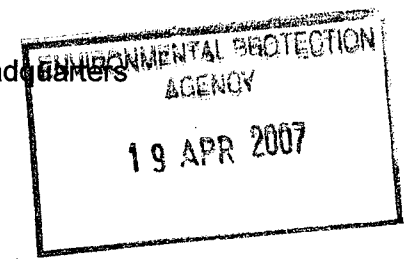
FEHILY TIMONEY & COMPANY

CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES

CORK DUBLIN

Our Ref:J:\2006\289\010\Let017\TR

Noeleen Keavey,
Licensing Unit,
Office of Licensing and Guidance
Environmental Protection Agency Headquarters
PO Box 3000
Johnstown Castle Estate,
County Wexford
EPA Reference No. W0234-01



17 April 2007

RE: Response to Notice in accordance with Article 14(2)(b)(ii) of the Waste Management (Licensing) Regulations with respect to W0234-01.

Dear Ms. Keavey,

This is a response to the Notice in accordance with Article 14 (2)(b)(ii) dated 12 February 2007 with respect to waste licence application register number W0234-01. This response is being made on behalf of Waterford City Council. Please find enclosed a report in response to the Notice. There is 1 original and 2 copies of the report and 2 CD-ROMS enclosed.

Please can you send all correspondence in relation to the above application to Mr. Michael Walsh, Director of Services, Planning, Culture and HR, Waterford City Council, Wallace House, Maritana Gate, Canada Street, Waterford City.

Yours sincerely

Tanya Ruddy
for and on behalf of **Fehily Timoney & Company**

Encl.

CORE HOUSE, POULADUFF ROAD, CORK, IRELAND
T: +353 21 4964133 **F:** + 353 21 4964464 **E:** info@ftco.ie **W:** www.fehilytimoney.ie

Directors: Eamon Timoney Declan O'Sullivan Gerry O'Sullivan Walter Quirke Oliver Tierney
Associates: Declan Egan Clodagh Mahony Adrian Duffy Bernadette Guinan
Paul Kelly Stephen Byrne Sarah Toal Company Secretary: John Hallahan

Registered in Ireland, Fehily Timoney & Company Ltd. Number 180497
Registered Office: Core House, Pouladuff Road, Cork VAT Registration Number: IE6580497D

ARTICLE 14 RESPONSE

IN SUPPORT OF
AN APPLICATION FOR A WASTE LICENCE
FOR WATERFORD CITY COUNCIL
COMPOSTING FACILITY

APPLICATION REGISTER NO. W0234-01

ORIGINAL

Prepared for:

Waterford City Council
Department of Planning, Culture and Human Resources
Wallace House, Maritana Gate
Canada Street
Waterford City

Prepared by:

Fehily Timoney & Company
Floor 2
Mill House
Ashtown Gate
Navan Road
Dublin 15

April 2007

ARTICLE 14 ESPONSE

IN SUPPORT OF
AN APPLICATION FOR A WASTE LICENCE
FOR WATERFORD CITY COUNCIL
COMPOSTING FACILITY

APPLICATION REGISTER NO. W0234-01

User is Responsible for Checking The Revision Status Of This Document

Rev. Nr.	Description of Changes	Prepared by:	Checked by:	Approved by:	Date:
0	Issue to Client	TR	PK		17-04-07

Client: Waterford City Council

Keywords: Article 12, Article 14, waste licence application

Abstract: This document contains the response to an Article 14 Notice from the Environmental Protection Agency (EPA). It provides clarification on a number of issues and re-application of a number of drawings. The drawings submitted as part of this response are not revisions of the waste licence application drawings but are new drawings. This response should be read in conjunction with the waste licence application and attachments and the Notice in accordance with the Article 14 (2)(b)(ii) Notice from the EPA.

TABLE OF CONTENTS

1. INTRODUCTION 1
2. EXPLANATION OF DRAWINGS 2
3. ARTICLE 12 COMPLIANCE REQUIREMENTS 4
4. REVISED NON-TECHNICAL SUMMARY 9

ATTACHMENTS

ATTACHMENT A	2006-289-01-201 REV A, ARTICLE 14 EXISTING SITE LAYOUT 2006-289-01-202 REV A, ARTICLE 14 EXISTING DRAINAGE LAYOUT 2006-289-01-301 REV A, ARTICLE 14 PROPOSED INTERIM SITE LAYOUT 2006-289-01-302 REV A, ARTICLE 14 PROPOSED INTERIM DRAINAGE LAYOUT 2006-289-01 - FIGURE 1 REV A RECEPTORS 2006-289-01 - FIGURE E.1 REV B ENVIRONMENTAL MONITORING LOCATIONS
ATTACHMENT B	ANIMAL BY-PRODUCTS LICENCE
ATTACHMENT C	ODOUR ASSESSMENT REPORT MAY 2005
ATTACHMENT D	ATTACHMENT FOR SECTION L OF THE WASTE LICENCE

.

1. INTRODUCTION

Waterford City Council (WCC) submitted an application for a waste licence in respect of Waterford City Composting Facility, Green Road, Waterford City on 6th December 2006. The application register number is W0234-01.

The Environmental Protection Agency (EPA) issued a Notice in accordance with Article 14(2)(b)(ii) of the Waste Management (Licensing) Regulations on 12th February 2007. This report is in response to that notice.

The report has been divided into 3 no. sections; an explanation of the drawing numbering and content, responses to each of the Article 12 compliance requirements and a revision of the non-technical summary.

All relevant drawings are included as Attachment with various other support documentation included in Attachments B, C and D

A number of the Article 12 compliance requests relate to the existing layouts. The topic is explained in full in this report and summarised as follows. The existing facility is as was on the date of application. Two new drawings have been produced to show this.

An interim phase of development is planned, to construct a leachate holding tank and ancillary infrastructure and a green waste storage area. Two new drawings have been produced to show this.

There is a conceptual plan for the future extension of the site to cater for a 20,000 tpa capacity.

2. EXPLANATION OF DRAWINGS

In the waste licence application, WCC submitted two sets of drawings; the existing site drawings and a conceptual future drawing.

The intention of WCC had been to immediately commence works on site to construct a leachate holding tank and ancillary infrastructure. Therefore by date of grant of licence it had been anticipated that the drawings would reflect the 'existing' layouts on site. As part of those works WCC had intended to construct a green waste storage area to improve the access to the site for members of the public. When dropping off their green waste, the public will no longer have to enter the operational area of the site. The new green waste storage area will be accessed directly from the facility entrance.

However, there were unforeseen delays in progressing the construction of the leachate tank. These works are referred to as interim works inthis report and will be substantially completed by the end of Summer 2007.

For the purposes of this Article 12 response, two new sets of drawings have been prepared (200 and 300 series drawings).

100 Series drawings– submitted with the waste licence application
200 Series drawings – submitted with this Article 14 response
300 Series drawings – submitted with this Article 14 response

The original 100 Series drawings are:

- 2006-289-01-101 Rev A Existing Site Layout
- 2006-289-01-102 Rev A Existing Drainage Layout
- 2006-289-01-103 Rev A Existing Water Supply and Ducting Layout
- 2006-289-01-104 Rev B Existing Site Layout

The new 200 Series drawings are:

- 2006-289-01-201 Rev A Article 14 Existing Site Layout
- 2006-289-01-202 Rev A Article 14 Existing Drainage Layout

These drawings show the site layout as per the date of application and now in April 2007 (no development took place on site since the application was submitted).

The new 300 Series drawings are:

- 2006-289-01-301 Rev A Article 14 Proposed Interim Site Layout
- 2006-289-01-302 Rev A Article 14 Proposed Interim Drainage Layout

These drawings show the proposed interim situation on site, that is, the proposed leachate holding tank and ancillary infrastructure and the green waste storage area. It is expected that the interim works will be at substantial completion stage by the end of the Summer 2007. Interim defines the period between existing layout and conceptual future layout (20,000 tpa facility).
The 300 Series are the same as the 100 Series drawings with a new drawing number and title.

3. ARTICLE 12 COMPLIANCE REQUIREMENTS

The Agency posed 14 no. queries in relation to the waste licence application. The responses to each are in the following section.

1. Provide a map showing the location of the nearest sensitive receptor(s) to the facility. Tabulate the distance from the site to each of the sensitive receptors.

Refer to Drawing Number 2006-289-01-Figure 1 Rev A Attachment A.
In this drawing the nearest buildings have all been labeled. The nearest receptors are shown in the table below. The distances are measured from the point in the facility that has the greatest potential to impact on the receptor, e.g. The distance from the material handling building to DHL is 30 m. The nearest residential location is 350 m away from the nearest point to it in the composting facility.

Sensitive Receptor	Orientation	Distance from facility (m)
Ballybeg Housing Estate	NNW	375 m
School	NNE	470 m
Church	NNE	560 m
Residential - Kilbarry Road	ESE	370 m
Various building & commercial companies (in industrial estate)	ESE	100 m
Commercial units (in industrial estate)	SSE	120 m
DHL facility (in industrial estate)	S	40 m
Veolia Ltd. WTS (in industrial estate)	S	45 m

2. Specify the grade of compost that is being produced at the composting facility- refer to the working document – Biological Treatment of Biowaste, 2nd draft.

A Class 2 compost is being produced.

3. Clarify why 2000kg of Urea is used at the facility per annum

Urea is a nitrogen containing chemical product. It is used like a fertilizer for the compost. It is used to achieve the ideal C:N ratio. Low nitrogen levels prevent the compost from heating up to reach the required 60˚C for two consecutive days. The ideal C:N ratio at the start of the process is 30:1. The amount of urea added to each batch is dependant on the C:N ratio.

4. The waste received at the facility is source segregated, however the application indicates there are large quantities of overs (up to 25%)? Explain the reasons for this and provide a breakdown of incoming waste types.

Source segregated biowaste is collected from the household and commercial sectors. Green waste is delivered to the facility by members of the public, landscapers and the Parks departments of the City and County Councils. Contaminants make their way into the source segregate bins, particularly household bins through non compliance with the 3 bin system and human error. The bins are collected at households and commercial premises' and are brought directly to Kilbarry composting facility. The major contaminant fraction is plastics.

The material is unloaded onto the tipping floor in the materials reception building. Large contaminants such as plastics, metals, rocks etc are removed here manually.

Following composting the material is screened to remove oversized un-decomposed materials or inert contaminants. Depending on the level of contamination, the larger fraction will be transported off-site for suitable disposal and the low contamination overs eg. wood chip are re-used in the process.

Therefore contaminants are removed both before and after the composting process.

The existing process generated approximately 25% overs. As stated in the application the operators are currently investigating technology that will further screen and sort overs. It is hoped to reduce the quantity of waste for disposal from the process to less than 10% of incoming materials.

The measures proposed are as follows:

- Shredding and handling at the front end of process
- Air separation at the end of the process

The breakdown of incoming wastes is described as follows:

- Source segregated household organics (as placed in the bin by the householder)
- Source segregated commercial organics (as placed in the bin by the commercial customer)
- Garden and parks waste is unloaded at the facility under the supervision of staff, however larger branches that do not go through the shredder are labelled as overs.

5. **Clarify the statement "Consideration will be given to the pre-treatment of leachate on site for the re-circulation or export off-site for disposal at an appropriate treatment facility'. Expand on the explanation of the possible methods being considered.**

There is no specific consideration at this time.
The applicant may consider leachate re-circulation in the future, if so full details would be forwarded to the Agency for approval prior to commencement of works to install required infrastructure.

6. **Provide a map of the existing drainage layout on the site showing the separate drainage of surface water and the foul waters (sanitary effluent and leachate).**

All drainage on site is currently combined in a single system, pumped to a single discharge point at the south east corner of site. A new drawing showing existing drainage on site has been prepared. This drawing is clearly labelled to indicate combined sewers, and the nature of each contributing pipe spur (leachate, surface water, sanitary).

Refer to Drawing No. 2006-289-01-201 Rev A, Attachment A.

7. **Provide a map of the proposed development showing the proposed drainage system, emission points, sampling points and monitoring points.**

Please refer to Drawing No. 2006-289-02-301 Rev A, Attachment A. This is a drawing of the interim drainage layout. Detailed drawings for the proposed 20,000 tpa facility do not exist yet as the design is conceptual at this point.

There is 1 no. emission point on site. The sampling/monitoring point is located at this emission point. It is called SW1. SW1 is shown on Drawing No. 2006-289-01-Figure E.1 Environmental Monitoring Location Map. It is proposed to sample the leachate tank bi-annuallly. The tank has been labelled with a monitoring/sampling point L1.

8. **Provide a map showing the hardstanding areas (indicating the type of hardstanding surface) and also showing the clean and dirty areas on site.**

Please refer to Drawing No. 2006-289-02-201 Rev A, Attachment A.

9. **Submit a copy of your Animal By-Product licence**

A copy of the Animal By-Product licence is included in Attachment B.

10. Submit a copy of the report on the odour impact assessment carried out in May 2005.

A copy of the report on the odour impact assessment carried out in May 2005 is included in Attachment C.

11. Give details of any proposed additional developments at the site since the application was received at the Agency and provide proposed time scale for all developments to be carried out on site.

No development has taken place on site since the application was submitted.

The interim works (leachate holding tank and ancillary infrastructure and green waste area will be constructed during the Summer of 2007. Works are expected to be at substantial completion stage by the end of the Summer.

The conceptual future development of the site as shown on Drawing Number 2006-289-02-104 Rev B (submitted with the waste licence application) is scheduled for full completion of works by the end of 2008.

12. It was noted on the Agency site visit (2/02/07) that there was no leachate storage tank in place on site as indicated in the license application. Please explain this and verify the current disposal route for the leachate.

There is no leachate storage tank on site. The leachate is currently discharged to sewer at the south eastern corner of the site.

It was the intention of WCC to construct a leachate holding tank on site immediately following the waste licence application submission. An invitation to tender was sent to 5 contractors. WCC did not proceed with tender negotiation at that time as only one tender was received.

Notwithstanding the fact that an uncompetitive tender has been received, WCC is in negotiation with the contractor with the intention of early commencement of works.

13. The Agency's site visit on 08/02/07 showed some of the infrastructure detailed and explained in the licence application is not presently on site. Confirm what infrastructure is actually on site and what infrastructure is proposed to be put in place on site, including a schedule and timescales.

Please refer to the drawings in Attachment A.

The 200 Series drawings refer to the actual existing site layout.

The 300 Series drawings refer to the proposed interim site layouts that the Council intends to construct in 2007. This site layout will be an interim solution until the site is expanded to cater for a 20,000 tpa capacity as per Drawing Number 2006-289-01-104 Rev B (Waste Licence Application).

Interim Schedule

The schedule and timescale for the development of the interim layout (leachate tank and ancillary infrastructure and a green waste storage area) is a 4 month programme, with a substantial completion date of end Summer 20007.

Conceptual Future Site Layout

The expansion of the facility to cater for a 20,000 tpa capacity is dependant on a number of factors; compost markets, biological treatment capacity in the Region, the implementation of the 3 bin collection system in the South East Region, financial and technical feasibility. Commercial factors such as gate fees at disposal facilities, landfill tax, capacity at other waste treatment facilities in the region etc will determine feasibility.

The conceptual future site layout is proposed for completion by end 2008. No detailed timeframe is available as yet but it is intended to commence the extension plans for the facility in 2008.

WCC will keep the Agency fully informed of any progression of the development in terms of schedule and timescale. As stated in the application, WCC is seeking a waste licence for the existing site with approval in principle to extend the capacity of the facility to 20,000 tpa. Proposed operational details will be forwarded to the Agency with the Specified Engineering Works (SEW) Report for approval to commence construction.

14. Complete section L.1'Section 40(4) WMA' of the application.

Section L has been re-written. This is included in Attachment D of this response.

4. REVISED NON-TECHNICAL SUMMARY

This is a revision of the non-technical summary submitted as part of the waste licence application. It reflects the information that has been supplied in compliance with the Article 14 Notice, insofar as that information impinged on the original non-technical summary. Few revisions were made, they are listed by bullet point here:

- Section (c)
- Section (i) directly under the heading '**Existing Unit Operations**,' the drawing number has been changed.
- Section (i) directly under the heading '*Static Pile Aeration*,' the drawing number has been changed.
- Section (k) Emissions to Surface Water, changes to clarify existing, interim and proposed leachate infrastructure.
- Section (m), the monitoring drawing has been revised.
- Section (o), clarification of leachate management

The full text of the revised non-technical summary is as follows: All references to Attachments or appendices are relevant to the waste licence application. In the case that a new drawing reference has been inserted into this revised non-technical summary, it is clearly stated that the new drawing is to be found attached to this Article 14 response.

This Non-Technical Summary has been prepared in accordance with Article 12(1) (u) of the Waste Management (Licensing) Regulations S.I. 395 of 2004. Sub-articles (a) to (t) of Article 12 are addressed below.

For clarity, the paragraph numbering is in accordance with the numbering of Article 12(1), (a) to (t).

(a) General Details

Waterford City Council,
Planning, Culture and HR,
Wallace House,
Maritana Gate,
Canada Street,
Waterford City

Tel: 051 309900
Fax: 051 849701

(b) Planning Authority

The development is at a site in the functional area of Waterford County Council.

Planning, Culture and HR,
Wallace House,
Maritana Gate,
Canada Street,
Waterford City.

(c) Sanitary Authority

Domestic sewage, storm water and leachate is currently discharged to sewer. It is proposed to divert leachate from the sewer in 2007. It will be collected in a holding tank and tankered off-site to an appropriate facility.

The sanitary authority is Waterford City Council, Water Services, Maritana Gate Canada St., Waterford.

(d) Location

The facility is located in the townland of Ballybeg, Waterford, Co. Waterford. The address is Waterford City Council Composting Facility, Green Road, Waterford. The National Grid reference for the site is:

E 2582 N 1096

The site location is shown on 2006-289-01-Figure B.2.1 Rev A, see Attachment B.2.

(e) Nature of the Development

This waste licence application is being made on behalf of Waterford City Council in respect of Waterford City Composting Facility, Green Road, an existing facility. It is located approximately 5 km from Waterford City. The site location is shown on 2006-289-01-Figure B.2.1 Rev A, see Attachment B.2.

The facility entrance is on Green Road which is accessed from the new Link Road or the N25 Waterford to Cork Road. This road is a cul-de-sac and is used only by vehicles accessing the Composting Facility and the adjacent Waste Transfer Station. The site is industrially zoned and is adjacent to an industrial estate, Six Cross Roads Business Park.

The facility accepts separately collected organic waste from the household and commercial sectors and green waste from householders, landscapers and the Parks Department of the City and County Councils. The waste material is digested to produce a high quality compost product that is sold as a soil improver. The facility operates near full capacity, processing 9,000 tpa. The application seeks a waste licence for the existing operations with approval in principal to extend the capacity of the facility to 20,000 tpa.

The existing process is summarised as follows:

- Waste reception (organic and green waste)
- Shredding of green waste
- Tipping and mixing
- Digestion in 20. no digestor units
- Maturation on Aerated Static Piles (ASPs)
- Screening of compost
- Storage of compost

It is anticipated that the proposed process will follow the same principles of composting. It is planned to construct a composting building incorporating in-tunnel aerobic digestion, maturation on ASP pads and screening. See Attachment D.2 for details of facility operation.

(f) Classes of Activity

The classes of activity applied for are as set out in the Third and Fourth Schedules of the Waste Management Acts 1996 to 2005:

Third Schedule – Waste Disposal Activities

Class 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).

Class 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.

Fourth Schedule – Waste Recovery Activities

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

Class 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.

The principal activity proposed is Class 2 of the Fourth Schedule as given above. For a brief technical description of each of the activities specified, see Attachment B.7.

(g) Quantity and Nature of Waste

The proposed extension to the existing operations will increase the annual tonnage for recovery from 9,000 tpa to 20,000 tpa. The proposed quantities are shown in Table A.1 in tonnes per annum (tpa).

Table A.1: Quantity and Nature of Waste

Waste Type	Existing Throughput (tonnes/annum)	Proposed Throughput (tonnes/annum)	EWC Code
Household organic waste Commercial organic waste	6,750	15,000	20 01 08 20 01 25
Green Waste	2,250	5,000	20 02 01
Total	**9,000**	**20,000**	

See Attachment H.1 for further details on the quantity and nature of waste.

(h) Raw Materials

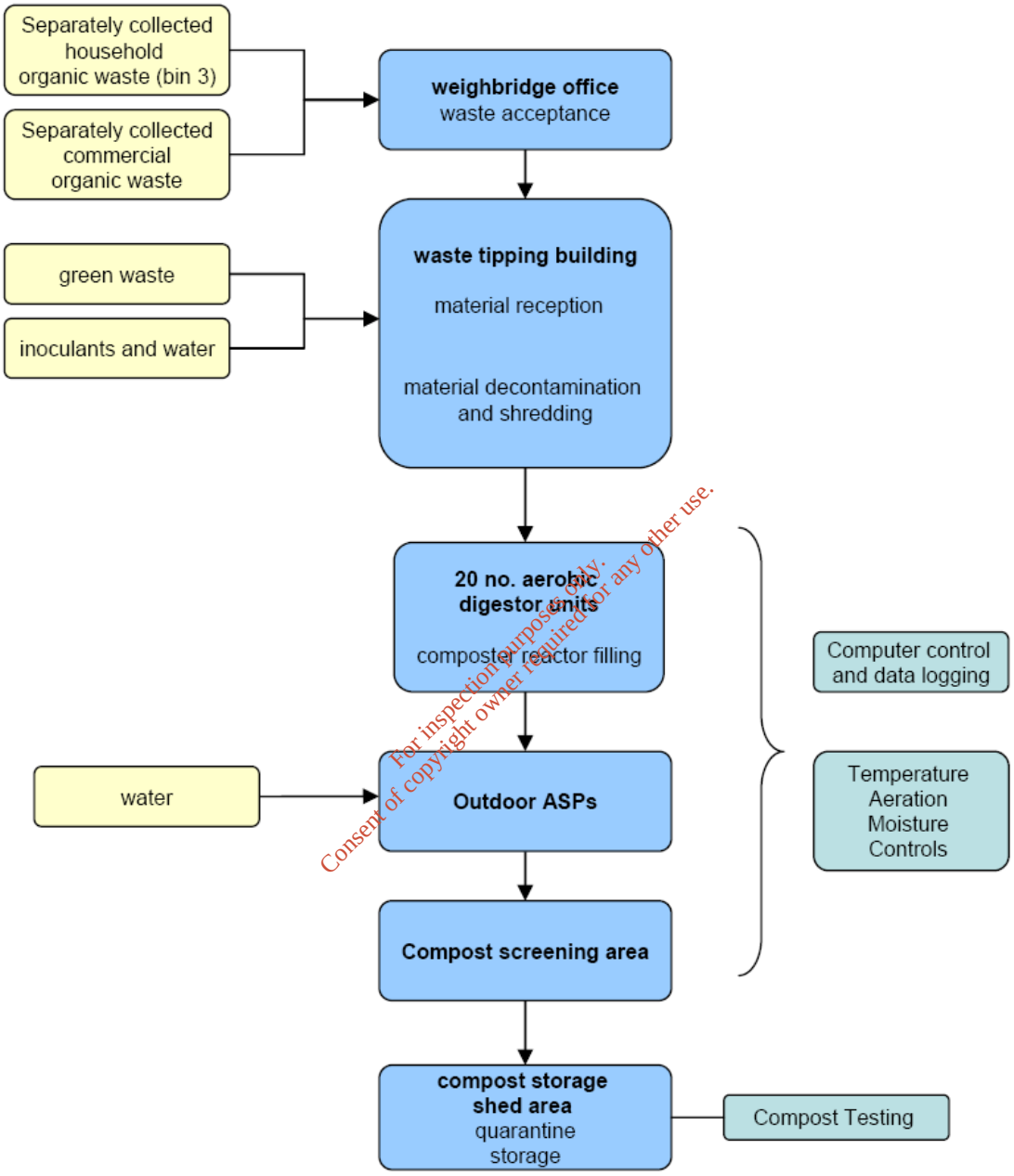
Table A.2 lists the quantities of raw materials and energy utilised at the existing facility.

Table A.2: Raw Material Consumption per Annum – Composting Facility

Resource		Quantities
Diesel Oil		14 m^3
Lubricant Oil		0.15 m^3
Coolant/Antifreeze		0.15 m^3
Electricity		600 kW
Water		21,250 m^3
Urea		2,000 kg
Cleaning Chemicals		0.20 m^3
Insect repellent	Fendona	0.15 m^3
Rat bait	Klerat or Contrac	50 kg

(i) Plant, Processes and Operating Procedures

Figure A.1: Unit Processes at Kilbarry Composting Facility



Existing Unit Operations

Drawing Number 2006-289-01-201 Rev A, Attachment A of this Article 14 response shows a plan of the site that indicates all existing activities, buildings and facilities. A flow diagram of the process is included as Figure A.1.

The existing Unit Operations at the facility are listed as follows:

- Waste Acceptance
- Material Reception
- Material Decontamination and Shredding
- Mixing with Amendment Material
- Loading into Compost Reactor Vessels
- Outdoor Static Pile Aeration
- Screening and Storage
- Compost Sampling

Waste Acceptance and Material Reception and Decontamination

Waste is accepted at the facility in accordance with the Waste Acceptance Procedures, see Attachment H.2. Waste is delivered to Waterford Composting Facility as green waste and organic waste.

Householders, landscaping contractors and the City and County Council Parks Departments use the facility to drop off green waste and collect compost.

Separately collected organic waste is accepted from the City Council and County Council collections. A private contractor delivers commercial source separated organics to the facility. Following tipping, all waste is visually checked for contamination. Large objects are manually removed. The protocol for the facility is for the enclosure of the wet organics within the composting digesters within 24 hours of arrival to avoid vermin, odour and leachate issues.

Material is transferred from the tipping floor into the mixer using a low loader. It is tipped directly into the mixer. Amendment material (shredded green waste) is added to the mixer between loads of organic material.

Mixing

An auger mixer is used to shred and blend materials for composting. During the shredding process, additional bulking materials, inoculants and water are added to ensure that the subsequent biomass will effectively heat when air is introduced.

At the end of the blending process, the moisture of the blend is checked and if necessary water is added. This process is a vital stage in the process as it allows the material to be adjusted for moisture, nutrient ratio, microbial activity and porosity to ensure effective subsequent heating and optimal composting. This process is also an odour prevention technique as correctly blended material will be less likely to become anaerobic and odorous.

Loading into Compost Reactors

There are 20 no. in-vessel digestor units. The blended "pre-compost" is transferred to the in-vessel digestors by a conveyor attached directly to the auger mixer. The conveyor helps break up any clumps of material and forms a homogenous well-structured compost pile within the container.

The Compost Reactor

The in-vessel composting system:

- is a closed composting reactor, which cannot be by-passed, i.e. it is a completely sealed
- has installations for monitoring temperature against time
- has an adequate safety system to prevent against insufficient heating

The containerised system at Waterford City Composting Facility utilises 30 cubic meter roll-off compatible containers as composting vessels. The vessels contain a false perforated floor which allows air to be introduced into the bottom of the vessels. This also allows any liquids to be collected under the false floor without interfering with the aeration system. The bottom floor of the vessel is graded to a drain away from the door. A valve is opened daily to allow leachate to drain out for collection.

Forced air allows aerobic conditions to prevail, which encourages the growth of thermophyllic microbes.

The process control system consists of the following components:

- industrial programmable logic controller (PLC)
- variable frequency drives for the blowers
- pressure, air flow and/or oxygen sensors
- personal computer with printer, ups and modem
- windows operating system software
- process control software
- pile logistics software

Static Pile Aeration

The Aerated Static Pile (ASP) Modules are the second composting barrier. They are located as shown on Drawing Number 2006-289-01-201 Rev A, see Attachment A of this Article 14 response.

This second phase of composting occurs within four outdoor ASP bunkers with three pile turns over a 7-8 week period.
The ASP process has been adopted for the second composting barrier as the method to inhibit the re-growth of pathogens (typically facultative anaerobic bacteria) under aerobic conditions.

The facility currently operates by combining the contents of six containers into one primary pile. Piles are turned regularly. Polyethylene pipes are buried in a concrete slab with upright pipes that are level with the curing pad floor. Air is drawn downward through the curing pile and exhausted through a separate bio-filter. This negative aeration process maintains the aerobic conditions needed for effective curing while further reducing the potential for odour. The material is typically maintained on the aerated pavement for six to eight weeks prior to screening.

Screening and Storage

After 9-10 weeks in the process, when the materials are cured, they can be moved to the storage area for screening.

A trommel screen is used for this process.

Oversized un-decomposed materials or inert contaminants fall out of the lower end of the rotating cylinder into a pile. Depending of the level of contamination, this larger fraction can be disposed of to an appropriate facility if it is highly contaminated. If contamination is low, the oversized materials, mostly un-decomposted wood chip are reused in new batches of compost as an innoculant and structural material to add porosity.

Once the compost is screened, it is stored for a minimum of 21 days while pathogen tests are carried out. Following testing it is stored on site until it is sold or used by Waterford City Council.

Compost Sampling

Currently compost sampling is carried out to provide documentary evidence of the pathogen reduction efficiency of the in-vessel/ASP 'twin barrier' technology for the Animal By-Products (ABP) application.

When operating at full capacity and filling two digesters per day, 10 digesters are filled per week and consequently 10 digesters are emptied per week. These 10 digesters fill two zones on the curing pad. After 2 no. weeks, these two zones are turned and allowed to mature for another 2 no. weeks. At the end of the eight week curing stage, there are 10 digesters of material ready for screening. As each digester holds approximately 18 tonnes of material, a batch represents approximately 180 tonnes of raw bio-waste. It has been observed that the bio-waste looses approximately 50% of its weight during the in-vessel and curing processes, giving approximately 90 tonnes of material before screening.

Typically screened material will give a 50/50 return of finished compost to oversized material that will be retained by the screen, giving between 40 and 50 tonnes of finished compost for ten initial digesters of bio-waste. Therefore each week a batch is screened to produce 40 – 50 tonnes of compost.

The finished compost is kept quarantined from any existing compost in the storage building until analysis results are received from the testing laboratory. This process normally takes two to three weeks. During this time, the material is agitated weekly to ensure any residual microbial activity has adequate oxygen to finish its life cycle.

When sampling, three sub-samples of approximately 5kgs each are taken from three different locations in the pile and are combined to make one sample of 15 kgs which is required by the testing laboratory. The samples are taken using a dedicated stainless steel shovel and placed into a clean black sack. It is then placed into a cooler box with cooling blocks and couriered to the testing laboratory overnight. The sampling shovel is disinfected between sampling events and all reasonable precautions are taken to avoid cross contamination.

Analysis of compost is carried out for the following parameters:

- Salmonella Sp: absence in 25g
- E. Coli <1,000 c.f.u/g
- Maturity tests
- Self Heating C
- pH
- Ammonia mg/l
- Nitrate mg/l
- Heavy Metals
- H_20 %
- Contamination (plastics, metals etc.)

These are based on Department of Agriculture recommendations.

Proposed Operations

It is proposed to extend the facility to increase the throughput capacity to 20,000 tpa. Proposed operational details will be forwarded to the Agency with the Specified Engineering Works (SEW) Report for approval to commence construction.

The existing facility with 20 no. digestor units does not have the capacity to treat the quantities of bio-waste that are predicted to be generated in the future, following the implementation of a 3-bin collection system across the South East Region to achieve the targets (diversion of bio-waste from landfill) set out in the National Strategy on Biodegradable Waste.

For this reason it is proposed to make some adjustments to the existing process. The proposed extension plan for the facility involves the installation of in-vessel tunnels and a composting building. This proposed layout is shown on Drawing Number 2006-289-01-104 Rev B, see Appendix 1.

The tunnel in-vessel systems can be large immobile containers or fixed concrete “tunnels.” They will be loaded and unloaded by a front-end loader. Waste material will be moved from the tipping hall (following mixing in the auger) into a tunnel reactor and emptied out into the composting building onto an aerated slab. 2 no. dedicated front-end

loaders will be used for loading and unloading, one dedicated to the tipping hall area (and raw waste), the other to the composting building (1st phase digested waste). The tunnels will be sized to accommodate the daily volume of materials to be processed by the facility. The tunnel system comes with a sophisticated process control system using both temperature and oxygen feedback systems to control aeration within the tunnels.

The mobile compost reactors will be retained on site for additional capacity at peak times.

The compost building will contain indoor ASP pads working on the same principal as above. Following the indoor stage, the material will be transferred to the existing outdoor pads for completion of the composting process. The material will be transferred into the compost building for screening before being placed in the compost storage shed. It is proposed to install an air extraction system in the composting building to mitigate potential odour, dust and noise impacts that may arise due to the intensification of activities on site.

Monitoring of the compost will be carried out in accordance the Waste Licence.

(j) Regarding Paragraphs (a) to (g) of Section 40 (4) of the Waste Management Act

The information contained within the waste licence application form and its attachments shows that the facility meets the above requirements of this Act.

(k) Emissions from the Site

Attachment E contains further details of emissions from the site. The following emissions are discussed in brief:

- Air
  - Dust
  - Odour
- Surface Water
- Sewer Discharge
- Groundwater
- Noise
- Environmental Nuisance

Emissions to Air

Dust Emissions

There is potential for dust emissions from the composting process at the existing facility. Mitigation measures are employed from the following processes:

- Tipping
- Mixing
- Shredding
- Turning
- Screening and general site operations

Tipping, sorting and mixing take place within the material reception building. Material on the ASP pads is turned only during favourable wind conditions. The material is sprayed during turning to add necessary moisture, but which also acts to prevent dust generation from the pile.

Shredding and screening takes place within the confines of the compost storage shed and are carried out during favourable wind conditions.

Dust due to road traffic is not a significant impact; road wetting is used to mitigate windblown dust due to traffic in very dry weather conditions. There is a wheel wash at the exit of the material reception building. All roads are hardstanding. Dust monitoring is carried out to record dust levels at three locations on site. The material reception building is washed down at the end of daily operations. General housekeeping practices ensure any waste spills are cleaned up immediately.

It is proposed to construct a composting building on site and to move the digestion phase and curing phase indoors. The composting building and material reception building will be fitted with an air extraction system. Screening will take place within the building. Air will be drawn from the tunnels and building through biofilters to remove dust from exhaust air.

Operating under a negative pressure within an enclosed environment will mitigate potential impacts from dust and will facilitate turning of the material on the ASP pads and screening regardless of wind conditions.

Odour Emissions

There are potential odour impacts from the composting process. The impacts could potentially arise from material acceptance, mixing, turning, screening and digestion.

Mitigation measures in place include the provision of 4 no. odour control units; 2 no. in the material reception building, 1 no. in the marshalling yard and 1 no. above the digestor pads.

Material reception and mixing takes place within the material reception building. In the past odour impacts arose due to a wind tunnel effect through the 2 operational doors.

The odour control units were installed. There have been no odour complaints since the units were installed. It is proposed to keep the second door shut.

Raw organic waste is delivered and tipped onto the floor of the material reception building. The aim of the process is to move that material as soon as possible into digestor units. The material reception building is cleaned at the end of the day's operation, floors, walls and machinery.

The digestion phase is a fully sealed system.

Turning of material on the ASP pads is carried out in favourable wind conditions to mitigate potential odour generation. The material is moistened on turning.

It is proposed to construct a composting building and in-tunnel digestors.

Material reception, mixing, digestion, turning and screening will take place within an enclosed building with negative air extraction. The exhaust air will be filtered to remove dust and odour particles. Details of the proposed system will be forwarded to the EPA as a SEW for approval.

Emissions to Surface Water

The activities and processes to be conducted or that are likely to occur, at the site that could potentially impact upon surface water are as follows:

- generation of surface water run-off from hardstanding areas and roofs
- generation of leachate on site
- storage of hydrocarbons on site
- generation of sewage from canteen and hygiene facilities

The measures proposed include avoidance, reduction and mitigation and include:

All surface water run-off from hardstanding areas and roofs will be collected and directed to sewer.

Hydrocarbons are not stored on site currently but it is proposed to install fuel tanks within a fully enclosed bunded area in the near future. The fuel will be used to re-fuel site machinery.

Leachate generation will be kept to a minimum, all waste handling activities; unloading, storage and processing are carried out under cover so rainfall does not result in leachate generation. The only activity that is carried out outdoors which generates leachate is the maturation pads (ASPs). This area is kerbed off to contain leachate within that zone. Woodchip is spread on the floor prior to tipping of commercial bio-waste to soak up excess leachate. The material reception building floor is cleaned at the end of each day and all washdown is collected as leachate. All sewage generated on site will be directed to sewer.

Interim Period

In the interim period it is proposed to construct a leachate holding tank and ancillary infrastructure and to collect and direct all leachate to it for tankering off site to an appropriate facility. Leachate will be collected and handled separately to surface water and sewerage.

Conceptual Future Operations

It is proposed to store hydrocarbons on site. These present a risk to surface water quality, however with storage and handling precautions, the risk to surface water quality is negligible.

It is not expected that the surface water management system will be altered due to the proposed changes to the process and facility. Clean surface water will be collected from roofs and directed to sewer. Storm water will be collected from the marshalling yard and directed to sewer. Leachate will be collected from the material reception building, tunnels and composting building and stored on site for reuse in tunnels or/and for tankering to an appropriate treatment facility. Consideration will be given to the pre-treatment of leachate on site for the re-circulation or export off-site for disposal at an appropriate treatment facility.

Emissions to Sewer

Stormwater, clean surface water, leachate and sewerage are discharged from the site to sewer.

Following interim works in the Summer 2007, leachate will no longer be discharged to sewer. It will be collected on site and tankered off-site to an appropriate facility.

Groundwater

There are no emissions to groundwater.

Noise

Noise monitoring was carried out in January 2006. The following is a brief conclusion of the sampling and interpretation.

Night time noise levels were slightly elevated on the eastern site boundary, due to a faulty composting vessel on-site and at the noise location south east of the site. The noise was due to traffic near the monitoring point. No noise was audible to the sampling personnel, from the facility at the point.

Although the daytime noise levels determined at N1 (southern site boundary) were slightly elevated due to operational noise at the composting facility, it is unlikely that the noise levels recorded at the site would give rise to nuisance at noise sensitive locations in the area or the adjacent facilities. The noise levels recorded at the noise sensitive

location exceeded levels recorded at the site during both daytime and night time monitoring and were not influenced by activities at the compost site.

The composting process does have the potential to generate noise from the following sources:

The composting process is a 24 hour operation. During night-time hours (22.00-08.00) (in the normal operational phase), digestion is the only activity carried out, therefore the potential noise impact are the blowers.

Since December 2005, some operations have been carried out at night (screening and turning piles). These hours are 4.30pm to 11.00pm, as required, from Monday to Friday. It is expected that once the facility is extended to incorporate indoor composting operations, odours will be significantly reduced and will result in less need for night time operations. The increased number of buildings on the site will also act to absorb sound.

During day-time hours the noise sources associated with the operation of the facility include:

- deliveries of material to the site for treatment
- shredding of green waste
- loading of waste within the reception hall
- transfer of waste material via the mixer to a digestor unit
- movement of digestors on site
- aeration system
- unloading of digestors to ASPs
- turning of material on ASPs
- screening of compost
- collection of final product from the site

The operating hours are such that the majority of activities that have the potential to cause noise are carried out within day time hours.

Noise from engines (of delivery trucks, low loaders, turners, shredder and screener) and reversing siren noise are the most significant potential impacts.

Noise monitoring did not record any significant noise levels from plant machinery. This plant machinery operates within a cordon of buildings to the south, east and west. They help mitigate potential noise impacts.

The digester units (20 no.) at this site operate on a 24-hour basis. The compost process requires air to be drawn through the digester. The air fans that move the air are a potential noise source. No elevated noise levels were recorded from the blowers. Regular inspection and maintenance of the blowers is carried out to ensure good working order. Noise monitoring is carried out to check such noise sources. As part of the waste licence, noise monitoring will be carried out on a more regular basis.

Proposed Operations

It is proposed to extend the facility. The proposed potential impacts from this are the construction phase noise and intensification of existing activities.

During the construction phase there may be short-term, temporary noise level increases. To mitigate the impacts of construction noise the site will implement normal construction management practices to manage noise. Working hours will be limited to daytime during weekdays and Saturdays. All night-time, Sunday, and Bank Holiday working will be avoided, except in emergency situations.

During the proposed operational phase, noise levels will consist of static equipment related noise, truck noise and mobile plant related noise. The noise associated with the increased heavy goods vehicles and traffic associated with the site will be imperceptible in the context of the exiting traffic levels on the road. The increase in traffic will be minor and will not contribute significantly to traffic noise. The majority of site activities will take place indoors for the proposed operation. The building will mitigate operational noise. All site machinery will be procured with regard to noise impacts.

Noise monitoring will be carried out in accordance with the waste licence requirements and levels recorded will be required to meet the waste licence limit requirements at the noise monitoring locations. In the event that noise levels are exceeded, an explanation will be put forward with mitigation measures.

Environmental Nuisance

Controls have been put in place for the following nuisances:

Vermin Control

As a precautionary measure, there is pest control on site. The site is inspected monthly and a number of bait points have been set up internal and external to the facility. There is a 1-2 working day follow up upon discovery of infestation until two clear site visits have been recorded.

Flying Insect Control

All internal walls from a height of 2 m to ceiling height are sprayed with Fendona or Qquapy with a motorised blower 6 times per annum.

Birds

Birds are not a nuisance at the facility but precautions are taken to prevent it. Raw material is received indoors; the nature of the material on the ASPs is not attractive to birds.

In addition, all vehicles entering the site with bio-waste are either fully enclosed RCVs or are completely covered. This minimises the potential for birds scavenging on site.

Litter

Litter is not a problem at the site due to the nature of the waste delivered to the site and the fact that it arrives in enclosed or covered refuse collection vehicles. In addition unloading and mixing of incoming raw waste is carried out within the material reception building.

As a precaution, regular litter patrols of the site perimeter and access road will be undertaken.

Fire Control

In general, fires are prevented by operating best practice including:

- Inspection of loads at the weighbridge
- Control of loads to ensure no burning or smouldering loads enter the facility
- Designation of smoking/non smoking areas
- Security
- Staff training in fire prevention and control
- The provision for fire extinguishers and fire hydrants at key locations throughout the site which are checked regularly
- Sufficient clearing to allow the fire brigade clean access to all buildings, site infrastructure and areas of the site

Traffic in the Existing Environment

Traffic is not an issue at the site.

The Green Road services only one other facility, the adjacent WTS. It has significantly higher volumes of traffic than the compost facility.

There is potential for spoiling of the road by waste. The likelihood of this occurring is extremely low as all commercial vehicles delivering waste to the facility are fully enclosed or covered.

Only approved vehicles are permitted to enter the compost facility.

At a maximum capacity of 20,000 tpa, the traffic movements will be approximately 10% of the traffic volume on Green Road. Veolia Environmental Ltd. has a waste licence (Register Number W0177-03) for the operation of the adjacent WTS. The licence permits the processing of 80,000 tpa. The majority of traffic on the road (90%) will be bound for the WTS. The impact of traffic from the compost facility will be negligible.

Road Cleansing

The entire site is hardstanding including the internal floors of the buildings. Vehicles arrive at the facility via the public network. All delivery vehicles wheels are power washed before exiting the materials reception hall. Road cleaning control measures are not required at this facility. Internal road sweeping are employed as part of general housekeeping measures as required.

(l) Effects of Emissions

The effects of the any emissions from the development are discussed in Attachment E of this document. The facility has been designed to minimise the emission of pollutants and operational procedures will be implemented to reinforce these design features.

(m) Monitoring and Sampling Points

A complete and comprehensive regime of regular environmental monitoring will be carried out at the site in accordance with the requirements of the waste licence.

The monitoring locations map is shown as Figure E.1 Rev B, Attachment A of this Article 14 response.

All monitoring shall be carried out according to established procedures, approved by the Agency.

Annual reports containing details of environmental monitoring will be prepared and presented to the Agency.

(n) Arrangements for Waste Arising from Activity

The composting process is a recovery process. 9,000 tpa of separately collected organic waste and green waste is recovered as approximately 2,600 tpa of compost that is sold as a soil improver. The majority of the mass of material is lost as moisture. Approximately 2,500 tpa of oversized items is generated by the process. These include items that aren't degraded by the process, plastics, metals etc. overs are transported off-site for disposal at an appropriate facility.

The operators are currently investigating technology that will further screen and sort overs to reduce the quantity of waste from the process for disposal to less than 10% of incoming material.

It is anticipated that 5,000 tpa of overs could be generated once the facility is extended. However, new technology combined with standards for landfill cover will reduce the quantities going for disposal to less than 10%.

(o) Arrangements for Off-Site Treatment or Disposal of Wastes

A volume of overs will be generated at the facility which cannot be recovered. These will be stored suitably on site and transported off site disposal at an appropriate facility, or for re-use if possible.

It is proposed to collect leachate on site and store it in a leachate storage tank for tankering off site to an appropriate treatment facility. Sewage from the canteen and hygiene facilities will continue to be directed to sewer.

(p) Unauthorised or Unexpected Emissions

Staff will be present on site at all times during opening hours to supervise and carry out operations and to deal with any emergencies. Key staff will be on-call to respond to any emergency situation outside of normal working hours e.g. night-time and Sundays.

(q) Closure and Restoration

It is anticipated that the plant will be operated indefinitely. However if the facility should close for some unforeseen reason all waste and all equipment will be removed from the facility. Waste would be removed to authorised facilities. Equipment would be recycled where possible. The building where waste activities are proposed would remain and would likely be used again.

(r) - (t) Landfilling of Waste or Dangerous Substances or Emissions to Aquifer

These paragraphs are not relevant to the composting facility or the proposed extension.

(u) Non-Technical Summary

Refer to the information provided above that has been reported in accordance with paragraphs (a) to (t) of Article 12 (1) of the Waste Management (Licensing) Regulations, S.I. 395 of 2004, see Attachment A.1.

Attachment A

2006-289-01-201 Rev A Article 14 Existing Site Layout

2006-289-01-202 Rev A Article 14 Existing Drainage Layout

2006-289-01-301 Rev A Article 14 Proposed Interim Site Layout

2006-289-01-302 Rev A Article 14 Proposed Interim Drainage Layout

2006-289-01-Figure 1 Article 14 Receptors

2006-289-01- Figure E.1 Rev B Environmental Monitoring Locations

Hyperlinks to drawings

LEGEND:

- Concrete - Dirty
- Concrete - Clean
- Bitumen - Clean

Southend United
Football Ground

Curing Bay Area 1

Curing Bay Area 2

Curing Bay Area 3

Curing Bay Area 4

Top Of Bank

Bottom Of Bank

Site Entrance

Weighbridge

Weighbridge Office

Portakabin

Proposed Wheelwash

Portacabin

Control Room

Toilet Building

Digestar

Raised Pearl Bed

Digestar Pad

Waste Reception Building

Tipping Floor

Marshalling Area

Greenwaste Storage Area

Quarantine Area

Compost Screening Area

Compost Storage Area

2.5m High Palisade Fence

Veolia Premises

Veolia Building

Industrial Units

0m 5m 10m 15m 20m 25m 30m 35m 40m 45m 50m

Scale 1:500

ORIGINAL DRAWING SIZE A1 - (841 x 594)

10 0 10 20 50 100mm NATURAL SCALE

Rev.	Drawn	Chk'd	Appr'd	Date	Description
A	GMK	TR	PK	17.04.07	ISSUE FOR APPROVAL
				Rev Origin	Cork
Revision History					A

Name of Client

WATERFORD CITY COUNCIL

Name of Job

KILBARRY COMPOSTING FACILITY
WASTE LICENCE APPLICATION

Title of Drawing

ARTICLE 14
EXISTING SITE LAYOUT

Scales Used
A1 - 1:500, A3 1:1000

Dwg. No. 2006-289-01-201
O:\ACAD\2006\289\01\wcc-wla_201

Rev. A

FEHILY TIMONEY & COMPANY
CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES
Core House, Pouladuff Rd, Cork, Ireland.
T:+353-21-4964133, F:+353-21-4964464
Mill House, Ashtown Gate, Navan Rd, Dublin 15, Ireland.
T:+353-1-6583500, F:+353-1-6583501
W: www.fehilytimoney.ie, E: info@ftco.ie

Legend:

- SS — Existing Surface Water Sewer
- LS — Existing Leachate Sewer
- FS — Existing Foul Sewer
- Existing Combined Sewer
- Existing Gully

CURING PAD 1
CURING PAD 2
CURING PAD 3
CURING PAD 4
WEIGHBRIDGE
OFFICE
CANTEEN & WC
Pump Chamber
Pumping Station
SHOWER BLOCK
CONTROL ROOM
DIGESTING UNITS
CONCRETE DIGESTER SLAB
BIOFILTER
BIOFILTER
WASTE RECEPTION BUILDING
COMPOST SCREENING AREA
COMPOST STORAGE AREA
GATE
2.5m HIGH PALLISADE FENCE
100mm ø gravity discharge to main sewer.
90mm ø Pumped Main
225mm ø Gravity
150mm ø Gravity
100mm ø Gravity
Scale 1:500

Rev.	Drawn	Chk'd	Appr'd	Date	Description
A	GMK	TR	PK	Cork 17.04.07	ISSUE FOR APPOVAL

Revision History: A

Name of Client

WATERFORD CITY COUNCIL

Name of Job

KILBARRY COMPOSTING FACILITY
WASTE LICENCE APPLICATION

Title of Drawing

ARTICLE 14 : EXISTING
DRAINAGE LAYOUT

Scales Used
A1-1:500, A3-1:1000

Dwg. No. 2006-289-01-202
O:\ACAD\2006\289\01\wcc-cpcw_202

Rev. A

FEHILY TIMONEY & COMPANY
CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES
Core House, Pouladuff Rd, Cork, Ireland.
T:+353-21-4964133, F:+353-21-4964464
Mill House, Ashtown Gate, Navan Rd, Dublin 15, Ireland.
T:+353-1-6583500, F:+353-1-6583501
W: www.fehilytimoney.ie, E: info@ftco.ie

ORIGINAL DRAWING SIZE A1 - (841 x 594)
NATURAL SCALE

LEGEND:

- Concrete - Dirty
- Concrete - Clean
- Bitumen - Clean

Southend United
Football Ground

Curing Bay Area 1

Curing Bay Area 2

Curing Bay Area 3

Curing Bay Area 4

Proposed Leachate
Holding Tank

Proposed Concrete
Pavement

Top Of Bank

Bottom Of Bank

Site Entrance

Weighbridge

Weighbridge Office

Portacabin

Proposed
Wheelwash

Portacabin

Control Room

Toilet Building

Digestor

Raised Peat Bed

Digestar Pad

Waste Reception
Building

Tipping Floor

Marshalling
Area

Greenwaste
Storage Area

Quarantine
Area

Proposed Bitumen Pavement

Proposed Compost
Building Extension

Compost Screening
Area

Compost Storage
Area

2.5m High
Palisade Fence

Industrial Units

Veolia Premises

Veolia Building

0m 5m 10m 15m 20m 25m 30m 35m 40m 45m 50m

Scale 1:500

Rev.	Drawn	Chk'd	Appr'd	Date	Description
A	GMK	TR	PK	Cork 17.04.07	ISSUE FOR APPROVAL

Revision History: A

Name of Client

WATERFORD CITY COUNCIL

Name of Job

KILBARRY COMPOSTING FACILITY
WASTE LICENCE APPLICATION

Title of Drawing

ARTICLE 14
PROPOSED INTERIM SITE LAYOUT

Scales Used
A1 - 1:500, A3 1:1000

Dwg. No.	Rev.
2006-289-01-301	A

O:\ACAD\2006\289\01\wcc-wla_301

FEHILY TIMONEY & COMPANY
CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES
Core House, Pouladuff Rd, Cork, Ireland.
T:+353-21-4964133, F:+353-21-4964464
Mill House, Ashtown Gate, Navan Rd, Dublin 15, Ireland.
T:+353-1-6583500, F:+353-1-6583501
W: www.fehilytimoney.ie, E: info@ftco.ie

ORIGINAL DRAWING SIZE A1 - (841 x 594)

NATURAL SCALE 10 0 10 20 50 100mm

LEGEND:

- LS — Leachate Gravity Sewer
- LM — Leachate Pumped Main
- SS — Foul & Surface Water Gravity Sewer
- S — Foul & Surface Water Pumped Main
- FS — Foul (Sanitary)
- Access Chamber
- Pump Chamber
- L1 — Leachate Monitoring Point
- EP1 — Emission Point
- S1 — Sampling Point
- L.G — Leachate Gully - Proposed
- S.G — Surface Water Gully - Proposed
- Surface Water Gully - Existing

Pump Chamber
Pump Chamber
Pump Chamber
Double S.G
S.G
L.G
MH 06
MH 05
L1
S1
100mm ø Pumped Main
90mmø Pumped Main
90mmø Pumped Main
Discharge to Foul Sewer
150ø @ 1/150
150ø @ 1/150
225mmø
100mmø
150mmø
Scale 1:500

Rev.	Drawn	Chk'd	Appd	Date	Description
A	GMK	TR	PK	Cork 17.04.07	ISSUE FOR APPROVAL
Revision History	A				

Name of Client

WATERFORD CITY COUNCIL

Name of Job

KILBARRY COMPOSTING FACILITY
WASTE LICENCE APPLICATION

Title of Drawing

ARTICLE 14 : PROPOSED INTERIM DRAINAGE LAYOUT

Scales Used
A1 - 1:500, A3 1:1000

Dwg. No. 2006-289-01-302
O:\ACAD\2006\289-01\wcc-mks_302

Rev. A

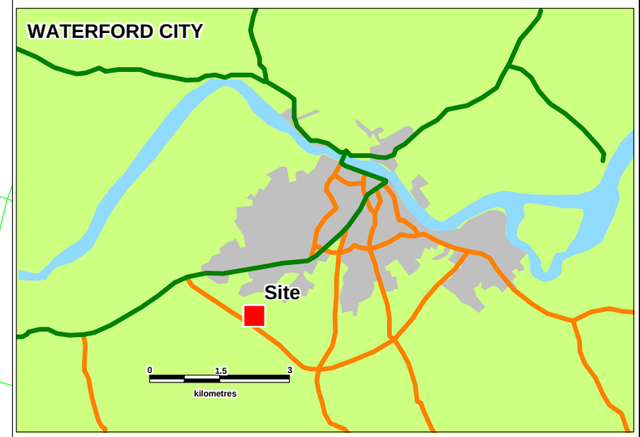
FEHILY TIMONEY & COMPANY
CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES
Core House, Pouladuff Rd, Cork, Ireland.
T:+353-21-4964133, F:+353-21-4964464
Mill House, Ashtown Gate, Navan Rd, Dublin 15, Ireland.
T:+353-1-6583500, F:+353-1-6583501
W: www.fehilytimoney.ie, E: info@ftco.ie

ORIGINAL DRAWING SIZE A1 - (841 x 594)
NATURAL SCALE

NOTES:

R1 Ballybeg Housing Estate
R2 School
R3 Catholic Church
R4 Presbytery
R5 Rugby Club Dressing Rooms
R6 Rugby Club Headquarters
R7 Veolia Ltd. Storage Building
R8 Veolia Ltd. MRF
R9 DHL
R10 Misc. building/commercial company
R11 Misc. building/commercial company
R12 Misc. building/commercial company
R13 Misc. building/commercial company
R14 Commercial Unit
R15 Commercial Unit
R16 Private Residences, Kilbarry Rd

Date of Revision A: 16/04/2007
Saved in R:\Map Production\2006\289\01\Workspace\
WCC-WLA_Figure 1 Rev A

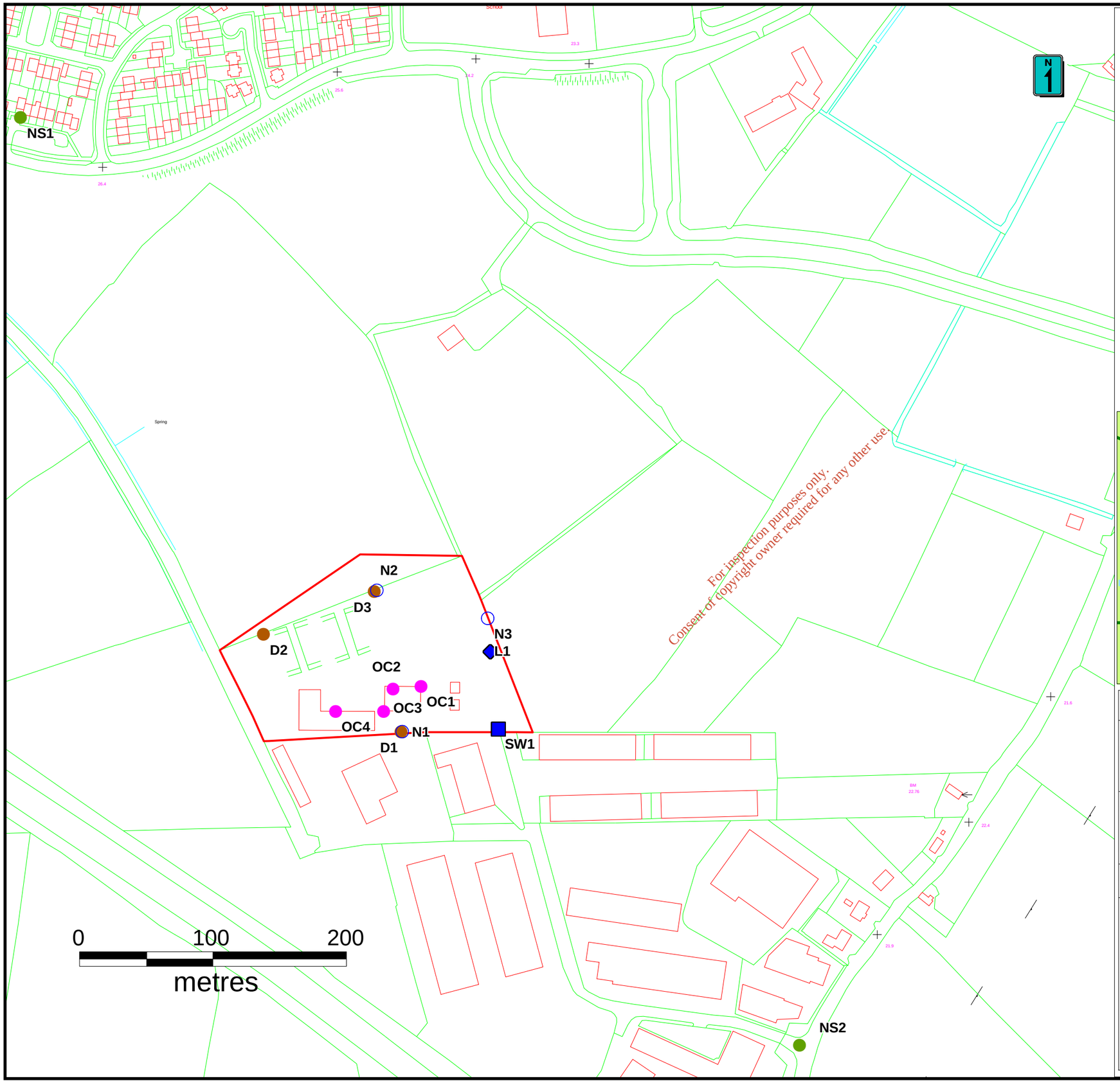


Name of Client	WATERFORD CITY COUNCIL
Name of Job	KILBARRY COMPOSTING FACILITY WASTE LICENCE APPLICATION
Title of Drawing	(ARTICLE 14) RECEPTORS
Dwg. No.	2006-289-01-FIGURE 1
Rev.	A

FEHILY TIMONEY & COMPANY
CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES
Core House, Pouladuff Rd, Cork, Ireland. T:+353-21-4964133, F:+353-21-4964464
Mill House, Ashtown Gate, Navan Rd, Dublin 15, Ireland T:+353-1-6583500, F:+353-1-6583501
W: www.fehilytimoney.ie, E: info@ftco.ie

LEGEND
- Licence Application Boundary
- 250 m Buffer
- 500 m Buffer
- Receptor

0 250 500
metres



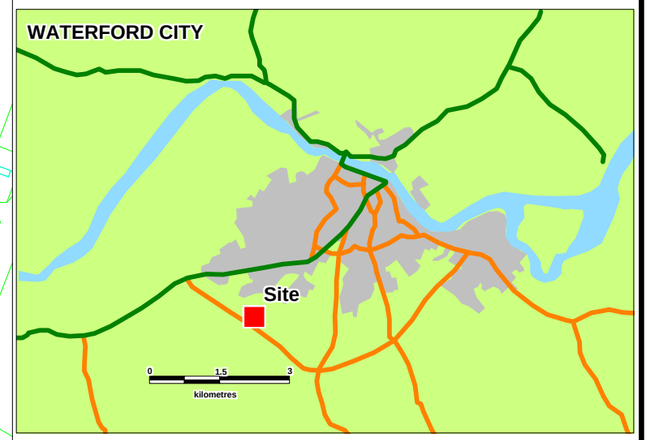
LEGEND

- Existing Dust Monitoring Location (3)
- Existing Noise (Sensitive) Monitoring Location (2)
- Existing Noise Monitoring Location (3)
- Existing Odour Control Unit Location (4)
- Proposed Interim SW Monitoring Location (1)
- Proposed Interim Leachate Monitoring Location (1)

NOTES:

Mapping Reproduced Under Licence from the Ordnance Survey Ireland Licence No. EN 0001206 © Government of Ireland

Date of Revision B: 16/04/2007
Saved in R:\Map Production\2006\289\01\Workspace\ WCC-WLA_Figure E.1 Environmental Monitoring Points



Name of Client	WATERFORD CITY COUNCIL
Name of Job	KILBARRY COMPOSTING FACILITY WASTE LICENCE APPLICATION
Title of Drawing	ENVIRONMENTAL MONITORING LOCATION MAP
Dwg. No.	2006-289-01-FIGURE E.1
Rev.	B

FEHILY TIMONEY & COMPANY
CONSULTANTS IN ENGINEERING & ENVIRONMENTAL SCIENCES
Core House, Pouladuff Rd, Cork, Ireland. T:+353-21-4964133, F:+353-21-4964464
Mill House, Ashtown Gate, Navan Rd, Dublin 15, Ireland T:+353-1-6583500, F:+353-1-6583501
W: www.fehilytimoney.ie, E: info@ftco.ie

Attachment B

Animal By-Product Licence

THE DEPARTMENT OF
AGRICULTURE & FOOD
AN ROINN TALMHAÍOCHTA AGUS BIA

RNP 6-1 (COMP – 5)

Date: 6th December 2006

Mr. Michael Storan,
Veolia Environmental Services,
Six Crossroads Business Park,
Waterford City.

RE: **European Communities (Animal By-Products) Regulations of 2003 – SI 248 of 2003, as amended by SI 707 of 2005 and EC Council Regulation No. 1774/2002**

Dear Mr. Storan

I am directed by the Minister of Agriculture & Food to inform you that your premises has been approved to operate as a Composting Plant from 1st October 2006 in accordance with Regulations 6,6(b) of the European Communities (Animal By-Products) Regulations of 2003 – SI 248 of 2003, as amended by SI 707 of 2005.

The official **approval number** allocated to your premises is **COMP - 5**

Your approval is subject to the following conditions:

1. Catering waste as detailed in Article 6,1,(l) of Regulation (EC) 1774/2002 and defined in Annex I of the same regulation may be accepted at your plant.

2. Manure, digestive tract content separated from the digestive tract, milk and colostrums as detailed in Article 5,2,(e) of Regulation (EC) 1774/2002 may be accepted at your plant

3. No other Animal by-products as defined in Article 2,1,(a) of Regulation (EC) 1774/2002 may be accepted at your plant.

4. Waste-water from your plant must be treated in accordance with other relevant Community legislation.

5.Representative samples of compost for microbiological analysis at a Department of Agriculture and Food approved laboratory must be taken on a monthly basis. (5 samples to be taken as per paragraph 7.2 of attached conditions document)

6. All necessary conditions as outlined in the Department of Agriculture and Food's document "*Conditions for approval and operation of composting and biogas plants treating animal by-products in Ireland*"(Attached)

cont'd/....

Pavillion B, Grattan Business Centre, Dublin Road, Portlaoise,Co Laois
Pailliún B, Ionan Gnó Grattan, Bóthar átha Cliath, Portlaoise, Co Laoise
Fax: 057 8694381
Email: info@agriculture.gov.ie Web: www.agriculture.gov.ie

VAT. Reg. IE4773186 Q

..../cont'd

Please note that failure to comply with these conditions may result in the withdrawal of your approval.

Dated this 6th Day of December 2006.

For the Minister for Agriculture and Food

Geraldine Lanigan

An Officer authorised in that behalf by the said Minister

CONDITIONS FOR APPROVAL AND OPERATION OF COMPOSTING AND BIOGAS PLANTS TREATING ANIMAL BY-PRODUCTS IN IRELAND

1. INTRODUCTION

Regulation (EC) No. 1774/2002 of the European Parliament and of the Council of 3 October 2002 lays down health rules concerning animal by-products not intended for human consumption. This regulation defines animal by-products as *" entire bodies or parts of animals or products of animal origin... not intended for human consumption"*. A distinction is drawn between the measures to be implemented in the use and disposal of the material concerned, depending on the nature of animal by-products involved.

Under the Regulation

- A **composting plant** is defined as *"a plant in which biological degradation of products of animal origin is undertaken under aerobic conditions"*

and

- A **biogas plant** is defined as *"a plant in which biological degradation of products of animal origin is undertaken under anaerobic conditions for the production and collection of biogas"*.

Article 15 of Regulation (EC) No. 1774/2002 requires that biogas plants and composting plants shall be subject to veterinary approval by the competent authority. Under Article 6 of S.I. 248 of 2003, the European Communities (Animal by-products) Regulations 2003 which implements the above Regulation, the Minister for Agriculture and Food may grant an approval, attach conditions to an approval, revoke or vary a condition, withdraw an approval or refuse an application.

2. CATEGORISATION OF ANIMAL BY-PRODUCTS

Under Regulation 1774/2002, animal by-products are now categorised in 3 distinct categories:

Category 1- very high risk
Category 2- high risk
Category 3- low risk

Category 1 Material includes:

- BSE carcases and suspects
- Specified Risk Material
- Catering waste from international transport

This material must be destroyed and is completely banned from use as feedstock in composting and biogas plants.

Category 2 Material includes the following material and these may be used for composting or biogas production

- Manure
- Digestive tract content separated from the digestive tract
- Milk and colostrums

Category 3 Material includes:

- Catering waste – *meaning all waste food including used cooking oil originating in restaurants, catering facilities and kitchens, including central kitchens and household kitchens.*
- Food factory waste and waste food from supermarkets.
- Parts of slaughtered animals, which are fit for human consumption but are not intended for human consumption for commercial reasons.
- Parts of animals, which are rejected as unfit for human consumption but are not affected by any signs of diseases communicable to humans or animals and derive from carcasses that are fit for human consumption.
- Fish or other sea animals, except sea mammals, caught in the open sea for the purposes of fishmeal production and fresh by-products from fish from plants manufacturing fish products for human consumption. In the case of facilities where fish by-products are the only animal by-product being treated, applications for approval should be forwarded to the Department of Communications, Marine and Natural Resources.

3. FEEDSTOCK

The following materials may be used as feedstock in a biogas or composting plant;

- Category 2 Material consisting of only the following:
  - Manure
  - Digestive tract content separated from the digestive tract, and
  - Milk and colostrum.
- Category 3 Material

No other animal by-product may be included within the feedstock treated in a biogas or composting plant

The Department of Agriculture and Food must be notified in writing and at least 2 weeks in advance, of any intended changes to feedstock that may entail additional animal by-products being processed

4. PREMISES

4.1. Location

The following controls are required for composting and biogas plants that are involved in the treatment of animal by-products:

- If a composting/biogas plant is located on premises where farmed animals are kept and does not only use manure which accrues from those animals, the plant shall be located at an adequate distance from the area where such animals are kept and there must, in any case, be total physical separation

between that plant and those animals and their feed and bedding, with fencing where necessary. Approval of such sites will be risk-based and likely to be subject to stringent conditions regarding dedication of both personnel and equipment.

- The facility must be surrounded on all sides by permanent stock-proof fencing of a minimum height of 1.8 m. Details of suitable fencing are included in annex 1.
- A lockable gate of minimum height of 1.8 m must be present at the entrance to the facility. This gate must be locked at all times when the facility is closed.
- In order to prevent the possibility of contact with farm animals either directly or indirectly (vermin, birds etc), all initial processing of raw material must be carried out indoors.

4.2. Equipment – Composting Plant

A composting plant must be equipped with:

(a) a closed composting reactor, which cannot be by-passed, with:

(i) installations for monitoring temperature against time;

(ii) recording devices to record, where appropriate continuously, the results of the monitoring measurements referred to in (i); and

(iii) an adequate safety system to prevent insufficient heating; (see paragraph 7.3)

(b) adequate facilities for cleaning and disinfecting of vehicles and containers transporting untreated animal by-products i.e. good bio security facilities.

However, other types of composting systems may be allowed provided they:

(i) ensure adequate measures to control vermin;

(ii) are managed in such a way that all the material in the system achieves the required time and temperature parameters, including, where appropriate, continuous monitoring of the parameters;

(iii) comply with all other requirements of Regulation 1774/2002.

In practice, in the absence of a closed composting reactor, it will be extremely difficult to provide adequate safeguards either to achieve sanitisation of the feedstock or to prevent potential access by vermin and birds to the raw material. An alternative system could only be considered equivalent in circumstances where it is capable of consistent performance and not reliant on variables such as individual operators and supervisors.

4.3. Equipment – Biogas Plant

A biogas plant must be equipped with:

(a) a pasteurisation/hygienisation unit, which cannot be by-passed, with:

(i) installations for monitoring temperature against time;

(ii) recording devices to record continuously the results of the monitoring measurements referred to in (i); and

(iii) an adequate safety system to prevent insufficient heating; (see paragraph 7.3)

(b) adequate facilities for the cleaning and disinfecting of vehicles and containers upon leaving the biogas plant, i.e. good bio security facilities.

However, a pasteurisation/hygienisation unit shall not be mandatory for biogas plants that transform only:

(i) animal by-products that have undergone processing Method 1;

(ii) Category 3 material that has undergone pasteurisation/ hygienisation elsewhere; or

(iii) animal by-products which may be used as raw material without processing.

4.4. Laboratory Requirements

Each biogas plant and composting plant must have its own laboratory or make use of an external laboratory. The laboratory must be equipped to carry out the necessary analyses and approved by the competent authority. A list of Non-Departmental laboratories approved for microbiological testing by the Department of Agriculture and Food (valid as of October 2005) is attached in annex 3.

4.5. Waste Permit/ Licence

Applicants seeking approval to treat animal by-products in biogas or composting plants under S.I. 248 of 2003 must also apply for a separate waste permit/licence from the local authority/EPA.

A facility must maintain all permits, licences and approvals attached to it in good standing. Failure to maintain any one of these authorisations will lead to the veterinary authorisation being revoked and the facility will no longer be entitled to accept or process the agreed types of animal by-products.

5. HYGIENE REQUIREMENTS

5.1. Animal by-products must be transformed as soon as possible after arrival, preferably within 24 hours of arrival at the plant. They must be stored properly until treated.

5.2. Containers, receptacles and vehicles used for transporting untreated material must be cleaned in a designated area. This area must be situated or designed to prevent risk of contamination of treated products.

5.3 Preventive measures against birds; rodents, insects or other vermin must be taken systematically. All initial processing of raw material (shredding, screening and mixing) must be done indoors. This dirty area must be constructed with smooth walls and floors. Floors must be designed and laid in a way to ensure adequate drainage of fluids. A fully documented pest-control programme must be implemented throughout the whole facility.

5.4 In the case of a facility where raw material is being transported outdoors from the dirty area for treatment/ hygienisation, this must be done using a closed container. In the case of a plant where catering waste is the only animal by-product to be used as a feedstock, other procedures may be acceptable to the Department of Agriculture and Food.

5.5 In cases where raw material and processed material are being transported around a facility, it is strongly recommended that separate machines would be used. If only one machine (loading shovel/tractor) is present, then separate buckets must be employed for raw and processed material. The entire machine must be steam-cleaned thoroughly between each and every use and this procedure must be documented and signed off by a responsible person.

5.6. Cleaning procedures must be documented and established for all parts of the premises. Suitable equipment and cleaning agents must be provided for cleaning.
A list of Department of Agriculture and Food approved disinfectants is attached in Annex 2. Up to date versions of this list are available on the Department of Agriculture and Food website. As part of a daily clean-up routine, steam-cleaning to remove all visible material may be used in place of disinfectants. However, in the case of a non-compliance being highlighted during sampling of processed product, the plant must be thoroughly disinfected under supervision of the Department of Agriculture and Food.

5.7. Hygiene control must include regular inspections of the environment and equipment. Inspection schedules and results must be documented. Visual inspections of all equipment must be made both daily and weekly and all results and corrective actions taken must be recorded.

5.8. Installations and equipment must be kept in a good state of repair and measuring equipment must be calibrated at regular intervals. An appropriate, competent agency must calibrate and certify measuring devices for time/ temperature parameters regularly and at a minimum of once a year.

5.9. Digestion residues and processed compost must be handled and stored at the plant in such a way as to prevent recontamination. Once compost/digestion residue has reached the time/temperature parameters as laid out in section 6 it may be stored outdoors for maturation purposes. It must be stored away from the intake area and operators must ensure that a one-way system of material flow is in operation at the site, in order to prevent recontamination of processed products.

6. PROCESSING STANDARDS

6.1. Category 3 material used as raw material in a biogas plant equipped with a pasteurisation/ hygienisation unit must be submitted to the following minimum requirements:

Maximum particle size before entering the unit: 12 mm;
Minimum temperature in all material in the unit: 70 °C; and
Minimum time in the unit without interruption: 60 minutes.

However, Category 3 milk, colostrums and milk products may be used without pasteurisation/ hygienisation as raw material in a biogas plant, if the Department of Agriculture and Food does not consider them to present a risk of spreading any serious transmissible disease.

6.2. Category 3 material used as raw material in a composting plant must be submitted to the following minimum requirements:

Maximum particle size before entering the composting reactor: 12 mm
Minimum temperature in all material in the reactor: 70 °C; and
Minimum time in the reactor at 70 °C (all material): 60 minutes.

6.3. In the case of a plant where catering waste is the only animal by-product to be used as a feedstock; other equivalent operating parameters may be accepted. The manufacturer/manager of a facility must produce documented evidence/research to guarantee an equivalent effect regarding the reduction of pathogens, unless the method employed is otherwise officially approved by the EU Commission as an acceptable alternative treatment method.

These equivalent requirements may also apply to catering waste when it is mixed with manure, digestive tract content separated from the digestive tract, milk and colostrums provided that the resulting material is considered as if it were from catering waste.

6.4. Where manure, digestive tract content separated from the digestive tract, milk and colostrums are the only material of animal origin being treated in a biogas or composting plant, the Department of Agriculture and Food may authorise the use of requirements other than those specified in these conditions provided that it:

a) Does not consider that those material present a risk of spreading any serious transmissible disease;
b) Considers that the residues or compost are unprocessed material.

6.5. Facilities processing the following material only:

- cereal grains
- edible material of plant or vegetable origin
- bread and dough
- chocolate

This feedstock is not defined as animal by-product and such facilities do not need approval. Any proposed change to the feedstock, which would entail the processing of animal by-products, must be notified to the Department of Agriculture and Food at least 3 months in advance.

7. SAMPLING OF DIGESTION RESIDUES AND COMPOST

7.1 Sampling Procedures

Sampling must be done in accordance with the approval as issued to a plant. During the initial commissioning and validation process of a plant, every batch of compost/ digestion residue must be sampled.[1] The frequency of sampling will reduce over time as the plant establishes reliability.

7.2 Standards

Representative samples of the digestion residues or compost taken during or immediately after processing at the biogas or composting plant in order to monitor the process must comply with the following standards:

Escherichia coli: n = 5, c = 1, m = 1000, M = 5000 in 1 g;

or

Enterococcaceae: n = 5, c = 1, m = 1000, M = 5000 in 1 g;

and

Representative samples of the digestion residues or compost taken during or on withdrawal from storage at the biogas or composting plant must comply with the following standards:

Salmonella: absence in 25 g: n = 5; c = 0; m = 0; M = 0

where:

n = number of samples to be tested;

m = threshold value for the number of bacteria; the result is considered satisfactory if the number of bacteria in all samples does not exceed m;

M = maximum value for the number of bacteria; the result is considered unsatisfactory if the number of bacteria in one or more samples is M or more; and

c = number of samples the bacterial count of which may be between m and M, the sample still being considered acceptable if the bacterial count of the other samples is m or less.

Digestion residues or compost, which does not comply with the requirements set out in this paragraph shall be re-processed, in the case of Salmonella handled or disposed of in accordance with the instructions of the Department of Agriculture and Food. (See paragraph 7.3 below).

[1] 1774/2002 defines a "Batch" as a unit of production produced in a single plant using uniform production parameters – or a number of such units, when stored together – and that can be identified for the purposes of recall and re-treatment or disposal should tests show that to be necessary. In practice, a batch will be taken as being the amount of final product produced in the period of time since the last sample.

7.3 Non-Compliances

In a situation where samples do not comply with these standards then, in accordance with the legislative provisions of Regulation (EC) No. 1774/2002, the following procedure must be adhered to:

- The Department of Agriculture and Food must be notified immediately
- The operator of the plant must establish the cause of the failure.
- The contaminated batch and any in-contact material must be re-processed or disposed of under the supervision of the Department of Agriculture and Food. In the case of facilities where the only animal by-product being processed is catering waste, contaminated batches may be sent directly for landfill or recycled through the plant. For facilities using Category 3 animal by-products, material may either be recycled through the plant or sent for processing in an approved Category 3 processing plant.
- No material suspected of being contaminated must be removed from the plant without the prior approval of the Department of Agriculture and Food.
- The frequency of sampling and testing will be increased in line with the recommendations in place at the time
- Records relating to the contaminated material must be investigated
- Appropriate decontamination and cleaning procedures must be followed.

Where appropriate, further recommendations will be issued for these cases.

8 RECORD KEEPING

All records relating to all aspects of the composting or biogas process must be kept on site for a minimum period of 2 years. These records must be available for inspection by an authorised officer from the Department of Agriculture and Food and must include:

- Thermographs relating to the composting or biogas process to ensure that the minimum parameters as laid out in section 6 are met
- Records for all batches of animal by-products delivered to or collected by the plant. In the case of Category 3 Material other than catering waste, the commercial documents for each batch must be kept by the facility.
- The pest control plan and all relevant documentation.
- Cleaning procedures and all relevant documentation.
- Hygiene control plan and cleaning schedules
- Equipment repair and calibration records.
- Sampling procedures and schedules as well as laboratory results for all samples taken (as outlined in section 7).
- A system to ensure traceability for all batches of compost produced and despatched from the plant must be in place. This must detail the source of the raw material, all relevant processing records, the date of dispatch and intended end-use of the finished product.
- A system of hazard analysis and critical control points (HACCP) plan for the plant. This plan must identify the critical control points and establish and implement methods for monitoring and checking these points. All non-

compliances and the corrective actions taken in each instance must also be recorded.

9 HACCP PLANS FOR COMPOSTING/BIOGAS PLANTS

In accordance with the principles prescribed in **Regulation (EC) No. 1774/2002,** the system of hazard analysis and critical control points (HACCP) plan must pay particular attention to the following points:

- Procedures at the plant for reception of by-products.
- Processing of material to the relevant standards
- Hygiene controls – including cleansing and disinfection facilities, as well as arrangements to prevent cross-contamination of processed material with raw material through the use of flow diagrams.
- Record keeping including laboratory sampling results
- Details of corrective actions to be taken as necessary

10 COLLECTION AND TRANSPORT

With the exception of catering waste, the following points are the conditions that apply to the collection and transport of animal by-products:

10.1 Identification

- Category 2 materials (referred to in section 3) and Category 3 materials must be kept separate and identifiable during collection and transportation unless they are being sent to the same composting plant. When transporting manure only, the following conditions need not apply.
- A label must be permanently attached on both sides of the container in such a way they are clearly legible and visible. The letters should be at least 15cms high.
- ALL signs must be PERMANENTLY attached to the trailer, i.e. bolted, welded or riveted. It will not suffice to have the signs attached with glue magnets or slide in slots.
- The label must bear the indication
  - For Category 3 Material: **Category 3 Material – Not for Human Consumption**
  - In the case of Digestive tract content, milk and colostrum: **Category 2 Material – Not for Animal Consumption.**

10.2 Vehicles And Containers

- All animal by-products must be transported in sealed new packaging or covered leak-proof containers or vehicles
- Containers, receptacles and vehicles used for transporting untreated animal by-products must be cleaned in a designated area. This area must be situated or designed in a manner so as to prevent risk of contamination of treated products
- Vehicles and all reusable equipment must:
  - Be cleaned, washed and disinfected after each use

- Be maintained in a clean condition
- Be clean and dry before use

- Reusable containers must be dedicated to the carriage of one particular animal by-product to prevent cross-contamination

10.3 Commercial Documents

- A Commercial Document must accompany all animal by-products during transport. This must be produced in triplicate with the original being retained by the receiver and copies are to be kept by the producer and the carrier
- Commercial Documents must include:
  (a) The date on which the product left the premises
  (b) A description of the material including the information on the label
  (c) The quantity of material
  (d) The place of origin of the material
  (e) The name and address of the carrier
  (f) The name and address of the composting/biogas plant and its approval number
  (g) The commercial documents must be kept for at least two years and made available on request to an authorised officer.

10.4 Records

- The consignor must keep records of (a), (b), (c), (e) and (f) above
- The haulier must keep records of (a), (b), (c), (d) and (f) above
- The consignee must keep records of (b), (c), (d) and (e) above
- Records relating to all material collected or delivered to the plant must be kept for a minimum period of 2 years. These records must be available at all times for examination by an authorised officer.

Please note that all of the above requirements (paragraphs 10.1 to 10.4) are detailed in Trader Notices issued by the Department of Agriculture and Food. Copies of these notices are available on request.

10.5 Catering Waste

Catering waste must be collected and transported in such a way as to ensure that it does not damage human health or the environment. In particular, all external surfaces of vehicles transporting catering waste must be kept clean and equipment must be available for this purpose. The wheels of these vehicles should be cleaned prior to the vehicle leaving the premises. (Under current EU rules, internal cleansing and disinfection is not routinely required for vehicles transporting catering wastes alone but is recommended).

11 END-USE OF COMPOST AND DIGESTION RESIDUES

As part of the approval process, an application for a compost/biogas facility must list all intended feedstock and the sources of these materials. Pre-notification of intended classes of end- use, as opposed to sites must be detailed in the application. However,

names and addresses of individuals receiving large quantities of material (in excess of 1 tonne) must be recorded.

Compost/digestion residues resulting from the processing of animal by- products can be spread on all types on non-pasture land – subject to environmental best practice and in line with other relevant legislation - provided that sufficient measures are in place to exclude animal access to this land.

Compost/digestion residues resulting from the processing of animal by- products cannot be spread on pastureland

For facilities using manure as the only animal by-product the following provisions apply:

- In the case of facilities that use home produced manure: – provided that this is the only type of animal by-product being used in the plant, then the residue can be spread on any type of land on the home farm or on land designated for this purpose.
- In the case of facilities that are transporting manure from neighbouring farms: – again provided that this is the only animal by-product being used then the residue may be spread on any type of land on the farms that supplied to the unit.

During spreading, measures must be taken to minimise spray drift of the product e.g., spreading during still conditions, use of an inverted splash plate, band spreading or shallow injection.

Conditions For Composting Of Animal By-Products In Ireland
Annex 1
Stock-Proof Fencing

STOCK PROOF FENCING.

The facility must be surrounded on all sides by permanent stock- proof fencing of a minimum height of 1.8 m. In cases where a border of 50 metres is being implemented, both perimeter fences (inside and outside) must be similarly stock- proofed.

Posts must be 2.3 m long minimum of either: -

a) Reinforced concrete 125mm x 125mm at butt end (to IS 177: 1980)

b) Galvanised angle iron 60mm x 60mm x 6mm thick

c) Galvanised tubular steel, 75mm outside diameter, and 3.2 mm thick

Uprights and strainers shall be embedded in 0.5m square concrete bases, not more than 3.0m apart. Four strands of 3.2 mm plain wire shall be strained, and stapled or tied to the uprights with tying wire. Chain link fencing, 2.5mm, (to IS 130:1980), 1.8m high, shall be secured to the outside of the line wires over entire fence. One strand of 1.5mm barbed wire shall be placed along the top of the fence.

A gate 1.8m high, of galvanised steel, or preservative treated timber, with closing bolts and locks, shall be fitted at the entrance to the facility. The only horizontal bars shall be at the top and bottom of the gates. Chain-link fencing shall be fitted to the outside of the gates. The gates shall be designed such that neither people nor stock can get through or under when closed.

Other proprietary fence systems will be acceptable if the above criteria are met.

DEPARTMENT OF AGRICULTURE AND FOOD

Diseases of Animals (Disinfectants) Order, 1975 (Amendment) Order, 1978

LIST OF APPROVED DISINFECTANTS (September 2004)

DISINFECTANT	Diseases in respect of which use is approved and dilution rates*				
	Foot and Mouth Disease	Swine Vesicular Disease	Fowl Pest (Newcastle Disease, Fowl Plague)	Tuberculosis	Anthrax, Brucellosis, Contagious Bovine Pleuro-pneumonia, Glanders and other Scheduled diseases
Agrisept MC Tabs* (see note)	271*	448*	271*	----	450*
Antec Ambicide	----	----	----	----	30
Antec Farm Fluid S	700	200	200	50	115
Antec Hyperox	150	50	375	100	179
Antec Long Life	----	----	60	----	60
Antec Long Life 250s	500	200	250	48	90
Antec New Formula Farm Fluid	300	110	70	30	65
Antec Virkon S	1300	200	280	----	120
Antec Virudine	600	650	140	51	125
Bio Guard	---	---	80	---	---
Bio Kill	---	---	365	---	---
Bio Phen	---	175	190	---	---
Bio Phen Plus	---	---	210	---	---
Bio Shield	---	---	155	---	---
Bio VX	---	---	285	---	---
Chlorasol	20	90	200	20	199
Citrox	----	----	0.66	----	----
Iinidine	320	----	140	----	----
Deosan Iodel FD	215	234	130	26	147
Dermicidal Extra	50	150	125	13	61
Enviroguard	60	300	150	10	60
Equisept*	271*	----	----	----	450*
FAM (New Formulation)	525	400	150	15	110
FAM 30	550	600	125	30	180
GPC 8 (New Formulation)	80	250	190	----	----
Iodosure Bio	240	160	110	----	25
Iosan Farm Disinfectant	240	180	80	15	80
Jeyes Fluid	---	----	30	----	50
Kick Start 2	800	160	145	44	256
Novagen FP	240	180	80	22	145
Omnicide 325	50	150	125	13	61
Opticide 200	50	150	125	13	61

Conditions For Composting Of Animal By-Products In Ireland
Annex 2
Approved Disinfectants

Osmodex	525	400	150	15	110
Purogene	250	240	20	20	22
Septrivet 17	1000	1000	700	----	1000
Sorgene 5	75	75	100	75	200
Spectocide 2000	60	300	150	10	60
Supercide	150	450	200	----	200
Superdine	550	600	125	30	180
Superkill	----	50	100	----	22
SWC Bacto Detsan	20	10	----	----	10
SWC Maxikleen	600	400	100	45	43
Tego 2000	----	----	----	----	32
Tegodor FARM	----	----	51	----	----
Trigene II	----	----	----	41	----
V26	200	200	200	105	178
Vandox	200	30	300	----	300
Vesphene D39	10	----	50	70	55
Verucidal Extra	1300	300	300	----	112
Virex	1300	200	300	----	112
Virochlor	271	448	271	---	450
Virophen	---	200	210	---	---
Virophen Plus	---	---	240	---	---
Virophor 2.8%	---	---	185	---	---
Viroshield	---	---	165	---	---
Zal Perax II	800	160	145	44	256

* Dilution rate is expressed as one part of the preparation to the number of parts of water in the appropriate column.
Note: The volume of mls of water above relate to 1g of the product – Agrisept MC Tabs are 5g each.

NOTE: READ CAREFULLY THE MANUFACTURER'S INSTRUCTIONS BEFORE USAGE PARTICULARLY IN RELATION TO SPECIFIED PRECAUTIONS

Note: Dilution rates for disinfectants for use against Foot and Mouth Disease and/or Swine Vesicular Disease relate to effectiveness when applied to a clean surface.
(a) thoroughly washed or sprayed with an approved disinfectant;
(b) thoroughly cleansed, ensuring that dung, litter, etc. is removed and disposed of so that there is no risk of contact with livestock; and
(c) (the clean area) washed or sprayed with an approved disinfectant used at the approved dilution.

Conditions for Composting Of Animal By-Products In Ireland
Annex 3
List of Non-Departmental Laboratories Approved for Microbiological Testing by Department of Agriculture and Food

Advanced Micro Services,
South Ring Business Park,
Tramore Rd,
Co Cork

Aire Laboratories
Cappagh Cross,
Fermoy
Co. Cork.

Anser Laboratories Ltd.
69A Killyman Street,
Moy, Co Tyrone
BT71 7ED.

Aqua Lab.
Donegal Road,
Killybegs,
Co. Donegal.

Biosearch (NI) Ltd
Dufferin Road
Belfast
BT3 9AA

Complete Laboratory Solutions
Ros Muc,
Connemara,
Co. Galway.

Consult-Us Ltd.
Glanmire Industrial Estate,
Glanmire,
Co. Cork.

Enfer Micro Laboratories Ltd,
Carrigeen Business Park,
Clonmel,
Co. Tipperary

Envirolab Ltd.
Christendom Enterprise Centre
Christendom
Ferrybank
Waterford

Eurofins Scientific Ireland Ltd.
Finnabair Industrial Estate,
Science Services Centre,
Dundalk, Co. Louth.

Foodtech Consutants Ltd.
Rocklawn,
West Village,
Ballincollig,
Co Cork.

Food Safety Laboratory,
Veterinary Department
Cork County Council,
County Hall,
Cork.

Independent Micro Lab Ltd.
Lismard Business Park,
Timahoe Road,
Portlaoise,
Co. Laois.

Irish Equine Centre
Johnstown,
Naas,
Co. Kildare.

Microchem Laboratories
Clogherane,
Dungarvan,
Co. Waterford

Microlab Ltd.
Drumillard Little,
Monaghan Road,
Castleblayney,
Co. Monaghan.

Mid Antrim Laboratory Services
42A Broughshane Road,
Ballymena,
Co. Antrim.

Monaghan Veterinary Laboratory
Clones Road,
Monaghan.

Oldcastle Laboratories Ltd.
Cogan Street,
Oldcastle,
Co. Meath.

Q Lab Ltd.
P.O. Box 27,
Kerlogue Industrial Estate,
Drinagh,
Wexford.

Southern Scientific Services Ltd.
Dunrine,
Killarney
Co. Kerry

Attachment C

Odour Impact Assessment May 2005

ODOUR & ENVIRONMENTAL ENGINEERING CONSULTANTS

Unit 32 De Granville Court, Dublin Rd, Trim, Co. Meath

Tel: +353 46 9437922
Mobile: +353 86 8550401
E-mail: info@odourireland.com
www.odourireland.com

ODOUR IMPACT ASSESSMENT OF THE CURRENT CELTIC COMPOSTING SYSTEM LOCATED IN WATERFORD CITY, CO. WATERFORD.

PREPARED BY:	Dr. Brian Sheridan
ATTENTION:	Mr. Derek Milton
DATE:	20th May 2005
REPORT NUMBER:	2005.A88
DOCUMENT VERSION:	Draft Document Ver. 001
REVIEWERS:	

TABLE OF CONTENTS

Section			Page number
TABLE OF CONTENTS			**i**
EXECUTIVE SUMMARY			**iii**
1.	**Introduction**		**1**
1.1		Olfactometry	
1.2		Odour measurement in accordance with PrEN13725:2003	
1.2.1		What is an odour unit?	
1.3		Characterisation of Odour	
1.4		Odour Qualities	
1.5		Perception of emitted odours	
1.6		Characteristics of composting odours	
1.7		Odour emissions formation from composting operations	
1.8		Atmospheric dispersion modelling of odours: What is dispersion modelling?	
1.8.1		Industrial Source Complex 3 (ISC ST3).	
1.8.2		Establishment of odour impact criterion for proposed facility.	
1.9		Methods, processes & Operating Procedures for Composting process.	
1.10		Odourous compound formation in composting facilities	
1.11		General rules for reduction of odour emissions from Composting operation by design.	
2.	**Materials and methods**		
2.1		Site location and layout	
2.2		Collection of point source odour samples	
2.3		Collection of area source odour samples	
2.4		Airflow rate measurement	
2.5		Measurement of odour threshold concentration	
2.6		Odour emission rate calculation.	
2.7		Meteorological data.	
2.8		Terrain data.	
3.	**Results**		
3.1		Odour emission data	
3.2		Odour emission rates from overall composting processes during current operation.	
3.3		Odour emission rates from current composting operations for atmospheric dispersion modelling Scenario 1 & 2	
3.4		Odour emission rates from proposed composting operations for atmospheric dispersion modelling Scenario 3 & 4	
3.5		Results of odour dispersion modelling for the current/future Waterford City Council composting operation and design	

4. Discussion of results
4.1 Odour plume dispersal for Scenarios 1 and 2
4.2 Odour plume dispersal for Scenarios 3 and 4
4.3 Odour plume dispersal for Scenarios 5 and 6

5. Conclusions

6. Recommendations

7. References

8. Appendix I-Dispersion modelling contour results using ISCST3 dispersion model.

9. Appendix II-Pictures of equipment

EXECUTIVE SUMMARY

Odour Monitoring Ireland was commissioned by Celtic Composting Systems Ltd (CCS) to carry out an odour impact assessment of the current composting operations located at Waterford City Council composting facility, Waterford City, Co. Waterford. The purpose of this assessment was to determine the potential for the generation of odour impact on the surrounding vicinity. Potential odour sources were identified from a site-specific odour measurement survey and were used to construct the bases of the modelling assessment. Odour emission rates were calculated from site-specific based olfactometry data. Dispersion modelling using ISC ST3 was used to identify the odour impact area of the processes and the effects of proposed odour abatement/minimisation strategies. A worst-case meteorological year and worst-case odour emission data was used to predict any potential odour impact in the vicinity of the current composting facility. Odour impact potential was discussed for the current operation of the composting process. The following conclusions were drawn:

1. It is predicted that odour impact will be perceived by the industrial units located in the vicinity of the current facility while the composting process is in operation when utilising dispersion model ISC ST3. Twelve industrial facilities will perceive an odour concentration of between 3.0 and 38.0 Ou_E m^{-3} at the 98th percentile in a worst-case meteorological year. All other receptors in the vicinity of the facility will perceive an odour concentration less than 3.0 Ou_E m^{-3}. Odour complaints were received about the current operating facility. The operators consider both turning/tipping, building door opening and biofilter operation as the major contributors of current odour impact. This can be observed clearly in *Figure 8.2*, whereby individual process impact can e observed.
2. It is predicted that following the implementation of odour minimisation/abatement techniques (i.e. building door operation, maintenance of negative extraction on waste acceptance building, improvement of ASP biofilter operation, installation of additional biofiltration system) proposed by CCS, odour plume spread is significantly reduce with 8 industrial facilities perceiving an odour concentration of between 3.0 Ou_E m^{-3} and 12 Ou_E m^{-3} at the 98th percentile. This odour impact would equate to a 69% reduction in perceived odour concentration and a 33% reduction in affected industrial facilities. The risks associated with odour impact are reduced and industrial receptors are less likely to complain about odour impact.

It was recommended:

1. Ensure a clear and concise odour management plan as discussed with CCS is implemented for the site so as to eliminate any significant odour emissions events. These include good housekeeping, turning management practices, preventative maintenance of odour abatement equipment, and closed-door strategy.
2. It is suggested that the current biofiltration systems are optimised through bed medium makeup, sealing supporting wall structures, optimising biofilter air distribution network and by providing pre-ammonia scrubbing. Currently, leakage is occurring from the ASP biofilters, which contributes, significantly to facility background odour. Significant improvements are required on overall biofilter odour removal efficiency. Removal efficiencies of greater than 90% should be

attainable within the current facility. The current digester biofilters need to be optimised to facilitate the treatment of the cyclic odour loading. Ammonia loading is significant on these digester biofilters. Operations should be optimised to allow for the "washing" of excess ammonia and nitrate from the media bed in order to maintain high odour removal capacity.

3. The current turning and aeration of the ASP's should maintain appropriate conditions within the composting matrix (i.e. oxygen, moisture and evenly distributed nutrients) and ASP turning should be performed in appropriate meteorological conditions (i.e. unstable, higher wind speeds, clear sky, in opposite direction to industrial receptors).
4. A closed-door strategy should be incorporated upon the operation of the indoor facility. The specific details are discussed within the document in detail. These doors should be alarmed to prevent operators from opening for long periods of time. Additionally the surface area of the door open area should be reduced by using flexible heavy-duty plastic curtains. Strict management practices will be required within this building to prevent significant puff odour emissions. Air curtains may be more appropriate whereby a physical barrier for odour leakage is provided by an invisible barrier of air.
5. Other recommendations are made through the document.

1. Introduction

Like the majority of industrial and processing facilities, the operations of Waterford City Council Composting system located in Waterford City is faced with the issue of preventing odours causing impact to the public at large. The current operations use conventional in vessel composting techniques and aerated static pile (ASP) maturation to process source segregated green and food waste. This odour impact assesses the likely odour impacts associated with those processes located in vessel and outdoors namely the ASP maturation, biofiltration systems, buildings and to a lesser extent turning and screening. Utilising site-specific odour emission data and atmospheric dispersion modelling techniques, the predicted overall odour impact of the current operations can be determined. The key odour impact sources are identified and assessed. Site-specific odour emission rates were developed for the composting operations. Contours of odour concentrations for the 98th percentile are predicted around the current composting operations in order to examine the extent of any odour impact and the effectiveness of utilised and considered odour minimisation/abatement protocols. It is predicted that during current operation, twelve industrial facilities will perceive an odour concentration of between 3.0 and 38.0 Ou_E m^{-3} at the 98th percentile in *a worst-case meteorological year*. All other receptors in the vicinity of the facility will perceive an odour concentration less than 3.0 Ou_E m^{-3}. It is predicted that following the implementation of proposed odour minimisation/abatement techniques (i.e. building door operation, maintenance of negative extraction on waste acceptance building, improvement of ASP biofilter operation, installation of additional biofiltration system), odour plume spread is significantly reduce with 8 industrial facilities perceiving an odour concentration of between 3.0 Ou_E m^{-3} and 12 Ou_E m^{-3} at the 98th percentile. This odour impact equated to a 69% reduction in perceived odour concentration and a 33% reduction in affected industrial facilities. The risks associated with odour impact are reduced and industrial receptors are less likely to complain about odour impact. Strict odour management plans will need to be implemented upon the current operating site. These are discussed within the document.

1.1 Olfactometry

Olfactometry using the human sense of smell is the most valid means of measuring odour (Dravniek et al, 1986) and at present is the most commonly used method to measure the concentration of odour in air (Hobbs et al, 1996). Olfactometry is carried out using an instrument called an olfactometer. Three different types of dynamic dilution olfactometers exist:

- Yes/No Olfactometer
- Forced Choice Olfactometer
- Triangular Forced Choice Olfactometer.

In the dynamic dilution olfactometer, the odour is first diluted and is then presented to a panel of screened panellists of no less than four (CEN, 2003) Panellists are previously screened to ensure that they have a normal sense of smell (Callan et al, 1993). According to the CEN standard this screening must be performed using a certified reference gas, *n*-butanol. This screening is applied to eliminate anosmia (low sensitivity) and super-noses

(high sensitivity). The odour analysis has to be undertaken in a low odour environment such as an air-conditioned odour free laboratory. Analysis should always be performed preferably within 6 hours of sampling.

1.2 Odour measurement in accordance with PrEN13725:2003

An ECOMA TO8 dynamic yes/no olfactometer was used throughout the experimental period to determine the odour threshold concentration of the emission source. The odour threshold concentration is defined as the dilution factor at which 50% of the panel can just detect the odour. Only those panel members who pass screening tests with n-butanol (certified reference gas, CAS 72-36-3) and who adhered to the code of behaviour are selected as panellists for olfactometry measurements (CEN, 2003).

The odour threshold concentration is calculated according to the response of the panel members and is displayed in $Ou_E\ m^{-3}$, which referred to the physiological response from the panel equivalent to that elicited by 40ppb/v n-butanol evaporated in one cubic metre of neutral gas (CEN, 2003). Odour units are considered a dimensionless unit, but the pseudo-dimensions of $Ou_E\ m^{-3}$ have been commonly used for odour dispersion modelling, in place of 'grams m^{-3}' (Sheridan, 2002).

1.2.1 What is an odour unit?

The odour concentration of a gaseous sample of odourant is determined by presenting a panel of selected screened human panellists with a sample of odourous air and varying the concentration by diluting with odourless gas, in order to determine the dilution factor at the 50% detection threshold. The Z_{50} value (threshold concentration) is expressed in European odour units ($Ou_E\ m^{-3}$).

Although odour concentration is a dimensionless number, by analogy, it is expressed as a concentration in odour units per cubic metre ($Ou_E\ m^{-3}$), a term which simplifies the calculation of odour emission rate. The European odour unit is that amount of odourant(s) that, when evaporated into one cubic metre of neutral gas (nitrogen), at standard conditions elicits a physiological response from a panel (detection threshold) equivalent to that elicited by one European Reference Odour Mass (EROM) evaporated in one cubic meter of neutral gas at standard conditions. One EROM is that mass of a substance (*n*-butanol) that will elicit the Z_{50} physiological response assessed by an odour panel in accordance with this standard. *n*-Butanol is one such reference standard and is equivalent to 123ug of *n*-butanol evaporated in one cubic meter of neutral gas at standard conditions (CEN, 2003).

1.3 Characterisation of Odour

The sense of smell plays an important role in human comfort. The sensation of smell is individual and unique to each human and varies with the physical condition of the person, the odour emission conditions and the individual's odourous education or memory. The smell reaction is the result of a stimulus created by the olfactory bulb located in the upper nasal passage. When the nasal passage comes in contact with the odourous molecules, signals are sent via the nerve fibres where the odour impressions are created and compared with stored memories referring to individual perceptions and social values.

Since the smell is individual, some people will be hypersensitive and some will be less sensitive (ansomia). Therefore, the sense of smell is the most useful detection technique available as it specialises in synthesising complex gas mixtures rather than analysing the chemical compound (Sheridan, 2000).

1.4 Odour Qualities

An odour sensation consists of a number of inter-linked factors. These include:

- Odour threshold/concentration
- Odour intensity
- Hedonic tone
- Quality/Characteristics
- Component characteristics

The odour threshold concentration dictates the concentration of the odour in $Ou_E\ m^{-3}$. The odour intensity dictates the strength of the odour. The Hedonic quality allows for the determination of pleasantness/unpleasantness. Odour quality/characteristics allow for the comparison of the odour to a known smell (i.e. turnip, like dead fish, flowers). Individual chemical component identity determines the individual chemical components that constitute the odour (i.e. hydrogen sulphide, benzoic acid benzyl aldehyde). Once odour qualities are determined, the overall odour impact can be assessed.

1.5 Perception of emitted odours

Complaints are the primary indicator that odours are a problem in the vicinity of any facility. Perceptions of odours vary from person to person, each with their own individual fingerprint. Several conditions govern a person's perception of odour:

- **Control:** A person is better able to cope with an odour if they feel it can be controlled.
- **Understanding:** A person can better tolerate an odour impact if they understand its source.
- **Context:** A person reacts to the context of an odour as we do to the odour itself.
- **Exposure:** When a person is constantly exposed to an odour they may lose their ability to detect that odour. For example, a plant operator who works in the facility may grow immune to the odour.

From these criteria, we can predict that odour complaints are more likely to occur when:

- A new facility locates in areas where people are unfamiliar with facilities;
- When a new process establishes within the facility;
- Or when an urban population encroaches on an existing facility.

The ability to characterise odours being emitted from the facility will help to develop a better understanding of the impact of the odour on the surrounding vicinity. It will also help to implement and develop better techniques to abate odours using existing technologies and engineering design.

1.6 Characteristics of composting odours

Odours from composting arise mainly from the uncontrolled anaerobic biodegradation of proteins and carbohydrates to produce unstable intermediates. Other odours come directly from accepted septic materials and bad handling/management practices. Odours are generated by a number of different components, the most significant being the sulphur containing compounds (thiols, mercaptans, hydrogen sulphide), volatile fatty acids (butyric acid, valeric acid), amines (methylamine, Dimethylamine), phenols (4-methylphenol), etc. (Dawson et al. 1997). Most of these compounds have very low odour threshold concentrations as illustrated in *Table 1.1*. Different concentrations and mixtures of these compounds can intensify or reduce odour threshold concentration, determined as synergism and antagonism respectively.

Table 1.1. Odour detection thresholds of composting odour precursors.

Chemical component	Threshold Concentration (mg m^{-3})
Ammonia	0.03-37.8
Methylamine	0.0012-6.1
Trimethylamine	0.00026-2.1
Hydrogen Sulphide	0.001-0.27
Methyl mercaptan	0.0000003-0.038
Ethyl mercaptan	0.000043-0.00033
Butyric acid	0.0004-42
Valeric acid	0.0008-0.12

O'Neill & Phillips et al. (1992)

1.7 Odour emissions formation from composting operations

The rate of release of odourous compounds into the atmosphere at composting operations is influenced by:

1. Long residence time of accepted input product in containers and on-site;
2. Temperature of accepted raw materials (increased temperature causes increased anaerobic conditions and volatilisation of odourous compounds);
3. The concentration of odourous compounds in the solid phase exposed to air and exposed surface area;
4. Processes that generate turbulence like mixing processes;
5. Excess moisture;
6. Incorrect Carbon:Nitrogen ratio; (i.e. ideal 30:1)
7. Maintenance of oxygen rich levels within the composting operations;
8. Tipping, screening and shredding of raw materials;
9. Non-homogenous aeration and mixing;
10. Inappropriate storage of finished material;
11. This is a non-exhaustive list.

Raw materials for composting can be odourous due to the development of anaerobic zones within the input material. When this raw material is disturbed through tipping, mixing and shredding/mixing operations, pockets of odourous air are released. Inappropriate storage of raw material such as in wet environments can lead to the rapid development of anaerobic material resulting in odourous release. It is important that basic odour management plans are implemented for site operation to prevent such situations from occurring (i.e. get raw material into the process as soon as possible, maintain raw

material under enclosed dry area; avoid acceptance of severely septic raw material). These scenarios should be covered within the acceptance procedure documentation developed for the site.

1.8 Atmospheric dispersion modelling of odours: What is dispersion modelling?

Any material discharged into the atmosphere is carried along by the wind and diluted by wind turbulence, which is always present in the atmosphere. This process has the effect of producing a plume of air that is roughly cone shaped with the apex towards the source and can be mathematically described by the Gaussian equation. Atmospheric dispersion modelling has been applied to the assessment and control of odours for many years, originally using Gaussian form ISCST 3 and more recently utilising advanced boundary-layer physics models such as ADMS and AERMOD (Keddie et al. 1992). Once the odour emission rate from the source is known, (Ou_E s^{-1}), the impact on the vicinity can be estimated. These models can effectively be used in three different ways: firstly, to assess the dispersion of odours and to correlate with complaints; secondly, in a "reverse" mode, to estimate the maximum odour emissions which can be permitted from a site in order to prevent odour complaints occurring; and thirdly, to determine which process is contributing greatest to the odour impact and estimate the amount of required abatement to reduce this impact within acceptable levels (McIntyre et al. 2000). In this latter mode, models have been employed for imposing emission limits on industrial processes, odour control systems and intensive agricultural processes (Sheridan et al., 2002).

1.8.1 Industrial Source Complex 3 (ISC ST3).

The model used is BREEZE Industrial Source Complex version 3. This model is recommended in the Environmental Protection Agency (EPA) guideline on Air Quality Modelling for applications to refinery-like sources and other industrial sources. It is a straight-line trajectory, Gaussian-based model. It was also recently recommended (Complex 1 section) by the Irish EPA to model the potential odour impact from intensive agriculture, mushroom composting and tannery facilities (EPA, 2002). It is used with meteorological input data from the nearest representative source. The most important parameters needed in the meteorological data are wind speed, wind direction, ceiling heights, cloud cover, and Pasquill-Gifford stability class for each hour. ISC ST 3 is run with a sequence of hourly meteorological conditions to predict concentrations at receptors for averaging times of one hour up to a year. It is necessary to use many years of hourly data to develop a better understanding of the statistics of calculated short-term hourly peaks or of longer time averages.

1.8.2 Establishment of odour impact criterion for proposed facility.

Odours from composting operations arise mainly from the volatilisation of odourous compounds generated from non-quiescence processes (i.e. waste tipping and mixing operations, etc). Most of the compounds emitted are characterised by their high odour intensity and ease of detection. Odour impact criteria have been developed for composting odours. A sample of a report carried out in the Netherlands ranking 20 generic and 20 environmental odours according to their like or dislike by a group of people professionally involved in odour management is illustrated in *Table 1.2* (EPA,

2002). This allowed for the establishment of odour impact criterion based on the odours specific hedonic tone characteristics.

Table 1.2. Sample of report ranking 20 environmental odours according to like and dislike (i.e. odour character).

Environmental Odours	Mean Ranking
Intensive agricultural farm	12.8 (Limit value 6.0 Ou_E m^{-3})
Waste water treatment plant	12.9 (Limit value 3.5 Ou_E m^{-3})
Green fraction composting	14.0 (Limit value 3.0 Ou_E m^{-3})
Landfill	14.1 (Limit value 3.18 Ou m^{-3})
Abattoir/Slaughterhouse	17.0 (Limit value 1.50 Ou_E m^{-3})

As can be observed, landfill odours are 8.5% more dislikeable than intensive agricultural odours and wastewater treatment odours and 20% more likeable than Abattoir/Slaughterhouse odours (see *Table 1.2*). Green fraction composting and landfill odours are similar in their dislike ability and therefore it is rational to suggest that a similar odour impact criterion may be used based on these facts. Selection of odour impact criterion can be illustrated through the mean ranking system (i.e. 1.5 Ou_E m^{-3} for Abattoir/slaughterhouse odours with a mean ranking of 17 (very dislikeable) to 3.0 Ou_E m^{-3} for green fraction composting odour with a mean ranking of 14 (more likeable).

Commonly used odour annoyance criteria in Ireland, UK and Netherlands are illustrated in *Table 1.3.* Generally, odour concentrations should be below 6.0 Ou_E m^{-3} for 98th percentile in order to prevent complaints arising from existing intensive pig facilities in Ireland. In Holland, odour concentrations should be below 3.0 Ou_E m^{-3} for the 98th percentile for existing composting facilities. Through extensive intensity relationship studies, an odour impact criterion of 3.0 Ou_E m^{-3} was established for the assessment of the proposed extension of Boghborough landfill, London.

Table 1.3. Odour annoyance criteria for dispersion modelling.

Concentration Limit Ou_E m^{-3}	Percentile value %	Application
Dutch (MPTER and Complex 1 Model)		
≤3.0	98th	Composting facility existing site, rural area or industrial estate.
English (ADMS model)		
≤5	98th	Waste water treatment works Greenfield site,
≤10		Existing WWTP Industrial estate in vicinity
Ireland (ISC ST Complex 1 section)		
≤6.0	98th	Expected level to be achieved by all intensive pig production facilities
≤3.0	98th	Target level to be achieved by all intensive pig production facilities and mushroom compost industry
Germany		
≤4		Waste water treatment works, level at which odour nuisance experienced Frechen (1995).
UK		
≤3.18	98th	Landfill odour impact criterion whereby odour become faint and non-offensive

(McIntyre et al. 2000; EPA, 2002; Longhurst et al. 1998)

If we accept that an odour threshold concentration of 1.0 Ou_E m^{-3} is the level at which an odour is detectable by 50% of the screened panellists. According to research on wastewater treatment works, the odour recognition threshold is approximately 3-5 times this concentration and is liable to cause offence (3-5 Ou_E m^{-3}). An odour impact criterion of ≤ 5 Ou_E m^{-3} is implemented in England for wastewater treatment works (DOE, 1993) and is accepted in planning applications for these facilities to limit odour impact (McIntyre et al., 2000) but this was established with the ADMS software package.

As odours from compost facilities are considered more hedonically unpleasant than odour from intensive agricultural facilities, it would be more prudent to limit the possibilities of odour impact and apply an odour impact criterion of = 3.0 Ou_E m^{-3}.

The current composting operation is operated indoors/in-vessel/outdoors (i.e. waste acceptance, mixing indoors, in-vessel first stage composting and ASP formation and composting). All waste acceptance, mixing and 2 week pre-composting is performed indoors/in-vessel. All second stage composting is performed outdoors. Second phase composting is significantly less odourous than phase one composting (*see Table 3.1*).

Due to the fact that all phase 1 composting is performed in an enclosed in-vessel composting system, it is reasonable to propose an odour impact criterion of 3.0 Ou_E m^{-3} at the 98th percentile for the indoor mixing/blending process and phase 2 maturation process. Any odours emitted from the second phase composting will be greatly reduced in offensiveness potential due to the pre-composting stage carried out in-vessel. It is therefore reasonable to suggest an odour impact criterion of 3.0 Ou_E m^{-3} at the 98th percentile for this process.

In accordance with the odour annoyance criterion above in *Table 1.3*, all residential dwellings should be located outside the = 3.0 Ou_E m^{-3} contour for the 98th percentile for future operations in one worst-case meteorological year as determined by atmospheric dispersion modelling software. It is important to emphasise that the composting facility is surrounded by industrial activities and hence receptors in this area would generally be less sensitive than residences. There have been some recorded complaints at the site over a period of time in the past, which were due to biofilter performance and waste acceptance building management practices.

The following assumptions are made throughout the study

- That no significant amounts of septic raw material are accepted on-site so as to cause offensive odour emissions.
- Raw material is processed and placed within the in-vessel composting system within 24 hours.
- That no raw material is accepted upon site unless sufficient bulking material is on-site to mix with the raw material.
- That good odour management practices are incorporated into the overall running of the facility to prevent any significant odour emission occurring (i.e. limit the occurrence of non-quiescence conditions).
- Meteorological conditions (i.e. unstable, wind speed and wind direction) are considered when carrying out operations upon the site (i.e. turning and screening of ASP material).
- Sufficient pre-composting is carried out to prevent the occurrence of offensive odours that are commonly encountered during composting.
- That the in-vessel composting system air stream is treated within a biofiltration system.
- That pre-composting is carried out for at least 14 days.
- That a closed-door strategy is maintained upon the waste acceptance/mixing/blending building. It is assumed for the case of this dispersion modelling assessment that one door is opened for 8 hours per day while doors 2 is only opened for 20 minutes per hour.
- That heavy-duty plastic curtains are installed upon the inlet and outlet door of the waste acceptance/mixing/blending building to reduce open area. Alternatively air curtains are installed upon the open doors to act as an invisible barrier for odour emissions.

1.9 Methods, processes & Operating Procedures for Composting process

The following operating Hours are currently in use at the composting facility; 8am – 4.30 pm Mon – Friday; 8 am – 12pm Sat.

The general reception of waste can be roughly broken into one quiet week with only the City council delivering and one busy week with both Waterford City and County councils delivering. It is assumed that a busy week to be more odorous and all odour dispersion modelling is based on this operation.

For the reception building, there are three deliveries per day (Mon –Fri) – 40 tonnes raw material. The westerly facing door is opened throughout the day to allow for loading of woodchip. The southerly facing door is opened for 20 minutes per hour.

The blended material is placed within the digester for 14 days. Following the 14-day curing period, the digester is tipped and placed upon the ASP maturation pad. Two digester are tipped per day, which equates to approximately 30 tonnes material tipped per day. The in vessel digesters operate on a 5 minute on, 15 minute off regime giving 15 minutes on per hour or 6 hours on per day. Twenty in vessel digesters are serviced by two biofiltration systems.

There is approximately 1500 tonnes of ASP maturation material sitting on ASP pads at any one time, which are serviced by 8 biofilters. The aeration blowers operating on a 30 minute on, 4 minute off cycle giving just over 21 hours on per day. Two ASP piles are turned per week. ASP 4 weeks into the cycle replace the 8-week mature material and the frequency of turning is twice per week. Turning takes about 4 hours per day. 140 tonnes of material is moved during this turning cycle. ASP material 8 weeks old is screened three days per week and approximately 120 tonnes of material is moved and screened.

1.10 Odourous compound formation in composting facilities

Odour generation from composting operations can occur at many stages of the overall process. These include:

- Raw material acceptance and type of material,
- Mixing of raw materials,
- Types of materials mixed and use to facilitate heat generation (i.e. gypsum can lead to the formation of H_2S, methyl mercaptan and dimethyl sulphide through oxidation and reduction of excess sulphates),
- Turner type and turning frequency,
- Maintaining pre-compost in aerobic conditions and maintaining correct C:N ratio,
- Handling of leachate.

1.11 General rules for reduction of odour emissions from Composting operation by design.

- Ensure that relatively non-septic raw material is accepted into the facility,
- Utilise raw materials within 24 hours and eliminate excess water within raw materials as anaerobic conditions will prevail quickly,
- Accept relatively stable materials,

- Avoid the use of gypsum for heat generation if possible as excess sulphates will generate mercaptans, hydrogen sulphide and sulphides,
- Carry out mixing indoors if possible,
- Avoid turbulent conditions and excess handling during windrows formation;
- Maintain ASP's and pre-composting materials at correct moisture content, oxygen, nutrients and C:N ratio to avoid formation of anaerobic conditions and formation of odourous side products,
- Apply recycled leachate in appropriate manner and avoid conditions that facilitate large inter facial area with recycled liquor (i.e. spraying leachate upon ASP using splash plate or other such techniques) The recycled leachate should be applied evenly and in close proximity to the windrows,
- Ensure clear and concise odour management plans are produced for plant operation and abatement systems (i.e. system operation and maintenance) (Sheridan, 1998, 2000, 2002). These should be integrated into any existing environmental management system where applicable.

2. Materials and methods

2.1 Site location and layout

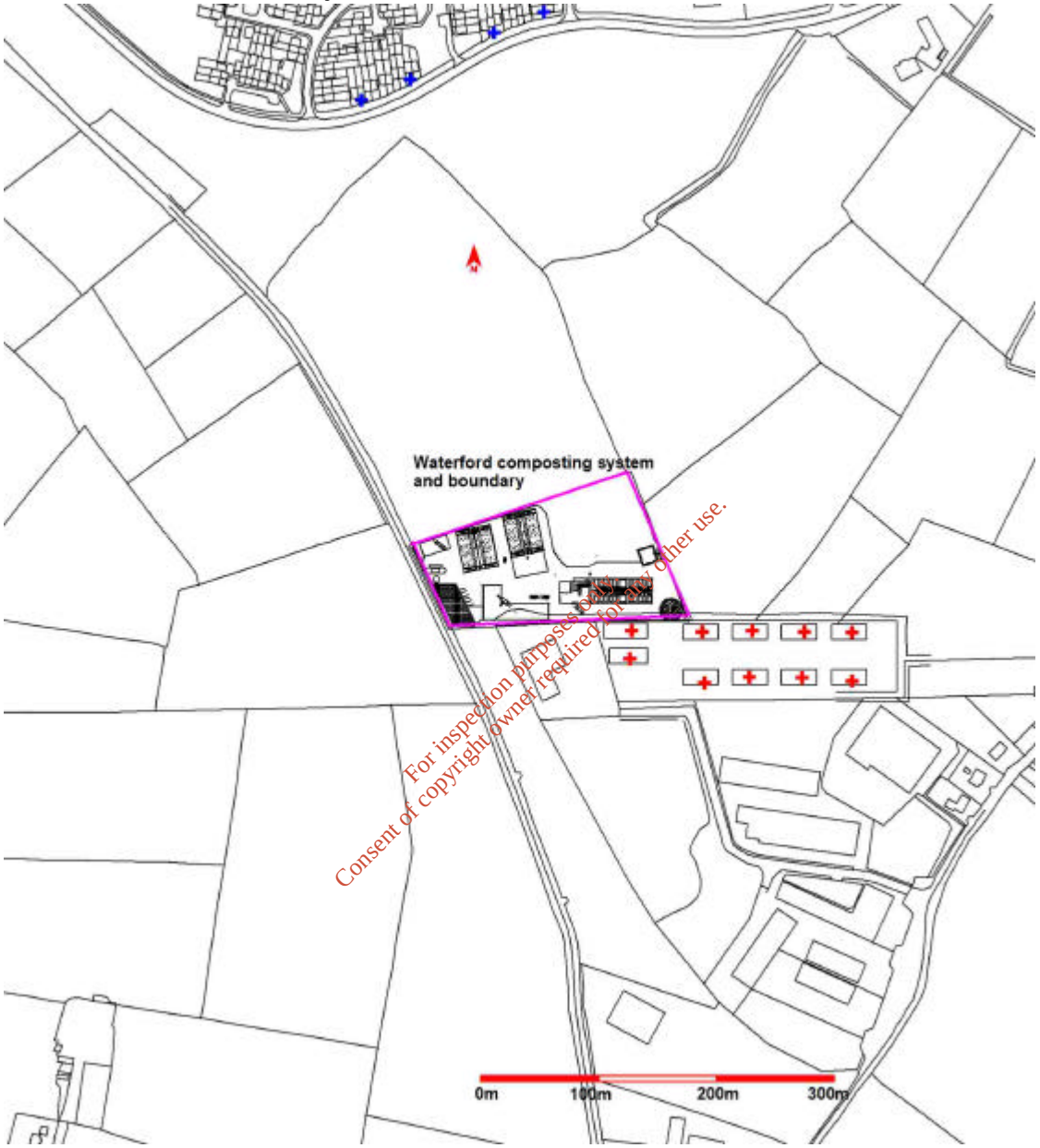


Figure 2.1. Arial diagram of current Waterford City Council composting process, proposed boundary (▬), residents (´) industrial (´).

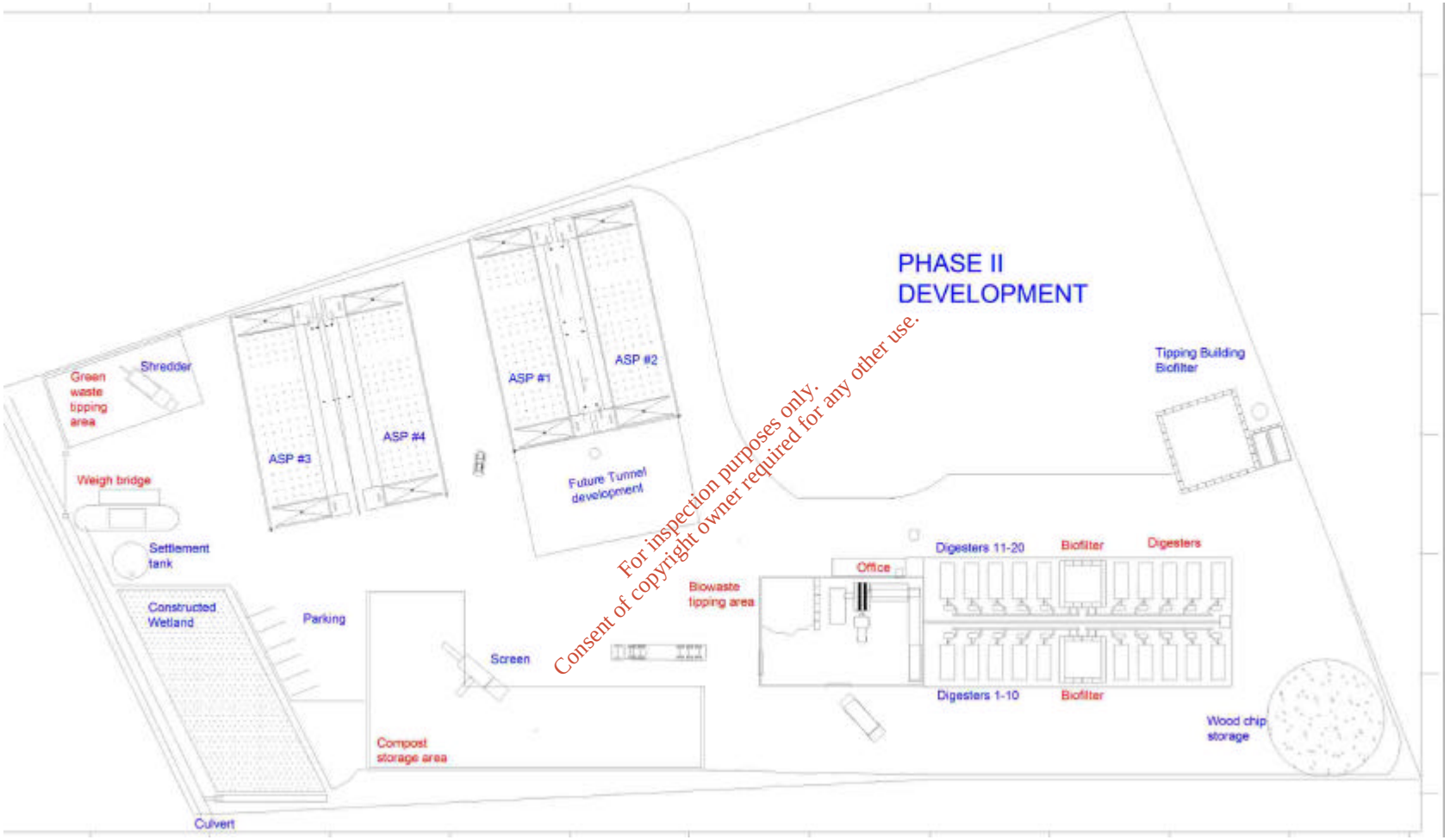


Figure 2.2. Close-up overview of Waterford City Council composting system.

The different distances and directions that the current composting operation is located from the neighbouring industrial facilities and dwellings are presented in *Figure 2.1*. As can be observed the closest industrial units are from approximately 10 to 150 metres from the compost facility boundary in a east north-east direction (meteorologically).

The closest residents are located from approximately 400 to 450 metres from the facility boundary in a south southeast direction (meteorological direction).

2.2 Collection of point source odour samples

In order to obtain air samples for odour assessment, a static sampling method was used where air samples were collected in 60 litre pre-conditioned Nalophan^{NA} bags using a vacuum sampling device over a ten-minute period. The sampler operates on the 'lung principle', whereby the air is removed from a rigid container around the bag by a battery powered SKC vacuum pump at a rate of 5 l min^{-1}. This caused the bag to fill through a stainless steel and PTFE tube whose inlet is placed in the odour stream, with the volume of sample equal to the volume of air evacuated from the rigid container. This prevents any potential contamination of the odour sample as the sample only comes in contact with materials specified in the PrEN13725:2003. A sampling period of 10 minutes was used to eliminate smoothing of cyclic odour emission peaks.

Dust was not removed, as it is considered that dust would not cause a problem during olfactometry. It is expected that any dust particles taken into the Nalophan^{NA} bag will adhere to the inner surfaces of each bag by electrostatic attraction.

The odour emission rate per unit amount of material was determined using this methodology. Once volumetric flow rate, material amount and odour concentration was known, the odour emission rate per unit amount of material could be calculated (Ou_E tonne^{-1} s^{-1}). The odour threshold concentration of the headspace of the building was also determined and by using the formula of Albright and Hellickson, 1990, Baptista et al., 1999, Chow et al., 2000 a volumetric airflow rate of 5 m^3 s^{-1} is calculated for the assumed open door area.

2.3 Collection of area source odour samples

In order to measure the odour emission rate from area odour surfaces a calibrated wind tunnel method was used. This calibrated sampling hood allowed for the accurate determination of odour emission rate from the surface of the tanks. In combination with the point source static sampling method a 60-litre sample over a ten-minute period was obtained (Jiang et al., 2002) (*see Figure 9.1*).

Additionally the outlet of the biofilter was sampled using a SS sampling hood. This consisted of a 1 m^2 sampling hood with a 75mm outlet in order to facilitate airflow rate measurement and efficient sampling of odourous air. The hood was based on designs presented by Bohn, 1993 and optimised (*see Figure 9.2*). The hood also allowed for the efficient measurement of equal air distribution of odourous air through the biofilter thereby isolating areas of possible short-circuiting and inefficient treatment.

2.4 Airflow rate measurement

Airflow rate measurements on the inlet of the wind tunnel, digester biofilters, ASP biofilters, and digester containers were measured using a pitot tube and 65mm vane

anemometer connected to a Testo 400 handheld in accordance with ISO 10780 where possible.

2.5 Measurement of odour threshold concentration

A T08 dynamic dilution olfactometer was used to determine the odour threshold concentration of the emission sources. The odour threshold concentration is defined as the dilution factor at which 50% of the panel can just detect the odour. Only those panel members who pass screening tests with *n*-butanol (certified reference gas, CAS 72-36-3) and who adhered to the code of behaviour will be selected as panellists for olfactometry measurements (CEN, 2003).

The odour threshold concentration is calculated according to the response of the panel members and is displayed in $Ou_E\ m^{-3}$, which referred to the physiological response from the panel equivalent to that elicited by 123µg m^{-3} n-butanol evaporated in one cubic metre of neutral gas (CEN, 2003). Odour units are considered a dimensionless unit, but the pseudo-dimensions of $Ou_E\ m^{-3}$ have been commonly used for odour dispersion modelling, in place of 'grams m^{-3}' (Sheridan, 2003).

2.6 Odour emission rate calculation.

The measurement of the strength of a sample of odourous air is, however, only part of the problem of quantifying odour. Just as pollution from a stack is best quantified by a mass emission rate, the rate of production of an odour is best quantified by the odour emission rate. For a chimney or ventilation stack, this is equal to the odour threshold concentration ($Ou_E\ m^{-3}$) of the discharge air multiplied by its flow-rate ($m^3\ s^{-1}$). It is equal to the volume of air contaminated every second to the threshold odour limit ($Ou_E\ s^{-1}$). The odour emission rate can be used in conjunction with dispersion modelling in order to estimate the approximate radius of impact or complaint (Hobson et al, 1995).

Area source mass emission rates/flux were calculated as either $Ou_E\ m^{-2}\ s^{-1}$ or $Ou_E\ s^{-1}$ depending if they are being represented as discrete point sources or area sources in the atmospheric dispersion model.

Odour emission rate per unit amount of material was calculated from the known odour threshold concentration ($Ou_E\ m^{-3}$) multiplied by known applied volumetric flow rate divided by sampled tonnage to give an emission rate of $Ou_E\ tonne^{-1}\ s^{-1}$. In this situation, the odour generation amount of each tonne of material process is used to calculate the site-specific odour emission rate. This allows the odour impact assessment to account for the handling and processing amounts within the facility.

2.7 Meteorological data.

Three years of hourly sequential meteorology data was used for the operation of ISC ST 3. This allowed for the determination of the worst-case meteorological year for the determination of overall odour impact from the Waterford Composting system on the surrounding population.

2.8 Terrain data.

Upon examination of terrain it was noted that the topography around the proposed site is not complex (i.e. no valley/hills) ranging within ±10 metres. All building wake effects are accounted for in the modelling scenarios (i.e. building effects on point sources) as this can have a major effect on the odour plume dispersion at short distances.

3. Results

3.1 Odour emission data

Three data sets for odour threshold concentration levels and emission rates were used to determine the potential odour impact of the current composting operation and design utilising the individual source odour emission data in *Table 3.1* and *3.2*. These scenarios included:

1. Predicted overall odour emission rate from current composting operations (Scenario 1 & 2) (*Table 3.3*).
2. Predicted overall odour emission rate from current composting operations following implementation of additional odour abatement procedures (Scenario 3 & 4) (*Table 3.4*). It is proposed to negatively extract odour from the waste acceptance biofilter and to secondary treat the odour emissions from the digester biofilters in an additional biofiltration system.

A worst-case odour-modelling scenario was chosen to estimate worst-case odour impact from the current Waterford City Council composting operations.

3.2 Odour emission rates from overall composting processes during current operation.

Table 3.1 and *3.2* illustrates the specific odour emission per unit tonne processed used to determine an overall odour emission rate (Ou s^{-1}) from the current operations. Additionally, odour emission rates were developed for the digester and ASP biofilters and an odour emission flux was calculated for the ASP continuous operation.

Table 3.1 Odour threshold concentrations and hedonic values for each individual process within Waterford City Council composting system.

Odour source[1,3]	Odour threshold conc. (Ou_E m^{-3})	Odour concentration offensive level/Odour descriptor [2]
Raw bio waste WCS01	36,781	2.2 Ou_E m^{-3} (alcohol, dustbin, sour beer, rotten vegetables)
Inlet to digester biofilter-WCS02	27,029	2.4 Ou_E m^{-3} (sour milk, rotten vegetables, domestic waste)
Outlet of digester biofilter-WCS03	5,793	3.1 Ou_E m^{-3} (ammonical, sour wine, rancid, musty)
Inlet to digester biofilter-WCS04	31,350	2.3 Ou_E m^{-3} (rancid butter, sour wine, rotten vegetables, hops)
Outlet of digester biofilter-WCS05	7,883	3.1 Ou_E m^{-3} (sour wine, caramel, burnt)
ASP material 8 weeks old-WCS06	2110	3.4 Ou_E m^{-3} (sweet, brewery hops, caramel)
ASP material 4 weeks old-WCS07	1448	3.0 Ou_E m^{-3} (sour, ammonical, fishy)
ASP material 0 days old-WCS08 (just out of digester vessel)	5,363	2.80 Ou_E m^{-3} (burnt, herbal, ammonical, sweet, rancid)
Inside waste acceptance building-WCS09	1448	2.30 Ou_E m^{-3} (alcohol, rancid, dustbin)
Inside waste acceptance building-WCS10 sample 2	532	2.90 Ou_E m^{-3} (rancid, dustbin, rotten vegetables)
Inlet to ASP3 biofilter-WCS11	25,025	2.60 Ou_E m^{-3} (sour milk, ammonical, rotten vegetables, intense dustbin)
Outlet of ASP3 biofilter-WCS12	8,514	3.10 Ou_E m^{-3} (caramel, sour wine, brown beer (ale))
Inlet to ASP2 biofilter WCS13	13,514	2.90 Ou_E m^{-3} (burnt, rotten vegetables, dank, alcohol)
Outlet of ASP2 bofilter-WCS14	1,689	4.2 Ou_E m^{-3} (caramel, ammonical, rancid, burnt)
Odour threshold flux from ASP2 material-WCS15	211	5.0 Ou_E m^{-3} (ammonical, musty, dank, burnt)
Odour threshold flux from ASP2 material-WCS16	168	4.3 Ou_E m^{-3} (ammonical, alcohol, musty)

Notes: [1] denotes that a known weight of process material was placed into cleaned enclosed vessel and a fixed volume of clean air was passed through the material in order to determine odour threshold concentration per unit volume of material for calculation of odour emission rate during turning, handling and screening processes.

[2] denotes in-house odour intensity and hedonic tone (i.e. pleasant/unpleasant) evaluation of odours.

[3] denotes all samples are blank corrected

Table 3.2. Odour emission rate/flux of specific processes within Waterford composting facility operation.

Odour source	Odour threshold concentration ($Ou_E\ m^{-3}$)	Weight of material sampled (kg)	Volumetric air flow rate ($m^3\ s^{-1}$)	Area of source (m^2)	Odour emission flux/rate (Ou_E tonne $^{-1}\ s^{-1}$)	Odour emission flux ($Ou_E\ m^{-2}\ s^{-1}$)[1]	Odour emission rate ($Ou_E\ s^{-1}$)
Raw bio waste WCS01	36,781	5200	0.11	-	778	-	-
Inlet to digester biofilter-WCS02	27,029	-	0.996	-	-	-	26,921
Outlet of digester biofilter-WCS03	5,793	-	0.996	-	-	-	5767
Inlet to digester biofilter-WCS04	31,350	-	1.21	-	-	-	37,993
Outlet of digester biofilter-WCS05	7,883	-	1.21	-	-	-	9538
ASP material 8 weeks old-WCS06	2110	2960	0.08	-	57	-	-
ASP material 4 weeks old-WCS07	1448	3520	0.125	-	51.4	-	-
ASP material 0 days old-WCS08 (just out of digester vessel)	5,363	3760	0.10		142.6	-	-
Inside waste acceptance building-WCS09	1448	-	5	-	-	-	7240
Inside waste acceptance building-WCS10 sample 2	532	-	5	-	-	-	2660
Inlet to ASP3 biofilter-WCS11	25,025	-	0.393	-	-	-	9834
Outlet of ASP3 biofilter-WCS12	8,514	-	0.393	-	-	-	3346
Inlet to ASP2 biofilter WCS13	13,514	-	0.276	-	-	-	3730
Outlet of ASP2 bofilter-WCS14	1,689	-	0.276	-	-	-	466
Odour threshold flux from ASP2 material-WCS15	211	-	0.011	0.33	-	7.0	-
Odour threshold flux from ASP2 material-WCS16	168	-	0.013	0.33	-	6.60	-

Notes: [1] denotes that a calibrated wind tunnel was used to sample the surface of the material in order to determine an odour emission flux per unit area and time.

3.3 Odour emission rates from current composting operations for atmospheric dispersion modelling Scenario 1 & 2

Table 3.3 illustrates the overall odour emission rate from the current Waterford Council Composting system operations including current odour minimisation procedures.

Table 3.3. Overall odour emission rate from Waterford composting system

Process identity	Odour emission flux/rate (Ou_E tonne^{-1} s^{-1})	Odour emission flux (Ou_E m^{-2} s^{-1})	Area exposed (m^2)/tonnage per week/day	Mixing frequency per week	Odour emission rate (Ou_E s^{-1})	Process characteristics	% Contribution to overall process (%)
Average outlet of digester biofilter 1-WCS03 & WCS05[1]	-	-	-	-	7653[8]	Continuous	12.41
Average outlet of digester biofilter 2-Assumed[1]	-	-	-	-	7653[8]	Continuous	12.41
ASP material 8 weeks old-WCS06[2]	57	-	140/week	Turning takes 8 hours per week-140 tonnes moved in three days-emission factor 0.42 for 1 day.	2931	Intermittent during turning	4.75
ASP material 4 weeks old-WCS07[3]	51.4	-	140/week	Turning takes 8 hours per week-140 tonnes moved in two days-emission factor 0.29 for 1 day.	2087	Intermittent during turning	3.39
ASP material 0 days old-WCS08 (just out of digester vessel)[4]	142.6	-	30 tonnes per day total	2 digesters per day	4278	Intermittent during emptying and mixing	6.94
Average odour emission from waste acceptance building-WCS09 & WCS10[5]	-	-	5 m^3 s^{-1} VLR	Westerly facing doors open 8 hours per day, southerly facing door open 20 min/hour	4950	Continuous for 8 hours per day	8.03
Outlet of ASP3-1 biofilter-WCS12	-	-	-	-	3346[9]	Continuous	5.43
Outlet of ASP2-1 bofilter-WCS14[6]	-	-	-	-	466[10]	Continuous	0.76
Outlet of ASP3-2 biofilter-Assumed	-	-	-	-	3346	Continuous	5.43
Outlet of ASP2-2 biofilter-Assumed	-	-	-	-	466	Continuous	0.76
Outlet of ASP1-1 biofilter-Assumed	-	-	-	-	3346	Continuous	5.43
Outlet of ASP1-2 biofilter-Assumed	-	-	-	-	3346	Continuous	5.43
Outlet of ASP4-1 biofilter-Assumed	-	-	-	-	3346	Continuous	5.43
Outlet of ASP4-2 biofilter-Assumed	-	-	-	-	3346	Continuous	5.43
Average odour threshold flux from ASP2-WCS15 & WCS16[7]	-	6.8	280	-	1904	Continuous	3.09
Average odour threshold flux from ASP1-Assumed	-	6.8	280	-	1904	Continuous	3.09
Average odour threshold flux from ASP3-Assumed	-	6.8	280	-	1904	Continuous	3.09
Average odour threshold flux from ASP4-Assumed	-	6.8	280	-	1904	Continuous	3.09
Storage of screened material	57	-	140	Screening takes 8 hours per week-140 tonnes moved in three days-emission factor 0.42 for 1 day.	3352	Intermittent during screening	5.44
Storage of finished material-Assumed	0.50	-	250 tonnes	-	125	Continuous	0.20
Total	**-**	**-**	**-**	**-**	**61,653**	**-**	**100**

Notes: [1] denotes that the average odour threshold concentration was used to calculate and average odour emission rate from digester biofilter 1 and 2.
[2] denotes ASP material 8 weeks old (at the end of its cycle) progresses to screening. The frequency of screening is 6 hours per day for 3 continuous days per week. 120 tonnes of material is moved and screened per week.
[3] denotes that ASP material replaces 8-week-old material. The frequency of turning takes 4 hours per day for two days. A total of 140 tonnes of material is moved.
[4] denotes that two digester are emptied per day. Emptying takes 2 hours therefore a total of 4 hours are required. A total of 30 tonnes of material are moved in total.
[5] denotes that waste acceptance and blending and mixing is carried out indoors within enclosed building. It is assumed that the building door is kept closed (plastic curtains (to reduce open area) and only opened for 20 minutes in each hour to accept waste material. A conservative building fabric odour reduction efficiency of 30% is assumed based on experience. Using this information and the formula of Albright and Hellickson, 1990, Baptista et al., 1999, Chow et al., 2000 a volumetric airflow rate of 5 m^3 s^{-1} is calculated. Knowing odour threshold concentration within the building, the odour emission rate from this process is determined. The same calculation is used to calculate blending and mixing odour emission rate. The odour source is represented as a volume sources within the dispersion model and emission factors and source characteristics are calculated from known operation (i.e. 8AM to 6 PM) and Volume Source Inputs" in the EPA's User's Guide for the Industrial Source Complex (ISC3) Dispersion Models Volume I - User Instructions (EPA-454/B-95-003a) for guidelines on estimating the initial lateral dimension of various types of volume and line sources.
[6] denotes that on odour emission rate of 3346 and 466 Ou_E s^{-1} were measured from the ASP biofilters. This odour emission rate is assumed for all biofiltrations systems treating odours from the ASP operation. Significant leakage was detected in the vicinity of thee biofilters. These biofilters should be sealed and automated moistening should be incorporated into the preventative maintenance schedule.
[7] denotes that an average odour emission flux of 6.80 Ou_E m^{-2} s^{-1} was measured from the surface of the ASP piles. It is assumed that this odour emissions rate is continuous from the surface of the ASP's.
[8] denotes that the odour removal efficiency of the digester biofilter is 78%. This biofilter should conservatively achieve greater than 90% odour removal through optimisation procedures.
[9] denotes that the odour removal efficiency of the ASP 3 biofilter is 66%. This biofilter should conservatively achieve greater than 90% odour removal through optimisation procedures, which are discussed later in this document.
[10] denotes that the odour removal efficiency of the ASP 2 biofilter is 88%. This biofilter should conservatively achieve greater than 90% odour removal through optimisation procedures, which are discussed later in this document. Significant leakage of untreated air was observed from the ASP biofilters, which are not accounted for in this assessment.

3.4 Odour emission rates from proposed composting operations for atmospheric dispersion modelling Scenario 3 & 4

Table 3.4 illustrates the overall odour emission rate from the new proposed Waterford Council Composting system operations including new additional odour minimisation procedures. It is proposed to improve the odour removal efficiency of the digester and ASP biofiltration system. Additionally, all odourous air from the waste acceptance building will be ventilated to a biofiltration system.

Table 3.4. Odour emission rate from Composting system following implementation of proposed odour abatement procedures.

Process identity	Odour emission flux/rate (Ou_E tonne $^{-1}$ s^{-1})	Odour emission flux (Ou_E m^{-2} s^{-1})	Area exposed (m^2)/tonnage per week/day	Mixing frequency per week	Odour emission rate (Ou_E s^{-1})	Process characteristics	% Contribution to overall process (%)
ASP material 8 weeks old-WCS06[2]	57	-	140/week	Turning takes 8 hours per week-140 tonnes moved in three days-emission factor 0.42 for 1 day.	2931	Intermittent during turning	7.14
ASP material 4 weeks old-WCS07[3]	51.4	-	140/week	Turning takes 8 hours per week-140 tonnes moved in two days-emission factor 0.29 for 1 day.	2087	Intermittent during turning	5.08
ASP material 0 days old-WCS08 (just out of digester vessel)[4]	142.6	-	30 tonnes per day total	2 digesters per day	4278	Intermittent during emptying and mixing	10.42
Outlet of ASP3-1 biofilter-WCS12	-	-	-	-	2130	Continuous	5.19
Outlet of ASP2-1 biofilter-WCS14[6]	-	-	-	-	455	Continuous	1.11
Outlet of ASP3-2 biofilter-Assumed	-	-	-	-	2130	Continuous	5.19
Outlet of ASP2-2 biofilter-Assumed	-	-	-	-	455	Continuous	1.11
Outlet of ASP1-1 biofilter-Assumed	-	-	-	-	2130	Continuous	5.19
Outlet of ASP1-2 biofilter-Assumed	-	-	-	-	2130	Continuous	5.19
Outlet of ASP4-1 biofilter-Assumed	-	-	-	-	2130	Continuous	5.19
Outlet of ASP4-2 biofilter-Assumed	-	-	-	-	2130	Continuous	5.19
Average odour threshold flux from ASP2-WCS15 & WCS16[7]	-	6.8	280	-	1904	Continuous	4.64
Average odour threshold flux from ASP1-Assumed	-	6.8	280	-	1904	Continuous	4.64
Average odour threshold flux from ASP3-Assumed	-	6.8	280	-	1904	Continuous	4.64
Average odour threshold flux from ASP4-Assumed	-	6.8	280	-	1904	Continuous	4.64
Storage of screened material	57	-	140	Screening takes 8 hours per week-140 tonnes moved in three days-emission factor 0.42 for 1 day.	3352	Intermittent during screening	8.17
Storage of finished material-Assumed	0.50	-	250 tonnes	-	125	Continuous	0.30
New biofiltration system treating odourous air from digester biofilters and waste acceptance building achieving greater than 90% odour removal.[1]			7.0 m^3 s^{-1}		6970 assuming 90% removal efficiency and no dilution	Continuous	16.98
Total	**-**	**-**	**-**	**-**	**41,049**	**-**	**100**

Notes: [1] denotes that digester biofilter outlet and waste acceptance building odourous air is passed through additional biofiltration system to achieve greater than 90% odour removal efficiency.
[2] denotes that remediation procedures will improve the odour removal capacity of the ASP biofiltration systems to greater than 90% odour removal. Remediation procedures will ensure the maintenance of an active biofilm within the biofilter medium and ensure even moisturising and even air distribution within the bed medium.

3.5 Results of odour dispersion modelling for the current/future Waterford City Council composting operation and design

ISC ST3 was used to determine the overall odour impact of the current and future-composting operation in Waterford City Council composting facility, as set out in odour annoyance criteria *Table 1.2* and *1.3*. The output data was analysed to calculate:

- Predicted odour emission contribution of overall current composting operation (Scenario 1) (*Table 3.3*), to odour plume dispersal at the 98th percentile for an odour concentration of 3.0 Ou_E m^{-3} using ISC ST3 dispersion model (*Figure 8.1*).
- Comparison between predicted odour emission contribution of individual processes within the composting operation (Scenario 2) (*Table 3.3*), to odour plume dispersal at the 98th percentile for an odour concentration of 3.0 Ou_E m^{-3} using ISC ST3 dispersion model (*Figure 8.2*).
- Predicted odour emission contribution of overall proposed future composting operation (Scenario 3) (*Table 3.4*), to odour plume dispersal at the 98th percentile for an odour concentration of 3.0 Ou_E m^{-3} using ISC ST3 dispersion model (*Figure 8.3*).
- Comparison between predicted odour emission contribution of individual processes within the future composting operation (Scenario 4) (*Table 3.4*), to odour plume dispersal at the 98th percentile for an odour concentration of 3.0 Ou_E m^{-3} using ISC ST3 dispersion model (*Figure 8.4*).
- Comparison between overall odour plume spread for current and future composting operation (Scenario 5), to odour plume dispersal at the 98th percentile for an odour concentration of 3.0 Ou_E m^{-3} using ISC ST3 dispersion model (*Figure 8.5*).
- Comparison between overall odour plume spread for current and future biofiltration operation (Scenario 6), to odour plume dispersal at the 98th percentile for an odour concentration of 3.0 Ou_E m^{-3} using ISC ST3 dispersion model (*Figure 8.6*).

These computations give the odour concentration at each 20-meter x y Cartesian grid receptor location that is predicted for 98% (175 hours) of the year.

This will allow for the predictive analysis of any potential impact on the neighbouring sensitive locations while the current/future composting system is in operation. It will also allow the operators of the composting site to assess the effectiveness of their considered odour abatement/minimisation strategies and consider further abatement on those odour sources contributing significantly to odour plume spread. The intensity of the odour from the two or more sources of the composting operation will depend on the strength of the initial odour threshold concentration from the sources and the distance downwind at which the prediction and/or measurement is being made. Where the odour emission plumes from a number of sources combine downwind, then the predicted odour concentrations may be higher than that resulting from an individual emission source. It is important to note that various odour sources have different odour characters. This is important when assessing those odour sources to minimise and/or abate. Although an odour source may have a high odour emission rate, the corresponding odour intensity (strength) may be low and therefore it is easily diluted. Those sources that express the same odour character, as an odour impact should be investigated first for abatement/minimisation before other sources are examined as these sources are the driving force behind the character of the perceived odour.

4. Discussion of results

The following section discusses the results obtained during the odour dispersion modelling assessment.

4.1 Odour plume dispersal for Scenarios 1 and 2

The plotted odour concentrations of ≤ 3.0 Ou_E m^{-3} for the 98th percentile for the current Waterford City Council composting operation utilising ISC ST3 dispersion model is illustrated in *Figure 8.1* (Scenario 1). As can be observed, it is predicted that current odour plume spread for the operating composting facility is radial with an impact radius of up to 325 metres. The minimum and maximum impact distances recorded during current composting processes is from 220 metres and 410 metres respectively. Twelve industrial units will perceive an odour concentration of between 3 and 38 Ou_E m^{-3} for the 98th percentile. In accordance with odour annoyance criterion in *Table 1.3*, and in keeping with currently recommended odour annoyance criterion in this country for outdoor composting operations (i.e. mushroom composting industry), these industrial units may generate odour complaints especially during meteorological conditions that do not facilitate odour dispersion. Industrial units are generally less sensitive than resident population as industrial facilities are generally closed between the hours of 7 PM till 7 AM.

Figures 8.2 (Scenario 2) illustrate the odour plume spread from individual processes within the operating composting facility. This dispersion modelling scenario allowed for the assessment of individual grouped process impact and facilitated the determination of worst case odour impact distance associated with particular processes within the composting facility. As can be observed, the overall odour impact can be graded as follows for individual processes: Overall operations>Biofiltration>Aerated static pile>Building>Turning operations>Tipping operations. We can conclude that currently, the biofiltration systems, ASP and building operations are the most significant odour emission sources. Since ASP operations are not easy to abate, biofiltration systems and building operations can be manipulated to achieve a reduction in odour impact distance.

4.2 Odour plume dispersal for Scenarios 3 and 4

The plotted odour concentrations of ≤ 3.0 Ou_E m^{-3} for the 98th percentile for the future proposed Waterford City Council composting operation utilising ISC ST3 dispersion model is illustrated in *Figure 8.3* (Scenario 3). The future proposed operation will facilitate waste acceptance, mixing and blending process indoors in a negatively ventilated building. Additionally, a second biofiltration system will be installed on-site to treat combined odour emissions from this building and secondary odour emissions from the digester biofilters. As can be observed, it is predicted that odour plume spread following the implementation of such odour minimisation techniques is significantly reduced with only 8 industrial units perceiving an odour concentration greater than 3.0 Ou_E m^{-3}. Eight industrial units will perceive an odour concentration between 3.0 Ou_E m^{-3} and 12 Ou_E m^{-3} at the 98th percentile. This odour impact reduction equates to a 69% reduction in perceived odour concentration and a 33% reduction in affected industrial facilities. The risks associated with odour impact are reduced and industrial receptors are less likely to complain about odour impact. In accordance with odour annoyance criterion in *Table 1.3*, and in keeping with currently recommended odour annoyance criterion in this country, odour complaints may be generated by these the remaining 8 industrial units. By implementing an odour management plan, the frequency of such complaints can be significantly reduced.

Figures 8.4 (Scenario 4) illustrate the odour plume spread for individual processes for future proposed operations following the implementation of improved odour minimisation procedures. As can be observed, the overall odour impact can be graded as follows for individual processes: Overall operations>Biofiltration>Aerated static pile>Turning operations>Tipping operations>Building operations. We can conclude that currently, the biofiltration systems, ASP and turning operations are the most significant odour emission sources. The building operation (which is located closest to the industrial units) is eliminated as a significant odour emission source. Guidance on operational strategies pertaining to odours can be obtained from this document, the BAT notes for the Waste licensing sector, EPA, County Wexford (www.epa.ie) and the Environment Agency odour guidance and waste management guidance documents, Bristol, UK (www.environment-agency.gov.uk).

4.3 Odour plume dispersal for Scenarios 5 and 6

Figure 8.5 illustrates the odour impact distance reduction achieved for overall processes following the implementation of odour minimisation procedures. As can be observe, an odour impact reduction distance from 40 metres to 120 metres is achieved thereby reducing perceived odour concentration in the vicinity of the facility by up to 69%. This reduces the risks of odour complaints.

Figure 8.6 illustrates the odour impact distance reduction achieved on the biofiltration process by improving overall operation and design. Odour impact distance reductions from 40 to 120 metres is achieved. More importantly, the hedonic tone of the exhaust odour from the biofiltration systems should be changed and significantly more pleasant thereby significantly reducing the capability of this exhaust odour causing complaint. By improving odour hedonic tone, the affected odour impact criterion can be increased from 3.0 Ou_E m^{-3} to 6.0 Ou_E m^{-3} at the 98th percentile.

5. Conclusions

A worst-case odour emission scenario was modelled using the atmospheric dispersion models ISC ST 3 with three years worth of hourly sequential meteorology data representative of the study area. A worst-case meteorological year and worst-case odour emission data was used to predict any potential odour impact in the vicinity of the proposed waste facility. Odour impact potential was discussed for the current/future operation of the composting operations. The following conclusions are drawn:

1. It is predicted that odour impact will be perceived by the industrial units located in the vicinity of the current facility while the composting process is in operation when utilising dispersion model ISC ST3. Twelve industrial facilities will perceive an odour concentration of between 3.0 and 38.0 Ou_E m^{-3} at the 98th percentile in a worst-case meteorological year. All other receptors in the vicinity of the facility will perceive an odour concentration less than 3.0 Ou_E m^{-3}. Odour complaints have been received about the current operating facility. The operators consider both turning/tipping, building door opening and biofilter operation as the major contributors of current odour impact. This can be observed clearly in *Figure 8.2*, whereby individual process impact can be observed.
2. It is predicted that following the implementation of odour minimisation/abatement techniques (i.e. building door operation, maintenance of negative extraction on waste acceptance building, improvement of ASP biofilter operation, installation of additional biofiltration system) proposed by

CCS, odour plume spread is significantly reduced with 8 industrial facilities perceiving an odour concentration of between 3.0 Ou_E m^{-3} and 12 Ou_E m^{-3} at the 98th percentile. This odour impact reduction equates to a 69% reduction in perceived odour concentration and a 33% reduction in affected industrial facilities. The risks associated with odour impact are reduced and industrial receptors are less likely to complain about odour impact.

3. *Figure 8.5* illustrates the odour impact distance reduction achieved for overall processes following the implementation of odour minimisation procedures. As can be observed, an odour impact reduction distance from 40 metres to 120 metres is achieved thereby reducing perceived odour concentration in the vicinity of the facility by up to 69%. This reduces the risks of odour complaints.
4. *Figure 8.6* illustrates the odour impact distance reduction achieved on the biofiltration process by improving overall operation and upgrading the design. Odour impact distance reductions from 40 to 120 metres is achieved. More importantly, the hedonic tone of the exhaust odour from the biofiltration systems should be changed and significantly more pleasant thereby significantly reducing the capability of this exhaust odour causing complaint. By improving odour hedonic tone, the affected odour impact criterion can be increased from 3.0 Ou_E m^{-3} to 6.0 Ou_E m^{-3} at the 98th percentile.

6. Recommendations

The following recommendations are presented:

1. Ensure a clear and concise odour management plan is developed for the site so as to eliminate any significant odour emissions events.
2. The turning of the ASP's as recommended by CCS should maintain appropriate conditions within the composting matrix (i.e. oxygen, moisture and evenly distributed nutrients) and turning should be performed in appropriate meteorological conditions (i.e. unstable, higher wind speeds, clear sky, direction away from the local industrial units).
3. **Biofiltration optimisation:** Currently the biofiltration systems are not performing optimally in terms of odour removal. This may be due to a number of limiting factors including, ammonia loading, cyclic heavy loading of odourous air streams, media selection type, moisture application, essential minerals application and air distribution network. Following an air distribution audit of the surface of the biofilters (namely digester biofilters) it was evident that equal air distribution was not optimised within the media bed matrix. This will essentially lead to short-circuiting and insufficient bed retention time and starving of biofilm where insufficient bed flows are achieved thereby facilitating the emissions of untreated odourous air through the biofilter bed. Following examination of the medium within the biofilter bed the following was evident:
    - No visible bio-film present,
    - Significant ammonia emissions,
    - Limited moisture application,
    - Visible medium degradation.
    - Difference of up to 68% in flow rate through different parts of the digester vessel biofilter beds, visual inspection of steam can act as on-site indicator of uneven flow through the biofilter bed.

It is recommended that the following should be performed to improve the odour removal capacity of the digester biofilters:

- Change medium bed to a 25mm softwood chip size,
- Install sprinkling system at top of biofilter bed,
- Change current air distribution network to false floor design and install baffles on floor edges.
- Purchase Phennings solution and keep reserved onsite for application to medium bed. Phennings solution contains essential minerals and nutrients to maintain healthy biofilm within the biofilter medium.
- Incorporate 8mm cylindrical water based activated carbon within the medium bed to act as reserve for cyclic odour flows. This will damping high odour flows and act as a feedstock during low loading events thereby maintaining healthy active biofilm reducing cyclic shock.
- Setup water addition management plan to leach excess nitrate and ammonia from medium bed on a weekly basis,
- Ideally, as proposed, install water scrubber (i.e. maybe add boric acid) before biofiltration system to scrub ammonia from airstream,
- Ideally, as proposed, a two stage biofiltration system should be installed on the digester vessels namely an inorganic semi biotrickling system (i.e. volcanic rock) and a second stage organic wood chip medium bed with small amounts of water based activated carbon. This will facilitate the removal of ammonia and alkaline based odourous in stage one while stage 2 will remove the acid based odourous based compounds like Volatile fatty acids and low concentration reduced sulphur compounds. A small volume of the dump water from stage 1 can be used as fertiliser for stage 2. Nitrate based nitrogen is preferred to maintain a stable based biofilm and will prevent overgrowth within the biofilm.
- Currently, some of the ASP biofilters are leaking and in need of repair. The air distribution network needs to be optimised while moisture application is absent. The current wood chip been used is from waste wood supplies. These waste wood supplies often contain anti bacterial and fungal agents and do not facilitate good growth of microbes. The chip size is uneven and significant ammonia levels are evident in the outlet air stream. By changing the medium bed to a 25 mm or greater chip size, the excess ammonia and nitrates can be leached from the biofilter on a weekly basis. Significant sealing of concrete panels are required to prevent odourous air from passing out of the biofilters untreated. By performing such changes significant improvement in odour removal capacity can be achieved. Other engineering works such as the scrubbers or trickling filters proposed by CCS would guarantee removal efficiencies greater than 90%.

7. References

1. Baptista, F.G., Bailey, B.J., Randall, J.M., and Meneses, J.F., (1999). Greenhouse ventilation rate: Theory and measurement with Tracer gas techniques. J. Agricultural Engng Resource. 72, 363-374.
2. Callan, B.T., (1993). Noses Knows Best. In malodour measurement and control. Proceedings of the International Tydnall School, September. 134-145.
3. Casey J.C., (2003). Desktop odour impact assessment of the proposed WWTP located in Co. Wexford. Jones Environmental Ireland Ltd. City West Business Park, Naas Rd, Dublin. Performed in accordance with tender specifications and Wexford Co. Co. requirements. Odour Monitoring Ireland.
4. CEN, (2003). prEN13725-Air-quality-Determination of odour concentration by dynamic olfactometry. Brussels, Belgium.
5. Chow. W.K., Fung, W.Y., Wong, L.T. (2002). Preliminary studies on a new method for assessing ventilation in large spaces. Buildings and Environment, 37. 145-152.
6. DOE, (1993). Report by the Inspector on a Public Inquiry into the Appeal by Northumbrian Water Limited for Additional Sewage treatment facilities on land adjacent to Spitial Burns, Newbriggin-by-the-Sea, Northumberland in March 1993. DoE ref APP/F2930/A/92/206240.
7. Dravniek, A., (1986). Atlas of odor character profiles. ASTM Committee on sensory evaluation of materials and products, ASTM data series. Baltimore, MD, USA.
8. EPA, (2001). Odour impacts and odour emission control measures for intensive agriculture. Commissioned by the Environmental Protection Agency (Ireland). OdourNet UK Ltd.
9. Longhurst, P., (1998). Odour impact assessment of an extension to the Brogborough landfill site. IREC, Cranfield University, England.
10. McIntyre, A., (2000). Application of dispersion modelling to odour assessment; a practical tool or a complex trap. Water Science and Technology, 41 (6). 81-88.
11. Sheridan, B.A. (2002). In house odour intensity and hedonic tone profile data of different odourous sources. Unpublished.
12. Sheridan, B.A., (2001). Controlling atmospheric emissions-BAT Note Development, UCD Environmental Engineering Group, Department of Agricultural and Food Engineering, UCD, Dublin 2.
13. Sheridan, B.A., Chadwick, P., (2000). Environmental Impact Statement-Air quality chapter for Clareabbey Wastewater treatment plant. Enfo Head Office, Suffolk Street, Dublin 2, Ireland.
14. Sheridan, B.A., Curran, T.P., Dodd, V.A., (2004). Biofiltration of air: current operational and technological advances. In review. Reviews in Environmental Technology. In review.
15. Sheridan, B.A., Hayes, E.T., Curran, T.P., Dodd, V.A., (2003). A dispersion modelling approach to determining the odour impact of intensive pig production units in Ireland. Bioresource Technology. Published.

8. Appendix I-Dispersion modelling contour results using ISCST3 dispersion model.

8.1 Predicted odour emission contribution of current composting operation (Scenario 1) (*Table 3.3*), respectively to odour plume dispersal at the 98th percentile for an odour concentration of 3.0 Ou_E m^{-3} using ISC ST3 dispersion model.

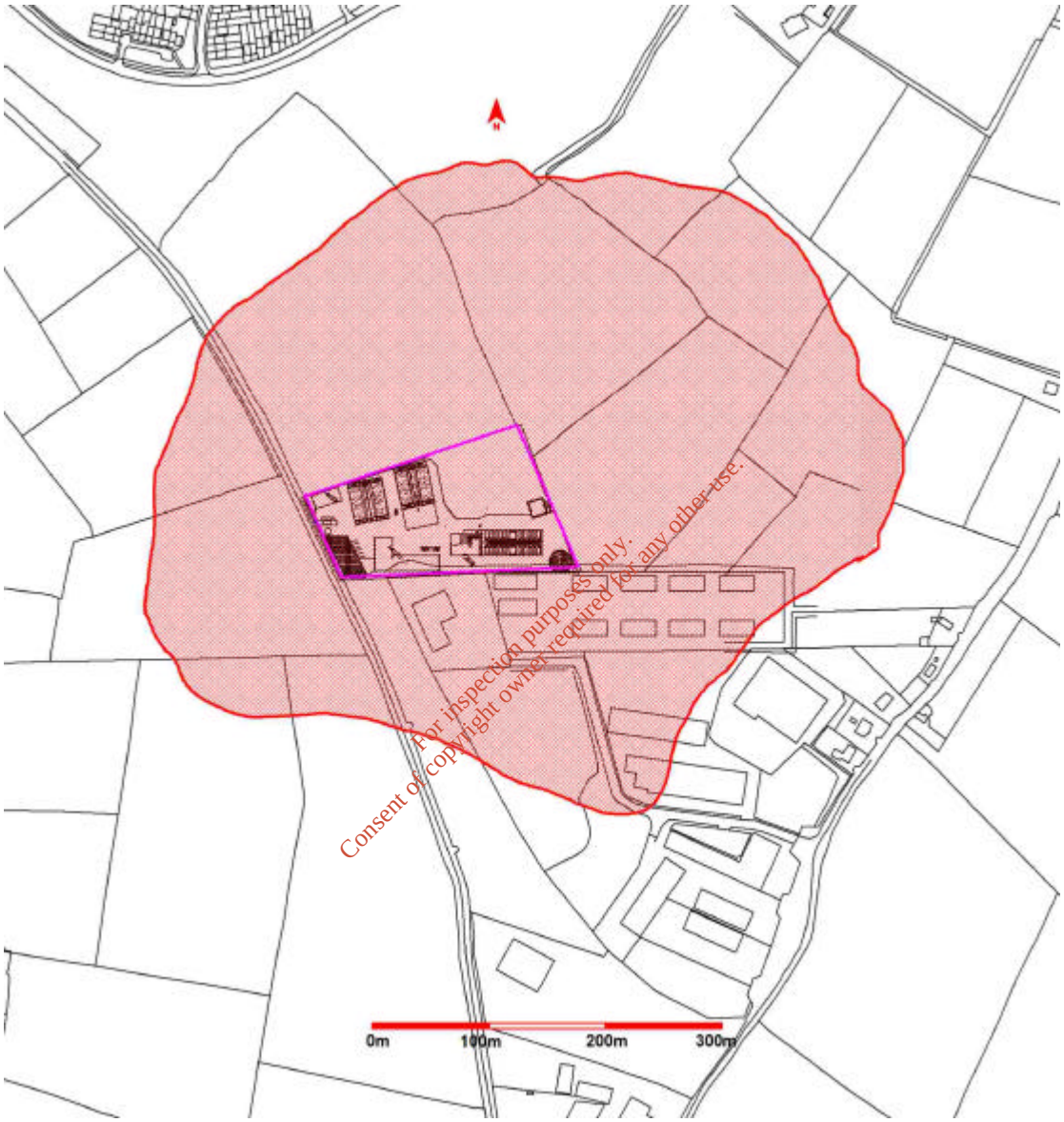


Figure 8.1. Predicted odour emission contribution of current overall composting system to odour plume spread at the 98th percentile for an odour concentration of less then 3.0 Ou_E m^{-3} (——).

8.2 Predicted odour emission contribution of current individual composting processes (Scenario 2) (*Table 3.3*), respectively to odour plume dispersal at the 98th percentile for an odour concentration of 3.0 Ou_E m^{-3} using ISC ST3 dispersion model (tipping and turning process is illustrated at 1.50 Ou_E m^{-3}).

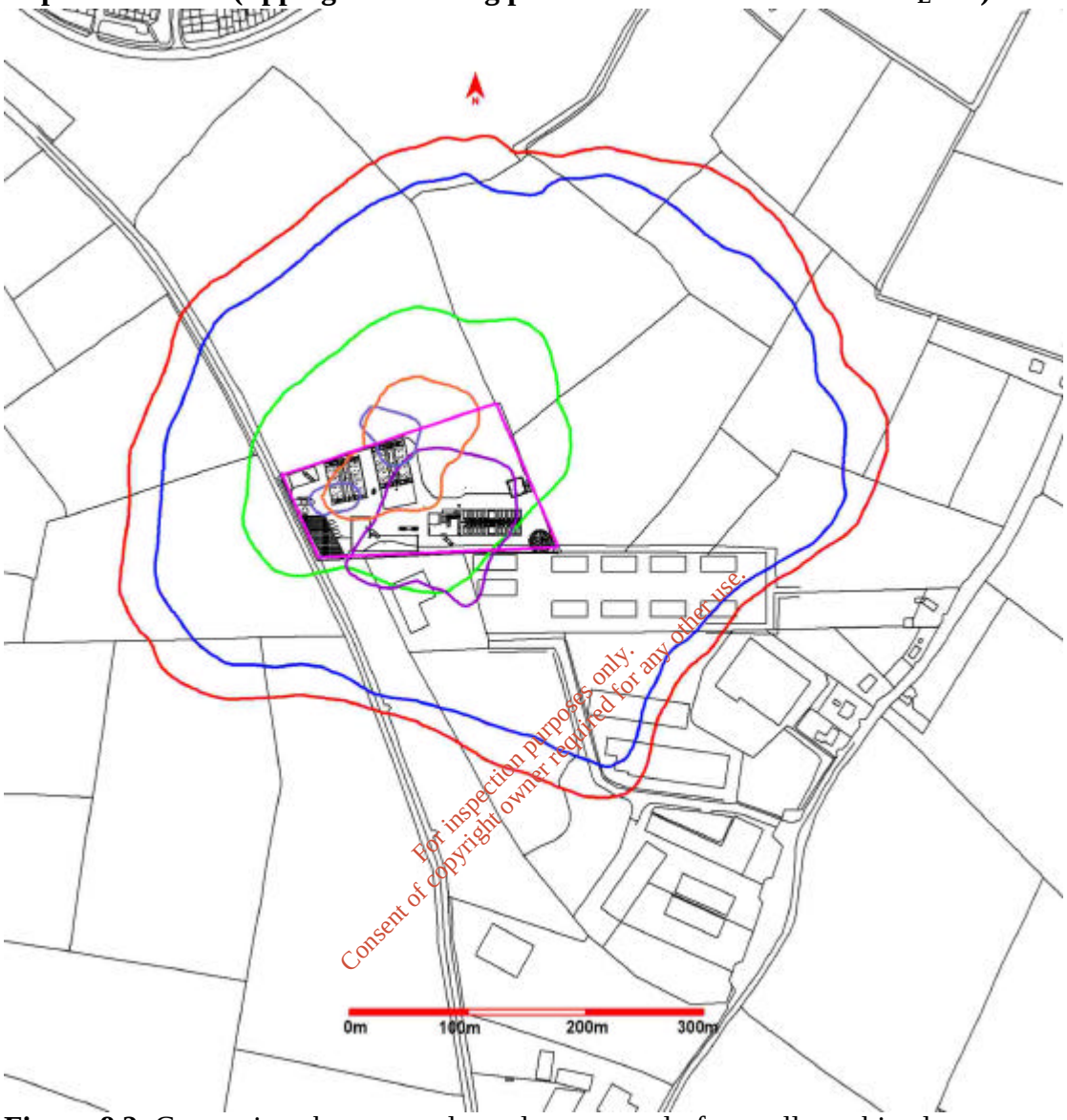


Figure 8.2. Comparison between odour plume spread of overall combined processes (——), biofilter processes (——), aeration static piles (ASP) (——), building emissions (——), tipping operation (——) and turning/screening operation (——) at the 98th percentile for a worst case meteorological year.

8.3 Predicted odour emission contribution of future composting operation (Scenario 3) (*Table 3.4*), respectively to odour plume dispersal at the 98th percentile for an odour concentration of 3.0 Ou_E m^{-3} using ISC ST3 dispersion model.

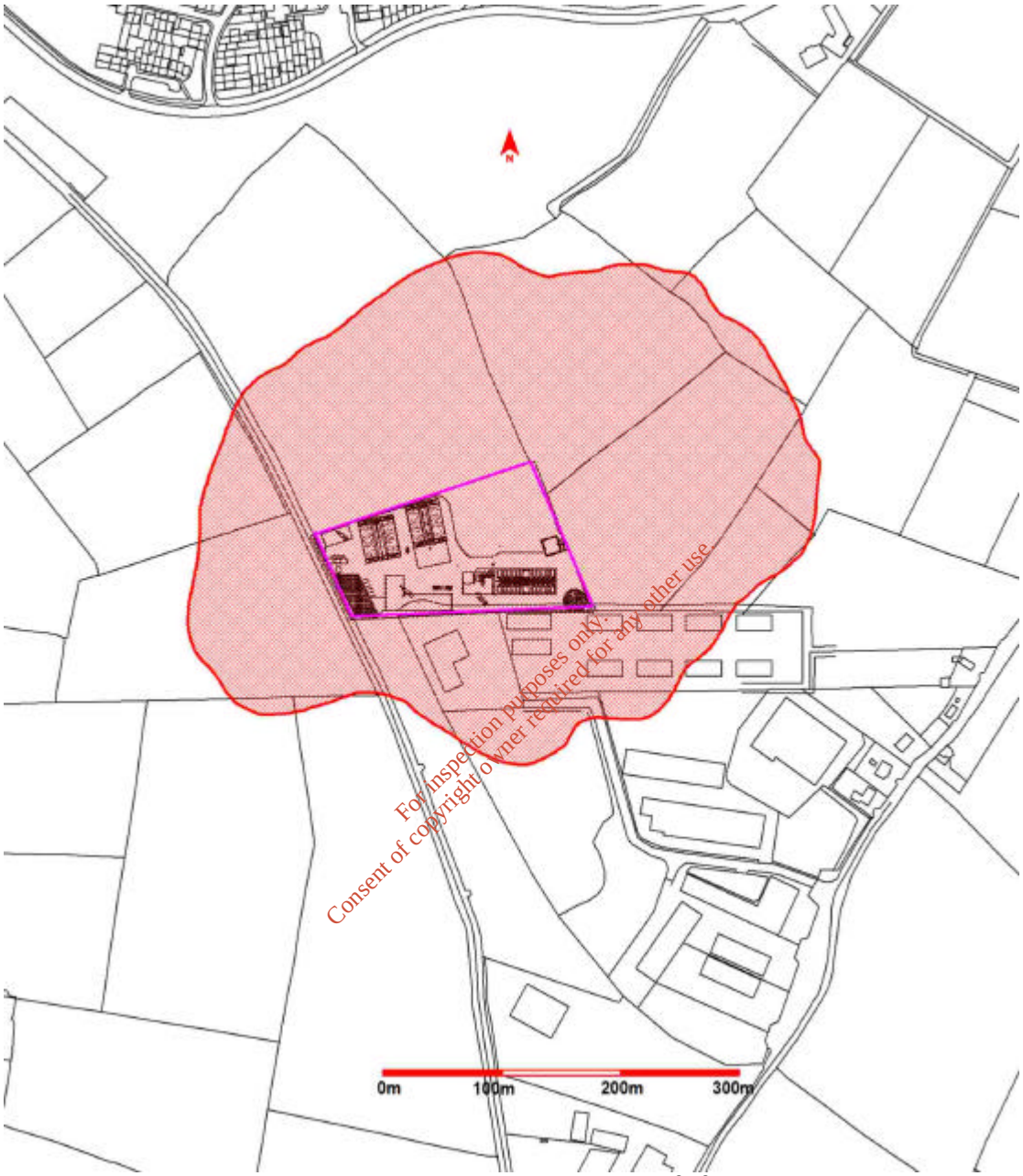


Figure 8.3. Predicted odour emission contribution of future overall composting system to odour plume spread at the 98th percentile for an odour concentration of less then 3.0 Ou_E m^{-3} (——).

8.4 Predicted odour emission contribution of future individual composting processes (Scenario 4) (*Table 3.4*), respectively to odour plume dispersal at the 98th percentile for an odour concentration of 3.0 Ou_E m^{-3} using ISC ST3 dispersion model (tipping and turning process is illustrated at 1.50 Ou_E m^{-3}).

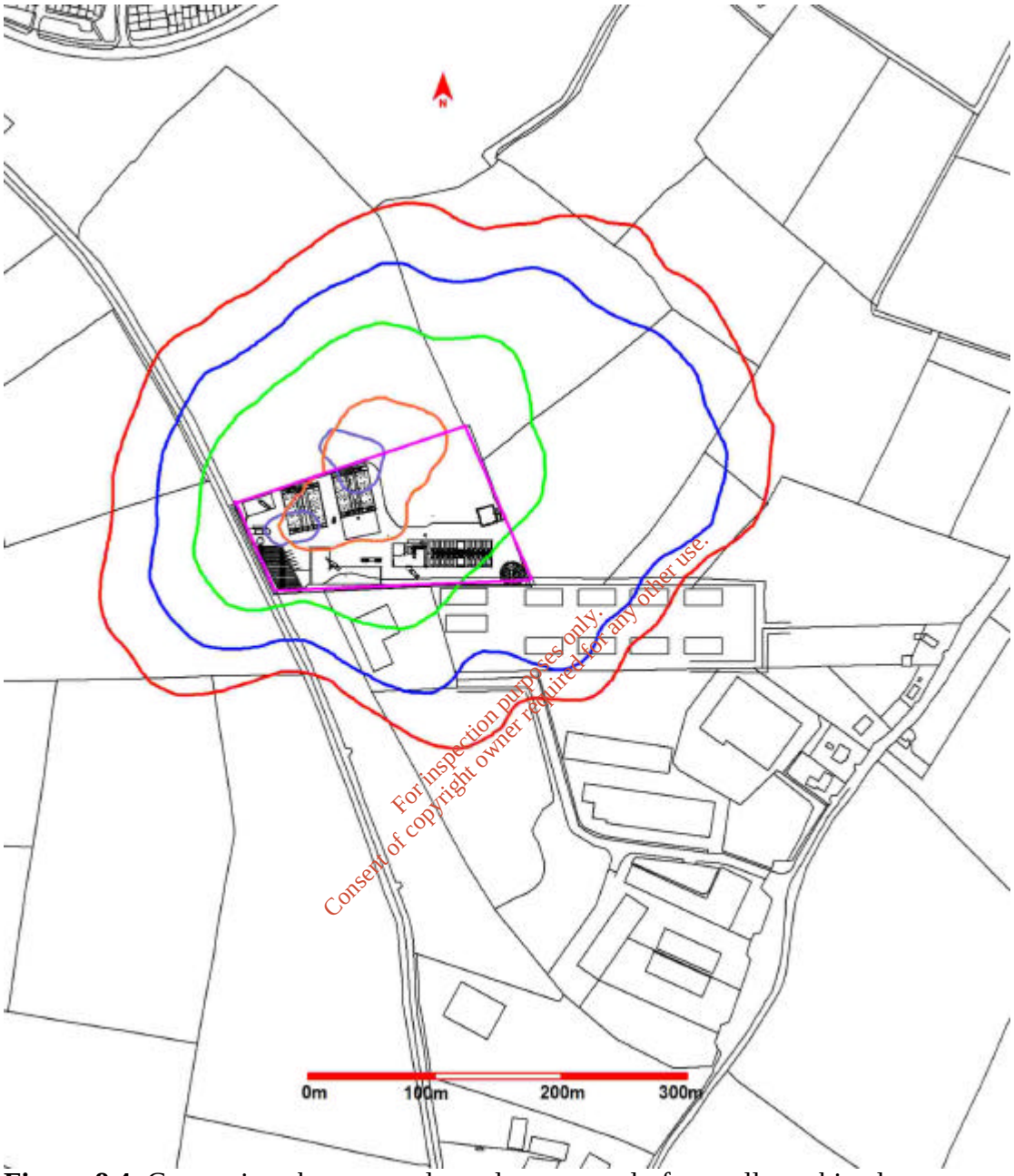


Figure 8.4. Comparison between odour plume spread of overall combined processes (——), biofilter processes (——), aeration static piles (ASP) (——), building emissions (——), tipping operation (——) and turning/screening operation (——) at the 98th percentile for a worst case meteorological year.

8.5 Comparison between odour plume spread for current and proposed future operations (Scenario 5) for an odour concentration of less than 3.0 Ou_E m^{-3} at the 98th percentile.

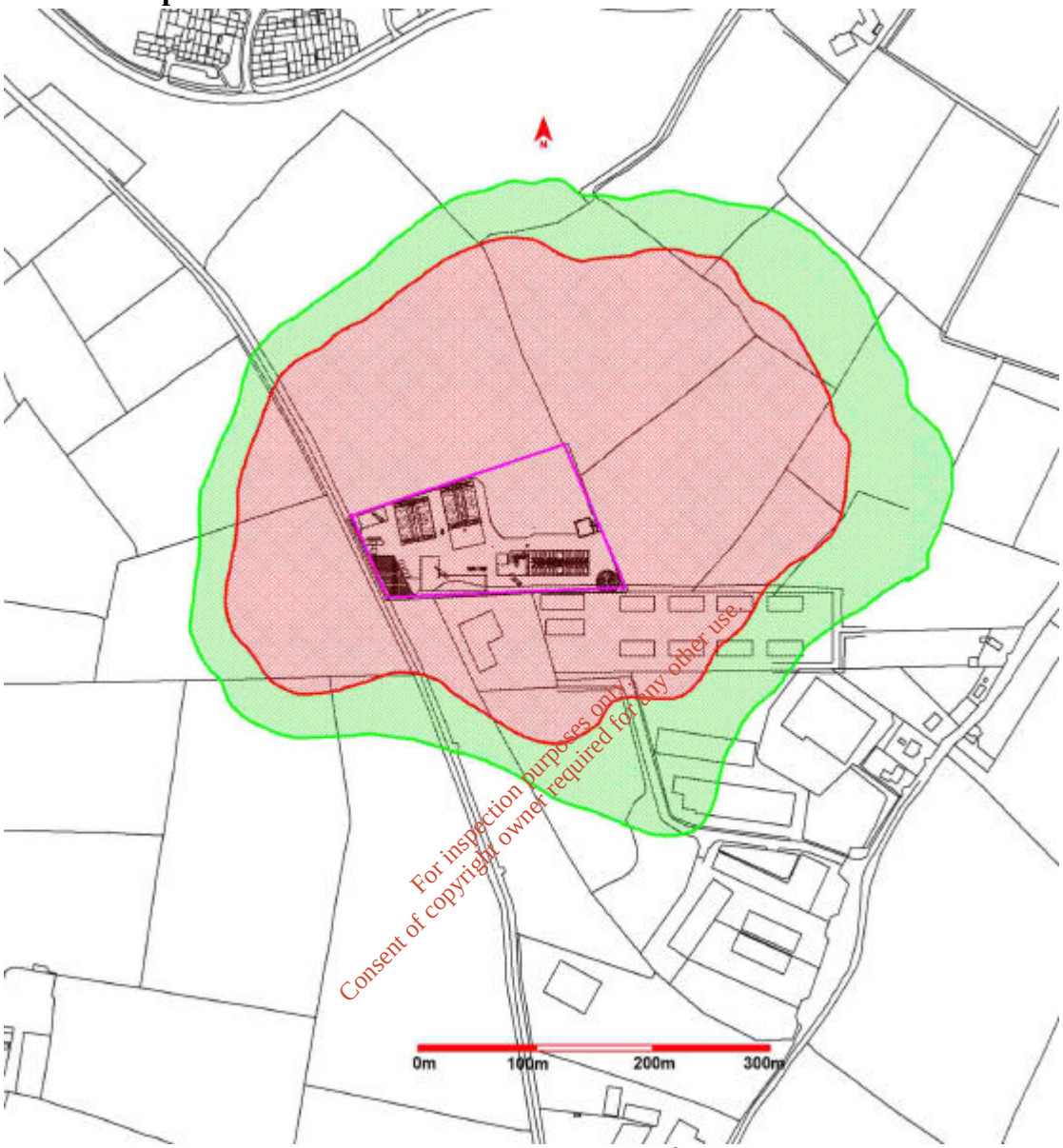


Figure 8.5. Comparison between odour plume spread for current (——) and proposed future (——) operations for an odour concentration less than 3.0 Ou_E m^{-3} at the 98th percentile in a worst case meteorological year.

8.6 Comparison between odour plume spread for current biofilter and proposed future biofilter operations (Scenario 6) for an odour concentration of less than 3.0 Ou_E m^{-3} at the 98th percentile.

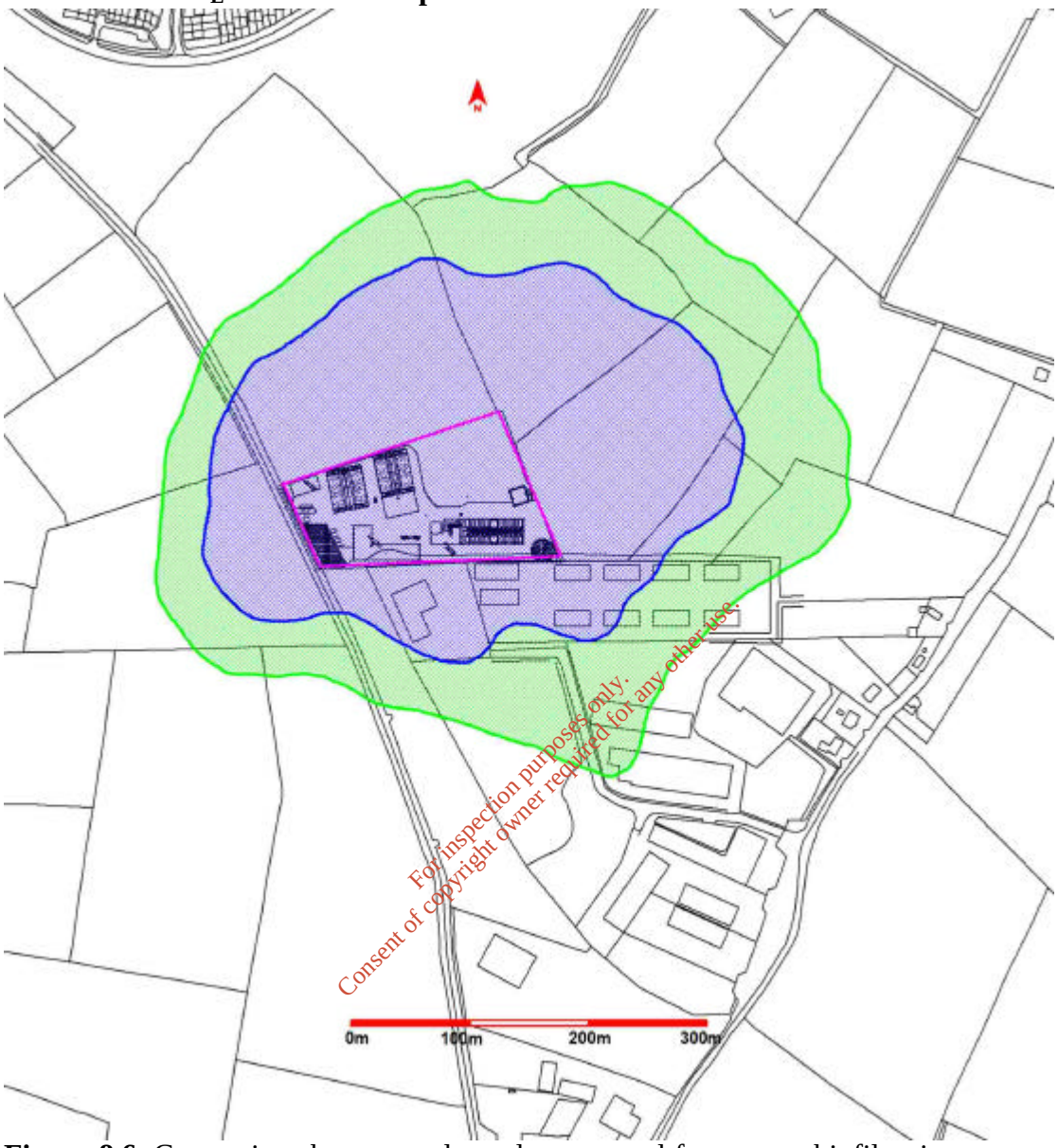


Figure 8.6. Comparison between odour plume spread for current biofiltration system operation (——) and proposed future biofiltration system (——) operations for an odour concentration less than 3.0 Ou_E m^{-3} at the 98th percentile in a worst-case meteorological year.

9. Appendix II-Pictures of equipment

Figure 9.1. Overview of wind tunnel odour sampling system for capturing odours from the ASP's

Figure 9.2. Overview of biofilter hood for capturing odours from the surface of the biofiltration systems. Additionally, the air distribution within the biofilter media was audited to check air distribution performance.

Attachment D

Section L

ATTACHMENT L - STATUTORY REQUIREMENTS

Attachment L.1 – Statutory Requirements

The information submitted in the Waste Licence Application and it's attachments, including the Environmental Impact Statement complies fully with Section 40 (4) [(a) to (i)] of the Waste Management Acts.

Best Available Technology (BAT) will be used throughout the development.

Attachment L.2 Fit and Proper Person

The applicant is Waterford City Council. As a local authority, this section is not applicable.