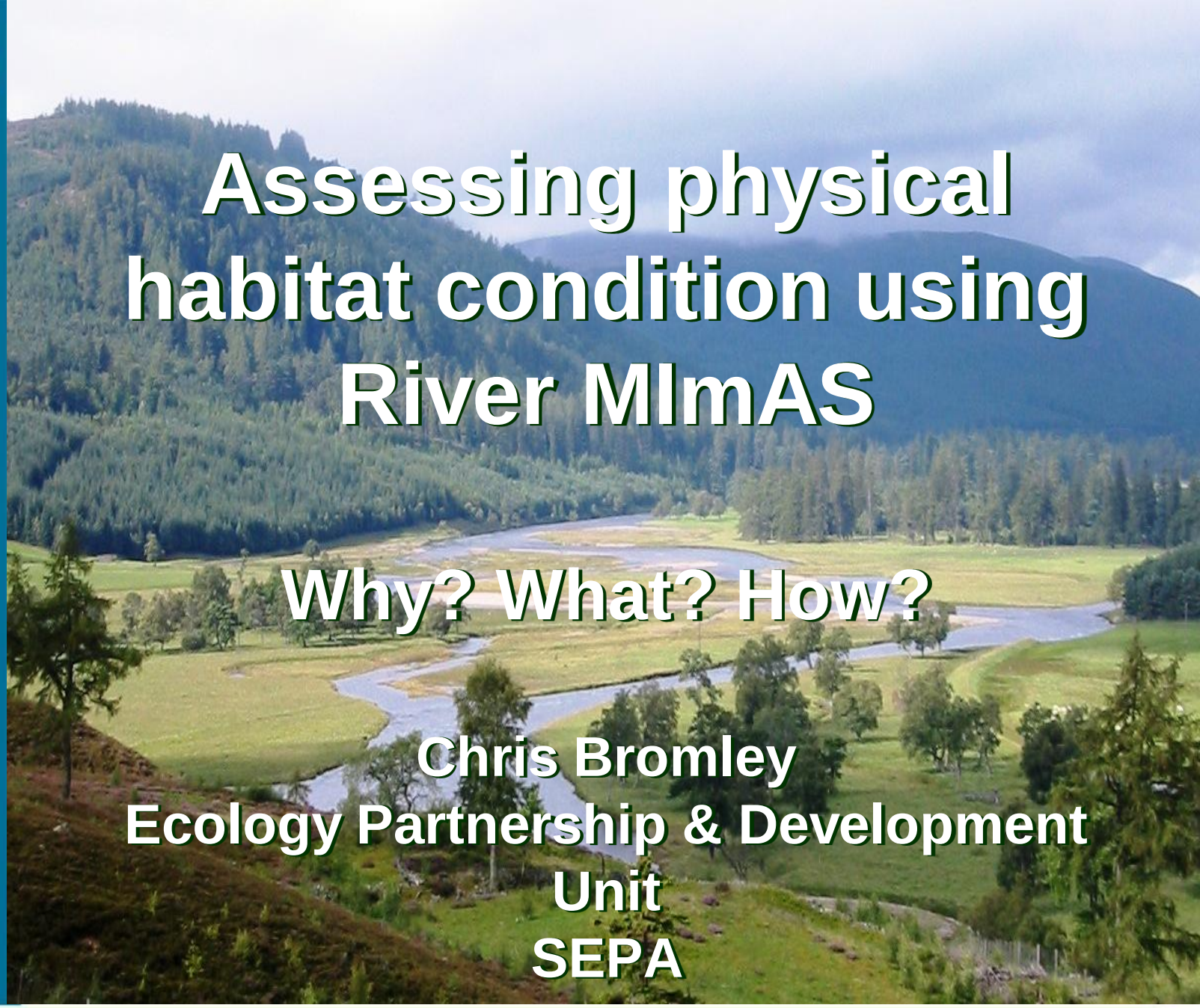


Assessing physical habitat condition using River MImAS

Why? What? How?

Chris Bromley
Ecology Partnership & Development Unit
SEPA

Overview

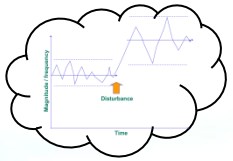
- Why did we chose the MImAS approach?
- What is MImAS?
- How does it work?
- Results of MImAS assessments
- How can we improve the tool?
- Examples

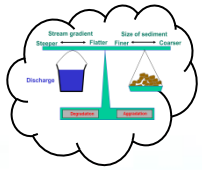
Why use the MImAS approach?

HIGH
GOOD
MODERATE
POOR
BAD

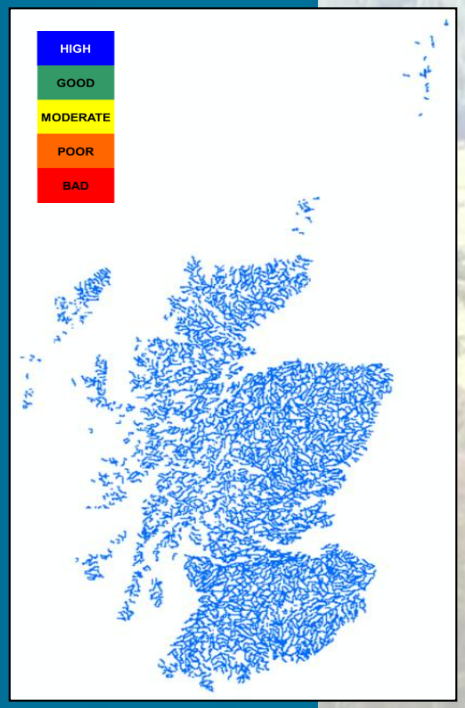
?

What is River MImAS?





River Morphological Impact Assessment System

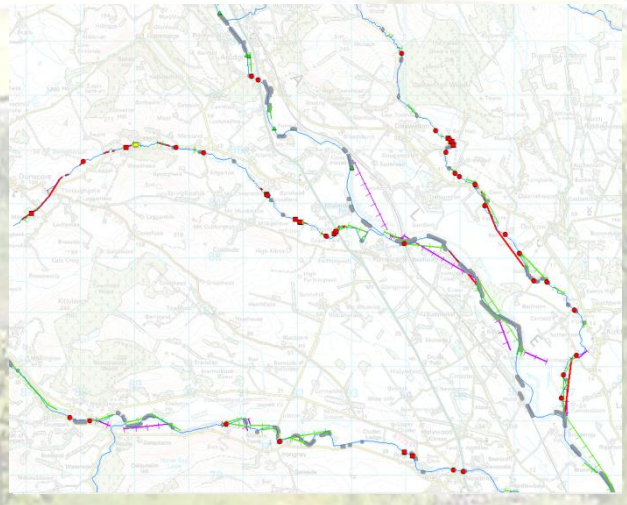


SEPA
Scottish Environment Protection Agency

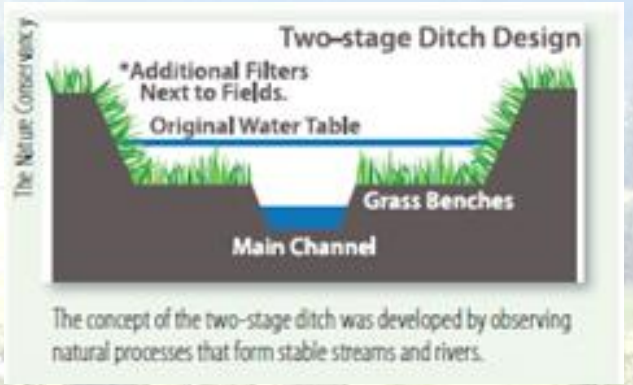
Water Use

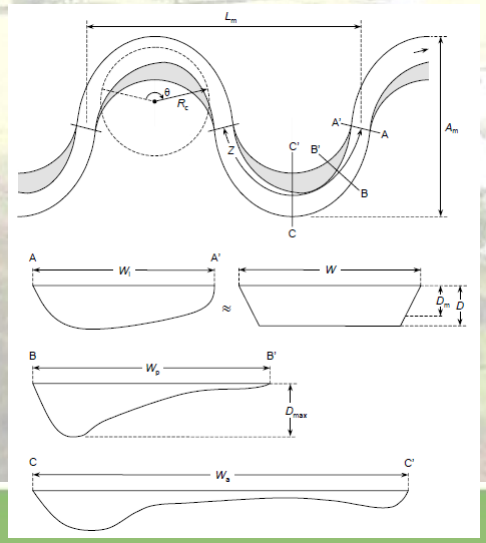
Supporting Guidance (WAT-SG-21)

Environmental Standards for River Morphology



What River MImAS isn't





How does MImAS work?

Key principles:

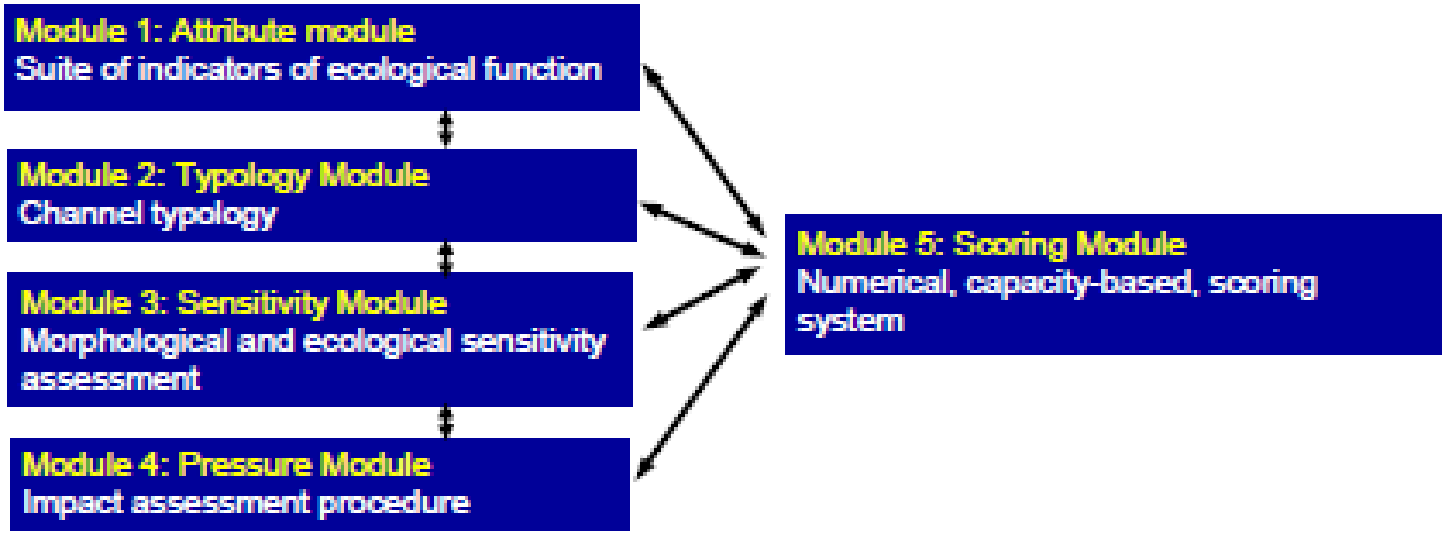
1. Transparent & consistent assessment of risk of failing GES posed by existing & future engineering activities.
2. Rivers will be managed to deliver the following WFD objectives:
   a) WBs at HES will be protected.
   b) WBs at GES will be protected as far as necessary to deliver GES for biota.
   c) WBs at <=MES will be protected to prevent deterioration of biological quality AND to ensure restoration potential to achieve GES for biota is not compromised.
3. Best available information on links between ecology & geomorphology used to protect ecologically relevant features & processes. Where links poorly understood, aim is to protect geomorphological processes & features.
4. The framework must allow refinement & evolution through time.

How does MImAS work?

Key assumptions:

1. There is a relationship between the extent of morphological alterations & the impact on biota and ecological status.
2. The response of a water body's morphology to engineering pressures is predictable for the type of water body in question.
3. The response of biota to morphological change is predictable and depends on their sensitivity.
4. Water bodies have the capacity to withstand some morphological alterations without changing their ecological status.
5. The thresholds (morphological condition limits) beyond which there is a risk to ecological status can be identified using expert judgment. These MCLs can be expressed as a **percentage capacity used**.
6. MImAS estimates whether the MCLs have been exceeded.

How does MImAS work?



- Five semi-independent modules allow incremental improvement through time.

How does MImAS work?

Module 1: Attribute module

Geomorphological & habitat attributes

1. Natural range of flow & morphological features.
2. Refuge habitat zones.
3. Self-sustaining & diverse riparian plant communities.
4. Presence, abundance & distribution of in-channel vegetation.
5. Habitat connectivity.

Geomorphological processes & disturbance patterns

1. Natural disturbance regime.
2. Mobilisation of channel bed surface gravels.
3. Periodic channel bed scour.
4. Infrequent channel resetting floods.
5. Balanced fine & coarse sediment budgets.
6. Channel migration.
7. Hyporheic flow exchange.
8. Connected & functional floodplains.

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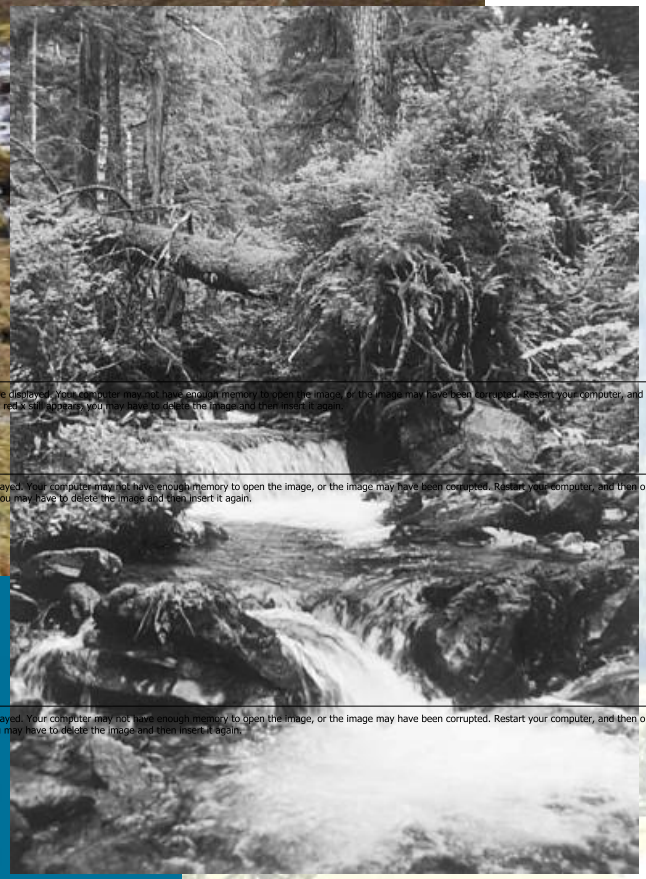
How does MImAS work?

Module 1: Attribute module

Eco-geomorphic attributes	Definition	Link to ecosystem attributes and processes	
Channel zone		Attributes	Processes
Hydraulic geometry	*Describes the size and shape of the channel*		
Planform	Spatial pattern and location of a channel, as viewed from above	ALL	ALL
Cross section	The cross sectional form of the channel (width-depth)	ALL	ALL
Profile (Slope)	Slope of the channel bed and the variation of that slope	ALL	ALL
Substrate condition	*Describes the size, structure and sorting of riverbed gravels*		
Substrate size	The size distribution of surface gravels	1, 4	2
Embeddedness	The extent to which framework gravels are covered or sunken into the silt, sand, or mud of the riverbed.	1, 4	7
Compaction	A measure of the degree of sediment imbrication and, potential mobility under normal flow conditions	1, 4	1, 2, 3,
Erosion/deposition character	*Describes trends in sediment, mobilization, transport and deposition*		
Lateral rate of adjustment	The extent and rate at which a channel can move in the river corridor	1, 2, 3,	1, 6, 8
Bar character	Size, distribution and stability of natural deposition features.	1, 2, 5	
Bedform pattern	Topography of the riverbed and bed features.	1, 4, 5	7
In-channel vegetation	*Describes the presence and distribution of vegetation features*		
Structure and extent of instream vegetation	The character and density of aquatic and terrestrial vegetation,	1, 2, 4	
Structure and extent of Woody debris	The character and density of large woody debris, linked to geomorphic structure and flow patterns	1, 2, 4, 5	1, 2, 3, 7
Continuity	*Assess artificial barriers to flow, sediment and migratory movement*		
Migratory movement	Ability of aquatic organisms to migrate freely through the channel	1, 5	
Sediment transport	The transport capacity of the channel. A measure of the competency of a channel to transport sediment.	1,	5
Floodplain connectivity	Ability of the channel to flood the adjacent land	1, 3, 5	5, 8
Banks and Riparian zone			
Bank morphology	The shape and character of the bank and presence of erosion features	1, 2, 3	8
Riparian vegetation structure	The character and density of vegetation, linked to geomorphic structure and flow patterns.	1, 2, 3, 4, 5	1, 5, 6, 8
Bank roughness	The roughness of the channel banks (includes consideration of materials and presence of vegetation).	1,	1

How does MImAS work?



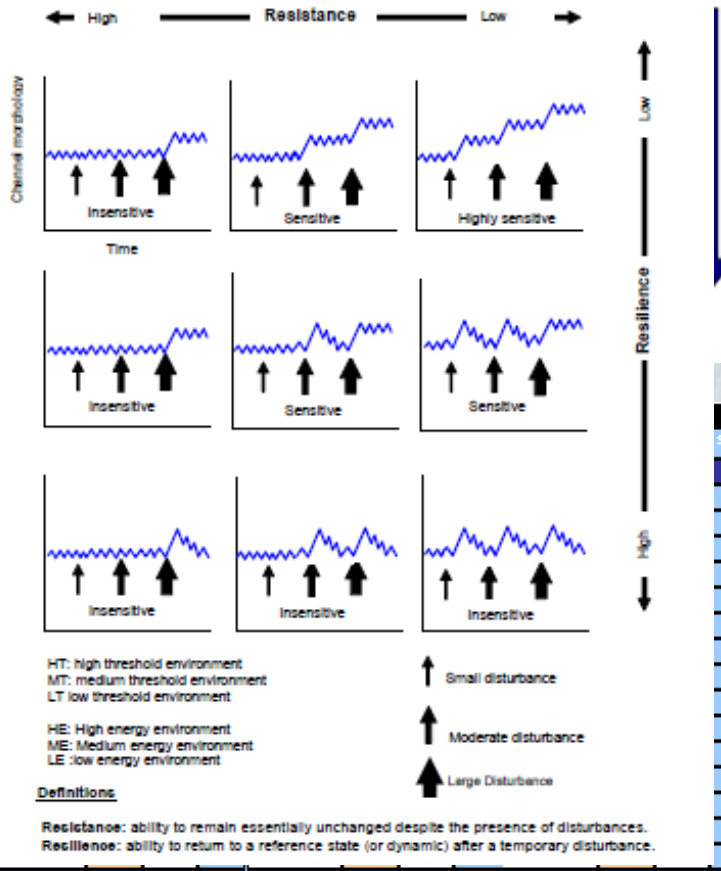
Module 2: Typology module

- Typical channel slope, sinuosity, valley confinement, dominant geology
- Type A (Bedrock, cascade)
- Type B (Step-pool, plane bed)
- Type C (Plane-riffle, braided, wandering)
- Type D (Active meandering)
- Type F (Passive meandering)

How does MImAS work?

Module 3: Sensitivity module (morphological)

- Qualitative assessment.
- Designed to underpin a simple assessment of risk posed by engineering activities.
- A range of important factors are not considered:
  - Rate of return to previous/reference state.
  - Whether a channel is close to a threshold of system change.
  - Do existing pressures make channel more sensitive to additional pressures?



Profile (Slope)	1	0	1	0	1	0.5	0.5	0.5	1	1	0.5														
Substrate condition																									
Substrate size	1	0.5	0.5	0.5	1	0.5	1	0.5	1	1	0.5														
Embeddedness	1	0.5	0.5	0.5	1	0.5	1	0.5	1	1	0.5														
Compaction	1	0.5	0.5	0.5	1	0.5	0.5	0.5	1	1	0.5														
Erosion/deposition character																									
Lateral rate of adjustment	0	0	0	0	1	0.5	0.5	0.5	1	1	0.5														
Bar character	1	0.5	0.5	0.5	1	0.5	0.5	0.5	1	1	0.5														
Bedform pattern	1	0.5	0.5	0.5	1	0.5	0.5	0.5	1	1	0.5														
In-channel vegetation																									
Structure and extent of instream vegetation	0	0	0	0	1	0.5	0.5	0.5	1	1	0.5														
Structure and extent of Woody debris	0	0.5	1	0	1	0.5	1	0.5	1	0.5	0.5														
Flow zone																									
Biotope diversity	1	0	0.5	0	1	0.5	0.5	0.5	1	1	0.5	0.5	1	1	1	1	1	1	1	1	1	0.5	0.5	0.5	
Continuity																									
Migratory movement	1	0.5	0.5	0.5	1	0.5	0.5	0.5	1	0.5	0.5	0.5	1	0.5	0.5	0.5	1	0.5	0.5	0.5	1	0.5	0.5	0.5	
Sediment transport	1	0.5	0.5	0.5	1	0.5	0.5	0.5	1	0.5	0.5	0.5	1	0.5	0.5	0.5	1	0.5	0.5	0.5	1	0.5	0.5	0.5	
Floodplain connectivity	0	0	0	0	1	0.5	1	0.5	1	1	0.5	0.5	1	1	0.5	0.5	1	1	1	1	1	0.5	1	0.5	
Banks and Riparian zone																									
Bank morphology	0	0	1	0	1	0.5	1	0.5	1	1	0.5	0.5	1	1	1	1	1	0.5	1	0.5	1	0.5	1	0.5	
Bank roughness	0	0	0	0	1	0.5	0.5	0.5	1	1	1	1	1	1	1	1	1	0.5	1	0.5	1	0.5	1	0.5	
Riparian vegetation structure	0	0.5	1	0	1	0.5	0.5	0.5	1	0.5	1	0.5	1	0.5	1	0.5	1	0.5	1	0.5	1	0.5	0.5	0.5	

How does MImAS work?

Module 3: Sensitivity module (ecological)

Ecological sensitivity
'*The risk of degradation of the intactness, integrity or naturalness of communities, or impacting on important organisms, thereby threatening ecological status.*'

Sensitivity	*Description*	
Sensitive	A moderate to large impact on a eco-geomorphic indicator of ecosystem health is likely to affect the intactness, integrity or naturalness of communities, or impact upon important organisms.	0.5
Highly sensitive	A small impact on a eco-geomorphic indicator of ecosystem health is likely to affect the intactness, integrity or naturalness of communities, or impact upon important organisms.	1.0

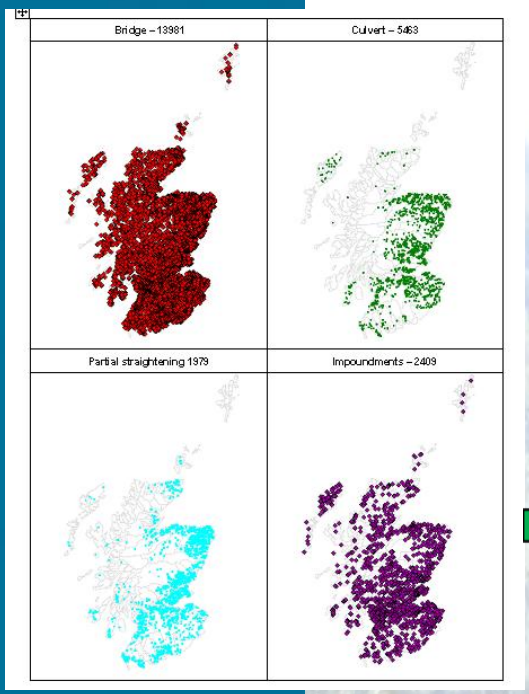
Ecological Sensitivity	Bedrock				Plane bed				Pool riffle etc			
Attribute	**HE-HT**			**A**	**HE-MT**			**B**	**ME-LT**			**C**
Channel	fish	invert	macro	tot	fish	invert	macro	tot	fish	invert	macro	tot
Hydraulic geometry												
Planform	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Cross-section	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	1.0	1.0
Slope/gradient	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Substrate condition												
Size	0.5	0.5	1.0	1.0	0.5	0.5	1.0	1.0	1.0	0.5	1.0	1.0
Compactness	0.5	0.5	1.0	1.0	0.5	0.5	1.0	1.0	1.0	0.5	1.0	1.0
Embeddedness	0.5	0.5	1.0	1.0	0.5	0.5	1.0	1.0	1.0	0.5	1.0	1.0
Erosion/deposition character												
Lateral rate of adjustment	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Bar character (Presence and form)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Bedform pattern	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	0.5	1.0
In-channel vegetation												
Structure and extent of instream vegetation *	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Structure and extent of woody debris *	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Flow												
Biotope diversity/ complexity	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	0.5	1.0	1.0
Continuity												
Migratory movement (biotic)	1.0	0.5	0.5	1.0	1.0	0.5	0.5	1.0	1.0	0.5	0.5	1.0
Sediment transport	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Floodplain connectivity	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Banks and Riparian zone vegetation												
Bank geometry/form	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Bank roughness/vegetation	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Structure and extent of riparian vegetation *	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	1.0

- Ecological sensitivity is channel type-specific, not pressure specific.
- When considering impact to eco-geomorphic attributes:
  - Direction of change not considered.
  - Only whether change has occurred or not.
- What is the likelihood that a change in the eco-geomorphic attribute, irrespective of its cause, impacts fish, macrophytes and macroinvertebrates?
- All sensitivities set to '*Sensitive*' unless two or more ecologists agreed that '*Highly sensitive*' was appropriate.

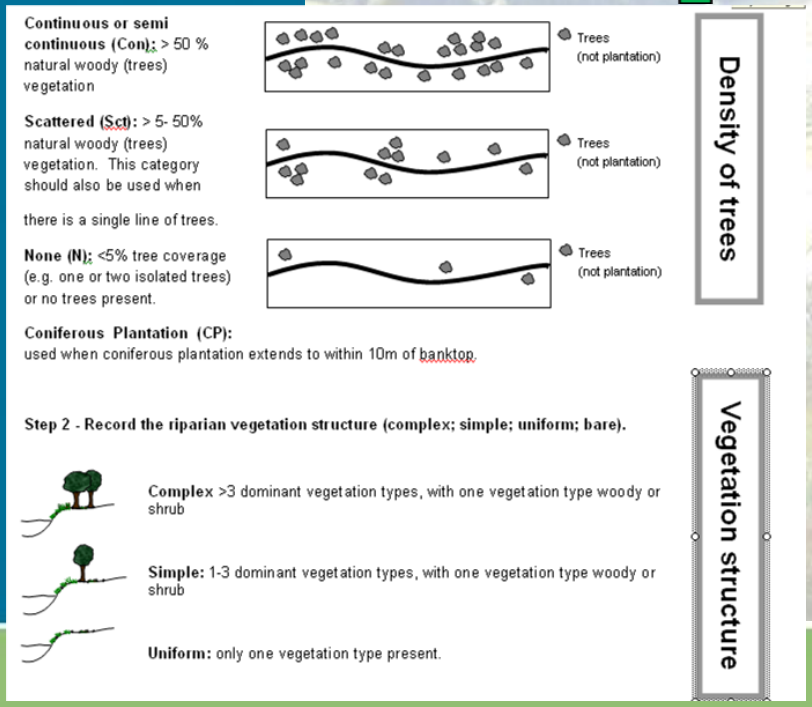
How does MImAS work?

Module 4: Pressure module (impact assessment procedure)

- Likelihood of impact?
- Pressure specific, not type specific



Impact class	*Definition*	
Likely	In most cases, this activity will result in an impact on a eco-geomorphic indicator.	1.0
Possible	In some cases, this activity will result in an impact on a eco-geomorphic indicator	0.5
Unlikely	In most cases, this activity will not result in an impact on a eco-geomorphic indicator	0.0



How does MImAS work?

Module 4: Pressure module (impact assessment procedure)

- Likelihood of impact?
- Pressure specific, not type specific
- Zone of impact

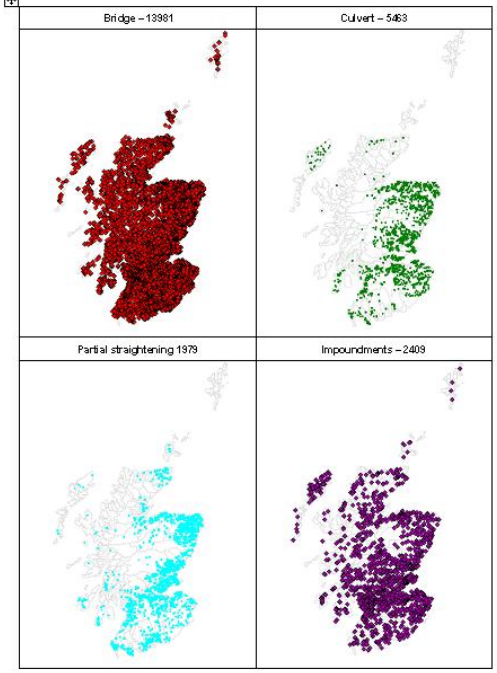
Impact class	*Definition*	
Likely	In most cases, this activity will result in an impact on a eco-geomorphic indicator.	**1.0**
Possible	In some cases, this activity will result in an impact on a eco-geomorphic indicator	**0.5**
Unlikely	In most cases, this activity will not result in an impact on a eco-geomorphic indicator	**0.0**

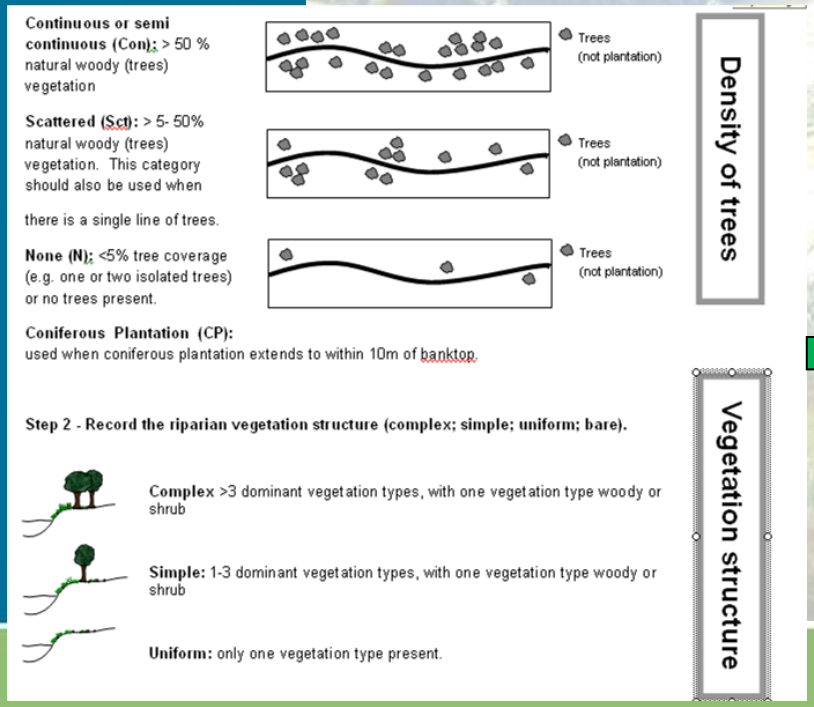
	Dredging	Embankment	Hard bank protection	Riparian Vegetation removal	Culverts	realignment	partly recovered realignment	Bed reinforcement (inc fords)
Channel								
Hydraulic geometry								
Planform	0.50	1.00	0.50	0.00	1	1.00	0.50	0.50
Cross-section	1.00	1.00	1.00	0.50	1	1.00	0.50	1.00
Slope/gradient	1.00	1.00	0.50	0.00	1	1.00	0.50	1.00
Substrate condition								
Size	1.00	1.00	0.50	0.50	1	1.00	0.00	1.00
Compactness	1.00	1.00	0.50	0.50	1	1.00	0.50	1.00
Embeddedness	1.00	0.50	0.50	0.50	1	1.00	0.50	1.00
Erosion/deposition character								
Lateral rate of adjustment	0.50	1.00	1.00	0.50	1	1.00	0.00	1.00
Bar character (Presence and form)	1.00	1.00	0.50	0.00	1	1.00	0.50	1.00
Bedform pattern	1.00	1.00	0.50	0.00	1	1.00	0.50	1.00
In-channel vegetation								
Structure and extent of instream vegetation *	1.00	1.00	0.50	0.00	1	1.00	0.50	1.00
Structure and extent of woody debris *	1.00	0.50	0.50	0.00	1	1.00	0.50	1.00
Flow								
Biotope diversity/ complexity	1.00	1.00	0.50	0.50	1	1.00	0.50	1.00
Continuity								
Migratory movement (biotic)	1.00	1.00	0.50	0.00	1	0.50	0.00	0.50
Sediment transport	1.00	1.00	0.50	0.00	1	1.00	0.50	1.00
Floodplain connectivity	1.00	1.00	0.50	0.00	1	1.00	0.50	0.50
Banks and Riparian zone vegetation								
Bank geometry/form	1.00	1.00	1.00	0.50	1	1.00	0.50	0.50
Bank roughness/vegetation	1.00	1.00	1.00	0.50	1	1.00	0.00	0.00
Structure and extent of riparian vegetation *	0.50	1.00	1.00	0.50	1	1.00	0.50	0.50

How does MImAS work?

Module 4: Pressure module (impact assessment procedure)

- Likelihood of impact?
- Pressure specific, not type specific
- **Zone of impact**





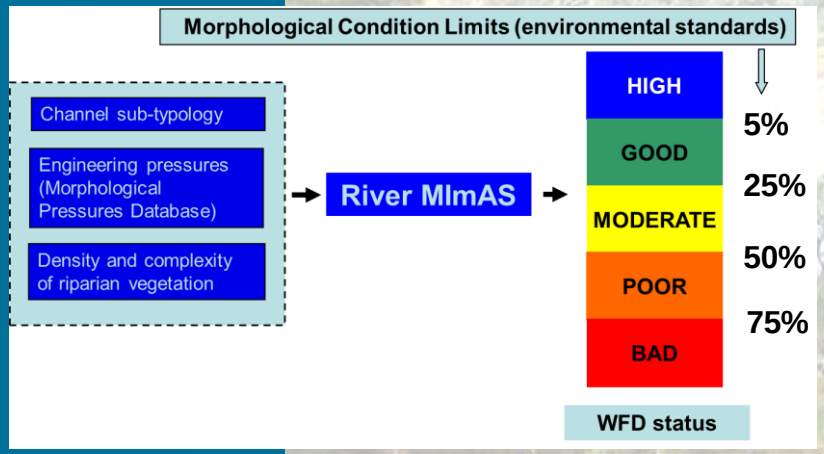
	Zones	
Attribute	**Channel**	**Banks and Riparian vegetation**
Sediment Removal	2	1
Sediment Manipulation	1.5	1
Dredging	2	1.5
Riparian Vegetation Loss	1.5	1.5
Embankment	2	1.5
Set Back Embankment	1	1
Hard Bank Protection	1.5	1.5
Soft Bank Protection	1.5	1.5
Bank Reprofiling	1.5	1.5
Straightening	2	2
Realignment Partly Recovered	1.5	1.5
Flood Bypass	1.5	1.5
Culverts	2	2
Croys/Flow Deflectors	1.5	1.5
Bed Reinforcement	2	1.5
Weirs	2	2
Artifical Substrate	1	1
Bridge Piers	1.5	1
Hydro Regime EXT Modified	1	1
Sediment Regime EXT Modified	1	1
zones are a multiple of length of activity		

How does MImAS work?

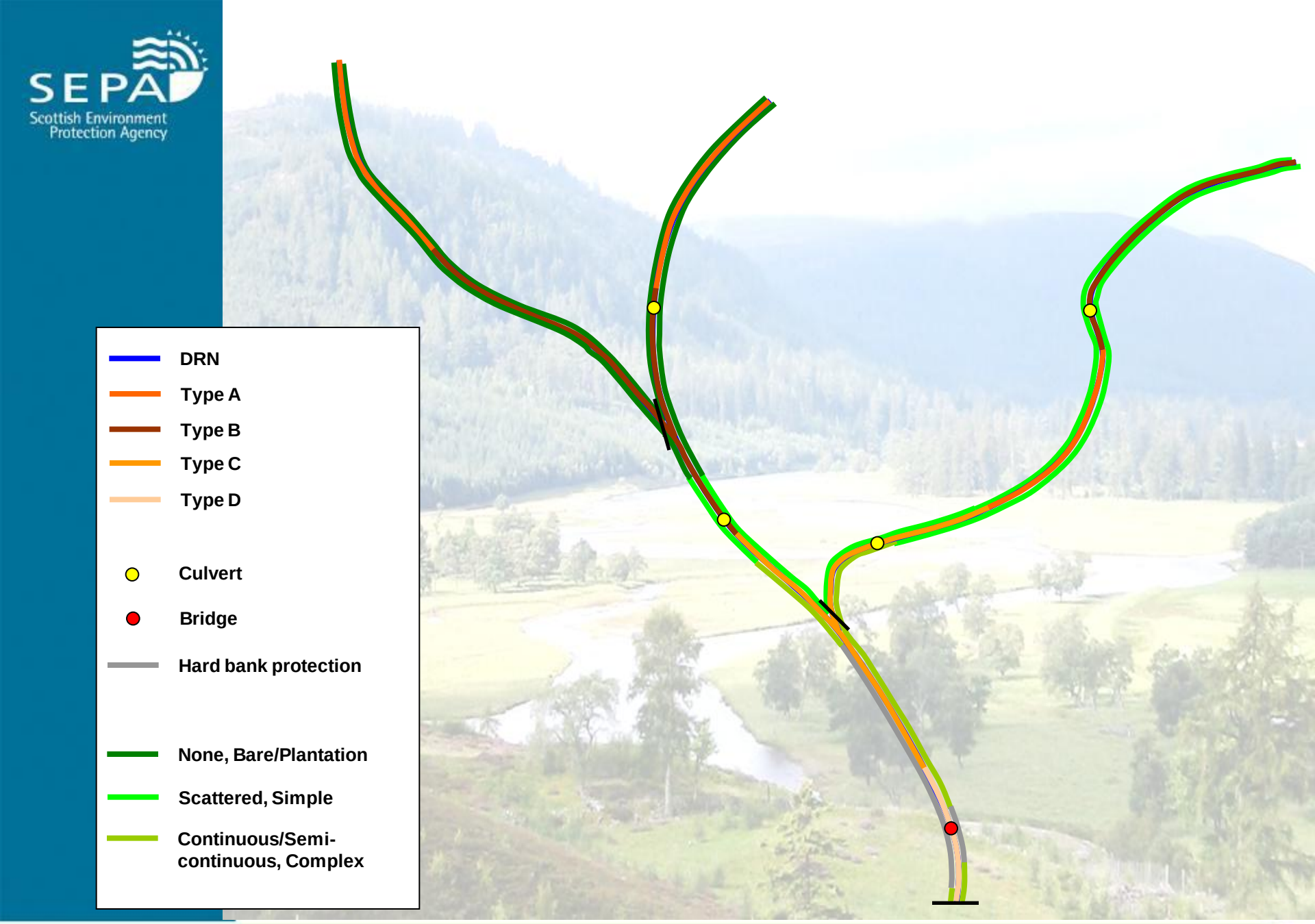
Module 5: Scoring module

$$\text{Impact rating} = \left(\text{Ecological sensitivity} \times \text{Morphological sensitivity} \times \text{Likelihood of impact} \times \text{Zone of impact}\right)$$

$$\text{Capacity used} = \left(\frac{\text{Impact Rating} \times \text{Pressure Footprint}}{\text{Water body length}}\right)$$



Morphological alteration	*River types to which the morphological conditions apply*					
	A	B	C	D	E	F
Set-back embankment	0	0	0	0	0	0
Embankment	0	0.38	0.75	0.63	0.38	0.38
Condition of Riparian (bankside) vegetation	0	0-0.19	0.02-0.31	0.02-0.31	0.01-0.19	0.01-0.19
Soft (or green) bank reinforcement	0	0.19	0.31	0.31	0.19	0.19
Hard (or grey) bank reinforcement	0	0.38	0.75	0.63	0.38	0.38
Culvert with natural bed (e.g. arch culvert)	0	0.50	1.00	0.83	0.5	0.50
Pipe or Box culvert	0	0.50	1.00	0.83	0.50	0.50
Sediment removal	0	0	0	0	0	0
Dredging	0	0.31	0.50	0.56	0.31	0.31
Bed reinforcement	0	0.13	0.25	0.19	0.13	0.13
Croys or groynes or other flow deflectors	0	0.38	0.75	0.63	0.38	0.38
Piled structures (including bridge piers)	0	0.08	0.17	0.17	0.08	0.08
Impoundments	0	0.33	0.67	0.58	0.33	0.33
High impact channel realignment	0	0.50	1.00	0.83	0.5	0.50
Low impact channel realignment	0	0.13	0.19	0.19	0.13	0.13
Where a range is given, UK agencies would apply a score that falls within the range and, which in the opinion of the agency, reflects the severity of the alteration.						


DRN
Type A
Type B
Type C
Type D
Culvert
Bridge
Hard bank protection
None, Bare/Plantation
Scattered, Simple
Continuous/Semi-continuous, Complex

River MImAS results

WB	Zone	Activity	Activity Impact (%)	Total Impact (%)	Zone	Activity	Activity Impact (%)	Total Impact (%)
3000	Channel	Embankments and Floodwalls no Bank Reinforcer	47.42	63.86	Banks and Riparian	Embankments and Floodwalls no Bank Reinforcement	22.25	36.72
3000	Channel	Low Impact Channel Realignment	5.75	63.86	Banks and Riparian	Low Impact Channel Realignment	3.32	36.72
3000	Channel	Riparian Vegetation	4.44	63.86	Banks and Riparian	Riparian Vegetation	6.07	36.72
3000	Channel	Green Bank Reinforcement and Bank Reprofiling	2.63	63.86	Banks and Riparian	Green Bank Reinforcement and Bank Reprofiling	3.51	36.72
3000	Channel	Set Back Embankments and Floodwalls	1.15	63.86	Banks and Riparian	Set Back Embankments and Floodwalls	0	36.72
3000	Channel	Impoundments	1.12	63.86	Banks and Riparian	Impoundments	0.36	36.72
3000	Channel	Grey Bank Reinforcement	0.54	63.86	Banks and Riparian	Grey Bank Reinforcement	0.54	36.72
3000	Channel	Bridges	0.42	63.86	Banks and Riparian	Bridges	0.41	36.72
3000	Channel	Pipe and Box Culverts	0.28	63.86	Banks and Riparian	Pipe and Box Culverts	0.15	36.72
3000	Channel	Intakes + Outfalls	0.12	63.86	Banks and Riparian	Intakes + Outfalls	0.11	36.72
3001	Channel	Impoundments	6.19	22.03	Banks and Riparian	Impoundments	2.29	14.74
3001	Channel	High Impact Channel Realignment	5.04	22.03	Banks and Riparian	High Impact Channel Realignment	3.17	14.74
3001	Channel	Embankments and Floodwalls no Bank Reinforcer	4.17	22.03	Banks and Riparian	Embankments and Floodwalls no Bank Reinforcement	1.94	14.74
3001	Channel	Riparian Vegetation	3.29	22.03	Banks and Riparian	Riparian Vegetation	4.31	14.74
3001	Channel	Grey Bank Reinforcement	2.13	22.03	Banks and Riparian	Grey Bank Reinforcement	2.13	14.74
3001	Channel	Bridges	0.71	22.03	Banks and Riparian	Bridges	0.68	14.74
3001	Channel	Set Back Embankments and Floodwalls	0.31	22.03	Banks and Riparian	Set Back Embankments and Floodwalls	0	14.74
3001	Channel	Green Bank Reinforcement and Bank Reprofiling	0.1	22.03	Banks and Riparian	Green Bank Reinforcement and Bank Reprofiling	0.14	14.74
3001	Channel	Intakes + Outfalls	0.09	22.03	Banks and Riparian	Intakes + Outfalls	0.09	14.74

MImAS validation

- Ascertain suitability of the H-G & G-M MCLs.
- 90 500m reaches assessed.
- Bank protection, weirs, culverts, embankments, realignment & dredging.
- Sites chosen to span the five status classes and six channel types, with morphological & biological data if possible.
- 77% sites agree; 94.5% within one class.
- SEPA assessment of H-G boundary (5%) for water body scale assessment suggests it's about right (4%).

Status	Description
High Status channels	The suite of eco-geomorphic attributes typical of that channel type should be present or abundant within a 500 metre reach. In essence we suggest that 90% of all features should be present or abundant for the river to be deemed of High Morphological Status. It is important for rivers of High Morphological (and ecological) Status to have both banks and the river bed intact. It is important that in the case of pool-riffle and step-pool channels a series of features are present and that individual geomorphic features are not present in isolation.
Good Status channels	The suite of eco-geomorphic attributes typical of that channel type should be present or abundant within a 500 metre reach. In essence we suggest that 75% of all features should be present or abundant for the river to be deemed of Good Morphological Status. It is important for rivers of Good Morphological/ecological Status to have at least one of the banks and the river bed intact. In the case of actively migrating channel types the intact bank should be the one undergoing natural erosion and any bank protection on the opposite bank not preventing deposition. It is important that in the case of pool-riffle and step-pool channels a series of features are present and that individual geomorphic features are not present in isolation.
Moderate Status channels	The majority of the suite of eco-geomorphic attributes typical of that channel type should be present within a 500 metre reach. In essence we suggest that over 50% of all features should be present for the river to be deemed of Moderate Morphological/ecological Status. It is important for rivers of Moderate Morphological Status to have at least one of the banks and the river bed intact.
Poor Status channels	Should maintain elements of the natural channel type such as a gravel bed and natural banks but engineering works have resulted in one of the following: the natural process of sediment transport being significantly altered, the natural flow hydraulics being fairly uniform and hence the natural processes of erosion, sediment transport and deposition so altered as to not create the range of features one would expect to be present. In such cases it is likely that only 25-50% of features that you would expect to be present are actually observed.
Bad Status channels	Will occur where the natural process of sediment transport have been significantly altered, so that the natural flow hydraulics have been modified to the extent that the processes of erosion, sediment transport and deposition do not create the range of features one would expect to be present. In such cases it is likely that only 0-50% of features that you would expect to be present are actually observed. Typically this will be due to either both banks being artificial, the river channel being artificially straight or the bed heavily modified.

Table 5 - The proportion of sites the model has accurately predicted.

		Sites in category	Number predicted correctly	Percentage correct
Morphological/ ecological status	High	6	6	100
	Good	30	18	60
	Less than good	54	48	89

Level of Agreement	Number	Percentage (%)
MImAS less sensitive -2 class	5	5.5
MImAS less sensitive to pressures- 1 class*	13	14
MImAS agrees with professional judgment	**69**	**77**
MImAS more sensitive to pressures- 1 class	3	3.5
MImAS more sensitive- 2 class	0	0

How can we improve MImAS?

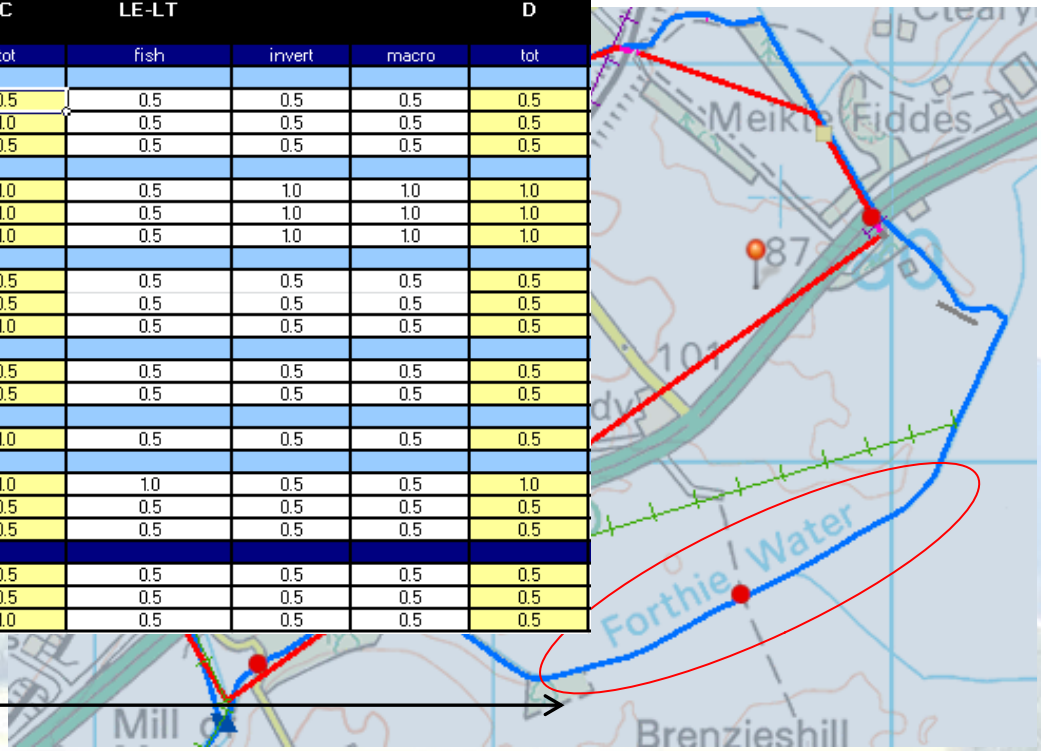
Input data

- Altitude threshold for tree growth.
- <GES field surveys
  - MImAS data
  - ST:REAM reaches
  - Indicators data
- Improved typology allocation.
- CLAS-MPD link.
- New pressure categories
  - Sediment discontinuity d/s from dams.
  - Livestock poaching.
  - Intensive catchment land use.

Inner workings

- River scale-sensitive assessments
  - Accounting for lost habitat area? (*Role for fish data?*)
- Arbitrary effect of water body length.
- Double-counting of pressure impacts.
- Empirical calibration of impact ratings – pressure-response R&D. (*Role for fish data?*)
  - Monitoring restoration projects at:
    - Four pilot catchments
    - Eddleston Water
    - Rottal Burn
  - University of Southampton SEM
- Revisions to impact ratings:
  - Boost weighting of rip veg
  - Greater flexibility for realignments & dredging

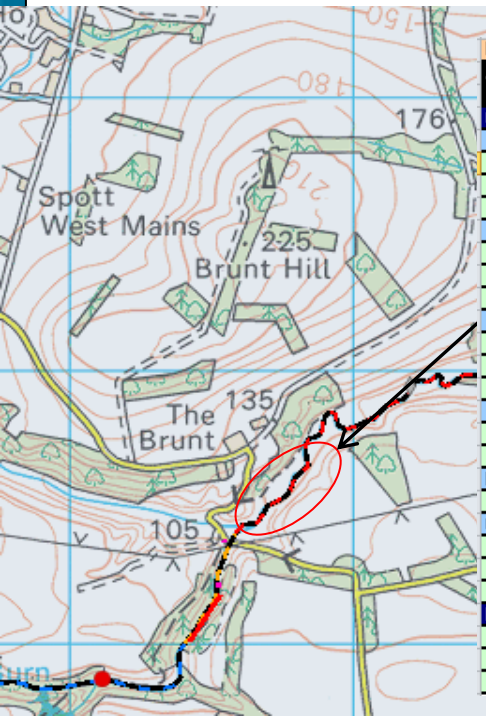
Ecological Sensitivity	Pool riffle etc				Active meandering			
Attribute	ME-LT			C	LE-LT			D
Channel	fish	invert	macro	tot	fish	invert	macro	tot
Hydraulic geometry								
Planform	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Cross-section	1.0	0.5	1.0	1.0	0.5	0.5	0.5	0.5
Slope/gradient	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Substrate condition								
Size	1.0	0.5	1.0	1.0	0.5	1.0	1.0	1.0
Compactness	1.0	0.5	1.0	1.0	0.5	1.0	1.0	1.0
Embeddedness	1.0	0.5	1.0	1.0	0.5	1.0	1.0	1.0
Erosion/deposition character								
Lateral rate of adjustment	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Bar character (Presence and form)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Bedform pattern	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5
In-channel vegetation								
Structure and extent of instream vegetation *	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Structure and extent of woody debris *	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Flow								
Biotope diversity/ complexity	1.0	0.5	1.0	1.0	0.5	0.5	0.5	0.5
Continuity								
Migratory movement (biotic)	1.0	0.5	0.5	1.0	1.0	0.5	0.5	1.0
Sediment transport	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Floodplain connectivity	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Banks and Riparian zone vegetation								
Bank geometry/form	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Bank roughness/vegetation	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Structure and extent of riparian vegetation *	0.5	0.5	1.0	1.0	0.5	0.5	0.5	0.5



- 23263 Forthie Water (summer 2014).
- Original channel type probably actively meandering.
- Bad status for morphology.

Example 2

- 3902 Dry Burn (September 2008).
- Original channel type probably actively meandering.
- WB moderate status for morphology (reach at Good).



Ecological Sensitivity	Pool riffle etc				Active meandering			
Attribute	ME-LT			C	LE-LT			D
Channel	fish	invert	macro	tot	fish	invert	macro	tot
Hydraulic geometry								
Planform	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Cross-section	1.0	0.5	1.0	1.0	0.5	0.5	0.5	0.5
Slope/gradient	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Substrate condition								
Size	1.0	0.5	1.0	1.0	0.5	1.0	1.0	1.0
Compactness	1.0	0.5	1.0	1.0	0.5	1.0	1.0	1.0
Embeddedness	1.0	0.5	1.0	1.0	0.5	1.0	1.0	1.0
Erosion/deposition character								
Lateral rate of adjustment	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Bar character (Presence and form)	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Bedform pattern	1.0	0.5	0.5	1.0	0.5	0.5	0.5	0.5
In-channel vegetation								
Structure and extent of instream vegetation *	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Structure and extent of woody debris *	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Flow								
Biotope diversity/ complexity	1.0	0.5	1.0	1.0	0.5	0.5	0.5	0.5
Continuity								
Migratory movement (biotic)	1.0	0.5	0.5	1.0	1.0	0.5	0.5	1.0
Sediment transport	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Floodplain connectivity	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Banks and Riparian zone vegetation								
Bank geometry/form	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Bank roughness/vegetation	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Structure and extent of riparian vegetation *	0.5	0.5	1.0	1.0	0.5	0.5	0.5	0.5

Some discussion points

- How might fish (plant or insect) data be used to improve the ecological sensitivity assessment?
- How might we develop an ecologically meaningful assessment of lost habitat *area*?