APPENDIX 3-1

2020 PRELIMINARY WATERCOURSE, OTTER AND MACRO INVERTEBRATE ASSESSMENT

Preliminary Watercourse, Otter and Macro-Invertebrate Assessment

Environs of the Meenbog Wind Farm, Shruhangarve Stream and Mourne Beg River, Co. Donegal

DOCUMENT DETAILS

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Planning and Environmental Consultants

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1. INTRODUCTION

Following a peat slide at the site of the Meenbog Wind Farm on or around the 12th November 2020, a large volume of peat entered the Shruhangarve Stream and from there entered the Mourne Beg River.

Planree Limited (the wind farm developers) have commissioned MKO to:

1. Establish the baseline ecological conditions within the river (post event)
2. Assess the environmental damage to protected habitats and species caused as a result of the peat slide.
3. Consider measures that could be employed to ameliorate any impacts
4. Monitor conditions within the river in the long term.

As a preliminary step in this process, ecologists from MKO completed ecological walkover surveys, and kick sampling for macro-invertebrates at various locations along the Mourne Beg River and it's tributaries. These surveys were designed to be a rapid assessment, with the information gained to be used to inform the scope of any further or additional surveys that may be required to fully assess the nature, scale and extent of any environmental damage that may have occurred as a result of the peat slide. Any further surveys will be designed in collaboration (where possible) with various environmental/ecological agencies that have an interest in the Mourne Beg River including Donegal County Council, the Loughs Agency and the Environmental Protection Agency.

This report provides the details of the surveys that were undertaken and draws some preliminary conclusions as to the ecological impact of the peat slide on the receiving environment and the scope of any further surveys required. It provides no assessment of the impact of the peat slide on fisheries. Preliminary fisheries impact assessments are proposed for the coming months.

1.1 Statement of Authority

The ecological surveys were undertaken between the 14th and the 17th of December 2020 by Pat Roberts B.Sc. (Env.) MCIEEM Pat has over 15 years' post graduate experience in ecological consultancy and impact assessment. He has conducted numerous ecological walkover surveys and river habitat surveys. He is experienced in surveying for aquatic macro-invertebrates and Q value assessments.

2. METHODOLOGY

2.1 Ecological Walkover and Otter Surveys

2.1.1 Location of walkover surveys

Ecological walkover surveys were undertaken on the Mourne Beg River both upstream and downstream of the Meenbog wind farm and included sections of the Bunadowen River and the Shruhangarve Stream, which discharge water to the Mourne Beg River from the wind farm site. The sites of all the walkover surveys are provided on Figure 2.1.

2.1.2 Methodology and Limitations

The multidisciplinary walkover survey was conducted in line with NRA (2009) guidelines (*Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes*). In most cases, one bank of the river was walked and notes made of the river habitats present, the bankside and surrounding vegetation, any signs of faunal activity with particular reference to otter (*Lutra lutra*). In particular, note was taken of any signs of peat/fibrous material present on the bank and in the watercourses, that may have arisen as a result of the peat slide. It is noted that these surveys were undertaken approximately one month after the peat slide and following an extended period of high rainfall and high water levels in the rivers. Water levels were moderate during the survey period. The water levels in the Mourne Beg and its tributaries rise and fall very fast after precipitation and surveys were abandoned on the 16th December 2020 due to high water levels. Water levels had receded sufficiently to allow surveys to resume on the 17th December.

It is likely that much of the peat that had discharged to the river as a result of the peat slide had been washed out during the high flows that preceded the survey. It is similarly likely that any bankside signs of otter activity would have been washed away during high water levels that preceded the surveys.

It is noted that the walkover survey was undertaken outside the optimum period for habitat surveys as set out in '*Best Practice Guidance for Habitat Survey and Mapping*' (Smith et al., 2011), though this was not regarded as a significant constraint to the survey as all the habitats were readily identifiable during the survey in December 2020.

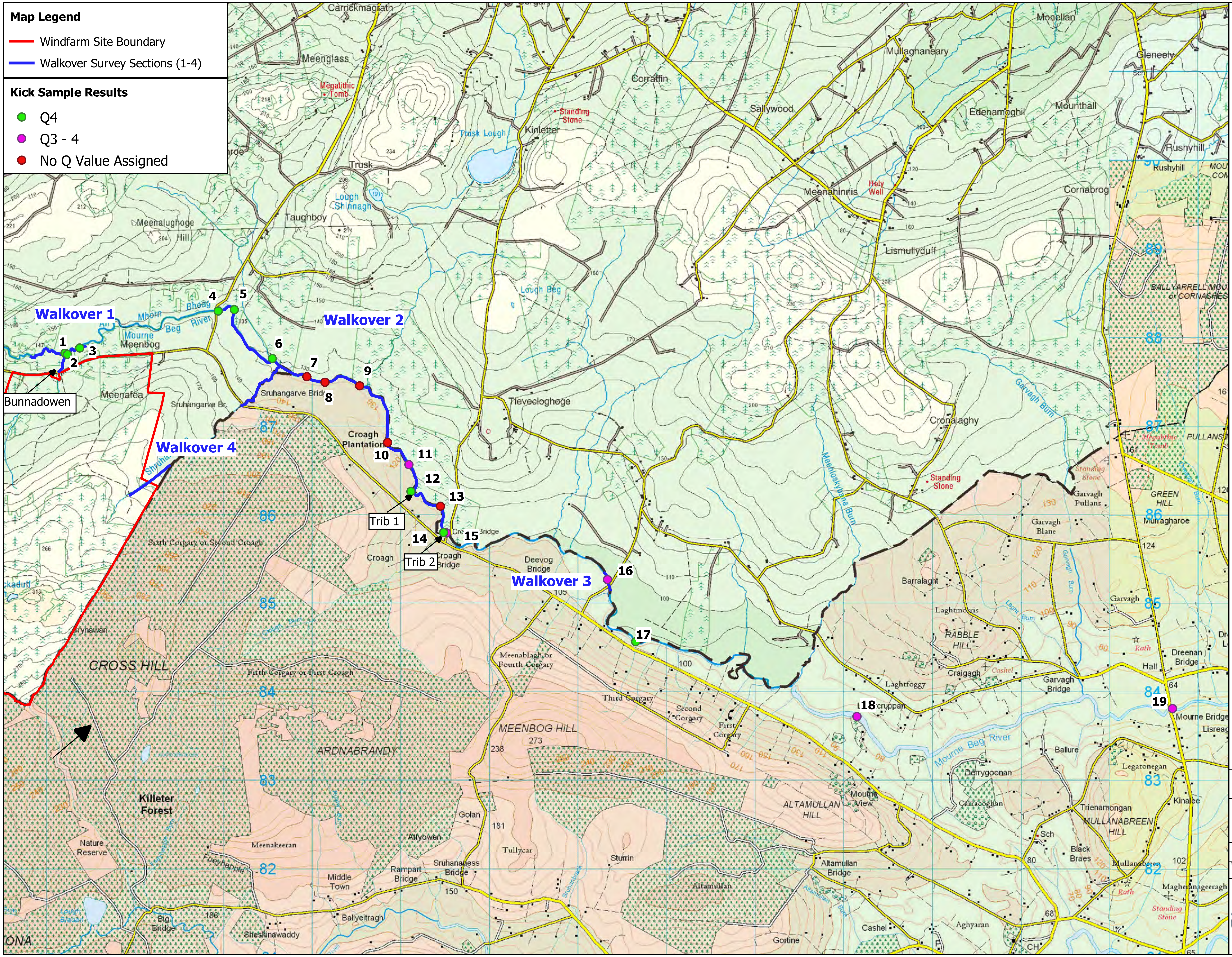
2.2 Aquatic Macro-Invertebrate Surveys

2.2.1 Location of Aquatic Macro-Invertebrate Surveys

Nineteen kick samples were undertaken on the Mourne Beg River both upstream and downstream of the Meenbog wind farm and included surveys of the Bunadowen River and the Shruhangarve Stream, which discharge water to the Mourne Beg River from the wind farm site. Surveys were also undertaken on two un-named streams downstream of the Shruhangarve. The sites of all the Macro-Invertebrate surveys are provided on Figure 2.1.

2.2.2 Methodology

The surveys undertaken involved the selection of suitable survey sites with water depths of >0.8m and riffle and/or glide habitats present. Three one minute kick samples were collected from representative sections of the stream bed within the survey area with a standard handnet (250 mm x 250 mm, with a 300 mm bag depth and a 1 mm mesh size). Rock washing was also carried out. The aquatic



Drawing Title: Ecological Survey Locations

Project Title: Meenbog Wind Farm

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LK	PR
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macroinvertebrates were then counted and assessed in the field. A representative number of the samples were collected and stored in a 70% alcohol solution and the subject of further examination.

Q values were assigned as per the EPA Publication 'Water Quality in Ireland 2001 – 2003' (Toner et. Al. 2003). The methodology for sampling differed slightly from the above in order to be more comparable with the methodology set out in the standard UK River Prediction and Classification System (RIVPACS). The deviation involved and increase in the duration of the kick sample to three minutes.

It is noted that the Macro-invertebrate sampling was undertaken outside the recommended survey period for RIVPACS assessment. However, the purpose of the survey was to provide some baseline information as to the ecological status of the river following the peat slide and to provide a preliminary overview of the nature and extent of impact on the river's macro-invertebrate communities. It is recommended that further, more detailed macro-invertebrate surveys be undertaken as part of the ongoing monitoring of the river in spring and summer 2021 As such, the timing of the surveys was not considered to be a significant constraint.

3. RESULTS

3.1 Walkover Surveys

3.1.1 Walkover Survey Section 1

This survey section covered a distance of approximately 750m of the Mourne Beg River and started approximately 500m upstream of the confluence with the Bunadowen River and ended approximately 750m downstream of it. It also included a section of the Bunadowen River of approximately 230m in length, running from the public road to the south and extending to the confluence with the Mourne Beg. Both banks of the Bunadowen River were walked but only the right bank (south) of the Mourne Beg was surveyed. This survey section was upstream of the peat slide.

3.1.1.1 Bankside Habitats

The habitats surrounding the river were dominated by forestry and peatlands, with rank wet grasslands that are dominated by Soft Rush (*Juncus effuses*) bordering the channel over much of the section. There was evidence of recent floods or high water on the banks in the form of deposition of vegetation/sediments and flattened rushes throughout the section.

3.1.1.2 River Channel

The channels of both the Mourne Beg and Bunadowen Rivers were typical of upland rivers with fast flowing, highly coloured (from peat) but relatively clear waters. The channels of both rivers appeared to be largely unchanged through drainage or modification with an apparently natural morphology with riffle, glide and pool features evident throughout. Drainage channels from the surrounding lands (forestry and peatlands) entered the river at various locations. Instream vegetation was limited to aquatic bryophytes with few bryophytes. There was little algae in either river, but this may be a function of the time of year that the surveys were undertaken, with higher levels of algae potentially present in the summer months.

The substrate of the Mourne Beg appeared to be very clean and free from silt, whereas there was light siltation in places in the Bunadowen.

3.1.1.3 Otter Survey

No signs of otter activity were recorded during this walkover survey though it is likely that the species is present in the area. There had been recent high water levels that could potentially have washed away signs of the species that may have been present.

Plate 3-1. Mourne Beg River immediately upstream of the confluence with the Bunadowen River. Glide and Riffle with surrounding rank grassland and forestry.

3.1.2 Walkover Survey Section 2

This survey section included approximately 4.5km of the Mourne Beg River from the road bridge at Meenbog (Grid Ref: E209914 N388332) to the next road bridge downstream (Grid Ref E212533 385773). It included approximately 1.2km upstream of the confluence with the Shruhangarve Stream (where the discharge from the peat slide entered the Mourne Beg) and 3km downstream thereof. The survey was conducted mainly from the right (south western) bank.

3.1.2.1 Bankside Habitats

The habitats surrounding the stream were dominated by forestry and peatland with rank wet grassland adjoining the bank in many areas. The bankside habitats showed evidence of recent high waters in the form of deposition of vegetation and sediments and the flattening of rushes. However, there was no obvious or discernible difference between the bankside habitats upstream and downstream of the Shruhangarve with the exception of around the confluence with the Sruhanagrve. Plate 3-2 shows the bankside close to the Meenbog road bridge, upstream of the Shruhangarve and unaffected by the peat slide. Plate 3-3 shows the levels of deposition at the confluence of the Shruhangarve with the Mournebeg, where localised bankside deposits were identified. No significant impacts on the bankside habitats were identified during the walkover survey.

Plate 3-2. Bankside upstream of the Shruhangarve and unaffected by the peat slide.

Plate 3-3. Bankside at the confluence between the Shruhangarve and the Mourne Beg Rivers

3.1.2.2 River Channel

As with Survey Section One, this section of the river channel appeared to be a relatively unmodified upland river with a range of naturally occurring series of riffle, glide and pool features along with some steeper sections that form cascades and one waterfall. One objective of the survey was to assess whether the peat slide had resulted in any significant hydromorphological impact on the Mourne Beg River resulting from the deposition of large volumes of peat within the channel, potentially altering the course or flow patterns within the channel. On the preliminary walkover survey, no evidence of large scale deposition of peat that may have resulted in significant changes to the channel hydromorphology were identified. Further survey and assessment is required to confirm this. There were no large areas where peat or sections of bog had lodged within the channel causing changes or obstruction of the flow. The only such feature was recorded upstream of the Shruhangarve, where the channel was not affected by the peat slide. This was a small section of bog (or bankside habitat) that had been washed into the channel. It is shown in Plate 3-4. There was no obvious covering of silts on the gravels within the channel either upstream or downstream of the Shruhangarve with the gravelly substrate clearly visible. However, during the course of the kick sampling that was undertaken, it became apparent that there was a significant difference in the amount of a fibrous, organic peaty material present within the gravels when comparing samples upstream and downstream of the Shruhangarve. This was not visible when undertaking the walkover survey but was evident by the content of material within the kick samples. Plate 3-5 shows a typical kick sample tray from upstream of the Shruhangarve with very clean gravels and little fibrous peaty material. Plate 3-6 shows a typical kick sample tray from downstream of the Shruhangarve with high levels of such material. Whilst there is always variability between the amount of organic material in a kick sample due to the location and nature of the sample station, it was clear in this case that:

1. Levels of fibrous material generally decreased the further downstream of the Shruhangarve that the sample was taken.

2. Samples taken upstream of the Shruhangarve and in tributaries downstream did not contain the elevated levels recorded in the Mourne Beg downstream of the Shruhangarve.

Plate 3-4. Section of bog/bankside habitat that was washed into the stream upstream of the Shruhangarve and not associated with the peat slide.

Plate 3-5. Kick sample located upstream of the Shruhangarve showing clean gravels with little fibrous peaty material.

Plate 3-6. Kick sample located downstream of the Shruhangarve showing high levels of fibrous peaty material.

3.1.2.3 Otter Survey

The survey site included two bridges, numerous rocks within the channel and other potential sprainting sites. The two bridges were thoroughly checked for spraint along with many of the rocks and other potential sprainting sites. No evidence of otter activity was recorded in this survey section, either upstream or downstream of the Shruhangarve. No spraints, tracks, couches, holts, paths or any other signs were identified. As with Survey Section 1, it is considered likely that the species is present in the area and the high water levels that preceded the survey are noted.

3.1.3 Walkover Survey Section 3

This survey Section included a distance of approximately 200metres surrounding a road bridge that is located approximately 5.8km downstream of the Shruhangarve (Grid Ref:E214373 N385174). The survey was conducted on both banks.

3.1.3.1 Bankside Habitats

The habitats alongside the river at this location were dominated by wet grasslands that included species such as soft rush (*Juncus effuses*) and creeping bent (*Agrostis stolonifera*). There were sporadic bankside trees including ash (*Fraxinus excelsior*) and grey willow (*Salix cinerea oleifolia*). There were signs of recent high water including the deposition of vegetation and sediments. However, these were consistent with similar features recorded upstream of the Shruhangarve and no impacts of the peat slide on the bankside habitats were evident during the walkover survey. This section is shown in Plate 3-7.

Plate 3-7. Mourne Beg River at Survey Section Three

3.1.3.2 River Channel

This section of a channel was wider than those surveyed upstream and had a less upland character and greater conveyance. Several tributaries and numerous field drains had entered the Mourne Beg River between Survey Sections 2 & 3. As with the above sections of channel, there was no visible signs of there being any significant hydromorphological alteration to the river and no evidence of mass peat deposition or the covering of the substrate with a blanket of sediment. However, as with all the previous kick samples taken within the Mourne Beg downstream of the Shruhangarve, there was evidence of fibrous peaty material collected in the pond net. The measurement of this was subjective but, it was less apparent than in samples taken further upstream.

3.1.3.3 Otter Survey

A number of fresh otter spraints and oily secretions were recorded under the bridge on the left (northern) bank of the river (See Plate 3-8). No other signs of this species were recorded at this location.

Plate 3-8. Otter signs under bridge at Survey Section 3

3.1.4 Walkover Survey Section 4

This survey section includes sections of the Shruhangarve Stream from the wind farm site itself to the confluence with the Mourne Beg River. The stream was walked from the most downstream part of the wind farm infrastructure (Grid Ref:208930 N386186) downstream for a distance of approximately 400 metres. It was then walked from the public road (Grid Ref:210201 N387209) for a distance of approximately 650 metres until its confluence with the Mourne Beg River.

3.1.4.1 Bankside habitats

The habitats alongside the bank of the Shruhangarve Stream consisted of forestry plantation in the southern sections of the survey section. Proceeding to the north/downstream, the stream is surrounded by blanket bog habitats. Large deposits of peat were recorded on either side of this stream. These deposits consisted both very soft and wet peat along with large sections of more solid peat with surface vegetation attached. These had been deposited both within the stream channel and on both banks. In places, the deposition spread up to a maximum of approximately 15 metres from the stream, though over much of the section it was less than 5 metres. In some areas, there were deep accumulations of peat on the banks with up to 0.5 metres of wet peat deposited. In other areas, the rushes which surround the stream were visible through the peat. Typical images of the Shruhangarve Stream are shown on Figures 3-9 and 3-10.

Plate 3-9. Shruhangarve Stream and peat deposited on its bank as viewed from upstream of the public road, facing downstream

Plate 3-10. Shruhangarve Stream as viewed from the public road

3.1.4.2 Stream Channel

The Shruhangarve Stream is at most approximately 2.5metres wide and is narrower over much of its course. It is a steep channel in which there are many rocks and boulders. Whilst the water flowing in the stream was not carrying a large sediment load during the surveys (as evidenced in the water quality data collected by MKO for Planree Ltd. for the corresponding period), the stream bed was obscured by deposited peat in many areas. This was evidenced when attempting kick samples within the stream. In addition, in some areas, depositions of peat have obscured the channel and altered the flowpath over short sections. There have been hydromorphological and physical changes to sections of this stream and whilst it appears relatively stable (in terms of not continuing to release sediment to the downstream catchment), it is unclear whether these changes will be short term or will persist for a longer period and the significance is yet to be determined.

3.1.4.3 Otter Survey

No signs of otter were recorded along this stream, as may be expected given the extent of impact to the stream itself and to the bankside habitat. It should be noted that this stream is very small and during fisheries surveys that were carried out in advance of construction, was not found to contain Salmonid fish (none were recorded in the electro-fishing undertaken though a single Eel (*Anguilla Anguilla*) was recorded). Whilst otter may use the stream to some extent, it is unlikely to provide significant habitat for the species.

3.2 Macro-Invertebrate Surveys

The Q value assessment of each of the 19 sites surveyed is provided in Table 3.1 below along with an indication of where the sample was taken in relation to the Shruhangarve Stream and a rationale in relation to the assessment. The location of each sample is shown on Figure 2.1. The samples that were assigned a Q value of 4 (unpolluted) are shaded in green in both Figure 2.1 and Table 3.1 below. Those samples that were assigned a Q value of 3/4 (Slightly Polluted) are shaded in purple and those where no Q value was assigned because the density of all species was so low that there was no appreciable community structure within the sample are shaded in red. Kick sample results are provided in Appendix 1.

These preliminary results indicate that the Mourne Beg River has a largely unpolluted status upstream of the Shruhangarve Stream but that there is a dramatic reduction in the density and diversity of aquatic macro-invertebrates downstream of it for a distance of approximately three kilometres. Throughout this section of the river there was high levels of fibrous peaty material within the gravels (though not forming a blanket covering thereon. Moving further downstream, the density and diversity of invertebrates within the kick samples increased and the amount of fibrous material decreased. In sample number 17 that was located approximately 6.4km downstream of the Shruhangarve Stream, a Q value of 4 was assigned as the density and diversity of invertebrates indicated unpolluted waters and the levels of fibrous, peaty material in the water were visible but slight. The remaining two sample stations (18 & 19) were assigned Q3/4 on the basis of the invertebrate communities and conditions recorded, though there were no obvious features to indicate that these conditions may have been caused by the peat slide (such as fibrous, peaty material) and were not indicative of the pre-peat slide baseline.

The Shruhangarve Stream was impacted to such an extent that a three minute kick sample was not possible and that any kick sample undertaken involved the suspension of fibrous peat which filed and clogged the pond net. No invertebrates were recorded during attempts to sample this stream.

Table 3.1 Macro Invertebrate Survey Results

Sample Station and QValue	Location in relation to Shruhangarve	Rationale for Assigned Value
001 Q4	Mourne Beg upstream of both Shruhangarve and Bunadowen	Q4 is assigned based on the presence of at least one Group A species in fair numbers with Group B Species also recorded in fair numbers and few Group C. Group D or E invertebrates were absent from the sample
002 Q4	Bunadowen at confluence with Mourne Beg	Q4 is assigned based on the presence of at least one Group A species in fair numbers with Group B Species also recorded in fair numbers and few Group C. Group D or E invertebrates were absent from the sample. Diversity within the sample was low.
003 Q4	Mourne Beg downstream of confluence with Bunadowen	Q4 is assigned based on the presence of at least one Group A species in fair numbers with Group B Species also recorded in fair numbers and few Group C, D or E. Diversity was relatively high with 8 taxa recorded

004 Q4	Mourne Beg at public road bridge approx.. 1.1km upstream of the Shruhangarve EPA monitoring Point: RS01MO10200	Q4 is assigned based on the presence of at least one Group A species in fair numbers with Group B Species also recorded in fair numbers and few Group C. Group D or E invertebrates were absent from the sample. Diversity was low with only 4 taxa recorded.
005 Q4	Mourne Beg approx. 900m upstream of the Shruhangarve Stream	Q4 is assigned based on the presence of at least one Group A species in fair numbers with Group B Species also recorded in fair numbers and few Group C. Group D or E invertebrates were absent from the sample. Diversity was low with only 2 taxa recorded in fair numbers and very low numbers of only three additional taxa recorded.
006 Q4	Mourne Beg immediately upstream of the Shruhangarve Stream	Q4 is assigned based on the presence of at least one Group A species in fair numbers with Group B Species also recorded in fair numbers and few Group C. Group D or E invertebrates were absent from the sample.
007	Mourne Beg approximately 400m downstream of the Shruhangarve Stream	No Q value assigned as only one individual animal was recorded in the sample. It is considered that the one individual Plecopteran that was recorded was likely to have washed into the area. This sample was not retained but, there is potential for Oligochaeta to have been present but not recorded due to the fibrous material (this was the case in other samples that were retained and analysed in the lab)
008	Mourne Beg approximately 570m downstream of the Shruhangarve Stream	No Q value assigned as the density of all species was so low that there was no appreciable community structure. Oligochaeta were present in the sample and their extent was only apparent when studied in the lab (obscured by the fibrous peaty material)
009	Mourne Beg approximately 1km downstream of the Shruhangarve Stream	No Q value assigned as the density of all species was so low that there was no appreciable community structure. Oligochaeta were present in the sample but may have been more abundant and not recorded in the field due to the amount of peaty material in the sample. The sample was not retained.

010	Mourne Beg approximately 1.9km downstream of the Shruhangarve Stream	No Q value assigned as the density of all species was so low that there was no appreciable community structure.
011 Q 3/4	Mourne Beg approximately 2.3km downstream of the Shruhangarve Stream	Q Value of 3/4 assigned as there was a Group A taxon represented in fair numbers and the density was slightly low compared to samples taken upstream of the Shruhangarve. The substrate was rocky but contained fibrous material – lowering the Q Value
012 Q4	Tributary of Mourne Beg approximately 2.3km downstream of the Shruhangarve Stream	Q Value of 4 assigned as there were Group A and Group B taxa represented in fair numbers. This tributary was not affected by the peat slide
013	Mourne Beg approximately 2.9km downstream of the Shruhangarve Stream	No Q value assigned as the density of all species was so low that there was no appreciable community structure. This sample was taken in deep glide habitat and the water was slightly slower flowing than in the samples that had been taken in riffle habitats. There was more deposition of fibrous material in this section than in upstream samples. The sample was not retained but it is likely that a higher density of species may have been recorded if it were analysed in the laboratory.
014 Q4	Tributary of Mourne Beg approximately 3.2km downstream of the Shruhangarve Stream	Q Value of 4 assigned as there were Group A and Group B taxa represented in fair numbers along with Group B. This tributary was not affected by the peat slide
015 Q3/4	Mourne Beg approximately 3.3km downstream of the Shruhangarve Stream	Q Value of 3/4 assigned as there were Group A, Group B and Group C taxa represented in fair numbers but there was a high degree of siltation in the form of fibrous peaty material that lowered the Q value. It should be noted that this sample was taken immediately downstream of the inflow of a tributary stream and this may have influenced the conditions in the stream in two ways. Firstly, the inflow of clean water could have lowered the impact of any pollution event and secondly, there could have been some

		inflow of invertebrates from the tributary into the main channel of the Mourne Beg.
016 Q3/4	Mourne Beg approximately 5.6km downstream of the Shruhangarve Stream	Q Value of 3/4 assigned as there was only Group A invertebrates recorded in fair numbers with all other taxa represented in very low numbers and an overall low density of invertebrates. In addition, there was evidence of some fibrous material in the smple. Overall, although sensitive (Group A invertebrates were recorded in fair numbers, the low density of invertebrates recorded and the fibrous peat recorded lowered the Q Value from 4 to 3/4.
017 Q4	Mourne Beg approximately 6.4km downstream of the Shruhangarve Stream	Q Value of 4 assigned as there 2 taxa from Group A represented in fair numbers with fair numbers of Baetis recorded also. Density was far higher in this sample than in those recorded upstream (even above the Shruhangarve). There was slight siltation but much less than encountered in the samples upstream. A number of small tributaries discharge into the Mourne Beg upstream of this sample point.
018 Q3/4	Mourne Beg approximately 9.5km downstream of the Shruhangarve Stream	Q Value of 3/4 assigned as although there is a taxon from Group A represented in fair numbers with fair numbers of Baetis recorded also, density and diversity of invertebrates was not as high in this sample as in Station 17. In addition, there was accumulation of leaf litter in the sample, likely caused by the overhanging trees at the sample site.
019 Q3/4	Mourne Beg approximately 14km downstream of the Shruhangarve Stream	Q Value of 3/4 assigned as taxa from Group A were represented in low numbers with numerous Group C taxa *Baetis* and *Gammarus* recorded. No signs of excessive fibrous peaty material were recorded in this sample.

3.2.1 Sampling in the Shruhangarve Burn

Sampling was attempted at several locations within the Shruhangarve Burn. At no location was a three minute kick sample possible without the pond net becoming filled with fibrous, peaty material. Any kick samples that were undertaken were of a shorter duration and no invertebrates were recorded in any of the samples. No Q value was assigned.

4. CONCLUSIONS

4.1 Bankside Habitats

- Following the walkover surveys, it is confirmed that there were no significant residual impacts on the bankside habitats surrounding the Mourne Beg River. The walkover surveys revealed similar levels of deposition of vegetation and sediment upstream and downstream of the Shruhangarve (discharge from peat slide). It is acknowledged that the walkover surveys were undertaken approximately one month after the event and that there had been a period of high water levels preceding the survey but nonetheless, there were very few signs of any impact to bankside habitats along the Mourne Beg.
- Whilst the peat slide does not appear to have resulted in impacts on the banks of the Mourne Beg River, there is potential to enhance habitats within the river and riparian zone through potential management of the drains that run into the river, stabilisation of eroding banks or through the planting and management of bankside vegetation.
- The bankside habitats surrounding the Shruhangarve Stream were highly impacted by the peat slide and large depositions of peat were recorded on both banks. Whilst this appeared relatively stable and not particularly susceptible to erosion, it should be monitored and if necessary managed to avoid run off and to promote bankside regeneration. In many areas, the vegetation alongside the bank was starting to regenerate and grow through the deposited peat. This is likely to increase during the spring and summer. If, following monitoring, management would prove beneficial, options that could be considered include, planting of vegetation, stabilisation of the peat with biodegradable matting or similar, peat removal or temporary silt fencing.

4.2 River Channel

- Following the preliminary walkover survey of the Mourne Beg River, no significant hydromorphological impacts on the river channel were immediately apparent. Further, more detailed surveys may be required to confirm this.
- The walkover survey recorded clear waters with no obvious turbidity or sediment load indicating that there was not a significant ongoing discharge of silty water from the Shruhangarve into the Mourne Beg River. This is confirmed in the ongoing monitoring that is being continually undertaken by MKO on behalf of Planree Limited.
- Preliminary surveys recorded no blanket depositions of silt or peat within the Mourne Beg and it is assumed that much of the peat that entered the system remained in suspension and was washed through during the period of heavy rain following the event. Fibrous, peaty material was recorded among the gravels during the kick samples undertaken. The impact of this material on the aquatic life in the river is as yet unknown and further studies are proposed to assess the impact on fisheries and aquatic species.
- The preliminary walkover survey did not assess the impact of the peat slide on fisheries. It is known that the Loughs Agency carried out a fisheries assessment of the Mourne Beg and further, fisheries assessments are proposed over the coming months to fully assess the impact of the peat slide on salmonid fish, lamprey, eel and other sensitive aquatic receptors.
- There have been effects on the substrate and hydromorphology of the Shruhangarve Stream. These will be fully assessed, monitored and where appropriate, remediated. This stream was known to support eel, but salmonid species and lamprey had not been previously recorded within it. Detailed fisheries assessments will be carried out on this stream over the coming months to fully assess the impact of the peat slide on fisheries and aquatic life therein.

4.3 Otter

- Few signs of otter were recorded during the surveys undertaken. However, it is noted that the species is likely to be present in the area and it is acknowledged that there had been a period of high rainfall and water levels in the weeks preceding the survey.
- Given the lack of impact to bankside habitats, it is unlikely that the peat slide would have impacted in any way on availability of breeding, resting or commuting habitat within the Mourne Beg River.
- This preliminary survey did not assess the impact of the peat slide on fisheries. There is the potential that the peat slide had a significant effect on fisheries. This could affect prey availability for otter populations and further detailed assessment of the impact on fisheries and thereby on otter is proposed.
- The Shruhangarve is a small upland stream and whilst it may have been used by otter to some extent, it is unlikely to have provided significant habitat for the species.

4.4 Macro – Invertebrate Sampling

- The preliminary surveying shows a clear difference in the density and diversity of aquatic macro-invertebrates between the samples that were taken upstream of the Shruhangarve and those taken downstream of it to a distance of approximately 3km.
- No Q values were assigned to a number of the samples in this area as no appreciable community structure was evident in the samples and densities of invertebrates were very low.
- Moving downstream, the effects were less apparent. However, it is acknowledged that the surveys are not compared against any pre peat slide baseline.
- The preliminary samples indicate that an event occurred and that its effect on macro-invertebrates gradually decreased with distance and with the inflow of tributary streams into the Mourne Beg.
- Whilst this shows that an impact on water quality occurred, the survey undertaken constitutes a rapid and preliminary assessment and in addition, does not provide an assessment on the impact on fisheries.
- Further, more detailed surveys of macro-invertebrates are proposed to fully assess the effect of the peat slide thereon and to monitor recovery of the watercourse. Similarly, fisheries assessments are proposed over the coming months to assess the impact of the peat slide on salmonids, lamprey, eel and other sensitive aquatic receptors.

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APPENDIX 1

KICK SAMPLE DATA

Station 1. Mourne Beg River Upstream of Confluence with Bunadowen

Table 1.1 Station One Results

Description of River at Station	This section of the river is located upstream of the confluence of the Bunadowen with the Mourne Beg River. The sample was taken in riffles. At this location the river is approximately 5 metres wide and was on average 0.25m deep at the time of the survey. The substrate was loose and was comprised of clean cobbles, gravels and fine gravels with little silt or sand. There was very little algal growth and instream vegetation was scarce. The bankside habitats included forestry and bog with some pasture lands. The water was clear but highly coloured with peat.
Grid Reference (Irish Grid)	E208207 N387821
Degree of Siltation	There was very little siltation or fibrous material within the stream
Density of Invertebrates	Average (for an upland stream)
Diversity of Invertebrates	Average (for an upland stream)

Invertebrates present		
Indicator Group	Taxon	Dominance
Group A (Most Sensitive to Pollution)	Plecoptera (Non Leuctra)	Numerous (21 -50%)
Group B (Moderately Sensitive to Pollution)	Trichoptera (Cased)	Common (6-20%)
	Plecoptera - Leuctra	Common (6-20%)
Group C (Moderately Pollution Sensitive)	Trichoptera (Caseless)	Few (1 -5 individuals)
	Coleoptera	Few (1 -5 individuals)
	Ephemoroptera – *Baetis rhodani*	Few (1 -5 individuals)
	Chironomidae	Few (1 -5 individuals)
Group D (Very Pollution Tolerant)		Absent
Group E (Most Pollution Tolerant)		Absent

Q Value Rating and Justification	Q4 is assigned based on the presence of at least one Group A species in fair numbers with Group B Species also recorded in fair numbers and few Group C. Group D or E invertebrates were absent from the sample

Station 2. Bunadowen at confluence with Mourne Beg

Table 1.2 Station Two Results

Description of River at Station	This section of the river is located on the Bunadowen, just upstream of its confluence with the Mourne Beg River. The sample was taken in riffles. At this location the river is approximately 5 metres wide and was on average 0.25m deep at the time of the survey. The substrate was loose and was comprised of clean cobbles, gravels and fine gravels with slight siltation. There was very little algal growth and instream vegetation was scarce. The bankside habitats were dominated by forestry. The water was clear but highly coloured with peat.
Grid Reference (Irish Grid)	E208233 N387806
Degree of Siltation	There was slight siltation within the stream
Density of Invertebrates	Average (for an upland stream)
Diversity of Invertebrates	Low (3 taxa)

Invertebrates present		
Indicator Group	Taxon	Dominance
Group A (Most Sensitive to Pollution)	Plecoptera (Non Leuctra)	Numerous (21 -50%)
Group B (Moderately Sensitive to Pollution)	Plecoptera - Leuctra	Common (6-20%)
Group C (Moderately Pollution Sensitive)	Trichoptera (Caseless)	Few (1 -5 individuals)
Group D (Very Pollution Tolerant)		Absent
Group E (Most Pollution Tolerant)		Absent

Q Value Rating and Justification	Q4 is assigned based on the presence of at least one Group A species in fair numbers with Group B Species also recorded in fair numbers and few Group C. Group D or E invertebrates were absent from the sample. Diversity within the sample was low.

Station 3. Mourne Beg Downstream of Confluence with Bunadowen

Table 1.3 Station Three Results

Description of River at Station	This section of the river is located on the Mourne Beg River, downstream of the confluence with the Bunadowen River. The sample was taken in riffles. At this location the river is approximately 7 metres wide and was on average 0.3m deep at the time of the survey. The substrate was more compacted than in survey stations 1 and 2 and was comprised of boulders and cobbles with few gravels and fine gravels. There was very little siltation. There was very little algal growth and instream vegetation was scarce but included aquatic bryophytes. The bankside habitats were dominated by forestry and bog. The water was clear but highly coloured with peat.	
Grid Reference (Irish Grid)	E208373 N387879	
Degree of Siltation	There was little or no siltation within the stream	
Density of Invertebrates	Average (for an upland stream)	
Diversity of Invertebrates	High (for an upland stream)	
Invertebrates present		
Indicator Group	**Taxon**	**Dominance**
Group A (Most Sensitive to Pollution)	Plecoptera (Non Leuctra)	Numerous (21 -50%)
	Ephemoptera - Heptagenidae	Few (1 -5 individuals)
Group B (Moderately Sensitive to Pollution)	Plecoptera - Leuctra	Common (6-20%)
	Trichoptera (Cased)	Common (6-20%)
Group C (Moderately Pollution Sensitive)	Trichoptera (Caseless)	Few (1 -5 individuals)
	Diptera - Simulidae	Few (1 -5 individuals)
	Ephemeroptera – *Baetis rhodani*	Few (1 -5 individuals)
Group D (Very Pollution Tolerant)		Absent
Group E (Most Pollution Tolerant)	Oligochaeta	Few(1 -5 individuals)
Q Value Rating and Justification	Q4 is assigned based on the presence of at least one Group A species in fair numbers with Group B Species also recorded in fair numbers and few Group C, D or E. Diversity was relatively high with 8 taxa recorded	

Station 4. Mourne Beg at Public Road Bridge Upstream of Sruhangarve

Table 1.4 Station Four Results

Description of River at Station	This section of the river is located on the Mourne Beg River, just downstream of the road bridge that is upstream of the confluence with the Shruhangarve. The sample was taken in riffles and glides. At this location the river is approximately 7 metres wide and was on average 0.4m deep at the time of the survey. The substrate was comprised of boulders, cobbles and. There was very little siltation. There was very little algal growth and instream vegetation was scarce but included aquatic bryophytes. The bankside habitats were dominated by forestry and bog. The water was clear but highly coloured with peat.
Grid Reference (Irish Grid)	E209941 N388285
Degree of Siltation	There was little siltation within the stream
Density of Invertebrates	Low
Diversity of Invertebrates	Low

Invertebrates present		
Indicator Group	**Taxon**	**Dominance**
Group A (Most Sensitive to Pollution)	Plecoptera (Non Leuctra)	Numerous (21 -50%)
Group B (Moderately Sensitive to Pollution)	Plecoptera - Leuctra	Common (6-20%)
Group C (Moderately Pollution Sensitive)	Trichoptera (Caseless)	Few (1 – 5 Individuals)
	Coleoptera	Few (1 – 5 Individuals)
Group D (Very Pollution Tolerant)		Absent
Group E (Most Pollution Tolerant)		Absent

Q Value Rating and Justification	Q4 is assigned based on the presence of at least one Group A species in fair numbers with Group B Species also recorded in fair numbers and few Group C. Group D or E invertebrates were absent from the sample. Diversity was very low with only 2 taxa recorded.

Station 5. Mourne Beg Upstream of Confluence with Shruhangarve

Table 1.5 Station Five Results

Description of River at Station	This section of the river is located on the Mourne Beg River, upstream of the confluence with the Shruhangarve. The sample was taken in riffles. At this location the river is approximately 11 metres wide and was on average 0.4m deep at the time of the survey. The substrate was loose and was comprised of boulders, cobbles, gravels and fine gravels. There was very little siltation. There was very little algal growth and instream vegetation was scarce but included aquatic bryophytes and some pondweed. The bankside habitats were dominated by forestry and bog. The water was clear but highly coloured with peat.		
Grid Reference (Irish Grid)	E210133 N387960		
Degree of Siltation	There was little or no siltation within the stream		
Density of Invertebrates	High (for an upland stream)		
Diversity of Invertebrates	Low		
Invertebrates present			
Indicator Group		Taxon	Dominance
Group A (Most Sensitive to Pollution)		Plecoptera (Non Leuctra)	Numerous (21 -50%)
Group B (Moderately Sensitive to Pollution)		Plecoptera - Leuctra	Numerous (21 -50%)
		Trichoptera (Cased)	Few (1 -5 individuals)
Group C (Moderately Pollution Sensitive)		Trichoptera (Caseless)	Few (1 -5 individuals)
		Ephemeroptera – Baetis rhodani	Few (1 -5 individuals)
Group D (Very Pollution Tolerant)			Absent
Group E (Most Pollution Tolerant)			Absent
Q Value Rating and Justification	Q4 is assigned based on the presence of at least one Group A species in fair numbers with Group B Species also recorded in fair numbers and few Group C. Group D or E invertebrates were absent from the sample. Diversity was low with only 2 taxa recorded in fair numbers and very low numbers of only three additional taxa recorded.		

Station 6. Mourne Beg immediately upstream of the Confluence with Shruhangarve

Table 1.6 Station Six Results

Description of River at Station	This section of the river is located on the Mourne Beg River, immediately upstream of the confluence with the Shruhangarve. The sample was taken in riffles and glides. At this location the river is approximately 10 metres wide and was on average 0.4m deep at the time of the survey. The substrate was loose and was comprised of boulders, cobbles, gravels and fine gravels. There was very little siltation. There was very little algal growth and instream vegetation was scarce but included aquatic bryophytes. The bankside habitats were dominated by forestry and bog. The water was clear but highly coloured with peat.	
Grid Reference (Irish Grid)	E210553 N386916	
Degree of Siltation	There was little or no siltation within the stream	
Density of Invertebrates	Average (for an upland stream)	
Diversity of Invertebrates	Average(for an upland stream)	
Invertebrates present		
Indicator Group	**Taxon**	**Dominance**
Group A (Most Sensitive to Pollution)	Plecoptera (Non Leuctra)	Numerous (21 -50%)
	Ephemeroptera - Heptagenidae	Few (1 -5 individuals)
Group B (Moderately Sensitive to Pollution)	Plecoptera - Leuctra	Common (6 - 20%)
	Trichoptera (Cased)	Few (1 -5 individuals)
Group C (Moderately Pollution Sensitive)	Trichoptera (Caseless)	Few (6 - 20%)
	Ephemeroptera – *Baetis rhodani*	Few (1 -5 individuals)
	Hydracarina	Few (1 -5 individuals)
	Dipteran larvae	Few (1 -5 individuals)
Group D (Very Pollution Tolerant)		Absent
Group E (Most Pollution Tolerant)		Absent
Q Value Rating and Justification	Q4 is assigned based on the presence of at least one Group A species in fair numbers with Group B Species also recorded in fair numbers and few Group C. Group D or E invertebrates were absent from the sample.	

Station 7. Mourne Beg Approximately 400m Downstream from Confluence with Shruhangarve

Table 1.7 Station Seven Results

Description of River at Station	This section of the river is located on the Mourne Beg River, approximately 400m downstream of the confluence with the Shruhangarve. The sample was taken in riffles and glides with additional surveying at the edge of a pool. At this location the river is approximately 10 metres wide and was on average 0.6m deep at the time of the survey. The substrate was loose and was comprised of boulders, cobbles, gravels and fine gravels. There was slightly more siltation than in the samples that were taken further upstream. There was very little algal growth and instream vegetation was scarce but included aquatic bryophytes. The bankside habitats were dominated by forestry and bog. The water was clear but highly coloured with peat. There were some small deposits of fibrous peat material in places on the banks around this area, though these were very minor and sporadic in extent.
Grid Reference (Irish Grid)	E210939 N387555
Degree of Siltation	There was little siltation within the stream with the gravels exposed on the substrate where the sample was undertaken. During the kick sampling operation, some fibrous material (peat derived) became suspended in the water column and was trapped in the pond net. This was not excessive – but was a marked difference from the upstream samples
Density of Invertebrates	Extremely Low
Diversity of Invertebrates	Extremely Low

Invertebrates present		
Indicator Group	**Taxon**	**Dominance**
Group A (Most Sensitive to Pollution)	Plecoptera (Non Leuctra)	One single individual – very small
Group B (Moderately Sensitive to Pollution)		Absent
Group C (Moderately Pollution Sensitive)		Absent
Group D (Very Pollution Tolerant)		Absent
Group E (Most Pollution Tolerant)		Absent

Q Value Rating and Justification	No Q value assigned as only one individual animal was recorded in the sample. It is considered that the one individual Plecopteran that was recorded was likely to have washed into the area. This sample was not retained but, there is potential for Oligochaeta to have been present but not recorded due to the fibrous material (this was the case in other samples that were retained and analysed in the lab)

Station 8. Mourne Beg Approximately 570m Downstream from Confluence with Shruhangarve

Table 1.8 Station Eight Results

Description of River at Station	This section of the river is located on the Mourne Beg River, approximately 570m downstream of the confluence with the Shruhangarve. The sample was taken in riffles and glides. At this location the river is approximately 8 metres wide and was on average 0.5m deep at the time of the survey. The substrate was loose and was comprised of boulders, cobbles, gravels and fine gravels. There was more fibrous material of peaty origin than was recorded in upstream samples. There was very little algal growth and instream vegetation was scarce but included aquatic bryophytes. The bankside habitats were dominated by forestry and bog. The water was clear but highly coloured with peat.
Grid Reference (Irish Grid)	E210974 N387523
Degree of Siltation	There was little siltation within the stream with the gravels exposed on the substrate where the sample was undertaken. During the kick sampling operation, large amounts of fibrous material (peat derived) became suspended in the water column and was trapped in the pond net. This was not excessive – but was a marked difference from the upstream samples
Density of Invertebrates	Extremely Low
Diversity of Invertebrates	Average (for upland stream)

Invertebrates present		
Indicator Group	**Taxon**	**Dominance**
Group A (Most Sensitive to Pollution)	Plecoptera (Non Leuctra)	Few (1 -5 individuals)
Group B (Moderately Sensitive to Pollution)	Plecoptera (Leuctra)	Few (1 -5 individuals)
Group C (Moderately Pollution Sensitive)	Trichoptera (Caseless)	Few (1 -5 individuals)
	Ephemeroptera – *Baetis rhodani*	Few (1 -5 individuals)
	Diptera - Chironomidae	Few (1 -5 individuals)
Group D (Very Pollution Tolerant)		Absent
Group E (Most Pollution Tolerant)	Oligochaeta	Common (6 - 20%)

Q Value Rating and Justification	No Q value assigned as the density of all species was so low that there was no appreciable community structure. Oligochaeta were present in the sample and their extent was only apparent when studied in the lab (obscured by the fibrous peaty material)

Station 9. Mourne Beg Approximately 1km Downstream from Confluence with Shruhangarve

Table 1.9 Station Nine Results

Description of River at Station	This section of the river is located on the Mourne Beg River, approximately 1km downstream of the confluence with the Shruhangarve. The sample was taken in riffles. At this location the river is approximately 10metres wide and was on average 0.4m deep at the time of the survey. The substrate was loose and was comprised of boulders, cobbles, gravels and fine gravels. There was fibrous material recorded in the samples, though there was no covering on the gravels. There was very little algal growth and instream vegetation was scarce but included aquatic bryophytes. The bankside habitats were dominated by forestry and bog. The water was clear but highly coloured with peat.
Grid Reference (Irish Grid)	E211536 N387499
Degree of Siltation	There was little siltation within the stream with the gravels exposed on the substrate where the sample was undertaken. During the kick sampling operation, large amounts of fibrous material (peat derived) became suspended in the water column and was trapped in the pond net. This was not excessive – but was a marked difference from the upstream samples
Density of Invertebrates	Extremely Low
Diversity of Invertebrates	Low

Invertebrates present		
Indicator Group	**Taxon**	**Dominance**
Group A (Most Sensitive to Pollution)		Absent
Group B (Moderately Sensitive to Pollution)	Plecoptera (Leuctra)	Few (1 -5 individuals)
Group C (Moderately Pollution Sensitive)	Trichoptera (Caseless)	Few (1 -5 individuals)
Group D (Very Pollution Tolerant)		Absent
Group E (Most Pollution Tolerant)	Oligochaeta	Few (1 -5 individuals)

Q Value Rating and Justification	No Q value assigned as the density of all species was so low that there was no appreciable community structure. Oligochaeta were present in the sample but may have been more abundant and not recorded in the field due to the amount of peaty material in the sample. The sample was not retained.

Station 10. Mourne Beg Approximately 1.9km Downstream from Confluence with Shruhangarve

Table 1.10 Station Ten Results

Description of River at Station	This section of the river is located on the Mourne Beg River, approximately 1.9km downstream of the confluence with the Shruhangarve. The sample was taken in riffles and cascades. At this location the river is approximately 12metres wide and was on average 0.4m deep at the time of the survey. The substrate was was comprised of boulders and cobbles with few gravels orfine gravels. There was little fibrous material recorded in the samples and there was no covering on the gravels. There was very little algal growth and instream vegetation was scarce but included aquatic bryophytes and some pondweeds. The bankside habitats were dominated by forestry and bog. The water was clear but highly coloured with peat.
Grid Reference (Irish Grid)	E211849 N386781
Degree of Siltation	There was very little siltation or fibrous material at this sample point. Some evidence in pond net but not in comparison to Stations 8 & 9. Possibly due to the steepness of the channel at this location.
Density of Invertebrates	Extremely Low
Diversity of Invertebrates	Low

Invertebrates present		
Indicator Group	**Taxon**	**Dominance**
Group A (Most Sensitive to Pollution)		Absent
Group B (Moderately Sensitive to Pollution)	Plecoptera (Leuctra)	Few (1 -5 individuals)
Group C (Moderately Pollution Sensitive)	Trichoptera (Caseless)	Few (1 -5 individuals)
Group D (Very Pollution Tolerant)		Absent
Group E (Most Pollution Tolerant)		Absent

Q Value Rating and Justification	No Q value assigned as the density of all species was so low that there was no appreciable community structure.

Station 11. Mourne Beg Approximately 2.3km Downstream from Confluence with Shruhangarve

Table 1.11 Station 11 Results

Description of River at Station	This section of the river is located on the Mourne Beg River, approximately 2.3km downstream of the confluence with the Shruhangarve. The sample was taken in riffles and glides. At this location the river is approximately 8metres wide and was on average 0.4m deep at the time of the survey. The substrate was comprised of boulders and cobbles with few gravels or fine gravels. There was abundant fibrous material recorded in the samples, though there was no covering on the gravels. There was very little algal growth and instream vegetation was scarce but included aquatic bryophytes. The bankside habitats were dominated by forestry and bog. The water was clear but highly coloured with peat.
Grid Reference (Irish Grid)	E212092 386550
Degree of Siltation	There was high levels of fibrous, peaty material suspended and captured in the net during the kick samples
Density of Invertebrates	Appeared low in the field but was less so when examined in the lab
Diversity of Invertebrates	Low

Invertebrates present		
Indicator Group	**Taxon**	**Dominance**
Group A (Most Sensitive to Pollution)	Plecoptera (Non Leuctra)	Common (6 – 20%)
Group B (Moderately Sensitive to Pollution)	Plecoptera (Leuctra)	Common (6 – 20%)
Group C (Moderately Pollution Sensitive)	Trichoptera (Caseless)	Few (1 -5 individuals)
	Coleoptera	Few (1 -5 individuals)
	Hydracarina	Few (1 -5 individuals)
Group D (Very Pollution Tolerant)		Absent
Group E (Most Pollution Tolerant)	Oligochaeta	Few (1 -5 individuals)

Q Value Rating and Justification	Q Value of 3/4 assigned as there was a Group A taxon represented in fair numbers and the density was slightly low compared to samples taken upstream of the Shruhangarve. The substrate was rocky but contained fibrous material – lowering the Q Value

Station 12. Tributary of Mourne Beg Approximately 2.6km Downstream from Confluence with Shruhangarve

Table 1.12 Station 12 Results

Description of River at Station	This sample was taken from a small stream that flows into the Mourne Beg approximately 2.6km downstream of the Shruhangarve. This drain ran through agricultural fields and had been the subject of drainage management. The sample was taken in a glide habitat At this location the stream is approximately 1 metre wide and was on average 0.15 m deep at the time of the survey. The substrate was comprised of gravels and fine gravels. There was slight siltation. There was very little algal growth and instream vegetation was scarce but included aquatic bryophytes. The bankside habitats were dominated by pasture and bog. The water was clear but highly coloured with peat.
Grid Reference (Irish Grid)	E212110 N386259
Degree of Siltation	There was slight siltation within the channel
Density of Invertebrates	Average
Diversity of Invertebrates	Average

Invertebrates present		
Indicator Group	Taxon	Dominance
Group A (Most Sensitive to Pollution)	Plecoptera (Non Leuctra)	Common (6 – 20%)
Group B (Moderately Sensitive to Pollution)	Plecoptera (Leuctra)	Numerous (21 -50%)
	Trichoptera (Cased)	Few (1 -5 individuals)
Group C (Moderately Pollution Sensitive)	Crustacea - Gammarus	Few (1 -5 individuals)
	Diptera - Simulidae	Few (1 -5 individuals)
Group D (Very Pollution Tolerant)		Absent
Group E (Most Pollution Tolerant)	Oligochaeta	Few (1 -5 individuals)

Q Value Rating and Justification	Q Value of 4 assigned as there were Group A and Group B taxa represented in fair numbers. This tributary was not affected by the peat slide

Station 13. Mourne Beg River Approximately 2.9km Downstream from Confluence with Shruhangarve

Table 1.13 Station 13 Results

Description of River at Station	This sample was taken from the Mourne Beg approximately 2.9km downstream of the Shruhangarve. The sample was taken in a glide habitat. At this location the river is approximately 6 metres wide and was on average 0.5 m deep at the time of the survey. The substrate was comprised of boulders and cobbles with few gravels or fine gravels. There was slight/moderate siltation. There was very little algal growth and instream vegetation was scarce but included aquatic bryophytes. The bankside habitats were dominated by forestry and bog. The water was clear but highly coloured with peat.
Grid Reference (Irish Grid)	E212397 N386094
Degree of Siltation	There was accumulations of fibrous peaty material at this location
Density of Invertebrates	Very Low
Diversity of Invertebrates	Low

Invertebrates present		
Indicator Group	Taxon	Dominance
Group A (Most Sensitive to Pollution)		Absent
Group B (Moderately Sensitive to Pollution)	Plecoptera (Leuctra)	Few (1 -5 individuals)
Group C (Moderately Pollution Sensitive)	Trichoptera (Caseless)	Few (1 -5 individuals)
Group D (Very Pollution Tolerant)		Absent
Group E (Most Pollution Tolerant)	Oligochaeta	Few (1 -5 individuals)

Q Value Rating and Justification	No Q value assigned as the density of all species was so low that there was no appreciable community structure. This sample was taken in deep glide habitat and the water was slightly slower flowing than in the samples that had been taken in riffle habitats. There was more deposition of fibrous material in this section than in upstream samples. The sample was not retained but it is likely that a higher density of species may have been recorded if it were analysed in the laboratory.

Station 14. Tributary of Mourne Beg River Approximately 3.2km Downstream from Confluence with Shruhangarve

Table 1.14 Station 14 Results

Description of River at Station	This sample was taken from a tributary of the Mourne Beg approximately 3.2km downstream of the Shruhangarve. The sample was taken in riffle and glide habitats. At this location the river is approximately 3 metres wide and was on average 0.2 m deep at the time of the survey. The substrate was comprised of cobbles, gravels and fine gravels. There was slight siltation. There was very little algal growth and instream vegetation was scarce but included aquatic bryophytes. The bankside habitats were dominated by pasture. The water was clear but highly coloured with peat.
Grid Reference (Irish Grid)	E212397 N386094
Degree of Siltation	There was slight siltation within the channel but the fibrous, peaty material that was found in the Mourne Beg was absent
Density of Invertebrates	High
Diversity of Invertebrates	Average

Invertebrates present		
Indicator Group	**Taxon**	**Dominance**
Group A (Most Sensitive to Pollution)	Plecoptera (Non Leuctra)	Common (6 -20%)
Group B (Moderately Sensitive to Pollution)	Plecoptera (Leuctra)	Numerous (21 - 50%)
Group C (Moderately Pollution Sensitive)	Trichoptera (Caseless)	Few (1 -5 individuals)
	Diptera *Chironomidae & Simulidae*	Few (1 -5 individuals)
Group D (Very Pollution Tolerant)		Absent
Group E (Most Pollution Tolerant)		Absent

Q Value Rating and Justification	Q Value of 4 assigned as there were Group A and Group B taxa represented in fair numbers along with Group B. This tributary was not affected by the peat slide

Station 15. Mourne Beg River Approximately 3.3km Downstream from Confluence with Shruhangarve

Table 1.15 Station 15 Results

Description of River at Station	This sample was taken the Mourne Beg approximately 3.3km downstream of the Shruhangarve and just downstream of a tributary stream that enters the main channel. The sample was taken in riffle and glide habitats. At this location the river is approximately 10 metres wide and was on average 0.25 m deep at the time of the survey. The substrate was comprised of boulders, cobbles, gravels and fine gravels. Whilst the gravels appeared clean, with little siltation, the kick sample suspended fibrous material that was collected in the sample. There was very little algal growth and instream vegetation was scarce but included aquatic bryophytes. The bankside habitats were dominated by pasture and bog. The water was clear but highly coloured with peat.
Grid Reference (Irish Grid)	E212513 N385790
Degree of Siltation	There was little obvious siltation when viewing the river substrate. However, kick sampling resulted in the suspension of fibrous peaty material that was caught within the pond net
Density of Invertebrates	Average
Diversity of Invertebrates	Average

Invertebrates present		
Indicator Group	**Taxon**	**Dominance**
Group A (Most Sensitive to Pollution)	Plecoptera (Non Leuctra)	Common (6 -20%)
	Ephemeroptera Heptagenidae	Common (6 -20%)
Group B (Moderately Sensitive to Pollution)	Plecoptera (Leuctra)	Common (6 – 20%)
	Trichoptera (Cased)	Few (1 – 5 Individuals)
Group C (Moderately Pollution Sensitive)	Trichoptera (Caseless)	Common (6 – 20%)
	Diptera *Tipulidae*	Few (1 -5 individuals)
	Ephemeroptera – *Baetis rhodani*	Few (1 -5 individuals)
	Hydracarina	Common (6 – 20%)

Group D (Very Pollution Tolerant)		Absent
Group E (Most Pollution Tolerant)	Oligochaeta	Common (6 – 20%)
Q Value Rating and Justification	Q Value of 3/4 assigned as there were Group A, Group B and Group C taxa represented in fair numbers but there was a high degree of siltation in the form of fibrous peaty material that lowered the Q value. It should be noted that this sample was taken immediately downstream of the inflow of a tributary stream and this may have influenced the conditions in the stream in two ways. Firstly, the inflow of clean water could have lowered the impact of any pollution event and secondly, there could have been some inflow of invertebrates from the tributary into the main channel of the Mourne Beg.	

Station 16. Mourne Beg River Approximately 5.6km Downstream from Confluence with Shruhangarve

Table 1.16 Station 16 Results

Description of River at Station	This sample was taken the Mourne Beg approximately 5.6km downstream of the Shruhangarve.. The sample was taken in riffle and glide habitats. At this location the river is approximately 15 metres wide and was on average 0.35 m deep at the time of the survey. The substrate was comprised of boulders, cobbles, gravels and fine gravels. Whilst the gravels appeared clean, with little siltation, the kick sample suspended fibrous material that was collected in the sample. A slight amount of fibrous peaty material was collected in the sample. There was very little algal growth and instream vegetation was scarce but included aquatic bryophytes. The bankside habitats were dominated by pasture and bog. The water was clear but highly coloured with peat.	
Grid Reference (Irish Grid)	E214355 N385261	
Degree of Siltation	There was little obvious siltation when viewing the river substrate. However, kick sampling resulted in the suspension of small amounts of fibrous peaty material that was caught within the pond net	
Density of Invertebrates	Low	
Diversity of Invertebrates	Average	
Invertebrates present		
Indicator Group	Taxon	Dominance
Group A (Most Sensitive to Pollution)	Plecoptera (Non Leuctra)	Common (6 -20%)

	Ephemeroptera Heptagenidae	Few (1 – 5 Individuals)
Group B (Moderately Sensitive to Pollution)	Plecoptera (Leuctra)	Few (1 – 5 Individuals)
Group C (Moderately Pollution Sensitive)	Trichoptera (Caseless)	Few (1 – 5 Individuals)
	Hydracarina	Few (1 – 5 Individuals)
Group D (Very Pollution Tolerant)		Absent
Group E (Most Pollution Tolerant)	Oligochaeta	Few (1 – 5 Individuals)
Q Value Rating and Justification	Q Value of 3/4 assigned as there was only Group A invertebrates recorded in fair numbers with all other taxa represented in very low numbers and an overall low density of invertebrates. In addition, there was evidence of some fibrous material in the sample. Overall, although sensitive (Group A invertebrates were recorded in fair numbers, the low density of invertebrates recorded and the fibrous peat recorded lowered the Q Value from 4 to 3/4.	

Station 17. Mourne Beg River Approximately 6.4km Downstream from Confluence with Shruhangarve

Table 1.17 Station 17 Results

Description of River at Station	This sample was taken the Mourne Beg approximately 6.4km downstream of the Shruhangarve. The sample was taken in riffle and glide habitats. At this location the river is approximately 17 metres wide and was on average 0.5 m deep at the time of the survey. The substrate was comprised of boulders, cobbles and gravels. A slight amount of silt was present, though it was not fibrous peaty material that was present in the upstream samples. There was very little algal growth and instream vegetation was scarce but included aquatic bryophytes. The bankside habitats were dominated by pasture and bog. The water was clear but highly coloured with peat.
Grid Reference (Irish Grid)	E214646 N384559
Degree of Siltation	There was a slight amount of silt in the substrate but it was not the very fibrous peaty material that was found in upstream samples.
Density of Invertebrates	Average
Diversity of Invertebrates	High

Invertebrates present		
Indicator Group	Taxon	Dominance
Group A (Most Sensitive to Pollution)	Plecoptera (Non Leuctra)	Common (6 -20%)
	Ephemeroptera Heptagenidae	Common (6 -20%)
Group B (Moderately Sensitive to Pollution)	Plecoptera (Leuctra)	Few (1 – 5 Individuals)
	Trichoptera (Cased)	Few (1 – 5 Individuals)
Group C (Moderately Pollution Sensitive)	Ephemeroptera – *Baetis rhodani*	Common (6 -20%)
	Hydracarina	Few (1 – 5 Individuals)
	Coleoptera	Few (1 – 5 Individuals)
	Diptera	Few (1 – 5 Individuals)
	Trichoptera (Caseless)	Common (6 -20%)
	Platyhelminthes	Few (1 – 5 Individuals)
Group D (Very Pollution Tolerant)		Absent
Group E (Most Pollution Tolerant)		Absent
Q Value Rating and Justification	Q Value of 4 assigned as there 2 taxa from Group A represented in fair numbers with fair numbers of Baetis recorded also. Density was far higher in this sample than in those recorded upstream (even above the Shruhangarve). There was slight siltation but much less than encountered in the samples upstream. A number of small tributaries discharge into the Mourne Beg upstream of this sample point.	

Station 18. Mourne Beg River Approximately 9.5km Downstream from Confluence with Shruhangarve

Table 1.18 Station 18 Results

Description of River at Station	This sample was taken the Mourne Beg approximately 9.5km downstream of the Shruhangarve. The sample was taken in riffle habitat. At this location the

	river is approximately 10 metres wide and was on average 0.3 m deep at the time of the survey. The substrate was comprised of cobbles, gravels and fine gravels. A slight amount of silt was present, though it was not fibrous peaty material that was present in the upstream samples, it was likely to have been associated with leaves from the broadleaved trees that overhung the channel. There was very little algal growth and instream vegetation was scarce but included aquatic bryophytes. The bankside habitats were dominated by pasture and broadleaved woodlands. The water was clear but highly coloured with peat.
Grid Reference (Irish Grid)	E217152 N383673
Degree of Siltation	There was a slight amount of silt in the substrate but it was not the very fibrous peaty material that was found in upstream samples, it was more likely to be associated with the overhanging trees at the sample station.
Density of Invertebrates	Average
Diversity of Invertebrates	Average

Invertebrates present		
Indicator Group	**Taxon**	**Dominance**
Group A (Most Sensitive to Pollution)	Plecoptera (Non Leuctra)	Common (6 -20%)
	Ephemeroptera Heptagenidae	Few (1 – 5 Individuals)
Group B (Moderately Sensitive to Pollution)		Absent
Group C (Moderately Pollution Sensitive)	Ephemeroptera – *Baetis rhodani*	Common (6 -20%)
	Hydracarina	Few (1 – 5 Individuals)
	Trichoptera (Caseless)	Common (6 -20%)
	Corixidae	Few (1 – 5 Individuals)
Group D (Very Pollution Tolerant)		Absent
Group E (Most Pollution Tolerant)	Oligochaeta	Few (1 – 5 Individuals)

Q Value Rating and Justification	Q Value of 3/4 assigned as although there is a taxon from Group A represented in fair numbers with fair numbers of Baetis recorded also, density and diversity of invertebrates was not as high in this sample as in Station 17. In addition there was accumulation of leaf litter in the sample, likely caused by the overhanging trees at the sample site.	

Station 19. Mourne Beg River Approximately 14km Downstream from Confluence with Shruhangarve

Table 1.19 Station 19 Results

Description of River at Station	This sample was taken the Mourne Beg approximately 14km downstream of the Shruhangarve. The sample was taken in riffle habitat. At this location the river is approximately 20 metres wide and was on average 0.4 m deep at the time of the survey. The substrate was comprised of boulders, cobbles, gravels and fine gravels. A slight amount of silt was present, though it was not fibrous peaty material that was present in the upstream samples. There was very little algal growth and instream vegetation was more abundant than in any of the upstream samples. The bankside habitats were dominated by pasture and tree lines lined the river. The water was clear and slightly coloured with peat.	
Grid Reference (Irish Grid)	E220732 N383812	
Degree of Siltation	There was a slight amount of silt in the substrate but it was not the very fibrous peaty material that was found in upstream samples.	
Density of Invertebrates	High	
Diversity of Invertebrates	Average	
Invertebrates present		
Indicator Group	Taxon	Dominance
Group A (Most Sensitive to Pollution)	Plecoptera (Non Leuctra)	Few (1 – 5 Individuals)
	Ephemeroptera Heptagenidae	Few (1 – 5 Individuals)
Group B (Moderately Sensitive to Pollution)		Absent

Group C (Moderately Pollution Sensitive)	Ephemeroptera – *Baetis rhodani*	Numerous (21-60%)
	Hydracarina	Few (1 – 5 Individuals)
	Corixidae	Few (1 – 5 Individuals)
Group D (Very Pollution Tolerant)		Absent
Group E (Most Pollution Tolerant)	Oligochaeta	Few (1 – 5 Individuals)
Q Value Rating and Justification	Q Value of 3/4 assigned as taxa from Group A were represented in low numbers with numerous Group C taxa *Baetis* and *Gammarus* recorded. No signs of fibrous peaty material were recorded in this sample.	

Sampling in the Shruhangarve Stream

Sampling was attempted at several locations within the Shruhangarve Stream. At no location was a three minute kick sample possible without the pond net becoming filled with fibrous, peaty material. Any kick samples that were undertaken were of a shorter duration and no invertebrates were recorded in any of the samples. No Q value was assigned.

APPENDIX 2

THE BIOLOGICAL MONITORING REPORT FOR MEENBOG. EPA 2021

MEENBOG LANDSLIDE

An investigation of the impact of the Meenbog landslide on the Macroinvertebrate community in the Mourne Beg river and tributaries

ABSTRACT

This report outlines the main ecological impact on the macroinvertebrate community in Mourne Beg following a landslide event in Meenbog, Co Donegal.

Dr. Neasa McDonnell (reviewed by Dr. Shane O Boyle and Dr. Catherine Bradley)

Ecological Monitoring and Assessment unit, EPA

Introduction

A Wind farm was being constructed in Meenbog, Co Donegal. The construction phase was ongoing when a large landslide occurred in the Meenbog area on the 12th of November 2020. The staff were constructing a 'floating Road' which is a temporary road to allow heavy vehicles to pass during the construction phase. They were approximately 500m from completing their task when a landslide occurred. The landslide resulted in a significant amount of peat being washed into the Shruhanagarve stream which is a tributary of the Mourne Beg river.

Due to the size of the landslide and the significant amount of peat observed within the Shruhanagarve stream and accumulations on the bankside it is thought that this event may result in chemical and physical changes in the river such as increased suspended sediment, lowering of the pH, substrate smothering causing a reduction in dissolved oxygen to the interstitial habitat, loss of macroinvertebrate habitat and refuge availability and clogging of gills causing immediate mortality. Macroinvertebrate are an important food supply for fish and so this will also impact the fish community and the wider food chain.

Several organisations in the area began monitoring immediately to assess the environmental damage caused by the landslide. As part of the ecological investigation the Lough's Agency requested assistance from the EPA in completing biological sampling on the rivers in the area. This report briefly outlines the results of the biological investigation which was carried out 16 days after the event occurred.

Methodology

Location

The Mourne Beg river flows out of the south end of Lough Mourne in Co. Donegal. Lough Mourne has populations of roach, pike, trout and eel and is used as a drinking water supply. The southwest of the lake forms part of Croaghonagh bog special area of conservation and it provides habitat for a range of important bird species. The Mourne Beg river is a tributary of the river Derg and forms part of the Foyle system. The soil type in the area is largely blanket Peat soil which overlays Precambrian quartzites, gneisses and schists. The events which took place in Meenbog impacted on the Shruhanagarve stream which is a tributary of the Mourne Beg river. Following the landslide, large amounts of peat moved down the valley and were carried by the Shruhanagarve into the Mourne Beg and on into the Derg river. Biological monitoring on the Mourne Beg and its tributaries was undertaken by the EPA to ascertain the impact of the landslide on the aquatic environment and specifically on the composition and abundance of river macroinvertebrates. The Mourne Beg runs along the border with Northern Ireland and therefore Northern Ireland Environment Agency (NIEA) were also involved in biological monitoring in Northern Ireland. The Loughs Agency carried out electric fishing to investigate the impact on fish communities in the catchment. Chemical sampling was carried out by Donegal County Council. This report only refers to the biological results obtained by the EPA during macroinvertebrate sampling.

An initial visit was made to the Meenbog area on the 19th of November but due to high flows in the river at that time sampling was not possible. When flow finally stabilised, biological sampling was carried out by the EPA on the 1st of December 2020 at four sites. One site was sampled on the Shruhanagarve (RS01S260830: 50m d/s of Sruhangarve bridge 210262, 387282) and two sites were chosen on the Mourne Beg, one site upstream of the confluence with the Shruhanagarve, which is

currently part of the EPA national monitoring programme (RS01M010200: Bridge SW of Tonreagh, NGR 209948, 388300) and one site downstream (RS01M010420: 150m u/s of Croagh bridge u/s croagh burn trib confluence NGR 212470, 385899). A final site was sampled on the Bunadaowen which had historical data available for the site (RS01B010100: Br. u/s Mourne Beg confluence 208141,387609). Map 1 shows the location of sampling points. A more detailed description of each site is presented under each site photo.

Due to the geology and soil type in this area, these sites are acid sensitive in nature and are typically characterised by low pH and low conductivity water which influences the macroinvertebrate communities. Acidification in these rivers reduces macroinvertebrate taxon richness where certain acid sensitive taxa can be reduced or absent in numbers.

Map 1. Map of the sampling locations

Table 1. Site locations

River	NGR	Name	EPA waterbody code	River code
Shruhanagarve	210262, 387282	Sruhangarve Br (50m d/s bridge	IE_NW_01S260830	RS01S260830
Mourne Beg	209948, 388300	Br SW of Tonreagh	IE_NW_01M010200	RS01M010200
Mourne Beg	212470, 385899	150m us of Croagh Bridge (us Croagh burn)	IE_NW_01M010420	RS01M010420
Bunadaowen	208141,387609	Br us Mourne Beg Confluence	IE_NW_01B010100	RS01B010100

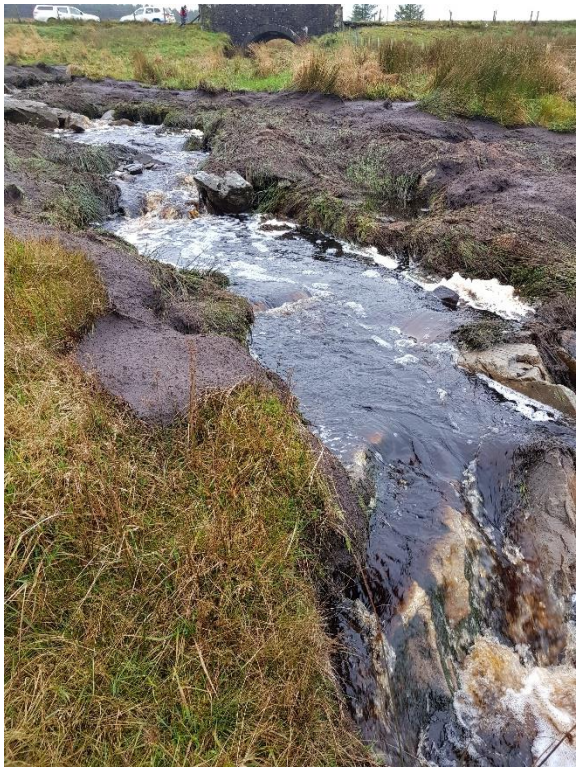


Photo 1. Shruhanagarve stream RS01S260830

General Description	**Water chemistry**
Fast flowing high gradient stream approximately 2m wide with a substrate of boulder, cobble, gravel and excessive peat accumulations observed both instream and along the bank. High water colour observed due to peat in the water. Due to the large size of the substrate and the pH of the stream the habitat here is poor for macroinvertebrates	**Dissolved oxygen** DO %-100.3% 12.13mg/l **Temperature** 7^{o}C **Conductivity** 36.2 µs/cm **pH** 4.51

Photo 2. Upstream Mourne Beg RS01M010200

General Description	**Water chemistry**
Moderate flow in the river, approximately 8m wide with a substrate dominated by cobble and gravel with no accumulations of peat observed. Slight water colour observed due to humic nature of the catchment. Excellent habitat observed for both macroinvertebrate and salmonids	**Dissolved oxygen** DO %-97.5% 11.91mg/l **Temperature** 6.7ºC **Conductivity** 34.3 µs/cm **pH** 6.07

Photo 3. Downstream Mourne Beg RS01M010420

General Description	**Water chemistry**
Moderately fast flowing stretch of river, approximately 10m wide with a substrate dominated by gravel and some cobble with some accumulations of peat observed on the bankside. Slight water colour observed due to peat in the catchment. Good salmonid spawning habitat observed (although noted this may not be usable habitat due to increase fines)	**Dissolved oxygen** DO %-100.1% 12.21mg/l **Temperature** 6.8°C **Conductivity** 35 µs/cm **pH** 5.72

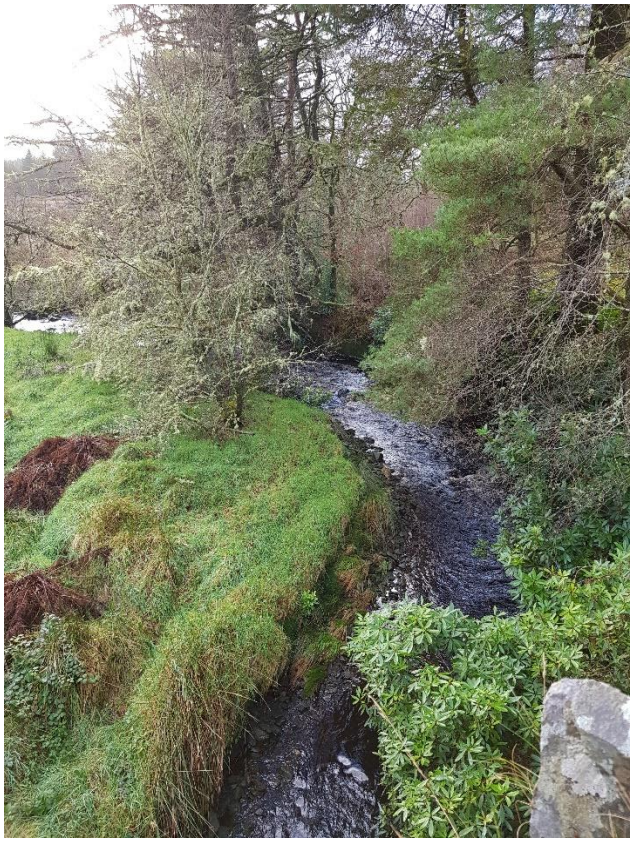


Photo 4. Bunadaowen RS01B010100

General Description	Water chemistry
Fast flowing stream, approximately 6m wide with a substrate dominated by cobble and some gravel. High water colour observed on the day which was not typical for this site. Quite a shaded stretch of stream and pH fluxes, this site is currently included in the EPA acid sensitive river monitoring programme.	**Dissolved oxygen** DO %-100.3% 12.06mg/l **Temperature** 7.1°C **Conductivity** 33.6 µs/cm **pH** 5.9

Macroinvertebrate Q-value Assessment

A three-minute kick sample was taken in a riffle stretch at each site on the 1st December 2020 and the macroinvertebrates were collected using a standard net as per the EPA Q-value Standard Operating Procedure. A stone search was also carried out to collect additional taxa attached to stones. The sample was placed in a tray and live sorted and a Q-value was assigned to the sample depending on the abundance and presence of five main indicator groups, Group A, B, C, D and Group E. Group A contains pollution sensitive taxa whereas Group E contains pollution tolerant taxa. The sample in the tray was then preserved in IMS and returned to the laboratory for sorting.

Once back in the laboratory the samples were sorted to family/genus level and the numbers counted.

A pro DSS was used to gather basic information on water chemistry. General field data was also gathered about the site and presented in the results section.

Table 2: Macroinvertebrate Q value assessment method status classes

Q Value*	WFD Status	Pollution Status	Condition**
Q5, Q4-5	High	Unpolluted	Satisfactory
Q4	Good	Unpolluted	Satisfactory
Q3-4	Moderate	Slightly polluted	Unsatisfactory
Q3, Q2-3	Poor	Moderately polluted	Unsatisfactory
Q2, Q1-2, Q1	Bad	Seriously polluted	Unsatisfactory

* These Values are based primarily on the relative proportions of pollution sensitive to tolerant macroinvertebrates (the young stages of insects primarily but also snails, worms, shrimps etc.) resident at a river site.

** "Condition" refers to the likelihood of interference with beneficial or potential beneficial uses.

Main results

Mourne Beg upstream site RS01M010200

The upstream site on Mourne Beg (RS01M010200) was at Q4 indicating good ecological conditions. This is consistent with the historical data for this site in 2019 when the site was also classified as Q4. Five Group A taxa were found at this site which is consistent with good water quality. This group are sensitive to pollution and require fast flowing, highly oxygenated clean substrate and are usually only found in rivers with good water quality however it should be noted there were no mayflies present which would suggest some acidification impacts.

Shruhanagarve stream RS01S260830

The Shruhanagarve tributary (RS01S260830) joins the Mourne Beg approximately 1.2km downstream from this site. No historical records were available for the Shruhanagarve stream. No Macroinvertebrates were found in the bankside sort or when the sample was returned to the laboratory and therefore the site (RS01S260830) was classified at Q1* (Bad ecological condition). This suggests that the landslide may have affected the macroinvertebrate community in this stream as some macroinvertebrates would be expected in a stream of this size and nature. Large accumulation of peat within and on the banks of the stream are concerning especially if winter high flows re-mobilise the material.

Mourne Beg downstream site RS01M010420

The macroinvertebrate fauna at the downstream site (RS01M010420) (3.2km downstream from the Shruhanagarve confluence) on the Mourne Beg was indicative of Q3-4* (* denotes impact by siltation) indicating moderate ecological condition. There was a noticeable difference in the biological community upstream and downstream of the Shruhanagarve confluence. Similar Group A taxa were recorded at the downstream site, but they occurred in low numbers (either as singletons or few). More group C taxa were recorded here which include taxa that are more tolerant to water

pollution. High numbers of oligochaeta were recorded downstream. The increase in numbers of oligochaeta may indicate poorer water quality in the downstream reaches. Although there is no previous historical data available for this site, the low numbers of pollution sensitive Group A's and the increase in pollution tolerant taxa representation suggest that the site is impacted. Graph 1 shows the % of each group at each site. The lack of Mayfly at the upstream site and only a single heptageniidae at the downstream Mourne Beg site suggests some acidic impacts.

Bunadaowen RS01B010100

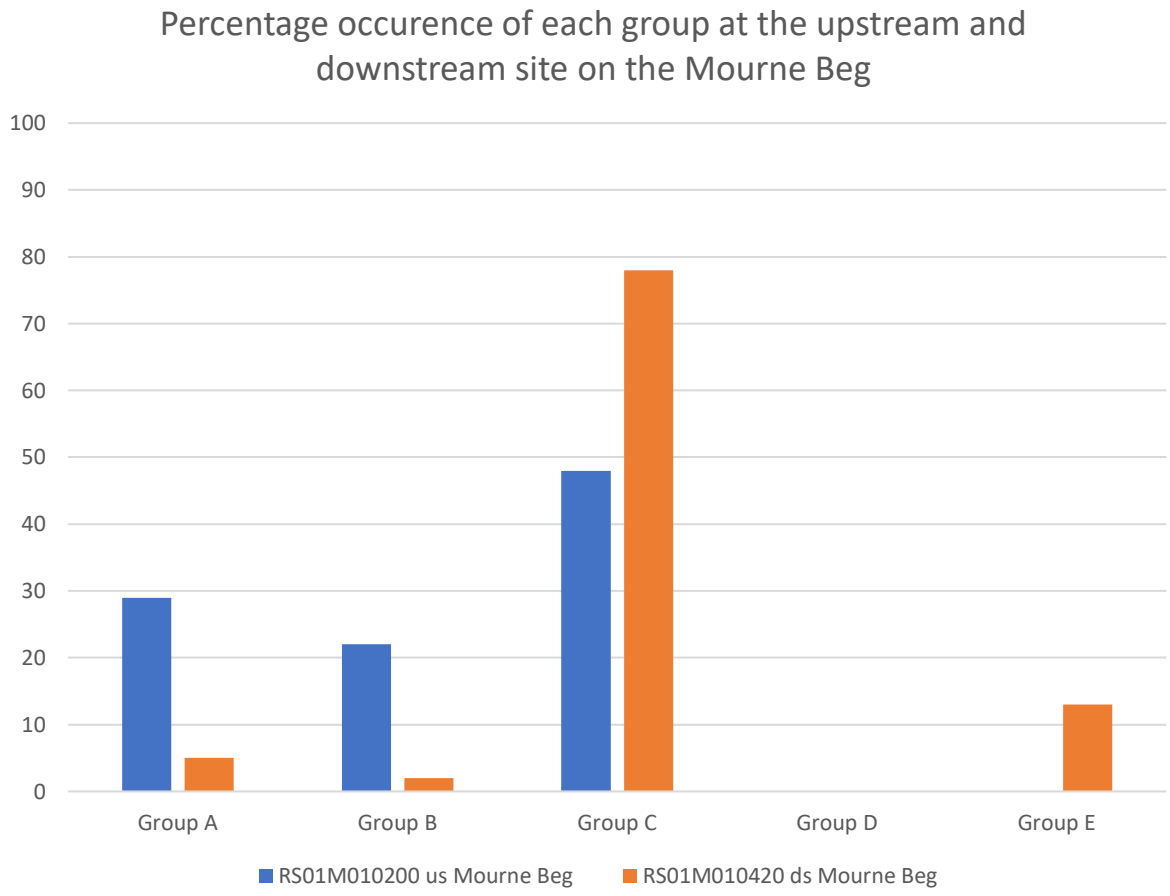
The Bunadaowen (RS01B010100) (an upstream tributary of the Mourne Beg) was also sampled and found to be at Q4* (* denotes impact by siltation) good ecological condition however it was affected by increased fines. There was a noticeable discolouration in the water on the day of sampling. This fine sediment had not settled on the stream bed at the time of sampling. The absence of heptageniidae and baetidae in the Bunadaowen suggest that acidification may be affecting the macroinvertebrate community. These sites (Bunadaowen is already part of the acid sensitive monitoring programme AWIC) will be included in the acid sensitive monitoring programme in spring 2021.

Table 3. Results of biological sampling on 1/12/2020

Group	Family	Genus	RS01M010200	RS01M010420	RS01B010100	RS01S260830
			Q4	Q3-4*	Q4*	Q1*
A	Perlodidae	Isoperla	12	2	4	0
	Nemouridae	Protonemura	19	0	127	0
		Amphinemura	10	1	22	0
	Nemouridae	unidentified	1	0	0	0
	Taeniopterygidae		4	0	1	0
	Chloroperlidae		16	1	3	0
	Heptageniidae		0	1	0	0
B	Leuctridae		48	1	72	0
	Limnephilidae		1	0	1	0
	Lepidostomatiae		0	1	0	0
C	Gyrinidae		2	1	0	0
	Rhyacophilidae		0	5	1	0
	Hydropsychidae		4	6	0	0
	Chironimidae		1	0	0	0
	elmidae		91	51	0	0
	Lumbriculidae		3	6	0	0
	Polycentropodidae	Polycentropus	2	1	7	0
	Lumbricidae		3	3	0	0
	Pediciidae		1	1	1	0
	Gammarus		0	1	0	0
	Simuliidae		0	0	1	0

E	Oligochaeta		0	12	0	0
	Total abundance		218	94	240	0
	Total No. Taxa		15	16	11	0

Graph 1



Main Conclusions and Recommendation

- The absence of any macroinvertebrates in the Shruhanagarve stream suggest a major pollution event has affected this stream. The volumes of peat material which have washed into the stream are likely to have caused an increase in total suspended sediment, a decrease in pH and a decrease in dissolved oxygen in the interstitial spaces causing a detrimental effect on the macroinvertebrate community.
- The results from the biological sampling suggest that the downstream site on the Mourne Beg is also impacted. The decrease in numbers of group A pollution sensitive taxa and the

increase in pollution tolerant taxa suggest that the site downstream has an impacted community.

- NIEA have sampled further downstream and so their results should ascertain the extent of the pollution impact downstream on the Mourne Beg.
- The presence of some sensitive taxa in the downstream Mourne Beg site is positive as it will aid the re-colonisation of the river reach and help encourage fish back up into the river.
- Biological macroinvertebrate sampling should be repeated in 2021 to assess macroinvertebrate community recovery and to determine if the impact is on-going.

Appendix 1

Historical results

No previous results were available for the downstream site on the Mourne Beg (RS01M010420) and the Shruhanagarve (RS01S260830). Historical (Q-value) data was available for the upstream site on Mourne Beg and the Bunadaowen river and is presented in table 3.

Table 4. Historical results for RS01M010200 and RS01B0100

River	**Mourne Beg**	**Bunadaowen**
Site	Bridge SW of Tonreagh, RS01M010200	Br. u/s Mourne Beg confluence RS01B010100
Year	**Q-value**	**Q-value**
1990	4	4*
1994	4	3
1997	4*	4*
1998	4*	3
2001	4*	3*
2004	4	3
2007	3*	3
2011	3	3
2013	3	3
2016	2-3/0	2/0
2017	-	2-3
2019	4	3-4

Please note there is more information in relation to water quality which is available on our website at: https://gis.epa.ie/EPAMaps/Water

BRIEFING NOTE

Project Reference	201174
Date & Time	25/01/2021
Subject	Meenbog Peat Slide – Action Plan Summary for Shruhangarve Stream
Author(s)	Thomas Blackwell

Introduction

An Action Plan was prepared by MKO and submitted to Donegal County Council by Planree Limited on December 3rd 2020. The purpose of the Action Plan document was to outline recommendations that Planree Limited could propose to Donegal County Council as a means to protect water quality and restore the Shruhangarve Stream following the peat slide on the Meenbog Wind Farm site on November 12th, 2020.

This briefing note is intended to provide the Loughs Agency with a brief synopsis of the works completed to-date and sets out those items that are still proposed in order to stabilise and restore the Shruhangarve Stream. In the interests of consistency, the proposed items set out in this briefing note are taken directly from the Action Plan (Version 1.0) dated December 3rd 2020. The action plan may be subject to periodic updates as revision as the situation in the field dictates, and as plans and stakeholder coordination progresses.

Emergency Works Completed

In response to the peat slide, and as required by the Environmental Liabilities Directive regulations, emergency works were undertaken within the first 24-72hours which consisted of measures to prevent further material from entering local watercourses. These measures are discussed in detail in the Action Plan submitted to Donegal County Council on December 3rd, 2020.

The immediate aim of the emergency works was to introduce check barrages to prevent the slide from reaching any watercourses in line with the CEMP. Immediate action was taken to reinforce and increase the height of the accessible roadway leading to T9. The barrage constructed at this location is known as Wall 1. The primary aim of Wall 1 was to limit or prevent the flow of liquefied peat into watercourses beyond the site.

Following a detailed geotechnical assessment two other points for further check barrages were identified, denoted as 'Wall 2' and 'Wall 3' in Figure 2.1. Wall 3 was located immediately downslope of an area of unstable peat where significant volumes of water or liquefied peat was released, and given the visual signs of further propagating cracks from aerial drone footage it was considered a priority to stabilise this upslope material. Wall two is located close to the T9 turbine base and is designed as a further check to catch any potential peat movement from downstream of Wall 3.

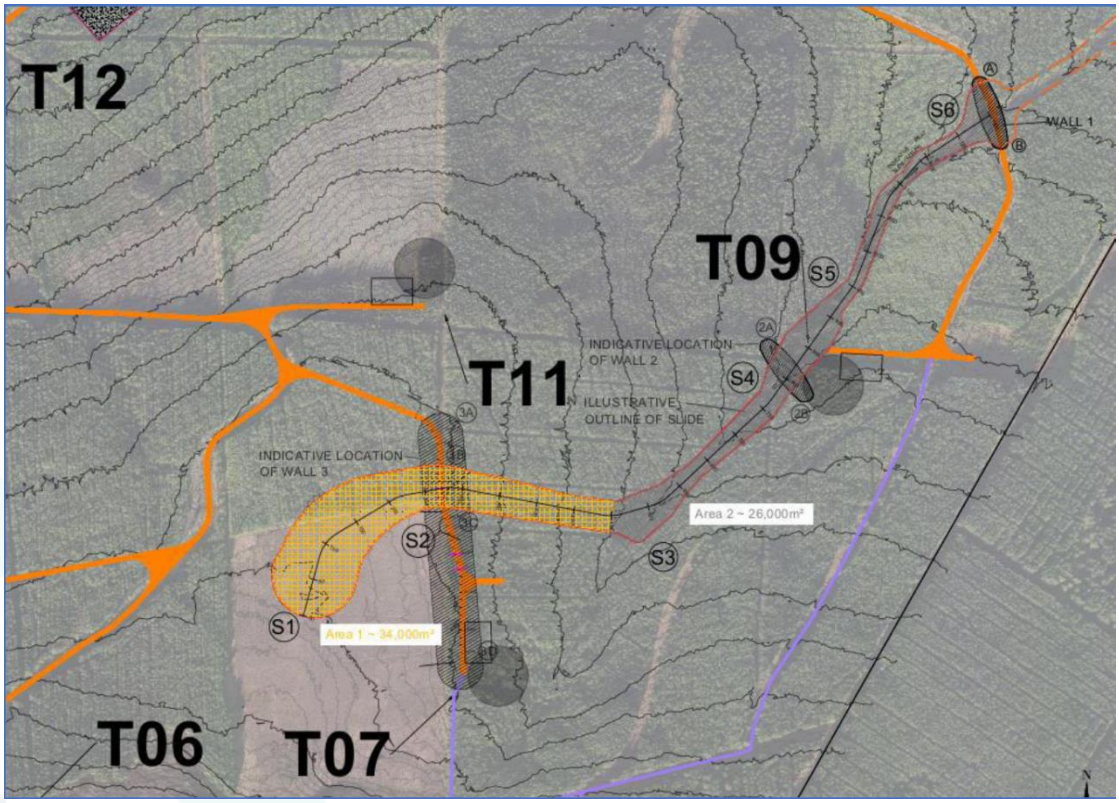


Figure 1 Emergency Works Area

Concurrent with the completion of the emergency works, an Action Plan was developed to outline a series of recommendations the strategy for works going forward. This document was submitted to Donegal County Council on December 3rd 2020 and provides eight recommendation intended to protect water quality, protect downstream habitats and species, and restore the environmental, ecological, and physical function and integrity of the Shruhangarve Stream. To-date, no response or comment has been received from Donegal County Council on the recommendations, in terms of their suitability or appropriateness for the situation at hand. The eight recommended actions are as follows:

1. *Impound water and sediment behind Wall 1*
2. *Intercept Clean Water*
3. *Stabilise downstream deposits of peat on stream banks*
4. *Trial sedimat capture in the Shruhangarve Stream*
5. *Install water treatment system*
6. *Remove deposited peat from impoundment area upstream of Wall 1*
7. *Stabilise upstream deposits of peat on stream bank*
8. *Stream restoration*

Implemented Action Plan Recommendations

To date, the first two items identified in the Action Plan have been implemented. These items were aimed at capturing as much peat as possible as close to source as possible, protecting water quality, and protecting in-stream habitat to the greatest extent possible. The implemented recommendations are discussed briefly below:

Recommendation 1 - Impound water and sediment behind Wall 1

Large volumes of sediment have been successfully impounded behind Wall 1 and prevented from entering downstream watercourses. Approximately 79% of water flows entering the Shruhangarve catchment upstream of Wall 1 have been intercepted upstream of the impounded sediment and diverted away from the sediment impounded behind Wall 1, thereby minimising the re-mobilisation of the impounded sediment.

Recommendation 2 – Intercept clean water

Large volumes of clean water being successfully intercepted upstream of the peat slide area on the Shruhangarve stream as a result of the emergency works, and are being prevented from reaching the peat slide area and becoming entrained with sediment, see Figure 5.4 below. Further volumes of clean water are being intercepted as overland flow, and prevented from reaching the peat slide area and becoming entrained with sediment. The more "clean" water that can be intercepted upstream or upgradient of the peat slide area, the less water will become soiled. Intercepting as much clean water as possible and diverting or pumping it to the downstream side of Wall 1 keeps that clean water clean and prevents that water mobilising further sediment or deposited peat sludge it might otherwise encounter.

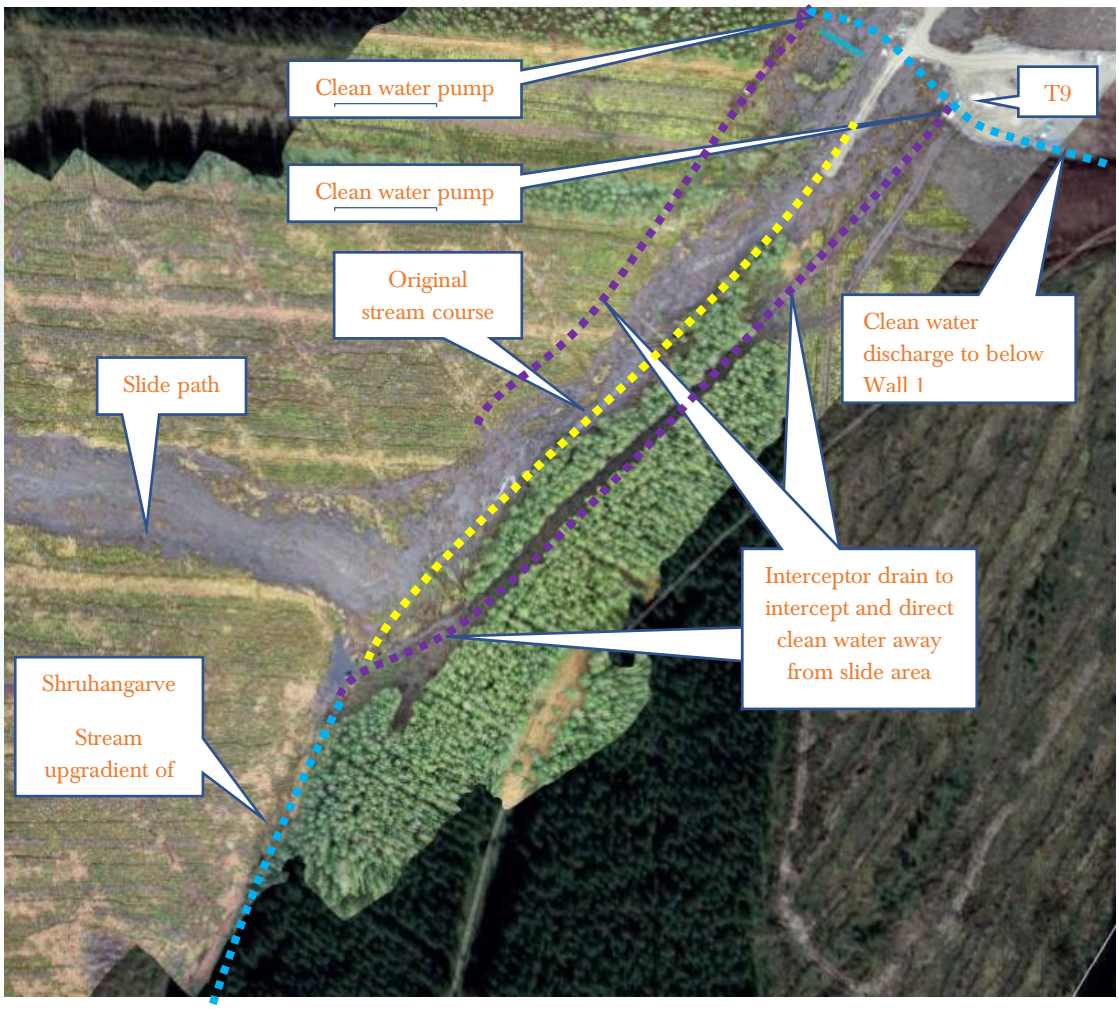


Figure 2 Aerial view of Stream Reach 1, showing interceptor drains collecting clear water for pumping around peat slide area

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Proposed Action Plan Items

The following recommendation are proposed to restore the effected reaches of the Shruhangarve Stream and to prevent further discharge of sediment into the stream. The ultimate goal of these measures is to ensure that lost stream habitat is restored and that water quality is protected by stabilising any residual peat.

Recommendation 3 – Stabilise downstream deposits of peat on stream banks

Present situation informing recommendations.

Large volumes of peat mobilised during the peat slide were deposited along the downstream reaches of the Shruhangarve stream during the peat slide event. The spatial and volumetric measurement of these peat deposits is presently underway and will be reported in future iterations of the Action Plan. The deposits extend to varying widths along the banks Shruhangarve stream for a distance of approximately 2.4 kilometres downstream of Wall 1 as far as the Mourne Beg River. Recent drone flight imagery taken along the Mourne Beg River will be used to assess if any such deposits of peat are present along the banks of that river.

The Shruhangarve stream downstream of Wall 1 continues to flow within the original natural stream channel, but larger flows during and after large rainfall events have caused some secondary mobilisation of the peat that would have been originally deposited on the stream banks. While the majority of the streambank peat deposits appear relatively stable, overland flows from the adjacent bog habitat towards the stream have caused some further mobilisation of the deposited peat in particular locations. It is not considered justifiable to leave the peat deposits in place without mitigation, as to do so would result in further secondary mobilisation of the deposited peat into the adjacent stream.

Work on the implementation of Recommendation 3 was started in December 2020 but has been paused pending approval from Donegal County Council. A short section of coir fibre matting was installed downstream of Wall 1 with the aim of stabilising shallow deposits of peat on the streambanks in that location.

Plate 1. Peat deposited on stream bank downstream of Wall 1, with intact vegetation partially visible and larger deposits of peat further back from stream edge

Objectives of recommendations

1. *Eliminate or limit the release of further polluting matter from areas down gradient of the landslide where material has been deposited.*
2. *Mitigate against the further dispersal of peat and sediment, deposited along the banks of the Shruhangarve, by the watercourse through and beyond the confines of the site.*

Recommended measures

1. *Continue to inspect stream banks to identify nature and depth of peat deposits, access options, ground conditions, etc. to assess safety of work areas, safe work methods, means of handling and delivering materials, etc.*
2. *Quantify distances, areas and volumes of deposited peat sludge from drone imagery, including larger deposition areas, to prioritise areas for work.*
3. *Confirm land access rights and arrangements.*
4. *Using manual labour, access the stream bank on foot where peat deposits are low, and clear a working area of approx. 1.5-metres along the stream bank of all excess peat deposits sitting on the surface. Peat removed from surface of stream bank to be placed further back from stream bank.*
5. *Install silt fencing along cleared path on stream bank, taking care to follow manufacture's specifications and ensure bottom of fence is property buried into ground surfacer and adequate fencing stakes are installed are regular intervals to support fence and the silt that will build up behind it. Specification for Terrastop silt fencing is included in Appendix 3.*
6. *Where vegetation remains intact under the cleared path, this will be left to regenerate naturally.*
7. *If any areas along the cleared path are devoid of natural vegetation, CoirMesh will be laid over the bare ground to prevent soil erosion and siltation of the watercourse. Specification for CoirMesh is included in Appendix 3.*
8. *No work on the stream bank should take place during or immediately periods of heavy rainfall.*
9. *Peat clearance, silt fence and CoirMesh installation to be carried out while taking extreme care not to damage stream bank, keep pedestrian traffic along the stream bank to a minimum, and prevent peat deposits entering stream.*

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10. *Maintain localised drainage pathways to prevent build up of open water behind silt fencing.*
11. *Inspect silt fencing regularly (at least weekly) and undertake repairs and maintenance as required.*
12. *Provide training on installation techniques to installation crews and have supervising ecologist or environmental in situ for first days of installation to ensure proper installation techniques are being used. Monitoring works regularly thereafter.*
13. *Divide works areas into sections and assign installation crews to sections.*
14. *In Spring/Summer 2021, deeper deposits of peat will be pulled back from behind silt fence and spread locally at shallower depths for reseeding with appropriate seed mix to be selected by ecologist. Where access allows, peat deposits to be removed and spread using low-pressure mechanical excavator working in a single pass to minimise tracking across the peatland habitat. Excavator to be left in situ overnight if work cannot be completed in a single day, and use different routes to exit site if required for refuelling.*
15. *Maintain silt fence in place for as long as necessary until all bare peat had reseeded and demonstrated to have well-establish root system of surface vegetation, capable or binding material together. Silt fence only to be removed with approval of supervising ecologist.*

Plate 2 CoriMesh biodegradable woven coconut fibre used on bare surfaces to prevent erosion and promote revegetation

Plate 3 Coir matting installed on the Shruhangarve downstream of Wall 1.

Recommendation 4 – Trial sediment capture in the Shruhangarve stream

Present situation informing recommendations

The water quality situation has stabilised since the completion of the emergency works and suspension of all other works within the Shruhangarve catchment. As other recommendations are implemented to improve the water quality over the longer term, manage and remove residual peat deposited upstream and eventually restore and reinstate the Shruhangarve stream to the greatest extent possible, some silt will become mobilised and will make its way into the stream channel.

The suspended peat material is colloidal in nature and does not easily settle out once suspended in water, particularly in a stream such as the Shruhangarve. Therefore, it is intended to trial the use of Sedimats in the lowest reach of the Shruhangarve in an attempt to capture some of the peat suspended in the stream that would otherwise reach the Mourne Beg River and downstream receptors. Specification details for the Sedimat product is included in Appendix 4 of the Action Plan.

The effectiveness of the proposed Sedimats cannot be guaranteed, and therefore this recommendation is being made on a trial basis, with the trial to be extended and repeated if proven to be effective.

Plate 4 Sedimat installed on stream bed to trap suspended sediment through upper layer of jute mesh and lower layers of wood wool.

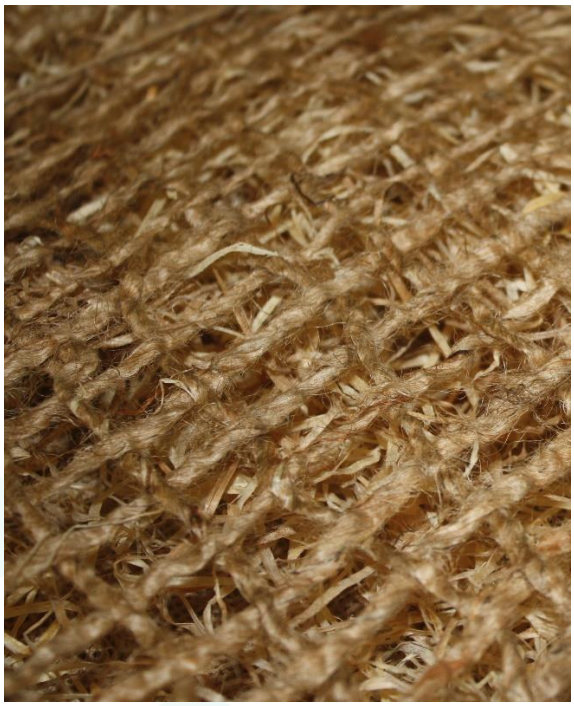

Plate 5 Narrow view of Sedimat with layered jute mesh and wood wool

Plate 6"Full" Sedimat after having been removed from stream bed

Objectives of recommendations

1. *Eliminate or limit the release of further polluting matter from areas down gradient of the landslide where material has been deposited.*
2. *Mitigate against the further dispersal of peat and sediment, deposited along the banks of the Shruhangarve, by the watercourse through and beyond the confines of the site.*

Recommended measures

1. *Inspect Stream Reach 5 for low gradient, slower flowing sections suitable for the installation of the Sedimat, with good access, ideally for machine removal.*
2. *Confirm land access rights and arrangements.*
3. *Calculate length of Sedimat required in stream channel based on flow measurements as per manufacturer's instructions.*
4. *Install Sedimat flat on stream bed, taking care to follow manufacturer's instructions. and leave in situ for a number of weeks, inspecting regularly for effectiveness.*
5. *Repeat as necessary in further locations if proven to be effective.*
6. *If effective, inspect Sedimats regularly and replace when mats are full of sediment.*
7. *Take care in the removal of full mats, and place further Sedimats temporarily downstream of removal location to capture any "leakage" of silt from the full Sedimat.*

Recommendation 5 – Install water treatment system

Present situation informing recommendations

While the water quality situation on-site and in the downstream catchments has stabilised since the completion of the emergency works and suspension of all other works within the Shruhangarve catchment, a portion (currently 21%) of the rainfall entering the upper reaches of the Shruhangarve catchment is still coming into contact with the peat slippage area, disturbed ground and deposited peat, and there is currently no effective means of treating this soiled water prior to its discharge to the downstream side of Wall 1. This is not recommended beyond the immediate short term and should be rectified as soon as possible.

Over the medium to long term it will also be necessary to carry out works in the catchment to manage and remove residual peat deposited upstream of Wall 1 and eventually restore and reinstate the Shruhangarve stream to the greatest extent possible. These works have the potential to mobilise and release peat sediment into downstream watercourses in the absence of mitigation. A water treatment system is recommended as the only realistic means of preventing the uncontrolled release of sediment during future phases of remedial works upstream of Wall 1, but more details are required before a definitive set of recommendations can be made.

Discussion are ongoing with a number of water treatment system providers to provide water treatment proposals, both in the short term and in the longer term, during future remedial works phases. Outlined below is a summary of the outcome of tests completed by Siltbuster, and some information relating to the use of a similar system on the Corrib Gas Pipeline project, where discharge occurred to an SAC receiving waterbody.

Please note, the system outlined below is provided for information purposes only and as an indication of what can be provided, but no commercial arrangement has been initiated to date. The intention here is to provide information regarding what can be achieved and the general setup of such a system. Further detail will be provided once discussions advance with the treatment system providers and a more firm proposal is available, following further engagement with stakeholders and regulatory authorities.

Objectives of recommendations

1. *Eliminate or limit the release of further polluting matter from the area where the landslide occurred.*
2. *Eliminate or limit the release of further polluting matter from areas up gradient of the land slide.*
3. *Eliminate or limit the release of further polluting matter from areas down gradient of the landslide where material has been deposited.*
4. *Prevent the catastrophic release of material built up behind the existing improvised impoundment structure on site.*

Recommendation 6 – Remove deposited peat from impoundment area upstream of Wall 1

Present situation informing recommendations

Large volumes of silt have been successfully impounded behind Wall 1 and prevented from entering downstream watercourses. The volumetric measurement of these silt volumes is presently underway and will be reported in future iterations of the Action Plan. Water flows have been largely intercepted upstream of the impounded silt and diverted away from the silt impounded behind Wall 1, thereby minimising the re-mobilisation of the impounded silt.

The long-term recommendation is to restore the natural water flows in the Shruhangarve stream and reinstate the stream to the greatest extent possible. To do so will require the silt and sediment that has accumulated behind Wall 1 to be removed and the area stabilised before normal flows can be restored in the channel and through a culvert under Wall 1 which was originally intended as an access road to Turbine 9.

Objectives of recommendations

1. *Eliminate or limit the release of further polluting matter from the area where the landslide occurred.*
2. *Eliminate or limit the release of further polluting matter from areas down gradient of the landslide where material has been deposited.*
3. *Prevent the catastrophic release of material built up behind the existing improvised impoundment structure on site.*

Recommended measures

1. *Complete volumetric calculations of silt and sediment volumes impounded upstream of Wall 1.*
2. *In Spring/Summer 2021, after having allowed time for water levels behind Wall 1 to decrease and the material to partially dry out, begin to recover as much deposited peat as possible from the upstream side of Wall 1, using long reach excavators working from the top of Wall 1.*
3. *With further engineering input, investigate feasibility of creating cells behind Wall 1 as water levels lowers and material dries out to assist recovering further volumes.*
4. *Transport recovered peat sludge to on-site treatment/management area. Consider treatment/management options further over coming period, including:*
    - Using existing on-site peat storage areas, with enhanced Siltbuster-type water treatment at outfall.
    - Lined settlement lagoon with centrifuge, sludge treatment and water treatment.
    - Tanker peat sludge off-site to licensed facility.
5. *Selected treatment/management option to determine other actions.*
6. *After all recoverable peat has been removed from the area upstream of Wall 1, the remaining peat deposits and unvegetated surface will be stabilised using soil erosion prevention materials, such as CoirMesh prior to reseeding, as shown in Figures 5.16 and 5.17 below.*
7. *More detailed recommendations for the removal of the peat and stabilisation of the unvegetated surfaces that remain will be developed in future iterations of the Action Plan.*

Plate 7 Large-scale use of CoriMesh to stabilise exposed ground, as likely required upstream of Wall 1 once large peat deposits are removed

Recommendation 7 – Stabilise upstream deposits of peat on stream bank

Present situation informing recommendations

Large volumes of peat were deposited on the banks of the Shruhangarve stream during the peat slide. Upstream from Wall 1 and T9 along stream reaches 1 and 2, these deposits will need to be stabilised and every effort made to prevent them being gradually washed into the stream channel before normal water flows can be restored in the Shruhangarve stream.

Peat sludge is deposited along the 850m stretch of the Shruhangarve upstream of Wall 1, up to distances of 35 metres from the stream channel. While water and silt are being impounded upstream of Wall 1, the priority will be on stabilising the material in stream reach 1, but stream reach 2 will also require similar remedial works before normal water flows can be restored in the Shruhangarve stream.

Access to certain areas in these stream reaches will be by forestry and ground conditions limited, and while it might be possible to get machinery into locations, it is impractical to expect to be able to remove the deposited peat material without causing further damage to the peatland habitats or constructing further access roads, which are both considered unwarranted.

Objectives of recommendations

1. *Eliminate or limit the release of further polluting matter from the area where the landslide occurred.*
2. *Eliminate or limit the release of further polluting matter from areas down gradient of the landslide where material has been deposited.*
3. *Mitigate against the further dispersal of peat and sediment, deposited along the banks of the Shruhangarve, by the watercourse through and beyond the confines of the site.*

Recommended measures

1. *Inspect stream banks to identify nature and depth of deposited peat, access options, ground conditions, etc to assess safety of work areas, safe work methods, means of handling and delivering materials, etc.*
2. *Quantify distances, areas and volumes of deposited peat from drone imagery, including larger deposition areas, to prioritise areas for work.*
3. *Utilise stabilisation methods and materials proven to be effective on the section of the Shruhangarve downstream of Wall 1.*
4. *Installation techniques and timing may have to be adjusted based on water flows in stream linked to rainfall.*
5. *Where machine access is possible and practical, use low-pressure excavators to remove excessive depths of deposited peat and spread out on surrounding ground to prevent future slumping of peat deposits. Then stabilise spread material.*
6. *Divide works areas into sections and assign installation crews to sections.*
7. *After the depth of all reachable areas of deposited peat have reduced, the remaining peat deposits and unvegetated surface will be stabilised using soil erosion prevention materials, such as CoirMesh prior to reseeding, as shown in Figures 5.16 and 5.17 above.*
8. *Seed the peat sludge deposits in Spring/Summer 2020 with appropriate seed mix (to be selected).*
9. *More detailed recommendations for the removal of the peat and stabilisation of the unvegetated surfaces that remain will be developed in future iterations of the Action Plan when access options to the areas in question have been further investigated.*

Recommendation 8 – Stream restoration

Present situation informing recommendations

Approximately 850 metres of the Shruhangarve Stream upstream of Wall 1 have been impacted by the peat slide (Stream Reaches 1 and 2). Mass movement and deposition of peat in this area has substantially damaged the original stream channel resulting in a loss of instream habitat in this area.

It is proposed to use natural channel design techniques to re-establish a functional stream channel in these reaches. The restoration design process will focus on the development of a stream design that is appropriate in terms of channel cross-sectional dimension, plan, and profile, and that will therefore be stable in the long term. In addition, the design will incorporate design elements to provide appropriate in-stream aquatic habitat. Stream banks and the riparian zone will be revegetated with native species with a view to enhancing bank stability in the new channel and reducing potential soil erosion in the riparian area.

Objectives of recommendations

1. *Eliminate or limit the release of further polluting matter from areas down gradient of the landslide where material has been deposited.*
2. *Mitigate against the further dispersal of peat and sediment, deposited along the banks of the Shruhangarve, by the watercourse through and beyond the confines of the site.*
3. *Restore lost instream habitat by reconstructing a*

Recommended measures

1. *Conduct geomorphological survey of Shruhangarve Stream both upstream of the slip area and downstream of Wall 1. Survey to include detailed cross sections, long profile, pebble counts, and analysis of radius of curvature in stream meanders.*
2. *Conduct desktop analysis of the impacted portion of Shruhangarve Stream (Reaches 1 and 2) along with field survey of impacted reaches to attempt to classify the likely character of the lost stream reaches.*
3. *Identify and conduct geomorphological survey of suitable reference reach stream channel.*
4. *Use reference reach data, survey of unimpacted and/or moderately impacted stream reaches, to develop dimensionless ratios to inform the conceptual design of new channel for Reaches 1 and 2.*
5. *Design will include in-stream structures and a detailed planting plan utilising appropriate native species.*
6. *Before stream design can be finalised or implemented, a geotechnical solution to stabilising the peat slide path will be required.*
7. *The impoundment area behind Wall 1 will need to be dewatered and accumulated peat sludge removed before design can be finalised.*
8. *Once the proposed restoration design has been finalised and approved work should commence at the upstream end and work down.*
9. *All work will be conducted in the dry, therefore pump arounds will be necessary.*
10. *More detailed recommendations for the restoration of the stream will be developed in future iterations of the Action Plan.*

Conclusion

Recommendations 1 and 2 have been implemented and as a result, the water quality in the Shruhangarve Stream and Mourne Beg River appears to have returned to pre-event levels.

Recommendation 3 has been partially implemented but has been paused pending further guidance from the EPA and Donegal County Council.

It is acknowledged that the implementation of recommendations 3 to 8 will require further prior engagement with Donegal County Council and possibly licencing from the Loughs Agency for in-stream works. It is anticipated that surveying and design work to progress these recommendations will proceed in Q1 of 2021.

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