SEVENTH FRAMEWORK PROGRAMME

THEME 6: Environment (including Climate Change)

Adaptive strategies to Mitigate the Impacts of Climate Change on European Freshwater Ecosystems

Collaborative Project (large-scale integrating project)
Grant Agreement 244121

Deliverable 6.5: Workshop proceedings on collaborative scoping of solutions in the Dee catchment, UK

Lead contractor: James Hutton Institute (JHI)
Other contractors involved:

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Estimated person months: 2
Abstract

Work package 6, Task 6.3 of the REFRESH Project is concerned with scoping possible measures to improve water quality through collaboration with local stakeholders. This is being undertaken at 6 case study catchments located in Scotland, England, Finland, Norway, the Czech Republic and Greece. Deliverable 6.5 represents the outcome of the collaborative scoping of solutions in the Dee catchment in Scotland. A workshop was held on February 3rd 2011 in Dunecht, northeast Scotland, to explore the views of local stakeholders on measures to improve water quality problems to achieve compliance with the Water Framework and Habitats Directives both now and under projected climate change. The workshop was designed and implemented following the Participatory Assessment of Adaptation Strategies protocol agreed in WP6, and built on the stakeholder engagement experience in WP1. A total of 12 people participated in the workshop, which focused on the Leuchar Burn and Loch of Skene, both within the River Dee catchment. The stakeholders have been categorized into three groups: farmers, other land users/managers and a general group comprising those who represent the interests of the ‘environment’, including government agencies and environmental interest groups.

The objectives of the workshop were addressed through three sets of activities: (1) discussion of water quality problems in the sub-catchment and the sources of these pressures, (2) discussion of measures to alleviate these problems and perceptions of their cost and effectiveness, and (3) discussion of climate change and its effect on water quality and adaptation measures. This was done through a combination of plenary discussions and break-out group activities.

The workshop was successful in gathering local views regarding these three issues. These views will feed into further WP6 cost-effective analysis modelling work, guide the selection of adaptation measures to be modelled in WP5 whilst lessons learnt will feed into the project’s general stakeholder and collaborative learning process in WP7.
Introduction

The REFRESH project aims to help design cost-effective adaptation and mitigation strategies for freshwaters to comply with the Water Framework and Habitats Directive, taking into account expected future impacts of climate change. An essential part of the REFRESH approach is to ground-truth scientific predictions in consultation with stakeholders. Task 6.3 is specifically concerned with scoping possible adaptation and restoration options for water quality improvement in collaboration with local stakeholders at the sub-catchment level. Such options are aimed at attaining compliance with the Water Framework and Habitats Directives both now and under potential future climate change.

As part of Task 6.3, a stakeholder workshop was held in Dunecbt, northeast Scotland, on February 3rd 2011. The aim of the workshop was to explore the views of local stakeholders on measures to alleviate water quality problems in the Leuchar Burn and Loch of Skene, in the eastern part of the Dee catchment. This sub-catchment was chosen as one of the demonstration sites for the WP6 work (see Deliverable 6.3 on the sub-catchment rationale and selection, Slee (2011). From the three Dee sub-catchments, this was considered to be more appropriate than the other two because: i) in the case of the Tarland sub-catchment, other stakeholder engagement processes were taking place at the same time, to avoid stakeholder fatigue, and ii) the Leuchar Burn and Loch of Skene is more representative of the general Dee catchment than the river Gairn.

This workshop builds on the long-term engagement between the James Hutton Institute (JHI), in collaboration with the Scottish Government, and stakeholders in the region developed as part of an ongoing research programme. The organisation and planning of the workshop has been facilitated by the involvement of the Dee Catchment partnership. The Dee Catchment Partnership is an independent association of agencies, organisations and individuals, committed to the sustainable use of the catchment's rivers, tributaries and lochs, as well as the habitats and species they support. The Partnership has been coordinating local stakeholders since 2003, with the aim of restoring habitat and water quality throughout the Dee catchment. Current projects include the restoration of urban watercourses, reducing pollution from septic tanks, reducing diffuse source pollution and floodplain restoration. JHI is a member of the Partnership.

Recent work in the sub-catchment, relevant to the REFRESH workshop, includes:

- Implementation of a range of measures under the Scottish Rural Development Plan;
- Development and implementation of the Scotland River Basin Management Plan;
- Publication of the Dee Catchment Management Plan (Cooksey, 2007);
- A meeting on land manager contributions to protecting the Dee Water Environment (November 2010);
- Catchment walks organized by the environmental regulator (SEPA), and
- A workshop/farm walk related to the ongoing Diffuse Pollution Priority Catchments initiative, organized by the Scottish Agricultural College, also held in Dunecbt in November 2011.

The workshop was designed and implemented following the Participatory Assessment of Adaptation Strategies protocol agreed in WP6 (Varjopuro et al. 2011), and links to other areas of work within the REFRESH Project in several ways:

- The workshop was designed to build on WP1 work on the Conceptual model of stakeholder views of measures and potential barriers to uptake (Deliverable 1.16, Waylen et al. 2011a). It specifically focuses on the mitigation measures analysed in the workshop Land Management

1 More information on the Dee Catchment Partnership and its activities can be found at: www.theriverdee.org
**Contributions to Protecting the Dee Water Environment** (Waylen et al. 2011b) held in the context of WP1, D.1.14.

- Stakeholder identification for this workshop is also supported by the findings of D1.14.

- From the long list of mitigation measures analysed in WP1, a shorter list of measures adapted specifically to the Leuchar Burn and Loch of Skene was produced, through discussion with modellers from REFRESH WP5 (Balana, 2011), in order to ensure the potential for modelling in WP5. It should be noted however that, following the principles of this task, the final set of measures analysed arose from the consensus with stakeholders in the workshop itself.

- Previous WP6 findings on identification and sources of pressures at the sub-catchment level (Balana et al., 2010) were used as a basis for discussion, to be contrasted with local knowledge.

- The climate change aspects of the workshop builds on the climate change scenarios developed in WP1 for the Dee catchment (Deliverable 1.6; Shahgedanova 2011).

- The outcomes of the workshop in terms of perception of cost-effectiveness and their adaptation under climate change will be used in the modelling of cost-effectiveness of measures in the linked work between WP6 and WP5 and will feed into Deliverable 6.11 (Cost-effectiveness Analysis reports for the Dee catchment, UK).

- The outputs of this workshop feed into REFRESH general Stakeholder Engagement/Collaborative learning process (WP7, Task 2).

The remainder of this document is organized as follows: Section 2 briefly describes the main pressures and problems in the sub-catchment, section 3 describes the process of stakeholder identification for this workshop, section 4 describes the preparation of the workshop and section 5 the workshop programme, while Section 6 details the workshop results. Conclusions and lessons learnt are presented in Section 7.

## 1 Identification of pressures/problems

The Leuchar Burn and Loch of Skene sub-catchment is part of the River Dee catchment, in northeast Scotland. As described in the Sub-catchments selection and characterization in River Dee catchment Report (; Balana et al. 2010), the sub-catchment is typical of the lower reaches of the Dee with a high proportion of intensive agriculture, some woodland, a small component of heathland/lowland moorland and estate policies around two large landed estates. It contains the enlarged lowland Loch of Skene which is designated as a Special Protection Area (SPA) and a Site of Special Scientific Interest (SSSI). The loch suffers from algal blooms due to nutrient inputs from a range of sources (effluent from private septic tanks and public waste water treatment plants, and inputs due to agriculture). The sub-catchment contains the village of Dunecht and a considerable scattered population in a dispersed settlement pattern which typifies the area. There are no migratory fish in the upper part of the catchment, due to barriers to their movement including several historic sites for water power production. It is one of the lowest water quality sub-catchments in the River Dee basin.

Table 1 summarizes the key water quality issues in the Leuchar Burn and Loch of Skene and the source of these issues, as identified in the sub-catchment characterization work.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Sources of pressures</th>
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<tbody>
<tr>
<td>Excessive nutrients (euthrophication) and algal blooms in Loch of Skene</td>
<td>Agriculture (inorganic fertilizers and animal manure)</td>
</tr>
</tbody>
</table>
• Impediments to migratory salmonids
• Poor water quality in streams caused by diffuse pollution
• Waste water treatments
• Droppings from birds (particularly from geese and gulls in winter)
• Forestry
• Internal cycling within the loch (organic matter on the loch bed)
• Weirs/dams
• Septic tanks
• Out-wintering of cattle/sheep in inappropriate locations
• Watering of stock from streams

Source: REFRESH 3 (Balana et al. 2010). For details see SEPA’s ongoing characterisation work (www.sepa.org.uk/water/river_basin_planning.aspx) and the Dee Catchment Management Plan (Cooksley, 2007)

3. Stakeholder identification

The Dee Catchment Partnership represents a unique setting for the identification of and contact with stakeholders. Most of the relevant stakeholders in the area are members of the Dee Catchment Partnership, including agencies who have signed up to the Plan’s Objectives, public bodies, land managers and individual householders. The trust built locally by the Partnership allows access to other relevant stakeholders, and as such an initial screening of relevant stakeholders was already available.

Following the principles established for the identification of stakeholders for WP6 in REFRESH (Varjopuro et al. 2011), a mapping of stakeholders and their relationships was developed for the Leuchar Burn and Loch of Skene. As anticipated in the stakeholder engagement work developed in WP1 (D1.16, Waylen et al. 2011b), the kinds of pressures affecting the Dee catchment and its sub-catchments (namely diffuse pollution and morphology) require action and engagement from farmers and other land owners, as well as other groups such as public agencies involved in forestry, environmental planning and water supply (the ‘implementers’).

Stakeholder mapping is shown in Figure 1. Different actors have an influence on the sub-catchment, ranging from the general public (an important example being septic tanks owners), to landowners and farm managers (of which the Duneccht Estate is predominant), other land users (such as the quarry) and a number of institutions. The latter include Aberdeenshire Council, the Forestry Commission, Scottish Water, the JHI, the Scottish Agricultural College (SAC), the Royal Society for the Protection of Birds (RSPB), Scottish Environmental Protection Agency (SEPA) and the Fishery Board. These are the organisations that signed up for actions in the Dee Catchment Management Plan, but it should be noted that the Dee Catchment Partnership is an informal organization.
Following the REFRESH WP6 stakeholder protocol (Varjopuro et al. 2011), from the above mapping of stakeholders a set of “must have” and “good to have” stakeholders were invited to the workshop. This was done through direct contact through the Dee Catchment Partnership or, where the JHI did not have direct access, through intermediates. A total of 31 people were contacted, of which 12 finally attended the workshop. Attendees included:

- One SEPA representative
- Two representatives of the Dunecht Estate, including the Estate forester and ranger
- Two representatives of Aberdeenshire Council: a council ranger and an environmental planner
- One RSPB representative and an amateur ornithologist representing the Loch of Skene Access Group
- Three farmers (tenants and the Dunecht Estate farm manager)
- The Dee Catchment Partnership Project Officer

The stakeholders can be broadly categorized into three groups: (1) a farmers group, including tenants and landowners; (2) representatives of other land users/managers, including representatives of Dunecht Estate, forestry and the quarry; and (3) a so-called environment group, which includes SEPA, the RSPB and ornithology interests, representatives of the Council and of the Dee Catchment Partnership.

Following Varjopuro et al.’s (2011) protocol, the division of stakeholders into levels of power and interests is presented in Table 2.

Table 2. Division of stakeholders into levels of power and interests

<table>
<thead>
<tr>
<th></th>
<th>Low power</th>
<th>Medium power</th>
<th>High power</th>
</tr>
</thead>
<tbody>
<tr>
<td>High interest</td>
<td>The Catchment Partnership Officer</td>
<td>SRPB Representative</td>
<td>SEPA representative</td>
</tr>
<tr>
<td></td>
<td>Estate forester</td>
<td>Council Environmental Planner</td>
<td>Farmers</td>
</tr>
<tr>
<td>Low interest</td>
<td>Estate Ranger</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 1. Mapping of stakeholders in the Leuchar Burn and Loch of Skene and their relationships
4 Pre-workshop preparation

The workshop was prepared in accordance with the protocol on Participatory Assessment of Adaptation Strategies prepared in WP6 (Varjorupo, et al. 2011). A team of four JHI researchers and two supporting staff participated in the preparations for the workshop. All preparations where done in collaboration with the Dee Catchment Partnership, building on previous stakeholder engagement work the Partnership has undertaken (see details in the introduction).

Preparation for the workshop included the following steps:

1. Definition of the aims of the workshop, to meet the demands of the REFRESH project whilst taking into account previous work in the area, to avoid stakeholder fatigue and overlapping of content.

2. Stakeholder identification and mapping (see section 3) and stakeholder contacting. Stakeholders were contacted via letter (Annex 1 includes an example letter), email and follow up telephone calls. Letters and emails were accompanied by a background summary document on the REFRESH project prepared for the occasion (Annex 2). To ensure appropriate representation, key stakeholders were used as contact points for obtaining access to other stakeholders less easily accessible (notably tenant farmers). In particular, we approached the Dunecht Estate management and requested contact details for farmers within a mapped area of the sub-catchment, in addition to obtaining the mailing list for the Loch of Skene Access Group.

3. Logistic preparation including the booking of an appropriate venue, preparation of a workshop outline, organising equipment and facilitation responsibilities.

4. Workshop design (see section 5 for details), including:
   a. Identification of pressures and sources of pressures according to the sub-catchment profile work (Balana et al. 2010)
   b. Identification of potential measures to mitigate the effect of these pressures. A comprehensive list of measures was drawn from the previous Dee workshop undertaken in WP1 (Waylen et al. 2011b) and was tailored specifically to the Leuchar Burn and Loch of Skene sub-catchment, in agreement with modellers from WP5 (, Balana, 2011)
   c. Design of a tool for gathering the perception of stakeholders on cost/effectiveness of mitigation measures to feed into WP5-WP6 modelling work
   d. Simplification of the narrative of climate change specific to the Dee catchment, based on the climate change scenarios produced in WP1 (Deliverable 1.6, Shahgedanova 2011)

5 Workshop programme

The workshop took place on Friday 3rd of February 2012, with a duration of 3 hours. It took place in a local restaurant in Dunecht and followed the programme presented in Table 3. The specific aims of the workshop were to gather local stakeholder views on:
The main pressures that affect water quality in Leuchar Burn and Loch of Skene.
The main measures that can help mitigate water quality problems, and the effectiveness of these measures.
How the effectiveness of these measures might be compromised in the future, due to climate change.

It was clearly stated to stakeholders that the purpose of the workshop was to gather their views on these topics.

Table 3. Workshop Programme

<table>
<thead>
<tr>
<th>Timeline</th>
<th>Activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>13.30</td>
<td>Gathering and refreshments</td>
</tr>
</tbody>
</table>
| 14.00     | Workshop introduction
            | Discussion of problems and pressures
            | Description of actions and mitigation measures                           |
| 15.15     | Tea/coffee break                                                          |
| 15.30     | Evaluation of measures
            | Discussion of the implications of climate change                         |
| 16.45     | Next steps and workshop evaluation                                        |
| 17.00     | Workshop close                                                            |

The objectives of the workshop were addressed in three sets of activities: (1) discussion of pressures and sources, (2) discussion of measures and perceptions on their costs and effectiveness, and (3) discussion of climate change and its effect on water quality and adaptation measures. This was done through a combination of plenary discussions and break-out group activities, and was developed as follows:

a) Project and workshop introduction

After a brief introduction of the REFRESH project in the context of the Dee Catchment Partnership, the objectives, outline and agenda of the workshop were presented to participants by the workshop Chair.

b) Pressures and sources of pressures on water quality

The main pressures and sources of pressures identified in the sub-catchment profile work (Balana et al. 2010 — summarized in Table 1) were presented to participants. A plenary discussion explored whether the pressures and sources were accurately identified according to local knowledge, and whether stakeholders considered any important pressure or source to be missing from the proposed list. A consensus on a list of pressures and sources was produced.

c) Measures to mitigate water quality problems

Stakeholders were divided into three break-out groups: farmers (as many of the mitigation measures under consideration concerned farm practice), other land users/managers, and a so-called environment group (see Section 3 for more detail on group composition). Each group included one facilitator from the JHI, who initiated a discussion on the relevant measures that could be applied to mitigate the effects of the pressures, as discussed in the plenary (Figure 2: facilitated discussion within a break-out group).
Each facilitator had a tailored list of mitigation measures for the Leuchar Burn and Loch of Skene that was used to stimulate discussion (this was not shown to the participants; Table 4). Stakeholders were encouraged to identify relevant measures according to their own views on the sub-catchment.

Table 4. List of relevant mitigation measures specifically identified as part of the preparation work for the Leuchar Burn and Loch of Skene (not shown to participants)

<table>
<thead>
<tr>
<th>Land Use measures</th>
</tr>
</thead>
<tbody>
<tr>
<td>Convert arable to extensive grassland</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Farm management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase the capacity of farm manure stores</td>
</tr>
<tr>
<td>Reduce fertilizer application rates</td>
</tr>
<tr>
<td>Reduce the length of the grazing day or grazing season</td>
</tr>
<tr>
<td>Reduce overall stocking rates on livestock farms</td>
</tr>
<tr>
<td>Establish cover crops</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Farm infrastructure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Establish and maintain constructed wetlands</td>
</tr>
<tr>
<td>Establish buffer strips along side streams</td>
</tr>
<tr>
<td>Fence off rivers and streams from livestock</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Other measures:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Measures to control of grey geese population</td>
</tr>
<tr>
<td>Septic tanks management measures</td>
</tr>
</tbody>
</table>

Source: Measures drawn from D.1.16 and tailored locally in agreement with WP5 modellers

A plenary followed, during which each group facilitator presented the list of measures identified in their break-out group and there was the opportunity for further discussion. A comprehensive list containing all measures identified by the participants was then compiled during the coffee break. Each measure was given a unique identifying number.
Individually and break-out groups: How cost-effective are these measures in practice?

Place measures in the diagram

Figure 3 Device to gather stakeholders’ views on costs and effectiveness of mitigation measures

d) Views and perceptions on the cost/effectiveness of the measures

Participants were split into the same break-out groups and were asked to state how cost-effective they considered each measure to be, in the local context of the Leuchar Burn and Loch Skene. These opinions were recorded on a diagram given to each participant (Figure 3). The horizontal axis of this recording device represents (qualitatively) the effectiveness of the measure in improving water quality; the vertical axis represents a (qualitative) measurement of costs. Therefore four quadrants are presented: measures of high cost and small effectiveness, of high cost and high effectiveness, of low cost and small effectiveness, and finally of low cost (or even farm gains) and high effectiveness. The last quadrant is the one of most interest, as it includes the most cost-effective measures, including win-win solutions. Participants were asked to place each of the measures in the most appropriate quadrant according to their opinion on cost and effectiveness. For this, the number coding given to each measure was used, as shown in Figure 3. A box was also provided for those measures which the participant did not feel they had enough knowledge to place within the quadrant, or did not consider relevant. This ensured that participants only provided opinions where they felt informed and able to do so meaningfully, and results were not generated due to guess-work or workshop pressure to provide all the ‘answers’. Participants were asked to do this work individually but in the context of break-out groups, so discussion among participants and clarification from the facilitators was possible. The cost/effective and win-win solutions identified were then flagged up during a plenary discussion. Figure 4 shows a break-out group discussion, using the cost-effectiveness diagram.
e) Climate change effects on water quality and on the effect of measures

The above activities were focused on compliance under current conditions, and was followed by a set of discussions focusing on the effects of climate change. This started with an introduction to a simplified narrative of likely climate change for the Dee catchment, based on the scenario work prepared in WP1 (Box 1).

There is now widespread acceptance of man-made climate change and expectation that it will have consequences for rural land use, water availability and demand, extreme events and the wider environment. Although there is still much uncertainty, the likely forecast for the Dee Catchment by 2050 is for: warmer, wetter winters, wetter springs, drier hotter summers and perhaps more extreme events.

Box 1. Simplified narrative of most likely climate change scenario in the Dee Catchment as presented to participants (Source: Deliverable 1.6, Shahgedanova 2011).

Participants were asked to think about the consequences of such climate change in the sub-catchment during a plenary session facilitated by the workshop chair (Figure 5). The following questions were discussed: How might climate change affect water quality in the Leuchar Burn and Loch of Skene? How might climate change affect the feasibility and effectiveness of the measures discussed? The latter involved discussing which measures might become more relevant under climate change, whether their effectiveness might change, and whether other measures might become relevant.
f) **Workshop closure**

The workshop ended with a collective reflection on the importance of the topic discussed and the importance of integrating local and scientific knowledge. Participants were thanked for their participation and asked for any immediate feedback or final thoughts. A feedback questionnaire was also distributed.

### 6 Workshop Results

**a) Pressures and sources of pressures on water quality**

Participants agreed that the main pressures in the area involve: (i) excessive nutrients and algal blooms in the loch, (ii) poor water quality in streams caused by diffuse pollution and (iii) impediments to migratory salmonids. The discussion further considered the sources of these pressures. While generally agreeing with the sources presented (see Table 1), participants made a number of additions.

Recent and fast-growing housing developments and ground sealing in the area, particularly around Westhill, were seen as increasing the amount of run-off with negative impacts on water quality. This was seen as important in the lower part of the Leuchar Burn and the east side of the Loch. This source is expected to be exacerbated by future developments planned in the next 10-15 years.

Besides forestry, other commercial pressures on water quality were highlighted. Notably, sediment runoff from the quarry was signalled as a potential source of water pollution.

The role of geese in polluting the loch was discussed. There was recognition that the geese numbers are increasing, but participants were not certain that geese are a real problem for the Loch of Skene. It was pointed out that agricultural sources have been frequently blamed for water quality issues in the sub-catchment, but other, perhaps more important, sources may exist, such as septic tanks. At this point, there was some confusion between a ‘pressure’ and its ‘impact’, but it was reiterated that multiple sources are responsible for the nutrient enrichment problem. One participant explained that SEPA have identified four sources of water quality issues for this water body: Sewage disposal, morphological issues, strengthening of channels and barriers within channels.

To conclude, it was agreed that the key pressures are diffuse pollution and barriers, with physical barriers considered the most challenging. It was stated that if these pressures can be resolved then the waterbodies will achieve good status. Examples of physical barriers include former hydropower dams (the Garlogie dam, for example, is considered ‘impassable’), in addition to other water mills (e.g. at Dunecht). Table 5 adapts the pressures and sources of pressures affecting water quality in the Leuchar Burn and Loch of Skene to include stakeholder views.

| Table 5. Pressures and sources of pressures affecting water quality in the Leuchar Burn and Loch of Skene, adapted to include stakeholder views |
|---|---|
| **Pressures** | **Sources of pressures** |
| Excessive nutrients (eutrophication) and algal blooms in Loch of Skene | Agriculture (inorganic fertilizers and manure) |
| Impediments to migratory salmonids | Housing developments increasing run-off |
| Poor water quality in streams caused by diffuse pollution from agriculture | Waste water treatments |
| Poor water quality caused by housing developments | Droppings from birds (geese/gulls) – Questioned to some extent |
| | Forestry |
| | Quarry sediments |
| | Internal nutrient cycling within the loch |
| | Weirs/dams |
| | Septic tanks |
| | Out-wintering of livestock in inappropriate locations |
| | Watering of stock from streams not troughs |
b) Measures to mitigate water quality problems

Annex 3 presents the list of measures identified by the three stakeholder groups for improving water quality in the area. This represents a significantly enlarged list compared to that previously identified in WP6 (Balana 2011). It was agreed that most of the measures discussed were suitable for tackling water quality problems in both streams and the loch. Table 6 includes the comprehensive list of measures agreed by participants in the plenary session. A unique number was given to each measure for use in the following exercise.

Table 6. Comprehensive list of measures to reduce water quality problems in the Leuchar Burn and Loch of Skene, as agreed by participants in plenary (numbering used for following exercise).

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>1. Contour ploughing</td>
<td>12. Increase capacity for manure storage</td>
</tr>
<tr>
<td>2. Reduce fertilizer/manure application</td>
<td>13. Limited grazing periods</td>
</tr>
<tr>
<td>3. Nutrient management systems</td>
<td>14. Reduced stocking rate</td>
</tr>
<tr>
<td>4. Improve management of commercial runoff</td>
<td>15. Implement NVZ measures</td>
</tr>
<tr>
<td>5. Improve septic tank management</td>
<td>16. Implement GAEC measures</td>
</tr>
<tr>
<td>6. Alternative water treatment, e.g. biodisc</td>
<td>17. Improve field drainage</td>
</tr>
<tr>
<td>7. Remove sediment from stream bed</td>
<td>18. Reduce household wastewater production</td>
</tr>
<tr>
<td>8. Follow best-practice in forest harvesting</td>
<td>19. Increase public transport (to reduce road use)</td>
</tr>
<tr>
<td>9. Create riparian woodland</td>
<td>20. Re-meandering</td>
</tr>
<tr>
<td>11. Fence watercourses from livestock</td>
<td>22. Create fish pass</td>
</tr>
<tr>
<td></td>
<td>23. Control of migratory birds</td>
</tr>
</tbody>
</table>

c) Views and perceptions on the cost/effectiveness of measures

Those measures perceived as being highly cost-effective by stakeholders are of most interest for the purposes of REFRESH, i.e. measures located in the bottom right quadrant (low costs or farm gains for a large reduction in the pressure). This analysis therefore focuses on these ‘win-win’ solutions, whilst searching for discrepancies within and across stakeholder groups, searching for knowledge gaps, and highlighting measures perceived as cost-ineffective (high cost, low effectiveness).

Improving septic tank management was unanimously considered to be a cost-effective solution, particularly awareness-raising campaigns relating to tank management. Similarly, the majority of stakeholders considered buffer strips to produce large effects for relatively low costs. Following best practice in forest harvesting was also seen as producing high effects for relatively low costs, although a number of stakeholders acknowledged a lack of knowledge regarding this measure. Other measures perceived as cost-effective by most stakeholders (including most farmers) were the reduction of fertilizer and manure application and the introduction of nutrient management systems. However, one farmer considered nutrient management systems as cost-ineffective. It should be noted that no other discrepancies among the farmer group were detected.

Increasing the capacity for manure storage was seen as cost-ineffective by a significant number of stakeholders from all three groups, including farmers. An increase in public transport to reduce road use was viewed as cost-ineffective, particularly by the environment group and most of the other land users (some farmers saw it as cost-effective, but most did not comment). Removing dams and weirs and creating fish passes was also considered as cost-ineffective by some stakeholders, but it should be noted that most stakeholders (including the regulator) did not comment on these measures.

Farmers did not comment on several farming operations, such as limiting grazing periods and reducing stocking rate. The perception on cost-effectiveness of these two measures was not clear
within the other groups either, so no clear message emerges. Similarly, improved management of commercial run-off was seen as cost-effective by the farmer and environmental groups (with the exception of the environmental regulator, who classed it as cost-ineffective), but there was no clear result from the other land users/managers.

Other measures for which no clear message emerged include: contour ploughing, alternative water treatments (e.g. biodiscs), reducing household wastewater production, removing sediment from the stream bed, creating riparian woodlands, improving field drainage, re-meandering and control of migratory birds. The control of migratory birds was seen as cost-ineffective and impractical by the RSPB and other ornithology interests. The implementation of measures relating to Nitrates Vulnerable Zone regulations and Good Environmental and Agricultural Condition are seen as cost-effective by farmers and some of the other land users, but many stakeholders did not comment on these measures.

A key outcome of this session is that farmers thought that many of the measures (such as limiting grazing periods, reducing stocking and removal of sediment from the stream bed) could become cost-effective if supported by subsidies. The following quote from one of the farmers clearly states this view:

"The cost of a measure is dependent on whether it is possible to get a subsidy – then it is ‘effective’. If you don’t get the grant it is not cost-effective for the farm"

Also, it was pointed out that the cost-effectiveness of some measures (e.g. dam/weir removal, re-meandering and alternative water treatments) depends entirely on the scale at which they are applied. Another key outcome of the plenary discussion was the difficulty of assessing the cost-effectiveness of measures when there is insufficient knowledge on the impact of the pressures or of the measures. Some examples discussed included the difficulties of knowing the input of nutrients from septic tanks or from geese.

Figure 6 provides a graphical representation of key outcomes of this session, with a focus on ‘win-win’ measures according to the three stakeholder groups, cost-ineffective measures and discrepancies within groups (circled in red).
d) Climate change effects on water quality and on the effect of measures

In the plenary discussion, participants only partially validated the climate change scenario presented to them. In general, there was agreement that warmer wetter winters and wetter springs are to be expected. However, cooler rather than hotter summers are seen as more likely and participants suggested the existence of wetter trends throughout the year, and had little confidence in the prediction of drier summers. There was consensus regarding the expectancy of more frequent storm events, leading to more frequent and extreme flood events.

Participants were then asked what they thought the consequences of these new climatic conditions would be for water quality and water use. Farmers did not think that climate change would necessitate increased irrigation in this region, where there are ample water resources. The potential for increased arable production and new crops (e.g. maize) and varieties, due to higher temperatures, was identified. Other potential positive effect on agricultural production might be a reduced need for in-wintering of cattle, with a resulting reduction in building and infrastructure needs and extension of grazing periods. Overall, therefore, farmers agreed that climate change may have some beneficial effect on agricultural profitability, but that the effects on water quality would be negative. However, a very important point made by farmers was that climate change impacts on production were seen as negligible (or much less important) compared to CAP reform. CAP reform was seen as the most important driver of any changes in agriculture.

Participants pointed out that more frequent storms would lead to heavier run off, increasing nutrient delivery to streams. This would also be a problem for the quarry, where it is a challenge to control run-off during quick, heavy downfall and flash flooding, and new and more expensive control measures might be required.

The number of geese was expected to increase due to climate change, increasing therefore their potential negative impacts on water quality in the Loch of Skene. Higher temperatures were also expected to increase the magnitude and duration of algal blooms, and also to bring about a reduction in salmonids in the sub-catchment.

Climate change was anticipated to have a negative impact on forestry in the area. More frequent high winds have been observed during the past 30 years, and the timing of these windy periods has become unpredictable. If this were to increase in the future, it would have potentially major negative consequences. More tree diseases are expected, and it was thought likely that more drought-resistant species would be needed, for example southeast European species, leading to a shift away from Sitka spruce cultivation. However, a later discussion contradicted this negative view of climate change impacts on forestry, as higher atmospheric CO\textsubscript{2} levels may lead to faster tree growth and therefore increased profitability, with knock-on effects for forestry as a land use and, indirectly, water quality.

Participants discussed the impact of high water tables, with climate change, and the potential for biofuels. Interlinked are government incentives for renewable energy development, resulting in increasing hydro-dams and resulting problems for salmonids. On some occasions, hydro-energy development is prevented due to the cost of fish ladders (therefore increased capital costs are required). Ensuring fish ladder installation would make it easier to consider and assist salmonids.

Furthermore, it was considered that any increasing movement of water would require increasing sediment traps, which would result in increasing costs. This is also an issue in urban areas, putting pressure on Sustainable Drainage Systems (SUDS) and requiring re-engineering (local examples were cited). Water metering was proposed as a method to reduce wastewater levels.

e) Workshop closure

A final plenary discussion on the importance of a practical approach to mitigation ended the workshop. It was concluded that it is important to highlight what is practical and what works locally –
this is considered crucial for catchment-level partnerships. The discussion concluded with an explanation that research is grounded in the sub-catchment level, with results to be ‘fed up’ to the Scottish Government, SEPA and the European Union. Participants were thanked for their participation. A feedback questionnaire was provided and a promise made to circulate a feedback report.

7 Conclusions and lessons learnt

a) From workshop results

This workshop was aimed at gathering the views of local stakeholders regarding measures to alleviate water quality problems in the Leuchar Burn and Loch of Skene, in the River Dee Catchment, to ensure compliance with the Water Framework and Habitats Directives and their adaptation under climate change. Three issues were the main focus of discussion and analysis: validation of the main water quality problems and the sources of these problems in the sub-catchment, identification of relevant mitigation measures and their perceived cost-effectiveness, and identification of how climate change might affect water quality in the area and the appropriateness and effectiveness of the mitigation measures.

Participants validated the pressures and sources of pressures already identified in the project but added new sources that had not been included in the analysis (ground sealing through housing developments and commercial pressures such as the quarry).

The list of measures to improve water quality identified in WP6 was significantly enlarged for this particular area. From this list, the measures perceived to be most cost effective in this area were adopting nutrient management systems, improving septic tank management, reducing fertilizer and manure application, following best practice in forestry harvesting and buffer strips. For a significant number of measures, however, no clear message emerged on their perceived cost-effectiveness.

A key finding of this workshop is that farmers in the area experience significant financial constraints, and as such the scale and availability of subsidies are perceived (particularly by farmers) as being crucially important for determining cost-effectiveness. This is consistent with the findings of the conceptual modelling work and stakeholder analysis developed in WP1 (D1.16/D1.14), where finance was found to be one of the key barriers to uptake of measures by land managers. D1.16 does not refer strictly to scale, but rather to geographical location and area of farming land, but in any case there is a clear spatial component that affects both the barriers to uptake and the perceived cost-effectiveness of measures. Other components of the conceptual model (e.g. time and labour) are less apparent regarding cost-effectiveness.

Regarding climate change, participants partly contested the climate change scenario that has been developed for the Dee in WP1 (D1.6). Despite the uncertainty regarding the details of how climate may change, participants were able to provide insightful and well-argued expectations about the effects of climate change on water quality and mitigation measures. A key finding is that climate change impacts on agriculture (and consequently on water quality) are seen as negligible compared to the effects of the CAP reform. Once again, this is consistent with the conceptual model (D1.16/D.1.14) in which external factors that affect capital (prices, markets) and other decisions that can affect the environment (such as CAP) play a major role. Actions to improve water quality in the face of climate change might therefore be more effective were they to address non-agricultural sources (e.g. commercial and housing).

b) From workshop process and feedback questionnaire

The workshop developed in a very positive and constructive way. A lot of interaction took place and activities developed smoothly. However, some parts ran more easily than others. During the cost-effectiveness exercise, the farmer group in particular had some difficulty understanding the diagram. Although they succeeded in carrying out the exercise, it is possible that they understood it one-
dimensionally rather than two-dimensionally. However, this does not affect the analysis of the results, which is based at the quadrant level rather than looking at the relative position of measures within the quadrant.

During the workshop it was argued that the climate change exercise was ‘tricky’ and should perhaps have been given more time. This would require a lengthening of the meeting by 30 minutes to an hour, as well as more structured discussion of the different topics.

The venue of the workshop was considered inappropriate, being adjacent to a noisy and distracting restaurant room.

A feedback questionnaire (Annex 4) was given to participants. Results show general satisfaction with the process and stakeholders mostly found the workshop useful and interesting. Three participants stated willingness to participate in similar events of this kind, versus four who stated that they would ‘maybe’ participate again. This ‘maybe’ is not necessarily negative, as it may not have been clear that we were referring to a different workshop, addressing different topics to those discussed at this event. One lesson learnt is, indeed, to make it explicit in the feedback questionnaire that further events would focus on related but different topics. An alternative way of gauging participant satisfaction would be to ask if they would recommend a similar event to a colleague.

c) Next steps

A feedback stakeholder brochure is being prepared to inform stakeholders on the format and results of the workshop. Besides being sent to participants, the brochure will be made available through the Dee Catchment Partnership website and in knowledge exchange events in which the JHI is involved. The brochure and this report will be shared with the Scottish Government and through the Centre of Expertise on Waters (CREW) that the JHI coordinates (http://www.crew.ac.uk/). These activities will all contribute to the general REFRESH stakeholder engagement process (WP7).

The results on the perception of measures and their cost-effectiveness (now and under climate change) is expected to feed into WP6 cost-effectiveness analysis modelling work in interaction with WP5 (D6.11), based on the use of the cost-effectiveness diagram.

Acknowledgements

We are grateful to members of the Dee Catchment Partnership for their help in contacting potential participants and advising on workshop content. We would like to also thank Sue Morris and Didac Jorda for their help in the preparation and delivery of the workshop and Bedru Balana for his valuable contribution. We are especially grateful those who assisted in providing contact details for other key stakeholders to ensure appropriate representation, including Stuart Young and Wendy Seel.

References


Annex 1. Example of invitation letter sent to stakeholders

Mr

13th January 2012

Dear Mr,

We are writing to you because you are involved in the Leuchar sub-catchment of the River Dee. We would like to invite you to a meeting on 3rd of February at Jaffs Bar & Restaurant, Dunecht, Westhill, Aberdeenshire, AB32 7AW, on behalf of the REFRESH project (http://www.refresh.ucl.ac.uk), run by researchers at the James Hutton Institute and other partners across Europe. This research complements work being carried out by the Dee Catchment Partnership and by SEPA in your area.

This meeting is an opportunity for you to communicate how you view the issues of water quality in the Leuchar sub-catchment, and help the research team construct possible adaptive solutions in line with policy, likely future scenarios and scientific understanding. Land managers are faced with the practical task of implementing a wide range of mitigation measures and complying with various legislative demands on the ground, and it is important that we understand how effective these measures are and what are the implications of these measures for land management and land use profitability.

The aim of the meeting is to scope out the possible mitigating, adaptive and restoration options that might enable compliance with the Water Framework Directive and Habitats Directive, identifying both positive and negative implications of such options for land-based businesses. Through group and plenary discussion, we wish to review the full range of broadly feasible land management strategies to mitigate water pollution and enhance habitats/biodiversity, now and under future climate change.

The workshop results will be reported within the REFRESH project and findings distributed to all attendees. The workshop will begin at 1:30pm and finish at 5pm. Refreshments will be provided and we are able to cover travel expenses (please keep receipts for us). We’d be grateful if you could contact us to confirm your attendance or if you have any queries.

We look forward to seeing you in on Friday 27th January.

Yours sincerely,

Julia Martín-Ortega
Social Economic and Geographical Sciences
The James Hutton Institute

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Annex 2. REFRESH Background document sent to stakeholders

REFRESH: ADAPTIVE STRATEGIES TO MITIGATE THE IMPACTS OF CLIMATE CHANGE ON EUROPEAN FRESHWATER ECOSYSTEMS

REFRESH is a research project funded by the European Union Framework Programme 7 (FP7). The project is being carried out by 25 Research Institutes and Universities across Europe.

GENERAL OBJECTIVES OF THE PROJECT

The REFRESH programme aims to develop a system to enable water managers to design cost-effective restoration programmes for freshwater ecosystems at both local and catchment scales that take into account expected future impacts of climate change and land-use change and comply with the European Commission Water Framework and Habitats Directives.

A main task of REFRESH is to undertake a process-based evaluation of the specific adaptive measures that might be taken to minimise the expected adverse consequences of climate change on freshwater quantity, quality and biodiversity. This evaluation is to be based on knowledge obtained from local stakeholders. REFRESH considers how freshwater ecosystems (rivers, lakes, reservoirs, and riparian wetlands) in Europe will change over the next fifty years, and uses a combination of novel experiments and modelling to generate the understanding and tools needed to implement an adaptive management strategy. Our focus is mainly on lowland systems since they are most threatened by predicted changes in temperature, water availability and nutrient loading.

SPECIFIC OBJECTIVES OF THE PROJECT

In EU two major environmental legislations, namely the Water Framework Directive and the Habitats Directive, are addressing aquatic ecosystems. The REFRESH project develops strategies on how to implement these directives while adapting to climate change. Strategies are being developed for catchments in different parts of the Europe to increase our understanding of the scope of adaptation measures needed.

A key part of the REFRESH project is holding participatory workshops with people in these different areas who have to comply with the Water Framework and Habitats Directives. These workshops aim to provide information about current understanding of the measures need for compliance, to assess potential measures, in particular, the effectiveness and feasibility of these measures in each local area.

Ultimately, REFRESH aims to generate scenarios and storylines for future climate, land-use/land management, nutrient loading and water resource demand relevant to the future management of freshwater ecosystems.
### Annex 3. Measures for mitigating water quality problems as identified per group of stakeholders

#### GROUP A: Farmers and landowners

<table>
<thead>
<tr>
<th>Major pressures [formatted]</th>
<th>Measures [non-formatted]</th>
</tr>
</thead>
</table>
| Excessive nutrients in Loch of Skene and algal blooms | Convert some arable land to grassland  
Control migratory birds  
Ltd grazing periods (SRDP) & stocking rate  
Buffer strips  
Wetland creation  
Fencing water courses from livestock  
Reduced N application  
Good drainage  
Riparian woodland  
Wetland creation (noted twice)  
GAEC measures  
NV7 measures |
| Impediments to migratory salmonids | Contour ploughing  
Create fish ladder  
Sediment trapping including commercial & agri |
| Poor water quality in streams caused by diffuse pollution | Convert some arable to grassland  
More effective commercial sediment traps  
Buffer strips  
Control migratory birds  
Good drainage  
Riparian woodland  
Wetland  
Fencing watercourses from livestock  
Hedge planting for run-off  
Reduced N application  
Contour ploughing  
Sediment traps  
GAEC measures  
In-wintering  
NV7 measures |
| Poor water quality/flooding due to urbanisation | SUDS  
Flooding control  
Ltd grazing periods (SRDP) & stocking rate  
Pressure on farmers: unable to clear ditches & drains flooding → poor drainage |

#### Group B: Other stakeholders

<table>
<thead>
<tr>
<th>Major pressures [formatted]</th>
<th>Measures [non-formatted]</th>
</tr>
</thead>
</table>
| Excessive nutrients in Loch of Skene and algal blooms | Goose management (HD allows?)  
Identify sources → riparian woodland (wet)  
Input from burns (+ measures under 3) |
| Impediments to migratory salmonids | Removal  
Fish pass |
| Poor water quality in streams caused by diffuse pollution | Nutrient management on farms (timing + amount; storage)  
DP mitigation measures:  
  * buffer strips  
  * removal of cattle waterings  
Septic tank management (inc Scottish Water)  
Historic seed deposition from quarry → restoration |
| Poor water quality/flooding due to urbanisation | SUDS: ↑ infiltration; silt traps,… |
Group C: Other stakeholders

<table>
<thead>
<tr>
<th>Major pressures [formatted]</th>
<th>Measures [non-formatted]</th>
</tr>
</thead>
</table>
| Excessive nutrients in Loch of Skene and algal blooms | Ploughing management → (wetlands/existed originally)  
Less fertilisers → re-allow meandering  
Improvement of water management from commercial use (quarry)  
Best practice  
Better education for septic tank and soakaway  
(?!) geese control not clear since the effects are not totally clear yet. Also they are “natural” Be careful to put money into it. |
| Impediments to migratory salmonids | Get rid of dams (2)  
→ for mills  
→ for hydropower (biggest problem)  
Get rid of weirs  
Remove sediments to prevent situation  
Re-allow meandering/Fish ladder |
| Poor water quality in streams caused by diffuse pollution | Forestry harvesting operation  
• → (better management/best practice) but it will always cause some pollution  
• Long term planning → replacing commercial conifers → riparian management allowing natural vegetation management  
Livestock not getting to stream  
Ploughing management  
Less fertilisers  
Improve water management in commercial (quarry) → best practice  
Better education for septic tank use and soakaway  
BIODISC (small treatment plant better than septic tank). Currently in place at quarry in other places → will come to Dunecht  
Better manure management |
| Poor water quality/flooding due to urbanisation (↑ traffic & roads) materials, salt | New development = buffer strips  
Reintroduce train/↑public transportation  
Buffer strips along streams |
Annex 4. Feedback questionnaire for participants

Adaptive strategies to mitigate water quality problems on freshwater ecosystems: the case of the Leuchar Burn and Loch of Skene

FEEDBACK QUESTIONNAIRE

We are very grateful for your participation in this meeting. We hope that this has been an interesting experience for you as well.
We value very much your opinion and would like to get some feedback from you.
Please, answer the following questions and hand-in this form at the end of the meeting or send it by email to: julia.martinortega@hutton.ac.uk

1. Did you find this meeting useful for your work?
   - Very useful
   - Useful
   - Somewhat useful
   - Not very useful
   - Not useful at all
   Why? …………………………………………………………………………………………………………………………………………………………………

2. Did you find this meeting interesting?
   - Very interesting
   - Interesting
   - Somewhat interesting
   - Not very interesting
   - Not interesting at all
   Why? …………………………………………………………………………………………………………………………………………………………………

3. Did you learn anything new?
   - I learnt a lot of new things
   - I learnt some new things
   - I learnt a few new things
   - I did not learn much
   - I did not learn anything
   What did you learn? …………………………………………………………………………………………………………………………………………………………………

4. Was the meeting process understandable and easy to follow?
   - It was understandable and very easy
   - It was understandable and easy
   - It was more or less understandable and easy
   - It was not very understandable and it was difficult
   - It was not understandable at all and very difficult
   Why? …………………………………………………………………………………………………………………………………………………………………

5. Would you like to participate on further events on related topics?
   - Definitely yes
   - Probably yes
   - Maybe
   - Probably not
   - Definitely not
   Why? …………………………………………………………………………………………………………………………………………………………………

6. Is there anything else you would like to tell us?
   …………………………………………………………………………………………………………………………………………………………………
   …………………………………………………………………………………………………………………………………………………………………
   …………………………………………………………………………………………………………………………………………………………………

Please, hand in this filled form after the meeting or send it by email to julia.martinortega@hutton.ac.uk
Results of the feedback questionnaire

1. Did you find this meeting useful?

2. Did you find this meeting interesting?

3. Did you learn anything new?

4. Was the meeting process easy/understandable?
5. Would you like to participate in further events on related topics?