APPENDIX 1

Odour Impact Assessment

Kerry Central Recycling Facility Ltd.

Licence Application No. W0250-01

Odour Impact Assessment

DOCUMENT CONTROL SHEET

Client	Kerry Central Recycling Facility Ltd.					
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This Document Comprises	DCS	TOC	Text	List of Tables	List of Figures	No. of Appendices
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1 INTRODUCTION

RPS was commissioned by Kerry Central Recycling Facility Ltd. to carry out an odour impact assessment consisting of odour control system design, odour minimisation, management and mitigation strategies and dispersion modelling assessment for the proposed Materials Recovery Facility (MRF) at Scart /Caherdean, Killarney, Co. Kerry.

The purpose of this assessment is to ensure that adequate odour mitigation measures are implemented as part of the design process for the facility. The odour mitigation measures are proposed to ensure that odour annoyance does not occur at any sensitive receptor off-site. This report details the proposed minimum design requirements for point source odour mitigation and presents details of mitigation measures for fugitive emissions.

This odour impact assessment was performed in accordance with the recommendations contained within the Environment Agency Technical Guidance Note IPPC H4 "*Horizontal Guidance for Odour and the EPA Guidance for Operators on Odour Management at Intensive Livestock Installations*." The Composting Association document *"An Industry Guide for the Prevention and Control of Odours at Biowaste Processing Facilities"* was also reviewed when carrying out this assessment.

The odour dispersion model was undertaken to assess minimum design requirements for the abatement system for the proposed waste drying tunnels and to estimate the ground level odour concentrations at sensitive receptors in the vicinity of the proposed facility.

This report has been prepared in response to an Article 14 Notice issued by the EPA for licence application W0250-01.

2 METHODOLOGY

2.1 GENERAL

A dispersion model was used to formulate design criteria for the abatement equipment. Provided the finalised design of the abatement equipment matches or exceeds the design criteria, the model results indicate compliance with odour annoyance criteria as specified in Odour Guidance such as H4 and EPA Guidance.

The guidance has indicated a series of annoyance criteria for odours from various waste and industrial sources. These bands are described in Table 2.1. In general, the higher the odour risk posed by a facility the more stringent the annoyance criteria (e.g. a landfill would have to comply with annoyance criteria of 1.5 Ou_E/m^3, whereas a bakery would only have to comply with 6.0 Ou_E/m^3 due to the less unpleasant nature of the odour).

Given the site location is adjacent to a number of residential properties it is considered appropriate to place the proposed operation in the high risk category and the relevant criteria for this assessment is 1.5 Ou_E/m^3 at the 98th percentile. These criteria are at the 98th percentile of the 1-hour average concentrations, which means they must be complied with 98% of the time. At this criteria the odours from the plant are not predicted to "give reasonable cause for annoyance" at the nearest sensitive receptors.

Table 2.1 Odour Annoyance Criteria

Activity	Risk	Indicative Criterion
Activities involving putrescible waste (eg Landfill), Processes involving animal or fish remains, Brickworks, Creamery, Fat & grease processing, Wastewater treatment, Oil refining, Livestock feed factory	High Risk	1.5 OU_E/m^3 at the 98th percentile of 1-hour averages
Intensive livestock rearing, Fat frying (food processing), Sugar beet processing	Medium Risk	3.0 OU_E/m^3 at the 98th percentile of 1-hour averages
Chocolate manufacture, Brewery, Confectionery, Fragrance and flavourings, Coffee roasting, Bakery	Low Risk	6.0 OU_E/m^3 at the 98th percentile of 1-hour averages

2.2 DISPERSION MODEL

The model used for Odour Dispersion Modelling was the US EPA approved AERMOD Prime model Version 7, which is the current regulatory model in the US. This model is a third generation model utilising advanced boundary-layer physics similar to the previous regulatory ISC model. AERMOD is run with a sequence of hourly meteorological conditions to predict concentrations at receptors for averaging times of one hour up to a year. Utilities associated with the dispersion model allow computation of ground level concentrations of pollutants over defined statistical averaging periods, consideration of building wake/downwash effects and the effects of elevated terrain in the vicinity of the site.

The model was used to assess the potential for odours from the site operations on the sensitive receptors in the vicinity of the site. The results are presented in the form of odour isopleths to indicate the spatial distribution of predicted odours.

3 DESCRIPTION OF THE SITE AND PROCESS

3.1 EXISTING SITE DESCRIPTION

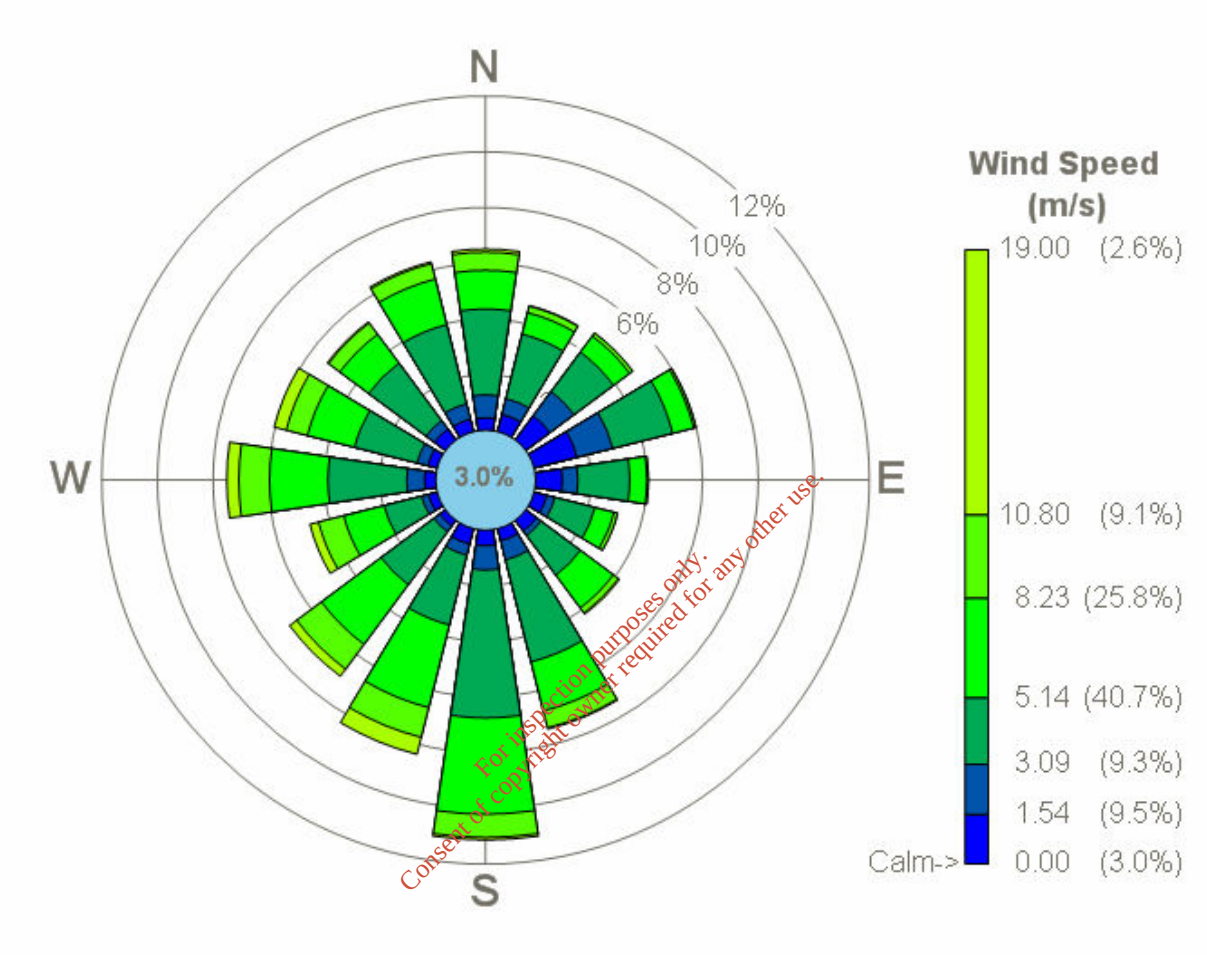
The site of the proposed facility is located in the townlands of Scart and Caherdean near Farranfore in Co. Kerry. The proposal will consist of the construction of a Material Recovery Facility (MRF), an office building, a public recycling centre, an internal access road and associated works. It is proposed to accept up to 95,000 tonnes of material per annum at the facility. Mixed municipal waste, source segregated materials and construction and demolition waste will be accepted at the facility. These materials will be mechanically sorted and the recoverable fraction will be sent off site for further processing. The organic fines remaining after this processing will be dried in tunnels within the facility. The dried organic material will be sent off site for recovery (as refuse derived fuels) and to landfill. Brown bin (source segregated organic material) will also be accepted at the facility for storage only. This material which will be stored indoors in covered containers, will be transported on a weekly basis to a composting facility for further processing. The overall operation and proposed quantity of materials accepted and processed is set out in **Table 3.1.**

Table 3.1 Overview of Waste Types, Quantities, Processes and Destination

Waste Material Type	Amount Accepted Tonnes per Annum(tpa)	Processing Step 1	Processing Step 2	Final Destination
Municipal Solid Waste	50,000	Manually & Mechanically	35,000 tpa organic fines dried in drying tunnels	25,000 tpa sent to landfill
				10,000 tpa recovered as refuse derived fuels
				15,000 tpa of dry recyclables sent off site for recovery
Source Segregated Recyclables	30,000	Manually & Mechanically	n/a	27,000 tpa sent for recovery
				3,000 tpa sent for disposal
Construction and Demolition Waste	12,000	Manually & Mechanically	n/a	10,000 tpa sent for recovery
				2,000 tpa sent for disposal
Source Segregated Organic Material (Brown Bin)	3,000	Stored on site	n/a	Composting Facility off-site
Total	**95,000**			**95,000 tpa**

The site is located in a rural area. There are a number of residential properties in the surrounding area. The nearest properties are located across the road to the east of the site. The prevailing winds are south, southwest. The 2005 windrow from Valencia Observatory (approx 50km southwest of the site) is presented below. There are relatively strong southerly winds and a small percentage (3%) of calms.

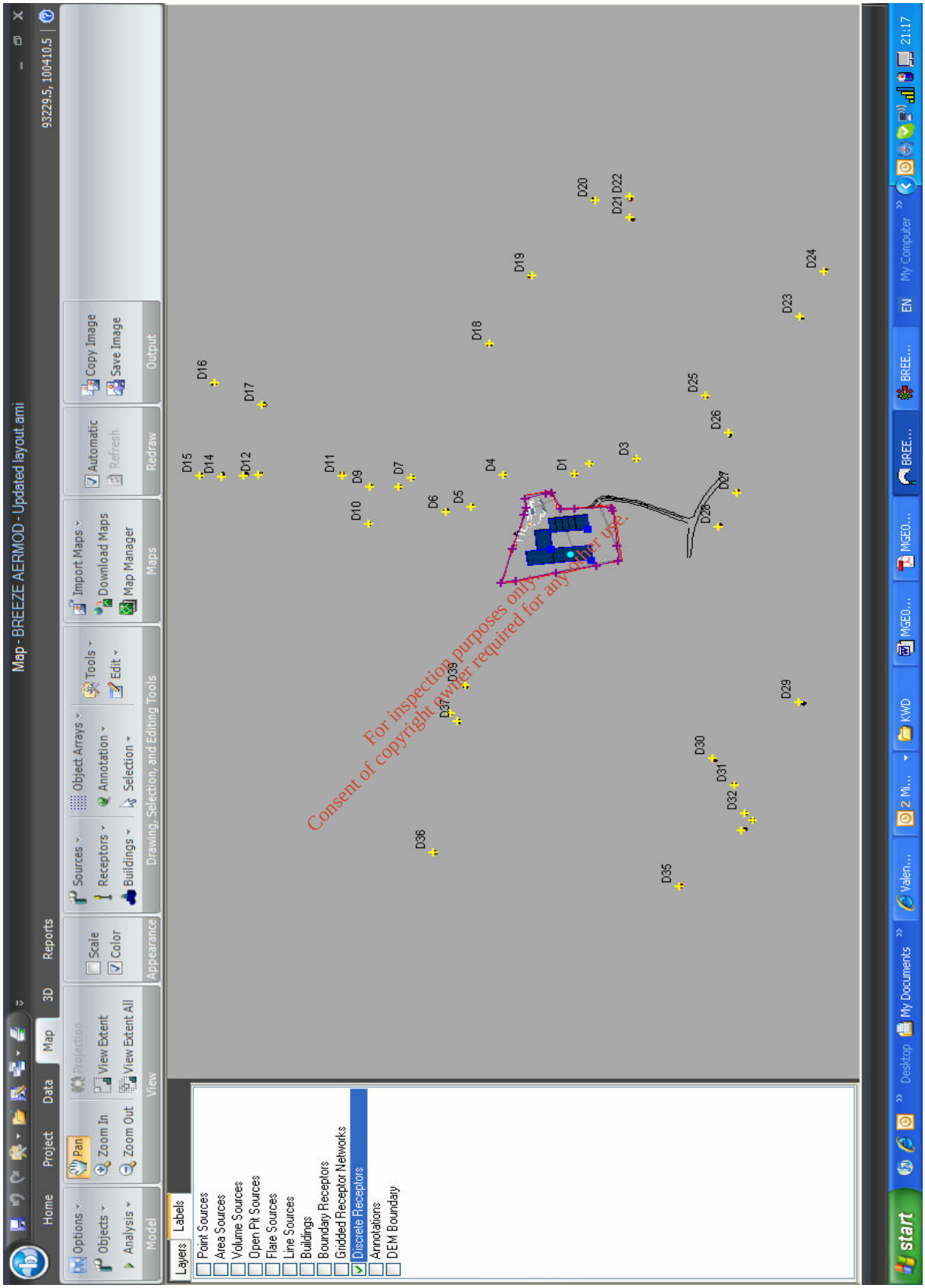
Figure 3.1 2005 Windrose from nearest meteorological station (Valencia Observatory)



3.2 RECEPTOR DATA

There are a number of sensitive receptors in the vicinity of the site which are illustrated in Figure 3.2.

Figure 3.2 Modelled receptor locations and site layout.



4 ODOUR DESIGN MITIGATION MEASURES

4.1 GENERAL MITIGATION MEASURES

The prevention of generation and release of odours from the process is key to ensure no odour impact in the vicinity of the facility. These include the implementation of odour management procedures, which will take account of daily operations to reduce the overall generation of odours from the facility. These include:

- Responsible operation and handling of waste.
- Closed-door management strategy.
- Facility management and cleaning procedures for all surfaces in contact with waste.
- Waste acceptance procedures to include enforcement of acceptance of enclosed waste loads, type of waste accepted into the facility and the procedures in handling waste within the facility.
- Other elements include the implementation of an Odour Management Plan and operation and maintenance management plans for the odour control system.
- The facility access doors will be fitted with rapid roller doors and high efficiency air curtains to prevent the release of odours through the access doors of the facility.
- The facility will operate an Odour Management Plan (OMP). The Plan will define the operational and control measures appropriate for the control of odour at the facility. The OMP will clearly state the odour management operational procedures for both normal and abnormal conditions. The OMP should include sufficient data to enable site management (and local authority / regulatory inspectors) to audit site operations on odour management.

4.2 ODOUROUS AIR TREATMENT MEASURES

- The reception building will be fitted with a Mist-Air system. A sketch of the proposed system is included in Appendix B. The system will suppress dust and odour in the reception building and is used on numerous facilities in the waste management industry.
- All air from inside the drying tunnels will be directed to an internal biofilter, which is located adjacent to tunnels. In order to ensure that the biofilter media is preserved, an acid scrubber will be fitted which will remove ammonia, amines and small particulates prior to discharge to the biofilter.
- The biofilter will be adequately sized to treat up to 35,000 m^3/hr from the tunnel process. Typical biofilter size requirements range from 50-150 m^3/m^2/hour. It is estimated that an area of 300m^2 will be sufficient for the proposed biofiliter.
- A preventative maintenance programme will be implemented for the acid scrubber and biofilter. The system will be maintained in good operational condition. The moisture of the biofilter will be maintained to ensure that no drying out occurs. Differential pressure will be measured weekly to ensure that adequate air is flowing through the filter bed. The biofilter media will be replaced every three years.

5 DISPERSION MODEL RESULTS

AERMOD Prime was used to determine the overall odour impact from the facility. The criteria employed to determine odour nuisance is that outlined in Section 2 as 1.5 Ou_E/m^3 at the 98th percentile of 1-hour averages. The model results for the proposed plant are described below.

In order to meet the criteria at the receptors, a series of scenarios were modelled. The mass odour emission, air volume flow and exit velocity of the proposed stack were modelled until the ground-level odour concentration was below the assessment criteria for all off-site receptors.

Provided the finalised abatement system can achieve these emission parameters, the impact on local receptors will not be significant. The emissions design parameters, which result in ground level concentrations below the assessment criteria, are presented in Table 5.1.

Table 5.1 Design Parameters

Parameter	Design Requirement
Biofilter total area	300 m^2
Odour Concentration at Stack emission point	2000 ou/m^3
Volume flow	9 m^3/s
Stack Diameter	1.2 m
Building height	11.7 m
Stack Height	12 m

The odour impacts associated with this design are presented in Table 5.2 and in Figure 5.1. The highest off-site concentrations are experienced at Receptors R1 and R2, the nearest receptors to the east perimeter of the site and R5 (nearest receptor to the north). The odour impact at these locations is below the assessment criteria of 1.50 Ou_E/m^3 (98th percentile). The results illustrate that receptors to the east and north have the potential to be exposed to odours if odours are not managed at the site. Receptors further east and in other directions around the site experience odour impact much lower than the assessment criteria.

The model results indicate that using the above design parameters, odour impacts from the point source emission will be below the assessment criteria at all modelled receptors.

Figure 5.1 Odour Isopleths figure for max 1-hr, 98th percentile. (Contour lines and text represent odour concentrations. Red marks represent receptors)

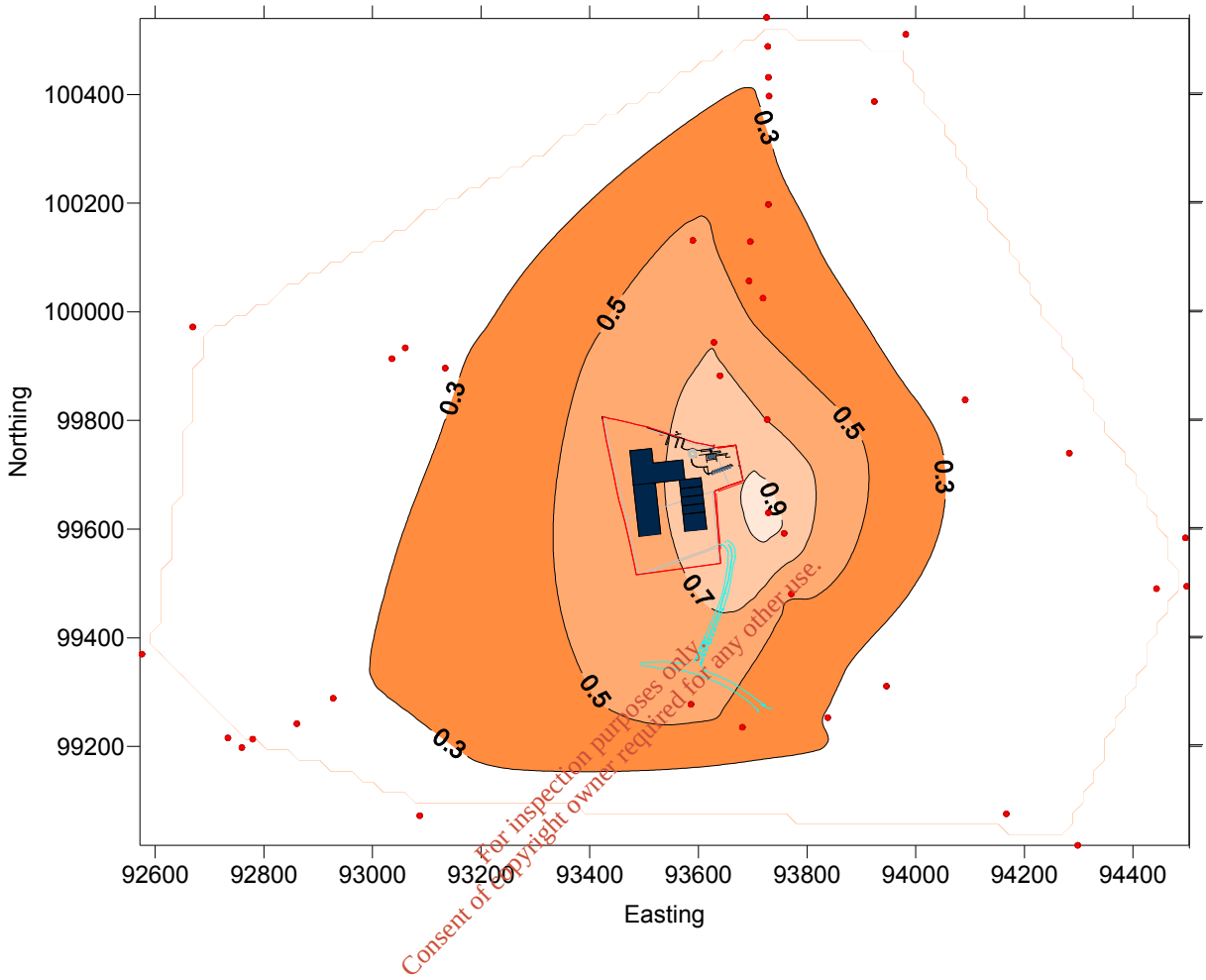


Table 5.2 Predicted 1-hour average odour concentrations (98th percentile) at sensitive receptors

Percentile Report

All Receptors:

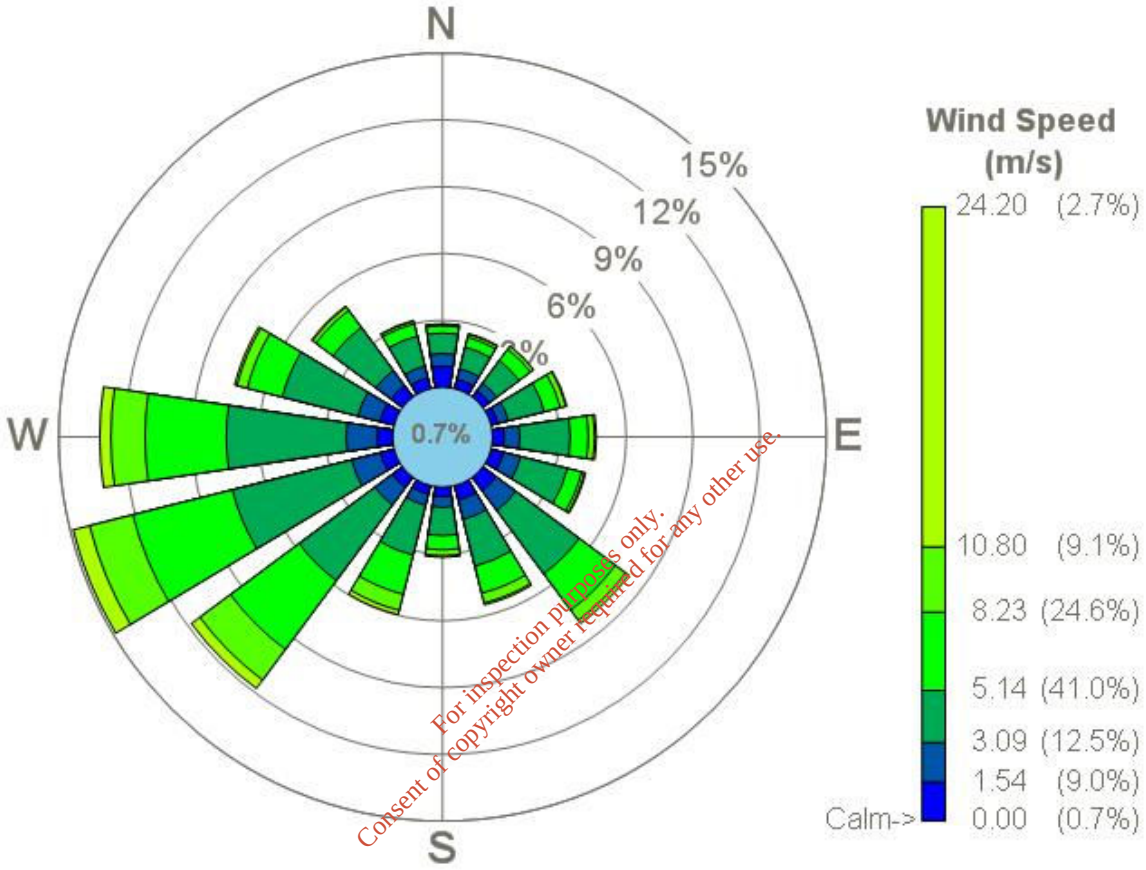
Percentile	Corresponding Highest Value	Receptor X-coord (m)	Receptor Y-coord (m)	Maximum Concentration
98	176	93726.30	99627.50	.10492E+01

Individual Receptors:

Receptor Number	Receptor X-coord (m)	Receptor Y-coord (m)	Percentile > > > 98
1	93726.30	99627.50	.10492E+01
2	93755.00	99590.00	.91013E+00
3	93768.60	99476.20	.50019E+00
4	93723.80	99801.30	.71424E+00
5	93635.50	99879.80	.76203E+00
6	93621.50	99941.40	.71309E+00
7	93716.80	100024.10	.41469E+00
8	93691.60	100054.90	.44297E+00
9	93691.60	100125.00	.41318E+00
10	93586.50	100129.20	.57496E+00
11	93721.00	100192.30	.34486E+00
12	93723.80	100396.90	.28343E+00
13	93721.00	100433.30	.27518E+00
14	93718.20	100486.60	.26268E+00
15	93721.00	100539.80	.24172E+00
16	93981.70	100503.40	.12593E+00
17	93920.00	100388.50	.15420E+00
18	94091.00	99833.50	.19241E+00
19	94281.50	99729.80	.15586E+00
20	94491.80	99575.70	.86297E-01
21	94444.10	99491.60	.92032E-01
22	94503.00	99491.60	.82613E-01
23	94166.60	99076.80	.91557E-01
24	94292.80	99017.90	.72430E-01
25	93945.20	99306.60	.19633E+00
26	93841.50	99250.60	.28997E+00
27	93673.40	99230.90	.42991E+00
28	93578.10	99275.80	.62643E+00
29	93087.60	99079.60	.16174E+00
30	92930.60	99289.80	.30840E+00
31	92855.00	99236.50	.25251E+00
32	92776.50	99211.30	.20803E+00
33	92756.90	99191.70	.19601E+00
34	92728.80	99219.70	.21584E+00
35	92571.90	99371.10	.22471E+00
36	92667.20	99970.90	.87096E-01
37	93034.30	99912.00	.19647E+00
38	93056.80	99928.80	.19963E+00
39	93135.20	99892.40	.27738E+00

Met Data Sensitivity Analysis: The model was also run using 10 years of Met Data from Dublin Airport. The Dublin data has a greater percentage of westerly winds, which will impact on dispersion at the east perimeter of the site. The analysis indicates that the 1.5 Ou/m^3 criterion is not breached at any sensitive receptor (highest 1-hr 98th percentile value: 1.38Ou/m^3). This implies an added level of confidence in the model results.

Figure 5.2 Windrose for 10 years Met data from Dublin Airport (used in sensitivity analysis)



6 CONCLUSIONS

A desktop assessment of the potential odour impact from the proposed operations at the facility has been carried out using standard procedures (see Table 6.1 for model checklist). It is proposed to extract odourous air from the drying tunnels through a scrubber (to remove ammonia and particulates) and biofilter (odour removal) prior to discharge to atmosphere.

This report sets out abatement efficiency criteria, which will be required in order to meet strict odour criteria at the nearest sensitive receptors. A series of emission parameters (Table 5.1) have been modelled. The model is valid for these source characteristics.

The resultant odour impact has been compared to the high-risk odour criteria presented in the IPPC H4 guidance documentation. The model predicts that the end-pipe emissions from the proposed biofiter stack will not give rise to reasonable cause for odour annoyance at the nearest sensitive receptors.

Additional mitigation measures are presented in Section 4 of this report. These include water misting roller doors and good housekeeping to reduce the risk of fugitive emissions. Proactive odour management and implementation of an Odour Management Plan with responsibilities assigned to senior personnel will assist in identifying and addressing odour impacts should they occur.

Table 6.1 Model Checklist

ITEM	√ / x / NA	Reason for Omission/ Notes
Location Map	√	
Site Map	√	
List of Pollutants Modelled and Relevant Criteria	√	
Details of Modelling Scenarios	√	
Background Concentrations Used	NA	
Model Description and Justification	√	
Special Model Treatments Used	√	
Details of Emission Parameters Used	√	
Details of Modelled Domain and Receptors	√	
Details of Met Data Used and justification	√	
Detail of Terrain Treatment	√	Flagpole receptors used to east to represent terrain.
Sensitivity Analysis	√	10 years met data from Dublin
Assessment of Impacts	√	

APPENDIX A

DETAILS OF MIST-AIR DUST SUPPRESSION SYSTEM

Airborne dust is effectively suppressed without wetting floors, stock, machinery or personnel; every thing stays dry, unlike sprinkler systems and rotary atomisers.

Mist-Air Fog is so fine, that it floats in the air without dropping to the floor, and actually attracts airborne dust particles increasing their weight. Mist is directed towards the dust forming areas, bombarding the dust as it is released, causing the particles to collide, and rapidly settling the dust close to the area it was formed in. Water sprays used for this application push past most of the fine dust due to the high surface tension of the water droplets.

Mist-Air has the capacity to produce huge volumes of mist, so can be used to treat several areas or buildings simultaneously from one base unit, and alteration or extensions can easily be done if required.

The Misting System

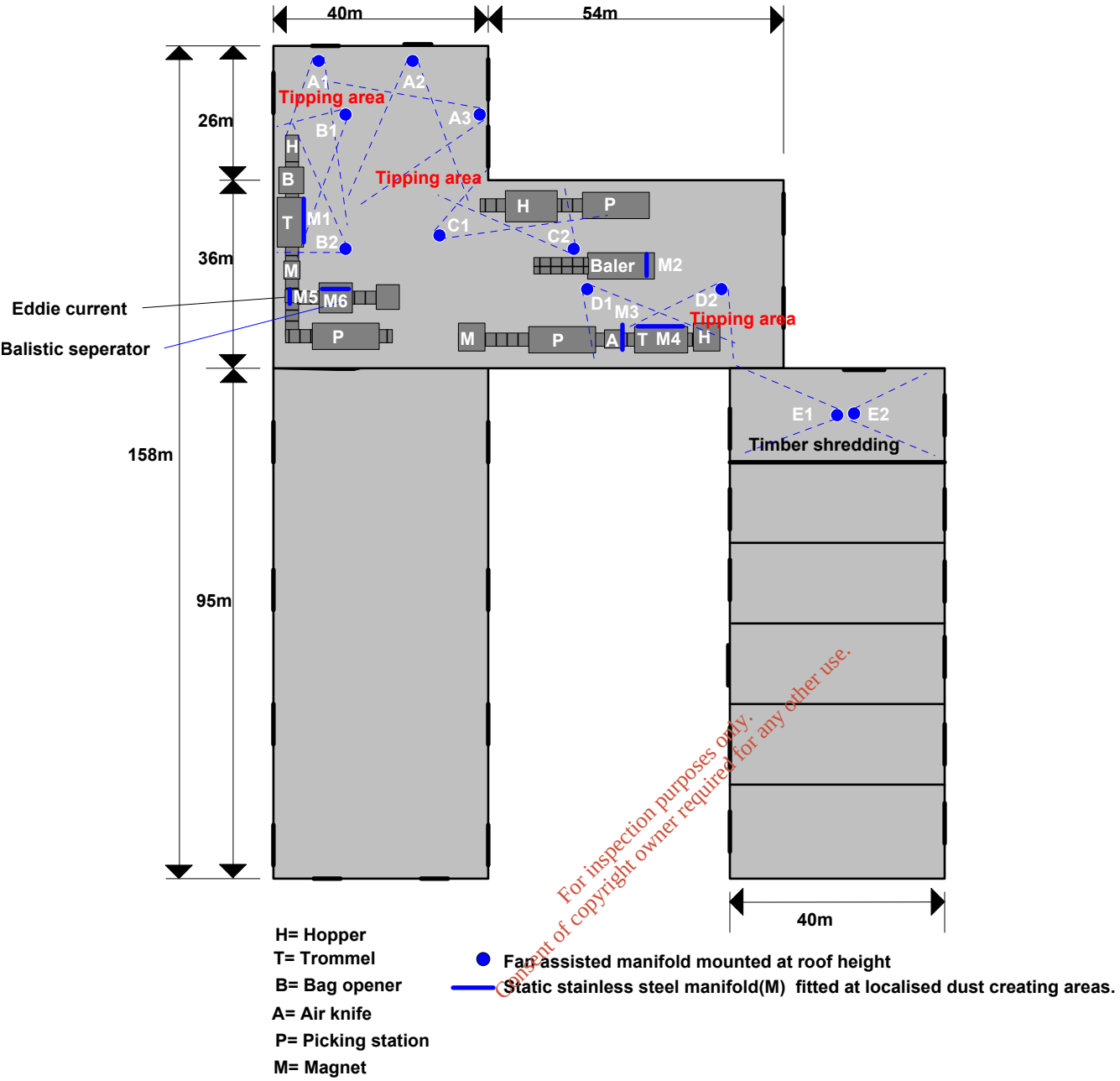
A Base Unit housed in a free standing lockable steel cabinet provides all the power for the system.

Reinforced circulation hose is then fed from the base unit to the various circuits around the site, allowing each area to be treated individually or simultaneously as required.

Stainless steel fan assisted misting manifolds are fitted to the roof trusses to direct mist to precisely the right areas when required, but positioned well out of the way of loading equipment and tipping vehicles.

Stainless steel static manifolds are used to good effect for quelling dust within contained areas preventing dust escaping from breathers, baler feeds, shredders, trommel fines bays, feed hoppers, or conveyor transfer points.

Each of the 5 circuits shown A B C D E can all be operated individually or simultaneously. Each circuit can be switched to constant or intermittent operation completely independent from any other circuit.



This sketch shows where the dust will be and how by using two fans opposing each other, the dust will be prevented from spreading to the rest of the building. The static manifolds kill dust locally, and are extremely effective in conjunction with the overhead fan assisted manifolds

System consists of:

One Base Unit c/w filtration system, automatic frost protection, electronic chemical dosing system, for deodouriser and insecticide application, water softener, auto pause system for variable intermittent operation, and control system. All wetted components are stainless steel or non ferrous materials.

11 off Fan assisted manifolds switched on 5 separate circuits.

16m Static stainless steel manifolds

687m Circulation hose, fittings and fastenings.

517m SY armoured cables c/w fittings and fastenings.

Maintenance

The system requires little maintenance and has a life expectancy in excess of 20 years.

Mist-Air offer a service to clean and check the system to ensure 100% efficiency or your own engineers can be instructed to do this.

APPENDIX 2

Drainage Calculation Report June 2009

Kerry Central Recycling Facility Ltd

Drainage Calculations

June 2009

MGE0109CR0002

RPS

Kerry Central Recycling Facility

Drainage Calculations

DOCUMENT CONTROL SHEET

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1 FOUL SEWER DESIGN PROCEDURE

It is proposed to treat the foul flow from the development in a wastewater treatment system and to discharge the flow to groundwater through a raised bed soil polishing filter as shown on **Drawing No. DR0001/01**. Details of on-site test results showing the suitability of the site for the discharge of foul flows to groundwater are shown on the Site Characterisation Form in Appendix A.

The proposed foul sewer system shown on **Drawing No. DR0001/01** was designed using the Foul Module of MicroDrainage WinDes and complies with the specifications set out in the "Recommendations for Site Development Works for Housing Areas" as issued by the Department of the Environment, Heritage and Local Government.

The outputs from the program are located in Appendix B and include the following:

- Network Design Table
- Network Results Table
- Pipeline Schedules
- Manhole Schedules

Longitudinal Sections are shown on **Drawing No. DR0002/05**.

1.1 DESIGN PARAMETERS

The following parameters were used for the basis of design in the WinDes Foul Module.

Parameters	Values	Reference
Flow Rates	Non-residential buildings	As per EPA Wastewater Treatment Manual
Peak Flow	6 x Dry Weather Flow (DWF)	Site Development Works 1998
Min Velocity	0.76m/s	Site Development Works 1998
Pipe Roughness	1.50	(Colebrook/White)
Pipe Cover	1.2 minimum roads and other trafficked areas 0.9m minimum in open spaces and footpaths not adjacent to roadways	Site Development Works 1998

1.2 PIPE & MANHOLE NUMBERING

The pipe numbers define the structure of the network. The first pipe at the head of a system on the main line is numbered 1.000, the second 1.001, the third 1.002 as so on. Likewise the first pipe in a branch line is numbered 2.000 and the second 2.001. Other branches follow suit, 3.000, 4.000 etc. The manhole numbers are shown as F1, F2, F3, etc. – see **Drawing No. DR0001/01**.

1.3 FOUL LOADINGS

The foul loadings that were used in modelling of the foul network are shown in Table 1.

Table 1: Foul Loadings

Foul System Users	Number of Persons	Flow (L/p/d)	Flow (L/d)	BOD (g/p/d)	BOD (g/d)	PE Flow	PE BOD
Office & Yard Staff	50	60*	3000	30	1500	16.7	25
Drivers	15	30**	450	15	225	2.5	3.75
Totals			**3450**		**1725**	**19.2**	**28.8**

* Table 3 – EPA Wastewater Treatment Manuals, Office and/or factory with canteen
** Foul Loading due to drivers assumed to be 50% of that from office and/or factory with canteen

1.4 WASTEWATER TREATMENT PLANT

An on-site wastewater treatment plant is proposed to treat the foul effluent. The treatment plant will be located as shown on **Drawing No. DR0001/01**. The proposed treatment plant will be provided with chemical dosing facilities to reduce the phosphorus levels in the treated effluent to <0.5mg/l (Orthophosphate). This will have a minimal effect on the phosphorus levels in the stream of approximately 0.0007mg/l. Refer to Chapter 5 and Chapter 6, surface water and ecological assessment in the EIS, for further assessment on the potential impacts on water quality. Details of the proposed wastewater treatment plant are shown in Appendix C.

2 STORM SEWER DESIGN PROCEDURE

2.1 SITE INVESTIGATION

Trial holes were dug on 5th May 2008 in order to determine the existing soil infiltration rate and the soil suitability for a soakaway pit. The location of the trial holes, (ST-01 and ST-02) is shown on **Drawing No. DR0001/01**.

At the time both holes contained groundwater, therefore a BRE Soakaway Test could not be carried out and the site was deemed unsuitable for the location of a soakaway pit. It is therefore proposed to discharge surface water run-off from the site via an attenuation pond to an existing drainage ditch / stream located at the south west end of the site.

2.2 STORM SEWER DESIGN

The storm sewer system was designed using the MicroDrainage WinDes Storm Module. This system uses the Modified Rational Method of storm flow modelling. This design procedure complies with the specifications set out in the "Recommendations for Site Development Works for Housing Areas" as issued by the Department of the Environment, Heritage and Local Government.

The proposed storm sewer system is shown on **Drawing No. DR0001/01**. The system incorporates both filter and carrier pipe. The filter pipe will be used as part of the road drainage system, with the carrier pipe used to drain other hard surface areas. Calculations for the storm sewers are shown in Appendix D.

The outputs from the MicroDrainage WinDes Storm Module program include the following:

- Network Design Table
- Network Results Table
- Manhole Schedules
- Pipeline Schedules

Longitudinal Sections are shown on **Drawing No. DR0002/01**, **02**, **03** and **04**. Longitudinal Sections for the road drainage system are shown on **Drawing No. DR0006/01**.

2.3 DESIGN PARAMETERS

The following parameters were used for the basis of design in the WinDes Storm Module.

Parameters	Values	Reference
Return Period	1 Year	Wallingford Procedure

M5-60	15.3	Wallingford Procedure
Ration 'R'	0.24	Wallingford Procedure
Max Rainfall	50mm/hr	Wallingford Procedure
Global Time Entry	4 minutes	Wallingford Procedure
Minimum Velocity	0.76m/s	Site Development Works 1998
Run-Off Co-efficient	Roof = 0.95 Road and Other Hard Surface Areas = 0.8	BS 8005 (Colebrook/White)
Pipe Roughness	0.6 – Carrier Pipe 1.5 – Filter Pipe	Colebrook/White
Pipe Cover	1.2 minimum without concrete encasement 0.75 minimum with concrete encasement	Site Development Works 1998

2.4 PIPE AND MANHOLE NUMBERING

The pipe numbers define the structure of the network. The first pipe at the head of a system on the main line is numbered 1.000, the second 1.001, the third 1.002 as so on. Likewise the first pipe in a branch line is numbered 2.000, the second 2.001 and so on. Other branches follow suit, 3.000, 4.000 etc. The Manhole Numbers are shown as S1, S2, S3. etc. – see **Drawing No. DR0001/01**.

2.5 HYDROCARBON INTERCEPTOR

In accordance with the requirements of BS EN 858, 4.1 (b) '(run-off) from impervious areas, e.g. car parks, roads, factory yards areas;' the size of the separator will depend on the design, rainfall intensity and the catchment area draining to the separator.

The maximum rainwater flow rate Q_r in l/s shall be calculated using the equation below in accordance with EN 752-4:

$$Q_r = \Psi.i.A$$

where

- I is the rainfall intensity, in l/s.ha
- A is the area receiving rainfall, measured horizontally, in ha;
- Ψ is a dimensionless coefficient (usually taken as one)

Pollution prevention guidelines (PPG 3) uses a rainfall intensity equal to 65mm/hr which corresponds to the following formula for a bypass separator:

$$NSB = 0.0018 \times A$$

where

- NSB: Nominal Size of Bypass separator
- A: Catchment Area in m^2

2.5.1 Hydrocarbon Interceptor No. 1

In this case, the area draining to the bypass separator is approximately 38,600m^2 which includes all road/paved areas within the site, resulting in the following:

$$NSB = 0.0018 \times 38{,}600m^2 = 69.5 \text{ l/s}$$

As per the Specification sheet for "Klargester" Bypass Separator included in Appendix E, the appropriate unit is the NSBD72, as highlighted. This unit is capable of handling a peak flow rate of 720 l/s as shown. Surface water calculations provided in the Appendix D show a maximum flow rate of 280 l/s which is significantly lower than the capacity of the unit.

2.5.2 Hydrocarbon Interceptor No. 2

In this case, the area draining to the bypass separator is approximately 2,240m^2, resulting in the following:

$$NSB = 0.0018 \times 2{,}240m^2 = 4.032 \text{ l/s}$$

As per the Specification sheet for "Klargester" Bypass Separator included in Appendix E, the appropriate unit is the NSBD6, as highlighted. Surface water calculations provided in the Appendix D show a maximum flow rate of 21.6 l/s. This unit is capable of handling a peak flow rate of 60 l/s as shown. This is significantly higher than the actual flow rate the unit will be required to handle.

3 ATTENUATION SYSTEM DESIGN

Attenuation of storm water on-site will be provided by means of an Attenuation Pond. This Attenuation Pond was designed using the following parameters:

(i) Return Period of 30 Years

(ii) Storm duration of 1 minute to 48 hours

(iii) M5-60 = 15.8

(iv) Ratio "R" = 0.3

(v) Coefficient of Runoff from Roofs = 0.95

(vi) Coefficient of Runoff from Road and Other Trafficked Areas = 0.8

The location of the Attenuation Pond is shown on **Drawing No. DR0001/01**. Details and schematic arrangement for the Attenuation Pond are shown on **Drawing No. DR0004/01**. Detail of the flow control unit to be installed in the outlet manhole from the attenuation pond are shown in Appendix F.

An attenuation pond with a capacity of 600m^3 is required.

Calculations for the storage capacity requirements are included in Appendix G.

APPENDIX A

Site Characterisation Form

SITE CHARACTERISATION FORM

1.0 GENERAL DETAILS (From planning application)

NAME & ADDRESS OF APPLICANT:	Kerry Central Recycling Facility Ltd. Scart/Caherdean, Killarney, Co. Kerry.				
SITE LOCATION AND TOWNLAND:	Scart/Caherdean, Killarney, Co. Kerry.				
TELEPHONE NO:	064 32458	**FAX NO:**	064 38661	**E-MAIL:**	brian.bruton@kwd.ie
MAXIMUM NO. OF RESIDENTS:	65 staff @ 60L/p/d 32 visitors @ 5L/p/d	**NO. OF DOUBLE BEDROOMS:**	-	**NO. OF SINGLE BEDROOMS:**	-
PROPOSED WATER SUPPLY: (tick as appropriate)	**mains** √	**private well/borehole**		**group well/borehole**	

2.0 DESK STUDY

SOIL TYPE	Till derived chiefly from Namurin Rocks	**Other (specify)**	**AQUIFER CATEGORY**	**Regionally Important**	**Locally Important** √	**Poor**	
VULNERABILITY Interim GSI Guidelines and site information		**Extreme**	**High**	**Moderate**	**Low**	**High to Low** √	**Unknown**
BEDROCK	Namurian Undifferentiated	**Name of Public/Group Scheme Water Supply within 1 km**				**None**	
Is there a GSI Groundwater Protection Scheme? (Y/N):	Y	**Groundwater Protection Response:**	R1	**Source Protection Area**		**SI** None	**SO** None
Presence of significant sites (archaeological, natural & historical):			N/A				
Past experience in the area:		N/A					

Comments:
(*Integrate the information above in order to comment on: the potential suitability of the site, potential targets at risk, and/or any potential site restrictions).*
From the above we can infer that percolation in the area would be acceptable. However, caution would have to be taken due to the under lying aquifer quality and usage and extreme vulnerability of the area.

NOTE: Only existing information available at the desk study stage should be used in this section

3.0 ON-SITE ASSESSMENT

3.1 Visual Assessment

LANDSCAPE POSITION:	N22 runs adjacent the eastern boundary of the site.	**SLOPE:**	STEEP (>1:5)	SHALLOW (1:5-1:20) √	RELATIVELY FLAT (<1:20)

SURFACE FEATURES (Distance to features should be noted in metres)	
HOUSES:	None on proposed site
SITE BOUNDARIES:	North – Factory & Agricultural Land East –N22 and Drainage Ditch South – Agricultural Land West – Drainage Ditch
ROADS:	N22 to East of site
EXISTING LAND USE:	Greenfield site with conifer plantation
OUTCROPS (ROCK AND/OR SUBSOIL):	None on site
SURFACE WATER PONDING:	None on site
LAKES:	None on site
BEACHES/SHELLFISH AREAS/WETLANDS:	None on site
KARST FEATURES:	None on site
WATERCOURSE/STREAM*:	None on site
DRAINAGE DITCHES*:	Running along the western and eastern boundary of the site. Internal drainage ditches will be captured in the internal drainage system.
WELLS*:	None on site
SPRINGS*:	None on site
VEGETATION INDICATORS:	Grass and rushes in area of proposed percolation area
GROUND CONDITION:	Soft and boggy

COMMENTS:
(Integrate the information above in order to comment on: the potential suitability of the site, potential targets at risk, the suitability of the site to treat the wastewater and the location of the proposed system within the site).

Water table possibly high on site. Foul water treatment on-site could cause risk to groundwater and surface water.

*** note** water level

3.2 Trial Hole No.1

Trial Hole should be a minimum of 2.1 m deep (3m where have regionally important aquifers)

Depth of trial hole (m):	**1.8m**	**Date and time of excavation:**	**05/05/08**	**Date and time of examination:**	**06/05/08**
Depth from ground surface to bedrock (m) (if present):			**Not encountered**		
Depth from ground surface to water table (m) (if present):			**1.4m**		

	Soil/Subsoil Texture & Classification**	Soil Structure	Density/ Compactness	Colour ***	Preferential flowpaths
0.1 m **0.2 m** **0.3 m** **0.4 m** **0.5 m** **0.6 m**	Peat	Blocky	Compact	Dark Brown	Grass Rootlets
0.7 m **0.8 m** **0.9 m** **1.0 m** **1.1 m** **1.2 m** **1.3 m** **1.4 m**	Blue Grey Clay with Gravel	Structureless Massive	Soft	Blue	None Water Table
1.5 m **1.6 m** **1.7 m** **1.8 m**					End of Dig
1.9 m **2.0 m** **2.1 m** **2.2 m** **2.3 m** **2.4 m** **2.5 m**	See next page for cross section of trial hole				

Other information

Depth of water ingress:	1.4	**Rock type (if present):**	N/A	**Plasticity and dilatancy results:**	**3 samples to be tested for each horizon and results should be entered above for each horizon**	**Likely T value:**	**>20**

EVALUATION: Ground suitable for discharge subject to P Test results.

** See Appendix E for BS 5930 classification
*** All signs of mottling should be recorded
Note: Depth of percolation test holes should be indicated on diagram above.

Trial Hole No.1 - Cross Section

(a) Percolation ("T") Test @ Invert of Percolation Pipe or relevant subsoil layer

Percolation Test Hole	1	2
Depth from ground surface to top of hole (mm) (A)	900mm	900mm
Depth from ground surface to base of hole (mm) (B)	1.3m	1.3m
Depth of hole (mm) [B - A]	400mm	400mm
Dimensions of hole [length x breadth (mm)]	300 x 300	300 x 300

Each hole must be pre-soaked twice before the test is carried out (from 10.00 am to 5.00 pm and from 5.00 pm to next morning)

Date of test	06/05/08	06/05/08
Date pre-soaking started	05/05/08	05/05/08
Time filled to 400 mm		
Time water level at 300 mm		

Percolation Test Hole No.	1			2		
Fill no.	Start Time (at 300 mm)	Finish Time (at 200 mm)	Δt (min)	Start Time (at 300 mm)	Finish Time (at 200 mm)	Δt (min)
1						
2						
3						
Average Δt				Average Δt		

Not carried out

Average Δt/4 = [Hole No.1] _____(t_1)

Average Δt/4 = [Hole No.2] _____(t_2)

T value* = (t_1 + t_2)/2 = _____(min/25 mm)

Result of Test : T =

COMMENTS:

- **If two very different T test results are obtained and where one of these values fails then a third test should be carried out to determine the representivity of each of the results.**

3.3 (b) Percolation ("P") Test @ Ground Level, Trial Hole No. 1

Percolation Test Hole	1	2
Depth of hole from ground surface (mm)	400	400
Dimensions of hole [length x breadth (mm)]	300x300	300x300

Each hole must be pre-soaked twice before the test is carried out (from 10.00 am to 5.00 pm and from 5.00 pm to next morning)

Date of test	06/05/08	06/05/08
Date pre-soaking started	05/05/08	05/05/08
Time filled to 400 mm	10:27	10:32
Time water level at 300 mm	11:01	11:10

Percolation Test Hole No.	1			2		
Fill no.	Start Time (at 300 mm)	Finish Time (at 200 mm)	Δp (min)	Start Time (at 300 mm)	Finish Time (at 200 mm)	Δp (min)
1	11:01	11:39	38	11:10	11:55	45
2	11:43	12:36	53	11:57	12:50	53
3	12:38	14:42	124	12:50	14:58	128
Average Δp			72	Average Δp		75
Average Δp/4 = [Hole No.1] 18 (p_1)				Average Δp/4 = [Hole No.2] 19 (p_2)		

P value* = (p_1 + p_2)/2 = 18.5 (min/25 mm)

Result of Test : P = 18.5

COMMENTS: The P value is 18.5, giving an infiltration rate of 20 L/m^2/day as the P value is between 5 and 20. This was lower than expected.

- **If two very different P test results are obtained and where one of these values fails then a third test should be carried out to determine the representivity of each of the results**

3.2 Trial Hole No. 2

Trial Hole should be a minimum of 2.1 m deep (3m where have regionally important aquifers)

Depth of trial hole (m):	**2m**	**Date and time of excavation:**	**05/05/08**	**Date and time of examination:**	**06/05/08**
Depth from ground surface to bedrock (m) (if present):			**Not encountered**		
Depth from ground surface to water table (m) (if present):			**1.1m**		

	Soil/Subsoil Texture & Classification**	Soil Structure	Density/ Compactness	Colour ***	Preferential flowpaths
0.1 m 0.2 m 0.3 m 0.4 m 0.5 m 0.6 m	Peat	Blocky	Compact	Dark Brown	Grass Rootlets
0.7 m 0.8 m 0.9 m 1.0 m 1.1 m 1.2 m 1.3 m 1.4 m	Blue Grey Clay	Structureless Massive	Soft	Blue	None Water Table
1.5 m 1.6 m 1.7 m 1.8 m 1.9 m 2.0 m 2.1 m 2.2 m 2.3 m 2.4 m 2.5 m	See next page for cross section of trial hole				End of Dig

Other information

Depth of water ingress:	N/A	**Rock type (if present):**	N/A	**Plasticity and dilatancy results:**		**Likely T value:**	**>20**

EVALUATION: Ground will provide adequate treatment subject to P test results.

** See Appendix E for BS 5930 classification
*** All signs of mottling should be recorded
Note: Depth of percolation test holes should be indicated on diagram above.

Trial Hole 2 - Cross Section

(a) Percolation ("T") Test @ Invert of Percolation Pipe or relevant subsoil layer

Percolation Test Hole	1	2
Depth from ground surface to top of hole (mm) (A)	900mm	900mm
Depth from ground surface to base of hole (mm) (B)	1.3m	1.3m
Depth of hole (mm) [B - A]	400mm	400mm
Dimensions of hole [length x breadth (mm)]	300 x 300	300 x 300

Each hole must be pre-soaked twice before the test is carried out (from 10.00 am to 5.00 pm and from 5.00 pm to next morning)

Date of test	06/05/08	06/05/08
Date pre-soaking started	05/05/08	05/05/08
Time filled to 400 mm		
Time water level at 300 mm		

Percolation Test Hole No.	1			2		
Fill no.	Start Time (at 300 mm)	Finish Time (at 200 mm)	Δt (min)	Start Time (at 300 mm)	Finish Time (at 200 mm)	Δt (min)
1						
2						
3						
Average Δt				Average Δt		

Not carried out

Average$\Delta t/4$ = [Hole No.1] _____(t_1)

Average $\Delta t/4$ = [Hole No.2] _____(t_2)

T value* = (t_1 + t_2)/2 =_____(min/25 mm)

Result of Test : T =

COMMENTS:

- **If two very different T test results are obtained and where one of these values fails then a third test should be carried out to determine the representivity of each of the results.**

3.3 (b) Percolation ("P") Test @ Ground Level , Trial Hole No. 2

Percolation Test Hole	1	2
Depth of hole from ground surface (mm)	400	400
Dimensions of hole [length x breadth (mm)]	300x300	300x300

Each hole must be pre-soaked twice before the test is carried out (from 10.00 am to 5.00 pm and from 5.00 pm to next morning)

Date of test	06/05/08	06/05/08
Date pre-soaking started	05/05/08	05/05/08
Time filled to 400 mm	10:01	10:03
Time water level at 300 mm	10:43	10:46

Percolation Test Hole No.	1			2		
Fill no.	Start Time (at 300 mm)	Finish Time (at 200 mm)	Δp (min)	Start Time (at 300 mm)	Finish Time (at 200 mm)	Δp (min)
1	10:43	11:51	68	11:26	12:14	48
2	11:51	13:06	75	12:15	13:41	86
3	13:08	15:10	122	13:44	16:04	140
Average Δp			88	Average Δp		91

Average Δp/4 = [Hole No.1] 22 (p_1)

Average Δp/4 = [Hole No.2] 23 (p_2)

P value* = (p_1 + p_2)/2 = 22.5 (min/25 mm)

Result of Test : P = 22.5

COMMENTS: The P value is 22.5, giving an infiltration rate of 10 L/m^2/day as the P value is between 20 and 40. This was lower than expected but is more conservative than the P value obtained at TH-01 and will be used in the sizing of the percolation area.

- **If two very different P test results are obtained and where one of these values fails then a third test should be carried out to determine the representivity of each of the results**

Sketch of site showing measurement to Trial Hole location and Percolation Test Hole locations, wells and direction of groundwater flow (if known), proposed house (incl. distances from boundaries) adjacent houses, watercourses, significant sites and other relevant features. North point should always be included.

[A copy of the site layout drawing should be used if available]

Please see Drawing No. DR0001/01.

4.0 CONCLUSION of SITE CHARACTERISATION:

(*Integrate the information from the desk study and on-site assessment (i.e. visual assessment, trial hole and percolation tests) above and conclude the type of system(s) that is (are) appropriate. This information is also used to choose the optimum final disposal route of the treated wastewater).*

Suitable for (delete as appropriate)****:

~~(a) septic tank and soil percolation system~~

~~(b) septic tank and intermittent filter system and polishing unit; or septic tank and constructed wetlands and polishing unit~~

(c) mechanical aeration system and polishing unit

****note:** ***more than one option may be suitable for a site and this should be recorded***

and

~~**SUITABLE**~~ / **UNSUITABLE** (delete as appropriate) for discharge to **surface water**[1]

SUITABLE ~~/ **UNSUITABLE**~~ (delete as appropriate) for discharge to **groundwater**

5.0 RECOMMENDATION:

Propose to install: EPS Bison Wastewater Treatment Plant followed by a raised bed soil filter and discharge to ~~surface water~~/groundwater (delete as appropriate)

Conditions (if any) e.g. special works, invert level of trench, site improvement works testing etc…….

See attached design

Signed: PJ Griffin, RPS Consulting Engineers

Address: Lyrr Building, IDA Business and Technology Park, Mervue, Galway

Qualifications/Experience: Chartered Engineer Date of Report: 12th Sept.2008

Phone: 091 534100 Fax: 091 534199 e-mail pj.griffin@rpsgroup.com

[1] A discharge of sewage effluent to "waters" (definition includes any or any part of any river, stream, lake, canal, reservoir, aquifer, pond, watercourse or other inland waters, whether natural or artificial) will require a licence under the Water Pollution Acts 1977-90

6.0 TREATMENT SYSTEM DESIGN DETAILS

System Type?	**BAF**	**Proposed Discharge route?**	~~Surface water~~	Groundwater
Size of Proposed Treatment System?	Primary/Septic Tank (m^3) 6.8	Secondary Treatment System Capacity (m^3) 6.8	Percolation Area/Polishing filter (State units - m or m^2)* 345m^2 soil polishing filter	
What Quality Assurance is proposed during the following?	**Installation & Commissioning** Installed and commissioned by EPS	**On-going Maintenance** On-going maintenance by EPS		

*** the calculated percolation area or polishing filter area should be shown on site plan**

7.0 REVIEW (by Local Authority)

Site visit	☐	Date:
Inspection of Trial Hole	☐	Date:
Inspection of Percolation Test Holes	☐	Date:

COMMENTS

SIGNED: Date:

APPENDIX B

Foul Sewer Calculations

FOUL SEWERAGE DESIGN

Global Variables

Pipe Size File C:\Program Files\Micro Drainage Ltd\WinDes\STANDARD.PIP
Manhole Size File C:\Program Files\Micro Drainage Ltd\WinDes\STANDARD.MHS

Industrial Flow (l/s/ha)	0.00
Industrial Peak Flow Factor	0.00
Flow Per Person (l/per/day)	180.00
Persons per House	1.00
Domestic (l/s/ha)	0.00
Domestic Peak Flow Factor	6.00
O'flow Setting (*Foul only)	0
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	0.000
Min Cover Depth for Optimisation (m)	1.200
Min Vel for Auto Design Only (m/s)	0.76
Min Slope for Optimisation (1:X)	1000
Minimum Outfall Invert (m)	0.000
Ground Level at Outfall (m)	107.480
Outfall Manhole Name	WWTP
Outfall Manhole Dia/Length (mm)	0
Outfall Manhole Width (mm)	0

Designed with Level Soffits

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Hse	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
1.000	63.51	0.690	92.0	0.000	19	0.0	1.500	o	150
1.001	80.95	0.640	126.5	0.000	0	0.0	1.500	o	150
1.002	21.08	0.170	124.0	0.000	0	0.0	1.500	o	150

Network Results Table

PN	US/IL (m)	E.Area (ha)	E.DWF (l/s)	E.Hse	Infil. (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
1.000	106.200	0.000	0.0	19	0.0	13	0.32	0.91	16.1	0.2
1.001	105.510	0.000	0.0	19	0.0	14	0.28	0.78	13.8	0.2
1.002	104.870	0.000	0.0	19	0.0	14	0.29	0.79	13.9	0.2

PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.000	o	150	F1	109.830	106.200	3.480	1200
1.001	o	150	F2	107.830	105.510	2.170	1200
1.002	o	150	F3	107.480	104.870	2.460	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.000	63.51	92.0	F2	107.830	105.510	2.170	1200
1.001	80.95	126.5	F3	107.480	104.870	2.460	1200
1.002	21.08	124.0	WWTP	107.480	104.700	2.630	0

MANHOLE SCHEDULES

M/Hole Number	Cover Level (m)	M/Hole Depth (m)	M/Hole Diam.,L*W (mm)	Pipes Out PN	Pipes Out IL.(m)	Pipes Out D (mm)	Pipes In PN	Pipes In IL.(m)	Pipes In D (mm)
F1	109.830	3.630	1200	1.000	106.200	150			
F2	107.830	2.320	1200	1.001	105.510	150	1.000	105.510	150
F3	107.480	2.610	1200	1.002	104.870	150	1.001	104.870	150
WWTP	107.480	2.780	0		OUTFALL		1.002	104.700	150

APPENDIX C

Bison Preliminary Design Proposal for Wastewater Treatment Plant

PRELIMINARY DESIGN PROPOSAL

FOR

WASTEWATER TREATMENT PLANT

CLIENT REPRESENTATIVE	**RPS**
ATTENTIOIN	**Mary Claire Sheridan**
DATE	**11th June 2009**
REFERENCE	**QB10159-08R**

TABLE OF CONTENTS

1. INTRODUCTION

The following report has been compiled using loading details and Population Equivalency (P.E.) supplied by RPS.
The design criteria and parameters have been calculated based on the recommended EPA loading rates as outlined in Table 2.1 below. Treatment plant selection has been based on the max loading rates based on 100% occupancy as per Table's 2.3, 2.4 and 2.5 below.

Prior to approval a site investigation and assessment will be required.

2. DESIGN PARAMETERS

Table 2.1. EPA Recommended Loading Rates

Situation	Source	Flow litres/day per person	BOD_5 grams/day per person
Industrial	Office and/or factory without canteen	30	20
	Office and/or factory with canteen	60	30
	Open industrial site e.g. quarry (excluding canteen)	40	25
Schools	Non-residential with cooking on-site	60	30
	Non-residential with no canteen	40	20
	Boarding school: (1). Residents (2). Day Staff (includes mid-day meal)	 180 60	 60 30
Hotels	Guests	250	75
	Guests (no meal)	180	45
	Resident staff	180	60
	Day Staff	60	30
	Conference	40	20
	Restaurant full meals: (1). Luxury Catering (2). Prepared Catering (3). Snack Bars (4). Function Rooms incl. Buffets (5). Fast Food	 25 15 10 10 10	 25 15 10 10 10
Pubs and Clubs	Residents	200	60
	Day Staff	60	30
	Bar Drinkers	10	10
	Bar Meals	10	10

Table 2.1 Continued.

Situation	Source	Flow litres/day per person	BOD_5 grams/day per person
Amenity Sites	Restaurants	15	15
	Function Rooms	10	10
	Toilet Blocks (per use)	5	10
	Toilet Blocks (long stay car parks)	10	15
	Golf Clubs	20	10
	Squash, with club house	25	15
	Swimming	10	10
	Football Club	30	20
	Caravan Sites (1). Touring (2). Static not serviced (3). Static fully serviced (4). Tent sites	 50 75 150 50	 35 35 55 35
Hospitals	Residential elderly people	250	60
	Residential elderly people plus nursing	300	65
	Nursing Homes	350	75

Table 2.2 EPA Recommended Minimum Distances from Treatment Systems

System Size P.E.	Approximate Number of Houses Served	Distance From Existing Development (m)
10 – 40	**2 – 10**	**28**
41 – 60	11 – 15	31
61 – 80	16 – 20	34
81 – 100	21 – 25	37
101 – 120	26 – 30	40
121 – 140	31 – 35	43
141 – 160	36 – 40	46
> 161	> 41	50

Table 2.3 Design Basis

Detail	Number	Unit
P.E.	**29**	P.E.
Hydraulic Loading	**180**	L/p/d
Organic Loading	**60**	gBOD/p/d
Gravity Inlet	**Assuming Yes**	Yes
Gravity Outlet	**Assuming Yes**	Yes
T-Value	**T.B.C.**	Min/25mm
Invert Level	**T.B.C.**	M
Power Supply	**T.B.C.**	Volts
Water Table	**T.B.C.**	M (BgL)

Table 2.4. Design Criteria

Parameter	Influent	Effluent	Unit
Design Flow	**3.45**	**3.45**	M^3/d
Peak Flow	**0.43**	**0.43**	M^3/hr 3DWF
BOD Load	**1.725**	**0.069**	Kg/d
T.N.	**-**		Mg/L
T.P	**-**	**<1**	Mg/L
Orthophosphates		**<0.5**	
S. Solids		**30**	Mg/L
BOD		**20**	Mg/L
Domestic/Commercial		**Domestic**	

2.5 DESIGN CALCULATIONS

E.P.S. Design Brief / Basis:

Hydraulic Loading = 3450 L/d

Organic Loading: = 1725 g/d

Total P.E (As per the Hydraulic Load) = 19.2 P.E.
Total P.E (As per the Organic Load) = 28.8 P.E.

EPS Ltd. propose 1 No. 30 P.E. SAF Treatment Plant

- SCOPE OF SUPPLY

The table below outlines all the main treatment options supplied by EPS. The items applicable to this development have been marked with a 'Y'.

Treatment System	Y/N	Description
Primary Treatment		
Primary Settlement Tank		*See Product Selection*
Secondary Treatment		
SAF Plants - *CT* - *Concrete*	**Y**	
SBR		
CAS		
MBR		
Tertiary Treatment		
Self Cleaning Sand Filter		
In-situ Sand Filter		
Reed Bed		
Disinfection - *UV* - *EFFG System* - *LBX System*		
Nutrient Removal		
Nitrification (Ammonia)		
Denitrification (Anoxic Zone)		
Phosphate Reduction	**Y**	
Additional Plant Items		
Screening		
Grease Removal		
Disposal Options Design		
Flow Splitting Chamber		
Recirculation Chamber		
Inlet Pumping Station		
Outlet Pumping Station		
Flow Metering	**Y**	*Optional*
Remote Monitoring	**Y**	*Optional*
Sampling	**Y**	*Optional*
Operation and Maintenance		
Service Contract		
Operation and Maintenance Contract	**Y**	

Treatment System	Y/N	Description
SAF PLANTS (grp) Standard Range		
CT 25		
CT 30	Y	
CT 50		
CT 75		
CT 100		
CT 125		
CT 150		
SAF PLANTS (grp) Nitrifying Range		
CT 35-N		
CT 50-N		
CT 75-N		
CT 100-N		
M 200		
M 250		
M 300		
M 400		
M 500		
M 600		
AQUAMAX RANGE		
30 PE Concrete		
50 PE Concrete		
75 PE Concrete		
100 PE Concrete		
150 PE Concrete		
200 PE Concrete		
250 PE Concrete		
300 PE Concrete		

Treatment System	Y/N	Description
SBR *(Sequencing Batch Reactor)*		
200		
300		
400		
500		
600		
700		
800		
900		
1000		
CAS		
150		
200		
300		
400		
Duplex Systems 400 PE upwards		
MBR		
125		
250		
375		
500		
750		
1000		
1500		
2000		
2500		

4. QUOTATION

Number QB10160-08R

Date 11th June 2009

Customer RPS Group

Address Lyrr Building, IDA Business & Technology Park, Mervue, Galway.

EPS Offer

Item 1:
TREATMENT PLANT
EPS propose the installation of 30 P.E. SAF treatment unit to deal with the sewage from the proposed development. Typical effluent discharge values achieved with secondary treatment would be 20mg/l BOD and 30mg/l SS. Prices include, transport, electrical, mechanical installation and commissioning.

Price € 9, 950.00 Excluding VAT

Item 2:
FERRIC DOSING SYSTEM
To achieve the Total Phosphorous parameter, The installation of a ferric dosing system is necessary. This includes the provision of a 100 litre day tank complete dosing pump to dose ferric sulphate into the treatment plant to reduce the phosphate levels to licence standard.

Price: €1,800.00 excluding VAT

<u>Optional Items.</u>

Item 3:
EYE WASH FACILITY [due to presence of Ferric Sulphate on site]
Hand held hose spray and stand.
Preforated spray head provides soft spray for cleansing eyes and face. Handle stays open once the valve is squeezed

Price: €470.00 excluding VAT

Item 4:
FLOW METER:
Mag Flow Digital Flow meter (C/w Integrated Recorder)

Price: € 2,000.00 excluding VAT

Item 5:
AUTOMATIC SAMPLER
Provision of automatic sampler to operate on a flow / time basis to take samples as required.

Price: €2,850.00 excluding VAT

Item 6:
GSM DIAL OUT FACILITY
To alert the plant operator in the case of a fault via GSM Messaging.

Price: €2,200 excluding VAT

VAT @ 13.5%

Payment Terms
40% With Order
55% On delivery of all or part of equipment to site.
(i.e.) Tanks/Equipment /Mechanical or Electrical installation.
5% On Commissioning
NOTE:

- *Order of equipment will only take place when deposit is received.*
- *Commissioning will only take place when paid up to 95%*
- *Final and full payment must be received. Maximum 90 days from payment of initial deposit.*

Delivery
6 working weeks from date of receipt of initial deposit on order

Basis of Selection
The treatment process proposed has been designed based on the information submitted to EPS and the recommended EPA loading guidelines.
All treatment plant options are selected on domestic sewage requirements or commercial sewage requirements where applicable. The option proposed is based on 100% occupancy.
No surface water or storm water is to enter the treatment plant.
The use of an appropriately sized and maintained grease trap is a client requirement, so as to ensure that no grease enters the treatment plant.

Design
The design of the treatment plant proposed is in accordance with BS6297. The design loading rates and applicable set-back distances are as per the EPA guidelines. The design of suitable disposable systems are as per the EPA guidelines or BS6297 where applicable.

Maintenance
EPS offer a full operation and maintenance after sales service which we encourage all customers to avail of.

Cancellation
EPS do reserve the right to recover reasonable costs from any deposit monies paid should a proposed project be cancelled.

Additional Terms

- Strictly Nett Monthly.
- Title does not pass until payment has been made in full.
- All goods/services subject to our standard conditions of sale (available on request). All payments to be forwarded to Head Office.
- All purchases subject to EPS standard credit terms and delivery unless otherwise agreed in writing.
- Retention does not apply to this quotation.

I HEREBY AGREE TO THE ABOVE TERMS AND INSTRUCT EPS TO PROCEED WITH THE ORDER AS OUTLINED ABOVE.

SIGNED _____

ON BEHALF OF _____

POSITION HELD _____

DATE _____

5. EXCLUSIONS AND CLIENT RESPONSIBILITIES

It shall be the responsibility of the client to provide the following:

- Provision of power to EPS Control Panel
- Any excavation or backfilling
- Any additional civil works or pumping as may be required for sites with water table issues.
- Site clearance and reinstatement
- Provision of ducting
- Provision of concrete hard standing areas as required
- Connection of inlet and outlet sewer lines
- Provision of seed sludge where applicable for plant start-up
- Provision and installation of and maintenance of a suitable grease trap if not otherwise included in EPS supply.
- Provision of chemicals as required for commissioning and set-up
- Access to treatment plant site for a 40ft articulated truck to allow for placement of tanks. Any necessary crane hire is the clients responsibility unless otherwise agreed by EPS.
- Provision of and construction of disposal systems.
- Provision of pipework from pump stations to disposal systems.
- All site security and fencing.
- Provision for telephone line or connection
- Provision for on- site induction/ Safety talks that are greater than 2 hours.
- Provision for builders discount.
- Provision of rising main and connection to EPS pipework.
- Provision for dry valve chamber to sump/ tanks c/w access cover.
- Provision of ESB metering box.
- Provision of a clean accessible working environment for EPS staff.

6. TREATMENT OPTIONS

6.1 PRIMARY TREATMENT

Our range of primary settlement tanks (PST) are available in both concrete and glass reinforced plastic (grp). We offer single stage, two stage and three stage settlement options.

All primary settlement tanks are designed to reduce the gross and suspended solids loading prior to secondary treatment. Sludge storage requirements are also included in PST design. Storage periods will vary depending on the option provided but as a general rule all primary settlement tanks should be desludged every 3 months at a minimum.

A primary settlement tank requires little maintenance, as there are no moving parts or electrical parts associated. Desludging and silt removal where applicable is the main requirement for primary settlement tanks.

6.2 SECONDARY TREATMENT

6.2.1 SAF PLANTS

A submerged aerated filter normally consists of a primary settlement tank, an aerated submerged biofilm reactor and a secondary settlement tank. This type of system is a well-developed technology and is regularly used for small communities.

6.2.2 CT RANGE

Incoming sewage is separated and stored in the first section of the primary settlement tank, allowing only settled liquor to pass forward for biological treatment.

The biological treatment stage comprises of two separate zones in series, both using submerged aerated filter technology and a well known jet aeration system – the VENTFLO Inductor.

The first biological stage treats the majority of the carbonaceous stage, resulting in a low loading rate for the second stage and a subsequent high overall removal rate.

Biomass (humus stage) sloughed from the submerged media is separated in the final humus settlement stage and returned intermittently by pump to the primary stage for co-settlement.

6.2.3 CONCRETE RANGE

Incoming sewage is separated and stored in the two stage primary settlement tank(s), allowing only settled liquor to pass forward for biological treatment.

The biological treatment tank comprises of select filter media to sustain biological growth and an aeration system comprising of a duty air blower and a diffused aeration system.

The treated effluent then passes to a final settlement tank prior to discharge where any humus sludge or suspended solid material settles out. A timer operated sludge return pump returns sludge intermittently to the primary settlement tank for storage.

6.2.4 SBR – Sequencing Batch Reactor

The Sequencing Batch Reactor process is a form of activated sludge treatment in which aeration, settlement and decanting occur in a single tank.

SBR's can operate as a uni-tank or multiple tank set-up.

The process employs a five stage cycle which may be repeated a number of times per 24 hour period. The five stages include fill, aerate, settle, decant, rest.

The wastewater is pumped into the SBR during the fill stage. The contents are then aerated and mixed prior to a quite settlement phase where all of the biomass and solids settle out. The clear supernatant is then decanted from the system. Following a rest phase the cycle is repeated. Periodically excess sludge is removed from the system during the rest phase and stored prior to removal off-site for treatment and disposal.

The SBR process provides good operational flexibility and allows for the option of incorporating nitrification, denitrification and phosphorous removal. It is a simple and reliable system, ideal for the treatment of varying flow and load conditions. This type of system is of particular benefit when treating wastewater from hotels, pubs and restaurants, etc.

6.2.5 CAS PLANT

The EPS CAS plant is based on conventional activated sludge technology. Each unit is factory built complete with all necessary equipment necessary for efficient operation.

A CAS plant is of steel construction, divided into two major sections – an aeration section and a clarifier. Each unit comprises of an inlet box, aeration header with drop pipes and diffusers, roots type blower including motor, controls, drives and fittings, sludge return and storage.

Following aeration the mixed liquor of activated sludge and treated effluent passes forward to the clarifier where conditions are favourable for the separation of settled sludge and the final effluent prior to discharge. All settled solids are returned continuously to the aeration section for further treatment.

Periodically excess sludge is wasted from the system to a sludge storage tank prior to removal off-site for treatment and disposal.

Nitrification, denitrification and phosphorous removal can also be accommodated with this system.

6.2.6 MBR – Packaged Membrane Bioreactors

MBR technology is a leading edge technology for the treatment of wastewater to a very high standard. Typically a final effluent standard of 5 : 5 : 5, BOD : SS : NH_4 is achieved consistently.

Background

The development of our submerged membrane bioreactor technology was the result of a Japanese Government initiative to produce compact, high quality effluent, treatment plants.

Since producing the first pilot plant using MBR technology in 1989 and the first commercial plant in 1991, over 950 plants have been installed worldwide. These treat a wide range of wastewaters, the principal application being sewage and sludge liquors, but also including industrial and food processing wastewater, and grey water recycling for a wide range of re-use purposes.

Process Description

The process employs simple flat sheet membrane panels housed in stainless steel cases and aerated by a coarse bubble diffuser system. A series of these membranes are submerged within an activated sludge treatment tank. An advantage of this design is that the membrane panels are securely retained and cannot touch or abrade each other, while the cases also act as a flume to ensure effective tank mixing and even distribution of the biomass.

The membrane panels are manufactured with an average pore size of 0.4 microns, which in operation becomes covered by a dynamic layer of protein and cellular material. This further enhances the performance effectiveness of the filtration process by providing an effective pore size of less than 0.01 microns, which is in the ultra-filtration range.

Our membrane bioreactor treatment produces a high quality disinfected effluent. The raw sewage generally only requires screening (to 3mm) and de-gritting prior to entering the membrane bioreactor tank. The process requires no primary or secondary settlement stages and no additional tertiary treatment or UV stages to achieve quality typically better than 5 : 5 : 5 mg/l BOD : Suspended Solids : Ammonia.

The MBR system has a number of inherent advantages. It does not remove the solids by settlement, therefore the biomass can operate at very high levels of mixed liquor suspended solids (MLSS), generally in the order of 12,000-18,000 mg/l, and up to 22,000 mg/l. This high concentration enables a low tank volume and a long sludge age to be utilised, which reduces sludge production and allows a small footprint. The associated viscosity with the suspended solids will affect the cross flow over the membrane surface. It is recommended that in normal operation the MLSS does not routinely go below 10,000 mg/l and that a minimum level of 8,000 mg/l at average flow is recommended.

The maximum hydraulic flow determines the required number of membrane units. Each membrane unit may contain up to 400 flat plate membrane panels housed within a rectangular case, together with an integral aeration system in the bottom section of the unit. Treated effluent is removed from the membrane units using gravity head (typically 1 –1.2m).

The membrane air diffuser typically allows 3-6% uptake of available oxygen at 3.3m-3.5m water depth, dependent on temperature and initial dissolved oxygen levels. Higher uptake rates will be found at lower temperatures and where the influent is initially anoxic.

Aeration is continuous at all times when permeate is flowing through the membrane units. During periods of low influent flow when the permeate flow stops, the aeration blowers can be cut out and will re-start automatically upon permeate flow resuming.

Operational Experience
Operating experience of pilot and main treatment plants has consistently resulted in an effluent of high quality that has little dependence on variations in feed strength and is fully disinfected with bacteria and viruses reduced to below the limits for bathing water or recreational water standards.

By minimising the effect of fouling through controlled cross flow velocities over the membrane surface, cleaning is required typically only twice per year using a backwash of dilute sodium hypochlorite solution into each membrane unit.

The process is designed to run without supervision and by using high quality materials, including stainless steel, the membrane panels and cases have long life expectancies in the most part beyond 10 years.

6.3 TERTIARY TREATMENT

6.3.1 Self-Cleaning Mechanical Sand Filter

EPS offer a self-cleaning up-ward flow mechanical sand filter for flows varying from 2.5m^3/hr up to 45m^3/hr. The stainless steel filters are skid mounted, manufactured, assembled and tested at our workshop in Mallow prior to delivery.

The filter design operates a well known and utilised technology of moving sand with the effluent passing upwards through a downward moving sand bed. The dirty sand is in turn re-circulated through a cleaning mechanism prior to re-entry to the top of the sand bed for further filtration.

Wash water is returned to the treatment plant for solid settlement and treatment at a maximum rate of 5% of the filters overall hydraulic design.

6.3.2 In-Situ Sand Filter

An In-Situ sand filter consists of varying stratified layers of sand and gravel. The treated effluent is distributed evenly over the entire filter area by a gravity distribution system or a pumped distribution system. It then passes down through the various layers of sand and gravel where it is further polished and filtered prior to entering the ground water or surface water.

6.3.3 Reed Bed System

A typically designed reed bed system for tertiary treatment can further improve the quality of an effluent prior to discharge or disposal. A reed bed system will lead to enhanced removal of BOD, COD and suspended solids, as well as ammonia, nitrates and phosphorous, if specifically designed for same.

A reed bed system can operate as a horizontal flow or vertical flow system.

The system comprises of an inlet and outlet and layer of gravel. The surface is planted with reeds known as *Phragmites Australis*, which ensures oxygen transfer down into the gravel bed through the rhizomes.

6.3.4 Disinfection: Ultra Violet (UV)

UV disinfection of a treated effluent prior to disposal is a necessary requirement for many sites. UV light is effective for disinfection as it ruptures the genetic structure of harmful bacteria leading to instantaneous destruction.

EPS offer two ranges of disinfection systems for varying flows and applications. EPS offer the EEFG range for flows of $1m^3$/hr to $40m^3$/hr and the LBX range for flows from 3 to $1000m^3$/hr. Both systems incorporate a reliable self-cleaning mechanism to prevent fouling of lamps during use.

6.4 NUTRIENT REMOVAL

6.4.1 Nitrification

Nitrification is the conversion of ammonium in wastewater to nitrate under aerobic conditions. Within the aeration tank the ammonium is converted firstly to nitrite and then nitrate through the action of autotrophic nitrifying bacteria. These nitrifying bacteria are recycled through the process to maintain high levels of nitrification. Because nitrifying bacteria are slower to reproduce than other heterotrophic bacteria long aeration periods are required to achieve sufficient growth.

6.4.2 Denitrification

Denitrification is the conversion of nitrate to nitrogen gas using suitable heterotrophic bacteria under anoxic conditions. In the absence of a readily available oxygen source the bacteria can use the oxygen available in the NO_3 for cell synthesis thus reducing the NO_3 to N_2. To help with the denitrification process sludge is returned from the end of the aeration system and also from the final settlement tank. This sludge, which is both high in nitrate and biomass, is essential for achieving good denitrification levels.

6.4.3 Phosphate Reduction

To reduce the soluble orthophosphate levels in the treated effluent, ferric sulphate is dosed into the primary settlement tank or the aeration tank. The ferric precipitates out the soluble phosphate and thus reduces the phosphorous levels. Typical P values achieved with dosing would be <2mg/L Total P.

6.5 ADDITIONAL OPTIONS

6.5.1 Screening

EPS offer a range of stainless steel screens for 3mm or 5mm requirements. All screens offered come with washing and compaction if required.

6.5.2 Grease Removal

The entrance of fats, oils and greases (Fogs) into any treatment plant is prohibited. It is imperative that any Fogs are removed by a suitable grease trap prior to entering the waste stream to any plant. Depending on the application and the potential loads of Fogs a number of grease traps are available for selection.

The use of enzyme type grease emulsifiers is not acceptable for the removal of Fogs from waste streams entering a treatment plant.

EPS encourage the use of undersink type systems and three chamber type interceptors that are sufficiently sized, suitably located and regularly maintained and emptied. The entrance of grease to a treatment plant will lead to inefficient operation and mal odours and it is for this reason that effective grease systems are installed.

6.5.3 Flow Splitting Chamber

For applications where duplex systems are proposed, EPS also offer factory assembled flow splitting chambers.

6.5.4 Recirculation Chamber

In applications where denitrification is required, recirculation chambers are available for splitting the final effluent stream and the diversion of a portion of same back to the front end of the treatment plant to an anoxic tank. This ensures that the nitrate is converted to nitrogen gas and water prior to subsequent discharge.

6.5.5 Inlet Pumping Station

Depending on varying site conditions and process selection an inlet pumping station may be required. EPS offer a range of pumping solutions to cater for same and offer a variety of pump type and make as well as sumps in steel or pre-cast concrete.

6.5.6 Outlet Pumping Station

Many applications require that the final treated effluent is pumped to a higher discharge point or onto a pressurised dispersion system (sand filter, etc). EPS offer a number of solutions for this requirement, with each site requiring a specific and individual design.

6.6 INSTRUMENTATION

For additional control and monitoring of treatment plants once installed, EPS offer a range of items that aid in meeting the operational and monitoring requirements of all discharge licences.

- Flow Metering (Inlet and Outlet)
- Remote Monitoring (gsm Dial Out Unit)
- Automatic Sampling
- Datalogging and trending of flows

6.7 OPERATION AND MAINTENANCE

EPS offer both Service Contracts and Full Operation and Maintenance Contracts for plants installed by us or by other companies.

Our operation and maintenance staff offer a service, which includes the following:

- Mechanical and Electrical Maintenance
- Process Operation
- Chemical Supply and Set-Up
- Desludging
- Preventative Maintenance
- Production of Operational Reports for Discharge Licence Requirements
- Trouble-shooting for Existing Plants
- Holiday Cover / Weekend Cover, etc.

6.8 DESIGN OF DISPOSAL SYSTEMS

EPS offer design recommendations for disposal systems for all sites as required. EPS require that a detailed site assessment be carried out. A subsequent site assessment report will then be utilised to design a suitable percolation area, soil polishing filter or sand polishing filter as required.

All recommendations will be in accordance with EPA guidelines and Risk Assessment in accordance with GSI/DOE guidelines.

EPS do not install disposal systems and cannot accept any liability for disposal systems once installed. Disposal systems should at all times be installed in accordance with EPA guidelines or BS6297 which ever is deemed appropriate.

APPENDIX D

Storm Sewer Calculations

STORM SEWER DESIGN by the Modified Rational Method

Global Variables

Pipe Size File C:\Program Files\Micro Drainage Ltd\WinDes\STANDARD.PIP
Manhole Size File C:\Program Files\Micro Drainage Ltd\WinDes\STANDARD.MHS

Location - Scotland & Ireland

Return Period (years)	1
M5-60 (mm)	17.900
Ratio R	0.250
Maximum Rainfall (mm/hr)	50
Foul Sewage (l/s/ha)	0.00
O'flow Setting (*Foul only)	0
Volumetric Runoff Coeff.	0.75
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.000
Min Cover Depth for Optimisation (m)	1.200
Min Vel for Auto Design Only (m/s)	0.76
Min Slope for Optimisation (1:X)	1000
Minimum Outfall Invert (m)	0.000
Ground Level at Outfall (m)	106.830
Outfall Manhole Name	Att. Pond
Outfall Manhole Dia/Length (mm)	0
Outfall Manhole Width (mm)	0

Designed with Level Soffits

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
1.000	31.68	0.310	102.2	0.064	4.00	0.0	0.600	o	225
1.001	42.74	0.147	290.8	0.082	0.00	162.9	0.600	o	600
2.000	19.27	0.100	192.7	0.183	4.00	0.0	0.600	o	450
1.002	23.05	0.050	461.0	0.030	0.00	0.0	0.600	o	600
3.000	35.87	0.150	239.1	0.128	4.00	0.0	0.600	o	300
3.001	58.63	0.248	236.4	0.397	0.00	0.0	0.600	o	300

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E.Area (ha)	E.DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
1.000	43.7	4.4	106.500	0.064	0.0	0.0	0.0	1.29	51.4	7.6
1.001	42.2	4.9	105.330	0.146	162.9	0.0	0.0	1.42	402.3	179.6
2.000	44.4	4.2	106.180	0.183	0.0	0.0	0.0	1.46	232.4	22.0
1.002	41.2	5.2	105.183	0.359	162.9	0.0	0.0	1.13	318.8	202.9
3.000	43.1	4.6	106.400	0.128	0.0	0.0	0.0	1.01	71.6	14.9
3.001	40.4	5.6	106.250	0.525	0.0	0.0	0.0	1.02	72.0	57.4

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
4.000	47.74	0.420	113.7	0.087	4.00	0.0	0.600	o	225
1.003	25.11	0.045	558.0	0.032	0.00	0.0	0.600	o	675
5.000	18.86	0.187	100.9	0.004	4.00	0.0	1.500	o	225
5.001	14.94	0.066	226.9	0.012	0.00	0.0	1.500	o	225
5.002	33.10	0.146	226.9	0.014	0.00	0.0	1.500	o	225
5.003	19.97	0.088	226.9	0.018	0.00	0.0	1.500	o	225
5.004	66.59	0.293	226.9	0.021	0.00	0.0	1.500	o	225
5.005	22.02	0.097	226.9	0.019	0.00	0.0	1.500	o	225
5.006	59.54	0.415	143.5	0.014	0.00	0.0	1.500	o	225
6.000	68.32	0.490	139.4	0.095	4.00	0.0	0.600	o	225
1.004	10.15	0.087	116.7	0.009	0.00	0.0	0.600	o	675
7.000	18.84	0.186	101.3	0.004	4.00	0.0	1.500	o	225
7.001	18.28	0.082	223.6	0.003	0.00	0.0	1.500	o	225
7.002	41.51	0.186	223.6	0.008	0.00	0.0	1.500	o	225
7.003	13.23	0.059	223.6	0.012	0.00	0.0	1.500	o	225
7.004	62.68	0.280	223.6	0.022	0.00	0.0	1.500	o	225
7.005	24.33	0.085	287.2	0.010	0.00	0.0	0.600	o	225
7.006	15.87	0.055	287.2	0.017	0.00	0.0	0.600	o	225
7.007	56.69	0.446	127.0	0.018	0.00	0.0	1.500	o	225

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E.Area (ha)	E.DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
4.000	42.9	4.6	106.455	0.087	0.0	0.0	0.0	1.23	48.7	10.1
1.003	39.4	5.9	105.058	1.003	162.9	0.0	0.0	1.10	394.5	270.0
5.000	44.2	4.3	106.755	0.004	0.0	0.0	0.0	1.14	45.4	0.5
5.001	43.1	4.6	106.568	0.016	0.0	0.0	0.0	0.76	30.2	1.9
5.002	41.0	5.3	106.502	0.030	0.0	0.0	0.0	0.76	30.2	3.3
5.003	39.8	5.8	106.356	0.048	0.0	0.0	0.0	0.76	30.2	5.2
5.004	36.5	7.2	106.268	0.069	0.0	0.0	0.0	0.76	30.2	6.8
5.005	35.6	7.7	105.975	0.088	0.0	0.0	0.0	0.76	30.2	8.5
5.006	33.8	8.7	105.878	0.102	0.0	0.0	0.0	0.96	38.1	9.3
6.000	41.8	5.0	106.251	0.095	0.0	0.0	0.0	1.11	43.9	10.8
1.004	33.7	8.8	105.013	1.209	162.9	0.0	0.0	2.43	868.0	273.1
7.000	44.2	4.3	106.755	0.004	0.0	0.0	0.0	1.14	45.3	0.5
7.001	42.9	4.7	106.569	0.007	0.0	0.0	0.0	0.77	30.5	0.8
7.002	40.3	5.6	106.487	0.015	0.0	0.0	0.0	0.77	30.5	1.6
7.003	39.6	5.9	106.302	0.027	0.0	0.0	0.0	0.77	30.5	2.9
7.004	36.5	7.2	106.243	0.049	0.0	0.0	0.0	0.77	30.5	4.8
7.005	35.5	7.8	105.962	0.063	0.0	0.0	0.0	0.77	30.5	6.1
7.006	34.9	8.1	105.878	0.080	0.0	0.0	0.0	0.77	30.5	7.6
7.007	33.3	9.0	105.822	0.098	0.0	0.0	0.0	1.02	40.5	8.8

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
1.005	7.31	0.009	847.7	0.000	0.00	0.0	0.600	o	675

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E.Area (ha)	E.DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
1.005	33.1	9.2	104.926	1.307	162.9	0.0	0.0	0.89	319.2	280.0

PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.000	o	225	S18	108.130	106.500	1.405	1050
1.001	o	600	S17	108.130	105.330	2.200	1500
2.000	o	450	RW Tank	108.130	106.180	1.500	1350
1.002	o	600	S20	108.130	105.183	2.347	1500
3.000	o	300	S21	108.130	106.400	1.430	1050
3.001	o	300	S22	108.130	106.250	1.580	1200
4.000	o	225	S23	108.130	106.455	1.450	1050
1.003	o	675	S24	108.130	105.058	2.397	1500
5.000	o	225	S25	108.180	106.755	1.200	1050
5.001	o	225	S26	108.130	106.568	1.337	1050
5.002	o	225	S27	108.080	106.502	1.353	1050
5.003	o	225	S28	107.930	106.356	1.349	1050
5.004	o	225	S29	107.830	106.268	1.337	1050
5.005	o	225	S30	107.530	105.975	1.330	1050
5.006	o	225	S31	107.380	105.878	1.277	1050
6.000	o	225	S32	108.130	106.251	1.654	1200

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.000	31.68	102.2	S17	108.130	106.190	1.715	1500
1.001	42.74	290.8	S20	108.130	105.183	2.347	1500
2.000	19.27	192.7	S20	108.130	106.080	1.600	1500
1.002	23.05	461.0	S24	108.130	105.133	2.397	1500
3.000	35.87	239.1	S22	108.130	106.250	1.580	1200
3.001	58.63	236.4	S24	108.130	106.002	1.828	1500
4.000	47.74	113.7	S24	108.130	106.035	1.870	1500
1.003	25.11	558.0	S33	107.190	105.013	1.502	1500
5.000	18.86	100.9	S26	108.130	106.568	1.337	1050
5.001	14.94	226.9	S27	108.080	106.502	1.353	1050
5.002	33.10	226.9	S28	107.930	106.356	1.349	1050
5.003	19.97	226.9	S29	107.830	106.268	1.337	1050
5.004	66.59	226.9	S30	107.530	105.975	1.330	1050
5.005	22.02	226.9	S31	107.380	105.878	1.277	1050
5.006	59.54	143.5	S33	107.190	105.463	1.502	1500
6.000	68.32	139.4	S33	107.190	105.761	1.204	1500

PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.004	o	675	S33	107.190	105.013	1.502	1500
7.000	o	225	S34	108.180	106.755	1.200	1050
7.001	o	225	S35	108.130	106.569	1.336	1050
7.002	o	225	S36	108.080	106.487	1.368	1050
7.003	o	225	S37	107.830	106.302	1.303	1050
7.004	o	225	S38	107.830	106.243	1.362	1050
7.005	o	225	S39	107.530	105.962	1.343	1050
7.006	o	225	S40	107.380	105.878	1.277	1050
7.007	o	225	S41	107.380	105.822	1.333	1050
1.005	o	675	S42	107.090	104.926	1.489	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.004	10.15	116.7	S42	107.090	104.926	1.489	1500
7.000	18.84	101.3	S35	108.130	106.569	1.336	1050
7.001	18.28	223.6	S36	108.080	106.487	1.368	1050
7.002	41.51	223.6	S37	107.830	106.302	1.303	1050
7.003	13.23	223.6	S38	107.830	106.243	1.362	1050
7.004	62.68	223.6	S39	107.530	105.962	1.343	1050
7.005	24.33	287.2	S40	107.380	105.878	1.277	1050
7.006	15.87	287.2	S41	107.380	105.822	1.333	1050
7.007	56.69	127.0	S42	107.090	105.376	1.489	1500
1.005	7.31	847.7	Att. Pond	106.830	104.917	1.238	0

MANHOLE SCHEDULES

M/Hole Number	Cover Level (m)	M/Hole Depth (m)	M/Hole Diam.,L*W (mm)	Pipes Out PN	Pipes Out IL.(m)	Pipes Out D (mm)	Pipes In PN	Pipes In IL.(m)	Pipes In D (mm)
S18	108.130	1.630	1050	1.000	106.500	225			
S17	108.130	2.800	1500	1.001	105.330	600	1.000	106.190	225
RW Tank	108.130	1.950	1350	2.000	106.180	450			
S20	108.130	2.947	1500	1.002	105.183	600	1.001	105.183	600
							2.000	106.080	450
S21	108.130	1.730	1050	3.000	106.400	300			
S22	108.130	1.880	1200	3.001	106.250	300	3.000	106.250	300
S23	108.130	1.675	1050	4.000	106.455	225			
S24	108.130	3.072	1500	1.003	105.058	675	1.002	105.133	600
							3.001	106.002	300
							4.000	106.035	225
S25	108.180	1.425	1050	5.000	106.755	225			
S26	108.130	1.562	1050	5.001	106.568	225	5.000	106.568	225
S27	108.080	1.578	1050	5.002	106.502	225	5.001	106.502	225
S28	107.930	1.574	1050	5.003	106.356	225	5.002	106.356	225
S29	107.830	1.562	1050	5.004	106.268	225	5.003	106.268	225
S30	107.530	1.555	1050	5.005	105.975	225	5.004	105.975	225
S31	107.380	1.502	1050	5.006	105.878	225	5.005	105.878	225
S32	108.130	1.879	1200	6.000	106.251	225			
S33	107.190	2.177	1500	1.004	105.013	675	1.003	105.013	675
							5.006	105.463	225
							6.000	105.761	225
S34	108.180	1.425	1050	7.000	106.755	225			
S35	108.130	1.561	1050	7.001	106.569	225	7.000	106.569	225
S36	108.080	1.593	1050	7.002	106.487	225	7.001	106.487	225
S37	107.830	1.528	1050	7.003	106.302	225	7.002	106.302	225
S38	107.830	1.587	1050	7.004	106.243	225	7.003	106.243	225
S39	107.530	1.568	1050	7.005	105.962	225	7.004	105.962	225
S40	107.380	1.502	1050	7.006	105.878	225	7.005	105.878	225
S41	107.380	1.558	1050	7.007	105.822	225	7.006	105.822	225
S42	107.090	2.164	1500	1.005	104.926	675	1.004	104.926	675
							7.007	105.376	225

MANHOLE SCHEDULES

M/Hole Number	Cover Level (m)	M/Hole Depth (m)	M/Hole Diam.,L*W (mm)	Pipes Out PN	Pipes Out IL.(m)	Pipes Out D (mm)	Pipes In PN	Pipes In IL.(m)	Pipes In D (mm)
Att. Pond	106.830	1.913	0	OUTFALL			1.005	104.917	675

STORM SEWER DESIGN by the Modified Rational Method

Global Variables

Pipe Size File C:\Program Files\Micro Drainage Ltd\WinDes\STANDARD.PIP
Manhole Size File C:\Program Files\Micro Drainage Ltd\WinDes\STANDARD.MHS

Location - Scotland & Ireland

Return Period (years)	1
M5-60 (mm)	17.900
Ratio R	0.250
Maximum Rainfall (mm/hr)	50
Foul Sewage (l/s/ha)	0.00
O'flow Setting (*Foul only)	0
Volumetric Runoff Coeff.	0.75
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.000
Min Cover Depth for Optimisation (m)	1.200
Min Vel for Auto Design Only (m/s)	0.76
Min Slope for Optimisation (1:X)	1000
Minimum Outfall Invert (m)	0.000
Ground Level at Outfall (m)	108.130
Outfall Manhole Name	S18
Outfall Manhole Dia/Length (mm)	0
Outfall Manhole Width (mm)	0

Designed with Level Soffits

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
1.000	50.01	0.172	290.8	0.060	4.00	0.0	0.600	o	225
1.001	23.43	0.081	289.3	0.238	0.00	0.0	0.600	o	300
2.000	54.46	0.900	60.5	0.307	4.00	0.0	0.600	o	225
3.000	18.30	0.453	40.4	0.051	4.00	0.0	0.600	o	225
1.002	23.32	0.042	555.4	0.021	0.00	0.0	0.600	o	375

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E.Area (ha)	E.DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
1.000	41.6	5.1	106.505	0.060	0.0	0.0	0.0	0.76	30.3	6.8
1.001	40.5	5.5	106.258	0.298	0.0	0.0	0.0	0.92	65.0	32.6
2.000	43.3	4.5	107.800	0.307	0.0	0.0	0.0	1.68	67.0	36.0
3.000	44.6	4.1	106.705	0.051	0.0	0.0	0.0	2.06	82.1	6.1
1.002	39.2	6.0	106.102	0.677	0.0	0.0	0.0	0.76	84.1	71.8

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
4.000	53.41	0.295	181.0	0.051	4.00	0.0	0.600	o	225
1.003	31.51	0.107	294.5	0.077	0.00	0.0	0.600	o	450
1.004	34.90	0.133	262.4	0.066	0.00	0.0	0.600	o	450
5.000	22.56	0.660	34.2	0.487	4.00	0.0	0.600	o	225
6.000	16.95	0.735	23.1	0.050	4.00	0.0	0.600	o	225
1.005	29.99	0.043	692.6	0.039	0.00	0.0	0.600	o	525
7.000	17.59	0.778	22.6	0.046	4.00	0.0	0.600	o	225
1.006	27.07	0.032	848.9	0.223	0.00	0.0	0.600	o	600
8.000	25.32	0.810	31.3	0.050	4.00	0.0	0.600	o	225
1.007	90.00	0.106	849.1	0.114	0.00	0.0	0.600	o	600
1.008	90.00	0.106	849.1	0.141	0.00	0.0	0.600	o	600

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E.Area (ha)	E.DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
4.000	42.1	4.9	106.505	0.051	0.0	0.0	0.0	0.97	38.5	5.8
1.003	38.1	6.5	105.985	0.805	0.0	0.0	0.0	1.18	187.6	83.1
1.004	37.1	6.9	105.878	0.871	0.0	0.0	0.0	1.25	198.8	87.5
5.000	44.5	4.2	106.630	0.487	0.0	0.0	0.0	2.25	89.3	58.7
6.000	44.8	4.1	106.705	0.050	0.0	0.0	0.0	2.74	108.8	6.1
1.005	35.9	7.5	105.670	1.447	0.0	0.0	0.0	0.84	182.6	140.7
7.000	44.7	4.1	106.705	0.046	0.0	0.0	0.0	2.76	109.9	5.5
1.006	34.9	8.1	105.552	1.715	0.0	0.0	0.0	0.83	234.0	162.1
8.000	44.5	4.2	106.705	0.050	0.0	0.0	0.0	2.35	93.4	6.0
1.007	32.0	9.9	105.520	1.879	0.0	0.0	0.0	0.83	234.0	162.9
1.008	29.7	11.7	105.414	2.020	0.0	0.0	0.0	0.83	234.0	162.9

PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.000	o	225	S1	107.930	106.505	1.200	1050
1.001	o	300	S2	108.130	106.258	1.572	1200
2.000	o	225	S3	109.830	107.800	1.805	1200
3.000	o	225	S4	108.130	106.705	1.200	1050
1.002	o	375	S5	108.830	106.102	2.353	1350
4.000	o	225	S6	108.230	106.505	1.500	1200
1.003	o	450	S7	108.330	105.985	1.895	1350
1.004	o	450	S8	108.130	105.878	1.802	1350
5.000	o	225	S9	108.130	106.630	1.275	1050
6.000	o	225	S10	108.130	106.705	1.200	1050
1.005	o	525	S11	108.130	105.670	1.935	1500
7.000	o	225	S12	108.130	106.705	1.200	1050
1.006	o	600	S13	108.130	105.552	1.978	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.000	50.01	290.8	S2	108.130	106.333	1.572	1200
1.001	23.43	289.3	S5	108.830	106.177	2.353	1350
2.000	54.46	60.5	S5	108.830	106.900	1.705	1350
3.000	18.30	40.4	S5	108.830	106.252	2.353	1350
1.002	23.32	555.4	S7	108.330	106.060	1.895	1350
4.000	53.41	181.0	S7	108.330	106.210	1.895	1350
1.003	31.51	294.5	S8	108.130	105.878	1.802	1350
1.004	34.90	262.4	S11	108.130	105.745	1.935	1500
5.000	22.56	34.2	S11	108.130	105.970	1.935	1500
6.000	16.95	23.1	S11	108.130	105.970	1.935	1500
1.005	29.99	692.6	S13	108.130	105.627	1.978	1500
7.000	17.59	22.6	S13	108.130	105.927	1.978	1500
1.006	27.07	848.9	S15	108.130	105.520	2.010	1500

PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
8.000	o	225	S14	108.130	106.705	1.200	1050
1.007	o	600	S15	108.130	105.520	2.010	1500
1.008	o	600	S16	108.130	105.414	2.116	1500

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
8.000	25.32	31.3	S15	108.130	105.895	2.010	1500
1.007	90.00	849.1	S16	108.130	105.414	2.116	1500
1.008	90.00	849.1	S18	108.130	105.308	2.222	0

MANHOLE SCHEDULES

M/Hole Number	Cover Level (m)	M/Hole Depth (m)	M/Hole Diam.,L*W (mm)	Pipes Out PN	Pipes Out IL.(m)	Pipes Out D (mm)	Pipes In PN	Pipes In IL.(m)	Pipes In D (mm)
S1	107.930	1.425	1050	1.000	106.505	225			
S2	108.130	1.872	1200	1.001	106.258	300	1.000	106.333	225
S3	109.830	2.030	1200	2.000	107.800	225			
S4	108.130	1.425	1050	3.000	106.705	225			
S5	108.830	2.728	1350	1.002	106.102	375	1.001	106.177	300
							2.000	106.900	225
							3.000	106.252	225
S6	108.230	1.725	1200	4.000	106.505	225			
S7	108.330	2.345	1350	1.003	105.985	450	1.002	106.060	375
							4.000	106.210	225
S8	108.130	2.252	1350	1.004	105.878	450	1.003	105.878	450
S9	108.130	1.500	1050	5.000	106.630	225			
S10	108.130	1.425	1050	6.000	106.705	225			
S11	108.130	2.460	1500	1.005	105.670	525	1.004	105.745	450
							5.000	105.970	225
							6.000	105.970	225
S12	108.130	1.425	1050	7.000	106.705	225			
S13	108.130	2.578	1500	1.006	105.552	600	1.005	105.627	525
							7.000	105.927	225
S14	108.130	1.425	1050	8.000	106.705	225			
S15	108.130	2.610	1500	1.007	105.520	600	1.006	105.520	600
							8.000	105.895	225
S16	108.130	2.716	1500	1.008	105.414	600	1.007	105.414	600
S18	108.130	2.822	0		OUTFALL		1.008	105.308	600

STORM SEWER DESIGN by the Modified Rational Method

Global Variables

Pipe Size File C:\Program Files\Micro Drainage Ltd\WinDes\STANDARD.PIP
Manhole Size File C:\Program Files\Micro Drainage Ltd\WinDes\STANDARD.MHS

Location - Scotland & Ireland

Return Period (years)	1
M5-60 (mm)	16.800
Ratio R	0.250
Maximum Rainfall (mm/hr)	50
Foul Sewage (l/s/ha)	0.00
O'flow Setting (*Foul only)	0
Volumetric Runoff Coeff.	0.75
Add Flow / Climate Change (%)	0
Minimum Backdrop Height (m)	0.200
Maximum Backdrop Height (m)	1.000
Min Cover Depth for Optimisation (m)	1.200
Min Vel for Auto Design Only (m/s)	0.76
Min Slope for Optimisation (1:X)	1000
Minimum Outfall Invert (m)	0.000
Ground Level at Outfall (m)	100.700
Outfall Manhole Name	
Outfall Manhole Dia/Length (mm)	0
Outfall Manhole Width (mm)	0

Designed with Level Soffits

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
1.000	14.53	0.191	76.1	0.010	4.00	0.0	1.500	o	225
1.001	14.12	0.062	226.9	0.005	0.00	0.0	1.500	o	225
1.002	23.63	0.437	54.1	0.008	0.00	0.0	1.500	o	225
1.003	44.72	1.585	28.2	0.015	0.00	0.0	1.500	o	225
1.004	49.18	1.855	26.5	0.024	0.00	0.0	1.500	o	225
1.005	60.08	2.100	28.6	0.030	0.00	0.0	1.500	o	225
1.006	33.35	0.343	97.3	0.016	0.00	0.0	1.500	o	225
2.000	32.53	0.428	76.1	0.020	4.00	0.0	1.500	o	225

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E.Area (ha)	E.DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
1.000	41.7	4.2	106.055	0.010	0.0	0.0	0.0	1.32	52.4	1.1
1.001	40.8	4.5	105.864	0.015	0.0	0.0	0.0	0.76	30.2	1.7
1.002	40.0	4.7	105.802	0.023	0.0	0.0	0.0	1.56	62.1	2.5
1.003	39.0	5.1	105.365	0.038	0.0	0.0	0.0	2.17	86.1	4.0
1.004	38.1	5.5	103.780	0.062	0.0	0.0	0.0	2.23	88.8	6.4
1.005	37.0	5.9	101.925	0.092	0.0	0.0	0.0	2.15	85.5	9.2
1.006	35.9	6.4	99.825	0.108	0.0	0.0	0.0	1.16	46.3	10.5
2.000	41.0	4.4	106.055	0.020	0.0	0.0	0.0	1.32	52.4	2.2

Network Design Table

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	T.E. (mins)	DWF (l/s)	k (mm)	HYD SECT	DIA (mm)
2.001	15.89	0.070	226.3	0.006	0.00	0.0	1.500	o	225
2.002	67.08	1.777	37.8	0.022	0.00	0.0	1.500	o	225
2.003	50.28	1.855	27.1	0.023	0.00	0.0	1.500	o	225
2.004	53.58	1.855	28.9	0.023	0.00	0.0	1.500	o	225
2.005	37.88	0.565	67.1	0.014	0.00	0.0	1.500	o	225
2.006	6.67	0.023	291.4	0.012	0.00	0.0	0.600	o	225
1.007	8.51	0.207	41.1	0.000	0.00	0.0	1.500	o	225

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	E.Area (ha)	E.DWF (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	CAP (l/s)	Flow (l/s)
2.001	40.0	4.8	105.627	0.026	0.0	0.0	0.0	0.76	30.3	2.8
2.002	38.3	5.4	105.557	0.048	0.0	0.0	0.0	1.87	74.4	5.0
2.003	37.4	5.7	103.780	0.071	0.0	0.0	0.0	2.21	87.9	7.2
2.004	36.4	6.2	101.925	0.094	0.0	0.0	0.0	2.14	85.1	9.3
2.005	35.5	6.6	100.070	0.108	0.0	0.0	0.0	1.40	55.8	10.4
2.006	35.2	6.7	99.505	0.120	0.0	0.0	0.0	0.76	30.3	11.4
1.007	35.0	6.8	99.482	0.228	0.0	0.0	0.0	1.79	71.3	21.6

PIPELINE SCHEDULES

Upstream Manhole

PN	Hyd Sect	Diam (mm)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.000	o	225	S1	107.480	106.055	1.200	1050
1.001	o	225	S2	107.480	105.864	1.391	1050
1.002	o	225	S3	107.400	105.802	1.373	1050
1.003	o	225	S4	106.790	105.365	1.200	1050
1.004	o	225	S5	105.205	103.780	1.200	1050
1.005	o	225	S6	103.350	101.925	1.200	1050
1.006	o	225	S7	101.250	99.825	1.200	1050
2.000	o	225	S8	107.480	106.055	1.200	1050
2.001	o	225	S9	107.480	105.627	1.628	1200
2.002	o	225	S10	107.400	105.557	1.618	1200
2.003	o	225	S11	105.205	103.780	1.200	1050
2.004	o	225	S12	103.350	101.925	1.200	1050
2.005	o	225	S13	101.495	100.070	1.200	1050
2.006	o	225	S14	100.930	99.505	1.200	1050
1.007	o	225	S15	100.920	99.482	1.213	1050

Downstream Manhole

PN	Length (m)	Slope (1:X)	MH No.	C.Level (m)	I.Level (m)	C.Depth (m)	MH DIAM., L*W (mm)
1.000	14.53	76.1	S2	107.480	105.864	1.391	1050
1.001	14.12	226.9	S3	107.400	105.802	1.373	1050
1.002	23.63	54.1	S4	106.790	105.365	1.200	1050
1.003	44.72	28.2	S5	105.205	103.780	1.200	1050
1.004	49.18	26.5	S6	103.350	101.925	1.200	1050
1.005	60.08	28.6	S7	101.250	99.825	1.200	1050
1.006	33.35	97.3	S15	100.920	99.482	1.213	1050
2.000	32.53	76.1	S9	107.480	105.627	1.628	1200
2.001	15.89	226.3	S10	107.400	105.557	1.618	1200
2.002	67.08	37.8	S11	105.205	103.780	1.200	1050
2.003	50.28	27.1	S12	103.350	101.925	1.200	1050
2.004	53.58	28.9	S13	101.495	100.070	1.200	1050
2.005	37.88	67.1	S14	100.930	99.505	1.200	1050
2.006	6.67	291.4	S15	100.920	99.482	1.213	1050
1.007	8.51	41.1		100.700	99.275	1.200	0

MANHOLE SCHEDULES

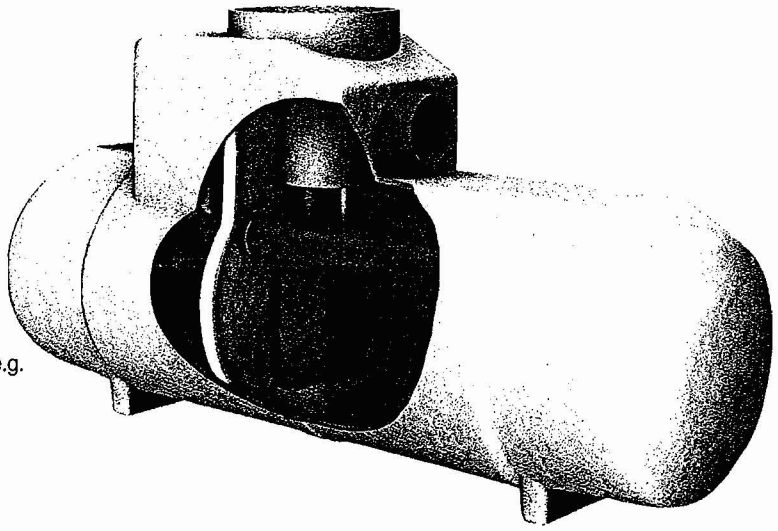
M/Hole Number	Cover Level (m)	M/Hole Depth (m)	M/Hole Diam.,L*W (mm)	Pipes Out PN	Pipes Out IL.(m)	Pipes Out D (mm)	Pipes In PN	Pipes In IL.(m)	Pipes In D (mm)
S1	107.480	1.425	1050	1.000	106.055	225			
S2	107.480	1.616	1050	1.001	105.864	225	1.000	105.864	225
S3	107.400	1.598	1050	1.002	105.802	225	1.001	105.802	225
S4	106.790	1.425	1050	1.003	105.365	225	1.002	105.365	225
S5	105.205	1.425	1050	1.004	103.780	225	1.003	103.780	225
S6	103.350	1.425	1050	1.005	101.925	225	1.004	101.925	225
S7	101.250	1.425	1050	1.006	99.825	225	1.005	99.825	225
S8	107.480	1.425	1050	2.000	106.055	225			
S9	107.480	1.853	1200	2.001	105.627	225	2.000	105.627	225
S10	107.400	1.843	1200	2.002	105.557	225	2.001	105.557	225
S11	105.205	1.425	1050	2.003	103.780	225	2.002	103.780	225
S12	103.350	1.425	1050	2.004	101.925	225	2.003	101.925	225
S13	101.495	1.425	1050	2.005	100.070	225	2.004	100.070	225
S14	100.930	1.425	1050	2.006	99.505	225	2.005	99.505	225
S15	100.920	1.438	1050	1.007	99.482	225	1.006 2.006	99.482 99.482	225 225
	100.700	1.425	0		OUTFALL		1.007	99.275	225

APPENDIX E

Bypass Separator Specification Sheet

Bypass Separator

NSBD Range



Application

Bypass separators are used when it is considered an acceptable risk not to provide full treatment, for very high flows, and are used, for example, where the risk of a large spillage and heavy rainfall occuring at the same time is small, e.g.

- Surface car parks
- Roadways
- Lightly contaminated commercial areas

Performance

Klargester are the first UK manufacturer to have separators tested to EN 858-1. Klargester have now added the NSBD bypass range to their portfolio of certified and tested models. The NSBD number denotes the maximum flow at which the separator treats liquids. The British Standards Institute (BSI) tested the required range of Klargester full retention separators and certified their performance in relation to their flow and process performance assessing the effluent qualities to the requirements of BS EN 858-1. Klargester bypass separator designs follow the parameters determined during the testing of the required range of bypass separators.

Each bypass separator design includes the necessary volume requirements for:

- Oil separation capacity
- Oil storage volume
- Silt storage capacity
- Coalescer

The unit is designed to treat 10% of peak flow. The calculated drainage areas served by each separator are indicated according to the formula given by PPG3 NSBD = 0.0018A(m^2). Flows generated by higher rainfall rates will pass through part of the separator and bypass the main separation chamber.

Class I separators are designed to achieve a concentration of 5mg/litre of oil under standard test conditions.

Class II separators are designed to achieve a concentration of 100mg/litre of oil under standard test conditions.

Features

- Light and easy to install
- Class I and Class II designs
- Inclusive of silt storage volume
- Fitted inlet/outlet connectors
- Vent points within necks
- Oil alarm system available (required by BS EN 858-1 and PPG3)
- Extension access shafts for deep inverts
- Maintenance from ground level

To specify a nominal size Bypass Separator, the following information is needed:-

- The calculated flow rate for the drainage area served. Our designs are based on the assumption that any interconnecting pipework fitted elsewhere on site does not impede flow into or out of the separator and that the flow is not pumped
- The required discharge standard. This will decide whether a Class I or Class II unit is required
- The drain invert inlet depth
- Pipework type, size and orientation

Sizes & Specifications:

Nominal Size	Flow (l/s)	Peak Flow Rate (l/s)	Drainage Area (m^2) PPG3 (0.0018)	Silt Storage Capacity Litres	Oil Storage Capacity Litres	Length	Dia.	Access Shaft Diameter	Base to Inlet	Base to Outlet Invert	Standard Fall Across Unit	Min. Inlet Invert	Standard Pipework Diameter
NSBD3	3	30	1670	300	45	1765	1225	750	1450	1350	100	500	160
NSBD4	4.5	45	2500	450	68	1765	1225	750	1450	1350	100	500	200
NSBD6	6	60	3335	600	90	1765	1225	750	1450	1350	100	500	200
NSBD8	8	80	4445	800	120	3065	1225	750	1450	1350	100	500	250
NSBD10	10	100	5560	1000	150	3065	1225	750	1450	1350	100	500	315
NSBD12	12	120	6670	1200	180	3915	1225	750	1450	1350	100	500	315
NSBD15	15	150	8335	1500	225	3915	1225	750	1450	1350	100	500	315
NSBD18	18	180	10000	1800	270	3200	2012	600	2110	2010	100	1000	375
NSBD24	24	240	13340	2400	360	3200	2012	600	2110	2010	100	1000	375
NSBD30	30	300	16670	3000	450	3915	2012	600	2110	2010	100	1000	450
NSBD36	36	360	20000	3600	540	3915	2012	600	2110	2010	100	1000	525
NSBD55	55	550	30560	5500	825	5085	2820	600	2310	2060	250	1000	600
NSBD72	72	720	40000	7200	1080	5820	2820	600	2310	2060	250	1000	675
NSBD84	84	840	46670	8400	1260	6200	2820	600	2310	2010	300	1000	750
NSBD96	96	960	53340	9600	1440	7375	2820	600	2310	2010	300	1000	825
NSBD110	110	1100	61110	11000	1650	7925	2820	600	2360	2010	350	1000	825
NSBD130	130	1300	72225	13000	1950	8725	2820	600	2360	2010	350	1000	825

APPENDIX F

Flow Control Unit

Hydro-Valve
Vortex Flow Control

- Customised Specification
- No Moving Parts
- Self Activating
- Self Cleansing
- Manual By-Pass
- Easy Installation
- 3-6 Times Greater Orifice CSA
- Hydraulic Data Available

Storm Water Flow Control

The Hydro-Valve is a vortex flow control device for controlling stormwater flow to a specific rate before discharge into a local storm drain or water course. Sizes are available between 1 –200 l/s depending on head height.

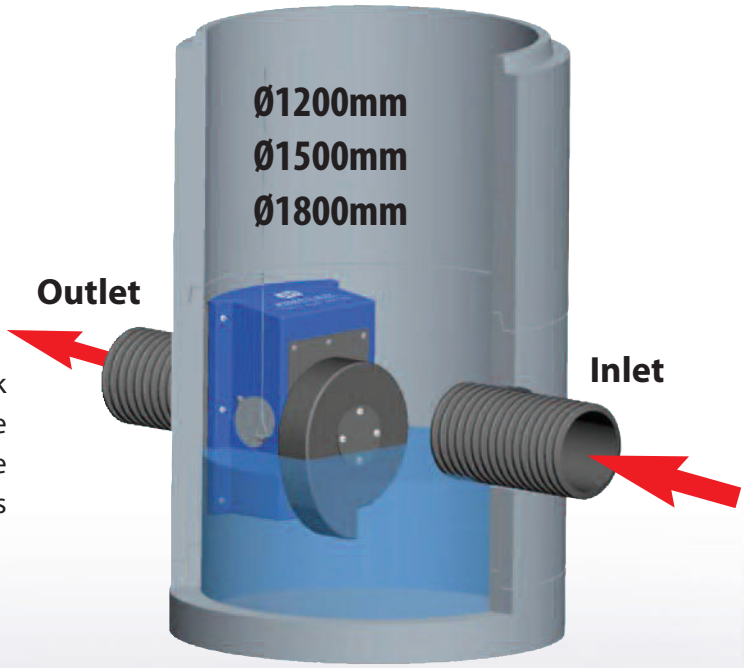
Design

JFC Hydro-Valves are manufactured to customer specifications. They are custom designed to achieve a specified design flow rate at a given head height. The units are designed to fit into one of the following manhole types depending on specification

- Ø1200mm
- Ø1500mm
- Ø1800mm
- Rectangular Manhole

Quality Assurance

JFC Hydro-Valves are manufactured to ISO 9001:2000 quality assurance system.



Installation

JFC Hydro-Valves unique patented design allows for quick and easy installation onto various types of manholes (see above). The unit is fixed to the inside wall of the manhole with a number of steel stud anchors. A manual by-pass is also incorporated in the valve for remote operation in the unlikely event of a blockage.

APPENDIX G

Attenuation Requirements

Extreme Rainfall Return Periods

Location: Tralee
Average Annual Rainfall: 1224

Maximum rainfall (mm) of indicated duration expected in the indicated return period.

	Return Period (years)								
Duration	1/2	1	2	5	10	20	50	100	30
1 min				1.6	1.8	2.1	2.5	2.9	2.3
2 min				2.7	3.1	3.6	4.4	5.0	3.9
5 min				4.8	5.5	6.5	8.0	9.1	7.1
10 min				6.9	8.0	9.4	11.8	13.5	10.4
15 min	4.5	5.6	6.2	8.3	10.1	12.0	15.1	18	13.3
30 min	6.3	7.7	8.6	11.4	13.7	16.2	20	23	17.9
60 min	8.6	10.4	11.6	15.3	18.2	22	27	31	24
2 hour	11.5	14.0	15.4	19.8	23	27	33	38	29
4 hour	16.7	19.9	21.6	27	32	36	43	49	39
6 hour	20.5	24.2	26	33	38	43	51	58	46
12 hour	27.5	32	35	44	50	57	66	75	61
24 hour	34	40	44	54	61	69	80	90	74
48 hour	43	51	55	67	75	85	98	110	90

Notes: Larger margins of error for 1, 2 ,5 and 10 minute values and for 100 year return periods
M560: 15.3 M52d: 63 M560/m52d: 0.24

Project Name: **Development at Scart Cross, Farranfore**
Project No.: **MGE0109 - Attenuation Pond**

INPUT PARAMETERS:

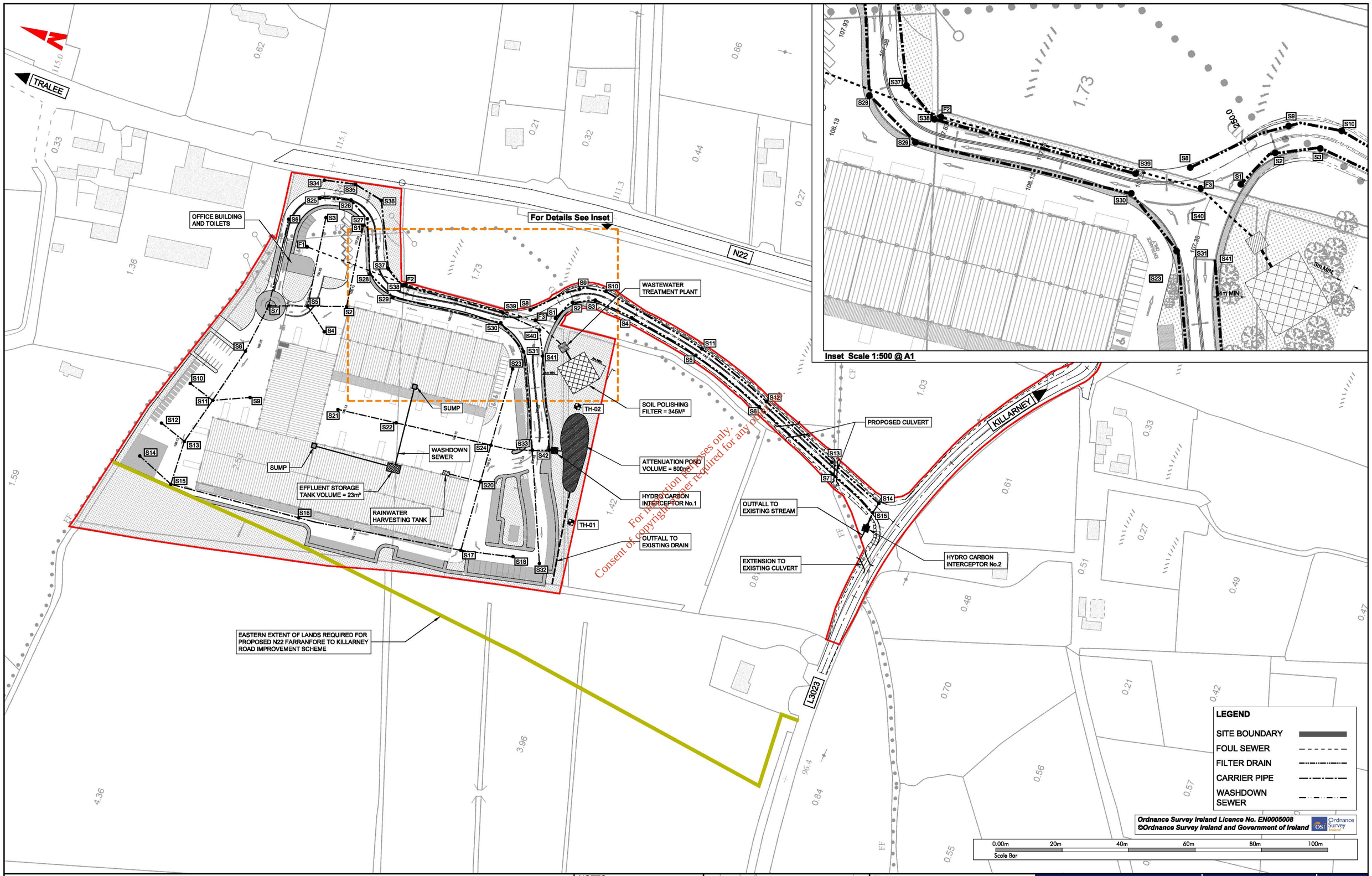
Total Impermeable Area :	3.86 ha		
Total Area :	4.86 ha		
Greenfield Runoff:	23.51 l/s/ha		
Greenfield runoff rate:	90.66 l/s		
Additional runoff (base flow):	0.00 l/s		
Volume Out (Greenfield+baseflow):	90.66 l/s	=	0.0907 cu.m/s

STORAGE VOLUME CALCULATION

Storm Duration		10 Year RP				20 Year RP				30 Year RP			
Min.	Second	Rainfall (mm)	V_{iN} (m^3)	V_{Out} (m^3)	Storage (m^3)	Rainfall (mm)	V_{iN} (m^3)	V_{Out} (m^3)	Storage (m^3)	Rainfall (mm)	V_{iN} (m^3)	V_{out} (m^3)	Storage (m^3)
1 min	60	1.8	69.05	5.44	63.61	2.1	80.43	5.44	74.99	2.3	87.78	5.44	82.34
2 min	120	3.1	118.38	10.88	107.50	3.6	138.38	10.88	127.50	3.9	151.34	10.88	140.46
5 min	300	5.5	213.01	27.20	185.81	6.5	250.20	27.20	223.06	7.1	274.48	27.20	247.28
10 min	600	8.0	306.96	54.40	252.57	9.4	363.77	54.40	309.37	10.4	400.95	54.40	346.55
15 min	900	10.1	388.09	81.59	306.50	12.0	463.23	81.59	381.64	13.3	512.69	81.59	431.10
30 min	1800	13.7	526.86	163.19	363.68	16.2	625.85	163.19	462.66	17.9	688.81	163.19	525.63
60 min	3600	18.2	701.39	326.37	375.02	21.5	829.77	326.37	503.40	23.6	910.06	326.37	583.68
2 hour	7200	23.3	896.69	652.75	243.94	27.0	1,040.84	652.75	388.09	29.4	1,133.21	652.75	480.47
4 hour	14400	31.6	1,218.58	1,305.49	-86.92	36.0	1,386.83	1,305.49	81.34	38.9	1,500.76	1,305.49	195.27
6 hour	21600	37.8	1,459.24	1,958.24	-499.00	43.1	1,662.48	1,958.24	-295.76	46.4	1,789.85	1,958.24	-168.40
12 hour	43200	49.6	1,913.92	3,916.48	-2002.56	56.5	2,180.67	3,916.48	-1735.81	60.6	2,336.26	3,916.48	-1580.22
24 hour	86400	60.8	2,346.47	7,832.96	-5486.49	68.8	2,654.26	7,832.96	-5178.71	73.6	2,837.37	7,832.96	-4995.59
48 hour	172800	75.4	2,908.40	15,665.92	-12757.52	84.7	3,265.83	15,665.92	-12400.09	90.3	3,483.20	15,665.92	-12182.72

APPENDIX H

Drawings



NOTES

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3. Levels are in metres to local datum.

No.	Date	Drn. Chk.	Amendment / Issue	App
P02	23.06.09	AB MCS	FUTHER INFORMATION REQUEST	PG
P01	29.07.08	A.N. J.O'C.	PLANNING ISSUE	P.G.

Client: **KERRY CENTRAL RECYCLING FACILITY LTD.**

Drawn By	Checked By	Approved By	Date
A.N.	J.O'C.	P.G.	July'08

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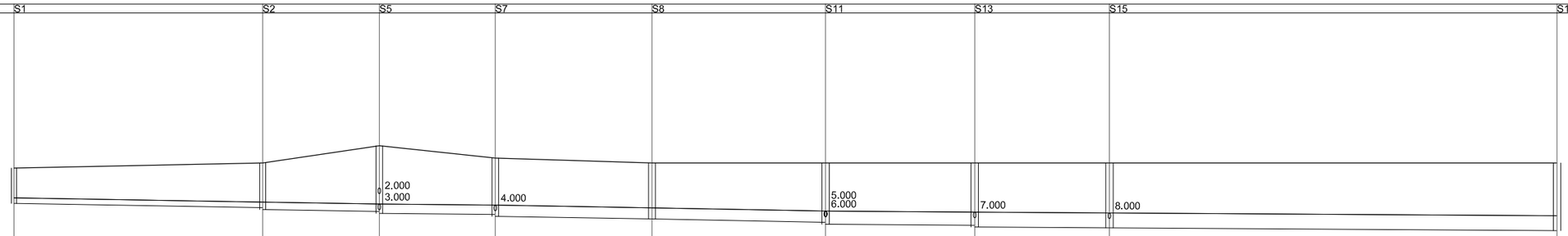
Drawing Number: DR0001/01
Rev: P02

Project: KERRY CENTRAL RECYCLING FACILITY LTD. PLANNING APPLICATION

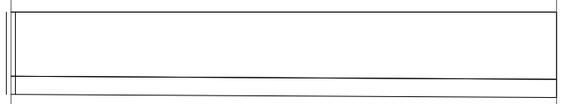
Title: PROPOSED WATER & FOUL SEWER LAYOUT (Sheet 1of 1)

Drawing Status	Scale / Sheet Size	
PLANNING	1:1000 @ A1	1:2000 @ A3

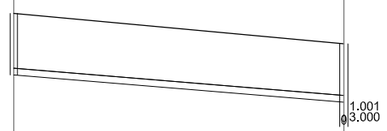
MGE0109DR0001.dwg

MH Name	S1	S2	S5	S7	S8	S11	S13	S15	S16
									
Hor Scale 500 Ver Scale 100 Datum (m) 100.000									
PN	1.000	1.001	1.002	1.003	1.004	1.005	1.006	1.007	
Dia (mm)	225	300	375	450	450	525	600	600	
Slope (1:X)	290.8	289.3	555.4	294.5	262.4	692.6	848.9	849.1	
Cover Level (m)	107.930	108.130	108.830	108.330	108.130	108.130	108.130	108.130	108.130
Invert Level (m)	106.505	106.333 106.258	106.177 106.102	106.060 105.985	105.878 105.878	105.745 105.670	105.627 105.552	105.520 105.520	105.414
Length (m)	50.01	23.43	23.32	31.51	34.90	29.99	27.07	90.00	

SECTIONAL ELEVATION STORM WATER SEWER
Manhole S1 to S16
(Scales Vert. 1:100, Horiz. 1:500 @ A1).
(Scales Vert. 1:200, Horiz. 1:1000 @ A3).

MH Name	S16	S17
		
Hor Scale 500 Ver Scale 100 Datum (m) 100.000		
PN	1.008	
Dia (mm)	600	
Slope (1:X)	849.1	
Cover Level (m)	108.130	108.130
Invert Level (m)	105.414	105.308
Length (m)	90.00	

SECTIONAL ELEVATION STORM WATER SEWER
Manhole S16 to S17 (Scales Vert. 1:100, Horiz. 1:500 @ A1).
(Scales Vert. 1:200, Horiz. 1:1000 @ A3).

MH Name	S3	S5
		
Hor Scale 500 Ver Scale 100 Datum (m) 100.000		
PN	2.000	
Dia (mm)	225	
Slope (1:X)	60.5	
Cover Level (m)	109.830	108.830
Invert Level (m)	107.800	106.900
Length (m)	54.46	

SECTIONAL ELEVATION STORM WATER SEWER
Manhole S3 to S5
(Scales Vert. 1:100, Horiz. 1:500 @ A1).
(Scales Vert. 1:200, Horiz. 1:1000 @ A3).

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3. Levels are in metres to local datum.

No.	Date	Dsn / Drn / Chk	Amendment / Issue	App
P01	29.07.08	L.H. / J.O'C.	Planning Issue	P.G.

Client: KERRY CENTRAL RECYCLING FACILITY LTD.

Drawn By	Checked By	Approved By	Date
L.H.	J.O'C.	P.G.	July'08

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Drawing Number: DR0002/01
Rev: P01

Project: KERRY CENTRAL RECYCLING FACILITY LTD. PLANNING APPLICATION

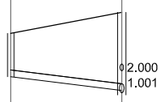
Title: STORM WATER SEWER LONG SECTIONS

(Sheet 1 of 5)

Drawing Status	Scale / Sheet Size	
PLANNING	As Shown @ A1	As Shown @ A3

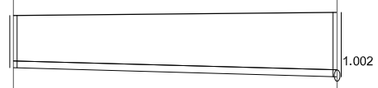
MGE0109DR0002.dwg

MH Name	S4	S5
Hor Scale 500		
Ver Scale 100		
Datum (m) 100.000		
PN	3.000	
Dia (mm)	225	
Slope (1:X)	40.4	
Cover Level (m)	108.130	108.830
Invert Level (m)	106.705	106.252
Length (m)	18.30	



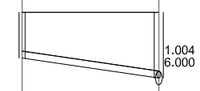
SECTIONAL ELEVATION STORM WATER SEWER
Manhole S4 to S5
(Scales Vert. 1:100, Horiz. 1:500 @ A1)
(Scales Vert. 1:200, Horiz. 1:1000 @ A3)

MH Name	S6	S7
Hor Scale 500		
Ver Scale 100		
Datum (m) 100.000		
PN	4.000	
Dia (mm)	225	
Slope (1:X)	181.0	
Cover Level (m)	108.230	108.330
Invert Level (m)	106.505	106.210
Length (m)	53.41	



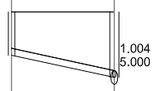
SECTIONAL ELEVATION STORM WATER SEWER
Manhole S6 to S7
(Scales Vert. 1:100, Horiz. 1:500 @ A1)
(Scales Vert. 1:200, Horiz. 1:1000 @ A3)

MH Name	S9	S11
Hor Scale 500		
Ver Scale 100		
Datum (m) 100.000		
PN	5.000	
Dia (mm)	225	
Slope (1:X)	34.2	
Cover Level (m)	108.130	108.130
Invert Level (m)	106.630	105.970
Length (m)	22.56	



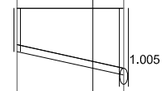
SECTIONAL ELEVATION STORM WATER SEWER
Manhole S9 to S11
(Scales Vert. 1:100, Horiz. 1:500 @ A1)
(Scales Vert. 1:200, Horiz. 1:1000 @ A3)

MH Name	S10	S11
Hor Scale 500		
Ver Scale 100		
Datum (m) 100.000		
PN	6.000	
Dia (mm)	225	
Slope (1:X)	23.1	
Cover Level (m)	108.130	108.130
Invert Level (m)	106.705	105.970
Length (m)	16.95	



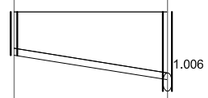
SECTIONAL ELEVATION STORM WATER SEWER
Manhole S10 to S11
(Scales Vert. 1:100, Horiz. 1:500 @ A1)
(Scales Vert. 1:200, Horiz. 1:1000 @ A3)

MH Name	S12	S13
Hor Scale 500		
Ver Scale 100		
Datum (m) 100.000		
PN	7.000	
Dia (mm)	225	
Slope (1:X)	22.6	
Cover Level (m)	108.130	108.130
Invert Level (m)	106.705	105.927
Length (m)	17.59	



SECTIONAL ELEVATION STORM WATER SEWER
Manhole S12 to S13
(Scales Vert. 1:100, Horiz. 1:500 @ A1)
(Scales Vert. 1:200, Horiz. 1:1000 @ A3)

MH Name	S14	S15
Hor Scale 500		
Ver Scale 100		
Datum (m) 100.000		
PN	8.000	
Dia (mm)	225	
Slope (1:X)	31.3	
Cover Level (m)	108.130	108.130
Invert Level (m)	106.705	105.895
Length (m)	25.32	



SECTIONAL ELEVATION STORM WATER SEWER
Manhole S14 to S15
(Scales Vert. 1:100, Horiz. 1:500 @ A1)
(Scales Vert. 1:200, Horiz. 1:1000 @ A3)

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Client: KERRY CENTRAL RECYCLING FACILITY LTD.

Drawn By	Checked By	Approved By	Date
L.H.	J.O'C.	P.G.	July'08

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Drawing Number: DR0002/02
Rev: P01

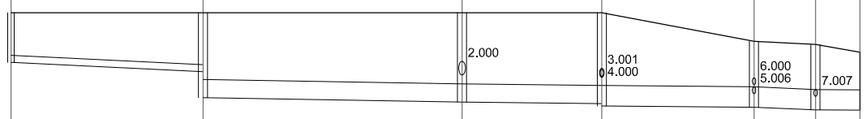
Project: KERRY CENTRAL RECYCLING FACILITY LTD. PLANNING APPLICATION

Title: STORM WATER SEWER LONG SECTIONS
(Sheet 2 of 5)

Drawing Status	Scale / Sheet Size	
PLANNING	As Shown @ A1	As Shown @ A3

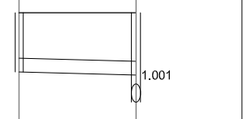
MGE0109DR0002.dwg

MH Name	S18	S17	S20	S24	S33	S42	Att. Pond
Hor Scale 500							
Ver Scale 100							
Datum (m) 100.000							
PN	1.000	1.001	1.002	1.003	1.004	1.005	
Dia (mm)	225	600	600	675	675	675	
Slope (1:X)	102.2	290.8	461.0	558.0	116.7	847.7	
Cover Level (m)	108.130	108.130	108.130	108.130	107.190	107.090	106.830
Invert Level (m)	106.500	106.190 105.330	105.183 105.183	105.133 105.058	105.013 105.013	104.926 104.926	104.917
Length (m)		31.68	42.74	23.05	25.11	10.15	7.31



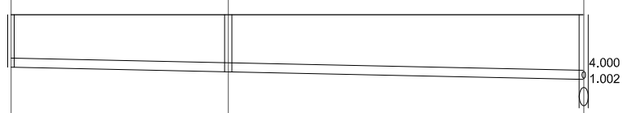
SECTIONAL ELEVATION STORM WATER SEWER
Manhole S18 to Attenuation Pond
(Scales Vert. 1:100, Horiz. 1:500 @ A1).
(Scales Vert. 1:200, Horiz. 1:1000 @ A3).

MH Name	RW Tank	S20
Hor Scale 500		
Ver Scale 100		
Datum (m) 100.000		
PN	2.000	
Dia (mm)	450	
Slope (1:X)	192.7	
Cover Level (m)	108.130	108.130
Invert Level (m)	106.180	106.080
Length (m)	19.27	



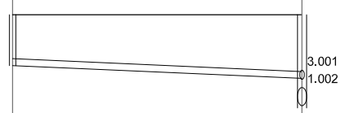
SECTIONAL ELEVATION STORM WATER SEWER
Manhole RAINWATER TANK to S20
(Scales Vert. 1:100, Horiz. 1:500 @ A1).
(Scales Vert. 1:200, Horiz. 1:1000 @ A3).

MH Name	S21	S22	S24
Hor Scale 500			
Ver Scale 100			
Datum (m) 100.000			
PN	3.000	3.001	
Dia (mm)	300	300	
Slope (1:X)	239.1	236.4	
Cover Level (m)	108.130	108.130	108.130
Invert Level (m)	106.400	106.250 106.250	106.002
Length (m)	35.87	58.63	



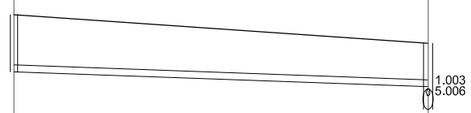
SECTIONAL ELEVATION STORM WATER SEWER
Manhole S21 to S24
(Scales Vert. 1:100, Horiz. 1:500 @ A1).
(Scales Vert. 1:200, Horiz. 1:1000 @ A3).

MH Name	S23	S24
Hor Scale 500		
Ver Scale 100		
Datum (m) 100.000		
PN	4.000	
Dia (mm)	225	
Slope (1:X)	113.7	
Cover Level (m)	108.130	108.130
Invert Level (m)	106.455	106.035
Length (m)	47.74	



SECTIONAL ELEVATION STORM WATER SEWER
Manhole S23 to S24
(Scales Vert. 1:100, Horiz. 1:500 @ A1).
(Scales Vert. 1:200, Horiz. 1:1000 @ A3).

MH Name	S32	S33
Hor Scale 500		
Ver Scale 100		
Datum (m) 81.000		
PN	6.000	
Dia (mm)	225	
Slope (1:X)	139.4	
Cover Level (m)	108.130	107.190
Invert Level (m)	106.251	105.761
Length (m)	68.32	



SECTIONAL ELEVATION STORM WATER SEWER
Manhole S25 to S33
(Scales Vert. 1:100, Horiz. 1:500 @ A1).
(Scales Vert. 1:200, Horiz. 1:1000 @ A3).

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Client: KERRY CENTRAL RECYCLING FACILITY LTD.

Drawn By	Checked By	Approved By	Date
L.H.	J.O'C.	P.G.	July'08

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Drawing Number: DR0002/03
Rev: P01

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Title: STORM WATER SEWER LONG SECTIONS

(Sheet 3 of 5)

Drawing Status	Scale / Sheet Size	
PLANNING	As Shown @ A1	As Shown @ A3

MGE0109DR0002.dwg

MH Name		S25		S26		S27		S28		S29		S30		S31		S33
																6.000 1.003
Hor Scale 500 Ver Scale 100 Datum (m) 100.000																
PN		5.000		5.001		5.002		5.003		5.004		5.005		5.006		
Dia (mm)		225		225		225		225		225		225		225		
Slope (1:X)		100.9		226.9		226.9		226.9		226.9		226.9		143.5		
Cover Level (m)		108.180		108.130		108.080		107.930		107.830		107.530		107.380		107.190
Invert Level (m)		106.755	106.568 106.568		106.502 106.502		106.356 106.356		106.268 106.268		105.975 105.975		105.878 105.878		105.463	
Length (m)			18.86		14.94	33.10		19.97		66.59			22.02		59.54	

SECTIONAL ELEVATION STORM WATER SEWER
Manhole S25 to S33
(Scales Vert. 1:100, Horiz. 1:500 @ A1)
(Scales Vert. 1:200, Horiz. 1:1000 @ A3)

MH Name		S34		S35		S36		S37		S38		S39		S40		S41		S42
																		1.004
Hor Scale 500 Ver Scale 100 Datum (m) 100.000																		
PN		7.000		7.001		7.002		7.003		7.004		7.005		7.006		7.007		
Dia (mm)		225		225		225		225		225		225		225		225		
Slope (1:X)		101.3		223.6		223.6		223.6		223.6		287.2		287.2		127.0		
Cover Level (m)		108.180		108.130		108.080		107.830		107.830		107.530		107.380		107.380		107.090
Invert Level (m)		106.755	106.569 106.569		106.487 106.487		106.302 106.302		106.243 106.243		105.962 105.962		105.878 105.878		105.822 105.822		105.376	
Length (m)			18.84		18.28	41.51		13.23		62.68			24.33		15.87	56.69		

SECTIONAL ELEVATION STORM WATER SEWER
Manhole S34 to S42
(Scales Vert. 1:100, Horiz. 1:500 @ A1)
(Scales Vert. 1:200, Horiz. 1:1000 @ A3)

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No.	Date	Dsn. / Chk.	Amendment / Issue	App
P01	29.07.08	L.H. / J.O'C.	Planning Issue	P.G.

Client: KERRY CENTRAL RECYCLING FACILITY LTD.

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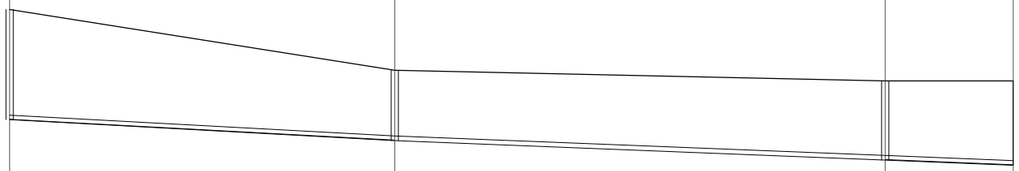
Title: STORM WATER SEWER LONG SECTIONS

(Sheet 4 of 5)

Drawing Status	Scale / Sheet Size	
PLANNING	As Shown @ A1	As Shown @ A3

MGE0109DR0002.dwg



MH Name		F1		F2		F3	WWTP
Hor Scale 500 Ver Scale 100 Datum (m) 100.000							
PN		1.000		1.001		1.002	
Dia (mm)		150		150		150	
Slope (1:X)		92.0		126.5		124.0	
Cover Level (m)	109.830		107.830		107.480		107.480
Invert Level (m)	106.200		105.510 105.510		104.870 104.870		104.700
Length (m)		63.51		80.95		21.08	

SECTIONAL ELEVATION FOUL SEWER
Manhole F1 to Waste Water Treatment Plant
(Scales Vert. 1:100, Horiz. 1:500 @ A1)
(Scales Vert. 1:200, Horiz. 1:1000 @ A3)

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P01	29.07.08	L.H. / J.O'C.	Planning Issue	P.G.

Client: KERRY CENTRAL RECYCLING FACILITY LTD.

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L.H.	J.O'C.	P.G.	July'08

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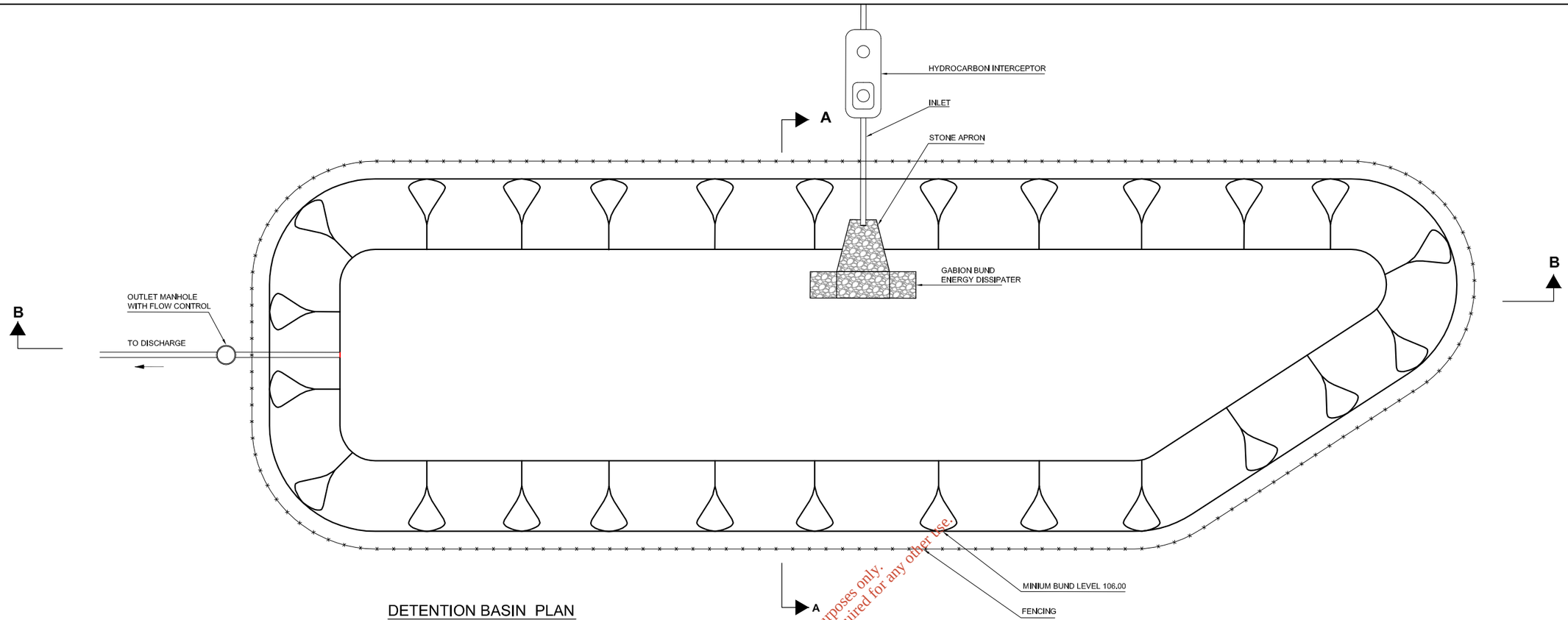
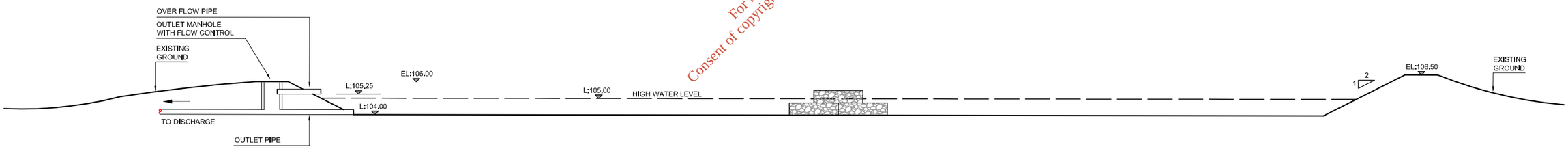
Title: FOUL SEWER LONG SECTIONS

Drawing Status	Scale / Sheet Size	
PLANNING	As Shown @ A1	As Shown @ A3

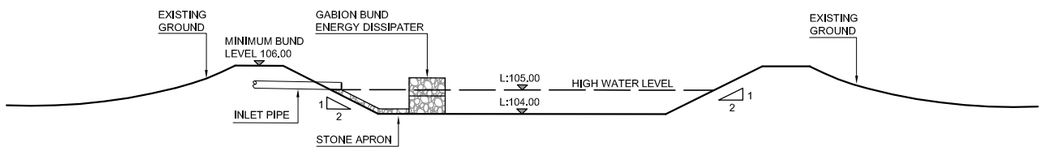
MGE0109DR0002.dwg



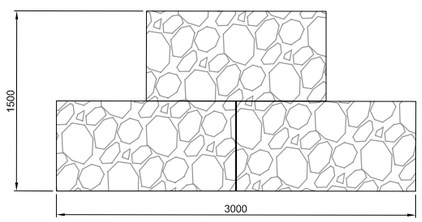
DETENTION BASIN PLAN
Not to Scale



SECTION B-B
Not to Scale



SECTION A-A
Not to Scale



GABION BUND DISSIPATER DETAIL
Not to Scale

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P02	23.06.09	AJD / CB	FUTHER INFORMATION REQUEST	
P01	29.07.08	A.N. / J.O'C.	PLANNING ISSUE	P.G.

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A.N.	J.O'C.	P.G.	July'08

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Drawing Number: DR0004/01
Rev: P02

Project: KERRY CENTRAL RECYCLING FACILITY LTD. PLANNING APPLICATION

Title: **ATTENUATION POND INDICATIVE DETAILS**

(Sheet 1 of 1)

Drawing Status	Scale / Sheet Size	
PLANNING	As Shown @ A1	As Shown @ A3

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P01	23.06.09	A.N. C.B.	FUTHER INFORMATION REQUEST	P.G.

Client: KERRY CENTRAL RECYCLING FACILITY LTD.

Drawn By	Checked By	Approved By	Date
A.N.	P.J.G.	M.W.	June'09

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Drawing Number: DR0005/01
Rev: P01

Project: KERRY CENTRAL RECYCLING FACILITY LTD. PLANNING APPLICATION

Title: EXISTING SURFACE WATER DRAINAGE (Sheet 1 of 1)

Drawing Status	Scale / Sheet Size	
PLANNING	1:1000 @ A1	1:2000 @ A3

MGE0109DR0005.dwg

MH Name		S1		S2		S3		S4		S5		S6		S7		S15	
																	2.006
Hor Scale 500 Ver Scale 100 Datum (m) 96.000																	
PN		1.000		1.001		1.002		1.003		1.004		1.005		1.006		1.007	
Dia (mm)		225		225		225		225		225		225		225		225	
Slope (1:X)		76.1		226.9		54.1		28.2		26.5		28.6		97.3		41.1	
Cover Level (m)	107.480		107.480		107.400		106.790		105.205		103.350		101.250		100.920		100.700
Invert Level (m)	106.055	105.864		105.802	105.802		105.365	105.365		103.780	103.780		101.925	101.925		99.825	99.825	99.482	99.482		99.275
Length (m)		14.53		14.12		23.63		44.72		49.18		60.08		33.35		8.51	

SECTIONAL ELEVATION STORM WATER SEWER
Manhole S25 to S33
(Scales Vert. 1:100, Horiz. 1:500 @ A1)
(Scales Vert. 1:200, Horiz. 1:1000 @ A3)

MH Name		S8		S9		S10		S11		S12		S13		S14	S15
															1.006
Hor Scale 500 Ver Scale 100 Datum (m) 96.000															
PN		2.000		2.001		2.002		2.003		2.004		2.005		2.006	
Dia (mm)		225		225		225		225		225		225		225	
Slope (1:X)		76.1		226.3		37.8		27.1		28.9		67.1		291.4	
Cover Level (m)	107.480		107.480		107.400		105.205		103.350		101.495		100.930		100.920
Invert Level (m)	106.055	105.627		105.627	105.557		103.780	103.780		101.925	101.925		100.070	100.070		99.505	99.505	99.482
Length (m)		32.53		15.89		67.08		50.28		53.58		37.88		6.67	

SECTIONAL ELEVATION STORM WATER SEWER
Manhole S25 to S33
(Scales Vert. 1:100, Horiz. 1:500 @ A1)
(Scales Vert. 1:200, Horiz. 1:1000 @ A3)

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No.	Date	Dsn. / Chk.	Amendment / Issue	App
P01	23.6.09	AJD / MCS	FUTHER INFORMATION REQUEST	P.G.

Client: **KERRY CENTRAL RECYCLING FACILITY LTD.**

Drawn By	Checked By	Approved By	Date
AJD	MCS	P.G.	July '09

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Project: KERRY CENTRAL RECYCLING FACILITY LTD. PLANNING APPLICATION

Drawing Status	Scale / Sheet Size	
PLANNING	As Shown @ A1	As Shown @ A3

Drawing Number: DR0006/01
Rev: P01

Title: ACCESS ROAD STORM WATER SEWER LONG SECTIONS
(Sheet 1 of 1)

MGE0109DR0006.dwg

APPENDIX 3

Updated Chapter 5- Surface Water

AN ASSESSMENT OF POTENTIAL IMPACTS OF THE PROPOSED MATERIALS RECOVERY FACILITY AT SCART/CAHERDEAN, KILLARNEY, COUNTY KERRY

AQUATIC ECOLOGY REPORT

June 2009

Conservation Services, Tullaha, Glenflesk, Killarney, Co. Kerry
Tel/Fax 064 6630130 e-mail cs@conservation-services.ie

CONTENTS

1. INTRODUCTION

RPS Group Ltd has commissioned Conservation Services, Ecological & Environmental Consultants to carry out a study of the potential impacts on the aquatic environment of a proposed recycling facility at Caherdean, Killarney, Co. Kerry. The location of the proposed development and potentially affected freshwaters is shown on Map 1. The study does not include assessment of impacts on receiving waters of trade effluent which is to be transported to existing effluent treatment facilities for treatment and discharge.

The main legal constraints on the proposed development in relation to aquatic flora, fauna, habitats and fisheries are:

The Local Government (Water Pollution) Act, 1977 (and associated regulations)	Prohibits the entry of unlicensed polluting matter into waters
The Local Government (Water Pollution) Act, 1977 (Water quality standards for phosphorus regulations, 1998)	Requires the local authority to maintain the water quality where satisfactory water quality exists, and in cases of unsatisfactory water quality to improve the quality to a status specified in the regulations. In the case of the present project, the regulations require that the water quality in the Gweestin and its tributaries should attain at least a Q4 unpolluted biological quality rating.
The Fisheries (Consolidation) Act, 1959 as amended by the Fisheries (Amendment) Act, 1962	Prohibits: 1. The entry of deleterious matter into waters. (Deleterious matter is defined as any substance that is liable to injure fish, their spawning grounds or their food, or to injure fish in their value as human food.) 2. Obstructing the passage of salmon, trout or eels or their smolts and fry 3. Injury or disturbance of the spawn or fry of salmon or trout or to their spawning or nursery areas

Fisheries (Amendment) Act 1999	Requires the regional fisheries board to have regard for the need for the conservation of fish and other species of fauna & flora, habitat and biodiversity of inland fisheries and ecosystems. It is the stated policy of the Regional Fisheries Boards that "*every river, stream, canal, lake, pond and reservoir must be regarded as constituting and/or supporting a Fishery under the meaning of the Fisheries Acts unless otherwise regarded by the Boards*."
The Wildlife Act 1976	Prohibits damage to protected species which includes certain freshwater aquatic species.
The Habitats Directive (92/43/EEC) as transposed into Irish law under the E.C. (Natural Habitats Regulations 1997 (S.I. No. 94 of 1997)	Lists certain species (Annex II) and habitats (Annex I) which require to be protected within Special Areas of Conservation (SACs). Annex II species include crayfish, salmon, and all three Irish species of Lamprey.
Water Framework Directive (2000/60/EC)	The Water Framework Directive requires the maintenance of good ecological quality in all surface waters, which in the Irish context is generally taken to mean achieving salmonid water quality standards regardless of whether the watercourse is designated under the Salmonid Regulations.

2. METHODOLOGY

2.1. CONSULTATION & LITERATURE REVIEW

The following were contacted by letter of 28/2/08 and invited to submit information or comments for this report:

Central Fisheries Board

Marine Institute

Department of the Environment (National Parks & Wildlife Service)

South Western Regional Fisheries Board

Responses have been received from the South Western Regional Fisheries Board and NPWS (see Appendix 1).

A literature review was carried out using publications in the Conservation Services collection of references on Irish aquatic ecology and international information on impacts and mitigation.

2.2. HABITAT ASSESSMENT

Habitat assessment was carried out on 7th, 9th & 14th April 2008.

2.2.1. Field Procedure

Biological sampling sites were assessed in terms of:

1. Stream width and depth

2. Substrate type, listing substrate fractions in order of dominance, i.e. large rocks, cobble, gravel, sand, mud etc.

3. Flow type, listing percentage of riffle, glide and pool in the sampling area

4. Dominant bankside vegetation, listing the main species overhanging the stream

5. Estimated degree of shade of the sampling site by bankside vegetation.

6. Rating of the site as habitat for salmonid adult, nursery and spawning on a scale of None/ Poor/ Fair/ Good/ Very Good/ Excellent broadly based on a qualitative procedure described by Kennedy (1984). This rating assesses the physical suitability of the habitat; the presence/absence/density of salmonids at the site will also depend on present and historical water quality and accessibility of the site to fish. A rating of "none" indicates that the ecologist carrying out the assessment regards it as impossible that the stream could support salmonid fish in the relevant life stage. A rating of "None - Poor" indicates that it is regarded as possible but extremely unlikely that the stream could support salmonid fish in the relevant life stage.

A general assessment of salmonid and lamprey habitat quality was carried out for c.2km downstream of the proposed development on watercourses shown on the 1:50,000 O.S. Map. This assessment consisted of walking/wading the stream channel. Salmonid and Lamprey habitat quality was assessed, taking into account the environmental features 1-5 listed above. Based on these observations and more detailed criteria outlined in Section 2.2.2 below, the value of each river section for salmonid and lamprey spawning, as a nursery area for juvenile salmonids and lamprey larvae, and as an area for adult salmonids, was estimated. Locations for identification of habitat sections were recorded as Irish Grid References using a GPS. To illustrate the habitat quality photographs were taken using a digital camera.

2.2.2. Criteria Used for Assessment of Salmonid and Lamprey Habitat Quality

Habitat quality for in-stream invertebrate and plant communities, and for fish, and riparian birds and mammals, is primarily a function of 'naturalness' and diversity. The more diverse the stream habitat in terms of substrate, flow rate, depth, riparian vegetation, light conditions etc., the richer the biological community is likely to be, and the more suitable it is likely to be for salmonid fish (trout and salmon).

Assessment of the quality of salmonid spawning habitat, nursery habitat and adult habitat is based on personal expertise developed over a period of 13 years of electrofishing and on published information such as the following:

i. Favourable locations for salmon spawning are likely to occur where the gradient of a river is 3% or less (Mills 1989).

ii. Preferred current velocity for spawning is within the range 25–90 cm s^{-1}, with a water depth in the range 17–76 cm (Hendry & Cragg-Hine 1997).

iii. Typical spawning sites are the transitional areas between pool and riffle where flow is accelerating and depth decreasing, where gravel of suitable coarseness is present and interstices are kept clean by up-welling flow (Peterson 1978, Bjorn & Reiser 1991).

iv. Salmon fry and parr occupy shallow, fast-flowing water with a moderately coarse substrate with cover (Symons & Heland 1978, Baglinière & Champigneulle 1986).

v. Deep or slow-moving water, particularly when associated with a sand or silt substrate, does not support resident juvenile salmonids (Wankowski & Thorpe 1979, Baglinière & Champigneulle 1986).

vi. Suitable cover for juveniles includes areas of deep water, surface turbulence, loose substrate, large rocks and other submerged obstructions, undercut banks, overhanging vegetation, woody debris lodged in the channel, and aquatic vegetation (Heggenes 1990; Bjorn & Reiser 1991; Haury et al. 1995).

vii. The juxtaposition of habitat types is also important. The proximity of juvenile habitat to spawning gravels may be significant to their utilisation. In addition, adults require holding pools immediately downstream of spawning gravels in which they can congregate prior to spawning. Cover for adult salmon waiting to migrate or spawn can be provided by overhanging vegetation, undercut banks, submerged vegetation, submerged objects such as logs and rocks, floating debris, deep water and surface turbulence (Bjorn & Reiser 1991).

viii. Bjorn & Reiser (1991) suggest that proximity of cover to spawning areas may be a factor in the selection of spawning sites by some salmonid species.

Lamprey habitat preferences change with the stages of their life cycle. They show a preference for gravel-dominated substratum for spawning. After hatching the larvae swim or are washed downstream by the current to areas of sandy silt in still or slow flowing water where they burrow and spend the next few years in tunnels. Lampreys therefore require mainly silt and sand dominated substratum for nursery habitat. Other important environmental characteristics for optimal ammocoete habitat are shallow waters with low water velocity, and the presence of organic detritus and/or plant material. Sub-optimal habitat supporting only a few individuals may consist of a few square centimetres of suitable silt in an open, comparatively high-velocity, boulder-strewn streambed. Spate rivers, with high flow velocities, tend to support fewer ammocoetes because they contain smaller areas of stable sediment (Maitland 2003).

2.3. BIOLOGICAL WATER QUALITY ASSESSMENT

2.3.1. Biological Sampling Sites

Macroinvertebrates were sampled at 4 locations (see Map 2):

Site Code	Grid Reference
TA2	V9361 9939
TB2	V9340 9980
G2	V9343 9862
G4	V9238 9821

2.3.2. Biological Sampling & Analysis

Sampling was carried out on 14th April 2008.

Invertebrates were sampled using the standard kick sampling method. After field sampling the sample was thoroughly sieved and live sorted for 30 minutes under laboratory conditions. Invertebrates were preserved in 70% alcohol, examined microscopically and identified to the taxonomic level required to calculate Q-ratings by the EPA methodology (McGarrigle *et al* 2002). The preserved samples were archived for future examination or verification. Based on the relative abundance of indicator species, a biotic index (Q-rating) was determined in accordance with the biological assessment procedure used by the Environmental Protection Agency (McGarrigle *et al* 2002 & S.I. No. 258 of 1998) and more detailed unpublished methodology (McGarrigle, Clabby and Lucey pers. comm.)

Biotic Index	Water Quality	Quality Status
Q5	Good	Unpolluted Waters
Q4-5	Fair - Good	
Q4	Fair	
Q3-4	Doubtful - Fair	Slightly Polluted Waters
Q3	Doubtful	Moderately Polluted Waters
Q2-3	Poor - Doubtful	
Q2	Poor	Seriously Polluted Waters
Q1-2	Bad - Poor	
Q1	Bad	

Submerged and emergent aquatic plants were assessed at each site by means of direct observation and recorded as % cover of the substratum.

2.4. ASSESSMENT OF FISH STOCK

Fish stock assessment was carried out on 3rd & 11th June 2008.

2.4.1. Salmonid Assessment

Electrofishing was carried out at eight sites on the tributaries downstream of the proposed development to determine the fish species present and a minimum density and Catch Per Unit Effort (CPUE) index of the salmonid population density. Assessment was carried out at the following locations (see Map 3).

	Site Code	Grid Reference
Western Tributary	W-A	V9293 9967
	W-B	V9271 9921
	W-C	V9250 9881
	W-D	V9237 9829
Eastern Tributary	E-A	V9362 9939
	E-B	V9335 9914
	E-C	V9336 9882
	E-D	V9342 9863

Fish were captured using a Safari Research Surveyor pulsed direct current backpack electrofisher. Prior to handling, fish were anaesthetised in a benzocaine solution to reduce handling stress. Fish were then identified, and fork length of salmonids was measured to the nearest mm. Trout age was determined by length frequency distribution combined with scale reading using a high power binocular microscope. Trout were classified according to age as less than 1 year old (0+), 1 year old (1+) etc.

2.4.2. Lamprey (Ammocoete) Assessment

Electrofishing for lamprey ammocoetes was carried out at the following sites on the Eastern Tributary which are within the cSAC (see Map 3).

	Site Code	Grid Reference
Eastern Tributary	E-C	V9336 9882
	E-D	V9342 9863

The assessment method used was the qualitative method described by O'Connor (2004). Sampling areas at each site were electrofished in a zigzag manner using a Safari Research Surveyor pulsed direct current electrofisher.

The area fished varies depending on the extent of fine-grained bed material and suitable water depth available at the site. At each one m² section of the surveyed area the anode is energised for 20 seconds, then turned off for approximately five second. The anode is switched on and off in this way for approximately two minutes (Harvey & Cowx 2003). While the gear is operated, the anode is slowly pulled backwards in the water to cause lampreys to emerge from burrows as a result of electro-taxis. When lampreys emerge the electrode is held in the 'on' position to stun the larvae for capture. By keeping the anode 10 – 15 cm above the sediment and pulling the anode backwards, the number of lampreys stunned within the substrate is thought to be reduced (O'Connor 2004). Fish are anaesthetized using a benzocaine solution before being measured and identified using the key and descriptive notes in Maitland (2003 & 2004). The area sampled is measured accurately so that the number of ammocoetes per unit area can be determined as a minimum estimate of density.

2.5. GUIDELINES USED FOR CLASSIFICATION OF IMPORTANCE OF FRESHWATERS

Rating

A **Internationally Important**

Habitats designated as SACs for Annex II species under the EU Habitats Directive. Major Salmon river fisheries. Major salmonid lake fisheries.

B **Nationally or Regionally Important**

Other major salmonid waters and waters with major amenity fishery value. Commercially important coarse fisheries. Waters with important populations of species protected under the Wildlife Act and/or important populations of Annex II species under the EU Habitats Directive. Waters designated or proposed as Natural Heritage Areas by Dúchas.

C **High Local Value**

Small water bodies with known salmonid populations or with good potential salmonid habitat, or any population of species protected under the Wildlife Act and/or listed Annex II species under the EU Habitats Directive. Large water bodies with some fisheries value.

D **Moderate Local Value**

Small water bodies with some coarse fisheries value or some potential salmonid habitat. Any stream with an unpolluted Q-value rating.

E **Low value**

Water bodies with no current fisheries value and no significant potential fisheries value. Habitat diversity low and degraded.

NRA (2004)

2.6. ASSESSMENT OF SIGNIFICANCE OF POTENTIAL IMPACTS

Impacts are defined on the basis of severity of impact on salmonid fish or any rare, protected, or commercially significant species and/or habitats. Assessment of the importance of a potential impact takes into account not only the ecological considerations in the immediate vicinity of the potential impact, but also geographical and wider catchment considerations. If spawning and nursery habitat are limiting factors in short supply in a particular river system, then impacts on them will have an importance out of proportion with their apparent 'face value'.

Because of their amenity, commercial and legal status, salmonid fish (trout and salmon) are given special consideration. If any aspect of a proposed development is judged likely to have a measurable negative effect on salmonid fish populations, it would be classified as a significant potential impact. The criteria for assessing the significance of impacts on flora, fauna and fisheries are as follows. (For details of water body categories see section 2.5.)

A Sites

	Temporary	Short-term	Medium-term	Long-term
Extensive	MAJOR	SEVERE	SEVERE	SEVERE
Localised	MAJOR	MAJOR	SEVERE	SEVERE

B Sites

	Temporary	Short-term	Medium-term	Long-term
Extensive	MAJOR	MAJOR	SEVERE	SEVERE
Localised	MODERATE	MODERATE	MAJOR	MAJOR

C Sites

	Temporary	Short-term	Medium-term	Long-term
Extensive	MODERATE	MODERATE	MAJOR	MAJOR
Localised	MINOR	MODERATE	MODERATE	MODERATE

D Sites

	Temporary	Short-term	Medium-term	Long-term
Extensive	MINOR	MINOR	MODERATE	MODERATE
Localised	NOT SIGNIFICANT	MINOR	MINOR	MINOR

E Sites

	Temporary	Short-term	Medium-term	Long-term
Extensive	NOT SIGNIFICANT	NOT SIGNIFICANT	MINOR	MINOR
Localised	NOT SIGNIFICANT	NOT SIGNIFICANT	NOT SIGNIFICANT	NOT SIGNIFICANT

NRA (2004)

In line with the EPA guidelines (EPA 2002) the following terms are defined when quantifying duration:

Temporary: Up to 1 year
Short-term: From 1 to 7 years
Medium-term: 7 to 15 years
Long-term: 15 – 60 years
Permanent: over 60 years.

For the purposes of this report 'localised' impacts on rivers are loosely defined as impacts measurable no more than 250 metres from the impact source. 'Extensive' impacts on rivers are defined as impacts measurable more than 250m from the impact source. Any impact on salmonid spawning habitat or nursery habitat where it is in short supply, would be regarded as an extensive

impact as it is likely to have an impact on the salmonid population beyond the immediate vicinity of the impact source.

2.7. LIMITATIONS ENCOUNTERED

No significant limitations were encountered.

3. EXISTING ENVIRONMENT

3.1. GWEESTIN RIVER CATCHMENT GENERAL INFORMATION

The Gweestin River rises in the vicinity of Knockacullig north west of Killarney and flows for c.23km in a roughly westerly direction to join the River Laune c.9km upstream of Killorglin.

3.1.1. Fishery Importance

The Gweestin is designated under the Quality of Salmonid Waters Regulations 1998 (S.I. No. 293, 1988). Fish surveys carried out by the Central Fisheries Board of the main channel of the Gweestin River recorded salmon at all sites assessed (McGinnity *et al* 2003). The Laune River to which the Gweestin flows drains a catchment of c320 square miles and is described by O'Reilly (2002) as "*a great salmon and trout river – both seatrout and brown trout.*" Documentation provided by NPWS states "*The May 2000 Fishery Report (Irish Fisheries 2001) noted that all draft nets had been removed from the Laune as part of the catchment management programme and that the effect had been positive with over 120 salmon caught in the Killarney Flesk River (tributary of the Laune) during one week in May*."

3.1.2. Water Quality

EPA biological monitoring data for the Gweestin are tabulated in Appendix 2. After the 2004 round of biological monitoring EPA described the Gweestin as "*Mostly satisfactory. Improvement recorded at upper Gweestin Bridge (0600) in 2001 has been maintained. Remaining unsatisfactory at final location, lower Gweestin Bridge (1200), due to moderately polluted conditions*."

3.1.3. Ecological Importance

Most of the Gweestin River is within the Castlemaine Harbour cSAC (Site code 80000343 see Site Synopsis in Appendix 3). The site is designated for a range of Annex I habitats and Annex II species including Sea Lamprey, River Lamprey, Atlantic Salmon. As a cSAC the Gweestin River is classified as of international importance.

3.2. POTENTIALLY AFFECTED WATERS

The proposed development site drains in a northerly and southerly direction. To the north the site drains to a small stream which flows for c.2.5km to join the Gweestin River just upstream of Gweestin Bridge. To the south the site drains to a stream which flows for c.1.5km to the Gweestin River c.2km upstream of Gweestin Bridge (see Map 1).

3.2.1. WESTERN TRIBUTARY

3.2.1.1. Biological Water Quality

The results of habitat assessment at each site is tabulated in Appendix 4. Site locations are shown on Map 2.

SITE TB2

The macroinvertebrate fauna recorded at the site merits a Q-rating of Q3 indicating moderately polluted conditions.

INDICATOR GROUP	TAXON	Number
Group A - Very Pollution Sensitive	None Recorded	
Group B - Moderately Pollution Sensitive	Nemouridae	1
Group C - Moderately Pollution Tolerant	*Potamopyrgus antipodarum*	57
	Gammarus duebeni	25
	Baetis rhodani	1
	Hydropsychidae	31
	Limnephilidae	2
	Chironomidae (ex. *Chironomus*)	1
Group D - Very Pollution Tolerant	Erpobdellidae	3
Group E - Most Pollution Tolerant	Tubificidae	1
Not assigned to any indicator group	Enchytraeidae	1
	Lumbriculidae	1

There is visual and olfactory evidence of more serious pollution of this stream at and for at least 500m downstream of an inflowing drain at V9317 9981. Upstream of the road bridge at Caherdean the stream had 90% cover by slime growths and a strong odour of slurry in May 2008.

3.2.1.2. Habitat Assessment

Habitat sections are shown on Map 4. Photographs are presented in Appendix 5.

Habitat Section W1

Location	V9362 9976 to V9353 9978
Description	This small watercourse emerges from underground at grid ref. V9362 9976. This section consists of a 1.5 wide drain with substrate of soft mud. The lower half of the section has been recently excavated. Good cover of willow on south side of the drain.
Length	c.200m
Photograph Number	1 - 3
Salmonid Adult Habitat	None
Salmonid Nursery Habitat	None
Salmonid Spawning Habitat	None
Lamprey Spawning	None
Lamprey Nursery	Poor - Fair

Habitat Section W2

Location	V9342 9980 to V9353 9978
Description	Muddy trickle heavily shaded by gorse.
Length	c.200m
Photograph Number	4 - 5
Salmonid Adult Habitat	None

Salmonid Nursery Habitat	None
Salmonid Spawning Habitat	None
Lamprey Spawning	None
Lamprey Nursery	None

Habitat Section W3

Location	V9353 9978 to V9317 9981
Description	Very small stream mostly muddy glide but with some muddy riffle on cobble and gravel. Heavily shaded by gorse.
Length	c.230m
Photograph Number	6
Salmonid Adult Habitat	None - Poor
Salmonid Nursery Habitat	Fair
Salmonid Spawning Habitat	Poor - Fair
Lamprey Spawning	Poor- Fair
Lamprey Nursery	Fair

Habitat Section W4

Location	V9317 9981 to V9270 9917
Description	Stream 1-2m wide, mostly riffle on muddy cobble, gravel, sand and some bedrock. Heavily shaded by furze, willow, bramble and alder.
Length	c.850m
Photograph Number	7 - 9

Salmonid Adult Habitat	Fair
Salmonid Nursery Habitat	Good
Salmonid Spawning Habitat	Fair - Good
Lamprey Spawning	Fair - Good
Lamprey Nursery	Poor - Fair

Habitat Section W5

Location	V9270 9917 to V9251 9871
Description	Good riffle over cobble, bedrock and gravel with some muddy glide. The stream flows through a c.10m pipe culvert at V9250 9874 which is likely to constitute a significant obstacle to upstream fish movement (photo. 14).
Length	c.520m
Photograph Number	10 - 14
Salmonid Adult Habitat	Fair
Salmonid Nursery Habitat	Good
Salmonid Spawning Habitat	Good
Lamprey Spawning	Good
Lamprey Nursery	Fair

Habitat Section W6

Location	V9251 9871 to V9224 9848
Description	Mostly straight uniform shallow channel with riffle and glide over muddy gravel, sand and gravel. A c.8m pipe culvert at V9234 9857 and a c. 50m pipe culvert from V9229 9840 to V9232 9835 are likely to constitute a significant obstacle to upstream fish movement.
Length	c.500m
Photograph Number	15 - 18
Salmonid Adult Habitat	Poor - Fair
Salmonid Nursery Habitat	Fair - Good
Salmonid Spawning Habitat	Fair - Good
Lamprey Spawning	Fair - Good
Lamprey Nursery	Fair

3.2.1.3. Salmonid Fish Assessment

Details of electrofishing sites and full survey data are presented in Appendix 6.

Site Code	Area Fished m²	Fishing Time (mins)	Species Recorded	Number of Brown Trout Captured	Minimum Brown Trout Density (per m²)	C.P.U.E. (trout per hour equivalent)
W-A	30	5	None	0	0	0
W-B	67	7	None	0	0	0
W-C	35	8	None	0	0	0

Site Code	Area Fished m²	Fishing Time (mins)	Species Recorded	Number of Brown Trout Captured	Minimum Brown Trout Density (per m²)	C.P.U.E. (trout per hour equivalent)
W-D	90	10	Brown Trout, Three-Spined Stickleback	1	0.011	6

3.2.1.4. Fishery Value

The habitat of the Western Tributary is adequate to support a significant population of juvenile brown trout. The apparently complete absence of trout from the stream except for a very low density just upstream of its confluence with the Gweestin River is likely to be due to serious pollution and the installation of several culverts along the length of the stream which would form an obstruction to upstream fish movement.

3.2.1.5. Ecological Value

As a small water course with some brown trout and good potential salmonid habitat, the Western Tributary is classified as of high local value.

3.2.2. EASTERN TRIBUTARY

3.2.2.1. Biological Water Quality

The results of habitat assessment at each site is tabulated in Appendix 4. Site locations are shown on Map 2.

SITE TA2

The macroinvertebrate fauna recorded at the site merits a Q-rating of Q3 indicating moderately polluted conditions.

INDICATOR GROUP	TAXON	Number
Group A - Very Pollution Sensitive	None Recorded	
Group B - Moderately Pollution Sensitive	Nemouridae	1
	Sericostomatidae	1
Group C - Moderately Pollution Tolerant	*Gammarus duebeni*	2
	Hydracarina	2
	Baetis rhodani	21
	Hydropsychidae	17
	Hydraena sp.	1
	Tipulidae	1
	Chironomidae (ex. *Chironomus*)	5
Group D - Very Pollution Tolerant	Erpobdellidae	4
Group E - Most Pollution Tolerant	None recorded	

3.2.2.2. Habitat Assessment

Habitat sections are shown on Map 4. Photographs are presented in Appendix 5.

Habitat Section E1

Location	V9365 9969 to V9363 9940
Description	Very small stream/drain which emerges from ground at V9365 9969. Mostly muddy substrate with limited muddy gravel at the lower end of the section. The watercourse flows through a c.5m long pipe culvert to join the stream at V9363 9940.
Length	c.300m
Photograph Number	19 & 20
Salmonid Adult Habitat	None
Salmonid Nursery Habitat	Poor
Salmonid Spawning Habitat	Poor
Lamprey Spawning	Poor
Lamprey Nursery	Poor

Habitat Section E2

Location	V9370 9943 to V9356 9935
Description	Very small stream, mostly riffle on muddy cobble and bed rock. Heavily shaded by hawthorn and gorse.
Length	c.200m
Photograph Number	21 - 23
Salmonid Adult Habitat	Poor
Salmonid Nursery Habitat	Fair
Salmonid Spawning Habitat	Poor - Fair
Lamprey Spawning	Poor - Fair

Lamprey Nursery	Poor

Habitat Section E3

Location	V9356 9935 to V9342 9863
Description	Small stream. Mostly muddy riffle over cobble and bed rock. Pools scarce. Good shade of oak, ash and willow.
Length	c.800m
Photograph Number	24 - 33
Salmonid Adult Habitat	Fair
Salmonid Nursery Habitat	Good
Salmonid Spawning Habitat	Fair
Lamprey Spawning	Fair
Lamprey Nursery	Poor

3.2.2.3. Salmonid Fish Assessment

Details of electrofishing sites and full survey data are presented in Appendix 6.

Site Code	Area Fished m²	Fishing Time (mins)	Species Recorded	Number of Juvenile Brown Trout Captured	Minimum Brown Trout Density (per m²)	C.P.U.E. (trout per hour equivalent)
E-A	27	10	Brown Trout	11	0.407	66
E-B	37	10	Brown Trout	11	0.297	66
E-C	22	7	Brown Trout	15	0.682	128

Site Code	Area Fished m²	Fishing Time (mins)	Species Recorded	Number of Juvenile Brown Trout Captured	Minimum Brown Trout Density (per m²)	C.P.U.E. (trout per hour equivalent)
E-D	22	5	Brown Trout	16	0.727	264

3.2.2.4. Juvenile Lamprey Assessment

The best area of potential lamprey nursery silt within c.100m of sites E3 & E4 were selected for juvenile lamprey assessment. At both sites the substrate was sub optimal lamprey nursery habitat consisting of a mixture of silt, gravel and sand.

Site Code	Area Fished m²	Number of Lamprey Captured	Minimum lamprey density (per m²)
E-C	2	0	0
E-D	2	0	0

3.2.2.5. Fishery Value

Good densities of juvenile brown trout were recorded at all sites assessed. The stream is therefore a significant brown trout spawning and nursery steam of the Gweestin River system. All trout recorded were early juvenile trout of less than 1 year old, except for a single one year old juvenile trout at site E-B.

3.2.2.6. Ecological Value

As a small water course with good juvenile brown trout population and habitat, the Western Tributary is classified as of high local value. No salmon or lamprey were recorded in the stream, this indicates that these species are either absent or present at very low densities. The lowest c.150m of the stream is part of the Castlemaine Harbour cSAC (see site synopsis in Appendix 3); the cSAC as a whole is classified as of international importance.

3.2.3. GWEESTIN RIVER

3.2.3.1. Biological Water Quality

Biological water quality assessment was carried out immediately downstream of the confluence with both the eastern and western tributaries. The results of habitat assessment at each site is tabulated in Appendix 4. Site locations are shown on Map 2.

SITE G2

The macroinvertebrate fauna recorded at the site merit a Q-rating of Q4-5 indicating unpolluted conditions.

INDICATOR GROUP	TAXON	Number
Group A - Very Pollution Sensitive	*Ecdyonurus sp.*	2
	Heptageniidae	4
	Rhithrogena sp.	27
	Chloroperlidae	3
	Isoperla grammatica	5
	Perla bipunctata	4
Group B - Moderately Pollution Sensitive	*Baetis muticus*	2
	Amphinemura sp.	1
	Brachyptera risi	1
	Goeridae	38
	Sericostomatidae	10
Group C - Moderately Pollution Tolerant	*Potamopyrgus antipodarum*	6
	Gammarus duebeni	12
	Hydracarina	1
	Baetis rhodani	26
	Hydropsychidae	11
	Limnephilidae	12
	Rhyacophilidae	1
	Chironomidae (ex. *Chironomus*)	3
	Tipulidae	7
	Elmidae	20
	Gyrinidae	3
Group D - Very Pollution Tolerant	None recorded	
Group E - Most Pollution Tolerant	None recorded	

SITE G4

The macroinvertebrate fauna recorded at the site merits a Q-rating of Q4-5 indicating unpolluted conditions.

INDICATOR GROUP	TAXON	Number
Group A - Very Pollution Sensitive	Heptageniidae	7
	Rhithrogena sp.	46
	Chloroperlidae	8
	Isoperla grammatica	4
	Perla bipunctata	3
Group B - Moderately Pollution Sensitive	*Baetis muticus*	5
	Leuctra sp.	3
	Sericostomatidae	4
Group C - Moderately Pollution Tolerant	*Gammarus duebeni*	13
	Hydracarina	7
	Baetis rhodani	c.130
	Caenidae	1
	Glossosomatidae	4
	Hydropsychidae	6
	Limnephilidae	1
	Rhyacophilidae	1
	Chironomidae (ex. *Chironomus*)	15
	Tipulidae	7
	Elmidae	6
	Gyrinidae	2
Group D - Very Pollution Tolerant	None recorded	
Group E - Most Pollution Tolerant	Tubificidae	2

3.2.3.2. Habitat Assessment

Habitat sections are shown on Map 4. Photographs are presented in Appendix 5.

Habitat Section G1

Location	V9342 9863 to V9239 9824
Description	Sinuous river with excellent flow and substrate diversity. Good mix of cobble and sandy gravel, riffle and glide and pools. Good marginal lamprey silts.
Length	c.1.5km
Photograph Number	34 - 38
Salmonid Adult Habitat	Very Good
Salmonid Nursery Habitat	Very Good
Salmonid Spawning Habitat	Very Good
Lamprey Spawning	Very Good
Lamprey Nursery	Very Good

3.2.3.3. Fishery Value

The section of the Gweestin River assessed has very good habitat for all salmonid life stages. The river is known to have a population of brown trout and salmon.

3.2.3.4. Ecological Value

In the present survey adult brook lamprey (*Lampetra planeri*) were observed in the Gweestin just downstream of the confluence with the eastern tributary. Salmon (*Salmo salar*) have also been recorded by CFB throughout the main channel of the Gweestin river. Both salmon and brook lamprey are listed in Annex II of the habitats directive. The Gweestin river is designated a cSAC specifically for the conservation of Salmon. As a designated cSAC the Gweestin River is classified as of international importance.

The surveyed section of the Gweestin River has habitat of moderate suitability for Freshwater Pearl (*Margaritifera margaritifera*) an endangered species listed in Annex II of the Habitats Directive. There are no records of *Margaritifera* from the Gweestin River. EPA water quality data (Gweestin Bridge EPA Site 0600 see Appendix 2) indicate moderately or slightly polluted conditions in three of the six monitoring rounds since 1990. Moorkens (2006) states "*The species requires very clean unsilted rivers, cleaner than the current requirements for human drinking water or salmonid waters, and of higher quality than the median levels associated with EPA Q5 waters, currently the highest quality described in Ireland*." It is therefore concluded that the likelihood of *Margaritifera* in the potentially affected section of the Gweestin River is insignificant.

4. POTENTIAL SIGNIFICANT IMPACTS OF THE DEVELOPMENT ON FRESHWATER AQUATIC FLORA, FAUNA AND HABITATS IN THE ABSENCE OF MITIGATION

The potential significant impacts of the proposed development will be:

1. Pollution of streams with suspended solids due to runoff of soil from construction areas

2. Pollution of streams, during construction phase, with other substances such as fuels, lubricants, waste concrete, waste water from site toilet and wash facilities, etc.

3. Pollution by effluent from the waste processing and storage area and ancillary structures and facilities

4. Pollution by surface water draining from non process area of the site e.g. car parking, roofs, access roads, paths etc.

5. Pollution by effluent from toilet, wash facilities, canteen etc.

6. Hydrological impacts due to changes in the flow regime of streams draining the proposed development site.

7. **Loss of stream habitat due to construction of the proposed development access road**

8. **Obstruction to upstream movement of fish and other aquatic fauna due to construction of proposed new development access road and upgrading of existing L3023 road adjacent to the proposed development**

Potential impacts are described under two headings:

i. An assessment of the potential environmental impact of the proposed development during the period of construction.

ii. An assessment of potential significant long-term effects of the existence of the proposed development on freshwater invertebrate fauna, flora, fish and habitats.

4.1. AN ASSESSMENT OF THE POTENTIAL AQUATIC ENVIRONMENTAL IMPACT OF THE PROPOSED DEVELOPMENT DURING THE PERIOD OF CONSTRUCTION

4.1.1. Pollution of streams/rivers with suspended solids

Research in North America indicates that the equivalent of many decades of natural or even agricultural erosion may take place during a single year from areas cleared for construction (Wolman and Schick 1967). Suspended sediment due to runoff of soil from construction areas, or due to disturbance of fine sub-surface sediments in the course of instream construction and excavation, can have severe negative impacts on invertebrate and plant life and on all life stages of salmonid fish.

- Suspended sediment can settle on spawning areas, infill the intragravel voids and smother the eggs and alevins (newly hatched fish) in the gravel.

- Bed Load (coarse material transported along the bottom of the stream) and settled sediments can infill pools and riffles, reducing the availability and quality of rearing habitat for fish.

- Suspended sediment can reduce water clarity and visibility in the stream, impairing the ability of fish to find food items.

- Settled sediments can smother and displace aquatic organisms such as macroinvertebrates, reducing biodiversity and reducing the amount of food items available to fish.

- Increased levels of sediment can displace fish out of prime habitat into less suitable areas. (Chilibeck *et al* 1992)

- Suspended solids can abrade or clog the gills of salmonid fish. It takes a high concentration of solid wastes to clog a fish gill and cause asphyxiation, but only a little to cause abrasions and thus permit the possibility of infections. (Solbe 1988)

4.1.2. Pollution of streams/rivers with other substances associated with the construction process

The potential exists for a range of serious pollutants to enter watercourses during construction. For example any of the following will have deleterious effects on fish, plants and invertebrates if allowed to enter watercourses.

- Raw or uncured concrete and grouts

- Wash down water from exposed aggregate surfaces, cast-in-place concrete and from concrete trucks

- Fuels, lubricants and hydraulic fluids for equipment used on the development site

- Waste from on site toilet and wash facilities

4.2. AN ASSESSMENT OF POTENTIAL SIGNIFICANT LONG-TERM EFFECTS OF THE EXISTENCE AND OPERATION OF THE PROPOSED DEVELOPMENT ON AQUATIC INVERTEBRATE FAUNA, FLORA, FISH AND HABITATS.

4.2.1. Potential pollution by surface water draining from non-process area of the site e.g. car parking, roofs, access roads, paths etc.

The main pollutants of concern in the runoff from paved areas not accessed by vehicles transporting waste material would be petrol, fuel oils, lubricating oils and hydraulic fluids. In unmodified form these are liquid, virtually insoluble and lighter than water. EIFAC - The European Inland Fisheries Advisory Commission (Svobodova *et al* 1993) states that "*a sensory assessment is preferred to toxicological analysis in determining the highest admissible amounts of oil and oil products that can be present in water; on this basis the highest admissible concentrations are in the range of 0.002 to 0.025 mg per litre*".

Harmful effects include:

- The prevention of gaseous exchange at the water surface, leading to reduced dissolved oxygen in the underlying water (Solbe 1988)

- In the case of turbulent waters the oil becomes dispersed as droplets into the water. In such cases, the gills of fish can become mechanically contaminated and their respiratory capacity reduced (Svobodova *et al* 1993).

- Oil products may contain various highly toxic substances, such as benzene, toluene, naphthenic acids and xylene which are to some extent soluble in water; these penetrate into the fish and can have a direct toxic effect. It is generally agreed that the lighter oil fractions (including kerosene, petrol,

benzene, toluene and xylene) are much more toxic to fish than the heavy fractions (heavy paraffins and tars) (Svobodova *et al* 1993).

4.2.2. Potential pollution by effluent from toilet, wash facilities, canteen etc. in the absence of adequate mitigation

4.2.2.1. Organic Pollution

Following the introduction of untreated or poorly treated sewage effluent to a stream, conditions of existence for many organisms becomes substantially degraded. Increased turbidity in the water will reduce light penetration, which in turn will reduce the volume of water capable of supporting photosynthesizing plants. Particulate matter in settling will flocculate small floating plants and animals from the water. As the material settles, sludge beds may be formed on the stream bed, and many of the areas that formerly could have been inhabited by bottom dwelling organisms become covered and uninhabitable. Within the zone of active decomposition the breakdown of organic products by bacteria may consume all available dissolved oxygen, resulting in the river becoming uninhabitable by fish and many other aquatic species.

4.2.2.2. Eutrophication: Phosphorus

The most serious threat to water quality of lakes and rivers in Ireland is eutrophication, defined as the enrichment of waters, beyond natural levels, principally by the nutrient phosphorus (P). This enrichment commonly results in excessive production of cyanobacteria (formerly referred to as blue-green algae), planktonic algae and rooted plants in such waters. Eutrophication of aquatic ecosystems also results in loss of biodiversity and degradation of aquatic habitats of high ecological quality (EPA 1997).

The adjacent streams are very small therefore the dilution available for any effluent directly discharged to surface waters or reaching surface waters via discharge to the ground will be extremely small. It is now EPA policy that except in exceptional circumstances the appropriate Environmental Quality Standard to

be applied to all Irish freshwaters would be for salmonid water quality (EPA 1997). This means that the target is to attain a Q4 rating or higher (unpolluted status/Class A) under EPA biological quality classification system or a median Molybdate Reactive Phosphorus concentration of 0.03 mg/l. The stream immediately adjoining the proposed development site has a population of brown trout and is designated as a cSAC from c.500m downstream of the proposed development. The present Q-rating of the stream is Q3 i.e. moderately polluted. Any significant further reduction in water quality is likely to result in the loss of the trout population in this nursery stream of the Gweestin River and would be in breach of the fisheries regulations and the water pollution regulations.

4.2.3. Potential pollution from process area and ancillary structures and facilities in the absence of adequate mitigation

The proposed development involves the construction of a Materials Recovery Facility (MRF). An annual intake of 95,000 tonnes per annum is proposed (50,000 tonnes of mixed municipal waste, 3,000 tonnes of organic waste, 30,000 tonnes of dry recyclables, 12,000 tonnes of non-hazardous Construction & Demolition waste (C&D waste).

A public recycling area will also be constructed for deposition of recyclables construction and demolition wastes, timber, metals, cardboard and paper, glass, plastic bottles/film, green waste, WEEE, fluorescent tubes, batteries, bulky waste, waste oils, textiles, household hazardous and residual waste.

Classification of waste as non-hazardous under the Waste Management Act 1996 is based largely on hazards to human health. Many substances classified as non-hazardous are potentially damaging to the aquatic environment, for instance:

- Any food stuffs or decomposable organic material
- All fats, greases & oils, whether of mineral or food origin

- Most household, garden and commercial chemicals
- Inert rubbles containing fine mineral particles
- A wide range of chemicals contained in small and large domestic and office appliances, batteries etc.

All biodegradable organic wastes such as food waste, garden waste, paper and cardboard products, animal products, treated or painted wood waste, and a range of commercial and industrial wastes, if exposed to rain will produce runoff detrimental to the aquatic environment.

Given the wide range of potential pollutants contained in the wastes to be processed at the proposed plant, the potential exists for significant contamination of surface waters from waste material exposed to rain, accidental spillages, etc. The most serious risk posed would be from accidental spillages of materials with high B.O.D. or other polluting potential.

Pollution could potentially arise from a range of sources e.g.:

- The processing area
- Storage areas for recovered waste etc. (skips and hardstanding)
- Fuel storage tanks
- Weighbridge
- Waste delivery area

4.2.4. Permanent loss of habitat

Permanent loss of aquatic and/or riparian habitat will potentially take place where the proposed development access road and the upgraded L3023 road adjacent to the proposed development are constructed through, over, or in close proximity to streams. Fishery Guidelines for Local Authority Works published by the Department of the Marine and Natural Resources (Anon 1998) state that "*culverts are highly inimical to stream plant and fish life and become effectively sterile*". By eliminating the natural aquatic vegetation and its associated invertebrate fauna,

culverts can result in a significant reduction in invertebrate drift downstream which constitutes a significant food source for salmonid fish. By changing the hydrology of a section of stream or river, culverts may also result in changes in upstream and downstream habitat, due to changes in flow conditions and substrates.

The proposed development access road includes a c.12m long culvert of Stream Section E1 which constitutes poor salmonid habitat, and a c. 22m wide crossing of Stream Section E2, which has a small population of juvenile trout. It is also proposed to extend the existing stream culvert under the L2023 by c.7m on its north side with a potential loss of trout habitat.

4.2.5. Obstruction to upstream movement of fish and other aquatic fauna due to road crossings

Habitat fragmentation, the splitting of natural habitats and ecosystems into smaller and more isolated patches, is recognised as one of the most important global threats to the conservation of biological diversity. Effective watercourse protection requires consideration of the needs of all species, including invertebrates and insects, fish, amphibians such as frogs and newts, and mammals such as otters. Streams and the interconnectedness of different parts of a stream or watershed are essential to these animals. For reasons as simple as escaping random disaster or as complex as maintaining genetic diversity, animals living in or along streams, ephemeral watercourses and linear wetlands need to be able to move unimpeded through the watershed.

Culverts and other artificial channels, if not appropriately designed and constructed with the aquatic ecosystem in mind, can totally prevent any upstream movement, of many aquatic organisms including fish. Even in the case of watercourses unsuitable for fish, movement of other aquatic

organisms in field drains or ephemeral watercourses can be disrupted by unsuitable culverts.

In the case of the present proposed development, the young trout recorded in the small stream adjacent to the proposed development are likely to be the offspring of adult trout which have run up into this stream from the Gweestin River to spawn beside the site upstream of the N22. Unsuitable culverting will prevent these adult fish from reaching their spawning areas.

4.3. SIGNIFICANCE OF POTENTIAL IMPACTS IN THE ABSENCE OF MITIGATION

In the absence of mitigation, the potential impact of the proposed facility on streams & rivers would be major during both the construction phase and operational phase.

4.4. SUMMARY OF SIGNIFICANCE OF POTENTIAL IMPACTS

	IMPACTS DURING CONSTRUCTION		LONG-TERM IMPACTS					
Potential Impact location	Suspended Solids Pollution	Other Pollutants	Pollution from non process area runoff	Pollution from process area effluent	Pollution from non process waste water	Hydro-logical Impacts	Habitat Loss	Obstruction to upstream movement of fish
East Tributary	Major	Major	Major	Major	Major	Moderate	Moderate	Moderate
West Tributary	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Not Significant	Not Significant
Gweestin River	Major	Major	Major	Major	Major	Minor or not significant	None	None

MITIGATION MEASURES

5.1. REDUCTION AND PREVENTION OF POLLUTION DURING THE CONSTRUCTION PROCESS

5.1.1. Reduction and prevention of suspended solids pollution

Release of suspended solids to all watercourses should be kept to a minimum and total suspended solids in discharges should not exceed 25mg/l. The key factors in erosion and sediment control are to intercept and manage off- and on-site runoff. This limits the potential for soils to be eroded and enter streams in runoff. Runoff and surface erosion control is more effective and less expensive than sediment control with sediment control ponds only.

The following general guidelines for erosion and sediment control are largely based on Goldman *et al* (1986):

i. Works with a high risk of suspended solids contamination such as earth moving or excavation close to watercourses/drains should not be carried out between the end of September and the beginning of May.

ii. Retain existing vegetation where possible and physically mark clearing boundaries on the construction site.

iii. Revegetate denuded areas, particularly cut and fill slopes and disturbed slopes as soon as possible. Use mulches or other organic stabilisers to minimise erosion until vegetation is established on sensitive soils.

iv. Cover temporary fills or stockpiles which are likely to erode into nearby watercourses with polyethylene sheeting.

v. Divert runoff away from denuded areas.

vi. Minimise the length and steepness of slopes where possible.

vii. Minimise runoff velocities and erosive energy by maximising the lengths of flow paths for precipitation runoff, constructing interceptor ditches and channels with low gradients to minimise secondary erosion and transport, and lining unavoidably steep interceptors or conveyance ditches with filter fabric, rock or polyethylene lining to prevent channel erosion.

viii. Retain eroded sediments on site with erosion and sediment control structures such as sediment traps, silt fences and sediment control ponds. Sediment control ponds should be designed for a minimum retention time of 15 hours.

ix. Access roads should be constructed or topped with a suitable coarse granular material/non-woven geotextile, and if possible organic topsoil should be stripped prior to access road construction.

x. It is important that at the planning stage provision is made for a sufficient land area to accommodate the necessary sediment control measures.

5.1.2. Prevention of pollution with other substances associated with the construction process

The following guidelines based on Chilibeck *et al* (1992), and NRA (2005) should be followed:

i. Raw or uncured waste concrete should be disposed of by removal from the site or by burial on the site in a location and in a manner that will not impact on the watercourse.

ii. Wash down water from exposed aggregate surfaces, cast-in-place concrete and from concrete trucks should be trapped on-site to allow sediment to settle out and reach neutral pH before clarified water is

released to the stream or drain system or allowed to percolate into the ground.

iii. Fuels, lubricants and hydraulic fluids for equipment used on the construction site should be carefully handled to avoid spillage, properly secured against unauthorised access or vandalism, and provided with spill containment according to current best practice (Enterprise Ireland BPGCS005).

iv. Fuelling and lubrication of equipment should not be carried out on sites close to water courses.

v. Any spillage of fuels, lubricants or hydraulic oils should be immediately contained and the contaminated soil removed from the site and properly disposed of.

vi. Oil booms and oil soakage pads should be kept on site to deal with any accidental spillage.

vii. Waste oils and hydraulic fluids should be collected in leak-proof containers and removed from the site for disposal or re-cycling.

viii. All pumps using fuel or containing oil should be locally and securely bunded when situated within 25m of waters or when sited such that taking account of gradient and ground conditions there is the possibility of discharge to waters.

ix. Foul drainage from site offices etc. should be removed to a suitable treatment facility or discharged to a suitable treatment system constructed in accordance with EPA guidelines.

5.1.3. Requirements for Contractors

Contractors should establish contact with the South Western Regional Fisheries Board and the National Parks & Wildlife Service before works commence, and there should be ongoing liaison with these bodies throughout the construction process. Contractors should be in possession of, and familiar with the contents of "*Control of water pollution from construction sites - Guidance for consultants and contractors*" published by the Construction Industry Research and Information Association (CIRIA 2001) (e-mail enquiries@ciria.org.uk).

5.2. REDUCTION AND PREVENTION OF IMPACTS FROM THE COMPLETED DEVELOPMENT

5.2.1. Mitigation of potential pollution of surface waters with effluent from the material recovery facility

All waste delivery, storage and processing areas should be fully roofed against rain, bunded to contain any accidental spillages, and drained on an impervious surface to a holding tank for tankering to a waste treatment facility. The holding tank should have the capacity to contain any potential accidental spillages. As leachate may arise from deliveries particularly of municipal wastes, delivery trucks should drive across the weighbridge and unload the waste into a housed delivery area which drains to the effluent storage tank.

The EPA are in the process of drawing up a groundwater protection response which will include guidelines for above ground and underground storage tanks (M.F. Rochford, EPA, pers comm.) Pending the completion of EPA guidelines, any underground effluent storage tanks should be double-skinned (that is, have an inner and outer skin) and have an interstitial monitoring device with automatic alarms. All USTs should be provided with overfill prevention. Any above ground fuel or effluent storage tanks should comply with current regulations and be adequately bunded.

Fuel storage tanks should adequately bunded and provided with a leakage detection system.

5.2.2. Mitigation of potential pollution by surface water draining from non-process area of the site e.g. car parking, roofs, access roads, paths etc.

A sustainable drainage system should be installed for all surface waters draining from the non-process area of the proposed development (including roofs). The system installed should have a proven capability of achieving and sustaining at least the following percentage pollution reduction in runoff:

Total Suspended Solids	85%
Heavy Metals	50 – 80%
Chemical Oxygen Demand	50%
Hydrocarbons	90%

Best management practices for treatment of runoff would include:

- Constructed Wetlands
- Vegetated lagoons
- Swales
- Filter strips
- Filter drains
- Infiltration devices
- Oil/grit separators

In a major EPA funded study of the impact of road runoff on water quality in Ireland (Bruen *et al* 2006) it is concluded that "*Each of the Best Management Practices outlined have individual advantages in the removal of pollutants from highway runoff. Therefore, a combination of these systems should be used for enhanced and more uniform overall pollutant removal performance. In fact a combination of runoff management and control measures is recommended whenever it is feasible."* This is also the conclusion of the CIRIA Report C608 on SUDS (Wilson *et al* 2004) which concludes that the more techniques used in a runoff treatment and attenuation system, the better the performance is likely to be.

Petrol/oil and grit interceptors should be located at outfalls to watercourses. Design of those interceptors should conform to the recommendations of CIRIA Report No. 142 (Luker & Montague 1994). The drainage system should have a shut off valve system and the capacity to contain a major accidental spillage.

As virtually all treatment options require proper maintenance in order to function properly, and as some such as oil interceptors can become a source of pollution if not properly maintained, a program of regular cleaning, maintenance and inspection of the runoff treatment system should be put in place to ensure it functions correctly.

5.2.3. Mitigation of potential pollution by effluent from toilet, wash facilities, canteen etc.

Effluent ortho-phosphate concentrations will not exceed 0.5mg/l (RPS pers. comm.) It is proposed to discharge the effluent to ground via a raised polishing filter. Based on maximum effluent discharge rates and the estimated 95 percentile and median flows of the eastern stream to which the discharged effluent would drain, the maximum elevation of ortho-phosphate in the receiving waters over the operational lifetime of the proposed development would be 0.00365 mg/l at 95 percentile low flows and a maximum elevation of 0.00071 at median stream flows. (RPS pers. comm.)

The annual median ortho-phosphate levels of Q3 streams calculated from a large number of streams and sites is 0.070 mg/l (McGarrigle et al 2002); a maximum elevation of 0.00365 mg/l ortho-phosphate at low stream flows would therefore typically represent a maximum increase in ortho-phosphate of c. 5%. A maximum elevation of 0.00071mg/l at median stream flows would typically represent a maximum increase of c. 1%. The existing status of the eastern stream does not meet the requirements of the phosphorus regulations or salmonid standards. In the absence of a reduction of phosphorus inputs from other unidentified sources upstream, any additional phosphorus inputs can only exacerbate the situation. However, the estimated maximum increases in phosphorus resulting from the proposed development would constitute a very minor input relative to other phosphorus inputs upstream. Whereas a "*straw that broke the camels back*" ecological impact on trout in the vicinity of the proposed development cannot be ruled out, such percentage increases of phosphorus would not under normal circumstance be described as significant.

It is the opinion of the author of this report that if the maximum elevation of phosphorus in the stream in the vicinity of the proposed development does not exceed the level estimated, there will be no detectable ecological effect on the cSAC to which this tributary flows.

5.2.4. Mitigation of hydrological impacts

The surface water drainage system for the proposed development should include sufficient flow attenuation to ensure no significant changes in maximum and minimum flow rates of the streams to which the site drains.

5.2.5. Mitigating permanent loss of habitat

To avoid loss of stream and bankside habitat:

i. **The proposed crossing of Stream Section E2 by the proposed development access road should be by way of a span bridge with support structures set back from the stream edge. Disturbance of the stream and its banks should be avoided during the construction process.**

ii. **The proposed culverting of c.12m of Stream Section E1 should be by way of open bottom culvert at least 1.2 times the bankfull width of the stream**

iii. **The proposed extension of the existing culvert under the L3023 by c.7m on its north side in Stream Section E2 should be by way of open bottom culvert at least 1.2 times the bankfull width of the stream or by span bridging.**

One of the most effective methods of minimising loss of stream and riparian habitat during developments such as new road construction is the establishment of Leave Strips. Leave strips are the areas of land and vegetation adjacent to watercourses that are to remain in an undisturbed state, throughout and after the development process (Chilibeck *et al* 1992). Leave strips are valuable not only because riparian vegetation is a vital component of a healthy stream ecosystem, but because this vegetation acts as an effective screen/barrier between the stream and the development area, intercepting runoff and acting as an effective filter for sediment and pollutants from the development area. Except at proposed bridge and culvert locations, a 5m wide riparian leave strip should be clearly marked along both sides of Stream Section E2 and its significance explained to machinery operators.

5.2.6. Mitigation of obstruction to upstream movement of fish and other aquatic fauna due to construction of culverts

In order to prevent significant obstruction to upstream movement of fish and other aquatic fauna, stream crossings should be constructed as specified in Section 5.2.5 above.

5.3. RESIDUAL IMPACTS

If all recommended mitigation measures are implemented in full, the impact of the proposed development on aquatic ecology will be as follows:

	IMPACTS DURING CONSTRUCTION			LONG-TERM IMPACTS				
Potential Impact location	**Suspended Solids Pollution**	**Other Pollutants**	**Pollution from non process area runoff**	**Pollution from process area effluent**	**Pollution from non process waste water**	**Hydro-logical Impacts**	**Habitat Loss**	**Obstruction to upstream movement of fish**
East Tributary	**Minor**	**Minor**	**Minor**	**None**	**Minor***	**Moderate**	**Not Significant**	**Not Signficant**
West Tributary	**Not Significant**	**Not Significant**	**Not Significant**	**Not Significant**	**Not Significant**	**Moderate**	**Not Significant**	**Not Significant**
Gweestin River	**Not Significant**	**Not Significant**	**Not Significant**	**Not Significant**	**Not Significant**	**Minor or not significant**	**None**	**None**

*However the very small stream to which the treated effluent would drain is already in a 'borderline' condition for trout survival. A very small additional phosphorus load from the proposed development could 'tip the balance' particularly immediately downstream.

6. NON TECHNICAL SUMMARY

6.1. EXISTING ENVIRONMENT

The proposed development site is drained by two tributaries of the Gweestin River. The Gweestin River rises in the vicinity of Knockacullig north west of Killarney and flows for c.23km in a roughly westerly direction to join the River Laune c.9km upstream of Killorglin.

The Gweestin is designated under the Quality of Salmonid Waters Regulations 1998 (S.I. No. 293, 1988). Fish surveys carried out by the Central Fisheries Board of the main channel of the Gweestin River recorded salmon at all sites assessed. Most of the Gweestin River is within the Castlemaine Harbour cSAC. The site is designated for a range of Annex I habitats and Annex II species including Sea Lamprey, River Lamprey, Atlantic Salmon. As a cSAC the Gweestin River is classified as of international importance.

The Laune River to which the Gweestin flows drains a catchment of c.320 square miles and is within the Castlemaine Harbour cSAC and is an important salmonid fishery (salmon, sea-trout and brown trout).

The northern part of the proposed development site drains to a small stream (the western tributary) which flows for c.2.5km to join the Gweestin River just upstream of Gweestin Bridge. The southern part of the proposed development site drains to a stream (the eastern tributary) which flows for c.1.5km to the Gweestin River c.2km upstream of Gweestin Bridge. The western tributary was found to be moderately polluted close to the proposed development, but more seriously polluted conditions were observed further downstream. The first 400m of this stream downstream of the proposed development were found to have low habitat value. Some good trout habitat was recorded further downstream. The fish survey carried out for this report recorded no trout at three sites and very low density just upstream of the confluence with the Gweestin River; this is likely to be due to serious pollution and the installation of several culverts along

the length of the stream which would form an obstruction to upstream fish movement. Nevertheless as a small water course with some brown trout and sections of good potential salmonid habitat, the western tributary is classified as of high local value.

The eastern tributary was found to be moderately polluted immediately downstream of the proposed development. The habitat assessment recorded significant salmonid nursery (juvenile) and spawning habitat in this stream and good densities of juvenile brown trout were recorded at all four sites assessed. As a small water course with good juvenile brown trout population and habitat, the western tributary is classified as of high local value. No salmon or lamprey were recorded in the stream; this indicates that these species are either absent or present at very low densities. The lowest c.150m of the stream is part of the Castlemaine Harbour cSAC; the cSAC as a whole is classified as of international importance.

Biological water quality assessment indicated unpolluted conditions and fair – good water quality in the Gweestin River immediately downstream of the confluences of the two tributaries which flow from the proposed development site. The section of the Gweestin River assessed has very good habitat for all salmonid life stages. The river is known to have a population of brown trout and salmon. In the present survey adult brook lamprey (*Lampetra planeri*) were observed in the Gweestin just downstream of the confluence with the eastern tributary. Salmon (*Salmo salar*) have also been recorded by CFB throughout the main channel of the Gweestin river. Both salmon and brook lamprey are listed in Annex II of the habitats directive. The Gweestin river is designated a cSAC specifically for the conservation of Salmon. As a designated cSAC the Gweestin River is classified as of international importance.

6.2. POTENTIAL IMPACTS

The potential significant impacts of the proposed development will be:

1. Pollution of streams with suspended solids due to runoff of soil from construction areas

2. Pollution of streams, during construction phase, with other substances such as fuels, lubricants, waste concrete, waste water from site toilet and wash facilities, etc.

3. Pollution by effluent from the waste processing and storage area and ancillary structures and facilities.

4. Pollution by surface water draining from non process area of the site e.g. car parking, roofs, access roads, paths etc.

5. Pollution by effluent from toilet, wash facilities, canteen etc.

6. Hydrological impacts due to changes in the flow regime of streams draining the proposed development site.

7. **Loss of stream habitat due to construction of the proposed development access road**

8. **Obstruction to upstream movement of fish and other aquatic fauna due to construction of proposed new development access road and upgrading of existing L3023 road adjacent to the proposed development**

In the absence of mitigation, the potential impact of the proposed facility on streams & rivers would be major during both the construction phase and operational phase.

6.3. MITIGATION MEASURES

Detailed measures are presented to minimise pollution generated during the construction process.

All drainage from the material recovery facility including delivery areas will be on an impervious surface to a holding tank for tankering to a waste treatment facility.

All non process paved and roofed areas will be drained according to sustainable drainage system (SUDS) principles . The surface water drainage system for the proposed development will include sufficient flow attenuation to ensure no significant changes in maximum and minimum flow rates of the streams to which the site drains.

Effluent from toilet, wash facilities, canteen etc. will be treated using best available techniques before discharge to ground. Specifically the discharged effluent will result in a maximum elevation in ortho-phosphorus in adjacent streams of 0.00365 mg/l at low flows and 0.00071 mg/l at median stream flows (RPS pers. comm.)

Any underground effluent storage tanks should be double-skinned (that is, have an inner and outer skin) and have an interstitial monitoring device with automatic alarms. All underground effluent storage tanks should be provided with overfill prevention. Any above ground fuel or effluent storage tanks should comply with current regulations and be adequately bunded and provided with a leakage detection system.

In order to protect stream habitat during the construction phase, a leave strip should be marked out and left undisturbed along both sides of the East Tributary where it flows between the N22 and the L3023.

In order to protect stream habitat and in order to avoid obstruction to upstream movement of fish and other aquatic fauna, the crossing of the

East Tributary by the proposed development access road should be by means of a span bridge with support structures set back from the stream banks; the 7m extension to the culvert under the L3023 should be by means of an open bottom culvert or span bridge, and the culverting of c.12m of Stream Section E1 should be by way of an open bottom culvert.

6.4. RESIDUAL IMPACTS

If all recommended mitigation measures are implemented in full, the impact of the proposed development on aquatic ecology will be minor. It is however noted that the very small stream to which the treated effluent would drain is already in a 'borderline' condition for trout survival. A very small additional phosphorus load from the proposed development could 'tip the balance', particularly immediately downstream of the proposed development. However, it is the opinion of the author of this report that if the maximum elevation of phosphorus in the stream in the vicinity of the proposed development does not exceed the level estimated, there will be no detectable ecological effect on the cSAC to which this tributary flows.

REFERENCES

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APPENDIX 1

SUBMISSIONS

APPENDIX 2

EPA MONITORING DATA

River and Code : **GWEESTIN** **22/G/06**
Tributary of : Laune OS Catchment No: 207
OS Grid Ref : V 833 948

Sampling Stations No.	Location	Biological Quality Ratings (Q Values) 1990	1994	1996	1998	2001	2004
0300	Dooneen Br	-	4	4	4-5	4	4
0400	Br E of Ballydeenlea	4	-	-	-	-	-
0600	Gweestin Bridge	3	4	3-4	3-4	4	4
0800	Rockfield Bridge	4	-	-	-	-	-
0900	Br u/s Listry Br	-	4	4	4	4	4
1000	Listry Bridge	4	-	-	-	-	-
1200	Gweestin Bridge	2-3	3	2-3	3	3	3

APPENDIX 3

NPWS cSAC SITE SYNOPSIS

SITE SYNOPSIS

SITE NAME: CASTLEMAINE HARBOUR

SITE CODE: 000343

This is a large site located on the south-east corner of the Dingle Peninsula, County Kerry. It consists of the whole inner section of Dingle Bay, i.e. Castlemaine Harbour, the spits of Inch and White Strand/Rosbehy and a little of the coastline to the west.The River Maine, almost to Castlemaine and much of the River Laune catchment, including the Gaddagh, Gweestion, Glanooragh, Cottoner's River and the River Loe, are also included within the site. The site is a candidate SAC selected for fixed grey dunes and alluvial wet woodlands, both priority habitats on Annex I of the E.U. Habitats Directive. The site is also selected as a candidate SAC for estuaries, tidal mudflats, Atlantic salt meadows, Salicornia mudflats, Mediterranean salt meadows, drift line vegetation, perennial vegetation of stony banks, dunes with creeping willow, dune slacks, embryonic shifting dunes and Marram dunes, all habitats listed on Annex I of the E.U. Habitats Directive. The site is also selected for the following species listed on Annex II of the same directive – Sea Lamprey, River Lamprey, Atlantic Salmon, Otter and the liverwort, Petalwort. Inch Spit holds a fine sand dune system. It is the largest and arguably one of the best remaining 'intact' dune systems in the country. In the younger, more mobile dunes, Marram (Ammophila arenaria) is common, with Groundsel (Senecio vulgaris), Sea Rocket (Cakile maritima) and Dandelion (Taraxacum sp.) also present. The fixed, more stable dunes support Lady's Bedstraw (Galium verum), Common Bird's-foottrefoil (Lotus corniculatus), Wild Thyme (Thymus praecox), Kidney Vetch (Anthyllis vulneraria), Wild Pansy (Viola tricolor) and Biting Stonecrop (Sedum acre), among others. The slightly damper conditions which prevail in dune slacks support Creeping Bent (Agrostis stolonifera), Crested Dog's-Tail (Cynosurus cristatus), Glaucous Sedge (Carex flacca), Creeping Willow (Salix repens) and Jointed Rush (Juncus articulatus). The rare bryophyte Petalwort (Petalophyllum ralfsii), which is listed on Annex II of the E.U. Habitats Directive, has been recorded in this system. A smaller spit, with a similar diversity of dune types, occurs at Rosbehy on the southern shore, from where Yellow Centaury (Cicendia filiformis) and Knotted Pearlwort (Sagina nodosa) have been recorded from a dune slack along with other, more common species. The sand spits, and also the Coomore peninsula, are underlain by shingle and in places the shingle is exposed and supports a characteristic flora. Species present include Lyme-grass (Leymus arenarius), Sandwort (Honkenya peploides) and two Red Data Book plants, Sea Pea (Lathyrus japonicus) and Sea-kale (Crambe maritima). The coastline is fringed in many places by saltmarsh. The vegetation here includes Thrift (Armeria maritima), Common Saltmarsh-grass (Puccinellia maritima), Sea Aster (Aster tripolium), Sea Rush (Juncus maritimus) and Sea Plantain (Plantago maritima). Upper saltmarsh communities extend inland, along estuarine channels, where they are mixed with freshwater communities. Sea Club-rush (Scirpus maritimus) and Common Reed (Phragmites australis) occur at these locations. Cordgrass (Spartina anglica) has colonised the lower part of the saltmarsh at Inch and extends out onto the open mudflat. West of Inch, cliffs of glacial drift occur, which support such plants as Ivy (Hedera helix), Red Fescue (Festuca rubra), Ling Heather (Calluna

vulgaris) and Honeysuckle (Lonicera periclymenum). Along the cliff-tops there is coastal grassland with species such as Sweet Vernal-grass (Anthoxanthum odoratum), Cock's-foot (Dactylis glomerata) and Wood Sage (Teucrium scorodonia). Much of the site consists of intertidal sand and mudflats, supporting beds of Eelgrass (Zostera marina) in some places. The rivers and their associated habitats also make up a considerable portion of the site. These associated habitats include wet grassland, woodland, scrub and bog/heath. In the valley up-river of Killorglin, is an interesting area of alluvial wet woodland, dominated by Alder (Alnus glutinosa) and Willow (Salix spp.). Five plants listed in the Irish Red Data Book have been recorded at this site: Sea-kale, Sea Pea, Corn Cockle (Agrostemma githago), Pennyroyal (Mentha pulegium) and Irish Lady's-tresses (Spiranthes romanzoffiana). The two last-named are legally protected under the Flora (Protection) Order, 1999 as is the rare bryophyte, Petalwort. Other scarce species which occur here are Yellow Bartsia (Parentucellia viscosa), Lax-flowered Sea-lavender (Limonium humile) and Blue-eyed-grass (Sisyrinchium bermudiana). Castlemaine Harbour is a very important site for passage and wintering waterfowl. The following figures are derived from counts between 1994/5 and 1996/7. One species occurs here in internationally important numbers - Brent Goose (734) – with 16 species having populations of national importance: Cormorant (215), Shelduck (129), Pintail (167), Scaup (138), Wigeon (3,513), Red-breasted Merganser (51), Oystercatcher (1,539), Ringed Plover (330), Golden Plover (1940), Grey Plover (122), Knot (347), Sanderling (207), Dunlin (1360), Redshank (299), Greenshank (26) and Turnstone (296). The vicinity of Castlemaine Harbour is also important as one of few areas in Ireland - all in Kerry - where the Natterjack Toad naturally occurs. This amphibian is listed in the Irish Red Data Book and on Annex IV of the E.U. Habitats Directive. The site also supports a small colony of Common Seal, while two Lamprey species have been recorded in the Laune river catchment. The Laune catchment is used by Otter and is an important salmon system with nurseries, riffles pools and glides. Castlemaine Harbour is of major ecological importance. It contains a range of coastal habitats of excellent quality, including many that are listed on Annex I of the EU Habitats Directive. It also includes long stretches of river and stream which are excellent habitats for Salmon, Lamprey and Otter. Inch dunes are recognised as among the finest in the country, with particularly well-developed dune slacks. The site supports internationally important waterfowl populations, rare plant species, the rare Natterjack Toad and populations of several animal species that are listed on Annex II of the E.U. Habitats Directive. Part of the site is designated a Special Protection Area and is listed as a site under the Ramsar Convention. Part of Castlemaine Harbour is a Statutory Nature Reserve, while Inch and Rosbehy are Wildfowl Sanctuaries.

APPENDIX 4

HABITAT ASSESSMENT AT INVERTEBRATE SAMPLING SITES

Site Code	TA2	TB2	G2	G4
Grid Reference	V9361 9939	V9340 9980	V9343 9862	V9238 9821
Photograph Number	21	6	34	38
Width (m)	1-2	0.74	6	15
Depth (cm)	8	5	25	10 – 20
Substrate	Gravel, Cobble, Mud	Mud, Gravel, Cobble	Cobble, Gravel, Sand	Cobble, Gravel, Sand
Flow Type	Riffle 50% Glide 50%	Riffle 40% Glide 60%	Riffle 20% Glide 80%	Riffle 25% Glide 75%
Instream Vegetation	None	None	Filamentous algae <1%	None
Dominant Bankside Vegetation	Hawthorn	Gorse	Willow	Ash
Summer Shade of Stream by Bankside Vegetation	30%	40%	35%	35%
Salmonid Adult Habitat	Poor	None	Good	Fair
Salmonid Nursery Habitat	Fair	Fair	Very Good	Good – Very Good
Salmonid Spawning Habitat	Poor - Fair	Poor - Fair	Good	Good

APPENDIX 5

PHOTOGRAPHS

APPENDIX 6

FISH SURVEY DATA

SITE E-A

Site Code	E-A
Grid Reference	V9362 9939
Photograph Number	21 - 23
Width (m)	0.3 – 0.75
Depth (cm)	3 - 10
Substrate	Bedrock, Mud, Cobble, Gravel
Flow Type	Riffle 35% Glide 65%
Instream Vegetation	None
Dominant Bankside Vegetation	Willow Hawthorn
Summer Shade of Stream by Bankside Vegetation	60%
Salmonid Adult Habitat	Poor
Salmonid Nursery Habitat	Fair – Good
Salmonid Spawning Habitat	Poor - Fair

Area Fished (m^2)	c.27
Duration of electrofishing (mins)	10
Fish Species Recorded	Brown Trout
Number of Brown Trout Recorded	11
Minimum brown trout density	0.407 m^2
C.P.U.E (trout per hour fishing equivalent)	66

Details of salmonids captured

Brown Trout Fork Length (cm)	Age
4.0	0+
4.1	
4.2	
4.2	
4.4	
4.5	
4.5	
4.6	
4.8	
4.8	
4.9	

SITE E-B

Site Code	E-B
Grid Reference	V9335 9914
Photograph Number	24 & 25
Width (m)	0.5 - 2
Depth (cm)	5 - 10
Substrate	Cobble, Gravel, Mud
Flow Type	Riffle 40% Glide 60%
Instream Vegetation	None
Dominant Bankside Vegetation	Willow, Hawthorn, Ash
Summer Shade of Stream by Bankside Vegetation	70%
Salmonid Adult Habitat	Poor
Salmonid Nursery Habitat	Fair – Good
Salmonid Spawning Habitat	Fair

Area Fished (m^2)	c.37
Duration of electrofishing (mins)	10
Fish Species Recorded	Brown Trout
Number of Brown Trout Recorded	11
Minimum brown trout density	0.297 m^2
C.P.U.E (trout per hour fishing equivalent)	66

Details of salmonids captured

Brown Trout Fork Length (cm)	Age
4.0	0+
4.3	
4.3	
4.4	
4.5	
4.5	
4.6	
5.1	
5.3	
5.6	
13.0	1+

SITE E-C

Site Code	E-C
Grid Reference	V9336 9882
Photograph Number	26 & 27
Width (m)	0.5 - 1
Depth (cm)	5 - 12
Substrate	Cobble, Gravel, Mud
Flow Type	Riffle 50% Glide 50%
Instream Vegetation	None
Dominant Bankside Vegetation	Sycamore, Oak, Hawthorn
Summer Shade of Stream by Bankside Vegetation	75%
Salmonid Adult Habitat	Poor
Salmonid Nursery Habitat	Fair – Good
Salmonid Spawning Habitat	Fair

Area Fished (m^2)	c.22
Duration of electrofishing (mins)	7
Fish Species Recorded	Brown Trout
Number of Brown Trout Recorded	15
Minimum brown trout density	0.682m^2
C.P.U.E (trout per hour fishing equivalent)	128

Details of salmonids captured

Brown Trout Fork Length (cm)	Age
3.8	0+
4.0	
4.1	
4.1	
4.2	
4.2	
4.3	
4.3	
4.3	
4.3	
4.4	
4.4	
4.8	
4.9	
5.0	

Lamprey Assessment

Location	V9336 9878
Photograph	28
Area Fished	2m²
Lamprey Recorded	0

SITE E-D

Site Code	E-D
Grid Reference	V9342 9863
Photograph Number	29
Width (m)	0.5 - 1
Depth (cm)	4 - 8
Substrate	Gravel, Cobble, Mud
Flow Type	Riffle 50% Glide 50%
Instream Vegetation	None
Dominant Bankside Vegetation	Willow, Gorse, Ash, Hawthorn
Summer Shade of Stream by Bankside Vegetation	85%
Salmonid Adult Habitat	None - Poor
Salmonid Nursery Habitat	Fair – Good
Salmonid Spawning Habitat	Fair

Area Fished (m^2)	c.22
Duration of electrofishing (mins)	5
Fish Species Recorded	Brown Trout
Number of Brown Trout Recorded	16
Minimum brown trout density	0.727m^2
C.P.U.E (trout per hour fishing equivalent)	264

Details of salmonids captured

Brown Trout Fork Length (cm)	Age
2.9	0+
3.2	
3.3	
3.4	
3.4	
3.7	
3.9	
3.9	
3.9	
4.2	
4.3	
4.3	
4.4	
4.5	
4.7	

Lamprey Assessment

Location	V9339 9868
Photograph	30
Area Fished	2m²
Lamprey Recorded	0

SITE W-A

Site Code	W-A
Grid Reference	V9293 9967
Photograph Number	23
Width (m)	1
Depth (cm)	7
Substrate	Gravel, Cobble, Mud
Flow Type	Riffle 75% Glide 25%
Instream Vegetation	None
Dominant Bankside Vegetation	Willow, Hawthorn
Summer Shade of Stream by Bankside Vegetation	65%
Salmonid Adult Habitat	Poor
Salmonid Nursery Habitat	Fair – Good
Salmonid Spawning Habitat	Poor

Area Fished (m^2)	c.30
Duration of electrofishing (mins)	5
Fish Species Recorded	None

SITE W-B

Site Code	W-B
Grid Reference	V9271 9921
Photograph Number	7 & 8
Width (m)	1.5
Depth (cm)	8
Substrate	Gravel, Cobble, Mud
Flow Type	Riffle 25% Glide 75%
Instream Vegetation	Slime growth 90%
Dominant Bankside Vegetation	Willow, Alder
Summer Shade of Stream by Bankside Vegetation	65%
Salmonid Adult Habitat	Poor
Salmonid Nursery Habitat	Fair
Salmonid Spawning Habitat	Poor

Area Fished (m^2)	c.67
Duration of electrofishing (mins)	7
Fish Species Recorded	None

SITE W-C

Site Code	W-C
Grid Reference	V9250 9881
Photograph Number	11
Width (m)	1
Depth (cm)	5 - 10
Substrate	Cobble, Mud, Gravel, Sand
Flow Type	Riffle 10% Glide 90%
Instream Vegetation	None
Dominant Bankside Vegetation	Willow, Gorse, Hawthorn, Alder
Summer Shade of Stream by Bankside Vegetation	80%
Salmonid Adult Habitat	Poor
Salmonid Nursery Habitat	Fair
Salmonid Spawning Habitat	Poor - Fair

Area Fished (m^2)	c.35
Duration of electrofishing (mins)	8
Fish Species Recorded	None

SITE W-D

Site Code	W-D
Grid Reference	V9237 9829
Photograph Number	18
Width (m)	1.5
Depth (cm)	5 - 20
Substrate	Cobble, Mud, Gravel, Sand
Flow Type	Riffle 5% Glide 95%
Instream Vegetation	None
Dominant Bankside Vegetation	Ash, Bramble
Summer Shade of Stream by Bankside Vegetation	50%
Salmonid Adult Habitat	Poor
Salmonid Nursery Habitat	Fair
Salmonid Spawning Habitat	Fair

Area Fished (m^2)	c.90
Duration of electrofishing (mins)	10
Fish Species Recorded	Brown Trout, Three-spined Stickleback
Number of Brown Trout Recorded	1
Minimum brown trout density	0.011m^2
C.P.U.E (trout per hour fishing equivalent)	6

Details of salmonids captured

Brown Trout Fork Length (cm)	Age
4.8	0+