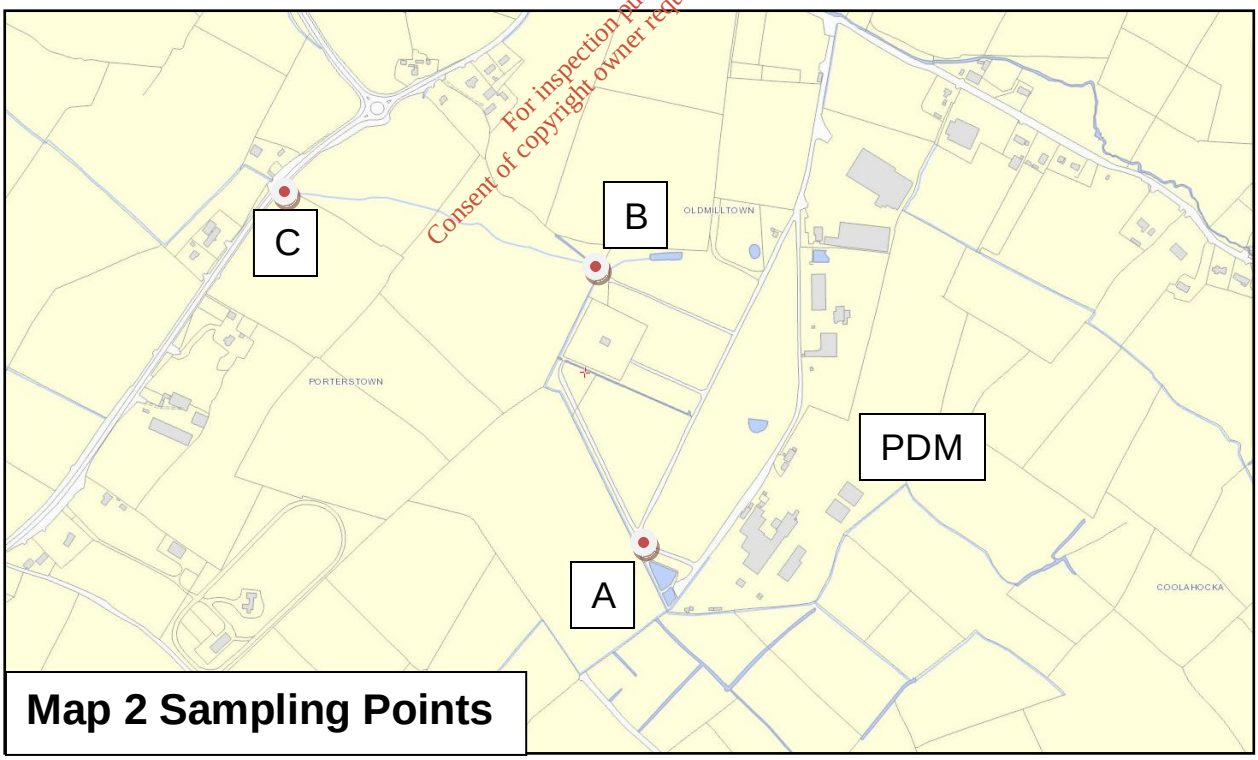
Section D.1.1: Assessment of Impact

The situation in regard to the discharge of effluent from PDM and the receiving waters is rather unusual. The treated effluent discharges from twin reed beds to a land drain with little or no other flow in it (Point A, see Maps 1 and 2). The land drain runs around the perimeter of a large private field owned by the ESB and used by it for storage of poles. As the effluent passes along this drain for a distance of about 700 m it receives dilution from a number of other field drains that join it. It also receives a further degree of purification through the abundant vegetation in the ditch which acts as a linear reed bed. The drain then flows out of the ESB/PDM site (Point B) to pass through farm lands for about 400 m to pass under a culvert on the minor Kilteel to Kill road (Point C), receiving inputs from other drains on the way. The drain system runs through more farmland for a distance of about 1 km before crossing through a culvert under the N7 Dublin-Naas motorway and thence to the Painestown River. The Painestown River joins the Morrell River which enters the River Liffey at a point near Straffan, Co. Kildare, about 8 km north-west of the PDM site.

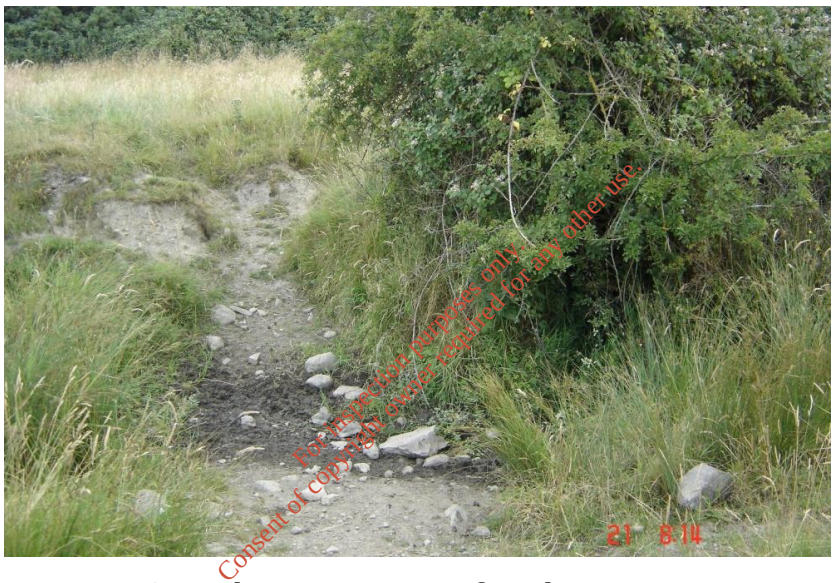


Map 2 Sampling Points

Monitoring Locations and Receiving Water

Point A is where the treated effluent flows out of the final sampling monitoring point into a field drain. The point of entry is at the head of the drain and there is no other flow in the ditch at this point.

Point B is where the effluent from the PDM plant flows out from the PDM/ESB site into a drainage ditch passing through agricultural land. The photo below shows the drain 50 m beyond the exit point from the PDM/ESB exit point in summer. The flow from the PDM effluent plant and the flow in the various drains in the area vary as a direct response to the rainfall. In summer the PDM discharge and the flow in the other drains in the area can drop to zero for several weeks.



50 m downstream of Point B

Point C is where the drain carrying the PDM effluent passes through a culvert on the Kill-Kilteel road. This is the first point at which the public can see the land drainage system.

Culvert at Point C

After passing Point C the effluent continues through farmland and then passes under a large culvert under the N7 Dublin - Naas motorway to meet the Painestown River, a tributary of the River Liffey. Many of the drains and former stream beds in this area have been heavily modified in recent years as a result of construction work on the motorway.

The River Liffey

The Liffey, an important river running between the Wicklow Hills and Dublin Bay, has many beneficial uses. Monitoring and assessment of the river shows that its overall quality status is as follows:

18% High
55% Good
13% Moderate
12% Poor
1% Bad

The Eastern River Basin District Management Plan shows that the Liffey in its hill sections are of good quality but that the bulk of the lowland section between Newbridge and Leixlip, including the Painestown River is classified as poor. The River Liffey is classified a Nutrient Sensitive River from Kildare town to Leixlip. The Plan states that the quality problems in the Liffey are:

High Nutrients (phosphorus)

Oxygen Demand
Low Ecological Rating
Inferior/heavily modified Habitats

The Liffey supports a range of fish and is an important angling river and is a valuable resource for wildlife. It is also important in recreational terms for boating and wildlife observation. The Liffey provides a source of drinking water for Dublin City and county with a major abstraction point at Leixlip about 15 km downstream from Straffan. There are no Special Ares of Conservation or Special Protection areas downstream of the PDM discharge.

The Liffey or its tributaries are not listed in Schedule 1 of the EC Environmental Objectives (Freshwater Pearl Mussel) Regulations SI 296 of 2009. There are no special areas of conservation or special protected areas between the PDM site and the River Liffey. It is considered that the receiving water should be assessed under the status of a freshwater protected under the Schedules of the EC Environmental Objectives Regulations 2009 (SI 272 of 2009).

Summary of Monitoring Results

The results of monitoring at Points B and C are shown in Tables D.1(i) and are summarised below. The effluent is a clear colourless and odourless liquid, visually indistinguishable from clean unpolluted river water. Testing has shown that the treated effluent has a very low toxicity (<1 Tu), a result supported by the healthy growth in the reed bed and the presence of abundant frog spawn in the effluent drain. Regular examination of the drain by environmental consultant Dr. Emmet Mc Mahon has never revealed any visual indication of any impact in terms of flora, fauna or aesthetic considerations. The drain receiving the discharge is indistinguishable from any drain in the area.

Taking into account the nature of the effluent and the EC Environmental Objectives Regulations 2009 (SI 272 of 2009), the potentially important parameters of the effluent are regarded as follows:

BOD, COD, Suspended Solids
Nitrogen and Phosphorus compounds

PAH compounds: Fluoranthene, Naphthalene, Anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(g,h,i)perylene and Indeno(1,2,3cd)pyrene.

Summary of Monitoring Results

The footnote to Table D.(i) has requested that the monitoring results be summarised. The results are summarised below and are also summarised in Tables 1,2,3 and 4 given later in this section).

BOD and COD

The value for BOD was at all times, at both monitoring points, less than 2 mg/l.

The value for COD was at all times, at both points, less than 10 mg/l.

Suspended Solids

The value for SS was at all times, at both points, less than 5 mg/l.

Nitrogen compounds

The raw effluent contains very little nitrogen and the monitoring results were consistent with this. The total nitrogen at Point B was always less than 1.95 mg/l and in 4 out of 5 samples was less than 1 mg/l. At Point C the total inorganic nitrogen level was always less than 1 mg/l.

The nitrate level at Point B never exceeded 0.28 mg/l.

The nitrate level at C never exceeded 0.53 mg/l.

The ammonia level recorded at Point B and Point C was always below 0.03 mg/l.

Phosphate

The raw effluent contains very little phosphorus and the monitoring results were consistent with this. At Point B the phosphate level was generally less than 0.04 mg/l with just one value of 0.13 mg/l. At Point C the phosphate level was always less than 0.03 mg/l.

PAH compounds

The company was required by the EPA to monitor for a package of the following 6 PAHs

Benzo(b)fluoranthene

Benzo(k)fluoranthene

Benzo(gthehi)perylene
Indeno(123cd)pyrene
Fluoranthene
Benzo(a)pyrene

At Point B the results for these 6 PAHs varied between 0.0003 and 0.001 with an average value of 0.0002 At Point C the results for these 6 PAHs varied between 0.0005 and 0.00008 with an average value of 0.0007

The monitoring results for the individual PAH compounds are shown in Tables D.(i) B and Tables D.(i) C and in Tables 3 and 4 in the next section.

Impact of the Discharge

The Water Framework Directive, Directive 2000/60/EC, was adopted in 2000 as a single piece of legislation covering rivers, lakes, groundwater and transitional (estuarine) and coastal waters and includes heavily modified and artificial waterbodies. Its objectives are to prevent further deterioration of and to protect, enhance and restore the status of all bodies of water with the aim of achieving at least good status by 2015.

The EPA undertook the development of classification systems and Environmental Quality Standards for the purpose of assessing the status of surface waters in Ireland. The EPA issued an initial discussion document on classification systems and standards. Comments received and further discussion about classification and standards at European level led to a set of regulations: S.I. No 272 of 2009 - European Communities Environmental Objectives (Surface Water) Regulations.

The discharge of the PDM effluent is to a river water body and so the requirements of the EC Environmental Objectives (Surface Water) Directive are appropriate. The physico-chemical quality elements to be taken into account (as set out in Table 7: of S.I. No. 272 of 2009) are shown in the Box.

General Conditions

1. Thermal conditions
2. Oxygenation conditions,
3. Body salinity
4. Acidification status
5. Nutrient conditions

Specific Pollutants

Environmental Quality Standards for specific pollutants are listed in Tables 10, 11 and 12 of Schedule 5 of these Regulations. An examination of the listing in the tables shows a number of compounds in the PAH family to be relevant. These are:

Fluoranthene
Naphthalene
Anthracene
Benzo(a)pyrene
Benzo(b)fluoranthene
Benzo(k)fluoranthene
Benzo(g,h,i)perylene
Indeno(1,2,3cd)

The results of the monitoring in 2011 are summarized in **Tables 1,2,3 and 4** together with the relevant standards set out in SI 272. The possible impact of the discharge is discussed below in relation to those environmental quality standards.

Thermal conditions

As the effluent temperature is at ambient after an average time of 30 days in the treatment system, there is no impact on temperature of the receiving body.

Biochemical Oxygen Demand

EQS for BOD, mg/l, in S.I. 272 of 2009

High status: <1.3 (mean) or <2.2 (95%ile)

Good status: <1.5 (mean) or <2.6 (95%ile)

Monitoring has shown that the value for BOD, at both Point B and C, was always less than 2 mg/l. On that basis the quality conforms to Good Status. This is consistent with the fact that after treatment in the Reed Bed the effluent has a very low BOD. (typically <3 mg/l). The Regulation does not contain any standard for COD. The value for COD was at all times, at both Point B and C, less than 10 mg/l and this is consistent with a very clean water.

Salinity and pH

As the effluent arises from rainwater falling on the site collecting traces of organic material there is no possibility of change to the pH or the salinity of the receiving water.

Nutrients

The effluent contains only very low levels of Nitrogen and Phosphorus compounds. The only source of nutrients on the site is the effluent from the septic tank which services the toilets and sinks of the 25 on-site employees. As the employees are present 5 day week and for 8 hours a day the outflow is probably equivalent to about 2 family houses on septic tanks. The effluent from the septic tank joins the effluent from the contaminated rainwater where it provides nutrients that are vital for the biological operation of the treatment system. The biological treatment system converts all nitrogen into nitrate and there is no ammonia in the discharged effluent.

Table 1 Assessment of Impact: Point B

Parameter All results in mg/l	Results 2011 RANGE	Results 2011 AVERAGE VALUE	EQS (SI 272 of 2009)
BOD	<2	<2	**High status:** <1.3 (mean) or <2.2 (95%ile) **Good status:** <1.5 (mean) or <2.6 (95%ile)
COD	<10 - 11	<10	none
Sus. Solids	<5	<5	none
Total Nitrogen as N	<1 – 1.95	<1.6	none
Ammonia as N	<0.02 – 0.03	<0.02	**High Status**: <0.040 (mean) or <0.09 (95%ile) **Good Status:** <0.065 (mean) or <0.14 (95%ile)
Nitrate as N	1.16 – 0.28	0.21	None in SI 272 11.3 mg/l as N in Drinking Water
Phosphate as P	<0.16 – 0.13	0.06	**High Status**: <0.025 (mean) or <0.045 (95%ile) **Good Status:** <0.035 (mean) or <0.075 (95%ile)
PAHs	See Table 3		

Table 2 Assessment of Impact: Point C

Parameter All results in mg/l	Results 2011 RANGE	Results 2011 AVERAGE VALUE	EQS (SI 272 of 2009)
BOD	<2	<2	**High status:** <1.3 (mean) or <2.2 (95%ile) **Good status:** <1.5 (mean) or <2.6 (95%ile)
COD	<10	<10	none
Sus. Solids	<5	<5	none
Total Nitrogen as N	<1	<1	none
Ammonia as N	<0.02	<0.02	**High Status**: <0.040 (mean) or <0.09 (95%ile) **Good Status:** <0.065 (mean) or <0.14 (95%ile)
Nitrate as N	0.34 – 0.53	0.39	None in SI 272 11.3 mg/l as N in Drinking Water
Phosphate as P	<0.16 – 0.03	0.03	**High Status**: <0.025 (mean) or <0.045 (95%ile) **Good Status:** <0.035 (mean) or <0.075 (95%ile)
PAHs	See Table 4		

Table 3 Assessment of PAH Impact: Point B

PAH Parameter All results in mg/l	EQS Annual Average	EQS MAC	Results 2011 RANGE	Results 2011 AVERAGE VALUE
EPA 6 PAHs	0.0002		0.0003 – 0.0001	0.0002
Fluoranthene	0.0001	0.001	0.00002 – 0.0001	0.0001
Naphthalene	0.0024		<0.0001	<0.0001
Anthracene	0.0001	0.0004	0.0098 – 0.00021	0.0016
Benzo(a)pyrene	0.00005	0.0001	<0.00009	<0.00009
Sum of Benzo(b+k) fluoranthenes	0.00003		<0.00005	<0.00005
Sum of Benzo(g,h,i)perylene + Indeno(1,2,3cd)pyrene	0.000002		<0.00003	<0.00003

Table 3 Assessment of PAH Impact: Point C

PAH Parameter All results in mg/l	EQS Annual Average	EQS MAC	Results 2011 RANGE	Results 2011 AVERAGE VALUE
EPA 6 PAHs	0.0002		0.00005 - 0.00008	0.00007
Fluoranthene	0.0001	0.001	0.00005 – 0.00009	0.00007
Naphthalene	0.0024		<0.0001	<0.0001
Anthracene	0.0001	0.0004	0.000055 – 0.00017	0.0001
Benzo(a)pyrene	0.00005	0.0001	<0.00009	<0.00009
Sum of Benzo(b+k) fluoranthenes	0.00003		<0.00005	<0.00005
Sum of Benzo(g,h,i)perylene + Indeno(1,2,3cd)pyrene	0.000002		<0.00003	<0.00003

Total Inorganic Nitrogen

No standard for total inorganic in river water is established in the regulations

The total Inorganic Nitrogen at Point B and C has always been less than 1 mg/l. This extremely low number indicates there is no impairment of the receiving water quality from nitrogen compounds**.**

Nitrate:

The monitoring results for Nitrate (mg/l as N) in the receiving system are as follows:

No standard for river water for Nitrate is established in the 2009 Regulations. As the EC Drinking water standard for Nitrate is 11.3 mg/l as N it can be seen that the PDM effluent will have no impact on downstream abstractions for drinking water.

Phosphate

The EQS for Phosphate (mg/l as P) in SI 272 of 2009 is:

High Status: <0.025 (mean) or <0.045 (95%ile)

Good Status: <0.035 (mean) or <0.075 (95%ile)

The monitoring results for Phosphates are as follows (results in mg/l as P)

Date	Point B	Point C
4/10	0.13	
18/10	0.04	0.03
1/11	<0.16	<0.16
18/11	0.04	0.03
6/12	0.03	0.03

The result for Point B on Oct 4th seems invalid in the light of all the other results. It also seems invalid on the basis of the Phosphate content of the untreated effluent which was always <0.16 mg/l. In particular a measurement of the total Phosphorus content in the treated effluent on that same day (4/10/2011) gave a value of 0.08 mg/l. Ignoring that October result the water quality at Point B and C is of good status.

It is clear that the effluent discharge from the PDM site does not have any adverse impact on the nutrient concentration or the organic content of the Painestown River or the River Liffey.

Suspended Solids

No standard for river water for SS is established in the 2009 Regulations. Monitoring results of samples taken at Point B and Point C have always shown a suspended solids level of <5 mg/l. This very low level is indicative of a very clean water.

COD

No standard for river water for COD is established in the 2009 Regulations. The COD value at Points B and C has always been at or below 11 mg/l indicating a very low level of organic content, which is consistent with the very low BOD figure.

Total Ammonia

The EQS for Ammonia (mg/l as N) in SI 272 of 2009 is:

High Status: <0.040 (mean) or <0.09 (95%ile)

Good Status: <0.065 (mean) or <0.14 (95%ile)

The conclusion is that the water is classifiable as of high status on the basis of ammonia content.

PAH Compounds

The Regulations (SI 272 of 2009) list a range of PAH compounds and associated Environmental Quality Standards. The standards for inland surface waters are shown below.

	AA	MAC
Fluoranthene:	**0.1**	**1**
Napthalene:	**2.4**	**not applicable**
Anthracene:	**0.1**	**0.4**
Benzo(a)pyrene	**0.05**	**n/a**
Benzo(b+k)fluoranthenes	**0.03**	**n/a**
Sum of Benzo(g,h,i)perylene and Indeno(1,2,3cd)pyrene	**0.002**	**n/a**

(AA is annual average. MAC is maximum allowable concentration. Units are µg/l)

The monitoring results for various PAHs at Points B and C are given in Tables 3 and 4. The table also includes a parameter termed EPA PAHs. In its document on EQOs and EQSs for the aquatic environment (Environmental Quality Objectives and Environmental Quality Standards, 1997) the EPA had recommended an EQS of 0.0002 mg/l for 6 specified PAHs as appropriate for the protection of both salmon and coarse fish. This package of PAHs has to a certain extent

been superseded by the standards for surface water contained in SI 272. Nevertheless it is interesting to consider this parameter as its IPPC permit requires PDM to monitor this parameter in its treated effluent.

The monitoring results in respect of PAHs are discussed as follows in relation to the EQS.

Point C is the monitoring location where the land drain first comes into public view and passes under a culvert on the minor Kilteel to Kill road. At this location the results (see Table 4) for the composite EPA 6 PAHs and for Fluoranthene, Naphthalene and Anthracene are all within the standard set out in SI 272. The results for the other parameters (Benzo(a)pyrene, Benzo(b+k)fluoranthene, Sum of Benzo(g,h,i)perylene and Indeno(1,2,3cd)pyrene) are all extremely low at less than their detection limits of <0.00009, <0.0005 and <0.0003 respectively. The standards set out in SI 272 are a little lower than the detection limit (see Table 4) so a exact comparison cannot be made. Looking at Table 3 for the results at Point B we see that even at that location (a field drain exiting the PDM/ESB site) the levels of these 3 parameters are below the detection limit. The levels of these PAHs in the treated effluent and discharged at Point A are as follows:

	Average value, mg/l
Benzo(a)pyrene:	<0.00003
Benzo(b+k)fluoranthene:	<0.0009
Sum of Benzo(g,h,i)perylene and Indeno(1,2,3cd)pyrene):	<0.000036

These low figures in the treated effluent suggest that the equivalent concentrations at Point C are below the level in SI 272 standards. The overall conclusion is that the quality of the water in the drain at Point C meets all the PAH quality requirements for a surface water.

Examining Table 3 for **Point B** we see that the only parameter which exceeds the SI Standard is for Anthracene where the average level of 0.00016 is slightly above the SI standard of 0.0001 mg/l. This is a remarkable result in that the drain from the site virtually meets all quality parameters required by SI 272 for a surface water, even before it meets the Painestown River.

It is clear that when the drain carrying effluent from the PDM site meets the Painestown River it will have no discernible impact on its water quality.