CREW Scoping Process – Background Paper for information

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Purpose:

This paper provides the background required to scope out CREW projects for the 2012 – 13 financial year.

These future projects should be delivered by a partnership of Main Research Providers (MRPs) and High Education Institutes (HEIs) and be focussed on policy support to Scottish Government and their agencies.

The paper sets out the ongoing work being carried out under the overall CREW themes of: A) Flooding and Hydrology, B) Monitoring Strategies and Technologies, C) Climate change and D) Wider Use of the Water Environment, in order that future projects are targeting the key 'gaps' as perceived by both the demand side (policy makers) and the supply side (the researchers).

However, this paper is NOT a definitive review of *research* gaps that may relate to CREW themes, given the focus on short term policy support. Relevant resources on research gaps and complementary research programmes can be found in the Annex.

The paper also introduces the concept that HOW projects are delivered is as important as WHAT topics are delivered – the most effective policy support processes may require something quite different from traditional research outputs.

If short of time, we suggest you focus on pages 3 – 6 and 14 – 17.

Circulation:

- Sent to Helen Jones (Scottish Government) and Bob Ferrier (James Hutton Institute) for comment on Thursday 11th August with responses required by 22nd August (yet to receive input from Helen Jones).
- Sent to members of PRAG 29th August with comments back by midday 7th September 2011.
    - Some suggestions will be tackled at the workshop and are not explicitly noted in this document.
- Sent to Scoping workshop attendees for information on 9th September 2011.

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CREW Objectives

The Centre of Expertise for Waters (CREW) aims:

1. **To build networks**: to establish a delivery mechanism at the science, policy and practice interface through which knowledge generated within the research and other sectoral communities flows, and reaches the people who can apply it, in a timely manner.
2. **To create new capacity**: to ensure that knowledge is generated from leading edge research of international significance to enhance the formation, implementation and delivery of water-related policies in Scotland. Additionally, to ensure emerging international knowledge and perspectives are available to the widest user community.
3. **To increase impact**: to enhance Scottish science so that it is placed at the centre of the global knowledge economy; informing and influencing international practices on water resource management.

Policy Support versus Research

Feedback from PRAG, the Steering Group and the ESPPI-CREW baseline questionnaires has highlighted the importance of keeping the CREW projects focussed on providing support to Scottish Government policy makers. This is somewhat different from traditional research, which is supported through the Scottish Government research programmes. The draft list of key policies of relevance is listed in the section below. The concept of policy support implies several aspects:

- Projects are focussed on the needs of policy makers and deliver outputs that fit with the policy making timetables
- Policy makers clearly articulate what they need and by when this is needed
- Researchers are honest about what can be done in the time and resources available
- These principles imply ongoing and frequent interaction between researchers and their policy 'clients'
- Policy makers have the time available to play their active role in these exchanges
- There may be less emphasis on final formal outputs such as papers and more on sharing ideas and information as working papers or drafts of maps or methodologies
- The emphasis may be less on innovative research and more on synthesis of existing knowledge, providing an expert commentary or advising what scientific discoveries might mean for policy.

Therefore the workshop will encourage the demand side to set out what they need and their preferences for the kind of interactions and outputs they would find most useful; and the supply side (researchers) to discuss how they might respond to these requests.

These differences will need to be considered when evaluating the bids for the projects – can some of these principles become assessment criteria for procurement?

These differences will also need to be considered when evaluating the completed projects – standard research council criteria may not be appropriate when judging utility to policy makers.

Key policies relevant to CREW

The main policies that CREW will be expected to support are listed below, with timelines appended.

Water Framework Directive (WFD) – Water Environment and Water Services (Scotland) Act, 2003, which includes the controlled activities regulations. Milestones include implementation of Programme of Measures in 2012 and the development of the next Characterisation Report in 2012 as preparation for the next River Basin Management Plan due for consultation in 2014. The Nitrates Directive and Urban Waste Water Treatment Directive plus the daughter directive on Ground waters are subsumed within these processes.

The revised Bathing Water Directive (2006/7/EC) is enacted by the Bathing Waters (Scotland) Regulations 2008, which came into effect in May 2008. Key features include increased provision of public information, tighter microbiological standards to be met by 2015 and monitoring to be commenced by 2012.

Habitats Directive (HD) as implemented by The Conservation (Natural Habitats, etc) Amendment (Scotland) Regulations 2007 covers aquatic special areas of conservation and special protection areas. There are ongoing reviews of whether sites meet favourable conditions but no particular milestones due in 2012. Also of relevance is the Nature Conservation (Scotland) Act 2004 that requires public bodies to conserve biodiversity and protect Sites of Special Scientific Interest (SSSI) – again unclear if there are specific milestones within 2012.

Floods Directive as implemented by Flood Risk Management (Scotland) Act (FRMA), 2009 has a milestone of finalising flood risk assessment for each flood risk management district by 22nd December 2011 and Flood hazard maps and flood risk maps by December 2013. Finally flood risk management plans are due in December 2015; with advisory groups being set up to develop these plans from now onwards.

Common Agricultural Policy as implemented by Scottish Rural Development Programme (SRDP) 2007-13 has ongoing interactions with the regional priorities advisory committees. Major milestone of the CAP review in 2013, although inputs will be required in 2011-12 to influence European thinking; and then in 2012-3 to influence implementation arrangements in Scotland. It is unclear how best to use this opportunity to align this review with the restoration of water bodies.

The Marine Bill as implemented by the Marine (Scotland) Act 2010 requires the preparation of a draft Scottish National Marine Plan and Strategic Environmental Assessment during 2011 and a network of marine protected areas to be set up by 2012.

The Marine Strategy Framework Directive aims to achieve Good Environmental Status (GES) in Europe's seas by 2020. Key requirements of which are an assessment of the current state of UK seas and a detailed description of what GES means for UK waters, with associated targets and indicators by 2012, establishment of a monitoring programme to measure progress toward GES by 2014, and the establishment of a programme of measures for achieving GES by 2016.

Scottish Land Use Strategy was published in March 2011 and an action plan is being developed for its implementation. Therefore it is unclear what milestones of relevance to CREW may arise during 2012-3. However, it is clear that the RBMP and FRMP are seen as vehicles for implementing the LUS; and there may be links to wider policies such as Landscape Character Mapping.

The Wildlife and Natural Environment Act (2010) introduces new responsibilities for SNH regarding invasive non-native species, which might trigger policy needs for several wetland and aquatic species and habitats.

Scottish Soils Framework was published in 2009 and provides a coordinating framework to help multiple partners ensure that Scottish soils are protected and continue to provide underpinning services to our society and economy. The document covers functions, pressures, policies and 13 outcomes. Those most relevant to CREW are: Soils making a positive contribution to sustainable flood management and Water quality enhanced through improved soil management.

Climate Change (Scotland) Act 2009 is implemented via targets within the Scottish Government Economic Strategy (2009), which aimed to reduce emissions by 2011 and achieve an 80% reduction by 2050. It also includes a statutory adaptation programme for all public bodies including the water sector. The National Performance Framework also contains national outcomes and indicators, which do not mention water per se, but are relevant to water (e.g. we value and enjoy our natural and built environment and protect it for future generations).

Planning etc (Scotland) Act 2006; National Planning Framework 2 2008 is being implemented as city regions and local authorities revise and develop structure and development plans. There are no national milestones for 2012, but as individual plans are developed, there are opportunities to consider the water implications for planning. The National Ecological Network also is of interest here.

National Park (Scotland) Act 2000 covers approximately 15% of Scotland, including the head waters of 4 of Scotland's major rivers. The 2nd strategic National Park Plans are being consulted on during 2011 and are due for ratification during 2012.

Strategic Environmental Assessment (SEA) and Environmental Impact Assessment (EIA) policies are implicit within other policy processes above and there are no specific milestones relevant to water due in 2012.

The CAMERA's document Focus on Freshwater Science also lists:

- The Water (Scotland) Act 1980
- The Water Supply (Water Quality) (Scotland) Regulations 2001 (as amended)
- The Private Water Supplies (Scotland) Regulations 2006
- The Cryptosporidium (Scottish Water) Directions 2003
- Council Regulation (EC) No. 1100/2007 establishing measures for the recovery of the stock of European eel
- The Aquaculture and Fisheries (Scotland) Act 2007
- The Nature Convention for the Conservation of Salmon in the North Atlantic Ocean (Scotland) Act 1983
- Animal Health Requirements for Aquaculture Animals etc. 2006/88/EC
- The Aquatic Animal Health (Scotland) Regulations 2009
- The Scottish Government Renewed Strategic Framework for Scottish Aquaculture
- EC Directive on Priority Substances (Directive 2008/105/EC)
- Water Industry (Scotland) Act 2002

The **European Commission's recent fitness check for water policy** (Volkerry et al., 2011) highlighted three main policies for future EU policy to address:

- Reaching or maintaining good ecological status
- Addressing water availability and water demand
- Tackling droughts and floods

The report believes that the WFD has harmonised with the Urban Waste Water Treatment and Nitrates Directives; and good progress is being made on integrating WFD with the Habitats Directive (although the results of an Adaptive Strategies to Mitigate the Impacts of Climate Change on Freshwater Ecosystems (REFRESH) workshop – see below – would suggest more work is needed). However, integration with SEA and EIA requirements; and with the Integrated Pollution Prevention and Control (IPPC) measures still requires more work; and there could be better harmonisation of public participation requirements to avoid consultation fatigue. The report reiterates findings by the OECD that state there needs to be more integration between water policies and Common Agricultural Policy, cohesion and energy policies at the European and member state levels. The report also argues that within implementation of WFD, the economic analysis is generally weak, there are insufficient economic instruments for the efficient use of water and full cost recovery is yet to be implemented. There have also been problems adjusting to a river basin approach. More data (economic and social as well as environmental) is needed on droughts, ground waters and floods.

One partner also noted that it is important to distinguish between different policy objectives or underpinning philosophies. For example, a policy focussed on maximising the benefits of the water environment to Scotland may require different inputs than policies more focussed on effective management of the Water Environment to balance economic and environmental objectives. Both approaches should be considered when identifying future 'gaps' and this point will also be debated when prioritisation of proposed projects takes place.

Existing Resources of relevance to CREW and policy support

Below is a summary of what was addressed under the previous research programme; and other projects where outputs support one or more of the 4 CREW topics.

Scottish Government Environment Programme 2006-2011

The previous Scottish Government Programme addressed the theme of Enhancing Water Quality, delivered via two work packages: Packages WP3.4 Methodologies to Assess Water Quality and WP3.5 Management to Enhance Water Quality. These WPs addressed the following research deliverables:

- *3.4.1 Use of the ecosystem approach to assess ecological health (including biodiversity) and status of water and methods to assess ecological impacts of diffuse pollution*
- *3.4.2 Methodologies for the characterisation of diffuse pollution.*
- *3.4.3. Methods for assessing the relative scale of present eutrophication and its past history*
- *3.4.4. Linkages between chemical status and ecological status of water bodies*
- *3.4.5. Assessment of the ecological impacts of engineering work*
- *3.5.1: Develop understandable (to the non-economist) approaches to costing water use which can be accepted and used UK-wide (including issues of unreasonable cost,*

disproportionality, ability to pay and local effects). Explore the breadth/ boundaries to the definition of 'water use'.

- *3.5.2 Develop approaches to the valuation of water resources, including both hard 'economic use' valuation, and non-use values.*
- *3.5.3 With respect to socially acceptable levels of pollution and carrying capacity, develop measures to establish marginal social benefit and marginal social cost.*
- *3.5.4: Practical methods and techniques to improve water quality.*
- *3.5.5 Efficient and effective control/mitigation of diffuse pollution through river basin management plans and through effective and informed engagement with local stakeholders.*
- *3.5.6 Adaptation of water resource management in the light of changes in climate, social and economic pressures and land use patterns.*

The two work packages also addressed the cross-cutting theme on climate change, by analysing long-term river flow records for the River Dee; exploring climate change impacts on changes in soil solution DOC concentrations; modelling how future deposition and climate will impact on biogeochemical processes and water quality; evaluating the impacts of climate change on runoff, nitrate leaching and erosion risk using the UKCIP02 scenarios. Research in programmes one and two also covered impacts on water (see Knowledge Scotland research briefs below).

Detail of what was delivered can be found in the end of programme final report on Environment – Land Use and Rural Stewardship (February 2011). Outputs are also published in the following locations:

- http://www.programme3.net/water/index.php
- http://www.macaulay.ac.uk/hydroworkshop/index.php
- http://www.macaulay.ac.uk/water/biogeochem.php
- http://www.macaulay.ac.uk/water/transport.php
- Catchment Advice Template and exCHange website (CATCH), (http://catch.macaulay.ac.uk/).
- Implementation of River Basin Management Planning: (http://www.programme3.net/water/water345gov.php).
- DVD exploring our impact on the water environment (http://www.macaulay.ac.uk/videos/wup/).
- 11 Water related research briefs are available through Knowledge Scotland: http://www.knowledgescotland.org/briefings.php?family=2 including information on public preferences for flood risk protection; health risks from Cryptosporidium and Toxoplasma; and spatial planning; or at: http://www.knowledgescotland.org/briefings.php?family=3 including uptake of diffuse pollution measures; river engineering and pearl mussels; and cost-effectiveness of measures.
- Our responses to prior policy consultations can be found at: http://www.macaulay.ac.uk/policyrelevance/
- Information on our work on coastal catchments can be found at: http://www.macaulay.ac.uk/coast/
- Information on research on the Allt a' Mharcaidh Catchment can be found here: http://www.macaulay.ac.uk/amc/

- Trends in Scottish River Water Quality report can be found here: http://www.sepa.org.uk/science_and_research/data_and_reports/water/scottish_river_water_quality.aspx

Other Research Projects: REFRESH

REFRESH (Adaptive Strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems) is an FP7 project that aims to enable water managers to design cost-effective restoration programmes for freshwater ecosystems, taking account of expected future impacts of climate change and land-use change in the context of the Water Framework and Habitats Directive. It began in 2009 and runs for another three years. Initial work completed includes results from a workshop involving land mangers discussing barriers to uptake of measures to support the Water Framework Directive and the Habitats Directive; as well as results from a workshop involving European policy makers discussing how to adapt WFD and HD to future drivers of change. Outputs can be found at: http://refresh.ucl.ac.uk/Public_News_Page

Other Research Projects: Natural Flood Management Workshop

In January 2011, the Scottish Government sponsored two workshops to initiate increasing understanding and dialogue between land managers and Government and Agency staff regarding appropriate Natural Flood Management (NFM) approaches. The results from these workshops can be found at: http://www.macaulay.ac.uk/water/nfmworkshop/index.php.

Other Research Projects: Aquarius

The Aquarius project focuses on farmers acting as water managers. The project, which is partly funded by the EU-North Sea Region Programme Interreg IVB, involves 15 partners from six nations around the North Sea, who are conducting seven national pilot projects. The common aim is to find and implement sustainable, integrated land-water management through engaging with land managers. The Scottish focus is to explore the necessary conditions for farmers to adopt flood alleviation measures on their land, to complement Aberdeenshire Council's Tarland Flood Prevention Scheme. Further information, including baseline data on the Tarland catchment and farmer attitudes to NFM and water management can be found at: http://www.macaulay.ac.uk/aquarius/html, whilst information on the trans-national learning can be found at: http://www.aquarius-nsr.eu/Aquarius.htm.

Other Research Projects: URFlood

URFLOOD is funded by the European ERA-Net CRUE consortium and aims to establish transnational collaborative research on "Flood resilient communities - managing the consequences of flooding" – particularly improvement of risk awareness and increasing public participation. The research uses case studies from Finland, Ireland, Italy and Scotland. Existing outputs including a literature review on communicating uncertainty and risk can be found at: http://www.macaulay.ac.uk/urflood/index.php.

Other Research Projects – Eddleston Water

There is an Eddleston Water restoration project (involving Dundee university & others, incl SEPA, SNH, BGS, SBC, Tweed Forum, etc) that considers integrated catchment management, habitat restoration and natural flood risk management. There is also an Eddleston/Wooler Water Tweed RELU project on managing borderlands of flood knowledge (involving Newcastle, Durham, York &

Dundee universities & Tweed Forum) that considers stakeholder use of knowledge for flood risk management.

Other Research Projects - UNESCO HELP Basins & NGO Catchment Organisations

There is ongoing research within UNESCO HELP Basins (Tweed, Dee and Spey in Scotland) – see http://www.dundee.ac.uk/water/projects/europeanhelpbasins/. There is also a Scottish Universities Insight Institute study looking at the Role of NGO Catchment Organisations in facilitating the participative management of Catchments – this led by Dundee University.

Other Research Projects - EU Striver

This project considers science, policy and stakeholders in water management (Dundee university UNESCO Centre and partners) - http://www.dundee.ac.uk/water/projects/striver/#d.en.40682

Other Research Projects - EU Livediverse

This project considers sustainable livelihoods and biodiversity in riparian areas in developing countries (Dundee university UNESCO Centre and others) - http://www.dundee.ac.uk/water/projects/livediverse/#d.en.27095

Planned 2011-12 deliverables relevant to CREW

From an analysis of the current CREW projects and the Scottish Government programmes (Programme One: Environmental Change and Programme Two: Food, Land and People), a number of relevant outputs should be delivered by **2012-13**. CREW projects might want to work with these existing research outputs to convert them into things more relevant for policy support, or build on them to provide more tailored answers.

Outputs relevant to Flood Management and Hydrology

There are three 1st year CREW projects of relevance. There are 6 projects within the Environmental Change programme, although only 4 plan to deliver policy relevant outputs within the time frame of this scoping process.

CREW; Module 1: Project 1 - Natural Flood Management – this aims to develop a knowledge system for NFM comprising of a paper collating data from recent research on NFM and farmers attitudes; a web-based database of practical data on NFM; paper on the farmer views on NFM features for SEPA/SNIFFER workshop (2012) and the provision of materials and expertise in support of the education project. Progress has been made with the web format NFM database, with some information now live on the website. A final draft of a policy brief and full research report on farmer's attitudes towards NFM has been completed. Wendy Kenyon is presenting a paper and chairing a session at the SNIFFER/SEPA workshop on the 19th October 2011.

CREW; Module 1: Project 2 - River functioning and resilience – a River Keeper's Handbook
Will cover Concepts in fluvial geomorphology and ecology and fluvial geomorphology in the Scottish environment in order to raise awareness and promote best practice. Stephen Addy has collated information that will be useful to the completion of the handbook but the project is waiting to commence once a HEI partner has been confirmed, which will be within the next month.

CREW; Module 3: Project 4 - Coastal Flooding - this aims to synthesise existing information relating to coastal flooding in Scotland and produce a guidance document for local authorities and practitioners for use in the development of flood risk management plans, with supporting web

pages. It has a clear link to work in the Climate Change Centre of Expertise. A questionnaire and accompanying letter has been sent to coastal flooding practitioners from local authorities through the SCOTS group, in order to establish the needs of end-users of the coastal flooding guidance booklet. Collation of feedback will commence mid-September.

RD2.4.1: Evidence and demonstration of the effectiveness, costs and benefits of NFM measures in a Scottish context – will provide information on empirical data pre and post intervention to illustrate impact of selected NFM measures on hydrology, water quality and ecology focussing on demonstration sites (to be selected) and instigating joint monitoring where possible.

RD2.4.2: Tools and evidence to help practitioners assess where NFM is feasible and appropriate – collation and synthesis of existing literature on NFM, leading to a review article, and establishing practitioner working group including an initial workshop.

RD2.4.3: Understanding and modelling seasonal shifts in the environment and the implications for flooding and water conservation – report on spatial data availability, gaps and opportunities for modelling on past, present and future climate and catchment characteristics.

RD2.4.4: Barriers, opportunities and routes for implementing NFM via behavioural and land use change by communities, landowners and planners – review of existing literature and baseline and assessments of opportunities and barriers.

RD2.4.5 Identification of opportunities for flood risk management measures to deliver multiple objectives (including for flooding, water quality, economy, amenity and biodiversity) – no outputs planned until year 3.

RD2.4.6. Identification of evaluation of potential negative impacts of flood risk management activities, including those on animal health and welfare, and how they may be managed - no outputs planned until year 3.

Outputs relevant to Monitoring Strategies and Technologies

There is one 1st year CREW project of relevance. There are 3 projects within the Environmental Change programme, although only one plans to deliver policy relevant outputs within the time frame of this scoping process. There are two projects within the People, Land and Food programme, although it is unclear when their outputs will be available.

CREW module two project one: Diffuse pollution management will integrate research with stakeholder work on DP Management resulting in various KE practices; workshops and training exchanges, resulting in a report on strategies for assessment of DP effectiveness for DP monitored and priority catchments, and priority measures for the future. A meeting with the Scottish Government (Ian Spiers) has been set up for the 23rd November. The planned workshop(s) has been postponed until the HEI partner has been confirmed and can input into the project.

RD2.2.1: Methods and technologies to improve environmental sustainability and resource efficiency of water and energy supply chains – by end of year one will have produced a Ranked list of technology/approach combinations to evaluate different technology/approach combinations of relevance to Scotland against environmental sustainability and resource efficiency criteria.

RD 2.3.1: Evidence on effectiveness of existing measures in NVZs and other diffuse pollution legislation will deliver an appraisal of existing monitoring data from national and specific initiatives by end of 2012.

RD2.2.3: Assessment of the main opportunities for delivering multiple benefits and avoiding disbenefits, from new and existing technologies and management practices for water and energy supply chains – no relevant outputs available until year 3.

RD 3.5.4: Assessment of the risks of biophysical 'pollution swapping' (e.g. reduction in aquatic emissions due to conversion into gas released to the atmosphere or vice versa) resulting from a range of land uses and practices – not due to start producing outputs until 2014.

WP5.2; RD5-SD1: Crops and horticultural plants with improved performance in terms of resource use and outputs. Tools and technologies to improve the resource use efficiency of crops in the face of climatic changes. SD1: Develop and establish water and temperature stress phenotypic screens to expand genotypic data and identify extreme variants for transcriptomic analysis and gene identification – work planned for years 1-3, but unlikely to produce outputs for the scoping period.

RD6.1.6: Research Deliverable 6.1.6 (Pollutants): An approach to determining the relationship between animal health and the emission of pollutants harmful to the environment, for example sheep dips and other chemotherapeutics, and methods to mitigate negative impacts – a Report describing the results of a horizon scanning exercise reporting potential concerns about inter-relationship between animal health and the emission of pollutants harmful to the environment is to be produced, but the Gantt chart just specifies ongoing activity from year 1-5.

Outputs relevant to Climate change and water

There is one 1st year CREW project of relevance. There are 4 projects within the Environmental Change programme, although only two will deliver policy relevant outputs within the time frame of this scoping process.

CREW; Module 3: Project 5-Climate Change and Water demand will produce a national-level assessment of changes in resources that combines climate change (UKCP09) and land use change scenarios to provide an indicative map of resource availability in 2050, particularly highlighting 'hotspot' areas where the supply-demand deficit is apparently unsustainable. The project has been put on hold until a HEI partner has been confirmed but background information relevant to the project has been collated.

RD2.1.3: Predictions of the impacts of land use and climate change upon capacity, supply chains and demand for water and energy and RD2.1.6: Evaluation of opportunities at local, regional and national scales to contribute to renewable energy targets. The project will evaluate the inter-relations between water and renewable energy supply and other ecosystem services, and evaluate impacts of future land use and climate change on water availability and provision of renewable energy, including consideration of future renewable options under a changed climate. However, the results will not be available within the scoping time frame.

RD 2.3.3: Improved understanding of the role of land management and climate change on total diffuse pollution loads in Scottish freshwaters and coastal waters and RD 2.3.4: Scenarios to explore

risk and impact of changes in water quality in response to land use and climate change. The project will develop tools to enable national diffuse pollution load assessments under current situations and future scenarios of climate and land management change. By 2012, a report on model selection should be available and by 2013, a national evaluation of models should be available.

RD3.2.4: Assessment of the cost-effectiveness of specific policy options in encouraging uptake of specific measures to reduce GHG emissions from the rural land use sector – this will not produce any water relevant outputs within the scoping timetable.

WP3.3.1 SD4: The soil, water & air interface and its response to climate and land use change: an integrated report on the key processes and threats at the soil water air interface in Scotland should be available by the end of 2012.

Outputs relevant to Wider Use of the Water Environment

There are three 1st year CREW projects of relevance. There are 4 projects within the Environmental Change programme, although only two will deliver policy relevant outputs within the time frame of this scoping process.

CREW; Module 4; Water Health and Well-being – this project will undertake a review of evidence relating to water, and mental health and well-being, on the topics of: water (inland and coastal, rural and urban) with respect to stress reduction; water as a threat (e.g. flood risk) and cause of stress; Sustainable Urban Drainage Systems (SUDS) and wastewater; and water quality interactions with those of well-being; leading to findings reported via Frequently Asked Questions – on health and water and science brief(s) posted on Knowledge Scotland. A literature review for the project is being developed and a stakeholder meeting is being organised for September- October time.

CREW; Module 4; CATCH-II will establish a common understanding of the established integrated catchment management (ICM) projects; use the established ICM projects to identify opportunities and challenges to delivering Scotland's policy commitments to water management at the catchment-level, and disseminate the key messages to ICM policy makers, agencies and practitioners. The material will be provided via web pages; short videos and a policy brief on 'Catchment-level delivery of national policy commitments to water management'. Interviews will commence within the next month and a workshop has been planned for the November although this maybe pushed back to January. A rough draft of the virtual tour of Tarland has been developed that will be on the website following editing.

CREW: Module 5: Hydro-literacy aims to help develop public understanding of the issues involved in the management of water and to increase science engagement and will produce a water pack for schools, and work with the Curriculum for Excellence to deliver projects on WaterPast, WaterPresent and WaterFuture. Planning the delivery of each of the five outputs are nearly complete. Background research relevant to the project has been collated and negotiations about links to the wider programme communications and KE strategy are being held.

RD2.1.1: Assessment of the capacity and geographical distribution of Scotland's water and renewable energy resources – maps To assess current availability of water resources in Scotland and to characterise their suitability for different uses should be available at end of year one.

RD2.1.5: Quantification of the risks, opportunities and constraints on supply of water and renewable energy - outputs unlikely to be available until year 3.

RD2.2.2: Analysis of how the use of renewable energy sources will impact on the environment (including GHG emissions, waste disposal), and more accurate data on Scotland's contribution to global carbon emissions from water and energy supply chains - a report synthesising existing literature on GHG emissions from water supply chains will be available by end of year 2.

RD2.2.5: New approaches, guidance and advice to policy makers on how public/industry/end user behaviour may be improved, in order to reduce waste and improve consumption choices (e.g. consequences of unrestricted consumption, water charging) – outputs unlikely to be available until year 3.

Outputs relevant to Integrated Catchment Management

This is an additional theme suggested by members of PRAG. There are 9 projects within the Environmental Change programme, although only 7 will deliver policy relevant outputs within the time frame of this scoping process.

RD1.2.1: Development of approaches to assessing the monetary and non-monetary value of key ecosystem services in Scotland will identify existing knowledge and gaps of ES provision by different habitats including freshwater and marine by 2012-3; and create a database of existing ES values relevant to Scotland.

RD 1.3.2 SD2: Review of the utility to policy makers of using the EA plans to evaluate the fit of an ecosystem approach with the current Scottish RBMP by end of 2012-3, including the fit with the roles of SEPA and other public bodies.

RD 2.1.2: An integrated approach to comparing supply with present and future demand of water and or energy and RD 2.1.4: Prediction of the impact of demographic change upon water and energy demand should provide a review of studies of water and energy demand by March 2012.

RD2.2.3: Assessment of the main opportunities for delivering multiple benefits and avoiding disbenefits, from new and existing technologies and management practices for water and energy supply chains – will produce a policy brief on how policies deliver various Ecosystem services and gaps remaining (in conjunction with Ecosystem services theme).

RD 2.3.1: Guidance and advice on improving implementation of water policy measures and increasing uptake of diffuse pollution measures via behavioural change will report on combined results of effectiveness evidence base.

RD 2.3.5: Identification of opportunities for diffuse pollution measures to deliver multiple objectives and to avoid unwanted pollutant swapping will not deliver until 2013-4.

RD3.5.3: Development of methods for assessing impacts of new technologies or management practices on multiple objectives, and application to selected practical examples with relevant user groups - by end of year two, will Develop and test tools for producing land use options; and Develop and test tools for trade-offs between options. Not specifically focussed on water case studies but of relevance to ICM.

RD 3.5.4 focuses on issues of pollutant swapping, which links with work on diffuse pollution to be carried out in the sustainable water and energy supply chain theme.

RD 5.3.2.4: Quantify and compare the outcomes from different efficiency indicators in intensive farm systems (dairy cattle) will look at use of water as an indicator of efficiency but work will not start until mid 2012 so unlikely to have outputs available for this scoping period.

RD 6.3.5.3: Quantitative assessment of the international trade and environmental implications of animal welfare changes will look at nitrate inputs to groundwater, but the work is not planned to start until 2013.

Outputs from Climate Change Centre of Expertise relevant to CREW:

The Centre of Expertise is organised into three work streams: Mitigation, Adaptation and Risk.

The mitigation stream plans to consider: Inventory, accounting and reporting; Land-based mitigation options; Co-benefits and trade-offs; and Distributional impacts and equity. The work proposed on co-benefits and trade-offs looks at ecosystem services and externalities including impacts on and use of water in production systems. Water is not specifically mentioned anywhere else in the proposal.

The adaptation stream plans to consider: Baseline and Systems Characterisation; Scenario Analysis and Planning; Benefits, Costs, Inter- and Intra-generational Trade-offs; and Knowledge Exchange (KE) & Decision Support Research on Attitudes and Behaviours are embedded throughout. Water resource management is one of the key sectors for the proposed case studies and integrated activities.

The risk stream plans to consider: Biodiversity & Ecosystem Services; Agriculture; Food security; Marine; Modelling; Perceptions and Communication of Risk and Uncertainty. The proposed work on waters, including flooding and drought, was not funded. However, the modelling activity plans to look at impacts on water resources as part of their work and the perceptions activities include attention to Strategic Environmental Assessment (including impacts on water) and perceptions of risks including flood risk. Water is not named, but is possibly implied, in the activity looking at risks to biodiversity and ecosystem services.

Call down service:

Please note there is a limited budget provided for rapid-response to pressing policy issues within CREW. Enquiries should be directed to the call down team on Tel: 01224 395 395 or Email: enquiries@crew.ac.uk, who will then forward the request for ratification and action.

Gap Analysis – suggested areas to workshop

The gaps suggested below are based on a review of the information above combined with information on projects put forward for 2011-2 but deferred and suggestions from PRAG members. These are ‘starters for ten’ – the purpose of the workshop is to identify gaps and suggestions of projects to deliver them. There will be plenty of opportunity to add to and/or alter this list.

The following gaps where policy support is likely to be required in 2012-3 are (in no particular order):

- Methodologies to monitor efficacy of programme of measures beyond diffuse pollution

- Methodologies to address efficacy of programme of measures beyond diffuse pollution under scenarios of climate changes
- Methodologies to evaluate the social/economic impact of programme of measures
- Institutional solutions to managing drinking water protected areas at source
- Linkages and unintended conflicts when integrating WFD with the HD and/or FRMA
- Identification of the main internal and external drivers of change relevant to WFD and FRMA to 'future proof' these policies, and allow policies to anticipate possible shocks
- Understanding or mapping the spread/protection against Non-Native Invasive species and their ecological, social and economic impacts
- Including measures of uncertainty in RBMP and FRMPs and how to communicate these
- Methodologies to allow policy integration at multiple scales (e.g. WFD applies at a water body level but other policies apply at a local authority or national scale)
- Water specific indicators to feed into the review of the Biodiversity strategy 2020
- Using the concept of ecosystem services/an ecosystem approach to implement FRMA
- Trade off analysis of provision of different ecosystem services by water bodies
- Analysis of conflicting measures/guidance under WFD/FRMA/Habitats Directive
- Methodologies to take account of protected areas in RBMP and FRMA
- Good practice for establishing and delivering flood risk advisory groups (SEPA highlighted this is needed as soon as possible)
- Evaluation of impacts of water based measures under SRDP and fit with RBMP/FRMA goals
- Methodologies to deliver the Land Use Strategy via RBMP and FRMPs
- Methodologies to ensure structure and development plans take sufficient account of RBMP objectives
- Improving integration of RBMP with SEA, IPPC, SRDP and Habitats Directive (this would also apply for FRMPs)
- Good practice in using economic instruments to promote water efficiency (in which sector(s))
- Good practice in implementing full cost recovery in water services
- Methodologies for monitoring groundwater
- Methodologies for monitoring flood waters
- Flood hazard and flood risk modelling and mapping methodologies
- Methodologies to measure the water 'footprint' in Scottish consumption (fit with national performance framework)
- Assessing the sustainability of Scottish aquaculture
- Levers to align the CAP review with water body restoration objectives
- Map ecosystem services provided within catchments (or a model catchment)
- Communication of flood risk
- Methodologies for appraising the costs and benefits of flood risk measure (in all settings, not just NFM) and potential links to ecosystem services.
- Further work on coastal flood management
- Options for improving the Coastal Boundaries dataset (formerly the Extreme Sea Level dataset) especially how the dataset can be extended up estuaries to provide better flood model outputs for tidal areas.

- Appraisal on how using an ecosystem service perspective can help manage the water-soil-vegetation ecosystem for optimal benefits for climate mitigation/pollution/flooding/drinking water
- Project on the quality, state and economics of urban water systems
- Assessment of land use change and link to water quality to inform SWIMI (Workshop and project)
- Guidance on buffer strip width and management (Project)
- Input to DPMAG effect of measures work (Project)
- Input to use of soils data in priority catchment prioritisation (Workshop)
- Assessment of farm scale field drainage systems (Project)
- Input to measures selection for the next SRDP (Workshop)
- Assessment of GHG emissions from water quality measures (Scoping workshop and project – link to Climate Change Centre?
- Evaluation of mapping tools for multiple benefits (Workshop and project)
- Input to water quality guidance post DPMAG review (Workshop and project)
- Methodologies to measure the water 'footprint' in Scottish consumption (fit with national performance framework)
- Alternatives and complements to a centralised water and sewerage system including appraising performance of local off-network system
- Use of low carbon technologies to reduce impacts of centralised systems – particularly climate change mitigation options for the water industry – links to Climate Change Centre of Expertise
- Aquatic ecology impacts from climate change
- Project considering the inter dependencies and synergies arising from year one project outputs (e.g. links between catchment management and flood management approaches or links between diffuse pollution; catchment management and water demand and supply)
- Further work on Diffuse Pollution Management needs to differentiate between Rural and Urban and Upland and Lowland land uses (e.g. renewable v. agriculture) and on their impacts/receptors (DOC in drinking water or eutrophication of estuaries).
- Future project on balancing creating value from the water environment for industry / energy generation and the value for environmental services, aligned with the Hydro-nation agenda.
- Establishing a baseline position (knowledge and data) at a water body level to inform the future outcomes to be achieved.
- Greater understanding of water resource issues is needed; especially the role of standing waters
- Better understanding of hydro-morphology and its linkage with ecological quality
- Effectiveness of participatory management and stakeholder engagement - what matters, what changes, who are the key influencers and actors
- Scaling issues in integrated catchment management
- Water specific tools for ecosystem service identification and risk analysis
- Pilot studies of integrated ecosystem service delivery options
- Wetland species and conflicts for habitat management
- Impacts of inter-basin transfers
- Barriers and solutions to catchment-wide uptake of *sustainable* water management options

- Dynamic Licensing of WWTW - Rivers in Spate versus Drought.
- Nano-materials in the environment.
- Bringing monitoring protocols/procedures in line with developments in monitoring technologies - optimising our response time on positive events.
- Determining the impacts of changes in land use upon water quality (e.g. Wind farm developments, forestry activities, changes in agricultural crops to support renewables - E.g. Biomass production)?

The following were accepted as relevant by Scottish Government but deferred - therefore they should be revisited to ensure they are still relevant and possibly re-scoped:

- Managing agricultural soils to minimise flooding of downstream urban areas
- Understanding barriers to uptake of Natural Flood Management at individual, catchment and national scales
- Trialling use of environmental sensor networks to advise farmers when to apply slurry in priority catchments
- Understanding Catchment/Climate connections through development of an integrated catchment-based assessment framework of links between land, water and management choices under climate scenarios.
- Understanding complementarities and conflicts in spatial planning (i.e. the coordination of different policies and plans within a catchment and river basin)
- Assessing impacts of shifts in biological and hydrological interactions in soils
- The water economy of agriculture: understanding the water footprint of a variety of agricultural commodities and farm types

The following previously proposed projects were deferred for decision by Scottish Government until 2012-13:

- Assessing health impacts of organic/inorganic chemicals – particularly bio-accumulation of emerging pollutants and priority hazardous substances
- Statistical evaluation of existing monitoring networks to provide more cost-effective data
- Evaluating the available mix of statutory and market mechanisms for managing water allocation

Annex: Analysis of Research Gaps

This annex refers the reader to resources that have identified research gaps within the arena of the water environment. However, the scoping exercise is focussed on gaps in policy support, building on existing research or research to be completed within 2012-13. Therefore these resources provide useful context, but should guide commissioning of further strategic research, rather than short-term policy support. Copies of the relevant reports will be placed on V-CREW. This list is not definitive. A more detailed summary of research already commissioned is being prepared by the NERC Water Security Knowledge Exchange Programme (WSKEP) and will be made available through the CREW website in due course.

CAMERAS Focus on Freshwater Science identifies the following science priorities:

- Ecosystem health (quality issues) - Pollution and contaminants; Contaminated land; Acidification; Biodiversity and Invasive species
- Ecosystem use (resource management) - Catchment management; Wetlands; Farming; Forestry; Fisheries; Aquaculture; Industry; Urbanisation;
- Cultural and well being/health - Human health (including provision of potable water); Culture and recreation and behavioural issues; Food security; Waste water management
- Water resources (quantity issues) – Drought; Flooding; Flood risk management; Water minimisation and reuse.

These priorities require engagement, Multidisciplinary approach; and data integration. Document is at:
http://www.camerasscotland.org/sites/default/files/images/docs_store/Focus%20on%20Freshwater%20Science.pdf

The Scottish Marine Science Strategy 2012-5 identifies three high level priorities:

- Understanding how the marine ecosystem functions
- Responding to climate change and its interaction with the marine environment
- Sustaining and increasing ecosystem benefits

Document is at:
http://www.camerasscotland.org/sites/default/files/images/docs_store/Scottish%20Marine%20Science%20Strategy%202010%20-%202015.pdf

'Science for Scotland: A strategic framework for science in Scotland' highlights the need to support science that:

- Improves our understanding of environmental change
- Assigns economic and societal value to our natural assets to inform policy and planning decisions
- Protects Scotland's natural assets (e.g. land, water, biodiversity etc.) for future generations in the face of competing pressures and threats
- Improves Scotland's economic and environmental performance

LWEC

The living with Environmental Change (LWEC) programme identifies six challenges: climate, ecosystem, health infrastructure, societal and resources: all are relevant but water is specifically highlighted by the resource challenge remit (see http://www.lwec.org.uk/challenges). They also list several foresight documents that might help guide the scoping process at: http://www.lwec.org.uk/products/foresight.

There are no specific documents addressing research/knowledge gaps that I could find. However, the UK Flood and Coastal Erosion Research Strategy will be published shortly and will provide a commentary on research gaps under three themes: Understanding Risk; Managing Probability and Managing Consequences. The report will be posted on V-CREW once available.

The NERC Water Security Knowledge Exchange Programme – the CFT is currently in dialogue about how to coordinate between this programme and CREW but there are no documents available regarding their priorities or knowledge gaps.

UK Foresight Land Use Futures Project

Of relevance to CREW are the topics on the interaction of land use and climate change and the delivery of public goods. The report particularly draws attention to land for water resource management with priorities to:

- develop a more integrated strategy for quality and supply – involving integrated catchment area management, water pricing, and demand management, particularly in areas of stress – and ensuring that the implications for water resources are factored more systematically into decision-making on land use and land management changes, nationally, regionally and locally.
- Develop a plan of action to reverse long-term degradation of aquifers due to ingress of nitrates and other contaminants.
- Research is also required on water pricing, technologies for water re-use and monitoring/modelling at multiple spatial and temporal scales.

See: http://www.bis.gov.uk/foresight/our-work/projects/published-projects/land-use-futures/reports-and-publications

DEFRA horizon scanning:

Past horizon scanning exercises have located water within landscape studies; studies on environmental constraints; energy policy impacts on biodiversity and rethinking the global economy. Current water issues identified in the June update include concerns about sea level rises and faster than expected changes in the marine environment.

See: http://horizonscanning.defra.gov.uk/

Research Councils UK

The Strategic vision of RCUK (see http://www.rcuk.ac.uk/documents/RCUKStrategicVision.pdf) notes six societal challenges, of which, the Living with Environmental Change (see above) is most

relevant to CREW. The vision notes the need to liaise with Technology Strategy Boards, of which the main relevant connection would be with the Environmental Sustainability Knowledge Transfer Network (https://ktn.innovateuk.org/web/sustainabilityktn). The RCUK Big Ideas for the Future document (http://www.rcuk.ac.uk/documents/publications/BigIdeasfortheFuturereport.pdf) highlights the following water related topics in the chapter on People and the Environment:

- Design of the built environment including porous pavements
- Prediction technologies
- Energy supply and reducing emissions
- Future of Food
- Integrated flood and storm surge management
- Ocean acidification
- Coastal flooding
- Waste management
- Biodiversity

Wellbeing from water in the landscape and water based sport and recreation is also mentioned in other sections.

European Commission

The WssTP (Water Supply and Sanitation Technology Platform) and ACQUEAU programmes plan to focus on the bio-based economy; Sustainable ecosystems; Healthier water systems for a healthier society; and Closing the water cycle gap – the commentary notes the need to consider extreme events, governance, regulation and technological innovation. See: http://www.wsstp.eu/files/WSSTPX0001/position%20paper/Position%20on%20Water%20JPI%20Vision%20Document%20WssTP.pdf

A consultation on EU research needs in the domain of ICT for water resources (2010) identified the following unranked challenges:

- combined efforts on integration of the real-time monitoring of resources;
- architectural needs related to functional, dependable, and energy-efficient/self sustainable requirements on sensors and actuators;
- fusion of data from heterogeneous sensors;
- enhancement of model-based predictions of water supply and demand, both in terms of their precision and shortening of computational time;
- Lack of maturity of DSS for water management is affected by lack of data (or data of insufficient quality), what is in turn a barrier for deployment.

http://ec.europa.eu/information_society/activities/sustainable_growth/docs/water_cons/ict-water-consultation_report_june2010.pdf

Information on current water research in Europe can be found at: http://www.wsstp.eu/content/default.asp?PageId=584&LanguageId=0

The WISE-RTD web portal is also a useful site for information on water policy, policy implementation and RTD projects being run in Europe. See: http://www.wise-rtd.info/