Environmental Protection Agency,
Licensing Unit
Office of Licensing and Guidance,
Environmental Protection Agency,
Headquarters
PO Box 3000
Johnstown Castle Estate
Co. Wexford

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Your Ref: letter dated 29th March 2006

12th May 2006

Re: Waste Licence Application Reg. 211-1 AVR Environmental

Further to our meeting with Ms. Ciara Maxwell and Mr. Patrick Byrne of the EPA on 16th March 2003 with respect to clarification of information regarding the above referenced licence, please find attached our written response with regard to same.

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If you require any further information/clarification with respect to the above please do not hesitate to contact the undersigned.

Best regards

_____

Denis O Sullivan
Project Manager

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Document Control Sheet

Client: AVR Environmental Services Ltd.	
Document Brief	
Report type (draft or final)	Final
Report from:	Denis O'Sullivan Project Manager SWS Group
Report Issue Date	12th May 2006
SWS Environmental Report Brief Ref.	2004_121 Response to information memorandum received from EPA and meeting of 16/03/06 and request for written response Waste Licence reg. 211-1

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Point 1:

Proposed emission of trade effluent. Based on the modeled results submitted in December 05 from the analysis undertaken, the EPA raised a query with respect to the exceedences noted from modeled results. The Agency also requested that cooling water to be included in any additional modeling with respect to potential discharge impact.

Response

The initial modelling results were based on "worst case scenario" results from samples analysed under laboratory conditions which do not accurately simulate real life results of treated condensate. These results were treated as worst case scenario and were provided to the Agency as such. Post submission of these laboratory tested results and discharge modelling to the Agency in December 05 (ref EPA Compliance Response licence Reg. 211-1 Doc 2004-121 Dec 05), it was possible to get condensate from the process analysed under real life conditions via submission of raw sludge samples to the supplier of the sludge drying facility Vomm impresia who have been involved in the sludge drying industry for over 35 years. These give an accurate representation of the proposed discharge prior to pumping to the on site Bord Na Mona Waste Water Treatment Facility where the effluent will be treated to meet limits stipulated by Cork County Council and The Agency prior to discharge.

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The condensate analysis suite was therefore provided to the proposed on site Waste Water Treatment provider with a suite of emission limit standards to be adhered to (Table 1) and the effluent discharge was remodelled to determine what impact the discharge would have on the receiving waters. The Environmental Division and the Sanitary Division of Cork County Council were contacted with respect to potential emission limit values. They noted that the discharge must, at a minimum, adhere to the requirements of the Urban Waste Water Treatment Directive and to take account of the Shellfish Directive, to ensure that the effluent does not negatively impact on water quality in the Blackwater Estuary. This was taken into account in stipulating emission limit values to be adhered to by the on site waste water treatment facility.

The discharge from the site waste water treatment plant will be to Youghal estuary and subsequently, when constructed, it is proposed that discharge be to Cork County Council Youghal Waste Water Treatment Facility. The discharge application therefore requires permission for the discharge of trade effluent to be issued from Cork County Council (CCC) to ensure emission limits will meet the requirements of their treatment facility when constructed. CCC were therefore consulted with respect to emission limits and emission parameters. The request for permission for same will be re-issued via the EPA to the Local Authority based on the revised emissions supplied. This treatment plant is currently being designed and anticipated

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to be in operation in c 5 years. A meeting with the relevant bodies in CCC will also be requested by the developer to ensure that their emission limit requirements are adhered to.

With respect to site foul effluent, it is now proposed that this would be treated separately to trade effluent with a small, biological membrane bioreactor package plant which will discharged via SE1 emission point. This treatment system is designed for treatment of light commercial wastewater with a 99.9% reduction in faecal coliforms. The site foul effluent system will treat on site effluent for up to 8 persons (maximum) with an average 2 person/daily load.

A specification for this proposed treatment system is attached for reference in appendix 1. Microbiological analysis of condensate from sludge was not undertaken as one of the benefits of using a thermal treatment system such as the VOMM drying system is that it is a proven technology in the field of industrial, pharmaceutical and municipal sludge drying nationally (sewage sludge) and internationally (all sludge types) and produces a pathogen-free, sterile product.

Results of the proposed trade effluent were modelled utilising a solute transport model to determine what impact this discharge would have on the receiving environment and results are presented in appendix 1. Additional parameters were also modelled as requested by the Agency (thermal discharge modelling based on cooling water impact on receiving environment). These results indicate that the proposed discharge will not negatively impact on the receiving environment. Table E 3(i) is resubmitted on the basis of the revised information.

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Table 1: Suite of Condensate Analysis

Youghal AVR Results

Condensate Analysis - prior to waste water treatment and discharge modelling

Analysis Suite provided to Waste Water Treatment Provider

Comparison of condensate with Relevant Standards

Apr-06

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Parameters	Units	Condensate raw water quality Results	Waste Water Treatment System - discharge limits to be adhered to at point of discharge	Urban Waste Water Treatment 91/271/EC	Shellfish Directive 91/692/EC SI 200 1994	Dangerous substances 76/464/EC SI 12/2001	EQS Surface Water	Drinking Water Standard
BOD	mg/l	<2	25	25				
Mercury	ug/l	<0.05	<0.05				1	1
Potassium	mg/l	4.8					-	12
Sodium	mg/l	42.5					-	150
SVOCs	ug/l	<1						
VOCs	ug/l	<1	10					

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Total Solids	mg/l	286						
Total Suspended Solids	mg/l	119	35	35	no greater rise than 20%		-	-
Total Phosphorous	mg/l	0.8		1			-	-
Disolved Aluminium low level	mg/l	0.083					0.2	0.2
Disolved Arsenic low level	ug/l	2				20	25	10
Disolved Boron low level	ug/l	14					2000	1000
Disolved Calcium low level	mg/l	38.8					-	200
Disolved Cadmium low level	ug/l	<1					5	5
Disolved Chromium low level	ug/l	6				15	30	50
Dissolved Cobalt low level	ug/l	<1					-	-
Dissolved Copper low level	ug/l	<1				5	30	2000

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Dissolved Iron low level	ug/l	103					1000	200
Dissolved Lead low level	ug/l	18				5	10	10
Dissolved Magnesium low level	ug/l	8.297					300	50
Dissolved Nickel low level	ug/l	10				25	50	20
Dissolved Selenium low level	ug/l	<1						10
Dissolved Zinc low level	ug/l	47				50	100	5000
TOC	mg/l	5						No abnormal change
Chloride	mg/l	28	28				250	250
Fluoride	mg/l	0.2	0.2				5	1
Orthophosphate (PO4)	mg/l	1.72	0.03				-	0.03
Sulphate	mg/l	17					200	250
Total Oxidised Nitrogen (as N)	mg/l	<0.3						

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pH	pH units	8.13	7-9.		7-9.		-	≤ 6.5 and ≥ 9.5
Total Dissolved Solids	mg/l	273					-	1000
Turbidity	NTU	1.5	1.5				-	No abnormal change
Kjeldahl Nitrogen	mg/l	15	2				-	-
Ammoniacal Nitrogen NH_3 (as N)	mg/l	8.5					0.02	0.3
COD	mg/l	199	125	125				
Free Cyanide	mg/l	<0.05				10	0.01	0.05
Total Nitrogen as N	mg/l	24		10			-	-
Total Alkalinity as $CaCO_3$	mg/l	210	210					No abnormal change
Temperature					no greater rise than 3°			

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*Note: Surface Water Regulations limits in Phosphates: 0.22 to 0.3 mg/l P

Ortophosphates 1.72 mg/l as PO4 = 0.56 mg/l as P

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TABLE E.3 (i): EMISSIONS TO SEWER (One page for each emission)

Emission Point:

Emission Point Ref. Nº:	SE 1
Location of connection to sewer :	Exact location to be agreed with Youghal Town Council but in close proximity to waste water treatment plant and storm water retention tank
Grid Ref. (10 digit, 5E,5N):	20973E 07986N
Name of sewage undertaker:	Sanitary Authority Youghal Town Council

Emission Details:

(i) Volume to be emitted			
Normal/day	132m^3	Maximum/day	168 m^3
Maximum rate/hour	7m^{3*}		

* this includes for any additional cooling water required. modelling and discharge calculations carried out on worst case scenario discharge. Thermal impact discharge takes account of impact of cooling/dilution water

(ii) Period or periods during which emissions are made, or are to be made, including daily or seasonal variations (*start-up /shutdown to be included):*

Periods of Emission (avg)	60 min/hr 24 hr/day 350 day/yr

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TABLE E.3(ii): EMISSIONS TO SEWER - Characteristics of the emission (1 table per emission point)

Emission point reference number : **SE1**

Parameter	Prior to treatment				As discharged				% Efficiency
	Max. hourly average (mg/l)	Max. daily average (mg/l)	kg/day	kg/year	Max. hourly average (mg/l)	Max. daily average (mg/l)	kg/day	kg/year	
BOD	<2		0.264	92.4	<2		0.264	92.4	NR
Mercury	<0.00005		0.0000066	0.0231	<0.00005		0.0000066	0.0231	NR
Potassium	4.8		0.6336	221.76	4.8		0.6336	221.76	NR
Sodium	42.5		5.61	1974	42.5		5.61	1974	NR
sVOC's	<0.001		0.000132	0.462	<0.001		0.000132	0.462	NR
VOC's	<0.001		0.000132	0.462	<0.001		0.000132	0.462	NR
Total Solids	286		37.752	13213	286		37.752	13213	NR
Total Suspended Solids	119		15.708	5497.8	35		4.62	1617	95
Total Phosphorous	0.8		0.1056	36.96	0.8		0.1056	36.96	*
Dissolved Aluminium	0.083		0.010956	3.8346	0.083		0.010956	3.8346	NR
Dissolved Arsenic	0.002		0.000264	0.0924	0.002		0.000264	0.0924	NR
Dissolved Boron	0.014		0.001848	0.6468	0.014		0.001848	0.6468	NR
Dissolved Calcium	38.8		5.1216	1792.56	38.8		5.1216	1792.56	NR
Dissolved Cadmium	<0.001		0.00132	0.462	<0.001		0.00132	0.462	NR
Dissolved Cobalt	<0.001		0.00132	0.462	<0.001		0.00132	0.462	NR

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Dissolved Chromium	0.006		0.000792	0.2772	0.006		0.000792	0.2772	NR
Dissolved Cobalt	<0.001		0.00132	0.462	<0.001		0.00132	0.462	NR
Dissolved Copper	<0.001		0.00132	0.462	<0.001		0.00132	0.462	NR
Dissolved Iron	0.103		0.013596	4.7586	0.103		0.013596	4.7586	NR
Dissolved lead	0.018		0.002376	0.8316	0.018		0.002376	0.8316	NR
Dissolved magnesium	0.008297		0.001095204	0.3833214	0.008297		0.001095204	0.3833214	NR
Dissolved nickel	0.01		0.00132	0.462	0.01		0.00132	0.462	NR
Dissolved selenium	<0.001		0.00132	0.462	<0.001		0.00132	0.462	NR
Dissolved zinc	0.047		0.006204	2.1714	0.047		0.006204	2.1714	NR
TOC	5		0.66	231					NR
Chloride	28		3.696	1293.6	28		3.696	1293.6	0
Flouride	0.2		0.0264	9.24	0.2		0.0264	9.24	0
Orthophosphate	1.72		0.22704	79.464					
Sulphate	17		2.244	785.4	17		2.244	785.4	0
Total oxidized nitrogen (N)	<0.3		0.0396	13.86					
pH	8.13					No change unless pH correction is required			
Total dissolved solids	273		36.036	12612.6					

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Turbidity	1.5		0.198	69.3					
Kjeldhal nitrogen	15		1.98	693	10				
Ammoniacal nitrogen NH3	8.5		1.122	392.7					
COD	199		26.268	9193.8	125				95
Free cyanide	<0.05		0.0066	2.31	<0.05		0.0066	2.31	
Total nitrogen as N	24		3.168	1108.8	10				
Total alkalinity	210		27.72	9702	210		27.72	9702	Assuming no pH correction
*Micro	Not relevant								NR
Temperature	25°C				25°C				NR

- MRB is not designed to remove metals. Metals associated with suspended solids in the feed will be removed by the process dissolved metals are not removed by process. Therefore, no metal reduction was assumed and figures are provided as worst case scenario data.

** no assumption made for reduction in P as emission are lower than emission limit requirements and therefore no while greater removal can be achieved by the addition of ferric chloride or ferric sulphate for P removal, none is considered necessary System is designed to steralise so is pathogen free and foul water is treated separately.

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Point 2:

With respect to the use of biomass as fuel in the boiler; the Agency requested clarification regarding disposal of ash and quantities generated per annum.

Response

i) Fuel

The design of the boiler shall be based on the processing of wood biomass with varying moisture content. All fuel shall be clean and free from contamination.

Wood Biomass will be sourced from un-contamined sources as follows:

i) Timber processing industry - clean woodchip, sawdust and bark

ii) licensed transfer stations - clean segregated wood

On site Standard Operating procedures will be put in place to ensure that wood sourced complies with the requirements of:

> Directive 2000/76/EC on the incineration of waste excludes certain plants from the scope of the Directive. Article 2(iv) provides for the exclusion of "*Wood waste with the exception of wood waste which may contain halogenated organic compounds or heavy metals as a result of treatment with wood-preservatives or coating, and which includes in particular such wood waste originating from construction and demolition waste*"

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Within this specification biomass wood sources as outlined above are excluded from the waste incineration directive.

ii) Ash from wood sourced from i) and ii) can be calculated at between 0.1- up to 1% of the total fuel, depending on the fuel mix. Therefore, for year 1-4 prior to full production, total ash volumes will be up to 70 t/pa and subsequently, up to 127 t/pa when the plant is in full operation based on fuel input of 700 t/pa (year 1-4)– 12,700 t/pa (post year 4 when plant is anticipated to be in full production)

iii) End use:

Initially it is proposed that material be disposed of in the adjacent Youghal Landfill (Waste licence reg. no 68-2). If a more environmentally appropriate option becomes available based on the EPA's policy of reduce, reuse and recycle to minimize disposal to landfill, a formal proposal shall be submitted to the EPA for approval at a later stage. At this stage until ash is produced from the plant it is premature to look at alternative options.

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Point 3:

The Agency Requested Standards for use of treated sludge pellets as a fuel and possible markets;

Response

The incoming waste materials will be sludges and wastewater which will be classified as per their EWC Code references. After processing at the sludge drying facility, the granulate product will be transported with EWC Code 19 12 12 or alternatively EWC Code 19 08 12 ; 19 08 14 or another suitable EWC Code based on the acceptance criteria of the receiving facility.

19 08 12	sludges from biological treatment of industrial waste water other than those mentioned in 19 08 11
19 08 14	sludges from other treatment of industrial waste water other than those mentioned in 19 08 13
19 12 12	other wastes (including mixtures of materials) from mechanical treatment of wastes other than those mentioned in 19 12 11

If a suitable Irish outlet becomes available at a later stage this would be considered with the approval of the Agency

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Point 4:

The Agency requested clarification with respect to volume of air to be treated in the biofilter from negative air pressure system in Sludge Drying Building. (how many air changes) and hooded WWTP (727m3/hr); specifications of biofilter including control parameters and key monitoring equipment; suitable abatement for potential acetone emission from WWTP.

Response

The proposed air emission abatement plant shall consist of a packaged biological filtration unit supplied by Bord na Móna Environmental Ltd utilising their "Mónashell" biofilter technology (appendix 2).

The proposed biofilter has a capacity of 1500m3/hr. There are two locations within the sludge dryer buildings were extractions are taken to the Biofilter. An extraction of 350m3/hr of non-condensables is taken from the cooling tower and an extraction of 100m3/hr is taken from the wet sludge storage silo. A further extraction of 727m3/hr is taken from the WWTP.

Further analysis was undertaken on the condensate from the drying plant to establish whether acetone and emisisons of hydrogen sulphide would be present in the extracted air. The results of this analysis were used to determine the type of biofilter applied. Results of this monitoring indicate that emissions of acetone Sulphide and indicate that levels are negligible and acetone emission levels were <1mg/.

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	Cooling Tower	Wet Sludge Storage silo	WWTP	Total
Min/day	4800m3	2000m3	16800m3	23600m3
Max./day	10800m3	3000m3	21600m3	35400m3

i) Reference schematic

ii) Specification of biofilter (Bord Na Mona technology) – See appendix 2 for Specification

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Point 5:

The Agency requested clarification with respect to noise levels at the nearest NSL average daytime level dB(A), night-time level currently 50dB(A), due to traffic and proximity to the R634. Can 55:45 be achieved at the site boundary from on-site activities?

Response

The night time level at leq $_{15\ min}$ at the NSR is recorded at a range of 30-59db with an average level of 43-44 dBa.

The only valid noise limit that can be imposed on the development is that noise from the plant will not increase the ambient noise level at the NSL by more than 5 dB(A).

The imposition of a mandatory level of 45 dB(A) for night time period will automatically result in exceedances from natural and existing anthropogenic noise sources which can exceed this level for considerable periods of time.

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Noise control and monitoring requirements for the facility should require monitoring at the perimeter and at the NSL to ensure that the facility is not contributing to nuisance noise levels.

Note:

i) the site is located near the coast therefore background noise levels will be higher than in remote inland locations.

ii) the site is located near a busy Regional and National Route which is a significant anthropogenic noise source in the area.

Background noise level is therefore greater than usual boundary noise limits because of traffic

The licencee requests that the EPA consider the licence in light of the above and while stipulating a limit of 45dB at night with an additional licence requirement stating that the noise from the facility will not increase background noise by more than 5dB. The licencee wishes to express concern that noise which is non related to the facility will result in non compliances in the licence if issued with a mandatory level of 45dBA without application of a second noise limit that would apply in the event of exceedances from natural and existing anthropogenic noise sources. In this case a stipulation that

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noise from the plant will not increase the ambient noise level at the NSL by more than 5 dB(A) should apply.

The licencee requests that the Licence be set for 30 minute Leq and not 15 minute Leq. For reference purposes note that the adjacent Youghal landfill ref 68-1: noise limits are set at 30min Leq. Other examples where this has been imposed include waste license 50-1 (AVR Safeway, Corrin, Fermoy, Co.Cork) Greenstar Recycling (Munster) Ltd., Glanmire, Co.Cork Ref. 136-2, Advanced Environmental Solutions, Kyletalesha, Co.Laois Ref. 194-1, Greenstar Ltd, Ballycoolin, Dublin Ref. 183-1,Greenstar materials Recovery Ltd, Rathcoole, co. Dublin Ref 188-1,Greenstar Recycling Holdings ref 171-1.

As discussed at our recent meeting, the Agency will review the necessity of setting 30min Leq noise monitoring intervals.

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Point 6:

Section L of Application Form – details of how the proposed facility will meet the requirements of Section 40(4)[(a) to (i)] of the WMA 1996 to 2005 and describe how the facility will meet BAT, making particular reference to the considerations referred to in Annex IV of the IPPC Directive

Response

As discussed at our meeting of 16th March 2006, the only outstanding item in this regard was in reference to discharge (ref SE1) from the on site waste water treatment facility and compliance with required discharge parameters. As per point 1 additional analysis and additional modelling were undertaken to ensure that this could be achieved. A meeting with the Environmental Division and Sanitary Division of Cork County Council was also requested to discuss any discharge requirements required to meet emission limit standards of Cork County Council. At the verbal request of Cork County Council (V. Hannon Environmental Division CCC pers comms), this meeting would take place post receipt of the results of the proposed discharge and modelling results to the Authority via the EPA.

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It was noted by CCC that, at a minimum, emission limits should meet limits set under the Urban Waste Water Treatment Directive (91/271/EC amended by 98/15/EC) and the Quality of Shellfish Waters Regulations. Emissions were also compared with other relevant standards including the Dangerous Substances Regulations 2001 (SI 12 2001) and EPA 2000 Water Quality in Ireland 1998-2000. Results of the modelling undertaken demonstrate that the discharge will not adversely impact on the receiving environment and will therefore meet the requirements of Section 40(4)[(a) to (i)] of the WMA 1996 to 2005 and will also meet the requirements of BAT.

Where:

2*. The Waste Management Act Section 40 (4 (a- i) states as follows:*

Section 40

(a) any emissions from the recovery or disposal activity in question ("the activity concerned") will not result in the contravention of any relevant standard, including any standard for an environmental medium, or any relevant emission limit value, prescribed under any other enactment,

(b) the activity concerned, carried on in accordance with such conditions as may be attached to the licence, will not cause environmental pollution,

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As noted in point 8 response to additional information, ESP air abatement technology will be replaced with filter technology which will conform to the requirements of BAT and will meet air emission standards with Authomatic cleaning with compressed air in counter current**.** A specification for same is provided in appendix 2.

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Point 7:

Wood Shredder – noise, dust abatement;

Response

As discussed at our recent meeting the wood shredder will be housed indoors and will not result in a fugitive emission source. The wood shredded will be located as indicated in Fig 1 in Appendix 3. This equipment will be housed indoors. There is no fugitive emission that requires dust abatement there is no vent or external fan. The wood shredder will only operate during day time hours. Acoustic bunding will be installed if required to ensure that noise emissions from the wood shredder will not exceed noise emission limits stipulated by the Agency.

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Point 8: AOB

i) Emission Monitoring Schedule Proposal

At the request of the Agency at our recent meeting for the licencee to propose emission monitoring requirements the licencee has reviewed the proposal with respect to emissions and timing of same and proposes the following emission monitoring programme be applied.

The following emission points have been identified:

- SE 1 – emission to sewer including foul water
- MW 1- Groundwater monitoring well - permanent
- MW 2 – Groundwater monitoring well – permanent
- SW 1 - Surface Water Discharge Point (flow, pH)
- A1 – Stack emission - boiler
- A2 – fugitive emission biofilter
- Dust monitoring
- Noise monitoring

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The following emission monitoring programme is proposed:

Monitoring Point Ref	Monitoring Parameters Proposed	Monitoring schedule Proposed	Continuous Monitoring
A1	NOx	Quarterly	
	CO	Quarterly	
	Particulates	Quarterly	
	Oxygen		
A2	H^2S	Biannual	
	VOC	Biannual	
	Acetone	Biannual	
SE1	pH, temperature, flow, Conductivity		√

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	P, PO4, Total N, NH3, BOD, COD, SS, TOC, VOC, sVOC	Monthly	
	Zn, Fe, Al.	Monthly	
	Micro	biannual	
SW 1	Temp		√
	pH, Conductivity		√
	Visual	Daily	
	TSS, BOD, COD. TOC	Quarterly	
MW1 and MW 2	pH,	Biannual	
	Conductivity	Biannual	
	DRO	Biannual	
	Iron	Biannual	
	Mg	Biannual	
	Mn	Biannual	
	Nitrate	Biannual	
	Chloride	Biannual	
	NH4	Biannual	
	Sulphate	Biannual	
	Arsenic	Biannual	
	PRO	Biannual	
Dust Sensitive locations	Four locations	Biannual	
Noise	NSL and boundary noise monitoring	Annual	

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Subsequent to the meeting of 16th March 06, the following additional points are also included

1. submission of Groundwater quality results from monitoring wells MW 1 and MW 2
2. Replacement of ESP with bag filter technology for abatement of particulate emissions – appendix 2.
3. Non technical summaries revised to reflect above – appendix 4
4. Air model utilization justification - appendix 5

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i) Submission of Historical Groundwater Results

Further information in response to the Agency's Notice in accordance with Article 14(2)(b)(ii) of the Waste Management (Licensing) Regulations.

As noted in the submission of additional information Dec 05 in response to Point 5 of the EPA's request for additional information, no historical groundwater monitoring was carried out on the site. While groundwater from the site will not be utilized / extracted, the developer undertook that baseline monitoring would be carried out at the two monitoring wells MW 1 and MW 2 to establish baseline groundwater quality (formally referred to as BH 4 and 6 respectively). This was undertaken and the results of this monitoring are attached as Table 2 over.

Groundwater Quality Results were compared with relevant Guideline Values available. Some elevated levels were noted relative to these guideline values and are either as a result of natural elevations associated with the sites geology or also resulting from fill material on the site.

A geotechnical investigation was conducted by IGSL at Foxhole in November 2005 and established that there is a varied level of man-made fill on the site which is not extensive across the site; rather instead it is confined to localised pockets and is generally of shallow depth (0.5 – 1.6 m). Fill material was characterised as C&D material and, also, metal, plastic and some ferrous material which may account for the elevated levels of iron, nickel, Mn. It is proposed that during the site excavation phase associated with the development, that where necessary, fill material will be removed for disposal/ use as capping material in the adjacent landfill operated by Cork County Council and that groundwater quality continue to be monitored from the two on site groundwater wells on a biannual basis. Groundwater is not being extracted from the site.

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Table 2 Groundwater Sampling from AVR on site Wells MW 1 and MW 2
Mar-06

Parameter	Units	Results MW1 09/03/2006	Results MW2 09/03/2006	Interim EPA GW Limit Values	Dutch Target Values Shallow/Deep	Dutch Intervention Values
Mercury	ug/l	<0.05	<0.05	1	0.05/0.01	0.3
K	mg/l	27	0.8	5	-	-
Na	mg/l	39	28	150	-	-
Mineral Oil	ug/l	<10	<10	10	50	600
Diesel Range Organics	ug/l	<10	<10	10	-	-
Petrol Range Organics C5-C9	ug/l	<10	<10	10	-	-
Petrol Range Organics C10-C12	ug/l	<10	<10	10	-	-
Benzene	ug/l	<10	<10	1	0.2	30
Toluene	ug/l	<10	<10	10	7	1000
Ethylbenzene	ug/l	<10	<10	10	4	150

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Total Xylene	ug/l	<10	<10	10	0.2	70
Total PCB	ug/l	<1	<1	0.01	0.01	0.01
TSS	mg/l	24	<10	-	-	-
Al	mg/l	<0.05	<0.05	0.2	-	-
Bo	mg/l	0.73	0.09	1	-	-
Cd	ug/l	<50	<50	5	0.4/0.06	6
Ca	mg/l	123.2	48.01	200	-	-
Co	ug/l	140	160	30	15/1.3	75
Iron	mg/l	6.29	0.52	0.2	-	-
Mg	mg/l	40.74	7.31	50	-	-
Mn	mg/l	0.53	0.34	0.05	-	-
Ni	ug/l	50	<50	20	15/2.1	75
P	mg/l	<0.05	0.67	0.01*	-	-
Zn	ug/l	50	<50	100	65/24	800
Total Hardness	mg/l	521	170	200	-	-
Arsenic	ug/l	<1	<1	10	10/7.2	60
Lead	ug/l	<1	<1	10	15/1.7	75
TOC	mg/l	4	3	0.01	-	-
Chloride	mg/l	41	48	30	100	-
Nitrate (as NO_3)	mg/l	<0.3	<0.3	25	-	-
Nitrite (as NO_2)	mg/l	0.07	<0.05	0.1	-	-
Sulphate	mg/l	9	17	200		

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Conductivity (at 25°C)	uS/cm	1,421	209	1,000	-	-
pH	pH units	7.22	8.41	6.5-9.5	-	-
Turbidity	NTU	0.5	0.8	-	-	-
NH_4(as N)	mg/l	3.5	<0.2	0.15	-	-
Total Alkalinity ($CaCO_3$)	mg/l	520	170	No abnormal change	-	-

* Towards setting guideline values for protection of groundwater in Ireland EPA interim report

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ii) Air Dispersion Model verification of the air dispersion model utilized for AVR Environmental in relation to other air dispersion models

The modeling was carried out by Imperial College of Science, Technology and Medicine, London, United Kingdom. A technical description of the model (Advanced Gaussian Plume air pollution model) is provided in appendix 4. This research paper has been published in a number of journals including the following: **Publications**

Johnston P. R., Durucan S., and Owen D. B. "The application of a geographical information system to environmental impact assessment in the minerals industry". *Proc 24th Int. Symp. on the Application of Computers and Operations Research in the Mineral Industries*, Montreal, Canada, October 31-November 3, 1993, CIM, Vol.2, pp.513-520.

Durucan, S. and Johnston, P.R., "Development of an advanced air pollution model for the minerals industry". *Proc 27th Int. Symp. on the Application of Computers and Operations Research in the Mineral Industries*, London, UK, 18-23 April, 1998, Institution of Mining and Metallurgy (IMM), pp.101-112.

Durucan, S. and Johnston P.R. "Air pollution modelling in practice: the advantages and limitations of current models" *Proc. 5th Int. Symp. on Environmental Issues and Waste Management in Energy and Mineral Production*, Ankara, Turkey, May 18-20,1998, Balkema, pp149-153.

PhD Thesis

Johnston, P.R., 1996 "A GIS Supported Methodology for Air Pollution Modelling in the Minerals Industry", Ph.D. Thesis, Imperial College, London.

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As noted in this paper, one of the major difficulties with air pollution model evaluation is that the uncertainty that exists in air pollution modelling is typically quite large. This uncertainty in an air pollution model is made up of three different elements: a) uncertainty due to errors in the model physics; b) uncertainty due to errors in the data; and c) inherent uncertainty.

As part of the European Initiative on *Harmonization within Atmospheric Dispersion Modelling for Regulatory Purposes* a model validation kit was prepared. The purpose of the model validation kit was to provide a framework within which differing models could be directly compared using common data sets and standard model evaluation procedures. The model validation kit is comprised of data from three atmospheric dispersion field experiments, namely Kincaid, U.S.A., Copenhagen, Denmark and Lillestrøm, Norway. These validation data sets were used in assessing the performance of the advanced Gaussian model developed and used in this report. A brief outline of the results obtained from one of the field experiments, Kincaid, U.S.A., is presented in the research paper (appendix 2) and summarised here.

In order to facilitate comparison the Pasquill-Gifford based air pollution model ISC2 was also applied to the field experiments. The ISC2 model is the US Environmental Protection Agency's (EPA) recommended regulatory model for industrial sources of air pollution in both rural and urban

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conditions (ISC2 has recently been updated to ISC3 by the US EPA. This has taken the form of some additions to its modelling capabilities, although the basics of the model have not changed).

Based on the statistical measures and the graphs of results, the advanced model has provided more accurate estimates of the concentration values for the Kincaid data set when compared to the ISC2 model. These improvements in concentration predictions are attributable to improvements in the scientific basis of the advanced model compared to the ISC2 model.

As a result the model provides a more accurate description of atmospheric dispersion in the boundary layer.

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Appendix 1

i) **Results of estuarine modeling on proposed discharge**

ii) **Specification of proposed foul water treatment system**

iii) **Copy of letter to Cork County Council requesting meeting**

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i) Results of estuarine modeling on proposed discharge

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iil Specification of foul water treatment system

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iii) Copy of letter submitted to CCC

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iv) Appendix 2 : Specification of Biofilter

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Appendix 3 : Location of Wood Shredder

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Appendix 4: Non Technical Summaries

(Re submission of Non Technical Summaries to take account of additional/revised information)

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i) Waste Licence non technical summary rev 2

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ii) EIS Non Technical Summary Rev 2

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Appendix 5: Specification for Bag Filter Technology

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Appendix 5: Air Dispersion Model

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Memo

To: Sinéad Hickey, Denis O'Sullivan

C.C.: Patrick Byrne

From: Ciara Maxwell

Re: Meeting Agenda – in relation to Waste Licence Application Reg. 211-1

Date: 16/03/2006

Time: 9.30 a.m.

Place: EPA Regional Inspectorate, McCumiskey House, Richview, Clonskeagh Road

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Attendees:

Sinéad Hickey, Project Manager, SWS
Denis O'Sullivan, Project Manager, SWS
Patrick Byrne, Senior Inspector, EPA
Ciara Maxwell, Inspector, EPA

Agenda:

The following issues will be discussed during the meeting between SWS Ltd., representing AVR – Environmental Solutions Ltd., and inspectors from the Licensing Unit of the EPA.

1. Proposed discharge of trade effluent to sewer; exceedances in phosphate, VOCs and hydrogen sulphate levels; adequacy of outfall and impact of the discharge; impact of cooling water was not included in worst-case scenario modelling, would there be a temperature impact; typical temperatures.

2. Use of biomass as fuel in the boiler; disposal of ash; quantities generated per annum;

3. Standards for use of treated sludge pellets as a fuel; markets;

4. Clarify volume of air to be treated in biofilter from negative air pressure system in Sludge Drying Building (how many air changes) and hooded WWTP (727m3/hr); specifications of biofilter including control parameters and key monitoring equipment; suitable abatement for potential acetone emission from WWTP.

5. Noise levels at nearest NSL average daytime level dB(A), night-time level currently 50dB(A), due to traffic and proximity to the R634. Can 55:45 be achieved at the site boundary from on-site activities?

6. Section L of Application Form – details of how the proposed facility will meet the requirements of Section 40(4)[(a) to (i)] of the WMA 1996 to 2005 and describe how the facility will meet BAT, making particular reference to the considerations referred to in Annex IV of the IPPC Directive.

7. Wood Shredder – noise, dust abatement;

8. AOB

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ADDENDUM TO REPORT

WATER QUALITY STUDY

December, 2005

MODEL STUDY OF
YOUGHAL HARBOUR,
CO. CORK.

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For: **SWS Energy Enterprises,**
Cork

By: **Aqua-Fact International Services Ltd.,**
12 Kilkerrin Park,
Liosbaun,
Galway.
www.aquafact.ie

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Introduction

Following the site investigation carried out in the main report, further model runs were conducted which contained more accurate and up to date concentrations for the various substances to be discharged into Youghal Harbour. Of particular concern in the last report was the high concentration of Volatile Organic Compounds and phosphates. The two dimensional model DIVAST was again used to predict the solute transportation. The modelled area is identical and also the location of the discharge point. All relevant boundary conditions including tidal boundaries and river inputs remained the same. Since the Kjeldahl nitrogen value was different to the last study, this parameter was considered again. Two new parameters (i.e. the temperature and the ammoniacal nitrogen concentration) were also modelled. The background water temperature was assumed to be 10^{o}C for the thermal discharge simulations.

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This document presents the model results predicting concentrations of phosphates, Kjeldahl nitrogen, VOC's, ammoniacal nitrogen and temperature variation throughout the model domain. These results are discussed in accordance with the same water quality standards used in the first site investigation together with the relevant standards for the new parameters modelled. The conclusions regarding the suitability of the current site are drawn based on the possible impact which the proposed discharge will have on the surrounding marine environment.

Solute Transport

The dispersion-diffusion terms summaries all non-advective transport processes, such as molecular diffusion, turbulent diffusion and dispersion due to the shear flow. The transport-dispersion model uses Elder's [1] dispersion equation:

$$D_L = k_L V_L H \qquad (1) \qquad\qquad D_T = k_T V_T H \quad (2),$$

where D_L and D_T are the longitudinal and transverse depth averaged dispersion coefficients (m^2/s), V the shear velocity, H the water depth and k_L and k_T are the

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longitudinal and transverse empirical dispersion constants. Assuming a logarithmic velocity distribution, the theoretical values for these constants are 5.93 and 0.23 respectively. Based on our own previous dye studies around the Irish coast it has been observed that the measured values of these dispersion constants are often significantly higher than the theoretical ones mentioned above. However, in the interest of conservatism it was decided to use the theoretical values in the simulations. These are the same values which were used in the last study and as such they represent a 'worst case scenario'. The simulations did not include any effects of diffusion due to wind which would tend to lower the concentrations. Again this was in the interest of conservatism and was consistent with the previous simulations.

Solute Transport Results

Using the flow rate and effluent concentrations specified in Table A.1 the model was run for a full spring - neap tidal cycle (i.e. 350hrs). Snapshots of the VOC, phosphate, nitrogen, ammonia, and temperature plumes within the study area were output by the model at four different stages of the tide, namely, high water, mid-ebb, low water and mid-flood, for both neap and spring tide conditions. The neap solute plumes were output by the model at approximately 175 hours into the simulation while the spring plumes were output after approximately 350 hours of the simulation. These solute plumes are illustrated in Figures A.1 – A.40. A table of the maximum concentrations predicted at each stage of the tide is presented below (table A.2). These maximum values occurred within a 25m grid square surrounding the outfall pipe.

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Rate of discharge (l/s)	Conc. of Phosphate (mg/l)	Conc. of VOC's (mg/l)	Conc. of nitrogen (mg/l)	Temperature of effluent degrees C^{o}	Conc. of Ammonia (mg/l)
1.5	0.56	1.0	15	25	8.5

Table A.1: Characteristics and flow rate of effluent from at discharge point

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Tidal stage	VOC conc. [µg/litre]	Phosphate conc. [µg/litre]	Nitrogen conc. [mg/litre]	Ammonia conc. [mg/litre]	Temperature Degrees oC
Neap mid flood	8.5	4.7	0.13	0.08	10.1
Neap high water	5.8	3.3	0.095	0.05	10.04
Neap mid ebb	7.0	3.7	0.1	0.06	10.04
Neap low water	8.5	4.5	0.13	0.07	10.06
Spring mid flood	4.5	2.9	0.07	0.04	10.04
Spring high water	2.5	1.4	0.04	0.025	10.01
Spring mid ebb	2.9	1.7	0.05	0.03	10.01
Spring low water	10.05	6.4	0.165	0.095	10.15

Table A.2: Maximum VOC, phosphate, nitrogen, and ammonia concentrations and temperatures at different periods in the tidal cycle

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Discussion of Results

Looking at the maximum values predicted at the discharge point for the different stages of the tide it is evident that, in general, higher solute concentrations occur during the neap tidal cycle due to a smaller tidal range and hence lower current velocity values which tend to inhibit rapid dilution of the effluent during this period. Conversely, dilution of the effluent plumes is greatest on the spring tide at periods of relatively high current velocity i.e. at mid-ebb and mid-flood tide, when the volume of water entering or leaving the bay is at a maximum. However, the absolute highest concentrations for each substance occurred at low water on the *spring* tide and are 10.05µg/l, 6.4µg/l, 0.165mg/l, and 0.095mg/l for VOC's, phosphates, Kjeldahl nitrogen, and ammoniacal nitrogen respectively. These will now be compared with the relevant water quality standards outlined in chapter 5 of the previous report. A summary of the standards presented in that chapter as well as relevant standards for temperature and ammoniacal nitrogen are as follows:

1. The EPA overview of water quality in Ireland [2] specifies that the median value of Kjeldahl nitrogen in estuarine and coastal waters should not exceed 2mg/l.

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2. An EC Directive on Surface Water Regulations gives values between 0.22 and 0.3mg/l as the limiting values for phosphate concentration.
3. The environmental quality standard for VOC's set down by the EPA is 10µg/l.
4. The EU Directive on water quality associated with freshwater fisheries, 78/659/EEC, stipulates that the maximum permissible levels of total ammonia, as N, is 0.3 mg/litre, which is considered to be that which would contain the limiting amount of un-ionised ammonia which is most harmful to freshwater aquatic life.
5. The EU Directive on water quality associated with freshwater fisheries, 78/659/EEC states that the temperature measured downstream of a point of thermal discharge (at the edge of the mixing zone) must not exceed the unaffected temperature by more than 1.5^{o}C for salmonid waters, and by 3^{o}C for Cyprinid waters.

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Conclusions

The maximum Kjeldahl nitrogen concentration is less than ten times the allowable limit while the maximum ammoniacal nitrogen concentration is approximately three times lower than the limit specified in the above standards. Hence the discharging of these substances should have no adverse effects on the surrounding water quality.

The phosphate levels predicted by the model are very low, 6.4µg/l (i.e. 0.0064mg/l), when compared with the allowable levels, 0.22mg/l – 0.3mg/l, and so will not cause any problems in relation to eutrophication. Similarly discharging the effluent at a temperature of 25^{o}C will have a negligible impact on the temperature of the surrounding waters with a maximum rise in temperature of approximately 0.15^{o}C.

The highest VOC level (i.e. 10.05µg/l) is practically the same as the allowable level of 10µg/l. However, this level is only reached for a few hours around low water on a spring tide and the high concentration is confined to a small area in the immediate vicinity of the discharge pipe i.e. within 25m which would be considered quite a small 'mixing zone'. The concentrations decrease rapidly with distance from the discharge point. Furthermore,

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given the conservative nature of the modelling exercise it is unlikely that as high a concentration would be found in reality. For these reasons it is unlikely that there would be any impact on the water quality resulting from the proposed discharge of these substances.

REFERENCES

[1] Elder, J.W. 1959. "The Dispersion of Marked Fluid in Turbulent Shear Flow", J. Fluid Mech, Vol.5 544-560

[2] E.P.A., 2000. "Water Quality in Ireland 1998 – 2000".

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Figure A.25: VOC concentrations at mid-flood on a neap tide (µg/l)

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Figure A.26: VOC concentrations at high water on a neap tide (µg/l)

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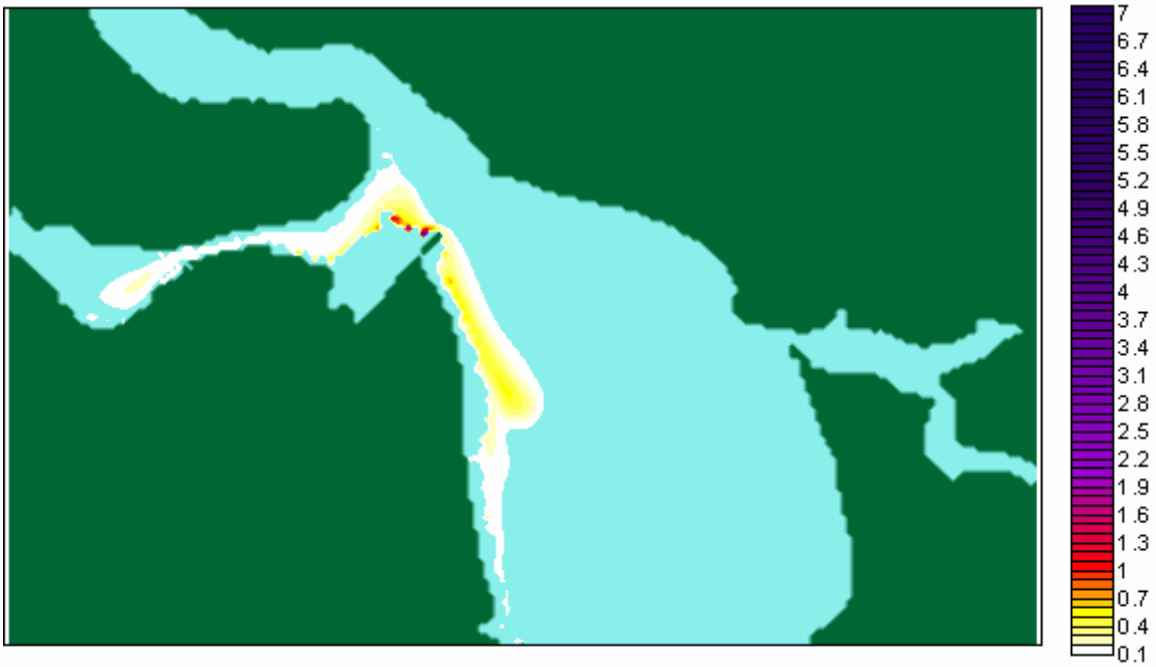

Figure A.27: VOC concentrations at mid ebb on a neap tide (µg/l)

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Figure A.28: VOC concentrations at low water on a neap tide (µg/l)

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Figure A.29: VOC concentrations at mid-flood on a spring tide (µg/l)

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Figure A.30: VOC concentrations at high water on a spring tide (µg/l)

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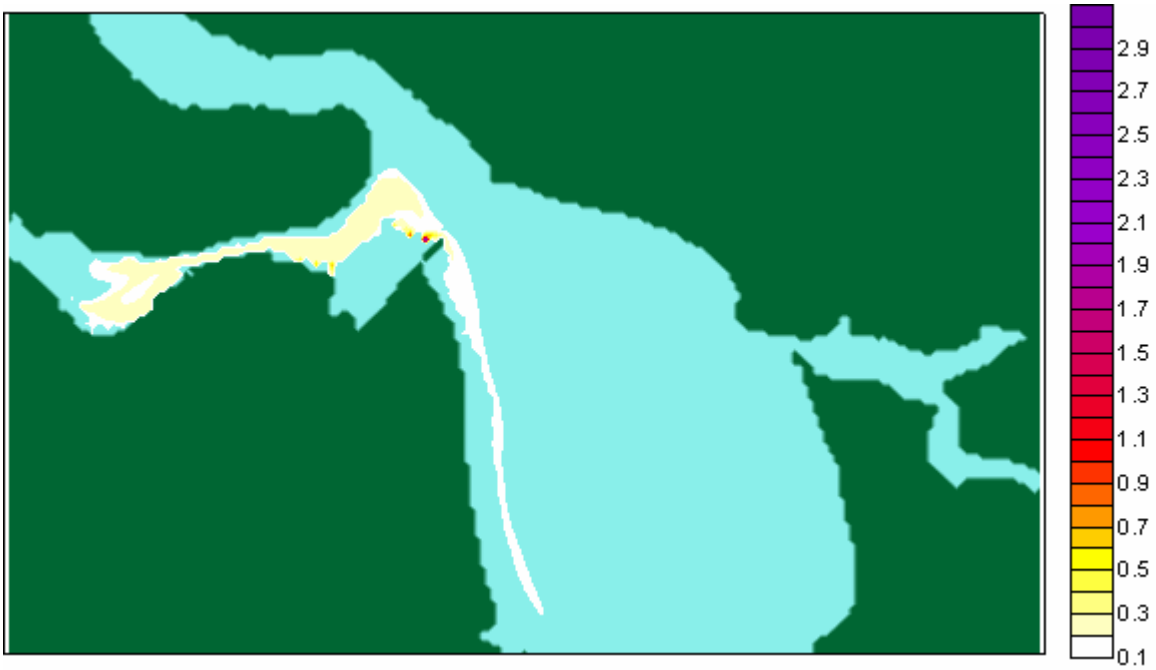

Figure A.31: VOC concentrations at mid ebb on a spring tide (µg/l)

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Figure A.32: VOC concentrations at low water on a spring tide (µg/l)

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Figure A.17: Ammoniacal nitrogen concentrations at mid-flood on a neap tide (mg/l)

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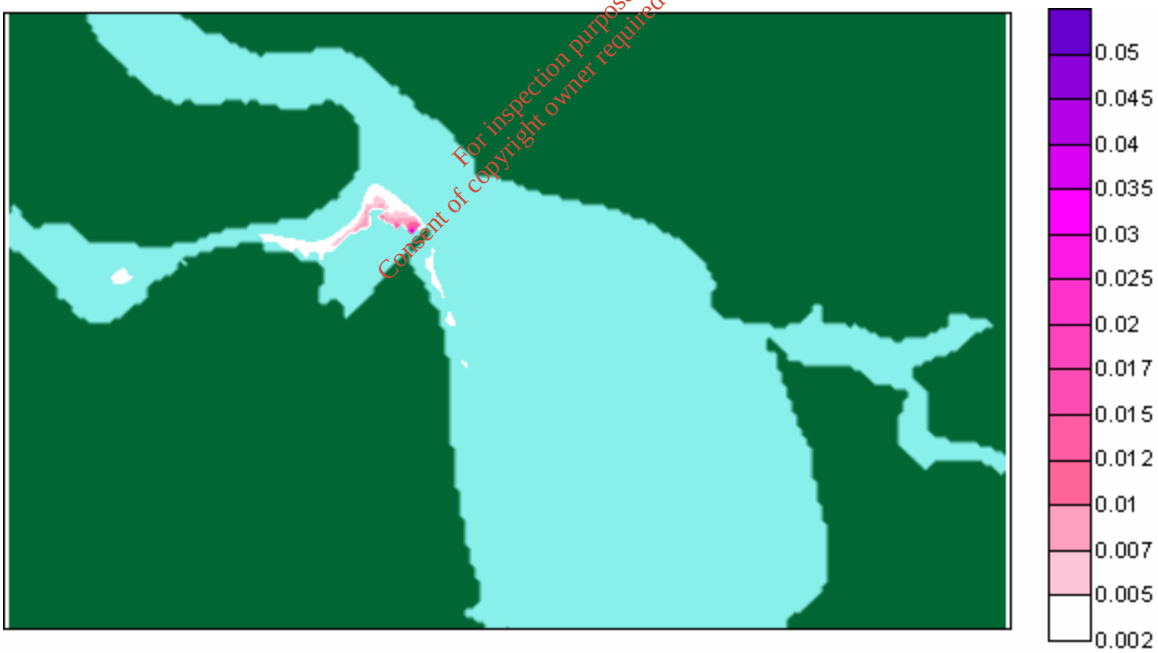

Figure A.18: Ammoniacal nitrogen concentrations at high water on a neap tide (mg/l)

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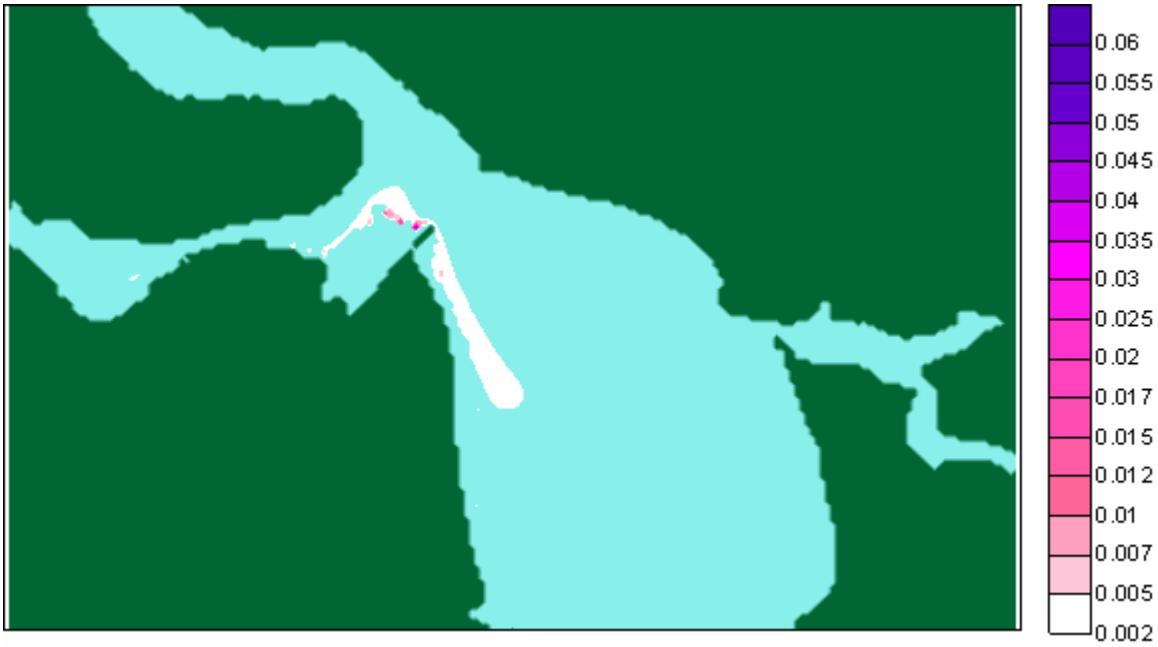

Figure A.19: Ammoniacal nitrogen concentrations at mid ebb on a neap tide (mg/l)

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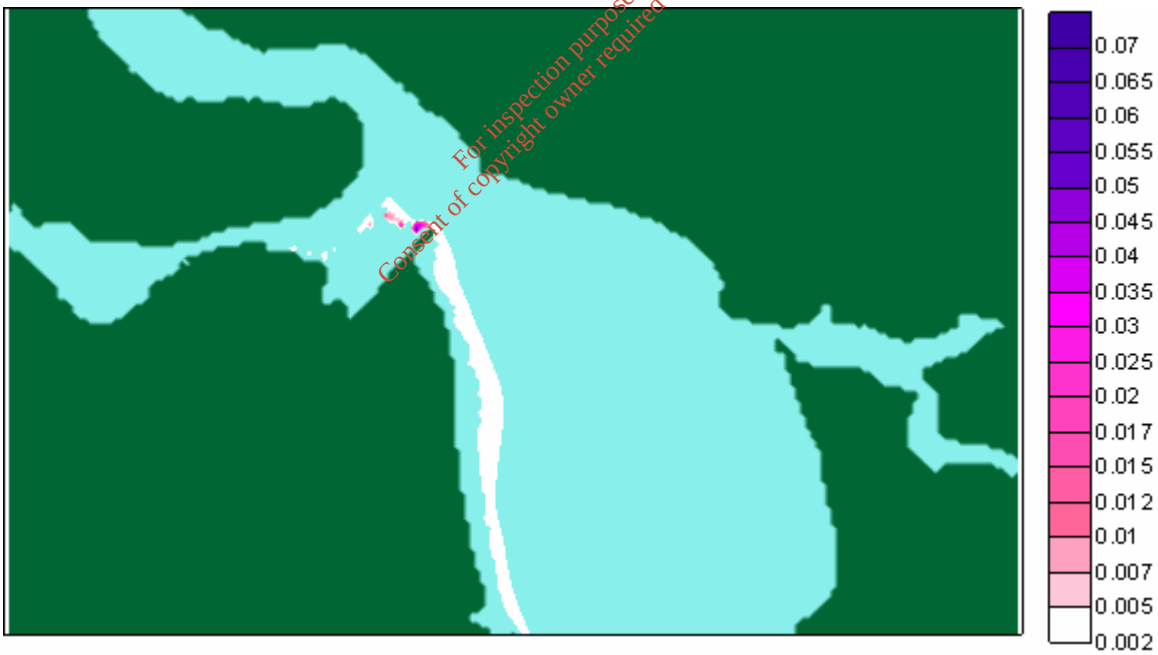

Figure A.20: Ammoniacal nitrogen concentrations at low water on a neap tide (mg/l)

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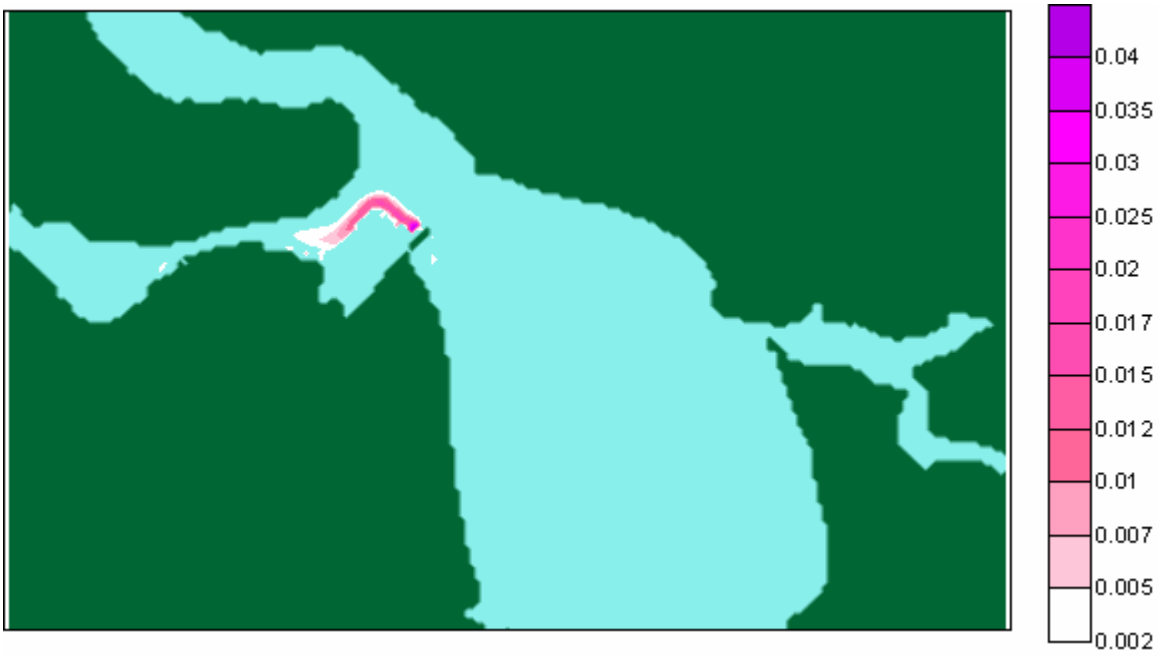

Figure A.21: Ammoniacal nitrogen concentrations at mid-flood on a spring tide (mg/l)

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Figure A.22: Ammoniacal nitrogen concentrations at high water on a spring tide (mg/l)

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Figure A.23: Ammoniacal nitrogen concentrations at mid ebb on a spring tide (mg/l)

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Figure A.24: Ammoniacal nitrogen concentrations at low water on a spring tide (mg/l)

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Figure A.9: Kjeldahl nitrogen concentration (mg/l) at mid-flood on a neap tide

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Figure A.10: Kjeldahl nitrogen concentration (mg/l) at high water on a neap tide

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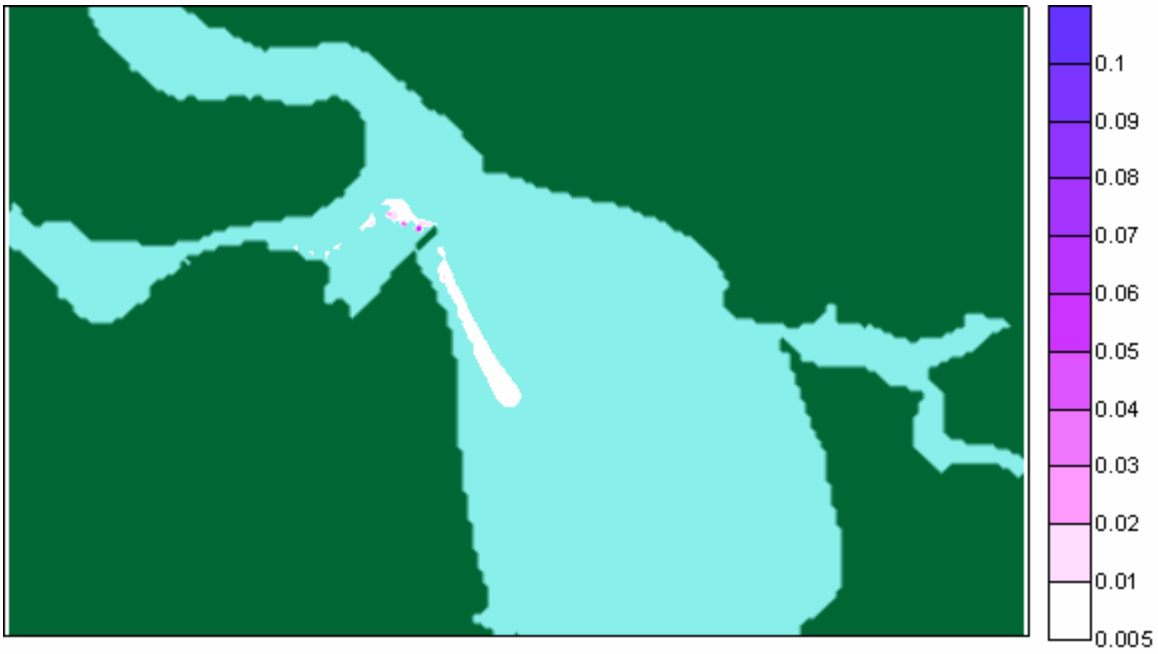

Figure A.11: Kjeldahl nitrogen concentration (mg/l) at mid-ebb on a neap tide

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Figure A.12: Kjeldahl nitrogen concentration (mg/l) at low water on a neap tide

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Figure A.13: Kjeldahl nitrogen concentration (mg/l) at mid-flood on a spring tide

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Figure A.14: Kjeldahl nitrogen concentration (mg/l) at high-water on a spring tide

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Figure A.15: Kjeldahl nitrogen concentration (mg/l) at mid ebb on a spring tide

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Figure A.16: Kjeldahl nitrogen concentration (mg/l) at low water on a spring tide

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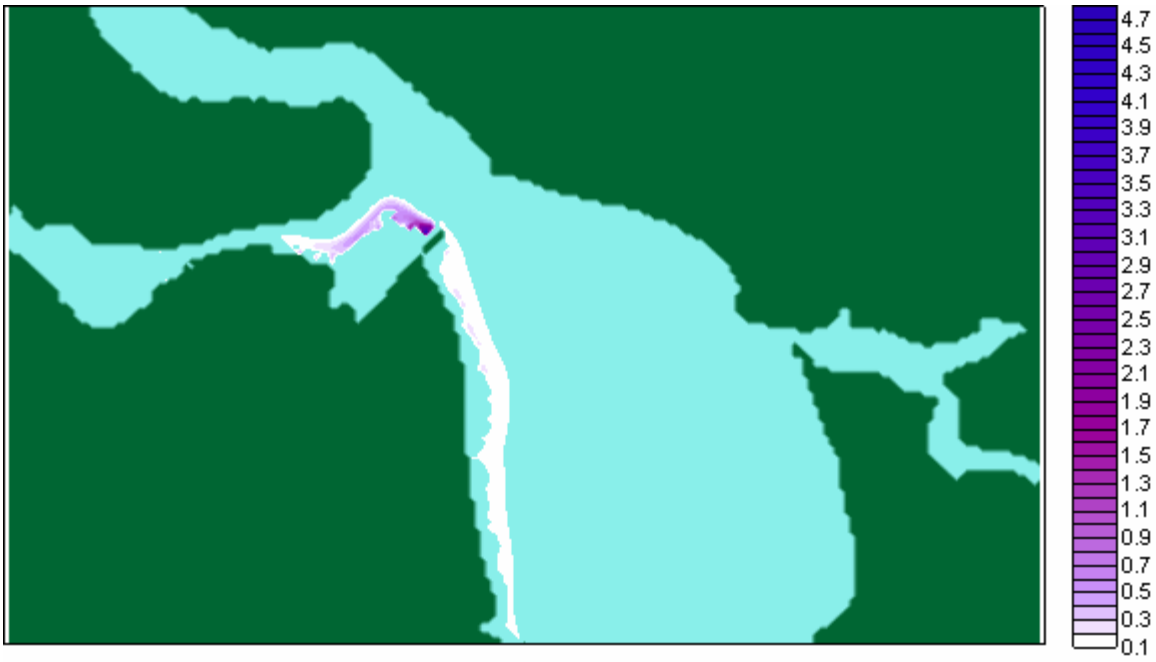

Figure A.1: Phosphate concentrations at mid-flood on a neap tide (µg/l)

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Figure A.2: Phosphate concentrations at high water on a neap tide (µg/l)

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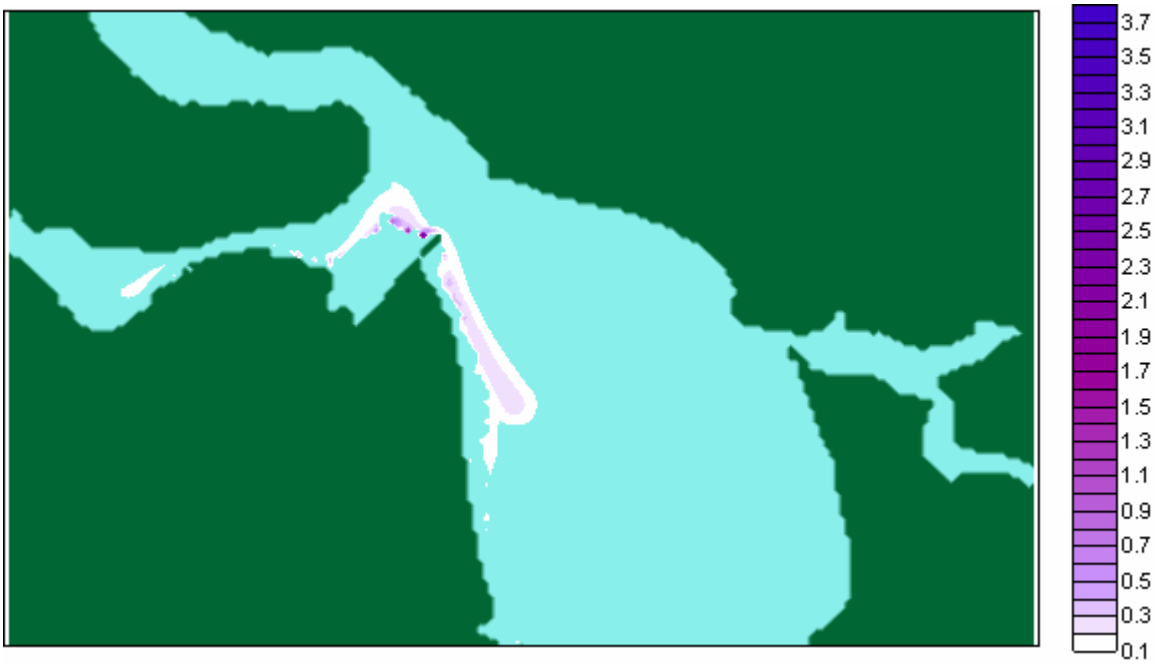

Figure A.3: Phosphate concentrations at mid ebb on a neap tide (µg/l)

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Figure A.4: Phosphate concentrations at low water on a neap tide (µg/l)

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Figure A.5: Phosphate concentrations at mid-flood on a spring tide (µg/l)

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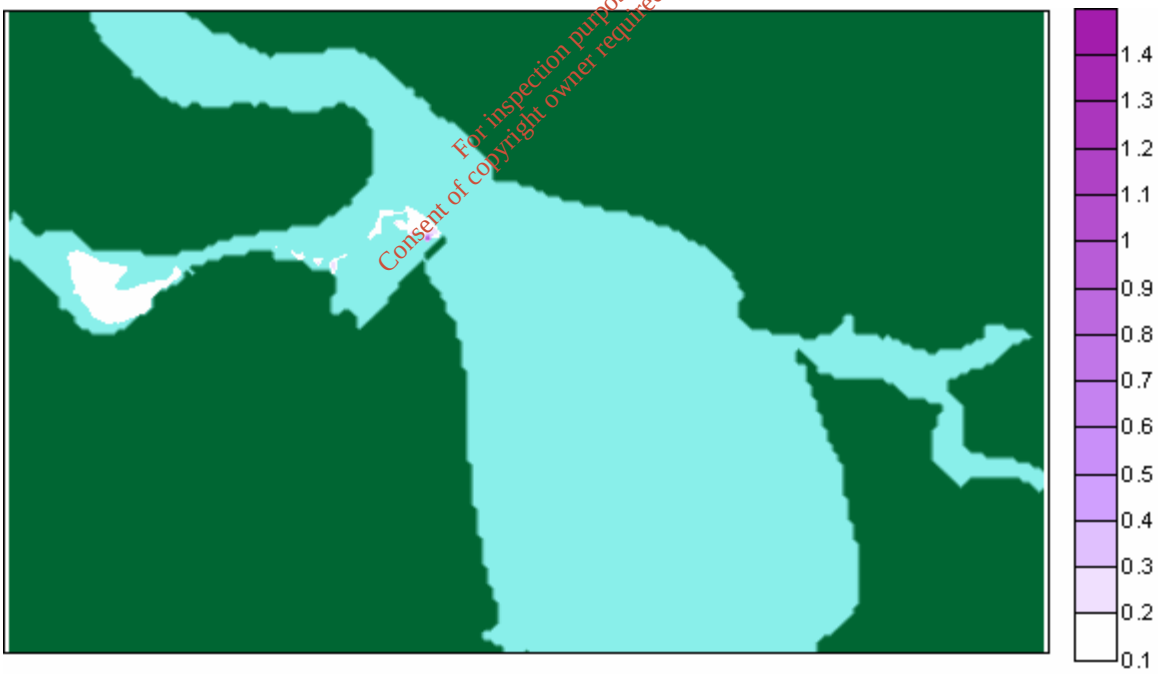

Figure A.6: Phosphate concentrations at high water on a spring tide (µg/l)

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Figure A.7: Phosphate concentrations at mid ebb on a spring tide (µg/l)

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Figure A.8: Phosphate concentrations at low water on a spring tide (µg/l)

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Figure A.33: Water temperature at mid-flood on a neap tide

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Figure A.34: Water temperature at high water on a neap tide

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Figure A.35: Water temperature at mid ebb on a neap tide

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Figure A.36: Water temperature at low water on a neap tide

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Figure A.37: Water temperature at mid-flood on a spring tide

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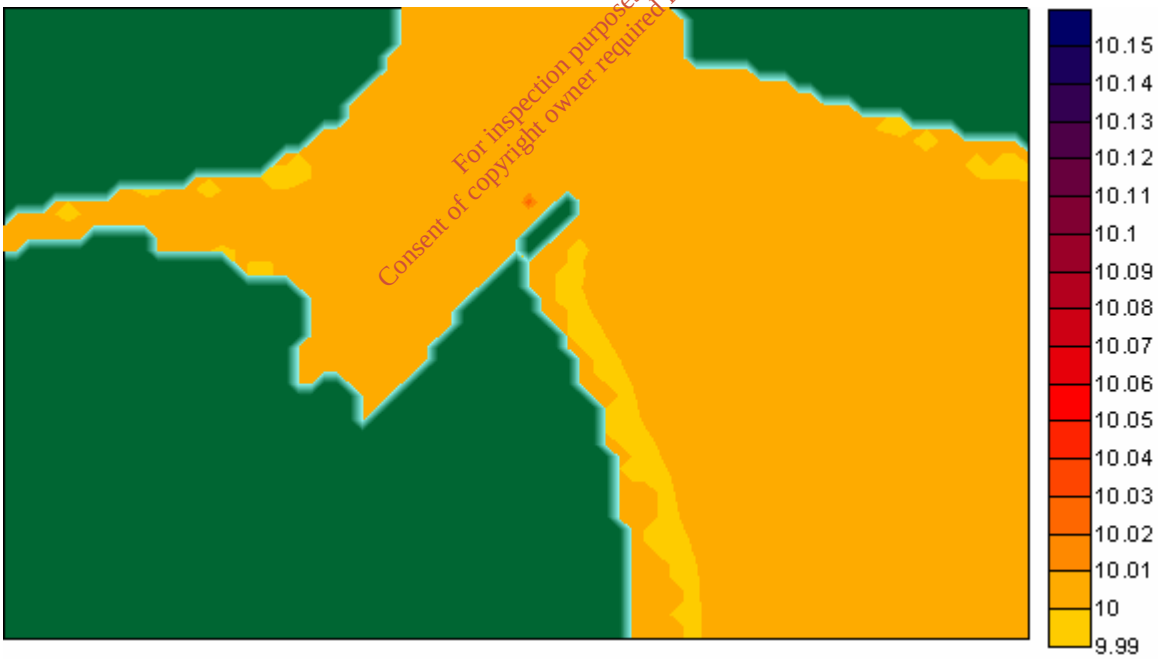

Figure A.38: Water temperature at high water on a spring tide

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Figure A.39: Water temperature at mid ebb on a spring tide

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Figure A.40: Water temperature at low water on a spring tide

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BORD NA MÓNA

BORD NA MÓNA ENVIRONMENTAL LIMITED

Wastewater Solutions

Puraflo

WASTEWATER TREATMENT SYSTEMS

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Wastewater Solutions

Clear Solutions from Bord na Móna Environmental Ltd

Bord na Móna has been supplying wastewater treatment systems in Ireland for over a decade. The company offers a broad technical capability, proven experience and a range of wastewater treatment solutions.

The Puraflo Peat Filter System from Bord na Móna Environmental Ltd. is the natural answer to domestic wastewater treatment. Using a unique biofibrous peat filter media, the Puraflo system is one of the longest running, most reliable systems available.

The modular nature of the system allows maximum flexibility for use in a range of applications including individual houses, small developments, commercial properties etc. The Puraflo system can also be used with existing septic tanks to resolve treatment and effluent dispersal difficulties. An all inclusive service is provided by Bord na Móna including pre-planning advice, system design, supply, delivery, installation, commissioning, guarantee, service contracts and maintenance call outs.

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How the Puraflo system works:

- Wastewater flows from the home into a watertight primary/septic tank. The solids settle and the liquid effluent flows by gravity to a pump/ sump chamber.
- The liquid effluent is pumped intermittently into the Puraflo modules where it is distributed evenly onto the biofibrous peat filter.
- A combination of biological, chemical and physical process treat the wastewater as it filters down through the modules.
- Treated liquid emerges from the base of the Puraflo unit and is dispersed into the ground through a percolation area (also called a polishing filter) or is collected for disposal by other methods.
- High treatment levels achieved in the Puraflo system prevent the treated wastewater from polluting groundwater whilst protecting the environment.

Puraflo Single House System Design

Max Population Served	Daily Flow m3/d - max (cubic metres per day)	Number of Modules
6	1.2	2
9	1.8	3
11	2.2	4
13	2.6	5
15	3.0	6

Gravity or pumped outlet versions available

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Why choose the Puraflo System?

Primary settlement of wastewater entering the Puraflo system occurs in a watertight septic tank	A large volume primary/septic tank ensures adequate retention time for wastewater and good solids settlement. The large sludge holding capacity of a primary/septic tank may reduce desludging frequency resulting in reduced operational costs.
Biofibrous Peat Filter	The Puraflo biofibrous peat filter provides unsurpassed treatment of domestic wastewater; 99.9% reduction of coliforms, including Ecoli and faecal coliforms plus elimination of pathogenic bacteria, resulting in a reduced risk of pollution of aquifers and drinking water supplies. It is ideally suited for intermittent or seasonal use, achieving consistently high treatment results even under variable and/or seasonal loading conditions. The peat filter also provides odour free wastewater treatment. A few centimetres of treatment media covers the distribution grid and suppresses any odours during dosing.
Intermittent pumping	The pump is activated, by means of a flotation device, when the liquid effluent reaches a pre-determined level in the sump unit. Pumping is therefore on an "as needed" basis only, making it extremely cost efficient, with very low running costs – less than 1.3 cent per day, depending on the volume of wastewater to be treated.
Minimal operation and maintenance requirements.	The Puraflo technology is based on simple passive, biofiltration principles. The bio-filter is low maintenance and requires no desludging or backwashing. Provided that the primary/septic tank and sump unit are maintained by regular desludging, as required, the system will continue to operate efficiently. The only mechanical device in the system is the pump, which works on an intermittent basis, minimising the possibility of mechanical problems.
Proven track record and reliability	With thousands of Puraflo systems operational throughout Ireland, Bord na Móna has acquired a significant expertise in wastewater treatment. The benefit of this extensive experience is passed onto customers from the pre-planning stage right through to installation and commissioning of the system.
Network of Agents	Site visits, pre-planning advice, knowledge of ground conditions and wastewater treatment requirements are all provided by a network of regional Customer Agents as part of Bord na Móna's service to customers.
Free delivery, installation & commissioning by trained Bord na Móna installation teams	The Puraflo system is not simply dropped on site, it is delivered, installed and commissioned by trained Bord na Móna installers at no extra cost. The electrical control panel and alarm warning system, essential elements of a wastewater treatment system, are included in the price.
Agrément Certified	The Puraflo system is Agrément certified, a building product certification, ensuring compliance with building and environmental requirements.
Guarantee and Service Agreements	The Puraflo system is guaranteed for 12 months from the date of installation. Thereafter Bord na Móna provides Service Contracts and a comprehensive Call Out service, ensuring regular inspection, maintenance of the system and peace of mind for customers. The Bord na Móna Service Agreement includes a septic/primary tank sludge measurement service at no extra cost. This involves measuring the level of sludge in the primary/septic tank and providing a recommendation as to whether the tank should be emptied or not.

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- ***Long term wastewater treatment experience.***
- ***Free pre-planning advice and site visits.***
- ***Free installation.***
- ***Agrément certified.***
- ***Bord na Móna Guarantee.***
- ***Network of Customer Agents and Installers.***
- ***Service agreements***

IRISH AGRÉMENT BOARD

BUILDING PRODUCT CERTIFICATION

CERTIFICATE No. 99/0060

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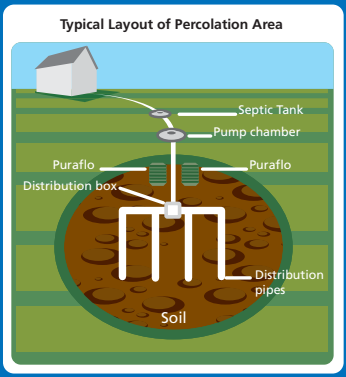
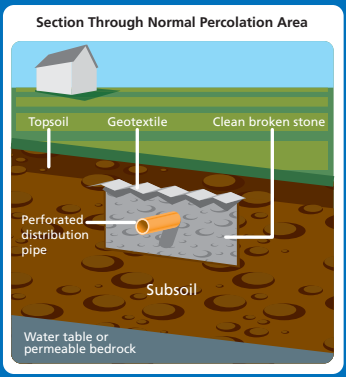
BORD NA MÓNA

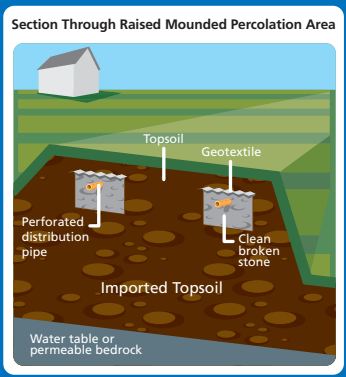
BORD NA MÓNA ENVIRONMENTAL LIMITED

www.bnm.ie

Treated Wastewater Percolation and Disposal







Treated wastewater may be disposed of by one of the following means, subject to satisfactory results from site suitability assessment and in accordance with local authority conditions:

Sub Surface Disposal: The treated effluent from the base of the Puraflo system passes into a percolation area (also known as a polishing filter), by gravity or pump, typically into a network of perforated pipes laid in stone filled trenches. The extent of the percolation area will be determined by a site assessment or characterisation, taking into account the population to be served, percolation test results and the subsoil type at the site. Site characterisations are carried out by suitably qualified site assessor and the results used to determine the percolation area, specification and design.

The treated effluent emerging from the Puraflo system is directed to a distribution chamber which divides the effluent equally between the distribution pipes supplying the percolation area. Layout of the trenches and percolation drains will be determined by site topography.

Because the treated effluent emerging from the Puraflo system is treated to such a high level with significantly reduced suspended solids it is readily absorbed into the soil. The percolation area will polish and distribute the effluent evenly over the land minimising the possibility of the ground becoming over saturated. Alternatively the treated effluent can be collected and pumped to irrigation in which case a site specific engineered design will be prepared.

Surface Water Disposal: Treated effluent from the Puraflo system can be discharged directly or via stone filled drain to receiving waters (ditch or drain). If this option is selected a licence to discharge to waters, on a case by case basis, will be required from the local authority to comply with the Water Pollution Acts (1977 – 1990 incl. amendments).

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Contact us

email: ed.info@bnm.ie
web: www.bnm.ie

Regional Offices

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Fax: 045 432312
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Lanesborough,
Co. Longford
Tel: **1850 581136**
Fax: 043 21259
West:
Clare, Donegal, Galway, Leitrim, Longford, Mayo, Roscommon, Sligo

Please cut along dotted line and return by post in the pre-paid envelope attached to:

Bord na Móna Environmental Ltd, Main Street Newbridge, Co. Kildare or fax to 045 432312.

Name _____ Postal Address _____

_____

Site Address _____

Telephone (H) _____ (M) _____ (Work) _____

Fax _____ E-Mail _____

Nature of development: (Please tick √ appropriate description):

☐ Single House ☐ Group of Houses ☐ Restaurant ☐ Caravan Park

☐ Hotel ☐ Other (Please Specify)

Please sent further details on the Puraflo system: ☐ Yes ☐ No

Please arrange for one of you Agents to contact me: ☐ Yes ☐ No

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Ms Valarie Hannon,
Environmental Division
Cork County Council
Inniscarra Laboratories
Inniscarra co Cork

cc. Ken Conroy
Water Services and Infrastructure
Cork County Council

Re: meeting Request AVR Environmental Solutions EPA waste licence Application Reg. 211-1

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12th May 2006.

Dear Ms Hannon,

Further to our recent telephone conversations to discuss the above referenced licence and Cork County Councils issue of a Section 52 with respect to emission of effluent we have now re submitted effluent discharge results and modelling results to the Agency taking account of Cork County Councils recommendations regarding same.

We have been advised by Ms Ciara Maxwell, licencing officer with the EPA that results will be resubmitted to yourselves for consideration. When you have had time to review and comment on same we would appreciate if you could facilitate a meeting with representatives of AVR to ensure that all requirements of Cork County Council are taken into consideration with respect to discharge parameter requirements.

We shall contact you in the next few weeks with a view to same. If you require any further information in the interim please do not hesitate to contact the undersigned

Best regards

_____
Sinead Hickey

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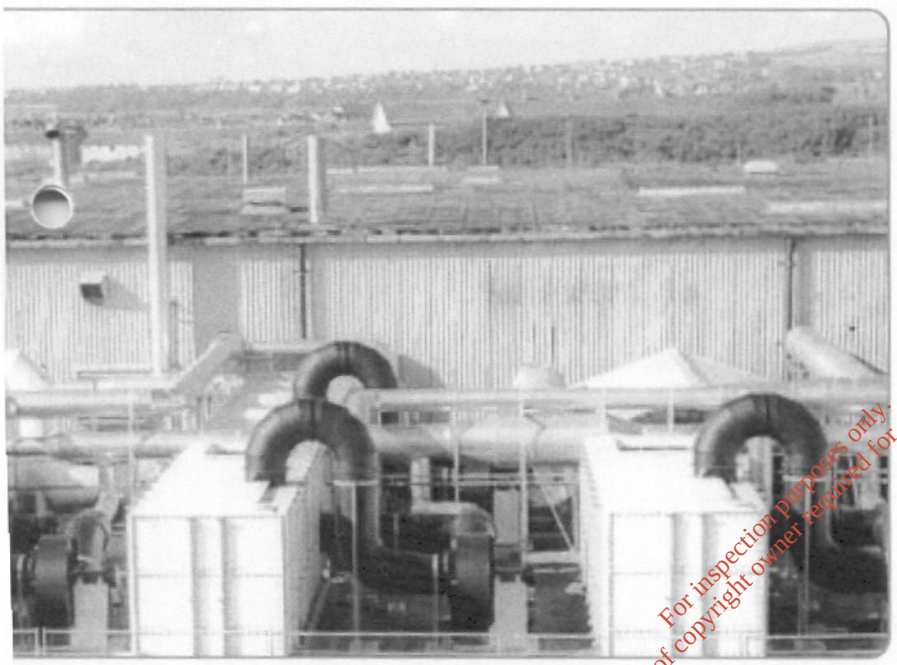
BORD NA MÓNA

BORD NA MÓNA ENVIRONMENTAL LIMITED

Clean Air Solutions

MÓNASHELL ENHANCED BIOFILTRATION



The MÓNASHELL Enhanced Biofiltration technology from Bord na Móna is an innovative patented solution for the treatment of medium to high levels of airbourne VOC from various industrial and municipal processes.

In 1998, an extensive in-house research & development programme was undertaken on this process with the first commercial installation commissioned in 2001. MÓNASHELL EBf was granted an Irish patent in July 2002 with an international patent pending.

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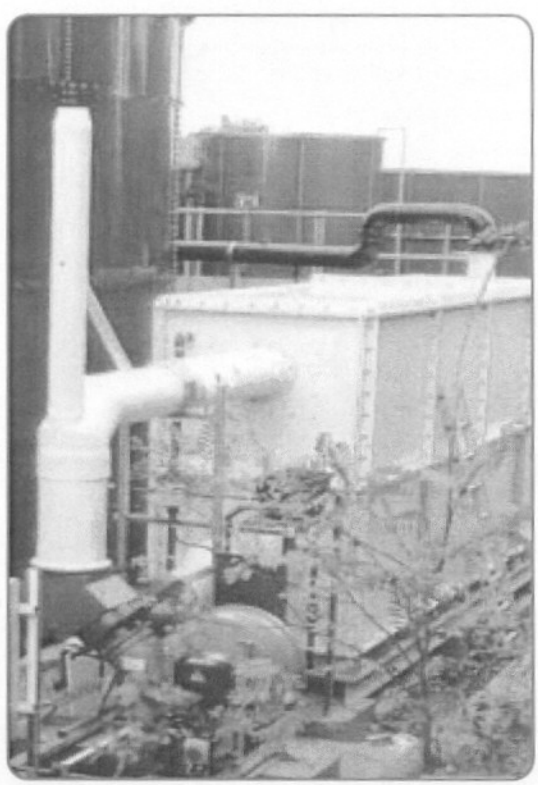
THE MÓNASHELL EBf PROCESS

The MÓNASHELL EBf process was developed following an initiative to explore the potential of Bord na Móna's existing technologies for use on Volatile Organic Compound (VOC) applications. This was achieved by employing two additional dynamics to enhance the technology and effect enhanced capture and catabolic breakdown of VOCs.

Recirculation of air stream
This dynamic contributes to pre-dilution of the inlet contaminants and acceleration of mass transfer resulting in increased efficiency (typically from 50>90%) and increased elimination capacity (typically by a factor of 4).

Electromagnetic stimulation of water
The stimulation of water regulates and controls the production of extra cellular polysaccharides by microbes and leads to a higher catabolic breakdown conversion of VOCs with most of the energy released as heat.



Applications

- Industrial VOC emissions
- Pharmaceutical industry
- Printing applications
- Print booths
- Semi conductors
- Aircraft maintenance
- Metal coating
- Geotextiles
- Tanneries

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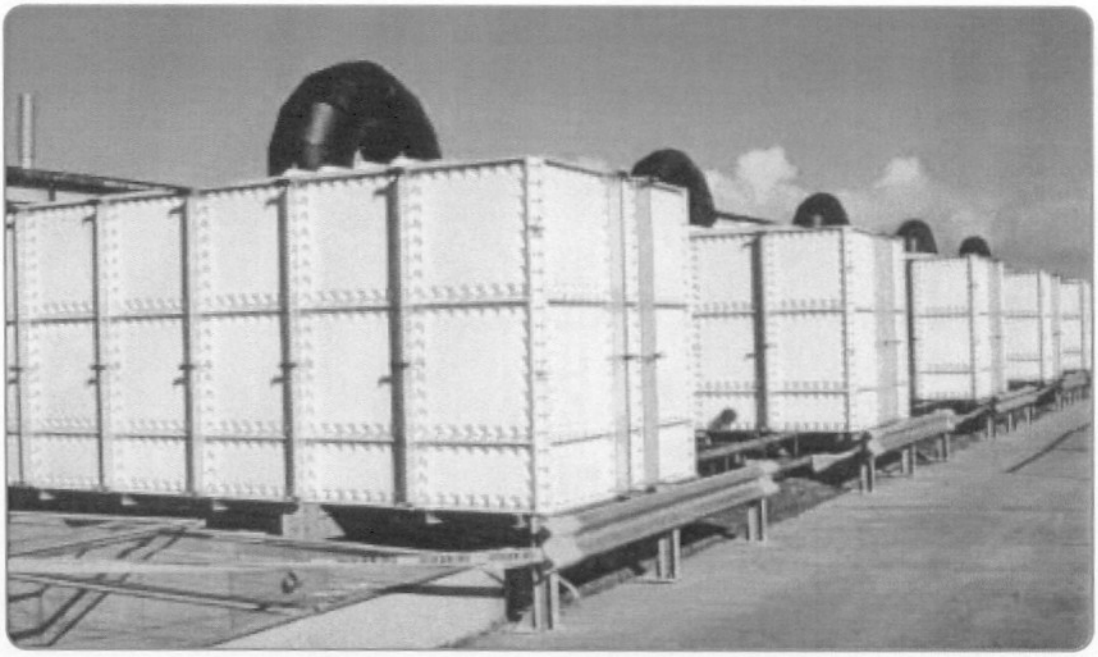
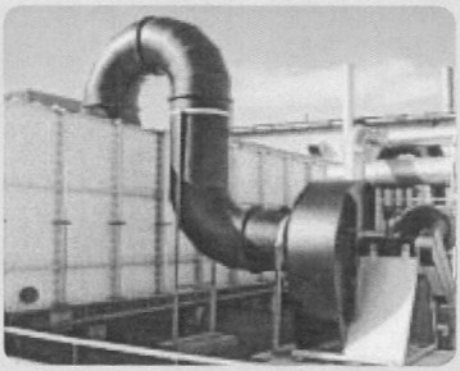
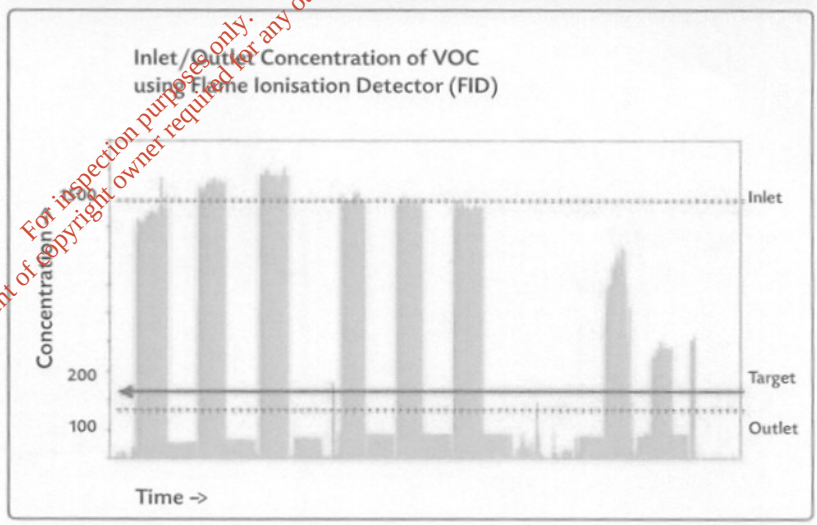




Benefits

- Low energy costs
- No supplementary fuel required
- Environmentaly friendly alternative to thermal treatment
- Good performance on wide range of compounds
- Low running costs
- Suitable for intermittent use
- Ease of operation
- Intrinsically safe bioreactor
- Varying inlet conditions does not affect running costs
- In the event of future process changes it can be adapted for use on low level odour emissions

Inlet/Outlet Concentration of VOC using Flame Ionisation Detector



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Fax: 001 336 547 8559
Email: bnm-us@bnm-us.com

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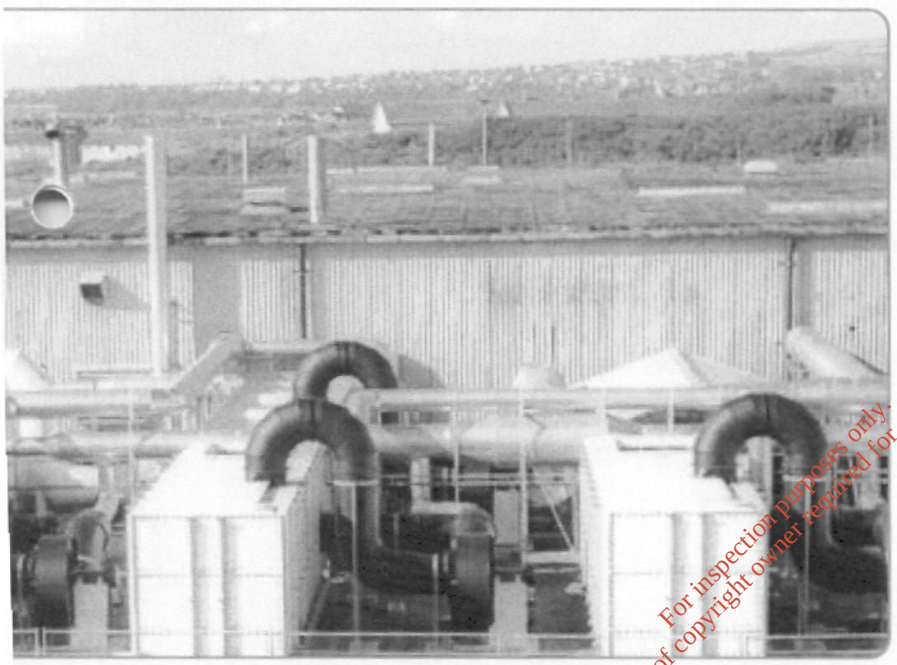

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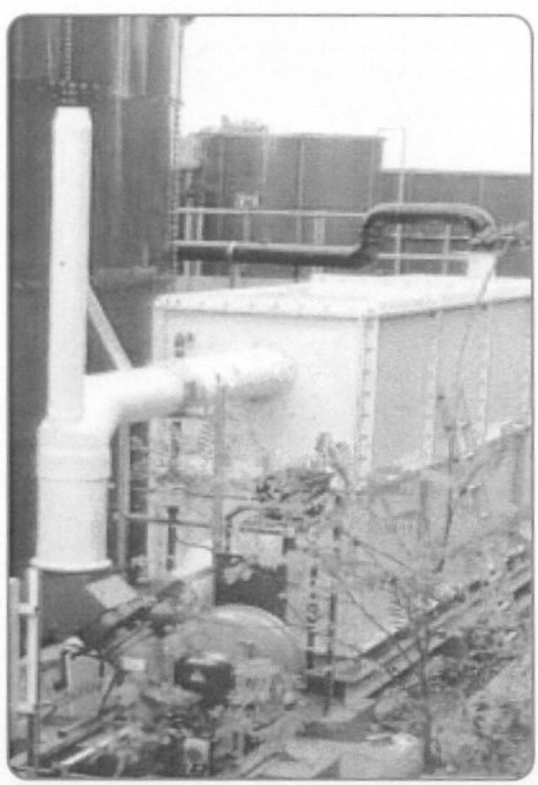

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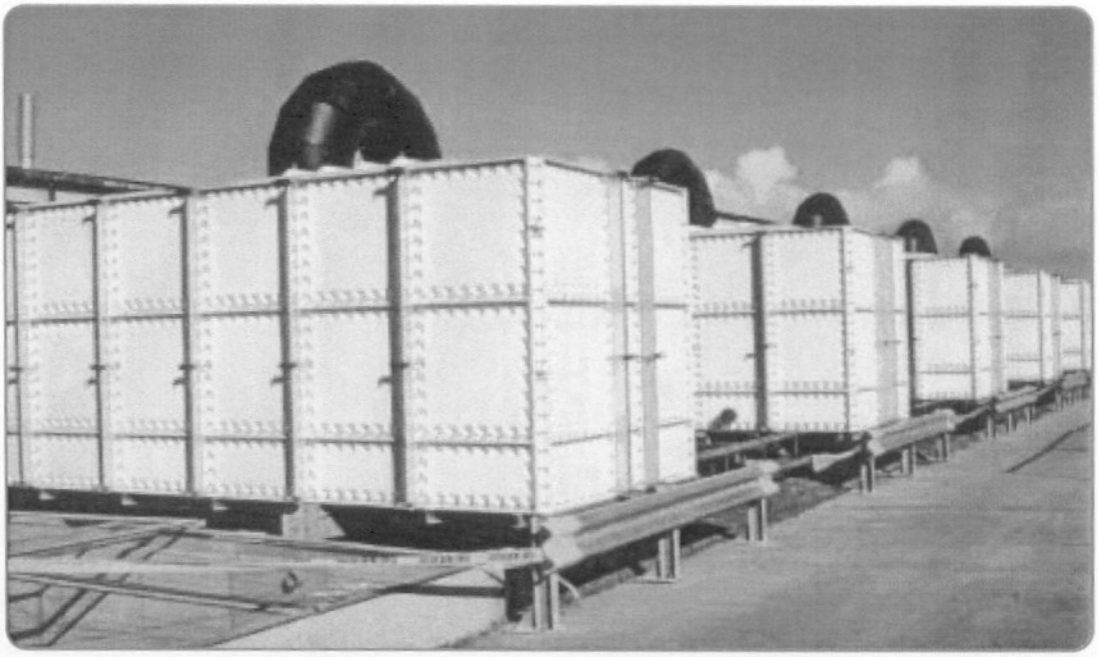

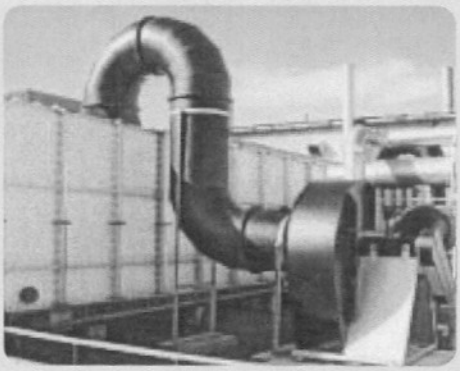

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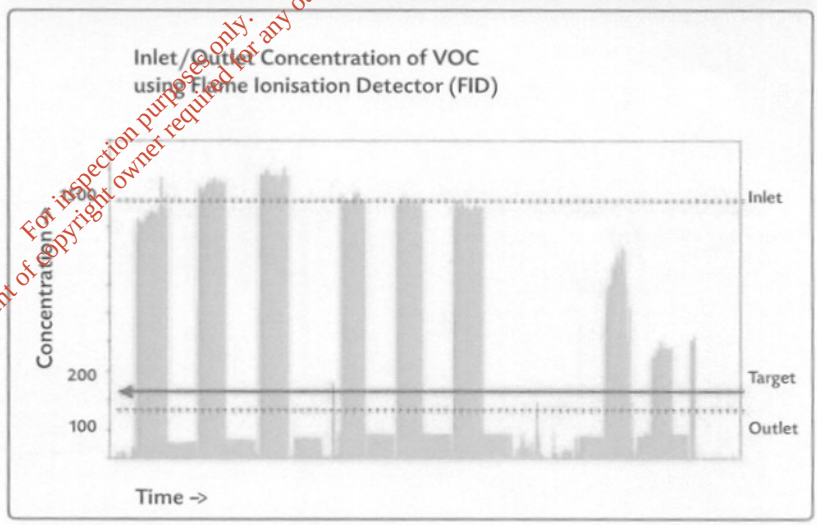

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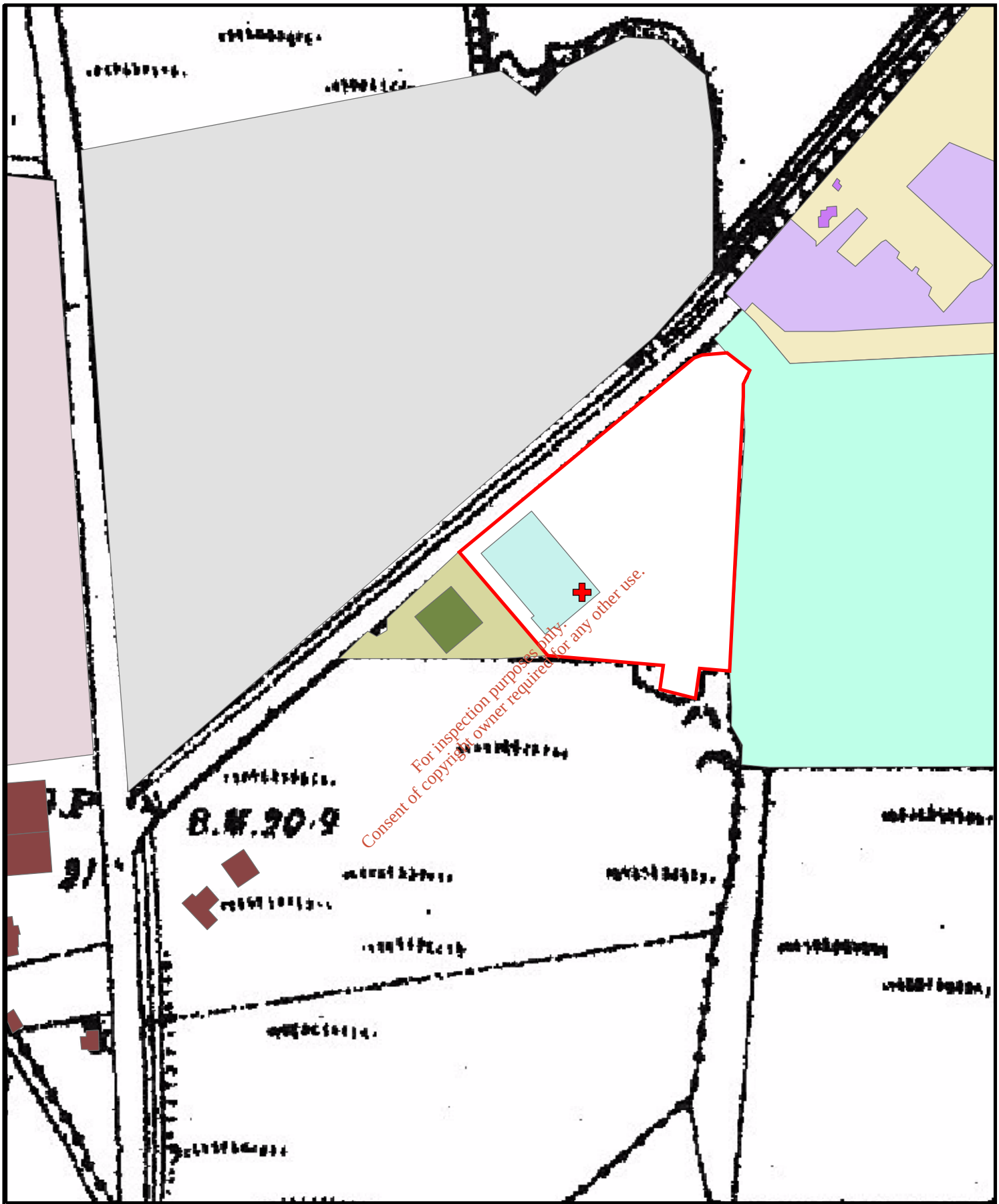

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Fig X.X
Shredder Location

SWS Environmental Services
MEMBER OF SWS Group

Scale: 1:2,500
0 25 50 Meters

N

Legend:
- Shredder_Location
- Building_Detail
- Site_Boundary_10052006
- Foxhole Business Park
- Foxhole Industrial Estate
- Dwelling Houses
- Youghal Shipping Lands
- landfill_bldgs
- civic_amenity_area
- Youghal Landfill (Cork Co.Co.)
- NCT_building
- NCT Centre

Prepared by: DO'S
Checked by:
Created in: ArcGIS 9.1
Drawing date: 09/05/2006
Drawing No: 2004_121_SL

Ordnance Survey Ireland
License No: AR 0017004

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ENVIRONMENTAL IMPACT STATEMENT
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Impact Statement

Non-Technical Summary

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Resubmission as part of Application 211-1

WASTE RECOVERY/TRANSFER & SLUDGE DRYING FACILITY

SWS Environmental Services
Shinagh House
Bandon
Co. Cork

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Document Control Sheet

Client: AVR Environmental Services Ltd.	
Document Brief	
Report type (draft or final)	Final
Report from:	Denis O'Sullivan Project Manager SWS Group
Report Issue Date	
SWS Environmental Report Brief Ref.	2004_121

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Revision Number	Prepared by:	Checked by:	Approved by:	Date	No Copies
2					3

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Non –Technical Summary

Introduction

SWS Environmental Services have prepared an Environmental Impact Statement (EIS) on behalf of AVR – Environmental Solutions Ltd. to submit as part of a planning application to Cork County Council and a waste licence application to the Environmental Protection Agency (EPA).

This is the Non-Technical Summary, Volume 1 of 2 of this EIS. The EIS was prepared as per the requirements set out in the Environmental Impact Assessment Regulations (EIA) [European Communities (EIA) Regulations, 1989] (SI No. 349 of 1989), and EIA Regulations [European Communities (EIA) Regulations, 1999] (SI No. 93 of 1999). The EIS was also prepared in accordance with the requirements of the Planning and Development Regulations, 2001 (S.I. No. 600 of 2001).

AVR – Environmental Solutions Ltd. propose to develop a Waste Recovery/Transfer and Sludge Drying Facility in the townland of Foxhole, Youghal, Co. Cork. The site of the proposed development is located off the R634 (former N25 Cork to Waterford Road) adjacent to the existing Youghal Landfill and Civic Amenity Centre.

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The area of the proposed development is zoned Industrial/Enterprise in the Cork County Development Plan, 2003. The existing site has Planning Permission (ref: S/00/7093) for “the construction of a waste transfer station” and also holds a Waste Management Permit (ref: CK(S) 23/03) for a “Waste Recycling/Transfer Station”.

No significant difficulties were encountered during the preparation of this EIS.

This EIS is divided into two volumes:
EIS Volume 1: Non-Technical Summary,
EIS Volume 2: Main Report and Appendices.
Waste handling will be in line with BAT Guidance Notes for the Waste Sector: Waste Treatment Activities, EPA, Draft November 2003. Best Available Technique (BAT) was used in the design of the proposed development and the EIS was prepared using national guidelines and regulations on the information to be contained therein.

The Cork County Development Plan 2003, National policy documents including Sustainable Development: A Strategy for Ireland, Making Ireland's Development Sustainable, Waste Management: Changing Our Ways, Preventing and Recycling Waste: Delivering Change,

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National Climate Change Strategy, and Litter Action Plan, the Waste Management Plan for Cork County 2004 and the Sludge Management Plan 2000 were all reviewed as part of EIS preparation. This EIS has been undertaken having regard to the Environmental Protection Agency's *'Guidelines on the information to be contained in Environmental Impact Statements' (*EPA, March 2002*)*.

Public Consultation

A number of public organisations and special interest groups were consulted regarding the proposed development during the scoping of the project.

Need for the Proposed Development

As a Member State of the European Union (EU), Ireland's most significant waste policies were drawn up in the 1990's and were derived from laws, policies and strategies adopted by the EU. The proposed Waste Recovery/Transfer and Sludge Drying Facility promotes these aims and targets by assisting in diverting waste from landfill and in providing waste for recycling.

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The Waste Management Plan for Cork County, 2004 reinforces Cork County Council's commitment to a system of waste management that will see the least amount of waste going to modern engineered landfills and that this will be achieved through the use of bring sites, civic amenity sites and material recovery and treatment facilities. The proposed Waste Recovery/Transfer and Sludge Drying Facility supports the principles and objectives of the Waste Management Plan for Cork County, 2004.

The Waste Management Plan for Cork County 2004, states that in 2002 there was approximately 130,000 tonnes of sludge type waste produced in Cork County and that *reduction of sludge to landfill is an objective of both industry and the local authority*. The proper introduction of EU directives on land spreading of sludge will mean that the current spreading of waste water treatment sludge will be limited. The proposed Sludge Drying facility will ensure that sludge is treated to current EU preferred methods and reduce the volume of sludge currently being landfilled.

The proposed sludge drying facility utilises a system of indirect drying. As non-hazardous sludge is part of the waste stream to be managed at the proposed facility the proposed development is in agreement with the policies set out in the Sludge Management Plan for Cork County 2000.

SEVESO

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The proposed activity does not fall within the European Communities (Control of Major Accidents Hazards involving Dangerous Substances) Regulations 2000 (SI No 476 of 2000). The site does not fall under the SEVESO Directives (96/82/EC; 2003/105/EC).

Site Selection

The site was chosen based on the following:

The policies and strategies of the Cork County Development Plan 2004 in establishing sustainable development,

The policies of the Waste Management Plan for Cork County 2004,

Road network and access,

Land-use zoning,

Utilisation of brownfield sites for further development,

Adjacent to an existing landfill,

Proximity to sources of waste.

Selection of a location with Planning Permission for *the construction of a waste transfer station*,

Selection of a location with a Waste Management Permit to operate a Waste Recycling/Transfer Station,

Existing Planning Permission (ref: S/00/7093) for *the construction of a waste transfer station*,

An existing Waste Management Permit (ref: CK(S) 23/03) for a "Waste Recycling/Transfer Station" at the site,

Proximity to sources of waste.

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Technology Selection

The selection of technology was based on Best Technology Available (BAT) including design to prevent impacts and nuisances during installation, commissioning and operations phases. The preferred chosen technology is thermal treatment using an indirect fully enclosed method of drying. The benefits of thermal treatment include:

Proven in the field of industrial, pharmaceutical and municipal sludge drying nationally (sewage sludge) and internationally (all sludge types),

High sludge volume reduction,

Pathogen-free, sterile product,

An end product with a market use,

In-line with regional sludge management policy.

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Site and Scheme Description

The proposed development on 3.54 acres consists of inter-alia;
a waste recovery and transfer building;
administration building and carpark;
transformer/plant building and standby generator;
boiler and woodchip storage building;
sludge reception building;
sludge drying building;
waste water treatment plant including balancing tank;
fire water storage tank;
storm water retention tank;
1 no. weighbridge;
1 no. wheelwash;
oil storage and bund walls;
waste quarantine area;
dried sludge discharge area;
mobile dewatering plant;
mobile fire fighting plant;
hard standings;
all boundary fencing and walls;
all associated site works;
and ancillaries.

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It is proposed to manage 70,000 tonnes/annum of commercial/enterprise and industrial waste, 30,000 tonnes/annum of non-hazardous biological sludge from waste water treatment plants, 10,000 tonnes/annum of leachate and 500 tonnes/annum of washings.

Waste Recovery/Transfer Activities

The following plant and equipment will be used at the Waste Recovery and Transfer building:
Materials Handling Grab,
Dosing Intake Conveyor,
Transfer Belt during phase 1 up to approximately 15,000 tonnes per annum,
Trommel Drum Screen or similar during phase 2 when throughput tonnages increase beyond approximately 15,000 – tonnes per annum,
Picking Station, Sorting Belt and Overband Magnet, fully air-conditioned with high lux fluorescent lighting,
Infloor Conveyor to Compactor,
Baler,
Shredder,
Woodchipper,

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Forklift or loading shovel.

It is proposed to operate the transfer station from 07:30hours to 21:00hours Monday to Saturday inclusive for fifty weeks per year

It is proposed to operate the sludge drying facility on a continuous basis 24hours per day, seven days per week, and fifty weeks per year.

It is proposed to accept waste from 07:30hours to 21:00hours Monday to Saturday inclusive for fifty weeks per year.

The process description at the Waste Recovery and Transfer building is presented in diagrammatical format.

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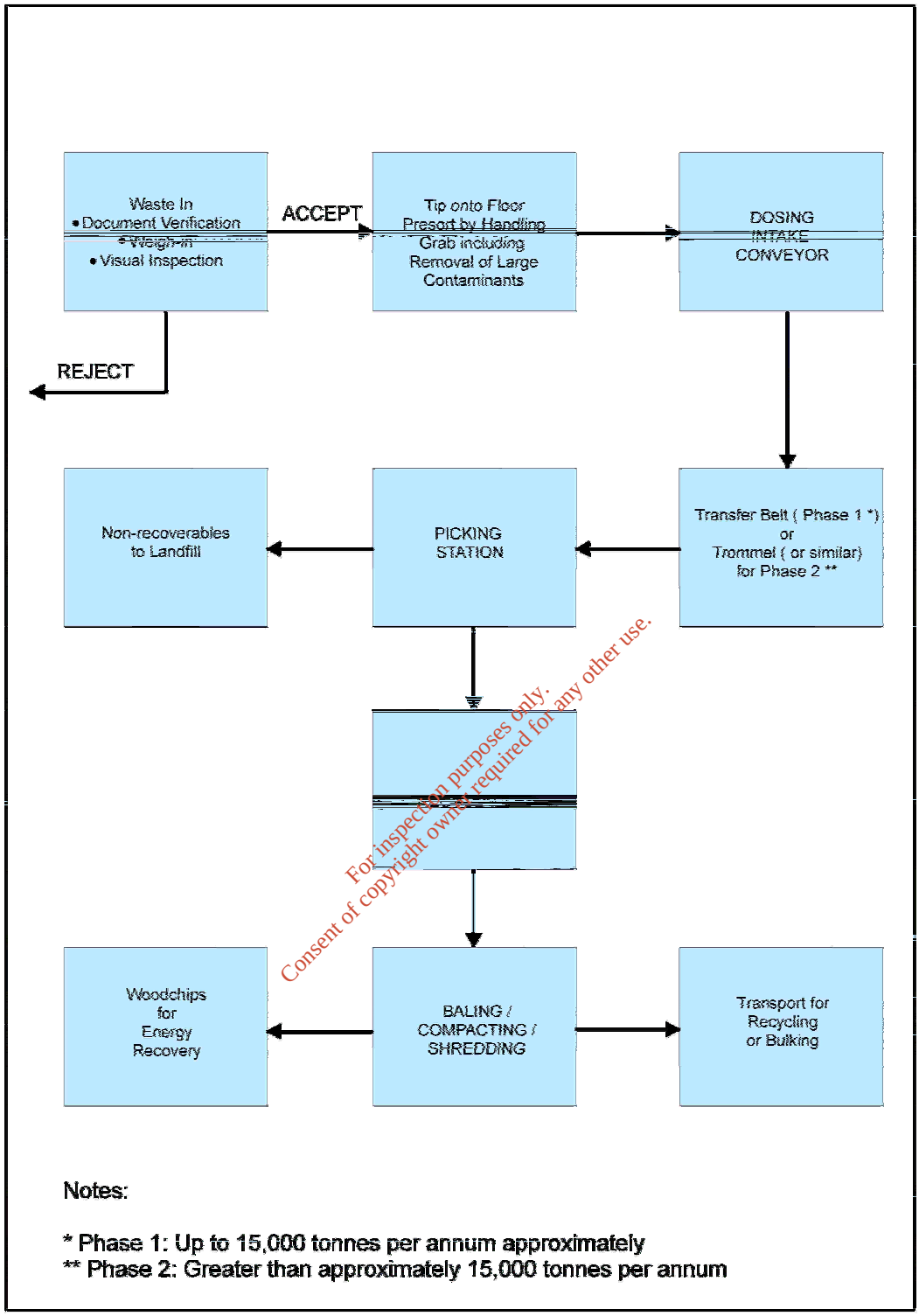

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Waste Recovery and Transfer Process Description

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Sludge Drying Activities

Wet sludge (with a minimum Dry Solids (DS) content of 10%) on arrival at the facility will be weighed and randomly sampled for analysis. The wet sludge is then tipped into sludge reception bins (covered with hydraulic lids and gratings) in the fully enclosed Sludge Reception building. The sludge is then pumped to a dosing/mixing bin that controls the flow of sludge into the dryer. The dryer is heated using a totally indirect method of heating; various energy sources are available to operate the dryer including biomass (woodchip) and light diesel oil. The dryer will be insulated, except at the ends, to minimize heat loss, thus reducing energy usage and provide for very safe working conditions.

The drying process creates steam; which is carried via the off-gas duct to the scrubber/separator or similar type plant, where it is condensed. Any fine particulate matter is returned to the dryer and the condensed effluent is sent to the hooded waste water treatment plant where it is treated to according EPA effluent discharge limits. Purge stream off-gas, volatile organics evaporating from the hooded waste water plant and odours from the sludge reception bin will be treated by a standalone biofilter odour abatement technology.

The dried sludge is received onto a discharge conveyor and transferred to a product cooling conveyor, and indirectly cooled. The product with a moisture content of less that 10% is then screened to separate the fines, which are returned by the fines conveyer to the front of the dryer. The end-product is a sterilised granulate.

This facility will run on a 24 hour basis 7 days a week including holidays. It will be shut down for maintenance.

The process description for the sludge drying facility is:

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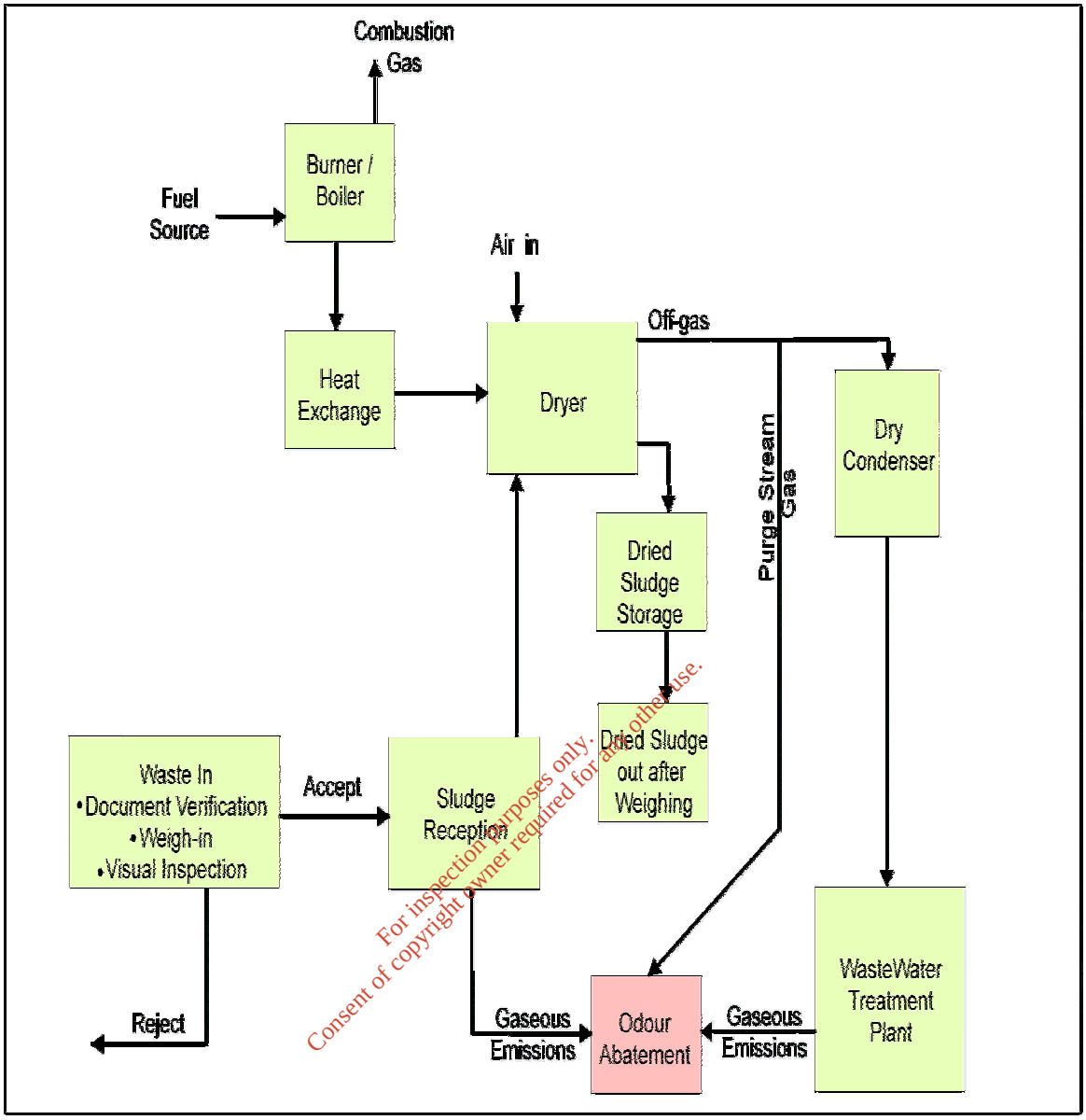

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Sludge Drying Process Description

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GEOLOGY AND HYDROGEOLOGY

Existing Environment

Though the limestones of the Youghal syncline are considered a major or regionally important aquifer (GSI, 1994) and they are classified as amongst the most productive in the country, due to the coastal location of the site, the risk of saline intrusion to the groundwater, limits its potential for potable use (GSI, 1994). Groundwater in the area, therefore, is not likely to be considered suitable for extraction.

Impacts during Construction

The geotechnical site investigation report describes the subsoils as sandy/gravelly clays; as such these materials have little economic value.

Impacts during Operation

The site is not intended to deal with hazardous materials or putrescible waste. Therefore, potential contamination during the operation of the facility should be minimal. Furthermore the hardstanding area of the site will divert surface water run-off and all storm waters will be collected and monitored prior to discharge.

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Impacts during Decommissioning

The main potential impact associated with the decommissioning of the facility would pertain to where contaminants had been stored on-site. Potential contaminants to be stored on-site will include fuels such as light diesel oil, which will be contained in bunded areas. The operator of the site has prepared a Decommissioning Plan. Therefore the control and management of the facility during decommissioning means that any potential risk is reduced.

Mitigation Measures

Impacts during Construction

It is intended to use this soil/overburden for landscaping purposes on-site.

Impacts during Operation

A quarantine area will be established on-site to temporarily store such materials should they unintentionally arrive on-site, thereby controlling, preventing and managing any potential risk. The entire operational area of the site will be concreted. This measure should protect the sub-surface from any potential contamination. Surface run-off will be directed from the site with the installation of hardstanding throughout the facility. Run-off from all site surfaces will be collected and monitored, thereby further reducing the pollution potential of the site. Process and foul water will be treated prior to discharge.

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Impacts during Decommissioning

All care will be taken during decommissioning, to ensure that potential contaminants will not be released from the site.

AIR

Existing Conditions

Baseline dust, dour and gaseous emissions are within permissible allowable levels.

Impacts Assessment

Construction Phase

It is expected that the construction phase will last a total of approximately 1 year and due to the scale of the development and short term earth moving activities, any impact on air quality will be minimal.

Operations Phase and Mitigation Measures

Dust

Activities at the proposed facility have the potential to generate dust in the loading and treatment of waste. However, as operations will be conducted indoors, dust generation will be prevented at source and thus impacts are considered minimal.

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Odour

The proposed facility will treat waste from commercial and industrial sources. The absence of any significant quantities of putrescible organic waste due to segregation by the producer will ensure that odour impacts any minimal.

The Sludge Drying building will be operated as a closed housed system to contain any generated dust. Dust potential from wet sludge is considered non-existent. The system is designed to prevent fugitive emissions. Proper housekeeping, maintenance and management of the sludge drying building will ensure that dust generating activities are limited.

Any dusts generated from combustion plant and vehicles on site will be minimised by regularly following effective maintenance and operation procedures. Staff operation and awareness training is proposed to ensure procedures are correctly followed. Regular cleaning and inspection of the site is essential to control dust levels.

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Any dust generated by boiler equipment and standby generator will be within proposed ground level concentrations as directed by the TA Luft 2002 guidelines and SI 271 of 2002 Air Quality Standards (Refer to Air Quality Data and Modelling Report). Therefore no mitigation measures are required.

Gaseous Emissions

Vehicles and plant associated with materials handling and the incoming waste material provide the only source of gaseous emissions at the Waste Recovery and Transfer building. Gaseous emissions levels are negligible. Sludge will be stored in a specially designed sludge reception building. The wet sludge will be pumped directly into the enclosed system.

The dried granular sludge has a very low odour potential and will be stored in closed silos and containers.

Excess process water and gas purge streams from the Sludge Drying Facility will be sent directed to the hooded wastewater treatment plant. Gaseous emissions from the hooded Waste Water Treatment plant will be treated by the standalone odour abatement technology.

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WATER

Existing Environment

The Blackwater catchment is one of the largest in the state, draining an area in excess of 2,000km^3. The Upper Blackwater Estuary shows decreased oxygen levels. Below this area, oxygen levels are increased, even though oxygenation is disturbed throughout the lower estuary and it then recovers fully by the Inner Youghal Bay.

Nitrogen and phosphate concentrations are somewhat elevated in the Upper Estuary under freshwater conditions. However, under saline conditions the Lower Estuary concentrations of these parameters are reduced to background coastal levels in Inner Youghal Bay.

Chlorophyll concentrations are overall elevated in both the Upper and Lower sections of the Estuary.

The breaching of these criteria levels classifies both sections of the Blackwater Estuary as eutrophic however; this classification does not appear to extend into the waters of Youghal Bay. Consequently, under the Urban Waste Water Treatment Regulations (S.I No. 254 of 2001 & 91/271/EEC) the Upper and Lower Blackwater Estuary are classified as Sensitive Areas.

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Improvements in the municipal waste water treatment schemes, as well as, the reduction in the landspreading of sludge and the introduction of the Nutrient Management Plans in this area, should lead to a reduction in pollution levels in the river and its tributaries in the future.

Impact Assessment and Mitigation Measures

Storm Waters

Surface water runoff from paved and roofed areas will be collected via the site drainage system. The entire site shall be bunded using kerbing to prevent the uncontrolled escape of storm water. Four Class One type oil and grit interceptors or similar will be installed with a 120m^3 Storm Water Retention Tank with a monitoring well so that contaminates and or spilled hydrocarbons.

A sluice valve will control discharge of the storm waters to the outfall via the Youghal Town Council sewer network. Discharges have bene modelled with respect to chemical and biological impact and will not impack on the receiving environment. Emisison limist will eb stipulated by the EPA in agreement with Youghal Town Council. In the event on an incident with potential for contamination of surface waters (e.g. spillage), the sluice valve will close preventing any discharge from the site.

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Foul Waters

These waters shall be collected in the site foul water system and treated on site prior to discharge.

Process Waters

The only process water on-site shall be the final effluent from the waste water treatment plant. This effluent shall be monitored so that it is within the emission limit values set by the EPA. Monitoring shall be carried out at a frequency, to be specified by the EPA. The impact of the plant output on the river flow rate is negligible and therefore does not require mitigation.

Fire Waters

In the event of an incident, for example a fire, the potential contaminated waters will be collected through the storm water drainage system with the entire site acting as a large bunded area using the raised kerbing as an extra backup measure. Fire water will be stored in the Firewater Retention Tank. Any spent fire water will then be treated at the waste water treatment plant.

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Bunds

There are a number of bunded areas at the proposed development and include the following:

Fuel storage area,

Quarantine area,

Standby generator pad.

All these bunds will be tested for integrity and a discharge valve will be installed to pump out any contaminated water and hydrocarbons to be treated at an EPA approved facility.

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NOISE

Existing Environment

The primary noise sources in the area are mobile vehicles including haulage vehicles and private cars utilising the civic amenity site and NCT centre. The noise environment would be typical for locations situated near major transport routes.

Overall, the average daytime Leq of 54dB(A) measured onsite was lower than the average daytime Leq of 66dB(A) measured at the nearest noise sensitive resident. This is due to traffic noise and the close proximity of the nearest noise sensitive location to the R634. During night time hours the noise levels at are reduced, however levels are still quite elevated with an average Leq of 50dB(A) due to traffic noise.

Impact Assessment and Mitigation Measures

Impact during the Construction Phase

The nearest dwelling (noise sensitive location) is over 180m from the site boundary. Noise levels at this distance were calculated from the sound power data assuming the plant would be operating at the nearest point of the boundary to the sensitive receivers. Construction equipment will not generally operate at the boundary of the site.

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Combined Impact of the Operation

The noise contribution from the facility, at the nearest noise sensitive location can be obtained by summing the individual noise contributions from the above elements. The increase in noise level from the facility at the nearest noise sensitive location is 31 dB(A) during daytime and 22dB(A) during night time.

The overall noise level, at the nearest noise sensitive location, can be predicted (BS 4142 1997 Method of Rating Industrial Noise affecting Mixed Residential and Industrial Areas) using the noise level contribution from the facility and the measured background noise levels at the nearest dwelling house.

Background noise level is greater than usual boundary noise limits because of traffic the site is located near a busy Regional and National Route which is a significant anthropogenic noise source in the area It is considered appropriate that while stipulating a limit of 45dB at night that an additional licence requirement stating that the noise from the facility will not increase background noise by more than 5dB

VIBRATION

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Some construction activities such as driving piles can give rise to considerable levels of ground vibration. However, at the proposed development flight augured piles will be used instead of driven piles. Therefore no adverse vibration effects are anticipated.

Plant and equipment is not expected to give rise to any vibration during the operations phase. Therefore it is not expected that vibration during the operations phase will impact on any adjacent building.

CLIMATE

Existing Environment

The long term weather patterns in this location reflect regional weather conditions of the South-Munster Area which is dominated by low-fronts from the west and south west during winter. During the summer more settled conditions prevail. For localised weather conditions meteorological measurements from nearby weather stations were consulted.

Impact Assessment and Mitigation Measures

No impacts are anticipated. Therefore, no mitigation measures are required.

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FLORA AND FAUNA

Existing Environment

There are no National Heritage Areas (NHAs), Special Areas of Conservation (SACs), Special Protection Areas (SPAs), wildfowl sanctuaries, Ramsar sites, Nature reserves or National Parks within the site boundary.

The site is located adjacent to the Blackwater River cSAC no. 002170, Blackwater River and Estuary pNHA no. 000072, Blackwater Estuary SPA no. 4028, and within 300m of a Ramsar site (Blackwater Estuary, Ireland 7IE028).

The site is located in Landscape Character Area no. 35 Youghal Bay (Composite Mosaic and Marsh Estuary), as mapped in the 2003 Cork County Development Plan. The landscape character is Type 2: Broad Bay Coast.

No tracks, traces or other signs of mammalian activity were observed at the site. Species that are likely to inhabit the site include the Brown Rat, Pygmy Shrew and Field Mouse. It is probable that foxes and rabbits (Oryctolagus cunniculus) also occur in the area. The site does not provide potential roosts for bat species. The common frog (Rana temporaria) was not observed at the site. Due to current vehicular movements at the site, it is unlikely that frogs reside here. During the site survey transect, a total of 44 birds of 14 species were recorded. 27 birds of 8 species were observed within the site itself. A further 17 birds of 10 species were observed within the vegetated site boundaries

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Finally consultation with the local National Parks and Wildlife Ranger corroborates that the site is not of great importance for birds, in regard to that of the surrounding habitats (P. Smiddy, pers comm). It is therefore considered unlikely that the loss of habitat within the proposed development site will have a negative impact on bird populations or habitat diversity of the surrounding areas.

Impacts on Flora and Fauna

The entire site will be cleared of existing vegetation. This will lead to the permanent and complete loss of existing habitats at the site. The habitats present at the site are not considered to be of high ecological value and are not listed as priority habitats in the Habitats Directive.

The main potential impacts for mammals occurring at the site will be the loss and fragmentation of habitat, and disturbance. Currently the habitats may provide feeding and residence opportunities for mammals (although no evidence of mammal setts or burrows was

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found). Loss of habitat will permanently remove these opportunities. Increased human activity at the site will deter mammals from using the site.

These impacts are not considered to be a significant negative impact because they will be localised and minimal. It is predicted that the local animal species will adapt to the change in their local environment, through either avoidance of the development site or restriction of their usage of the site. Mammals can move to another location which has similar habitat types.

Mitigation

It is recommended that specified areas be used to dispose of excavated material and that all waste and unused building materials be removed from site. Vegetation from the surface should be stockpiled and used to resurface bare ground along road edges and disturbed areas.

A landscaping programme for the developed site has been agreed with Cork County Council under planning permission requiremenst for the development. This proposal takes account of the existing environment and includes hedgerow planting and management that involve the use of native species that are in line with those species present in the surrounding area

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CULTURAL HERITAGE

Existing Environment

The study of the three editions of OS maps did not reveal any features of archaeological significance on or near the site of the proposed development. There are no references to any features of archaeological significance that might be affected by the proposed development. The field inspection covered the entire site and did not reveal any features of archaeological potential.

Impacts and Mitigation Measures

The combined desktop, literary and field inspection did not reveal any previously unrecorded features of archaeological significance on or near the site of the proposed development.

It is recommended that a licensed and experienced archaeologist monitor the removal of all topsoil prior to construction of this development. The archaeologist will examine all deposits revealed during the course of excavations and, where possible, determine a date and context for any archaeological features that may emerge.

The developer must report the discovery of any archaeological features to DOEHLG and facilitate and fund both their investigation and recording.

Any artefacts uncovered during the course of excavation must be reported to the Duty Officer of the National Museum of Ireland.

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LANDSCAPE

Existing Environment

The area of the proposed development is zoned Industrial/Enterprise in the Cork County Development Plan 2003.

The overall visual impression of the site is a brown field site with a complex of built anthropogenic structures such as high metal fencing and posts, telephone and electricity poles, Youghal Landfill and Civic Amenity Centre, the NCT Centre, Foxhole IDA Industrial Estate and Foxhole Business Park incorporating Millennium Court office buildings.

The site occupies a very low-lying elevation, as it is enclosed to a significant extent by the confluence of rivers that surrounds it. Elevations changes across the site are negligible in comparison to the surrounding landscape. The site can be seen from the N25 scenic particularly in Waterford section directly opposite the site. However the Youghal Landfill and Civic Amenity Centre is the focal point of this fragmented landscape.

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Site Aspect is south facing with the minimal sloping degree of 0-1. Therefore, site exposure is greatest on the eastern and southern side of the site, across the Blackwater Estuary and Youghal Bay.

The Cork County Development Plan 2003, supports the Landcover classification as the site is located in an area zoned for industrial and enterprise development.

Agricultural practices such as tillage, grasslands and forestry dominate the landuse patterns of the hills.

Impact Assessment and Mitigation Measures

The proposed development will form a linear block between the NCT Centre and the Youghal Landfill and Civic Amenity reducing the visual impact of the existing developments.

A Landscape plan and planting specifications for the proposed site was agreed with Cork County Council.

Much of the roadways in the vicinity of the site (i.e. N25 and R634) are well screened by the presence of hedgerows and structural landscaping. Therefore the proposed development is not significantly visible from roads. Intermittent views may occur. These will be further obscured by the proposed landscaping measures at the site.

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The R634 from Youghal Town to the N25 was also assessed to determine potential visibility. The commercial/industrial developments at Foxhole are clearly visible from this location. The absence of any screening on the northern side of these structures renders them highly visible. However, screening of the proposed development from these buildings and from the tree planting detailed in the Landscape Development Report will reduce the visual impact of the development significantly.

The sky is predominately cloudy and grey for the majority of the yearly climatic conditions therefore it is recommended that the buildings in the proposed site will have a ‘goose-wing grey’ colour to harmonise with the natural background sky.

Finally, the proposed development will be on a scale with existing structures in the Foxhole area. It will form a linear block between the NCT Centre and the Youghal Landfill and Civic Amenity reducing the visual impact of the existing developments.

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TRAFFIC

Existing Environment

Traffic data collected as part Traffic section of the Environmental Impact Statement (EIS) prepared by Fehily Timoney & Company on behalf of Cork County Council in May 2003 for the *Intensification of Use of Youghal Landfill* shows an annual average daily traffic (AADT) volume of approximately 5,496 vehicles per day of which 22% were heavy good vehicles (HGV's). This equates to the removal of 48% of the total predicted 2003 traffic (i.e. using a growth factor of 3.5% per annum) on this portion of the R634 if the Youghal Bypass had not been built.

It can be assumed that most traffic accessing this road are visiting Youghal Landfill and Civic Amenity Site as the NCT Centre generates low volumes, likewise Youghal Shipping uses the lands adjacent to the landfill rarely.

Impact Assessment and Mitigation Measures

The proposed development will increase the growthed AADT 2004 figure of 5,688 by an AADT of 42.12 in terms of HGV's, the number of car movements is negligible. Therefore the proposed development generated traffic will not have any significant impact on the surrounding road network. In fact it can be stated that the proposed facility at Foxhole, Youghal will not result in any significant impact on traffic flows along the adjoining roads due to the opening of the N25, Youghal Bypass.

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The geometry of the T12 does not facilitate two-way movement for HGV's, though it did historically. However this was removed by Cork County Council due to illegal camping activities and fly tipping. Cork Council created two lay-bys. As part of the planning conditions granted for the *Intensification of Use of Youghal Landfill* by An Bord Pleanala Cork County Council is required to upgrade the road to facilitate further two-way movement of HGV's.

Construction Phase

As the impact is considered negligible during the construction phase, no mitigation measures are required other than good construction practice and site housekeeping.

Operations Phase

The primary mitigation measure will be the upgrade of the T12 connecting the site to the R634, Cork County Council will have to complete these works by 2006 as part of the planning conditions granted for the *Intensification of Use of Youghal Landfill* by An Bord Pleanala.

It is also proposed to introduce additional mitigation measures, which will include the following:

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Staggering of deliveries/collections to/from the proposed facility, this limits the number of HGV's on the surrounding road network, at any one time,
Instructing all vehicles travelling to the site from outside Youghal town will access the site off the N25 Youghal Bypass,
Segregated Service and Vehicular access in the interest of safety,
Implementing a traffic management plan to prevent congestion and queuing in the local environs.

Sustainable Modes of Transport

Pedestrian and cycle modes are high in the pyramid of sustainability and will be accommodated fully at the proposed development, by means of bicycle racks and a pedestrian entrance into the facility. The bicycle racks will be located in a well lit, secure area near the Administration building.

Car Parking

There is sufficient parking for both staff and visitors. This is also conforms to the Car Parking Standards in Appendix IV of the Cork County Development Plan 1996. This will ensure that over spill onto the public road occurs.

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HUMAN BEINGS

Existing Environment

The 2002 Census contains the latest available employment statistics in the Town Council Area. The single largest employment sector in Youghal is the Manufacturing Industries. This sector has most likely decreased greatly since the census was compiled due to the closures of a number of factories.

Impact Assessment and Mitigation Measures

The main areas of concern with respect to the potential effects of the development on the human environment are air quality impact, noise impact, ecological impact, visual impact traffic impact and impacts associated with decommissioning of the facility. These impacts are presented under their various headings above. Other potential impacts include: health and safety impacts to employees and locals, potential impacts on tourism and socio-economic impacts.

Health and Safety considerations for employees were given merit at the design stage of this facility. These considerations include ventilation in the picking station at the Waste Recovery and Transfer building. Part of the design and scoping process for selection of the indirect method of sludge drying was the safety and environmental controls that could be put in place as preventative control measures rather than mitigation measures.

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Operations during the lifespan of the facility will be conducted inline with the relevant legislation and implementation of the site Health and Safety Plan and will be overseen by the Health and Safety Manager.

Hazardous materials will not be stored on-site. Only diesel oil and waste will be stored on site. Both of which will be stored securely.

MATERIAL ASSETS

Existing Environment

The site of the proposed development is located within commutable distance to a number of significant towns in the Cork County region. At the time of the last census (2002), unemployment was running at low levels in Youghal. However, by February 2003, two of the town's major employers had announced closures. Therefore, there is most likely a good supply of labour presently available in Youghal. In terms of transportation, Youghal is well serviced by roads. The N25 National Secondary Route from Cork to Waterford serves the town. This route is also a designated Euroroute E30; thus it is part of the officially designated European network of roads, which represent the core of the transport system throughout Europe.

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Decommissioning Plan

A Decommissioning Plan has been prepared to ensure that the proposed facility is shut down and decommissioned in a safe and environmentally sound manner.

Impact Assessment and Mitigation Measures

Economic Impact

It is estimated that the construction phase of the proposed development will bring up to 30 jobs to Youghal. Throughout the operational phase, a minimum of 17 persons will be employed at the facility. Spin off industries associated with the proposed development may also produce jobs in the form of cleaning services, catering providers, etc.

Existing Infrastructure

It is proposed that the site will have its own waste water treatment plant. Therefore, there are no impacts expected to the existing sewage infrastructure. There is no negative impact expected to other infrastructure in the area, which has been planned with industrial development in mind.

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Transport Infrastructure

The proposed development is located adjacent to the Youghal by-pass. Therefore, there are no negative economic impacts anticipated for the town of Youghal related to vehicular movements to and from the site. This represents a positive impact for the area.

Proximity to the existing landfill will ensure that any waste contaminants that may have to be disposed of can be done in close proximity to the site without generating excessive traffic on the roads.

Property Values

The area of the proposed development has been zoned by the planning authority as Industrial/Enterprise. Also, there is little evidence to suggest that adjacency to a well managed waste management facility negatively impacts on house prices.

Tourism

The Cork County Development Plan 2003 states as an aim the desire, to promote development in Youghal with regard to its coastal setting and its special recreational, heritage and marine tourism functions. With this in mind, the Department of Arts, Sport and Tourism (DAST) was consulted during the Public Consultation Stage, along with other relevant parties.

A landscape assessment was conducted to investigate the impact of the proposed development on views and prospects in the Youghal area. This assessment concludes that the visual impact of the proposed development on the surrounding environment will be minor to negligible. This is due to the fact that the site will be well screened by trees and other developments in its vicinity such as the Millennium Court office buildings at Foxhole Business Park, the NCT centre and Youghal Landfill. The site will therefore be in harmony with the other buildings in this industrial and commercial zoned area.

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Natural Resources

The facility of the proposed development will reduce the volume of waste requiring disposal in the Cork Area. The Waste Recovery/Transfer Facility will promote recovery and recycling. The Sludge Drying Facility will reduce sludge volumes currently being exported and landfilled.

These measures represent a positive impact on natural resources and are in keeping with sustainable development practices.

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INTERACTION OF THE FOREGOING

Environmental Impact Assessment (S.I No. 349 of 1989; S.I. No. 93 of 1999) states that not only are the impacts on the individual elements of the environment to be considered, but so too are the interactions between those elements.

Table 1.1 illustrates the interaction of impacts assessed for this project.

	Geology	Air	Water	Noise	Climate	Flora & Fauna	Cultural Heritage	Land-scape	Traffic	Human Beings	Material Assets
Geology			✓			✓		✓			
Air				✓	✓				✓	✓	
Water					✓	✓					
Noise									✓	✓	
Climate		✓	✓								
Flora & Fauna	✓		✓								
Cultural Heritage								✓		✓	✓
Land-scape	✓						✓			✓	✓
Traffic		✓								✓	✓
Human Beings		✓		✓							
Material Assets							✓		✓	✓	

Table 1.1 Impact Interaction Matrix

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Finally this EIS provides the community, government, non-government bodies and other interested parties with information regarding the existing environment, potential impacts associated with the proposed development during the construction and operation phases, and any mitigation measures required to ameliorate these impacts.

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Attachment A1: Non Technical Summary

Introduction

SWS Environmental Services have prepared an Environmental Impact Statement (EIS) on behalf of AVR – Environmental Solutions Ltd. to submit as part of a planning application to Cork County Council and a waste licence application to the Environmental Protection Agency (EPA).

This is the Non-Technical Summary of the Waste Licence application and form Attachment A1. The information contained in this Non-Technical complies with the requirements of Article 12(1) (u) of the Waste Management (Licensing) Regulations, SI 395 of 2004. This non technical summary has been revised on the basis of additional information submitted to the Agency rev 2.

The EIS was prepared as per the requirements set out in the Environmental Impact Assessment Regulations (EIA) [European Communities (EIA) Regulations, 1989] (SI No. 349 of 1989), and EIA Regulations [European Communities (EIA) Regulations, 1999] (SI No. 93 of 1999). The EIS was also prepared in accordance with the requirements of the Planning and Development Regulations, 2001 (S.I. No. 600 of 2001).

12 (1) (a) Addresses (Registered and Correspondence)

AVR – Environmental Solutions Ltd., with registered offices at Corrin, Fermoy, Co. Cork are applying to the Environmental Protection Agency for a Waste Licence and Cork County Council for Planning Permision in respect of its proposed development of a Waste Recovery/Transfer and Sludge Drying Facility in the townland of Foxhole, Youghal, Co. Cork.

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Any correspondence in relation to this project should be sent to Project Manger (AVR – Environmental Solutions Ltd.) c/o SWS Natural Resources Ltd., Shinagh House, Bandon, Co. Cork.

12 (1) (b) Planning Authority

The proposed development is within the functional area of Cork County Council. The area of the proposed development is zoned Industrial/Enterprise in the Cork County Development Plan, 2003. The project received planning permission for development of a waste recovery/transfer and sludge drying facility vai An Bord Pleanala on 14th July 2005 (PL 211117 PA reg 04/7531)

12 (1) (c) Sanitary Authority

AVR – Environmental Solutions Ltd. propose to discharge treated foul sewage, waste water and storm water to the Youghal Town Council outfall via the Youghal Town Council Sewer for the medium term until the proposed municipal waste water treatment plant is built in Youghal.

12 (1) (d) Townland (Future Postal Address) and National Grid Reference

The site of the proposed development is located off the R634 (former N25 Cork to Waterford Road) adjacent to the existing Youghal Landfill and Civic Amenity Centre.

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The future postal address of the proposed facility is Foxhole, Youghal, Co. Cork. The site has National Grid Reference 2097E, 7977N.

12 (1) (e) Nature and Capacity of Facility

The proposed development consists of a Waste Recovery/Sludge Drying Facility on 3.54acres. It is proposed to manage 70,000 tonnes/annum of commercial/enterprise and industrial waste, 30,000 tonnes/annum of non-hazardous biological sludge from waste water treatment plants, 10,000 tonnes/annum of leachate and 500 tonnes/annum of washings.

12 (1) (f) Classes of Activity under the Third and Fourth Schedules

Third Schedule — Waste Disposal Activities

7. "Physico-chemical treatment not referred to elsewhere in this Schedule which results in final compounds or mixtures which are disposed of by means of any activity referred to in paragraphs 1 to 5 or paragraphs 8 to 10 of this Schedule (including evaporation, drying and calcination)".

11. "Blending or mixture prior to submission to any activity referred to in a preceding paragraph of this Schedule".

12. "Repackaging prior to submission to any activity referred to in a preceding paragraph of this Schedule".

13. "Storage prior to submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where the waste concerned is produced".

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Fourth Schedule — Waste Recovery Activities

Principal Activity:

2. "Recycling or reclamation of organic substances, which are not used as solvents (including composting and other biological processes)".

Other Activities:

3. "Recycling or reclamation of metals and metal compounds".

4. "Recycling or reclamation of other inorganic materials".

9. "Use of any waste principally as a fuel or other means to generate energy".

11. "Use of waste obtained from any activity referred to in a preceding paragraph of this Schedule".

12. "Exchange of waste for submission to any activity referred to in a preceding paragraph of this Schedule".

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13. "Storage of waste intended for submission to any activity referred to in a preceding paragraph of this Schedule, other than temporary storage, pending collection, on the premises where such waste is produced".

12 (1) (g) European Waste Catalogue Codes

It is proposed to treat wastes with the following European Waste Catalogue Codes as presented by the Commission Decision 2000/532/EC of 3 May 2000.

02 Wastes From Agriculture, Horticulture, Aquaculture, Forestry, Hunting And Fishing, Food Preparation And Processing	
02 01 04	Waste plastics (except packaging)
02 01 10	Waste metal
02 02 04	Sludges from on-site effluent treatment
02 03 05	Sludges from on-site effluent treatment
02 04 03	Sludges from on-site effluent treatment
02 05 02	Sludges from on-site effluent treatment
02 06 03	Sludges from on-site effluent treatment
02 07 05	Sludges from on-site effluent treatment

03 Wastes From Wood Processing, and the Production of Panels and Furniture, Paper and Cardboard	
03 01 01	Waste bark and wood
03 01 05	Sawdust, shavings, cuttings, wood particle board, and veneer other than those mentioned in 03 01 04
03 03 01	Waste bark and wood
03 03 11	Sludges from on-site effluent treatment other than those mentioned in 03 03 10

04 Waste from the Leather, Fur and Textile Industries	
04 01 07	Sludges, in particular from on-site effluent treatment free of chromium
04 02 20	Sludges from on-site effluent treatment other than those mentioned in 04 02 19

05 Waste from Petroleum Refining, Natural Gas Purification and Pyrolytic Treatment of Coal	
05 01 10	Sludges from on-site effluent treatment other than those mentioned in 05 01 09

06 Waste from Inorganic Chemical Processing	
06 05 03	Sludges from on-site effluent treatment other than those mentioned in 06 05 02

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07 Wastes From Organic Chemical Processes	
07 01 12	Sludges from on-site effluent treatment other than those mentioned in 07 01 11
07 02 12	Sludges from on-site effluent treatment other than those mentioned in 07 02 11
07 02 13	Waste plastic
07 03 12	Sludges from on-site effluent treatment other than those mentioned in 07 03 11
07 04 12	Sludges from on-site effluent treatment other than those mentioned in 07 04 11
07 05 12	Sludges from on-site effluent treatment other than those mentioned in 07 05 11
07 06 12	Sludges from on-site effluent treatment other than those mentioned in 07 06 11
07 07 12	Sludges from on-site effluent treatment other than those mentioned in 07 07 11

10 Waste Packaging	
10 01 21	Sludges from on site effluent treatment other than those mentioned in 10 01 20
10 12 13	Sludge from on site effluent treatment

15 Waste Packaging	
15 01 01	Paper and cardboard packaging
15 01 02	Plastic packaging
15 01 03	Wooden packaging
15 01 04	Metallic packaging
15 01 05	Composite packaging
15 01 06	Mixed packaging
15 01 07	Glass packaging
15 01 09	Textile packaging

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17 Construction and Demolition Wastes	
17 01 01	Concrete
17 01 02	Bricks
17 01 03	Tiles and ceramics
17 01 07	Mixture of concrete, bricks, tiles and ceramics other than those mentioned in 17 01 06
17 02 01	Wood
17 02 02	Glass
17 02 03	Plastic
17 03 02	Bituminous mixtures containing other than those mentioned in 17 03 01
17 04 01	Copper, bronze, brass
17 04 02	Aluminium
17 04 03	Lead
17 04 04	Zinc
17 04 05	Iron and steel
17 05 06	Tin
17 05 07	Mixed metals

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17 04 11	Cables other than those mentioned in 17 04 10
17 05 04	Soil and stone other than those mentioned in 17 05 03
17 05 06	Dredging spoil other than those mentioned in 17 05 05
17 05 08	Track ballast other than those mentioned in 17 05 07
17 06 04	Insulation material other than those mentioned in 17 06 01 and 17 06 03
17 08 02	Gypsum-based construction materials other than those mentioned in 17 08 01
17 09 04	Mixed construction and demolition wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03

19 Wastes From Waste Management Facilities, Off-Site Waste Water Treatment Plants And The Preparation Of Water Intended For Human Consumption And Water For Industrial Use	
19 02 03	Premixed wastes composed only of non-hazardous wastes
19 02 06	Sludges from physico/chemical treatment other than those mentioned in 19 02 05
19 06 04	Digestate from anaerobic treatment of municipal waste
19 06 06	Digestate from anaerobic treatment of animal and vegetable waste
19 07 03	Landfill leachate other than those mentioned in 19 07 02
19 08 05	Sludges from the treatment of urban waste water
19 08 12	Sludges from biological treatment of industrial waste water other than those mentioned in 19 08 11
19 08 14	Sludges from other treatment of industrial waste water other than those mentioned in 19 08 13
19 09 02	Sludge from water clarification
19 09 03	Sludges from decarbonation
19 09 06	Solutions and sludges from regeneration of ion exchangers
19 10 01	Iron and steel
19 10 02	Non-ferrous waste
19 11 06	Sludges from on-site effluent treatment other than those mentioned in 19 11 05
19 12 01	Paper and cardboard
19 12 02	Ferrous metal
19 12 03	Non-ferrous metals
19 12 04	Plastic ad rubber
19 12 05	Glass
19 12 07	Wood other than those mentioned in 19 12 06
19 12 08	Textiles
19 12 09	Minerals (for example sand, stone)
19 12 10	Combustible waste (refuse derived fuel)
19 12 12	Other wastes (including mixtures of materials from mechanical treatment of waste other than those mentioned in 19 12 11
19 13 04	Sludges from soil remediation other than those mentioned in 19 13 03
19 13 06	Sludges from groundwater remediation other than those mentioned in 19 13 05

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20 Municipal Wastes	
20 01 01	Paper and Cardboard
20 01 02	Glass
20 01 10	Clothes
20 01 11	Textiles
20 01 34	Batteries and accumulators other than those mentioned in 20 01 33
20 01 36	Discarded electrical and electronic equipment other than those mentioned in 20 01 21, 20 01 23 and 20 01 35
20 01 38	Wood other than those mentioned in 20 01 37
20 01 39	Plastics
20 01 40	Metals
20 02 02	Soil and stones
20 03 04	Septic tank sludge

12 (1) (h) Raw, ancillary material, substances, preparations, fuels and energy

It is not proposed to treat the wastes accepted in the Waste Recovery/Transfer Facility other than in a mechanical fashion, chipping, compressing, baling, etc.

The proposed Sludge Drying Facility will be powered by a steam boiler using wood chip fuel or light diesel oil. A back-up generator unit will employ diesel fuel. It is estimated to be in the region of

It is estimated that electrical consumption shall be in the range of 3750000kWh at full production.

Other materials utilised include:

- Hydraulic Oil,
- Disinfectant,
- Engine Oil,
- Superfloc,
- Nutient dosing chemicals,
- Acids/Bases.

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12 (1) (i) Plants, methods, processes, ancillary processes, abatement technologies, treatment systems and operating procedures

Waste Recovery and Transfer Building

The following plant and equipment will be used at the Waste Recovery and Transfer building:

- Materials Handling Grab,
- Dosing Intake Conveyor,
- Transfer Belt during phase 1 up to approximately 15,000 tonnes per annum,
- Trommel Drum Screen or similar during phase 2 when throughput tonnages increase beyond approximately 15,000 – tonnes per annum,
- Picking Station, Sorting Belt and Overband Magnet, fully air-conditioned with high lux fluorescent lighting,
- Infloor Conveyor to Compactor,
- Baler,
- Shredder,
- Woodchipper,
- Forklift or loading shovel.

It is proposed to operate the Waste Recovery and Transfer building will only operate between 07.30am and 9:00pm Mondays to Saturday, set-up and clean-up will take place between 7:00am and 8:00am and 9:00pm and 10:00pm Mondays to Fridays.

The process description at the Waste Recovery and Transfer building is presented in a flow diagram.

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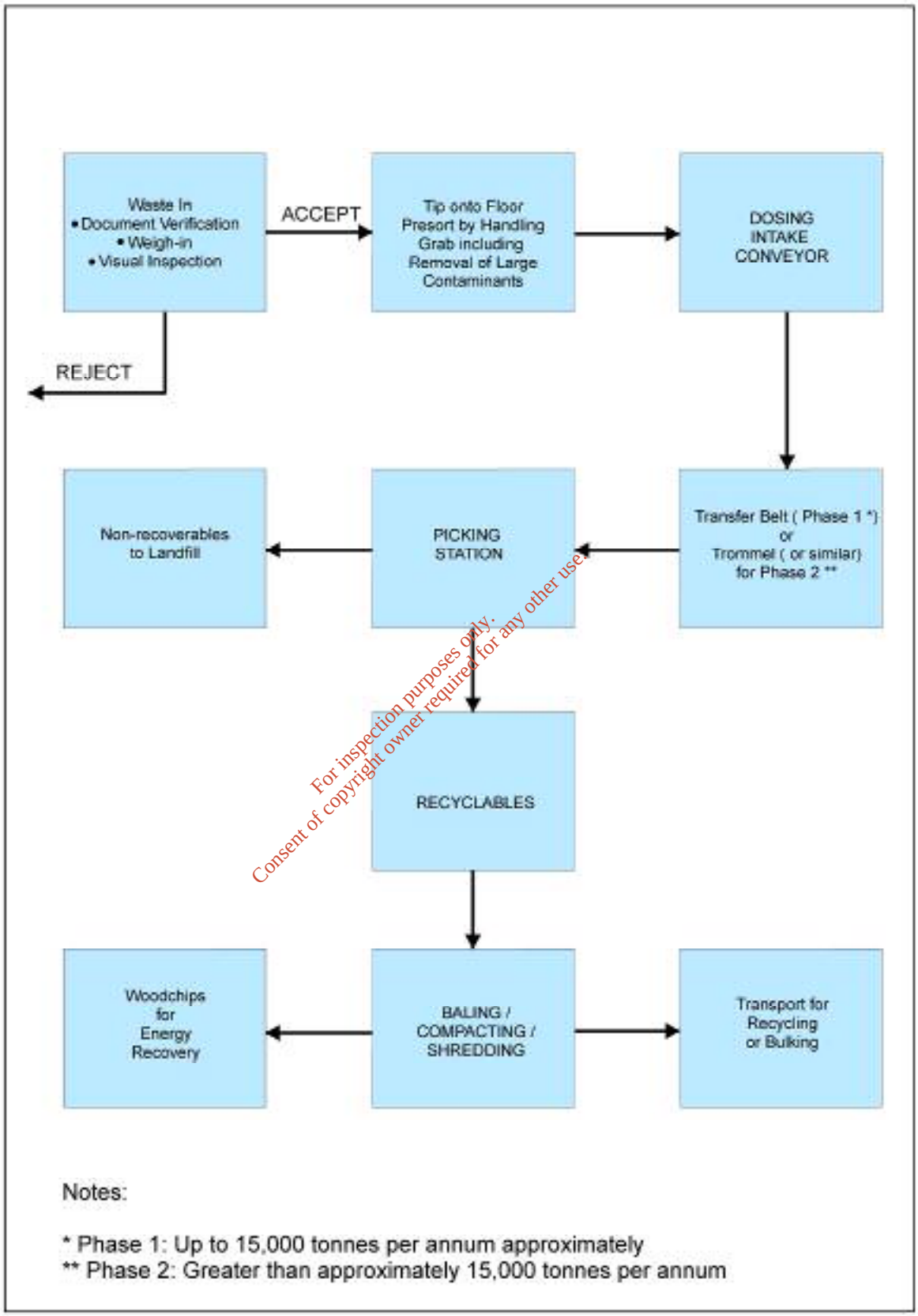

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Sludge Drying Facility

Wet sludge (with a minimum Dry Solids (DS) content of 10%) on arrival at the facility will be weighed and randomly sampled for analysis. The wet sludge is then tipped into sludge reception bins (covered with hydraulic lids and gratings) in the fully enclosed Sludge Reception building. The sludge is then pumped to a dosing/mixing bin that controls the flow of sludge into the dryer. The dryer is heated using a totally indirect method of heating; various energy sources are available to operate the dryer including biomass (woodchip) and light diesel oil. The dryer will be insulated, except at the ends, to minimize heat loss, thus reducing energy usage and provide for very safe working conditions.

The drying process creates steam; which is carried via the off-gas duct to the scrubber/separator or similar type plant, where it is condensed. Any fine particulate matter is returned to the dryer and the condensed effluent is sent to the hooded waste water treatment plant where it is treated to according EPA effluent discharge limits. Purge stream off-gas, any volatile organics evaporating from the hooded waste water plant and odours from the sludge reception bin will be treated by a standalone odour abatement biofilter technology.

The dried sludge is received onto a discharge conveyor and transferred to a product cooling conveyor, and indirectly cooled. The product with a moisture content of less that 10% is then screened to separate the fines, which are returned by the fines conveyer to the front of the dryer. The end-product is a sterilised granulate.

This facility will run on a 24 hour basis 7 days a week including holidays. It will be shut down for maintenance.

The process description for the sludge drying facility is presented in a diagrammatical format.

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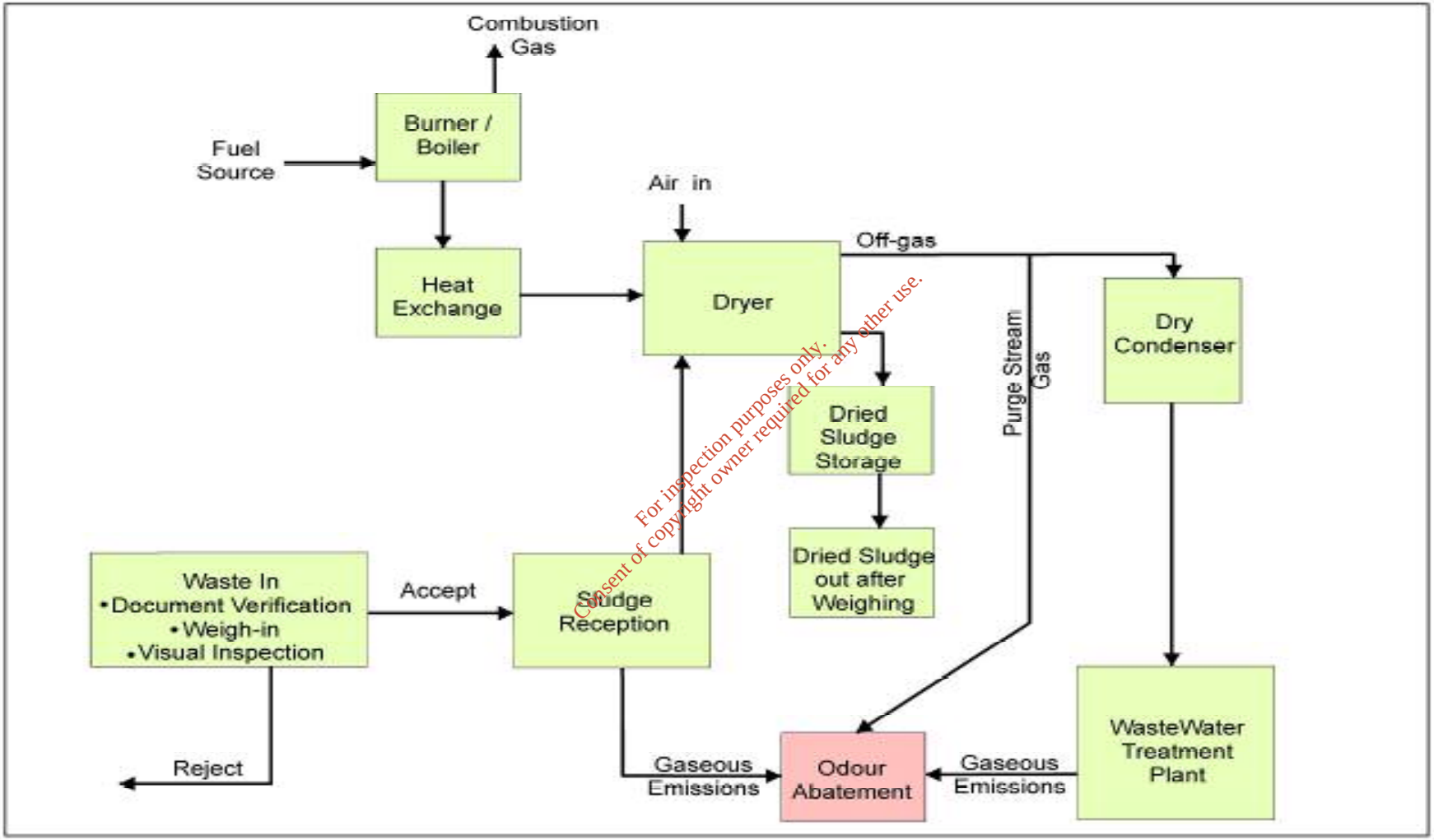

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Ancillary facilities include:

- Administrative Building including SCADA centre, laboratory; canteen; sauna; toilet and shower facilities, parking including disabled parking bays; cycle racks and motorcycle bay,
- Weighbridge,
- Wheelwash,
- Transformer/Plant Building,
- Standby Generator,
- Truck Parking and Bulk Storage Area,
- Material Inspection Area,
- Waste Quarantine Area,
- Bunded Fuel Storage Area,
- Boiler and Woodchip Storage Building,
- Stormwater Retention Tank,
- Interceptor Compound,
- Firewater Storage Tank,
- Sludge Reception Building,
- Dried Sludge Discharge Area,
- Mobile Dewatering Plant,
- Mobile Firefighting Plant,
- Waste Water Treatment Plant and Balancing Tank.

Waste handling will be in line with BAT Guidance Notes for the Waste Sector: Waste Treatment Activities, EPA, Draft November 2003. Best Available Technique (BAT) was used in the design of the proposed development and the EIS was prepared using national guidelines and regulations on the information to be contained therein.

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12 (1) (j) Section 40(4) of the Act

Section 40(4) of the Act does not apply as this waste application is not part of a licence review.

12 (1) (k) Emissions

Liquid Emissions

Liquid emissions from the integrated facility will include foul waters, storm waters and potential fire waters process waters will be collected and directed to the waste water treatment plant (WWTP) . Foul waters will be treated via a small scale treatment plant. Storm and fire waters will be collected in retention tanks. In the event of contamination of these waters, the tanks will be equipped to pump the water to the WWTP if necessary. It is estimated that at maximum operating capacity AVR – Environmental Solutions Ltd. will discharge approximately 10m^3/hr of treated effluent and storm waters.

The surface water drainage system on the site will be fitted with Class 1 oil and grit interceptors or similar. These will prevent the escape of vehicular fuels or any oil spillages on-site. The WWTP will treat effluent from the sludge drying process and will also treat storm/fire waters, should contamination occur.

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Liquid emissions from the WWTP and discharges from the retention tanks will be to the Youghal Town Council outfall via the Youghal Town Council sewer network.

Air Emissions (Gaseous, Odour and Dust)

Potential impacts on existing air quality would be posed by emissions from the sludge reception area, the boiler system, the sludge drying process, the WWTP and abatement and control technologies such as a biofilter. Emissions will be limited by the use of abatement systems such as a biofilter, and bag filter to treat air emissions from the facility. Each of the facilities will also be fully enclosed to prevent fugitive emissions. It is estimated that at maximum operating capacity AVR – Environmental Solutions Ltd. will discharge approximately 350,000Nm^3/d of treated effluent and storm waters.

Noise Emissions

The layout of the facility has been designed in such a way as to minimise the potential for noise disturbance associated with the facility at the nearest sensitive locations. Noise associated with operations at the facility will be minimised by the use of Kingspan Insulation in the buildings. An approximately 2m block-on-flat wall will be constructed adjacent to the Waste Recovery/Transfer Facility to further limit any potential impact on the nearest noise sensitive locations. Recommendations from the Guidance Notes for Noise in Relation to Scheduled Activities, EPA, 1995 for the appropriate noise criteria relevant for a development of this type were used. This document specifies that to avoid disturbance at noise sensitive locations noise levels should be kept below 55dB $L_{Aeq,1hr}$ for daytime hours (08:00 – 22:00hrs) and below 45dB $L_{Aeq,1hr}$ for nighttime hours (22:00 – 08:00hrs). Background noise level is therefore greater than usual boundary noise limits because of traffic the site is located near a busy Regional and National Route which is a significant anthropogenic noise source in the area It is considered appropriate that while stipulating a limit of 45dB at night that an additional licence requirement stating that the noise from the facility will not increase background noise by more than 5dB

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12 (1) (l) Impact Assessment

GEOLOGY AND HYDROGEOLOGY

Existing Environment

Though the limestones of the Youghal syncline are considered a major or regionally important aquifer (GSI, 1994) and they are classified as amongst the most productive in the country, due to the coastal location of the site, the risk of saline intrusion to the groundwater, limits its potential for potable use (GSI, 1994). Groundwater in the area, therefore, is not likely to be considered suitable for extraction.

Impacts during Construction

The geotechnical site investigation report describes the subsoils as sandy/gravelly clays; as such these materials have little economic value.

Impacts during Operation

The site is not intended to deal with hazardous materials or putrescible waste. Therefore, potential contamination during the operation of the facility should be minimal. Furthermore the hardstanding area of the site will divert surface water run-off and all storm waters will be collected and monitored prior to discharge.

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Impacts during Decommissioning
The main potential impact associated with the decommissioning of the facility would pertain to where contaminants had been stored on-site. Potential contaminants to be stored on-site will include fuels such as light diesel oil, which will be contained in bunded areas. The operator of the site has prepared a Decommissioning Plan. Therefore the control and management of the facility during decommissioning means that any potential risk is reduced.

Mitigation Measures

Impacts during Construction
It is intended to use soil/overburden for landscaping purposes on-site where feasible and any unsuitable soil will be sent to the adjacent landfill.

Impacts during Operation
A quarantine area will be established on-site to temporarily store such materials should they unintentionally arrive on-site, thereby controlling, preventing and managing any potential risk. The entire operational area of the site will be concreted. This measure should protect the sub-surface from any potential contamination. Surface run-off will be directed from the site with the installation of hardstanding throughout the facility. Run-off from all site surfaces will be collected and monitored, thereby further reducing the pollution potential of the site. Process and foul water will be treated prior to discharge.

Impacts during Decommissioning
All care will be taken during decommissioning, to ensure that potential contaminants will not be released from the site.

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AIR

Existing Conditions
Baseline dust, dour and gaseous emissions are well within permissible allowable levels.

Impacts Assessment

Construction Phase
It is expected that the construction phase will last a total of approximately 1 year and due to the scale of the development and short term earth moving activities, any impact on air quality will be minimal.

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Operations Phase and Mitigation Measures

Dust

Activities at the proposed facility have the potential to generate dust in the loading and treatment of waste. However, as operations will be conducted indoors, dust generation will be prevented at source and thus impacts are considered minimal.

Odour

The proposed facility will treat waste from commercial and industrial sources. The absence of any significant quantities of putrescible organic waste due to segregation by the producer will ensure that odour impacts any minimal.

The Sludge Drying building will be operated as a closed housed system to contain any generated dust. Dust potential from wet sludge is considered non-existent. The system is designed to prevent fugitive emissions. Proper housekeeping, maintenance and management of the sludge drying building will ensure that dust generating activities are limited.

Any dusts generated from combustion plant and vehicles on site will be minimised by regularly following effective maintenance and operation procedures. Staff operation and awareness training is proposed to ensure procedures are correctly followed. Regular cleaning and inspection of the site is essential to control dust levels.

Any dust generated by boiler equipment and standby generator will be well within proposed ground level concentrations as directed by the draft TA Luft 2002 guidelines and SI 271 of 2002 Air Quality Standards (Refer to Air Quality Data and Modelling Report). Therefore no mitigation measures are required.

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Gaseous Emissions

Vehicles and plant associated with materials handling and the incoming waste material provide the only source of gaseous emissions at the Waste Recovery and Transfer building. Gaseous emissions levels are negligible. Sludge will be stored in a specially designed sludge reception building. The wet sludge will be pumped directly into the enclosed system.

The dried granular sludge has a very low odour potential and will be stored in closed silos and containers.

Excess process water and gas purge streams from the Sludge Drying Facility will be sent directed to the hooded wastewater treatment plant. Gaseous emissions from the hooded Waste Water Treatment plant will be treated by the standalone odour abatement technology.

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WATER

Existing Environment

The Blackwater catchment is one of the largest in the state, draining an area in excess of 2,000km3. The Upper Blackwater Estuary shows decreased oxygen levels. Below this area, oxygen levels are increased, even though oxygenation is disturbed throughout the lower estuary and it then recovers fully by the Inner Youghal Bay.

Nitrogen and phosphate concentrations are somewhat elevated in the Upper Estuary under freshwater conditions. However, under saline conditions the Lower Estuary concentrations of these parameters are reduced to background coastal levels in Inner Youghal Bay.

Chlorophyll concentrations are overall elevated in both the Upper and Lower sections of the Estuary.

The breaching of these criteria levels classifies both sections of the Blackwater Estuary as eutrophic however; this classification does not appear to extend into the waters of Youghal Bay. Consequently, under the Urban Waste Water Treatment Regulations (S.I No. 254 of 2001 & 91/271/EEC) the Upper and Lower Blackwater Estuary are classified as Sensitive Areas.

Improvements in the municipal waste water treatment schemes, as well as, the reduction in the landspreading of sludge and the introduction of the Nutrient Management Plans in this area, should lead to a reduction in pollution levels in the river and its tributaries in the future.

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Impact Assessment and Mitigation Measures

Storm Waters

Surface water runoff from paved and roofed areas will be collected via the site drainage system. The entire site shall be bunded using kerbing to prevent the uncontrolled escape of storm water. Four Class One type oil and grit interceptors or similar will be installed with a 120m^3 Storm Water Retention Tank with a monitoring well so that contaminates and or spilled hydrocarbons.

A sluice valve will control discharge of the storm waters to the outfall via the Youghal Town Council sewer network. The monitoring well will ensure that discharges are within acceptable emission limit values, again these limits will be set by the EPA in agreement with Youghal Town Council. In the event on an incident with potential for contamination of surface waters (e.g. spillage), the sluice valve will close preventing any discharge from the site.

Foul Waters

These waters shall be collected in the site foul water system and treated prior to discharge . via a small scale treatment plant.

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Process Waters

The only process water on-site shall be the final effluent from the waste water treatment plant. This effluent shall be monitored so that it is within the emission limit values set by the EPA. Monitoring shall be carried out at a frequency, to be specified by the EPA. The impact of the plant output on the river flow rate is negligible and therefore does not require mitigation.

Fire Waters

In the event of an incident, for example a fire, the potential contaminated waters will be collected through the storm water drainage system with the entire site acting as a large bunded area using the raised kerbing as an extra backup measure. Fire water will be stored in the Firewater Retention Tank. Any spent fire water will then be treated at the waste water treatment plant.

Bunds

There are a number of bunded areas at the proposed development and include the following:

- Fuel storage area,
- Quarantine area,
- Standby generator pad.

All these bunds will be tested for integrity and a discharge valve will be installed to pump out any contaminated water and hydrocarbons to be treated at an EPA approved facility.

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NOISE

Existing Environment

The primary noise sources in the area are mobile vehicles including haulage vehicles and private cars utilising the civic amenity site and NCT centre. The noise environment would be typical for locations situated near major transport routes.

Overall, the average daytime Leq of 54dB(A) measured onsite was lower than the average daytime Leq of 66dB(A) measured at the nearest noise sensitive resident. This is due to traffic noise and the close proximity of the nearest noise sensitive location to the R634. During night time hours the noise levels at are reduced, however levels are still quite elevated with an average Leq of 50dB(A) due to traffic noise.

Impact Assessment and Mitigation Measures

Impact during the Construction Phase

The nearest dwelling (noise sensitive location) is over 180m from the site boundary. Noise levels at this distance were calculated from the sound power data assuming the plant would be operating at the nearest point of the boundary to the sensitive receivers. Construction equipment will not generally operate at the boundary of the site.

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Combined Impact of the Operation
The noise contribution from the facility, at the nearest noise sensitive location can be obtained by summing the individual noise contributions from the above elements. The increase in noise level from the facility at the nearest noise sensitive location is 31 dB(A) during daytime and 22dB(A) during night time.

The overall noise level, at the nearest noise sensitive location, can be predicted (BS 4142 1997 Method of Rating Industrial Noise affecting Mixed Residential and Industrial Areas) using the noise level contribution from the facility and the measured background noise levels at the nearest dwelling house.

VIBRATION

Some construction activities such as driving piles can give rise to considerable levels of ground vibration. However, at the proposed development flight augured piles will be used instead of driven piles. Therefore no adverse vibration effects are anticipated.

Plant and equipment is not expected to give rise to any vibration during the operations phase. Therefore it is not expected that vibration during the operations phase will impact on any adjacent building.

CLIMATE

Existing Environment
The long term weather patterns in this location reflect regional weather conditions of the South-Munster Area which is dominated by low-fronts from the west and south west during winter. During the summer more settled conditions prevail. For localised weather conditions meteorological measurements from nearby weather stations were consulted.

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Impact Assessment and Mitigation Measures
No impacts are anticipated. Therefore, no mitigation measures are required.

FLORA AND FAUNA

Existing Environment
There are no National Heritage Areas (NHAs), Special Areas of Conservation (SACs), Special Protection Areas (SPAs), wildfowl sanctuaries, Ramsar sites, Nature reserves or National Parks within the site boundary.

The site is located adjacent to the Blackwater River cSAC no. 002170, Blackwater River and Estuary pNHA no. 000072, Blackwater Estuary SPA no. 4028, and within 300m of a Ramsar site (Blackwater Estuary, Ireland 7IE028).

The site is located in Landscape Character Area no. 35 Youghal Bay (Composite Mosaic and Marsh Estuary), as mapped in the 2003 Cork County Development Plan. The landscape character is Type 2: Broad Bay Coast.

No tracks, traces or other signs of mammalian activity were observed at the site. Species that are likely to inhabit the site include the Brown Rat, Pygmy Shrew and Field Mouse. It is probable that foxes and rabbits (Oryctolagus cunniculus) also occur in the

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area. The site does not provide potential roosts for bat species. The common frog (Rana temporaria) was not observed at the site. Due to current vehicular movements at the site, it is unlikely that frogs reside here. During the site survey transect, a total of 44 birds of 14 species were recorded. 27 birds of 8 species were observed within the site itself. A further 17 birds of 10 species were observed within the vegetated site boundaries

Finally consultation with the local National Parks and Wildlife Ranger corroborates that the site is not of great importance for birds, in regard to that of the surrounding habitats (P. Smiddy, pers comm). It is therefore considered unlikely that the loss of habitat within the proposed development site will have a negative impact on bird populations or habitat diversity of the surrounding areas.

Impacts on Flora and Fauna

The entire site will be cleared of existing vegetation. This will lead to the permanent and complete loss of existing habitats at the site. The habitats present at the site are not considered to be of high ecological value and are not listed as priority habitats in the Habitats Directive.

The main potential impacts for mammals occurring at the site will be the loss and fragmentation of habitat, and disturbance. Currently the habitats may provide feeding and residence opportunities for mammals (although no evidence of mammal setts or burrows was found). Loss of habitat will permanently remove these opportunities. Increased human activity at the site will deter mammals from using the site.

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These impacts are not considered to be a significant negative impact because they will be localised and minimal. It is predicted that the local animal species will adapt to the change in their local environment, through either avoidance of the development site or restriction of their usage of the site. Mammals can move to another location which has similar habitat types.

Mitigation

It is recommended that specified areas be used to dispose of excavated material and that all waste and unused building materials be removed from site. Vegetation from the surface should be stockpiled and used to resurface bare ground along road edges and disturbed areas.

A landscaping programme has been agreed with the local authority as part of the planning compliance for the site under planning **PL04. 211117**

To reconcile for the destruction and removal of existing habitats, the landscape design includes hedgerow planting and management that involve the use of native species that are in line with those species present in the surrounding area. Hedgerow planting will also act as a buffer zone, (e.g. to reduce disturbance) between the development and the surrounding areas.

CULTURAL HERITAGE

Existing Environment

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The study of the three editions of OS maps did not reveal any features of archaeological significance on or near the site of the proposed development. There are no references to any features of archaeological significance that might be affected by the proposed development. The field inspection covered the entire site and did not reveal any features of archaeological potential.

Impacts and Mitigation Measures

The combined desktop, literary and field inspection did not reveal any previously unrecorded features of archaeological significance on or near the site of the proposed development.

A licensed and experienced archaeologist has been commissioned to monitor the removal of all topsoil prior to construction of this development. The archaeologist will examine all deposits revealed during the course of excavations and, where possible, determine a date and context for any archaeological features that may emerge.

The developer must report the discovery of any archaeological features to DOEHLG and facilitate and fund both their investigation and recording.

Any artefacts uncovered during the course of excavation must be reported to the Duty Officer of the National Museum of Ireland.

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LANDSCAPE

Existing Environment

The area of the proposed development is zoned Industrial/Enterprise in the Cork County Development Plan 2003.

The overall visual impression of the site is a brown field site with a complex of built anthropogenic structures such as high metal fencing and posts, telephone and electricity poles, Youghal Landfill and Civic Amenity Centre, the NCT Centre, Foxhole IDA Industrial Estate and Foxhole Business Park incorporating Millennium Court office buildings.

The site occupies a very low-lying elevation, as it is enclosed to a significant extent by the confluence of rivers that surrounds it. Elevations changes across the site are negligible in comparison to the surrounding landscape. The site can be seen from the N25 scenic particularly in Waterford section directly opposite the site. However the Youghal Landfill and Civic Amenity Centre is the focal point of this fragmented landscape.

Site Aspect is south facing with the minimal sloping degree of 0-1. Therefore, site exposure is greatest on the eastern and southern side of the site, across the Blackwater Estuary and Youghal Bay.

The Cork County Development Plan 2003, supports the Landcover classification as the site is located in an area zoned for industrial and enterprise development.

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Agricultural practices such as tillage, grasslands and forestry dominate the landuse patterns of the hills.

Impact Assessment and Mitigation Measures

The proposed development will form a linear block between the NCT Centre and the Youghal Landfill and Civic Amenity reducing the visual impact of the existing developments.

A Landscape Masterplan and detailed planting specifications for the proposed site was prepared and the proposed planting is based on the recommendations of Cork Rural Design Guide published by Cork County Council.

Much of the roadways in the vicinity of the site (i.e. N25 and R634) are well screened by the presence of hedgerows. Therefore the proposed development is not significantly visible from roads. Intermittent views may occur. These will be further obscured by the proposed landscaping measures at the site.

The R634 from Youghal Town to the N25 was also assessed to determine potential visibility. The commercial/industrial developments at Foxhole are clearly visible from this location. The absence of any screening on the northern side of these structures renders them highly visible. However, screening of the proposed development from these buildings and from the tree planting detailed in the Landscape Development Report will reduce the visual impact of the development significantly.

The sky is predominately cloudy and grey for the majority of the yearly climatic conditions therefore it is recommended that the buildings in the proposed site will have a 'goose-wing grey' colour to harmonise with the natural background sky.

Finally, the proposed development will be on a scale with existing structures in the Foxhole area. It will form a linear block between the NCT Centre and the Youghal Landfill and Civic Amenity reducing the visual impact of the existing developments.

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TRAFFIC

Existing Environment

Traffic data collected as part Traffic section of the Environmental Impact Statement (EIS) prepared by Fehily Timoney & Company on behalf of Cork County Council in May 2003 for the *Intensification of Use of Youghal Landfill* shows an annual average daily traffic (AADT) volume of approximately 5,496 vehicles per day of which 22% were heavy good vehicles (HGV's). This equates to the removal of 48% of the total predicted 2003 traffic (i.e. using a growth factor of 3.5% per annum) on this portion of the R634 if the Youghal Bypass had not been built.

It can be assumed that most traffic accessing this road are visiting Youghal Landfill and Civic Amenity Site as the NCT Centre generates low volumes, likewise Youghal Shipping uses the lands adjacent to the landfill rarely.

Impact Assessment and Mitigation Measures

The proposed development will increase the growthed AADT 2004 figure of 5,688 by an AADT of 42.12 in terms of HGV's, the number of car movements is negligible. Therefore the proposed development generated traffic will not have any significant impact on the surrounding road network. In fact it can be stated that the proposed facility at Foxhole, Youghal will not result in any significant impact on traffic flows along the adjoining roads due to the opening of the N25, Youghal Bypass.

The geometry of the T12 does not facilitate two-way movement for HGV's, though it did historically. However this was removed by Cork County Council due to illegal camping activities and fly tipping. Cork Council created two lay-bys. As part of the planning conditions granted for the *Intensification of Use of Youghal Landfill* by An Bord Pleanala Cork County Council is required to upgrade the road to facilitate further two-way movement of HGV's.

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Construction Phase

As the impact is considered negligible during the construction phase, no mitigation measures are required other than good construction practice and site housekeeping.

Operations Phase

The primary mitigation measure will be the upgrade of the T12 connecting the site to the R634, Cork County Council will have to complete these works by 2006 as part of the planning conditions granted for the *Intensification of Use of Youghal Landfill* by An Bord Pleanala.

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It is also proposed to introduce additional mitigation measures, which will include the following:

- Staggering of deliveries/collections to/from the proposed facility, this limits the number of HGV's on the surrounding road network, at any one time,
- Instructing all vehicles travelling to the site from outside Youghal town will access the site off the N25 Youghal Bypass,
- Segregated Service and Vehicular access in the interest of safety,
- Implementing a traffic management plan to prevent congestion and queuing in the local environs.

Sustainable Modes of Transport

Pedestrian and cycle modes are high in the pyramid of sustainability and will be accommodated fully at the proposed development, by means of bicycle racks and a pedestrian entrance into the facility. The bicycle racks will be located in a well lit, secure area near the Administration building.

Car Parking

There is sufficient parking for both staff and visitors. This is also conforms to the Car Parking Standards in Appendix IV of the Cork County Development Plan 1996. This will ensure that no over spill onto the public road occurs.

HUMAN BEINGS

Existing Environment

The 2002 Census contains the latest available employment statistics in the Town Council Area. The single largest employment sector in Youghal is the Manufacturing Industries. This sector has most likely decreased greatly since the census was compiled due to the closures of a number of factories.

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Impact Assessment and Mitigation Measures

The main areas of concern with respect to the potential effects of the development on the human environment are air quality impact, noise impact, ecological impact, visual impact traffic impact and impacts associated with decommissioning of the facility. These impacts are presented under their various headings above. Other potential impacts include: health and safety impacts to employees and locals, potential impacts on tourism and socio-economic impacts.

Health and Safety considerations for employees were given merit at the design stage of this facility. These considerations include ventilation in the picking station at the Waste Recovery and Transfer building. Part of the design and scoping process for selection of the indirect method of sludge drying was the safety and environmental controls that could be put in place as preventative control measures rather than mitigation measures.

Operations during the lifespan of the facility will be conducted inline with the relevant legislation and implementation of the site Health and Safety Plan and will be overseen by the Health and Safety Manager.

Hazardous materials will not be stored on-site. Only diesel oil and waste will be stored on site. Both of which will be stored securely.

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MATERIAL ASSETS

Existing Environment

The site of the proposed development is located within commutable distance to a number of significant towns in the Cork County region. At the time of the last census (2002), unemployment was running at low levels in Youghal. However, by February 2003, two of the town's major employers had announced closures. Therefore, there is most likely a good supply of labour presently available in Youghal. In terms of transportation, Youghal is well serviced by roads. The N25 National Secondary Route from Cork to Waterford serves the town. This route is also a designated Euroroute E30; thus it is part of the officially designated European network of roads, which represent the core of the transport system throughout Europe.

Decommissioning Plan

A Decommissioning Plan has been prepared to ensure that the proposed facility is shut down and decommissioned in a safe and environmentally sound manner.

Impact Assessment and Mitigation Measures

Economic Impact

It is estimated that the construction phase of the proposed development will bring up to 30 jobs to Youghal. Throughout the operational phase, a minimum of 17 persons will be employed at the facility. Spin off industries associated with the proposed development may also produce jobs in the form of cleaning services, catering providers, etc.

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Existing Infrastructure

It is proposed that the site will have it's own waste water treatment plant. Therefore, there are no impacts expected to the existing sewage infrastructure. There is no negative impact expected to other infrastructure in the area, which has been planned with industrial development in mind.

Transport Infrastructure

The proposed development is located adjacent to the Youghal by-pass. Therefore, there are no negative economic impacts anticipated for the town of Youghal related to vehicular movements to and from the site. This represents a positive impact for the area.

Proximity to the existing landfill will ensure that any waste contaminants that may have to be disposed of can be done in close proximity to the site without generating excessive traffic on the roads.

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Property Values

The area of the proposed development has been zoned by the planning authority as Industrial/Enterprise. Also, there is little evidence to suggest that adjacency to a well managed waste management facility negatively impacts on house prices.

Tourism

The Cork County Development Plan 2003 states as an aim the desire, to promote development in Youghal with regard to its coastal setting and its special recreational, heritage and marine tourism functions. With this in mind, the Department of Arts, Sport and Tourism (DAST) was consulted during the Public Consultation Stage, along with other relevant parties.

A landscape assessment was conducted to investigate the impact of the proposed development on views and prospects in the Youghal area. This assessment concludes that the visual impact of the proposed development on the surrounding environment will be minor to negligible. This is due to the fact that the site will be well screened by trees and other developments in its vicinity such as the Millennium Court office buildings at Foxhole Business Park, the NCT centre and Youghal Landfill. The site will therefore be in harmony with the other buildings in this industrial and commercial zoned area.

Natural Resources

The facility of the proposed development will reduce the volume of waste requiring disposal in the Cork Area. The Waste Recovery/Transfer Facility will promote recovery and recycling. The Sludge Drying Facility will reduce sludge volumes currently being exported and landfilled.

These measures represent a positive impact on natural resources and are in keeping with sustainable development practices.

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INTERACTION OF THE FOREGOING

Environmental Impact Assessment (S.I No. 349 of 1989; S.I. No. 93 of 1999) states that not only are the impacts on the individual elements of the environment to be considered, but so too are the interactions between those elements.

Table 14.1 illustrates the interaction of impacts assessed for this project.

	Geology	Air	Water	Noise	Climate	Flora & Fauna	Cultural Heritage	Land-scape	Traffic	Human Beings	Material Assets
Geology			✓			✓		✓			
Air				✓	✓				✓	✓	
Water					✓	✓					
Noise									✓	✓	
Climate		✓	✓								
Flora & Fauna	✓		✓								
Cultural Heritage								✓		✓	✓
Land-scape	✓						✓			✓	✓
Traffic		✓								✓	✓
Human Beings		✓		✓							
Material Assets							✓		✓	✓	

Table 14.1 Impact Interaction Matrix

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12 (1) (m) Monitoring of Emissions

Discharges from the storm water retention tanks will be monitored continuously for the parameters as set by the EPA. In the event of any contamination of these waters, the discharge to the sewer will cease. The waters will instead be sent for treatment in the WWTP. The final effluent from the WWTP will be regularly monitored to ensure that it complies with EPA licence limit values.

Air and noise monitoring is proposed to be carried out annually to ensure the proposed facility is within the EPA limit values specified.

AVR – Environmental Solutions intend to implement the ISO14000 Environmental Management System. This system will ensure that all environmental legislation relevant to the site is complied with and that there is continuous improvement in environmental performance at the site.

Liquid emissions, air emissions and noise emissions are expected to be the only emissions on the proposed site. Emission characteristics will be in line with limit values to be issued by the EPA.

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12 (1) (n) Prevention, minimization and recovery of Waste arising on site

Best Available Technique (BAT) was used in the design of the proposed development and the EIS was prepared using national guidelines and regulations on the information to be contained therein. All processes and technology used are designed to operate to prevent and minimise waste arising

12 (1) (o) Off-site treatment or disposal of waste

Recovered materials or those awaiting disposal will be stored temporarily on-site. Disposal of materials will occur at licensed and permitted facilities, to be agreed with the EPA. Waste collectors with valid Waste Collection Permit will be used to convey the sorted waste.

While this site is not intended to deal with hazardous materials, some may inadvertently arrive at the site. Should this occur, these wastes will be contained in a quarantine area pending removal from the site. All facilities used for the off-site processing of these wastes will be appropriately licensed and permitted.

12 (1) (p) Emergency measures

An Emergency Response Plan will be implemented in the event of any accident, fire or other such incident. This Plan will be in line with the requirements of the ISO14000 Environmental Management System. The purpose of the Plan is to minimise the environmental impact of any emergency situation which could potentially occur.

A Health & Safety/Environmental Officer will be appointed to implement the Health & Safety Plan for the site. Duties of the Officer are as follows:

- The Health & Safety/ Environmental Officer is responsible for ensuring that the emergency response procedure provides for an appropriate response to unexpected or accidental incidents,
- To give directions to bring back evacuees when the emergency is over or when appropriate,
- To carry out a health & safety and environmental risk assessment of the site periodically and it is important to carry out a risk assessment especially after an accident or emergency onsite,
- To maintain records of the employees training, fire equipment service records and Incident Reports,
- To make any modifications to the Emergency Response Procedure in accordance with the Documentation Control in the Environment Management System and review this procedure annually from the date of release,
- To put in place any mitigation measures from the risk assessment as soon as possible.

The risk assessment will not be limited to but will include the assessment of the operability of the emergency equipment and the adequacy of existing emergency procedures.

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The Training Responsibilities assigned to the Health & Safety/Environmental Officer will include:

- Fire Extinguisher Training,
- Mobile Fire Fighting Unit Training,
- Evacuation Procedure,
- First Aid Training.

In the long term, it is not envisaged that there will be a requirement to shutdown operations at the Waste Recovery/Transfer and Sludge Drying Facility. Decommissioning of the facility has been considered at the design stage. All plant removal will be evaluated and managed properly to prevent emissions as a result of decommissioning. Any wastes generated through the decommissioning process will be handled in line with best practice.

12 (1) (q) Closure, Remediation and Aftercare

In the long term, it is not envisaged that there will be a requirement to shutdown operations at the Waste Recovery/Transfer and Sludge Drying Facility. Decommissioning of the facility has been considered at the design stage. All material and plant removal will be evaluated and managed properly to prevent emissions as a result of decommissioning. Any wastes generated through the decommissioning process will be handled in line with best practice.

12 (1) (r) Landfill

This section is not applicable.

12 (1) (s) Control of Major Hazards involving Dangerous Substances

The proposed activity does not fall within the European Communities (Control of Major Accidents Hazards involving Dangerous Substances) Regulations 2000 (SI No 476 of 2000). The site does not fall under the SEVESO Directives (96/82/EC; 2003/105/EC).

12 (1) (t) List I and II

The proposed development can not give rise to an emission containing List I and II substances specified under 80/68/EEC of 17 December 1979 into an aquifer.

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Air Pollution Modelling

Dispersion Modelling

Dispersion modelling was conducted by using (MAPMOS) the Advanced Gaussian Plume Model. The purpose of the dispersion model is to provide a means of calculating air pollution concentrations given information about the pollutant emissions and the nature of the atmosphere. Numerical data from the model were incorporated into a Geographic information system to produce air quality maps. The concentrations of pollutants at ground level are determined in order to calculate compliance with air quality standards. Maximum expected emission concentrations for the air emission point were utilised in the model. Since air quality objectives are expressed in a variety of averaging periods, it is important that dispersion models also calculate air pollutant concentrations in the same manner. Hourly average, daily average and annual average concentrations were calculated. Percentiles of hourly and daily averages were also calculated. Contour plots of maximum ground level concentrations occurring were plotted.

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In this exercise, modelling for ground level concentrations for NOx, Dust, Carbon, CO and So2 from the Boiler Stack was undertaken for the following parameters:

- NOX annual mean concentrations
- NOX hourly averaged concentrations.
- PM10 annual mean concentrations.
- PM10 daily averaged concentrations.
- PM10 hourly averaged concentrations.
- Carbon annual mean concentrations.
- Carbon daily averaged concentrations.
- Carbon hourly averaged concentrations.
- SO2 daily averaged concentrations.
- SO2 hourly averaged concentrations.
- CO maximum 8 hour-averaged concentrations.

Two proposed boiler fuel options were examined;

- Part1. A boiler fuelled by light diesel oil;
- Part 2. Untreated wood as the boiler fuel source.

Both options were modeled separately using the MAPMOS model. Raster grids and overlaid contour plots (from ArcGIS) of the predicted pollutants ground level concentration were presented

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in addition to options for both Light Fuel Oil Option and Figures 13 to 22 for the Woodchip Option.

All ground level concentrations of the pollutants are well below the current air quality standards / guidelines of the Irish and European legislation.

Advanced Gaussian plume Model Validation

Model validation plays an important role in the development and the application of an air pollution model, by providing measures of the performance and capabilities of a model. This is achieved by comparison of various model parameters and predictions to the measured data of an evaluation scenario, and also possibly by reference to other models.

There are two basic methods used in the evaluation of air pollution models[14]: a) operational (or statistical) evaluation of a model in a particular application context using statistical performance measures, usually achieved with the comparison of observed to predicted concentration values; and b) diagnostic (or scientific) evaluation of the physics of a model, i.e. is the model giving good predictions for the right reasons. This is should be carried out by assessment of the scientific basis of a model and by evaluation of the models parameters by reference to observations and predictions.

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One of the major difficulties with air pollution model evaluation is that the uncertainty that exists in air pollution modelling is typically quite large, a portion of which is essentially irreducible because of the nature of the process modelled. This uncertainty in an air pollution model is made up of three different elements: a) uncertainty due to errors in the model physics; b) uncertainty due to errors in the data; and c) inherent uncertainty.

As part of the European Initiative on *Harmonization within Atmospheric Dispersion Modelling for Regulatory Purposes* a model validation kit has been prepared.

The purpose of the model validation kit was to provide a framework within which differing models could be directly compared using common data sets and standard model evaluation procedures. The model validation kit is comprised of data from three atmospheric dispersion field experiments, namely Kincaid, U.S.A., Copenhagen, Denmark and Lillestrøm, Norway. These validation data sets were used in assessing the performance of the advanced Gaussian model.

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In order to facilitate comparison the Pasquill-Gifford based air pollution model ISC has also been applied to the field experiments. The ISC model is the US Environmental Protection Agency's (EPA) recommended regulatory model for industrial sources of air pollution in both rural and urban conditions. The modelling options used were those recommended in the user's guide for the conditions of the field experiments. It should also be noted that ISC2 has recently been updated to ISC3 by the US EPA. This has taken the form of some additions to its modelling capabilities, although the basics of the model have not changed.

The statistical analysis of the results from the two dispersion models is given in Tab. 1. The observed values of the statistical measures represent what a perfect model should achieve, although in practice no model could achieve these values because of the inherent uncertainty present in the diffusion process.

Table. 1 : Statistical measures of arcwise normalized concentration predictions compared to observations. Units are s $m^{-3} \times 10^{9}$

Statistical measure	Observed values	Advanced model	ISC2
Mean	54.34	49.44	23.64
Standard deviation	40.33	48.29	30.21
Bias	0.00	4.90	30.69
NMSE	0.00	1.20	2.81
Correlation	1.000	0.191	-0.058
FA2	1.000	0.577	0.370
FB	0.000	0.094	0.787
FS	0.000	-0.180	0.286

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From the examination of the statistical measures and the graphs of the results the following conclusions can be drawn:

a) The comparison of the statistical measures between the models suggests that the advanced model has performed considerably better than the ISC2 model.

b) As can be seen from the plots, the ISC2 model predicts a large number of zero concentrations when a non-zero concentration has been observed. This can be attributed to the "all or nothing" approach to plume penetration into the elevated stable layer above

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the boundary layer used in the model. This assumes that the ground level concentration is zero if the calculated effective height of the plume due to buoyancy is above the height of the boundary layer. However, this prediction of zero concentrations also occurs to a lesser extent for the advanced model, which may be an indication of problems with the partial plume penetration algorithm used in the model.

c) These zero predictions have an influence on the statistical measures of the mean, bias and FB, suggesting underprediction by both of the models. However, examination of the quantile plots shows that the advanced model adequately match predictions to observations.

d) The ISC2 consistently underpredicts concentrations.

Based on the statistical measures and the graphs of results, the advanced model has provided more accurate estimates of the concentration values when compared to the ISC2 model.

The next stage in the evaluation is to ensure that these improvements in concentration predictions are attributable to improvements in the scientific basis of the advanced model compared to the ISC2 model. This was carried out using residual plots of the ratio C_p/C_o to the variation in a model parameter. Residual plots that use individual points can be difficult to interpret because of the variability in values of C_p/C_o. An alternative is to cluster the data and plot statistical values. As the ratio has been shown to follow a lognormal distribution, each model parameter has been divided into approximately equal sized groups, and the geometric mean and uncertainty of C_p/C_o calculated for each group. The uncertainty was calculated as the 95% confidence limit of a lognormal distribution using the geometric standard deviation. The geometric standard deviation accounts for the inherent uncertainty in C_p/C_o and errors in the input meteorological measurements.

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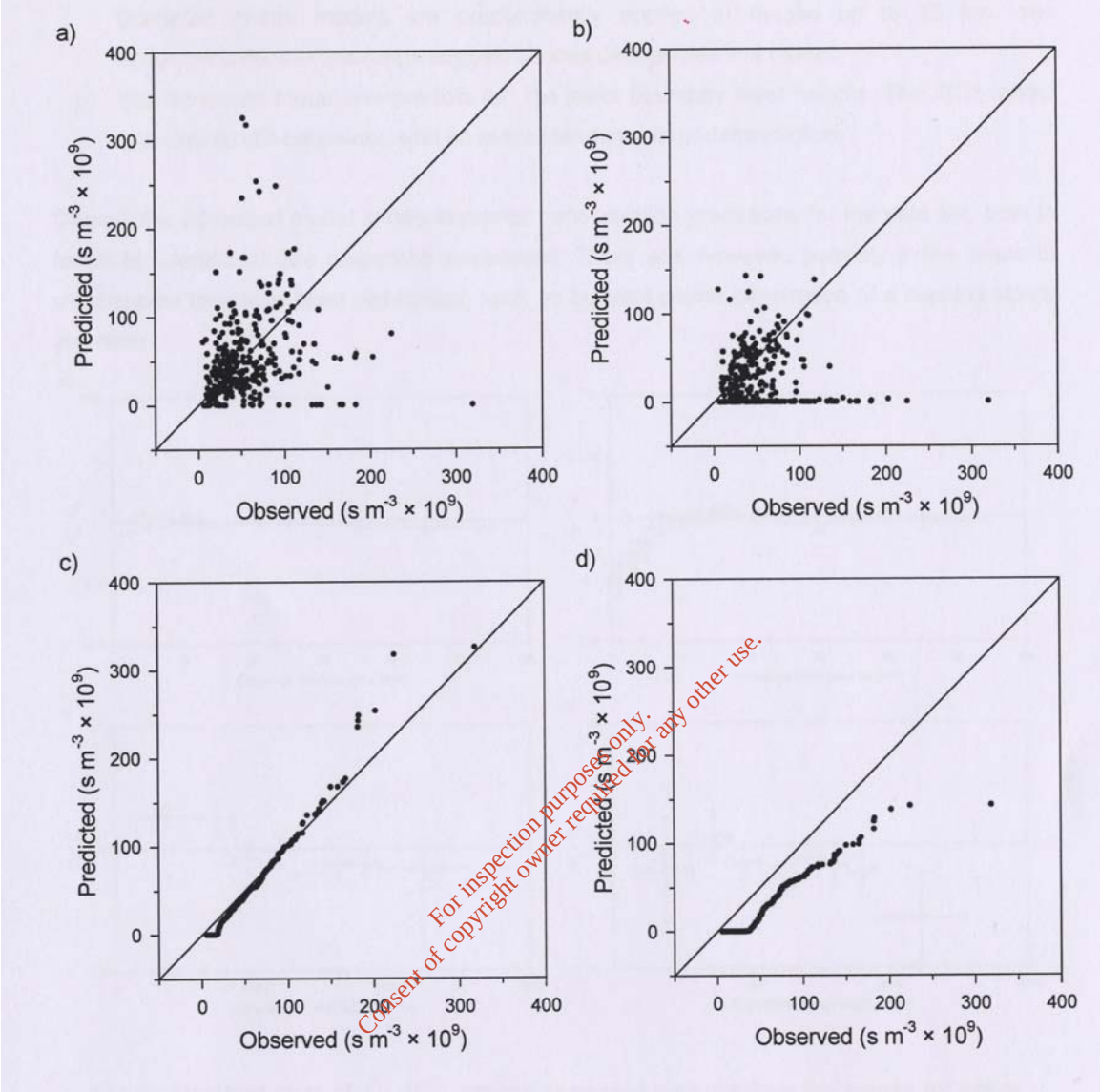

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Fig. 2 : Plots of predicted to observed arcwise normalized concentrations where: a) scatter plot, advanced model; b) scatter plot, ISC2; c) quantile plot, advanced model; and d) quantile plot, ISC2.

By way of illustration, residual plots using this approach for two model parameters, downwind distance from the source and boundary layer height, are shown in Fig. 3. Based on these plots alone the following points can be made:

a) The ISC2 model has large underpredictions at distances closer than 10 km to the source, and the advanced model has a slight tendency towards underprediction. Given that Gaussian plume models are predominantly applied in ranges up to 10 km, any

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underpredictions in this range suggest serious deficiencies in a model.

b) The advanced model overpredicts for the lower boundary layer heights. The ISC2 model has very erratic behaviour, with an overall tendency to underprediction.

Overall, the advanced model shows improved concentration predictions for the data set, both in terms of operational and diagnostic evaluations. There are, however, possibly a few areas of weaknesses that have been highlighted, such as buoyant plume penetration of a capping stable inversion.

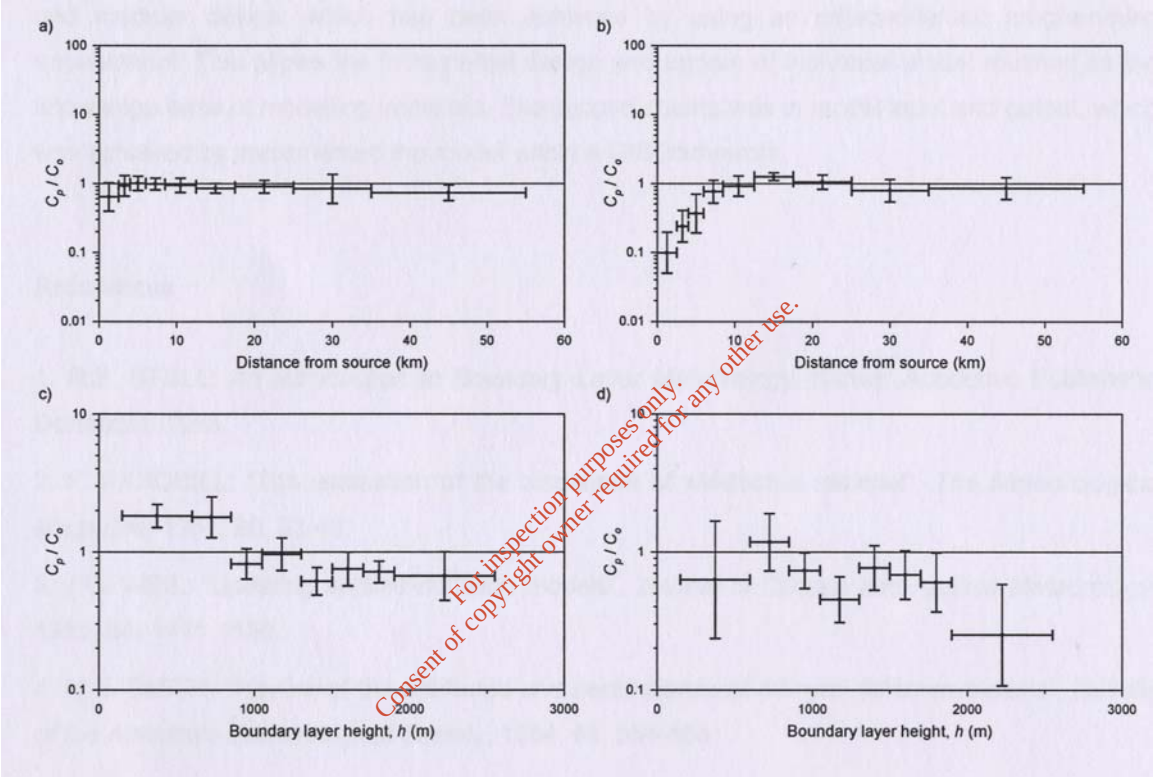

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Fig. 3 : Residual plots of C_p/C_o against downwind distance from the source for where: a) downwind distance, advanced model; b) downwind distance, ISC2; c) boundary layer height, advanced model; and d) boundary layer height, ISC2.

Conclusions

The results obtained from the model evaluation suggest that the model developed represents a significant improvement over those air pollution models currently used in practice. A point of particular importance is that the improved results obtained from model evaluation arise from the use of a better physical characterization of the boundary layer and dispersion in the model.

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The improvement in the results has also been achieved whilst retaining the relative simplicity of the meteorological input requirements of the model. This is of importance to industrial operations are often located in remote areas where full scale meteorological monitoring campaigns will be impractical in terms of the cost and effort required. Overall, the advanced Gaussian plume model developed will improve the analysis of the environmental impacts of air pollution from industry, and should lead to a more effective means of quantifying and alleviating those impacts.

The other two criteria in developing the model have also been met. The first of these was flexible and modular design, which has been achieved by using an object-oriented programming environment. This allows the incremental design and update of individual model routines as the knowledge base of modelling improves. The second criteria was in model input and output, which was achieved by implemented the model within a GIS framework.

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The Development of an advanced Gaussian plume air pollution model air

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Abstract

One of the commonest methods of air quality modelling is the Gaussian plume model, the strengths of which are: its relative simplicity; the fact that dispersion parameters can be estimated using readily obtainable surface meteorological observations; and that results obtained are often comparable to the results obtained by other more complex models. However, the Gaussian plume model has many limitations, not the least of these is that the dispersion parameters are estimated using generalized empirical methods. Recent research in atmospheric modelling has lead to a better understanding of the physics of the atmospheric boundary layer and its influence on dispersion. Using these latest findings an advanced Gaussian plume model has been developed with the aim of providing improved air pollution predictions. This requires that the parameters of importance in dispersion, such as surface heat flux, surface friction, atmospheric stability, and the vertical boundary layer structure are introduced into the model.

Modularity at a higher level was achieved by the division of the model developed into a meteorological preprocessor and a dispersion model. Flexibility in the model input and output has been achieved by integrating the model with a Geographical Information System (GIS). As well as providing extended capabilities for model input and display, this also allows for the analysis of results directly or in combination with other forms of spatial data to model interacting environmental impacts of minerals extraction. The advanced model was evaluated using a well established validation kit which is comprised of data from three atmospheric dispersion field experiments. The results obtained have represented a considerable improvement in the air quality predictions made when compared to conventional Gaussian plume models.

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Introduction

The dispersion of air pollutants primarily occurs within the atmospheric boundary layer. This boundary layer is the lowest layer of the atmosphere and is defined by interaction with the Earth's surface, responding to surface forcings with a time scale of about one hour or less[1]. Consequently, most modelling of air pollution dispersion is concerned with the study of the meteorology of this boundary layer.

The primary mechanism for dispersion in the boundary layer is turbulence. Combined with advection by the mean wind this results in a very efficient method for the transport and dispersion of air pollutants. However, the presence of turbulence presents considerable problems when it comes to modelling dispersion. Numerical methods for solving the complete set of equations that define boundary layer flow and turbulence, the Navier-Stokes equations, are both complex and computationally intensive.

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Provided that certain assumptions are made about dispersion and advection in the boundary layer, the Gaussian plume model, which takes advantage of the fact that steady-state conditions can normally be assumed to exist in the boundary layer over an averaging period of one hour, can be used as a simpler alternative. The model assumes the advection transport of an air pollutant in the hourly mean wind direction combined with statistical descriptions of turbulent dispersion in the crosswind and vertical directions. As the model name suggests, the dispersion distributions due to turbulence are Gaussian, the shape of which are functions of downwind distance. The parameters used in the model are defined using a minimum set of easily measurable meteorological observations. This is of particular importance when modelling air pollution from the minerals extraction industry, as operations are often located in remote areas. Using a Cartesian co-ordinate system the Gaussian plume model has the general form

$$\chi(x,y,z) = \frac{Q}{2\pi u \sigma_y \sigma_z} \exp\left[-0.5\left(\frac{y}{\sigma_y}\right)^2\right] \exp\left[-0.5\left(\frac{z-H}{\sigma_z}\right)^2\right] \quad (1)$$

where χ is the concentration at a location (x, y, z), Q is the source emission rate, u is the average wind speed at the release height, H is the height of the plume centreline, which is the source release height for non-buoyant plumes, and σ_y and σ_z describe the Gaussian concentration distributions in the crosswind and vertical directions respectively, commonly termed the dispersion parameters. The x axis is taken as being in the wind direction, the y axis as the crosswind direction, and the z axis as the vertical; the origin is at ground level directly below the source release point.

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The models currently used in practice typically use the empirical Pasquill-Gifford[2] method of atmospheric stability classification to define dispersion. The Pasquill-Gifford method uses an empirical scheme to define six stability categories ranging from unstable to stable. This classification is based on wind speed, cloud cover, time of day, and solar altitude to indirectly define the surface heat flux. These six stability categories are then used to define the stability. Although the Pasquill-Gifford method has the advantage of simplicity, the improved understanding of boundary layer physics has highlighted its deficiencies. These are: a) the use of stability categories introduces a stratification of atmospheric conditions, whereas in fact stability is a continuum; b) it is biased towards neutral conditions; c) it does not recognize the vertical structure of the boundary layer which can influence dispersion depending on the height of a release; and d) the vertical dispersion distribution in unstable conditions is now known to be non-Gaussian. These weaknesses in the model all lead to inaccurate definition of the dispersion, and have lead to the Gaussian plume model performing poorly in application[3,4]. Predictions when compared to observations are often out by a factor of two or more. However, it is worth noting at this point that there is always a relatively large degree of uncertainty associated with all air pollution modelling because of the nature of the process.

The potential solutions to these weaknesses in the Gaussian plume model lie in applying the improvements that have been made in the understanding of the physics of the boundary layer. The starting point is the implementation of methods that define the fundamental parameters of the boundary layer, such as the surface heat flux and characteristic length and velocity scales. These can then be used to provide relationships that define the vertical structure of the boundary layer, stability, dispersion and vertical profiles of wind speed and temperature.

This paper describes the research that has been carried out to provide an effective and practical methodology for modelling air pollution from minerals extraction. An improved or

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advanced Gaussian plume model has been developed that provides a more accurate description of atmospheric dispersion in the boundary layer. During the development of the model the important criteria were considered to be:

- The model should reflect recent improvements in the theoretical understanding of the atmospheric boundary layer and should include the fundamental parameters that describe boundary layer meteorological conditions and dispersion. The emphasis in this area has been towards improving the basic principles of the model.
- The relative simplicity of the Gaussian plume model should be maintained, particularly the requirement that only a minimum set of meteorological observations be needed to define the parameters that characterize the dispersion and meteorological conditions.
- The model should be flexible and modular so that it can easily be updated as the understanding of the problem improves.
- Methods of input and output for the model should be clear and flexible, incorporating graphical presentation of the results to improve interpretation and environmental impact evaluation.

The last point is considered to be of importance as many of the Gaussian plume models currently in use are characterized by ungainly methods of input and output, with very little provision for the display of results.

Theoretical Background

Related to the stability of the atmosphere mentioned in the introduction is the diurnal variation in the structure of the boundary layer. Normally during the daytime, incoming solar radiation heats the Earth's surface. This is then transferred to the atmosphere as a heat flux away from the surface. This generates convection within the boundary layer and can greatly enhance turbulence and dispersion, and the atmosphere is described as unstable. At night, the reverse process happens with heat transferred to the Earth's surface, and stable conditions generally exist. The simplest method for introducing the effect of this surface heat flux is to calculate the energy balance at the Earth's surface assuming an ideal surface with no heat or mass storage. The energy balance is then given by[5]

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$$Q^* = Q_H + Q_E + Q_G \tag{2}$$

where Q^* is the net radiation, Q_H is the sensible heat flux, Q_E is the latent heat flux, and Q_G is the soil heat flux. Several simple parameterization schemes exist for the various components of the surface energy balance[1,6].

Given this diurnal variation, our interest is in characteristic boundary layer parameters to define both the state of the atmosphere and the dispersion. The most important of these are:

a) The friction velocity, u_*,which is a measure of the surface momentum flux, or shear stress. The friction velocity can be determined from the logarithmic profile law for the wind, modified to account for atmospheric stability, so that[7]

$$u_* = k \; u\left[\ln\left(\frac{z}{z_0}\right) - \psi_M\left(\frac{z}{L}\right)\right]^{-1} \tag{3}$$

where u is the wind speed measured at a reference height z, ψ_M is a stability function, $k = 0.4$ is von Kármán's constant, and z_0 is the aerodynamic roughness length, the height at which the mean wind speed becomes zero. As can be seen, this relationship can also be used to defined the vertical profile of the wind.

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b) The Obukhov length (or Monin-Obukhov length), L, which is given by

$$L = -\frac{\rho c_p u_*^3 T}{kgQ_H} \tag{4}$$

where ρ is the density, c_p is the specific heat at constant pressure, and T is the temperature. The magnitude of the Obukhov length is a measure of the relative importance of buoyancy forces to shear forces. For stable conditions $L > 0$, for unstable conditions $L < 0$, and for neutral conditions $L \to \infty$ as $Q_H \to 0$.

c) The convective velocity scale, a velocity scale of convection generated turbulence given by

$$w_* = \left(\frac{ghQ_H}{\rho c_p T} \right)^{1/3} \tag{5}$$

d) The height of the boundary layer. Methods for determining this height are dependant on atmospheric stability. In neutral conditions it can be found from[8]

$$h = c\frac{u_*}{f} \tag{6}$$

where c is an empirical constant f is the Coriolis parameter. In stable conditions the boundary layer height can be found using[9]

$$h = 0.37\left(\frac{u_* L}{f} \right)^{1/2} \tag{7}$$

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In the convective boundary layer the growth in the height of the boundary layer occurs in response to the continual supply of heat at the surface. As a consequence diagnostic equations have been found to be unsatisfactory for predicting the mixed layer height, and rate equations have to be used instead. The basic approach is to equate the heat supplied during the day to that absorbed[1]

$$\int_{t_0}^{t_1} \frac{Q_H}{\rho c_p}(t)dt = \int_{\theta_0}^{\theta_1} \theta_s \, d\theta \tag{8}$$

where θ_s is the initial early morning potential temperature profile and $Q_H / \rho c_p (t)$ is the surface heat flux from the initial time t_0 to a time t_1. The exact details of various methods can be found elsewhere[1,10,11].

There are three principle methods which are used for defining the dispersion[12]: a) surface layer similarity; b) convective scaling; and c) statistical theory analysis. The first two are forms of dimensional analysis which in part are also used in defining the previous characteristic boundary layer parameters. For example, using surface layer similarity theory it is argued that diffusion should be a function of the characteristic velocity scale u_* and the length scales z and L. Statistical theory analysis differs from the two forms of dimensional analysis by defining the dispersion as a function of either measured or estimated turbulent velocity fluctuations. However, the three methods are to some extent interrelated as, for example, the same scaling parameters used in the two forms of dimensional analysis are commonly used in statistical theory analysis in defining the turbulent velocity fluctuations.

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There is a large number of formulae suggested in the literature[12] based on these three principle methods that can be used for defining the dispersion parameters, and it is not proposed to review them here. Given this wide array of possible formulae for the dispersion the choice of which to use remains to some extent the choice of the modeller, as there is no definitive best answer.

Model Development

Based on the theory briefly outlined in the previous section, an advanced air pollution model has been developed. The model is broken down into two constituent parts, a meteorological preprocessor and a dispersion model. The meteorological preprocessor describes atmospheric conditions as a continuum in terms of characteristic boundary layer scaling parameters, derived using a minimum set of meteorological measurements. These characteristic scales are then used by the dispersion model for defining the dispersion and vertical profiles of parameters used in the advanced Gaussian plume model. The principle design criteria of the air pollution model were that it should be representative, modular, flexible and yet remain conceptually simple.

Generally, in an air pollution study the set of meteorological observations that are available for use is limited. Conventional Gaussian plume models using the Pasquill-Gifford dispersion scheme are capable of modelling air pollution using these limited measurements. This capability has been maintained for the advanced model so that the characteristic boundary layer parameters that describe the dispersion can be defined using the limited set of meteorological observations. For the meteorological preprocessor an absolute minimum required set of meteorological measurements was defined which for each modelling period are wind speed, wind direction, temperature and cloud cover. These are used to define the parameters: a) surface heat flux, Q_H; b) friction velocity, u_*; c) Obukhov length, L; d) convective velocity scale, w_*; e) potential temperature scale, θ_*; and f) boundary layer height h. These boundary layer parameters are then used to define the dispersion and vertical profiles of wind speed and temperature in the dispersion model.

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For dispersion, the atmospheric conditions have been classified into the stable, neutral and convective regions, with the boundaries between the regions defined by the characteristic length scales z (or H), L and h. In the neutral and convective regions, a further distinction is made by the surface layer defined as $z/h \le 0.1$, so that releases are classified as either surface releases for $H/h \le 0.1$, or elevated releases for $H/h > 0.1$. In the stable and neutral regions the Gaussian distribution is used, with the dispersion parameters found from the turbulent wind fluctuations using a combination of statistical theory analysis and similarity scaling. If measured turbulent wind fluctuations are available at the source release height, these can be used instead. In convective conditions a Gaussian formulation is used for the lateral dispersion and also for vertical dispersion from surface releases at downwind close to the source, with the dispersion parameters determined using convective scaling. Given that interest is primarily in ground level concentrations, formulae for the dimensionless ground level crosswind-integrated concentration have been used to define vertical dispersion in all other conditions, which accounts for the non-Gaussian vertical distribution. The dispersion model also integrates into the dispersion calculations the standard approach[13] for dealing with plume buoyancy.

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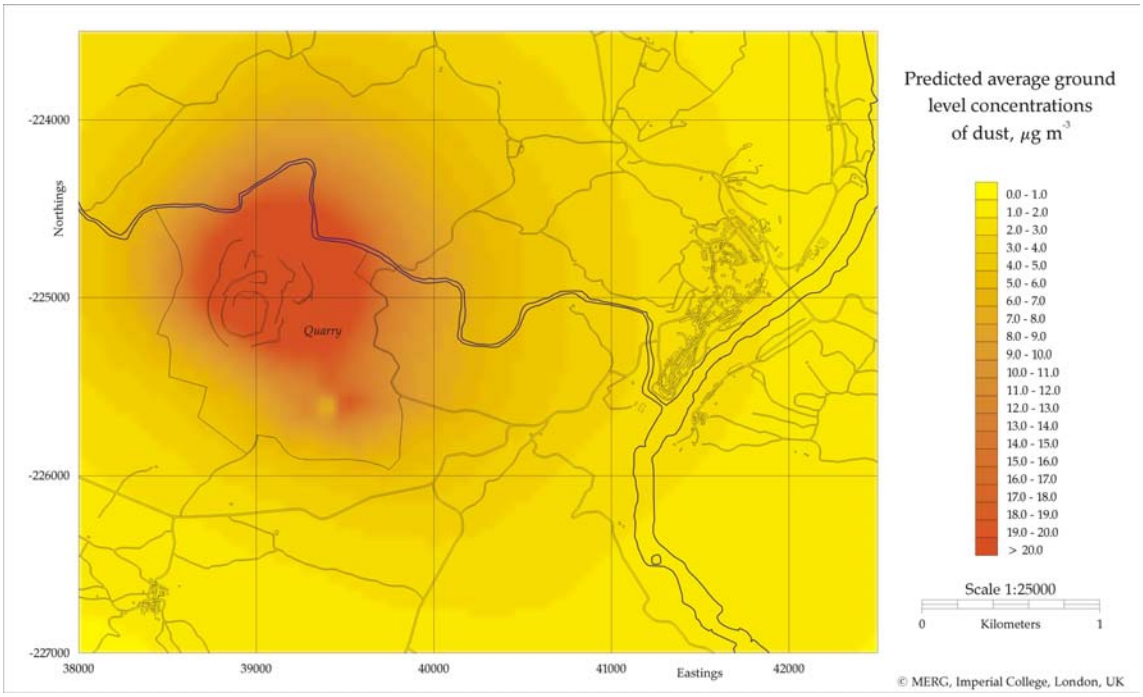

Fig. 1 : Air pollution model output: spatial representation of predicted dust concentrations in relation to other geographic and urban/rural features around a quarry.

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The model has been coded in the object-oriented language C++ which allows a high degree of modularity in the program design. The importance of modularity in the model structure is that it allows the constituent model parts to be easily updated as improvements are made in the understanding of the dispersion, and this is an inherent feature of object-oriented programming. With object-oriented programming the problem domain is defined in terms of data types upon which distinct operations can be performed, resulting in a high degree of modularity. In this case, data types were meteorology, sources and receptors, on which distinct operations could be performed, either as an individual data type or in combination.

This modularity represents one form of flexibility in the design of a model. Another important area of flexibility in a model is in its input and output. Just as achieving a representative description of the dispersion is an important goal, equally important is the ability to interpret and analyze model parameters and results. At a practical level this includes the avoidance of ungainly methods of input and output. Whilst this does not affect the modelling ability of a particular air pollution model, it does enhance the possibility of sources of error in input and effects the interpretability of the end results. Flexibility in the model input and output has therefore been achieved by integrating the model with a GIS. As well as providing extended capabilities for model input and display, it also allows for the analysis of results directly or in combination with other forms of spatial data. This analysis is important as although the modelling of the physical process of atmospheric dispersion is an important part of understanding air pollution problems, equally important is the ability to interpret and analyze the results of the modelling. These results are of an inherently spatial nature, and interpretation and analysis will be in combination with other spatial data. This requirement is easily achieved through the integration of the model with a GIS. Fig. 1 demonstrates the enhanced model output display and analysis capability using the GIS.

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Model Validation

Model validation plays an important role in the development and the application of an air pollution model, by providing measures of the performance and capabilities of a model. This is achieved by comparison of various model parameters and predictions to the measured data of an evaluation scenario, and also possibly by reference to other models.

There are two basic methods used in the evaluation of air pollution models[14]: a) operational (or statistical) evaluation of a model in a particular application context using statistical performance measures, usually achieved with the comparison of observed to predicted concentration values; and b) diagnostic (or scientific) evaluation of the physics of a model, i.e. is the model giving good predictions for the right reasons. This is should be carried out by assessment of the scientific basis of a model and by evaluation of the models parameters by reference to observations and predictions.

For operational evaluation there are six statistical measures in common usage[14,15,16], as presented in Tab. 1. Here, $\overline{C}_o$ is the mean of the observed concentrations C_o, $\overline{C}_p$ is the mean of the predicted concentrations C_p, and σ_{C_o} and σ_{C_p} are the standard deviations of the observed and predicted concentrations. In diagnostic evaluation several methods can be used: a) scientific judgment as to the validity of model physics; b) operational evaluation comparing observed to predicted concentrations; c) the comparison of predicted to observed model parameters, such as boundary layer height; and d) the comparison of the variation of model parameters to differences in concentrations. This last is usually carried out by plots that compare residuals, which are the difference or ratio between observed and predicted concentrations, to the variation in a model parameter. If there is a trend in the plot this may indicate an error in the model physics.

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Tab. 1 : Statistical measures in common usage for operational evaluation

Name	Method	Description
Bias	$\mathrm{BIAS} = \overline{C}_o - \overline{C}_p$	A measure of the variability of the differences between observed and predicted concentrations. Ideal value is 0.
Normalized mean square error	$\mathrm{NMSE} = \frac{\overline{(C_o - C_p)^2}}{\overline{C}_o \overline{C}_p}$	A measure of the variability of the differences between observed and predicted concentrations, normalized to remove bias towards overprediction or underprediction by models. Ideal value is 0.
Fractional bias	$\mathrm{FB} = \frac{2(\overline{C}_o - \overline{C}_p)}{\overline{C}_o + \overline{C}_p}$	A measure of how well a model reproduces the mean of observed concentrations. The ideal value is 0 and it can range between -2 and +2, with ±0.67 representing predictions within a factor of two of observations.
Fractional variance (scatter)	$\mathrm{FS} = \frac{2(\sigma_{C_o} - \sigma_{C_p})}{\sigma_{C_o} + \sigma_{C_p}}$	A measure of how well a model reproduces the spread of observed concentrations. The ideal value is 0 and it can range between -2 and +2, with ±0.67 representing predictions within a factor of two of observations.
Correlation coefficient	$r = \frac{\overline{(C_o - \overline{C}_o)(C_p - \overline{C}_p)}}{\sigma_{C_o}\sigma_{C_p}}$	The value r^2 is the fraction of the variance resolved by the model, with a range of -1 to +1.
Fraction within a factor of two (FA2)	$0.5 \le C_o/C_p \le 2$	The fraction of predicted concentrations within a factor of two of observed concentrations, expressed as a percentage. The ideal value is 100%.

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One of the major difficulties with air pollution model evaluation is that the uncertainty that exists in air pollution modelling is typically quite large[14,16], a portion of which is essentially irreducible because of the nature of the process modelled. This uncertainty in an air pollution model is made up of three different elements[16]: a) uncertainty due to errors in the model physics; b) uncertainty due to errors in the data; and c) inherent uncertainty.

As part of the European Initiative on *Harmonization within Atmospheric Dispersion Modelling for Regulatory Purposes* a model validation kit has been prepared[17]. The purpose of the model validation kit was to provide a framework within which differing models could be directly compared using common data sets and standard model evaluation procedures. The model validation kit is comprised of data from three atmospheric dispersion field experiments, namely Kincaid, U.S.A., Copenhagen, Denmark and Lillestrøm, Norway. These validation data sets were used in assessing the performance of the advanced Gaussian model developed in this study. A brief outline of the results obtained from one of the field experiments, Kincaid, U.S.A., is presented here.

In order to facilitate comparison the Pasquill-Gifford based air pollution model ISC2 has also been applied to the field experiments. The ISC2 model is the US Environmental Protection Agency's (EPA) recommended regulatory model[18] for industrial sources of air pollution in both rural and urban conditions. The modelling options used were those recommended in the user's guide[19] for the conditions of the field experiments. It should also be noted that ISC2 has recently been updated to ISC3 by the US EPA. This has taken the form of some additions to its modelling capabilities, although the basics of the model have not changed.

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Kincaid field experiment

The Kincaid field experiment was carried out at the Kincaid power plant in Illinois during 1980-81, and is the most extensive of the three data sets. The area around the power plant is flat farmland with some lakes The tracer used was SF_6, released into a buoyant plume from a 187 m high stack. Monitoring stations were placed in arcs on a daily basis in accordance with the expected wind direction and the distance to the maximum ground level concentration. The concentrations compared were the maximum in each arc of monitoring stations, the arc-wise maxima, to the predicted plume centre-line concentration. Both observed and predicted concentrations were normalized by division by the emission rates.

A large number of variables were measured including boundary layer height and wind speed, wind direction and temperature at various heights up to 100 m. In accordance with the recommended guidelines[17] the observed boundary layer height was used as input for both models. Pasquill-Gifford stability categories for the ISC2 model were calculated using the standard method, and the meteorological preprocessor of the advanced model was used to calculate its input parameters.

The statistical analysis of the results from Kincaid for the two dispersion models is given in Tab. 2. The observed values of the statistical measures represent what a perfect model should achieve, although in practice no model could achieve these values because of the inherent uncertainty present in the diffusion process. Scatter and quantile plots of observed to predicted concentrations are shown in Fig. 2. The quantile plots are concentration values paired independently in time and space, i.e. highest to highest, second highest to second highest, etc.

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Tab. 2 : Kincaid: Statistical measures of arcwise normalized concentration predictions compared to observations. Units are s $m^{-3} \times 10^9$.

Statistical measure	Observed values	Advanced model	ISC2
Mean	54.34	49.44	23.64
Standard deviation	40.31	48.29	30.21
Bias	0.00	4.90	30.69
NMSE	0.00	1.20	2.81
Correlation	1.000	0.191	-0.058
FA2	1.000	0.577	0.370
FB	0.000	0.094	0.787
FS	0.000	-0.180	0.286

From the examination of the statistical measures and the graphs of the results the following conclusions can be drawn:

a) The comparison of the statistical measures between the models suggests that the advanced model has performed considerably better than the ISC2 model.

b) As can be seen from the plots, the ISC2 model predicts a large number of zero concentrations when a non-zero concentration has been observed. This can be attributed to the "all or nothing" approach to plume penetration into the elevated stable layer above the boundary layer used in the model. This assumes that the ground level concentration is zero if the calculated effective height of the plume due to buoyancy is above the height of the boundary layer. However, this prediction of zero concentrations also occurs to a lesser extent for the advanced model, which may be an indication of problems with the partial plume penetration algorithm used in the model.

c) These zero predictions have an influence on the statistical measures of the mean, bias and FB, suggesting underprediction by both of the models. However, examination of the quantile plots shows that the advanced model adequately match predictions to observations.

d) The ISC2 consistently underpredicts concentrations.

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Based on the statistical measures and the graphs of results, the advanced model has provided more accurate estimates of the concentration values for the Kincaid data set when compared to the ISC2 model.

The next stage in the evaluation is to ensure that these improvements in concentration predictions are attributable to improvements in the scientific basis of the advanced model compared to the ISC2 model. This was carried out using residual plots of the ratio C_p/C_o to the variation in a model parameter. Residual plots that use individual points can be difficult to interpret because of the variability in values of C_p/C_o . An alternative is to cluster the data and plot statistical values. As the ratio has been shown to follow a lognormal distribution[14], each model parameter has been divided into approximately equal sized groups, and the geometric mean and uncertainty of C_p/C_o calculated for each group. The uncertainty was calculated as the 95% confidence limit of a lognormal distribution using the geometric standard deviation. The geometric standard deviation accounts for the inherent uncertainty in C_p/C_o and errors in the input meteorological measurements[14].

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Fig. 2 : Kincaid: Plots of predicted to observed arcwise normalized concentrations where: a) scatter plot, advanced model; b) scatter plot, ISC2; c) quantile plot, advanced model; and d) quantile plot, ISC2.

By way of illustration, residual plots using this approach for two model parameters, downwind distance from the source and boundary layer height, are shown in Fig. 3. Based on these plots alone the following points can be made:

a) The ISC2 model has large underpredictions at distances closer than 10 km to the source, and the advanced model has a slight tendency towards underprediction. Given that Gaussian plume models are predominantly applied in ranges up to 10 km, any underpredictions in this range suggest serious deficiencies in a model.
b) The advanced model overpredicts for the lower boundary layer heights. The ISC2 model has very erratic behaviour, with an overall tendency to underprediction.

Overall, the advanced model shows improved concentration predictions for the Kincaid data set, both in terms of operational and diagnostic evaluations. There are, however, possibly a few areas of weaknesses that have been highlighted, such as buoyant plume penetration of a capping stable inversion.

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Fig. 3 : Kincaid: Residual plots of C_p / C_o against downwind distance from the source for where: a) downwind distance, advanced model; b) downwind distance, ISC2; c) boundary layer height, advanced model; and d) boundary layer height, ISC2.

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Conclusions

This paper has described the development of an advanced Gaussian plume air pollution model. The results obtained from the model evaluation suggest that the model developed represents a significant improvement over those air pollution models currently used in practice. A point of particular importance is that the improved results obtained from model evaluation arise from the use of a better physical characterization of the boundary layer and dispersion in the model.

The improvement in the results has also been achieved whilst retaining the relative simplicity of the meteorological input requirements of the model. This is of importance to the minerals extraction industry as operations are often located in remote areas where full scale meteorological monitoring campaigns will be impractical in terms of the cost and effort required. Overall, the advanced Gaussian plume model developed will improve the analysis of the environmental impacts of air pollution from minerals extraction, and should lead to a more effective means of quantifying and alleviating those impacts.

The other two criteria in developing the model have also been met. The first of these was flexible and modular design, which has been achieved by using an object-oriented programming environment. This allows the incremental design and update of individual model routines as the knowledge base of modelling improves. The second criteria was in model input and output, which was achieved by implemented the model within a GIS framework.

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