



# Hydro Nation Scholars Programme: A Decade of Impact on Scotland's Water Future 2013–2025

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The Hydro Nation Scholars Programme is supported by the Scottish Government and managed by the Hydro Nation International Centre. We extend our sincere gratitude to our network of scholars, alumni, supervisors, stakeholders, and steering group for their invaluable contributions. Their continued dedication and engagement plays a vital role in shaping the success of the programme, fostering research excellence, and driving impactful water sector innovation in Scotland and beyond.

**Cover photograph courtesy of:** The International Water Resources Association.

# Introduction

Since its foundation in 2013, the [Hydro Nation Scholars Programme \(HNSP\)](#) has played a pivotal role in advancing Scotland's water research landscape by fostering interdisciplinary collaboration between academia, policymakers, and industry leaders.

Over the past 12 years, the programme has brought together more than 50 talented students from around the globe to study water-related PhD projects at various universities across Scotland and played a unique role bridging the research community, policymakers and practitioners. The HNSP is designed to meet the future strategic needs of Scottish Government and its delivery partners, laying the groundwork for meaningful impact. By aligning cutting-edge research with real-world policy and industry needs, HNSP ensures that scientific insights translate into tangible societal and environmental benefits.

Effective knowledge exchange and research impact are critical to the success of the HNSP, ensuring the work makes a difference and a positive contribution to the Hydro Nation agenda and the water sector in Scotland and abroad.

This impact assessment report evaluates the programme's contributions, achievements and value, measuring its success in knowledge dissemination, policy influence, stakeholder engagement, and alumni career trajectories.

## HNSP: Developing the Global Water Leaders of the Future

Scotland's Hydro Nation strategy reflects a progressive commitment to sustainable water management, aiming to optimise the economic and societal benefits of Scotland's water resources. Supporting the Water Resources (Scotland) Act 2013, this initiative directs Scottish Ministers to take appropriate steps to develop the full value of these resources, considering both market and non-market value.

To support this vision, a collaborative approach was established bringing together industry regulators, agencies, stakeholders, the research community, and the public. This policy-driven approach leverages diverse expertise, particularly in science and research, to shape decision-making and guide policy development.

The HNSP is a key component of the Hydro Nation agenda, supporting the next generation of experts and leaders dedicated to Scotland's water management goals. Through this programme, promising talent from around the world is attracted to address critical challenges and advance water management strategies. Our Hydro Nation Scholars gain access to an expansive support network of researchers and policymakers, industry collaborations, and valuable data, enabling them to contribute to impactful research on issues in a wide range of topics from e.g. emerging pollutants to surface water management.

A cornerstone of the Hydro Nation strategy, and by extension the HNSP, is the understanding that effective water management requires both immediate

institutional reforms and a focus on long-term challenges. This includes generating new knowledge on low-carbon water management approaches, improving efficiencies, and ensuring a just transition that addresses both climate change and biodiversity crises.

While tangible impacts such as economic gains, job creation, and improved social cohesion take time, the HNSP is a policy-driven initiative that serves as an essential platform for building this impact, creating networks, shaping shared visions, and gathering evidence to drive Scotland's water policy. The programme's legacy not only advances Scotland's sustainable water goals but also contributes to Scotland's water science excellence. This legacy continues through its scholars and alumni who carry forward Hydro Nation's mission as leaders and ambassadors.

The HNSP is funded by the Scottish Government via the Scottish Funding Council. The programme funds postgraduate projects aligned to the strategic priorities of Scotland's Hydro Nation Agenda and is a partnership between academia, industry, and policy.



# Measuring the Success of the HNSP

In 2023, the HNSP Secretariat undertook a comprehensive review and update of its processes and policies, led by the HN Policy Officer. This initiative included an evaluation of the programme's legacy and impact. As part of this effort, the first Alumni Survey was developed to assess the experiences of past scholars and gather insights into the programme's effectiveness.

The survey had three primary objectives:

- 1. Alumni Database Enhancement:** Collect personal and professional information to update the Alumni database. This data remains confidential, accessible only to the HNSP Secretariat, and is not shared without prior consent.
- 2. Programme Impact Assessment:** Evaluate how the programme has influenced scholars' career trajectories and contributed to talent development, retention, and overall professional growth in Scotland.
- 3. Project-Specific Insights:** Assess stakeholder involvement in alumni projects and the resulting impact.

Capturing the programme's impact is essential for securing future funding and demonstrating its value. In alignment with this, the third objective sought to

identify case studies for deeper analysis through a stakeholder engagement survey and, where relevant, follow-up interviews. This stakeholder survey complemented the alumni survey by examining the flow of information between project leads and stakeholders (ensuring it reaches the right audiences at the right time) and assessing its practical applications. Additionally, it explored the mutual benefits of stakeholder involvement, including how engagement has strengthened projects and influenced policy and practice.

The findings from both surveys were analysed independently and in combination to produce this report and to support the continued enhancement of HNSP processes.

## What Our Alumni Say: Survey 2024

The HNSP is not just shaping research, it is a catalyst for change, equipping the next generation of water leaders with the skills, networks, and expertise to shape policy, influence practice, and drive sustainable innovation. With an 85% response rate from alumni, the latest HNSP Alumni Survey 2024 provides compelling evidence of the programme's long-term influence on both individual career trajectories and broader sectoral advancements.

### Career Acceleration and Lasting Influence

- 87% of alumni reported to be employed full time, with nearly 60% working in Scotland, many in roles directly tied to their PhD research.
- Graduates credit the HNSP's structured training, interdisciplinary collaboration, and stakeholder engagement as pivotal in shaping their careers.
- The programme fosters a strong pipeline of highly skilled professionals who continue to contribute to Scotland's water sector and beyond.

### From Research to Real-World Change

- Scholars actively engaged with key stakeholders, such as Scottish Government, SEPA, NHS Highland, and Scottish Water, ensuring their research had practical and policy impact.
- Alumni reported significant contributions to government policies, public health initiatives, and environmental management strategies, demonstrating the tangible benefits of their work.
- The HNSP's bespoke training in impact assessment has strengthened scholars' ability to connect research with real-world applications.

## A Proven Model for Future Leaders

- The programme's distinctive structure, bridging academia, government, and industry, ensures that scholars are not just researchers but policy influencers and sector pioneers.
- The strong emphasis on networking, mentorship, and interdisciplinary learning sets the HNSP apart as a launchpad for global leadership in the water sector.

## Opportunities for Growth

While satisfaction is high, alumni identified areas for enhancement, including:

- Stronger alumni engagement (mentoring, networking events, reunions).

- Expanded training in quantitative skills and media communication.
- Increased opportunities for industry placements and stakeholder collaborations.

The findings of this survey reinforce HNSP's critical role in advancing Scotland's Hydro Nation agenda, developing water-sector talent, and influencing global water policies, while providing a strategic foundation for its next decade of impact. For a more in-depth analysis of the programme's impact, refer to the full HNSP Alumni Survey 2024 Summary Report.

# Success in Action: How HNSP Research is Making a Difference

Two case studies were selected from the Alumni surveys. Complementary stakeholder surveys and follow-up interviews further contextualised the findings, offering a holistic view of the effectiveness of the HNSP's unique model in fostering cross-sector collaboration and translating research into real-world applications.

## 1. HNSP Topic "Case Studies and Evaluation of Technology for a Scottish Context Including Long-Term Sustainability of Chemical Treatment of Water and Wastewater in the UK"

### The Ask

In 2016, the HNSP launched a call for projects that sought to explore case studies and evaluation of technology for a Scottish context, including the long-term sustainability of chemical treatment of water and wastewater in the UK.

### The Project Solution

The project, entitled '*Pharmaceutical occurrence, distribution and degradation in rural wastewaters and surface waters in Scotland*' investigated the introduction, fate, and degradation of pharmaceuticals in wastewater treatment plants (WWTPs) and effluent-receiving water systems, and the potential environment risks of pharmaceuticals and degradation products while optimising analytical methods and bioassay techniques for assessing pharmaceutical impacts.

Led by Lydia Niemi, the study explored mitigation strategies at point sources, such as hospitals, and examined urban-rural differences, assessing the presence of pharmaceuticals in freshwater and the effectiveness of wastewater treatment in removing these pollutants. The research focused on assessing pharmaceutical pollution in rural water environments, due to the knowledge gaps of pharmaceutical occurrence and effects in rural regions across Scotland. In collaboration with the University of the Highlands and Islands, the James Hutton Institute, and key stakeholders in healthcare, water, and environmental agencies, the project contributed to Scotland's approach to addressing pharmaceutical pollution, and fed critical data into Scotland's national pharmaceutical pollution database ([CREW, 2022](#)). Additionally, it led to interdisciplinary research in sustainable healthcare and social behaviour

towards medicine usage and water stewardship in the healthcare sector and by the public. By evaluating pharmaceutical occurrence, distribution, degradation pathways, and environmental risks at various WWTP treatment stages, the research helped understand the potential risks in rural environments to ensure better water quality management.

### **The Impact**

Specifically, the outcomes of this project contributed to the following impact categories, identified via the stakeholder surveys. Further details are provided in the description below:

- Contributing evidence to support decision making across the water sector
- General awareness: contributing to policy issues, reframing debates (i.e. changing ways of thinking)
- Natural environment: influencing the delivery (e.g. actions on the ground) targeting the natural environment)
- Public health: influencing the delivery (e.g. actions-on-the-ground) targeting public health
- Practice/capacity building: development of technical and personal skills, including methods
- Government policy: on the strategic level objectives of funders and decision makers
- Institutional policy: influencing the development of policy, practice or service provision, shaping legislation
- Improving/changing working practice (within an industry organisation)
- Reputational
- Strengthening ties (e.g. between academia and industry, academia and government)

The project had a far-reaching impact across multiple sectors, organisations, and policy levels, significantly advancing the agenda on pharmaceutical pollution in the environment (PiE), with key achievements for the foundation of initiatives and collaborations, policy influence, hospital accreditation and technical advances, and research and analytical tool development.

The project had important implications for research and innovation in the healthcare and environmental sectors. The work fed into the early-stage development of the [One Health Breakthrough Partnership \(OHBP\)](#) and supported shaping future work with the agencies involved, including subsequent grant applications with the Scottish Government, Medical Research Council (MRC) and UKRI NERC (MOT4Rivers). Further, the River Dee monitoring work conducted during the PhD helped to shape the sampling strategy and methodology for the RESAS Emerging Water Futures project that the James Hutton Institute has carried out on the River Dee (and Ugie and other sites in Aberdeenshire).

This PhD work and its subsequent contributions to the OHBP ensured PiE remained a priority on the Scottish and UK policy agendas helping to shape the Scottish Government's Climate Change and Sustainability Strategy, the only UK strategy to incorporate water stewardship and pharmaceutical pollution. This makes Scotland the only one of the First Nations to incorporate water stewardship and pharmaceutical pollution into its climate strategy. Research outputs were presented at Scottish Government and UK Parliament meetings, shaping policy discussions and supporting the development of the Pharmaceutical Pollution Hub in England.

Additionally, the research directly contributed to Caithness General Hospital achieving the Alliance for Water Stewardship (AWS) Accreditation - the first hospital and still the only in the world to receive this recognition. It demonstrated the impact of hospitals on pharmaceutical pollution and local water quality and influenced best practices for healthcare waste management and water stewardship. The establishment of Scotland's pharmaceuticals pollution database, integrating environmental monitoring data with national prescription data, was a significant achievement. This was the first whole nation baseline assessment of pharmaceuticals in the UK and is now integrated into national monitoring efforts, helping to guide intervention strategies and inform decision-making for water management and healthcare sustainability.

The work strengthened collaborations nationally between SEPA, Scottish Water, NHS Highland,

CREW and government bodies, and contributed to international collaborations, such as with [Uppsala University in Sweden](#). By building an extensive network of interdisciplinary experts, it fostered new projects and funding opportunities, showcasing the project as an exemplar of good practice globally. Public engagement was a critical aspect of the project, with research findings featured in BBC Scotland and presented at conferences, policy workshops, and stakeholder meetings, including with MSPs, supporting wider visibility for the work.

Further, stakeholders noted that their engagement in this project led to benefits in processes, tools to visualise data, and knowledge in their organisations. The project lead, Lydia Niemi transitioned from research to leadership role, as she adopted the project coordinator position within the OHBP, sitting on Scotland's Climate Board and chairing groups even before the end of her PhD.

In conclusion, beyond academic research, this project delivered real-world environmental, policy, and healthcare contributions. It helped shape national policies, improved hospital sustainability practices, informed government strategies, and established long-term research collaborations. This project exemplifies effective integration of academic research into practical, policy, and technical applications, ensuring long-term benefits for water quality and pharmaceutical pollution management, and its legacy continues to drive advancements in pharmaceutical pollution management and environmental stewardship in Scotland and beyond.

To view the project's KE outputs: <https://www.hydrationscholars.scot/scholars/dr-lydia-niemi>  
[Pharmaceutical occurrence, distribution and degradation in rural wastewaters and surface waters in Scotland. Niemi, L. M. \(Author\). 25 Jan 2021.](#)

## 2: HNSP Topic: Assessing the Future Water Landscape of Scotland

### The Ask

The water "landscape" in Scotland will be affected by several different drivers, including climate change, urbanisation, commercial demands, changes in agricultural production, and land use. Understanding future scenarios of change is an important pre-requisite for developing national strategy, planning, and policy. In 2018, the HNSP launched a call for projects to explore future demands and pressures on the water environment, including linking biophysical, social, and economic perspectives. Developing and exploring scenarios of change and their subsequent impacts was key.

### The Project Solution

The project entitled "*Scotland's Freshwater Landscape and Its Resilience to Change: An Assessment to Support Future Policy*" was funded to explore future demands, pressures, and trade-offs on the water environment. The project engaged stakeholders in the development

of future scenarios, participatory modelling, and the interpretation of model outputs to inform environmental planners, managers, and policymakers. The primary aim of the project was to provide a comprehensive understanding of the interplay between land use, management, industry, and water quality/quantity in Scotland, particularly in the context of climate change. This understanding is essential for managers and policymakers to make informed decisions that promote sustainability and resilience in water management.

To achieve this aim, the project focused on exploring future scenarios in the Eden catchment, considering drivers of change such as climate, land use, demographic and relevant economic factors within SEPA's [One Planet Choices](#) framework. A Bayesian Belief Network (BBN) model was developed to assess how factors like climate change and demographic shifts would

impact the catchment systems. After extensive stakeholder consultations and surveys, policy recommendations were produced in a [policy brief](#). This work was further supported by regular feedback from SEPA and Scottish Water colleagues, establishing a strong foundation and practical basis for the research project. Additionally, the study played a critical role in evaluating management options beyond siloed approaches, encouraging a systems-thinking methodology to support policy decisions.

### **The Impact**

The project achieved impacts during and beyond the lifecycle of the PhD research. Specifically, the outcomes of this project contributed to the following impact categories, identified via the stakeholder surveys. Further details are provided in the description below:

- Contributing evidence to support decision making across the water sector,
- General awareness: contributing to policy issues, reframing debates (i.e. changing ways of thinking)
- Natural environment: influencing the delivery (e.g. actions on the ground) targeting the natural environment
- Practice/capacity building: development of technical and personal skills, including methods
- Government policy: on the strategic level objectives of funders and decision makers
- Institutional policy: influencing the development of policy, practice or service provision, shaping legislation
- Improving/changing working practice (within an industry organisation)
- Reputational
- Strengthening ties (e.g. between academia and industry, academia and government)

The project advanced collaborative and future-focused decision-making for SEPA and Scottish Water, shaping the One Planet Choices methodology and addressed critical gaps in Scotland's water management policies. It identified limitations in existing strategies for managing diffuse pollution and water quality

under future scenarios, emphasising the need for systems-scale, collaborative solutions. The research highlighted that siloed approaches to water management create policy gaps in addressing emerging challenges such as climate change, population growth, and land use changes. To overcome these issues, the project engaged a broad range of stakeholders through interviews, focus groups, and workshops, fostering collaboration and co-creation of solutions. This process led to the co-development of a BBN model tailored to SEPA and Scottish Water's specific needs, enabling the evaluation of multiple environmental, economic and social outcomes.

The BBN tool has since been integrated into SEPA and Scottish Water's decision-making processes, with research findings informing funding prioritisation, strategic discussions, and policy-making at both national and international levels, including Scottish Government programmes and global forums. Stakeholders noted significant benefits to their organisations in terms of processes, tools, and knowledge exchange. The project also strengthened collaboration and capacity-building efforts, reinforcing institutional ties and enhancing SEPA and Scottish Water's ability to review and adopt innovative approaches. Plans are now in place to provide staff training to ensure the sustained application of the model, ensuring long-term impact and continued improvements in Scotland's water management strategies.

While implementation of the BBN tool and policy recommendations is ongoing, discussions among stakeholders implies substantial long-term impacts. The Scottish Government, SEPA, and Scottish Water continue to explore how the tool can be refined and made more accessible for decision-making. Additionally, the success of the project has led to subsequent funding and new contracts for the further development and application of the model in the Eden catchment, with ongoing interest in making the Bayesian model transferable to other Scottish catchments. Further, the One Planet Choices methodology is being integrated into new initiatives, including SEPA's River Basin Planning strategy and was

recognised as a potential framework for other catchment studies such as Scottish Water's River Almond Lighthouse Project.

This project exemplifies impactful, demand-driven research, bridging the gap between scientific innovation and practical policy implementation.

By fostering stakeholder collaboration, systems thinking, and data-driven decision-making, it provides a long-term framework for sustainable water management in Scotland. The work has been widely presented at national and international conferences, Scottish Government meetings, and

published in leading journals, ensuring its findings contribute to academic and policy circles. The project serves as a model for future research partnerships between academia, industry, and government, demonstrating the value of applied research in shaping Scotland's water future.

To view the project's KE outputs: <https://www.hydrinationscholars.scot/scholars/dr-kerr-adams>

[Scotland's freshwater landscape and its resilience to change: an assessment to support future policy.](#) Adams, K. (Author). 10 Nov 2023.

## Why HNSP Matters: Insights from Industry, Academia, and Government

Further to project specific feedback, the survey responses and follow up meetings provided valuable insights into stakeholder engagement with the HNSP. Respondents primarily came from academic institutions, government bodies, and research organisations, with many serving as PhD supervisors, researchers, or industry and government partners. Their involvement in the programme varied, including supervising scholars, mentoring and advising, collaborating on research projects, and participating in knowledge exchange initiatives.

The impact of the HNSP was widely recognised, particularly in strengthening Scotland's expertise in water-related research. Nearly all respondents agreed that the programme has significantly contributed to capacity building, supporting early-career researchers, and fostering high-quality PhD research. Many also highlighted the real-world applications of research produced through HNSP, with findings contributing to government policies, industry best practices, and broader water resource management strategies. A key factor in the programme's impact has been its focus on addressing future challenges and helping stakeholder organisations prepare and build resilience in their policies, operations, and practices. Additionally, the programme was seen as instrumental in raising Scotland's international profile in water research, with scholars frequently attending global conferences and facilitating international collaborations. Beyond research, the programme had a meaningful impact on participants' careers and institutions.

Many respondents credited their involvement in the HNSP with expanding their professional networks and enhancing their research portfolios, while some noted direct career advancements as a result. On an institutional level, the HNSP was perceived as playing a key role in shaping policies related to water resource management and sustainability. Several respondents also recognised its contributions to industry, particularly in facilitating knowledge transfer and workforce development.

The overall perception of HNSP was overwhelmingly positive with the consensus among stakeholders being that the HNSP is an invaluable initiative that has delivered significant benefits to individuals, institutions, and the broader water sector. All respondents stated they would recommend participation in the programme to others, with some emphasising the importance of securing additional resources to further enhance its long-term success.

# Conclusions: The Enduring Legacy of the HNSP

Over the past 12 years, the HNSP has played a pivotal role in advancing Scotland's leadership in sustainable water management, nationally and internationally. By bridging the gap between academic research, policy development, and industry practices, the programme has cultivated a generation of experts whose work continues to shape national and international water strategies.

The findings from this impact assessment underscore the programme's effectiveness in driving meaningful change. Alumni have not only advanced cutting-edge water research but have also influenced policy reforms, improved institutional practices, and contributed to environmental stewardship.

Looking ahead, the HNSP remains committed to amplifying its impact by deepening industry collaborations, refining its training methodologies,

and expanding opportunities for interdisciplinary research to address emerging challenges facing the water sector. To sustain this momentum, securing long-term investment and fostering stronger international partnerships will be crucial. By continuing to adapt to emerging challenges and leveraging Scotland's Hydro Nation vision, the HNSP will ensure that water-related research remains a cornerstone of sustainable development for years to come.

## Supplementary Reading

[Overview of Knowledge Exchange and Impact \(KEI\) Activities](#)

[Synthesis Report: Preliminary Assessment on Achievements and Impact from 10 years of the HNSP](#)

[HNSP Alumni Survey 2024 Summary Report](#)

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Rachel Helliwell is the Director of the Hydro Nation International Centre and Centre of Expertise for Waters. She works at the science: policy interface delivering evidence and knowledge gathered by Scottish and international academics to the water community of practice (policy, industry and regulators). She is a board member of the Hydro Nation Chair Programme, member of the Hydro Nation Forum, a representative on the research and innovation committee for the Scottish Alliance for Geoscience Environment and Society, and Scottish Freshwater Group. Rachel also sits on local, national, and global stakeholder consultation groups covering pressing policy issues including net zero, climate crisis, circular economy and resource efficiency.



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Maricela Blair is an interdisciplinary professional with a background in soil & water sciences, and anthropology. She has experience as a policy adviser for S&T and R&D, applying her expertise and skills in academia and government to assist triple helix R&D organisations for the advancement of research and innovation, knowledge management, S&T education, and international cooperation; having worked as Chief Science Officer creating the R&D Unit and developing institutional processes for the Ministry for Science, Technology and Innovation in Honduras, and later, as Adviser for S&T for the Government of Honduras. Maricela is also the primary coordinator for the [Hydro Nation Scholars Programme](#).



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