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AQUATIC ASSESSMENT OF THE MAGHERARNEY RIVER

JUNE 2022

GROVE TURKEYS LTD
SMITHBOROUGH
CO. MONAGHAN

LICENCE NO. P0832-01

DATE:	07th June 2022	**PREPARED BY:**	Martin O'Looney, BSc.
REPORT NUMBER:	RQA_22_21573	**REVIEWED BY:**	Mike Fraher, BSc.

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EXECUTIVE SUMMARY

Panther Environmental Solutions Ltd (PES Ltd) was commissioned by Grove Turkeys Ltd, Smithborough to carry out an aquatic assessment of the Magherarney River in accordance with the site IE licence.

Monitoring was conducted at two sampling stations, on Thursday 02nd June 2022, under low to normal flow conditions, which are located upstream and downstream of the discharge point in the Magherarney River. Monitoring was conducted by Martin O'Looney BSc of PES Ltd.

The weather during spring and early summer 2022 was characterised by mostly above average temperatures and below average rainfall. The last week of May witnessed a heatwave. However, the heatwave had ceased by the beginning of June 2022, during the time at which the aquatic assessment was completed. Therefore, high temperature and low flow conditions may have caused additional stress upon macroinvertebrate communities within the Magherarney River

Temperature and pH were within the expected ranges. Dissolved oxygen levels remained below the normal level of c.9mg/l O_2 and 80-120%saturation, due to there being no significant riffle area in the near upstream vicinity (i.e. low surface mixing).

Past dredging of the river-bed and cattle accessing the river at monitoring point 2 and cattle accessing the river upstream of MP1 is apparent. However, more significant areas of gravel substrate had developed at both monitoring locations in 2022. No sewage slime or fungus was noted at either monitoring point.

There was no significant difference in the biotic index results obtained from monitoring stations upstream and downstream of the discharge point. However, there was a slight variation in species present between the two monitoring locations. Species diversity in 2022 has increased since 2021 at both monitoring sites.

It is considered that the improvement in taxon richness and species sensitivity since 2021 may be due to the early season monitoring period and the development of more favourable gravel substrate at the two monitoring sites.

Overall, the quality of the River remains moderately polluted with both monitoring locations holding a quality rating of Q3.

As per EPA monitoring, the Magherarney River has maintained the status of Q2 to Q3 for the last thirty years at monitoring locations upstream and downstream of this assessment's monitoring locations.

It is concluded that the Grove Turkeys Ltd effluent discharge does not appear to be resulting in a negative impact upon the biotic quality of the Magherarney River.

1.0 INTRODUCTION AND SCOPE OF WORK

Grove Turkeys Ltd is a producer and processor of poultry products, mainly Turkeys. This site takes in live turkeys and produces fresh and frozen whole turkeys, and value-added products for the major retail outlets in Ireland and the UK.

The installation is adjacent to the Magherarney Lough but has no discharges to the lake. There is an on-site wastewater treatment plant for treating on-site process and imported effluent. The treated effluent from the wastewater treatment plant is discharged to the Magherarney River.

A local family founded the company in 1972. Kerry Group acquired the company in 1988 and the business continued to grow and expand into new products and markets. In January 2007, the company changed hands in a management buyout (MBO) by a Management team within Kerry Foods. The 2 Sisters Food Group acquired the business in 2016.

The site is licenced to carry out the following activity, under Industrial Emissions Licence No P0832-01;

7.4.1 "The *operation of slaughterhouses with a carcass production capacity greater than 50 tonnes per day*".

11.1 "*The recovery or disposal of waste in a facility within the meaning of the Act of 1996, which facility is connected or associates with another activity specified in this Schedule in respect of which a licence or revised licence under Park IV is in force or in respect of which a licence under the said Part is or will be required.*"

Panther Environmental Solutions Ltd (PES Ltd) was commissioned by Grove Turkeys Ltd to carry out an aquatic assessment of the Magherarney River. This assessment is required as the site discharges treated effluent to the Magherarney River, under IED licence conditions, from its primary and biological effluent treatment plant.

This Aquatic Assessment was compiled as a requirement under the IED licence, as follows:

Schedule C.6 Ambient Monitoring

Receiving Water Monitoring

Location: Upstream & downstream of discharge point.

Parameter	Monitoring Frequency Note 1	Analysis Method/Technique
Biological Quality (Q) Rating/Q Index	Annually	To be agreed by the Agency

Note 1: Monitoring period - June to September.

2.0 DESCRIPTION OF THE MAGHERARNEY RIVER.

Hydrometric Area 36 contains the Erne Catchment (area 4,372 km^2). The River Finn (36F01), of which the Magherarney River is a tributary, rises in the townland of Corragunt, Co Fermanagh, west of Knockatallon in Co Monaghan. It is a tributary of Upper Lough Erne and enters the Erne 6.5km outside Clones. The surface catchments drained by the River Erne discharge to the sea at Ballyshannon, County Donegal.

The Magherarney River IE_NW_36_1082 (36M01) (catchment area 66.6 km^2) rises at Drumloo Lough, west of Scotstown, Co Monaghan, and flows for approximately 16.2 km before meeting the River Finn at Derryleggan, Co. Monaghan.

Figure 2.1: Magherney River, EPA Monitoring Stations and Survey Stations

The Magherarney River is not a designated waterbody for drinking water, nutrient sensitive waters, salmonid species or shellfish. There are no SAC or SPA designated sites within the vicinity of the Magherarney River.

The discharge from the Smithborough UWWTP (D0464-01) [E264465,N318871] is located approximately 1km downstream of the discharge from the Grove Turkeys facility.

The European Communities Environmental Objectives (Surface Waters) Regulations (S.I. 272 of 2009) provide for the classification of surface water bodies by the EPA for the purposes of the Water Framework Directive, and the establishment of legally binding quality objectives for all surface waters.

These regulations establish that those surface waters classified by the Agency as being of "high" or "good" status shall be maintained at their current level, and those surface waters which have been classified as less than "good" status shall be improved to at least good status by 2021.

The EPA Interim Report on the Biological Survey of River Quality - Results of 2004 Investigations stated that the Magherarney River "*had improved below Smithborough', since 2001 but was still far from satisfactory there and again upstream.*'' The river has a biological quality rating of 3 (moderately polluted).

EPA monitoring in 2013 classified the Magherarney River as poor status in the locations of Br East of Smithborough and Magherarney Br. "*A lack of sensitive macroinvertebrate fauna characterised both sites sampled on the Magherarney in 2013. Unsatisfactory ecological conditions have persisted in the Magherarney river for over thirty years.*"

The 2017 EPA monitoring report noted "*The Magherarney River was in quite poor condition at both sites surveyed in September 2017. Cattle access at the upper site (0150) was causing physical damage to the river banks, leading to unnecessary siltation and nutrient inputs.*"

EPA monitoring in 2019, the most recent reporting year, classified the Magherarney River as poor status in the locations of Br East of Smithborough and Magherarney Br.

Table 2.1: EPA Recording Stations – Q-values

River	**Magherarney River. (36M01)**				
Station Code	**0100**	**0150**	**0200**	**0250**	**0300**
Location	**Magherarney Br 2km NE of Smithborough**	**Br E of Smithborough**	**Magherarney Br**	**Magherarney 0.2 km u/s Maghery R confl**	**Magherarney 0.2 km d/s Maghery R confl**
2019		2-3	3		
2017		2-3	3		
2013		2-3	2-3		
2010		3	3		
2007			3		
2004		3	3		
2001		2-3	2/0		
1998		3	3		
1997		3	3		
1993		3	3		
1989	2-3	3	2-3	2-3	3
1987	3	3	2-3		
1986			2		2-3
1982	3		2		
1980	3		2-3		
1977			3		

3.0 DESCRIPTION OF MONITORING LOCATIONS

The two selected sampling stations are located upstream and downstream of the discharge point in the Magherarney River.

Table 3.1: Sampling Station Locations

Station	River	Location	Grid Ref
1	Magherarney	Behind Meadows housing estate (West). Upstream of discharge point.	E258575, N 330330
2	Magherarney	Behind Meadows Housing Estate (East). Downstream of discharge point.	E258520, N330218

Appendix A contains a map overview of monitoring locations and the discharge point along the course of the Magherarney River. Further details of monitoring location characteristics are presented within Table B3 in Appendix B.

Monitoring Point 1 is located approximately 35m upstream of the discharge point. It is west of the Meadows Housing Estate. The EPA monitoring location "*Br E of Smithborough*" (Station code RS36M010150) is located approximately 2.2 km upstream of this monitoring point. In 2020, this monitoring position has been moved closer to the discharge point as safe access was available to a riffle area.

Reed clearing since 2021 has provided increased areas of fine gravel within the riverbed.

Figure 3.1: *Monitoring Point 1*

Monitoring Point 2 is located 100m downstream of the discharge point. It is East of the Meadows Housing Estate. The EPA monitoring location "*Magherarney Br*" (Station code RS36M010200) is located approximately 950m downstream of this monitoring point.

Following the dredging of this section of river several years ago, the substrate of the river continues to change significantly, year on year. Since 2019, a large earth island in the centre of the channel has decomposed and earth deposits are now present on the edges of the channel. In 2022, sections of 2020/2021 muddier substrate had a fair cover of fine gravels.

Figure 3.2: *Monitoring Point 2*

4.0 METHODOLOGY

Monitoring of the sampling stations was conducted by Martin O'Looney BSc of PES Ltd on Thursday 02nd June 2021 under low to normal flow conditions. Weather conditions were mild and cloudy with scattered showers.

Temperature, Dissolved Oxygen and pH were measured in the field at the time of sampling using Wti Multi-meters with an inbuilt thermometers.

Ecological analysis was carried out in accordance with Standard Methods "*Benthic Macroinvertebrates*" Section 10500, Chapter 1, page 10-63 and Toner et al (2005). A single two-minute kick sample and stone wash was collected at each monitoring station.

Specimens were segregated and preserved in 70% ethanol and stored in specimen jars following collection. Identification was carried out by means of a high-powered microscope and dichotomous keys, as per section 8.0 below.

The methodology outlined in Toner *et al* (2005) was followed in order to determine the Biotic Quality Rating (Q) at each monitoring location. Macroinvertebrates were identified down to the lowest taxon as outlined in Appendix I of Toner et al (2005).

In the presence of pollution, characteristic and well-documented changes are induced in the flora and fauna of rivers and streams. The changes which occur are due to the varying sensitivities of the different components of the community to the stresses caused by pollution. It is therefore possible to relate certain faunal groupings or community types to particular levels of pollution.

Identified macroinvertebrates were grouped into categories based upon their relative sensitivities to pollution, from "Group A" being most sensitive to "Group E" being the most tolerant of pollution. The relative abundances of each group were calculated and the Q-rating for each monitoring station was determined. The correlation between Q values and water quality can be seen in Table 4.1 below.

Table 4.1: Relationship between Q-value and Water Quality

Biotic Index	Water Quality	Condition
Q5	Good	Satisfactory (Pristine)
Q4	Fair	Satisfactory
Q3-4	Transitional (Slight Pollution)	Unsatisfactory
Q3	Doubtful	Unsatisfactory
Q2	Poor	Unsatisfactory
Q1	Bad	Unsatisfactory

The intermediate ratings, Q1-2, Q2-3, Q3-4 and Q4-5, are used to denote transitional conditions, ratings within parenthesis, i.e. (Q4), indicate borderline values, and a rating including a zero i.e. Q3/0, indicate toxic effects rather than eutrophication.

The BMWP (Biological Monitoring Working Party) Score and ASPT (Average Score per Taxon) were also calculated. These measures involve a precise calculation using scores that reflect species sensitivity to organic pollution, assigning a value of 1 to 10 in order of decreasing tolerance to pollution. The numbers assigned to each taxon identified within a sample are then added to attain the BMWP score.

The scoring system used for the BMWP system is included in Appendix C. BMWP scores have been recently revised (Walley & Hawkes, 1996), including updated taxon sensitivity scores and habitat specific scores, and these are now becoming accepted as more accurately reflecting pollution sensitivity in Britain.

The BMWP scoring system was devised for the taxonomic families occurring in British rivers, with established correlation to known water quality status, and would need modification for use in Irish rivers. Therefore, the scores determined as part of this assessment should be viewed with caution.

The BMWP scoring system is widely used in Britain by organisations such as the Environment Agency, and water quality bands have been adapted for use in several regions. As previous surveys have used the Severn-Trent BMWP Scoring System, it has been included in the following table for comparison with the results of this assessment.

Table 5.2: Severn-Trent BMWP Scoring System.

BMWP Score Bands	Category	Interpretation
0-12	Very Poor	Heavily Polluted
13-35	Poor	Polluted or Impacted
36-70	Moderate	Moderately Impacted
71-90	Good	Clean but Somewhat Impacted
90-150	Very Good	Clean but Slightly Impacted
>150	Excellent	Unpolluted/Un-impacted

The Average Score Per Taxon (ASPT) represents the average tolerance score of all taxa within a community and is calculated by dividing the BMWP by the number of families represented in the sample. The ASPT helps to standardise data and minimise factors unrelated to pollution pressure such as unusually low or high habitat diversity or inconsistent sampling effort.

Site characteristics for each station have also been included in order to allow a more complete assessment of the ecological make-up at each site. This included an examination of substrate characteristics, riparian vegetation and shade, macrophyte growth and percentage cover. Site information is summarised in Table B3 of Appendix B.

5.0 RESULTS

The following tables detail the finding of this June 2022 aquatic assessment of the Magherarney River. Results of previous year's assessments have been included.

5.1 FIELD MEASUREMENT RESULTS FOR THE MAGHERARNEY RIVER.

Table 5.1: Temperature, Dissolved Oxygen and pH Levels

Station	pH	DO (mg/l)	DO (%Sat)	Temperature (°C)
1	7.4	8.13	72.2	9.8
2	7.3	7.85	71.7	11.0

5.2 ECOLOGICAL RESULTS FOR THE RIVER.

Appendix B, Chart B1 contains further details of species abundance and biotic indices for this 2022 assessment of the Magherarney River.

Table 5.2: Magherarney River 2022 Survey and Historical Q-values for MP1 and MP2

STATION / YEAR	Q-values	
	MP1	**MP2**
2022	Q3	Q3
2021	Q3	Q3
2020	Q3	Q3
2019	Q3	Q3
2018	Q3	Q3

Appendix B, Table B2 contains further details of species abundance, BMWP scoring and ASPT scoring for this 2022 assessment.

Table 5.3: Magherarney River 2022 Survey and Historic BMWP Scores

STATION / YEAR	BMWP SCORE	
	MP1	**MP2**
2022	76.4	81.0
2021	38.0	42.9
2020	72.7	59.3
2019	67.7	68.6
2018	50.2	58.8

Table 5.4: Magherarney River 2022 Survey and Historic ASPT Scores

STATION / YEAR	ASPT SCORE	
	MP1	MP2
2022	6.4	5.8
2021	4.8	4.8
2020	5.6	5.9
2019	5.6	5.7
2018	5.0	5.9

6.0 DISCUSSION

6.1 DISCUSSION OF CHEMICAL RESULTS

Field Measurements

pH values recorded in the Magherarney River were within the normal range of values which have been recorded in previous years. All pH measurements were within the 6-9 pH range as specified in the Freshwater Fish Directive (2006/44/EC).

Dissolved Oxygen is essential for the survival of fish and other aquatic life and is an important indicator of pollution and/or eutrophication in rivers. Dissolved oxygen levels in the Magherarney River were below the 9 mg/l O_2 limit, ranging from 7.85 mg/l to 8.13 mg/l.

DO saturation for both monitoring locations were also below the 80 to 120% saturation range as specified in the Environmental Objectives (Surface Waters) Regulations 2009 (S.I. No. 272 of 2009).

Decreased DO levels are primarily due to the monitoring areas. The monitoring locations are within or closely downstream of pool type areas, with no significant riffle area in close proximity upstream. Therefore, the DO within the river at these locations are not being readily replenished.

Lower water temperatures and increased gravel areas have increased levels from previous surveys.

6.2 DISCUSSION OF ECOLOGICAL RESULTS

The weather during spring and early summer 2022 was characterised by mostly above average temperatures and below average rainfall. The last week of May witnessed a heatwave. However, the heatwave had ceased by the beginning of June 2022, during the time at which the aquatic assessment was completed.

Therefore, high temperature and low flow conditions may have caused additional stress upon macroinvertebrate communities within the Magherarney River

As with previous years, the macroinvertebrate community included predominantly the moderately pollution-tolerant species. However, in 2022, more sensitive species were also present in small to fair numbers.

The 2022 monitoring survey was carried out earlier in the season (June vs July) than previous surveys. It is also noted that both sites included more significant areas of fine gravels (rather than mud). These factors may account for the presence of more sensitive species in 2022.

Community abundance ranged from 202 to 281 between the two locations and a taxon richness of 12 at MP1 and 14 at MP2 in the Magherarney River.

The following table outlines the relationship between the EPA Biotic Index (Q) and the corresponding water quality.

Table 6.1: EPA scheme of Biotic Indices (Q) and its Corresponding Water Quality

Biotic Index	Quality Status	Quality Class
Q5, Q4-5, Q4	Unpolluted	Class A
Q3-4	Slightly Polluted	Class B
Q3, Q2-3	Moderately Polluted	Class C
Q2, Q1-2, Q1	Seriously Polluted	Class D

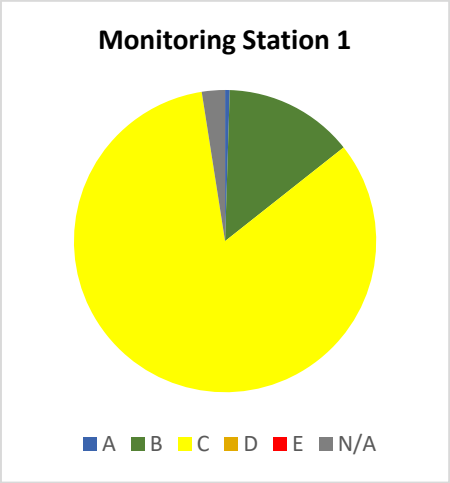

Figure 6.1.: Monitoring location 1

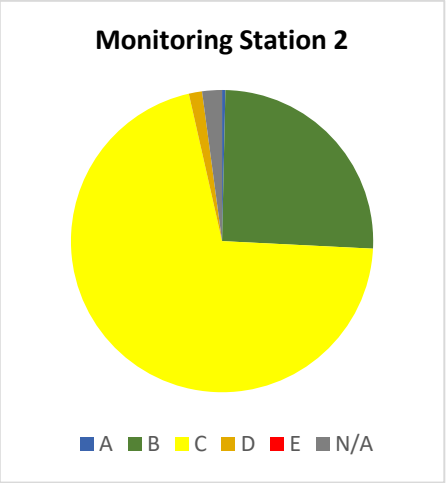

Figure 6.2: Monitoring location 2

All monitoring stations along the Magherarney River were dominated by Group C species. The Magherarney River was dominated (fair numbers to numerous) by pollution tolerant species such as the freshwater shrimp *Gammarus pulex, Chironomidae* and *Elminthidae* beetles.

The Group B mayfly *Baëtidae* and caddisfly *Sericostomatidae* were present in '*small numbers'* to '*common*' abundance.

Only single specimens of the Group A mayfly *Heptageniidae* were detected at both monitoring locations of the Magherarney River.

While the river has improved with the presence of more pollution tolerant species (Group B), Group A taxa are not present in at least '*small*' numbers. It is also noted that DO% saturation remains below the 80% to 120% range. Therefore, the river quality has not improved to Q3-4.

Due to the dominance of pollution tolerant Group C organisms, stations 1 and 2 have been classified as being of moderately polluted ecological status (Q3). Therefore, the Q index for the sites is unaltered from previous years.

Species diversity in 2022 is increased since 2021 at both monitoring locations. This would indicate a slight improvement in the ecological quality of the river since 2021.

BMWP and ASPT Scores

As BMWP scores are not developed for use in Ireland, these figures should be viewed as a general metric on water quality trends and not viewed as a measure of actual water quality present in the rivers.

The BMWP Score for MP1 was found to be 76.4 and in the "good" category (clean but somewhat impacted). The BMWP Score for MP2 was 81.0 and also characterised as "good" (clean but somewhat impacted).

The ASPT score for MP1 was found to be 6.4 and 5.8 for MP2, showing the similar species composition between the two sites.

It is considered that the improvement in BMWP and ASTP scores since 2021 may be due to the early season monitoring period and the development of more favourable gravel substrate at the two monitoring sites.

Overall, the river is considered to be moderately polluted, both upstream and downstream of the discharge from the Grove Turkeys Ltd facility.

7.0 CONCLUSIONS

- The Quality rating showed that Group C was dominant at both monitoring locations with many such species, including *Gammarus sp*. being "*numerous*" at monitoring stations 1 and 2.

- While the river has improved with the presence of more pollution tolerant species (Group B), Group A taxa are not present in at least '*small*' numbers.

- It is also noted that DO% saturation remains below the 80% to 120% range.

- Both monitoring locations were classified as ecological status Q3 which indicates that the water quality is "moderately polluted". This condition is considered unsatisfactory in terms of the Water Framework Directive.

- It should be noted, as per EPA Monitoring, that there has been a long-term absence of sensitive macroinvertebrate fauna in the Magherarney River. Unsatisfactory ecological conditions have persisted in the Magherarney River for over thirty years.

- Historic EPA ecological status at monitoring locations upstream and downstream of this assessment's monitoring stations has ranged from Q2 to Q3, maintaining predominantly at Q3.

- It is considered that the improvement in taxon richness and species sensitivity since 2021 may be due to the early season monitoring period and the development of more favourable gravel substrate at the two monitoring sites.

- The Grove Turkeys Ltd effluent discharge does not appear to be resulting in a negative impact upon the biotic quality of the Magherarney River.

8.0 REFERENCES

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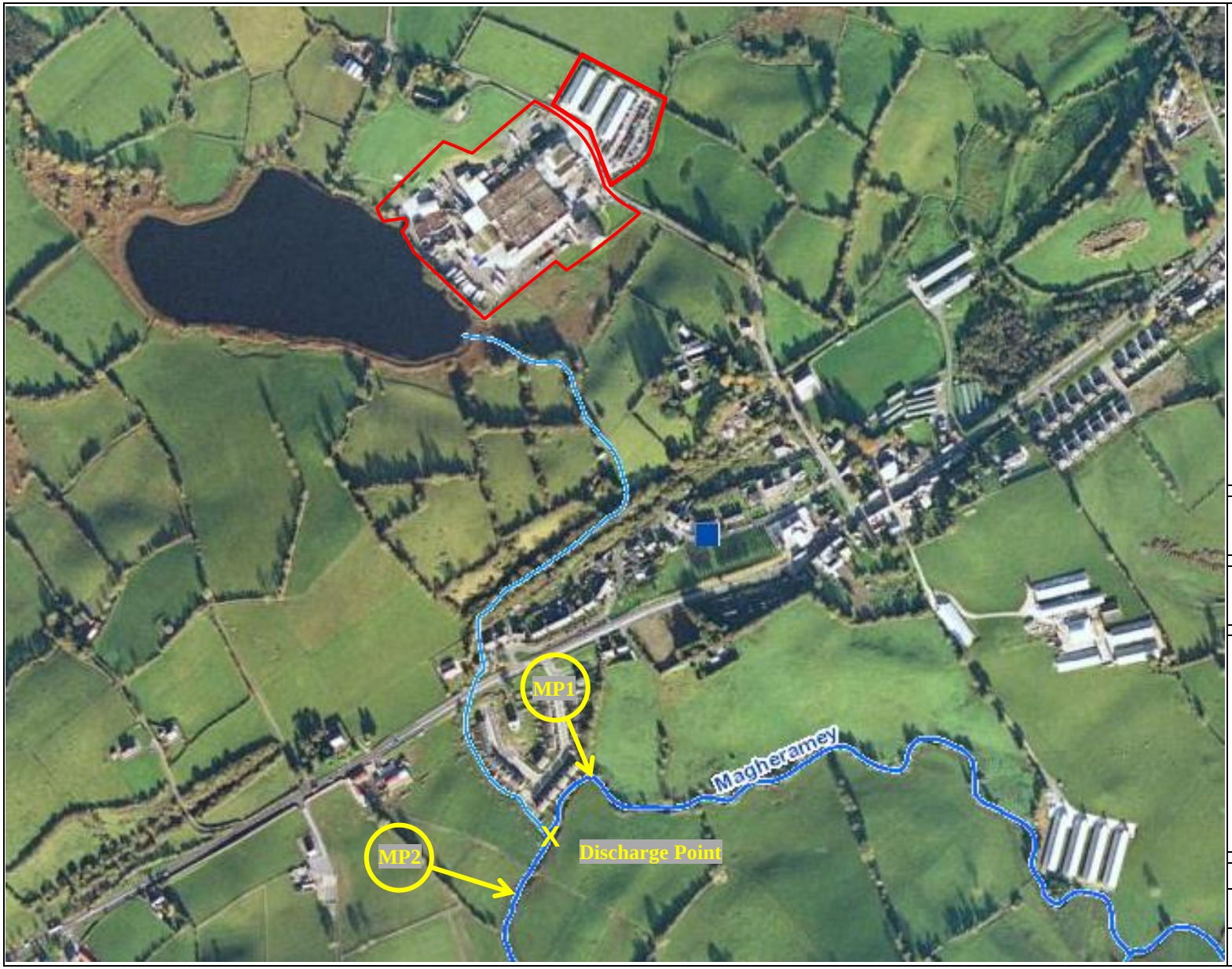
APPENDIX A

RIVER MONITORING LOCATIONS



Notes:

N

MP1 – **Upstream Monitoring Point**

MP2 – **Downstream Monitoring Point**

– **Site Area**

ECOLOGICAL MONITORING LOCATIONS MAP

GROVE TURKEYS LTD
SMITHBOROUGH, CO. MONOGHAN

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datum:	EPA	scale:	NTS A4
		drawn:	MOL
drawing no.	rev	checked:	MF
PES_20_9732-1	A	approved:	-
		date:	24.07.20

APPENDIX B

ECOLOGICAL MONITORING RESULTS

Table B1: List of Species Identified for the Magherarney River

EPHEMEROPTERA - MAYFLIES	**COLEOPTERA – BEETLES**
Baëtis sp	*Elmis aenea* (adult & larva)
Baëtis rhodani	*Esolus parallelepipedus* (adult & larva)
Ephemerella ignita	*Limnius volckmari* (adult & larva)
Heptagenia sulphurea	Dytiscidae (adult)
PLECOPTERA - STONEFLIES	**CRUSTACEA - CRUSTACEANS**
	Gammarus pulex (freshwater shrimp)
	Asellus spp. (hog-lice)
TRICHOPTERA – CADDISFLIES	**DIPTERA - TRUE FLIES**
Rhyacophila dorsalis	Simuliidae (black-flies)
Hydropsyche sp.	Tipulidae
Hydropsyche siltalai	Chironomidae (non-biting midges)
Polycentropus flavomaculatus	*Chironomous* spp. (blood worm)
Sericostoma personatum	Dicranota sp.
Lepidostoma hirtum	Ceratopogonidae sp.
Limnephilis spp.	**HIRUDINEA - LEECHES**
Silo Pallipes	Piscicolidae
Hydroptilidae	Erpobdella
HYDRACARINA – WATERMITES	Glossiphonidae
Hydracarina	**OLIGOCHAETE - WORMS**
TRICLADIDA - FLATWORMS	Lumbriculidae
Polycelis sp.	*Tubifex tubifex* (sludge worm)
MOLLUSCA – MOLLUSCS	**HEMIPTERA**
Ancylidae	

Table B2: Abundances of Species Identified for the Magherarney River

Benthic Macroinvertebrate Survey Results		
Station	**1**	**2**
EPHEMEROPTERA		
Baetidae	17	56
Ephemerellidae		6
Heptageniidae	1	1
TRICHOPTERA		
Rhyacophilidae		1
Hydropsychidae	1	2
Polycentropidae		
Sericostomatidae	9	16
Lepidostomatidae		
Limnephilidae		
Hydroptilidae	1	
Goeridae	1	
CRUSTACEA		
Gammarus sp.	100	100
Asellus sp.		1
COLEOPTERA		
Elminthidae	17	16
Dytiscidae		
PLANARIIDAE		
Polycelis sp.		
HIRUDINEA		
Piscicolidae	1	1
Erpobdella		
Glossiphonidae		1
HYDRACARINA		
Hydracarina	3	11
DIPTERA		
Simuliidae	10	20
Tipulidae		
Chironomidae	36	43
Chironomous spp.		
Dicranota sp.	1	1
Ceratopogonidae sp.	1	1
MOLLUSCA		
Ancylidae	3	

Benthic Macroinvertebrate Survey Results		
Station	**1**	**2**
OLIGOCHAETE		
Lumbriculidae	3	4
Tubificidae		
OTHER		
Q-RATING	3	3
TAXON RICHNESS	12	14
BMWP SCORE	76.4	81.0
ASTP SCORE	6.4	5.8

Table B3: Monitoring Station Characteristics for the Magherarney River.

STATION	WIDTH (m)	DEPTH (cm)	CURRENT	SUBSTRATE	COMMENT
1	4.8	300-500	Fast	Gravel, some sand, with sections of loose stones	%Shade = 30% Primarily grass and field/hedgerow species with yellow iris (*Iris pseudacorus*) and alder (*Alnus glutinosa*). Gravels with no slime, sewage fungus or excessive algal development noted. Siltation was noted due to cattle access upstream for drinking water.
2	5.1	130	Fast	Mud and gravel with scattered stones	%Shade = 10% Primarily common grassland species. The river has been channelized in this section of the river in the past and there is a lot of variation in the stream bed, year on year. Gravels on mud substrate with no slime, sewage fungus or excessive algal development noted. Sections of earth extend into the river channel at water level. Macrophyte/ bryophyte cover 10% with Common Water-Starwort (*Callitriche stagnalis*), and Brooklime (*Veronica beccabunga*).

APPENDIX C

BIOLOGICAL MONITORING WORKING PARTY SCORES

Table C1: Biological Monitoring Working Party Scores

Biological Monitoring Working Party Scores						
Common Name	**Family**	**Original BMWP Score**	**Revised BMWP Score**	**Habitat Specific Scores**		
				Riffles	**Riffle Pools**	**Pools**
Flatworms	Planariidae	5				
	Dendrocoelidae	5				
Snails	Neritidae	6	7.5	6.7	8.1	9.3
	Viviparidae	6	6.3	2.1	4.7	7.1
	Valvatidae	3	2.8	2.5	2.5	3.2
	Hydrobiidae	3	3.9	4.1	3.9	3.7
	Lymnaeidae	3	3	3.2	3.1	2.8
	Physidae	3	1.8	0.9	1.5	2.8
	Planorbidae	3	2.9	2.6	2.9	3.1
Limpets and Mussels	Ancylidae	6	5.6	5.5	5.5	6.2
	Unionidae	6	5.2	4.7	4.8	5.5
	Sphaeriidae	3	3.6	3.7	3.7	3.4
Worms	Oligochaeta	1	3.5	3.9	3.2	2.5
Leeches	Piscicolidae	4	5	4.5	5.4	5.2
	Glossiphoniidae	3	3.1	3	3.3	2.9
	Hirudididae	3	0	0.3	-0.3	
	Erpobdellidae	3	2.8	2.8	2.8	2.6
Crustaceans	Asellidae	3	2.1	1.5	2.4	2.7
	Corophiidae	6	6.1	5.4	5.1	6.5
	Gammaridae	6	4.5	4.7	4.3	4.3
	Astacidae	8	9	8.8	9	11.2
Mayflies	Siphlonuridae	10	11	11		
	Baëtidae	4	5.3	5.5	4.8	5.1
	Heptageniidae	10	9.8	9.7	10.7	13
	Leptophlebiidae	10	8.9	8.7	8.9	9.9
	Ephemerellidae	10	7.7	7.6	8.1	9.3
	Potamanthidae	10	7.6	7.6		
	Ephemeridae	10	9.3	9	9.2	11
	Caenidae	7	7.1	7.2	7.3	6.4

Biological Monitoring Working Party Scores						
Common Name	Family	Original BMWP Score	Revised BMWP Score	Habitat Specific Scores		
				Riffles	Riffle Pools	Pools
Stoneflies	Taeniopterygidae	10	10.8	10.7	12.1	
	Nemouridae	7	9.1	9.2	8.5	8.8
	Leuctridae	10	9.9	9.8	10.4	11.2
	Capniidae	10	10	10.1		
	Perlodidae	10	10.7	10.8	10.7	10.9
	Perlidae	10	12.5	12.5	12.2	
	Chloroperlidae	10	12.4	12.5	12.1	
Damselflies	Platycnemidae	6	5.1	3.6	5.4	5.7
	Coenagriidae	6	3.5	2.6	3.3	3.8
	Lestidae	8	5.4			5.4
	Calopterygidae	8	6.4	6	6.1	7.6
Dragonflies	Gomphidae	8				
	Cordulegasteridae	8	8.6	9.5	6.5	7.6
	Aeshnidae	8	6.1	7	6.9	5.7
	Corduliidae	8				
	Libellulidae	8	5			5
Bugs	Mesoveliidae *	5	4.7	4.9	4	5.1
	Hydrometridae	5	5.3	5	6.2	4.9
	Gerridae	5	4.7	4.5	5	4.7
	Nepidae	5	4.3	4.1	4.2	4.5
	Naucoridae	5	4.3			4.3
	Aphelocheiridae	10	8.9	8.4	9.5	11.7
	Notonectidae	5	3.8	1.8	3.4	4.4
	Pleidae	5	3.9			3.9
	Corixidae	5	3.7	3.6	3.5	3.9
Beetles	Haliplidae	5	4	3.7	4.2	4.3
	Hygrobiidae	5	2.6	5.6	-0.8	2.6
	Dytiscidae	5	4.8	5.2	4.3	4.2
	Gyrinidae	5	7.8	8.1	7.4	6.8
	Hydrophilidae	5	5.1	5.5	4.5	3.9
	Clambidae	5				
	Scirtidae	5	6.5	6.9	6.2	5.8

Biological Monitoring Working Party Scores						
Common Name	Family	Original BMWP Score	Revised BMWP Score	Habitat Specific Scores		
				Riffles	Riffle Pools	Pools
	Dryopidae	5	6.5	6.5		
	Elmidae	5	6.4	6.5	6.1	6.5
	Chrysomelidae *	5	4.2	4.9	1.1	4.1
	Curculionidae *	5	4	4.7	3.1	2.9
Alderflies	Sialidae	4	4.5	4.7	4.7	4.3
Caddisflies	Rhyacophilidae	7	8.3	8.2	8.6	9.6
	Philopotamidae	8	10.6	10.7	9.8	
	Polycentropidae	7	8.6	8.6	8.4	8.7
	Psychomyiidae	8	6.9	6.4	7.4	8
	Hydropsychidae	5	6.6	6.6	6.5	7.2
	Hydroptilidae	6	6.7	6.7	6.8	6.5
	Phryganeidae	10	7	6.6	5.4	8
	Limnephilidae	7	6.9	7.1	6.5	6.6
	Molannidae	10	8.9	7.8	8.1	10
	Beraeidae	10	9	8.3	7.8	10
	Odontoceridae	10	10.9	10.8	11.4	11.7
	Leptoceridae	10	7.8	7.8	7.7	8.1
	Goeridae	10	9.9	9.8	9.6	12.4
	Lepidostomatidae	10	10.4	10.3	10.7	11.6
	Brachycentridae	10	9.4	9.3	9.7	11
	Sericostomatidae	10	9.2	9.1	9.3	10.3
True Flies	Tipulidae	5	5.5	5.6	5	5.1
	Chironomidae	2	3.7	4.1	3.4	2.8
	Simuliidae	5	5.8	5.9	5.1	5.5

Notes

* These families are now excluded from the list used for the calculation of the score. A blank indicates that there were insufficient records for the calculations. The Revised families recorded in approximately 17,000 samples. BMWP Scores are based on the analysis of frequency of occurrence of the The Habitat Specific Scores are based on the following substrate compositions:

Riffles: >= 70% boulders and pebbles,
Pool: >= 70% sand and silt,
Riffle/Pool: the remainder.