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WORKSHOP REPORT ON SHARING KNOWLEDGE AND EXPERIENCE TO SUPPORT INTEGRATED MANAGEMENT OF CORK HARBOUR AND CATCHMENT

Held on February 24th 2026 at

University College Cork – Sustainability Institute: Beaufort Building,
Ringaskiddy, County Cork



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v1.0 Report issued 25th March, 2026

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EVENT SUMMARY

This report summarises contributions by Cork Harbour and Catchment stakeholders who participated in the “Sharing knowledge and experience to support integrated management of Cork Harbour and Catchment” workshop, held in University College Cork’s Sustainability Institute: Beaufort Building on 24th February 2026. Invitations were extended to local authorities, government departments and agencies, NGO, industry sectors and the academic community with 18 stakeholders involved on the day. The Workshop, through a series of structured parallel and plenary sessions, allowed participants to identify a range of issues and discuss and agree associated recommendations. This report outlines the approach adopted and presents both the issues raised and the participants suggestions to address these concerns with a focus on improving the efficacy of integrated management of the Harbour and Catchment.

Over the course of three discussion sessions “Scene Setting: A shared region and shared visions”, “Current Information and data sharing”, and “Integrating knowledge and information”, attendees established a shared understanding of the Cork Harbour and Catchment region, current and future priorities, and identified the key barriers to integrated management. They then shared their professional experiences of decisions they make in their roles concerning the harbour and/or catchment, before identifying the information needs they have, or information gaps that could improve decision-making. The final session focused on how the gaps could be resolved, with participants identifying practical steps, and potential collaborative actions that, if implemented, could advance integrated management of the Harbour and Catchment in a manner that balances thriving local economies, environmental resilience, and social well-being.

The half day event mapped out a range of issues that regulators, industry and civil society representatives working in the region would like to see addressed, potentially by improving regional capacity to manage and make decisions in a more integrated fashion. Participants engaged productively with the discussions, resulting in a wealth of perspectives, information, and guidance. A comprehensive analysis was conducted, consisting of a manual review and assisted text analysis to address potential bias. This approach ensured that all perspectives were incorporated and recognised’. It helped to identify patterns, gaps, and prevalent topics within the stakeholder feedback, which were then validated through team discussions and cross-referenced with the original discussion records to ensure consistency and validity.

The goal was to create a robust, actionable summary that reflects the depth and diversity of participant contributions. Fifteen overall recommendations were extracted from the perspectives shared over the course of the discussions. They are presented here alongside the highlighted challenges, and identified needs to help guide future efforts, maintain momentum and promote action that addresses those issues.

AGENDA

Registration & Tea/Coffee
Scene Setting: A shared region and shared visions Establish a shared understanding of the Cork Harbour and Catchment region, current and future priorities, and identify the key barriers to integrated management.
Tea/Coffee
Current Information and data sharing Identify the decisions you need to make, assess whether current information systems support those decisions, and prioritise critical data and infrastructure gaps.
Refresh & Reset
Integrating knowledge and information Define practical steps, infrastructure needs, and collaborative actions required to advance integrated management.
Lunch



SESSION 1: SCENE SETTING - A SHARED REGION AND SHARED VISIONS

Participants, working in three parallel groups, were asked to consider two key questions:

- 1) *What issues are you (the stakeholders) currently trying to tackle / address?*
- 2) *What is the nature of existing efforts?*

After roundtable introductions, the facilitated discussions allowed participants to highlight the following challenges that restrain or complicate effective decision making:

- Data Fragmentation and Accessibility Issues – People noted widespread gaps in data availability (e.g., noise, and availability of metadata) and the lack of a centralised, user-friendly repository. The importance of one-stop-shop data repositories (e.g., National Biodiversity Data Centre) to consolidate and improve data usability was highlighted.
- Lack of Data Sharing Platforms - The absence of online platforms for collaborative data collection, storage, and sharing about Cork Harbour and catchment was highlighted.
- Competing Economic, Environmental, and Social Pressures – Participants acknowledged the tension between development, conservation, and recreational uses, tension that requires balanced decision-making despite the information gaps.
- Unclear Governance and Responsibilities – There is a perception that the regulatory framework is fragmented which has consequences for monitoring, compliance and oversight. For example, there is no single entity responsible for the entire harbour catchment, leading to enforcement gaps and a lack of coordination.
- Public Engagement Gaps – Participants highlighted low public interest and participation in the harbour and catchment, emphasising the need for citizen science and inclusive outreach programmes.
- Climate Change as a Cross-Cutting Threat - The urgent need to address climate impacts, was emphasised (for example, from flooding).
- Short-Term Focus vs. Long-Term Planning - The absence of long-term strategies for climate adaptation, infrastructure, and environmental management was noted.
- Infrastructure and Resource Shortfalls - Delays in critical infrastructure projects were highlighted, along with chronic funding shortages for sustained data and management initiatives.
- Need for Whole-Catchment Planning – The need for a holistic, catchment-wide approach was recognised, to replace piecemeal projects and better connect upstream and inshore communities.
- Weak Public Connection to the Harbour - Many locals, even in Cork City, let alone upstream in the catchment lack a personal or cultural connection to the harbour, requiring creative engagement strategies to connect them to the Harbour and Catchment.

- Collaboration and Coordination Gaps – Discussions highlighted the lack of integrated management and cross-sector collaboration, highlighting that there are examples of past forums that were successful, well received initiatives for collaboration and coordination, and had tangible impact. For example, the Cork Harbour Forum was well supported by stakeholders and led directly to Cork Harbour being included as a distinct area in the County Development Plan. It should be noted that Forums, have historically been linked to, and reliant on, timebound EU funded projects so any new initiative should not be reliant on short-term funding.
- Flooding as a Dual Challenge and Opportunity - Flooding was recognised as having both negative impacts and educational value, helping communities understand the harbour's history and future risks.
- Mixed Perceptions of the Harbour - While water quality has improved, negative perceptions persist, requiring efforts to shift public mindsets.
- Erosion Management Needs - There is a need for both hard and soft erosion control solutions, with opportunities for innovative, nature-based approaches.
- Ineffective Information Sharing – Poor communications persist between those with a recognised and clear stake in the harbour, and those un-recognised stakeholders in the general public. Datasets such as the Cork Chamber's survey, and potentially many others, could be underutilised, compounded by a lack of awareness that it exists.
- Biodiversity and Consenting Challenges - Recognised issues with the use of outdated data in consenting processes, and the need for clearer biodiversity protection frameworks were discussed.
- Business and Economic Vulnerabilities – The participants highlighted challenges associated with rising costs (energy, geopolitical factors etc.) and the need for stable funding mechanisms to support harbour-related initiatives.
- Regulatory Rigidity as a Barrier – The ways in which inflexible regulatory frameworks can hinder adaptive action were noted, calling for more agile processes to be used.
- Baseline Data Deficits – There is a lack of baseline data on public perceptions and connections to the harbour, necessitating surveys or studies.
- Restoration and Adaptive Management Opportunities – the potential for ecological restoration was explored, alongside adaptive strategies to address historical impacts (e.g., pollution, habitat loss).
- Funding and Validity Challenges – There was recognition of a 'Catch-22' or 'chicken and egg' problem concerning funding, i.e. the need to demonstrate value to secure funds, even when baseline data is lacking.
- Licensing and Data Usability Barriers - Challenges associated with data licensing, ownership, and the need for clearer protocols to improve usability and sharing.

SESSION 2: CURRENT INFORMATION AND DATA SHARING

Following on from the previous session, participants reconvened in their groups to consider the issues raised in the context of improved knowledge, information and data sharing and to consider these questions:

- 1) *What decisions are you faced with making in relation to monitoring and future management?*
- 2) *What information do you need to support these decisions?*
- 3) *Are there any gaps?*

For convenience the topics discussed, their context and the varied needs of the stakeholders have been tabulated below.

Discussion Topic	Context	Critical Needs
Data Availability and Accessibility	Decisions impacted concern research, conservation, consenting, compliance, and port development. Data are often unavailable or non-existent, whilst there is also difficulty associated with accessing data from landowners, companies, and industry, especially for non-designated sites. A lack of centralised repositories complicates matters.	- One-stop-shop data repositories for all stakeholders. - Long-term and up-to-date datasets for robust decision-making. - Clear metadata and cataloguing to identify who holds what data. - Coordination of data gathering, to improve awareness/situation gaps.
Data Quality and Robustness	Decisions impacted include Appropriate Assessment (AA), mitigation, compliance, and research. Conflicting data sources, outdated data, and variable robustness of citizen science data create challenges.	- Cross-checking mechanisms between official and citizen-collected data. - Training for citizen scientists to ensure reliable data collection. - Ground-truthing to account for climate change impacts.
Data Sharing and Integration	Decisions impacted include compliance, integrated management, and cross-sector collaboration. Duplication of efforts, lack of interoperability between datasets, and GDPR realities limit effective data sharing.	- Standardised data formats to enable integration. - Voluntary/mandatory data-sharing mechanisms to maximise existing data use. - Networked collaboration to reduce red tape and foster integration.
Stakeholder Engagement and Communication	Decisions impacted include public outreach, compliance, and conflict resolution. Unfounded stakeholder concerns, undervalued local knowledge, and lack of awareness about responsible entities create barriers.	- Clear communication channels for fact-checking and public engagement. - Partnerships with universities to address data gaps.

		- Revitalised or re-established Cork Harbour Forum to unite stakeholders.
Resource and Capacity Constraints	Decisions impacted include monitoring, compliance, and long-term planning. Limited human and financial resources, time-consuming data requests, and lack of training for data collectors hinder progress.	- Dedicated funding for data management and monitoring. - Streamlined processes to reduce duplication and administrative burdens.
Policy and Regulatory Challenges	Decisions impacted include compliance, permitting, and adaptive management. Inflexible regulations, policy misalignment, and lack of priority ambitions for the harbour and catchment lead to fragmented efforts.	- Clear policy drivers for data standards and sharing. - Flagship challenges to unite stakeholders around common goals, while respecting ambitions outside the flagship challenges.
Social and Economic Data Gaps	Decisions impacted include climate adaptation, public awareness, and business sustainability. Limited social and economic data, lack of business information for sustainability, and lack of public awareness relating to successes are key issues.	- Place-based data (economic, environmental, social, health) for adaptation. - Outreach programmes to highlight successful interventions.
Learning from Legacy and Building Networks	Decisions impacted include long-term planning and adaptive management. Failure to learn from past projects and missed opportunities for student-led research to fill data gaps are notable opportunities to address.	- Mechanisms to capture and apply learnings from past efforts. - Targeted university partnerships and guidance to address specific data gaps.
Clarifying Governance and Public Sector Roles	Decisions impacted include compliance, enforcement, and public trust. Tensions exist between national and local planning (e.g. the incinerator planning application for Ringaskiddy). Additionally, public sector roles are often overlooked or underutilised, and no single entity oversees the entire harbour catchment.	- Clearer definition and promotion of the governance roles and responsibilities of various management bodies operating in the harbour and catchment - Greater integration of public sector actors with local communities in harbour and catchment management.

SESSION 3: INTEGRATING KNOWLEDGE AND INFORMATION

To conclude, a plenary discussion between all stakeholders on how best to integrate existing, and obtain new, knowledge and information was conducted. From this, the following set of non-prioritised recommendations were derived:

- **Maintain Momentum:** Sustain progress and engagement beyond the workshop to ensure ongoing impact.
- **Establish a Central Data Repository:** Create a one-stop shop for Cork Harbour and catchment data, integrating both national databases and local knowledge (environmental, GIS, etc.). Ensure the repository is managed, updated, and accessible.
- **Clarify Roles and Responsibilities:** Define which official body is responsible for what, especially for compliance monitoring and enforcement. Meanwhile, clarify which bodies hold what data, how they share it, and how they could improve or facilitate sharing.
- **Develop a Stakeholder Forum:** Consolidate a Cork Harbour Network Group with inclusive representation from all sectors (policy, industry, science, society). Suggest holding quarterly meetings to foster dialogue, share updates, and drive collaborative actions.
- **Promote Cross-Sector Collaboration:** Encourage cross-sector partnerships to address shared challenges and scale initiatives.
- **Create a "Living Lab" or data coordination hub for Cork Harbour:** Position Cork Harbour as a "Living Lab" for testing innovative solutions and best practices in integrated management, while coordinating data gathering to address knowledge gaps and network the various data holders.
- **Improve Public Outreach and Communication:** Provide accurate and accessible outreach information for the public, to raise awareness and engagement, and connect them to the harbour and catchment.
- **Secure Funding for Collaboration:** Seek funding to support the forum, data repository, and collaborative initiatives such as the coordination hub.
- **Catalogue and Share Data:** Have each organisation create a list of data they can potentially share (with or without restrictions), ideally making it publicly available.
- **Formalise Collaboration Structures:** Establish formal channels for ongoing conversation and collaboration, rather than depend on *ad hoc* activities.

- **Support Infrastructure Development:** Advocate to support effective infrastructure delivery for people and economic growth.
- **Foster Knowledge and Experience Sharing:** Create mechanisms for continued knowledge exchange among stakeholders in Cork Harbour and Catchment.
- **Prepare for up-scaling of successful Initiatives:** Identify and prepare ourselves to scale up initiatives that arise from the forum, to maximise impact across the region.
- **Encourage Open Collaboration:** Remain open to ongoing collaboration and conversation to adapt to new challenges and opportunities.
- **Support enhanced monitoring:** Strengthen our capability to encourage alignment of communities with developed Cork Harbour and Catchment-focused priorities and support accountability and transparency.



DISCUSSION

Participants discussed how best to share information and there was a definite consensus that having a regular Cork Harbour and Catchment Forum would be extremely useful. To make this meaningful it was suggested that representation should include and/or extend to the following groups / individuals (non-exhaustive list):

Cobh & Harbour Chamber	Department of Climate, Energy, and the Environment	National Parks and Wildlife Service
Port of Cork Company Ltd	Office of Public Works	The Environmental Forum
Maritime Area Regulatory Authority	Coastwatch	Sustainable Water Network
University College Cork	Fáilte Ireland	Cork City Council
Local residents	Leisure, Kayaking / diving clubs	Head of Climate Action Regional Offices (CAROs)
Inland Fisheries Ireland	Department of Agriculture, Food and the Marine (DAFM)	Tidy Towns committees
Bord Iascaigh Mhara (BIM)	Angling clubs	Office of Public Works
Pharma industries	Marine Institute	Department of Transport
ESB	Southern Regional Assembly	River Basin Managers
Irish Naval Service	CHASE	IBEC
Ring of Cork	Meitheal Mara	Uisce Éireann
Cork County Council: Biodiversity Officers	Environmental Protection Agency	SECAD (community development organisation)



It was agreed that an informal, but regular event would be welcomed by stakeholders and UCC confirmed that they would look into the best way to proceed and respond to all in due course.

In terms of better understanding how the Harbour and Catchment were functioning it was noted that participants were prepared to share information (e.g. tide information) with other stakeholders and that the idea of a “living lab” was deemed to have definite merit. As such, UCC agreed to follow up to determine how this could be achieved, and how stakeholders could actively participate.

In closing, participants were thanked for their time and it was agreed that a draft event report would be shared by UCC with all present for review and comment, before wider dissemination of a final version to all relevant stakeholders.

PRESENTATIONS



Sharing knowledge & expertise to support integrated management of Cork Harbour & Catchment

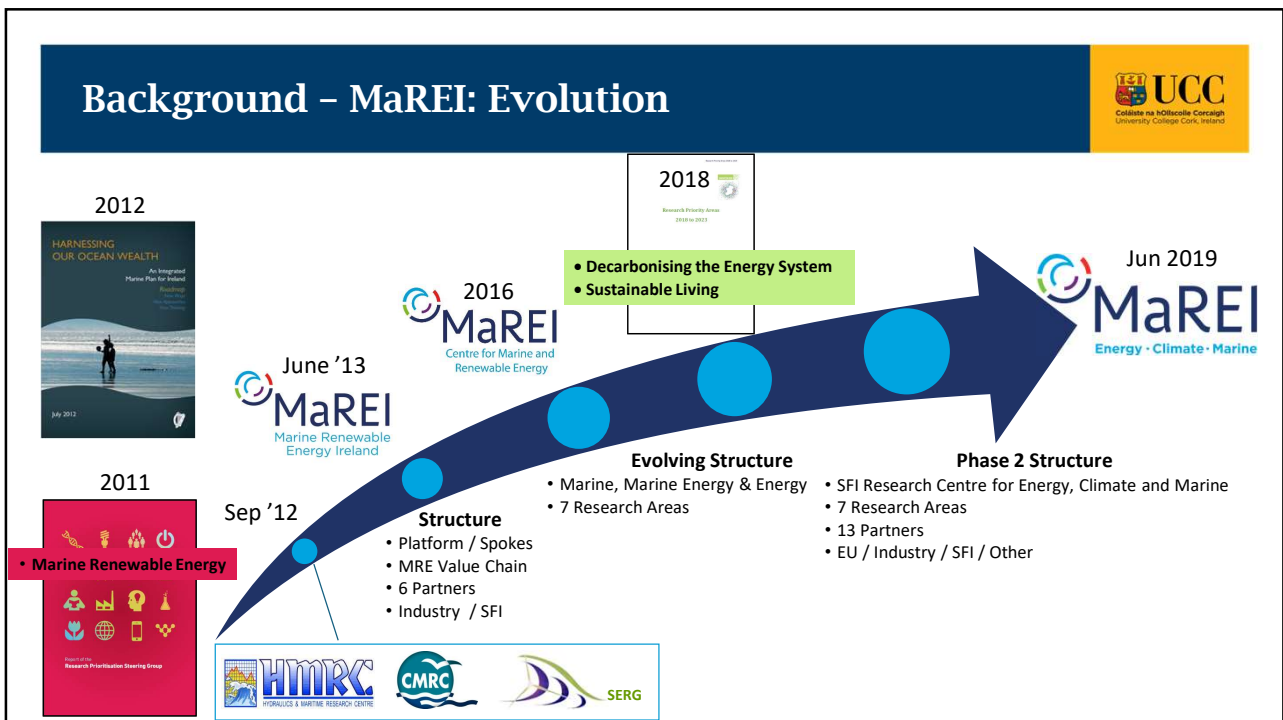
MaREI Centre, Sustainability Institute: Beaufort Building

24th February 2026

Jeremy Gault – j.gault@ucc.ie



1



2

Background – MaREI: Research Ireland's National Centre for Energy, Climate and Marine



Working across 13 Institutions

Headquartered in the
Sustainability Institute UCC



- Dundalk Institute of Technology
- Dublin Institute for Advanced Studies
- Dublin City University
- University College Dublin
- Trinity College Dublin
- TU Dublin
- The Economic and Social Research Institute

- **University College Cork**
- Munster Technical University
- Tyndall National Institute

3

MaREI – Research Areas



Seven, interlinked Research Areas (RA) collaboratively delivering across the Centre's Focus Areas

Energy Transition – Climate Action – Blue Economy



4

MaREI – Research Areas



MARINE GOVERNANCE

MARINE ECOLOGY

**COASTAL DYNAMICS AND MARINE
SYSTEMS MODELLING**

CLIMATE IMPACTS AND ADAPTATION

**Communication, Stakeholder
Engagement And Societal Impact**

5



Welcome & today's Plan...



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Time	Item
09:00- 09:15	Registration & Tea/Coffee Starting at 09:30 sharp
09:30 – 11:00	Scene Setting: A shared region and shared visions Establish a shared understanding of the Cork Harbour and Catchment region, current and future priorities, and identify the key barriers to integrated management.
11:00- 11:15	Tea/Coffee
11:15-12:30	Current Information and data sharing Identify the decisions you need to make, assess whether current information systems support those decisions, and prioritise critical data and infrastructure gaps.
12:30 – 12:45	Refresh & Reset
12:45-13:30	Integrating knowledge and information Define practical steps, infrastructure needs, and collaborative actions required to advance integrated management.
13:30 – 14:30	Lunch

7



Cork Harbour and Catchment: Our shared region, and shared challenge

Rory Scarrott



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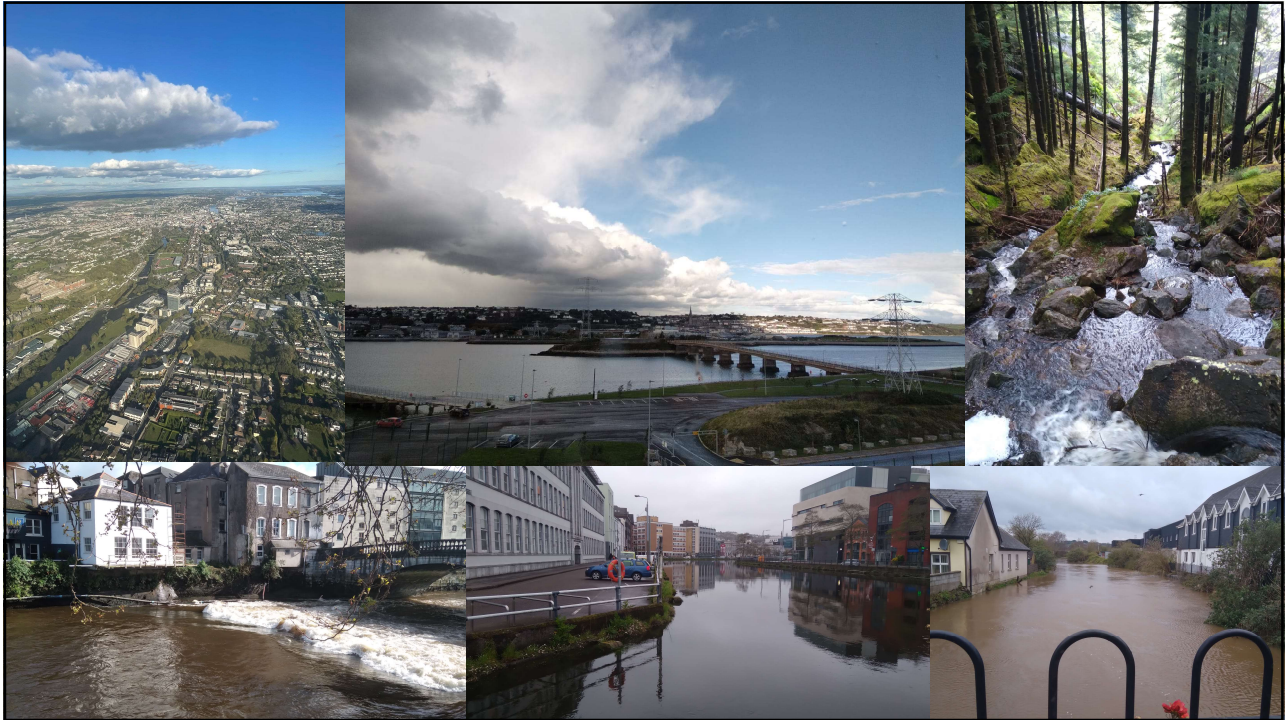


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Not just the harbour – A highly connected system



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Cork homes flooded during heavy rain from Storm Barbet

© 19 October

Storm Babet

DAMIEN RYTEL/PA MEDIA

Flooding in the town of Midleton, County Cork, caused by Storm Babet on Thursday

Storm Babet has brought heavy rain to the island of Ireland, causing severe flooding in County Cork, where hundreds of properties have been damaged.

The Irish army and the Civil Defence helped firefighters to evacuate people from flooded homes and businesses.

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THU, 20 AUG, 2020 - 19:56

Watch: Flooding in Cork as high tide hits

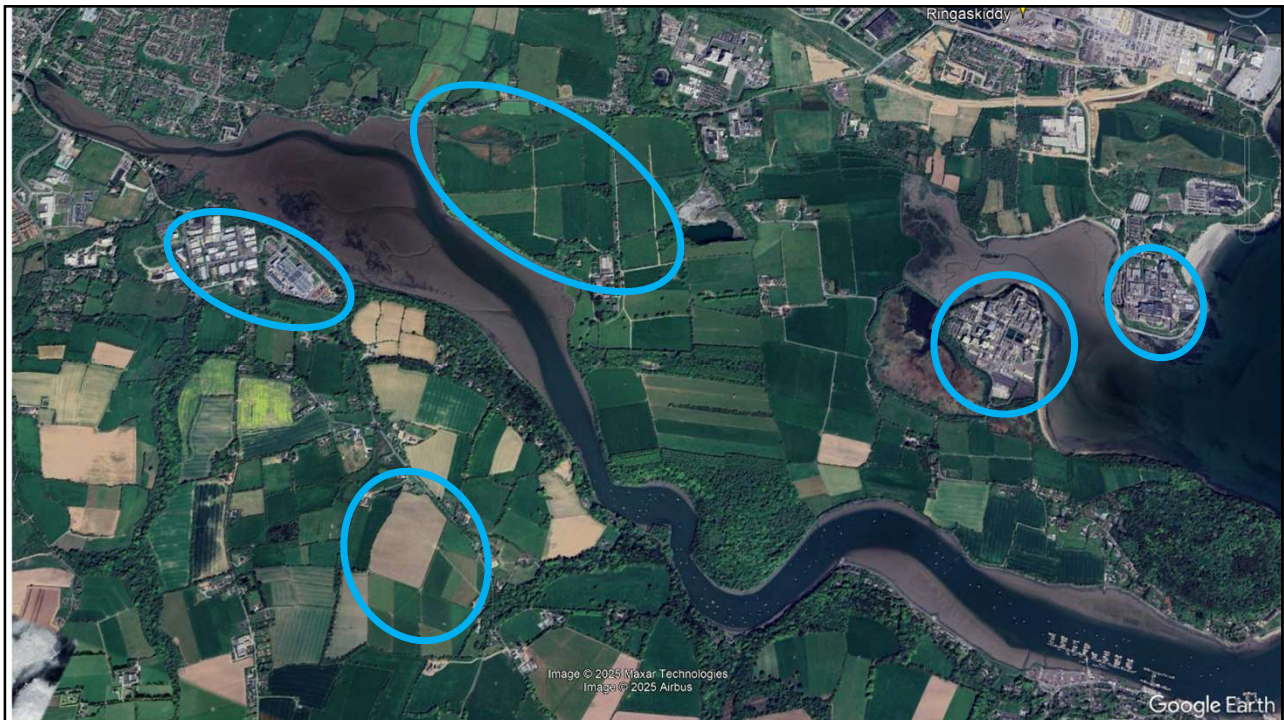
Flooding at Fr Mathew quay in Cork City

ROISIN BURKE

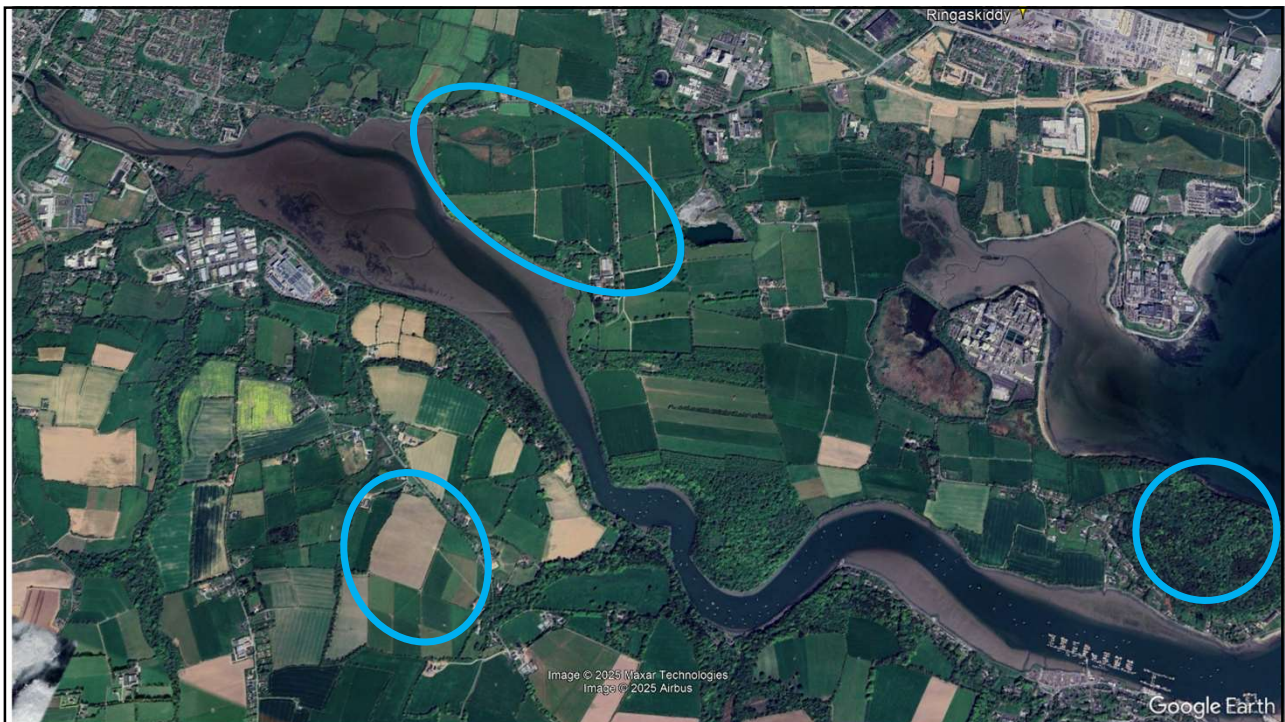
Parts of the city centre have flooded during high tide this evening with emergency services on hand in case it experiences the serious flooding that has



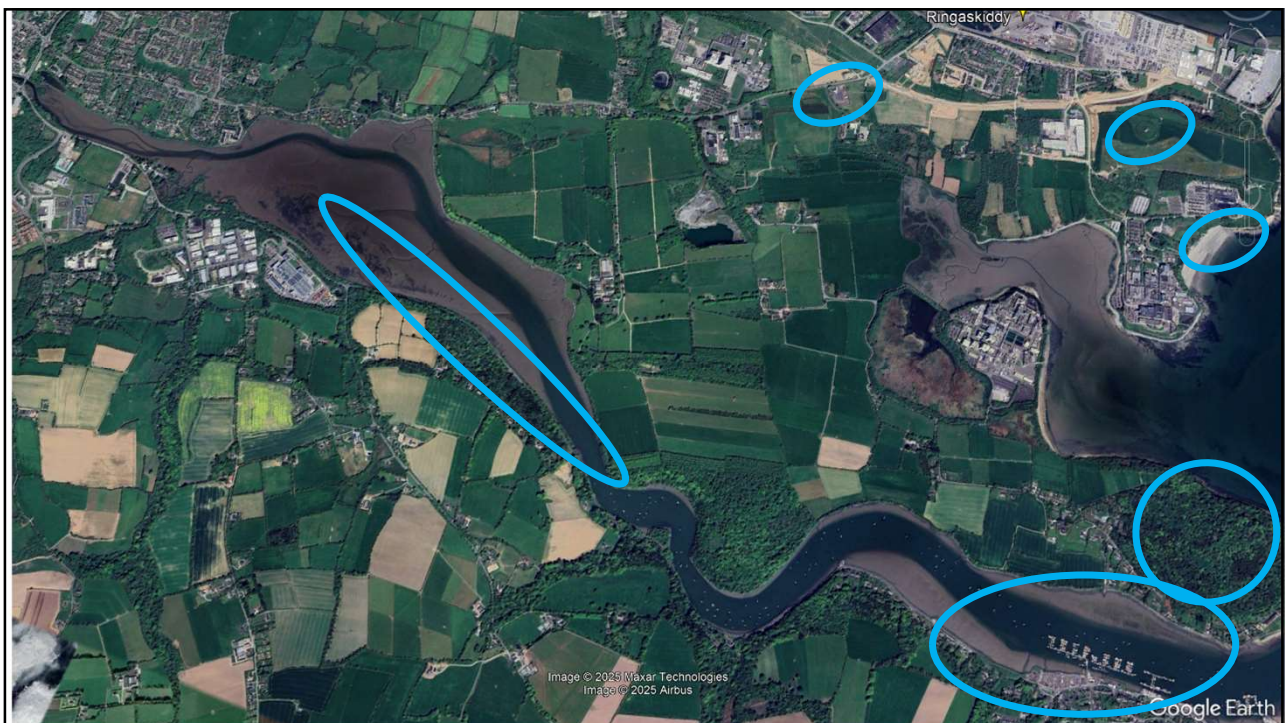
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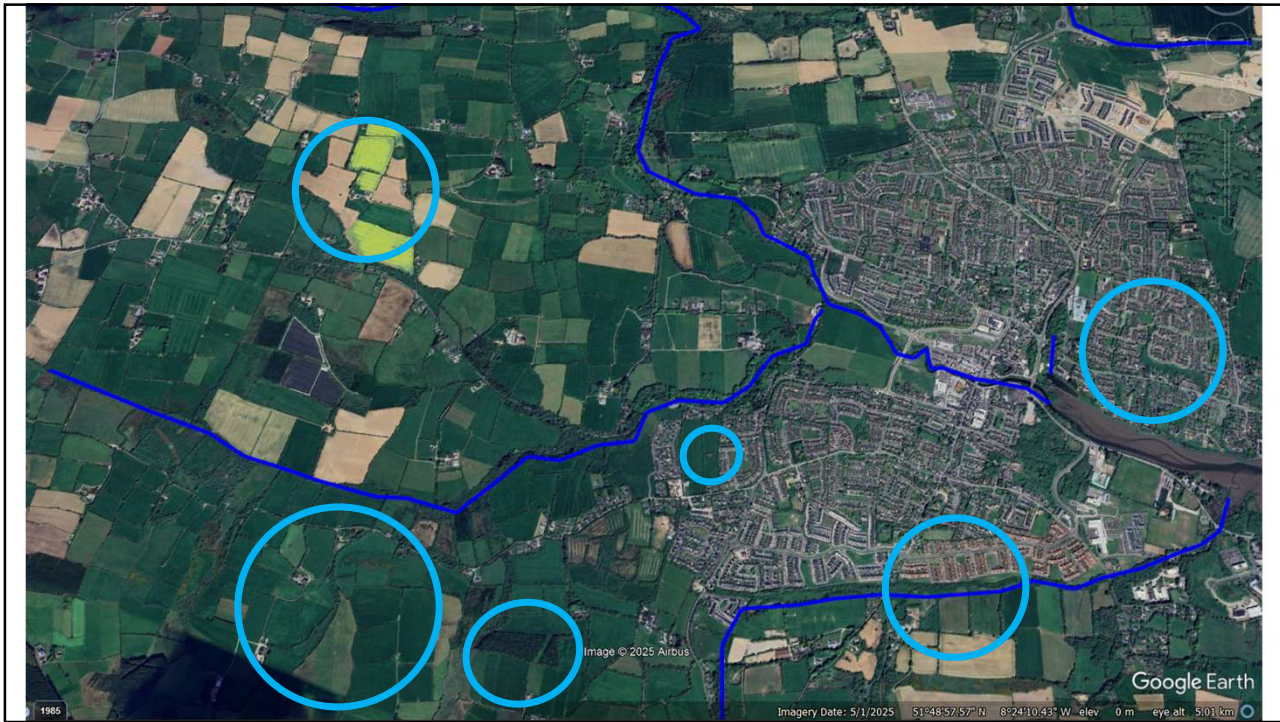
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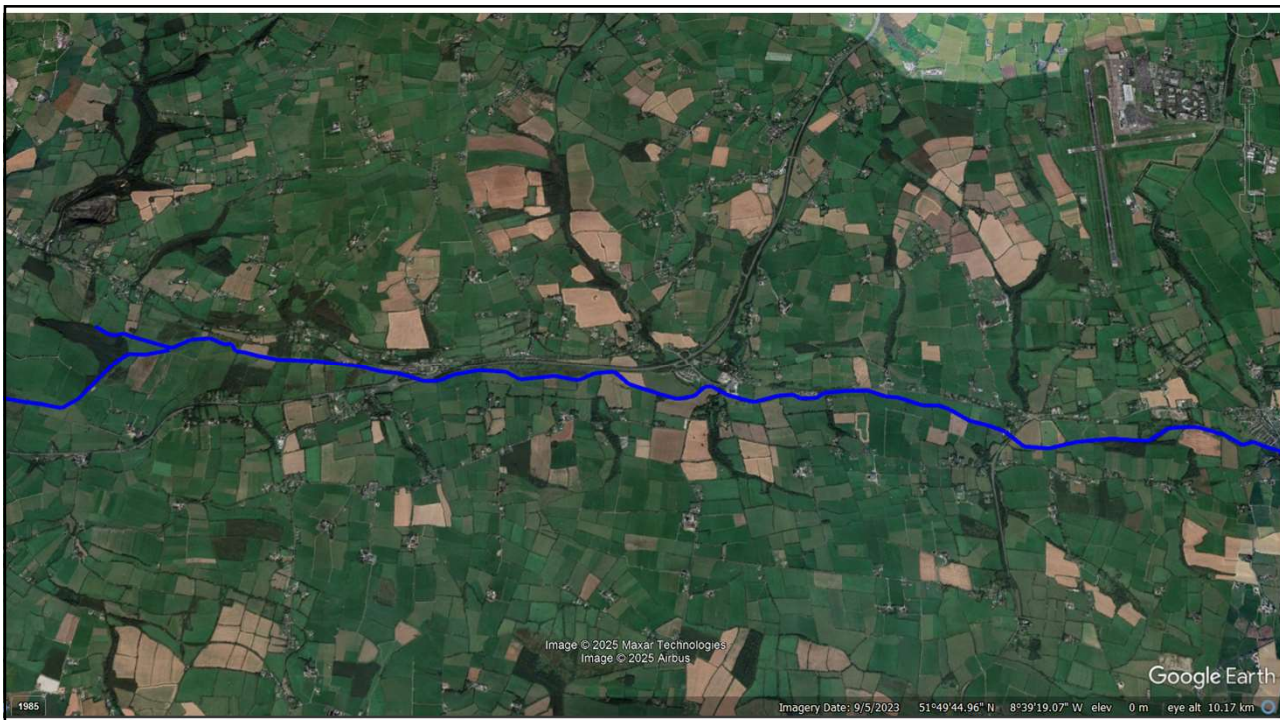
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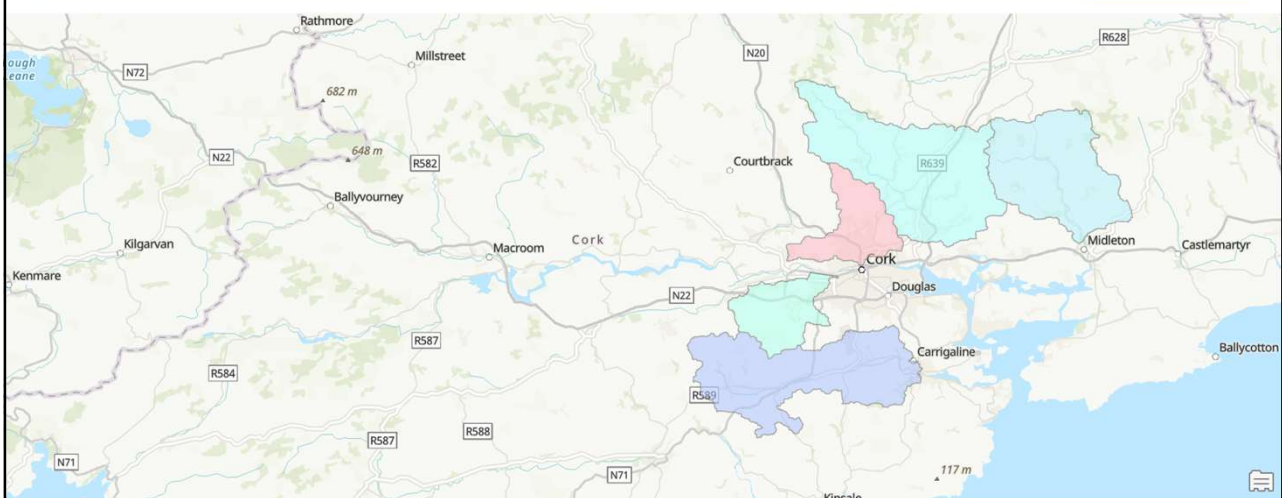
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Not just the Lee



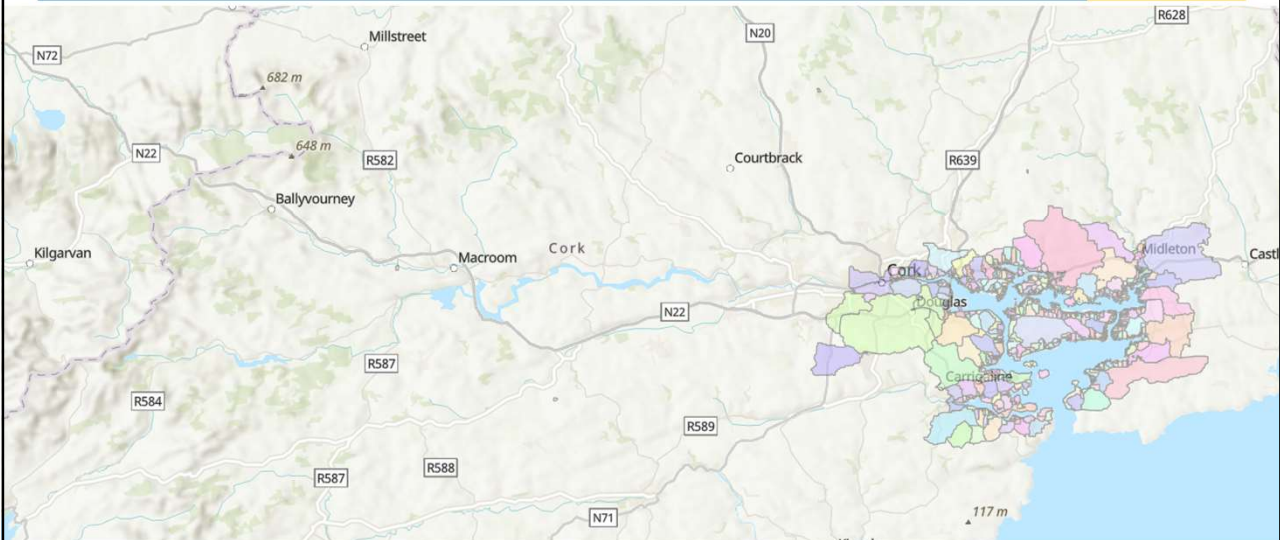
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...also other important systems...



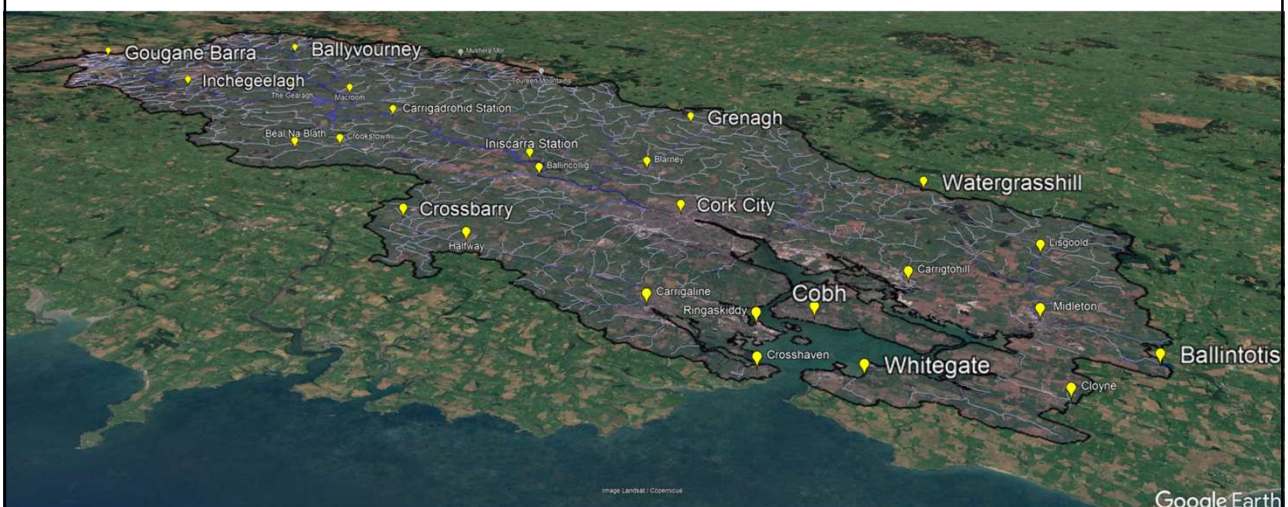
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...and a large number of unknowns...

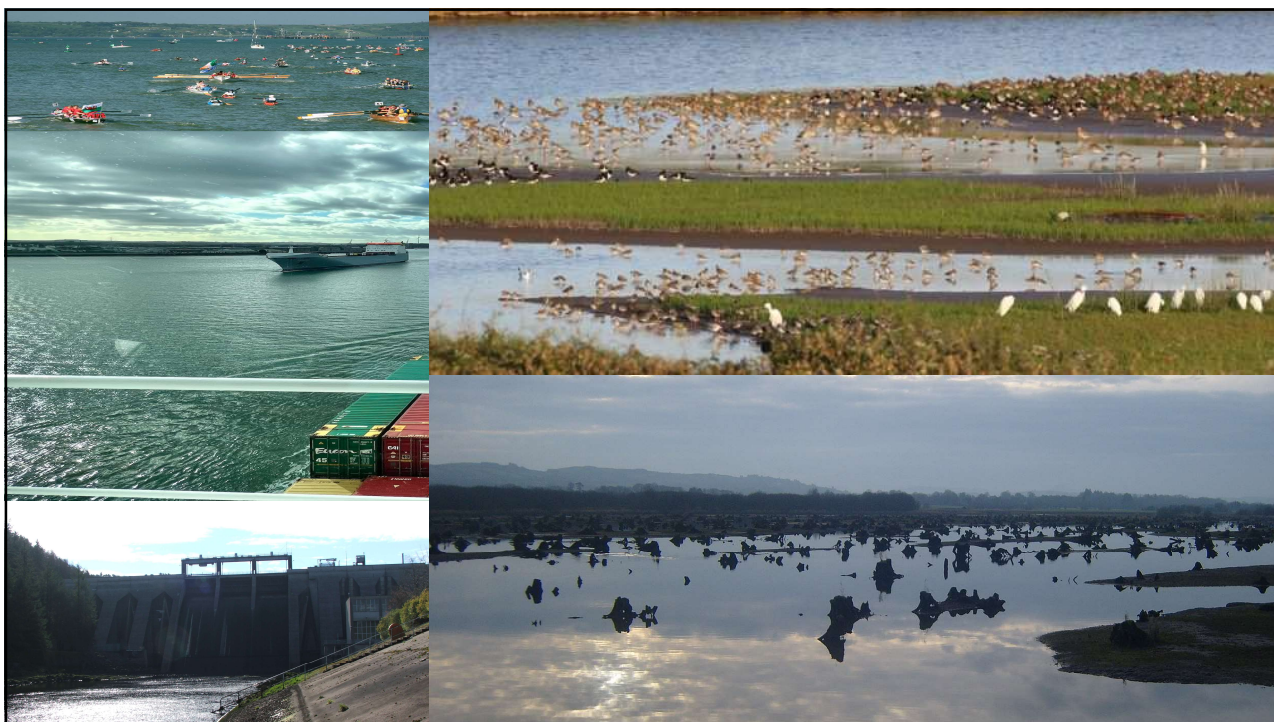


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Not just the harbour – A highly connected system



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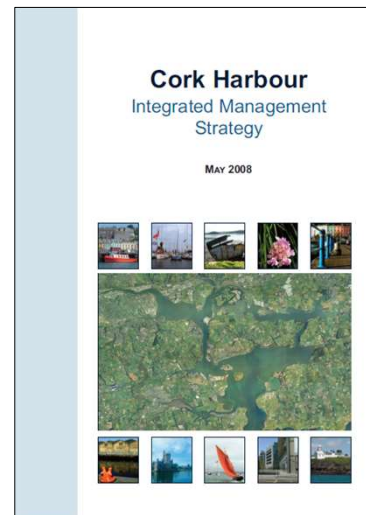
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Integrated Management: Cork Harbour



Micheál Martin, T.D. Minister for Enterprise, Trade & Employment



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Integrated Management: Cork Harbour



**VOLUME ONE
MAIN POLICY
MATERIAL**

**CORK COUNTY
DEVELOPMENT
PLAN 2022**



1

County Development Plan Objective

CS 2-3: County Metropolitan Cork Strategic Planning Area

- (b) Recognise Cork Harbour as a unique and strategic asset both nationally and internationally and promote the development of the Cork Harbour Economy as a key driver of economic growth at a metropolitan, county, regional, national and international level, while simultaneously sustainably managing the future development of the Cork Harbour area, taking account of its environmental, ecological, heritage and landscape values.

County Development Plan Objective

MCI 7-3: Integrated Coastal Zone Management

- (a) Support the development of an integrated approach to coastal zone management in Ireland generally and in particular to foster the application of this concept in appropriate coastal zones throughout the County including Cork Harbour.

- Consider the whole continuum - Cork Harbour and Catchment.
- Recognise and respect our different viewpoints, goals and challenges.
- Share our collective knowledge, experience, and diverse expertise.
- Determine how best to integrate this information to support informed decision-making and better management of the continuum.

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Discussion: A shared region and shared visions



Establish a shared understanding of the Cork Harbour and Catchment region, current and future priorities, and identify the key barriers to integrated management.

- Introductions
- What issues are the stakeholders currently trying to tackle / address?
- What is the nature of existing efforts?
- Prioritise the challenges in each group.

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Coffee Break



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A researcher's journey looking at source-to-sea environmental issues

Ashenafi Battamo
Tuesday, 24th February 2026



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Collaborative efforts for integrated management of Cork Harbour and Catchment



Research focus and expertise

Specializes in modeling compound extreme climatic event dynamics with interdisciplinary and systems-based approaches

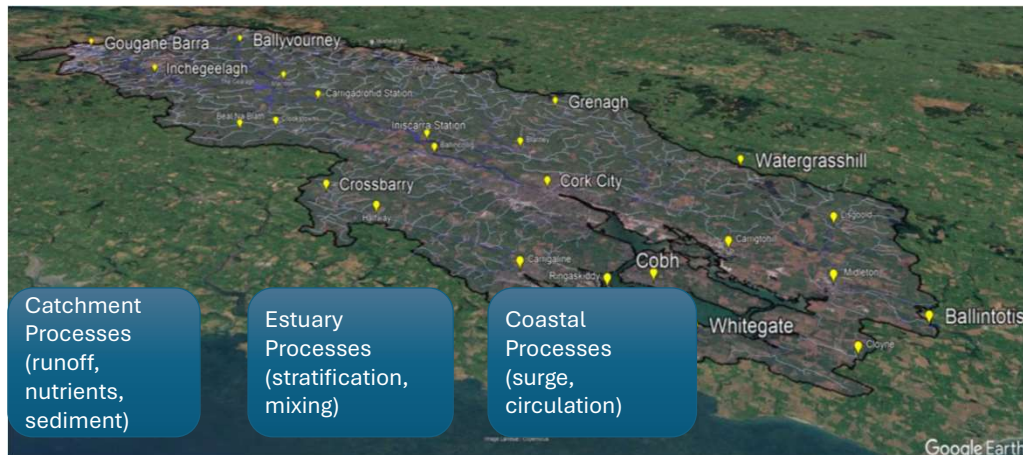
Examines environmental risks across river–estuary–coast continuum considering climatic, hydrological, and ecological factors.

Integrated research approach

Combines data analytics, hydrodynamic modelling, extreme event statistics, water-quality models, and Earth observation analytics.

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Cork Harbour and Catchment



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What was I doing?



Flooding

- Investigating how flood risk evolves along the upper stream catchments to the lower and outer harbour
- Examining flood dynamics from headwaters (Upstream catchments) → upper harbour → lower harbour → outer harbour.
- Developing coupled tide-surge-river models for compound flood scenarios.
- Developing AI powered near real-time flood forecasting models

Eutrophication

- Investigating how water quality risks evolve along the Source-to-Sea continuum
- Eutrophication drivers across catchment → estuary → harbour
- Building multi-layered biogeochemical models for nutrients, phytoplankton, and DO.
- Developing AI powered near real-time quality prediction models

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What have I found so far?



Flooding

Poorly constrained multi-driver interactions

- Insufficient understanding of combined river, surge, tide, rainfall, and groundwater interactions

No full source-to-Sea flood risk frameworks

- No unified analytical structures linking catchment–estuary–coast processes

Limited real-time capability

- Lack of high-frequency real time measurements limits extreme flood event detection and forecasting

Governance gaps

- Institutional separation limits coherent Source-to-Sea planning

OPW and Met Éireann are the hub for flood data

Eutrophication

Missing high-frequency nutrient

- Absence of continuous high-frequency nitrogen, phosphorus, and ammonia data
- Irish Environmental Protection Agency (EPA) monitors water quality of the Lee, Cork Harbour and Youghal Bay at 32 monitoring stations
- No integrated upstream catchments–lower harbour–outer harbour nutrient accounting
- In cork, eutrophic events happen, and they exhibit storm pulses.
- Sources of ammonia and phosphate in Cork harbour result from direct anthropogenic input
- Need to consider both in-harbour and upstream sources to get a grip on WQ for Cork harbour.
- EPA are the hub for WQ data

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Cont'd



Flooding

Overseas best practices

- The Dutch and UK playbook (Room for the River; TE2100)
- The Netherlands uses multi-hazard forecasting systems combining river, meteorological, and oceanographic data for flood management

Eutrophication

Overseas best practice

- Chesapeake Bay TMDL (US) and HELCOM (Baltic Sea)
- Baltic Sea states use long-term coordinated monitoring to track eutrophication trends with consistency and accuracy.

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What would I like to do?



Flooding

Develop a Cork harbour "Flood Digital Twin"

- Couple rainfall–runoff–groundwater–drainage models with tide–surge–SLR hydrodynamics.
- **A unified digital twin will reveal nonlinear system interactions currently hidden by domain-segmented models.**

Advance AI-powered flood forecasting

- Integrate physics-based hydrodynamic models with real-time sensor assimilation.
- **Physics-aware AI will increase lead time and spatial precision for compound flood forecasting compared to purely deterministic systems.**

Support adaptive and collaborative governance

- Create decision pathways linking scientific thresholds to operational responses.
- **Collaboratively designed flood governance will outperform static management in a climate-altered hazard regime.**

Eutrophication

Integrated continuous water quality monitoring system

- **Develop an integrated Continuous Water Quality monitoring (CWQM) System**
- Merge in-situ sensors with satellite data and multi-layer biogeochemical models.
- **High-frequency integrated CWQM will detect critical early-warning signatures of water quality issues such as bloom formation and hypoxia not visible in traditional monitoring.**

Establish multi-source data fusion frameworks

- **Combine in-situ sensors, remote sensing, and AI-driven models and physical-biogeochemical simulations,**
- Data-fusion models can map nutrient hotspots and bloom risk zones with unprecedented temporal fidelity.

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Data and systems already exist for flood forecasting in Cork Harbour



What information is available for flood forecasting in Cork Harbour?

1. Network of meteorological, hydrological, and coastal data managed provided by Met Éireann and the OPW

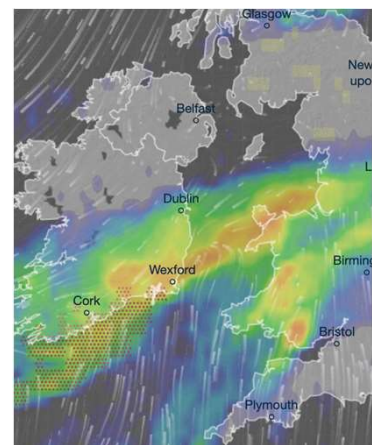
- Precipitation measurements and rainfall forecasts
- River level and flow rate measurements
- Tide, storm surges, and water level measurements
- Wind speed, atmospheric pressure, Sea temperature, and air pressure

2. High-resolution hydrodynamic modelling capability

- Nested hydrodynamic model (MSN_Flood) resolving Cork Harbour down to 2m street scale

3. OPW flood maps and hydrometric data

4. Open data portal from Cork City Council



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What information is missing or insufficient for real-time flood forecasting?



- Data synchronization challenges and lack of operational real-time river–tide–surge coupling
- Lack of real-time coupling of river inflow, tide, surge, rainfall, and groundwater dynamics
- OPW and MET Éireann data exist, but not at the integration and resolution needed for real time flood forecasting
- Low-density monitoring networks in upper and smaller catchments
- Insufficient soil moisture and groundwater monitoring data
- Lack of real-time data assimilation into advanced AI/ML models
- AI/ML powered flood forecasting models with live rainfall, river, and coastal gauge networks

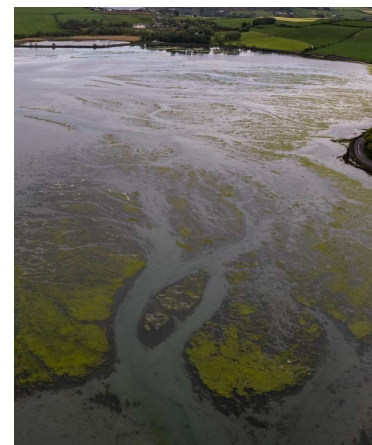
37

Data and systems already exist for complex eutrophication modelling in Cork Harbour



What information is available for real-time complex eutrophication modelling in Cork Harbour?

- 1. Nutrient inputs and sources data from the EPA**
HydroNet and OPW WaterLevel.ie platforms (**Available**)
 - Inputs of nutrients (N and P), ammonia, and phosphate are mainly from domestic and industrial sources
 - EPA classification of eutrophic zones (**Lee Estuary** and **Lough Mahon areas** classified as eutrophic)
- 2. Water quality data (Available)**
 - **Water quality monitoring data** at 32 stations including water temperature, pH, dissolved oxygen, total organic nitrogen, ammoniacal nitrogen, molybdate reactive phosphorus, biological oxygen demand, transparency, *Chlorophyll a* and algal bloom frequency, and dissolved inorganic nitrogen. Available at <https://www.catchments.ie/data>
- 3. Sediment and benthic processes (Available)**
- 4. Numerical water-quality modelling (Available)**



Algae blooms in Clonakilty Bay, West Cork. Picture: Andy Gibson

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Eutrophication and biogeochemical data gaps



Cork fish kill on the River Blackwater

What information is missing or insufficient for complex eutrophication modelling in Cork Harbour ?

Nutrient monitoring deficiencies

- Continues, near real time, high-frequency data on nitrogen, phosphate, and ammonia are lacking, despite their strong temporal variability.

Oxygen observation limitations

- Continuous dissolved oxygen data is insufficient, hindering detection of episodic hypoxic events linked to algal bloom decay.

Stratification and water column data

- Sporadic collection of stratification profiles causes uncertainties in understanding bloom persistence and vertical nutrient trapping.

Sediment biogeochemistry gaps

- Critical gaps exist in quantifying benthic nutrient regeneration and sediment oxygen demand affecting eutrophic conditions.

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What could we do?



What the emerging technological and infrastructure needs for cork harbor integrated management?

Real-time sensor networks

- Multi-parameter sensors in rivers and coastal zones provide real-time data on water quality parameters and flood conditions.

Autonomous data collection

- Gliders, drones, and robotic profilers capture detailed spatial and temporal environmental data beyond fixed stations.

Satellite remote sensing

- Satellites detect algal blooms, thermal anomalies, and turbidity fronts to enhance early warning and synoptic monitoring.

AI powered advanced modelling

- AI-driven models integrate diverse data sources to forecast flood hazards and eutrophication events effectively.



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Bridging gaps through integrated management



Interconnected environmental processes and innovations in monitoring

- Harmonized monitoring programs across agencies ensure consistent data and shared situational awareness.

Unified scientific and modelling frameworks

- Fully coupled models link hydrology, hydrodynamics, and biogeochemistry for robust flood forecasting and water quality scenario testing.

AI powered prediction and monitoring technologies

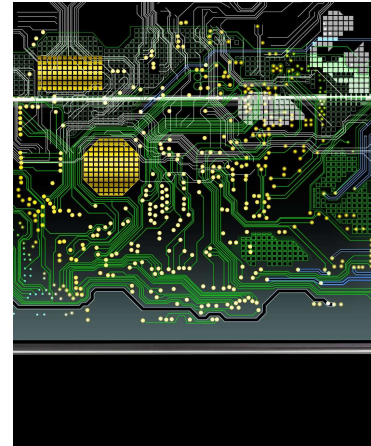
- AI-enhanced flood forecasting and continuous water-quality monitoring are vital for climate adaptation and environmental stewardship.
- Digital twins + sensors + AI/ML models + Dynamic Adaptation Pathways can convert science into trigger-ready decisions.

Collaborative governance and management approaches

- Co-designed management strategies involve researchers, authorities, industry, and communities for sustainable development.

Sustainable funding and knowledge exchange

- Long-term funding and knowledge-exchange mechanisms reduce fragmentation and support adaptive management.



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Thank you

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Discussion: Shared realities



Identify the decisions you need to make, assessing whether current information support those decisions.

- What decisions are you faced with making in relation to monitoring and future management?
- What information do you need to support these decisions?
- Are there any gaps?

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Refresh and Reset



15 minutes

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Discussion: Integrating knowledge and information



Define practical steps, needs, and collaborative actions required to advance integrated management.

- Who is missing from the room – what could they provide?
- One thing you have learned today – new or otherwise?
- What is your (big) ask?

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Next Steps....



- Draft Report (for your consideration)
 - Sessions overviews
 - Conclusions
 - Potential way forward
- Final Report

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Wrap-up & Thank you...



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Lunch



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