

ERFF/NERC POSTGRADUATE AND PROFESSIONAL SKILLS NEEDS REVIEW OVERVIEW AND OUTPUTS

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ERFF/NERC POSTGRADUATE AND PROFESSIONAL SKILLS NEEDS REVIEW OVERVIEW OF REVIEW AND OUTPUTS

INTRODUCTION

1. This Overview describes the ERFF/NERC Postgraduate and Professional Skills Needs Review. It also identifies the six outputs we are making available as background to [Most Wanted](#), which is the main report for the Review.

BACKGROUND ON THE REVIEW

What is it?

2. The Postgraduate and Professional Skills Needs Review was set up to collect evidence on the postgraduate and professional skills needs and training priorities in the UK environment sector (ES) in the next decade. For the purposes of the Review, the ES is defined as those parts of the UK economic, political and social systems that significantly rely on, or generate, knowledge concerned with investigating the state and condition of the Earth. The Review was established at the end of 2007 by the Environment Research Funders' Forum (ERFF¹) and the Natural Environment Research Council (NERC). There have been two phases.

Phase 1

3. Phase 1 of the Review was undertaken through contracts awarded to the Institute of Employment and Research (IER) at the University of Warwick, and the Institute of Manufacturing (IfM) at the University of Cambridge. IER's remit included determining the evidence already available to inform the Review, developing some boundaries for the study and recommending how the rest of the work should be carried out. IfM looked at the possibility of developing a roadmap or framework for identifying skills needs. The conclusions drawn by the Project Board from this work were that:
 - a) there is little evidence already available due to the disparate nature of the environment sector,
 - b) a different method to the standard approaches to employment research would be required if meaningful conclusions were to be drawn,
 - c) using open questions to canvass views from stakeholders provided very generalised responses, and
 - d) a framework for developing ideas on skills was required.

Phase 2

4. The output papers presented here relate to Phase 2 of the Review which started in mid-2009. At this time, NERC took on a more significant role in the project's management due to the organisation's pressing need for an evidence-based analysis to inform decisions on levels and direction of postgraduate support. It particularly wanted to identify areas where there were critical national shortages. A new Project Board, chaired by Janice Timberlake, NERC Director for People, Skills and Communication was established. The Board had a wide breadth of membership and included senior representatives from stakeholder organisations in the academic and public sectors –see [Annex 1](#) for full membership.

¹ It was announced on 10 June 2010 that ERFF would merge with the Living With Environmental Change Programme

5. The two **Objectives** for Phase 2 were:
 - i) To identify the postgraduate skills needs which are training priorities, over the short, medium and long term, for challenges facing the three main parts of the environment sector; and
 - ii) To develop a robust process for undertaking the review so that the work can be repeated/ refreshed/ extended.

6. The three parts of the ES on which we focused are:
 - a) The environmental sciences research base comprising the organisations which generate knowledge concerned with investigating the state and condition of the Earth (academic sector),
 - b) The public sector bodies charged with responsibility for various aspects of the environment eg policy makers and regulators (public sector), and
 - c) The major relevant industrial/commercial organisations where the principal activity is the significant provision or use of the environmental resources/ services/ products/ expertise (private sector).

7. Important elements of the work were a public consultation and the establishment of an expert Review Group comprising 46 key organisations and senior representatives from the three parts of the environment sector. Both elements provided valuable contributions to the development of a Skills Framework for the Environment Sector – the main output from the project. A list of members of the Review Group is in [Annex 2](#).

8. It is intended that the Framework will provide a reference point for postgraduate level training activities within the environment sector including continuing professional development and short courses. This will help us ensure that there are people with the right mix of skills and knowledge available to employers in the future.

THE OUTPUTS

9. In addition to the overarching report *Most Wanted* which contains the key findings and messages, there are six output papers as listed below. Output 2, the Skills Framework, forms a separate document and is available [here](#) while the other five are contained in this document. Each output is designed to be as self-supporting as possible and therefore there is some repetition between them. We advise that the Skills Framework is read in conjunction with the Guide (Output 1). An additional set of annexes in support of the outputs papers is [here](#).

Output 1	Guide to the Postgraduate and Professional Skills Framework – development, use and interpretation
Output 2	The Skills Framework for the Environment Sector
Output 3	The Postgraduate and Professional Skills Needs Inventory
Output 4	Report on additional feedback from the consultation
Output 5	Report on the Methodology
Output 6	Discussion of “The Way Forward”

GLOSSARY

10. A glossary explaining terms and abbreviations is in [Annex 3](#).

ACKNOWLEDGEMENTS

11. ERFF is very grateful to the many members of the environment sector who have spent time contributing to the Review and helping us to develop the Skills Framework. This includes the members of the Skills Board, the respondents to the consultation, the members of the Review Group and all the other stakeholders who have advised us. We hope that you will continue to work with us.

PROJECT TEAM

12. The project was managed initially by Kirsty Grainger, and then by Jo Tudor. They would like to thank the following members of the project team for their valuable contributions at different stages in the Review.
 - Sam Austin (Administrator, Living with Environmental Change Programme)
 - Susan Ballard (Communications, Living with Environmental Change Programme)
 - Katie Bowden (summer vacation student from the University of Reading)
 - Ursula Cockrem (PA to Janice Timberlake, NERC)
 - Amy Foxtton (Science Programmes Officer, NERC)
 - Chris Smith (PhD student on six-month internship to NERC from the University of Sussex)

FURTHER INFORMATION

13. NERC is to act as custodian of the Skills Framework for the Environment Sector including overseeing its development and monitoring how the findings are taken forward by stakeholders. For further information, please email skills@nerc.ac.uk

ERFF/NERC POSTGRADUATE AND PROFESSIONAL SKILLS NEEDS REVIEW

OUTPUT 1 – GUIDE TO THE SKILLS FRAMEWORK FOR THE ENVIRONMENT SECTOR

INTRODUCTION

1. This paper provides a Guide to the Skills Framework for the Environment Sector. This Framework is the key output from Phase 2 of the ERFF/NERC Postgraduate and Professional Skills Needs Review and can be found [here](#). A short overarching report, *Most Wanted*, contains the main findings and messages from the Review. The Framework summarises what the environment sector (ES) has told us, so far, about the postgraduate and professional skills it requires. The Framework is a living document which provides a picture of the skills that are needed over the next decade to address the key challenges which the Community faces. This Guide provides information on the development of the Framework; its structure and interpretation; and its potential uses. It is the first time that such a Framework has been produced and we are keen to receive comments and suggestion on how it might evolve in the future (contact information is provided [here](#)). A glossary of the terms used is in [Annex 3](#).

DEVELOPMENT OF THE FRAMEWORK

Rationale for a Framework

2. The decision to use a framework approach to identify postgraduate and professional skills needs was made because the initial work in Phase 2 to canvass stakeholders' views had not proved successful. This work had started with a "blank sheet of paper" but provided only very generalised responses. Full information on the Review methodology is included in the Report on Methodology ([Output 5](#)). However, key points from the perspective of a user of the Skills Framework are provided here to aid its interpretation.

Development of the prototype

3. A prototype Skills Framework was produced within NERC using a combination of the evidence already available from previous work and advice from individuals across the NERC community. This prototype listed 36 key challenges each associated with one of eight specific drivers. The drivers we used (again, based on earlier horizon-scanning work by NERC and ERFF) were climate change; sustainable use of natural resources; changing technologies; changing ecosystems; societal change; economic-political change; Earth system science; and environment and health. For each challenge, potential postgraduate and professional skills needs were suggested. For instance, "dealing with uncertainty" was identified as a challenge resulting from the "climate change" driver for which skills in "uncertainty modelling" were required.

Public Consultation

4. The prototype formed the basis of a public consultation launched in November 2009 which invited comment from the three main components of the environment sector (academic, public and private sectors). The consultation documentation can be found in [Annex 4](#). Consultees were invited to:
 - Comment on the information already in the draft Framework,
 - Identify additional challenges faced by the sector over the next ten years, and

- Record the graduate and postgraduate and professional knowledge and skills required to meet the challenges.

Review and Targeted Groups

5. In addition to being published on the NERC website, the consultation was sent to an expert Review Group, an important element of the Phase 2 methodology. The Group, comprising 46 key organisations and senior representatives from the academic, public and private sectors, had accepted the Project Board's invitation to help with the development of the Framework. As well as responding to the consultation (and encouraging others to do so), they reviewed and commented on the initial analysis and interpretation of responses. Its membership is shown in [Annex 2](#).
6. The consultation paper was also emailed to a Targeted Group of over 500 individuals in the community and the heads of NERC-funded academic departments.

Responses to the Consultation

7. There were 143 responses to the consultation of which 70 came from the research base, 17 from the public sector, 29 from the private sector and 27 from representative or overarching bodies. 121 of the responses represented the views of entire organisations or groups of individuals within organisations while the remaining 22 came from individuals. The Environmental Sustainability Knowledge Transfer Network (<https://ktn.innovateuk.org/web/sustainabilityktn>) kindly helped with obtaining responses from the private sector.
8. The Skills Project Board agreed that there was sufficient coverage of the community and the eight drivers to proceed with the analysis. A list of respondents is in [Annex 5](#).

Initial analysis of Responses

9. Full details of the analysis of the responses are included in the Methodology paper ([Output 5](#)). Briefly, the respondents identified 736 challenges facing the Community which would need addressing by people, with the appropriate postgraduate and professional knowledge and skills, over the next decade. For each of these challenges, they provided details of the types of knowledge and skills needed. It was found that many of the challenges suggested were similar or overlapping. To reduce them to a more manageable number for the analysis and interpretation, they were consolidated into 124 broader challenges under 59 topic areas, linked to the eight drivers in the Framework. These were agreed with research council staff with expertise in the areas covered by the challenges. ***From this point on, all references to challenges refer to the 124 broader consolidated challenges unless indicated otherwise.*** [Annex 6](#) provides details of the challenge/topic/driver hierarchy.
10. The prototype Skills Framework was updated to include the 124 agreed challenges. Summaries of the graduate, postgraduate and professional knowledge and skills needed to address each one were prepared and added. At this stage, the Review Group was consulted on the Framework. Of the 46 members, 34 responded and their feedback, including their views on the relative priority of the challenges was incorporated on the new Framework. As a result of the Review Group's feedback, challenges were designated as critical, priority or other. The production of this annotated Framework was an important milestone in the Review and is discussed further in the afore-mentioned methodology paper ([Output 5](#)).

Restructuring of the Framework

11. In order to interpret the Framework better and understand what it was telling us about knowledge and skills needs across the Community, the Skills Project Board decided that it should be restructured. Essentially, it was reorganised to become primarily a list of priority postgraduate and professional knowledge and skills needs with an indication of the challenges (critical, priority or other) for which they were needed. The terminology used for the list of knowledge and skills areas is faithful to that used by the respondents – there was no attempt, at this stage, to fit them to an existing or tailored classification scheme.
12. Over 220 knowledge and skills areas were identified and it was necessary to prioritise which should appear on the Framework. This was done by selecting those areas which were identified as being in shortage and/or which were needed to address a large number of challenges. Firstly, **Areas of Concern** were identified and these are the knowledge and skills areas highlighted by respondents as being in shortage with regard to at least one specific challenge. Secondly, **Key Skills Areas** were designated and these are the knowledge and skills areas highlighted by respondents as being frequently required to address challenges. As a result of this selection process, 83 knowledge and skills areas were added to the Framework which has been divided into four sections as follows:
 - Section A: Priority 1 Areas of Concern** – Twenty-three areas identified by the ES as being **in shortage** with respect to at least one challenge designated as **critical**. (In addition to being in shortage for at least one critical challenge, these knowledge/skills areas are needed to address a range of both critical and priority challenges.)
 - Section B: Priority 2 Areas of Concern** – Ten areas identified by the ES as being **in shortage** with respect to at least one challenge identified as a **priority**. (In addition to being in shortage for at least one priority challenge, these knowledge/skills areas are needed to address a range of both critical and priority challenges.)
 - Section C: Priority 1 Key Skills Areas** – Twenty-two areas identified by the ES as needed to address between 10 and 44 different challenges. (These areas were not highlighted by contributors as being in shortage for any specific priority or critical challenge - although **more general feedback** may have indicated that some are in shortage or they may be closely linked subject-wise to areas where there are reported shortages with respect to specific challenges.)
 - Section D: Priority 2 Key Skills Areas** – Twenty-eight areas identified by the ES as needed to address between 5 and 9 different challenges. (These areas were not highlighted by contributors as being in shortage for any specific priority or critical challenge - although **more general feedback** may have indicated that some are in shortage or they may be closely linked subject-wise to areas where there are reported shortages with respect to specific challenges.)
13. The Framework has been augmented with the outputs from two parallel strands of work. Firstly, work was done to identify existing training provision in the Areas of Concern and Key Skills Areas and examples have been included on the Framework. Secondly, a literature search was undertaken to identify additional evidence in the published literature relevant to the Areas of Concern and Key Skills Areas. References have been added to the Framework and a copy of the complete bibliography is in [Annex 7](#).
14. Lastly, cross-references have been added to show where there are clear linkages between the Areas of Concern and Key Skills Areas. (In the future, it might be appropriate to develop or adopt a more structured classification scheme for describing knowledge and skills areas.)

INTERPRETATION OF THE FRAMEWORK

15. The Skills Framework for the Environment Sector forms [Output 2](#) and can be found here. It is the first edition of a living document which we hope the environment sector will find interesting and useful. It is not yet comprehensive but we hope that, with the help of the environment sector, it will become an increasingly valuable tool. The Skills Framework identifies those knowledge and skills areas we have designated as *Areas of Concern* or *Key Skills Areas*. These are priorities for further consideration because they have been identified as being in shortage and/or are needed to address a large number of challenges faced by the Community.
16. Looking at the Framework structure, you will see that there are seven columns labelled A to G. An explanation of their contents is given in the Table below:

COLUMN	HEADING	DESCRIPTION OF CONTENTS	FURTHER DETAILS
A	F/W POS.	Position of knowledge/skill area on the Framework.	There are 83 Areas of Concern/ Key Skills Areas. Their position on the Framework is determined by a) whether they are in shortage for a critical or priority challenge, and b) the number of challenges for which they are required. (See Paragraph 12 above for further information.)
B	NO OF CS.	Total number of challenges for which the specified knowledge/skill is needed.	This refers to the total number of critical, priority or other challenges (as advised by the Review Group) for which the knowledge/skills area is needed. (See Paragraph 10 above.)
C	AREA OF CONCERN/ KEY SKILL AREA	Title of knowledge/skill area, skill ref. number and cross-references to linked skills areas.	In addition to the knowledge/skill area and its project reference number, there are cross-references to other areas which are clearly linked or overlapping. Users of the Framework may wish to link other areas together.
D	SUMMARY OF AREA AND EXAMPLES OF CONSULTEE/REVIEW GROUP COMMENTS	Summary of knowledge/skills needs in specified skills area with examples of views from the respondents to the public consultation and from the Review Group members.	As noted in the previous column.
E	CHALLENGES FOR WHICH SKILL/KNOWLEDGE IS REQUIRED	Reference numbers of each of the challenges facing the sector for which the specified knowledge/skill is	Respondees to the public consultation suggested over 700 individual challenges linked to the eight different drivers specified in the

		required. C, P or O denotes a critical, priority or other challenge respectively.	consultation. These were amalgamated and categorised to form the 124 consolidated Challenges which the Review Group helped to prioritise. This, in turn, helped us to prioritise the knowledge and skills needs. (See Paragraphs 10-13.)
F	EXAMPLES OF EXISTING TRAINING PROVISION	Examples of existing training provision/training initiatives in the specified area.	The main sources of existing examples are the NERC, ESRC, and the ERFF Environmental Research Database.
G	ADDITIONAL EVIDENCE FROM THE PUBLISHED LITERATURE	Cross-references to additional evidence in the published literature.	NERC, the current custodian for the Framework, is keen to build up a more comprehensive picture of existing training in the areas of concern. Please follow this link for advice on how to submit further information. A literature search was undertaken and a bibliography comprising almost 100 publications compiled. This can be found in Annex 7 .

USING THE FRAMEWORK

17. We hope that the Skills Framework for the Environment Sector will be useful to a wide range of stakeholders both in the environment sector and associated with it. These include:
 - funders of training eg research councils, government agencies,
 - providers of training eg universities, employers,
 - employers of people trained to postgraduate level including those from the research base and private and public sectors,
 - policy makers, and
 - employees and students (graduates and undergraduates).
18. There are many ways in which the Skills Framework could be used and is already starting to be used. These stem from the original rationale for doing the Review which was to *build up a more comprehensive picture of UK skills needs and training priorities in the environment sector so that NERC and the other members of the ERFF (now the Living with Environmental Change Programme) can help ensure a healthy environmental science base in the UK and provide UK employers with the skilled people they need.*
19. The desired outcomes which were identified at the beginning of the Review were that it should contribute to:
 - Better informed decisions on training strategies;
 - Short term remedial action and reduction of skills gaps in the longer term;
 - Better informed dialogue between trainers/ funders/ suppliers/ users ie on priorities, delivery and on ownership/ responsibilities; and

- Raising the profile of skills – encouraging/ enabling the creation of a skills community.

20. Specific uses we foresee for the Framework include:

- informing the training strategies of the LWEC (formerly ERFF) members,
- helping training funders and providers assess what they are already doing to address know knowledge and skills needs,
- assisting training providers in developing new training opportunities eg PhDs, masters courses, short courses etc,
- providing students with information to help make choices about their training,
- providing employees with information to help make choices about their continuing professional development, and
- identifying areas for further work with stakeholders to define knowledge and skills needs more precisely.

21. We have already been told that the Framework is being used or will be used:

- to inform the direction of the new NERC training strategy,
- by a NERC research establishment to extract the skills relevant to them and consolidate them as a simpler document for internal use
- by a government agency to identify knowledge and skills areas which they will need to support in house through continuing professional development
- by NERC to contribute to requests from government for evidence on skills needs
- by a government agency to identify current training provision or initiatives in the knowledge and skills areas of interest to them

Developing the Framework

22. We invite you to look at the Framework and consider your role in addressing or developing it further (contact details below). As a first step, we are keen to build up a more comprehensive picture of existing training in the Areas of Concern and Key Skills Areas and would be grateful for your contributions.

CONTACT DETAILS

23. Please contact us by email in the first instance at skills@nerc.ac.uk

**ERFF/NERC POSTGRADUATE AND PROFESSIONAL SKILLS NEEDS REVIEW
OUTPUT 2 – THE SKILLS FRAMEWORK FOR THE ENVIRONMENT SECTOR**

The Skills Framework is the key output from the Review and can be found in a separate document available [here](#).

ERFF/NERC POSTGRADUATE AND PROFESSIONAL SKILLS NEEDS REVIEW

OUTPUT 3 – THE POSTGRADUATE AND PROFESSIONAL SKILLS NEEDS INVENTORY

BACKGROUND

1. The ERFF/NERC Postgraduate and Professional Skills Needs Review has helped to identify the postgraduate and professional knowledge and skills needed to address challenges facing the environment sector over the next decade. The key output from Phase 2 of the work is the [Skills Framework](#) for the Environment Sector (Output 2). The main findings and key messages from the Review can be found in a short overarching report, [Most Wanted](#). Over two hundred different knowledge and skills areas were identified and 83 of these have been included on the Skills Framework. The Framework includes 33 areas which we have designated as *Areas of Concern*. This is because shortages of those skills (at a postgraduate level) have been identified with regard to specific challenges. The Framework also includes a further 50 areas called *Key Skills Areas*. These skills areas are identified as necessary to address a significant number of challenges (ie between 5 and 44) and are therefore also regarded as key requirements. An overview of the Review and other outputs is [here](#) while a Guide to understanding and using the Framework (Output 1) can be found [here](#). This paper describes the full list of 224 postgraduate and professional skills needs as described by the Sector which we have called the *Postgraduate and Professional Skills Needs Inventory*.

THE POSTGRADUATE AND PROFESSIONAL SKILLS NEEDS INVENTORY

2. In addition to the 83 knowledge/skills areas on the Skills Framework, a further 141 skills areas were identified, each of which is needed to address up to four of the total 124 challenges facing the Community. These skills areas vary in scope and scale with some being related to or sub-categories of areas on the Framework. They are therefore also likely to be of interest and are included in the [Inventory](#) which lists all 224 of the knowledge and skills areas identified.
3. The Skills Inventory includes information in six columns:
Column A: the title of the knowledge/skill area eg modelling,
Column B: an identifier code for the knowledge/skill (those with the prefix A to D appear on the Skills Framework),
Column C: whether knowledge/skill is in shortage with regard to at least one critical challenge facing the ES
Column D: whether knowledge/skill is in shortage with regard to at least one priority challenge facing the ES
Column E: the total number of challenges requiring the specified knowledge/skill
Column F: the percentage of challenges requiring the specified knowledge/skill
4. The Inventory can be sorted by clicking on the column heading and, for example, used to:
 - See all the knowledge/skills areas arranged in alphabetical order for ease of reference,
 - Sort knowledge/skills areas into the order of frequency for which they are needed to address challenges,
 - Pick out areas which are in shortage, or
 - Identify the areas needed to address 50% or more of the challenges.

CONTACT DETAILS

5. For further information on the Skills Inventory, please contact us by email in the first instance at skills@nerc.ac.uk

**ERFF/NERC SKILLS NEEDS REVIEW
INVENTORY OF SKILLS**

SKILL/ KNOWLEDGE AREA	IDENTIFIER CODE	WHETHER AREA IDENTIFIED AS A SHORTAGE FOR AT LEAST ONE CRITICAL CHALLENGE	WHETHER AREA IDENTIFIED AS A SHORTAGE FOR AT LEAST ONE PRIORITY CHALLENGE	NUMBER OF CHALLENGES REQUIRING KNOWLEDGE/ SKILL IN AREA (TOTAL = 124)	PERCENTAGE OF CHALLENGES FOR WHICH KNOWLEDGE/ SKILL REQUIRED
Modelling	A014	Y	N	84	67.7
Inter- / Multi- disciplinarity	A010	Y	N	50	40.3
Data Management	A004	Y	N	42	33.9
Statistical Analysis	A020	Y	N	41	33.1
Communication	A003	Y	N	34	27.4
Fieldwork	A008	Y	N	34	27.4
Science-Policy Interface / Translation	A018	Y	N	28	22.6
Risk Assessment & Management	A017	Y	N	25	20.2
Taxonomy & Systematics	A022	Y	N	19	15.3
Dealing with Uncertainty	A005	Y	N	17	13.7
Mathematics / Applied Mathematics	A011	Y	N	17	13.7
Soil Science	A019	Y	N	17	13.7
Environmental Epidemiology	A007	Y	N	13	10.5
Business Awareness	A002	Y	N	12	9.7
Sustainability Science	A021	Y	N	12	9.7
Agriculture	A001	Y	N	7	5.6
Microbiology / Microbial Physiology	A013	Y	N	7	5.6
Media Skills	A012	Y	N	6	4.8
Natural Science - Social Science Interface	A015	Y	N	6	4.8
Town & Country Planning	A023	Y	N	4	3.2
Energy Provision	A006	Y	N	3	2.4
Integrated Freshwater Sciences	A009	Y	N	3	2.4
Renewable Energy Technology	A016	Y	N	3	2.4
Ecology / Ecological Sciences including Conservation	B003	N	Y	43	34.7
Spatial Analysis & GIS	B010	N	Y	37	29.8
Economics	B004	N	Y	33	26.6

SKILL/ KNOWLEDGE AREA	IDENTIFIER CODE	WHETHER AREA IDENTIFIED AS A SHORTAGE FOR AT LEAST ONE CRITICAL CHALLENGE	WHETHER AREA IDENTIFIED AS A SHORTAGE FOR AT LEAST ONE PRIORITY CHALLENGE	NUMBER OF CHALLENGES REQUIRING KNOWLEDGE/ SKILL IN AREA (TOTAL = 124)	PERCENTAGE OF CHALLENGES FOR WHICH KNOWLEDGE/ SKILL REQUIRED
Approaches					
Carbon Sciences	B001	N	Y	9	7.3
Palaeontology	B009	N	Y	8	6.5
Life Cycle Assessment	B008	N	Y	5	4.0
Computer Science	B002	N	Y	4	3.2
Geoengineering	B005	N	Y	4	3.2
Landscape Sciences	B007	N	Y	2	1.6
Introduced / Invasive Species	B006	N	Y	1	0.8
Futures Thinking / Planning	C001	N	N	44	35.5
Social Science	C002	N	N	37	29.8
Psychology	C003	N	N	29	23.4
Geomorphology & Earth Surface Processes	C010	N	N	23	18.5
Biology / Biological Sciences	C004	N	N	22	17.7
Remote Sensing	C005	N	N	22	17.7
Engineering	C006	N	N	22	17.7
Community Engagement	C007	N	N	19	15.3
Innovation	C008	N	N	19	15.3
Ecosystem Services	C009	N	N	19	15.3
Political Science / Politics	C011	N	N	18	14.5
Environmental Informatics	C012	N	N	15	12.1
Systems Approach	C013	N	N	14	11.3
Deliberative Techniques	C014	N	N	14	11.3
Biogeochemistry	C015	N	N	12	9.7
Emerging Technologies.	C016	N	N	12	9.7
Field Observation	C019	N	N	12	9.7
Biodiversity	C017	N	N	11	8.9
Environmental Valuation	C018	N	N	11	8.9
Earth Observation Systems	C021	N	N	11	8.9
Cost-Benefit Analysis	C020	N	N	10	8.1
Chemistry / Chemical Sciences	C022	N	N	10	8.1
Policy Awareness	D002	N	N	9	7.3
Environmental Impact Assessment	D004	N	N	8	6.5
Hazard & Risk Assessment	D005	N	N	8	6.5
Geochemistry	D008	N	N	8	6.5
Archaeology	D003	N	N	7	5.6

SKILL/ KNOWLEDGE AREA	IDENTIFIER CODE	WHETHER AREA IDENTIFIED AS A SHORTAGE FOR AT LEAST ONE CRITICAL CHALLENGE	WHETHER AREA IDENTIFIED AS A SHORTAGE FOR AT LEAST ONE PRIORITY CHALLENGE	NUMBER OF CHALLENGES REQUIRING KNOWLEDGE/ SKILL IN AREA (TOTAL = 124)	PERCENTAGE OF CHALLENGES FOR WHICH KNOWLEDGE/ SKILL REQUIRED
Environmental Management	D007	N	N	7	5.6
Geophysics	D009	N	N	7	5.6
Geosciences	D010	N	N	7	5.6
Hydrological Science	D011	N	N	7	5.6
Health Impact Assessment	D018	N	N	7	5.6
Earth Sciences	D013	N	N	6	4.8
Environmental Ethics	D014	N	N	6	4.8
Forestry	D015	N	N	6	4.8
Genomics	D016	N	N	6	4.8
Geopolitics	D017	N	N	6	4.8
Numerical / Mathematical Modelling	D019	N	N	6	4.8
Legislation / Legislative Process	D001	N	N	5	4.0
Programming	D006	N	N	5	4.0
Science Communication	D012	N	N	5	4.0
Physics	D020	N	N	6	4.8
Sensor Design	D021	N	N	6	4.8
Environmental Change	D024	N	N	6	4.8
Parameterisation and Assimilation	D025	N	N	6	4.8
Behavioural Change	D022	N	N	5	4.0
Data Mining	D023	N	N	5	4.0
Public Health & Wellbeing	D026	N	N	5	4.0
Sampling Techniques	D027	N	N	5	4.0
Science – Engineering Interface	D028	N	N	5	4.0
Socioeconomics	D029	N	N	5	4.0
Atmospheric Science	E004	N	N	4	3.2
Climate Science	E009	N	N	4	3.2
Hydrogeology	E021	N	N	4	3.2
Mapping / Cartography	E025	N	N	4	3.2
Marine Biology	E026	N	N	4	3.2
People Skills	E034	N	N	4	3.2
Population Dynamics	E036	N	N	4	3.2
Sociology	E046	N	N	4	3.2
Understanding Climate Models	E054	N	N	4	3.2
Agent-based	E001	N	N	3	2.4

SKILL/ KNOWLEDGE AREA	IDENTIFIER CODE	WHETHER AREA IDENTIFIED AS A SHORTAGE FOR AT LEAST ONE CRITICAL CHALLENGE	WHETHER AREA IDENTIFIED AS A SHORTAGE FOR AT LEAST ONE PRIORITY CHALLENGE	NUMBER OF CHALLENGES REQUIRING KNOWLEDGE/ SKILL IN AREA (TOTAL = 124)	PERCENTAGE OF CHALLENGES FOR WHICH KNOWLEDGE/ SKILL REQUIRED
modelling					
Analytical Chemistry	E003	N	N	3	2.4
Behavioural Science	E005	N	N	3	2.4
Bioenergy	E006	N	N	3	2.4
Coastal Geomorphology	E010	N	N	3	2.4
Coastal Management	E011	N	N	3	2.4
Design Engineering	E013	N	N	3	2.4
Environmental Accounting	E014	N	N	3	2.4
Environmental Monitoring	E015	N	N	3	2.4
Experimental Design	E016	N	N	3	2.4
Geological Characterisation	E017	N	N	3	2.4
Hydrochemistry	E020	N	N	3	2.4
International Perspective	E024	N	N	3	2.4
Materials Science / Testing	E028	N	N	3	2.4
Measurement of Physical Processes	E030	N	N	3	2.4
Monitoring Climate Change	E031	N	N	3	2.4
Population Biology	E035	N	N	3	2.4
Process Engineering	E037	N	N	3	2.4
Resource Assessment	E041	N	N	3	2.4
Statistical Inference	E048	N	N	3	2.4
Strategic Planning	E049	N	N	3	2.4
Technology Assessment & Uptake	E050	N	N	3	2.4
Telemetry	E051	N	N	3	2.4
Toxicology	E053	N	N	3	2.4
Water Management	E056	N	N	3	2.4
Air & Water Quality	E002	N	N	2	1.6
Catchment Management	E007	N	N	2	1.6
Climate Proxies	E008	N	N	2	1.6
Communication of Risk	E012	N	N	2	1.6
Geological Survey	E018	N	N	2	1.6
Human Geography	E019	N	N	2	1.6

SKILL/ KNOWLEDGE AREA	IDENTIFIER CODE	WHETHER AREA IDENTIFIED AS A SHORTAGE FOR AT LEAST ONE CRITICAL CHALLENGE	WHETHER AREA IDENTIFIED AS A SHORTAGE FOR AT LEAST ONE PRIORITY CHALLENGE	NUMBER OF CHALLENGES REQUIRING KNOWLEDGE/ SKILL IN AREA (TOTAL = 124)	PERCENTAGE OF CHALLENGES FOR WHICH KNOWLEDGE/ SKILL REQUIRED
Instrumentation	E022	N	N	2	1.6
Integrated Assessment Modelling	E023	N	N	2	1.6
Market Awareness	E027	N	N	2	1.6
Mathematical Modelling	E029	N	N	2	1.6
Nuclear Physics	E032	N	N	2	1.6
Pathology	E033	N	N	2	1.6
Process Mapping	E038	N	N	2	1.6
Project Management	E039	N	N	2	1.6
Quaternary Analysis / Reconstruction	E040	N	N	2	1.6
Sediment Dynamics	E042	N	N	2	1.6
Signal Processing	E043	N	N	2	1.6
Social & Policy Consideration	E044	N	N	2	1.6
Societal Change	E045	N	N	2	1.6
Software Development	E047	N	N	2	1.6
Time Series Analysis	E052	N	N	2	1.6
Using Climate Scenarios	E055	N	N	2	1.6
Action Planning	F001	N	N	1	0.8
Assessing Climate Change	F002	N	N	1	0.8
Biological Understanding	F003	N	N	1	0.8
Biomathematics	F004	N	N	1	0.8
Biotechnology	F005	N	N	1	0.8
Chemical Engineering	F006	N	N	1	0.8
Coding	F007	N	N	1	0.8
Complex Natural Systems	F008	N	N	1	0.8
Data Assimilation	F009	N	N	1	0.8
Dating Techniques	F010	N	N	1	0.8
Demography	F011	N	N	1	0.8
Development of Metrics	F012	N	N	1	0.8
Dialogue Facilitation	F013	N	N	1	0.8
Disaster Planning	F014	N	N	1	0.8
Ecojustice	F015	N	N	1	0.8
Ecological Assessment	F016	N	N	1	0.8
Ecological Design	F017	N	N	1	0.8
Economic Geography	F018	N	N	1	0.8

SKILL/ KNOWLEDGE AREA	IDENTIFIER CODE	WHETHER AREA IDENTIFIED AS A SHORTAGE FOR AT LEAST ONE CRITICAL CHALLENGE	WHETHER AREA IDENTIFIED AS A SHORTAGE FOR AT LEAST ONE PRIORITY CHALLENGE	NUMBER OF CHALLENGES REQUIRING KNOWLEDGE/ SKILL IN AREA (TOTAL = 124)	PERCENTAGE OF CHALLENGES FOR WHICH KNOWLEDGE/ SKILL REQUIRED
Ecotoxicology	F019	N	N	1	0.8
Entomology	F020	N	N	1	0.8
Environment & Society	F021	N	N	1	0.8
Environmental Chemistry	F022	N	N	1	0.8
Environmental Forensics	F023	N	N	1	0.8
Environmental Health	F024	N	N	1	0.8
Environmental Legislation / Legislative Process	F025	N	N	1	0.8
Environmental Taxation	F026	N	N	1	0.8
Evolutionary Biology	F027	N	N	1	0.8
Experimental Geoscience	F028	N	N	1	0.8
Exploration Geology	F029	N	N	1	0.8
Flood Engineering	F030	N	N	1	0.8
Fluid Dynamics	F031	N	N	1	0.8
Fuel Technology	F032	N	N	1	0.8
Genetics	F033	N	N	1	0.8
Geodiversity Auditing	F034	N	N	1	0.8
Geotechnology	F035	N	N	1	0.8
Green Chemistry	F036	N	N	1	0.8
Habitat Management	F037	N	N	1	0.8
Hydrometeorology	F038	N	N	1	0.8
Image Processing	F039	N	N	1	0.8
Industrial Ecology	F040	N	N	1	0.8
Intelligent Systems	F041	N	N	1	0.8
Interactive Natural Systems	F042	N	N	1	0.8
International Development	F043	N	N	1	0.8
International Relations	F044	N	N	1	0.8
Isotope Chemistry	F045	N	N	1	0.8
Marine Chemistry	F046	N	N	1	0.8
Measurement Science	F047	N	N	1	0.8
Medical Sciences	F048	N	N	1	0.8
Mineral Exploration	F049	N	N	1	0.8
Mineral Resource Extraction & Storage	F050	N	N	1	0.8
Mineralogy	F051	N	N	1	0.8

SKILL/ KNOWLEDGE AREA	IDENTIFIER CODE	WHETHER AREA IDENTIFIED AS A SHORTAGE FOR AT LEAST ONE CRITICAL CHALLENGE	WHETHER AREA IDENTIFIED AS A SHORTAGE FOR AT LEAST ONE PRIORITY CHALLENGE	NUMBER OF CHALLENGES REQUIRING KNOWLEDGE/ SKILL IN AREA (TOTAL = 124)	PERCENTAGE OF CHALLENGES FOR WHICH KNOWLEDGE/ SKILL REQUIRED
Model Testing and Analysis	F052	N	N	1	0.8
Model Validation	F053	N	N	1	0.8
Molecular Biology	F054	N	N	1	0.8
Morphological Adjustments	F055	N	N	1	0.8
Pollution Chemistry	F055	N	N	1	0.8
Multi-level modelling	F056	N	N	1	0.8
Mycology	F057	N	N	1	0.8
Nanotechnology	F058	N	N	1	0.8
Negotiation	F059	N	N	1	0.8
Petrology	F060	N	N	1	0.8
Phenology	F061	N	N	1	0.8
Physical Geography	F062	N	N	1	0.8
Physical Sciences	F063	N	N	1	0.8
Plant Pathology	F064	N	N	1	0.8
Plant Physiology	F065	N	N	1	0.8
Public Administration	F067	N	N	1	0.8
Regulatory Policy	F068	N	N	1	0.8
Relating Data to Theory	F069	N	N	1	0.8
Research Design	F070	N	N	1	0.8
Safety Protocols	F071	N	N	1	0.8
Snowpack Estimation	F072	N	N	1	0.8
Socio-Ecology	F073	N	N	1	0.8
Stakeholder Engagement	F074	N	N	1	0.8
State of Environment Reporting	F075	N	N	1	0.8
Strategic Business Management	F076	N	N	1	0.8
Sustainable Engineering	F077	N	N	1	0.8
SWOT Analysis	F078	N	N	1	0.8
Thermodynamics of Geology	F079	N	N	1	0.8
Using Climate Ensembles	F080	N	N	1	0.8
Using Indicators & Proxies	F081	N	N	1	0.8
Vulnerability Studies	F082	N	N	1	0.8
Waste Reduction & Management	F083	N	N	1	0.8
Waste Technology	F084	N	N	1	0.8

ERFF/NERC POSTGRADUATE AND PROFESSIONAL SKILLS NEEDS REVIEW

OUTPUT 4 – REPORT ON ADDITIONAL FEEDBACK FROM THE CONSULTATION

INTRODUCTION

1. The ERFF/NERC Postgraduate and Professional Skills Needs Review has helped to identify the postgraduate and professional knowledge and skills needed to address challenges facing the environment sector (ES) over the next decade. The key output from Phase 2 of the work is the [Skills Framework](#) for the Environment Sector (Output 2). The main findings and key messages from the Review are in the overarching report, [Most Wanted](#) while a short overview of the Review and other outputs is [here](#). Output 4 provides a summary of more general feedback received from the ES ie this was feedback which was additional to the comments received on the skills needs associated with specific challenges. Output 4 also provides further information on the knowledge and skills needs of the private sector within the ES.
2. Both the respondents to the public consultation and the Review Group members provided valuable additional inputs. Some of this feedback came in response to supplementary questions in the consultations while other comments were made in covering letters and emails, and attached documents.
3. Firstly, in addition to populating the draft skills framework, **contributors to the public consultation** were invited to answer four supplementary questions:
 - Is there any information currently in the draft Skills Framework which you particularly agree with and would like to support?
 - Is there any information currently in the draft Skills Framework that you wish to challenge?
 - On a scale of 1-5 (where 5 is high), have you found that Roberts Funding has had a positive impact on postgraduates entering the job market?
 - Are there any additional issues relating to skills for the environment sector which you would like to raise?
4. Secondly, when considering the emerging findings (presented to them as the updated Skills Needs Framework), **Review Group members** were asked to provide some general feedback to the following five questions:
 - Are you broadly content that the challenges falling within your remit/ area of interest are comprehensive and correct?
 - Are you generally content that the correct mix of postgraduate knowledge and skills has been identified for each of the challenges you have considered?
 - Where shortages of postgraduate skills have been reported or predicted for challenges you have considered, do you agree that these skills are in short supply or will be unless remedial action is taken?
 - Are you aware of any additional challenges where you believe that there are or will be a skills shortage?
 - Are there any other issues that you would like to bring to our attention?
5. Many respondees to the consultation and review group members used these questions as an opportunity to make general statements on skills shortages and needs which were pervasive across the ES, ie not associated with particular challenges. Some also commented on the review methodology/ process. Some key messages to emerge from a consideration of all the feedback are presented under the following four sub-headings:
 - Additional Feedback on Skills Shortages

- Roberts Funding
- Private Sector Needs
- Feedback on the Review Process

ADDITIONAL FEEDBACK ON SKILLS SHORTAGES

Additional feedback from respondents to the public consultation

6. In the answers to the supplementary questions, respondents to the consultation identified a range of knowledge and skills areas as generally being in shortage, as lacking or as areas where there is a need for greater focus/development. Within the environmental sciences discipline itself, these included taxonomy, soil science and Earth sciences/Earth systems science. Looking more broadly at the physical sciences, numeracy and chemistry skills were explicitly described as lacking.
7. As far as cross-cutting and inter-disciplinary skills are concerned, there was much call for better interfacing between the physical/environmental and social sciences (including behavioural science). This included using/integrating scientific data/results in regulatory policy or management frameworks. The interdisciplinary areas of environmental and ecological economics, environment and health were also particularly mentioned. Public understanding of science (now generally termed science and society) also emerged as needing more attention.

Additional feedback from Review Group members

8. In the additional feedback from Review Group members, a commonly recurring theme was again, the need for more interdisciplinary/interfacing skills in order to “see the big picture”, particularly at the following interfaces:
 - Environmental science/business or commercial (industrial placements suggested)
 - Environmental science/mathematics, statistics or computing
 - Environmental science/engineering
9. However, two Review Group members noted a need to beware of focussing on interdisciplinarity at the expense of a solid grounding in one or two areas.
10. Review Group members identified a range of areas where they generally saw a need for better/stronger postgraduate skills:
 - BBSRC vulnerable and quantitative niche skills ([see BBSRC report](#))
 - Biodiversity
 - Ecosystem function
 - Fieldwork – extended experience
 - Mathematics
 - Modelling
 - Next generation data collection, storage and modelling (national capability)
 - Planning – urban and town
 - Quantitative aspects of ES
 - Statistics
 - Taxonomy and systematics (noted that within taxonomy, science of classification and identification skills are distinct subjects - both are important but require a different approach.)
 - Technology development (national capability)
 - Uncertainty – dealing with

11. The Table below combines the general feedback received on skill shortages which are widespread with information on skills shortages associated with specific challenges (as recorded on the *Skills Framework [Output 2]*). Column A of the Table lists the 33 knowledge and skills areas identified as *Areas of Concern* on the Framework (due to being a shortage with respect to at least one challenge). The position on the Framework of each Area of Concern, and the number of challenges with which it has been linked are shown in Columns B and C respectively. Column D indicates where respondents to the consultation have also highlighted the Areas of Concern as a general or widespread shortage in their supplementary information while Column E does the same for Review Group members. Those knowledge and skills areas which are both designated as an Area of Concern and identified as generally being in shortage are highlighted in red and bold. The Table shows that many of the Areas of Concern (especially the Priority A ones) were also picked up in the general comments thus reinforcing their inclusion on the Framework.

Table identifying the Areas of Concern on the Skills Framework which were also identified as generally being in shortage

(Areas highlighted in red and bold are those which were also picked up in feedback.)

A. AREA OF CONCERN (AND IDENTIFIER CODE)	B. POSITION OF AREA OF CONCERN IN FRAMEWORK	C. NO OF SPECIFIC CHALLENGES, AREA OF CONCERN HAS BEEN LINKED WITH	D. ALSO, IDENTIFIED AS A PERVASIVE SHORTAGE IN ADDITIONAL FEEDBACK FROM CONSULTEES	E. ALSO IDENTIFIED AS A PERVASIVE SHORTAGE IN FEEDBACK FROM REVIEW GROUP
SECTION A: PRIORITY 1 AREAS OF CONCERN				
Agriculture A001	16	7		
Business awareness A002	14	12		YES (at interface with env. Sciences)
Communication A003	5	34	YES (more attention to public understanding of science)	
Data management A004	3	42	YES (data assimilation)	YES (next generation data collection, storage and modelling)
Dealing with uncertainty A005	10	17		YES
Energy provision A006	21	3		
Environmental epidemiology A007	13	13	YES (environment and health)	
Fieldwork A008	6	34		YES
Integrated freshwater sciences A009	22	3		
Inter-/ multi-disciplinarity A010	2	50		YES
Mathematics/ applied mathematics	11	17	YES (numeracy)	YES (at interface with env. Sciences)

A. AREA OF CONCERN (AND IDENTIFIER CODE)	B. POSITION OF AREA OF CONCERN IN FRAMEWORK	C. NO OF SPECIFIC CHALLENGES, AREA OF CONCERN HAS BEEN LINKED WITH	D. ALSO, IDENTIFIED AS A PERVASIVE SHORTAGE IN ADDITIONAL FEEDBACK FROM CONSULTEES	E. ALSO IDENTIFIED AS A PERVASIVE SHORTAGE IN FEEDBACK FROM REVIEW GROUP
A011				
Media skills A012	18	6		
Microbiology/ microbial physiology A013	17	7		
Modelling A014	1	84	YES (more numerate graduates; courses needed in empirical modelling and mechanistic statistical models)	YES
Natural science – social science interface / translation A015	19	6	YES (more exposure to the behavioural sciences)	YES (interface between env sciences and social sciences)
Renewable energy technology A016	23	3		
Risk assessment and management A017	8	25		
Science-policy interface /translation A018	7	28		
Soil science A019	12	17	YES	
Statistical analysis A020	4	41	YES (numeracy)	YES
Sustainability science A021	15	12		
Taxonomy and systematics A022	9	19	YES (true taxonomy remains critical)	YES
Town and country planning A023	20	4		YES
SECTION B: PRIORITY 2 AREAS OF CONCERN				
Carbon sciences B001	27	9		
Computer science/ high performance computing B002	30	4		
Ecology/ ecological sciences (incl. conservation) B003	24	43		YES (Ecosystem Function)
Economic approaches	26	33	YES	

A. AREA OF CONCERN (AND IDENTIFIER CODE)	B. POSITION OF AREA OF CONCERN IN FRAMEWORK	C. NO OF SPECIFIC CHALLENGES, AREA OF CONCERN HAS BEEN LINKED WITH	D. ALSO, IDENTIFIED AS A PERVASIVE SHORTAGE IN ADDITIONAL FEEDBACK FROM CONSULTEES	E. ALSO IDENTIFIED AS A PERVASIVE SHORTAGE IN FEEDBACK FROM REVIEW GROUP
B004				
Geoengineering B005	31	4		
Introduced/ invasive species B006	33	1		
Landscape sciences B007	32	2		
Life cycle assessment B008	29	5		
Palaeontology B009	28	8		
Spatial analysis and GIS B010	25	37		

ROBERTS FUNDING

12. One of the supplementary questions in the public consultation asked about the effectiveness of Roberts funding. This is funding which supports training in transferable skills – see box below for further details.

Q4: Over the last six years, NERC and the other research councils have provided funds (Roberts funding) to training providers to enable research students to receive training in transferable skills. On a scale of 1-5 (where 5 is high), have you found that this funding has had a positive impact on postgraduates entering the job market. Please provide any evidence to support your view.

Background information – In response to the recommendations in *SET for success – the supply of people with science, technology, engineering and mathematics skills* (Report from the Roberts Review, 2002), the research councils have provided additional annual payments for training researchers in transferable skills. Transferable skills are additional to scientific, engineering, economic etc competences and include such attributes as communication, business awareness and team working; employers told the Robert Review that these skills were often lacking in postgraduates entering the job market.

13. Of the 143 respondents to the consultation, 47 answered the question about Roberts funding. They were asked to grade its impact on transferable skills on a scale of 1-5, where 5 is high. Twenty-one of the 47 who commented gave such a grade and the distribution is shown in the Table below. In the two cases, where respondents gave a grade between a whole number, their score has been allocated to the lower number eg 2/3 was counted as 2.

Table to show impact scores for Roberts Funding

Sub-sector within the environment sector	Impact Score				
	1	2	3	4	5
Academic Sector	2	1	3	6	5

Public Sector	0	1*	0	0	0
Private Sector	0	0	1	0	0
Representative bodies, research networks etc	0	1	0	1*	0
Total	2	3	4	7	5

* The main role of these respondents is actually in academia

14. More information on the tenet of the comments received in the responses is in the following Table.
15. The following tentative conclusions are drawn from the above analysis:
- The academic sector values Roberts funding and generally has very positive perceptions of its impact on transferable skills and employability of postgraduates.
 - The sample size very small, but the lack of comments from non-academics which relate specifically to Roberts Funding, suggests there might be very little awareness of it outside academic sector².
 - The sample size is very small but the general tone of comments from outside academia suggest that there is a prevailing view that transferable skills of postgraduates are not yet adequate.
 - As several academic respondents noted, to understand the impact of Roberts Funding more fully, it would be helpful to undertake a more rigorous analysis involving employers outside the academic sector. This work suggests areas which might be explored in such an analysis.

² Much of the feedback from the private sector was obtained on the Review's behalf by the Environmental Sustainability Knowledge Transfer Network – see Paragraph 5.11 and onwards.

SUMMARY OF RESPONSES ON IMPACT OF ROBERTS FUNDING

Note that in each case “No.” refers to the number of responses

Comments in each cell are listed in descending order of frequency. No of times mentioned shown in brackets

Sub-sector of environment sector	No.	No of positive comments	Themes among/ examples of positive comments about Roberts Funding	No of “neutral” or negative comments	Themes among/ examples of neutral, non-committal or negative comments about Roberts Funding	No taking opportunity to make general comments about transferable skills	Themes among/ examples of general comments about transferable skills
Academic	36	28	Notable increase in transferable skills and/or positive effect on employability of postgrads (13). Positive feedback from students (3). Also, helps enhances research (1). Good results when combined with specific skills training (1). Important to retain ring fenced money (1)	8	Hard to judge objectively, can only comment anecdotally, need more rigorous analysis - including from perception of employers (6). Better but scope for further improvement (2) Can detract from research (2). No impact/employability of students has always been good (2). Mixed feedback from students (1) University provides good provision anyway, would prefer to see courses in maths/ stats (1) Would like to use money more flexibly (1) Difficult to judge because job market not static (1)	0	
Public	3	0		1		3	Transferable skills very valuable. Need to be able to think and act beyond narrow discipline. Ability to deal with and communicate uncertainty. (1) Little evidence that postgrads have significant transferable skills but they are becoming increasingly important (1)

					<p>Lack of skills to relate work to policy or operational opportunities (1)</p> <p>Lack of writing skills (1)</p> <p>Transferable skills training detracts from research and results in repetition for masters students* (1)</p>
Private	3	1	0	2	<p>Reported lack of transferable skills in sector but may be continuation of historical grumbles (1)</p> <p>Dissemination skills are critical</p> <p>Complementary business skills are key – including communication and change management (1)</p> <p>Some graduates well trained but most learn on the job (1)</p>
Representative bodies, research networks etc	5	2	2	1	<p>Courses in transferable skills generally unhelpful. More effort should be made to integrate such training as part of supervisor and research teams' roles rather than hiving off (1)</p> <p>Transferable skills are vital (1)</p> <p>Training has provided my research students with valuable project management and related business skills eg negotiating and bargaining (1*)</p> <p>Feedback from postgrad members of the network has been positive wrt communication, outreach and networking) (1)</p> <p>Would like to be able to use the money more flexibly (1)</p>
TOTAL	47	31	11	6	

* The main role of these respondents is actually in academia

PRIVATE SECTOR NEEDS

16. The *Skills Framework [Output 2*]* reflects the views of the entire environment sector on postgraduate and professional knowledge and skills needs and shortages. However, the Skills Project Board wanted further information on the specific needs of the private sector which it felt might be lacking on the Framework. The responses and additional feedback from this sector were therefore considered as a subset.
17. Initially, only eight responses were received to the public consultation from the private sector. To generate more responses, the Environmental Sustainability Knowledge Transfer Network (<https://ktn.innovateuk.org/web/sustainabilityktn>) kindly targeted private sector organisations directly on the Skills Project Board’s behalf. They conducted telephone interviews with companies using a shorter more tailored version of the consultation document. This targeted approach resulted in a further 22 short responses making a total of 30 in all. Generally, the private sector did not annotate the draft skills framework which was part of the general public consultation exercise; and therefore its skills needs have not been linked to the same extent with specific challenges.
18. A summary of the key messages in the 30 responses is provided below. As might be expected, the requirements of the private sector have a slightly different emphasis than those received from other sectors. This presumably reflects the different priority areas and timescales of commercial enterprises in the environmental sciences sector compared, for to other sub-sectors. As with the review in general, a plethora of important knowledge and skills areas were identified and these are considered under the four categories below (although it is acknowledged that the distinction between skills in different groups is not always clear-cut):
- Transferable skills,
 - Core-commercial skills,
 - Environmental science and closely-related subject areas, and
 - Inter-disciplinary/cross-cutting/other skills

Transferable Skills

19. One of the major generic issues highlighted by responses from the private sector was the shortage of well-rounded graduates and postgraduates entering employment - particularly in the applied Earth sciences. Four respondent organisations mentioned the fact that they had little or no trouble finding highly qualified people but struggled to find applicants that could combine subject expertise with a good level of transferable skills or desirable personal attributes. Other companies cited skills in areas such as project management, communication, presentation and relationship management as being of particular importance. This was supported by another respondent who identified practical experience of the working environment through previous employment or work experience as being as important to them in recruitment terms as good academic qualifications. Furthermore, another respondent claimed that the only way they can effectively train people in the skills they require is through on-the-job experience.
20. The transferable or “soft” generic business skills cited by respondents as needed within the environment sector include those in the table below:

Transferable Skills	
Business Management	Policy Evaluation
Communication	Politics
Contingency Valuation	Prediction Techniques
Corporate Social Responsibility	Professional Networking

Decision Making	Project Management
Entrepreneurship	Public Administration
Innovation	Regulations
Intellectual Property Management	Relationship Management
Interpersonal skills	Strategic Business Planning
Leadership	Translating Data for Business
Management Skills	Uncertainty Assessment
Market Awareness	Understanding of Industry Constraints
Marketing	

Core commercial activities needed for particular business areas

21. Private sector respondents also identified a variety of specific skills needed for particular business activities within their organisations. Six of the 30 respondent private sector organisations identified themselves as environmental consultants, with numerous others providing support across relevant consultancy areas such as alternative energy provision, waste management and environmental monitoring. As such, many of the core skills areas identified by respondents relate to the successful performance of commercial activities within an environmental consultancy type organisation. The specific commercial skills cited by respondents as needed within the environmental sciences include those in the table below:

Core Commercial Skills

Contaminated Land Assessment	Resource Risk Assessment
Cost-benefit Analysis	Risk Assessment & Management
Environmental Assessment	Sensitivity Analysis
Environmental Impact Assessment	Site Investigation and Monitoring
Environmental Management Systems	Sustainability Assessment
Financial Investment Modelling	Sustainable Development
Life Cycle Assessment	

Environmental Sciences and related subject areas

22. Private sector respondents also cited particular shortages or needs in a number of more “traditional” environmental science or closely related subject areas. One of the skills shortage areas identified was Earth sciences, particularly in terms of the availability of geologists, geomorphologists and geographers, where many graduates do not have the breadth of skills required in industry. Other respondents identified skills needs within both the energy sector and within the field of ecotoxicology highlighted as of particular importance in order to manage environmental impact within rapidly growing economies such as China and India.

Environmental Science and related subject areas

Biodiversity	Geophysics
Ecotoxicology	Geosciences
Energy Provision / Renewable Energy	Hydrogeology
Geo-Engineering	Measuring Carbon Impacts
Geology	

Interdisciplinary, cross-cutting and skills from other disciplines

23. Numerous skills sets / subject areas outside of those that represent either transferable, core commercial or environmental sciences were mentioned by respondents as important to private sector organisations working within the environment sector. These ranged from specific skills such as numerical / mathematical modelling to niche subject areas such as geophysics to broad fields such as engineering (all mentioned by 4 of the 30 respondent organisations).

Interdisciplinary, cross-cutting and skills from other disciplines

Database Manipulation	Resource Efficiency
Economics	Spatial Analysis & GIS
Engineering Services	Spatial Statistics
Environmental Law / Legislation	Translating Science into Policy
Inter/Multidisciplinarity	Waste Prevention / Management
Numerical / Mathematical Modelling	

Additional Issues

24. In addition to identifying knowledge and skills needs, the private sector raised issues relating to how it needs to operate. These related to data integrity and use, career development for postgraduates and the potential for greater engagement between industry and academia. In order to ensure that often costly data collection is of greatest value to the sector, one respondent identified a need for greater transparency in relation to the sharing of data while another mentioned a need to match the recent explosion in data collection with appropriate stewardship and quality assurance in order to retain the integrity of environmental data. With reference to career development for postgraduates, one respondent also reported that SMEs generally struggle to offer new graduates the transparent career development plans they might desire, highlighting the importance of affiliation / membership with relevant trade / professional bodies which can provide both legitimacy and structure.
25. The Table below illustrates how the private sector's particular views on skills needs relate to the Areas of Concern and Key Skills Needs for the environment sector as a whole as summarised in the *Skills Framework*.

Table to show those Areas of Concern and Key Skills Areas on the Skills Framework which were particularly identified as areas of shortage or need by the private sector. (Areas highlighted in red and bold are those identified by the private sector.)

SECTION OF SKILLS FRAMEWORK				
A Areas of Concern	B Areas of Concern	C Key Skills Area	D Key Skills Area	Area required by private sector that did not fulfil criteria for inclusion on main skills framework
In shortage for at least one critical challenge and needed to address more	In shortage for at least one priority challenge and needed to address more	Needed to address 10 or more challenges	Needed to address 5-9 challenges	
Agriculture	Palaeontology	Emerging technologies	Geopolitics	Prediction techniques
Business awareness (Private sector identifies requirements as including business management, entrepreneurship, management, market awareness, marketing, project management, strategic business planning, translating data for business, and understanding of industry constraints)	Economic approaches (economics)	Systems approach	Forestry	Interpersonal skills
	Introduced/ invasive species	Biology/ biological sciences	Archaeology	Relationship management
	Life cycle assessment	Psychology	Hydrological sciences (Hydrogeology)	Sensitivity analysis
	Spatial analysis and GIS	Innovation	Behavioural change	Professional networking
Communication	Ecology/ ecological sciences (incl. conservation)	Chemistry/ chemical science	Environmental ethics	Intellectual property management
Data management (Translating data for business, database manipulation)	Geoengineering (Geoengineering)	Deliberative techniques	Environmental management	Decision-making
Dealing with uncertainty (Uncertainty assessment)	Computer science/ high performance computing	Engineering (engineering services)	Data mining	Ecotoxicology
Energy provision	Carbon sciences (Measuring carbon impacts)	Cost-benefit analysis	Environmental impact assessment (Environmental assessment, site investigation and monitoring)	Public administration
Environmental epidemiology	Landscape	Social science	Environmental impact assessment (Environmental assessment, site investigation and monitoring)	Waste prevention/ management
Fieldwork		(Corporate social responsibility)	Earth sciences	Leadership
Integrated freshwater sciences		Political science/ politics	Parameterisation and assimilation	Financial investment modelling
Inter-/ multi-disciplinarity		Biodiversity	Numerical/ mathematical modelling	
Mathematics/ applied mathematics		Field observation	Policy awareness (Policy evaluation)	
Media skills		Futures thinking/ planning	Physics	
Microbiology/ microbial		Earth observation systems	Legislation/ legislative	
		Community engagement		

physiology Modelling	Remote sensing	process (Regulations, environmental law/leg)
Natural science – social science interface / translation	Environmental informatics	
Renewable energy technology	Geomorphology & Earth surface processes	Geosciences Geophysics
Risk assessment and management (Resource risk assessment)	Biogeochemistry	Environmental change
Science-policy interface /translation	Ecosystem services (Contingency valuation,)	Hazard and risk assessment (Contaminated land assessment)
Soil science	Environmental valuation	Genomics
Statistical analysis (spatial statistics)		Health impact assessment
Sustainability science (Sustainable assessment, sustainable development, resource efficiency)		Sensor design
Taxonomy and systematics		Programming
Town and country planning		Public health and wellbeing
		Sampling techniques
		Science communication
		Science- engineering interface
		Socioeconomics

FEEDBACK ON THE REVIEW PROCESS

26. This section summarises feedback from respondents to the consultation and from Review Group members on the review process or methodology. It is important because one of the two objectives for Phase 2 of the Review was *to develop a robust process for undertaking the review so that the work can be repeated/ refreshed/ extended*. Future skills work will benefit from this input.

Feedback on the review process from respondents to the public consultation

27. In providing answers to the four supplementary questions included at the end of the Framework, respondents took the opportunity to provide feedback on the methodology. Some made positive comments about both the fact that the review was taking place and the level of detail included in the draft framework document. Others were more critical. Views expressed included:

- The Framework brings a beneficial structured approach to the analysis of skills needs
- The Framework is complicated and time consuming to fill in.

- The process takes too much of a supply driven or ‘top-down’ approach thereby focussing on the skills that training establishments provide rather than the range of job vacancies that require graduates with particular skills. As a result academia could have had a measure of ‘self-interest’.
 - One respondent felt that the Framework was too short-term while another felt that it was too conventional and lacked vision.
28. One respondent involved in facilitating strategic change in organisations suggested that the “driver approach” to identifying knowledge and skills needs is a useful one but issues may arise through respondents’ differing ideas/definitions of “knowledge” and “capability”. They also suggest that allowing respondents to specify both niche and cross-cutting skills may have been useful, as would have been the ability to conduct supporting workshops / follow up sessions.
29. Those that provided negative feedback generally failed to propose an alternative approach. Alternatives which were suggested included identifying the skills required by potential employers or conducting a quantitative assessment of current and future labour markets.

Responses from the Review Group

30. The Review Group raised similar points of praise and criticism of the methodology, in its consideration of the emerging findings, to those made by the respondents to the consultation. While some found the review to have been fascinating and informative with impressive outputs, others raised concerns over issues they felt might have hindered the work. Concerns expressed by some Review Group members included:
- Overly-complicated nature of the “framework exercise”.
 - Potential for lobbying by some stakeholders with a vested interest in promoting both their line of research and training
 - Bias due to the greater number of academic responses compared to those from other sectors resulting in to greater focus on the supplier perspective.
 - Too many challenges with examples of duplications, omissions and variations in scope

Comment on Feedback

31. The issues raised by respondents and Review Group members will be considered carefully in the planning of future work on postgraduate and professional skills needs. A few initial comments are made here. It should be noted that the feedback discussed above relates to the first and interim versions of the Framework which were very ambitious in that they attempted to summarise all the graduate and postgraduate knowledge and skills requirements associated with all the challenges facing the entire environment sector for the next decade. The current version is now focussed on the priority knowledge and skills needed by postgraduates and professionals and the sector has yet to comment on it.
32. With regard to supplier versus demand-led issues, the public consultation set out to identify the postgraduate skills needs of both private and public sectors employers ie the demand for skills. It needs to be borne in mind that the academic sector is a key employer of postgraduate researchers as well as a supplier of trained postgraduates and therefore its views on the postgraduate skills its needs to meet its research challenges are important too. Additionally, the use of the Review Group to consider the emerging findings was designed to help eliminate any ‘self-interest’. However, it is agreed that this is an issue which needs careful consideration in the future including looking at ways to secure more feedback from private and public sector employers to ensure balance.
33. As far as the challenges were concerned, considerable effort did go into rationalising the 736 different suggestions into a smaller and coherent set of 124 consolidated challenges. This involved

consulting with individuals with appropriate expertise in the areas covered by the Challenges. However, there is certainly scope for considering this issue further should a similar exercise be undertaken in the future

ERFF/NERC POSTGRADUATE AND PROFESSIONAL SKILLS NEEDS REVIEW

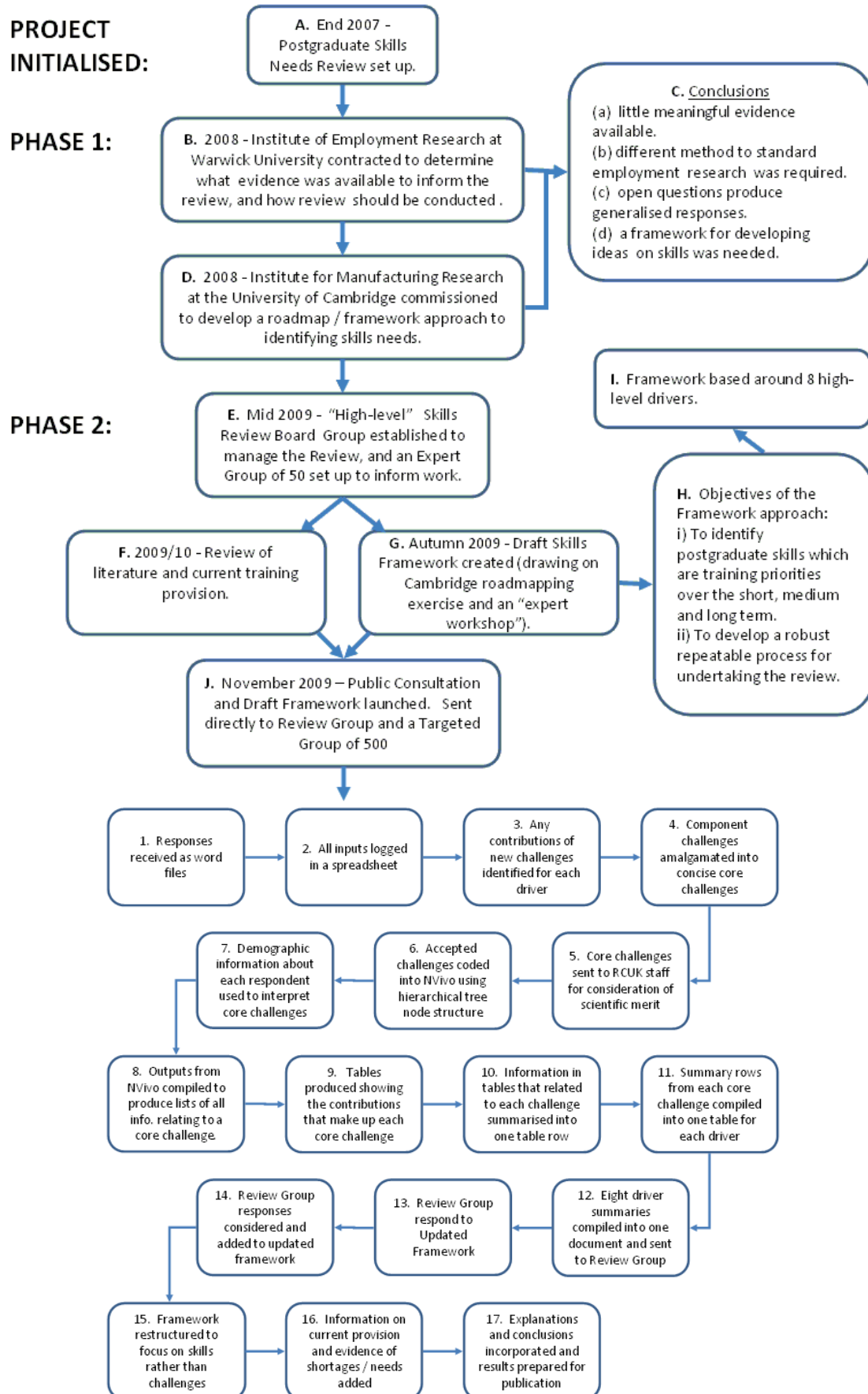
OUTPUT 5 - REPORT ON THE METHODOLOGY

INTRODUCTION

1. The Postgraduate and Professional Skills Needs Review was set up by the Environment Research Funders' Forum (ERFF³) and the Natural Environment Research Council (NERC) at the end of 2007. Its purpose has been to collect evidence on UK postgraduate and professional skills needs and training priorities in the environment sector (ES) for the next decade. An overview of the Review is available [here](#). The key output from Phase 2 of the work is the [Skills Framework](#) for the Environment Sector (Output 2). The main findings and key messages from the can be found in a short overarching report, [Most Wanted](#). Output 5 describes the methodology developed for Phase 2 of the work, which started in 2009. Two objectives were set:
 - i) To identify the postgraduate skills needs which are training priorities, over the short, medium and long term, for challenges facing the three main parts of the environment sector; and
 - ii) To develop a robust process for undertaking the review so that the work can be repeated/ refreshed/ extended.
2. Achieving the first of the above Objectives on identifying postgraduate skills needs was dependent on realising the second which required the development of a novel and appropriate methodology. The design of the methodology was therefore an integral part of the Review and this paper describes the way in which the Review was conducted in some detail. A glossary of the terms used is at [Annex 3](#).
3. While the focus of this account is on the methodology for Phase 2 of the Review, it starts with a brief summary of the Phase 1 work since this and its outcome formed the rationale for later work. A summary of the methodology for the entire Skills Review is shown in the following diagram:

³ It was announced on 10 June 2010 that ERFF would merge with the Living With Environmental Change Programme

METHODOLOGY FOR THE POSTGRADUATE AND PROFESSIONAL SKILLS NEEDS REVIEW



PHASE 1 METHODOLOGY – SUMMARY

4. Phase 1 of the Review is illustrated in Steps A to D of the Methodology Diagram. This work was undertaken during 2008 by the Institute of Employment Research (IER) at the University of Warwick. Their remit was to determine the evidence already available to inform the review, develop some boundaries for the study and to make recommendations on how the rest of the work should proceed. In addition to a wide-scale consultation, IER staff worked closely with senior NERC/ERFF colleagues to test a proposed methodology. Following this work, in Spring 2009, the Institute of Manufacturing at the University of Cambridge was commissioned to explore the possibility of developing a roadmap or framework for identifying skills needs.
5. The main conclusions drawn by the Project Board from the above contracts were that a) there is little meaningful evidence already available due to the disparate nature of the environment sector, b) a different method to the standard approaches to employment research would be required if meaningful conclusions were to be drawn, c) using open questions to canvass views from stakeholders provided very generalised responses, and d) a framework for developing ideas on skills was required.

PHASE 2 METHODOLOGY

6. At the beginning of Phase 2, NERC took on a more significant role in the Review's management due to the increasingly urgent need for an evidence-based analysis to inform decisions on levels and direction of postgraduate support. NERC particularly wanted to know where there were critical national shortages.
7. The methodology for Phase 2 was developed in response to the objectives set for this new phase of work and the challenges encountered during Phase 1. Important elements of the Phase 2 methodology were the establishment of an expert Review Group to advise the project board, development of a prototype draft Skills Framework, launch of an associated public consultation to canvass the views of stakeholders, and the careful approach taken to analysing the inputs to the consultation and from the Review Group.
8. The Phase 2 methodology is illustrated in the [Methodology Diagram](#) from Step E onwards and discussed below. Each heading relates to a step or steps in the diagram (specified by the letter(s) in brackets).

Establishment of new Project Board and Expert Review Group (E)

9. A new **Project Board**, chaired by Janice Timberlake, NERC Director for People, Skills and Communication was established and first met in September 2009. This had a wide breadth of membership and included senior representatives from stakeholder organisations in the academic and public communities – a membership list is in [Annex 1](#).
10. An important feature of Phase 2 was the Board's early decision to establish an expert **Review Group** to advise on the Review. This Group was set up during October/November 2009 and comprised 46 key organisations and senior representatives from across the academic, private and public components of the environment sector. They were asked to help populate the Skills Framework and, later, to review the emerging findings. The Review Group included the NERC Theme Leaders, professional and scientific societies, public sector departments and agencies, a range of companies and various networks. [Annex 2](#) provides a full list of Review Group members.

Review of Literature and Current Training Provision (F)

11. The **Literature Review** identified almost 100 publications of interest and these are listed in the Bibliography in [Annex 7](#). References from the literature review were used as additional evidence on the Skills Framework for the Environment Sector (the main output from the Review – see Paragraphs 14 onwards).
12. Another of the project work packages was to undertake a review of existing training in the environment sector and of the relevant published literature. This remained in progress for the duration of the Review.
13. **The Review of Existing Training Provision** involved:
 - i) considering a) the broad training strategies and activities of NERC and other ERFF members with regard to funding; and b) the training provided by the key UK providers in the environment sector,
 - ii) identifying current training funded by NERC, ESRC and others in priority knowledge/skills areas and adding to the Skills Framework (see Paragraph 14), and
 - iii) interrogating the ERFF Environmental Research Database to get a feel for the amount of funding from ERFF members in some of the priority areas since September 2005. Again, this information was added to the Skills Framework.

Draft Skills Framework created (G, H, I)

14. As indicated above, the key component of the methodology for Phase 2 was the development of a **skills framework for articulating knowledge and skills requirements**. At the start of Phase 2, it had been intended, initially, to use a workshop approach to gain this information before going to a consultation phase. However, after a trial workshop with senior NERC colleagues in September 2009, it was agreed that this was not feasible due to the challenges encountered by participants when “starting from a blank piece of paper” and the growing recognition that inputs were required from specialists as well as generalists.
15. Therefore, it was decided to develop a draft or prototype Skills Framework in-house using a combination of the evidence already available and advice from individuals across the NERC community. This would then be tested and developed through a wider and public consultation. The initial draft Framework comprised a list of 36 challenges facing the community as a result of a set of 8 drivers. Alongside each challenge, the knowledge requirements, research or other capabilities and specific skills required of postgraduates were identified. The 8 drivers selected, based on earlier work by NERC and ERFF, were climate change, sustainable use of natural resources, changing technologies, changing ecosystems, societal change, economic-political change, Earth system science, and natural hazards, and environment and health. The prototype Skills Framework became the basis of the public consultation – see next section.

Public consultation and Draft Skills Framework launched (J)

16. An objective of the Review was to identify postgraduate and professional skills needs by asking the environment sector to tell us about the knowledge and skills they would need over the next decade. A public and targeted consultation was therefore launched to ask the community to comment on and develop the draft Skills Framework. The documentation was developed in conjunction with Skills Project Board members and the consultation paper published on the NERC and ERFF websites on 20 November 2009. The consultation documentation is in [Annex 4](#).

17. Consultees were asked comment on and input to the prototype Framework by suggesting additional challenges and associated skills needs. Additionally, they were invited to respond to four supplementary questions:
- Is there any information currently in the draft Skills Framework which you particularly agree with and would like to support?
 - Is there any information currently in the draft Skills Framework that you wish to challenge?
 - On a scale of 1-5 (where 5 is high), have you found that Roberts Funding has had a positive impact on postgraduates entering the job market?
 - Are there any additional issues relating to skills for the environment sector which you would like to raise?
18. To encourage a good response, the consultation paper was also sent directly to the Review Group, to a Targeted list of 500 individuals, all the heads of academic departments currently receiving NERC funding, and included on various NERC list servers. Additionally, a NERC “media alert” was published which resulted in publicity in the Times Higher Education Supplement and Research Fortnight.
19. By the deadline of 8 January 2010, 75 responses had been received with more promised. This figure rose to exactly 100 by 13 January, the date of the January Skills Project Board meeting. After considering, the number and profile of responses received, the Board felt that there were too few to proceed with the analysis. The deadline was therefore extended to the end of January, considerable “chasing” was undertaken and the [Environmental Sustainability Knowledge Transfer Network](#) kindly carried out tailored telephone interviews with private sector companies. This work raised the total number of responses to 143 and the Board was satisfied that the number and coverage of the sectors and drivers were sufficient to proceed with the analysis. A list of respondees is at [Annex 5](#).

Analysis of Responses to the Consultation

20. The analysis of the responses to the public consultation was an important and challenging part of the methodology with regard to achieving both Objective 1 and 2 of Phase 2 of the Review (see Paragraph 1). The process of analysis is summarised in Boxes 1-17 on the [Methodology Diagram](#). A description of what happened under each of the 17 steps represented by the boxes follows. Greater detail of the analysis stage is provided in [Annex 8](#).

Responses received as word files (Box 1)

21. The 143 responses to the public consultation arrived as Word documents and comprised comments on and amendments to the prototype Skills Framework, and responses to the supplementary questions. Accordingly, much of the information was in the form of comments on the knowledge requirements, research or other capabilities, specific skills, postgraduate and professional training/development and existing training provision associated with specific challenges facing the ES.

All inputs logged in a spreadsheet (Box 2)

22. Responses were allocated a unique reference number and their details logged onto an Excel spreadsheet. Of the 143 responses, 70 were from the research base, 17 from the public sector, 29 from the private sector and 27 from societies, organisations and networks. 121 came from entire organisations/departments/groups with only 22 received from individuals.

Any contributions of new challenges identified for each driver (Box 3)

23. Initial analysis of the responses determined that the Sector had identified 736 component challenges distributed across the eight drivers. The Climate Change driver had the highest number with 128 challenges while Economic and Political Change had the lowest with 47 challenges

- Component challenges amalgamated into fewer consolidated challenges (Box 4)***
24. As many of the component challenges were closely linked or overlapping, it was agreed to rationalise them to obtain a more manageable number for further analysis. They were initially categorised under topics within each driver area and then amalgamated to form fewer consolidated challenges.
- Consolidated challenges sent to Research Council staff for consideration of scientific merit (Box 5)***
25. Details of the consolidated challenges and topic areas were sent to Research Council staff, with the appropriate expertise, for comment and confirmation that they made “scientific sense”. After incorporating their suggested amendments, the number of challenges had been reduced to 124 consolidated challenges with between nine and 20 in each of the driver areas. [Annex 6](#) contains the hierarchy of drivers, topics and challenges.
- Accepted challenges coded into Nvivo using hierarchical tree node structure (Box 6)***
26. NVivo 8 (qualitative data management software) was used to help store the data in an accessible, traceable and organised manner. The information (including the profile of the response) relating to each of the component challenges was coded so that it could be related to the broader consolidated challenges, topics and drivers with which it was associated. This provided a platform from which the data could be managed and stored.
- Demographic information about each respondent used to interpret consolidated challenges (Box 7)***
27. NVivo was used to provide an overview of the demographic profile of the responses received which was used by the Skills Project Board to consider the origin and spread of responses for the consolidated challenges and drivers. The Board was further reassured that the analysis should proceed.
- Outputs from NVivo compiled to produce lists of all information relating to consolidated challenges (Box 8)***
28. NVivo was used to retrieve all the information relevant to each of the drivers and its associated topics and challenges resulting in eight lists of raw data.
- Tables produced showing the contributions that make up each core challenge (Box 9)***
29. A Table, in the same format as the draft Skills Framework, was produced for each consolidated challenge. Each row represented one of the component challenges and, at this stage, still contained all the information which had been submitted about that challenge.
- Information in tables that related to each challenge summarised into one table row (Box 10)***
30. An important step in the analysis, requiring the consideration and judgement of project team members, was to produce a summary row for each of the consolidated challenges. The information across the component challenges was considered very carefully in developing succinct and informative representations about the knowledge and skills required of postgraduates for that challenge and recording them in the summary rows.
- Summary rows from each core challenge compiled into one table for each driver (Box 11)***
31. A Table was produced for each driver containing the summary rows only for each of the consolidated challenges falling under that driver.
- Eight driver summaries compiled into one document and sent to Review Group (Box 12)***
32. The eight tables of consolidated challenges were amalgamated to form an updated draft Skills Framework. This comprised 124 rows, each one relating to a consolidated challenge, arranged by

topic and driver and each containing the project team's summary of information on knowledge and skills needs associated with that challenge.

33. This document was sent to the Review Group which was asked to comment on the emerging findings and answer some specific questions about the challenges:

- Their relative priority for the ES to address by grading– high, medium or low
- Whether they were comprehensive and correct
- Whether the correct mix of knowledge and skills had been identified for each one
- Whether they had any advice on appropriate training to deliver the required knowledge and skills
- Whether they were able to confirm respondents' views on current or predicted skills shortages
- Whether they foresaw any other skills shortages

The documentation sent to the Review Group including the updated draft Skills Framework can be found in [Annex 9](#).

Review Group responds to updated Framework (Box 13)

34. Of the 46 review Group members, 34 responded with 26 amending the Framework. Each of the 124 challenges was commented on by at least three Review Group members with most receiving at least six comments and some 10 or more. There were many suggestions for additional knowledge and skills areas which needed to be added to particular challenges. Review Group members also made general comments on the challenges, skills needs, delivery of training and the review process. These are discussed in [Output 4](#) – Feedback from the Community.

Review Group responses considered and added to updated Framework (Box 14)

35. The draft Skills Framework was updated again with all the comments from the Review Group relating to specific challenges. Challenges were also categorised according to their perceived priority by the Group. Those given a majority of high grades became known as ***critical challenges*** while those with mostly medium grades have been designated ***priority challenges***. Challenges with mostly low grades are described as ***other challenges***. The production of this annotated Framework was an important milestone in achieving Objective 1 of the Review which was to:

identify the postgraduate skills needs which are training priorities, over the short, medium and long term, for challenges facing the three main parts of the environment sector

Framework restructured to focus on skills rather than challenges (Box 15)

36. The next step was one of the most important as it involved the restructuring of the Framework to focus on postgraduate knowledge and skills shortages and needs, and the challenges for which each was needed. (Note that the earlier versions of the Framework listed the challenges and identified the skills needed for each). The Board agreed that, at this stage of the work, the descriptions of skills and knowledge needs should remain largely faithful to the type of language respondents had used in their submissions. Therefore, no formal classification was used to categorise them although this issue could be revisited in the future.

37. A total of 224 different knowledge and skills areas were identified and it was necessary to prioritise which should appear on the restructured Framework. Eighty-three knowledge/skills areas were selected and divided among 4 discrete sections on the Framework. The selection procedure was:

Section A: Priority 1 Areas of Concern – 23 areas identified by the ES as being in shortage with respect to at least one critical challenge. (In addition to being **in shortage** for at least one critical challenge, these knowledge/skills areas are needed to address a range of both critical and priority challenges.)

Section B: Priority 2 Areas of Concern – 10 areas identified by the ES as being in shortage with respect to at least one priority challenge. (In addition to being **in shortage** for at least one priority challenge, these knowledge/skills areas are needed to address a range of both critical and priority challenges.)

Section C: Priority 1 Key Skills Areas – 22 areas identified by the ES as needed to address between 10 and 44 different challenges. (These areas were not highlighted by contributors as being in shortage **for any specific priority or critical challenge**; however, more general feedback may have indicated that some are in shortage or they may be closely linked subject-wise to areas where there are reported shortages with respect to specific challenges.)

Section D: Priority 2 Key Skills Areas – 28 areas identified by the ES as needed to address between five and nine different challenges. (These areas were not highlighted by contributors as being in shortage **for any specific priority or critical challenge**; however, more general feedback may have indicated that some are in shortage or they may be closely linked subject-wise to areas where there are reported shortages with respect to specific challenges.)

38. Each Area of Concern or Key Skills Area occupies one row in the resultant restructured Framework. The row includes the number of challenges for which the skill is required, examples of respondents' and review group members' views, the reference numbers of all the challenges for which they were required, some examples of existing training provision, and references to the published literature.

Information on current training provision and evidence of shortages/needs added (Box 16)

39. Further examples of training provision relevant to the Areas of Concern/Key Skills Areas were sought from NERC colleagues and other ERF members and added to the Framework. Also, additional general comments and views on the priority areas which had been received from both the respondents to the consultation and Review Group members were added to the Framework. These general comments had been made in the answers to the supplementary questions and in covering emails and letters.

Explanations and conclusions incorporated and results prepared for publication (Box 17)

40. The Skills Project Board agreed that, after some further modification, the restructured Skills Framework should be made available to the ES on the NERC website along with other outputs from the Review. The modifications made prior to publication included completing short summaries of the skills requirements for each Area of Concern and Key Skills Area and inserting cross-references between similar, overlapping and linked areas. There would also be a short overarching final report with the key findings and messages. The Report, [*Most Wanted*](#), and the [*Skills Framework*](#) are regarded as the key outputs from Phase 2 of the Review with regard to both Objectives 1 and 2 of the work.

CONTACT DETAILS

41. For further information, please contact us by email in the first instance at skills@nerc.ac.uk

**ERFF/NERC POSTGRADUATE AND PROFESSIONAL SKILLS NEEDS
REVIEW
OUTPUT 6– THE WAY FORWARD**

To help develop this resource and prevent future skills gaps the [Skills Framework](#) has to be a living document. It cannot sit on the shelf gathering dust; it must be used to help to identify developing shortages. The Skills Framework needs to be challenged, reviewed, and updated. For these reasons, the [Most Wanted](#) report makes two clear recommendations:

One – People across the environment sector should: (i) use it (ii) learn from it (iii) replicate the process and (iv) help develop the work further.

This has been a considerable undertaking and during the review process a number of lessons have been learnt. One of the biggest lessons is that if you talk to employers about skills needs you need to frame the questions carefully and provide a guiding structure for their answers to avoid getting limited and disparate information. It is difficult starting with a blank piece of paper which is why the Skills Framework was developed. It is a complex framework that can be adapted to need and will be helpful both for the information it contains and as a methodology for generating further information.

A number of organisations have already started thinking about how they can use the information collected with suggestions such as:

- for extracting specialist discipline-based information;
- developing action plans that can be used to bid for funding;
- encouraging different disciplines to collaborate on tailoring course provision to improve student employability.

Feedback on how the Skills Framework can be improved, the gaps which have been missed or misinterpreted, and changing skills needs is welcome (see below). The tailoring of the Skills Framework is also welcome. It is being published under a creative commons licence to encourage people to:

Share — to copy, distribute and transmit the work
Remix — to adapt the work

Under the following conditions:

Attribution — You must attribute the work to NERC/ERFF (but not in any way that suggests that they endorse you or your use of the work).

Share Alike — If you alter, transform, or build upon this work, you may distribute the resulting work only under the same or similar license to this one.

See the creative commons website (<http://creativecommons.org/>) for further information.

Two – NERC should nurture this resource – refreshing the work regularly.

NERC have already welcomed this recommendation and agreed both to manage the review outputs on behalf of the environment sector and to refresh the work regularly. This is important as skills needs change, and gaps will have been missed, overstated and understated. The first refresh of the work, which NERC intend to carry out in 2012, will involve a Review Panel who will challenge and tension the views raised and take on board additional evidence received. If you wish to contribute to this refresh please contact: skills@nerc.ac.uk.