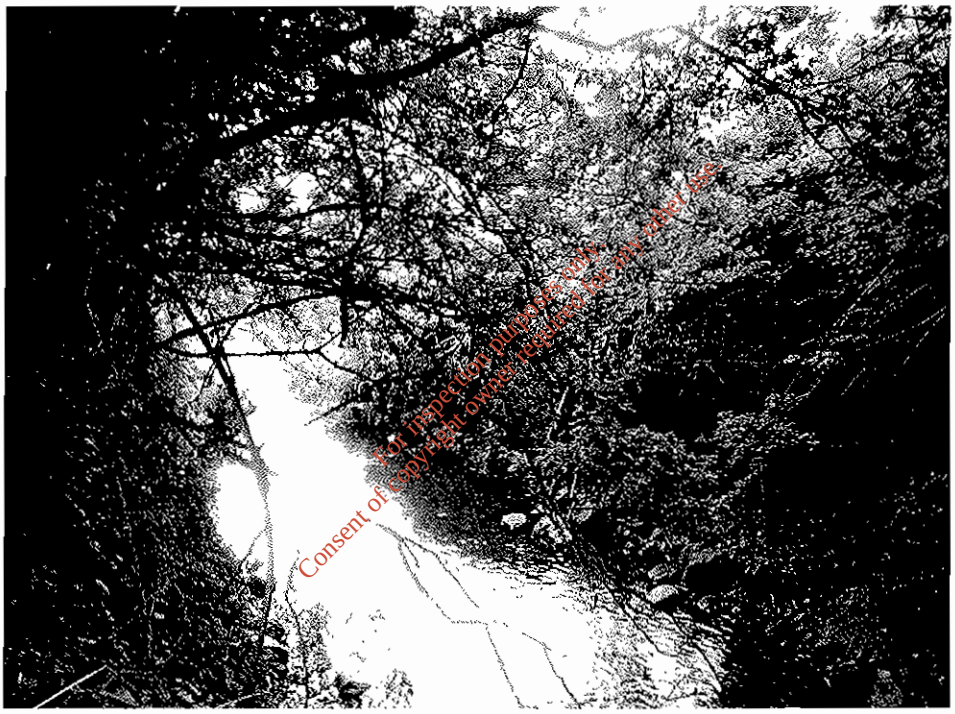
APPENDIX C – REPORT ON THE FLORA AND FAUNA

Flora and Fauna Assessment for the Extension of the Carrickmacross Waste Water Treatment Works

Compiled by

AQUENS Ltd.



Commissioned by

T.J. O'Connor & Associates

Consulting Engineers

ENVIRONMENTAL IMPACT STATEMENT

September 2004

Table of Contents

1.0 Flora and Fauna Assessment of the Proules River and Carrickmacross WWTW Site of Proposed Extension

1.1 Introduction

A study of the Waste Water Treatment Works (WWTW) for Carrickmacross was commissioned jointly by Carrickmacross Town Council and Monaghan County Council. It is proposed to increase the capacity of the WWTW to allow for existing and proposed developments in the area to the year 2025. The existing treatment works was constructed in 1997-1998 and was designed to cater for a population equivalent (p.e.) of 12,150. It provides secondary treatment only of wastewater. It currently discharges into the Proules River that flows along the north-east boundary of the WWTW. It is estimated to be overloaded by an average of 90% to a maximum of 300%. The proposed upgrade to the works intends to provide a capacity of 30,000 p.e. in the first phase while the second phase will cater for a p.e. of 44,000 as and when it is required. The Urban Waste Water Treatment Regulations – S.I. No.254, 2001 designated thirty water bodies as 'sensitive areas'. The third schedule was of direct relevance to the WWTW at Carrickmacross. The stretch downstream of the outfall arising from the WWTW on the Proules River to the confluence with the Glyde River was identified as one such 'sensitive area'. This effectively demands the provision of nutrient reduction facilities (tertiary treatment) at the plant. The effect of this designation has prompted this proposal for the upgrade of the Carrickmacross WWTW.

This project has been undertaken by T. J. O'Connor & Associates Consulting Engineers who in turn have commissioned AQUENS (Aquatic Environmental Services) to carry out an ecological impact report in relation to the upgrade. The objective of this survey was to assess the current ecological status of both the Proules River into which the plant discharges and the site of the proposed extension. Further to this, any possible impacts of the proposed upgrading works were to be assessed and where appropriate recommendations were to be made with respect to measures required to mitigate the impacts. Five sites in total were evaluated along the River Proules a brief description of each is presented in Table 1. Sampling was concentrated at and below the point of discharge where the primary effects, if any, of

the discharge would be seen. One site was selected upstream of the town, while another was selected downstream of the town but upstream of the outfall. These were selected to show the quality of the water before it enters the town, after it flows through the town and before it receives the discharge. This allows the effect if any, due to the discharge from the WWTW, to be isolated from any other possible effects. The investigations incorporated approximately 2.5km of river (Fig.1). The study included macroinvertebrates, aquatic vegetation, water quality, fish, birds and mammals. Plates 1 to 8 show areas within the study area.

1.2 Study Area

1.2.1 The Proules River

The Proules River is approximately 15km in length. It rises about 3km north-west of the town of Carrickmacross where the phreatic surface is at ground level. Flowing in a south-easterly direction, along its course it enters two lakes, firstly Lough Naglack (Plate 5) and then Moynalty Lough which it exists confluencing with the Glyde River approximately 6km further downstream. The River drops about 10m over the study area. It drains mainly agricultural land flowing through the urban area of Carrickmacross in the middle reaches. For much of its course the river is narrow, shallow and with moderate flow. Downstream of the Carrickmacross (WWTW) it slows, deepens and is impeded by prolific growth of instream vegetation until it enters Lough Naglack. Water is abstracted from Moynalty Lough for the Killanny Group Water Supply Scheme.

1.2.2 Site of Proposed Extension

The site of the proposed extension for the upgrading of the WWTW is adjacent to the existing plant (Plate 6). It is situated north of the plant and extends north-east to the boundary with the River Proules and north-west to the main N2 roadway. The new link road currently being developed runs along the northern boundary of the site separated by a perimeter of trees and a fence. A green metal fencing divides the site into two sections. A line of trees and fencing also separates the site from the river. The site of the proposed extension supports man-made habitats. It has a hard surface and is currently used as a storage area for vehicles and materials by the local authority. The entrance compound consisted of roads, a grassy bank along the main entrance road, another small area of grass, and a larger area of bare ground with

rubble, grass cuttings, pipes and spoil heaps. The main compound was divided from the entrance compound by a green fence and also adjoined the existing plant. It was covered mainly with gravel and had some patches of grass and weeds. Piles of pipes, blocks and road materials were scattered around the main compound. Vehicles and machinery were also present.

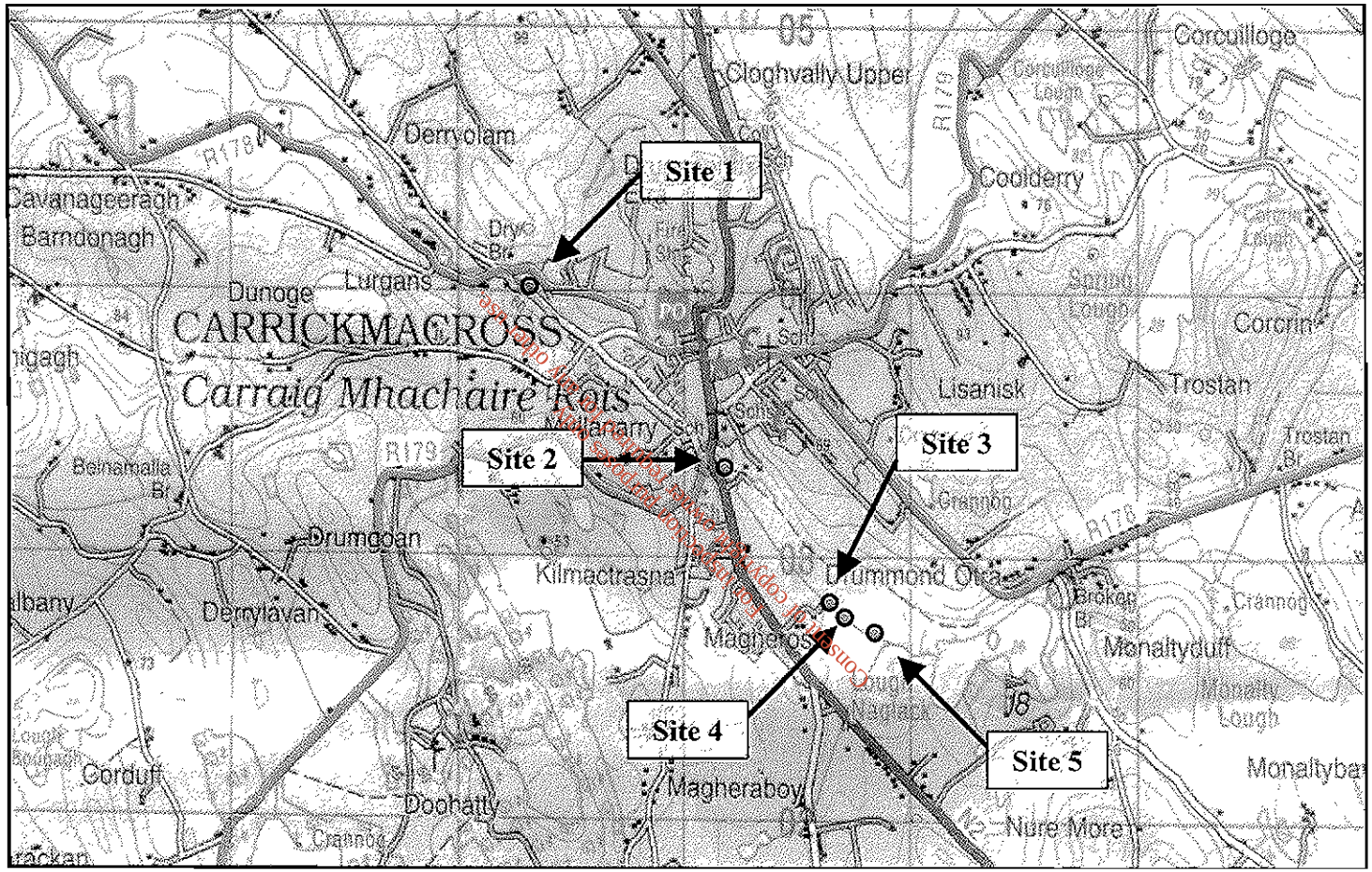


Figure 1. Map showing the location of the sampling sites selected along the Proules River Carrickmacross

Table 1 Description of macroinverterbate sampling sites on the Proules River

Site	Description	Grid Reference	Width (m)	Depth (cm)	Flow	Substrate	Habitat	Other
1	Dry Br. (Plate 1)	83273 04063	1.5	5	moderate	40% cobble, 30% pebble, 20% gravel & 10% sand	70% riffle 30% glide	Shaded site, no silt present but full of glass bottles. Brown trout *Salmo trutta* L. present
2	Ardee Rd. Br.	84185 03278	3	15	moderate	10% boulder, 40% cobble, 20% pebble, 20% gravel, 5% sand & 5% silt	50% riffle 50% glide	Heavily shaded site with a high steep right bank.
3	Immediately D/S outfall (Plates 2-3)	84630 02835	2-5	10-30	moderate	70% cobble, 10% gravel & 20% mud	60% riffle, 30% glide, 10% pool	50% tree cover and adult damsel fly observed over the river
4	100m D/S outfall	84719 02763	1.5	30-75	slow/no	20% cobble, 10% sand, 70% mud/silt	depositing	river completely choked with vegetation silt 0.5ft deep and a sulphurous smell was evident
5	Just upstream L. Naglack	84916 02680	2	60	slow/no	100% mud/silt	depositing	River completely choked with vegetation, silt 1ft deep in places.

2.0 Ecological Survey of the Proules River

2.1 Macroinvertebrates, Hydrochemistry and Aquatic Vegetation Assessment

2.1.1 Macroinvertebrates

Macroinvertebrates are the most commonly used organisms when assessing water quality for a number of reasons. They are widespread, abundant, easy to sample and they exhibit differential responses to physical and chemical changes in their environment. Some are tolerant of water pollution while others are sensitive. They provide a realistic record of prevailing conditions and are not affected by a temporary amelioration of pollution.

Macroinvertebrate sampling took place on the 11th of August 2004. Five sampling sites were selected (Fig. 1) and a brief description of each is provided in Table 1. Five replicate 'kick' samples each twenty seconds in duration were obtained from each of the sites using a standard FBA pond net (1mm mesh). Sampling was confined to riffle/glide areas where possible as recommended by Pinder *et al.* (1987). Such habitat was not available at Sites 4 and 5 where the river was slow flowing, depositing in nature and choked with vegetation (Plate 4). However, despite the difficult nature of the sampling area, the same sampling method was applied here. Samples were returned to the laboratory and preserved in 70% alcohol. The samples were sorted and the macroinvertebrates were identified by microscopic examination using appropriate FBA taxonomic keys. Water quality ratings were derived using the biological index (Q-values) developed by the EPA for Irish Rivers, recently updated by McGarrigle *et al.* (2002). This Q-value system is a five point score based on the proportions of five groups of organisms, with different pollution tolerances (Appendix B).

The percentage representation of the major macroinvertebrate groups is set out in Table 2. The percentage representation of the key macroinvertebrate taxa used in the EPA Q-value system are presented in Tables 3 and 4. The water quality ratings assigned to each site along with the interpretation of each rating are included in Table 5. The complete list of macroinvertebrates recorded at each site is presented in Table 6. Appendix A contains the raw macroinvertebtrate data for each individual site while Appendix B presents the EPA Biotic Index or Q-value system.

A total of 54 taxa were recorded across all sites on the Proules River. Seven taxa were present at all sites, they were as follows; Oligochaeta, *Helobdella stagnalis* (L.), *Glossiphonia complanata* (L.), *Erpobdella octoculata* (L.), the crustaceans *Asellus* spp. and *Gammarus* spp. and finally the Chironomiidae. The highest number of taxa was found at Site 1 (37) while the lowest was 17 taxa at Site 2 (Table 5). Sites 3, 4 and 5 recorded taxon richness values of 19, 26 and 20, respectively.

The Diptera were found to be the dominant taxon at Site 1 (50%) and Site 3 (52%) due mostly to the abundance of the Chironomiidae (Table 3). Site 1 showed the highest representation of the Ephemeroptera across all the sites (10%). This group represented a small proportion of the overall fauna at Sites 2 and 3, while the Ephemeroptera were absent from Sites 4 and 5. At Site 2 the Oligochaeta dominated (43%) followed closely by the Crustacea (35%). The Crustacea were composed of two genera, *Asellus* spp. and *Gammarus* spp., the former being most abundant. The Diptera dominated at Site 3, due mostly to an abundance of Simuliidae. The dominant fauna at Site 4 were the Oligochaeta (35%), followed by a co-dominance of Hirudinea (25%) and Crustacea (23%). The Hirudinea were represented by four species, *Glossiphonia complanata* being the most numerous (Table 7). The Oligochaeta also dominated at Site 5 (51%) while the Crustacea and Diptera were well represented (21% & 22%, respectively). Other groups including the Mollusca, Plecoptera, Trichoptera and Coleoptera were poorly represented overall.

Table 2 The percentage representation of main macroinvertebrate groups at each site

Taxon	Site 1	Site 2	Site 3	Site 4	Site 5
OLIGOCAETA	4.10	42.39	8.89	35.50	50.76
HIRUDINEA	0.46	4.18	13.45	24.68	3.52
CRUSTACEA	26.13	35.53	22.23	23.22	20.99
MOLLUSCA	0.71	0.75	2.65	3.40	2.07
EPHEMEROPTERA	9.97	0.35	0.07	0.00	0.00
PLECOPTERA	0.86	0.00	0.00	0.00	0.00
TRICHOPTERA	2.43	0.00	0.00	0.00	0.07
HEMIPTERA	1.11	0.00	0.00	0.18	0.00
COLEOPTERA	4.61	0.03	0.55	0.26	0.28
DIPTERA	49.52	16.77	51.93	12.67	22.31
HYDRACARINA	0.00	0.00	0.00	0 04	0.00
PLATYHELMINTHES	0.10	0.00	0.22	0.04	0.00

Group A (Sensitive) fauna were recorded at only one site, namely Site 1 the furthest upstream site located at the edge of the town of Carrickmacross. This group includes the Heptageniidae or 'Flattened Mayfly' requiring clean water conditions and the Plecoptera or 'Stonefly' who are especially sensitive to organic pollution. Both the Heptageniidae and Plecoptera were recorded at Site 1 though in low numbers and poor diversity. Group B (Less Sensitive) fauna represented by low numbers of cased caddis, Baetidae (Ephemeroptera) and *Leuctra* spp. (Plecoptera) were recorded at Sites 1 and 5 only (Table 4). At Site 5 the Group B fauna were represented by one individual cased trichopteran namely *Sericostoma personatum* (Spence). Group C (Tolerant) fauna dominated at Sites 1 and 3. At Site 1 this dominance was due to the Chironomiidae and *Gammarus* spp. The Simuliidae were the best represented Group C fauna at Site 3. Group D (Very Tolerant) fauna were represented at all sites but dominated at Site 2 and 4. The crustacean *Asellus* spp. were abundant at both these sites. The 'Blood Worm' *Chironomus* spp. a Group E (Most Tolerant) fauna were recorded at Sites 2 and 4 only, but in low numbers.

Table 3 The percentage representaion of the key macroinvertebrate taxa at each site

Taxon	Group	Site 1	Site 2	Site 3	Site 4	Site 5
Heptageniidae	A	0.27	0.00	0.00	0.00	0 00
Leuctra spp.	B	0.91	0.00	0.00	0.00	0.00
Baetidae (excl. *B. rhodani*)	B	0.91	0.00	0.00	0.00	0.00
Cased Trichoptera	B	1.88	0.00	0.00	0.00	0.14
Baetis rhodani (Pict.)	C	0.48	0.20	0.00	0.00	0.00
Ephemerellidae	C	8.92	0.40	0.08	0.00	0.00
Chironomidae (excl. *Chironomus* spp.)	C	49.25	27.23	20.23	3.91	44.85
COLEOPTERA	C	4.89	0.05	0.61	0.41	0.56
Gammarus spp.	C	27.04	7.51	3.39	1.51	7.62
GASTROPODA (excl. *L. peregra* & *Physa* spp.)	C	0 48	0.95	2.67	4.94	1.69
PLATHYHELMINTHES	C	0.11	0.00	0.24	0.07	0.00
Simuliidae	C	1.56	1.25	36.71	12.63	0.14
Tipuliidae	C	0.00	0.00	0.00	0.07	0.00
HYDRACARINA	C	0.00	0.00	0.00	0.07	0 00
Uncased Trichoptera	C	0.65	0.00	0.00	0.00	0.00
HEMIPTERA (excl. *A. aestivalis*)	C	1 18	0.00	0.00	0.27	0.00
Piscicola spp.	C	0.05	0 00	0 00	0.14	0.00
Asellus spp	D	0.70	54.20	21 04	34.59	35.26
HIRUDINEA ((excl. *P. geometra*)	D	0.43	7.26	14.78	38.23	7.19
Lymnaea peregra (Mull)	D	0.11	0.00	0.20	0.07	0.28
Physa spp.	D	0.00	0.00	0.00	0.00	0.28
Sphaeriidae	D	0.16	0.35	0.04	0.27	1.97
Chironomus spp.	E	0.00	0.60	0.00	2.81	0.00

Table 4 Summary of the percentage representation of the key macroinvertebrate groups

Group	Site 1	Site 2	Site 3	Site 4	Site 5
A	0.27	0.00	0.00	0.00	0.00
B	3.71	0.00	0.00	0.00	0.14
C	94.62	37.59	63.93	24.02	54.87
D	1.40	61.81	36.07	73.16	44.99
E	0.00	0 60	0.00	2.81	0.00

The highest Q-rating was assigned to Site 1, Q3-4 indicating slight pollution (Table 5). This site was last assessed by the EPA in 1997 when it received a higher rating of Q4-5 (unpolluted). Enrichment is evident in the form of prolific growth of *Apium* spp. along this stretch. The possible sources of this enrichment is run-off from the agricultural land in the upper catchment. Group A fauna were represented at this site by the Heptageniidae (5 individuals) composed of two genera, *Ecdyonurus* spp. and *Rithrogena* spp. Site 2 situated at the edge of town approximately 1km downstream of Site 1, was assigned a lower Q-rating of Q2-3 indicating a moderately polluted water. This was assigned due to a dominance of Group D fauna composed mainly of *Asellus* spp. and the Hirudinea. A small representation of Group E was also recorded (1%). When this site was last assessed by the EPA in 1990 it was given a Q-value of Q4, therefore it too has deteriorated in water quality since then. Site 3 located approximately 700m downstream of Site 2 and immediately below the outfall received a slightly higher rating of Q3. This was due to the dominance of Group C fauna. The remaining two Sites 4 and 5 were assigned Q-ratings of Q2-3 and Q3 respectively. Both these sites were classed as depositing in nature, whereas the other sites were eroding. Nutrient enrichment was evident, as this was completely choked with vegetation impeding flow. It was not possible to see the water from the bank. In addition to this, both sites were heavily silted, up to 600mm in places. The Q-rating assigned to Site 5 indicates a slight sign of improvement moving downstream of Site 4 before entering Lough Naglack. The EPA assigned a Q-rating of Q2-3 to Site 5 in 2000.

Table 5 The Q-values assigned to each site using the EPA Biotic Index System

Site	Number of Taxa	Q-value	Pollution Status
1	37	Q3-4	Slight Pollution
2	17	Q2-3	Moderate Pollution
3	19	Q3	Moderate Pollution
4	26	Q2-3	Moderate Pollution
5	20	Q3	Moderate Pollution

Table 6 Complete macroinvertebrate list for all sites on the Proules River 2004

Taxon	Family	Genus/Species	Site 1	Site 2	Site 3	Site 4	Site 5
Oligochaeta	spp. indet.		81	1471	242	804	735
Hirudinea	Piscicolidae	*Piscicola geometra* (L.)	1	-	-	2	-
	Glossiphonidae	*Hellobdela stagnalis* (L.)	4	2	112	103	1
		Glossiphonia complanata (L.)	2	90	76	302	42
		Theromyzon tessulatum (Müller)	-	-	1	-	-
	Erpobdelidae	*Erpobdella octoculata* (L.)	2	53	176	152	8
	spp. indet.		-	-	1	-	-
Crustacea	Gammaridae	*Gammarus duebeni* Lilj.	503	150	84	22	54
	Asellidae	*Asellus aquaticus* (L.)	13	1083	521	504	250
Mollusca	Ancylidae	*Ancylus fluviatilis* Müller	7	11	2	-	-
	Lymnaeidae	*Lymnaea peregra* (Müller)	2	-	5	1	2
		Lymnea palustris (Müller)	-	-	-	3	-
	Spaeriidae	*Pisidium* spp.	3	6	-	4	13
		Sphaerium spp.	-	1	1	-	1
	Hydrobiidae	*Potomopyrgus antipodarum* (Gray)	2	-	54	15	10
	Planorbidae	*Planorbis contortus* (L.)	-	8	10	47	-
		Planorbis planorbis (L.)	-	-	-	-	2
	Succineidae	*Succinea putris*	-	-	-	7	-
	Physidae	*Physa fontinalis* (L.)	-	-	-	-	2
Ephemeroptera	Ephemerellidae	*Ephemerella ignita* (Poda)	166	8	2	-	-
	Baetidae	*Baetis rhodani* (Pictet)	9	4	-	-	-
		Baetis muticus (L.)	17	-	-	-	-
	Heptageniidae	*Ecdyonurus dispar* (Curt.)	1	-	-	-	-
		Ecdyonurus spp.	2	-	-	-	-
		Rithrogena spp.	1	-	-	-	-
		Rithrogena semicolorata (Curt.)	1	-	-	-	-
Plecoptera	Leuctridae	*Leuctra inermis* Kmp.	17	-	-	-	-
Trichoptera	Sericostomatidae	*Sericostoma personatum* (Spence)	25	-	-	-	-
	Goeridae	*Silo nigricornis* (Pictet)	2	-	-	-	1
	Limnephilidae	*Halesus radiatus* (Curt.)	2	-	-	-	-
		Potomophylax latipennis (Curtis)	2	-	-	-	-
		spp. indet.	2	-	-	-	-
	Glossomoatidae	*Glossoma conformis* Neboiss	1	-	-	-	-
	Lepidostomatidae	*Lepidostoma hirtum* (Fabr.)	1	-	-	-	-
	Rhyacophilidae	*Rhyacophila dorsalis* (Curt.)	10	-	-	-	-
	Philopotamidae	*Philopotamus montanus* (Donovan)	2	-	-	-	-
	spp. indet.		1	-	-	-	-
Hemiptera	Veliidae	*Velia* spp.	22	-	-	1	-
	Corixidae	spp. indet	-	-	-	3	-
Coleoptera	Elmidae	*Limnius volckmari* (Panz.)	25	-	-	-	-
		Elmis aenea (Müller)	44	1	-	-	2
	Dysticidae	*Oreodytes sanmarki* (Sahlberg)	21	-	-	-	-
		Agabus spp.	-	-	14	4	-
		Colymbetes fuscus (Linnaeus)	-	-	-	2	1
	Hydraenidae	*Limnebius truncatellus* (Thunberg)	1	-	-	-	-
	spp. indet.		-	-	1	-	1
Diptera	Stratiomyidae	spp. indet.	2	-	-	-	-
	Simuliidae	spp. indet.	29	25	909	184	1
	Chironomidae	spp. indet.	916	544	501	57	318
		Chironomus spp.	-	12	-	41	-
	Ephydridae	spp. indet	25	-	-	1	-
	Tabanidae	spp. indet.	1	-	-	-	-
	Platypezidae	spp. indet.	-	1	-	-	-
	Muscidae	spp. indet.	-	-	3	-	-
	Empididae	spp. indet.	-	-	-	1	1
	Tipulidae	spp. indet.	-	-	-	1	-
	spp. indet.		5	-	-	2	3
Hydracarina	spp. indet.		-	-	-	1	-
Platyhelminthes	Planaridae	spp. indet.	2	-	6	1	-

2.1.2 Hydrochemical Water Quality

Carrickmacross is a thriving market town located along the N2 national primary route with a sound industrial base and a flourishing farming hinterland. The farming is mixed including dairy, pig and fowl production. Three national and three secondary schools serve the educational needs of the young population in the area. The town is experiencing continued growth in the residential sector. It has a strong industrial base including; Rye Valley Foods, Bose, Barfood meats, Oxfleisch, Gerflor and Kingspan. Therefore the WWTW receives discharges from different types of industry, retail outlets, schools as well as from domestic sources. Land use in the catchment area is important when analysing and interpreting water chemistry data.

Field measurements including dissolved oxygen, oxygen saturation, temperature, conductivity and pH were taken at all sites on the 11th August 2004 the results of which can be seen in Table 7. The pH values ranged from 6.62 – 7.27 typical values for hard water systems. Dissolved oxygen and oxygen saturation levels were unsatisfactory at all sites. Dissolved oxygen concentrations ranged from 3.61 mg/l O_2 (Site 4) to 6.45mg/l O_2 (Site 3). These levels are not considered adequate to support salmonids and all fall below both the limits for salmonids (50% ≥9mg/l O_2, 100%≥7 mg/l O_2) and cyprinids (50% ≥8mg/l O_2, 100% ≥5 mg/l O_2) set out in the Freshwater Fish Directive (78/659/EEC) (Flanagan, 1990). Conductivity values increased in a downstream direction from 315µS/cm (Site 1) to 871µS/cm (Site 4). The biggest increase occured at Site 3 immediately below the outfall. Temperatures ranged from 13.8°C (Site 1) to 17.8°C (Site 1). The temperature at Site 1 was much lower than the other sites due to the time of sampling and the shaded nature of the site. All other water chemistry results were obtained from the EPA survey 1998-2000 and are presented in Tables 8 and 9. All median BOD values were satisfactory, however the maximum values for Site 2 and 5 exceed the I/MAC for Freshwater Fish of ≤3mg/l O_2 (S) and ≤6mg/l O_2 (C) indicating intermittent input of organic matter to the watercourse (see Table 8). Maximum levels of un-ionised ammonia slightly exceed the value of 0.02mg/l NH_3 at Sites 2 and 5. This value is a long-term toxic effect level for fish, both salmonid and cyprinid (Flanagan, 1990). The ortho-phosphate concentrations at all sites were in excess of 0.030mg/l P. Concentrations of orthophosphate in excess of this level can cause eutrophication. Median levels of

oxidised nitrogen (Nitrate + Nitrite) were satisfactory however the maximum value recorded at Site 5 was high (5.7mg/l N) (EPA 1998-2000).

Table 7 Field measurement data from all sites taken on the 11th August 2004

	Temperature °C	pH pH units	Dissolved Oxygen mg/l O_2	% Saturation	Conductivity µS/cm @ 25°C
Site 1	13.8	7.06	5.78	85.2	315
Site 2	16.4	7.27	5.26	77.6	496
Site 3	17.5	7.24	6.45	96.5	818
Site 4	17.0	6.62	3.61	48.3	871
Site 5	17.0	7.18	5.13	79.5	795

Table 8 Results of water chemistry analysis carried out by the EPA at three stations along the Proules River 1998-2000

Site	EPA Station Code	Description	BOD mg/l O_2			Un-Ionised Ammonia mg/l NH_3			Oxidised Nitrogen mg/l N			Ortho-phosphate mg/l P		
			Min	Med	Max	Min	Med	Max	Min	Med	Max	Min	Med	Max
Site 1	**0100**	Br. W. of Old Workhouse*	<1.0	1.2	4.1	<0.001	0.001	0.006	1.2	2.4	3.5	<0.02	0.04	0.09
Site 2	**0200**	Ardee Rd Br. Carrickmacross	1.1	1.9	34.2	<0.001	0.001	0.021	0.6	2.6	3.7	0 03	0.08	0.62
Site5	**0300**	Just u/s Lough Naglack	1.2	3	8.8	<0.001	0.002	0.023	1.3	3.3	5.7	0.04	0.16	0.79

*This site is located in close proximity to Site 1

2.1.3 Aquatic and Associated Riparian Vegetation Survey

Information about the floristic interest of the sites was gathered solely through field work. This was carried out on August 31st 2004. Habitats were identified according to the nomenclature in Fossitt (2000) and using the methodology for a Phase 1 Habitat Survey (JNCC, 1990). A list of plant species associated with the habitats was compiled at each of the water sampling sites (Appendix C). All plant species were named according to Stace (1995). English names followed Stace or Scannell and Synott (1987). Bryophytes were named according to Watson and Richards (1955).

The timing of field work was optimum for identifying aquatic plant species as most aquatic plants flower and fruit in mid-late summer. The river sites were principally associated with one habitat type. The habitat, its code (Fossitt, 2000) and location are as follows:

Depositing lowland river, (FW2), All sites along the Proules River.

The plant species associated with this habitat type along the river are listed separately in Appendix C (I). The following account provides an assessment of their floristic interest.

Characteristics of the sites are shown in Table 9. None of the plant species identified is on the list of plants requiring protection under the Flora Protection Order (S. I. 94 of 1999) or listed in the Red Data book for plants (Curtis and McGough, 1988). While none of the species identified in the river is rare, they are native plants and are typical of this type of lowland river. Thus they have potential to be used as indicators. The majority of species recorded both upstream and downstream of the WWTW are associated with mesotrophic to eutrophic alkaline waters. Site 2 did not support flowering plants as the excessive shade did not allow for their growth.

Table 9 Vegetation at all sampling sites on the Proules River

Water Sample Site	1. Dry Bridge	2. Ardee Bridge	3. Point of discharge @ WWTW	4. 100m downstream	5. Upstream of tributary confluence
Shade/ Flow rate	No shade effect at sample site for vegetation	The impact of shading has a limiting effect on aquatic flora.	No shade effect at sample site. Fast flow rate relative to Sites 4 and 5.	No shade effect, flow rate moderate.	No shade effect, flow rate slow.
Emergent species	Fool's water cress *(Apium nodiflorum)* Water cress *(Rorippa microphylla)* Small sweet-grass *(Glyceria declinata)* Brooklime *(Veronica beccabunga)*		Reed sweet grass *(Phalaris arundinacea)* Water figwort *(Scrophularia aquatica)*	Reed sweet grass *(Phalaris arundinacea)* Fool's water cress *(Apium nodiflorum)* Water figwort *(Scrophulariaquatica)* Amphibious Bistort *(Polygonum amphibium)*	Reed sweet grass *(Phalaris arundinacea)*
In-channel species	Water moss *(Fontinalis antipyretica)*	Water moss *(Fontinalis antipyretica)*	Duckweed *(Lemna minor)*	Common water starwort *(Callitriche stagnalis)* Ivy leaved crowfoot *(Ranunculus hederaceus)*	Branched bur-reed *(Sparganium erectum)*

The presence/absence of plants and the robustness of their growth provide some evidence of nutrient enrichment. Water moss is only present above the discharge point. Its absence downstream of the WWTW may be evidence of changing water quality or it may be accounted for by the absence of suitable growing surfaces such as rocks and tree roots. The abundant vegetative growth of branched bur-reed *Sparganium erectum* at Site 5 and downstream is remarkable. This has probably resulted from high nutrient levels in the water compounded by a slower flow rate.

The most valuable areas for flora are the sites associated with the Proules River. Wetland habitats are relatively uncommon in developed landscapes and the species associated with them are of limited distribution. Distribution and growth habit information may provide some indications of water quality. On a regional level neither the habitat nor the species found at any of the river sites are rare. They are of local interest for biodiversity.

2.1.4 Impact of the Proposed Development on the Macroinvertebrate Communities, Aquatic Vegetation and Hydrochemistry

The macroinvertebrate survey showed that Site 1 upstream of the town is slightly polluted. The other four sites surveyed are moderately polluted. These findings suggest that the river is being impacted upstream of the sewage outfall. Possible sources of pollution to the river Proules may be diffuse run-off from agricultural land and/or point sources arising from the town. Downstream of the outfall the river was choked with prolific growth of instream vegetation, which is indicative of eutrophic conditions. Sampling points 4 and 5 were heavily silted and the flow of the river was impacted. The existing works is significantly overloaded by and average of 90% and up to a maximum of 300%. This overloading is having an impact on the river downstream of the WWTW discharge point. It is expected that the effluent from the upgraded treatment works will meet the requirements set out in three directives; Freshwater Fish (78/659/EEC), Surface Water (75/440/EEC) & Dangerous Substances (76/464/EEC). On this basis the quality of the water downstream of the plant should improve. The proposed development that aims to reduce the loading should not have any negative impact on the residing macroinvertebrate communities. In-stream vegetation may become less prolific, thus reducing the risk of de-oxygenation in the pre-dawn hours. In the long term, the upgrading of the plant

should reduce the loading of phosphorus into the river and should have a positive effect on the ecological health of the river resulting in a more diverse flora and fauna. However, it is clear that the Proules River is being impacted by other sources upstream of the outfall. If enrichment from activities in the catchment continues then this may have a limiting effect on any possible improvement brought about by the WWTW upgrade. Pollution sources upstream will have to be identified and addressed if the river is to improve in quality overall.

2.1.5 Mitigation Measures

Due to the shallow and narrow nature of the receiving water it is imperative that a buffer zone be established along the north-east boundary of the site with the river, mitigating against earth entering the water during works. Following completion of the extension, frequent monitoring of both the effluent and receiving water for the relevant water chemical parameters should be carried out. This will ensure that the required effluent concentrations of the various parameters are being met. In addition it is recommended that macroinvertebrate samples should also be taken to evaluate the ecological health of the system post-works. This will provide a 'watchful eye' on the status of the water. If deterioration becomes apparent then steps should be taken within the facility to rectify the problem areas. The design should allow for such a scenario.

2.2 River Bird Survey

Species lists were compiled at five sites along the River Proules on 11th August 2004 between 10.30 and 13.30. At these 5 sites, all birds within 25m of the river were recorded. These counts lasted approximately 20 minutes. The results from these 5 sites along with the species recorded whilst walking between Sites 3 and 4 and between Sites 4 and 5 are presented in Table 10. The important species associated with rivers recorded during these surveys were kingfisher *Alcedo atthis* and mallard *Anas platyrhynchos*. A kingfisher was seen flying over the river downstream between Sites 4 and 5. A female mallard was seen in the river behind the existing Treatment Works between Sites 3 and 4. Works at the northern junction of the new Carrickmacross bypass were postponed for a few days in July when a water hen's nest with unhatched eggs was discovered along the route on a bank of the Proules River. This was close to the new northern interchange and just off the existing

Castleblayney Road. The delay cost the contractors, Jons Moneley, a considerable but undisclosed financial sum it is understood. The nest was discovered by officers of the Eastern Regional Fisheries Board (ERFB). Reed buntings *Emberiza schoeniclus* were recorded along the banks of the river between Sites 4 and 5, where the vegetation consisted of tall reeds and grasses. Reed buntings are associated with marshy areas, such as banks of rivers, edges of lakes and poorly drained farmland. The fact that kingfisher was recorded along the river is important as it is protected under Annex 1 of the EU Birds Directive (Directive 79/409 on the Conservation of Wild Birds) and is also an amber listed species of conservation concern in Ireland (Newton *et al.*, 1999). The other species recorded during these surveys are not associated with rivers but use the hedges and trees along their banks, or were flying overhead. Site 1 contained the highest numbers and diversity of birds with 9 species and 18 individuals recorded. This site had many broadleaf trees growing on the riverbanks and a coniferous plantation beside it also. This explained the presence of species such as coal tit *Parus ater*, goldcrest *Regulus regulus*, blackcap *Sylvia atricapilla* and collared dove *Streptopelia decaocto* at Site 1. Species such as blue tit *Parus caeruleus*, coal tit and swallow *Hirundo rustica* were recorded at some of the other sites.

Table 10 Numbers of each bird species observed at the 5 sites (between Sites 3 & 4 and between Sites 4 & 5) along the River Proules on 11th August 2004

Common Name	Scientific Name	Site 1	Site 2	Site 3	Between Sites 3 & 4	Site 4	Between Sites 4 & 5	Site 5
Blackbird	*Turdus merula*	2			1			
Blackcap	*Sylvia atricapilla*	1						
Blue Tit	*Parus caeruleus*	1					1	2
Bullfinch	*Pyrrhula pyrrhula*	2						
Chaffinch	*Fringilla coelebs*						1	
Coal Tit	*Parus ater*	2	1	1				
Collared Dove	*Streptopelia decaocto*	1						
Goldcrest	*Regulus regulus*	2	1	1				
Goldfinch	*Carduelis carduelis*	3*		1				
Greenfinch	*Carduelis chloris*							
Kingfisher	*Alcedo atthis*						1	
Linnet	*Carduelis cannabina*							
Mallard	*Anas platyrhynchos*				1			
Magpie	*Pica pica*						1	1
Reed Bunting	*Emberiza schoeniclus*					1	10	
Robin	*Erithacus rubecula*	3	2				1	
Rook	*Corvus frugilegus*							
Swallow	*Hirundo rustica*			1*		1*	2*	2*
Woodpigeon	*Columba palumbus*			1	1			1
Wren	*Troglodytes troglodytes*	1	1				3	

* birds recorded flying overhead

The weather conditions on 11th August 2004 during the survey were perfect with strong sunshine, warm temperatures and no wind.

2.2.1 Potential Impacts for the River Birds

If the sewage treatment works results in increased pollution of the river then kingfishers, mallards, grey wagtails and other river species could be affected.

2.2.2 Mitigation Measures

Care should be taken to avoid any additional water pollution to the River Proules following the upgrade to the current facility. Frequent monitoring during works and post works should be carried out.

2.3 Fish

Water quality of the Proules River has been a problem for many years. A piggery in the area used to be a contributor of pollution resulting in a seriously polluted water at one point. This river is no longer seriously polluted but nonetheless is moderately polluted in sections. Up to the early 1960's salmon were known to spawn in this river. In July 2004 the Eastern Regional Fisheries Board went about relocating fish stocks from a portion of the river, which is to be diverted to facilitate a new bridge on the northern interchange outside the town. A small stock of brown trout *Salmo trutta* L. currently exists in the river (Jim O'Brien ERFB pers. comm.).

A brown trout fry was encountered during macroinvertebrate sampling at Site 1. Lough Naglack, which the Proules River flows into, is one of the largest lakes in the Carrickmacross area. It offers a very varied stock of fish. This was the most famous of the local lakes in the early years of Coarse angling in the area. Fishing is especially good from the woods on the roadside of the lake. Specimen fish are found in this lake all year round lake. Species present include; Bream, Roach, Tench, Perch, Rudd. Approximately 7km downstream of Lough Naglack, the Proules River confluences with the Glyde River. The upper reaches of the Glyde are known as the Lagan River which is deep and slow flowing. Electrofishing operations undertaken by the ERFB on behalf of AQUENS in 2001 showed that good numbers of both salmon and brown trout occur in the Glyde River. The stretches examined had 1+, 2+, 3+ and 4+ brown trout while 1+ salmon were recorded (AQUENS 2001). Other fish species noted

were pike *Esox lucius* and roach *Rutilus rutilus*. Catches of spring Salmon are taken usually between February to May. The Sea trout have become scarce over the years, although good stocks of brown trout are found in some areas.

2.3.1 Potential Impacts on the Fish

Earthmoving due to works may coat the substrate of the riverbed destroying spawning beds if it is allowed to enter the river. The current loading into the river is promoting eutrophication. Heavy siltation is occurring downstream of the outfall. These are unsuitable conditions for salmonids. Any additional impacts on the river would have deleterious effects on the residing fish population.

2.3.2 Mitigation Measures

Silt arising from the plant during the development of the site must be contained. Effluent being discharged from the upgraded plant needs to adhere strictly to the standards set out in the aforementioned regulations so as to ensure the survival of the fish, in particular the stock of brown trout. The discharge should be monitored closely. The reduced phosphate loading into the river post works should result in less vegetation and consequently lessen the risk of pre-dawn oxygen sags, which affect the fish.

2.4 Other Fauna

All of the five sites along the Proules River were visited on the 11th August. Each site was examined for any evidence of otter *Lutra lutra* L. or mink *Mustela lutreola* Schreber tracks or spraint. Despite an extensive search at each site, no evidence was found.

Butterflies observed during the survey were noted. Green-veined Whites *Pieris napi* were recorded along the river. Speckled Woods *Pararge aegeria* were recorded at Sites 1 and 5. Small Copper *Lycaena phlaeas* and Large White *Pieris brassicae* were recorded at Site 5.

2.4.1 Possible Impacts on Other Fauna

The river acts as a corridor for the movement of mammal species. It is probable that otter and/or mink use the river as a corridor. Although the proposed works will not

directly affect the physical nature of the river itself, the narrow grassy strip dividing the site from the river should be retained as a 'buffer strip' and wildlife corridor.

2.4.2 Mitigation Measures

Impacts on the river and banks should be minimized wherever possible. A buffer strip, where it exists should be maintained along the river bank adjacent to the site, this will act to protect the river against run-off from the site and act as a corridor for wildlife. Although buffer strips may be of any width, they must be at least 2m wide to be effective (SEPA 2000). The buffer strip should be clearly marked and fenced off during development to protect it from damage by heavy machinery, building debris etc.

3.0 Ecological Survey of the Proposed Site of the Extension

3.1 Floristic Survey of the Extension Site

The floristic survey of the site of the extension was also carried out on August 31st 2004. Habitats were again identified in the field, according to the nomenclature in Fossitt (2000) and using the methodology for a Phase 1 Habitat Survey (JNCC, 1990). A list of plant species associated with the habitats was compiled. All plant species were named according to Stace (1995). English names followed Stace or Scannell and Synott (1987). Bryophytes were named according to Watson and Richards (1955).

The timing of field work was less suitable for species in the site of the waste water treatment works. This was not a major constraint to field work as the habitats at the site of the extension are of lesser potential value than those associated with the river. Therefore, the timing of field work did not significantly affect the adequacy of the description of flora for this study.

The sample sites were principally associated with one of three habitat types. The habitats; their codes (Fossitt, 2000) and location are as follows:

Spoil and bare ground	(ED2)	Site of proposed extension
Recolonising bare ground	(ED3)	Site of proposed extension
Treeline	(WL2)	Boundary along extension site

The plant species associated with the habitats at the extension site are listed in Appendix C (II). The following account provides an assessment of their floristic interest.

The majority of the site was covered by habitats ED2/ED3 which are typical of disturbed ground. Plant cover is found on 50% of the site. The treeline was found along the northern and north-eastern boundary of the site. It was composed of planted (< 20 years old) cultivated varieties of Birch and Whitebeam, Leylandii and Portuguese Laurel. Birch was regenerating near this treeline. This habitat had low biodiversity value. It is of potential value as a nesting/roosting habitat for birds and could easily be improved by planting of native species of trees and shrubs.

Field work revealed the presence of a high diversity of flowering plants in the habitats associated with disturbed ground (ED2/ED3). A total of thirty six species of flowering plants were identified. The most common species was Common couch grass which formed a mono-dominant sward near the boundary. Other species of some interest include the wetland plants Meadowsweet, Sharp-flowered Rush and Small Sweet-grass. Their presence may indicate the previous existence of a wetland on the site linked to the Proules River.

The site of the extension is of local interest for biodiversity due to the high diversity of flowering plants. This is likely to support good insect and butterfly diversity. The treeline has potential for improvement. None of the species found is rare or unusual. The species recorded are predominantly weedy species typical of disturbed areas.

While the site of the extension has a significantly higher diversity of plants than the river sites the plants are widely distributed species which can colonise a wide variety of habitats. These habitats are common locally and regionally.

On a regional level neither the habitats nor the species found at the site are rare. To repeat they are of local interest for biodiversity.

3.1.1 Impacts on the Site Flora

Construction of the proposed works will result in the loss of all habitats at the site of the proposed extension. This will not lead to the loss of any habitat or species of significant conservation importance.

3.1.2 Mitigation Measures

By following the landscaping guidelines below, it will be possible for development to result in local and long-term biodiversity gains. The existing boundary area (with planted trees and shrubs) should be excluded from development and landscaped to improve its value to nature. Landscaping should involve:

- The removal of all specimens of Leylandii and Laurel without disturbing adjacent tree species.
- The establishment of native ash, oak and hawthorn in the resulting gaps, with hawthorn outside.
- Where opportunities exist (at the corner of the site) these species should be planted in clumps.

Management should actively manage vegetation growth around the trees by strimming until the scrub/woodland is established. Once established no further management will be required.

3.2 Bird Survey of the Extension Site

The bird survey at the Carrickmacross Waste Water Treatment Works site of proposed extension was conducted on 11th August 2004. The land beside the existing plant where the extension is to be built was surveyed between 09.15am and 10.15am. The study site of the proposed extension consisted of two areas or compounds. Several methods of bird survey can be used including point count methods and territory mapping methods (Bibby *et al.*, 2000). However, the best results from these

methods are obtained by carrying out several visits during the breeding season (April to June), which can then be used to estimate the breeding bird population of the site. As this survey was conducted outside the breeding season, territory mapping could not be used. The point count method involves standing at fixed points in a study area and recording all birds seen or heard within a specified time period, e.g. 5 or 10 minutes. In early August, birds have finished breeding and therefore stopped singing. This combined with the high number of juvenile birds makes this time of year difficult for accurate point counts of adult birds in an area to be made. Also there was much noise in the area from machinery and vehicles, which also blocked the view of the site from several positions within the site. Disturbance due to the development of the new link road also hindered the survey. These factors also hampered successful point counts. Thus, a one hour survey was conducted in the study site, which involved walking around the site recording all birds seen and heard. Care was taken not to record the same birds more than once. This survey was considered to be the best use of time and resources for obtaining a list of the bird species present in the study site, especially as the site was mainly of poor quality habitat for birds.

All birds recorded during the 1 hour survey are listed in Table 11. The site was low in both bird species diversity and abundance, with 17 birds of 9 different species recorded (Table 11). Goldfinches *Carduelis carduelis* and linnets *Carduelis cannabina* were recorded on the hedge in the main compound, on overhead wires, and feeding on the ground in both compounds. One goldfinch was singing on overhead wires in the entrance compound. A single grey wagtail *Motacilla cinerea* and a greenfinch *Carduelis chloris* were seen on the wires over the entrance compound. Two blackbirds *Turdus merula* were recorded in the site. A wren *Troglodytes troglodytes* was recorded singing and a robin *Erithacus rubecula* was recorded calling from the hedge in the main compound near the fence of the entrance compound. A woodpigeon *Columba palumbus* was singing in the hedge at the end of the main compound that runs along the River Proules. Another woodpigeon was recorded in the hedge also, along with three birds flying over that area. One rook *Corvus frugilegus* landed in the site and another was also seen flying overhead. An extra four species were recorded flying over the site: black-headed gull *Larus ridibundus*, house martin *Delichon urbica*, mallard *Anas platyrhynchos* and swallow *Hirundo rustica* (Table 11). The black-headed gulls were landing and presumably feeding in the

existing Treatment Works. From a personal communication with Matthew Lamb, the plant manager, it appears that grey herons *Ardea cinerea* have been seen in the site of the existing plant and they may also visit the proposed site.

Table 11 Numbers of each bird species observed within the site of the proposed extension to Carrickmacross Water Treatment Works on 11th August 2004.

Common Name	Scientific Name	Numbers in the Site	Numbers Flying Overhead
Blackbird	*Turdus merula*	2	
Black-headed Gull	*Larus ridibundus*		4+
Goldfinch	*Carduelis carduelis*	4	
Greenfinch	*Carduelis chloris*	1	
Grey Wagtail	*Motacilla cinerea*	1	
House Martin	*Delichon urbica*		2
Linnet	*Carduelis cannabina*	4	
Mallard	*Anas platyrhynchos*		1
Robin	*Erithacus rubecula*	1	
Rook	*Corvus frugilegus*	1	1
Swallow	*Hirundo rustica*		2
Woodpigeon	*Columba palumbus*	2	3
Wren	*Troglodytes troglodytes*	1	

It is unlikely that many birds would breed in the study site due to the lack of trees and shrubs available as suitable nesting sites. However, as this survey was not conducted during the breeding season the number of birds breeding in the site cannot be known for certain.

3.2.1 Possible impacts on the Birds of the Site

The possible removal of the hedge around the main compound of the proposed site would reduce the abundance and diversity of birds in the site, as this is the main bird habitat of the site. Also, it appears that finches, such as goldfinch and linnet, are feeding on the ground of both the entrance and main compounds of the proposed site. The building of the extension on the site would remove these feeding areas for these species. Thus, the removal of these nesting and feeding habitats would severely reduce the species diversity of birds in the site.

3.2.2 Mitigating measures

The hedge around the two sides of the main compound (Plate 7) should be retained as this is the main bird habitat of the site of the proposed extension. When the site is landscaped, broad-leaved trees and shrubs could be planted, especially berry producing species, to provide more habitat for birds.

3.3 Other Fauna on the Extension Site

On the 11th of August a mammal survey was conducted on the site of the proposed extension. Care was taken in covering all areas of the site searching for animal tracks and scats. Spoil heaps, pipes and waste present aswell as puddles were all examined for any sings of mammal fauna. The grassy boundaries were checked carefully for burrows tracks etc. No mammals were observed during the survey and no evidence of mammalian activity was recorded anywhere on the site. During this survey Large Whites *Pieris brassicae* and Green-veined Whites *Pieris napi* butterflies were recorded in the main compound.

3.3.1 Possible Impacts on the Other Fauna of the Site

Although no evidence of mammals was observed at the time of the survey, they may still be present. The smaller mammals e.g. wood mouse *Apodemus sylvaticus* L., brown rat *Rattus norvegicus* Berkenhaut, pygmy shrew *Sorex minutus* L., hedgehogs *Erinaceus europaeus* L., are likely to use the hedgerow for food and cover which also acts as a corridor to the river. The removal of this tree perimeter may impact on these fauna. The removal of all grassy areas from the site will probably result in the disappearance of the butterflies recorded on site, as this will remove their feeding areas.

3.3.2 Mitigation Measures

The tree perimeter should be retained as a wildlife corridor with additional planting of native tree species. The grassy area which runs along the perimeter at the river-side of the site should also be retained in so far as is possible.

4.0 Overall Evaluation

The macroinvertebrate survey showed that Site 1 the furthest upstream site was slightly polluted while all the other sites were moderately polluted. Activities in the upper catchment and town pollution sources are impacting on the river as well as the overloading of nutrients from the WWTW. Concentrations of ortho-phosphate were considered to be high at all sites and at such levels as to cause eutrophication. This was especially evident at Sites 4 and 5 where prolific growth of instream vegetation was observed. High levels of oxidised nitrogen were found at Site 5 just upstream of Lough Naglack. Dissolved oxygen concentrations were low at all sites. Brown trout fry were recorded at Site 1. The upgrading of the WWTW should reduce the loading of nutrients into the river and should have a positive effect on the ecological health of the river resulting in a more diverse flora and fauna. However, if enrichment from activities in the catchment continues then this may have a limiting effect on any possible improvement brought about by the WWTW upgrade. Pollution sources upstream will have to be identified and addressed if the river is to improve in quality overall.

The site of the proposed extension has a high diversity of flora. A total of 37 species of flowering plants have established there. The majority of these are common types; opportunistic species which are well distributed throughout the county and region. The river habitat supports a smaller number of species (11). These are of local ecological value as these species are less common locally and regionally and they can be used as indicators of environmental quality. All the habitats examined for this study are common types and under current criteria are not eligible for designation under the Habitats Directive (Council Directive No. 92/43/EEC of 21 May 1992). None of the plant species identified during the survey in April 2003 are listed for protection under the Flora Protection Order (S.I. No. 94 of 1999) or in the Red Data book for plants (Curtis and McGough 1988). Development of the proposed extension will not impact significantly on habitats or species diversity. The development of the proposed extension could increase the wildlife value of the site if the boundary treeline/shrubbery was retained and planted up with native species of trees and shrubs and natural grassy areas.

The site was low in both bird species diversity and abundance, with 9 different species recorded. The species associated with rivers recorded during these surveys were kingfisher *Alcedo atthis* and mallard *Anas platyrhynchos*. The fact that the kingfisher was recorded along the river is important as it is protected under Annex 1 of the EU Birds Directive (Directive 79/409 on the Conservation of Wild Birds) and is also an amber listed species of conservation concern in Ireland (Newton *et al.*, 1999). It was recommended that the hedge around the two sides of the main compound should be retained as this is the main bird habitat of the site. When the site is landscaped, broadleaved trees and shrubs could be planted, especially berry producing species, to provide more habitat for birds. These measures should adequately mitigate for any ecological impacts arising from the extension to the Carrickmacross WWTW.

Overall the extension to the existing Carrickmacross WWTW should be of benefit to the receiving environment. This is dependent on the reduction of the current loadings and full compliance with the relevant regulations for BOD, orthophosphate, ammonia, nitrate and nitrite in particular. Monitoring of these parameters in the receiving water following completion of the upgrade is recommended. Particular attention should be paid to the concentrations of unionised ammonia and nitrite, which is extremely toxic to fish since denitrification will not be part of the treatment process. In the event of a deterioration in water quality the design of the extension should allow for the incorporation of additional facilities to rectify the problem. While quality of the River Proules should benefit from the works, however, it will continue to be impacted by activities upstream of the outfall if these are not addressed also. It is recommended that a buffer strip be maintained inside the fence along the river (Plate 8) so as to minimise the effects due to the development. This will also act as a wildlife corridor. It is also recommended that the existing tree/shrub perimeter be retained and planted with native broad-leaf and berry producing trees.

A combination of the proposed discharge standards from the WWTW and the reduction of run-off from agricultural land should help improve the trophic status of the River Proules overall. Also the proposed decommissioning of the existing storm-overflows should result in an improved water quality for the River Proules.

5.0 References

- AQUENS (2001) An environmental impact assessment of the two rivers in the ardee region, the river Dee and Garra.

- Bibby, C.J., Burgess, N.D., Hill, D.A. and Mustoe, S.H. (2000) *Bird Census Techniques (2nd Edition).* Academic Press, London.

- Curtis, T. and McGough, N. (1988) Irish Red Data Book. 1. *Vascular Plants.* Stationary Office, Dublin.

- Flanagan, P.J. (1990) *Parameters of water quality.* Interpretations and Standards. Environmental Research Unit. St. Martins House, Waterloo Road, Dublin 4, Ireland.

- Fossett, J. (2000) *A Guide to Habitats in Ireland.* The Heritage Council, Kilkenny.

- Joint Nature Conservation Committee (1990) *Handbook for Phase 1 Habitat Survey-a technique for environmental audit.* Joint Nature Conservation Committee, Peterborough, UK.

- McGarrigle *et al.*, (2002) Water Quality in Ireland 1998 – 2000. EPA.

- Newton, S., Donaghy, A., Allen, D., and Gibbons D. (1999) *Birds of Consevation Concern in Ireland. Irish Birds*, **6** (3), 333-344.

- Pinder, L.C.V. *et al* (1987) Biological Surveillance of water quality – 1. *A comparison of macroinvertebrate surveillance methods in relation to assessment of water quality, in a chalk stream.* Arch. Hydrobiol., **102** (2), 207-226.

- Scannell, M. and Synott, D. (1987) *Census catalogue of the Flora of Ireland*. Stationary Office, Dublin.

- Scottish Environment Protection Agency (2000) *Habitat Enhancement Initiative* (HEI): Farming & Watercourse Management Handbook.

- Stace, C. (1995) *New flora of the British Isles*. Cambridge University Press.

- Watson, E. V. (1995) *British Mosses and Liverworts*. Cambridge University Press.

APPENDIX A (Tables I-V)
Raw Macroinvertebrate Lists for each site on the Proules River 2004

Table 1 Raw macroinvertebrate list for Site 1 on the Proules River 2004

Taxon	Family	Genus/Species	A	B	C	D	E	TOTAL
Oligochaeta	spp. indet.		8	21	5	32	15	81
Hirudinea	Piscicolidae	*Piscicola geometra* (L.)	-	1	-	-	-	1
	Glossiphonidae	*Hellobdela stagnalis* (L.)	-	3	-	-	1	4
		Glossiphonia complanata (L.)	-	1	-	1	-	2
		Theromyzon tessulatum (Müller)	-	-	-	-	-	-
	Erpobdelidae	*Erpobdella octoculata* (L.)	-	1	-	1	-	2
	spp. indet.		-	-	-	-	-	-
Crustacea	Gammaridae	*Gammarus duebeni* Lilj.	70	97	68	129	139	503
	Asellidae	*Asellus aquaticus* (L.)	2	2	1	7	1	13
Mollusca	Ancylidae	*Ancylus fluviatilis* Müller	5	1	1	-	-	7
	Lymnaeidae	*Lymnaea peregra* (Müller)	1	1	-	-	-	2
		Lymnea palustris (Müller)	-	-	-	-	-	-
	Spaeriidae	*Pisidium* spp.	2	1	-	-	-	3
		Sphaerium spp.	-	-	-	-	-	-
	Hydrobiidae	*Potomopyrgus antipodarum* (Gray)	-	1	-	-	1	2
	Planorbidae	*Planorbis contortus* (L.)	-	-	-	-	-	-
		Planorbis planorbis (L.)	-	-	-	-	-	-
	Succineidae	*Succinea putris*	-	-	-	-	-	-
	Physidae	*Physa fontinalis* (L.)	-	-	-	-	-	-
Ephemeroptera	Ephemerellidae	*Ephemerella ignita* (Poda)	18	51	37	44	16	166
	Baetidae	*Baetis rhodani* (Pictet)	2	-	7	-	-	9
		Baetis nuticus (L.)	-	2	11	2	2	17
	Heptageniidae	*Ecdyonurus dispar* (Curt.)	-	-	1	-	-	1
		Ecdyonurus spp.	-	-	1	-	1	2
		Rithrogena spp.	-	-	1	-	-	1
		Rithrogena semicolorata (Curt.)	-	-	-	-	1	1
Plecoptera	Leuctridae	*Leuctra inermis* Kmp.	1	1	12	3	-	17
Trichoptera	Sericostomatidae	*Sericostoma personatum* (Spence)	9	1	2	5	8	25
	Goeridae	*Silo nigricornis* (Pictet)	-	-	1	-	1	2
	Limnephilidae	*Halesus radiatus* (Curt.)	-	-	-	-	2	2
		Potomophylax latipennis (Curtis)	-	1	1	-	-	2
		spp. indet.	-	2	-	-	-	2
	Glossomoatidae	*Glossoma conformis* Neboiss	1	-	-	-	-	1
	Lepidostomatidae	*Lepidostoma hirtum* (Fabr.)	-	-	-	1	-	1
	Rhyacophilidae	*Rhyacophila dorsalis* (Curt.)	1	4	4	-	1	10
	Philopotamidae	*Philopotamus montanus* (Donovan)	-	-	2	-	-	2
	spp. indet.		-	-	1	-	-	1
Hemiptera	Veliidae	*Velia* spp.	1	3	4	13	1	22
	Corixidae	spp. indet.	-	-	-	-	-	-
Coleoptera	Elmidae	*Limnius volckmari* (Panz.)	9	2	7	1	6	25
		Elmis aenea (Müller)	7	6	16	7	8	44
	Dytiscidae	*Oreodytes sanmarki* (Sahlberg)	-	6	-	13	2	21
		Agabus spp.	-	-	-	-	-	-
		Colymbetes fuscus (Linnaeus)	-	-	-	-	-	-
	Hydraenidae	*Limnebius truncatellus* (Thunberg)	1	-	-	-	-	1
	spp. indet.		-	-	-	-	-	-
Diptera	Stratiomyidae	spp. indet.	-	-	-	-	2	2
	Simuliidae	spp. indet.	-	20	3	2	4	29
	Chironomidae	spp. indet.	4	321	16	568	7	916
		Chironomus spp.	-	-	-	-	-	-
	Ephydridae	spp. indet.	-	12	-	7	6	25
	Tabanidae	spp. indet.	-	1	-	-	-	1
	Platypezidae	spp. indet.	-	-	-	-	-	-
	Muscidae	spp. indet.	-	-	-	-	-	-
	Empididae	spp. indet.	-	-	-	-	-	-
	Tipulidae	spp. indet.	-	-	-	-	-	-
	spp. indet.		-	2	1	-	2	5
Hydracarina	spp. indet.		-	-	-	-	-	-
Platyhelminthes	Planaridae	spp. indet.	2	-	-	-	-	2

Table II Raw macroinvertebrate list for Site 2 on the Proules River 2004

Taxon	Family	Genus/Species	A	B	C	D	E	TOTAL
Oligochaeta	spp. indet.		70	117	504	558	222	1471
Hirudinea	Piscicolidae	*Piscicola geometra* (L.)	-	-	-	-	-	-
	Glossiphonidae	*Hellobdela stagnalis* (L.)	-	-	-	-	2	2
		Glossiphonia complanata (L.)	9	7	28	25	21	90
		Theromyzon tessulatum (Müller)	-	-	-	-	-	-
	Erpobdelidae	*Erpobdella octoculata* (L.)	2	2	12	22	15	53
	spp. indet.		-	-	-	-	-	-
Crustacea	Gammaridae	*Gammarus duebeni* Lilj.	30	16	15	32	57	150
	Asellidae	*Asellus aquaticus* (L.)	134	144	222	301	282	1083
Mollusca	Ancylidae	*Ancylus fluviatilis* Müller	4	1	-	4	2	11
	Lymnaeidae	*Lymnaea peregra* (Müller)	-	-	-	-	-	-
		Lymnea palustris (Müller)	-	-	-	-	-	-
	Spaeriidae	*Pisidium* spp.	1	-	2	1	2	6
		Sphaerium spp.	1	-	-	-	-	1
	Hydrobiidae	*Potamopyrgus antipodarum* (Gray)	-	-	-	-	-	-
	Planorbidae	*Planorbis contortus* (L.)	1	-	-	4	3	8
		Planorbis planorbis (L.)	-	-	-	-	-	-
	Succineidae	*Succinea putris*	-	-	-	-	-	-
	Physidae	*Physa fontinalis* (L.)	-	-	-	-	-	-
Ephemeroptera	Ephemerellidae	*Ephemerella ignita* (Poda)	-	-	2	5	1	8
	Baetidae	*Baetis rhodani* (Pictet)	-	-	-	4	-	4
		Baetis muticus (L.)	-	-	-	-	-	-
	Heptageniidae	*Ecdyonurus dispar* (Curt.)	-	-	-	-	-	-
		Ecdyonurus spp.	-	-	-	-	-	-
		Rithrogena spp.	-	-	-	-	-	-
		Rithrogena semicolorata (Curt.)	-	-	-	-	-	-
Plecoptera	Leuctridae	*Leuctra inermis* Kmp.	-	-	-	-	-	-
Trichoptera	Sericostomatidae	*Sericostoma personatum* (Spence)	-	-	-	-	-	-
	Goeridae	*Silo nigricornis* (Pictet)	-	-	-	-	-	-
	Limnephilidae	*Halesus radiatus* (Curt.)	-	-	-	-	-	-
		Potamophylax latipennis (Curtis)	-	-	-	-	-	-
		spp. indet.	-	-	-	-	-	-
	Glossomatidae	*Glossoma conformis* Neboiss	-	-	-	-	-	-
	Lepidostomatidae	*Lepidostoma hirtum* (Fabr.)	-	-	-	-	-	-
	Rhyacophilidae	*Rhyacophila dorsalis* (Curt.)	-	-	-	-	-	-
	Philopotamidae	*Philopotamus montanus* (Donovan)	-	-	-	-	-	-
	spp. indet.		-	-	-	-	-	-
Hemiptera	Veliidae	*Velia* spp.	-	-	-	-	-	-
	Corixidae	spp. indet.	-	-	-	-	-	-
Coleoptera	Elmidae	*Limnius volckmari* (Panz.)	-	-	-	-	-	-
		Elmis aenea (Müller)	-	-	1	-	-	1
	Dytiscidae	*Oreodytes sanmarki* (Sahlberg)	-	-	-	-	-	-
		Agabus spp.	-	-	-	-	-	-
		Colymbetes fuscus (Linnaeus)	-	-	-	-	-	-
	Hydraenidae	*Limnebius truncatellus* (Thunberg)	-	-	-	-	-	-
	spp. indet.		-	-	-	-	-	-
Diptera	Stratiomyidae	spp. indet.	-	-	-	-	-	-
	Simuliidae	spp. indet.	2	10	11	-	2	25
	Chironomidae	spp. indet.	42	60	256	162	24	544
		Chironomus spp.	-	-	-	-	12	12
	Ephydridae	spp. indet.	-	-	-	-	-	-
	Tabanidae	spp. indet.	-	-	-	-	-	-
	Platypezidae	spp. indet.	-	-	-	-	1	1
	Muscidae	spp. indet.	-	-	-	-	-	-
	Empididae	spp. indet.	-	-	-	-	-	-
	Tipulidae	spp. indet.	-	-	-	-	-	-
	spp. indet.		-	-	-	-	-	-
Hydracarina	spp. indet.		-	-	-	-	-	-
Platyhelminthes	Planaridae	spp. indet.	-	-	-	-	-	-

Table III Raw macroinvertebrate list for Site 3 on the Proules River 2004

Taxon	Family	Genus/Species	A	B	C	D	E	TOTAL
Oligochaeta	spp. indet.		144	12	20	30	36	242
Hirudinea	Piscicolidae	*Piscicola geometra* (L.)	-	-	-	-	-	-
	Glossiphonidae	*Hellobdela stagnalis* (L.)	28	25	4	30	25	112
		Glossiphonia complanata (L.)	14	6	34	9	13	76
		Theromyzon tessulatum (Müller)	-	-	1	-	-	1
	Erpobdelidae	*Erpobdella octoculata* (L.)	28	31	44	17	56	176
	spp. indet.		1	-	-	-	-	1
Crustacea	Gammaridae	*Gammarus duebeni* Lilj.	6	1	65	1	11	84
	Asellidae	*Asellus aquaticus* (L.)	155	64	51	136	115	521
Mollusca	Ancylidae	*Ancylus fluviatilis* Müller	-	-	2	-	-	2
	Lymnaeidae	*Lymnaea peregra* (Müller)	-	1	3	1	-	5
		Lymnea palustris (Müller)	-	-	-	-	-	-
	Spaeriidae	*Pisidium* spp.	-	-	-	-	-	-
		Sphaerium spp.	-	-	1	-	-	1
	Hydrobiidae	*Potomopyrgus antipodarum* (Gray)	3	-	49	2	-	54
	Planorbidae	*Planorbis contortus* (L.)	1	-	5	4	-	10
		Planorbis planorbis (L.)	-	-	-	-	-	-
	Succineidae	*Succinea putris*	-	-	-	-	-	-
	Physidae	*Physa fontinalis* (L.)	-	-	-	-	-	-
Ephemeroptera	Ephemerellidae	*Ephemerella ignita* (Poda)	-	-	2	-	-	2
	Baetidae	*Baetis rhodani* (Pictet)	-	-	-	-	-	-
		Baetis muticus (L.)	-	-	-	-	-	-
	Heptageniidae	*Ecdyonurus dispar* (Curt.)	-	-	-	-	-	-
		Ecdyonurus spp.	-	-	-	-	-	-
		Rithrogena spp.	-	-	-	-	-	-
		Rithrogena semicolorata (Curt.)	-	-	-	-	-	-
Plecoptera	Leuctridae	*Leuctra inermis* Kmp.	-	-	-	-	-	-
Trichoptera	Sericostomatidae	*Sericostoma personatum* (Spence)	-	-	-	-	-	-
	Goeridae	*Silo nigricornis* (Pictet)	-	-	-	-	-	-
	Limnephilidae	*Halesus radiatus* (Curt.)	-	-	-	-	-	-
		Potomophylax latipennis (Curtis)	-	-	-	-	-	-
		spp. indet.	-	-	-	-	-	-
	Glossomoatidae	*Glossoma conformis* Neboiss	-	-	-	-	-	-
	Lepidostomatidae	*Lepidostoma hirtum* (Fabr.)	-	-	-	-	-	-
	Rhyacophilidae	*Rhyacophila dorsalis* (Curt.)	-	-	-	-	-	-
	Philopotamidae	*Philopotamus montanus* (Donovan)	-	-	-	-	-	-
	spp. indet.		-	-	-	-	-	-
Hemiptera	Veliidae	*Velia* spp.	-	-	-	-	-	-
	Corixidae	spp. indet.	-	-	-	-	-	-
Coleoptera	Elmidae	*Limnius volckmari* (Panz.)	-	-	-	-	-	-
		Elmis aenea (Müller)	-	-	-	-	-	-
	Dysticidae	*Oreodytes sanmarki* (Sahlberg)	-	-	-	-	-	-
		Agabus spp.	2	-	-	4	8	14
		Colymbetes fuscus (Linnaeus)	-	-	-	-	-	-
	Hydraenidae	*Limnebius truncatellus* (Thunberg)	-	-	-	-	-	-
	spp. indet.		1	-	-	-	-	1
Diptera	Stratiomyidae	spp. indet.	-	-	-	-	-	-
	Simuliidae	spp. indet.	3	221	685	-	-	909
	Chironomidae	spp. indet.	63	112	35	42	249	501
		Chironomus spp.	-	-	-	-	-	-
	Ephydridae	spp. indet.	-	-	-	-	-	-
	Tabanidae	spp. indet.	-	-	-	-	-	-
	Platypezidae	spp. indet.	-	-	-	-	-	-
	Muscidae	spp. indet.	2	-	-	-	1	3
	Empididae	spp. indet.	-	-	-	-	-	-
	Tipulidae	spp. indet.	-	-	-	-	-	-
	spp. indet		-	-	-	-	-	-
Hydracarina	spp. indet.		-	-	-	-	-	-
Platyhelminthes	Planaridae	spp. indet	3	-	3	-	-	6

Table IV Raw macroinvertebrate list for Site 4 on the Proules River 2004

Taxon	Family	Genus/Species	A	B	C	D	E	TOTAL
Oligochaeta	spp. indet.		57	48	336	276	87	804
Hirudinea	Piscicolidae	*Piscicola geometra* (L.)	-	-	1	1	-	2
	Glossiphonidae	*Hellobdela stagnalis* (L.)	13	-	63	20	7	103
		Glossiphonia complanata (L.)	36	2	207	49	8	302
		Theromyzon tessulatum (Müller)	-	-	-	-	-	-
	Erpobdelidae	*Erpobdella octoculata* (L.)	38	-	90	24	-	152
	spp. indet.		-	-	-	-	-	-
Crustacea	Gammaridae	*Gammarus duebeni* Lilj.	21	-	-	1	-	22
	Asellidae	*Asellus aquaticus* (L.)	213	8	205	55	23	504
Mollusca	Ancylidae	*Ancylus fluviatilis* Müller	-	-	-	-	-	-
	Lymnaeidae	*Lymnaea peregra* (Müller)	1	-	-	-	-	1
		Lymnea palustris (Müller)	3	-	-	-	-	3
	Spaeriidae	*Pisidium* spp.	-	1	3	-	-	4
		Sphaerium spp.	-	-	-	-	-	-
	Hydrobiidae	*Potomopyrgus antipodarum* (Gray)	14	1	-	-	-	15
	Planorbidae	*Planorbis contortus* (L.)	23	5	14	4	1	47
		Planorbis planorbis (L.)	-	-	-	-	-	-
	Succineidae	*Succinea putris*	5	2	-	-	-	7
	Physidae	*Physa fontinalis* (L.)	-	-	-	-	-	-
Ephemeroptera	Ephemerellidae	*Ephemerella ignita* (Poda)	-	-	-	-	-	-
	Baetidae	*Baetis rhodani* (Pictet)	-	-	-	-	-	-
		Baetis muticus (L.)	-	-	-	-	-	-
	Heptageniidae	*Ecdyonurus dispar* (Curt.)	-	-	-	-	-	-
		Ecdyonurus spp.	-	-	-	-	-	-
		Rithrogena spp.	-	-	-	-	-	-
		Rithrogena semicolorata (Curt.)	-	-	-	-	-	-
Plecoptera	Leuctridae	*Leuctra inermis* Kmp.	-	-	-	-	-	-
Trichoptera	Sericostomatidae	*Sericostoma personatum* (Spence)	-	-	-	-	-	-
	Goeridae	*Silo nigricornis* (Pictet)	-	-	-	-	-	-
	Limnephilidae	*Halesus radiatus* (Curt.)	-	-	-	-	-	-
		Potomophylax latipennis (Curtis)	-	-	-	-	-	-
		spp. indet.	-	-	-	-	-	-
	Glossomoatidae	*Glossoma conformis* Neboiss	-	-	-	-	-	-
	Lepidostomatidae	*Lepidostoma hirtum* (Fabr.)	-	-	-	-	-	-
	Rhyacophilidae	*Rhyacophila dorsalis* (Curt.)	-	-	-	-	-	-
	Philopotamidae	*Philopotamus montanus* (Donovan)	-	-	-	-	-	-
	spp. indet.		-	-	-	-	-	-
Hemiptera	Veliidae	*Velia* spp.	-	1	-	-	-	1
	Corixidae	spp. indet.	-	3	-	-	-	3
Coleoptera	Elmidae	*Limnius volckmari* (Panz.)	-	-	-	-	-	-
		Elmis aenea (Müller)	-	-	-	-	-	-
	Dysticidae	*Oreodytes sanmarki* (Sahlberg)	-	-	-	-	-	-
		Agabus spp.	2	1	-	-	1	4
		Colymbetes fuscus (Linnaeus)	-	1	-	1	-	2
	Hydraenidae	*Limnebius truncatellus* (Thunberg)	-	-	-	-	-	-
	spp. indet.		-	-	-	-	-	-
Diptera	Stratiomyidae	spp. indet.	-	-	-	-	-	-
	Simuliidae	spp. indet.	184	-	-	-	-	184
	Chironomidae	spp. indet.	48	2	-	5	2	57
		Chironomus spp.	-	1	40	-	-	41
	Ephydridae	spp. indet.	1	-	-	-	-	1
	Tabanidae	spp. indet.	-	-	-	-	-	-
	Platypezidae	spp. indet.	-	-	-	-	-	-
	Muscidae	spp. indet	-	-	-	-	-	-
	Empididae	spp. indet.	1	-	-	-	-	1
	Tipulidae	spp. indet.	-	-	-	1	-	1
	spp. indet.		-	-	1	-	1	2
Hydracarina	spp. indet.		-	-	-	1	-	1
Platyhelminthes	Planaridae	spp. indet.	-	-	1	-	-	1

Table V Raw macroinvertebrate list for Site 5 on the Proules River 2004

Taxon	Family	Genus/Species	A	B	C	D	E	TOTAL
Oligochaeta	spp. indet.		45	258	240	30	162	735
Hirudinea	Piscicolidae	*Piscicola geometra* (L.)	-	-	-	-	-	-
	Glossiphonidae	*Hellobdela stagnalis* (L.)	-	-	-	1	-	1
		Glossiphonia complanata (L.)	11	22	6	3	-	42
		Theromyzon tessulatum (Müller)	-	-	-	-	-	-
	Erpobdelidae	*Erpobdella octoculata* (L.)	2	5	1	-	-	8
	spp. indet.		-	-	-	-	-	-
Crustacea	Gammaridae	*Gammarus duebeni* Lilj.	21	27	6	-	-	54
	Asellidae	*Asellus aquaticus* (L.)	98	89	42	13	8	250
Mollusca	Ancylidae	*Ancylus fluviatilis* Müller	-	-	-	-	-	-
	Lymnaeidae	*Lymnaea peregra* (Müller)	2	-	-	-	-	2
		Lymnea palustris (Müller)	-	-	-	-	-	-
	Spaeriidae	*Pisidium* spp.	1	-	4	6	2	13
		Sphaerium spp.	-	-	1	-	-	1
	Hydrobiidae	*Potomopyrgus antipodarum* (Gray)	-	-	4	4	2	10
	Planorbidae	*Planorbis contortus* (L.)	-	-	-	-	-	-
		Planorbis planorbis (L.)	-	-	-	1	1	2
	Succineidae	*Succinea putris*	-	-	-	-	-	-
	Physidae	*Physa fontinalis* (L.)	2	-	-	-	-	2
Ephemeroptera	Ephemerellidae	*Ephemerella ignita* (Poda)	-	-	-	-	-	-
	Baetidae	*Baetis rhodani* (Pictet)	-	-	-	-	-	-
		Baetis muticus (L.)	-	-	-	-	-	-
	Heptageniidae	*Ecdyonurus dispar* (Curt.)	-	-	-	-	-	-
		Ecdyonurus spp.	-	-	-	-	-	-
		Rithrogena spp.	-	-	-	-	-	-
		Rithrogena semicolorata (Curt.)	-	-	-	-	-	-
Plecoptera	Leuctridae	*Leuctra inermis* Kmp.	-	-	-	-	-	-
Trichoptera	Sericostomatidae	*Sericostoma personatum* (Spence)	-	-	-	-	-	-
	Goeridae	*Silo nigricornis* (Pictet)	1	-	1	-	-	1
	Limnephilidae	*Halesus radiatus* (Curt.)	-	-	-	-	-	-
		Potamophylax latipennis (Curtis)	-	-	-	-	-	-
		spp. indet.	-	-	-	-	-	-
	Glossomoatidae	*Glossoma conformis* Neboiss	-	-	-	-	-	-
	Lepidostomatidae	*Lepidostoma hirtum* (Fabr.)	-	-	-	-	-	-
	Rhyacophilidae	*Rhyacophila dorsalis* (Curt.)	-	-	-	-	-	-
	Philopotamidae	*Philopotamus montanus* (Donovan)	-	-	-	-	-	-
	spp. indet.		-	-	-	-	-	-
Hemiptera	Veliidae	*Velia* spp.	-	-	-	-	-	-
	Corixidae	spp. indet.	-	-	-	-	-	-
Coleoptera	Elmidae	*Limnius volckmari* (Panz.)	-	-	-	-	-	-
		Elmis aenea (Müller)	2	-	-	-	-	2
	Dysticidae	*Oreodytes sanmarki* (Sahlberg)	-	-	-	-	-	-
		Agabus spp.	-	-	-	-	-	-
		Colymbetes fuscus (Linnaeus)	1	-	-	-	-	1
	Hydracnidae	*Limnebius truncatellus* (Thunberg)	-	-	-	-	-	-
	spp. indet.		-	1	-	-	-	1
Diptera	Stratiomyidae	spp. indet.	-	-	-	-	-	-
	Simuliidae	spp. indet.	1	-	-	-	-	1
	Chironomidae	spp. indet.	60	93	99	60	6	318
		Chironomus spp.	-	-	-	-	-	-
	Ephydridae	spp. indet.	-	-	-	-	-	-
	Tabanidae	spp. indet.	-	-	-	-	-	-
	Platypezidae	spp. indet.	-	-	-	-	-	-
	Muscidae	spp. indet.	-	-	-	-	-	-
	Empididae	spp. indet.	-	-	-	1	-	1
	Tipulidae	spp. indet.	-	-	-	-	-	-
	spp. indet.		2	-	-	-	1	3
Hydracarina	spp. indet.		-	-	-	-	-	-
Platyhelminthes	Planaridae	spp. indet.	-	-	-	-	-	-

APPENDIX B (Tables I-IV)
EPA Biotic Index-Q-value System

Table I Macroinvertebrates grouped according to their sensitivity to organic pollution (McGarrigle *et al.*, 2002)

Taxa	Group A *Sensitive*	Group B *Less Sensitive*	Group C *Tolerant*	Group D *Very Tolerant*	Group E *Most Tolerant*
Plecoptera	All except *Leuctra* spp.	*Leuctra* spp.			
Ephemeroptera	Heptageniidae	Baetidae (excl. *Baetis rhodani)*	*Baetis rhodani*		
	Siphlonuriidae	Leptophlebidae	Caenidae		
	Ephemera danica		Ephemerellidae		
Trichoptera		Cased spp.	Uncased spp		
Odonata		All taxa			
Megaloptera				Sialidae	
Hemiptera		*Apheilecheirus aestivalis*	All except *A. aestivalis*		
Coleoptera			Coleoptera		
Diptera			Chironomidae (excl. *Chironomus* spp.)		*Chironomus* spp.
			Simuliidae		*Eristalis* spp.
			Tipulidae		
Hydracarina			Hydracarina		
Crustacea			*Gammarus* spp.	*Asellus* spp.	
			Austropotamobius pallipes	*Crangonyx* spp.	
Gastropoda			Gastropoda (excl. *Lymnaea peregra* & *Physa* spp.)	*Lymnaea peregra* *Physa* spp.	
Lamellibranchiata	*Margaritifera margaritifera*		*Anodonta* spp.	Sphaeriidae	
Hirudinea			*Piscicola* sp.	All except *Piscicola* sp.	
Oligochaeta					Tubificidae
Plathyhelminthes			All		

Table II Biotic Indices (Q-values) and typical associated macroinvertebrate community structure and abundance levels (McGarrigle *et al.*, 2002)

Macroinvertebrate Faunal Groups	Q5	Q4	Q3-4	Q3	Q2	Q1
Group A	At least 3 taxa well represented	At least I taxon in reasonable numbers	At least 1 taxon Few - Common	Absent	Absent	Absent
Group B	Few to Numerous	Few to Numerous	Few/Absent to Numerous	Few/Absent	Absent	Absent
Group C	Few	Common to Numerous *Baetis rhodani* often Abundant Others never Excessive	Common to Excessive (usually Dominant or Excessive)	Dominant to Excessive	Few or Absent	Absent
Group D	Few or Absent	Few or Absent	Few/Absent to Common	Few/Absent to Common	Dominant to Excessive	Few or Absent
Group E	Few or Absent	Few or Absent	Few or Absent	Few or Absent	Few / Absent to Common	Dominant

Table III Abundance categories and relationship to percentage frequency of occurrence (McGarrigle *et al.*, 2002)

Abundance *Category*	**Approx. Percentage** *Frequency*
absent	no specimens
Present	1 or 2 individuals
Scarce/few	<1% of the total fauna
Small numbers	<5%
Fair Numbers	5-10%
Common	10-20%
Numerous	25 -50%
Dominant	50 -75%
Excessive	*>75%*

Table IV Interpretation of quality ratings (McGarrigle *et al.*, 2002)

Quality ratings	Pollution status
Q5, Q4-5 and Q4	Unpolluted
Q3-4,	Slightly polluted
Q3 and Q2-3	Moderately polluted
Q2, Q1-2 and Q1	Serious pollution

APPENDIX C (I-II)
Floral Species lists of at the River Sites (I) & at the Site of the Proposed Extension (II)

(I) - Floral Species List for Sites on the River Proules

Common name	Latin name
Amphibious bistort	*Polygonum amphibium*
Angelica	*Angelica sylvestris*
Brooklime	*Veronica beccabunga*
Common duckweed	*Lemna minor*
Common starwort	*Callitriche stagnalis*
Fool's watercress	*Apium nodiflorum*
Ivy leaved crowfoot	*Ranunculus hederaceus*
Reed canary-grass	*Phalaris arundinacea*
Small sweet-grass	*Glyceria declinata*
Water cress	*Rorippa microphylla*
Water figwort	*Scrophularia aquatica*

(II) - Floral Species List for the Site of Proposed Extension

Common name	Latin name
Annual meadow-grass	*Poa annua*
Black medick	Medicago lupulina
Clustered dock	*Rumex conglomeratus*
Cock's foot	*Dactylus glomerata*
Common bent	*Agrostis capillaris*
Common couch	*Elytrigia repens*
Common mouse-ear	*Cerastium fontanum*
Creeping bent	*Agrostis stolonifera*
Creeping cinqufoil	*Potentilla reptans*
Creeping thistle	*Cirsium arvense*
Dandelion	*Taraxacum* sp.
Great willowherb	*Epilobium hirsutum*
Groundsel	*Senecio vulgaris*
Hedge bindweed	*Calystegia sepium*
Herb Robert	*Geranium robertianum*
Hoary willowherb	*Epilobium parviflorum*
Greater plantain	*Plantago major*
Ivy leaved toadflax	*Cymbalaria muralis*
Knotgrass	*Polygonum aviculare*
Meadow buttercup	*Ranunculus acris*
Meadowsweet	*Filipendula ulmaria*
Meadow vetchling	*Lathyrus pratensis*
Nettle	*Urtica dioica*
Perennial sow thistle	*Sonchus arvensis*
Pineapple weed	*Matricaria discoidea*
Ragwort	*Senecio jacobea*
Red bartsia	*Odontites rubra*
Ribwort plantain	*Plantago lanceolata*
Silverweed	*Potentilla anserina*
Sharp flowered rush	*Juncus acutiflorus*
Small sweet-grass	*Glyceria declinata*
Spear thistle	*Cirsium vulgare*
Water figwort	*Scrophularia aquatica*
White clover	*Trifolium repens*
Wood dock	*Rumex sanguineus*
Yorkshire fog	*Holcus lanatus*

Plates 1 – 8

Plate 1 **Site 1 the furthest upstream site located at the edge of town at Dry Br.**

Plate 2 **The discharge point arising from the WWTW Carrickmacross.**

Plate 3 Site 3 located immediately downstream of the outfall pipe.

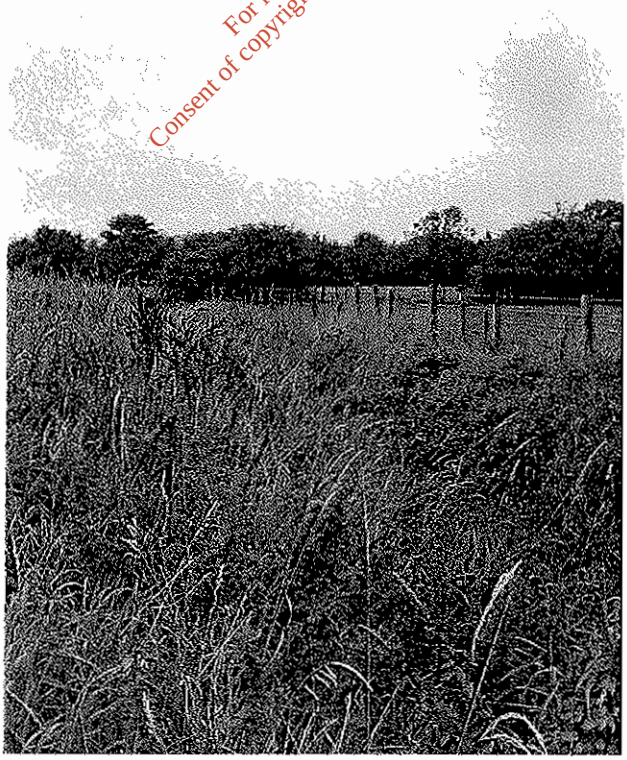


Plate 4 Site 4 located approximately 100m downstream of the outfall. Note the prolific growth of vegetation choking the river.

Plate 5 **Site 5 located just upstream of Lough Naglack.**

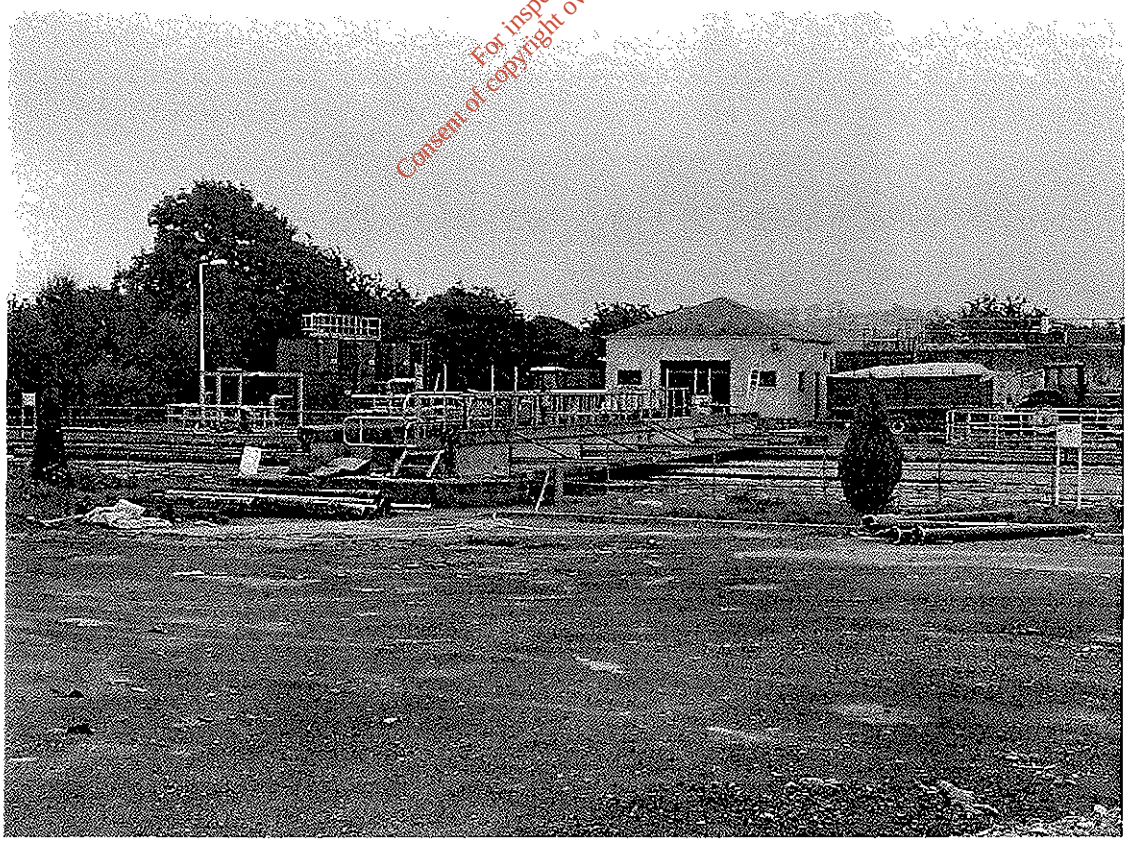


Plate 6 **The existing WWTW at Carrickmacross County Monaghan.**

Plate 7 **The tree perimeter at the northern boundary of the proposed site of extension. This should be retained and planted with native trees.**

Plate 8 **The proposed retention of a 'buffer' strip at the north-east boundary of the proposed site.**