



Theme C. Water & the Aquatic Environment

EPA 2020 Vision:

Goal 3: Protected Water Resources

"Our surface water and groundwater will not be depleted and will be of excellent quality, meeting all national and international standards."

STRIVE Programme 2007-2013 Strategy:

Theme C. Water & the Aquatic Environment

Supporting Ireland's commitments under the Water Framework Directive, this research area will contribute to ensuring excellent water quality in Ireland by focusing on investigating significant fundamental knowledge gaps, measures to support relevant water policy and the development of new technologies to protect our water environment.

Overview

There are a number of organisations, including the EPA, that support water related research in Ireland. In developing EPA's future research programmes it is essential that overlap between these other organisations is avoided and that, through collaborative efforts, synergies are developed. The EPA research programme has played a significant role in supporting the Water Framework Directive (WFD) implementation in Ireland. Future research calls will need to address remaining WFD gaps required for the effective implementation of the directive.

It is recommended that a wider perspective is adopted for future water research calls, addressing:

- **Basic research** to improve our understanding of aquatic ecosystems and support more applied research;
- **WFD research** to address specific gaps related to the directive, e.g. outstanding ecological classification tools;
- **Cross-cutting research** to address water research issues which overlap with other research themes, e.g. climate change, soils, health and environmental technologies.

A range of research activities are planned in the coming years with a big focus on building research capacity and capability in Ireland, increased dissemination and communication, and on maximising our investment through collaboration with other stakeholders.

Significant progress has been made in the implementation of the WFD in Ireland by various government departments and agencies and the local authorities. In the European Commission's (EC) most recent assessment of WFD implementation, Ireland was ranked highest among all Member States for criteria concerning the Directive's reporting requirements¹. It is envisaged that the programme will continue to provide significant research expertise in support of the implementation of the Water Framework Directive.

¹European Commission (2007) Towards sustainable water management in the European Union - First stage in the implementation of the Water Framework Directive 2000/60/EC. Communication from the Commission to the European Parliament and the Council. Brussels, COM(2007) 128 final.

1. Background and Policy Drivers

1.1. Background

Almost 29 per cent of surveyed river channel has unsatisfactory water quality. Some 11 per cent is moderately or seriously polluted. A number of major estuaries, predominantly in the south-east and south of the country, persistently display symptoms of nutrient enrichment. Water quality in 66 lakes, or 15 per cent of lakes assessed, is also unsatisfactory. In addition, there are elevated nitrate concentrations in groundwater in the east and south-east of the country and elevated phosphate concentrations in the west of the country. Most of the pollution is characterised by eutrophication and attributed to a number of causes including municipal, agricultural and other sources (industry, forestry, etc). To enable these water bodies to achieve a satisfactory quality status, as required by the EU Water Framework Directive, more focused efforts are now required and water must be managed as a key resource. For instance, environmental quality standards, which set limits on pollutants in the aquatic environment, must be fully complied with.

Discharges to water must be controlled and incidences of pollution accurately tracked back to their source and tackled. The Nitrates Action Plan must be fully implemented to tackle pollution from diffuse agricultural sources, while development planning must be closely linked with appropriate provision of sewage treatment facilities and of safe drinking water.

It is estimated that more than half of the surface water and groundwater bodies in Ireland are at risk of failing to meet EU water quality objectives. Bringing water resources up to standard, eliminating contamination of drinking water supplies and implementing water conservation measures (e.g. reducing leakages in the distribution network) are key priorities for Ireland. The provision of urban wastewater treatment for all inland receiving waters is also a major challenge.

1.2. Policy-Drivers

The Water Framework Directive (WFD; 2000/60/EC), which came into force in 2000, provides a new overarching legislative background for water protection in Europe. Transposed into Irish legislation in 2003 (S.I. No. 722 of 2003), the WFD aims to improve and prevent the deterioration of all waters (groundwater, rivers, lakes, transitional waters (estuaries), coastal waters and wetlands). Whilst, ecology and specifically good ecological status is the main focus of the WFD, the reduction and phasing out of priority substances is also required. The main vehicle for effecting change in the WFD is through the development of river basin management plans, which will contain measures to tackle specific pressures on the water environment.

The WFD provides a framework for other existing legislation, which will continue to play an important role in protecting the water environment. These include requirements under the Nitrates Action Plan, Phosphorus Regulations, Bathing Water Regulations, Urban Wastewater Treatment Regulations and the Drinking Water Regulations. The WFD will also link with requirements under the Habitats and Birds Directives through the protection of water bodies containing Natura 2000 sites. The new Groundwater Directive will compliment the requirements of the WFD through the protection of groundwater and groundwater dependent ecosystems.

Significant progress has been made in the implementation of the WFD in Ireland by various government departments and agencies and the local authorities through the River Basin District projects. The WFD sets out clear deadlines for each of the requirements, which add up to an ambitious overall timetable (EC, 2008). Table 1 presents the key milestones for the implementation of the WFD (EC, 2008²).

Table 1 Key milestones for the implementation of the WFD.

Year	Issue	Article	Status
2000	Directive entered into force	25	✓
2003	Transposition into national legislation	23	✓
2004	Characterisation of river basins:		
	(a) Reference conditions, delineation and typology of water bodies,	5(a) 5(b)	✓ ✓
	(b) Assessment of pressures and impacts	5(c)	✓
	(c) Economic analysis of water use	6	✓
	Register of protected areas		
2006	Establishment of monitoring network	8	✓
	Start public consultation (at the latest)	14	✓
2008	Present draft river basin management plan	13	✗
2009	Finalise river basin management plan (Art. 13) including programmes of measures (Art. 11) and begin first management cycle	13 & 11	✗
2010	Introduce pricing policies	9	✗
2012	Make operational programmes of measures	11	✗
2015	Meet environmental objectives, first management cycle ends, second river basin management plan and first flood risk management plan	4	✗
2021	Second river basin management cycle ends	4 & 13	✗
2027	Third river basin management cycle ends	4 & 13	✗

The Water Pollution Acts, 1977 and 1990 and regulations made thereunder, including regulations giving effect to EU Directives, constitute the main national legislation in this regard.

1.3. Past & ongoing Research

The EPA has a statutory role to coordinate environmental research in Ireland. The EPA's Programme for Science, Technology, Research and Innovation for the Environment (STRIVE) and its predecessors have played a significant role in supporting and coordinating WFD related research in Ireland. There remain some specific gaps in characterisation which warrant inclusion in future programmes, e.g. there remains the need to develop classification tools for a number of biological elements such as for fish. In addition, the EPA's strategy 2020 Vision: Protecting and Improving Ireland's Environment identifies as one of its key goals to "coordinate environmental research to support implementation of the EU Water Framework Directive".

² European Commission (2008) Timetable for implementation of the Water Framework Directive. Available at http://ec.europa.eu/environment/water/water-framework/info/timetable_en.htm, accessed 10 January 2008.

There are a number of government agencies in Ireland and the UK that have developed programmes of research whose outputs have been subsequently used to support WFD implementation in Ireland's river basin districts:

- The Marine Institute (MI) supports research to progress the estuarine and marine elements of the WFD
- The DEHLG also supported a number of projects concerning economic analysis for the WFD
- The National Parks and Wildlife Service (NPWS) have supported research into the assessment and protection of habitats and species (Natura 2000 sites) required under the Habitats and Birds Directives
- The Department of Agriculture and Forestry have also initiated a programme of research to support implementation of the Nitrates Action Plan through a series of mini-catchment studies
- The NS-SHARE project (funded by INTERREG III) was designed to progress WFD implementation for the river basins in Northern Ireland and the international RBDs (IRBDs) shared with Ireland
- The UKTAG SNIFFER (Scottish Northern Ireland Forum For Environmental Research) research programme
- The RBD projects have initiated a series of programmes of measures and standards studies (POMS), many of which included strong research elements (Appendix-1).
- At European level the EU Framework Programmes (particularly FP5, FP6 and FP7) have also funded a large number of projects targeted to support different aspects of WFD implementation.

2. Overall Aim

The overall aim of this thematic area is to: *"Support Ireland's commitments under the Water Framework Directive. This research area will contribute to ensuring excellent water quality in Ireland by focusing on investigating significant fundamental knowledge gaps, measures to support relevant water policy and the development of new technologies to protect our water environment."*

The research will focus on the key challenges outlined in the EPA 2020 Vision and Ireland's Environment 2008 including the development of the in-house capacity to undertake the analysis of dangerous substances in water as required under the Water Framework Directive and the coordination of environmental research to support the implementation of the EU Water Framework Directive.

A key indicator of success for this thematic area will be evidence of increased research capability & capacity building in these areas, support provided towards meeting the requirements of the Water Framework Directive and enhanced dissemination & synergies with the various funding bodies in the water research area.

3. Our Approach

3.1. Research Needed to Meet the Goals – Key Planned Activities (2009/2010)

The research will focus on the key challenges outlined in the EPA 2020 Vision and Ireland's Environment 2008 and will need to address remaining WFD gaps required for the effective implementation of the directive.

It is proposed during the 2009-2010 period to mainly concentrate the research efforts towards:

- **Building Research Capacity** in the Water area should be one of the main objectives of our research programme (PhDs and Research Fellowships).
- **Management and completion of on-going research projects** and to revise this document in light of their findings (See Appendix 1).
- **Communication and Dissemination** - enhance communication & expertise by co-operation and disseminate more actively the information
- **Involvement of Irish representatives on international working group** – link with the JRC (Joint Research Centre), the EEA (European Environment Agency) or WSSTP (Water Supply and Sanitation Technology Platform)
- Encourage **FP7 involvement** in relevant calls of Irish researchers
- **Workshops** (see next Section)

Depending on funding available, it is recommended that a wider perspective is adopted for future water research calls, which addresses:

1. **Basic research** to improve our understanding of aquatic ecosystems. Irrespective of the WFD, and indeed to support the WFD, there will always be an essential need for basic research to provide the solid foundations for more applied research.
2. Research to address **specific WFD gaps**. Particular gaps remain in advance of the end of the first river basin management cycle in 2015. These include addressing **economics** in the WFD, addressing **marine issues** (e.g. coastal wetlands), developing outstanding **classification tools** and research to link with the NAP and DAFF funded research. Subsequent cycles will identify other priorities.
3. **Cross-cutting research** to address water issues related to other EPA thematic areas including climate change, soils, biodiversity and socio-economics. Health and environmental technologies are also key cross-cutting areas. One example is the need to develop adaptation and mitigation strategies against hydrological extremes (floods and droughts) induced by climate change. Another example is the need to better integrate soil and water processes into our hydrological models.

Of particular importance, efforts should concentrate on:

- **Liaison with the Marine Institute** to avoid duplication and enhance synergies. Possible areas include refinement of ecological classification tools and the assessment of marine wetlands.
- Identifying and understanding recent **water quality trends** in Irish **estuaries** through the evaluation and interpretation of historical monitoring data (proposed ERC Fellowship)
- **Liaison with NPWS:** to improve our understanding of complex ecosystems with for example research on environmental supporting conditions for Groundwater Dependent Terrestrial Ecosystems (GWDTEs).
- Analysis of Biological and Physico-Chemical Water Quality Elements in support of **Status Assessments and Characterisation** of Irish Rivers and Lakes (proposed ERC Fellowship)

- **Research on Economics and WFD.** The development of such projects is recommended in the context of on-going activities funded by the DEHLG or carried out by the RBDs.
- **Losses from agricultural sources to water.** For the WFD, the Nitrate Action Plan and the DAFF funded mini-catchments projects are the main vehicle for addressing this issue. Future projects should be developed in this area which compliments these on-going activities.

Detailed project proposals should be developed in the context of EPA's overall work programme and its priorities and the views of the Irish research community. Some of these areas could be addressed by **Joint calls** developed with MI, DAFF, COFORD, Teagasc and NPWS in areas of mutual interest.

In addition, research gaps identified in the EPA Water Research Workshop in 2006 (See Appendix-3), remain a key reference point for developing water related research projects. The following research priorities were not covered by projects funded under the last Call for proposals in 2007:

- Develop hydrological models at different scales
- Development of assessment and management strategies for the protection of sensitive catchments
- Assess the implications of climate change on pressures in the water environment
- Impact of waste water treatment technologies
- Methods for stakeholder involvement
- Economic analysis for the WFD.

Development of new technologies (monitoring, analyses & early detection) will be developed in collaboration with the Environmental Technologies Thematic Area. Research on water quality and its impacts on human health will be dealt with by the Environment & Health Thematic Area.

3.2. Maximising our investment through collaboration with others

The active **co-operation of a number of key stakeholders** will be required to meet the immediate targets and the overall objectives of the STRIVE programme. The thematic area will continue to be developed in consultation with the DEHLG, EPA (OEA, Licensing, OEE), and the Research Community, General Public, Local Authorities, Teagasc, MI, NPWS and DAFF. We will maintain contact and liaison with the EU level activities and other relevant international activities (FP7, ERA-Nets, SNIFFER, LIFE+ etc).

We will establish an **expert group** that will advise the research needs of the programme which will include:

- Jim Bowman (EPA)
- Colin Byrne (DEHLG)
- Representatives of NPWS, DAFF, MI, RBDs
- A representative of the JRC

Links with the Water Framework Directive National Coordination group will be also strengthened.

Our approach will be to consult with the stakeholders on a bi-lateral basis in the first half of 2009 with a view to hold a **one-day workshop** with stakeholders in late 2009.

We will also actively support the work required towards the implementation Water Framework Directive. We will disseminate the findings of the individual research projects and the overall programme to the widest possible audience in a coherent and timely manner (see separate paper on VFM & Research to Policy).

4. Outputs and Medium-Term Outcomes

The key outputs from this Thematic Area include:

- Reports
- Tools & Methods
- Briefing Papers
- Theses
- Publications
- Scientific Papers
- Databases
- Guidance Notes
- Workshops
- Conferences
- STRIVE Staff Papers

The proposed research & activities above will have for overall objectives to

- Significant support for emerging international, EU and national environmental and research plans, policies and legislation
- Input to future DEHLG Strategy Documents and other policy initiatives
- Effective partnership with the key stakeholders in this area
- STRIVE Researchers leverage funding from international funding programmes (e.g. FP7, LIFE+)
- Established specific and targeted knowledge brokering and dissemination mechanisms that facilitate the production of policy-relevant knowledge in a timely and effective manner
- Managed the programme to the highest standards with respect to project/programme evaluation and ensuring optimal value for money for stakeholders

5. Conclusion – Overall Vision 2020

The water research programme will help to support Ireland's commitments under the Water Framework Directive This research area will contribute to ensuring excellent water quality in Ireland by focusing on investigating significant fundamental knowledge gaps, measures to support relevant water policy and the development of new technologies to protect our water environment.

One major objective of the research programme will be to built research capacity & capability among the Irish research community and to enhance communication and synergies with other organisations involved in water research. The findings of the individual research projects and the overall programme will be disseminated to the widest possible audience in a coherent and timely manner.

6. Relevant Links

- Climate Change Research Strategy
- Environmental Technologies Research Strategy
- Environment & Health Research Strategy
- Environmental Research Centre

Appendix 1 – RBD Programmes of Measures and Standards Studies

Leading RBD	Measures & Standards Study Name
WRBD	On-site Waste Water Treatment Systems Forest and Water
ShRBD / SERBD	Freshwater Morphology Setting Chemical Water Quality Standards
SWRBD	Industrial & Municipal Regulation Dangerous Substances Marine Morphology
ERBD	Heavily Modified Water Bodies & Artificial Water Bodies Abstraction Pressures Groundwater Risk from Diffuse Mobile Organics Urban Pressures in rivers, transitional and ground waters Further Economic Characterisation

Appendix 2 – Water research priorities identified during the October 2006 EPA Water Research Workshop. Note the numbering does not denote any order of prioritization.

No.	Topic	Description
1	Improving our understanding of how different pressures impact on the ecological and chemical status of water bodies	Refinement of ecological classification tools so that the status for different water bodies can be adequately described to reflect different pressures, including hydro-morphological pressures and alien species.
2	Improving our understanding of the efficacy of existing measures to improve water quality	Measures to be assessed include buffer zones, wetlands (natural and constructed), agricultural bye laws, REPS, and other measures listed as “basic” and “supplementary” measures in the WFD.
3	Develop hydrological models at different scales	Applications including flood management and nutrient management. Address issues of scale, uncertainty and application to un-gauged catchments.
4	Improving our understanding of contaminant pathways between the land surface and receptors	Including receptors such as river/lake ecosystems, drinking water supplies and groundwater dependent ecosystems. Particular emphasis on linking soil and water research. Contaminants include less well studied priority substances and pathogens.

No.	Topic	Description
5	Development of sensors which are rugged, low-cost and easily deployed, and appropriate deployment strategies	Including nutrients, general physical parameters, microbiological parameters and mixed contaminant samples. Development of sensor deployment and networking strategies for river basin-wide assessment from stream head-waters to estuaries and coastal waters.
6	Development of assessment and management strategies for the protection of sensitive catchments	Particular focus on Q5 sites, rivers supporting <i>Margaritifera Spp.</i> and wetlands. Establish key indicators of change in these catchment and restorative measures. Developing monitoring and assessment methods for these complex systems.
7	Assess the implications of climate change on pressures in the water environment	Effects of changes in recharge, land cover and land use practices on water quality. Improve understanding of the effects of climate change on ecology of water bodies.
8	Impact of waste water treatment technologies	Assess the long term impact of septic tanks. Develop strategies for the optimisation of UWWT.
9	Methods for stakeholder involvement	Development of robust methodologies for effect stakeholder involvement.
10	Support the development of environmental quality standard for the WFD	Provide scientific studies to support the development of EQS for priority substances and specific pollutants for the WFD and Groundwater Directive.
11	Economic analysis for the WFD	Develop a strategy for assessing the cost effectiveness of measures designed to improve status and a framework carrying out disproportionate cost analysis.

Appendix 3 – Current On-going ERTDI & STRIVE Projects in the Water Area

Projects	Lead Organisations	Completion Year	Expected Outputs
ILLUMINATE	TCD	2009	<ul style="list-style-type: none"> ○ Establish and populate a common database for the two catchments that is compatible with EPA/ERTDI-funded GSI/Data management initiatives ○ Characterisation of pre-anthropogenic baseline reference conditions using multi-proxy palaeolimnological techniques ○ Evaluation of the roles of different pressures and combinations of pressures using variance partitioning statistical techniques. ○ A means of constraining simulations of future ecological pressures and responses to and beyond the WFD implementation deadline of 2016 ○ Produce simulations of past and future responses in phytoplankton and/or zooplankton. ○ Contribute to reducing uncertainties in future characterisations of water bodies in the RBDs concerned.
IMPLANT	UCC	2009	<ul style="list-style-type: none"> ○ Identification of those environmental factors that mitigate the ecological impact of eutrophication of streams in the Munster area. ○ Establishment of quantitative relationships between nutrients, light (shade), primary producers and invertebrate grazers. ○ Development of a user-friendly classification system that identifies stream types which are most at risk from eutrophication. ○ Development of guidelines to improve management of stream ecosystems, and to decrease risk of stream degradation.

Projects	Lead Organisations	Completion Year	Expected Outputs
WINCOMS	UCD	2009	<ul style="list-style-type: none"> ○ Produce a comprehensive scientific and technical description of all measures available to meet the requirements of the WFD together with a ranking on the basis of all relevant criteria ○ Survey existing decision support systems and identify a short-list of 2 or 3 of the most suitable for WFD decision-making. Implement, adopt and test these in a case-study situation. ○ Identify and study the knowledge, opinions and preferences of all relevant stakeholders and integrate the results with the decision support systems
Pathways	QUB	2013	<ul style="list-style-type: none"> ○ Identification of significant hydrological pathways within RBDs. ○ Quantification of flows along pathways ○ Identification of critical source areas (CSAs) for pollutants reaching groundwater and relevant ecological receptors (aquatic and groundwater dependent terrestrial ecosystems). ○ Identification of significant pathways for pollutant transport and attenuation, with particular emphasis on the attenuation of nutrients (nitrogen and phosphorus species), particulate matter (pathogenic micro organisms and sediments) and priority substances. ○ Development of a catchment management tool to underpin a decision support system suited to Irish conditions.
HYDROFOR	UCD	2013	<ul style="list-style-type: none"> ○ An up-to-date literature review of forest impacts on hydrochemistry, hydrology and ecology with particular attention to the performance and design of buffer strips ○ A database of Irish data on forest-surface interactions (hydrochemistry & ecology) ○ Analysis of factors influencing forestry impacts on ecology with a conceptual model. ○ A data set of the performance of buffer strips in the research catchment. ○ A set of design guidelines for the planning, construction and maintenance of buffer strips. ○ A prediction of the future impacts, nationally, of forestry on ecology.

Projects	Lead Organisations	Completion Year	Expected Outputs
Groundwater Fauna	U.Ulster	2011	<ul style="list-style-type: none"> ○ Literature review ○ All-Ireland survey for subterranean fauna; detailed temporal monitoring on subset of sites, taxonomic determination ○ Structure and functioning of subterranean fauna
Alien Invasive Species	QUB	2010	<ul style="list-style-type: none"> ○ Improve our knowledge of the nature and extent of alien invasive species in Ireland and their impact on natural ecosystems ○ Develop and trial control measures for selected species.
EFFECT	TCD	2011	<ul style="list-style-type: none"> ○ Evaluate changes in the chemical and ecological statuses of aquatic ecosystems (rivers, streams and lakes) in the Irish Ecoregion since the implementation in the 1990s and subsequently of POMs aimed at reducing P and other nutrient inputs to water bodies.
Monitoring of Dangerous substances	DCU	2011	<ul style="list-style-type: none"> ○ Review existing techniques for the measurement of priority pollutants ○ Modify and improve current methods to enable detection of chemicals present in the environmental waters ○ Develop on-line analytical approaches to determine priority pollutants in environmental waters ○ Make recommendations based on the large volume of data obtained on how a successful monitoring programme for priority pollutants could be established and run successfully.