Importance of chemical legislation to water quality in agriculture

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The agriculture water interface: Current topics

Royal Society of Chemistry, London

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Outline of talk

- Importance of water to agriculture
- Introduction to legislation
  - Water Framework Directive
    - Surface water
    - Groundwater
  - Nitrates
  - Plant Protection Products (PPP)
    - Metaldehyde
- Conclusions
- Questions

Global Food Security Challenges

- Population expected to increase to 9-10 billion by 2050
- Increased demand for food & feed (+ 50%)
- Use scarce natural resources more efficiently
- Combat poverty & hunger
- Adapt to climate change

Importance of water to agriculture

- Globally, 70% of freshwater is used for agriculture
- By 2030, water needs will exceed current supplies by 40%
- Water is biggest limiting factor in our ability to feed a growing population
- Agriculture uses most freshwater, yet it also plays a major role in water pollution – especially degradation of inland & coastal waters
- Critical that legislation is in place to protect this increasingly finite resource

Water Framework Directive 2000/60/EC

Drinking Water Directives 98/83/EC & 2015/1787	Groundwater Directives 2006/118/EC & 2014/80/EU	Priority Substances Directive 2013/39/EU
Urban Wastewater Directive 91/271/EEC	Env Quality Standards Directive 2008/105/EC	Bathing Waters Directive 2006/7/EC
Chem Analysis / Monitoring of water status Directive 2009/90/EC	Marine Strategy Framework Directive 2008/56/EC	Industrial Emissions Directive 2010/75/EC
Floods Directive 2007/60/EC	REACH Regulation No. 1907/2006	Plant Protection Products Regulation (EC) No. 1107/2009
Biocidal Products Regulation (EU) No. 528/2012	Nitrates Directive 96/676/EEC	Birds Directive 2009/147/EC & Habitats Directive 92/43/EEC

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EU Water Framework Directive (2000/60/EC)

"Purpose… is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater"

Prevents further deterioration… of aquatic ecosystems

Promotes sustainable water use

Reduce discharges, emissions & losses of priority substances

Reduce pollution of groundwater

Help mitigate effects of floods & droughts

https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32000L0060

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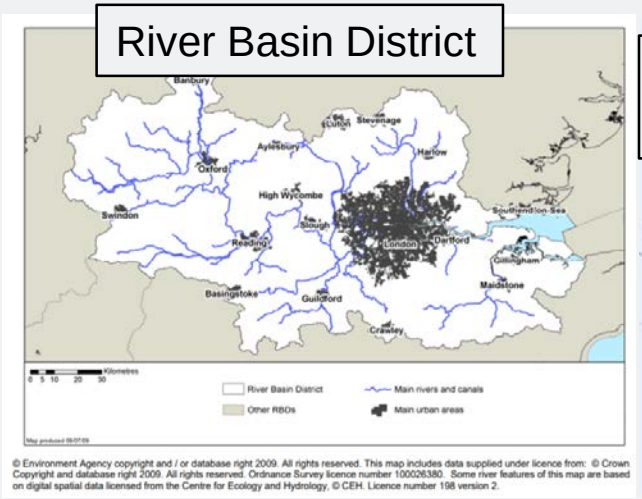
EU Water Framework Directive

- Innovative approach for water management based on river basins (natural geographical & hydrological units)
- Aim is for Member States to achieve “good status” of all water bodies by set deadline.
- Key objectives (EU level) to protect water quality:
  - General (ecological) protection of aquatic ecosystem
  - Specific protection of unique & valuable habitats, drinking water resources & bathing water
- River Basin Management Plans (RBMPs) help set these statutory objectives to achieve good status & measures needed to achieve them (updated every 6 years)

River Basin

Source: wikipedia

River Basin District



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National & International River Basin Districts

ec.europa.eu

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EU WFD: Ecological protection of surface water

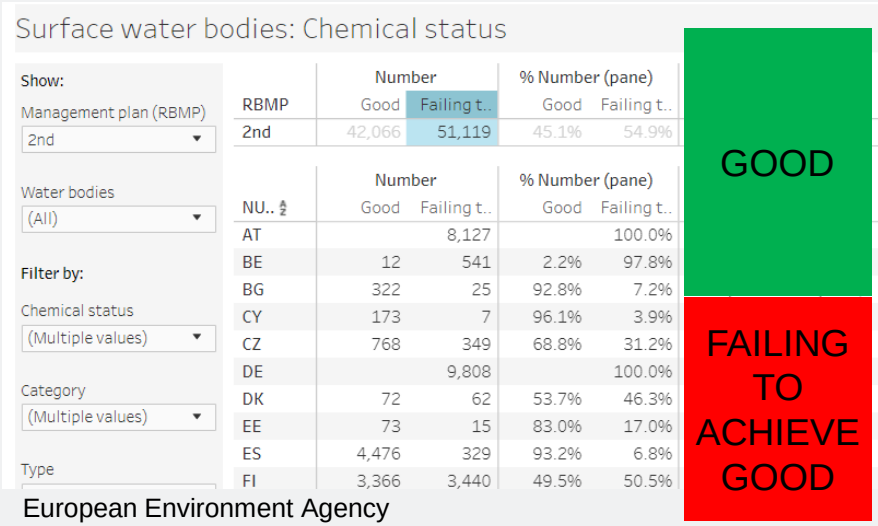
- Account for majority of volume of EU freshwaters
- Key habitats
- Abstractions from key rivers e.g. Danube, Rhine, Thames for drinking water
- Quality varies due to upstream activities
- Traditionally been disposal route for human, agricultural & industrial waste
- Altered to facilitate agriculture & urbanisation

EU WFD: Ecological protection of surface water

- "Good ecological status"
  - Biological community quality
    - allowed only a slight change from natural conditions as a result of human activity
  - Hydrological characteristics
  - Chemical characteristics
- "Good chemical status"
  - Compliance with all quality standards established for chemical substances at EU level
  - Includes Priority substances & other EU-level dangerous substances
  - 38% of EU SW bodies "good" (EEA 2018)

Status	Definition
High	Near natural conditions. No restriction on the beneficial uses of the water body. No impacts on amenity, wildlife or fisheries.
Good	Slight change from natural conditions as a result of human activity. No restriction on the beneficial uses of the water body. No impact on amenity or fisheries. Protects all but the most sensitive wildlife.
Moderate	Moderate change from natural conditions as a result of human activity. Some restriction on the beneficial uses of the water body. No impact on amenity. Some impact on wildlife and fisheries.
Poor	Major change from natural conditions as a result of human activity. Some restrictions on the beneficial uses of the water body. Some impact on amenity. Moderate impact on wildlife and fisheries.
Bad	Severe change from natural conditions as a result of human activity. Significant restriction on the beneficial uses of the water body. Major impact on amenity. Major impact on wildlife and fisheries with many species not present.

European Environment Agency



European Environment Agency

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EU WFD: Quality Standards legislation to achieve good chemical status in SW

- "Priority substances" (EU-wide concern)
  - EQSD / PSD establishes limits on concentrations in SW:
    - 33 priority substances
      - e.g. atrazine, simazine, chlorpyrifos, heavy metals
    - 15 priority hazardous substances
      - uPBTs (PSD): ubiquitous, Persistent, Bioaccumulative & Toxic
      - e.g. mercury, polycyclic aromatic hydrocarbons (PAHs)
    - 8 other pollutants e.g. DDT

Env Quality Standards Directive 2008/105/EC

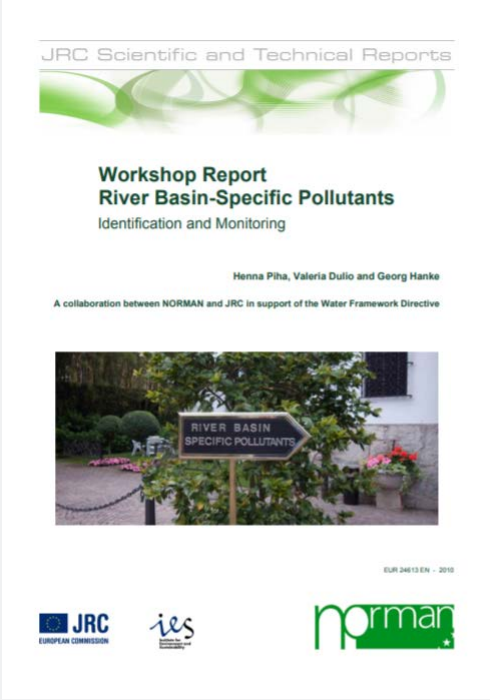
Priority Substances Directive 2013/39/EU

EU WFD: Quality Standards legislation to achieve good chemical status in SW

- "River basin specific pollutants" (MS level)
  - Regional or local importance
  - Similar process to priority substances:
    - Identify pollutants
    - Provide EQS & monitoring schemes
    - Determine regulatory measures
  - Discretion of each MS
  - No harmonised approach exists
  - UK examples: glyphosate, methiocarb

Env Quality Standards Directive 2008/105/EC

Priority Substances Directive 2013/39/EU



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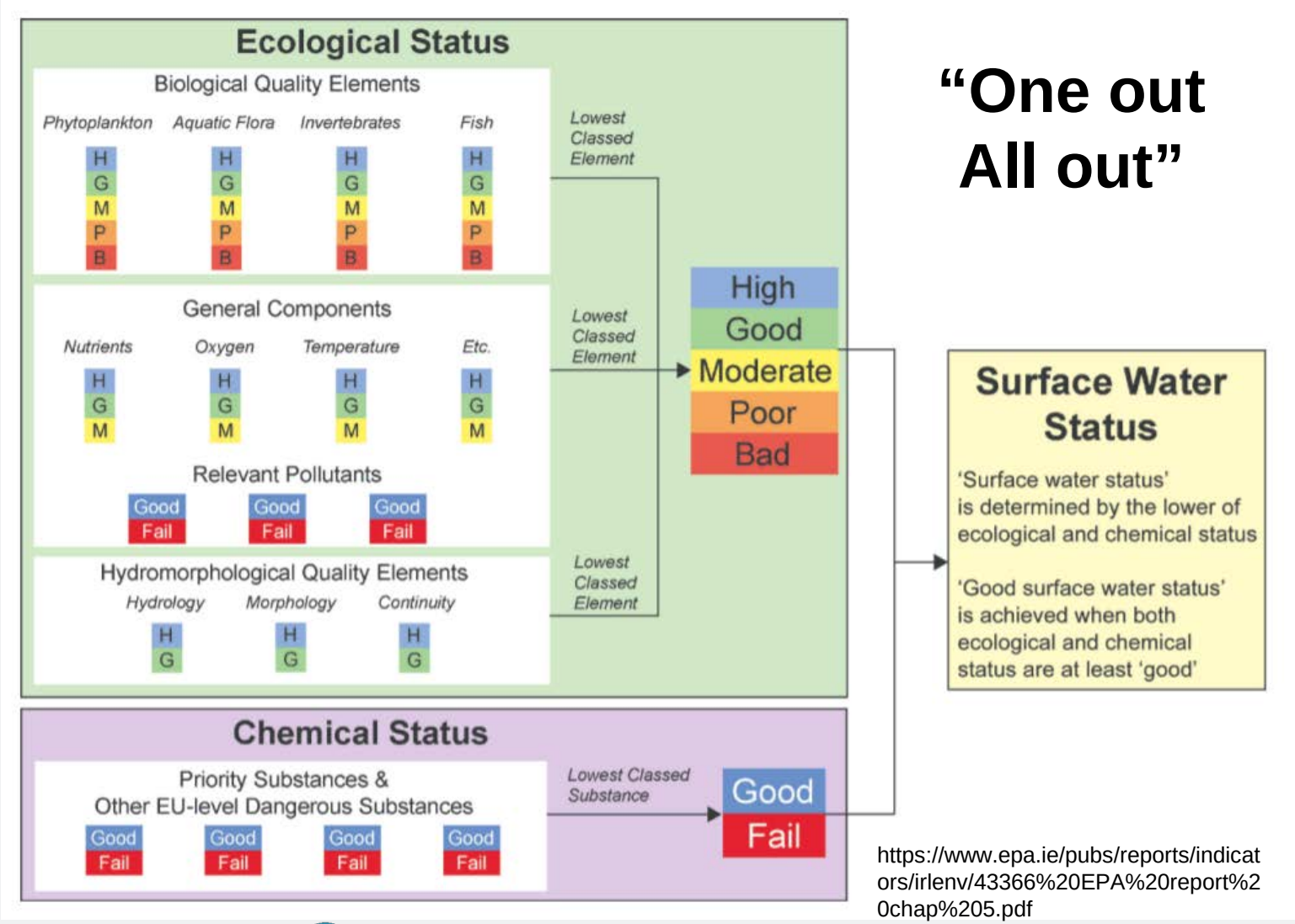
EU WFD: Ecological protection of surface water



"One out All out"

https://www.epa.ie/pubs/reports/indicators/irlenv/43366%20EPA%20report%20chap%205.pdf

EU WFD: Ecological protection of groundwater

- Constitutes largest reservoir of freshwater in world (>97% excluding glaciers & ice caps)
- Historic focus largely for drinking water, irrigation (agriculture) & cooling (industry)
- Recent focus to protect GW for its environmental value (e.g. hydrological cycle)
- Moves slowly through subsurface – impact of man-made activities may last for a long time
- Inaccessibility means focus must be on preventing pollution in first place

EU WFD: Ecological protection of groundwater

- "Good chemical status"
  - Presumption is that it should not be polluted at all
  - Few standards exist at EU level for particular issues which must be adhered to
  - General protection uses a precautionary approach:
    - prohibits direct discharges to GW
    - Requires monitoring of GW bodies to identify upward trends & reversal of manmade pollution (indirect discharges)
  - 78% of EU GW bodies "good" (EEA 2018)
- "Good quantitative status"
  - Measures degree to which GW is affected by direct & indirect abstractions
  - To achieve good, available GW resource must not be exceeded by long-term annual average rate of abstraction

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EU WFD: Quality Standards legislation to achieve good chemical status in GW

- GWD complements WFD & requires operational measures to prevent or limit inputs of pollutants into GW so that WFD environmental objectives can be achieved.

Groundwater Directive 2006/118/EC

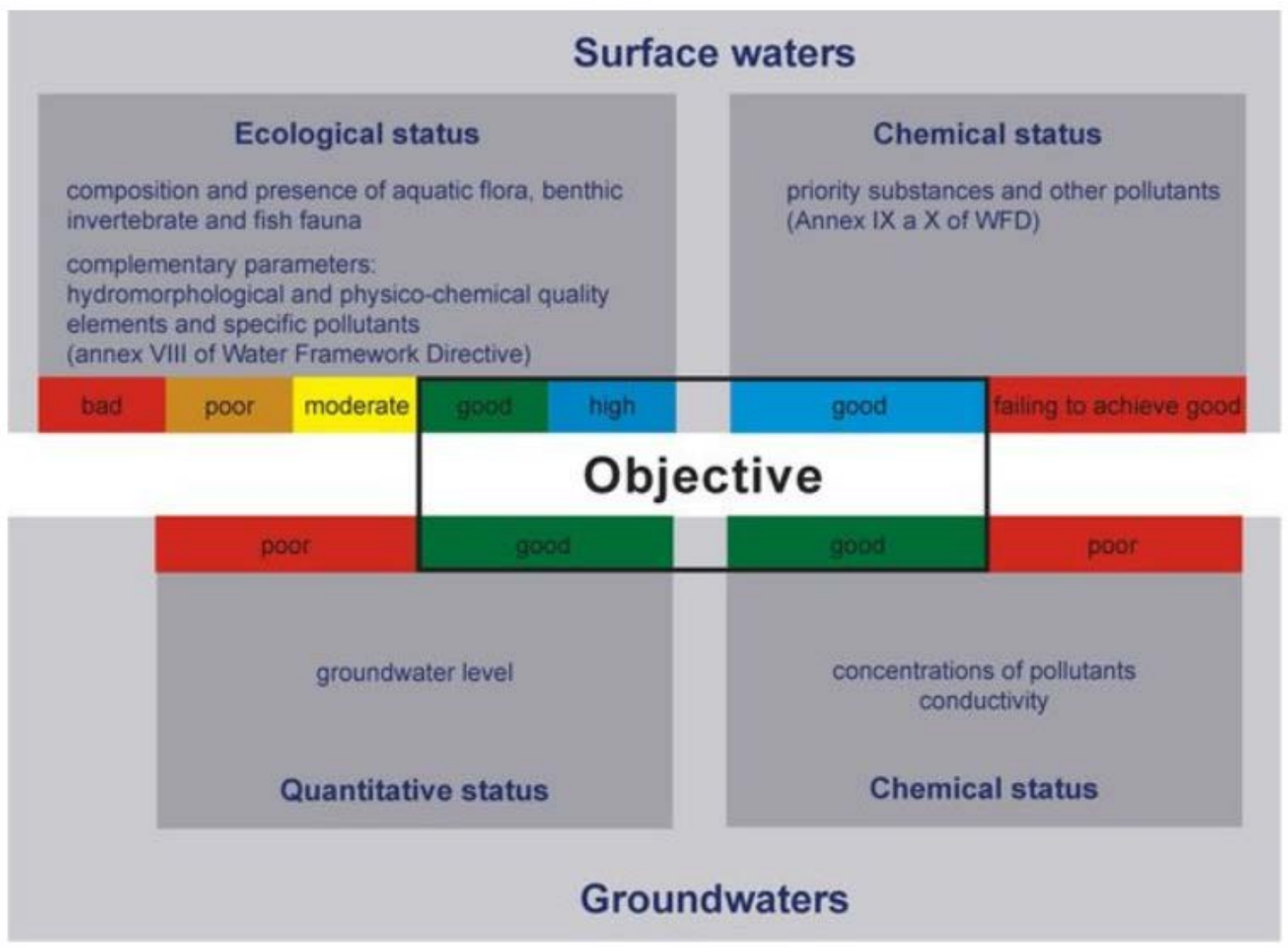
Commission Directive 2014/80/EU

- Annex I (GWD): Groundwater Quality

Pollutant	Quality Standards
Nitrates	**50 mg/L**
Active substances in pesticides, including their relevant metabolites, degradation & reaction products	**0.1 µg/L** **0.5 µg/L (total)**

Total = sum of all individual pesticides detected & quantified in monitoring procedure including metabolites, degradation & reaction products

EU WFD: Ecological protection of SW & GW



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hhttps://www.ikse-mkol.org/en/eu-directives/water-framework-directive/

Drinking Water Directive 98/83/EC

- Protects human health by ensuring water quality intended for human consumption is wholesome & clean
- Lays down 48 essential quality standards at EU level:
  - Microbiological e.g. *E.coli,* Enterococci
  - Indicator, e.g. chloride, taste, odour
  - Chemical:

Drinking Water Directive 98/83/EC

Commission Directive (EU) 2015/1787

Parameters	Max. concentration
Nitrate	**50 mg/L**
Pesticides: Aldrin, Dieldrin, Heptachlor, Heptachlor epoxide	**0.03 µg/L**
Other pesticides	**0.1 µg/L**
Total pesticides	**0.5 µg/L**

Nitrates Directive (1991)

1. Identification of water bodies polluted / at risk
   - e.g. GW / SW containing >50 mg/L nitrates
2. Designate Nitrate Vulnerable Zones
   - i.e. areas of land which drain into polluted waters or those at risk of pollution
   - Approx. 61% of EU agricultural area (2015) designated as NVZ with obligations to achieve balanced fertilisation.
3. Establish farmer action programmes within NVZs
   - e.g. limit fertiliser applications
4. Establish codes of good agricultural practice (voluntary)
   - e.g. apply correct amounts
   - require minimum storage capacity for manure
   - use buffer zones
5. National monitoring & reporting
   - every 4 years MS report on nitrate concentrations in GW/SW

Nitrates Directive 96/676/EEC

European Commission

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Plant Protection Products Regulation (EC) No. 1107/2009

- PPPs are pesticides that protect crops or desirable plants
- Aim to ensure high level of protection of human & animal health & environment and to safeguard competitiveness of EU agriculture
- Active substances approved at EU level by COM following intensive evaluation by MS and EFSA
- Products authorised at EU level, zonal or MS level following AS approval
- Art. 4: “substance shall have no unacceptable effects on the environment, **especially regarding contamination of surface waters, groundwater**, air and soil…….”

Plant Protection Products Regulation (EC) No. 1107/2009

PPP Regulation & water quality

- This is achieved via adherence to data requirements (& other key legislation):
  - Reg. (EC) No. 283/2013 (Active Substance)
  - Reg. (EC) No. 284/2013 (Product)
- Use study endpoints & application details to calculate PECs for environmental compartments
- Calculate TER to characterise risk (NOEC/PEC)
- Must comply with standards in WFD, GW Directive etc. (not risk-based)
  - 0.1 / 0.5 µg/L cut-off for GW/DW
- Refinement necessary if above these limits
  - e.g. Refine application rate
  - Use higher tier modelling e.g. FOCUS

Plant Protection Products Regulation (EC) No. 1107/2009

Metaldehyde

- Current approval date (EU): 1st June 2011
- Current approval expires: 31st May 2023
  - Extended by 2 years under AIR IV
- EFSA Conclusion published in 2010:
  - Single representative product “Metarex” (50 g/kg) ready to use bait for control of slugs & snails
  - Evaluated uses: cereals & OSR
  - High to v. high mobility (K_{Foc} 38-149 mL/g)
  - Groundwater: FOCUS refinement concluded low potential for GW exposure (0.1 µg/l):
    - 9/9 scenarios passed for cereals & spring OSR
    - 5/6 scenarios passed for winter OSR
  - PECs calculated based on specific kinetic release rate characteristics of Metarex product

EFSA Conclusion (2010) – Key points

- Surface water / sediment
  - PEC SW & SED acceptable (FOCUS Steps 1-3)
- Aquatic organisms
  - Harmful to aquatic organisms
  - H411 classification
- Birds & mammals
  - High risks identified for granivorous species
- Product renewals ongoing in 2018 (e.g. in UK) …

Conclusions

- 70% of global freshwater used by agriculture; however, it plays a major role in water pollution
- Critical that legislation is in place to protect this finite resource
- Implementation of Water Framework Directive introduced an integrated approach to manage water quality
- This has led to improvements in quality of surface water and groundwater across EU but further work is needed to achieve targets set out in WFD and related directives.

Questions?

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