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Knowledge and awareness of water quality protection issues within Local Authorities

Gianluca Grilli^{a,b}, John Curtis^{a,b}

Abstract: The EU Water Framework Directive (WFD) outlines an integrated framework for water management. The major objective of the WFD is that member states should achieve at least good ecological status of all national waters. This ambitious target can only be achieved with efficient water management governance because water quality is complex and sources of pollution are manifold. Within countries, multiple institutions are responsible for water management, often operating within a hierarchical structure, in which each level has different responsibilities. The top levels of the hierarchy outline the strategy for water management at national level, however most actions with direct impact on water quality occur at the lower levels of the hierarchy. Therefore, it is essential that knowledge and awareness of water management is effectively transferred through the hierarchical structure to the staff responsible for day-to-day activities. In Ireland, daily operations of water quality management are undertaken by the employees of the Local Authorities (i.e. local government), amongst others. This study investigates the level of knowledge and awareness of water quality issues among Local Authority staff within Ireland and the extent to which water protection measures are implemented within core functions of local government. Staff are knowledgeable about high level issues and policy, including institutions responsible for water management, awareness of WFD and river basin management plans. Knowledge and awareness levels are considerably lower on more specific details, including on water quality status and protection measures being implemented within their jurisdictional areas. Overall, the study suggests that there is considerable scope for improvement in knowledge and awareness, and therefore priority towards, water quality and protection issues among Local Authority staff.

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Executive Summary

The general governance structure of River Basin Management Planning (RBMP) in Ireland involves three interlocking elements; policy, technical leadership and implementation. Several public sector bodies are actively engaged across all elements and levels of governance. The success of the RBMP depends in part on Local Authorities and other State agencies delivering on their responsibilities. To ensure effective water management, knowledge of RBMP's aims and objectives should be effectively transferred to the public bodies that carry out daily activities impacting water quality, especially to staff engaged in day-to-day operational decision making. This research examines the dissemination of knowledge of key water quality metrics among Local Authority staff and the effectiveness of existing water governance hierarchy in transferring high level strategic vision of the RBMP into practical daily actions across the functions of local government.

The research is based on a survey of Local Authority staff and establishes a baseline assessment of Local Authority employees' general and specific knowledge on water quality and management. The survey was intended to provide a broad-brush assessment of staff knowledge, which is sufficient to identify where knowledge gaps exist or where remedial actions may be necessary. The study has three research questions: 1) whether Local Authority staff are aware of the status of Irish waters and whether there are substantive differences in knowledge across job grades, divisions and working experience; 2) whether Local Authority staff are aware of the objectives of the Water Framework Directive and RBMP; and 3) whether staff within various working divisions are aware of the actions undertaken to improve water quality objectives in their day-to-day activities.

Conclusions and Policy Recommendations

Knowledge of water quality and specific issues relevant to the RBMP is relatively high among some Local Authority staff but the survey research demonstrates that there is considerable scope for improvement across all divisions, including among Environment divisions where knowledge is greatest. Based on the survey research, recommendations are outlined below to improve the dissemination of pertinent information through the tiers of water governance within Local Authorities and also improve the knowledge and competencies of staff to help people perform better in their roles. The recommendations fall across three areas: training, dissemination, and networks.

1. Training

Training should be established to help people perform better and more efficiently in their jobs, while acknowledging that Local Authority staff do not all need the same level of knowledge and expertise related to water quality and WFD/RBMP.

(a) Induction training

A module on water quality and river basin management should be included in new staff induction training. Providing basic awareness training to staff working across Local Authority functions (e.g. housing, waste, emergency services, etc.) should prompt such staff to seek assistance from colleagues elsewhere in the Local Authority when issues that may have a potential impact on water quality occasionally arise.

(b) Role-based training

Within functions with a more direct link to water quality, bespoke role or function based training should be established. This is especially relevant within Environment and Planning divisions. The elements of such training should include, amongst others, accessing and utilising tools, mapping and data resources; interpreting relevant data; guidance on framing of planning conditions.

(c) Continuing professional development

As legislative contexts, scientific knowledge, resources and practices are continually evolving, role-based training should be repeated on a regular recurring basis.

(d) Senior managers

Career progression in Local Authorities, as in many organisations, requires skills and competencies related to people and project management. Senior managers, e.g. Director of Services, may not personally require highly technical or in-depth knowledge to successfully fulfil their roles, as they can rely on the technical knowledge of their teams. However, a lack of awareness of the broader context for water quality and RBMP can influence priorities. Specific training for senior management roles should focus on priorities and responsibilities for Local Authorities in implementing the RBMP. Such training should be a mandatory requirement for all new appointments in senior roles within Environment and Planning functions.

(e) Training provision

Centralised development and provision of training will ensure consistency across Local Authorities. The Local Authority Services National Training Group (LASNTG), which already develops and delivers a broad range of training to Local Authority staff is ideally suited to undertake this role. LASNTG are already commencing new training in 'Catchment Science and Management' in 2021 with modules on catchment science, characterisation, as well as protection and mitigation. This course has immediate relevance for people working in catchment science and management, but its content, or elements thereof, has relevance to Local Authority staff across several divisions.

2. Dissemination

The survey research confirms that there is room for improvement in the dissemination of information related to water quality among Local Authority staff, including policy priorities and national programmes (e.g. Blue Dots, PAA). While senior managers are members of various RBMP governance structures (e.g. Regional Local Authority committees), the survey research fails to demonstrate that more junior staff have sufficient awareness of national priorities related to water quality. This is especially relevant in the Environment and Planning divisions where Local Authority decisions can have a direct impact on water quality.

- (a) Each Local Authority should assess its internal communications processes to determine whether staff at all levels are being adequately briefed on water quality issues. Are staff receiving sufficient and regular updates relevant to their job function? Are staff aware of national policy priorities? Do staff understand the motivation behind internal processes and notifications? Are staff aware when issues should be escalated or when other teams should be notified?
- (b) The EPA should assess its dissemination strategy for water quality information. The target audience or the people attending its conferences and workshops or reading its reports may not be sufficiently wide. It should consider how it can more actively engage with Local Authority staff, especially in Environment and Planning divisions, across all job grades to improve awareness of the status of water quality and increase understanding of how their work contributes to water quality protection.

3. Networks

Staff working in specific functional areas, such as Environment and Planning, often have extensive workloads shared among relatively small teams. Within smaller teams practical experience and institutional knowledge can be limited, while extensive workloads can limit the time devoted to particular issues. The Network for Ireland's Environmental Compliance and Enforcement (NIECE), whose vision is improving the implementation of environmental protection legislation, is a forum to support public authority staff, including Local Authority staff, share experiences and support each other in environmental protection work.

- (a) Utilise the NIECE network to engage all Local Authority staff working in functions that have water quality responsibility to increase awareness of water quality status, local programmes and initiatives, and environmental pressures.

1 Introduction

The EU Water Framework Directive (WFD) (2000/60/EC) proposes an integrated framework for the preservation of water quality and sets binding water quality targets for all EU country members. Among the WFD's ambitious targets is the achievement of 'good ecological status' in all water bodies, comprising both ground waters and surface waters. The maintenance of high water quality in water bodies is complex because there are many factors and sources that contribute to water pollution, across the two broad categories of pollution: point and diffuse water pollution (Moss, 2008). Point source water pollution refers to contaminants that enter the water body in a circumscribed and easily identified area. Diffuse water pollution indicates the release of pollutants from many different places and activities, which may have small individual effect but very large cumulative impacts at basin scale. Different from previous legislation, the WFD sets targets at water body scale rather than by administrative units.

Under the WFD EU member states are required to draft a River Basin Management Plan (RBMP) in which actions to protect rivers, lakes, estuaries and coastal waters are outlined at basin scale. The switch of water management from administrative boundaries to a basin scale is one of the major changes introduced by the WFD. This modification of the geographical extent of water management has been made to account for water pollutants that affect water quality beyond administrative boundaries (Kallis & Butler, 2001). Following an ecosystem-based approach to management, catchment-level water management facilitates the assessment of water quality and pollution at the scale of the entire ecosystem, rather than at each administrative unit. However, the new approach of the RBMP requires cooperation across public bodies, which previously worked independently, especially within geographical administrative areas. Therefore, the success of WFD implementation depends to a great extent on the capacity of administrative public bodies to develop effective plans, coordinate activities and share data (Paisley & Henshaw, 2014).

In Ireland, the Department of Housing, Local Government and Heritage (DHLGH) has overall responsibility for the RBMP, which outlines national governance and management structure for water protection. The general governance structure involves three interlocking elements; policy, technical leadership and implementation. Various public sector bodies are actively engaged across all elements and levels of governance. To ensure effective water management, knowledge of aims and objectives should be effectively transferred to the public bodies that carry out daily activities impacting water quality, especially to staff engaged in day-to-day operational decision making (Ipe, 2003). In particular, the translation of RBMP objectives into management actions is among the responsibilities of 31 Local Authorities, among other actors.¹ The success of the RBMP depends in part on Local Authorities delivering on their responsibilities. The current reporting cycle of the WFD runs from 2016–2021 with plans for the next reporting cycle underway. It is an opportune time therefore to examine both the dissemination of knowledge of key water quality metrics among Local Authority staff and the effectiveness of existing water governance hierarchy

¹ Local Authorities in Ireland are responsible for the provision of public services and facilities such as housing, planning, roads, and environmental protection.

in transferring high level strategic vision of the RBMP into practical daily actions across the functions of local government.

This paper reports a study on Local Authority (LA) employees' knowledge of water quality and management. The results establish a baseline assessment of LA employees' general and specific knowledge on water quality and management. Specifically, the study answers the following questions: 1) whether LA staff are aware of the status of Irish waters and whether there are substantive differences in knowledge across job grades, divisions and working experience; 2) whether LA staff are aware of the objectives of WFD and RBMP; and 3) whether staff within various working divisions are aware of the actions undertaken to improve water quality objectives in their day-to-day activities. Ideally the answers to these questions should be strongly positive but where that is not the case, areas for remedial action to improve the implementation of the RBMP are easily identifiable. The rest of the paper is organised as follows. The next section outlines the main public bodies in charge of water resource management in Ireland. Section three describes the methodological approach used in the analysis, including the data collection. Analytical results are presented in section four, which is followed by a discussion of the results and policy implications. The final section offers some conclusions and policy recommendations.

2 Background

2.1 The theoretical framework of water governance

Adopted in 2000, the EU WFD is one of the first legislative proposals to adopt ecosystem-scale measures to enhance water governance (Jager et al., 2016; Petersen et al., 2009). However, the urgency to improve water policies is not exclusive to the EU WFD but advocated worldwide (Woodhouse & Muller, 2017). Good water governance underpins the human right to water and sanitation (HRtWS), which is explicitly recognised in the United Nations General Assembly's resolution 64/292 (28 July 2010) and the Human Rights Council's resolution 15/9 (6 October 2010). Internationally the uptake of innovative and effective water governance is generally unsatisfactory with most water governance failures attributed to scientific knowledge on water governance systems, which is still limited despite growing scholarly expertise (Pahl-Wostl, 2017).

With the objective of supporting the implementation of effective water policy, the Organisation for Economic Co-operation and Development (OECD) has identified seven knowledge gaps in water governance, which cover policy, accountability, funding, capacity, information, administrative, and objectives (Akhmouch et al., 2020). Based on these knowledge gaps, OECD outline 12 water governance principles that are essential for governments to design and implement effective, efficient, and inclusive water policies (Akhmouch & Correia, 2016). The 12 principles relate to (OECD, 2015):

- Clear roles and responsibilities;

- Appropriate scales within basin systems;
- Policy coherence;
- Capacity;
- Data and information;
- Financing;
- Regulatory frameworks;
- Innovative governance;
- Integrity and transparency;
- Stakeholder engagement;
- Trade-offs across users, rural and urban areas, and generations;
- Monitoring and evaluation.

The OECD principles represent a solid theoretical framework to assess the effectiveness of water governance (VanNijnatten, 2020; Jetoo, 2019; Van Rijswick et al., 2014). In a cross-country assessment Neto et al. (2018) find that four OECD principles are especially critical: policy coherence, financing, managing trade-offs, and ensuring integrity and transparency by all decision-makers and stakeholders. Stakeholder engagement and public participation are other key aspects of water governance (Akhmouch & Clavreul, 2016). Increasing public participation is encouraged not only by OECD, but also by the WFD (Fritsch, 2019; Graversgaard et al., 2018). Participation of stakeholders and local communities in water and other natural resource governance facilitates consensus over management rules that are both economically and ecologically sustainable (Razzaque, 2009; Priscoli, 2004). Based on these considerations, polycentric and multi-level governance systems have been formulated in opposition to central governance (Ostrom, 2010). Under polycentric governance, the authorities of local government, such as municipalities and Local Authorities, are responsible for environmental decision-making, including water quality (Huitema et al., 2009; García et al., 2019). In this way, water governance responsibilities are decentralised and assigned to the public bodies that are closer to local communities and water users (Baldwin et al., 2018). When daily water management operations are delegated from central to local government, assessing whether the strategic vision outlined in the RBMP is effectively disseminated across operational levels of water management is crucial to achieve water quality goals (Rollason et al., 2018). In the assessment of water multi-level governance, key principles to consider are: clarity of roles and responsibilities, capacity building, data, and outcome measurement (Akhmouch & Clavreul, 2016).

The effectiveness of water governance in Ireland has recently been evaluated in the using the OECD principles as a framework (O’Riordan et al., 2021; Boyle et al., 2021) with several recommendations

outlined. Among them is a call to clarify roles across governance tiers and discuss priorities, resourcing and policy coherence. The suggestion about clear definition of roles is particularly relevant for Local Authorities. Other recommendations include increasing capacity across governance organisations, to scale up lessons learned from projects and local initiatives, and improving data collection and policy outcome measurement.

2.2 Water governance in Ireland

Irish river basins comprise more than 70,000 km², across 46 catchments with a total of 4,829 water bodies. Water quality varies considerably across water bodies. The proportion of water bodies compliant with EU quality standards is: 53 percent for rivers, 51 percent for lakes, 38 percent for estuaries 80 percent for coastal waters and 92 percent for groundwater bodies (EPA, 2020b).

There are several public bodies that are directly or indirectly involved in water resource management in Ireland. The 3-year RBMP, developed by DHLGH, sets water quality targets and management actions following the WFD guidelines. Included within the WFD/RBMP governance structure are several committees comprising public bodies, including 1) the Water Policy Advisory Committee (WPAC), 2) Water Forum/An Fóram Uisce, 3) The National Co-ordination & Management Committee (NCMC), 4) The National Technical Implementation Group (NTIG), 5) The Regional Local Authority Structures, supported by the Local Authorities Waters Programme (LAWPRO). The WPAC provides high-level policy and monitors the implementation of the RBMP; WPAC also advises the Minister on the progress of plans and measures. The Water Forum/An Fóram Uisce is an independent entity with advisory responsibility and is the only statutory body representative of all stakeholders with an interest in the quality of Ireland's water bodies. The NCMC committee's role is to ensure that the programme of measures included in the RBMP is actively managed; NCMC is also an interface between science, policy and programme delivery. The NTIG is chaired by the Environmental Protection Agency (EPA) and includes many other public bodies (e.g. Office of Public Works, Inland Fisheries Ireland). NTIG's main duty is to supervise the technical implementation of the RBMP and coordinates the various actors with responsibilities for water management. The Regional Local Authority Structures comprises Local Authorities, which are coordinated by 5 regional committees (Border, Midlands, West, South East and South West). The role of the Regional Committees is to coordinate actions across all public relevant bodies in the region. LAWPRO is a national initiative situated within Local Authorities that engages with communities and other stakeholders to achieve the objectives of the RBMP.

Local Authorities (LA) are responsible for a wide range of functions, including provision of public services, road maintenance, local planning and environmental protection. Many of these services have the potential to influence water quality. For example, planning permissions may produce environmental alterations that ultimately impact on water quality. While Local Authorities are not uniformly structured, all 31 Local Authorities have responsibilities relevant to water quality management. Within LA's or-

organisational structures there are usually four divisions with involvement in water quality management, namely Environment, Planning, Communities, and Roads divisions. Environment divisions have direct responsibility for water quality management prescribed under legislation. Other divisions have an indirect relationship with water quality and often rely on inputs from the Environment division, from Inland Fisheries, or others. While LAs have responsibilities within their own functional areas, the 5 regional committees coordinate actions across administrative boundaries among LAs and other public bodies to ensure enhance the delivery of water quality measures at water body and catchment scale.

Two key aspects of the RBMP are the creation of the Blue Dot Catchments Programme (BDCP) and the Priority Areas for Actions (PAAs). The EPA have identified the waters in Ireland that should have a high status objective, and these are commonly known as Blue Dot waters or Blue Dots and include rivers, lakes, estuaries, and coastal waters. The BDCP aims to maintain and restore high-status water bodies, i.e. waters with the highest quality nationally within the Water Framework Directive classification system of High, Good, Moderate, Poor or Bad status. PAAs are areas deemed at risk of not meeting their WFD objectives.

3 Methodology

3.1 Data Collection

The data for this study was collected by survey, administered to employees of the four relevant divisions of the Local Authorities (i.e. Environment, Planning, Roads and Communities). The questionnaire was drafted in cooperation with LAWPRO who have expertise on the structure within Local Authorities, as well as the work and responsibilities within the four functional areas. The survey questionnaire was piloted on a sample of employees of the regional committees, who gave feedback on wording and clarity of the questions. The main survey was completed online between early December 2020 and the end of January 2021. Invitations to participate in the survey were sent directly to employees' email and two reminder emails to complete the survey were sent in January. The questionnaire comprises 55 questions but subsections were limited to staff working within specific functional areas. Questions regarding actions undertaken for water quality protection were specific to the division where respondents were employed. The Environment division has the greatest range of responsibilities with respect to water quality, therefore the number of questions dedicated to this division is greater than to other divisions. Also some questions were targeted at senior management levels of the Local Authorities. Questions were divided into 4 sections. The first section captured personal information of the employees, i.e. Local Authority and division where they were employed, years of experience, and grade within the Local Authority. The second section contained questions on general knowledge related to water quality in Ireland, which was included to introduce the topic and help respondents to think about water quality. The third section was dedicated to personal knowledge of WFD, RBMP and interactions with members of other public bodies, specifically

LAWPRO staff. The last section asked respondents to indicate the actions that they undertake in their job to meet WFD guidelines, preserve water quality and progress with the RBMP.

General knowledge of water quality, WFD and RBMP and actions for water quality management cannot be assessed with a single question. Therefore, several indicators were used as proxies, each capturing one different aspect of the topic. The most relevant indicators for each topic are shown in Table 1. On general knowledge, respondents were asked whether they know the organisations responsible for water quality in Ireland; and questions about water quality both nationally as well as within the LA area.

In compliance with General Data Protection Regulations information on the target sample of LA employees was not shared with the authors. Instead, the invitation to participate in the survey was distributed by the Local Governance Management Agency (LGMA), an organisation that the senior LA staff are familiar with and regularly receive email correspondence. Subsequent reminder emails to participate in the survey were sent by the LGMA. The estimated total sample size (i.e. the number of employees who received a link to the survey), is 1209 LA staff across 31 LAs.

3.2 Statistical Analysis

The main objectives of this study are 1) to provide an overview of the current status of knowledge of water management and actions undertaken to improve water quality within Local Authority administrative areas, and 2) explore systematic differences in knowledge and actions across organisations. The first objective is addressed using descriptive statistics, percentages and frequency tables of the answers. The second part of the analysis is undertaken with regression techniques, with functional forms that depend on the type of dependent variable considered. The dependent variables are summarised in Table 1 and can be broadly divided into either binary or ordered variables.

Variables with a binary outcome are modelled using logistic regression, in which the probability of an outcome equal to 1 for the dependent variable Y is described by the following probability function (Greene, 2003):

$$Pr(Y = 1|X_i, \beta) = \frac{\exp(\beta X_i)}{1 + \exp(\beta X_i)} \quad (1)$$

where X_i is a set of individual characteristics of respondent i , and β represent the effect of X_i on the probability of an answer equal to 1.

One indicator of general knowledge originated from a question that asked respondents their knowledge about the Blue Dot programme. The possible answers are: 1) ‘No’, 2) ‘Yes, but don’t have much knowledge of programme’, and 3) ‘Yes, and aware of the programme and its objectives’. The resulting indicator has three ordered outcomes and is modelled using an ordered logit model. The ordered logit generalises the binary logistic regression to ordinal outcomes (Cameron & Trivedi, 2005). Though knowledge might

Table 1: Indicators for water quality and WFD/RBMP knowledge used in the analysis

Metric	Question	Answer options	Format	Type of indicator	Statistical model
Indicators of general knowledge					
Water quality Ireland	How would you describe water quality in Ireland?	Satisfactory	Single choice	Multinomial	Multinomial logit
		Unsatisfactory		Unordered	
		Don't Know			
Water quality area	How would you describe water quality in your area?	Satisfactory	Single choice	Multinomial	Multinomial logit
		Unsatisfactory		Unordered	
		Don't Know			
Good ecological status	What proportion of Ireland's 2,355 river water bodies assessed nationally do you think are in satisfactory ecological health being in either good or high status?	20-30%	Single choice	Binary	Binary logit
		30-40%		1 = 50-60 %	
		40-50%			
		50-60%			
		60-70%			
		Don't Know			
Knowledge of WFD and RBMP					
WFD	Are you aware of the WFD?	Aware	Single choice	Binary	Binary logit
		Not aware		1 = aware	
RBMP	Are you aware of RBMP?	Aware	Single choice	Binary	Binary logit
		Not aware		1 = aware	
Blue Dot	Prior to today were you aware of the Blue Dot Catchment Programme?	Aware	Single choice	Ordinal	Ordered logit
		Somewhat aware			
		No			
Local Blue Dots	Are you aware if there are any high status objective water bodies, pristine water bodies, also referred to as 'Blue Dots', within your area?	Yes	Single choice	Binary	Binary logit
		No			
PAA	Are you aware if there are any PAA within	Yes	Single choice	Binary	Binary logit
		No			

be measured on a continuous scale when only observed at discrete intervals the ordered logit model is appropriate. Formally, the equation that describes y^* , measuring knowledge or awareness, is the following:

$$y^* = \beta'X + \varepsilon$$

where ε is an identically and independently distributed (IID) random disturbance. The variable y^* ranges in the interval $[-\infty, +\infty]$ but it is observed only in j discrete intervals, with the following system of censoring (Greene & Hensher, 2009):

$$y = \begin{cases} 0, & \text{if } -\infty < y^* \leq \tau_0 \\ 1, & \text{if } \tau_0 \leq y^* \leq \tau_1 \\ \dots & \\ j, & \text{if } \tau_j \leq y^* < +\infty \end{cases}$$

where τ_0 and τ_1 are threshold parameters to estimate. The probability of outcome j is given by:

$$Prob[y = j|X] = F[\tau_j - \beta'X] - F[\tau_{j-1} - \beta'X], \quad j = 0, 1, \dots, j.$$

where $F(\cdot)$ is the logistic density function.

All models were estimated using R; logit models were carried out using the base installation package ‘glm’, while the ordered logit regression was performed with the function ‘porl’ available in the ‘MASS’ package.

4 Results and discussions

4.1 Response rate

The survey was answered by 691 employees, however many questionnaires were incomplete, indicating where employees opened the link to the questionnaire but did not submit responses to any questions. In total, 521 questionnaires were answered fully and useful for the analysis. The effective response rate is 43 percent.

The breakdown of respondents by working division is shown in Figure 1. Environment divisions returned 257 questionnaires, which corresponds to a response rate of approximately 70 percent. Roads divisions contributed with 94 responses (33 percent response rate), Communities divisions returned 91 questionnaires (47 percent response rate) and Planning divisions returned 79 questionnaires, a 32 percent response

rate. As a share of the total sample responses, 49 percent are from Environment division staff, 18 percent from Roads division staff, 17 percent from Communities divisions and the remaining 16 percent from Planning divisions. Environment divisions have greatest responsibility for water-related management and a proportionately higher number of responses was anticipated.

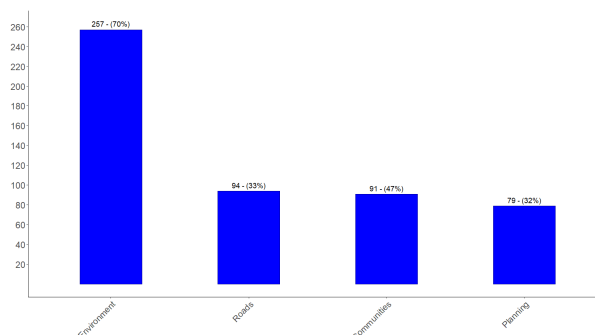


Figure 1: Respondents by LA (response rate in parenthesis)

4.1.1 General knowledge of water quality and management

The general knowledge of respondents on water quality and management is assessed with four main indicators. The frequency of answers is reported in Table 2. When asked to indicate the organisations responsible for water quality monitoring in Ireland, most respondents selected the most appropriate answers, i.e. EPA (about 80 percent) and LAs (73 percent). The Geological Survey of Ireland, another acceptable answer, was selected by only 8 percent of the sample. Substantial minorities selected DECC or DHLGH government departments as additional options, especially in Planning and Communities divisions. The proportion of answers did not significantly change on the basis of seniority of positions within the LAs, as the proportions of answers is similar between the sub-sample of respondents with a grade of 6 or less and the group with a grade of 7 or more.

With respect to opinions on water quality in Ireland, some 40 percent of respondents perceive water quality to be of satisfactory quality status, 53 percent unsatisfactory and 6 percent don't know. Therefore, almost half of respondents have views on water quality that are at odds with the trend of declining water quality in Irish water bodies (EPA, 2020b). Respondents in the Environment and Planning divisions returned a share of 'unsatisfactory' opinion in excess of 60 percent, while employees in the community and road divisions 32 and 54 percent, respectively. Opinions did not change significantly based on employee grade within the LA. When asked to consider water quality in their own administrative area, interestingly respondents reported a 'don't know' answer more frequently, globally about 10 percent of the sample.

A second indicator on water quality knowledge asked respondents to indicate the proportion of rivers in good ecological status according to WFD definition. The correct answer, i.e. 50–60 percent of the total, was answered by some 25 percent of the sample. About 10 percent of the sample over-estimated

river ecological status, while 55 percent stated 50 percent or less. The proportion of correct answers was greatest among employees of Environment divisions. Among employees in senior management roles (grade 7+) the proportion of correct answers was 30 percent, while the frequency of other grades was comparable to the general average.

Table 2: General knowledge: frequency table

Code	Options	Sample (%)	Environment (%)	Planning (%)	Communities (%)	Roads (%)	Grade 6 or lower	Grade 7 or higher
Water quality Organizations	Geological Survey of Ireland	9%	12%	8%	3%	5%	8%	9%
	Environmental Protection Agency	79%	84%	82%	68%	77%	76%	85%
	Local Authorities	73%	83%	66%	67%	57%	72%	76%
	DECC	21%	23%	13%	29%	18%	21%	22%
	DHLGH	12%	15%	6%	12%	7%	10%	14%
	Ordnance Survey Ireland	1%	0%	0%	2%	0%	1%	1%
Water quality, nationally	Met Éireann	0%	2%	0%	1%	1%	1%	2%
	Satisfactory	40%	35%	32%	44%	58%	39%	42%
	Unsatisfactory	53%	61%	63%	44%	33%	55%	51%
	Don't Know	6%	4%	4%	12%	9%	6%	7%
Water quality, within LA area	Satisfactory	48%	44%	49%	45%	62%	48%	48%
	Unsatisfactory	42%	49%	32%	43%	29%	42%	41%
	Don't Know	10%	7%	19%	12%	9%	10%	10%
Good ecological status	20-30%	20%	19%	37%	15%	16%	20%	21%
	30-40%	18%	17%	19%	28%	12%	19%	17%
	40-50%	18%	19%	12%	15%	20%	19%	15%
	50-60%	25%	31%	19%	12%	27%	22%	30%
	60-70%	10%	8%	7%	16%	10%	11%	7%
	Don't Know	9%	6%	4%	15%	15%	8%	9%

Table 3 shows statistical model results that explore whether answers systematically vary based on personal characteristics of the employees. Overall, the regression models have many estimated coefficients that are not statistically significant, which suggests that personal characteristics are not associated with knowledge of water quality issues. The first model considers respondents' opinion on water quality in Ireland, which comprises two columns. The first column contains coefficients that indicate the probability of answering 'satisfactory' compared to the reference level, i.e. 'don't know', while the second contains coefficients related to the probability of answering 'unsatisfactory'. Opinions on water quality are significantly affected by respondents' grade; employees in senior management roles are less likely to consider Irish water quality as 'unsatisfactory'.

Employees in the Planning division are more likely to express an opinion, whether 'satisfactory' or 'unsatisfactory', compared to a 'don't know' answer; the upper grades of the Planning divisions, however, are much more likely not to have opinions on water quality and tend to answer 'don't know' to this question. Other statistically relevant differences for employees of other divisions were not detected. There is no statistical association between duration of employee experience and opinions on water quality, indicating that that opinions on water quality in Ireland are not associated with years of experience within the LA.

With respect to water quality in respondents' local area, respondents employed in Roads divisions were more likely to express a 'don't know' answer compared to 'unsatisfactory'. Overall, staff with longer LA service have a higher likelihood of expressing an opinion that local water quality has a satisfactory status. Based on the regression interaction terms between division and respondent's grade, upper management levels of the Environment and Roads divisions are less likely to indicate 'don't know'.

Table 3: Regression models for the indicators of general knowledge

	<i>Dependent variable:</i>		
	Water quality, nationally (1)	Water quality, locally (2)	River Ecological status (3)
Grade 7 or higher	-0.479 (0.565)	-0.283 (0.567)	1.852** (0.878)
Division (ref. level: Communities)			
Environment	0.096 (0.408)	0.240 (0.404)	2.106*** (0.762)
Planning	0.914 (0.570)	-0.218 (0.524)	1.448* (0.870)
Roads	-0.766 (0.515)	-0.383 (0.514)	1.164 (0.883)
Years of experience (ref. level: Less than 2 years)			
2–9 years	-0.296 (0.273)	-0.293 (0.265)	0.157 (0.289)
10 years or more	-0.410 (0.272)	-0.612** (0.267)	0.096 (0.299)
LA region (ref. level: Border)			
Midlands	-0.569 (0.392)	-0.458 (0.378)	0.141 (0.407)
South East	-0.312 (0.442)	-0.263 (0.427)	-0.125 (0.484)
South West	-0.280 (0.394)	-0.226 (0.380)	0.379 (0.406)
West	-0.029 (0.537)	-1.136** (0.519)	0.679 (0.520)
Interactions between respondents' grade and division)			
Grade 7 or higher x Environment	0.820 (0.650)	0.357 (0.644)	-1.887** (0.934)
Grade 7 or higher x Planning	-0.651 (0.827)	0.200 (0.804)	-1.421 (1.090)
Grade 7 or higher x Roads	0.214 (0.779)	0.030 (0.783)	-0.618 (1.074)
Constant	0.933* (0.534)	0.598 (0.520)	-3.076*** (0.840)
Observations	376	376	376
Log Likelihood	-242.067	-251.322	-213.696
Akaike Inf. Crit.	512.135	530.644	455.392

Note: $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$

Job grade and division were significantly associated with knowledge of the proportion of rivers in a high ecological status. Respondents in higher grades were 6 times more likely to indicate the correct proportion of rivers in a high ecological status compared to employees in lower grades. Compared to the reference levels of community division, respondents of the Environment and Planning divisions were 8 and 4 times more likely to indicate the correct answer, respectively. An interesting result is related to the conditional analysis of respondents by grades and division. The upper management of the Environment division is less likely to answer correctly, while other divisions' grades were broadly comparable.

4.1.2 Knowledge of water framework directive

Answers to indicators capturing the awareness by LA employees of WFD and RBMP issues are reported in Table 4. Overall 82 percent of respondents cited an awareness of the WFD and its objectives; the share rises to 94 percent and 87 percent for employees in the Environment and Planning divisions, respectively. The Community division reported the lowest WFD awareness at 47 percent of respondents. There is slightly greater awareness of WFD among senior managers at 88 percent compared 78 percent among other staff.

General knowledge of the RBMP is slightly lower compared to WFD, as awareness was reported by 77 percent of respondents. Similarly to the WFD case, the Environment and Planning divisions reported the highest levels of awareness at about 91 and 84 percent of the employees, respectively. Slightly more than half of respondents the Communities and Roads divisions reported awareness of RBMP. Awareness among senior management roles is higher at 85 percent compared to 72 percent among other staff.

The levels of knowledge of specific aspects of RBMP such as the Blue Dot programme and the PAAs was considerably lower within the sample. When respondents were asked whether they were aware of the Blue Dot programme, 52 percent of respondents answered negatively; around 20 percent declared to have some knowledge and only around 27 percent stated to be aware of the programme and its objectives. The awareness of Blue Dot programme was lowest for the community division, where 85 percent of staff were not aware of the programme. Knowledge of the Blue Dot programme is highest in the Environment division, though 30 percent have no awareness of the programme.

When asked about the presence of a Blue Dot water body in their LA area, just 32 percent of respondents indicated awareness.² While there are a relatively small number of Blue Dot catchments across the country, awareness of whether a Blue Dot catchment is situated within a LA area (or not) is an indicator of the priority of RBMP objectives within LA areas. Awareness of Blue Dots is highest at 45 percent among Environment divisions and lowest among staff of Communities divisions where focus on water related issues is substantially lower. There is no practical difference in awareness of Blue Dot catchments by role seniority.

² The Blue Dot Catchments programme aims to maintain and restore high-status water bodies

When respondents were asked whether they were aware of any PAA in their local area, 46 percent of respondents answered positively.³ This share increased to 67 percent for Environment division staff. Only 15 and 19 percent of Community and Roads divisions respectively have knowledge of PAAs within their LAs.

Table 4: WFD and RBMP knowledge: frequency table

Code	Options	Total (%)	Environment (%)	Planning (%)	Communities (%)	Roads (%)	Grade 6 or lower	Grade 7 or higher
Awareness of WFD	No	18%	5%	13%	52%	28%	21%	12%
	Yes	82%	95%	87%	48%	73%	79%	88%
Awareness of RBMP	No	23%	9%	13%	48%	44%	27%	15%
	Yes	77%	91%	84%	52%	56%	73%	85%
Blue Dot	No	53%	30%	60%	85%	80%	54%	51%
	Yes, some knowledge	19%	32%	18%	1%	1%	19%	20%
	Yes	28%	37%	22%	13%	19%	27%	29%
Local Blue Dots	Don't know	41%	26%	46%	64%	73%	43%	38%
	No	27%	28%	24%	25%	64%	27%	28%
	Yes	32%	45%	29%	9%	36%	31%	34%
Local PAAs	No	54%	32%	60%	85%	81%	54%	53%
	Yes	46%	68%	40%	15%	19%	46%	47%

Table 5 shows statistical models that explore variables associated with WFD and water quality related knowledge. The odds ratio for job grade of respondent is positive and statistically significant in all 5 models, meaning that respondents in senior management roles are more likely to possess a higher degree of WFD/RBMP knowledge. With respect to duration of working experience in LAs, there is no statistical difference in awareness of WFD or RBMP among employees. However, staff with 10 or more year's experience are twice as likely be be aware of Blue Dot catchments or PAAs than staff with less than 2 year's experience.

The odds ratio associated with division of employment echo the earlier results related to higher awareness among Environment division staff followed by Planning, and Roads staff relative to the Communities division. For example, Environment division staff are 8 times more likely to be aware of Blue Dot catchments in their LA than Communities division staff and over 11 times more likely to be aware of PAAs in their LA. The comparable figure for Planning division staff for Blue Dots is 4 times but in the case of PAAs, Planning division staff are no more likely to be aware of PAAs in their LA area than Communities division staff. Roads and Communities division staff have similar levels of awareness of Blue Dots or PAAs in their LA area. Given the community focus in PAAs it was anticipated that Community division staff would have higher levels of awareness of PAAs than staff in other divisions.

The regression analysis also examines differences across regions using the Border region as reference category. Across all five models, the odds of staff in the South West region being aware of water quality issues, whether WFD, RBMP, Blue Dots or PAAs is relatively low. With respect to PAAs, staff in the Midlands, the South East, and the South West are less than half as likely to be aware of PAAs in their LA area compared to the Border region.

³ PAAs are areas deemed at risk of not meeting their WFD objectives and necessitate specific actions to improve water quality.

Table 5: Regression models for indicators of WFD and RBMP knowledge (Odds ratio)

	<i>Dependent variable:</i>				
	Knowledge of WFD	Knowledge of RBMP	Knowledge of Blue Dots	Blue Dots in local area	PAA in local area
	<i>logistic</i>	<i>logistic</i>	<i>ordered logistic</i>	<i>logistic</i>	<i>logistic</i>
	(1)	(2)	(3)	(4)	(5)
Grade 7 or higher	3.841** (1.344)	4.608** (1.544)	1.833** (0.385)	1.56 (0.368)	1.655* (0.391)
Years of Experience (ref. level: less than 2 years)					
2–9 years	1.382 (0.519)	0.818 (0.284)	1.289 (0.313)	2.46** (0.689)	1.063 (0.285)
10 years or more	1.297 (0.479)	1.257 (0.441)	1.937* (0.482)	2.249* (0.652)	2.083* (0.577)
Employee's functional area (ref. level: Communities)					
Environment	24.042** (10.747)	12.138** (4.880)	15.992** (5.965)	8.234** (3.598)	11.708** (4.379)
Planning	6.942* (3.374)	6.323* (3.130)	4.258* (1.805)	3.895 (1.936)	3.282 (1.395)
Roads	2.689 (1.046)	1.064 (0.404)	1.361 (0.589)	1.678 (0.848)	1.187 (0.524)
Regional committee (ref. level: Border)					
Midlands	0.603 (0.489)	0.545 (0.378)	0.672 (0.213)	0.238*** (0.090)	0.474*** (0.191)
South East	0.566 (0.476)	0.549 (0.399)	1.411 (0.518)	0.507** (0.214)	0.457*** (0.206)
South West	0.249*** (0.194)	0.168*** (0.112)	0.524*** (0.168)	0.443*** (0.162)	0.278*** (0.111)
West	0.447 (0.440)	2.248 (2.745)	2.059 (0.885)	1.11 (0.537)	0.654 (0.343)
Constant	1.112 (0.949)	1.624 (1.210)		0.109*** (0.062)	0.272*** (0.146)
Cut-off 1			8.605* (4.122)		
Cut-off 2			46.96* (23.527)		
Observations	416	415	457	455	453
Log Likelihood	-143.822	-161.181		-242.274	-249.145
Akaike Inf. Crit.	309.645	344.362		506.547	520.289

Note: *p<0.1; **p<0.05; ***p<0.01

4.1.3 Actions for water quality protection

Table 6: Inclusion of water quality objectives in decision-making: frequency distribution

<i>Have you incorporated water issues in...</i>			
Environment: incorporated in Decision making			
	All	Grade ≤ 6	Grade ≥ 7
Yes	61%	58%	69%
No	7%	5%	13%
Don't Know	32%	38%	18%
<i>Fisher test on grade</i>		.003***	
<i>(p-value)</i>			
Planning: incorporated in Planning decision processes			
Yes	26%	28%	25%
No	9%	3%	14%
Don't Know	65%	69%	61%
<i>Fisher test on grade</i>		.1094	
<i>(p-value)</i>			
Communities: incorporated in rural recreation, town & village renewal			
Yes	23%	17%	31%
No	11%	6%	17%
Don't Know	66%	77%	52%
<i>Fisher test on grade</i>		.46	
<i>(p-value)</i>			
Roads: incorporated in roadway management			
Yes	38%	23%	56%
No	19%	16%	22%
Don't Know	44%	61%	22%
<i>Fisher test on grade</i>		.0014***	
<i>(p-value)</i>			

Activities related to water protection are division-specific, reflecting different functional responsibilities. Survey participants were asked to indicate the actions that are currently undertaken within their LA. It should be noted that answers reflect opinions on actions undertaken rather than data on actual activity.

One question asked across all divisions was whether the objectives of RBMP were included in their decision making (Table 6). Across Environment divisions 61 percent of staff answered positively, while almost 32 percent did not know. These proportions differ by grade, rising to 69 percent for senior managers compared to 57 percent at lower staff grades. These differences across grades are statistically significant based on a Fisher test of independence ($p\text{-value} < .01$). A majority of Planning division staff answered 'don't know' (65 percent) with no statistical difference across grades ($p\text{-value} = > .10$). This is

an unexpectedly high figure but may reflect lack of knowledge on whether the procedures were updated since the start of the current WFD cycle (2018–2021) rather than indicating that they don’t know if water quality issues are incorporated in their decision making. Responses from Community division staff were similar to those in the Planning division. Lastly, 38 percent of Road division staff answered positively concerning inclusion of WFD objectives in their decision-making with respect to roadway and drainage management and responses were significantly different between grades ($p\text{-value} < .01$), similar to the Environment division.

Environment and Communities divisions were asked whether they had commenced a water related enhancement project or identified opportunities to integrate water issues into plans and projects, as itemised in Table 7. Environment division staff were divided almost equally between yes and no, whereas the majority of respondents of the Communities divisions answered ‘Don’t know’. While there was no *ex ante* anticipation of likely responses to these questions, they illustrate the wide disparity in knowledge of water-related activities within LAs.

Environment divisions usually have responsibility for enforcement of water pollution incidents. Table 8 lists potential enforcement activities and the proportion of Environment division staff indicating specific measures that are actively used to address either point or diffuse source water pollution. With respect to point source water pollution, Section 4 licence inspections, statutory notices, and unauthorised discharge investigations are cited by the highest number of respondents, implying these are the the most frequently used enforcement actions. The proportion of respondents indicating enforcement actions for diffuse source pollution are substantially lower. The most common enforcement action related to diffuse source water pollution is issuing poor land management advisories. ‘Cross Report to DAFM’ refers to reporting non-compliances to the Department of Agriculture, Food, and Marine under the Good Agricultural Practice for the Protection of Waters Regulations (GAP Regs/Nitrates Regs), with 59% of staff indicating its use. Cross Compliance is a statutory mechanism designed to ensure the sustainable use of land and the maintenance of natural resources. The absolute number of incidents of cross-compliance reporting is relatively low (EPA, 2020a).

Table 7: Plans and projects of Communities and Environment divisions

Environment division		
<i>Has your LA commenced any natural water resource related enhancement projects or initiatives in the last 2 years?</i>		
Yes	No	
49%	51%	
Communities division		
<i>Has your LA identified new opportunities to integrate natural water resources into plans or projects?</i>		
Yes	No	Don't know
28%	3%	68%

Table 8: Proportion of Environment division staff indicating specific enforcement measures are utilised

Point source water pollution		Diffuse source water pollution	
Measure	Frequency	Measure	Frequency
Section 4 licence inspections	80%	Serve statutory notices under legislation	57%
Statutory notices	73%	Cross-report to DAFM	55%
Prosecute pollution incidents	63%	Identify critical areas using GIS	41%
Farm inspections	65%	Monitoring to isolate diffuse pollution areas	47%
Cross-report to DAFM	59%	Communication to Promote best practices	42%
Unauthorised discharge investigations	77%	Promote nutrient management planning	42%
Programme targeting water quality	52%	Communicate best practices to agricultural contractors	24%
		Issue poor land management advisory	66%

5 Discussion and Recommendations

The stated purpose of the survey on the introductory page of the questionnaire was “to collect data on knowledge and awareness of water quality issues within Local Authority functional areas for the purpose of improving the effectiveness of River Basin Management Planning and achieving national targets with respect to the EU Water Framework Directive.” Irrespective of the design, a survey questionnaire eliciting information from staff across a broad range of functional responsibilities, even allowing for questions conditional on the respondent’s role, is likely to be inadequate to unequivocally assess staff knowledge and awareness. Instead the survey, as designed, is intended to provide a broad-brush assessment of staff knowledge, which is sufficient to identify where knowledge gaps exists or where remedial actions may be necessary. A more definitive assessment requires an alternative methodological approach, possibly using qualitative interviews.

5.1 General Knowledge

The analysis suggests that employees’ knowledge of institutions responsible for water quality in Ireland is nominally high, with some differences across divisions. Environment and Planning are the divisions with the greatest knowledge, possibly reflecting interactions with other institutions involved in water management during the course of their work. General knowledge of river ecological status was much lower, with just 25 percent of respondents correctly reporting ecological status, whereas 46 percent of respondents either don’t know or believe that water quality is satisfactory. For over two decades the EPA has been documenting the decline in water quality and this statistic suggests that diffusion of that message could be improved. Only a proportion of LA staff might be expected to have detailed knowledge of the issues around water quality but basic knowledge on the status and pressures facing water bodies is essential if LAs are to fulfil their responsibilities across all functional divisions with respect to protecting water quality. Given the importance of LA staff within the context of WFD/RBMP, greater emphasis on knowledge and training with respect to water quality is merited.

A conspicuous finding on water quality knowledge relates lower knowledge levels among staff in upper management roles within Environment divisions. For example, just 1 in 3 of such senior managers are aware of the share of rivers with good or high ecological status. Career progression in such roles is usually not dependent on scientific or technical knowledge, however, the lack of awareness of the broader context for water quality in Ireland may influence priorities among competing demands of LA functions. A question asked in this research is whether the strategic vision and priorities related to the RBMP are disseminating through water management governance structures? The survey results suggest that this might not always be the case. While staff in more junior roles appear to have greater knowledge of specific water issues, the lower level of knowledge among staff in senior management roles raises doubt about their awareness of priorities and responsibilities for LAs in implementing the RBMP.

5.2 Knowledge of water framework directive

Awareness of WFD and RBMP is high. The frequency of answers that stated awareness of WFD and RBMP exceeded 75 percent in both questions. Due to reporting responsibilities and participation in water management governance structures one might anticipate greater in-depth knowledge or awareness of WFD/RBMP among staff in senior management roles. The survey elicited data about high-level awareness rather than in-depth knowledge, information that one would anticipate would disseminate through all hierarchical governance structures. The statistical analysis shows that senior managers across all divisions are 4–5 times more likely to be aware of the WFD/RBMP and about twice as likely to be aware of the Blue Dot programme compared to junior staff. This suggests that information about water management does not circulate effectively to lower staff grades within LAs. Staff in lower grades include executives and technicians that are responsible for day-to-day operations that impact on water quality. It is crucial that they are aware of water-related issues, particularly, critical initiatives such as Blue Dot programme and PAAs.

It was anticipated that staff in Environment divisions would have the highest levels of awareness of water related topics as water management falls closest to their areas of functional responsibility. The relative difference in awareness across divisions is very high. For instance, Environment division staff are 11 times more likely to be aware of PAAs within their LA area than Communities division staff, as reported in Table 5. This finding is particularly relevant in the context of WFD/RBMP advocating a deeper involvement by local communities in water management. LAWPRO is undertaking several initiatives of community engagement to improve awareness of water quality and increase participation in water management. Given the limited knowledge among Communities division staff, especially related to PAAs in their local area, engagement with the public on water protection issues is likely to be low.

The variation in awareness of water issues across divisions possibly reflects different experiences among staff with respect to briefings about water topics. Just 3 percent of Communities division staff indicated that they receive monthly updates, 5 percent quarterly updates, 10 percent annual updates and the balance

receiving no updates. More Environment division staff receive briefings and with greater frequency. Poor awareness of water quality issues reflects the absence of or infrequent staff briefings on water quality. The absence of such briefings may also indicate the relative priority attached to water quality issues within specific LAs.

Knowledge and awareness of water quality management issues increases with experience (i.e. length of service), therefore a positive association between knowledge and experience may be reasonably assumed. Within the sample 33 percent of respondents have less than 2 year's experience, and 18 percent less than 1 year's experience. In some instances, the relatively high share of newly hired employees that are still assimilating into their new roles may have affected findings on overall knowledge levels. While this may be attributed as explanation of the lower knowledge levels in some instances, staff recruitment is ongoing and therefore a priority for new staff should be education and mentoring to expedite knowledge and awareness of water management issues.

5.3 Water quality proofed decision making

The overarching conclusion from survey responses is that most staff are aware of what activities are undertaken for water quality protection and how LAs incorporate water protection in their decision-making. Overall, the large frequency of 'don't know' responses to questions about how RBMP objectives have been incorporated into decision making within their specific division indicates that WFD/RBMP objectives are not clearly appreciated in daily work. The situation among Environment divisions is the most positive, as might be anticipated, nonetheless 32 percent of Environment division staff do not know whether RBMP objectives are considered in their decision-making, as reported in Table 6. Not all employees in Environment divisions have direct responsibility for water quality, therefore some staff might reasonably ignore some water quality issues. However, as water quality is inextricably linked to many other aspects of environmental quality, strong coordination across all employees in the Environment division is essential. In other divisions the large share of 'don't know' answers is equally striking. For example, 65 percent of Planning division staff reported 'don't know' when asked if RBMP objectives are been incorporated into decision making. Planning division staff are responsible for development plans, which set out the planning policies within the LA functional area. Development plans must be compatible with national and regional planning strategies, and also incorporate an environmental report that highlights any significant environmental effect the plan may have. The survey results raises the question as to whether RBMP objectives are been being adequately incorporated in LA development plans.

5.4 Enforcement

A simple comparison of enforcement actions indicates that more enforcement actions arise on point as opposed to diffuse source water pollution. With better resources and enforcement tools, point source pollution is easier to detect and identify the malefactor compared to diffuse source pollution. EPA (2020b) concludes that the most significant pressure on the ecological health and quality of waters is agriculture

and that within agriculture the first cited pressure is the run-off of nutrients and sediments from agricultural land. While point source pollution is not to be ignored, a greater enforcement focus on diffuse source pollution is merited.

LAs' enforcement actions are concentrated around a limited number of actions within a larger set of possible measures. As noted earlier, there is relatively low level of cross-compliance reporting. With just 3,878 on-farm inspections in 2019, which represents less than 3 percent of farms the EPA is seeking an increase in the level of cross reporting and notes that LAs' reluctance to follow the cross-reporting approach to enforcement is because it can result in loss of stakeholder engagement where financial sanctions are applied and that minor non-compliance can be resolved through other enforcement actions (EPA, 2020a, 2021). It is therefore surprising that the softer enforcement actions, such as communicating best agricultural practices or promoting nutrient management planning, are among the least utilised enforcement measures.

5.5 Recommendations

LA staff have responsibility for day-to-day decisions on many issues that ultimately impact on water quality (e.g. environmental protection, roads drainage, planning and development). Knowledge of water quality and specific issues relevant to the RBMP is relatively high among some LA staff but the survey research demonstrates that there is considerable scope for improvement across all divisions, including among Environment divisions where knowledge is greatest. Based on the survey research, recommendations are outlined below to improve the dissemination of pertinent information through the tiers of water governance within LAs and also improve the knowledge and competencies of staff to help people perform better in their roles. The recommendations fall across three areas: training, dissemination, and networks.

1. Training

LA staff do not all need the same level of knowledge and expertise related to water quality and WFD/RBMP. Depending on functional area and role, different competencies and knowledge levels are required to effectively complete their work. Training should be established to help people perform better and more efficiently in their jobs.

(a) Induction training

A module on water quality and river basin management should be included in new staff induction training. Providing basic awareness training to staff working across LA functions (e.g. housing, waste, emergency services, etc.) should prompt such staff to seek assistance from colleagues elsewhere in the LA when issues that may have a potential impact on water quality occasionally arise.

(b) Role-based training

Within functions with a more direct link to water quality, bespoke role or function based training should be established. This is especially relevant within Environment and Planning divisions. The elements of such training should include, amongst others, accessing and utilising tools, mapping and data resources; interpreting relevant data; guidance on framing of planning conditions.

(c) Continuing professional development

As legislative contexts, scientific knowledge, resources and practices are continually evolving, role-based training should be repeated on a regular recurring basis.

(d) Senior managers

Career progression in LAs, as in many organisations, requires skills and competencies related to people and project management. Senior managers, e.g. Director of Services, may not personally require highly technical or in-depth knowledge to successfully fulfil their roles, as they can rely on the technical knowledge of their teams. However, a lack of awareness of the broader context for water quality and RBMP can influence priorities. Specific training for senior management roles should focus on priorities and responsibilities for LAs in implementing the RBMP. Such training should be a mandatory requirement for all new appointments in senior roles within Environment and Planning functions.

(e) Training provision

Centralised development and provision of training will ensure consistency across LAs. The Local Authority Services National Training Group (LASNTG), which already develops and delivers a broad range of training to LA staff is ideally suited to undertake this role. LASNTG are already commencing new training in ‘Catchment Science and Management’ in 2021 with modules on catchment science, characterisation, as well as protection and mitigation. This course has immediate relevance for people working in catchment science and management, but its content, or elements thereof, has relevance to LA staff across several divisions.

2. Dissemination

The survey research confirms that there is room for improvement in the dissemination of information related to water quality among LA staff, including policy priorities and national programmes (e.g. Blue Dots, PAA). While senior managers are members of various RBMP governance structures (e.g. NCMC, Regional Local Authority committees), the survey research fails to demonstrate that more junior staff have sufficient awareness of national priorities related to water quality. This is especially relevant in the Environment and Planning divisions where LA decisions can have a direct impact on water quality.

- (a) Each LA should assess its internal communications processes to determine whether staff at all levels are being adequately briefed on water quality issues. Are staff receiving sufficient and regular updates relevant to their job function? Are staff aware of national policy priorities? Do staff understand the motivation behind internal processes and notifications? Are staff aware when issues should be escalated or when other teams should be notified?
- (b) The EPA should assess its dissemination strategy for water quality information. The target audience or the people attending its conferences and workshops or reading its reports may not be sufficiently wide. It should consider how it can more actively engage with LA staff, especially in Environment and Planning divisions, across all job grades to improve awareness of the status of water quality and increase understanding of how their work contributes to water quality protection.

3. Networks

Staff working in specific functional areas, such as Environment and Planning, often have extensive workloads shared among relatively small teams. Within smaller teams practical experience and institutional knowledge can be limited, while extensive workloads can limit the time devoted to particular issues. The Network for Ireland's Environmental Compliance and Enforcement (NIECE), whose vision is improving the implementation of environmental protection legislation, is a forum to support public authority staff, including LA staff, share experiences and support each other in environmental protection work.

- (a) Utilise the NIECE network to engage all LA staff working in functions that have water quality responsibility to increase awareness of water quality status, local programmes and initiatives, and environmental pressures.

6 Conclusion

Achieving WFD targets of good ecological status for all water bodies necessitates successful implementation of a myriad of measures. A key element of achieving this is that water governance structures effectively operate and communicate with each other. This research examines one aspect, the extent to which knowledge of water quality issues and RBMP objectives disseminate through water management governance hierarchies into Local Authority functional areas and work responsibilities. Three main questions were addressed: 1) whether employees are aware of the status of water quality in Ireland, 2) whether employees possess technical knowledge on water framework directive and river basin management plan, and 3) whether employees are aware of the actions undertaken for water quality protection and enforcement.

The answers to the three questions are similar. There is a good level of general knowledge, e.g. awareness of WFD and RBMP particularly at national level. Detailed knowledge, specifically related to PAAs and Blue Dot catchments within staff's own LA area, is substantially lower. Knowledge levels are highest among Environment division staff. Knowledge levels also differ by length of service, and by whether in managerial roles or not. Senior managers were 3–4 times more likely to have knowledge of WFD and RBMP compared to junior staff, for example. When focusing on PAAs or Blue Dots within their own functional area knowledge that difference in knowledge is substantially lower. Therefore, one can conclude that while general knowledge and awareness levels are relatively high, there is considerable scope for improvement across all divisions.

The dissemination of RBMP priorities and actions through water governance hierarchies is evident. For instance, knowledge among senior managers, who are higher up the hierarchy, is greater than more junior staff, which is consistent with the fact that the same level knowledge and expertise related to water quality and RBMP is not required across all functions and roles. However, there is also some evidence that a better balance may be necessary, especially in functions with direct impact on water quality. For instance, reported water quality knowledge among staff in senior management roles within Environment divisions is relatively low, with just 1 in 3 of such senior managers knowledgeable on the ecological status of rivers. This finding may also reflect the challenging context within which LA staff work, as the competing priorities of LA functions do not all have a direct connection with water quality. Nonetheless, it is imperative that LA staff have a strong understanding of LA responsibilities and how these fit within the wider water governance hierarchy. More than half of LA respondents were not aware of the Blue Dot catchments and PAAs within their local authority area. The success of initiatives such as the Blue Dots catchment programme and the PAAs relies on broad engagement across all sectors of society to protect water quality. From a local government perspective this means that these initiatives are not just the preserve of the Environment division but require a comprehensive cross-organisation approach to their delivery.

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References

Akhmouch, A., & Clavreul, D. (2016). Stakeholder engagement for inclusive water governance: "practicing what we preach" with the oecd water governance initiative. *Water*, 8(5), 204.

- Akhmouch, A., Clavreul, D., Hendry, S., Megdal, S., Nickum, J., Nunes-Correia, F., & Ross, A. (2020). *Oecd principles on water governance: From policy standards to practice*. Routledge.
- Akhmouch, A., & Correia, F. N. (2016). The 12 oecd principles on water governance—when science meets policy. *Utilities Policy*, 43, 14–20.
- Baldwin, E., McCord, P., Dell’Angelo, J., & Evans, T. (2018). Collective action in a polycentric water governance system. *Environmental Policy and Governance*, 28(4), 212–222.
- Boyle, R., O’Riordan, J., O’Leary, F., & Shannon, L. (2021). *Using an experimental governance lens to examine governance of the river basin management plan for ireland 2018–2021*. Environmental Protection Agency. (https://www.epa.ie/publications/research/water/Research_Report_373.pdf)
- Cameron, A. C., & Trivedi, P. K. (2005). *Microeconometrics: methods and applications*. Cambridge University Press.
- EPA. (2020a). *Focus on local authority environmental enforcement — 2018 performance report*. Environmental Protection Agency. (<https://www.epa.ie/publications/compliance–enforcement/public-authorities/EPA-LA-ENV-2020-v6.pdf>)
- EPA. (2020b). *Ireland’s environment - an integrated assessment*. Environmental Protection Agency. (https://www.epa.ie/pubs/reports/indicators/SOER2020_HiRES.pdf)
- EPA. (2021). *Focus on local authority environmental enforcement — activity report 2019*. Environmental Protection Agency. (<https://www.epa.ie/publications/compliance–enforcement/public-authorities/EPA/LAEnforcementReport2019.pdf>)
- Fritsch, O. (2019). Participatory water governance and organisational change: Implementing the water framework directive in england and wales. *Water*, 11(5), 996.
- García, M. M., Hileman, J., Bodin, Ö., Nilsson, A., & Jacobi, P. R. (2019). The unique role of municipalities in integrated watershed governance arrangements. *Ecology and Society*, 24(1).
- Graversgaard, M., Hedelin, B., Smith, L., Gertz, F., Højberg, A. L., Langford, J., ... others (2018). Opportunities and barriers for water co-governance—a critical analysis of seven cases of diffuse water pollution from agriculture in europe, australia and north america. *Sustainability*, 10(5), 1634.
- Greene, W. H. (2003). *Econometric analysis* (5th ed.). New Jersey: Prentice Hall.
- Greene, W. H., & Hensher, D. A. (2009). *Modeling ordered choices: A primer*. Cambridge, UK: Cambridge university press. (<https://doi.org/10.1037/0021-9010.91.1.97>)

- Huitema, D., Mostert, E., Egas, W., Moellenkamp, S., Pahl-Wostl, C., & Yalcin, R. (2009). Adaptive water governance: assessing the institutional prescriptions of adaptive (co-) management from a governance perspective and defining a research agenda. *Ecology and society*, 14(1).
- Ipe, M. (2003). Knowledge sharing in organizations: A conceptual framework. *Human resource development review*, 2(4), 337–359.
- Jager, N. W., Challies, E., Kochskämper, E., Newig, J., Benson, D., Blackstock, K., ... others (2016). Transforming european water governance? participation and river basin management under the eu water framework directive in 13 member states. *Water*, 8(4), 156.
- Jetoo, S. (2019). An assessment of the baltic sea action plan (bsap) using the oecd principles on water governance. *Sustainability*, 11(12), 3405.
- Kallis, G., & Butler, D. (2001). The eu water framework directive: measures and implications. *Water policy*, 3(2), 125–142.
- Moss, B. (2008). Water pollution by agriculture. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 363(1491), 659–666.
- Neto, S., Camkin, J., Fenemor, A., Tan, P.-L., Baptista, J. M., Ribeiro, M., ... Elfithri, R. (2018). Oecd principles on water governance in practice: an assessment of existing frameworks in europe, asia-pacific, africa and south america. *Water international*, 43(1), 60–89.
- OECD. (2015). *Oecd principles on water governance welcomed by ministers at the oecd ministerial council meeting on 4 june 2015*. OECD Paris.
- O’Riordan, J., Boyle, R., O’Leary, F., & Shannon, L. (2021). *Using the oecd water governance indicator framework to review the implementation of the river basin management plan for ireland 2018–2021*. Environmental Protection Agency. (https://www.epa.ie/publications/research/water/Research_Report_372.pdf)
- Ostrom, E. (2010). Beyond markets and states: polycentric governance of complex economic systems. *American economic review*, 100(3), 641–72.
- Pahl-Wostl, C. (2017). An evolutionary perspective on water governance: from understanding to transformation. *Water Resources Management*, 31(10), 2917–2932.
- Paisley, R. K., & Henshaw, T. W. (2014). If you can’t measure it, you can’t manage it: Transboundary waters, good governance and data & information sharing & exchange. *Ind. Int’l & Comp. L. Rev.*, 24, 203.

- Petersen, T., Klauer, B., & Manstetten, R. (2009). The environment as a challenge for governmental responsibility—the case of the european water framework directive. *Ecological Economics*, 68(7), 2058–2065.
- Priscoli, J. D. (2004). What is public participation in water resources management and why is it important? *Water international*, 29(2), 221–227.
- Razzaque, J. (2009). Public participation in water governance. In *The evolution of the law and politics of water* (pp. 353–371). Springer.
- Rollason, E., Bracken, L., Hardy, R., & Large, A. (2018). Evaluating the success of public participation in integrated catchment management. *Journal of Environmental Management*, 228, 267–278.
- VanNijnatten, D. L. (2020). The potential for adaptive water governance on the us–mexico border: application of the oecd’s water governance indicators to the rio grande/bravo basin. *Water Policy*, 22(6), 1047–1066.
- Van Rijswick, M., Edelenbos, J., Hellegers, P., Kok, M., & Kuks, S. (2014). Ten building blocks for sustainable water governance: an integrated method to assess the governance of water. *Water international*, 39(5), 725–742.
- Woodhouse, P., & Muller, M. (2017). Water governance—an historical perspective on current debates. *World Development*, 92, 225–241.