Environmental Sensitivity Mapping

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Collaborative partners

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EPA STRIVE Research Programme & Ordnance Survey Ireland

EPA SEA Team

SEA and Spatial Planning

- Population and human health
- Biodiversity, flora, fauna
- Air and climate
- Soils and geology
- Water
- Landscape
- Cultural heritage
- Material assets
- Inter-relationships

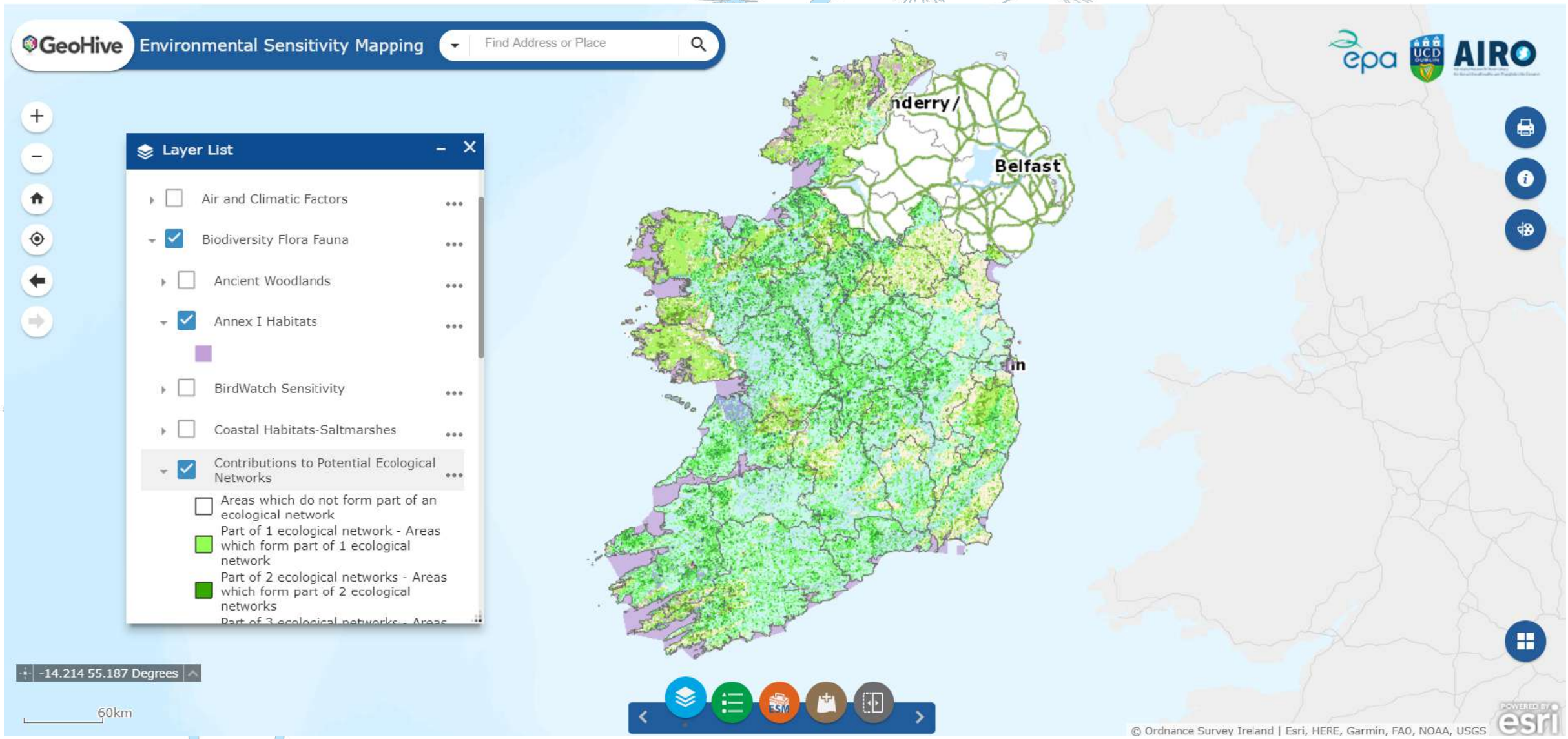
Multiple considerations, spatial implications, consultation

Spatial evidence-base for SEA and planning decisions

- ✓ Assessment consistency and transparency
- ✓ Intrinsic environmental conditions > susceptible to change
- ✓ Early-warning of potential land-use conflicts

Data Viewer

Access, Visualisation, Discovery



Over 100 SEA-relevant Geospatial datasets

Air and Climate

- Air zones
- Coal restricted areas
- Historical flood extents
- Soil carbon (eco serv)
- Vegetation carbon (eco serv)
- Water retention (eco serv)
- Wind speeds

Biodiversity, Flora & Fauna

- Ancient woodlands
- Annex I habitats (Habitats Direct)
- Birdwatch sensitivity (to windfarms)
- Coastal habitats – Saltmarshes
- Contributions to pot. ecological networks (eco serv)
- Forest inventory
- Legally protected and policy relevant species (eco serv)
- Margaritifera sensitive areas
- Natural Heritage Areas (NHAs)
- Proposed NHAs
- Salmonid waters
- Special Areas of Conservation (SACs)
- Special Protection Areas (SPAs)
- Terrestrial biodiversity (eco serv)
- Woodland habitats

Cultural Heritage

- Irish landmark trust
- Museums, collections and archives
- NIAH
- Sites and Monuments Record
- Walled towns
- World Heritage Sites

Landscape

- Landscape character areas

Material Assets

- Active quarries
- Airfields and airports
- Broadband access
- Current wind farms
- Discharge licences
- Extractive industries register
- Historic mine districts
- IPPC licences
- Landfill sites
- Licensed waste facilities
- Ports
- Railway network
- Road network
- Settlements
- Waste water treatment plants and status

Population and Human Health

- Disability
- General health
- Pobal HP Deprivation Index
- Housing stock (vacant & holiday homes)
- Travel to work >30min and >1hr
- Labour force unemployed
- Population change (percentage and total)
- Population density per Km^2
- WFD RPA Drinking water (lakes, rivers and groundwater)

Soils and Geology

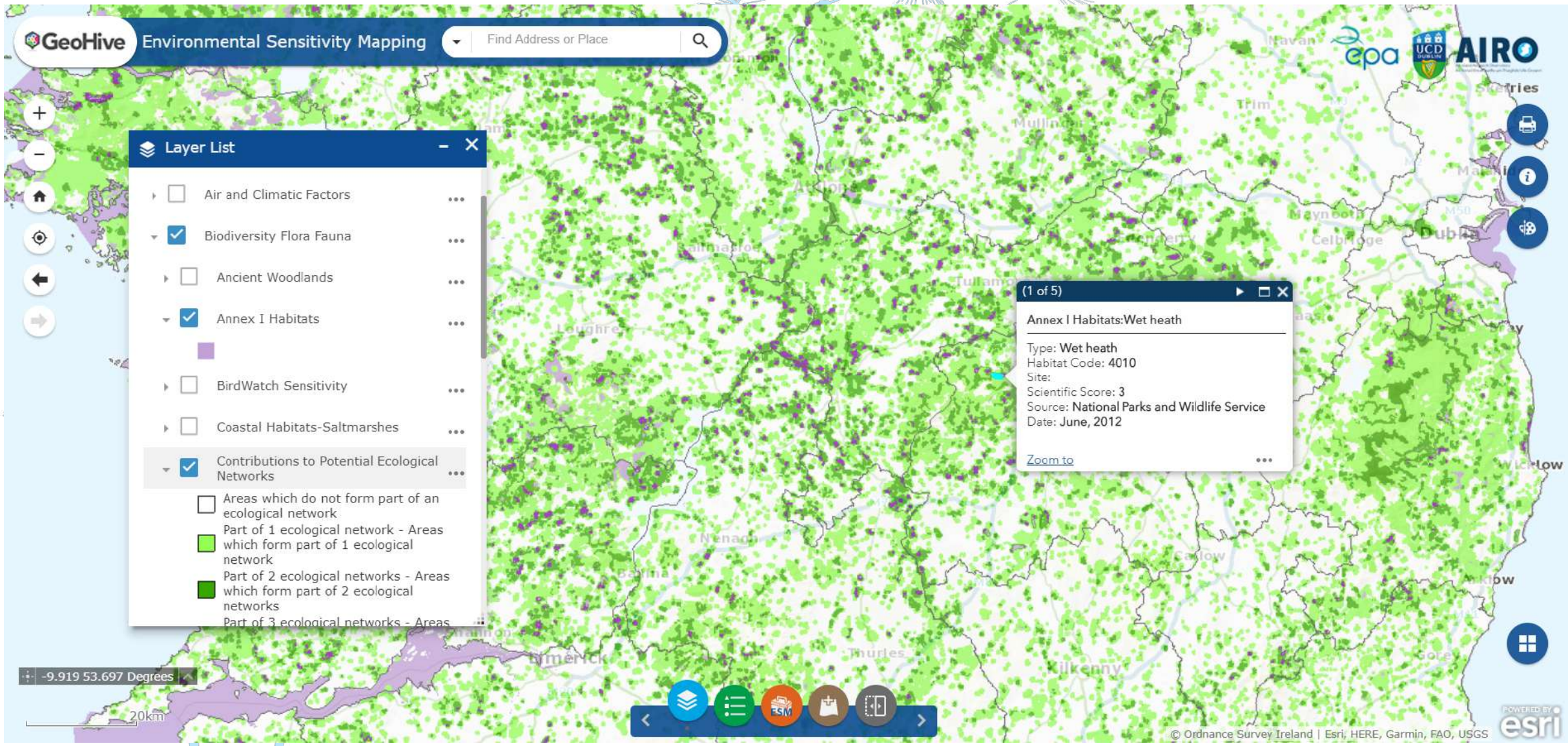
- Bedrock
- CORINE landcover
- Geoparks
- Geosites
- Landslide events and susceptibility
- Mineral locations
- Outcrops
- Peat bogs
- Soil permeability
- Soils

Water

- Aquifer vulnerability
- Bedrock aquifer
- Biological Q values
- Hydrometric areas
- Groundwater source protection areas
- Wetlands
- Water abstraction points
- WFD high status objectives
- WFD risk
- WFD status
- WFD RPA: Nutrient sensitive WFD RPA: Recreational waters
- WFD RPA: Shellfish areas
- WFD RPA: Water dependent habitats (SACs, SPAs)
- Water management Units

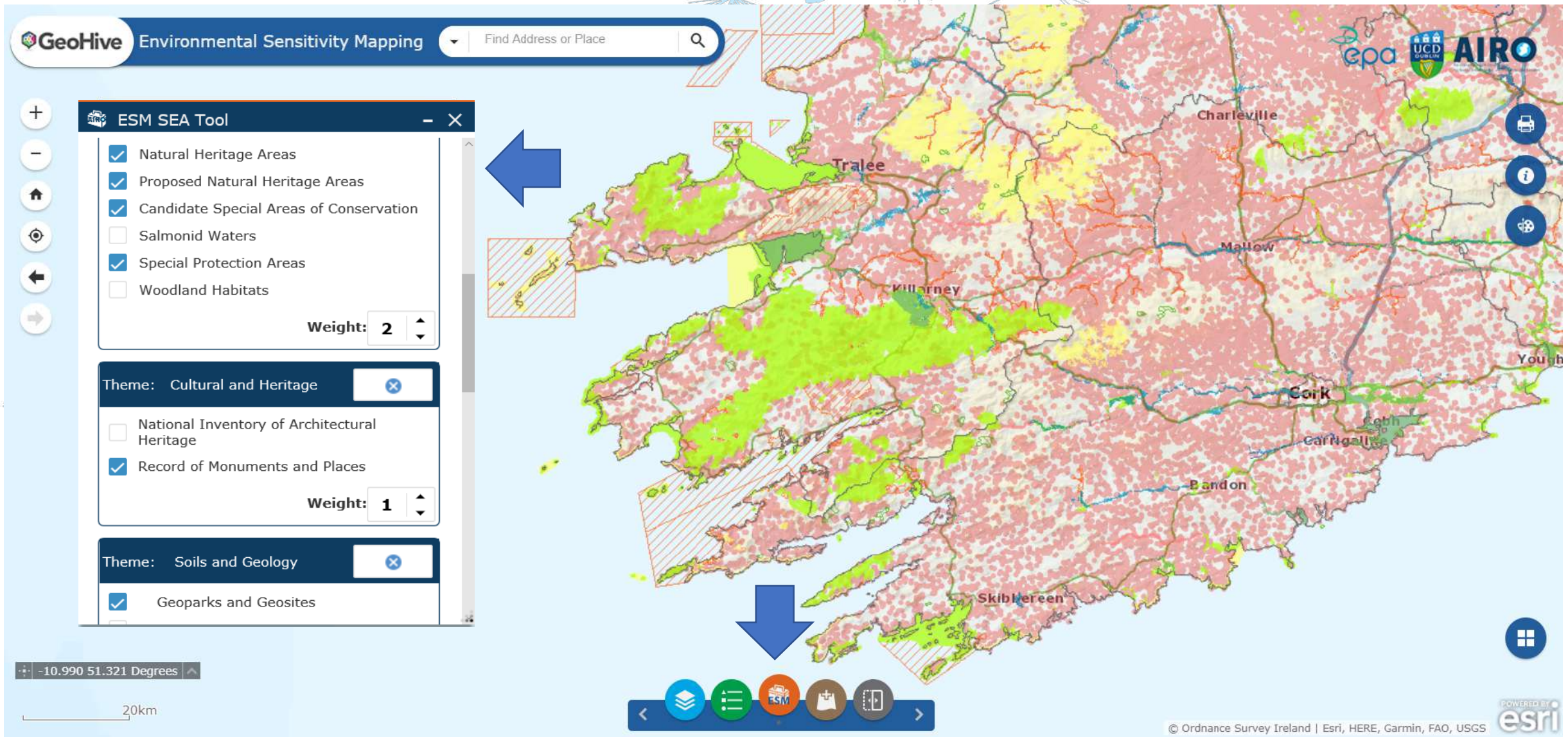
Data Viewer

Access, Visualisation, Discovery



ESM Widget

Bespoke geoprocessing tool



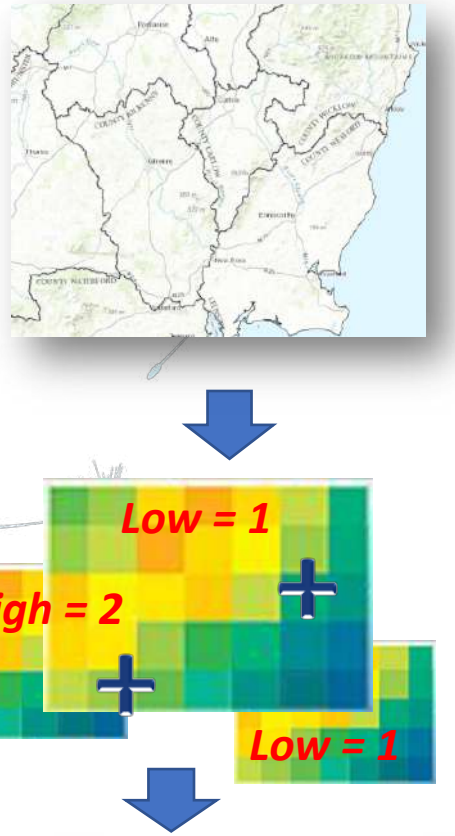
ESM Widget Methodology

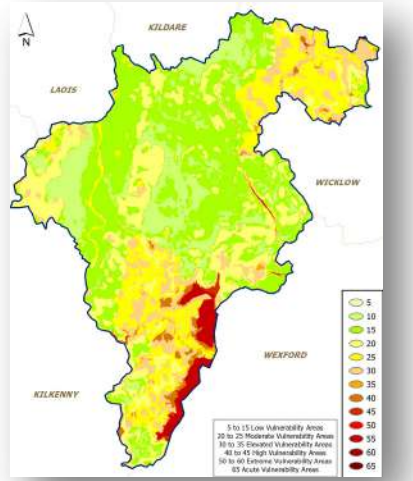
Multi-criteria spatial analysis

- Weighted linear algorithm
- Aggregation of multiple criteria
- Incorporation of stakeholders concerns or importance values in the form of weights

$$ES = \sum_{j=1}^{n} WjVj$$

where ES = Environmental Sensitivity
Wj = Environmental susceptibility of factor j according to scientific scores
Vj = Environmental significance of factor j according to public/stakeholder opinion



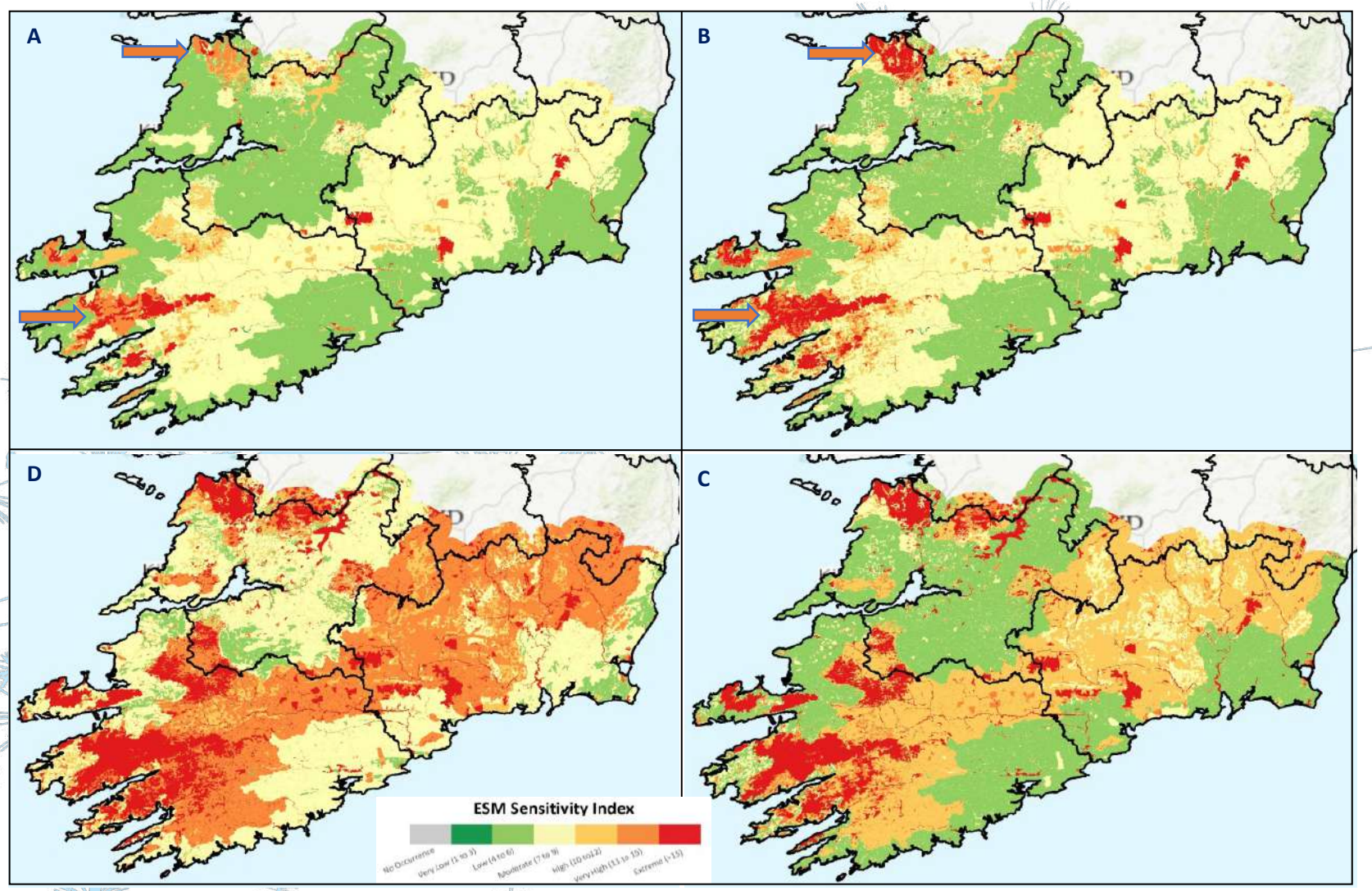


Scientific Scores

- Based on conservation status, quality and risk
- Extensive consultation
- 3 stakeholder workshops – development and testing of the webtool
- Over 40 stakeholders from government, local authorities, consultancies…SEAI, NPWS, NIEA, EirGrid…

Sensitivity Scores 1=Low, 2=Medium, 3=High	1	2	3
Population and Human Health			
% Population change 2006-2011 EDs • Decreasing • Increasing			
Population density per sq km 2011 SAs •High •Low			
Total population 2011			
WFD RPA Groundwater drinking water			X
WFD RPA Surface water drinking water (Lakes)			X
WFD RPA Surface water drinking water (Rivers)			X
Biodiversity, Flora and Fauna			
Ancient woodlands • Ancient Woodland • Possible Ancient Woodland • Long-established Woodland (LEW I) • Long-established Woodland (LEW II)		 X X	X X
Habitat Directive Annex I Habitats			X
BirdWatch sensitivity (to wind energy dev.)			
Coastal habitats (Saltmarshes)		X	
Forest Inventory and Planning System • Deciduous • Coniferous	X	X	
Margaritifera sensitive areas • Catchments of SAC populations listed in S.I. 296 of 2009 • Catchments of other extant populations • Catchments with previous records of Margaritifera but current status unknown		 X	X X
Natural Heritage Areas			X
Proposed Natural Heritage Areas		X	

Contextualising Sensitivity



(a) biodiversity, flora and fauna and water sensitivities; (b) sensitivities associated biodiversity, water, cultural heritage and soils where all have the same weight/importance; (c) sensitivities associated with biodiversity, water, cultural heritage and soils where the biodiversity themes is given greater importance (i.e. a weight of 2); and d) sensitivities associated with biodiversity, water, cultural heritage and soils where the biodiversity and water themes are given greater importance (i.e. a weight of 2).

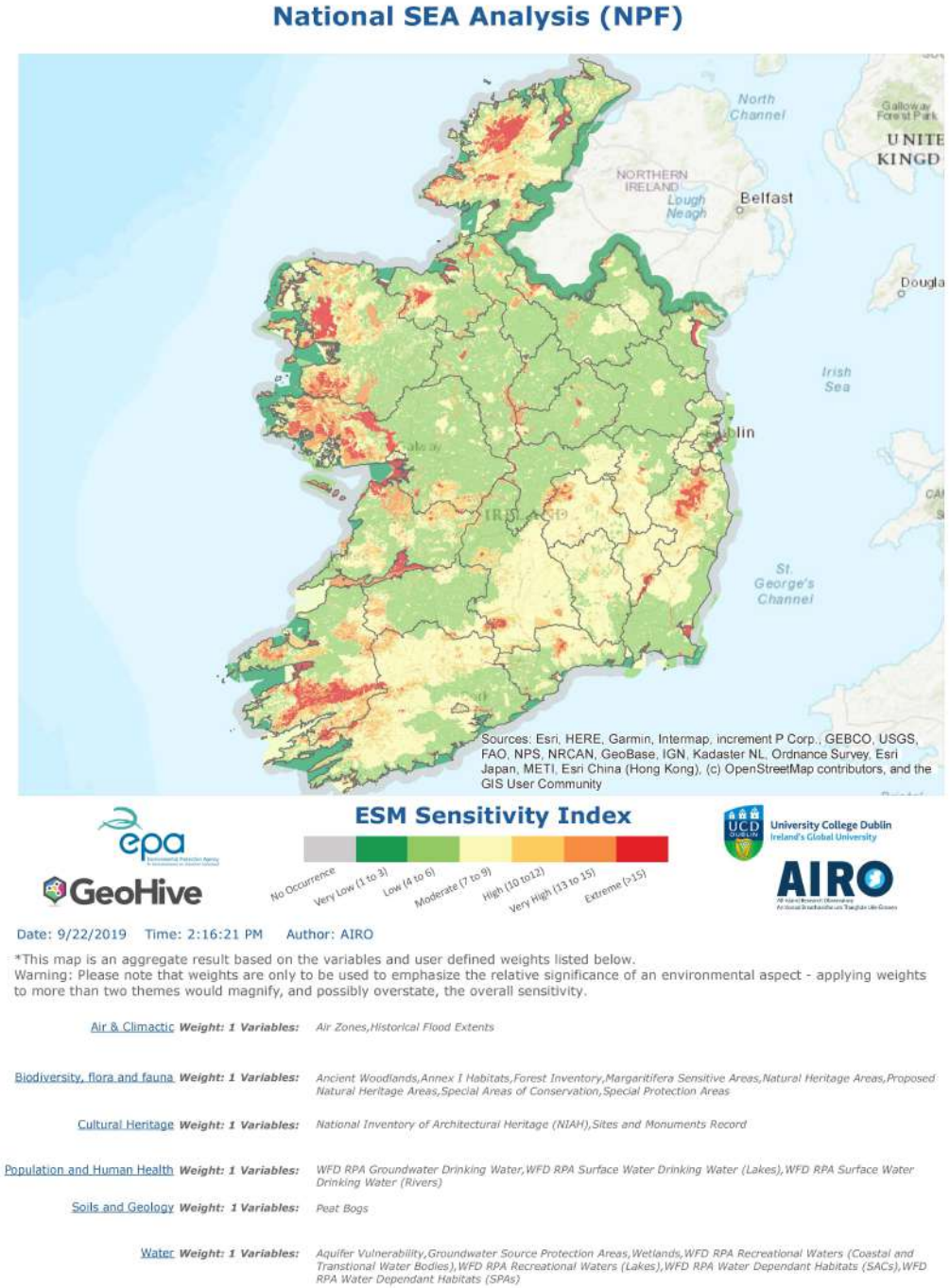
ESM Output

Transparency

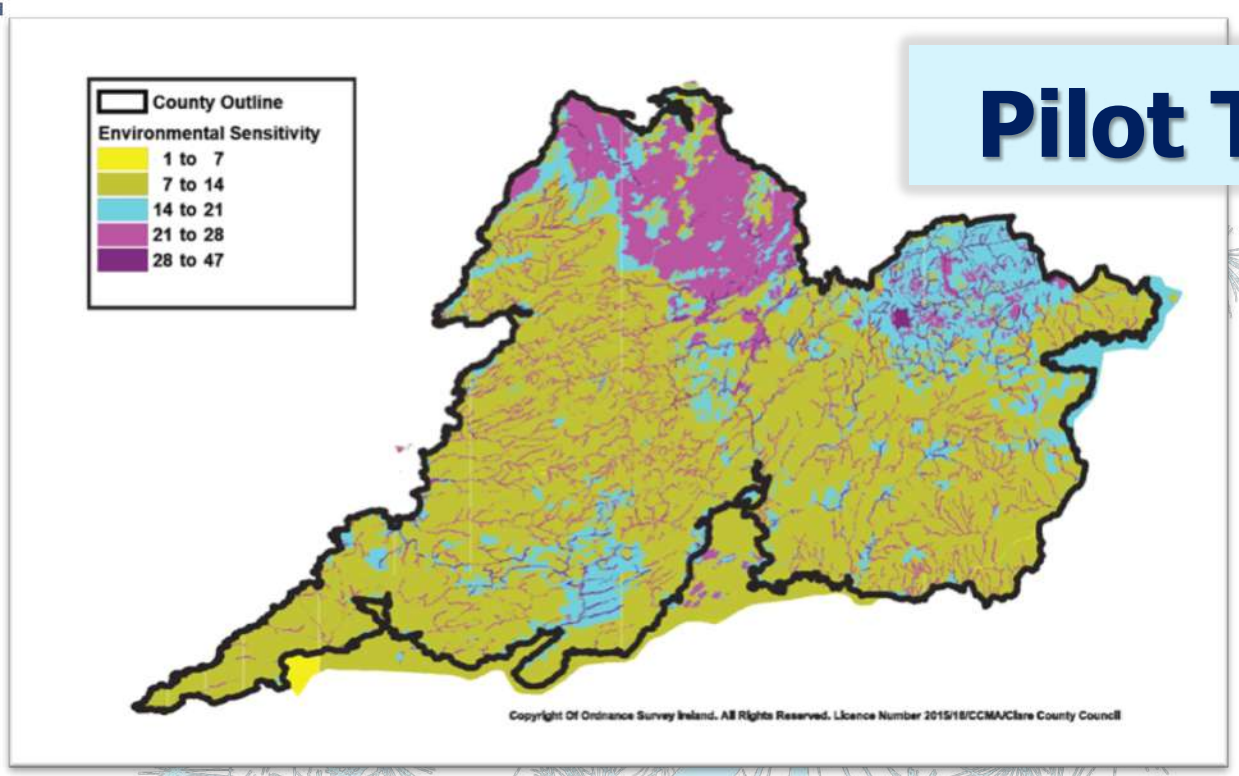
- Map creator
- Date
- Selected datasets
- Applied weights

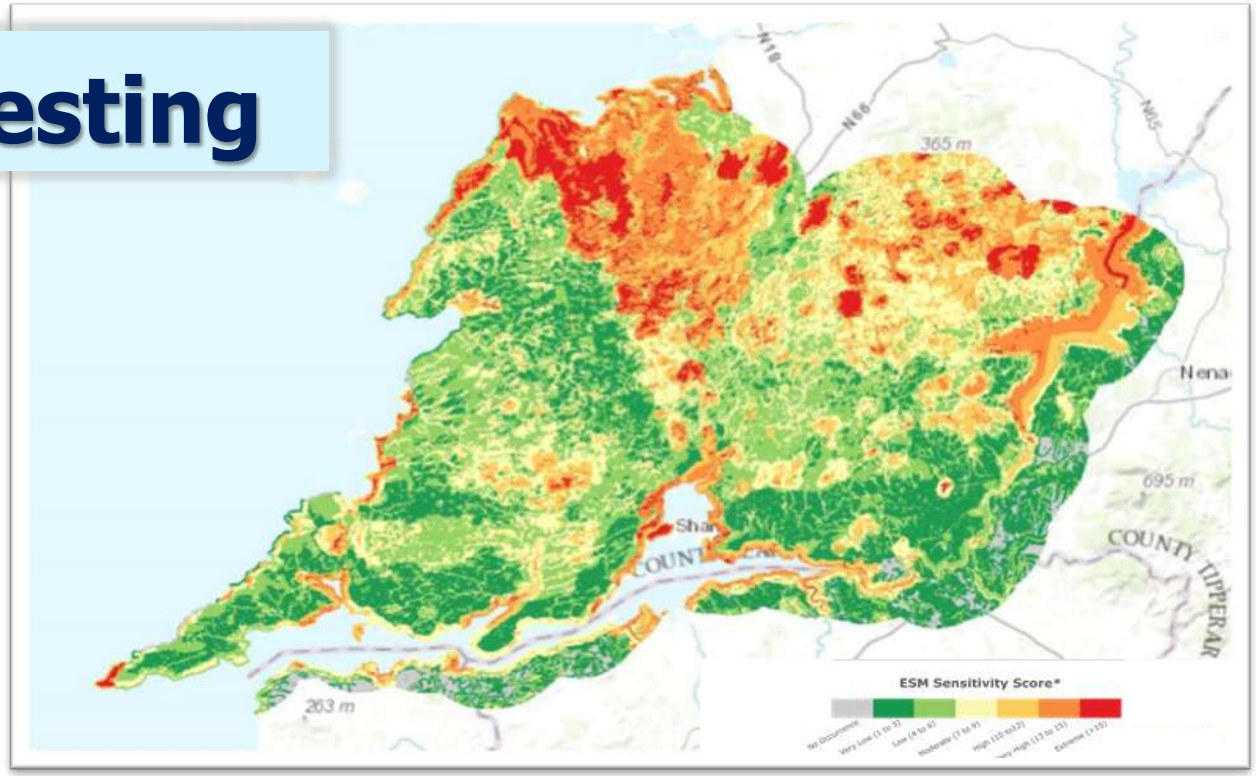
Comparability

- Transboundary
- When selecting same criteria and weights



Pilot Testing





Quicker times
No GIS expertise needed
Better and comparable results
Easier to analyse outputs

"The ESM output compares well and may actually be better than the in-house process undertaken for the County Development Plan SEA."

"The sensitivity identifies areas where development would need to be carefully considered and sensitively planned."

"Access to multiple datasets all in one platform is an excellent resource."

Data scale and availability (e.g. LCAs)
Double counting
Weight for full exclusion
Assessment scope

"Helpful tool for overall visual appreciation - really depends on the datasets."

"(…) Scale and resolution would however remain issues."

"I'm not sure it does anything more than what some local authorities do at this scale which is probably down to the detail of the datasets."

Real Life Applications: NPF & RSESs

Table 5.16 – Data Variables used in the ESM Mapping

Theme	Weight	Variables
Biodiversity, Flora and Fauna	2	Special Areas of Conservation, Special Protection Areas, Natural Heritage Areas, Proposed Natural Heritage Areas, *Margaritifera* Sensitive Areas, Ancient Woodlands, Annex I Habitats, Coastal Habitats - Saltmarshes, Forest Inventory Planning System, Salmonid Waters, Woodland Habitats
Population and Human Health	1	WFD RPA Surface Water Drinking Water (Lakes), WFD RPA Surface Water Drinking Water (Rivers)
Soils and Geology	1	Geoparks and Geosites, Peat Bogs, Soil Permeability
Water	1	Aquifer Vulnerability, Bedrock Aquifer Susceptibility, Groundwater Source Protection Areas, Wetlands, WFD Groundwater Status, WFD Lake Status, WFD River Status, WFD RPA Nutrient Sensitive Areas (Lakes),WFD RPA Nutrient Sensitive Areas (Rivers), WFD RPA Recreational Waters Coastal, WFD RPA Recreational Waters Lakes, WFD RPA Water Dependant Habitats (SPAs), WFD RPA Water Dependant Habitats (SACs)
Air and Climate	1	Historical Flood Extents
Cultural Heritage	1	National Inventory of Architectural Heritage, Record of Monuments and Places

Source: AIRO ESM Webtool with user-selected input variables.

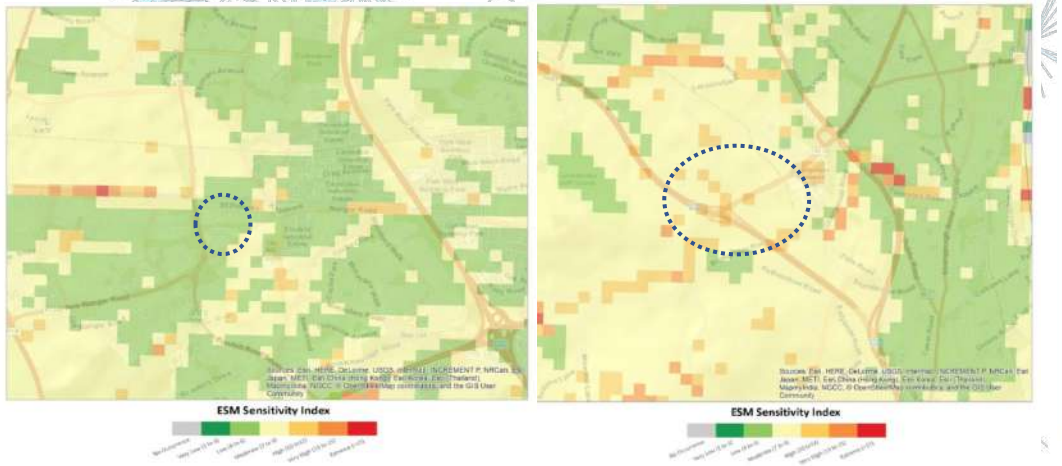
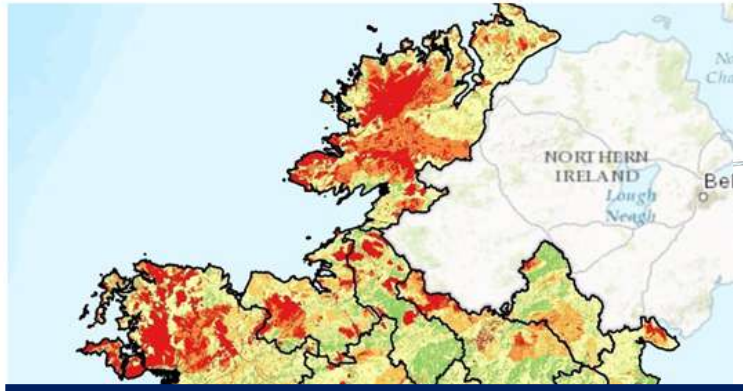
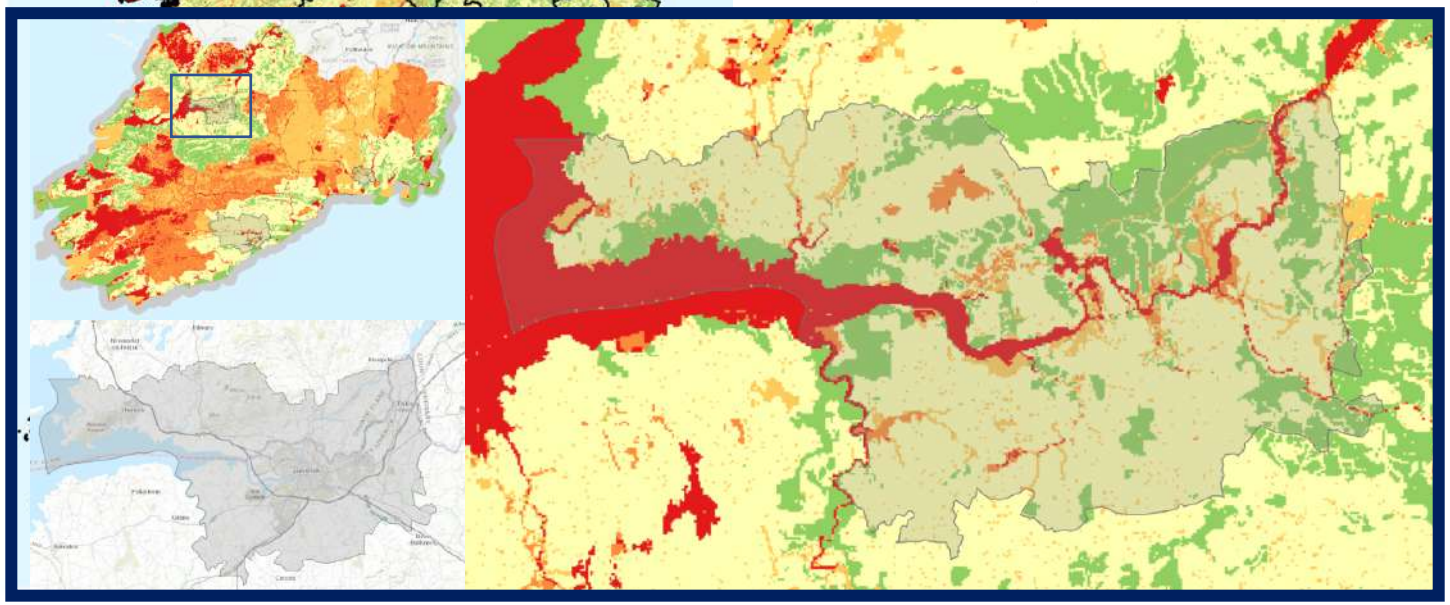


Figure 5.23 – ESM for Ireland





Tionól Reigiúnach Oirthir agus Lár-Tíre
Eastern and Midland Regional Assembly

Northern & Western Regional Assembly

Tionól Réigiúnach an Deiscirt
Southern Regional Assembly

"In preparing the NPF, an Environmental Sensitivity Mapping (ESM) tool was used in the SEA and environmental assessments. *ESM is a method for identifying at a strategic level, environmentally sensitive areas and to help inform cumulative and in-combination effects on the environment. It also provides a visual overview of the relative sensitivity of areas, particularly where they overlap, in order* ***to provide a more strategic and informed approach to planning"*** *(NPF, Chapter 11.1, p.15).*

Dissemination and peer-review

- **Final Research Report**

Developing and Testing an Environmental Sensitivity Mapping Webtool to Support Strategic Environmental Assessment in Ireland

- **4 peer-reviewer international papers**

✓ González, A (2017). A conceptualisation framework for building consensus on environmental sensitivity. *Journal of Environmental Management*, 200: 114-122.

✓ González, A (2017). Mapping environmental sensitivity: A systematic online approach to support environmental assessment and planning. *Environmental Impact Assessment Review,* 66, 86-98.

✓ González, A, Gleeson, J and McCarthy, E (2019). Designing and developing a web tool to support Strategic Environmental Assessment. *Environmental Modelling & Software*, 111: 472-482

✓ González, A, Kelly, C and Rymszewicz, A (under review). Advancements in interactive Web-mapping tools and potential to support terrestrial and marine spatial planning practice. *Transactions in GIS*.

- **8 conference presentations: ESRI International, IAIA, IRLOGI, etc.**

Game changer?

- **Publicly available**
- **Evidence-based assessments and decisions**
- **Efficiency**…time and cost savings
- **Good governance - consistency, transparency, comparability**
- **Exploratory** rather than definitive answers…data limitations, subjective but not arbitrary weights influencing outputs
- **Future developments**
  - Offshore (marine data)…Northern Ireland
  - Support tool for the preparation of LARES (SEAI-funded)

SEA and planning support tool

ESM Webtool

Bringing environmental assessment to your fingertips

www.enviromap.ie