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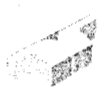
LAOIS GROUNDWATER SEWERAGE SCHEME

SUMMARY REPORT ON UPGRADE PROPOSALS FOR STAGE 3 APPROPRIATE ASSESSMENTS - STRADBALLY

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January 2012



Nicholas O'Dwyer
CONSULTING ENGINEERS

LAOIS COUNTY COUNCIL

LAOIS GROUPED TOWNS SEWERAGE SCHEME

SUMMARY UPGRADE REPORT - STRADBALLY

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January 2012

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APPENDIX 1 –LAYOUT PLAN OF WWTW UPGRADE

1. INTRODUCTION

1.1 Background

In March 2009, Laois County Council applied for a Wastewater Discharge Licence from the Environmental Protection Agency (EPA) for the town of Stradbally. As part of the Discharge Licence application, Ecofact Environmental Consultants Ltd carried out a Receiving Water Impact Assessments on behalf of Laois County Council.

The receiving water for the existing Wastewater Treatment Works (WWTW) at Stradbally is the Stradbally River, a tributary of the River Barrow. The River Barrow is part of the River Nore and River Barrow Special Area of Conservation (SAC) (Site Code 002162).

Following correspondence from the EPA in August 2009, Laois County Council were required to conduct an Appropriate Assessment (Stage 2) based on Circular Letter L8/08 (Water Services Investment and Rural Water Programmes - Protection of Natural Heritage and National Monuments) issued by the Department of the Environment, Heritage and Local Government in relation to a determination as to the likelihood of discharges from the waste water works having a significant effect on a European site.

Laois County Council instructed Ecofact Environmental Consultants Ltd to prepare the Appropriate Assessment reports. In June 2011, Ecofact finalised the Stage 2 Appropriate Assessment Report. The conclusions of the Stage 2 Appropriate Assessment Report can be summarised as follows:-

- The existing Stradbally Wastewater Treatment Works (WWTW) is operating at capacity, with the requirement for greater capacity and a higher level of treatment recommended by the SERBD River Basin Management Plan.
- The Stradbally Wastewater Treatment Works (WWTW) discharge is likely to be in excess of the Urban Wastewater Treatment Directive for treatment plants discharging to sensitive areas during occasional or sustained flow conditions.
- The Stradbally Wastewater Treatment Works discharge has been identified as having a direct, localised impact on the qualifying interests of the SAC i.e. floating river vegetation, otter, lamprey and Atlantic salmon. These

localised impacts are not evaluated as being significant with regard to adversely affecting the conservation objectives or the integrity of the River Barrow and River Nore SAC as a whole.

- There remains the potential for indirect and cumulative impacts on the conservation objectives of this Natura 2000 site which may affect the integrity of the site. The existing WWTW at Stradbally therefore must progress to a Stage 3 Appropriate Assessment (Considerations of Alternatives).

Nicholas O'Dwyer Ltd has been requested to prepare this Summary Upgrade Report to provide details of the current upgrade proposal for the town of Stradbally. The Summary Upgrade Report is required to provide sufficient information to demonstrate that the proposal is practical and achievable by providing detailed design information and a timetable for delivery. In addition, it must be demonstrated that the proposed plant will not cause the effects that the existing plants are presently doing and that it will not alone or in combination with other projects or plans, significantly affect the integrity of the Natura 2000 site with respect to the conservation objectives of the site and to its structure and function".

1.2 Description of Scheme

Stradbally is situated on the N80 in the east of County Laois. The nearby Stradbally River is a tributary of the River Barrow. The confluence of the two rivers is approximately 7km downstream of the town. The River Barrow is part of the River Barrow and River Nore Special Area of Conservation (Site Code 002162).

Stradbally is one of 5 towns included in the Laois Grouped Towns Sewerage Scheme. The upgrade of the Wastewater Treatment Works (WWTW) in each town is included in Contract A – Design Build Operate Scheme. The proposed WWTW is located on a new site to the west of the existing WWTP. The new plant will cater for 3,500 population equivalent (PE). The plant will continue to discharge to the Stradbally River. The existing plant will be decommissioned.

The procurement of the scheme is by means of a Design Build Operate (DBO) contract, which is a form of Public Private Partnership (PPP). Tenders are invited from suitably qualified contractors to design and build a wastewater treatment plant to meet the level of service required in the Employer's Requirements. In the

case of DBO, not only does the contractor design and build the plant, he also contracts to operate it for a set period.

Design Build Operate Contracts combine, in a single contract, the requirement to design and construct a wastewater treatment plant and to deliver the associated level of service required to achieve the effluent standards and other specified requirements. This is an important shift of focus towards service provision. While these types of contracts are financed from public funds, the responsibility for the construction of the facility and its operation for a defined period of time rests with the private sector. As with other types of PPP arrangements the treatment plant remains in the ownership of the Local Authority and responsibility for management returns to the Local Authority at the end of the contract period, at which time a further service contract may be procured.

1.3 Current Status of Upgrade Proposals

The Laois Grouped Towns Sewerage Scheme is currently listed on the Department of Environment Community and Local Government (DECLG) Water Services Investment Programme (2010 to 2012). The scheme is designated to start construction in 2010 to 2012.

The scheme was given approval to proceed to tender by the Minister for the Environment in July 2011. The prequalification process for the shortlisting of suitable contractors was commenced in July following the Minister's announcement. Expressions of Interest were requested and 11 No. submissions were received in September 2011. A review of the submission for compliance with the suitability criteria is currently underway, and shortlisting will be carried out by a board convened by Laois County Council, expected to be in February 2012.

Following shortlisting, it is anticipated that the tender process will begin in December. It is anticipated that the tender award and hence design and construction will commence March 2013. A summary of the project milestones for the WWTW element of the scheme is given in Table 1.1 overleaf.

Table 1.1 – Timeline for LTVWIS Contract A – DBO Scheme

Task Item	Commencement / Completion Date	Status
Design Review Report	December 2005	Complete
Preliminary Risk Assessment	November 2006	Complete
Preliminary Work <ul style="list-style-type: none"> ▪ Archaeology ▪ Noise/Odour Study ▪ Site Investigation ▪ Environmental Appropriate Assessment 	June 2006 October 2006 February 2007 September 2006	Complete Complete Complete Complete
Part 8 Planning	January 2007	Complete
Land Acquisition/Wayleaves	January 2007	Complete
Polluter Pays Report	November 2006	Complete
Draft Tender Documents	April 2006	Complete
Finalise Tender Documents	December 2010	Complete
Approval to proceed to Tender	July 2011	Complete
Prequalification (re-run of process due to passage of time)	October 2010	Complete
Prequalification Interview Process	February 2012	-
Tender period	April 2012	-
Tender evaluation/Report on Tenders	July 2012	-
Approval and Tender Award	October 2012	-
Commencement on Site	March 2013	-
Laois T&V Wastewater Improvement Scheme Construction Completed	March 2015	-

2. WASTE ASSIMILATIVE CAPACITY AND PROPOSED EFFLUENT STANDARDS

On commencing the preparation of the tender documents for the scheme, a Design Review Report was carried out by Nicholas O'Dwyer Ltd in 2005. Following the client approval of the Design Review Report, and the submission of the draft Design Build Operate Tender Documents in 2006, Laois County Council applied for Part VIII planning for the treatment plant sites. As part of the consultation process, National Parks and Wildlife Service (NPWS) recommended that an Appropriate Assessment be carried out in relation to the impacts on the Nore Freshwater Pearl Mussel which is an endangered species. The effluent standards for the towns were reviewed based on guideline values recommended in studies of Freshwater Pearl Mussels and on draft NPWS guidance for protection of the species.

The River Barrow and River Nore Report to Inform an Appropriate Assessment (Entec and O'Dwyer, 2007) concluded that only the discharges at Abbeyleix and Durrow would have a direct impact on the population of fresh water pearl mussels in the River Nore channel. The effluent standards for those towns were recommended to be revised accordingly. The effluent standards at Stradbally recommended in the Design Review Report in 2005 were not affected.

In 2009, the Environmental Objectives (Surface Water) Regulations S.I. 272 of 2009 came into effect. These regulations implement the Water Framework Directive and aim to prevent the deterioration in the existing status of waters, including the maintenance of "high status" where it exists, and at ensuring that all waters, with some limited exceptions, achieve at least "good status" by 2015.

In addition, the Environmental Objectives (Freshwater Pearl Mussel) Regulations S.I. 296 of 2009 also came into effect. These regulations provide for Draft Management Plans for Freshwater Pearl Mussels to be prepared for each catchment where the species is known to exist.

Furthermore, the Draft South East River Basin Management Plan (SERBMP) was published in December 2008. The objectives of the SERBMP are to achieve protected areas status, prevent deterioration of water quality, restore good status and reduce chemical pollution by 2015. The Environmental Objectives Regulations identified above provide a basis for deciding on the appropriate treatment required in order to meet the River Basin Management Plan objectives, enabling

necessary infrastructure and operational improvements to be prioritised in line with Water Framework Directive objectives.

The proposed effluent standards included in the DBO Tender Documents were reviewed and revised in accordance with the above legislation, and were based on background river water quality data obtained directly from the Environmental Protection Agency Regional Laboratory in Kilkenny in 2009.

2.1 Waste Assimilative Capacity Calculations

Waste Assimilative Capacity - BOD

In accordance with accepted water quality management plan requirements, the waste assimilative capacity of BOD for a watercourse is a function of its 95-percentile flow and its background biological quality. The Waste Assimilative Capacity (WAC) in mg/l for BOD is therefore calculated as follows:

$$WAC = (C_{max} - C_{back}) \times F_{95} \times 86.4 \text{ kg BOD/day} \quad (1)$$

Where:

C_{max} = maximum permissible BOD concentration in river (mg/l)

C_{back} = background (upstream) pollutant concentration (mg/l)

F_{95} = 95%ile flow in river (m^3/s)

86.4 = conversion factor

The waste load (WL) from the plant is given by:

$$WL = C_{eff} \times F_{eff} \times 86.4 \text{ kg BOD/day} \quad (2)$$

Where:

C_{eff} = Effluent Concentration (mg/l)

F_{eff} = Average Daily effluent flow (m^3/s)

86.4 = conversion factor

Equation 1 and 2 are combined as follows:

$$\frac{(C_{back} \times F_{95} \times 86.4) + (C_{eff} \times F_{eff} \times 86.4)}{[(F_{95} + F_{eff}) \times 86.4]} = C_{max}$$

The equation is then transposed to determine the effluent concentration as follows:

$$C_{eff} = \frac{[(C_{max} \times (F_{95} + F_{eff})) - (C_{back} \times F_{95})]}{F_{eff}} \text{ mg/l Effluent Conc.}$$

Where:

C_{eff} = required effluent BOD concentration in river (mg/l)

- C_{max} = maximum permissible BOD concentration in river = 2.6 mg/l
 C_{back} = background (upstream) pollutant concentration = 1.35 mg/l
 F_{river} = F_{95} (for BOD calculations) = 0.12 m³/s
 F_{eff} = effluent flow = $3,500 \times 0.225 / (60 \times 60 \times 24) = 0.0091$ m³/s

The Surface Water Regulations are more stringent than the Urban Wastewater Treatment Regulations and the Salmonid Regulations for this water quality parameter. The maximum concentration of Carbonaceous BOD stated in the Surface Water Regulations is 2.6 mg/l.

The background BOD concentration (C_{back}) has been taken as the medium concentration recorded at EPA station 0200 between 2003 and 2006. Station 0200 is located at Stradbally Bridge, upstream of Stradbally WWTW.

$$C_{eff} = \frac{[(2.6 * (0.12 + 0.0091)) - (1.35 * 0.12)]}{0.0091} = 19 \text{ mg/l}$$

The maximum allowable BOD concentration, as stated in the Surface Water Regulations, is set out at 2.6 mg/l for waters of good ecological status. The total flow is the sum of the 95th percentile river flow and the dry weather effluent flow.

The background BOD concentration is the mean concentration recorded in the river upstream of the discharge point. The associated flow is the 95th percentile river flow.

The maximum allowable effluent concentration has been determined by dividing the net allowable daily increase in BOD by the daily flow of effluent. However, the relatively large 95th percentile flow in the river gives a very high assimilative capacity. As a result, the Urban Wastewater Treatment Regulations minimum standard for secondary treatment has been adopted for BOD, Suspended Solids and COD.

It is recommended that, for discharge to the current outfall location, a minimum level of BOD removal of 93%, which will result in an effluent BOD standard of 19 mg/l. A 92% level of reduction in suspended solids (SS) is required to achieve a standard of 25mg/l.

Waste Assimilative Capacity - Phosphorus

The waste assimilative capacity of phosphorous has been determined using the 95th percentile flow.

The median background Ortho-Phosphate concentration recorded at the Station 0200 on the Stradbally River from the 2008-2009 data, is 0.06 mg/l.

Using the Waste Assimilation Capacity calculation as derived in the previous section, the maximum allowable phosphorus concentration to the river is calculated as follows:

$$C_{\text{eff}} = \frac{[(C_{\text{max}} \times (F_{\text{river}} + F_{\text{eff}})) - (C_{\text{back}} \times F_{\text{river}})]}{F_{\text{eff}}} \quad \text{mg/l Effluent Conc.}$$

C_{max} = maximum permissible Phosphate concentration in river = 0.075 mg/l

C_{back} = background (upstream) pollutant concentration = 0.06 mg/l

F_{river} = F_{95} (for P calculations) = 0.12 m³/s

F_{eff} = effluent flow = 3,500 x 0.225 / (60 x 60 x 24) = 0.0091 m³/s

$$C_{\text{eff}} = \frac{[(0.075 * (0.12 + 0.0091)) - (0.06 * 0.12)]}{0.0091} = 0.22 \text{ mg/l}$$

The maximum allowable phosphorous concentration, as stated in the Surface Water Regulations, is set out at 0.075 mg/l at 95thile flows for waters of good ecological status. The background median phosphorous concentration is 0.06 mg/l upstream at Stradbally Bridge. The associated flow is the 95th percentile river flow.

The maximum allowable effluent concentration has been determined by dividing the net allowable daily increase in phosphorous by the daily flow of effluent. The allowable concentration of Ortho Phosphate is taken as 0.8 times the allowable concentration of Total Phosphorous. The required effluent standard is equal to 0.22 / 0.8 = 0.30 mg/l of Total Phosphorous.

Waste Assimilative Capacity - Ammonia

Using the Waste Assimilation Capacity calculation as set out in the previous section, the maximum allowable ammonia concentration to the river is calculated as follows:

$$C_{\text{eff}} = \frac{[(C_{\text{max}} \times (F_{\text{river}} + F_{\text{eff}})) - (C_{\text{back}} \times F_{\text{river}})]}{F_{\text{eff}}} \quad \text{mg/l Effluent Conc.}$$

C_{max} = maximum permissible Ammonia concentration in river = 0.14 mg/l

C_{back} = background (upstream) pollutant concentration = 0.01 mg/l

F_{river} = F_{95} (for ammonia calculations) = 0.12 m³/s

F_{eff} = effluent flow = 4,000 x 0.225 / (60 x 60 x 24) = 0.0104 m³/s

$$C_{\text{eff}} = \frac{[(0.14 * (0.12 + 0.0091)) - (0.01 * 0.12)]}{0.0091} = 1.85 \text{ mg/l}$$

The maximum allowable ammonia concentration, as stated in the Surface Water Regulations, is set out at 0.14 mg/l for waters of good ecological status.

The background ammonia concentration is the mean concentration recorded in the river upstream of the discharge. The associated flow is the 95th percentile river flow.

The background NH concentration (C_{back}) has been taken as the medium concentration recorded at station 0200 between 2005 and 2006. Station 0200 is located at Stradbally Bridge. The DWF is 0.0091m³/s.

The resulting maximum allowable concentration of Ammonia is 1.85 mg/l.

Waste Assimilative Capacity - Total Oxidised Nitrogen

There is no requirement for a Total Oxidised Nitrogen standard at Stradbally.

2.2 Proposed Effluent Standards to be achieved by Upgrade Proposal

The effluent standards for the proposed upgrade at Stradbally identified in Table 2.1 below are the effluent standards included in the tender documents for the Laois Grouped Towns Sewerage Scheme – Contract A Design Build Operate Contract.

Table 2.1 – Proposed Effluent Standards at Stradbally WWTW in DBO Contract Documents

Parameter	Concentration
BOD ₅ (mg/l)	19
Total Suspended Solids (mg/l)	25
COD (mg/l)	125
Total Phosphorus (mg/l P)	0.30
Total Oxidised Nitrogen (mg/l N)	NR ¹
Total Ammonia (mg/l N)	1.85

1. NR = Not Required

2.3 Required Effluent Standards during Design Build Period

Under the DBO Contract, the Contractor shall take over responsibility for the operation and maintenance of the existing wastewater treatment plant from Laois County Council.

The proposed effluent standards for the existing plants to be maintained during the Design Build Phase (prior to upgraded plants coming into operation) are shown in Table 2.2 below.

Table 2.2 – Proposed Effluent Standards during Design Build Phase

Parameter	Concentration
BOD ₅ (mg/l)	25
Total Suspended Solids (mg/l)	35
COD (mg/l)	125

2.4 EPA Discharge Licence Standards

At the time of this report, the Wastewater Discharge Licence for Stradbally has not been issued by the Environment Protection Authority (EPA) under the Wastewater Discharge (Authorisation) Regulations (S.I. 684 of 2007). It is anticipated that the effluent standards required by the Discharge Licences will be similar to the proposed effluent standards in the Employer's Requirements, however more or less stringent standards may be prescribed by the EPA.

If the Wastewater Discharge Licence is issued post tender, any modification to the Employer's Requirements required in order to comply with the Licence conditions will have to be instructed by Laois County Council as a variation to the Contract.

In other locations, where plant upgrades were in progress and anticipated to be complete after the issue of the discharge licence, less stringent interim effluent standards have been applied by the EPA for an agreed timeframe, until the upgrade is complete and operational.

2.5 Key Specification Requirements

2.5.1 General Design Requirements

Under the DBO Contract, the Contractor shall be fully responsible for the design of the Works. The design of the Works shall be such as to facilitate operation, inspection and maintenance of all processes and equipment and shall be in accordance with all applicable approvals, standards and Regulations. All mechanical and electrical equipment supplied shall have a proven reliability record in similar works.

The Works shall be suitable for operating continuously, satisfactorily and fully automatically under the most severe historical climatic conditions recorded on the site or in the local area for the projected design life as required under Section 3.1.5 herein. The Contractor shall be deemed to have obtained all information as necessary for the purpose of preparing his designs.

All equipment shall be new and unused and shall comply at a minimum with the standards specified in the Employer's Requirements. All workmanship and standards shall comply with specification. All equipment shall be capable of operating through the full range of flows and loads. Adequate turn-down capability shall be provided. Provision for manual control of the plant shall also be provided.

The proposed treatment process shall:

- a) Be designed to achieve the stated effluent quality standards and stated noise and odour emissions standards, and
- b) Incorporate measures to minimise the impact of the development on the environment, and
- c) Be of modular design, robust, fit for purpose and can easily accommodate future expansion as described.

No treatment process will be acceptable to the Employer which is not based on proven technology. A process based on proven technology is defined as a process which:

- has been demonstrated by at least three (3) years satisfactory operation under stable process conditions;
- has been employed successfully on at least three (3) municipal wastewater treatment plants of similar sized modules to those proposed, treating a similar flow and load to that at the new wastewater treatment plants and has achieved the standards required; and
- has operated successfully under climatic conditions similar to those at the proposed sites.

The hydraulic design of the facilities shall be flexible. The Contractor shall ensure that the final effluent requirements are met during any maintenance of equipment or process units. By-passing of a process unit shall be permissible only if the final effluent requirements are met during any such by-passing.

The Contractor shall allow in his design for fluctuations in the average daily BOD, suspended solids, phosphorus and nitrogen loads of up to 125% of the specified influent daily loads on a continuous basis. The Contractor shall also allow in his design for peak flows to treatment of 3 times the Dry Weather Flow (DWF). Flows in excess of 3 times dry weather flow shall be stored and returned to treatment when the inflows subside up to a maximum storage volume (equivalent to 3 DWF for 2 hours).

The treatment plant and process design shall allow for peak flows for an extended period of time with no derogation of effluent quality. The wastewater treatment plants shall be capable of achieving the Final Effluent Discharge Limit Standards during any combination of load conditions up to the design loads and peaks loads specified.

2.5.2 Summary of Employer's Requirements at Stradbally WWTW

The indicative layout used for the Part 8 Planning Documents is shown in Drawing No. 20345-SR-SY-101. The Contractor shall comply fully with the requirements of the Part 8 Planning Documents. In particular any treatment process / treatment process layout offered by the Contractor shall be considered appropriate provided that:

- a) The impacts are equal to the impacts outlined in the Part 8 Planning Documents; and/or
- b) The positive impacts are of greater significance than those outlined in the Part 8 Planning Documents; and
- c) The negative impacts are of lesser significance than those outlined in the Part 8 Planning Documents.

However, no treatment process will be acceptable which is not based on proven technology.

The plant shall, as a minimum, include the following:

- Inlet Lift Pump Station (if required)
- Preliminary treatment – to include screening and grit removal – grease removal shall be provided if the Contractor considers it necessary;
- Biological treatment and phosphorus removal;
- Liquid sludge thickening and storage;
- Sludge Dewatering and cake storage
- Storm storage and treatment;
- Influent Sewer from the interface with the Network Contract to the plant.

The Inlet Works including preliminary treatment shall be designed and built to cater for the Stage 2 peak flows to treatment. Mechanical and electrical equipment shall be provided in the inlet works to cater for the Stage 1 flows.

3. DETAILS OF UPGRADE PROPOSALS

3.1 Population Projections and Staging of the Scheme

The population projections for Stradbally were identified in the Design Review Report (Nicholas O'Dwyer Ltd, 2005). The Design Review Report indicated that full development of all available land within the 2006 to 2011 development boundary would result in a design P.E. of 4,600. High, medium and low population growth rates were examined. The adoption of a high growth rate to the project horizon would result in a design P.E. of 4,372. The adoption of a medium growth rate was recommended which resulted in a design P.E. of 3,500, which was adopted as the Stage 1 design capacity.

The following table details the projected total population equivalent for Stradbally including the proposed single staging of the scheme to the project horizon of 2025.

Table 3.1 - Current and Future WWTW Population Equivalents at Stradbally

Stradbally WWTW	Population Equivalent (p.e.)		
	2005	2015	2025
Domestic	3,326	2,457	2,293
Commercial	65	120	143
Educational	80	148	176
Total	1,471	2,726	3,242
Existing/Proposed WWTW Capacity	2,000	3,500	3,500

The Staging of the Scheme (and the resulting Proposed Upgrade Capacity) is as follows:

Stage 1 (20 years) = 3,500 p.e.

Ultimate = 4,600 p.e.

A recent review on the population projections carried out in the *Report on Compliance - WWTW* (Nicholas O'Dwyer Ltd, August 2011) indicates that the population projections in the Design Review Report are broadly in line with actual population growth experienced in the intervening period.

3.2 Proposed Layout of Upgrade Proposal

Refer to Drg. 20345-SR-DY-101 in Appendix A for details of the proposed WWTW Upgrade and indicative layout developed for the purposes of obtaining Part 8 Planning Permission for the site. Due to the Design Build Operate nature of the procurement process, the final layout may look different from the indicative layout in accordance with the successful Contractor's preference and proposals.

3.3 Proposed Timetable for Upgrade Proposal

The timetable for completion of the individual towns within the scheme is estimated from the expected duration of the construction works at each location, and the priority of towns included within the Employer's Requirements for the Scheme and is shown in Table 3.2 below.

It is anticipated that the WWTW upgrade at Stradbally will be brought into operation in September 2014, 18 months after the anticipated contract commencement.

Table 3.2 – Anticipated Commencement and Completion Dates for DBO Scheme

Task Item	Commencement Date	Completion Date
Tender period	April 2012	June 2012
Tender evaluation/Report on Tenders	July 2012	September 2012
Approval and Tender Award	October 2012	March 2013
Contract Start-up and Commencement	March 2013	
Design Phase	March 2013	May 2013
Commencement on Site	March 2013	March 2015
Abbeyleix	March 2013	September 2014
Stradbally	March 2013	September 2014
Durrow	July 2013	January 2015
Mountrath	July 2013	January 2015
Rathdowney	July 2013	March 2015
Design Build Phase Completion	-	March 2015
Defect Liability Period	March 2015	March 2016
Operations and Maintenance Period	March 2015	March 2035

4. SIGNIFICANT EFFECTS IDENTIFIED

4.1 Environmental Reports prepared for Upgrade Proposal

An Appropriate Assessment was carried out by Ecofact Environmental Consultants Ltd. on behalf of Laois County Council in June 2011 to assess the impacts of the effluent discharged from the existing Stradbally WwTW on the River Barrow and River Nore Special Area of Conservation (SAC). The Stradbally WWTW discharges to the Stradbally River, some of which is designated as part of the River Barrow and River Nore SAC and therefore has the potential to directly affect the SAC. It is proposed to upgrade the WwTW at Stradbally which will also discharge to the River Barrow and River Nore SAC. The potential for the discharge from the upgraded WwTW to impact on the River Barrow and Nore SAC is discussed in the following sections.

4.2 Significant Effects on SAC Identified in Environmental Reports

The Stradbally WwTW discharges directly to the Stradbally River. The 2011 Appropriate Assessment carried out by Ecofact concluded that as the Stradbally River downstream of Stradbally town is designated within the River Barrow and River Nore SAC, the WwTW could potentially result in direct, localised negative impacts on the conservation interests of the SAC within the Stradbally River. The proposed WwTW will also discharge to the Stradbally River and therefore also has the potential for direct impacts on the SAC.

Water quality assessments indicate that the Stradbally WwTW is having an adverse affect on the water quality of the Stradbally River. This gives rise to the potential for the declining water quality in the Stradbally River to negatively impact protected species downstream both in the Stradbally River and in the River Barrow which is located approximately 7km downstream of the Stradbally WwTW. The discharges from the Stradbally WwTW have the potential to contribute to in combination impacts giving rise to cumulative impacts on water quality in the Stradbally River within the SAC. Due to the compromised background water quality, the Stradbally River has poor waste assimilative capacity for a number of parameters. Therefore there is the potential for water quality impacts affecting the designated site. It is also therefore feasible that discharges from the upgraded WwTW may indirectly or cumulatively impact on the conservation interests of the SAC.

Impacts on Qualifying Features

The Appropriate Assessment concluded that discharges from the operation of the current Stradbally WwTW are not thought to be impacting on the following SAC qualifying features.

- **Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) (91E0)**
- **Petrifying springs with tufa formation (*Cratoneurion*) (7220)**
- **Hydrophilous tall herb fringe communities of plains / montane to alpine levels (6430)**
- **Brook lamprey (1096)**
- **Otter (1355)**
- **Desmoulin's whorl snail (1016)**
- **Irish Freshwater pearl mussel (1990) and Nore Freshwater pearl mussel (1029)**

The proposed upgrade of the Stradbally WwTW will result in a highly significant improvement in the quality of the effluent and consequently improved water quality in the Stradbally River downstream of the discharge location. It is therefore reasonable to assume that the proposed Stradbally WwTW will not impact on these SAC conservation interests.

The Appropriate Assessment concluded that discharges from the operation of the existing Stradbally WwTW may impact on the following conservation interests of the SAC

- **Water courses of plain to montane levels with the *Ranuncion fluitantis* and *Callitricho Batrachion* vegetation (3260)**

According to NPWS (2008) discharges, fertilisation and water pollution are identified as the main pressures affecting this water dependant habitat. This has implications for the existing WwTW at Stradbally, which is contributing to cumulative impacts on background water quality in the Stradbally River. The WwTW therefore has the potential to contribute to nutrient loading and background water pollution affecting the structure and function of this habitat within the SAC.

- **Atlantic Salmon (1106)**

The discharge is affecting the potential of the Stradbally River as a salmon producing watercourse, in combination with additional pressures; this may

have limiting impacts on the range of this species. The WwTW discharge is therefore determined to be resulting in direct impacts on salmon in the designated Stradbally River, with indirect, cumulative impacts on this species.

- **White-clawed crayfish (1092)**

Reduced water quality and ecological status downstream of the discharge of the Stradbally WwTW could potentially have direct effects on crayfish which may occur in the Stradbally River downstream. Impacts affecting water quality in the Stradbally River are considered to result in both indirect and cumulative impacts on the River Barrow.

It is reasonable to therefore conclude that discharges from the proposed WwTW also have the potential to impact on these conservation interests.

4.3 Details of Measures to avoid Significant Environmental Effects

A summary of measures to mitigate the potential effects of the discharge from the proposed Stradbally WwTW are presented in Table 4.1 below. For completeness mitigation measures to avoid impacts during the construction phase are also included. The mitigation of impacts arising from discharges of wastewater through the implementation of strict effluent standards is discussed in more detail in Section 4.3.1.

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Table 4.1 Summary of Required Mitigation

Potentially Significant Effect on SAC	Mitigation/Enhancement	Residual Adverse Affect on Integrity of SAC?	Rationale
Construction			
Release of sediments resulting in negative effects on SAC species.	Contractor to produce a Method Statement which should be approved by the EPA, NPWS and SRFB. Method Statement should include/refer to the following measures:	No	Risk has been minimised as far as possible. Despite a high level of mitigation there remains an extremely small possibility of an unforeseen event (e.g. sudden extreme weather conditions). However the risk of this is considered to be so low as to be negligible.
	A coffer dam to be used during in-channel works.		
	Dewatered water to pass through settlement tanks prior to return to the river.		
	In-channel work to be carried out during the period July to September Work to avoid wet weather conditions.		
Discharge of chemicals to SAC (e.g. fuels, oils) resulting in negative effects on SAC species.	Adoption of additional pollution prevention measures outlined in relevant guidance.	No	Risk has been minimised as far as possible. Despite a high level of mitigation there remains an extremely small possibility of an unforeseen event (e.g. failure of machinery/equipment). However the risk of this is considered to be so low as to be negligible.
	Site briefing to be held with site personnel prior to commencement of works.		
	Chemicals stored in bunded areas away from the river and secured/removed overnight. Adoption of pollution prevention measures outlined in relevant guidance.		
	Any refuelling must be carried out in bunded areas of 110% volume at least 50m away from banks.		
Damage/disturbance to bank side habitat resulting in negative effects on SAC species.	Contractors to have an appropriate emergency response plan in place in the event of spillages.	No	Low potential to affect small area therefore no significant effect on populations of Annex II species predicted.
	Adoption of additional pollution prevention measures outlined in relevant guidance.		
	Site briefing to be held with site personnel prior to commencement of works.		
Operation			

Potentially Significant Effect on SAC	Mitigation/Enhancement	Residual Adverse Affect on Integrity of SAC?	Rationale
Discharges of inadequately treated sewage to the SAC resulting in a reduction in water quality and negative effects on SAC features.	The WWTW would be designed and operated to ensure that the effluent standards specified in Table 4.2 would be complied with.	No	Risk has been minimised as far as possible. Despite a high level of mitigation there remains an extremely small possibility of an unforeseen event (e.g. failure of treatment plant). However the risk of this is considered to be so low as to be negligible.
	Water quality around the discharge point would be slightly reduced from background levels however the effluent standards specified in Table 4.2 would enable the passage of migratory fish.		
	Sufficient storm water storage would be provided to ensure a minimum retention time of 2 hours for peak flows.		
Alteration of river flow pattern around River Barrow outfall affecting quality of river habitat for SAC species.	Discharge to the centre of the channel where flow is highest and use of diffuser to maximise dilution.	No	Low potential to affect small area therefore no significant effect on populations of Annex II species predicted.
	Discharge rate would be controlled to ensure effluent flow does not disrupt the natural river flow pattern.		
Disturbance of SAC species' habitat during outfall maintenance operations.	Schedule any significant maintenance operations (except for emergency works) to be carried out during the period July to September.	No	Low potential to affect small area avoiding most sensitive time therefore no significant effect on populations of Annex II species predicted.

4.3.1 Effluent standards

Waste Assimilative Capacity calculations have been carried out for the Stradbally River as per section 2.1 of this document. Effluent standards have been set to ensure compliance with Surface Water Regulations 2009 requirements for 'good status' water bodies and the Urban Wastewater Treatment Regulations for BOD, Ammonia and Phosphorus. The proposed effluent standards for the Stradbally WWTW are presented in Table 4.2 below.

Table 4.2 – Proposed Effluent Standards at Stradbally WWTW in DBO Contract Documents

Parameter	Concentration
BOD ₅ (mg/L)	19
Total Suspended Solids (mg/L)	25
COD (mg/L)	125
Total Phosphorus (mg/L P)	0.30
Total Oxidised Nitrogen (mg/L N)	NR ¹
Total Ammonia (mg/L N)	1.85

5. CONCLUSION

It has been concluded that effective mitigation measures would remove the potential for the majority of activities associated with the WwTW capacity upgrade to have a significant effect alone (or in-combination) on the River Barrow and River Nore SAC. The only exceptions where it is not considered possible to entirely remove the risk of a significant effect on the SAC are instances of construction and operational pollution, as there would always remain an extremely small possibility of extreme/unforeseen events, as currently exists with respect to the Stradbally WwTW already being operational. However, by employing the specified mitigation measures and enforcing the effluent standards in Table 4.2, it is considered that the risk of such events occurring has been reduced to the lowest possible level (negligible risk) and thus the integrity of the SAC would not be adversely affected. Overall, the upgrade of the Stradbally WwTW will result in a reduction in contaminant loadings and a reduction in the discharge of poorly treated sewage to the SAC.

The scheme will not result in significant adverse effects on the integrity of the SAC or prevent the achievement of favourable conservation status for the qualifying interests of the SAC.

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APPENDIX 1 – LAYOUT PLAN OF WWTW UPGRADE

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Stradbally Wastewater Treatment Plant

Appropriate Assessment Report for the purposes of the Waste Water discharge (Authorisation) Regulations, 2007 (S.I. No. 684 of 2007)

Version: June 2011

Prepared on behalf of Laois County Council



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FOREWORD

The current Appropriate Assessment has been prepared following the EPA (2009) 'Note on Appropriate Assessments for the purposes of the Waste Water Discharge (Authorisation) Regulations, 2007 (S.I. No. 684 of 2007)'. This provides guidance for Appropriate Assessment for the purposes of a waste water licence application under the Waste Water Discharge (Authorisation) Regulations (2007).

The EPA guidance note makes reference to the relevant EC legislation regarding designated sites (i.e. the EC Council Directives on the Conservation of Natural Habitats and of Wild Flora and Fauna 92/43/EEC and on the Conservation of Wild Birds 2009/147/EC) and also to the EC guidance available at the time of publishing (EC 2001 and EC 2007). However, the Department of the Environment, Heritage and Local Government guidance 'Appropriate Assessment of Plans and Projects in Ireland. Guidance for Planning Authorities' (DoEHLG, 2009) had not been published at this time.

Following the DoEHLG (2009) guidance, the Appropriate Assessment process assesses the potential adverse or negative effects of a plan or project, in combination with other plans or projects, on a European Site (i.e. Special Area of Conservation, Special Protection Area or Ramsar site). However, following the EPA (2009) guidance note in the context of a Waste Water Discharge Licence Application for Local Authority waste water discharges, the EPA guidance considers the assessment to be limited to the discharge which 'will only have an impact on the aquatic environment [and] it can be inferred that the 'in combination' effect need only apply to other plans and projects that have an impact on the aquatic environment'.

Therefore the current assessment for the Waste Water Discharge Licence is limited to assessing the potential adverse effects on the aquatic elements of the Natura 2000 network of the plant discharge, in combination with other plans / projects affecting the aquatic environment. The potential adverse effects of the plant discharge of the proposed plant is also considered in the context where this plant is proposed as a mitigation measure, however other potential impacts associated with the construction or operation the proposed plant are outside of the scope of the current document. It is recognised therefore that this does not correspond to the requirements of the Habitats Directive and the DoEHLG (2009) Guidance; where the Stage 2 assessment in the current report does not correspond to the rigours of a Natura Impact Statement (NIS).

The EPA (2009) guidance note states that it is the responsibility of each Local Authority to ensure that the AA process is carried out in accordance with the Habitats Directive and relevant national legislation. It is noted that an Article 6 Appropriate Assessment for a number of WwTP sites in Co. Laois, including the proposed Stradbally WwTP, was completed in 2006 (Entec & O'Dwyer, 2006). However this AA was completed prior to the publication of the European Communities Environmental Objectives (Surface Water) Regulations (SI No 272 of 2009) and DoEHLG (2009) guidelines on Appropriate Assessment.

The current therefore document provides an Appropriate Assessment following the EPA (2009) guidance, to form part of the overall Article 6 Appropriate Assessment process. The purpose of the current report is limited to the purposes of applying for a waste water licence application under the Waste Water Discharge (Authorisation) Regulations (2007).

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1. INTRODUCTION

The current document provides an Appropriate Assessment of the discharge of the Stradbally Waste Water Treatment Plant (WwTP) with regard to the potential for adverse effects on the River Barrow and River Nore Special Area of Conservation (SAC). Effects upon both habitats and species within the SAC are considered, where the key qualifying interests of the site are primarily aquatic.

An Article 6 Appropriate Assessment is required under the Habitats Directive (92/43/EEC), in instances where a plan or project may give rise to significant effects upon a Natura 2000 site. Natura 2000 sites are those identified as sites of European Community importance designated under the Habitats Directive (Special Areas of Conservation, hereafter referred to as SACs or the Birds Directive (Special Protection Areas, hereafter referred to as SPAs).

This report follows the guidance for Appropriate Assessment published by the EPA (2009) '*Note on Appropriate Assessments for the purposes of the Waste Water Discharge (Authorisation) Regulations, 2007 (S.I. No. 684 of 2007)*'; taking account of the National Parks and Wildlife Service (NPWS 2009) '*Appropriate Assessment of Plans and Projects in Ireland. Guidance for Planning Authorities*' and The Department of the Environment Circular L8/08 '*Water Services Investment and Rural Water Programmes – Protection of Natural Heritage and National Monuments*' (DoEHLG, 2008) as relevant. The EPA (2009) guidance is for the purposes of the Waste Water Discharge (Authorisation) Regulations, 2007 (S.I. No. 684 of 2007) and the current report only meets the requirements of the EPA (2009) document, and is therefore not a full Natura Impact Statement (see foreword for explanation).

In the current situation, with regard to the WwTP at Stradbally, the magnitude of impact of the discharge is not easily quantifiable at Stage 1: Screening; indicating the potential for adverse effects on the SAC with respect to the direct discharge from the WwTP into the SAC. The existing WwTP at Stradbally is located approximately 1km east of Stradbally town and discharges directly to the Stradbally River which is designated within the River Barrow and River Nore Special Area of Conservation (SAC) downstream of Stradbally town. Therefore the discharge is directly into this internationally designated site. The plant therefore has the potential for both direct and indirect effects on this Natura 2000 Site. The site synopsis for the affected SAC is included as Appendix I to this report. Designated Natura 2000 sites within 15km of the Stradbally WwTP are assessed in the Screening Assessment and are presented in Figure 1.

Therefore a Stage 2: Appropriate Assessment has been undertaken. This stage considers whether the plan or project, alone or in combination with other projects or plans, will have adverse effects on the *integrity* of a Natura 2000 site, and includes any mitigation measures necessary to avoid, reduce or offset negative effects. It is noted that the current assessment only considers part of the project or plan, i.e. the discharge itself (as per EPA, 2009 guidelines). This document also only concerns the existing plant, although an assessment of the proposed plant is also made where it is introduced as a mitigation measure.

This document draws upon the information supplied in the Receiving Water Impact Assessment (RWIA) for the existing Stradbally Waste Water Treatment Plant (WwTP) produced on behalf of the Water Services section of Laois County Council (Ecofact, 2009). It is acknowledged that a screening report has already been prepared to assess the implications of the ongoing operation of the Stradbally Waste Water Treatment Plant (WwTP) upon the River Barrow and River Nore SAC. However, the current document provides an updated screening assessment following NPWS (2009) and EPA (2009) guidelines.

The current report was prepared by Ecofact Environmental Consultants Ltd. on behalf of Laois County Council during March 2010.

2. METHODOLOGY

2.1 Desktop Review

A review of areas designated (or being considered for designation) for nature conservation was carried out by consulting the National Parks and Wildlife Service (NPWS). These included Special Areas of Conservation and Special Protection Areas for birds within 15 km of the WwTP discharge point. Information contained in the Stradbally Receiving Water Impact Assessment (RWIA; Ecofact, 2009) produced on behalf of the Water Services section of Laois County Council was also consulted. This RWIA is included in Appendix 2 of the current document. An Appropriate Assessment was prepared by Entec & O'Dwyer (2006) '*Laois towns and villages wastewater improvement scheme: River Barrow and River Nore SAC Appropriate Assessment – Draft Report*', which was reviewed as part of the current assessment.

2.2 Appropriate Assessment Methodology

This Appropriate Assessment follows the EPA (2009) '*Notes on Appropriate Assessments for the purposes of the Waste Water Discharge (Authorisation) Regulations, 2007 (S.I. No. 684 of 2007)*' with further cognisance of the guidance published by the National Parks and Wildlife Service (NPWS 2009) '*Appropriate Assessment of Plans and Projects in Ireland. Guidance for Planning Authorities*'. Based on these guidelines, the Appropriate Assessment process is a four staged approach described below:

Stage One: Screening / Test of Significance - the process which identifies the likely impacts upon a Natura 2000 site of a project or plan, either alone or in combination with other projects or plans, and considers whether these impacts are likely to be significant;

Stage Two: Appropriate Assessment - the consideration of the impact of the project or plan on the integrity of the Natura 2000 site, either alone or in combination with other projects or plans, with respect to the site's structure and function and its conservation objectives. Additionally, where there are adverse impacts, an assessment of the potential mitigation of those impacts;

Stage Three: Assessment of Alternative Solutions - the process which examines alternative ways of achieving the objectives of the project or plan that avoid adverse impacts on the integrity of the Natura 2000 site; and

Stage Four: Assessment Where Adverse Impacts Remain - an assessment of compensatory measures where, in the light of an assessment of Imperative Reasons of Overriding Public Interest (IROPI), it is deemed that the project or plan should proceed.

The safeguards set out in Article 6(3) and (4) of the Habitats Directive are triggered not by certainty but by the possibility of significant effects. Thus, in line with the precautionary principle, it is unacceptable to fail to undertake an appropriate assessment on the basis that it is not certain that there are significant effects. In this case only effects potentially caused directly, indirectly or cumulatively by the actual discharge are considered.

The current report includes both a Stage One (Screening) and a Stage 2 Appropriate Assessment. This report is not a Natura Impact Statement (NIS) but a Appropriate Assessment Report for the purposes of the Waste Water discharge (Authorisation) Regulations, 2007 (S.I. No. 684 of 2007). Please refer to the foreword for a discussion of the limitations of this report.

The first test within a Stage 1 Screening is to identify whether the proposed plan or project can be excluded from Appropriate Assessment requirements because it is directly connected with or necessary to the management of the site; which is not the case for the current WwTP at Stradbally. The Appropriate Assessment process must be engaged in this instance.

3. STAGE 1: SCREENING / TEST OF SIGNIFICANCE

3.1 Description of the WwTP

Stradbally is a medium sized town located approximately 12km south-east of Portlaoise. The Stradbally River flows through the town from southwest to northeast and is designated within the River Barrow and River Nore Special Area of Conservation (SAC) under the Habitats Directive (92/43/EEC). The WwTP discharges directly into the Stradbally River, designated within the SAC less than a kilometre downstream of Stradbally town.

According to the WWDA Licence Application submitted by Laois County Council to the EPA (Reg. No. DO292-01) the Stradbally WwTP is currently at or near capacity. Current loading of the plant is 1,599 p.e. and the design capacity of the plant is approximately 2,000 p.e., so it can be assumed there is no capacity for the additional loading. There are two infrastructural projects prioritised for the Stradbally Agglomeration; these are the Laois Towns and Villages Wastewater Improvement Scheme which encompasses a major infrastructural development plan for the Stradbally Waste Water Works; and the Laois Towns and Villages Main Drainage project involves the upgrading of the collection system. The existing collection system in Stradbally currently includes two storm water outfalls to the Stradbally River. These projects will include tertiary treatment and separation of storm water and sewage streams. The new plant has been designed for a population equivalent of 5,000 p.e. and the design will cater for population projections up to 2025.

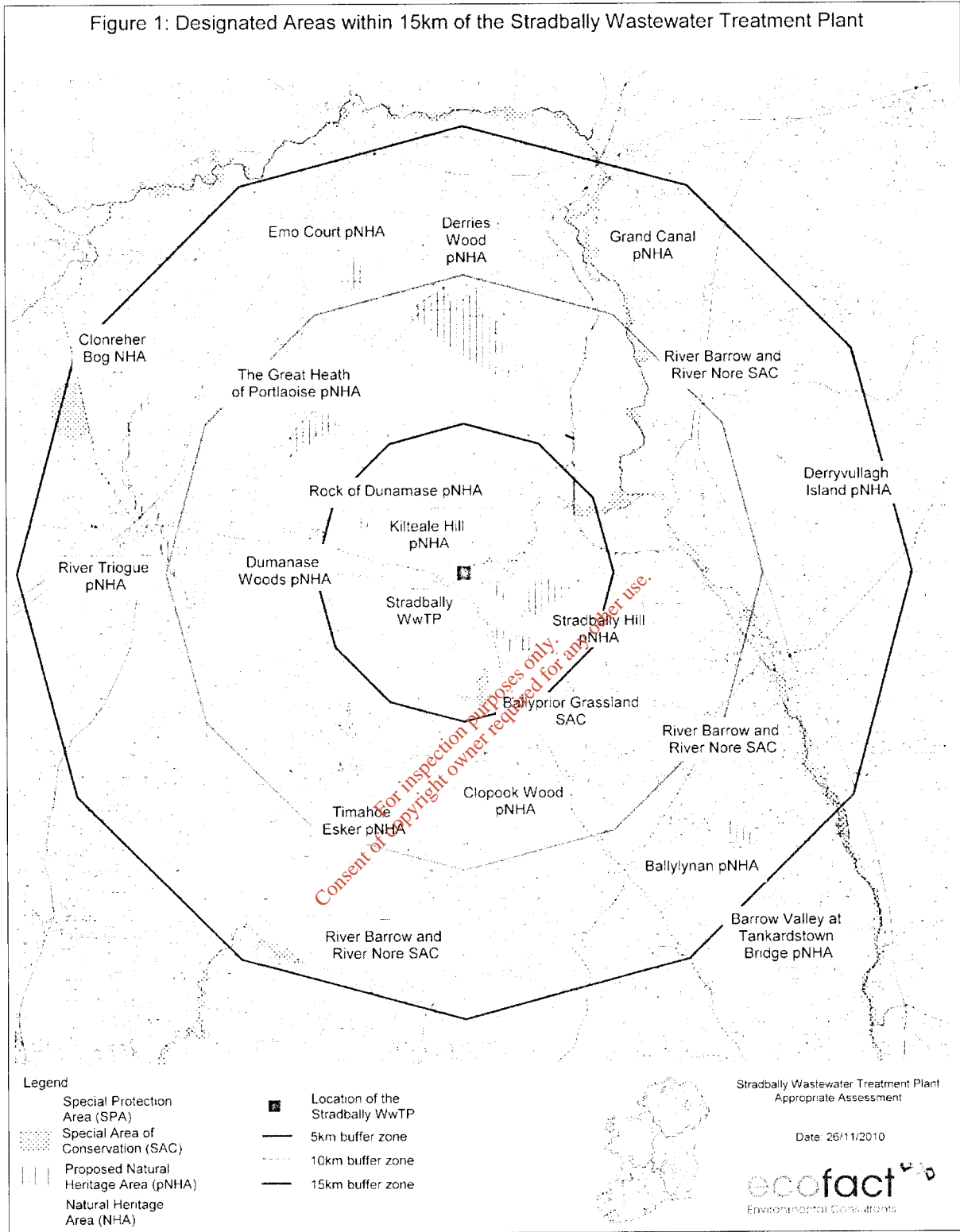
According to the monitoring data provided by the EPA and Laois County Council presented in the Receiving Water Impact Assessment (RWIA), Nitrates, Orthophosphates and Ammonia were found to be elevated in the Stradbally River upstream and downstream of the WwTP discharge, with levels increasing downstream of the discharge in the Stradbally River within the SAC (Ecofact, 2009).

3.2 Identification of relevant Natura 2000 Sites

The current Screening Assessment has identified the designated Natura 2000 sites within a 15km radius of the WwTP, as presented in Table 1. The only site within 15km that is likely to be directly, indirectly or cumulatively affected by the Stradbally WwTP discharge is the River Barrow and River Nore SAC. Additional Natura 2000 sites within 15km of Stradbally are not connected with the WwTP, either geographically or hydrologically, with regard to their conservation interests. The qualifying interests of the River Barrow and River Nore SAC site are detailed below. A map of the Stradbally region showing the location of the Stradbally WwTP and designated areas within 15km is provided in the Figures section. The Natura 2000 sites within 15km of the Stradbally WwTP are shown in Figure 1.

Table 1 Summary details of the designated areas affected by the Stradbally Wastewater Treatment Plant.

Name	Site Code	Distance from WwTP (km)	Notes	Included in the current Screening Assessment
River Barrow and River Nore SAC	2162	0	Site of considerable conservation significance for the occurrence of good examples of habitats and of populations of plant and animal species that are listed on Annexes I and II of the E.U. Habitats Directive respectively.	Yes, Stradbally WwTP discharges directly to this SAC (at Stradbally River).
Ballyprior Grassland SAC	2256	4	Site designated due to the presence of the priority Annex I habitat 'Orchid rich calcareous grassland', this site is also recognized for its rich mycoflora diversity.	No.



3.3 Assessment of likely impacts affecting the Natura 2000 site

3.3.1 Assessment of likely direct impacts

The receiving water for the Stradbally WwTP discharge is the Stradbally River. The Stradbally River downstream of Stradbally town is designated within the River Barrow and River Nore cSAC. Therefore the discharge from the WwTP goes directly into this internationally important site.

The results of the chemical water quality assessments in the RWIA (Ecofact, 2009) indicate that the Stradbally WwTP is further contributing to the elevated background levels of Nitrates, Orthophosphate and Ammonia in the Stradbally River. Biological assessment results also showed a slight decrease in water quality downstream of the plant. This indicates that the plant is potentially resulting in direct, localised negative impacts on the conservation interests of the SAC within the Stradbally River downstream of the plant.

3.3.2 Assessment of likely indirect impacts

Indirect (or secondary) impacts are defined as effects that are "caused by and result from the activity although they are later in time or further removed in distance, but still reasonably foreseeable" (Bowers-Marriott, 1997).

The results of the chemical water quality and biological water quality assessments in the RWIA (Ecofact, 2009) indicate that the Stradbally WwTP discharge is having an adverse affect on the water quality of the receiving water (Stradbally River). This gives rise to the potential for the declining water quality in the Stradbally River to negatively impact protected species downstream both in the Stradbally River and in the River Barrow which is located approximately 7km downstream of the Stradbally WwTP.

3.3.3 Assessment of cumulative impacts

Cumulative impacts or effects are changes in the environment that result from numerous human-induced, small-scale alterations. Cumulative impacts can be thought of as occurring through two main pathways: first, through persistent additions or losses of the same materials or resource, and second, through the compounding effects as a result of the coming together of two or more effects (Bowers-Marriott, 1997).

The discharge from the Stradbally WwTP has the potential to contribute to in combination impacts giving rise to cumulative negative impact on water quality in the Stradbally River within the SAC. The overall contribution of the Stradbally plant discharge in terms of water quality impacts is unknown (Ecofact, 2009). Due to the compromised background water quality, the RWIA (Ecofact, 2009) identified that the Stradbally River has poor assimilation capacity for Orthophosphate, Nitrate, total Phosphorus based on the mean background levels of these parameters in the river upstream of the discharge. Furthermore, the river was found to have no assimilation capacity for Total Ammonia, Nitrates, Orthophosphates, Suspended solids, Total phosphorus and BOD when the maximum concentration of the parameters was assessed. Therefore there is the potential for water quality impacts affecting the designated site.

3.4 Screening statement with conclusions

According to NPWS (2009), the Appropriate Assessment Stage 1: Screening exercise can result in one of three conditions:

- An Appropriate Assessment is not required i.e. where the plan/proposal is associated with the management of the site;
- There is no potential for significant effects i.e. Appropriate Assessment is not required;

- Significant effects are certain, likely or uncertain i.e. the project must either proceed to Stage 2: Appropriate Assessment or be rejected.

Following the requirements of a Screening Stage Appropriate Assessment as outlined in the EPA's 'Note on Appropriate Assessments for the purposes of the Wastewater Discharges (Authorisation) Regulations (2007)' the requirements of the DoEHLG Circular Letter 'L8/08 – Water Services Investment and Rural Water Programmes – Protection of Natural Heritage and National Monuments' have been followed in establishing the conclusion of the Screening Statement.

1. **Is the development in a nature conservation site?** Yes, the Stradbally WwTP is discharging to the Stradbally River designated within the River Barrow and River Nore SAC boundary.
2. **Is the development in the surface water catchment of a nature conservation site (or part of such a site)?** Yes, the River Barrow catchment, designated within the River Barrow and River Nore SAC.
3. **Are the qualifying habitats and species of the site water dependant?** Yes, the majority of the Annex II species and some of the Annex I habitats.
4. **Is there a WFD sub-basin management plan for the site or its protected habitats/species?** Yes, particularly in relation to Freshwater pearl mussels.
5. **Does this plan cover all potential receptors (habitats/species)?** No, therefore the Screening process must conclude that further impact assessment is required.

From the current screening assessment, taking account of supporting documentation, there are ongoing, unquantified impacts affecting the Stradbally River within the River Barrow and River Nore SAC arising from the current operation of the Stradbally WwTP; particularly in relation to water quality. There is therefore the potential for further downstream effects on the River Barrow which would require further assessment. It is stated in the EPA guidelines (2009) that '*if significant effects are likely then an appropriate assessment must be carried out. In addition, if the likelihood of significant effects is in doubt then the precautionary principle applies and an appropriate assessment must be carried out*'. The magnitude of impact on the SAC resulting from the Stradbally WwTP discharge is not known. Therefore it is necessary for the 'Appropriate Assessment' process to proceed to Stage 2 with regard to the potential for adverse effects on the River Barrow and River Nore SAC.

4. STAGE 2: APPROPRIATE ASSESSMENT

At this stage the impact of a project or plan ('the discharge') alone and in combination with other projects or plans on the integrity of the Natura 2000 site is considered with respect to the conservation objectives of the site and to its structure and function (NPWS, 2009). The Stage 2 Appropriate Assessment provides a description of the existing Stradbally WwTP discharge to the Stradbally River. The conservation objectives of the River Barrow and River Nore SAC are identified, where those potentially affected by the proposed discharge are listed and potential impacts outlined.

At Stage 2 the impact of the project / plan affecting the *integrity* of a Natura 2000 site is considered with respect to the conservation objectives of the site. Integrity is defined as:

'the coherence of the site's ecological structure and function, across its whole area, or the habitats, complex of habitats and/or populations of species for which the site is or will be classified'.

Therefore the integrity of a site is principally related to the structure and function of the site with regard to its Annex I habitats and Annex II species listed as the qualifying interests. The conservation status of these qualifying interests comprises the primary conservation objectives for all designated Natura 2000 sites.

Favourable conservation status is defined for Annex I habitats and Annex II species in the Habitat Directive (1992):

Article 1 (i)

Conservation status of a natural habitat means the sum of the influences acting on a natural habitat and its typical species that may affect its long-term natural distribution, structure and functions as well as the long-term survival of its typical species within the territory referred to in Article 2.

The conservative status of a natural habitat will be taken as 'favourable' when: its natural range and areas it covers within that range are stable or increasing, and the specific structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future.

Article 1 (ii)

Conservation status of a species means the sum of the influences acting on the species concerned that may affect the long-term distribution and abundance of its populations within the territory referred to in Article 2;

The conservation status will be taken as 'favourable' when: population dynamics data on the species concerned indicate that it is maintaining itself on a long-term basis as a viable component of its natural habitats, and the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future, and there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis.

The conservation status of the qualifying interests within the River Barrow and River Nore SAC are subject to the Conservation Management Plans in preparation by the NPWS. The conservation status of Annex I Habitats and Annex II species as qualifying interests of the SAC are assessed as follows:

- Range
- Area
- Specific structures and functions
- Future prospects

The conservation status of the qualifying interests within the River Barrow and River Nore SAC are available at a national level; however, there is currently no Conservation Management Plan for this SAC where the conservation status of the qualifying interests within the site may be identified. The current assessment therefore utilises the available literature and the national '*Conservation Status Assessment Report*' (NPWS, 2008).

4.1 Description of Natura 2000 Site affected

The River Barrow and River Nore Special Area of Conservation (site code 002162) is the only site potentially affected. This site is selected for alluvial wet woodlands and petrifying springs, priority habitats on Annex I of the E.U. Habitats Directive, 1992. The site is also selected as a SAC for old oak woodlands, floating river vegetation, estuary, tidal mudflats, *Salicornia* mudflats, Atlantic salt meadows, Mediterranean salt meadows, dry heath and eutrophic tall herbs, all habitats listed on Annex I of the E.U. Habitats Directive.

As well as habitats, the SAC has been selected due to the presence of invertebrate, fish and mammal species which are listed under Annex II of the EU Habitats Directive, including freshwater pearl mussel (*Margaritifera margaritifera* and its hardwater form *M. durrovensis*), freshwater crayfish (*Austropotamobius pallipes*), Atlantic salmon (*Salmo salar*), twaite shad (*Alosa fallax fallax*), the three Irish Lamprey species - sea (*Petromyzon marinus*), brook (*Lampetra planeri*) and river (*Lampetra fluviatilis*), the Desmoulin's whorl snail *Vertigo moulinsiana* and Eurasian otter (*Lutra lutra*). A detailed map of the Stradbally WwTP study area, indicating the River Barrow and River Nore SAC site boundary, is given in Figure 2.

4.2 Description of habitats in the affected area of the SAC

The qualifying interests of the River Barrow and Nore SAC are presented in Table 2 and are discussed individually below.

Table 2 Qualifying Interests of the River Barrow and River Nore SAC and their potential to occur within the study area.

	Natura Code	Item Description	Present in the Stradbally river or riparian habitats	Present in the River Barrow within 15km
Annex II Species	1095	Sea lamprey (<i>Petromyzon marinus</i>)		
	1096	Brook lamprey (<i>Lampetra planeri</i>)	✓	✓
	1099	River Lamprey <i>Lampetra fluviatilis</i>		
	1102	Allis shad (<i>Alosa fallax</i>)		
	1106	Atlantic salmon (<i>Salmo salar</i>)	✓	✓
	1103	Twaite shad (<i>Alosa alosa</i>)		
	1355	Otter (<i>Lutra lutra</i>)	✓	✓
	1092	White-clawed crayfish (<i>Austropotamobius pallipes</i>)		✓
	1029	Freshwater pearl mussel (<i>Margaritifera margaritifera</i>)		
	1990	Nore Freshwater pearl mussel (<i>Margaritifera durrovensis</i>)		
	1016	Desmoulin's whorl snail (<i>Vertigo moulinsiana</i>)		✓
	1421	Killarney Fern (<i>Trichomanes speciosum</i>)		
Annex I Habitats	91A0	Old sessile oak woods with Ilex and Blechnum in the British Isles		
	91E0	Alluvial forests with <i>Alnus glutinosa</i> and <i>Fraxinus excelsior</i> (<i>Alno-Padion</i> , <i>Alnion incanae</i> , <i>Salicion albae</i>)		✓
	3260	Water courses of plain to montane levels with the <i>Ranunculion fluitantis</i> and <i>Callitriche-Batrachion</i> vegetation		✓
	1310	<i>Salicornia</i> and other annuals colonizing mud and sand		
	1330	Atlantic salt meadows (<i>Glauco-Puccinellietalia maritimae</i>)		
	1410	Mediterranean salt meadows (<i>Juncetalia maritimi</i>)		
	4030	European dry heaths		
	7220	Petrifying springs with tufa formation (<i>Cratoneurion</i>)		✓
	6430	Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels		✓
	1320	<i>Spartina</i> swards (<i>Spartinion maritimae</i>)		
1140	Mudflats and sandflats not covered by seawater at low tide			
1130	Estuaries			

4.2.1 Annex I Habitats: Primary Reason for the Selection of the Site

The site is an SAC selected for alluvial wet woodlands and petrifying springs which are priority habitats on Annex I of the E.U. Habitats Directive. The site is also selected as an SAC for old oak woodlands, floating river vegetation, estuary, tidal mudflats, *Salicornia* mudflats, Atlantic salt meadows, Mediterranean salt meadows, dry heath and eutrophic tall herb communities, all habitats listed on Annex I of the E.U. Habitats Directive. For the purpose of this study Estuaries; *Salicornia* species colonising mud and sands; Atlantic and Mediterranean salt meadows; *Spartina* swards; and tidal mudflats / sandflats are not considered further. This decision has been made on the basis that the conservation status of these habitats are not associated with or potentially affected by the Stradbally WwTP, due to the distance from the discharge point in the Stradbally River. Terrestrial habitats and habitats not classified as 'water dependant' e.g. Dry heaths and Old sessile oak woods are considered to be outside the scope of this study and not included further, as there is no pathway through which changes in the current and future WwTP can impact on these habitats. The site synopsis for the River Barrow and River Nore cSAC is included in Appendix 1. The individual Annex 1 habitats that could be affected by the plant discharge are discussed below.

4.2.1.1 Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) (91E0)

This habitat occurs along the riparian corridor of the River Barrow within the SAC, but was not recorded downstream of the WwTP discharge in the Stradbally River. The conservation status of this Priority Annex I habitat within the current study area takes account of the overall national conservation status i.e. 'Bad'; where the range is identified as favourable; with the reference area (Bad); structure and functions (Bad); and future prospects (Bad).

4.2.1.2 Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation (3260)

This Annex I habitat type occurs frequently within the River Barrow and River Nore SAC, where suitable gradient and flow occurs. The Stradbally WwTP discharges to the Stradbally River which is known to contain this habitat (Ecofact, 2009). At a national level its range is evaluated as being 'favourable'. However, overall nationally it is evaluated as being of 'Bad' conservation status (NPWS, 2008); due to failures in relation to specific structures and functions and also in relation to future prospects, principally in relation to impacts affecting the aquatic environment e.g. water quality impacts.

4.2.1.3 Petrifying springs with tufa formation (*Cratoneurion*) (7220)

This priority Annex I habitat is listed as a qualifying interest of the River Barrow and River Nore SAC. Calcareous springs are known to occur within the riparian corridor and floodplain of the River Barrow main channel. In the absence of a conservation status evaluation for this habitat within the River Barrow and River Nore SAC it is considered that the national conservation status 'Unfavourable Bad' (NPWS 2008) is utilised for the current assessment. This habitat has not been identified in the vicinity of the Stradbally WwTP discharge.

4.2.1.4 Hydrophilous tall herb fringe communities of plains and of the montane to alpine levels (6430)

This Annex I habitat occurs on the River Barrow main channel downstream of the Stradbally River confluence. 'Tall herb fringe communities' are evaluated as being of 'Inadequate' conservation status (NPWS 2008); where the range and area for this habitat are identified as being 'Favourable'.

4.2.2 Annex II Species: Primary Reason for the Selection of this Site

Species present at this site and listed on Annex II of the E.U. Habitats Directive include: sea lamprey *Petromyzon marinus*, river lamprey *Lampetra fluviatilis*, brook lamprey *Lampetra planeri*, freshwater pearl mussel *Margaritifera margaritifera*, Nore freshwater pearl mussel *Margaritifera durrovensis*, white-clawed crayfish *Austropotamobius pallipes*, twaite and allis shad *Alosa fallax* and *Alosa alosa* respectively, Atlantic salmon *Salmo salar*, otter *Lutra lutra*, Desmoulin's whorl snail, *Vertigo moulinsiana* and the Killarney fern *Trichomanes speciosum*.

The Killarney fern (1421) will not be considered in this assessment due to its current distribution, which is limited to areas close to Carlow in the River Barrow catchment; taking cognisance of its connection to terrestrial habitats; and the absence of pathways for impacts arising in the aquatic environment.

Sea lampreys (1095) and River lampreys (1099) are anadromous and appear to be confined in general to the lower reaches of the River Barrow. King, (2006) reported the occurrence of sea lamprey ammocoetes in the Fusheoge tributary, 43km upstream of the upper tidal limit at St. Mullins, Co. Waterford. Lampreys are poor swimmers and cannot jump or climb (Reinhardt *et al*, 2009), so will have significant difficulty getting past the main stem weirs on the River Barrow. This species will therefore not be discussed any further in this assessment as it is not considered likely that they could be affected by the ongoing operation of the plant. Twaite Shad (1103) and Allis Shad (1102) are among the rarest fish species breeding in Irish freshwaters. Shad have an anadromous life cycle and have been recorded in the lower reaches of the River Barrow. However, it is clear that both shad species are confined to the lower reaches of the river below the weirs in the lower river and would therefore not occur in the study area. These species are also not discussed further in this report. The remaining Annex II species occurring within the study area are discussed individually below. The Freshwater pearl mussel is designated within the cSAC; however, this species does not occur in the Stradbally River or in the River Barrow downstream of the Stradbally River confluence. This species is therefore not considered further in the current assessment.

4.2.2.1 Brook lamprey (1096)

The brook lamprey is the smallest of the three lampreys native to Ireland and it is the only one of the three species that is non-parasitic and spends all its life in freshwater (Maitland & Campbell 1992). Brook lampreys are likely to occur in the Stradbally River and have been recorded in significant numbers in the River Barrow downstream. This species is evaluated as being of 'Favourable' conservation status nationally (NPWS 2008).

4.2.2.2 Atlantic salmon (1106)

Salmon are present throughout the Barrow catchment, including the Stradbally River (McGinnity *et al*, 2003). Poor water quality downstream of the discharge will affect the conservation status of salmon in the Stradbally River; as this species requires clean water (Q4) for spawning and early life stages. Salmon are likely to spawn in the Stradbally River downstream of the WwTP where suitable substrate occurs. This species is evaluated as being of overall 'Bad' conservation status nationally (NPWS 2008).

4.2.2.3 Otter (1355)

Otter are widespread in the River Barrow and River Nore catchments within the SAC designation. The conservation status of this species is dependent on fish stocks, which are ultimately dependent on water quality. Evidence of otter activity has been recorded from the Stradbally River.

4.2.2.4 White-clawed crayfish (1092)

White-clawed crayfish occur in the River Barrow catchment but were not recorded in the Stradbally River (Ecofact 2009). Crayfish are recognized as being tolerant of moderate pollution levels and are classed as Group C organisms in the EPA Q-Value biotic index. This species is evaluated as being of overall 'Inadequate' conservation status nationally (NPWS 2008).

4.2.2.6 Desmoulin's whorl snail (1016)

In the River Barrow and River Nore cSAC the status of this snail population is considered 'Unfavourable' (Conservation Status Assessment Report, 2007). This species has been recorded within the riparian corridor of the River Barrow. According to NPWS (2008) *Vertigo moulinsiana* is sensitive to eutrophication and consequent vegetation changes to its riparian and fen habitats. This species is evaluated as being of overall 'Bad - Unfavourable' conservation status nationally (NPWS 2008).

4.3 Impact Prediction / Assessment

The discharge from the existing Stradbally WwTP is to the Stradbally River which is designated within the River Barrow and River Nore SAC. The chemical water quality of the receiving water (Stradbally River) is adversely affected directly downstream of the plant (Ecofact, 2009). The Stradbally WwTP discharge therefore affects the Waste Assimilation Capacity of this watercourse.

According to EPA biological water quality monitoring data for the Stradbally River in 2009 this water course was rated as Q3-4 'Unsatisfactory Status' upstream and downstream of the Stradbally WwTP discharge, with unsatisfactory water quality persisting to the River Barrow confluence.

The Stradbally WwTP is identified as a point pressure in the Southeastern River Basin District River Basin Management Plan within the Stradbally Water Management Unit Action Plan and is considered to be at risk (SERBD, 2010). The capacity of the plant is identified as an issue and a Performance Management System is recommended for implementation (SERBD, 2010)

On this basis it is concluded that the ongoing operation of the plant has the potential for direct, indirect and cumulative impacts on the conservation objectives of this SAC within the Stradbally River and also on the River Barrow main channel. The effluent from the Stradbally WwTP is discharged directly to the designated Stradbally River. From the RWIA (Ecofact, 2009) it was identified that water quality both upstream and downstream of the plant was compromised and that the existing plant may be having a localised effect on the biological and chemical water quality of the Stradbally River immediately downstream of the plant and subsequently the water quality of the main channel of the River Barrow downstream may also be indirectly affected. The impacts of the existing plant are discussed in more detail below for the relevant key conservation interest of the SAC site.

4.3.1 Impacts affecting Annex I Habitats within the SAC

4.3.1.1 Alluvial forests with *Alnus glutinosa* and *Fraxinus excelsior* (*Alno-Padion*, *Alnion incanae*, *Salicion albae*) (91E0)

Alluvial woodland may occur on the banks of the River Barrow within the SAC, downstream of the Stradbally WwTP. This habitat is not a water dependant habitat and is not directly connected to the aquatic fluvial environment. However, as it occurs along the riparian corridor and within the flood plain of the River Barrow within the SAC there is the potential for alteration of the ground flora and botanical communities of this woodland habitat in a localised context, arising from increased nitrification of the soils within the woodland. This may arise during flood events, where nutrient enriched silt downstream of the WwTP discharge may be deposited within the woodland. The current assessment considers that the potential for such indirect alterations to this habitat arising from the Stradbally WwTP would not occur taking account of the low level of cumulative, background impacts to the River Barrow arising from the discharge. Although there is no recent data regarding the conservation status of this habitat within the SAC, it is concluded that the ongoing discharge would not have a significant effect on the integrity of this habitat.

4.3.1.2 Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation (3260)

According to NPWS (2008) discharges, fertilisation and water pollution are identified as the main pressures affecting this water dependant habitat. This has implications for the existing WwTP at Stradbally, which is contributing to cumulative impacts on background water quality in the Stradbally River. It is considered that the ongoing operation of the Stradbally plant is contributing to background water quality pressures in the Stradbally River. This would give rise to direct impacts affecting this habitat within the SAC downstream, in combination with elevated background water quality pressures within the Stradbally River. In the absence of detailed conservation status data for this habitat within the River Barrow and River Nore SAC, the national context of 'Unfavourable - Bad' conservation status is utilised for the current assessment, where the WwTP at Stradbally has the potential to contribute to nutrient-loadings and water pollution affecting the structure and function of this habitat.

4.3.1.3 Petrifying springs with tufa formation (*Cratoneurion*) (7220)

This habitat is associated with calcareous springs occurring within the SAC boundary downstream of Stradbally within the River Barrow corridor. These springs are separate aquatic entities to the main watercourses designated within the SAC, and are connected to the catchment via tributaries of these main watercourses. The extent and location of these habitats within the SAC has not been identified or evaluated. Tufa-forming springs are considered likely to be independent of water quality within the River Barrow. The ground-water/surface-water interactions within the Barrow catchment have not been investigated, where poor background water quality may impact on these habitats via groundwater connections. There are no records of this habitat from within the local area of the Stradbally WwTP and any impacts arising are considered unlikely to affect the conservation status of this priority Annex I habitat.

4.3.1.4 Hydrophilous tall herb fringe communities of plains / montane to alpine levels (6430)

According to the NPWS (2008) water quality and discharges are not identified as being main pressures or threats affecting this habitat. It is considered that there is the potential for significant water quality deterioration to affect / alter the botanical communities of these habitats along the riparian corridor of the River Barrow within the SAC. It is considered that the conservation status of this habitat is independent of the operation of the WwTP at Stradbally and that cumulative impacts on water quality arising from the Stradbally WwTP is not of the order that would result in impacts affecting this habitat.

4.3.2 Impacts affecting Annex II Species within the SAC

4.3.2.1 Brook lamprey (1096)

Water quality impacts downstream of the Stradbally WwTP outfall would have been shown to result in direct impacts in a localised context. There is further cumulative indirect impacts affecting the Waster Assimilation Capacity of this watercourse; both of which are considered to affect recruitment of this species. This is due to lampreys' requirements for good water quality for successful spawning and ova survival. However, brook lampreys are found throughout the SAC and have a favourable conservations status nationally. In this respect it is considered that the ongoing operation of the Stradbally plant may be having a conservation status of this qualifying interest or the integrity of the SAC.

4.3.2.2 Atlantic salmon (1106)

Poor water quality will affect the conservation status of salmon in the Stradbally River, as this species requires clean water (Q4) for spawning and early life stages. The Stradbally WwTP was considered to be contributing to background water quality problems with a deterioration in biological and chemical water quality downstream of the WwTP discharge (Ecofact, 2009). The discharge is therefore affecting the potential of the Stradbally River as a salmon producing watercourse, in combination with additional pressures, this may have limiting impacts on the range of this species. The WwTP discharge is therefore determined to be resulting in direct impacts on salmon in the designated Stradbally River, with indirect, cumulative impacts on this species within the River Barrow.

4.3.2.3 Otter (1355)

Reduced water quality and ecological status downstream of the discharge of the Stradbally WwTP is not considered to be at a scale which would result in direct or indirect effects on otters. The otter is dependent on fish stocks, which are ultimately dependent on water quality. However, there is no indication that the ongoing operation of this plant is having an adverse effect on otters within the River Barrow and River Nore SAC as a whole.

4.3.2.4 White-clawed crayfish (1092)

White-clawed crayfish occur in the River Barrow catchment, although apparently not in the general area of the Stradbally WwTP (Ecofact, 2009). Reduced water quality and ecological status downstream of the discharge of the Stradbally WwTP could potentially have direct effects on crayfish

which may occur in the Stradbally River downstream. Impacts affecting water quality in the Stradbally River are considered to result in both indirect and cumulative impacts on the River Barrow and River Nore SAC.

4.3.2.6 Desmoulin's whorl snail (1016)

In River Barrow and River Nore cSAC the status of this snail population is considered unfavourable (Conservation Status Assessment Report, 2007). No records of this species were found in the survey undertaken during 2009. This is a semi-aquatic species and direct effects of the WwTP discharge are localised, the ongoing discharge is unlikely to have the potential to affect the conservation status of this qualifying interest.

4.4 Conservation Objectives for the River Barrow and River Nore SAC

At a national level the conservation status of the water dependant qualifying interests has been provided in the NPWS Conservation Status Report (2008) 'The status of EU Protected Habitats and Species in Ireland'. For habitats/species identified as being affected by the Stradbally WwTP, the following conservation status conclusions were made (NPWS, 2008):

- Floating river vegetation – Unfavourable / Bad conservation status
- Brook lamprey – Favourable conservation status
- Atlantic salmon – Bad conservation status
- Otter – Inadequate conservation status
- Desmoulin's whorl snails - Unfavourable / Bad conservation status

The Conservation Management Plan detailing the conservation interests of the River Barrow and River Nore SAC is currently under preparation by the National Parks and Wildlife Service (NPWS) of the Department of the Environment, Heritage and Local Government. However, the draft conservation objectives of all Conservation Management Plans were available at the time of preparing the current report. The conservation objectives of the draft Conservation Management Plan for the River Barrow and River Nore SAC are given in Table 3.

Table 3 The conservation objectives of the draft Conservation Management Plan for the River Barrow and River Nore cSAC.

Number	Objective
Objective 1	To maintain the Annex I habitats for which the cSAC has been selected at favourable conservation status.
Objective 2	To maintain the Annex II species for which the cSAC has been selected at favourable conservation status.
Objective 3	To maintain the extent, species richness and biodiversity of the entire site
Objective 4	To establish effective liaison and co-operation with landowners, legal users and relevant authorities.

European and national legislation places a collective obligation on Ireland and its citizens to maintain at favourable conservation status areas designated as candidate Special Areas of Conservation. The Government and its agencies (i.e. the NPWS, local authorities and other statutory bodies) are responsible for the implementation and enforcement of regulations that will ensure the ecological integrity of these sites. According to the EU Habitats Directive (1992), favourable conservation status of a habitat is achieved when:

"...its natural range, and area it covers within that range, is stable or increasing, and the ecological factors that are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future, and the conservation status of its typical species is favourable". The favourable conservation status of a species is achieved when *"population data on the species concerned indicate that it is maintaining itself, and the natural range of the species is neither being reduced or likely to be reduced for the foreseeable future, and there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis"*.

The operation of the existing plant at Stradbally has been recognised as having an adverse effect on the water quality of the Stradbally River within the SAC downstream of the plant. Deleterious impacts on water quality will directly interfere with the structure and function of the SAC, where the conservation objectives of the site are focussed on maintaining the conservation interests i.e. aquatic Annex I habitats and Annex II species, at favourable conservation status. It is therefore considered that the conservation status of the Annex II species is being directly, indirectly and cumulatively affected by water quality impacts within SAC designation.

Cumulative impacts in the Stradbally catchment increase the significance of the impact posed by the Stradbally WwTP. possibly pose the greatest risk to the conservation objectives of the SAC, particularly when taken into account with additional WwTP discharges within the River Barrow catchment. Other impacts which are likely to act cumulatively on the cSAC result from the following:

- Chemical fertiliser application to agricultural lands (the main fertilisers in use supply nitrogen, phosphorus, potassium and sulphur);
- Agricultural practices such as ploughing leads to greater mineralisation and nitrification, and in the case of old grassland, it can result in an increase in the release of nitrogen over a number of years (OECD, 1986);
- Artificial drainage increases nitrate leaching and reduce the morphological qualities of watercourses, thereby reducing the quality of habitat for flora and fauna;
- Endocrine disruptors in domestic sewage, including the main active component in the oral contraceptive pill, can interfere with the endocrine system of plants and animals which controls a wide range of processes including metabolism, growth and reproduction. Effects include a high degree of intersexuality downstream of sewage works (Routledge *et al.* 1998);
- Forestry may alter water quality indirectly through increased evaporation losses and hence an increase in solute concentrations
- On-site wastewater treatment systems, poorly performing septic tank units and other small effluent systems can be significant sources of nutrients to rivers
- Water abstraction from rivers can cause low flows, which can be directly damaging due to reducing flows and assimilation capacity

The provisions of Article 6 of the 'Habitats' Directive 92/43/EC (2000) defines 'integrity' as the '*coherence of the site's ecological structure and function, across its whole area, or the habitats, complex of habitats and/or population of species for which the site is or will be classified*'.

4.5 Mitigation measures

4.5.1 Existing Plant

Laois Co. Co. recognises that the existing plant is not operating to the required standards and therefore is in the process of designing and constructing a new plant where effluent quality will be significantly better than is currently the case.

Mitigation measures recommended ensuring the plant operates to its full potential and environmental quality checks are given hereunder and these should be adopted by Laois Co. Co. if not being carried out already:

- Improving the operating standards of the existing plant to reduce the impact of the ongoing operation of the existing plant at the discharge source.
- Immediate introduction of plant maintenance with ongoing monitoring of the operation of the plant machinery with regard to compliance with the operating standards of the plant.
- Continuation of monitoring of the discharge, both upstream and downstream of the plant to allow for accurate determination of the impact of the existing plant on the SAC and the background water quality loadings affecting the Stradbally River, upstream of the plant.
- It is also recommended that annual biological monitoring be undertaken upstream and downstream of the WwTP outfall. Any biological monitoring should be carried out during the summer / autumn period. Further monitoring for dangerous substances from the WwTP discharge is recommended.

4.5.2 Reduction in cumulative background water quality pressures

Laois County Council is already making significant efforts to reduce cumulative impacts on water quality in the Stradbally catchment and is concurrently working with the EPA to identify sources of background pollution potentially affecting the SAC downstream of Stradbally. Laois Co. Co. is engaging with the farming community and examining farms in the Stradbally and Barrow catchments to reduce background pollution loadings, through farm surveys and other work of their Environmental department.

It is considered that the reduction of background loadings to the river through targeting both diffuse and point pollution sources, particularly other licensed discharges upstream of the Stradbally WwTP discharge would result in significant benefits to the Stradbally River making WAC available for the proposed WwTP and reducing cumulative impacts on the River Barrow and River Nore SAC.

4.5.3 Provision of a new WwTP for Stradbally

Laois County Council is currently moving towards providing a new state-of-the-art 3,500 PE plant for Stradbally (O' Dwyer, 2007). The proposed plant will incorporate micro-screening to provide additional treatment. Phosphorus reduction shall be provided if necessary in order to achieve the final effluent standards specified (0.37mg/l) and there will be a facility for Phosphorus removal. Biological removal will be the main process, a chemical dosing facility shall also be provided as a backup to assist the biological removal process. Upgrading of the plant should be undertaken as soon as possible, as this would result in a highly significant improvement in the quality of the effluent and consequently improve water quality in the Stradbally River downstream of the discharge point.

The design standard for the proposed WwTP is 19mg/l BOD, 1.85mg/l Total Ammonia, 25mg/l suspended solids and 0.3mg/l Total Phosphorus. For the proposed plant, with a design population equivalent (PE) of 3,500, the dry weather flow is 9.4 L/s with a peak flow to treatment of 27.3 L/s (3DWF). Details regarding the design, location and proposed treatment for the new plant at Stradbally are provided by Laois County Council in Appendix 4. The site layout of the proposed plant is shown in Figure 3.

A waste assimilation capacity (WAC) assessment was undertaken to show the impact of the discharge from the proposed plant to the Stradbally River. In this assessment, flow data for the river has been taken from the EPA Hydrometric Data System (see Appendix 3) and the 30%ile flow has been taken as the mean flow as indicated in 'Hydrological data' by MacCarthaigh (1997). Mean background values of parameters have been taken from the RWIA prepared for the Stradbally WwTP (Ecofact, 2009).

The predicted concentrations are based on the effluent discharge standard and background level downstream of the mixing zone (usually ca. 25 times the width of the river downstream). It is noted that there would be higher concentrations within the immediate vicinity of the outfall. Due to the natural recovery process that takes place in rivers, the concentration downstream of the mixing zone would be expected to decrease with distance from the discharge.

From Table 4 it can be seen that the background water quality in the Stradbally River upstream of the Stradbally WwTP discharge is significantly elevated above the SWR (2009) 'good status' standards at mean flow for BOD, Total Ammonia and Ortho-phosphate. There is no WAC for BOD, Total Ammonia or Orthophosphate or 'high status' or 'good status' standards at mean flow due to the elevated background levels in the receiving water.

At 95%ile flows there is WAC for Orthophosphate at 'good status'; however, there is no WAC for BOD or Total Ammonia at 95%ile flows at both high and good status standards.

The theoretical maximum WAC for both high and good status at mean flows and at 95%ile flows was calculated for BOD, Total Ammonia and Ortho-phosphate to establish the fraction of the theoretical maximum WAC consumed by the effluent discharged from the proposed plant under pristine background water quality conditions. This exercise found that in the event that water quality in the Stradbally River was significantly improved, i.e. pristine, there would be significant WAC available for BOD, Total Ammonia and Ortho-phosphate at 'high status' mean flows.

4.5.3.1 Conservation Objectives with regard to the new plant

The poor performance of the existing plant, in addition to the background pressures on water quality in the Stradbally River catchment, means that upgrading of the plant (Stage 1) should be undertaken as soon as possible, as per the Laois Towns and Villages Wastewater Improvement Scheme. The provision of a new plant as a mitigation measure for the shortfalls of the existing plant has been considered in the current WDA Stage 2 Appropriate Assessment.


The proposal to upgrade the existing WwTP to include improved discharge standards and the proposal of a new plant are key mitigations in the AA. However, the limited assimilation capacity within the Stradbally River means that the discharge standards for the proposed plant need to be revised and/or concrete proposals put in place for the reduction of background loadings to the Stradbally River.

The current WAC assessment has determined that an improvement in water quality in the Stradbally River upstream of the discharge from the new plant is required, as there is no WAC in the Stradbally River currently available.

The proposed plant does not currently meet the required standards of the Surface Waters Regulations (2009); however, it is considered that any improvement in water quality either in relation to the proposed new WwTP or upstream background conditions would result in direct positive impacts on Annex II species for which the SAC was selected and which occur in the Stradbally River and the River Barrow downstream; i.e. floating river vegetation, Atlantic salmon, white-clawed crayfish and brook lamprey. No discernible impacts affecting terrestrial habitats for which the SAC is designated are identified in relation to the operation of the new plant.

As required in the EPA 'Note on Appropriate Assessments for the purposes of the Waste Water Discharge Authorisation Regulations, 2007 (S.I. No. 684 of 2007)' the proposed mitigation measures require evidence of their efficacy and implementation and a timescale of when these will be undertaken. The degree of confidence of the success of these mitigation measures is also required. These issues are to be addressed in the submission by Laois County Council (Appendix 4) where the schedule for the delivery of the new WwTP is provided.

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Waste Water Treatment Plant: Stradbally Proposed				
Receiving Water: Stradbally River (River Barrow and River Nore cSAC)				
WwTP Characteristics				
Discharge volume DWF (m ³ /day)		Discharge volume DWF (l/s)		
	BOD	Total Ammonia	Ortho-phosphate	Total Phosphorus
Design standard (mg/l)	2.0	1.00	0.025	0.3
Receiving Water Characteristics				
River mean flow ^{1,2} (m ³ /sec)		Mean flow dilution factor		200.7
River 95%ile flow ² (m ³ /sec)		95%ile flow dilution factor		21.4
	BOD (mg/l)	Total Ammonia	Ortho-phosphate	Total Phosphorus
Background concentration³ (mg/l)	2.00	0.05	0.025	0.30
Environmental Quality Standards⁴				
	BOD	Total Ammonia	Ortho-phosphate	Total Phosphorus
High Status mean flow (≤mg/l)	1.3	0.04	0.025	N/A
Good Status mean flow (≤mg/l)	1.5	0.065	0.035	N/A
High Status 95%ile flow (≤mg/l)	2.2	0.09	0.045	N/A
Good Status 95%ile flow (≤mg/l)	2.6	0.14	0.075	N/A
Predicted Loadings, Concentration Increases⁴ and Waste Assimilation Capacity⁶ (WAC)				
	BOD	Total Ammonia	Ortho-phosphate⁷	Total Phosphorus
Plant loading (Kg/day)	14.94	1.45	0.200	0.24
MEAN FLOW				
Concentration increase (mg/l)	0.09	0.01	0.001	0.00
- Resultant D/S concentration (mg/l)	1.86	0.08	0.041	0.13
- WAC (High Status)				
WAC (kg/day)	-74.15	-4.73	-2.37	
- Consumed by discharge (%)	N/A	N/A	N/A	
Theoretical maximum WAC ⁸ (kg/day)	205.10	6.31	3.94	
- Consumed by discharge (%)	7	23	5	
- WAC (Good Status)				
WAC (kg/day)	-42.60	-0.99	-0.79	
- Consumed by discharge (%)	N/A	N/A	N/A	
Theoretical maximum WAC (kg/day)	236.65	10.25	5.52	
- Consumed by discharge (%)	6	14	4	
95%ile FLOW				
Concentration increase (mg/l)	0.77	0.08	0.010	0.01
- Resultant D/S concentration (mg/l)	2.54	0.15	0.050	0.14
- WAC (High Status)				
WAC (kg/day)	7.24	0.34	0.08	
- Consumed by discharge (%)	206	432	238	
Theoretical maximum WAC (kg/day)	37.07	1.52	0.76	
- Consumed by discharge (%)	40	96	26	
- WAC (Good Status)				
WAC (kg/day)	13.98	1.18	0.59	
- Consumed by discharge (%)	107	123	34	
Theoretical maximum WAC (kg/day)	43.80	2.36	1.26	
- Consumed by discharge (%)	34	62	16	
¹ 30%ile flow taken as the mean flow as indicated in 'Hydrological data' by MacCarthaigh (1997) ² Data from the EPA Hydrometric Data System: http://watermaps.wfdireland.ie/HydroTool (for receiving river segment #1_007 - Stradbally River) ³ Mean values taken from 'Receiving Water Impact Assessment: Duro w WwTP, Ecofact (2009) (mean values derived from WQ results between January 2007 and November 2008 - originally supplied by Laois Co. Co.). Ammonia taken as Total Ammonia. ⁴ European Communities Environmental Objectives (Surface Waters) Regulations 2009 (S.I. 272 of 2009). ⁵ Formula for resultant concentration = [(background conc. X background vol.) + (effluent conc. X effluent vol.)] / (background vol. + effluent vol.) ⁶ Formula for calculating WAC = (Environmental quality standard concentration - background concentration) X 86.4 X flow ⁷ Ortho phosphate taken as 85% Total Phosphorus. ⁸ Theoretical maximum WAC = WAC in the receiving water when background parameter concentration is not taken into account. Exceedences of SWR 'Good status' (2009) shown in red.				
Model title				
Waste Assimilation Capacity Assessment for the proposed Stradbally WwTP discharge to the Stradbally River			 environmental consultants	

Stradbally WwTP.

5 STAGE 2 APPROPRIATE ASSESSMENT CONCLUSIONS

The current Appropriate Assessment has been prepared following the EPA (2009) 'Note on Appropriate Assessments for the purposes of the Waste Water Discharge (Authorisation) Regulations, 2007 (S.I. No. 684 of 2007)'. The Department of the Environment, Heritage and Local Government guidance 'Appropriate Assessment of Plans and Projects in Ireland. Guidance for Planning Authorities' (DoEHLG, 2009) has also been taken into account. Therefore the current assessment for the Waste Water Discharge Licence investigates the potential adverse effects on the aquatic qualifying interests of the Natura 2000 network arising from the Stradbally plant discharge, in combination with other plans / projects affecting the aquatic environment. The assessment considers whether the Stradbally WwTP discharge, alone or in combination with other projects or plans, will have adverse effects on the *integrity* of a Natura 2000 site, and includes any mitigation measures necessary to avoid, reduce or offset negative effects.

The impact assessment for the current Stage 2 Appropriate Assessment draws upon the information supplied in the Receiving Water Impact Assessment (RWIA) for the existing Stradbally Waste Water Treatment Plant (WwTP) produced on behalf of the Water Services section of Laois County Council (Ecofact, 2009) and the WWDA licence application submitted to the EPA for the Stradbally discharge by Laois County Council. Proposed discharge standards for a new WwTP at Stradbally were also supplied by Laois County Council and have been utilised in the current assessment. The South Eastern River Basin Management Plan (SERBD, 2010) was assessed with reference to the Stradbally Water Management Unit Action Plan which identifies the Stradbally WwTP as a priority point pressure and at risk within the WMU. This Action Plan identifies the need for greater capacity and a Performance Management System to be introduced at the plant.

The Stradbally WwTP is recognised as being at capacity by Laois County Council, with the requirement for greater capacity and a higher standard of treatment required recommended by the SERBD River Basin Management Plan (SERBD, 2010). It is considered that the existing plant is therefore likely to be in excess of the Urban Wastewater Treatment Directive 91/271/EEC for treatment plants discharging to sensitive areas during occasional or sustained flow conditions. According to Laois County Council data, EPA chemical water quality monitoring data and the SERBD River Basin Management Plan both the Stradbally River and the River Barrow main channel are affected by elevated loadings in the background chemical water quality which affects the waste assimilation capacity for WwTP discharges at point source; although there is greater capacity for dilution within the Barrow, downstream of the Stradbally River confluence. The existing Stradbally WwTP and its associated storm water outfalls discharge to the Stradbally River at the upstream boundary of the River Barrow and River Nore SAC and this discharge has been identified as having a direct, localised impact on the qualifying interests of the SAC i.e. floating river vegetation, otter, lamprey and Atlantic salmon. These localised impacts are not evaluated as being significant with regard to adversely affecting the conservation objectives or the integrity of the River Barrow and River Nore SAC as a whole.

With regard to indirect and cumulative impacts there is currently a shortfall in monitoring data with regard to the extent of impacts from the existing Stradbally WwTP affecting the River Barrow main channel downstream. This leads to uncertainty with regard to unquantified cumulative impacts affecting water quality, a key indicator of conservation value for the SAC. The storm water outfalls associated with the Stradbally WwTP have also been identified as posing an unquantified water quality impact affecting the River Barrow and River Nore SAC. It was not feasible to quantify the extent of the cumulative impacts arising from the plant within the current Appropriate Assessment study given that two or more years monitoring data, in addition to data regarding the discharges from the storm water outfalls would be required. This data is not currently available from Laois County Council.

The mitigation measures provided in the current assessment with regard to the existing plant are limited to the introduction of a performance management system and the provision of more monitoring to establish the extent of impacts arising from the plant and the associated storm water outfalls within the Stradbally collection system. The proposed design standards of the new WwTP at Stradbally have been considered as a mitigation measure in the current Stage 2 Appropriate Assessment. As required in the EPA 'Note on Appropriate Assessments for the purposes of the Waste Water Discharge Authorisation Regulations, 2007 (S.I. No. 684 of 2007)' the proposed mitigation measures require

evidence of their efficacy and implementation and a timescale of when these will be undertaken. The degree of confidence of the success of these mitigation measures is also required.

The design standards provided for a new WwTP were inputted into a Waste Assimilation Capacity Model (see Table 4). The current proposals in relation to the new WwTP fall short of the requirements of the Surface Waters (Objectives) Regulations (2009). The Waste Assimilation Capacity model for the proposed new plant has shown that despite the improved rate of discharge from the new plant, there is no assimilation capacity available in the Stradbally River under mean flows or 95%ile flow conditions to meet 'good status' requirements – with the exception of available WAC for Ortho-phosphate at mean flows. However, it is noted that the proposed WwTP discharge will only require a small percentage of the 'theoretical maximum' WAC at high status and good status limits under mean and 95%ile flow conditions. Therefore it is concluded that the proposed plant will not significantly contribute to cumulative background water quality impacts affecting the conservation interests of the River Barrow and River Nore SAC.

Defined improvements are required in the background water quality to achieve good ecological status in the Stradbally River downstream of the discharge, taking account of the need to provide storm water collection and treatment at the new facility. The proposed discharge design standards for the Stradbally WwTP will deliver significant benefits over the existing situation, but this discharge will not be compliant with the requirements of the Surface Waters Regulations (2009) due to existing elevated background levels of key parameters in the Stradbally River, and also poor dilution capacity at 95%ile flows. Due to the uncertainty regarding the scale and significance of cumulative effects resulting from the Stradbally WwTP affecting the designated Stradbally River downstream and the River Barrow main channel, it is considered that there remains the potential for indirect and cumulative impacts on the conservation objectives of this Natura 2000 site which may affect the integrity of the site as summarised in Table 5. The existing WwTP at Stradbally therefore must progress to Stage 3: Consideration of Alternatives.

Table 5 Integrity of Site Checklist (adapted from DoEHLG, 2009) for the existing WwTP discharge at Stradbally with regard to the River Barrow and River Nore SAC.

Integrity of Site Checklist Conservation objectives	
Does the project or plan have the potential to:	
Cause delays in progress towards achieving the conservation objectives of the site?	Yes – unquantified cumulative impacts affecting water quality within the SAC.
Interrupt progress towards achieving the conservation objectives of the site?	Yes – unquantified cumulative impacts affecting water dependant qualifying interests of the SAC
Disrupt those factors that help to maintain the favourable conditions of the site?	Yes – water quality is identified as a key indicator of conservation value for the SAC
Interfere with the balance, distribution and density of key species that are the indicators of the favourable condition of the site?	Yes – unquantified impacts affecting Annex I habitats and Annex II species leads to uncertainty with regard to the significance of impacts affecting the favourable conservation status of these interests.
Other objectives	
Does the project or plan have the potential to:	
Cause changes to the vital defining aspects (e.g. nutrient balance) that determine how the site functions as a habitat or ecosystem?	Yes
Change the dynamics of the relationships (between, for example, soil and water or plants and animals) that define the structure and/or function of the site?	Yes
Interfere with predicted or expected natural changes to the site (such as water dynamics or chemical composition)?	Yes
Reduce the area of key habitats?	Yes – with regard to localised direct water quality impacts and indirect cumulative water quality impacts affecting the aquatic habitat of qualifying interests of the SAC.
Reduce the population of key species?	Yes – unquantified cumulative impacts affecting water quality are identified as having uncertain impacts on key species.
Change the balance between key species?	Yes – unquantified cumulative impacts affecting water quality are identified as having uncertain impacts on key species.
Reduce diversity of the site?	Yes – unquantified cumulative impacts affecting water quality are identified as having uncertain impacts on the diversity of the site.
Result in disturbance that could affect population size or density or the balance between key species?	Yes – unquantified cumulative impacts affecting water quality are identified as having uncertain impacts in this regard.
Result in fragmentation?	Yes – with regard to the potential for water pollution resulting in habitat loss.
Result in loss or reduction of key features (e.g. tree cover, tidal exposure, annual flooding, etc.)?	No – direct or indirect habitat loss is not a feature of the discharge, with the exception of loss of aquatic habitats due to pollution

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APPENDIX 1 NPWS Site Synopsis

SITE NAME: RIVER BARROW AND RIVER NORE
SITE CODE: 002162

This site consists of the freshwater stretches of the Barrow/Nore River catchments as far upstream as the Slieve Bloom Mountains and it also includes the tidal elements and estuary as far downstream as Creadun Head in Waterford. The site passes through eight counties – Offaly, Kildare, Laois, Carlow, Kilkenny, Tipperary, Wexford and Waterford. Major towns along the edge of the site include Mountmellick, Portarlington, Monasterevin, Stradbally, Athy, Carlow, Leighlinbridge, Graiguenamanagh, New Ross, Inistioge, Thomastown, Callan, Bennettsbridge, Kilkenny and Durrow. The larger of the many tributaries include the Lerr, Fushoge, Mountain, Aughavaud, Owenass, Boherbaun and Stradbally Rivers of the Barrow and the Delour, Dinin, Erkina, Owveg, Munster, Arrigle and King's Rivers on the Nore. Both rivers rise in the Old Red Sandstone of the Slieve Bloom Mountains before passing through a band of Carboniferous shales and sandstones. The Nore, for a large part of its course, traverses limestone plains and then Old Red Sandstone for a short stretch below Thomastown. Before joining the Barrow it runs over intrusive rocks poor in silica. The upper reaches of the Barrow also runs through limestone. The middle reaches and many of the eastern tributaries, sourced in the Blackstairs Mountains, run through Leinster Granite. The southern end, like the Nore runs over intrusive rocks poor in silica. Waterford Harbour is a deep valley excavated by glacial floodwaters when the sea level was lower than today. The coast shelves quite rapidly along much of the shore.

The site is a candidate SAC selected for alluvial wet woodlands and petrifying springs, priority habitats on Annex I of the E.U. Habitats Directive. The site is also selected as a candidate CSAC for old oak woodlands, floating river vegetation, estuary, tidal mudflats, *Salicornia* mudflats, Atlantic salt meadows, Mediterranean salt meadows, dry heath and eutrophic tall herbs, all habitats listed on Annex I of the E.U. Habitats Directive. The site is also selected for the following species listed on Annex II of the same directive – Sea Lamprey, River Lamprey, Brook Lamprey, Freshwater Pearl Mussel, Nore Freshwater Pearl Mussel, Crayfish, Twaite Shad, Atlantic Salmon, Otter, *Vertigo moulinsiana* and the plant Killarney Fern.

Good examples of Alluvial Forest are seen at Rathsnagadan, Murphy's of the River, in Abbeyleix estate and along other shorter stretches of both the tidal and freshwater elements of the site. Typical species seen include Almond Willow (*Salix triandra*), White Willow (*S. alba*), Grey Willow (*S. cinerea*), Crack Willow (*S. fragilis*), Osier (*S. viminalis*), with Iris (*Iris pseudacorus*), Hemlock Water-dropwort (*Oenanthe crocata*), Angelica (*Angelica sylvestris*), Thin-spiked Wood-sedge (*Carex strigosa*), Pendulous Sedge (*C. pendula*), Meadowsweet (*Filipendula ulmaria*), Valerian (*Valeriana officinalis*) and the Red Data Book species Nettle-leaved Bellflower (*Campanula trachelium*). Three rare invertebrates have been recorded in this habitat at Murphy's of the River. These are: *Neoascia obliqua* (Diptera: Syrphidae), *Tetanocera freyi* (Diptera: Sciomyzidae) and *Dictya umbrarum* (Diptera: Sciomyzidae).

A good example of petrifying springs with tufa formations occurs at Dysart Wood along the Nore. This is a rare habitat in Ireland and one listed with priority status on Annex I of the EU Habitats Directive. These hard water springs are characterised by lime encrustations, often associated with small waterfalls. A rich bryophyte flora is typical of the habitat and two diagnostic species, *Cratoneuron commutatum* var. *commutatum* and *Eucladium verticillatum*, have been recorded.

The best examples of old Oak woodlands are seen in the ancient Park Hill woodland in the estate at Abbeyleix; at Kyleadahir, on the Delour, Forest Wood House, Kylecorragh and Brownstown Woods on the Nore; and at Cloghristic Wood, Drummond Wood and Borris Demesne on the Barrow, though other patches occur throughout the site. Abbeyleix Woods is a large tract of mixed deciduous woodland which is one of the only remaining true ancient woodlands in Ireland. Historical records show that Park Hill has been continuously wooded since the sixteenth century and has the most complete written record of any woodland in the country. It supports a variety of woodland habitats and an exceptional diversity of species including 22 native trees, 44 bryophytes and 92 lichens. It also contains eight indicator species of ancient woodlands. Park Hill is also the site of two rare plants, Nettle-leaved Bellflower and the moss *Leucodon sciuroides*. It has a typical bird fauna including Jay, Long-eared Owl and Raven. A rare invertebrate, *Mitostoma chrysomelas*, occurs in Abbeyleix and

only two other sites in the country. Two flies *Chrysogaster virescens* and *Hybomitra muhlfeldi* also occur. The rare Myxomycete fungus, *Licea minima* has been recorded from woodland at Abbeyleix.

Oak woodland covers parts of the valley side south of Woodstock and is well developed at Brownsford where the Nore takes several sharp bends. The steep valley side is covered by Oak (*Quercus* spp.), Holly (*Ilex aquifolium*), Hazel (*Corylus avellana*) and Birch (*Betula pubescens*) with some Beech (*Fagus sylvatica*) and Ash (*Fraxinus excelsior*). All the trees are regenerating through a cover of Bramble (*Rubus fruticosus* agg.), Foxglove (*Digitalis purpurea*) Wood Rush (*Luzula sylvatica*) and Broad Buckler-fern (*Dryopteris dilatata*).

On the steeply sloping banks of the River Nore about 5 km west of New Ross, in County Kilkenny, Kylecorragh Woods form a prominent feature in the landscape. This is an excellent example of a relatively undisturbed, relict Oak woodland with a very good tree canopy. The wood is quite damp and there is a rich and varied ground flora. At Brownstown a small, mature Oak-dominant woodland occurs on a steep slope. There is younger woodland to the north and east of it. Regeneration throughout is evident. The understorey is similar to the woods at Brownsford. The ground flora of this woodland is developed on acidic, brown earth type soil and comprises a thick carpet of Bilberry (*Vaccinium myrtillus*), Heather (*Calluna vulgaris*), Hard Fern (*Blechnum spicant*), Cowwheat (*Melampyrum* spp.) and Bracken (*Pteridium aquilinum*).

Borris Demesne contains a very good example of a semi-natural broad-leaved woodland in very good condition. There is quite a high degree of natural re-generation of Oak and Ash through the woodland. At the northern end of the estate Oak species predominate. Drummond Wood, also on the Barrow, consists of three blocks of deciduous woods situated on steep slopes above the river. The deciduous trees are mostly Oak species. The woods have a well established understorey of Holly (*Ilex aquifolium*), and the herb layer is varied, with Brambles abundant. Whitebeam (*Sorbus devoniensis*) has also been recorded.

Eutrophic tall herb vegetation occurs in association with the various areas of alluvial forest and elsewhere where the flood-plain of the river is intact. Characteristic species of the habitat include Meadowsweet (*Filipendula ulmaria*), Purple Loosestrife (*Lythrum salicaria*), Marsh Ragwort (*Senecio aquaticus*), Ground Ivy (*Glechoma hederacea*) and Hedge Bindweed (*Calystegia sepium*). Indian Balsam (*Impatiens glandulifera*), an introduced and invasive species, is abundant in places. Floating River Vegetation is well represented in the Barrow and in the many tributaries of the site. In the Barrow the species found include Water Starworts (*Callitriche* spp.), Canadian Pondweed (*Elodea canadensis*), Bulbous Rush (*Juncus bulbosus*), Milfoil (*Myriophyllum* spp.), *Potamogeton x nitens*, Broad-leaved Pondweed (*P. natans*), Fennel Pondweed (*P. pectinatus*), Perfoliated Pondweed (*P. perfoliatus*) and Crowfoots (*Ranunculus* spp.). The water quality of the Barrow has improved since the vegetation survey was carried out (EPA, 1996).

Dry Heath at the site occurs in pockets along the steep valley sides of the rivers especially in the Barrow Valley and along the Barrow tributaries where they occur in the foothills of the Blackstairs Mountains. The dry heath vegetation along the slopes of the river bank consists of Bracken (*Pteridium aquilinum*) and Gorse (*Ulex europaeus*) species with patches of acidic grassland vegetation. Additional typical species include Heath Bedstraw (*Galium saxatile*), Foxglove (*Digitalis purpurea*), Common Sorrel (*Rumex acetosa*) and Bent Grass (*Agrostis stolonifera*). On the steep slopes above New Ross the Red Data Book species Greater Broomrape (*Orobanche rapum-genistae*) has been recorded. Where rocky outcrops are shown on the maps Bilberry (*Vaccinium myrtillus*) and Wood Rush (*Luzula sylvatica*) are present. At Ballyhack a small area of dry heath is interspersed with patches of lowland dry grassland. These support a number of Clover species including the legally protected Clustered Clover (*Trifolium glomeratum*) – a species known from only one other site in Ireland. This grassland community is especially well developed on the west side of the mud-capped walls by the road. On the east of the cliffs a group of rock-dwelling species occur, i.e. English Stonecrop (*Sedum anglicum*), Sheep's-bit (*Jasione montana*) and Wild Madder (*Rubia peregrina*). These rocks also support good lichen and moss assemblages with *Ramalina subfarinacea* and *Hedwigia ciliata*.

Dry Heath at the site generally grades into wet woodland or wet swamp vegetation lower down the slopes on the river bank. Close to the Blackstairs Mountains, in the foothills associated with the Aughnabrisky, Aughavaud and Mountain Rivers there are small patches of wet heath dominated by

Purple Moor-grass (*Molinia caerulea*) with Heather (*Calluna vulgaris*), Tormentil (*Potentilla erecta*), Carnation Sedge (*Carex panicea*) and Bell Heather (*Erica cinerea*).

Saltmeadows occur at the southern section of the site in old meadows where the embankment has been breached, along the tidal stretches of in-flowing rivers below Stokestown House, in a narrow band on the channel side of Common Reed (*Phragmites*) beds and in narrow fragmented strips along the open shoreline. In the larger areas of salt meadow, notably at Carrickcloney, Ballinlaw Ferry and Rochestown on the west bank; Fisherstown, Alderton and Great Island to Dunbrody on the east bank, the Atlantic and Mediterranean sub types are generally intermixed. At the upper edge of the salt meadow in the narrow ecotonal areas bordering the grasslands where there is significant percolation of salt water, the legally protected species Borrer's Saltmarsh-grass (*Puccinellia fasciculata*) and Meadow Barley (*Hordeum secalinum*) (Flora Protection Order, 1987) are found. The very rare Divided Sedge (*Carex divisa*) is also found. Sea Rush (*Juncus maritimus*) is also present. Other plants recorded and associated with salt meadows include Sea Aster (*Aster tripolium*), Sea Thrift (*Armeria maritima*), Sea Couch (*Elymus pycnanthus*), Spear-leaved Orache (*Atriplex prostrata*), Lesser Sea-spurrey (*Spergularia marina*), Sea Arrowgrass (*Triglochin maritima*) and Sea Plantain (*Plantago maritima*).

Salicornia and other annuals colonising mud and sand are found in the creeks of the saltmarshes and at the seaward edges of them. The habitat also occurs in small amounts on some stretches of the shore free of stones.

The estuary and the other Habitats Directive Annex I habitats within it form a large component of the site. Extensive areas of intertidal flats, comprised of substrates ranging from fine, silty mud to coarse sand with pebbles/stones are present. Good quality intertidal sand and mudflats have developed on a linear shelf on the western side of Waterford Harbour, extending for over 6 km from north to south between Passage East and Creadaun Head, and in places are over 1 km wide. The sediments are mostly firm sands, though grade into muddy sands towards the upper shore. They have a typical macro-invertebrate fauna, characterised by polychaetes and bivalves. Common species include *Arenicola marina*, *Nephtys hombergii*, *Scoloplos armiger*, *Lanice conchilega* and *Cerastoderma edule*.

The western shore of the harbour is generally stony and backed by low cliffs of glacial drift. At Woodstown there is a sandy beach, now much influenced by recreation pressure and erosion. Behind it a lagoonal marsh has been impounded which runs westwards from Gaultiere Lodge along the course of a slow stream. An extensive reedbed occurs here. At the edges is a tall fen dominated by sedges (*Carex* spp.), Meadowsweet, Willowherb (*Epilobium* spp.) and rushes (*Juncus* spp.). Wet woodland also occurs. This area supports populations of typical waterbirds including Mallard, Snipe, Sedge Warbler and Water Rail.

The dunes which fringe the strand at Duncannon are dominated by Marram grass (*Ammophila arenaria*) towards the sea. Other species present include Wild Sage (*Salvia verbenaca*), a rare Red Data Book species. The rocks around Duncannon ford have a rich flora of seaweeds typical of a moderately exposed shore and the cliffs themselves support a number of coastal species on ledges, including Thrift (*Armeria maritima*), Rock Samphire (*Crithmum maritimum*) and Buck's-horn Plantain (*Plantago coronopus*).

Other habitats which occur throughout the site include wet grassland, marsh, reed swamp, improved grassland, arable land, quarries, coniferous plantations, deciduous woodland, scrub and ponds.

Seventeen Red Data Book plant species have been recorded within the site, most in the recent past. These are Killarney Fern (*Trichomanes speciosum*), Divided Sedge (*Carex divisa*), Clustered Clover (*Trifolium glomeratum*), Basil Thyme (*Acinos arvensis*), Hemp nettle (*Galeopsis angustifolia*), Borrer's Saltmarsh Grass (*Puccinellia fasciculata*), Meadow Barley (*Hordeum secalinum*), Opposite-leaved Pondweed (*Groenlandia densa*), Autumn Crocus (*Colchicum autumnale*), Wild Sage (*Salvia verbenaca*), Nettle-leaved Bellflower (*Campanula trachelium*), Saw-wort (*Serratula tinctoria*), Bird Cherry (*Prunus padus*), Blue Fleabane (*Erigeron acer*), Fly Orchid (*Ophrys insectifera*), Broomrape (*Orobanche hederæ*) and Greater Broomrape (*Orobanche rapum-genistæ*). Of these the first nine are protected under the Flora Protection Order 1999. Divided Sedge (*Carex divisa*) was thought to be extinct but has been found in a few locations in the site since 1990. In addition plants which do not

have a very wide distribution in the country are found in the site including Thin-spiked Wood-sedge (*Carex strigosa*), Field Garlic (*Allium oleraceum*) and Summer Snowflake (*Leucojum aestivum*). Six rare lichens, indicators of ancient woodland, are found including *Lobaria laetevirens* and *L. pulmonaria*. The rare moss *Leucodon sciuroides* also occurs.

The site is very important for the presence of a number of EU Habitats Directive Annex II animal species including Freshwater Pearl Mussel (*Margaritifera margaritifera* and *M. m. durrovensis*), Freshwater Crayfish (*Austropotamobius pallipes*), Salmon (*Salmo salar*), Twaite Shad (*Alosa fallax fallax*), three Lamprey species - Sea (*Petromyzon marinus*), Brook (*Lampetra planeri*) and River (*Lampetra fluviatilis*), the marsh snail *Vertigo moulinsiana* and Otter (*Lutra lutra*). This is the only site in the world for the hard water form of the Pearl Mussel *M. m. durrovensis* and one of only a handful of spawning grounds in the country for Twaite Shad. The freshwater stretches of the River Nore main channel is a designated salmonid river. The Barrow/Nore is mainly a grilse fishery though spring salmon fishing is good in the vicinity of Thomastown and Inistioge on the Nore. The upper stretches of the Barrow and Nore, particularly the Owenass River, are very important for spawning.

The site supports many other important animal species. Those which are listed in the Irish Red Data Book include Daubenton's Bat (*Myotis daubentoni*), Badger (*Meles meles*), Irish Hare (*Lepus timidus hibernicus*) and Frog (*Rana temporaria*). The rare Red Data Book fish species Smelt (*Osmerus eperlanus*) occurs in estuarine stretches of the site. In addition to the Freshwater Pearl Mussel, the site also supports two other freshwater Mussel species, *Anodonta anatina* and *A. cygnea*.

The site is of ornithological importance for a number of E.U. Birds Directive Annex I species including Greenland White-fronted Goose, Whooper Swan, Bewick's Swan, Bartailed Godwit, Peregrine and Kingfisher. Nationally important numbers of Golden Plover and Bar-tailed Godwit are found during the winter. Wintering flocks of migratory birds are seen in Shanahoe Marsh and the Curragh and Goul Marsh, both in Co. Laois and also along the Barrow Estuary in Waterford Harbour. There is also an extensive autumnal roosting site in the reedbeds of the Barrow Estuary used by Swallows before they leave the country.

Landuse at the site consists mainly of agricultural activities – many intensive, principally grazing and silage production. Slurry is spread over much of this area. Arable crops are also grown. The spreading of slurry and fertiliser poses a threat to the water quality of the salmonid river and to the populations of Habitats Directive Annex II animal species within the site. Many of the woodlands along the rivers belong to old estates and support many non-native species. Little active woodland management occurs.

Fishing is a main tourist attraction along stretches of the main rivers and their tributaries and there are a number of Angler Associations, some with a number of beats. Fishing stands and styles have been erected in places. Both commercial and leisure fishing takes place on the rivers. There is net fishing in the estuary and a mussel bed also. Other recreational activities such as boating, golfing and walking, particularly along the Barrow towpath are also popular. There is a golf course on the banks of the Nore at Mount Juliet and GAA pitches on the banks at Inistioge and Thomastown. There are active and disused sand and gravel pits throughout the site. Several industrial developments, which discharge into the river, border the site. New Ross is an important shipping port. Shipping to and from Waterford and Belview ports also passes through the estuary.

The main threats to the site and current damaging activities include high inputs of nutrients into the river system from agricultural run-off and several sewage plants, overgrazing within the woodland areas, and invasion by non-native species, for example Cherry Laurel and Rhododendron (*Rhododendron ponticum*). The water quality of the site remains vulnerable. Good quality water is necessary to maintain the populations of the Annex II animal species listed above. Good quality is dependent on controlling fertilisation of the grasslands, particularly along the Nore. It also requires that sewage be properly treated before discharge. Drainage activities in the catchment can lead to flash floods which can damage the many Annex II species present. Capital and maintenance dredging within the lower reaches of the system pose a threat to migrating fish species such as lamprey and shad. Land reclamation also poses a threat to the salt meadows and the populations of legally protected species therein.

Overall, the site is of considerable conservation significance for the occurrence of good examples of habitats and of populations of plant and animal species that are listed on Annexes I and II of the E.U. Habitats Directive respectively. Furthermore it is of high conservation value for the populations of bird species that use it. The occurrence of several Red Data Book plant species including three rare plants in the salt meadows and the population of the hard water form of the Pearl Mussel which is limited to a 10 km stretch of the Nore, add further interest to this site.

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APPENDIX 2 RECEIVING WATER IMPACT ASSESSMENT (RWIA) for the Stradbally WwTP (ECOFACT, 2009)

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Appendix 3 Estimation of Flow Duration Curve for Receiving Water

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Laois County Council

RECEIVING WATER IMPACT ASSESSMENT

STRADBALLY



Version: 22nd September 2009

Prepared on behalf of:

WATER SERVICES
LAOIS COUNTY COUNCIL
County Hall
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Foreword – response to EPA consultation letter (17th June-Ref D0156-01)

Following the receipt of comments from the EPA this report was updated to include additional information. The comments from the EPA are listed below with a response directing the reader to the section of the report where this information is contained.

- *“Where it is considered that any of the substances listed in Annex X of the Water Framework Directive (2000/60/EC) or any of the relevant pollutants listed in Annex VIII of the Water Framework Directive (2000/60/EC) are being discharged from the waste water works or are seen to be present in the receiving water environment downstream of a discharge from the works (as a result of any monitoring programme) the applicant shall screen the discharge for the relevant substance” “Provide information on any further zinc sampling carried out on the discharges from the plant. What is the possible source of the zinc found in the WWTP discharges?”*

All available information on these substances in relation to the Stradbally River and Stradbally plant is provided in ‘Section 3.2.3 Dangerous substances’ and ‘Appendix 3 Laois Co. Co. Monitoring Data’ of this report.

- *“Provide the 50%ile, 95%ile and dry weather flow for the Gloreen Stream. Carry out assimilative capacity calculations for the discharge from the primary discharge point. 95%ile flow shall be used to calculate the capacity of the receiving waterbody for BOD, Suspended Solids, total nitrogen, nitrates, COD, and total phosphorus. In addition, a calculation shall be presented for the capacity of the surface waterbody, based on the 50%ile flow, for ortho-phosphate. Provide all figures used in your calculations”*

Flows in the receiving water are given in Section ‘3.1 Catchment Description’. Assimilative capacity calculations are provided in Section 3.2.4 ‘Assimilation capacity’.

- *“Conduct an appropriate assessment based on Circular Letter L8/08 (Water Services Investment and Rural Water Programmes - Protection of Natural Heritage and National Monuments) issued by the Department of the Environment, Heritage and Local Government in relation to a determination as to the likelihood of discharges from the waste water works having a significant effect on a European site. If the discharges are deemed likely to have a significant effect, an appropriate assessment of the implications for the designated site in view of the sites conservation objectives must be carried out in accordance with ‘waste water discharge licensing appropriate assessment guidance notes’. Any assessment, should it be deemed necessary, shall be submitted as part of the reasoned response to this notice”*

Areas designated for nature conservation which could be affected by the operation of the existing (and proposed) plant are described in Section 3.4. An Appropriate Assessment (Stage 1, Screening Assessment) has been completed in Section 4.3 ‘Impact on Areas designated for Nature Conservation and also in Appendix 6 ‘Screening Assessment’.

- *“Provide details of any drinking water abstraction points downstream of your wastewater treatment plant (in your response pay attention to any risk assessments carried out for the abstraction points and outline if the discharges from your wastewater treatment plant have an impact on the quality of water at the downstream abstraction points). If the discharges from your wastewater treatment plant are impacting on downstream abstraction points outline what measures will be taken to minimise this impact”*

All available information on water abstractions is provided in Section 3.7 water Abstractions of this report.

- *“Provide a description of the existing environment in terms of water quality with particular reference to environmental quality standard regulations and other legislative standards. Your response should include: A copy of the Draft River Basin Management Plan in place for the receiving water body. Provide an evaluation of the discharge in relation to the objectives of the water quality management or catchment plan. Indicate the levels of dilution available within the receiving water body, and the estimated volumetric contribution by the site emissions to dry weather flow of the receiving waters”*

The existing environment in terms of water quality and environmental standards is described in Section 3.2 water Quality. A copy of the Draft River Basin Management Plan for the South Eastern River Basin District (December 2008) can be downloaded from http://www.wfdireland.ie/docs/1_DraftRiverBasinManagementPlans/South%20Eastern%20Tier%202.pdf. An evaluation of the discharge from the existing plant in relation to the objectives of the water quality management plan is included in Section 4.2 Impact on Water Quality. All available information on dilution in the receiving water is provided in ‘Section 4.9 Likely impact of the new plant on receiving waters’.

Other issues raised in the response from the EPA are addressed separately by Laois County Council.

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EXECUTIVE SUMMARY

This is a receiving water impact assessment report for the Stradbally Waste Water Treatment Plant (WwTP). It has been prepared under Section F of the Environmental Protection Agencies Waste Water Discharge Licensing Application Guidance Note. This report was prepared during the period December 2008 to February 2009 on behalf of Laois County Council by ECOFACT Environmental Consultants Ltd.

The current study was based on information compiled during a desk study and a field assessment. Information compiled during the desk study included water quality monitoring information supplied by the Environmental Protection Agency and Laois County Council, along with information on areas designated for nature conservation obtained from the National Parks and Wildlife Service (NPWS). The field study consisted of a walkover of the existing WwTP and adjoining river sections along with ecological and biological water quality appraisals at upstream (reference) and downstream (receptor) sites.

Background water quality in the Stradbally River was found to be compromised upstream of the Stradbally WwTP, based on EPA biological and chemical water quality monitoring data. This was also confirmed by Laois County Council monitoring data from the period October 2006 to November 2008. Chemical water quality data from Laois County Council and biological water quality assessments carried out by ECOFACT for the current study suggested that there is a further deterioration in water quality directly downstream of the existing WwTP discharge. In particular, mean ortho-phosphate concentrations were 20% higher downstream of the discharge. A slight decline was also recorded in the biotic indices obtained. It is therefore concluded that the existing plant is having a slight negative impact on chemical and biological water quality downstream of the plant.

This report concludes that the background water quality in the Stradbally River is affected by elevated nutrient levels upstream of the existing WwTP discharge. This situation is being compounded to a slight degree by the discharge from the plant, as there is limited assimilation capacity in the river. It is considered of primary importance that the background pollution in the Stradbally River is controlled in order to achieve the required 'good ecological status', as per the Water Framework Directive 2000. Recommendations in relation to the proposed design standards for the new WwTP are made.

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1. INTRODUCTION

1.1 Background

Stradbally is a medium sized town located on the N80 National Secondary Route approximately 12km south of Portlaoise. The town of Stradbally is classified as a secondary settlement under the County Development Plan 2006-2012, with a population of 1,565 in 2006. The Stradbally River flows through the town from southwest to northeast and is designated as within the River Barrow and River Nore Special Area of Conservation (SAC) directly downstream of Stradbally town. The Stradbally River receives the discharge from the Stradbally WwTP, which is located less than 1km east of the town in the townland of Brockley Park. This report provides a Receiving Water Impact Assessment for the Waste Water Treatment Plant (WwTP) serving this town.

This report has been prepared under the Waste Water Discharge (Authorisation) Regulations, 2007, using Section F of the Environmental Protection Agencies Waste Water Discharge Licensing Application Guidance Note (EPA, 2008). The purpose of the report is to assess whether the existing waste water discharge(s) from the plant are having a significant adverse impact on the receiving waters, or any Natura 2000 Site.

This report was prepared during January 2009 by Ecofact Environmental Consultants Ltd. on behalf of the Water Services Section of Laois County Council.

1.2 Legislation

The current report was prepared with consideration to the following water quality legislation:-

- Waste Water Discharge (Authorisation) Regulations 2007 (SI No. 684 of 2007);
- Urban Wastewater Treatment Regulations, 2001 (S.I. No. 254 of 2001);
- European Communities (Water Policy) Regulations, 2003 (SI No. 722) implementing the Water Framework Directive (WFD) 2000/60/EC.
- Water Policy Regulations (S.I. No. 722 of 2003) and Water Policy Regulations (Amendment) (S.I. No. 413 of 2005) implementing the EU Water Framework Directive (2000/60/EC);
- Local Government (Water Pollution) Acts, 1977 (Water Quality Standards for Phosphorus) Regulations, 1998. (S.I. No. 258 of 1998), and Local Government (Water Pollution) (Amendment) Act, 1990. (Act No. 21 of 1990);
- European Communities (Quality of Salmonid Waters) Regulations, 1988 (S.I. No. 293 of 1988) implementing Freshwater Fish Directive (78/659/EEC);
- Quality of Bathing Waters Regulations, 1992, and Quality of Bathing Waters Regulations (Amendment), 1996. (implementing Bathing Water Directive, 76/160/EEC);
- European Communities Quality of Surface Water Intended for the Abstraction of Drinking Water Regulations, 1989. (Implementing the Surface Water Directive, 75/440/EEC);
- Water Quality (Dangerous Substances) Regulations, 2001.(Implementing the Dangerous Substances Directive, 76/464/EEC);
- Protection of Groundwater Regulations, 1999. (S.I. No. 41 of 1999);
- Water Quality (Dangerous Substances) Regulations, 2001 (S.I. No. 12 of 2001).

In addition, cognisance was also made to the following legislation relating to nature conservation and fisheries:-

- The European Communities (Natural Habitats) (Amendment) Regulations 2005 (S.I. No. 378/2005), The European Communities (Natural Habitats) (Amendment) Regulations 1998 (S.I. No. 233/1998), and the European Community (Natural Habitats) Regulations 1997 (S.I. No. 94/1997) (implementing Council Directives

- 92/43/EEC and 97/62/EC on the conservation of natural habitats and of wild fauna and flora);
- Wildlife Act, 1976 (S.I. No. 39 of 1976) and the Wildlife (Amendment) Act, 2000 (S.I. No. 71 of 2001);
- Fisheries (Amendment) Act, 1997, (S.I. No. 23 of 1997) and Fisheries (Consolidation) Act, 1959 (S.I. No. 14 of 1959);
- The EU Birds Directive (79/409/EEC).

1.3 Methodology

This report has been prepared under the Waste Water Discharge (Authorisation) Regulations, 2007, using Section F of the Environmental Protection Agencies Waste Water Discharge Licensing Application Guidance Note (EPA, 2008). The current study involved a desk study and a field assessment. The literature review and field sampling programme was designed primarily as a descriptive study to provide information on the existing environmental status of the surface water area under investigation. An integrated assessment approach was employed. This approach merges biological (effects) and physical/chemical (causes) using a combination of field and desk study evaluations.

1.3.1 Desktop Review

A desktop review was carried out to identify features of surface water importance within the study area and surrounding region. A review of areas designated (or being considered for designation) for nature conservation was carried out by consulting the National Parks and Wildlife Service (NPWS). These included Special Areas of Conservation, Special Protection Areas for birds (both internationally important) and proposed Natural Heritage Areas (of national importance). The locations of any designated salmonid waters, recreational and bathing waters and nutrient sensitive areas within the study area were identified through consultation with the Environmental Protection Agency (EPA). Likewise the presence of any important recreational or commercial fisheries was identified through consultation with the Southern Regional Fisheries Board (SREB).

Technical files and previous reports prepared for the WwTP were supplied by Laois County Council for review in the current assessment. These reports included the catchment report for the town, prepared as part of the National Urban Waste Water Study. In addition, monitoring information on the discharges from the WwTP and the receiving waters were obtained from Laois County Council and used in this assessment. A review of the published literature, including the Laois County Development Plan 2006-2012, was undertaken in order to collate data on the receiving environment, including aquatic species and habitats of conservation concern in the study area. A range of additional sources of information including scientific reports produced by, and information on the websites of the EPA, NPWS, Laois County Council and other agencies were also reviewed. A full bibliography of information sources reviewed is given in the references section. Ordinance Survey Maps and OS aerial photographs were also reviewed during the desk assessment.

1.3.2 Field Survey Work

The field survey comprised a systematic walk over of the WwTP site, outfalls, and receiving waters. A kick sampling assessment of benthic macro-invertebrates was undertaken a point located upstream (reference) and downstream (receptor) of the primary discharge to supplement information collected during the desk study. The exact location and description of these sites is provided in Table 1.

Table 1 Location of the 2008 survey sites.

	Reference Site (u/s WwTP)	Receptor Site (d/s WwTP)
Location	Brockley Park, approximately 10m upstream of the WwTP outfall	Brockley Park, approx. 200m downstream of the Stradbally WwTP discharge
NOS Grid	S57892 96872	S57946 96925
Reference		

The kick-sampling assessment followed the EPA standard methodology (Toner *et al.*, 2005). This procedure involved the use of a 'D' shaped hand net (mesh size 0.5 mm; 350 mm diameter) which was submerged on the river bed with its mouth directed upstream. The substrate upstream of the net was then kicked for one minute in order to dislodge invertebrates, which were subsequently caught in the net. This procedure was undertaken at three points across the watercourse, where depth/access allowed. Stone washings and vegetation sweeps were also undertaken to ensure a representative sample of the fauna present at each site was collected. All samples of invertebrates were combined for each site and live sorted on the river bank for 20 minutes. Specimens retained were preserved in ethanol for later identification. Identification was undertaken in the laboratory using high-power and low-power binocular microscopes.

Specimens were identified using the standard keys which are listed in the bibliography section. The abundances of organisms present was assessed as follows: Present (1 or 2 individuals), Scarce/Few (<1%), Small Numbers (<5%), Fair Numbers (5-10%), Common (10-20%), Numerous (25-50%), Dominant (50-75%) and Excessive (>75%)

The Quality Rating (Q) System (Toner *et al.*, 2005) was used to obtain a water quality rating for each site. The use of this particular biotic index allows for comparison with data published by the EPA. This method categorizes invertebrates into one of five groups, depending on their sensitivity to pollution. The higher the biological diversity and the greater the abundance of invertebrate species sensitive to organic pollution, the higher the water quality is assumed to be, and the higher the 'Q value' assigned to that sampling station. The revised BMWP scheme (Walley and Hawkes, 1997) is another biotic index of water quality that was used in the current appraisal. In this system, each family recorded in the sample is assigned a habitat specific score. This score depends on the pollution sensitivity of the invertebrate family together with the characteristics of the site where the invertebrates were found. A higher BMWP score is considered to reflect a better water quality and a score over 100 is indicative of very good water quality.

1.3.3 Assessment Methodology

Impact significance is a combined function of the value of the affected feature (its water quality, fisheries or aquatic ecology importance), the type of impact and the magnitude of the impact. It is therefore necessary to identify the value of surface water features within the study area in order to evaluate the significance and magnitude of possible impacts. To achieve this, the results of the desk and field assessment were evaluated to determine the significance of identified features located in the study area on an importance scale ranging from international-national-county-local. The criteria used are shown in Table 2.

The means of assessing impact significance was based on the Institute of Ecology and Environmental Management's "Guidelines for Ecological Impact Assessment in the United Kingdom" (IEEM, 2006) and the EPA's "Waste Water Discharge Licensing Application Guidance Note" (EPA, 2008). The significance of impacts was assessed on a combined basis of the value of the feature being affected and the magnitude of the impact. According to the EPA (2008), a discharge from a WwTP would be considered to have a significant adverse effect on the receiving waters if it were to:-

- Cause a deterioration in the chemical status or ecological status (or ecological potential as the case may be) in the receiving body of surface water;
- Cause a deterioration in the chemical status in the receiving body of groundwater;
- Cause the input into groundwater of hazardous substances, except where it is established that the input concerned is in a quantity and concentration so small as to obviate any present or future danger of deterioration in the quality of the receiving groundwater;
- Cause deterioration or result in significant and sustained upward trends in the concentrations of pollutants in groundwater in the case of pollutants that are not hazardous,
- Permanently exclude or compromise the achievement of the objectives established for protected species and natural habitats in the case of European sites where the

maintenance or improvement of the status of water is an important factor in their protection or which is inconsistent with the achievement of environmental quality standards established under national Regulations in relation to designated bathing waters, designated shellfish waters, areas designated for the protection of freshwater fish and areas designated

1.3.4 Appropriate Assessment

A Stage One Screening / Test of Significance Assessment was carried out to identify the effects of the discharge(s) upon the nearest Natura 2000 site(s) and consider whether these impacts are significant. The Department of the Environment, Heritage and Local Government has not published guidelines for undertaking Appropriate Assessment in Ireland. The current screening assessment was carried out using the following guidance:

- Managing Natura 2000 Sites: the provisions of Article 6 of the 'Habitats' Directive 92/43/EEC, Office for Official Publications of the European Communities, Luxembourg (EC 2000);
- Assessment of Plans and Projects Significantly Affecting Natura 2000 Sites: Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC, Office for Official Publications of the European Communities, Luxembourg (EC 2001);
- Guidance for Competent Authorities when dealing with proposals affecting SAC freshwater sites, Scottish Natural Heritage, Perth (SNH 2006); and
- Guidance document on Article 6(4) of the 'Habitats Directive' 92/43/EEC – Clarification of the concepts of: alternative solutions, imperative reasons of overriding public interest, compensatory measures, overall coherence, opinion of the commission. Office for Official Publications of the European Communities, Luxembourg (EC, 2007).

Table 2 Criteria used in assessing the importance of surface water features (taken from NRA 2004).

Rating	Qualifying Criteria
A	<p>Internationally Important</p> <p>Sites designated (or qualifying for designation) as SAC* or SPA* under the EU Habitats or Birds Directives.</p> <p>Undesignated sites containing good examples of Annex I priority habitats under the EU Habitats Directive.</p> <p>Major salmon river fisheries</p> <p>Major salmonid lake fisheries.</p>
B	<p>Nationally Important</p> <p>Sites or waters designated or proposed as an NHA* or statutory Nature Reserves.</p> <p>Undesignated sites containing good examples of Annex I habitats (under EU Habitats Directive).</p> <p>Undesignated sites containing significant numbers of resident or regularly occurring populations of Annex II species under the EU habitats Directive or Annex I species under the EU Birds Directive or species protected under the Wildlife (Amendment) Act 2000.</p> <p>Major trout river fisheries.</p> <p>Water bodies with major amenity value.</p> <p>Commercially important coarse fisheries.</p>
C	<p>High Value, Locally Important</p> <p>Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or significant populations of locally rare species.</p> <p>Small water bodies with known salmonid populations or with good potential salmonid habitat.</p> <p>Sites containing any resident or regularly occurring populations of Annex II species under the EU habitats Directive or Annex I species under the EU Birds Directive.</p> <p>Large water bodies with some coarse fisheries.</p>
D	<p>Moderate Value, Locally Important</p> <p>Sites containing some semi-natural habitat or locally important for wildlife.</p> <p>Small water bodies with some coarse fisheries value or some potential salmonid habitat.</p> <p>Any water body with unpolluted water (Q-value 4-5).</p>
E	<p>Low Value, Locally Important</p> <p>Artificial or highly modified habitats with low species diversity and low wildlife value.</p> <p>Water bodies with no current fisheries value and no significant potential fisheries value.</p>

1.4 Consultation

Preparation of this report included consultation with the following agencies and state bodies:-

- Laois County Council (Laois Co. Co.);
- National Parks and Wildlife Service (NPWS);
- Environmental Protection Agency (EPA);
- Southern Regional Fisheries Board (SRFB);
- South Eastern River Basin District Office (SERBDO);
- Department of Communications, Marine and Natural Resources (DCMNR);
- Botanical Society of the British Isles (BSBI);
- Geological Society of Ireland (GSI).

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2. SCHEME DESCRIPTION

2.1 Introduction

Stradbally is a medium sized town located on the N80 National Secondary Route approximately 12km south of Portlaoise. The town of Stradbally is classified as a secondary settlement under the County Development Plan 2006-2012, with a population of 1,565 in 2006. Stradbally has been designated as a service Town in the midlands regional planning guidelines and provides an important retail, residential, service and amenity function for the local hinterland. Stradbally has well established active community groups within the area. The council recognise their role both in providing and facilitating the expansion of community based facilities and will co-operate with all organisations in the development of community facilities. Stradbally has its own wastewater treatment plant. Approval was given in 2007 to upgrade the WwTP to cater for 3,000 Population Equivalent/P.E. (Source: Draft Stradbally Town Plan).

2.2 Sewerage Scheme Design

At present there is approximately 5.85km of sewerage pipeline servicing Stradbally. The majority of the network consists of combined sewers although there is some surface separation provided. The existing treatment plant provides secondary treatment to the influent wastewater by means of an aeration tank. The existing plant is not overloaded but a new treatment plant is required to cater for future population projections.

Stage 1 of the Stradbally WwTP will include the following; preliminary treatment including screening and grit removal, biological treatment and Phosphorous removal, liquid sludge thickening and storage and storm treatment. The design of the Stradbally WwTP is such as to facilitate operation, inspection and maintenance of all processes. Equipment will be in accordance with all applicable approvals, standards and regulations. All mechanical and electrical equipment to be used the plant has a proven reliability record in similar works. The design life of the permanent works will not less than 40 years in the case of all buildings and concrete structures. All non-concrete tanks, building elements and finishes will have a minimum of 10 years residual design life at the end of the operation and maintenance period. All other plant will have a residual design life of a minimum of 5 years (O' Dwyer, 2007). The WwTP will have a control system to provide automatic control of the plant and outlying pumping stations. This control system will be capable of automatically controlling all critical plant elements.

The design of the plant will allow for fluctuations in the average daily BOD, suspended solids, phosphorus and nitrogen loads of up to 125% of the specified influent daily loads on a continuous basis. The design of the plant will also allow for peak flows to treatment of 3 times the dry weather flow. The treatment plant and process design allows for peak flows for an extended period of time with no derogation of effluent quality. The wastewater treatment plants shall be capable of achieving the final effluent discharge limit standards during any combination of load conditions up to the design loads and peaks specified below. Table 3 presents the design influent loads for the future plant. The plant peak design flow will be not less than 3 DWF and will be fully treated through the plant. Flows in excess of the plant peak design flow will overflow to the stormwater tank. The stormwater will flow by gravity to the stormwater tank. The stormwater tank will have a minimum retention time of 2 hours for flows between the plant peak design flow and the Peak Flow Factor x DWF. Runoff from all process areas including sludge handling areas of the treatment plant will be collected and returned to the treatment process downstream of the influent sampling point.

At the existing plant, primary treatment is via a coarse screen. This removes large objects from untreated waste water prior to the treatment processes. Stage 1 of the future plant will have the following primary treatment components. Mechanical screens will remove all solids greater than 6mm in any direction. Screenings will be automatically removed from the flow and washed and dewatered. The screenings, washing and dewatering unit will achieve a minimum dry solids content of 50% and a minimum removal efficiency of organic solids of

90%. The screenings will be bagged and discharged to an enclosed container. Automatic grit removal will also be provided. The grit removal system will be designed to remove 95% by weight of the incoming grit, with grit being defined as all inorganic particles greater than 0.2mm diameter. The grit removed will be automatically washed to remove a minimum of 90% of the organic material and discharged to an enclosed container.

Table 3 Stradbally WwTP design influent loads for future plant (From O' Dwyer, 2007).

Parameter	Existing	Stage 1	Stage 2
Design population equivalent	2000	4000	8000
Dry weather flow (L/sec)		10.4	20.8
Peak flow to treatment (L/sec)		31.3	62.5
Minimum storm capacity (m ³)			
Outfall capacity (L/sec)		166.7	166.7
Average BOD (kg/day)		240	480
Suspended Solids (kg/day)		300	600
Total Phosphorous (kg/day)		9	18

Table 4 Proposed treatment plant effluent discharge standards (Stage 1 concentrations from O' Dwyer, 2007).

Parameter	BOD (mg/l)	Total Suspended Solids (mg/l)	COD (mg/l)	Total Phosphorus mgP/l
Stage 1 ¹	25	35	125	2
Stage 1 ²	50	70	250	4

¹Final effluent discharge limit standard

²Upper final effluent discharge limit standard

The existing Stradbally WwTP does not incorporate tertiary treatment but in the proposed Stage 1 plant, microscreening would be used to provide additional treatment. Phosphorus reduction shall be provided if necessary in order to achieve the final effluent standards specified (0.37mg/l) and there will be a facility for Phosphorus removal. Biological removal will be the main process, a chemical dosing facility shall also be provided as a backup to assist the biological removal process.

In the future (Stage 1), sludge holding tanks will be constructed at the Stradbally WwTP to meet the odour limits at the boundary of the site. It is also proposed that the liquid sludge from the Stradbally plant will be transported to the Abbeyleix dewatering plant for dewatering prior to delivery to the Portlaoise Sludge Hub. All sludge cake would be transported to the Sludge Hub Centre at Portlaoise. All sludge would be screened to 6mm in all directions and dewatered to cake with a minimum dry solids content of 20%.

2.3 Discharge Standards

The requirements of Urban Wastewater Treatment Directive 91/271/EEC for treatment plants serving more than 2000 population equivalent are:

Biochemical Oxygen Demand (BOD ₅)	25 mg/l O ₂
Chemical Oxygen Demand	125 mg/l O ₂
Suspended Solids (p.e. >10 000)	35 mg/l
Suspended Solids (p.e. 2000 - 10 000)	60 mg/l

The following additional requirements apply for discharges to areas that are deemed to be sensitive:

Total Phosphorus (10 000 – 100 000 p.e.)	2 mg/l
Total Phosphorus (over 100 000 p.e.)	1 mg/l
Total Nitrogen (10 000 – 100 000 p.e.)	15 mg/l
Total Nitrogen (over 100 000 p.e.)	10 mg/l

Currently, the plant can cater for a P.E. of 700. Stage 1 has a capacity for 3,000 P.E. and be constructed to facilitate upgrading to a 6,000 P.E. plant.

2.4 Flows

Flow information was not available for the existing plant at the time of preparing the current report. The proposed plant (stage 1) will cater for 4,000 P.E. and have a dry weather flow of 10.4l/s. This DWF corresponds to an emission of 899m³/day. The maximum flow for which the upgraded plant will cater is 3DWF (31.2l/s) or 2,696m³/day. Flows in excess of the plant peak design will flow to full treatment shall overflow to the stormwater tank. Flows of up to 8 DWF shall gravitate to the wastewater treatment plant. The influent sewer will be designed to handle 8 DWF at the Stage 2 P.E.

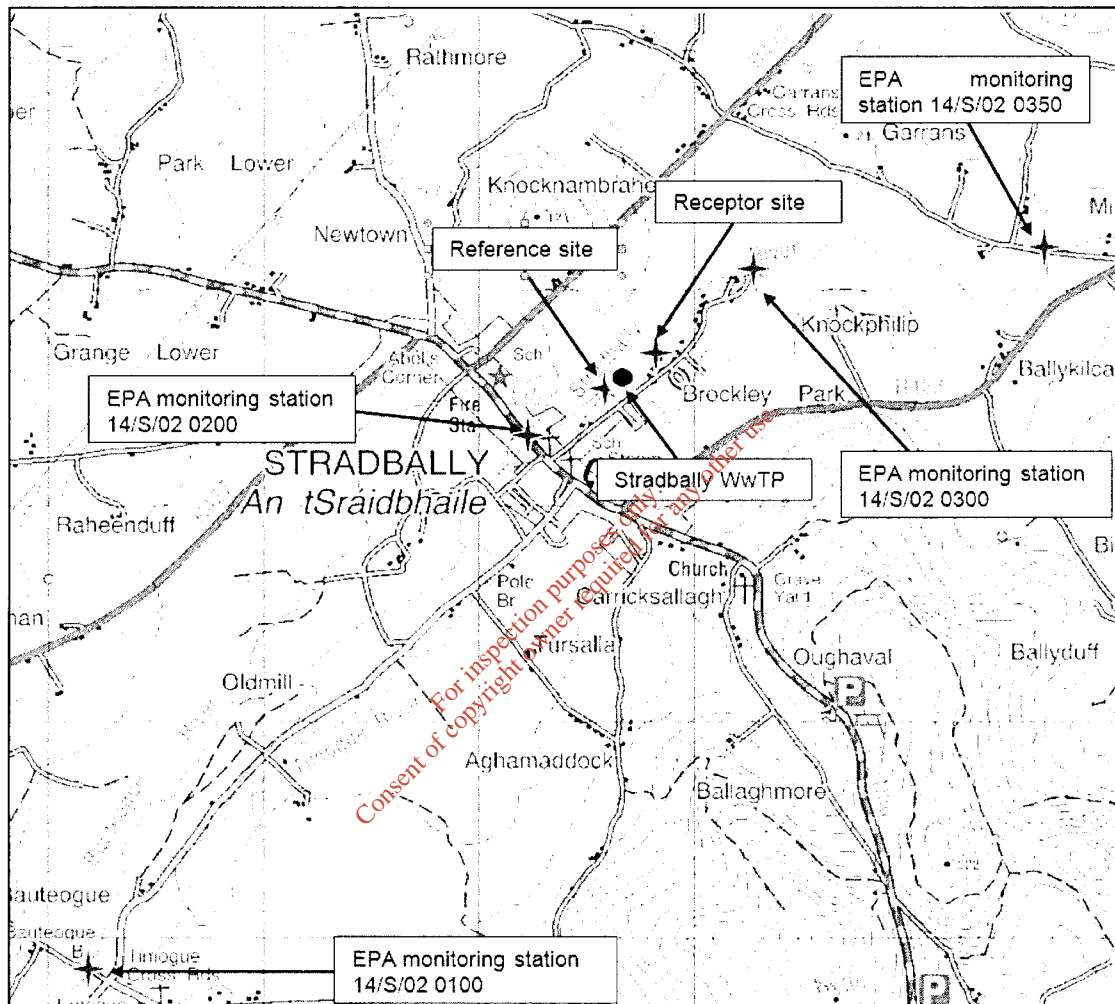


Figure 1 Location of the Stradbally WwTP, WwTP outfall, biological monitoring sites in the current assessment and EPA monitoring sites. (Copyright Ordnance Survey of Ireland. Laois County Council OS License used).

2.5 Monitoring

Monitoring of the water quality of the outfall from the Stradbally WwTP is undertaken by Laois County Council on an approximate monthly basis. Water quality is also monitored in the Stradbally River upstream and downstream of the primary discharge. The parameters measured in the water samples are; Ammonia, Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Conductivity, Nitrates, Ortho-phosphate, and pH and Suspended Solids. In the future (Stage 1), the flows to the treatment works will be measured, recorded and monitored. This monitored flow will exclude all returned, recycled or runoff flows which will be monitored separately.

3. RECEIVING ENVIRONMENT

3.1 Catchment Description

The Stradbally River (EPA code 14/S/02) is a tributary of the River Barrow (EPA code 14/B/01). The Stradbally River is under the jurisdiction of the Southern Regional Fisheries Board (SRFB website). It is not until downstream of Stradbally that the watercourse is called the Stradbally River, after the joining of the Timogue and Bauteogue Rivers. The Bauteogue River rises approximately 3km south of Timahoe at Fossy Hill and flows through the town of Timahoe, approximately 4km from its source as a 3rd order stream (in this reach it is called the Timahoe River). Approximately 2km downstream of Timahoe, it is joined by a tributary which rises east of Cullenagh Mountain. From Timahoe, it continues in a north-easterly direction for approximately 7km to meet the Timogue River.

The Crooked River (EPA code 14/C/02) is a water course of approximately 15km long and is known as the Timogue River in its lower reaches. This river rises in the townland of Fernyhill approximately 8 km south of Stradbally. This river has few tributaries and with the confluence of the Crooked River and a tributary from Fossy Mountain it becomes a 3rd order river. From this point, at Timogue, the river flows for approximately 4km to meet the Bauteogue River. After the confluence of the Timahoe/Bauteogue and the Crooked/Timogue Rivers less than 1km upstream (SE) of Stradbally, it is a 4th order watercourse called the Stradbally River. Much of the lower reaches of this part of the river system are straight modified channels. In 2003, dredging of the Timogue River at Timogue Bridge and above resulted in silt deposits downstream resulting in an unsatisfactory condition (Clabby *et al.*, 2003).

After flowing through the town of Stradbally, the river flows sinuously in a west-northwesterly direction for approximately 10km before meeting the River Barrow, 1.5km southeast of Vicarstown. No significant tributaries contribute to the river in this reach and the Grand Canal crosses the river at Derrybrock (via the Camac Aquaduct). The OPW monitor a Hydrometric station at Derrybrock (Station No. 14007), approximately 2km upstream of the River Barrow confluence. The area of the Stradbally River catchment at this location is 115km² (MacCarthaigh, 1997).

The underlying bedrock is mainly viséan limestone and calcareous shale with nemurian shale, sandstone, siltstone and coal at the periphery of the basin (GSI website). The catchment is in the broad physiographic division of flat to undulating lowland mainly on dry mineral soils with the principal soil being grey-brown podzolics derived from a parent material of limestone gravelly till (MIDA atlas).

The topography of the lower reaches of the Stradbally River is flat and low-lying. The subsoils are dominated by gravels, which have high rates of infiltration. This is supported by the free draining nature of the land. Therefore recharge is generated from rainfall that falls directly on the groundwater body. A representative value for the proportion of runoff generated from effective rainfall is estimated to be in the order to 20% (Daly, 1983). The dominant types of discharge mechanisms in this groundwater body are likely to be baseflow to streams and seepages at the extremities of the sand and gravel deposit. Springs are likely to occur at a point where the ground slope becomes very gentle or where the subsoils change from gravels to peat or boulder clay downstream. The groundwater body is considered to be a locally important gravel aquifer. There are no overlying deposits and therefore a high proportion of effective rainfall will infiltrate through the permeable deposits to the water table. This also means that the vulnerability of the groundwater resource is high (Deakin *et al.*, 2002).

For the period 1980-2001, the derived mean annual flow at Derrybrock Hydrometric station (Station No. 14007) was 1.5693m³/s with annual average rainfall of 910mm and estimated annual losses of 448mm (OPW Hydro-data, website). The derived duration percentiles for the Stradbally River at Derrybrock between 1980 and 2001 are given in Table 5 below. The 95thile and mean flow (50thile) correspond with flows provided by Laois Co. Co. A dry weather flow would be expected to correspond to a 99thile flow which is given as 0.11m³/s by the OPW.

Table 5 Duration percentile data for flows equaled or exceeded for the given percentage of time derived for the period 1980 to 2001 at Derrybrock. Source: OPW Hydro-data, website.

% of time	1%	5%	10%	50%	80%	90%	95%	99%
Flow (m ³ /s)	8.19	4.50	3.43	1.07	0.43	0.26	0.20	0.11

3.2 Water quality

3.2.1 Existing information

3.2.1.1 EPA biological water quality data

The biological water quality of the Stradbally River (EPA code 14/S/02) is monitored by the EPA upstream and downstream of Stradbally WwTP, as well as in the town of Stradbally. Upstream of Stradbally there is a monitoring station at the bridge near Bauteogue (3km upstream). In the EPA assessment for the Stradbally River (Clabby *et al.*, 2006), it was stated that the upper reaches of the river continued to be 'Satisfactory', but that low water levels were likely to have exacerbated pollution effects in the Stradbally River in 2003. This was particularly evident at Bauteogue (Station 0100) upstream of Stradbally and again at Ballykilcavan (Station 0350) below the town; both locations were assessed as Q3, 'Moderately polluted'; a deterioration in comparison to their previous status. Stations at Stradbally Bridge and Dowlings Park have not been assessed since 1993.

In 2003, the Crooked River upstream of its confluence with the Stradbally River was very heavily silted and in a distinctly unsatisfactory condition at Timogue Bridge, approximately 3km upstream of the Bauteogue confluence. The EPA cited dredging as the cause of this pollution (Clabby *et al.*, 2006). Pole Bridge, approximately 3km upstream of the Bauteogue confluence was last sampled in 1993 when it was rated as Moderately polluted (Q3-4).

Additional biological water quality data was recorded by the EPA in 2006 (Neill, 2008). The Ballykilcavan monitoring station (0350) ca. 3km downstream of Stradbally was rated as Q3-4. This indicates an improvement from 2003. Further downstream at Derrybrock Bridge (Station 0400), near the Grand Canal Camac Aqueduct, the Stradbally River has been assigned a Q3-4 rating from EPA monitoring data in 2006 (Neill, 2008).

The River Barrow (EPA code 14/B/01) was also assessed by the EPA in 2003. Dunrally Bridge (station 1400) and Bert Bridge (station 1500) are approximately 3km upstream and 5km downstream of the Stradbally River confluence respectively. Both stations have been consistently rated as 'Unpolluted' (Q4) since 1980 with the exception of the downstream location which was 'Moderately polluted' (Q3-4) in 1997 and 2000. However, from EPA monitoring data in 2006 (Neill, 2007) the Bert Bridge station, downstream of the Stradbally River confluence dropped to Q3-4.

Table 6 presents a summary of the EPA water quality results for both the River Barrow and the Stradbally River. Table 7 presents EPA water quality data for the Stradbally River at stations upstream and downstream of the existing WwTP site.

3.2.1.2 EPA chemical water quality data

Water quality at Stradbally Bridge (Station 0200), upstream of the WwTP discharge and at Dowlings Bridge, Brockley Park (Station 0300), downstream of the discharge was monitored by the EPA during 2006. Monitoring was undertaken on four occasions at both stations on the following dates: 24.01.2006, 16.05.2006, 17.07.2006 and the 14.11.2006.

The chemical water quality parameters at the Stradbally Bridge upstream station were broadly found to be within prescribed limits with the following exceptions: Nitrates at 5.7mg/l on the 24.01.06; Colour at 60 Hazen and Orthophosphate at 0.21mg/l on the 16.05.06; and nitrates at 5.8mg/l on the 14.11.06.

At the downstream station at Brockley Park Nitrates were also elevated on the same date (24.01.06) at 5.6; while Colour and Orthophosphate were also elevated at this station on the

16.05.06, at 60 Hazen and 0.24mg/l respectively; Nitrates were also elevated at the downstream station on the 14.11.06 at 5.8mg/l.

These results do not show a significant increase in nutrients within the watercourse when upstream and downstream monitoring stations are compared based on this 2006 data (Neill 2007).

Additional chemical water quality monitoring was undertaken by the EPA on four occasions during 2007 (Neill 2008) at the downstream monitoring station 0300 at Brockley Park. Sampling was undertaken on the following dates: 15.03.2007, 10.05.2007, 10.07.2007 and 26.09.2007. From this data it can be seen that Nitrates were elevated at 5.5mg/l and 5.1mg/l on the 15.03.07 and 10.05.07. Colour was also found to be elevated at 100 Hazen on the 10.07.07.

EPA monitoring was also carried out on the same dates further downstream at Derrybrock Bridge (0400). The analysis at this location shows a continuation in increased Nitrates on both relevant dates, on both occasions showing an increase in Nitrates in a downstream direction (5.7mg/l and 5.4mg/l on the two respective dates). An incidental increase in BOD (at 136%) was also recorded at this downstream station on the 10.05.07.

This data is discussed separately from the Laois County Council monitoring data, as the sampling and analysis were undertaken by a separate authority and not considered suitable to be pooled together.

Table 6 Summary of EPA water quality results showing overall results for the Barrow and Stradbally Rivers. Data is from EPA biological surveys during the period 2004-2006 (adapted from Clabby *et al.*, 2008).

Catchment	Class A	Class B	Class C	Class D	Total (km)
Barrow (km)	92	45.5	2.5	0	140
Barrow (%)	65.7	32.5	1.8	0.0	100
Stradbally (km)	12	6	0	0	18
Stradbally (%)	67	33	0	0	100

Table 7 Stradbally River (EPA code 14/S/02) Biological Quality Ratings (Q values) from sampling stations upstream (0100, 0200) and downstream (0300, 0350) of the Stradbally WwTP (Adapted from Clabby *et al.*, 2006).

Station	Station location	1980	1984	1989	1993	1997	2000	2003
0100	Bridge near Bauteogue (approx. 3km u/s Stradbally).	4	3-4	3-4	4	3-4	3-4	3
0200	Stradbally Bridge	4	4	4	4	-	-	-
0300	Dowlings Bridge (in Brockley Park)	4	3-4	3	3	-	-	3
0350	Bridge WNW of Ballykilocavan House (< 3km d/s Stradbally)	4	3-4	3-4	3-4	3	3-4	3

Table 8 Crooked/Timogue River (EPA code 14/C/02) Biological Quality Ratings (Q values) from three sampling stations upstream of the Stradbally River confluence, adapted from Clabby *et al.*, 2006).

Station	Station location	1989	1993	1997	2000	2003
0600	Timogue Bridge, approximately 3km u/s Bauteogue confluence	4	4	3-4	3	3*
0800	2 nd bridge u/s Bauteogue River confluence (ca. 1.5km u/s confluence)	-	-	3-4	3-4	3-4
0900	Pole Bridge, approximately 0.25km u/s of the Bauteogue River confluence	4	3-4	-	-	-

*Silt

Table 9 River Barrow (EPA code 14/B/01) Biological Quality Ratings (Q values) from two sites (one u/s and one d/s of the Stradbally River confluence), adapted from Clabby *et al.*, 2006).

Station	Station Location	1980	1982	1986	1989	1994	1997	2000	2003	2006
1400	Dunrally Bridge (approx. 3km u/s Stradbally River confluence)	4	-	4	4	4	4	4	4	4*
1500	Bert Bridge (approx. 5km downstream of Stradbally River confluence.	4	4	4	4	4	3-4	3-4	4	3-4*

*taken from EPA monitoring data in Neill (2007).

3.2.1.3 Laois County Council Monitoring Data

Laois County Council monitors water quality in the Stradbally River at a station located upstream (Code 8002) and downstream (Code 8102) of the Stradbally WwTP discharge. The results of the most recent monitoring of chemical water quality at these two sites were provided by Laois County Council for use in the current assessment. This data extends from the period January 2007 to November 2008. A statistical summary of this data is provided in Appendix 3.

Dissolved Oxygen

Mean Dissolved Oxygen (D.O.) values for the upstream and downstream sites complied with the requirements outlined for designated waters under the Salmonid Waters Regulations (1988). However, the minimum D.O levels upstream and downstream of the WwTP were below the 9mg/l limit at 7.8mg/l and 6.86mg/l, respectively.

Nitrates

The concentration of nitrate in rivers is an important quality indicator, as it is responsible for enriching effects in the aquatic environment. A maximum level of 2 mg/l N has been deemed appropriate for protecting the most sensitive freshwater species (Lucey, 2007). Mean levels of this parameter were exceeded both upstream (4.46mg/l) and downstream (3.66mg/l) of the WwTP. A very high maximum level of 21.21mg/l was recorded upstream of the plant on 30th May, 2007. This was an atypical result and if excluded from the analysis, the mean level of Nitrates would be slightly higher downstream of the plant.

Nitrites

The Salmonid Waters Regulations (1988) set a limit of 0.05mg/l NO₂, while the EPA (2001) state that levels in unpolluted waters are normally below 0.03mg/l, with values greater than this indicating sewage pollution. It is this more stringent limit that is taken in this assessment. Neither the upstream nor downstream sites had elevated Nitrite levels, it is important to note that this result is based on only two observations.

Total Ammonia

In water, dissolved ammonia exists in equilibrium between free ammonia gas (NH₃ or un-ionized ammonia) and the solvated ammonium cation (NH₄⁺). The NH₃ – NH₄⁺ equilibrium is of profound importance to the biogeochemical cycling of ammonia. Over the pH range typical of Irish rivers, NH₄⁺ is the dominant species. The equilibrium is extremely dependent upon pH, and to a lesser extent on temperature. High pH favors the formation of the free gaseous NH₃, with a sharp dissociation at a pH around 9. The NH₄⁺ ion is nontoxic and is not of concern to organisms. However, un-ionized ammonia (NH₃) is harmful to aquatic life and may accumulate in the organism and cause alteration in metabolism or increases in body pH. Salmonids and juvenile fish are especially sensitive to elevated concentrations of NH₃. According to EPA (2001) "arising from the complex relationship between total ammonia concentration, pH and temperature there emerges a level for Total Ammonia of around 0.3 mg/l which is considered to be that which would contain the limiting amount of un-ionised ammonia".

A similar guideline limit of 0.25 mg/l for Total Ammonia has been adopted by the UK Environment Agency for Class RE1 Rivers (i.e. Class A) under the UK Surface waters (River Ecosystem) Regulations (2004). The US Environmental Protection Agency use a guideline figure of 0.2 mg/l for American Rivers. The Freshwater Fish Directive (78/659/EEC) has a guideline figure of 0.04 mg/l for Total Ammonia for salmonid waters, while a figure of 0.2 mg/l is used for coarse fish waters. The EPA also notes that that "levels [of Total Ammonia] above 0.1mg/l N indicate sewage or industrial contamination" (EPA, 2001). In the draft consultation paper for the European Communities Environmental Objectives (Surface Waters) Regulations 2009 (SI 272 of 2009) the concentration guidelines for Total Ammonia are given according to the statistical measure of flow rate based on the processing of water level records. In this paper, a river is assigned 'High status' if Ammonia concentrations are ≤0.040mg/l at mean

flow rates or $\leq 0.09\text{mg/l}$ at 95%ile flows. Similarly, a river is assigned 'Good status' if Ammonia concentrations are $\leq 0.065\text{mg/l}$ at mean flow rates or $\leq 0.14\text{mg/l}$ at 95%ile flows. Using the mean Ammonia concentration derived from Laois County Council monitoring data and assuming mean flows in the river, the river both upstream and downstream of the plant do not meet either criteria for high status or good status. Upstream of the plant, mean Ammonia concentrations are close to the good status level of 0.065mg/l (at assumed mean flow).

If the strict level of 0.1mg/l is used, mean Ammonia concentrations upstream and downstream of the plant are below this limit, but the concentration downstream was approaching it. The maximum concentrations at the upstream and downstream stations were 0.303mg/l and 0.33mg/l , respectively; both considerably above the limit level.

Total Nitrogen

The Salmonid Waters Regulations (1988) do not provide limits for total Nitrogen. Total Nitrogen is not a significant nutrient in the freshwater environment in terms of limiting growth. The Surface Waters Regulations (1989) set values of between 1mg/l and 3mg/l for drinking waters; however, this limit is not relevant to this study.

Total Phosphorus

No limits are set for Total Phosphorus in the Freshwater Fish Directive (78/659/EEC); however, an indicative value of 0.062mgP/l is given for salmonid waters in order to reduce eutrophication (EPA, 2001). Samples were analyzed only twice for Total Phosphorus and revealed that minimum and mean levels were above the guideline limit both upstream and downstream of the plant. Such a limited data set does not provide adequate information to verify concentrations of this parameter in the river.

Orthophosphates

The phosphorus loads permitted in a river are governed by the Phosphorus Regulations (S.I. 258 of 1998). These regulations require water quality to be maintained or improved by reference to the biological quality rating (of rivers) or trophic status (of lakes) that the EPA assigned in the 1995-97 review period or at the first occasion thereafter. This represents the baseline water quality data. The minimum Ortho-phosphate (measured as MRP/Molybdate Reactive Phosphorus) concentrations for the upstream and downstream stretches of the Stradbally River are 0.03mgP/l . This level corresponds to ratings of Q3-4 on the Timahoe and Q3 on the Timogue River upstream of Stradbally in 1997 and Q3 on the Stradbally River (downstream of plant) in 1997.

Mean Ortho-phosphate levels were above the 0.03mg/l limit upstream and downstream of the Stradbally WwTP but levels were higher below the WwTP discharge (0.04mg/l upstream vs 0.06mg/l downstream). A high 0.08mg/l was the maximum Ortho-phosphate concentration recorded upstream of the plant while downstream, the maximum concentration was 0.199mg/l .

Under the European Communities Environmental Objectives (Surface Waters) Regulations 2009 (SI 272 of 2009) a river can be assigned 'High status' or 'Good status' based on Ortho-phosphate concentrations. 'High status' is assigned to a river if concentrations are $\leq 0.025\text{mg/l}$ during mean flows or ≤ 0.045 during 95%ile flows. 'Good status' is assigned if concentrations are ≤ 0.035 during mean flows or $\leq 0.075\text{mg/l}$ during 95%ile flows.

Suspended Solids

The Salmonid Waters Regulations (1988) set a limit of 25mg/l for suspended solids. The mean suspended solids values for the upstream station were significantly elevated at 48mg/l ; while the downstream values were within the limit at 10.5mg/l , respectively. Maximum upstream values were elevated at 77mg/l while downstream values were 12mg/l .

BOD

A Biochemical Oxygen Demand (BOD) limit is set at 5 mg/l by the Salmonid Waters Regulations (1988) where this value is to be conformed to by 95% of samples. In the European Communities Environmental Objectives (Surface Waters) Regulations 2009 (SI 272 of 2009) regulations 'High ecological status' is assigned to a river water body if the BOD \leq 1.3mg/l for mean flow rates or \leq 2.2mg/l for 95%ile flows. 'Good ecological status' is assigned if the BOD \leq 1.5mg/l for mean flow rates or \leq 2.6mg/l for 95%ile flows. In the sampling carried out by Laois County Council there were no corresponding flow rates, so the status of the river cannot be determined using oxygenation conditions. Using the EPA (2001) limit value of 3mg/l, mean levels of BOD were within the guideline level upstream (1.77mg/l) and downstream (1.95mg/l) of the plant.

COD

There are no limits for Chemical Oxygen Demand (COD) in rivers, however it can be expected that elevated COD would have the same effects on aquatic systems as BOD. The mean COD concentrations upstream and downstream of the plant were 166.50mg/l and 20.67mg/l respectively.

3.2.2 Results of the January 2009 on-site assessment

3.2.2.1 Upstream reference site

This site was located just upstream of the Stradbally WwTP discharge to the Stradbally River. The wetted width of the river at this point was approximately 8m, with a mean depth of approximately 25cm. The substrate consisted of rock (5%), cobble (35%), gravel (40%) and fine material (20%). Riffle was the predominant flow feature (50%), with glide (35%) and pool (15%) accounting for the remainder. There was approximately 5% instream vegetation cover of water crowfoot *Ranunculus* sp.

A total of 16 different benthic macroinvertebrate families were recorded at this site. Mayfly larvae were well represented with four species occurring. Three of these were pollution sensitive Group A taxa from the family Heptagenidae; the autumn dun *Ecdyonurus dispar* (scarce), yellow upright *Rhithrogena semicolorata* (small numbers) and the yellow may dun *Heptagenia sulphurea* (scarce). Larvae of the large dark olive mayfly *Baetis rhodani*, a Group C pollution tolerant indicator was dominant at this site. Stonefly larvae of the common yellow sally *Isoperla grammatica* (Group A) and the needlefly *Leuctra* sp. (Group B) were both present, as was larvae of the cased microcaddisfly *Hydroptila* sp. (Group B). Larvae of the grey flag *Hydropsyche siltalai* and the sandfly *Rhyacophila dorsalis*, both caseless Group C caddisflies were scarce. True fly (Dipteran) larvae, Group C indicators recorded included blackfly (Simuliidae) and crane fly (fair numbers of both) and green chironomidae. Riffle beetle larvae of *Elmis* sp. were recorded in small numbers, while *Limnius* sp. larvae were scarce. Small numbers of aquatic earthworms (Group D) were also recorded. Orb mussels, freshwater shrimp *Gammarus deubeni* (Group C) and hog louse *Asellus aquaticus* (Group D); all pollution tolerant indicators were present at this site.

Using the EPA freshwater biological monitoring system (Toner *et al.*, 2005), this stretch of the Stradbally River is deemed to be borderline with 'Class B Slightly Polluted' and 'Class A, Unpolluted (Q4)'. The BMWP habitat specific score was based on a riffled habitat (\geq 70% boulders and pebbles) and a score of 101.3 was calculated for this site. This score is indicative of "Very good" water quality and interpreted as "Un-impacted". However, it just makes this rating (threshold 100). The corresponding ASPT was 6.33, which is also indicative of good water quality.

3.2.2.2 Receptor site

This site was located on the Stradbally River approximately 150m downstream of the Stradbally WwTP discharge. The river at this site had mean and maximum depths of

approximately 35cm and 55cm, respectively. The riffle, glide and pool flow characteristics at this site were in the proportion 45%, 40% and 15%, correspondingly. The banks were high at approximately 2.5m and had approximately 95% vegetative cover.

A macroinvertebrate family richness of 16 was recorded at this site. Heptagenid mayfly larvae (Group A) of the autumn dun *Ecdyonurus dispar* and yellow upright *Rithrogena semicolorata* were both scarce, while larvae of the large dark olive mayfly *Baetis rhodani* (Group C) were numerous. The only larva of stonefly found was that of the pollution sensitive (Group A) winter stonefly *Brachyptera risi*, which was present (it is possible that this specimen drifted down from an upstream location). Fair numbers of larvae of the Group B cased caddisfly *Hydroptila* sp. were recorded. Three species of Group C caseless caddisfly at larval stage were recorded; the sandfly *Rhyacophila dorsalis* (small numbers), grey flag *Hydropsyche siltalai* (present) and the trumpet-net caddisfly *Polycentropus kingi* (present). Group C blackfly larvae (Simuliidae) were numerous, crane fly (including *Dicranota* sp.) were found in fair numbers and larvae the green chironomid was present. Group C whirligig beetle larvae (Gyrinidae) and riffle beetle larvae were both scarce. Aquatic earthworms and the Group D leech *Erpobdella octoculata* were also scarce at this site. Crustaceans present were the freshwater shrimp *Gammarus deubeni* (Group C) and hog louse *Asellus aquaticus* (Group D).

At this site, the structure of the macroinvertebrate community with respect to the pollution sensitivity groups indicates that this stretch of the Stradbally River is 'Class B, Slightly Polluted (Q3-4)' but perhaps borderline with Q4 conditions. The BMWP score for this riffled site was 99.1 so according to this biotic index, water the quality at this site is rated as 'Good' but is deemed to be 'Slightly impacted'. However, as the threshold here is 100 this is a very borderline result again. The associated ASPT for this site was 6.19 - a score indicative of good water quality.

3.2.2.3 Overview

A full species list for the macroinvertebrates recorded from both the upstream reference and downstream receptor sites is presented in Appendix 4. Table 10 below summarises the structure of the macroinvertebrate communities recorded from each site, according to the pollution sensitivity of the groups present. From this table it can be seen that the upstream reference site was found to have a higher overall diversity of macroinvertebrate taxa with a slightly stronger presence of Group A (most sensitive) taxa in this community. However, the differences between the biological communities at both sites was not found to be very significant.

Table 10 Classification of macroinvertebrate taxa recorded at each site in terms of their pollution sensitivity (EPA methods).

Pollution indicator group	Reference		Receptor	
	Number	% of total	Number	% of total
Group A (Most sensitive)	13	4.9	6	3.1
Group B (Less Sensitive)	3	1.1	10	5.2
Group C (Tolerant)	235	88.3	168	87.0
Group D (Very Tolerant)	15	5.6	9	4.7
Group E (Most tolerant)	0	0.0	0	0.0
Total	266	100	193	100

Tables 11 and 12 present the results of the functional group analysis at both sites, based on the structure of the macroinvertebrate communities and the implications of the trophic groups on food supply for juvenile salmonids. The ratio of scrapers to total collectors and shredders (P/R ratio) gives the ratio of gross primary production to community respiration. Both the control and receptor site had macroinvertebrate compositions indicative of heterotrophic ecosystems i.e. one which is dependent on external inputs for its maintenance. With a heterotrophy/autotrophy threshold of 0.75, where >0.75 implies an autotrophic ecosystem, both the reference and receptor sites could be rated as heterotrophic with respective scores of 0.64 and 0.41, although the reference site score is close to the autotrophic level.

The ratio of behavioral drifters (filtering and gathering collectors) to accidental drifters (scrapers, shredders and predators) was used to derive the juvenile salmonid food index for

both sites. At both the reference and receptor sites, a 'Predictable' juvenile salmonid food supply was obtained, with ratios of 0.88 and 1.40 respectively.

Table 11 Functional group characteristics of the two survey sites. P/R = ratio of Scrapers to total collectors + shredders (a surrogate for ratio of gross primary production to community respiration). Heterotrophy vs Autotrophy based on a P/R threshold of >0.75 = autotrophic (Rabenil *et al.*, 2005).

Functional Group	Reference site		Receptor site	
	Numbers	%	Numbers	%
Filtering Collector	41	15	74	38
Gathering Collectors	83.5	31	39	20
Scraper	100.5	38	53	27
Predator	9	3	13	7
Shredder	32	12	15	8
Total	266	100	193	100
P/R	0.64		0.41	
Heterotrophy Vs Autotrophy	Heterotrophic		Highly heterotrophic	

Table 12 Juvenile salmonid food index. Predictable invertebrate supply is the ratio of behavioral drifters (filtering and gathering collectors) to accidental drifters (scrapers, shredders and predators). Based on a threshold of >0.50 for predictable supply (Rabenil *et al.*, 2005).

Site	Behavioral drifters/accidental drifters	Predictable Vs Unpredictable
Reference	0.88	Predictable
Receptor	1.40	Predictable

3.2.3 Dangerous substances

The assumed influent quality with respect to dangerous substances is given in Table 13. Sampling for a suite of dangerous substances was carried out by Laois Co. Co. in November and December of 2008. The outfall was sampled along with the Stradbally River upstream and downstream of the discharge. The results from this assessment are provided in Appendix 3.

The results were compared with the limit values given for selected parameters in the EPA (2001) publication 'Parameters of Water Quality: Interpretation and Standards' and also in the EC Dangerous Substances Directive (76/464/EEC and Daughter Directives. All parameters are within the limits given in these sources.

Table 13 Assumed influent quality at the Stradbally WwTP (From O' Dwyer, 2007).

Parameter	Range of values expected
Range of COD:BOD ratios	2.5:1 – 4:1 ¹
pH range	5.5 – 8.5
Influent temperature range	5 – 30°C
	Maximum concentration (mg/l)
Fats, oils, greases	100
Free cyanides	0.5
Arsenic	1
Chromium III	2
Chromium VI	0.2
Copper	0.5
Mercury	0.2
Total heavy metals	10
Individual heavy metals (Zn, Pb, Cd, Ni)	2
Total hydrocarbons	30

¹As a 24 composite sample.

3.2.4 Assimilation capacity

The assimilation capacity of the Stradbally River has been calculated using flow data provided by Laois Co. Co. along with chemical water quality data provided by Laois County Council for the years 2007 and 2008. Flows in the river were provided by Laois Co. Co. with the 95%ile flow corresponding to that at Derrybrock Bridge and the average flow given as 1.07m³/s. The assimilation capacity results for 95%ile and average flows are presented in Table 14. The

capacity of the river to receive discharges from the WwTP has been calculated based on the limit values cited by the EPA (2001) and the European Communities Environmental Objectives (Surface Waters) Regulations 2009 (SI 272 of 2009) Phosphorus target ratings and concentrations have been taken as Q4 and 0.030mg/l (Clenaghan, 2003). From these calculations it was found that the Stradbally River has poor assimilation capacity for Orthophosphate, Nitrate, total Phosphorus based on the mean background levels of these parameters in the river upstream of the discharge. Furthermore, the river was found to have no assimilation capacity for Total Ammonia, Nitrates, Orthophosphates, Suspended solids, Total phosphorus and BOD when the maximum concentration of the parameters was assessed.

Table 14 Assimilation capacity of the Stradbally River at mean (1.07m³/s) and 95%ile flow (0.2m³/s) for selected parameters at the discharge point based on mean background parameter levels in 2007 and 2008 (BOD=1.77mg/l, Orthophosphate=0.04mg/l, Total Ammonia=0.07mg/l, Suspended Solids=48mg/l;N=2, Total Phosphorus=0.13;N=2 mg/l, Nitrates=4.446mg/l and Nitrites=0.006mg/l;N=2). It is noted that Limit Standards for Total Nitrogen, COD, Total Phosphorus and Nitrates are not provided in the EPA manual EPA (2001) or in the European Communities Environmental Objectives (Surface Waters) Regulations 2009 (SI 272 of 2009).

BOD	Mean flow			95%ile flow		
Environmental standard	WFD HS	WFD GS	FFD	WFD HS	WFD GS	FFD
Limit concentration (mg/l)	1.3	1.5	3	2.2	2.6	3
BOD WAC (kg/day)	-43.45	-24.96	113.71	7.43	14.34	21.25
Ortho-phosphate	Mean flow			95%ile flow		
Environmental standard	WFD HS	WFD GS	EPA (2001)	WFD HS	WFD GS	EPA (2001)
Limit concentration (mg/l)	0.025	0.035	0.03	0.045	0.075	0.03
WAC (kg/day)	-1.39	-0.46	-0.92	0.09	0.60	-0.17
Total Ammonia	Mean flow			95%ile flow		
Environmental standard	WFD HS	WFD GS	SWR	WFD HS	WFD GS	SWR
Limit concentration (mg/l)	0.04	0.065	1	0.09	0.14	1
WAC (kg/day)	-2.77	-0.46	85.98	0.35	1.21	16.07
Suspended Solids	Mean flow			95%ile flow		
Environmental standard	SWR			SWR		
Limit concentration (mg/l)	25			25		
WAC (kg/day)	-2126.30			-397.44		
Total Phosphorus	Mean flow			95%ile flow		
Environmental standard	Level suggested for salmonid waters in EPA (2001) to reduce eutrophication			Level suggested for salmonid waters in EPA (2001) to reduce eutrophication		
Limit concentration (mg/l)	0.062			0.062		
WAC (kg/day)	-6.29			-1.18		
Nitrates	Mean flow			95%ile flow		
Environmental standard	Strict limit value suggested in Lucey (2007) for protecting sensitive aquatic species.			Strict limit value suggested in Lucey (2007) for protecting sensitive aquatic species.		
Limit concentration (mg/l)	2			2		
WAC (kg/day)	-227.98			-42.61		
Nitrites	Mean flow			95%ile flow		
Environmental standard	Strict value taken from Freshwater Fish Directive 78/659/EEC for salmonids.			Strict value taken from Freshwater Fish Directive 78/659/EEC for salmonids.		
Limit concentration (mg/l)	0.01			0.01		
WAC (kg/day)	0.37			0.07		

WFD GS=Good status (95%ile flow), SWR = Salmonid Water regulations (1998), EPA (2001) Level suggested for salmonid waters to reduce eutrophication, PR=Phosphorous Regulations, median value, FFD (S) = Salmonid Waters Standard. Levels of Ammonia above 0.3 are considered harmful EPA (2001).

There are limitations to the precision of the assimilation capacity results. In calculating the assimilation capacity, the background concentration is a key constraint. Variations in sampling for background concentrations would be expected due to changes in flow rates, season and local activities on the land. Therefore, a different set of samples could yield significantly different background concentrations and consequently, different assimilation capacities for various parameters. It also can be expected that flows in the stream will be regularly above the 95%ile level providing increased dilution. Indeed they will be at or below this level for only 5% of the time. Likewise, the standards taken in the current assessment are the most stringent given in EPA (2001) or the European Communities Environmental Objectives (Surface Waters) Regulations 2009 (SI 272 of 2009). However, taking these issues into

account it remains clear that for most of the parameters, there is limited assimilative capacity in the Stradbally River.

3.3 Sediment quality

No data was available for sediment composition or quality during the preparation of this report.

3.4 Areas designated for nature conservation

Sites of international conservation importance are designated as Special Areas of Conservation (SACs) under the Habitats Directive (1992) and/or Special Protection Areas (SPAs) under the Birds Directive (1979). Together, SACs and SPAs make up the Natura 2000 network of wildlife conservation sites. Sites of national importance for wildlife are designated as Natural Heritage Areas (NHAs) under the Irish Wildlife Act, 2000.

The WwTP at Stradbally is located less than 1km east of Stradbally town and discharges directly to the Stradbally River. This river is designated within the River Barrow and River Nore Special Area of Conservation (SAC) downstream of Stradbally town. Therefore the discharge is directly into this internationally designated site.

The River Barrow and River Nore SAC site is selected for the following conservation interests; alluvial wet woodlands and petrifying springs (priority habitats on Annex I of the E.U. Habitats Directive); old oak woodlands; floating river vegetation; estuary; tidal mudflats; *Salicornia* mudflats; Atlantic salt meadows; Mediterranean salt meadows; dry heath; and eutrophic tall herbs (all habitats listed on Annex I of the E.U. Habitats Directive). In addition to habitats, the cSAC has been selected due to the presence of invertebrate, fish and mammal species which are listed under Annex II of the EU Habitats Directive, including; freshwater pearl mussel (*Margaritifera margaritifera* and its hardwater form *M. m. durrovensis*); freshwater crayfish *Austropotamobius pallipes*; Atlantic salmon *Salmo salar*; twaite shad *Alosa fallax*; the three lamprey species present in Irish watercourses (sea lamprey *Petromyzon marinus*, brook lamprey *Lampetra planeri* and river lamprey *Lampetra fluviatilis*); Desmoulin's whorl snail *Vertigo moulinsiana*; and the Eurasian otter *Lutra lutra*. The River Barrow is one of only a handful of spawning grounds in the country for twaite shad, and is the most important site for this species. Other important fauna species found in the Barrow/Nore cSAC include: Daubenton's bat *Myotis daubentoni*; badger *Meles meles*; Irish hare *Lepus timidus hibernicus*; and the common frog *Rana temporaria*, all species listed in the Irish Red Data Book. The rare Red Data Book fish species smelt *Osmerus eperlanus* is also known to occur in the estuary of the River Barrow. Two other freshwater mussel species, *Anodonta anatina* and *A. cygnea* are also found in the Barrow (Lucey, 1998).

In addition to this SAC there are a number of other designated conservation sites in the vicinity of the existing WwTP at Stradbally. Both Stradbally Hill pNHA and Kilteale Hill pNHA are designated for the presence of oak-ash-hazel woodland. These scattered designations lie 1-2km east and extend in a southerly direction. Further south (ca. 4km) the Ballyprior grassland SAC is designated due to the presence of the priority Annex I habitat 'Orchid rich calcareous grassland', this site is also recognized for its rich mycoflora diversity.

Approximately 4.5km east of Stradbally the Grand Canal passes over the Stradbally River by means of an aquaduct at Derrybrock. The Grand Canal is designated as a pNHA for the conservation of a number of protected habitats, flora and fauna of national importance.

3.5 Protected aquatic flora and fauna

Table 15 gives a list of the protected species recorded in the River Barrow catchment and their status. Each species is discussed separately below in relation to the operation of the Stradbally WwTP.

Table 15 Status of fauna listed in the Habitats Directive (92:43:EEC) in the River Barrow catchment (adapted from Lucey, 1998).

Common name	Scientific name	Main channel	Tributaries
Pearl mussel	<i>Margaritifera margaritifera</i>	Extinct	Rare
White-clawed crayfish	<i>Austropotamobius pallipes</i>	Common	Common
Brook lamprey	<i>Lampetra planeri</i>	Common	Common
River lamprey	<i>Lampetra fluviatilis</i>	Rare	Rare
Sea lamprey	<i>Petromyzon marinus</i>	Rare	Rare
Twaite shad	<i>Alosa fallax</i>	Rare	Absent
Atlantic salmon	<i>Salmo salar</i>	Common	Common
Eurasian Otter	<i>Lutra lutra</i>	Common	Common

3.5.1 White-clawed crayfish

The white-clawed crayfish is the only freshwater crayfish recorded in Ireland. Populations of the species in the rest of Europe have declined dramatically and Ireland is seen as a unique stronghold for this species in a European context (Reynolds, 1998). It is classified as vulnerable and rare in the IUCN Red List and is protected in Ireland under the schedules of the Wildlife Act 1976. It is also listed in Appendices II and V of the Habitats Directive (92:43:EEC). It is generally considered to be widespread in lowland lakes and rivers such as the River Barrow, which are underlain by Carboniferous limestone, or its derivative - glacial drift (Reynolds, 1998). This species is probably present in the Stradbally River, however it was not recorded during the current biological assessment.

3.5.2 Lampreys

The brook lamprey is the smallest of the three lampreys native to Ireland and it is the only one of the three species that is non-parasitic and spends all its life in freshwater (Maitland & Campbell 1992). The river lamprey is larger in size than the brook lamprey and exhibits an anadromous¹ life cycle. The sea lamprey is the largest of the Irish lampreys. Brook lamprey and sea lamprey are listed in Appendix II, while river lamprey is listed in both Appendices II and IV of the Habitats Directive (92:43:EEC). All three species are listed in Appendix III of the Bern Convention. All three lamprey species have been recorded from the Barrow catchment (Kurtz & Costello, 1999). However, only brook lamprey would occur in the Stradbally River.

3.5.3 Shad

Twaite Shad and Allis Shad are among the rarest species of fish breeding in Irish freshwaters and are listed under Annexes II and V of the EU Habitats Directive. Both species are also listed in Appendix III of the Bern Convention. Shad have an anadromous life cycle and both species are thought to occur in the Barrow Estuary. However, it is clear that these species are confined to the lower reaches of the river and would therefore not occur in the study area.

3.5.4 Atlantic salmon

¹ Anadromous fish spend most of their adult lives in salt water, and migrate to freshwater rivers and lakes to reproduce.

The Atlantic salmon is listed under Annexes II and V of the EU Habitats Directive and Appendix III of the Bern Convention. It is an economically important species and salmon recreational and commercial fisheries occur throughout Ireland. Salmon are present throughout the Barrow catchment (Lucey, 1998). Salmon are likely to spawn in the Stradbally River within the study area.

3.5.5 Eurasian Otter

The otter *Lutra lutra* is a legally protected species under the Wildlife Act, 1976 (and Wildlife (Amendment) Act, 2000). It is listed under Annex II of the EU Habitats Directive and under Annex II of the Berne Convention. It is found throughout Ireland where it has apparently avoided the population declines that have occurred in many other countries (Hayden and Harrington, 2000). Evidence of otter activity has been recorded from the study area and this species is widespread in the River Barrow catchment.

3.5.6 Freshwater Pearl-mussel

Freshwater Pearl-Mussel (*Margaritifera margaritifera*) occurs in the River Barrow catchment; however this species is now extinct in the main channel of the river (Lucey, 1998).

3.6 Recreational and Commercial fisheries

The Stradbally River is mentioned in O' Reilly (2004) with regard to the Vicarstown angling club. Members of this club fish extensively on the Stradbally River, Killkenny River and the River Barrow. O' Reilly (2004) indicates that most of the water is better suited to coarse fish except for the Stradbally River which 'holds a good stock of fine brown trout'. Downstream of the Stradbally River confluence, the Athy and District Angler's Club has access to an extensive stretch of the River Barrow. This water is fished for salmon late in the season and trout fishing is regarded as being fair (O' Reilly, 2004).

3.7 Water abstractions

There are no Drinking Water RPAs on the River Barrow within 10km downstream of the study area (Source: EPA Envision). It is expected that the river is used by farms for animal drinking water.

3.8 Designated recreational and bathing waters

There are no designated recreational or bathing waters on the River Barrow (Source: EPA Envision).

3.9 Other amenity areas

The River Barrow main channel is an important amenity for waterside and waterborne activities. A national walking trail enables walkers and cyclists to travel along the banks of the river. Management of the locks and navigation system permits pleasure cruisers to travel from the main line of the Grand Canal down via the Barrow Line and onto the open River Barrow itself. This permits boats to go to sea via the St. Mullins locks.

3.10 Nutrient sensitive areas

The River Barrow is classified as a nutrient sensitive water downstream of Portarlinton town, Co. Laois to Graiguenamanagh Bridge, Co. Kilkenny, under the Urban Wastewater Treatment Regulations (2001); this designation encompasses the River Barrow within the current study area.

4. IMPACT ASSESSMENT

4.1 Introduction

According to the EPA (2008), a discharge from a WwTP would be considered to have a significant adverse effect on the receiving waters if it were to:-

- Cause a deterioration in the chemical status or ecological status (or ecological potential as the case may be) in the receiving body of surface water;
- Cause a deterioration in the chemical status in the receiving body of groundwater;
- Cause the input into groundwater of hazardous substances, except where it is established that the input concerned is in a quantity and concentration so small as to obviate any present or future danger of deterioration in the quality of the receiving groundwater;
- Cause deterioration or result in significant and sustained upward trends in the concentrations of pollutants in groundwater in the case of pollutants that are not hazardous,
- Permanently exclude or compromise the achievement of the objectives established for protected species and natural habitats in the case of European sites where the maintenance or improvement of the status of water is an important factor in their protection or which is inconsistent with the achievement of environmental quality standards established under national Regulations in relation to designated bathing waters, designated shellfish waters, areas designated for the protection of freshwater fish and designated nutrient sensitive areas.

As there is no discharge directly into groundwater from the Stradbally WwTP, no assessment of local groundwater is made in this assessment. It is considered that through the interaction between surface and ground waters, any significant impact on the receiving surface waters could also potentially result in a similar impact on local groundwater.

The receiving water for the Stradbally WwTP discharge is the Stradbally River. The Stradbally River downstream of Stradbally is designated as a Special Area of Conservation under the EU Habitats Directive. Therefore the discharge from the WwTP is directly into this internationally important site.

A summary of the receiving water impact assessment is provided in Table 16. The impact on identified receptors is outlined in the following sections. Appendix 6 gives criteria for assessing impact type and impact magnitude.

Table 16 Summary of the receiving waters impact assessment

Receptor	Scale of impact on the Stradbally River
Water quality	Slight negative
Designated conservation Sites	Slight negative
Protected flora and fauna	Likely to affect salmon, lamprey and crayfish to a slight degree
Fisheries	Slight negative impact
Water abstractions	No impact
Recreational areas	No impact
Nutrient sensitive areas	No impact
Conclusion	Slight negative impact requiring further assessment

4.2 Impact on water quality

Water quality in the Stradbally River both upstream and downstream of the discharge was found to be compromised. Mean Ortho-phosphate concentrations were 20% higher downstream of the discharge. Orthophosphate is a key water quality parameter related to eutrophication in watercourses and background levels in the Stradbally River were found to be elevated. Downstream of the Stradbally WwTP, there was a further increase in concentrations of this parameter. It is therefore concluded that the plant is having a slight negative impact on

chemical water quality downstream of the plant. Further monitoring would be required, in particular it is recommended to record information on flows in the river when monitoring.

The results of the current study suggest that there is a slight deterioration in the biological communities between the areas upstream and downstream of the Stradbally WwTP outfall. However, this assessment should ideally be repeated during the summer months. The Stradbally River may also recover biologically downstream of the plant.

Dangerous substances results does not indicate that the Stradbally WwTP is having an adverse impact on the Stradbally River.

From the assimilation capacity assessment the Stradbally River has been shown to be limited with respect to orthophosphates and other selected parameters.

4.3 Article 6 Assessment (Impacts on designated sites, habitats and species)

The Stradbally River downstream of Stradbally town is included within the River Barrow and River Nore SAC. As the WwTP discharge to the river has been found to be having a slight negative impact on the water quality and subsequently on the ecological communities, it may be concluded that it is also having a slight negative impact on the SAC for a stretch of the Stradbally River downstream of the plant. With the exception of the River Barrow and River Nore SAC, the designated sites in the vicinity of the Stradbally WwTP are not connected in any way to the activities or discharges from the existing plant. The terrestrial pNHA and SAC sites are removed both geographically and in terms of ecological communities from the WwTP. Furthermore the Grand Canal pNHA is considered to be materially separate from the Stradbally River, as it is contained within an aquaduct structure.

4.3.1 White-clawed crayfish

This species is probably present in the Stradbally River but was not recorded during the current biological assessment. Crayfish are recognised as being tolerant of moderate pollution levels and are classed as Group C organisms in the EPA Q-Value biotic index. If white-clawed crayfish occur in the Stradbally River, it is considered that they would only be slightly affected at most due to their tolerance of pollution (borderline Unpolluted downstream of discharge).

4.3.2 Lampreys

Water quality impacts downstream of the Stradbally WwTP outfall would not be expected to have significant negative impacts on existing lamprey populations, as they would tolerate such pollution. O'Connor (2007) recorded disproportionately high abundances of brook lamprey in the River Sinking (a tributary of the River Clare) in sewage sludge deposits located immediately downstream of the overloaded Dunmore sewage works in County Galway during 2006. Such pollution would however be expected to affect recruitment of this species as they are understood to require a high standard of water quality for successful spawning and ova survival. Water quality downstream of the plant is deemed sufficient to allow successful spawning for this species.

4.3.3 Shad

Shad do not occur in the study area as they are confined to the tidal reaches of the River Nore. Therefore this species is not affected by the operation of the Stradbally WwTP.

4.3.4 Atlantic salmon

Poor water quality will affect the conservation status of salmon in the Guilie River; this species requires clean water (Q4) for spawning and early life stages. It was found that the juvenile salmonid food supply was Predictable both upstream and downstream of the discharge so in this respect, the WwTP does not appear to be impacting on the rearing and foraging element

of salmonid activity. Overall, however, a slight decline in water quality is likely to be having a slight negative impact on salmon.

4.3.5 Eurasian otter

Reduced water quality and ecological status downstream of the discharge of the Stradbally WwTP could potentially have indirect effects on otters as a result of reduced food supply (e.g. salmonids).

4.4 Impact on protected flora and fauna

Protected species within the study area directly affected by water quality may include otter salmon, lamprey species and white-clawed crayfish. Overall, it is concluded that the slight deterioration in water quality downstream of the plant could probably be having some level of a negative effect on protected species in the SAC. However, the significance of this is unknown at this stage.

4.5 Impact on fisheries

The River Barrow is currently closed to all salmon angling due to conservation concerns. Salmonids are considered to be under pressure in the River Barrow within the study area due to poor water quality conditions. Unsatisfactory water quality will also affect other native species within the river. The ongoing operation of the Stradbally WwTP in the absence of the proposed upgrade presents the potential for ongoing impacts to water quality and further (probably slight) deterioration in the fish communities present within the study area. This would have slight adverse impacts on the fisheries and recreational angling.

4.6 Impact on water abstractions

There are no drinking water abstractions on the Stradbally River downstream of the Stradbally WwTP. The WwTP does not impact on any designated water abstraction sites.

4.7 Impact on recreational areas

The Stradbally River does not have any designated recreational or bathing water designations and therefore the WwTP has no impact in this regard.

4.8 Impact on nutrient sensitive areas

The River Barrow is designated as a nutrient sensitive area from Portarlinton town to Graiguenamanagh Bridge in Co. Kilkenny. The Stradbally River meets the River Barrow within this designation. It is unlikely considering the distance from this area that the Stradbally WwTP discharge would be having any perceptible impact.

4.9 Likely impact of new plant on receiving waters

Tables 17-19 gives the projected concentrations of selected parameters in the Stradbally River downstream of the outfall of the new Stradbally WwTP, Stage 1. These have been based on the design assumptions for the plant upgrade, a DWF of 10.4l/s (898.56m³/day) and a 95 Percentile flow of 0.2m³/sec (OPW hydrological data from the Stradbally River at Derrybrock). The average flow of 1.07m³/s was also used. Background concentrations are the mean values taken from Laois Co. Co between January 2007 and November 2008.

The dilution of the effluent at 95%ile flow (0.2m³/s) would be approximately 19.2:1 and 103:1 at average flow (1.07m³/s).

From Table 18 it can be seen that the current design standard for Total Phosphorous (2 mg/l) would not allow the river to reach good status downstream of the plant even if background levels of orthophosphate were zero.

Table Projected concentrations of selected parameters in the Stradbally River downstream of the upgraded Stradbally WwTP using background parameter concentrations and pristine conditions (zero background concentration). Based on Laois Co. Co. monitoring data from 2007 and 2008, a 95%ile flow of 0.2 m³/s in the Stradbally River and a dry weather flow of 898.56m³/day from the new plant. Discharge standards are from Nicholas O Dwyer (2007). Design of 2 mg/l Total Phosphorus (TP) corresponds to 1.7 mg/l Ortho-phosphate (Maximum orthophosphate = 0.85 TP). A standard of 0.5 mg/l TP corresponds to 0.425mg/l Orthophosphate and is shown for comparison.

Parameter	Discharge standards (mg/l)	Background conc. parameter (mg/L)	Resulting d/o conc. parameter (mg/L)	Guideline limit (mg/l)	Compliance with limit values
Total Phosphorus (design)	2	0.13 0 (pristine)	0.22 0.1	0.062 (EPA, 2001) 0.062 (EPA, 2001)	
Total Phosphorus (taken for comparison)	0.5	0.13 0 (pristine)	0.15 0.02	0.062 (EPA, 2001) 0.062 (EPA, 2001)	
Suspended solids	35	48 (N=2) 0 (pristine)	47.4 1.7	25 (SWR)* 25 (SWR)*	
Ortho-phosphate	1.7	0.04 0 (pristine)	0.122 0.084	0.03 0.03	0.045 WFD 0.045 WFD 0.075 GS*
Ortho-phosphate (taken for comparison)	0.425	0.04 0 (pristine)	0.059 0.021	0.03 0.03	0.045 WFD 0.045 WFD 0.075 GS*
BOD	25	1.3 0 (pristine)	2.018 1.236	3 3	2.6 WFD GS* 2.2 WFD HS*
				(FFD)*	2.6 WFD 2.2 WFD HS*

WFD GS=Good status (95%ile flow), SWR = Salmonid Water regulations (1998), EPA (2001) Level suggested for salmonid waters to reduce eutrophication, PR=Phosphorous Regulations, median value, FFD (S) = Salmonid Waters Standard. Levels of Ammonia above 0.3 are considered harmful EPA (2001).

Table Projected concentrations of selected parameters in the Stradbally River downstream of the upgraded Stradbally WwTP using background parameter concentrations and pristine conditions (zero background concentration). Based on Laois Co. Co. monitoring data from 2007 and 2008, a mean flow of 1.07 m³/s in the Stradbally River and a dry weather flow of 898.56m³/day from the new plant. Discharge standards are from Nicholas O Dwyer (2007). Design of 2 mg/l Total Phosphorus (TP) corresponds to 1.7 mg/l Ortho-phosphate (Maximum orthophosphate = 0.85 TP). A standard of 0.5 mg/l TP corresponds to 0.425mg/l Orthophosphate and is shown for comparison.

Parameter	Discharge standards (mg/l)	Background conc. parameter (mg/L)	Resulting d/o conc. parameter (mg/L)	Guideline limit (mg/l)	Compliance with limit values
Total Phosphorus (design)	2	0.13 0 (pristine)	0.15 0.02	0.062 (EPA, 2001) 0.062 (EPA, 2001)	
Total	0.5	0.13	0.13	0.062 (EPA, 2001)	

Phosphorus (taken for comparison)		0 (pristine)	0	0.062 (EPA, 2001)		
Suspended solids	35	48 (N=2)	47.9	25 (SWR)*		
		0 (pristine)	0.3	25 (SWR)*		
Ortho- phosphate	1.7	0.04	0.056	0.03	0.045	0.075
				PR*	WFD	WFD
					HS*	GS*
		0 (pristine)	0.016	0.03	0.045	0.075
				PR*	WFD	WFD
					HS*	GS*
Ortho- phosphate (taken fo comparison)	.425	0.04	0.044	0.03	0.045	0.075
				PR*	WFD	WFD
					HS*	GS*
		0 (pristine)	0.004	0.03	0.045	0.075
				PR*	WFD	WFD
					HS*	GS*
BOD	25	1.77	1.994	3	2.6 WFD	2.2
				(FFD)*	GS*	WFD
						HS*
		0 (pristine)	0.241	3	2.6 WFD	2.2
				(FFD)*	GS*	WFD
						HS*

WFD GS=Good status (95%ile flow), SWR = Salmonid Water regulations (1998), EPA (2001) Level suggested for salmonid waters to reduce eutrophication, PR=Phosphorous Regulations, median value, FFD (S) = Salmonid Waters Standard. Levels of Ammonia above 0.3 are considered harmful EPA (2001).

5. RECOMMENDATIONS

Ongoing chemical monitoring of the Stradbally River upstream and downstream of the discharge is recommended to establish a clearer picture of the background concentrations of nutrient loading in the river. This is particularly important, as a number of parameters were only sampled twice during the study period. Ideally flow measurements should also be taken at each site visit (i.e. reading taken from the nearest staff gauge). The design of the new plant should be discussed in relation to the results of the predictions made in the current report. A higher effluent treatment standard may be required for this plant to ensure that the Stradbally River is not prevented from reaching 'good ecological status' in the future.

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APPENDIX 1 BIOTIC INDICES

EPA River Quality Classification Scheme

The Q values are a measure of the EPA's Biological River Quality classification system. The EPA conducts a rolling programme of biological surveys of selected rivers. The higher the biological diversity and the greater the abundance of invertebrate species sensitive to organic pollution, the higher the water quality is assumed to be, and the higher the 'Q value' assigned to that sampling station. The EPA's water quality classification systems are summarized below:

Table A1.1 Biological River Quality Classification and River Water Quality Class System (McGarrigle *et al.*, 2002).

'Q' value	Community Diversity	Water Quality	Condition*	Status	Quality
Q5	High	Good	Satisfactory	Unpolluted	Class A
Q4	Reduced	Fair	Satisfactory	Unpolluted	Class A
Q3	Much Reduced	Doubtful	Unsatisfactory	Slightly Polluted	Class B
Q2	Low	Poor	Unsatisfactory	Moderately Polluted	Class C
Q1	Very Low	Bad	Unsatisfactory	Seriously Polluted	Class D

* 'Condition' refers to the likelihood of interference with beneficial or potential beneficial use.

Class A waters are those in which problems relating to existing or potential uses are unlikely to arise. They are therefore regarded as being in a 'satisfactory' condition. Classes B, C and D are to a lesser or greater extent 'unsatisfactory' in this regard. For example, the main characteristics of Class B and C waters is eutrophication, which may interfere with the amenity, abstraction or fisheries uses of such waters. The general characteristics of waters of the various Biological Quality Classes are provided in Table A1.2.

Table A1.2 The general characteristics of waters of the various Biological Quality Classes.

Quality Classes	Class A		Class B		Class C		Class D	
Quality Ratings	Q5	Q4	Q3	Q3	Q2	Q1		
Pollution Status	Pristine, Unpolluted	Unpolluted	Slight Pollution	Moderate Pollution	Heavy Pollution	Gross Pollution		
Organic Waste Load	None	None	Light	Considerable	Heavy	Excessive		
Maximum B.O.D.	Low (<3mg/l)	Low (<3mg/l)	Occasionally elevated	High at times	Usually High	Usually very high		
Dissolved Oxygen	Close to 100% at all times	80%-120%	Fluctuates from <80% to >120%	Very unstable, Potential fish-kills	Low, sometimes zero	Very low, often zero		
Annual median PO₄	0.015 mg/l	0.03 mg/l	0.045 mg/l	0.07 mg/l	> 0.1mg/l	> 0.1 mg/l		
Siltation	None	May be light	May be light	May be considerable	Usually heavy	Usually very heavy and anaerobic		
'Sewage Fungus'	Never	Never	Never	May be some	Usually abundant	May be abundant		
Filamentous Algae	Limited development	Considerable growth, diverse communities	Luxuriant growths, typically Cladophora	Excessive growths, typically Cladophora	Usually abundant	None		
Macrophytes	Diverse communities, limited growths	Diverse Communities, Considerable Growths	Reduced diversity, luxuriant growths	Limited diversity, excessive growths	Tolerant species only, may be abundant	Most tolerant forms, minimal diversity		
Water Quality	Highest quality	Fair Quality	Variable quality	Doubtful quality	Poor quality	Bad quality		
Abstraction Potential	Suitable for all	Suitable for all	Potential problems	Advanced treatment	Low grade abstractions	Extremely limited		
Fishery Potential	Game fisheries	Good game fisheries	Game fish at risk	Coarse fisheries	Fish usually absent	Fish absent		
Amenity Value	Very high	High	Considerable	Reduced	Low	Zero		

Table A1.3 Revised BMWP (Biological Monitoring Working Party) Score Sheet. (Adapted from Walley and Hawkes, 1997).

Common Name	Family	Original BMWP Score	Revised BMWP Score	Habitat Specific Scores		
				Riffles	Riffle pools	Pools
Flatworms	Planariidae	5	4.2	4.5	4.1	3.7
	Dendrocoelidae	5	3.1	2.3	4.1	3.1
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	3.0	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
Worms	Sphaeriidae	3	3.6	3.7	3.7	3.4
	Oligochaeta	1	3.5	3.9	3.2	2.5
Leeches	Piscicolidae	4	5.0	4.5	5.4	5.2
	Glossiphoniidae	3	3.1	3.0	3.3	2.9
	Hirudidae	3	0.0	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	9.0	8.8	9.0	11.2
Mayflies	Siphonuridae	10	11.0	11.0		
	Baetidae	4	5.3	5.5	4.8	5.1
	Heptageniidae	10	9.8	9.7	10.7	13.0
	Leptophlebiidae	10	8.9	8.7	8.9	9.9
	Ephemerellidae	10	7.7	7.6	8.1	9.3
	Potamanthidae	10	7.8	7.6		
	Ephemeridae	10	7.3	9.0	9.2	11.0
	Caenidae	7	7.7	7.2	7.3	6.4
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	10.0	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	6.0	6.1	7.6
Dragonflies	Gomphidae	8				
	Cordulegasteridae	8	8.6	9.5	6.5	7.6
	Aeshnidae	8	6.1	7.0	6.9	5.7
	Corduliidae	8				
	Libellulidae	8	5.0			5.0
Bugs	Mesoveliidae *	5	4.7	4.9	4.0	5.1
	Hydrometridae	5	5.3	5.0	6.2	4.9
	Gerridae	5	4.7	4.5	5.0	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	Halplidae	5	4.0	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
	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	4.0	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

Common Name	Family	Original BMWP Score	Revised BMWP Score	Habitat Specific Scores		
				Riffles	Riffle pools	Pools
	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	8.0
	Hydropsychidae	5	6.6	6.6	6.5	7.2
	Hydroptilidae	6	6.7	6.7	6.8	6.5
	Phryganeidae	10	7.0	6.6	5.4	8.0
	Limnephilidae	7	6.9	7.1	6.5	6.6
	Molannidae	10	8.9	7.8	8.1	10.0
	Beraeidae	10	9.0	8.3	7.8	10.0
	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	11.0
	Sericostomatidae	10	9.2	9.1	9.3	10.3
True flies	Tipulidae	5	5.5	5.6	5.0	5.1
	Chironomidae	2	3.7	4.1	3.4	2.8
	Simuliidae	5	5.8	5.9	5.1	5.5

* 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 BMWP Scores are based on the analysis of frequency of occurrence of the families recorded in approximately 17,000 samples. 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.

Table A1.4 BMWP Scoring System.

BMWP score	Category	Interpretation
0-10	Very poor	Heavily polluted
11-40	Poor	Polluted or impacted
41-70	Moderate	Moderately impacted
71-100	Good	Clean but slightly impacted
>100	Very good	Unpolluted, unimpacted

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APPENDIX 2 NPWS Designated site descriptions

SITE NAME: RIVER BARROW AND RIVER NORE SAC

SITE CODE: 002162

This site consists of the freshwater stretches of the Barrow/Nore River catchments as far upstream as the Slieve Bloom Mountains and it also includes the tidal elements and estuary as far downstream as Creadun Head in Waterford. The site passes through eight counties – Offaly, Kildare, Laois, Carlow, Kilkenny, Tipperary, Wexford and Waterford. Major towns along the edge of the site include Mountmellick, Portarlinton, Monasterevin, Stradbally, Athy, Carlow, Leighlinbridge, Graiguenamanagh, New Ross, Inistioge, Thomastown, Callan, Bennettsbridge, Kilkenny and Durrrow. The larger of the many tributaries include the Lerr, Fushoge, Mountain, Aughavaud, Owenass, Boherbaun and Stradbally Rivers of the Barrow and the Delour, Dinin, Erkina, Oweg, Munster, Arrigle and King's Rivers on the Nore. Both rivers rise in the Old Red Sandstone of the Slieve Bloom Mountains before passing through a band of Carboniferous shales and sandstones. The Nore, for a large part of its course, traverses limestone plains and then Old Red Sandstone for a short stretch below Thomastown. Before joining the Barrow it runs over intrusive rocks poor in silica. The upper reaches of the Barrow also runs through limestone. The middle reaches and many of the eastern tributaries, sourced in the Blackstairs Mountains, run through Leinster Granite. The southern end, like the Nore runs over intrusive rocks poor in silica. Waterford Harbour is a deep valley excavated by glacial floodwaters when the sea level was lower than today. The coast shelves quite rapidly along much of the shore.

The site is a candidate SAC selected for alluvial wet woodlands and petrifying springs, priority habitats on Annex I of the E.U. Habitats Directive. The site is also selected as a candidate CSAC for old oak woodlands, floating river vegetation, estuary, tidal mudflats, *Salicornia* mudflats, Atlantic salt meadows, Mediterranean salt meadows, dry heath and eutrophic tall herbs, all habitats listed on Annex I of the E.U. Habitats Directive. The site is also selected for the following species listed on Annex II of the same directive – Sea Lamprey, River Lamprey, Brook Lamprey, Freshwater Pearl Mussel, Nore Freshwater Pearl Mussel, Crayfish, Twaite Shad, Atlantic Salmon, Otter, *Vertigo moulinsiana* and the plant Killarney Fern.

Good examples of Alluvial Forest are seen at Rathsnagadan, Murphy's of the River, in Abbeyleix estate and along other shorter stretches of both the tidal and freshwater elements of the site. Typical species seen include Almond Willow (*Salix triandra*), White Willow (*S. alba*), Grey Willow (*S. cinerea*), Crack Willow (*S. fragilis*), Osier (*S. viminalis*), with Iris (*Iris pseudacorus*), Hemlock Water-dropwort (*Oenanthe crocata*), Angelica (*Angelica sylvestris*), Thin-spiked Wood-sedge (*Carex strigosa*), Pendulous Sedge (*C. pendula*), Meadowsweet (*Filipendula ulmaria*), Valerian (*Valeriana officinalis*) and the Red Data Book species Nettle-leaved Bellflower (*Campanula trachelium*). Three rare invertebrates have been recorded in this habitat at Murphy's of the River. These are: *Neoascia obliqua* (Diptera: Syrphidae), *Tetanocera freyi* (Diptera: Sciomyzidae) and *Dictya umbrarum* (Diptera: Sciomyzidae).

A good example of petrifying springs with tufa formations occurs at Dysart Wood along the Nore. This is a rare habitat in Ireland and one listed with priority status on Annex I of the EU Habitats Directive. These hard water springs are characterised by lime encrustations, often associated with small waterfalls. A rich bryophyte flora is typical of the habitat and two diagnostic species, *Cratoneuron commutatum* var. *commutatum* and *Eucladium verticillatum*, have been recorded.

The best examples of old Oak woodlands are seen in the ancient Park Hill woodland in the estate at Abbeyleix; at Kyleadohir, on the Delour, Forest Wood House, Kylecorragh and Brownstown Woods on the Nore; and at Cloghristic Wood, Drummond Wood and Borris Demesne on the Barrow, though other patches occur throughout the site. Abbeyleix Woods is a large tract of mixed deciduous woodland which is one of the only remaining true ancient woodlands in Ireland. Historical records show that Park Hill has been continuously wooded since the sixteenth century and has the most complete written record of any woodland in the country. It supports a variety of woodland habitats and an exceptional diversity of species including 22 native trees, 44 bryophytes and 92 lichens. It also contains eight indicator

species of ancient woodlands. Park Hill is also the site of two rare plants, Nettle-leaved Bellflower and the moss *Leucodon sciuroides*. It has a typical bird fauna including Jay, Long-eared Owl and Raven. A rare invertebrate, *Mitostoma chrysomelas*, occurs in Abbeyleix and only two other sites in the country. Two flies *Chrysogaster virescens* and *Hybomitra muhlfeldi* also occur. The rare Myxomycete fungus, *Licea minima* has been recorded from woodland at Abbeyleix.

Oak woodland covers parts of the valley side south of Woodstock and is well developed at Brownsford where the Nore takes several sharp bends. The steep valley side is covered by Oak (*Quercus* spp.), Holly (*Ilex aquifolium*), Hazel (*Corylus avellana*) and Birch (*Betula pubescens*) with some Beech (*Fagus sylvatica*) and Ash (*Fraxinus excelsior*). All the trees are regenerating through a cover of Bramble (*Rubus fruticosus* agg.), Foxglove (*Digitalis purpurea*) Wood Rush (*Luzula sylvatica*) and Broad Buckler-fern (*Dryopteris dilatata*).

On the steeply sloping banks of the River Nore about 5 km west of New Ross, in County Kilkenny, Kylecorragh Woods form a prominent feature in the landscape. This is an excellent example of a relatively undisturbed, relict Oak woodland with a very good tree canopy. The wood is quite damp and there is a rich and varied ground flora. At Brownstown a small, mature Oak-dominant woodland occurs on a steep slope. There is younger woodland to the north and east of it. Regeneration throughout is evident. The understorey is similar to the woods at Brownsford. The ground flora of this woodland is developed on acidic, brown earth type soil and comprises a thick carpet of Bilberry (*Vaccinium myrtillus*), Heather (*Calluna vulgaris*), Hard Fern (*Blechnum spicant*), Cowwheat (*Melampyrum* spp.) and Bracken (*Pteridium aquilinum*).

Borris Demesne contains a very good example of a semi-natural broad-leaved woodland in very good condition. There is quite a high degree of natural re-generation of Oak and Ash through the woodland. At the northern end of the estate Oak species predominate. Drummond Wood, also on the Barrow, consists of three blocks of deciduous woods situated on steep slopes above the river. The deciduous trees are mostly Oak species. The woods have a well established understorey of Holly (*Ilex aquifolium*), and the herb layer is varied, with Brambles abundant. Whitebeam (*Sorbus devoniensis*) has also been recorded.

Eutrophic tall herb vegetation occurs in association with the various areas of alluvial forest and elsewhere where the flood-plain of the river is intact. Characteristic species of the habitat include Meadowsweet (*Filipendula ulmaria*), Purple Loosestrife (*Lythrum salicaria*), Marsh Ragwort (*Senecio aquaticus*), Ground Ivy (*Glechoma hederacea*) and Hedge Bindweed (*Calystegia sepium*). Indian Balsam (*Impatiens glandulifera*), an introduced and invasive species, is abundant in places. Floating River Vegetation is well represented in the Barrow and in the many tributaries of the site. In the Barrow the species found include Water Starworts (*Callitriche* spp.), Canadian Pondweed (*Elodea canadensis*), Bulbous Rush (*Juncus bulbosus*), Milfoil (*Myriophyllum* spp.), *Potamogeton x nitens*, Broad-leaved Pondweed (*P. natans*), Fennel Pondweed (*P. pectinatus*), Perfoliated Pondweed (*P. perfoliatus*) and Crowfoots (*Ranunculus* spp.). The water quality of the Barrow has improved since the vegetation survey was carried out (EPA, 1996).

Dry Heath at the site occurs in pockets along the steep valley sides of the rivers especially in the Barrow Valley and along the Barrow tributaries where they occur in the foothills of the Blackstairs Mountains. The dry heath vegetation along the slopes of the river bank consists of Bracken (*Pteridium aquilinum*) and Gorse (*Ulex europaeus*) species with patches of acidic grassland vegetation. Additional typical species include Heath Bedstraw (*Galium saxatile*), Foxglove (*Digitalis purpurea*), Common Sorrel (*Rumex acetosa*) and Bent Grass (*Agrostis stolonifera*). On the steep slopes above New Ross the Red Data Book species Greater Broomrape (*Orobanche rapum-genistae*) has been recorded. Where rocky outcrops are shown on the maps Bilberry (*Vaccinium myrtillus*) and Wood Rush (*Luzula sylvatica*) are present. At Ballyhack a small area of dry heath is interspersed with patches of lowland dry grassland. These support a number of Clover species including the legally protected Clustered Clover (*Trifolium glomeratum*) – a species known from only one other site in Ireland. This grassland community is especially well developed on the west side of the mud-capped walls by the road. On the east of the cliffs a group of rock-dwelling species occur, i.e. English

Stonecrop (*Sedum anglicum*), Sheep's-bit (*Jasione montana*) and Wild Madder (*Rubia peregrina*). These rocks also support good lichen and moss assemblages with *Ramalina subfarinacea* and *Hedwigia ciliata*.

Dry Heath at the site generally grades into wet woodland or wet swamp vegetation lower down the slopes on the river bank. Close to the Blackstairs Mountains, in the foothills associated with the Aughnabrisky, Aughavaud and Mountain Rivers there are small patches of wet heath dominated by Purple Moor-grass (*Molinia caerulea*) with Heather (*Calluna vulgaris*), Tormentil (*Potentilla erecta*), Carnation Sedge (*Carex panicea*) and Bell Heather (*Erica cinerea*).

Saltmeadows occur at the southern section of the site in old meadows where the embankment has been breached, along the tidal stretches of in-flowing rivers below Stokestown House, in a narrow band on the channel side of Common Reed (*Phragmites*) beds and in narrow fragmented strips along the open shoreline. In the larger areas of salt meadow, notably at Carrickcloney, Ballinlaw Ferry and Rochestown on the west bank; Fisherstown, Alderton and Great Island to Dunbrody on the east bank, the Atlantic and Mediterranean sub types are generally intermixed. At the upper edge of the salt meadow in the narrow ecotonal areas bordering the grasslands where there is significant percolation of salt water, the legally protected species Borrer's Saltmarsh-grass (*Puccinellia fasciculata*) and Meadow Barley (*Hordeum secalinum*) (Flora Protection Order, 1987) are found. The very rare Divided Sedge (*Carex divisa*) is also found. Sea Rush (*Juncus maritimus*) is also present. Other plants recorded and associated with salt meadows include Sea Aster (*Aster tripolium*), Sea Thrift (*Armeria maritima*), Sea Couch (*Elymus pycnanthus*), Spear-leaved Orache (*Atriplex prostrata*), Lesser Sea-spurrey (*Spergularia marina*), Sea Arrowgrass (*Triglochin maritima*) and Sea Plantain (*Plantago maritima*).

Salicornia and other annuals colonising mud and sand are found in the creeks of the saltmarshes and at the seaward edges of them. The habitat also occurs in small amounts on some stretches of the shore free of stones.

The estuary and the other Habitats Directive Annex I habitats within it form a large component of the site. Extensive areas of intertidal flats, comprised of substrates ranging from fine, silty mud to coarse sand with pebbles/stones are present. Good quality intertidal sand and mudflats have developed on a linear shelf on the western side of Waterford Harbour, extending for over 6 km from north to south between Passage East and Creadaun Head, and in places are over 1 km wide. The sediments are mostly firm sands, though grade into muddy sands towards the upper shore. They have a typical macro-invertebrate fauna, characterised by polychaetes and bivalves. Common species include *Arenicola marina*, *Nephtys hombergii*, *Scoloplos armiger*, *Lanice conchilega* and *Cerastoderma edule*.

The western shore of the harbour is generally stony and backed by low cliffs of glacial drift. At Woodstown there is a sandy beach, now much influenced by recreation pressure and erosion. Behind it a lagoonal marsh has been impounded which runs westwards from Gaultiere Lodge along the course of a slow stream. An extensive reedbed occurs here. At the edges is a tall fen dominated by sedges (*Carex* spp.), Meadowsweet, Willowherb (*Epilobium* spp.) and rushes (*Juncus* spp.). Wet woodland also occurs. This area supports populations of typical waterbirds including Mallard, Snipe, Sedge Warbler and Water Rail.

The dunes which fringe the strand at Duncannon are dominated by Marram grass (*Ammophila arenaria*) towards the sea. Other species present include Wild Sage (*Salvia verbenaca*), a rare Red Data Book species. The rocks around Duncannon ford have a rich flora of seaweeds typical of a moderately exposed shore and the cliffs themselves support a number of coastal species on ledges, including Thrift (*Armeria maritima*), Rock Samphire (*Crithmum maritimum*) and Buck's-horn Plantain (*Plantago coronopus*).

Other habitats which occur throughout the site include wet grassland, marsh, reed swamp, improved grassland, arable land, quarries, coniferous plantations, deciduous woodland, scrub and ponds.

Seventeen Red Data Book plant species have been recorded within the site, most in the recent past. These are Killarney Fern (*Trichomanes speciosum*), Divided Sedge (*Carex divisa*), Clustered Clover (*Trifolium glomeratum*), Basil Thyme (*Acinos arvensis*), Hemp nettle (*Galeopsis angustifolia*), Borrer's Saltmarsh Grass (*Puccinellia fasciculata*), Meadow Barley (*Hordeum secalinum*), Opposite-leaved Pondweed (*Groenlandia densa*), Autumn Crocus (*Colchicum autumnale*), Wild Sage (*Salvia verbenaca*), Nettle-leaved Bellflower (*Campanula trachelium*), Saw-wort (*Serratula tinctoria*), Bird Cherry (*Prunus padus*), Blue Fleabane (*Erigeron acer*), Fly Orchid (*Ophrys insectifera*), Broomrape (*Orobanche hederaceae*) and Greater Broomrape (*Orobanche rapum-genistae*). Of these the first nine are protected under the Flora Protection Order 1999. Divided Sedge (*Carex divisa*) was thought to be extinct but has been found in a few locations in the site since 1990. In addition plants which do not have a very wide distribution in the country are found in the site including Thin-spiked Wood-sedge (*Carex strigosa*), Field Garlic (*Allium oleraceum*) and Summer Snowflake (*Leucojum aestivum*). Six rare lichens, indicators of ancient woodland, are found including *Lobaria laetevirens* and *L. pulmonaria*. The rare moss *Leucodon sciuroides* also occurs.

The site is very important for the presence of a number of EU Habitats Directive Annex II animal species including Freshwater Pearl Mussel (*Margaritifera margaritifera* and *M. m. durrovensis*), Freshwater Crayfish (*Austropotamobius pallipes*), Salmon (*Salmo salar*), Twaite Shad (*Alosa fallax fallax*), three Lamprey species - Sea (*Petromyzon marinus*), Brook (*Lampetra planeri*) and River (*Lampetra fluviatilis*), the marsh snail *Vertigo moulinsiana* and Otter (*Lutra lutra*). This is the only site in the world for the hard water form of the Pearl Mussel *M. m. durrovensis* and one of only a handful of spawning grounds in the country for Twaite Shad. The freshwater stretches of the River Nore main channel is a designated salmonid river. The Barrow/Nore is mainly a grilse fishery though spring salmon fishing is good in the vicinity of Thomastown and Inistioge on the Nore. The upper stretches of the Barrow and Nore, particularly the Owenass River, are very important for spawning.

The site supports many other important animal species. Those which are listed in the Irish Red Data Book include Daubenton's Bat (*Myotis daubentoni*), Badger (*Meles meles*), Irish Hare (*Lepus timidus hibernicus*) and Frog (*Rana temporaria*). The rare Red Data Book fish species Smelt (*Osmerus eperlanus*) occurs in estuarine stretches of the site. In addition to the Freshwater Pearl Mussel, the site also supports two other freshwater Mussel species, *Anodonta anatina* and *A. cygnea*.

The site is of ornithological importance for a number of E.U. Birds Directive Annex I species including Greenland White-fronted Goose, Whooper Swan, Bewick's Swan, Bartailed Godwit, Peregrine and Kingfisher. Nationally important numbers of Golden Plover and Bar-tailed Godwit are found during the winter. Wintering flocks of migratory birds are seen in Shanahoe Marsh and the Curragh and Goul Marsh, both in Co. Laois and also along the Barrow Estuary in Waterford Harbour. There is also an extensive autumnal roosting site in the reedbeds of the Barrow Estuary used by Swallows before they leave the country.

Landuse at the site consists mainly of agricultural activities – many intensive, principally grazing and silage production. Slurry is spread over much of this area. Arable crops are also grown. The spreading of slurry and fertiliser poses a threat to the water quality of the salmonid river and to the populations of Habitats Directive Annex II animal species within the site. Many of the woodlands along the rivers belong to old estates and support many non-native species. Little active woodland management occurs.

Fishing is a main tourist attraction along stretches of the main rivers and their tributaries and there are a number of Angler Associations, some with a number of beats. Fishing stands and styles have been erected in places. Both commercial and leisure fishing takes place on the rivers. There is net fishing in the estuary and a mussel bed also. Other recreational activities such as boating, golfing and walking, particularly along the Barrow towpath are also popular. There is a golf course on the banks of the Nore at Mount Juliet and GAA pitches on the banks at Inistioge and Thomastown. There are active and disused sand and gravel pits throughout the site. Several industrial developments, which discharge into the river, border the site. New Ross is an important shipping port. Shipping to and from Waterford and Belview ports also passes through the estuary.

The main threats to the site and current damaging activities include high inputs of nutrients into the river system from agricultural run-off and several sewage plants, overgrazing within the woodland areas, and invasion by non-native species, for example Cherry Laurel and Rhododendron (*Rhododendron ponticum*). The water quality of the site remains vulnerable. Good quality water is necessary to maintain the populations of the Annex II animal species listed above. Good quality is dependent on controlling fertilisation of the grasslands, particularly along the Nore. It also requires that sewage be properly treated before discharge. Drainage activities in the catchment can lead to flash floods which can damage the many Annex II species present. Capital and maintenance dredging within the lower reaches of the system pose a threat to migrating fish species such as lamprey and shad. Land reclamation also poses a threat to the salt meadows and the populations of legally protected species therein.

Overall, the site is of considerable conservation significance for the occurrence of good examples of habitats and of populations of plant and animal species that are listed on Annexes I and II of the E.U. Habitats Directive respectively. Furthermore it is of high conservation value for the populations of bird species that use it. The occurrence of several Red Data Book plant species including three rare plants in the salt meadows and the population of the hard water form of the Pearl Mussel which is limited to a 10 km stretch of the Nore, add further interest to this site.

SITE NAME: GRAND CANAL pNHA
SITE CODE: 002104

The Grand Canal is a man-made waterway linking the River Liffey at Dublin with the Shannon at Shannon Harbour and the Barrow at Athy. The Grand Canal Natural Heritage Area (NHA) comprises the canal channel and the banks on either side of it. The canal system is made up of a number of branches - the Main Line from Dublin to the Shannon, the Barrow Line from Lowtown to Athy, the Edenderry Branch, the Naas and Corbally Branch and the Milltown Feeder. The Kilbeggan Branch is dry at present, but it is hoped to restore it in the near future. Water is fed into the summit level of the canal at Lowtown from Pollardstown Fen, itself an NHA.

A number of different habitats are found within the canal boundaries - hedgerow, tall herbs, calcareous grassland, reed fringe, open water, scrub and woodland. The hedgerow, although diverse, is dominated by Hawthorn (*Crataegus monogyna*). On the limestone soils of the midlands Spindle (*Euonymus europaeus*) and Guelder-rose (*Viburnum opulus*) are present. The vegetation of the towpath is usually dominated by grass species. Where the canal was built through a bog, soil (usually calcareous) was brought in to make the banks. The contrast between the calcicolous species of the towpath and the calcifuge species of the bog is very striking.

The diversity of the water channel is particularly high in the eastern section of the Main Line - between the Summit level at Lowtown and Inchicore. Arrowhead (*Sagittaria sagittifolia*) and Watercress (*Nasturtium officinale*) are more common in this stretch than on the rest of the system. All sites for Hemlock Water-dropwort (*Oenanthe crocata*) on the Grand Canal system are within this stretch. The aquatic flora of the Corbally Extension of the Naas Branch of the canal is also very diverse, with a similar range of species to the eastern Main Line.

Otter spraints are found along the towpath, particularly where the canal passes over a river or stream. The Common Newt breeds in the ponds on the bank at Gollierstown in Co. Dublin. The Rare and legally protected Opposite-leaved Pondweed (*Groenlandia densa*) (Flora Protection Order 1987) is present at a number of sites in the eastern section of the Main Line, between Lowtown and Ringsend Basin in Dublin.

The ecological value of the canal lies more in the diversity of species it supports along its linear habitats than in the presence of rare species. It crosses through agricultural land and therefore provides a refuge for species threatened by modern farming methods (NPWS, 1995).

APPENDIX 3 Laois Co. Co. water quality monitoring data

Table A3.1 Limits for physiochemical values taken in this report to suggest elevated levels. These limits are based on values provided in EPA (2001). Some of these criteria may be low and do not represent mandatory limits for one off samples. It is also noted that the receiving water is not a designated salmonid water, although it is likely to be / has potential to be a salmon and trout spawning area. Chronic exceedance of the below limits would be considered to be harmful to aquatic ecology and fisheries.

Parameter	Limit value	Standard
pH	<6 or >9	Salmonid Water Regulations (1988)
Conductivity ($\mu\text{S cm}^{-1}$)	none	EPA (2001)
Total Suspended Solids mg/l	>25	Salmonid Water Regulations (1988)
Temperature ($^{\circ}\text{C}$)	>21.5	Salmonid Water Regulations (1988)
Dissolved Oxygen (%)	<70 or >130	Salmonid Water Regulations (1988)
Dissolved Oxygen ($\text{mg O}_2\text{l}^{-1}$)	<9	Salmonid Water Regulations (1988)
BOD ($\text{mg O}_2\text{l}^{-1}$)	>3	Level for salmonid fish in the EU Freshwater Fish Directive 78/659/EEC. Salmonid Water Regulations (1988) limit value is 5mg/l.
Total ammonia (mg N l^{-1})	>0.1 (or >0.3)	Strict value taken from EPA (2001), levels above 0.3 mg/l would be harmful. However, EPA (2001) notes that these limits may be unduly low in certain circumstances. Limit of 1mg/l given in Salmonid Water Regulations (1988).
Un-ionised ammonia ($\text{mg NH}_3\text{l}^{-1}$)	>0.02	Salmonid Water Regulations (1988)
Nitrate as $\text{NO}_3\text{ mg/l}$	>2	This is a strict limit value suggested in Lucey (2007) for protecting sensitive aquatic species. Limit of 1.7mg/l required to protect Pearl Mussels. Limit of 50 mg/l given in Surface water Regulations (1989).
Nitrite as $\text{NO}_2\text{ mg/l}$	>0.01	Strict value taken from Freshwater Fish Directive 78/659/EEC for salmonids. Value of 0.05 given in Salmonid Water Regulations (1988)
ortho-phosphate (mg P l^{-1})	>0.03	Interim statutory standard for unpolluted rivers (EPA, 2001)
Total Phosphorous (mg/l)	>0.062	Level suggested for salmonid waters to reduce eutrophication (EPA, 2001)
Total Alkalinity as CaCO_3	none	EPA (2001)
Total Hardness (mg/l)	none	EPA (2001)

Table A3.2 Summary water quality results for the Stradbally River upstream and downstream of the Stradbally WwTP outfall during the period January 2007 to November 2008. Derived from data supplied by Laois County Council. Values considered to be elevated are highlighted in bold.

Ammonia(NH₃)							
	N	Mean	Min	Max	St.dev	Var	C.I .95
Upstream of plant	22	0.07	0.008	0.303	0.07	0.00	0.03
Downstream of plant	22	0.08	0.012	0.33	0.09	0.01	0.04
BOD							
	N	Mean	Min	Max	St.dev	Var	C.I .95
Upstream of plant	22	1.77	1	6	1.27	1.61	0.53
Downstream of plant	22	1.95	1	4	1.00	1.00	0.42
COD							
	N	Mean	Min	Max	St.dev	Var	C.I .95
Upstream of plant	4	166.50	1	643	317.74	100958.33	311.38
Downstream of plant	3	20.67	2	54.00	28.94	837.33	32.74
Conductivity @ 25°C							
	N	Mean	Min	Max	St.dev	Var	C.I .95
Upstream of plant	22	546.45	289	851	124.27	15443.21	51.93
Downstream of plant	22	552.73	289	812.00	123.71	15303.73	51.69
Dissolved Oxygen (mgO₂/l)							
	N	Mean	Min	Max	St.dev	Var	C.I .95
Upstream of plant	21	10.14	7.8	13.2	1.31	1.71	0.56
Downstream of plant	21	10.14	8.86	13.10	1.38	1.91	0.59
Hardness							
	N	Mean	Min	Max	St.dev	Var	C.I .95
Upstream of plant	2	309.40	292.9	325.9	23.33	544.50	32.34
Downstream of plant	2	308.01	295.09	320.93	18.27	333.85	25.32
Nitrates(NO₃)							
	N	Mean	Min	Max	St.dev	Var	C.I .95
Upstream of plant	22	4.466	1.75	21.21	3.89	15.15	1.63
Downstream of plant	22	3.66	1.797	5.41	0.99	0.98	0.41
Nitrite(NO₂)-N							
	N	Mean	Min	Max	St.dev	Var	C.I .95
Upstream of plant	2	0.006	0.005	0.007	0.00	0.00	0.00
Downstream of plant	2	0.008	0.007	0.009	0.00	0.00	0.00
Ortho-phosphate							
	N	Mean	Min	Max	St.dev	Var	C.I .95
Upstream of plant	22	0.04	0.009	0.08	0.02	0.00	0.01
Downstream of plant	22	0.06	0.018	0.113	0.03	0.00	0.01
pH							
	N	Mean	Min	Max	St.dev	Var	C.I .95
Upstream of plant	22	8.00	7.523	8.41	0.27	0.07	0.11
Downstream of plant	22	8.09	7.703	8.336	0.19	0.04	0.08

Suspended Solids							
	N	Mean	Min	Max	St.dev	Var	C.I .95
Upstream of plant	2	48	19	77.00	41.01	1682.00	56.84
Downstream of plant	2	10.5	9	12	2.12	4.50	2.94
Total Nitrogen							
	N	Mean	Min	Max	St.dev	Var	C.I .95
Upstream of plant	1	4.1	4.1	4.10	N/A	N/A	N/A
Downstream of plant	1	3.4	3.4	3.4	N/A	N/A	N/A
Total Phosphorous							
	N	Mean	Min	Max	St.dev	Var	C.I .95
Upstream of plant	2	0.13	0.12	0.14	0.01	0.00	0.02
Downstream of plant	2	0.1	0.08	0.12	0.03	0.00	0.04

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Receiving Water Impact Assessment: Stradbally

Table A3.3 Results of the dangerous substances monitoring of the Stradbally WwTP outfall during November and December 2008. Levels which may be considered elevated are highlighted in bold. All parameters are within the limits given in the EC Dangerous Substances Directive (76/464/EEC and Daughter Directives).

Parameter	Unit	Limit of Detection	Outlet		Upstream		Downstream		Dangerous substances standards (ug/l) for freshwater	Dangerous substances standards (ug/l) for all freshwater	Freshwater Fish Directive (78/659/EEC) limit	Salmonid Water Reg (1998) limit	Compliant downstream
			12138-4	12412-1	12139-5	12413-1	12139-4	12413-2					
Dichloromethane	ug/l	5	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	-	10	N/A	N/A	✓
Toluene	ug/l	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	10.0	N/A	N/A	✓
pm xylene	ug/l	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	10.0	N/A	N/A	✓
o xylene	ug/l	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	10.0	N/A	N/A	✓
Atrazine	ug/l	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	1	N/A	N/A	✓
Simazine	ug/l	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	1	N/A	N/A	✓
As	ug/l	0.2	0.6	0.8	<0.2	<0.2	<0.2	<0.2	25	-	N/A	N/A	✓
Ba	ug/l	1	64.2	32.2	35.4	43.4	33.7	41.1	-	N/A	N/A	N/A	✓
Cd	ug/l	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	5	N/A	N/A	✓
Cr	ug/l	0.1	1.4	<0.1	<1.0	<1.0	<1.0	<1.0	30	-	N/A	N/A	✓
Hg	ug/l	0.02	0.05	<0.02	<0.02	<0.02	<0.02	<0.02	-	-	N/A	N/A	✓
Ni	ug/l	0.5	3	<0.5	<0.5	<0.5	<0.5	<0.5	50	-	N/A	N/A	✓
Pb	ug/l	0.3	4.2	<0.3	<0.3	<0.3	<0.3	<0.3	10	-	N/A	N/A	✓
Se	ug/l	0.2	0.5	0.7	0.6	0.5	0.6	1.8	-	N/A	N/A	N/A	✓
Zn	ug/l	1	47.7	3.2	6.4	<1.0	2.9	<1.0	-	-	N/A	N/A	✓
B	mg/l	0.02	0.05	0.06	0.02	0.03	0.02	0.03	-	2000	N/A	N/A	✓
Cu	ug/l	3	24.9	<3.0	<3.0	<3.0	<0.3	<3.0	5	30	<0.04 mg/l Cu	Water hardness <0.005-0.112 mg/l Cu	✓
Cyanide	ug/l	5	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	10	-	N/A	N/A	✓
Sulphate	mg/l	1	22.2	<1.0	10.9	17.1	10.9	17.1	-	-	N/A	N/A	✓
Total Nitrogen	ug/l	1	12	3	4	5	9	9	-	-	N/A	N/A	✓
Total P	ug/l	0.003	0.5	1.1	<0.3	0.13	<0.3	0.09	-	-	N/A	N/A	✓
Fluoride	ug/l	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	500	-	N/A	N/A	✓
Phenols	ug/l	0.005	0.006	0.006	<0.005	0.091	0.005	0.035	-	-	N/A	N/A	✓
Tributyl Tin	ug/l	0.02	<0.02	Note 3	<0.02	Note 3	<0.02	Note 3	-	0.001	N/A	N/A	✓

APPENDIX 4 Biological water quality assessment (2009)

Table A4.1 Biological water quality assessment results; Stradbally, 2009.

Group/organism	Pollution sensitivity group	Functional group	Relative abundance	
			Reference site	Receptor site
MAYFLIES (Ephemeroptera)				
Family Heptageniidae				
Autumn dun <i>Ecdyonurus dispar</i>	A	Scraper & gathering collector	2	2
Yellow upright <i>Rhithrogena semicolorata</i>	A	Scraper & gathering collector	6	3
Yellow may dun <i>Heptagenia sulphurea</i>	A	Scraper & gathering Collector	3	
Family Baetidae				
Large dark olive <i>Baetis rhodani</i>	C	Scraper & gathering collector	156	72
STONEFLIES (Order Plecoptera)				
Family Perlodidae				
Common yellow sally <i>Isoperla grammica</i>	A	Shredder	2	
Needleflies (Leutridae)				
<i>Leutra</i> sp.	B	Shredder	1	
Family Taeniopterygidae				
<i>Brachyptera risi</i>	A	Shredder		1
CASED CADDIS FLIES (Trichoptera)				
Microcaddisflies (Hydroptilidae)				
<i>Hydroptila</i> sp.	B	Scraper	2	10
CASELESS CADDIS FLIES (Trichoptera)				
Grey flags (Hydropsychidae)				
<i>Hydropsyche siltalai</i>	C	Filtering Collector	3	1
Green sedges (Rhyacophilidae)				
The sandfly <i>Rhyacophila dorsalis</i>	C	Predator	4	6
Family Polycentropodidae				
<i>Polycentropus kingi</i>	C	Filtering collector		1
TRUE FLIES (Diptera)				
Blackfly (Simuliidae)				
	C	Filtering collector	22	68
Crane flies (Tipulidae)				
<i>Dicronata</i> sp.	C	Shredder	26	9
Family Chironomidae				
Green chironomid	C	Filtering collector	2	1
BEE TL ES (Coleoptera)				
Whirligig beetle larvae (Gyrinidae)				
	C	Predator	5	3
Riffle beetle larvae (Elmidae)				
<i>Elmis</i> sp. (larvae)	C	Scraper	11	4
<i>Limnius</i> sp. (larvae)	C	Scraper	4	
MUSSELS (Mollusca)				
Family Sphaeriidae				
<i>Pisidium</i> sp.	D	Filtering Collector	2	
CRUSTACEANS (Crustacea)				
Amphipoda (Family Gammaridae)				
<i>Gammarus duebeni</i>	C	Shredder	2	1
Isopoda (Family Asellidae)				
<i>Asellus aquaticus</i>	D	Shredder	1	2
LEECHES (Hirudinae)				
Family Erpobdellidae				
<i>Erpobdella octoculata</i>	D	Predator		4
SEGMENTED WORMS (Annelida)				
Aquatic earthworm (Lumbriculidae)	D	Collector	12	3
Total number of organisms			266	193
Number of families			16	16
Q value			Q4*	Q3-4*
Quality class			Class A*	Class B*
BMWP score			101.3*	99.1*
ASPT			6.33*	6.19*

*NB: These results are all very borderline. At most there is only a slight deterioration in biological water quality between the two sites.

Table A4.2 Selected water quality characteristics of the two sites surveyed on the Stradbally River adjacent to the Stradbally WwTP outfall on the 7th January 2009.

	Reference site	Receptor site
Temperature (°C)	2.5	2.4
Dissolved Oxygen (%)	93.4	93.7
Dissolved Oxygen (mg O2l-1)	12.74	12.76
Conductivity (µS cm-1)	620	682

Table A4.3 Selected physical characteristics of the two sites surveyed on the Stradbally River near the Stradbally WwTP outfall on the 7th January 2009.

Physical parameter	Reference site	Receptor site
Wetted width (m)	8	7.5
Mean depth (cm)	25	35
Maximum depth (cm)	45	55
Rock (%)	5	5
Cobble (%)	35	35
Gravel (%)	40	40
Fine (%)	20	20
Riffle (%)	50	45
Glide (%)	35	40
Pool (%)	15	15
Shade (%)	20	5
Instream vegetation (%)	5	5
Bank height (m)	1.5	2.5
Bank slope (°)	60	45
Bank cover (%)	95	95

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APPENDIX 5 Screening Assessment

DOEHLG Circular L8/08 Assessment

The Department of the Environment, Heritage and Local Government (DOEHLG) Circular L8/08 'Water Services Investment and Rural Water Programmes – Protection of Natural Heritage and National Monuments' issued in September 2008 provides guidance on identifying potential issues relating to protection of natural heritage (including sites, habitats and species) during the planning of water services schemes. The requirements of this circular were followed during the preparation of the section. In order to identify potential ecological constraints, this report examines the current project (existing and proposed) in accordance with the checklist provided in Appendix 1 of L8/08 for natural heritage, and the checklist in Appendix 2 of L8/08 for archaeological heritage. The flow diagram provided in Circular L8/08 and replicated in Figure A5.1 of this report was also utilized. The outcome of the assessment is provided in Table A5.1.

Table A5.1 Natural heritage check-list (from DOEHLG Circular L8/08).

Checklist	Response	Conclusion
Is the development in or on the boundary of a nature conservation site NHA/SAC/SPA?	Yes	Further assessment required.
Will nationally protected species be directly impacted? Wildlife Acts (1976 and 2000), Flora Protection order (S.I. 94 of 1999)	Yes	Further assessment required.
Is the development a surface water discharge or abstraction in the surface water catchment or immediately downstream of a nature conservation site with water dependant qualifying habitats/species?	Yes	Further assessment required.
Is the development a groundwater discharge or abstraction in the ground water catchment or within 5 km of a nature conservation site with water-dependant qualifying habitats/species?	No	No likely impacts
Is the development in the surface water or groundwater catchment of salmonid waters?	Yes	Further assessment required.
Is the treatment plant in an active or former floodplain or flood zone of a river, lake, etc?	Yes	Further assessment required.
Is the development a surface discharge or abstraction to or from marine waters and within 3km of a marine nature conservation site?	No	No likely impacts
Will the project in combination with other projects (existing and proposed) or changes to such projects affect the hydrology or water levels of sites of nature conservation interest or the habitats of protected species?	No	No likely impacts
Conclusion		Assess Impacts

Article 6 Screening Assessment (summary)

An Appropriate Assessment (Stage 1, Screening Assessment) has been completed in Section 4.3 Impact on Areas designated for Nature Conservation. The flow diagram provided in Figure A5.2 of this report was utilized. The outcome of the assessment is provided in Table A5.2.

Table A5.2 Summary of Article 6 Screening Assessment.

Checklist	Response	Conclusion
Is the PP directly connected with or necessary to the site management for nature conservation?	Yes	Screening necessary
Is the PP likely to have significant effects on the site?	Yes	Stage 2 Assessment required
Conclusion		Assess Impacts

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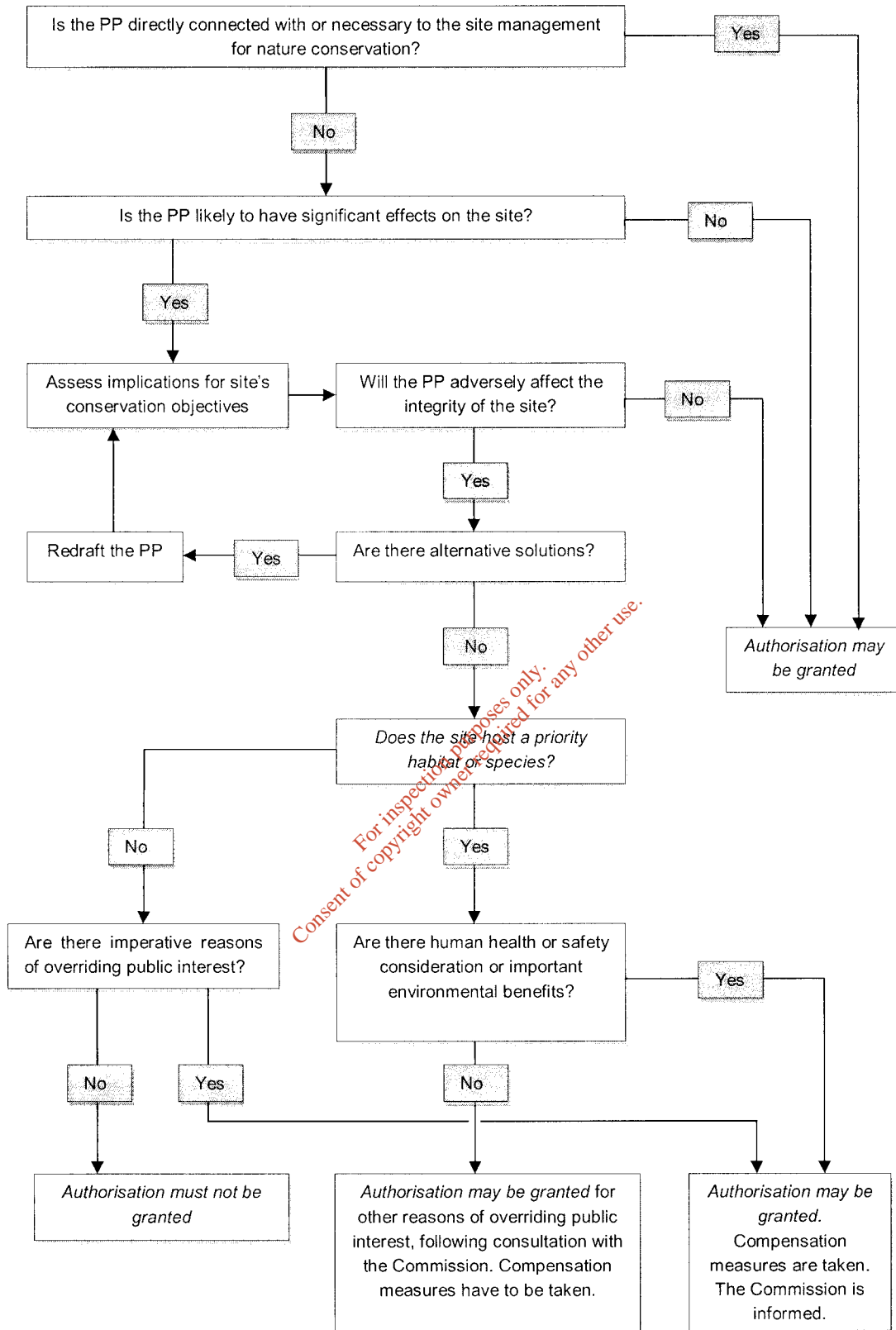


Figure A5.1 Flowchart outlining the appropriate assessment process (Adapted from EC, 2001).

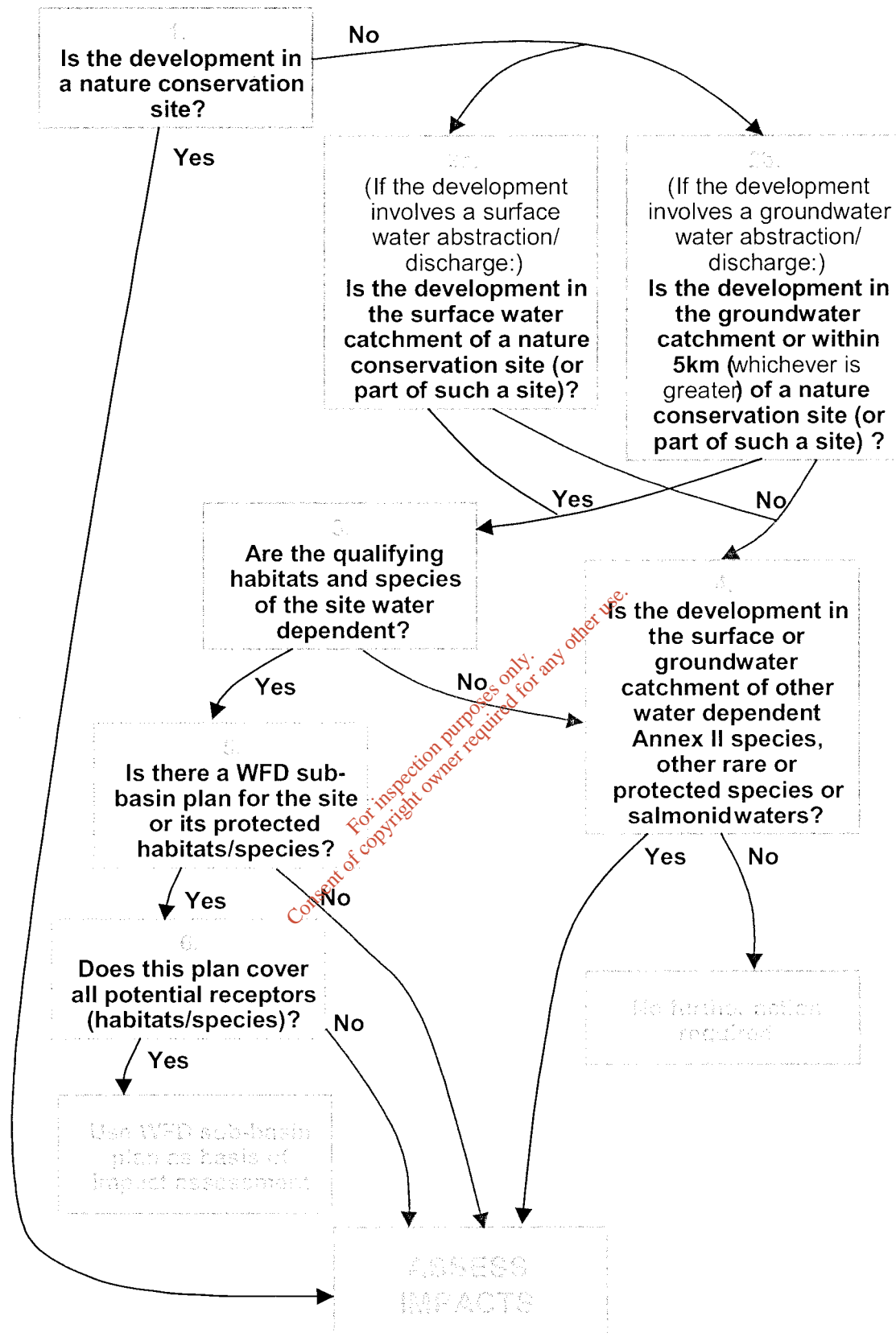


Figure A5.2 Flow chart for assessing screening requirements (from DOEHLG circular L8/08).

Appendix 6 Assessment of Impacts and Impact Significance

Criteria for assessing impact type and magnitude are presented in Tables A6.1 and A6.2, respectively.

In assessing the magnitude and significance of impacts it is important to consider the value of the affected feature, this is taken into account in Table 2 in the main body of the report.

Table A6.1. Criteria for assessing impact type.

Impact type	Criteria
Positive impact:	A change is likely to improve the ecological feature in terms of its ecological value.
Neutral	No effect.
Negative impact:	The change is likely to adversely affect the ecological value of the feature.

Table A6.2 Criteria for assessing impact magnitude.

Impact magnitude	Definition
No change:	No discernible change in the ecology of the affected feature.
Imperceptible Impact:	A change in the ecology of the affected site, the consequences of which are strictly limited to within the development boundaries.
Minor Impact:	A change in the ecology of the affected site which has noticeable ecological consequences outside the development boundary, but these consequences are not considered to significantly affect the distribution or abundance of species or habitats of conservation importance.
Moderate Impact:	A change in the ecology of the affected site which has noticeable ecological consequences outside the development boundary. These consequences are considered to significantly affect the distribution and/or abundance of species or habitats of conservation importance.
Substantial Impact:	A change in the ecology of the affected site which has noticeable ecological consequences outside the development boundary. These consequences are considered to significantly affect species or habitats of high conservation importance and to potentially affect the overall viability of those species or habitats in the wider area.
Major Impact:	A change in the ecology of the affected site which has noticeable ecological consequences outside the development boundary. These consequences are considered to be such that the overall viability of species or habitats of high conservation importance in the wider area ² is under a very high degree of threat (negative impact) or is likely to increase markedly (positive impact).