15. HYDROLOGY, HYDROGEOLOGY & WATER QUALITY

Additional information relevant to Section 15 is presented in Appendix I in Volume 2 of 3 of the EIS.

15.1 RECEIVING ENVIRONMENT

15.1.1 Background and Objectives

The objectives of the assessment are as follows:

- Produce a baseline study of the existing water environment (surface water and groundwater) in the area of the proposed wind farm development.
- Identify likely positive and negative impacts of the proposed development on surface water and groundwater during construction and operational phases of the development.
- Consideration of potential cumulative impacts arising from other wind farm developments within the same regional hydrological catchment.
- Identify mitigation measures to avoid, remediate or reduce significant negative impacts.

Relevant Legislation

Particular reference has been paid to the following legislation:

- European Communities (Natural Habitats) Regulations, 1997 resulting from the EU Habitats Directives (92/43/EEC) and the Birds Directive (79/409/EEC).
- Quality of Salmon Water Regulations, 1998 resulting from the EU Freshwater Fish Directive (78/659/EEC).
- European Communities Environmental Objectives (Surface Waters) Regulations, 2009 and European Communities (Water Policy) Regulations, 2003, resulting from the EU Water Framework Directive (2000/60/EC) and daughter Directive (2006/118/EC). Since 2000, water management in the EU has been directed by the Water Framework Directive ("WFD"). The key objectives of the WFD are that all water bodies in Member States achieve (or retain) at least 'Good' status by 2015. Water bodies comprise both surface and groundwater bodies, and the achievement of 'Good' status for these depends also on the achievement of 'Good' status by dependent ecosystems. Phases of characterisation, risk assessment, monitoring and the design of programmes of measures to achieve the objectives of the WFD have either been completed or are ongoing. In 2015, it will fully replace a number of existing water related directives, which are successively being repealed, while implementation of other Directives (such as the Habitats Directive 92/43/EEC) will form part of the achievement of implementation of the objectives of the WFD.
- Protection of Groundwater Regulation 1999, resulting from EU Groundwater Directive (80/68/EEC).
- European Communities (Quality of Surface Water Intended for the Abstraction of Drinking Water) Regulations 1989, resulting from EU Directive 75/440/EEC (repealed by WFD 2000/60/EC in 2007).

- Quality of Water intended for Human Consumption Regulations, 2000 and European Communities (Drinking Water No. 2) Regulations, from EU Drinking Water Directive (98/83/EC) and the Water Framework Directive (2000/60/EC).
- European Communities Environmental Objectives (Surface Waters) Regulations, 2009
- European Communities Environmental Objectives (Groundwater) Regulations, 2010
- European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations, 2009

Relevant Guidance

The guidance contained in the following has been applied:

- Institute of Geologists Ireland (2013) Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements.
- National Roads Authority (2005) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes.
- Forestry Commission (2004) Forests and Water Guidelines, Fourth Edition. Publ. Forestry Commission, Edinburgh.
- Coillte (2009) Forest Operations & Water Protection Guidelines.
- Forestry Services (Draft) Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures.
- Forestry Services (2000) Forestry and Water Quality Guidelines.
- Forestry Schemes Manual (2000) The Code of Best Forest Practice – Ireland.
- COFORD (2004) Forest Road Manual – Guidelines for the Design, Construction and Management of Forest Roads.
- Eastern Regional Fisheries Board (not dated): Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites.
- Good Practice During Wind farm Construction (Scottish Natural Heritage, 2010).
- PPG1 - General Guide to Prevention of Pollution (UK Guidance Note).
- PPG5 – Works or Maintenance in or Near Water Courses (UK Guidance Note).
- CIRIA (Construction Industry Research and Information Association) Guidance on 'Control of Water Pollution from Linear Construction Projects' (CIRIA Report No. C648, 2006).
- Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors. CIRIA C532. London, 2001.

15.1.2 Methodology - Desk Study

A desk study of the site and the surrounding area was completed in advance of undertaking a walkover survey. This involved collecting all relevant hydrological, hydrogeological and meteorological data and included consultation with the following:

- Environmental Protection Agency database (www.epa.ie).

- Geological Survey of Ireland - National Draft Bedrock Aquifer map.
- Geological Survey of Ireland - Groundwater Database (www.gsi.ie).
- Met Éireann Meteorological Databases (www.met.ie).
- National Parks & Wildlife Services Public Map Viewer (www.npws.ie).
- Water Framework Directive "WaterMaps" Map Viewer (www.wfdireland.ie).
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 21 (Geology of Kerry - Cork). Geological Survey of Ireland (GSI, 1999).
- Geological Survey of Ireland – Bearna Sneem Groundwater Body Initial Characterisation Report - Draft (2004).
- Office of Public Works (OPW) Indicative Flood Maps (www.flooding.ie).
- Environmental Protection Agency – "Hydrotool" Map Viewer (www.epa.ie).
- CFRAM Preliminary Flood Risk Assessment (PFRA) maps (www.cfram.ie).
- Department of Environment, Community and Local Government on-line mapping viewer (www.myplan.ie).

15.1.3 Methodology - Site Investigations

A site walkover and hydrological baseline monitoring was undertaken on 6-7 July 2015. Site investigations included the following:

- A walkover survey and hydrological mapping of the site and the surrounding area were undertaken whereby water flow directions and drainage patterns were recorded.
- Field hydrochemistry measurements (electrical conductivity, pH and temperature) were taken to determine the origin of surface water flows.
- Surface water sampling was undertaken to acquire contemporary baseline water quality data for the primary surface waters originating from the site.

15.1.4 Methodology – Assessment of Sensitivity

In addition to the general methodology employed, the sensitivity of the water environment receptors was assessed on completion of the desk study and baseline study. Levels of sensitivity, which are defined in Table 15.1, are then used to assess the potential effect that the proposed development may have on them.

Table 15.1: Receptor Sensitivity Criteria (Adapted from www.sepa.org.uk)

Sensitivity Criteria	
Not sensitive	Receptor is of low environmental importance (e.g. surface water quality classified by EPA as A3 waters or seriously polluted), fish sporadically present or restricted). Heavily engineered or artificially modified and may dry up during summer months. Environmental equilibrium is stable and is resilient to changes which are considerably greater than natural fluctuations, without detriment to its present character. No abstractions for public or private water supplies. GSI groundwater vulnerability "Low" – "Medium" classification and "Poor" aquifer importance.
Sensitive	Receptor is of medium environmental importance or of regional value. Surface water quality classified by EPA as A2. Salmonid species may be present and

Sensitivity Criteria	
	may be locally important for fisheries. Abstractions for private water supplies. Environmental equilibrium copes well with all natural fluctuations but cannot absorb some changes greater than this without altering part of its present character. GSI groundwater vulnerability "High" classification and "Locally" important aquifer.
Very sensitive	Receptor of high environmental importance, of national or international value i.e. NHA or SAC. Surface water quality classified by EPA as A1 and salmonid spawning grounds present. Abstractions for public drinking water. GSI groundwater vulnerability "Extreme" classification and "Regionally" important aquifer

15.1.5 Site Description & Topography

The elevation range of the overall site varies between approximately 200 mOD and 570 mOD, and it has a mountainous topography. The Barnastooka area is situated on an east – west trending topographic divide and slopes moderately in a south-easterly direction with little bedrock exposure. The Grousemount area is characterised by two distinct topographic divides which have approximate north – south orientations. Bedrock exposures are numerous and form scarps on the steeper sections of these two areas.

The Roughty River rises in a catchment to the south of the development and flows in a northerly direction through the site. In addition, the site is drained by numerous upland streams that flow directly into the Roughty River as it passes through the site. The proposed development includes three river crossings over the main Roughty River channel along with numerous stream crossings over first and second order streams that are tributaries to the Roughty River and the Red Trench River

15.1.6 Water Balance

Long-term rainfall and evaporation data was sourced from Met Éireann. The 30-year (1981–2010) annual average rainfall (AAR) recorded at Mount Ballingeary (Meelin Mountain), 5 km southeast of the site, are presented in Table 15.2. Mount Ballingeary is the closest station with a similar elevation to the site.

Table 15.2: Local Average Long Term Rainfall Data (mm)

Jan	Feb	Mar	Apr	May	Jun	Total
213.9	165.1	154.4	115.4	120.7	109.2	1,885
July	**Aug**	**Sept**	**Oct**	**Nov**	**Dec**	
106	126.8	137	215.7	206.6	213.9	

The closest synoptic station where the average potential evapotranspiration (PE) is recorded is at Valentia Observatory, approximately 60 km to the west. The long-term average PE for this station is 520 mm/yr. This value is used as a best estimate of the site PE. Actual Evaporation (AE) at the site is estimated as 494 mm/yr (which is 0.95 × PE).

The effective rainfall (ER) represents the water available for runoff and groundwater recharge. The ER for the site is calculated as follows:

Effective rainfall (ER) = AAR – AE = 1,885 mm/yr – 494 mm/yr = 1,391 mm/yr.

Based on recharge coefficient estimates from the GSI (www.gsi.ie), a conservative estimate of 5% recharge is taken for the site as an overall average. This value is for "Peat" with a "Moderate" vulnerability rating. Areas of thinner peat or thin peaty soils, i.e. Extreme vulnerability, may have slightly higher recharge rates, but on this site, these areas are generally on sloping ground with very poor natural drainage. The lowest value in the available range was chosen to reflect the large coverage of peat and poorly draining soil types, and the high stream drainage density. Therefore, annual recharge and runoff rates for the site are estimated to be 70 mm/yr and 1,321 mm/yr respectively. Therefore, the sites hydrology will be characterised by high surface water runoff rates and a very flashy stream network.

15.1.7 Regional & Local Hydrology

Regionally the site is located in the Roughty River surface water catchment within Hydrometric Area 21 of the South Western River Basin District (SWRBD). The Roughty River flows through the site in a northerly direction before heading west and entering the sea at Kenmare. A regional hydrology map is shown as Figure 15.1.

In terms of local hydrology, the site lies within seven Water Framework Directive (WFD) delineated Surface Water Bodies (SWBs) that contribute flow to the Roughty River, as follows:

The eastern and southern sections of the site lie within the Roughty 3_Mid and Roughty Upper SWBs respectively. The central section of the site lies within the Knockanruddig SWB, while the western section of the site lies within the Foilduff and Coolnagoppoge SWBs. The most northerly sections of the site lie within the Roughty 2_Mid and the Sillahertane SWBs, with the main site entrance being located in the latter SWB. A local hydrology map showing the proposed infrastructure is presented as Figure 15.2. A summary of the WFD surface water bodies and the elements of wind farm infrastructure within each is shown in Table 15.3.

Table 15.3: Summary of Site Sub-catchments, Infrastructure and Drainage Features

WFD Sub-catchment	Development Infrastructure
Roughty Upper	8 no. turbines, 1 no. borrow pit, 2 no. meteorological masts & site access tracks
Roughty 3_Mid	14 no. turbines, 3 no. borrow pits, 1 no. substation, 1 no. meteorological mast & sites access tracks
Knockanruddig	1 no. turbine, 1 no. borrow pits & site access tracks
Foilduff	No development
Coolnagoppoge	12 no. turbines, 4 no. borrow pits & site access tracks
Roughty 2_Mid	3 no. turbines & site access tracks
Sillahertane	Site entrance & site access tracks

15.1.8 Site Drainage

In addition to the Roughty River, the other main mapped drainage feature is the Red Trench River, which flows in an easterly direction through the Barnastooka area of the site prior to merging with the Roughty River. The majority of this area drains to the Red Trench River via numerous first and second order streams. The majority of the Grousemount area of the site drains directly to the Roughty River via a dense network of first and second order streams. Many of these are expected to be ephemeral in nature. Existing site drainage maps of the proposed development site are shown on Figures 15.3 – 15.5.

15.1.9 Flood Risk Identification

OPW's indicative river and coastal flood map (www.floodmaps.ie), CFRAM Preliminary Flood Risk Assessment (PFRA) maps (www.cfram.ie), Department of Environment, Community and Local Government on-line planning mapping (www.myplan.ie), and historical mapping (i.e. 6" & 25" base maps) were consulted to identify those areas as being at risk of flooding.

The PFRA mapping shows the extents of the indicative 100-year flood zone which relates to fluvial and pluvial (river and rainfall) flood events. There is no significant 100-year fluvial flood zone mapped within the development areas. Where it is mapped, it typically exists in close proximity to the main Roughty River channel or its contributing second or third order streams. No significant pluvial flood zones are mapped within the site, as would be expected in mountainous terrain with sloping topography.

OPW's indicative river and coastal flood map was consulted to identify those areas as being at risk of recurring flooding. There were no mapped reports of recurring flooding within the site and there is no significant risk of flooding, due to the elevated nature of the majority of the site.

A recurring flood event (OPW Flood ID 4707) is mapped on the Sillahertane Stream approximately 1 km upstream of its confluence with the Roughty River. This area upstream of the reported flooding is not influenced by the wind farm development. Kerry County Council's Kenmare Area meeting minutes report the following about this event:

> *A similar type event occurred at Insheese on the L3021, a section of road way was washed away c 1990/91 and previously in 1986 at same location. A similar event also occurred at Coomclogherane. Even localised thunder storms can cause such damage.*

There is no text on local available historical 6" or 25" mapping for the site that identifies areas that are "prone to flooding" within or downstream of the site.

There are no areas within the site or immediately downstream of it mapped as "Benefiting Lands". These are defined by the OPW as lands that might benefit from the implementation of Arterial (Major) Drainage Schemes (under the Arterial Drainage Act 1945) and indicating areas of land subject to flooding or poor drainage.

It is a key mitigation of the wind farm development to ensure all surface water runoff is treated (water quality control) and attenuated (water quantity control) prior to discharge. As such, the mechanism by which potential downstream flooding is prevented and controlled is through avoidance by design. These proposed drainage attenuation measures are outlined in the impact assessment herein.

15.1.10 Surface Water Hydrochemistry

Q-rating data is available for the Roughty River within and downstream of the site. All stations are reported to have a Q-rating of 4-5 (High Status).

Table 15.4: EPA Water Quality Monitoring Q-Rating Values

Water Body	EPA Location Description	Location (E/N)	EPA Q-Rating Status
Roughty River	Bridge (Ford) near Knockanruddig	508670 / 570883	Q4-5 High
Roughty River	Inchee Bridge	507710 / 573972	Q4-5 High

Water Body	EPA Location Description	Location (E/N)	EPA Q-Rating Status
Roughty River	Ford d/s of Slaheny River confluence	499732 / 572882	Q4-5 High

Field hydrochemistry measurements of unstable parameters, electrical conductivity (µS/cm), pH (pH units) and temperature (°C) were taken at various locations in surface watercourses at the site on 6-7 July 2015. The range of results is shown in Table 15.5.

Electrical conductivity for the site's smaller streams / watercourses was in the range 33-66 µS/cm. This relatively low value range is consistent with the fact that all catchments, particularly on the upper slopes, are dominated by peaty or poorly draining soils and that the water in the drains is mainly meteoric in origin, either from direct rainfall or runoff from the surrounding mountain landscape.

The Roughty River further downstream of the development, i.e. at surface sample locations SW1 - SW4, had only a slightly higher electrical conductivity range of 71-86 µS/cm and this is due to the fact that the Roughty River may receive some groundwater base flow from the mineral subsoil and underlying bedrock, albeit base flows are expected to be very small. However, these values are also very low and this is likely due to the non-calcareous nature of the bedrock geology, i.e. sandstone and siltstone.

pH values were in the range 6.2-7.2 with the majority of the pH readings being slightly acidic. This is also due the fact that all catchments are dominated by peat, which creates slightly acidic drainage water. pH values at the sample locations were in the range 6.9-7.2. The higher pH is likely brought about by the higher acidity buffering capacity of groundwater baseflow to the Roughty River.

Table 15.5: Surface Water Chemistry Measurements

Location ID	Location (E/N)	Conductivity (µS/cm)	pH	Temp. °C
SW1	508670 / 579463	71	6.9	14.5
SW2	508720 / 570982	80	7.1	15
SW3	508540 / 572182	86	7.2	14.3
SW4	508000 / 573892	80	7.1	14.6
FP1	509760 / 570853	62	6.8	14.2
FP2	509740 / 570053	58	6.5	16
FP3	508680 / 569632	53	6.4	15
FP4	508710 / 568833	33	6.5	13.9
FP5	505850 / 570943	42	6.2	15
FP6	506090 / 571133	50	6.5	15.5
FP7	506740 / 571432	66	6.2	14.3

Surface water samples were taken from the Roughty River downstream of the development footprint in July 2015 at locations SW1 - SW4. (Refer to Figures 15.3-15.5). Samples were stored in a cool environment and transported to City Analysts Laboratory (Dublin: 016136003) where they were analysed for a list of parameters as shown in Table 15.6. Results of the analysis are shown alongside relevant surface water regulations. For comparison, Environmental Objectives Surface Water Regulations, 2009 are shown in Table 15.7. Certificates of analysis are presented in Appendix I.

Table 15.6: Analytical Results for Surface Water Sampling

Parameter	EC Directives			Sample ID			
	2006/44/EC		EC DW Regs 2007	SW1	SW2	SW3	SW4
	Salmonid	Cyprinid					
Total Suspended Solids (mg/l)	≤ 25 (O)	≤ 25 (O)	-	4	<2	<2	<2
Ammonia N (mg/l)	≤0.04	≤0.02	0.3	<0.02	<0.01	0.03	<0.01
Ortho-Phosphate – P (mg/l)	-	-	-	<0.025	<0.025	<0.025	<0.025
Nitrate - NO3 (mg/l)	-	-	50	<8.8	<8.8	<8.8	<8.8
Phosphorus (mg/l)	-	-		<0.05	<0.05	<0.05	<0.05
Chloride (mg/l)	-	-	250	<10	<10	<10	<10
BOD	≤ 3	≤ 6	-	<2	<2	<2	<2

Total suspended solids were between <2 mg/l and 4 mg/l, which is significantly below the Freshwater Fish Directive (2006/44/EC) limits.

With the exception of ammonia in SW3, parameter results were below their respective laboratory detection limit with no exceedance of either the Freshwater Fish Directive (2006/44/EC) or the European Communities Drinking Water Regulations 2007. Ammonia in SW3 slightly exceeded the cyprinid threshold in relation to the Freshwater Fish Directive (2006/44/EC). Slightly elevated ammonia concentrations is not uncommon in water emanating from peatland sites.

In comparison to the European Communities Environmental Objectives (Surface Water) Regulations 2009, all results for ammonia and ortho-phosphate were within "High Status" range. BOD was reported as less than 2 mg/l and, therefore, is also likely to indicate High Status.

*Table 15.7: Chemical Conditions Supporting Biological Elements**

Parameter	Threshold Range		
	High Status	Good Status	Poor Status
BOD	≤ 1.3 (mean)	≤ 1.5 mean	-
Ammonia-N	≤ 0.04 (mean)	≤0.065 (mean)	-
Ortho-phosphate	≤0.025 (mean)	≤0.035 (mean)	>0.035 (mean)

* Environmental Objectives Surface Water Regulations 2009

15.1.11 Hydrogeology

The Bird Hill Formation (comprising siltstone and fine sandstone), which underlie the majority of the wind farm site, is predominately classified by the GSI (www.gsi.ie) as a

Poor Bedrock Aquifer (Pl), having bedrock that is generally unproductive except for local zones. The very northern section of the site is within the Slaheny Sandstone Formation, which is classified as a Locally Important Aquifer (LI). A local bedrock aquifer map is presented as Figure 15.6.

The bedrock of this area has little or no inter-granular permeability; groundwater flow occurs in fractures and faults; in-filling of fractures is to be expected. The permeability of individual fractures and the degree of interconnection will be generally low, with fracturing confined to local zones. Permeability is highest in the upper few metres but generally decreases very rapidly with depth. In general, groundwater flow is concentrated in the upper 5-15 m of the aquifer, although deeper inflows from along fault zones or connected fractures can be encountered. Significant yields can be obtained where boreholes are drilled into known fault zones. In these rocks groundwater flow paths are expected to be relatively short, typically 30-300 m, with groundwater discharging to small springs or to the streams that traverse the aquifer. Flow directions are expected to approximately follow the local surface water catchments (GSI, 2004).

Baseflow contribution to streams tends to be very low, particularly in summer, as the groundwater regime cannot sustain summer baseflows due to low storativity within the aquifer. In winter, low permeabilities will lead to a high water table and potential water logging of soils which is consistent with the mapped soil type of the site i.e. poorly drained mineral and peaty soil. Local groundwater flow directions will mimic topography, whereby flow paths will be from topographic high points to lower elevated discharge areas at local streams and rivers.

15.1.12 Groundwater Vulnerability

The GSI (www.gsi.ie) groundwater vulnerability rating of the aquifer underlying the site ranges from High to Extreme (X). Some of the lower lying slopes within the site are typically rated as High and this is likely due to the presence of deeper pockets of peat and mineral subsoils. The High vulnerability rating suggests that the combined thickness of peat and mineral subsoils at the site ranges from 3 m to 10 m in these areas. The upper slopes of the site are rated from Extreme (E) to Extreme (X) with the latter indicating outcropping bedrock or rock close to the surface.

The low groundwater recharge coefficient and the preference for high surface water runoff rates means there is a low potential for groundwater dispersion and movement within the aquifer, thereby making surface water bodies such as streams / watercourses more vulnerable than groundwater at this site.

15.1.13 Groundwater Hydrochemistry

In accordance with recognised hydrogeological practice at wind farms, no groundwater samples were taken at the site. However, the site and surrounding area is underlain by non-carbonate rock units, which include sandstone and siltstone rocks. In general, groundwater alkalinity in these types of rocks are in the range 10-300 mg/l (as $CaCO_3$) and hardness in the range 40-220 mg/l (moderately soft to moderately hard). These sandstone formations largely contain calcium bicarbonate type water and conductivities in these units are relatively low, in the range 125-600 µS/cm, with an average of approximately 300 µS/cm. In general, high iron (Fe) and manganese (Mn) concentrations can occur in groundwater derived from sandstones, due to the dissolution of Fe and Mn where reducing conditions occur (WFD, 2005).

15.1.14 Water Framework Directive Water Body Status & Objectives

The South Western River Basin District (SWRBD) Management Plan (2009 – 2015) has been adopted by all local authorities in the SWRBD. Its objectives, which will be integrated into the design of the wind farm, include the following:

- Prevent deterioration and maintain a high status where it already exists.
- Protect, enhance and restore all waters with aim to achieve at least good status by 2015.
- Ensure waters in protected areas meet requirements.
- Progressively reduce chemical pollution.

Regardless of their current quality, surface waters should be treated the same in terms of the level of protection and mitigation measures employed, i.e. there should be no negative change in status. Strict mitigation measures in relation to maintaining a high quality of surface water runoff from the development and groundwater protection will ensure that the status of both surface water and groundwater bodies in the vicinity of the site will be maintained (see below for WFD water body status and objectives) regardless of their existing status.

15.1.15 Groundwater Body Status

Local Groundwater Body (GWB) and Surface Water Body (SWB) status reports are available for download from www.wfdireland.ie.

The site is situated within the Bearna Sneem GWB (IE_SW_G_019), which is assigned 'Good Status'[28] (www.wfdireland.ie) in respect of both quantitative status and chemical status. The objectives for the GWBs is to protect the current 'Good Status' condition, requiring that its chemical and quantitative status needs to be maintained.

15.1.16 Surface Water Body Status

The eastern section of the site is located in the Roughty_3Mid SWB (IE_SW_21_4731), which is assigned an overall 'High Status' with a risk result of 2b (Not At Risk).

The southern section of the site is located in the Roughty Upper SWB (IE_SW_21_5823), which is assigned an overall 'Good Status' with a risk result of 2a (Probably Not At Risk).

The majority of the western section of the site is located in the Coolnagoppoge Upper SWB (IE_SW_21_4737), which is assigned an overall 'High Status' with a risk result of 2a (Probably Not At Risk). A small section of the western site boundary extends into the Foilduff SWB (IE_SW_21_17), which is assigned an overall 'Good Status' with a risk result of 2a (Probably Not At Risk).

The central section of the site is situated in the Knockanruddig SWB (IE_SW_21_6507), which is assigned an overall 'Good Status' with a risk result of 2a (Probably Not At Risk).

The northern section of the site is in the Roughtly_2Mid SWB (IE_SW_21_6757), which is assigned an overall 'High Status' with a risk result of 2b (Not At Risk). The site entrance extends into the Sillahertane SWB (IE_SW_21_976), which is assigned an overall 'High Status' with a risk result of 2b (Not At Risk).

[28] Status' means the condition of the water in the water body. It is defined by its chemical status and its ecological status, whichever is worse. Waters are ranked in one of five classes: High, Good, Moderate, Poor and Bad (WFD, 2010).

A summary of the water body status, risk result and protection objective for the various SWBs, which are shown on Figure 15.2, is presented in Table 15.8.

Table 15.8: Summary WFD Information for Surface Water Bodies

Surface Water Body	Physio-Chemical Status	Overall Ecological Status	Overall Status	Overall Risk Result	Overall Objective
Roughty 3_Mid	n/a	High	High	2b	Protect
Roughty Upper	n/a	Good	Good	2a	Protect
Coolnagoppoge	n/a	High	High	2a	Protect
Foilduff	n/a	Good	Good	2a	Protect
Knockanruddig	n/a	Good	Good	2a	Protect
Roughty 2_Mid	n/a	High	High	2b	Protect
Sillahertane	n/a	High	High	2b	Protect

n/a - not assessed

15.1.17 Designated Sites & Habitats

Ballagh Bog pNHA is located immediately south of the development site and a small section of the pNHA extends inside the site boundary. However, no development will take place within the pNHA. Sillahertane Bog NHA borders a small section of the site to the northeast. The primary interest of both these designated sites is intact upland blanket bog.

Approximately 3.5 km downstream of the proposed development site a section of the Roughty River is designated a pNHA. The locations of designated sites are shown on Figure 15.7.

Figure 15A: Topographic Cross-section between T6 and Sillahertane Bog NHA

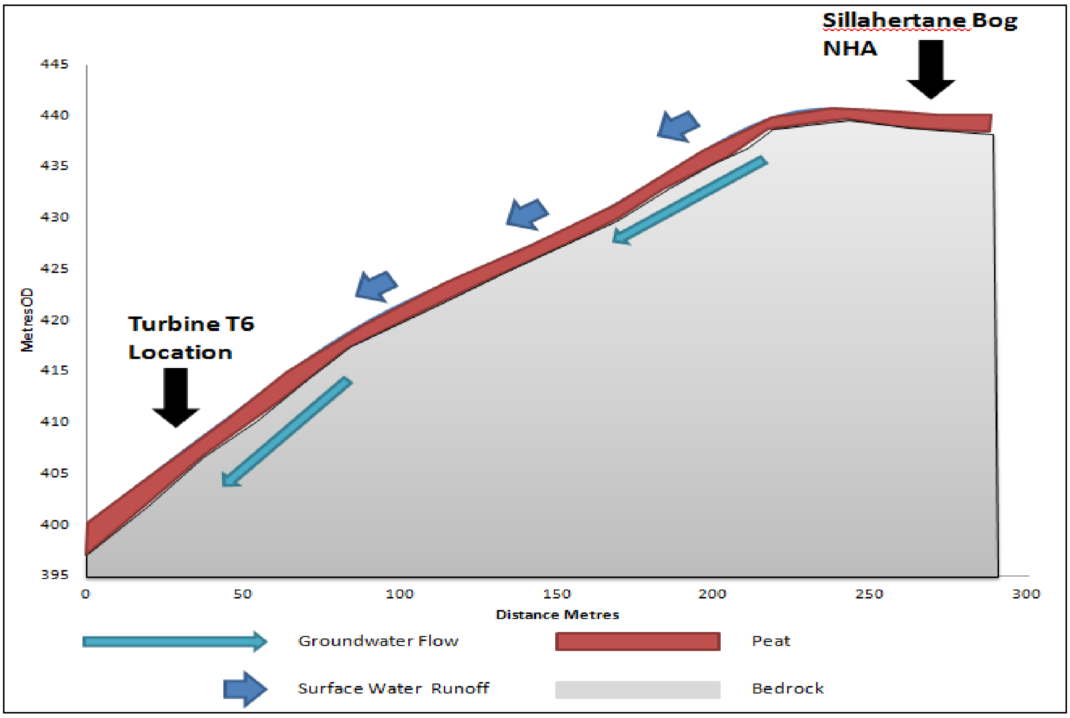
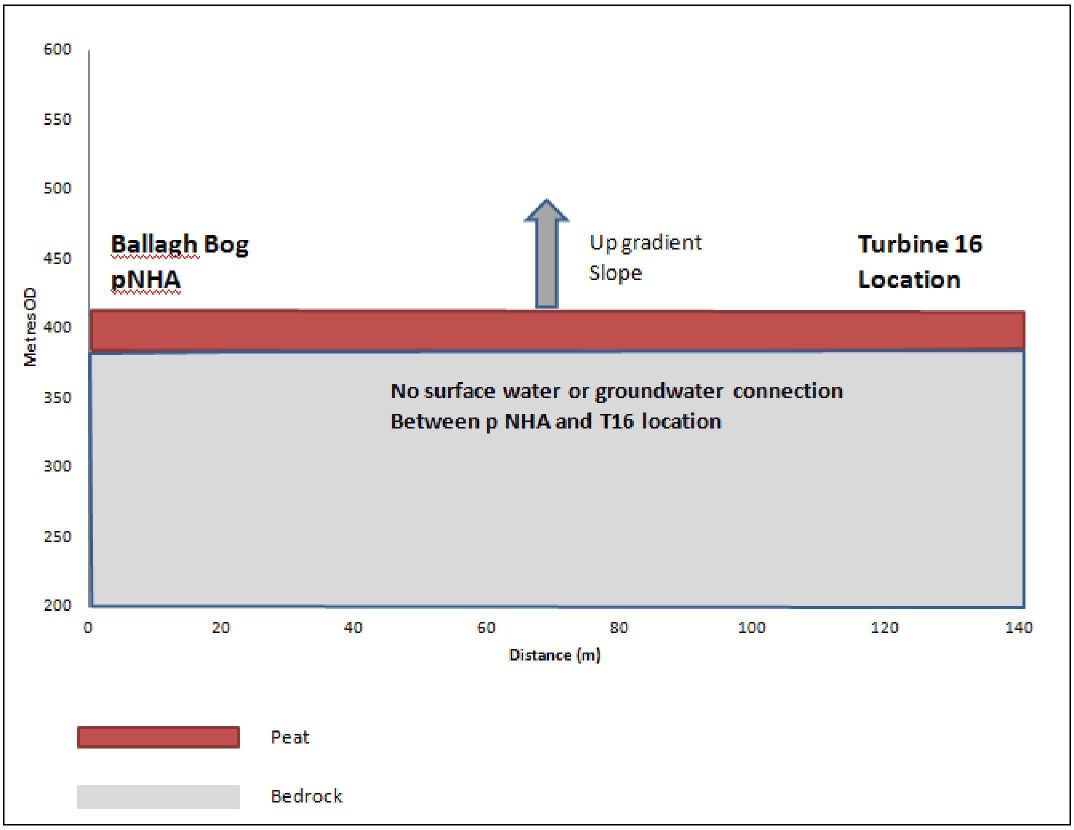


Figure 15B: Topographic Cross-section between T16 and Ballagh Bog pNHA



15.1.18 Water Resources

A search of the GSI well database indicates that there is one private well within 500 m of the site. This mapped well is located within 100 m the northern site entrance and is used for agricultural and domestic purposes (refer to Figure 15.6).

As the GSI well database is not exhaustive in terms of the locations of all wells in an area, since it relies on the submission of data by drillers, the public, etc., it is very conservatively assumed that every private dwelling in the vicinity of the proposed development has a water supply well associated with it. However, due to the remote setting of the proposed development site there are no inhabited dwellings down gradient of any proposed turbine or borrow pit locations and therefore there will be no potential to impact on private well supplies. The locations of inhabited private dwellings are shown on Figure 15.6.

15.1.19 Receptor Sensitivity

Due to the nature of wind farm developments, which are “near surface” construction activities, impacts on groundwater are generally negligible and surface water is generally the main sensitive receptor assessed during impact assessments. The primary risk to groundwater at the site would be from hydrocarbon spillage, leakages at excavations and borrow pits, and from on-site wastewater discharge. These are common potential impacts to all construction sites, such as road works and industrial sites. These potential contamination sources will be carefully managed at the site.

Based on criteria set out in Table 15.1, groundwater at the site can be classed as Not Sensitive to pollution, as the underlying sandstones are classified as a Poor Aquifer. In addition, the majority of the site is covered in peat and poorly draining soils, which act as a protective cover to the underlying aquifer. Any contaminants that may be accidently released on site are more likely to travel to nearby streams / watercourses within surface runoff. The relatively low permeability of the bedrock means that any contaminant that may reach the bedrock would not disperse and would remain localised to the source or would be removed as runoff during wet periods.

Both Sillahertane Bog NHA and Ballagh Bog pNHA can be considered very sensitive to hydrological impacts.

Surface waters such as the downstream Roughty River, part of which is a pNHA, and its tributaries can be considered very sensitive to potential contamination. Freshwater Pearl Mussel are known to exist in the Roughty River downstream of the proposed development site.

Mitigation measures will ensure that surface runoff from the developed areas will be of a high quality and, therefore, will not impact on the quality of downstream surface water bodies or habitats. Any introduced drainage works at the site will mimic the existing hydrological regime, thereby avoiding changes to flow volumes leaving the site.

A hydrological constraints map for the site is shown as Figures 15.8-15.10. A key pollution prevention measure during the construction phase is the avoidance of ecologically sensitive natural water features where possible. A self-imposed 50 m wide stream/river buffer is proposed for surface water protection. Where necessary development occurs within 50 m of a watercourse (such as at stream and drain crossings), additional mitigation measures will be put in place to ensure maximum protection of the local stream or river.

The hydrological constraints map shows that most of the proposed development areas are significantly away from areas on the site that have been determined to be hydrologically sensitive. The large setback distance from sensitive hydrological features means they will not be impacted by excavations/drains etc. It also allows adequate room for the proposed drainage mitigation measures (discussed below) to be properly installed up-gradient of primary drainage features within sub-catchments. This will allow attenuation of surface runoff to be more effective

15.1.1 Assessment in Changes in Site Runoff Volumes

The following water balance assessment gives a preliminary indication of the average highest monthly volume of surface water runoff expected. The calculations are carried out for the month with the highest average recorded rainfall versus evapotranspiration for the current baseline site conditions in terms of subsoil and bedrock exposure (Table 15.9). Therefore, it represents the average daily and monthly wettest scenarios in terms of volumes of surface water runoff from the site area pre-development. The runoff co-efficient for the site is estimated to be a conservative 95%, based on the predominant poorly draining soil coverage at the site and the relatively low permeability bedrock.

The highest long-term average monthly rainfall of 216 mm at Mount Ballingeary rainfall station occurred in October. The average monthly evapotranspiration for the synoptic station at Valentia Observatory over the same period was 25.8 mm. Actual evapotranspiration (AE) for the site is taken to be 24.51 mm/yr (0.95 PE). The calculation is carried out for the total site area. The balance indicates that a conservative estimate of surface water runoff for the total site area during the highest rainfall month is 2,665,062 m^3/month, which equates to an average of 85,970 m^3/day, as outlined in Table 15.10.

Table 15.9. Water Balance and Baseline Runoff Estimates for Wettest Month

Water Balance Component	Depth (m)
Average October Rainfall (R)	0.2160
Average October Potential Evapotranspiration (PE)	0.0258
Average October Actual Evapotranspiration (AE = PE x 0.95)	0.0245
Effective Rainfall October (ER = R - AE)	0.1915
Recharge co-efficient (5% of ER)	0.0096
Runoff (m)	0.1819

Table 15.10. Baseline Runoff for Total Site Area

Approximate Area (m^2)	Baseline Runoff / month (m^3)	Baseline Runoff / day (m^3)
14,650,000	2,666,062	85,970

The covering of the development footprint with impermeable materials, which is a worst case scenario that will not be the case in reality, could result in an increase in average total site surface water runoff of 3,638m^3/month for the month of highest average recorded rainfall (an increase of 0.14% over the baseline condition). This equates to an average increase of 117m^3/day (Table 15.11). This is a very small increase and results from a small area being developed, the proposed development footprint being approximately 38 ha, representing 2.6% of the total site area of 1,465 ha. The additional volume in all sub-catchments is low due to the fact that the runoff potential from the site is naturally high (95%). Additionally, the calculation conservatively assumes that all hardstanding areas will be impermeable (i.e. has 100% runoff). This in reality will not be the case, since almost all hardstanding areas will be permeable to some extent. Therefore, the actual increase in runoff will be negligible. This is without taking account of the mitigation measures that will be put in place, such as attenuation and use of check dams and silt traps to slow runoff down within the proposed wind farm drainage system. Therefore, there will be no risk of exacerbated flooding down-gradient of the site.

Table 15.11. Water Balance and Estimated Development Runoff Volumes.

Baseline Runoff / month (m^3)	Baseline Runoff / day (m^3)	Hardstanding Area (m^2)	Hardstanding Area 100% Runoff (m^3)	Hardstanding Area 95% Runoff (m^3)	Net Increase / month (m^3)	Net Increase / day (m^3)	Increase on Baseline Conditions
2,665,062	85,970	380,000	72,766	69,128	3,638	117	0.14%

15.1.2 Wind Farm Drainage Design

Overview of Proposed Drainage Management

Runoff control and drainage management are key elements in terms of mitigation against impacts on surface water bodies. Two distinct methods will be employed to manage drainage water, as follows:

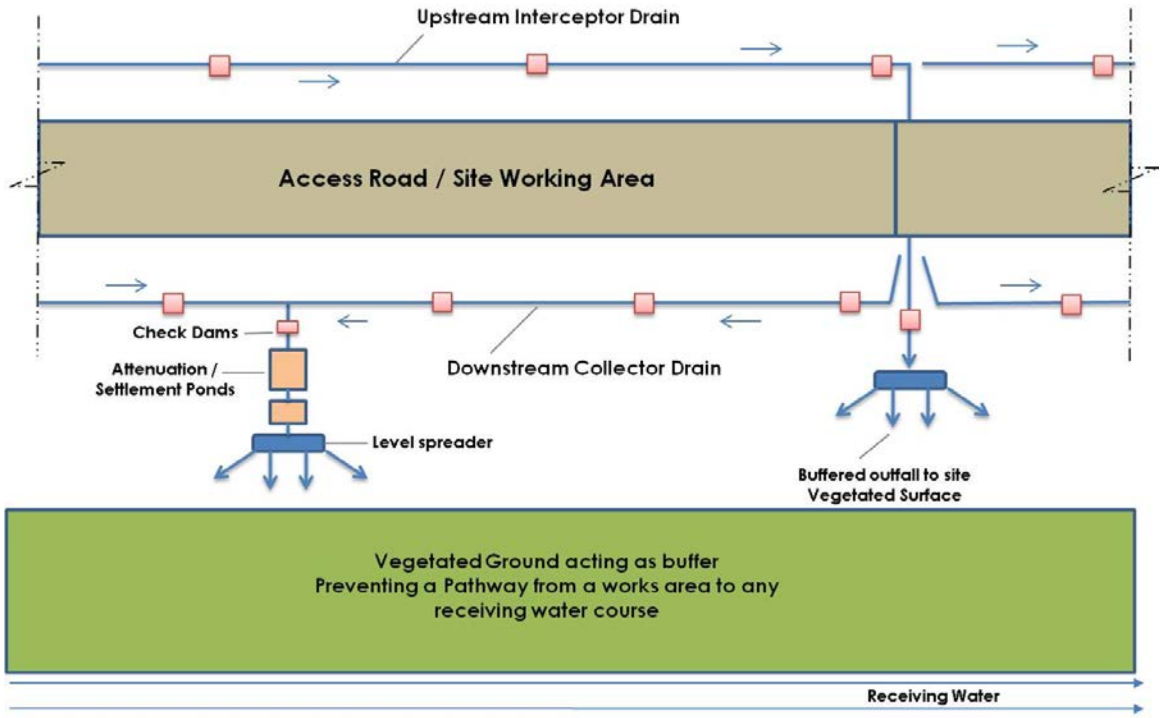
- Keeping clean water clean by avoiding disturbance to natural drainage features, minimising any works in or around artificial drainage features and diverting clean surface water flow around excavations, construction areas and temporary storage areas.

- Collecting any drainage waters from works areas within the site that might carry silt or sediment and nutrients and routing them towards stilling ponds prior to controlled diffuse release over vegetated surfaces.

There will be no direct discharges to surface waters. During the construction phase, all runoff from works areas, i.e. dirty water, will be attenuated and treated to a high quality prior to being released.

A schematic of the proposed site drainage management is shown in Figure 15C. A Surface Water Management Plan (SWMP) - Sustainable Urban Drainage System (SUDs) design - for the wind farm development, which is based on the drainage philosophy as shown below, is presented in Appendix I.

Figure 15C: Schematic of Proposed Drainage Design



15.2 IMPACT OF THE DEVELOPMENT

15.2.1 Overview of Impact Assessment Process

The conventional source-pathway-target model was applied to assess potential impacts on downstream environmental receptors resulting from the development. The stepwise impact assessment process applied is presented below. The definitions and descriptions show how the source-pathway-target model and the EPA impact descriptors are combined.

- Description of Potential Impact Source: The activity that brings about the potential impact or the potential source of pollution is described. The significance of effects is briefly described.

- Pathway / Mechanism: The route by which a potential source of impact can transfer or migrate to an identified receptor is outlined. Surface water and groundwater flows are the primary pathways for wind farm developments. For example, excavation or soil erosion are physical mechanisms by which a potential impact is generated.

- Receptor: A receptor is a part of the natural environment that could potentially be impacted upon, *e.g.* human health, plant / animal species, aquatic habitats, soils/geology, water resources, water sources. The potential impact can only arise as a result of a source and pathway being present.
- Pre-mitigation Impact: Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impact before mitigation is put in place.

15.2.2 Earthworks (Removal of Vegetation Cover, Excavations and Stockpiling) Resulting in Suspended Solids Entrainment in Surface Waters

Construction phase activities including access track and turbine base construction will require earthworks resulting in removal of vegetation cover and excavation of soil and mineral subsoil where present. Potential sources of sediment laden water include:

- Drainage and seepage water resulting from road and turbine base excavation.
- Stockpiled excavated material providing a point source of exposed sediment.
- Construction of access road culverts resulting in entrainment of sediment from the excavations during construction.
- Erosion of sediment from emplaced site drainage channels.

These activities can result in the release of suspended solids to surface watercourses and could result in an increase in the suspended sediment load, resulting in increased turbidity which in turn could affect the water quality and fish stocks of downstream water bodies. Potential impacts can be significant if not mitigated against.

Pathway / Mechanism: Drainage and surface water discharge routes.

Receptor: Down-gradient rivers and dependant ecosystems.

Pre-mitigation Impact: Indirect, negative, significant, short term, medium probability impact.

15.2.3 Potential Impacts on Local Groundwater Levels due to Borrow Pit Dewatering

Typically, dewatering of borrow pits has the potential to impact on local groundwater levels and flow regimes.

Groundwater level impacts at the site are not anticipated to be significant, as there will be no requirement to actively dewater borrow pits during the construction phase. For the avoidance of doubt, dewatering is defined here as the requirement to permanently drawdown the local groundwater table by means of over pumping, e.g. as would be required for the operation of a bedrock quarry in a valley floor. At the borrow pits surface water flow will dominate over groundwater seepages and as such the drainage design is focused on these more significant flow inputs, and inherent factors of safety within the surface water design will account for any minor groundwater seepages that occur into borrow pits.

In summary, no borrow pit dewatering will be required at the wind farm site for the following reasons:

- The proposed borrow pits are located on the side of mountains/hills where the ground elevations are between 300 m OD and 500 m OD. These elevations are significantly above the elevations of the local valleys and major streams/rivers.
- The local bedrock comprises sandstone and siltstone bedrock layers. These are known to have very localised groundwater flow paths in the area of this site. This means that groundwater flows will be relatively minor.
- The flow paths, i.e. the distance from the point of recharge to the point of discharge, in this type of geology will be short, localised and relatively shallow.
- No regional groundwater flow regime, i.e. large volumes of groundwater flow, will be encountered at these elevations. Therefore, shallow groundwater inflows will largely be fed by recent rainfall and possibly by limited groundwater storage.
- The sloping nature of the ground where the borrow pits are proposed, together with the coverage of poorly draining soil, means groundwater recharge will be low.
- As such, the shallow groundwater flow system will be small in comparison to the expected surface water flows, meaning that there will be a preference for surface water runoff as opposed to groundwater recharge and flow.

In summary, due to the anticipated localised, low volume groundwater flow patterns within the relatively low permeability bedrock in the area of the site, and the sloping and elevated nature of the topography in the vicinity of the borrow pits, significant groundwater seepages into any of the borrow pits is not anticipated. Therefore, impacts on local groundwater levels are anticipated to be negligible.

15.2.4 Potential Impacts on Local Groundwater Supplies During Excavation Works

Quantitative and qualitative impacts on water supply wells can potentially occur by two main pathways:

- Up-gradient wells and other hydrogeological features could potentially be affected by groundwater drawdown during excavation work (typically a relatively small area).
- Down-gradient wells and other hydrogeological features whose zones of contribution may exist within the proposed working area could potentially be affected by contaminated groundwater and to a lesser extent groundwater drawdown (potentially a much larger area).

A search of the GSI well database indicates that there is one private well in the locality and that it located more than 1.5 km from the closest turbine or borrow pit. Therefore, no impacts are anticipated.

For the conservative assumption that every private dwelling in the vicinity has a water supply well associated well with it, no identified dwelling is located hydraulically down-gradient of the proposed infrastructure where large excavations are required, i.e. turbine bases or borrow pits. Therefore, there is no potential to impact on groundwater quality or quantity supplying these potential wells.

15.2.5 Excavation Pumping and Potential Impacts on Surface Water Quality

Surface water inflows and minor groundwater seepages may occur in turbine base excavations and borrow pits and this would create additional volumes of water to be treated by the runoff management system. These inflows will likely require management and treatment to reduce suspended sediments. Potential impacts on surface water quality are likely to be significant if mitigation is not put in place.

Pathway / Mechanism: Overland flow and site drainage network.

Receptor: Down-gradient surface water bodies.

Pre-mitigation Impact: Indirect, negative, significant, temporary, low probability impact to surface water quality.

15.2.6 Potential Release of Hydrocarbons During Construction and Storage

Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a significant pollution risk to groundwater, surface water and associated ecosystems, and to terrestrial ecology. The accumulation of small spills of fuels and lubricants during routine plant use can also be a pollution risk.

Hydrocarbon has a high toxicity to humans and all flora and fauna, including fish, and is persistent in the environment. It is also a nutrient supply for adapted micro-organisms, which can rapidly deplete dissolved oxygen in waters, resulting in death of aquatic organisms. The potential effects on the surface water aquatic environment in particular are significant.

Pathway / Mechanism: Groundwater flow paths and site drainage network.

Receptor: Groundwater and surface water.

Pre-mitigation Impact: Indirect, negative, significant, temporary, medium probability impact to surface water quality.

15.2.7 Groundwater and Surface Water Contamination from Wastewater Disposal

Release of effluent from domestic wastewater treatment systems has the potential to significantly impact on groundwater and surface waters if site conditions are not suitable for an on-site percolation unit. Due to the low permeability of the subsoils at the site, surface waters are more susceptible to impact rather than groundwater.

Pathway / Mechanism: Groundwater flow paths and site drainage network.

Receptor: Groundwater and surface water.

Pre-mitigation Impact: Indirect, negative, significant, temporary, low probability impact to surface water quality. Indirect, negative, slight, temporary, low probability impact to local groundwater.

15.2.8 Morphological & Water Quality Impacts Arising During the Stream Crossing Construction Works

Diversion, culverting and bridge crossing of surface watercourses can result in changes to drainage patterns and alteration of aquatic habitats. Construction of structures over water courses has the potential to significantly interfere with water quality and flows during the construction phase.

There will be a requirement for crossings over the main channel of the Roughty River. In addition, there will be numerous crossings required over first and second order streams that flow into both the Roughty River and the Red Trench River. There will be no requirement for stream/river channel realignment works and, therefore, no significant impacts are anticipated.

Pathway / Mechanism: Site drainage network.

Receptor: Surface water flows and stream morphology.

Pre-mitigation Impact: Negative, direct, moderate, short term, low probability impact.

15.2.9 Release of Cement-Based Products

Concrete and other cement-based products are highly alkaline and corrosive and can have significant negative impacts on water quality. They generate very fine, highly alkaline silt (pH 11.5) that can physically damage fish by burning their skin and blocking their gills. Entry of cement based products into the site drainage system, into surface water runoff, and hence to surface watercourses or directly into watercourses represents a risk to the aquatic environment. Peat ecosystems are dependent on low pH hydrochemistry. They are extremely sensitive to the introduction of high pH alkaline waters into the system. Batching of wet concrete on site and wash out of transport and placement machinery are the activities most likely to generate a risk of cement based pollution. Due to the avoidance of wet cement batching at the site, no significant effects are anticipated.

Pathway / Mechanism: Site drainage network.

Receptor: Surface water and peat water hydrochemistry.

Pre-mitigation Impact: Indirect, negative, moderate, short term, medium probability impact to surface water

15.2.10 Hydrological Impacts on Local Designated Bogs

Sillahertane Bog NHA, which borders a small section of the proposed development, is located in a separate sub-catchment immediately to the northeast. No wind farm development infrastructure will be located either up-gradient or down-gradient of it and there will be no impacts on the surface water hydrology of the NHA. Additionally, being in a separate sub-catchment, there is no groundwater flow from the development areas towards the NHA. There will be no hydrological impacts from potential alteration of groundwater flow paths.

Similarly, Ballagh Bog pNHA is predominately located in a separate sub-catchment of the Roughty River to the south of the wind farm. While a section of Ballagh Bog does extend into the wind farm site, no development will take place within the pNHA boundary. Additionally, no wind farm development infrastructure is located either up-gradient or down-gradient of it and there will be no impact on the surface water hydrology of the pNHA. In addition, there can be no hydrological impacts from potential alteration of groundwater flow paths, as there is no groundwater flow from the site towards the pNHA.

Pathway / Mechanism: Site drainage network and downstream watercourses.

Receptor: Blanket bog hydrology.

Pre-mitigation Impact: No impacts are anticipated.

15.2.11 Replacement of Natural Surface with Lower Permeability Surface

Progressive replacement of the vegetated surface with hardstanding surfaces could potentially result in an increase in the proportion of surface water runoff reaching the surface water drainage network. The footprint comprises turbine bases and hardstandings, access tracks and Coomataggart Substation. During storm rainfall events, additional runoff coupled with increased velocity of flow could increase hydraulic loading, resulting in erosion of watercourses and impact on aquatic ecosystems.

The calculated increase in surface water runoff of 5,958 m³/month for the month of highest average recorded rainfall represents an increase of 0.23% in the average daily / monthly volume of runoff from the site in comparison to the baseline pre-development site runoff conditions. No significant effects are anticipated.

Pathway / Mechanism: Site drainage network.

Receptor: Surface waters and dependant ecosystems.

Pre-mitigation Impact: Direct, negative, slight, permanent, medium probability impact.

15.2.12 Felling of Coniferous Plantation

A minimal amount of tree felling of coniferous forestry is required where approximately 500 m of the turbine transport route from Clonkeen is within a currently afforested area. A clear felled corridor of 20 m will be created resulting in 1 ha of existing plantation forestry being felled.

Potential impacts during tree felling occur mainly from:

- Exposure of soil and subsoils due to vehicle tracking, and skidding or forwarding extraction methods resulting in a source of suspended sediment which can become entrained in surface water runoff and enter surface water courses.
- Entrainment of suspended sediment in watercourses due to vehicle tracking through watercourses.
- Damage to roads resulting in a source of suspended sediment which can become entrained in surface water runoff and enter surface water courses.
- Release of sediment attached to timber in stacking areas.
- Nutrient release.

In Ireland, forestry is an activity that operates under strict environmental controls such as tree felling licences and also principles of sustainable forest management with great emphasis on the protection of the aquatic environment. Therefore, no significant effects are anticipated from tree felling.

Pathway / Mechanism: Drainage and surface water discharge routes.

Receptor: Surface waters and associated dependant ecosystems.

Pre-mitigation Impact: Indirect, negative, moderate, short term, medium probability impact.

15.2.13 Impacts on Downstream Freshwater Pearl Mussel Sites

Freshwater Pearl Mussel (FWPM) surveys were completed on 14.88 km of the Roughty River from Cahergal Bridge (Grousemount) upstream to the bridge east of Knockanruddig. FWPM were found to be widely distributed at relatively low densities along the stretch investigated with abundance decreasing in an upstream direction. A total of 669 mussels were recorded with occasional concentrations occurring in restricted patches of suitable stable substrate.

FWPM are known to be particularly sensitive to the presence of fine sediments. Earthworks such as those proposed at the Grousemount Wind Farm have the potential to impact on FWPM sites from site runoff, if the appropriate stringent mitigation measures are not put in place.

Pathway / Mechanism: Site drainage network and downstream watercourses.

Receptor: Freshwater Pearl Mussel sites

Pre-mitigation Impact: Indirect, negative, slight, temporary, medium probability impact.

15.3 MITIGATION

15.3.1 Overview of Mitigation Process

Taking the impact assessment process into account, the mitigation process is approached in the following manner:

- Proposed Mitigation Measures: Control measures that will be put in place to prevent or reduce all identified significant adverse impacts. In relation to wind farm developments, these measures are generally provided in two types: (1) mitigation by avoidance, and (2) mitigation by engineering design.
- Post-mitigation Residual Impact: Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential impacts after mitigation is put in place.
- Significance of Effects: Describes the likely significant post-mitigation effects of the identified potential impact source on the receiving environment.

15.3.2 Earthworks (Removal of Vegetation Cover, Excavations and Stockpiling) Resulting in Suspended Solids Entrainment in Surface Waters

Mitigation by Avoidance

The key mitigation measure during the construction phase is the avoidance of sensitive aquatic areas where possible.

From Figures 15.8-15.10 it can be seen that most of the proposed development areas are actually away from the delineated 50 m buffer zones. Where there is development within the 50 m buffer, additional mitigation measures as outlined further below will be put in place.

The setback from sensitive hydrological features means that adequate room is maintained for the proposed drainage mitigation measures to be properly installed and operate effectively. The proposed buffer zones will:

- Avoid physical damage to watercourses, and associated release of sediment.
- Avoid excavations within close proximity to surface water courses.
- Avoid the entry of suspended sediment from earthworks into watercourses.
- Avoid the entry of suspended sediment from the construction phase drainage system into watercourses, achieved in part by ending drain discharge outside the buffer zone and allowing percolation across the vegetation of the buffer zone.

Mitigation by Design

The following source controls will be applied:

- Interceptor drains, v-drains, diversion drains, flume pipes, erosion and velocity control measures such as use of sand bags, oyster bags filled with gravel, filter fabrics and other similar/equivalent or appropriate systems.
- Small working areas, covering stockpiles, weathering off stockpiles, cessation of

works in certain areas or other similar/equivalent or appropriate measures.

The following in-line controls will be applied:

- Interceptor drains, v-drains, oversized swales, erosion and velocity control measures such as check dams, sand bags, oyster bags, straw bales, flow limiters, weirs, baffles, silt fences, filter fabrics, and collection sumps, temporary sumps/attenuation lagoons, sediment traps, pumping systems, settlement ponds, temporary pumping chambers, or other similar/equivalent or appropriate systems.

The following treatment systems will be applied:

- Temporary sumps and attenuation ponds, temporary storage lagoons, sediment traps, and settlement ponds, and proprietary settlement systems such as Siltbuster (mobile silt trap that can remove fine particles from water using a proven technology and hydraulic design in a rugged unit, and specifically designed for use on construction sites) and/or other similar/equivalent or appropriate systems.

The following outfall controls will be applied:

- Level spreaders, buffered outfalls, vegetation filters, silt bags, and flow limiters and weirs.

Management of Runoff from Peat and Subsoil Storage Areas

It is proposed that excavated peat will be used for landscaping throughout the site and any excess peat will be stored in the proposed borrow pits.

During the initial placement of peat and subsoil, silt fences, straw bales and biodegradable geogrids will be used to control surface water runoff from the storage areas. 'Siltbuster' treatment trains will be employed if previous treatment is not to a high quality.

Drainage from peat storage areas will ultimately be routed to an oversized swale and a number of settlement ponds and a 'Siltbuster' with appropriate storage and settlement designed for a 1 in 100 year 6-hour return period before being discharged to the on-site drains.

Peat/subsoil storage areas will be sealed with a digger bucket and vegetated as soon possible to reduce sediment entrainment in runoff. Once re-vegetated and stabilised peat/subsoil storage areas will no longer be a potential source of silt laden runoff.

Additional Mitigation Measures for Works Inside 50m Buffers

Water Treatment Train

If the discharge water from construction areas fails to be of a high quality, then a filtration treatment system (such as a 'Siltbuster' or similar equivalent treatment train / sequence of water treatment processes) will be used to filter and treat all surface discharge water collected in the dirty water drainage system. This will apply for all of the construction phase.

Silt Fences

Silt fences will be installed as single, double or a series of triple silt fences, depending on the space available and the anticipated sediment loading. The silt fence designs follow the technical guidance document 'Control of Water Pollution from Linear Construction Projects' published by CIRIA (CIRIA, No. C648, 1996). Up to three silt fences may be deployed in series.

The Stage 1 (Coarse) silt fence will consist of a geotextile fabric such as Terram 1000 attached by staples to fixed stakes. The Terram sheets will be folded in an L shape with one metre extending horizontally in towards the works area. This horizontal section will be buried at a depth of approximately 150 mm beneath a clean stone surface. Terram 1000 is a permeable fabric through which water can pass, but through which sediment particles cannot. It does however, impede water flow and can lead to the backing up of water and sediment, which reduce its effectiveness.

The Stage 2 (Medium) silt fence will consist of straw bales, embedded 100 mm into the soil / ground and fixed in place with stakes. A geotextile fabric will be pegged and stapled to the straw bales and stakes.

The Stage 3 (Fine) silt fence will be similar to the Stage 1 fence, with the addition of a course sand and/or fine gravel at the base of the geotextile.

Silt Bags

Silt bags provide an effective way to collect harmful sediments from dirty water pumped out of excavation works, such as foundations, that would otherwise pollute the surrounding environment. The silt filter bags provide a passive non-mechanical solution, without the use of excessive or specialist machinery (other than possible lifting equipment when full), and do not require a large work area.

Sediment-laden water is pumped into the high quality filter bags, which trap the solids inside and allow filtered water to flow freely out through the geotextile fabric to disperse into the surrounding ground or another collection point.

Flow rates will vary depending on the size of the dewatering bag, the type and amount of sediment discharged into the bag, the type of ground, rock or other substance under the bag and the degree of the slope on which the bag lies. Filtration efficiency may be increased by placing the bag on an aggregate base to maximize water flow through the under surface of the bag. A standard 1.8 m x 1.8 m dewatering bag has the capacity to trap approximately 1 t of silt and cope with flow rates up to 100 m^3/hr, while larger bags can trap more than 4 t of silt and cope with higher flow rates.

Sedimats

Sediment entrapment mats will be placed at the outlet of the silt bag to provide further treatment of the water outfall from the silt bag. Sedimats will be secured to the ground surface using stakes. The sedimat will extend to the full width of the outfall to ensure all water passes through this additional treatment measure.

Pre-emptive Site Drainage Management

The works programme for the initial construction stage of the development will also take account of weather forecasts and, in particular, predicted rainfall. Large excavations and movements of subsoil or vegetation stripping will be suspended or scaled back if heavy rain is forecast. The extent to which works will be scaled back or suspended will relate directly to the amount of rainfall forecast.

Forecasting systems are available and will be used on a daily basis at the site to direct proposed construction activities.

Using the safe threshold rainfall values will allow work to be safely controlled (from a water quality perspective) in the event of forecasting of an impending high rainfall intensity event.

Works should be suspended if forecasting suggests either of the following is likely to occur:

>10 mm/hr (high intensity local rainfall events).

>25 mm in a 24 hour period (heavy frontal rainfall lasting most of the day).

>half monthly average rainfall in any 7 days.

Prior to works being suspended the following control measures should be completed:

- Secure all open excavations.
- Provide temporary or emergency drainage to prevent back-up of surface runoff.
- Avoid working during heavy rainfall and for up to 24 hours after heavy rainfall events to ensure drainage systems are not overloaded.

Timing of Site Construction Works

Construction of the site drainage system will only be carried out during periods of low 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. Construction of the drainage system during this period will also ensure that attenuation features associated with the drainage system will be in place and operational for all subsequent construction works.

Monitoring

An inspection and maintenance plan for the on-site drainage system will be prepared in advance of commencement of any works. Regular inspections of all installed drainage systems will be undertaken, especially after heavy rainfall, to check for blockages and to ensure there is no build-up of standing water in parts of the systems where it is not intended. Inspections will also be undertaken after tree felling. Any excess build up of silt levels at dams, the settlement pond, or any other drainage features that may decrease the effectiveness of the drainage feature, will be removed.

During the construction phase field testing and laboratory analysis of a range of parameters with relevant regulatory limits and EQSs will be undertaken for each primary watercourse, and specifically following heavy rainfall events, i.e. weekly, monthly and event based. The monitoring will be completed in consultation with IFI.

Surface water quality will be monitored during the construction phase and this monitoring will also extend into the post-construction phase. The locations of the monitoring points are set out as follows:

- Grab sampling will be completed at sampling locations S1-SW4.

The monitoring programme at the above locations will include:

- Daily visual checks.
- Weekly sampling and analysis for suspended solids and turbidity in catchments where construction or tree felling is on-going.
- Monthly sampling and analysis for a full suite of parameters.
- Additional sampling in the event of trigger level exceedance, after heavy rainfall, etc.
- Post-construction sampling programme (fortnightly for 2–3 months).

Post-mitigation Impact (residual): Indirect, negative, imperceptible, short term, low probability impact.

Significance of Effects: Given the level of protection provided by the hydrological buffer zones and the proposed SUDs drainage measures, no significant residual effects are anticipated.

15.3.3 Excavation Pumping and Potential Impacts on Surface Water Quality

Mitigation by Design

Management of inflows and subsequent treatment prior to discharge into the drainage network will be undertaken as follows:

- Appropriate interceptor drainage to prevent upslope surface runoff from entering excavations will be put in place.
- If required, pumping of excavation inflows from a sump will prevent build up of water in the excavation.
- The interceptor drainage will be discharged to the site constructed 'clean' drainage system or onto natural vegetated surfaces and not directly to surface waters.
- The pumped water volumes will be discharged via volume and sediment attenuation ponds adjacent to excavation areas.
- There will be no direct discharge to surface watercourses, and therefore no risk of hydraulic loading or contamination will occur.
- Daily monitoring of excavations by a suitably qualified person will occur during the construction phase. If high levels of seepage inflow occur, excavation work should immediately be stopped and a geotechnical assessment undertaken.
- A mobile 'Siltbuster' or similar equivalent specialist treatment system will be available for emergencies in order to treat sediment polluted waters from settlement ponds or excavations should they occur.
- The proposed borrow pits will only be used during the construction phase and will be backfilled with peat once extraction is complete.
- The available vegetation layer (from the areas been stripped of peat) will be placed on the top of the filled borrow pits. The vegetation part of the sod will be facing right way up and this will encourage growth of plants and vegetation at the surface of the peat within the borrow pits. This will reduce runoff velocities by encouraging diffuse flow and prevent erosion by a having a natural "cap" over the emplaced peat.

Once the borrow pits are reinstated and re-vegetated there will be no potential to impact on downstream water quality.

Mitigation measures proposed to avoid release of hydrocarbons at borrow pit locations are as follows:

- There will be no storage of hydrocarbons permitted within borrow pit areas.
- The plant used will be regularly inspected for leaks and fitness for purpose.
- Spill kits will be available to deal with and accidental spillages within borrow pit areas.
- An emergency plan for the construction phase to deal with accidental spillages will be contained within the Construction Environmental Management Plan.

The proposed drainage management measures and pollution prevent measures will ensure that the borrow pits will be operated without impacting on downstream surface waters. Borrow pits operations will not create significant groundwater management issues that are often associated with deep bedrock quarries. In the context of the proposed development, the borrow pits will be managed in the same way as the turbine base excavations.

Post-mitigation Impact (residual): Indirect, negligible, short term, low probability impact on local surface water bodies.

Significance of Effects: No significant residual impacts on surface water quality are anticipated.

15.3.4 Potential Release of Hydrocarbons During Construction and Storage

Mitigation by Design

Oils and fuels will be used in plant and equipment during the construction phase, and the following procedures will be implemented for on-site storage of fuels, lubricants and hydraulic fluids used on the construction site:

- Storage of fuels, lubricants and hydraulic fluids will occur mainly at the contractor's compound(s), which will be fenced and have a lockable gate, thereby ensuring that the area in which fuels, lubricants and hydraulic fluids are stored will be properly secured against unauthorised access or vandalism.
- The storage area within the compound will contain a small bund lined with an impermeable membrane in order to prevent any contamination of the surrounding soils and vegetation and of groundwater.
- Selection of the location for storage of fuels, lubricants and hydraulic fluids will be based on the following:
  - It will be remote from surface drains and watercourses.
  - It will be readily visible for supervision and inspection.
  - It will be readily accessible for filling and maintenance.
  - It will be protected against accidental impact.
- The bund will have capacity of at least 110% of the largest tank accommodated or 25% of the total maximum capacities of all tanks, whichever is the greater, where more than one tank is installed. They will be constructed and managed in accordance with the EPA Guideline, Bunding and Spill Management (2007).
- Outside the contractor's compound(s) there will be short-term storage of fuels for diesel generators used on site.

The following procedures will be implemented during construction operations:

- Fuels and oils will be carefully handled to avoid spillages.
- Any spillage of fuels, lubricants or hydraulic oils will be immediately contained and the contaminated soil removed from the site and disposed of appropriately.
- Any waste oils and hydraulic fluids will be collected in leak-proof containers and removed from the site for disposal or recycling.
- As a minimum, simple spill protection equipment that will be held locally will

include specialist absorbent mats / pillows and granules for containment / clean-up of oil. Adequate quantities will be held in stock and be available for immediate use.

- Appropriate spill control equipment, such as oil soakage pads, will be available on site to deal with any accidental spillage and emergency response procedures will be put in place.
- Designated contractors' personnel will be trained and certified in oil spill control and clean up procedures, and in the proper and safe disposal of any waste generated through such an event.

15.3.5 Groundwater and Surface Water Contamination from Wastewater Disposal

Self-contained chemical toilets with an integrated waste holding tank will be used during the construction phase. They will be maintained by the contractor and will be removed on completion of the construction works.

The limited waste water arising from Coomataggart Substation will discharge to a sealed holding tank, which will be fitted with a high level alarm connected to the SCADA system to alert any need for non-routine empting.

Post-mitigation Impact (residual): None

Significance of Effects: None

15.3.6 Morphological & Water Quality Impacts Arising During Stream Crossing Construction Works

Mitigation By Design

Measure to prevent morphological and water quality impacts are as follows:

- Any culverting works will be undertaken on dry streams / watercourses where possible and in low flow conditions on streams/rivers that do not run dry.
- All bank sides and beds will be fully reinstated to avoid ongoing erosion.
- All bridges/culverts will be sized to cope with a minimum 100-year flood event.
- The methods of watercourse crossing outlined in Table 10.20 will be implemented.
- At a minimum, all minor stream culverts will be 900 mm in diameter regardless of the anticipated flood flow.
- During the construction work near watercourses, double silt fences will be emplaced immediately down-gradient of the area for the duration of the construction.
- There will be no on-site batching of concrete and no storage of cement will be permitted within 50 m of the crossing construction areas.
- Section 50 applications will be made for all proposed new crossings and upgrades.

Site preparation and construction will adhere to best practise and conform to the publication 'Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites'

Post-mitigation Impact (residual): Negative, Direct, negligible, short term, low probability impact.

Significance of Effects: No significant residual impacts on morphology or site drainage patterns are anticipated.

15.3.7 Release of Cement-Based Products

Mitigation By Avoidance

- No batching of wet-cement products will occur on site.
- Where possible, pre-cast elements will be used for culverts and concrete works.
- No washing out of any plant used in concrete transport or concreting operations will be allowed on site, except as outlined below.
- 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 will be tanked and removed from the site to a suitable, non-polluting, discharge location.
- Weather forecasting will be used to plan dry days for pouring concrete.
- It will be ensured that the concrete pour site is free of standing water prior to concreting and plastic covers will be available in case of sudden rainfall event.

Post-mitigation Impact (residual): Negative, indirect, imperceptible, short term, moderate probability impact.

Significance of Effects: No significant residual impacts on the aquatic environment are anticipated.

15.3.8 Replacement of Natural Surface with Lower Permeability Surface

Permanent road side drainage installed as part of the construction stage will be adopted for the operational phase. The will include the use of interceptor drains, swales, check dams and stilling ponds. These measures will buffer site runoff during periods of high rainfall by retaining the water until the storm hydrograph has receded.

Post-mitigation Impact (residual): Neutral, indirect, negligible, long term, moderate probability impact.

Significance of Effects: No significant residual impacts on local or downstream hydrology are anticipated.

15.3.9 Tree Felling

Mitigation by Avoidance

There is a requirement in the Forest Service Code of Practice and in the FSC Certification Standard for the installation of buffer zones adjacent to aquatic zones at planting stage. Minimum buffer zone widths recommended in the Forest Service (2000) guidance document Forestry and Water Quality Guidelines are shown in Table 15.12.

Table 15.12. Minimum Buffer Zone Widths (Forest Service, 2000)

Average Slope Leading to the Aquatic Zone		Buffer Zone Width on Either Side of the Aquatic Zone	Buffer Zone Width for Highly Erodible Soils
Moderate	(0 – 15%)	10 m	15 m
Steep	(15 – 30%)	15 m	20 m
Very steep	(>30%)	20 m	25 m

The tree felling area is located outside the 50 m stream buffer zone. The large distance between proposed felling areas and sensitive aquatic zones means that potential poor quality runoff from the felling area can be adequately managed and attenuated prior to reaching the aquatic buffer zone and primary drainage routes (see Mitigation by Design).

Mitigation by Design

Best practice methods related to water incorporated into the forestry management and mitigation measures have been derived from the Forestry Commission, Coillte and Forest Service guidelines presented in Section 15.1.1 herein.

Best practice methods for protection of water quality include the following:

- Machine combinations will be chosen that 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 ongoing through any felling operation. No tracking of vehicles through watercourses will occur, as vehicles will use road infrastructure and existing watercourse crossing points. Where possible, existing drains will not be disturbed during felling works.
- Ditches which drain from the 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% - 3.0% 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.
- Sediment traps will be sited in drains downstream of felling areas. Machine access will be maintained to enable the accumulated sediment to be excavated. Sediment will be carefully disposed of in the peat disposal areas. 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. This measure will be reviewed on site during construction.
- 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, thereby 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 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. Where there is risk of severe erosion occurring, extraction will be suspended during periods of high rainfall.
- Timber will be stacked in dry areas and outside the 50 m watercourse buffer zones. Straw bales and check dams to be emplaced on the down gradient side of timber storage/processing sites.
- Works will 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 ongoing through the felling operation.
- Maintenance of machinery will not occur within 100 m of a watercourse.
- A dedicated refuelling area within the construction compounds will be used during the felling works.
- Branches, logs or debris will not be allowed to build up in aquatic zones. All such material will be removed when harvesting operations have been completed, but care will be taken to avoid removing natural debris deflectors.

Silt Traps: Silt traps will be strategically placed down-gradient within forestry drains near streams / watercourses. The main purpose of the silt traps and drain blocking is to slow water flow, increase residence time, and allow settling of silt in a controlled manner. As mineral subsoils are present beneath the peat, additional mitigation by way of use of specialist treatment systems such as Siltbuster systems with two stage chemical dosing to aid settlement may be employed at short notice, if required.

Drain Inspection and Maintenance

The following activities will be carried out during inspection pre-felling and afterwards:

- Communication with tree felling operatives in advance to determine whether any areas have been reported where there is unusual water logging or bogging of machines.
- Inspection of all areas reported as having unusual ground conditions.
- Inspection of main drainage ditches and outfalls. During pre-felling inspection, the main drainage ditches shall be identified. Ideally, the pre-felling inspection shall be carried out during rainfall.
- Following tree felling, all main drains will be inspected to ensure that they are functioning.
- Extraction tracks near drains need to be broken up and diversion channels created to ensure that water in the tracks spreads out over the adjoining ground.
- Culverts on drains exiting the site will be unblocked.

- All accumulated silt will be removed from drains and culverts, and silt traps, and this removed material will be deposited away from streams / watercourses to ensure that it will not be carried back into the trap or streams / watercourses during subsequent rainfall.

Surface Water Quality Monitoring: Sampling will be completed before, during (if the felling operation is conducted over a protracted time) and after the felling activity. The 'before' sampling will be conducted within four weeks of the felling activity, preferably in medium to high water flow conditions. The "during" sampling will be undertaken once a week or after rainfall events. The 'after' sampling will 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.

The surface water quality monitoring proposals for tree felling will be submitted with the felling license. The criteria for the selection of water sampling points will include the following:

- Avoid man-made ditches and drains or watercourses that do not have year round flows, i.e. avoid ephemeral ditches, drains or watercourses.
- Select sampling points upstream and downstream of the forestry activities.
- It is advantageous if the upstream location is outside/above the forest in order to evaluate the impact of land-uses other than forestry.
- Where possible, three downstream locations should be selected: one immediately below the forestry activity, the second at exit from the forest, 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).

Post-mitigation Impact (residual): Indirect, negative, slight, short term, low probability impact.

Significance of Effects: No significant residual impacts on the aquatic environment are anticipated.

15.3.10 Impacts on Downstream Freshwater Pearl Mussel Sites

Section 15.3.2 above and the Surface Water Management Plan (Appendix I) describe how surface water runoff will be managed at the site in order to avoid significant impacts on downstream surface waters, thereby protecting downstream FWPM sites in the Roughty River.

While settlement ponds form an important element of the drainage proposals for the site (including the borrow pits), they are not stand alone but occur as part of a treatment train of systems that will be applied in series to ensure protection of downstream watercourses. Having a series of elements provides better treatment and also allows for fail safe should one element temporarily fail or require maintenance.

This information is summarised in the process flow diagrams overleaf for the following elements of the proposed development: borrow pits, turbine bases and access roads

Figure 15D: Water Treatment Train for Borrow Pits

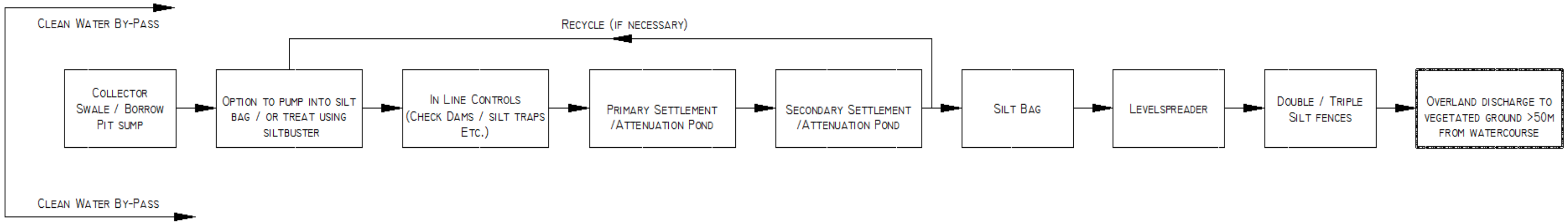


Figure 15E: Water Treatment Train for Turbine Bases

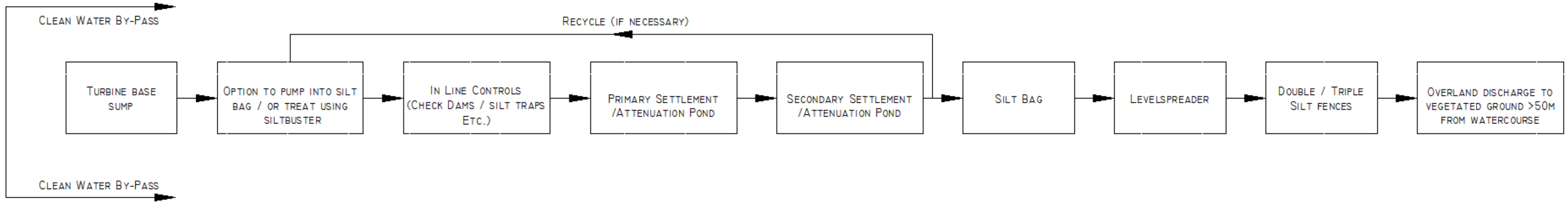
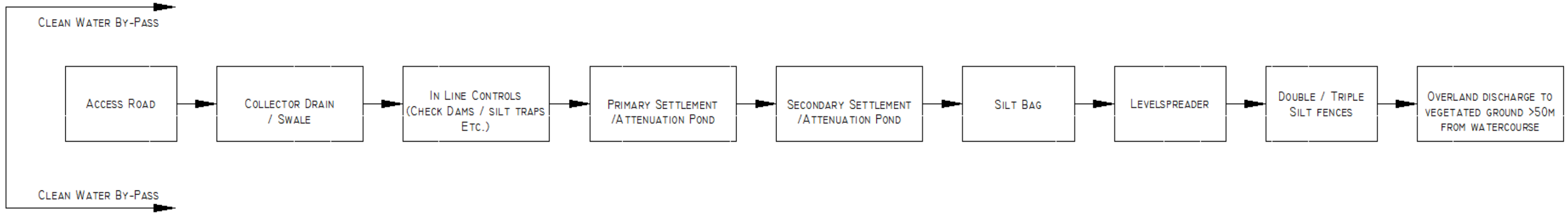


Figure 15F: Water Treatment Train for Access Tracks



In addition, run off from the site will continually checked along the drainage infrastructure areas to ensure that they are in good working order at all times. If issues are noted during these inspections, they will be fixed. Whilst each drainage point has been specifically designed to cater for run-off during heavy rainfall events, any areas where the measures in place are considered close to capacity, additional measures will be employed in advance of any failure. Such measures will include additional silt bags, silt fences or sedimats to increase treatment capacity.

In the event that a local failure occurs, the problem will be identified and remedied immediately. Additional pumping equipment, sedimats, siltbags and silt fencing materials (as described in Section 15.3.2 above) will be available on site at all times, for use in emergency situations. The necessary materials and equipment to create at least five discharge points with silt bags, sedimats and triple silt fencing will be stored on site at all times in a location that is known to all staff. This will be used to control all surface water run-off from the site and ensure no silt laden run off enters the watercourses.

In the unlikely event that the above measures prove ineffective, Siltbuster HB50 units will be employed on the site. These modular units, which can be placed in series or in parallel, will be used as a series of units in parallel if necessary to reduce throughput and increase settlement capacity if necessary.

Siltbusters can operate at low flows and high flows, and they take up less space than conventional settlement ponds, albeit they complete the same task. The mobile units are specifically designed for use on construction sites. The technical information associated with the Siltbuster HB50 on the manufacturer's website states that this product can effectively settle out suspended particles when operated with a throughput of 50 m3 per hour. Higher flows can be achieved by running units in parallel or by including chemical dosing within the treatment process. Chemical dosing is required to treat water with colloidal peat or clay particles. It must also be noted that the dosing rates required to force very fine particles together are small, being in the order of 2-10 mg/l. The storage and use of chemicals on site will be in accordance with best practice management, with bunding to prevent release into the environment.

The measures that have been prescribed and the approach taken follows best practice and has been successfully employed on similar development schemes in similar upland / forestry sites.

In summary, the proposed development will not result in any significant effects on FWPM for the following reasons:

- There will be no direct emissions to watercourses during any stage of construction or operation with a 50 m buffer in place between any discharge point and a watercourse if possible.
- The measures described herein and in the SWMP (Appendix I) demonstrate how potential pathways for impact on this species as a result on this project have been identified and either discounted or blocked through appropriate design and water treatment processes.
- Whilst there is confidence in the design of the scheme to avoid water pollution of any kind, further measures are proposed which constantly monitor the baseline conditions and efficacy of the water treatment measures. This level of monitoring is designed to minimise the potential for failure of any silt control measures and to be able to respond in the highly unlikely event of a failure in the proposed control

measures

-

- The proposed diffuse discharge from the site not only avoids any direct discharge to watercourses but also contributes in a small way to the reversion of drainage of the site back to pre drainage where present, Greenfield drainage regime through the blocking of drainage pathways (this blocking will be undertaken when there is no flow in such drains). The proposed development will therefore result in a slightly slower rate of discharge from areas where existing manmade drainage is present.
- The development has been designed to prevent emissions from the site that would prevent the receiving waters from allowing the Freshwater Pearl Mussel population downstream to achieve favourable conservation status in the future.

Post-mitigation Impact (residual): Indirect, negative, imperceptible, temporary, low probability impact.

Significance of Effects: No significant residual impacts on the aquatic environment are anticipated.

15.3.11 Cumulative Hydrological Impacts

Hydrological cumulative impacts of Grousemount Wind Farm (including Coomataggart Substation), the approved grid connection and other wind farms in the region are assessed herein.

Only approximately 7 km of the underground cable from Coomataggart Substation to ESB Networks' Ballyvouskill Substation is located in the Roughty River catchment. Outside of the wind farm the grid connection route follows public roads over its full length within the Roughty River catchment. The only significant watercourse crossing is at the Sillahertane Stream and this will be accommodated within the existing bridge, thereby avoiding in-stream works. Therefore, no significant cumulative hydrological impacts are anticipated from the construction of the Grousemount Wind Farm and the underground cable.

The wind farm developments that have been considered are listed in Table 15.13 and are shown on Figure 15.11. In terms of the potential hydrological impacts of wind farm developments on downstream surface water bodies, the biggest risk is during the construction phase of the development, as this is the phase when earthworks and excavations will be undertaken at the site.

Table 15.13: Other Wind Farm Developments in the Roughty River Catchment

Wind Farm	Status	Turbines in Roughty Catchment
Inchincoosh	Constructed	6
Lettercannon	Constructed	7
Coomagearlahy	Constructed	15
Inchee	Constructed	6
Foilgreana / Coolknoohill	Constructed	6
Coolknoohil (Everwind)	Constructed	11
Sillahertane	Constructed	10

Wind Farm	Status	Turbines in Roughty Catchment
Coolknoohil	Permitted	2
Total Potential Turbines		63

The total number of turbines that could potentially be operating within the Roughty River catchment is 101 (38 at Grousemount and 63 at the other constructed and permitted wind farms shown in Table 15.13). The total catchment area of the Roughty River is approximately 206 km² and this is equivalent to one turbine for approximately every approximately 2 km² in the catchment. This is imperceptible in terms of potential cumulative hydrological impacts.

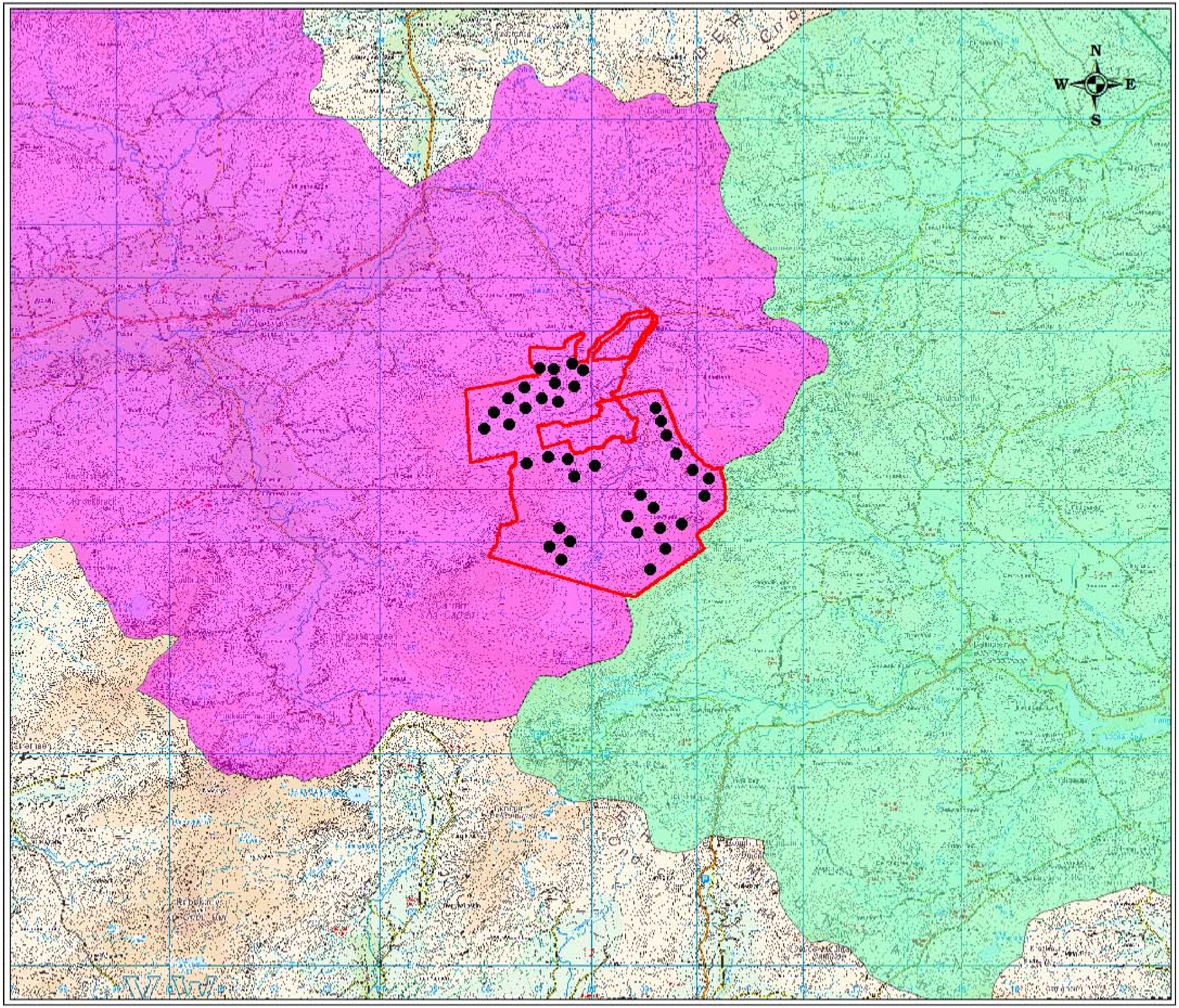
In relation to the other wind farm developments, it is noted that all but one, which comprises only two turbines, are already operational and thus these developments are not anticipated to contribute to cumulative hydrological impacts, since construction is already completed. It is unlikely that the permitted development will be constructed at exactly the same time as the Grousemount Wind Farm development and even if this did occur, with only two turbines involved, the extent of any incremental impact arising would be limited in terms of scale.

Therefore, no significant cumulative hydrological impacts are anticipated from the construction of the proposed Grousemount Wind Farm, the proposed grid connection and other wind energy developments in the region.

15.4 CONCLUSIONS

Consideration of surface water hydrology of the development and the receiving environment indicates that there is potential for local impacts during the construction phase at isolated locations within the site. Mitigation drainage designs are required so that no residual significant impacts will occur on the water environment or on sensitive downstream aquatic receptors.

Approximately 2.6% of the site lands will be incorporated into the completed development, so changes to runoff are not significant. While the removal of some forestry results in more rainfall reaching the surface and running off directly into local watercourses, the changes at Grousemount are not considered significant in the context of the limited area involved.



Legend:

- Site Boundary
- Roughty River Catchment
- River Lee Catchment
- Turbine Locations

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22 Lower Main St
Dungarvan
Co. Waterford
Ireland
tel: +353 (0)5844122
fax: +353 (0)5844244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

Title: Regional Hydrology Map

Client: ESBI

Job: Grousemount WF, Co. Kerry

Project No: P1293

Figure No: 15.1

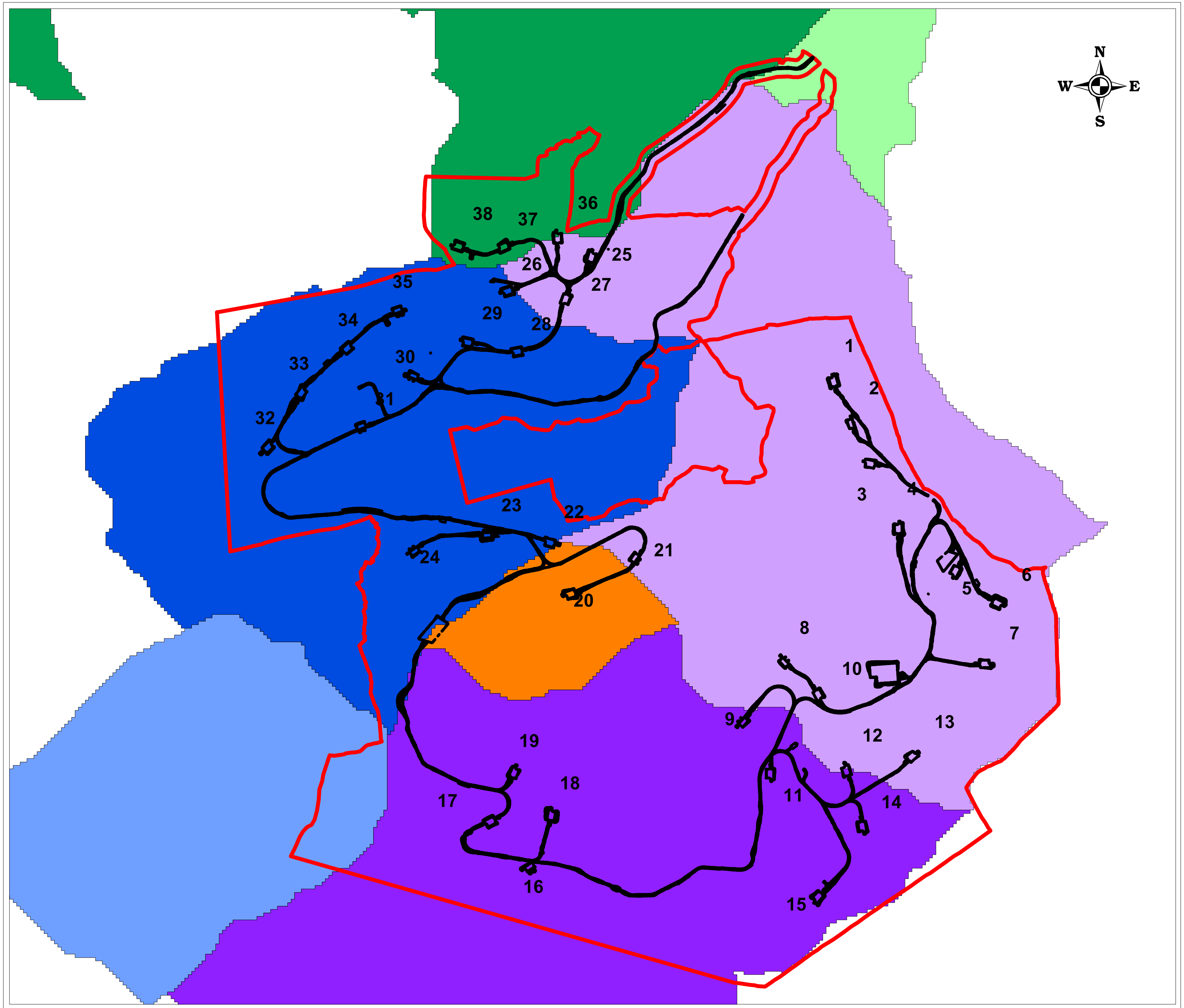
Sheet Size: A4

Drawing No: P1293-0815-001-00A

Date: - 26/08/2015

Scale: - 1:500000

Drawn By: GB | Checked By: MG



Legend:

- Site Boundary
- Roughty Upper SWB
- Roughty 3_Mid SWB
- Knockanruddig SWB
- Coolnagoppoge SWB
- Foilduff SWB
- Roughty 2_Mid SWB
- Sillahertane SWB
- Wind Farm Site Layout
- 1 Turbine No.

HYDRO ENVIRONMENTAL SERVICES
22 Lower Main St
Dungarvan
Co. Waterford
Ireland
tel: +353 (0)5844122
fax: +353 (0)5844244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

Title: Local Hydrology Map

Client: ESBI

Job: Grousemount WF, Co. Kerry

Project No: P1293

Figure No: 15.2

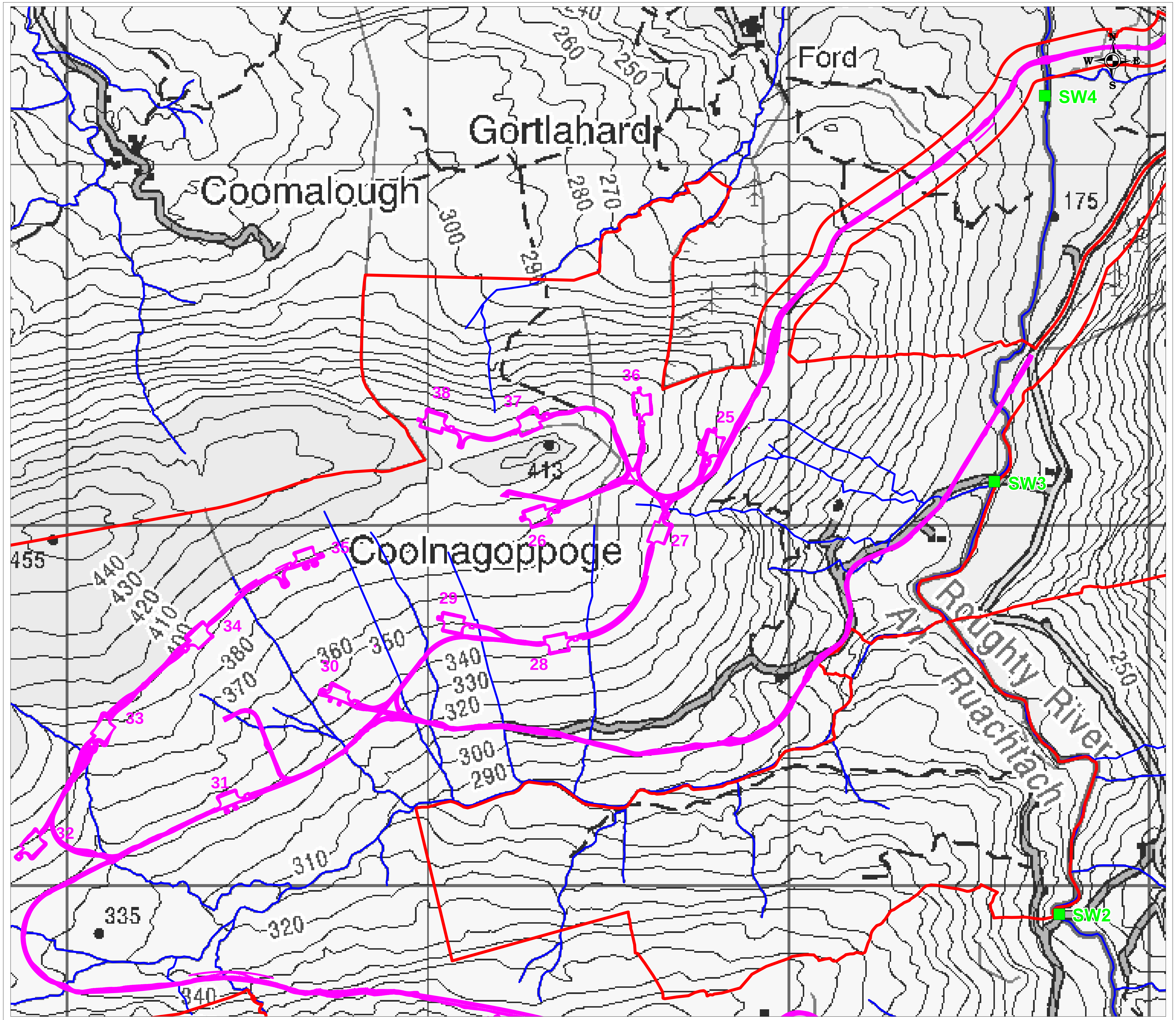
Sheet Size: A4

Drawing No: P1293-0815-A4-002-00A

Date: - 26/08/2015

Scale: - 1:30000

Drawn By: GB | Checked By: MG



LEGEND:

- Site Boundary
- Wind Farm Site Layout
- Rivers/Streams

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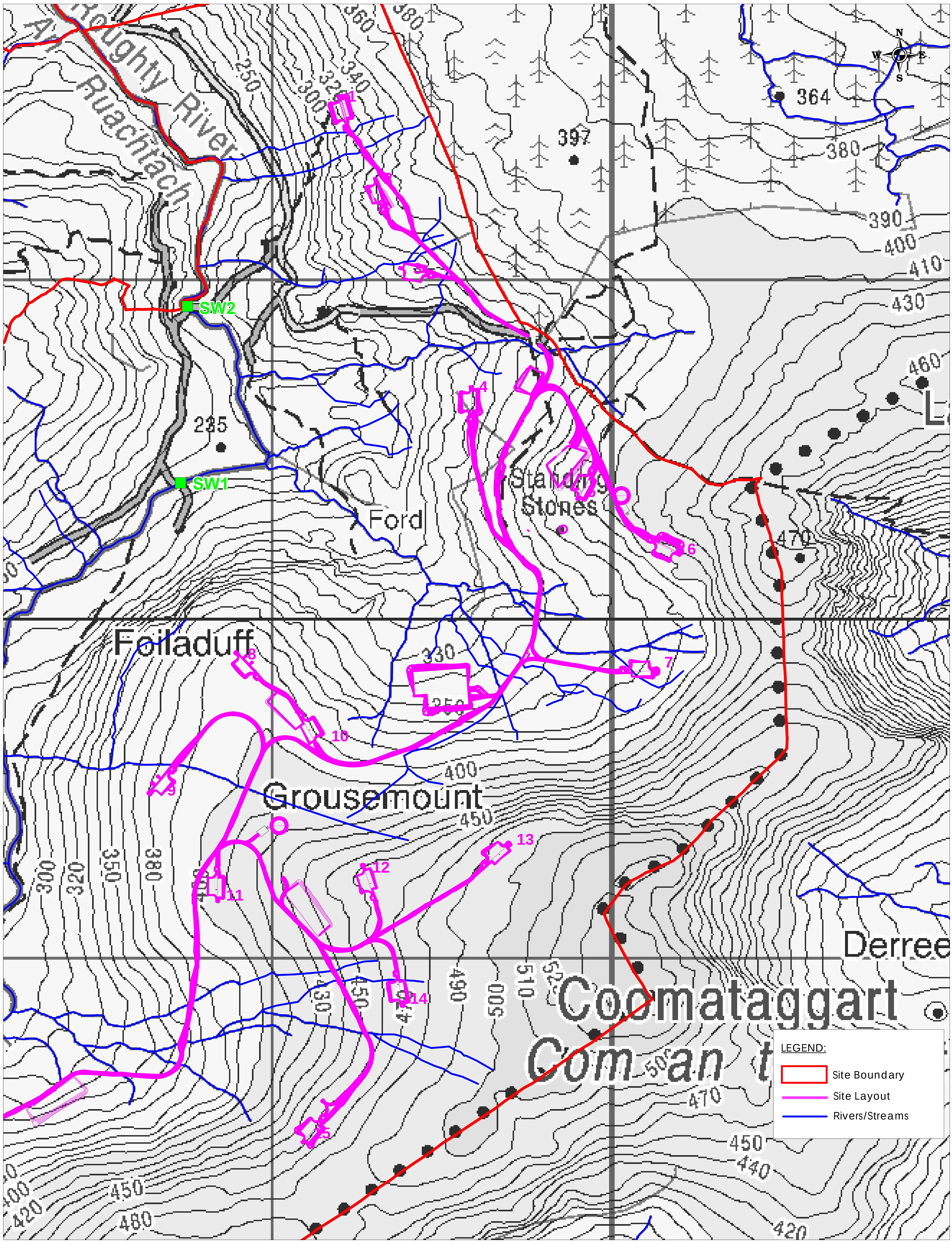
22 Lower Main St
Dungarvan
Co.Waterford
Ireland

tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

Client: ESBI	
Job: Grousemount Wind Farm, Co. Kerry	
Title: Existing Site Drainage Map 1	
Figure No: 15.3	
Drawing No: P1293-0815-A3-003-00A	
Sheet Size: A3	Project No: P1293
Scale: - 1:5000	Drawn By: GB
Date: - 26/08/2015	Checked By: MG



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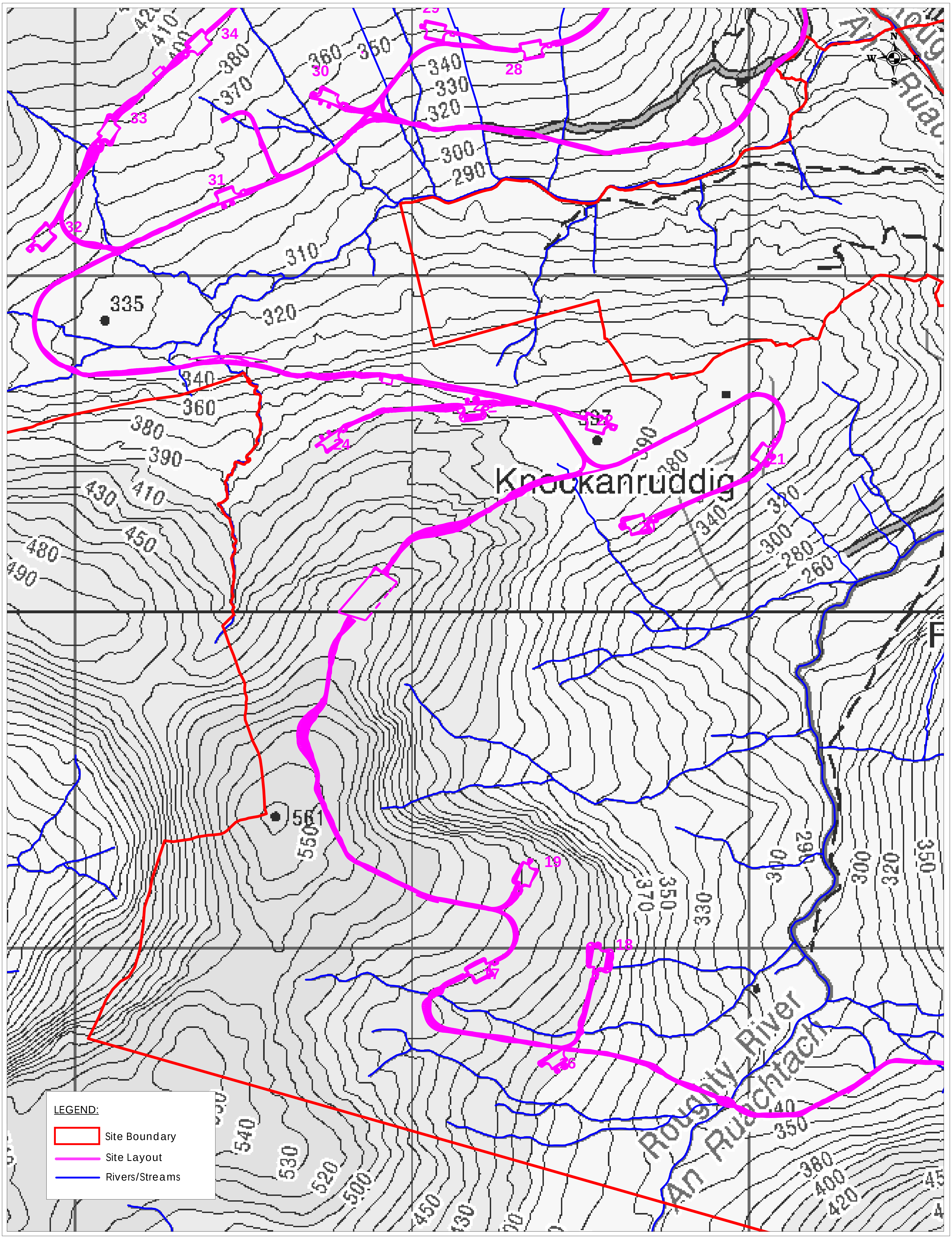
Job: Grousemount Wind Farm, Co. Kerry	Sheet Size: A3	Project No: P1293
Title: Existing Site Drainage Map 2	Scale: - 1:5000	Drawn By: GB
Figure No: 15.4	Date: - 26/08/2015	Checked By: MG

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



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Job: Grousemount Wind Farm, Co. Kerry	Sheet Size: A3	Project No: P1293
Title: Existing Site Drainage Map 3	Scale: - 1:5000	Drawn By: GB
Figure No: 15.5	Date: - 26/08/2015	Checked By: MG

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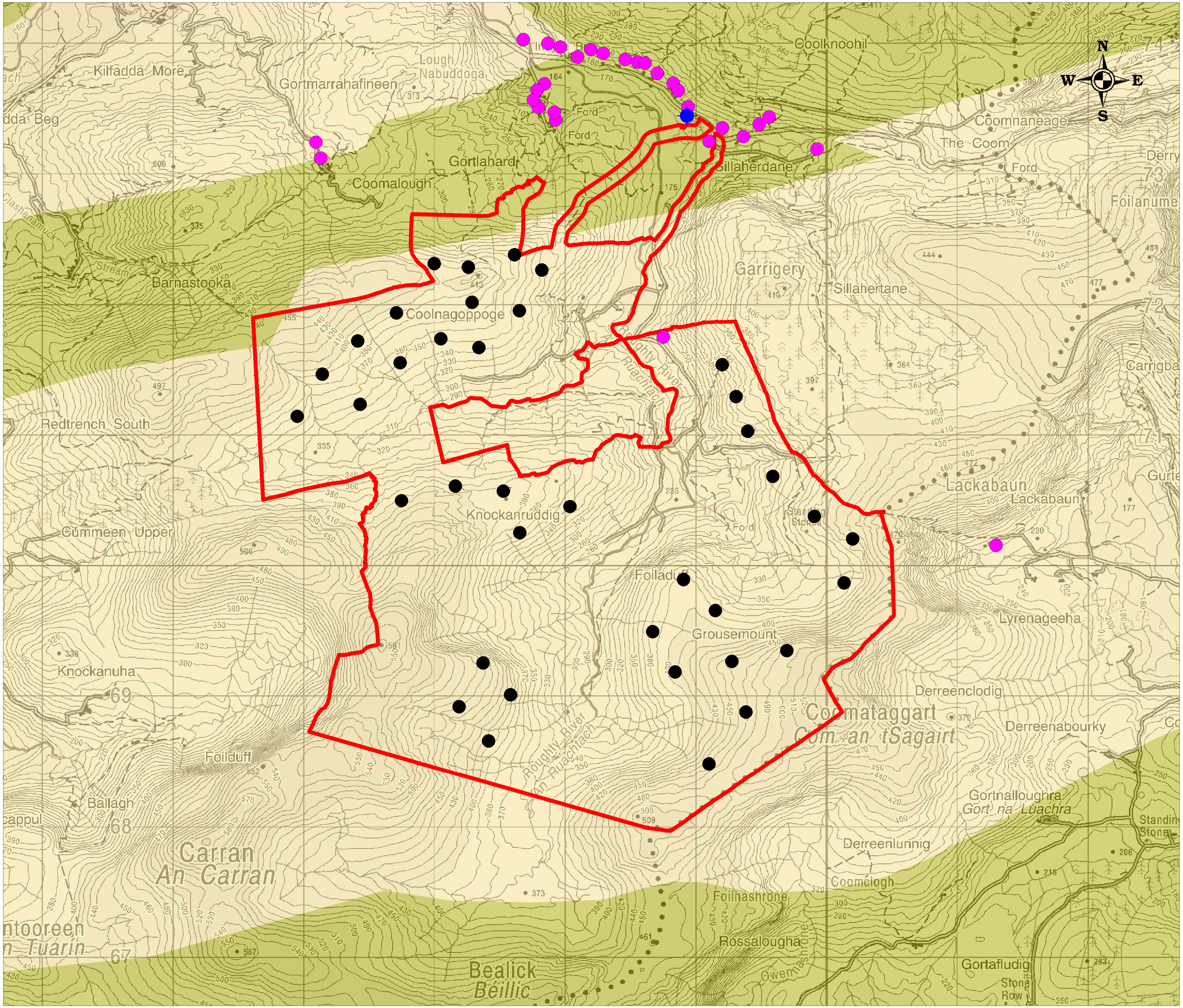
22 Lower Main St
Dungarvan
Co.Waterford
Ireland
tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie



Legend:

- Site Boundary
- Locally Important Aquifer (LI)
- Poor Aquifer (PI)
- Turbine Locations
- GSI Mapped Well with 500m of site boundary
- Dwelling Locations within 1km

HYDRO ENVIRONMENTAL SERVICES
22 Lower Main St
Dungarvan
Co. Waterford
Ireland
tel: +353 (0)5844122
fax: +353 (0)5844244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

Title: Bedrock Aquifer Map

Client: ESBI

Job: Grousemount WF, Co. Kerry

Project No: P1293

Figure No: 15.6

Sheet Size: A4

Drawing No: P1293-0815-006-A4-00A

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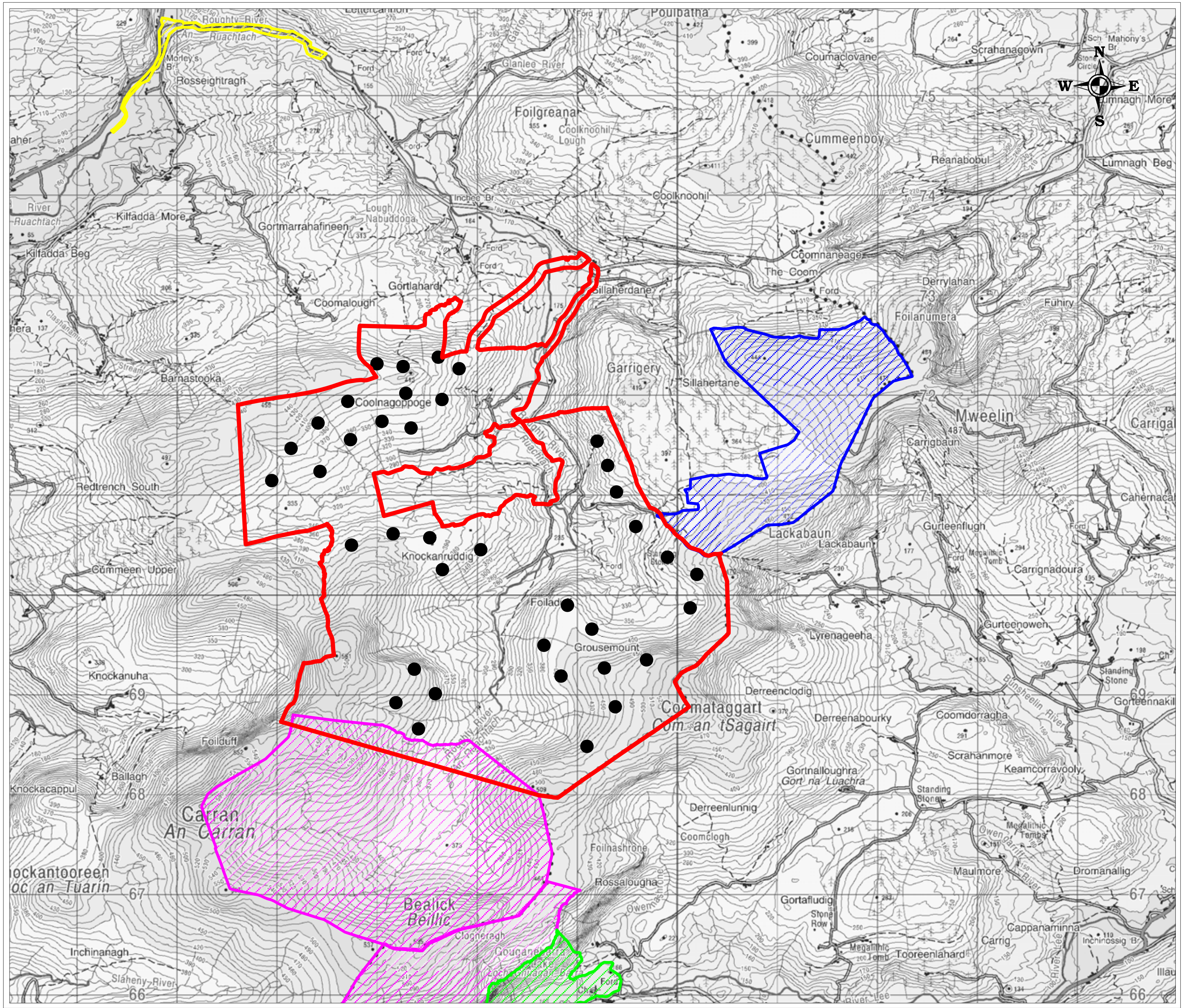

Legend:

- Site Boundary
- Roughty River pNHA
- Ballagh Bog pNHA
- Sillahertane Bog NHA
- Gouganebarra Lake pNHA
- Turbine Locations

HYDRO ENVIRONMENTAL SERVICES

22 Lower Main St
Dungarvan
Co. Waterford
Ireland

tel: +353 (0)5844122
fax: +353 (0)5844244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

Title: Local Designated Sites Map	
Client: ESBI	
Job: Grousemount WF, Co. Kerry	
Project No: P1293	
Figure No: 15.7	
Sheet Size: A4	
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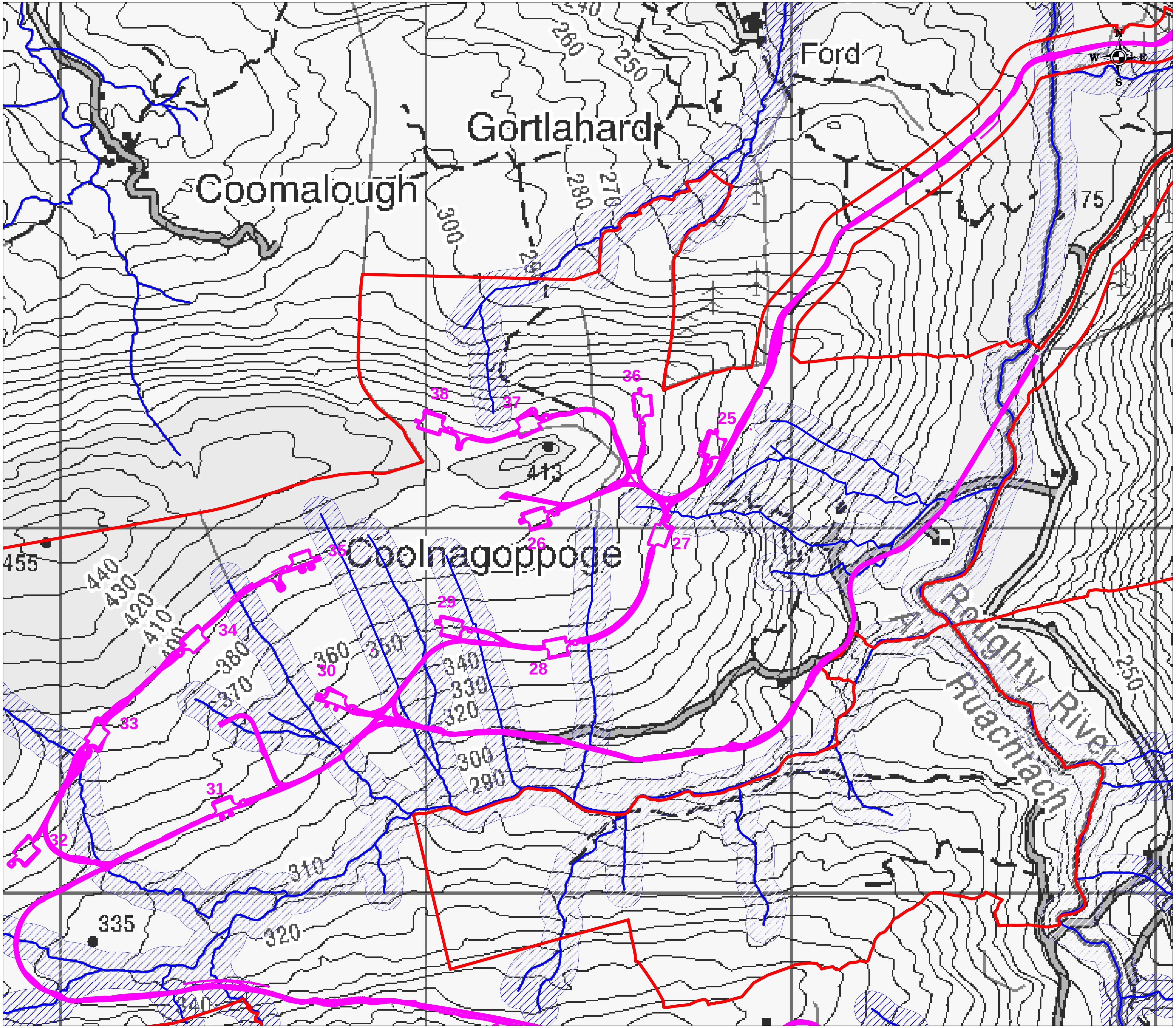

LEGEND:

- Site Boundary
- Wind Farm Site Layout
- Rivers/Streams
- 50m Stream Buffer

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

Client: ESBI	
Job: Grousemount Wind Farm, Co. Kerry	
Title: Hydrological Constraints Map 1	
Figure No: 15.8	
Drawing No: P1293-0815-A3-008-00A	
Sheet Size: A3	Project No: P1293
Scale: - 1:5000	Drawn By: GB
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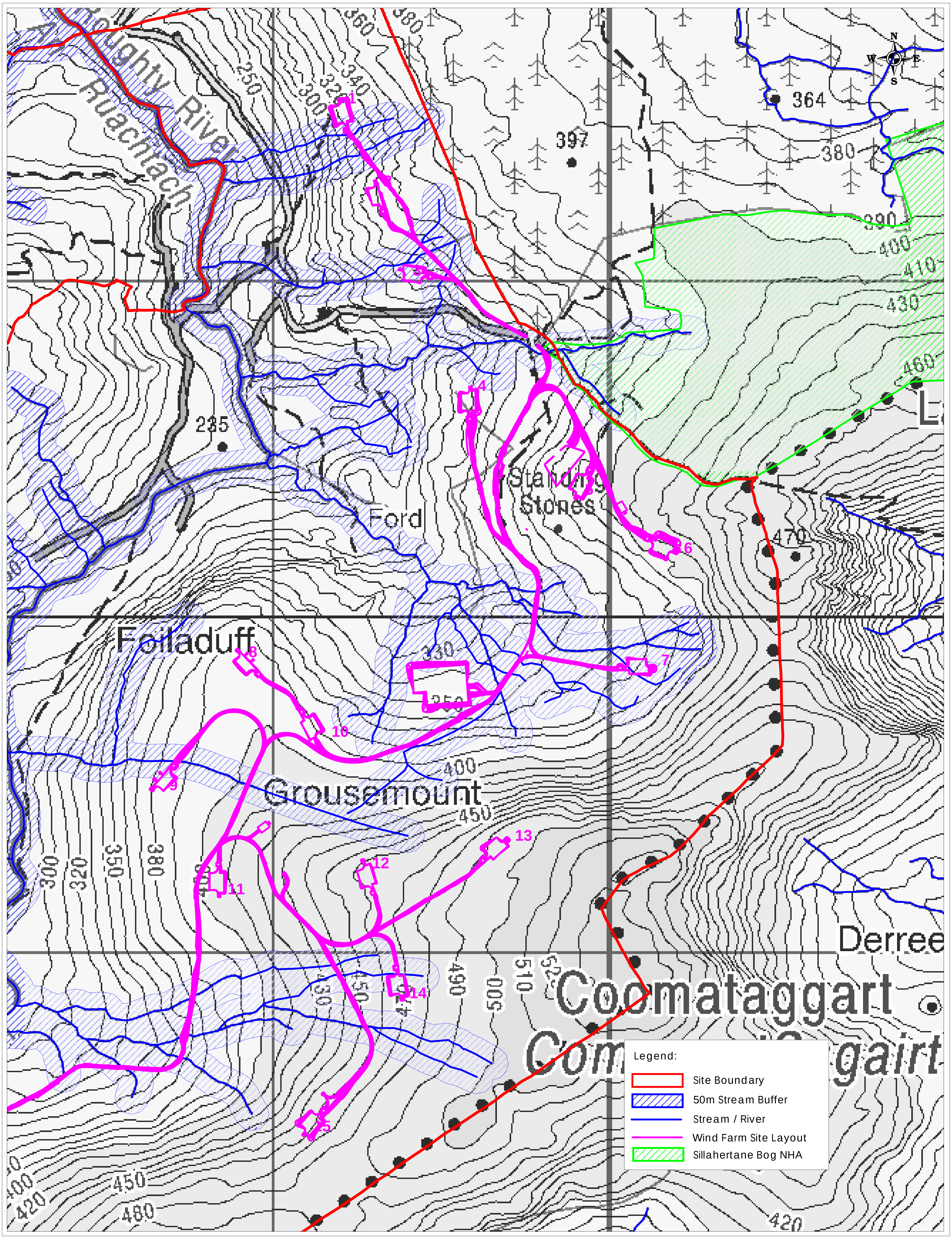

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Job: Grousemount Wind Farm, Co. Kerry	Sheet Size: A3	Project No: P1293-0	
Title: Site Constraints Map 2	Scale: - 1:5000	Drawn By: GB	
Figure No: 15.9	Date: - 26/08/2015	Checked By: MG	

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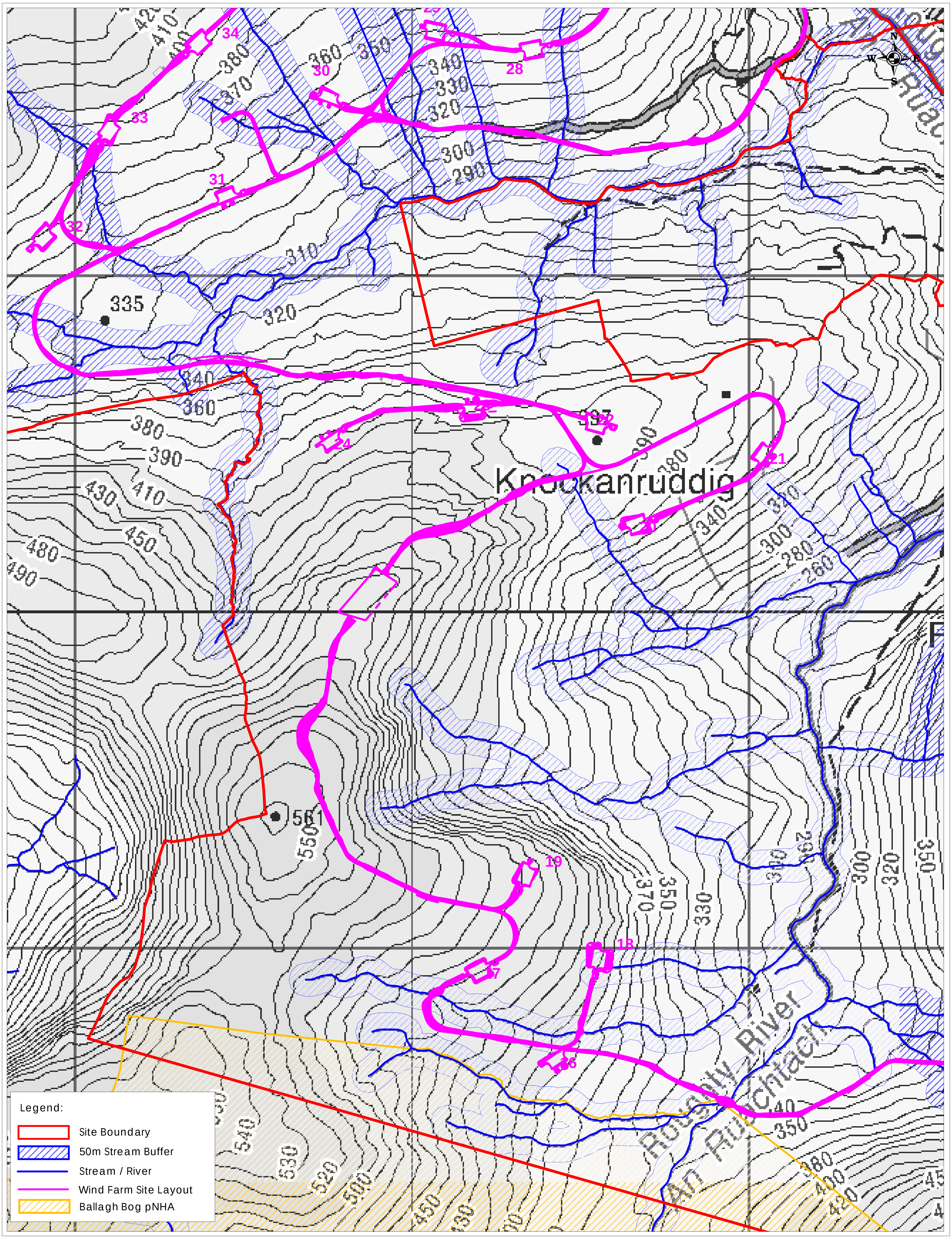
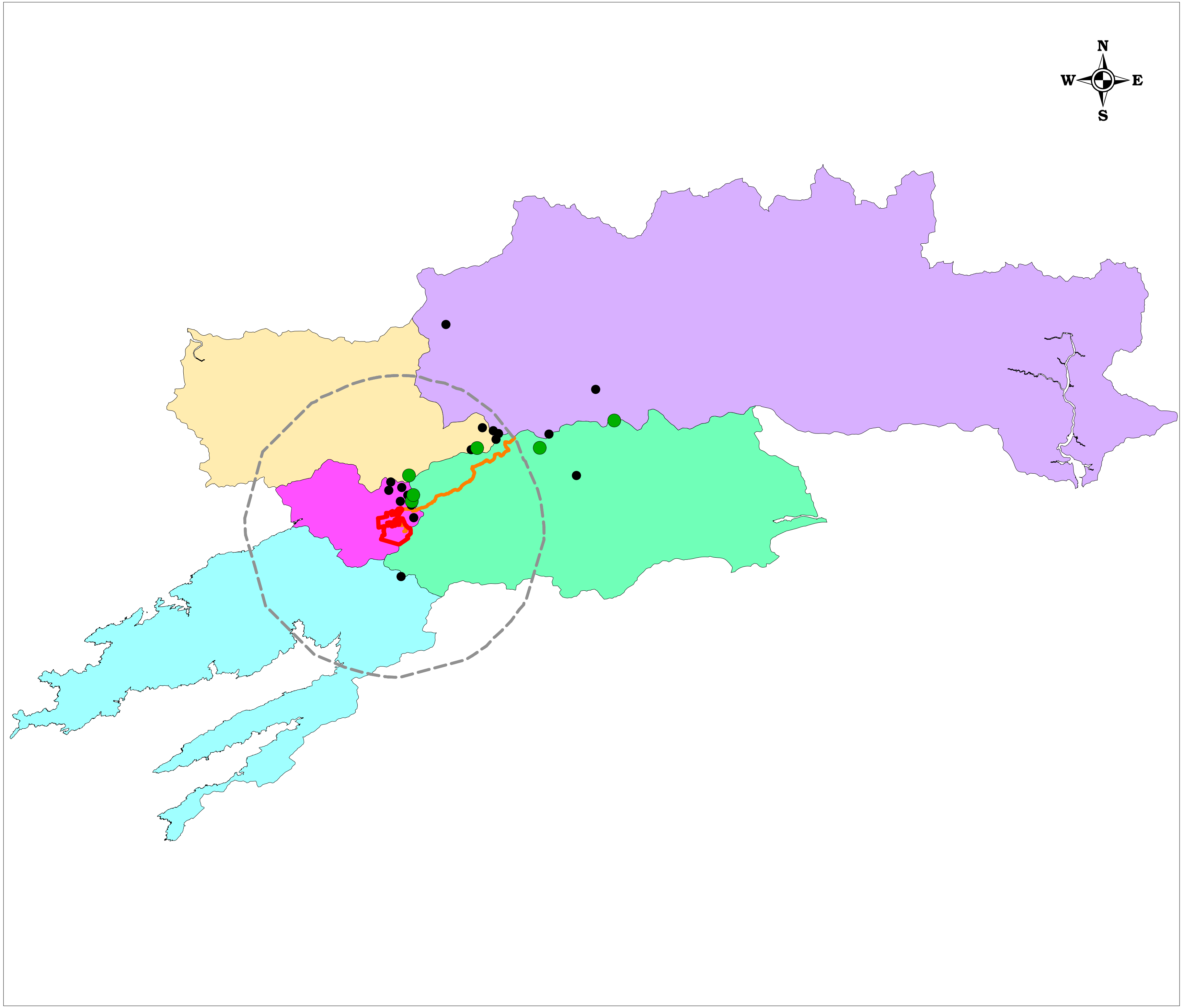
22 Lower Main St
Dungarvan
Co.Waterford
Ireland
tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie



Client: ESBI	Drawing No: P1293-0815-A3-010-00A	
Job: Grousemount Wind Farm, Co. Kerry	Sheet Size: A3	Project No: P1293
Title: Hydrological Constaints Map 3	Scale: - 1:5000	Drawn By: GB
Figure No: 15.10	Date: - 26/08/2015	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



Legend:

- Site Boundary
- Roughty River Catchment
- River Lee Catchment
- Owvane-Mealagh-Glengarriff Catchment
- Laune Catchment
- Blackwater Catchment
- 20km Radius
- Proposed Grid Connection Route
- Constructed Wind Farm Locations
- Permitted Wind Farm Locations

HYDRO ENVIRONMENTAL SERVICES
22 Lower Main St
Dungarvan
Co. Waterford
Ireland
tel: +353 (0)5844122
fax: +353 (0)5844244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

Title: Cumulative Impacts Map	
Client: ESBI	
Job: Grousemount WF, Co. Kerry	
Project No: P1293	
Figure No: 15.11	
Sheet Size: A4	
Drawing No: P1293-0815-001-00A	
Date: - 26/08/2015	
Scale: - 1:100000	
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