Independent Board Member and Science Advisor

Dr Elizabeth (Liz) Jazwinska (PhD, MBA, GAICD, BSc Hons) has more than 30 years' experience in research and development (R&D), management and business development, and has held senior positions in academia, industry and government internationally.



Liz is currently an independent board member and science advisor to various boards in both Australia and New Zealand. These include member of the Board of the Westmead Institute of Medical Research (WIMR), member of the WIMR IP & Commercialisation Committee, Chair of the Board of FOXG1 Research Foundation Australia and Chair of the

Governance Board of Phenomics Australia (a national collaborative research infrastructure strategy facility). In these roles, she combines her knowledge of genomic sciences with her expertise in industry to deliver strategic R&D partnerships between academic groups, industry and government, focusing on increasing the impact of research outcomes through translation into commercial products.

Liz has held senior leadership positions at Monash University in Melbourne (Director, Business Development), RMIT University in Melbourne (Director Research, Innovation and Entrepreneurship), Agency for Science, Technology and Research (A*STAR) in Singapore (Director Industry Engagement), the Ministry of Science and Innovation in New Zealand (Deputy Chief Executive Science Strategy and Investment), the Australian Research Council (Executive Director Biological Sciences and Biotechnology) and Johnson & Johnson Research (Executive Director, Strategic Alliances). She founded the molecular diagnostics company SpeedX in 2009.

Before joining industry, Liz established a substantial academic portfolio in human molecular genetics and authored more than 62 publications in high-ranking peer-reviewed journals. She holds a BSc (Hons) from the University of Aberdeen, a PhD from the University of Edinburgh, Scotland, and an MBA from the Australian Graduate School of Management. She is also a graduate of the Australian Institute of Company Directors.

Professor James Curran, Auckland University

Professor James Curran (PhD, MSc Hons, BSc) is Professor of Statistics and Head of Department at the University of Auckland. James's research specialty is in statistical problems in forensic science, and especially problems relating to the statistical interpretation of evidence.

James has over 160 publications in this area and others, including two books on forensic statistics. James has been at the University of Auckland since 2005. Before this,



he was a member of academic staff at the University of Waikato, from 1999–2005, after a postdoctoral fellowship with Professor Bruce Weir at North Carolina State University (1997–99).

James has considerable involvement in the forensic community. He is currently the President of the Australian and New Zealand Forensic Science Society (2020–) and is a past president of the New Zealand Forensic Science Society (2016–20). James currently sits on the American Academy of Forensic Sciences DNA Consensus Body and is an affiliate of the US OSAC for Human Biology. James is a Fellow of the Chartered Society of Forensic Sciences (UK), a Fellow of the American Academy of Forensic Sciences and a Fellow of the American Statistical Association.

James is also a past President of the New Zealand Statistical Association (2011–14), past editor-in-chief of the *Australian and New Zealand Journal of Statistics* (2016–19) and past co-director of the New Zealand Bioinformatics Institute (2007–11).

Dr Kēpa Morgan, Pou Hautū Mahi Maioro Professionals Ltd

Dr Morgan who is of Ngāti Pīkiao, Te Arawa, Ngāti Kahungunu, Kāi Tahu and Kāti Māmoe descent, is an innovator, academic, professional engineer and former iwi chief executive. Kēpa's expertise and research is focused on enhancing research outcomes and impacts through solutions that are developed using multiple knowledge systems and frameworks. His company produces evaluations that draw on both mātauranga and science to create solutions that benefit everyone.



Kēpa developed the Mauri Model Decision-Making Framework to provide a holistic process for decision support in contexts of complexity.

Kēpa was made a fellow of the Institution of Professional

Engineers in 2010 and received the Furkert Supreme Technical Award for sustainability and clean technologies in 2016. This coincided with being awarded the Ngā Pae o Te Māramatanga Fulbright Senior Scholar which Kēpa completed at the University of Hawai'i, Colorado School of Mines, and the University of Arizona, Tucson.

Kēpa's unique approach to problem-solving has been applied to national and international challenges including the *Rena* disaster recovery, Merauke Integrated Food and Energy Estate (Papua), Toquaht Nation Development (Vancouver Island, BC). He is now providing direction for delivering Te Mana o Te Wai outcomes, mauri-based evaluation, freshwater monitoring in lakes and rivers, geothermal development, land-use decision support, infrastructure policy, and marine ecosystem modelling.

Kēpa holds a BE (Civil) and PhD (Civil Engineering) from the University of Auckland, PGDipMgmt and MBA (Technology) from Deakin University, Victoria, Australia, and has extensive governance experience across state, engineering, research and indigenous institutions including several ministerial appointments. Kēpa has been a board member of the International Association for Hydraulic Research (2013–17), the International Association for Impact Assessment (Indigenous Peoples Section Chair 2010–19), was elected life member of South Pacific Professional Engineers for Excellence in 2013 and is currently an elected member for Te Tatau o Te Arawa partnership with Rotorua Lakes Council.

Tō mātou rōpū kaihautū matua

Our senior leadership team

ESR's senior leadership team (SLT) use their science and business expertise to provide strategic and operational advice and support to the ESR Board and its committees. The role of the Chief Executive and ESR's SLT is to manage the day-to-day operations of ESR on behalf of the Board and the shareholding Ministers.



Photo: Caleb Starrenburg

From left: Dr Jill Vintiner, John Bone, Peter Lennox, Jymal Morgan, Trish Bolger, Dr Brett Cowan and Mark Ottaway.

Senior leadership team members 1 July 2021 to 30 June 2022:

To view their biographies, visit ESR's website www.esr.cri.nz or LinkedIn.

Peter Lennox, Chief Executive

Dr Brett Cowan, Chief Scientist

Trish Bolger, General Manager People and Culture

John Bone, General Manager Forensics

Dr Jill Vintiner, Joint General Manager Health and Environment – Health

Jymal Morgan, General Manager Māori Impact

Mark Ottaway, General Manager Business Services (from 16 August 2021)



Amber McEwen

Amber McEwen, General Manager Business Services (until 31 August 2021)



Dr Libby Harrison

Dr Libby Harrison, Joint General Manager Health and Environment – Environment.

Chief executive's remuneration

The remuneration of our chief executive is reviewed annually by the Board and determined by factors such as advice from external remuneration specialists, including job sizing and market relativity exercises. These are undertaken on a regular basis and drawn on to inform the determination of salary package.

Chief executive remuneration summary 2018–2022

	Financial year	Salary ^a	STI ^b	Percentage STI against maximum	Benefits ^c	Total
Peter Lennox	2022	\$504,858	n/a	n/a	\$15,594	\$520,452
	2021	\$454,372	n/a	n/a	\$14,048	\$468,420
Keith McLea	2021	\$134,961	n/a	n/a	\$19	\$134,980
	2020	\$508,210	n/a	n/a	\$533	\$508,743
	2019	\$394,746	\$89,200	81%	\$599	\$484,545
	2018	\$379,256	\$80,000	73%	\$644	\$459,900

^a Chief executive remuneration since 2020 has not included a short-term incentive (STI) component.

^b STIs are shown for the year to which they relate but were unpaid as at that balance date.

^c Benefits comprise insurance cover and employer KiwiSaver contributions.

Senior management remuneration

The total combined remuneration of our senior management team (excluding the Chief Executive's remuneration) from 2018–2022 was:

Financial year	Salary and STI ^a	Benefits ^b	Total
2022	\$2,223,603	\$68,629	\$2,292,232
2021	\$2,104,372	\$57,595	\$2,161,967
2020	\$1,463,900	\$42,189	\$1,506,089
2019	\$1,827,863	\$55,489	\$1,883,352
2018	\$1,681,556	\$45,248	\$1,726,804

^a Senior management remuneration since 2020 has not included a short-term incentive (STI) component. STIs are shown for the year to which they relate but were unpaid as at that balance date.

^b Benefits comprise insurance and employer KiwiSaver contributions.

Employee remuneration

As at 30 June 2022, the following total remuneration was paid to staff.

Remuneration range	No. of staff
\$100,000 – \$109,999	37
\$110,000 – \$119,999	43
\$120,000 – \$129,999	30
\$130,000 – \$139,999	27
\$140,000 – \$149,999	15
\$150,000 – \$159,999	9
\$160,000 – \$169,999	7
\$170,000 – \$179,999	4
\$180,000 – \$189,999	5
\$190,000 – \$199,999	4
\$200,000 – \$209,999	2
\$230,000 – \$239,999	2
\$250,000 – \$259,999	2
\$260,000 – \$269,999	3
\$280,000 – \$289,999	2
\$290,000 – \$299,999	2
\$520,000 – \$529,999	1
Total	195

WĀHANGA 5 – NGĀ WHAKAHAERE PŪTEA / PART 5 FINANCIAL PERFORMANCE

Ngā tūtohu whakahaere pūtea

Financial performance indicators

Results at 30 June 2022

	Actual 2022	Budget 2022	Actual 2021
Revenue	\$111m	\$98m	\$97m
Operating margin <i>Earnings before interest, tax, depreciation and amortisation (EBITDA) as a percentage of revenue</i>	6.8%	4.6%	9.5%
Return on equity <i>Net profit after taxation as a percentage of equity</i>	0.8%	(4.3%)	2.0%
<i>Return on equity excluding one-off Workday Human Capital Management and Finance system implementation costs</i>	5.2%	0.0%	n/a
Return on assets <i>Earnings before interest and tax as a percentage of total assets</i>	0.5%	(4.7%)	1.7%
Profit volatility <i>The standard deviation of EBITDA as a percentage of average EBITDA over the preceding 7 years</i>	16%	36%	26%
Acid test ratio <i>Current assets excluding prepayments and inventory to current liabilities excluding deferred revenue</i>	2.3	2.3	2.8
Equity ratio <i>Equity as a percentage of total assets</i>	63.1%	71.0%	67.6%
Gearing <i>Debt (including lease liabilities) as a percentage of debt and equity</i>	6.0%	3.75%	5.5%
Revenue per full-time equivalent employee	\$211,000	\$208,000	\$205,500
Operating margin per full-time equivalent employee <i>Earnings before interest, tax, depreciation and amortisation, per average full-time equivalent employee for the year</i>	\$14,300	\$8,500	\$19,500

Te whakahaere pūtea me ngā tauākī pūtea

Financial performance and statements

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Te pūrongo kaiōtita motuhake

Independent auditor's report



To the readers of Institute of Environmental Science and Research Limited's Group financial statements for the year ended 30 June 2022.

The Auditor-General is the auditor of Institute of Environmental Science and Research Limited (ESR) and its controlled entities (the Group). The Auditor-General has appointed me, Sarah Turner, using the staff and resources of PricewaterhouseCoopers, to carry out the audit of the financial statements of the Group on his behalf.

Opinion

We have audited the financial statements of the Group on pages 74 to 98, that comprise the Statement of financial position as at 30 June 2022, the Statement of profit or loss and other comprehensive income, Statement of changes in equity and Statement of cash flows for the year ended on that date and the notes to the financial statements that include a Statement of significant accounting policies and other explanatory information.

In our opinion, the financial statements of the Group:

- present fairly, in all material respects:
 - its financial position as at 30 June 2022; and
 - its financial performance and cash flows for the year then ended; and
- comply with generally accepted accounting practice in New Zealand in accordance with New Zealand equivalent to International Financial Reporting Standards and International Financial Reporting Standards.

Our audit was completed on 28 September 2022. This is the date at which our opinion is expressed.

The basis for our opinion is explained below. In addition, we outline the responsibilities of the Board of Directors and

our responsibilities relating to the financial statements, we comment on other information, and we explain our independence.

Basis for our opinion

We carried out our audit in accordance with the Auditor-General's Auditing Standards, which incorporate the Professional and Ethical Standards and the International Standards on Auditing (New Zealand) issued by the New Zealand Auditing and Assurance Standards Board. Our responsibilities under those standards are further described in the Responsibilities of the auditor section of our report.

We have fulfilled our responsibilities in accordance with the Auditor-General's Auditing Standards.

We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our audit opinion.

Responsibilities of the Board of Directors for the financial statements

The Board of Directors is responsible on behalf of the Group for preparing financial statements that are fairly presented and that comply with generally accepted accounting practice in New Zealand.

The Board of Directors is responsible for such internal control as it determines is necessary to enable it to prepare financial statements that are free from material misstatement, whether due to fraud or error.

In preparing the financial statements, the Board of Directors is responsible on behalf of the Group for assessing the Group's ability to continue as a going concern. The Board of Directors is also responsible for disclosing, as applicable, matters related to going concern and using the going



concern basis of accounting, unless the Board of Directors has to cease operations, or has no realistic alternative but to do so. The Board of Directors' responsibilities arise from the Crown Research Institutes Act 1992.

Responsibilities of the auditor for the audit of the financial statements

Our objectives are to obtain reasonable assurance about whether the financial statements, as a whole, are free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion.

Reasonable assurance is a high level of assurance, but it is not a guarantee that an audit carried out in accordance with the Auditor-General's Auditing Standards will always detect a material misstatement when it exists. Misstatements are differences or omissions of amounts or disclosures and can arise from fraud or error. Misstatements are considered material if, individually or in the aggregate, they could reasonably be expected to influence the decisions of readers taken on the basis of these financial statements.

For the budget information reported in the financial statements, our procedures were limited to checking that the information agreed to the Group's statement of corporate intent.

We did not evaluate the security and controls over the electronic publication of the financial statements.

As part of an audit in accordance with the Auditor-General's Auditing Standards, we exercise professional judgement and maintain professional scepticism throughout the audit. Also:

- We identify and assess the risks of material misstatement of the financial statements, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for our opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.
 - We obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances but not for the purpose of expressing an opinion on the effectiveness of the Group's internal control.
 - We evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by the Board of Directors.
 - We conclude on the appropriateness of the use of the going concern basis of accounting by the Board of Directors and, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the Group's ability to continue as a going concern. If we conclude that a material uncertainty exists, we are required to draw attention in our auditor's report to the related disclosures in the financial statements or, if such disclosures are inadequate, to modify our opinion. Our conclusions are based on the audit evidence obtained up to the date of our auditor's report. However, future events or conditions may cause the Group to cease to continue as a going concern.
 - We evaluate the overall presentation, structure and content of the financial statements, including the disclosures and whether the financial statements represent the underlying transactions and events in a manner that achieves fair presentation.
 - We obtain sufficient appropriate audit evidence regarding the financial statements of the entities or business activities within the Group to express an opinion on the consolidated financial statements. We are responsible for the direction, supervision and performance of the Group audit. We remain solely responsible for our audit opinion.
- We communicate with the Board of Directors regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that we identify during our audit.
- Our responsibilities arise from the Public Audit Act 2001.



Other Information

The Board of Directors is responsible for the other information. The other information comprises the information included on pages 3 to 70, and 99 to 104, but does not include the financial statements, and our auditor's report thereon.

Our opinion on the financial statements does not cover the other information and we do not express any form of audit opinion or assurance conclusion thereon.

In connection with our audit of the financial statements, our responsibility is to read the other information. In doing so, we consider whether the other information is materially inconsistent with the financial statements or our knowledge obtained in the audit, or otherwise appears to be materially misstated. If, based on our work, we conclude that there is a material misstatement of this other information, we are required to report that fact. We have nothing to report in this regard.

Sarah Turner

On behalf of the Auditor-General
Wellington, New Zealand

Independence

We are independent of the Group in accordance with the independence requirements of the Auditor-General's Auditing Standards, which incorporate the independence requirements of Professional and Ethical Standard 1: *International Code of Ethics for Assurance Practitioners* issued by the New Zealand Auditing and Assurance Standards Board.

In addition to the audit we have carried out an engagement in the area of assurance relating to the Group's Report of Federal Awards in accordance with the OMB Uniform Guidance Program Provisions for the year ended 30 June 2021. Other than the audit and this engagement, we have no relationship with, or interests in, the Group or any of its subsidiaries.

PricewaterhouseCoopers

Statement of profit or loss and other comprehensive income

For the year ended 30 June 2022

Group		Group Actual 2022	Group Budget 2022 unaudited	Group Actual 2021
	Notes	\$'000s	\$'000s	\$'000s
Revenue				
Operating revenue	2	98,531	85,354	84,374
Strategic science investment funding		12,234	12,234	12,234
		110,765	97,588	96,608
Operating expenses				
Scientific materials		10,153	8,273	8,029
Subcontracting, commissions and royalties		11,683	9,027	10,595
Personnel		61,688	57,270	51,153
Depreciation and amortisation	5/6	7,061	7,081	7,736
Other expenses	3	19,753	19,700	17,681
		110,338	101,351	95,194
Operating profit				
		427	(3,763)	1,414
Interest income		516	330	542
Finance expense		(138)	(39)	(35)
Share of net loss of associate accounted for using the equity method	15	–	–	(75)
		378	291	432
Profit before income tax expense				
		805	(3,472)	1,846
Income tax expense / (benefit)	4	310	(972)	680
Profit for the period attributable to the shareholder of the parent				
		495	(2,500)	1,166
Other comprehensive income				
		–	–	–
Total profit or loss and other comprehensive income for the period attributable to the shareholder of the parent				
		495	(2,500)	1,166

The accompanying notes form an integral part of these financial statements.

Statement of changes in equity

For the year ended 30 June 2022

Group	Share capital \$'000s	Retained earnings \$'000s	Total equity \$'000s
Balance at 30 June 2020	8,494	50,467	58,961
Profit for the period	–	1,166	1,166
Other comprehensive income	–	–	–
Total comprehensive income	–	1,166	1,166
Transactions with owners:			
Dividend	–	–	–
Balance at 30 June 2021	8,494	51,633	60,127
Balance at 30 June 2021	8,494	51,633	60,127
Profit for the period	–	495	495
Other comprehensive income	–	–	–
Total comprehensive income	–	495	495
Transactions with owners:			
Dividend	–	–	–
Balance at 30 June 2022	8,494	52,128	60,622

The accompanying notes form an integral part of these financial statements.

Statement of financial position

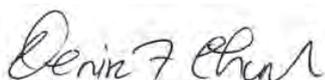
As at 30 June 2022

Group	Notes	Group Actual 2022 \$'000s	Group Budget 2022 unaudited \$'000s	Group Actual 2021 \$'000s
Non-current assets				
Property, plant and equipment	5	29,382	33,887	26,840
Right-of-use assets	7	3,844	2,000	3,520
Other investments		30	30	30
Investment cash		8,000	5,000	5,000
Intangible assets	6	4,979	7,052	6,090
Deferred taxation	12	1,743	–	180
		47,978	47,969	41,660
Current assets				
Cash and cash equivalents		2,037	766	2,182
Investment cash		31,023	19,000	32,549
Trade and other receivables	8	9,442	9,653	9,928
Contract assets	2	4,616	1,515	1,713
Inventories – scientific materials and consumables		1,035	1,010	874
Derivative financial instruments	18	–	–	9
Income tax receivable		–	462	–
		48,153	32,406	47,255
Current liabilities				
Trade and other payables	9	14,233	8,081	11,362
Contract liabilities	2	8,892	6,060	6,283
Employee benefits	10	5,674	4,635	4,586
Lease liability	7	344	600	501
Derivative financial instruments	18	15	–	–
Income tax payable	11	802	–	748
		29,960	19,376	23,480
Net current assets		18,193	13,030	23,775
Non current liabilities				
Lease liability	7	3,539	1,616	3,019
Employee benefits	10	2,010	2,266	2,289
Deferred taxation	12	–	40	–
		5,549	3,922	5,308
Net assets		60,622	57,077	60,127
Equity				
Share capital	13	8,494	8,494	8,494
Retained earnings		52,128	48,583	51,633
Total equity		60,622	57,077	60,127

The Board of Directors of the Institute of Environmental Science and Research Limited authorised these financial statements for issue on 28 September 2022.

On behalf of the Board:

Denise Church QSO
Chair
28 September 2022



Cristin Print
Deputy Chair
28 September 2022



The accompanying notes form an integral part of these financial statements.

Statement of cash flows

For the year ended 30 June 2022

Group	Notes	Group Actual 2022 \$'000s	Group Budget 2022 unaudited \$'000s	Group Actual 2021 \$'000s
Cash flows from/(used in) operating activities				
<i>Cash was provided from:</i>				
Customers and strategic science investment funding		110,741	97,305	97,036
Interest received		502	330	529
		111,243	97,635	97,565
<i>Cash was applied to:</i>				
Suppliers and employees		(99,893)	(90,911)	(82,369)
Interest paid		–	–	(18)
Income tax paid	11	(1,819)	–	(2,709)
		(101,712)	(90,911)	(85,096)
Net cash inflow from operating activities	14	9,531	6,724	12,469
Cash flows from/(used in) investing activities				
<i>Cash was provided from:</i>				
Term deposit maturities		36,049	10,000	27,000
		36,049	10,000	27,000
<i>Cash was applied to:</i>				
Purchase of property, plant and equipment		(6,641)	(11,536)	(3,530)
Purchase of intangible assets		(1,066)	(3,077)	(943)
Investments in term deposits		(37,523)	(3,000)	(35,549)
		(45,230)	(17,613)	(40,022)
Net cash outflow from investing activities		(9,181)	(7,613)	(13,022)
Cash flows from/(used in) financing activities				
<i>Cash was provided applied to:</i>				
Repayment of lease liabilities		(495)	(600)	(598)
Net cash outflow from financing activities		(495)	(600)	(598)
Net (decrease) in cash held		(145)	(1,489)	(1,151)
Cash and cash equivalents at the beginning of the period		2,182	2,255	3,333
Cash and cash equivalents at the end of the period		2,037	766	2,182

The accompanying notes form an integral part of these financial statements.

NGĀ ĀPITITANGA KI NGĀ TAUĀKĪ PŪTEA / NOTES TO THE FINANCIAL STATEMENTS

1. Statement of significant accounting policies

Reporting entity

These financial statements of the Institute of Environmental Science and Research Limited and its subsidiaries ("ESR" and the "Group") are for the year ended 30 June 2022.

ESR is a Crown entity incorporated and based in New Zealand. Its registered office is 34 Kenepuru Drive, Porirua.

ESR is a Crown research institute that provides specialist scientific services and research to the public health, food safety, security and justice systems, and the environmental sector.

Statement of compliance

The financial statements have been prepared in accordance with the requirements of the Crown Entities Act 2004, the Crown Research Institute Act 1992, the Companies Act 1993 and the Financial Reporting Act 2013.

These financial statements have been prepared in accordance with Generally Accepted Accounting Practice in New Zealand (NZ GAAP). They comply with New Zealand equivalents to International Financial Reporting Standards (NZ IFRS), International Financial Reporting Standards and other New Zealand accounting standards and authoritative notices as appropriate for for-profit entities.

Basis of preparation

The financial statements are prepared on the basis of historical cost, except for financial instruments and long service leave as identified in the specific accounting policies and accompanying notes.

The financial statements are presented in New Zealand dollars and all values are rounded to the nearest thousand dollars (\$000).

The budget and target figures presented in these financial statements are unaudited.

Critical accounting estimates and judgements

The preparation of financial statements requires judgements, estimates and assumptions that affect the application of policies and reported amounts of assets and liabilities, income and expenses. The estimates and associated assumptions are based on historical experience and various other factors that are believed to be reasonable under the circumstances. Actual results may differ from these estimates. The estimates and assumptions are reviewed on an ongoing basis.

The decision to treat some property development expenditure as property, plant and equipment requires

considerable judgement around the probability of future economic benefits arising from that expenditure. In particular, judgement is required concerning the availability of resources required to complete the capital project.

The judgements that have the most significant effect on amounts recognised in the financial statements are applied in the determination of revenue, service leave accrual, and the carrying value of some items of property, plant and equipment.

Strategic science investment funding

ESR receives strategic science investment funding from the Government in order to perform scientific research activities. Strategic science investment funding is treated as a government grant and recognised in the statement of profit or loss and other comprehensive income on a systematic basis over the periods in which ESR recognises as expenses the related costs for which the grants are intended to compensate when the requirements under the funding agreement have been met.

Inventories

Stocks of consumables and work in progress are stated at the lower of cost and net realisable value. Cost is determined on a first in, first out basis.

Interest income

Interest income is recognised in the statement of profit or loss and other comprehensive income on a time proportion basis, using the effective interest rate method.

Foreign currency

Items included in the financial statements of each of the Group's entities are measured using the currency of the primary economic environment in which the entity operates. The Group financial statements are presented in New Zealand dollars, which is ESR's functional currency.

Foreign currency transactions are recorded at the foreign exchange rates in effect at the dates of the transactions. Monetary assets and monetary liabilities denominated in foreign currencies are translated at the rates of exchange ruling at the end of each reporting period.

Other accounting policies

Other significant accounting policies adopted in the preparation of these financial statements are provided throughout the notes to the financial statements.

Changes in accounting policies

During the year, the Group revised its accounting policy in relation to upfront configuration and customisation costs incurred in implementing Software-as-a-service arrangements in response to the IFRIC agenda decision clarifying its interpretation of how current accounting standards apply to these types of arrangements. The new accounting policy is presented in Note 6. There has been no impact on historical financial information.

Other than the above, accounting policies have been applied on a basis consistent with prior year.

Adoption status of relevant new financial reporting standards and interpretations

The Group has elected not to early adopt any other new standards or amendments to existing standards that have been issued but are not yet effective as at 30 June 2022. It is anticipated that these standards will not significantly affect the financial statements of the Group once adopted.

2. Operating revenue

a) Total operating revenue

COVID-19

The pandemic continues to have some impact on commercial revenues primarily from the sale of forensic and related science services to domestic and international customers. The revenue reduction has been offset by revenue generated from services provided to the Ministry of Health for COVID-19 and, in the 2021 financial year, COVID-19 response and recovery funding provided by the Government.

Group	2022 \$'000s	2021 \$'000s
Revenue from contracts with customers	98,531	81,224
COVID-19 response and recovery funding	–	3,150
Total operating revenue	98,531	84,374

b) Revenue from contracts with customers

Revenue from contracts with customers is recognised when control of the goods or services is transferred to the customer at an amount that reflects the consideration to which the Group expects to be entitled in exchange for those goods or services.

For some contracts, revenue is recognised based on the actual service provided to the end of the reporting period as a proportion of the total services to be provided, as the customer receives and uses the benefits simultaneously

or the Group has an enforceable right to payment for performance completed to date. The revenue recognised is typically determined based on actual labour hours and other costs incurred.

Estimates of revenues, cost or extent of progress toward completion are revised if circumstances change. Any resulting increases or decreases in estimated revenues or costs are reflected in profit or loss in the period in which the circumstances that give rise to the revision become known by management.

In case of fixed-price contracts, the customer pays the fixed amount based on a payment schedule. If the services rendered by the Group exceed the payment schedule, a contract asset is recognised. If the payments exceed the services rendered, a contract liability is recognised.

Sale of software

The Group sells expert forensic analysis software. Contracts for the sale of this software comprise several deliverables: software licence, software upgrades, training and support.

Revenue for each deliverable is recognised as the related performance obligation is satisfied, either at a point in time or over time. Revenue from software licences and training is recognised at a point in time when, respectively, the customer has been provided with access to the software licences and training has been delivered. Software upgrades and support revenues are recognised over time. Software upgrade revenue is recognised over time as the Group has a stand ready obligation to provide software upgrades and enhancements as and when they are available. Software support revenue is recognised as the customer utilises the support purchased with the software licence.

Invoicing or payment for software upgrades and support is generally made in advance of the satisfaction of these performance obligations. A contract liability is recognised to the extent payment received or due exceeds the services rendered by the Group.

The transaction price is allocated to each performance obligation based on the standalone selling price or estimated based on industry benchmarks.

Satisfaction of performance obligations

Revenue for contract deliverables is recognised as the related performance obligation is satisfied, either at a point in time or over time.

The Group has determined that the various deliverables included within a contract for the sale of forensic analysis software are capable of being distinct.

For the majority of other contract deliverables, the Group has concluded that the satisfaction of performance obligations occurs over time. In these circumstances, the Group has determined that an input method is most appropriate in measuring progress on a contract as there is a direct relationship between the Group's effort (ie, labour hours and other costs incurred) and the transfer of services to the customer. In these circumstances, the Group recognises revenue on the basis of labour hours expended and other costs incurred, relative to the total expected cost to complete the service.

Revenue from the balance of commercial and research activities is recognised at a point in time. This is the point at which the Group has determined it has transferred control of the related good or service to the customer.

i) Disaggregated revenue information

Group – year ended 30 June 2022	Domestic \$'000s	International \$'000s	Total \$'000s
Core government contracts	71,239	–	71,239
Research	8,668	3,846	12,514
Commercial products and services	3,915	10,863	14,778
	83,822	14,709	98,531

Group – year ended 30 June 2021	Domestic \$'000s	International \$'000s	Total \$'000s
Core government contracts	56,599	–	56,599
Research	8,832	2,467	11,299
Commercial products and services	3,829	9,497	13,326
	69,260	11,964	81,224

Note that the overall research output of the Group includes activity funded by \$12,234,000 (2021: \$12,234,000) of Strategic Science Investment Funding. This funding is accounted for as a government grant and not included in the table above.

ii) Remaining performance obligations

The transaction price for bundled deliverables associated with software licence sales is allocated to each performance obligation based on the standalone selling price or estimated based on industry benchmarks.

The transaction price allocated to the remaining performance obligations (unsatisfied or partially unsatisfied) was \$12,069,000 as at 30 June 2022 (2021: \$16,896,000), split between current and non-current as below:

Grant

During the 2022 financial year, the Ministry of Health funded the purchase of items of scientific equipment to be used in relation to the response to COVID-19. This funding has been accounted for as a grant under NZ IAS 20: Accounting for Government Grants and Disclosure of Government Assistance. There are no conditions or other contingencies attached to this grant.

	2022 \$'000s	2021 \$'000s
Current	10,063	11,195
Non-current	2,006	5,701
	12,069	16,896

The remaining performance obligations expected to be recognised in more than one year relate to multi-year research projects to be completed over the next five years, and prepaid software upgrades. All other remaining performance obligations are expected to be recognised within one year.

The balance of current remaining performance obligations does not include obligations under contracts for periods of one year or less.

iii) Contract balances

Principal versus agent considerations

The Group has concluded that it is the principal in its revenue arrangements as it controls the goods or services before they are transferred to the customer.

Variable consideration

Where the consideration in a contract includes a variable amount arising from a value-based rebate, the Group estimates the amount of consideration to which it will be entitled in exchange for transferring the goods or services to the customer. The Group applies the most likely amount method to determine the amount to which it will ultimately be entitled.

Financing components

The Group does not have any contracts where the period between the transfer of the promised goods or services to the customer and payment by the customer exceeds one year. As a consequence, the Group does not adjust any of the transaction prices for the time value of money.

The Group recognised revenue of \$2,524,000 (2021: \$2,427,000) during the period that was included in contract liabilities at the beginning of the period. No revenue was recognised in the period from performance obligations partially or fully satisfied in prior periods.

Group	2022 \$'000s	2021 \$'000s	2020 \$'000s
Trade receivables	7,876	8,128	8,620
Contract assets	4,616	1,713	1,052
Contract liabilities	8,892	6,283	5,717

Trade receivables are non-interest bearing and generally on terms of 30 to 90 days.

Contract assets comprise revenue due from customers and capitalised costs of obtaining contracts for software sales:

- Revenue due from customers are balances recognised for services rendered where receipt of consideration is dependent on the completion of a project milestone and acceptance by the customer. Amounts initially recognised as contract assets are reclassified as trade receivables as milestones are completed and invoicing agreed with the customer.
- Incremental costs of obtaining contracts for software sales are \$387,000 as at 30 June 2022 (2021: \$357,000). These costs are initially capitalised and then amortised systematically as the related performance obligation is satisfied. Amortisation recognised in 2022 was \$1,908,000 (2021: \$1,716,000).

Contract liabilities represent amounts relating to research projects and software sales and support where the payment received or due under the contract precedes the satisfaction of performance obligations by the Group. Contract liabilities are recognised as revenue when these performance obligations are satisfied.

3. Other expenses

Group	Note	2022 \$'000s	2021 \$'000s
Communication costs (including network charges)		280	257
Depreciation expense on right-of-use assets		506	582
Directors' expenses		20	23
Directors' fees	17	192	150
Fair value gain on forward exchange contract		(16)	(69)
Fees paid to PricewaterhouseCoopers for: the audit of the statutory financial statements			
– the audit of the statutory financial statements		201	156
– other assurance services		43	68
Impairment of investment		–	153
IT systems maintenance and licence costs		3,442	2,287
Legal and consulting fees		3,435	4,536
Occupancy and insurance		3,789	3,609
Office and administration		2,629	1,862
Other operating costs		201	748
Outsourced costs		4,207	1,930
Rental and lease costs		226	217
Restructuring expense		79	316
Impairment/(reversal of impairment) of receivables		4	(33)
Travel		515	889
Total other expenses		19,753	17,681

Given the nature of ESR's principal business activities, research comprises part of ESR's everyday business operations. As such, expenses relating to research are not separately identified. The cost of research to ESR is distributed between the relevant expense items, for example, employee benefits and scientific materials used.

The increase in IT systems maintenance and licence costs and Outsourced costs is due to the implementation of the new Workday Human Capital Management and Finance System.

4. Taxation

Group	Note	2022 \$'000s	2021 \$'000s
The taxation charge has been calculated as follows:			
Profit before income tax expense		805	1,846
Prima facie taxation at 28%		225	517
<i>Plus taxation effect of:</i>			
Net prior years under/(over) estimation		51	46
Non-deductible/(assessable) items		34	117
Tax expense for the year		310	680
<i>The tax expense for the year is represented by:</i>			
Current taxation	11	1,873	2,019
Deferred taxation	12	(1,563)	(1,339)
Tax expense for the year		310	680

5. Property, plant and equipment

Items of property, plant and equipment are initially recorded at cost and subsequently at cost less accumulated depreciation and impairment. The cost of property, plant and equipment includes the value of consideration given to acquire the assets and the value of other directly attributable costs that have been incurred in bringing the assets to the location and condition necessary for their intended use.

The carrying amounts of property, plant and equipment are reviewed at least annually to determine if there is any indication of impairment. Where an asset's recoverable amount is less than its carrying amount, it will be reported as its recoverable amount and an impairment loss will be recognised.

Losses resulting from impairment are reported in the statement of profit or loss and other comprehensive income.

Realised gains and losses arising from the disposal of property, plant and equipment are recognised in the profit or loss and other comprehensive income in the periods in which the transactions occur.

Depreciation is charged on a straight-line basis at rates calculated to allocate the cost of an item of property, plant and equipment, less any estimated residual value, over its estimated useful life, as follows:

Type of asset	Estimated useful life
Land	Not depreciated
Freehold buildings and building fit out	1 – 50 years
Leasehold improvements	10 years
Plant, equipment and vehicles	3 – 10 years
IT equipment	3 – 12 years

Group	Freehold land \$'000s	Buildings and leasehold improvements \$'000s	IT equipment \$'000s	Plant, equipment and vehicles \$'000s	Assets under construction \$'000s	Total \$'000s
At 1 July 2020						
Cost	476	33,269	10,429	37,751	300	82,225
Accumulated depreciation	–	(13,860)	(8,107)	(31,211)	–	(53,178)
Net book value at the end of the year	476	19,409	2,322	6,540	300	29,047
Year ended 30 June 2021						
Net book value at the beginning of the year	476	19,409	2,322	6,540	300	29,047
Additions	–	277	864	2,038	112	3,291
Transfers from assets under construction	–	261	33	6	(300)	–
Disposals	–	(7)	(44)	(23)	–	(74)
Depreciation for the year	–	(2,354)	(1,331)	(1,739)	–	(5,424)
Net book value at the end of the year	476	17,586	1,844	6,822	112	26,840
At 30 June 2021						
Cost	476	33,789	7,959	37,984	112	80,320
Accumulated depreciation	–	(16,203)	(6,115)	(31,162)	–	(53,480)
Net book value at the end of the year	476	17,586	1,844	6,822	112	26,840
Year ended 30 June 2022						
Net book value at the beginning of the year	476	17,586	1,844	6,822	112	26,840
Additions	–	387	1,263	2,484	3,297	7,431
Transfers from assets under construction	–	101	10	1	(112)	–
Disposals	–	–	–	(5)	–	(5)
Depreciation for the year	–	(1,874)	(1,179)	(1,831)	–	(4,884)
Net book value at the end of the year	476	16,200	1,938	7,471	3,297	29,382
At 30 June 2022						
Cost	476	34,277	9,052	39,871	3,297	86,973
Accumulated depreciation	–	(18,077)	(7,114)	(32,400)	–	(57,591)
Net book value at the end of the year	476	16,200	1,938	7,471	3,297	29,382

ESR does not have any property, plant and equipment used as security for liabilities.

resulted in a number of fully depreciated assets being removed from the asset register.

During the 2021 financial year a stock take of plant, property and equipment assets was carried out and this

ESR has plans to redevelop the Kenepuru Science Centre. The useful life of building and plant assets at this site has been reassessed and the Group is accelerating depreciation on these assets to between 1 and 5 years.

Design costs associated with the redevelopment of the Kenepuru Science Centre are included within assets under construction.

Restriction on title

In relation to the transfer of land owned by ESR, shareholding ministers shall have regard to the principles of Te Tiriti o Waitangi in accordance with section 10 of the Crown Research Institutes Act 1992.

Properties owned by ESR in Christchurch, Wellington and Auckland have caveats on the land as required by section 31 of the Crown Research Institutes Act 1992, which maintains the general provisions of the Public Works Act 1981. ESR complies with section 31 of the Crown Research Institutes Act 1992.

6. Intangible assets

Computer software

Items of computer software that do not comprise an integral part of the related hardware are treated as intangible assets with finite lives. Intangible assets with finite lives are recorded at cost, and subsequently recorded at cost less any accumulated amortisation and impairment losses. Amortisation is charged to the statement of profit or loss and other comprehensive income on a straight-line basis over the useful life of the net asset (between three and 12 years).

Customer contracts

The intangible asset customer contracts present the fair value of future revenue streams from customer contracts acquired under business combinations. Initial recognition of the intangible asset is stated at fair value. Subsequent to initial recognition, acquired intangible assets are stated at initially recognised amounts less accumulated amortisation and any impairment. Amortisation of acquired intangible assets is made according to the straight-line method over their estimated useful life, not exceeding 10 years.

Research and development costs – internally generated intangible assets

Expenditure on research is expensed when it is incurred.

Development expenditure incurred on an individual project is capitalised if the process is technically and commercially feasible, future economic benefits are probable and ESR

intends to, and has sufficient resources to, complete development and to use or sell the asset.

Any expenditure capitalised is amortised over three years from the point the asset is ready to use, which is the point of expected future sales from the related project.

Software-as-a-Service (SaaS) arrangements

SaaS arrangements are service contracts providing the Group with the right to access the cloud provider's application software over the contract period. Costs incurred to configure or customise, and the ongoing fees to obtain access to the cloud provider's application software, are recognised as operating expenses when the services are received.

Some of these costs incurred are for the development of software code that enhances or modifies, or creates additional capability to, existing on-premise systems and meets the definition of and recognition criteria for an intangible asset. These costs are recognised as intangible software assets and amortised over the useful life of the software on a straight-line basis. The useful lives of these assets are reviewed at least at the end of each financial year, and any change accounted for prospectively as a change in accounting estimate.

There are no costs recognised as intangible software for the current year (2021: nil).

Impairment of non-financial assets

Intangible assets that have an indefinite useful life or intangible assets not yet ready to use are not subject to amortisation and are tested annually for impairment.

Assets that are subject to depreciation and amortisation are reviewed for impairment whenever events or changes in circumstances indicate that the carrying amount may not be recoverable. An impairment loss is recognised for the amount by which the asset's carrying amount exceeds its recoverable amount. The recoverable amount is the higher of an asset's fair value less costs to sell and its value in use. For the purposes of assessing impairment, assets are grouped at the lowest levels for which they are separately identifiable cash flows (cash-generating units).

Group	Computer software – externally purchased \$'000s	Computer software – internally generated \$'000s	Customer contracts \$'000s	Assets under construction \$'000s	Total \$'000s
At 1 July 2020					
Cost	9,589	15,707	1,338	927	27,561
Accumulated amortisation and impairment losses	(8,842)	(9,922)	(1,338)	–	(20,102)
Net book value at the end of the year	747	5,785	–	927	7,459
Year ended 30 June 2021					
Net book value at the beginning of the year	747	5,785	–	927	7,459
Additions	20	135	–	788	943
Transfers from assets under construction	–	871	–	(871)	–
Amortisation for the year	(431)	(1,881)	–	–	(2,312)
Net book value at the end of the year	336	4,910	–	844	6,090
At 30 June 2021					
Cost	4,916	15,366	1,338	844	22,464
Accumulated amortisation and impairment losses	(4,580)	(10,456)	(1,338)	–	(16,374)
Net book value at the end of the year	336	4,910	–	844	6,090
Year ended 30 June 2022					
Net book value at the beginning of the year	336	4,910	–	844	6,090
Additions	26	246	–	794	1,066
Transfers from assets under construction	–	446	–	(446)	–
Amortisation for the year	(287)	(1,890)	–	–	(2,177)
Net book value at the end of the year	75	3,712	–	1,192	4,979
At 30 June 2022					
Cost	4,942	16,058	1,338	1,192	23,530
Accumulated amortisation and impairment losses	(4,867)	(12,346)	(1,338)	–	(18,551)
Net book value at the end of the year	75	3,712	–	1,192	4,979

During the 2021 financial year, a stock take of computer software assets was carried out and this resulted in a number of fully amortised assets being removed from the asset register.

ESR does not have any intangible assets for which title is restricted or used as security for liabilities.

Intangible assets include ESR's laboratory operating system with a net book value of \$2,197,158 (2021: \$3,183,248). The laboratory operating system has an estimated remaining useful life of three years.

7. Leases

The Group assesses at contract inception whether a contract is, or contains, a lease. That is, if the contract conveys the right to control the use of an identified asset for a period of time in exchange for consideration.

The Group applies a single recognition and measurement approach for all leases, except for short-term leases and leases of low-value assets. The Group recognises lease liabilities to make lease payments and right-of-use assets representing the right to use the underlying assets.

Right-of-use assets

The Group recognises right-of-use assets at the commencement date of the lease (ie, the date the underlying asset is available for use). Right-of-use assets are measured at cost, less any accumulated depreciation and impairment losses, and adjusted for any remeasurement of lease liabilities. The cost of right-of-use assets includes the amount of lease liabilities recognised, initial direct costs incurred and lease payments made at or before the commencement date less any incentives received. The recognised right-of-use assets are depreciated on a straight-line basis over the shorter of their estimated useful lives and the lease term. Right-of-use assets are subject to impairment.

Lease liabilities

At the commencement date of the lease, the Group recognises the lease liabilities measured at the present value of lease payments to be made over the lease term.

In determining the non-cancellable term of a lease, the Group considers all relevant facts and circumstances that create an economic incentive for the lessee to either exercise an option to extend a lease or to terminate the lease.

In calculating the present value of lease payments, the Group uses the incremental borrowing rate at the lease commencement date if the interest rate implicit in the lease is not readily determinable. After the commencement date, the amount of lease liabilities is increased to reflect the accretion of interest and reduced for the lease payments made. In addition, the carrying amount of lease liabilities is remeasured if there is a modification, a change in the lease term or a change in the in-substance fixed lease payments.

Amounts recognised in the statement of financial position and statement of profit and loss and other comprehensive income

	Right-of-use assets			
	Buildings	Motor vehicles	Total	Lease liabilities
	\$'000s	\$'000s	\$'000s	\$'000s
As at 1 July 2021	3,514	6	3,520	3,520
Additions and modifications to contracts	725	105	830	720
Depreciation expense	(485)	(21)	(506)	–
Interest expense	–	–	–	138
Payments	–	–	–	(495)
As at 30 June 2022	3,754	90	3,844	3,883

	Right-of-use assets			
	Buildings	Motor vehicles	Total	Lease liabilities
	\$'000s	\$'000s	\$'000s	\$'000s
As at 1 July 2020	1,310	24	1,334	1,346
Additions and modifications to contracts	2,756	12	2,768	2,755
Depreciation expense	(552)	(30)	(582)	–
Interest expense	–	–	–	17
Payments	–	–	–	(598)
As at 30 June 2021	3,514	6	3,520	3,520

The maturity of the lease liabilities is as follows:

	2022 \$'000s	2021 \$'000s
Less than one year	344	501
One to five years	3,539	3,019
Total lease liabilities	3,883	3,520

8. Trade and other receivables

Trade and other receivables are recognised initially at fair value and subsequently measured at amortised cost using the effective interest method, less any provision for impairment.

Collectability of receivables is reviewed on an ongoing basis. A provision for doubtful debts is established from day one in the acknowledgement that the expected credit losses model assumes that there are very limited circumstances under which a debt has no risk (implying a nil provision is not appropriate). Bad debts are written off in the period in which they are identified.

As a result of the COVID-19 pandemic, the Group has reassessed the credit risk for all its trade receivables balance. An assessment was undertaken to identify all trade receivables that posed a higher credit risk based on the Group's understanding and experience with the customer's ability to pay its debt given the current and forecast economic conditions. There were no trade receivables for which the Group has recorded additional provisions for expected credit losses.

Group	2022 \$'000s	2021 \$'000s
Trade debtors	7,953	8,201
Allowance for expected credit losses	(77)	(73)
	7,876	8,128
Prepayments	1,566	1,800
Total trade and other receivables	9,442	9,928

As at 30 June 2022, trade receivables of \$1,588,000 (2021: \$1,711,000) were past due but not impaired. These relate to a number of customers for whom there is no recent history

of default. The ageing analysis of these trade receivables is as follows:

Group	2022 \$'000s	2021 \$'000s
Past due 1 – 30 days	480	584
Past due 31 – 60 days	117	326
Past due >61 days	991	801
Total past due trade receivables	1,588	1,711

9. Trade and other payables

Trade payables are obligations to pay for goods or services that have been acquired in the ordinary course of business from suppliers. Accounts payable are classified as current liabilities if payment is due within one year or less. If not, they are presented as non-current liabilities. Trade payables are recognised initially at fair value and subsequently at amortised cost using the effective interest method.

Goods and Services Tax

Items in the statement of profit or loss and other comprehensive income and statement of cash flows are disclosed net of Goods and Services Tax (GST). All items in the statement of financial position are stated net of GST with the exception of receivables and payables, which include GST invoiced.

Group	2022 \$'000s	2021 \$'000s
Accrued expenses	4,804	3,843
GST payable	225	678
Trade payables	9,204	6,841
Total trade and other payables	14,233	11,362

10. Employee benefits

Wages, salaries and annual leave

Liabilities for wages and salaries including annual leave that are expected to be settled within 12 months of the reporting date are recognised in respect of employees' services up to the reporting date and are measured at the amounts expected to be paid when the liabilities are settled.

Obligations for contributions to defined contribution retirement plans are recognised as an expense in the statement of profit or loss and other comprehensive income as they fall due.

Long service leave and retirement leave

Liabilities for long service leave and retirement leave are recognised as employee benefit liabilities and measured as the present value of expected future payments to be made in respect of services provided by employees up to the reporting date. Consideration is given to the expected future salary levels, experience of employee departures and periods of service. Expected future payments are discounted using market yields at the reporting date for government bonds with terms to maturity and currency that match, as closely as possible, the estimated future cash outflows.

Group	2022 \$'000s	2021 \$'000s
Annual leave accrual	5,265	4,345
Service leave accrual	324	230
Other	85	11
Total current employee benefits	5,674	4,586
Service leave accrual	1,949	2,193
Retirement leave accrual	61	96
Total non-current employee benefits	2,010	2,289

11. Income tax payable

Current tax is calculated with reference to the current period's taxable profit or loss calculated using tax rates and tax laws that have been enacted or substantially enacted by

reporting date. Current tax for the current and prior periods is recognised as a liability (or asset) to the extent that it is unpaid (or refundable).

Group	2022 \$'000s	2021 \$'000s
Balance at the beginning of the year	748	1,438
Current year charge	1,878	1,989
Prior period adjustment	(5)	30
Provisional taxation payments	(1,819)	(2,709)
Total income tax payable	802	748

12. Deferred taxation

Deferred tax is calculated using the comprehensive balance sheet liability method in respect of temporary differences arising from differences between the carrying amount of assets and liabilities in the financial statements and the tax base for those terms.

Deferred tax assets and liabilities are not recognised if the temporary differences giving rise to them from the initial recognition of assets and liabilities (other than as a result of a business combination) affects neither taxable income nor accounting profit.

Deferred tax assets are recognised for deductible temporary differences and unused tax losses only if it is probable that future taxable amounts will be available against which deductible temporary differences or unused tax losses and tax offsets can be utilised.

Deferred tax assets and liabilities are measured at the tax rates expected to apply when the assets are recovered or liabilities settled using tax rates and tax laws that have been enacted or substantially enacted by the reporting date.

Group	2022 \$'000s	2021 \$'000s
Balance at the beginning of the year	(180)	1,159
Prior period adjustment	56	10
Charge to settlement of profit or loss and other comprehensive income	(1,619)	(1,349)
Total deferred taxation (asset) / liability	(1,743)	(180)

	Accelerated tax depreciation \$'000s	Employee benefits \$'000s	Provisions and other items \$'000s	Total \$'000s
Year ended 30 June 2021				
Balance at the beginning of the year	2,891	(1,665)	(67)	1,159
Over provision in prior years	–	10	–	10
Current year charge/(credit) of statement profit or loss and other comprehensive income	(665)	(357)	(327)	(1,349)
Total deferred taxation	2,226	(2,012)	(394)	(180)
Year ended 30 June 2022				
Balance at the beginning of the year	2,226	(2,012)	(394)	(180)
Over provision in prior years	56	–	–	56
Current year charge/(credit) of statement profit or loss and other comprehensive income	(654)	(264)	(701)	(1,619)
Total deferred taxation	1,628	(2,276)	(1,095)	(1,743)

There are no unrecognised deferred tax assets or liabilities.

13. Equity

Share capital

Ordinary shares are classified as equity. Incremental costs directly attributable to the issue of new shares or options are shown, as appropriate, in equity as a deduction, net of tax, from the proceeds.

Dividends

A provision is made for the amount of any dividend declared on or before the end of the financial year but not distributed at balance date.

Share capital Group	2022 \$'000s	2021 \$'000s
8,494,000 ordinary \$1 shares (issued and fully paid)	8,494	8,494

All ordinary shares rank equally with one vote attached to each fully paid ordinary share.

No dividends were proposed or declared for the 30 June 2022 year (2021: nil).

14. Reconciliation of profit/(loss) after taxation to cash flows from operating activities

Cash and cash equivalents

Cash means cash on hand, demand deposits and other highly liquid investments in which ESR has invested as part of its day-to-day cash management. The following definitions are used in the statement of cash flows:

- Investing activities are those relating to the acquisition, holding and disposal of fixed assets and investments.
- Financing activities are those activities that result in changes in the size and composition of the capital structure of ESR and this includes both equity and debt not falling within the definition of cash. Dividends paid in relation to the capital structure are included in financing activities.
- Operating activities are the principal revenue-producing activities and other activities that are not investing and financing activities.

Investment cash

Investment cash represents cash held in bank deposits with original maturities of between 3 and 12 months. Investment

cash movements are included in investing activities in the statement of cash flows.

Reconciliation of profit/(loss) after taxation to cash flows from operating activities

Group	Note	2022 \$'000s	2021 \$'000s
Profit for the year after taxation		495	1,166
Non-cash items:			
Depreciation and amortisation expense	5/6	7,061	7,736
Depreciation on right-of-use assets	7	506	582
Gain on modification of lease contracts	7	(110)	(12)
Equity accounted earnings from associate company investment		–	75
Impairment of associate company investment		–	153
Increase/(decrease) in allowance for expected credit losses	8	4	(29)
Increase in deferred tax asset	12	(1,563)	(1,339)
Fair value gain/(loss) on derivative financial instruments		24	(9)
Other non-cash items		(5)	(5)
		5,917	7,152
Changes in working capital:			
Decrease in trade and other receivables and contract assets		(2,417)	(109)
(Increase)/decrease in inventories		(161)	15
Increase in trade and other payables and contract liabilities		5,480	4,057
Increase/(decrease) in income tax payable		54	(690)
Increase in employment benefits		809	548
		3,765	3,821
Items classified as investing and financing activities:			
Loss on disposal of property, plant and equipment		6	73
(Decrease)/increase in trade payables related to property, plant and equipment		(790)	239
Finance charge on leases		138	18
		(646)	330
Net cash inflow from operating activities		9,531	12,469

15. Investments

Subsidiaries

The consolidated financial statements incorporate the assets and liabilities of all subsidiaries of ESR as at 30 June 2022 and the results of the operations of all subsidiaries for the year then ended.

Subsidiaries are those entities controlled, directly or indirectly, by the Parent. Subsidiaries are consolidated from the date on which control is transferred to ESR. They are de-consolidated from the date that control ceases.

The acquisition method of accounting is used to account for the acquisition of business by the Group. The cost of an acquisition is measured as the fair value of the assets

given, equity instruments issued and liabilities incurred or assumed at the date of exchange. Identifiable assets acquired and liabilities and contingent liabilities assumed in a business combination are measured initially at their fair values at the acquisition date, irrespective of the extent of any non-controlling interest. The excess of the cost over the fair value of the Group's share of the identifiable net assets acquired is recorded as goodwill. If the cost of acquisition is less than the Group's share of the fair value of the identifiable net assets of the subsidiary acquired, the difference is recognised directly in the profit or loss.

ESR has two wholly owned subsidiary companies:

Name	Balance date	Country of incorporation
ESR Limited	30 June	New Zealand
STRmix Limited	30 June	New Zealand

ESR's financial statements include the financial statements of ESR and entities controlled by ESR. All intra-group transaction balances, income and expenses are eliminated in full on consolidation.

No stake in any subsidiary was acquired or disposed of during the year.

16. Commitments

Capital commitments

Group	2022 \$'000s	2021 \$'000s
Property, plant and equipment	3,354	641
Intangible assets – software	41	10
Total capital commitments	3,395	651

ESR has a number of standard operational agreements for the purchase of materials and consumables that have

both fixed and variable components, some of which extend beyond one year.

17. Related party transactions and key management personnel

Related party transactions

ESR is a wholly owned entity of the Crown. ESR receives Strategic Science Investment Fund funding from the Government and enters into transactions with other Crown entities on a commercial basis. In the year ended 30 June 2022 revenue from commercial transactions with Crown entities amounted to 72% of operating revenue (30 June 2021: 67%).

Related parties include the entities disclosed in note 15.

The following transactions were carried out by ESR with related parties:

- Personnel and equipment were supplied to STRmix Limited to the value of \$3,710,000 (30 June 2021: \$3,109,000). As at balance date, STRmix Limited owed ESR \$269,129 (30 June 2021: \$303,000).

- Fees paid to directors during the year were \$192,000 (30 June 2021: \$150,200). Directors' fees of \$4,005 were payable at balance date (30 June 2021: nil).
- During the 2022 financial year, ESR purchased services of \$47,300 (2021: \$8,400) from Ihu Pakiri Limited, a company of which a member of the ESR Senior Leadership Team is a director. The services purchased related to Te Reo and Tikanga Māori Learning.

No provision has been required, nor any expense recognised, for impairment of receivables from related parties.

Key management personnel compensation

Key management personnel comprise the Chief Executive Officer, senior management and the directors.

Key management personnel compensation is disclosed below.

Group	2022 \$'000s	2021 \$'000s
Salaries and other short-term employee benefits	2,813	2,765
Directors' fees	192	150
Total key management personnel compensation	3,005	2,915

18. Financial instruments by category

The designation of financial assets and financial liabilities by ESR into instrument categories is determined by the business purposes of the financial instruments, policies and practices, the relationship with other instruments and the reporting costs and benefits associated with each designation.

Financial assets

The Group classifies its financial assets either at amortised cost or at fair value through profit and loss. ESR determines the classification of its financial assets at initial recognition.

Financial assets at amortised cost are non-derivative financial assets with fixed or determinable payments that are not quoted in an active market. They are included in current assets, except for maturities greater than 12 months after the reporting date, which are classified as non-current assets. ESR's financial assets at amortised cost comprise trade and other receivables, investment cash, and cash and cash equivalents in the statement of financial position.

Regular purchases and sales of financial assets are recognised on the trade-date – the date on which the Group commits to purchase or sell the asset. Financial assets are derecognised when the rights to receive cash flows from the investments have expired or have been transferred and the Group has transferred substantially all risks and rewards of ownership. Financial assets at amortised cost use the effective interest method.

The Group recognises an allowance for expected credit losses (ECLs) for all financial assets at amortised cost or for all financial assets not at fair value through profit or loss. ECLs are based on the difference between the contractual cash flows due in accordance with the contract and all the cash flows that the Group expects to receive, discounted at an approximation of the original effective interest rate.

Financial liabilities

Financial liabilities held by ESR include trade and other payables, employee benefits and lease liabilities.

Such financial liabilities are recognised initially at fair value less transaction costs and subsequently measured at amortised cost using the effective interest rate method.

Derivatives

Derivative financial instruments are recognised both initially and subsequently at fair value. They are reported as either assets or liabilities depending on whether the derivative is in a net gain or net loss position. ESR does not use hedge accounting and, as such, derivatives are classified as held-for-trading financial instruments with fair value gains or losses recognised in the statement of profit or loss and other comprehensive income. Such derivatives are entered into for risk management purposes.

Group		Financial assets at amortised cost	Financial assets at fair value through profit or loss	Total
	Note	\$'000s	\$'000s	\$'000s
Year ended 30 June 2022				
Assets as per balance sheet				
Trade and other receivables excluding prepayments	8	7,876	–	7,876
Cash and cash equivalents		2,037	–	2,037
Investment cash		39,023	–	39,023
Total		48,936	–	48,936

Group		Financial liabilities at amortised cost	Financial liabilities at fair value through profit or loss	Total
	Note	\$'000s	or loss \$'000s	\$'000s
Liabilities as per balance sheet				
Employee benefits		7,684	–	7,684
Trade payables and accrued expenses	9	14,008	–	14,008
Lease liability	7	3,883	–	3,883
Derivative financial instruments		–	15	15
Total		25,575	15	25,590

Group		Financial assets at amortised cost	Financial assets at fair value through profit or loss	Total
	Note	\$'000s	\$'000s	\$'000s
30 June 2021				
Assets as per balance sheet				
Trade and other receivables excluding prepayments	8	8,128	–	8,128
Cash and cash equivalents		2,182	–	2,182
Investment cash		37,549	–	37,549
Derivative financial instruments		–	9	9
Total		47,859	9	47,868

Group		Financial liabilities at amortised cost	Financial liabilities at fair value through profit or loss	Total
	Note	\$'000s	or loss \$'000s	\$'000s
Liabilities as per balance sheet				
Employee benefits		6,875	–	6,875
Trade payables and accrued expenses	9	10,684	–	10,684
Lease liability	7	3,520	–	3,520
Total		21,079	–	21,079

19. Financial risk management

ESR's activities are exposed to a variety of financial risks, market risks (including cash flow and fair value interest rate risk), credit risk and liquidity risk. ESR's overall risk management programme focuses on the unpredictability of financial markets and seeks to minimise potential adverse effects on ESR's financial performance. The policies approved and financial instruments being utilised at balance date are outlined below.

a) Market risk

In accordance with its Treasury Management Policy, ESR uses derivative financial instruments to economically hedge its exposure to foreign exchange risks from its operational, financing and investment activities. These derivatives are classified at fair value through profit or loss, and gains and losses are recognised as profit or loss in the statement of profit or loss and other comprehensive income.

i) Foreign exchange risk

Foreign exchange risk occurs as a result of transactions denominated in a currency other than ESR's functional currency of New Zealand dollars. Currencies commonly transacted in, and giving rise to, foreign exchange risk include the United States dollar, Australian dollar, Euro and the Pound sterling. ESR is subject to foreign currency risk through its trade receivables and trade payables balances.

ESR is required by its Treasury Management Policy to hedge net foreign currency exposures equivalent to greater than NZ\$100,000 using approved treasury instruments.

At 30 June 2022, ESR held six (30 June 2021: three) forward exchange contracts with notional principal amounts totalling US\$2,948,000 (30 June 2021: US\$750,000). The gains or losses on the forward exchange contracts are recognised in the statement of profit or loss and other comprehensive income.

The carrying amounts of the Group's trade and other receivables denominated in foreign currencies are:

	2022 \$'000s	2021 \$'000s
US dollar	1,729	2,396
Australian dollar	21	17
Euro	68	85

The carrying amounts of the Group's trade and other payables denominated in foreign currencies are:

	2022 \$'000s	2021 \$'000s
US dollar	481	418
Australian dollar	70	88
Pound sterling	1	8
Euro	–	15
Swiss franc	2	–

ii) Interest rate risk

As at reporting date, ESR is subject to interest rate risk through the holding of cash and cash equivalents and investment cash. ESR uses a mixture of call and short-term deposit investment accounts to hold excess funds. Available interest rates are monitored to ensure the best return on cash.

iii) Market risk sensitivity analysis

ESR is exposed to market risk through the holding of the following financial instruments: cash, trade receivables and trade payables. ESR has analysed the sensitivities in market risk factors over a 12-month period below:

- proportional foreign exchange rate movement of -10% (depreciation of New Zealand dollar) and +10% (appreciation of New Zealand dollar) against foreign currencies
- a parallel shift of +2%/-2% (30 June 2021: +1%-1%) in market interest rates in New Zealand.

If these movements were to occur (all other variables held constant), the impact on ESR's reported net profit after tax for the year ended 30 June 2022 would be:

- foreign currency \$135,000 (30 June 2021: \$178,000)
- interest rates \$552,000 (30 June 2021: \$240,000).

b) Credit risk

Credit risk refers to the risk that a counterparty will default on its contractual obligations, resulting in financial loss to ESR. The financial instruments that expose ESR to credit risk are, principally, cash and cash equivalents, investment cash, trade receivables and contract assets.

Bank balances and short-term investments (comprising cash and cash equivalents and investment cash) are held with New Zealand registered banks in accordance with ESR's Treasury Management Policy.

The majority of high-value trade receivables and contract assets comprise government entities and therefore the potential risk of default is low. ESR has a contract management policy which requires assessment of the credit worthiness of potential clients, where the value of the contract is material as defined in the policy.

A provision for doubtful debts is maintained in respect of trade receivables and this is reassessed on a regular basis. No collateral is held by ESR in respect of cash and cash equivalents, investment cash and trade receivables as at 30 June 2022 (30 June 2021: nil).

The carrying amount of financial assets recognised in the statement of financial position best represents ESR's maximum exposure to credit risk at the reporting date.

As at 30 June 2022, the trade receivables balance included \$3,250,672 (30 June 2021: \$3,330,268) owed by entities within, or owned by, the New Zealand Government. It is not believed that there is any material risk of loss with these receivables.

c) Liquidity risk

Prudent liquidity risk management implies the availability of funding through adequate levels of committed credit facilities. Liquidity risk is monitored through the forecasting of cash flows and ensuring that the committed credit lines in place remain adequate for requirements.

The contractual undiscounted maturity analysis of financial liabilities is presented below.

Group 2022	Carrying value \$'000s	Less than 1 year \$'000s	1–2 years \$'000s	2–5 years \$'000s	Greater than 5 years \$'000s
Trade payables	14,008	14,008	–	–	–
Employee benefits	7,684	5,674	125	64	1,821
Lease liabilities	3,883	344	358	354	2,827
	25,575	20,026	483	418	4,648
Group 2021	Carrying value \$'000s	Less than 1 year \$'000s	1–2 years \$'000s	2–5 years \$'000s	Greater than 5 years \$'000s
Trade payables	10,684	10,684	–	–	–
Employee benefits	6,875	4,586	152	55	2,082
Lease liabilities	3,520	501	443	461	2,115
	21,079	15,771	595	516	4,197

d) Fair values

The carrying value of financial assets and liabilities recorded in the financial statements approximate their fair values.

Fair value is generally based on the contracted amount payable/receivable of financial assets and financial liabilities, being the amount for which the financial instrument is to be exchanged. Fair value includes the impact of any assessed impairment of the financial instruments – refer to the statement of significant accounting policies for details of each financial instrument and their recognition criteria.

e) Capital risk management

ESR objectives when managing capital are to maintain financial stability, achieve sustainable growth, and realise

its strategic goals and targets, all within the risk appetite of its shareholder, board and management.

In line with government requirements, ESR monitors its capital structure through the return on equity and gearing ratios. Government provides ESR with guidelines, with the expectation that an appropriate average return is achieved over time, rather than requiring that ESR meet the specified targets annually.

Each year, ESR internally sets return on equity and gearing ratio targets, bearing in mind the overall results expected by the Government. The ratios are reported in the Statement of Corporate Intent.

The return on equity and gearing ratios as at 30 June 2022 and 30 June 2021 were as follows, along with the relevant annual targets set by ESR.

Group	2022	2021
Return on equity ratio	\$'000s	\$'000s
Profit for the year	495	1,166
Average equity	60,375	59,544
Actual ratio	0.8%	2.0%
Target ratio	(4.3%)	(3.7%)
Gearing ratio		
Net debt		
Lease liabilities – current	344	501
Lease liabilities – non-current	3,539	3,019
	3,883	3,520
Equity	60,622	60,127
Actual ratio	6.0%	5.5%
Target ratio	3.7%	0.9%

20. Contingent liabilities

ESR was subject to a legal claim in the United States of America that alleged patent infringement related to aspects of the Group's commercial operations in that country. ESR successfully defended the case and it was resolved in September 2021. There are no contingent liabilities as at 30 June 2022.

21. Subsequent events

There were no other events subsequent at reporting date that require disclosure in the financial statements.



*Denitrification monitoring
at Barkers Creek, South
Canterbury, South Island.
Photo: Richard Sutton*

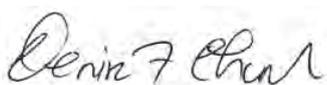
Te Tauākī Haepapa

Statement of Responsibility

We certify that the Institute of Environmental Science and Research Limited (ESR) has operated in accordance with the principles of the Crown Research Institutes Act 1992 and the Companies Act 1993. ESR has also complied with all statutory environmental regulations. We acknowledge responsibility for the preparation of these financial statements and for the judgements used therein.

Internal control procedures are considered to be sufficient to provide reasonable assurance as to the integrity and reliability of the financial reports.

In our opinion, these financial statements fairly reflect the financial position and operations of ESR for the year ended 30 June 2022.



Denise Church QSO
Chair



Cristin Print
Deputy Chair

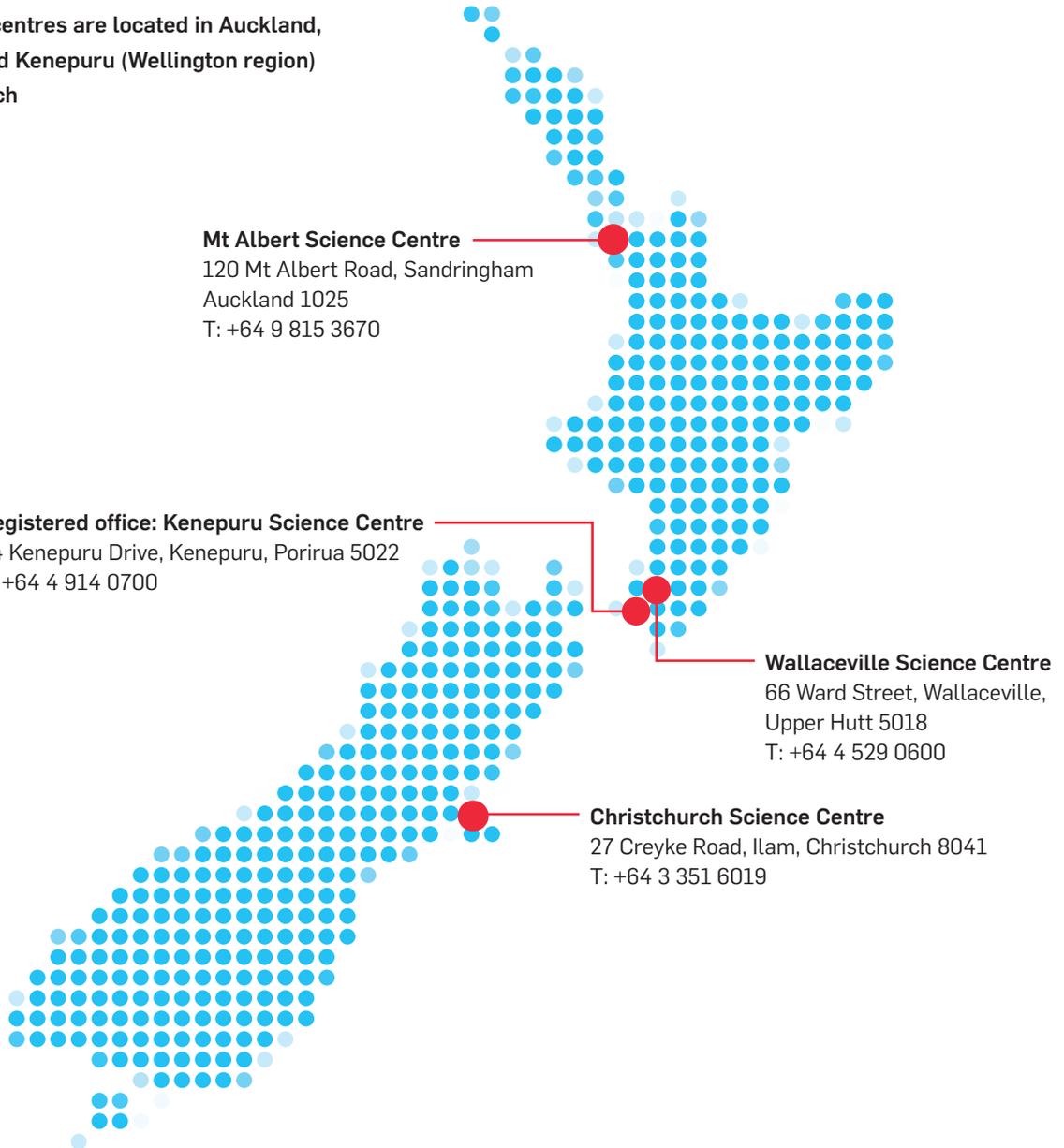


Wastewater sampling.
Photo: Bronwyn Humphries

Ko wai mātou

About us

ESR's science centres are located in Auckland, Wallaceville and Kenepuru (Wellington region) and Christchurch



Science working for New Zealand

The Crown Research Institutes (CRIs) proudly work, individually and collectively, to create a more prosperous, sustainable and innovative New Zealand



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