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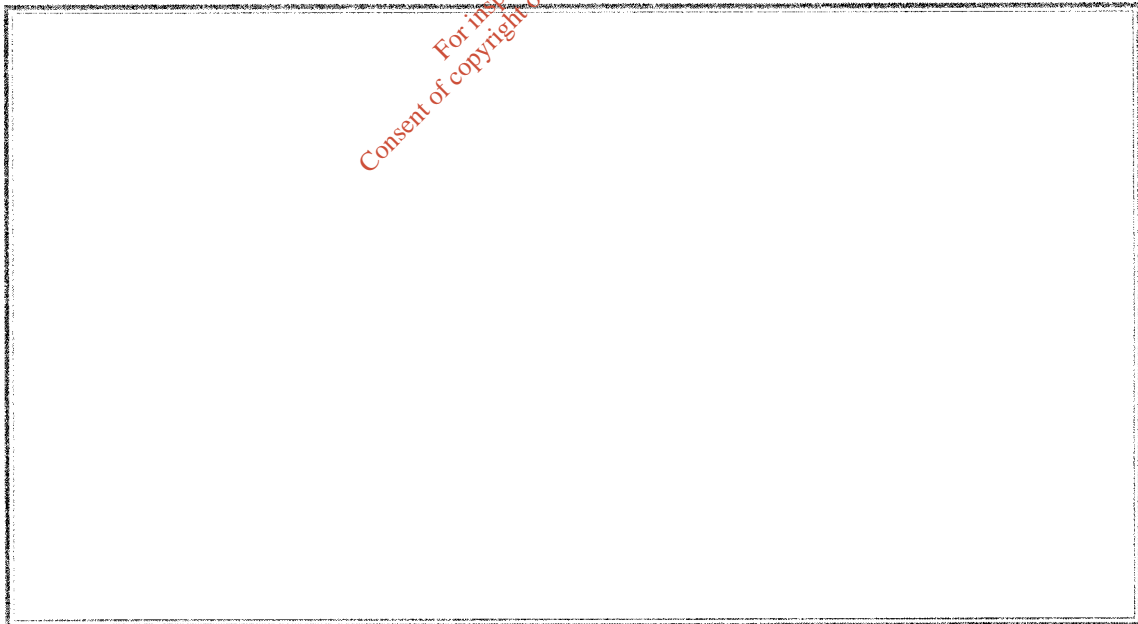


Laois County Council

LAOIS GROUPED TOWNS SEWERAGE
SCHEME

**SUMMARY REPORT ON UPGRADE
PROPOSALS FOR STAGE 3 APPROPRIATE
ASSESSMENTS - DURROW**

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January 2012



Nicholas O'Dwyer
CONSULTING ENGINEERS

LAOIS COUNTY COUNCIL

LAOIS GROUPED TOWNS SEWERAGE SCHEME

SUMMARY UPGRADE REPORT - DURROW

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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 Durrow. 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 Durrow is the Erkina River, a tributary of the River Nore. The River Nore is part of the River Nore and River Barrow Special Area of Conservation (SAC) (Site Code 002162).

Following correspondence from the EPA in June 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 Durrow Wastewater Treatment Works (WWTW) is operating significantly above capacity, and the discharge was found to have a direct localised impacts on the qualifying interests of the SAC.
- The existing Durrow Wastewater Treatment Works (WWTW) cannot meet the required effluent standards identified in the relevant legislation.
- Significant upgrade proposals would be required to satisfy the requirements for 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 Durrow. 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 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

Durrow is situated on the N8 in the south of County Laois. The nearby Erkina River is a tributary of the River Nore. The confluence of the two rivers is just downstream of the town. The River Nore is part of the River Barrow and River Nore Special Area of Conservation (Site Code 002162).

Durrow is one of 5 towns included in the Laois Towns and Villages Wastewater Improvement 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 3,000 population equivalent (PE). The plant will continue to discharge to the Erkina 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 Towns and Villages Wastewater Improvement 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 below.

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	-

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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.

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 (m³/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 (m³/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 = 0.95 mg/l
 F_{river} = F_{95} (for BOD calculations) = 0.75 m³/s
 F_{eff} = effluent flow = 3,000 x 0.225 / (60 x 60 x 24) = 0.0078 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 0500 between 2005 and 2006. Station 0500 is located at Durrow Footbridge, upstream of Durrow.

$$C_{\text{eff}} = \frac{[(2.6 * (0.75 + 0.0078)) - (0.95 * 0.75)]}{0.0078} = 161 \text{ mg/l}$$

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 25 mg/l. A 90% level of reduction in suspended solids (SS) is required to achieve a standard of 35mg/L.

Waste Assimilative Capacity – Total Ammonia, Oxidised Nitrogen and Ortho-Phosphate

The *River Barrow and River Nore Report to Inform an Appropriate Assessment (Entec and O'Dwyer, 2007)* concluded that the background concentrations for total ammonia, oxidised nitrogen and ortho-phosphate in the River Nore downstream of the Durrow outfall all exceed the recommended water quality standards for the protection of Freshwater Pearl Mussels. Stringent effluent standards were proposed for the Durrow discharge in order to treat effluent to a standard that minimises the additional increases in the River Nore. The predicted concentrations in the River Nore due to the proposed works at Durrow shall be increased marginally above the background as a result of using the Best Available Technology for sewage treatment. The predicted levels necessarily exceed the standard for the protection of Freshwater Pearl Mussel, since the background levels already exceed the standards due to sources other than wastewater from Durrow. Total ammonia, oxidised nitrogen and ortho-phosphate concentrations downstream of the Durrow outfall are predicted to increase by 5%, 0.3% and 1.7% respectively.

The predicted increase in total ammonia, oxidised nitrogen and ortho-phosphate concentrations downstream of the Durrow outfall from the proposed effluent standards as a percentage of the Freshwater Pearl Mussel guidance standard are 10%, 5% and 7% respectively.

It should be noted, however, that the background contaminant concentrations in the River Nore are elevated and already exceed the recommended water quality standards for protection of Freshwater Pearl Mussels (Table 6.2). The approach taken to reduce any further water quality deterioration was to derive discharge standards that minimised additional increases in concentration of these parameters using Best Available Technology to treat sewage. In order for the receiving waters to comply with the recommended water quality standards, a catchment wide reduction in nutrient enrichment (such as from agricultural runoff and inputs from inadequate treatment of sewage upstream of the Freshwater Pearl Mussel habitat) will be required. The proposed effluent discharges should not be a significant factor in achieving the NPWS guidance levels for these parameters in the receiving waters in the future if catchment wide improvements are achieved.

2.2 Proposed Effluent Standards to be achieved by Upgrade Proposal

The effluent standards for the proposed upgrade at Durrow identified in Table 2.1 below are the effluent standards included in the tender documents for the Laois Towns and Villages Wastewater Improvement Scheme – Contract A Design Build Operate Contract.

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

Parameter	Concentration
BOD ₅ (mg/L)	25
Total Suspended Solids (mg/L)	35
COD (mg/L)	125
Total Phosphorus (mg/L P)	0.37
Total Oxidised Nitrogen (mg/L N)	11.2
Total Ammonia (mg/L N)	1.0

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 Durrow 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 (3 DWF). Flows in excess of 3 DWF will be diverted to a storm tank which will have a storage capacity of 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 Durrow WWTW

The indicative layout used for the Part 8 Planning Documents is shown in Drawing No. 20345-SR-AX-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;
- Storm 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 Durrow 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 6,000. 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 5,145. The adoption of a medium growth rate was recommended which resulted in a design P.E. of 3,000, which was adopted as the Stage 1 design capacity.

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

Table 3.1 - Current and Future WWTW Population Equivalents at Durrow

Durrow WWTW	Population Equivalent (p.e.)		
	2005	2015	2025
Domestic	1053	1852	2203
Commercial	118	207	247
Educational	42	74	88
Total	1,213	2,133	2,537
Existing/Proposed WWTW Capacity	700	3,000	3,000

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

Stage 1 (20 years) = 3,000 p.e.

Ultimate = 6,000 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-DW-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 Durrow will be brought into operation in January 2015, 21 months after the anticipated contract commencement.

Table 3.2 – Anticipated Commencement 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 Durrow WwTW with regard to the potential for adverse effects on the River Barrow and the River Nore Special Area of Conservation (site code 002162). The Durrow WwTW discharges to the River Erkina which is designated as part of the River Barrow and River Nore SAC. The WwTW therefore has the potential to directly impact on the SAC. The proposed WwTW at Durrow will also discharge to the River Erkina and therefore may also directly impact on the SAC. The potential for the discharge from the proposed WwTW to impact on the River Barrow and River Nore SAC is discussed in the following sections.

4.2 Significant Effects on SAC Identified in Environmental Reports

The 2011 Appropriate Assessment carried out on the existing WwTW firstly concluded that there could be direct impacts from discharges from the existing Durrow WwTW on the SAC as the WwTW discharges directly to the SAC. As the proposed WwTW will also discharge directly to the River Barrow and Nore SAC the proposed WwTW also has the potential to directly impact the SAC.

It was also concluded that the existing Durrow WwTW may indirectly impact on SAC qualifying interests such as Freshwater Pearl Mussel further downstream and may also work in combination with background water quality to cumulatively impact on the SAC. It is therefore feasible that discharges from the proposed WwTW may also cause indirect and cumulative impacts on the conservation interests of the SAC.

Impacts on Qualifying features

The Appropriate Assessment concluded that discharges from the operation of the current Durrow 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)**
- **Atlantic salmon (1106)**
- **Otter (1355)**
- **White-clawed crayfish (1092)**
- **Desmoulin's whorl snail (1016)**

It is proposed to upgrade the existing WWTW at Durrow which will result in a highly significant improvement in the quality of the effluent being discharged to the River Erkina. This will consequently improve water quality in the River Erkina downstream of the discharge location. It is therefore reasonable to conclude that the upgraded Erkina WWTW will not impact on these SAC conservation interests.

The Appropriate Assessment carried out for the existing WWTW also concluded that discharges from the operation of the existing Durrow WWTW may impact on the following conservation interests

- **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; with a direct application to the current WwTP at Durrow. The WwTP at Durrow has the potential to contribute to nutrient-loadings and water pollution affecting the structure and function of this habitat.

- **Irish Freshwater Pearl Mussel (1990) and Nore Freshwater Pearl Mussel (1029)**

There is no monitoring data available to demonstrate the significance of impacts that the Durrow WwTP is having on water quality in the river Nore main channel, however, the ongoing impacts to water quality arising from the plant, affecting the River Erkina within the SAC will contribute to cumulative background water quality impacts potentially affecting the conservation status of the Freshwater Pearl Mussel.

It is therefore feasible that discharges from the proposed WwTP at Durrow could also impact on these SAC qualifying features.

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 Durrow 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.

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. Contractors to have an appropriate emergency response plan in place in the event of spillages.		
	Adoption of additional pollution prevention measures outlined in relevant guidance.		
	Site briefing to be held with site personnel prior to commencement of works.		

Potentially Significant Effect on SAC	Mitigation/Enhancement	Residual Adverse Affect on Integrity of SAC?	Rationale
Damage/disturbance to bank side habitat resulting in negative effects on SAC species.	Minimal vegetation clearance on banks.	No	Low potential to affect small area therefore no significant effect on populations of Annex II species predicted.
Operation			
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 Erkina tributary 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' waterbodies and the Urban Wastewater Treatment Regulations for BOD, Ammonia and Phosphorus.

The *River Barrow and River Nore Report to Inform an Appropriate Assessment (Entec and O'Dwyer, 2007)* concluded that the background concentrations for total ammonia, oxidised nitrogen and ortho-phosphate in the River Nore downstream of the Durrow outfall all exceed the recommended water quality standards for the protection of Freshwater Pearl Mussels. Stringent effluent

standards were proposed for the Durrow discharge in order to treat effluent to a standard that minimises the additional increases in the River Nore. The report identified an Ammonia, Phosphorus and Total Oxidised Nitrogen effluent standards of 1 mg/l, 0/37 mg/l and 11.2 mg/l respectively to minimise the impact on the Freshwater Pearl Mussel population in the River Nore downstream of the River Erkina Stream. The proposed effluent standards for Durrow WwTW are presented in Table 4.2.

Table 4.2 - Proposed Effluent Standards at Durrow WWTW in DBO Contract Documents

Parameter	Concentration
BOD ₅ (mg/L)	25
Total Suspended Solids (mg/L)	35
COD (mg/L)	125
Total Phosphorus (mg/L P)	0.37
Total Oxidised Nitrogen (mg/L N)	11.2
Total Ammonia (mg/L N)	1.0

The effluent standards as presented in Table 4.2 for the new WwTW at Durrow will result in a noticeable and significant improvement in water quality in the Erkina River downstream of the discharge. An improvement in water quality downstream of the Durrow WwTW would result in direct positive impacts on the qualifying interests for which the SAC is selected and which occur in the Erkina River; i.e. Floating River vegetation, Atlantic salmon, otter, and brook lamprey. Subsequent to The *River Barrow and River Nore Report to Inform an Appropriate Assessment (Entec and O'Dwyer, 2007)* Waste Assimilative Capacity Calculations carried out as part of the 2011 Appropriate Assessment undertaken by Ecofact found that the proposed plant, with its improved discharge will be within the Waste Assimilative Capacity under 95%ile flows for 'High Status' in the Erkina; therefore, complying with the water quality requirements of the Annex II aquatic conservation interests for which the River Barrow and River Nore SAC are designated. No discernible impacts affecting water dependent Annex 1 habitats are therefore envisaged with the operation of the plant.

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 Durrow 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 Durrow 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 therefore, 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 including the Nore Freshwater Pearl Mussel.

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APPENDIX 1 –LAYOUT PLAN OF WWTW UPGRADE

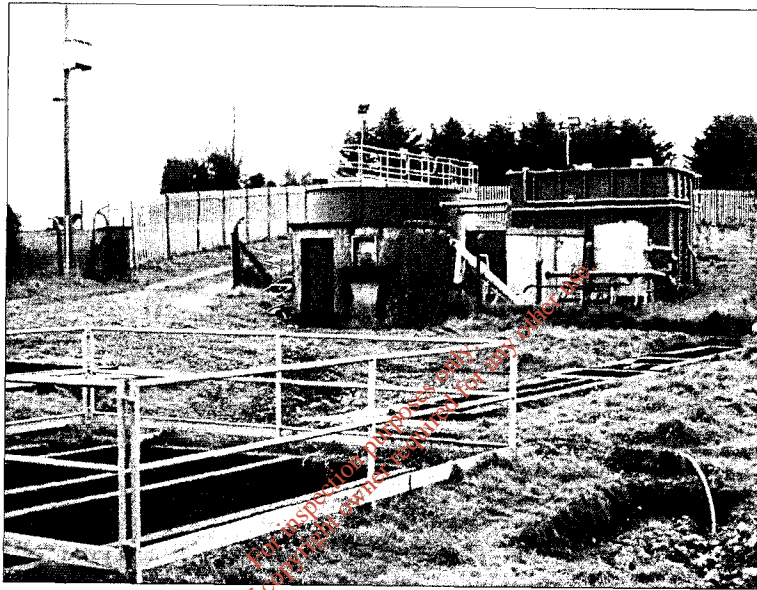
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Laois County Council

Durrow 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 a 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 of 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 Durrow 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 Durrow 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. The Durrow WwTP discharges directly into the River Barrow and River Nore SAC and therefore has the potential for direct 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 Durrow WwTP are presented in Figure 1.

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 Durrow, the magnitude of impact of the discharge is not easily quantifiable at Stage 1: Screening; indicating the potential for adverse effects on the SAC. 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 Durrow 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 Durrow 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.

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. The Receiving Water Impact Assessment (RWIA; Ecofact, 2009) produced on behalf of the Water Services section of Laois County Council was also utilised and this document is included in Appendix 2 of this report.

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' as relevant. 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 Durrow. The Appropriate Assessment process must be engaged in this instance.

3. STAGE 1: SCREENING / TEST OF SIGNIFICANCE

3.1 Description of the Durrow WwTP

Durrow town is located south of Portlaoise, on the main Dublin-Cork National primary route (N8) and on the Durrow-Kilkenny National Secondary Road. The town of Durrow is classified as a Secondary Settlement under the County Development Plan 2006-2012, with a population of 1,258 in 2006 (Source: Durrow Town Plan, Laois County Council website). The existing WwTP is located immediately to the east of the town and discharges in the River Erkina, approximately 1km upstream of its confluence with the River Nore. The existing WwTP at Durrow has a capacity of only 700 P.E. with the present population served at approximately 1,213 P.E.; the plant is therefore overloaded (Entec & O' Dwyer, 2006). There are two pumping stations on the network, at Erkina Bridge and at Cork Road. The Erkina Bridge pumping station has an overflow directly to the Erkina, in addition there is a separate overflow on the network in the main street which discharges in close proximity to main road bridge. A detailed assessment of the existing Durrow WwTP is presented in the Receiving Water Impact Assessment for the plant (Ecofact, 2009), which is included in Appendix 2 of the current document.

A new plant is proposed for the Durrow site as part of the Laois Towns and Villages Wastewater Improvement Scheme. Furthermore, the Laois Towns and Villages Main Drainage project involves the upgrading of the collection system. These projects will include tertiary treatment and separation of storm water and sewage streams. The layout of the proposed plant (Stage 1) is such that it could be easily expanded (Stage 2) to cater for future loads within the proposed site. The design population equivalent for Durrow was taken as 3,000 PE for Stage 1. To cater for future growth, the site layout allows for a total future (Stage 2) design PE of 6,000.

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 proposed WwTP, as presented in Table 1. The only site within 15 km that is likely to be affected either directly, indirectly or cumulatively by the Durrow WwTP discharge is the River Barrow and River Nore SAC. Additional Natura 2000 sites within 15km of Durrow 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.

Table 1 Summary details of the designated areas located within 15km of the WwTP.

Name	Distance from SAC (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.	Included as the Durrow WwTP discharges directly to this SAC.
Lisbigney Bog SAC 0869	4.5km north east	Wetland dominated by fen vegetation of considerable conservation significance for the good example of <i>Cladium</i> fen, a priority habitat that is listed on Annex I of the E.U. Habitats Directive, and for the population of <i>Vertigo moulinsiana</i> that it supports.	Not included as there is no connection between this site and the Durrow WwTP.
Cullahill Mountain SAC 0831	10km south west	The importance of this site lies in the presence of the large population of Greenwinged Orchid in grassland referable to a type listed, with priority status, on Annex I of the EU Habitats Directive.	Not included as there is no connection between this site and the Durrow WwTP.
Galmoy Fen SAC 1858	13km south west	This site contains a variety of natural grassland communities that are rare in Ireland. The presence of a population of Green-winged Orchid in grassland referable to a type listed, with priority status, on Annex I of the EU Habitats Directive is notable.	Not included as there is no connection between this site and the Durrow WwTP.
Spahill and Clomantagh Hill SAC 0849	14km southwest	As above	Not included as there is no connection between this site and the Durrow WwTP.

3.3 Assessment of likely impacts affecting the Natura 2000 site

3.3.1 Assessment of likely direct impacts

The discharge from the existing Durrow WwTP is into the River Erkina, which is included within the River Barrow and River Nore SAC designation. The discharge point is located approximately 1km upstream of the confluence of the River Erkina with the River Nore main channel. The results of both chemical and biological water quality assessments (Ecofact, 2009) suggest that the Durrow WwTP discharge could potentially be causing an adverse effect on the water quality of the River Erkina within the SAC. However, there are other pollution sources affecting the river from upstream, with additional background water quality impacts affecting the River Nore main channel. Therefore, the overall significance of the Durrow plant in terms of water quality impacts is unknown.

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 existing WwTP is known to be overloaded, with chemical and biological water quality indicating that the ongoing operation of the plant is having a localized effect on the River Erkina. Although there is no conclusive evidence that the operation of the plant is having any indirect effects on the main channel of the River Nore downstream i.e. with regard to the conservation interests of the SAC and with particular regard to the presence of Annex II Freshwater pearl mussels within the Nore, downstream of the Erkina confluence, this would require further detailed study. In this regard it must be concluded that the operation of the existing plant has at least the potential to be causing significant effects on the SAC.

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).

Due to compromised background water quality, the River Erkina has a limited waste assimilation capacity, particularly in relation to phosphorous (Ecofact, 2009). The existing discharge from the Durrow WwTP was found to increase certain parameters in the river to levels which are at or above the relevant water quality standards (Ecofact, 2009). It is therefore concluded that the existing WwTP at Durrow is having an adverse effect on the River Erkina in terms of assimilation capacity in combination with background levels, which has associated cumulative impacts on water quality within the SAC.

3.4 Screening statement with conclusions

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

- 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 –

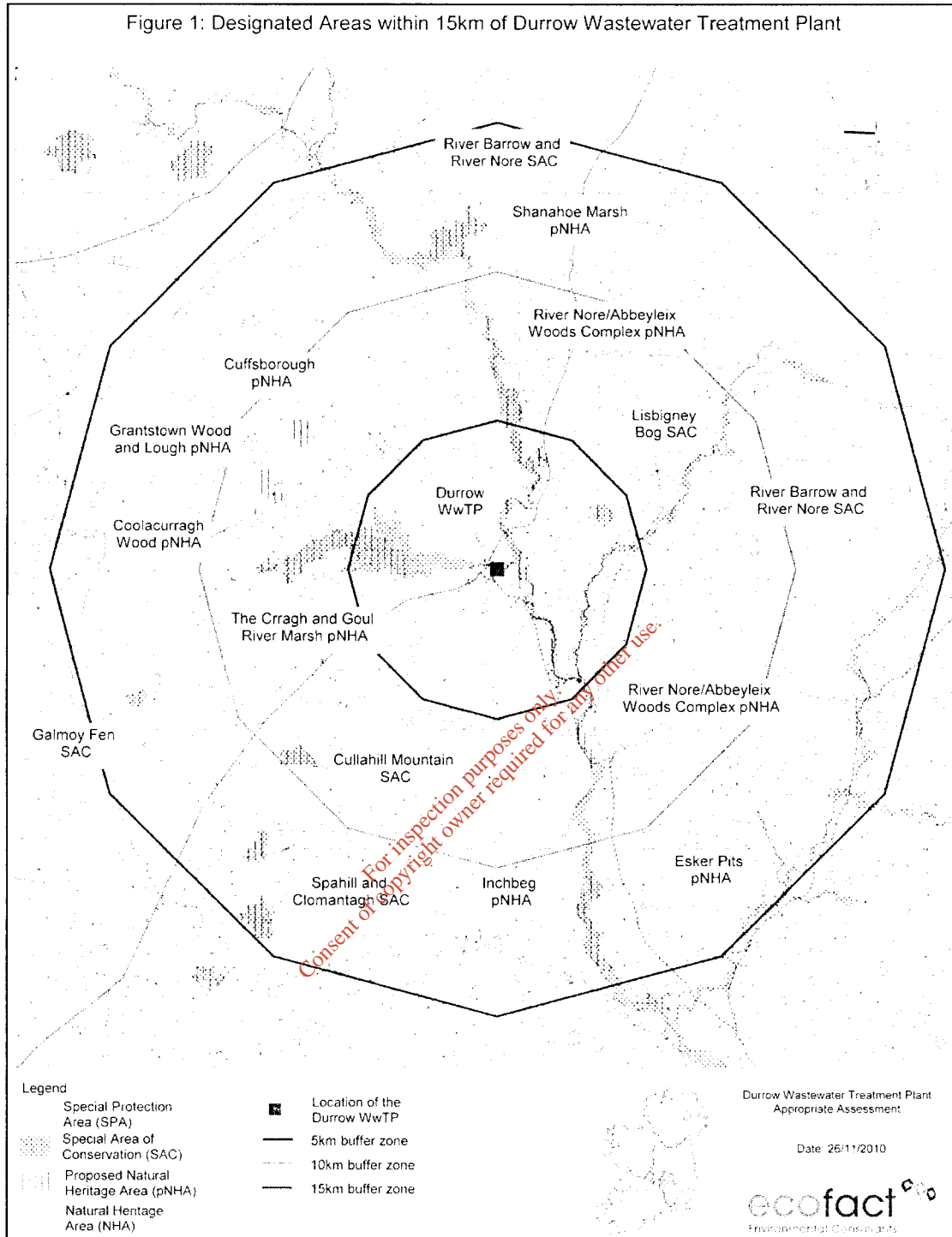
Water Services Investment and Rural Water Programmes – Protection of Natural Heritage and National Monuments' have been followed in establishing the conclusion of the Screening Statement.

1. **Is the development in a nature conservation site?** Yes, the Durrow WwTP is discharging directly to the River Barrow and River Nore SAC, where the Erkina River is designated within the SAC.
2. **Is the development in the surface water catchment of a nature conservation site (or part of such a site)?** – Yes, as above.
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 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 River Erkina within the River Barrow and River Nore SAC arising from the current operation of the Durrow WwTP; particularly in relation to water quality. There is therefore the potential for further downstream effects on the SAC which would require further assessment.

It is stated in EPA (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 Durrow 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.

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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 WwTP discharge to the River Erkina. The conservation objectives of the River Barrow and River Barrow and River Nore SAC are identified, where those potentially affected by the proposed discharge are listed and potential impacts outlined. A detailed map of the Durrow WwTP study area, indicating the River Barrow and River Nore SAC, is given in Figure 2.

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 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*). 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 Erkina River or riparian habitats	Present in the Nore River within 15km
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>)			
Habitats	91A0	Old sessile oak woods with <i>Ilex</i> and <i>Blechnum</i> 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>Ranunculus fluitantis</i> and <i>Callitriche-Batrachion</i> vegetation	✓	✓
	1310	<i>Salicornia</i> and other annuals colonizing mud and sand		
	1330	Atlantic salt meadows (<i>Glaucopuccinellietalia maritimae</i>)		
	1410	Mediterranean salt meadows		

Natura Code	Item Description	Present in the Erkina River or riparian habitats	Present in the Nore River within 15km
	(<i>Juncetalia maritimi</i>)		
4030	European dry heaths		
7220	Petrifying springs with tufa formation (Cratoneurion)		
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 Description of the conservation interests of the SAC

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 Durrow WwTP, due to the considerable distance from the discharge point in the River Erkina.

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 in the Durrow area, both along sections of the River Erkina and also on the River Nore downstream of the Erkina confluence. Alluvial woodland habitats along the River Nore were surveyed as part of the National Survey of Native Woodlands (Perrin, 2008); however, individual site data applicable to the River Barrow and River Nore SAC was not available for the current assessment. The conservation status of this Priority Annex I habitat 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). The national conservation status context is taken into account for this habitat within the River Barrow and River Nore SAC – i.e. 'Unfavourable - Bad' conservation status.

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

This Annex I habitat type occurs frequently within the River Barrow and River Nore SAC, where suitable gradient and flow occurs. It was recorded within the River Erkina downstream of the Durrow WwTP, where a faster flowing section of this watercourse was identified (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.

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 occur within the alluvial woodland habitat at Durrow, associated with the River Erkina floodplain. 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.

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

This Annex I habitat occurs within the River Barrow and River Nore, both within the River Erkina channel and also on the River Nore main channel. This habitat is 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 plant 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.

Sea lampreys (1095) are anadromous and appear to be confined in general to the lower reaches of the River Nore. There is no evidence that they ascend any further upstream than Kilkenny, and are probably confined to the area of the river below Bennettsbridge Weir (c 40km downstream from the WwTP discharge). 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 Nore. River lampreys (1099) are also an anadromous species. They are also poor swimmers and cannot jump and climb so they are almost certainly confined to the lower reaches of the River Nore below Bennettsbridge (c. 40km downstream of the Erkina confluence). 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. The anadromous lamprey species will therefore not be discussed any further in this assessment. Twaite Shad (1103) and Allis Shad (1102) are one of the rarest fish species which breed in Irish freshwaters. Shad have an anadromous life cycle and have been recorded in the lower reaches of the River Nore. 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 other species are discussed individually below.

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 lamprey were recorded in the study area occurring within the River Erkina downstream of the Durrow WwTP discharge and within the River Nore main channel (Ecofact, 2009). The affected stretch of the River Erkina contains both nursery and potential spawning habitats for this species. 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 Nore catchment, including the Erkina (McGinnity *et al*, 2003). The stretch of the River Erkina in the vicinity of Durrow WwTP outfall contains physical

habitat suitable for use as both a spawning and nursery. The conservation status of salmon in the River Erkina is dependent on good water quality status; as this species requires clean water (Q4) for spawning and early life stages. This species is evaluated as being of overall 'Bad' conservation status nationally (NPWS 2008).

4.2.2.3 Otter (1355)

Evidence of otter activity has been recorded from the study area along the River Erkina (Ecofact, 2009) and this species is widespread in the River Barrow and River Nore SAC and from within the River Erkina catchment. The conservation status of this species is dependent on fish stocks which are ultimately dependent on water quality.

4.2.2.4 White-clawed crayfish (1092)

White-clawed crayfish occur in the River Nore catchment but were not recorded in the River Erkina during the field work carried by Ecofact (2009). This species was not also not recorded during a separate sampling survey carried out on the River Erkina at Ballboodin and Durrow (Ecofact, unpublished). Crayfish are recognized as being tolerant of moderate pollution levels and are classed as Group C organisms in the EPA Q-Value biotic index. They may occur in the study area but were not detected during the aforementioned surveys. This species is evaluated as being of overall 'Inadequate' conservation status nationally (NPWS 2008).

4.2.2.5 Irish Freshwater pearl mussel (1990) and Freshwater pearl mussel (1029)

The Freshwater pearl mussel (*Margaritifera margaritifera*) does not occur in the River Erkina catchment; however, a population occurs in the River Nore itself in the vicinity of Durrow (Moorkens *et al*, 2007). The populations of *M. margaritifera* within the River Nore have been described as a separate hard water species (*Margaritifera durrovensis*), or as a subspecies; however discussion remains as to whether these hard water populations are actually an ecophenotypic hard water form of *M. margaritifera* (Lucey, 2006). The most recent monitoring surveys for *M. durrovensis* indicate that, while there may be outliers downstream, its main population is now restricted to approximately 10km length of river and 500 individuals, and that there is no evidence of reproduction (2007). The majority of the population is located between Watercastle and Tallyho Bridges (DOELG, 2009).

Pearl mussels have a complicated life cycle, involving native salmon or trout. The key cause of decline in pearl mussel populations in Ireland is unsuitable habitat for juvenile mussels after they fall off the gills of host salmonids (Moorkens, 2007). This stage requires the safety of remaining within the river bed gravels, before growing to a size that allows the emergence of the filtering siphons into the open water body. While the juvenile mussels remain within the river bed gravels, they filter the interstitial water within the gravels. Where the gaps between the gravel and stones get clogged with fine silt, either physical (from suspended solids entering the river) or organic (from algal growth and decay prompted by nutrients in the water), the flow of water in the interstices becomes very restricted. Without adequate water movement and replacement, oxygen levels are exhausted and young mussels die. The decline in interstitial water quality in silted gravels has been detailed by a number of authors in the scientific literature. Fine sediments in gravels have been shown to increase mortality in juvenile mussels to 100%. As river quality becomes depressed, breeding stops and populations become "functionally extinct", i.e. older adults persist, but are not replaced by a new generation (Moorkens, 2007). The mussel population eventually dies out when the older individuals die of old age. Once breeding stops, it becomes very difficult to save a population. No mussel river in this situation has yet been recovered to a fully independent, recovered and breeding colony. In this knowledge, the pearl mussel has been identified as being internationally endangered.

The Irish pearl mussel *Margaritifera durrovensis* is listed as critically endangered in the Republic of Ireland in the most recent review of local IUCN threat status of Irish molluscs. It is evaluated as being of overall 'Unfavourable to Bad' conservation status nationally (Moorkens, 2007; 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 in Durrow and could occur along the Erkina and Nore areas in the study area. 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

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.

The discharge from the existing Durrow WwTP is directly into the River Barrow and River Nore SAC (site code 002162) and both the chemical and biological water quality of the receiving water (River Erkina) within the SAC is affected directly downstream of the plant (Ecofact, 2009). On this basis it is concluded that the ongoing operation of the plant has a significant, although localized, effect on the SAC; where water quality is identified as a key indicator of conservation value for the River Barrow and River Nore cSAC.

According to the Freshwater Pearl Mussel Nore Sub-basin Management Plan (NPWS 2010) the River Erkina was sampled during 2009 and was evaluated as polluted / 'Poor Status' (Q3) upstream of its confluence with the Nore, downstream of Durrow. EPA biological water quality monitoring data for the River Erkina during 2010 recorded 'Good Status' (Q4) at the monitoring station in Durrow town; however, this is located upstream of the WwTP discharge. It is important to note that the River Nore was rated as 'Good Status' (Q4) at monitoring stations upstream and downstream of the Erkina confluence during the 2010 monitoring period.

In relation to the Durrow WwTP the Erkina Water Management Unit Action Plan (SERBD, 2010) identifies this plant as a point pressure within the Erkina catchment and an increase to the capacity of the overloaded Durrow WwTP has been identified as a Priority 1 Action (SERBD, 2010).

From Ecofact (2009) it was concluded that the effluent from the Durrow WwTP undergoes significant dilution due to the size of the Erkina River downstream of Durrow. It was estimated that the effluent is diluted a factor of over 90 even at 95%ile (low) river flow. The chemical water quality results for the river upstream and downstream of the discharge showed deterioration in chemical water quality downstream of the discharge. This is a localized effect in the last 1km of the river before it is further diluted by the River Nore.

The general conclusion of the sampling undertaken in 2008 as part of the Ecofact (2009) study was that the Erkina was considered to be impacted with imbalances in terms of the biological water quality (reflected in the macroinvertebrate communities present at the sites investigated) both upstream and downstream of the plant. Downstream of the Durrow WwTP outfall, the macro-invertebrate communities indicated deterioration in water quality, with greater relative abundances of the pollution tolerant taxa and increased allochthonous dependence, pointing to a decline in ecological status at the downstream site, highlighting a localised impact on the SAC downstream of the WwTP.

Therefore the plant outfall is considered to be having an adverse effect on biological water quality in the River Erkina, within the vicinity of the discharge. The role of storm water outfalls in affecting biological water quality at both of these sites is unknown. The Ecofact (2009)

report utilised the extent of data available and there was no evidence that water quality in the River Nore main channel is significantly affected by the Durrow WwTP. 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 on Annex I Habitats

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

Alluvial woodland occurs within the Durrow Demesne on both banks of the River Erkina. 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 Erkina and River Nore 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 nutrification 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 alterations to this habitat are unlikely in the overall context of the Nore catchment. 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 *Ranunculum fluitantis* and *Callitriche-Batrachion* vegetation (3260)

It is considered that the ongoing operation of the Durrow plant would have localised impacts in this habitat. According to NPWS (2008) discharges, fertilisation and water pollution are identified as the main pressures affecting this water dependant habitat; with a direct application to the current WwTP at Durrow. 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 Durrow 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 vicinity of Durrow and also within the SAC along the Erkina corridor and the River Nore corridor. However, 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 Erkina; however, the ground-water/surface-water interactions within the Erkina catchment have not been investigated, where the Durrow WwTP discharge, affecting the River Erkina may impact on these habitats via groundwater connections.

Based on the information currently available it is therefore not possible to assess whether the ongoing discharge would significantly affect this cSAC feature. However, it is clear that due to the size of the Durrow plant that any impacts would be localised, and would not be expected to have integrity level impacts on this conservation interest.

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. However, 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 Erkina and River Nore within the SAC.

However, this habitat currently occurs within the Erkina irrespective of ongoing background water quality issues and it is considered that the conservation status of this habitat is

independent of the operation of the WwTP at Durrow, where a significant deterioration in water quality is considered unlikely. Water quality is not referred to as a threat to this habitat by the Conservation Status Assessment Report (NPWS, 2008).

4.3.2 Impacts on Annex II Species

4.3.2.1 Brook lamprey (1096)

Water quality impacts downstream of the Durrow WwTP outfall would not be expected to have significant negative impacts on existing brook lamprey populations, as they would tolerate such pollution. 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. Therefore the current poor water quality status of the River Erkina, which the Durrow plant is contributing to, has the potential to affect this species. However, brook lampreys can be expected to be found throughout the SAC and have a favourable conservation status nationally. In this respect it is unlikely that the ongoing operation of the Durrow plant would have the potential to affect the integrity of this SAC conservation interest.

4.3.2.2 Atlantic salmon (1106)

Poor water quality will affect the conservation status of salmon in the River Erkina, as this species requires clean water (Q4) for spawning and early life stages. The Durrow WwTP was considered to be further contributing background water quality problems with a shift in the trophic status of the macroinvertebrate community compared to upstream (Ecofact, 2009). In this light, the Durrow WwTP is affecting the potential of the River Erkina as a salmon producing watercourse, with localised impacts on this species within the SAC. Overall however, the conservation status of salmon in the River Barrow and River Nore SAC is not thought to be affected by the Durrow plant discharge as this species has a wide range in the catchment and impacts from the Durrow plant appear to be localised only.

4.3.2.3 White-clawed crayfish (1092)

White-clawed crayfish occur in the River Nore catchment, although apparently not in the general area of the Durrow WwTP (Ecofact, 2009). Crayfish are recognised as being tolerant of moderate pollution levels and are classed as Group C organisms in the EPA Q-Value biotic index. A recent report found that "crayfish were most often found in unpolluted waters but were also found in slightly polluted and moderately polluted waters. Some populations were even found at sites with very low water quality" (Demers *et al*, 2005). However, the relationship between water quality and crayfish populations is not fully understood and there have been some cases of crayfish populations being lost from rivers which deteriorated from slightly (Q3-4) to moderately polluted (Q3) conditions (Reynolds, 2007). It is therefore considered sensible to consider them as a species that is vulnerable to water quality changes (Reynolds, 2007).

Reduced water quality and ecological status downstream of the discharge of the Durrow WwTP could potentially have indirect effects on crayfish. Overall however, the integrity of the white-clawed crayfish population in the River Barrow and River Nore SAC is not thought to be affected by the Durrow plant discharge at a level that would affect the integrity of this conservation interest. This is because this species has a wide range in the catchment and impacts from the Durrow plant appear to be localised only.

4.3.2.4 Otter (1355)

Reduced water quality and ecological status downstream of the discharge of the Durrow WwTP could be potentially having indirect effects on otters; as a result of reduced food supply i.e. reduced macroinvertebrate and fisheries production. 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.

4.2.2.5 Irish Freshwater pearl mussel (1990) and Freshwater pearl mussel (1029)

The Freshwater Pearl mussel population is at unfavourable conservation status in the Nore catchment (DoEHLG, 2010). The population of *Margaritifera durrovensis* in the Nore River is known to be critically endangered for some time with evidence that there has been no recruitment for some time (DoEHLG, 2010). The population is failing in its habitat quality (through evidence of heavy siltation, macrophyte and filamentous green algal growth), and its population demographic profile, where it is evident that there are not the numbers of juveniles present in the population to provide sustainable replacement of the current adult numbers. The population is now thought to be restricted to a short section of approximately 10km of the main Nore channel in very low numbers (DoEHLG, 2010). Freshwater pearl mussels occur in the River Nore both upstream and downstream of the River Erkina confluence

Although point discharges in the sub-basin are identified as being a significant threat in the Freshwater Pearl Mussel Nore Sub-Basin Management Plan (DoEHLG, 2010), the Durrow WwTP itself is not given in the list of WwTPs in the sub-basin that have high risks associated with them and that have been identified to be in need of improvements. However, the Erkina downstream of Durrow is rated as (Q3) i.e. 'Poor Status' (DoEHLG, 2010), indicating the potential for cumulative impacts arising from the existing Durrow WwTP upstream. There is no monitoring data available to demonstrate the significance of impacts that the Durrow WwTP is having on water quality in the River Nore main channel; however, the ongoing impacts to water quality arising from the plant, affecting the River Erkina within the SAC will contribute to cumulative background water quality impacts potentially affecting the conservation status of the Freshwater pearl mussel. According to DoEHLG (2010) the Nore sub-basin catchment currently fails all of the five Environmental Quality Objectives (EQOs) as specified in Schedule 4 of the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations, S.I. 296 of 2009 (DoEHLG, 2010).

4.2.2.6 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 2008. However no specific methodology was used to survey this species. Suitable habitat for this species exists in the vicinity of the Durrow plant. However as this is a semi-aquatic species and effects of the Durrow discharge are probably only localised, the ongoing discharge is unlikely to have the potential to affect the integrity of this cSAC feature.

4.4 Conservation Objectives for River Barrow and River Nore SAC

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. The current assessment therefore utilises the available literature and the national 'Conservation Status Assessment Report' (NPWS, 2008). The conservation objectives of the generic Conservation Management Plan for the River Barrow and River Nore SAC are given in Table 3. Favourable conservation status is defined for Annex I habitats and Annex II species in the Habitat Directive (1992):

Article 1 (e)

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 (i)

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.

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

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.

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 operation of the existing plant at Durrow has been recognised as having an adverse localised effect on the water quality of the River Erkina within the SAC. 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 aquatic Annex I habitats and Annex II species at favourable conservation status. Within the Erkina, this would relate to impacts affecting aquatic Annex II species including Atlantic salmon, brook lamprey and otter. It is considered that the conservation status of these species is directly affected by water quality impacts in the Erkina, but with cognisance of the background water quality issues, as a

cumulative impact; where the existing plant alone is not considered to be affecting the population size and range of these species within the Erkina or within the designated portion of the River Nore within the SAC. 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*'.

With regard to the integrity of the site as a whole, both the River Erkina and the River Nore main channel are affected by background water quality which affects the waste assimilation capacity for WwTP discharges at point source, although there is greater capacity for dilution within the Nore. There is no evidence that the plant at the Durrow WwTP is having a negative impact on the water quality of the River Nore main channel; however, the ongoing impacts to water quality arising from the plant, affecting the River Erkina within the SAC will contribute to cumulative background water quality impacts potentially affecting the endangered Irish Pearl Mussel population in the Nore main channel. The Durrow WwTP, discharging to the River Erkina within the SAC is therefore impacting directly on the qualifying interests of the SAC within a localised context on the River Erkina; however, there is no evidence of impacts affecting the River Nore main channel in relation to water quality (Ecofact, 2009). According to DoEHLG (2010) the Nore sub-basin catchment currently fails all of the five Environmental Quality Objectives (EQOs) as specified in Schedule 4 of the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations, S.I. 296 of 2009 (DoEHLG, 2010). It is clear that the overloaded Durrow plant is potentially contributing to this non-compliance at present, but this contribution is unknown.

4.5 Mitigation measures

4.5.1 Existing plant

Laois County Council recognises that the existing plant is not operating to the required standards. Mitigation measures recommended for the ongoing operation of the existing plant, pending the development of a new plant at the site include:

- 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 is recommended with regard to compliance with the operating standards of the plant – i.e. a performance management system.
- 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 Erkina, upstream of the plant. Monitoring of the storm water outfalls associated with the Durrow WwTP is also required to accurately determine the water quality impacts affected the SAC.
- 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 Improve background water quality

Laois County Council is already making significant efforts to improve water quality in the Erkina catchment and is concurrently working with the EPA to identify sources of background pollution potentially affecting the River Barrow and River Nore SAC. Laois Co. Co. is actively engaging with the farming community and examining farms in the Erkina catchment to reduce background pollution loadings, through farm surveys and other work of their Environmental department. This work, together with improvements in plant operation until the proposed plant is operational will primarily reduce the magnitude of impact affecting water quality within the SAC, with direct beneficial impacts affecting the qualifying interests of the site i.e. the water dependant Annex II species occurring within the Erkina River. According to Laois County Council a total of 167 farm surveys were carried out in the Erkina catchment during the period 2007-2008.

4.5.3 Provision of a new WwTP – A key mitigation measure

Laois County Council is proposing to build a new waste water treatment plant at Durrow. The proposal to replace the existing WwTP with a new, improved plant to meet the required discharge standards is a key mitigation in the current AA. The design standards for the plant has been prepared with a population equivalent of 3,000 PE, i.e. Stage 1 of the proposed new WwTP. The design standard for the proposed WwTP based on figures supplied by Laois County Council is 25mg/l BOD, 35 mg/l suspended solids, 125 mg/l COD, Total Phosphorous 0.37mg/l, TON 11.2mg/l and Total Ammonia 1mg/l.

Based on the design parameters proposed by Laois County Council for this proposed plant, a waste assimilation capacity (WAC) assessment was undertaken to show the likely impact of the proposed discharge to the River Erkina. This assessment is presented in Table 4. In this assessment, flow data for the river has been taken from the EPA Hydrometric Data System 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 and relate to the period January 2007 and November 2008 (Ecofact, 2009).

Even with the limited assimilation capacity for some parameters (i.e. orthophosphate) the Erkina River downstream of the new plant would comply with the European Communities Environmental Objectives (Surface Waters) Regulations 2009 (SI 272 of 2009) 'High Status' EQS under 95%ile flow conditions. This is very significant and demonstrates the benefits that such a 'state of the art' plant would deliver. Under clean river conditions (i.e. theoretical maximum conditions) at 95%ile flows the proposed plant would only require 13% of the WAC for BOD, 12% of Ammonia and 8% of Orthophosphate.


Under mean flow conditions there is no WAC for Total Ammonia or Ortho-phosphate at 'High Status' standards. This is solely due to elevated background levels of these parameters in the Erkina River upstream of the plant. This is demonstrated by the fact that under theoretical maximum i.e. clean river concentrations, the proposed plant would only require 3% and 1% of the available WAC for Ammonia and Orthophosphate respectively. However the mitigation measures required here will require a tandem approach of reducing background parameter levels in the Erkina and providing a new plant. The Freshwater Pearl Mussel Nore Sub-Basin Management Plan (DoEHLG, 2010) has similar objectives and it is feasible with this plan and the current work that Laois County Council is currently undertaking that background levels of these and other parameters will be reduced significantly over the next few years.

In addition to the provision of a new treatment plant at Durrow there are provisions for improvements to the collection network within Durrow town. Separation of storm water has been proposed with regard to the two storm water overflows currently existing in the town. It is recommended that all storm water overflows are accounted for in the proposed new treatment plant and that storm water interception and treatment facilities are installed.

4.5.3.1 Conservation Objectives with regard to the new plant

Based on the design standards provided by Laois County Council for a new WwTP at Durrow there would be a noticeable and significant improvement in water quality in the Erkina River downstream of the discharge. An improvement in water quality downstream of the Durrow would result in direct positive impacts on the qualifying interests for which the SAC is selected and which occur in the Erkina River; i.e. Floating river vegetation, Atlantic salmon, otter, and brook lamprey. It has been demonstrated that the proposed plant, with its improved discharge will be within the Waste Assimilation Capacity under 95%ile flows for 'High Status' in the Erkina; therefore, complying with the water quality requirements of the Annex II aquatic conservation interests for which the River Barrow and River Nore SAC is designated. No discernible impacts affecting water dependant Annex I habitats are envisaged with the operation of the new plant. Reducing background parameter levels would allow the EQS for 'High Status' to be met at both 95%ile and mean flows, of significant importance with regard to the Freshwater pearl mussel Objectives for the River Nore and the populations of these species located in the River Nore main channel downstream of the Erkina confluence.

Table 4 Waste assimilation capacity assessment for the proposed new Durrow discharge to the Erkina River (see Appendix 3).

Waste Water Treatment Plant: Durrow Proposed				
Receiving Water: Erkina 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)	2.5	1	0.035	0.03
Receiving Water Characteristics				
River mean flow ^{1,2} (m ³ /sec)		Mean flow dilution factor		899.6
River 95%ile flow ² (m ³ /sec)		95%ile flow dilution factor		90.6
	BOD (mg/l)	Total Ammonia	Ortho-phosphate	Total Phosphorus
Background concentration³ (mg/l)	1.3	0.04	0.025	0.03
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 Increases⁵ and Waste Assimilation Capacity⁶ (WAC)				
	BOD	Total Ammonia	Ortho-phosphate⁷	Total Phosphorus
Plant loading (Kg/day)	16.85	0.67	0.212	0.25
MEAN FLOW				
Concentration increase (mg/l)	0.03	0.001	0.0003	0.00
- Resultant D/S concentration (mg/l)	1.13	0.071	0.0403	0.13
- WAC (High Status)				
WAC (kg/day)	121.25	-18.19	-9.09	
- Consumed by discharge (%)	14	N/A	N/A	
Theoretical maximum WAC ⁸ (kg/day)	788.15	4.22	15.16	
- Consumed by discharge (%)	2		1	
- WAC (Good Status)				
WAC (kg/day)	242.51	-3.03	-3.03	
- Consumed by discharge (%)	7	N/A	N/A	
Theoretical maximum WAC (kg/day)	908.40	39.41	21.22	
- Consumed by discharge (%)	2	2	1	
95%ile FLOW				
Concentration increase (mg/l)	0.26	0.01	0.003	0.00
- Resultant D/S concentration (mg/l)	1.36	0.08	0.043	0.13
- WAC (High Status)				
WAC (kg/day)	67.19	1.22	0.31	
- Consumed by discharge (%)	25	55	70	
Theoretical maximum WAC (kg/day)	134.39	5.50	2.75	
- Consumed by discharge (%)	13	12	8	
- WAC (Good Status)				
WAC (kg/day)	91.63	4.28	2.14	
- Consumed by discharge (%)	18	16	10	
Theoretical maximum WAC (kg/day)	158.82	8.55	4.58	
- Consumed by discharge (%)	11	8	5	
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 15_005 - Erkina River) ³ Mean values taken from 'Receiving Water Impact Assessment: Durrow 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 85.4 X flow. ⁷ Orthophosphate 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 Durrow WwTP discharge to the Erkina River				

5. Stage 2 Appropriate Assessment Conclusion Statement

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 plant discharge, in combination with other plans / projects affecting the aquatic environment. The assessment considers whether the 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 Durrow 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 Durrow site by Laois County Council. Proposed discharge standards for a new WwTP at the Durrow site 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 Erkina Water Management Unit Action Plan which identifies the Durrow WwTP as a priority point pressure within the Erkina catchment. The Freshwater Pearl Mussel Nore Sub-basin Management Plan (DoEHLG, 2010) also identifies poor water quality in the lower Erkina below Durrow town, immediately upstream of the Nore confluence, as a significant pressure on the pearl mussel populations in the Nore main channel.

The Durrow WwTP is operating significantly above the treatment capacity of the plant and is recognised as being overloaded, with the requirement for greater capacity and a higher standard of treatment required. 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 River Erkina and the River Nore 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 Nore, downstream of the River Erkina confluence.

The plant and its associated storm water outfalls discharge to the River Erkina within the River Barrow and River Nore SAC and has been identified as having 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 Durrow WwTP affecting the River Nore main channel downstream. This leads to uncertainty with regard to unquantified cumulative impacts potentially affecting the endangered Irish Pearl Mussel and Freshwater pearl mussel populations in the Nore main channel downstream. The storm water outfalls associated with the Durrow 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.

According to DoEHLG (2010) the Nore sub-basin catchment currently fails all of the five Environmental Quality Objectives (EQOs) as specified in Schedule 4 of the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations, S.I. 296 of 2009 (DoEHLG, 2010). It is clear that the overloaded Durrow plant is potentially contributing to this non-compliance with regard to cumulative impacts; however, the scale and significance of this contribution is currently unknown. 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.

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

Integrity of Site Checklist Conservation objectives	Yes/No
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

The design standards for a new WwTP were provided by Laois County Council for consideration in the current 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) which demonstrated that the requirements of the Surface Water Regulations (2009) standards would be achievable. The WAC model has identified that a new WwTP operating at these design standards would only require in the region of 1% and 3% of

the theoretical maximum WAC in the River Erkina for Orthophosphate and Total Ammonia respectively under mean flow conditions. Should these design standards be met in the delivery of a new WwTP at Durrow it is evaluated that there would be a significant improvement in treatment capacity and water quality in the River Erkina downstream of Durrow; resulting in the avoidance of impacts affecting the qualifying interests of the River Barrow and River Nore SAC.

Due to the uncertainty regarding the scale and significance of cumulative effects resulting from the Durrow WwTP affecting the River Nore main channel, with specific regard to the populations of Freshwater pearl mussel, 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. The existing WwTP at Durrow therefore must progress to Stage 3: Consideration of Alternatives.

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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 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 mouliniana* 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 Aughnabriskey, 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 (Ecofact, 2009)

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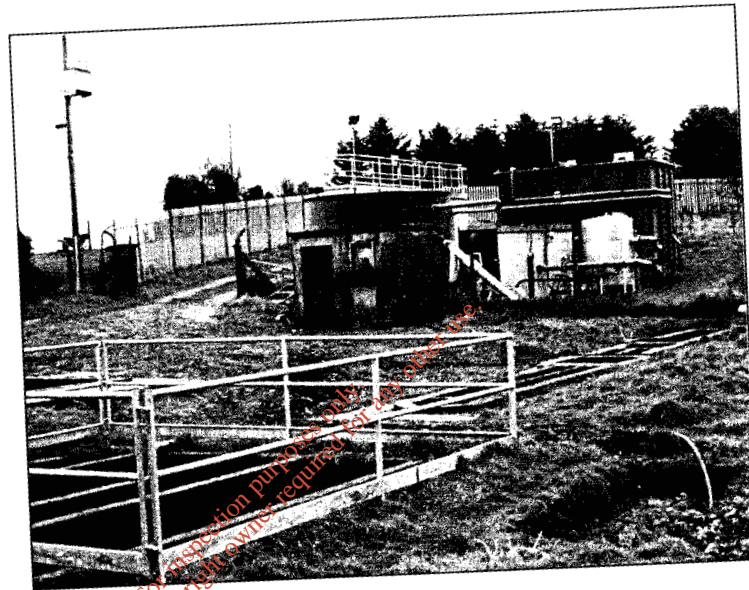
Appendix 3 River flow estimations using Hydrotool

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Laos County Council

**RECEIVING WATER IMPACT ASSESSMENT:
DURROW WwTP**



Version: 22nd September 2009

Prepared on behalf of

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Foreword – response to EPA consultation letter

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 Erkina River and Durrow plant is provided in ‘Section 3.2.3 Dangerous substances’ and Table A3.5 in ‘Appendix 3 Monitoring data from the River Erkina’ of this report.

- *“Provide the 50%ile, 95%ile and dry weather flow for the Erkina River. 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 ‘3.1.2 The Erkina River. Assimilative capacity calculations are provided in Section ‘3.2.4 Assimilative capacity’.

- *“The licence application has not adequately addressed the likelihood of a significant impact on the River Barrow and River Nore SAC. If it is unlikely that there will be a significant impact, provide a reasoned response to that effect. However, if it is likely that there will be a significant impact, conduct an appropriate assessment 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 4.2.4 Assimilation capacity'.

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 Durrow Waste water Treatment Plant (WwTP). It has been prepared under Section F of the Environmental Protection Agency (EPA) 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 EPA 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 site and adjoining river section, along with ecological and biological water quality appraisals at upstream (control) and downstream (receptor) sites.

The Durrow WwTP is located immediately to the east of Durrow Village and discharges to the Erkina River less than 1km upstream from the Nore confluence. Both the River Erkina and River Nore at this point are included in the River Barrow and River Nore Special Area of Conservation (SAC). The River Nore is also a designated Salmonid Water. The River Erkina does have this designation, but contains significant populations of salmonids. The only global population of the Nore pearl Mussel occurs in the stretch of the River Nore that is met by the River Erkina. Declining water quality has been identified as the key threat to the survival of this species.

Laois County Council monitoring data showed unsatisfactory chemical water quality in the River Erkina both upstream and downstream of the Durrow WwTP; however there was a significant further deterioration in chemical water quality downstream of the WwTP outfall. The results from the current onsite biological assessment also indicated there was significant background pollution in the River Erkina with a further reduction in ecological status downstream of the WwTP. The River Erkina has a poor water assimilation capacity, particularly in relation to Phosphorous. The results of the current assessment suggest that the existing Durrow WwTP is having an adverse negative impact on water quality in the River Erkina. The new Durrow WwTP will provide significant improvements over the existing situation.

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INTRODUCTION

1.1 Background

Durrow is small town in south County Laois. This report provides a Receiving Water Impact Assessment for the Waste Water Treatment Plant (WwTP) serving this town. This facility discharges waste water treated to secondary level into the Erkina River, a tributary of the River Nore. The Erkina joins the River Nore less than 1km downstream of the WwTP outfall. A new plant is proposed for the site.

The Nore main channel is a designated salmonid water under the European Communities (Quality of Salmonid Waters) Regulations of 1988 (S.I. No. 293, 1988), implementing the Freshwater Fish Directive (78/659/EEC). The main channel of the River Nore is also protected as a component of the River Barrow and River Nore candidate Special Area of Conservation (SAC) under the Habitats Directive (92/43/EEC). The River Erkina at the Durrow WwTP discharge point is also part of this internationally important site. The only population of the critically endangered Nore Pearl Mussel occurs in the River Nore in the vicinity of the Erkina confluence. The NPWS site synopsis for this site is provided in Appendix 1.

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);
- European Communities Environmental Objectives (Surface Waters) Regulations 2008 (Draft).
- 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 taken of 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 (SRFB).

Monitoring information on the receiving water were obtained from Laois County Council and used in this assessment. EPA reports on water quality in County Laois (Neill, 2008 and Neill, 2007) commissioned by Laois County Council were also reviewed. 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. Laois Towns and Villages Wastewater Improvement Scheme Tender Documents supplied by Laois County Council were also examined.

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.

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

An appropriate assessment of the proposed upgrade to the Durrow WwTP has been prepared by Entec and O' Dwyer (2006). The impact of the existing discharge is also considered in relation to Article 6(4) of the 'Habitats Directive' 92/43/EEC.

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).

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 <u>priority</u> 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 <u>significant numbers</u> 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 <u>any</u> 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>

2 SCHEME DESCRIPTION

2.1 Introduction

Durrow is located south of Portlaoise, on the main Dublin-Cork National primary route (N8) and on the Durrow-Kilkenny National Secondary Road. The town of Durrow is classified as a Secondary Settlement under the County Development Plan 2006-2012, with a population of 1,258 in 2006 (Source: Durrow Town Plan, Laois County Council website). Rapid economic progress in recent years has placed unprecedented pressure on infrastructure particularly Water and Wastewater facilities. A major challenge for Laois County Council is to ensure that infrastructural development keeps pace with economic growth. The provision of adequate Water and Wastewater infrastructure is fundamental to economic growth and to meeting the particular requirements of industrial, residential, agricultural and commercial developments (Source: water services section of Laois County Council website). The location of Durrow and the River Erkina is presented in Figure 1.

The present population equivalent of Durrow is approximately 1,213 P.E. However, the existing plant has a capacity of only 700 P.E. so is overloaded (O' Dwyer, 2007). The layout of the proposed plant (Stage 1) is such that it could be easily expanded (Stage 2) to cater for future loads within the proposed site. The design population equivalent for Durrow was taken as 3,000 PE for Stage 1. To cater for future growth, the site layout allows for a total future (Stage 2) design PE of 6,000.

2.2 Sewerage Scheme Design

The existing (with temporary upgrade) WwTP at Durrow is designed to deliver an effluent standard of 25mg/l BOD, 35 mg/l suspended solids and 125 mg/l COD. According to Laois County Council the plant is also designed to deliver an effluent Total Phosphorous Standard of 2mg/l. In Table 3 the observed effluent quality from the plant during the period January 2007 to January 2009 is summarised. The results confirm that the plant is overloaded and performing poorly. Information on existing storm water outflows (i.e. volume and quality) was not available at the time of preparing the current document. The design of the proposed plant (Stages 1 and 2) is outlined below.

Table 3 Summary water quality results from the effluent at the Durrow WwTP during the period January 2007 to January 2009. Derived from data supplied by Laois County Council.

	N	Mean	St dev	Variance	CI (95)
Ammonia(NH3) (mg/l)	26	33.74	17.46	304.68	6.71
BOD (mg/l)	23	117.96	84.99	7222.95	34.73
Chemical Oxygen Demand (mg/l)	26	277.69	201.27	40510.22	77.36
Conductivity @ 25°C	26	1439.58	381.94	145880.17	146.81
Nitrates(NO3) (mg/l)	26	1.34	2.39	5.70	0.92
Nitrite(NO2)-N (mg/l)	2	0.36	0.43	0.18	0.59
Ortho-phosphate (mg/l)	25	3.13	1.27	1.61	0.50
pH	26	7.87	0.21	0.05	0.08
Suspended Solids (mg/l)	26	110.92	76.03	5780.07	29.22
Temperature (°C)	2*	10.95	0.78	0.61	1.08
Total Nitrogen (mg/l)	2*	27.65	1.34	1.81	1.86
Total Phosphorus (mg/l)	2*	3.42	0.25	0.06	0.35

*NB: Limited data.

Stage 1 of the new Durrow 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 Durrow 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 be 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 plant is capable of achieving the final effluent discharge limit standards during any combination of load conditions up to the design loads and peaks specified by O' Dwyer 2007, presented in Table 4. The plant peak design flow will 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 storm water tank. The storm water will flow by gravity to the storm water tank. The storm water 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.

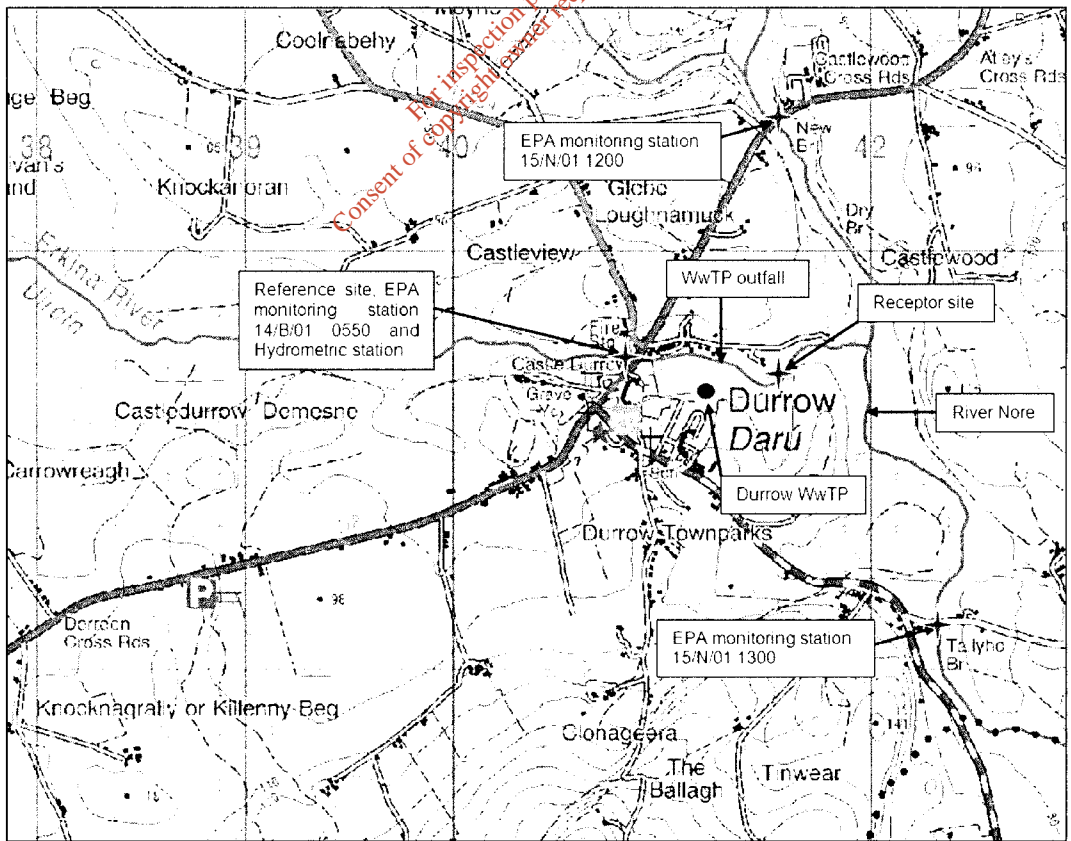


Figure 1 Location of the Durrow WwTP, outfall, biological monitoring sites in the current assessment, EPA monitoring sites and Hydrometric station.

2.2.1 Primary Treatment

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 proposed 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 4 Durrow WwTP design influent loads (From O' Dwyer, 2007).

Parameter	Existing	Stage 1	Stage 2
Design population equivalent	700	3000	6000
Dry weather flow (L/sec)	-	7.8	15.6
Peak flow to treatment (L/sec)	-	23.4	46.9
Minimum storm capacity (m ³)	-	281.3	562.5
Outfall capacity (L/sec)	-	125.0	125.0
Average BOD (kg/day)	-	180	360
Suspended Solids (kg/day)	-	225	450
Total Phosphorous (kg/day)	-	6.75	13.5

Table 5 Existing and proposed treatment plant effluent discharge standards (Stage 1 concentrations from O' Dwyer, 2007).

	BOD (mg/l)	Total Suspended Solids (mg/l)	COD (mg/l)	Total Phosphorus mgP/l	Total Oxidised Nitrogen (mg/l N)	Total Ammonia (mgN/l)
Existing	25	35	125	2	-	-
Stage 1 ¹	25	35	125	0.37	11.2	1.0
Stage 1 ²	50	70	250	0.74	22.4	2.0

¹Final effluent discharge limit standard

²Upper final effluent discharge limit standard

2.2.2 Secondary Treatment

The existing plant has an imhoff tank to treat waste water at both preliminary and secondary stages. The existing plant reduces BOD to 25mg/l and Total Suspended Solids to 35mg/l.

2.2.3 Tertiary Treatment

The existing Durrow WwTP does not incorporate tertiary treatment but in the future Stage 1 plant micro-screening would be used to provide additional treatment. Phosphorus reduction will be provided in order to achieve the final effluent standards specified (0.37mg/l). Phosphorus removal will be achieved using either enhanced biological phosphorus removal, or chemical precipitation. Where biological removal is provided as the main process, a chemical dosing facility shall also be provided as a backup to assist the biological removal process.

2.2.4 Sludge Treatment and Disposal

In the future (Stage 1), sludge holding tanks will be constructed at the Durrow WwTP to meet the odour limits at the boundary of the site. It is also proposed that the liquid sludge from the Durrow 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

The discharge standards for the existing and proposed plants are provided in Table 5. The new plant (stages 1 and 2) will significantly exceed the requirements of the Urban Wastewater Treatment Directive 91/271/EEC for WwTPs discharging into sensitive catchments.

2.4 Flows

The rate of discharge from Durrow WwTP to the River Erkina from the existing plant was not available at the time of preparing this draft report.

The proposed plant (Stage 1) will cater for 3,000 P.E. and have a dry weather flow of 7.8l/s. This DWF corresponds to an emission of 674 m³/day. The maximum flow for which the upgraded plant will cater is 3DWF (23.4l/s) or 2021.7 m³/day. Flows in excess of the plant peak design 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 Population Equivalent.

2.5 Monitoring

Monitoring of the water quality of the outfall from the Durrow WwTP is undertaken by Laois County Council on an approximate monthly basis. Water quality is also monitored in the River Erkina 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.

2 RECEIVING ENVIRONMENT

3.1 Catchment Description

3.1.1 River Nore

The River Nore rises on the eastern slopes of the Devil's Bit Mountain in Co. Tipperary and flows east through Borris-in-Ossory before turning south through Co. Kilkenny, passing through Ballyragget, Kilkenny City and Thomastown before meeting the tide at Inistoge. The river has a total length of 118km, a catchment area of 2,359km², and an annual mean discharge of 40m³ sec⁻¹ (Lucey, 1998; McGarrigle, 2002). The Nore, for a large part of its course, traverses limestone planes of Carboniferous age and then Old Red Sandstone below Thomastown and before joining the Barrow, runs over Ordovician shales. The river is, for the most part floored with, or influenced by Carboniferous limestone and this is reflected in its natural characteristics (Lucey, 1998). It has 36 tributaries, the largest of which are the Kings, the Erkina, and the Dinin. The River Nore and its tributaries are in Hydrometric Area 15. According to O'Reilly (2004) 'The river has a fairly steep gradient but the flow is checked by numerous weirs. He also notes that 'the surrounding land is used for mixed farming; mostly pasture and dairy with some tillage and bloodstock'.

The River Nore is a designated salmonid water under the EU Freshwater Fish Directive and designated Special Area of Conservation (SAC) under the EU Habitats Directive (River Barrow and River Nore SAC) for the conservation of both habitats and fauna listed on Annex I and Annex II of the EU Habitats Directive, respectively. Of particular conservation concern are the 'endangered' populations of *Margaritifera margaritifera*, within the River Nore. The significance of this population is further discussed in Section 3.5.6. Following the 2004 EPA monitoring programme, it was stated in the overall assessment of the River Nore that numbers of both the pearl mussel and crayfish have declined recently, with an unexplained collapse of the Nore crayfish population occurring in August 2004 (Clabby *et al*, 2006).

3.1.2 River Erkina

The River Erkina rises at Cullahill in Co. Tipperary and generally flows in an easterly direction to meet the River Nore. The total length of the River Erkina channel is approximately 35km. Approximately 6km from its source, at Errill, it is a 3rd order stream. Approximately 15km from its source near Rathdowney, it is met by the Donaghmore Stream from the north, a 4th order stream draining an adjacent catchment. Approximately 10km downstream of Rathdowney, the River Erkina is joined by its largest tributary, the River Goul (4th order). The River Goul rises near Urlingford, Co. Kilkenny and generally flows in a north-westerly direction to meet the River Erkina in the townland of Black Island approximately 4km upstream of Durrow. At this stage, after the River Goul confluence, the lower reach of the Erkina is a 5th order river. After Durrow, The Erkina continues to flow east for over 1km to meet the River Nore.

There is a hydrometric station on the River Erkina at Durrow footbridge (McCarthaigh, 1997) near the town of Durrow at NOS grid reference S406 774 (OPW Hydro-data website). This station is less than 2km upstream of the River Nore confluence and the catchment area upstream of this point is 387km² (McCarthaigh, 1997). The derived 50%ile, 95%ile and 99%ile flows (flows equaled or exceeded for the given percentage of time) at this station for the period 1972 to 2005 were 4.34m³/s, 0.71m³/s and 0.41m³/s, respectively (OPW Hydro-data website). Annual average rainfall in the catchment for the same time period (1972-2005) was 900mm with estimated annual losses of 436mm (McCarthaigh, 1997). The upper/elevated reaches of the catchment (Errill) drain surface water gleys, acidic ground water gleys and acid brown earths/brown podzolics over Devonian sandstone till, along with some cutaway raised bog. The bulk of the catchment (on lower ground) drains grey brown podzolics, basic brown earths, mainly over carboniferous limestone till. Land cover is mainly pastures with smaller element of coniferous forestry (EPA online Envision map). The Erkina River downstream of Durrow is located within the 'River Barrow and River Nore' SAC, see Appendix 2 for the SAC site synopsis.

3.2 Water quality

3.2.1 Existing information

3.2.1.1 EPA published data

Nore

Water quality has been monitored in the River Nore main stem (EPA code 15/N/01) and in selected tributaries by the Environmental Protection Agency (EPA) and its predecessors since 1971. Both chemical and biological variables have been measured. The biological monitoring involves assessment of the status of benthic macroinvertebrates in stony, shallow, fast flowing areas (riffles) through kick sampling (Toner *et al*, 2005). Within each catchment, the EPA has established a network of such sites and a constant use of these sites permits temporal and spatial comparisons.

The main channel of the River Note was surveyed in 2004 and continued to be mainly unsatisfactory (Clabby *et al*, 2006). Table 6 presents a summary of the EPA water quality results from biological monitoring data for the River Nore and Erkina during the period 2004-2006 (adapted from Clabby *et al*, 2008). In a recent EPA assessment of the River Nore (Neill, 2007) it was said that 'overall, water quality in the River Nore was mediocre – but not good – due to various effluent discharges and to diffuse agricultural runoff, much of which was intermittent. There was enrichment at some locations in Co. Laois but otherwise satisfactory in this stretch. There was poor water quality downstream of Kilkenny City at all times (Q3 and high Ortho-phosphate with intermittent problems at Kilkenny sewage treatment plant. The lower reaches (downstream Thomastown to Inistiogue) were moderately polluted with abundant weed growth at all times'. Data from the EPA biological surveys (adapted from Clabby *et al*, 2006) is presented in Table 7 with the latest available results from Neill (2008).

Table 6 Summary of EPA water quality results showing overall results for the River Nore and River Erkina. Data is from EPA biological surveys undertaken during the period 2004-2006. (Adapted from Clabby *et al*, 2008).

Catchment	Class A	Class B	Class C	Class D	Total (km)
Nore (km)	52	62.5	3.5	0	118
Nore (%)	44.1	53.0	3.0	0	100
Erkina (km)	9	16	3	0	28
Erkina (%)	32.1	57.1	10.7	0	100

Table 7 The following is the EPA data for the River Nore (EPA code 15/N/01) upstream and downstream of the River Erkina confluence (Adapted from Clabby *et al*, 2006 and Neill, 2008).

Station No.	EPA 15/N/01 1100	EPA 15/N/01 1200	EPA 15/N/01 1300
Site	Watercastle Bridge (approx 4km upstream of Erkina confluence)	New Bridge (approx 1.3km upstream of Erkina confluence)	Tallyho Bridge (approx 1.5km downstream of River Erkina confluence)
1971	5	-	4-5
1975	5	-	4-5
1979	4-5	-	4-5
1981	-	-	-
1984	4	4	4
1987	4	4	4
1991	4-5	4	4
1995	3-4	-	3-4
1998	3-4	-	4
2001	4	-	4-5
2004	4	-	4-5
2007	4	-	4

The nearest EPA biological monitoring station upstream of the River Erkina confluence is approximately 1.3km upstream: station 15/N/01 1200 at New Bridge. However, this station was monitored only 3 times in the 1971 – 2004 period (1984, 1987 and 1981) when it was rated as 'Unpolluted (Q4)' on all occasions. Monitoring at Watercastle Bridge (station 15/N/01 1300) approximately 4km upstream of the Erkina confluence was more frequent. In 1995 and 1998, water quality at this station was 'Slightly polluted (Q3-4)' but was 'Unpolluted (Q4 or Q4-5)' when monitored at other times including 2007. In the three most recent monitoring surveys, this site was rated as 'Unpolluted (Q4)'.

The nearest EPA station downstream of the River Erkina confluence was at Tallyho Bridge (Station code 15/N01 1300). This is located approximately 1.5km downstream of the River Erkina confluence. With the exception of 1995 when it was rated as (Q3-4), this station has consistently been 'Unpolluted (Q4 or Q4-5)'. In the 2001 and 2004 surveys, this site was rated as Q4-5 but declined slightly to Q4 in 2007. The Gully River (EPA code 16/G/03) is a 3rd order river that joins the River Nore between Watercastle Bridge and Tallyho Bridge. This stream has consistently been rated as being 'unpolluted' by the EPA. It is clear that biological water quality between these two stations on the Nore is being influenced by inputs other than the Erkina.

A summary of the EPA chemical water quality results for the River Nore at New Bridge (upstream of River Erkina confluence) and at Tallyho Bridge (downstream of the River Erkina confluence) for the period January 2006 to October 2007 is provided in Table 8. From this assessment it can be seen that maximum levels of Ammonia and Nitrate in the River Nore were above guideline limits in EPA (2001) upstream of the River Erkina confluence. Mean levels of Nitrate (2.9mg/l) were also elevated upstream of the River Erkina. Nitrate concentrations less than 1.7mg/l are required to protect pearl mussels and this species is known to occur in this stretch of the River Nore so strict Nitrate limits would apply to this part of the River Nore. A Nitrite level of value 0.05mg/l is given in the Salmonid Water Regulations (1988) while a level below 0.03mg/l is indicative of unpolluted waters (EPA, 2001). All values upstream of the River Erkina were below these levels in the 2006-2007 period.

On the River Nore downstream of the River Erkina confluence, at Tallyho Bridge, minimum Nitrite levels were above the strict EPA limit of 0.01mg/l but were well below the Salmonid Water regulations limit. Compared to upstream however, there was an increase in the mean concentration of this parameter by 12.5%. An even greater increase of approximately 27% was recorded for mean Nitrate concentrations downstream of the River Erkina with mean levels of 3.69mg/l (N=15). This is over twice the limit of 1.7mg/l required to protect pearl mussels which occur in this part of the river. Differences in water quality between the two stations could also be influenced by factors other than the River Erkina, for example input from agricultural areas, septic tanks etc. However the Erkina is the only tributary entering this area (and shown on the 1:10,000 scale OS maps).

Erkina

The EPA undertakes biological monitoring on the River Erkina at Durrow Bridge (14/B/01 0550) but not downstream of the Durrow WWTP outfall. Since 1985 the site on the Erkina at Durrow has been rated as 'Slightly polluted, (Q3-4)' by the EPA since 2001. The EPA assessment of the River Erkina based on observation made in 2007 was '*poor water quality downstream of Rathdowney with elevated ammonia, Ortho-phosphate, Nitrate and Nitrite and low dissolved Oxygen at all times. The overall quality was unsatisfactory*' (Neill, 2007). In 2007, there were signs of improvement downstream of Rathdowney but '*overall water quality was mediocre*' (Neill, 2008).

Table 8 EPA chemical water quality results for the River Nore at New Bridge (u/s Erkina confluence) and at Tallyho Bridge (d/s of the Erkina confluence). From Neill (2007) and Neill (2008). Values in bold exceed EPA (2001) limits.

Unit	New Bridge (Sampling station 15/N/01/1200)				Tallyho Bridge (Sampling station 15/N/01/1300)				
	N	Mean	Min	Max	N	Mean	Min	Max	
Temp	mg/l	15	12.24	5.7	18.8	17	12.37	5.4	18.2
D.O.	%	14	94.64	89	103	17	97.20	82	116
D.O.	mg/l O ₂	14	10.31	9.1	12	17	10.41	8.5	11.9
BOD	mg/l O ₂	15	1.36	0.7	2.5	17	1.22	0.8	1.7
pH	mg/l	15	8.15	7.9	8.5	16	8.17	8	8.4
Conductivity	uS/cm	15	519.6	368	645	17	605	450	717
Ortho-phosphate	mg/l P	15	0.028	0.01	0.07	16	0.029	0.01	0.05
Ammonia	mg/l NH ₃	15	0.033	0.01	0.12	17	0.025	0.01	0.04
Un-ionised Ammonia	mg/l	14	0.002	0.000	0.010	15	0.001	0.000	0.00
Nitrite	mgO ₂ /l	15	0.016	0.009	0.026	17	0.018	0.011	0.029
Nitrate	mg/l N	15	2.9	1.7	3.6	17	3.69	2.3	4.8
Chloride	mg/l Cl	15	16.93	10	20	17	20.07	14	33

3.2.1.2 Laois County Council Monitoring Data

Laois County Council monitors water quality in the River Erkina at the stations located upstream (Code 6602) and downstream (Code 6702) of the Durrow 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 July 2004 to November 2008 but only more recent data from January 2007 to November 2008 was used in this assessment. A statistical summary of this data is provided in Appendix 3. Table 11 compares mean parameter results upstream and downstream of the plant.

Background water quality in the River Erkina was found to be compromised with mean levels of Nitrates, Nitrites, Orthophosphate and Total Phosphorous above limits outlined in EPA (2001). In addition to these parameters, mean Suspended Solids concentrations were above guideline limits downstream of the Durrow WwTP outfall.

From Table 11, with the exception of Nitrite and Total Phosphorus, it can be seen that all parameters increase in concentration downstream of the plant. Mean Ortho-phosphate levels increased by 25% while Suspended Solids showed a similar increase in concentration downstream of the WwTP. Mean COD and BOD levels respectively increased by 200% and 76% downstream of the WwTP. Ammonia levels also doubled downstream of the plant. Minimum levels of Dissolved Oxygen (D.O.) were lower than guideline levels at both upstream and downstream sites. A detailed discussion for each parameter at the upstream and downstream monitoring locations on the River Erkina is presented below.

Dissolved Oxygen

In the January 2007 to November 2008 interval, mean dissolved oxygen values for the upstream and downstream sites complied with the requirements outlined for designated waters under the Salmonid Waters Regulations (1988). However, the minimum levels recorded at both sites were near 6mg/l and suggest occasional depression of D.O. levels at both sites.

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 2mg/l N has been deemed appropriate for protecting the most sensitive freshwater species, for example Pearl Mussels (Lucey, 2007). This stringent limit has been applied in this report as the River Erkina is contained within an SAC which has been designated for the conservation of freshwater pearl mussels, an endangered species sensitive to water quality deterioration. In the January 2007 to November 2008 period, this level was exceeded for samples taken from both upstream and downstream of the Durrow WwTP discharge. Mean Nitrate levels at the reference site upstream of the outfall were 4.83mg/l, while the corresponding level downstream was 4.98mg/l (N=20 both upstream and downstream).

Table 9 EPA biological monitoring data for the River Erkina (EPA code 14/E/01) upstream of the Durrow WwTP discharge at Durrow Bridge, (Clabby *et al.*, 2006). This the most downstream site surveyed by the EOA on the River Erkina.

Station No.	River Erkina EPA 14/E/01 0550
Site	Durrow Bridge (town of Durrow)
1985	4
1988	4
1991	3-4
1995	3-4
1998	4
2001	3-4
2005	3-4
2007	3-4

Table 10 Chemical water quality results from the River Erkina at Durrow footbridge (Adapted from Neill, 2007 and Neill, 2008). This site is located upstream of the Durrow WwTP outfall.

Date	27/03/07	01/05/07	17/09/07	28/11/07	25/01/06	16/05/06	08/08/06
Temp	6.9	14	12.5	10	6.4	12.5	17
D.O. (%)	94	91	115	85	86	85	98
D.O. (mgO ₂ /l)	11.3	9.5	12.2	9.5	10.6	9.1	9.5
BOD (mgO ₂ /l)	1.5	1	1	0.3	0.9	1	0.8
Colour Hazen	30	20	20	20	15	60	10
pH	8	8.2	7.9	8	8.1	8.11	8.1
Conductivity (uS/cm)	745	737	760	783	773	734	806
O-Phosphate	0.02	0.01	0.01	0.01	0.04	0.04	0.04
Ammonia (mg/l N)	0.03		0.01	0.02	0.04	0.06	0.02
un-ionised-Ammonia	0.0005		0.0002	0.0004	0.0008	0.002	0.0008
Nitrite (mg/l N)	0.02	0.031	0.013	0.016	0.03	0.032	0.013
Nitrate (mg/l N)	6.6	5.2	5.7	4.5	7.1	4.9	5
Chloride (mg/l Cl)	22	26	22	23	19	24	27

Table 11 Mean concentrations of parameters upstream (local station code 6602) and downstream (local station code 6702) of the Durrow WwTP and percentage increase or decrease of parameters downstream of the outfall during the period January 2007 to November 2008.

Parameter	Upstream (mg/l)	Downstream (mg/l)	% increase/decrease
Ammonia(NH ₃)	0.07	0.14	100
Biological Oxygen Demand (BOD)	1.1	1.94	76.4
Chemical Oxygen Demand (COD)	4	12	200
Conductivity @ 25°C	732.9	735.8	0.4
Dissolved Oxygen (Measurement)	9.12	9.44	3.5
Hardness	408.4	419.2	2.7
Nitrates(NO ₃)	4.83	4.98	3.1
Nitrite(NO ₂)-N	0.0195	0.019	-2.6
Ortho-phosphate	0.04	0.05	25
pH	7.95	8.05	1.3
Suspended Solids	22.5	28	24.4
Temperature	8.85	9.15	3.4
Total Nitrogen	4.15	4.6	10.8
Total Phosphorus	0.13	0.12	-7.7

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. This parameter was tested for only twice by Laois County Council over the January 2007 to November 2008 monitoring period and levels both upstream and downstream of the plant were almost the same at just under 0.02mg/l. Such infrequent monitoring is insufficient to make an informed assessment of Nitrite concentrations in the river.

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 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 $\leq 0.040\text{mg/l}$ 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 Erkina both upstream and downstream of the plant do not meet criteria for good status.

Ortho-phosphates

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. Where quality has been found to be unsatisfactory, the Regulations require that the water be improved by 2007. Up to 2007, the minimum Ortho-phosphate (measured as MRP) concentration for the upstream stretch of the River Erkina and downstream stretch of the River Nore under the regulations was 0.045mgP/l (MRP values are taken from EPA, 2001). This limit corresponded to a water quality rating of Q3-4 for both locations in 1995. However, an improvement to Q4 implies that a level of 0.03mg/l is the new standard for the Erkina downstream of Durrow and the River Nore downstream of the Erkina confluence. Regardless, after 2007 all Irish Rivers should ideally be restored to good ecological status which relates to a mean annual orthophosphate concentration of 0.03 mg/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 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. In this regard, the River Erkina upstream of the WwTP is assigned 'High status', assuming samples were taken at 95%ile flows. At 95%ile flows, the river downstream of the plant is assigned 'Good status'. The 0.04 mg/l level recorded upstream is however considered to be elevated in relation to the requirement of the Phosphorous Regulations.

BOD

A Biological Oxygen Demand (BOD) limit is set at 5mg/l by the Salmonid Waters Regulations (1988) where this value is to be conformed to by 95% of samples. The EPA set a stricter guideline limit value of 3mg/l and this value is used in this assessment. Minimum and mean BOD concentrations were below the 3mg/l concentration upstream (N=20) and downstream (N=20) during the January 2007 to November 2008 monitoring period. The maximum BOD value recorded both upstream and downstream of the plant exceeded the indicative level of 3mg/l but the downstream site was worse (4mg/l upstream versus 6mg/l downstream). This represents an increase in concentration by 76% downstream of the plant.

In the European Communities Environmental Objectives (Surface Waters) Regulations 2009 (SI 272 of 2009) a river can be assigned either 'High status' or 'Good status' according to oxygenation conditions; BOD concentrations $\leq 1.3\text{mg/l}$ (mean flows) or $\leq 2.2\text{mg/l}$ (95%ile flows) imply 'High status'; BOD concentrations ≤ 1.5 (mean flows) or $\leq 2.6\text{mg/l}$ imply 'Good status'. During either mean or 95%ile flows therefore, the river upstream of the plant would be assigned 'High status' but it would have to be assumed that the river downstream of the plant had samples taken at 95%ile flows to be assigned 'High status'.

COD

There are no limits for Chemical Oxygen Demand (COD) in rivers, however it can be expected that COD would have the same effects on aquatic systems as BOD. Upstream of the plant between January 2007 and November 2008, the mean and maximum COD concentrations were 4mg/l and 9mg/l respectively. Downstream, the corresponding concentrations were 12mg/l and 24mg/l . Comparing mean values, there is an increase of 200% in the

concentration of COD downstream of the plant but it should be noted that this is based on a total of only 5 samples (3 upstream and 2 downstream).

3.2.2 Results of the December 2008 on-site assessment

This section presents the results of the December 2008 biological assessment carried out at a site located upstream and downstream of the Durrow WwTP outfall. This assessment was undertaken to compliment the existing information discussed above. The procedure followed was EPA kick sampling (Toner *et al*, 2005). Biotic indices including Q-values and BMWP scores were derived and macroinvertebrate functional analysis was also carried out. Table 12 gives the macroinvertebrate taxa recorded at each site in terms of their pollution sensitivity while Tables 13 and 14 summarizes the functional group analysis results.

3.2.2.1 Reference Site

This site was located immediately upstream of the N8 Bridge in Durrow, approximately 0.5km upstream of the Durrow WwTP discharge. There is a storm water outfall from the town located under this bridge. Above this bridge there is a weir and the kick sampling was undertaken downstream of the weir in riffled water. The mean and maximum water depths at this site were 45cm and 60cm, respectively. Rock, cobble, gravel and fine substrates in the proportions 10%, 50%, 25% and 15% respectively were recorded. Instream vegetation (mainly water crowfoot *Ranunculus* spp.) covered approximately 20% of the river bed (comprising an Annex I habitat listed on the Habitats Directive).

Macroinvertebrates in 16 different families were recorded at this site. Mayfly larvae of the large dark olive *Baetis rhodani* and the green/grey drake mayfly *Ephemera danica* were scarce, the latter being the only Group A pollution sensitive indicator recorded at this site. Cased caddisfly larvae of three species (Group B, less sensitive indicators) were recorded but all were scarce; those of the northern caddisfly *Potamophylax* sp., the black caperer primitive caddisfly *Sericostoma personatum* and the microcaddisfly *Hydroptila* sp. Larvae of the caseless caddisflies (Group C, pollution tolerant indicators) were less diverse but more abundant; fair numbers of grey flag larvae *Hydropsyche pellucidula* and small numbers of larvae of the sandfly *Rhyacophila dorsalis* were recorded. True fly larvae recorded were those of blackfly (common), bloodworm (present) and the crane fly *Dicranota* sp. (present). Riffle beetles (Elmidae) were recorded at both larval and adult stages with generally small number of *Elmis* sp. recorded while *Limgius* sp. were present. Also present were the river limpet *Ancylus fluviatilis* and ramshorn snail *Planorbis planorbis*. The most abundant organism was the pollution tolerant freshwater shrimp *Gammarus deubeni* (Group C) which was dominant. Aquatic earthworms (Lumbriculidae) and flatworms (Platyhelminthes) were also present at this site.

Using EPA freshwater biological monitoring criteria (Toner *et al.*, 2005), this site was deemed to be 'Class B, Slightly polluted (Q3-4)'. This was due to the scarcity of Class A indicators and the relative abundances of the other indicator groups. The BMWP habitat specific score was based on a riffled habitat (>= 70% boulders and pebbles) and a score of 95.5 was calculated for this site. This score is indicative of good water quality but deemed to be slightly impacted. The corresponding ASPT was 5.9, indicating good water quality.

This site was also surveyed by ECOFACT in June 2008 (as part of a different project) and a more diverse macroinvertebrate assemblage of 22 different families was recorded. In this earlier survey only one Group A pollution indicator was recorded and was also scarce. Group B and C indicators comprised the bulk of the community resulting in a classification of 'Class B, Slightly Polluted (Q3-4)' and a BMWP score of 132.5, indicating 'Very good' water quality.

3.2.1.3 Receptor site

The receptor site was located at the first riffled stretch of river downstream of the discharge, encountered approximately 250m downstream of the WwTP. At this point the river was approximately 12m wide and had maximum and mean depths of approximately 80cm and 45cm, respectively. The river was a combination of riffle (60%) and glide (40%), with a

substrate of rock (10%), cobble (50%), gravel (30%) and fines (10%). Instream vegetation cover at this site was approximately 25%.

A macroinvertebrate family diversity of 18 was recorded at this site. Two Class A pollution sensitive species of mayfly at larval stage were present; the yellow may dun *Heptagenia sulphurea* and the green drake mayfly *Ephemera danica*. Mayfly larvae of the pollution tolerant large dark olive *Baetis rhodani* were scarce. Pollution tolerant caseless caddisfly larvae of the family Hydropsychidae were common, while fair numbers of the sandfly *Ryacophila dorsalis* were recorded. Blackfly larvae (Simuliidae), another pollution tolerant organism was numerous with other members of the true fly group (cranefly, bloodworm and green chironomid) generally scarce. Larvae of riffle beetles, the orb mussel *Pisidium* sp., ramshorn snail and bladder snail *Physa fontinalis* were also scarce. Crustaceans were well represented in numbers with both the freshwater shrimp *Gammarus deubeni* and hog louse *Asellus aquaticus* being common. The leeches *Erpobdella octoculata* and *Piscicola geometra* (a parasitic fish leech) along with aquatic earthworms and flatworms were all scarce at this site.

The downstream receptor site was dominated by Group C pollution tolerant organisms and no Group B less sensitive indicators were found. Only 2 Group A pollution sensitive indicators were recorded. Therefore, this site was rated as 'Class B, Slightly Polluted (Q3-4)' using the EPA freshwater biological monitoring system. However, this rating has been assigned only tentatively, given the scarcity of Group A and Group B sensitive indicators and the dominance of Group C and Group D in the macroinvertebrate assemblage. This site was bordering on moderately polluted status (Q3). The BMWP score for this riffled site was 90.2, reflecting good water quality; while the ASPT was 5 (where 5.5 reflects good water quality).

Table 12 Classification of macroinvertebrate taxa recorded at each site in terms of their pollution sensitivity (EPA methods).

Pollution group	indicator	Reference		Receptor	
		Number	% of total	Number	% of total
Group A (Most sensitive)		3	1.0	2	0.7
Group B (Less Sensitive)		5	1.7	0	0.0
Group C (Tolerant)		284	95.3	217	76.4
Group D (Very Tolerant)		4	1.3	61	21.5
Group E (Most tolerant)		2	0.7	4	1.4
Total		298	100	284	100

Table 13 Functional group characteristics of the two survey sites. P/R = ratio of grazers 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		Receptor	
	Number	% of total	Number	% of total
Filtering Collector	70	23	152	54
Gathering Collectors	7.5	3	8	3
Grazer	22.5	8	11	4
Predator	11	4	17	6
Shredder	187	63	96	34
Total	298	100	284	100
P/R	0.09		0.04	
Heterotrophy Vs Autotrophy	Heterotrophic		Heterotrophic	

Table 14 Juvenile salmonid food index. Predictable invertebrate supply is the ratio of behavioral drifters (filtering and gathering collectors) to accidental drifters (grazers, shredders and predators). Based on a threshold of >0.50 for predictable supply (Rabenil *et al.*, 2005).

Site	Behavioral drifters	drifters/accidental	Predictable Vs Unpredictable
Control	0.35		Unpredictable
Receptor	1.29		Predictable

3.2.1.4 Overview

In the current field study, both the reference and receptor sites were comparable from a physical perspective. However, there was a significant difference between the composition of the macroinvertebrate community and trophic structure at the two sites. Both sites were rated as being Q3-4 'slightly polluted' or 'satisfactory' using EPA methodology. However, the receptor site was considered to be borderline with 'moderately polluted' or 'Unsatisfactory', due to the increased abundance of Group C tolerant and Group D very tolerant indicators. For example the Group D hog louse was not recorded at the upstream reference site but was common at the receptor site. Moreover, cased caddisfly larvae were not detected at the receptor site, despite three species in this taxonomic group recorded from the reference site. Overall Group C and D indicators respectively accounted for 95.3% and 1.3% of the macroinvertebrate community at the reference site, as opposed to 76.4% and 21.5% at the receptor site.

The receptor had a greater family richness with 2 more families than the reference site. This increase in diversity however was brought about partially by the presence of pollution tolerant hog louse, leeches and a snail. The macro-invertebrate functional group composition varied significantly between the two sites. At the control site shredders and filtering collectors comprised approximately 63% and 23% of the community, respectively. Grazers (also known as scrapers) formed approximately 8% of the macroinvertebrate assemblage. Organisms specializing as filtering collectors, predominantly blackfly larvae and to a lesser extent grey flag caddisfly larvae constituted 54% of the community at the receptor site. Comparing the reference and receptor site, the relative abundance of grazers dropped by ½ at the receptor. This shift in the trophic structure of the community represents a change ecological status between the two sites. The relative abundance of macroinvertebrate scrapers and filtering collectors in the riffle/run habitat is an indication of the periphyton community composition, availability of suspended fine particulate organic material (FPOM) and availability of attachment sites for filtering. Scrapers increase with increased diatom abundance and decrease as filamentous algae and aquatic mosses (which scrapers cannot efficiently harvest) increase. The ratio of scrapers to total collectors and shredders (P/R ratio) gives the ratio of gross primary production to community respiration. The P/R ratio was low for both sites (0.09 for reference, 0.04 for receptor) and showed that the communities at both sites were dependent on inputs from outside the river for sustenance. However, the P/R ratio for the receptor site was more than 50% lower than the reference site, indicating that the receptor is more dependent on external sources (e.g. sewage inputs) than the upstream site. The relative abundance of grazers at both sites show that the macroinvertebrate community on the River Erkina around Durrow has adapted to these heterotrophic conditions. Part of the Erkina catchment upstream of Durrow is cutaway raised bog and this no doubt influences the trophic structure of the macroinvertebrate assemblage in the river.

The juvenile salmonid food index suggested that 'Predictable' supply of invertebrate food was available for juvenile salmonids at the receptor site but was 'Unpredictable' at the reference site. This index is based on the ratio of behavioral drifters (filtering and gathering collectors) to accidental drifters (scrapers, shredders and predators). The ratio for the reference and receptor site was 0.35 and 1.29, respectively. The higher value for the receptor site was due to the numbers of blackfly and grey flag caddisfly larvae recorded. The dominance of freshwater shrimp (shredder) at the reference site was a significant factor in reducing the juvenile salmonid food index value. Overall, both the upstream and downstream stations on the River Erkina are considered to be impacted with imbalances in terms of the macroinvertebrate communities present but there is a reduction in water quality downstream of the discharge.

3.2.3 Dangerous substances

The predicted influent quality for the Durrow WwTP has been estimated by O' Dwyer (2007) and is presented in Table 15.

Table 15 Estimated influent quality at the Durrow 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.

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 River Nore 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. The outfall was also sampled at this time. These results are presented in Table A3.5 in Appendix 3.

Because sampling was only undertaken on one occasion, further monitoring would be required to obtain more understanding of the status of these substances in the River Erkina and in the outfall from the plant.

3.2.4 Assimilation capacity

In Table 16 the waste assimilation capacity of the River Erkina at Durrow is calculated for the parameters Biological Oxygen Demand (BOD), Suspended Solids, Total Phosphorous, Ammonia and orthophosphate (biological available phosphorous). The calculation uses Laois County Council mean parameter values in the River Erkina upstream of the discharge (January 2007 to November 2008) and a 95%ile flow of 0.71m³ sec⁻¹ in the River Erkina. The waste assimilation capacity of a river is the ability of a river at a particular point to assimilate waste and provides a link between water quality and effluent emission standards. The standards taken in the current model are the European Communities Environmental Objectives (Surface Waters) Regulations 2009 (SI 272 of 2009) limit values for 'good standard' rivers (BOD, and orthophosphate) and limit values provided for suspended solids and ammonia in the Salmonid Waters Regulations (1988). Other indicative limits for BOD and Ammonia are also used. The median annual orthophosphate level given in the Phosphorous Regulations (1998) is also used for comparative purposes in the model.

The waste assimilation capacity of the Erkina is limited for some parameters due to existing background pollution levels (see section 3.2.1.2). In particular the river has limited capacity or no capacity for phosphorous depending on which standard is taken.

Table 16 Assimilation capacity of the River Erkina at mean (4.34m³/s) and 95%ile flow (0.71m³/s) for selected parameters at the discharge point based on mean background parameter levels between January 2007 and November 2008 (BOD=1.1mg/l, Orthophosphate=0.04mg/l, Total Ammonia=0.07mg/l, Suspended Solids=22.5mg/l, Total Phosphorus=0.13mg/l, Nitrates=4.83mg/l and Nitrites=0.0195mg/l). 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 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)	75.00	149.99	712.45	67.48	92.02	116.55
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)	-5.62	-1.87	-3.75	0.31	2.15	-0.61
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)	-11.25	-1.87	348.73	1.23	4.29	57.05
Suspended Solids	Mean flow			95%ile flow		
Environmental standard	SWR			SWR		
Limit concentration (mg/l)	25			25		
WAC (kg/day)	937.44			153.36		
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)	-25.50			-4.17		
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)	-1061.18			-173.60		
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)	-3.56			-0.58		

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).

3.3 Sediment quality

No information on sediment quality in the Nore catchment was identified during the current assessment.

3.4 Areas designated for nature conservation

Areas designated for nature conservation located within five kilometers of the Durrow WwTP are listed in Table 17. Sites of international conservation importance are designated Special Protection Areas (SPA), under the Birds Directive or Special Areas for Conservation (SAC) under the Habitats Directive. Together, SPAs and SACs make up the Natura 2000 network of wildlife sites.

The nearest SAC to the Durrow WwTP is the 'River Barrow and River Nore' SAC (site code 002162). The River Erkina is designated as a SAC at the WwTP discharge location. The 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 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. As well as 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 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*. This site 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 animal species are also found in the Barrow/Nore cSAC. These include Daubenton's bat (*Myotis daubentoni*), badger (*Meles meles*), Irish hare *Lepus timidus hibernicus* and frog *Rana temporaria*, all species listed in the Irish Red Data Book. The rare Red Data Book fish species smelt *Osmerus eperlanus* occurs in the estuary. Two other freshwater mussel species, *Anodonta anatina* and *A. cygnea* are also found in the Nore (Lucey, 1998). The Barrow/Nore is mainly a grilse fishery though spring salmon fishing is good in the vicinity Inistioge on the Nore. 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.

Sites of national importance for wildlife are designated as Natural Heritage Areas (NHAs) under the Irish Wildlife Act, 2000. There is one Natural Heritage Area located within a 5km radius of the Durrow WwTP. This is the Curragh & Goul River Marsh (Code 000420). This site is not located within the catchment area affected by the discharge from the Durrow WwTP.

Table 17 Sites designated for nature conservation within a 5km radius of the outfall from the Durrow WwTP.

Name	Site code	Approximate distance from site	Designation	Notes
River Barrow & River Nore	00216 2	0km	SAC	12 Annex I habitats including floating river vegetation and tall herb fringes; 12 Annex II species including white-clawed crayfish <i>Austropotamobius pallipes</i> , river lamprey <i>Lampetra fluviatilis</i> , brook lamprey <i>L. planeri</i> , sea lamprey <i>Petromyzon marinus</i> , freshwater pearl mussel <i>Margaritifera margaritifera</i> and Nore freshwater pearl mussel <i>M.durrovensis</i> , the whorl snail <i>Vertigo moulinsiana</i> , Atlantic salmon <i>Salmo salar</i> and otter <i>Lutra lutra</i> . The River Erkina, a component of this SAC, flows through the town of Durrow. Durrow WwTP discharges directly into the River Erkina.
The Curragh & Goul River Marsh	00042 0	2km	NHA	Important winter feeding site for Greenland white-fronted goose, listed in Annex I of the E.U. Birds Directive 1979. Also for opposite leaved pondweed listed on the FPO, 1999.

3.5 Protected aquatic flora and fauna

The status of fauna listed in the European Union Directive on the Conservation of Natural and Semi-Natural Habitats and of Wild Fauna and Flora (Habitats Directive, 92:43:EEC) which have been recorded from the Nore catchment is presented in Table 18.

Table 18 Status of fauna listed in the Habitats Directive (92:43:EEC) in the Nore catchment (adapted from Lucey, 1998).

Common name	Scientific name	Main channel	Tributaries
Pearl mussel	<i>Margaritifera margaritifera</i>	Rare	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 *Austropotamobius pallipes* is known to occur in the Erkina River, contained in the River Barrow and River Nore SAC. This species is protected under both European and Irish legislation. It is protected by the Wildlife Act, 1976 (Amendment 2000) and has been classified as vulnerable in the IUCN Red List. It is also listed under Appendix III of the Bern Convention and Annexes II and V of the EU Habitats Directive (1992).

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 Nore, which are underlain by Carboniferous limestone, or its derivative - glacial drift (Reynolds, 1998). This species is thought to be present in the River Erkina. However, it was not found during the December 2008 survey at sites located both upstream and downstream of the Durrow WwTP outfall. Numbers of white clawed crayfish have declined recently with an unexplained collapse of the Nore crayfish population occurring in August 2004 (Clabby *et al* 2006).

3.5.2 Lamprey species

Legally protected lamprey species; river lamprey *Lampetra fluviatilis*, brook lamprey *Lampetra planeri*, and sea lamprey *Petromyzon marinus* are all known to occur in the River Barrow and River Nore SAC. 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 Nore catchment (Kurtz & Costello 1999). Only brook lamprey occurs in the study area.

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 Nore 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

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 Nore catchment (Lucey 1998, McGinnity *et al*, 2003). Salmon are likely to spawn in the River Erkina 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 Nore catchment.

3.5.6 Freshwater Pearl-mussel

Freshwater Pearl-Mussel (*Margaritifera margaritifera*) occurs in the River Nore catchment; however this species is now rare in the main channel of the river (Lucey, 1998). The freshwater pearl mussel *Margaritifera margaritifera* has been recorded from both the River Nore and the River Barrow catchments with populations still recorded from the River Nore in the vicinity of Durrow town (Moorkens *et al*, 2007). The populations of *M. margaritifera* within

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

the River Nore have been described as a separate hard water species (*Margaritifera durrovensis*), or as a subspecies; however discussion remains as to whether these hard water populations are actually an ecophenotypic hard water form of *M. margaritifera* (Lucey, 2006).

The hard water form found in the Nore (*Margaritifera durrovensis*), has been attributed a synonym of *M. margaritifera* and has been included in Annex V of the EU Habitats Directive. Furthermore it is acknowledged as a subspecies (*Margaritifera margaritifera ssp. durrovensis*) on the International Union for Conservation of Nature and Natural Resources (IUCN) red list of threatened species (Lucey, 2006). The European Union Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (Habitats Directive) lists *Margaritifera margaritifera* under Annex II (species of Community interest whose conservation requires the designation of special areas of conservation) and Annex V (species of Community Interest whose taking in the wild and exploitation may be subject to management measures). This Directive was transposed into Irish law by the EC Habitats Regulations S.I. 94 of 1997 and its amendment of 2005. The species is also protected under the Convention on the Conservation of European Wildlife and Natural Habitats. It is listed as 'Endangered' on the International Union for Conservation of Nature and Natural Resources (IUCN) Red Data List, while *M. durrovensis* is listed as 'Critically Endangered'. In Ireland, *M. margaritifera* is protected under the Wildlife Act 1976 and Wildlife Amendment Act 2000. To date, 19 cSACs have been designated for *M. margaritifera* and one for *M. durrovensis*, the only known site in the world.

The distribution of the Nore freshwater pearl mussel *M. m. durrovensis* is limited to a 14km stretch of the river between Watercastle and Attanagh Bridge, a reach of the river to which the River Erkina discharges. The population is considered to be on the verge of extinction (Moorkens & Costello, 1994). From studies carried out between 1990 and 1994, it was estimated that the total mussel numbers in the Nore had fallen from 2,000 to 420 (Moorkens and Costello 1994). In the most recent mussel counts, carried out in 2004, a total population of around 500 individuals was estimated, with no evidence of juvenile survival (Moorkens 2004). The latest results confirm that the Nore population is at a critically low level, and the indications are that it is unable to successfully recruit young.

Pearl mussels have a complicated life cycle, involving native salmon or trout. The key cause of decline in pearl mussel populations in Ireland is unsuitable habitat for juvenile mussels after they fall off the gills of host salmonids (Moorkens, 2005). This stage requires the safety of remaining within the river bed gravels, before growing to a size that allows the emergence of the filtering siphons into the open water body. While the juvenile mussels remain within the river bed gravels, they filter the interstitial water within the gravels. Where the gaps between the gravel and stones get clogged with fine silt, either physical (from suspended solids entering the river) or organic (from algal growth and decay prompted by nutrients in the water), the flow of water in the interstices becomes very restricted. Without adequate water movement and replacement, oxygen levels are exhausted and young mussels die. The decline in interstitial water quality in silted gravels has been detailed by a number of authors in the scientific literature. Fine sediments in gravels have been shown to increase mortality in juvenile mussels to 100%. As river quality becomes depressed, breeding stops and populations become "*functionally extinct*", i.e. older adults persist, but are not replaced by a new generation (Moorkens, 2005). The mussel population eventually dies out when the older individuals die of old age. Once breeding stops, it becomes very difficult to save a population. No mussel river in this situation has yet been recovered to a fully independent, recovered and breeding colony. In this knowledge, the pearl mussel has been identified as being internationally endangered.

3.5.6.1 Water Quality requirements for Pearl Mussels

The water quality requirements for Pearl Mussels have recently been reviewed by Young (2005). The main findings of this review are as follows:-

- Juvenile mussels and glochidia are often more susceptible than adults to poor water conditions.
- Interstitial water chemistry is of crucial importance to juvenile mussels but only one study has been carried out on the requirements of juvenile freshwater pearl mussels.

- Unnaturally high levels of nutrients, conductivity, nitrates, phosphates, BOD, metals and some pesticides are detrimental to Pearl Mussels, as well as unnaturally high and low pH.
- Eutrophication is widely regarded as very damaging to mussel populations but few studies have quantified this problem.
- Biocides have frequently been shown to be toxic to mussels of all species.

Guidance on water quality requirements for Pearl Mussels has also been given in an Irish context by Moorkens (2000) and the draft guidelines provided in NPWS (2005). General recommendations for favourable Water Quality Objectives for Pearl Mussels for a number of sources are provided in Table 19.

Table 19 General recommendations for favourable Water Quality Objectives for Pearl Mussels.

Parameter	Target (Oliver 2000)	Target (Bauer 1999)	Proposed Minimum Standard (Moorkens 2000)	Proposed Standard (NPWS 2005)
Ammonia	N/A	N/A	<0.10	0.01
Nitrate (mg/l)	<1.0	<0.5	<1.7	0.125
Phosphate (mg/l)	<0.03	<0.03	<0.005	<0.005
pH (pH units)	6.5-7.2	N/A	<8.0 - >6.3	
Conductivity (µs/cm)	<100	<70	<200	
Calcium (mg/l Ca CO ₃)	<10	2	N/A	
BOD (mg/l)	<1.3	<1.4	<3	
Suspended solids (mg/l)	N/A	N/A	N/A	N/A
Dissolved Oxygen (% saturation)	90-100	N/A	50% >8	

3.6 Recreational and Commercial fisheries

The fish fauna of Ireland is not as diverse as other European countries due to the impact of glaciation. Most of the fish species present in Irish river catchments, such as the River Nore, have colonized from the sea or have been artificially introduced. Native fish species in the Nore catchment include the three Irish lamprey species (brook lamprey, river lamprey, and sea lamprey) (Kurz & Costello, 1999), the Atlantic salmon, (Lucey, 1998) and the Twaite Shad, (Lucey, 1998) all of which are listed under the EU Habitats Directive. The Nore is the most important river in Ireland for the latter species; however these fish do not ascend past the weir at St. Mullins (King, 2002). The European eel, brown trout, and three-spined stickleback, are other common native species present in the Nore catchment, while introduced fish species include northern pike *Esox lucius*, stone loach *Barbatula barbatula*, roach *Rutilus rutilus*, dace *Leuciscus leuciscus*, and minnow *Phoxinus phoxinus* (Lucey, 1998). The smelt *Osmerus eperlanus*, a species listed as vulnerable in the red data list (Whilde, 1993), is present in the Nore Estuary (King, 2002).

The freshwater stretches of the River Nore main channel is a designated salmonid river under the EU Fish Directive (78/659/EEC). The Nore is an important salmon and trout fishery which was once regarded as being one of the finest salmon rivers in the country (O'Reilly, 2004). It is mainly a grilse fishery though spring salmon fishing is reported to be good in the vicinity of Thomastown and Inistioge. Due to the presence of a number of weirs on the river, salmon are generally confined to the lower areas of the river until late in the year and very few salmon are now caught above Kilkenny (O'Reilly, 2004). Recent installation of two new weirs at Kilkenny (in particular Lacken Weir) as part of the Kilkenny Drainage Scheme is believed to have further impacted on upstream passage of salmon in the river (Irish Examiner, 3 January 2005). Brown trout angling is important in the River Nore, and the best stocks in the entire river are reportedly found downstream of the Dinin confluence (O' Reilly, 2004).

The River Nore catchment (fishery code 38) which includes the River Erkina is classified as a salmon and sea trout fishery (McGinnity *et al*, 2003). The River Erkina has a good stock of trout with fish up to 1.6kg (O' Reilly, 2004) with the best fishing early in the season. O' Reilly states that the Erkina is a slow moving river with a silty bottom, and occasional gravel-bottomed streams.

3.7 Water abstractions

There are no Drinking Water RPAs on the River Nore within 10km downstream of the study area (EPA online Envision map). 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 Nore (EPA online Envision map).

3.9 Nutrient sensitive areas

The River Nore is classified as a nutrient sensitive water downstream of Kilkenny under the Urban Wastewater Treatment Regulations (2001).

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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 Durrow 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 Durrow WwTP discharge is the River Erkina, which is included in the River Barrow and River Nore SAC designation, protected under the EU Habitats Directive. The impact on identified receptors is outlined in the following sections.

4.2 Impact on water quality

The impact of the current discharge regime on the receiving water (River Erkina) is discussed under the following sub-headings and is summarized at the end of Section 4 in Table 20:

- Chemical water quality
- Biological water quality
- Dangerous substances
- Assimilation capacity

4.2.1 Chemical water quality

Overall, across the spectrum of parameters monitored by Laois County Council between January 2007 and November 2008, there is a significant increase in the concentration of chemical water quality parameters downstream of the plant. It was considered that some parameters were not monitored frequently enough to interpret reasonable conclusions for the impact of the plant on the River Erkina (i.e. Total Phosphorous, Total Nitrogen and Nitrite). However, it is clear that the Durrow WwTP discharge is having an adverse affect on the River Erkina with regard to Ammonia and Ortho-phosphate in particular. However, this is a localized effect in the last 1km of the river before it is further diluted by the River Nore.

There is no evidence that that water quality in the River Nore is significantly affected by the Durrow WwTP. However, further sampling immediately upstream and downstream of the Erkina confluence would be required to confirm this.

4.2.2 Biological water quality

Overall, the Erkina is considered to be impacted with imbalances in terms of the macroinvertebrate communities present at the sites investigated both upstream and downstream of the plant. However, the situation is slightly worse downstream of the Durrow WwTP outfall, with greater relative abundances of the pollution tolerant taxa and increased allochthonous dependence, pointing to a decline in ecological status at the downstream site. Therefore the plant outfall is considered to be having an adverse effect on biological water quality in the River Erkina. The role of storm water outfalls in affecting biological water quality at both of these sites is unknown.

4.2.3 Dangerous substances

Sampling for a suite of dangerous substances was carried out by Laois Co. Co. in November and December of 2008. The results from this assessment are provided in Appendix 3 and do not indicate any issues.

4.2.4 Assimilation capacity

Because of the generally poor background water quality, the River Erkina has a limited waste assimilation capacity, particularly for phosphorous. The existing discharge from the WwTP is exasperating this situation by increasing a range of parameters to levels which are at or above the relevant water quality standards. It is therefore concluded that the existing Durrow plant is having a significant adverse effect on the River Erkina in terms of assimilation capacity. However, this is a localized effect in the last 1km of the river before it is further diluted by the River Nore.

The River Erkina has a mean flow of 4.34m³/s and a 95%ile flow of 0.71m³/s and the proposed dry weather flow from the plant would be 674m³/day (value taken from (Nicholas O'Dwyer, 2007). The respective dilution of the effluent at mean and 95%ile flows in the River Erkina would be approximately 556:1 and 91:1.

4.3 Article 6 Screening Assessment

The discharge from the Durrow WwTP is directly into the River Barrow and River Nore SAC (site code 002162) and the results of both the chemical and biological water quality assessments suggest that the Durrow WwTP discharge is having an adverse affect on the water quality of the receiving water (River Erkina). On this basis it must be concluded that the ongoing operation of the plant is having a significant, although localized effect on the SAC. An appropriate assessment of the impacts of the proposed upgraded of the Durrow WwTP on the River Barrow and River Nore SAC has been prepared by Entec and O'Dwyer (2006).

4.3.1 Pearl mussels

Freshwater pearl mussels occur in the River Nore both upstream and downstream of the River Erkina confluence and have also been recorded from the River Erkina at Durrow. The population in the River Nore catchment is considered to be on the verge of extinction (Moorkens & Costello 1994; Costello *et al*, 1997). Pearl mussels have such high water quality requirements that any negative impact on water quality in the River Nore, as a result of the discharge from the Durrow WwTP and associated discharges, would be considered to be putting an internationally endangered species at risk.

4.3.2 White-clawed crayfish

White-clawed crayfish occur in the River Nore catchment but were not recorded in the River Erkina within the study area. Wintertime is not the ideal time however for surveying this species. Crayfish are recognised as being tolerant of moderate pollution levels and are classed as Group C organisms in the EPA Q-Value biotic index. A recent report found that

"crayfish were most often found in unpolluted waters but were also found in slightly polluted and moderately polluted waters. Some populations were even found at sites with very low water quality" (Demers *et al.*, 2005). However, the relationship between water quality and crayfish populations is not fully understood and there have some cases of crayfish populations being lost from rivers which deteriorated from slightly (Q3-4) to moderately polluted (Q3) conditions (Reynolds, 2007). It is therefore considered sensible to consider them as a species that is vulnerable to water quality changes (Reynolds, 2007). Reduced water quality and ecological status downstream of the discharge of the Durrow WwTP could potentially have indirect effects on crayfish.

4.3.3 Lampreys

Water quality impacts downstream of the Durrow WwTP outfall would not be expected to have significant negative impacts on existing brook 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. Therefore the current poor water quality status of the River Erkina – particularly downstream of the WwTP discharge – has the potential to affect the favourable conservation status of this species.

4.3.4 Atlantic salmon

Poor water quality will affect the conservation status of salmon in the River Erkina; this species requires clean water (Q4) for spawning and early life stages. The juvenile salmonid food index suggested that a 'Predictable' supply of invertebrate food was available for juvenile salmonids at the receptor site but 'Unpredictable' at the reference site. Benthic macroinvertebrate communities both upstream and downstream of the discharge were deemed to be unbalanced indicating significant background pollution in the River Erkina. The Durrow WwTP was considered to be further contributing to the problem with a shift in the trophic status of the macroinvertebrate community compared to upstream. In this light, the Durrow WwTP is affecting the potential of the River Erkina as a salmon producing watercourse.

4.3.5 Eurasian Otter

Reduced water quality and ecological status downstream of the discharge of the Durrow WwTP could be potentially having indirect effects on otters as a result of reduced food supply.

4.4 Impact on fisheries

The River Nore is currently closed to all salmon angling due to conservation concerns. Salmonids are considered to be under pressure in system area due to poor water quality conditions. Unsatisfactory water quality will also affect other native species within the river such as brown trout. The ongoing operation of the Durrow WwTP presents the potential for ongoing impacts to water quality and further deterioration in the fish communities present within the study area. This would have significant adverse impacts on the fisheries and recreational angling taking place on the River Erkina and to a lesser extent the River Nore.

4.5 Impact on water abstractions

There are no drinking water abstractions on the Rivers Erkina or Nore downstream of the Durrow WwTP. The WwTP does not impact on any designated water abstraction sites.

4.6 Impact on recreational areas

There are no designated recreational or bathing waters on the River Erkina or River Nore downstream of the Durrow WwTP, so the existing discharges from same are having no impact on such designated areas.

4.7 Impact on nutrient sensitive areas

The nearest nutrient sensitive area to the Durrow WwTP is the main channel of the River Nore downstream of the Kilkenny (Purcellinsinch) sewage outfall, to Inistioge Bridge. This area of the Nore is located over 20km downstream of the discharge.

Table 20 Summary of the receiving waters impact assessment.

Receptor	Rating of receiving waters	Impacts	Scale of impact
Water quality	Moderately Polluted	Causing a deterioration in the chemical and ecological status	Significant, adverse impact on receiving water (Erkina)
Designated conservation sites	Receiving water is an SAC	Likely to contribute to cumulative negative impacts on water quality in the SAC	Significant, potentially causing adverse impact on receiving water
Protected flora and fauna	Salmon, brook lamprey, otter. Pearl mussels also located in the River Nore less than 1km downstream.	Likely to affect salmon and lamprey recruitment in the River Erkina. Risk to sensitive Pearl Mussel populations in Nore.	Significant, potentially causing adverse impact on receiving water
Fisheries	Receiving water (River Erkina) is tributary of designated salmonid water (River Nore)	Likely to affect recruitment of salmonid fish	Significant, potentially causing adverse impact on receiving water
Water abstractions	No abstractions	No impact	Not significant
Recreational areas	No recreational areas	No impact	Not significant
Nutrient sensitive areas	Nearest is >20km downstream	No impact	Not significant
Conclusion			Significant, potentially causing adverse impact on receiving water

4.8 Likely impact of new plant on receiving waters

The tables in Appendix 5 give the projected concentrations of selected parameters in the River Erkina downstream of the outfall of the new proposed Durrow WwTP. The background levels of these parameters in the River Erkina are based on the mean values from the period January 2007 to November 2008 provided in Appendix 3. The 95%ile flow of 0.71m³/s was used for the River Erkina.

With the proposed tertiary treatment, there will be a highly significant improvement in the quality of the effluent discharged from the new plant over the existing situation. This is apparent with comparisons between the predicted values (Appendix 5) and observed data downstream of the discharge (Appendix 3). Even with the limited assimilation capacity for some parameters (i.e. orthophosphate) the Erkina downstream of the plant would still be compliant with the European Communities Environmental Objectives (Surface Waters) Regulations 2009 (SI 272 of 2009)) using the current background water quality information.

5. RECOMMENDATIONS

The existing plant is overloaded. Therefore, upgrading of the plant (Stage 1) should be undertaken as soon as possible as this would be result in a highly significant improvement in the quality of the effluent and consequently improve water quality in the River Erkina. The upgrade would also be likely to have the significant benefits for the River Nore and the Nore Pearl Mussel.

Sampling of the River Erkina should continue at the same frequency as before (monthly) and each sample should be analyzed for Nitrite, Suspended Solids, Total Nitrogen and Total Phosphorus along with other parameters. Ideally, flow readings should be taken concurrently with samples. The OPW operate a hydrometric station at Durrow footbridge (Station 15005) and information could possibly be taken from this to complement the water sampling.

Further monitoring for dangerous substances from the WwTP discharge is recommended.

Every effort should be made by Laois County Council to work with other relevant agencies to reduce background pollution levels in the River Erkina (and Nore).

It is also recommended that annual biological monitoring be undertaken upstream and downstream of the WwTP outfall. Biological monitoring should be carried out during the summer autumn period.

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APPENDIX 1 NPWS Designated 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, Portarlinton, 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 Aughnabriskey, 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*, *Janice 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 hederarum*) 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 (*Austroptamobius 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 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 A2.1 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 A2.2.

Table A2.2 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	Q3-4	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% to 120%	Fluctuates from <80% to >120%	Very unstable, Potential fish-kills	Low, sometimes zero	Very low, often zero
Annual median PO ₄	0.015 mg/l	0.03 mg/l	0.045 mg/l	0.07 mg/l	>0.1 mg/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 A2.3 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
	Sphaeriidae	3	3.6	3.7	3.7	3.4
Worms	Oligochaeta	1	3.5	3.9	3.2	2.5
Leeches	Piscicolidae	4	5.0	4.5	5.4	5.2
	Glossiphoniidae	3	3.1	3.0	3.3	2.9
	Hirudididae	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	7.7	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	7.6	7.6		
	Ephemeridae	10	7.3	9.0	9.2	11.0
	Caenidae	7	7.3	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
		Halipidae	5	4.0	3.7	4.2
Beetles	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

Caddisflies	Rhyacophilidae	7	8.3	8.2	8.6	9.6
	Philopotamidae	8	10.6	10.7	9.8	
	Polycentropidae	7	8.6	8.6	8.4	8.7
	Psychomyiidae	8	6.9	6.4	7.4	8.0
	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
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 A2.4 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 3 Monitoring data from River Erkina

Table A3.1 Summary water quality results for the River Erkina upstream and downstream of the Durrow VVWTP outfall during the period January 2007 to November 2008. Derived from data supplied by Laois County Council. Values in bold are in breach of limits set out in EPA (2001).

Ammonia(NH3) (mg/l)							
	N	Mean	Minimum	Maximum	St.dev.	Variance	95% C.I.
Upstream of plant	20	0.07	0.02	0.22	0.05	0.00	0.02
Downstream of plant	20	0.14	0.03	0.40	0.10	0.01	0.04
BOD (mgO₂/l)							
	N	Mean	Minimum	Maximum	St.dev.	Variance	95% C.I.
Upstream of plant	20	1.10	0.60	2.00	0.35	0.13	0.16
Downstream of plant	20	1.94	1.00	4.00	0.92	0.84	0.40
COD (mg/l)							
	N	Mean	Minimum	Maximum	St.dev.	Variance	95% C.I.
Upstream of plant	3	4.00	0.00	9.00	4.58	21.00	5.19
Downstream of plant	2	12.00	0.00	24.00	16.97	288.00	23.52
Conductivity @ 25°C (uS/cm)							
	N	Mean	Minimum	Maximum	St.dev.	Variance	95% C.I.
Upstream of plant	20	732.95	640.00	868.00	55.75	3108.16	24.43
Downstream of plant	20	735.85	658.00	800.00	45.42	2063.29	19.91
Dissolved Oxygen (mg O₂l⁻¹)							
	N	Mean	Minimum	Maximum	St.dev.	Variance	95% C.I.
Upstream of plant	20	9.12	6.03	11.70	1.53	2.35	0.67
Downstream of plant	19	9.44	6.17	12.60	1.59	2.52	0.71
Hardness							
	N	Mean	Minimum	Maximum	St.dev.	Variance	95% C.I.
Upstream of plant	2	408.40	405.24	411.56	4.47	19.98	6.19
Downstream of plant	2	419.23	417.56	420.91	2.37	5.63	3.29
Nitrates(NO₃) (mg/l)							
	N	Mean	Minimum	Maximum	St.dev.	Variance	95% C.I.
Upstream of plant	20	4.83	2.76	6.76	1.02	1.04	0.45
Downstream of plant	20	4.98	2.64	7.07	1.13	1.27	0.49
Nitrite(NO₂)-N (mg/l)							
	N	Mean	Minimum	Maximum	St.dev.	Variance	95% C.I.
Upstream of plant	2	0.0195	0.017	0.022	0.004	0.00001	0.005
Downstream of plant	2	0.019	0.017	0.021	0.003	0.00001	0.004
Ortho-phosphate (mgP/l)							
	N	Mean	Minimum	Maximum	St.dev.	Variance	95% C.I.
Upstream of plant	20	0.04	0.01	0.14	0.03	0.00	0.01
Downstream of plant	20	0.05	0.02	0.12	0.02	0.00	0.01
pH							
	N	Mean	Minimum	Maximum	St.dev.	Variance	95% C.I.
Upstream of plant	20	7.95	7.37	8.27	0.23	0.05	0.10
Downstream of plant	20	8.05	7.53	8.67	0.22	0.05	0.10
Suspended Solids (mg/l)							
	N	Mean	Minimum	Maximum	St.dev.	Variance	95% C.I.
Upstream of plant	2	22.50	20.00	25.00	3.54	12.50	4.90
Downstream of plant	4	28.00	0.00	71.00	32.79	1075.33	32.14
Total Nitrogen (mg/l)							
	N	Mean	Minimum	Maximum	St.dev.	Variance	95% C.I.
Upstream of plant	2	4.15	4.10	4.20	0.07	0.00	0.10
Downstream of plant	2	4.60	4.30	4.90	0.42	0.18	0.59
Total Phosphorus (mg/l)							
	N	Mean	Minimum	Maximum	St.dev.	Variance	95% C.I.
Upstream of plant	2	0.13	0.04	0.21	0.12	0.01	0.17
Downstream of plant	2	0.12	0.05	0.18	0.09	0.01	0.13

Table A3.2 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. The Erkina is not a designated salmonid water but flows into the Nore a short distance d/s of the WwTP outfall. 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 NO_3 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 NO_2 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)

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Table A3.5 Results of the dangerous substances monitoring of the Durrow WwTP outfall during November and December 2008.

PARAMETER	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 REGULATIONS (1998) LIMIT	COMPLIANT DOWNSTREAM
	12138	12412	12139	12413	12139	12413					
Dichloromethane	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	-	10	N/A	N/A	✓
Toluene	<0.1	0.6	<0.1	<0.1	<0.1	<0.1	-	10.0	N/A	N/A	✓
pm xylene	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	10.0	N/A	N/A	✓
o xylene	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	10.0	N/A	N/A	✓
Atrazine	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	1	N/A	N/A	✓
Simazine	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	1	N/A	N/A	✓
As	0.5	0.6	<0.2	0.6	<0.2	0.8	25	-	N/A	N/A	✓
Ba	50.4	46.8	68.9	106	73	99.1	-	N/A	N/A	N/A	✓
Cd	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	N/A	N/A	N/A	✓
Cr	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	5	30	N/A	N/A	✓
Hg	0.06	<0.02	<0.02	<0.02	<0.02	<0.02	-	-	N/A	N/A	✓
Ni	1.4	<0.5	<0.5	0.9	<0.5	0.9	8	50	N/A	N/A	✓
Pb	0.5	<0.3	<0.3	<0.3	<0.3	<0.3	5	10	N/A	N/A	✓
Se	0.8	2	<0.6	1.2	0.8	1.9	-	N/A	N/A	N/A	✓
Zn	19.2	38.2	4.1	11	6.6	7.8	-	-	N/A	N/A	✓
B	0.07	0.15	<0.02	0.02	0.02	0.02	-	2000	N/A	N/A	✓
Cu	15.7	6.5	<3.0	<3.0	<3.0	<3.0	5	30	<0.04 mg/l Cu	Water hardness <0.005-0.112 mg/l Cu	✓
Cyanide	12	<5.0	<5.0	<5.0	<5.0	<5.0	10	-	N/A	N/A	✓
Sulphate	27.4	2.8	19.9	48.6	19.1	48.3	-	-	N/A	N/A	✓
Total Nitrogen	28	23	7	4	5	5	-	-	N/A	N/A	✓

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Total Phosphorus	ug/l	2.4	2.4	0.5	0.06	<0.3	<0.03	-	-	-	N/A	N/A	✓
Fluoride	ug/l	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	500	500	-	N/A	N/A	✓
Phenols	ug/l	0.006	<0.005	<0.005	0.095	<0.005	0.065	-	-	-	N/A	N/A	✓
Tributyl Tin	ug/l	<0.02	-	<0.02	-	<0.02	-	-	-	0.001 (applies to tidal rivers)	N/A	N/A	✓

Note: Limits of detection for some parameters may be raised due to sample dilution, digestion or sample volume extracted.

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FLATWORMS (Platyhelminthes)	C	Gathering collector	1	4
Total number of organisms			298	284
Number of families			16	18
Q value			3-4	3-4 ¹
Quality class			B	B
BMWP score			95.5	90.2
ASPT			5.9	5.0

¹Borderline with Q3, Class C

Table A4.2 Selected water quality characteristics of the two sites surveyed on the River Erkina near the Durrow WwTP outfall on the 2nd December 2008.

Chemical parameter	Reference site	Receptor site
Temperature (°C)	5.6	5.5
Dissolved Oxygen (%)	85.2	86.1
Dissolved Oxygen (mg O ₂ l ⁻¹)	10.73	10.37
Conductivity (µS cm ⁻¹)	767	814

Table A4.3 Selected physical characteristics of the two sites surveyed on the River Erkina near the Durrow WwTP outfall on the 2nd December 2008.

Physical parameter	Reference site	Receptor site
Wetted width (m)	16	12
Mean depth (cm)	45	45
Maximum depth (cm)	60	80
Rock (%)	10	10
Cobble (%)	50	50
Gravel (%)	25	30
Fine (%)	15	10
Riffle (%)	70	60
Glide (%)	30	40
Pool (%)	0	0
Shade (%)	0	0
Instream vegetation (%)	20	25
Bank height (m)	0.5	0.25
Bank slope (°)	90	30
Bank cover (%)	100	90

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APPENDIX 5 WAC MODELS FOR NEW PLANT

Estimated concentrations of selected parameters in the River Erkina downstream of the proposed new Durrow WwTP outfall. Model uses a 95 Percentile flow of 0.71 m³/sec in the River Erkina and a plant DWF of 674 m³ day⁻¹ (Nicholas O'Dwyer, 2007). Model uses mean background water quality from Laois Co. Co. monitoring period January 2007 to November 2008. For comparison, zero background parameter levels are also used.

Table A5.1 Projected concentrations of selected parameters in the River Erkina downstream of the upgraded Durrow WwTP using background parameter concentrations and pristine conditions (zero background concentration). Based on Laois Co. Co. monitoring data between January 2007 and November 2008, a 95%ile flow of 0.71m³/s in the River Erkina and a dry weather flow of 674 m³/day from the new plant. Discharge standards are from Nicholas O Dwyer (2007). Design of 0.37mg/l Total Phosphorus (TP) corresponds to 0.314mg/l Ortho-phosphate (Maximum orthophosphate = 0.85 TP).

Parameter	Discharge standards (mg/l)	Background conc. of parameter (mg/L)	Resulting d/s conc. of parameter (mg/L)	Guideline limit (mg/l)	Compliance with limit values				
Total Phosphorus	0.37	0.13	0.13	0.062 (EPA, 2001)	No				
		0 (pristine)	0	0.062 (EPA, 2001)	Yes				
Suspended solids	29	22.5	22.6	25 (SWR)*	Yes				
		0 (pristine)	.04	25 (SWR)*	Yes				
Total ammonia	1	0.07	0.08	0.1 (EPA, 2001)	Yes				
		0 (pristine)	0.011	0.1(EPA, 2001)	Yes				
Ortho-phosphate	0.314	0.04	0.043	0.03 PR*	0.045 WFD	0.075 WFD	No		
					HS*	GS*	Yes	Yes	Yes
				0 (pristine)	0.003	0.03 PR*	0.045 WFD	0.075 WFD	Yes
BOD	25	1.1	0.36	3 (FFD)*	2.6 WFD	2.2 WFD	Yes		
					GS*	HS*	Yes	Yes	Yes
				0 (pristine)	0.27	3 (FFD)*	2.6 WFD	2.2 WFD	Yes
				GS*	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 A5.2 Projected concentrations of selected parameters in the River Erkina downstream of the upgraded Durrow WwTP using background parameter concentrations and pristine conditions (zero background concentration).
Based on Laois Co. Co. monitoring data between January 2007 and November 2008, a mean flow of 4.34m³/s, in the River Erkina and a dry weather flow of 674 m³/day from the new plant. Discharge standards are from Nicholas O Dwyer (2007). Design of 0.37mg/l Total Phosphorus (TP) corresponds to 0.314mg/l Ortho-phosphate (Maximum orthophosphate = 0.85 TP).

Parameter	Discharge standards (mg/l)	Background conc. of parameter (mg/L)	Resulting d/s conc. of parameter (mg/L)	Guideline limit (mg/l)			Compliance with limit values		
Total Phosphorus	0.37	0.13	0.13	0.062 (EPA, 2001)			No		
Suspended solids	29	22.5	22.5	25 (SWR)*			Yes		
Total ammonia	1	0.07	0.072	0.1 (EPA, 2001)			No		
Ortho-phosphate	0.314	0.04	0.04	PR*	WFD	WFD	No	Yes	Yes
		0 (pristine)	0.001	0.03	0.045	0.075			
BOD	25	1.1	1.143	PR*	WFD	WFD	Yes	Yes	Yes
		0 (pristine)	0.045	3 (FFD)*	2.6 WFD	2.2			

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

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APPENDIX 6 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 A6.1 of this report was also utilized. The outcome of the assessment is provided in Table A6.1.

Table A6.1 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 A6.2 of this report was utilized. The outcome of the assessment is provided in Table A6.2.

Table A6.2 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

An appropriate Assessment for the Laois Towns & Villages Wastewater Improvement Scheme, which includes the proposed upgrade to the Abbeyleix WwTP, has been already prepared by Entec O'Dwyer (2006). According to Laois County Council, this has already been accepted by NPWS.

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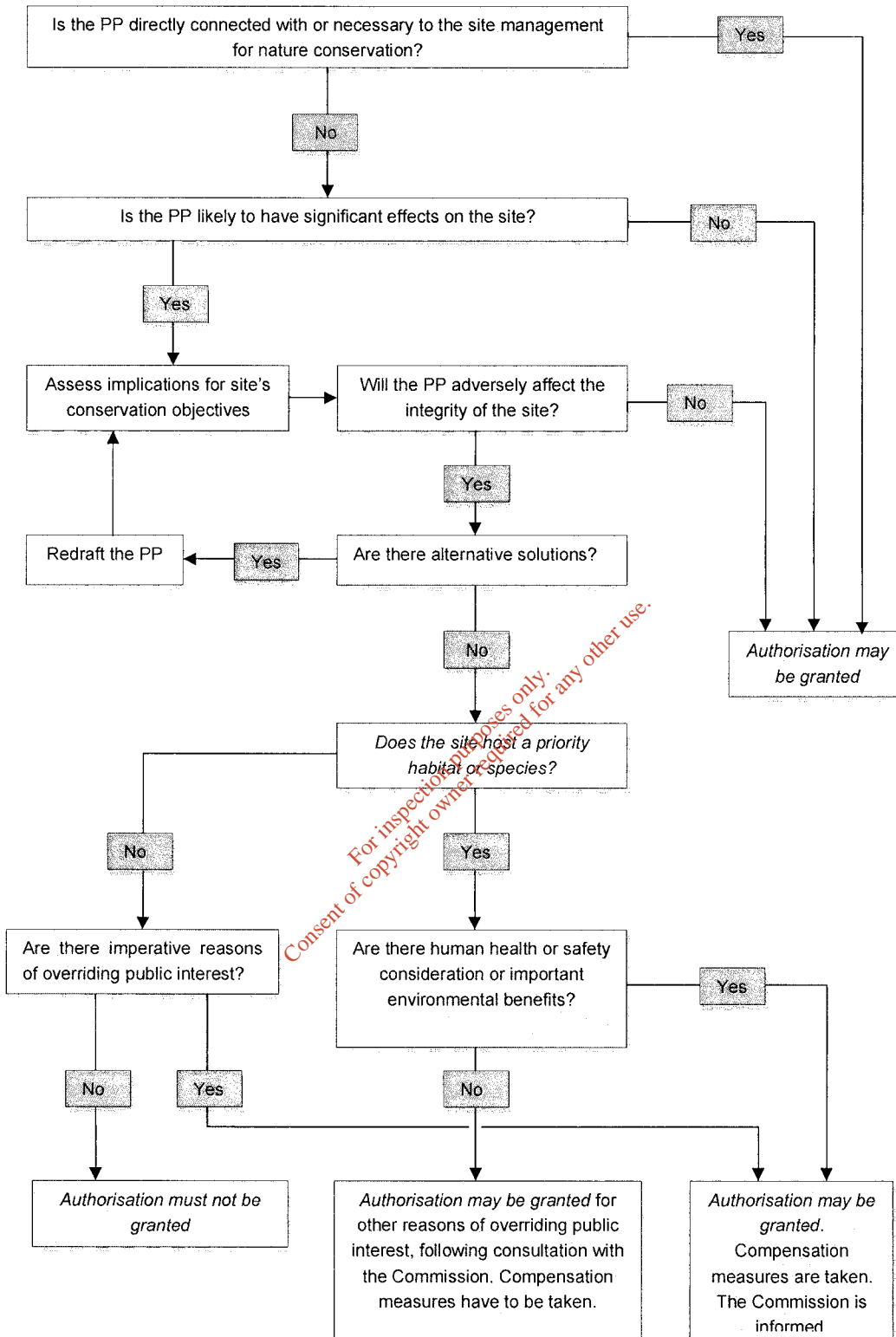


Figure A6.1 Flowchart outlining the appropriate assessment process (Adapted from EC, 2001).

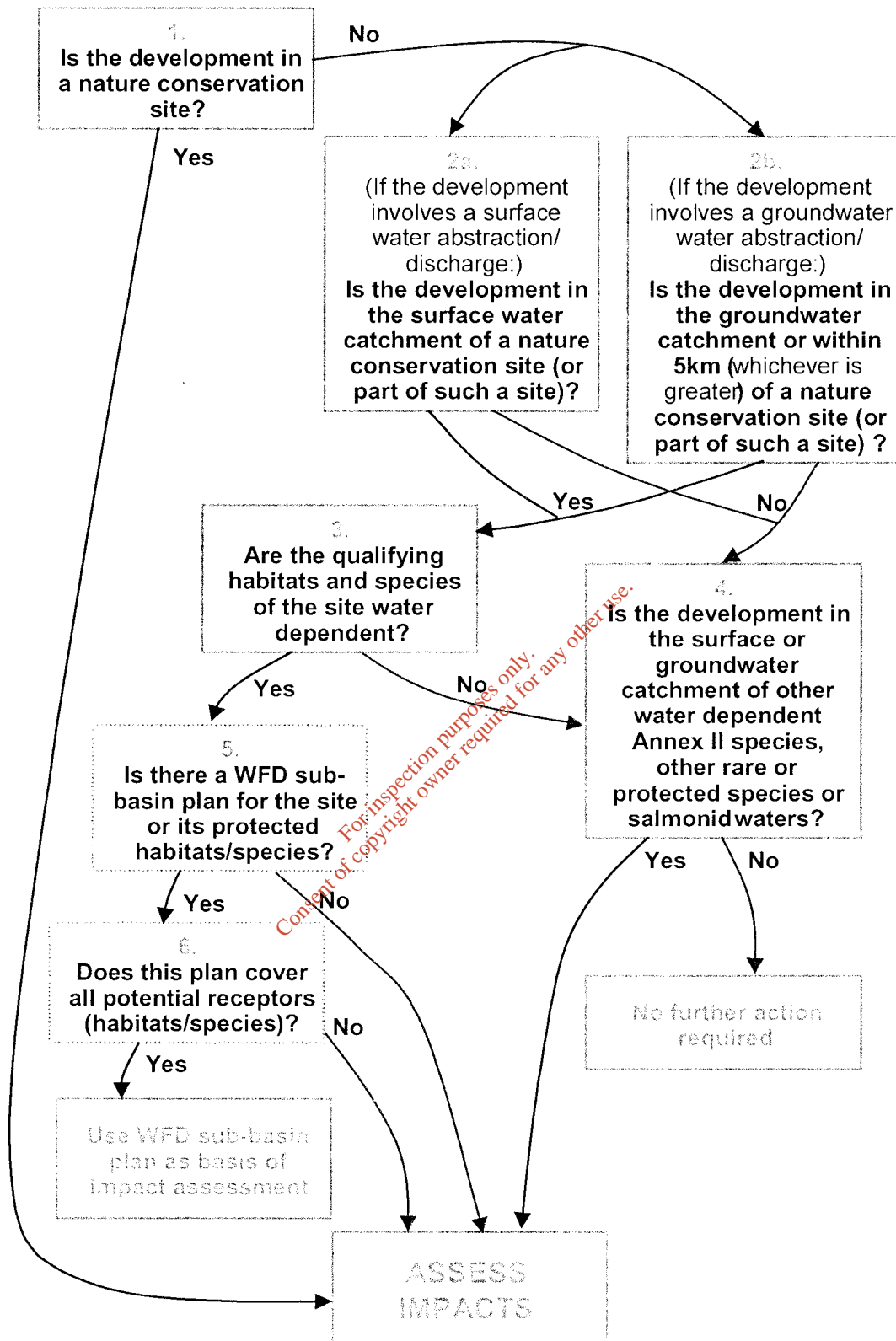


Figure A6.2 Flow chart for assessing screening requirements (from DOEHLG circular L8/08).

Appendix 7 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 A2.2.

Table A7.1. 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 A7.2 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).