



Emerging Risks of Chemicals in the Environment

Guidance for invited research grant Full Proposals

Full Proposal deadline: 16.00 BST 10 January 2018

1. Summary

NERC is inviting Proposals for research under the NERC funded programme on Emerging Risks of Chemicals in the Environment. This £6m research programme aims to conduct research to predict how the environment and its functioning will respond to chemical exposure in the UK. The anticipated high level outcome is a move towards a transformation in the way chemical risk assessment is considered: one in which ecological relevance and sustainable ecosystems are given much greater emphasis.

This research programme will deliver fundamental process understanding underpinning chemical behaviour and impact in the environment and a predictive capability to support novel approaches to chemicals management, in three interlinked research questions:

- I. What are the impacts of hazardous chemicals on populations, ecosystems and ecosystem services?
- II. What are the ecological risks from chemical mixtures?
- III. How important are chemical stressors in relation to other stressors in the environment?

Proposals should be framed around particular regulatory, policy and/or industry challenges and can address any or all of the research questions above, recognising that for some scenarios, some of the questions may be less relevant than others. Proposals should focus on addressing issues that regulators or industry are currently facing or might face in the future and concerning chemicals whose environmental impacts have yet to be explored: NERC is not seeking research on chemical issues where environmental impact is reasonably well understood.

Projects will supported up to £1.9m (at 80% FEC) for four years and will be expected to start in September 2018. It is expected that the programme will support up to three projects.

NERC is inviting successful applicants of the Outline Bid stage to submit Full Proposals. NERC will only accept Full Proposals from applicants that had been previously submitted an Outline Proposal and have subsequently received confirmation from NERC that a Full Proposal can be submitted.

It is expected that proposals will evolve between the Outline and the Full Proposal (including personnel), but major science elements of the project proposed are expected to remain broadly the same, within the confines of any feedback from the Outline stage. Applicants should agree any significant proposed changes with NERC prior to submitting their Full Proposals. Applicants are advised to strongly consider the feedback from the outline panel when further developing your full proposal for submission.

2. Background

There are many tens of thousands of chemicals that we use in our homes, industries and food systems and the market is growing by about 2000 new compounds per yearⁱ. Chemical use is dynamic; looking to the future, the changing demographics of a globally rising, and in developed countries increasingly ageing and medicated, population will lead to more drugs discharged through the water systems; changing agricultural practices, energy and material needs are likely to lead to new effluents and pressures; new pest and disease pressures and increasing resistance to products will alter use of agrochemical and veterinary products; green chemistry has the potential to drive the development of novel sustainable and non-hazardous chemistries in the future; and a focus on recycling and reuse will change how we use products and manage waste streams.

The persistence and fate of chemicals entering the environment are controlled by complex interactions with natural processes. Ecosystems are exposed to combinations of chemical mixtures and other environmental stressors and environmental changes. The potential impacts of exposure on individual organisms has been the focus of considerable research, and has influenced much of the existing chemicals legislation. However, understanding of dynamic, complex and long-term exposure and the implications for critical ecosystems and the services they provide, remain uncertain and difficult to predictⁱⁱ. Furthermore, there is ongoing loss of biodiversity and other evidence for environmental degradation and it is not known what contribution chemicals make towards this.

In the UK, Defra and the Devolved Administrations have responsibility to ensure a cleaner, healthier environment, benefiting people and the economy. These bodies and their Agencies implement policy and regulation of chemical use to achieve good environmental quality, for example REACH, pesticides regulations and the Water Framework Directive. It is important to ensure that regulation affords adequate protection of the environment and humans, and that measures to reduce risk are proportionate and cost-effective. Key concerns for regulators are therefore to ensure the right risks are addressed and dealt with in a proportionate way, and to anticipate emerging risks.

Many industries developing new chemicals and products are committed to responsible innovation through environmental policies, all have a legal requirement to comply with regulatory standards, and wish to avoid costs developing products that are not safe. Industry has a very good understanding of the chemical properties of its products and is working to

improve knowledge of chemical exposure and ecologically relevant risk-assessment to develop screening techniques.

Current approaches to environmental regulation of chemicals do not include the broader ecosystem view. New approaches and modelling techniques now exist to improve our understanding and certainty of the impacts of chemicals on the environment, which is an opportunity to improve an assessment system that might not be adequately performing and may be over or under protective. Gaining knowledge to fill current gaps is an opportunity to improve regulations for the UK and promote sustainable innovation, investment and jobs.

3. Scope

3.1 Programme objectives

The aim of this programme is to conduct research to predict how the environment and its functioning will respond to chemical exposure that regulators or industry are currently facing or might face in the future in the UK. The anticipated high level outcome is to move towards a transformation in the way chemical risk assessment is considered, toward one with greater ecological relevance and more explicit emphasis on sustainable ecosystems. The impact will be to enable sustainable innovation and stimulate future changes in the regulatory framework to allow proportionate regulation; affording adequate environmental protection and avoiding unnecessary costs for industry and regulators.

This research programme will deliver fundamental process understanding underpinning chemical behaviour and impact in the environment and a predictive capability to support novel approaches to chemicals management, in three interlinked research questions:

I. What are the impacts of hazardous chemicals on populations, ecosystems and ecosystem services?

- To date, research has focussed on the hazard and risks of single chemicals on individual organisms under controlled laboratory conditions, thus missing impacts on higher levels of biological organisation and ecosystem services.
- The scientific challenge is to move beyond looking at individuals to determine chemical impacts at the population-level and on ecosystem function and ability to provide ecosystem services at ecologically relevant exposure levels. Approaches could include (but are not restricted to) modelling that bridges the gap from adverse outcome models at the cellular and individual level to population models incorporating species traits and life histories. Alternatively, novel data science approaches could exploit very large under-utilised environmental monitoring datasets to identify associations between chemical measurements and subtle changes in ecological status.

II. What are the ecological risks from chemical mixtures?

- Prospective approaches to chemical regulation have mainly addressed risks one substance at a time at the point of authorisation or registration. Retrospective approaches have also focussed on managing chemicals one at a time, which means there has been little progress in assessing the risks posed by the

presence of combinations of chemicals in the environment.

- The scientific challenge is to advance chemical mixture research to address both exposure and effects. Approaches could include laboratory and fieldwork to improve understanding of behaviours and fate of chemical mixtures in the environment, including degradation to understand if this is an important factor in mixture effects. Experimental research could determine whether additivity is an adequate explanation of chemical effects when they occur in combination, and where more sophisticated types of interaction (like antagonism or synergism) are likely to be important. This process understanding could be used in models and provide tools to assess the likely impact of mixtures, that are occurring or are like to occur in the future.

III. How important are chemical stressors in relation to other stressors in the environment?

- Organisms are exposed to a range of environmental stressors throughout their lifetime (e.g. nutrient enrichment, habitat change, competition from invasive species, etc.), of which chemicals are only one. To date, there has been little advance in our understanding of the importance of chemical stressors in relation to other stressors. This is important to ensure measures to improve the environment are well-targeted and resources are focussed on the most significant pressures.
- The scientific challenge is to understand the ecological effects of combinations of chemicals (see II above) and other stressors that are occurring or are like to occur in the future, to determine the importance of chemicals as environmental stressors. Mechanistic studies, coupled with empirical field observations and epidemiological studies could enable the impacts of multiple stressors, including chemical mixtures, on ecological functioning to be understood at different spatial and temporal scales, trophic levels and degrees of biological organisation. This understanding may be used to identify and predict how combinations of stressors can affect ecosystems and the circumstances in which these interactions are most important.

3.2 *Proposal requirements*

Proposals should be framed around particular regulatory, policy and/or industry challenges and are required to address at least one of the questions described in section 3.1. Proposals may choose to address one or more of the questions, recognising that some may be less relevant to the regulatory, policy or industry challenge proposed.

Some examples of challenges **for illustrative purposes only** include:

- Land spreading of organic materials

Organic-rich wastes are a key source of soil improvers supplying nutrients, liming agents and organic matter to UK farmland. As well as providing benefits, recycled materials also introduce chemical contamination to soil. Regulation is based on

research focussed on heavy metals and currently no such robust evidence base exists for many emerging hazards in modern waste streams including flame retardants, personal care products, and pharmaceuticals and rare earths. There is a need to understand more about these organic wastes and to balance benefit to soil quality against risks arising from the presence of a mixture of chemical contaminants. Farmers, landowners, waste managers (including anaerobic digestion and compost facility operators) and businesses that produce organic waste or production residues (e.g. distillers) all have a stake in this system.

- Future policy to control persistent contaminants

Some substances used in construction, personal care products and industry persist in the environment where they can pose ongoing or periodic risks e.g. when contaminated sediments are disturbed by dredging or storm events. The development of future policy to tackle persistent pollutants requires good evidence of their likely presence and an intelligent approach to the design of the most effective interventions. The policy challenge is to predict the behaviour, distribution and impact of these chemicals and whether proposed measures (e.g. source control, end of pipe treatment for sewage treatment works, dredge and treat options for river sediment) will be effective or whether due to complexities of ecosystem response and chemical combinations, different approaches are needed.

Proposals are expected to take a systems approach to addressing these challenges and ensure both point and diffuse sources of pollution, and transfer across environmental media, are considered. Proposals will also be expected to determine general principles for managing chemicals in the environment so that the research is broadly applicable to a wider set of regulatory and industry problems.

Applicants are encouraged to seek appropriate partnerships and undertake early consultation with regulators, policy and/or industry. Defra, Environment Agency, Scottish Environmental Protection Agency, Natural Resources Wales and the UK Water Industry Research group have expressed an interest in being involved in projects relevant to their business needs and contact details are listed in Annex 1. Partnerships are not a pre-requisite for this call and there is no obligation to include any of the organisations listed, but the assessment process will consider whether *appropriate* partnership is taken into account in the proposals. It is expected that proposals with any industry partnerships will ensure that effective agreements and processes are in place to assure the independence and impartiality of the research.

Proposals must be within [NERC remit](#). Research supported can be based across the natural environment, including freshwater, marine, terrestrial, atmospheric etc. and their interfaces. The research will be focussed on UK systems but can take note of broader global issues if this is linked.

Proposals should focus on addressing issues that regulators or industry are currently facing or might face in the future and concerning chemicals whose environmental impacts have yet to be explored: NERC is not seeking research on chemicals or chemical issues where the environmental impact is reasonably well understood.

The successful portfolio of projects will be selected to ensure a balanced programme of research.

4. Programme requirements

4.1 Programme funding

There is £6m available for this programme which will fund up to three collaborative research grants for four years, and additional integrative activities across the successful proposals

4.2 Implementation and delivery

Projects will be up to £1.9m (at 80% FEC) for four years and will be expected to start in September 2018. Additional funds will be made available to successful projects at a later date to support the integrative activities.

4.3 Knowledge Exchange and impact

Knowledge Exchange (KE) is vital to ensure that environmental research has wide benefits for society, and should be an integral part of any research. All applicants must consider how they will or might achieve impact outside the scientific community and include this in the Case for Support in the section on proposed Pathways to Impact. The Pathways to Impact will identify those who may benefit from or make use of the research, how they might benefit or make use of the research, and methods for disseminating data, knowledge and skills in the most effective and appropriate manner. This activity may have associated delivery costs but Pathways to Impact activities do not have to be cost-incurring; it is not a requirement to include funded activities. Any funds required to carry out any proposed, outcome-driven activities identified within the Pathways to Impact **must** be fully justified within the Justification of Resources statement.

4.4 Data management

The [NERC Data Policy](#) must be adhered to and applicants are expected to outline a data management plan as part of the Case for Support. NERC will pay the data centre directly on behalf of the programme for archival and curation services, but applicants should ensure they request sufficient resource to cover preparation of data for archiving by the research team.

4.5 NERC facilities

Prior to submitting a proposal, applicants wishing to use a NERC service or facility must contact the facility to seek agreement that they could provide the service required. Applicants wishing to use a NERC facility will need to submit a mandatory 'technical assessment' with their proposal (including aircraft but excluding ships and HPC). For NERC, this means a quote for the work which the facility will provide. A [full list](#) of the Facilities requiring this quote can be found here on the NERC website. The costs for the service or facility (including NMF costs) must be included within the Directly Incurred Other Costs section of the Je-S form and also within the facilities section of the Je-S form. Further information on [NERC services and facilities](#) can be found on the NERC website.

4.6 Programme management and coordination

Following the award of grants, additional funds of up to £300K will be available to deliver activities designed to improve integration and coordination of research efforts (such as synthesis activities and science meetings) but also carry out cross-cutting knowledge exchange, impact and innovation activities. This will be planned by the successful grants in consultation with NERC and awarded to projects as additional funding streams. It is an expectation that all successful grants will take part in this activity and this will be an additional condition on grant awards.

5. Application process

5.1 How to apply

5.1.1 Full Bid Stage

Closing date: 10 January 2018

Only applicants successful in the outline proposal stage are eligible to submit a full bid.

Full Bid Proposals must be submitted using the Research Councils' Joint Electronic Submission system (Je-S). For all proposals please select Proposal Type - 'Standard Proposal' and then select Scheme - 'Directed' and the Call - 'Chemicals JAN18'.

Applicants must ensure that their Proposal is received by NERC by 4pm on the closing date. Any proposal that is received after the closing date, is incomplete, or does not meet the eligibility criteria of this call for proposals, will be returned to the applicant and will not be considered.

For all proposals the Principal Investigator must submit a completed Je-S Full Bid proforma together with a Case for Support. All documents should be completed in single-spaced typescript of minimum font size 11 point Arial font or other sans serif typeface of equivalent size to Arial 11, with margins of at least 2 cm. Please note that Arial narrow and Calibri are not allowable font types as they are smaller and any proposal which has used either of these font types within their submission will be rejected. References and footnotes must also be presented in minimum font size 11 point and should be in the same font type as the rest of the document. Headers and footers should not be used for references or information relating to the scientific case. Applicants referring to websites should note that referees may choose not to use them.

Applicants should ensure that their proposal conforms to all eligibility and submission rules, otherwise their proposal may be rejected without peer review. More details on NERC's submission rules can be found in the [NERC research grant and fellowships handbook](#) and in the [submission rules](#) on the NERC website.

Proposals for this call should be submitted in Large grant format following the requirements outlined in Section F of the [NERC research grant and fellowships handbook](#).

Please note that on submission to Council ALL non PDF documents are converted to PDF, the use of non-standard fonts may result in errors or font conversion, which could affect the overall length of the document.

Additionally where non-standard fonts are present, and even if the converted PDF document may look unaffected in the Je-S System, when it is imported into the Research Councils Grants System some information may be removed. We therefore recommend that where a document contains any non-standard fonts (scientific notation, diagrams etc.), the document should be converted to PDF prior to attaching it to the proposal.

No associated studentships can be requested under this call.

5.2 Eligibility

Normal individual eligibility applies and is in Section C of the [NERC research grant and fellowships handbook](#). NERC research and fellowship grants for all schemes may be held at approved UK Higher Education Institutions (HEIs), approved Research Council Institutes (RCIs) and approved Independent Research Organisations (IROs). Full details of [approved RCIs and IROs](#) can be found on the RCUK website.

Investigators may be involved in no more than two proposals submitted to this call and only one of these may be as the lead Principal Investigator.

6. Assessment process

Proposals will be subject to international expert peer review. Final assessment will be by a Moderating Panel drawn from the Outline Panel membership plus other expertise as required. Applicants will be given the opportunity to provide a written response to peer review comments prior to the moderating panel meeting. Full Proposals will be assessed against the following criteria:

- **Research Excellence:** a proposal that demonstrates excellence can be characterised by terms such as: novel, ambitious, timely, exciting, at the international forefront, adventurous, elegant or transformative, but need not demonstrate all of them.
- **Fit to Scheme (scientific only):** - proposals will be assessed against the extent to which they address the programme's scope and scientific requirements as detailed in this AO.

The Moderating Panel will make funding recommendations to NERC based on the criteria outlined above and the potential for the projects to deliver a balanced portfolio to address the programme objectives. NERC reserves the right to withhold programme funding if the full extent of the programme objectives are not covered in this call or the balance of funding across recommended projects does not fit the structure of programme funding and its objectives. NERC also reserves the right to weight *Fit to Scheme* appropriately to achieve the strategic aims of the programme.

7. Timetable

Full Proposals invited
Closing date for Full Proposals
Full Proposal Moderating Panel
Grants awarded
Grants start

w/c 6 November 2017
10 January 2018
mid-May 2018
June 2018
September 2018

8. Reporting requirements

As with all NERC grant holders, there will be a requirement to report through the RCUK reporting system; this is required annually and continues for up to five years post grant end. NERC strategic research programmes are also required to biannually report on activity at the programme level. This will be delivered by the projects collectively and be part of the activity outlined in section 4.6.

9. Contact

For all enquiries, please contact: James Box (chemicals@nerc.ac.uk) 01793 411564.

References for Background text

ⁱ Daughton C.G. Non-regulated water contaminants: emerging research. *Environmental Impact Assessment Review* 2004; 24: 711-732. doi: 10.1016/j.eiar.2004.06.003.

Richardson S.D., Ternes T.A. Water Analysis: Emerging Contaminants and Current Issues. *Analytical Chemistry* 2014; 86: 2813-2848. doi: 10.1021/ac500508t.

ⁱⁱ Holmstrup M., et al. Interactions between effects of environmental chemicals and natural stressors: A review. *Science of the Total Environment* 2010; 408: 3746-3762. doi: 10.1016/j.scitotenv.2009.10.067.

Johnson A.C., Sumpter J.P. Putting pharmaceuticals into the wider context of challenges to fish populations in rivers. *Philosophical Transactions of the Royal Society B-Biological Sciences* 2014; 369: 6. doi: 10.1098/rstb.2013.0581.

Annex 1

Potential project partners whom applicants may wish to approach

Several organisations have expressed an interest in contributing resources to individual projects for this call. Applicants may choose to approach any of these of relevance but are not obliged to include any of these organisations.

Government departments and agencies

The Department for Environment, Food and Rural Affairs (Defra) and the Environment Agency (EA)

Defra can offer applicants support in kind, updates on policy thinking, data and technical expertise sharing, engagement with Defra Expert Committees and Defra Science Advisory Council. Please contact Giles Golshetti (Giles.Golshetti@defra.gsi.gov.uk) from the Defra Chief Scientific Adviser's office.

Where proposals are interested in research of relevance to the EA (notably in connection with water quality or persistent organic pollutants), applicants may wish to approach the EA to identify possible access to existing chemical and biological monitoring data, and advice on possible sites for investigation. Please contact Paul Whitehouse (paul.whitehouse@environment-agency.gov.uk) for water quality or Richard Hawkins (richard.hawkins@environment-agency.gov.uk) for persistent organic pollutants.

Natural Resources Wales (NRW)

Where proposals are interested in one or more of the research questions, applicants may wish to approach NRW who can provide access to sites, data and expertise for those elements that are directly related to NRW's regulatory responsibilities. Please contact Mark.Charlesworth@cyfoethnaturiolcymru.gov.uk in the first instance.

Scottish Environment Protection Agency (SEPA)

Where proposals are interested in research of relevance to SEPA (e.g. land spreading of organic materials and urban diffuse water pollution), applicants may wish to approach SEPA to identify possible access to existing chemical and biological monitoring data and advice on possible sites for investigation. Please contact Daniel Merckel (daniel.merckel@sepa.org.uk).

Industry

UK Water Industry Research (UKWIR)

Where proposals are interested in research of relevance to the water industry, applicants may wish to approach UKWIR to identify a possible partner from the UK water industry. Such partners may be able to offer access to sites, data, advice, and other forms of in kind support, as appropriate. Please contact Mandy Fletton (mfletton@ukwir.org.uk).