The EU Groundwater Directive (2006) (GWD) and the Groundwater Regulations (2010)

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Acknowledgement: Colleagues in EPA, DEHLG and on WFD Groundwater Working Group

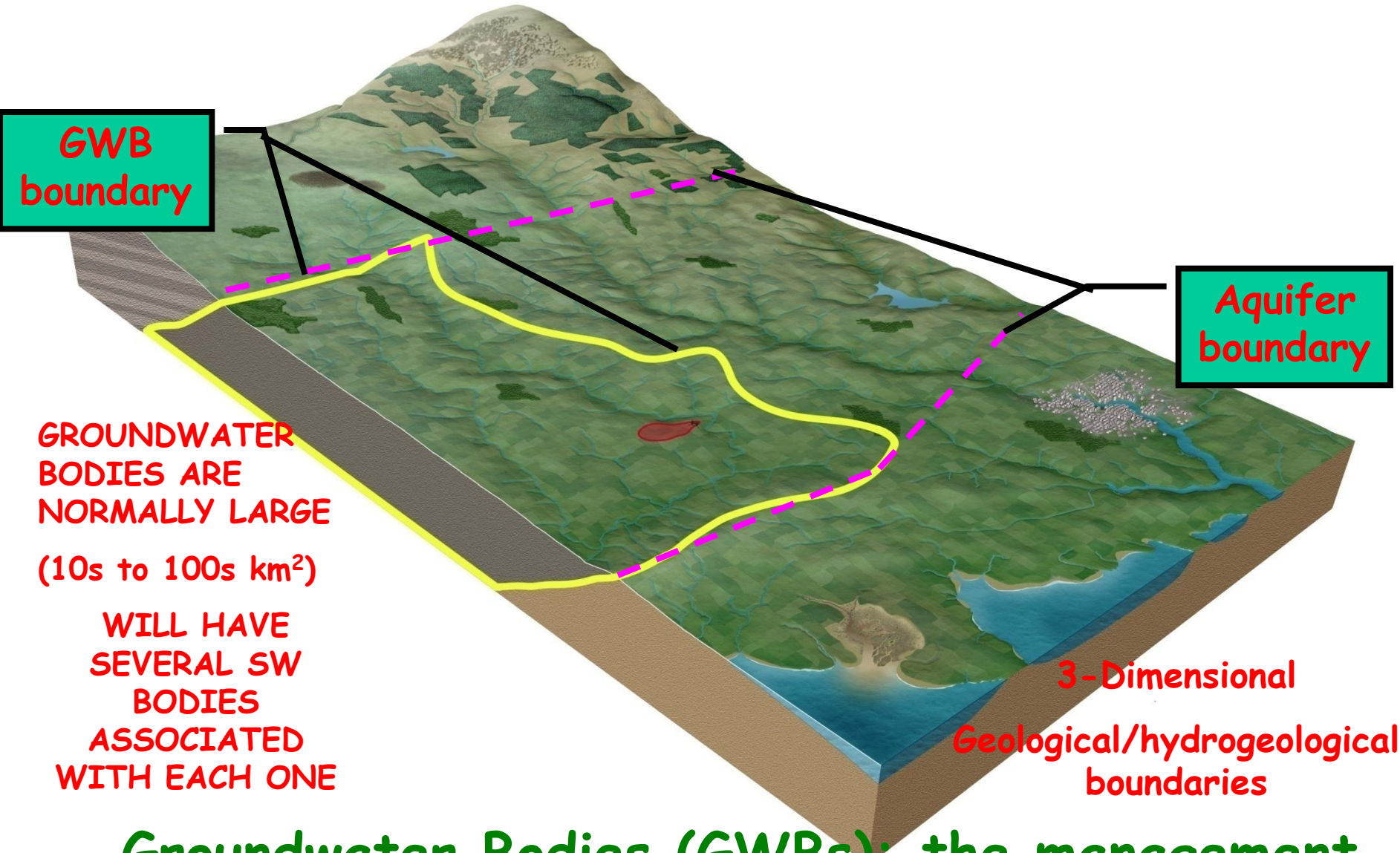
This presentation is intended:

1. To give "a flavour" of the GWD and Groundwater Regs;

2. Outline progress to-date in implementing the groundwater aspects of the Directives;
and
3. Raise some issues that may be particularly relevant to geoscientists.

EU Water Framework (WFD) & Groundwater "Daughter" Directives

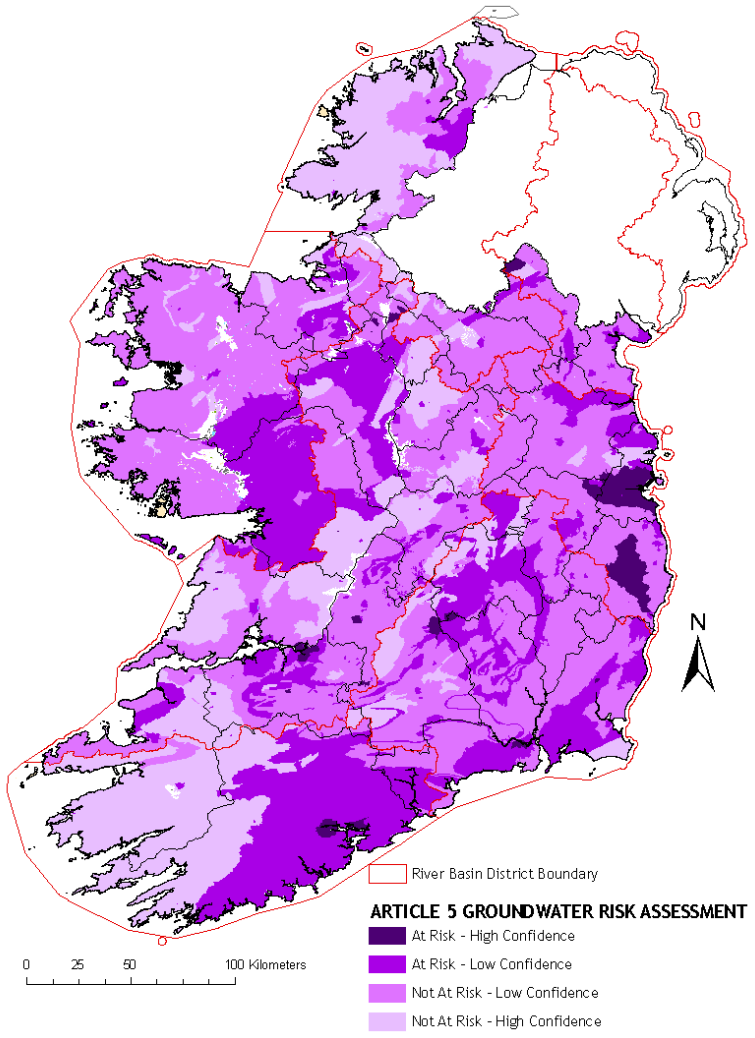
- Groundwater Directive a "daughter" of the WFD
- Groundwater must be
  - Characterised
  - Monitored
  - Classified
  - Have objectives established
  - Protected and, where necessary, improved



Groundwater Bodies (GWBs): the management unit of the WFD (not aquifers)

Article 5 Characterisation (2005)

- GWBs are the water management units that are assessed under WFD
- 757 GWBs in RoI
- 442 GWBs identified as being "At Risk" from Chemical/WQ Pressures (relating to 26% of RoI's land area) in Article 5 assessment



Monitoring

- Monitoring networks has been developed to assess the GW Quality elements of the WFD

- They include 281 MPs, including:
  - 27 weirs
  - 62 piezometers in 'poorly productive' aquifers
  - 135 groundwater level MPs, with data loggers
  - Investment of €3.75 million by EPA since 2006

- Water samples taken quarterly

Photos: Henning Moe, CDM

What is Groundwater?

- WFD Definition:

"All water which is below the surface of the ground in the saturated zone and in direct contact with the ground or subsoil"

What isn't Groundwater?!!!

- Not defined in WFD or GWDD!
- It is not: "pore water in low permeability deposits" in my view (note UKTAG Guidance)
- Example: low permeability tills/boulder clays

Low permeability (<1x10-8m/s) glacial till.

"CLAY" in BS5930 terms

Figure 4: Example of Groundwater in Groundwater Bodies and Overlying Strata.

Diagram illustrated by Nathan Fletcher.

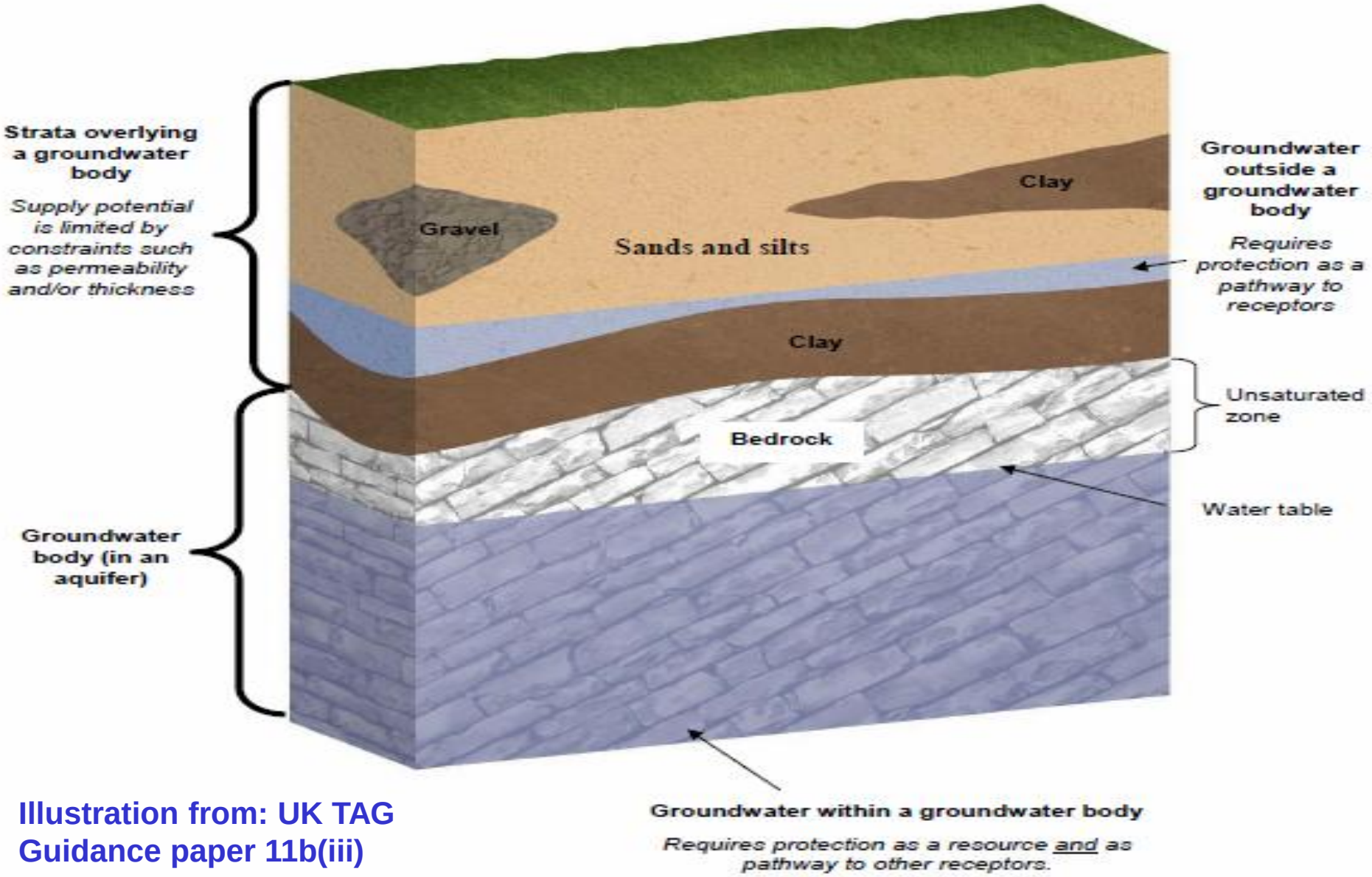


Illustration from: UK TAG Guidance paper 11b(iii)

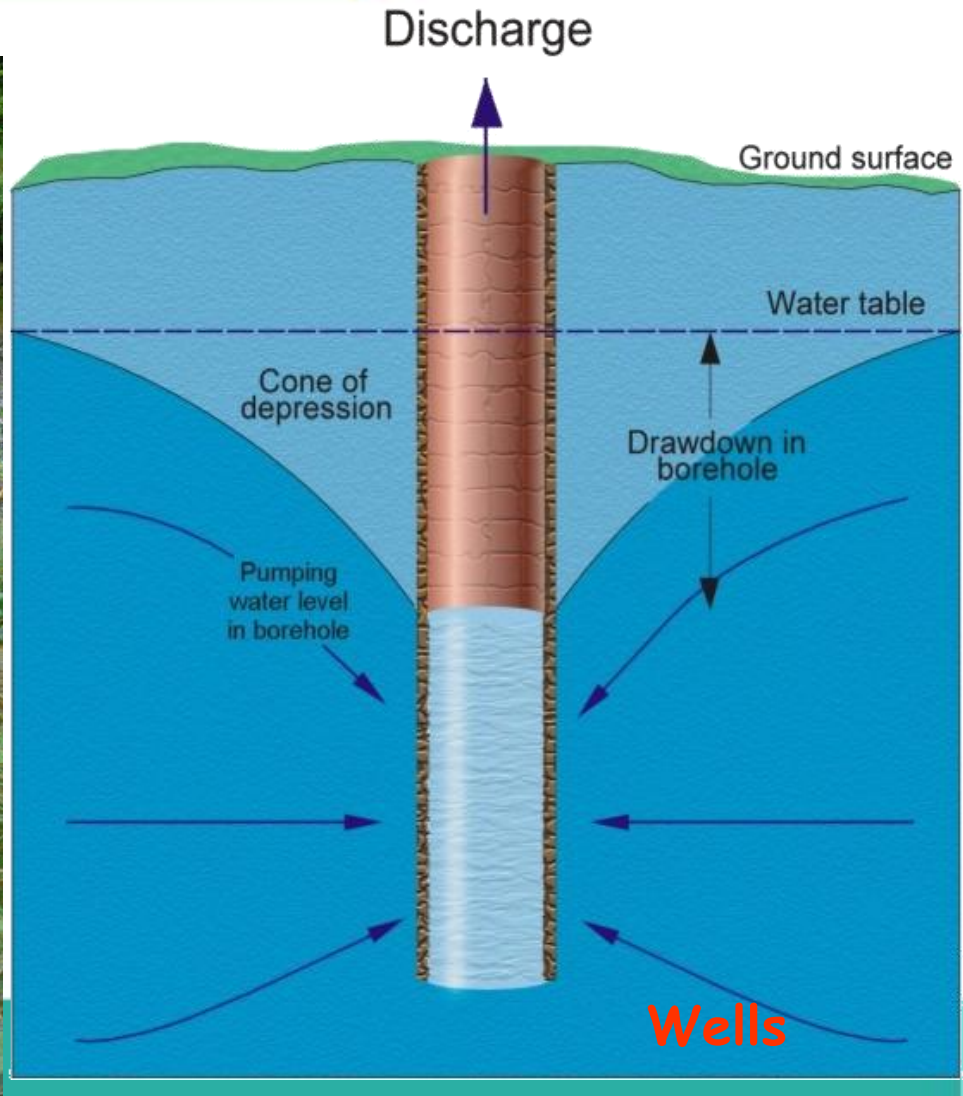
Rethinking "Groundwater" (!!)

- A "mind shift" needed by the hydrogeological community

- WFD & GWD are receptor-oriented (and risk-based).
  - In particular, seeing groundwater in terms of ecologically-oriented objectives
    - Surface water ecosystems
    - Groundwater dependent terrestrial ecosystems (GWDTEs)

No longer sufficient to 'see' groundwater largely in terms of wells

Springs



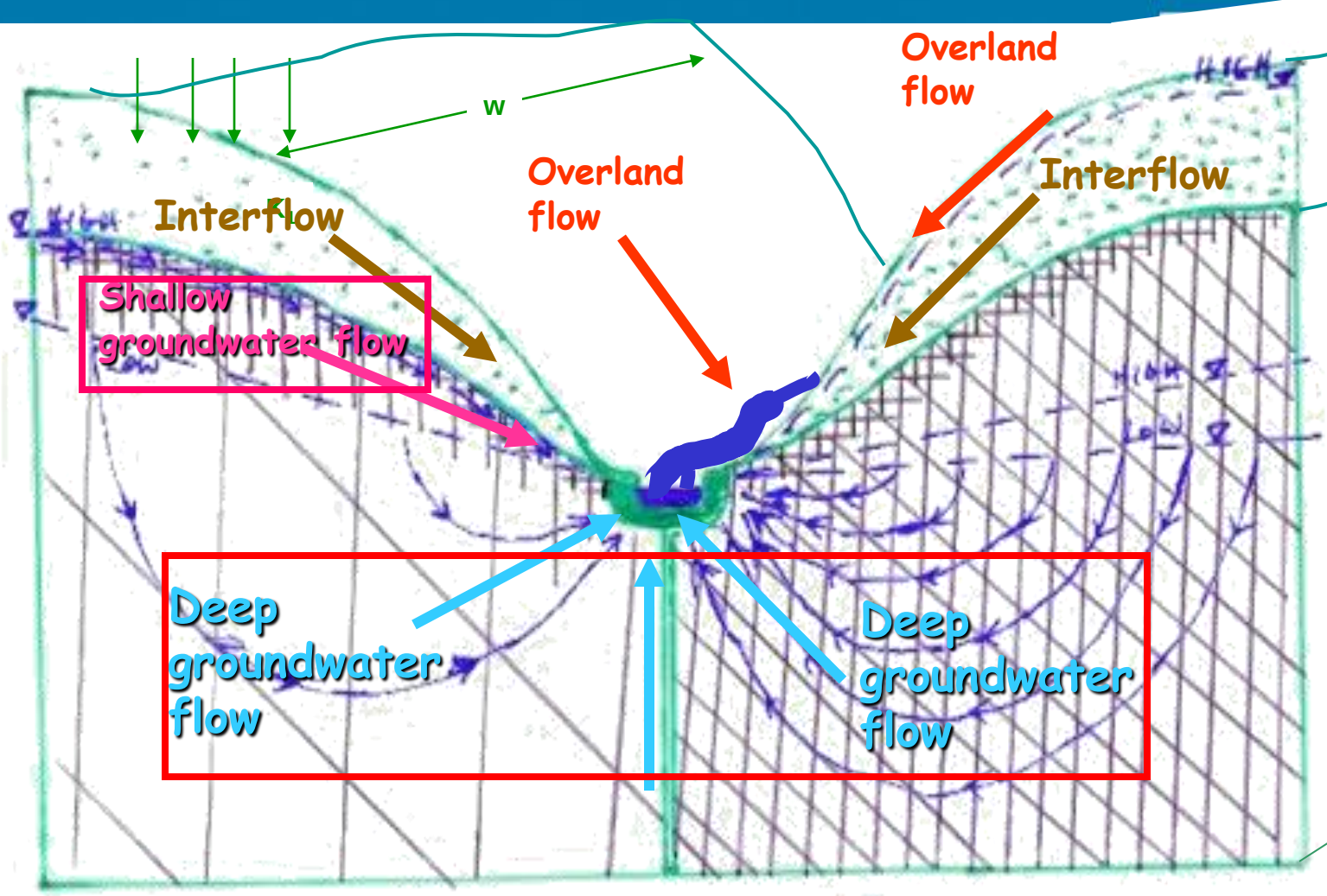
Wells

Groundwater as a contributor to surface water

Groundwater as a contributor to groundwater dependent ecosystems

Pollardstown Fen - a GWDTE

Changing the mind set: What is groundwater?!



Slide source: Donal Daly & Taly Hunter-Williams

Low transmissivity bedrock

High transmissivity bedrock

Weathered zone as fluid pathway

Weathered/broken rock zone at top of bedrock aquifer (Poor Aquifer)

Weathered/broken rock zone as fluid pathway

Hook Head, Co. Wexford

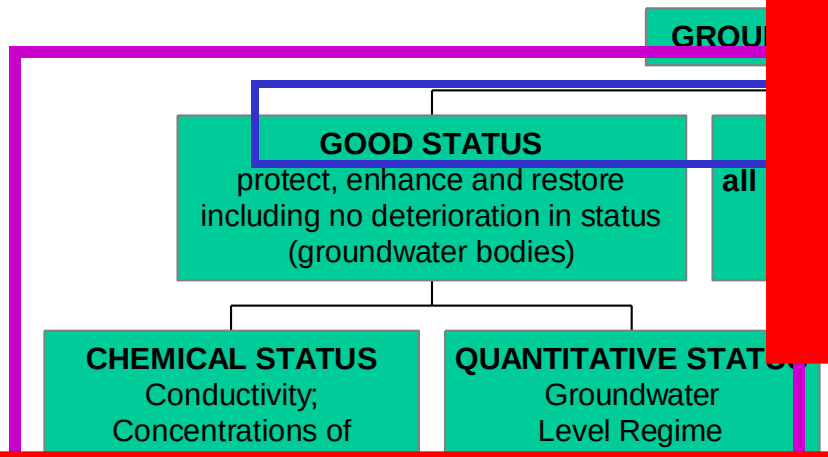
GW Contribution to flow in surface water bodies

- Groundwater flow to rivers can come from both deep GW (resource) and shallow "top of the rock" flow
- The percentage groundwater contributes to SW flow was calculated for different GWBs using:
  - GIS (used to get data inputs);
  - Modelling (NAM model used to separate flows into overland flow, Deep GW & Intermediate flows); &
  - Conceptual Understanding

Aquifer type	Groundwater contribution (%)	
Pl Pu	Mean	**24**
	Range	21 - 29
Ll	Mean	**34**
	Range	22 - 45
Rf	Mean	**66**
	Range	65 - 69
Rg Lg	Mean	**90**
	Range	-
Rk	Mean	**86**
	Range	-

Based largely on the Suir catchment

Protection of Groundwater in the W



"Good" status for 'all' groundwater bodies to be achieved by 2015.

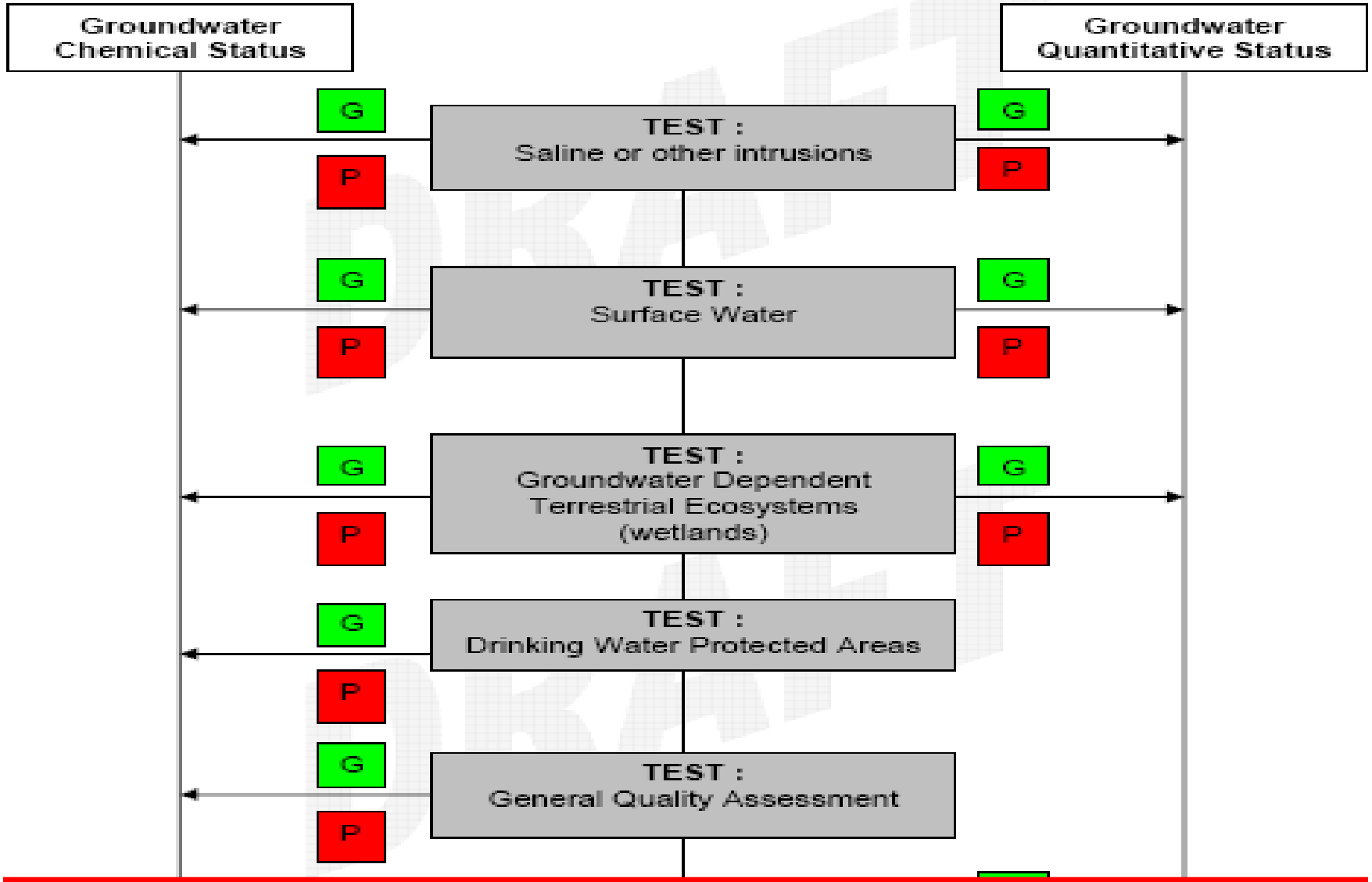
However, extended deadlines and less stringent objectives can apply

RTICLE 17

R DAUGHTER DIRECTIVE

The new Groundwater Regs: S.I. 9 of 2010

- Regulations transpose into Irish law the measures needed to achieve the environmental objectives established by the WFD and GWD.



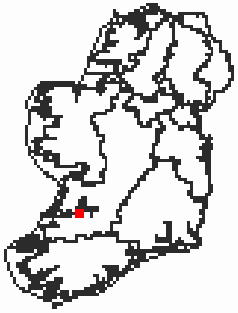
GWBs are classified as either POOR or GOOD STATUS for <u>both</u> quantitative and chemical elements

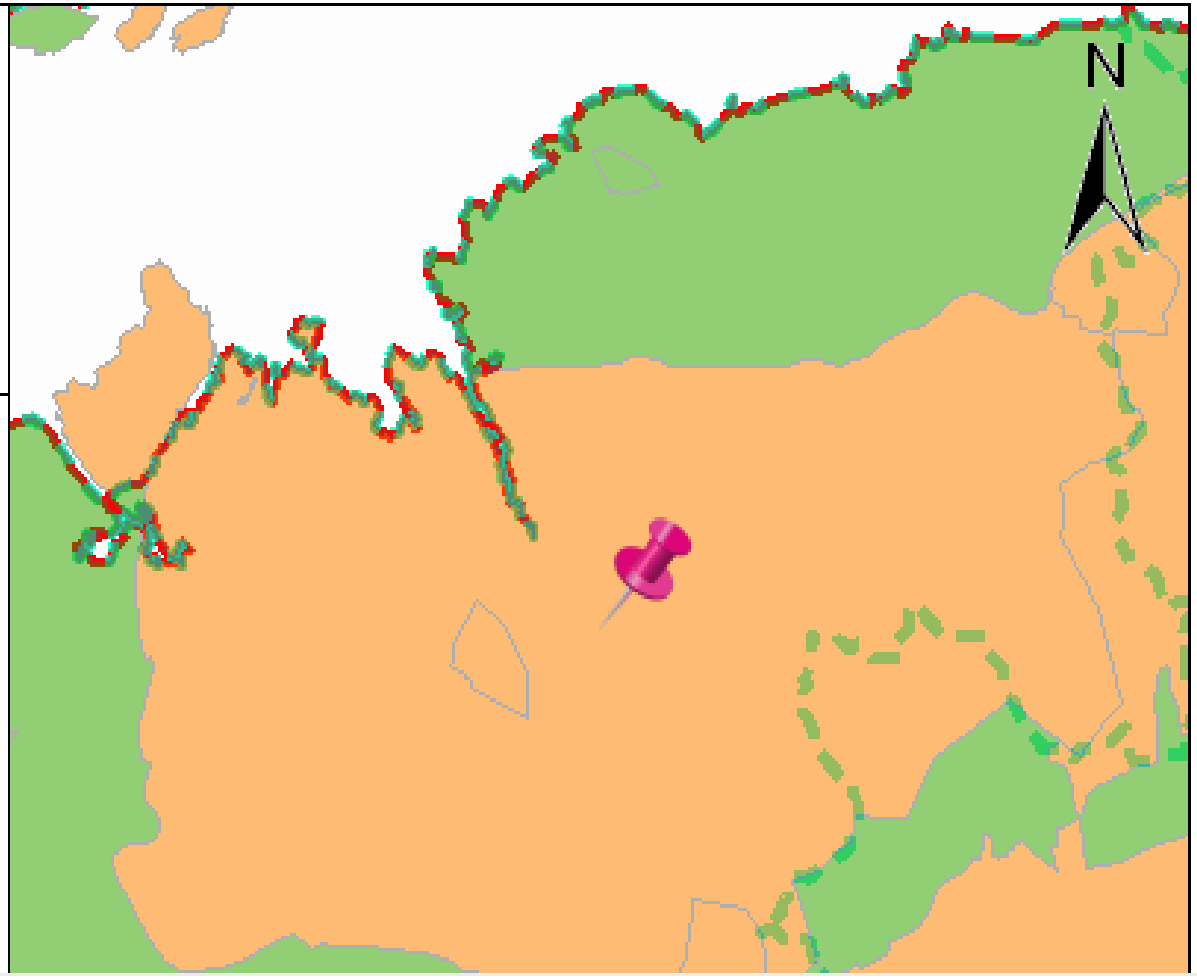
Groundwater Status

- Status is based on an assessment of the current state of GWBs
- The overall aim of the WFD is to achieve "**Good Status**" for all GWBs by 2015
- Status assesses **Average GWB Conditions**
- Local issues are managed under site specific **"Prevent or Limit"** legislation, but they may still impact on status

water matters
"Help us plan!"

Full Report for Waterbody Askeaton





Legend

- High
- Good
- Moderate
- Poor
- Bad
- Yet to be determined

water matters
"Help us plan!"

Summary Information:

WaterBody Category:	Groundwater Waterbody
WaterBody Name:	Askeaton
WaterBody Code:	IE_SH_G_010
Overall Status:	Poor
Overall Objective:	Restore
Overall Risk:	1a At Risk
Applicable Supplementary Measures:	Unsewered;
	Report data based upon Draft RBMP, 22/12/2008.

Date Reported to Europe: 22/12/2008

Date Report Created 06/05/2010

eastern
river basin district

Programme of Measures
Groundwater

1. Water Framework Directive
2. Groundwater
3. Overview of Groundwater
4. Groundwater Status
5. Objectives
6. Protected Areas
7. What are the Problems to address?
8. Programme of Measures
9. Target Date
10. Cost to implement the plan

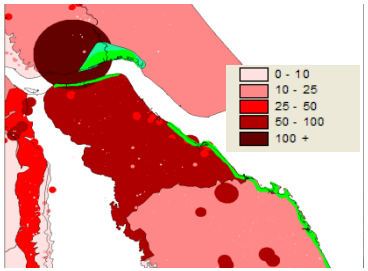
www.erbd.ie

The Four Quantitative Tests

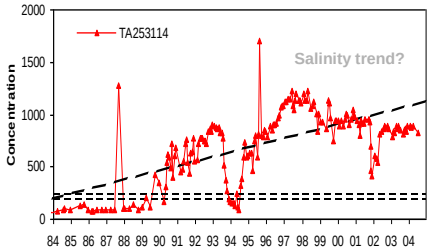
impacts on the GW body

impacts on dependent receptors

1. GWABS as % recharge



2. saline or other intrusions



3. SW body ecological status

4. GW dependent wetlands

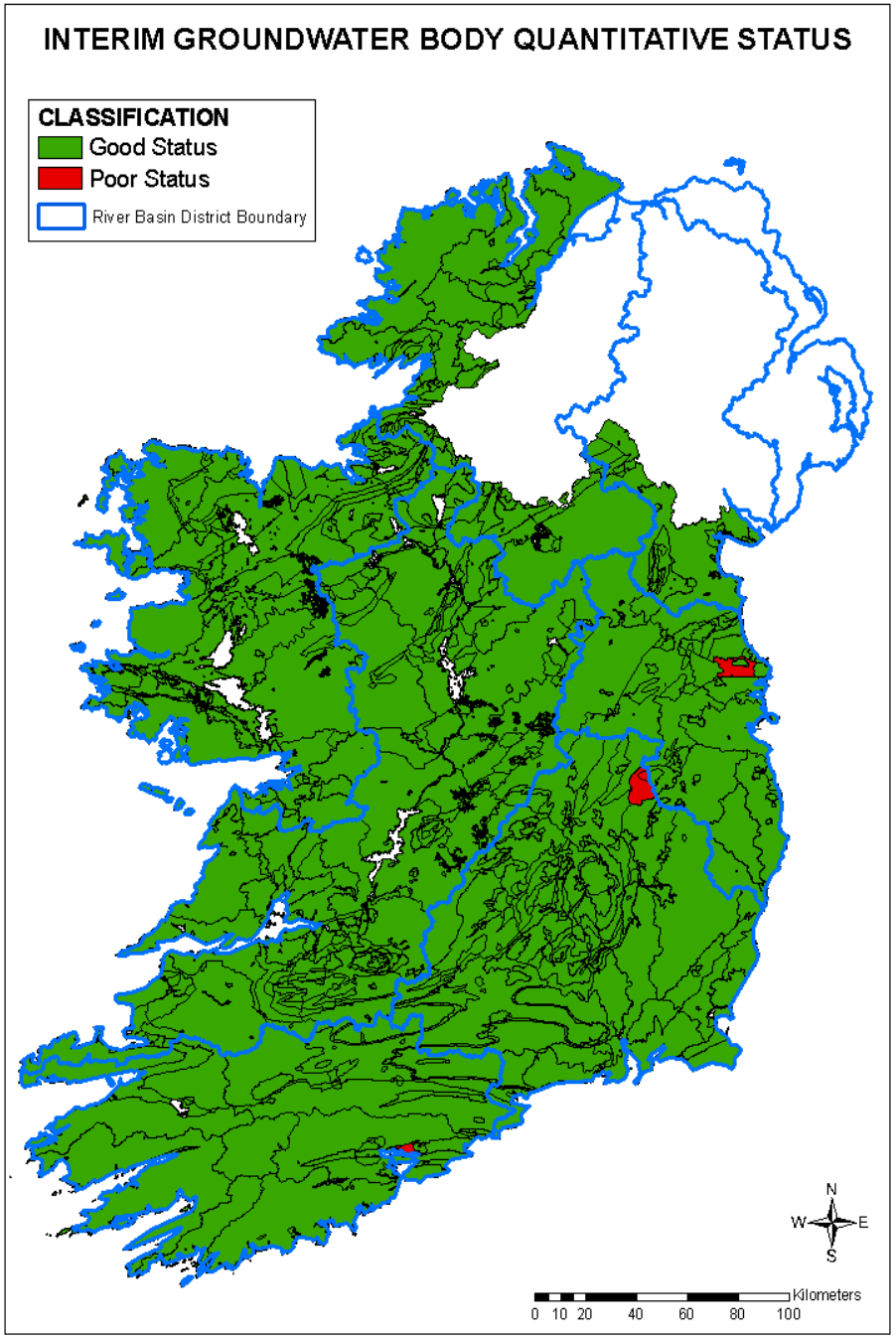
Slide source: EA (England & Wales)

Water Balance Test

- A GWB-wide test; considers cumulative effects of pumping
- Information needs:
  - Recharge (average annual);
  - Average annual abstraction ;
  - Long-term ecological flow needs.
  - Groundwater levels
- Sustained long-term decline in water levels = Poor Status
- Available gw resource = Recharge less Ecological Flow Requirements
- Ecological flow requirements not known!!
- Assume minimum 20% of recharge needed.
- Therefore, if more than 80% of recharge is abstracted = Poor Status
- If more than 20% of recharge is abstracted = At Risk.

Overall Quantitative Status

- **4 GWBs at Poor Status**
  - 2 due to unsustainable long-term abstraction
  - 2 due to abstractions impacting on the supporting water level/flow conditions of wetlands
- **Future needs:**
  - An improved abstraction register
  - Ecological flow requirements of rivers and wetlands
  - Large GW abstraction well fields & quarries must take a/c of implications for GWB status



Groundwater Threshold Values (TVs)

- TVs are in the Groundwater Regulations and have been reported to the EU
- TVs are **mean concentrations**
- TVs are **not** Emission Limit Values (ELVs)
- TVs are **trigger values** that prompt further

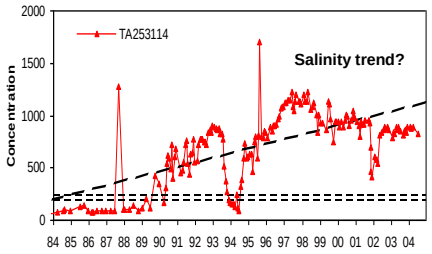
No "simple" "cookbook" approach.
Threshold values (TVs) do not map directly to status categories

Param			TV
Nitrate			
TCE/PC			int Source
Chlorid			
Conduc			
MRP			
Ammonium	**65 ug/l N**	Surface Water Quality	SW EQS

The Five Chemical Tests

Impacts on the GW body

Saline or other intrusions



Drinking Water Protected Areas

Impacts on dependent receptors

SW body chemical & ecological status

General Chemical Assessment

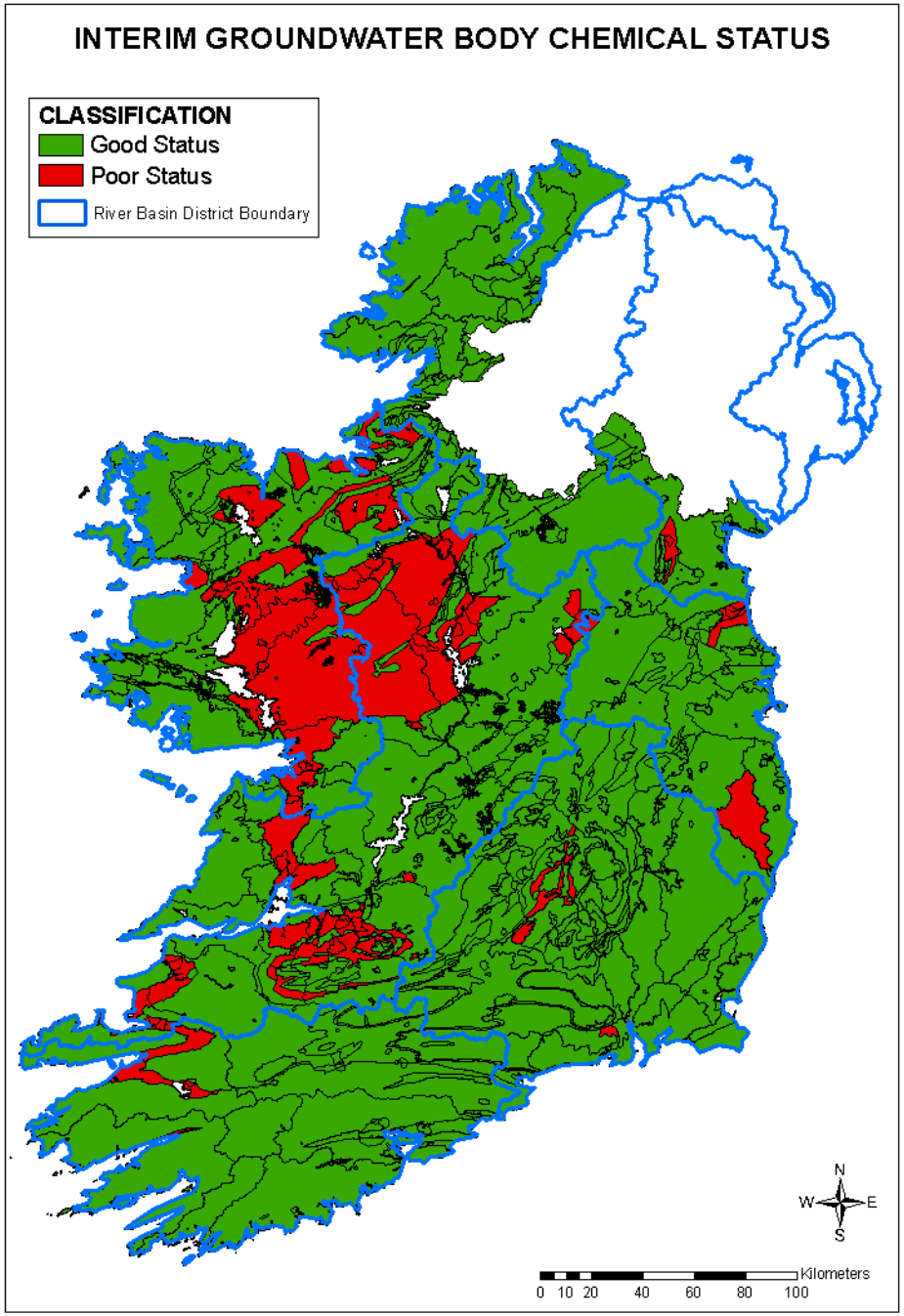
GW chemical status

GW dependent terrestrial ecosystems

Slide source: EA (England & Wales)

Overall Chemical Status

- 111 GWBs at POOR STATUS
  - Relates to 14% of RoIs area
- Main Drivers:
  - MRP contributing to SW Eutrophication
  - Metals from Historic Mining Activities
  - Contaminated land / Urban



General Assessment of Quality

- For Point Source Pollutants (Contaminated Land, Mines, Urban Areas):
  - Average concentration of "pollutants" calculated for plume at site
  - Aggregate with background concentration for remainder of GWB
- If the aggregated mean concentration > appropriate TV, then the GWB will be at POOR STATUS

Status: Implications & Recommendations

- Be aware and take account, as appropriate, of the status results for consideration of existing and new developments.
- See groundwater not only as a source of drinking water but as a pathway for pollutants to surface water.
- Background values for some potential pollutants are available. EPA now has 275 MPs with quality data collected quarterly.

"Prevent or Limit" Objective

- The most important WFD/GWDD objective for protecting groundwater
  - Status = GWB-wide, 6-early review, can miss local impacts
  - Prevent or Limit = Deals with localised pollution; first line of defence; can impact on status
- But, both complementary

The "Limit" Objective

- Requires measures to ensure that:
  - There is no deterioration in status
  - There is no significant and sustained upward trend
- This implies no harm to a receptor and keeping loadings below that which would result in average pollutant concentrations above relevant standards
- Applies to both point and diffuse sources

The "Limit" Objective: possible approaches

- Check current status and risk assessment results for relevant water bodies - see 'water matters' maps @ www.wfdireland.ie/maps.html
- Check and nominate relevant nearby receptors, e.g. river, well, groundwater dependent terrestrial ecosystem

The "Limit" Objective: possible approaches (cont.)

- Assume nearby river is receptor
- Objective: to ensure **no deterioration** in the river body status by controlling the pollutant input
- Check the EQS values for the relevant pollutants (assumes that there is an EQS)
- Back-calculate from this standard to derive an unacceptable input at the point of release

The "Limit" Objective: possible approaches (cont.)

- Back-calculations should (try to) take account of attenuation along the flowpath.
- I recommend basing the ELV on loading analysis (but take care on where this is applied to) and attenuation estimation, not just concentrations.
- Take account of exceedances of TVs, but note that they are NOT ELVs.
- Probably need to decide on compliance point (could be virtual) and MP(s)

Figure 3 – Receptors, Compliance Points and Standards

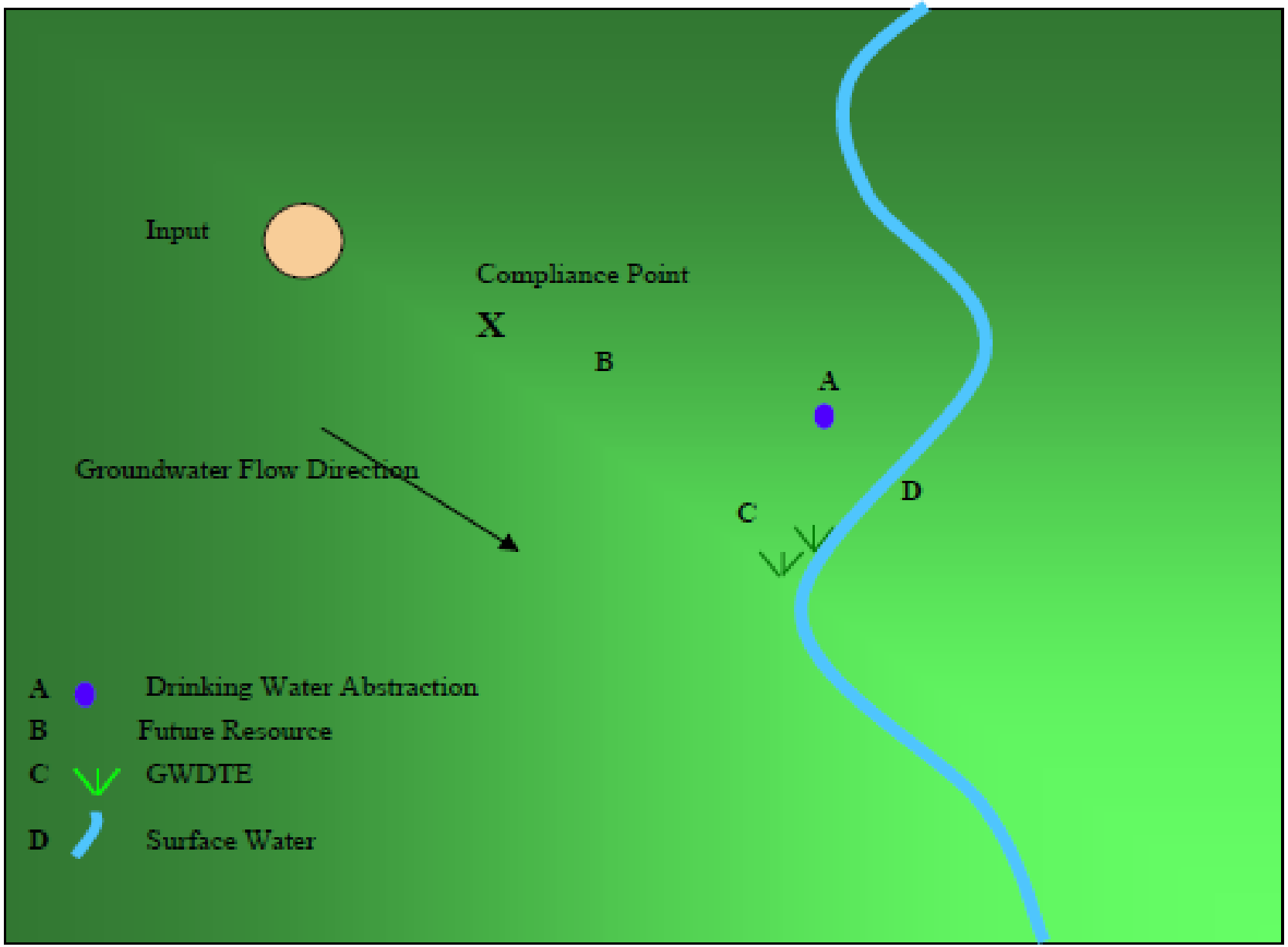
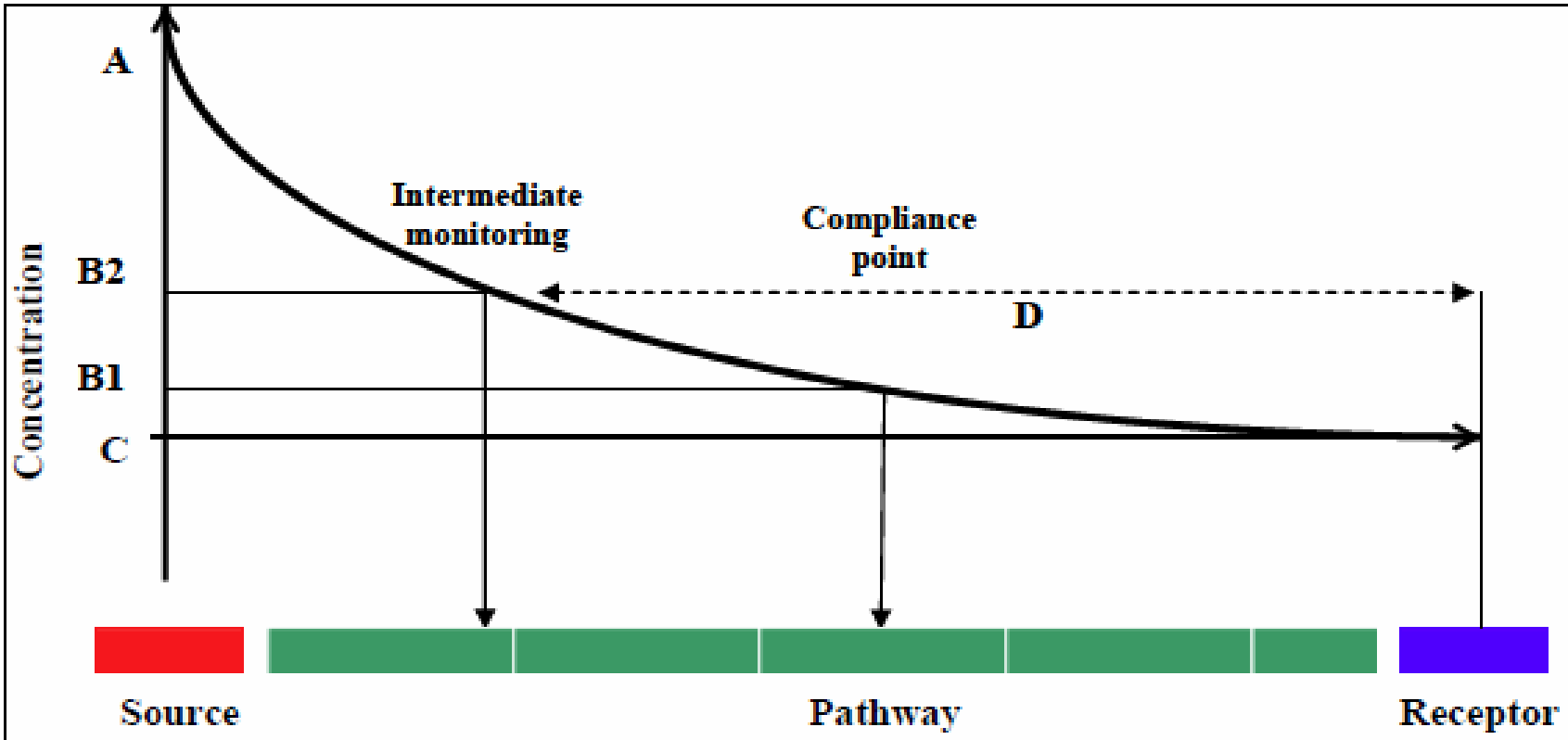


Figure 2 - Receptors, Compliance Points, and Concentrations



C = **Quality standard** required at the **receptor**, based on an appropriate **environmental standard**.

B1 = Compliance Value at a **compliance point**, set to ensure the quality standard required at the receptor is/will be met (may be physical, i.e. an actual **monitoring point** or virtual, i.e. a point used for prediction/calculation)

B2 = Quality measurement at **intermediate monitoring points** to provide advance information.

D = Possible range of compliance point locations according to specific conditions (hydrogeology, resource management) – could be at the receptor itself, or some other point along the pathway.

A = Limit value applied at the source (e.g applied to a permit) to protect the receptor or the resource value of the groundwater and meet other WFD objectives.

The "Limit" Objective: other points

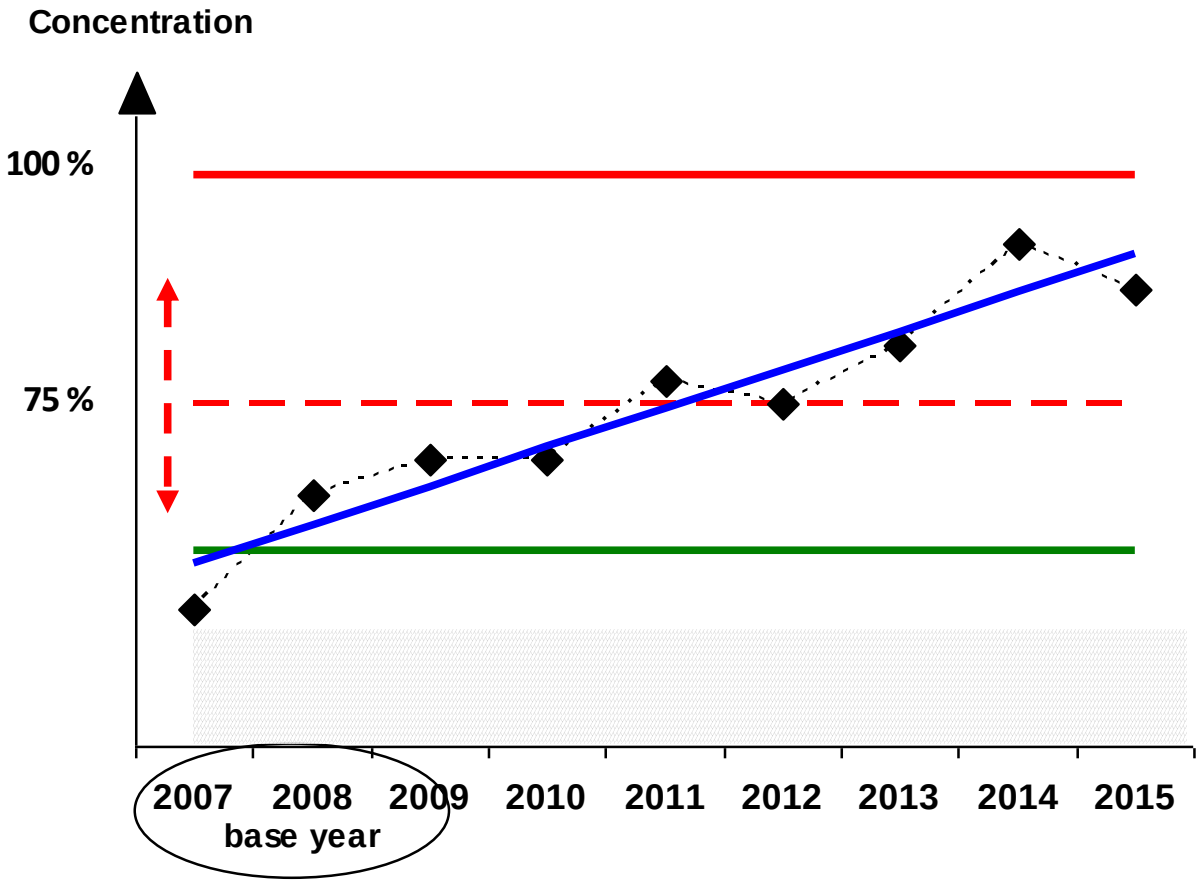
- Where there is no obvious receptor, permits must prevent deterioration in status, i.e. prevent widespread deterioration in gw quality.
- What is situation where the relevant water body is "less than good" already?
  - No further 'significant' inputs allowable????
- Diffuse inputs are likely to become an issue in the future.
- GWD: For existing plumes, trend assessments & monitoring required, if a serious threat
- Other issues: the 'prevent' objective, direct discharges and exemptions

Guidance on Discharges to Groundwater

- No consistency among regulatory bodies

- EPA will complete Guidance before end 2010, as a means of implementing the Groundwater Regs

Trend identification and reversal elements



Slide Source: Johannes Grath, EU WG-C

Trends: Nitrate Trends in Groundwater

- Trend analysis undertaken by EPA for 119 wells/springs
- Statistically significant downward trend at 11 sites
- Statistically significant upward trend at 12 sites
- Environmentally and statistically significant upward trend at 2 sites

Role of Competent Authorities

- "A public body shall not, in the performance of its functions, undertake those functions in a manner that knowingly causes or allows deterioration in the quantitative status or chemical status of a body of groundwater"
- Local Authorities
  - Responsible for River Basin Management Plans, and Programmes of Measures
- EPA
  - Monitoring, classification (status) and reporting
  - Reviewing authorised inputs to GW by Dec 2012
  - Issuing advice to and/or give directions to a public authority on the measures to be taken
  - Reviewing and updating existing systems of pollution control

Conclusions

- WFD, GWD and Groundwater Regulations are complex from both scientific and administrative/governance perspectives

- They provide a coherent means of managing groundwater in the context of an integrated, holistic, 3-D approach to catchment management.

Bottom Line

Groundwater cannot any longer be "out of sight, out of mind"!!