iCASP Response to Environmental Audit Committee Inquiry: Nitrates Pollution in the UK

April 2018

iCASP

1. Yorkshire Integrated Catchment Solutions Programme (iCASP) is a five-year (2017-2022) Natural Environment Research Council-funded partnership established to support the UK Industrial Strategy. iCASP aims to generate £50 million+ of benefits to Yorkshire's economy by influencing investments, informing policies and strategies, identifying cost savings, and creating new products and jobs. It will do this through projects that support the use of environmental science in catchment management. As well as regional impact, iCASP is aspiring for national and international influence through sharing the experience of regional projects at the national level, and by exporting catchment management expertise and products internationally.

2. iCASP partners are: University of Leeds, University of Sheffield, University of York, National Centre for Atmospheric Science, Arup, Bradford Metropolitan Borough Council, City of York Council, Dales to Vales River Network-Yorkshire Dales Rivers Trust, Environment Agency, IUCN UK Peatland Programme, JBA Trust, Leeds City Council, Linking Environment and Farming, Met Office, Natural England, National Farmers' Union, Pennine Prospects, Yorkshire Water, Yorkshire West Local Nature Partnership, and Yorkshire Wildlife Trust. iCASP is also looking to work with additional organisations through its projects.

3. iCASP is based out of water@leeds at the University of Leeds, one of the largest interdisciplinary centres for water research in any university in the world.

4. iCASP has already had success in providing evidence for major flood risk mitigation business cases in Yorkshire, and supporting the development of the Leeds City Region Green and Blue Infrastructure Strategy.

5. Further information about iCASP can be found at https://icasp.org.uk/

Response to Inquiry

6. **This response is from the iCASP Programme Office based at the University of Leeds, rather than on behalf of the iCASP partners.** It addresses five of the questions from the Inquiry:

   (i) What is the scale of nitrate pollution in the UK and what is the likelihood of the pollution getting worse?

7. Despite efforts made under the Water Framework Directive by 2015 to improve water quality, there is still a continuous decline in freshwater quality in the UK. Nitrate

concentrations are exceeding the EU drinking water standard and have a rising trend in many rivers[1].

(ii) What are the consequences of nitrate pollution for the environment and for human life?

8. See written evidence submission (ref # NO30006) to this Inquiry by Dr Paul Kay, University of Leeds.

(iii) How important are the different sources of nitrate pollution? Where should action be undertaken?

9. See written evidence submission (ref # NO30006) to this Inquiry by Dr Paul Kay, University of Leeds.

(iv) How effectively does Government regulate nitrate usage so that nitrate pollution is reduced as quickly as possible?

(v) What more could Government do to reduce nitrate pollution as quickly as possible?

10. Flow through all major UK aquifers has 'dual behaviour' made up of: i) slow flow through the rock matrix which means that nitrate typically moves very slowly through aquifers, and ii) preferential flow through fractures in the rock, especially in the chalk, Sherwood Sandstone, and Magnesian Limestone aquifers, which means that nitrate can also move very quickly (~20-400 metres per day) to rivers and groundwater abstraction wells[2].

11. Thus in areas of the UK where ground water dominates river flow, the impact of any changes to land management practices on nitrate concentrations can take many decades to be observed. Current environmental water management strategy rarely considers this time lag[3]. In addition where fractures are extensive in the aquifer they represent a major route for rapid nitrate transport to surface waters.

12. On the whole, the slow movement of nitrate through aquifers makes reducing nitrate pollution quickly very difficult and challenging.

13. A key question for further investigation is how long will it take for nitrate concentrations in groundwater to peak and then stabilise at an acceptable level in response to historical and future land management measures. It is therefore necessary to invest in research

[1] Wang, L., M.E. Stuart, M.A. Lewis, R.S. Ward, D. Skirvin, P.S. Naden, A.L. Collins, M.J. Ascott. (2016) 'The changing trend in nitrate concentrations in major aquifers due to historical nitrate loading from agricultural land across England and Wales from 1925 to 2150', *Science of the Total Environment*, **542**, pp.694-705 http://dx.doi.org/10.1016/j.scitotenv.2015.10.127

[2] Medici G., L.J. West, N.P. Mountney. (2016) 'Characterizing flow pathways in a sandstone aquifer: Tectonic vs sedimentary heterogeneities', *Journal of Contaminant Hydrology*, **194**, pp.36-58. http://dx.doi.org/10.1016/j.jconhyd.2016.09.008; Medici G., L.J. West, N.P., Mountney. (2018) 'Characterization of a fluvial aquifer at a range of depths and scales: the Triassic St Bees Sandstone Formation, Cumbria, UK', *Hydrogeology Journal*, **26**, pp. 565-591, http://dx.doi.org/10.1007/s10040-017-1676-z

[3] Wang, L., M.E. Stuart, M.A. Lewis, R.S. Ward, D. Skirvin, P.S. Naden, A.L. Collins, M.J. Ascott. (2016) 'The changing trend in nitrate concentrations in major aquifers due to historical nitrate loading from agricultural land across England and Wales from 1925 to 2150', *Science of the Total Environment*, **542**, pp.694-705 http://dx.doi.org/10.1016/j.scitotenv.2015.10.127

investigating the impacts of historical nitrate loading from agricultural land on the changing trends in nitrate concentrations for the major aquifers in the UK.

14. Hydraulically-active rock-fractured areas are priorities for Government intervention, but also offer the opportunity to measure the effectiveness of different approaches to nitrate usage regulation and land management given the rapid transfer of nitrate in these areas.

Future work to support this Inquiry

15. iCASP is in the process of setting up a project to review/consolidate the scientific evidence on different land management activities and their delivery of public goods. The focus of this review will be the public goods of: improved water quality, soil health, flood risk mitigation, and increased biodiversity.

16. The aim of this evidence review is to provide easier access to evidence, and greater awareness of the levels of certainty/uncertainty associated with that evidence, that can inform the debate on the future of land-use policy and practice post-Brexit. The review will be submitted to Defra as part of the consultation on 'Future for food, farming and the environment'. Summaries will be produced for policy makers (including the Secretariat of State and Ministers, MPs and Defra staff), as well as for farmers and the agricultural supply chain.

17. Environment Agency, Natural England, Yorkshire Water and National Farmers' Union, will be some of the organisations advising the scope and format of the review.

18. The focus on water quality and soil health will mean that insight into the effect of land management activities for reducing/managing nitrate pollution will be provided. This will be useful evidence for informing which land management activities the Government should support to reduce nitrate leaching to surface and ground waters, and will also reveal any evidence gaps that could be addressed through UK Research and Innovation investment.

19. The review's focus on the interaction between land management activities on the delivery of different public goods across catchment scale will also highlight the consequences of nitrate pollution for the environment and for human life.

20. The review will draw upon evidence including that produced at the University of Leeds - some of which is profiled above, or referenced in the written evidence submission (ref # NO30006) to this Inquiry by Dr Paul Kay, University of Leeds.

21. In addition, research has been carried out by the University of Leeds to identify the sources and transport pathways for nitrate within the Yorkshire chalk aquifer and sandstone aquifers in North-West England, and to use isotopic approaches to distinguish agricultural-derived nitrate from other anthropogenic and natural sources, in order to inform nitrate mitigations plans including land-management approaches such as controls on fertiliser applications in nitrate vulnerable zones, safeguarding zones around abstraction wells, and grass-clover leys in arable rotations.

Conclusions

22. Generally nitrate movement through aquifers in the UK is very slow, making it difficult to test the effectiveness of different mitigation measures and to reduce nitrate pollution quickly.

23. However, rock fractures can mean that nitrate is transported quickly in some parts of the country (e.g. Sherwood Sandstone areas in Yorkshire[4]) to rivers and water wells. These areas should be prioritised for Government intervention. They also present opportunities to investigate the effectiveness of different mitigation measures.

24. The Yorkshire Integrated Catchment Solution Programme's (iCASP) review of evidence on agri-land management for public goods delivery that will be released in the summer of 2018 will be a useful source of information to help inform the Government's approach to nitrate regulation and management.

[4] Bottrell S.H., L.J. West, K. Yoshida. (2006) 'Combined isotopic and modelling approach to determine the source of saline groundwaters in the Selby Triassic sandstone aquifer, UK', *Geological Society Special Publication*, **263**, pp.325-338, https://doi.org/10.1144/GSL.SP.2006.263.01.19