Freshwater Morphological Assessment in Rivers

Comparative Studies of Morphological Fieldwork Techniques

Outcome Report – April 2007

Final Draft

shannon
river basin district

neagh bann
international
river basin district
North South Shared Aquatic Resource (NS SHARE)

north eastern
river basin district
North South Shared Aquatic Resource (NS SHARE)

north western
international
river basin district
North South Shared Aquatic Resource (NS SHARE)

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REVISION CONTROL TABLE					
Rev.	**Description of Changes**	**Prepared by**	**Checked by**	**Approved by**	**Date**
0	Issued for comment	LH	GG	AGB	16.05.07
1	Steering Gp Comments Addressed	LH	GG	AGB	25.06.07
The User is Responsible for Checking the Revision Status of this Document					

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GLOSSARY OF TERMS

EHS	Environment and Heritage Service (NI)
EPA	Environmental Protection Agency (RoI)
EU	European Union
GQA	General Quality Assessment
HMWB	Heavily Modified Water Body (pHMWB indicates provisional HMWB)
IRBD	International River Basin District
MImAS	Morphological Impact Assessment System
NI	Northern Ireland
NS SHARE	North- South Shared Aquatic Resource Project
R.A.T	Rapid Assessment Technique
RBD	River Basin District
RHS	River Habitat Survey
RoI	Republic of Ireland
SEPA	Scottish Environmental Protection Agency
SHIRBD	Shannon International River Basin District
SNIFFER	Scotland and Northern Ireland Forum for Environmental Research
WFD	Water Framework Directive

1.0 Introduction

In the Republic of Ireland and Northern Ireland, monitoring of the morphological condition of rivers is a relatively new area. Since 2005, Environment Agency's River Habitat Survey (RHS) has been used by the Environment and Heritage Service (EHS) in Northern Ireland (NI) to monitor the physical condition of rivers. The results have been added to the Environment Agency's database. River morphology has not been systematically monitored in Republic of Ireland's (RoI's) rivers to date.

The Water Framework Directive (WFD) presents a need for classification of rivers in terms of morphology and also a possible need for regulation of engineering activities on rivers to ensure there is no deterioration of water body status. Figure 1 illustrates the role of hydromorphological elements in determining ecological status according to the WFD.

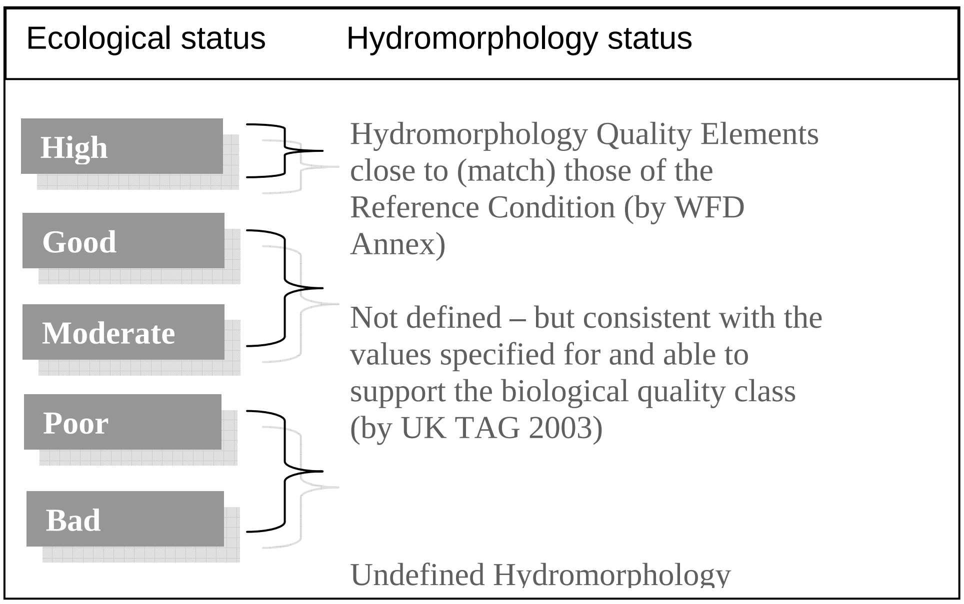

Figure 1: Hydromorphological elements contribution to 'ecological status'

For a site to achieve high ecological status, it must also have morphological status close to or matching that of reference condition.

Three monitoring types are required within WFD; surveillance, operational and investigative monitoring where necessary. The expectation for surveillance monitoring is that biological, hydromorphological and all general and specific physico-chemical quality elements are required to be monitored.

At good and moderate ecological status the hydromorphological elements should be capable of supporting the biological quality class. The WFD allows non-biological parameters to be monitored where these indicate the biological quality elements. (GeoData, 2007).

Hydromorphology may also help in determining the sampling strategy, to identify the range of river types within the waterbody and provide a representative assessment and basis for extrapolation (GeoData, 2007).

In the light of these requirements a morphological assessment methodology must be established both in NI and RoI, not only to classify rivers in terms of morphological status, but also to manage morphological change brought about by human activity so that deterioration in status can be prevented. Further Characterisation is a WFD requirement which follows the initial Pressures and Impacts Analyses of waterbodies carried out in 2004/'05 under Article 5. The aim of Further Characterisation is to resolve the uncertainties associated with the initial risk assessment of surface and groundwater bodies.

In NI and RoI, the uncertainties associated with freshwater morphology are being addressed through specific Further Characterisation studies being undertaken by the NS SHARE project and the Shannon RBD project. It is considered that a harmonised approach between each jurisdiction is preferable and in keeping with WFD.

Both Freshwater Morphology Further Characterisation studies have two main objectives:

1. To refine risk assessment thresholds with respect to 2 key morphological pressures; intensive land use and channelisation so that the uncertainties identified in the Article 5 risk assessment can be resolved

2. To develop a management response framework for regulators - so that morphological change to rivers can be monitored for classification and/or regulatory purposes.

In meeting these objectives a morphological assessment methodology must be established that can meet the following requirements:

- **Refine morphological thresholds applied to rivers so that the uncertainties with the Article 5 risk assessment can be resolved**

- **Enable NI and RoI agencies to monitor and classify rivers in terms of morphology supporting the biological elements so that ecological status can be defined**

- **Manage and track morphological status so that waterbody status deterioration can be prevented**

The CEN standard (CEN 2004) 14614 objective to set standards for measuring departure from natural is not strictly linked to ecological status assessments, but to the degree of modification. Therefore it is important that morphological change over time is monitored.

This outcome report summarises the work that has been undertaken to date through the NS SHARE project and the Shannon RBD project in assessing morphological field assessment techniques and how they can be applied to RoI and NI rivers to meet these requirements.

The results and findings have been combined to present recommendations that can be applied to both NI and RoI in a harmonised solution. The EHS and GeoData reports are listed in Chapter 9.0.

2.0 Background

Two of the morphological assessment techniques developed for WFD purposes in the UK are:

- Morphological Impact Assessment Technique (MImAS) – developed by SNIFFER and currently used within SEPA's Controlled Activities Regulations
- Rapid Assessment Technique (R.A.T) – developed through the North South Shared Aquatic Resource (NS SHARE) project as a method for assessing the hydromorphology of rivers.

MImAS is an impact assessment tool to support river engineering regulatory decisions and classification. The term MImAS refers to an overall assessment procedure which includes a field survey to collect pressure data where needed. Both the channel zone and riparian zone are assessed separately in terms of the river's capacity to accept further morphological change.

R.A.T is a field technique which assigns a classification for a waterbody based on the departure from reference condition for the channel type. Channel typology influences the attributes assessed in the field. The technique assigns a morphological classification directly related to that of WFD – high, good, moderate, poor and bad.

A third morphological assessment technique currently used in the UK is the River Habitat Survey (RHS). The attained scores do not equate to the WFD status classes, but record the level of modifications based on inventories of features (GeoData, 2007).

National comparative studies encompassing the trialling of these techniques were initiated in 2006 by the NS SHARE project and EHS in NI; and the Shannon RBD Project in RoI under WFD Further Characterisation for freshwater morphology. The main aim of each Comparative Study was to trial each technique in terms of the results they produce, their ease of implementation in the field, and their ability to be rolled out on a national basis within each jurisdiction in an overall morphological assessment methodology.

3.0 Comparative Studies in RoI and NI

3.1 Overview of Methodology

The Comparative Studies in NI and RoI were facilitated through the mechanisms indicated by Table 1:

Table 1: Comparative Study Mechanisms

Type	**Item**	**Description**
Field Assessment and Data Collection:	Field Surveys of 20 river sites in RoI - morphological assessment trials using MImAS, R.A.T and RHS (GeoData Ltd)	GeoData undertook MImAS, R.A.T and RHS surveys at each river site (refer to Table 2)
	Field Surveys of 69 river sites in NI – morphological assessment trials using MImAS, R.A.T and RHS (EHS)	EHS and GeoData undertook MImAS, R.A.T and RHS surveys at each river site (refer to Table 3)
	Biological Data Collection (Macroinvertebrates)	1.Collection of EPA Q values for each site, 1990 – 2005 (refer to Appendix A) 2.Collection of EHS, GQA values for each NI site, 2002 - 2006(refer to Appendix A) 3.Shannon RBD and NS SHARE project staff undertook biological Q surveys at each RoI river site to obtain 2006 dataset
Expert Judgement using Desktop Assessment:	<u>Expert Group 1:</u> UK based Fluvial Geomorphologists Assessment of a subset of 20no. river sites using desktop datasets	Provision of secondary desktop datasets and field assessment sheets to 4no. Fluvial Geomorphologists. Field results obtained using R.A.T and MImAS surveys were not provided i.e. blind trial
	<u>Expert Group 2:</u> RoI and NI based river management experts Assessment of same subset of 20no. river sites using desktop datasets	Freshwater Morphology Workshop, March 2007. Provision of secondary datasets and field assessment sheet to river management experts in RoI and NI Field results obtained using R.A.T and MImAS surveys were not provided i.e. blind trial
Expert Opinion	Forum to discuss the field techniques, overall morphological assessment process with respect to application in RoI and NI	Freshwater Morphology Workshop, March 2007 On site demonstrations of MImAS and R.A.T

The expert judgement desktop assessments were undertaken on a subset of 20 sites (10 from NI and 10 from RoI) using the secondary datasets listed in Table 2.

Table 2: Datasets used in Desktop Assessments

Dataset	Description
Article 5 risk assessment report	A report indicating the Article 5 risk assessment results for the waterbody within which the site is located. The results for abstraction, morphology, diffuse pollution, and point source pollution pressures are summarised.
Site Maps	Ordnance Survey image indicating site location and surrounding landscape.
Historical Mapping	Image showing 1st Edition 6" series mapping of the mid 19th century
Site Ortho-photos	Low detail aerial photos of the site.
Site Ground Photos	Photographs taken on the site showing upstream and downstream views and significant features.
Site Metrics (& Geology)	Site Altitude Distance from Source Altitude at Source Slope Stream Link Magnitude Geology (if available)
Site Biology Data	RoI – Environmental Protection Agency's biological quality results at the site (Q Assessments) NI – Environment and Heritage Service's biological quality results (General Quality Assessment, GQA)
Land Use Information	General land use types within the vicinity of the site taken from the CORINE Land Cover map 2000 datasets and from site visits. Site specific land use information
Digital Terrain Model	Image indicating the topography within the vicinity of the site and the location of the site within its river network
GIS Layers	Ordnance Survey Tile (if available) Historical Mapping Tile River Polylines Site Location Geology layer (if available)

The desk based assessments were undertaken by completing a standard site assessment form as included in Appendix B.

A Freshwater Morphology workshop was held in Enniskillen, Co. Fermanagh on 6th and 7th March 2007. The workshop was attended by 32 river management experts from NI and RoI including Rivers Agency, Central Fisheries Board, Department of Communications Marine and Natural Resources (DCMNR), Marine Institute, Loughs Agency, EHS, EPA and Queen's University Belfast. The same desk top assessment was completed in working groups for each of the 20 sites.

Expert opinion on morphological assessment was recorded at the workshop discussion sessions. In addition site visits were held to demonstrate how MImAS and R.A.T are conducted in the field. This also generated comments from the workshop delegates which have been taken into account in the recommendations.

3.2 Sites Surveyed

The sites surveyed using R.A.T and MImAS are indicated by Tables 3 and 4:

Table 3: RoI Sites Surveyed by GeoData

SITE ID	RIVER
G3	Goulaun
G4	Srahmore
G1	Owenbrin
G2	Owenbrin
D2	Caher (CE)
D3	Caher (CE)
B7	Recess
B6	Glendavock
E5	Owenglin
D1	Owenduff (Blacksod)
C8	Carroward
C4	Glenree
C1	Bonet
C2	Cashel St (Bonet)
E2	Eanymore Water
A3	Eglish
A2	Lowerymore
A4	Oily
H12	Clady (DL)
H13	Glentornan

Table 4: NI Sites Surveyed by EHS / GeoData

SITE ID	RIVER	SITE ID	RIVER
DEG10	River Derg Upper	**GFF10**	Glenariff River
GVR10	Garvary River	**BUS06a**	Bush
GLK10	Glenlark River	**GMK10**	Glenmakeeran River
BAA10	Bannagh River	**TOW11**	Tow
ROO10	Roogagh	**GSK12**	Glenshesk
BDT10	Dunnyboe burn	**CRY11**	Carey
CLH10	Claggagh River	**BBR10**	Bloody Bridge River
COL14	Colebrooke	**SNS10**	Spences River
TEM10	termon River	**KKR10**	Kilkeel River
BLK12	Fury River	**AHM10**	Aughrim River
LUG10	Lurgan	**TWW12**	The White water
ROE10	Roe	**MAI10**	Main River
ALT10	Altanakan Burn	**EHSNI10**	Doughery Water
WFT12	Waterfoot River	**EHSNI11**	Doughery Water
KIL10	Kilbroney river	**EHSNI8**	Glencurry Burn
MOY10	Moyola River	**EHSNI9**	Glenscollip Burn
KIN10	Kinnahalla River	**EHSNI1**	Agivey
LIS10	Lissan water	**EHSNI2**	Agivey
CAM10	Cam burn	**EHSNI12**	Annalong
AGV10	Agivey River	**EHSNI13**	Annalong
STO10	Stonyford River	**EHSNI15**	Blackwater
CYE10	Clanrye River	**EHSNI14**	Callan
CYE12	Clanrye River	**EHSNI6**	Clady
NWYR10	Jerrettspass River	**EHSNI3**	Dervock
NWYR11	Newry River Tributary	**EHSNI4**	Dervock
CTY10	County Water	**EHSNI5**	Faughan
CGG10	Creggan River	**EHSNI7**	Pollen
CYW10	Cully Water	**KCU10**	Kilcurry River
KST10	Kilnasaggart	**SHI12_01**	Shimna River
COR10	Cor Water	**ACY10**	Annacloy River
TYN10	Tynan River	**GDN10**	Glendun River
BTH10	Balteagh	**BON10**	Ballyemon River
MBLK10	Monaghan Blackwater River	**GFF12**	Essathoham
BLK10	Ballymortrim	**LAR10**	Larne
BLK11	Blackwater	**CAL11**	Callan River Lower
CAL10	Butter Water	**CAL03**	Callan RiverUpper

4.0 Comparison of morphological assessment field techniques in terms of facilitating simple and rapid classification of rivers to support WFD

Morphology Fieldwork took place during 2006 as follows:

1. EHS – Survey of 57 river sites during 2006 within NI looking at a range of sites identified as “probably at risk” or “probably not at risk” due to morphological pressures in the Article 5 Pressures and Impacts analysis.
2. GeoData – Survey of 32 sites during a 2 week period in October 2006 within RoI and NI looking at a range of waterbodies including those “probably at risk” due to channelisation and intensive land use pressures (including overgrazing) and high quality river sites.

The Rapid Assessment Technique (R.A.T), MImAS and River Habitat Survey (RHS) were undertaken at each site.

On site demonstrations were undertaken by GeoData and EHS at two river sites as part of the Freshwater Morphology workshop held in March 2007. River management experts from RoI and NI attended the site visits and were asked for their opinion on the field methodology, the field sheets to be completed and the features recorded. A range of experts from fisheries agencies, EPA, EHS, OPW, Rivers Agency and Environment Agency (UK) were present.

The MImAS and R.A.T field survey sheets are included in Appendix C.

4.1 Findings

It is clear that the three techniques differ in their approach and original design objectives.

- R.A.T was specifically developed through the North South Shared Aquatic Resource Project (NS SHARE) to assess status to WFD classes for Irish Rivers.
- MImAS, developed by the Scottish Environment Protection Agency (SEPA), was developed within the context of engineering regulations to assess quality of channel and riparian zones separately.
- RHS is the most established system with a broad range of conservation and river management applications derived from multiple, mostly physical attributes.

Comparison of key features for the three survey methodologies in the field are summarised in Tables 5 and 6.

Table 5: Comparison of RHS, R.A.T and MImAS field methodologies (GeoData, 2007)

Feature	Survey Methodology		
	R.A.T	**MImAS**	**RHS**
Form design	Simple	Intermediate	Complex
Survey speed (form only)	Fast (<5 mins)	Moderate (~ 30 mins)	Slow (~40 mins)
Survey style	Continuous	Stop - start	Stop - start
Survey length	Variable (<500m) based on channel width multiplier	Fixed (500m)	Fixed (500m)
Survey flexibility	Flexible	Inflexible - must start at downstream end	Flexible
Experienced required for survey	Expert	High	High (surveyor must be accredited for acceptance into RHS)
Detail captured by survey	Low (only records scores not features)	High	Very high
Locates specific features	Poor – only when the surveyor chooses to note it.	Precise locations and size of features captured with GPS[†]	Locates features at the 500m reach level or when feature coincides with a spot check.
When access to site is not possible	Form allows you to shade out cells and note.	Form provides no ‘not visible’ record	Flexible – codes allow record of ‘not visible’
Quality of Survey manual provided	Moderate	Good	Excellent
Survey period	Not limited	Not limited	Summer

Table 6: Objectives / Uses of each Survey Technique (GeoData, 2007)

Objectives / Uses	Survey technique		
	R.A.T	MImAS	RHS
WFD Class			
Developed for WFD	Yes	Yes	No
Output sensitive to typology	Yes	Yes	No
Survey technique			
Cost to run a survey	Medium	High	High
Easy to replicate an existing survey	No	Yes	Yes
Scale up to catchment level	Yes	Yes	Yes
Provides habitat information	Yes	Surrogates	Yes
Risk assessment			
Methodology driven by	Expert judgement	Data	Data
Predictive ability	None	None	Yes
Transparency (justify your analysis)	No	Yes	Yes
Consistent Output	No	Yes	Yes
Regulatory (standard of proof)	Low	Moderate	Moderate
Appraisal of restoration			
Track morphological changes	No	Yes	Yes
Chart progress	Yes	Yes	Yes
Good for repeat surveys	No	Yes	Yes

R.A.T emerged as the simplest, most cost effective and flexible technique in the field. This was agreed by the majority of river management experts in RoI and NI including representatives from the agencies responsible for WFD morphological monitoring - EHS in NI and EPA in RoI. It was considered most conducive to making a simple rapid assessment in the field to classify high, good, moderate or poor morphological status.

It was considered by both EHS and EPA that R.A.T should be used for WFD monitoring, at least in this year's programme for both RoI and NI. However, suggested changes to the field sheet were made during the site visits. There are as follows:

1. Record which bank the river was surveyed from.
2. Removing shading from boxes – to allow assessment across all features.
3. Rules required for determining average width, the use of a range finder at top, middle and bottom of the site is recommended.
4. A better definition for flow status is needed.
5. Change the significance of weighting for certain attributes.
6. Calculating percentage in relation to attributes is notoriously difficult to estimate.
7. R.A.T notes page is of uncertain value, needs further specification of types of information needed and ways of categorising the record.

8. Include site details on all sheets
9. Provide form in Excel format so that the score can be automatically calculated.

Training in R.A.T is essential; it is preferable that this is undertaken by the developer of the technique in conjunction with a consultation on the aforementioned suggested changes to the field sheet.

Whilst RHS is an established monitoring method, it was designed pre-Water Framework Directive, and as such, it does not map easily to the classification requirements. Further consideration of RHS as a field technique for classification was ruled out at this stage.

Whilst R.A.T is considered most suitable for classification purposes it does not necessarily provide a means of tracking morphological change, refining thresholds or supporting regulation. Its reliance on expert judgement means that it may not be effective in terms of repeatability when used by EPA in RoI or EHS in NI over time.

The following chapters make comparisons of R.A.T and MImAS against biology and expert judgement to identify key findings which will progress development towards establishing a morphological assessment methodology meeting all of the requirements as below.

- ***Enable NI and RoI agencies to classify rivers in terms of morphology supporting the biological elements so that ecological status can be defined***

- ***Manage and track morphological status so that waterbody status deterioration can be prevented***

- ***Refine morphological thresholds applied to rivers so that the uncertainties with the Article 5 risk assessment can be resolved***

5.0 Comparison of Field Scores: Morphology and Biology

The R.A.T and MImAS field techniques generate different types of scores. The R.A.T survey assigns a hydromorphological score which can code directly into the WFD classes.

MImAS can calculate WFD classes by determining the effect that activities have along a given length. MImAS assumes a specific river type has a fixed amount of ‘capacity’ to sustain/absorb engineering pressures. A tool designed in MS Excel by SEPA accepts as input, channel type and activity “footprints” and calculates how much system capacity has been used to predict WFD Status.

Note that the R.A.T survey codes into 1 of 5 WFD classes (high, good, moderate, poor and bad) whilst the MImAS codes only into 3 (high, good and failed).

To facilitate direct comparisons of the results, those sites obtaining a “moderate”, “poor” or “bad” status class using R.A.T (i.e. less than “good”) were equated to a “Fail” status using MImAS as indicated by Tables 7 and 8.

Table 7 indicates the R.A.T and MImAS field results obtained by GeoData for RoI river test sites. Available biological quality data (Q Data) is also tabulated for each site for each year that the site was surveyed by EPA. The biological results shown for 2006 are the results obtained by NS SHARE and Shannon RBD project staff during the same time period that GeoData undertook the R.A.T and MImAS surveys. Refer to Appendix B for background information on Q surveys and results).

Table 8 indicates the R.A.T and MImAS field results obtained by EHS and GeoData for NI river test sites. Available biological quality data (GQA Data) is also tabulated for each site under each year that the site was surveyed by EHS. (Refer to Appendix B for background information on GQA surveys and results).

Table 7: RoI Test Sites – Morphology Field Results Compared with EPA's Biological Q Results (Note: 06 results obtained by Project Staff during same time period as R.A.T and MImAS Surveys (H = High, G = Good, F = Fail)

	Article 5 Risk Assessment			CHANNEL TYPE	MORPHOLOGY		BIOLOGY – EPA Q VALUES												
Site ID	**Significance**	**Morphology**	**Overall**	**River type (based upon MImAS)**	**MImAS Status**	**R.A.T Status**	**'90**	**'93**	**'94**	**'95**	**'96**	**'97**	**'98**	**'99**	**'00**	**'01**	**'02**	**'03**	**'06**
MImAS and R.A.T field results agree																			
A3	Intensive Land Use	1a	1a	Bedrock Channel and Upland Cascading Channel	HIGH	HIGH	Q5		Q4			Q5		Q4			Q4-5		**Q 4-5**
A4	Intensive Land Use	1a	1a	Step-pool channel	GOOD	GOOD	Q5		Q4			Q4-5		Q4-5			Q4		**Q4**
B7	Intensive Land Use	1b	1b	Step-pool channel	HIGH	HIGH	Q4					Q4-5		Q4				Q4	**Q 5**
C8	Channelisation	1b	1b	Pool riffle and plane riffle	FAIL	FAIL		Q4-5		Q4			Q4			Q4			**Q 4**
G2	Overgrazing	2a	1a	Actively Meandering Channel	HIGH	HIGH		Q3			Q3-4				Q4			Q3-4	**Q4**
MImAS and R.A.T field results disagree																			
A2	Intensive Land Use	1a	1a	Bedrock Channel and Upland Cascading Channel	HIGH	GOOD			Q4			Q4-5					Q4-5		**Q4-5**
B6	Intensive Land Use	1b	1b	Actively meandering channel	FAIL	HIGH	Q5		Q3-4			Q4		Q4			Q4		**Q 4**
C1	Channelisation	1b	1b	Pool riffle and plane riffle	HIGH	GOOD	Q4-5		Q5			Q4-5			Q4-5			Q4-5	**Q 4**
C2	Channelisation	1b	1b	Pool riffle and plane riffle	FAIL	GOOD	Q4-5		Q5			Q4-5			Q4				**Q4**
C4	Channelisation	1b	1b	Pool riffle and plane riffle	FAIL	GOOD													
D1	High Quality Site	2a	2a	Actively meandering channel	FAIL	GOOD	Q4-5		Q4-5			Q4		Q4-5			Q4		**Q 4**
D2	High Quality Site	2b	2b	Step Pool Channel	GOOD	HIGH	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**Q4**
D3	High Quality Site	2b	2b	Bedrock Channel and Upland Cascading Channel	GOOD	HIGH	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	**Q4**
E2	High Status	2a	2a	Pool riffle and plane riffle	FAIL	GOOD	Q5		Q5			Q4-5		Q5			Q4		**Q4**
E5	High Status	2a	1b	Step-pool channel	FAIL	HIGH	Q5		Q5			Q5		Q5			Q4-5		**Q 4-5**
G1	Overgrazing	2b	2b	Step Pool Channel	FAIL	GOOD		Q3			Q3				Q3				**Q5**
G3	Overgrazing	1b	1a	Step Pool Channel	GOOD	HIGH	Q5		Q4			Q4		Q4			Q3		**Q3-4**

G4	Overgrazing	2b	2b	Lowland passive meandering channels	FAIL	GOOD	Q4-5		Q4-5			Q4		Flood					**Q 4**
H12	pHMWB	1a	1a	Pool riffle and plane riffle	FAIL	GOOD	Q4-5		Q4			Q4-5			Q4-5			Q4	**Q 3-4**
H13	pHMWB	1a	1a	Step Pool Channel	FAIL	HIGH	Q5		Q5			Q5			Q4-5			Q4-5	**Q 4-5**

Indicates those sites for which Article 5 morphology pressures placed overall waterbody "at risk" or "probably at risk" of failing to meet WFD objectives by 2015.

Note: The 2006 Q results were obtained in October, which is outside the normal monitoring season of June - September

Table 8: NI Test Sites – Morphology Field Results Compared with EHS's GQA Biological Survey Results

			CHANNEL TYPE	MORPHOLOGY		BIOLOGY – EHS GQA VALUES			
ID	**Article 5 Risk Assessment**		**River type (based upon MImAS)**	**MImAS Status**	**R.A.T WFD Status**		**GQA Biology Results**		
	MORPHOLOGY	**OVERALL**				**2002**	**2003**	**2004**	**2005**
MImAS and R.A.T field results agree									
DEG10	1b	1b	Actively meandering channels	FAIL	FAIL	A	A	A	A
BLK12	2a	1a	Pool riffle and plane riffle	GOOD	GOOD	A	A	B	A
ALT10	2a	1a	Bedrock channels and upland cascading channels	HIGH	HIGH	C	B	B	B
WFT12	-		Bedrock channels and upland cascading channels	HIGH	HIGH	A	A	B	A
KIL10	2a	1a	Pool riffle and plane riffle	GOOD	GOOD	C	C	A	A
COL14	1b	1a	Actively meandering channels	FAIL	FAIL	A	A	A	A
TEM10	2a	1a	Actively meandering channels	FAIL	FAIL	B	C	C	B
CAM10	1b	1a	Pool riffle and plane riffle	FAIL	FAIL	B	B	C	A
AGV10	2a	1b	Pool riffle and plane riffle	FAIL	FAIL	A	A	A	A
STO10	1a	1a	Actively meandering channels	FAIL	FAIL	C	B	C	B
CYE10	1b	1a	Actively meandering channels	FAIL	FAIL	D	D	E	C
CYE12	1b	1a	Actively meandering channels	FAIL	FAIL	B	B	B	A
NWYR10	1a	1a	Actively meandering channels	FAIL	FAIL	C	C	C	B
NWYR11	1b	1a	Actively meandering channels	FAIL	FAIL			C	D
CTY10	2a	1a	Pool riffle and plane riffle	FAIL	FAIL	C	C	B	B
CYW10	1b	1a	Pool riffle and plane riffle	FAIL	FAIL	B	A	B	B

KST10	1b	1a	Pool riffle and plane riffle	FAIL	FAIL	A	B	B	A
COR10	1a	1a	Actively meandering channels	FAIL	FAIL	C	D	C	C
TYN10	1b	1a	Pool riffle and plane riffle	FAIL	FAIL	C	C	D	C
BTH10	1b	1a	Actively meandering channels	FAIL	FAIL	C	D	C	C
MBLK10	1b	1a	Actively meandering channels	FAIL	FAIL	C	D	C	D
BLK10	1b	1b	Actively meandering channels	FAIL	FAIL			E	D
BLK11	1b	1b	Actively meandering channels	FAIL	FAIL	B	C	B	B
CAL10	1a	1a	Pool riffle and plane riffle	FAIL	FAIL	B	B	C	B
CAL11	1b	1b	Actively meandering channels	FAIL	FAIL	C	B	C	C
KCU10	1b	1a	Pool riffle and plane riffle	FAIL	FAIL	B	A	A	A
ACY10	1b	1a	Pool riffle and plane riffle	FAIL	FAIL	B	B	C	B
GFF12	2a	2a	Steep pool channels	HIGH	HIGH	A	A	A	A
GFF10	1b	1a	Bedrock channels and upland cascading channels	HIGH	HIGH	A	A	A	A
BUS06a	1b	1a	Bedrock channels and upland cascading channels	FAIL	FAIL	B	B	C	B
GMK10	2a	1a	Steep pool channels	GOOD	GOOD	B	B	B	C
LAR10	1b	1a	Pool riffle and plane riffle	FAIL	FAIL	B	C	A	B
TOW11	1b	1a	Actively meandering channels	FAIL	FAIL	B	C	C	C
GSK12	1b	1b	Pool riffle and plane riffle	FAIL	FAIL	B	B	B	B
CRY11	2a	1a	Pool riffle and plane riffle	FAIL	FAIL	B	C	C	C
SNS10	On coast		Bedrock channels and upland cascading channels	HIGH	HIGH	B	C	C	C
KKR10	1a	1a	Pool riffle and plane riffle	FAIL	FAIL	C	B	B	A
AHM10	1b	1a	Pool riffle and plane riffle	FAIL	FAIL	C	B	B	A
EHS NI 1	1b	1b	Pool riffle and plane riffle	FAIL	FAIL	A	A	A	A
EHS NI 11	1b	1b	Pool riffle and plane riffle	FAIL	FAIL	-	-	-	-
EHS NI 12	2a	1a	Bedrock channels and upland cascading channels	HIGH	HIGH	B	B	C	C
EHS NI 13	2a	1a	Step pool channels	GOOD	GOOD	B	B	C	C
EHS NI 14	1b	1a	Lowland passive meandering channels	FAIL	FAIL	C	B	C	C
EHS NI 2	1b	1b	Actively meandering channels	GOOD	GOOD	-	-	A	A
EHS NI 3	1b	1b	Pool riffle and plane riffle	FAIL	FAIL	C	C	C	C
EHS NI 4	1b	1b	Pool riffle and plane riffle	FAIL	FAIL	C	C	C	C
EHS NI 5	1b	1b	Pool riffle and plane riffle	GOOD	GOOD	C	C	C	C
EHS NI 6	1b	1b	Pool riffle and plane riffle	FAIL	FAIL	B	A	B	B
EHS NI 9	1b	1a	Pool riffle and plane riffle	FAIL	FAIL	B	C	C	B
MImAS and R.A.T field results disagree									
GVR10	2a	1b	Pool riffle and plane riffle	FAIL	HIGH	A	A	A	A

GLK10	2a	1a	Pool riffle and plane riffle	FAIL	GOOD	C	B	B	B
BAA10	2a	1a	Step pool channels	FAIL	GOOD	B	B	B	A
ROO10	2a	1a	Bedrock channels and upland cascading channels	GOOD	HIGH	A	A	A	A
BDT10	1b	1b	Pool riffle and plane riffle	FAIL	GOOD	B	A	B	A
CLH10	2a	1b	Step pool channels	FAIL	GOOD	B	B	B	B
LUG10	2a	1a	Pool riffle and plane riffle	FAIL	GOOD	B	B	B	B
ROE10	2a	1b	Pool riffle and plane riffle	FAIL	GOOD	A	A	A	A
MOY10	2a	1b	Actively meandering channels	FAIL	GOOD	B	A	B	A
KIN10	1a	1a	Step pool channels	GOOD	HIGH	A	B	A	B
LIS10	2a	1b	Pool riffle and plain riffle	GOOD	HIGH	A	A	A	A
CGG10	2a	1a	Step pool channels	FAIL	GOOD	B	B	B	C
CAL03	1b	1a	Pool riffle and plane riffle	FAIL	GOOD	B	A	A	A
SHI12_01	1a	1a	Bedrock channels and upland cascading channels	HIGH	GOOD	B	B	B	B
GDN10	1b	1a	Step pool channels	GOOD	HIGH	D	B	A	A
BON10	1b	1a	Step pool channels	GOOD	HIGH	A	E	B	B
BBR10	on coast		Bedrock channels and upland cascading channels	FAIL	HIGH	C	C	E	B
TWW12	2a	2a	Step pool channels	FAIL	GOOD	A	B	B	B
MAI10	1b	1a	Actively meandering channels	FAIL	GOOD	C	B	B	B
EHS NI 15	1b	1b	Step pool channels	FAIL	HIGH	C	C	C	C
EHS NI 7	1b	1b	Pool riffle and plane riffle	GOOD	HIGH	-	-	A	A
EHS NI 8	1b	1a	Step pool channels	HIGH	GOOD	B	C	C	B

(Yellow box) Indicates those sites for which Article 5 morphology pressures places overall waterbody "at risk" or "probably at risk" of failing to meet WFD objectives by 2015.

5.1 Comparison of R.A.T and MImAS field scores

60% of all sites had matching morphology scores using R.A.T and MImAS.

The remaining 40% had different R.A.T results to that obtained using the MImAS field methodology.

Where R.A.T and MImAS results do not agree, the general trend is that river sites tend to fail when assessed using MImAS but are classified has good or high using R.A.T. This pattern is evident in both the RoI and NI sites.

The suggested explanation by GeoData is that R.A.T relies heavily on expert judgement and is more subjective than MImAS. The MImAS survey records engineering and pressure data which informs the calculation of a total "footprint" contributing to the loss of the river's capacity to accept morphological change. When the capacity used up is greater than 15% the river is deemed to "fail". This approach is conducive to a regulatory assessment when deciding whether a proposed engineering activity should be approved or not. R.A.T does not record engineering / pressure features. The surveyor is required to assess channel vegetation, substrate diversity, channel flow status, bank structure and stability, bank vegetation, riparian land use and connectivity to floodplain. The subjective nature of assessing these attributes as opposed to recording "real" features present could result in a more lenient assessment.

In comparing the morphology results with the Site Selection criteria (RoI) and Article 5 risk assessment results for morphology (NI) the results obtained using MImAS and R.A.T are somewhat conflicting. For example, the majority of the Channelisation 1b sites in RoI failed using MImAS, but had high or good status using R.A.T. These sites have been subject to arterial drainage schemes in the past. It is not clear which morphology result is the better reflection of reality as some of these sites may have recovered morphologically and can now be deemed as good or high status. In terms of refining thresholds used in assessing risk, these sites were selected on the basis that channelisation pressures were the only pressures, morphological or otherwise that were considered to place the waterbody at risk in the Article 5 assessment. The risk category for these sites was capped at 1b (probably at risk) due to the uncertainty of impact of channelisation on a river's overall status.

Since the morphological assessment approach of R.A.T is a closer reflection of the vegetation and substrate diversity the results suggests that recovery is possible in channelised rivers as these sites are not subjected to other pressures such as diffuse or point source pollution. The findings in this trial will be further explored in fieldwork planned for 2007 so that thresholds can be refined and risk can be more definitively assigned. This requires further fieldwork investigation.

It is considered that closer investigation is necessary if morphological change over time is to be monitored and controlled. Since MImAS records features and pressures, it is considered to be more effective in terms of repeatability and is more suitable as a regulatory tool.

Furthermore, sites *EHS NI 5* and *KIN 10* in NI were deemed "at risk" due to morphology pressures during the Article 5 risk assessment but were assigned good or high morphology status in the field. Similarly, sites expected to fail morphologically in RoI due to overgrazing pressures were assigned good or high status in the field. This raises the issue of waterbody scale, and how representative a single site assessment is of the waterbody as a whole. Sampling strategies must be devised so that surveys are representative at a waterbody scale.

Comparison of the field results against that of expert judgement using desk top assessments is discussed in Chapter 6.0.

5.2 Comparison of R.A.T and MImAS Field Scores and Biology Scores

It is recognised across the EU that the scientific link between hydromorphology and freshwater ecology is not well established. Ongoing research within Member States is working to address this issue. The comparison of morphology against biological scores in this report does not attempt to prove the link between morphological condition and biological quality. However, comparison of the R.A.T and MImAS scores, against biology scores, albeit using small sample sizes could help to identify which technique more closely reflects the biological condition in its scoring and also refine risk assessment thresholds for freshwater morphology.

Both the Q results in RoI and the GQA results in NI represent the quality of macroinvertebrate taxa in a kick sample taken at the river site. It does not represent the presence of aquatic macrophyte or fish.

Tables 9 and 10 indicate the scoring systems of the EPA Q System and the EHS GQA system

Table 9: Definition of EPA Biological Q Ratings

Quality Ratings	Category of River Water Quality
Q5, Q4-5, Q4 Q3-4 Q3, Q2-3 Q2, Q1-2, Q1	unpolluted slightly polluted moderately polluted seriously polluted

Table 10: Definition of EHS General Quality Assessment (GQA) Ratings

Biological Class	EQI for ASPT	EQI for Taxa
A (Very Good)	1.00 or above	0.85 or above
B (Good)	0.90-0.99	0.70-0.84
C (Fairly Good)	0.77-0.89	0.55-0.69
D (Fair)	0.65-0.76	0.45-0.54

E (Poor)	0.50-0.64	0.30-0.44
F (Bad)	less than 0.50	less than 0.30

In looking at those sites for which R.A.T and MImAS results agreed, there is no distinct relationship evident linking the biological quality at the river site to the morphological status. There are sites for which the morphology failed using R.A.T and MImAS and for which long term poor biology has been recorded, but it is not frequent enough to draw a definitive conclusion.

In some cases, R.A.T and MImAS yielded a “fail” but the biological quality was a Q4-5 or Q5 in RoI sites or class “A” in NI sites. It is considered by EPA that the macroinvertebrate kick samples alone are not enough when comparing to morphological condition as it is representative of the river substrate and not the channel or riparian zones.

The results may indicate poor/bad morphology whilst the biology score is high but with low density of sensitive macroinvertebrates. In this instance we cannot draw definitive conclusions. This is largely influenced by the substrate type. In order to ascertain what this result indicates reference conditions would need to be developed for the detailed typologies with respect to macroinvertebrates and knowledge of the carrying capacity or productivity of that river typology.

In those cases where R.A.T and MImAS disagree, all of the RoI sites that were assigned “high” or “good” status using R.A.T have been assigned Q 4 to Q 5 status each year that it was sampled. This pattern is reflected in the NI results where 86% of the sites for which R.A.T and MImAS disagreed had “high” or “good” status using R.A.T and also had “very good” or “good” biological quality. The majority of these sites failed using the MImAS field technique despite exhibiting high biological quality.

Again, the difference in what each technique measures in the field is significant when looking at the biological quality in terms of macroinvertebrates. R.A.T records specific substrate condition, channel vegetation, bank and riparian vegetation. These are scored and accumulated to contribute towards the overall “Hydromorph score” which relates to overall status. The recording of such attributes, in particular the recording of substrate condition, may be the reason that R.A.T results more closely align with the macroinvertebrate surveys. It is recommended that further biological fieldwork to i.e. macrophyte surveys are undertaken so that the associated alignment of R.A.T and biology surveys when used for classification can be explored.

6.0 Comparison of Scores – Morphology Field Scores and Expert Desk Based Assessment Scores

Tables 11 and 12 overleaf indicate the morphology results obtained in the field against the morphology results obtained by experts using a desktop assessment with secondary datasets.

The subset of 20 sites chosen was selected across a range of channel typologies. In addition sites were chosen for which the R.A.T and MImAS field results both agreed and disagreed. 10 NI sites and 10 RoI sites were assessed.

Table 11: RoI Sites: Channel Typologies, Field Results and Expert Results using Desk Top Information for subset of 20 sites

	Surveyors			UK Geomorphologist Experts								RoI and NI Experts							
	GeoData			1		2		3		4		A		B		C		D	
Site ID	River type (based upon MImAS)	MImAS Status	R.A.T Status	Agreed with Typology?	Status	Agreed with Typology?	Status	Agreed with Typology?	Status	Agreed with Typology?	Status	Agreed with Typology?	Status	Agreed with Typology?	Status	Agreed with Typology?	Status	Agreed with Typology?	Status
MImAS and R.A.T field results agree																			
A3	Bedrock Channel and Upland Cascading Channel	H	H	Y	F	Y	G	N	G	Y	H	Y	H	Y	H	Y	H	Y	H
B7	Step-pool channel	H	H	N	F	N	G	N	H	N	H	Y	H	Y	H	N	H	N	G
C8	Pool riffle and plane riffle	F	F	N	F	N	F	Y	F	Y	F	N	F	x	x	Y	F	N	F
MImAS and R.A.T field results disagree																			
B6	Actively meandering channel	F	H	Y	F	N	F	N	F	Y	G	Y	F	Y	G	N	G	Y	G
C1	Pool riffle and plane riffle	H	G	Y	F	N	G	Y	G	Y	F	Y	H	x	x	Y	G	Y	G
D1	Actively meandering channel	F	G	Y	F	Y	F	Y	F	Y	G	N	F	Y	G	x	x	Y	G
E5	Step-pool channel	F	H	Y	F	N	G	Y	G	N	G	N	F	Y	F	Y	F	Y	F
G4	Lowland passive meandering channels	F	G	Y	F	Y	F	N	F	Y	F	N	F	Y	F	Y	F	Y	F
H12	Pool riffle and plane riffle	F	G	Y	F	Y	F	Y	F	N	F	N	F	Y	F	x	x	Y	F
H13	Step Pool Channel	F	H	Y	F	Y	F	Y	G	Y	G	N	F	Y	G	x	x	Y	F

Table 12: NI Sites: Channel Typologies, Field Results and Expert Results using Desk Top Information for subset of 20 sites

	Surveyors			UK Geomorphologist Experts								RoI and NI Experts							
	GeoData / EHS			1		2		3		4		A		B		C		D	
Site ID	River type (based upon MImAS)	MImAS Status	R.A.T Status	Agreed with typology?	Status	Agreed with typology?	Status	Agreed with typology?	Status	Agreed with typology?	Status	Agreed with typology?	Status	Agreed with typology?	Status	Agreed with typology?	Status	Agreed with typology?	Status
MImAS and R.A.T field results agree																			
COR 10	Actively Meandering Channel	**F**	**F**	N	**F**	N	**F**	Y	**F**	Y	**F**	N	**F**	Y	**F**	Y	**F**	Y	**F**
CRY 11	Pool riffle and plane riffle	**F**	**F**	Y	**F**	Y	**G**	Y	**G**	Y	**G**	N	**G**	Y	**F**	Y	**G**	Y	**G**
EHSNI 2	Actively meandering channel	**G**	**G**	N	**F**	N	**G**	Y	**G**	N	**G**	Y	**H**	Y	**F**	N	**F**	Y	**G**
GFF 12	Step-pool channel	**H**	**H**	Y	**G**	Y	**G**	Y	**G**	Y	**H**	X	**X**	Y	**H**	Y	**H**	Y	**G**
MAI 10	Actively meandering channel	**G**	**G**	N	**F**	N	**F**	Y	**F**	N	**F**	Y	**G**	N	**F**	Y	**F**	X	**X**
MImAS and R.A.T field results disagree																			
EHSNI 8	Step-pool channel	**H**	**G**	N	**F**	N	**F**	N	**G**	N	**F**	Y	**G**	Y	**G**	Y	**G**	x	**x**
GDN 10	Step-pool channel	**G**	**H**	N	**H**	Y	**G**	Y	**G**	Y	**H**	N	**H**	Y	**H**	Y	**G**	Y	**H**
LUG 10	Pool riffle and plane riffle	**F**	**G**	Y	**G**	Y	**G**	Y	**H**	Y	**H**	x	**x**	Y	**G**	Y	**H**	N	**G**
ROE 10	Pool riffle and plane riffle	**F**	**G**	Y	**G**	Y	**G**	Y	**G**	Y	**H**	Y	**F**	Y	**H**	Y	**G**	N	**H**
ROO 10	Bedrock channel and upland cascading channel	**G**	**H**	Y	**F**	Y	**G**	Y	**H**	Y	**F**	x	**x**	Y	**G/F**	Y	**G**	Y	**G**

6.1 Channel Typologies

Analysis of survey data is tied to river type. The methodologies use different terminologies when assigning a stretch of river to a type (Table 13). MImAS and R.A.T surveys expect a stream type to be calculated prior to the field survey. R.A.T verifies typology in the field following an initial assignment using desk top data, and MImAS may also assign in the field, but is derived from secondary data and thresholds established for types.

Table 13: The different river types which are used by each survey technique (GeoData, 2007)

R.A.T	MImAS
▪ Bedrock ▪ Step-pool / Cascade ▪ Braided / Wandering ▪ Pool-Riffle ▪ Lowland Meandering ▪ Anastomosing	▪ Bedrock / Cascade ▪ Step – pool / Plane bed ▪ Pool-Riffle / Braided / Wandering / Plane Riffle ▪ Low gradient active meandering ▪ Groundwater ▪ Low gradient passive meandering

The techniques variously use channel typologies to help define what is anticipated as a ‘natural’ status of the system, either through field interpretation or secondary data assignment.

The correct establishment of channel typology is the fundamental basis to morphological assessment using either R.A.T or MImAS. The experts undertaking the desk based assessments were provided with the channel typology assigned to each river in the field (using the MImAS types) and were asked if they agreed with it before proceeding to the actual site assessment.

Both EHS and GeoData found that there was general agreement in the channel type descriptions used in MImAS and RAT. However there is significant variation with respect to the assignment of channel typology in the desk based assessments. Tables 11 and 12 indicate that for approximately 50% of the sites, the experts agreed with the assigned typology and also allocated morphology status class either matching at least R.A.T or MImAS. However, there are also cases where experts’ did not agree with the typology, yet their assessment agreed with the field morphology status.

It is clear that the assignment of channel typology must be standardised to reduce reliance on correct assignment by the surveyor in the field or using photographs. This will reduce variation. Experts suggested that other typology systems such as Rosgen may be more suitable. Further work is required to establish a standard methodology for assigning channel type using the key variables of slope, sinuosity, valley confinement and geology. This is currently being developed for use within the MImAS tool in Scotland.

6.2 Sites for which MImAS and R.A.T field results agreed – Comparison against Experts' Desk Assessments

Table 14 indicates experts' percentage agreement with the field results where R.A.T and MImAS assigned the same status to a river site.

Table 14: Sites for which MImAS and R.A.T results agree - % agreement of expert groups

SITE	R.A.T / MImAS FIELD RESULT	% AGREEMENT BY FLUVIAL GEOMORPHOLOGISTS -DESKTOP ASSESSMENT	% AGREEMENT BY RoI & NI EXPERTS - DESKTOP ASSESSMENT	OVERALL % AGREEMENT OF EXPERTS
A3	HIGH	25	100	63
B7	HIGH	50	75	63
C8	FAIL	100	100	100
COR 10	FAIL	100	100	100
CRY 11	FAIL	25	25	25
EHSNI 2	GOOD	75	25	50
GFF 12	HIGH	25	66	43
MAI 10	GOOD	0	33	14

The overall agreement of experts is 50% or greater for 5 out of the 8 sites shown in Table 8. Since the assessments made by experts were using desk data only, this suggests that there is scope for developing remote sensing and desk based assessments (with the current pace of development in Ireland only recent photographs are useful for this).

Unanimous agreement was reached by both expert groups for 2 of the sites that failed. One site, CRY 11 was assigned a "fail" in the field but gained only 25% agreement by both expert groups. The overall level of agreement for sites assigned "high" or "good" status in the field is not as strong. It is considered that whilst desk assessments may be effective for clear cut cases, there is still a need for field surveys to provide supplementary data at sites where desk based assessment is not enough.

In general, the assessments made by RoI and NI experts at the workshop were more frequently in agreement with the field morphology result than that of the fluvial geomorphologists. This suggests that local knowledge is a significant factor.

6.3 Sites for which MImAS and R.A.T field results disagreed – Comparison against Experts' Desktop Assessments

Table 15 indicates the sites for which R.A.T and MImAS results disagreed and the level of agreement with each result amongst the expert groups.

Table 15: Sites for which MImAS and R.A.T results disagree - % agreement of expert groups

SITE	% Agreement with R.A.T Result	% Agreement with MImAS result	Technique most aligned with expert judgement
B6	0	50	MImAS
C1	57	14	R.A.T
D1	43	57	MImAS
E5	0	63	MImAS
G4	0	100	MImAS
H12	0	100	MImAS
H13	0	57	MImAS
EHSNI 8	57	0	R.A.T
GDN 10	63	38	R.A.T
LUG 10	57	0	R.A.T
ROE 10	50	13	R.A.T
ROO 10	14	50	MImAS

For 7 of the 12 sites, the experts agreed with the MImAS result, for the remaining 5 sites experts agreed with the R.A.T result. In terms of the field technique which most closely aligns with the results obtained by the experts' desk based assessment, a definitive conclusion cannot be made. A larger sample of sites may be required in order to achieve this.

However, the MImAS result has gained a higher percentage of agreement with 100% agreement for 2 sites. In the cases where R.A.T has the majority agreement it is generally by a lower margin. The main source of data used by the experts in the desk assessments was ground photographs. This suggests that experts placed importance on the presence/absence of specific engineering features such as bridges or flood banks in reaching their decision. Such features are recorded in MImAS but not in R.A.T which may explain why the MImAS result matched that of expert judgment more often.

6.4 Summary of Experts' Desk Based Assessments

Table 16 summarises the results of the fluvial geomorphologists and RoI/NI expert groups by indicating the mode and range for each site.

Table 16: Mode and Range of the Expert Groups' Assessments against Field Results

FIELD RESULTS			FLUVIAL GEOMORPHOLOGISTS		ROI AND NI EXPERTS	
SITE	**MImAS**	**RAT**	**MODE**	**RANGE**	**MODE**	**RANGE**
MImAS and RAT field results agree						
A3	HIGH	HIGH	**GOOD**	FAIL - HIGH	**HIGH**	HIGH
B7	HIGH	HIGH	**HIGH**	FAIL - HIGH	**HIGH**	GOOD - HIGH
C8	FAIL	FAIL	**FAIL**	FAIL	**FAIL**	FAIL
COR 10	FAIL	FAIL	**FAIL**	FAIL	**FAIL**	FAIL
CRY 11	FAIL	FAIL	**GOOD**	FAIL-GOOD	**GOOD**	FAIL-GOOD
EHSNI 2	GOOD	GOOD	**GOOD**	FAIL - GOOD	**FAIL**	FAIL - HIGH
GFF 12	HIGH	HIGH	**GOOD**	GOOD - HIGH	**HIGH**	GOOD – HIGH
MAI 10	GOOD	GOOD	**FAIL**	FAIL	**FAIL**	FAIL – GOOD
No. AGREEMENT WITH FIELD RESULT			4		5	
MImAS and RAT field results disagree						
B6	FAIL	HIGH	**FAIL**	FAIL-GOOD	**GOOD**	FAIL – GOOD
C1	HIGH	GOOD	**FAIL/ GOOD**	FAIL - GOOD	**GOOD**	GOOD – HIGH
D1	FAIL	GOOD	**FAIL**	FAIL- GOOD	**GOOD**	FAIL - GOOD
E5	FAIL	HIGH	**GOOD**	FAIL - GOOD	**FAIL**	FAIL
G4	FAIL	GOOD	**FAIL**	FAIL	**FAIL**	FAIL
H12	FAIL	GOOD	**FAIL**	FAIL	**FAIL**	FAIL
H13	FAIL	HIGH	**FAIL/ GOOD**	FAIL - GOOD	**FAIL**	FAIL - GOOD
EHS NI 8	HIGH	GOOD	**FAIL**	FAIL - GOOD	**GOOD**	GOOD
GDN 10	GOOD	HIGH	**GOOD /HIGH**	GOOD- HIGH	**HIGH**	GOOD-HIGH
LUG 10	FAIL	GOOD	**GOOD /HIGH**	GOOD - HIGH	**GOOD**	GOOD – HIGH
ROE 10	FAIL	GOOD	**GOOD**	GOOD - HIGH	**HIGH**	FAIL – HIGH
ROO 10	GOOD	HIGH	**FAIL**	FAIL-HIGH	**GOOD**	FAIL - GOOD
No. AGREEMENT WITH RAT			2.5		5	
TOTAL AGREEMENT WITH RAT			**6.5**		**10**	
No. AGREEMENT WITH MImAS			5		5	
TOTAL AGREEMENT WITH MImAS			**9**		**10**	

Table 16 indicates that the UK based geomorphologists agreed with the MImAS result more often than with the R.A.T results. However, the level of agreement between each technique was equal by the RoI/NI experts.

The fact that the pressure based MImAS has slightly more expert agreement can be explained by the approach taken in undertaking a desk based assessment. The data used to make the assessment was dominated by ground photos and pressure data, which will have focussed on structures such as bridges, flood banks, embankments and weirs. This approach is more closely reflected by the MImAS technique which records and quantifies an engineering footprint that contributes to the overall score by assessing how much capacity to accept morphological change has been taken up by the presence of such features. This is known as a “top-down” approach which starts with the human activities (i.e. pressures) in the river and derives what impact this will have on the morphological condition, and subsequently the expected impact on ecological status.

In contrast, the R.A.T technique uses the “bottom–up” approach, which starts with identifying the impacts in a river such as loss of substrate diversity, siltation, changes to vegetation structure, lack of floodplain connectivity and bank stability, which are considered to be the impacts caused by morphological pressures, and assesses these impacts as a measure of morphological status.

7.0 Conclusions

The MImAS and R.A.T approaches can be considered as complementary in that MImAS records pressure data and features in a river which can be used to assess the level of morphological change and to manage and control further change in the future. This makes it more suitable as a regulatory tool with respect to river morphology. On the other hand, R.A.T directly relates what is actually observed in the field to morphological pressures. Therefore the impact that can be seen at a particular site is assessed and a morphological status is derived from this, as opposed to assessing the engineering features that may cause deterioration in status.

The following conclusions are made based on the findings of the Comparative Studies as combined and summarised in this report in relation to the following morphological assessment requirements:

1. Enabling NI and RoI agencies to classify rivers in terms of morphology supporting the biological elements so that ecological status can be defined

2. Managing and tracking morphological status so that waterbody status deterioration can be prevented

3. Refining morphological thresholds applied to rivers so that the uncertainties with the Article 5 risk assessment can be resolved

1. Enabling NI and RoI agencies to classify rivers in terms of morphology supporting the biological elements so that ecological status can be defined

The R.A.T, MImAS and RHS field techniques differ in their approach and original design objectives. This can be generalised by making the following points:

- R.A.T suitable for classification
- MImAS suitable for regulation
- RHS designed pre-WFD and does not translate easily to classification requirements

R.A.T emerged as the simplest, most cost effective and flexible technique in the field for classification purposes and is preferred by both EHS in NI and EPA in RoI. It is considered that R.A.T should be used for WFD monitoring, at least in 2007 in both jurisdictions. It was considered most conducive to making a simple rapid assessment in the field to classify high, good, moderate or poor morphological status.

The site visit demonstrations provided a forum for experts to suggest changes to the field sheets. These are as follows:

1. Record which bank the river was surveyed from.
2. Removing shading from boxes – to allow assessment across all features.
3. Rules required for determining average width, the use of a range finder at top, middle and bottom of the site is recommended.
4. A better definition for flow status is needed.
5. Change the significance of weighting for certain attributes.
6. Calculating percentage in relation to attributes is notoriously difficult to estimate.

7. R.A.T notes page is of uncertain value, needs further specification of types of information needed and ways of categorising the record.
8. Include site details on all sheets
9. Provide form in Excel format so that the score can be automatically calculated.

Training in R.A.T is essential; it is preferable that this is undertaken by the developer of the technique in conjunction with a consultation on the aforementioned suggested changes to the field sheet.

2. Managing and tracking morphological status so that waterbody status deterioration can be prevented

The Comparative Studies have identified useful findings useful that will progress the development of a management framework which can control, monitor and track morphological change in rivers. However further work is required before a complete morphological assessment method can be fully established.

It is clear that the assignment of channel typology must be standardised to reduce reliance on correct assignment by the surveyor in the field or using photographs. This will reduce variation. The need for an automated GIS based tool using the metrics, slope, valley confinement, geology and sinuosity is required so that channel typologies can be assigned before undertaking field surveys. Appropriate thresholds relating these metrics to channel typology descriptions such as pool-riffle or active meandering must be developed.

Whilst R.A.T is considered most suitable for classification purposes it may not meet the requirements in terms of tracking morphological change, refining thresholds or regulation. Its reliance on expert judgement means that it may not be effective in terms of repeatability when used by EPA in RoI or EHS in NI over time.

MImAS assumes a specific river type has a fixed amount of ‘capacity’ to sustain/absorb engineering pressures. The MImAS survey records engineering and pressure data which informs the calculation of a total “footprint” contributing to the loss of the river’s capacity to accept morphological change. When the capacity used up is greater than 15% the river is deemed to “fail”. This approach is conducive to a regulatory assessment when deciding whether a proposed engineering activity should be approved or not.

R.A.T relies heavily on expert judgement and is more subjective than MImAS. R.A.T does not record engineering / pressure features. The surveyor is required to assess channel vegetation, substrate diversity, channel flow status, bank structure and stability, bank vegetation, riparian land use and connectivity to floodplain. The subjective nature of assessing these attributes as opposed to recording “real” features could result in a more lenient assessment.

It is important to note that the MImAS field survey is used in situations where a satisfactory amount of pressure data with respect to morphological alterations is not available. It is supplementary to a desk based assessment within SEPA’s regulatory process. SEPA is currently compiling a morphological alterations database, including aerial photographs which will be used in the MImAS process.

The comparison of field results against desktop assessments carried out in this study demonstrates the effectiveness of morphological assessment using data such as ground photographs, aerial imagery, local knowledge and channel dimensions. If remote sensing is further developed using G.I.S technology, this effectiveness can be improved. It is recommended that the role of remote sensing is further developed. It is considered that a field technique for monitoring morphological change is used as a supplementary method of collecting field based data where needed.

The issue of waterbody scale was identified by comparing R.A.T and MImAS results with the criteria with which pilot waterbodies were selected. Land Use pressures such as overgrazing cannot be detected by monitoring a single site within a waterbody. Sampling strategies must be devised so that surveys are representative at a waterbody scale. Further fieldwork planned for 2007 should select test sites at the upstream and downstream end of waterbodies where possible.

Again, the role of remote sensing, in particular, detailed aerial imagery should be explored so that waterbody scale assessments can be made.

3. Refine morphological thresholds applied to rivers so that the uncertainties with the Article 5 risk assessment can be resolved

The relationship between observed impact of morphology pressures on supporting elements and ecology is to be examined to identify thresholds for sustainable levels of pressure in rivers. A definitive conclusion on this cannot be drawn from the comparisons made between morphology field results and corresponding macroinvertebrate data in RoI and NI.

Further biological surveys, including macrophyte surveys are required to determine if this is a more robust biological indicator as it is considered that macroinvertebrate surveys are only reflective of substrate condition.

In RoI, the sites assigned “likely high status” on EPA’s surveillance monitoring list for 2007 are those which have a Q4-5 or Q5 biological status. These sites will be surveyed this summer to determine if they are sites of high ecological status. There is a need to survey the morphological condition in conjunction with the biological Q survey to determine if the morphology elements support high ecological status. R.A.T has been agreed as the most appropriate technique for this purpose. This approach is also agreed by the EHS in NI for classification.

8.0 Recommendations

Based on the conclusions discussed in Chapter 7.0, the recommendations for future work are as follows:

1. Undertake R.A.T surveys for those sites considered to be “likely high status” for EPA / EHS surveillance monitoring in 2007;
2. Develop an automated GIS based methodology for assigning channel typology using a uniform approach for use by both EPA and EHS;
3. Proceed with Shannon RBD investigative fieldwork programme for summer 2007 to include macrophyte surveys, MImAS surveys, R.A.T surveys to work towards development of a morphological assessment technique which can be used for management and tracking of morphological change in rivers and refinement of risk assessment thresholds;

4. Conduct this fieldwork in conjunction with the development of remote sensing GIS tools using high detail aerial photography to establish the role of field assessment within the overall management framework.

9.0 References

- Freshwater Morphology Further Characterisation, Comparative Field Trials of R.A.T and MImAS morphological assessment techniques (EHS, 2007).
- Shannon International River Basin District Project, Freshwater Morphological POMS Study, Fieldwork 2006: Comparative Study of Morphological Assessment Techniques for Rivers (GeoData, 2007).

APPENDIX A

FRESHWATER BIOLOGY ASSESSMENTS UNDERTAKEN IN NI AND RoI (Macroinvertebrates)

The Biological Assessment Procedure for Rivers carried out by the EPA in the Republic of Ireland

Biological water quality assessments by the Environmental Protection Agency are based on the composition of the macroinvertebrate communities which inhabit the substratum of rivers and streams. These comprise, in the main, immature aquatic stages of insects, together with crustacea (e.g. shrimps), mollusca (snails and bivalves), oligochaeta (worms), and hirudinea (leeches). Shallow, fast-flowing, well-aerated stretches of river "riffles" are sampled in preference to "nonriffle" areas, as they show most clearly the water quality status and effects of pollution.

For assessment purposes the communities have been divided arbitrarily into four groups - sensitive, less sensitive, tolerant, very tolerant and most tolerant forms. The relative proportions of the various organisms in a sample are determined, and the water quality status is then inferred by comparison with the expected ratios in unpolluted habitats of the type under investigation. The assessment procedure also takes into account other relevant factors such as the intensity of algal and/or weed development, water turbidity, bottom siltation, nature of the sub-stratum, speed of current, and water depth. The biological information is then condensed to readily understandable form by means of a 5-point biotic index (Q values), in which community composition and water quality are related:

Biotic Index (Q Value)	**Water Quality**
5 (diversity high)	good
4 (diversity slightly reduced)	fair
3 (diversity significantly reduced)	doubtful
2 (diversity low)	poor
1 (diversity very low)	bad

Intermediate values e.g. Q3-4 or Q1-2, are used to describe conditions where appropriate. Also, where toxic influences are suspected the suffix 0 is appended to the relevant Q rating, e.g. Q 1/0 or Q 1-2/0. In the interests of simplicity four main classes of water quality have been defined. These relate to the Q Value scale and indicate the degree of pollution as follows:

Quality Ratings	**Category of River Water Quality**
Q5, Q4-5, Q4	unpolluted
Q3-4	slightly polluted
Q3, Q2-3	moderately polluted
Q2, Q1-2, Q1	seriously polluted

The Biological General Quality Assessment Scheme carried out by the Environment and Heritage Service in NI

Biological classification is based on comparison of the macroinvertebrate fauna found at a sampling site with what would be expected to be found in the absence of pollution. The closer the approximation between what is found and what would be expected to be found in the absence of pollution, the better the biological class of the river. There are six quality classes ranging from Very Good through Fair to Bad.

NI rivers support over 1,500 species of aquatic macroinvertebrates (such as insect larvae, molluscs and shrimps) which vary in their sensitivity to pollution and in particular to different types of pollution. For example, shrimps and mayfly larvae tend to be sensitive to the effects of acidification, whereas stonefly nymphs are highly sensitive to depressed dissolved oxygen levels that might result from pollution by organic wastes. Molluscs are sensitive to metal pollution which interferes with their shell forming processes.

Unpolluted waters contain a wide diversity of these organisms but usually with no single species in great abundance. The effect of pollution is to selectively remove certain types of organisms, possibly resulting in certain other species becoming excessively abundant. For example, the discharge of biodegradable organic matter to a river can selectively remove the pollution sensitive stonefly nymphs while encouraging the productivity of pollution insensitive organisms such as the oligochaete worms, midge larvae and hog-lice. Moreover, when invertebrate communities are damaged by environmental stress, complete recovery can take several months. Macroinvertebrates can therefore act as an in-line monitoring system for pollution events.

Because of their relative lack of mobility in rivers, these organisms are exposed to the full effects of pollution. For these reasons, the identification of imbalances in the diversity and abundance of macroinvertebrates within river reaches offers a ready means of detecting intermittent pollution and the effects of substances such as pesticides and acids which may not be detected by GQA chemical monitoring. Because of the relatively small range of chemical determinands routinely monitored, rivers can be classified as of good chemical quality while supporting an impoverished macroinvertebrate community. The effects of pollution can therefore be underestimated if reliance is placed on one classification system in isolation.

In the same way, the abundance and diversity of aquatic plants and algae can provide valuable information regarding nutrient enrichment in river waters and sediments. Taken together with GQA chemistry, the evaluation of macroinvertebrates and plants can give a much more holistic assessment of river water quality and improve the detection of intermittent or insidious pollution.

Summary Statistics in the Assessment of Biological Quality

Macroinvertebrate data are summarised throughout the United Kingdom using the Biological Monitoring Working Party (BMWP) biotic score system. This method of data collation separates invertebrate groups or taxa on the basis of their relative sensitivity to pollution with the more pollution sensitive taxa being allocated higher scores and the more pollution tolerant taxa lower scores. The overall community is described by the sum of the individual taxon scores. In general, higher total biotic scores describe better quality invertebrate communities reflecting the better end of the water quality spectrum.

Two other measures which describe biological quality are the number of BMWP scoring taxa present and the average pollution sensitivity of the macroinvertebrate community as described by the Average Score per Taxon (ASPT), which is derived from the community biotic score divided by the number of taxa represented. In general, the higher the number of taxa present, the better the biological quality of the reach, especially where the ASPT values are high (greater than 5.5)

Biological Classification

Since the late 1970s, a computer model called RIVPACS (River Invertebrate Prediction and Classification System) has been under development in the United Kingdom. Using the physical, geographical and chemical characteristics of a monitoring site, RIVPACS can predict what the natural macroinvertebrate fauna of that site would be in the absence of environmental stress of which pollution is an important form. The computer model was modified prior to the 1995 quinquennial survey to take account of factors that are peculiar to NI. For example, certain macroinvertebrates found in high quality waters in England, Scotland and Wales may be absent from NI waters not because the waters are polluted, but because the organisms in question have not colonised Irish waters. This modification has improved the accuracy of biological water quality classification in NI. Further modifications are being carried out to improve the accuracy with which smaller streams and headwaters can be classified.

Comparison of the predicted macroinvertebrate communities with those observed during the biological sampling and analytical programme allows the calculation of ecological quality indices (EQIs). The most relevant EQIs in describing biological quality are those based on the number of macroinvertebrate taxa and on ASPT. These are derived from the equations:

$$\text{EQItaxa} = \frac{\text{BMWP Observed Number of Taxa}}{\text{BMWP Predicted Number of Taxa from RIVPACS}}$$

and

$$\text{EQIASPT} = \frac{\text{BMWP Observed ASPT}}{\text{BMWP Predicted ASPT from RIVPACS}}$$

An EQI value of approximately one indicates that the observed macroinvertebrate fauna is what would be expected in an unstressed river reach, whereas lower EQI values reflect communities that are stressed to a lesser or greater degree. The EQI bandings agreed nationally for the range of biological qualities are set out in **Table 1.**

Table 1 Biological Classification Bandings

Biological Class	EQI for ASPT	EQI for Taxa
A (Very Good)	1.00 or above	0.85 or above
B (Good)	0.90-0.99	0.70-0.84
C (Fairly Good)	0.77-0.89	0.55-0.69
D (Fair)	0.65-0.76	0.45-0.54
E (Poor)	0.50-0.64	0.30-0.44
F (Bad)	less than 0.50	less than 0.30

Class A – Very Good
The biology is similar to (or better than) that expected for an average, unpolluted river of this size, type and location. There is a high diversity of taxa, usually with several species in each. It is rare to find a dominance of any one taxon.

Class B – Good
The biology shows minor differences from Class A and falls a little short of that expected for an unpolluted river of this size, type and location. There may be a small reduction in the number of taxa that are sensitive to pollution, and a moderate increase in the number of individuals in the taxa that tolerate pollution (like worms and midges). This may indicate the first signs of organic pollution.

Class C - Fairly Good
The biology is worse than that expected for an unpolluted river of this size, type and location. Many of the sensitive taxa are absent or the number of individuals is reduced, and in many cases there is a marked rise in the numbers of individuals in the taxa that tolerate pollution.

Class D – Fair
The biology shows considerable differences from that expected for an unpolluted river of this size, type and location. Sensitive taxa are scarce and contain only small numbers of individuals. There may be a range of those taxa that tolerate pollution and some of these may have high numbers of individuals.

Class E – Poor
The biology is restricted to animals that tolerate pollution with some taxa dominant in terms of the numbers of individuals. Sensitive taxa will be rare or absent.

Class F – Bad
The biology is limited to a small number of very tolerant taxa, often only worms, midge larvae, leeches and the water hog-louse. These may be present in very high numbers but even these may be missing if the pollution is toxic. In the very worst case there may be no life present in the river.

APPENDIX B

SITE ASSESSMENT FORMS USED IN THE DESK BASED ASSESSMENTS UNDERTAKEN BY RIVER EXPERT GROUPS.

Site Assessment Form - EXAMPLE

Assessor Name: xxx

Site Reference Code: XXXX

Channel typology: Pool Riffle

1 Do you agree with channel typology that has been assigned? If not give reasons why.

2 Based on the site information and data provided and your expert opinion, assign with the letter "X" one of the following categories to this site which you feel best reflects its hydro-morphological status.

➢ High	
➢ Good	
➢ Moderate	
➢ Fail	

3 Please provide the reasons for your assessment in the following format as applicable:

➢ **Primary reason**

➢ **Secondary reason(s)**

- **Tertiary reason(s)**

4 Please rank the items of information that you used to make your assessment in order of importance, with number 1 as the most important.

- Site maps ☐
- Ground photos ☐
- Orthophotos ☐
- Detailed Aerial photos ☐
  (if provided)
- Historical mapping ☐

- Slope ☐
- Altitude ☐
- Distance from Source ☐
- Altitude at Source ☐
- Stream Order ☐
- Stream Link Magnitude ☐

- Article 5 risk reports ☐
- Geology ☐
- Land use information ☐
- Digital Terrain Model ☐

5 Please provide any additional comments you may have.

APPENDIX C

R.A.T and MImAS FIELD SHEETS

Sheet 1: NS Share Hydromorphological Assessment Field Survey

Site Identification

River Name ____ Site Number ________________

WFD Typology _________________________

Easting _______________________ Northing _______________________

Desk-study notes:

Expected stream type:

____

Native vegetation types:

____

Riparian land use:

____

Pressures:

____

Other comments:

____

____

____

____

Survey Identification

Date ___________________________________ Time _________________________

Surveyors ____

Weather conditions

Now ____ Rain in last week? _____________________

Channel characteristics

Estimated stream width: ___________________________ Reach length: ____________________________

Stream type: _____________________________________

Photograph numbers and details:

____

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Additional notes: unusual features, particular conditions, other comments:

Sheet 2: Field Assessment of Hydromorphological Condition

	Bedrock	Step-pool / Cascade	Braided / Wandering	Pool-riffle	Lowland Meandering	Anastomosing
Channel form and flow types	4	4	4	4	4	4
Channel vegetation	4	4	4	4	4	4
Substrate condition	4	4	4	4	4	4
Channel flow status	4	4	4	4	4	4
Bank structure & stability L+R			4	4	4	4
Bank vegetation L+R			4	4	4	4
Riparian land use L+R	4	4	4	4	4	4
Floodplain connectivity L+R			4	4	4	4
Total	20	20	32	32	32	32
Hydromorph * Score						
WFD class **						

$$\text{* Hydromorph score} = \frac{\Sigma \text{ Assessment scores}}{\text{Maximum possible score}}$$

**	WFD Class	> 0.8 = high
		0.6 – 0.8 = good
		0.4 – 0.6 = moderate
		0.2 - 0.4 = poor
		< 0.2 = bad.

MImAS FIELD SHEET

1. SITE DETAILS (all fields are mandatory)		**SURVEYER NAME AND DATE**			
RIVER NAME				[redacted]	
SITE NGR: **Downstream end** **Upstream end**	…………………….. ……………………..	**SITE No. / LOCATION CODE:**		**WATERBODY ID**	
PHOTOGRAPHS - number taken at each pressure & file names. Please indicate whether upstream (u/s) or downstream (d/S) view.					

2. PRESSURE ASSESSMENTS (fill in section(s) appropriate to the pressure)

2.1 CONIFER PLANTATION and RIPARIN CORRIDER –

LEFT BANK

If a conifer plantation is present, does it encroach on the channel? (Y / N) (Please circle)

Mean width of riparian Corridor		**Vegetation Character:** Complex/Simple/ Uniform/Bare		**Woody vegetation Density:** Cont./Semi cont./ Occasional/Scattered/ None		**Estimated total length of: natural/semi-natural riparian vegetation (m).**	

RIGHT BANK

If a conifer plantation is present, does it encroach on the channel? (Y / N) (Please circle)

Mean width of riparian corridor		**Vegetation Character:** Complex/Simple/ Uniform		**Woody vegetation Density:** Cont./Semi cont./ Scattered/ None		**Estimated total length of: natural/semi-natural riparian vegetation (m).**	

2.2 FLOODPLAIN LANDUSE – estimate for land adjacent to 500m section

ADJACENT TO LEFT BANK

Floodplain land use Extensive (E)/Present (P)	**Arable**		**Unimproved grass**		**Improved grass**	
	Plantation		**Scrub/shrub/heath**		**Urban**	

ADJACENT TO RIGHT BANK

Floodplain land use Extensive (E)/Present (P)	**Arable**		**Unimproved grass**		**Improved grass**	
	Plantation		**Scrub/shrub/heath**		**Urban**	

2.3 ENGINEERING WORKS – record all activities present within 500m section

ENGINEERING WORK- Whole channel	**TALLY (m) and NGR**	**TOTAL (m)**
Flow deflectors	3 (NGR) 5 (NGR) 5 (NGR) (3 flow deflectors, eg croys)	13
Dredging	50 (NGR) (evidence of 50 meters of dredging)	50
Culverts (natural substrate)	20 (NGR) (20m long arch culvert)	20
Culverts (non-natural substrate)	10 (NGR) (10m long box or pipe culvert)	10

Bed reinforcement	15 (NGR) 20 (NGR) (15m ford and 20m reinforced bed)	35
Artificial substrate	20 (NGR) (20m of channel has artificial bed material)	20
Part recovered channel realignment	100 (NGR) (100m of channel displays evidence of realignment that has begun to recover, e.g. straightened channel beginning to meander	100
Channel realignment	50 (NGR) 100 (NGR) (two sections of straightened channel)	150

Engineering work- Bank related	**LEFT BANK TALLY (m) NGR**	**TOTAL**	**RIGHT BANK TALLY (m) NGR**	**TO TAL**
Green bank protection				
Grey bank reinforcement (full face)				
Bank reprofiling / resectioning				
Embankment				
Set back embankment				
Flood-by-pass channel				

IMPOUNDMENTS – if more than 5 impoundments recorded in 500m stretch please record details in 'additional' section below

Does the structure block the passage of fish or sediment?	1	2	3	4	5	**Length of structure (m) (along riverbank)**	1	2	3	4	5
Width of structure (across river) (m)	1	2	3	4	5	**Height of structure**	1	2	3	4	5

BRIDGES - if more than 4 bridges recorded in 500m stretch please record details in 'additional' section below

Width of bridge (along riverbank)	1	2	3	4	**Length of bridge (across river)**	1	2	3	4	**No. in-channel supports**	1	2	3	4

3. COMMENTS a) Please provide any additional information on engineering pressures that could not be recorded above.
b) Please provide any additional information about this site that think might be use in assessing morphological impacts (e.g. evidence of fine sediment deposition, non-natural bank erosion, bed armouring etc)

4. SPECIAL FEATURES Please provide a brief description of any special features at the site (e.g. fallen tress, instream vegetation, gravel/silt depositions, key habitats)

5. Overall Assessment

Do you consider the waterbody to be at risk of not meeting good status based on what you have seen at either the spot checks (conifer plantation pressure) or the 500m walk through (engineered structures)	YES / NO (circle one) Comments:
Confidence in Assessment Comments:	HIGH / MEDIUM / LOW (circle one)