Mitigating Climate Change Impacts on the Water Quality of Scottish Standing Waters

Section 1: Project Overview

Introduction

The Centre of Expertise for Waters (CREW) wishes to commission a capacity building project within CREW's **Hydrological Extremes, Coasts and Risk Management** theme and aligned with addressing the climate crisis for Scottish standing waters.

This project (phase 2) will build out the outputs of a previous CREW report (phase 1), which provided evidence to improve our understanding of climate change impacts on the water quality of Scottish standing waters at national, regional and local scales. Phase 1 focused on the interactions between climate change, the drivers of eutrophication problems and their impacts.

Aim and key questions

The project aims to build on phase 1 by identifying and prioritising changes in management practices for Scottish standing waters to maximise the success of climate mitigation action.

The four key questions to be addressed within the project are:

1. To what extent can changes in catchment management practices and in-lake processes successfully mitigate climate change impacts on water quality of Scottish standing waters?[1]
2. Does existing water policy, and its implementation, sufficiently take climate change impacts on the water quality of Scottish standing waters into account?
3. In this specific policy context, what changes may be required and applied under current and projected climate change scenarios for adaptive management responses, monitoring and prioritisation of mitigation measures/solutions?[2]
4. What are the recommendations, priorities for action and practical mitigation measures/solutions that can be implemented in the short term (<5yrs) and longer term (>5yrs)?

Background & knowledge gap

The climate crisis is affecting the quality of Scotland's standing waters such as lochs and reservoirs, causing changes in water temperatures, hydrological regimes, ecology, and nutrient budgets. This impacts the sustainable use and integrity of these waterbodies for recreation, wellbeing and tourism, freshwater biodiversity, and ecosystem functioning[3], water supply and land and water resource management. The increasing importance of these climate change impacts on water quality issues in Scottish standing waters is reflected in revised and recent legislation, policy goals, statutory

[1] This should be based on past example case studies and include a baseline to assess success.
[2] This project will include a high-level cost-benefit analysis.
[3] (e.g., as a suitable habitat for plants and wildlife that are of conservation importance)

commitments, and policy decisions at European, national, regional and local scales. (See Appendix A for examples).

There is now an urgent need for fit for purpose mitigation/adaptation strategies that can be created and implemented in Scotland without delay. These will safeguard the integrity, biodiversity, and sustainable use of the water environment for people, animals and nature, and also provide financial benefits. Further work is required to identify catchment management and in-lake measures that can successfully mitigate climate change impacts on water quality of Scottish standing waters.

Anticipated impacts

An evidence-based evaluation of the risks, informed water policy changes and implementation of successful mitigation strategies will help to increase amenity value (including recreational and wellbeing benefits), financial benefits, reduce public health risk and safeguard communities and animals from climate-driven water quality issues in Scottish standing waters under current and projected climate change scenarios. In the longer term this project will help to prioritise coordinated adaptive responses to establish future resilience and prevent further deterioration from climate-driven water quality issues in Scottish standing waters.

The primary beneficiaries will be Scottish conservation and regulatory agencies (e.g., NatureScot; SEPA); and water resource managers (e.g., Scottish Water; Local Authorities), who have a need for evidence-based information to underpin strategic changes in water policy and management implementation plans aimed at ensuring future resilience is established and that further deterioration of water quality in Scottish standing waters due to climate change impacts is successfully mitigated. If changes are realised this project will contribute to improvements in public health by helping to reduce the occurrence of algal blooms or minimise the risk through appropriate measures.

Deliverables

- A final report of 20-30 pages, excluding annexes and the bibliography, and including:
    - A critical analysis *(Utilising locational guidance and case studies)*
    - A high-level cost-benefit analysis
    - A concise set of recommendations and priorities for action
    - Cover image(s) with associated photo credits
- A plain English summary of aims and results (up to 1 page)
- Policy brief
- Communications and impact plan – supported by CREW's Impact Officer
- Website summary (200 words)
- Press release
- Infographics
- 5-min professional project summary video (scope for sub-contract)

Events/meetings

- Stakeholder-engagement workshop. *(To include the primary beneficiaries identified above)*
- Project Steering Group meetings *(throughout the project lifecycle)*
- A dissemination event/workshop

Anticipated timescale

The project will commence in **February 2023** with the project report submitted by **September 2023** and all project outputs signed off by the CREW Director by **February 2024**.

Funding

The maximum amount of funding available inclusive of VAT (where applicable) is **£125,000.**

This budget includes an associated costs (excluding sub-contractor) budget of **£5,000** to cover:

- start-up and/or end project steering group room and equipment hire;
- room and equipment hire for the workshop and dissemination event;
- travel and subsistence.

In addition, approximately **£10,000** of the **total project budget** should be used to produce a professional and high-quality video, which can be sub-contracted.

Section 2: Further information for applicants

Project management

Day-to-day communication will be between the research/review team (the contractor) and a CREW Project Manager and is likely to involve short catchups as agreed.

Project steering group

A CREW project steering group (PSG) generally include representatives of Scottish Government and its delivery partners plus a CREW representative. The PSG for CRW2022_03 will include representatives of NatureScot, SEPA and CREW.

Submitting a proposal

Please send a completed application form (available here) addressing the project requirements.
A copy of expectations and the award criteria are provided below for reference.

Proposals need to be submitted to the Research Support Officer – Centres of Expertise (Regan.Tammi@hutton.ac.uk) for evaluation **by noon on Friday 27th January 2023.** We aim to notify the successful bidder by **Friday 17th February 2023** and we may request a pre-contract meeting**.**

Please contact the Research Support Officer Regan.Tammi@hutton.ac.uk if you would like any clarification on any of the above. You should highlight any potential conflicts of interest in your proposal. For queries about what may constitute a potential conflict of interest please contact the CREW Deputy Manager (Nikki.Dodd@hutton.ac.uk).

Expectations

No.	Criteria	Descriptor
1	Duration	The proposed duration will align closely to the details provided in the anticipated timescales section of the specification.
2	Staff time and effort	The proposed allocation of staff time and effort is appropriate and includes all deliverables. The proposal must also provide a commitment that named staff members will be available to work on the contract if the bid is successful.
3	Project costs	The estimated breakdown of project costs is realistic and inclusive of all deliverables.

Award criteria

No.	Criteria	Descriptor
1	Understanding the project ask and policy background	The proposal should include an introduction which demonstrates a clear understanding of the project requirements. This should include an understanding of the policy background and the supporting role of this project; the need for this research; the project aim; and how the proposal will address this aim.
2	Proposed methodology	The proposal should demonstrate a high quality and workable methodology, including: • how the evidence will be identified, reviewed and assessed • consulting relevant stakeholders and/or experts where appropriate to address the key questions and produce the deliverables in the timescales required. It should explain the suitability, robustness and limitations of the proposed methodology.
3	Milestones	The project milestones are logical, practical and include all deliverables.
4	Project Management	The staff, resources and expertise are appropriate for conducting the proposed project. The proposal should name the project lead and outline their project management experience.
5	General and specific topic expertise and experience	The proposal should provide details of individual staff members who will work on this project and demonstrate how they will meet the project requirements, specifically: - general research experience and expertise; - specific experience and expertise on the topics of water quality in standing waters and climate mitigation.
6	General communication and deliverables	The proposal should describe the approach to producing the deliverables, which will be published on the CREW website. It should detail who will take lead responsibility for report-writing and overall report quality. It should provide examples of previous reports, policy briefs and workshops in which they have been involved.
7	Quality assurance	The proposal should provide details of quality assurance procedures to demonstrate how the contract will be continuously delivered to a high standard. It should specifically address issues of quality control at different stages of the project, including evidence gathering, analysis and report writing. It should include a timetable for delivery of tasks, project milestones and allocation of staff and staff time against each task, covering the duration of the contract.
8	Risk	The proposal should provide a risk assessment matrix detailing any risks identified in relation to the delivery of this contract, and proposed mitigation measures to minimise their probability and impact, focused particularly on risk to completion on time.

Appendix A. Relevant legislation, policy goals and statutory commitments

- Climate Change Committee (2021). Independent Assessment of UK Climate Risk: Advice to Government for the Third Climate Risk Assessment (CCRA3)
- Climate Change (Scotland) Act 2009; Scottish Government Climate Emergency Response Statement (2019); and Land Use Strategy
- Controlled Activities Regulations (Regulations) (2005)
- Cyanobacteria (Blue-Green Algae) in Inland and Inshore waters: Assessment and Minimisation of Risks to Public Health – Scottish Government Revised Guidance (2012)
- Defra (2018). A Green Future; Our 25 Year Plan to Improve the Environment
- Scottish Biodiversity Strategy post 2020 – Statement of Intent
- EU Habitats Directive (1992) as retained (*et seq*.)
- EU Water Framework Directive (2000)
- EU recast Drinking Water Directive (2021)
- Scottish Government land use strategy policy and future agri-environment support (2021) – e.g., Land Use - getting the best from our land strategy 2021-2026
- The State of Nature 2019 – The State of Nature partnership
- The Urban Wastewater Treatment (Scotland) Regulations 1994 and The Urban Waste Water Treatment (Scotland) Amendment Regulations 2003
- Planning (Scotland) Act 2019 implemented *via* National Planning Framework 4

Appendix B. Relevant reports and studies

Carvalho, L., Miller, C., Spears, B.M., Gunn, I.D.M., Bennion, H. & May, L. (2012) Water quality of Loch Leven: responses to enrichment, restoration and climate change. Hydrobiologia 681: 35-47. https://doi.org/10.1007/s10750-011-0923-x

Defew, L. H. (2008). The influence of high-flow events on phosphorus delivery to Loch Leven, Scotland, UK. School of GeoSciences, University of Edinburgh. Ph.D. thesis, 275pp.

Dudley, B., Defew, L. & May, L. (2007) Elevated phosphorus inputs to Loch Leven during storm events - implications for load estimation and catchment management. In: Heckrath, Goswin; Rubaek, Gitte H.; Kronvang, Brian, (eds.) Diffuse Phosphorus Loss. Risk assessment, mitigation options and ecological effects in river basins. Aarhus, Denmark, National Environment Research Institute, University of Aarhus, 141-144, 4pp. (DJF Plant Science, 130).

Elliott, J.A. & Defew, L. (2012) Modelling the response of phytoplankton in a shallow lake (Loch Leven, UK) to changes in lake retention time and water temperature. Hydrobiologia 681: 105-116. https://doi.org/10.1007/s10750-011-0930-y

Lang, P., et al. (2016) Phytoplankton community responses in a shallow lake following lanthanum-bentonite application. Water Research 97 (Special Issue on Geo-engineering to Manage Eutrophication in Lakes): 55-68. https://doi.org/10.1016/j.watres.2016.03.018

May, L., Taylor, P., Gunn, I.D.M., Thackeray, S.J., Carvalho, L.R., Hunter, P., Corr, M., Dobel, A.J., Grant, A., Nash,G., Robinson, E & Spears, B.M (2022). Assessing climate change impacts on the water quality of Scottish standing waters. CRW2020_01. Scotland's Centre of Expertise for Waters (CREW). Available online at: crew.ac.uk/publications

May, L. & Spears, B. (2012) Loch Leven: 40 years of scientific research. Understanding the links between pollution, climate change and ecological response. Developments in Hydrobiology 218, 130pp

May, L. & Spears, B.M. (2012) Managing ecosystem services at Loch Leven, Scotland, UK: actions, impacts and unintended consequences. Hydrobiologia 681: 117-130. https://doi.org/10.1007/s10750-011-0931-x

May, L. (2018) Water governance at Loch Leven, Scotland. Unpublished report to the Scottish Government's Rural and Environment Science and Analytical Services (RESAS). 10pp.

May, L., Dick, J., Gunn, I.D.M. & Spears, B. (2019) River Leven Catchment Initiative: Synthesis of current knowledge to help identify environmental management priorities to improve the water environment. CD2018/2. Available online at: crew.ac.uk/publications.

May, L., Moore, A., Woods, H., Bowes, M., Watt, J., Taylor, P. & Pickard, A. (2017) Loch Leven nutrient load and source apportionment study. Inverness, Scottish Natural Heritage, 73pp. (Scottish Natural Heritage Commissioned Report no. 962)

O'Reilly, C.M., et al. (2015) Rapid and highly variable warming of lake surface waters around the globe. Geophysical Research Letters 42 (24): 10773-10781. https://doi.org/10.1002/2015GL066235

Richardson, J., et al. (2019) Response of cyanobacteria and phytoplankton abundance to warming, extreme rainfall events and nutrient enrichment. Global Change Biology 25 (10): 3365-3380. https://doi.org/10.1111/gcb.14701