Provision of silt traps- Monitoring Report

Action C4

LIFE09 NAT/IE/000220 BLACKWATER SAMOK

July 2015

The IRD Duhallow LIFE Project is supported through the LIFE financial instrument of the European Community.

Contents

Executive Summary

A key aim of this action was to develop and place wetlands and silt traps to intercept soiled water from forestry drains.

Walkover surveys at the onset of the project identified that farm drains were a major source of silt to the River Allow. It was estimated that 86 of farm drains were discharging directly into the SAC, with 30 actively eroding.

A survey of silt traps already in place in the upland area of the Allow catchment receiving drainage water from forestry found that 55% were not functionally optimally and needed to be services on a more regular basis.

The project found that the risk of silt loss and damage to the SAC increased with drainage maintenance of the opening drains.

The DuhallowLIFE project developed a project innovation "silt trapping technique" for farmland drains, which was found to be effective in entrapping silt before it was transferred thorough the farm drain network to the SAC.

Initial plans to develop large wetlands which could function as water attenuation areas met with difficulties due to licensing concerns (SPA and SAC with different criteria and environmental windows).

A customised technique was developed to place small attenuation wetlands in forest drainage networks using a novel approach.

Background

Field Drain Silt Trapping

Agricultural drainage is practiced worldwide (Oosterbaan, 1994). It is one of the main measures of improving farmland as many sectors in agriculture benefit from reduced water levels in soil (Oosterbaan, 1994; Burdon, 1986). If drainage is implemented and sustained in an effective manner it can increase productivity and improve grazing conditions on heavy, wet soils (Touhy *et al.*, 2012).

In some soils, the natural drainage processes are sufficient for growth and production of agricultural crops, but in many other soils, artificial drainage is needed for efficient agricultural production (EPA, 2012). The soils in the Allow Catchment are poorly drained with low permeability subsoils. This has led to artificial drainage being common place along the Allow River and the presence of significant pathways for nutrients and sediment entering the main channel (Tedd, 2014).

Under the Drainage (Ireland) Act of 1842 many river catchments were modified. Consequent drainage schemes added to the decline of many of the lowland rivers (Anon., 2010). Farm drains that flow directly into streams and rivers have the potential to carry silt and nutrients in the main channel which can reduce water quality (Busman & Sands, 2012; NZ Landcare Trust, 2010). Instream habitats can be affected by agricultural drainage (Blann, *et al.*, 2009) and can be detrimental to aquatic species such as Atlantic salmon and Freshwater pearl mussel (Extence, *et al.*, 2013;Convery, 2013; Anon, 2010; Heywood & Walling, 2007)

A walkover survey of the Allow River in 2009 (Anon., 2010) listed field drainage as one of seven high risk categories affecting Freshwater Pearl Mussels. The study also found that field drainage was evident at 20% of high risk sites.

The DuhallowLIFE project (LIFE09 NAT/IE/000220 Blackwater SAMOK) identified six newly opened or newly cleaned drains that had the potential to add significant amounts of sediment to the Allow. Silts trapping systems (*See appendix*) were installed to prevent material from entering the main channel.

Forestry Drain Silt Trapping

The potential environmental impacts from forestry includes alterations to the site hydrology particularly in peatland areas, potential increased run off during wet weather, increased nutrient loading, increased acidification over certain soil and bedrock types, and siltation associated with forestry operations (planting, thinning, road building and harvesting) (Rodgers, et al., 2008). The latter is potentially the greatest issue for established forestry operations in upper River Allow catchment. Anon (2010) states that the "threat from forestry operations in pearl mussel catchments can be significant"

Road/Trackside forestry drains tend to be more shallow that agricultural drains. Hence, a different approach to the installation of silt boxes was explored. A silt trapping technique was developed and trialled in a forestry drain near the source of the River Allow.

This document reports on the efficacy of this innovative system on three of the six sites treated. These three sites have continuous flows and therefore carry material to the main channel continually. The other three are dry drains (only flow during heavy rain events). This document also illustrates the development and trialling of a silt trapping pool using grassed up geotextile bags in a forestry drain.

Site Description

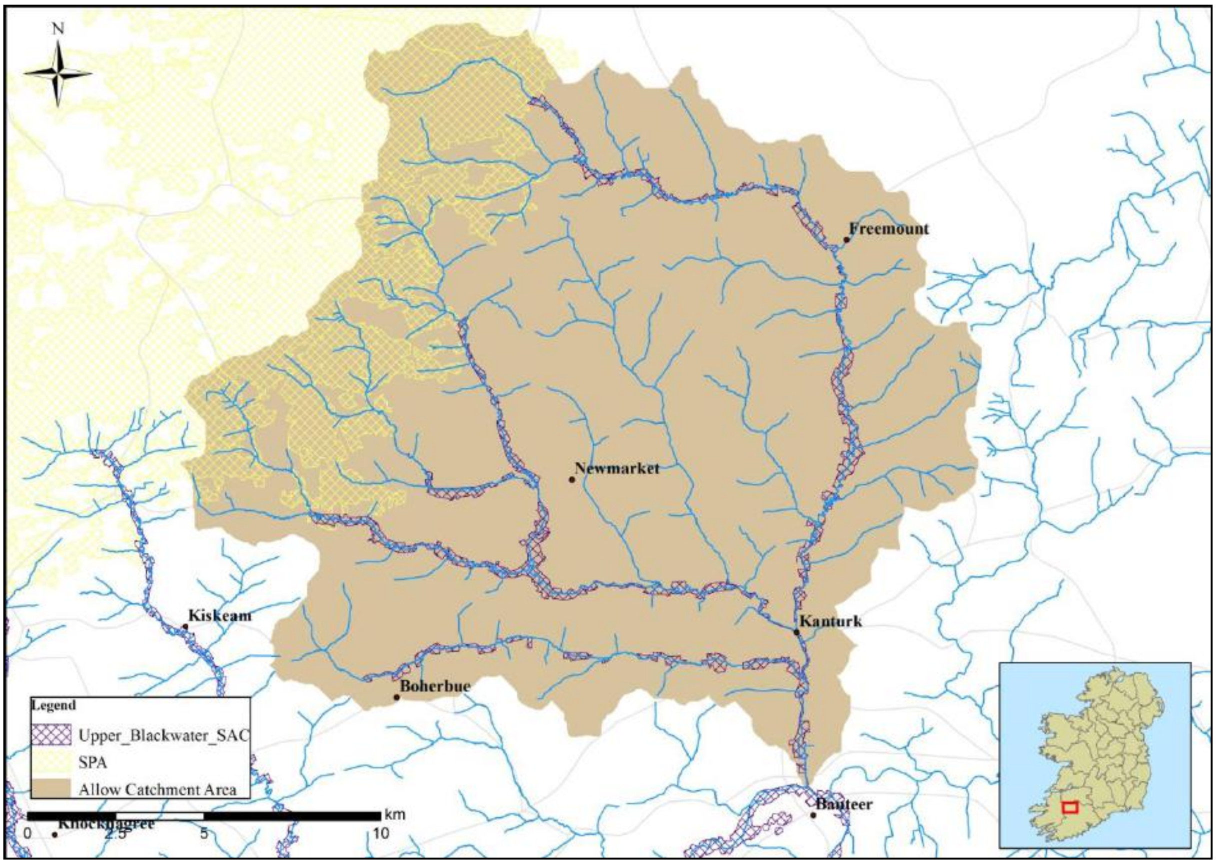

Figure 1 River Allow catchment area

The River Allow catchment is 310km^2 (*Figure 1*). The three major rivers that drain the catchment are the Allow, Dalua and Brogeen. The main agricultural land use in the catchment is pasture with dairying and sucklers forming the majority of farming practices.

The majority (70%) of the soils in the Allow catchment are deep, poorly drained mineral soils. Blanket peat covers approximately 5% of the catchment, mostly in upland reaches. Mineral alluvium is associated with the river channels, while shallow well drained mineral soils make up the remaining soil type in the catchment (EPA/Teagasc, 2006; Tedd, 2014).

The River Allow catchment rivers (Allow, Dalua, Brogeen, Glenlara and Owenkeale) form part of the Blackwater River (Cork/Waterford) Special Area of Conservation (Natura 2000 site code: 002170). These tributaries provide important habitat for Freshwater pearl mussel *Margaritifera margaritifera*, Atlantic salmon *Salmo salar* and European otter *Lutra lutra*, all of which a listed in the Annex II of EU Habitats Directive.

The upper reaches of the Allow catchment contain the Stack's to Mullaghareirk Mountains, West Limerick Hills and Mount Eagle Special Protection Area, which was designated as such for Hen Harrier *Circus cyaneus* (listed in Annex I of the EU Bird's Directive)

Methods

Field Drain Silt Traps

Six drains/small streams had silt traps installed. All silt trapping systems were installed in freshly cleaned out drains or small streams. Three drains are dry for most of the year and three have a constant flow of water. The latter will, for the rest of this document, be referred to as streams.

The silt trapping systems, or treatment trains, that were installed in the streams were maintained and emptied as required. On two occasions, silt boxes in two treatment trains were found to be covered. The material was prevented from entering the main channel due to the structure of the silt traps. The weight of the excess material was calculated and added to the total amount of material trapped.

As the water in these streams has a constant flow, material such as silt and gravel was carried towards the main channel of the Allow River. The silt boxes were installed to prevent the majority of this material from entering the main channel and posing a risk to salmon spawning beds and juvenile freshwater pearl mussels.

- The percentage of fine materials trapped in the three stream treatment trains was extrapolated from samples taken
- The weight of material trapped by the silt traps in the streams, and prevented from entering the main channel, was also extrapolated from these samples. As was the extra excess sediment caught in the traps.

Forestry Drain Attenuation

Bags made of biodegradable geotextile were assembled on the grounds of the James O'Keeffe Institute and filled with gravel, sand and compost, following a modified procedure outlined by Alexander (2003). Wild grass seed was also added to the compost to encourage quick growth of leaf and root. The bags were then transported to a forestry drain, which was adding sediment to the main channel, in the Mullaghareirk Mountains near the source of the River Allow (ITM: 528590,619358).

Once the drain was cleared of overhanging vegetation, the bags were then installed in a layered manner so to create a wall at the downstream end of the pool (Figure 11 - Appendix). The bed of the drain was then partially excavated, by hand, to create a pool.

The geotextile bags are designed to decompose over time, leaving an earthen bank to attenuate water and prevent silt and other fine materials entering the main channel. As the water builds up clean water will filter through the bank and even spill over the top. The method can be used as best practice in other forestry drains as it is a straightforward, low maintenance technique at trapping silt.

Results

Farm Drain Silt Traps

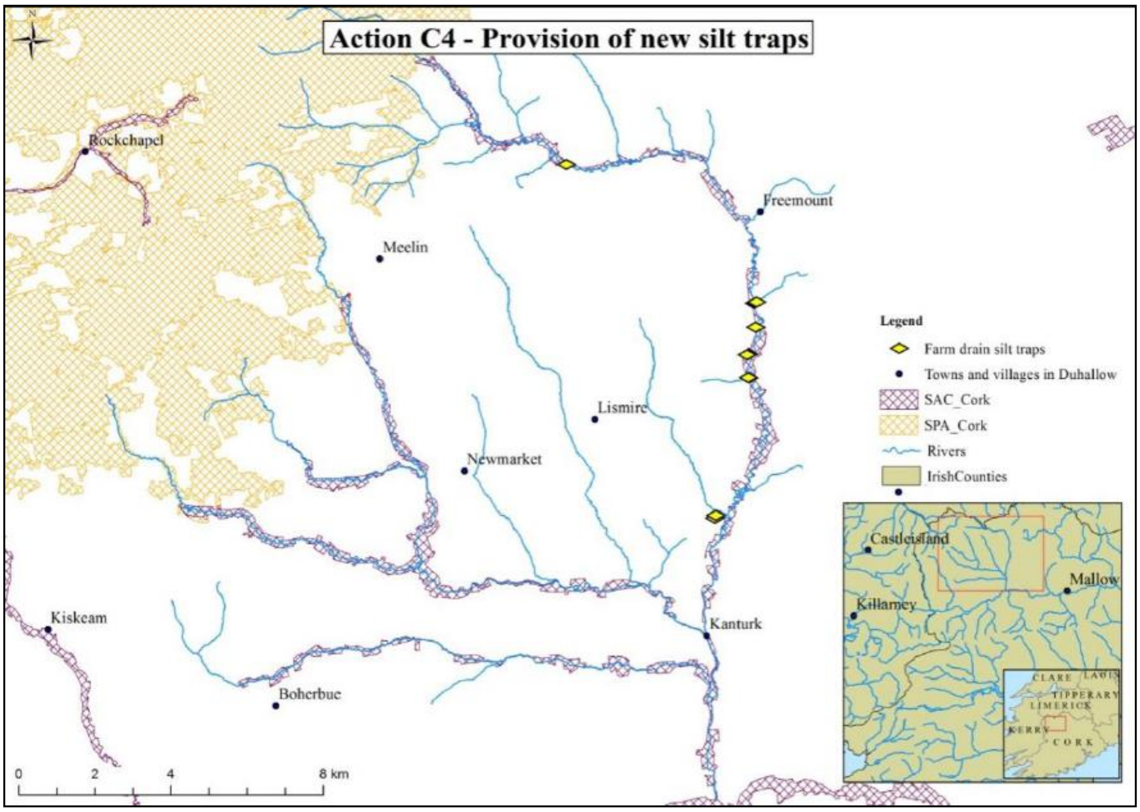

Figure 2 Locations of silt traps installed by the LIFE project along the Allow River

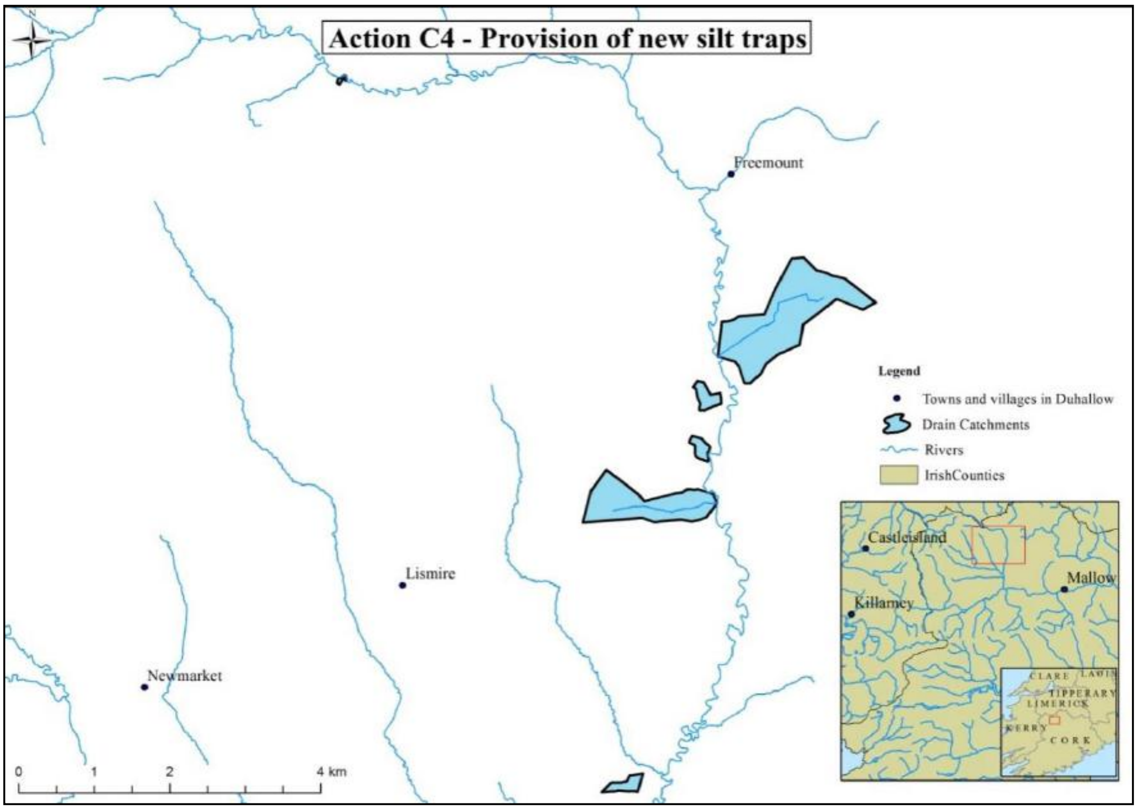

Figure 3 Size and extent of the catchments of each drain and stream treated with silt traps

Table 1 Details of the six sites where silt traps were installed along the Allow River

Location (ITM)	Rathranna (538463, 606388)
Drain Catchment Area (ha)	6.89
Date installed	10/10/2013
Volume of box (m^3)	0.165
Height of drain (m)	1
Length of drain/stream (m)	694
	415
Closest trap to river (m)	216
Location	Bawnmore South (539305, 609928)
Drain Catchment Area (ha)	68.54
Date installed	28/08/2013
Volume of box (m^3)	0.165
Height of drain (m)	1.2
Length of drain/stream (m)	1454
Closest trap to river (m)	104
Location	Curraheen (539281, 610537)
Drain Catchment Area(ha)	5.35
Date installed	28/08/2013
Volume of box (m^3)	0.081
Height of drain (m)	0.7
Length of drain/stream (m)	380
Closest trap to river (m)	25
Location	Kilknockane (539495, 611902)
Drain Catchment Area(ha)	7.83
Date installed	27/05/2013
Volume of box (m^3)	0.165
Height of drain (m)	0.5
Length of drain/stream (m)	450
Closest trap to river (m)	140
Location	Kilberrihert (539490, 611902)
Drain Catchment Area(ha)	129.31
Date installed	09/05/2013
Volume of box (m^3)	0.165
Height of drain (m)	0.8
Length of drain/stream (m)	1874
Closest trap to river (m)	25
Location	Knockskavane (534524, 615516)
Drain Catchment Area(ha)	0.71
Date installed	14/09/2013
Volume of box (m^3)	0.165
Height of drain (m)	0.8
Length of drain/stream (m)	165
Closest trap to river (m)	2.5

Table 2 Dates when the silt traps in the streams were emptied

Location	Bawnmore South
Date	02/09/2013
	18/03/2014
	07/04/2014
	02/09/2014
	03/02/2015
Total times emptied	**5**
Location	**Curraheen**
Date	02/09/2013
	18/03/2014
Total times emptied	**2**
Location	**Kilberrihert**
Date	22/05/2013
	12/03/2014
	26/04/2014
	09/03/2015
Total times emptied	**4**

Table 3 Weights and volumes of samples taken from each stream silt trap. Total amount of material retained in each trap was extrapolated from these weights and volumes.

Silt Trap Sample	Wet (kg)	Dry (kg)		Water Content (%)	Silt Content (%)	Volume (m^3)	Extrapolated weigh for silt box (kg)	Wet weight (kg)
Bawnmore South Upper	**1.85**	**1.77**		4.29	8.40	**0.00112**	**260.586**	271.77
		1.40	2.8mm			0.00084		
		0.23	1mm			0.00016		
		0.11	300µm			0.00008		
		0.03	<300µm			0.00004		
Bawnmore South Middle	**1.56**	**1.27**		18.75	14.06	**0.00108**	**193.106**	229.32
		0.54	2.8mm			0.00035		
		0.54	1mm			0.00052		
		0.17	300µm			0.00018		
		0.005	<300µm			0.00002		
Bawnmore South Lower	**1.45**	1.20		20.93	15.27	**0.00111**	**177.995**	215.25
		0.52				0.00034		
		0.49				0.00042		
		0.17				0.00018		
		0.012				0.00016		
Curraheen (Upper)	**1.61**	**1.22**		24.22	57.50	**0.0014**	**68.989**	85.70
		0.007	2.8mm			0.00014		
		0.51	1mm			0.00043		
		0.61	300µm			0.00073		

		0.09	<300μm			0.00013		
Curragheen (Lower)	**0.89**	**0.61**				**0.00083**	**59.689**	78.82
		0.089	2.8mm			0.00015		
		0.22	1mm	32.06	49.04	0.00026		
		0.27	300μm			0.00030		
		0.02	<300μm			0.00011		
Kilberrihert (Upper)	**1.24**	**0.75**				**0.00060**	**206.955**	272.49
		0.26	2.8mm			0.00018		
		0.24	1mm	31.67	33.26	0.00016		
		0.18	300μm			0.00018		
		0.067	<300μm			0.00006		
Kilberrihert (Mid)	**1.39**	**0.944**				**0.00095**	**164.226**	217.31
		0.56	2.8mm			0.00024		
		0.21	1mm	32.33	17.43	0.00043		
		0.11	300μm			0.00016		
		0.04	<300μm			0.00011		
Kilberrihert (Lower)	**1.25**	**0.82**				**0.00139**	**97.126**	130.58
		0.22	2.8mm			0.00035		
		0.37	1mm	34.45	27.20	0.00056		
		0.14	300μm			0.00041		
		0.08	<300μm			0.00006		

Table 4 Sediment and fine material weights extrapolated from samples taken from each silt trap

Silt Trap Sample	Number of times emptied	Extrapolated weight of sediment for trap (kg)	Extrapolated mass of fines (kg)	Percentage Fine material (< 1mm)
Bawnmore South (Upper)	5	1302.93	109.50	8.40
Bawnmore South (Mid)	5	965.53	135.78	14.06
Bawnmore South (Lower)	5	889.98	135.88	15.27
Curraheen (Upper)	2	137.98	79.33	57.50
Curraheen (Lower)	2	119.38	58.55	49.04
Kilberrihert (Upper)	4	827.82	275.31	33.26
Kilberrihert (Mid)	4	656.91	114.47	17.43
Kilberrihert (Lower)	4	388.50	105.68	27.20

Table 5 Extrapolated weight of excess material removed from treatment trains

	Volume of excess material removed (m^3)	Weight of excess material removed (kg)
Bawnmore South (Lower)	0.282	303.848
Bawnmore South (Mid)	0.045	52.665
Bawnmore South (Upper)	0.225	355.344

Kilberrihert (Upper)	0.054	67.73089161
Kilberrihert (Mid)	0.054	53.74678609
Kilberrihert (Lower)	0.054	31.78674104

Table 6 Total amount of sediment and instream material prevented from entering the main Allow River channel.

Site	Weight of material removed (kg)
Bawnmore South	3870.30
Curragheen	257.36
Kilberrihert	2026.49

Forestry Drain Attenuation

Figure 4 RSS participants installing hemp back, filled with gravel, sand, compost and grass seeds, on the downstream end of the pool dug into the bed of the train.

Figure 5 Five months after the geotextile bags were inserted. Note the water retention and the grass growth on the bags (which are now indistinguishable).

Figure 6 Side-view of where the geotextile bags were place five months previous. (Note the algal growth in the retained water, indicating the attenuation of not only silt and water but also of nutrients).

Conclusion

Two of the three streams (Bawnmore South and Kilberrihert) that had treatment trains installed had historically been straightened (OSI, 2015). Straightening a channel can increase the slope of it bed. Consequently, the channel will erode the river or streambed and carry this sediment and material further downstream (Environment Agency, 2013; Mihov & Hristov, 2011). These two streams if left untreated with the silt trap system developed by the LIFE project would have added more than 5.8t of sediment and loose material to the Allow River.

One of these streams, Bawnmore South, prevented 3.87t from entering the main channel. The silt traps installed in this stream retained over 380kg of fine materials (sediment less than 1mm in diameter). The treatment train in this stream was installed in August 2013. In the than two years it trapped 3870.30kg of material. The location at which this stream enters the Allow is the one of the most important sites for Freshwater pearl mussels in the catchment. The project team counted over 650 individual mussels within 60m downstream of where the stream enters the main channel.

The stream at Kilberrihert would have transported over 2t of material into the Allow were the silt traps not in place. The drain was cleared in 2013 and before the treatment drain was installed high volumes of silt and fine materials must have been washed into the Allow River. In the two years that the treatment train has been in place 495.46kg of fine materials have been trapped. Approximately 380m upstream of where the stream enters the Allow is a site with high levels of erosion. The drain at this point is over 4m deep. This may be due to the straightening of the stream in the past and the source of much of the material that has been caught in the silt traps.

The stream at Curragheen from which the final sediment samples were taken is a narrow stream approximately 75cm in width. It is less disturbed that the other two streams; Bawnmore South has cattle entering it upstream of the project works as has Kilberrihert. Kilberrihert has the aforementioned deep eroding action. Both silt traps at Curragheen, on average, recorded over their sampled volumes as having over 50% fine materials.

It was stated that the sheer size of silt trap required to improve freshwater pearl mussel habitat and reach favourable conditions were impractical (Magee, M., 2013). The results of this study shows that a treatment train of three silt traps, as long as it is maintained, has the potential to prevent over 2t of sediment from entering a river over a two-year period. In plain terms; a well maintained treatment train of silt traps can prevent one tonne a year from causing potential harm to freshwater pearl mussels and fish spawning grounds.

The silt trapping procedure that was done at the forestry drain has the potential to become best practice for silt and water attenuation in the forestry sector. This is especially the case post clear-felling when soils are exposed and the risk of river channel siltation increases. While only one forestry drain was treated in this manner, its development and trial was an indicator of the efficacy at retaining of silt and nutrients (Figure 6).

The forestry and agricultural drains, that were treated by the project, enter the River Allow SAC. Siltation and nutrient enrichment for agriculture and forestry are two of the biggest threats facing freshwater pearl mussels (Anon., 2010). Hence, there is a requirement for the continual maintenance of each of the two designs of silt traps.

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Appendix

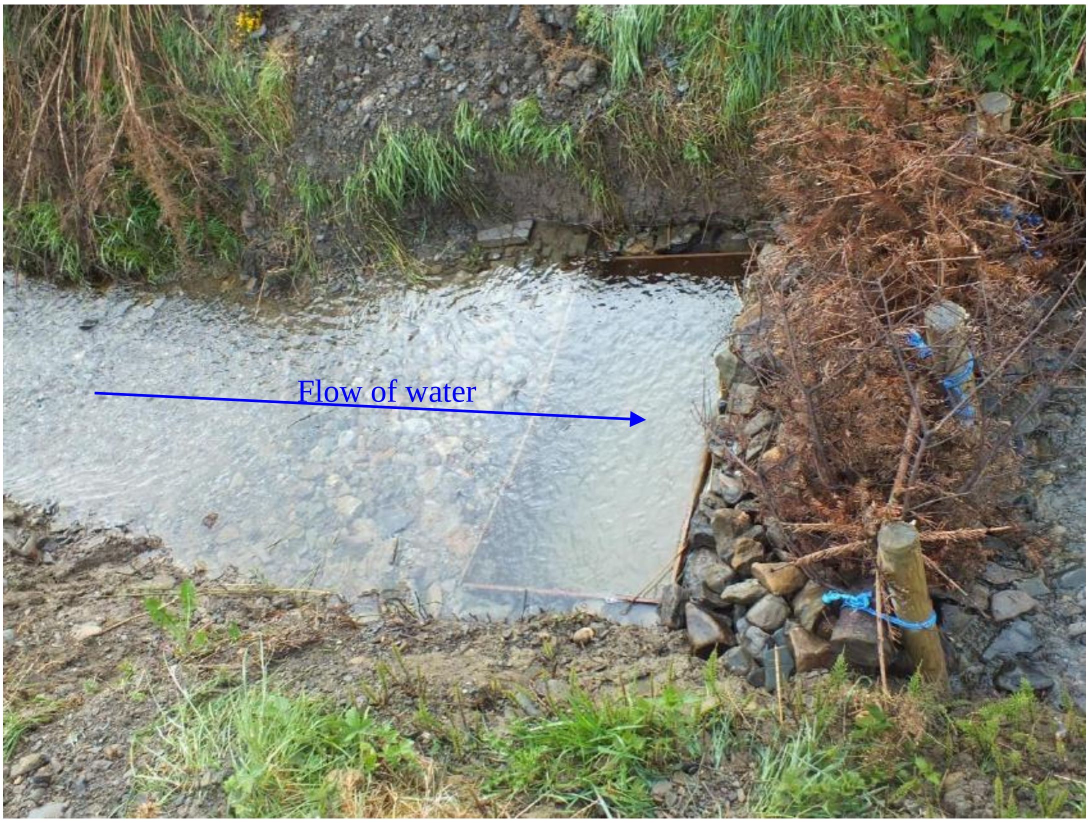

Figure 7 Silt trap installed in stream at Kilberrihert

Figure 8 Upstream view of the treatment train installed at Kilberrihert

Figure 9 Hessian bag trialled to assess the growth of grass through the material. (Ten days after grass seeds were applied).

Figure 10 Same hessian bag with grass growth after three weeks.

Figure 11 Construction of water attenuation pool