

Determination of nutrient threshold values relevant to groundwater-dependent terrestrial ecosystems (GWDTEs) in Ireland: Progress and challenges



Hydrogeological Group of the Geological Society
Birmingham and Midland Institute, February 2013
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Presentation outline

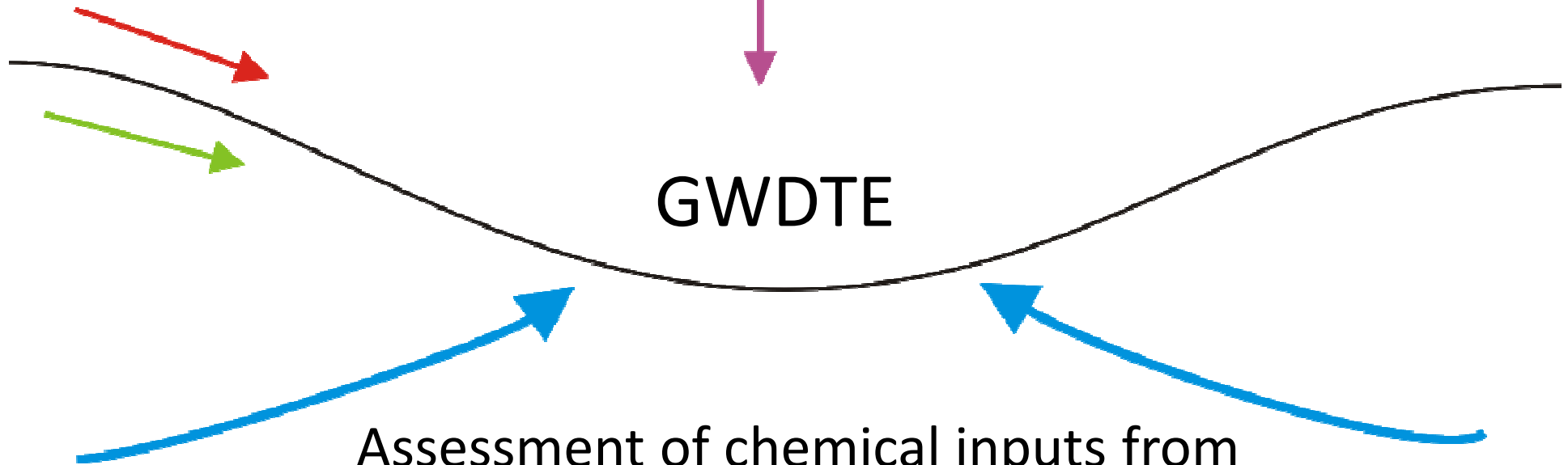
- Groundwater (GW) body chemical status assessment, GWDTEs and threshold values (TVs)
- GWDTE types occurring in Ireland
- UK WFD Technical Advisory Group (TAG) method for determining chemical TVs
- Application of UK TAG method to Irish GWDTEs
- Progress to date
- Conclusions

GWB chemical status assessment: GWDTE Test

Assessment of ecological
damage within GWDTE



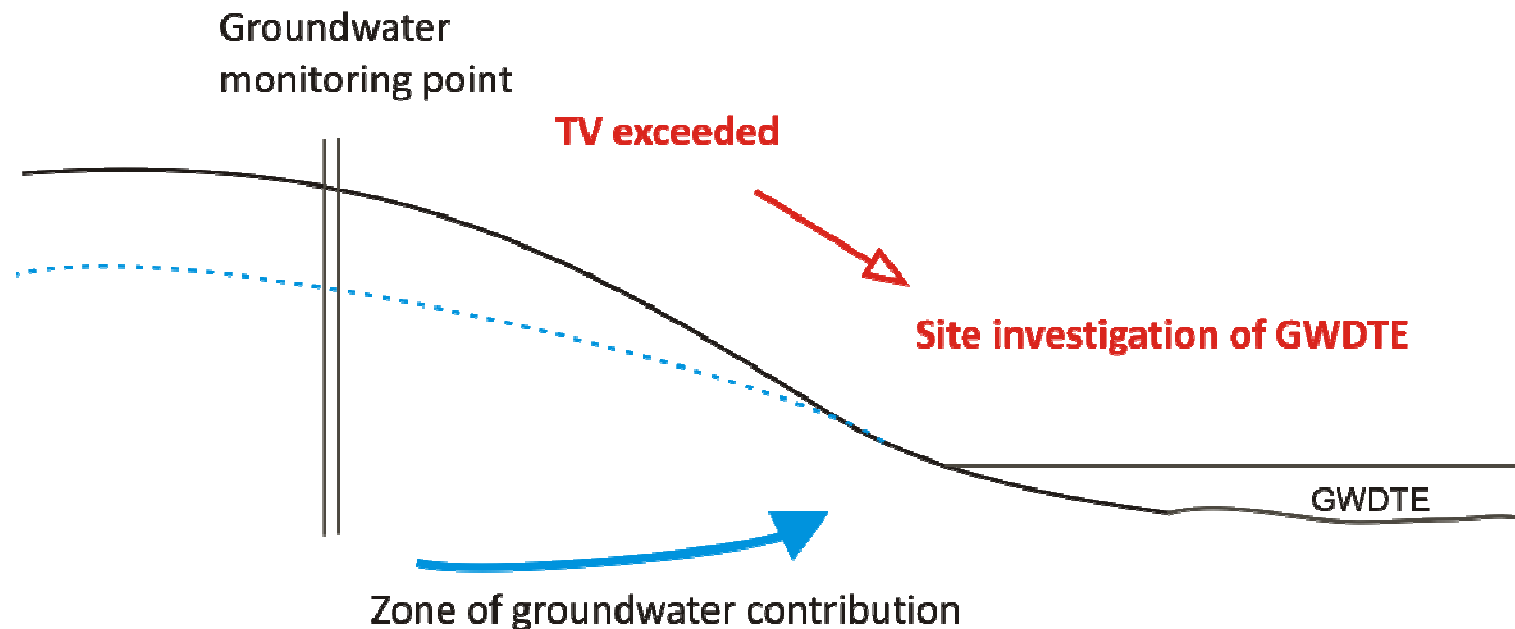
GWDTE



Assessment of chemical inputs from
groundwater bodies into GWDTEs.

GWDTE test and threshold values

- TVs are used in the assessment of nutrient inputs from groundwater bodies into GWDTEs



- To date, no specific TVs have been determined for Irish GWDTEs.

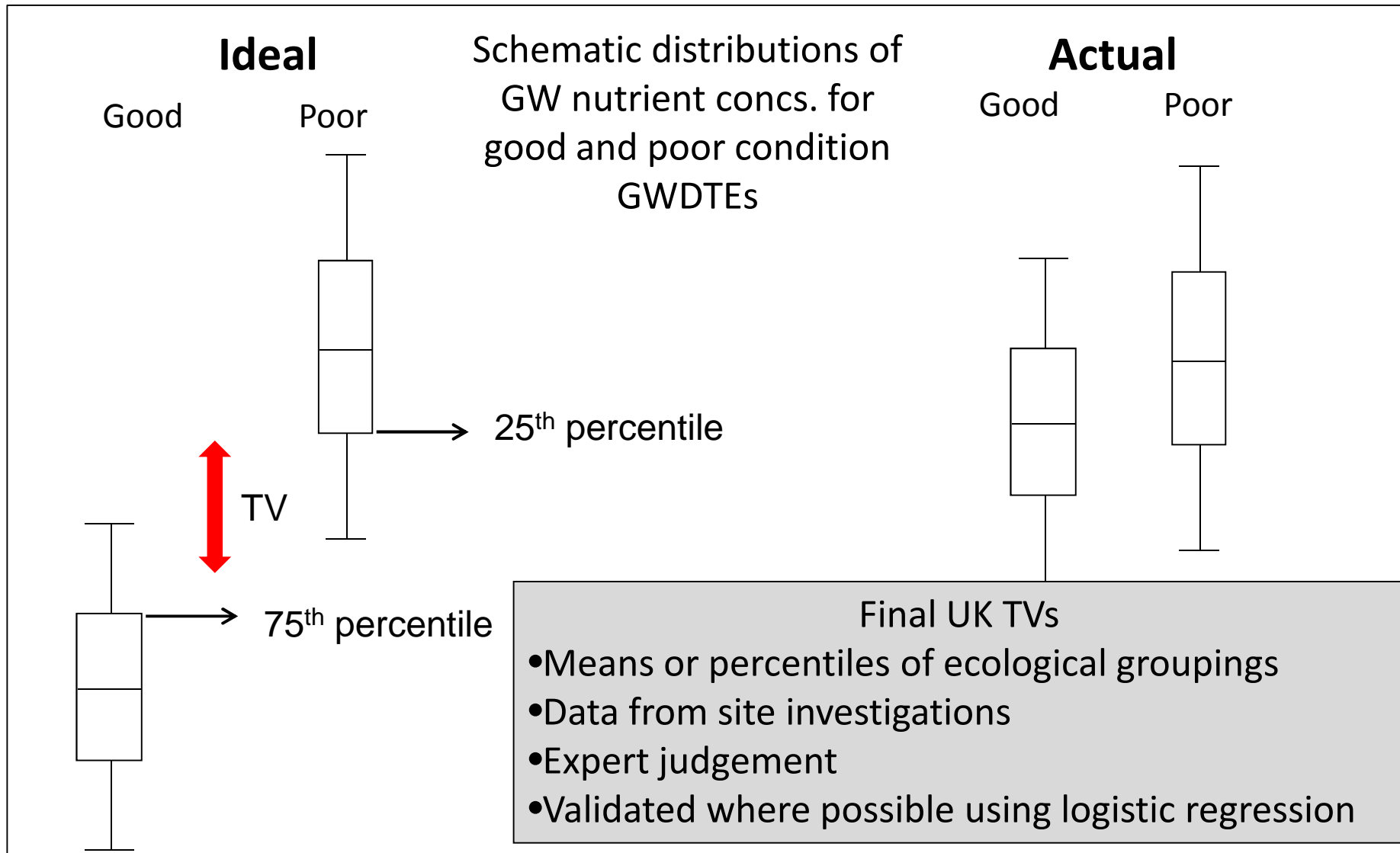
Eleven Irish GWDTE types

GWDTE Type/Annex I Habitat Type EU Habitats Directive
Alkaline fen
*Calcareous fen with <i>Cladium mariscus</i> and <i>Carex davalliana</i>
*Petrifying springs with tufa formation (<i>Cratoneurion</i>)
Transition mire (quaking bogs)
*Active Raised bog
*Turloughs
Blanket bog (* if active) (FLUSHES ONLY)
Northern Atlantic wet heaths with <i>Erica tetralix</i> (FLUSHES ONLY)
*Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i>
Machair (*in Ireland)
Humid dune slacks

UK TAG methodology for determining TVs

- Compare GW nitrate and phosphate concentrations among good and poor ecological condition groupings
 - Identify protected groundwater-dependent wetlands with hydrogeologically linked GW monitoring boreholes.
 - Calculate 6 or 3 yearly mean GW N and P concs. for each site.
 - Assign sites to either good or poor ecological condition groups.

UK WFD TAG methodology for determining TVs



Application of TV methodology to Irish GWDTEs

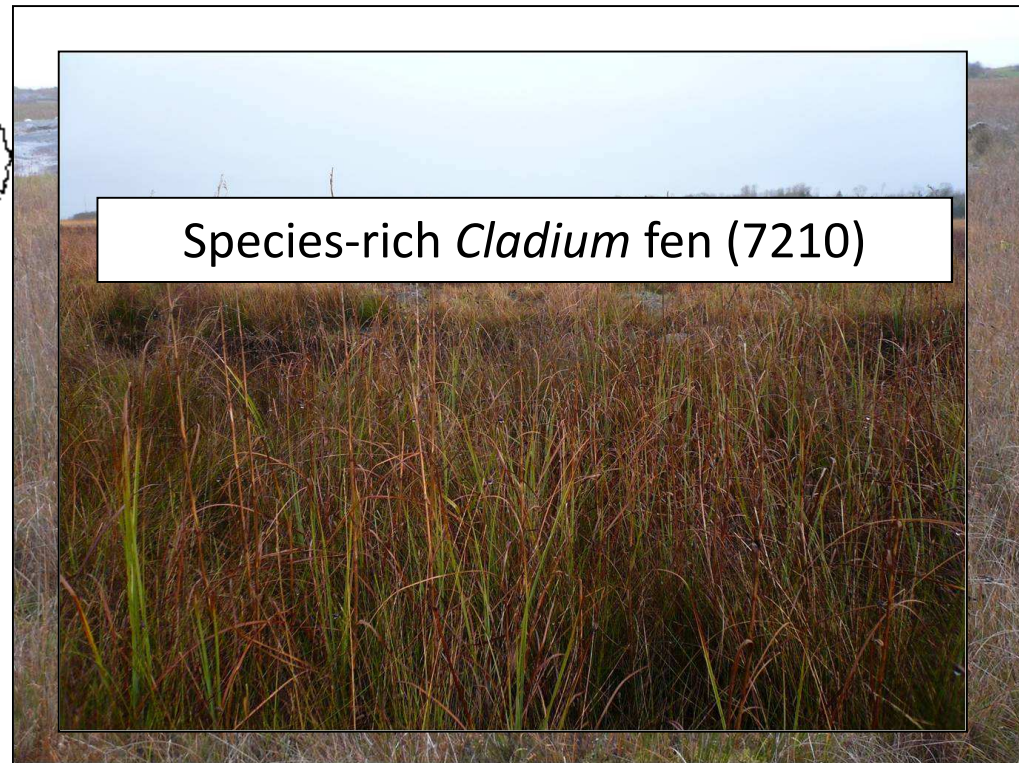
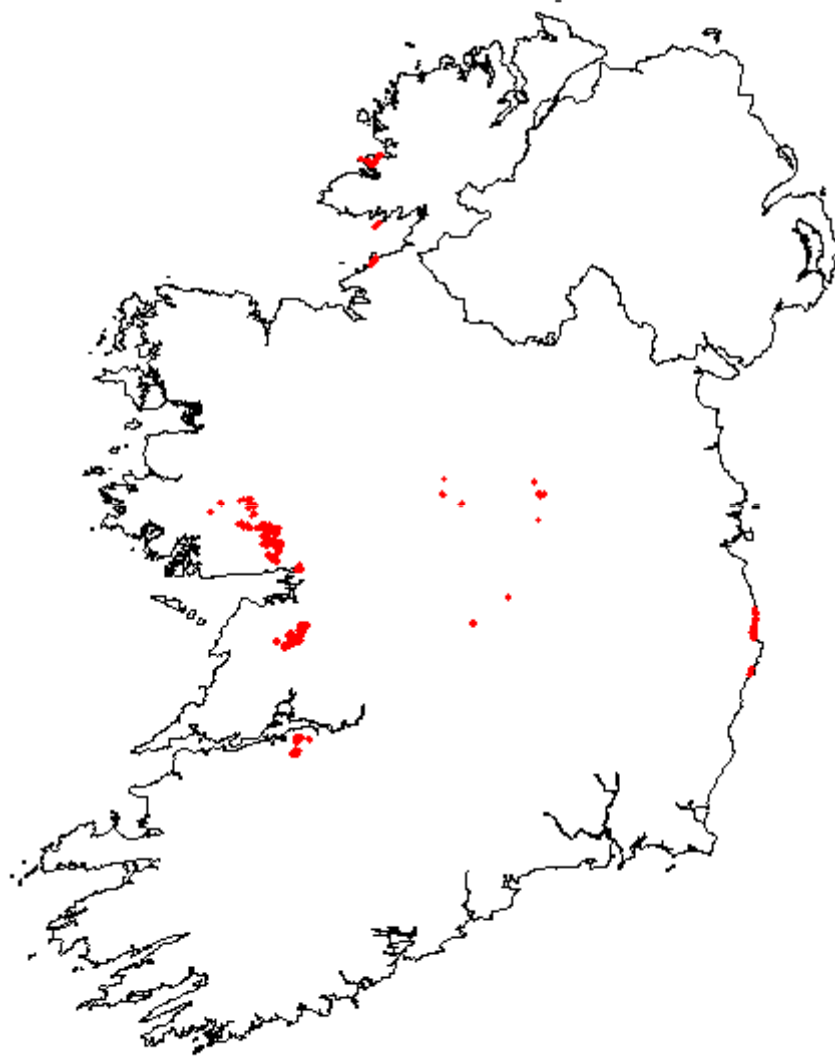
Availability of groundwater quality data

1. Monitoring points for the EU Drinking Water Directive (1998) (DW MP) include groundwater used for public water supply – dataset includes nitrate data but not phosphate data.
2. Monitoring points for the national groundwater quality monitoring programme for the WFD (2000), (GWQ MP). Lower density of sampling locations but includes phosphate data.

Application of TV methodology to Irish GWDTEs

GWDTE Type	No. of sites	No. of sites within 5km of DW MP (Ground or Spring) <i>Nitrate only</i>	No. of sites within 5km of GWQ MP <i>Nitrate and Phosphate</i>
Alkaline fen	110	71	21
*Calcareous fen with <i>Cladium mariscus</i> and <i>Carex davalliana</i>			
*Petrifying springs with tufa formation (<i>Cratoneurion</i>)	14	10	5
Transition mire (quaking bogs)	50	18	0
*Active Raised bog	136	101	29
*Turloughs	256	206	108
Blanket bog (* if active) (FLUSHES ONLY)	441	152	54
Northern Atlantic wet heaths with <i>Erica tetralix</i> (FLUSHES ONLY)	48	24	5
*Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i>	191	100	52
Machair (*in Ireland)	61	19	6
Humid dune slacks	311	99	24

Annex I Calcareous fens

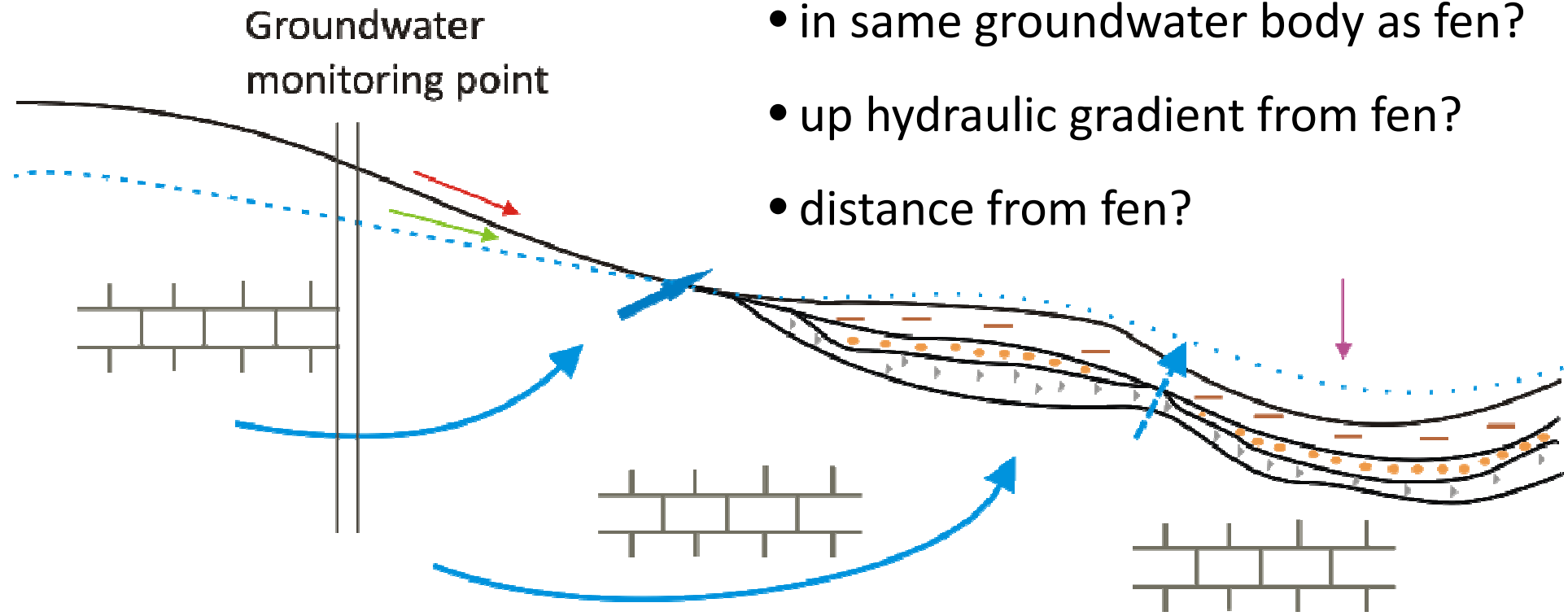


Distribution of Annex I Calcareous fens in Ireland (Kilroy et al., 2008)

Selecting suitable DW and/or GWQ MPs

Issues to consider:

- in same groundwater body as fen?
- up hydraulic gradient from fen?
- distance from fen?



- Precipitation
- Overland flow
- Interflow
- GW flow
- Spring
- GW Seepage

- Fen Peat
- Marl
- Limestone till

- Water table
- Potentiometric surface

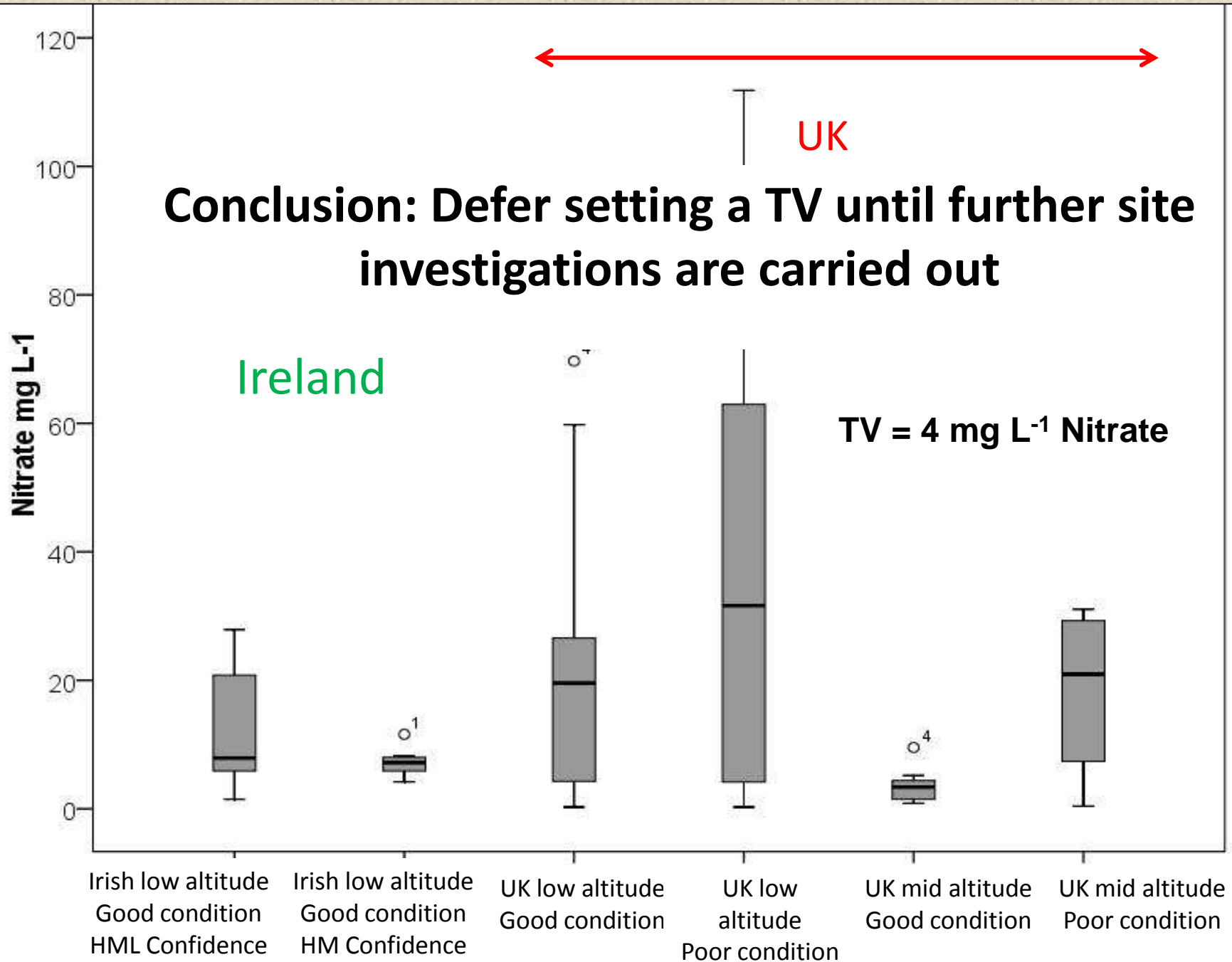
Selecting suitable DW and/or GWQ MPs

- Initial screening: 71 sites within 5 km of a GW monitoring point
- Further screening: 44 sites have a hydrogeologically linked GW monitoring point

Ecological Condition (confidence level)	Number of calcareous fen sites
Good (High and Moderate Confidence)	13
Good (Low confidence)	29
Sites with disputed ecological condition	2

NB no sites with agreed poor ecological condition based on existing ecological data

Nitrate concentrations at hydrogeologically linked MPs



Further Site Investigations

- Basic surveys of 44 calcareous fens with hydrogeologically linked GW monitoring points
- Fen types (e.g. Basin fen, Open-water transition fen etc.)
- Dominant habitat types (Guide to Habitats in Ireland (Fossitt, 2000))
- Within-site management
- Surrounding land-use intensity
- Assessments of nutrient impact using nutrient indicators

Positive Nutrient Indicators

Annex I Calcareous fen habitat types



Negative Nutrient Indicators

Wet grassland dominated by *Juncus* spp.
and/or *Glyceria* spp.



Negative Nutrient Indicators



Extensive, dense *Reed and large sedge swamps FS1* dominated by Common Reed (*Phragmites australis*) and/or Bulrush (*Typha latifolia*)

Negative Nutrient Indicators

Extensive, dense *Scrub WS1*



Results

Of the 44 sites surveyed:

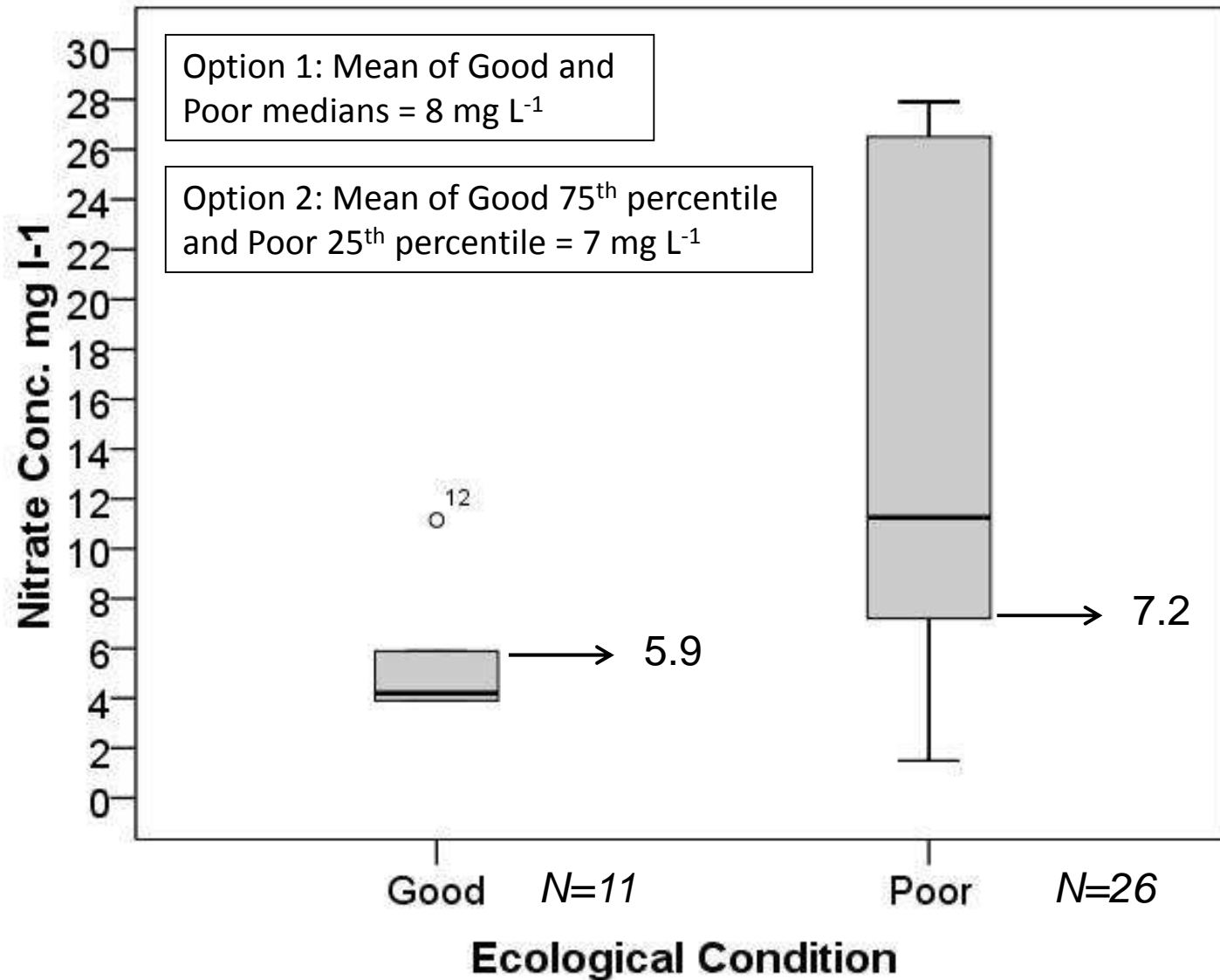
3 were not accessed

2 not calcareous fens

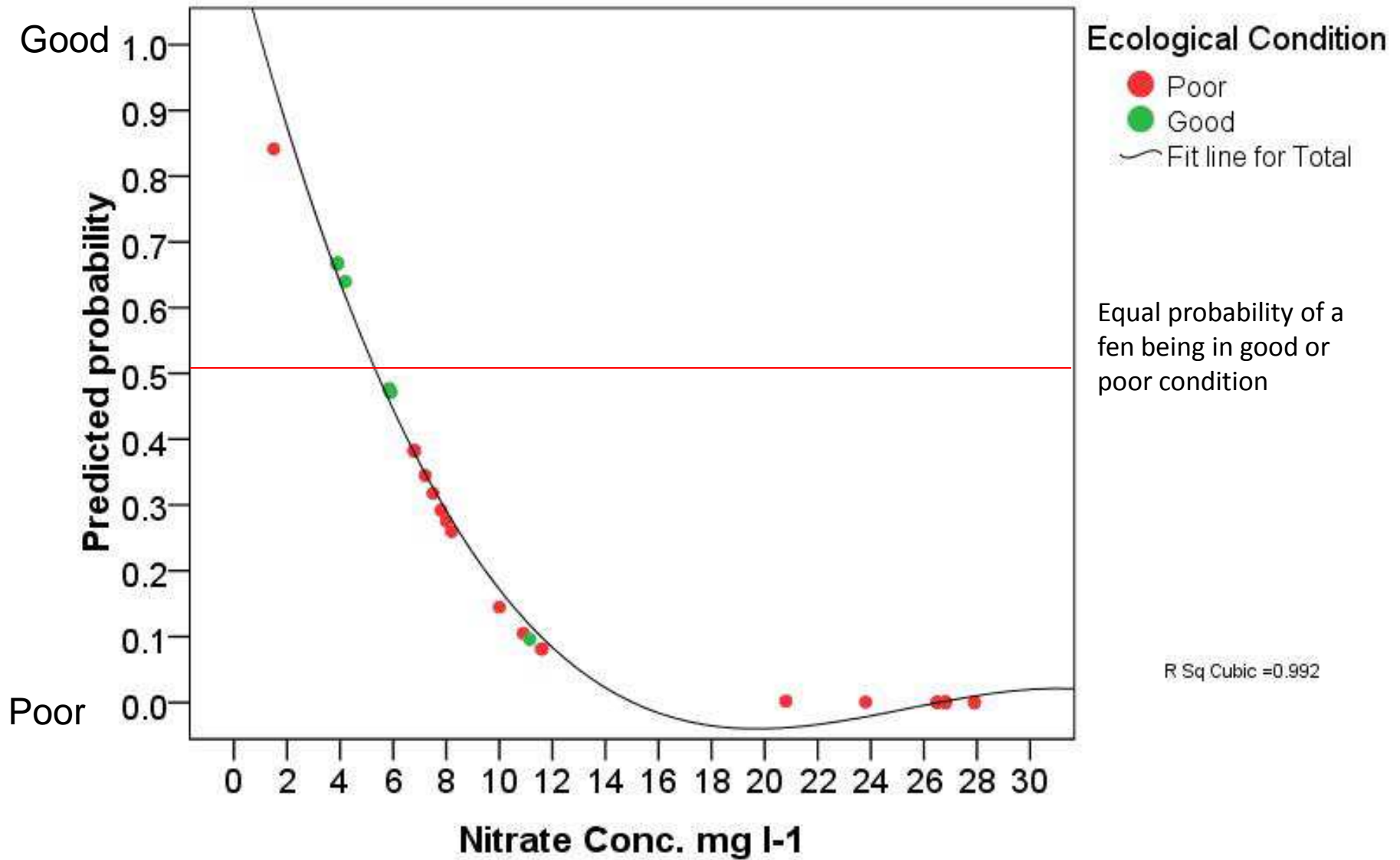
2 under significant quantitative pressures

Ecological Condition	Criteria	No. of sites
Good	Sites with only positive indicators	11
Poor	Sites with negative indicators	26

Results: Following UK TAG method directly



Results: Binary logistic regression

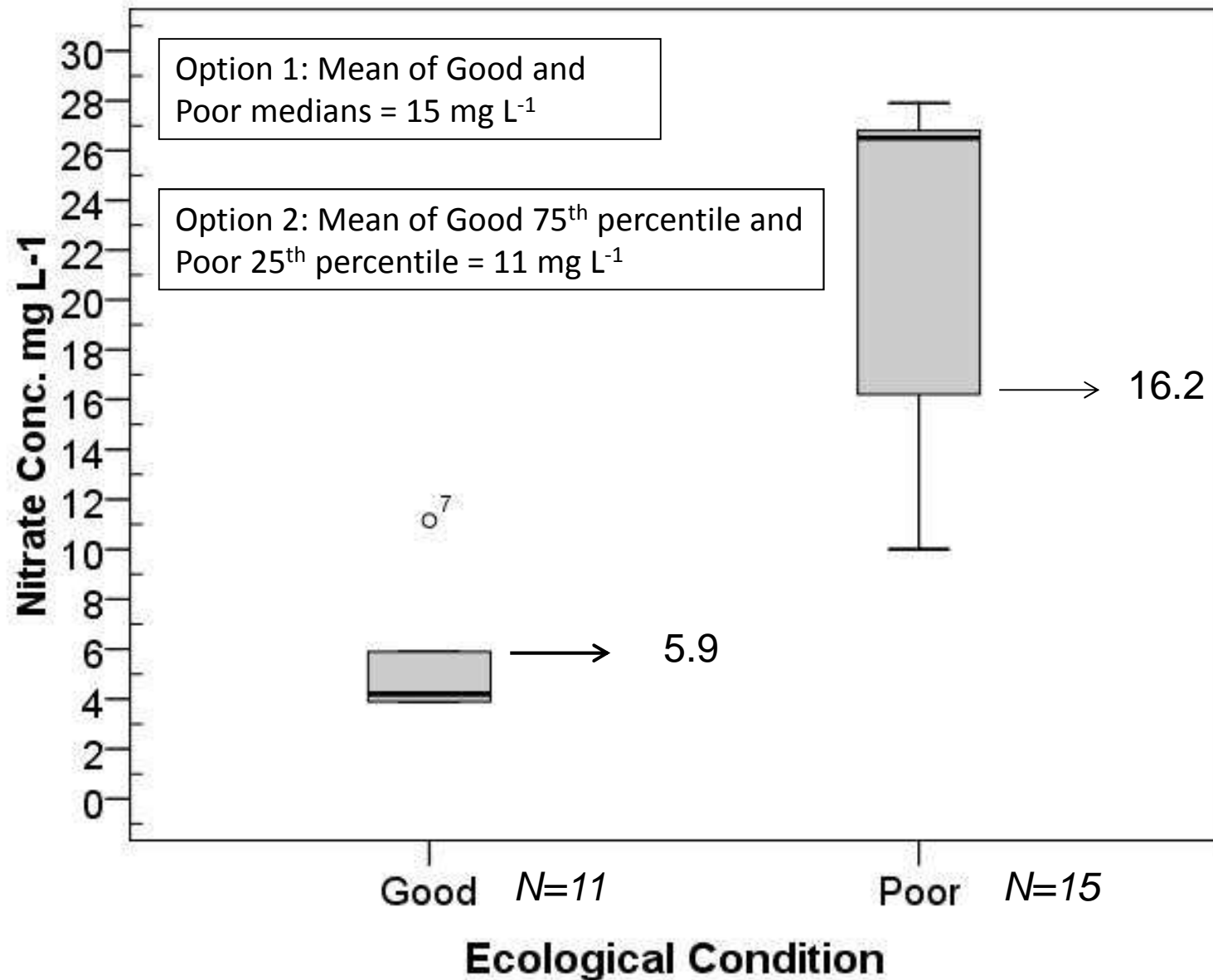


Results: Data screening followed by UK TAG approach

Ecological Condition	Criteria	No. of sites
Good	Sites with only positive indicators	11
Poor*	Sites with negative indicators	15

*Poor condition sites with GW nitrate concs. less than the Irish NBL (9.2 mg L^{-1}) excluded on the basis that the poor condition is unlikely to be attributable to GW nitrate inputs at these sites.

Results: Data screening



Phosphate Threshold Values

- P could be the key limiting nutrient in some fens
- Irish dataset is inadequate to determine a TV for P (groundwater P only available for 4 MPs hydrogeologically linked to fens)
- Future monitoring of groundwater P in the vicinity of fens is necessary

Conclusions

- TVs trigger site investigations which should focus on sites with HD habitat types and evidence of a nutrient impact from GW.
- There is a need for data screening, which deviates from the UK TAG approach.
- TV should lie between the 75th percentile for good condition sites and the 25th percentile for poor condition sites.
- Basic habitat surveys of GWDTEs are a minimum requirement for inclusion within the GWB classification process.
- Groundwater monitoring appropriate for karst situations should be conducted within a range of calcareous fen sites.
- Research is needed into the nature of nutrient limitation within Alkaline fens (7230) and species-rich *Cladium* fens (7210).

Acknowledgements

Co-authors: Catherine Coxon, Trinity College
Dublin; Matthew Craig, EPA and Hans Schutten,
SEPA

Donal Daly, EPA

Aine O`Connor, NPWS

EPA for funding the research

Landowners for granting access to sites

