

Digital Environment: views on emerging issues and wider possibilities

A public dialogue conducted on behalf of the Natural Environment Research Council



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This report has been prepared by Hopkins Van Mil (HVM). It was commissioned by the Natural Environment Research Council (NERC).

NERC is part of UK Research and Innovation (UKRI). It is funded by government to commission excellent, independent environmental research. NERC is the UK's main agency for funding and managing research, training and knowledge exchange in the environmental sciences. NERC's work covers the full range of atmospheric, Earth, biological, terrestrial and aquatic science, from the deep oceans to the upper atmosphere and from the poles to the equator. It coordinates some of the world's most exciting research projects, tackling major issues such as climate change, environmental influences on human health, the genetic make-up of life on Earth, and much more.

HVM facilitates engagement so that voices are heard, learning is shared, and understanding achieved. In practice this means finding the process by which people can explore their hopes, fears, challenges and aspirations for the future. HVM's work enables stakeholders, technical specialists, and a diversity of publics to work together as equals to make actionable, better informed, and powerful decisions.



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1. Executive summary

The NERC-led Digital Environment Programme¹ is part of UKRI’s overarching Strategic Priorities Fund (SPF)². It aims to develop a digitally enabled environment, delivering the capacity to improve the understanding and modelling of longer-term environmental change and the prediction of events. HVM was commissioned to design and deliver a small-scale trial public dialogue to test the potential for future, larger dialogic activities engaging a diverse range of publics with NERC’s work in this area.

This report sets out how HVM designed a process to enable NERC to listen and respond to the issues and opportunities raised by citizens as stakeholders in research on the topic of Digital Environment. The pilot process involved two rounds of public dialogue workshops in two locations. 13 people were involved as participants in London and 12 in Swindon. The process is set out in figure 1.

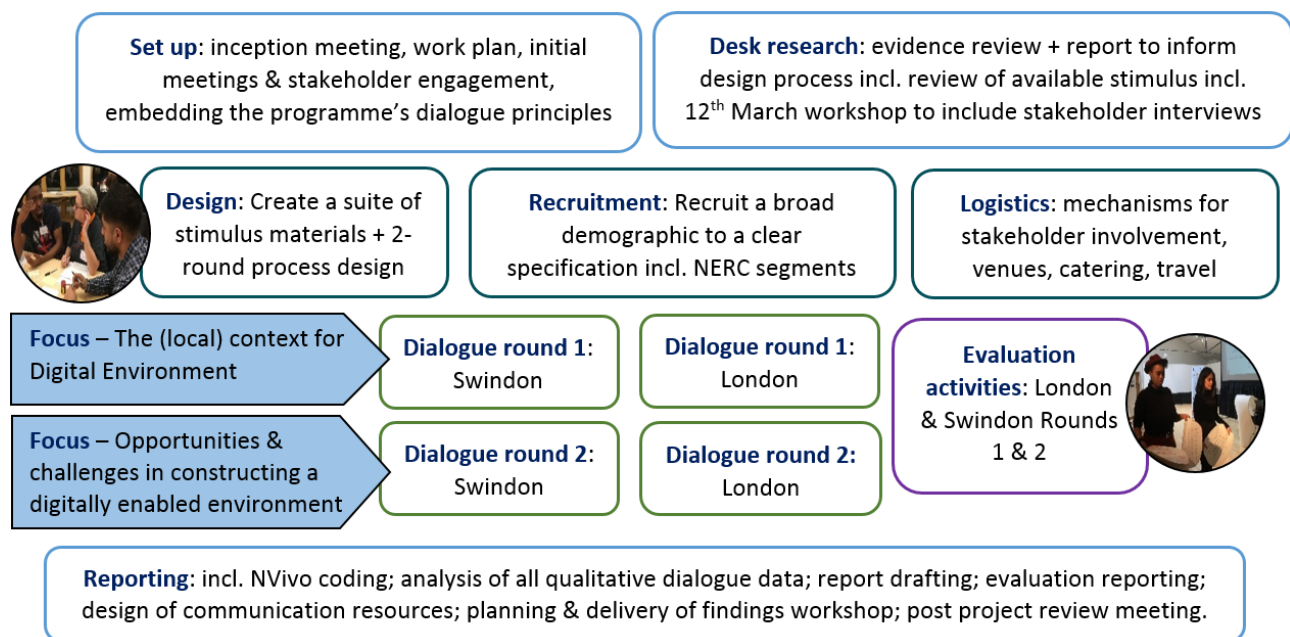


Figure 1: A summary of the pilot dialogue process

This report explains the findings from a detailed analysis of the discussions generated through public dialogue on a significant topic for NERC. It presents the key themes identified by participants as important. What is clear from the analysis is that when people are given enough evidence and information on digital technologies used for research into the environment they are struck by the importance of the subject and the need for ongoing collaboration, endorsing NERC’s aim that citizens are important stakeholders in research. This is summed up in the quotations below,

I guess the theme is the working together, it is the heart of NERC’s work on digital programmes. It doesn’t work if it’s on its own. So, it is the essence of wonderfully clever people, researchers, scientists, etc and us as people, citizens, coming together to actually make it work as a discipline to help the environment. | Swindon

¹ <https://nerc.ukri.org/innovation/activities/environmentaldata/digitalenv/>

² A new collective fund across UKRI which aims to better enable investment in cross-departmental research and innovation priorities

It was great to learn about ways the public can interact with the digital environment and those studying it, and to think that ultimately this could allow us to call on the powers that be to take action. | London

1.1 Main findings

The main findings from the dialogue are grouped around the ideas set out in figure 2.

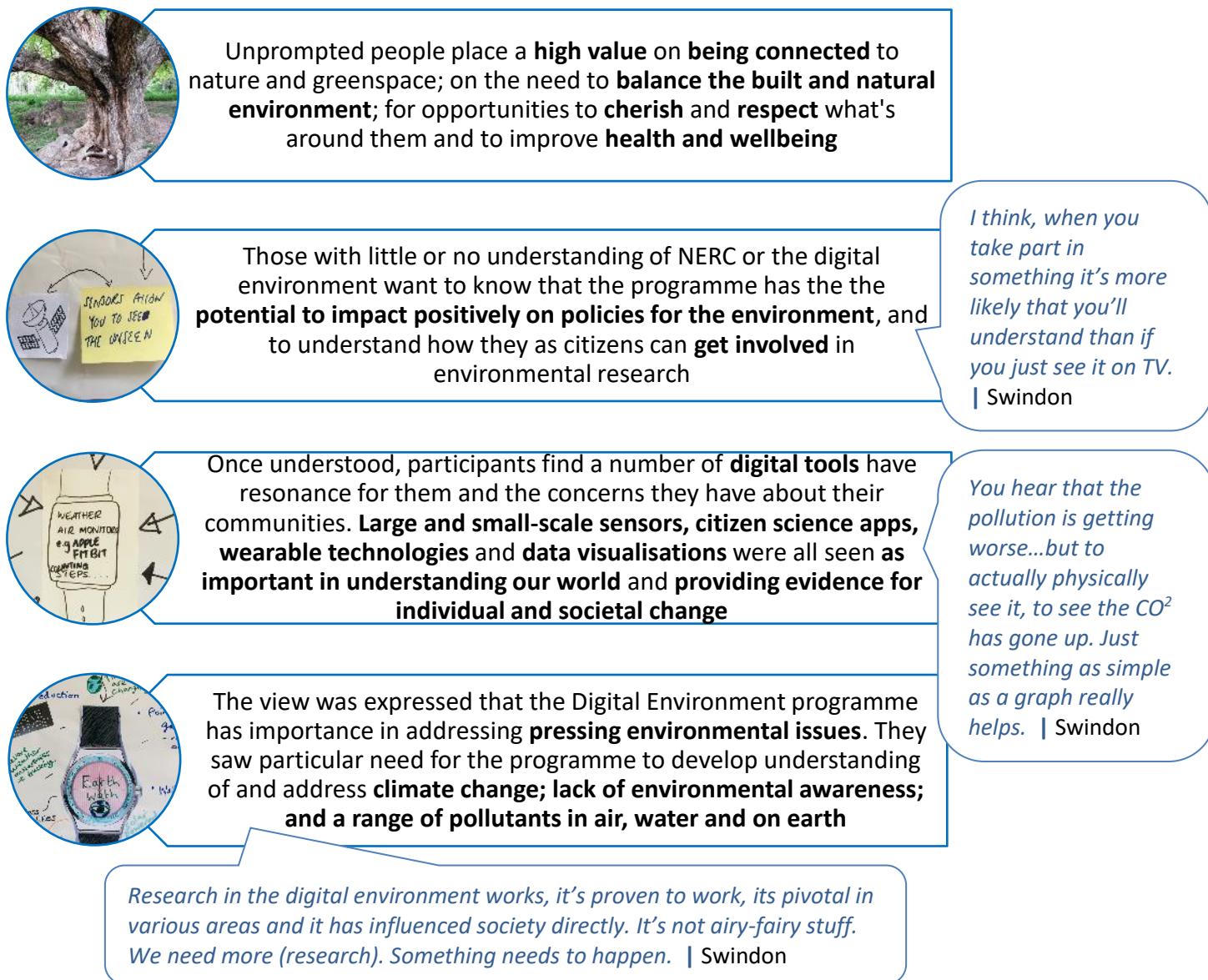


Figure 2: A summary of the main findings

1.2 Recommendations

The recommendations made in this report are split in to two sections, those made to NERC by participants in the Digital Environment programme as part of the dialogue process (figure 3);

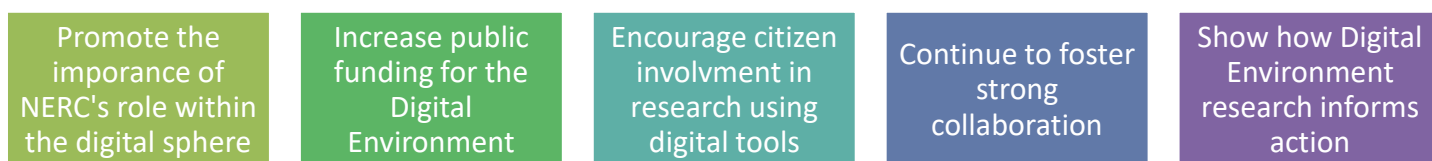


Figure 3: Participant recommendations

and those made by HVM having listened to participants and analysed the qualitative data that has emerged from the dialogue. The latter are grouped into the two categories set out in (figure 4).



Digital environment recommendations

- Given the finding that a wide range of different scale technologies, from satellites to wearables, resonate with participants, we recommend **investment across digital scales**, particularly as research findings from the largest to the smallest technologies can have a great impact on people's lives, as well as on long-term strategic planning
- Ensure that **all communication strategies** for the Digital Environment **embed good practice** in clear and jargon free written and spoken English
- Continue to engage online with the participants involved in this pilot study as an informed audience who can **ensure the language used in communications is appropriate for a lay audience** and to provide opportunities to **test digital tools** including the use of **Citizen Science Apps**
- This dialogue has confirmed previous research findings that communications with citizens on the **research resulting from digital technologies should start by focusing on local and community issues** before taking the engagement further **to embrace national and global themes**
- However dialogue participants put funding for digital tools to understand and react to climate change and research into alternative energy sources, as a priority above using them to monitor and address pollution in air, water and on the ground. As such **we recommend communications which provide accessible and clear information and evidence on global issues**. Given the right evidence, citizens quickly understand the connections between the local and the global, and the value digital tools have in understanding those connections.



Public dialogue recommendations

- In future deliberative processes we **recommend involving a dialogue contractor earlier** in the process, particularly in **the framing of the research questions** to give the deliberations a focus which is as clear as possible from the outset
- Allow **sufficient time and budget** for the involvement of a **greater number of participants and stakeholders** in the process so that participants hear evidence from a **range of sources and perspectives** and the findings reflect views from a **broad demographic across the country**
- Continue to **embed public dialogue** in the Digital Environment programme, particularly on issues which are potentially controversial and / or with an emotional dimension such as: **trust and data protection; public confidence on data usage; testing ways of using the research for influencing and advocacy**
- Consider **public dialogue**, and other forms of **deliberation such as larger-scale Citizens' Assemblies and Juries**, to inform a range of strategic priority developments across NERC's portfolio.

Figure 4: HVM recommendations

2. Introduction to the research

2.1 Research purpose and scope

The Strategic Priorities Fund (SPF) is a new collective fund across UKRI which aims to better enable investment in cross-departmental research and innovation priorities. Its purpose is to increase high quality multi-disciplinary and inter-disciplinary research and innovation, and position UKRI to be able to respond to strategic priorities and opportunities. Part of this programme is the NERC-led Digital Environment Programme a strategic fund established to develop a digitally enabled environment. A strategic focus for NERC, the Digital Environment Programme will deliver the capacity to improve the understanding and modelling of longer-term environmental change and the prediction of events. This will benefit a range of public and private sector users and provide evidence to support both decision-making and operational activities.

Advances in digital technology have led to a rapid increase in the volume of environmental data being captured, curated and managed on a daily basis. Alongside this, new technologies have enabled a step-change in global capacity for integrated monitoring, analysis, modelling and visualisation of the natural environment at scales which have the potential to transform our understanding of the Earth. The Digital Environment programme will provide insight into how these technologies could be used more efficiently to inform policymaking and benefit businesses, communities and individuals. The topic is therefore an important one for NERC's future strategic thinking, and the process equally significant in testing how citizens respond to complex new and near horizon technologies being used to understand and plan for the future of the natural environment.

HVM was commissioned to design and deliver a small-scale trial public dialogue to test the potential for future, larger dialogic activities engaging a diverse range of publics with NERC's work in this area. The overall aim of the public dialogue was to enable NERC to listen and respond to the issues and opportunities raised by members of the public as stakeholders in research, on the topic of Digital Environment. The specific project engagement objectives were to:

- Provide an enjoyable, worthwhile public dialogue in which participants can explore emerging issues and wider possibilities associated with NERC Digital Environment activities through an interaction with NERC decision makers, environmental scientists, data managers and users, and other research stakeholders
- Identify emerging issues raised by participants, alongside other relevant stakeholders, for NERC funding priorities that can be fed into the development of future NERC funding calls and events focused on the Digital Environment
- Demonstrate that NERC listens and responds to a wide range of stakeholders in research, including the public, in a participatory manner on emerging research themes
- Develop NERC staff capacity and skills to deliver high-quality and relevant public dialogue and to develop understanding of how and where dialogue can be used as a process to improve NERC science decision making
- Learn from recent, relevant, successful examples of trialled public dialogue, with consideration as to how NERC can contribute to best practice and become more innovative in the sphere.

As a result of this public dialogue NERC aimed to demonstrate a greater openness to public views, having listened to a wider range of stakeholders in a participatory manner. They also expected the following outcomes and impacts, that:

- NERC research has enhanced relevance and impact, following consultation with the public as stakeholders in research to provide useful insight in shaping, challenging and broadening its thinking
- Dialogue participants feel the experience to be positive and worthwhile; having enjoyed the opportunity and having been enabled to share their views and ideas on areas of research that affect them; and have had sufficient information following their input
- Planning excellent communications for dialogue activities and providing results, learnings and benefits from the dialogue in a format that can be used and communicated to NERC staff as well as relevant stakeholders including members of the public and NERC researchers
- NERC staff capacity and skills to deliver high-quality and relevant public dialogue has been increased enabling adoption of dialogue as a process to engage and inform NERC. This includes NERC staff feeling that public dialogue is a useful and necessary activity when developing programmes with associated social and ethical issues
- NERC staff involved in the project understand how and where dialogue can be used as a process to improve NERC science decision making, considering it a useful and necessary activity and communicate this to UKRI colleagues
- The Digital Environment public dialogue and evaluation is perceived as a current, relevant, successful example of public dialogue and NERC can learn from this small-scale trial in future, larger dialogue activities.

To achieve these aims, objectives, outcomes and impacts HVM worked with a small NERC project panel including staff members from the Public Engagement and Digital Environment teams. The methodology, public dialogue, was selected by NERC prior to commissioning as the principle engagement tool. Public dialogue is an important process for enabling all those involved to:

- *Think before they react*
- Interact with others who have a range of experience of the issue whether through lived or professional experience
- Actively participate in discussions which lead to informed policy and decision making.

2.2 Participant recruitment

2.2.1 Public dialogue recruitment

This engagement programme is a pilot to trial public dialogue as a future public engagement tool for NERC, with a small-scale budget and timing constraints. As such the number of participants involved in the process was small, with up-to 14 public participants involved in each location. Nevertheless HVM employed best practice in recruitment to model the opportunities for scaling up for future larger public dialogues. Recruitment for the dialogue was conducted by HVM's fieldwork team, Roots Research, against a detailed specification and screener. Participants were not self-selecting.



The recruitment had two main aims - to:

1. Cover a **broad demographic** in line with 2011 census data for each location
2. Include a spread of views across the **five segments** defined as sub-sets of the national population in the Public Insights Research commissioned by NERC³. In this way the research included participants on a scale from those who are highly engaged and interested in environmental research to those who have had little or no exposure to research in an environmental context.

The methods for recruitment included on street selection and drawing on Roots Research's standing panel to identify those who were a best fit for the recruitment specification. This is done by means of a questionnaire which is conducted by an experienced fieldworker to ensure that all the criteria are met. In line with best practice⁴ HVM pays incentives for participants involved in dialogue sessions as a recognition of the time they give to the process whilst not compromising the principle of freely given and fully informed consent. In this case participants were paid £165 to attend one evening and one day-long workshop.

The small-scale budget also meant that no more than two locations could be selected for inclusion in the dialogue process. The choices of Kennington in London and Swindon were pragmatic to allow HVM to manage the dialogue within the budget, but they nevertheless worked well in terms of meeting recruitment objectives to include people with urban, sub-urban and rural lived experiences. They also ensured the availability and participation of specialists from NERC and the Digital Environment Digital Champions.

2.3 Methodology

The public dialogue process design was informed by discussions with the NERC project team, desk research on relevant NERC funded projects and a limited number of stakeholder telephone interviews. The HVM lead designer also attended the Digital Environment workshop⁵ held in Manchester on 12 March. Further interviews took place at this workshop and observation of the presentations and discussions at this early stage of the programme were significant in informing the process design and identifying relevant stimulus materials to support participant understanding of Digital Environment.

2.3.1 The purpose and management of a two-round process

A two-round process is a fundamental element of a deliberative public dialogue⁶, allowing participants time to reflect both at the workshops and with friends and family outside the sessions. This programme held a first evening workshop at the end of April, followed, four weeks later, by a Saturday day-long second workshop in each location. The timescale was in part dictated by avoiding holding workshops during the Easter break, and is at the longer-end of what is typical for reflection time in between dialogue workshops. However, it served its purpose which is to allow participants, the facilitation and project teams time to consider what is being said and understood and work flexibly in response to that. It encourages people to think beyond their first thoughts and, in response to a variety of evidence-based stimuli to engage in the subject in depth.

³ ComRes [Public Insight Research](#) NERC, March 2017

⁴ Including ESRC's Framework for Research Ethics (2015)

⁵ <https://nerc.ukri.org/innovation/activities/environmentaldata/digitalenv/news/digital-workshop/>

⁶ BEIS/ Sciencewise [The Government's Approach to Public Dialogue on Science and Technology](#) (2018 update)

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The same process was used in each location, with variations in the examples used to reflect the fact that research has shown that when UK publics are interested in environmental research generally, the interest is strongest when they can see how it might affect their own lives, for example air quality monitoring stations near their own homes. This provided the HVM team with a useful steer on how to frame the dialogue, e.g. drawing people in with local contextual examples relevant for each location in Round 1 and extending that to global examples where relevant in Round 2, when participants were more comfortable with the subject matter.

Participants were divided into two small groups in each location. The small group allocations were formed by ensuring there was a spread in each group across the recruitment criteria. Participants stayed in the same group for both workshops to ensure that trust was built and people are able to feel increasingly comfortable in expressing their views. Each group was run by a senior HVM facilitator, with a Lead Facilitator managing the whole session. The same facilitator stayed with the group they were allocated to in round 1, again to support the rapport being developed, an essential part of the dialogue process giving people confidence to interact with each other, their facilitator and the expert witnesses as equals, all bringing rich lived experience to the process. Another factor to note was that the same two senior HVM facilitators worked in both locations ensuring a continuity of approach and to allow each session to inform and build on the next.

2.3.2 Round 1 summary

The Round 1 workshops were held from 5.45 to 9.00pm on week-day evenings in London and Swindon. HVM's approach to all public dialogue initial discussions and presentations, particularly when the subject matter is likely to be completely new to participants, is to set a warm and welcoming space and tone, an approach which chimes with NERC's AccessLab's⁷ learning in this area on room set up. In preparation for the events, participants were asked to bring in an image that reflected what they value in their own environment. Discussions on this were followed by contextual presentations ([see 1.3.4](#)). Participants were asked to reflect on the questions they had on anything they had heard by this mid-point in the evening, with participants' top priority questions being asked in a panel Q&A discussion.

The panel comprised NERC staff and the two Digital Champions⁸ for the Digital Environment programme, whose role it is to oversees the programme (London only). Questions that were not covered in this discussion were taken away so that NERC could respond to them in between Rounds 1 and 2. Participants then used maps of Swindon and London to identify what they considered to be environmental challenges, on whatever scale they considered important. Having identified the challenges each small group considered the digital tools they felt might help towards finding a solution to these challenges. The session ended with a plenary sharing of ideas.

⁷ <https://engage.nerc.ac.uk/2018/05/11/accesslab/>

⁸ Ron Corstanje, Professor of Data Sciences and Head of the Centre for Environmental & Agricultural Informatics and Stephen Hallett is Associate Professor in Environmental Informatics, both at Cranfield University

2.3.3 Round 2 summary

Round 2 workshops were held in the same locations, with the same participants and where possible the same specialists in attendance to act as a resource for the session. Both workshops were held from 6-9pm on a Friday evening and from 10am to 4pm on a Saturday. Participants were asked to attend both workshops in their location. Before the second dialogue workshop participants were asked to spend the time testing out a range of [Citizen Science apps](#). They were also asked to look out for news clips, broadcast news, social media items, or any other source of information on environmental research, particularly those using digital tools, and to bring that information back to the Round 2 dialogue workshop. The workshop therefore began with a sharing of this information leading into more [contextual information](#) being provided by HVM and the specialist observers in the room. After questions were answered participants, working in small groups, were given a theoretical pot of money (£10 million) to allocate against four digital environment priorities that they agreed on. Participants were then given materials to create the designs for an environmental tracker. They were advised that this could be a small-scale individual tracker that people would use going about their lives, or a much larger-scale monitoring system. As a result of thinking on the trackers, participants were given the space to reflect on the issues and opportunities that arise from digital environment. The session ended with the creation and presentation of key messages that the participants wished to share with NERC and other policy makers and shapers.



2.3.4 Dialogue materials

Due to the requirement to prepare dialogue materials in under a month so that the round one workshops could be completed before the end of NERC's financial year, time was much shorter than is standard for this work, which more normally takes between 6-8 weeks. However, the workshop design and creation of stimulus was achieved by means of a close co-design process between HVM and the NERC project team. In the initial stage of the dialogue the participants themselves provided the principle stimulus input. They were asked to take a snapshot of anything that represents something they value in the environment and bring it to the workshop. These materials were used in the first warm-up session of the dialogue. The discussion on them allowed participants to begin their reflections where they know best: their own homes and communities, and for the facilitation team to gain a sense of what people knew about the subject before the discussions began in earnest. This process also demonstrated to everyone the broad aspects of the environment that could potentially be under discussion when considering the implications of digital environment. Reflections on what people value are given in the [next chapter](#) of this report.

Round 1 Materials: Exploring local contexts

In this evening workshop the stimulus used included film clips, presentations and handouts intended to introduce participants to the context of NERC funded, and key concepts in Digital Environment such as 'big data'. They included:

- An HVM welcome presentation explaining the purpose of the dialogue
- A presentation introducing participants to NERC and its funded science

- An introduction to the science funded by NERC contained in the film clip [Inspiring Scientists](#)
- An HVM produced animation [The Big Data Explainer](#)
- BBC news film on a programme to [monitor air quality](#)
- Handouts on NERC funded [air quality research](#), [citizen science apps](#), [NERC Data Centres](#) and a [Big Data infographic](#)
- Film clip explaining [micro-plastics research at the National Oceanography Centre](#)
- A live search conducted on soil quality in both locations using the [UK Soil Observatory map app](#).

Round 2 Materials: Global contexts and funding priorities

The purpose of the round 2 stimulus materials was to cement the understanding of NERC's role and of the Digital Environment programme gained at the Round 1 workshop; and to introduce the global nature of digitally enabled natural environment research. The materials included:

- An HVM presentation as a reminder programme aims and ways of working
- A NERC presentation as a reminder of their work and funding remit and the purpose of the Digital Environment programme
- A NERC film clip [Explore the world at your feet](#) explaining how NERC science affects us all
- Three film clips looking at NERC funded research [on the ground](#), [in the air](#) and [in the oceans](#)
- An HVM presentation summarising the key things discussed by participants in the Round 1 workshops as a reminder and as a prompt to build on earlier thoughts.

2.4 Recording, analysis & reporting

2.4.1 Recording the workshop discussions

It is important that the discussions are recorded effectively so that participants' discussions can be transcribed and used for data collation and analysis whilst making sure participants' right to privacy is protected. HVM uses three main recording methods:

- Audio recording of each small group and the plenary sessions – these recordings are transcribed after each workshop
- Flip chart recording by the facilitator who notes the key points made and themes arising
- Post-it notes used by participants to record thoughts and headline points in their own words – these are transcribed as part of the flip chart transcription process
- Photographs were taken of the environmental trackers created towards the end of Round 2
- Photographs were taken of participants undertaking various dialogue activities.

Participants are requested to sign permission forms for photographs to be taken and used on HVM and NERC websites and on social media platforms. They are asked verbally if they consent to the audio recording process having been assured by facilitators that their name will not be associated with what they have said in the audio transcriptions, nor used in any of the quotations used in the report. Participants are given, both individually and in small groups, opportunities to ask for the recorder to be turned off at any given point. It is stated in the welcome presentation that all audio recordings are destroyed once the dialogue analysis has been completed.

2.4.2 Analysis and reporting

A large range of written and visual materials resulted from the two-round process in two locations. HVM uses framework analysis⁹ as a robust and standard process for large qualitative data sets. Transcription is the starting point, with constant re-reading of the data to ensure team familiarisation. The data distillation stage involves data cleaning and iterative labelling so that early codes emerge. We use NVivo software to facilitate this process, which enables the coding of visual and audio material, as well as text. This begins with data from each of the workshop locations, before aggregating across all data sets so that we can compare location specific with wider findings.

The initial coding framework is developed and reviewed in a team analysis workshop, where HVM discuss patterns and themes, compare our perspectives, identify relationships between data categories, and test the validity of the codes, ensuring they are comprehensive for the purposes of the study. The NVivo coding framework is used as the principal tool for analysis, with data searched for statements that fit into the conceptual categories. Coding and analysis were conducted iteratively across the programme beginning from the first data collection so that emerging findings were reported on as headline findings to participants and used to inform the next stage of the programme. The report was written from May to June 2019, presented in draft form to NERC with opportunities for comment and review with a final report being submitted in June 2019.

2.5 Evaluation

On commissioning HVM to design and deliver the dialogue, NERC also requested that an evaluation was conducted of the process. This is in line with good practice as established through programmes such as Sciencewise¹⁰ which provides advice, guidance and support to public sector dialogue programmes. To ensure the evaluation was independent from the work of the HVM team, HVM commissioned Mike King of Resources for Change (R4C) to plan and deliver this evaluation programme, remaining outside the design and delivery of the dialogue. The evaluation has been conducted in two phases. The first is in parallel with the preparation and delivery of the dialogue which has assessed the immediate impact of the process on dialogue participants and the NERC team involved. The second phase will be conducted in autumn 2019 and will reflect on the impact of the dialogue on stakeholders, including NERC staff, once some time has elapsed and it is possible to see how modelling best practice public dialogue has influenced NERC's forward and strategic plans for engaging the public.

⁹ Framework analysis was developed in the 1980s by applied qualitative researchers working in an independent social research unit within the Social and Community Planning Research Institute (Ritchie & Spencer, 1994). It is now an established method for researchers to immerse themselves in reflective qualitative data to increase their understanding of participant views and experiences.

¹⁰ <http://sciencewise.org.uk/>

3. What people value

Chapter 3 summary

Participants in the dialogue were asked to reflect on what they value in the environment even before arriving at the first workshop. This chapter summarises the key themes that emerged at this early stage and through to the end of Round 2. Main points made include:



Figure 5: Summary of what people value

These have been summarised in two sections on having connections to nature and greenspace and opportunities to cherish and respect the environment. The chapter concludes with the reflection that speaking about what is valued in the environment also led participants to reflect on loss within an environmental context. They spoke of having already observed a loss of biodiversity and habitats for wildlife in their local area and a fear that such losses will continue particularly in relation to clean air and spaces to feel free.

3.1 Connection to nature and greenspace

Participants spoke eloquently of the importance to them of having a connection to nature and greenspace, on both a large and small scale. They included in this, being in areas dark enough to be able to see the stars at night which they value for its beauty, vastness and as a means to understand our place in the universe by being able to track the stars across the night sky. Equally important to participants was the environment closer to home, being able to grow vegetables and plants in an allotment, or to see foxes thriving near their city homes, which some saw as an important indication that some species can do well in a built-up environment.

I'm very pleased that there's open spaces where foxes can actually survive and thrive. I think it shows that the environment is not too bad in Canary Wharf where I am. | London

Others brought in pictures of local ponds which for them demonstrated the value of looking after different environments to provide habitats for wildlife and spaces for our own wellbeing. They spoke of the value in creating habitats to provide,

Safe havens and getaways for the wildlife and ourselves. | London

Parks were mentioned in both locations as significant places for connecting with nature, for giving children and adults alike space to feel free and to improve wellbeing via a connection with nature and fresh air. Participants felt that local small-scale parks and green spaces are as significant as our National Parks. This is well summarised by a London participant who reflected on the two images he and his discussion partner had brought in as their valued part of the environment,

Well hers is of a National Park and mine was just of some green space by my flat. So, like quite different, but I think it goes to show how environments at different levels are important. I guess I'd tell people that you can work on creating good in your neighbourhood or in your little patch, as well as protecting the bigger spaces that are really important. | London

People understood there to be a direct correlation between having access to greenspace and the environment and our own personal health and wellbeing. They talked about the value of trees in improving air quality; in gardening giving people a purpose and of nurturing, even in an area the size of a window box, our natural world; and of the value in being connected to the environment providing a space to breathe and feel peace. As one participant put it,

Peace and tranquillity, the escape from the everyday, going to that little bit of space. | Swindon

3.2 Opportunities to cherish and respect the environment

The workshops began and ended with the word 'cherish' on many lips. At the beginning of Round 1 a participant brought in a picture of a walnut tree. She described the fact that it had been growing in the grounds of a large hall before her house was built. She is worried for the tree because of its age and because of damage to it potentially caused by the squirrels and woodpeckers that have made it their home.

It's maybe 150 years plus and it needs to be cherished. | London

Throughout the dialogue people spoke of the importance to them of respecting the environment, for the resources it brings such as water to drink and air to breathe, and for the benefits it brings for health and wellbeing. People spoke of the importance of the daily, small, opportunities they have to enjoy the tranquillity of their local greenspace,

I walk through to get to the shops, and you know, coming out from an estate which is busy and then going into the shops which is just busy again, but that walk through the park kind of refreshes me. | Swindon

Others discussed the importance of protecting the green spaces we have from, for example, housing developments, and as citizens having some control over how the land around our communities is used. They reflected on the importance of mapping the green spaces that are available for developing habitats for various wildlife, for understanding where families can go to enjoy their greenspaces and develop their understanding of the value of the environments available to them. As one participant put it,

You can go out there and help to protect your green space, maybe adopting a bit of land, and you're in control and look after that piece of land. You can map green spaces, so people know where these are and they're able to use them more. | London

Others spoke of everyone's responsibility for looking after unique parts of our environment for future generations. This included major parks, such as Richmond Park which was discussed by London participants as being between 400 and 500 years old, with designations as both a site of special scientific interest (SSSI) and as a National Nature Reserve. They value it for its history and for the range of human, animal and plant life which benefit from having the park as their habitat,

An oasis in South West London. | London

There was a strong emphasis, from the London participants in particular, in having green as well as built up space. They cherished the moments when,

You're surrounded by nature. Your mind's got time to think. But if you're not, you've got construction going on, noises, it's just hard to live well. You need nature. It is important for your psychology. | London

Others expressed the view that there is a wonderful balance to be struck between the built and natural environment. They valued moments when both seem beautiful and in tune with each other, like a sunset over a cityscape or a bridge connecting the urban with the rural. One participant described her choice of the Clifton Suspension Bridge as a valued part of the environment,

I really like how it's balancing nature and us, and how there's an open space and nature but there's also buildings and people transporting over. And I like how it's a bridge because it's connecting both sides, like the nature side and the building environment. | Swindon

Participants spoke of the fact that you may not be thinking about the environment all the time, but trees, clean air and fresh water, for example are essential to our lives and are valued by everyone. As one participant summarised it,

Cherish the world, you only have one. | Swindon

3.3 Fear of loss

A consideration of what people value about the environment led to various discussions over the public dialogue in both locations about the fear of the loss of what they value most in the environment. They spoke on a local scale of housing and business developments encroaching on the green spaces they value. They also discussed more general issues such as air and water quality and climate change as major national and international challenges which could cause significant loss to valued environments. These points are explored in more depth in [Chapter 4](#). In the context of what people value, participants spoke of major developments which are changing the nature of their local environments. They talked about the expansion of small towns and the impact that has on their lives, giving them a sense that they are becoming increasingly removed from the much-loved landscape they remember from childhood,

My tiny little town has grown into a huge town that is now starting to join onto Swindon. The town that I remember from when I was growing up, is not that anymore. | Swindon

And the loss of opportunities for children to simply be outside playing and enjoying the benefits of

time with their friends - some saw this as a wider question of children being locked into screen time and others felt that their views had changed over time and with different circumstances,

Now I'm a parent, I look at my child and I think 'I don't want her surrounded by all that, I want her to be able to go out and play down the woods and next to the stream and things.' I want her to be able to go and have that walk, I want her to have that freedom to be able to go out and do these things. | Swindon

Others were fearful about the loss of biodiversity in towns, cities and in the rural landscape. One participant, a primary school teacher, could track a change from her childhood, twenty years ago, to the present day. She was concerned that not being able to find frogspawn was an indication of a wider loss of biodiversity,

I used to collect the frogspawn when I was little. But now I couldn't find any anywhere. So, it was just like how wildlife is just on a decline. | London

This concern for loss of biodiversity was also raised in Swindon, where one participant, reflecting the views of many after a long discussion at the end of Round 1 took his group back in time,

Imagine you're in a car sixteen years ago. You go for an hour drive, what used to happen every time? You'd come back with splattered bugs all over your windshield. How often does that happen now? How often do you see a dead bug on your windscreen? Which is a horrible way to look at it, but we have no insect population anymore. | Swindon

This leads us into the next chapter which summarises participants considerations on what they need to know to understand the Digital Environment programme. What was clear at the early stage of the dialogue, when participants were simply reflecting on what they valued in the environment, before considering this in the context of the 'digital environment', was that at the beginning of the process they felt this was a 'new' area of discovery for them. They recognised that the environment as a whole was, and would continue to be, a key part of what they value in their daily lives including providing significant health and wellbeing benefits through a connection with and opportunities to cherish the environment.

4. What people need to know

Chapter 4 summary

In this chapter we describe what people with little knowledge and understanding of NERC's role and what the research in this area might entail need to know in order to engage more fully with the digital environment agenda.

In response to presentations on NERC and its work and a number of film clips showing digital tools in operation, participants formulated questions around:

- What the digital environment is
- How NERC operates
- How members of the public can get involved in environmental research
- Some of the specifics of the environmental research shown.

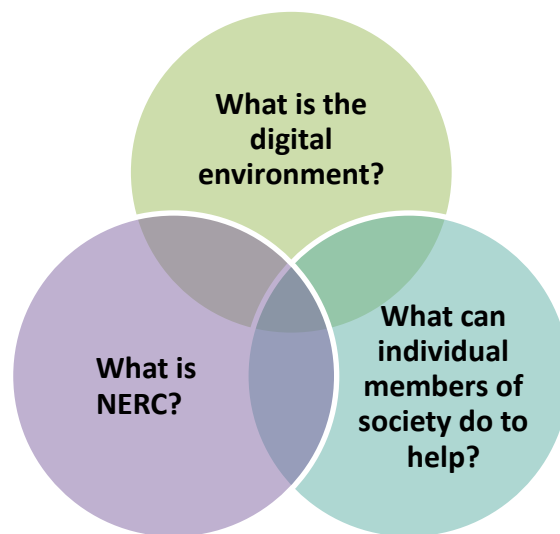


Figure 6: Summary of what people need to know

Participants' reflections on this demonstrated that NERC's programme would benefit from greater publicity so that individuals in society at large can support NERC's work in this area.

The suggestion was made to change the name of the programme to **Digital Natural Environment** to make it instantly clear that the programme is about the intersection between the digital world and the natural environment.

Participants in the dialogue had very low awareness of both the role of NERC and indeed the digital environment. The more they found out about NERC and the relevance of its work to the local, national and global environment, the more they appreciated its existence. Participants in both locations felt strongly that part of the funding for Digital Environment should be allocated to engagement with citizens as well as learning and education activities to increase public engagement with the digital environment and achieve an improved awareness of NERC's remit (see section 5.6).

The following sections provide a summary of what people need to know in order to engage more fully with the digital environment agenda.

4.1 What is the digital environment?

The phrase digital environment was not conducive to spontaneous understanding. Participants were clear about the meaning of 'digital' and the concept of 'environment' but often had difficulty understanding that the Digital Environment is set up to fund research that, based on a digital representation of the real world, enables researchers to test what the consequences are of specific changes in the natural environment and provide evidence to help inform policy making,

The first one is, what is the digital environment? We know what the environment is. We know what digital is, but they don't go particularly together, so I think it's a slightly confusing term. | London

There was a sense that digital environment is too broad and vague given that so much of our lives is digital in this day and age. The suggestion was made to change the name of the programme to a **Digital Natural Environment** to make it instantly clear that the programme is about the intersection between the digital world and the natural environment. Likewise, some participants suggested that it would be helpful if NERC would explain what it does by using a phrase like *'developing and employing digital tools to monitor the natural environment'*.

4.2 What is NERC?

Participants were astonished to find out about NERC. They knew very little if anything at all about NERC as the biggest funder of environmental science research in the UK. Many had not considered that a better understanding of the changing planet has the potential to positively affect so many aspects of society including health, wellbeing and economic growth.

In response to the presentations and film clips, they formulated questions. These included:

- How NERC is funded
- How it organises its work
- Which environmental agencies and research bodies NERC collaborates with
- Who decides on research priorities
- How it shares its findings and
- The extent of its public engagement and education activities,

What has NERC done to bring scientific research into the community? | London

In both locations participants asked about the impact of NERC's work on individuals, society and the wider world, including developing countries. For example, a participant in Swindon said,

Has NERC done something which has affected policy? Does government listen to you? Does industry listen? And are there any specific instances where policy has been affected by the data? | Swindon

In Swindon questions were asked about how digital data are being shared and what measures are in place to regulate the data collection.

Having learned more about how NERC operates, participants recognised that a digital infrastructure requires substantial investment and extensive international collaboration. This led to questions about the level of funding that NERC receives,

£330m for NERC – is this enough considering important work your agency performs? | Swindon

There were also questions about the impact on NERC of the uncertainty around the UK's imminent departure of the European Union. Responses to all the questions raised in round 1 in both locations were prepared by the NERC project team and circulated to participants at the round 2 workshops. Participants found the responses valuable when reflecting on the issues and opportunities they identified on the digital environment and it was useful for facilitators to refer to these as they worked with dialogue participants. It is HVM's understanding that these responses are important tools in dialogue. The number of questions and responses extended over seven pages indicating the importance of having the opportunity to capture the areas on which participants are uncertain or unclear. Such a large number of questions lent itself to a printed handout at the sessions, but other options might also be considered in a larger-scale public dialogue with more preparation time such as:

- Printing the questions/ responses in a large font on individual A4 sheets to display around the dialogue space during round 2
- Emailing participants a weekly batch of answers as a way of updating participants between each dialogue round; and/ or
- Giving a presentation on the answers at the beginning of the round 2 workshop

More reflection on the value of the dialogue stimulus materials, including the questions is given in the independent evaluation report.

4.3 What can we do to help?

The dialogue was so enlightening to many, that participants expressed an interest in becoming active actors in NERC's quest for digital data (see Chapter 5),

We were saying about things that we can get the general public to do to assist. | Swindon

Participants came to a growing realisation that looking after the environment is everyone's responsibility. One of the groups in Swindon said,

Every human being, we lead to all these things. One person is going to have an effect on emissions, light pollution, plastics. All of us are contributing to that. We need to understand that more. | Swindon

By round 2, active citizens' involvement became a theme in both locations, framed in Swindon as *developing a citizen's army for the environment*, with suggestions being made to develop a range of citizen science apps that help people of all ages monitor changes in their own local environment. (see section 5.6).

5. Resonant digital tools

Chapter 5 summary

From the end of the Round 1 discussions onwards participants emphasised some digital tools over others. This chapter explores which tools participants had the greatest resonance with and why.

In finding digital solutions for the challenges they see as a top priority in their local environment participants referred to tools for small- and large-scale monitoring. Air quality monitors on back packs, monitoring stations, water quality sensors and satellites were all tools that spoke to participants' concerns. Equally galvanising citizens to engage through digitally enabled citizens' science projects was seen as a powerful resource. This was linked to the high number of references to wearable technologies (watches, clips to attach to bags, light-weight sensors) when participants developed their own environmental trackers. Being able to visualise the data to inform analysis was a theme that resonated with participants' desire to be able to understand what is happening in their local area, and for researchers to provide evidence to inform policy making and shaping.



Figure 7: Participant views on digital solutions for local challenges

The chapter ends with reflections on the fact that participants throughout the dialogue emphasised the value they placed on a continuous feedback loop, including live data, despite trade-offs that may need to take place in terms of data privacy. They place a high value on the data collected being shared, used to inform research and to provide evidence for individual and societal change.

Participants considered digital tools throughout the dialogue, but they focused on them in two specific small group activities. At the end of the first evening workshop participants were asked to consider which digital tools might best address the environmental challenges that they see as pressing in their local areas. The second was in the afternoon of the second workshop when participants created an environmental tracker that would make use of digital tools to address a specific challenge. The trackers are discussed further in [Chapter 6](#). In this section we review the digital tools that had the strongest resonance with participants. These have been grouped in the next five sections around the broad categories of monitoring tools; Citizens Science apps and social media; wearables; data visualisation and a continuous feedback loop.

5.1 Monitoring tools

Given the lack of knowledge on the digital environment described in the [previous chapter](#) participants understandably did not explore specific digital tools in any technical detail and with only a vague understanding, gained from the stimulus provided at the dialogue, of what monitoring tools are currently in use or in development for near future use. However, there was a strong sense that monitoring tools were extremely valuable in providing a clear picture of what is happening in the environment so that action can be taken by individuals and industry to change their behaviour; researchers and research funders to focus on the issues that really are challenging society; and for policy makers to create evidence based policies. Dialogue participants highlighted the following:

The tool	What it does	Why this is important for participants
Satellites	Building an accurate digital map of traffic flows over time	Predicting and managing congestion and pollution hotspots
	Mapping what can't be seen at ground level	Protecting natural assets, particularly those of special scientific interest, from damage
	Monitoring high and low weather pressure systems	Allowing people time to prepare for extreme weather events such as storms and flooding
	Using GPS for locally specific data collection	Gaining a greater understanding of soil, air and water quality issues where they are occurring
Sensors	Street-level air quality sensors	Measuring pollution levels and providing early warning systems for people with asthma for example
	Which can be scanned having been embedded in plastic packaging	Providing citizens with data on what can and can't be recycled and why and to inform purchasing decisions on, for example, cosmetics
	Monitoring quality variables in the air, water and soil	Informing a range of fundamental social behaviours including evidence for where to live and what to eat

Figure 4: Monitoring tools with particular resonance for participants

Participants felt that sensors and satellites provided multi-function data collection possibilities. For example one of the digital trackers proposed a sensor which will,

Monitor variables such as pollen in the air, the exact moment and location. It will measure the UV rays and radiation. It will also measure the temperature, air pollution, toxins in the air, the levels of oxygen. It will monitor the water, and any impurities in water, and also fruits as well, and vegetables, the levels of nitrates and nutritional value. | London

They also felt that monitoring equipment such as satellites and sensors could be used together to provide a richer data set. As one participant put it,

You can have sensors on the road monitoring the traffic in densely built up areas. You can monitor it with sensors and use satellite information to prove the point that this is happening. | Swindon

5.2 Citizen Science apps and social media

We live in a digital age and the majority of the population have access to a smart phone and/or apps on their computers. As such citizen science apps, although not well known at the beginning of the process, had a strong resonance with participants. This was particularly so once they had been made more aware of them through a list of apps distributed at the end of round 1 with a request for participants to test those listed, or others of their choice, before returning to round 2.

The majority of environmental trackers (6 of the 8) created by participants incorporated some sort of citizens science app to engage people in data collection. The apps they felt would be helpful had a range of purposes for both information provision and information sharing. Under information provision they spoke of an adaption of current map applications which would indicate the less polluted routes for people to use if they are walking to school or work and apps to highlight the range of green spaces in a local environment (e.g. woods, fields, recreation areas).

For information sharing the focus was on continuing the work they had tested on citizen science apps and social media tools to upload images of wildlife observed and changes to habitats for specific birds and animals. One participant in Swindon summarised it as,

Having actual apps where people can contribute on wildlife they've observed and then learn (via the app) how to sustain it, whether it's providing food sources, protective areas in winter. | Swindon

They also saw a value in apps which would enable citizens to report issues which are causing harm to the environment such as fly tipping.

5.3 Wearables

Participants were struck by a BBC News Film¹¹ shown in the round 1 contextual workshop which showed a pilot programme where school children had air quality monitoring sensors attached to their school back packs. Many of the digital solutions people raised focused on similar wearable devices which would monitor air quality. They also linked this back to health tracker tools. As one person put it,

It's a bit like those watches that they wear now that count your step, because people are looking at how many steps have done. They are thinking, 'Oh I've lost weight, I should go and do this and be healthier there.' | London

Understanding that you can wear a sensor and which can give you live data on your situation participants felt is a valuable advance, giving the wearer choices about where they walk; how they behave to minimise the negative impact poor air quality can have on health; or to encourage people take positive steps to improve their environment.

Participants in Swindon emphasised the value of small-scale wearable digital devices which could demonstrate that there are wide ranges of environments in quite a small geographic area. They felt there is a risk that if one air quality monitor based in one small area is used to make assumptions about what is happening in, say, a thirty-mile radius, then there is the potential to draw the wrong conclusions. One participant echoed the small group consensus in saying,

¹¹ <https://www.bbc.co.uk/news/av/uk-england-london-47629571/london-children-fighting-toxic-air-with-school-bags>
Where stories, ideas & views matter
www.hopkinsvanmil.co.uk

So, the reason that a personal tracker would be important is because it's not doing an assumption on the air quality for a wide surrounding area. It's something that can be taken with everyone, so it can be specific about the air challenges in that very specific location. | Swindon

5.4 Data visualisations

Participants were struck by the value of data visualisations such as mapping and modelling to bring the analysis of the environment to life for citizens, researchers, policy makers and industry. In London they used the analogy of bus data and the change that has made to Londoners being able to know with certainty when the next bus is coming because they have a 'bus checker' app on their phone which gives them a visualisation of where the bus they want to catch currently is.

They spoke of the fact that climate change is being discussed widely but that such discussions can be ill-informed or based on a knee-jerk reaction to a demonstration or a headline without quite understanding what the underlying issues are. There was a sense that being able to see a visualisation of the impacts of climate change is helpful for everyone in understanding the issues and take either individual small-scale actions or making larger-scale policy interventions. As one participant put it,

Yes, you hear that the pollution is getting worse, the environment impact is going downhill. You hear all this, but to actually physically see it, to see that CO² has gone up. Just something as simple as a graph really helps. | Swindon

5.5 A continuous feedback loop

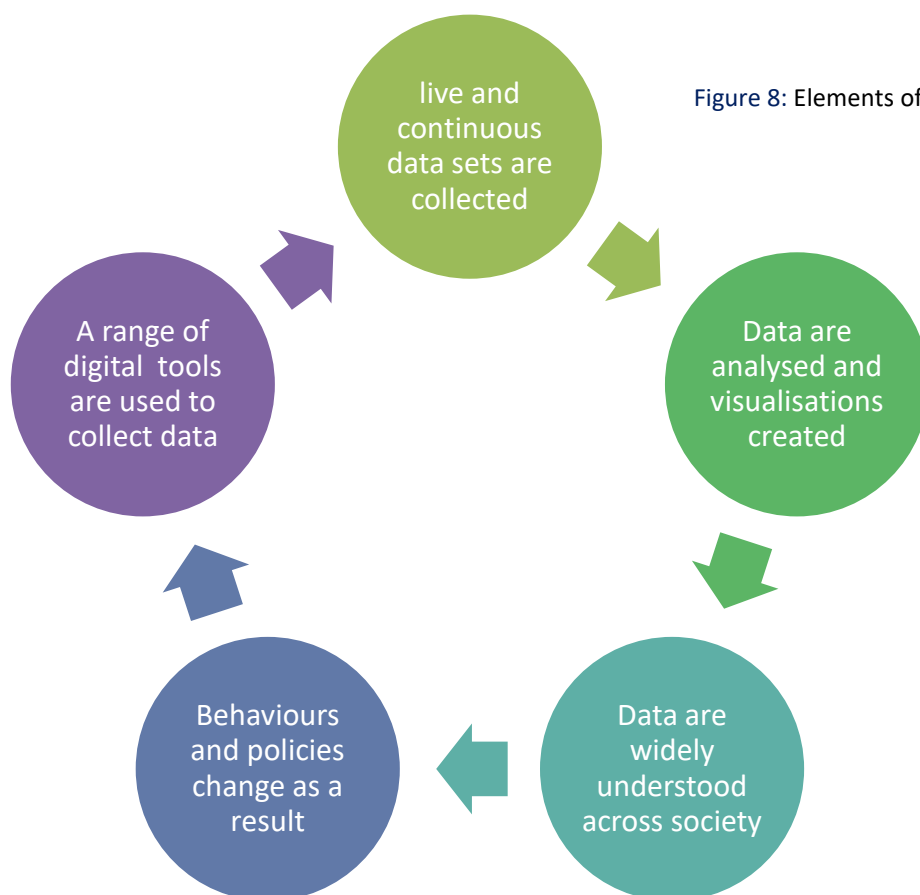
Whatever the digital tool, the idea that had most resonance with participants was of a feedback loop where there is a clear link through from data collection, using the most appropriate digital tools to grow understanding in society which result in changes in behaviour and policies. [Section 5.6](#) of this report covers participants' views on education and engagement, in this section we highlight the views of participants that monitoring and data collection are redundant if they don't result in a positive outcome for the environment. They said,

It's the action that's missing. It's the changing enough things. | London

A majority of participants across both the locations expressed the view that it was really important for those collecting data, whether NERC funded researchers or citizens' app users, to see the results of that data collection in terms of personal accountability and social and political responsibility. They felt this could feed into longer term strategic thinking to protect our environment. One person echoed the views of many in saying,

If we want to do something about the environment, just doing it for one person is not enough, it needs to be a movement informed by data collected. It needs to be a vision rather than a corrective action all of the time. | Swindon

Figure 8: Elements of a feedback loop



They felt that this feedback loop would ensure that action was taken by government and industry, so that government has policies for positive environmental developments and industry has the evidence to use innovation in the development of its products. One environmental tracker described a process for monitoring water quality which would lead ultimately to manufacturers creating clothing from recycled materials,

The action is that we've got a newspaper cutting of where they've created polo shorts out of reused plastic and plastic bottles, that's as a result of understanding the harm of plastics in water. | London

The view was also expressed in both locations that a continuous feedback loop would allow different areas of the country and the world to compare their performance and share data analytics to hold those responsible for change to account. For local councils participants felt that sharing data on poor performance had the potential to spur greater action.



If you know your pollution hot spots, holding that local authority or government to that high pollution. | London

This raises the question of data protection. Participants were tested by facilitators and observers as to the acceptability of sharing data, particularly, for example for wearables and those tools which could pinpoint environmental challenges to a specific area or street. We raise this in [section 5.6](#) in relation to public engagement. In the context of digital tools and their resonance participants felt that if the continuous feedback loop was applied and people were aware of the benefits of using anonymised data then there would be wide-spread acceptance. Lines were drawn where the data collected becomes personal,

It's not saying that Mr A. who lives in that street has just eaten two pieces of 5-a-day. That's obviously a key thing. | Swindon

The key issue identified by participants on data sharing was around trust. Participants suggested that if there was a raised awareness of NERC and the benefits to the environment of those conducting digital environment researchers collecting and using anonymised data, then that would lead to a willingness to share. There was a sense in both locations that people already share a lot of data and this is just another step in that process. People said,

If people think it's just being used plainly and clearly for science and the benefit of society that's not a challenge. | Swindon

They also felt there was no need for everyone in society to buy in to data sharing, simply a large enough sample of people,

You are not going to have everyone who bought into it but you're going to have enough people who see the benefits of it. | Swindon

They were also clear by the end of the process that Digital Environment was focused on big data, using tools such as AI and machine learning to analyse vast amounts of data from a variety of digitally collected data sources. They demonstrated throughout the process a great acceptance of collecting large data sets which as one participant phrased it,

Creates a national picture that will be giving you lots of local pictures. | Swindon

However, given that data protection was not the main focus for the deliberations there would be some merit in further deliberation which specifically explores this issue in relation to the digital environment.

6. Emerging issues informing funding priorities

Chapter 6 summary

This chapter presents an overview of the environmental issues participants identified as the pressing and with the potential to be understood and addressed by digital technologies. When invited to imagine they were in charge of the Digital Environment Programme, with a funding pot of £10m (the sum available for the current Digital Environment for 2018-2022), participants identified climate change and alternative energy sources; engagement and education; a range of pollutants and waste management and recycling as funding priorities for the programme. Figure 9 shows a breakdown of their budget allocation and a summary of the focus for research in each area.

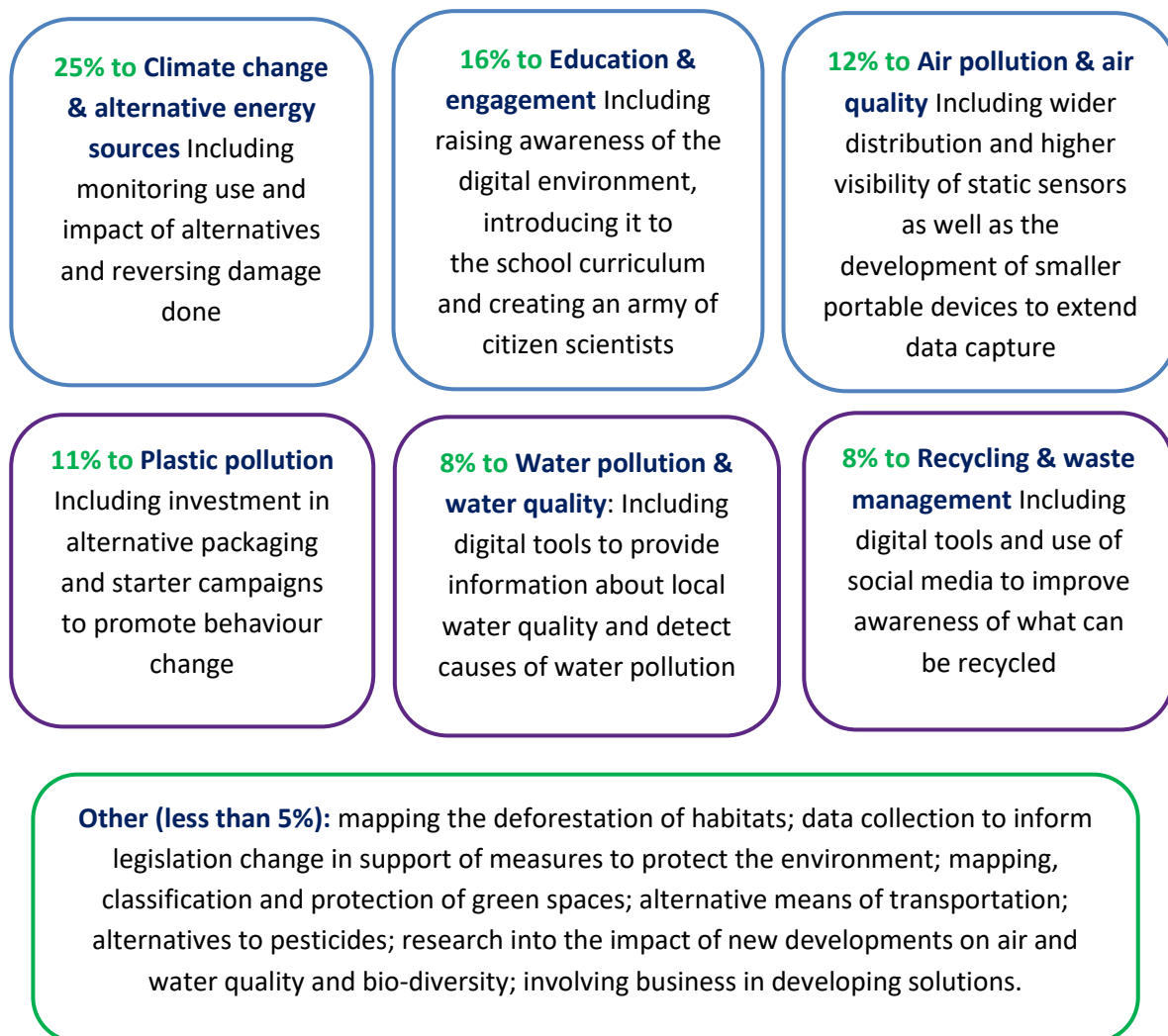


Figure 9: Participant views on budget allocation for NERC's Digital Environment programme

Identifying funding priorities for Digital Environment was arrived at iteratively and embedded within other key activities (see [Round 2 summary](#)). The purpose of the discussion was to develop understanding of the potential for digital tools and new technologies to understand and respond to challenges in the environment. Facilitators introduced the topic of NERC's Strategic Funding Programme in the second half of the Round 1 evening workshops. Participants used maps to identify environmental challenges in their area and were then asked how digital tools might help society work towards solutions to those challenges. Participants were given a very open space to consider the challenges and therefore priorities which mattered to them. In future public dialogue

programmes around NERC's work, to ensure a focus on the areas on which NERC can fund research and make an impact, it may be more helpful to give participants a clearer steer on the spheres in which NERC operates and what is on and off the table for discussion.

In their small groups in round 2 participants were invited to imagine they were in charge of NERC's Digital Environment Programme with access to a funding pot of £10m which had to be allocated over the financial years 2018-2019 to 2021-2022. Before they were asked to allocate money to what they viewed as the most pressing issues for the Programme, they were asked to create a long list of local, regional and global challenges they thought the programme could help address. Participants indicated they had high hopes and expectations of the programme and identified challenges across the length and breadth of the environmental policy spectrum. Figure 9 above provides a summary of participants' views on funding priorities for NERC's Digital Environment Programme. Considerations around the top tier priorities are described in more detail below.

Other themes that were explored for the programme but not prioritised for funding included human consumption and how it affects the environment and digital solutions to prevent over fishing. The findings are summarised in the following section from the least to the most significant funding priority in the minds of participants.

6.1 Climate change and alternative energy sources

Participants acknowledged the multi-faceted nature of climate change. They talked about how global warming impacts on air and water quality, weather patterns and as a result leads to a global loss of habitats, biodiversity and livelihoods. Their route into these discussions were the environmental challenges they identified in their locality. These included, for example, increased numbers of commuters driving to work (Swindon) and the impact of housing developments on green space and air quality (e.g. Battersea Power Station in London).

Participants cited a range of non-digital solutions that are already in place, including carbon-neutral targets being embraced by Local Authorities and cities; a reduction in meat consumption; examples of carbon neutral transportation options, including the bio-methane double-decker buses in designated air management areas in Bristol and hydrogen single-decker buses in London; and car sharing schemes. Being prompted to think about digital solutions, participants across the two locations came up with ideas for sensors and monitors that track changes in the environment over time and provide a visual representation of the challenges. These included, for example, the increase in local CO₂ emissions after a development scheme is implemented (London); or a decline in wildlife through the use of apps which encourage people to record wildlife in their localities (Swindon).

Some of the trackers developed by participants showed there was an understanding that digital tools can play a significant role in monitoring changes over time. One of the groups in Swindon developed a wearable weather events tracker, 'Earth Watch', which would monitor changes in the atmosphere, stratosphere, ocean and soil,

It does this with satellite sensors, satellite signals, cameras, weather stations, like that. And I think the whole point is that perhaps as a citizen you can have some app with heat maps and data that will show you storms before they happen, so you know roughly what time it's going to hit. | Swindon

Analysis of the data collected through the Earth Watch could inform a more sophisticated early warning system for citizens in case of extreme weather events than is currently in place to avoid panic and casualties and improve agricultural and urban planning.

Three of the four groups saw Climate change and global warming as an important funding priority for the Digital Environment Programme. As a group in Swindon said,

We decided to give main priority to global warming and emissions, or the study of them, and plastic pollution. They seem to be the most pressing issues in terms of saving the planet, to use the cliché. With sustainable, renewable energy, more research is needed, but it's an outlook that's already in people's minds. | Swindon

For three groups investing in affordable, carbon neutral ways of harvesting energy from alternative sources was in their view part of the solution to the global emission issue and they therefore allocated substantial funding to this area as well,

We prioritised reproducing, reusing energy, whether it be producing it yourself or putting it onto the grid. We thought that was a high priority. | Swindon

One of the groups in London believed that there was less of a need for investing in alternative energy sources because in their view the infrastructure for renewable energy is already in place in the UK. Instead they saw opportunities for the Digital Environment programme to develop digital tools to monitor their use and work towards improved distribution of excess energy. Another group in London allocated funding to the development of digital tools to reverse the damage done by pollution and climate change including water and air cleaning devices.

6.2 Education and engagement with the digital environment

A lack of awareness of environmental research, the digital environment and NERC's role were identified as key challenges in both locations from round 1 through to the round 2 dialogues. As participants knew very little, if anything, at all about NERC and the digital natural environment all groups in the two research locations allocated part of their Digital Environment budget to communication, awareness raising and education. There was a strong sense that NERC's work is important and needs to be brought into people's consciousness more,

I certainly feel that NERC is doing a brilliant job, but somebody should be doing a brilliant job of telling us. PR is such an important part of people's lives, because there are so many things competing for people's attention. Somebody's got to bang a drum for them. | London

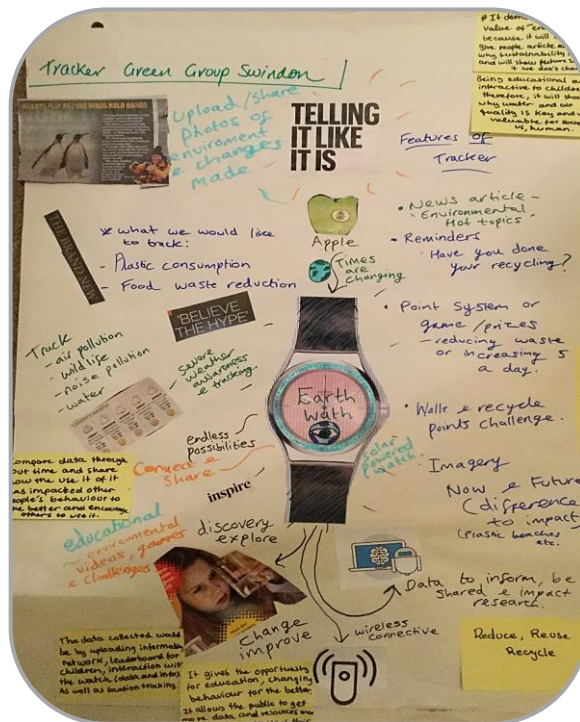


Figure 10: Illustration of a multi-purpose tracker

We wanted to say thank you, because before both sessions, I live in Swindon, I didn't know about NERC, the fact that you do so much, and you can recognise all of us. | Swindon

Participants felt strongly that every citizen has a role to play and that making citizens aware of their own individual environmental footprint is essential for enhancing engagement with the natural environment. They felt that in general people have very little awareness of the impact of their actions and consumption patterns and the media/ social media promote high levels of consumption. They made comments such as,

It's all about what you feed to people. Right now, they don't feed us this information, they feed us about buying stuff, consuming stuff, and what the celebrities are doing and stuff like that. | London

We're not told about the after-effects. We're not aware of where things end up after we no longer want our bits and bobs. Some people may be, but the majority of people are not aware. It comes back to making people more aware of what their consumption is doing to the environment. | Swindon

There was a strong sense in both locations that the more people become aware, the more they will make change.

A group in Swindon said that 'shock value' is important in awareness raising campaign, confronting people with hard hitting facts to wake them up to what is happening in the natural environment. Whilst the report authors understand that this is at odds with current social science in this area, participants nevertheless considered it important. They likened it to the tactics employed by Extinction Rebellion, the group of environmental activists who brought London to a standstill in the weeks the dialogue sessions were held. In a similar vein one of the groups in London talked about the impact of David Attenborough's Our Planet, which was being streamed on Netflix at the time of the dialogue and showed the devastating effects of plastics in the ocean. Others in London pointed out the success of the introduction of paid-for carrier bags to illustrate the point that people are capable of change if they understand the impact of their behaviour.

I think there's a trust that if you actually knew what was in front of you, you would want to change it. If you really understood the value of what you were doing when you fly tipped or what you were doing when you wasted a resource, in simple and easy to understand ways, then you appreciate it and want to join any particular bandwagon, glue yourself to somewhere [as Extinction rebellion activists did]. | London

There was consensus amongst participants that there is a clear role for NERC's digital environment programme in raising awareness of, and inspiring engagement with, the natural environment, for example by replicating the pilot public dialogue model they were part of,

NERC could potentially start a conversation or restart a conversation that we're already having but with new people and just make people more aware. | Swindon

The digital natural environment was seen as a huge opportunity in this respect. As a group in London said,

We've decided that, firstly, we want to educate the nation and engage them. [...] People can become more aware of what's going on using the digital environment, and how they can even help to contribute towards that digital environment. | London

Participants shared the view that successful engagement starts with drawing attention to what is happening in people's local environment. As a participant in London said,

I think it'd help them [citizens] to become more aware of what's going on in their environment so then they'll take measures to see how they can combat that and how they cannot add to that problem. For instance, if they know about how much air pollution is there on their daily commute and stuff like that, they'll be more mindful when they're using their car when they may not need it.
| London

Participants recognised that there is a need to change mindsets and talked about creating an *army of citizen scientists* who voluntarily contribute their time, effort, and resources toward environmental research, by developing digital tools that will help people navigate local environmental challenges.



Figure 11: Summary of views on how NERC can help create an army of citizen scientists

Fun, easy to use, free apps were seen as an excellent way to enable citizens to collect data in their everyday lives and subsequently inform research. This was seen as active and therefore more impactful engagement compared to passive engagement by way of, for example, watching documentaries.

I think, when you take part in something it's more likely that you'll understand than if you just see it on TV. | Swindon

Participants indicated that the uptake of digital tools will depend on the extent to which the tools generate data that people can understand and use, which one group called *socialising the research*. The group in Swindon that developed the Earth Watch tracker as a solution to help change behaviour (see section 5.6) was convinced that citizen science apps that work well and generate

insights that are relevant to the user will rapidly help increase the volume of environmental data collected,

For example, if someone has the Earth Watch, then they would tell other people and other people would be like, 'Oh what is that?' and they would look into that and it would create that craze. | Swindon

A group in London said that digital tools and citizen science apps have the opportunity to make the environment accessible,

It's like helping the environment made easy, because usually you find it quite hard to help the environment, but that's easy, you take a picture and done, you feel you do something good. | London

The dialogue showed that there are split views on the need to incentivise the use of apps by way of encouraging uptake. Some participants believed that incentives will help. Suggestions included reductions in council tax for those taking part in environmental monitoring activities and virtual coins that can be converted in Paypal credit. Others felt that contributing to environmental research is an incentive in itself as we are making the environment a better place.

Recognising that our location is already trackable when using smart phones, participants tended to agree that using their post code or other means of identifying their location is acceptable for environmental trackers. Although some participants had reservations, the majority was positive about the trade-off between their privacy in this respect and the opportunity to contribute to vital scientific research. However, across the two locations most participants said they were less likely to use digital environmental tools which require them to share personal or financial data.

A small number of participants drew attention to the need to provide alternative modes of data gathering for those who don't own a smart phone and are more likely to use more conventional tools, i.e. including phoning a free number to report a sighting of particular species or environmental events. Across the locations there was a view that digital engagement needs to start from a young age to bring about the societal change required to protect the natural environment,

If you make that a way of life for children, that I think is the priority, to protect it. This is long-term, it needs to be addressed from the grass roots first, and what we are doing today is reactive, all of what we'll do today is reactive, but the children can be more proactive. | Swindon

Participants recognised that it's about creating new habits and that children's learning rubs off positively on parents, who may be less engaged with environmental issues,

Going out there, educating people. They might not necessarily know. They're just going about their business, getting the plastic bags, driving their cars that are polluting. It's just starting at the primary level. I know it's never too late to start something, a new habit, but if we can educate the children, get them involved, the children could put pressure on adults. | Swindon

One of the groups imagined NERC developing an educational app in collaboration with the Department for Education which could be rolled out across all schools in the UK,

One of the things we talked about is potentially linking up with the Department for Education to come up with an educational app, which would then be rolled out across all schools and that would

have a generic format so you could roll out updates, and then kids are getting linked into that at an early age and they'd hopefully follow that through into their home life as well. | Swindon

Participants in London and Swindon discussed opportunities for NERC to collaborate with corporate partners to get the message out,

Corporate client partners could buy into something, make it commercially profitable for a company to be environmentally friendly. | Swindon

Businesses are good at running campaigns about everything under the sun. If businesses take more responsibility for how they're impacting the environment, then that can lead to us being more aware. I know certain places like Marks & Spencer and, I think, H&M were doing it, 'Recycle your old clothes and we'll give you £5 back.' Recycle batteries in shops. | London

6.3 Air pollution and air quality

Air pollution felt the 'closest to home' of all the environmental challenges discussed by participants during these workshops. Far from being a remote issue, as is sometimes the case with issues related to climate change, air pollution was seen as something that has a direct impact on all of us: where we live, work and choose to spend our spare time. As one participant in Swindon said, *it's affecting the way we live.*

Participants in London were more readily able to identify specific locations of air pollution concern than those in Swindon. Perceived hotspots included Epping Forest, the Blackwall Tunnel, Rotherhithe and Brixton Road.

The area where I live is extremely green on the map. Epping Forest starts at the top of my road, but I live in one of the most polluted areas in London traffic wise, the area is dreadful even though we are right next to the forest, because we have got the A506 and the A12 intersections. | London

Evidence of air pollution in their everyday environment were also easy for participants to identify, with references to traffic congestion, cars idling - particularly around schools - and perceived pollution from factories and waste facilities. In the newspapers on the day of one of the workshops in London, there was a news story about a young girl in London whose death was being investigated as being potentially attributed to air pollution.

In terms of what pollution should be measured, participants didn't spontaneously name air borne toxins. Pollen was mentioned by several participants and there was some confusion that CO₂ is a pollutant.

Initiatives mentioned by participants to help reduce air pollution included Brazil's number plate system to limit the number of cars on the road on any given day; banning cars from picking up children from school within a one-mile radius; and airports using electric only vehicles throughout their estate and planting trees as a quid pro quo if they want to expand.

The visibility of data gathering devices and reduction initiatives such as air monitoring stations and London's new Ultra Low Emissions Zone inspired participants to urge a greater democratisation of how air pollution is monitored, measured and acted on. They wanted the what they saw as the slightly mysterious dark cabinets containing air monitoring equipment to be made more visible, portable and numerous.

Of the eight trackers developed by participants in Swindon and London, four were wholly or partly dedicated to measuring air quality. All wanted to see air quality monitoring technology miniaturised so that it could be easily portable.

One group suggested using the postal service to carry air quality monitoring devices attached to their uniforms and vans, as illustrated in the tracker graphic in figure 12. Another group produced a wearable 'Watch' tracker which included pollen and air quality monitoring as two of its functions (see figure 13).

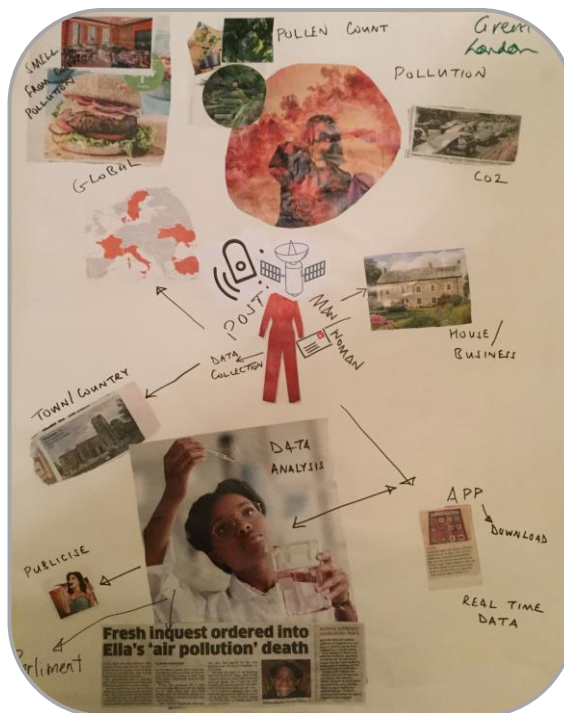


Figure 12: Illustration of air pollution tracker



Figure 13: Illustration of water quality tracker

As well as illustrating how the data would be captured on small devices enabling NERC to cover a wider range of areas than the current static air monitoring stations, the trackers also set out how the data would be shared. One group identified a citizens' forum that could be coalesced around the air quality tracker's results. A pollution index could be used to quickly identify areas of concern. This would bring pressure to bear on local and national government to act if hot spots were identified.

As well as a wider distribution of monitors, some participants proposed an increased visibility of air pollution data, for example, having levels displayed on screens in school car parks.

Something like in a school if there was an air monitor, if it was a simple thing, and an air monitor was there then the children would see for themselves how much the CO2 has increased when their parents came to drop them off in cars. | Swindon

In terms of investment, air pollution received the second highest share of budget at 12%, behind Climate Change and Education. Some participants spoke of investment in air monitoring devices would help to make the technology smaller and more available.

6.4 Plastic pollution

If air quality felt close to home, then plastic pollution was seen as both a near and far issue. The majority of participants had reflected on the issue as a result of seeing the now iconic episode of the BBC's Blue Planet II presented by Sir David Attenborough (2017). They reflected on the fact that what felt like a remote issue, plastic in the Indian Ocean, was now known to be caused by human activity across the globe from micro-beads in cosmetics, to single use plastic bottles, bags and packaging. A participant highlighted their feelings of horror at what was happening by describing a news item they had seen,

They did a post-mortem on a whale¹² and discovered nearly 70% of its stomach content was plastic. It was things ranging from micro-fibres of plastic from the very smallest grain all the way up to entire carrier bags, bottles, things like that that it had swallowed while going for the fish. This is disturbing¹³. | Swindon

Reflections on digital solutions to this challenge were divided into two main themes: using social media and digital campaigns to raise awareness of the challenge, so that step change action can be taken by everyone in society and investing in alternatives to plastic packaging. It should also be noted that one sub-group in London made a conscious choice to exclude plastic waste and pollution from their list of priorities. They felt the issue was already high in people's consciousness and that there were more pressing issues affecting them and their communities. This was a much-discussed issue in many groups and included in a range of funding priority discussions. It was not one that became the main focus for an environmental tracker, although was integrated in the overarching theme for some of the trackers.

Participants wanted to ensure that awareness was raised on the damage plastics, in some situations, can do to the environment. They were impressed by the fact that it was NERC funded research that had led to the evidence of the harm micro-beads do to the environment. They felt this highlighted an important role for the Digital Environment programme, in providing the data to government and policy makers to support change.

The microbeads, being the first to tell (stakeholders) about that. Which leads to informed legislation. The reason that we have put £4 million is data collection, and (that) stuff takes time and costs money, but the thinking was that legislation, once it says no to something, then it's no. | Swindon

Participants didn't feel that NERC funded research should only provide the evidence for change to governments and stakeholders. They also believed that there should be more awareness amongst individuals and communities to inform behaviour change. They felt that at times there was more of an argument for small-scale starter campaigns to act as a catalyst for change, rather than large-scale investment. One group allocated just £500,000 of their £10 million available funding to such a campaign because,

We can't change the world here, so, not necessarily going down through the whole legislation, education, the whole group, but just something as a starter campaign or adverts. | Swindon

¹² The article referenced in this quotation by the participant is from [The Independent](#), 18 March 2019

¹³ A case study on this issue is available here [https://nerc.ukri.org/research/impact/casestudies/society/plastic/Where stories, ideas & views matter](https://nerc.ukri.org/research/impact/casestudies/society/plastic/Where%20stories,%20ideas%20&%20views%20matter) [32]
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London participants echoed the sentiment of investment as a catalyst for behaviour change, particularly when plastics are seen as a route to convenience and nothing else. They felt there could be return to previous behaviours when people used paper to wrap their food purchases made at the butcher or greengrocer for example. There was a sense that investment in campaigns which encouraged people to consider whether their use of plastics was absolutely necessary or not would be very positive.

Another group called for investment, informed by NERC research, into alternatives to plastic packaging. They felt that using digital tools to monitor the extent of the challenge of coloured plastics in packaging, particularly black plastics, which they felt were harder or impossible to recycle, would be the first step. This would be followed by an informed approach to making more recycling of different types of plastic possible, as well as encouraging manufacturers, food producers and communities to reduce their overall usage. Some took this to an industrial level, suggesting the creation of a digital tool which would, *eliminate the wrong plastics being used in the first place.* | Swindon

London participants focused on recycling when they raised the issue of plastics. They felt that having plastics was not a problem in and of itself. *It's what happens when we dispose of it* that they saw as a more significant problem. Embedded in their comments though was an agreement with Swindon participants that research into alternatives to plastics might provide the route to the solution of plastic pollution. They too were concerned of the effects of plastics on the ecosystem. They said,

Our question would be what alternatives to plastic are there that can be functional and long-lasting and strong without doing the damage that it's doing to our planet and ourselves and our animals, the wildlife. | London

6.5 Water pollution and water quality

For some participants, the starting point when discussing the issue of water quality was their own experience of seeing rivers or lakes near them polluted with junk or what they thought to be industrial pollutants. Others raised concerns about fertilisers and animal effluent leaching into rivers. News articles featuring fish containing levels of cocaine were mentioned by some participants and seen as emblematic of humankind's lack of care for an essential resource such as water. Some participants were surprised to hear that NERC research had identified paint from road markings in watercourses and were worried that this too could be a cause of pollution.

There are other run-offs like the stuff we're spraying on fields, the water ends up somewhere. The stuff we're feeding cattle, the effluent ends up somewhere. | London

We figured that the stuff that we're using on crops at the moment does impact animals and habitats, and as a result that it also affects the water system because all of these harsh chemicals are coming down through the environment. | Swindon

The global issue with water featured concerns about plastics in the world's oceans (discussed in more detail in section 4.4). Some saw water as a global resource and talked of how they had heard that the water supply could be running out in future decades.

I was thinking about the long term; we need water to drink and I think it's one of the resources that is at the most risk. So, it's a global thing. | Swindon

When imagining using digital tools to monitor water quality, participants wanted to be told about the cleanliness of water they might swim in, e.g. at the beach, but also given this data if they live near a water course.

We were talking about things around developing apps which would show you the water quality in a particular area you're visiting, so if you're taking your kids to the beach you can understand what the water quality is like in that particular area. | Swindon

Some participants discussed the desirability of digital tools to help with the detective work of finding causes of pollution so that better prevention measures could be put in place.

The quality of the canal water [...] also caused by ourselves, residents, tourists, homeless people, drug dealers destroys the ecosystem of the canal water. So, I think there may be some sensor to make or some app to monitor which part of the canal is ruined, or maybe some CCTV to identify the cause of the rubbish or the cause of the unpleasant smell. So, with the evidence then, to take the other step further. | London

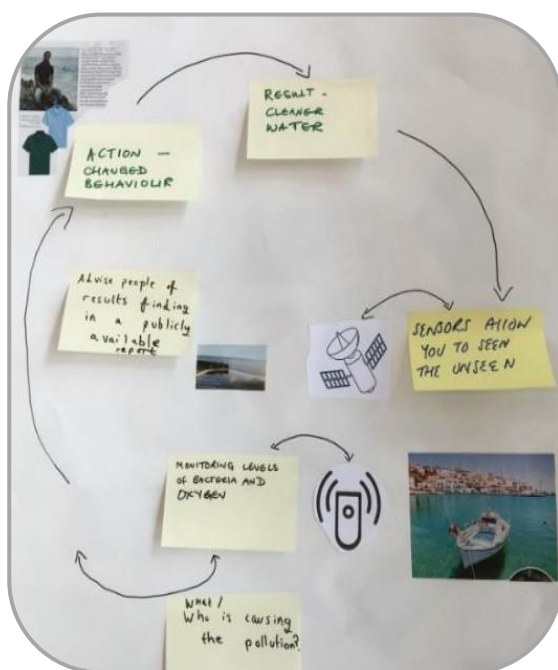


Figure 14: Illustration of water quality tracker

Of the eight trackers developed by participants, one focused exclusively on water quality. The image here describes the virtuous circle of sensors monitoring water quality, in this case bacteria and oxygen levels, and potentially identify the source of the pollution. This data is then made publicly available which, the hope is, will change behaviour and lead to cleaner water.

Water quality received a lower level of investment when compared with other issues discussed by participants (8%). However, those who included it in their top 4 priorities wanted to see investment in alternatives to pesticides to help reduce water pollution.

6.6 Recycling and waste management

Waste and recycling are environmental issues rather than a focus for NERC as environmental research. As stated previously, future dialogues might spend more time making this distinction clearer for participants so that they focus on areas where NERC can realistically make progress in providing evidence and helping to form solutions to challenges. Nevertheless, in discussing local challenges for some participants, waste is seen as one of the most visually impactful of all environmental issues. At the start of our discussions, one participant spoke in shocked tones about seeing a car driver in front of them dump fast food containers out onto the street,

I was driving to work and the car in front of me, all the windows got powered down, the next thing, all this rubbish from McDonalds just got slung out the window. I actually felt almost physically sick, because I thought, 'How on Earth can anybody do it?' | London

The issue of waste accumulating in areas of natural beauty or tourist areas was raised by some participants who saw it as a failing of society and an indicator of people not valuing the environment around them.

One of the challenges raised by participants was around a lack of awareness and trust about what is recycled and how. Participants discussed their confusion about what can be recycled and what can't, particularly around different plastics. Some also discussed their fears of pollution being emitted from waste incinerators.

When considering the digital tools to help with the issue of recycling and waste management, participants saw a role for commercial organisations, local authorities and citizens. Some wanted these different players to be better connected to help build trust and compliance with recycling practices by issuing clear guidance to members of the public.

'Do put that in your recycling.' 'Don't put that in it - nothing will happen', then you might actually stop buying it. So, a better interface between producing our recycling and the people who are actually managing it, would be useful. | London

On a number of occasions participants discussed digital tools that build trust in and compliance with local authority recycling practice. For some, this meant local authorities compiling and sharing data on the amount of different materials that is recycled and what it is then used for. Participants thought this information would encourage people to buy recyclable products and to comply with recycling instructions. This should be, as much as possible, shared in real time so that it is seen as authentic and have immediate impact.

Other ideas about digital tools included a device that analyses a shopping receipt and immediately tells the person making the purchase which items are recyclable and which aren't. Some extended this idea and said that loyalty points (such as Tesco Clubcard) could be awarded to those who bought the most recycling-friendly items.

The app where, say you do a weekly shop, you have all your receipts of things you've paid for, so you can detect everything you buy. If you then have some sort of recycling system where you can record everything you've bought, then you can place the packaging and tick it off as you go, then you know how much of each thing you're using each week, and you can perhaps cut the plastics you're using. | Swindon

Involving the public in tackling waste issues through challenges posted on social media was discussed, particularly in Swindon. Some participants were inspired by a recent campaign that went viral. Young people posted selfies of themselves in front of a scene of rubbish and then posted another photo of themselves with the rubbish cleaned away. The result was lots of young people and groups posting their own litter clearing achievements in the same way. Participants wanted to see this competitive enthusiasm to improve the environment leveraged in different ways at local levels using social media.

With the way the world's going with the increase in technology, younger children having phones, it'd be good if some had the apps to be challenged to do different tasks around the environment. They respond well to challenges and competition. Seeing how many bags of litter you could pick up.

| Swindon



Figure 15: Illustration of waste management tracker

One of the eight digital environment trackers developed by participants focused on the issue of recycling and waste management. The City Spy, illustrated by figure 15, is an app that enables users to post photos of fly tipping. This immediately alerts the local council so that the rubbish can be collected quickly. Participants also wanted to see data on how much fly-tipped rubbish is being collected and what happens to it.

Recycling received a similar level of investment priority (8%) as water quality. Those who chose it as one of their four priorities wanted to see research and data used to create digital tools that support activities such as refill centres to allow for packaging re-use and a 'detect – record – reward' system to incentivise recycling.

7. Participants' recommendations

Chapter 7 summary

Chapter five provides an overview of the five key messages participants formulated for NERC's stakeholders towards the end of the final dialogue session. These are distinct from the dialogue finding recommendations which are summarised in chapter 7. Participants demonstrated in their key messages strong support for NERC's Digital Environment programme and recognition of its timeliness given current environmental concerns. A summary of the key messages is given at figure 16.

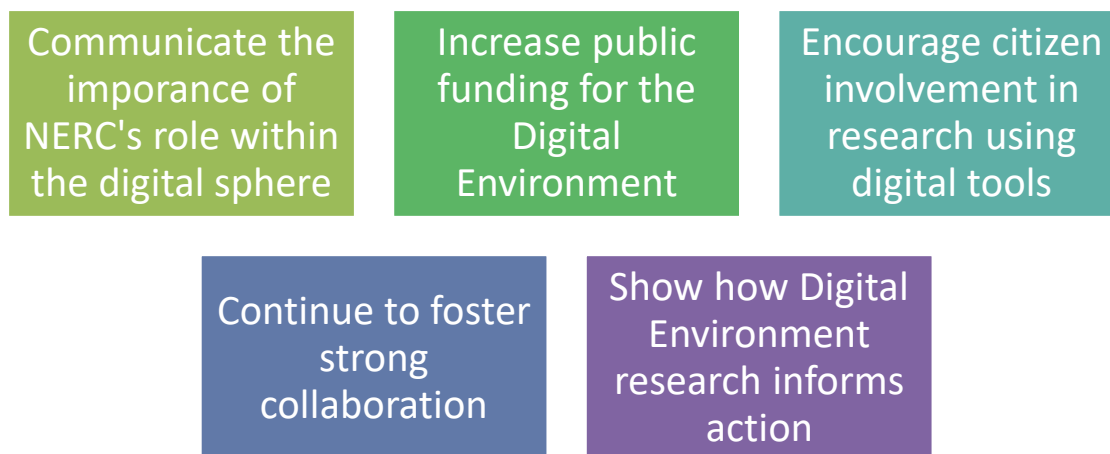


Figure 16: Summary of participants' recommendations

At the end of Round 2 participants were invited in their small groups to write a statement for those who have a stake in NERC funding, summarising their views on issues and opportunities for the Digital Environment Programme. Five key messages emerged, these are distinct from HVM recommendations which are summarised in section 7 of this report.

7.1 Communicate the importance of NERC's role within the digital sphere

Participants were concerned that NERC's role within the digital sphere, and more broadly, is not known widely enough to a lay audience. As described in section 4.6, all participant groups felt strongly that NERC should communicate its role more widely; using language that is appropriate for a non-specialist audience, explaining in Plain English what is meant by *digital environment* on NERC's and the programme's websites. They spoke of using the new communication tools being development for the Digital Environment programme to highlight the value to society of this research.

It's like that L'Oréal advert, 'because I'm worth it'. I think someone should say get your message out more, because what you're doing is amazing, and I would guess that's the same for every single person
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The digital environment programme is our greatest chance for a better change. The digital environment is a collaborative project giving more frequent and longer-term data over a bigger area. This big data will help influence policies across key areas. In addition, it will help with funding for researchers and assist on a more sustainable means of living.
Swindon

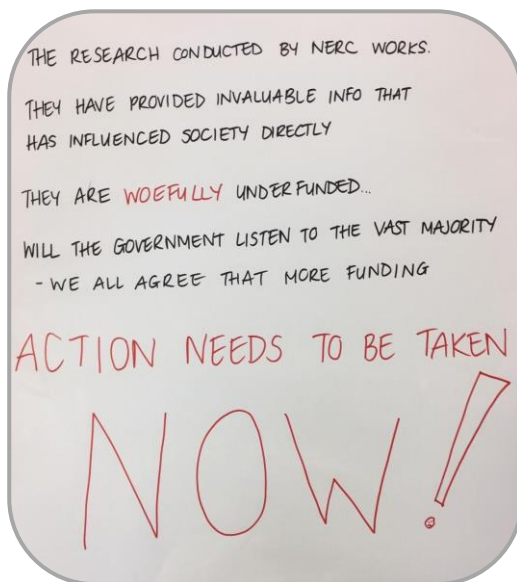
Figure 17: Message for NERC stakeholders

that's attended as a participant. It's been eye-opening to know what's going on (in the digital environment) and how significant it is. But we only know because we've been exposed to two days of intense discussion but who else is going to find out? |London

Figure 18 shows a statement participants in Swindon produced to express their view on the importance of NERC's role and the Digital Environment programme.

7.2 Increase public funding for the Digital Environment

Many participants felt that NERC and the Digital Environment programme are not funded well enough to do what they saw as an incredibly important job,



We need to a digital environment because our future is in danger if we carry on as we are! Without working together, the preservation of lives and wellbeing is at risk.

|Swindon

There was agreement across the locations that NERC matters because the environment underpins everything human beings do and impacts heavily on the future of mankind. As a mother in Swindon said,

It matters because I'm a citizen. My daughter's a citizen. She's got future children. Altogether it's not enough money. |Swindon

Figure 18: Message for NERC stakeholders

7.3 Encourage citizen involvement in research using digital tools

Participants urged NERC, specifically those working on the Digital Environment programme, to give more encouragement to citizens to contribute to research by getting involved in gathering data using digital tools. They suggested NERC should make scientific research more accessible to ensure a range of publics can take greater ownership over the issues the digital environment research highlights,

We said that if there's a better interface between scientists, the government and the public that means there's a bigger base source of data, which in turn gives the public more ownership over the issues if they're involved in gathering the data. Then the government can create new programmes to improve the environment and the lifestyles of the public, based on the new research and technology. |London

They said that people respond well to technology and therefore identified a significant opportunity for the Digital Environment programme to enable individuals to make a difference by engaging them with the environment as citizen scientists (see section 5.6) and advocates for change. One of the groups in Swindon gave voice to the sense of urgency all participants shared and their hopes that NERC will allocate sufficient resource to public engagement,

We just wanted to say action needs to be taken now. Whether it's more engagement, whether it's more of these types of things. Something needs to happen. |Swindon

7.4 Continue to foster strong collaborations

At the dialogue one of the groups in Swindon burst into song with a rendition of *We got the whole world in our hands* after they had shared their statement for NERC stakeholders. They stressed the urgency of a strong collaboration between NERC, citizens and policy makers as follows,

We need to construct a digital environment because our future is in danger if we carry on as we are. Without working together, the preservation of lives and wellbeing are at risk. | Swindon

This sentiment was present in London as well, where participants stressed the importance of strong collaboration with the business community, not only to help to get the environmental message out to citizens (see section 5.6), but also to ensure findings from the Digital Environment programme lead to improved processes and product innovation. A group in London described this as a virtuous circle of NERC funded researchers monitoring change to the environment and reporting on what is happening; with businesses responding to NERC's research with innovative ways of reducing the environmental impact of their products and business practices on the environment.

7.5 Show how Digital Environment research informs action

A fifth key message produced by participants revolved around the perception that data and research conducted using digital environment tools have little meaning if they don't result in action. Having learned that analysis of the big data gathered through the Digital Environment programme leads to a better understanding of environmental patterns and trends, participants felt strongly that NERC's data collection and analysis has much more societal relevance if it leads to concrete action. Therefore, one of the groups asked NERC what the bigger picture is for the research it funds,

Where is this information going? What local projects will eventually be created? What different types of legislation will be pushed for as a response of this research? How do you see the bigger picture in terms of local area planning? It's about the use of that research, not just to put a number on a thing and say, 'This is the case,' but to actually use it to create action, to produce, engineer, design, a new method to dealing with different situations. | Swindon

In both locations participants expressed the view that it would be helpful if NERC communicated clearly, when the programme is more established, how the data gathered as a result of the Digital Environment programme will be used. They were particularly interested in understanding how local and central government can be held to account,

You've got those high polluting areas and if you've got that data set of a protracted period of time, identifying those pollution hot spots and holding someone to account for that. If it's persistently coming up as a pollution hot spot holding someone to account for it. Whether that be central or local government. | London

They stressed that in their view the outcome of the data sharing should lead to concrete action resulting in positive outcomes for both the environment and people. As a participant said in relation to air pollution,

If the council knew this was a hot spot for air pollution, why don't we make this road really safe for cyclists? | London

This group in London called for a clear protocol between NERC and Government outlining how information will feed into policy making,

We hope there would be channels where those issues could be raised at a ministerial level. Having said that, maybe there aren't those channels, or they're not delineated clearly so that should be written into a contract. | London

As identified in section 5.5 participants saw opportunities for NERC in working with the business community to inspire behaviour change, informed by digital environment research. In discussions about the air pollution example above, someone in London suggested that an example of concrete action could be NERC working with Halfords to bring down the cost of bicycles in those areas or issuing vouchers to local residents giving 20% off a bicycle.

Participants tended to be more in favour of incentives as opposed to penalties to achieve behaviour change. A group in London discussed felt, for example, that it might be beneficial to introduce half fare bus or taxi rides to encourage people to leave their car at home if the sensors installed in their area indicates high levels of air pollution.

8. HVM recommendations and conclusions

NERC commissioned HVM to run a small-scale public dialogue to test its value for shaping the stage Digital Environment Programme in an early stage in its development. The independent evaluation report, due to be published in late autumn 2019, will further enhance understanding of the impacts of the dialogue process to the programme.

8.1 HVM recommendations

The recommendations in this section are divided in to two sections. The first focuses on those relating to the Digital Environment programme. The second, given that this dialogue was a pilot for are focused on public dialogue:

8.1.1 Digital Environment recommendations:

1. Given the finding that a wide range of different scale technologies, from satellites to wearables, resonate with participants, we recommend **investment across digital scales**, particularly as research from the smallest technologies can have a great impact on people's lives as well as on long-term strategic planning
2. Ensure that **all communication strategies** for the Digital Environment **embed good practice** in clear and jargon free written and spoken English
3. There is a desire within **NERC and the Digital Environment programme** to continue to engage with the specific participants involved in this pilot study. HVM supports this specifically to engage **how this now informed group of individuals can test the clarity of evidence and information provided on the Digital Environment website¹⁴** for non-specialists; and to highlight (and provide opportunities to test) new and emerging citizen science apps. As a starting point we recommend that when this report is sent to participants it is accompanied by the link to the site with a request to join the newly established Forum for discussion and for articles on the site's blog to be highlighted which might have resonance for this group with requests to respond. Ensuring the language used on the site is appropriate and engaging for non-specialists will be key to ensuring citizens can be stakeholders in Digital Environment research.
4. This dialogue had confirmed previous research findings findings that communications with citizens on the **research resulting from digital technologies** should **start by focusing on local and community issues** before taking the engagement further **to embrace national and global themes**
5. However dialogue participants put funding for digital tools to understand and react to climate change and research into alternative energy sources as a priority above using them to monitor and address pollution in air, water and on the ground. As such **we recommend communications which provide accessible and clear information and evidence on global issues**. Given the right evidence, citizens quickly understand the connections between the local and the global, and the value digital tools have in understanding those connections.

¹⁴ <https://digitalenvironment.org>
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8.1.1 Public dialogue recommendations:

1. To ensure future dialogues are framed effectively it is helpful to **involve a dialogue contractor in the early stages of scoping the deliberative engagement**, particularly the research questions, ensuring these are broad enough to encompass the key issues whilst being focused enough to meet the desired outcomes. It is therefore recommended that public dialogue consultants are engaged at an earlier stage in the programme planning.
2. Allow sufficient time and budget for collaboration with a **wider range of participants and stakeholders** beyond those managing and delivering the Digital Environment Programme. This might include, for example, presentations from those conducting **NERC funded digital environment research** and **government departments using the evidence which results from the research to implement policy**. Bringing diverse perspectives to the main issues is also very effective for a wider-scale dialogue. It enables dialogue contractors to draw more effectively on the expertise available within NERC's network, which will contribute to the process of **embedding dialogue findings in future decision-making**. This will also ensure the findings reflect **views from a broad demographic** across the country.
3. Public dialogue is demonstrably well suited to inform NERC's thinking on the Digital Environment programme and more broadly, particularly on issues which have a controversial or emotional dimension and are more challenging to discuss in a less reflective space. In line with participants' views on the value of the process (see section 4.6 and p7 of the independent evaluation) we therefore recommend continuing **to embed public dialogue in NERC's Digital Environment programme**, ensuring sufficient time and resource is allocated to allow for the process to be designed in close collaboration with NERC stakeholders and sessions to be held across the country involving a larger number of people. Subjects that emerge as lending themselves to further research include the specifics of trust and data protection, public confidence on what happens as a result of the data collected through the programme, and testing ways of influencing and advocacy, including key messages, around priority areas.
4. We encourage NERC to use the findings and recommendations from this report, to embed reflective deliberative thinking in strategic funding areas, particularly in similar early stages in the programme as in this case. This gives scope for the findings to fundamentally influence what happens within the programme and demonstrates to participants that their views are valued; and to the wider policy landscape that NERC listens to a wide range of views in the framing of its research funding, including the citizens whose daily lives are affected by it.

In addition to these recommendations HVM draws three main conclusions from the research.

8.2 Digital environment lays bare uncomfortable truths

Participants in the Digital Environment dialogue moved from being completely unaware of NERC and the range of work being done in the digital environment, to expressing a view that this programme, and NERC's work more broadly, has a significant role to play and is rightly funded as a strategic focus for NERC. Being given a platform to consider digital environmental research opportunities in a meaningful way, enabled even those identified in the recruitment process (based on the segments identified in NERC's Public Insight Research¹⁵) as being sceptical about the value of environmental research and those who have had little exposure to it, to embrace the subject. This led to emotive expressions of appreciation and support for NERC and the Digital Environment programme.

¹⁵ <https://nerc.ukri.org/about/whatwedo/engage/public/public-insight-report/>
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The workshops took place against a backdrop of increased media attention for environmental issues. Extinction Rebellion¹⁶ was making itself heard in the streets of London; many participants had watched episodes of David Attenborough's *Our Planet* which was streaming on Netflix from mid-April 2019; the Committee on Climate Change had published *Net Zero – The UK's contribution to stopping global warming*¹⁷ and the United Nations' Intergovernmental Panel on Climate Change (IPCC) its *Fifth Assessment report*¹⁸, both of which were widely reported in the news. This contributed to participants devising the message that immediate action on climate change is an imperative. Participants in the second round of workshops sought to understand how Digital Environment enhanced research could enrich society's understanding of climate change solutions.

That whole thing around Extinction Rebellion and the environment is hugely in the public eye at the moment. It's an opportunity, there's that focus, because they almost bought the country to a standstill, well... certainly the capital. | Swindon

The timing of this public dialogue on Digital Environment added to the surge in awareness and sparked people's curiosity further. This view of a participant in London chimed with many,

It's insane. You don't realise how much is happening until you start looking into it. | London

Participants had a dawning realisation that Digital Environment has the potential to lead to insights that might affect the decisions people make about their daily lives such as where they want to live and their routes to work, school and leisure activities. They understood that the evidence revealed through the programme could, for example, highlight an area of the country at risk of flooding; or demonstrate the pollution hot spots at key times of the day in specific locations; show poor water quality or provide evidence for instability in the ground beneath where we live because of what research tells us about the impacts of subterranean tunnelling. All of which could inform what people think about certain areas of the country. However, there was consensus that despite the potential for revealing these issues, transparency is preferable over not having access to the information from monitoring the environment. As a participant in London said,

We've got every right to know everything about our environment. | London

Clear, unequivocal data about their environment expressed in terms which are understandable for people with no specialist knowledge of the subject, can be a catalyst for citizens to act, as we will see below.

8.3 Citizen science apps as a route to purposeful engagement

The dialogue demonstrated that engagement with research about the environment leads to an increased interest in potential threats to it. Participants told us that in their busy daily lives it is all too easy to live without contact with the natural environment. They are likely to engage with challenges to their local environment in the first instance. Only one of the tools/ trackers participants developed focused on bigger global issues such as extreme weather events with the

¹⁶ <https://rebellion.earth/>

¹⁷ <https://www.theccc.org.uk/publication/net-zero-the-uks-contribution-to-stopping-global-warming/>

¹⁸ <https://www.ipcc.ch/report/ar5/wg1/>

majority taking the local environment as the starting point.

This latent appetite for environmental engagement could be employed to great effect to enrich NERC's implementation of the Digital Environment Programme. Although participants in the dialogue called for general awareness raising of and education on the environment they showed a particular desire for purposeful involvement. They made it clear that they are genuinely interested in digital ways of being involved with NERC funded environmental research, which was seen as immensely powerful due to its ability to capture and combine big data sets. There was a clear appetite for taking a role in NERC's monitoring activities, preferably through easy to use, well-functioning and free citizens science apps.

8.4 Public engagement routed in deliberation

The dialogue was a pilot programme to test the suitability of public dialogue as an engagement approach for NERC's programmes of work. The evaluation of the public dialogue, conducted and reported on independently by Mike King from Resources for Change, shows that the majority of participants were very engaged in the discussions and learnt a lot from being involved. Equally, NERC staff said they found the dialogue very valuable and through being involved had a much clearer idea how dialogue can be used to inform NERC's decision making.

HVM concludes that deliberation, giving people time to think and reflect before responding (both in workshops and in the time between a two-round process), is a powerful tool which supports understanding of complex scientific areas including the deployment of digital technologies.

9. Acknowledgements

Hopkins Van Mil: Creating Connections is very grateful to all participants who attended the dialogue sessions in Swindon and London. Everyone's enthusiasm and willingness to discuss what for many was new information was really impressive. Their eagerness to get to grips with digital environmental research and the use of digital tools to understand and plan for the future more effectively has been fundamental to the success of this pilot public dialogue.

NERC demonstrated a great commitment to the public dialogue process. We are particularly grateful to Hannah King who tirelessly gave her time to provide invaluable support to the design of the dialogue, and to attend and present at the workshops, based on a thorough understanding of the public engagement. Hannah Lacey and Sarah Campbell, also part of the core team steering this work provided calm reflection and valuable inputs in the design phase and at the workshops, for which thanks. We also valued the presence of Kirsten Dutton, Audrey Sharp and Tom Doyle at the workshops for their clear demonstration of the range, scope and importance of NERC's work which provided a vital resource for participants.

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Particular thanks are due to Hannah Collins and Jo Thompson who have championed public engagement within NERC and whose thoughtful and passionate reflections back to groups at the end of sessions provided participants great reassurance that their voices had been heard, and that what they had said would make a difference to NERC's future strategic thinking.

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