NS 2 FRESHWATER PEARL MUSSEL SUB-BASIN MANAGEMENT PLANS

REPORT ON MORPHOLOGICAL MONITORING AND CATCHMENT WALKOVER RISK ASSESSMENTS IN THE BALLYMURPHY CATCHMENT

September 2009

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INTRODUCTION

In order to assess the hydromorphological alterations within the Ballymurphy catchment the EPA WFD classification tool called the River Hydromorphology Assessment Technique (RHAT) was utilised by RPS. This tool was developed through the North South Share project, to classify rivers in terms of their morphology. It is a field technique which assigns a channel typology. This influences the rivers physical attributes assessed in the field. The technique assigns a morphological classification directly related to that of the WFD – high, good, moderate, poor and bad.

RHAT surveys were carried out at high risk areas located within pearl mussel populations. The methodology classifies river hydromorphology based on a departure from naturalness, and assigns a morphological classification, based on semi-quantitative criteria. It is designed to be a rapid visual assessment based on information from desktop studies, using GIS data, aerial photography, historical data and data obtained from previous field surveys as well as observations in the field.

A catchment walkover risk assessment survey sheet was also designed by the project team in conjunction with NPWS in order to focus the collation of the pressure data in the field with respect to the Freshwater Pearl Mussel. The risk sheet was divided into eight categories designed to highlight the main pressures within the catchment. The eight categories are as follows:

- Source of erosion
- Diffuse Nutrient
- Diffuse Silt
- Current Riparian Zone
- Field Drainage
- Outfalls
- Abstractions
- Barriers to Migration

Each sub-pressure within the eight categories is analysed and an overall risk assessment of High, Medium or Low is assigned to that category. The “one out all out principle” is then used to assign the river stretch or point an overall risk category. A detailed description, together with a series of photographs outlining the pressures is also taken. The risk assessment sheets will assist the project team in focussing the specific freshwater pearl mussel measures within the catchment.

Location of survey stretches and points are shown in **Figure 1**

2.0 METHODOLOGY

Sampling was carried out on the 21st of April 2009.

2.1 RIVER HYDROMORPHOLOGY ASSESSMENT TECHNIQUE (RHAT)

Classification of hydromorphology can be used to contribute to the status classification of water bodies at high ecological status only. However, RHAT plays a vital role in identifying why a water body might be failing to achieve Good Ecological Status as it is based on the observed impact in the field. It can assist in deciding what indirect and direct efforts are needed to improve status and in helping to prevent further deterioration.

The eight criteria that are scored are:

1. Channel morphology and flow types
2. Channel vegetation
3. Substrate diversity and embeddedness
4. Channel flow status
5. Bank and bank top stability
6. Bank and bank top vegetation
7. Riparian land use
8. Floodplain connectivity

Sheet 1 of the RHAT form contains the Field Health and Safety sheet which is filled on arrival at the site. Before the field survey, a desk study is required this element of the survey was completed as part of the development of the draft sub-basin management plans. The reach identification and physical characterisation sections for each field site are recorded on Sheet 2 (see Appendix 1) with all information available from GIS and aerial photographs, including:

a. expected stream type and the description of various stream types
b. catchment and reach-scale pressures (these may help to identify, confirm or explain field observations);
c. expected riparian vegetation types (for high quality status);
d. the weather conditions on the day of the survey, and those immediately preceding the day of the survey. This information is important to interpret the effects of storm events on the survey results;
e. the estimated stream width and the reach length to be assessed (~ 40 x width).
f. any other notable issues (e.g. from previous surveys).

A score is allocated to each relevant attribute (the number of attributes to be assessed will depend on the stream type). Where the condition departs from the reference condition, note should be made if this condition results from a particular identifiable pressure. Where possible and where relevant, all attributes should be included in the assessment, using the assessment sheet (Sheet 3, see Appendix 1). If an attribute is not assessed, the score-summary table should be amended (cells shaded) and a note made as to why the assessment was not carried out. The WFD status can still be calculated on the basis of other attributes, but with a note that a particular attribute was omitted.

Transfer scores for individual attributes to the summary table on the survey Sheet 2. Finally the overall WFD category can be calculated using the following values:

> 0.8	= high
0.6 – 0.8	= good
0.4 – 0.6	= moderate
0.2 – 0.4	= poor
< 0.2	= bad

For the purposes of the assessment as part of the NS2 project, a high status for morphology is desirable for pearl mussel habitats. Through work carried out by the Shannon IRBD project on the Freshwater Morphology Programme of Measures Study, it was found that an observed relationship exists between biological data and a RHAT score. The study confirmed that morphological pressure can impact biology and therefore ecological status. In general, sites with RHAT scores less than 0.6 also have less than good Q scores. Similarly high levels of siltation affecting macrophyte populations are reflected by less than good RHAT scores.

Grid references were recorded at all sites using a GPS together with site photographs which were taken using a digital camera.

2.2 CATCHMENT WALKOVER RISK ASSESSMENT

During the development of the draft sub-basin management plans throughout 2008 a complete desk study was conducted of all relevant biological, water quality and pressure source data within the Ballymurphy catchment. Best use was made of all available datasets such as the pressure source data collated by the River Basin District Projects for the Article V Characterisation and Programme of Measures Studies. This work Ballymurphyed the NS 2 project team to assess the catchment through the combined availability of aerial imagery and digitised pressure information. Where gaps in this data existed together with areas that required ground truthing such as physical barriers to migration, catchment walkover risk assessments were focussed throughout the 2009 field survey season.

The catchment walkover risk assessment sheet (See Appendix 3) covers eight main categories or pressures which are subsequently sub-divided into the various sources. Each source is ticked if present and an overall risk assessment for each pressure assigned from High to Medium to Low over the survey length or point. All eight pressures are combined to give an overall risk assessment to the catchment based on the “one out all out principle”.

3.0 RESULTS

Figure 1 indicates where the Ballymurphy morphology RHAT assessments were carried out throughout the catchment.

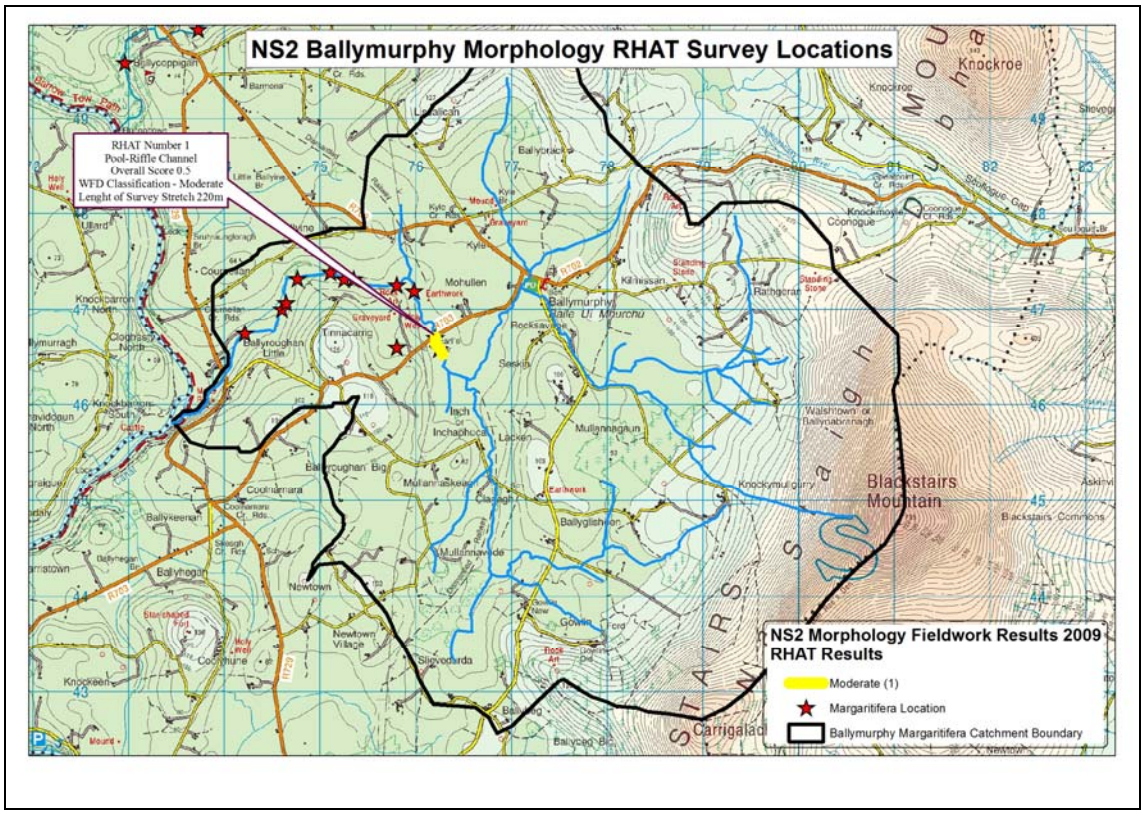


Figure 1 Morphology RHAT Assessment Locations

(The RHAT numbering system corresponds to the site code which may mean they are not sequential where a RHAT was not carried out at a particular site)

3.1 RHAT Survey Results

One RHAT survey was carried out throughout the Ballymurphy catchment within the vicinity of the pearl mussel populations. The results from this survey can be found in the electronic appendix. This survey stretch of 220m was deemed to be at moderate status. This was due to the very poor substrate condition together with the various pressures from the surrounding landuse which is intensive agriculture. Cattle poaching and trampling was evident along both banks with a poor buffer zone. Siltation levels within the channel greatly exceeded the expected values for this river type; however this is largely due to the underlying soil type rather than from a diffuse source. The heavy

siltation has lead to an increased growth of macrophytes along the stretch again at higher levels than you would expect for a river of this type.

Representative photographs from reach:

RHAT 1 	**RHAT 1** 
RHAT 1 	**RHAT 1** 

Details in relation to photographs are tabulated in Appendix 2.

3.1 Catchment Walkover Risk Assessment Results

A total of twelve sites were surveyed in the Ballymurphy sub-basin catchment, with a risk assessment carried out at ten of these sites (two stopping points). **Figure 2** outlines the stopping point locations in addition to the High to Low Risk Assessment from the Catchment Walkover Risk Assessments. Seven high risk sites were recorded out of the ten that were assessed. The remaining three sites were recorded as medium risk, meaning no low risk sites were recorded within this catchment. **Figure 3** outlines the percentage of sites classified at high and medium risk together with the number of stopping points throughout the catchment.

The most common high risk categories identified were:

- Erosion – evident at 100% of high risk sites,
- Diffuse Silt – evident at 86% of high risk sites,

The Current Riparian Zone category of the Catchment Walkover Risk Assessment slightly varies from the seven other categories or pressures. The Current Riparian Zone is not a pressure in itself; however the aspects listed in this category are the interceptors to the pressure and convey the extent or lack of buffer provided by the riparian zone. A high risk riparian zone indicates that the pressures acting on the river are more likely to have significant impact. For example the lack of fencing along a river stretch can lead to excessive trampling and/or poaching which in turn may lead to siltation within a pearl mussel habitat. The various categories and pressures listed in the Catchment Walkover Risk Assessment sheet were designed to assist the project in focussing the measures which will be needed to combat the pressure along its pathway, rather than removing a source which may not always be possible such as intensive agriculture. Recording the Riparian Zone in terms of its current performance as a buffer is important in this regard.

Current Riparian Zone has ten aspects as follows:

- Fencing
- Buffer
- Tree line at bank

- Tree line buffer
- Plantation with no buffer
- Urbanisation
- Flood Protection
- Marshy Land
- Landuse at bank
- Other Sources

Where one or any of these aspects is found to be the cause of significant impact to the riparian zone, or the channel along the stretch then this category may be assigned a high risk score. Within the Ballymurphy catchment the most significant pressures is from intensive agriculture with many of the current riparian zone aspects highlighting the impact this pressure is having such as a lack of fencing where sheep and cattle are grazing. Very poor or small buffer zone beside fields where slurry is being spread and in many areas direct access to the channel by cattle for drinking water. **Figure 3** outlines the percentage number of sites at High, Medium or Low risk. Locations where pressures were evident in the field which were not highlighted through the desk based assessment were also noted as stopping points. These points were not selected prior to fieldwork, they were opportunistic as the catchment drive through was taking place. The pie chart in **Figure 3** also indicates the percentage of stopping points also.

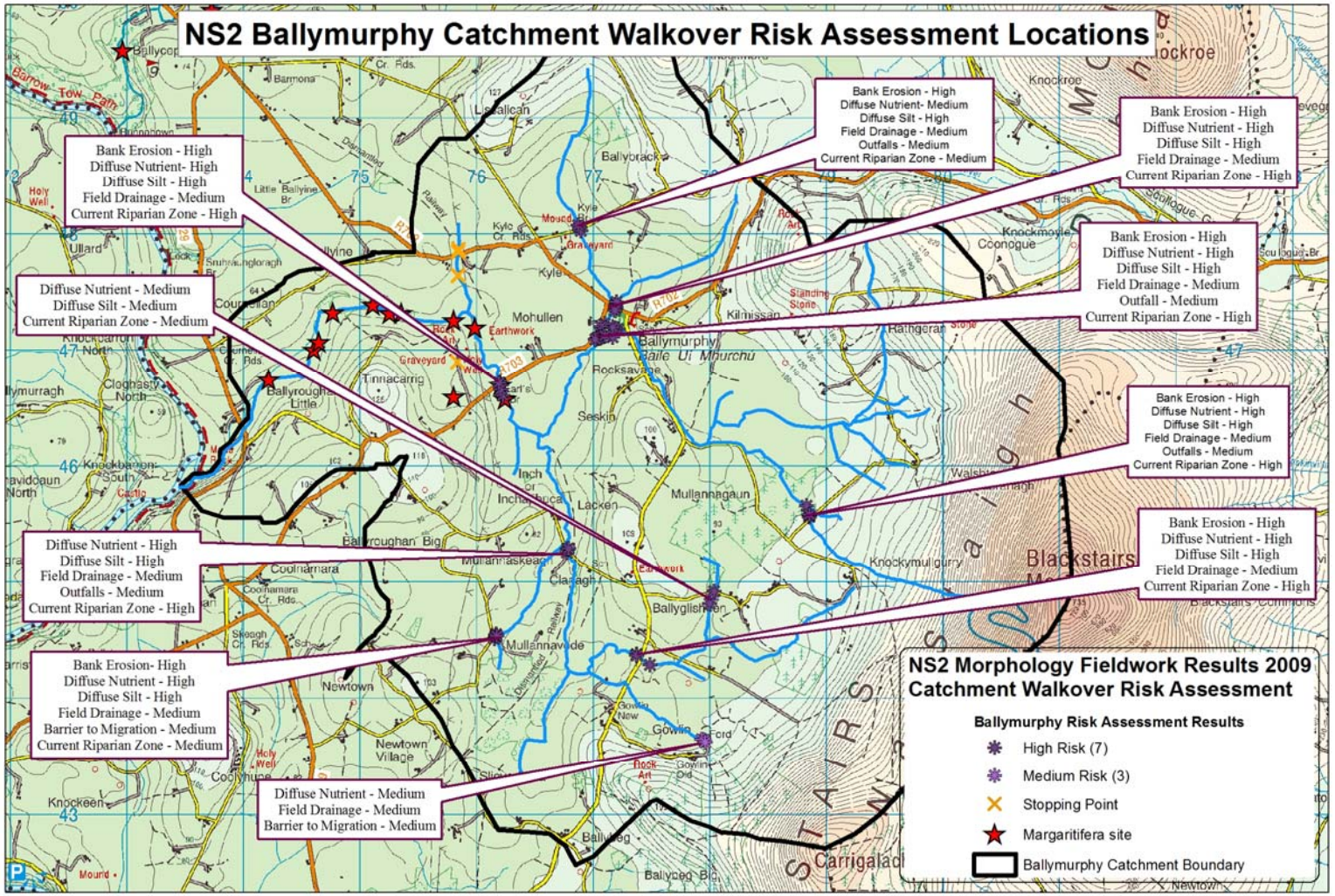


Figure 2 Location of Stopping points and Catchment Walkover Risk Assessments

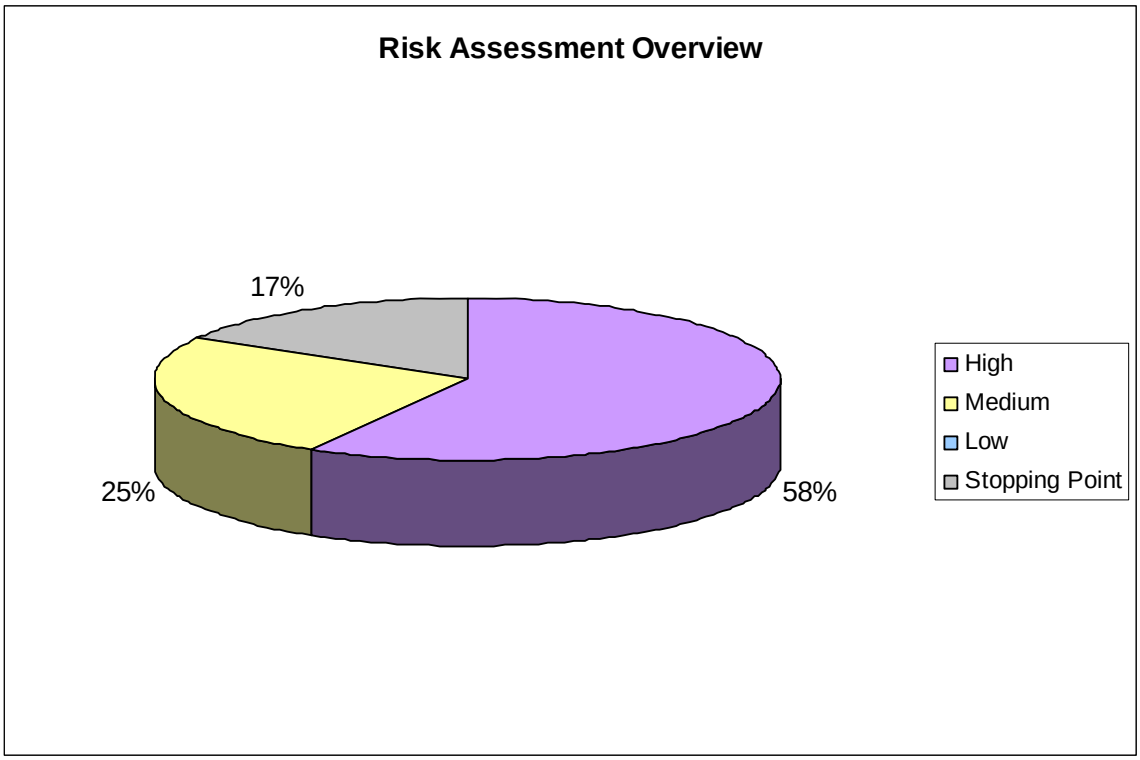
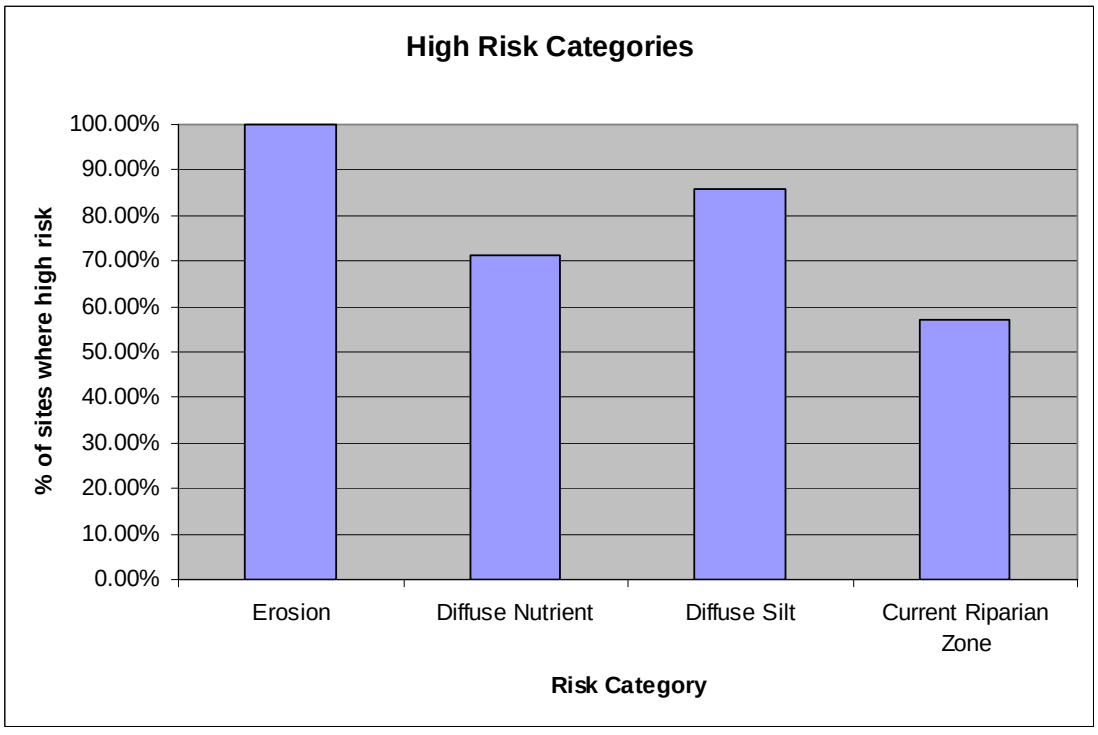


Figure 3. Risk Assessment Overview

The break-down of pressure categories identified as high risk are outlined in Figure 4 with erosion and diffuse silt causing the most problems.

The most common sources of erosion were bank erosion and channel manipulation; each recorded as high risk at six sites. A break-down of the individual sources of erosion at high risk sites is given in Figure 5 below.

Figure 4 Breakdown of High Risk Categories



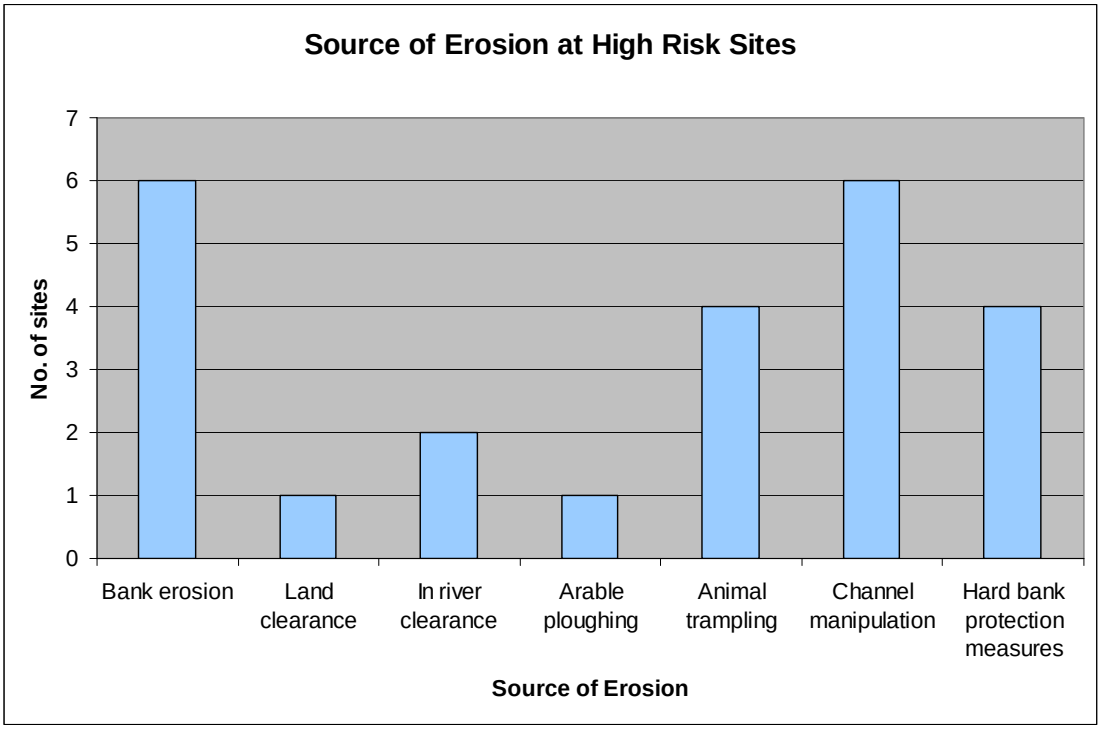


Figure 5 source of erosion at high risk sites

From figure 5 the main source of erosion is largely from bank erosion which is as a direct result of cattle and/or sheep access to the channel for drinking water. This is a significant issue in the Ballymurphy due to the erodible nature of the substrate. The pressure from this animal access is leading to an excessive build up of fine silts in the channel which in turn allows macropytes to take root and expand across the channel.

4.0 CONCLUSIONS

The Ballymurphy sub-basin catchment is a relatively small catchment and as such only one risk assessment was undertaken in the vicinity of Freshwater Pearl Mussel populations, however it is significant that this site was found to be high risk. The sub-basin catchment is in a relatively poor condition from a morphological point of view with erosion an extensive feature throughout the catchment including locations in the upper reaches, in addition seven risk assessments recorded as high risk and three sites at medium risk illustrates the level of extent of risk to Freshwater Pearl Mussel populations within this catchment.

APPENDIX A

RHAT Field Sheet

Field Health and Safety sheet

River Name_____ Site Code_____ Date_____

1 = Low risk 5 = High risk

Please circle applicable number

PARKING	1	2	3	4	5
FENCES/BARRIERS	1	2	3	4	5
GROUND STABILITY	1	2	3	4	5
DENSE VEGETATION	1	2	3	4	5
BANK STEEPNESS OR STABILITY	1	2	3	4	5
RISK FROM ANIMALS	1	2	3	4	5
PHONE COVERAGE	1	2	3	4	5

Previous RHS/RAT/RHAT surveys - year and code _____

Details of access _____

RHAT (VERSION 2)

TRIBUTARY / MAIN CHANNEL*

Site Identification

River Name _____ Site Code _____

Nearest WFD site FF10 _____

Water Body ID _____ Start U / S or D / S*

First IGR _____ Last IGR _____

Bank surveyed from L / R / Both / in-Channel*

Desk-study notes		Field Notes
ACTION TO TAKE PRIOR TO FIELDWORK General overall shape of river Check weirs, impoundments etc. on catchment		River type Date
Floodplain connectivity and land use Expected river type Rain last week Estimated river width Estimated survey length Riparian land cover(s) River Agency designated? Other comments including geology - limestone / siliceous / peat*		Time Surveyors Weather conditions now Estimated river width (m) (average 3 readings) Estimated survey length (m) (40 X wetted width) Estimated river depth (m) Channel characteristics (e.g. different stream types on the reach)
RESULTS		Pressures
Hydromorph score WFD class		*Circle as appropriate

Photograph details include IGR or approximate location

_____

_____

_____

_____

N.B. The survey length should be 40x the wetted width with a minimal stretch of 160m but not exceeding 1km.

NS RHAT

Anthropogenic Impacts

River Name _____ Site Code _____ Date _____

Feature		Tick if present, record as E if > 30%		
Resectioning		None ☐	Left bank ☐	Right bank ☐
Reinforcement		None ☐	Left bank ☐	Right bank ☐
Embankments	NO*	LB ☐	RB ☐	Set back LB ☐ SB RB ☐
Culverts**		Y / N / Unknown*		
Over deepening		Y / N / Unknown*		
Wver widened		Y / N / Unknown*		
Narrowing		Y / N / Unknown*		
Fords**		Y / N*		
		Major	Intermediate	Minor
Bridges**	NO*			
Weirs**	NO*			
Fish Pass**	NO*			

Physical features or resource use if applicable. *

Deflectors / Jetties / Arterial drainage / Side channels / Mid channel bar / Field Drains / Mill Race

Navigation / Fishing / Recreation / Forestry/ Urban / Industry / HEP

Trashline present (height __ m) above water / Buffer zone (LBm / RBm back from water edge)

Other observations - Invasives - Trees - Birds - Pollution indicators - Invertebrates*

Rhododendron / Himalayan Balsam / Japanese Knotweed / Giant hogweed / Snowberry / Cherry-Laurel/ Gunnera

Sycamore / Beech / Conifers / Oak / Ash / Alder / Willow / Birch / Hazel / Hawthorn / Blackthorn / Holly

Heron / Sand martin / Grey wagtail / Dippers / Kingfishers /

Sewage fungus / Diatomaceous algae / Oil / Cladophora / Vaucheria / Dumping / Silt on Substrate

Other comments:

_____

** Circle as appropriate E - extensive. ** Tally as appropriate. LB - left bank / RB - right bank*

RHAT RIVER HYDROMORPHOLOGY ASSESSMENT TECHNIQUE

Field Assessment of Morphological Condition

River Name _____ Site Code _____ Date _____

If river in spate ignore 3 and 4 but deduct individual scores from overall if either feature not visible. Greyed boxes may be scored but note why in Comments/Notes.

	Bedrock	Cascade / Step-pool	Pool-riffle-glide	Lowland Meandering
1. Channel form and flow types	4	4	4	4
2. Channel vegetation	4	4	4	4
3. Substrate condition	4	4	4	4
4. Barriers to continuity	4	4	4	4
5. Bank structure & stability L+R	4	4	4	4
6. Bank vegetation L+R	4	4	4	4
7. Riparian land cover L+R	4	4	4	4
8. Floodplain connectivity L+R	4	4	4	4
TOTAL	32	32	32	32
Hydromorph Score *				
WFD class **				

* Hydromorph score - Assessment score = 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.

SHEET 5

NOTES

APPENDIX 2

PHOTOGRAPHS

Photographs of site locations and catchment pressures on the Ballymurphy River and tributaries 2009. All field work photographs can be found in the accompanying electronic appendix.

Overall Risk * uses the “one out all out” principle

Site No.	Photo No	Bank Erosion	Diffuse Nutrient	Diffuse Silt	Field Drainage	Outfalls	Abstraction	Barrier to Migration	Current Riparain Zone	Risk Overall	Pressure/Photo Details
Site 1	Site 1 Photo 1	High	Medium	High	Medium	Low	Low	Low	High	High	Looking downstream from Earls Bridge - *Ranunculus* growth primarily mid-channel
Site 1	Site 1 Photo 2	High	Medium	High	Medium	Low	Low	Low	High	High	Looking upstream from Earl's Bridge - poaching evident on LB
Site 1	Site 1 Photo 3	High	Medium	High	Medium	Low	Low	Low	High	High	Heavy poaching on RB just upstream of bridge
Site 1	Site 1 Photo 4	High	Medium	High	Medium	Low	Low	Low	High	High	Heavy poaching on RB just upstream of bridge
Site 1	Site 1 Photo 5	High	Medium	High	Medium	Low	Low	Low	High	High	Set back fencing approx. 3 m back from river bank
Site 1	Site 1 Photo 6	High	Medium	High	Medium	Low	Low	Low	High	High	Incoming land drain/field ditch on LB
Site 1	Site 1 Photo 7	High	Medium	High	Medium	Low	Low	Low	High	High	View of land drain and some poaching from RB
Site 1	Site 1 Photo 8	High	Medium	High	Medium	Low	Low	Low	High	High	Excessive *Ranunculus* growth approx. 50m upstream from bridge
Site 1	Site 1 Photo 9	High	Medium	High	Medium	Low	Low	Low	High	High	Localised dumping on LB downstream of bridge
Site 2	Site 2 Photo 1	High	High	High	Medium	Low	Low	Low	High	High	Looking upstream of bridge, water appears cloudy, perhaps channelised in the past
Site 2	Site 2 Photo 2	High	High	High	Medium	Low	Low	Low	High	High	Confluence of tributaries, heavy poaching, *berula erecta* - moderate tolerance to enrichment
Site 2	Site 2 Photo 3	High	High	High	Medium	Low	Low	Low	High	High	Extremely cloudy tributary as you move upstream from main channel
Site 2	Site 2 Photo 4	High	High	High	Medium	Low	Low	Low	High	High	No fencing off on LB looking downstream from bridge
Site 3	Site 3 Photo 1										Dried up river bed upstream of road at dismantled railway line
Site 3	Site 3 Photo 2										Quad biking track confirmed in use as per pressure identified in plans from orthophotos
Site 3	Site 3 Photo 3										Poaching on LB of Tribuatry
Site 3	Site 3 Photo 4										Ford/Crossing point for farmer - cattle in adjacent field

Site 4	Photo 1	High	High	High	Medium	Medium	Low	Low	Medium	High	Looking upstream from Kyle bridge
Site 4	Photo 2	High	High	High	Medium	Medium	Low	Low	Medium	High	Poaching on LB looking downstream
Site 4	Photo 3	High	High	High	Medium	Medium	Low	Low	Medium	High	Recent slurry spreading looking downstream at Kyle bridge
Site 5	Photo 1										Recently reseeded field, looking downstream from road bridge
Site 5	Photo 2										Dry river channel, looking downstream from road bridge
Site 5	Photo 3										Improved grassland field, bare ground patch - source of silt
Site 6	Photo 1	High	High	High	Medium	Medium	Low	Low	High	High	LB looking upstream, old poached out area prior to fencing being put in place
Site 6	Photo 2	High	High	High	Medium	Medium	Low	Low	High	High	Housing development 50m from LB- see notes on catchment walkover risk assessment
Site 6	Photo 3	High	High	High	Medium	Medium	Low	Low	High	High	Excessive *Ranunculus* growth throughout obstructing flow
Site 6	Photo 4	High	High	High	Medium	Medium	Low	Low	High	High	Poaching where access has been fenced off for cattle to drink
Site 6	Photo 5	High	High	High	Medium	Medium	Low	Low	High	High	Confluence where cloudy tributary joins as per Site 2 Photo 3
Site 6	Photo 6	High	High	High	Medium	Medium	Low	Low	High	High	Excessive shading L & RB, causing tunnelling effect
Site 6	Photo 7	High	High	High	Medium	Medium	Low	Low	High	High	Septic tank/Waste water treatment system approx. 10m from LB
Site 6	Photo 8	High	High	High	Medium	Medium	Low	Low	High	High	Stock piles from housing development
Site 6	Photo 9	High	High	High	Medium	Medium	Low	Low	High	High	Stock piles from housing development
Site 6	Photo 10	High	High	High	Medium	Medium	Low	Low	High	High	Storm drain pipe, large black pipe
Site 6	Photo 11	High	High	High	Medium	Medium	Low	Low	High	High	Land drain pipe, yellow perforated pipe
Site 6	Photo 12	High	High	High	Medium	Medium	Low	Low	High	High	Eroding bank on RB
Site 6	Photo 13	High	High	High	Medium	Medium	Low	Low	High	High	FM Environmental Treatment Systems
Site 7	Photo 1	High	High	High	Medium	Medium	Low	Low	High	High	Indication of where flow comes from in heavy rains

Site 7	Site 7 Photo 2	High	High	High	Medium	Medium	Low	Low	High	High	Culverted stream at road crossing
Site 7	Site 7 Photo 3	High	High	High	Medium	Medium	Low	Low	High	High	Poaching LB of river 2m downstream of bridge
Site 7	Site 7 Photo 4	High	High	High	Medium	Medium	Low	Low	High	High	Bank erosion on LB downstream very high on bank indicating high flows at certain times. Heavy siltation.
Site 8	Site 8 Photo 1	Low	Medium	High	Medium	Medium	Low	Low	High	High	Looking upstream from bridge, river has again excessive ranunculus also alot of Apium
Site 8	Site 8 Photo 2	Low	Medium	High	Medium	Medium	Low	Low	High	High	Looking downstream of bridge areas of heavy poaching on left and right bank
Site 8	Site 8 Photo 3	Low	Medium	High	Medium	Medium	Low	Low	High	High	Improved grassland on RB
Site 9	Site 9 Photo 1	Low	Medium	Medium	Low	Low	Low	Low	Medium	Medium	Looking upstream, very narrow channel, slightly shaded
Site 10	Site 10 Photo 1	High	High	High	Medium	Low	Low	Low	High	High	Looking downstream from bridge, extensive bank and channel clearance
Site 10	Site 10 Photo 2	High	High	High	Medium	Low	Low	Low	High	High	Bank cleared, channel manipulation
Site 10	Site 10 Photo 3	High	High	High	Medium	Low	Low	Low	High	High	Looking downstream from bridge, extensive channel manipulation
Site 10	Site 10 Photo 4	High	High	High	Medium	Low	Low	Low	High	High	RB clearance, in channel manipulation. Channelisation. Riparian vegetation removed and placed in stock piles in adjacent field
Site 10	Site 10 Photo 5	High	High	High	Medium	Low	Low	Low	High	High	Entire lenght of tributary looks to be cleared along bank
Site 11	Site 11 Photo 1	Low	Medium	Low	Medium	Low	Low	Medium	Low	Medium	Ford crossing the road
Site 11	Site 11 Photo 2	Low	Medium	Low	Medium	Low	Low	Medium	Low	Medium	Downstream end of ford
Site 11	Site 11 Photo 3	Low	Medium	Low	Medium	Low	Low	Medium	Low	Medium	Upstream end of ford
Site 12	Site 12 Photo 1	High	High	High	Medium	Low	Low	Medium	Medium	High	Source of tributary downstream of road
Site 12	Site 12 Photo 2	High	High	High	Medium	Low	Low	Medium	Medium	High	Source of tributary upstream of road
Site 12	Site 12 Photo 3	High	High	High	Medium	Low	Low	Medium	Medium	High	Looking upstream, looks deepened, channelised
Site 12	Site 12	High	High	High	Medium	Low	Low	Medium	Medium	High	Stockpiles adjacent to river - topsoil

Site 12	Photo 4 Site 12 Photo 4	High	High	High	Medium	Low	Low	Medium	Medium	High	Stockpiles adjacent to river - topsoil

Appendix 3 – Catchment Walkover Risk Assessment Survey Sheet

Sheet 1: Catchment Walkovers	Version 1. 07/04/2009
Tributary/Main Channel*	
Site Identification	
River Name	Site Code
Water Body ID	Start U/S or D/S*
First site IGR	Last site IGR
Bank surveyed from L/R/In-channel*	
Photograph details include IGR or approximate location.	

* Select as appropriate

	Present?					
	Yes	No		Grid Reference of specific pressure	No.of Photographs	Comments
Source of Erosion						
Bank erosion						
Land clearance						
In river clearance						
Arable ploughing						
Animal trampling						
Fords						
Channel manipulation						
Hard bank protection measures						
Other sources						
Overall Risk	High	Medium	Low			
Diffuse Nutrient						
Arable						
Grazing						
Improved grassland						
Silage						
Forestry						
Housing						
Industry and associated works						
Other sources						
Overall Risk	High	Medium	Low			
Diffuse Silt						
Arable						
Grazing						
Over-grazing						
Improved grassland (Re-seeding)						
Forest						
Silage						
Industry						
Construction stages						
Housing						
Infilling						
Peat cutting						
Quarries						
Other sources						
Overall Risk	High	Medium	Low			

	Present?					
	Yes	No		Grid Reference of specific pressure	No.of Photographs	Comments
Current Riparian Zone						
Fencing						
Buffer						
Tree line at bank						
Tree line buffer						
Plantation with no buffer						
Urbanisation						
Flood protection						
Marshy land						
Landuse at bank						
Other sources						
Overall Risk	High	Medium	Low			
Field Drainage						
Ditch managed						
Ditch unmanaged						
Drainage on high slope						
Drainage on low slope						
Land drainage (perforated pipes)						
Other sources						
Overall Risk	High	Medium	Low			
Outfalls						
Industrial discharges						
Storm drains						
Culvert outfalls						
Other sources						
Overall Risk	High	Medium	Low			
Abstractions						
Small						
Large						
Overall Risk	High	Medium	Low			
Barriers to migration						
Culverts						
Bridge aprons						
Weirs						
Stone weirs						
Other sources						
Overall Risk	High	Medium	Low			