# PINEWOODS WIND LIMITED

# Pinewoods Wind Farm, Co. Laois and Co. Kilkenny.

# PRELIMINARY CONSTUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

## February 2017

**Pinewoods Wind Limited,**
c/o Galetech Energy Services,
Clondargan,
Stradone,
Co. Cavan

Tel.: +353 49 555 5050

**Jennings O'Donovan & Partners Limited,**
Consulting Engineers,
Finisklin Business Park, Sligo.
Tel.: 071 - 916 1416
Fax: 071 - 916 1080
e mail: info@jodireland.com

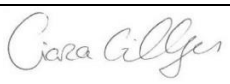
**JENNINGS O'DONOVAN & PARTNERS LIMITED**
Project, Civil and Structural Consulting Engineers,
FINISKLIN BUSINESS PARK,
SLIGO,
IRELAND.

Telephone (071) 91 61416
Fax (071) 91 61080

Email info@jodireland.com
Web Site www.jodireland.com

# DOCUMENT APPROVAL

| | | |
|---|---|---|
| **PROJECT** | Pinewoods Wind Farm | |
| **CLIENT / JOB NO** | Pinewoods Wind Limited | 5538 |
| **DOCUMENT TITLE** | Preliminary CEMP | |

| | **Prepared by** | **Reviewed** | **Approved by** |
|---|---|---|---|
| Document<br>Draft | Name<br>Ciara Gilligan | Name<br>Nuala Carr | Name<br>David Kiely |
| Date<br>21st December 2016 |  |  |  |

| | **Prepared by** | **Reviewed** | **Approved by** |
|---|---|---|---|
| Document<br>Final | Name<br>Ciara Gilligan | Name<br>Nuala Carr | Name<br>David Kiely |
| Date<br>6th February 2017 |  |  |  |

# PINEWOODS WIND FARM, CO. LAOIS & CO. KILKENNY

# CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN

## CONTENTS

## FIGURES



## TABLES



## APPENDICES



## TECHNICAL SCHEDULES

# 1.0 INTRODUCTION

## 1.1 BACKGROUND TO REPORT

Pinewoods Wind Limited c/o Galetech Energy Services is embarking a development, to be known as "*Pinewoods Wind Farm*" located in the townlands of Knockardagur, Boleybawn, Garrintaggart, Ironmills (Kilrush) and Graiguenahown, County Laois; and Crutt, Co. Kilkenny. Jennings O'Donovan & Partners Limited were requested by Galetech Energy Services to respond to a further information request issued by Laois County Council in relation to the proposed Pinewoods Wind Farm, Co. Laois / Co. Kilkenny (Laois Co. Co. Planning Ref: 16/260). The development comprises the construction 11 no. turbines, each with a maximum height of up to 136.5 metres, and all associated site development and ancillary works, including a 110kV electricity substation, switchroom and equipment compound; two single circuit strain towers with a maximum height of up to 26.5 metres; turbine foundations; crane hardstandings; a total of 7.4 kilometres of site access tracks (2km of site access tracks are located in Co. Kilkenny) ; underground electricity and commutations cabling; site drainage works; 7 no. site entrances; permanent meteorological mast with maximum height of up to 85 metres; and temporary upgrade to the R430/L7800 road junction.

Jennings O'Donovan & Partners Limited (JOD), on behalf of Galetech Energy Services has prepared this preliminary Construction Environmental Management Plan (CEMP) for the proposed development. This document has been prepared on a preliminary (outline) basis and will be further developed and expanded following the appointment of the Contractor for the main construction works. Some items of this CEMP can only be finalised with appropriate input from the Contractor who will actually carry out the main construction works. This CEMP identifies for the incoming Contractor, the key planning, EIA and Contract Document constraints that must be adhered to in order to deliver optimum environmental reassurance for the site.

This document should be read in conjunction with the Environmental Impact Statement, Planning Report, Further Information and Planning Drawings for the various elements of the proposed development.

## 1.2 PLANNING HISTORY

A planning application for that part of the development situate in County Kilkenny was lodged with the Planning Department of Kilkenny County Council and a planning application for that part of development situate in County Laois was lodged with the Planning Department of Laois County Council on 30th May 2016. Pursuant to Article 33 of the Planning and Development Regulations 2001

(as amended), Laois County Council have requested that further information be furnished to the planning department.

Item 3(a) of the Request for Further Information states that:

*'Notwithstanding that the applicant proposes in Section 6.1.4 of the NIS to prepare a Construction Method Statement and a Construction Phase Environmental Management Plan prior to the commencement of development, if granted permission, the Planning Authority requires that a preliminary Construction Environmental Management Plan submitted as part of additional information to ensure the implementation of the crucial mitigation measures proposed in the NIS, in order to ensure no negative impacts results on the River Barrow and River Nore Special Area of Conservation (SAC)'.*

## 1.3 AIMS AND OBJECTIVES OF CEMP

This preliminary Construction Environmental Management Plan (CEMP) has been developed in accordance with the Institute of Environmental Management and Assessment (IEMA) Practitioner "*Environmental Management Plans*", Best Practice Series, Volume 12, December 2008 and has been designed to cover the proposed environmental construction strategies that are to be carried out, before and during the proposed development works. It is intended that this preliminary CEMP will be finalised by the contractor in the form of a detailed CEMP should the works progress to construction stage.

This preliminary CEMP aims to define good practice as well as specific actions required to implement mitigation requirements as identified in the Natura Impact Statement (NIS) and Environmental Impact Statement (EIS), the planning process and/or other licensing or consenting processes.

The preliminary CEMP is considered to be a live document which will be developed further and / or amended where necessary subsequent to planning consent to take account of planning condition requirements and any information which may be made available from additional consultations, site surveys etc.

The preliminary CEMP will form part of the main Civil Construction works Contract. The Civil Contractor will take account of the structure, content, methods and requirements contained within the various sections of this CEMP when further developing this document (to include environmental plans and other related Construction Management Plans) as required by the Contract.

A summary of the CEMP development process and the required input from the main parties involved in the post planning and construction of the wind farm is indicated in Figure 1.1.

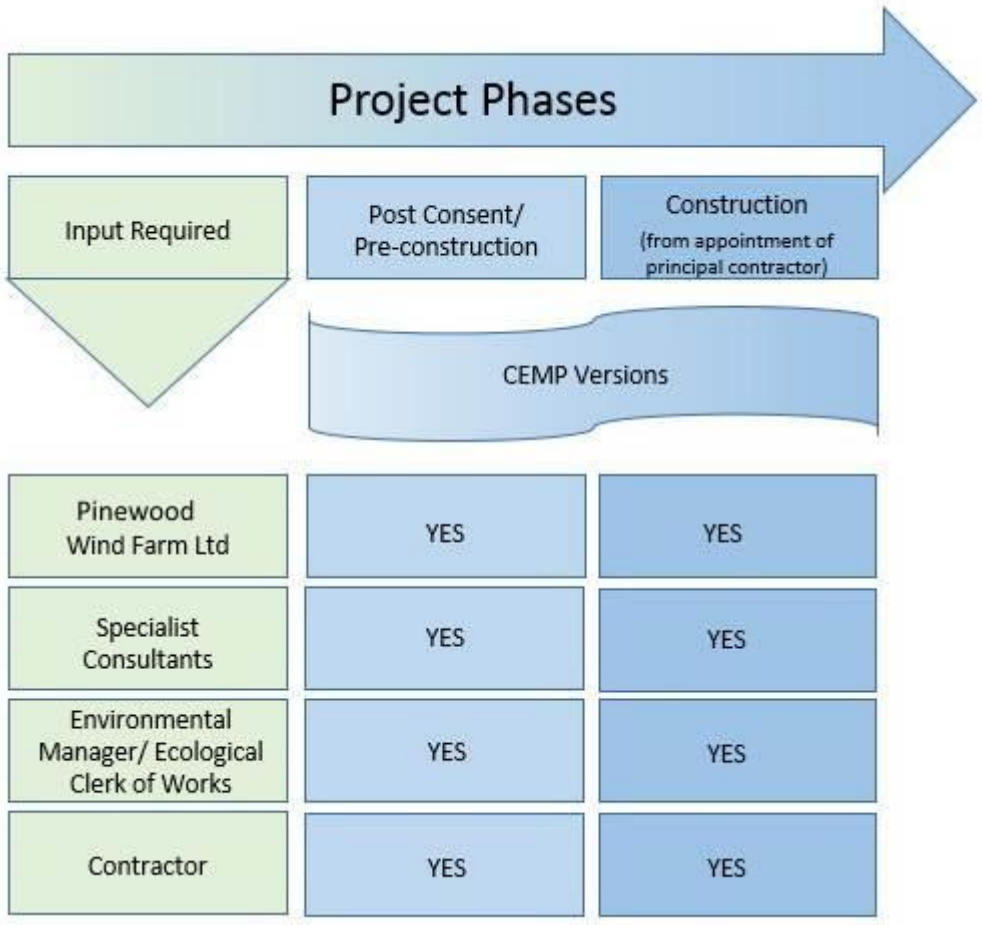



**Figure 1.1 Summary of CEMP development process**

## 1.4 CEMP ROLES AND RESPONSIBLITIES

Prior to commencement of construction works, the Contractor will identify a core Environmental Management Group, comprising of specific project personnel and including the Ecological Clerk of Works (ECoW). The Environmental Management Group will meet monthly to discuss the monthly environmental report and will advise site personnel on areas where improvements may be made on site. The group will draw on technical expertise from relevant specialists where required and will liaise with other relevant external bodies as required.

The Contractor will appoint an Environmental Manager who will be responsible for coordination and development of the CEMP and any other surveys, reports or construction management plans required for discharge of relevant pre-commencement planning conditions. In conjunction with the ECoW, the

Environmental Manager will also review the Contractors construction management plans and environmental plans as required by the CEMP, carry out compliance auditing during the construction phase and coordinate the Environmental Management Group and required liaisons between Pinewoods Wind Limited, the Contractor, the planning case officer and other statutory authorities.

The Contractor will appoint an independent Ecological Clerk of Works (ECoW). The main roles and responsibilities of the ECoW relate to compliance monitoring with the CEMP and planning conditions and advice provision in relation to ecological matters. The ECoW will also assist the Environmental Manager.

## 1.5 REPORTING PROCEDURES

Figure 1.2 provides a diagrammatic outline of the general tasks and communication lines, based on the roles described in Tables 3.2 and 3.3 in Section 3, and tasks detailed in the Technical Schedules. The Contractor will update this information as part of the detailed CEMP.

Technical Schedule TS1, Environmental Incident and Emergency Response Plan, includes a figure illustrating the communications plan for reporting procedures for all potential environmental risks, hazards or incidents which may relate to ecology, water quality, dust, noise or archaeology.

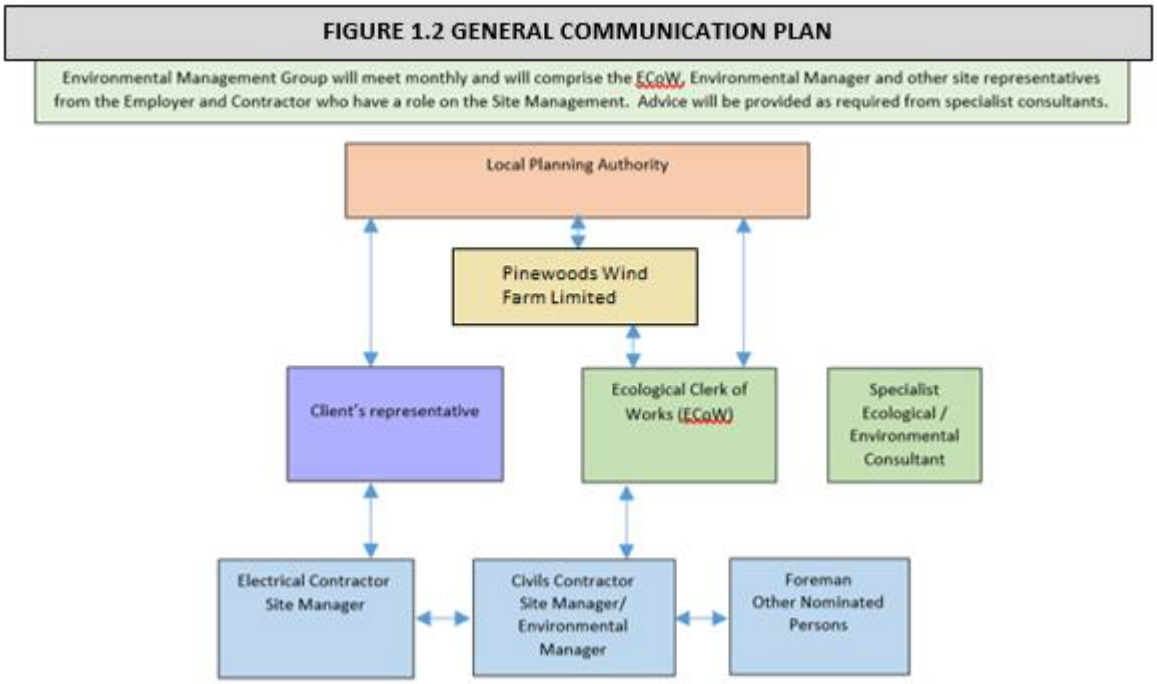



**Figure 1.2 General Communication Plan**

## 1.6 CEMP STRUCTURE

The CEMP is divided into discreet Sections which are designed to be filed as separate documents / folders if required. A copy of the CEMP documents / folder(s) will be kept in the site offices for the duration of the site works and will be made available for review at any time. The Contractor's Environmental Manager will be responsible for the CEMP and will keep all sections updated throughout the construction phase.

Where the Contractor has standard documents within his own company / corporate Environmental Management Plans which cover a particular requirement of this CEMP, these will either be inserted or cross referenced within the relevant Section of this CEMP.

An overview of the structure of the CEMP and sub-plans is illustrated in Figure 1.3.

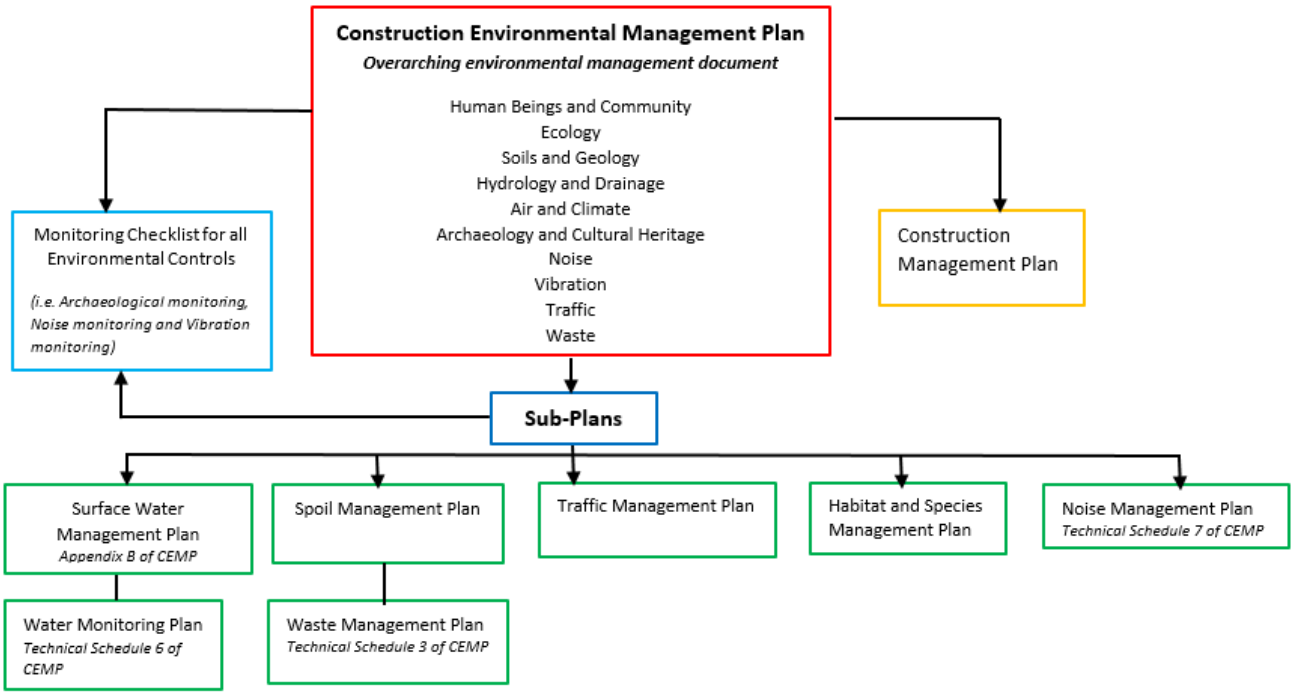



**Figure 1.3 Structure of the CEMP and sub-plans**

The CEMP Sections are listed in Table 1.1 as follows:

TABLE 1.1: CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP): Document Structure

| Section | Title & Brief Description | Contractor Development Required |
|---|---|---|
| 1 | Introduction | No (Information purposes only) |
| 2 | Project Information<br>Provides details on site location, scheme description and a summary of the environmental sensitivities at the site in Table 2.1 (as derived from the Environmental Impact Statement, Planning Reports and Appropriate Assessment Screenings and other information where available). Provides details on relevant Planning Consent Conditions. Any documents prepared by Pinewoods Wind Limited in response to Consent Conditions will be recorded in Table 2.6. Contains a record of all Scheme Amendments and a Register of Variations. | Yes<br>Any documents prepared by the Contractor in response to Consent Conditions will be recorded by the Contractor in Table 2.6 and inserted in the CEMP where necessary. Any Scheme Amendments and / or Variations to the CEMP required during the works will be recorded by the Contractor in Tables 2.6 and 2.7. |
| 3 | Environmental Communications Plan<br>Contains details on specific requirements relating to:<br>• Contact details for Pinewoods Wind Limited personnel, technical specialists, Contractor personnel, regulators, landowners, other stakeholders etc;<br>• Meetings, reports and consultations;<br>• Roles and responsibilities; and<br>• General reporting procedures and tasks. | Yes<br>The Contractor will:<br>i) Insert contact information for regulatory authorities and other stakeholders (where not already provided) into Table 3.1<br>ii) Refer to Table 3.2 for details on requirements for meetings, reports and consultations<br>iii) Insert information on Contractor appointments and responsibilities relating to environmental management and implementation of this CEMP into Table 3.3.<br>iv) Refer to Figure 1.2 for a summary of the main communication lines. |
| 4 | Correspondence, Records, Reports<br>This Section relates to document control and retention of records. The information at the start of Section 4 provides:<br>• A list of all documents to be retained / filed within the CEMP.<br>Table 4.1 provides a record of all Environmental Consents, Licenses and Permits issued for the project. | Yes<br>The Contractor will complete Table 4.1. Throughout the duration of the Contract, the Contractor will insert / file all communication records, data, field records and reports associated with Environmental Management and implementation of this CEMP into this Section 4. This Section may be sub-divided into sub-folders for specific information relating to discrete areas of Environmental Management (such as waste management, pollution prevention, water quality monitoring, ecology etc). Alternatively, this information may be filed within the individual Technical |

| TABLE 1.1: CONSTRUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP): Document Structure | | |
|---|---|---|
| **Section** | **Title & Brief Description** | **Contractor Development Required** |
| | | Schedules in Section 5. The filing method selected by the Contractor will be made explicit at the start of Section 4. |
| 5 | Appendices<br><br>**Appendix A -** Drawings<br>**Appendix B –** Surface Water Management Plan<br>**Appendix C -** Site Investigation Report<br>**Appendix D –** Employer's Project Programme<br>**Appendix E -** Mitigation Management Summary | No.<br><br>The Contractor is not required to develop the Appendices to this document. The Appendices are reference documents provided for information purposes. |
| 6 | Technical Schedules & Available Information<br><br>Technical Schedules include the following:<br><br>TS1 Environmental (Incident and Emergency) Response Plan (ERP)<br><br>TS2 Emergency Communications Plan (in event of a spillage).<br><br>TS3 Waste Management Plan (WMP)<br><br>TS4 Watercourse Crossing Plan (WCP)<br><br>TS5 Induction Schedule<br><br>TS6 Water Quality Monitoring Plan (WQMP)<br><br>TS7 Noise Management Plan (NMP) | Yes<br><br>The Contractor is required to develop the Technical Schedules and/or include additional information or construction management plans as appropriate and where required by the Contract. The development of the Technical Schedules will generate more site specific documents which address particular environmental management procedures applicable for works in specified areas of the site. These Technical Schedules form the Contractor's Environmental Plans (for example, Waste Management Plan).<br><br>Table 5.1 lists all Technical Schedules and provides information on Contractor responsibilities. |

**Table 1.1. Document Structure for Construction Environmental Management Plan**

## 2.0 ENVIRONMENTAL CONTROLS

Prior to commencement of construction works the contractor will draw up a detailed Construction Management Plan which will be informed by the guidance documents and best practice measures listed below. This Construction Management Plan will be adhered to by the contactor and will be overseen by the project representative/foreman.

The contractor is required to supply detailed Construction Management Plan for proposed activities on site which demonstrate how the environmental controls are outlined in the following sections are to be achieved on site. These Construction Management Plans are subject to review and are to be agreed in advance of any works taking place on site. In some instance, with reference to works which may present a risk of sediment release, it will be requirement that the Inland Fisheries Ireland (IFI) are consulted with respect to the development of the Construction Management Plan.

The following documents should contribute to the Construction Management Plan supplemented by specific additional measures proposed below:

- Forestry and Water Quality Guidelines-Forest Service (DMNR, 2000)
- Forestry and Freshwater Pearl Mussel Requirements- Site Assessment and Mitigation Measures (Forest Service, 2009);
- Forest Operations & Water Quality Guidelines (Coillte, 2009)
- Guidelines on Protection of Fisheries during Construction Work in and Adjacent to Water (IFI, 2016).

## 2.1 HUMAN BEINGS AND COMMUNITY

The main mitigation measures relating to potential impacts of the proposed development on the local community during the construction phase relate to good construction management practices which are provided for in the relevant section of this document.

The works will be managed appropriately to keep members of the public away from work areas.

## 2.2 ECOLOGY

All mitigation measures have been developed in the context of national and international legislative guidance for the protection and management of flora, habitats of conservation importance, fauna and

aquatic ecological interest. The description of mitigation measures is provided in terms of mitigation by avoidance, reduction and remediation.

### *2.2.1 River Barrow and River Nore SAC*

The remedial measures below will be sufficient for the River Barrow and River Nore SAC, and will protect the conservation interests of this site.

Particular care is required with regard to the Owenbeg River and the lower reaches of the Graiguenahown and Knockbaun Streams which are designated within the River Barrow and River Nore SAC downstream of the proposed development site. Particular focus must be paid to water quality mitigation measures.

A Surface Water Management Plan (SWMP) has been prepared and is attached in Appendix B with the goal of complying with the conservation objectives of the River Barrow and River Nore SAC.

Erosion and sediment control measures will be incorporated into each element of the works. Work elements have been divided into the following;

- Upgrading of existing drainage network;
- Upgrading of existing access tracks and roadside swales,
- New access tracks;
- Crane hardstanding areas and turbine foundations;
- Borrow pit;
- Substation compound/temporary construction compound, and cable trenches.

Where appropriate, the following measures will be used for each element of the works:

- Installation of interception drains installed upslope of proposed work areas;
- Installation of silt traps at discharge points from trackside swales;
- Blocking of any drains which currently collect discharge from roadside swales and discharge directly to existing watercourses;
- Perimeter swales to collect dirty surface water runoff from crane hardstanding areas/turbine bases including locations of proposed check-dams, cross-drains, sediment traps and discharge points from same. All such features to be assigned unique reference number to facilitate ongoing inspection and monitoring of same during the course of the works;

- Primary and secondary settlement ponds to facilitate the treatment of potential silt laden water. Such features to be assigned unique reference number to facilitate ongoing inspection and monitoring during the course of the works;
- Tertiary treatment lagoon-type sediment ponds will be designed with a retention time of 10 days to remove any risk to Freshwater Pearl Mussel in the River Nore downstream of the proposed development.
- Application of a capping layer of crushed limestone or sandstone to both existing and newly constructed existing carriageways to protect the underlying shale material which is more prone to sedimentation under traffic;
- Repository sites for peat excavated on the basis of the detailed geotechnical assessment undertaken for each area;
- Silt control measures necessary to collect and treat surface water run-off from stored excavated peat.

Generally accepted best practice pollution control measures, as outlined below, will be employed during the construction phase when working in or near the minor watercourses in the study area to prevent the transport of deleterious substances to the River Barrow and River Nore SAC:

- Release of suspended solids to all surface waters will be controlled by interception (e.g. silt traps) and management of site run-off. Any surface water run-off must be treated to ensure that it is free from suspended solids, oil or any other polluting materials;
- Silty water shall be treated using silt trays/settlement ponds and temporary interceptors and traps will be installed until such time as permanent facilities are constructed;
- Lagoon-type sediment traps will be installed as a tertiary treatment system to remove any risk to Freshwater Pearl Mussel in the River Nore downstream of the proposed development
- Straw bales or silt fences shall be appropriately located near watercourses to help prevent untreated surface water run-off entering any watercourse;
- All fuels, lubricants and hydraulic fluids will be kept in secure bunded areas away from watercourses. The bunded area will accommodate 110% of the total capacity of the containers within it;
- Containers will be properly secured to prevent unauthorised access and misuse. An effective spillage procedure will be put in place with all staff properly briefed;
- Any waste oils or hydraulic fluids will be collected, stored in appropriate containers and disposed of offsite in an appropriate manner;
- Fuelling and lubrication will not be conducted within 50m of watercourses;

- Storage areas, machinery depots and site offices will be located at least 50m from the nearest watercourse;
- Foul drainage from the site offices and facilities will be properly treated and removed to a suitable treatment facility;
- Spill kits will be made available close to streams and all staff will be properly trained on correct use;
- Disposal of raw or uncured waste concrete will be controlled to ensure that watercourses or other sensitive areas will not be impacted;
- Settlement ponds and lagoon-type sediment traps shall be designed, allowing 10 day settlement before discharge to the overland flow.

The following design criteria shall apply to the construction of settlement ponds at the site:

- Install interceptor drains upslope of the works areas, where gradient requires to separate uncontaminated surface runoff and divert it away from the works.

- Settlement ponds will be lined with Bontec geotextile material.

- Side slopes to be shallow, nominally at a 1 in 3 side slope (maximum).

- Material excavated from the settlement ponds will be compacted around the edge of the pond, which will prevent site personnel from falling into the pond.

- Settlement ponds will be subject to regular inspection and maintenance by the contractor on site.

The lagoon-type sediment trap design will be refined prior to construction, following detailed site investigations and topographical survey. They will be irregularly shaped to fit in with existing depressions in the topography to help retain the discharge, and will be designed for a 10 day retention period. The lagoon-type sediment traps will be designed to fully meet the requirements outlined in the Natura Impact Statement. These will assist as part of an overall strategy to remove any risk to Freshwater Pearl Mussel in the River Nore downstream of the proposed development.

Works adjacent to or over watercourses within the study area will be carried out outside of the salmonid spawning season and the times that early life stages of salmonid fish will be present. Overall, no instream work will be undertaken during the period October to April. The publication

'*Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites'* by Murphy (2004) and the NRA's '*Guidelines for the crossing of watercourses during the construction of national road schemes'* (NRA, 2005) and the IFI's '*Guidelines on Protection of Fisheries during Construction Work in and Adjacent to Water'* (IFI, 2016), will be followed during the construction of new access roads or instream works. It is imperative that no impacts (direct, indirect or cumulative) occur on the streams downstream of the proposed development or the downstream catchment areas. In advance of any works taking place a Construction Management Plan for protecting the rivers streams on the site, shall be developed and agreeded with the IFI and NPWS.

### *2.2.2 Habitats and flora*

- The existing commercial forestry divisions and firebreaks and existing tracks within the proposed development site have been considered at design stage. This measured approach has reduced the scale of potential impacts on habitats. It is considered that there is further scope for micro-siting of the wind turbine locations and associated hardstands to avoid hedgerow habitat and areas of scrub (though removal of large areas of scrub is not anticipated).

- During the construction of the proposed development, waste materials may be generated such as excavated spoil/rubble during the works phase. This material will not be placed/stored on/near surface water features, scrub or hedgerow habitats occurring within the study area; disposal of any waste material at any location will require a waste permit.

- Appropriate measures will be taken to ensure that machinery does not facilitate the establishment and spread of non-native invasive species into the proposed development area. Refuelling of machinery will be undertaken away from the watercourses. Temporary toilet facilities will be provided and there will be no discharges to ground from this unit. Site management procedures will include provisions for removing rubbish generated by on-site staff.

- Land clearance and soil stripping within the footprint of the works will be limited to the works area, with habitats outside of the required works or access requirements left intact. Disturbed areas within the footprint of the works will be allowed to regenerate naturally i.e. no reseeding/replanting to be carried out. The required works footprint for the proposed development, including turbine locations, access roads etc will be clearly defined and sited to reduce land take impacts affecting habitats. Fencing of the works area during construction will minimise impacts on adjoining habitats.

- Replanting mitigations for loss of hedgerow and any scrub habitats will ensure that there is no net loss of these locally important habitats within the study area. Any planting to be carried out will utilise native species only and will take cognisance of the varying habitat structure within the local landscape. Prescriptions for landscape planting will be prepared by a qualified landscape architect with input from a qualified ecologist, making reference to the baseline habitats and ecological conditions; i.e. scrub, hedgerows and treelines. The development of a Habitat and Species Management Plan (HSMP) in consultation with the NPWS will be required at detailed design stage to ensure native species are used. This plan will be drawn up with reference to the extent of habitats disturbed, fencing and plant species.
- To protect the habitat 'eroding upland rivers' which comprise the Graiguenahown Stream and the Knockbaun Streams within the proposed development site, guidance in Murphy (2004) and NRA (2005) will be followed during the construction of new access roads over the Graiguenahown Stream and during any instream works.

- A Surface Water Management Plan has been prepared (Appendix B). This plan will be implemented to control surface water run-off and to protect water quality in all eroding watercourses draining the proposed development site.

### *2.2.3 Fauna*

***Non-volant mammals***

- There will need to be a pre-construction badger survey on the site and a derogation licence will be required to work within 50m of any setts, should new setts be established prior to construction stage. However, overall terrestrial mammals will not be a significant constraint here and again will benefit from the Habitat and Species Management Plan.

- Temporary fencing (paling with 25 mm mesh) will be erected around the required site works to delineate and restrict the works area and to minimise the potential for disturbance impacts outside of the works area. As no otter holts, or indeed any mammal dwellings, were identified within the impact area of the proposed development, there is no specific mitigation required for the protection of mammals in relation to relocation / construction of artificial dwellings.

- The retention of areas of habitats of high conservation interest and linear features such as treelines, hedgerows and areas of scrub will reduce impacts on many common mammal species within the site, where badger and deer possibly occur within the study area. Hedgerow removal, if required will be carried out slowly to ensure that any stoats present can escape.

Ongoing monitoring for protected species within the development site including Irish hare, badger and stoats will be undertaken by the site ecologist.

- A detailed Habitat and Species Management Plan (HSMP) is to be prepared as part of the development of the detailed CEMP.

***Bats***

- Landscaping or design to keep turbines away from the forestry edges and hedgerows has already informed site design/layout and will be further addressed in the Habitat and Species Management Plan. This will reduce the risk of bat collisions with turbine rotors and barotrauma. Natural England *Interim Guidance on Bats and Onshore Wind Turbines* (Carlin and Mitchell-Jones, 2009) suggest a minimum distance between features (such as forest or woodland edge) of 50 metres to reduce risk of impact.

- The distance that the turbine would have to be from forest edge in order to comply with Natural England Guidelines would be c.55 metres. For turbines in the vicinity of hedgerows, it means that turbines need to be placed a minimum of **36 metres** from them (assuming a maximum feature height of 5 metres). Where this is not physically feasible (e.g. due to small field sizes or other constraints) hedgerows need to be removed within the 36 metre radius from the turbine and re-planted in order to maintain the hedgerow network and habitat availability.

- General mitigation measures for bats will follow the National Road Authority's *'Guidelines for the Treatment of Bats during the Construction of National Road Schemes'* (Kelliher and Marnell, 2006). This document outlines the requirements that should be met in the pre-construction (site clearance) and construction phases of any development to minimise negative impacts on roosting bats, or prevent avoidable impacts resulting from significant alterations to the immediate landscape. The avoidance of hedgerows by proposed turbines and hardstands during construction stage as recommended in mitigation for habitats (section 2.2.2) will also reduce impacts on bat commuting /feeding corridors. There are no bat roosts within the proposed development site. Nonetheless, any felled mature trees with ivy should be left to lie on the ground for 24 hours to allow bats that may have been roosting in them to escape.

The above mitigation measures, including recommended distances between turbines and linear features will be set out in the Habitat and Species Management Plan. Progress on the implementation of the measures for bats will be reported to NPWS. Post-construction monitoring of bats will be

reported to NPWS. Post-construction monitoring of bats will be required in order to establish the effectiveness of the measures that have been put in place.

***Birds***

- Any clearance or removal of semi-natural habitats, scrub or vegetation should not be undertaken during the bird breeding season as detailed under Section 40 of the 1976 Wildlife Act, as amended by Section 46 of the Wildlife Amendment Act (2000), whereby it is forbidden to cut or remove trees or other semi-natural vegetation during the bird nesting season, from the 1st of March to the 31st of August. This includes riparian vegetation along river corridors (i.e. reeds and marginal vegetation) which could be used by water birds subject to marginal exemptions for the maintenance of roads, farms and the clearing of sites for development. Micro-siting of turbines away from hedgerows as recommended in section 2.2.2 will reduce the impact of site clearance on birds.

- In the event that turbines cannot be relocated, replanting will be carried out as per mitigation for habitats which would result in re-establishment of hedgerows around turbines and associated hardstands.

- Care will be taken to ensure that disturbance will be restricted to the required foot-print of the development infrastructure to ensure that the surrounding habitats are not disturbed.

- Post construction monitoring will be considered and monitoring of the ornithological resource at regular intervals throughout the operation of the wind farm.

***Fish***

Generally accepted best practice pollution control measures, as outlined for the protection of the River Barrow and River Nore SAC (section 2.2.1) are also relevant in relation to the fish, and will be employed and strictly observed during the construction phase when working in or near the minor watercourses in the study. Additional mitigation measures to protect water quality during the construction phase are detailed in hydrology section 2.4.

- A detailed Surface Water Management Plan (SWMP) for the control of silt-laden water and other pollutants within the site has been prepared. The IFI and the NPWS will be consulted and supplied with a detailed Construction Management Plan outlining the proposed methodology for the undertaking of works within and affecting the watercourses within the

proposed development site. The implementation of the SWMP will be monitored by an independent environmental consultant, reporting directly to the IFI and NPWS. The independent environmental consultant will carry out visual examinations of watercourses receiving flows from the proposed development during the construction phase and regular water samples will be taken.

- The implementation of the comprehensive Surface Water Management Plan designed with drainage awareness and aimed at retaining of soils and reducing the incidence of surface water pollution within the boundary of the proposed development will help protect water quality in sensitive aquatic areas downstream, including the lower reaches of the Graiguenahown Stream and the Owenbeg River.

- The surface run-off attenuation design strategy will be implemented to protect the minor watercourses within the study area, limited to the Graiguenahown and Knockbaun Streams and a drainage ditch connected to a 1st order tributary of the Moneycleare River.

- A fundamental aim of the Surface Water Management Plan will be to intercept silt laden waters and remove sediment prior to release into the watercourse.

- Measures such as those outlined in Altmüller & Dettmer (2006) in particular whereby **sediment trapping** can be accomplished by constructing ponds or wetlands within the proposed development site prior to construction and directing runoff to these retention areas prior to waters entering surface waters that flow out of the site. These attenuation ponds/wetlands will be constructed with vegetated depressions and will act as sand, coarse silt and suspended solids sinks. Existing drains along the roads have been integrated into the Surface Water Management Plan where appropriate by installing check dams. Each silt control feature will be given a reference number and an on-site quality system of maintenance and monitoring of each trap will be implemented. Any wetland features built during construction should be left in place to include post decommission stage, as such features will continue to provide a positive ecological function.

- Where haul roads pass close to watercourses, silt fencing will be used to protect the streams. These fences will be secured into the ground and divert water into silt traps.

- Silt traps should be constructed at locations that will intercept run-off to the drainage network and should not be constructed immediately adjacent to watercourses. A buffer zone should

remain between the silt trap and the watercourse with natural vegetation left intact so as to assist silt interception. All natural watercourses which have to be traversed during site development and road construction works should be effectively bridged prior to commencement. Additional silt fencing will be kept on site for the ongoing maintenance of the structures provided. Again, maintenance and monitoring of such silt fences will be subject to an on-site quality management system.

- Wheel washing facilities will be provided at the site entrance draining to silt traps. Spoil heaps from the excavations for the turbine bases will be covered and surrounded by silt fences to filter sediment from the surface water run-off from excavated material.

- Berms will be covered with a pre-seeded matting to expedite the vegetation cover. The berms will be surrounded by silt fencing until the vegetation has been established.

- The construction of swales for access road drainage will follow the natural flow paths on site where possible. Existing overland flow channels will be maintained and cross-drains provided in the access roads to allow continuity of flow. Interceptor drains will be constructed upslope where there are no existing channels with cross-drains provided at 50m intervals. The roadside swales will therefore only carry the access road run-off and so avoid carrying large volumes of water and concentrating flows. Where swales are laid at slopes greater than 2%, check dams will be provided. This will reduce effective slope, run-off velocities and any consequent potential for erosion. Furthermore, excavation and installation of roads / access tracks should be undertaken so as not to result in the creation of preferential flow paths that may result in erosion. During the construction process and operation phase, natural flow paths should not be interrupted or diverted so as to give rise to create potential for erosion.

- Cross-drains will be provided for drainage crossings and conveying flows from existing and proposed drains across the access tracks. Sub-surface drains will be installed if a water ponding problem is likely to develop, this will be taken into account in the detailed design of the Construction Management Plan..

- The contractor shall ensure that erosion control and attenuation facilities, namely sediment/silt traps, swales and ponds are regularly maintained during the construction phase and will review same on a regular basis and maintain a log of issues/maintenance and any remediation completed. The contractor shall ensure that all personnel working on site are trained in pollution incident control response.

- Appropriate signage will be in place on site outlining the spillage response procedure and a contingency plan to contain silt.

- The operation of machinery within watercourses affected by the proposed development and any instream works will be minimised through strategic scheduling.

- All of the construction machinery operating in or near these watercourses will be systematically checked in order to avoid leaks of oils, hydraulic fluids and fuels.

- All oils and fuels should be stored in secure bunded areas, and particular care and attention should be taken during refuelling and maintenance operations on plant equipment. Where site works involve the discharge of drainage water to receiving rivers and streams, temporary oil interceptor facilities should be installed and maintained. Adequate security should be provided on site to prevent spillage as a result of vandalism.

- Standing water in the excavations will contain an increased concentration of suspended solids. The excavations will be pumped into temporary settlement basins which will be lined and which will drain into existing or proposed drainage channels on site following settlement of suspended solids. The settlement basins will be constructed in advance of any excavations for the turbine bases.

- Cables will be installed in trenches underneath and directly adjacent to access tracks as far as possible.

- Trenches will be excavated during dry periods where possible in short sections and left open for minimal periods to avoid acting as a conduit for surface water flows.

- Clay bunds will be constructed within the cable trench at intervals. Pre-cast concrete should be used whenever possible, to eliminate the risk to all forms of aquatic life. When cast-in-place concrete is required, all work must be done in periods of dry weather and effectively isolated from any water that may enter the drainage network for a period sufficient to cure the concrete. A risk assessment will be prepared prior to any wet concrete operations being carried out and will only be conducted where sufficient periods of dry weather are forecast.

- Stream structures should not damage fish habitat or create blockages to fish and macroinvertebrate passage. A Construction Management Plan for stream crossings (if

required) will be agreed in advance with NPWS and the fisheries authorities. IFI is charged under the Fisheries Act (1980) with the responsibility to protect and conserve all freshwater fisheries within its area of jurisdiction. This is not expected to represent an issue, as the reaches of the Graiguenahown and Knockbaun Streams within the site are too small to support fish.

- Any diesel or fuel oils stored on site will be bunded to 110 % of the capacity of the storage tank. Such facilities will not be located near any drain or watercourse. Design and installation of fuel tanks will be in accordance with best practice guidelines. Refuelling of plant during construction will be carried out on a designated concrete pad, away from watercourses, draining to an oil interceptor. Drip trays and spill kits will be kept available on site. Only emergency breakdown maintenance will be carried out on site. Appropriate containment facilities will be provided to ensure that any spills from the vehicle are contained and removed off site.

- Direct crossings of watercourses and any required diversions will be carried out outside of the salmonid spawning season and the times that early life stages of salmonid fish will be present. Overall, no instream work will be undertaken during the period October to April inclusive following agreement with Inland Fisheries Ireland (IFI). The publication '*Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites*' by Murphy (2004) and the NRA's '*Guidelines for the crossing of watercourses during the construction of national road schemes*' (NRA, 2008) will be followed during the construction works. Work on the site will be timed to occur outside periods where very heavy rainfall would be expected (i.e. the winter months).

- The construction period will also not coincide with major forestry operations. Portaloos will be used to provide temporary toilet facilities for site personnel. Sanitary waste will be removed from site via a licensed waste disposal contractor.

- A regular review of weather forecasts of heavy rainfall will be required and the contractor is required to prepare a contingency plan for before and after such events in relation to pre-cast concrete use, in-stream work or work in proximity to any watercourse.

***Reptiles and Amphibians***

- Should any areas that could potentially be used by frogs for spawning require disturbance between the months of February to June, the area should be inspected by an ecologist to ensure

that no spawn or froglets are present. A derogation license from the NPWS will be required if frogs are to be interfered with and frogs will be relocated to a suitable habitat in the locality.

***Invertebrates***

- No protected macroinvertebrates were recorded within the study area. Mitigations to protect water quality and fisheries will protect aquatic macroinvertebrates within the aquatic habitats and watercourses potentially affected by the proposed development. with the mitigation measures outlined for water quality protection (in Section 2.4).

Please refer to Figure 2.1a and Figure 2.1b for Habitat Maps of Pinewoods Wind Farm site.

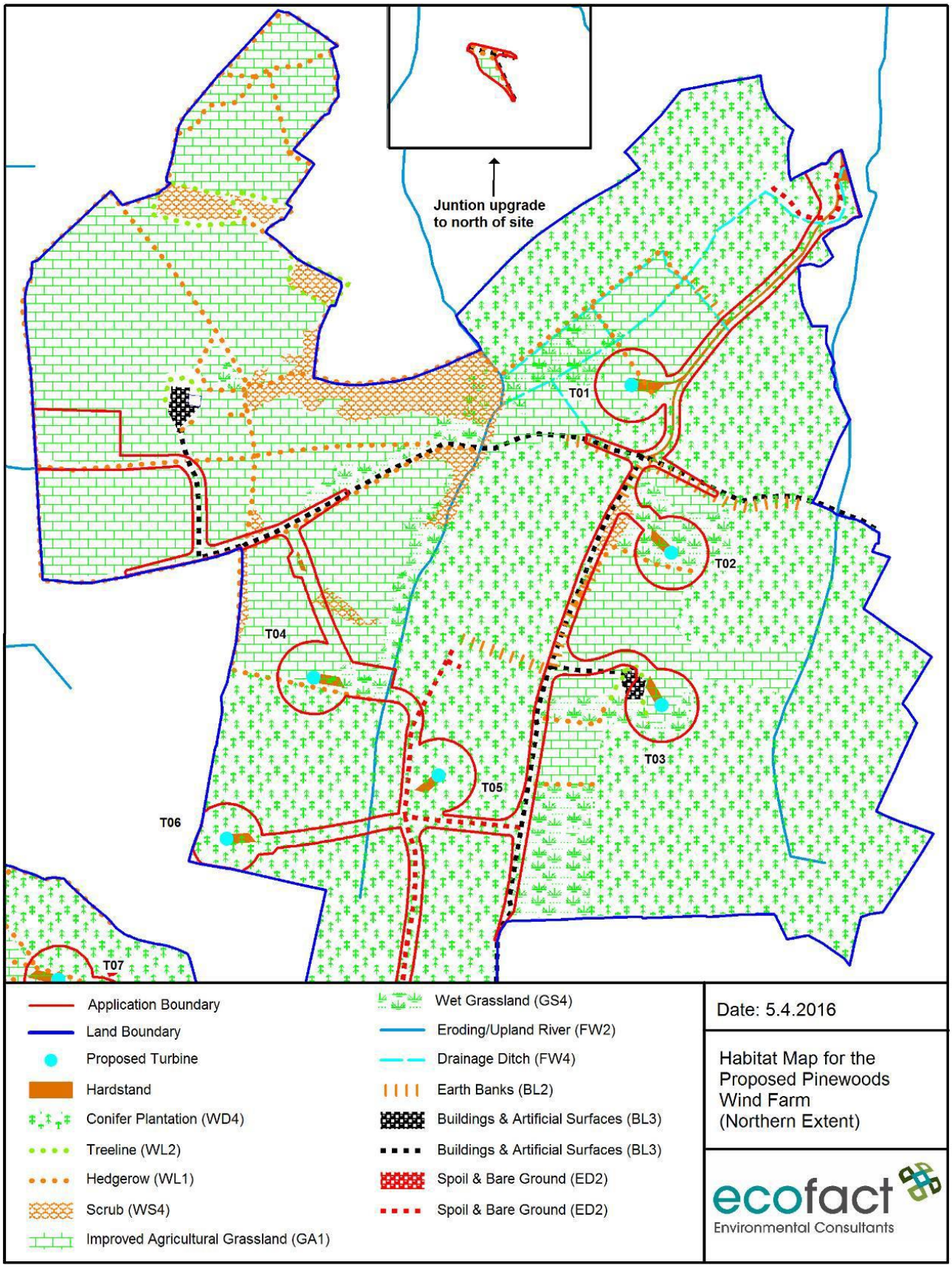



**Figure 2.1a. Habitat map showing the northern section of the proposed development site**

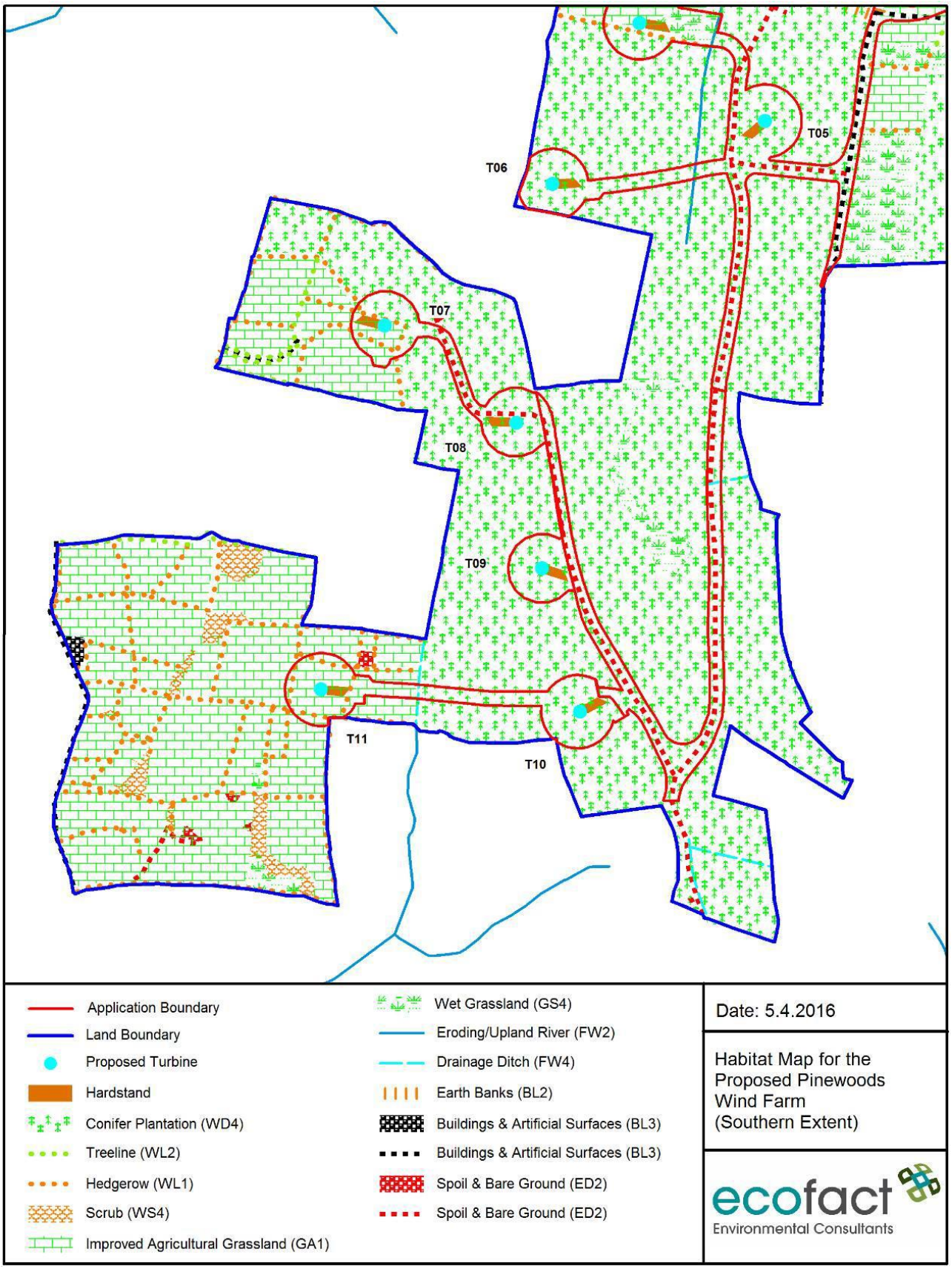



**Figure 2.1b. Habitat map showing the southern section of the proposed development site**

## 2.3 SOILS AND GEOLOGY

As part of the Environmental Impact Assessment comprehensive site investigations comprising trial pits and gouge cores (see Table 2.3 and Table 2.4) were undertaken by Hydro Environmental Services (HES). Please refer to Figure 2.2 for Trial Pit and Gouge Core locations.

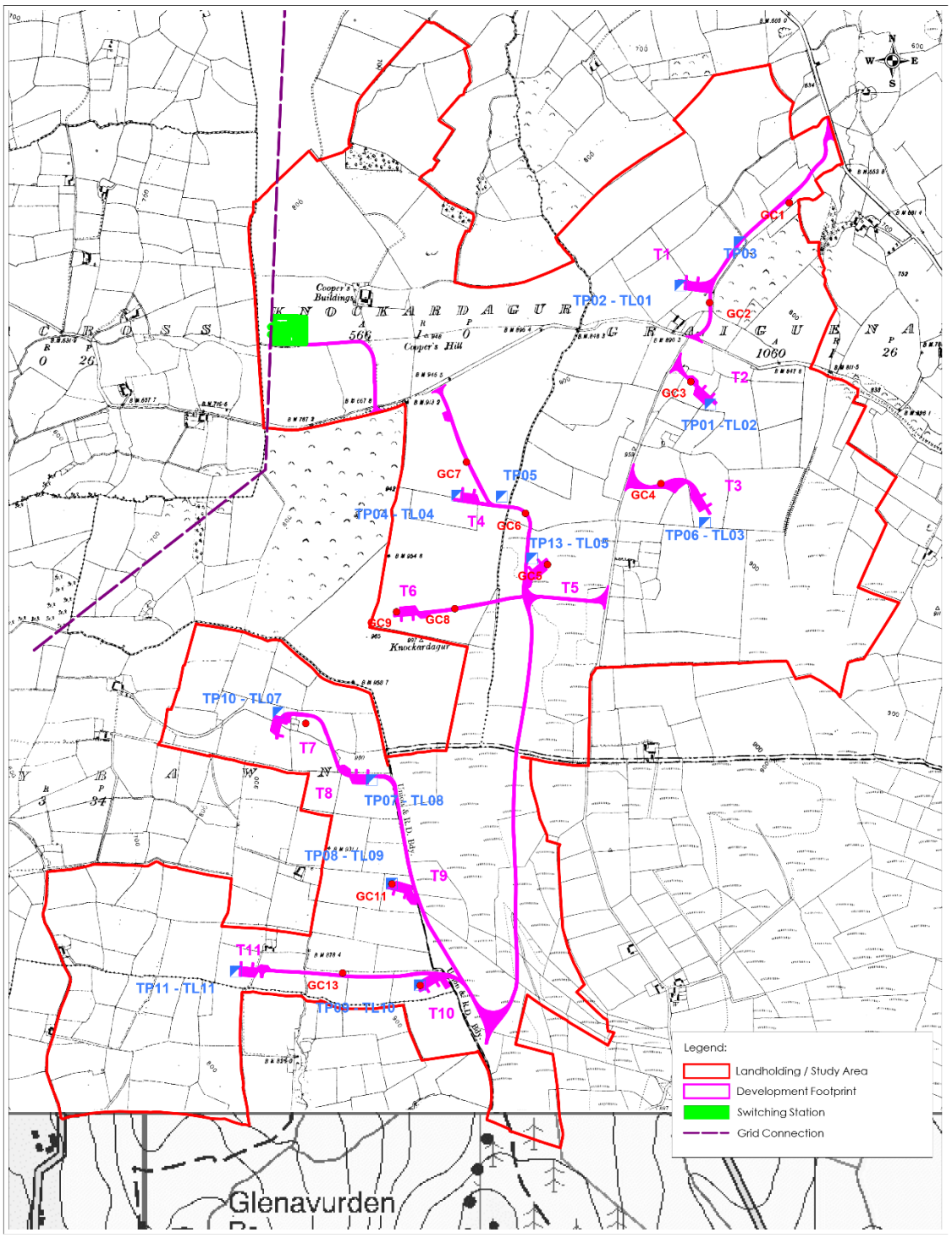
| *Trial Pit Name* | *Location* | *Primary Subsoil Lithology* | *Depth to Bedrock (m)* |
|---|---|---|---|
| TP01 (T2) | Turbine location 2 | Firm CLAY – CLAY/SILT | 1.2 |
| TP02 (T1) | Turbine location 1 | Soft to firm SILT/CLAY | 0.3 |
| TP03 | Access road north Of T1 | Firm CLAY/SILT over very firm CLAY | 0.75 |
| TP04 (T4) | Turbine location 4 | Soft to firm SILT over firm sandy SILT/CLAY | 0.8 |
| TP05 | Access road north Of T4 | Soft to firm sandy SILT | 2.0 |
| TP06 (T3) | Turbine location 3 | Soft to firm CLAY | 0.9 |
| TP07 (T8) | 15m north of T8 | Soft to firm SILT over firm CLAY | 1.6 |
| TP08 (T9) | 60m east of T9 | PEAT over dense silty SAND | 1.3 |
| TP09 (T10) | 100 east of T10 | PEAT over dense silty SAND | 2.0 |
| TP10 (T7) | Turbine location 7 | Firm, gravelly SILT/CLAY | 1.2 |
| TP11 (T11) | Turbine location 11 | Firm SILT/CLAY | 1.1 |
| TP12 | Off forestry track | Soft to firm sandy SILT | 1.2 |
| TP13 (T05) | 50m west of T5 | Soft to firm CLAY | 1.9 |

**Table 2.3 Summary of Trial Pit Investigations**

| **Location** | **Easting** | **Northing** | **Soil/subsoil Description** |
|---|---|---|---|
| GC1 | 251,928 | 182,708 | soil over SILT/CLAY |
| GC2 | 251,690 | 182,410 | Organic soil over SILT |
| GC3 | 251,634 | 182,174 | Organic soil over SILT |
| GC4 | 251,545 | 181,870 | Mineral soil over SILT/CLAY |
| GC5 | 251,206 | 181,628 | 1m PEAT over CLAY |
| GC6 | 251,140 | 181,781 | 0.3m PEAT over SILT/CLAY |
| GC7 | 250,964 | 181,934 | Mineral soil over SILT/CLAY |
| GC8 | 250,929 | 181,497 | 0.6m PEAT over SILT/CLAY |
| GC9 | 250,755 | 181,487 | 1.7m PEAT over SILT/CLAY |
| GC10 | 250,484 | 181,154 | Organic soil over SILT/CLAY |
| GC11 | 250,742 | 180,675 | Peaty topsoil over SILT/CLAY |
| GC12 | 250,826 | 180,372 | Peaty topsoil over SILT/CLAY |
| GC13 | 250,595 | 180,409 | Mineral soil over SILT/CLAY |

**Table 2.4 Summary of Soil/Subsoil Gouge Cores**

Detailed Site Investigations will be carried out at pre-construction stage. This Section will be updated following receipt of site investigation results.




| | | |
|---|---|---|
| Client: Pinewoods Wind Ltd | Drawing No: P1264-0-0416-A3-503-00A | |
| Job: Pinewoods WF Co. Laois / Kilkenny | Sheet Size: A3 | Project No: P1264 |
| Title: Site Investigation Map | Scale: - 1:10000 | Drawn By: DB |
| Figure No: 5.3 | Date: - 27/04/2016 | Checked By: MG |

HYDRO ENVIRONMENTAL SERVICES
22 Lower Main St, Dungarvan, Co.Waterford, Ireland
tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

**Figure 2.2 Site Investigations Map**

### *2.3.1 Peat, Subsoil Excavation and Bedrock Excavation*

- No turbines or directly related infrastructure will be constructed near or on any designated sites such as NHAs or SACs;
- Rock aggregate for construction purposes is to be sourced off-site to avoid large on-site borrow pits;
- The soil, subsoil and bedrock which will be removed during the construction phase will be localised to the turbine location and access roads.

### *2.3.2 Contamination of Soil by Leakages and Spillages and Alteration of Peat/Soil Geochemistry*

- Minimal refuelling or maintenance of construction vehicles or plant will take place on site. Off-site refuelling will occur at a controlled fuelling station;
- On site refuelling will be undertaken using a double skinned bowser with spill kits on the ready for accidental leakages or spillages;
- Fuels stored on site will be minimised. Storage areas, where required, will be bunded appropriately for the fuel storage volume for the time period, and fitted with a storm drainage system and an appropriate oil interceptor;
- The electrical control building will be bunded appropriately to the volume of oils likely to be stored; and to prevent leakage of any associated chemicals to groundwater or surface water. The bunded area will be fitted with a storm drainage system and an appropriate oil interceptor;
- The plant used during construction will be regularly inspected for leaks and fitness for purpose;
- An Emergency Response Plan for the construction phase to deal with accidental spillages will be contained within Technical Schedule 1 of this document. Spill kits will be available to deal with and accidental spillage in and outside the refuelling area.

### *2.3.3 Erosion of Exposed Subsoils During Tree Felling, Access Road and Turbine Base Construction Work*

- Peat and subsoils removed from turbine locations and access roads will be used for landscaping, cast aside and deposited on-site;

- Any excess temporary mounded subsoils in storage for long periods will be covered by a polyethylene sheets or seeded at the earliest opportunity. This will prevent erosion of soil. Silt fences will be installed around stockpiles to limit movement of entrained sediment in surface water runoff. The use of bunds around earthworks and mounds will prevent egress of water from the works;

- In order to minimise erosion of mineral subsoils stripping of topsoil will not take place during extremely wet periods (to prevent increased silt rich runoff). Temporary drainage systems will be required to limit runoff impacts during the construction phase;

- In forestry areas, brash mats will be used to support vehicles on soft ground, reducing topsoil and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal will take place when they become heavily used and worn. Provision will be made for brash mats along all off-road routes, to protect the soil from compaction and rutting.

### *2.3.4 Peat Instability and Failure*

Whitefords Geoservices Ltd appraisal of the Hazard Rankings, for each proposed turbine and structure location indicates that the site (encompassing turbines T1, T2, T3, T4, T5, T6, T7, T8, T9, T10, T11 and the electrical switchroom and permanent met-mast) carry INSIGNIFICANT Hazard Rankings in relation to peat instability.

Application of the following procedures will have the effect of reducing the Hazard Ranking associated with Peat Instability:

- Excavated spoil will not be deposited on the down slope or up slope edges of the adjacent peat. This spoil will instead be deposited on the two flanks either side of the excavation where gradient is least.

- Bog Burst is recognised to be a difficult condition to mitigate against. Bog Burst tends to occur within deep peat (> 3.00m thickness) after very heavy or prolonged precipitation. To ward against this possibility the design of turbine bases should be engineered to ensure that excavations do not cut into deep peat (> 2.50m). **This does not apply to the proposed Pinewoods Wind Farm site.**

- The hardstandings surrounding the turbine bases should be designed in a manner such that crane loadings can be transferred directly onto the competent strata underlying the peat soils. In order to facilitate these works it will be necessary to undertake limited excavations.

- Movement can often occur during or following severe rainstorm events, particularly when following a prolonged dry spell. Extra vigilance will be maintained at such times, during construction.
- All slopes will be regularly checked for development of tension cracks.
- Extra care will be taken where the peat has previously been tilled. Note; during site visits there was evidence of peat harvesting at the proposed site.
- Construction Management Plans will be followed at all times.
- Slopes will not be undercut or excavations left unsupported for periods in excess of 24 hours. Excavations are to be backfilled as soon as practicable. Excavation and filling operations shall be coordinated to minimise the time an excavation remains opened.
- Pore water pressure within excavations should be kept low at all times by draining deliberate or intentional sumps at regular intervals. This is to prevent ponding of water within excavations which can in turn increase hydraulic heads locally and potentially lead to instability.
- The potential for Peat Slide will be monitored regularly during the construction works, by means of regular site visits and assessments, by a suitably qualified and experienced professional.
- Site staff will also undergo induction training to learn about the risks associated with working on "upland environments" and procedures aimed at reducing Peat Slide risk.

### *2.3.5 Subsoil Excavation Volumes and Repository Areas*

The overall indicative volume of subsoil excavation in Pinewood Wind Farm site has been established as being approximately 10,969m$^3$ from roads and 9,072m$^3$ from hardstands and the substation. The estimated volume of subsoil to be re-used on site is 20,038m$^3$. A small section of road in Co Kilkenny will be excavated amounting to 288m$^3$ of subsoil excavated and a volume of 192.5m$^3$ re-used in a roadside berm. Therefore the indicative volume of subsoil excavation in Pinewood Wind Farm within Co Laois has been established as being approximately 10,681m$^3$ from roads and 9,072m$^3$ from hardstands and the substation. The estimated volume of subsoil to be re-used on site within Co Laois is 19,845.51m$^3$. Please refer to Table 2.8 – Indicative Subsoil Excavation Volumes and Repository Areas. Please also refer to Drawings No. 5538-S300-C-104 to 5538-S300-C-108 in **Appendix A**, for locations of repository areas.

| Site Location | Spoil Excavated $m^3$ | | Repository | | |
|---|---|---|---|---|---|
| | Road | Hardstand | Area | | Volume |
| | | | | $m^2$ | $m^3$ |
| Site Entrance 1 To Site Entrance 2 | 3211 | 495 | 1 | 891 | 425.405 |
| | | | 2 | 1123 | 530.965 |
| | | | 3 | 1071 | 497.305 |
| | | | 4 | 4019 | 1848.645 |
| | | | 5 | 414 | 198.37 |
| | | | 6 | 445 | 232.475 |
| | | | 7 | 221 | 120.555 |
| At T02 | 965 | 495 | 8 | 417 | 199.735 |
| | | | 9 | 2803 | 1295.365 |
| At T03 | 1958 | 495 | 10 | 1362 | 649.71 |
| | | | 11 | 2213 | 1757.205 |
| At T05 | 294 | 495 | 12 | 2783 | 1286.265 |
| At T04 | 1234 | 495 | 13 | 3593 | 1654.815 |
| Substation | | 3627 | 14 | 3527 | 3733.35 |
| At T06 | 750 | 495 | 15 | 2099 | 985.045 |
| T7 to T8 | 415 | 990 | 16 | 1778 | 652.3 |
| | | | 17 | 385 | 135.5 |
| | | | 18 | 1570 | 491 |
| At T09 | 10 | 495 | 19 | 1992 | 448.32 |
| T10 to T11 | 1844 | 990 | 20 | 1920 | 961.2 |
| | | | 21 | 530 | 287.05 |
| | | | 22 | 1274 | 617.89 |
| | | | 23 | 540 | 271.9 |
| | | | 24 | 1124 | 565.14 |
| Total in Co Laois | 10681 | 9072 | | | 19845.51 |
| Co Kilkenny | 288 | | 25 | 385 | 192.5 |
| Overall Wind Farm Total | 10969 | 9072 | | | 20038.01 |

**Table 2.5 Indicative Subsoil Excavation Volumes and Repository Areas.**

Subsoil reinstatement will be possible through the following methods:

- Saving the top layer of the subsoil excavated for landscaping uses over any backfilled areas.

- Placing the excavated subsoil along roadside berms as indicated in Drawings No 5538-S300-C-104 to 5538-S300-C-108.

The subsoil management proposals are discussed further in Section 2.3.6.

In the unlikely event that excess subsoil is encountered, which cannot be reused on site, this subsoil will be disposed of in an environmentally sensitive manner by a licensed waste contractor in consultation with Laois County Council.

### *2.3.6 Subsoil storage management and restoration*

A Detailed Subsoil (Spoil) Management Plan will be prepared prior to the commencement of construction at the site. The preparation, application and documentation of this Detailed Subsoil Management Plan should enable all parties – including contractors, designers and competent authorities – to learn from the systematic implementation and assessment of best practice, particularly through the recording of summary information on performance outcomes.

The Detailed Subsoil (Spoil) Management Plan will also cover the storage and restoration of all subsoil excavated during the construction phase. Subsoil with a volume of approximately **20,038m³** will be re-used during the construction phase as follows;

- Resurfacing of hardstanding and splay areas.
- Reinstatement of splays, stilling ponds, etc.
- Roadside berms and landscaping
- Landowner land reclamation/improvement activities

Subsoil will not be placed:

- Within 50 m of natural watercourses.
- Within 20 metres of a major arterial drain or 10m of any minor drain or drains containing dry weather flows greater than 1 litre/second.
- Within areas of gradient greater than 1:20.
- Within areas designated as sensitive habitat.

### *2.36 Subsoil Excavation and Reinstatement Methodology*

The following methodology is proposed for such work:

- Prior to excavation, all grass areas shall be cut into turves and will be carefully stacked and re-used within one week of cutting during the period 1st April to 31st August or within two

weeks of cutting during the remainder of the year. Turves not used within these periods shall be regarded as topsoil.

- Subsoil will be re-used to form berms either side of the track for the first 418m and on the western side of the track as far as entrance 2, as indicated on drawing. Berm heights will not exceed 0.5m.

- All reinstatement areas will be suitably fenced and signs warning the public will be erected.

- Bare subsoil will be seeded with a wild flower mix to enhance biodiversity.

- Any bare areas to be seeded shall be covered with topsoil to a minimum depth of 100mm which shall be reduced to a fine tilth, free from stones and debris with any dimensions greater than 35mm. The topsoil shall be graded and lightly compacted to a 100mm thickness or existing thickness-whichever is greater. Any upstanding debris or stones exceeding 35mm dimension shall be removed.

- Due regard will be paid to the season and weather condition before sowing the wild flower seed. Immediately prior to sowing the seed, the topsoil shall be reduced to a fine tilth. An even distribution of the approved mix will be applied. The seed shall be covered by lightly raking into the surface of the topsoil.

- All work will be carried out in an environmentally sensitive manner in consultation with the Local Authority and the National Parks and Wildlife Service.

- A waste license will be obtained from the Local Authority / Environmental Protection Agency prior to any disposal of subsoil as per the Waste Management Regulations 2006 and the Waste management Act 1996 to 2008.

## 2.4 HYDROLOGY AND DRAINAGE

The drainage measures proposed for this eleven turbine development provide a surface water management regime that will mitigate any adverse impact on the hydrology of the site and surrounds during the construction phase of the project.

The following mitigation measures apply when working within the watercourses or in the vicinity of watercourses.

- Avoid construction near streams in wet weather, whenever possible.
- Stone will be of a local geochemistry i.e. be sourced from one of the nearby quarries.
- No concrete will be used in watercourses.
- Runoff from excavations will not be pumped directly to watercourses. Where dewatering of excavations is required, water shall be pumped to the head of a treatment train (swale or concrete sump in the case of turbine bases) in order to receive full treatment prior to re-entry to the natural drainage system.
- At watercrossings and the substation site, where construction will be carried out within the 50m buffer around watercourses, best practice construction methods will be used to protect the watercourses, such as silt fencing and silt bags. Tool box talks will be given to all staff on the importance of maintaining water quality. Small working areas will be used for better control of sedimentation and all works in these areas will cease during periods of high precipitation and any bare soil will be covered.

All drains and streams on and in the vicinity of the proposed development site have been surveyed in detail. By incorporating a SuDS design, all surface water run-off shall be strictly controlled such that no silt or other pollutants enter watercourses and that no artificially elevated levels of downstream siltation or no plumes of silt arise when substratum is disturbed. The drainage design adopts the following temporary works during the construction phase:

- Open Constructed Swales for development run-off
- Infiltration Interception Drains for upslope “clean” water

- Filtration Check Dams to reduce velocities along steeper slopes

- Settlement Ponds and lagoon-type sediment traps to control and store development runoff to encourage settlement prior to discharge.

- Greenfield Runoff for the site will not be exceeded and settlement ponds and lagoon-type sediment traps have been designed to ensure that the capacity is adequate to achieve this.

In areas of steep slope, tracks will be constructed with an appropriate surface cross slope so as to ensure all storm water flow will be directed towards the constructed roadside swales. The flow will then be directed through filtration check dams, settlement ponds and lagoon-type sediment traps with a 10 day retention period, before being discharged into green-field areas.

The Surface Water Management Plan for the site can be found in **Appendix B**.

Please refer to **Technical Schedule 4** –Watercourse Crossings Plan for details of the Watercourse Crossing and Section 50 applications will be lodged pre-construction.

**Technical Schedule 6** outlines the Water Quality Monitoring Plan. A detailed version of TS 6 shall be prepared by the Contractor prior to construction commencing.

### *2.4.1 Clear Felling of Coniferous Plantation*

It is estimated that approximately 6 hectares in total of existing coniferous plantation forestry will be felled to allow for development of the proposed wind farm infrastructure. With the exception of the proposed stream crossings all proposed tree felling areas are generally located outside of imposed buffer zones. The large distance between proposed felling areas and sensitive aquatic zones means that potential poor quality runoff from felling areas can be adequately managed and attenuated prior to even reaching the aquatic buffer zone and primary drainage routes. Where tree felling is required in the vicinity of streams, the following additional mitigation measures will be employed.

- During the wind farm construction phase a self-imposed buffer zone of 50m will be maintained for all streams where possible. These buffer zones are shown on Figure 2.3.

- Machine combinations will be chosen which are most suitable for ground conditions at the time of felling, and which will minimise soils disturbance;

- Checking and maintenance of roads and culverts will be on-going through any felling operation. No tracking of vehicle through watercourses will occur, as vehicles will use road infrastructure and watercourse crossing points. Where possible, existing drains will not be disturbed during felling works;

- Drains which drain from the area to be felled towards surface watercourses will be blocked, and temporary silt traps will be constructed. No direct discharge of such drains to watercourses will occur. Drains and sediment traps should be installed during ground preparation. Collector drains will be excavated at an acute angle to the contour (0.3%-3% gradient), to minimise flow velocities. Main drains to take the discharge from collector drains must be provided with water drops and rock armour where there are steep gradients, and should avoid being placed at right angles to the contour;

- Sediment traps will be sited outside of buffer zones and will have no direct outflow into the aquatic zone. Machine access will be maintained to enable the accumulated sediment to be excavated. Sediment will be carefully disposed of away from all aquatic zones. Where possible, all new silt traps will be constructed on even ground and not on sloping ground;

- In areas particularly sensitive to erosion, it may be necessary to install double or triple sediment traps, lagoon-type sediment trap and disturbed sediment entrainment mats;

- All drainage channels will taper out before entering the aquatic buffer zone. This ensures that discharged water gently fans out over the buffer zone before entering the aquatic zone, with sediment filtered out from the flow by ground vegetation within the zone. On erodible soils silt traps will be installed at the end of the drainage channels to the outside of the buffer zone;

- Drains and silt traps will be maintained throughout all felling works, ensuring that they are clear of sediment build-up and are not severely eroded. Correct drain alignment, spacing and depth will ensure that erosion and sediment build-up are minimised and controlled;

- Brash mats will be used to support vehicles on soft ground, reducing peat and mineral soils erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal should take place when they become heavily used and worn. Provision should be made for brash mats along all off-road routes, to protect the soil from compaction and rutting. Where there is risk of severe erosion occurring, extraction should be suspended during periods of high rainfall;

- Timber will be stacked in dry areas, and outside a local 50m stream buffer zone. Straw bales and check dams to be emplaced on the down gradient side of timber storage/processing sites;

- Works should be carried out during periods of no, or low rainfall, in order to minimise entrainment of exposed sediment in surface water run-off;

- Checking and maintenance of roads and culverts will be on-going through the felling operation;

- Refuelling or maintaining machinery will not be permitted within 50m of an aquatic zone. Dedicated refuelling areas will be used during the felling works; and,

- Branches, logs or debris will be prohibited to build up in aquatic zones. All such material will be removed when harvesting operations have been completed, but avoid removing natural debris deflectors.

### *2.4.2 Potential Release of Hydrocarbons during Construction and Storage*

- On site refuelling of machinery will be carried out using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer will be re-filled off site, and will be towed around the site by a 4x4 jeep to where machinery is located. The 4x4 jeep will also carry fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level area in the construction compound when not in use and only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations;

- Fuels stored on site will be minimised. Any storage areas will be bunded appropriately for the fuel storage volume for the time period of the construction;

- The electrical control building shall be bunded appropriately to the volume of oils likely to be stored, and to prevent leakage of any associated chemicals and to groundwater or surface water. The bunded area will be fitted with a storm drainage system and an appropriate oil interceptor;

- The plant used shall be regularly inspected for leaks and fitness for purpose; and,

- An Emergency Reponses Plan for the construction phase to deal with accidental spillages will be contained within Technical Schedule 1. Spill kits will be available to deal with accidental spillages.

### *2.4.3 Groundwater and Surface Water Contamination from Wastewater Disposal*

- Self-contained port-a-loos with integrated waste holding tank will be used at the site compound, maintained by the providing licensed contractor, and removed from site on completion of the construction works;

- Water supply for the site office and other sanitation will be brought to site and removed after use from the site to be discharged at a suitable off-site treatment location;

- No water will be sourced on the site, or discharged to the site.

### *2.4.4 Release of Cement-Based Products*

- No batching of wet-cement products will occur on site. Ready-mixed supply of wet concrete products and where possible, emplacement of pre-cast elements, will take place;

- Where possible, pre-cast elements for culverts and concrete works will be used;

- No washing out of any plant used in concrete transport or concreting operations will be allowed on-site;

- Where concrete is delivered on site, only the chute need be cleaned, using the smallest volume of water possible. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed. Chute cleaning water is to be tanked and removed from the site to a suitable, non-polluting, discharge location;

- Use weather forecasting to plan dry days for pouring concrete;

- Ensure pour site is free of standing water, and plastic covers will be ready in case of sudden rainfall event.

### *2.4.5 Morphological Changes to Surface Watercourses & Drainage Patterns*

- Where possible all proposed new stream crossings will be bottomless culverts and the existing banks will remain undisturbed. No in-stream excavation works are proposed and therefore there will be no impact on the stream at the proposed crossing location;
- Where the proposed grid connection cable route runs adjacent to a proposed access road or road proposed for upgrade, the cable will pass over the culvert within the access road;
- Any guidance/mitigation measures proposed by the OPW or the Inland Fisheries Ireland will be incorporated into the design of the proposed crossings;
- As a further precaution near stream construction work will only be carried out during the period permitted by Inland Fisheries Ireland for in-stream works according to the Eastern Regional Fisheries Board (2004) guidance document "*Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites"*, that is, May to September inclusive. This time period coincides with the period of lowest expected rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses;
- During the near stream construction work double row silt fences will be emplaced immediately down-gradient of the construction area for the duration of the construction phase. There will be no batching or storage of cement allowed in the vicinity of the crossing construction areas;
- All access road river/stream crossings will require a Section 50 application (Arterial Drainage Act, 1945). The river/stream crossings will be designed in accordance with OPW guidelines/requirements on applying for a Section 50 consent.

The proposed mitigation measures for protection of surface water quality which will include buffer zones and drainage control measures (*i.e.* interceptor drains, swales, settlement ponds, lagoon-type sediment traps) will ensure that the quality of runoff from proposed development areas will remain unchanged.

### *2.4.6 Surface Water Quality Monitoring*

Sampling will be done before, during (if the operation is conducted over a protracted time) and after the construction works. The 'before' sampling should be conducted within 4 weeks prior to the

construction work beginning, preferably in medium to high water flow conditions. The "during" sampling will be undertaken once a week or after rainfall events. The 'after' sampling should comprise as many samplings as necessary to demonstrate that water quality has returned to pre-activity status (i.e. where an impact has been shown).

Criteria for the selection of water sampling points include the following:

1. Avoid man-made drains and watercourses without all-year flow;
2. Select sampling points upstream and downstream of the works;
3. It is advantageous if the upstream location is outside/above the site in order to evaluate the impact of land-uses other than the development works; and,
4. Where possible, three downstream locations should be selected: one immediately below the working area, the second at exit from the site boundary, and the third some distance from the second (this allows demonstration of no impact through dilution effect or contamination by other land-uses where impact increases at third downstream location relative to second downstream location).

**Technical Schedule 6** outlines the Water Quality Monitoring Plan. A detailed version of TS 6 shall be prepared by the Contractor prior to construction commencing.

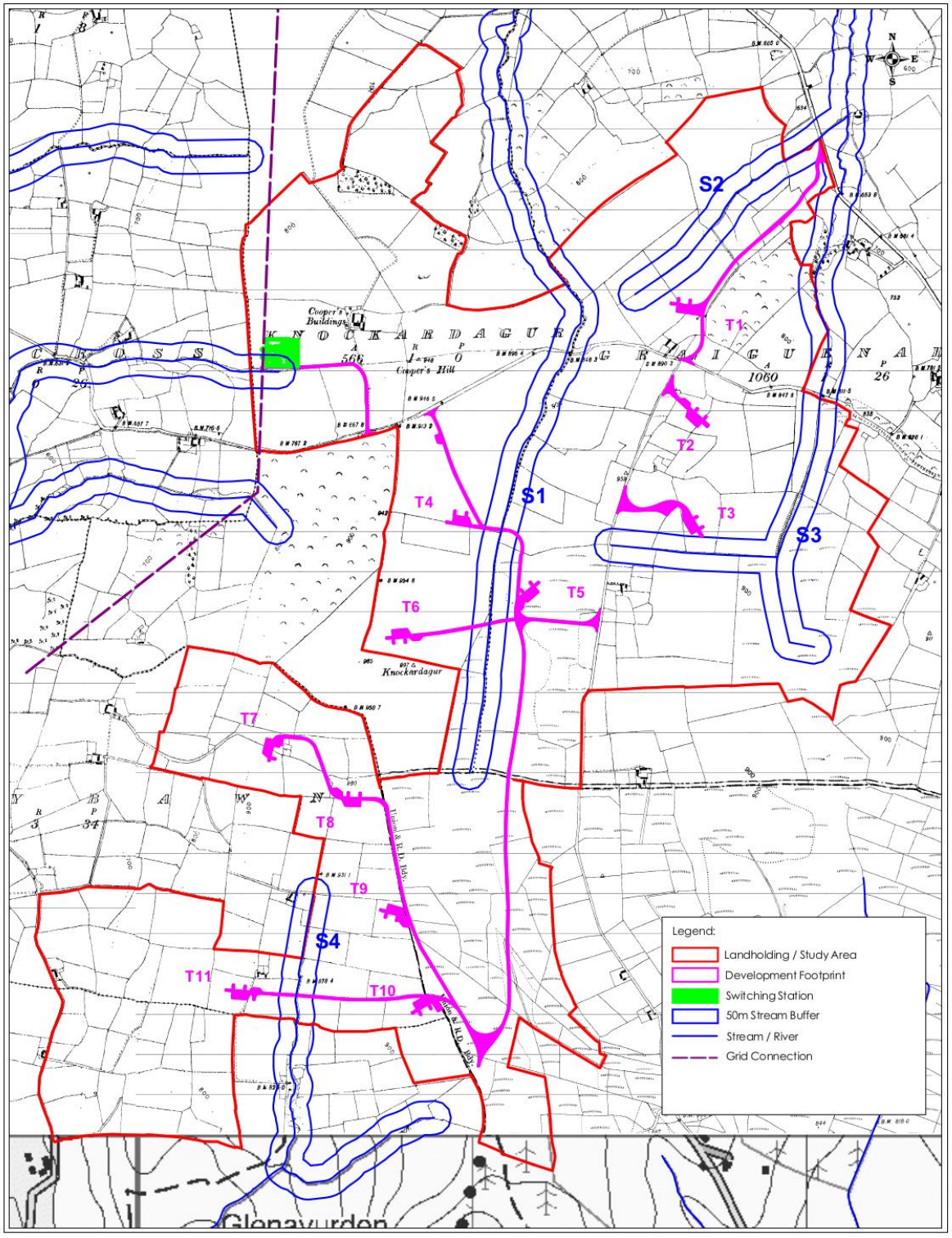



**Figure 2.3 Hydro Constraints Map**

## 2.5 AIR AND CLIMATE

As with all projects, construction activities are likely to generate some dust emissions.

- Where dust suppression is considered to be required by the Contractor, such requirements and methodology shall be subjected to the agreement with Ecological Clerks of Works.

- Water misting or sprays will be used as required if particularly dusty activities are necessary during dry or windy periods.

- Dust Minimisation Plan will be formulated as part of the Construction Management Plan for the construction phase of the project.

## 2.6 ARCHAEOLOGY AND CULTURAL HERITAGE

Due to the presence of two RMP sites within the 1km study area and the discovery of a find from a townland within the development area recorded in the Topographical Files, it is recommended that archaeological monitoring be carried out in all areas of proposed land take.

- Archaeological Monitoring will be carried out under Licence to the Department of Arts, Heritage and the Gaeltacht and the National Museum of Ireland. Provision should be made for the full excavation and recording of any archaeological features or deposits that may be exposed during monitoring;

- It is recommended that a written and photographic record be created, well in advance of any development works, where the access tracks truncate the townland, parish, barony and county boundaries.

- It is also recommended that monitoring be carried out where the access tracks truncate the townland, parish, barony and county boundaries. Provision should be made for the full excavation and recording of any archaeological features or deposits that may be exposed during monitoring.

## 2.7 NOISE

To ensure that construction noise remains below 'nuisance' levels, reference will be made to BS 5228: Part 1: 1997 (Noise Control on Construction and Open Sites – Part 1. Codes of Practice for Basic Information and Procedures for Noise Control) which offers detailed guidance on the control of noise

from demolition and construction activities. The following mitigation measures for control of construction noise will be implemented, as recommended in BS 5228: Part 1:1997:

- The hours of construction activity will be limited to between 08.00 hours and 20.00 hours Monday to Friday and 08.00 hours and 18.00 hours on Saturdays. It should be noted that it may be necessary to commence turbine base concrete pours from 06.00 due to time constraints incurred by the concrete curing process. Additional emergency works may also be required outside of normal working hours as quoted above;

- Communication links will be established and maintained between the developer, contractor, Local Authority and local residents;

- Equipment and technology with generation of low noise levels will be selected where possible;

- Noise generating equipment will be located as far as possible away from local noise sensitive areas identified;

- In the unlikely event that irregularities or complaints arise, the source of the problem will be sought and dealt with;

- Temporary barriers or screens can be erected if necessary around noisy equipment such as generators and compressors.

A Noise Management Plan has been prepared for the proposed development, please refer to **Technical Schedule 7**.

## 2.8 VIBRATION

The road quality survey and any consequent improvements to the road surface will ensure that vehicles travelling to and from site do not cause significant groundborne vibrations at houses along local roads leading to the site.

Construction activity on site is not expected to be a source of significant vibration at nearby houses. However, similar to the case of environmental noise it is prudent to appoint a liaison to which residents can address any vibration related complaints arising from the construction works. If any piling activity is required which may give rise to perceptible vibration at the neighbouring houses, then the residents should be informed in advance of the timing and duration of such works.

## 2.9 TRAFFIC

A Traffic Impact Assessment has been prepared by Jennings O'Donovan & Partners Limited, the following mitigation measures have been considered:

- A Traffic Management Plan shall be agreed with the local authority as part of the Construction Management Plan in advance of the commencement of works;

- Traffic movements will be limited to 08:00 - 18:00 Monday to Friday and 08:00 – 16:00 on Saturdays, unless otherwise agreed in writing with Laois County Council. Further, deliveries will be scheduled to avoid peak times around the morning and evening peak hours. This will avoid HGV traffic arriving during the morning peak hour creating conflict with local residents on their commute/school run. Construction personnel will be encouraged to car-pool, or to travel to site in minibuses;

- Wheel wash equipment will be used on site to prevent mud and stones being transferred from The Application Site to the public highway. All drivers will be required to ensure their vehicle is free from dirt and stones prior to departure from the construction site. In addition, any dust generating activities will be minimised where practical during windy conditions, and drivers will adopt driving practices to minimise dust creation. Finally, loads will be covered into and out of the site where required;

- During the construction phase, clear construction warning signs will be placed on the R430, L7800 and the L78001, advising the general public as to the presence of the construction site. The site entry point will also be appropriately signed. Access to the construction site will be controlled by on site personnel and all visitors will be asked to sign in and out of the site by security / site personnel. Security gates will be sufficiently set back from the road, so that vehicles entering the site will stop well clear of the public road. Site visitors will all receive a suitable Health and Safety site induction, and Personal Protective Equipment ("PPE") will be worn.

- Once construction of the Development is completed all portacabins, machinery and equipment will be removed and temporary hardstandings excavated and reinstated. The area will be re-graded with the stockpiled topsoil to a natural profile and allowed to regenerate from the seed bank within the topsoil.

## 2.10 WASTE

Subsoil excavation and reinstatement methodology measures, as outlined in section 2.3.6 are also relevant in relation to waste control measures, and will be employed and strictly observed during the construction phase:

- All waste arising during the construction phase will be managed and disposed of in a way that ensures the provisions of the Waste Management Act 1996 and associated amendments and regulations.

- Any excess construction material shall be installed be immediately removed from the area and disposed of in a fully licenced landfill.

- No stockpiling of material should be permitted in the constraint zones.

- A Detailed Subsoil (Spoil) Management Plan will be prepared prior to the commencement of construction at the site.

- A Waste Management Plan (Technical Schedule 3) has been prepared and shall be developed in detail by the contractor in advance of the works commencing.

## 2.11 PROPOSED CONSTRUCTION SCHEDULE

The construction programme is anticipated to take approximately 12 months, taking into account the erection and commissioning of the turbines. This programme will take due cognisance of the requirements of the Planning Conditions and detailed requirements stipulated by Statutory Consultees.

An example of the Employer's Project Programme can be found in **Appendix E**.

## 2.12 CONSTRUCTION SEQUENCE

The outline construction period and the Contractor's proposed sequence of works will take due cognisance of the requirements of any stipulated Planning Conditions and by the Contractors Contractual obligations.

The outline construction sequence of the proposed development is as follows:

- The construction of the site entrances;

- Construction of the temporary construction compound for off-loading materials and components, and to accommodate temporary site offices;

- Construction of bunded areas for oil, fuel and lubricant storage tanks;

- Progressive construction of internal on-site access tracks;

- As the internal access tracks progress to each turbine location, foundation excavations for the turbines and substation will commence and foundations laid. The hardstanding areas and the substation, switchroom and compound will be constructed as the track advances;

- Once the tracks are completed, the trenching and laying of underground cabling will begin. Where possible, cable trenches will be constructed at the same time as access track construction to allow re-vegetation of topsoil as quickly as possible;

- Installation of turbines will commence once the site tracks, hardstandings, reinforced concrete turbine foundations and drainage measures are in place and the temporary road junction upgrade is complete. It is anticipated that each turbine will take 2 to 3 days to install. Two cranes will be used for this operation. As each turbine is completed, the electrical connections will be made;

- Hardstanding's will be partially re-sodded, where necessary, following construction phase crane operations;

- Decommissioning of the temporary meteorological mast and installation of the permanent meteorological mast will then take place;

- Progressive site reinstatement and restoration including removal of temporary construction compound. Once the turbines are installed, the substation and electrical system completed, the turbines will be tested and commissioned.

Given the pre-existing local road network, seven site entrances are proposed, four of which are already in existence. The areas of hardstanding for crane operations and on-site access tracks will generally be constructed as follows:

- Topsoil and subsoil will be removed and stored in separate mounds in appropriate areas adjacent to the crane site/access tracks;

- Crushed stone will be laid on a geo-textile mat to an appropriate depth;

- For hardstandings, after turbines are erected the topsoil will be used to cover the hardstanding where appropriate, to reduce the visual and environmental impact, but the hard-standing shall be retained in situ for the operational phase of the wind farm. In the event that maintenance work requiring a large crane is needed (e.g. replacement of a blade set), the crane hardstanding areas will be re-exposed and will again be recovered with topsoil and reseeded on completion of the work;

Where access tracks require to cross any drainage ditches or water feature, appropriate methods will be used to prevent any interference with watercourses as detailed in the Watercourse Crossing Plan (Technical Schedule No. 4);

- The hardstanding and on-site access tracks will be removed during the decommissioning phase, unless the Planning Authority agree to their retention for forestry/agricultural activities.

- During the construction period, a temporary construction compound will be required and will comprise:

- Temporary cabins to be used for the site office, the monitoring of incoming vehicles and welfare facilities for the construction staff, including temporary toilets;

- Parking for construction staff, visitors and construction vehicles;

- Secure storage for tools, plant and small parts;

- Safe bunded storage of components and materials including fuels, lubricants and oils;

- Security fencing around the compound.

- Temporary portaloo chemical toilets for construction staff will be sealed chemical units to ensure that no discharges will escape into the local environment. These will be supplied and maintained by a licensed supplier. Potable drinking water (for drinking, food preparation, hand washing etc.) will be supplied on-site by water dispenser.

A detailed Construction Management Plan (CMP) for construction will be prepared by the Contractor in advance of all construction activities and will incorporate all mitigation measures recommended

elsewhere in this report. This report will be issued to the Contractor to ensure that all environmental mitigation measures required will be captured in the detailed CMP.

## 2.13 PLANNING CONDITIONS AND OUTLINE CONSTRUCTION MANAGEMENT PLANS

This CEMP and its future versions/revisions will form part of the Contract for Pinewoods Wind Farm. It will therefore be updated and revised during the different stages of the wind farm development. Table 2.6 will list all the planning conditions associated with the planning permission should it be granted.

The Contractor will consider all of the mitigation measures and best practice construction methods detailed within the above consents in his design and in any detailed environmental plans as required by this CEMP or the Contract.

Please refer to the Mitigation Management Summary in **Appendix E** which summarises all mitigation measures from the EIS and associated documents.

Where any mitigation measures or construction methods described in other documents deviate in any way from those contained within this CEMP, the Contractor will abide by whichever is the most onerous and stringent in terms of environmental protection.

**TABLE 2.6 RELEVANT PLANNING CONDITIONS AND RELATED DOCUMENTATION**

| Condition No. | Planning Condition | |
|---|---|---|
| 1. | | |
| 2. | | |
| 3. | | |
| 4. | | |
| 5. | | |

| TABLE 2.6 RELEVANT PLANNING CONDITIONS AND RELATED DOCUMENTATION | | |
|---|---|---|
| **Condition No.** | **Planning Condition** | |
| | | |
| 6. | | |
| 7. | | |
| 8. | | |

**Table 2.6 Relevant Planning Conditions and Related Documentation**

## 2.14 SCHEME AMENDMENTS

Scheme Amendments will be recorded in Table 2.7. These amendments do not include changes to the scheme design which are completed in accordance with the existing planning consent; instead, this refers to changes in the design of the wind farm for which additional approvals and / or consents may be required from the Laois County Council and Kilkenny County Council. For example, amendments to track layouts or turbine locations outside of approved micrositing boundaries as per the current grants of planning.

The purpose of recording Scheme Amendments here is to provide a record of any changes in the design and siting of the wind farm infrastructure such that any associated environmental impacts and mitigation measures may be appropriately instigated through this CEMP.

| TABLE 2.7 SCHEME AMENDMENTS | | | |
|---|---|---|---|
| **Reference** | **Date** | **Scheme Amendment Description** | **Environmental Sensitivities Potentially Impacted by Scheme Amendment.** |
| | | | |
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**Table 2.7 Scheme Amendments**

## 2.15 REGISTER OF VARIATIONS

Where any amendments and variations to the Technical Schedules and CEMP are required (either as a result of Scheme Amendments or through corrective actions or improvements noted and undertaken on site) these will be recorded in Table 2.8, Register of Variations. Furthermore, all changes to construction methods, design, mitigation and the implications of these changes and authorising personnel will be recorded in Table 2.8.

| TABLE 2.8 REGISTER OF VARIATIONS | | | |
|---|---|---|---|
| **No.** | **Variation Description** | **Authorising Personnel** | **Completion Date** |
| | | | |
| | | | |
| | | | |
| | | | |

**Table 2.8 Register of Variations**

# 3.0 COMMUNICATION PLAN

## 3.1 INTRODUCTION

Both the Contractor and the Client will appoint Project Managers to the wind farm project. These Project Managers will be the main points of contact between the two parties. The Contractors team will report directly to the Construction Project Manager, with all Client staff reporting directly to the Client Project Manager.

It is envisaged that main project communications will take the form of structured reporting arrangements and meetings.

All issues in relation to environmental management/monitoring will be reported to the Site Environmental Manager/Engineer. The Site Environmental Manager/Engineer shall report to the Contractor and Client on a regular basis.

## 3.2 COMMUNICATIONS CONSULTANT

Both the Contractor and the Client will appoint an external Communications Consultant to whom members of the public, third parties and the Planning Authority can address any queries or complaints in relation to the proposed development.

It is envisaged that the Communications Consultant will structure a process for which queries/complaints can be reported and maintain regular communications with the local householders (i.e. through flyers advising of construction updates and a web page etc.).

## 3.3 CONTACT SHEETS

Table 3.1 provides a list of all Pinewoods Windfarm Limited, Contractor and relevant third party contact details. This table should be updated and kept current by the Contractor for the duration of the Contract.

**TABLE 3.1 CONTACT SHEETS**

| Company | Position | Name | Telephone |
|---|---|---|---|
| Pinewoods Windfarm Limited | Client Project Manager | | |
| Contractor | Site Manager / Environmental Manager | | |
| Contractor | Contracts Manager | | |
| Contractor | General Manager | | |
| Contractor | Foreman | | |
| Contractor | Ecological Clerk of Works | | |
| Contractor | Communications Consultant | | |

| | | | |
|---|---|---|---|
| Jennings O'Donovan | Construction Project Manager | | |

**Table 3.1 Contact Sheets**

## 3.4 MEETINGS REPORTS AND CONSULATIONS

Table 3.2 lists all meetings and consultations as required by the Contract. The table also provides details on the schedule/frequency, scope & objectives and attendees / responsibility for each meeting.

## 3.5 ROLES AND RESPONSBILITIES

Roles and responsibilities for environmental management, monitoring and reporting are detailed in Table 3.3.

The Contractors Site Environmental Manager/Engineer will be responsible for the delivery of all elements of the Environmental Management Plan.

The Site Environmental Manager/Engineer will retain all responsibility for issuing, changing and monitoring the Environmental Management Plan.

| TABLE 3.2 MEETINGS, REPORTS AND CONSULTATIONS | | | |
|---|---|---|---|
| **Meeting/Report** | **Schedule/Frequency** | **Scope & Objective** | **Attendees/Responsibilities** |
| A Record of all meetings, checks, permissions and licenses will be retained within Section 4 of this CEMP | | | |
| Site Inductions | All new site personnel and visitors | | Contractor to organize and maintain records |
| Weekly environmental meetings | Weekly | To provide updates on environmental mitigation measures and performance and identify actions for improvement. As per Pollution Prevention measures outlined in Section 10 of the CMS, the ECoW is required to maintain a Pollution Prevention Measures Register (PPMR) in which mitigation measures put into place will be listed, and checked weekly to assess the requirement for maintenance. The results of these checks will be discussed at the meeting and corrective actions agreed as required. | Attendance required: ECoW, Site Manager, and any other relevant personnel or statutory consultees where necessary. Meeting minutes to be summarised by ECoW and forwarded to the Site Environmental Manager in the event that any significant environmental issues are reported. |
| Monthly Environmental Report & Monthly Environmental Management Group Meeting | Monthly | To provide a compiled record of weekly meeting minutes and environmental performance and monitoring results (e.g. air, noise or water quality monitoring as appropriate). To identify any areas / action for improvement. | To be prepared by ECoW. Report to be issued to the Contractor and Construction Project Manager before the end of each calendar month. Report to be discussed at the monthly meeting with recommendations for improvement passed to the Contractor in written format |
| Final Environmental Report | Upon completion of construction works | The final report will document the environmental and ecological effects of the construction period. The evidence for effects will be based on findings included in the minutes of weekly meetings and monthly meetings, together with other recording information maintained by the ECoW. The report will relate results to residual effects predicted in the ES. | The Final Report will be prepared by the ECoW. The report will be made available to the Contractor, Construction Project Manager, Planning Authority. |

| | | | |
|---|---|---|---|
| Environmental Checks and Monitoring of Mitigation Works | As required in advance of construction works regular checks should also be made at least every 14 days. | Environmental Checks are to be carried out in advance of construction works. This will comprise an on-site meeting / inspection to confirm the appropriate use of identified mitigation measures and highlight any further issues / measures which may be relevant prior to commencement of works in any area.<br><br>As a minimum, Environmental Checks will be completed at each main piece of site infrastructure (turbine bases, construction compounds, sub-station, control room) prior to works commencing in that area. Advance checks will be undertaken no less than every 100m of constructed or upgraded access track.<br><br>Environmental Checks will include:<br><br>• Checks for visual evidence of contamination / sediment alongside watercourses, nearby working areas and in areas of surface water discharge.<br><br>• Regular checks of all plant and equipment to identify any oil or fuel leaks to confirm the condition of the plant.<br><br>• Inspection of drainage and erosion and sediment control measures. Additional checks should be made before, during (where safe to do so) and immediately following anticipated storm events or periods of continuous or heavy intermittent rainfall over one or more days.<br><br>• Environmental checks will also encompass a review of:<br><br>– Waste management procedures;<br><br>– General site tidiness;<br><br>– Temporary materials storage (extracted materials stockpiles) and restoration works; And<br><br>– Peat stability | Environmental checks will be undertaken by the Contractor, supervised by the ECoW where appropriate. The ECoW may also undertake regular checks, either independently or in conjunction with the Contractor's checks as required.<br><br>The Contractor and ECoW will retain a record of all inspections / findings of Environmental Checks within Section 4 of this CEMP. All records will be made available for audit / review. All records will also be made available for discussion during regular meetings as scheduled herein. |
| Environmental Audit | At least once every month. | | Environmental Audits may be carried out by the Contractor, Pinewoods Wind Farm Ltd or any |

| | | | |
|---|---|---|---|
| | | | other interested party at any time during the works.<br><br>Audit procedures and forms are included within Section 4 and TS1. These will be followed / completed by the Employer when undertaking environmental audits and may also be adopted by the Contractor, unless alternative procedures and forms are submitted and approved as part of the Contractor's detailed EMP. |
| Liaison with regulator / statutory Consultees | As Required | Provide regular updates to relevant authority on environmental performance and maintain good working relationships with the regulatory bodies. | Contractor and ECoW where required. Meetings will be initiated as required by Planning Condition, Technical Schedules or as agreed throughout the duration of the construction phase. The Contractor is responsible for obtaining all relevant permissions, consents, licenses and permits. Some permits may require application and implementation by an appropriately qualified person. In these instances, the Contractor will consult with the ECoW or other specialist Environmental Consultant where required. |

**Table 3.2 Meetings, Reports and Consultations**

| TABLE 3.3 ROLES AND RESPONSIBILITIES | |
|---|---|
| Position | Roles and Responsibilities |
| Construction Project Manager | The Construction Project Manager will:<br><br>Ensure that the Contractor has obtained the relevant approvals and licenses and consents from regulatory bodies and statutory consultees where required. Ensure that the Contractor has submitted all relevant documentation to the ECoW and Project Environmental Manager, Liaise with the Site Manager and the ECoW and ensure that corrective actions and variations to the CEMP have been instigated. |
| Project Site Manager/Engineer | The Site Manager will provide liaison between the ECoW and the Contractor where environmental sensitivities, instruction for environmental performance improvements or corrective actions are requested by the ECoW, Environmental Manager or other appropriate person(s) as a result of environmental checks or audits conducted by these person(s). The Site Manager will ensure that all notifications of environmental sensitivities and incidents as well as other general observations on environmental performance are reported back to the Construction Project Manager. The Project Site Manager is responsible for review and further development of the CEMP. |
| ECoW:<br><br>Ecological Clerk of Works | The Ecological CoW will work with Pinewoods Wind Farm Ltd and the Contractor to ensure compliance with best practice and with all environmental mitigation and monitoring requirements as detailed within the ES, relevant planning conditions and CEMP.<br><br>Where a particular ecological concern exists at the site, or specific habitat management activities are to be undertaken in conjunction with the main civils construction works, a Specialist Ecologist / Environmental Consultant may also be required unless the ECoW is suitably qualified to undertake the particular ecological responsibilities. The main roles of the Ecological CoW are as follows:<br><br>• Organise start-up meeting / Tool box talks with the Contractor to agree working methods, specifically including communications; weekly schedules; monitoring of data storage; and preparation of plans indicating location of key features including mitigation measures, monitoring points and sensitive habitats.<br><br>• Maintain a weekly presence on site during the main construction works.<br><br>• Organise a minimum of weekly meetings with the Site Manager and / or Foreman, to allow briefing on the programme of works on site and to provide on-site guidance during construction. Note: It is essential that the Contractor supplies information on proposed works and scheduling to the ECoW in advance in order to anticipate and address any issues, specifically including drainage, silt mitigation measures, cabling, roads, turbine bases, met masts, compounds, landscaping, topsoil removal, storage and replacement, vegetation reinstatement and restoration works, planting, felling and habitat management.<br><br>• Highlight the need for compliance with planning conditions.<br><br>**Note: If failures occur and actions are taken which contravene legislation then the ECoW has the power to stop works in the affected area with immediate effect and the appropriate statutory agency and planning officer will be informed. These actions will only be taken where appropriate. Notification to stop works will be by verbal means, followed up with written confirmation** |

| | |
|---|---|
| | **recording the time and date of the instruction, personnel involved and reasons for the instruction. Upon recommencement of works, details of any corrective actions and / or remedial measures implemented will be recorded within Section 4.**<br>• Give tool box talks as agreed with the site contractor to address key areas, including water pollution prevention, protected species management, and on-site biodiversity.<br>• Monitor potential environmental impacts, including:<br>− Use of and storage of oils and toxic chemicals on site, e.g. cement<br>− Dewatering of excavations (including turbine bases)<br>− Silt control<br>− Water management, including working in or close to watercourses<br>− Protection of ecological interests, e.g. protected species and habitats<br>• Identify environmentally-sensitive areas and ecological hazards for demarcation by the Contractor.<br>• Produce written reports to the Contractor following site visits and meetings. This includes monthly reports and a final report. |
| Specialist Ecologist / Environmental Consultant | Where a Specialist Ecologist / Environmental Consultant is employed on a project, this person(s) will:<br>• Provide advice and maintain regular liaison with the Project Site Manager, Project Manager, Ecologist and Environmental Manager, Contractor and / or ECoW other specialist Environmental Consultant as and when required.<br>• Undertake specific monitoring activities and reporting as defined in agreed documentation prepared as part of the planning process. |
| **Contractor Appointments** | |
| Construction Manager | [The Contractor is required to specify roles and responsibilities for each individual below] |
| Site Agent | |
| Foreman | |
| Environmental Manager | |
| Communications Consultant | |

**Table 3.3 Roles and responsibilities**

## 3.6 TRAINING, AWARENESS AND COMPETENCE

All site personnel will receive environmental awareness information as part of their initial site briefing. The detail of the information should be tailored to the scope of their work on site. This will ensure that personnel are familiar with the environmental aspects and impacts associated with their activities, the procedures in place to control these impacts and the consequences of departure from these procedures.

The CEMP will be posted on the main site notice board during the project. The environmental performance at the site will be on the agenda of the monthly project management meetings for the project. Elements of the CEMP will be discussed at these meetings including objectives and targets, the effectiveness of environmental procedures etc. Two-way communication will be encouraged by inviting all personnel to offer their comments on environmental performance at the site.

## 3.7 EMERGENCY PREPAREDNESS AND REPONSE

An emergency preparedness and response procedure is required to prevent environmental pollution incidents. Suitable spill kits and absorbent material for dealing with oil spills will be maintained on site. In the event of pollution or potential risk of pollution, Laois County Council and Kilkenny County Council should be informed immediately. In the case of water pollution in addition to Laois County Council and Kilkenny County Council, Inland Fisheries Ireland should also be informed immediately.

# 4.0 CORRESPONDENCE, RECORDS & REPORTS

## 4.1 REQUIREMENTS

The Contractor will insert / file all communication records and reports associated with Environmental Management and implementation of this CEMP under this Section 4. As a guide, the following sub-sections of filed information are required (at a minimum):

4-A) Meeting minutes and attendance record

4-B) Weekly Environmental Reports

4-C) Monthly Environmental Reports

4-D) Environmental Checks

4-E) Audit Reports

4-F) Ecology documentation and monitoring records

4-G) Pollution Prevention, including a Pollution Prevention Measures Register

4-H) Water Quality documentation and monitoring records

4-I) Archaeology documentation and monitoring records

4-J) Ground Risk, including a Geotechnical Risk Register

4-K) Waste Management documentation

4-L) Licensing and Consents: copies of all permissions, consents, licenses and permits and related correspondence. A summary record of all such documents shall also be provided as per Table 4.1 of this CEMP.

4-M) General Correspondence: all other relevant internal and external communication records relating to environmental management issues and implementation of the CEMP.

4-N) Training Records

4-O) Toolbox Talk Records

4-P) Environmental Manager Reports

All of these documents and records should be made available for inspection in the site office. The documentation shall be to date and shall be reviewed on a regular basis with revisions controlled in accordance with the site quality plan.

| TABLE 4.1 RECORD OF ENVIRONMENTAL CONSENTS, LICENSES AND PERMITS ISSUED | | |
|---|---|---|
| **Consents, Licenses & Permits** | **Governing Legislation** | **Licensed Activity** |
| **Pollution Control & Hydrology** | | |
| Section 50 consent for watercourse crossing will be made should the planning decision be favorable | EU(Assessment and Management of Flood Risks) Regulations SI 122 of 2010 and Section 50 of The Arterial Drainage Act, 1945 | Construction, Replacement or Alteration of Bridges and Culverts (Please refer to TS4 for details). |
| Discharge Consent | | |
| Section 14 License (application in progress) | Fisheries (Consolidation) Act, 1959. | Electrofishing |
| **Biodiversity** | | |
| | | |
| | | |
| **Waste Management / Contaminated Land** | | |
| | | |
| **Noise / Vibration** | | |
| | | |
| **Archaeology** | | |
| | | |
| **Transport** | | |
| | | |
| **Other** | | |
| | | |

**Table 4.1 Record of Environmental Consents, Licenses and Permits Issued**

## 4.2 ENVIRONMENTAL AUDITS

The Site Environmental Manager will consult and assist with the Client Environmental Manager in evaluating compliance with applicable legislation by means of a monthly Environmental Audit.

A blank Environmental Audit Report form is included in TS1 Environmental Incident and Emergency Response Plan.

All completed audit report forms and records of corrective actions (and close outs) must be filed within this Section of the CEMP.

## 4.3 ENVIRONMENTAL CONSENTS, LICENSES AND PERMITS

The Contractor's Environmental Manager (or otherwise nominated responsible person(s), in conjunction with the ECoW, will complete the summary record for all applicable permissions, consents, licenses and permits obtained for the site. This record will follow the format provided in Table 4.1.

## 4.4 ENVIRONMENTAL MONITORING AND MEASURING

All of the Environmental Procedures will contain a section on monitoring, where applicable. The Contractor will put in place a program of monitoring for dust, noise, vibration and water sampling in accordance with the requirements of this CEMP.

Copies of these records will be maintained in the site office and will be reviewed by the Contractor.

## 4.5 NON-CONFORMANCE, CORRECTIVE AND PREVENTATIVE ACTION

Non-Conformance Notices will be issued where there is a situation where limits associated with activities on the project are exceeded, or there is an internal/external complaint associated with environmental performance.

Non-Conformance is the situation where essential components of the EMS are absent or dysfunctional, or where there is insufficient control of the activities and processes to the extent that the functionality of the EMS in terms of the policy, objectives and management programmes, is compromised.

Correction will be required in order to improve the identified non-conformance. The EMS and all its components must conform to the CEMP, objectives and targets and the requirements of the ISO 14001 management standard. In the event of non-conformance with any of the above, the following must be undertaken:

- Cause of the non-compliance;
- Develop a plan for correction of the non-compliance;
- Determine preventive measures and ensure they are effective;
- Verify the effectiveness of the correction of the non-compliance;
- Ensure that any procedures affected by the corrective action taken are revised accordingly.

Responsibility must be designated for the investigation, correction, mitigation and prevention of non-conformance.

# 5.0 TECHNICAL SCHEDULES & AVAILABLE INFORMATION

## 5.1 TECHNICAL SCHEDULES

Various Technical Schedules have been prepared by Pinewoods Windfarm Ltd as listed in Table 5.1. These are intended to provide a benchmark for best practice and to define Pinewoods Windfarm Ltd's minimum requirements for environmental management and mitigation.

## 5.2 CONTRACTOR REQUIREMENTS

The Contractor is required to further develop the Technical Schedules into detailed site and works specific environmental plans, construction management plans and procedural documents. Table 5.1 provides a summary of the content of the Technical Schedules and the Contractor's obligations for their further development.

**TABLE 5.1 LIST OF TECHNICAL SCHEDULES**

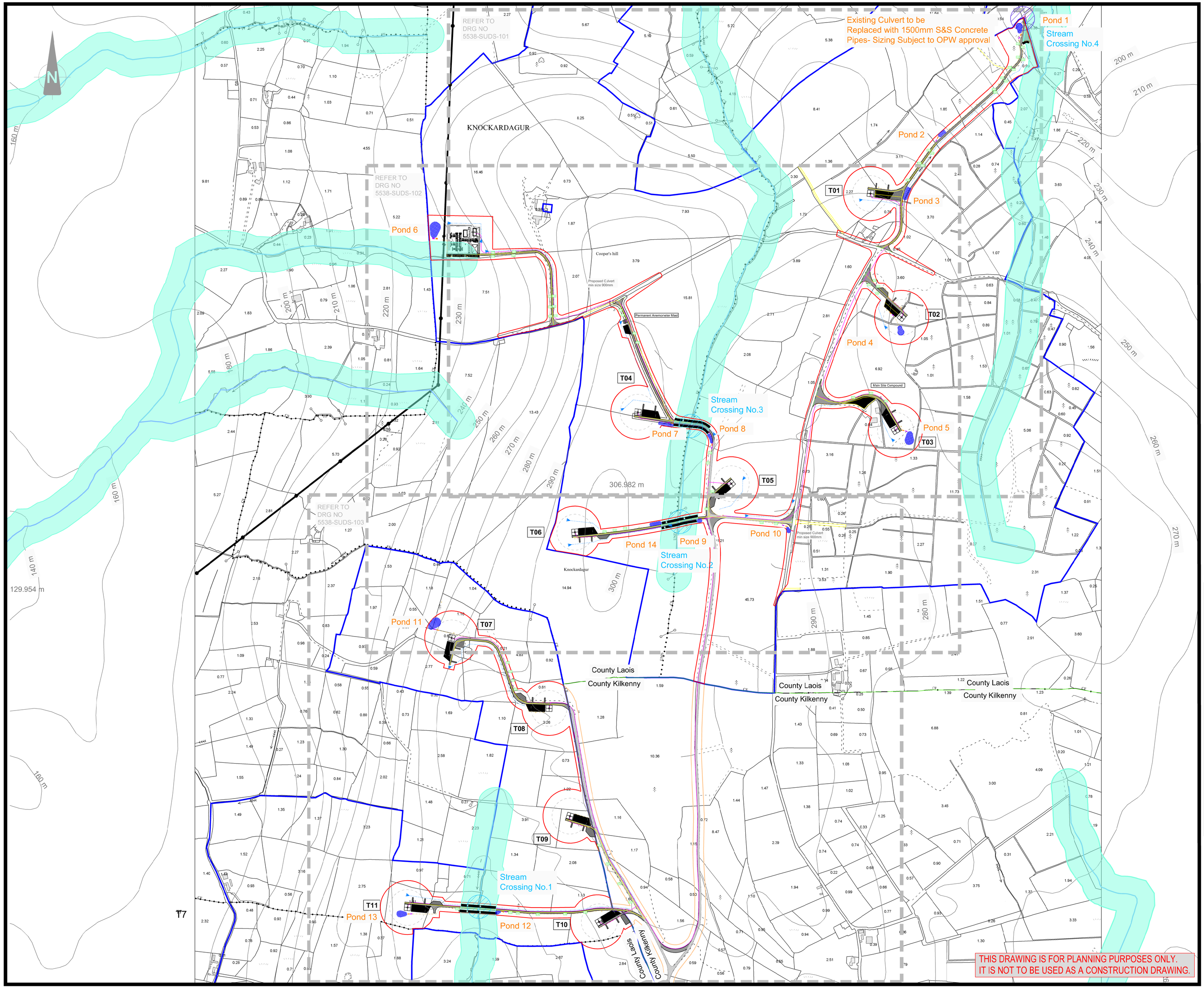
| | | |
|---|---|---|
| TS 1 | Environmental Incident and Emergency Response Plan | The Contractor will prepare a detailed Environmental (Incident and Emergency) Response Plan. This will include procedures for dealing with containment of accidental chemical or fuel spills, potential overload of the drainage system by silt during unforeseen adverse weather conditions and also procedures for dealing with potential mass movement of material from peat instability / slide events. |
| TS 2 | Communication Plan (in the event of a spillage) | The Contractor will prepare a Communication Plan for emergency response in the event of a spillage. Detailed procedures will be outlined in this document. |
| TS 3 | Waste Management Plan (WMP) | A WMP is intended to implement reduction and effective management of resources and waste during the early design stages of the wind farm construction, through to completion, such that legal compliance is met; project build costs are minimised; a framework for continuous improvement and best practice is implemented and maintained; and carbon emissions and other negative environmental impacts associated with the production and management of waste materials are minimised. The WMP contained within Technical Schedule TS3 provides an outline of the minimum requirements to be contained within the Contractor's detailed WMP. TS3 also provides an outline of the anticipated waste management procedures and routes that may apply during construction. In preparation of the detailed WMP, the Contractor will liaise the local authority and relevant bodies to determine requirements for, and obtain, licenses and |

| | | |
|---|---|---|
| | | consents associated with waste management and foul water discharge from the site where appropriate. |
| TS 4 | Watercourse Crossing Plan (WCP) | The Contractor will carry out a detailed survey of all watercourse crossings at the detailed design stage and prepare a detailed Watercourse Crossing Plan. The Contractor is responsible for liaison with the OPW to determine all authorisations required. |
| TS 5 | Induction Schedule | The Contractor is required to produce detailed Site Induction Procedures |
| TS 6 | Water Quality Monitoring Plan | The Contractor is required to produce a detailed version of the Water Quality Monitoring Plan which shall be submitted to the Local Authority for approval prior to commencement of construction. |
| TS 7 | Noise Management Plan | The Noise Management Plan has been prepared and contains details of the noise management strategies that will be implemented during the construction phase, and to ensure that the sections of the license, relating to noise issues and management, are addressed and enforced at all times during the construction of the proposed development. |

**Table 5.1 List of Technical Schedules**

# APPENDICES

# Appendix A
# Drawings




NOTES:
1. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
2. ALL DRAWINGS TO BE CHECKED BY THE CONTRACTOR ON SITE.
3. ENGINEER TO BE INFORMED OF ANY DISCREPANCIES BEFORE ANY WORK COMMENCES.
4. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS AND SPECIFICATIONS.
5. ALL LEVELS REFER TO ORDNANCE DATUM (MALIN HEAD)

## Legend:

- Ownership Boundary
- Application Boundary (Co. Laois)
- Application Boundary for concurrent application made in Co. Kilkenny
- County Boundary
- Wind Farm Tracks
- Existing Tracks (requiring upgrade)
- Indicative Cable Routes
- Proposed Wind Turbines
- Recorded Way Leave Areas
- Existing Watercourse Shown Thus
- Watercourse Buffer 50m Shown Thus
- Existing Watercourse Crossings Shown Thus
- Proposed Watercourse Crossings Shown Thus
- Proposed Primary Settlement Pond / Lagoon-type sediment trap Shown Thus (Pond 3)
- Proposed Final Settlement Pond / Lagoon-type sediment trap Shown Thus
- Proposed Buffered Outfall Shown Thus
- Proposed Clean Water Drain Shown Thus
- Proposed Dirty Water Drain Shown Thus
- Proposed Check Dam Shown Thus (C-D)
- Proposed Culvert Shown Thus
- Proposed Precast Dished Drainage Channel Shown Thus
- Proposed Silt Fence Shown Thus
- Proposed Lagoon - Type Sediment Trap Shown Thus
- Proposed Spoil Repository Shown Thus (24)



| rev. | modifications | by | chkd | date |
|---|---|---|---|---|
| 05. | Drainage Revised | JB | N.C | 02/17 |
| Layout Ref.: | | | | |
| file | | | | |

client
PINEWOOD WIND FARM

project
PINEWOOD WIND FARM

stage
FURTHER INFORMATION

title
DRAINAGE PLAN

MASTER LAYOUT

scale
1:10,000 @ A1

| surveyed | drawn | checked | date |
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| OSI | J.O.D. | OOC | JAN 2017 |


JENNINGS O'DONOVAN & PARTNERS
CONSULTING ENGINEERS,
FINISKLIN,
SLIGO,
IRELAND.
TEL. +353 (0)71 916 1416
FAX. +353 (0)71 916 1080
Email: info@jodireland.com

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|---|---|---|
| 5538 | S300-SUDS-100 | 05 |

KNOCKARDAGUR

Cooper's hill

Existing Culvert to be Replaced with 1500mm S&S Concrete Pipes- Sizing Subject to OPW approval

Proposed Culvert min size 900mm

Permanent Aremometer Mast

Main Site Compound

Pond 2

Pond 3

Pond 4

Pond 5

Pond 7

Pond 8

Stream Crossing No.3

T01

T02

T03

T04

T05

306.982 m

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| 05. | Drainage Revised | JB | N.C | 02/17 |
| Layout Ref.: | | | | |
| file | | | | |

client: PINEWOOD WIND FARM

project: PINEWOOD WIND FARM

stage: FURTHER INFORMATION

title: DRAINAGE PLAN

LAYOUT DRAWING 1 of 3

scale: 1:2500 @ A1

| surveyed | drawn | checked | date |
|---|---|---|---|
| OSI | J.O.D. | OOC | JAN 2017 |



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CONSULTING ENGINEERS,
FINISKLIN,
SLIGO,
IRELAND.
TEL. +353 (0)71 916 1416
FAX. +353 (0)71 916 1080
Email: info@jodireland.com

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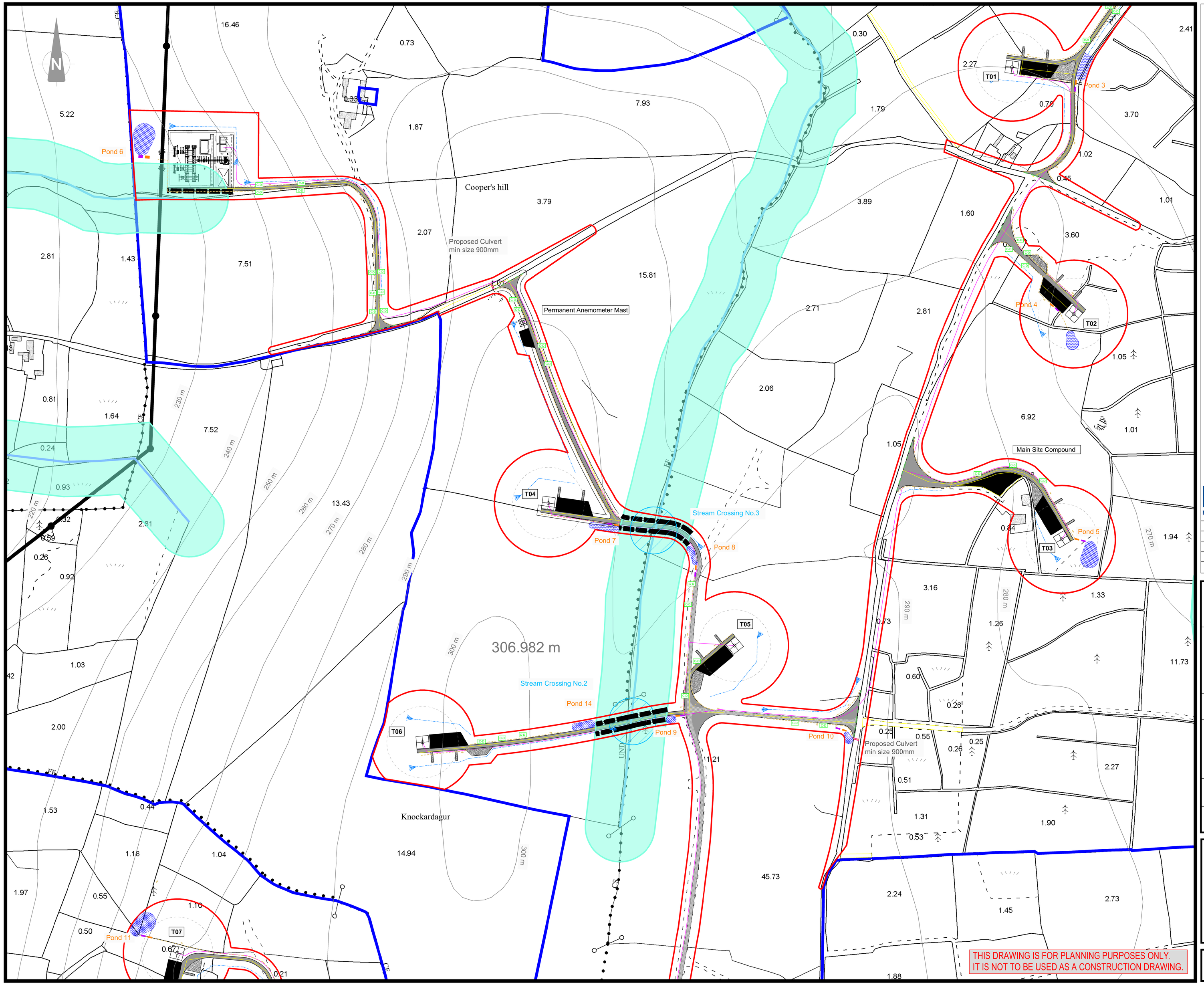


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| file | | | | |

client: PINEWOOD WIND FARM

project: PINEWOOD WIND FARM

stage: FURTHER INFORMATION

title: DRAINAGE PLAN

LAYOUT DRAWING 2 OF 3

scale: 1:2500 @ A1

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CONSULTING ENGINEERS,
FINISKLIN,
SLIGO,
IRELAND.
TEL. +353 (0)71 916 1416
FAX. +353 (0)71 916 1080
Email: info@jodireland.com

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| Layout Ref.: | | | | |
| file | | | | |

client: PINEWOOD WIND FARM

project: PINEWOOD WIND FARM

stage: FURTHER INFORMATION

title: DRAINAGE PLAN

LAYOUT DRAWING 3 OF 3

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CONSULTING ENGINEERS,
FINISKLIN,
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IRELAND.
TEL. +353 (0)71 916 1416
FAX. +353 (0)71 916 1080
Email: info@jodireland.com

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# Appendix B
# Surface Water Management Plan

# PINEWOODS WIND LIMITED

# PINEWOODS WIND FARM

# BALLINAKILL, COUNTY LAOIS

## SURFACE WATER MANAGEMENT PLAN

**February 2017**

**Pinewood Wind Ltd**
Greaghcrottagh,
Tullyco,
Cootehill,
Co Cavan.

**Jennings O'Donovan & Partners Limited,**
Consulting Engineers,
Finisklin Business Park, Sligo.
Tel.: 071 - 916 1416
Fax: 071 - 916 1080
e mail: info@jodireland.com

*JENNINGS O'DONOVAN & PARTNERS LIMITED*
*Project, Civil and Structural Consulting Engineers,*
*FINISKLIN BUSINESS PARK,*
*SLIGO,*
*IRELAND.*

Telephone (071) 91 61416
Fax (071) 91 61080

Email info@jodireland.com
Web Site www.jodireland.com

# DOCUMENT APPROVAL

| | | |
|---|---|---|
| **PROJECT** | Pinewood Wind Farm, Ballinakill, Co. Laois. | |
| **CLIENT / JOB NO** | Pinewood Wind Limited | 5538 |
| **DOCUMENT TITLE** | Surface Water Management Plan | |

| | **Prepared by** | **Reviewed/Approved by** |
|---|---|---|
| Document<br>DRAFT | Name<br>Nuala Carr | Name<br>David Kiely |
| Date | Signature | Signature |

| | **Prepared by** | **Reviewed/Approved by** |
|---|---|---|
| Document<br>Final | Name<br>Nuala Carr | Name<br>David |
| Date<br>6th February 2017 | Signature<br>  | Signature<br>  |

# TABLE OF CONTENTS

# APPENDICES

## APPENDIX A - RAINFALL DATA AND GREEN FIELD RUNOFF RATE

## APPENDIX B – SETTLEMENT POND CALCULATIONS

## APPENDIX C – FIGURES

## APPENDIX D – SITE LAYOUT DRAWINGS

## APPENDIX E – ALTMULLER AND DETTMER (2006)

# 1 INTRODUCTION

## 1.1 Location and Land use

Pinewood Wind Farm site straddles the county boundary between County Laois and County Kilkenny, in the townlands of Knockardugar, Boleybawn, Garrintaggart, Ironmills (Kilrush) and Graiguenahown, County Laois and Crutt, County Kilkenny. The nearest towns are Abbeyleix, approximately 8km north-west and Castlecomer, approximately 8km south-east. The village of Ballinakill is approximately 4km south-west of the site. Please refer to Figure 1.1 Pinewood Wind Farm Site location.

The topography in the wider environs of the subject site is dominated by the upland area known as the Castlecomer Plateau, characterised by undulating hills and steep escarpments at its fringes. Dissecting the lowlands on either side of the plateau are the rivers Barrow and Nore, which lie to the east and west respectively. The lowlands are a mixture of pasture and tillage with fields typically bordered by mature broadleaf tree lines and hedgerows. Agricultural land uses extend into the upland areas in the form of more marginal grazing with scrubby hedgerow field boundaries. Extensive commercial conifer plantations emerge on higher slopes and throughout the Castlecomer Plateau. There are also occasional small patches of woodland associated with demesne landscapes within the lowlands, as well as narrow strips of riparian vegetation at the margins of streams and rivers. A number of quarries are also present in the wider area. The site itself is located on a generally flat section of ridgeline at the north-western edge of the Castlecomer Plateau and contains a mixture of pastoral farming, commercial conifer plantation and scrub, where forest harvesting has taken place.

The site ranges in elevation from approximately 190m to 300m above sea level. The area of the site landholding is approximately 351.8 ha (351,800m$^2$), while the red line boundary is 39.89 ha (398,900m$^2$). It is intended to construct a wind farm with 11 no. wind turbine generators, each with a maximum height of up to 136.5 m, plus all associated site development and ancillary works, including a 110kV electricity substation, switchroom and equipment compound, two single circuit strain towers with a maximum height of up to 26.5m, turbine foundations, crane hardstandings, 7.4 km of site access tracks (approximately 2 km of which is in Co Kilkenny),

underground electricity and communications cabling, site drainage works, 7 no. site entrances, a permanent meteorological mast with a maximum height of up to 85m, and a temporary upgrade to the R430/L7800 road junction.

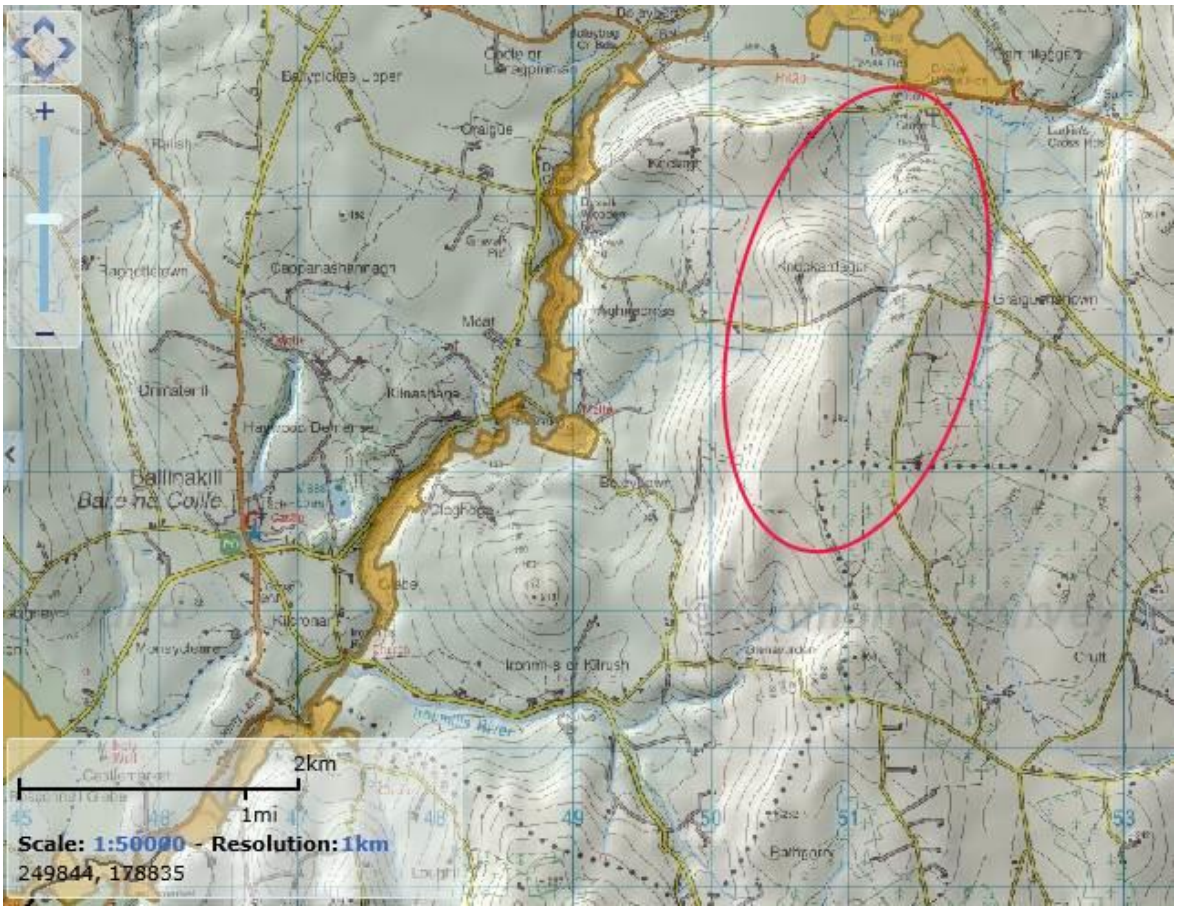



**Figure 1.1 Pinewood Wind Farm Site Location**

## 1.2 Background

Jennings O'Donovan & Partners Ltd. (JOD&P) were commissioned by Galetech Energy Services to respond to several items outlined in a Request for Further Information from Laois County Council. This report is in response to Item 7 (e) of the Further Information Request, which states:

*"A detailed drainage design shall be carried out for the proposed development. During times of heavy downpours, the rain water will flow downhill on either side of the proposed access road in the drainage ditches and calculations of this flow is required and a drainage system designed with a suitable out-fall. This may or may*

*not result in drainage piping or a culvert being installed across under the L7800. The applicant will need to survey the drains or streams the proposed drainage waters are to be directed to, to ensure the drainage system is capable of taking the extra volumes and not cause flooding downstream of the development. An allowance for the extra rain water runoff from the forest should be taken into account as this proposed access road will have the effect of providing increased drainage of the forest as well as intercepting a number of other drains in the forest and redirecting them towards the access junction. This is necessary to stop water crossing the L7800 during times of heavy rainfall which could cause a hazard to motorists using the road."*

Through the utilisation and implementation of SuDS, JOD&P have determined that the drainage design for the development and associated infrastructure, will mitigate any likely significant risk to the hydrological regime of the site and there is reasonable scientific certainty that, with full implementation of all of the measures proposed, that there will be no impact on any designated European sites having regards to their conservation objectives.

The development of tracks and cable trenches has the potential to alter natural drainage on the site by the development of preferential flow pathways. There will be no effect on the total quantity of water flowing off the site, but the speed of run-off may be increased with the potential for erosion, transportation of sediment and local flooding. These potential effects will be mitigated with the appropriate use of SuDS.

### *1.2.1 Existing Data*

As part of the Environmental Impact Assessment, a comprehensive site investigations comprising trial pits and gouge cores were undertaken by Hydro Environmental Services (HES).

In summary, site investigations included the following:

- Trial pits (13 no.) were undertaken at (or in the proximity of) the proposed turbine and access road locations to investigate overburden thickness and subsoil and bedrock lithology;

- Where a trial pit could not be undertaken at the exact proposed location of a turbine due to access issues, a gouge core was undertaken instead to investigate the subsoil lithology;
- Logging of bedrock outcrops and subsoil exposures;
- Mineral subsoils and peat were logged according to BS: 5930 and Von Post Scale respectively; and,

## 1.3 Hydrology

Pinewood Wind Farm site is located in the Nore River surface water catchment within Hydrometric area 15 of the South Eastern River Basin District (SERBD). A regional hydrology map is shown as Figure 1.2. Populations of Freshwater Pearl Mussel are known to exist in the River Nore catchment. The drainage system has been designed to entirely remove any risk to Freshwater Pearl Mussel and their habitat from siltation.

In terms of local hydrology, the proposed development site is situated within the Owenbeg River and the Dinin River surface water catchments. The Owenbeg River flows in southerly direction approximately 2km west of the site while the Dinin River flows in a southerly direction approximately 6km southeast of the site. A local hydrology map is shown as Figure 1.3.

In terms of the proposed development, all of the proposed 11 no. turbines are located in the Owenbeg River catchment. A section of access road is located within the Dinin River catchment.

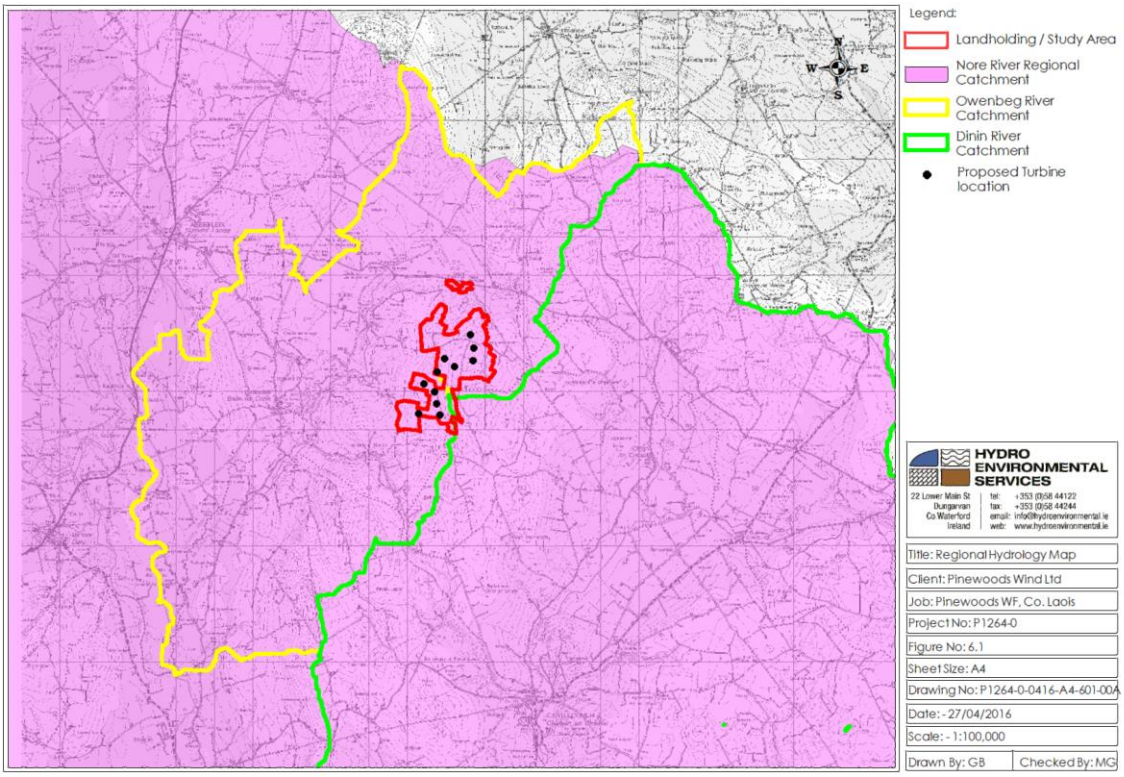



**Figure 1.2 Regional Hydrology**

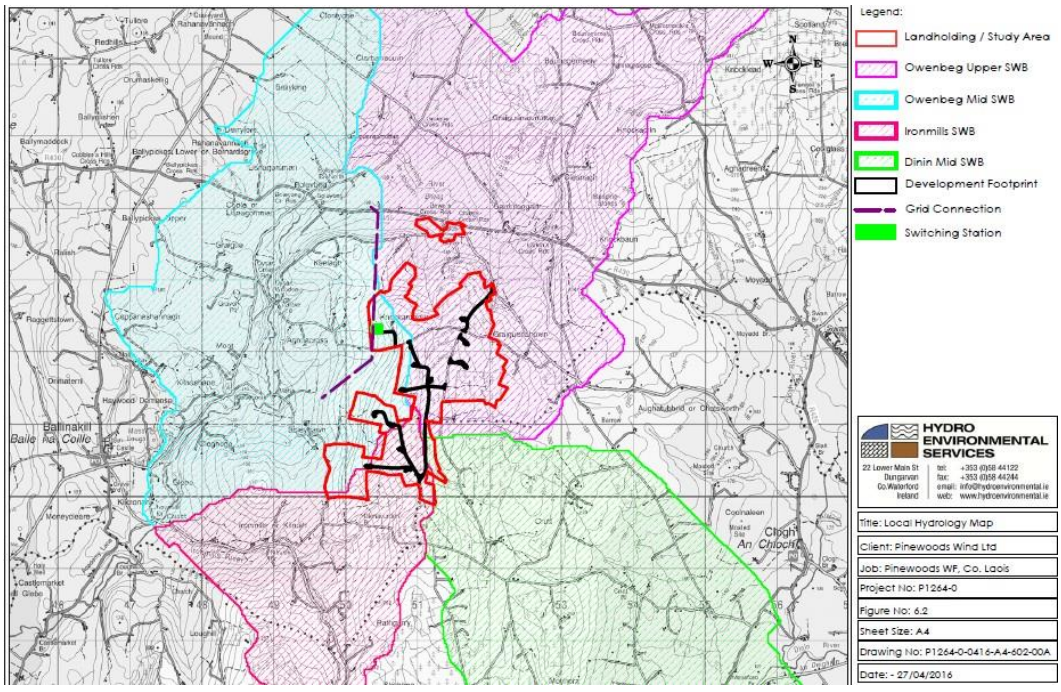



**Figure 1.3 Local Hydrology**

## 1.4 Geology

Based on the GSI bedrock map the bedrock units underlying the proposed development site comprises Namurian shales and sandstones and Westphalian shales and sandstones. The Castlecomer Plateau, of which this area is a part, is a broad gentle syncline (V-shaped fold) in which the rock strata generally dip towards the centre. The Plateau is then subdivided into a series of compartments by NE-SW and NW-SE trending faults. There are no mapped faults in the area of the proposed development. A bedrock geology map of the area is illustrated in Figure 1.4.

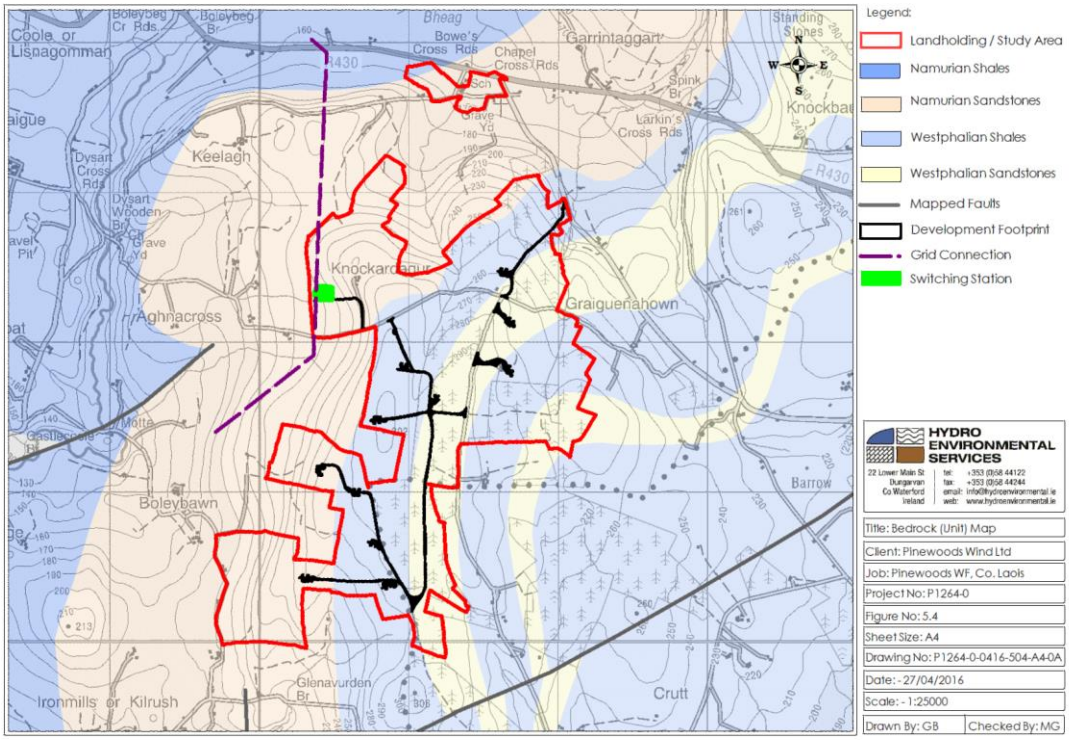



**Figure 1.4 Bedrock Geology Map**

Trial pits (13 no.) were undertaken at (or in the proximity of) the proposed turbine and access road locations to investigate overburden thickness and subsoil and bedrock lithology. Both shale and sandstone bedrock was encountered in the trial pits. Evidence of coal was noted within the shale bedrock at turbine T3. The upper profile of the shale bedrock was found to be generally weathered or very soft with excavation of the shale being possible with the excavator bucket. The sandstone bedrock was generally noted to be more competent with the exception of trial pit

locations TP08 and TP09 where soft sandstone was proved down to a depth of 4.5m below ground level.

The depth to bedrock at the proposed development site is between 0.3 and 2m. The bedrock is poorly exposed within the proposed development site.

The published soils map (www.epa.ie) for the area shows that poorly draining mineral soil (AminPD), deep well draining mineral soil (AminDW) and shallow mineral soil (AminSW) are the dominant soil types at the site. (refer to **Figure 1.5**). The majority of the proposed turbines are located in areas mapped as AminDW or AminSW. Other soil types mapped in the site include shallow poorly draining soil (AminSP) and blanket peat. Blanket peat is mapped on an area of elevated ground east of turbine locations T6 and T8.

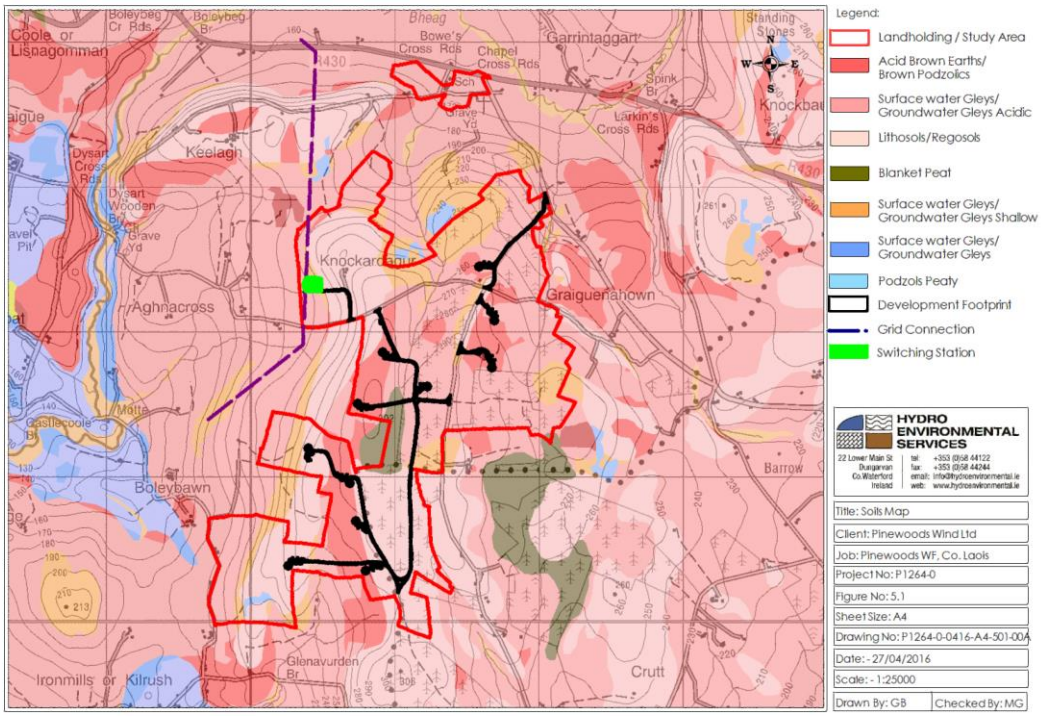



**Figure 1.5 Soils Map**

A map of the local subsoil cover is illustrated in **Figure 1.6** (www.gsi.ie). This indicates that the proposed site is predominately underlain by Namurian sandstone and shale tills. Bedrock is mapped close or at the surface on the more elevated areas of the site and along steep, lower-lying sections particularly on the western facing

slopes of the site. A localised section of blanket peat is mapped on an area of elevated ground east of turbine locations T6 and T8.

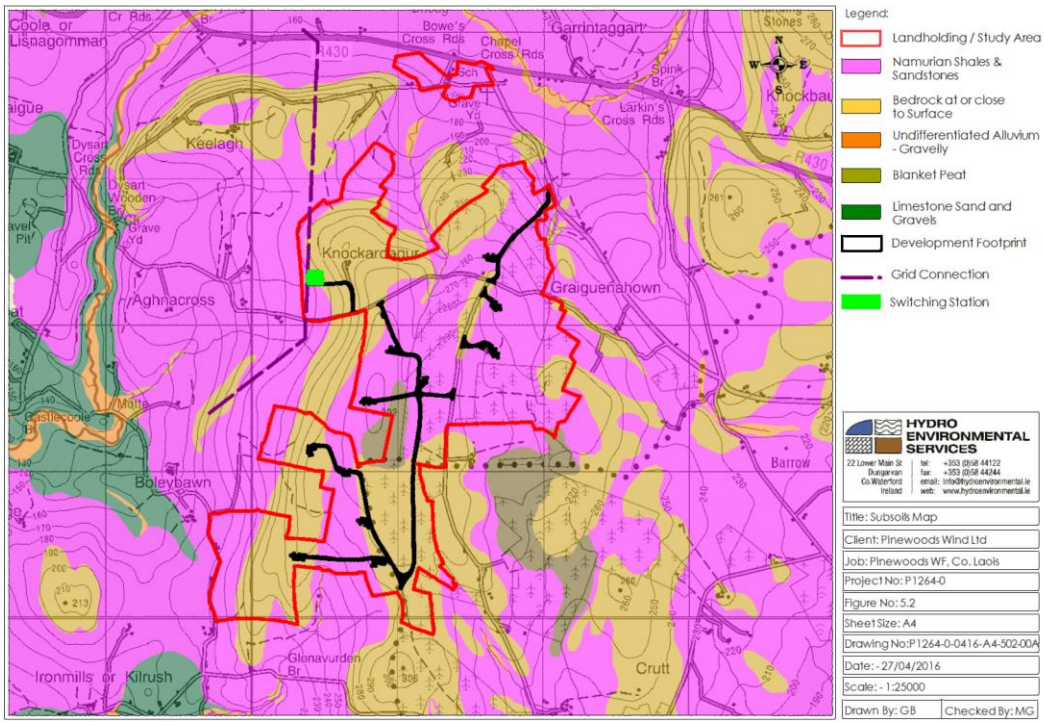



**Figure 1.6 Subsoils Map**

Sandstone or shale tills were encountered at all of the trial pit locations and the till subsoil typically comprised firm SILT/CLAY or CLAY. The regular occurrence of CLAY subsoils and the general absence of sand as a subcomponent (*i.e.* sandy SILT/CLAY) would suggest the parent material of the subsoils in this area is predominately shale bedrock. However, silty sand was encountered in trial pits TP08 and TP09 which is a sandstone till.

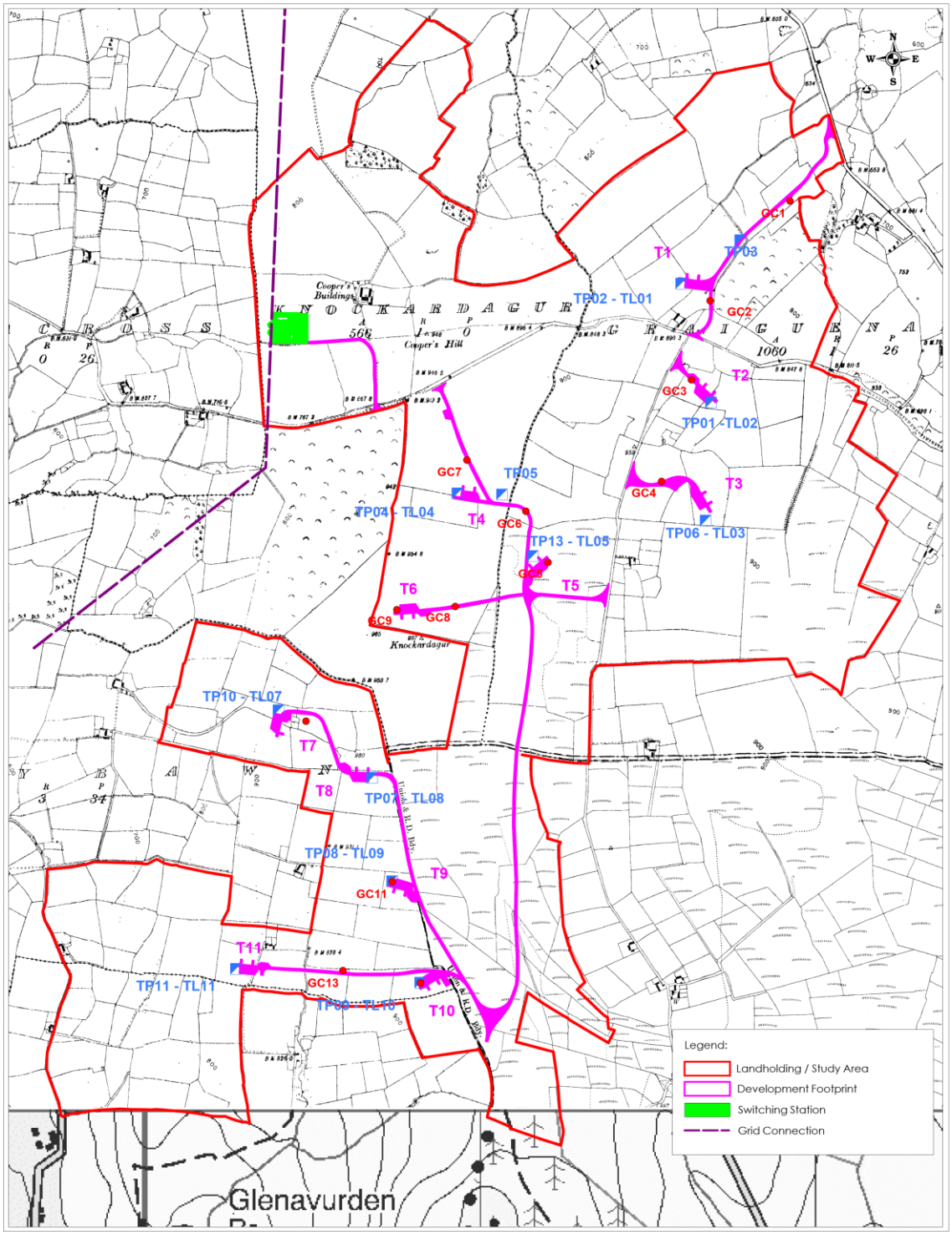
Peat with an approximate thickness of 0.5m was encountered in trial pits TP08, TP09 and TP13. TP08 and TP09 were carried out just off the forestry access road east of turbine locations T9 and T10. TP13 was undertaken 50m west of turbine location T5. Peat with an approximate thickness of 1m and 1.7m was encountered at gouge core locations GC5 and GC9 respectively which were undertaken at respective turbine locations T5 and T6. Peat was also encountered on proposed sections of access road between T5 – T6 (GC8) and T4 – T5 (GC6). The peat coverage is relatively

consistent with the GSI mapping which shows blanket peat mapped in the central section of the landholding, albeit based on the site investigation data the peat does exist further south and west than shown by the GSI mapping. Outside of the localised blanket peat area, the till subsoils were typically overlain by mineral topsoil in areas of agricultural land and thin peaty/organic topsoil in forestry areas. Only turbine locations T5 and T6 were found to have blanket peat present.

Based on the trial pits undertaken, the overall subsoil thickness within the proposed development site varies between 0.3 and 2m. An undefined transition zone between the subsoils and bedrock was noted in some areas that existed over weathered shale bedrock. The transition zone between the subsoil and bedrock was generally more defined where sandstone bedrock was encountered and this was due to the less weathered state of the sandstone.

| ***Trial Pit Name*** | ***Location*** | ***Primary Subsoil Lithology*** | ***Depth to Bedrock (m)*** |
|---|---|---|---|
| TP01 (T2) | Turbine location 2 | Firm CLAY – CLAY/SILT | 1.2 |
| TP02 (T1) | Turbine location 1 | Soft to firm SILT/CLAY | 0.3 |
| TP03 | Access road north Of T1 | Firm CLAY/SILT over very firm CLAY | 0.75 |
| TP04 (T4) | Turbine location 4 | Soft to firm SILT over firm sandy SILT/CLAY | 0.8 |
| TP05 | Access road north Of T4 | Soft to firm sandy SILT | 2.0 |
| TP06 (T3) | Turbine location 3 | Soft to firm CLAY | 0.9 |
| TP07 (T8) | 15m north of T8 | Soft to firm SILT over firm CLAY | 1.6 |
| TP08 (T9) | 60m east of T9 | PEAT over dense silty SAND | 1.3 |
| TP09 (T10) | 100 east of T10 | PEAT over dense silty SAND | 2.0 |
| TP10 (T7) | Turbine location 7 | Firm, gravelly SILT/CLAY | 1.2 |
| TP11 (T11) | Turbine location 11 | Firm SILT/CLAY | 1.1 |
| TP12 | Off forestry track | Soft to firm sandy SILT | 1.2 |
| TP13 (T05) | 50m west of T5 | Soft to firm CLAY | 1.9 |

**Table 1.1 Summary of Trial Pit Investigations**




| | | |
|---|---|---|
| Client: Pinewoods Wind Ltd | Drawing No: P1264-0-0416-A3-503-00A | |
| Job: Pinewoods WF Co. Laois / Kilkenny | Sheet Size: A3 | Project No: P1264 |
| Title: Site Investigation Map | Scale: - 1:10000 | Drawn By: DB |
| Figure No: 5.3 | Date: - 27/04/2016 | Checked By: MG |

HYDRO ENVIRONMENTAL SERVICES
22 Lower Main St, Dungarvan, Co.Waterford, Ireland
tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

**Figure 1.7 Site Investigations Map**

| Location | Easting | Northing | Soil/subsoil Description |
|---|---|---|---|
| GC1 | 251,928 | 182,708 | soil over SILT/CLAY |
| GC2 | 251,690 | 182,410 | Organic soil over SILT |
| GC3 | 251,634 | 182,174 | Organic soil over SILT |
| GC4 | 251,545 | 181,870 | Mineral soil over SILT/CLAY |
| GC5 | 251,206 | 181,628 | 1m PEAT over CLAY |
| GC6 | 251,140 | 181,781 | 0.3m PEAT over SILT/CLAY |
| GC7 | 250,964 | 181,934 | Mineral soil over SILT/CLAY |
| GC8 | 250,929 | 181,497 | 0.6m PEAT over SILT/CLAY |
| GC9 | 250,755 | 181,487 | 1.7m PEAT over SILT/CLAY |
| GC10 | 250,484 | 181,154 | Organic soil over SILT/CLAY |
| GC11 | 250,742 | 180,675 | Peaty topsoil over SILT/CLAY |
| GC12 | 250,826 | 180,372 | Peaty topsoil over SILT/CLAY |
| GC13 | 250,595 | 180,409 | Mineral soil over SILT/CLAY |

**Table 1.2 Summary of Soil/Subsoil Gouge Cores**

## 1.5 Hydrogeology

The Westphalian sandstones which are mapped to underlie the central section of the subject site are classified by the GSI (www.gsi.ie) as a Locally Important Aquifer, bedrock which is generally moderately productive (Lm).

The Westphalian shales and Namurian sandstones, which underlie the remainder of the subject site, are classified as a Poor Aquifer, having bedrock which is generally unproductive except for local zones (Pl / Pu).

The shales and sandstones that underlie the site generally have an absence of inter-granular permeability, and most groundwater flow is expected to be in the uppermost part of the aquifer comprising a broken and weathered zone typically less than 3m thick, a zone of interconnected fissuring 10m thick, and a zone of isolated poorly connected fissuring typically less than 150m.

# 2 REFERENCE INFORMATION

## 2.1 Legislative Background

This report is carried out in accordance with the following legislation:

- S.I. 10 of 1972 Dangerous Substances Act, 1972, as amended
- S.I. No. 293 of 1988 Quality of Salmon Water Regulations
- S.I. No. 249 of 1989 Quality of Surface Water Intended for Abstraction (Drinking Water)
- S.I. No. 94 of 1997 European Communities (Natural Habitats) Regulations
- S.I. No. 41 of 1999 Protection of Groundwater Regulations
- Water Framework Directive (2000/60/EC)
- S. I. No. 600 of 2001 Planning and Development Regulations 2001, as amended
- S.I. No. 722 of 2003 European Communities (Water Policy) Regulations
- S.I. 547 of 2008 European Communities (Environmental Liability) Regulations
- S.I. No. 272 of 2009 European Communities Environmental Objectives (Surface Waters) Regulations
- S.I. No. 9 of 2010 European Communities Environmental Objectives (Groundwater) Regulations 2010
- S.I. No. 350 of 2014 European Union (Water Policy) Regulations 2014

## 2.2 Construction Industry Research and Information Association (CIRIA) – Guidance Manuals

- CIRIA (Construction Industry Research & Information Association) Report C502 Environmental Good Practice on Site

- CIRIA 521 - Sustainable Urban Drainage Systems; Design Manual for Scotland and Northern Ireland
- CIRIA Report C532 Control of Water Pollution from Construction Sites
- CIRIA Report C648 Control of Pollution from Linear Construction Project. Technical Guidance
- CIRIA Handbook C650 Environmental good practice on site
- CIRIA Handbook C651 Environmental good practice on site checklist
- CIRIA Report C609 - SuDS - hydraulic, structural & water quality advice
- CIRIA Report C697 - The SuDS Manual
- Guidelines on Protection of Fisheries during Construction Work in and Adjacent to Water (Inland Fisheries Ireland, January 2016).

# 3 DRAINAGE SYSTEM OVERVIEW

## 3.1 SuDS Drainage Design Criteria

The design criteria for the SuDS design are as follows:

- To minimise alterations to the ambient site hydrology and hydrogeology. To provide settlement and treatment controls as close to the site footprint as possible and to replicate, where possible, the existing hydrological environment of the site.

- To minimise sediment loads resulting from the development run-off during the construction phase.

- To preserve greenfield runoff rates and volumes.

- To strictly control all surface water runoff such that no silt or other pollutants shall enter watercourses and that no artificially elevated levels of downstream siltation or no plumes of silt arise when substratum is disturbed .

- To provide appropriate retention times such that and no flooding will occur on local roads in the vicinity of the proposed development site which may cause a traffic hazard and no additional drainage no drainage piping or culverts are required to installed across or under the local roads.

- To provide settlement ponds to encourage sedimentation and storm water runoff settlement.

- To provide lagoon-type sediment traps which follow a design outlined by Altmuller and Dettmer (2006). The tertiary treatment system of the lagoon maturation ponds will absorb the fine particles, which may not settle in the primary and secondary settlement ponds.

- To reduce stormwater runoff velocities throughout the site to prevent scouring and encourage settlement of sediment locally.

- To manage the problems of erosion and allow for the effective revegetation of bare surfaces.

- To control water within the site and allow for the discharge of runoff from the site within the limits prescribed in the Freshwater Pearl Mussel and Salmonid Regulations.

## 3.2 SuDS Design Philosophy

The approach to treatment and attenuation of storm water is as follows:

- Additional drainage measures will only be added as necessary. The dimensions of these features will avoid intercepting large volumes of water.

- Storm water runoff from hardstandings and roads will be managed via filter drains consisting of open land drains, swales and settlement ponds/lagoon-type sediment traps. Roads and hardstandings will crossfall downslope to mimic the natural drainage patterns of the site.

- Swale/settlement pond vegetation used will be appropriate to the local area.

- Temporary erosion protection together with silt fences may be required until the vegetation becomes established (coir matting or similar).

- Roads and hardstandings will be constructed from aggregate and will not be surfaced with bitumen materials, thus helping to reduce runoff volumes. Therefore a reduced runoff coefficient of 50% is applicable.

- An additional 10% will be included to take account for global warming.

- A large portion of the hardstanding construction will be of single sized stone therefore the pore spacing in the hardstanding and road will also act to store and attenuate water.

- Swales will be primarily used to attenuate water and to encourage discharge into the ground locally.

- Outflow points will be taken from the swales into the existing onsite drainage channels. Silt fences will be maintained at the interface between the proposed and existing drainage channels for the duration of the construction phase.

- Stormwater runoff within the swale will be treated through the provision of small silt fences or check dams, within a range depending on local slope of swale.

- The stone used for the construction of the check dams will be washed graded stone with a size range between approximately 5mm and 40mm.

- Swales will provide a flow route in extreme events to carry water to the existing surface water channels across site. It will be necessary to increase the cross sectional area of the swales further downstream of the footprint as larger volumes of stormwater are conveyed.

- Discharging directly back into the surrounding area will assist in maintaining the hydrological characteristics of the site.

- Vegetation will be reinstated on slopes as early as possible.

- Under track drainage will be provided with associated sumps and silt fences. The under track drainage will provide a means for flows to pass from a swale on the uphill side of the slope to the downhill side of the slope.

- A sump will be required for the turbine to collect dewatering's, water will subsequently be pumped into settlement ponds and allowed to settle prior to discharging into the swales. The general location of the small sump will ensure that they pose minimal health and safety risk to site personnel, particularly whilst constructing the wind turbine rotor blades during the installation process (as this process takes place adjacent to the crane hard standing).

- All swales and ponds will be kept as shallow as possible so that they do not pose any health and safety risk to plant or personnel. Maximum depth of standing water will be limited to 0.75m within the ponds and 0.3m within swales.

- The settlement ponds and lagoon-type sediment traps will be permanent features which will continue to be used during the operational phase of the wind farm.

- Field drains/streams will be piped directly under the track through appropriately sized drainage pipes.

- The Office of Public Works (OPW) will be consulted on all stream crossings through the applications for Section 50 consent, prior to works commencing. The design of these crossings follow guidance from Inland Fisheries Ireland.

- Appropriate site management measures will be taken such that runoff from the construction site is not contaminated by fuel or lubricant spillages.

- There will be no discharge of trade effluent, sewage effluent or contaminated drainage into any watercourse system or ditch.

- The drainage system will be monitored regularly during the construction phase for effectiveness, and cleaned or unblocked if necessary.

### 3.3 Purpose of a SuDS Drainage Design

There is increased potential for water pollution, in particular sedimentation to local watercourses due to the large volumes of spoil and emplacement of stone materials during the construction stage of the project.

The purpose of incorporating a SuDS design is:

- To provide sufficient detail such that water pollution will not occur as a result of construction activities at the site and to minimise the risk of any such occurrence.

- To regulate the rate of surface water run-off downslope to prevent scouring and to encourage settlement of sediment locally.

- To minimise the quantity of sediment laden stormwater and resulting settlement pond sizes by separating "clean" water from the "dirty" development runoff.

## 3.4 Water Buffer Zones

The following buffer zone rules will apply in the development of the site:

Areas not acceptable for stockpiling of excavated material include the following:

- 10m buffer zone around manmade drainage channels

- 50m buffer zone around sensitive surface water features

Areas which will be acceptable for construction activities with mitigation measures:

- Areas within the respective surface water buffer which have previously been passed through by existing tracks which will be updated as part of the wind farm development.

- Additional water crossing points to facilitate the crossing of watercourses (manmade drainage and minor streams).

- A section of the substation.

Works will need to take place inside the buffer zones at certain locations, for example watercourse crossings and the substation site. In such instances, silt fences will be installed around the watercourse to prevent sediment/silt infiltration into the

watercourse and best practice methods will be employed to strictly control all surface water runoff such that no silt or other pollutants shall enter watercourses .

## 3.5 Design Philosophy

The SuDS design must be managed and monitored, at all times and particularly after storm or heavy rainfall and during construction phase environmental auditing. The design rationale is that of an integrated approach where each element of the wind farm infrastructure is assessed for its potential contribution to sediment suspension and the appropriate mitigation measures integrated into the layout design. The design principles are as follows:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Minimise** | → | **Intercept** | → | **Treat** | → | **Disperse** | → | **Dilute** |

***Minimise***

The main principle of this SuDS design is to minimise the volume of 'dirty' water requiring treatment through means of informed, integrated and sustainable drainage design. It achieves this by keeping 'clean' water clean by interception and separation, and by collecting the 'dirty' water and treating it by removing the suspended sediments. The resultant outflow is dispersed across vegetation, and will become diluted through contact with the clean water runoff in the buffer areas before entering site/ roadside drains.

***Intercept***

The key sediment control measure is the separation of construction runoff from the clean water runoff that arises in the undisturbed areas of the site and surrounding lands. This significantly reduces the volume and velocity of dirty water that the sediment and erosion control measures need to deal with. To achieve separation, clean water infiltration interception drains are positioned on the upslope and dirty water swales positioned along the verge, with site surfaces sloped towards dirty water swales. The remainder of this clean water will be regularly piped under both the site roads and dirty water swales to avoid contamination. Piping the clean water regularly under the site roads allows the clean water to follow the course it would have taken

before construction thus mimicking the existing surface water sheet flow pattern of the site.

***Treat, Disperse and Dilute***

The clean water infiltration interceptor drains are positioned upslope of the development footprint, to prevent any mixing of the clean and 'dirty' water. The infiltration interceptor drains redirect the clean water away from the site infrastructure, as best suits the natural topography of each sector. The clean water outflow is then discharged into either, an existing drainage network or dispersed through an area of vegetation where it can percolate into the ground naturally.

In the drawings (5538-S300-SUDS-100 to 5538-S300-SUDS-103), 'dirty water' swales, indicated in brown, collect all incident rainwater that falls on the development infrastructure. These then drain into the primary and secondary settlement ponds. The treated effluent then goes through tertiary treatment in the form of lagoon-type sediment traps to further filter the discharge. Dispersal in this manner has the effect of allowing the smaller particle sizes to be taken up by the vegetation.

## 3.6 Design Considerations

The following issues have been identified in the SuDS design of the development.

- Detailed design of track drainage;
- Detailed design of turbine and hardstanding drainage;
- Requirement for attenuation storage in the form of settlement ponds and lagoon-type sediment traps; and
- Definition of buffer-zones.

# 4 DETAILED DESIGN CONSIDERATIONS

## 4.1 Overview

This SuDS adopts a permanent design for the drainage of the site. The following elements in series are proposed:

- Open Constructed Swales for development run-off collection and treatment;
- Infiltration Interception Drains for upslope "clean" water collection and dispersion;
- Ditches which drain from the proposed area to be felled towards existing surface watercourses will be blocked, and temporary silt traps will be constructed. No direct discharge of such ditches to watercourses will occur. Drains and sediment traps will be installed during ground preparation. Collector drains will be excavated at an acute angle to the contour (~0.3%-3% gradient), to minimise flow velocities. Main drains to take the discharge from collector drains will include water drops and rock armour, as required, where there are steep gradients, and should avoid being placed at right angles to the contour
- Filtration Check Dams to reduce velocities along sections of road which run perpendicular to contours;
- Settlement Ponds and lagoon-type sediment traps to control and store development runoff to encourage settlement prior to discharge, at greenfield runoff rates, to eliminate any risk to Freshwater Pearl Mussel in the River Nore downstream of the proposed development.
- Disturbed Sediment Entrainment Mats (SEDIMATS) in all watercourses draining the site, to provide further level of protection in relation to silt release.

These measures provide a surface water management train that will mitigate any adverse impact on the hydrology of the site and surrounds during the construction phase of the project.

## 4.2 Infiltration Interception Drains

Drainage management will ensure that natural runoff is not permitted to mix with construction runoff from sources such as excavation dewatering or track runoff. Design will ensure that infiltration interceptor drains be installed upslope of development, to intercept and divert clean surface water runoff, prior to it coming in contact with areas of excavation. Design will ensure that natural runoff infiltration interceptor drains are installed ahead of main earthworks.

This is intended to reduce the flow of natural runoff onto any exposed areas of rock and soil, thereby reducing the amount of potential silt laden runoff requiring treatment. Installed drainage will allow provision for natural runoff water, upslope of the development, to collect in infiltration interceptor drains and be directed away from the development. In certain areas it will be required to pass through under track clean water culverts, separate to drainage provided for track runoff, and be discharged downstream of site development, as shown in **Figure 4.3** in **Appendix C**.

Temporary silt / pollution prevention and scour protection measures will be provided in artificial natural runoff drainage installed in order to mitigate potential for scouring and transport of sediment from newly excavated channels which will be formed as part of the construction runoff drainage provisions. All drainage is to be dispersed over vegetated ground.

Frequency of outflow points are designed to avoid collection and interception of large catchments creating significant point flows, with associated risks due to scour and hydraulic capacity.

## 4.3 Linear Track Drainage (Swales)

Where linear track drainage swales are utilised, it is proposed that rock filled check dams will be installed at a regular frequency, in order to reduce flow velocities and improve conditions for the settlement of solids in transit. Check dams will be

constructed from 5-40mm crushed rock locally won, and will constitute the majority of the check dams. It is intended that these dams will be relatively simple to construct but will provide treatment of construction runoff at source. See **Figure 4.1** shown within **Appendix C** which displays a diagrammatic cross section through a swale within the drainage regime. There will be outflow points (spillways) from the swales to the existing onsite drains to preserve the hydraulic efficiency of the site and to prevent ponding of water. No outflow will be permitted directly into natural watercourses.

## 4.4 Flow Attenuation & Filtration Check Dams

The proposed development of Pinewood Wind Farm includes areas where infrastructure and accompanying swales run directly downhill. In such situations, appropriate flow attenuation measures will be installed.

The road will be constructed with an appropriate surface cross slope, so that all storm water flow will be directed towards the constructed grass swales located along both road verges as per **Figure 4.1** within **Appendix C**. The width and depth of constructed swales will be minimised as far as practical in order to reduce ground disturbance, excavation footprint (and hence volume of excavated materials) and also disruption of local hydrology as far as possible.

Permanent check dams (flow barriers or dams constructed across the drainage channel) will be installed at regular intervals within clean water and dirty water cut off drains in order to reduce erosion and allow for greater flow control. Please refer to **Figure 4.1** for details. These check dams are required in order to reduce the velocity of water and therefore allow settlement of coarser sediment particles as well as silt at low flow conditions. Reduction in flow velocity will also prevent scouring of the drainage channel itself.

These dams will be fixed in place to the downstream face of weir over notched out area. Bontec is the geotextile material being employed. It will be replaced during the peak periods of silt runoff (i.e. the construction phase). The number and location of check dams will be dependent on the slope, flow and volume of water, although the following general rules will be applied:

- The maximum spacing between check dams should be such that the toe of the upstream dam is at the same elevation as the top of the downstream dam;

- The centre of the check dam should be at least 0.2m lower than the outside edges;

- Side slopes should be 1:2 or less;

- Check dams should be keyed at least 0.1m into the drainage channel bottom in order to prevent the dam washing out; and

- Check dams will be maintained and monitored on a regular basis. Sediment should be removed before it reaches one half the original dam height.

As a Rule of Thumb; the maximum spacing between check dams should be such that the toe of the upstream dam is at the same elevation as the top of the downstream dam.

Worked examples:

- The depth of a check dam is 0.3m high:

  => 0.3m x (1 in 100 gradient) = 30m spacing;

  => 0.3m x (1 in 50 gradient) = 15m spacing.

- For a 0.5m high check dam:

  => 0.5m x (1 in 50 gradient) = 25m spacing.

See **Table 4.1** for recommended spacing, relative to the gradient of swale, for a 0.3m high check dam.

| Max Spacing (m) | Gradient |
|---|---|
| 3m | 10% (1 in 10) |
| 4m | 8% (1 in 13) |
| 5m | 6% (1 in 17) |
| 6m | 5% (1 in 20) |
| 8m | 4% (1 in 25) |
| 10m | 3% (1 in 33) |
| 15m | 2% (1 in 50) |
| 20m | 1.5% (1 in 67) |
| 30m | 1% (1 in 100) |
| 40m | 0.75% (1 in 133) |

**Table 4.1 Check Dam Spacing for typical 0.3m high check dam**

Note: **Table 4.1** spacing only applies to check dams with a **0.3m height**. The spacing between check dams increase if the check dam height increases.

## 4.5 Settlement Ponds

Runoff from large hardstanding areas such as the site compound, turbine hardstandings and substation will be attenuated to mimic natural runoff patterns. To capture runoff generated within the development footprint it is proposed to use Constructed Grassed Swales. Swales will be utilised to attenuate water and to encourage discharge into the ground locally and will also act as a conduit for any rainfall during the emplacement of the rock fill base for the hard standing infrastructure for the turbines. Accumulations of runoff will then be transferred to settlement ponds, where the flow velocity will reduce to allow sediment and silt to be deposited. From the settlement ponds the water will flow through a tertiary treatment system, based on a design from Altmuller and Dettmer (2006), of lagoon-type sediment ponds which will absorb the fine particles that may not settle in the primary and secondary settlement ponds. See **Figure 4.1** shown within **Appendix C** which displays a diagrammatic cross section through a settlement pond within the drainage regime. All swales and ponds will be kept as shallow as possible so that they pose no health and safety risk to plant or personnel. Maximum depth of standing water will be limited to 0.75m within the settlement ponds.

The settlement ponds are utilised to attenuate rain water runoff rates to that of existing green field rates. In addition the ponds shall aid the removal of suspended solids from site runoff water. Please refer to **Figure 4.1** for details of settlement

ponds. All the pond locations are displayed within the Appendix D site layout Drawings 5538-S300-SUDS-100 up to 5538-S300-SUDS-103. Settlement ponds will be emplaced at 14 locations along the drainage footprint.

Calculation parameters for the determination of storage requirements have been undertaken and are as follows:

- A 1 in 100 year rainfall return design (Source: Met Eireann - Please refer to **Appendix A**).

- Greenfield run-off rate for the site was calculated using the Qbar method. Within the 100 storm event the expected current Greenfield runoff rate should be 9.05l/hectare/second (Source: HR Wallingford – Please refer to **Appendix A**).

- The rational method is subsequently applied to calculate the flow volumes into each settlement pond over these respective periods. The Rational Method is expressed by the formula $V = 2.78 \cdot C \cdot A \cdot I \cdot t$, where V is the volume of water generated in the settlement pond, C is the run-off co-efficient, A is the area of the hardstanding / catchment, I is the rainfall depth and t is the duration of rainfall occurrence.

- Particle settlement has been calculated using Stokes Law, based on particle size of 0.08mm.

- A runoff coefficient of 0.5 (50% for runoff) is conservatively applied to all footprint areas.

- An addition allowance of 10% has been applied with respect to climate change.

| Pond Ref. | Ref. Geometric Drawings | Coordinate | Contributing Area ($m^2$) | Dim. length (m) | Dim. Width (m) | Dim. Depth (m) | Overall Volume of Attenuation Pond ($m^3$) | Settling Velocity m/s < 0.0016 | Settling Duration Hours > 4hrs |
|---|---|---|---|---|---|---|---|---|---|
| Pond 1 | Main site access road to T1 | 252,017mE, 182,899mN | 2080 | 15.4 | 2.8 | 0.75 | 32.3 | 0.0008964 | 4.772277 |
| Pond 2 | Main site access road to T1 | 252,793mE, 182,617mN | 1330 | 11 | 2.5 | 0.75 | 20.6 | 0.0006444 | 4.742001 |
| Pond 3 | Main site access road to T1 | 252,697mE, 182,432mN | 2500 | 16.2 | 3.2 | 0.75 | 38.9 | 0.0009427 | 4.773481 |
| Pond 4 | At T2 | 252,665mE, 182,114mN | 1835 | 15.8 | 2.4 | 0.75 | 28.4 | 0.0009226 | 4.757102 |
| Pond 5 | At T3 | 252,702mE, 182,779mN | 3850 | 15.9 | 5 | 0.75 | 59.6 | 0.0009291 | 4.753534 |
| Pond 6 | At Sub-Station | 250,403mE, 182,275mN | 5697 | 23.6 | 5 | 0.75 | 88.5 | 0.0013749 | 4.768107 |
| Pond 7 | Located between T4 & T5 | 251,074mE, 181,796mN | 1915 | 15.8 | 2.5 | 0.75 | 29.6 | 0.0009243 | 4.748304 |
| Pond 8 | Located Between T4 & T5 | 251,107mE, 181,794mN | 1055 | 13.1 | 2.5 | 0.5 | 16.4 | 0.0007638 | 4.764066 |
| Pond 9 | Located Between T5 & T6 | 251,063mE, 181,517mN | 1493 | 15.5 | 3 | 0.5 | 23.3 | 0.0009008 | 4.779826 |
| Pond 10 | Site access road to T5 | 251,363mE, 181,506mN | 805 | 10.1 | 2.5 | 0.5 | 12.6 | 0.0005828 | 4.81376 |
| Pond 11 | At T7 | 250,357mE, 181,209mN | 4435 | 22.9 | 4 | 0.75 | 68.7 | 0.0013379 | 4.754579 |
| Pond 12 | Located Between T10 & T11 | 250,492mE, 180,405mN | 6350 | 26.5 | 4.95 | 0.75 | 98.4 | 0.0015479 | 4.755405 |
| Pond 13 | Located Between T10 & T11 | 250,492mE, 180,407mN | 2150 | 15 | 2.95 | 0.75 | 33.2 | 0.0008794 | 4.73789 |
| Pond 14 | Located Between T5 & T6 | 251,040mE, 181,519mN | 2600 | 11.9 | 4.5 | 0.75 | 40.2 | 0.0006972 | 4.741288 |

**Table 4.2 Settlement Pond Sizing**

**Table 4.2** identifies settlement ponds designed to treat each development catchment area. Settlement pond 12 has the largest residual volume requirement of 98.4 $m^3$.

## 4.6 Lagoon-type Sediment Traps

In addition to the settlement ponds, a tertiary treatment system will also be designed to absorb any fine particles that may not settle in the primary and secondary settlement ponds. From the settlement ponds the water will flow through lagoon-type sediment ponds which will be designed with a retention time of 10 days. For design of maturation ponds the retention time is generally 5 – 10 days.

From Met Eireann rainfall return periods, the following rainfalls would arise based on a 1 in 100 year return period:

5 Days (by interpolation) – 130.15mm

10 Days – 171.3mm

The 10 day value is 32% higher than the 5 day. The 10 day value is assumed.

Run-off is computed from the formula Q = CIA where

I = Rainfall intensity

A = Area

C = Factor based on degree of impermeability

For unsealed site roads and hardstands, 'C' is generally assumed to be in the range of 0.6 to 0.85. For this report, 0.85 is assumed.

Table 4.3 outlines the volumes computed for each lagoon-type sediment trap:

| Pond Number | Contributing Area | 10-Day Rainfall | "C" | Volume | Depth | Area | Diameter |
|---|---|---|---|---|---|---|---|
| | ($m^2$) | (m) | | ($m^3$) | (m) | ($m^2$) | (m) |
| | | | | | | | |
| 1 | 2080 | 0.1713 | 0.85 | 302.8584 | 0.75 | 403.8112 | 22.67481 |
| 2 | 1330 | 0.1713 | 0.85 | 193.65465 | 0.75 | 258.2062 | 18.13167 |
| 3 | 2500 | 0.1713 | 0.85 | 364.0125 | 0.75 | 485.35 | 24.85891 |
| 4 | 1835 | 0.1713 | 0.85 | 267.18518 | 0.75 | 356.2469 | 21.29757 |
| 5 | 3850 | 0.1713 | 0.85 | 560.57925 | 0.75 | 747.439 | 30.8491 |
| 6 | 5697 | 0.1713 | 0.85 | 829.51169 | 0.75 | 1106.016 | 37.52625 |
| 7 | 1915 | 0.1713 | 0.85 | 278.83358 | 0.75 | 371.7781 | 21.75687 |
| 8 | 1055 | 0.1713 | 0.85 | 153.61328 | 0.75 | 204.8177 | 16.14873 |
| 9 | 1493 | 0.1713 | 0.85 | 217.38827 | 0.75 | 289.851 | 19.21065 |
| 10 | 805 | 0.1713 | 0.85 | 117.21203 | 0.75 | 156.2827 | 14.1062 |
| 11 | 4435 | 0.1713 | 0.85 | 645.75818 | 0.75 | 861.0109 | 33.10998 |
| 12 | 6350 | 0.1713 | 0.85 | 924.59175 | 0.75 | 1232.789 | 39.61858 |
| 13 | 2150 | 0.1713 | 0.85 | 313.05075 | 0.75 | 417.401 | 23.0532 |
| 14 | 2600 | 0.1713 | 0.85 | 378.573 | 0.75 | 504.764 | 25.35121 |

**Table 4.3 Lagoon-type sediment trap sizing**

The design of the lagoon-type sediment traps will be refined prior to construction.

The proposed development site is located in the catchment of the specified Freshwater Pearl Mussel populations as set out in First Schedule of the European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009 (S.I No. 296/2009). Sedimentation poses the biggest threat to the Freshwater Pearl Mussel which is the qualifying interest of the River Barrow and River Nore SAC (Site Code: 002162). All surface water run-off shall be strictly controlled such that no silt or other pollutants enter water courses and that no artificially elevated levels of downstream siltation or no plumes of silt arise when substratum is disturbed in accordance with the Fourth Schedule of the Regulations.

The settlement ponds and lagoon-type sediment traps will be designed to fully meet the requirements outlined in the Natura Impact Statement. These will assist as part of an overall strategy to remove any risk to Freshwater Pearl Mussel in the River Nore downstream of the proposed development. It is also proposed to use Disturbed Sediment Entrainment Mats - SEDIMATS (see http://www.hy-

tex.co.uk/ht_bio_sed.html) in all watercourses draining the site. These will be installed according to the manufacturer's instructions at locations agreed with NPWS and IFI. The use of these mats will provide a further level of protection in relation to silt release. Further information on FMP mitigation can be found in the Construction Environmental Management Plan (CEMP).

## 4.7 Spoil Management

It is understood that excavated spoil is to be side cast adjacent to proposed access track alignments. Areas of stored spoil:

- Will not be permitted within watercourse buffer zones;
- Will not be permitted to obstruct the flow of overland surface water.
- Where areas of spoil storage other than side casting is proposed, formal drainage will be designed on a bespoke basis to allow controlled dewatering and prevent washout of suspended solids to the receiving water environment.

## 4.8 Floated Roads

Anywhere a floating road is indicated by the roads designer, existing drainage routes are not to be altered unnecessarily. Existing drainage routes and overland flow-rates should be maintained through the placement of drainage pipes at existing land drainage locations, unless stated otherwise by the SuDS Designer.

# 5 CONSTRUCTION PHASE MITIGATION

## 5.1 Overview

A process of mitigation by avoidance has been adopted by the design team. A number of best practice SuDS mitigation measures are also proposed to minimise impacts to water quality.

The following measures will be enforced by the appointed Contractor, on site:

- All site personnel should be made aware of their environmental responsibilities at the site.
- Requirements for contractors will include contingency plans to deal with spillages, should they occur.
- Land disturbance will be kept to minimum and disturbed areas will be stabilised as soon as possible.
- In principle, soil excavation should be undertaken during dry periods, whenever possible.
- Site visits by a Design Engineer will be agreed in advance and will be undertaken at various stages of the construction process to ensure that the proposed SuDS scheme is being constructed in line with the design.
- As-built and final inspections to review the SuDS design on site will be provided by the Design Engineer.
- In order to verify the efficacy of pollution prevention and mitigation works during construction, Water Quality Monitoring will be undertaken by a suitably qualified Environmental Manager(s), prior to, during and post completion of construction works. This will include all watercourses within the catchment of the construction area. The monitoring will comprise visual, hydrochemistry and grab sample monitoring. The Water Quality Monitoring

Plan is outlined in Technical Schedule 6 of the Construction Environmental Management Plan.

## 5.2 Working in the Vicinity of Water

The following mitigation measures apply when working within the watercourses or in the vicinity of watercourses.

- Avoid construction near streams in wet weather, whenever possible.
- Stone will be of a local geochemistry i.e. be sourced from one of the nearby quarries.
- No concrete will be used in watercourses.
- Runoff from excavations will not be pumped directly to watercourses. Where dewatering of excavations is required, water shall be pumped to the head of a treatment train (swale or concrete sump in the case of turbine bases) in order to receive full treatment prior to re-entry to the natural drainage system.
- At watercrossings and the substation site, where construction will be carried out within the 50m buffer around watercourses, best practice construction methods will be used to protect the watercourses, such as double silt fencing, sedimats and silt bags. Tool box talks will be given to all staff on the importance of maintaining water quality. Small working areas will be used for better control of sedimentation and all works in these areas will cease during periods of high precipitation and any bare soil will be covered.

## 5.3 Infiltration Interceptor Drains

Install interceptor drains upslope of the works areas, where gradient requires, to separate uncontaminated surface runoff i.e. clean water, and divert it away from the works. All ‘clean water’ drainage is to be dispersed over vegetated ground.

In certain areas it will be required to pass through under track clean water culverts, separate to drainage provided for track runoff, and be discharged downstream of site development, as shown in **Figure 4.3** in **Appendix C.**

## 5.4 Watercourse Crossings

The following general mitigation will be put in place for these watercourse crossings.

- Flow will not be restricted.
- Risk of sedimentation or pollution will be controlled by using best practice construction methods, such as silt fencing.

### *5.4.1 Stream Crossings*

There are 4 no. stream crossings proposed on the Pinewood Wind farm site. Three of these stream crossings are new crossing points and one is existing. See Table 5.1 for the locations of these crossings. The Office of Public Works (OPW) and Inland Fisheries Ireland (IFI) will be consulted on all watercourse crossings through the applications for Section 50 consent prior to works commencing. The design of these crossings will be sized post planning consent and follow guidance from the OPW.

At site entrance 1 (Stream crossing 4 (SX04)), the existing culvert seems to be too small currently and in bad condition. It is proposed to upgrade this culvert to a 1500mm S&S Concrete Pipe. Sizing of this culvert will be subject to OPW approval.

| Crossing Ref. | Approximate Locations | | Culvert Size Dia. (mm) |
|---|---|---|---|
| | Easting | Northing | |
| SX01 | 250479 | 180410 | TBC |
| SX02 | 251056 | 181519 | TBC |
| SX03 | 251092 | 181799 | TBC |
| SX04 | 252044 | 182964 | TBC |

**Table 5.1 Section 50 culvert locations (Diameters to be confirmed)**

### *5.4.2 Proposed Culverts under Local Roads*

Two new culverts are proposed under local roads.

- A new 900mm culvert is proposed from the access road to T4 under the road at Cooper's Hill.

- A new 900mm culvert is proposed from the access road to T5 under the L78001.

Both culverts will be sized post planning consent.

### *5.4.3 Road Cross Drains*

Road cross drains will be installed where required, under the site roads to link roadside swales. These are to be a minimum of 300mm diameter HDPE Twinwall or equivalent approved track drainage pipe.

## 5.5 Settlement Ponds

The following design criteria shall apply to the construction of settlement ponds at the site:

- Install interceptor drains upslope of the works areas, where gradient requires, to separate uncontaminated surface runoff and divert it away from the works.

- Settlement ponds will be lined with Bontec geotextile material.

- Side slopes to be shallow, nominally at a 1 in 3 side slope (maximum).

- Material excavated from the settlement ponds will be compacted around the edge of the pond, which will prevent site personnel from falling into the pond.

- Settlement ponds will be subject to regular inspection and maintenance by the contractor on site.

## 5.6 Lagoon-type sediment traps

The design of the lagoon will be refined prior to construction, following detailed site investigations and topographical survey. They will be irregularly shaped to fit in with

existing depressions in the topography to help retain the discharge, and will be designed for a 10 day retention period. The lagoon-type sediment traps will be designed to fully meet the requirements outlined in the Natura Impact Statement. These will assist as part of an overall strategy to remove any risk to Freshwater Pearl Mussel in the River Nore downstream of the proposed development.

## 5.7 Turbine Bases

Drainage and dewatering from turbine base excavations will be pumped into swales. Delivery trucks, tools and equipment will be cleaned at a designated concrete washout area located within the temporary construction compound. In addition, the following drainage measures will apply:

- Installation of infiltration interception cut-off drains around the working areas will intercept uncontaminated surface runoff and divert it around and away from the works.

- The base of the excavation will be constructed level, and water will be gathered in a sump, and pumped at a low flow rate into a concrete sump.

- The foundation working areas will be re-vegetated as soon as possible after construction.

## 5.8 Control Building and Temporary Construction Compound Area

The following shall apply to the construction of the substation and temporary construction compound at the site:

- During construction of the substation and temporary compounds, similar measures to those implemented during turbine/crane pad construction will be used to limit water ingress, sediment erosion and concrete pollution.

- Infiltration interception drains or similar will be constructed around the substation to ensure ground water levels around the building can be managed and that internal sumps within the building do not become waterlogged.

# 6 OPERATIONAL PHASE - DETAILED CONSIDERATIONS

Collection of surface water for the 39.89 ha development footprint (i.e. red line boundary) of the proposed development, will be through open vegetated swales. Discharge will be via vegetated swales, settlement ponds and lagoon-type sediment traps.

# 7 CONCLUSION

The drainage measures proposed for this eleven turbine development provide a surface water management regime that will mitigate any adverse impact on the hydrology of the site and surrounds during the construction phase of the project.

All drains and streams on and in the vicinity of the proposed development site have been surveyed in detail. By incorporating a SuDS design, all surface water run-off shall be strictly controlled such that no silt or other pollutants enter watercourses and that no artificially elevated levels of downstream siltation or no plumes of silt arise when substratum is disturbed. The drainage design adopts the following temporary works during the construction phase:

- Open Constructed Swales for development run-off
- Infiltration Interception Drains for upslope “clean” water
- Filtration Check Dams to reduce velocities along steeper slopes
- Settlement Ponds and Lagoon-type sediment traps to control and store development runoff and to encourage settlement prior to discharge.
- Greenfield Runoff for the site will not be exceeded and settlement ponds/ Lagoon-type sediment traps have been designed to ensure that the capacity is adequate to achieve this.

In areas of steep slope, tracks will be constructed with an appropriate surface cross slope so as to ensure all storm water flow will be directed towards the constructed roadside swales. The flow will then be directed through filtration check dams and settlement ponds, before being discharged into lagoon-type sediment traps.

The drainage system has been designed to mimic greenfield runoff rates so as to be capable of taking the extra volumes of surface water and not to cause any flooding downstream of the proposed development which could cause a hazard to motorists using the road. An allowance for the extra rain water runoff from the existing forestry activities has been taken into account in the design of the surface water drainage strategy.

At site entrance 1 (Stream crossing 4 (SX04)), the existing culvert seems to be too small currently and in bad condition. It is proposed to upgrade this culvert to a 1500mm S&S Concrete Pipe. Sizing of this culvert will be subject to OPW approval.

Two new culverts are proposed under local roads. A new 900mm culvert is proposed from the access road to T4 under the road at Cooper's Hill. A new 900mm culvert is proposed from the access road to T5 under the L78001. Both culverts will be sized post planning consent.

In order to verify the efficacy of pollution prevention and mitigation works during construction, Water Quality Monitoring will be undertaken by a suitably qualified Environmental Manager(s), prior to, during and post completion of construction works. This will include all watercourses within the catchment of the construction area. The monitoring will comprise visual, hydrochemistry and grab sample monitoring. The Water Quality Monitoring Plan is outlined in Technical Schedule 6 of the Construction Environmental Management Plan.

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 250095, Northing: 183720,

| | Interval | | Years | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| DURATION | 6months, | 1year, | 2, | 3, | 4, | 5, | 10, | 20, | 30, | 50, | 75, | 100, | 150, | 200, | 250, | 500, |
| 5 mins | 2.8, | 3.8, | 4.3, | 5.1, | 5.6, | 6.0, | 7.3, | 8.7, | 9.6, | 10.9, | 12.0, | 12.9, | 14.2, | 15.3, | 16.1, | N/A , |
| 10 mins | 3.8, | 5.2, | 6.0, | 7.0, | 7.8, | 8.3, | 10.1, | 12.1, | 13.4, | 15.2, | 16.8, | 18.0, | 19.8, | 21.3, | 22.5, | N/A , |
| 15 mins | 4.5, | 6.2, | 7.0, | 8.3, | 9.1, | 9.8, | 11.9, | 14.2, | 15.8, | 17.9, | 19.7, | 21.2, | 23.4, | 25.0, | 26.4, | N/A , |
| 30 mins | 6.0, | 8.0, | 9.1, | 10.7, | 11.7, | 12.5, | 15.1, | 17.9, | 19.7, | 22.3, | 24.5, | 26.2, | 28.7, | 30.7, | 32.3, | N/A , |
| 1 hours | 7.9, | 10.5, | 11.8, | 13.7, | 15.0, | 16.0, | 19.1, | 22.5, | 24.7, | 27.7, | 30.3, | 32.3, | 35.4, | 37.7, | 39.6, | N/A , |
| 2 hours | 10.4, | 13.6, | 15.3, | 17.7, | 19.2, | 20.4, | 24.2, | 28.3, | 30.9, | 34.5, | 37.6, | 40.0, | 43.5, | 46.2, | 48.5, | N/A , |
| 3 hours | 12.3, | 15.9, | 17.8, | 20.5, | 22.3, | 23.6, | 27.8, | 32.4, | 35.3, | 39.2, | 42.6, | 45.2, | 49.1, | 52.1, | 54.5, | N/A , |
| 4 hours | 13.8, | 17.8, | 19.8, | 22.8, | 24.7, | 26.1, | 30.7, | 35.6, | 38.7, | 43.0, | 46.6, | 49.4, | 53.6, | 56.7, | 59.3, | N/A , |
| 6 hours | 16.2, | 20.8, | 23.1, | 26.4, | 28.5, | 30.2, | 35.2, | 40.7, | 44.1, | 48.8, | 52.9, | 55.9, | 60.5, | 63.9, | 66.8, | N/A , |
| 9 hours | 19.1, | 24.3, | 26.9, | 30.6, | 33.0, | 34.8, | 40.5, | 46.5, | 50.3, | 55.5, | 59.9, | 63.3, | 68.3, | 72.1, | 75.1, | N/A , |
| 12 hours | 21.5, | 27.1, | 29.9, | 34.0, | 36.6, | 38.5, | 44.7, | 51.2, | 55.3, | 60.8, | 65.5, | 69.1, | 74.4, | 78.5, | 81.7, | N/A , |
| 18 hours | 25.3, | 31.7, | 34.9, | 39.4, | 42.3, | 44.5, | 51.3, | 58.5, | 63.0, | 69.1, | 74.3, | 78.2, | 84.0, | 88.4, | 92.0, | N/A , |
| 24 hours | 28.4, | 35.4, | 38.8, | 43.7, | 46.9, | 49.3, | 56.6, | 64.3, | 69.2, | 75.7, | 81.2, | 85.4, | 91.6, | 96.3, | 100.0, | 112.7, |
| 2 days | 36.5, | 44.6, | 48.5, | 54.0, | 57.5, | 60.2, | 68.2, | 76.6, | 81.8, | 88.7, | 94.6, | 98.9, | 105.4, | 110.2, | 114.1, | 127.1, |
| 3 days | 43.4, | 52.4, | 56.7, | 62.7, | 66.5, | 69.3, | 78.0, | 87.0, | 92.5, | 99.8, | 106.0, | 110.5, | 117.3, | 122.3, | 126.4, | 139.8, |
| 4 days | 49.7, | 59.4, | 64.0, | 70.5, | 74.5, | 77.6, | 86.8, | 96.2, | 102.0, | 109.7, | 116.1, | 120.9, | 128.0, | 133.2, | 137.4, | 151.3, |
| 6 days | 60.9, | 71.9, | 77.2, | 84.4, | 88.9, | 92.2, | 102.4, | 112.7, | 119.0, | 127.4, | 134.3, | 139.4, | 147.0, | 152.6, | 157.0, | 171.7, |
| 8 days | 71.2, | 83.4, | 89.1, | 96.9, | 101.9, | 105.5, | 116.5, | 127.6, | 134.3, | 143.2, | 150.6, | 156.0, | 164.0, | 169.9, | 174.6, | 190.0, |
| 10 days | 80.9, | 94.1, | 100.2, | 108.7, | 113.9, | 117.8, | 129.5, | 141.3, | 148.4, | 157.8, | 165.6, | 171.3, | 179.6, | 185.8, | 190.7, | 206.8, |
| 12 days | 90.2, | 104.3, | 110.8, | 119.8, | 125.4, | 129.5, | 141.8, | 154.2, | 161.7, | 171.6, | 179.7, | 185.6, | 194.4, | 200.8, | 205.9, | 222.6, |
| 16 days | 107.9, | 123.6, | 130.9, | 140.8, | 146.9, | 151.4, | 165.0, | 178.5, | 186.6, | 197.2, | 206.0, | 212.4, | 221.7, | 228.6, | 234.1, | 251.9, |
| 20 days | 124.7, | 141.9, | 149.8, | 160.6, | 167.2, | 172.1, | 186.6, | 201.1, | 209.8, | 221.2, | 230.5, | 237.3, | 247.2, | 254.5, | 260.2, | 279.0, |
| 25 days | 145.0, | 163.8, | 172.5, | 184.2, | 191.4, | 196.7, | 212.4, | 228.0, | 237.3, | 249.4, | 259.3, | 266.6, | 277.1, | 284.8, | 290.9, | 310.7, |

NOTES:
N/A Data not available
These values are derived from a Depth Duration Frequency (DDF) Model
For details refer to:
'Fitzgerald D. L. (2007), Estimates of Point Rainfall Frequencies, Technical Note No. 61, Met Eireann, Dublin',
Available for download at www.met.ie/climate/dataproducts/Estimation-of-Point-Rainfall-Frequencies_TN61.pdf

Pinewood Windfarm Storm Water Calculations

Attenuation Qualities Based 100y Return

Pond 1

| Days | Duration hours | Duration min | Rainfall mm | Area 1 | Runoff m3 (A) | max discharge m3 | amount to be Attenuated m3 (A) |
|---|---|---|---|---|---|---|---|
| | | 5 | 12.9 | 0.208 | 14.7576 | 0.56472 | 14.19288 |
| | | 10 | 18 | 0.208 | 20.592 | 1.12944 | 19.46256 |
| | | 15 | 21.2 | 0.208 | 24.2528 | 1.69416 | 22.55864 |
| | | 30 | 26.2 | 0.208 | 29.9728 | 3.38832 | 26.58448 |
| | 1 | 60 | 32.3 | 0.208 | 36.9512 | 6.77664 | 30.17456 |
| | 2 | 120 | 40 | 0.208 | 45.76 | 13.55328 | 32.20672 |
| | 3 | 180 | 45.2 | 0.208 | 51.7088 | 20.32992 | 31.37888 |
| | 4 | 240 | 49.4 | 0.208 | 56.5136 | 27.10656 | 29.40704 |
| | 6 | 360 | 55.9 | 0.208 | 63.9496 | 40.65984 | 23.28976 |
| | 9 | 540 | 63.3 | 0.208 | 72.4152 | 60.98976 | 11.42544 |
| | 12 | 720 | 69.1 | 0.208 | 79.0504 | 81.31968 | -2.26928 |
| | 18 | 1080 | 78.2 | 0.208 | 89.4608 | 121.97952 | -32.51872 |
| 1 | 24 | 1440 | 85.4 | 0.208 | 97.6976 | 162.63936 | -64.94176 |
| 2 | 48 | 2880 | 98.9 | 0.208 | 113.1416 | 325.27872 | -212.13712 |
| 3 | 72 | 4320 | 110.5 | 0.208 | 126.412 | 487.91808 | -361.50608 |
| 4 | 96 | 5760 | 120.9 | 0.208 | 138.3096 | 650.55744 | -512.24784 |
| 6 | 144 | 8640 | 139.4 | 0.208 | 159.4736 | 975.83616 | -816.36256 |
| 8 | 192 | 11520 | 156 | 0.208 | 178.464 | 1301.11488 | -1122.6509 |
| 10 | 240 | 14400 | 171.3 | 0.208 | 195.9672 | 1626.3936 | -1430.4264 |

Drainage Area 0.208 Hectors
Allowable Discharge 9.05 l/hec/s
Discharge 1.8824

Pinewood Windfarm Storm Water Calculations

Attenuation Qualities Based 100y Return

Pond 2

| Days | Duration hours | Duration min | Rainfall mm | Area 1 | Runoff m3 (A) | max discharge m3 | amount to be Attenuated m3 (A) |
|---|---|---|---|---|---|---|---|
| | | 5 | 12.9 | 0.1335 | 9.471825 | 0.3624525 | 9.1093725 |
| | | 10 | 18 | 0.1335 | 13.2165 | 0.724905 | 12.491595 |
| | | 15 | 21.2 | 0.1335 | 15.5661 | 1.0873575 | 14.4787425 |
| | | 30 | 26.2 | 0.1335 | 19.23735 | 2.174715 | 17.062635 |
| | 1 | 60 | 32.3 | 0.1335 | 23.716275 | 4.34943 | 19.366845 |
| | 2 | 120 | 40 | 0.1335 | 29.37 | 8.69886 | 20.67114 |
| | 3 | 180 | 45.2 | 0.1335 | 33.1881 | 13.04829 | 20.13981 |
| | 4 | 240 | 49.4 | 0.1335 | 36.27195 | 17.39772 | 18.87423 |
| | 6 | 360 | 55.9 | 0.1335 | 41.044575 | 26.09658 | 14.947995 |
| | 9 | 540 | 63.3 | 0.1335 | 46.478025 | 39.14487 | 7.333155 |
| | 12 | 720 | 69.1 | 0.1335 | 50.736675 | 52.19316 | -1.456485 |
| | 18 | 1080 | 78.2 | 0.1335 | 57.41835 | 78.28974 | -20.87139 |
| 1 | 24 | 1440 | 85.4 | 0.1335 | 62.70495 | 104.38632 | -41.68137 |
| 2 | 48 | 2880 | 98.9 | 0.1335 | 72.617325 | 208.77264 | -136.15532 |
| 3 | 72 | 4320 | 110.5 | 0.1335 | 81.134625 | 313.15896 | -232.02434 |
| 4 | 96 | 5760 | 120.9 | 0.1335 | 88.770825 | 417.54528 | -328.77446 |
| 6 | 144 | 8640 | 139.4 | 0.1335 | 102.35445 | 626.31792 | -523.96347 |
| 8 | 192 | 11520 | 156 | 0.1335 | 114.543 | 835.09056 | -720.54756 |
| 10 | 240 | 14400 | 171.3 | 0.1335 | 125.777025 | 1043.8632 | -918.08618 |

Drainage Area 0.1335 Hectors
Allowable Discharge 9.05 l/hec/s
Discharge 1.20818

Pinewood Windfarm Storm Water Calculations

Attenuation Qualities Based 100y Return

Pond 3

| Days | Duration hours | Duration min | Rainfall mm | Area 1 | Runoff m3 (A) | max discharge m3 | amount to be Attenuated m3 (A) |
|---|---|---|---|---|---|---|---|
| | | 5 | 12.9 | 0.25 | 17.7375 | 0.67875 | 17.05875 |
| | | 10 | 18 | 0.25 | 24.75 | 1.3575 | 23.3925 |
| | | 15 | 21.2 | 0.25 | 29.15 | 2.03625 | 27.11375 |
| | | 30 | 26.2 | 0.25 | 36.025 | 4.0725 | 31.9525 |
| | 1 | 60 | 32.3 | 0.25 | 44.4125 | 8.145 | 36.2675 |
| | 2 | 120 | 40 | 0.25 | 55 | 16.29 | 38.71 |
| | 3 | 180 | 45.2 | 0.25 | 62.15 | 24.435 | 37.715 |
| | 4 | 240 | 49.4 | 0.25 | 67.925 | 32.58 | 35.345 |
| | 6 | 360 | 55.9 | 0.25 | 76.8625 | 48.87 | 27.9925 |
| | 9 | 540 | 63.3 | 0.25 | 87.0375 | 73.305 | 13.7325 |
| | 12 | 720 | 69.1 | 0.25 | 95.0125 | 97.74 | -2.7275 |
| | 18 | 1080 | 78.2 | 0.25 | 107.525 | 146.61 | -39.085 |
| 1 | 24 | 1440 | 85.4 | 0.25 | 117.425 | 195.48 | -78.055 |
| 2 | 48 | 2880 | 98.9 | 0.25 | 135.9875 | 390.96 | -254.9725 |
| 3 | 72 | 4320 | 110.5 | 0.25 | 151.9375 | 586.44 | -434.5025 |
| 4 | 96 | 5760 | 120.9 | 0.25 | 166.2375 | 781.92 | -615.6825 |
| 6 | 144 | 8640 | 139.4 | 0.25 | 191.675 | 1172.88 | -981.205 |
| 8 | 192 | 11520 | 156 | 0.25 | 214.5 | 1563.84 | -1349.34 |
| 10 | 240 | 14400 | 171.3 | 0.25 | 235.5375 | 1954.8 | -1719.2625 |

Drainage Area 0.25 Hectors
Allowable Discharge 9.05 l/hec/s
Discharge 2.2625

Pinewood Windfarm Storm Water Calculations

Attenuation Qualities Based 100y Return

Pond 4

| Days | Duration hours | Duration min | Rainfall mm | Area 1 | Runoff m3 (A) | max discharge m3 | amount to be Attenuated m3 (A) |
|---|---|---|---|---|---|---|---|
| | | 5 | 12.9 | 0.1835 | 13.019325 | 0.4982025 | 12.5211225 |
| | | 10 | 18 | 0.1835 | 18.1665 | 0.996405 | 17.170095 |
| | | 15 | 21.2 | 0.1835 | 21.3961 | 1.4946075 | 19.9014925 |
| | | 30 | 26.2 | 0.1835 | 26.44235 | 2.989215 | 23.453135 |
| | 1 | 60 | 32.3 | 0.1835 | 32.598775 | 5.97843 | 26.620345 |
| | 2 | 120 | 40 | 0.1835 | 40.37 | 11.95686 | 28.41314 |
| | 3 | 180 | 45.2 | 0.1835 | 45.6181 | 17.93529 | 27.68281 |
| | 4 | 240 | 49.4 | 0.1835 | 49.85695 | 23.91372 | 25.94323 |
| | 6 | 360 | 55.9 | 0.1835 | 56.417075 | 35.87058 | 20.546495 |
| | 9 | 540 | 63.3 | 0.1835 | 63.885525 | 53.80587 | 10.079655 |
| | 12 | 720 | 69.1 | 0.1835 | 69.739175 | 71.74116 | -2.001985 |
| | 18 | 1080 | 78.2 | 0.1835 | 78.92335 | 107.61174 | -28.68839 |
| 1 | 24 | 1440 | 85.4 | 0.1835 | 86.18995 | 143.48232 | -57.29237 |
| 2 | 48 | 2880 | 98.9 | 0.1835 | 99.814825 | 286.96464 | -187.14982 |
| 3 | 72 | 4320 | 110.5 | 0.1835 | 111.522125 | 430.44696 | -318.92484 |
| 4 | 96 | 5760 | 120.9 | 0.1835 | 122.018325 | 573.92928 | -451.91096 |
| 6 | 144 | 8640 | 139.4 | 0.1835 | 140.68945 | 860.89392 | -720.20447 |
| 8 | 192 | 11520 | 156 | 0.1835 | 157.443 | 1147.85856 | -990.41556 |
| 10 | 240 | 14400 | 171.3 | 0.1835 | 172.884525 | 1434.8232 | -1261.9387 |

Drainage Area 0.1835 Hectors
Allowable Discharge 9.05 l/hec/s
Discharge 1.66068

Pinewood Windfarm Storm Water Calculations

Attenuation Qualities Based 100y Return

Pond 5

| Days | Duration hours | Duration min | Rainfall mm | Area 1 | Runoff m3 (A) | max discharge m3 | amount to be Attenuated m3 (A) |
|---|---|---|---|---|---|---|---|
| | | 5 | 12.9 | 0.385 | 27.31575 | 1.045275 | 26.270475 |
| | | 10 | 18 | 0.385 | 38.115 | 2.09055 | 36.02445 |
| | | 15 | 21.2 | 0.385 | 44.891 | 3.135825 | 41.755175 |
| | | 30 | 26.2 | 0.385 | 55.4785 | 6.27165 | 49.20685 |
| | 1 | 60 | 32.3 | 0.385 | 68.39525 | 12.5433 | 55.85195 |
| | 2 | 120 | 40 | 0.385 | 84.7 | 25.0866 | 59.6134 |
| | 3 | 180 | 45.2 | 0.385 | 95.711 | 37.6299 | 58.0811 |
| | 4 | 240 | 49.4 | 0.385 | 104.6045 | 50.1732 | 54.4313 |
| | 6 | 360 | 55.9 | 0.385 | 118.36825 | 75.2598 | 43.10845 |
| | 9 | 540 | 63.3 | 0.385 | 134.03775 | 112.8897 | 21.14805 |
| | 12 | 720 | 69.1 | 0.385 | 146.31925 | 150.5196 | -4.20035 |
| | 18 | 1080 | 78.2 | 0.385 | 165.5885 | 225.7794 | -60.1909 |
| 1 | 24 | 1440 | 85.4 | 0.385 | 180.8345 | 301.0392 | -120.2047 |
| 2 | 48 | 2880 | 98.9 | 0.385 | 209.42075 | 602.0784 | -392.65765 |
| 3 | 72 | 4320 | 110.5 | 0.385 | 233.98375 | 903.1176 | -669.13385 |
| 4 | 96 | 5760 | 120.9 | 0.385 | 256.00575 | 1204.1568 | -948.15105 |
| 6 | 144 | 8640 | 139.4 | 0.385 | 295.1795 | 1806.2352 | -1511.0557 |
| 8 | 192 | 11520 | 156 | 0.385 | 330.33 | 2408.3136 | -2077.9836 |
| 10 | 240 | 14400 | 171.3 | 0.385 | 362.72775 | 3010.392 | -2647.6643 |

Drainage Area 0.385 Hectors
Allowable Discharge 9.05 l/hec/s
Discharge 3.48425

Pinewood Windfarm Storm Water Calculations

Attenuation Qualities Based 100y Return

Pond 6

| Days | Duration hours | Duration min | Rainfall mm | Area 1 | Runoff m3 (A) | max discharge m3 | amount to be Attenuated m3 (A) |
|---|---|---|---|---|---|---|---|
| | | 5 | 12.9 | 0.5697 | 40.420215 | 1.5467355 | 38.8734795 |
| | | 10 | 18 | 0.5697 | 56.4003 | 3.093471 | 53.306829 |
| | | 15 | 21.2 | 0.5697 | 66.42702 | 4.6402065 | 61.7868135 |
| | | 30 | 26.2 | 0.5697 | 82.09377 | 9.280413 | 72.813357 |
| | 1 | 60 | 32.3 | 0.5697 | 101.207205 | 18.560826 | 82.646379 |
| | 2 | 120 | 40 | 0.5697 | 125.334 | 37.121652 | 88.212348 |
| | 3 | 180 | 45.2 | 0.5697 | 141.62742 | 55.682478 | 85.944942 |
| | 4 | 240 | 49.4 | 0.5697 | 154.78749 | 74.243304 | 80.544186 |
| | 6 | 360 | 55.9 | 0.5697 | 175.154265 | 111.364956 | 63.789309 |
| | 9 | 540 | 63.3 | 0.5697 | 198.341055 | 167.047434 | 31.293621 |
| | 12 | 720 | 69.1 | 0.5697 | 216.514485 | 222.729912 | -6.215427 |
| | 18 | 1080 | 78.2 | 0.5697 | 245.02797 | 334.094868 | -89.066898 |
| 1 | 24 | 1440 | 85.4 | 0.5697 | 267.58809 | 445.459824 | -177.87173 |
| 2 | 48 | 2880 | 98.9 | 0.5697 | 309.888315 | 890.919648 | -581.03133 |
| 3 | 72 | 4320 | 110.5 | 0.5697 | 346.235175 | 1336.37947 | -990.1443 |
| 4 | 96 | 5760 | 120.9 | 0.5697 | 378.822015 | 1781.8393 | -1403.0173 |
| 6 | 144 | 8640 | 139.4 | 0.5697 | 436.78899 | 2672.75894 | -2235.97 |
| 8 | 192 | 11520 | 156 | 0.5697 | 488.8026 | 3563.67859 | -3074.876 |
| 10 | 240 | 14400 | 171.3 | 0.5697 | 536.742855 | 4454.59824 | -3917.8554 |

Drainage Area 0.5697 Hectors
Allowable Discharge 9.05 l/hec/s
Discharge 5.15579

Pinewood Windfarm Storm Water Calculations

Attenuation Qualities Based 100y Return

Pond 7

| Days | Duration hours | Duration min | Rainfall mm | Area 1 | Runoff m3 (A) | max discharge m3 | amount to be Attenuated m3 (A) |
|---|---|---|---|---|---|---|---|
| | | 5 | 12.9 | 0.1915 | 13.586925 | 0.5199225 | 13.0670025 |
| | | 10 | 18 | 0.1915 | 18.9585 | 1.039845 | 17.918655 |
| | | 15 | 21.2 | 0.1915 | 22.3289 | 1.5597675 | 20.7691325 |
| | | 30 | 26.2 | 0.1915 | 27.59515 | 3.119535 | 24.475615 |
| | 1 | 60 | 32.3 | 0.1915 | 34.019975 | 6.23907 | 27.780905 |
| | 2 | 120 | 40 | 0.1915 | 42.13 | 12.47814 | 29.65186 |
| | 3 | 180 | 45.2 | 0.1915 | 47.6069 | 18.71721 | 28.88969 |
| | 4 | 240 | 49.4 | 0.1915 | 52.03055 | 24.95628 | 27.07427 |
| | 6 | 360 | 55.9 | 0.1915 | 58.876675 | 37.43442 | 21.442255 |
| | 9 | 540 | 63.3 | 0.1915 | 66.670725 | 56.15163 | 10.519095 |
| | 12 | 720 | 69.1 | 0.1915 | 72.779575 | 74.86884 | -2.089265 |
| | 18 | 1080 | 78.2 | 0.1915 | 82.36415 | 112.30326 | -29.93911 |
| 1 | 24 | 1440 | 85.4 | 0.1915 | 89.94755 | 149.73768 | -59.79013 |
| 2 | 48 | 2880 | 98.9 | 0.1915 | 104.166425 | 299.47536 | -195.30894 |
| 3 | 72 | 4320 | 110.5 | 0.1915 | 116.384125 | 449.21304 | -332.82892 |
| 4 | 96 | 5760 | 120.9 | 0.1915 | 127.337925 | 598.95072 | -471.6128 |
| 6 | 144 | 8640 | 139.4 | 0.1915 | 146.82305 | 898.42608 | -751.60303 |
| 8 | 192 | 11520 | 156 | 0.1915 | 164.307 | 1197.90144 | -1033.5944 |
| 10 | 240 | 14400 | 171.3 | 0.1915 | 180.421725 | 1497.3768 | -1316.9551 |

Drainage Area 0.1915 Hectors
Allowable Discharge 9.05 l/hec/s
Discharge 1.73308

Pinewood Windfarm Storm Water Calculations

Attenuation Qualities Based 100y Return

Pond 8

| Days | Duration hours | Duration min | Rainfall mm | Area 1 | Runoff m3 (A) | max discharge m3 | amount to be Attenuated m3 (A) |
|---|---|---|---|---|---|---|---|
| | | 5 | 12.9 | 0.1055 | 7.485225 | 0.2864325 | 7.1987925 |
| | | 10 | 18 | 0.1055 | 10.4445 | 0.572865 | 9.871635 |
| | | 15 | 21.2 | 0.1055 | 12.3013 | 0.8592975 | 11.4420025 |
| | | 30 | 26.2 | 0.1055 | 15.20255 | 1.718595 | 13.483955 |
| | 1 | 60 | 32.3 | 0.1055 | 18.742075 | 3.43719 | 15.304885 |
| | 2 | 120 | 40 | 0.1055 | 23.21 | 6.87438 | 16.33562 |
| | 3 | 180 | 45.2 | 0.1055 | 26.2273 | 10.31157 | 15.91573 |
| | 4 | 240 | 49.4 | 0.1055 | 28.66435 | 13.74876 | 14.91559 |
| | 6 | 360 | 55.9 | 0.1055 | 32.435975 | 20.62314 | 11.812835 |
| | 9 | 540 | 63.3 | 0.1055 | 36.729825 | 30.93471 | 5.795115 |
| | 12 | 720 | 69.1 | 0.1055 | 40.095275 | 41.24628 | -1.151005 |
| | 18 | 1080 | 78.2 | 0.1055 | 45.37555 | 61.86942 | -16.49387 |
| 1 | 24 | 1440 | 85.4 | 0.1055 | 49.55335 | 82.49256 | -32.93921 |
| 2 | 48 | 2880 | 98.9 | 0.1055 | 57.386725 | 164.98512 | -107.5984 |
| 3 | 72 | 4320 | 110.5 | 0.1055 | 64.117625 | 247.47768 | -183.36006 |
| 4 | 96 | 5760 | 120.9 | 0.1055 | 70.152225 | 329.97024 | -259.81802 |
| 6 | 144 | 8640 | 139.4 | 0.1055 | 80.88685 | 494.95536 | -414.06851 |
| 8 | 192 | 11520 | 156 | 0.1055 | 90.519 | 659.94048 | -569.42148 |
| 10 | 240 | 14400 | 171.3 | 0.1055 | 99.396825 | 824.9256 | -725.52878 |

Drainage Area 0.1055 Hectors
Allowable Discharge 9.05 l/hec/s
Discharge 0.95478

Pinewood Windfarm Storm Water Calculations

Attenuation Qualities Based 100y Return

Pond 9

| Days | Duration hours | Duration min | Rainfall mm | Area 1 | Runoff m3 (A) | max discharge m3 | amount to be Attenuated m3 (A) |
|---|---|---|---|---|---|---|---|
| | | 5 | 12.9 | 0.1493 | 10.592835 | 0.4053495 | 10.1874855 |
| | | 10 | 18 | 0.1493 | 14.7807 | 0.810699 | 13.970001 |
| | | 15 | 21.2 | 0.1493 | 17.40838 | 1.2160485 | 16.1923315 |
| | | 30 | 26.2 | 0.1493 | 21.51413 | 2.432097 | 19.082033 |
| | 1 | 60 | 32.3 | 0.1493 | 26.523145 | 4.864194 | 21.658951 |
| | 2 | 120 | 40 | 0.1493 | 32.846 | 9.728388 | 23.117612 |
| | 3 | 180 | 45.2 | 0.1493 | 37.11598 | 14.592582 | 22.523398 |
| | 4 | 240 | 49.4 | 0.1493 | 40.56481 | 19.456776 | 21.108034 |
| | 6 | 360 | 55.9 | 0.1493 | 45.902285 | 29.185164 | 16.717121 |
| | 9 | 540 | 63.3 | 0.1493 | 51.978795 | 43.777746 | 8.201049 |
| | 12 | 720 | 69.1 | 0.1493 | 56.741465 | 58.370328 | -1.628863 |
| | 18 | 1080 | 78.2 | 0.1493 | 64.21393 | 87.555492 | -23.341562 |
| 1 | 24 | 1440 | 85.4 | 0.1493 | 70.12621 | 116.740656 | -46.614446 |
| 2 | 48 | 2880 | 98.9 | 0.1493 | 81.211735 | 233.481312 | -152.26958 |
| 3 | 72 | 4320 | 110.5 | 0.1493 | 90.737075 | 350.221968 | -259.48489 |
| 4 | 96 | 5760 | 120.9 | 0.1493 | 99.277035 | 466.962624 | -367.68559 |
| 6 | 144 | 8640 | 139.4 | 0.1493 | 114.46831 | 700.443936 | -585.97563 |
| 8 | 192 | 11520 | 156 | 0.1493 | 128.0994 | 933.925248 | -805.82585 |
| 10 | 240 | 14400 | 171.3 | 0.1493 | 140.662995 | 1167.40656 | -1026.7436 |

Drainage Area 0.14933 Hectors
Allowable Discharge 9.05 l/hec/s
Discharge 1.35117

Pinewood Windfarm Storm Water Calculations

Attenuation Qualities Based 100y Return

Pond 10

| Days | Duration hours | Duration min | Rainfall mm | Area 1 | Runoff m3 (A) | max discharge m3 | amount to be Attenuated m3 (A) |
|---|---|---|---|---|---|---|---|
| | | 5 | 12.9 | 0.0805 | 5.711475 | 0.2185575 | 5.4929175 |
| | | 10 | 18 | 0.0805 | 7.9695 | 0.437115 | 7.532385 |
| | | 15 | 21.2 | 0.0805 | 9.3863 | 0.6556725 | 8.7306275 |
| | | 30 | 26.2 | 0.0805 | 11.60005 | 1.311345 | 10.288705 |
| | 1 | 60 | 32.3 | 0.0805 | 14.300825 | 2.62269 | 11.678135 |
| | 2 | 120 | 40 | 0.0805 | 17.71 | 5.24538 | 12.46462 |
| | 3 | 180 | 45.2 | 0.0805 | 20.0123 | 7.86807 | 12.14423 |
| | 4 | 240 | 49.4 | 0.0805 | 21.87185 | 10.49076 | 11.38109 |
| | 6 | 360 | 55.9 | 0.0805 | 24.749725 | 15.73614 | 9.013585 |
| | 9 | 540 | 63.3 | 0.0805 | 28.026075 | 23.60421 | 4.421865 |
| | 12 | 720 | 69.1 | 0.0805 | 30.594025 | 31.47228 | -0.878255 |
| | 18 | 1080 | 78.2 | 0.0805 | 34.62305 | 47.20842 | -12.58537 |
| 1 | 24 | 1440 | 85.4 | 0.0805 | 37.81085 | 62.94456 | -25.13371 |
| 2 | 48 | 2880 | 98.9 | 0.0805 | 43.787975 | 125.88912 | -82.101145 |
| 3 | 72 | 4320 | 110.5 | 0.0805 | 48.923875 | 188.83368 | -139.90981 |
| 4 | 96 | 5760 | 120.9 | 0.0805 | 53.528475 | 251.77824 | -198.24977 |
| 6 | 144 | 8640 | 139.4 | 0.0805 | 61.71935 | 377.66736 | -315.94801 |
| 8 | 192 | 11520 | 156 | 0.0805 | 69.069 | 503.55648 | -434.48748 |
| 10 | 240 | 14400 | 171.3 | 0.0805 | 75.843075 | 629.4456 | -553.60253 |

Drainage Area 0.0805 Hectors
Allowable Discharge 9.05 l/hec/s
Discharge 0.72853

Pinewood Windfarm Storm Water Calculations

Attenuation Qualities Based 100y Return

Pond 11

| Days | Duration hours | Duration min | Rainfall mm | Area 1 | Runoff m3 (A) | max discharge m3 | amount to be Attenuated m3 (A) |
|---|---|---|---|---|---|---|---|
| | | 5 | 12.9 | 0.4435 | 31.466325 | 1.2041025 | 30.2622225 |
| | | 10 | 18 | 0.4435 | 43.9065 | 2.408205 | 41.498295 |
| | | 15 | 21.2 | 0.4435 | 51.7121 | 3.6123075 | 48.0997925 |
| | | 30 | 26.2 | 0.4435 | 63.90835 | 7.224615 | 56.683735 |
| | 1 | 60 | 32.3 | 0.4435 | 78.787775 | 14.44923 | 64.338545 |
| | 2 | 120 | 40 | 0.4435 | 97.57 | 28.89846 | 68.67154 |
| | 3 | 180 | 45.2 | 0.4435 | 110.2541 | 43.34769 | 66.90641 |
| | 4 | 240 | 49.4 | 0.4435 | 120.49895 | 57.79692 | 62.70203 |
| | 6 | 360 | 55.9 | 0.4435 | 136.354075 | 86.69538 | 49.658695 |
| | 9 | 540 | 63.3 | 0.4435 | 154.404525 | 130.04307 | 24.361455 |
| | 12 | 720 | 69.1 | 0.4435 | 168.552175 | 173.39076 | -4.838585 |
| | 18 | 1080 | 78.2 | 0.4435 | 190.74935 | 260.08614 | -69.33679 |
| 1 | 24 | 1440 | 85.4 | 0.4435 | 208.31195 | 346.78152 | -138.46957 |
| 2 | 48 | 2880 | 98.9 | 0.4435 | 241.241825 | 693.56304 | -452.32122 |
| 3 | 72 | 4320 | 110.5 | 0.4435 | 269.537125 | 1040.34456 | -770.80744 |
| 4 | 96 | 5760 | 120.9 | 0.4435 | 294.905325 | 1387.12608 | -1092.2208 |
| 6 | 144 | 8640 | 139.4 | 0.4435 | 340.03145 | 2080.68912 | -1740.6577 |
| 8 | 192 | 11520 | 156 | 0.4435 | 380.523 | 2774.25216 | -2393.7292 |
| 10 | 240 | 14400 | 171.3 | 0.4435 | 417.843525 | 3467.8152 | -3049.9717 |

Drainage Area 0.4435 Hectors
Allowable Discharge 9.05 l/hec/s
Discharge 4.01368

Pinewood Windfarm Storm Water Calculations

Attenuation Qualities Based 100y Return

Pond 12

| Days | Duration hours | Duration min | Rainfall mm | Area 1 | Runoff m3 (A) | max discharge m3 | amount to be Attenuated m3 (A) |
|---|---|---|---|---|---|---|---|
| | | 5 | 12.9 | 0.635 | 45.05325 | 1.724025 | 43.329225 |
| | | 10 | 18 | 0.635 | 62.865 | 3.44805 | 59.41695 |
| | | 15 | 21.2 | 0.635 | 74.041 | 5.172075 | 68.868925 |
| | | 30 | 26.2 | 0.635 | 91.5035 | 10.34415 | 81.15935 |
| | 1 | 60 | 32.3 | 0.635 | 112.80775 | 20.6883 | 92.11945 |
| | 2 | 120 | 40 | 0.635 | 139.7 | 41.3766 | 98.3234 |
| | 3 | 180 | 45.2 | 0.635 | 157.861 | 62.0649 | 95.7961 |
| | 4 | 240 | 49.4 | 0.635 | 172.5295 | 82.7532 | 89.7763 |
| | 6 | 360 | 55.9 | 0.635 | 195.23075 | 124.1298 | 71.10095 |
| | 9 | 540 | 63.3 | 0.635 | 221.07525 | 186.1947 | 34.88055 |
| | 12 | 720 | 69.1 | 0.635 | 241.33175 | 248.2596 | -6.92785 |
| | 18 | 1080 | 78.2 | 0.635 | 273.1135 | 372.3894 | -99.2759 |
| 1 | 24 | 1440 | 85.4 | 0.635 | 298.2595 | 496.5192 | -198.2597 |
| 2 | 48 | 2880 | 98.9 | 0.635 | 345.40825 | 993.0384 | -647.63015 |
| 3 | 72 | 4320 | 110.5 | 0.635 | 385.92125 | 1489.5576 | -1103.6364 |
| 4 | 96 | 5760 | 120.9 | 0.635 | 422.24325 | 1986.0768 | -1563.8336 |
| 6 | 144 | 8640 | 139.4 | 0.635 | 486.8545 | 2979.1152 | -2492.2607 |
| 8 | 192 | 11520 | 156 | 0.635 | 544.83 | 3972.1536 | -3427.3236 |
| 10 | 240 | 14400 | 171.3 | 0.635 | 598.26525 | 4965.192 | -4366.9268 |

Drainage Area 0.635 Hectors
Allowable Discharge 9.05 l/hec/s
Discharge 5.74675

Pinewood Windfarm Storm Water Calculations

Attenuation Qualities Based 100y Return

Pond 13

| Days | Duration hours | Duration min | Rainfall mm | Area 1 | Runoff m3 (A) | max discharge m3 | amount to be Attenuated m3 (A) |
|---|---|---|---|---|---|---|---|
| | | 5 | 12.9 | 0.215 | 15.25425 | 0.583725 | 14.670525 |
| | | 10 | 18 | 0.215 | 21.285 | 1.16745 | 20.11755 |
| | | 15 | 21.2 | 0.215 | 25.069 | 1.751175 | 23.317825 |
| | | 30 | 26.2 | 0.215 | 30.9815 | 3.50235 | 27.47915 |
| | 1 | 60 | 32.3 | 0.215 | 38.19475 | 7.0047 | 31.19005 |
| | 2 | 120 | 40 | 0.215 | 47.3 | 14.0094 | 33.2906 |
| | 3 | 180 | 45.2 | 0.215 | 53.449 | 21.0141 | 32.4349 |
| | 4 | 240 | 49.4 | 0.215 | 58.4155 | 28.0188 | 30.3967 |
| | 6 | 360 | 55.9 | 0.215 | 66.10175 | 42.0282 | 24.07355 |
| | 9 | 540 | 63.3 | 0.215 | 74.85225 | 63.0423 | 11.80995 |
| | 12 | 720 | 69.1 | 0.215 | 81.71075 | 84.0564 | -2.34565 |
| | 18 | 1080 | 78.2 | 0.215 | 92.4715 | 126.0846 | -33.6131 |
| 1 | 24 | 1440 | 85.4 | 0.215 | 100.9855 | 168.1128 | -67.1273 |
| 2 | 48 | 2880 | 98.9 | 0.215 | 116.94925 | 336.2256 | -219.27635 |
| 3 | 72 | 4320 | 110.5 | 0.215 | 130.66625 | 504.3384 | -373.67215 |
| 4 | 96 | 5760 | 120.9 | 0.215 | 142.96425 | 672.4512 | -529.48695 |
| 6 | 144 | 8640 | 139.4 | 0.215 | 164.8405 | 1008.6768 | -843.8363 |
| 8 | 192 | 11520 | 156 | 0.215 | 184.47 | 1344.9024 | -1160.4324 |
| 10 | 240 | 14400 | 171.3 | 0.215 | 202.56225 | 1681.128 | -1478.5658 |

Drainage Area 0.215 Hectors
Allowable Discharge 9.05 l/hec/s
Discharge 1.94575

Pinewood Windfarm Storm Water Calculations

Attenuation Qualities Based 100y Return

Pond 14

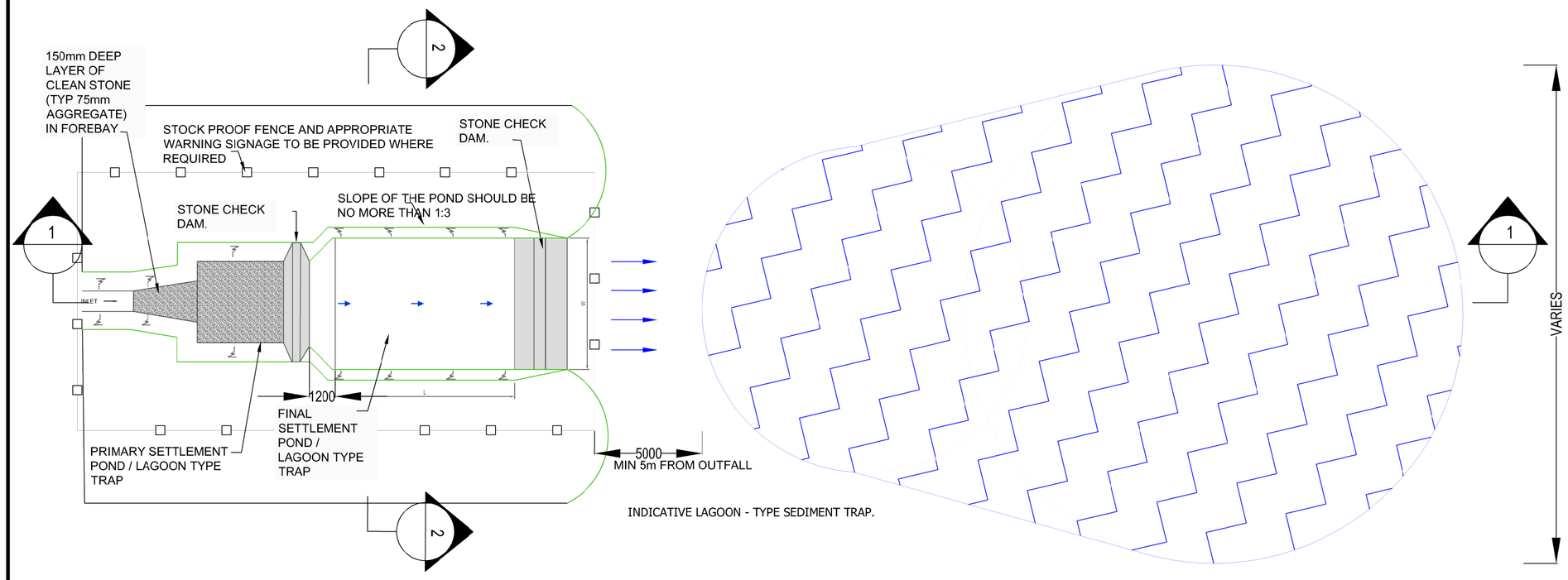
| Days | Duration hours | Duration min | Rainfall mm | Area 1 | Runoff m3 (A) | max discharge m3 | amount to be Attenuated m3 (A) |
|---|---|---|---|---|---|---|---|
| | | 5 | 12.9 | 0.26 | 18.447 | 0.7059 | 17.7411 |
| | | 10 | 18 | 0.26 | 25.74 | 1.4118 | 24.3282 |
| | | 15 | 21.2 | 0.26 | 30.316 | 2.1177 | 28.1983 |
| | | 30 | 26.2 | 0.26 | 37.466 | 4.2354 | 33.2306 |
| | 1 | 60 | 32.3 | 0.26 | 46.189 | 8.4708 | 37.7182 |
| | 2 | 120 | 40 | 0.26 | 57.2 | 16.9416 | 40.2584 |
| | 3 | 180 | 45.2 | 0.26 | 64.636 | 25.4124 | 39.2236 |
| | 4 | 240 | 49.4 | 0.26 | 70.642 | 33.8832 | 36.7588 |
| | 6 | 360 | 55.9 | 0.26 | 79.937 | 50.8248 | 29.1122 |
| | 9 | 540 | 63.3 | 0.26 | 90.519 | 76.2372 | 14.2818 |
| | 12 | 720 | 69.1 | 0.26 | 98.813 | 101.6496 | -2.8366 |
| | 18 | 1080 | 78.2 | 0.26 | 111.826 | 152.4744 | -40.6484 |
| 1 | 24 | 1440 | 85.4 | 0.26 | 122.122 | 203.2992 | -81.1772 |
| 2 | 48 | 2880 | 98.9 | 0.26 | 141.427 | 406.5984 | -265.1714 |
| 3 | 72 | 4320 | 110.5 | 0.26 | 158.015 | 609.8976 | -451.8826 |
| 4 | 96 | 5760 | 120.9 | 0.26 | 172.887 | 813.1968 | -640.3098 |
| 6 | 144 | 8640 | 139.4 | 0.26 | 199.342 | 1219.7952 | -1020.4532 |
| 8 | 192 | 11520 | 156 | 0.26 | 223.08 | 1626.3936 | -1403.3136 |
| 10 | 240 | 14400 | 171.3 | 0.26 | 244.959 | 2032.992 | -1788.033 |

Drainage Area 0.26 Hectors
Allowable Discharge 9.05 l/hec/s
Discharge 2.353

Pinewoods - Final Ponds

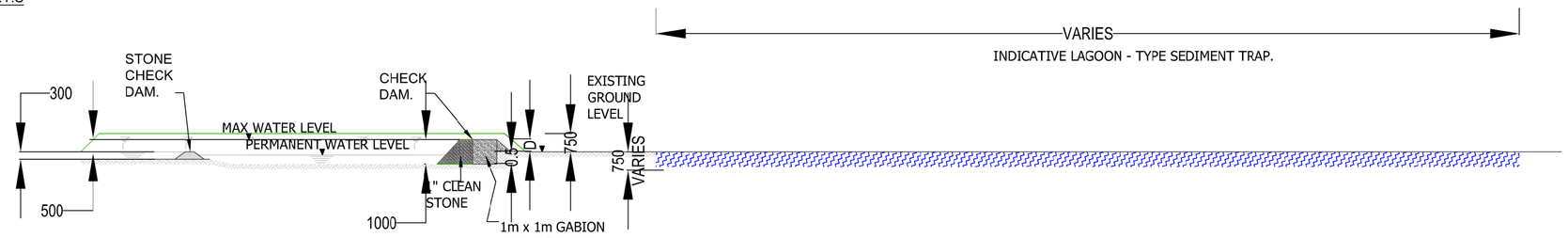
| Pond Number | Contributing Area | 10-Day Rainfall | "C" | Volume | Depth | Area |
|---|---|---|---|---|---|---|
| | (m2) | (m) | | (m3) | (m) | (m2) |
| | | | | | | |
| 1 | 2080 | 0.1713 | 0.85 | 302.8584 | 0.75 | 403.8112 |
| 2 | 1330 | 0.1713 | 0.85 | 193.65465 | 0.75 | 258.2062 |
| 3 | 2500 | 0.1713 | 0.85 | 364.0125 | 0.75 | 485.35 |
| 4 | 1835 | 0.1713 | 0.85 | 267.18518 | 0.75 | 356.2469 |
| 5 | 3850 | 0.1713 | 0.85 | 560.57925 | 0.75 | 747.439 |
| 6 | 5697 | 0.1713 | 0.85 | 829.51169 | 0.75 | 1106.016 |
| 7 | 1915 | 0.1713 | 0.85 | 278.83358 | 0.75 | 371.7781 |
| 8 | 1055 | 0.1713 | 0.85 | 153.61328 | 0.75 | 204.8177 |
| 9 | 1493 | 0.1713 | 0.85 | 217.38827 | 0.75 | 289.851 |
| 10 | 805 | 0.1713 | 0.85 | 117.21203 | 0.75 | 156.2827 |
| 11 | 4435 | 0.1713 | 0.85 | 645.75818 | 0.75 | 861.0109 |
| 12 | 6350 | 0.1713 | 0.85 | 924.59175 | 0.75 | 1232.789 |
| 13 | 2150 | 0.1713 | 0.85 | 313.05075 | 0.75 | 417.401 |
| 14 | 2600 | 0.1713 | 0.85 | 378.573 | 0.75 | 504.764 |

| Diameter (m) |
|---|
| |
| 22.67481 |
| 18.13167 |
| 24.85891 |
| 21.29757 |
| 30.8491 |
| 37.52625 |
| 21.75687 |
| 16.14873 |
| 19.21065 |
| 14.1062 |
| 33.10998 |
| 39.61858 |
| 23.0532 |
| 25.35121 |



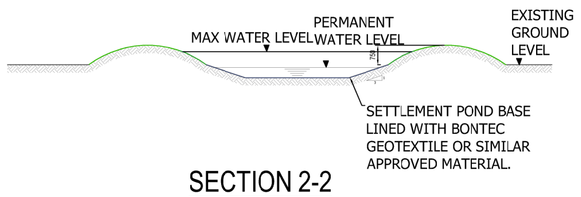

## INDICATIVE SETTLEMENT POND / LAGOON - TYPE SEDIMENT TRAP DETAILS -

SCALE N.T.S




## SECTION 1-1

SCALE N.T.S

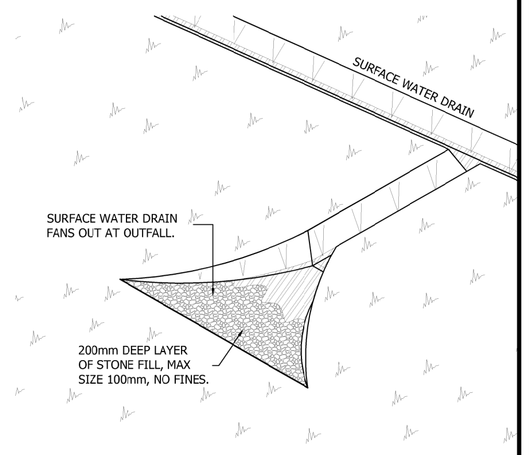



## SECTION 2-2

SCALE N.T.S

| Pond Ref. | Ref. Geometric Drawings | Coordinate | Development Area (m²) | Dim. length (m) | Dim. Width (m) | Dim. Depth (m) | Overall Volume of Attenuation Pond (m³) | Settling Velocity m/s < 0.0016 | Settling Duration Hours > 4hrs |
|---|---|---|---|---|---|---|---|---|---|
| Pond 1 | Main site access road to T1 | 252,017mE, 182,899mN | 2080 | 15.4 | 2.8 | 0.75 | 32.3 | 0.0008964 | 4.772277 |
| Pond 2 | Main site access road to T1 | 252,793mE, 182,617mN | 1335 | 11 | 2.5 | 0.75 | 20.6 | 0.0006444 | 4.742001 |
| Pond 3 | Main site access road to T1 | 252,697mE, 182,432mN | 2500 | 16.2 | 3.2 | 0.75 | 38.9 | 0.0009427 | 4.773481 |
| Pond 4 | At T2 | 252,665mE, 182,114mN | 1835 | 15.8 | 2.4 | 0.75 | 28.4 | 0.0009226 | 4.757102 |
| Pond 5 | At T3 | 252,702mE, 182,779mN | 3850 | 15.9 | 5 | 0.75 | 59.6 | 0.0009291 | 4.753534 |
| Pond 6 | At Sub-Station | 250,403mE, 182,275mN | 5697 | 23.6 | 5 | 0.75 | 88.5 | 0.0013749 | 4.768107 |
| Pond 7 | Located between T4 & T5 | 251,074mE, 181,796mN | 1915 | 15.8 | 2.5 | 0.75 | 29.6 | 0.0009243 | 4.748304 |
| Pond 8 | Located Between T4 & T5 | 251,107mE, 181,794mN | 1055 | 13.1 | 2.5 | 0.5 | 16.4 | 0.0007638 | 4.764066 |
| Pond 9 | Located Between T5 & T6 | 251,063mE, 181,517mN | 1493 | 15.5 | 3 | 0.5 | 23.3 | 0.0009008 | 4.779826 |
| Pond 10 | Site access road to T5 | 251,363mE, 181,506mN | 805 | 10.1 | 2.5 | 0.5 | 12.6 | 0.0005828 | 4.81376 |
| Pond 11 | At T7 | 250,357mE, 181,209mN | 4435 | 22.9 | 4 | 0.75 | 68.7 | 0.0013379 | 4.754579 |
| Pond 12 | Located Between T10 & T11 | 250,492mE, 180,405mN | 6350 | 26.5 | 4.95 | 0.75 | 98.4 | 0.0015479 | 4.755405 |
| Pond 13 | Located Between T10 & T11 | 250,492mE, 180,407mN | 2150 | 15 | 2.95 | 0.75 | 33.2 | 0.0008794 | 4.73789 |
| Pond 14 | Located Between T5 & T6 | 251,040mE, 181,519mN | 2600 | 11.9 | 4.5 | 0.75 | 40.2 | 0.0006972 | 4.741288 |

## SETTLEMENT PONDS SIZING SCHEDULE




## DRAINAGE CHANNEL BREAKOUT DETAIL

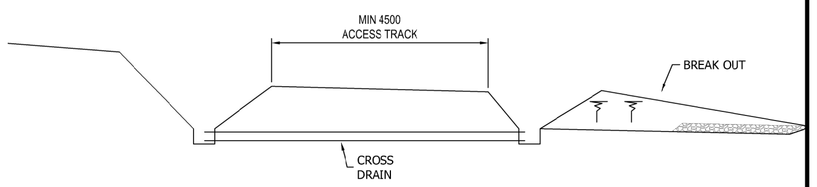
SCALE NTS

## NOTES:

1 FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
2 ALL DRAWINGS TO BE CHECKED BY THE CONTRACTOR ON SITE.
3 ENGINEER TO BE INFORMED OF ANY DISCREPANCIES BEFORE ANY WORK COMMENCES.
4 THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS AND SPECIFICATIONS.

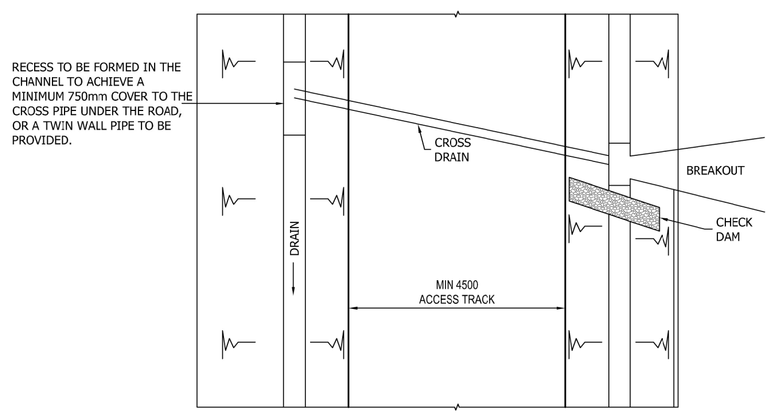
| Pinewoods - Final Ponds | | | | | | | |
|---|---|---|---|---|---|---|---|
| Pond Number | Contributing Area (m2) | 10-Day Rainfall (m) | "C" | Volume (m3) | Depth (m) | Area (m2) | Diameter (m) |
| 1 | 2080 | 0.1713 | 0.85 | 302.8584 | 0.75 | 403.8112 | 22.67481 |
| 2 | 1330 | 0.1713 | 0.85 | 193.65465 | 0.75 | 258.2062 | 18.13167 |
| 3 | 2500 | 0.1713 | 0.85 | 364.0125 | 0.75 | 485.35 | 24.85891 |
| 4 | 1835 | 0.1713 | 0.85 | 267.18518 | 0.75 | 356.2469 | 21.29757 |
| 5 | 3850 | 0.1713 | 0.85 | 560.57925 | 0.75 | 747.439 | 30.8491 |
| 6 | 5697 | 0.1713 | 0.85 | 829.51169 | 0.75 | 1106.016 | 37.52625 |
| 7 | 1915 | 0.1713 | 0.85 | 278.83358 | 0.75 | 371.7781 | 21.75687 |
| 8 | 1055 | 0.1713 | 0.85 | 153.61328 | 0.75 | 204.8177 | 16.14873 |
| 9 | 1493 | 0.1713 | 0.85 | 217.38827 | 0.75 | 289.851 | 19.21065 |
| 10 | 805 | 0.1713 | 0.85 | 117.21203 | 0.75 | 156.2827 | 14.1062 |
| 11 | 4435 | 0.1713 | 0.85 | 645.75818 | 0.75 | 861.0109 | 33.10998 |
| 12 | 6350 | 0.1713 | 0.85 | 924.59175 | 0.75 | 1232.789 | 39.61858 |
| 13 | 2150 | 0.1713 | 0.85 | 313.09075 | 0.75 | 417.401 | 23.0532 |
| 14 | 2600 | 0.1713 | 0.85 | 378.573 | 0.75 | 504.764 | 25.35121 |

## LAGOON - TYPE SEDIMENT TRAP SIZING SCHEDULE




## SECTION OF BREAKOUT & CROSS DRAIN DETAIL

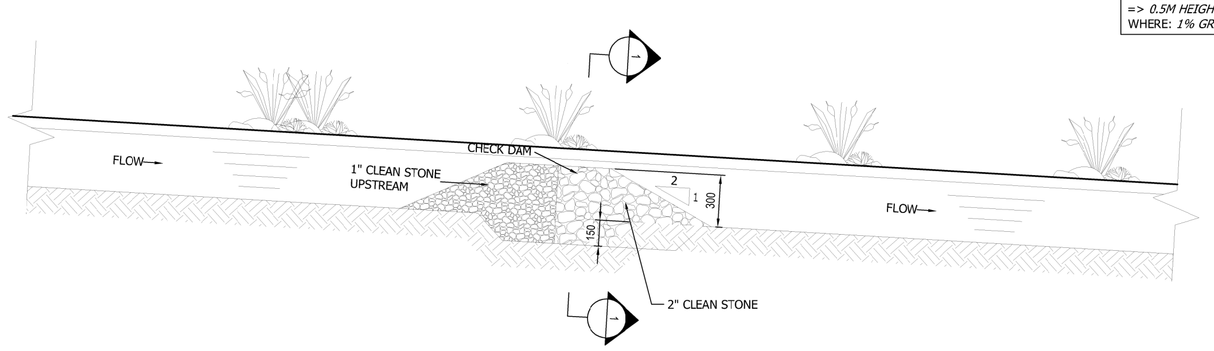
SCALE 1:100




## PLAN OF BREAKOUT & CROSS DRAIN DETAIL

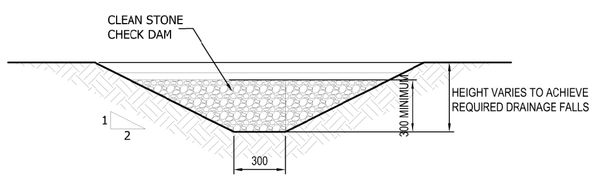
SCALE 1:100

NOTE:
AS A RULE OF THUMB FOR CHECK DAM SPACING. THE MAXIMUM SPACING BETWEEN CHECK DAMS SHOULD BE SUCH THAT THE TOE OF THE UPSTREAM DAM IS AT THE SAME ELEVATION AS THE TOP OF THE DOWNSTREAM DAM. SPACING IS CALCULATED FROM THE GRADIENT AND CHECK DAM HEIGHT.
SEE WORKED EXAMPLES:
*=> 0.3M HEIGHT X (1 IN 100) = 30M SPACING;*
*=> 0.3M HEIGHT X (1 IN 50) = 15M SPACING;*
*=> 0.5M HEIGHT X (1 IN 50) = 25M SPACING.*
WHERE: *1% GRADIENT = (1 IN 100)* AND *2% GRADIENT= (1 IN 50)* ETC...



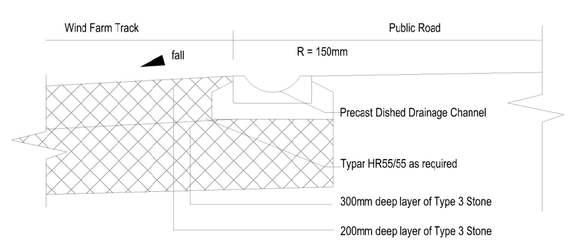

## TYPICAL LONGITUDINAL SECTION THROUGH ROADSIDE SWALE WITH CHECK DAMS

SCALE 1:25




## SECTION 1-1

SCALE 1:25




## DISHED DRAINAGE CHANNEL DETAIL

SCALE 1:10

THIS DRAWING IS FOR PLANNING PURPOSES ONLY.
IT IS NOT TO BE USED AS A CONSTRUCTION DRAWING.

| rev. | modifications | by | chkd | date |
|---|---|---|---|---|
| 02. | Lagoon trap added | J.B | N.C | 01/17 |

Client
**PINEWOOD WIND LIMITED**

Project
**PINEWOOD WIND FARM**

Stage
**FURTHER INFORMATION**

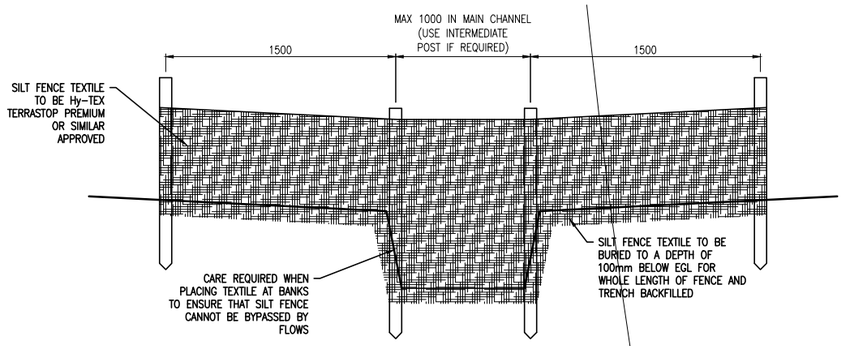
Title
TYPICAL DRAINAGE DETAILS

Scales
AS SHOWN @ A1

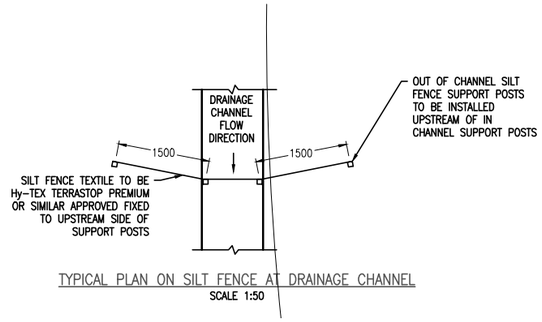
| Surveyed | Prepared By | Checked | Date |
|---|---|---|---|
| | J.B. | N.C. | Jan 17 |


JENNINGS O'DONOVAN & PARTNERS LIMITED,
CONSULTING ENGINEERS,
FINISKLIN,
SLIGO,
IRELAND.
TEL. (0035371) 9161416.
FAX. (0035371) 9161080.
Email. info@jodireland.com
Web. www.jodireland.com

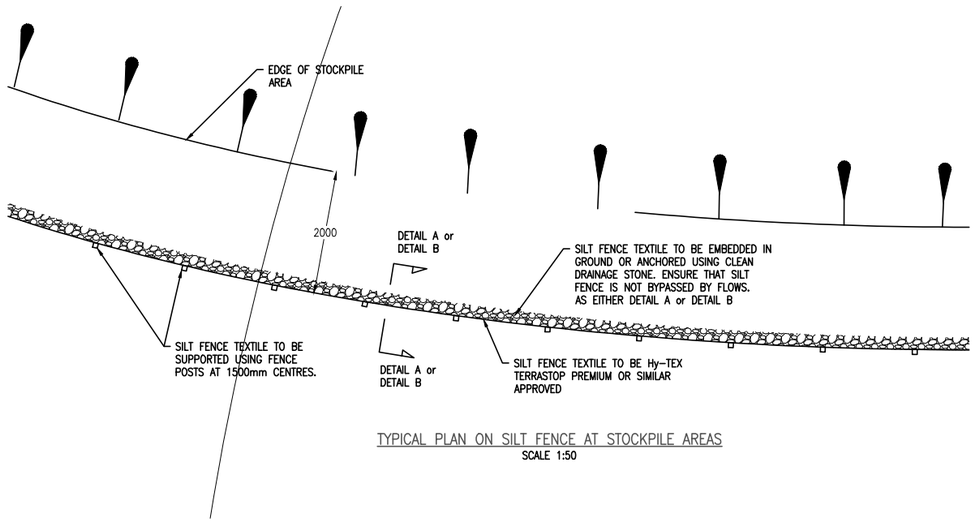
| Job No. | Drawing no. | Revision |
|---|---|---|
| 5538 | FIGURE 4.1 | 02 |



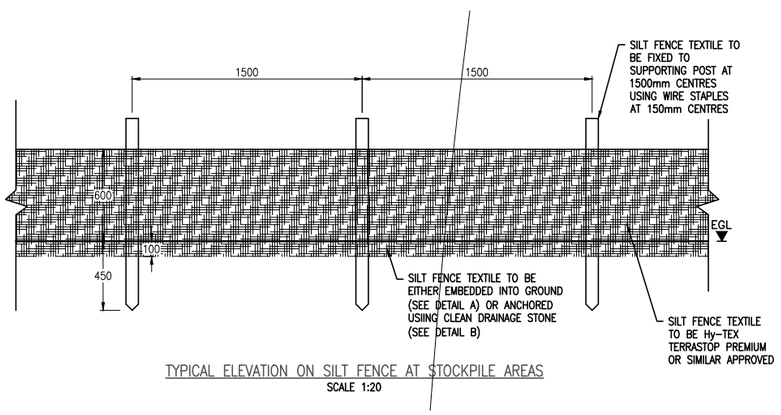

TYPICAL ELEVATION ON SILT FENCE AT DRAINAGE CHANNEL
SCALE 1:20



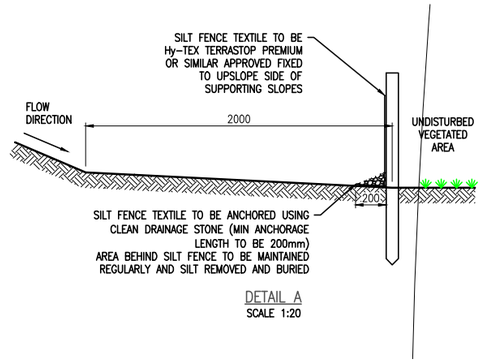

TYPICAL PLAN ON SILT FENCE AT DRAINAGE CHANNEL
SCALE 1:50



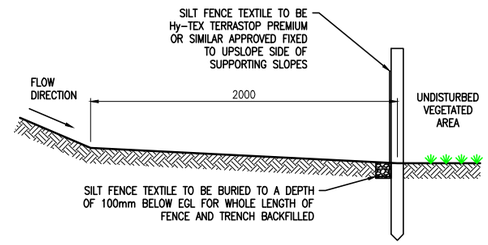

TYPICAL PLAN ON SILT FENCE AT STOCKPILE AREAS
SCALE 1:50




TYPICAL ELEVATION ON SILT FENCE AT STOCKPILE AREAS
SCALE 1:20




DETAIL A
SCALE 1:20




DETAIL B
SCALE 1:20

THIS DRAWING IS FOR PLANNING PURPOSES ONLY.
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NOTES:

1 FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING.
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3 ENGINEER TO BE INFORMED OF ANY DISCREPANCIES BEFORE ANY WORK COMMENCES.
4 THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS AND SPECIFICATIONS.

| rev. | modifications | by | date |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

Client
**PINEWOOD WIND LIMITED**

Project
**PINEWOOD WIND FARM**

Stage
**FURTHER INFORMATION**

Title
TYPICAL DRAINAGE DETAILS
SILT FENCE

Scales
As Noted

| Surveyed | Prepared By | Checked | Date |
|---|---|---|---|
| | J.B. | N.C. | Jan 17 |


JENNINGS O'DONOVAN & PARTNERS LIMITED,
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TEL. (0035371) 9161416.
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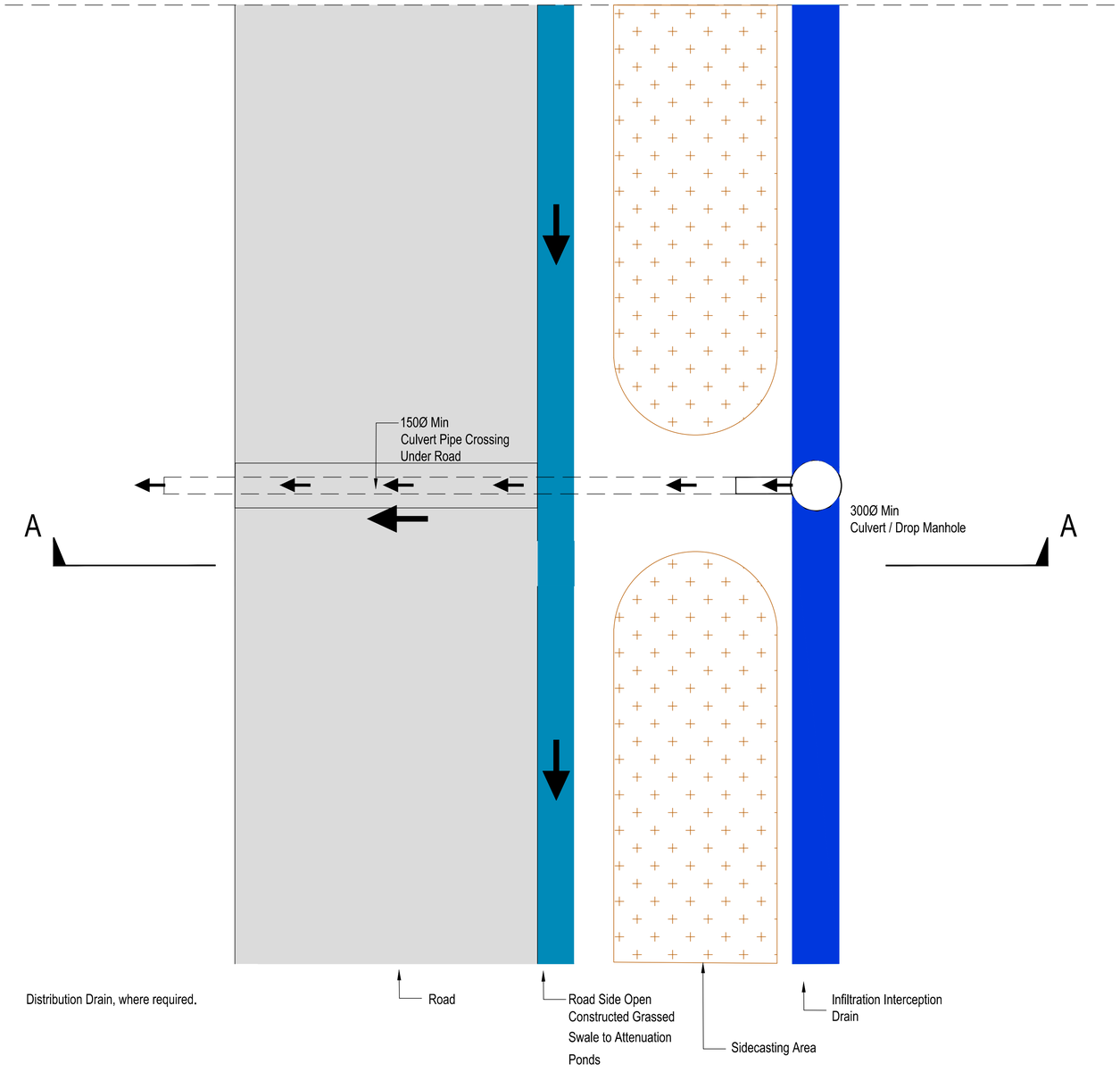
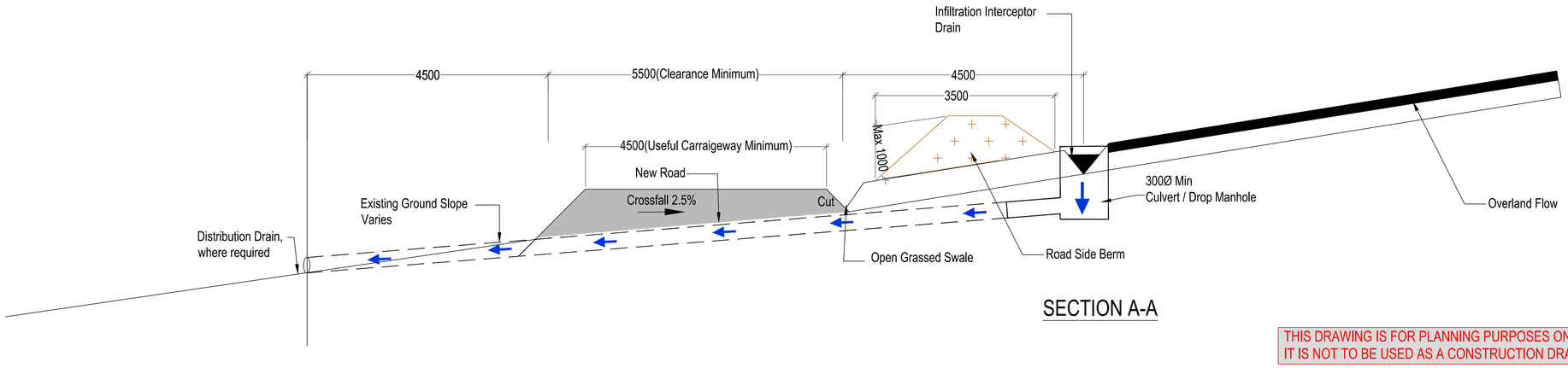
Web. www.jodireland.com

| Job No. | Drawing no. | Revision |
|---|---|---|
| 5538 | FIGURE 4.2 | |




PLAN




SECTION A-A

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4 THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS AND SPECIFICATIONS.

| rev. | modifications | by | date |
|---|---|---|---|
| | | | |
| | | | |
| | | | |

Client
**PINEWOOD WIND LIMITED**

Project
**PINEWOOD WIND FARM**

Stage
**FURTHER INFORMATION**

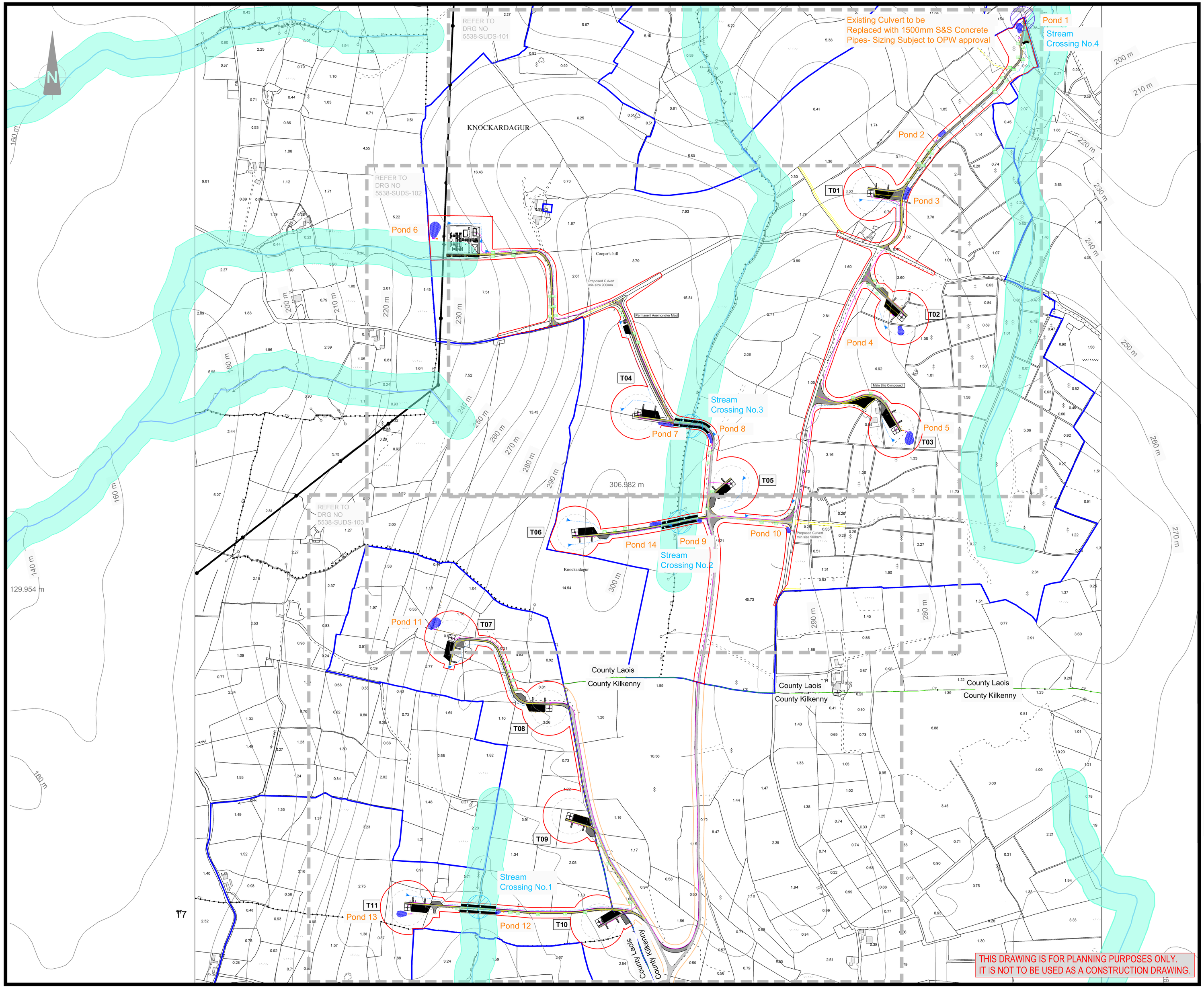
Title
TYPICAL DRAINAGE DETAILS
INFILTRATION INTERCEPTOR DRAIN AND
CLEAN WATER CROSSING

Scales
1:50 @ A1

| Surveyed | Prepared By | Checked | Date |
|---|---|---|---|
| | J.B. | N.C. | Jan 17 |


JENNINGS O'DONOVAN & PARTNERS LIMITED,
CONSULTING ENGINEERS,
FINISKLIN,
SLIGO,
IRELAND.
TEL. (0035371) 9161416.
FAX. (0035371) 9161080.
Email. info@jodireland.com
Web. www.jodireland.com

| Job No. | Drawing no. | Revision |
|---|---|---|
| 5538 | FIGURE 4.3 | |




NOTES:
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3. ENGINEER TO BE INFORMED OF ANY DISCREPANCIES BEFORE ANY WORK COMMENCES.
4. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS AND SPECIFICATIONS.
5. ALL LEVELS REFER TO ORDNANCE DATUM (MALIN HEAD)

## Legend:

- Ownership Boundary
- Application Boundary (Co. Laois)
- Application Boundary for concurrent application made in Co. Kilkenny
- County Boundary
- Wind Farm Tracks
- Existing Tracks (requiring upgrade)
- Indicative Cable Routes
- Proposed Wind Turbines
- Recorded Way Leave Areas
- Existing Watercourse Shown Thus
- Watercourse Buffer 50m Shown Thus
- Existing Watercourse Crossings Shown Thus
- Proposed Watercourse Crossings Shown Thus
- Proposed Primary Settlement Pond / Lagoon-type sediment trap Shown Thus (Pond 3)
- Proposed Final Settlement Pond / Lagoon-type sediment trap Shown Thus
- Proposed Buffered Outfall Shown Thus
- Proposed Clean Water Drain Shown Thus
- Proposed Dirty Water Drain Shown Thus
- Proposed Check Dam Shown Thus (C-D)
- Proposed Culvert Shown Thus
- Proposed Precast Dished Drainage Channel Shown Thus
- Proposed Silt Fence Shown Thus
- Proposed Lagoon - Type Sediment Trap Shown Thus
- Proposed Spoil Repository Shown Thus (24)



| rev. | modifications | by | chkd | date |
|---|---|---|---|---|
| 05. | Drainage Revised | JB | N.C | 02/17 |
| Layout Ref.: | | | | |
| file | | | | |

client
PINEWOOD WIND FARM

project
PINEWOOD WIND FARM

stage
FURTHER INFORMATION

title
DRAINAGE PLAN

MASTER LAYOUT

scale
1:10,000 @ A1

| surveyed | drawn | checked | date |
|---|---|---|---|
| OSI | J.O.D. | OOC | JAN 2017 |


JENNINGS O'DONOVAN & PARTNERS
CONSULTING ENGINEERS,
FINISKLIN,
SLIGO,
IRELAND.
TEL. +353 (0)71 916 1416
FAX. +353 (0)71 916 1080
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| Job No. | Drawing no. | Revision |
|---|---|---|
| 5538 | S300-SUDS-100 | 05 |

KNOCKARDAGUR

Cooper's hill

Existing Culvert to be Replaced with 1500mm S&S Concrete Pipes- Sizing Subject to OPW approval

Proposed Culvert min size 900mm

Permanent Aremometer Mast

Main Site Compound

Pond 2

Pond 3

Pond 4

Pond 5

Pond 7

Pond 8

Stream Crossing No.3

T01

T02

T03

T04

T05

306.982 m

THIS DRAWING IS FOR PLANNING PURPOSES ONLY.
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4. THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DRAWINGS AND SPECIFICATIONS.
5. ALL LEVELS REFER TO ORDNANCE DATUM (MALIN HEAD)

## Legend:

- Ownership Boundary
- Application Boundary (Co. Laois)
- Application Boundary for concurrent application made in Co. Kilkenny
- County Boundary
- Wind Farm Tracks
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- Proposed Check Dam Shown Thus (C-D)
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- Proposed Precast Dished Drainage Channel Shown Thus
- Proposed Silt Fence Shown Thus
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- Proposed Spoil Repository Shown Thus (24)



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JENNINGS O'DONOVAN & PARTNERS
CONSULTING ENGINEERS,
FINISKLIN,
SLIGO,
IRELAND.
TEL. +353 (0)71 916 1416
FAX. +353 (0)71 916 1080
Email: info@jodireland.com

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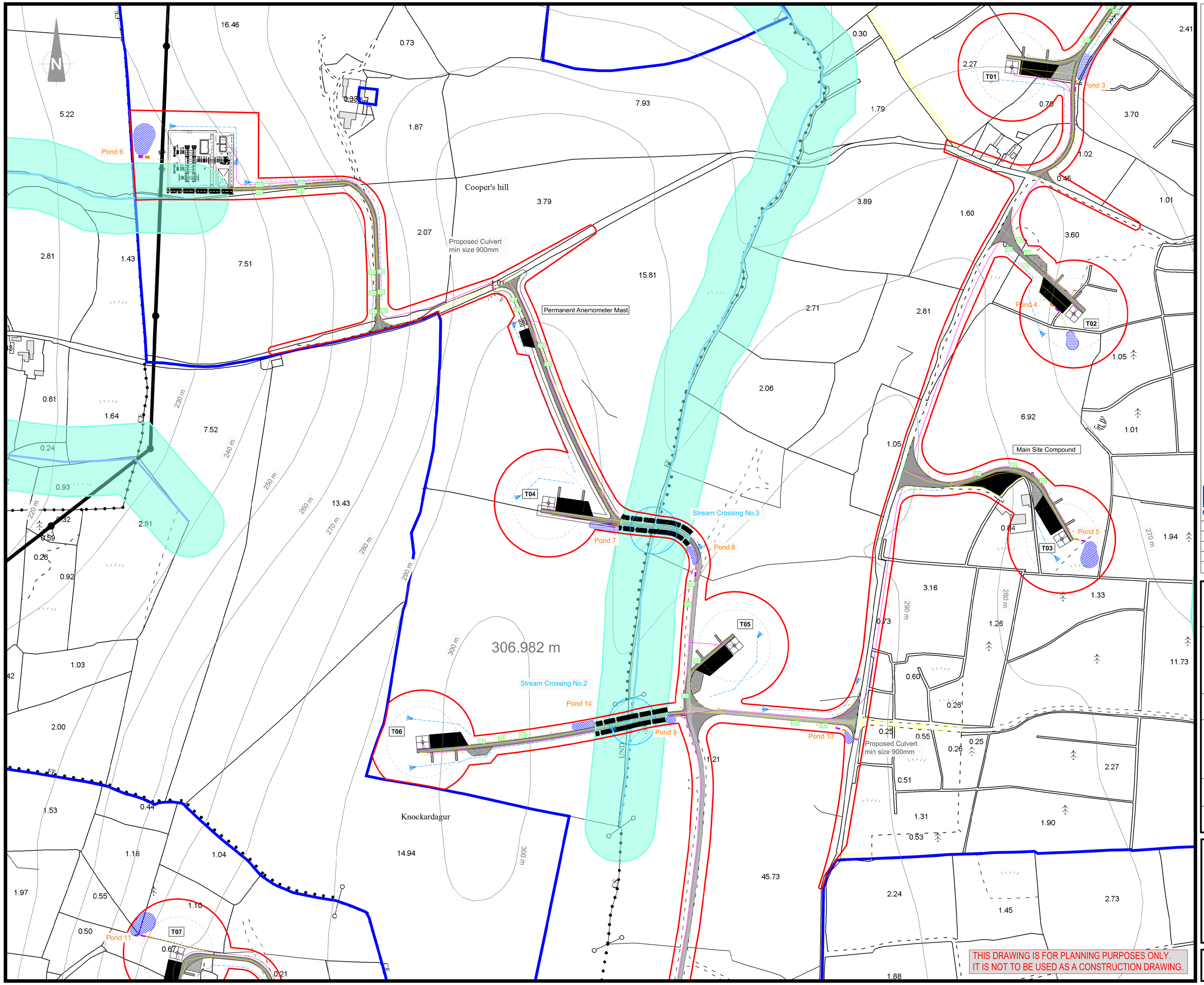


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project: PINEWOOD WIND FARM

stage: FURTHER INFORMATION

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JENNINGS O'DONOVAN & PARTNERS
CONSULTING ENGINEERS,
FINISKLIN,
SLIGO,
IRELAND.
TEL. +353 (0)71 916 1416
FAX. +353 (0)71 916 1080
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client: PINEWOOD WIND FARM

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stage: FURTHER INFORMATION

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JENNINGS O'DONOVAN & PARTNERS
CONSULTING ENGINEERS,
FINISKLIN,
SLIGO,
IRELAND.
TEL. +353 (0)71 916 1416
FAX. +353 (0)71 916 1080
Email: info@jodireland.com

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**Foreword and acknowledgment**

This pdf-file is the English version of an article which is published with three other articles dealing with species and biotope protection for the freshwater pearl mussel *Margaritifera margaritifera* in Lower Saxony, North Germany (see: http://www.nlwkn.niedersachsen.de/master/C35794242_N14750639_L20_D0_I5231158.html). With this pdf-file we want to give our non-German speaking colleagues an opportunity to read about the chance to do something for this endangered mussel species in Europe.

To get a good readable English text we are very glad to have our Irish friends and colleagues EVELYN MOORKENS and IAN KILLEEN on our side in our efforts to help *Margaritifera*, and we are very thankful to them for helping us in bringing our “Denglish” to a readable English version.

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# Successful species protection measures for the Freshwater Pearl Mussel (*Margaritifera margaritifera*) through the reduction of unnaturally high loading of silt and sand in running waters
## – Experiences within the scope of the Lutterproject -

by Reinhard Altmüller and Rainer Dettmer

**Contents**



## 1 Introduction and Objectives

The conservation of freshwater pearl mussels [FPM] (*Margaritifera margaritifera*) and thick-shelled river mussels (*Unio crassus*) is a task of european importance (Habitats Directive, Water Framework Directive). This task can only be solved by cooperative efforts of all groups and institutions that are involved with running waters.

All conservation efforts in the past for these two mussel species were focused on maintaining high water quality. For the FPM it is a requirement as all known populations of FPM live only in running waters with the highest water quality. For the thick-shelled river mussel this requirement is as well documented by the fundamental investigations from HOCHWALD (1997). But the question does arise as to whether there are more important factors for the survival of the thick-shelled river mussel than water quality alone. This species was widely distributed in Lower Saxony, for example the river Weser from the city Hannoversch-Münden

(in the south of Lower Saxony) to the city of Bremen (367 km to the north) in very different ecological conditions.

For the FPM, we have been able to clearly demonstrate that in addition to the best water quality, a naturally very low level of fine sediments is characteristic to an intact, recruiting FPM environment After leaving their host fish the young Freshwater Pearl mussels (only 0.5 mm long) live in the hollow system (=Interstitium) between gravel and stones, well protected against water current. The present day high amounts of input and load of fine materials in running waters resulting from current landuse clog up the interstitium and suffocate the typical freshwater organisms living there, including, the young FPM. Because of the failure of young mussels to survive, the FPM was threatened with extinction in the Lutter river and is threatened with extinction all over Europe in human populated regions. If the load of fine material is reduced to naturally occurring amounts, even brooks with overaged FPM populations can recover and numerous young mussels can survive and grow. This has been successfully demonstrated within the lutterproject (ABENDROTH 1993, ALTMÜLLER & DETTMER 2000, ALTMÜLLER 2005). The lutterproject is situated at the south edge of the Lüneburg Heath (Germany, Lower Saxony). It is a nature conservation project led by the counties of Celle and Gifhorn to restore the heather brook Lutter. The reason and main target organism is the freshwater pearl mussel. This very successful nature conservation project was made possible through the financial support of the German Federal Agency for Nature Conservation within the scope of its programme concerning riparian land (SCHERFOSE *et al*. 1996) by the Ministry for Environment of Lower Saxony and of the financial and manpower support of the counties of Celle and Gifhorn.

For successful measures to be taken to reduce unnaturally high sediment load it is necessary to know the origin of the sediment. Apart from the necessity to analyse the specific sediment origin throughout the catchment there are some general experiances and information knowledge. The experiences of unnaturally high loading in the Lutter catchment was reported by ALTMÜLLER & DETTMER (1996). The experiences of unnaturally high loading in the Lutter catchment was reported by ALTMÜLLER & DETTMER (1996). This paper showed that soil erosion and fish pond waste were important contributers to the high loading of fine sediments in running waters.

Since 1996 more knowledge and experience has been gained about the reasons for the unnaturally high load of fine material, which are described herein. All observations and measurements have been carried out to determine the reasons of the extreme sediment input to running waters and to find workable countermeasures.

## 2 Study of sediment levels entering the Lutter - an example from the Endeholz Ditch

Within the scope of the measurement program „quantifying load of sand and mud in heather creeks“ a sediment trap was installed in the Endeholz Ditch. The Endeholz Ditch is a small tributary of the Lutter river which has a catchment size of about 2.38 $km^2$ (HEUER-JUNGEMANN i. lit). Originally it was a small creek which has been extended to form a drainage ditch. About 10 m above it’s confluence with the Lutter river a wooden box was installed in the river bottom (Fig. 1).

Fig. 1: Sediment trap in the Endeholz Ditch to quantify the load of fine sediments. The wooden box (Size: 2 m long, 1 m wide, 0.5 m deep) is open on the top. The sandy material which is mostly transported by rolling over the substrate, along with organic material is deposited in and caught by the box. The sand ripples which are seen in Fig. 1 on the left are typical of an unnaturally high sandy load and are more characteristic of a beach than the bottom of a natural heather creek.

From the end of 1991 to mid 2002 the sediment trap was emptied every week by young men who were doing their civilian service[1] (Zivildienstleistende = ZDL) in the nature conservation specialist agency of Lower Saxony. The amount of deposited material was measured as exactly as possible (Fig. 2).

Fig. 2: Sediment trap in the Endeholz Ditch just before the confluence with the Lutter river (background) with the mound of sandy and organic material which was taken out of the trap from 1991 to 03. April 1998. The size of the mound shows the large amount of material carried by this small ditch.

[1] The sample collection within the measurement program „quantifying load of sand and mud in heather creeks“ has been done by the ZDL of the nature conservation agency. The following ZDL beared the main responsibility: Carsten Brauns (1991), Gundolf Reichert (1991/92), Gerrit Grannas (1992/93), Dierk Rischbieter (1993/94), Moritz Haupt (1994/95), Niels Ubbelohde (1995/96), Tobias Polch (1996/97), Michael Koslowski (1997/98), Gunther May (1998/99), Bernhard Schwarz (1999/2000) Arnold Ziesche (2000/01) und Michael. Herbst (2001/02).

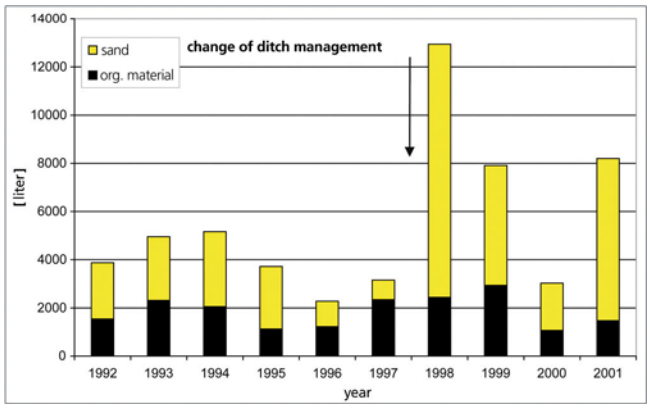


Fig 3: Annual sum of sediment load in the Endeholz Ditch. The change in the method of ditch management from hand clearance to machine clearance from the end of 1997 had a damaging effect on the ditch bottom and its banks, and the sediment load increased significantly. The amount of load after the maintenance of the ditch by machines was much higher than is shown in the figure as the sediment trap overflowed in the first weeks after that occasion.

In Fig 3 the result of weekly emptying the sediment trap is shown as annual sums. The change of load amount from about 3.2 $m^3$ in the year 1997 to about 12.9 $m^3$ in the year 1998. Up to 1997 management of the Endeholz Ditch was carried out by hand but from autumn 1997 it was was done using an excavator. The effect of the excavator was to loosen the sand from the banks and bed of the ditch and to transport it downstream. The authors only heard of this change from the young men who were doing their civilian service, who suddenly every week had to remove more than one $m^3$ out of the sediment trap. The figures 4 to 6 show the effect of this change.

Fig. 4: The Endeholz Ditch in spring of 1998 after management by machines. On the right side the excavated material can be seen. The river bottom is exclusively sand. The ripples are characteristic of the moving sand.


Fig. 5: Mouth of the Endeholz Ditch to the Lutter river in April 1994. At this time very little sand was transported into the Lutter river.


Fig. 6: Mouth of the Endeholz Ditch to the Lutter river on 03.04.1998. The large mass of sand which has been transported into the Lutter river after management of the ditch by machines is clearly seen. The sand which is seen here wasn't caught in the sediment trap 10 m upstream, because the trap was full. Therefore, the amount of load shown in Figure 3 for 1998 is an underestimate.

## 3 Reduction of unnaturally high sand load through installation of sediment traps and monitoring by photo documentation

The input of unnaturally high load of fine sediments in running waters can arise from several different sources depending on the type of land use. Therefore different measures are required to reduce the input. Erosion from farmland results in a considerable loss of valuable soil, therefore it makes sense for farmers to increase their efforts to minimize this loss. In spite of the efforts of the farmers, there will be soil conditions (for example directly after

ploughing) when heavy rainfall will bring high amounts of erosion. There needs to be methods utilised that will reliably prevent harmful input of fine sediments in all situations.

Once it was recognised that the unnaturally high sand load from drainage ditches which flow into the Lutter and its tributaries was the essential reason for the absence of FPM reproduction, sediment traps and plant beds were designed to stop the problem. Sediment traps are created by widening and deepening the drainage ditches. This causes the flow velocity in the area to be reduced so that the sand, silt and coarse organic material is deposited and can be excavated with ease. The function can be demonstrated by taking the sediment trap near the village of Bargfeld as an example. A photo series shows the origin of the sandy load and the successful disposal of these pollutants by the use of the sediment trap.

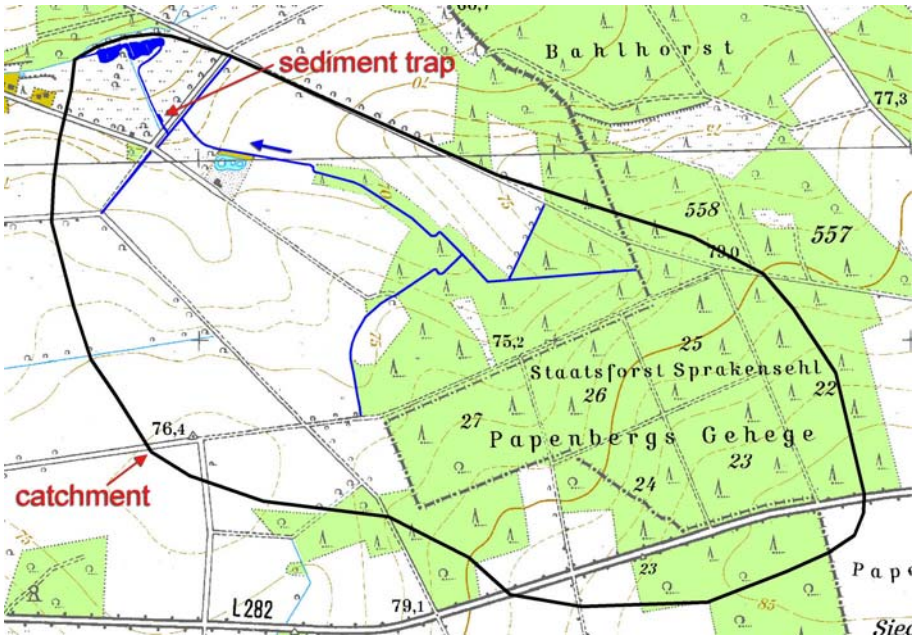


Fig.7: The sediment trap of Bargfeld (in the picture top on the left side) . The sediment trap is situated near a road and, therefore it is within easy and cost-effective reach by machines to empty it.

The sediment trap of Bargfeld (Fig. 7) (WIDRINKA in litt.) receives material from a catchment of about 2 km², of which about 50 % is farmland. This area is almost completely drained and the drainage ditches are cleaned out by machines every year as part of the obligations of water maintenance. The sandy soils are very thin and lay on impervious glacial till. Because of this they can hold and store only small amounts of water. So the drainage ditches are constantly water-bearing only in wet years. In „normal“ years they dry out in summertime.

As with all other cases within the Lutterproject, this sediment trap is situated for ecological reasons directly downstream of the part of the drainage ditch that is under periodic maintenance. So the total sand load of the entire stretch upstream can be caught. The riverbed downstream is not under water maintenance - only the vegetation above water level is cut, in exceptional circumstances. Being permanently water-bearing, the strech downstream of the sediment trap is free of unnatural sediment loads and can develop in a near-natural way.

For economic reasons the sediment trap is built near a road in order to reach it easily with machines for excavation. The system of water management is shown in Fig. 7 and 8. The water which comes from the farmland flows into ditches near the road, crosses the road (red arrow) and flows to the north north-west (nnw) into the little creek called “Köttelbeck” in the

region of “Langenfeld”. In this ditch a sediment trap was built near the road in the winter of 1998/99.

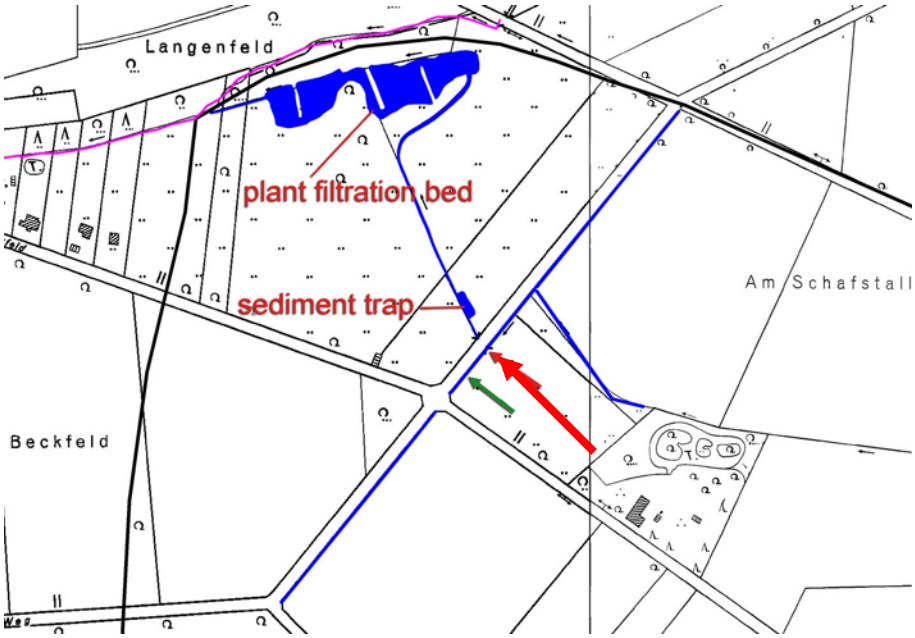


Fig. 8: The complete system, comprising the sediment trap and the plant-bed situated at the lower end of the catchment. The water from the drainage ditches first enters the the sediment trap and then flows through the plant filtration bed. This is a secondary system to absorb the fine particles, which are so small that they do not settle in the sediment trap.

Fig. 9: View in flow direction of the „Sediment trap Bargfeld“ in summer of 1999 about one year after completion and after the first time of excavation. In front of the left side the mouth of the drainage ditch can be seen. At the far end on the left of the sediment trap the drainage ditch continues its flow through dense vegetation.

In winter 2004/2005 the function of this sediment trap was documented photographically. It should be pointed out that there is a time difference between “cause of the unnaturally high load” (this means: ditch management) and “occurrence of the sand downstream” (this means: in the sediment trap).

The following photo series clearly show the effect of ditch management by machines, the successive transport of sand and the function of the sediment trap.

**Photo series 1 (Fig. 10a-d)**
The position of the photographer is about at the top of the red arrow in Fig. 8. For an illustration of the situation in autumn, a picture was taken in autumn of 2005. (Fig. 10a).


Fig. 10: Drainage ditch running parallel to the farm road. For position of the photographer see Fig. 8, top of the red arrow, view direction: sw.
Fig. 10a: Situation before the annual ditch maintenance (12.11.2005).
Fig. 10b: directly after maintenance by machines (21.11.2004).
Fig 10c: More than one month after maintenance at 30.12.2004 . Additional sand is transported in this stretch.
Fig. 10d: At 16. 03. 2005, most of the sand which was loosened during clearance is washed away. It remains a stony and gravely river bed as is typical for natural creeks in this region.

**Photo series 2, Fig. 11a – 11 d:** Position of the photographer the same as in fig. 9, south of the sediment trap. View direction: north in flow direction of the drainage ditch.


Fig. 11: Sediment trap ”Bargfeld”.
Fig. 11a: the sediment trap on 30 12. 2004. No sand has reached the sediment trap, more than five weeks after the ditch clearance and only 30 m downstream of position fig. 9 and 10. Only after two months (fig.: 11b, 22.01.2005), the amount of transported sand becomes more visible and then more evident two weeks later (fig. 11c, 06.02.2005). One month later (fig. 11d, at 16. 03. 2005) the sand transportation in the drainage ditch has been completed and the sand has reached the sediment trap. The plant has done its job. The sediment trap is approximately one third full, equivalent to about 50 m³. At this time the drainage ditch is already washed free of sandy material (see fig. 10d). Without the sediment trap the mass of sand would have been transported downstream to the Lutter River where it would have infiltrated and overlayed the naturally stony and gravely river bed similar to the situation visible in fig. 10b and 10c. Also, without the sediment trap there would be no evidence of the quantity of sand that was mobilised by only one episode of ditch management by machine.

Both photo series demonstrate and explain one origin of unnaturally high sand load in a small drainage ditch in a low gradient area. It is a stark demonstration of the ecological problem present for the FPM. They also show that the chances to minimize this source of threat for the biocoenosis of running waters is relatively easy when located at the right place. Additionally they show that one needs a sediment trap to demonstrate the huge amounts of sand which can be contributed to a natural creek by one small drainage ditch. At the same point on the drainage ditch the situation can look stable for a long time (Fig. 10b and 10c). However, the sand passes over this area and, therefore one is unable to formulate an impression of the quantity of the sand that has passed through.

The sediment trap Bargfeld is an example of how unnatural sand input is prevented from entering natural running waters within the Lutterproject. Installation of sediment traps in each of the numerous drainage ditches within the catchment of the Lutter River was reliant on the fact that the areas were purchased by the project management. Then a procedure was developed to get permission to install the sediment traps. The realization of all the necessary projects took a very long time - from 1989 up to the present (2006). Therefore the input of sand could only be reduced in successive stages. The effect to the biocoenoses of all these measures therefore could only arise after the gradual improvement of the ecological conditions.

## 4 Accelerated reduction of fine sediment load by the use of a mill pond as a sediment trap

The reduction of fine sediment load in the lower reaches of the Lutter River got an important boost through purchasing the rights to an old Mill in the village of Eldingen by the lutterproject management. The remaining semi natural streches of the river Lutter lie downstream of this mill. In the summer of 1989 the owner of the mill was informed about the problems the pearlmussels had with mobilized sediments coming from the mill pond. After this he kindly agreed not to drain off the mill pond. Previously, the mill weir had been raised during flood events to preserve the buildings. The effect or success of not raising the weir is shown in figure 12. After purchasing the watermill in 1992, the water level of the mill pond has been permanently lowered as far as it was possible, so that the water could pass the mill even in flood without damaging the buildings (See 12b). Since then the mill pond has never been emptied and it acts as a very large sediment trap. The accumulated sand and mud has been taken out by the use of a suction dredge. To date, about 6,800 $m^3$ of sand and mud have been pumped out (personal communication: government of the county of Celle and engineering office HEIDT & PETERS, Celle).


Fig. 12: Back water of the mill of Eldingen just before (left) and just after (right) the notary certification of the contract of sale. Prior to 1992, large quantities of sediments had already accumulated in the backwater of the mill (right picture).

As these pumped out masses of sediments are not washed downstream, they have not covered the natural river bottom and killed the typical biocoenosis. On the contrary, the sand masses which covered the stony and gravely river bottom up to this time were successively washed away so that gravel and stones appeared again at the surface. Fig. 13 shows how much the quantity of sediment drift has been reduced by this action. In the year 1968 under leadership of BISCHOFF a small bypass was built in a narrow curve of the Lutter about seven kilometres downstream of the mill of Eldingen. About 5 - 10 % of the Lutter water runs through this bypass. In January of 1991 a sediment trap like the one shown in fig. 1 was built in this bypass. This sediment trap has been emptied weekly since then. Fig. 13 shows the annual sum of the sediment drift from 1991 to 2006. The sum of rainfall has been measured in the private „weather station“ of the first author, which is located about 5 km from the sediment trap. The high rainfall in winter 1993/94 gave rise to a corresponding high flow in

the Lutter, and produced very high sediment drift. In 1994 up to 19 $m^3$ sand was removed from the sediment trap. This equates to about 190 - 380 $m^3$ sand transport in the Lutter. As with the trap in the Endeholz ditch, this sediment trap also overflows in the weeks with the highest sand transport. As the fine sand fraction doesn't deposit, the real amount of transported material is even higher than has been measured.

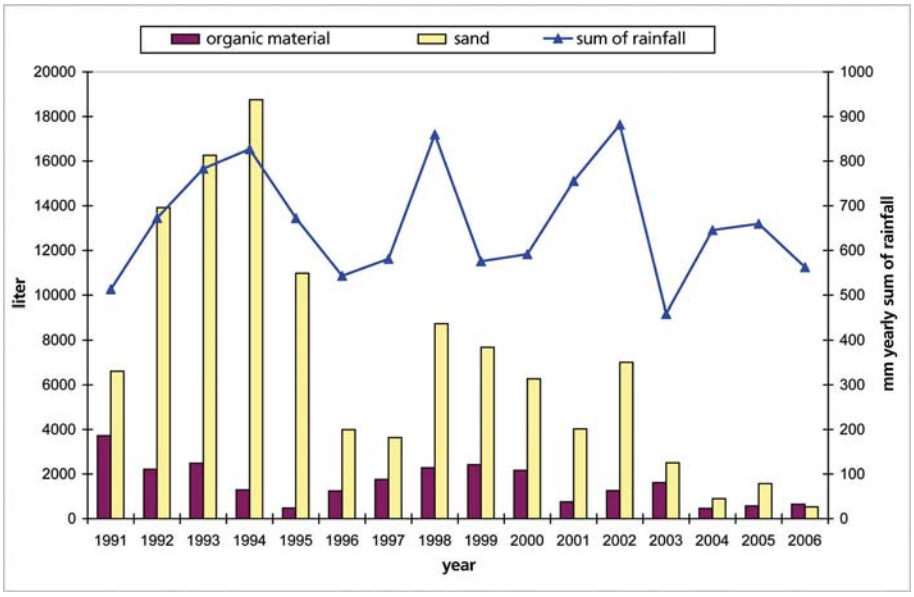


Fig. 13: Trend of sediment transportation in the Lutter. The amount has been measured in a sediment trap as shown in fig. 1. The success of the sediment trap "mill pond" and of the sediment traps in the drainage ditches is clearly seen.

Initially the upper reaches of the c. seven kilometre long stretch downstream of the mill were washed free from overlaying sand. The stony and gravely substrate emerged again and could be colonized by the typical Flora and Fauna. The typical inhabitants of a natural brook reacted immediately to this naturally recovered structure of the river bottom. An example of this phenomenon was the new high reproduction of minnows (*Phoxinus phoxinus*).

## 5 Successes for the biocoenosis of the brook

### 5.1 Example minnows (*Phoxinus phoxinus*)

Minnows are typical and numerous inhabitants of waters with stony gravely bottom and / or shores. In the lower reaches of the river Lutter downstream of the mill of Eldingen they had only seldom been caught by annual electro fishing, which had been carried out since 1985. This changed after the transport of fine sediments was stopped in summer 1992. The winter flood in 1993/94 then washed out the sand, which had previously covered the stony gravely river bottom (ALTMÜLLER & DETTMER 1996). The minnows reacted immediately to this and reproduced very successfully. Given their former rareness the sudden appearance of breeding minnows was very surprising. It was also confirmation that the large amounts of sand were the greatest remaining problem for the river ecosystem.
Minnows spawn in gravel material and prefer a grain size of 2 cm in diameter (BLESS 1992), and they spawn in sections with high current. While spawning the Minnow -♀ inject their eggs between the gravel (Fig. 14). The eggs cling on to the gravel because of their adhesive surface. Here they are protected against voracious individuals of the same species and are supplied by a circulation of oxygen rich water. After about a one week's embryonic development the hatched out fish larvae migrate as deep as possible into the substrate, most likely to escape the suction from the turbulent water above them. They are supported by a yolk sac and are not able to swim (benthic phase). They hide in narrow niches between stones where the current is at its lowest (Fig. 15). Here they are most protected. However,

these are also the parts of the river bed that are first clogged if sediments are brought into the river - which is fatal for the inhabitants. After development within the substrate the minnow larvae migrate upwards through the interstitium into the open water (pelagic phase, free swimming larvae).

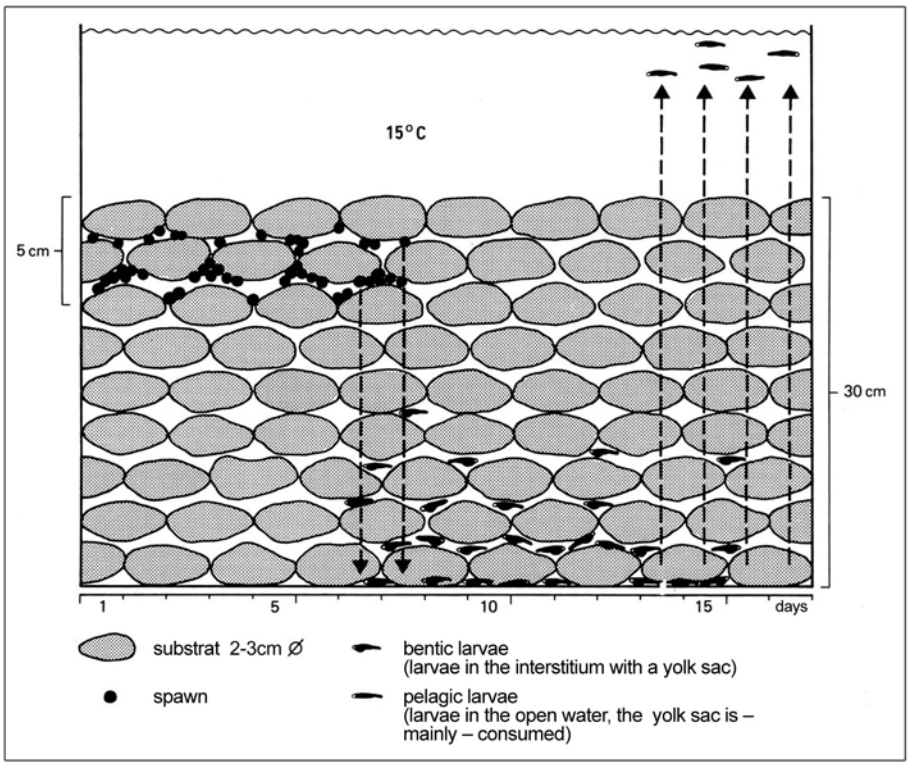


Fig. 14: Time table (Tage = days) of the space used by juvenile stages of minnows at 15 °C water temperature (after experiments in an aquarium). The aquarium is filled with a 30 cm thick gravel layer in a size which minnow-♀ prefer. For explanation see text (Figure adapted slightly from BLESS 1992).

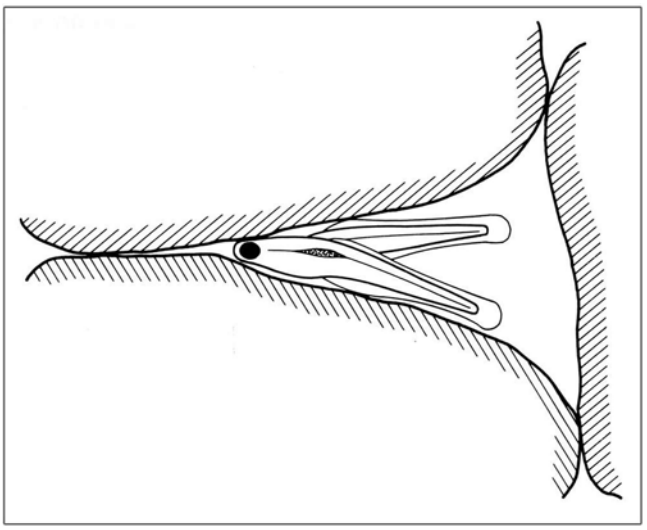

Fig. 15: Minnow larvae hide into narrow niches made by the gravel, probably to protect themselves against upward suction by the current. Here (as deep as possible in the bottom in the narrow niches formed by the gravel) the suction power is lowest and so is the danger of washout (after BLESS 1992).

The following graphs (Fig. 16a-e) show the minnow population in the lower reaches of the river Lutter downstream the mill of Eldingen. In the graphs the number of minnows per 100

metres is shown within each of the randomly selected fishing sectors. The sectors which have not been fished are marked. It can be clearly seen that the minnows - starting in the upper reaches - successively colonized (or re colonized) the river Lutter. Minnows are now (in 2006) again the typical and most numerous inhabitants of the river, and always accompany the author during the snorkelling surveys to investigate the pearl mussel population.

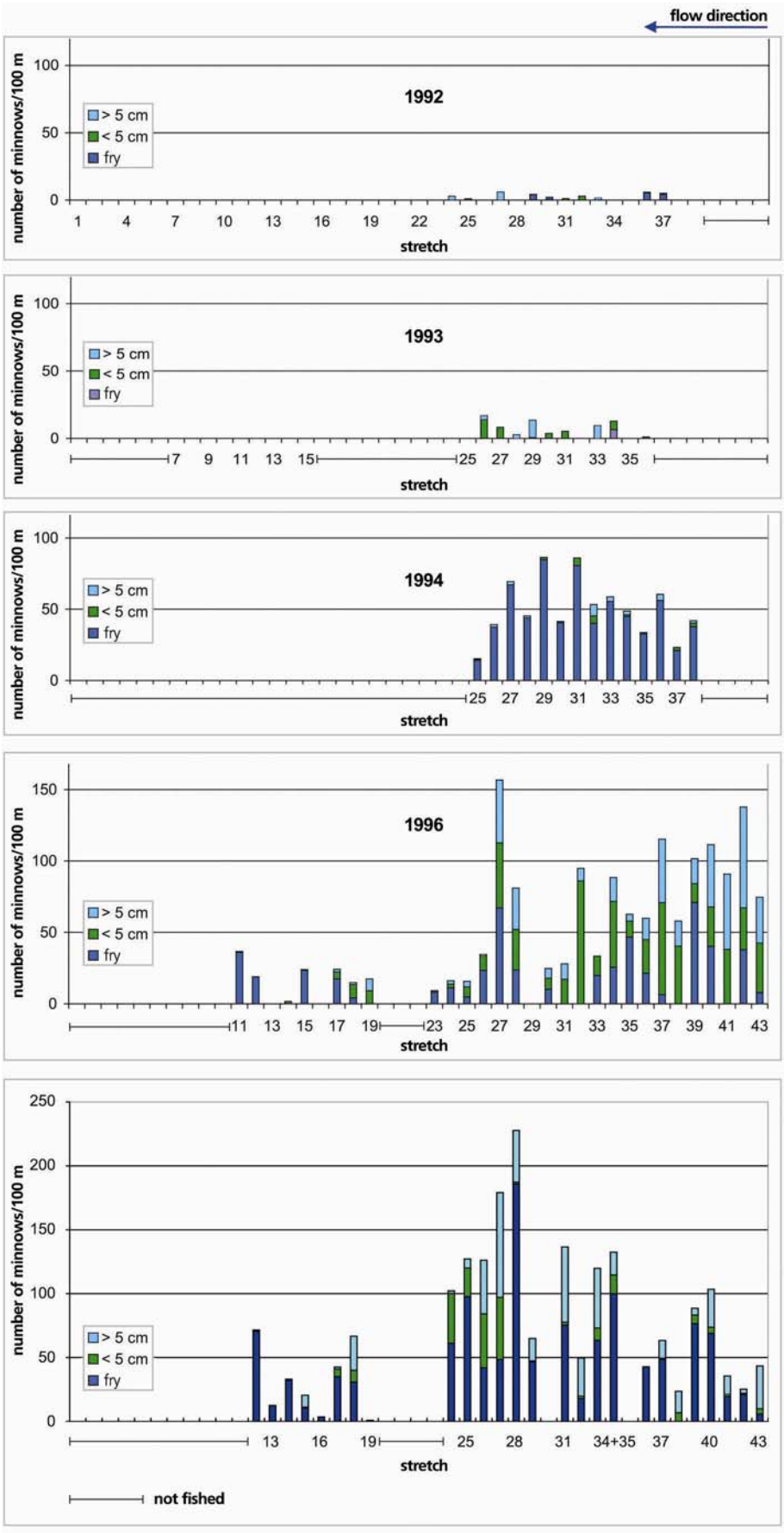


Fig. 16a-e: Development of the minnow population in the natural lower reaches of the river Lutter in the years 1992 - 1998. Sectors which were not investigated by electro fishing are shown by a line. Abschnitt = stretch; nicht befischte = not fished.

## 5.2 Example of the Freshwater Pearl Mussel

As the rate of growth of the FPM is very slow and the young mussels spend at least the first 5 years of their life hidden in the river bed substrate, the success of the measures for the species and biotope protection for the FPM (the target species), could only be shown after several years.

In the river Lutter the young FPM need to reach the age of about seven years before they are big enough to emerge from the gravel into the flowing water to get more water through their gills for better oxygen and food supply. It is only then that they can be seen by the investigator without destroying their habitat by dredging.

Fig. 17: River bottom of the Lutter with an adult FPM and three young mussels which are not easily seen between the gravel.

The first shells of young mussels were found in 1997, and the mussel population has been investigated by snorkelling annually since 2000.

The results of these investigations are shown in figure 18. In 2006 more than 83 % of the total of about 7,400 FPM in the river Lutter are younger than 20 years. This success is in great contrast to the fact that all other european freshwater pearl mussel populations in human settled regions are without successful reproduction and therefore they are threatened with extinction (GEIST 2005).

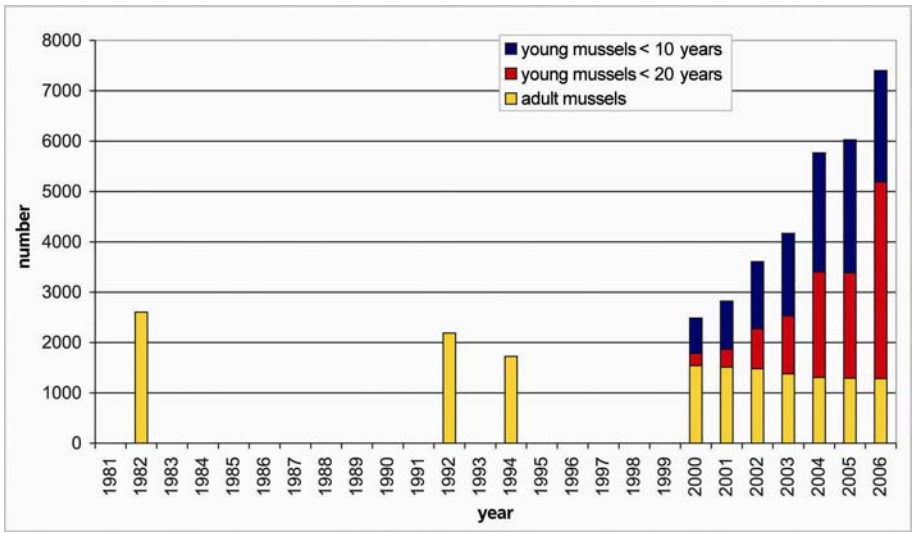


Fig. 18: Population development of the Freshwater Pearlmussels in the river Lutter. This positive trend is due to the reduction of the anthropogenic sand load since the upstream mill pond has not been drained off and therefore the sediments are no longer washed out of the mill pond.

The long term survival of the FPM population in the river Lutter was given additional hope with the verification of the presence of young brown trout (*Salmo trutta f. fario*) in 2005 and 2006, which were naturally infected with FPM glochidia. (Fig. 19). Since the year 2003 no brown trout have been artificially infected with larva (glochidia) of the FPM in the natural lower reaches of the river Lutter. Furthermore, given that the oldest of the young FPM came to mature age and in view of such a large number of young mussels, natural infection of brown trout should be possible. However, to be certain of this, the artificial infection of brown trout with FPM glochidia must be stopped. The young infected brown trout which were found in 2005 and 2006 live in reaches of the river Lutter where only a few old FPM can be found. These few individuals produce too few glochida to successfully infect brown trout. The high number of glochida necessary for an intensive infection can only come from the high number of young mussels which are maturing at present.

The age composition of the infected brown trout is very interesting. Most of the infected fish examined in May of 2006 were born the previous year. They had been infected at an age of only a few months old. During the periods of artificial infection, fish this young were not utilised as they are very sensitive and easily damaged.

Fig. 19: Young brown trout of 2005 with nearly ripe young freshwater pearl mussels in the gills (light points) (result of electro fishing for monitoring - 07.05.2006). The glochidia are derived from young mussels which have matured after successful species and biotope protection measures. They will build up the F2 generation, but any success cannot be proven for another 5 – 7 years.

## 6 Conclusion and outlook on the future

Unnaturally high sediment load, produced by human land use and other activities, considerably affects running waters and their biocoenosis. Most of the running waters of the northern german lowland are in this damaged condition.

Taking the example of the river Lutter and its ecologically very demanding resident population of freshwater pearl mussel, it has been shown that there are indeed opportunities for restoration and, within this, chances of survival even for very demanding species which once were typical and abundant. This is dependent upon water quality not being reduced by waste water or unnaturally high input of nutrients, that there is still the original or a near-natural river bottom, and no unnatural sediment input.

The nature conservation measures for the freshwater pearl mussel in the catchment of the river Lutter were only made possible by the considerable funds made available for the Lutter Project, and by the goodwill, trust and cooperation of everyone involved in the project (ALTMÜLLER 2005).

The experiences and knowledge from the Lutter Project should be used not only for freshwater pearl mussel conservation measures in other catchments, they should be used in general for river conservation, development and restoration measures.

Anthropogenically derived high sediment load clogs the lattice system (Interstitium) between sand, gravel and stones so that the typical animals living there die. Furthermore, sediment covers continously, in a rolling movement – like shifting sand dunes – even in a river bottom that was originally stable.

Each river bottom that is mainly stable is colonized by organisms almost on the surface. Where there is light and nutrient, algae may grow, but even small animals colonise a stable bottom in huge numbers or they live burrowed by themselves in the upper film. Even these less demanding surface organisms are suffocated by shifting sediment dunes, as well as those that live in the deeper interstitium.

As with the reduction of nutrient load, the reduction of fine sediment load must become a general requirement within running water restoration and protection work and a common goal of water and nature conservation.

In every case the place for reducing the unnaturally high load should be located as close as possible to the source of the problem. Erosion is harmful to a farmer’s business and, therefore, it is in every farmer’s interest to take all known and possible steps to reduce erosion and preserve economic viability. The most important measure is to have as complete a soil cover as possible. However in the course of a year their may be a phase without soil cover for arable farmland. For this period of time it is necessary to take precautionary measures on all sites which are at risk from erosion. For some farmers this precaution may seem to be excessive, because incidents of erosion are relatively few in number and with long periods between, and may even discourage some farmers from taking precautionary measures because of economic impact. However, even a single high erosion incident can bring major sediment input which can severely damage running waters and their very long lived biocoenosis.

Within the sphere of the Lutter project with maintenance of waters, especially management of drainage ditches, and the resultant sediment load, from an economic point of view it is indispensable to install sediment catchers in all drain ditches. In time it is possible to take out of the waters both the sediments which are mobilized by ditch management and those which are coming from erosion and/or other origins.

The excavation of the sediment traps can be done within the yearly maintenance of waters without any significant increase in cost, provided that the sediment trap is located where it will have maximum effect and its dimensions are big enough. However, the emptying of the sediment traps has to be done with care or else they will refill very quickly and then overflow. Special responsibility for the correct management of the sediment traps has to be taken by the association that also maintains the waters and manages the ditches.

The measures of nature and water protection that are described in this article especially apply to the preservation and recovery of the freshwater pearl mussel. But all measures together already contribute towards fulfilling targets set within several Directives of the European Parliament. So the restoration work on the lower reaches of the river Lutter are very successfull species and habitat conservation projects within the European Habitats Directive but also within the European Water Framework Directive to achieve good ecological conditions:

- Within the European Habitats Directive the habitat 3260 „Water courses of plain to montane levels with the *Ranunculion fluitantis* and *Callitricho-Batrachion* vegetation " have been brought into favourable conservation status (Annex I, Directive 92/43/EWG)
- the populations of the freshwater pearl mussel, the Green Club-tailed Dragonfly (*Ophiogomphus cecilia*) and the Bullhead (*Cottus gobio*) has been brought into favourable conservation status (Annex II, Directive 92/43/EWG).

Within the European Water Framework Directive (Directive 2000/60/EC) the recovered stretch of the river Lutter, or rather the condition of it, was brought into a good status, i.e. the hydromorphological characteristics and the physico-chemical quality elements.

In addition to the above, the special feature of this water protection, water conservation and nature conservation project is that there are only small follow-up costs and also no costs to manage a specific state of cultural landscape.

## 7 Table of the colleagues involved in the species protection measures for the freshwater pearl mussel

The results of electrofishing and the success of the species protection measures that are described here has been achieved by enthusiastic friends of nature, generally in their free time. The spawning time of the FWP-♀ is not predictable. Therefore in summer from mid-July all private appointments had to be subordinate to the life history of the mussels. In the following all attendees of the species protection measures for the freshwater pearl mussel in Lower Saxony (also in the rivers Lachte and Bornbach) are listed in alphabetic order.

Reinhard Altmüller, Wolf-Dietrich Bischoff, Dietrich Blanke, Ulli Brandt, Rainer Dettmer, Frauke und Heiner Drögemüller, Christian Gietz, Otto Golze, Günter Grein, Roger Günsel, Stefan Heitz, Iris Herrmann, Thomas Herrmann, Matthias Holsten, Renate und Stefan Hölter, Lennart, Manuel und Norbert Horny, Gerd Hübner, Thomas Kaiser, Heinrich Klaholt, Andreas Knoop, Ernst und Ole Kohls, Henning Köneke, Gabi Kremming, Jens Kubitzki, Peter Lorz, Hans-Jürgen Löther, Sonja Lüßmann, Christian Makala, Anna, Hans und Moritz Menneking, Lars und Wolfgang Mosel, Annette Most, Dirk Mundt, Matthias Olthoff, Sören Ostermann, Ulrich Pittius, Gabriele Potabgy, Anke Preiß, Manfred Rasper, Günter, Ronja und Vigdis Ratzbor, Dierk Rischbieter, Thomas Schick, Gudrun Schmal, Daniel Schneider, Burkhard und Ulrich Schnepper, Peter Sellheim, Brigitte Steinhardt, Egon Steinkraus, Agnes Steinmann, Andreas Thiess, Frank, Hans-Hermann und Holger Trumann, Wieland Utermark, Günther Wilkens.

In addition to the young men listed an page 3 who made their civilian service (ZDL) were the following ZDL involved in the species protection measures and the surveys:

Thomas Clavier, Carsten Dettmann, Michael Friese, Thorben Fründt, Michael Geilke, Manfred Grenz, Günther Hansen, Horst Hildebrandt, Markus Kietz, Thomas Klug, Andreas Nitschke, Ulrich Söffker und Alexander Wiebe.

## 8 Summary

The freshwater pearl mussel was formerly abundant in running waters of the „Lüneburg Heath“, a north eastern landscape in Lower Saxony in the North of Germany. Using the example of the remaining freshwater pearl mussel population in the river Lutter it has been shown that good water quality alone is not enough for its survival. The unnaturally high amounts of load (sand and silt) are harmful substances for the river biocoenosis. Only after the reduction of these high amounts of load could typical fish such as minnows (*Phoxinus phoxinus*) naturally reproduce. Also, it is only after the reduction of the huge load that the relief measures which focused on artificially infecting wild living brown trout (*Salmo trutta* f. *fario*) with glochidia became successful with young mussels surviving and growing. Currently the next mussel generation has started to grow up without any artificial help.

With the installation of sediment traps in all drainage ditches a method has been developed and used, which can help to reduce the problems with unnaturally high load of fine sediment and which may be applied across Europe.

Some targets of the European Habitats Directive and of the European Water Framework Directive are shown to be achievable.

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**The authors**

Dr. Reinhard Altmüller, born 1948, studied biology and read for his doctorate at the Georg-August-Universität at Göttingen. Since 1976 he has been responsible for Invertebrates at the Lower Saxony Specialist Agency for Nature Conservancy. One focus of his job has been to investigate the organisms of running waters, especially the freshwater pearl mussel, and the development of ways to improve their habitats.

Rainer Dettmer, born 1955, studied biology at Hanover. In his dissertation he investigated the biology of the freshwater pearl mussel (1982). Since then he has worked on the biology and conservation of naiads and other limnological questions, especially electro fishing, funded by different institutions (TiHo Hannover, Lower Saxony State Agency for Ecology, NLWKN, Nature Conservation Organisations, Nature Conservation Council).

**Impressum**

Editor:

Lower Saxony Water Management, Coastal Defence and Nature Conservation Agency [Niedersächsischer Landesbetrieb für Wasserwirtschaft, Küsten- und Naturschutz (NLWKN) – Fachbehörde für Naturschutz –]

The „Informationsdienst Naturschutz Niedersachsen“ is published at least 4 x a year. ISSN 0934-7135

http://www.nlwkn.niedersachsen.de/master/C14754742_N14750639_L20_D0_I5231158.html

1. edition 2006, 1 – 3.000

Fotos: R. Altmüller ©.

Fig. 13 u. 14 (page 13) from „BLESS, R. (1992): Einsichten in die Ökologie der Elritze *Phoxinus phoxinus* (L.). Praktische Grundlagen zum Schutz einer gefährdeten Fischart. – Schr.-Reihe für Landschaftspflege und Naturschutz 35“ kindly allowed by the German Federal Agency for Nature Conservation (Bundesamt für Naturschutz), Bonn.

Origin of the topographic maps:

Source: Extract from geospatial basic data of the Surveying and Cadastral Authority of Lower Saxony, Germany LGN

Cartography: Peter Schader, NLWKN – Naturschutz –

Editorship: Manfred Rasper, NLWKN – Naturschutz –

Authors address:

Dr. Reinhard Altmüller

NLWKN, Betriebsstelle Hannover-Hildesheim

Göttinger Chaussee 76 A, 30453 Hannover

reinhard.altmueller@nlwkn-h.niedersachsen.de

Rainer Dettmer

Giesener Str. 13

30519 Hannover

Order:

Niedersächsischer Landesbetrieb für Wasserwirtschaft, Küsten- und Naturschutz (NLWKN) – Naturschutzinformation –

Postfach 91 07 13, 30427 Hannover

e-mail: naturschutzinformation@nlwkn-h.niedersachsen.de

fon: 0511 / 3034-3305

fax: 0511 / 3034-3501

**www.nlwkn.de** > Naturschutz > Veröffentlichungen

# Appendix C
# Site Investigation Report

# Appendix D
# Employer's Project Programme

# Appendix E
# Mitigation Management Summary

# PINEWOODS WIND LIMITED

# Pinewoods Wind Farm, Co. Laois and Co. Kilkenny.

# PRELIMINARY CONSTUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

TECHNICAL SCHEDULE NO. 1
Environmental (Incident & Emergency) Response Plan

**January 2017**

**Pinewoods Wind Limited,**
c/o Galetech Energy Services,
Clondargan,
Stradone,
Co. Cavan

Tel.: +353 49 555 5050

**Jennings O'Donovan & Partners Limited,**
Consulting Engineers,
Finisklin Business Park, Sligo.
Tel.: 071 - 916 1416
Fax: 071 - 916 1080
e mail: info@jodireland.com

**JENNINGS O'DONOVAN & PARTNERS LIMITED**
Project, Civil and Structural Consulting Engineers,
FINISKLIN BUSINESS PARK,
SLIGO,
IRELAND.

Telephone (071) 91 61416
Fax (071) 91 61080

Email info@jodireland.com
Web Site www.jodireland.com

## DOCUMENT APPROVAL

| | | |
|---|---|---|
| **PROJECT** | Pinewoods Wind Farm | |
| **CLIENT / JOB NO** | Pinewoods Wind Limited | 5538 |
| **DOCUMENT TITLE** | Preliminary CEMP<br>Technical Schedule No. 1 Environmental (Incident & Emergency) Response Plan | |

| | **Prepared by** | **Reviewed** | **Approved by** |
|---|---|---|---|
| Document<br>Final | Name<br>Ciara Gilligan | Name<br>Nuala Carr | Name<br>David Kiely |
| Date<br>January 2017 |  |  |  |

| | **Prepared by** | **Reviewed** | **Approved by** |
|---|---|---|---|
| Document | Name | Name | Name |
| Date | | | |

# CONTENTS

# 1. INTRODUCTION

## 1.1 Why have an Environmental (Incident & Emergency) Response Plan?

Many construction and industrial sites intrinsically have the potential to cause significant environmental harm which could threaten water supplies, public health and wildlife in the event of an environmental incident. As such, strict conditions form part of the planning permission that was granted for the development of Pinewoods Wind Farm. The aim of this plan is to ensure that in the event of an emergency, quick action will limit any impacts on humans and the local environment.

This response plan forms part of the conditions of work for staff, and for every contractor or sub-contractor at the site.

## 1.2 Outline of this Environmental (Incident & Emergency) Response Plan.

The information contained in this plan forms the Environmental (Incident & Emergency) Response (ERP) Plan, part of the Construction Environmental Management Plan for Pinewooods Wind Farm.

It contains details of:

- Who should be contacted in an emergency;
- Procedures to be followed in an emergency
- Staff responsibilities in an emergency.

## 1.3 What is an Environmental Incident?

This plan should be instigated once there has been an emergency or environmental incident on site or elsewhere linked to the construction of Pinewoods Wind Farm. Such an incident is a discharge to air, land or water that could cause environmental damage. Causes of environmental incidents on site include:

- Leaking plant or equipment;

- Containment Failure;
- Fire;
- Peat Slide;
- Vandalism;
- Overfilling of containment vessels;
- Flooding on site;
- Discharge of raw or partially treated effluent;
- Leaking Portaloo;
- Wind-blown waste, litter or dust;
- Fuel drips or spills during refuelling;
- Leak from fuel or chemical containers;
- Contaminated water or sediment/silt entering a water course or drain;
- Failure of pumps and pipelines.

Any of these incidents could affect drainage systems, surface waters, aquatic ecosystems, groundwater and soil. These incidents could also affect air quality by producing toxic fumes and airborne pollutants which may damage human health, wild and domestic animals and ecosystems.

## 1.4 Reference Documents

Current legislation has been taken into account into the production and further development of the Contractor's Construction Phase Plan.

This plan has been developed alongside other technical schedules that form part of the preliminary Construction Environmental Management Plan (CEMP) including:

Surface Water Management Plan

Spoil Management Plan

Environmental Impact Statement (EIS)

Inland Fisheries Ireland (IFI) Guidelines

Communication Plan (TS2)

Waste Management Plan (WMP – TS3)

Induction Schedule (IS – TS5)

Water Quality Monitoring Plan (WQM – TS6)

Noise Management Plan (TS7)

## 2. GENERAL REQUIREMENTS OF AN ERP PLAN

As mentioned, environmental incidents may include: flooding; spillages (oil and chemicals); contaminated run-off; riverbed disturbance; damage to underground services; damage to habitats; poor waste disposal and storage.

This Environmental Incident & Emergency Response (ERP) plan:

- Provides an outline of the construction works and references to relevant existing environmental plans;
- Summarises local environmental sensitivities;
- Identifies key mapping reference points for the site;
- Identifies key staff and 24 hour contact details to be contacted in the event of an emergency;
- Identifies key external bodies and emergency response numbers who should be contacted in the event of an emergency;
- Details an Inventory of Chemical Products and Waste Inventory on Site*;
- Details an Inventory of Pollution Prevention Equipment;
- Provides details of staff trained in the use of spill kits and booms etc;
- Provides details of reporting requirements;
- Provides detailed procedures to be followed in the event of an emergency and details staff responsible for re-positioning and moving of plant;
- Provides a summary sheet for operatives outlining key actions in the event of an emergency. This will be available to all operatives on site.

***Because of the nature of wind farm construction operations the nature of works on site, the potential pollutants will vary. Therefore sections 4 and 5 will be continually updated at the site office*.

## 3. CONSTRUCTION WORKS AT PINEWOODS

Pinewoods Wind Limited intend to commenced construction works for their wind farm in late Q4 2017. Pinewoods wind farm will comprise of 11 no. turbines, each with a maximum height of up to 136.5 metres, and all associated site development and ancillary works, including a 110kV electricity substation, switchroom and equipment compound; two single circuit strain towers with a maximum height of up to 26.5 metres; turbine foundations; crane hardstandings; a total of 7.4 kilometres of site access tracks (2km of site access tracks are located in Co. Kilkenny) ; underground electricity and commutations cabling; site drainage works; 7 no. site entrances; permanent meteorological mast with maximum height of up to 85 metres; and temporary upgrade to the R430/L7800 road junction. Planning approval was granted by the Department of the Environment Planning Service for this development, as detailed in section 1.2 of the CEMP.

Detailed geotechnical site investigation will be carried out at pre-construction stage, and will be included in this plan.

## 4. INCIDENT & HAZARD REPORTING

A system has been developed for reporting environmental incidents or hazards for the site. These reports will be logged so that they can be regularly revised and form part of the response plan procedural review.

The last page on this report has attached a blank environmental incident report that should be completed in the event of an accident/incident. This includes details of all non-compliance and corrective actions carried out as a result of any incidents.

## 5. WASTE DISPOSAL AFTER ENVIRONMENTAL INCIDENCES.

If spill kits etc are used in the event of a pollution incident, operatives need to ensure that such used equipment should be carefully disposed of by placing them in a sealed bag or container. They should then be removed from site by a licensed waste contractor as per the Site Waste Management Plan (TS 3).

## 6. SITE INDUCTION AND TOOL BOX TALKS

It is imperative that all contractors, sub-contractors and staff on site are fully familiar with this Environmental (Incident & Emergency) Response Plan and it will be detailed regularly in Tool Box Talks. During these talks, they will also receive regular reminders of the importance of the local environment and of the necessary environmental controls that are in place on site. Please refer to TS 4 Site Induction Schedule.

## 7. SUMMARY SHEET FOR MACHINERY & PLANT OPERATORS

This summary sheet is for all site personnel. A laminated copy will be kept on all site vehicles/ machinery.

**Procedures to be followed in the event of an incident:**

The following procedures are intended as a guide in dealing with incidents. Health & safety guidance should be followed at all times applying common sense and ensuring the health & safety of yourself and others:

1. Identify the source of the spillage and cut off source if possible e.g. by closing valve, righting container etc.

2. Work on site will cease and all operatives will assist in placing spill mats on the affected area. Site Manager/ Main Contact should be notified.

3. Identify where spillage may go. If spillage is near a watercourse (drainage/ditch/ river) divert spillage away from the watercourse through the use of absorbent materials from the spill kit.

4. SUSPENDED SOLIDS CONTAMINATION OF WATERCOURSE. If watercourse is at risk of contamination from suspended solids from a slope failure, do as follows:

   a) Place straw bales wrapped in geotextile or sand/gravel bags with geotextile curtains **immediately** in the watercourse(s) at regular intervals downstream from the incident. These sand/straw bags and bales will be removed and replaced with stone filters once water quality is stabilised.

b) Stone check dams faced with a layer of geotextile will be constructed at critical points along the watercourse.

c) Small sumps will be formed intermittently between the check dams to reduce the amount of suspended solids contained in the water.

5. OIL SPILL IN WATERCOURSE. If spill has reached the watercourse, do as follows:

a) Place flexible absorbent booms across watercourse, ahead of the contamination within a quiet stretch of water.

b) Place absorbent cushions in the water immediately upstream of these booms as well as downstream of the booms.

c) Remove and replace saturated absorbent material as required. Please ensure removed cushions are placed in sealed polythene bags/containers and disposed of by the principal waste contractor.

6. Notify all parties in the order listed overleaf. Notification should be made by one member of staff whilst remainder of staff present deal with the spill.

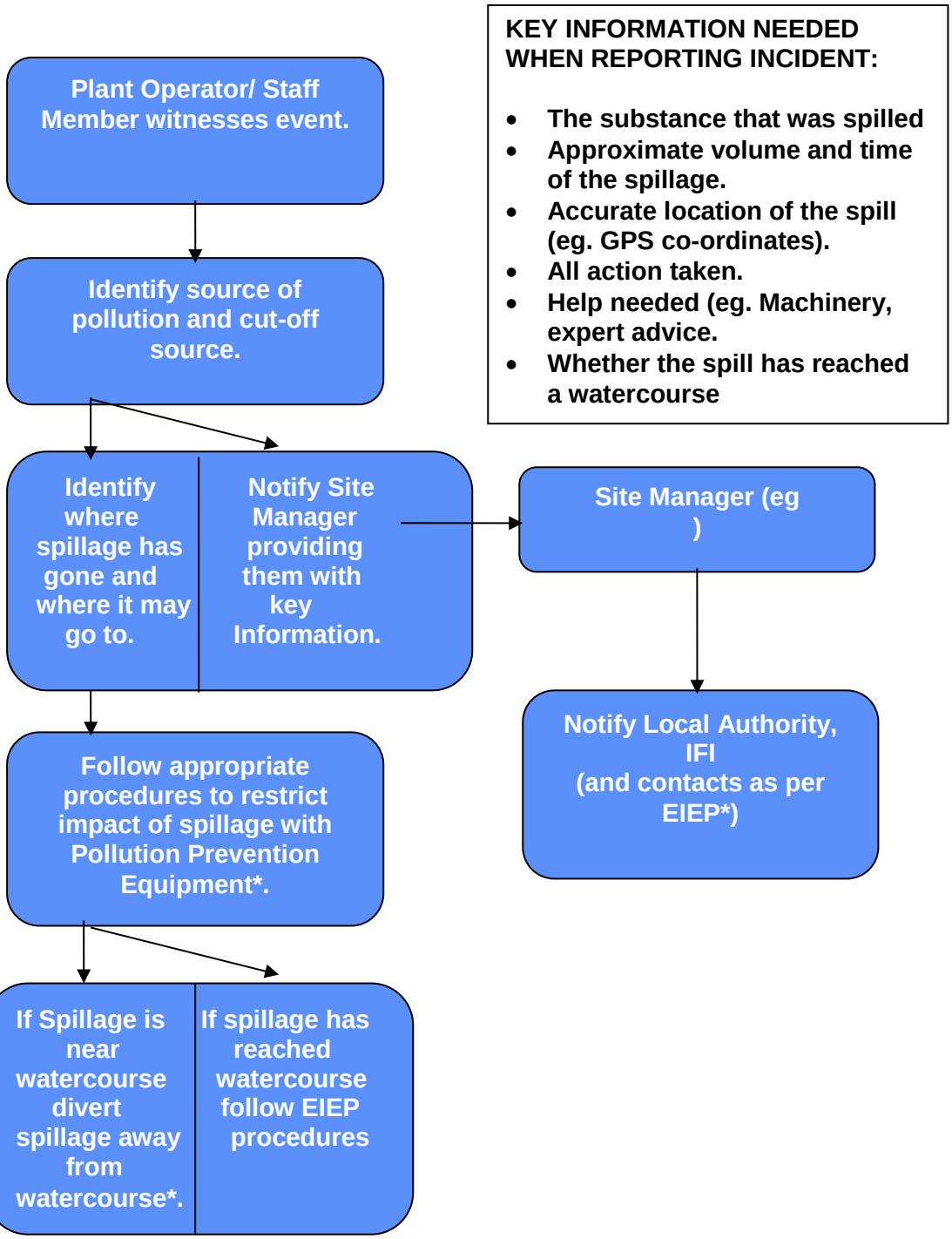
7. Dig up all contaminated ground as soon as possible/immediately. All contaminated materials should be placed in sealed polythene bags/containers and disposed of appropriately by an appropriate licensed waste contractor.

8. Complete required record of incident and response into reporting system

## 7.1 Communication Plan

A Communication Plan (to be followed in the event of a spillage) will be provided by the Contactor, in liaison with relevant stakeholders and will be included in the updated Environmental (Incident & Emergency) Response Plan prior to commencement of site

development works. An outline Communication Plan is proposed below:



## 8. ENVIRONMENAL (INCIDENT & EMERGENCY) RESPONSE PLAN FOR PINEWOODS WIND FARM.

### INCIDENT RESPONSE PLAN FOR PINEWOODS WIND FARM

*Based on template provided in PPG 21 – Pollution Prevention Guidelines.-*

| | |
|---|---|
| **Site Address:**<br>Knockardugar, Boleybawn, Garrintaggart, Ironmills (Kilrush) and Graiguenahown, County Laois and Crutt, County Kilkenny.<br><br>**Official Company Address:**<br>Pinewoods Wind Limited,<br>Greaghcrottagh<br>Tullyco<br>Cootehill<br>Co. Cavan<br><br>**KEY HOLDERS FOR SITE – NAME & CONTACT NUMBERS:** | **NGR:**<br><br>**Map references: OSI Discovery Sheet 60**<br><br>**Link to Map:** |
| **Overview of the activities on site:**<br>**Include number of employees at different time of the day:**<br><br>Daylight Hours:<br><br>Dusk to Dawn:<br><br>Weekend Dusk to Dawn:<br><br>Bank Holidays: | |
| **Date & Version of the plan:** | **Name & position of person responsible for compiling/approving the plan:** |
| **Review Date** | **Date of next exercise:** |
| **Objectives of the plan:**<br>To limit any potential harmful impact to the local environment through swift and appropriate actions in the event of an emergency. | |
| **List of external organisations consulted in the preparation of this plan with contact details** | |
| **Distribution list of who has received this plan and which version.** *Please note that it is recommended that you review and revise this plan regularly:* | |

## 9.1 External Contacts

| Contact | Office Hours | Out of Office |
|---|---|---|
| **Emergency Services** (Fire/Police/Ambulance) | 999 or 112 | 999 or 112 |
| **Local Garda Station** Knocknamoe, Abbeyleix, Co. Laois | (057) 873 0580 | 999 |
| **Local Hospital** Midland Regional Hospital, Portlaoise, Co. Laois | (057) 862 1364 | (057) 862 1364 |
| Saint Luke's Hospital, Co. Kilkenny | (056) 778 5000 | (056) 778 5000 |
| **Local Authority Environmental Section** | | |
| Co. Laois | (057) 867 4312 | (057) 86 64000 |
| Co. Kilkenny | 056 - 7794470 | 1890 252654 |
| **Inland Fisheries Ireland** | 01 8842600 | 01 8842600 |
| **Local Authority – Roads Section** | | |
| Co. Laois | (057) 86 64000 | (057) 86 64000 |
| Co. Kilkenny | 056 - 7794010 | 1890 252654 |
| **ESB- Electricity Company** | 01 8529534 | |
| **Telecommunications – Eircom** | 1800475475 | |
| | | |
| | | |
| | | |

## 9.2 Internal Contacts

| Names and position of staff authorised and trainers to activate and co-ordinate the plan.<br>Staff to be contacted if need to move or evacuate the site |
|---|
| Other Staff: |
| Managing Director |
| Site Manager |
| Environmental Manager |
| Health & Safety Manager |
| |
| |

## 9.3 Chemical Product & Waste Inventory

| Trade name/ substance | Solid/liquid/ gas or powder | UN number | Max amount | Location marked on site plan | Type of Containment | Relevant health & Environmental properties |
|---|---|---|---|---|---|---|
| | | | | | | |
| | | | | | | |
| | | | | | | |
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| | | | | | | |
| | | | | | | |

## 9.4 Pollution Prevention Equipment Inventory (On/Off-Site Resources)

| Type | Location | Amount | Staff contact |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

*For example:*

- *Personal protective Equipment (PPE) available that should be worn.*
- *absorbents;*
- *drain mats/covers;*
- *pipe blockers;*
- *booms;*
- *pumps;*
- *sand bags,*
- *silt fencing,*
- *over drums.*

*IF ANY OF THIS EQUIPMENT REQUIRES SPECIALIST TRAINING – STATE WHO HAS BEEN TRAINED IN ITS USE AND DATE OF TRAINING (attach evidence where possible).*

## 8.1 Site Plan

Please refer Figure 2 for example of a typical Temporary Construction Compound layout. Detail drawings of the Site Layout will be included pre-construction.

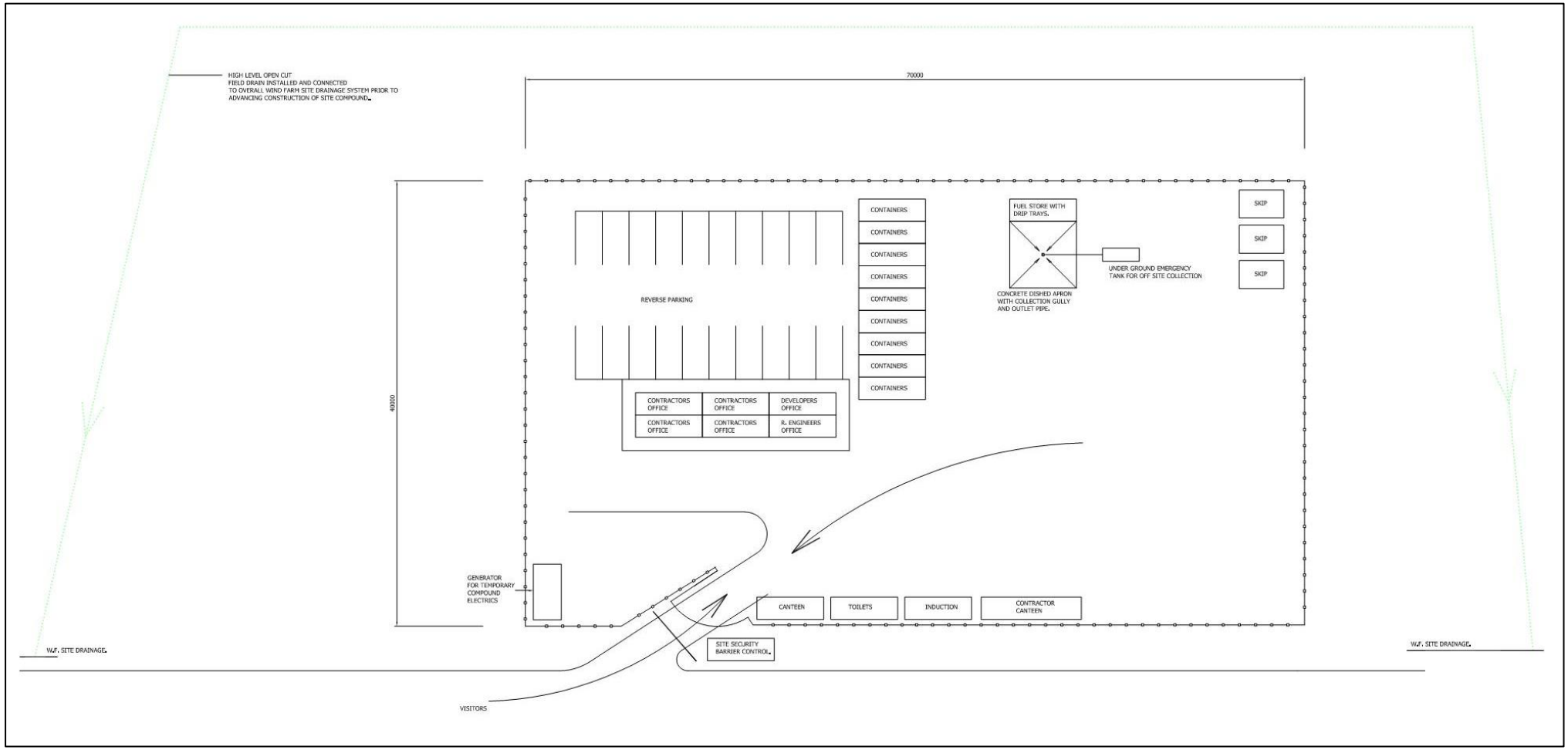



**Figure 2 Typical Temporary Construction Compound – Plan**

PINEWOODS WIND FARM ENVIRONMENTAL INCIDENT REPORT

## 8.2 Site Environmental Incident Report Form

| | | | |
|---|---|---|---|
| Site | | Date | |
| Time | | Weather: | |

| | | | |
|---|---|---|---|
| Report By: | | Position: | |
| Pinewoods personnel present: | | Position: | |
| Contractor Personnel Present: | | Position: | |

| |
|---|
| Description of incident: |

| | |
|---|---|
| Item Spilled | |
| Estimate of Volume of Spillage: | |

| List of actions followed once incident was noted | Time | Corrective Action By | |
|---|---|---|---|
| | | Action | By |
| Who first observed incident? | | | |
| First action | | - | |
| Next Action | | | |
| Time Pollution Hotline was contacted | | | |
| Other | | | |

PINEWOODS WIND FARM ENVIRONMENTAL INCIDENT REPORT

| | | | |
|---|---|---|---|
| | | | |

| Details of Clean-Up contractor or how contamination was removed from site: |
|---|
| |

| | |
|---|---|
| Details of how this could be avoided in future: | |
| Details of review of internal procedures as result of this incident: | |

DATE REPORT COMPLETED_____

PINEWOODS WIND FARM ENVIRONMENTAL AUDIT REPORT

| | | | |
|---|---|---|---|
| **Site:** | | **Date**: | |
| **Time:** | | **Weather conditions:** | |

| | | | |
|---|---|---|---|
| **Report by:** | | **Position**: | |
| **Galetech Energy Services personnel present:** | | **Position:** | |
| **Contractor personnel present:** | | **Position:** | |

| **Item** | **Questions** | **Yes** | **No** | **Corrective Action Required** | |
|---|---|---|---|---|---|
| | | | | **Action** | **By** |
| **1. Miscellaneous** | | | | | |
| 1.01 | Does the contractor carry out regular internal environment audits on the site? Are recommendations recorded and is corrective action monitored? | | | | |
| 1.02 | Have any environment incidents occurred and have these been reported as per on site procedure? | | | | |
| 1.03 | Does the site induction contain a section on environmental requirements, including spill procedures, and is this communicated effectively? | | | | |
| **2. Land** | | | | | |
| 2.01 | Are areas of hard standing (excluding bunded and refuelling areas) appropriately drained? | | | | |
| 2.02 | Have local roads been inspected and cleaned where necessary? | | | | |
| 2.03 | Has all test pitting and soil stripping been monitored by an archaeologist? | | | | |
| 2.04 | Have all site clearance works been checked by an ecologist prior to works? | | | | |

PINEWOODS WIND FARM ENVIRONMENTAL AUDIT REPORT

| Item | Questions | Yes | No | Corrective Action Required | |
|---|---|---|---|---|---|
| | | | | Action | By |
| **3. Material and equipment** | | | | | |
| 3.01 | Is there general knowledge of pollution prevention guidelines such as the UK PPG 21 Pollution Prevention Guidelines? | | | | |
| 3.02 | Are transformers/ generators located in secondary containment bunds? | | | | |
| 3.03 | Are all bunds capable of containing 110% of the volume of the largest container? | | | | |
| 3.04 | Is refuelling carried out in a designated refuelling bay? | | | | |
| 3.05 | Does all site drainage on hard standing drain to an oil interceptor? | | | | |
| 3.06 | Is the designated area for oil, fuel and chemical storage appropriately sited (i.e. on hard standing at least 10m from a watercourse)? | | | | |
| 3.07 | Are there procedures in place to monitor bund integrity and mange bund rainwater levels?<br><br>Are these followed and recorded? | | | | |
| 3.08 | Is there awareness that oil or residue from contaminated water removed from bunds should be disposed of as special waste and not discharged to land or the water environment? (oil absorbent materials (pads etc.) should be used first) | | | | |
| 3.09 | Are all drums and mobile plant (e.g. generators) placed on drip trays more than 10m from any watercourse? | | | | |
| 3.10 | Is all plant maintained in a good state of leaks?<br>Are there records of this? | | | | |
| 3.11 | Are there adequate spill kits available and stored either on machinery or in close proximity to potential risks? | | | | |
| 3.12 | Are all refuelling browsers double skinned, locked when not in use, and in a good state of repair? | | | | |

PINEWOODS WIND FARM ENVIRONMENTAL AUDIT REPORT

| Item | Questions | Yes | No | Corrective Action Required | |
|---|---|---|---|---|---|
| | | | | Action | By |
| 3.13 | Is there evidence of unmanaged/ unrecorded fuel / oil spillages on site? | | | | |
| 3.14 | Are dry or wet wheel washing facilities fully operational and effective? | | | | |
| 3.15 | If wet wheel washing facilities are required, are these closed systems with no discharge to the water environment? | | | | |
| 3.16 | Are there laboratory certificates (**accredited by the Irish National Accreditation Board (INAB)**) to confirm that imported material stone aggregate brought onto site is free from any contamination? | | | | |
| **4. Noise, Dust and Light** | | | | | |
| 4.01 | Are there facilities to dampen stockpiles and site working areas/roads to suppress dust? | | | | |
| 4.02 | Are vehicles carrying loose material sheeted at all times? | | | | |
| 4.03 | Are construction works, or deliveries of materials to and from the development, audible at noise sensitive premises? | | | | |
| 4.04 | Has all external construction lighting received the approval of the planning authority? | | | | |
| **5. Waste** | | | | | |
| 5.01 | Is the site tidy and free from litter? | | | | |
| 5.02 | Is there evidence of waste beyond the site boundary? | | | | |
| 5.03 | Is waste segregated and kept securely in containers in clearly designated areas? | | | | |
| 5.04 | Does all waste leaving the site have the appropriate duty of care paperwork? | | | | |
| 5.05 | Is all waste leaving the site being taken to an appropriately licenced site? | | | | |
| 5.06 | Does all special/ hazardous waste (e.g. oil contaminated soils, waste oil) have the appropriate Special Waste Consignment Note? | | | | |
| 5.07 | Is material re-used/recycled on site where possible? | | | | |

PINEWOODS WIND FARM ENVIRONMENTAL AUDIT REPORT

| | | | | | |
|---|---|---|---|---|---|
| 5.08 | Are waste management practices in line with the site waste management plan? | | | | |
| 5.09 | Are relevant Waste Management Exemptions in place for use of waste on site (e.g. use of waste concrete to create foundation sub-base)? | | | | |
| **Item** | **Questions** | **Yes** | **No** | **Corrective Action Required** | |
| | | | | **Action** | **By** |
| 5.10 | Is there any evidence of burning on site? | | | | |
| 5.11 | Is there any evidence of unlicensed burial of waste? | | | | |
| **6. Water** | | | | | |
| 6.01 | Do all discharges to land or watercourses have appropriate authorisation from Local Authority? | | | | |
| 6.02 | Does all watercourse engineering (bank protection, crossing etc.) have the appropriate authorization from Local Authority? | | | | |
| 6.03 | Do any abstractions from a watercourse or groundwater body have the appropriate authorization from Local Authority? | | | | |
| 6.04 | Has confirmation for the SUDS design for access roads been gained from Local Authority/Road Department? | | | | |
| 6.05 | Are cut-off ditches installed on the uphill side of the working area to avoid contaminated surface water run-off? | | | | |
| 6.06 | Have field drain been diverted where necessary? | | | | |
| 6.07 | Is adequate treatment (e.g. settlement tank/lagoons/discharge to land) provided to prevent silt contaminated water entering watercourses and groundwater? | | | | |
| 6.08 | Has vegetation removal/ clearance of the site been minimised to avoid unnecessary areas of bare ground? | | | | |
| 6.09 | Have buffer-strips been left between working area and watercourses? | | | | |
| 6.10 | Is plant operating in the watercourse? | | | | |
| 6.11 | Have all culverts been installed at the base of stockpiles situated within close proximity to watercourses? | | | | |
| 6.12 | Have silt fences been installed at the base of stockpiles situated within close proximity to watercourses? | | | | |

PINEWOODS WIND FARM ENVIRONMENTAL AUDIT REPORT

| | | | | | |
|---|---|---|---|---|---|
| 6.13 | Are there adequate controls on site construction roads to minimize sediment runoff into watercourses (in particular, are there adequate flow Attenuation measures within surface drain)? | | | | |
| 6.14 | Are there any sign of decaying straw bales in water courses? (this could lead to organic pollution of the water course) | | | | |
| 6.15 | Are silt traps regularly maintained? | | | | |
| 6.16 | Has ease of maintenance been considered in the design of permanent drainage features? | | | | |
| **Item** | **Questions** | **Yes** | **No** | **Corrective Action Required** | |
| | | | | **Action** | **By** |
| 6.17 | Is there evidence of contamination of any watercourse (e.g. with oil, sediment, concrete, waste) in the vicinity of the works? | | | | |
| 6.18 | Is monitoring of potential impacts on watercourses carried out on a regular basis and fully recorded? | | | | |
| 6.19 | Are dewatering operations being carried out in such a way to minimise sediment contamination? | | | | |
| 6.20 | Is drainage and run off in concrete batching areas adequate? | | | | |
| 6.21 | Are adequate pollution prevention measures considered and put in place during concrete pours? | | | | |
| **7. Landscape** | | | | | |
| 7.01 | Have earthworks been designed to promote successful re- instatement of vegetation? | | | | |
| 7.02 | Are reinstatement and restoration works being implemented in a timely manner as per the requirements of the Contract? | | | | |
| **8. Ecology** | | | | | |
| 8.01 | Have storage sites (soil, plant etc.) been sited on areas of lower quality habitat where possible? | | | | |
| 8.02 | Is the ECoW a member of the institute of Ecology and /or Environmental management as required by planning conditions? | | | | |
| 8.03 | Has the ECoW inspected areas of forest prior to felling? | | | | |
| 8.04 | Have buffer zones been constructed and maintained around designated protected | | | | |

PINEWOODS WIND FARM ENVIRONMENTAL AUDIT REPORT

| | | | | | |
|---|---|---|---|---|---|
| | species exclusion areas (e.g. red squirrel dreys, water vole habitats, otter holts etc.)? | | | | |
| 8.05 | Have bat emergence/ dawn surveys been carried out prior to tree felling to ensure bats are not present in forested areas? | | | | |
| 8.06 | Have toolbox talks on the subject of ecology and environmental responsibilities on site been delivered?<br><br>Have attendance record been maintained for these? | | | | |

**9. Documentation Check**

| Item | Questions | Yes | No | Corrective Action Required | |
|---|---|---|---|---|---|
| | | | | Action | By |
| 9.01 | Start-up meeting record | | | | |
| 9.02 | Full contacts list in Section 3, Table 3.1 of CEMP | | | | |
| 9.03 | Induction records | | | | |
| 9.04 | Pollution Prevention Measures Register | | | | |
| 9.05 | Geotechnical Risk Register | | | | |
| 9.06 | Weekly meeting minutes | | | | |
| 9.07 | Records of environmental checks and routine monitoring of mitigation measures | | | | |
| 9.10 | Water Quality Monitoring Results | | | | |
| 9.11 | Safety and Environmental Awareness Reports (SEARs). Filed and entered on database? | | | | |
| 9.12 | Safety and Environmental Audit Reports for the site.<br><br>(If yes, insert date of last audit_____) | | | | |
| 9.13 | Contractor's Environmental Plans (Technical Schedules or Construction Method Statements): | | | | |

# PINEWOODS WIND LIMITED

## Pinewoods Wind Farm,
## Co. Laois and Co. Kilkenny.

# PRELIMINARY CONSTUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

TECHNICAL SCHEDULE NO. 2
Emergency Communications Plan

**January 2017**

**Pinewoods Wind Limited,**
c/o Galetech Energy Services,
Clondargan,
Stradone,
Co. Cavan

Tel.: +353 49 555 5050

**Jennings O'Donovan & Partners Limited,**
Consulting Engineers,
Finisklin Business Park, Sligo.
Tel.: 071 - 916 1416
Fax: 071 - 916 1080
e mail: info@jodireland.com

**JENNINGS O'DONOVAN & PARTNERS LIMITED**
Project, Civil and Structural Consulting Engineers,
FINISKLIN BUSINESS PARK,
SLIGO,
IRELAND.

Telephone (071) 91 61416
Fax (071) 91 61080

Email info@jodireland.com
Web Site www.jodireland.com

## DOCUMENT APPROVAL

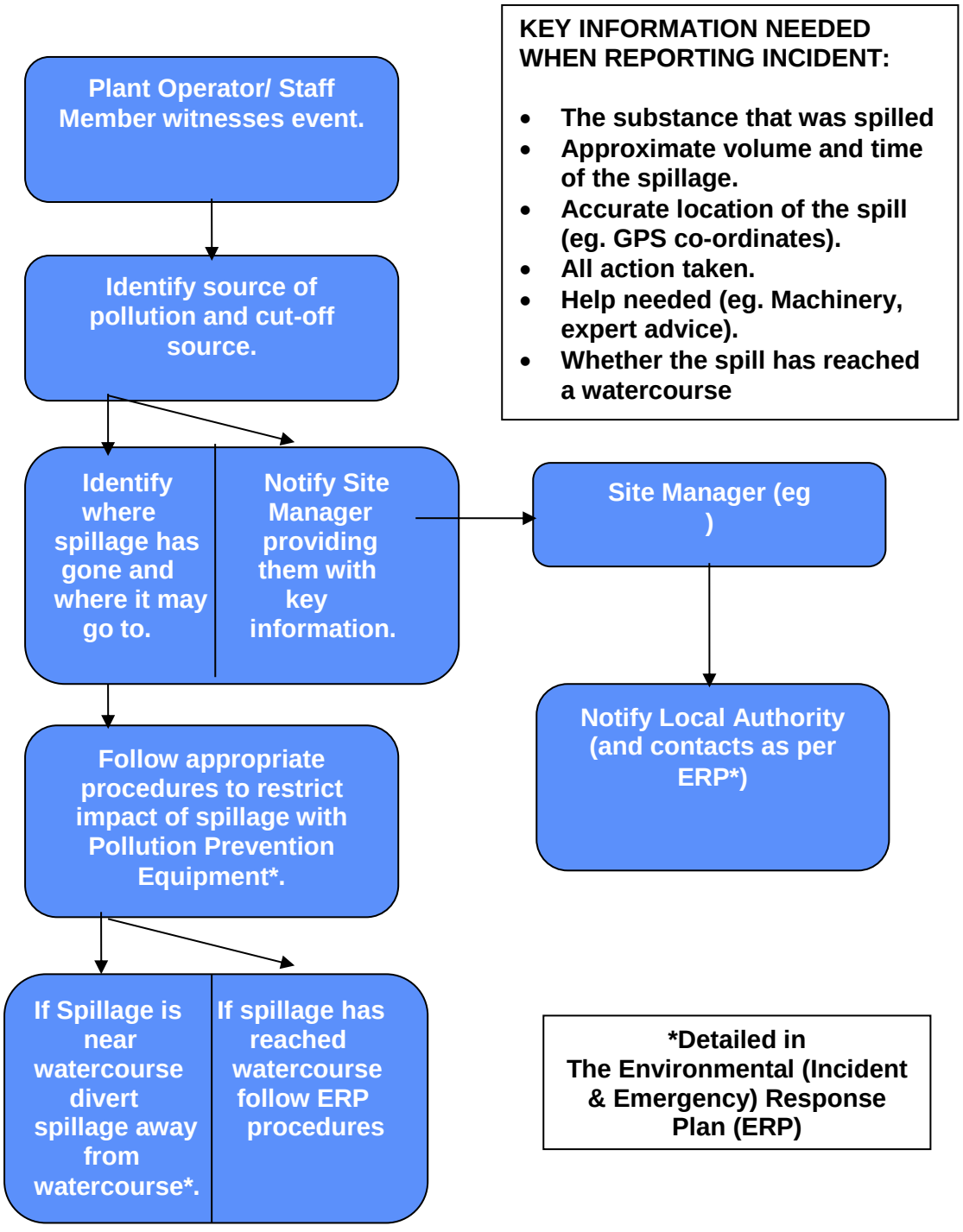
| | | |
|---|---|---|
| **PROJECT** | Pinewoods Wind Farm | |
| **CLIENT / JOB NO** | Pinewoods Wind Limited | 5538 |
| **DOCUMENT TITLE** | CEMP<br>Technical Schedule No. 2 - Emergency Communications Plan | |

| | **Prepared by** | **Reviewed** | **Approved by** |
|---|---|---|---|
| Document<br>Final | Name<br>Ciara Gilligan | Name<br>Nuala Carr | Name<br>David Kiely |
| Date<br>January 2017 |  |  |  |

| | **Prepared by** | **Reviewed** | **Approved by** |
|---|---|---|---|
| Document | Name | Name | Name |
| Date | | | |

**COMMUNICATION PLAN IN EVENT OF SPILLAGE /POLLUTION INCIDENT**

Diagram showing the lines of action regarding communication in the event of an incident:



The following information should be provided in a clear, concise manner:

- The substance that was spilled.
- Approximate volume and time of the spillage.
- Accurate location of the spill (eg. GPS co-ordinates).
- All actions taken.
- Help needed (eg. machinery, expert advice, disposal).
- Whether the spill has reached a watercourse.

## PINEWOODS SITE ENVIRONMENTAL INCIDENT REPORT

| | | | |
|---|---|---|---|
| Site | | Date | |
| Time | | Weather: | |

| | | | |
|---|---|---|---|
| Report By: | | Position: | |
| Pinewoods personnel present: | | Position: | |
| Contractor Personnel Present: | | Position: | |

| |
|---|
| Description of incident: |

| | |
|---|---|
| Item Spilled | |
| Estimate of Volume of Spillage: | |

| List of actions followed once incident was noted | Time | Corrective Action By | |
|---|---|---|---|
| | | Action | By |
| Who first observed incident? | | | |
| First action | | - | |
| Next Action | | | |
| Time Pollution Hotline was contacted | | | |
| Other | | | |

## PINEWOODS SITE ENVIRONMENTAL INCIDENT REPORT

| Details of Clean-Up contractor or how contamination was removed from site: |
|---|
| |

| | |
|---|---|
| Details of how this could be avoided in future: | |
| Details of review of internal procedures as result of this incident: | |

DATE REPORT COMPLETED_____

# PINEWOODS WIND LIMITED

# Pinewoods Wind Farm, Co. Laois and Co. Kilkenny.

# PRELIMINARY CONSTUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

TECHNICAL SCHEDULE NO. 3
Waste Management Plan

## January 2017

**Pinewoods Wind Limited,**
c/o Galetech Energy Services,
Clondargan,
Stradone,
Co. Cavan

Tel.: +353 49 555 5050

**Jennings O'Donovan & Partners Limited,**
Consulting Engineers,
Finisklin Business Park, Sligo.
Tel.: 071 - 916 1416
Fax: 071 - 916 1080
e mail: info@jodireland.com

**JENNINGS O'DONOVAN & PARTNERS LIMITED**
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FINISKLIN BUSINESS PARK,
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IRELAND.

Telephone (071) 91 61416
Fax (071) 91 61080

Email info@jodireland.com
Web Site www.jodireland.com

## DOCUMENT APPROVAL

| | | |
|---|---|---|
| **PROJECT** | Pinewoods Wind Farm | |
| **CLIENT / JOB NO** | Pinewoods Wind Limited | 5538 |
| **DOCUMENT TITLE** | CEMP<br>Technical Schedule No. 3 - Waste Management Plan | |

| | **Prepared by** | **Reviewed** | **Approved by** |
|---|---|---|---|
| Document<br>Final | Name<br>Ciara Gilligan | Name<br>Nuala Carr | Name<br>David Kiely |
| Date<br>January 2017 |  |  |  |

| | **Prepared by** | **Reviewed** | **Approved by** |
|---|---|---|---|
| Document | Name | Name | Name |
| Date | | | |

# Contents

# 1. INTRODUCTION

## 1.1 Scope and Requirements

The information in this document forms part of Technical Schedule No.3 – The Site Waste Management Plan (WMP) of Pinewoods Wind Farm Construction Environmental Management Plan (EMP).

The EMP and the measures detailed in this Waste Management Plan are part of the main requirements for consents for planning permissions. As such, the contractor (and all sub-contractors) on site are obligated to incorporate these waste requirements (contained herein) in all operations.

The general methods and principles detailed within this document will be adhered to by the contractor as they are committed to reduce the resources it uses in the construction work of Pinewoods Wind Farm.

## 1.2 Waste Prevention & Waste Regulations:

There are regulations of note in the production of this Site Waste Management Plan (WMP):

- Waste Management Acts 1996 to 2008

S.I. No. 126/2011 - European Communities (Waste Directive) Regulations 2011 infers a duty on all waste producers to take measures to apply the waste hierarchy priority order:

***Waste Management Priority Hierarchy which contractors are obligated to apply: (Source: EPA):***

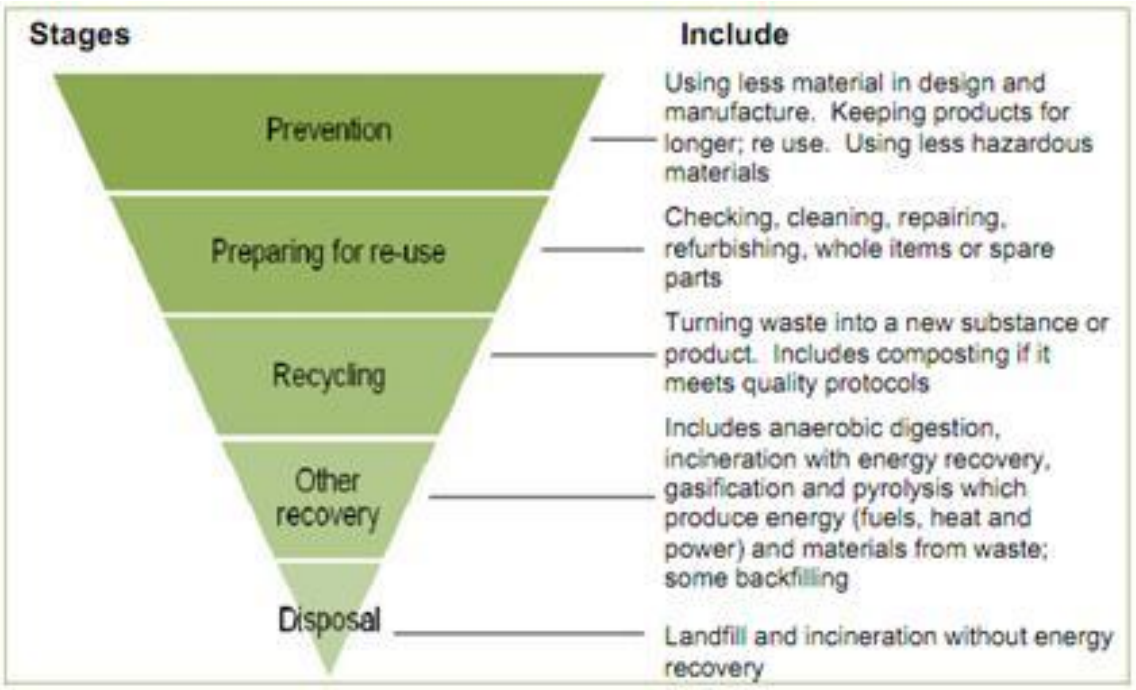

The waste management hierarchy applies to all waste, including hazardous waste. The top of the triangle indicates that the priority should be in preventing waste being produced in the first place.

## 1.3 Benefits of Waste Prevention.

The contractor must be committed to preventing waste through implementing reduction and effectively managing resources from the design stage of construction to the completion of the construction of the project. This will ensure that:

- Legal obligations are met
- Waste production is minimised.
- Build costs are minimised.
- A framework for continuous assessment and best practice is implemented.
- Carbon emissions and negative environmental impacts of and from waste materials are reduced.

The following image explains this in more detail. The least favoured option is to dispose of waste to landfill where embodied energy is not recovered.




### 1.4 Reference Documentation

As well as the Waste Management Act 1996-2008 other guidance documents have been used to develop this plan. These include:

**Pollution Prevention Guidelines:**

Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects, Dept. of Environment, Heritage & Local Government, July 2006.

**EU Directive:**

**Article 4 of Waste Framework Directive (Directive 2008/98/EC)**

This sets out the five steps for dealing with waste.

## 2. WMP MINIMUM REQUIREMENTS

A Site Waste Management Plan (WMP) involves the following stages:

- Planning
- Implementation

- Monitor
- Review

## 2.1 Planning

The planning stage of the development of Pinewoods Wind Farm has taken into account the nature of the site, design of the wind farm, environmental considerations and construction methods to minimise the quantity of waste produced on site during its construction.

## 2.2 Implementation

This WMP will include:

1. An inventory of waste type expected to be produced in the course of the project.

2. Estimates of each type of waste that will be produced in the construction of this wind farm.

3. A statement showing how the contractor will minimise each type of waste to be produced prior to any activity generating this waste.

4. Procedures for identification of the waste management actions proposed for each different waste type, including re-using, recycling, recovery and disposal (as per the waste hierarchy priorities).

## 2.3 Monitoring

### 2.3.1 Checks and Records

All stores on site of oil, fuel, chemicals etc should be regularly checked (in particular in extreme weather conditions) for evidence of leaks or spills. The timing of each of these checks is detailed in section 3. These checks will be visual inspections to look for evidence of contamination.

Records of all visual checks must be maintained and be available for inspection on request.

Waste Management will be a regular item on team meetings as required by the EMP. Waste Management Practices should be revised at these meetings. There should be a site waste audit carried out every six months (see section 2.3.3).

### 2.3.2 Waste Inventory

A waste inventory should be maintained and kept up to date. It will include an inventory of all waste materials leaving the site for disposal. A Waste Inventory Spreadsheet should be added to this plan by the Contractor.

### *2.3.3 Monitoring of Site Waste Management Plan*

The contractor will appoint a person to implement and monitor the WMP.

As stated, the WMP should include an inventory of the types and estimates of the waste to be produced on site. The aim will be to keep volumes of waste produced below the estimates of waste to be produced. The appointed person should ensure that a Site Waste Audit is carried out every **six months**.

## 2.4 Completion, Audit and Review

Upon completion of construction works but before the end of the defects correction period, a Waste Management Review should be undertaken. The aim of this is to identify project progress, measure compliance with licenses and to consider lessons learnt.

A Waste Management Review will be carried out at the end of construction.

## 2.5 Site Waste Management as Part of Site Induction process

All workers on-site should be fully briefed with the WMP. All site visitors will be briefed on appropriate waste storage and disposal units. Littering on site will not be tolerated. All personnel have a Duty of Care to challenge others noted littering on site.

# 3. GENERAL WASTE MANAGEMENT PRINCIPLES

3.1 The contractor will avoid or minimise the volume of waste generated.

3.2 Waste including spoil, will not be stored within 50m of a watercourse at Pinewoods.

3.3 Waste storage and disposal will be carried out in a way which prevents pollution in compliance with legislation.

3.4 A waste to be transported off site to a licensed disposal site. Duty of Care Waste Control dockets must be produced and filed on site with each load. These **MUST** detail:

- An adequate description of the waste.
- Where the waste came from.
- The appropriate code from the List of Wastes Regulations for the waste (commonly referred to as the EWC code).
- Information on the quantity and nature of the waste and how it is contained.
- Names and addresses of the transferor at Pinewoods Wind Farm (the person currently in control of the waste) and the transferee (usually either a registered waste carrier or a waste management licence holder (waste manager).
- The Standard Industry Classification (SIC) code (2007 or 2003 for hazardous waste only) of the business from where the waste was received.
- Where applicable, indicate that the Waste Hierarchy has been complied with.
- The place, date and time of transfer of the waste. If using a season ticket the period for which it is valid (i.e. valid from dd/mm/yyyy to dd/mm/yyyy).
- If the waste is being taken to landfill the transfer note **must** also contain details of any treatments or processes that have already been applied

3.5 Only trained operatives should handle hazardous substances. All stored hazardous waste will be clearly labelled.

3.6 All Oil Storage facilities of over 200litres need secondary containment facilities of 110% storage capacity (eg. bund, enclosure, drip tray). All of these will be regularly

inspected for visual signs of leaks or something that would impact on their capacity – eg. a drip tray full of rainwater.

3.7 Waste storage areas will be clearly located and signed. If space allows, key waste streams will be separated.

3.8 All waste should be transported from site at appropriate frequency by a registered waste contractor to prevent over-filling of waste containers.

3.9 Frequency of Checks. The contractor will ensure that all storage facilities are checked on a weekly basis. The checklist for completion is attached below.

# VISUAL WASTE STORAGE CHECKLIST

| Waste Area Checked | Date Checked | Initials of Checker |
|---|---|---|
| GENERAL OFFICE WASTE | | |
| BOWSER | | |
| PORTALOO | | |
| EXCAVATED SOIL | | |
| WASHINGS | | |
| CONCRETE | | |
| OIL | | |
| HAZARDOUS WASTE | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

# 4. ANTICIPATED CONSTRUCTION WASTE STREAMS

As stated previously, the contractor will outline prior to commencement of construction all anticipated waste streams to be produced at the construction site at Pinewoods Wind Farm.

## 4.1. Waste from Staff Facilities

### *4.1.1 General Waste Generate at Staff facilities.*

There will be the typical waste generated in an office such as left-over food and sandwich wrappers. All such waste should be stored appropriately and safely from wind, rain and wild animals that often tear apart rubbish bags. Provision for separation of waste streams will be provided so that eg. paper & cardboard waste and bottles may be recycled.

### *4.1.2 Sewage*

In addition, the facility will comprise self-contained port-a-loo units which will be managed and serviced regularly (by removal of the contents by tanker to a designated sewage treatment plant) and removed off site on completion of construction.

## 4.2 Concrete

### *4.2.1 Concrete Waste and wash-out water*

Methods for dealing with concrete waste and wash out water are provided in the site Drainage Management Plan.

### *4.2.2 Treatment of Suspended Solids from Concrete Batching*

Any wastewater generated from concrete batching will be adequately treated to deal with suspended solids and high alkalinity before discharge.

## 4.3 Chemicals, Fuel and Oils

Engine and hydraulic waste oil will be stored on site in compliance with site Drainage Management Plan. All storage containers of over 200 litres will have a secondary containment of 110% capacity to ensure that any leaking liquid is contained and does not enter the aquatic environment.

As part of this WMP there will be a **Chemical and Waste Inventory kept**. This inventory will include:

- List of all substances stored on-site (volume and description);
- Procedures and location details for storage of all materials listed; and
- Waste disposal records, including copies of all Waste Transfer Notes (WTN) detailing disposal routes and waste carriers used.

- Any tap or valve permanently fixed to the mobile unit through which oil can be discharged to the open or when delivered through a flexible pipe which is fitted permanently to the mobile unit, must be fitted with a lock and locked shut when not in use.

- Sight gauges must be fitted with a valve or tap, which must be shut when not in use. Sight gauge tubes, if used must be well supported and fitted with a valve.

- Mobile units must have secondary containment when in use/out on site.

Where mobile bowers are used on site guidelines will be followed so that:

- Any flexible pipe, tap or valve **will** be fitted with a lock where it leaves the container and be locked shut when not in use;

- Flexible delivery pipes **will** be fitted with manually operated pumps or a valve at the delivery end that closes automatically when not in use. Where possible, a nozzle designed to dispense oil is used;

- The pump or valve will have a lock and be locked shut when not in use.

### *4.3.1 Transport of Diesel/Oils to the site.*

Diesel is now classified as a dangerous substance. Under the EU Directive 95/55/EC all such dangerous substances should be conveyed in a container that compiles with the ADR. As such the manufacturer of each bowser should provide certification to contractors that the following:

- A leak-proof test certificate.
- A copy of the IBC approval certificate.
- An identification plate attached to the container.

For loads in excess of 1000 litres (220 gallons), the bowser vehicle driver will have undergone training and hold a special license.

### 4.3.2 *Refuelling* on Site

Where possible all refuelling on site will be within the temporary compound within the re-fuelling area. Only essential refuelling (eg. cranes) will be carried out outside of this area, but not within 100m of watercourses. In such cases a non-permeable HDPE membrane will be provided beneath connection points to catch any residual oil during filling and disconnection. This membrane will be inspected and if there is any sign of oil contamination, it will be removed from site by a specialist licensed waste contractor.

All vehicles will be well maintained and free from oil or hydraulic fuel leaks.

## 4.4 Packaging

Packaging will be brought on site and can include cardboard, wood and plastics used to package turbine components. As per the waste hierarchy, packaging will be returned to the originator ahead of re-use or recycling. Where this is not possible, waste should be separated as appropriate and safely stored on site appropriately

## 4.5 Waste Metals

Waste metals from concrete reinforcing etc should have commercial value and will be re-used or recycled with the appropriate licensed waste contractor.

## 4.6 Cleaning Activities

Cleaning of vehicles etc can produce large amounts of polluted water. All cleaning will be carried out in an enclosed area and the wastewater will be captured for treatment and discharged as per the site Drainage Management Plan which can be found in **Appendix B** of the CEMP.

# 5. EXCAVATED MATERIALS

The Spoil Management Plan details the methods, storage and use of excavated materials. These excavated materials will be required for habitat and ecological restoration, reprofiling and backfilling as per the Spoil Management Plan. But whilst they are being stockpiled on site, they need to be classified in order to comply with waste legislation.

## 5.1 Anticipated materials to be excavated on site.

It is anticipated that Mineral Soil be identified during construction:

### 5.1.2 Classification and Plan for Excavated Materials on site.

The contactor will detail expected volumes and types of materials to be extracted and also the storage and re-use procedures for all materials.

The contractor will liaise with the Local Authority on all aspects of waste management relating to excavated soil to ensure compliance during construction.

## 5.2 Estimated Volumes of Soil

This is detailed in the Spoil Management Plan. This demonstrates that whilst there will be significant volumes of soil to be excavated on site during the construction of Pinewoods, there is a legitimate requirement to reuse all excavated material in essential reinstatement and restoration works.

The Spoil Management Plan outlines the disposal of excavated materials.

## 5.3 Waste or Not Waste

Any excavated materials which are not intended to be disposed of or discarded will NOT be considered as waste and hence will not be regulated under waste management controls only if the following six criteria are all met:

i) The use is a necessary part of the planned works.

ii) The material is suitable for that use.

iii) The material does not require any processing or treatment before it is reused.

iv) No more than the quantity necessary is used.

v) The use of the material is not a mere possibility but a certainty.

vi) The use of the soil will not result in pollution of the environment or harm to human health.

If excavated materials do not meet any one of the above criteria unless it is treated to recover the waste, it will have to be classified as waste initially. But following treatment and re-use on site it will no longer be classified as waste.

If excavated soil on site does not meet all of the six criteria listed above, for the purposes of waste description, it would fall under chapter 17 of the European Waste Catalogue (EWC) Construction and Demolition wastes and the EWC code ’17,05’04 soil and stones (non hazardous) waste would apply.

The principles of the waste hierarchy will be strictly adhered to avoid and minimise production of excavated soil, and to ensure that all materials are recovered and reused on site.

## WASTE INVENTORY

## THE CONTRACTOR WILL PREPARE AND UPDATE REGULARLY A WASTE INVENTORY FOR INCLUSION IN THE WASTE MANAGEMENT PLAN

# PINEWOODS WIND LIMITED

# Pinewoods Wind Farm, Co. Laois and Co. Kilkenny.

# PRELIMINARY CONSTUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

TECHNICAL SCHEDULE NO. 4

Watercourse Crossing Plan

**January 2017**

**Pinewoods Wind Limited,**
c/o Galetech Energy Services,
Clondargan,
Stradone,
Co. Cavan

Tel.: +353 49 555 5050

**Jennings O'Donovan & Partners Limited,**
Consulting Engineers,
Finisklin Business Park, Sligo.
Tel.: 071 - 916 1416
Fax: 071 - 916 1080
e mail: info@jodireland.com

**JENNINGS O'DONOVAN & PARTNERS LIMITED**
Project, Civil and Structural Consulting Engineers,
FINISKLIN BUSINESS PARK,
SLIGO,
IRELAND.

Telephone (071) 91 61416
Fax (071) 91 61080

Email info@jodireland.com
Web Site www.jodireland.com

## DOCUMENT APPROVAL

| | | |
|---|---|---|
| **PROJECT** | Pinewoods Wind Farm | |
| **CLIENT / JOB NO** | Pinewoods Wind Limited | 5538 |
| **DOCUMENT TITLE** | CEMP - Technical Schedule No. 4 Watercourse Crossing Plan | |

| | **Prepared by** | **Reviewed** | **Approved by** |
|---|---|---|---|
| Document<br>Final | Name<br>Ciara Gilligan | Name<br>Nuala Carr | Name<br>David Kiely |
| Date<br>January 2017 |  |  |  |

| | **Prepared by** | **Reviewed** | **Approved by** |
|---|---|---|---|
| Document | Name | Name | Name |
| Date | | | |

# CONTENTS



APPENDICES

# 1.0 INTRODUCTION

This document concerns the proposed operations required for watercourse crossing works in the Pinewoods wind farm site (the Site) should the planning decision be favourable. The information contained herein will be used by the *Contractor* in developing his detailed design of all watercourse crossings at the Site and also compliance with planning conditions relating to the development, Section 50 consents and the requirements of the Environmental Management Plan (EMP), notably those relating to protection of water quality and fisheries.

**Location of watercourse crossings**:

It is proposed that 4 no. new stream crossings will be required to facilitate the wind farm access road. This includes two crossings over stream S1, one crossing over stream S4 and to replace the existing culvert at the temporary upgrade to the R430/L7800 road junction. Please refer to Figure 1 map overleaf. Where possible all proposed new stream crossings will be bottomless culverts and the existing banks will remain undisturbed. Any guidance/mitigation measures proposed by the OPW or the Inland Fisheries Ireland will be incorporated into the design of the proposed crossings. The locations of this and a description of the location will be provided in the Section 50 application drawings and will be lodged pre-construction. The Section 50 application and drawings will be provided in **Appendix 1** of this document.

| Crossing Ref. | Approximate Locations | | Culvert Size Dia. (mm) |
|---|---|---|---|
| | Easting | Northing | |
| SX01 | 250479 | 180410 | TBC |
| SX02 | 251056 | 181519 | TBC |
| SX03 | 251092 | 181799 | TBC |
| SX04 | 252044 | 182964 | TBC |

**Table 1.1 Section 50 culvert locations (Diameters to be confirmed)**

**Control Building and Temporary Construction Compound Area**

The construction of the substation and temporary construction compound at the site are within the imposed 50m buffer zone, the following mitigation measures shall apply:

- During construction of the substation and temporary compounds, similar measures to those implemented during turbine/crane pad construction in the Surface Water Management Plan will be used to limit water ingress, sediment erosion and concrete pollution.

- Infiltration interception drains or similar will be constructed around the substation to ensure ground water levels around the building can be managed and that internal sumps within the building do not become waterlogged

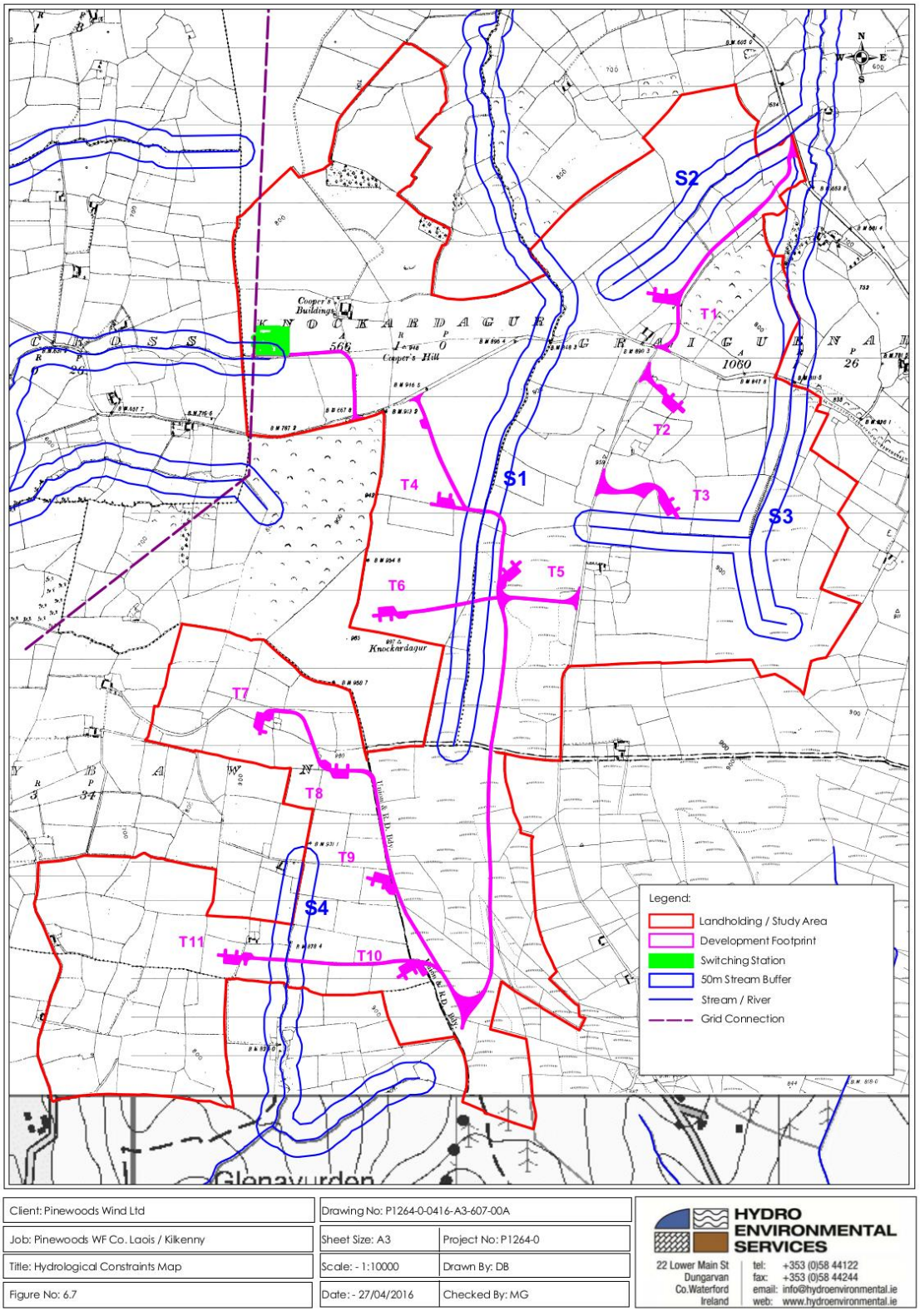



**Figure 1 Drain Crossing Location.**

In addition to the detailed drainage design philosophy detailed in the Surface Water Management Plan in Appendix B of the CEMP, the contractor will be obliged to:

- Carry out culverting works in dry conditions where possible and in low flow conditions on drains that do not run dry;
- All bank sides and streambeds should be fully reinstated to avoid ongoing erosion;
- All culverts and the stream crossing will be positioned with an invert slightly below the natural bed level;
- During the near stream construction work double silt fences should be emplaced immediately down-gradient of the construction area for the duration of the construction phase; and,
- There should be no batching or storage of cement allowed in the vicinity of the crossing construction areas.

**Fish passage**

Actions will be taken to ensure the continued passage of fish including, properly managed instream works at the stream crossing point. Culverts are to be as large as possible, and adequate to carry flows associated with a 1:100-year storm event as published by The Office of Public Works, 2013 '*A Guide to Applying for Consent under Section 50 of the EU (Assessment and Management of Flood Risks) Regulations SI 122 of 2010 and Section 50 of The Arterial Drainage Act, 1945'*. The original river gravel, or other appropriate gravel, should be emplaced in the culvert bottom. They should be installed wherever possible to conform with the natural alignment and gradient of the stream. Screens, which are detrimental to fish, should not be used and the design of the culvert should allow for the free-passage of debris at high flows. There should be no interruption of fish passage during the construction phase of the project or in the long term.

It will be the role of the Ecological CoW to ensure compliance with best practice and with all environmental mitigation and monitoring requirements, relating to pollution control and watercourse crossings, as detailed within the EIS, relevant planning conditions, Drainage

Management Plans and EMP. The ECoW report after construction will provide confirmation of how the measures will be monitored post construction.

**How water is pumped from excavated areas**

Interceptor drains will be installed up-gradient and around excavations to intercept clean surface runoff and divert it around and away from the works; surface water runoff may also be diverted around the excavation by silt fences, sand bags or similar, laid on the surface of the ground. The base of the excavation will be constructed level, and water will be gathered in a temporary sump and pumped at a low flow rate into either a temporary settlement pond or swale type feature for treatment prior to controlled release onto the natural vegetation surface. The use of a proprietary settlement system such as Siltbuster may be required to treat dirty construction water where additional treatment is required. Please refer to the Drainage Management Plans for detailed site drainage.

**Release of other pollutants**

All precautions will be taken to avoid spillages of diesel, oil or other polluting substances during the construction phase. This will be achieved through good site practices as described in the Inland Fisheries Ireland guide for the protection of watercourses during construction works Requirements for the protection of Fisheries Habitat during Construction and Development Works at River Sites.

**Pollution contingency plans**

A pollution contingency plan is outlined in the CEMP in TS 1 Environmental Incident and Emergency Response Plan.

## 2.0 REFERENCE DOCUMENTS

All construction works on the Site, and specifically design and construction works to be undertaken within and in the vicinity of any watercourses, will be completed in compliance with current legislation and best practice as detailed within the Environmental Impact Statement and Planning Reports, CEMP Technical Schedules (TS), Method Statement, current legislation and published guidance, including (non-exhaustive list):

- Section 50 Application will be lodged pre-construction. This document will provide details on watercourse crossing point for Pinewoods Wind Farm site, including crossing description and general approach.

- CEMP TS1 Environmental (Incident & Emergency) Response Plan. This provides information on best practice to be implemented in the event of a pollution incident.

- CEMP TS3 Site Waste Management Plan. This provides information on best practice for mitigation of risks to watercourses from storage and handling of waste materials.

- Guidelines on Protection of Fisheries during Construction Work in and Adjacent to Water" as published by Inland Fisheries Ireland, January 2016.

- Engineering in the Water Environment, Good Practice Guide, Construction of River Crossings, First edition, SEPA, April 2008.

- Culvert Design Guide, Report 168, CIRIA, 1997;

## 3.0 CONSTRUCTION REQUIREMENTS

The *Contractor* is required to produce a detailed Watercourse Crossing Plan prior to commencement of the works. This plan will take into account the stream crossing information for the Section 50 application (and referred to above) as well as any further information that may be obtained during subsequent surveys that may be undertaken prior to construction works commencing (for example further ground investigations, ecological baseline studies etc).

Specifications of pipes to be used in the crossings must comply with the Section 50 Consent Letter when received.

The *Contractor's* Watercourse Crossing Plan will be submitted to the Employer (Pinewoods Wind Limited), ECoW and the Local Authority for review and approval where appropriate.

The Ecological Clerk of Works (ECoW) will be consulted with regard to all watercourse crossing works. Surveys by the ECoW will be carried out immediately prior to construction to

ensure that adequate mitigation is built into the design in respect to fish passage and avoiding impact on downstream ecology.

The Archaeological Clerk of Works (ACoW) will also be consulted with regard to all Watercourse Crossing works. All known sites of Cultural Heritage will be fenced to avoid accidental damage during the construction phase. All groundworks to be undertaken within identified archaeologically sensitive areas will be monitored by the ACoW. All works associated with cultural heritage will be overseen and coordinated by the ACoW.

Prior to the commencement of watercourse crossing works an on-site meeting will be held where deemed necessary. This meeting will be between the *Contractor*, Environmental Manager, ECoW, and Consultees, where appropriate. The purpose of this meeting is to agree specific requirements and working practices at key locations, or for particular structures (culverts).

During the watercourse crossing construction operations, both regular and periodic consultation may be made with the Consultees as required / agreed at this commencement meeting.

Further details relating to locations, descriptions and agreed approaches to watercourse crossings are contained in the following appendices to this document:

**Appendix 1** – Section 50 Application Cover Letter and Drawings

**Appendix 2** – Section 50 consent letter from OPW, when received.

# APPENDIX 1 - SECTION 50 APPLICATION COVER LETTER AND DRAWING

# APPENDIX 2 – SECTION 50 CONSENT LETTER FROM OPW

# PINEWOODS WIND LIMITED

# Pinewoods Wind Farm, Co. Laois and Co. Kilkenny.

## PRELIMINARY CONSTUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

TECHNICAL SCHEDULE NO. 5

Site Induction Schedule

**January 2017**

**Pinewoods Wind Limited,**
c/o Galetech Energy Services,
Clondargan,
Stradone,
Co. Cavan

Tel.: +353 49 555 5050

**Jennings O'Donovan & Partners Limited,**
Consulting Engineers,
Finisklin Business Park, Sligo.
Tel.: 071 - 916 1416
Fax: 071 - 916 1080
e mail: info@jodireland.com

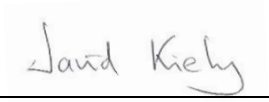
**JENNINGS O'DONOVAN & PARTNERS LIMITED**
Project, Civil and Structural Consulting Engineers,
FINISKLIN BUSINESS PARK,
SLIGO,
IRELAND.

Telephone (071) 91 61416
Fax (071) 91 61080

Email info@jodireland.com
Web Site www.jodireland.com

## DOCUMENT APPROVAL

| | | |
|---|---|---|
| **PROJECT** | Pinewoods Wind Farm | |
| **CLIENT / JOB NO** | Pinewoods Wind Limited | 5538 |
| **DOCUMENT TITLE** | CEMP<br>Technical Schedule No. 5 - Site Induction Schedule | |

| | **Prepared by** | **Reviewed** | **Approved by** |
|---|---|---|---|
| Document<br>Final | Name<br>Ciara Gilligan | Name<br>Nuala Carr | Name<br>David Kiely |
| Date<br>January 2017 |  |  |  |

| | **Prepared by** | **Reviewed** | **Approved by** |
|---|---|---|---|
| Document | Name | Name | Name |
| Date | | | |

# Contents

# 1. SITE INDUCTION

The Contractor will ensure that all contractor employees, sub-contractors, suppliers, and other visitors to the site are made aware of the Construction Environmental Management Plan (CEMP) and are provided with an introduction to the contents and responsibilities contained therein.

As a minimum, the following information will be provided to all inductees:

- Identification of specific environmental risks associated with the work to be undertaken on site by the inductee.
- Summary of the main environmental aspects of concern at the site, in particular:
  - i) Species and / or habitat protection
  - ii) Pollution prevention (e.g. silt mitigation and protection of the water environment).
  - iii) Surface Water Management
  - iv) Ground stability and peat slide risk
  - v) Waste management.
- Environmental Incident and Emergency Response Procedures. Refer to TS1 for further information. This will include information on site areas with limited or no mobile phone reception, and means of alternative communication.

Fact sheets and posters will be displayed at prominent positions within the site offices / canteen areas relating to specific species or habitat information relevant to the site. The Contractor will liaise with the ECoW to determine the content of these fact sheets and posters.

Any areas of environmental sensitivity (ecological, archaeological, hydrological or geological) will be demarcated on site. These areas will be indicated on a map to be shown at all site inductions, with the exception of where specific areas are extremely sensitive and their location is required to be kept confidential for protection purposes (e.g. locations of breeding bird sites, etc). In instances of extreme sensitivity only, a general buffer zone will be intimated at site inductions. The Contractor will liaise with the ECoW on the demarcation and advertising of sensitive areas.

## 2. TOOL BOX TRAINING TOPICS

During construction, in order to provide on-going reinforcement and awareness training, the above topics, along with any other environmental issues which arise on site, will be discussed at regular tool box talks.

Toolbox talks will generally be undertaken at the work face and be provided to Contractor's personnel who are engaged in the tool box talk activity. Tool box talks will also be provided to a wider range of site personnel, including managers, in order to raise general awareness of environmental issues and the EMP procedures.

The Contractor will agree topics, frequency of tool box talks and proposed attendees with the ECoW and prepare a tool box talk programme

A record of all toolbox talks and attendees will be maintained and recorded within Section 4 of the EMP.

# PINEWOODS WIND LIMITED

# Pinewoods Wind Farm, Co. Laois and Co. Kilkenny.

## PRELIMINARY CONSTUCTION ENVIRONMENTAL MANAGEMENT PLAN (CEMP)

TECHNICAL SCHEDULE NO. 6

WATER QUALITY MONITORING PLAN

**January 2017**

**Pinewoods Wind Limited,**
c/o Galetech Energy Services,
Clondargan,
Stradone,
Co. Cavan

Tel.: +353 49 555 5050

**Jennings O'Donovan & Partners Limited,**
Consulting Engineers,
Finisklin Business Park, Sligo.
Tel.: 071 - 916 1416
Fax: 071 - 916 1080
e mail: info@jodireland.com

**JENNINGS O'DONOVAN & PARTNERS LIMITED**
Project, Civil and Structural Consulting Engineers,
FINISKLIN BUSINESS PARK,
SLIGO,
IRELAND.

Telephone (071) 91 61416
Fax (071) 91 61080

Email info@jodireland.com
Web Site www.jodireland.com

## DOCUMENT APPROVAL

| | | |
|---|---|---|
| **PROJECT** | Pinewoods Wind Farm | |
| **CLIENT / JOB NO** | Pinewoods Wind Limited | 5538 |
| **DOCUMENT TITLE** | CEMP<br>Technical Schedule No. 6 - Water Quality Monitoring Plan | |

| | **Prepared by** | **Reviewed** | **Approved by** |
|---|---|---|---|
| Document<br>Final | Name<br>Ciara Gilligan | Name<br>Nuala Carr | Name<br>David Kiely |
| Date<br>January 2017 |  |  |  |

| | **Prepared by** | **Reviewed** | **Approved by** |
|---|---|---|---|
| Document | Name | Name | Name |
| Date | | | |

# CONTENTS



**Appendices**

# 1.0 INTRODUCTION

## 1.1 Scope and Requirements

**1.1.1** The *Contractor* is solely responsible for pollution prevention for the duration of the contract and until such time as permanent measures, such as permanent drainage and silt mitigation controls, are deemed to be adequate and appropriately constructed.

**1.1.2** In order to verify the efficacy of pollution prevention and mitigation works during construction, Water Quality Monitoring is required to be undertaken by a suitably qualified Environmental Manager(s), prior to, during and post completion of construction works. This will include all watercourses within the catchment of the construction area. The monitoring will comprise visual, hydrochemistry and grab sample monitoring.

**1.1.3** The details of the monitoring will be contained within a detailed Water Quality Monitoring Plan (i.e. Version 2 of this plan) to be prepared by the Contractor and submitted to the Local Authority for approval prior to commencement of construction. The approved plan will be coordinated and implemented on site by the Environmental Manager.

## 1.2 Reference Documentation

**1.2.1** Construction works have the potential to cause pollution of the water environment. All construction works on site, and specifically construction works to be undertaken within and in the vicinity of any watercourses, will be completed in compliance with current legislation and best practice as detailed within the Drainage Management Plan, CEMP, Technical Schedules in particular:

- TS3 Waste Management Plan
- TS4: Watercourse Crossing Plan

**1.2.2** The following reports (along with any further surveys conducted) will be used to inform the scope of the construction phase Water Quality Monitoring Plan.

- Environmental Impact Statement (EIS)
- Natura Impact Statement (NIS)
- CEMP

# 2.0 RESPONSIBILITIES

## 2.1 General

**2.1.1** Responsibility for the water quality monitoring programme, and coordination thereof, will lie with the independent Environmental Manager appointed at the start of the programme.

## 2.2 Hydrochemistry Monitoring

### 2.2.1 Field Monitoring

**2.2.2** Field monitoring of water quality parameters and collection of samples may be undertaken by the Ecological Clerk of Works (ECoW) or other nominated person(s) based at the site. The ECoW or nominated site person(s) will be appropriately trained on the required monitoring methods and the use, calibration and maintenance of all monitoring equipment used. Training will be provided by the Environmental Manager appointed to undertake the Water Quality Monitoring programme.

**2.2.3** If the ECoW is to undertake duties relating to the Water Quality Monitoring programme, these will be in addition to the ECoW responsibilities for species and habitat monitoring, advanced environmental checks and monitoring of mitigation works.

### 2.2.4 Laboratory Analysis

**2.2.5** Laboratory analysis of water samples will also be undertaken as part of the monitoring programme by an independent and appropriately certified laboratory to be appointed by the Environmental Manager.

**2.2.6** Coordination of the laboratory sampling and analytical programme will be undertaken by the ECoW or other nominated site person(s) may be responsible for field collection of the samples required for laboratory analysis. Samples will be dispatched for analysis under chain of custody procedures. Laboratory analytical results will be sent directly to the ECoW.

**2.2.7** Interpretation and reporting of both the field and laboratory data will be the responsibility of the Environmental Manager.

## 2.3 Reporting

### 2.3.1 Monthly water quality reporting

**2.3.2** Results of water quality monitoring shall assist in determining requirements for improvements in drainage and pollution prevention measures implemented on site. A monthly report on water quality will be prepared by the ECoW.

**2.3.3** It will be the responsibility of the ECoW to present the ongoing results of water quality and weather monitoring at site meetings and with outside bodies. This shall be done at weekly meetings and reported within the overall Monthly Environmental Report to be prepared by the ECoW.

**2.3.4** The monthly reports on water quality will consider all visual, field monitoring and results of laboratory analysis received that month. Reports will describe how the results compare with baseline data as well as previous monthly reports on water quality. The reports will also describe whether any deterioration or improvement in water quality has been observed and whether any effects are attributable to construction activities and what remedial measures or corrective actions have been implemented.

**2.3.5** Monthly reports on water quality will be provided to Pinewoods Wind Limited by the Environmental Manager.

### 2.3.6 Final report on water quality

**2.3.7** Upon completion of all post-construction monitoring, the Environmental Manager will prepare a final report on water quality. This final report will cover the overall performance against baseline data, details on any impacts attributed to construction works and recommendations for remedial works if required.

**2.3.8** The final report will be provided to the Local Authority and Inland Fisheries Ireland.

### 2.4 Contingency Sampling & Emergency Response

**2.4.1** Where pollution arising from the construction works, such as that resulting from a spill or accidental release of chemicals, oils and fuels or concrete effluent, threatens to enter, or has entered a watercourse, additional sampling and analysis of surface water samples will be undertaken to determine the level of impact to the surface water receptor and remedial requirements, where necessary.

**2.4.2** Where a pollution incident has occurred as a result of construction works, the ECoW, Environmental Manager and the Local Authority shall be consulted to determine sampling requirements and any additional survey requirements where potentially significant impacts are identified. Where it is demonstrated that the pollution occurred as a result of non-compliance with this CEMP, the costs of any additional sampling or survey requirements shall be borne by the *Contractor*.

**2.4.3** The results of any monitoring or survey work undertaken by the *Contractor* shall be made available to the ECoW, the Environmental Manager and the Local Authority and copies of all correspondence and test certificates shall be retained on site.

## 3.0 WATER QUALITY MONITORING: OUTLINE SCOPE

### 3.1 General

**3.1.1** The full scope of monitoring will be determined at the detailed design stages (prior to commencement) and will be tailored to take into account the intended construction programme and phasing of works within each catchment. The full scope of monitoring will be agreed with the Local Authority prior to commencement of construction works.

**3.1.2** Key trigger levels at which action will be required to prevent an impact occurring to a water feature will be determined through consultation with the Local Authority and Inland Fisheries Ireland and analysis of the results of any baseline monitoring data.

**3.1.3** Water Quality Monitoring locations will be identified through grid reference, photographic record and indicated on a plan. For repeat sampling locations, each location will also be marked on the ground (stake/post) to ensure that the correct location is sampled each time.

**3.1.4** Sample locations shall be labelled consistently for the duration of the monitoring period. Where any

additional locations are sampled during the works, the location (grid reference) of the sampling point will be recorded and a photograph will be taken at the time of sampling.

**3.1.5** 'Control' sample locations may also be included in the scope of any monitoring.

**3.1.6** A water sampling location map is included in Appendix 1.

### 3.2 Hydrochemistry Monitoring

**3.2.1** The detailed scope will be determined and agreed with the Local Authority prior to commencement of construction.

**3.2.2** Sample locations and monitoring frequency will be specified and agreed with the Local Authority and Inland Fisheries Ireland.

**3.2.3** As a minimum, the monitoring programme will include:

- At least one baseline monitoring visit.
- Daily visual observation in areas of high construction activity or during high rainfall periods to identify any evidence of siltation, oil or silt. Visual inspections will include details of the color of the water at the time of inspection.
- Weekly monitoring including visual inspections and field hydrochemistry (pH, temperature, turbidity, TSS, conductivity, dissolved oxygen, suspended solids) during construction. Grab sampling to be carried out at a frequency and specification to be agreed with the Local Authority and Inland Fisheries Ireland.
- Post construction monitoring, to a frequency and specification to be agreed with the Local Authority and Inland Fisheries Ireland. Post construction will be defined as when the reinstatement phase is completed.

**3.2.4** Analytical determinants (including limits of detection and frequency of analysis) will be specified and agreed with the Local Authority and Inland Fisheries Ireland for each sample location. The expected suite of grab sample determinants may include the following:

**Parameters for hydrochemistry analysis**

- pH
- Temperature
- Total Suspended Solids (TSS)
- Dissolved Organic Carbon (DOC)
- Conductivity
- Dissolved Oxygen (DO)
- Total Oxidized Nitrogen (TON)
- Ammoniacal Nitrogen
- Ammonia
- Potassium
- Phosphate
- Biological Oxygen Demand (BOD)
- Chemical Oxygen Demand (COD)
- Total Petroleum Hydrocarbons (TPH) (*Only during construction phase)
- EColi

# APPENDICES

# Appendix 1

# Water Sampling Location Map

Pinewoods Wind Farm

# Construction Noise Monitoring Programme

Pinewood Wind Limited

Galetech Energy Services T/A I.W.C.M. Ltd, Clondargan, Stradone, Co. Cavan Ireland

Telephone +353 49 555 5050

| | |
|---|---|
| ***File Reference:*** | |
| ***Employer:*** | Pinewood Wind Limited |
| ***Project Title:*** | Pinewoods Wind Farm |
| ***Specification Title:*** | Pinewoods Wind Farm Construction Noise Monitoring Programme |
| ***Specification No.:*** | 5220 - CNMP |
| ***Rev. No.:*** | 0 |
| ***Volume** 1 **of** 1* | |

| | |
|---|---|
| ***PRODUCED BY:***<br>***TITLE:*** | ***DATE:*** |
| ***CHECKED BY:***<br>***TITLE:*** | ***DATE:*** |
| ***APPROVED BY:***<br>***TITLE:*** | ***DATE:*** |

# Contents

## 1.0 Introduction

Pinewoods Wind Limited has been requested by the Planning Authority to submit further information in respect of the noise impact of the construction of the proposed Pinewoods Wind Farm (Reg. Ref. 16/260). This document addresses Item 11(a) of the Request for Further Information, reproduced here:

> *"11. Noise and Vibration*
>
> *(a) The applicants shall submit a monitoring programme for noise during the construction of the proposed development if permitted in a revised Chapter 10 'Noise'. The program shall include a map showing the location of the monitoring stations, details, of procedure of monitoring, timeframe for monitoring, details on the availability of monitoring results on site and submission of results to the planning authority, details of the arrangements with the occupants of the residential dwellings identified as Noise Sensitive Locations to carry out monitoring shall be submitted. Evidence shall be submitted showing that the occupants of these dwellings agree to the timing, frequency and location that these measurements will take place."*

The remainder of this document addresses the points raised above.

It should be noted that this Construction Noise Monitoring Programme is a draft document only and will be subject to further agreement with the Planning Authority, as necessary, including further amendments in response to any conditions of consent.

A glossary of noise and vibration terms is shown in **Appendix A**.

## 2.0 Construction Noise Limits

The following section on noise limits from the EIS is reproduced here:

There is no statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. Planning authorities normally control construction activities by imposing noise limits and restrictions on the hours of operation.

In the absence of statutory noise limits, appropriate criteria relating to permissible construction noise levels for a development proposal of this scale may be found in the National Roads authority (NRA) publication '*Guidelines for the Treatment of Noise and Vibration in National Road Schemes*'[1]. **Table 1** sets out the maximum permissible noise levels at the facade of dwellings during construction as recommended in the NRA guidelines. The majority of the construction activity in this instance is expected to occur during the normal working hours.

| *Days and Times* | *Noise Levels (dB re. 2x10$^{-5}$ Pa)* | |
|---|---|---|
| | $L_{Aeq(1hr)}$ | $L_{Amax}$ |
| Monday to Friday 07:00 to 19:00hrs | 70 | 80 |
| Monday to Friday 19:00 to 22:00hrs | 60 | 65 |
| Saturdays 08:00 to 16:30hrs | 65 | 75 |
| Sundays & Bank Holidays 08:00 to 16:30hrs | 60 | 65 |

***Table 1: Maximum Permissible Noise Levels at the Facade of Dwellings during Construction Source: National Roads Authority***

*Note: Construction activity outside of these times, other than that required for emergency works, will normally require the explicit permission of the relevant local authority.*

## 3.0 Locations for Construction Noise Monitoring

On review of the site layout, including site roads and accesses from public roads, the following four locations are selected for construction noise monitoring.

- NM1 at coordinates E251995 N182896, which serves as a proxy location for H03;
- NM2 at E250791 N182410 near the substation, where H31 is the nearest house,
- NM3 at E251509 N181106 corresponding to house H14; and
- NM4 at E249754 N180469 corresponding to house H27.

These locations are shown in **Figure 1**.

NM1 is located on lands under the control of the applicant and therefore no letter of consent is required. As it was not considered possible to get permission from the landowner for H03, NM1 is a proxy location for H03 and, as it is located at the site entrance, is considered particularly suited for monitoring the potential noise impact of construction traffic.

The applicant has consulted with the relevant landowners for NM2, NM3 and NM4 who have each consented to the use of their property for the purpose of noise

monitoring as described in this Construction Noise Monitoring Programme. Each of the landowners has been made aware of the arrangements in respect of timing, frequency and locations included within this document at which construction noise monitoring will take place**.** A copy of the letters of consent is enclosed at **Appendix B**.

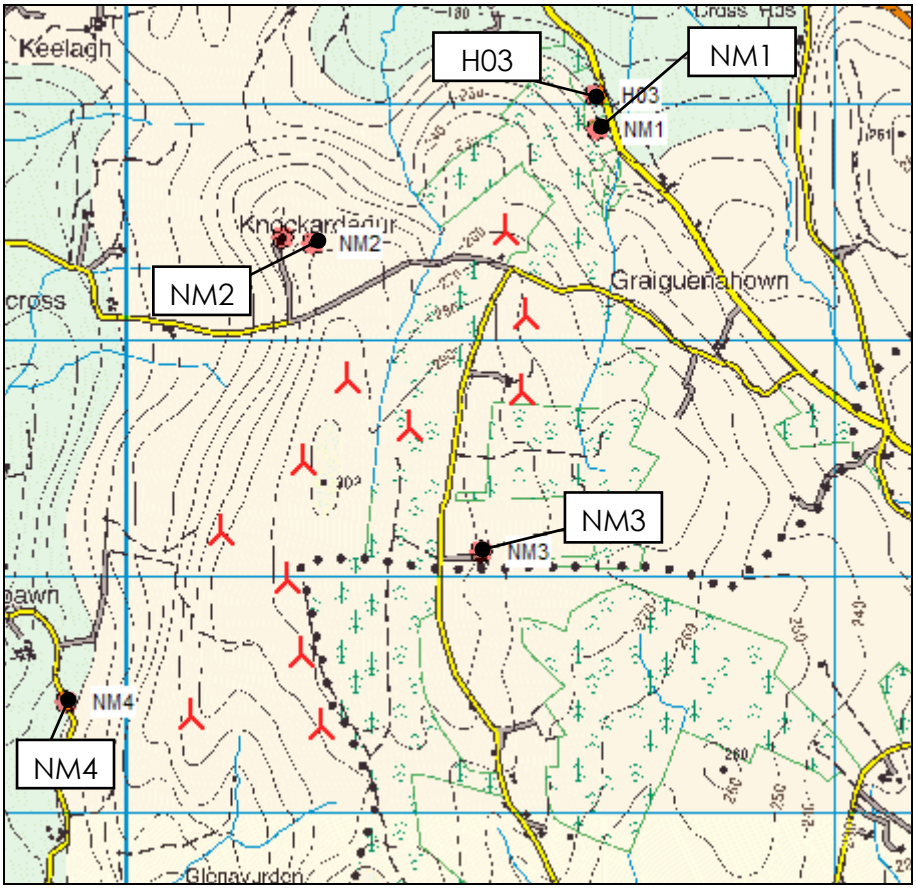



***Figure 1: Proposed Construction Noise Survey Locations***

## 4.0 Duration and Timing

Although construction works hours are limited to those described in Section 10.4.1 of the EIS, the construction noise survey will record noise levels on a 24-hour basis using unattended noise monitoring equipment, similar to the equipment used for the background noise survey included in the EIS, throughout the entire construction period.

## 5.0 Procedures for Monitoring

For NM1, the noise level meter and microphone will be installed adjacent to the site entrance and the public road.

For NM1, NM2 and NM3, the noise level meters and microphones will be located in the surroundings of the house, located in an area primarily used for relaxation and amenity purposes i.e. garden or patio, ideally in the general direction between the house and the windfarm or nearest part of the site works.

In each case, the microphone will be located 10m from the any reflective surface other than the ground (e.g. building façade) in order to measure in free-field conditions.

The sound level meters will be similar to those described in the EIS and configured to record $L_{Aeq}$ values over consecutive 1-hour periods, for comparison with the limit values in **Table 1**.

## 6.0 Monitoring records

All construction noise monitoring records will be held in a dedicated file and will be made available to the Planning Authority, upon request.

## 7.0 Contact Person

The contact person to whom all queries or complaints in relation to noise may be addressed shall be identified in the Construction Environmental Management Plan (CEMP)

## References:

1. National Roads Authority, 2004. *Guidelines for the Treatment of Noise and Vibration in National Road Schemes.*
2. International Organization for Standardization, 1996. ISO 9613-2, *Acoustics – Description, Measurement and Assessment of Environmental Noise:* Parts 1 and 2.

## APPENDIX A – GLOSSARY OF TERMS

**Dwelling**: a permanently or seasonally occupied residence.

**Noise**: a sound that can be described as being unnecessary or unwanted.

**Noise sensitive location**: any dwelling, hotel, hospital, educational establishment, or any other place of high amenity that requires the absence of noise at nuisance levels for proper use.

**Screening**: an environmental or man-made barrier between noise source and receiver that interrupts the transmission path, reducing the received noise levels.

**Sound level meter**: the instrumentation used to measure noise with a standardised frequency and time weighting. There are many types used to measure various descriptions of sound. The measurement should be capable of accuracy and repeatability.

# APPENDIX B – CONSENT LETTERS

Michael McEvoy

Graiguenahown

Spink

Abbeyleix

Co. Laois

Planning Department

Laois County Council

Aras an Chontae

Portlaoise

County Laois.

To whom it may concern,

**Re:** **Pinewoods Wind Farm**

**Applicant:** **Pinewood Wind Limited**

I, Michael McEvoy, hereby consent to Pinewood Wind Limited carrying out noise monitoring at my property in accordance with the Noise Monitoring Programme.

Yours Sincerely

Michael McEvoy.

Michael McEvoy

Noreen Cahill

Aughnacross

Ballinakill

Co. Laois

Planning Department

Laois County Council

Aras an Chontae

Portlaoise

County Laois.

To whom it may concern,

**Re:** **Pinewoods Wind Farm**

**Applicant:** **Pinewood Wind Limited**

I, Noreen Cahill, hereby consent to Pinewood Wind Limited carrying out noise monitoring at my property in accordance with the Noise Monitoring Programme.

Yours Sincerely

Noreen Cahill

Noreen Cahill

Mark Mansfield

Boleybawn

Ballinakill

Co. Laois

Planning Department

Laois County Council

Aras an Chontae

Portlaoise

County Laois.

To whom it may concern,

**Re:** **Pinewoods Wind Farm**

**Applicant:** **Pinewood Wind Limited**

I, Mark Mansfield, hereby consent to Pinewood Wind Limited carrying out noise monitoring at my property in accordance with the Noise Monitoring Programme.

Yours Sincerely

Mark Mansfield

Mark Mansfield

Coillte
Dublin Road
Newtownmountkennedy
Co. Wicklow
A63 DN25

T 1890 367 378
F + 353 1 2011199
E info@coillte.ie

www.coillte.ie

Planning Department
**Laois County Council**
Áras an Chontae
Portlaoise
Co. Laois

Our Ref.: CEN_LCC_LTR_320

6th February 2017

**SUBJECT TO AGREEMENT/ AGREEMENT DENIED**

**Re: Letter of Consent regarding the erection of noise monitoring equipment on Coillte's Graiguenahown, Knockardagur, Crutt and Boleybawn properties, Co. Laois**

Dear Sir/Madam,

Coillte hereby confirm that it is in order for Pinewoods Wind Limited to erect noise monitoring equipment on the Option Property (Graiguenahown, Knockardagur, Crutt and Boleybawn) pursuant to clause 4.1 of the Option Agreement dated 12th day of December 2014 (the "Option") for the purposes of measuring construction noise.

Please note that I have no authority to bind Coillte and no binding agreement shall exist or be deemed to exist until such a time as a formal contract has been agreed between all parties, executed and exchanged and all sums due there-under paid in full. Please note that this letter is not and shall not constitute a note or memorandum in writing for the purposes of Section 51 of the Land and Conveyancing Law Reform Act, 2009.

We trust you will find the above in order. Should you have further queries, please do not hesitate to contact us.

Yours sincerely,

Brenda Molloy
For and On Behalf of Coillte