Functional Assessment of Wetlands: Linking Science to Policy in Europe

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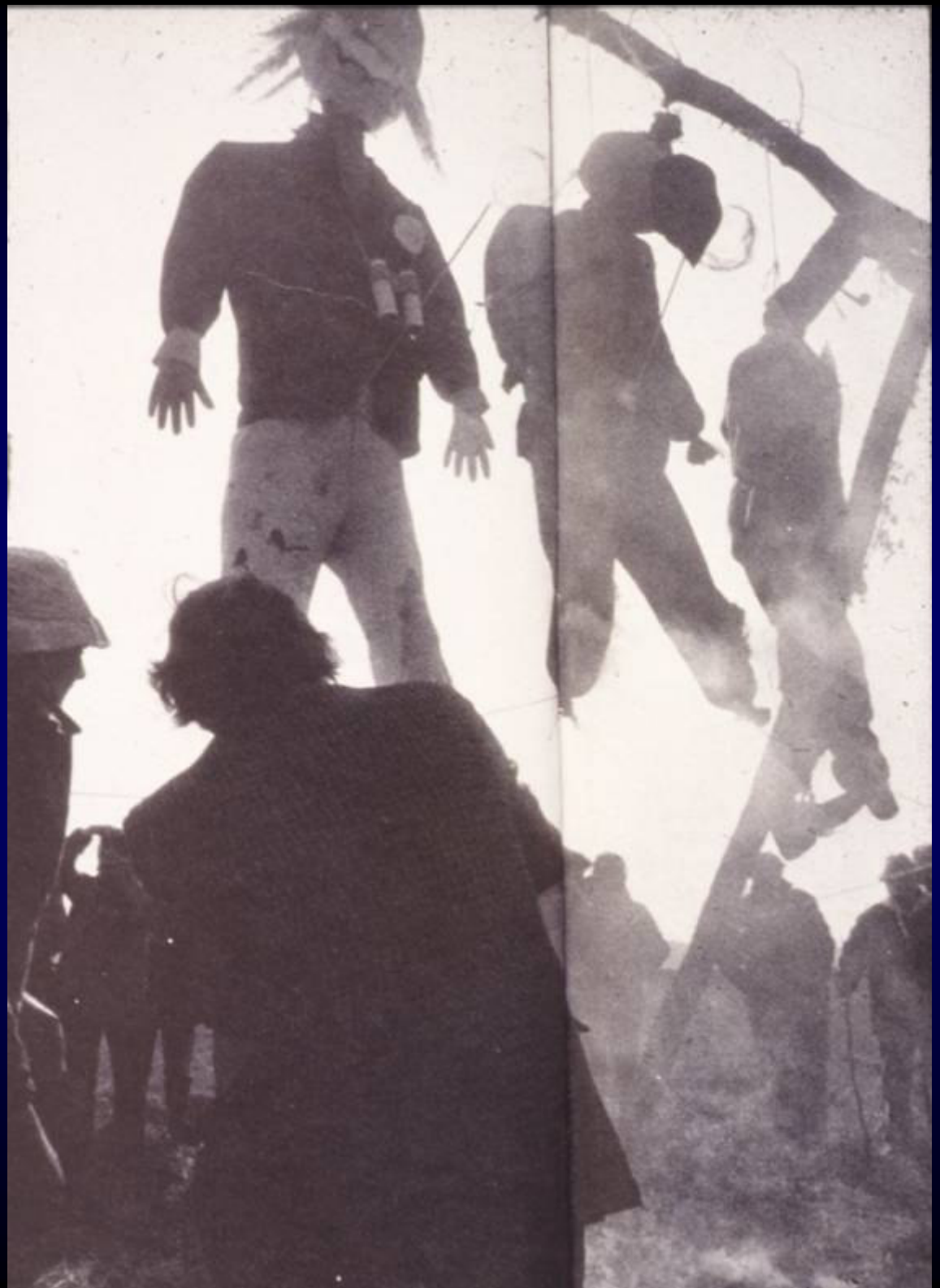
September 2005



The separation between

- Nature and people
- Ecology and economics
- Different interest groups
- Research and information

Has not served well the need for sound environmental management

Rationale for functional assessment

- Most knowledge of wetlands is restricted to ‘jewels in the crown’
- Limited data on dynamic processes and interactions
- Science base is inadequate to explain how different wetland ecosystems work
- Wetlands do not all perform the same function, nor are all functions performed to the same degree
- Empirical studies are expensive and time-consuming – so they cannot be conducted at all the wetlands of interest
- Conservation and management of wetlands is more effective if functioning and the effects of alterations can be predicted

Wetland functional assessment had developed in the USA, but techniques could not be applied directly in Europe because:

- Limitations and bias in the science and literature base
- Many European wetlands have been modified by land use and management
- The small size of most European wetlands
- Lack of a strong or specific regulatory framework for wetlands in Europe

European wetlands are
often highly modified

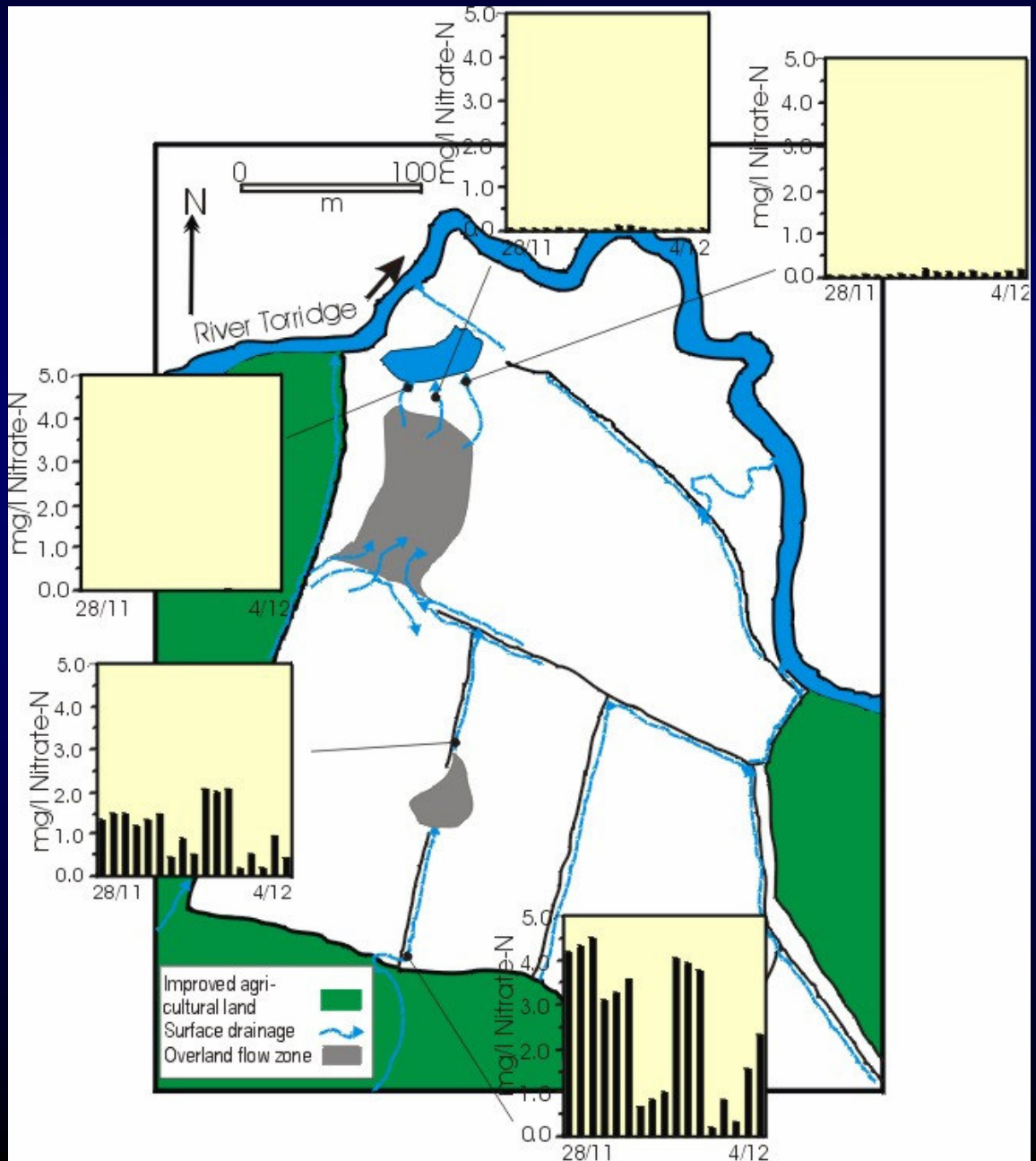
The Development of the Functional Approach

Conservation and management of wetlands using the traditional approach alone has proved insufficient to protect Europe's wetlands from degradation and loss.

- Scientific research has been deficient in range, depth, emphasis or applicability.
- Policies have been weak in competition with other societal priorities.
- The mechanisms for implementation of scientific advances or policy objectives has been lacking.
- The greater part of the wetland resource lies outside formal networks of protected areas.

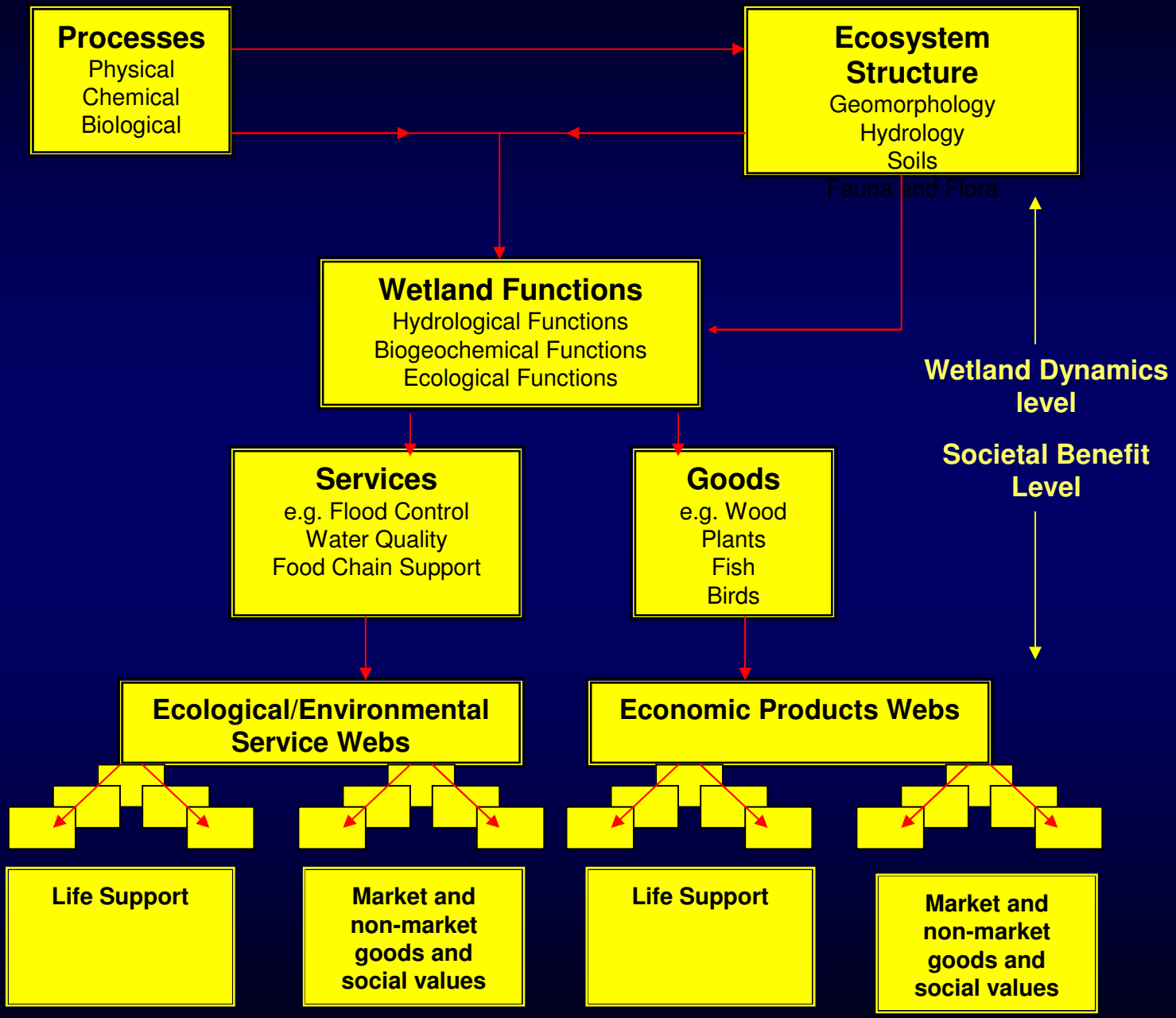
Incongruity between Science and Policy

Kismeldon Meadows, Devon UK



Wetland processes, functions and values

- **Processes** are physical, chemical and biological reactions and interactions, which are controlled by a variety of factors (controlling variables), which combine within the ecosystem structure, allowing wetlands to provide…
- **Functions**, which provide environmentally beneficial **goods** such as timber and fish) and **services** (such as flood control and nutrient removal) and, together with **attributes** (such as biodiversity and cultural heritage), can be given…
- **Values** by society … *recognises the fact that the functions performed by a wetland take place with or without the presence of society, usually as part of a self sustaining ecosystem (intrinsic features), whereas wetland values require the presence of society (extrinsic features), and these will vary over time and space while the functions may not.*


Processes
Physical
Chemical
Biological
Ecosystem Structure
Geomorphology
Hydrology
Soils
Fauna and Flora
Wetland Functions
Hydrological Functions
Biogeochemical Functions
Ecological Functions
Wetland Dynamics level
Societal Benefit Level
Services
e.g. Flood Control
Water Quality
Food Chain Support
Goods
e.g. Wood
Plants
Fish
Birds
Ecological/Environmental Service Webs
Economic Products Webs
Life Support
Market and non-market goods and social values
Life Support
Market and non-market goods and social values

The Functional Analysis Procedures

Wetland ecosystems – extremely diverse, thus not all perform same functions and to the same degree.

Procedures/methods are needed to:

- *predict the likelihood of functioning for a particular wetland*
- *assess the magnitude of functioning for a particular wetland*
- *assess to what extent a function may provide goods and/or services (economic value)*
- *evaluate the extent that functioning may be impacted on (management scenarios).*

Requirements for a wetland evaluation methodology:

- *To aid <u>appropriate</u> decision-making*
- *Legislation implementation*
- *Wetland-functioning protection*
- *Rapid, user-friendly assessment (detailed evaluation - time-consuming/resource intensive)*

The Functional Analysis Procedures

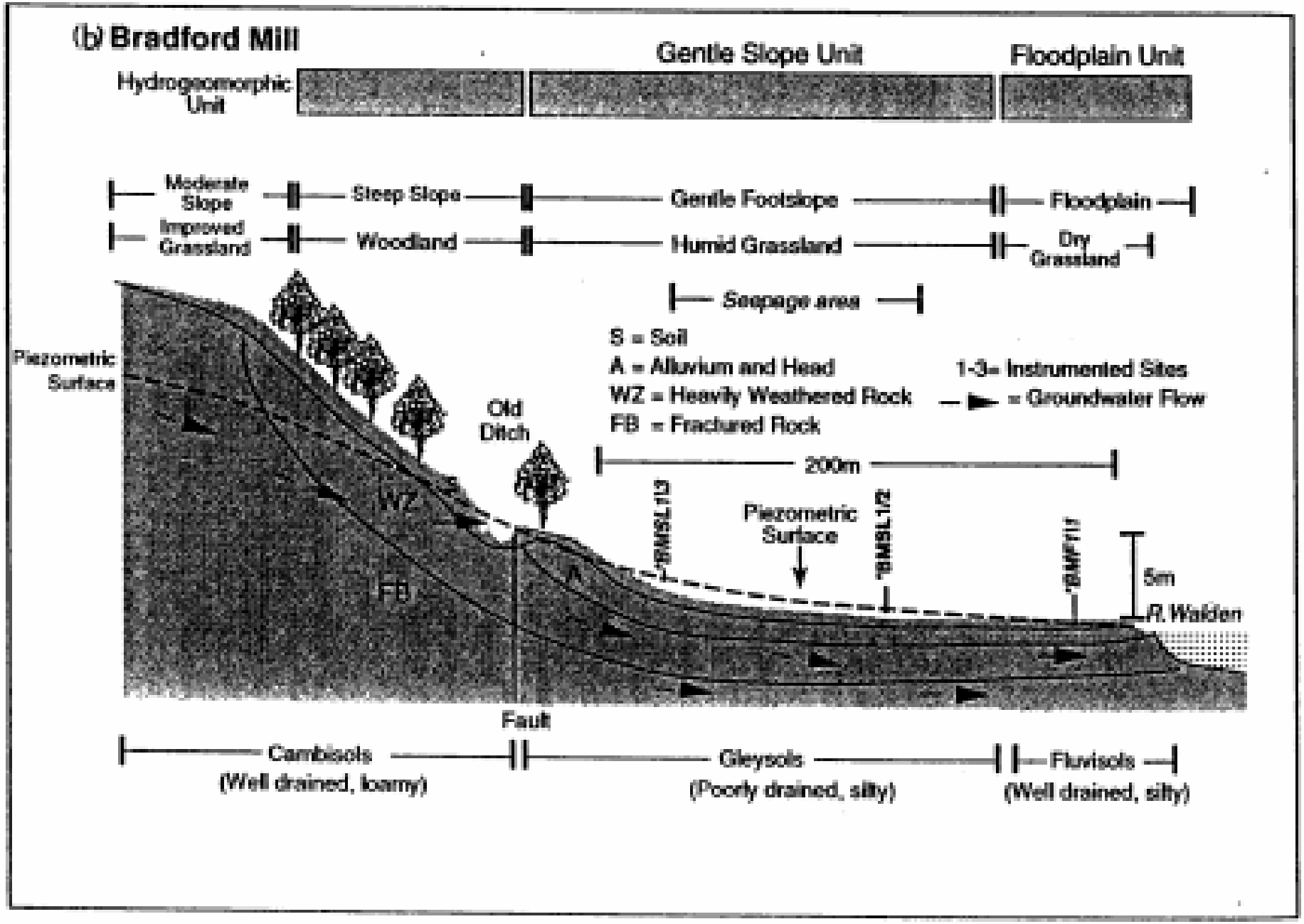
Developed concurrently with the hydrogeomorphic classification of wetlands Brinson (1993) to assess the relationship between ecosystem structure and function by translating physical properties into wetland functions.

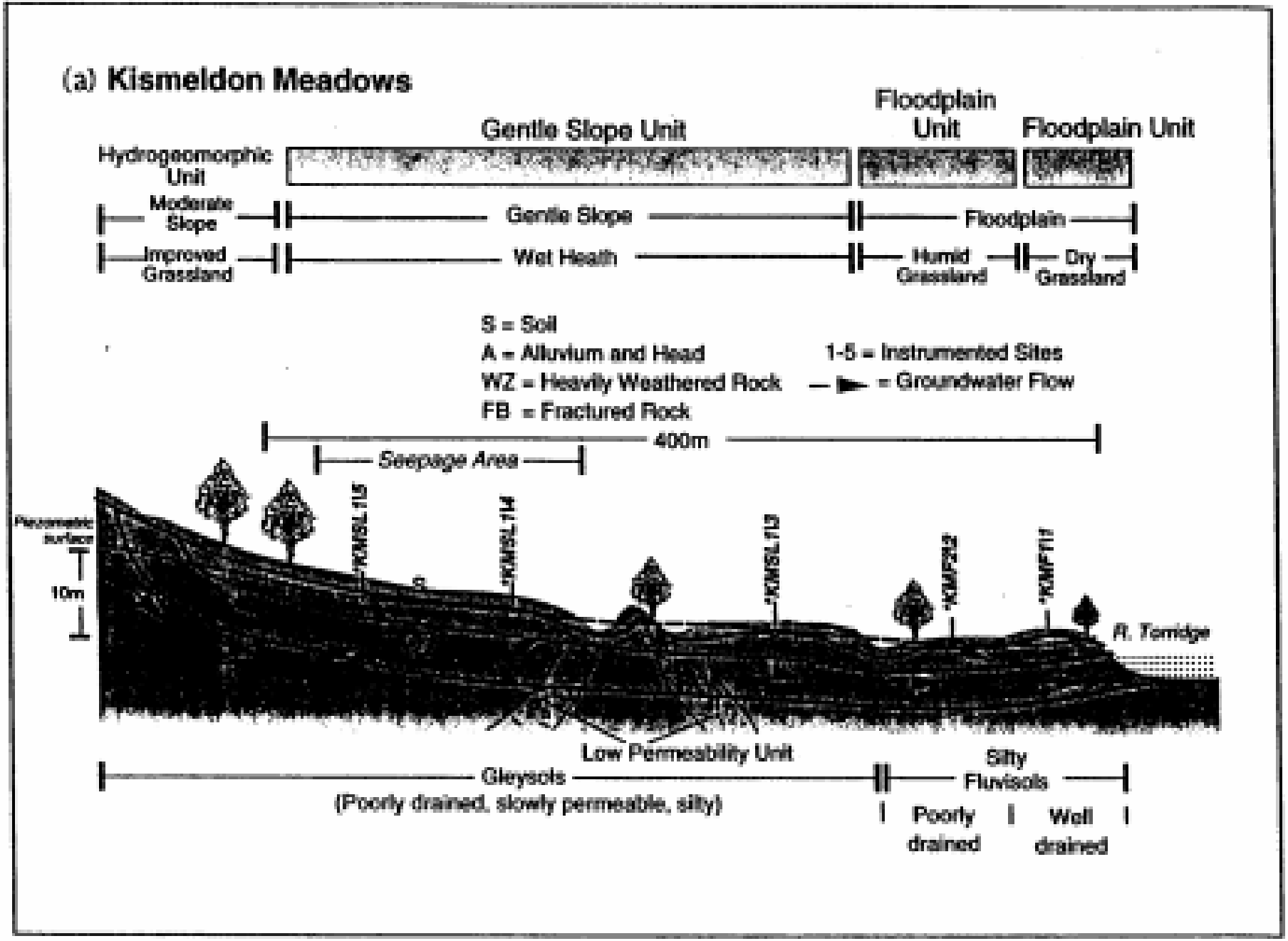
The underlying principle of the procedures is that a basic functional unit: a hydrogeomorphic unit (HGMU) can be defined in wetlands.

> *An area of homogenous geomorphology, hydrology and/or hydrogeology, and under normal conditions homogenous soil (Maltby et al., 1996).*

Vegetation is not used as a defining characteristic due to the significant influence of historic and current land-use, particularly in Europe. However, vegetation is described for each HGMU as part of the procedures.

Functional assessment procedures for European river marginal and lake marginal wetland ecosystems


(b) Bradford Mill
Gentle Slope Unit
Floodplain Unit
Hydrogeomorphic Unit
Moderate Slope
Steep Slope
Gentle Footslope
Floodplain
Improved Grassland
Woodland
Humid Grassland
Dry Grassland
Seepage area
S = Soil
A = Alluvium and Head
WZ = Heavily Weathered Rock
FB = Fractured Rock
1-3= Instrumented Sites
= Groundwater Flow
Piezometric Surface
Old Ditch
200m
WZ
FB
A
BMSL1/3
Piezometric Surface
BMSL1/2
BMF1/1
5m
R. Walden
Fault
Cambisols
(Well drained, loamy)
Gleysols
(Poorly drained, silty)
Fluvisols
(Well drained, silty)


(a) Kismeldon Meadows
Floodplain Unit
Gentle Slope Unit
Floodplain Unit
Hydrogeomorphic Unit
Moderate Slope
Gentle Slope
Floodplain
Improved Grassland
Wet Heath
Humid Grassland
Dry Grassland
S = Soil
A = Alluvium and Head
WZ = Heavily Weathered Rock
FB = Fractured Rock
1-5 = Instrumented Sites
= Groundwater Flow
400m
Seepage Area
Piezometric surface
10m
*KMSL15
*KMSL14
*KMSL13
*KMPS12
*KMPT11
R. Torridge
Low Permeability Unit
Gleysols
(Poorly drained, slowly permeable, silty)
Silty Fluvisols
Poorly drained
Well drained

The Functional Analysis Procedures

The development of a methodology and procedures for evaluating the functioning of European wetland ecosystems based on detailed process studies – an expert approach.

- *For a variety of non-expert users*
- *Rapid implementation*

Developed over three projects

- *Functional Analysis of European Wetlands - FAEWE (1991-1994)*
- *FAEWE II (1994-1999)*
- *Procedures for the Operationalisation of Techniques for the Functional Analysis of European Wetland Ecosystems - PROTOWET (1996-1999)*

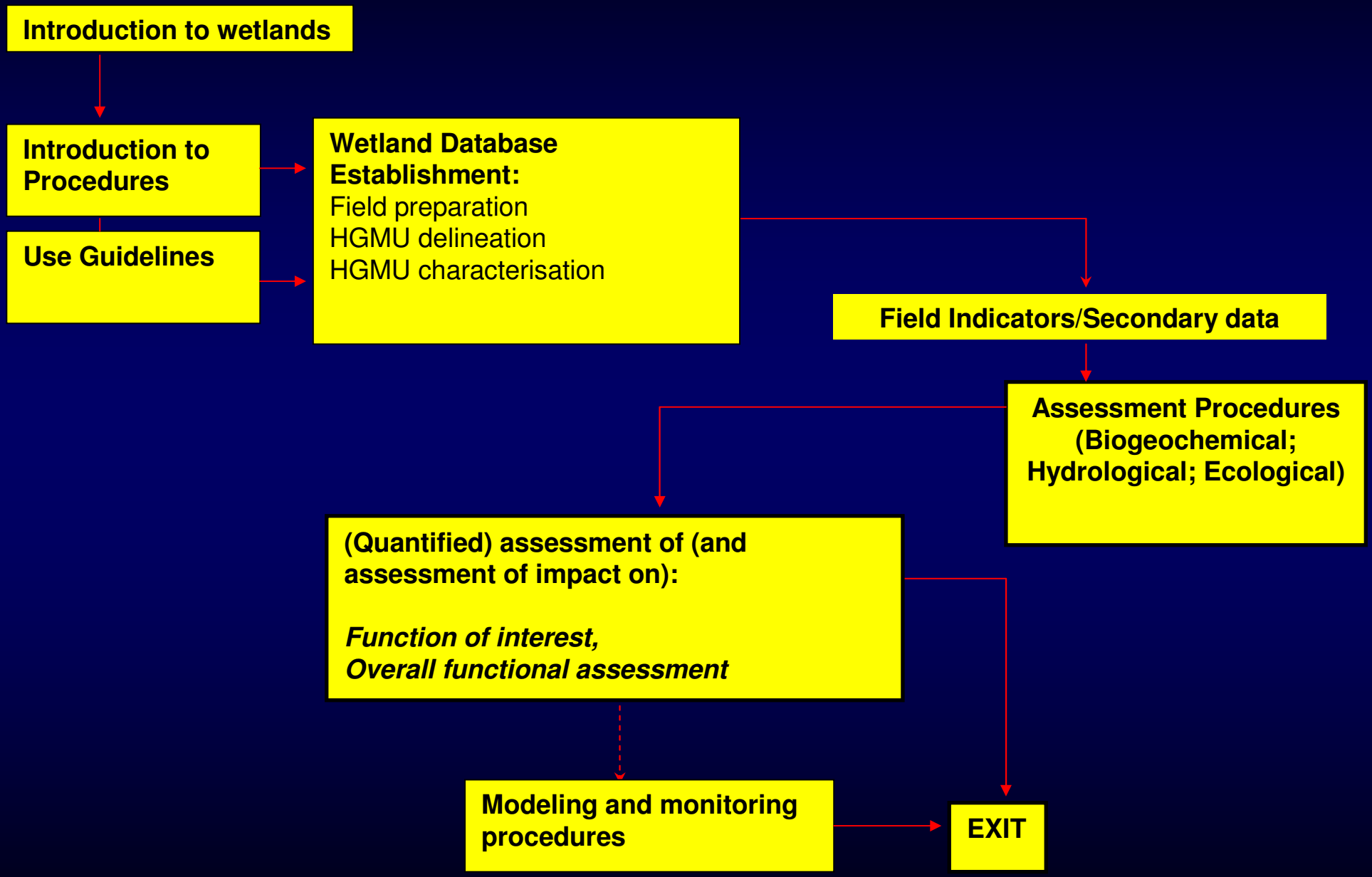
The Functional Analysis Procedures

The Procedures are based around the identification and characterisation of HGMUs using field and desk-based information.

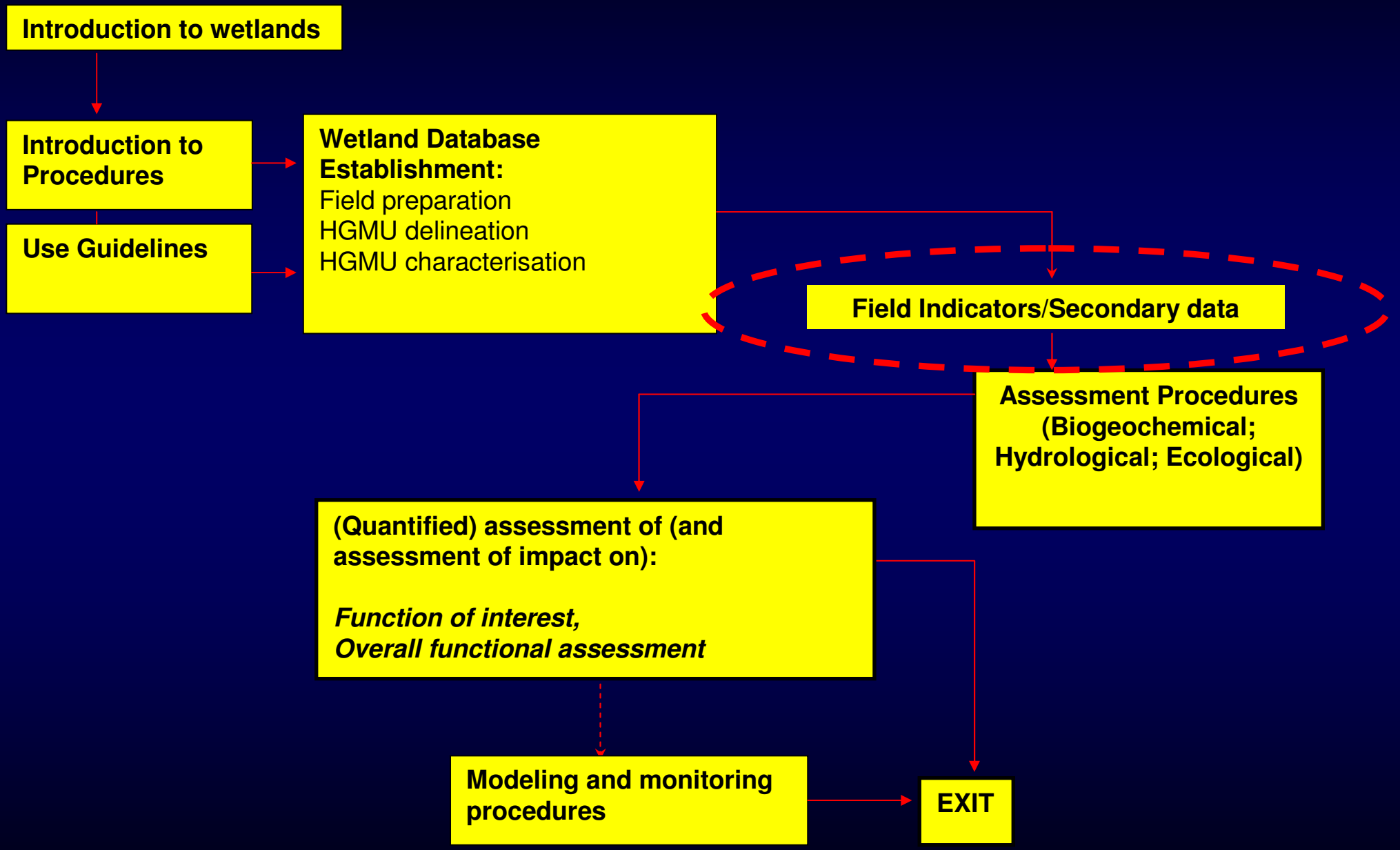
They provide simple but detailed explanation of how to do this and structure the information into a powerful database.

Functional assessment then interrogates this database and derives an output through detailed decision trees for each function.

Functional Analysis Procedures / (TECWET layout)



Functional Analysis Procedures / (TECWET layout)



Biogeochemical functions (water quality)

- **Nutrient retention** (five processes)
- **Nutrient export** (four processes)
- **In situ carbon retention** (one process)
- **Trace element storage** (three processes)
- **Trace element export** (three processes)
- **Organic carbon concentration control** (two processes)

Wetland functions and processes (biogeochemical)

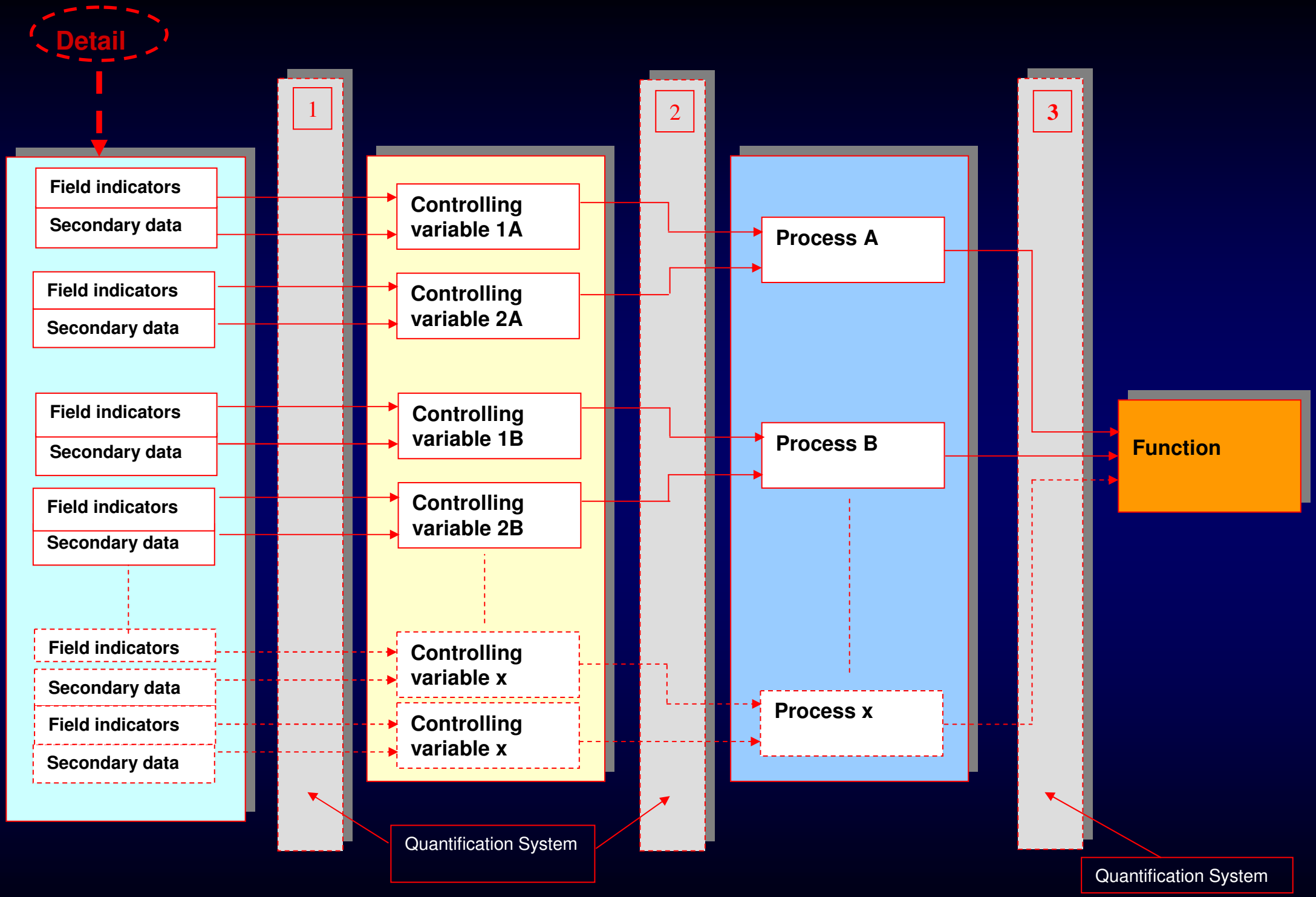
Biogeochemical functions (water quality)	**Processes supporting functions**
Nutrient retention (N and P)	Plant uptake
	Storage in soil organic matter
	Adsorption of N as ammonium
	Adsorption and precipitation of P in the soil
	Retention of particulate nutrients
Nutrient export	Gaseous export of N by: i) denitrification ii) ammonia volatilisation
	Nutrient (N and P) export through land use management
	Nutrient (N and P) export through physical processes

Functional Analysis

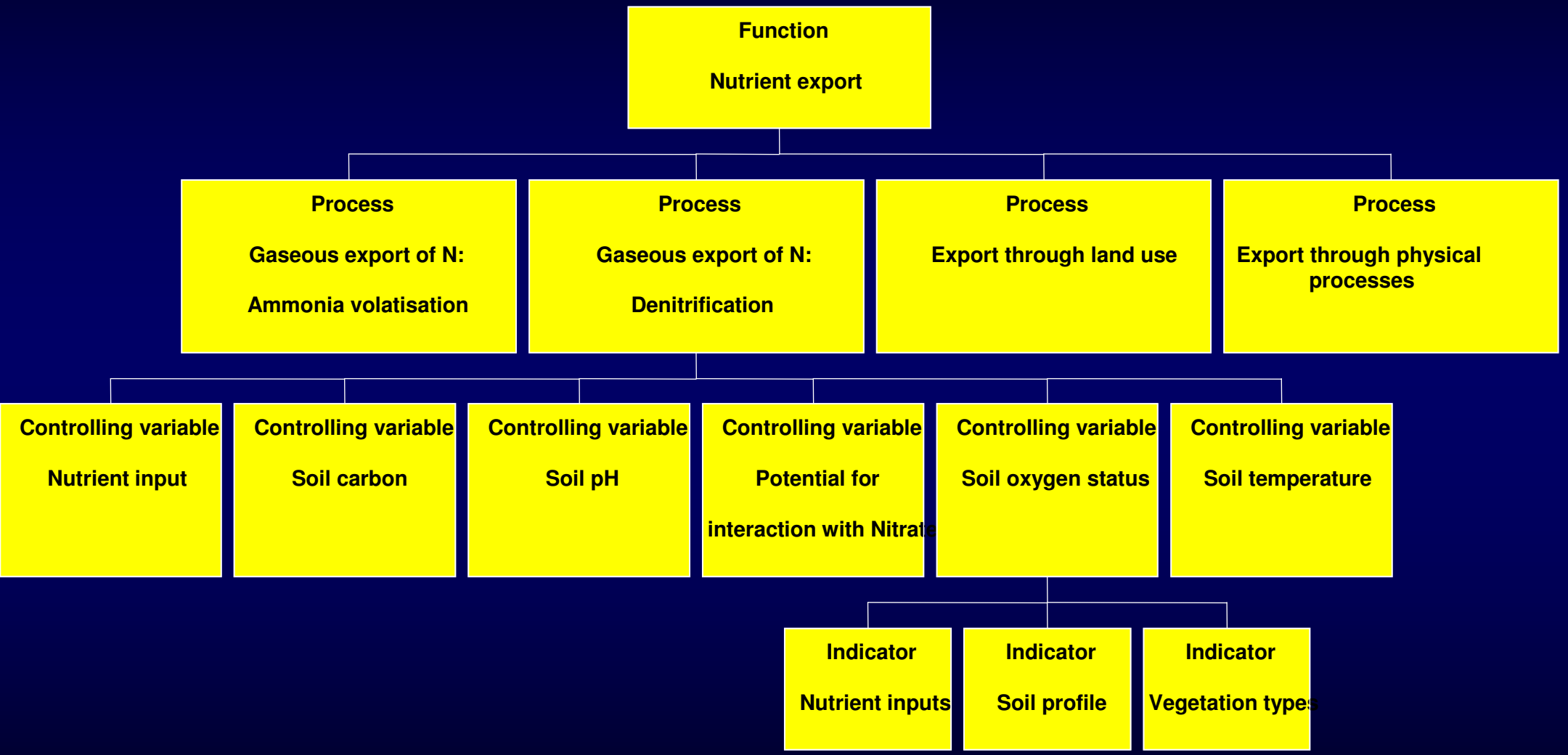
Achieved through the interrogation of Controlling Variables, which use field indicators and secondary data determined in the Wetland database.

Interrogation is conducted by the user answering questions structured in decision trees within the function.

The answers are combined to give information on the various component processes in the form of a rationale or explanatory statement coupled with a functional analysis outcome.


Detail
1
2
3
Field indicators
Secondary data
Field indicators
Secondary data
Field indicators
Secondary data
Field indicators
Secondary data
Field indicators
Secondary data
Field indicators
Secondary data
Controlling variable 1A
Controlling variable 2A
Controlling variable 1B
Controlling variable 2B
Controlling variable x
Controlling variable x
Process A
Process B
Process x
Function
Quantification System
Quantification System

Detail of denitrification: process within the function of Nutrient Export



Denitrification Functional Statement - output example

1. The process is definitely being performed

CV1	CV 2	CV 3	CV 4	CV 5	CV 6	Rationale	CODE	Quantification
1a 2a	N/A	1c	1|2| #3	(1|2| 3) (4|5)	1c| 2	A direct input of nitrogen (probably containing nitrate) is applied to the surface of the HGMU at least annually. Carbon, soil oxygen, pH and soil temperature are conducive to denitrification. Anaerobic soil conditions or alternation between aerobic and anaerobic soil conditions prevail, which are favourable for denitrification. Significant N_2 and N_2O emissions are likely.	1/b	>10 but < 80 kg N ha^{-1} y^{-1}
1a 2a	N/A	1c	1|2| #3	5	1c| 2	A direct input of nitrogen (probably containing nitrate) is applied to the surface of the HGMU at least annually. Carbon, soil oxygen, pH and soil temperature are conducive to denitrification. Anaerobic soil conditions prevail, which are favourable for denitrification. Because of the predominantly anaerobic soil conditions N_2O production is low.	1/b	>10 but < 80 kg N ha^{-1} y^{-1}

Denitrification Functional Statement - output example

2. The process is not (significantly) being performed

CV 1	*CV 2*	*CV 3*	*CV 4*	*CV 5*	*CV 6*	***Rationale***	*Code*
#(1a-d)|1e	*	*	*	*	*	The HGMU does not receive any nutrient input, or it is uncertain whether the HGMU receives a nutrient input. If other Controlling Variables are conducive, the process can still occur, but only as part of natural nitrogen cycling. Maximum denitrification rates will be around 2 kg N $ha^{-1}y^{-1}$.	**2**
*	*	#1a	*	*	*	Other factors may be suitable but the temperature of the soil will prevent denitrification from occurring at all.	**2**

Denitrification Functional Statement - output example

3. THE PROCESS IS BEING PERFORMED, BUT THERE ARE CONSTRAINING FACTORS OR UNCERTAINTIES

CV1	*CV2*	*CV3*	*CV4*	*CV5*	*CV6*	***Rationale***	*Code*
1c (2a|2d)	*	*	*	*	*	A nutrient input derived from artificial fertiliser or organic industrial waste is applied directly to the surface of the HGMU, but it is uncertain whether this input contains nitrogen.	**1/x**
1d (2k|2l)	*	*	*	*	*	The HGMU receives an indirect nutrient input derived from artificial fertiliser or organic industrial waste, but it is uncertain whether this input contains nitrogen.	**1/x**

Assessment Output

The processes outputs are combined to give an output for the assessment of the entire function that is given in the same format as for processes.

Quantified processes are summed.

The output to both process and function assessment is expressed as one of these general statements:

1. ***the process is definitely being performed.***
2. ***the process is not (significantly) being performed.***
3. ***the process is probably being performed but there are constraining factors or uncertainties.***
4. ***the process is definitely not being performed.***

The user is given an output that gives an assessment of the wetland's functioning and the performance of its constituent processes. Management decisions can be founded upon a process based assessment of functioning.

1. THE PROCESS IS DEFINITELY BEING PERFORMED

If answers to the questions for this function agree with any of the combinations in the table below, then the HGMU is definitely performing the process of carbon retention via accumulation of organic matter, and estimation is given of the amount of carbon retained (based on data collected from empirical studies).

CV1	*CV2*	*CV3*	*CV4*	*CV5*	*Rationale*	*Code*	*Quantification*
(1|2a|2b|2c|2d|3) 4a (5a|5b)	(1|2|3|4) #5	1|2	1|2	1	The soil has been identified as a peat or organic soil, and presently is not cultivated or extensively mined. Waterlogging and/or inundation predominate, producing anaerobic soil conditions which favour accumulation of organic matter. The vegetation is indicative of a high rate of organic matter accumulation. The landform is indicative of organic matter accumulation or the depressional nature of the landform favours waterlogging and anaerobic soil conditions. Finally climatic conditions favour accumulation of organic matter.	**1/a**	> 200, < 1000 kgC/ha/y
(1|2a|2b|2c|2d|3) 4a (5a|5b)	(1|2|3|4) #5	3|4	1|2	1	The soil has been identified as a peat or organic soil, and presently is not cultivated or extensively mined. Waterlogging and/or inundation predominate, producing anaerobic soil conditions which favour accumulation of organic matter. The vegetation is indicative of organic matter accumulation. The landform is indicative of organic matter accumulation or the depressional nature of the landform favours waterlogging and anaerobic soil conditions. Finally climatic conditions favour accumulation of organic matter.	**1/b**	> 100, < 500 kgC/ha/y

Detailed Structure of the TECWET document

Introduction to Wetlands:
Definition of wetlands
Extent and distribution of wetlands
The importance of wetlands
Threats and impacts
Wetland conservation and management
Economic assessment of wetlands
Legislative and regulatory framework

Introduction to Procedures:
Background to the concepts of ecosystems and ecosystem management
Concepts underpinning the methodology
Development of the functional assessment procedures
Applications of the methodology

Database establishment:
Data recording sheets
Fieldwork preparation
Delineating hydrogeomorphic units
Characterising hydrogeomorphic units

The Functional Assessment Procedures:

Hydrological Procedures
Floodwater detention (function) ***(nq)***
Groundwater recharge (function) ***(nq)***
Groundwater discharge (function) ***(nq)***
Sediment retention (function) ***(nq)***

Not quantified ***(nq)*** *but rapid quantification methods and advanced modeling techniques are referred to in floodwater detention and in sediment retention.*

Biogeochemical Procedures
Nutrient retention (function)
Long-term retention of nutrients (N and P) through plant uptake (process)
Storage of nutrients (N and P) in soil organic matter (process)
Adsorption of N and Ammonium (process) ***(nq)***
Adsorption and precipitation of P in the soil (process) ***(nq)***
Retention of particulate nutrients (N and P) (process) ***(nq)***
Nutrient export (function)
Gaseous export of N (process)
Export of nutrients through vegetation management (process)
Export of nutrients via water and wind mediated processes (process) ***(nq)***
In-situ Carbon retention (function)
Organic matter accumulation ***(nq)***
Organic Carbon export into surface waters (function)
Physical retention of trace elements (function)
Biogeochemical retention of trace elements (function)
Plant uptake of trace elements (function)

Mixture of quantified and non-quantified ***(nq)*** *processes and functions.*

Ecological Procedures
Ecosystem maintenance (function)
Provision of overall habitat structural diversity (process) ***(nq)***
Provision of microsites (macro-invertebrates; fish; herptiles; birds; mammals) (processes) ***(nq)***
Provision of plant and habitat diversity (process) ***(nq)***
Food web Support (function)
Productivity (process)
Biomass import via physical processes (process)
Biomass import via biological processes (process)
Biomass export via physical processes (process)
Biomass export via biological processes (process)

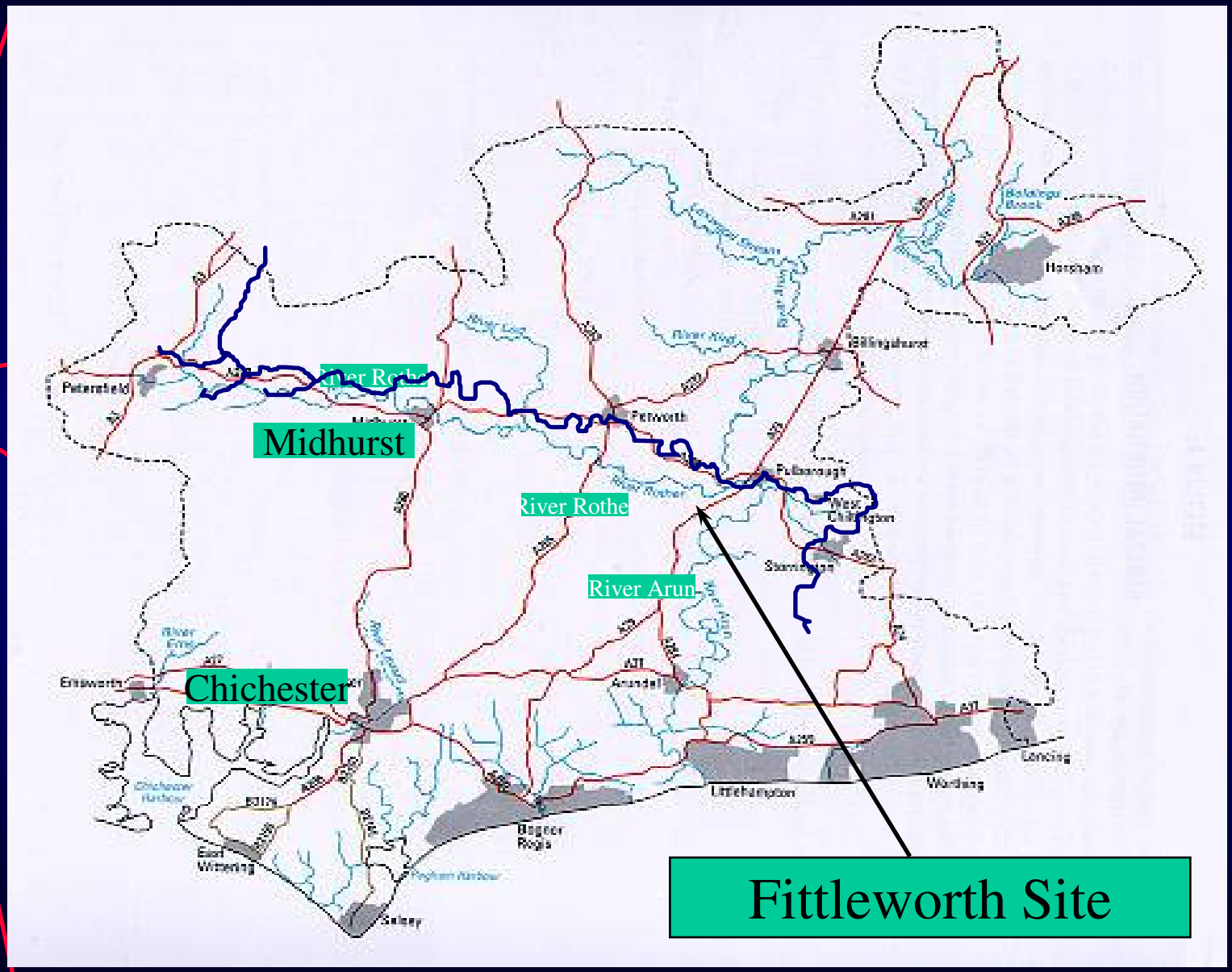
Mixture of a quantified (food web support) function and non-quantified ***(nq)*** **/semi-quantified** *(ecosystem maintenance) function.*

(Modelling Techniques)

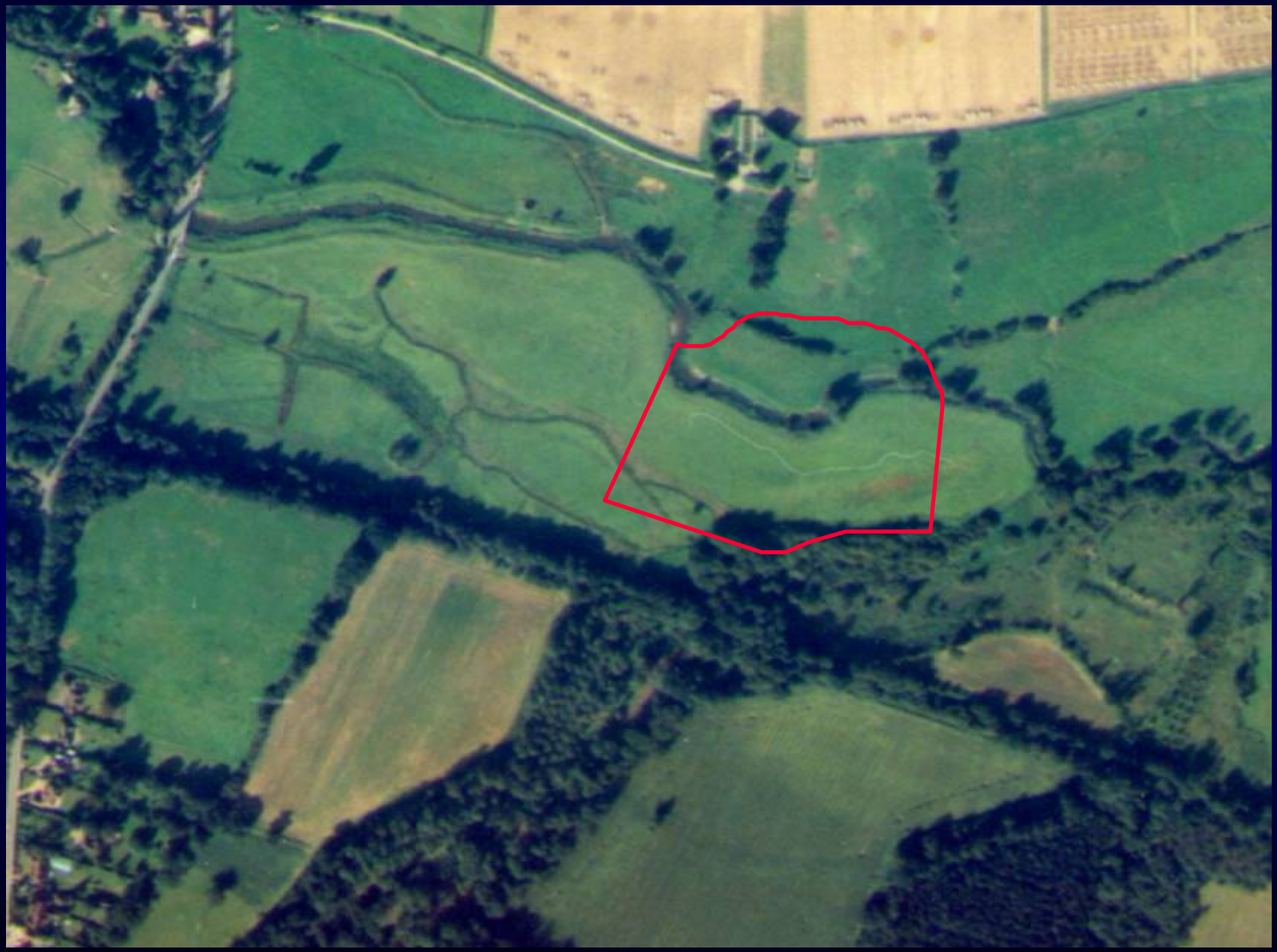
Main Steps in Database Establishment

- BASE MAP PREPARATION FOR SITE TO BE ASSESSED AND THE AREA OF LAND CONTRIBUTING TO IT
- DESK BASED MAPPING OF BACKGROUND INFORMATION
- FIELD MAPPING OF HYDROGEOMORPHIC ASSESSMENT UNITS
- RECORDING OF FUNCTIONAL PREDICTORS FOR EACH ASSESSMENT UNIT

DEMONSTRATION OF DATABASE ESTABLISHMENT



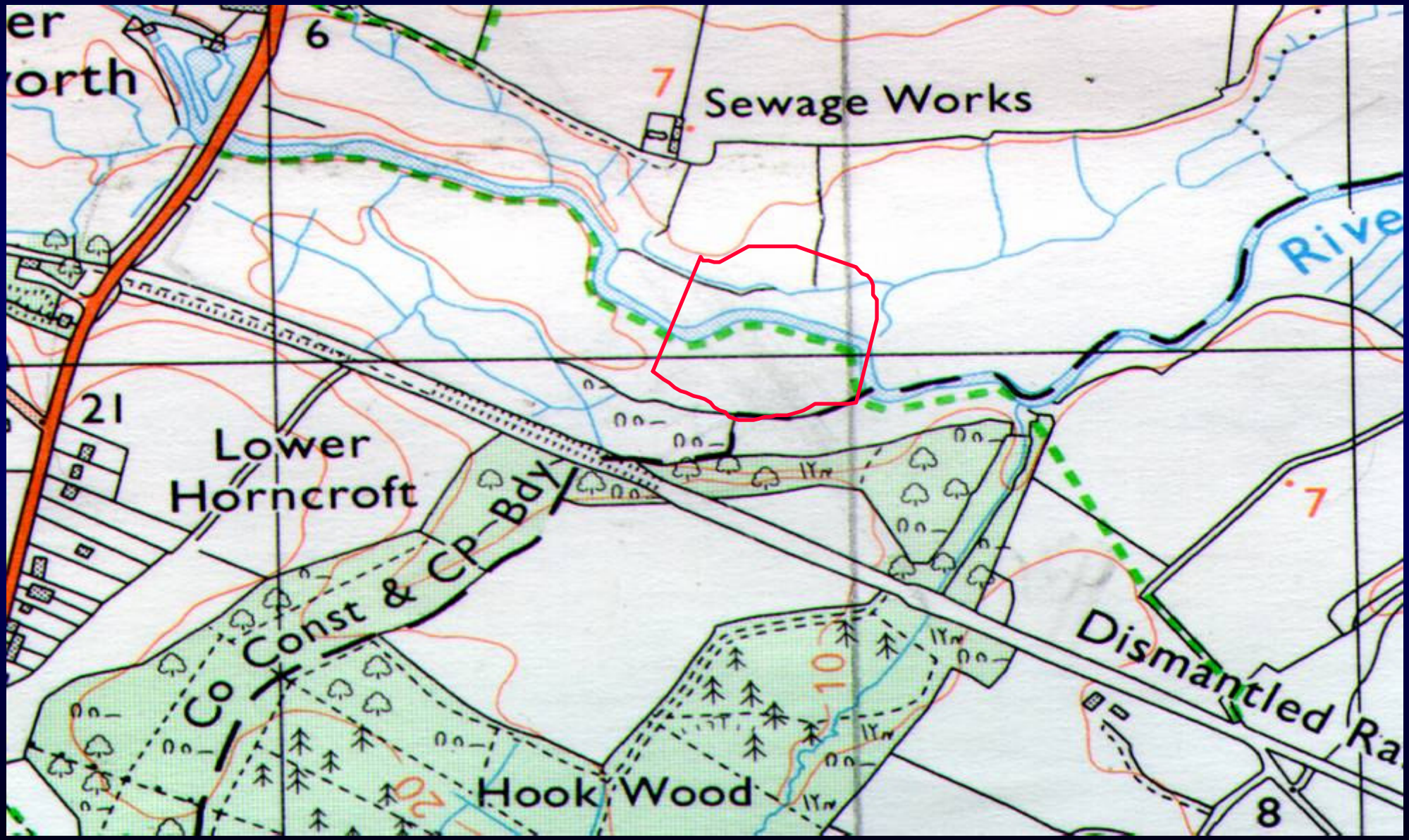
Aerial Photo of Site



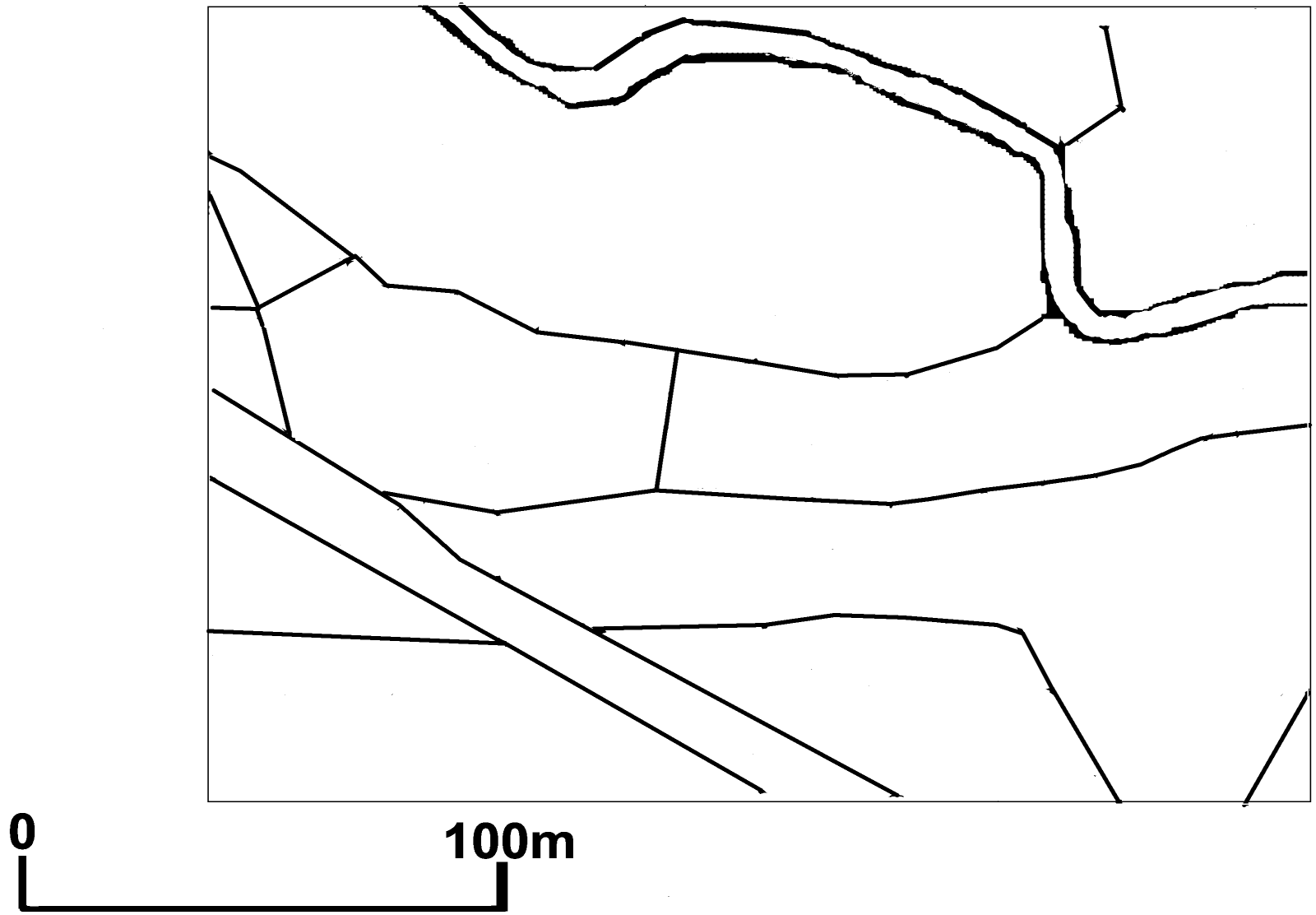
View across demonstration site

View across demonstration site

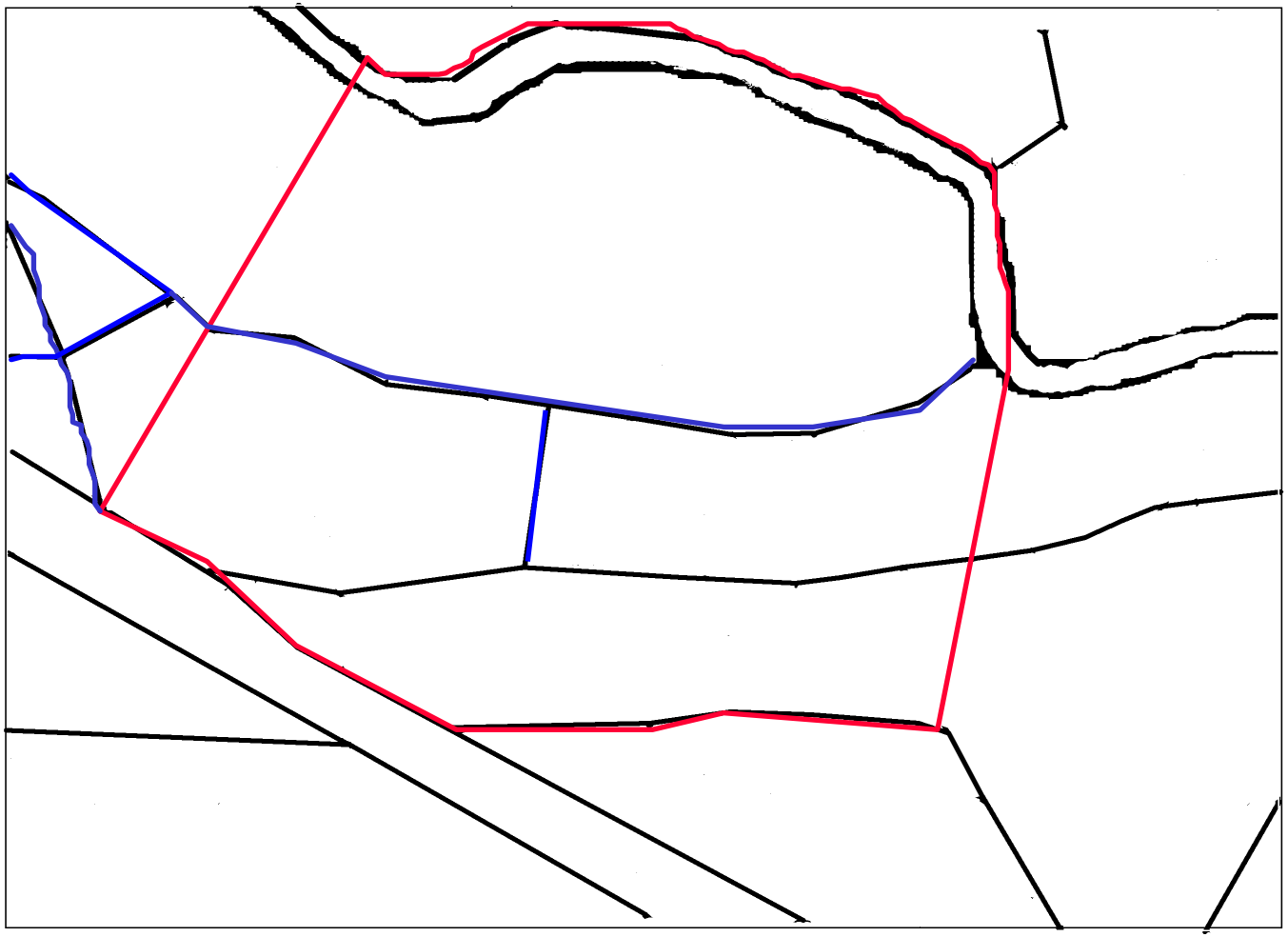
River Rother Valley and Fittleworth Site.



Blank map of site before mapping



Site map showing assessment area and ditches



0 100m

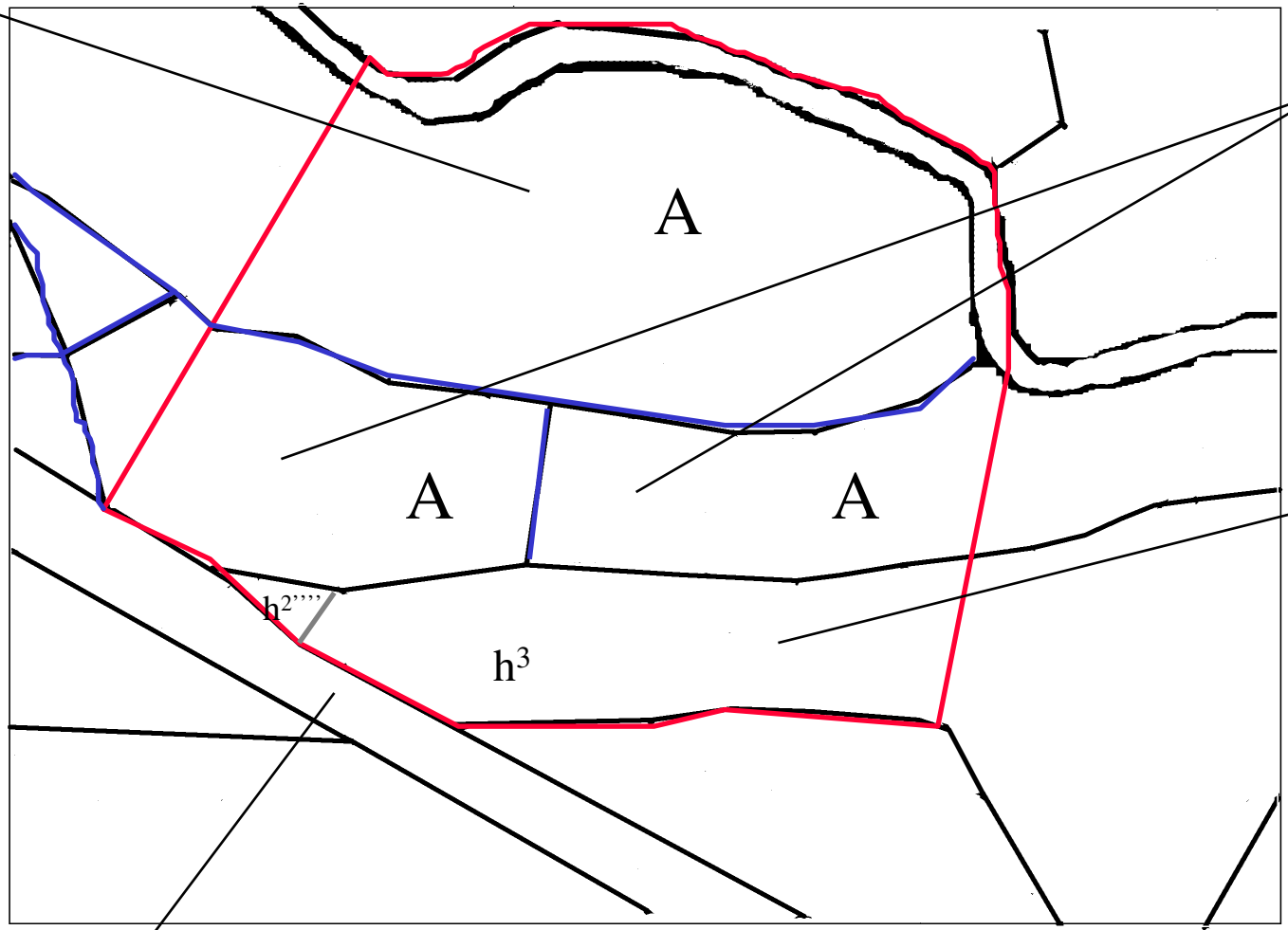
Name: Fittleworth	Date:	Field recorder:	North:
Reference co-ordinates: 014180	Scale:	Weather conditions:	

Land use and geology

Rough Pasture
Subject to harvesting of vegetation, surface drainage, and shooting. Sheep >10 per ha. Liable to flood.

Mixed Deciduous Woodland
Subject to surface drainage and shooting. Liable to flood.

Mixed Deciduous Woodland
Subject to felling and shooting.

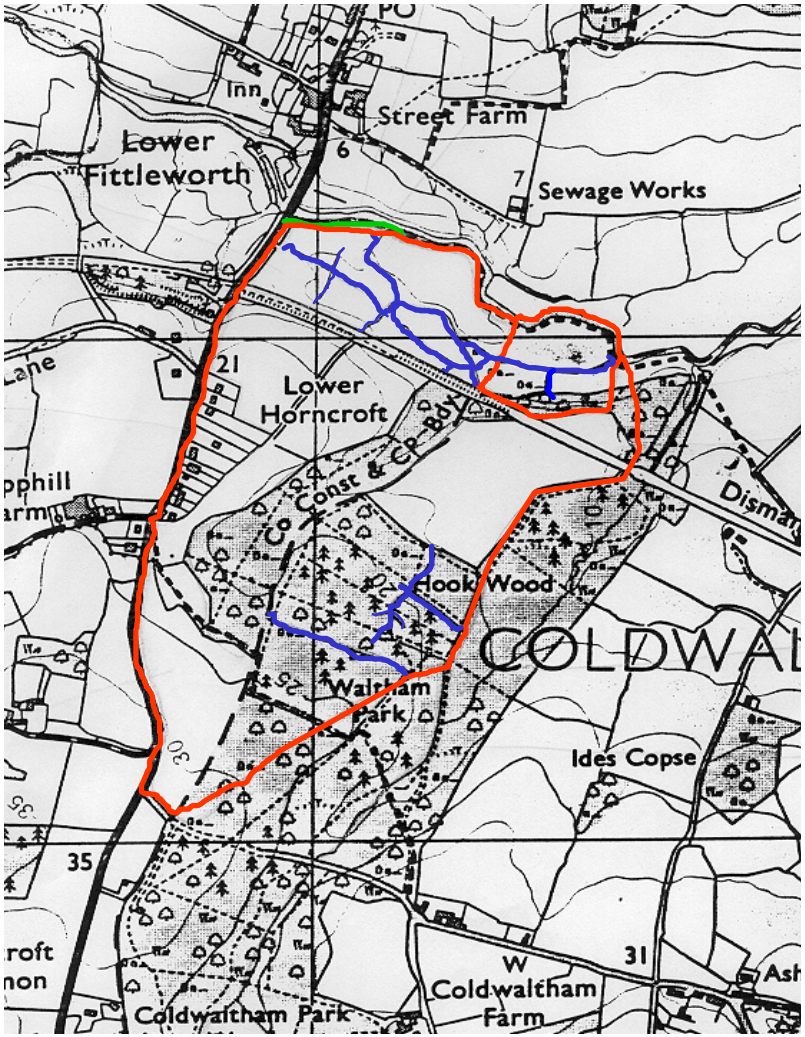


Geology
A - Alluvium
h^3 - Gault (Marly Clay)
$h^{2''''}$ - Folkstone Beds (sand & ferrug. rocks)

0 — 100m

Disused Railway

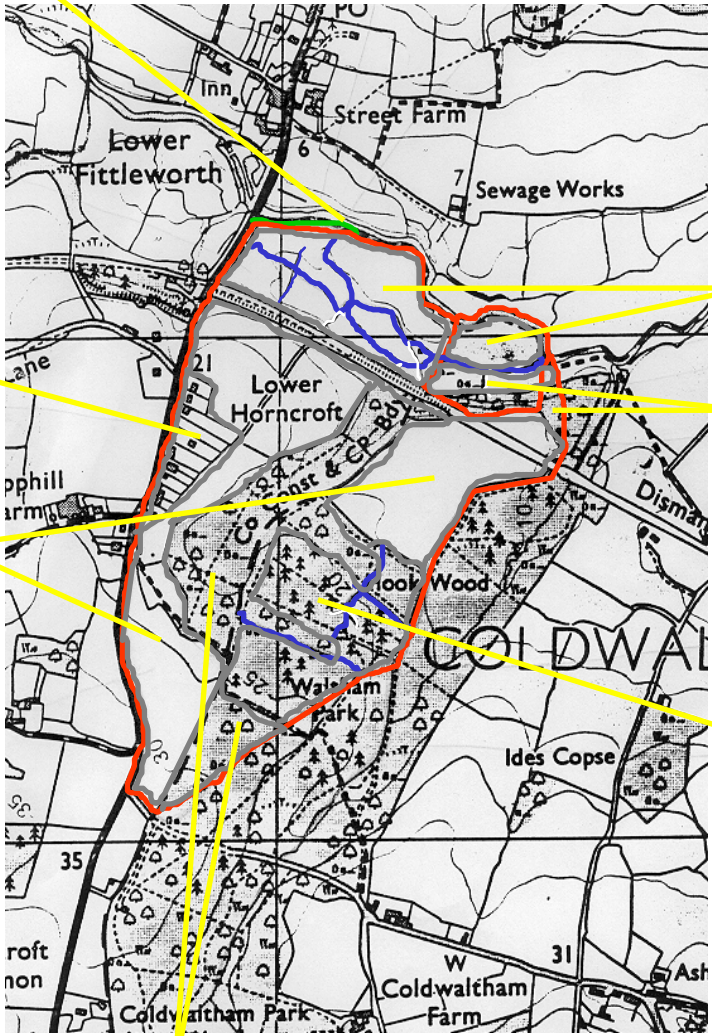
Name: Fittleworth	Date:	Field recorder:	North:
Reference co-ordinates: 014180	Scale:	Weather conditions:	



Map of area contributing to assessment area

Land use of area contributing to assessment area

Embankment



Urban

Rough Pasture Sheep > 10 per ha.

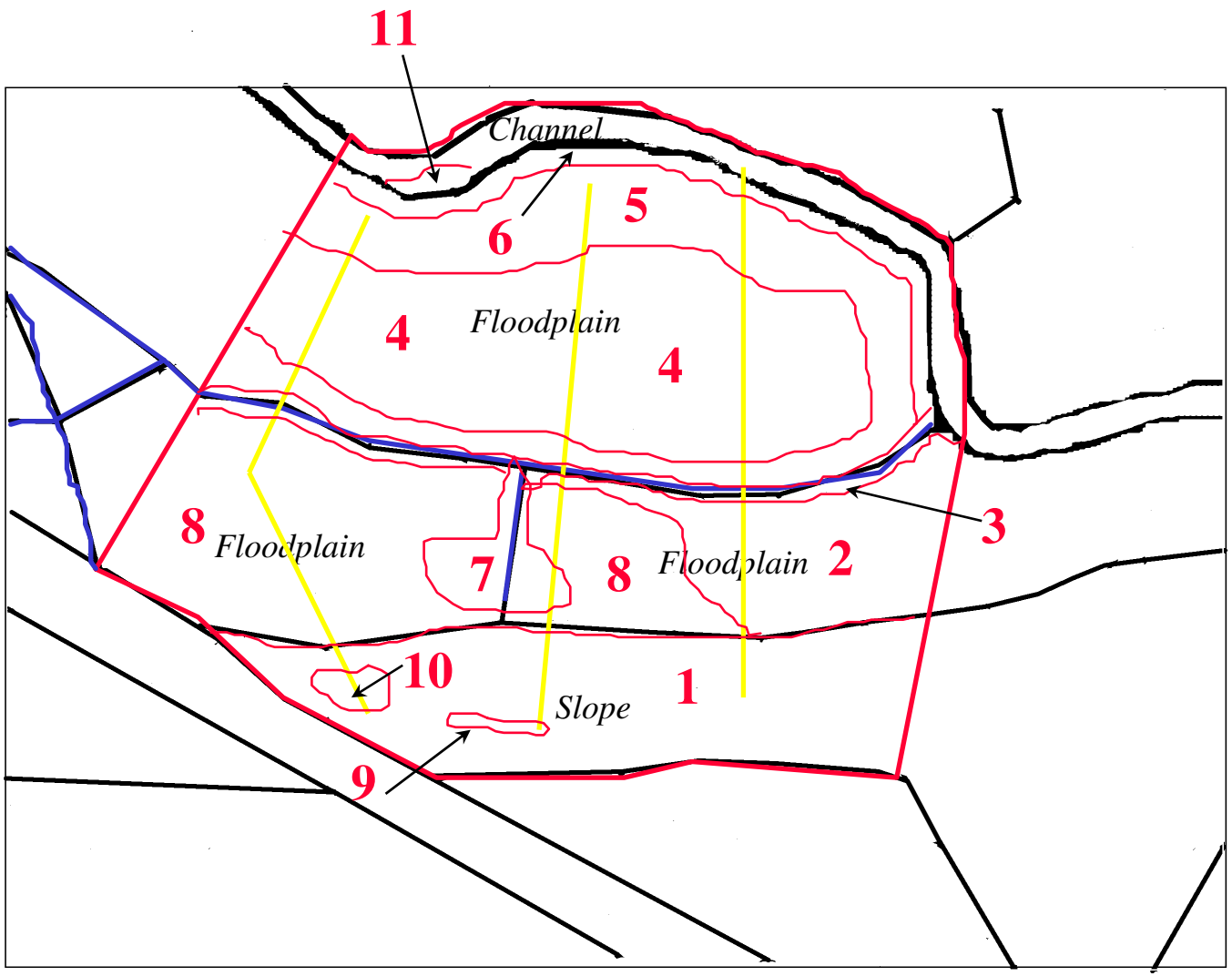
Mixed Deciduous Woodland

Ploughed Land Fertiliser application. Subject to ploughing.

Coniferous Woodland

Mixed Deciduous Woodland

Field mapped assessment area



0 100m

Name: Fittleworth	Date:	Field recorder:	North:
Reference co-ordinates: 014180	Scale:	Weather conditions:	

Form2

Generic Wetland Evaluation Tool

Ver. 01

MENU 1

Help

Enter Site Information and validate

Assessment Area Name: Val

Number of HGMUs: Val

then Select an item

DATA MANAGEMENT GO

PROCEDURES GO

Change data for a New Scenario GO

Quit

Ver. 01

MENU 2

Generic Wetland Evaluation Tool

RECORDING SHEET 1

- Climatic Information
- Landuse and Management
- Conservation and Protection Status
- River/lake Water Information
- GroundWater, Catchment, Trace Element Information

RECORDING SHEET 2

RECORDING SHEET 3

Information from maps or neighbouring areas

PERFORM PROCEDURES

Display by PROCESS - HGMU

REPORT

Quit

Menu 1

Feuille 1

Feuille 1

MDIForm1 - [LAND USE AND MANAGEMENT]

RECORDING SHEET 1

Landuse and Management

RS ENTRIES	FIELD - CODE	DATA
Inorg. fertiliser AA	1C3-2-1a	a
Inorg. fertiliser HGMU	1C3-2-1b	b
Composition of Fertiliser in AA	1C3-2-2a	b
Composition of Fertiliser in HGMU	1C3-2-2b	a
Rate of N Applied AA	1C3-2-3ai	a
Rate of P Applied AA	1C3-2-3aii	a
Rate of N Applied HGMU	1C3-2-3bi	c
Rate of P Applied HGMU	1C3-2-3bii	b
Org. Fert. Spray. AA	1C3-2-4a	b
Org. Fert. Spray. HGMU	1C3-2-4b	a
Org. Inj. AA	1C3-2-5a	c
Org. Inj. HGMU	1C3-2-5b	b
Org. Ind. AA	1C3-2-6a	b
Org. Ind. HGMU	1C3-2-6b	b
Lime App. AA	1C3-2-7a	c
Lime App. HGMU	1C3-2-7b	b
Inorg. Fertiliser CA	1C3-2-8	c
Comp. Fertil. CA	1C3-2-9	c
Org. Spray. CA	1C3-2-10	b
Org. Inj. CA	1C3-2-11	a
Org. Ind. CA	1C3-2-12	b
Lime App. CA	1C3-2-13	c
Burning Frequency in AA	1C3-3-1a	b
Burning Frequency in HGMU	1C3-3-1b	b
Harvesting Frequency in AA	1C3-4-1a	a
Harvesting Frequency in HGMU	1C3-4-1b	a
Harvesting Practices AA	1C3-4-2a	b
Harvesting Practices HGMU	1C3-4-2b	b
Harvesting Time and Freq. AA	1C3-4-3a	b
Harvesting Time and Freq. HGMU	1C3-4-3b	b
Ploughing Frequency in AA	1C3-5-1a	b
Ploughing Frequency in HGMU	1C3-5-1b	b
Ploughing Frequency in CA	1C3-5-2	a
Forestry Frequency in AA	1C3-6-1a	b
Forestry Frequency in HGMU	1C3-6-1b	b
Livestock Density in AA	1C3-7-1a	b
Livestock Density in HGMU	1C3-7-1b	b
Production in AA	1C3-7-2a	n
Production in HGMU	1C3-7-2b	n
Feed in Rest/Sleep area AA	1C3-7-3a	y
Feed in Rest/Sleep area HGMU	1C3-7-3b	n
Livestock Density in CA	1C3-7-5	a
Large Bird Population in AA	1C3-8-1a	n
Large Bird Population in HGMU	1C3-8-1b	y
Bird Population Density in AA	1C3-8-3a	b
Bird Population Density in HGMU	1C3-8-3b	b
Surface Drainage in AA	1C3-9-1	n
Surface Drainage Within CA	1C3-9-3	n
Sub-surface Drainage in AA	1C3-9-5a	y
Sub-surface Drainage in HGMU	1C3-9-5b	y
Sub-surface Drainage Within CA	1C3-9-7	y
Peat Cutting and Extraction in AA	1C3-10-1a	a
Peat Cutting and Extraction in HGMU	1C3-10-1b	a
Peat Cutting and Extraction in CA	1C3-10-2	a
Mining and Extraction Within AA	1C3-11-1a	a
Mining and Extraction Within HGMU	1C3-11-1b	a
Mining and Extraction Within CA	1C3-11-2	a
Frequency of Inorg. Waste Appl. In AA	1C3-12-1a	a
Frequency of Inorg. Waste Appl. In	1C3-12-1b	a
Frequency of Inorg. Waste Appl. In CA	1C3-12-2	a
Construction Work in AA	1C3-13-1a	n
Construction Work in HGMU	1C3-13-1b	y
Construction Work in CA	1C3-13-2	y
Extent of Hunting, Shooting, Fishing in	1C3-14-1	a
Extent of Recreation in AA	1C3-15-1	a

Menu 2

Quit

Delete a record

Add a record

Previous

Click here to VALIDATE

NEXT

Rec Sheet 1 - LAND USE AND MANAGEMENT

	HGMU-Nb	1C3-2-1a	1C3-2-1b	1C3-2-2a	1C3-2-2b	1C3-2-3ai	1C3-2-3aii	1C3-2-3bi	1C3-2-3
	1	41	c	43	a	45	46	b	b
	2	c	c	c	c	c	c	c	c
▶	3	a	b	b	a	a	a	c	b
*									

Data1

Ver. 01

MEN

Process Output

HGMU n°2

(P1) 3.1.A: Floodwater detention (Hydrological process)

Code= 1/4a

It is evident that the HGMU floods frequently with stream/lake water. It is not known what contribution is made to alleviation of downstream floods. Flow velocity is probably low and flood duration long.

Quit

Menu 1

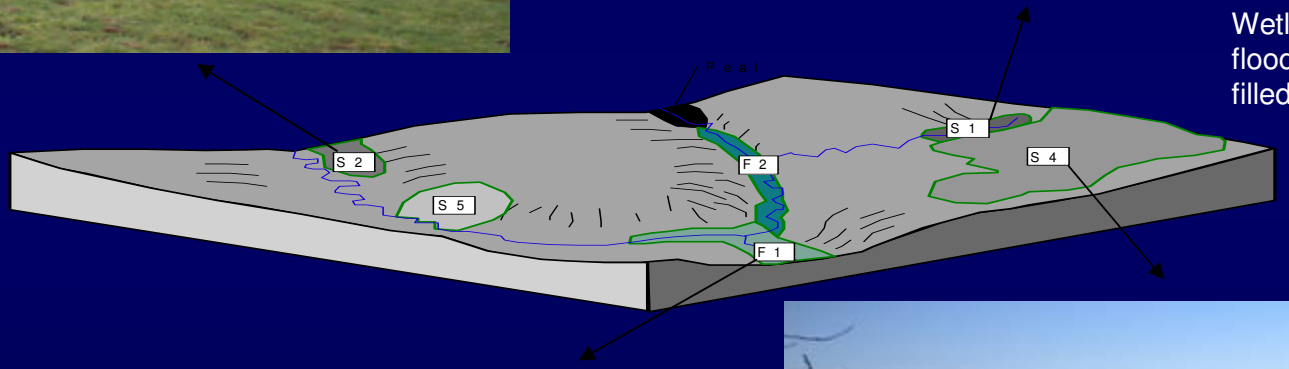
Menu 2

Démarrer | procedure... | Form2 | MDIForm1 | Form2 | RS2 | Form4 | Form7 | Feuille 1 | Matrice | Process ... | FR | 13:05

Functional Landscape units

Wetland developed in zone of strong groundwater seepage adjacent to floodplain.

Wetland in valley bottom lacking floodplain development, can be peat-filled.



Floodplain of flashy river system can experience short periods of inundation from over-bank flooding.

Fen and wet grassland on soils of low permeability on gently-sloping interfluves running down to stream headwaters.

Unit	Functions				
	Plant uptake	**Storage in organic matter**	**Nsorb as ammonium**	**Psorb/pptn in soil**	**Retention of particulate nutrients**
Floodplain					
F1	No/little (infrequent flooding)	No	No	No	No/little (infrequent flooding)
F2	Yes	Yes/little (variable organic matter)	Yes	Yes (if soil is clay)	Yes
F3	Yes	Yes	Yes	Yes (if clay soil)	Yes
Slope					
SL1	Potential (if nutrient inputs via surface water)	No/little (very few wet peaty areas)	Potential (if nutrient inputs via surface water)	Potential (if clay soils and nutrient inputs via surface water)	No
SL2	Little (low nutrient inputs via ground water)	Little (high organic matter but low nutrient inputs)	Little (low nutrient inputs)	No (organic soils and low nutrient inputs)	No
SL3	Little (low nutrient inputs via ground water)	Little (high organic matter but low nutrient inputs)	Little (low nutrient input)	No (organic soils and low nutrient inputs)	No
SL4	Potential (but nutrient inputs damage ecology)	Potential (but nutrient inputs damage ecology)	Potential (but nutrient inputs damage ecology)	Potential (but nutrient inputs damage ecology)	No
SL5	No/little (slope limits detention of nutrients)	No/little (very few wet peaty areas)	No/little (slope limits detention of nutrients)	No/little (slope limits detention of nutrients and few clay soils)	No

Common Implementation Strategy for the Water Framework Directive

Horizontal Guidance Document on the Role of Wetlands in the Water Framework Directive

An assessment by E.Maltby and M.Blackwell based on the work of the Wetlands Working Group

Wetlands and the WFD - a crosscutting issue

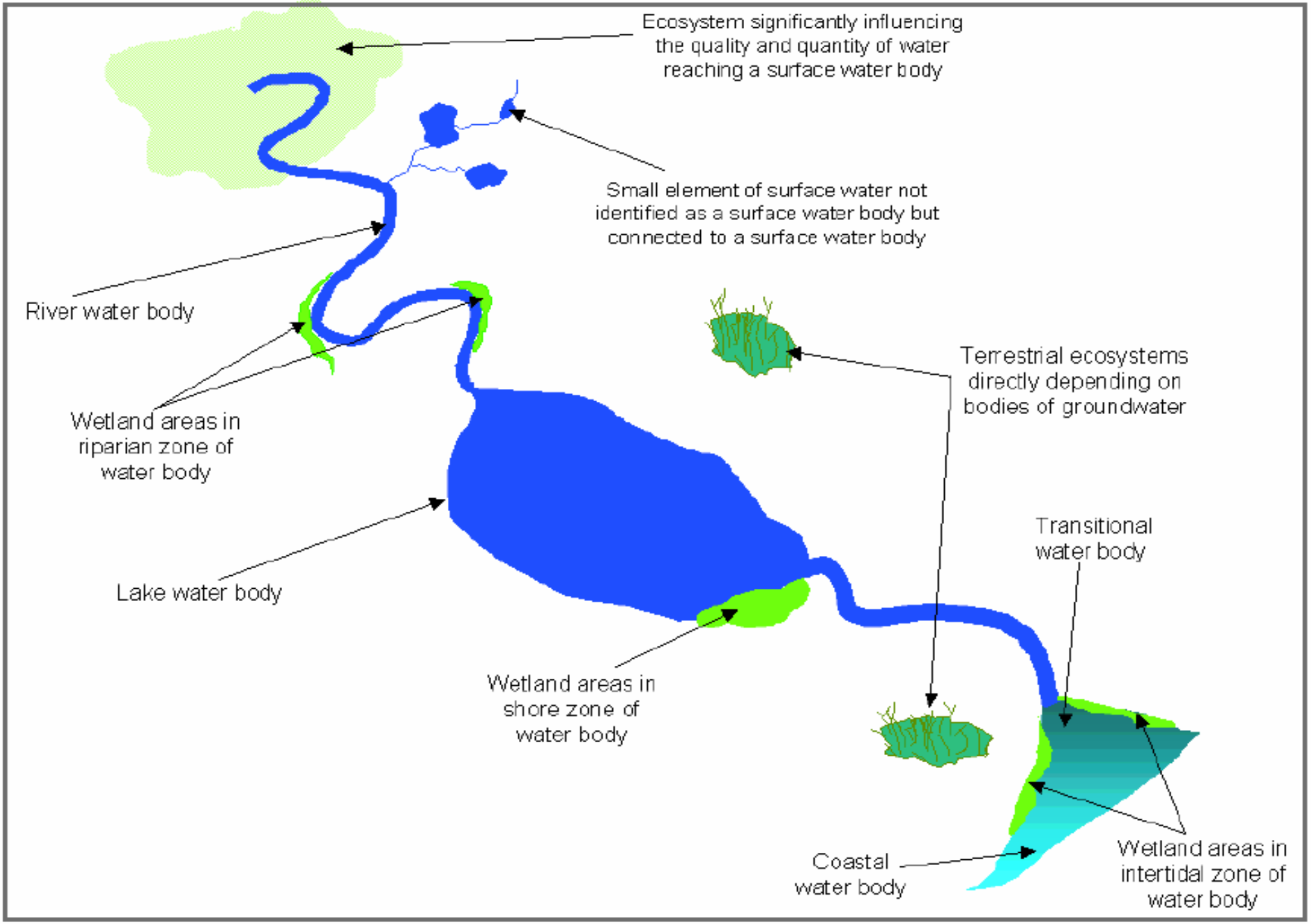
Wetlands can comprise part or all of the ecosystems designated for protection within the WFD

Wetlands can contribute to the protection and enhancement of ecosystems specified within the WFD

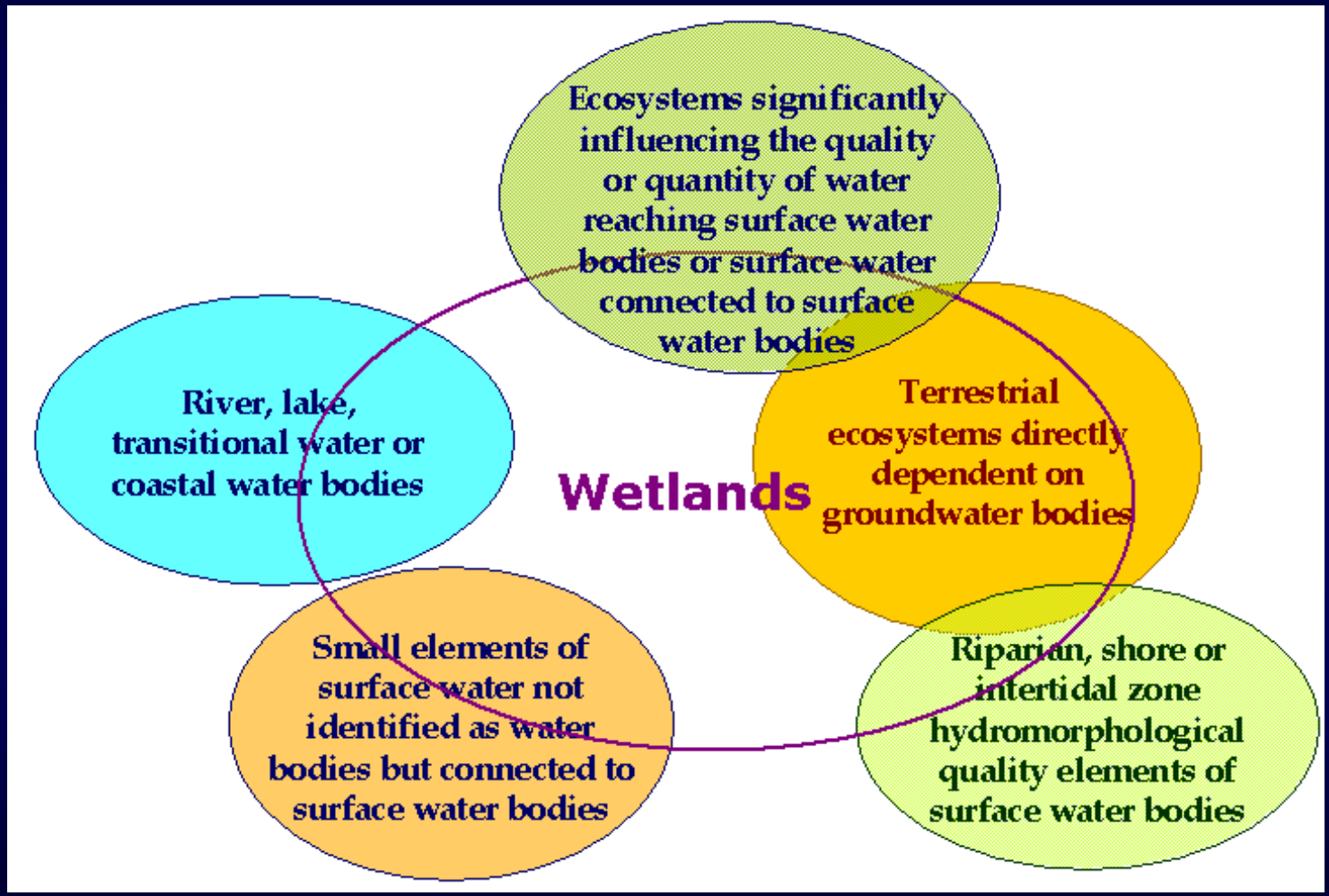
The purpose of the WFD in relation to wetlands as stated in Article 1 is unambiguous. Article 1(a) states that the Directive will

'*establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater, which:*

'*prevents further deterioration and protects and enhances the status of aquatic ecosystems and, with regard to their water needs, terrestrial ecosystems and* ***wetlands*** *directly depending on the aquatic ecosystems.'*


Ecosystem significantly influencing the quality and quantity of water reaching a surface water body
Small element of surface water not identified as a surface water body but connected to a surface water body
River water body
Terrestrial ecosystems directly depending on bodies of groundwater
Wetland areas in riparian zone of water body
Transitional water body
Lake water body
Wetland areas in shore zone of water body
Coastal water body
Wetland areas in intertidal zone of water body

Ecosystems relevant to the achievement of the Directives objectives



Wetlands and the Water Framework Directive

Issues

Wetlands have the capability and potential to help deliver the objectives of the WFD, but they are not the subject of specific emphasis in the Directive

- Regulatory and other responsible agencies are wrestling with questions of how to implement the WFD
- This is a particular issue with regard to wetlands

Specific aims of Directive:

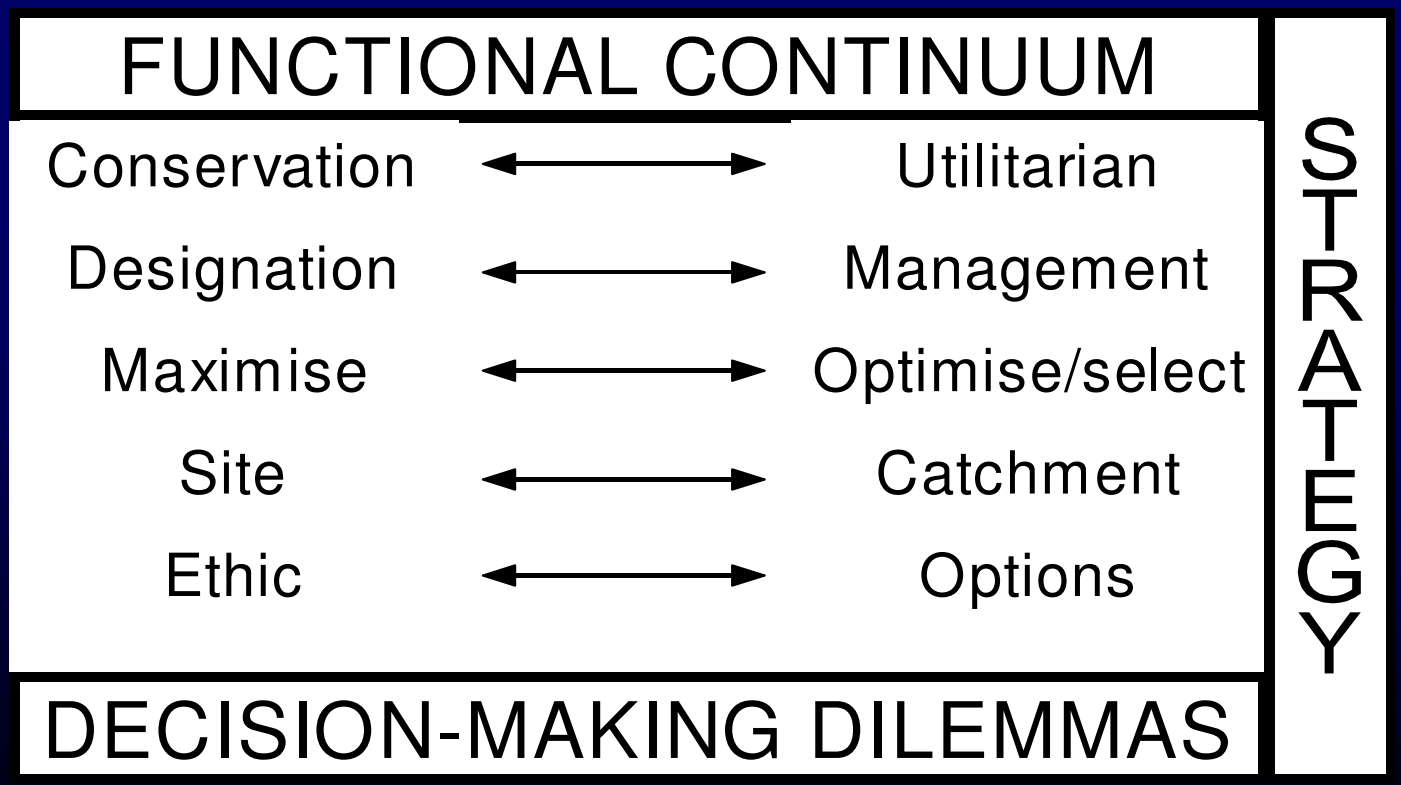
Wetland functioning may help to deliver a number of the specific aims of the WFD

- mitigation of floods and droughts (article 1)
- reduction of pollution of groundwater (article 1)
- the provision of good quality surface and groundwater (article 1)
- contribution to ecological status of surface waters (article 4)
- balance between groundwater abstraction and recharge (article 4)

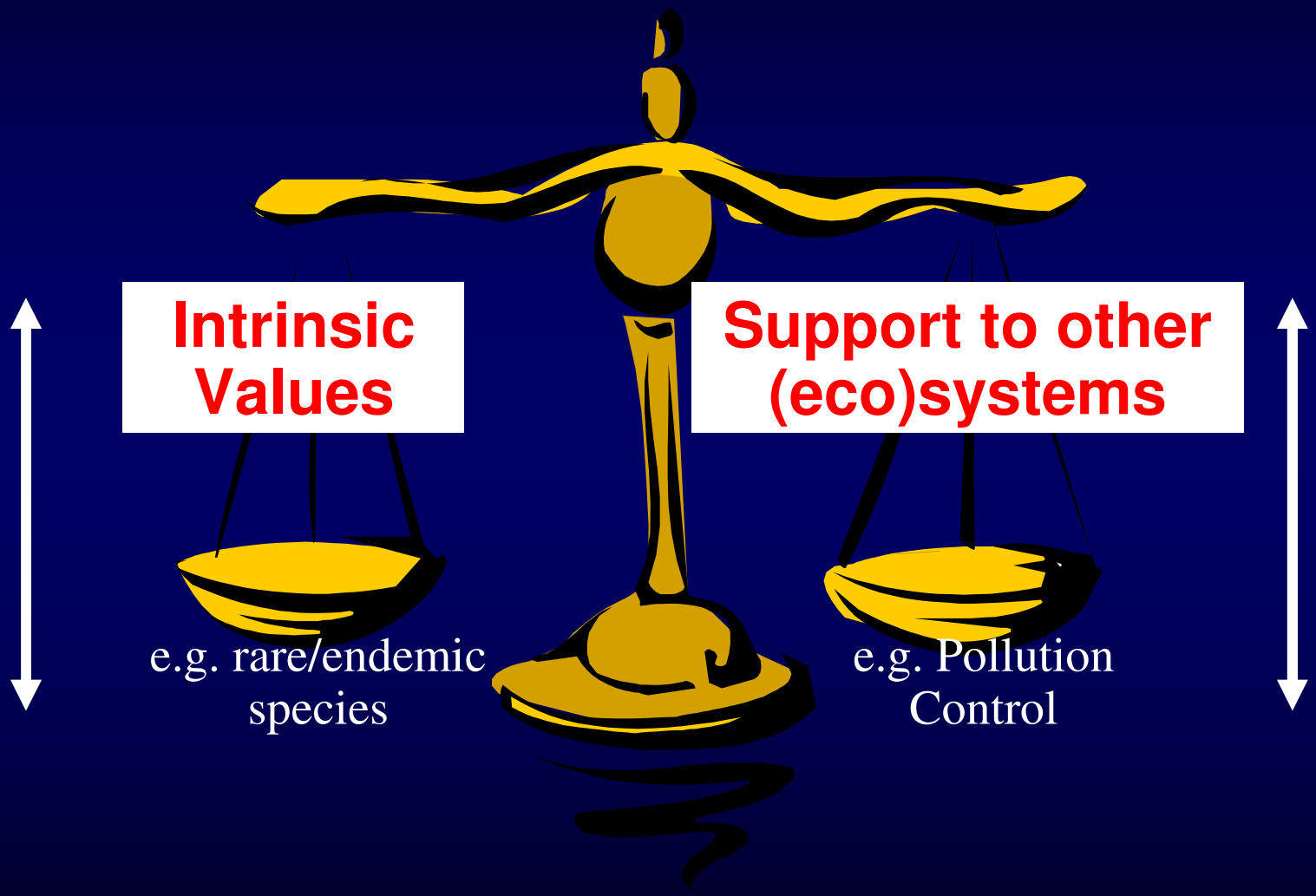
Wetlands & WFD

Duality of the Link

Wetland protection ⟷ Delivery? ⟷ Contribution to water management objectives



Wetlands - Questions of Balance



EVALUWET Objectives

- To establish a harmonised approach amongst European environmental agencies and stakeholders to the implementation of wetland relevant legislation, especially the WFD.
- To develop a Wetland Evaluation decision support system (WEDSS) which integrates wetland function and value information.
- To develop a catchment scale functional evaluation methodology for application across Europe that fulfils the requirements of the WFD.
- To develop a model for socio-economic valuation and decision making.

Definitions and Terminology:

New Functional Definition

"Wetlands are heterogeneous but distinctive ecosystems in which special ecological, biogeochemical and hydrological functions arise from the dominance and particular sources, chemistry and periodicity of inundation or saturation by water. They occur in a wide range of landscapes and may support permanent shallow (<2m) or temporary standing water. They have soils, substrates and biota adapted to flooding and/or waterlogging and associated conditions of restricted aeration."

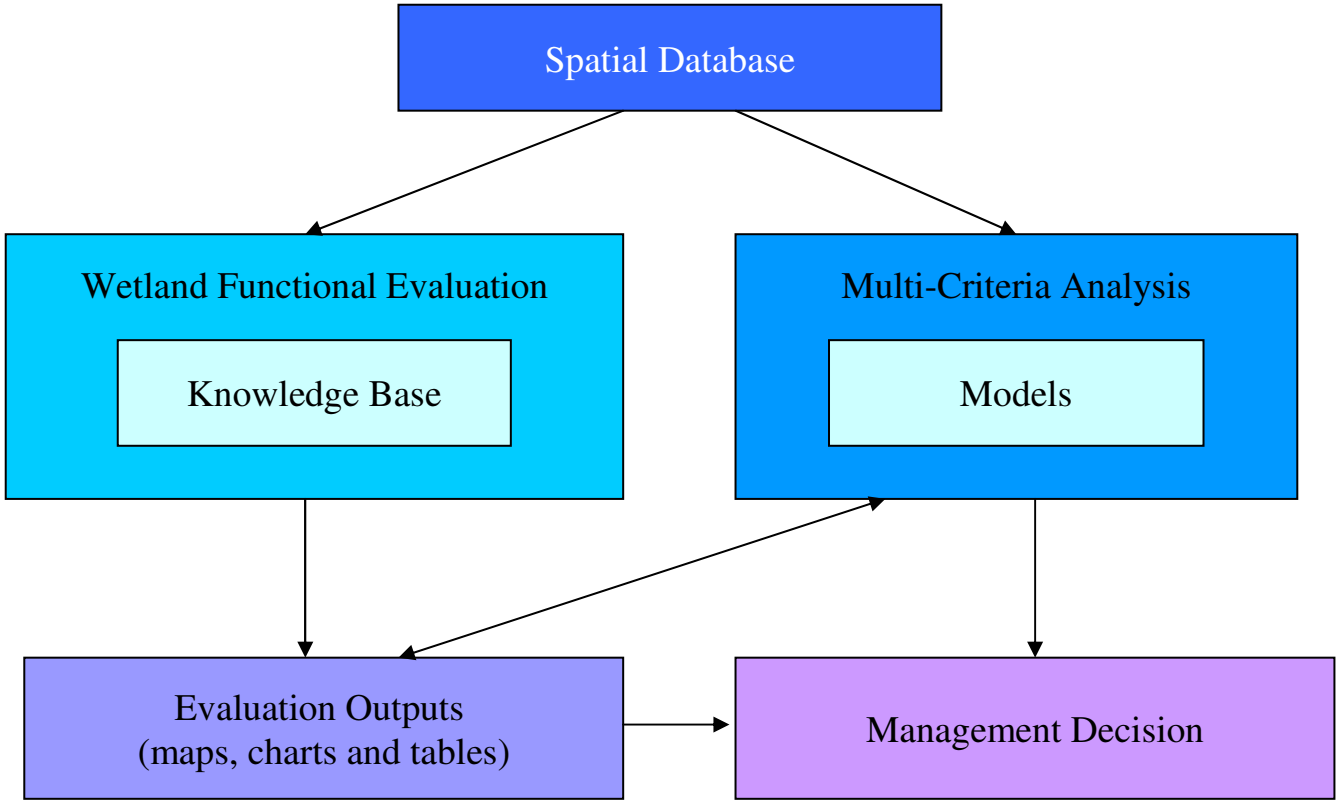
Notes (excluding):

- Deeper water bodies.
- Permanent rivers and streams per se.
- 'Other RAMSAR types'.

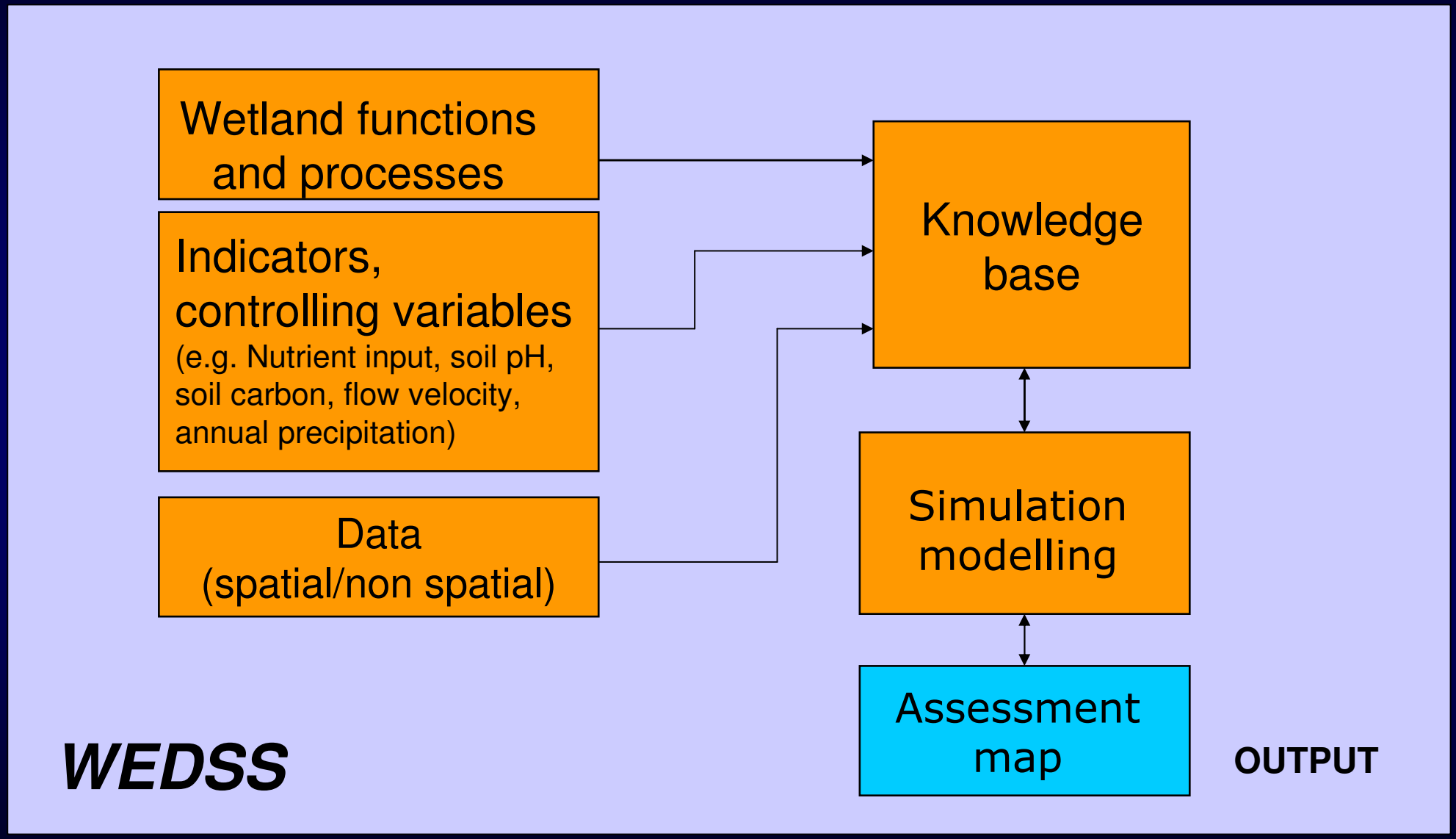
WEDSS - Key Steps

- Data input: Delineation and characterisation of hydrogeomorphic units (field and office)
- Functional assessment of each HGMU and production of maps
- Linkage of functional outputs with ‘value’ criteria in each HGMU
- Spatial aggregation of ‘values’ to produce score for whole wetland
- Comparison of different wetlands or scenarios using multi-criteria analysis

WEDSS Structure

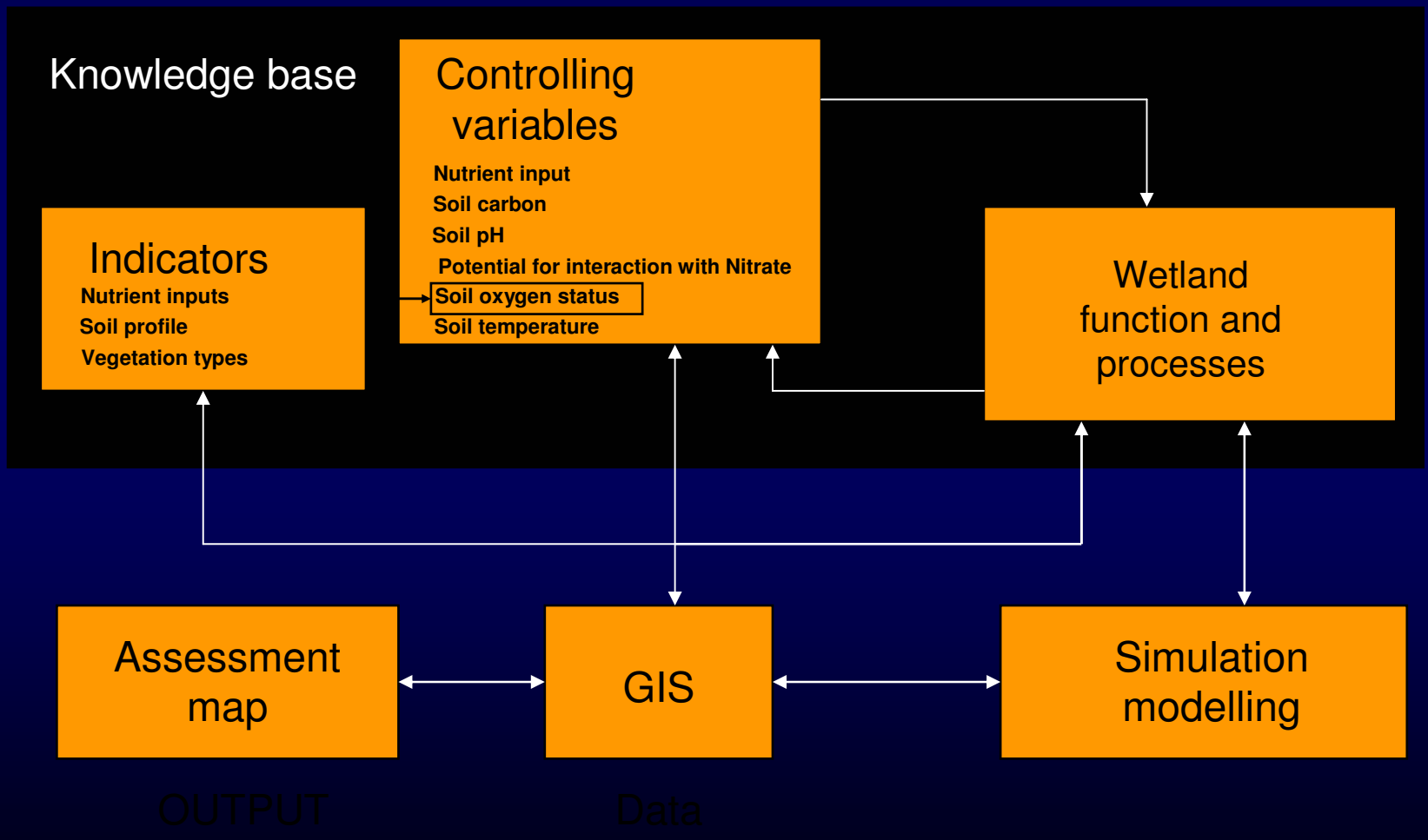


Knowledge Base and WEDSS



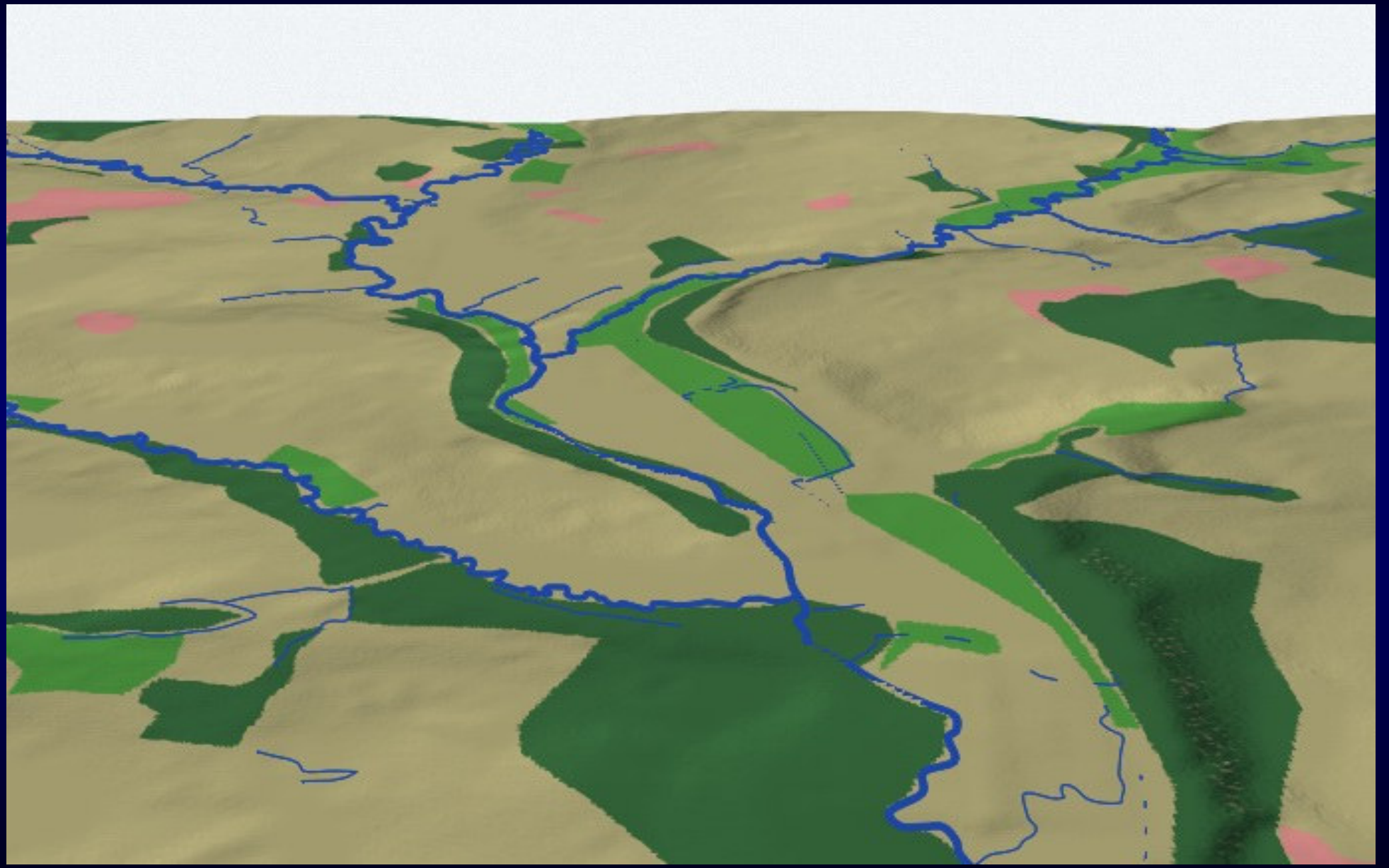
KB Example: Nutrient Export

removal of excess nutrients (nitrogen and/or phosphorus) from a wetland via biological, biochemical, physical and land management processes.



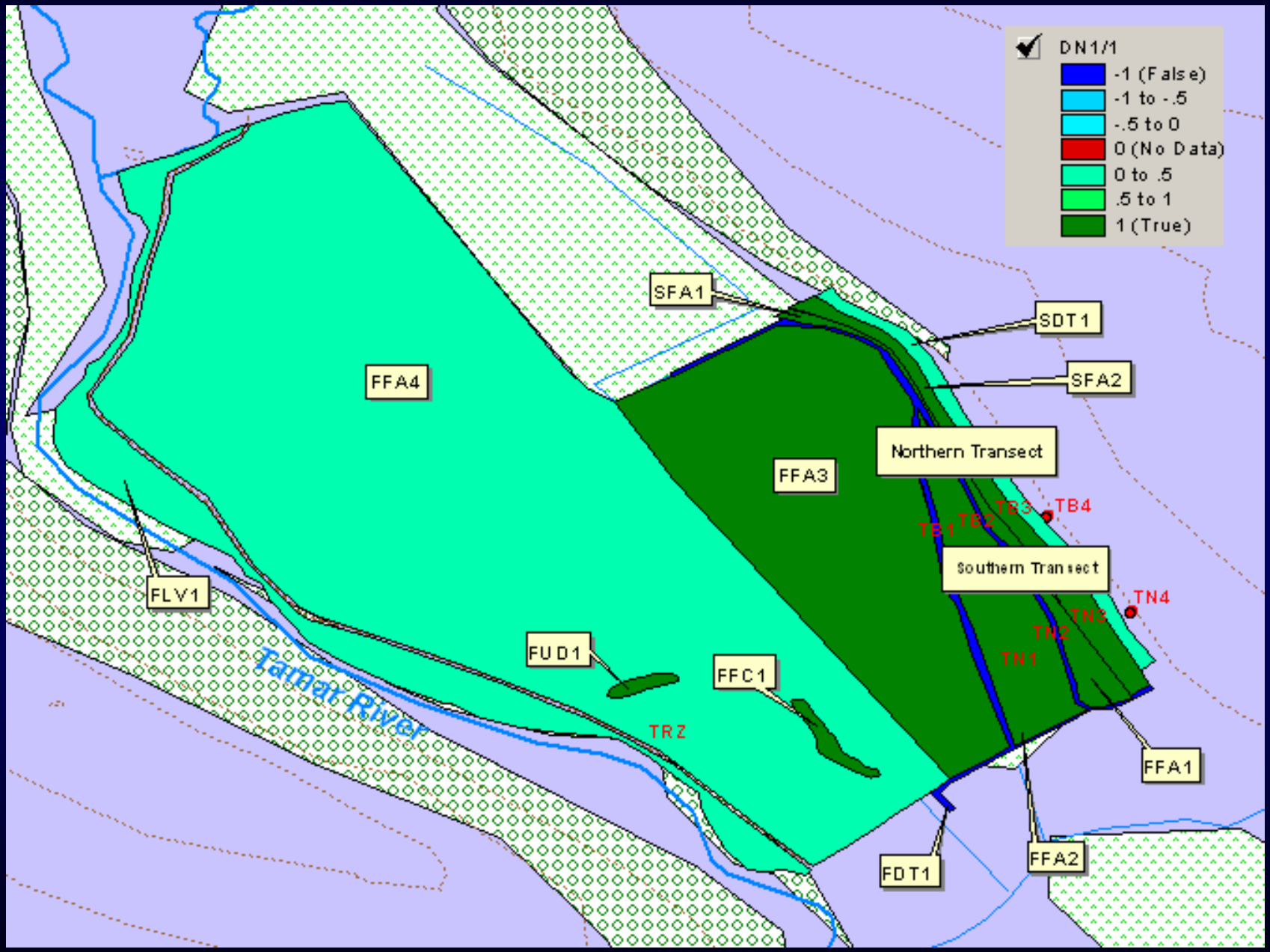
Typical landscape

HGMU delineation



HGMU delineation

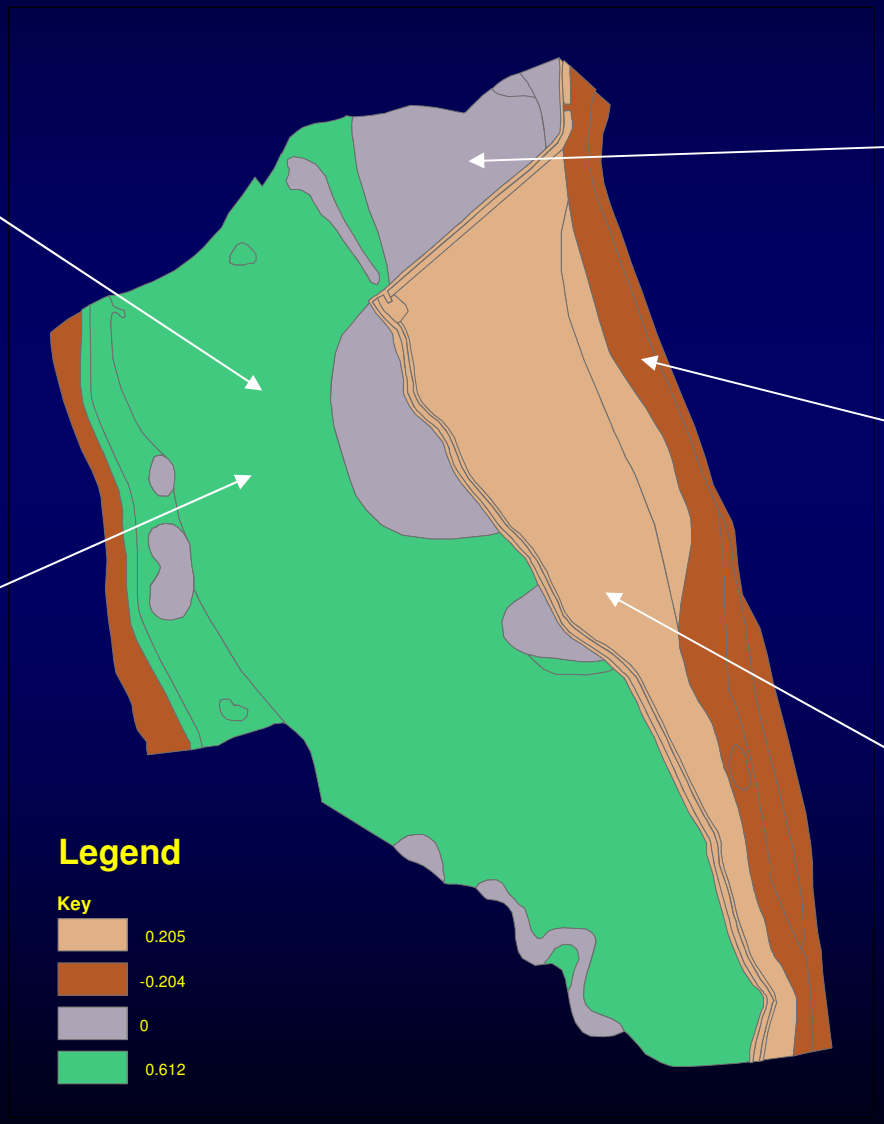
Assessment Outcome



Export of Nutrients through Vegetation Management

Quantification:
> 10 but < 50 kg N ha^{-1} y^{-1}
> 1 but < 5 kg P ha^{-1} y^{-1}

1/d: The HGMU receives either a direct or indirect nutrient input. Grassland vegetation indicative of a high rate of nutrient uptake is present. The HGMU experiences a low degree of disturbance from drought, waterlogging, ploughing, mining or extraction or construction work, so the ability of plants to take up nutrients is not affected.
Grazing results in the export of nutrients taken-up by the plants. The amount of nutrients exported through grazing is always less than the amount of nutrients exported through harvesting, because not all vegetation will be grazed and animals spill a lot of (nutrient-rich) plant material i.e. not all plant material will end up in the mouth of the animal. Some material will fall down after it is bitten by animals. This material is more nutrient-rich than plant material deposited after plant mortality because of senescence. This phenomenon is particularly important with regard to geese. Additionally nutrients can return to the system in the form of excrement.



No results

2: Shrubs or trees indicative of a high rate of nutrient uptake are present, but they are not felled and removed. NB: The process of long-term retention of nutrients can be performed. This process is assessed in section 3.2.A.1.

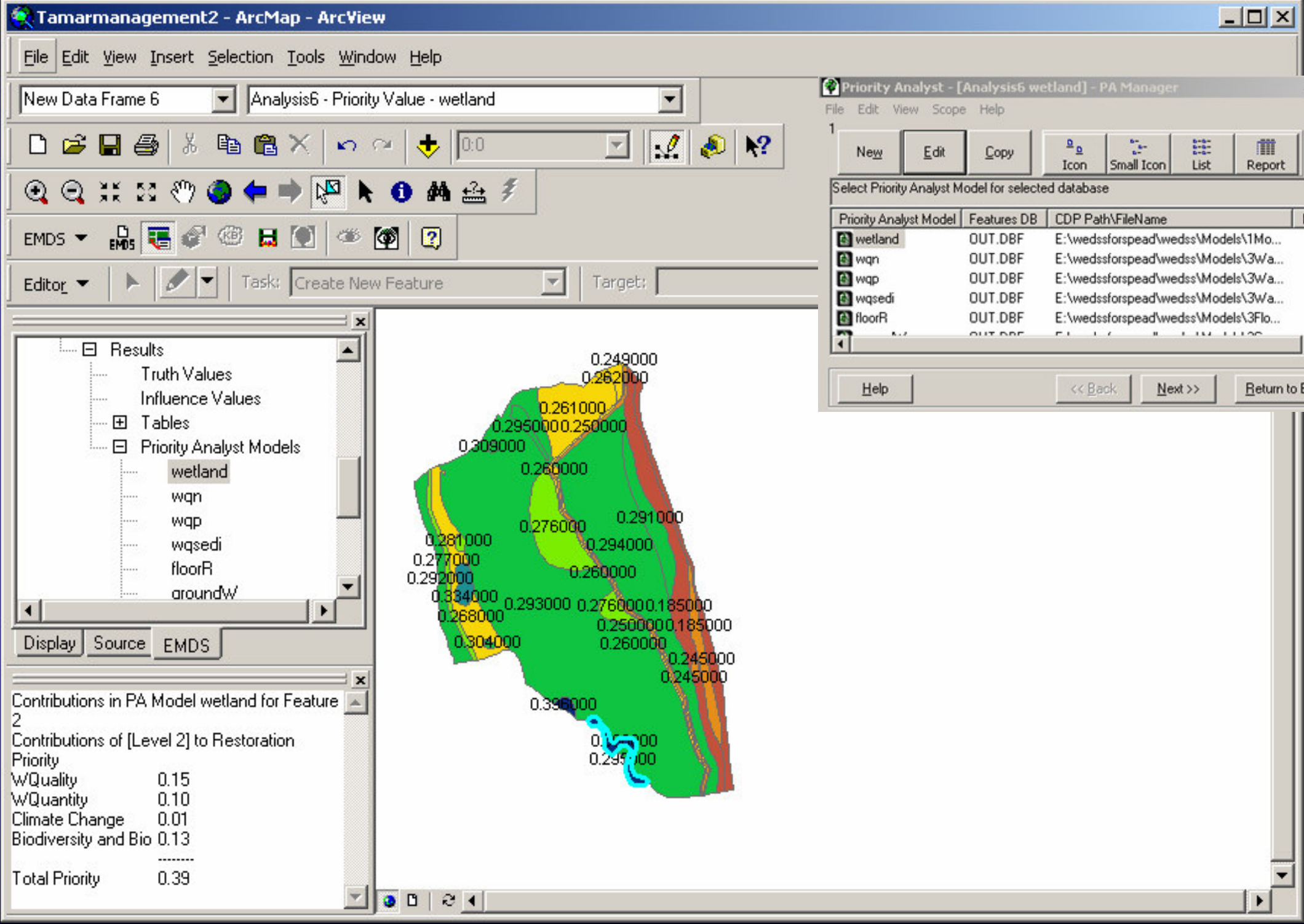
2: No (management) activities resulting in the export of nutrients take place.
NB: The process of long-term retention of nutrients can be performed. This process is assessed in section 3.2.A.1.

Linking functions to socio-economic criteria

- Generic list of criteria developed relevant ones selected
- Processes linked by simple models to socio-economic criteria (range 0-1)
- Other criteria are not defined by functional outputs but are user defined
- For ease of analysis criteria grouped together in categories
- Scores spatially aggregated

Categories and Criteria

Category	Criteria	Category	Criteria
Water Quality	WQ-N WQ-P WQ-Sediment WQ-Trace Elements WQ-DOC	Water Quantity	Flood risk reduction Groundwater maintenance Base flow support Water supply
Climate change	Carbon retention Greenhouse gas emissions	Heritage	Cultural heritage Landscape Pres. of arch. remains Pres. of paleo-env
Biodiveristy and biomass	Habitat diversity Sp. diversity – flora Sp. diversity – fauna Biomass	Local Economy	Agriculture Natural Harvest Forestry Shipping Residential Recreation Tourism


Tamarmanagement2 - ArcMap - ArcView
File Edit View Insert Selection Tools Window Help
New Data Frame 6
Analysis6 - Priority Value - wetland
EMDS
Editor
Task: Create New Feature
Target:
Results
Truth Values
Influence Values
Tables
Priority Analyst Models
wetland
wqn
wqp
wqsedi
floorR
groundW
Display Source EMDS
Contributions in PA Model wetland for Feature 2
Contributions of [Level 2] to Restoration Priority
WQuality 0.15
WQuantity 0.10
Climate Change 0.01
Biodiversity and Bio 0.13
Total Priority 0.39
Priority Analyst - [Analysis6 wetland] - PA Manager
File Edit View Scope Help
New Edit Copy Icon Small Icon List Report
Select Priority Analyst Model for selected database
Priority Analyst Model Features DB CDP Path\FileName PA_ID
wetland OUT.DBF E:\wedssforspead\wedss\Models\1Mo... 1
wqn OUT.DBF E:\wedssforspead\wedss\Models\3Wa... 2
wqp OUT.DBF E:\wedssforspead\wedss\Models\3Wa... 3
wqsedi OUT.DBF E:\wedssforspead\wedss\Models\3Wa... 4
floorR OUT.DBF E:\wedssforspead\wedss\Models\3Flo... 5
Help << Back Next >> Return to EMDS
0.249000
0.262000
0.261000
0.295000
0.250000
0.309000
0.260000
0.276000
0.291000
0.281000
0.294000
0.277000
0.260000
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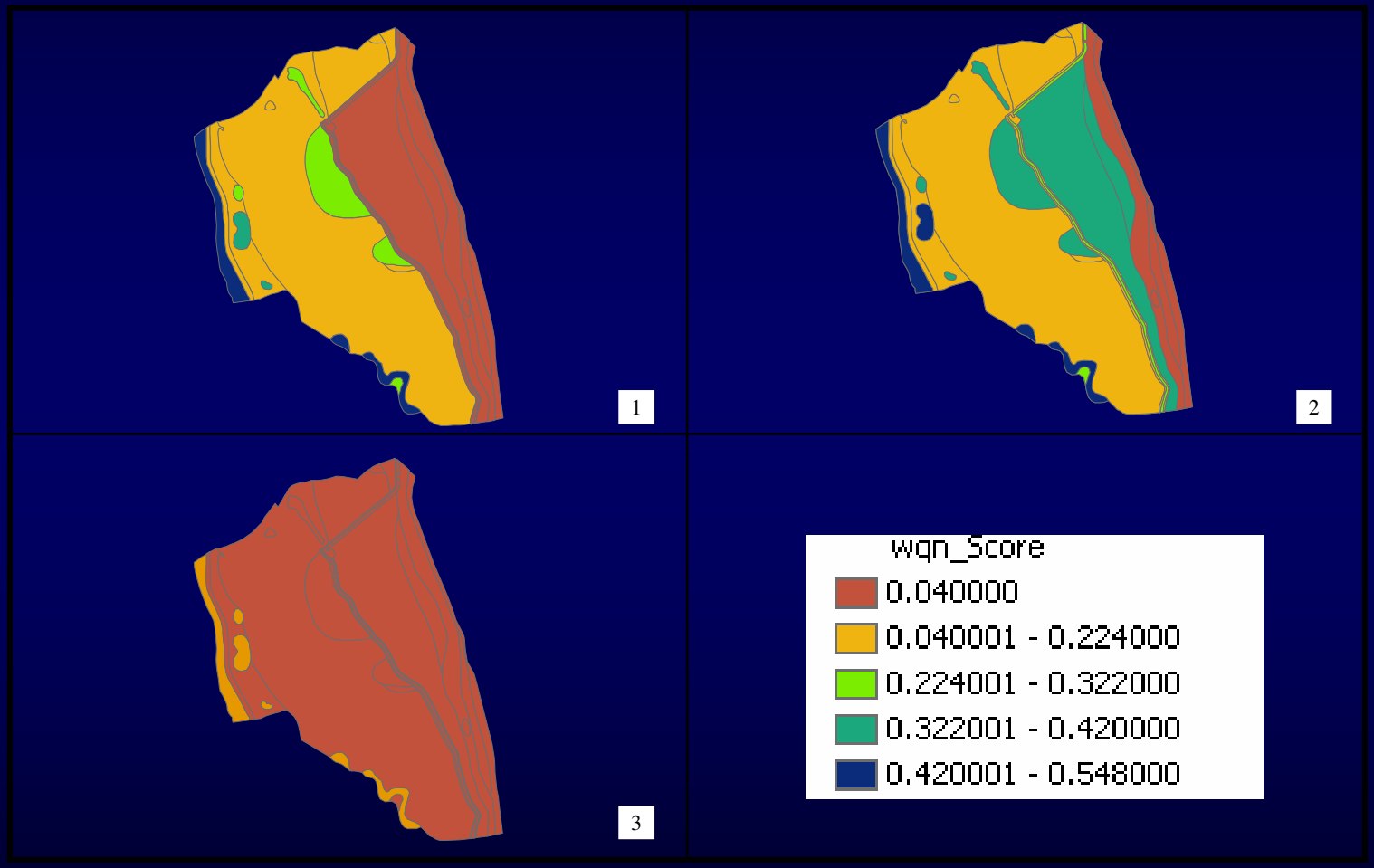
0.185000
0.268000
0.250000
0.185000
0.304000
0.260000
0.245000
0.245000
0.396000

Water Quality Enhancement (N)



Conclusions

- A method for functional assessment without the need for empirical research exists
- Functional tools require more critical evaluation
  - *Testing, gap-filling, refinement*
- Statutory and non-statutory bodies need to assess applicability
- DSS needs to evolve into specific problem solving formats
  - *Impacts of changing climate or land use*
- Policy framework needs to integrate scientific understanding
- Implementation of WFD needs to take wetlands into account as part of River Basin Management Plans

Access: Evaluwet website

- The Tamar Catchment Wetland Classification can be accessed online at the following URL:
  http://www1.rhbnc.ac.uk/rhier/evaluweb/weds_ims.shtml