3.1 Air

3.1.1 Dust

3.1.1.1 Existing Environment

The location of the site is in a rural area. Potential sources of dust include roadside traffic and farming activities. Based on similar sites around the country dust deposition rates are likely to be well below (typically 0 – 60 mg/m^2/day) the normal emission limit value of 350 mg/m^2/day set in waste licences granted by the Environmental Protection Agency. A baseline survey will be carried out prior to waste activities commencing at the facility.

3.1.1.2 Potential Emissions & Likely Impacts

Dust is the potential emission and could be generated from waste operation at the facility. It is unlikely that dust will give rise to a significant impact as all waste operations are to be carried on indoors and traffic movements will take place on hardstanding areas only.

3.1.1.3 Mitigation Measures

Mitigation measures include all waste activities being carried on indoors; roads are constructed of hard base material. A mature landscape around the facility will also alleviate any dust generated.

3.1.1.4 Likely Significant Impacts

It is unlikely that dust will give rise to a significant impact.

3.1.2 Odour

3.1.2.1 Existing Environment

There has been a history of odour complaints in the locality. These were associated with Michell Ireland Ltd. The factory is no longer operational therefore the source of potential odours no longer exists.

3.1.2.2 Potential Emissions & Likely Impacts

There is potential for odours from the composting facility. Such odours if not managed properly could have an impact on the surrounding environment and in particular residences within the vicinity. AES will take all measures to ensure the proper management of odours – this includes incorporation of odour control in the design of the facility and appropriate management of the facility. Odour Monitoring Ireland was requested to carry out an odour impact assessment. The results of this survey, which are attached as Appendix 3.1, indicate there will not be a significant impact from the operation of the facility.

3.1.2.3 Mitigation Measures

The entire composting process occurs within a totally enclosed and controlled environment. The buildings at the facility will operate under negative air pressure. All process air will be extracted and piped through biofilters – a carefully managed natural medium consisting of layers of gravel, compost and wood chips. Microorganisms in the biofilter naturally consume odorous compounds eliminating odours.

3.1.2.4 Likely Significant Impacts
An odour impact assessment indicates there will not be a significant impact from the operation of the facility

3.1.3. Aerosols

3.1.3.1 Existing Environment
Bioaerosol is the term used to describe microorganisms (bacteria, fungi/moulds or viruses) or their products that are airborne. Bioaerosols are naturally present in the air, mainly as soil-borne microorganisms in airborne dust, so everyone is constantly exposed to them. Concentrations change depending on the weather, season and indoors or outdoors. Typical bioaerosol concentrations are greater in rural areas, because of nearby vegetation, than in urban areas. Bioaerosols can result from any process that makes microbially contaminated material airborne. An example in the workplace is contaminated industrial process water. In agriculture, bioaerosols may be created from handling dusty contaminated material such as grain or animal feed, or from animal housing.

At present, there is not a defined means to measure bioaerosols and there are no defined allowable limits for airborne microorganisms or their metabolites.

3.1.3.2 Potential Emissions & Likely Impacts
Composting is a natural process in which microorganisms (fungal/mould spores and certain types of bacteria called actinomycetes) are encouraged to grow to break down waste material. As a result, very large numbers of microorganisms are present in compost and any handling of the material that generates dust will create a bioaerosol. To encourage efficient composting, the piles of material (called windrows) have to be well aerated and therefore are turned regularly. At the end of the process, the compost is often screened (sieved) to produce a quality soil supplement. Both of these activities will create bioaerosols. Since the nearest residential property is approximately 300m away there is unlikely to be an impact.

3.1.3.3 Mitigation Measures
All the waste compost process will take place in doors. Air will be extracted from within the buildings and treated via the biofiltration unit.

3.1.3.4 Likely Significant Impacts
All waste activities will take place in doors and air will be treated via the biofilter unit. These measures should ensure that there is not a significant impact from the operation.

3.1.4 Litter
3.1.4.1 Existing Environment
The location of the site is in a rural area. There does not appear to be any main source with the potential to litter.

3.1.4.2 Potential Emissions & Likely Impacts

Litter is the potential emission and could be generated from waste operation at the facility. It is unlikely that litter will give rise to a significant impact as all waste operations are to be carried on indoors. In addition, all vehicles delivering waste to the facility will be required to have the waste load covered to prevent litter blowing from the load.

3.1.4.3 Mitigation Measures

Mitigation measures include all waste activities being carried on indoors and covering loads of waste being delivered to the facility to prevent litter blowing from the load.

3.1.4.4 Likely Significant Impacts

It is unlikely that litter will give rise to a significant impact.

3.2 Climate

3.2.1 Existing Environment

Data from the nearest Met Éireann stations (Kilkenny and Rosslare) indicate a 30-year (1968-1996) mean annual rainfall of 823mm for Kilkenny and 877mm for Rosslare. Mean monthly rainfall varies from 51mm (June, Rosslare and June, Kilkenny) to 98mm (December, Rosslare) and 89mm (December, Rosslare). The 30-year mean annual wind speed is 11.5 knots (1 metre per second = 1.94 knots) for Rosslare (varies from 9.5 knots, July to 12.9 knots in January) and 6.5 knots for Kilkenny (varies from 5.6 knots, July and August to 7.7 knots in March). Met data for Rosslare indicates that for the 30 year period the prevailing wind direction is from the south-southwest and west direction, and predominantly from the southwest direction.

3.2.2 Potential Emissions & Likely Impacts

Potential emissions include emissions to air and water from the proposed activities. These are dealt with in the sections on air and water.

The nearest resident is approximately 300m from the facility and located to the south west of the facility. This is the predominant wind direction, therefore for the majority of the time this resident will be upwind of the facility.

3.2.3 Mitigation Measures

This is discussed in the relevant emissions section.

3.2.4 Likely Significant Impacts

This is discussed in the relevant emissions section.

3.3 Cultural & Archaeological Heritage

Information from the Environmental Impact Statement submitted, as part of the planning application for the Michell Ireland factory is included as Appendix 3.2.

3.3.1 Existing Environment

The above-referred report concluded that no archaeological features, monuments or stray finds were noted in the fields where the Michell Ireland factory would be sited or in the immediate vicinity. The factory has since been constructed.

3.3.2 Potential Emissions & Likely Impacts

There are no recorded archaeological features therefore there will not be any associated potential emissions.

3.3.3 Mitigation Measures

No mitigation measures are required.

3.3.4 Likely Significant Impacts

There are no recorded archaeological features therefore there will not be any significant impact.

3.4 Flora & Fauna

Information from the Environmental Impact Statement submitted, as part of the planning application for the Michell Ireland factory is included as Appendix 3.3.

3.4.1 Existing Environment

The above-referred report found two species of plants, Greater Pond Sedge and Opposite-leaved Pondweed, which are rare in Ireland, in ditches and the River Suir. Opposite-leaved Pondweed is a protected specie in Ireland. Michell Ireland identified mitigation measures to avoid interference with flora in the ditches where pipe work to the River Suir had to cross. Mitigation measures were also identified in relation to hedges around the facility. Further details on these measures can be found under mitigation measures in the above-referred report. The Report on Flora and Fauna concluded that the construction of the infrastructure relating to the Michell Ireland factory would have little direct ecological impact. The factory has since been constructed including laying of pipes to the River Suir and the planting of trees and shrubs. The operation of the factory has been ongoing up to 2004. This included discharge consents under the IPC licence for treated effluent and storm water to the River Suir.

3.4.2 Potential Emissions & Likely Impacts

Treated effluent from the wastewater treatment plant and uncontaminated surface water collected in the yard and released to the River Suir. This is not likely to have an impact, as existing emission limit values will be used to control the discharge.

3.4.3 Mitigation Measures

The treated effluent and surface water, which is collected in a storm water sump, will be monitored as per Section 4 prior to the release to the River Suir. The proposed facility relates to the existing factory building and surrounding hardstand area. As such there will be no interference with existing hedgerows/plant life therefore no other mitigation measures will be required.

3.4.4 Likely Significant Impacts

The mitigation measure to control treated effluent and collected surface water should ensure that there would be no likely significant impact from the release of treated effluent and collected surface water to the River Suir.

3.5 Human Beings

3.5.1 Existing Environment

The following details on population have been extracted from the 2002 Central Statistics Office, Census Report.

		Ref. No. of Electoral Division in 2002 Census	1996 Persons	2002 Persons	Percentage change 1996-2002
Rural Area	Portlaw	10	1,149	1,081	-5.9
Town	Portlaw*		978	904	-7.6
Rural Area	Fiddown	017	696	684	-1.7

(* = part of Electoral Division 10)

The proposed facility is located at Killowen, Portlaw, County Waterford, which is between Portlaw and Fiddown. The town of Portlaw is 3km from the facility while Fiddown is some 2km away. The 2002 Census indicates both of these areas have experienced a population decrease between 1996 and 2002.

Figure 3.1 shows the location of houses in relation to the facility. Two houses, which based on predominant wind direction are upwind of the proposed facility, are located within 500m of the facility. No house is within 250m of the facility.

3.5.2 Potential Emissions & Likely Impacts

Potential emissions include dust, odour, noise, treated effluent and run-off. These emissions (dust - Section 3.1.1, odour - Section 3.1.2, noise - Section 3.9 and run-off - Section 3.10) and likely impacts are dealt with in the Sections on the topic.

3.5.3 Mitigation Measures

Mitigation measures for the potential emissions have been described in their respective sections.

3.5.4 Likely Significant Impacts

In terms of potential emissions and with the implementation of the mitigation measures, it is not envisaged that the proposal will have a significant impact on human beings. However there will be a positive impact from the development, as it will create employment in the area. It is expected that between twelve and twenty five jobs will be created directly from the start up of the facility.

3.6 Traffic

Information from the Environmental Impact Statement submitted, as part of the planning application for the Michell Ireland factory is included as Appendix 3.4

3.6.1 Existing Environment

The above-referred report indicated that Michell Ireland would have had some 17 heavy vehicles accessing the plant each day. The report concluded that this level of traffic would not give rise to a significant impact. The current proposal is for the acceptance of 100,000 tonnes of waste per annum. A breakdown of the estimated lorry movements into and out of the facility is given below:

Lorry movements into plant:

~ 6 per day into the compost plant (based on acceptance of 40,000 tonnes per annum, a 6 day week and lorries carrying 20 tonnes)

~ 8 per day into the WWTP (based on acceptance of 60,000 tonnes per annum, a 6 day week and lorries carrying 25 tonnes of effluent)

Lorry movements out of plant:

~ 3 per day (based on 20,000 tonnes per annum – includes residual, compost and sludges from wastewater treatment plant, a 6 day week and lorries carrying 20 tonnes)

Total ~ 17 movements

This equates to thirty four lorry movement into and out of the facility, which is equivalent to the lorry movements that previously used the Michell Ireland factory.

3.6.2 Potential Emissions & Likely Impacts

Potential emissions included noise and mud from the vehicles. There is not likely to be an impact as there will be less or equivalent traffic movements to that previously experienced.

3.6.3 Mitigation Measures

The proposed facility will likely have less traffic entering and leaving than the former Michell Ireland factory. Noise should not be an issue since the level of traffic is less than or equivalent to that experienced previously. The vehicles will travel on hard standing roads and areas within the facility so it is unlikely that mud will be a problem. If required a vehicle wash will be provided with resulting water being recycled through the washing unit, or collected and used in the compost process.

3.6.4 Likely Significant Impacts

It is not anticipated that there will be any additional impacts from that encountered previously from traffic entering and leaving the facility.

3.7 Soils, Geology & Groundwater

Information from the Environmental Impact Statement submitted, as part of the planning application for the Michell Ireland factory is included as Appendix 3.5.

3.7.1 Existing Environment

Historic data indicates that the site is underlain by some 30m of overburden overlying weathered limestone bedrock, which is a major aquifer. Michell Ireland abstracted its water needs from groundwater wells. A pumping test carried out as part of Michell Irelands IPC application indicated a drawdown of 1m in the test well for a pumping rate of 900m^3/day. The abstraction caused a drawdown of 0.7m in the observation well associated some 130m from the pumping well. The existing development at the site had no discharges to groundwater, with a wastewater treatment plant used to treat wastewaters and the resulting effluents being discharged to the River Suir. Groundwater quality has been tested as part of the requirements of IPC licence 238. Most recent analysis results are attached (Appendix 3.6).

It is not anticipated that the proposed development will have any discharges to groundwater. Domestic wastewater will be treated on site in the wastewater treatment plant. All uncontaminated water will be collected in a sump before testing and eventual discharge to the River Suir.

3.7.2 Potential Emissions & Likely Impacts

Discharges from the wastewater treatment plant and collected uncontaminated water will be controlled by emission limit values similar to those set in IPC licence 238. These emissions should not have an impact on groundwater.

3.7.3 Mitigation Measures

All fuels stored at the facility will be stored in appropriately bunded areas. No additional mitigation measures are necessary.

3.7.4 Likely Significant Impacts

The proposed development is not likely to have any impact on groundwater.

3.8 Landscape

Information from the Environmental Impact Statement submitted, as part of the planning application for the Michell Ireland factory is included as Appendix 3.7.

3.8.1 Existing Environment

The above-referred report concluded that the visual impact of the Michell Ireland development would be small in the short term and minimal in the long term once proposed landscaping screening became established. The Michell Ireland factory and associated screening has since been established.

One house has been constructed in the vicinity of the proposed facility since the previous EIS was completed. This house is some 300m from the facility. The alternations to the plant will not be visible to this house with the current screening.

The proposed development intends using the existing factory, with some modifications. These are extending the factory to incorporate an enclosed reception/tipping area and the installation of an Eweson digester – the location of these features is shown on Figure 2.3. These additional elements will not have a significant impact on the landscape.

3.8.2 Potential Emissions & Likely Impacts

There are no potential emissions that will interfere with the landscape.

3.8.3 Mitigation Measures

The proposed extension to the factory building will be consistent in terms of colouring with the existing structure.

3.8.4 Likely Significant Impacts

The proposed development will have little additional impact on the landscape.

3.9 Noise & Vibration

3.9.1 Existing Environment

Information on existing noise levels for 2002 and 2003 around the facility have been obtained from data submitted to the Environmental Protection Agency as part of Michell Ireland's IPC licence reporting requirements and are attached as Appendix 3.8. The daytime noise levels are below an L_{ART} value of 55 dB(A), which is the normal guideline level used. It should be noted that these noise levels incorporate the activities being carried out at the Michell Ireland factory.

3.9.2 Potential Emissions & Likely Impacts

The potential emission will be noise from equipment and plant at the facility. Noise sources will include lorries for delivery/removal of waste, operation of the digester, trommel equipment, front-end loader for loading the digester, machinery for turning windrows of compost.

3.9.3 Mitigation Measures

Plant to be used on site will be selected to be of low emission type and to comply with Statutory Instrument No. 320 of 1988 'European Communities (Construction Plant and Equipment) (Permissible Noise Levels) Regulations 1988. All waste operations will take place within buildings.

3.9.4 Likely Significant Impacts

The nearest resident to the facility is some 300m away. The proposed activity will not adversely affect any residence in the vicinity of the facility. Noise from the facility will be maintained within set guideline values and will not exceed daytime (55dB(A)) or night time limits (45dB(A)).

It is not anticipated that there will be any activity carried out which would give rise to vibration affects; as such the likely significant impacts are insignificant.

3.10 Surface Water

3.10.1 Existing Environment

The River Suir is located to the north of the proposed facility. The IPC licence relating to the Michel Ireland Ltd factory includes discharge consents for treated effluent from the wastewater treatment plant and for uncontaminated surface water from a sump (see Figure 3.1 for details). Emission limit values are provided in the IPC licence for the discharge of treated effluent, while a limit range for pH and limit vale for conductivity are provided under which a surface water discharge may be made to the River Suir. In the event that testing of the surface water to be discharged, indicate that the pH is outside the range or the conductivity limit is exceeded the surface water had to be diverted to the wastewater treatment works. The IPC licence required Michell Ireland to carry out monitoring of the River Suir. Results submitted as part of the IPC licence reporting requirements indicates that discharges from the facility are not having an impact on the River. Extracts relating to emission limit values and monitoring requirements from the IPC licence are attached as Appendix 3.9. A licence (Register No. WPW/03/2004) to discharge trade and sewage effluents to waters under the Local Government (Water Pollutions) Act 1977 and 1990 exists for the facility (copy attached as Appendix 3.9).

3.10.2 Potential Emissions & Likely Impacts
The potential emissions are treated effluent and uncontaminated surface water discharged to the River Suir.

3.10.3 Mitigation Measures
The treated effluent and uncontaminated surface water will be monitored as per Section 4 of this EIS.

3.10.4 Likely Significant Impacts
There should not be an impact on surface water with the implementation of the above mitigation measure.

3.11 Materials Assets
3.11.1 Existing Environment
There are private residences, an orchard and farms in the vicinity of the proposed facility. Existing buildings at the site include a factory, which was previously used by Michell Ireland and this building will be modified and used for the proposed composting of waste. A wastewater treatment plant is located onsite.

In terms of services the site is accessed by the R680, which is a regional road. Water supply to the site is obtained from groundwater. The site is also supplied by electricity, telephone and gas.

3.11.2 Potential Emissions & Likely Impacts
Potential emissions from the facility are emissions to air (dust, noise and odours), emissions to ground or water body (treated effluent and uncontaminated surface water) and waste (litter). These emissions have been dealt with in earlier sections.

3.11.3 Mitigation Measures
Measures to deal with the emissions have been dealt with in the relevant sections of this EIS.

3.11.4 Likely Significant Impacts

It is not expected that there will be a negative impact on materials assets by the proposed activity. The building for the proposed operation already exists and is currently not being used. It will be extended and modified slightly. Existing services will be put to use, but it is not expected that this will be to any greater extent than that to which they were previously subjected. There will be a positive impact, as waste, which would have been destined for disposal, will be reduced in volume and turned into a commodity.

3.12 Interrelationships

A number of interrelationships can exist.

- Air emissions (dust, odour, noise) can interact or affect human beings, landscape and material assets.
- Climate can interact or affect air emissions e.g. wind direction and surface water e.g. rainfall and soils, geology and groundwater.
- Cultural heritage can interact or affect human beings.
- Flora and fauna can interact or affect soils, geology, and groundwater; surface water and landscape.
- Human beings can interact or affect air, cultural heritage, flora and fauna, other human beings, soils, geology and groundwater, landscape, surface water and materials assets.

The previous sections of the EIS deal with any potential interaction and specify mitigation measures. It is not expected that there will be any significant impact from the interactions as a result of the proposed activity.

Placeholder

This page has been inserted to indicate that content has been extracted from this location in the document and has been stored in a separate file. (This is due to file size issues.)

The extracted content can be found in the following electronic pdf file:

EIS-Drawing-8

Licence: W0212-01

Appendix 3.1

- Odour Report.

ODOUR monitoring IRELAND

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 PROPOSED WASTE MANAGEMENT FACILITY, PORTLAW, CO. WATERFORD.

PREPARED BY:	Dr. Brian Sheridan
ATTENTION:	AES Ireland Ltd
DATE:	31st October 2004
REPORT NUMBER:	2004.A72
DOCUMENT VERSION:	Draft Document Ver. 003
REVIEWERS:	Mr. Peter Carey

TABLE OF CONTENTS

EXECUTIVE SUMMARY

Odour Monitoring Ireland was commissioned by AES Ireland Ltd to carry out an odour impact assessment of the proposed composting and waste water treatment plant (WWTP) operations to be located in Portlaw, 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 consultation with AES Ireland Ltd and were used to construct the bases of the modelling assessment. Odour emission rates were calculated from library based olfactometry data. Dual dispersion modelling using both ISC ST3 and AERMOD Prime was used to identify the odour sources contributing greatest to odour impact 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 proposed waste facility. Odour impact potential was discussed for the proposed operation of the composting and WWTP. The following conclusions were drawn:

1. It is predicted that no significant odour impact will be perceived in the vicinity of the facility during proposed operation when utilising dispersion model ISC ST3 with all residents perceiving an odour concentration less than 3.5 $Ou_E\ m^{-3}$ at the 98^{th} percentile in a worst case meteorological year;
2. It is predicted that no significant odour impact will be perceived in the vicinity of the facility during proposed operation when utilising dispersion model AERMOD Prime with all residents perceiving an odour concentration less than 3.5 $Ou_E\ m^{-3}$ at the 98^{th} percentile in a worst case meteorological year;
3. It is predicted that ISC ST3 predicts higher perceived odour concentrations and a greater odour impact area when utilising identical meteorological, terrain, odour input data and model build characteristics. This is probably due to the less accurate assessment of dispersion in more complex building and topographical sites.

It was recommended:

1. To ensure the biofiltration system is designed so as to allow good air distribution, media moistening, access to sprinklers, low face velocity, correct retention time, ideal media and supply of essential minerals and nutrients. This will ensure good performance.
2. To maintain good housekeeping practices (i.e. keep yard area clean and tidy, etc.), closed-door management strategy and to implement an odour management plan for the operators of the WWTP.
3. To avoid accumulation of floating debris and persistent sediments in holding tanks by design (balancing tanks, etc.).

4. To maintain quiescence conditions within WWTP so as to eliminate puff odour emissions.
5. To ensure all sludge-handling processes are operated in order to prevent any significant odour emissions.
6. To operate WWTP within specifications to eliminate overloading and under loading, which may increase septic conditions within the SBR aeration basins.

1. Introduction

Like the majority of industrial and processing facilities, the proposed operations of AES Ireland Ltd to be located in Portlaw, Co. Waterford is faced with the issue of preventing odours causing impact to the public at large. The proposed operations will use both conventional wastewater treatment technology and advanced composting techniques to process wastewater, solid waste and sludge's. Utilising odour emission data and atmospheric dispersion modelling techniques, the predicted overall odour impact of the proposed operations can be determined. The key odour impact sources are identified and assessed. In order to eliminate any error in the estimation of the odour emission rate from the composting operations, it was assumed that all odourous air would be passed through a fixed bed biofiltration system with a maximum volumetric flow rate of 47.20 $m^3 s^{-1}$ and odour concentration of 500 $Ou_E m^{-3}$. Standard library odour emission rates were used for the wastewater treatment plant (WWTP) operations. Contours of odour concentrations for the 98^{th} percentile are predicted around the proposed composting and WWTP 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 proposed operation, residences in the vicinity of the composting and WWTP will perceive an odour concentration of $\leq$ 3.5 Ou_E for less than 175 hours (i.e. 98^{th} percentile) in a worst-case meteorological year for ISC ST3 and AERMOD Prime dispersion models, respectively. In comparison with the odour annoyance criterion in *Table 1.2* and *1.3,* no significant odour impact will be perceived by residents in the vicinity of the proposed facility and operations.

1.1 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).

1.2 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).

1.3 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.

1.4 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.

1.5 Characteristics of WWTP and Composting odours

Odours from wastewater treatment plants and composting arise mainly from the uncontrolled anaerobic biodegradation of proteins and carbohydrates to produce unstable intermediates. Other odours come directly from industrial wastewater (solvents, volatile organic compounds, petroleum derivatives) or indirectly from warm, highly degradable sulphurous effluents (Burgess et al. 2001). 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), chlorinated hydrocarbons (trichloroethylene, tetrachloride), 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 waste water odour precursors.

Chemical component	Threshold Concentration (mg m^{-3})
Ammonia	0.03-37.8
Methylamine	0.0012-6.1
Trimethylamine	0.00026-2.1
Indole	0.0006-0.0071
Scatole	0.00035-0.00078
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)

1.6 Odour emissions formation from WWTP's and Composting operations

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

1. Long residence time of waste water in process;
2. Temperature of mixed liquor (increased temperature causes increased anaerobic conditions and volatilisation of odourous compounds);
3. The concentration of odourous compounds in the liquid phase exposed to air;
4. Processes that generate surface turbulence;
5. Total air/surface wastewater interface area;
6. Maintenance of oxygen rich conditions within the wastewater handling and treatment operations.
7. Tipping, screening and shredding of raw materials;
8. Mixing operations;
9. Non-homogenous aeration;
10. Inappropriate storage of finished material;
11. This is a non-exhaustive list.

Raw wastewater has high concentrations of odourous substances. Processes that create surface turbulence and high rates of interface renewal have much higher emission rates and volatilisation of odourous compounds than quiescent processes as these processes allow for the change in the partial pressure at the surface interface and the mass transfer of the odourous compounds to the gaseous phase.

Raw materials for composting can be odourous due to the development of anaerobic zones within the waste. When this raw material is disturbed through tipping, mixing and shredding operations, pockets of odourous air are released. Inappropriate storage of raw material such as 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 activities from occurring.

1.7 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).

1.7.1 Industrial Source Complex 3 (ISC ST3).

The model used is BREEZE Industrial Source Complex version 3. This model is recommended in 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.

1.7.2 AERMOD Prime

The model used is BREEZE AERMOD Prime. This model is a third generation model utilising advanced boundary-layer physics. The most important parameters needed in the meteorological data are wind speed, wind direction, Monin Obukhov length, mechanical mixing height, friction velocity, etc. for each hour. AERMOD is run with a sequence of hourly meteorological conditions to predict concentrations at receptors for averaging times of one hour up to a year. 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. Utilities associated with the dispersion model allow computation of ground level concentrations of pollutants over defined statistical averaging periods, consideration of building wake/downwash effects and the effects of elevated terrain in the vicinity of the plant.

1.7.3 Establishment of odour impact criterion for proposed facility.

Odours from WWTP's and composting operations arise mainly from the volatilisation of odourous compounds generated from non-quiescence processes (i.e. pumping of wastewater, displacement of odourous air due to flow of influent liquid/sludge, 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 WWTP's and composting odours. All odourous air from the composting process will be passed through a biofilter. The odour emanating from a working biofilter is generally a musty/woodchip odour and not offensive when the biofilter functions properly. Generally, an odour impact criterion of 6.0 Ou_E m^{-3} can be used for biofilter odours when the biofilter is achieving sufficient odour removal and performance. 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, 5.0 and 6 Ou_E m^{-3})
Landfill	14.1 (Limit value 3.18 Ou m^{-3})

As can be observed from the report, intensive agricultural odours are 0.5% more likable than wastewater treatment plant odours, while landfill odours are 6% more dislikable than wastewater treatment odours (see *Table 1.2*). Based on these facts, it is rational to suggest similar dislike ability will be associated with intensive pig production and WWTP odours while landfill odour are much more dislikeable than waste water treatment odour.

Commonly used odour annoyance criteria in Ireland, UK and Netherlands are illustrated in *Table 1.3*. An odour threshold concentration of 1 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. Generally, odour concentrations should be below 6 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 3.5 Ou_E m^{-3} for the 98th percentile for wastewater treatment plants and this is shown through its greater dislike ability to intensive agricultural odours (*see Table 1.2*). As the proposed WWTP and composting operations are located within a rural area, it is rational to suggest an odour impact criterion of 6.0 Ou_E m^{-3} at the 98th percentile for this facility would suffice.

Table 1.3. Odour annoyance criteria for dispersion modelling.

Concentration Limit $Ou_E\ m^{-3}$	Percentile value %	Application
Dutch (MPTER and Complex 1 Model)		
≤3.5	98^{th}	Wastewater treatment works existing site, rural area or industrial estate.
English (ADMS model)		
≤5	98^{th}	Waste water treatment works Greenfield site,
≤10		Existing WWTP Industrial estate in vicinity
Ireland (ISC ST Complex 1 section)		
≤6.0	98^{th}	Expected level to be achieved by all intensive pig production facilities
≤3.0	98^{th}	Target level to be achieved by all intensive pig production facilities
Germany		
≤4		Waste water treatment works, level at which odour nuisance experienced Frechen (1995).
UK		
≤3.18	98^{th}	Landfill odour impact criterion whereby odour become faint and non-offensive

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

In accordance with the odour annoyance criterion above in *Table 1.2* and *1.3* and in keeping with recommendations for other industries all residential dwellings should be located:

- Outside the ≤ 6.0 $Ou_E\ m^{-3}$ isopleth (i.e. odour contour) for the 98^{th} percentile for all odour emissions from the facility;
- Outside the ≤ 3.5 $Ou_E\ m^{-3}$ isopleth (i.e. odour contour) for the 98^{th} percentile for the WWTP odour emissions;

It is assumed

- That all odourous air from the composting operations are negatively ventilated to a biofiltration system achieving good performance in terms of odour character change (i.e. hedonic tone) and removal efficiency;
- That balancing tank 2 is aerated;

- That no severely septic wastewater is accepted so as to cause offensive odour emissions.

1.8 Proposed methods, processes & Operating Procedures for Composting process

1.8.1 Tipping Area

During normal weekday operation, waste will be tipped onto the floor. Solid waste and sludge will have separate dedicated areas. Any oversize items will be manually removed prior to the waste being sorted (if not pre segregated), mixed (solid waste and sludge) and loaded into the digester. Towards the end of the week, waste will be stockpiled in the Tipping Area to allow continuous processing over the weekend when there are no deliveries. The storage area would have sufficient capacity for 1 to 2 days waste therefore the facility would require deliveries over 6 days per week. The Tipping Area will be maintained under negative air pressure and the delivery entrance will be provided with automatic roller shutter doors.

1.8.2 Eweson Digesters

The selected composting process will be the Bedminster process. The core of the Bedminster process is the 'Eweson Digester', a revolving compartmentalised aerobic drum that accelerates the natural process of biological decomposition. Solid waste and sludges are fed into the digester in optimum balance. Temperature and moisture are controlled to encourage a dense and varied microbial population. All of the waste in the Eweson Digester is constantly turned and aerated to ensure total waste sanitation. The digester will be turned at a rate of approximately 1 rpm by hydraulic motors. The patented Eweson Digester contains three separate compartments with the waste material being retained for 1 day in each section. Within 3 days, the organic fraction is transformed into a new product. The rough compost is automatically unloaded onto a conveyor and is screened through a trommel screen to remove large residues, which will go for further recycling or disposal to an appropriate facility. The cleaned rough compost will then be transferred to the Aeration Hall.

1.8.3 Aeration Hall

For the next 21 days, the product undergoes controlled secondary composting and curing in the aeration hall before final screening. The material will be turned on a frequent basis. This will ensure that aerobic conditions are maintained within the enclosed windrows. The temperature and moisture content levels of the composting material will be monitored and adjusted to obtain optimum maturation.

Air will be circulated through the windrows by forcing air from the Fan Arrays up through the aeration floor into the base of the windrows. Leachate from the maturing compost will be collected under the aeration floors for treatment at the onsite wastewater treatment plant. The composting process consumes water therefore the treated effluent may be reintroduced to the process. The Aeration Hall will be maintained under negative air pressure to ensure that none of the process odours can escape. All process air will be treated by the biofilters prior to release to atmosphere. Once the compost has matured sufficiently it will be further screened to remove any remaining large particles.

1.8.4 Biofilter

The entire composting process occurs within a totally enclosed and controlled environment. All odourous air from the buildings and process passes through biofilters – a carefully managed natural medium that can consist of layers of gravel, compost and /or wood chips. Through adsorption and absorption processes, microorganisms attached to the biofilter medium naturally consume odourous compounds thereby treating and purifying the inlet odourous air. The biofilter will measure approximately 1000 m^2. All process air will be extracted from the Tipping Area, Eweson Digesters, and Aeration Hall and piped to the biofilter from where it will discharge to atmosphere. No odourous air will be allowed to escape from the composting process.

1.9 Wastewater Treatment Plant Process

The WWTP operates on the sequencing batch reactor (SBR) process, which is a form of activated sludge treatment in which aeration, settlement, and decanting can occur in a single reactor. The process employs a five-stage cycle: fill, react, settle, empty and rest. Wastewater enters the reactor during the fill stage; it is aerobically treated in the react stage; the biomass settles in the settle stage; the supernatant is decanted during the empty stage; sludge is withdrawn from the reactor during the rest stage; and the cycle commences again with a new fill stage.

The wastewater to be treated, typically from the following industries - brewery and food processing, will be brought to the site by enclosed tankers where it will be pumped into the reception tank. It will then be pumped into an aerated balancing tank (e.g. Tank No. 2). Wastewater that may be high in solids content will be pumped into balancing tank 1 where it will be passed through the centrifuge and then pumped back into balancing tank 2 for process through the system. All wastewater from balancing tank 1 will be pumped into either aeration tank 1 or 2. Sludge draw off from both aeration tanks will be pumped back into the sludge holding tank.

1.10 Odourous compound formation in wastewater treatment plants

The formation of odourous components at wastewater treatment plants is usually limited to reception, settlement processes and to the areas of sludge handling, particularly during the handling of primary sludge. Under anaerobic conditions, the untreated primary sludge will readily decay, producing odourous components in the process. The possibility for anaerobic conversion of surplus activated sludge depends on the sludge-loading rate (k) in the activated sludge works. At a lower sludge-loading rate, the surplus activated sludge tends to be more stabilised, thus giving less cause for odour impact. In general the following values may be adhered to:

- $k < 0.05$; extreme sludge stabilisation, no anaerobic bacterial decay to be expected;
- $0.05 < k < 0.1$; moderate sludge stabilisation, some decay possible;
- $k > 0.1$ partial sludge stabilisation, anaerobic bacterial decay is most likely to occur.

The production of odourous components depends on the reduction-oxidation potential (redox-potential) and on the Biological Oxygen Demand (BOD) of the wastewater. The redox-potential is the condition under which decay can take place, while BOD is the parameter most commonly used to define the pollution strength of a wastewater.

Anaerobic bacterial decay will only take place if the redox-potential of the wastewater is low enough. Frequently this condition arises in rising mains, where anaerobic conditions occur. In gravitational sewers a slight draft provides enough oxygen to limit this, as oxygen is highly toxic to anaerobic bacteria (Sheridan, 1998). In certain cases, the dosing of bleach and Ferric chloride will act as an oxidant and electron donator and limit such conditions. It is important to use sophisticated monitoring equipment to measure dissolved oxygen and pH of the liquor to maintain ideal conditions for aerobic processes to dominate.

Sludge handling processes can be more complicated depending on dewatering equipment design and processed sludge storage facilities. For example, it is reported that using high-speed centrifuges facilitate higher odour and H_2S emission than low speed centrifuge due to the shearing of proteins and carbohydrates within the sludge. This allows for the oxidation and reduction of methanthione and other proteins which readily reduced/oxidised to dimethyl sulphide, methyl mercaptan and finally H_2S.

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

- Ensure sludge storage trailers are sealed to eliminate the emission of fugitive odour emissions;
- Eliminate the spillage and leakage of such waste water/raw material, which may increase perceived odour concentration outside the building;
- Avoid high airflow over raw product. High airflow may increase stripping of odourous compounds and therefore increases odour loading on the abatement system. This increase in odour loading may reduce the effectiveness of such a abatement system and therefore increase perceived odour concentration in the vicinity of the facility;
- Maintain good housekeeping techniques within the facility as contaminated surfaces/equipment radiates odour and increases perceived odour concentration;
- Eliminate the odour contamination of essentially non-odourous sections of the facility by ventilation or structural design. Odour emissions from the entire facility will increase odour source size and essentially increase perceived odour concentration in close proximity to the facility;
- Enclosed identified odour emission units should be sealed and vented to odour abatement systems if necessary. Provide storage provisions on site for odour prevention medium and chemicals.
- It is essential to implement abatement technologies that effectively reduce perceived odour concentration and more importantly change odour character/hedonic tone. Intensification of the outlet odour emission should not occur as odour impact distances will increase and odour impact criterion will decrease (i.e. become more stringent);
- 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

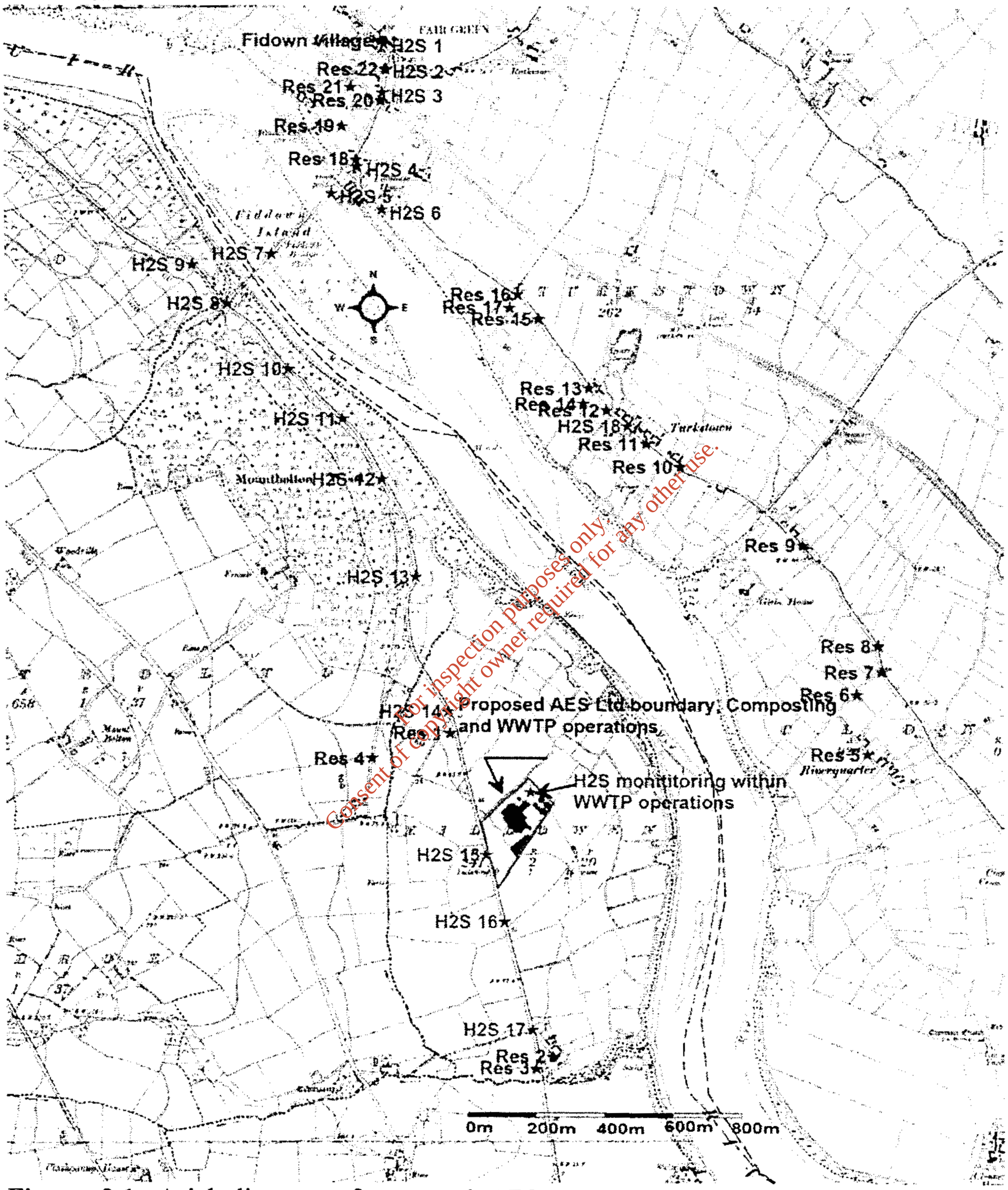


Figure 2.1. Arial diagram of proposed AES (Ireland) Ltd composting and WWTP process (▬), proposed boundary (—), resident locations (⋆ Res) and relative location of H_2S monitoring locations (✱ H2S).

The different distances and directions that the proposed composting and WWTP operation is located from the neighbouring dwellings are represented in *Figure 1.1.* As can be observed the closest resident is approximately 300 metres from the proposed operations of the AES facility in a north northwesterly direction (meteorologically).

2.2 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.

2.3 Meteorological data.

Three years worth of hourly sequential meteorology data (Rosslare 1999 to 2001) was used for the operation of ISC ST 3 and Aermod Prime. This allowed for the determination of the worst-case meteorological year for the determination of overall odour impact from the proposed composting and WWTP operations on the surrounding population.

2.4 Terrain data.

Upon examination of terrain it was noted that the topography around the proposed site is very complex ranging from 0 metres to approximately 110 metres. All significant deviations in terrain are examined in modelling computations through terrain incorporation using AerMap software. All building wake effects are accounted for in the modelling scenarios (i.e. building effects on point (diffuse) sources) as this can have a significant effect on the odour plume dispersion at short distances.

2.5 Ambient H_2S screen

H_2S is commonly associated with WWTP and composting operations. It is used as an indicator gas for the assessment of significant odour nuisance in the vicinity of WWTP's. The World Health Organization (WHO) recommends that in order to avoid substantial complaints about odour annoyance among the exposed population, hydrogen sulphide concentrations should not be allowed to exceed 0.005 ppm (5 ppb; 7 μg m^{-3}), with a 30-minute averaging time. The OEHHA (2000) adopted a level of 8 ppb (10 μg m^{-3}) as the chronic Reference Exposure Level (cREL) for use in evaluating long-term emissions from hot spots facilities. The only instrument capable of providing comparison with such reference levels is a Jerome meter. This is a real time data-logging H_2S gold leaf analyser for the measurement of ambient hydrogen sulphide levels (Sheridan 2003).

An ambient H_2S profile monitoring exercise was carried out in the vicinity of the proposed composting and WWTP using a pre-calibrated Jerome 631 X H_2S gold leaf continuous analyser with data logging capabilities. Samples were taken approximately 1.0 meter above ground level. The Jerome meter is a real time analyser with a range of detection from 3 ppb to 50 ppm. The Jerome meter was allowed to sample continuously at each monitoring locations H2S 1 to H2S 24. Every 1 minute, the average H_2S ambient air concentration was recorded. Average H_2S concentrations were computed from 3 replicate samples at each location to allow for establishment of ambient H_2S levels in the vicinity of the proposed composting and WWTP process.

3. Results

3.1 Odour emission data

Data sets for odour emission rate were calculated to determine the potential odour impact of the proposed composting and WWTP operation and design utilising the individual source odour emission data in *Table 3.1*. This scenario included:

1. Predicted overall odour emission rate from proposed composting and WWTP operations (Scenario 1) (*Table 3.2*).

A worst care odour-modelling scenario was chosen to estimate worst-case odour impact from the proposed AES Ireland Ltd operations.

3.2 Odour emission rates from individual processes during proposed composting and WWTP operation.

Table 3.1 illustrates the specific odour emission rate/fluxes used to determine an overall odour emission rate from the proposed operations. Each odour source emission factor is presented as either an emission flux ($Ou_E\ m^{-2}\ s^{-1}$) or emission rate ($Ou_E\ s^{-1}$) depending on source characteristics. Each odour source descriptor and offensiveness level based on previous experience is also presented. This is useful is determining the potential of the proposed facility to emit hedonically unpleasant odours.

Table 3.1. Odour emission rate for each individual process within proposed AES composting and WWTP operations.

Odour source	Odour emission flux ($Ou_E\ s^{-1}\ m^{-2}$) [1]	Odour emission rate ($Ou_E\ s^{-1}$)	Odour concentration offensive level/Odour descriptor [3]
Inlet reception chamber[2]	85		2.4 to 3.2 $Ou_E\ m^{-3}$ (Sour/organic acid/rotten eggs odour)
Balancing tank 1[2]	25		2.4 to 3.2 $Ou_E\ m^{-3}$ (Sour/organic acid/rotten eggs odour)
Balancing tank 2[2]	15		3.20 $Ou_E\ m^{-3}$ (Sour/waste water/organic odour)
Aeration tank 1	8.6		6.0 to 8.0 $Ou_E\ m^{-3}$ (Musty dank odour)
Aeration tank 2	8.6		6.0 to 8.0 $Ou_E\ m^{-3}$ (Musty dank odour)
Sludge holding tank	45		1.80 $Ou_E\ m^{-3}$ (rotten vegetables/rotten eggs odour)
Sludge centrifuge and thickened sludge storage	45		1.80 $Ou_E\ m^{-3}$ (rotten vegetables/rotten eggs odour)
Biofilter[4]		47.2 $m^3\ s^{-1}$ × 500 $Ou_E\ m^{-3}$	6.0 to 8.0 $Ou_E\ m^{-3}$ (musty odour)

Note: [1]denotes taken from Odour Monitoring Ireland database. Measurements were performed on similar WWTP's in Ireland, UK and Germany;
[2]denotes that it is assumed that inlet wastewater is not severely septic and that established management plans are in place to prevent significant emissions of odours;
[3]denotes in-house odour intensity and hedonic tone evaluation of odours performed in Ireland and USA. This is a worst-case scenario.
[4]denotes that a maximum allowable limit is used to model the odour emission rate from the biofilter. This odour emission rate is based on the expected volumetric flow rate ($m^3\ s^{-1}$) multiplied by an established maximum odour concentration from the biofilter ($Ou_E\ m^{-3}$). This prevents any errors due to estimation of odour emission rate from the composting operations. It is assumed that all odourous air generated from the composting operations is passed through the proposed biofiltration system. This 500 $Ou_E\ m^{-3}$ odour concentration is typical of odour concentration emitted from a fixed biofilter operating properly.

3.3 Odour emission rates from proposed AES Ireland Ltd composting and WWTP operations for atmospheric dispersion modelling Scenarios 1, 2, 3, 4, 5, 6 and 7

Table 3.2 illustrates the overall odour emission rate from the proposed AES Ireland Ltd composting and WWTP operation.

Table 3.2. Predicted overall odour emission rate from proposed composting and WWTP operation (Scenario 1).

Source identity	Exposed area (m^2)	Volumetric airflow rate ($m^3\ s^{-1}$)	Odour emission flux ($Ou_E\ m^{-2}\ s^{-1}$)	Odour emission rate ($Ou_E\ s^{-1}$)	Percentage of odour emission contribution (%)
Inlet reception chamber[1]	2	-	85	170	0.40
Balancing tank 1[1]	154.51	-	25	3,862.80	9.75
Balancing tank 2[1]	302.61	-	15	4,539.20	11.45
Aeration tank 1[1]	302.73	-	8.6	2,603.50	6.57
Aeration tank 2[1]	303.05	-	8.6	2,606.20	6.58
Sludge holding tank[2]	24.97	-	45	1,123.70	2.84
Sludge centrifuge and thickened sludge storage[2]	10	-	45	450	1.14
Biofilter	1000	47.194	500 $Ou_E\ m^{-3}$	23,597	60
Total	-	-	-	**36,346.20**	**100**

Note: [1] denotes maximum assumed odour emission flux based on Odour Monitoring Ireland database of measurement performed within Ireland and UK on similar operating plants;
[2] denote that sludge storage and handling processes will be operated accordingly to minimise any significant odour emissions;

3.4 Results of the Ambient H_2S monitoring exercise

Various odour detection thresholds as determined by various researchers are presented in *Table 3.3*. The H_2S monitoring results from Monitoring locations H2S 1 to H2S 24 on-site 12th July 2.30 PM to 4.30 PM using a real time Jerome analyser are presented in *Table 3.4*. No operations have been carried on at the facility since early 2004 when the tannery plant closed. Computation between both tables allows for the determination of H_2S contributed odour concentration on-site and in the vicinity of the site due to the presence of any odour sources.

Table 3.3. Various odour detection thresholds for H_2S based on library data

H_2S odour detection threshold (ppb)	H_2S odour detection threshold ($\mu g\ m^{-3}$)	References
0.515	0.77	Valentin (1981)
0.510	0.76	Steward (1998)
0.670	1.00	Sheridan, 1998
0.135	0.20	Sheridan, 2001
1.34	2.00	Sheridan, 2000

Table 3.4. Equivalent odour concentration contribution of H_2S monitoring location illustrated in Figure 2.1.

Location identity[1]	Minimum/Maximum Odour detection threshold [ppb]	H_2S [ppb]	Odour concentration range in ambient air ($Ou_E\ m^{-3}$)
Monitoring location Res 1	0.135 to 1.35	3	2.22 to 22.22
Monitoring location Res 2	0.135 to 1.35	2	1.48 to 14.81
Monitoring location Res 3	0.135 to 1.35	2	1.48 to 14.81
Monitoring location Res 4	0.135 to 1.35	3	2.22 to 22.22
Monitoring location Res 5	0.135 to 1.35	3	2.22 to 22.22
Monitoring location Res 6	0.135 to 1.35	2	1.48 to 14.81
Monitoring location Res 7	0.135 to 1.35	2	1.48 to 14.81
Monitoring location Res 8	0.135 to 1.35	2	1.48 to 14.81
Monitoring location Res 9	0.135 to 1.35	3	2.22 to 22.22
Monitoring location Res 10	0.135 to 1.35	4	2.9 to 29.63
Monitoring location Res 11	0.135 to 1.35	4	2.9 to 29.63
Monitoring location Res 12	0.135 to 1.35	3	2.22 to 22.22
Monitoring location Res 13	0.135 to 1.35	3	2.22 to 22.22
Monitoring location Res 14	0.135 to 1.35	3	2.22 to 22.22
Monitoring location Res 15	0.135 to 1.35	4	2.9 to 29.63
Monitoring location Res 16	0.135 to 1.35	3	2.22 to 22.22
Monitoring location Res 17	0.135 to 1.35	3	2.22 to 22.22
Monitoring location Res 18	0.135 to 1.35	4	2.9 to 29.63
Monitoring location Res 19-Enterance to facility	0.135 to 1.35	4	2.9 to 29.63
Monitoring location Res 20-Next to hide unloading area	0.135 to 1.35	5	3.7 to 37.04
Monitoring location Res 21-Next to sulphur oxidation tank A	0.135 to 1.35	4	2.9 to 29.63
Monitoring location Res 22-At inlet reception sump	0.135 to 1.35	10[2]	7.4 to 74.07
Monitoring location Res 23-Next to centrifuge	0.135 to 1.35	8[2]	5.9 to 59.26
Monitoring location Res 24-In propose area for biofilter	0.135 to 1.35	3	2.22 to 22.22

<u>**Note:**</u> [1]denotes please refer to *Figure 2.1* for relative locations.

<u>**Note**</u> [2] relates to stagnant liquid in inlet pipe and centrifuge.

3.5 Results of odour dispersion modelling for the proposed AES Ireland Ltd composting and WWTP operation and design

ISC ST3 and AERMOD Prime were used to determine the overall odour impact of the proposed composting and WWTP operation to be located in Portlaw, Co. Waterford, 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 composting and WWTP operation (Scenario 1) (*Table 3.2*), respectively to odour plume dispersal at the 98th percentile for an odour concentration of 3.5 Ou_E m^{-3} using ISC ST3 dispersion model (*Figure 8.1*).
- Predicted odour emission contribution of biofilter operation (Scenario 2) (*Table 3.2*), respectively to odour plume dispersal at the 98th percentile for an odour concentration of 6.0 Ou_E m^{-3} using ISC ST3 dispersion model (*Figure 8.2*).
- Predicted odour emission contribution of WWTP operation (Scenario 3) (*Table 3.2*), respectively to odour plume dispersal at the 98th percentile for an odour concentration of 3.5 Ou_E m^{-3} using ISC ST3 dispersion model (*Figure 8.3*).
- Predicted odour emission contribution of overall composting and WWTP operation (Scenario 4) (*Table 3.2*), respectively to odour plume dispersal at the 98th percentile for an odour concentration of 3.5 Ou_E m^{-3} using AERMOD Prime dispersion model (*Figure 8.4*).
- Predicted odour emission contribution of biofilter operation (Scenario 5) (*Table 3.2*), respectively to odour plume dispersal at the 98th percentile for an odour concentration of 6.0 Ou_E m^{-3} using AERMOD Prime dispersion model (*Figure 8.5*).
- Predicted odour emission contribution of WWTP operation (Scenario 6) (*Table 3.2*), respectively to odour plume dispersal at the 98th percentile for an odour concentration of 3.5 Ou_E m^{-3} using AERMOD Prime dispersion model (*Figure 8.6*).
- Comparison between ISC ST3 and AERMOD Prime for odour plume spread of overall composting and WWTP operation odours (Scenario 4) (*Table 3.2*), respectively at the 98th percentile for an odour concentration of 6.0 Ou_E m^{-3} (*Figure 8.7*).

These computations give the odour concentration at each 50-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 composting and WWTP is in operation. It will also allow the operators of the composting and WWTP site, respectively to assess the effectiveness of their considered odour abatement/minimisation strategies. The intensity of the odour from the two or more sources of the biofilter and WWTP 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

4.1 Odour plume dispersal for Scenarios 1, 2 and 3 utilising ISC ST3 dispersion model

The plotted odour concentrations of ≤ 3.5 Ou_E m^{-3} for the 98th percentile for the proposed AES Ireland Ltd composting and WWTP operation utilising ISC ST3 dispersion model is illustrated in *Figure 8.1* (Scenario 1). As can be observed, it is predicted that odour plume spread follows the local topography and predominant wind direction with distances of up to 360 metres from the proposed facility boundary in a southeast direction. The odour plume spread is approximately from 100 to 200 metres in all other directions. No resident locations are incorporated by the odour plume spread with all residents in the vicinity of the proposed composting and WWTP operations perceiving an odour concentration less than 3.5 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, no significant odour impact should be perceived by residents in the vicinity of the proposed composting and WWTP operations. Those sources considered hedonically more offensive have been abated and therefore it is less likely that any resident will complain.

Figures 8.2 and *8.3* illustrate the odour plume spread contribution of the individual processes namely the biofilter and the WWTP (i.e. Scenarios 2 and 3, respectively). As can be observed, the odour plume spread is greater for the WWTP. As the odour emitted from a biofilter is relatively neutral in hedonic tone, it is unlikely that this source would cause any odour impact.

4.2 Odour plume dispersal for Scenarios 4, 5, 6 and 7 utilising AERMOD Prime dispersion model

The plotted odour concentrations of ≤ 3.5 $Ou_E\ m^{-3}$ for the 98th percentile for the proposed AES Ireland Ltd composting and WWTP operation utilising AERMOD Prime dispersion model is illustrated in *Figure 8.4* (Scenario 4). As can be observed, it is predicted that odour plume spread follows the local topography and predominant wind direction with distances of up to 400 metres from the proposed facility boundary in a southeast direction. The odour plume spread is approximately from 80 to 180 metres in all other directions. No resident locations are incorporated by the odour plume spread with all residents in the vicinity of the proposed composting and WWTP operations perceiving an odour concentration less than 3.5 $Ou_E\ m^{-3}$ 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, no significant odour impact should be perceived by residents in the vicinity of the proposed composting and WWTP operations. Those sources considered hedonically more offensive have been abated and therefore it is less likely that any resident will complain.

Figures 8.5 and *8.6* illustrate the odour plume spread contribution of the individual processes namely the biofilter and the WWTP. As can be observed, the odour plume spread is greater for the WWTP (i.e. Scenarios 5 and 6, respectively). As the odour emitted from a biofilter is relatively neutral in hedonic tone, it is unlikely that this source would cause any odour impact. The odour plume spread utilising AERMOD Prime from the biofilter is significantly different for AERMOD Prime and ISC ST3. This is due to AERMOD Prime better treatment of building wake effects and topography.

Figure 8.7 illustrates comparison between the odour plume spread of ISC ST3 and AERMOD Prime. As can be observed, ISC ST3 predicts greater odour impact area and perceived odour concentration within identical areas when compared to AERMOD Prime. AERMOD Prime is a third generation boundary layer model and takes better account of meteorological conditions, terrain and building wake effects. It has been shown through validations studies to be more accurate than ISC ST3 and therefore this odour plume spread is a more realistic picture of predicted long-term odour impact.

4.3 Ambient H_2S screen

Table 3.4 illustrates ambient monitoring results for H_2S. As can be observed, ambient H_2S concentrations are below the recommended WHO guideline values (5ppb; 7ugm-3) except within one location of the current WWTP. A range of odour detection thresholds has been calculated for H_2S (*see Table 3.4*). As a range exists, the minimum and maximum formulated odour detection threshold is used to calculate the contributory factor in $Ou_E\ m^{-3}$. As can be observed a range from 1.48 to 74.07 $Ou_E\ m^{-3}$ existed as H_2S odour at all monitoring locations. A characteristic rotten eggs odour was detected emanating form the inlet reception chamber within the existing WWTP, which related to stagnant liquid in the inlet pipe. The visiting odour consultant noted a strong fruity/orange odour at H_2S monitoring locations 3 to 4. It is therefore concluded that detected ambient H_2S concentrations are not significant. This study is important for WWTP odours as WWTP's can be a significant source of H_2S.

5. Conclusions

A worst-case odour emission scenario was modelled using the atmospheric dispersion models ISC ST 3 and AERMOD Prime with 3 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 proposed operation of the composting and WWTP. The following conclusions are drawn:

1. It is predicted that no significant odour impact will be perceived in the vicinity of the facility during proposed operation when utilising dispersion model ISC ST3 with all residents perceiving an odour concentration less than 3.5 $Ou_E\ m^{-3}$ at the 98th percentile in a worst case meteorological year;
2. It is predicted that no significant odour impact will be perceived in the vicinity of the facility during proposed operation when utilising dispersion model AERMOD Prime with all residents perceiving an odour concentration less than 3.5 $Ou_E\ m^{-3}$ at the 98th percentile in a worst case meteorological year;
3. It is predicted that ISC ST3 predicts higher perceived odour concentrations and a greater odour impact area when utilising identical meteorological, terrain, odour input data and model build characteristics. This is probably due to the less accurate assessment of dispersion in more complex building and topographical sites.

6. Recommendations

The following recommendations are presented:

1. Ensure the biofiltration system is designed so as to allow good air distribution, media moistening, access to sprinklers, low face velocity, correct retention time, ideal media and supply of essential minerals and nutrients. This will ensure good performance.
2. Maintain good housekeeping practices (i.e. keep yard area clean and tidy, etc.), closed-door management strategy and to implement an odour management plan for the operators of the WWTP.

3. Avoid accumulation of floating debris and persistent sediments in holding tanks by design (balancing tanks, etc.).
4. Maintain quiescence conditions within WWTP so as to eliminate puff odour emissions.
5. Ensure all sludge-handling processes are operated in order to prevent any significant odour emissions.
6. Operate WWTP within specifications to eliminate overloading and under loading, which may increase septic conditions within the SBR aeration basins.

7. References

1. Callan, B.T., (1993). Noses Knows Best. In malodour measurement and control. Proceedings of the International Tydnall School, September. 134-145.
2. 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.
3. CEN, (2003). prEN13725-Air-quality-Determination of odour concentration by dynamic olfactometry. Brussels, Belgium.
4. 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.
5. Dravniek, A., (1986). Atlas of odor character profiles. ASTM Committee on sensory evaluation of materials and products, ASTM data series. Baltimore, MD, USA.
6. EPA, (2001). Odour impacts and odour emission control measures for intensive agriculture. Commissioned by the Environmental Protection Agency (Ireland). OdourNet UK Ltd.
7. Longhurst, P., (1998). Odour impact assessment of an extension to the Brogborough landfill site. IREC, Cranfield University, England.
8. 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.
9. Sheridan, B.A., (1998). Odour impact assessment of Clareabbey WWTP, EIA, Enfo Head Office, Suffolk St, Dublin 2.
10. Sheridan, B.A. (2002). In house odour intensity and hedonic tone profile data of different odourous sources. Unpublished.
11. Sheridan, B.A., (2001). Controlling atmospheric emissions-BAT Note Development, UCD Environmental Engineering Group, Department of Agricultural and Food Engineering, UCD, Dublin 2.

12. 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.
13. Sheridan, B.A., Curran, T.P., Dodd, V.A., (2004). Biofiltration of air: current operational and technological advances. In review. Reviews in Environmental Technology.
14. 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 and Aermod Prime.

8.1 Predicted odour emission contribution of overall composting and WWTP operation (Scenario 1) (*Table 3.2*), respectively to odour plume dispersal at the 98th percentile for an odour concentration of 3.5 Ou_E m^{-3} using ISC ST3 dispersion model.

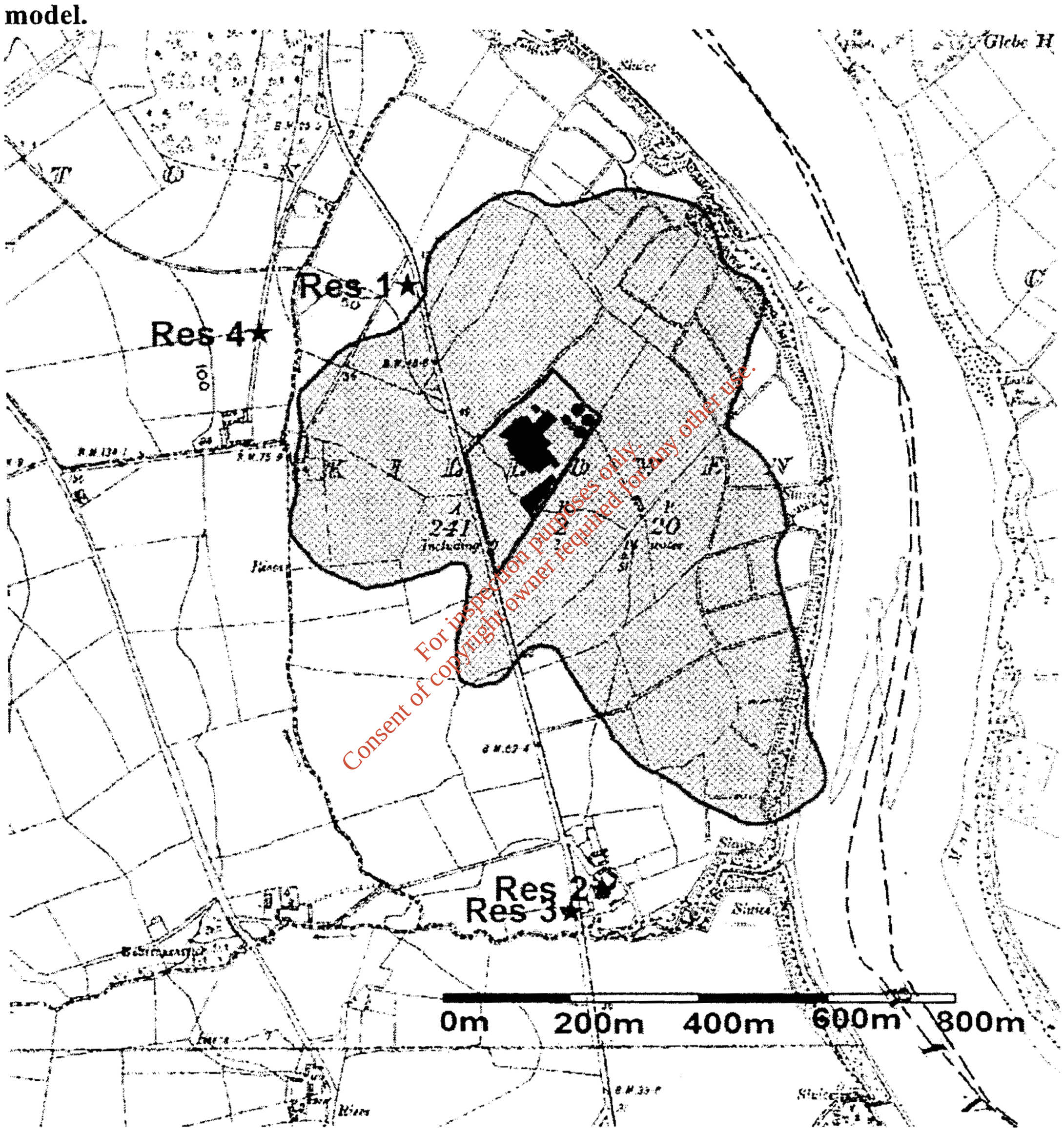


Figure 8.1. Predicted odour emission contribution of proposed composting and WWTP operation to odour plume dispersal for Scenario 1 at the 98th percentile for odour concentrations ≤ 3.5 Ou_E m^{-3} (—).

8.2 Predicted odour emission contribution of biofilter operation (Scenario 2) (*Table 3.2*), respectively to odour plume dispersal at the 98th percentile for an odour concentration of 6.0 Ou$_E$ m^{-3} using ISC ST3 dispersion model.

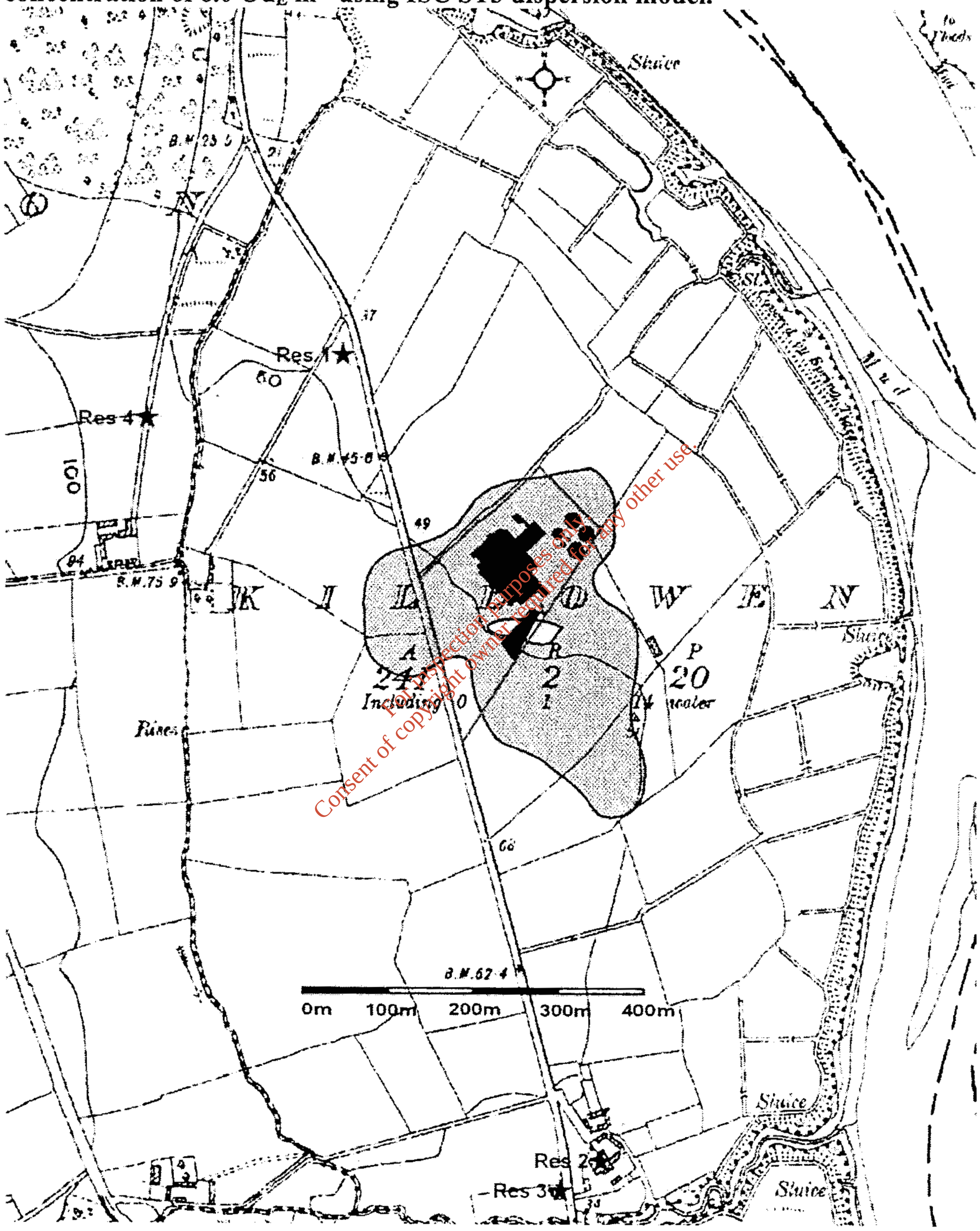


Figure 8.2. Predicted odour emission contribution of proposed biofilter operation to odour plume dispersal for Scenario 2 at the 98th percentile for odour concentrations ≤ 6.0 Ou$_E$ m^{-3} (**—**).

8.3 Predicted odour emission contribution of WWTP operation (Scenario 3) (*Table 3.2*), respectively to odour plume dispersal at the 98th percentile for an odour concentration of 3.5 Ou_E m^{-3} using ISC ST3 dispersion model.

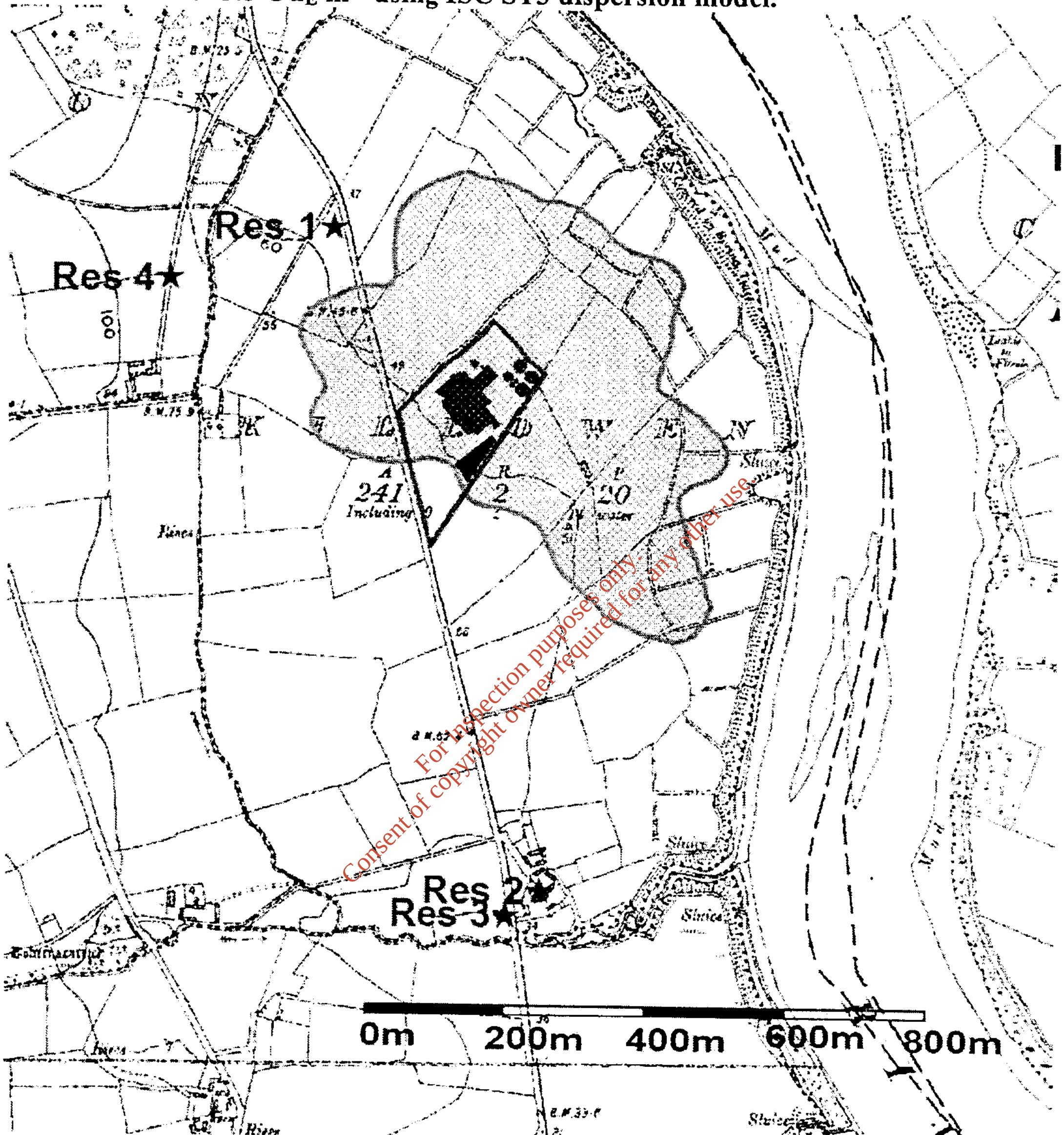


Figure 8.3. Predicted odour emission contribution of proposed WWTP operation to odour plume dispersal for Scenario 3 at the 98th percentile for odour concentrations ≤ 3.5 Ou_E m^{-3} (——).

8.4 Predicted odour emission contribution of overall composting and WWTP operation (Scenario 4) (*Table 3.2*), respectively to odour plume dispersal at the 98th percentile for an odour concentration of 3.5 Ou_E m^{-3} using AERMOD Prime dispersion model.

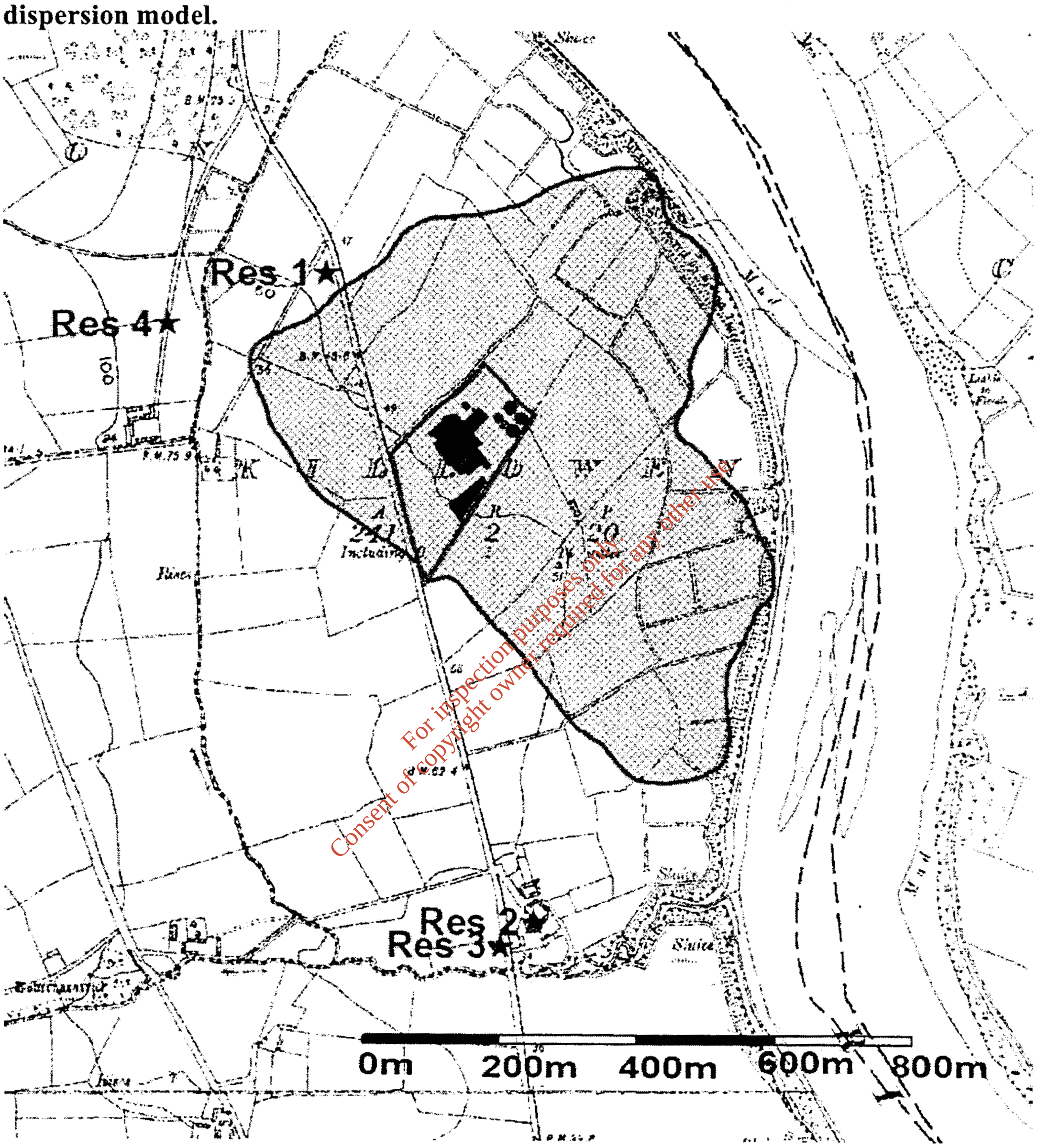


Figure 8.4. Predicted odour emission contribution of proposed composting and WWTP operation to odour plume dispersal for Scenario 4 at the 98th percentile for odour concentrations ≤ 3.5 Ou_E m^{-3} (▬).

8.5 Predicted odour emission contribution of biofilter operation (Scenario 5) (*Table 3.2*), respectively to odour plume dispersal at the 98th percentile for an odour concentration of 6.0 Ou_E m^{-3} using AERMOD Prime dispersion model.

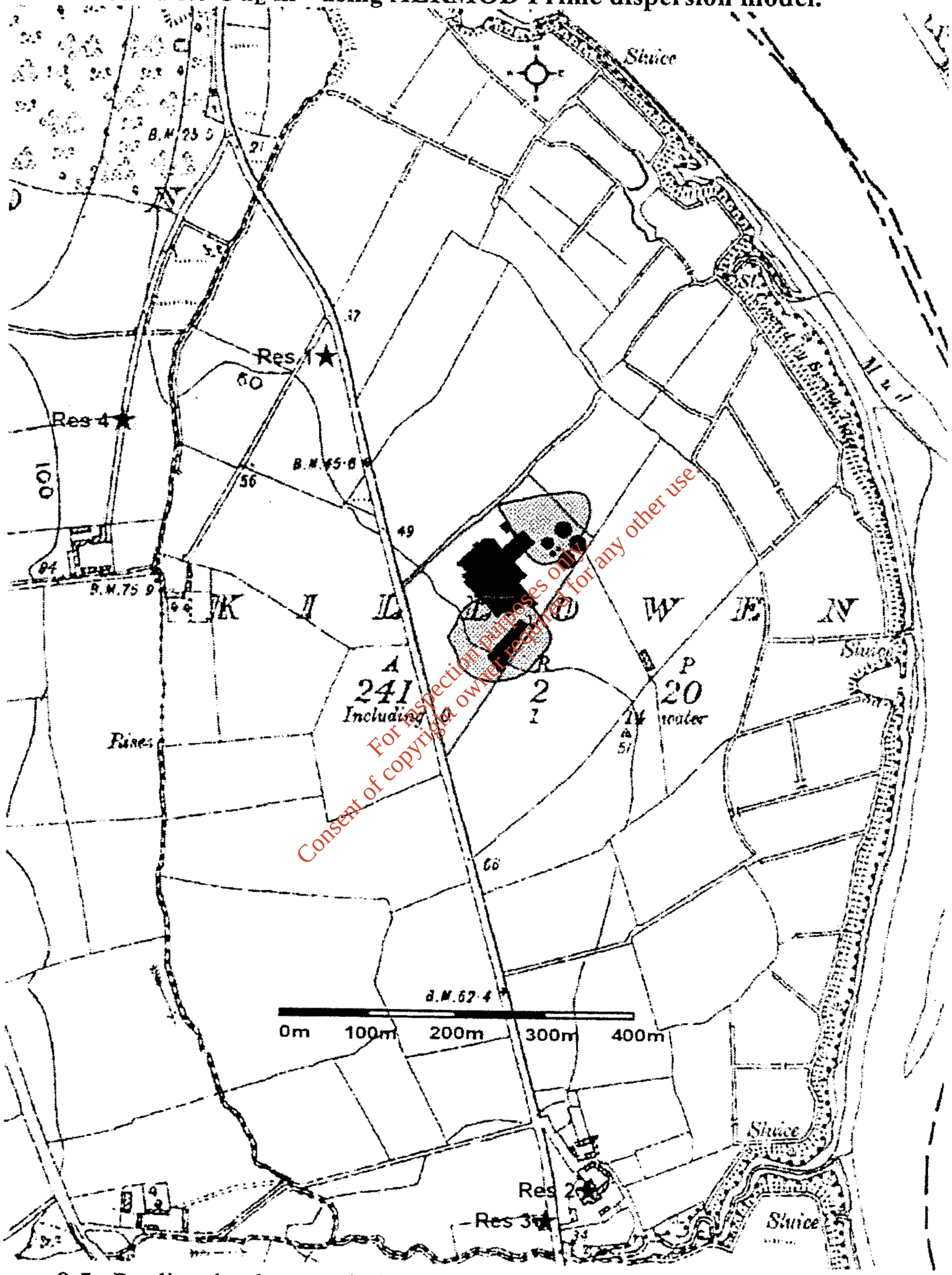


Figure 8.5. Predicted odour emission contribution of proposed biofilter operation to odour plume dispersal for Scenario 5 at the 98th percentile for odour concentrations ≤ 6.0 Ou_E m^{-3} (——).

8.6 Predicted odour emission contribution of WWTP operation (Scenario 6) (*Table 3.2*), respectively to odour plume dispersal at the 98th percentile for an odour concentration of 3.5 Ou_E m^{-3} using AERMOD Prime dispersion model.

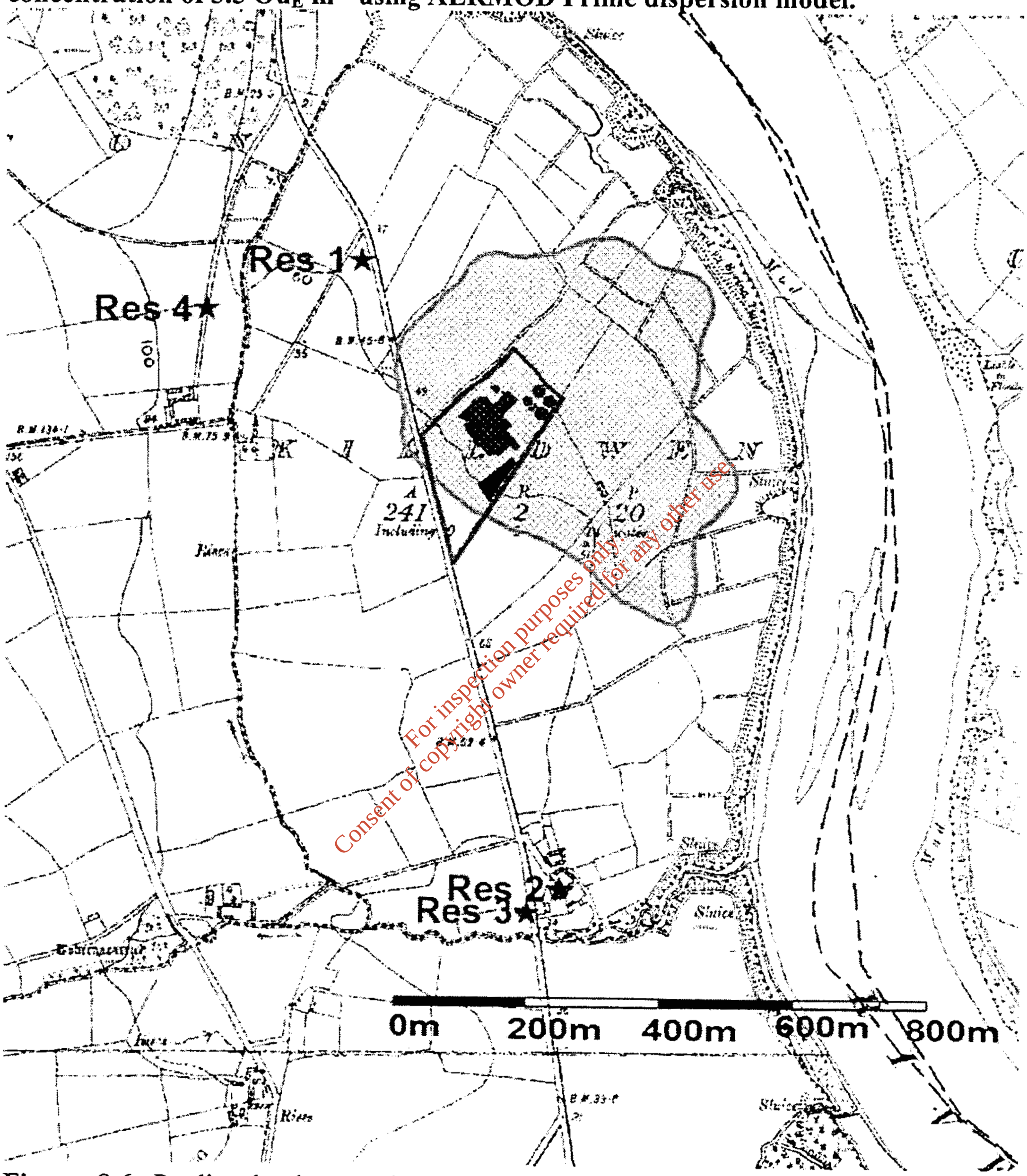


Figure 8.6. Predicted odour emission contribution of proposed WWTP operation to odour plume dispersal for Scenario 6 at the 98th percentile for odour concentrations ≤ 3.5 Ou_E m^{-3} (——).

8.7 Comparison between ISC ST3 and AERMOD Prime for odour plume spread of overall composting and WWTP operation odours (Scenario 7) (*Table 3.2*), respectively at the 98th percentile for an odour concentration of 6.0 Ou_E m^{-3}.

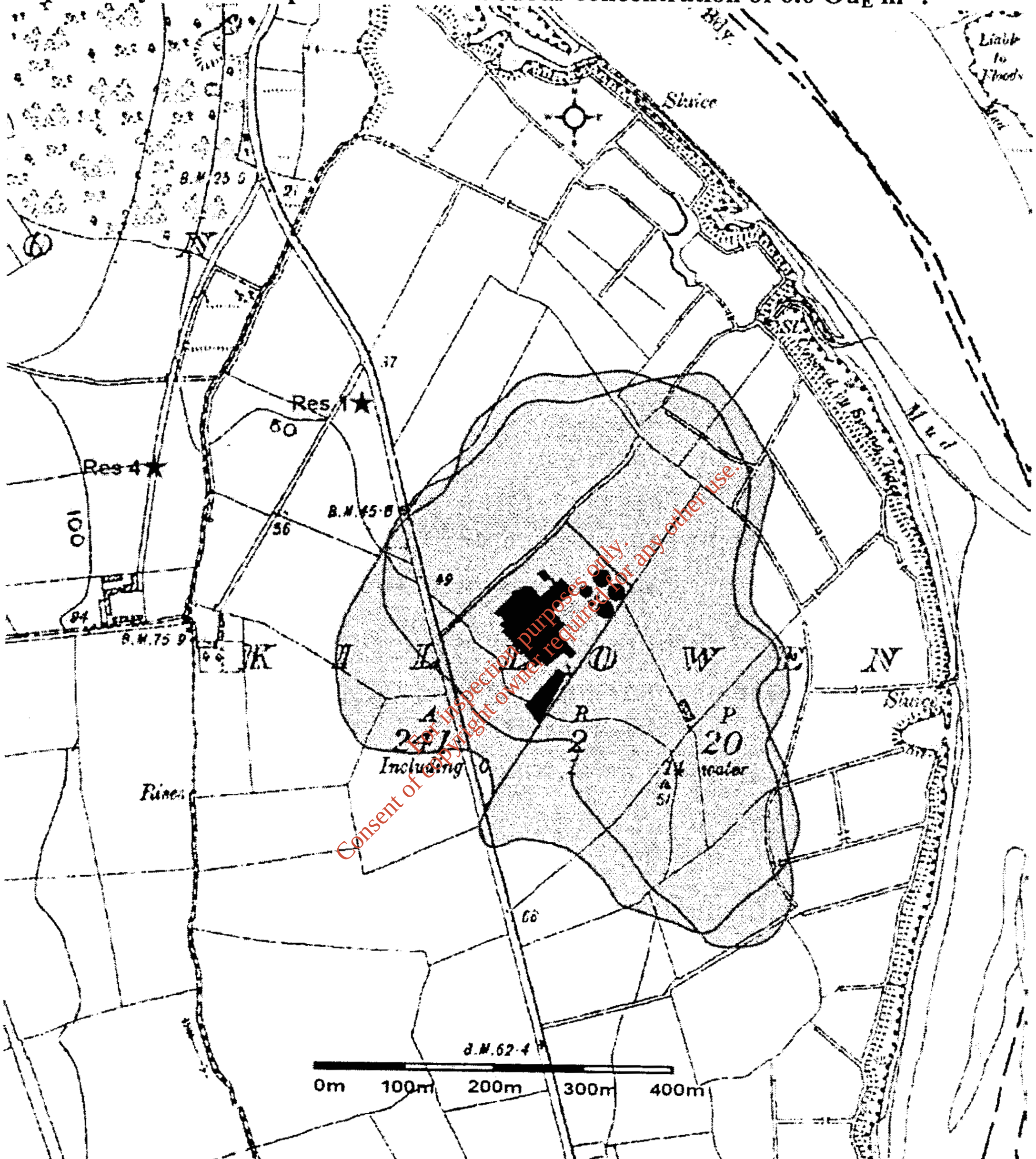


Figure 8.7. Comparison between odour plume spread between ISC ST3 (——) and AERMOD Prime (——) (Scenario 7) at the 98th percentile for an odour concentration of 6.0 Ou_E m^{-3}.

9. Appendix II-3D Graphical illustration of topography in the vicinity of the facility

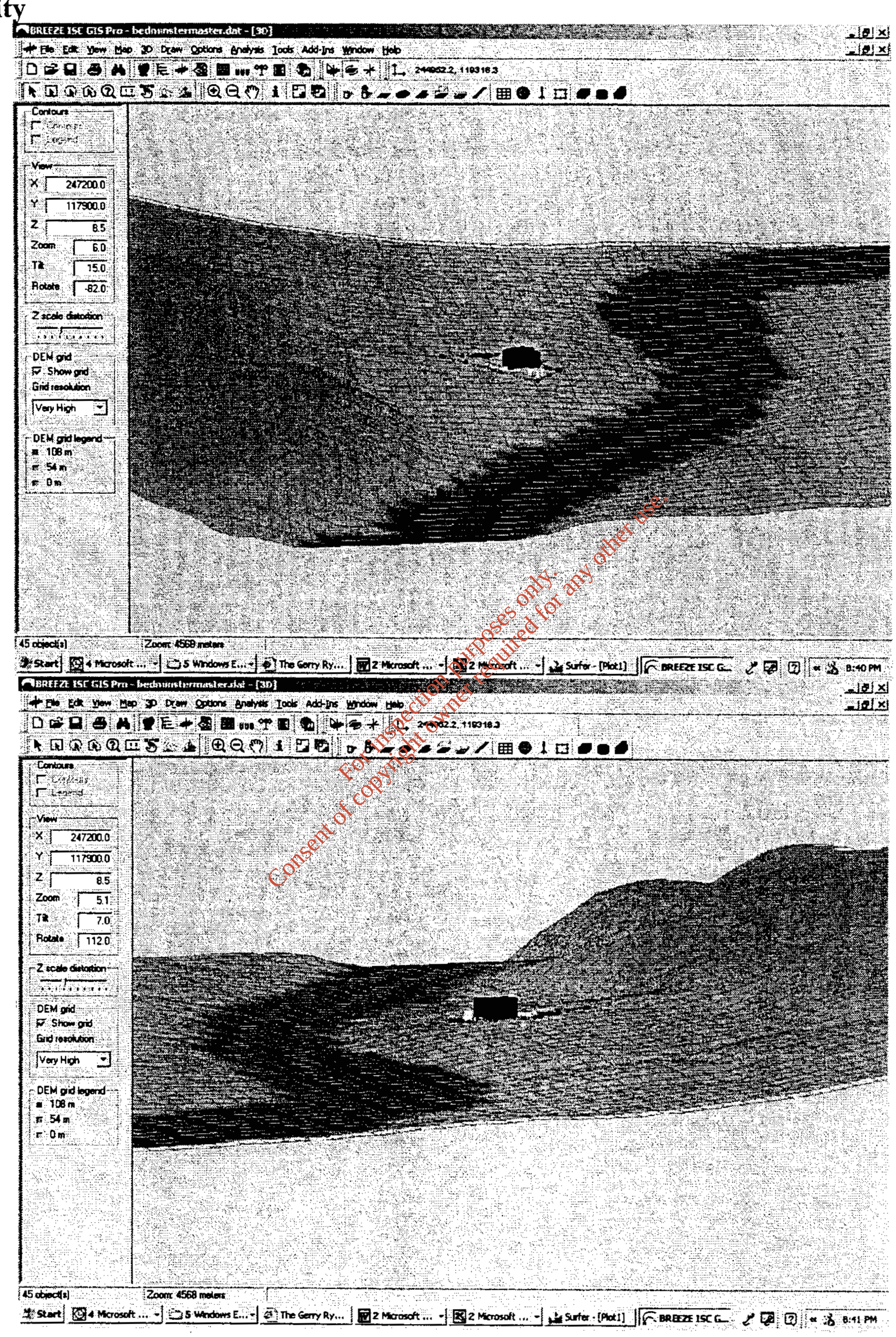


Figure 9.1.3D illustrations of dispersion model build showing topography (green), main building, biofilter, WWTP (dark blue) and river Suir (deep blue).

Appendix 3.2

- Cultural and Archaeological Heritage.

SECTION 8
ARCHAEOLOGY

8.1 SITE INVESTIGATIONS

The site was inspected on the 30th of April 1991. The Sites and Monuments Record (S.M.R) of the Office of Public Works was consulted.

No archaeological features, monuments or stray finds were noted in the fields where the plant would be sited, or in the immediate vicinity. The area was examined for evidence of Fulachta Fiadha (prehistoric cooking places), but none were apparent. The existence of Fulachta Fiadha in the area is known from the occurrence of at least one at Mayfield or Rocketcastle (S.M.R. ref. WA 008 045, at National Grid 24771/11568), less than half a mile to the east.

The only other apparent archaeological site or monument in the vicinity is the tower house (castle) of Rocketcastle or Mayfield approximately 500m. to the east (S.M.R. ref. WA 008 004, at National Grid 24798/11660). The monument was examined, even though the field had been ploughed to almost the foot of the castle, no stray finds or signs of associated settlement were apparent in the ploughed soil.

Other monuments in Killowen townland are ecclesiastical remains. These are located at approximately half a mile from the site of the proposed development (S.M.R. ref. WA 004 010). The townland may derive its name from this site. The proposed development is unlikely to have an effect on the environments of either site as both are located at considerable distances (Rocketcastle is approximately 1 mile and Killowen ecclesiastical site is about half a mile).

8.2 IMPACT & MITIGATION

The development should not have any effect on any known archaeological site or monuments. Any proposed future expansion in the immediately adjacent area would also be unlikely to affect the archaeological sites or their environment.

The greatest danger of encountering buried archaeological remains is in the vicinity of the river. This is because Fulachta Fiadha are often located close to water.

Although no known archaeological sites will be affected by the construction of the plant at this site, it is possible that undetected archaeological remains will be disturbed. For this reason, it will be necessary for an archaeologist to be present during stripping of the topsoil. If any remains are unearthed, these can then be described and collected.

Appendix 3.3

- Flora and Fauna.

SECTION 9
FLORA AND FAUNA

9.1 FLORA AND FAUNA SURVEY

Introduction

Site visits were carried out in June and July, 1991 to investigate the flora and fauna. Special attention was paid to the vascular flora, but birds, mammals, butterflies and dragonflies were also noted. The area surveyed included both the fields where the proposed plant would be constructed and the area down to the river where the outflow pipes would be constructed. In addition, local naturalists were contacted for information on the flora and fauna.

Flora

The parts of the site described in the following account are shown in Figure 9.A. All the species which were recorded are listed in Appendix 20, which also provides the scientific names of species.

The fields (1) are improved pasture of little botanical interest. The dominant species are Perennial Rye-grass and White Clover. Other species include Creeping Buttercup, Creeping Thistle, Redshank, Scentless Mayweed and Daisy.

The two fields where the plant would be sited are surrounded by tall hedges (areas 2-9) except for the north-eastern perimeter of the north-east field, where there is no hedge. The hedges are predominantly Gorse or Bramble. When the field work was carried out most of the hedges were about 2-3m high with few gaps.

Several of the hedges have Ash trees in them and the positions of these are shown in Figure 3.A. These are about 10-15m high. In addition there are occasionally taller Hawthorns which are 5m high or more and a few other species (eg. Elder and Willow).

Herbaceous species present in the hedges were common plants such as Goosegrass, Stinging Nettle, Hogweed, Germander Speedwell and Herb Robert together with the climbing Honeysuckle and Ivy. Ferns noted were Soft Shield Fern, Bracken and Hart's Tongue Fern.

Between these fields and the river there are further areas of improved pasture surrounded by ditches (marked 10 in Figure 9A). Beyond these, there is a flood prevention bank which is covered in a rank growth of ruderal species (area 11), and an area of rank willow scrub between this bank and the river (area 12).

The ditches contain a range of common aquatic plants, including Watercress, Fool's Watercress, Floating Sweet-grass and Water Plantain, and Opposite-leaved Pondweed which is rare in Ireland (Webb, 1977). Site investigations indicate that it may be confined to the

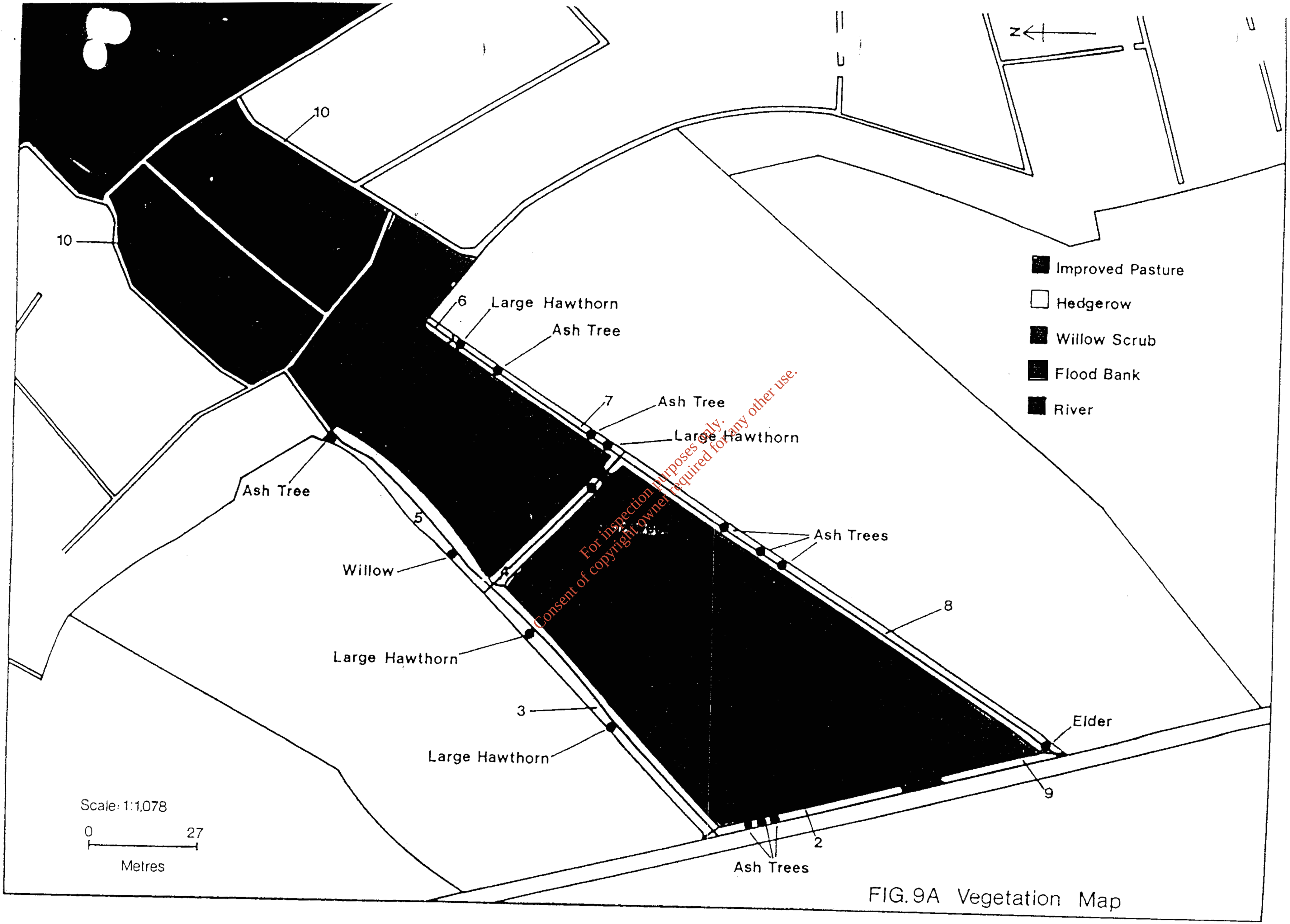


FIG. 9A Vegetation Map

ditch which runs parallel to the flood bank (where it is common), although it might also be present in some of the other ditches.

Waterside plants include Marsh Thistle, Square-stalked St. John's Wort, Water Figwort, Marsh Horsetail, Brookweed and Greater Pond Sedge which is rare in Ireland.

The willow scrub has a rank growth of tall herbs, mainly Hemlock Water Dropwort with some Cow Parsley and Common Valerian.

Fauna

A list of birds, mammals, amphibians, butterflies and dragonflies is provided in Appendix 21. All species recorded were common. Fifteen species of bird were recorded at the proposed plant site and a further four species were recorded in the willow scrub adjacent to the river.

Parts of the Suir valley are important for wintering wildfowl and wading birds. These include the Fiddown Bridge area and the Coolfin Wildfowl Reserve. Peak numbers of birds in these areas were supplied by Mr. D. McGrath, a local ornithologist. Coolfin is particularly important for Greylag Geese (up to 600), Whooper Swans (maximum 65) and waders such as Golden Plover and Curlew. The Fiddown Bridge area is important for ducks, especially Teal (maximum 537).

Coolfin is a designated Area of Scientific Interest (ASI) and it is listed in a directory of birdwatching sites in Ireland (Hutchinson, 1986).

There appear to be no counts available for the fields below the proposed site. These may be used by some water birds in winter or on migration.

Ecology/Conservation Significance

The two fields where the plant would be sited have little ecological value. However, the ditches between these fields and the river contain two species of plants which are rare in Ireland, of which one (Opposite-leaved Pondweed) is specially protected in Ireland. It is one of the 52 species of flowering plants and ferns which were listed under an Order of the Wildlife Act, 1976. This means that, except under licence from the Department of the Environment, it is an offence "to cut, pick uproot or otherwise take any of this plant". It is also an offence "to alter, damage, destroy or interfere with the habitats" of the species.

The hedges do not contain rare species but they are of some ecological significance.

The significance of the fields below the plant site for wintering and migrant water birds is not known although their fairly small size and general location would tend to indicate that they are not very important.

9.2 IMPACT AND MITIGATION

Impact

The construction of the tannery and waste water treatment plant will have little direct ecological impact. The flora of the ditches is of conservation significance and construction of the waste pipe is a potentially damaging operation. Steps will need to be taken to avoid infringement of the Wildlife Act, 1976.

Most of the hedges will not be affected by the proposed development although the hedge and bank adjacent to the road will have to be removed to make way for the site entrance and slipway. The construction of the pipelines will have some disturbing influence on any water birds which use the fields below the proposed plant site. However, this would only be a temporary impact.

The waste water is expected to have minimal impact on the ecology of the Suir and it is not envisaged that there would be any impact on the bird life of the areas below the site due to pollution. At the mouth of the Suir, Waterford Harbour has some significance for wading birds although it holds only small numbers of these birds in comparison with other estuaries on the south coast of Ireland (Prater, 1981).

Mitigation

The most significant potential ecological impacts could occur during the laying of the pipe from the water treatment plant to the river. At the two points where the pipe will cross the ditches special measures will be taken to prevent undue impact.

In order to ensure that Opposite-leaved Pondweed is not damaged a botanist will be employed to locate crossing points for the ditches where the plant is not present. If it is not possible to locate a safe crossing point it will be necessary to apply for a licence as necessitated by the Wildlife Act.

It will also be necessary to ensure that the sediment in the ditch is not unduly disturbed as this could have a detrimental effect on the water-plants. Before digging across the ditches commences the water in the remainder of the ditch will be hydrologically isolated from the digging operations. High quality rust-proof piping will be used so that leakage to the ditches is unlikely. Furthermore, the pipe will be inspected at intervals to ensure that no leaking to the ditches or to the groundwater is taking place.

The impact of removing the hedge adjacent to the road will be compensated for in two ways. Firstly, a new bank will be constructed between the slipway and the site and this will be planted with a new hedge. Secondly, existing hedges will be strengthened by further planting of trees and shrubs. In order to retain the existing character of the area as much as possible only native species should be planted.

Adjacent to the slipway Gorse will be planted on top of the new bank. This evergreen species will provide year-round visual screening from the road. Ash trees should also be planted at intervals along the bank to provide further screening in the future. The existing hedges should be strengthened where there are gaps by planting Hawthorn. Further Ash trees should be planted at intervals alongside the existing hedges to provide additional screening in the future.

Where the waste water pipes crosses the hedge marked 4 in Figure 9A, there will be some loss of screening at the point where the pipe passes. Trees and shrubs should not be planted over the pipe since the roots could cause pipe fracture in the future. There will also be loss of willows in the willow scrub (area 12).

Where the pipes are layed across fields it will be sufficient to replace the soil over the top of the pipe and seed with an agricultural grass seed mix including Lolium perenne and Trifolium repens.

The best time to construct the pipelines is probably the Spring (April/May). This would avoid disturbance to any wintering water birds which might use the fields below the plant site. Furthermore, this would be a good time of the year to carry out restoration work on the vegetation.

Appendix 20 Plants Recorded

Appendix 20 Plants Recorded

A. Plants recorded in the two fields where the plant would be constructed.

Annual Meadow Grass	Poa annua
Ash	Fraxinus excelsior
Blackthorn	Prunus spinosus
Bracken	Pteridium aquilinum
Bramble	Rubus fruticosus
Broad-leaved Dock	Rumex obtusifolius
Brown Bent	Agrostis tenuis
Bush Vetch	Vicia sepium
Cocksfoot	Dactylis glomerata
Creeping Thistle	Cirsium arvense
Dog Rose	Rosa canina
Dog Violet	Viola riviniana
Elder	Sambucus nigra
Germander Speedwell	Veronica chamaedris
Goat Willow	Salix caprea
Goosegrass	Galium aparine
Gorse	Ulex europaeus
Greater Birdsfoot Trefoil	Lotus uliginosus
Greater Plantain	Plantago majus
Grey Willow	Salix cinerea
Hart's Tongue Fern	Phyllitis scolopendrium
Hawthorn	Crataegus monogyna
Herb Robert	Geranium robertianum
Hogweed	Heracleum sphondylium
Honeysuckle	Lonicera periclymenum
Ivy	Hedera helix
Marsh Thistle	Cirsium palustre
Marsh Woundwort	Stachys palustris
Meadow-sweet	Filipendula ulmarius
Meadow Vetchling	Lathyrus pratensis
Mouse-eared Chickweed	Cerastium fontanum
Nipplewort	Lapsana communis
Oxe-eye Daisy	Leucanthemum vulgare
Pedunculate Oak	Quercus robur
Perennial Rye-grass	Lolium perenne
Prickly Sowthistle	Sonchus asper
Redshank	Polygonum aviculare
Scaly Male Fern	Dryopteris borreri
Scentless Mayweed	Matricaria perforata
Shepherd's Purse	Capsella bursa-pastoris
Soft Shield Fern	Polystichum setiferum
Spear Thistle	Cirsium vulgare
Stinging Nettle	Urtica dioica
White Clover	Trifolium repens

B. Additional species recorded between the site and the river.

Branched Bur-reed	Sparganium erectum
Brookweed	Samolus valerandi
Common Reed	Phragmites australis
Common Valerian	Valeriana officinalis
Cow Parsley	Anthriscus sylvestris
Crack Willow	Salix fragilis
Curled Dock	Rumex crispus
Floating Sweet-grass	Glyceria fluitans
Fool's Watercress	Apium nodiflorum
Gipsywort	Lycopus europaeus
Greater Birdsfoot Trefoil	Lotus uliginosus
Greater Pond Sedge	Carex riparia
Greater Yellowcress	Rorippa amphibia
Hairy Willowherb	Epilobium hirsutum
Hedge Bindweed	Calystegia sepium
Hemlock Water Dropwort	Oenanthe crocata
Lesser Duckweed	Lemna minor
Marsh Bedstraw	Galium palustre
Marsh Foxtail	Alopecurus geniculatus
Marsh Horsetail	Equisetum palustre
Marsh Ragwort	Senecio aquaticus
Marsh Thistle	Cirsium palustre
Meadow-sweet	Filipendula ulmarius
Opposite-leaved Pondweed	Groenlandia densa
Reedmace	Typha latifolia
Scarlet Pimpernel	Anagalis arvensis
Self-heal	Prunella vulgaris
Sharp-flowered Rush	Juncus acutiflorus
Silverweed	Potentilla anserina
Soft Rush	Juncus effusus
Square-stemmed St. John's Wort	Hypericum tetrapterum
Sweet Vernal Grass	Anthoxanthum odoratum
Watercress	Nasturtium officinale
Water Figwort	Scrophularia auriculata
Water Plantain	Alisma plantago-aquatica
Water Mint	Mentha aquatica
White Willow	Salix alba
Woody Nightshade	Solanum dulcamara
Yorkshire Fog	Holcus lanatus

Appendix 21 Fauna Recorded

Appendix 21 Fauna Recorded

A. Birds

Blackbird
Blue Tit
Coal Tit
Dunnock
Goldfinch
Great Tit
Hooded Crow
Jackdaw
Magpie
Pheasant
Pied Wagtail
Reed Bunting
Robin
Rook
Song Thrush
Swallow
Swift
Woodpigeon
Wren

B. Mammals

Rabbit

C. Amphibians

Frog

D. Butterflies

Meadow Brown
Ringlet
Small Tortoiseshell
Small White
Speckled Wood

E. Dragonflies

Blue-tailed Damselfly	*Ischnura elegans*
Large Red Damselfly	*Pyrrhosoma nymphula*

Appendix 3.4

- Traffic.

SECTION 12
TRANSPORT

12.1 EXISTING ROAD AND TRAFFIC CONDITIONS

Access to the proposed site is from regional route R680. Heavy traffic will access the plant from the N24 via the R680 from Carrick on Suir. The R680 has a carriageway width of about 5.5m with minimal verges. The road surface is in good condition and has a reasonable riding quality. Sight distances are generally adequate except for the T intersection at Fiddown Bridge where available sight distance from the bridge approach is somewhat restricted.

The section of the N24 at Fiddown is relatively hazardous due to its curved alignment and restricted sight distances. There is a 30 miles per hour speed limit restriction on the N24 through Fiddown village but this ends immediately before the T intersection with Fiddown Bridge although the substandard alignment continues for a few hundred metres to the southeast. The sight distance available at the T intersection of the N24 with Fiddown Bridge appears adequate although the information signs are somewhat difficult to see when approaching from the N24.

Based on traffic counts carried out by Waterford County Council on the R680 at Kilmeaden (Table 12.1) supplemented by a limited volume count at the plant location it is estimated that the Annual Average Daily Traffic (AADT) on the R680 at the plant location is about 1450 vehicles/day (10% heavy vehicles).

Table 12.1 Traffic counts at Kilmeaden Station (R680)

Results of 12 hour counts

Year	Cars Only	Light Traffic incl. Cars	Heavy Goods incl. Buses	Peak Hour	Total No. Vehicles at Peak Hr.	Total
1988	997	1,226	62	7-8pm	171	1,288
1990	959	1,379	238	5-6pm	210	1,617

Note: The traffic counts were carried out for a 12 hour period from 8 am to 8pm. (information provided by Waterford County Council).

The equivalent value for a 24 hour period at Kilmeaden is approximately 1450 vehicles/day (15% heavy vehicles). The peak hour volume at either location is estimated to be not more than 250 vehicles/hour. Consequently there are no capacity problems on this route.

12.2 TRAFFIC GENERATED BY THE PROPOSED PLANT

This would consist mainly of employees commuting to the plant by car and heavy vehicles delivering material to and from the plant. It is expected that the plant will employ a total of 54 people.

The majority of employees would attend the plant between 7.00am and 5.00pm each day. Consequently it would be expected that not more than 50 cars would enter/depart from the plant close to these times each working day (Monday to Saturday). While the pattern of employee movements is not known, it is reasonable to assume that not more than 35 to 40 cars would travel in the maximum flow direction.

Daily heavy vehicle movements generated by the plant are estimated as follows:

*	Hide Deliveries	8
*	Outward Shipments	2
*	Chemical Deliveries	1
*	Deliveries of other supplies	3
*	Waste Vehicle	3

This results in a total of 17 heavy vehicles accessing the plant each day giving an average of 3 or 4 movements (in or out) per hour. Most heavy vehicle arrivals and departures are anticipated to occur between 8.00am and 5.00pm each working day. The traffic will generally access the plant from the N24 via Fiddown Bridge or via the R680 from Carrick on Suir.

12.3 TRAFFIC IMPACT OF THE PROPOSED PLANT

Impacts During Plant Operation

Traffic impact should be relatively low because of the adequate spare capacity on the adjacent roads system. While it may be undesirable that any additional traffic should use the sub-standard Fiddown section of the N24, the relatively small number of vehicles generated by the plant are unlikely to cause any significant safety problems. Kilkenny County Council are examining two alternative road alignments for improving the Fiddown section of the N24 but it is unlikely that any such re-alignment will be made within the next few years.

Vehicles accessing the plant will cause some disturbance to the small number of residents on the adjacent roads particularly before 7.00am. Vehicles carrying waste products from the plant will be adequately sealed to prevent any spillage or odours.

There should be no problem in designing an appropriate plant entrance with adequate sight distances along the R680. A sight distance of 230m should be available in both directions from a point 3m back from the carriageway edge (Geometric Design Guidelines: Intersections of Grade, An Foras Forbartha 1984, p61).

Impacts During Construction

The major traffic impact from the proposed plant is likely to occur during the construction period. Approximately 20 cars carrying construction workers will travel to and from the plant site each day during the peak of construction. They will probably reach the site just before 8.00am each morning and departing each evening after 5.00pm. A considerable number of heavy vehicles will be involved in transporting construction materials. The impact of construction activities will only last for a limited period and there are few houses along the R680.

Loose material should be removed from the wheels of construction traffic by spraying with water. Adequate off road parking spaces should be provided in order to ensure that vehicles are not parked on the relatively narrow R680 during the construction period.

Summary of Traffic Impacts

Generally these will be small because of the relatively small number employed (54) and the small number of heavy vehicles projected to access the plant each day (17 in and 17 out). Apart from the construction period, the principal traffic impacts would appear to be the increased noise from early morning traffic before 7.00am on the few residences along the R680 and the addition of 3 or 4 heavy vehicles each hour through the sub-standard Fiddown section of the N24.

12.4 MITIGATION REQUIREMENTS

Dangers resulting from traffic entering and leaving the site will be avoided by implementing the entrance design illustrated in Figure 2E.

Potential hazards resulting from traffic joining the N24 at the T junction by the bridge could be reduced by erecting new road signs. The average highway speed along this section of the N24 is only about 25 miles per hour. Drivers should be informed by the erection of a suitable sign (there is an existing "dangerous bend ahead" sign). Alternatively the existing speed limit of 30mph could be extended by agreement with the local authority.

Appendix 3.5

- Soils, Geology & Groundwater

SECTION 7
SITE GEOLOGY

7.1 SOILS, SUBSURFACE CONDITIONS AND GROUNDWATER

Soils and Subsurface Conditions

A geotechnical appraisal of the site was carried out by Ove Arup & Partners Ireland in June 1991. This is available for inspection at the offices of Michell Ireland.

The geotechnical appraisal found that in general the site is composed of 0.3 meters of topsoil on approximately 2.0 meters of medium dense brown silty clayey sand with gravel and cobbles. This was over at least 2.0 meters (limit of trial pits) of firm to stiff, brown, sandy, silty clay with some gravel, cobbles and the occasional boulder. This is typical of the well drained granular glacial drift deposits expected from the geological maps of the region. On this basis an overburden general allowable bearing pressure of 100kN/m^2 was estimated. Due to the susceptibility of the exposed overburden to deterioration in wet or heavily trafficked conditions, summer construction is recommended.

The alluvial flats which the wastewater outfall pipes will pass through are composed of 0.2 meters of topsoil underlain by at least 4.0 meters of soft blackish brown peaty silt. It was concluded that the outfall pipes should also be installed during summer in one day to prevent excessive groundwater infiltration and trench destabilisation.

Groundwater

A trial well drilling and testing programme was carried out on the Killowen site in the autumn of 1990 and the report describing the results are contained in Appendix 19. The drilling programme indicated that the site is underlain by some 30m of unconsolidated overburden overlying a weathered limestone bedrock. The limestone bedrock constitutes a major aquifer and the project's total freshwater demand can be supplied by ground water abstracted from this strata.

The chemical analysis of the groundwater abstracted in the autumn drilling programme (Appendix 19) indicates that the groundwater is safe for human consumption. It is recommended that the water be passed through UV light before consumption as a precautionary measure.

7.2 IMPACT AND MITIGATION

Impact on Soil and Substrata

The development will have no impact on the local soils and substrata as long as the following practices are adhered to during the construction phase:

The recommended allowable bearing pressure is not exceeded.

Major siteworks are undertaken during the summer months to minimise the likelihood of silt laden runoff.

The topsoil removed from the hardstanding and building excavations is respread consistently over the new landscape berms and stabilised by planting as soon as possible.

Truck wheels pass through a wash before leaving the site.

Dust nuisance is minimised by surface spraying the excavated areas.

Impact on Groundwater

The pumping test carried out on one of the trial wells completed on the site returned a drawdown of about 1m for a pumping rate of $900m^3$/day. This abstraction caused a drawdown of some 0.7m in the observation well located some 130m from the pumping well. This result indicates that the cone of depression associated with the proposed groundwater abstraction will have a very limited impact on the level of the local water table.

The limestone bedrock aquifer may be connected to the water supply available for local surface wells. The developer is advised to monitor the water levels in the neighbouring wells in advance of any groundwater abstraction on the Killowen site to determine the baseline conditions of these locations. Further regular measurements will indicate what impact, if any, the abstraction is having on the existing levels and the need for any remedial action.

There are no planned discharges to groundwater in the development with all wastewaters being collected, treated and discharged to surface waters. All the wastewater tankage is above ground, to minimise the possibility of an undetected leakage. The proposed development will therefore have no significant impact on local groundwater quality.

Report on the Drilling and Testing
Of
Trial Water Wells
At
Killowen, Portlaw.

December 1990.

Table Of Contents

List Of Figures

List Of Tables

List Of Appendices

K. T. Cullen & Co. Ltd.
Hydrogeological & Environmental Consultants.

7a Olivemount Terrace
Windy Arbour
Dundrum
Dublin 14
Tel 01 - 2697082, 2698331, 2697122

Report on the Drilling and Testing Of Trial Water Wells At Killowen, Portlaw.

December 1990.

1. Introduction

Michell Leather intend to apply to Waterford County Council for planning permission to develop a wet blue tannery on a site at Killowen, Portlaw in County Waterford. This office was retained by Michell to investigate the possibility of supplying the tannery's fresh water demand estimated at 450m^3/d with groundwater from production wells located on the development site. This report describes the results of the groundwater investigation programme and makes recommendations on the construction of production wells to supply the proposed factory.

2. Regional Setting And Resistivity Survey

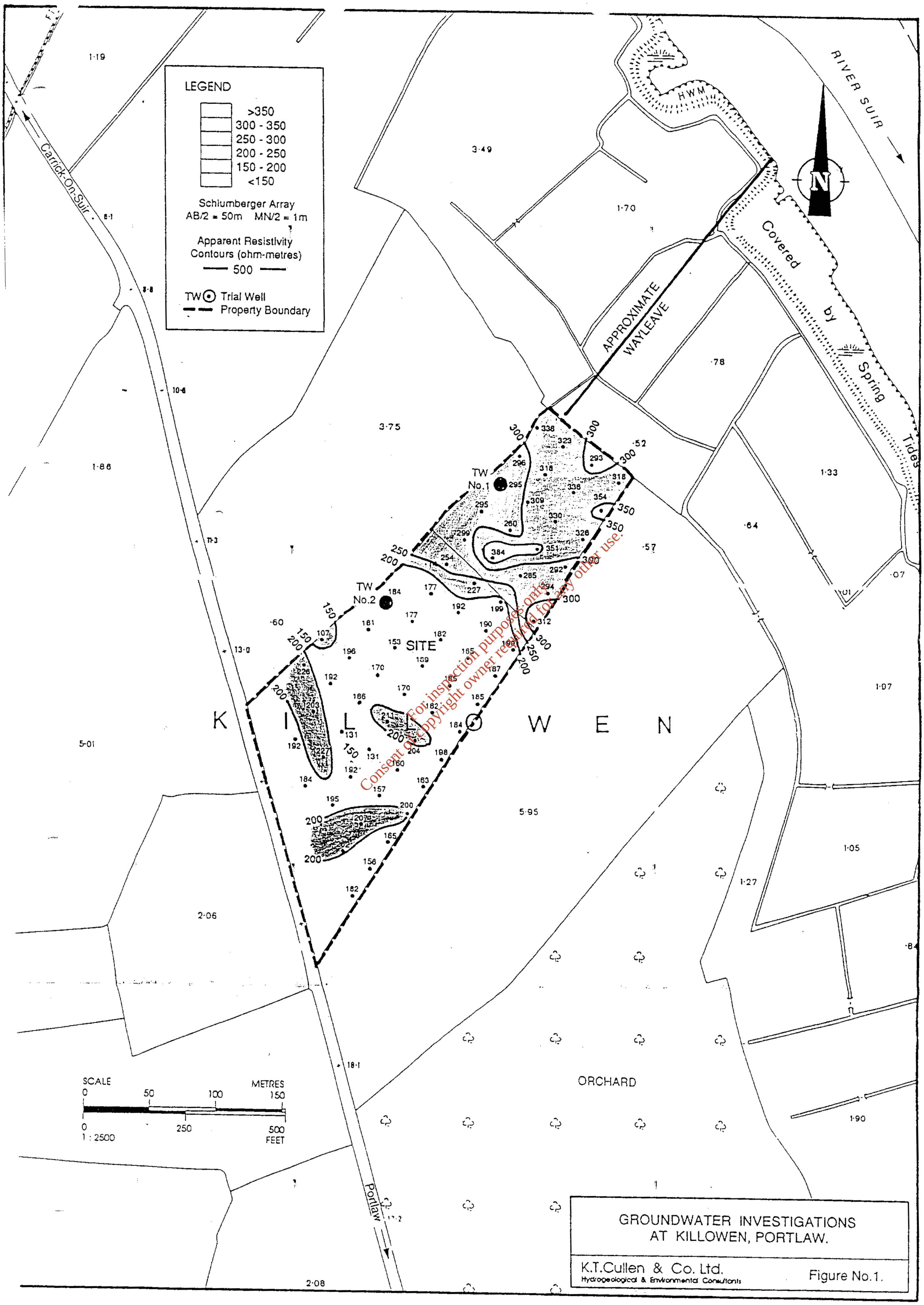
The Portlaw Site occupies relatively low lying ground on the southern bank of the River Suir. This narrow tract of low ground separates the high ground of the Slievenamon Mountains to the north of the River Suir and the Comeragh Mountains to the south. The elevated ground is underlain by inliers of Lower Palaeozoic and Devonian rocks composed mainly of shales and sandstones. The intervening low ground is underlain by Lower Carboniferous strata of the Carrick-On-Suir Syncline. The Carboniferous rocks consist mainly of limestones although the lower part of the successions contains a number of sandstone units. The marked elevation difference between the Carboniferous strata and the older Lower Palaeozoic rocks is a common feature throughout the island and reflects the easily weathering nature of limestones in comparison to the more weather resistant shales and sandstones.

The entire area was glaciated in the recent geological past by at least one major glacial event. The high ground tends to have only a thin covering of glacial tills. The lower lying ground can have widely varying depths of glacial overburden depending on the undulations within the buried bedrock surface.

Groundwater has been widely developed in the limestones of southern Ireland. While the limestone bedrock itself lacks an intergranular permeability, fracturing and karstification have combined to make these strata regionally important aquifers. Unfortunately, as is common to most fissure flow aquifers, the groundwater potential of a particular site is difficult to predict and requires a trial well drilling programme to define the actual ground conditions present. Surface resistivity has proven to be a useful tool in groundwater development projects in Ireland as it provides a general appreciation of the variation in the underlying geology and usually provides suitable well drilling targets. It is not used as a tool to quantify the groundwater potential of a site but rather to indicate changes in the underlying geology and to provide drilling targets.

The Killowen site was surveyed with surface resistivity and the results of this work are given in the accompanying Fig. No. 1. The survey was carried out using an Abem SAS 300 resistivity meter with readings taken every 25m along profile lines 25m apart. The contoured apparent resistivity values shown in Fig. No. 1 define two zones with slightly differently resistivity characteristics. The ground closer to the River Suir is marked by apparent resistivity values above 250ohm-metres while the slightly higher two thirds of the site returned values of less than 200ohm-m. While this difference is not large in real terms the division is quite definite and obviously reflects a geological discontinuity of some description.

The range of values defined by the geophysical survey at Killowen would suggest either thick overburden or conductive bedrock. Two trial well drilling sites were chosen as shown in Fig. No. 1 to investigate the groundwater potential in these two areas within the development site. As Site No. 2 was more suitable in terms of the tannery development this site was investigated first while Site No. 1 was subsequently drilled to provide additional hydrogeological information.


LEGEND
>350
300 - 350
250 - 300
200 - 250
150 - 200
<150
Schlumberger Array
AB/2 = 50m MN/2 = 1m
Apparent Resistivity
Contours (ohm-metres)
500
TW Trial Well
Property Boundary
Carrick-On-Suir
RIVER SUIR
HWM
Covered by Spring Tides
APPROXIMATE WAYLEAVE
TW No.1
TW No.2
SITE
K I L L O W E N
ORCHARD
Portlaw
SCALE
METRES
0 50 100 150
0 250 500
1 : 2500
FEET
GROUNDWATER INVESTIGATIONS
AT KILLOWEN, PORTLAW.
K.T.Cullen & Co. Ltd.
Hydrogeological & Environmental Consultants
Figure No.1.

3. Drilling Results

A trial water well (Trial Well No. 2) was drilled at Site No. 2 and the log of this borehole is given in Fig. No. 2 accompanying this report. The well was drilled using a down-the-hole-hammer drilling system using compressed air as the flushing medium. The trial well construction involved the setting of 150mm diameter casing down to 35m below ground level and deepening the well to a total depth of 55m. The well encountered silty sand to 5m, underlain by pebbly clay to 19m. A layer of sandy gravel was intersected from 19m to the rock surface at 34m. The underlying limestone was heavily weathered and numerous large fractures and cavities were encountered from 34m to the bottom of the well at 55m. It had been planned to complete the trial well down to 90m but the collapsing conditions encountered within the weathered limestone prevented drilling below 55m.

Groundwater inflows were recorded in both the sandy gravel and the underlying limestone. The upper inflows were sealed off by the steel casing and it was not possible to fully test the output of the bedrock inflows due to the fractured nature of the bedrock. However, it was estimated at the time of drilling that the trial well had a yield of some 275 - 360m^3/day which was close to the projected tannery demand.

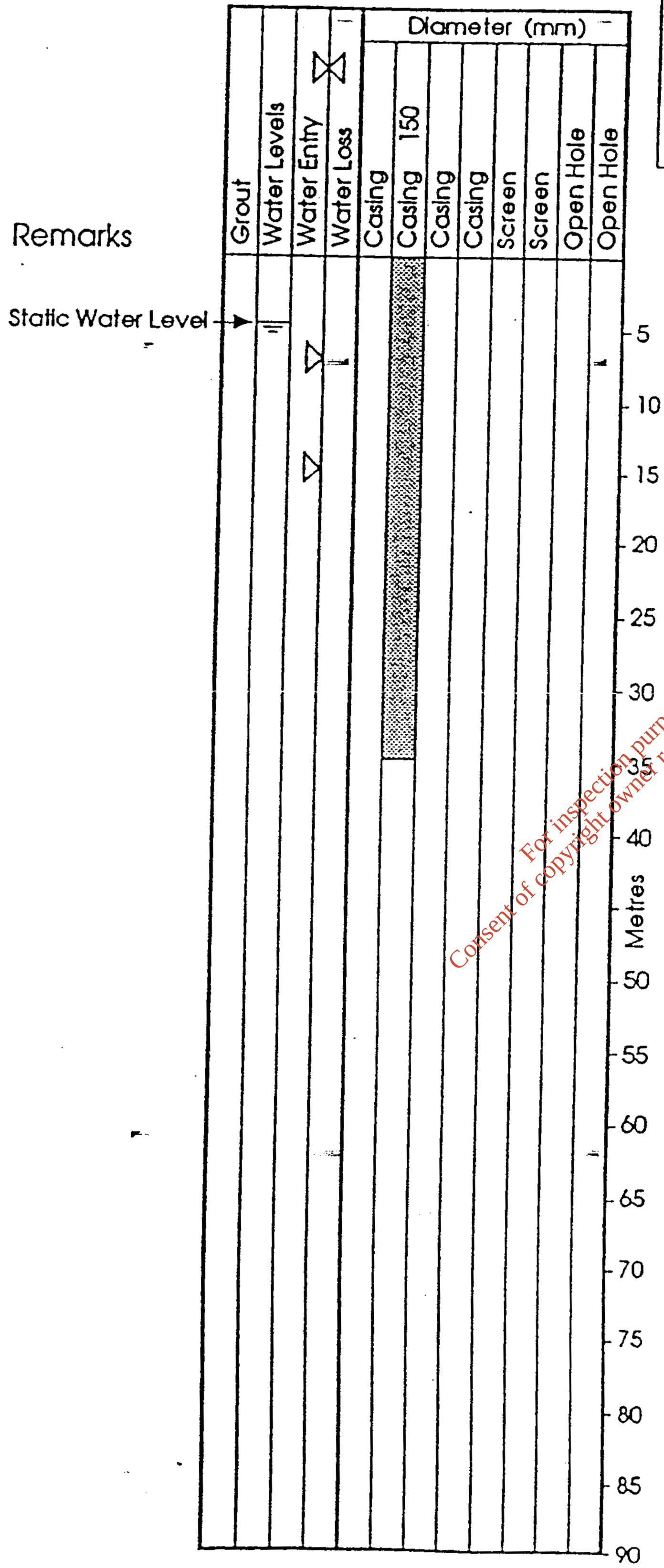
A second trial well (Trial Well No. 1) was drilled at the lower site to investigate the ground conditions in this portion of the property and to provide additional pumping capacity if required. The log and construction details of this well are given in Fig. No. 3. This well was drilled to a depth of 25m and it encountered some 12.5m of clay and sand overlying what appears to be a heavily weathered limestone bedrock. As with the first trial well the bedrock contained numerous fractures and cavities and required support with steel casing to the total depth of the well at 25m. Groundwater was encountered in both the overburden and the underlying bedrock but it was difficult to quantify the output of either of these units due to the unstable nature of the formations. The occurrence of bedrock at a shallower depth in the second trial well is consistent with the resistivity results and suggests that the upper part of the site is underlain by an over-deepened channel now infilled with glacial and post glacial sediments.

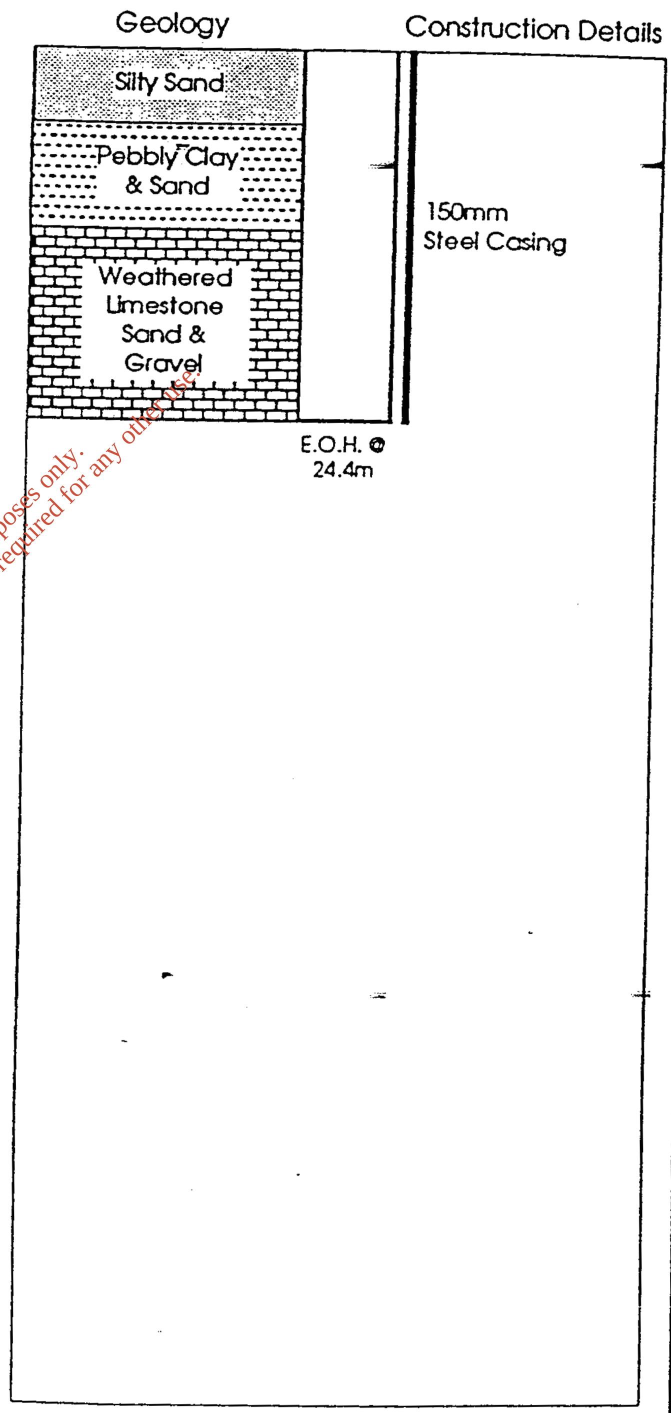
Drilling with down-the-hole-hammer with compressed air provides a fast efficient method of well drilling and is widely used throughout Ireland for domestic, agricultural and industrial water wells. Under most circumstances it is possible to provide reliable geological logs and to complete the wells to the target depth. The ground conditions found at Killowen can be described as the most unsuitable for this drilling method as the well walls remained unstable throughout. In these conditions the resultant geological logs can only be taken as a guide to the stratification beneath the site as the returned samples are a mixture of the well walls above a particular depth. A different method of drilling would be required to provide more accurate geological logs and to provide geotechnical samples of both the overburden and bedrock beneath the Killowen site.

Completed Well Design

Trial Well No.1

Client : Michell
Project : Portlaw
Location : Killowen
County : Waterford
Date : October 1990
Driller : D.O'Donohoe
Aquifer : Weathered Limestone
Output : Est. >1000 m^3/day
Specific Capacity : — m^3/day/m
National Grid : 247,000 East
Co - ordinates : 118,500 North





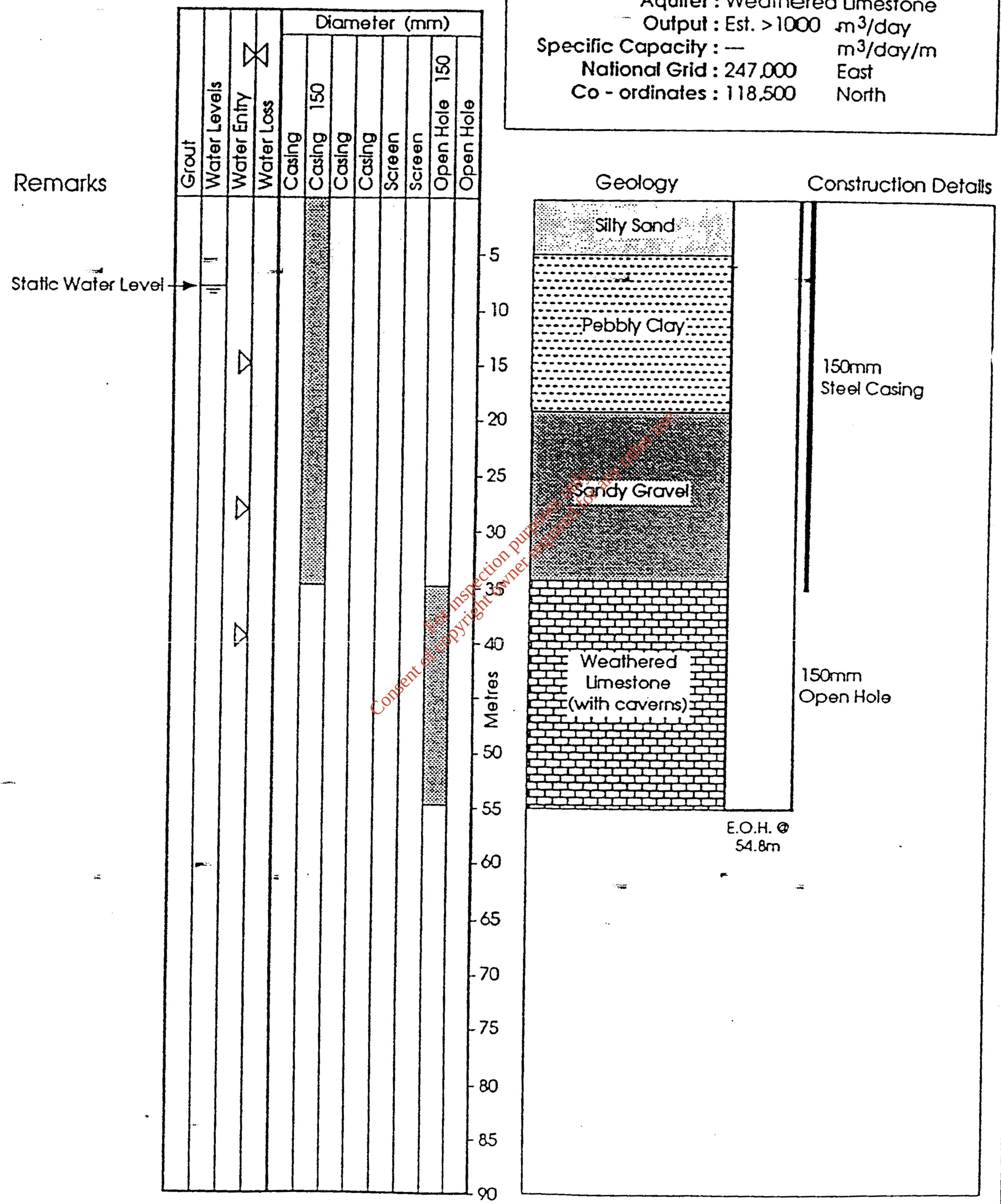
K.T.Cullen & Co. Ltd.
Hydrogeological & Environmental Consultants

Figure No.3.

Completed Well Design

Trial Well No.2

Client : Michell
Project : Portlaw
Location : Killowen
County : Waterford
Date : October 1990
Driller : D.O'Donohoe
Aquifer : Weathered Limestone
Output : Est. >1000 m3/day
Specific Capacity : — m3/day/m
National Grid : 247,000 East
Co - ordinates : 118,500 North



K.T.Cullen & Co. Ltd.
Hydrogeological & Environmental Consultants

Figure No.2.

4. Pump Testing

On completion of the drilling exercise Trial Well No. 2 was test pumped to provide yield information and the resulting time-drawdown data is tabulated in Appendix I and shown graphically in Fig. No. 4. The test was carried out using a Mono-pump powered by a diesel engine with the pumped water piped to the River Suir. The pumping rates were determined with an on-line flow meter and confirmed by filling a container of known volume. Water level measurements were collected at regular intervals throughout the test which were continuously supervised by the contractor. Water level measurements were taken by an electrical contact dipper installed in a dipper pipe to prevent cascading effects.

The well was pumped for 30 minutes at a rate of 200m^3/day at which time the rate was increased to 430m^3/day. The output was again increased to 900m^3/day after 60 minutes into the test and maintained at this rate for the remainder of the test. The drawdown at the end of the 72 hour test was less than 1m. This result indicates that the limestones beneath the Killowen site constitute a major aquifer which is capable of supplying large quantities of groundwater. In particular, the result indicates that the projected demand of the tannery (450m^3/day) can be supplied by a single production well.

Water levels were monitored in Trial Well No 1 during the pumping test and these are also shown in Fig. No 4. While the drawdown in this observation well is less than in the pumped well as expected the fluctuation in the water levels in both wells during the latter part of the test reflect tidal influences. This result indicates a hydraulic continuity between the aquifer tapped by the trial wells and the nearby River Suir which is tidal for some distance upstream of the Killowen site.

5. Hydrochemistry

Samples of the pumped water were collected and sent for chemical and bacteriological analyses and the results are tabulated in Table No. 1. The groundwater at Killowen is of excellent quality with a hardness of 214mg/l Ca CO_3 and a conductivity of 395 US/cm. The chloride level of 18mg/l is low and shows that the groundwater is free from salt water contamination. In addition the relatively low conductivity value indicates a lower mineral content than would be found in most Irish limestone aquifers. This characteristic may reflect the sandstone horizons found here, especially the Devonion strata that are known to lie between the Carboniferous limestones and the Lower Palaeozoic shales and sandstones.

The bacteriological quality is generally good with no E. Coli or coliforms recorded. The plate count at 22^{oC} is high but this figure may reduce with continuous pumping.

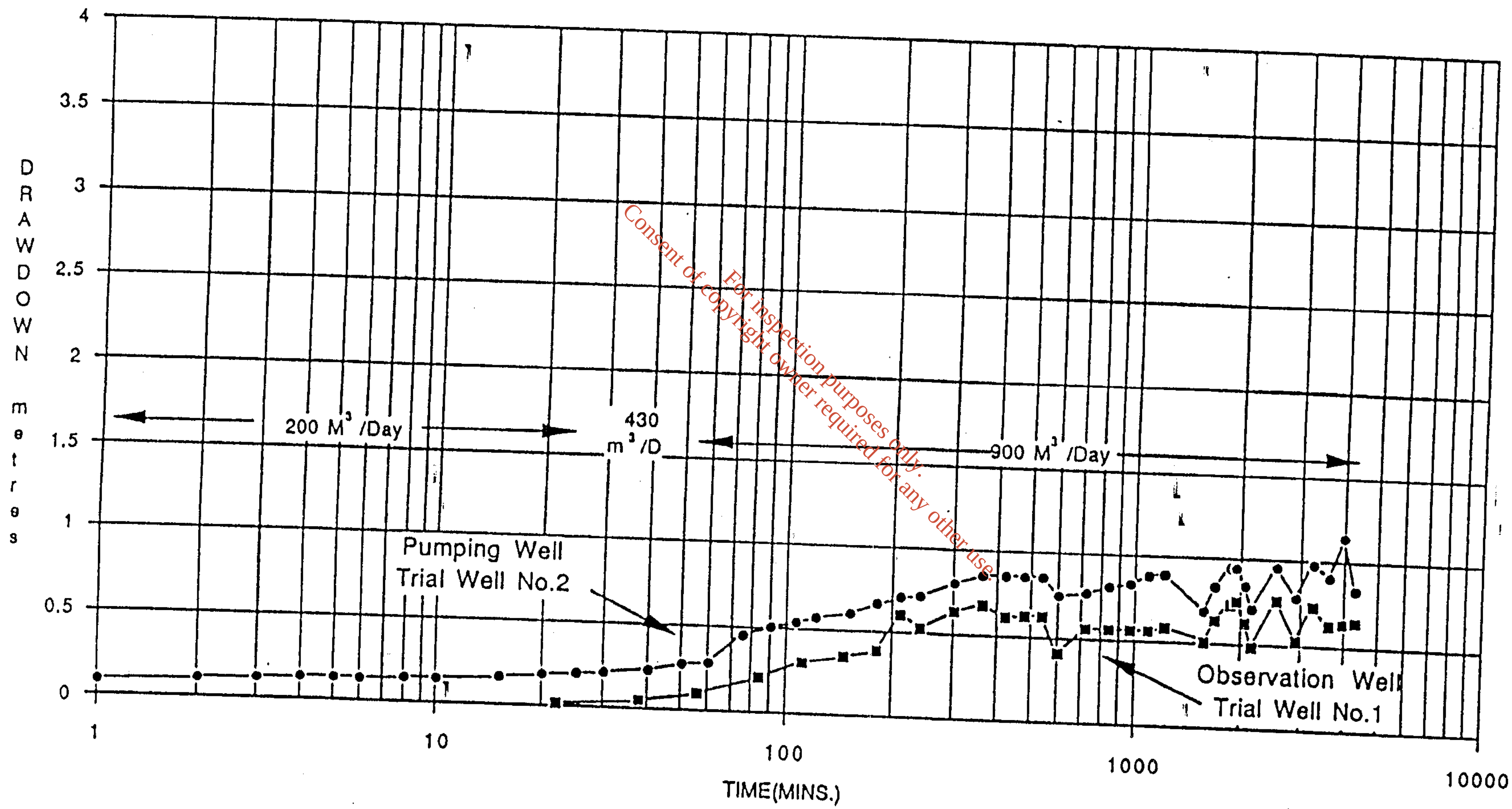


Figure No. 4 Time Drawdown Graph of pumping and observation wells at Killowen, Portlaw.

PARAMETERS	UNIT	WELL No. 2	POTABLE Water M.A.C.
Calcium	Ca mg/l	62	200
Magnesium	Mg mg/l	14	50
Sodium	Na mg/l	10	150
Potassium	K mg/l	1.1	12
Bicarbonate	HCO3 mg/l	219	---
Sulphate	SO4 mg/l	13	250
Chloride	Cl mg/l	18	250
Ammonium	NH4 mg/l	<0.05	0.3
Nitrate	NO3 mg/l	12.3	50
Nitrite	NO2 mg/l	0.06	0.1
Copper	Cu mg/l	<0.01	0.5
Iron	Fe mg/l	0.13	0.2
Manganese	Mn mg/l	<0.01	0.05
P.V. @ 4 hours	O2 mg/l		5
T.O.C.	C mg/l	16	---
pH	units	7.7	6 - 9
Hardness	CaCO3 mg/l	214	>60
Colour	mg/l Pt/Co	7.5	20
Turbidity	F.T.U.	21	4
Conductivity	µ S/cm	395	1,500
Alkalinity	CaCO3 mg/l	184	>30
Coliforms	MPN/100ML	0	0
E - coli	MPN/100ML	0	0
Plate Count @ 37 C	COL/ML	40	
Plate Count @ 22 C	COL/ML	11300	No significant increase above background level

NOTE: N.E. = Not Examined N.D. = None Determined < = Less Than

M.A.C. = Maximum Admissable Concentration under E.C. directive (No.80/778/E.C.)

e 1 Chemical Analysis of groundwater at Killowen, Portlaw.

6. Conclusions And Recommendations

The results of the trial well drilling and testing programme have indicated that;

1. The Killowen site is underlain by heavily weathered limestone bedrock.

2. The bedrock is overlain by a variable depth (12.5 - 35m) of unconsolidated clays, silts, and gravel.

3. The limestone bedrock constitutes a major aquifer capable of supplying large volumes of groundwater.

4. The groundwater at Killowen is of potable quality with a relatively low hardness of 214mg/l $Ca\ CO_3$ and a conductivity value of 395 US/cm.

5. A single production well at the Killowen site would be capable of providing the total fresh water demand of the tannery which is estimated at $454m^3$/day.

The drilling results at the two trial well sites have shown that the Killowen site is underlain by unconsolidated overburden overlying a heavily weathered limestone bedrock. The construction of production water wells to a depth of 50 - 60m in these conditions will be a difficult operation. It is recommended that duty and stand-by production wells be developed a the Killowen site at the site of Trial Well No. 2. These wells should be fully lined and screened over their total depth to prevent against pump loss due to well wall collapse. The installation of well screens in these unstable conditions will probably require the use of mud drilling, although cable tool drilling might be able to case the weathered limestone. In any event the construction of the production wells at Killowen should be controlled by a definite contract as the cost of providing a finished diameter well of 200mm is likely to be significantly higher than would normally be the case in Ireland. The use of down-the-hole-hammer drilling should not be used for the construction of the production wells.

Appendix I

Time Drawdown Data

From

Pumping Test at Killowen, Portlaw,

Co. Waterford.

TIME (mins.)	WATER LEVEL below G.L. (m.)	DRAWDOWN (metres)
0	3.88	0
22	3.91	0.03
38	3.94	0.06
56	3.99	0.11
83	4.09	0.21
111	4.19	0.31
145	4.23	0.35
180	4.27	0.39
210	4.48	0.6
240	4.41	0.53
300	4.51	0.63
360	4.56	0.68
420	4.49	0.61
480	4.5	0.62
540	4.5	0.62
600	4.29	0.41
720	4.44	0.56
840	4.44	0.56
960	4.44	0.56
1080	4.44	0.56
1200	4.46	0.58
1560	4.39	0.51
1680	4.51	0.63
1860	4.61	0.73
1920	4.63	0.75
2040	4.5	0.62
2160	4.37	0.49
2520	4.64	0.76
2880	4.41	0.53
3240	4.61	0.73
3600	4.5	0.62
3960	4.51	0.63
4320	4.52	0.64

Time Drawdown Data from Trial Well NO.1 Killowen, Portlaw.

TIME (mins.)	WATER LEVEL below G.L. (m.)	DRAWDOWN (metres)	YIELD (m3/day)
0	7.9	0	
1	8	0.1	200
2	8.02	0.12	
3	8.03	0.13	
4	8.04	0.14	
5	8.04	0.14	
6	8.04	0.14	
8	8.05	0.15	
10	8.05	0.15	
15	8.07	0.17	
20	8.09	0.19	
25	8.1	0.2	
30	8.11	0.21	430
40	8.14	0.24	
50	8.18	0.28	
60	8.19	0.29	900
75	8.36	0.46	
90	8.41	0.51	
105	8.44	0.54	
120	8.47	0.57	
150	8.5	0.6	
180	8.56	0.66	
210	8.61	0.71	
240	8.62	0.72	
300	8.7	0.8	
360	8.75	0.85	
420	8.75	0.85	
480	8.75	0.85	
540	8.75	0.85	
600	8.65	0.75	
720	8.67	0.77	
840	8.71	0.81	
960	8.73	0.83	
1080	8.78	0.88	
1200	8.8	0.9	
1560	8.59	0.69	
1680	8.73	0.83	
1860	8.85	0.95	
1920	8.85	0.95	
2040	8.74	0.84	
2160	8.61	0.71	
2520	8.86	0.96	
2880	8.68	0.78	
3240	8.88	0.98	
3600	8.81	0.91	
3960	9.05	1.15	
4320	8.73	0.83	

Time Drawdown Data from Trial Well NO.2 Killowen, Portlaw.

Appendix 3.6

- Groundwater Test Results from IPC Licence 238.

EURO environmental services

Environmental Science & Management
Water, Soil & Air Testing

Customer Name	Dermot Moore	*Lab Report Ref. No.*	1540/004/01S
Company	Michell Ireland	*Date of Receipt*	26/02/04
Address	Killowen	*Date Testing Commenced*	26/02/04
	Portlaw	*Received or Collected*	Collected by Courier
	Waterford	*Condition on Receipt*	Acceptable
CustomerPO	24538	*Date of Report*	30/03/04

CERTIFICATE OF ANALYSIS - Supplementary

lientRef: Bore 1

Lab Ref: 1540/004/01

Test Parameter	Method of Analysis	Analytical Technique	Result	Units
BOD	SOP 113	Electrometry	3	mg/L
Chromium	SOP 177	ICPMS	<10	ug/L
Conductivity	SOP 112	Electrometry	434	uscm -1 @ 25C
Pesticides (Organochlorine)	SOP 156	GC-MS	<0.1	ug/L
Pesticides (Organophosphorous)	SOP 159	GC-MS	<0.1	ug/L
pH	SOP 110	Electrometry	7.8	pH Units

Signed : Donna Heslin

Date : 30/03/04

Results shall not be reproduced, except in full, without the approval of EURO envoirnmental services
Results contained in this report relate only to the samples tested
* Indicates test which has been subcontracted

Unit 35, Boyne Business Park, Drogheda, Co. Louth, Ireland | Tel: 353 41 984 5440 | Fax: 353 41 984 6171 | Email: info@euroenv.ie | www.euroenv.ie

EURO environmental services

Environmental Science & Management
Water, Soil & Air Testing

Customer Name	Dermot Moore	*Lab Report Ref. No.*	1540/004/02S
Company	Michell Ireland	*Date of Receipt*	26/02/04
Address	Killowen	*Date Testing Commenced*	26/02/04
	Portlaw	*Received or Collected*	Collected by Courier
	Waterford	*Condition on Receipt*	Acceptable
CustomerPO	24538	*Date of Report*	30/03/04

CERTIFICATE OF ANALYSIS - Supplementary

ClientRef: Bore 2

Lab Ref: 1540/004/02

Test Parameter	Method of Analysis		Analytical Technique	Result	Units
BOD	SOP	113	Electrometry	<2	mg/L
Chromium	SOP	177	ICPMS	<10	ug/L
Conductivity	SOP	112	Electrometry	499	uscm -1 @ 25C
Pesticides (Organochlorine)	SOP	156	GC-MS	<0.1	ug/L
Pesticides (Organophosphorous)	SOP	159	GC-MS	<0.1	ug/L
pH	SOP	110	Electrometry	7.7	pH Units

Signed : Donna Hesin

Date : 30/03/04

Results shall not be reproduced, except in full, without the approval of EURO envoirnmental services
Results contained in this report relate only to the samples tested
*Indicates test which has been subcontracted

Regional Winner - National Enterprise Awards 2000

Unit 35, Boyne Business Park, Drogheda, Co. Louth, Ireland | Tel: 353 41 984 5440 | Fax: 353 41 984 6171 | Email: info@euroenv.ie | www.euroenv.ie

EURO environmental services

Environmental Science & Management
Water, Soil & Air Testing

Customer Name	Dermot Moore	*Lab Report Ref. No.*	1540/005/01
Company	Michell Ireland	*Date of Receipt*	01/03/2004
Address	Killowen	*Date Testing Commenced*	01/03/2004
	Portlaw	*Received or Collected*	Delivered by Customer
	Waterford	*Condition on Receipt*	Acceptable
CustomerPO		*Date of Report*	24/03/2004

CERTIFICATE OF ANALYSIS

ClientRef: Bore 3

Lab Ref: 1540/005/01

Test Parameter	Method of Analysis		Analytical Technique	Result	Units
BOD	SOP	113	Electrometry	<2	mg/L
Chromium	SOP	177	ICPMS	<10	ug/L
Conductivity	SOP	112	Electrometry	502	uscm -1 @ 25C
Pesticides (Organochlorine)	SOP	156	GC-MS	<0.1	ug/L
Pesticides (Organophosphorous)	SOP	159	GC-MS	<0.1	ug/L
pH	SOP	110	Electrometry	7.8	pH Units

Signed: Donna Heslin

Date: 24/03/04

Donna Heslin - Senior Laboratory Technician

Results shall not be reproduced, except in full, without the approval of EURO envoirnmental services
Results contained in this report relate only to the samples tested
indicates test which has been subcontracted

Regional Winner - National Enterprise Awards 2000

Appendix 3.7

- Visual & Landscape Environment.

SECTION 10
VISUAL AND LANDSCAPE ENVIRONMENT

This section examines the existing visual and landscape environment of the Killowen site and analyses the steps taken to integrate the development into the environment. This enables the visual impact to be assessed.

10.1 THE VISUAL ENVIRONMENT OF KILLOWEN AND THE SITE

The site is located in the Killowen division of the Portlaw district on the lower southern slope of the Suir Valley. The Suir at Killowen is 200 to 300 meters wide and tidal.

Killowen is characterised by gently sloping river flat and lower valley topography. The fertile soils have facilitated a well established grazing landuse, with fields of 2 to 5 hectares surrounded by hedgerows being typical. Other landuses such as a recently harvested forestry plantation and an orchard can be found approx. 1 Km north and south of the site respectively.

Established smaller farm residences are dotted throughout Killowen, generally on the southern side of the R680 (which cuts centrally through Killowen parallel to the Suir). The nearest residence to the site is 0.4 Km away.

Significant visual features (Fiddown Island and Rocketcastle) are on the outskirts of Killowen, approximately 1.5 Km north and south of the site.

The local topography and the prevalence of mature hedgerows and trees effectively prevent close views of the site and restrict distant views to locations on an arc to the north and northeast of the site. Due to the river bank these views are also restricted to the northern third of the river and beyond.

The continuous hedgerow along the northern side of the R680 prevents any views of the site from vehicles travelling past the site from either direction.

A photographic survey of the distant views is included in Appendix 22. The survey demonstrates that the scale and significance of the site in the total view from the distant locations indicated is small. The developments impact from these locations will only be significant if the development is obtrusive.

The site has no special visual foci or features. Visually impressive aspects of the site relate to its substantial hedgerows and views from the top of the site across the Suir to the northeast. These views reinforce the sites inherent rural characteristics.

The composition of the hedgerows which includes mature trees is detailed in the Flora and Fauna section and its related appendices. The hedgerows effectively enclose the site except for the boundary closest to the Suir which opens onto the river flats. A substantial hedgerow also divides the site into two distinct fields, with the top (roadside or southern) field being two and a half times the size of the lower field.

The views from the top field are possible because of its relative elevation compared to the lower site and river flats. (The site rises from 3 to 17 meters above the low river level over a distance of 450 meters). The hedgerows impair these views as they are approached.

10.2 INTEGRATING THE FACILITY INTO THE VISUAL ENVIRONMENT

Plate 1 (frontispiece) is a photograph of the 1:250 architectural model of the development.

The architects prime design objective for the development was visual integration with the existing environment. Steps have been taken to minimise the visual impact and make the development unobtrusive.

Site Selection

Major factors in the selection of the Killowen site were the potential it offers to screen and landscape the development, the limited views of the site from surrounding areas and its lack of visual features or foci.

Scale

The overall scale of the development will be minimised by cut and fill, height reduction and screening.

Figure 2E illustrates how the offices, factory, maintenance and wastewater facilities progressively step down and are set into the site. This reduces the height of the development and it creates an overall form that runs with the landscape.

Height reduction has been achieved by minimising roof pitches and by restricting tank heights to six meters. The maximum height at the ridge of the factory is 11 meters.

Screening of the development will be achieved by reinforcing the existing hedgerows with trees and shrubs as indicated in the landscaping plan Figure 2G. Further screening will be achieved by tree planting and earth berming at the top of the site. Planting around the access parking and loading areas will help to reduce the scale of these open areas.

Colour

The green colours chosen for the factory cladding and wastewater tanks will blend well with the existing visual environment. The off-white (blockwork) and rich green (window frames) colours used for the offices are not bold enough, or of a sufficient area to cause an impact. They are also colours readily associated with the rural setting.

Materials and Construction

Materials and construction techniques that are in use in the local region have been utilised in the factory design. Techniques of a 'high tech' or unusual nature have been avoided. The wastewater tanks which are lined with a smooth fibreglass, have been coloured light green to prevent the material from being visually emphasised.

Form and Shape

The shoulders of the buildings have been rounded to reduce the impact of their form. As previously stated the development has been given a horizontal shape by keeping the height to a minimum.

Focus

The factory buildings have been located away from the road and the river flats to reduce their focal impact. The form, colours and landscape screening utilised will reduce the focal impacts of the development from a distance.

Associations

Materials, colours, forms and vegetation that are normally associated with the rural setting will be used wherever possible. The stone entry wall is an example of this. Native vegetation is proposed for the landscape design. Pitched roofs which are a traditional roofing form have been utilised in the factory design.

Retaining Existing Hedgerows

A large section of the hedgerow on the R680 will have to be relocated to allow for safe vehicular access to the site. To prevent this causing a significant visual impact it will be reinstated in a similar form using the same vegetation types.

Screening

The Landscape Plan Figure 2G indicates the extensive landscape screening which will be undertaken. This will enhance the unobtrusive design of the development.

Screening below the wastewater system will minimise the visual impact of the development from the Kilkenny (northern) side of the river.

10.3 THE MODEL

A three dimensional scale model of the development has been constructed and is available for public inspection

10.4 VISUAL IMPACT SUMMARY

The visual impact of this development will be small in the short term and minimal in the longer term once the proposed landscape screening becomes established. This is largely due to the steps that have been proposed to integrate the development into the landscape. It is important that the integration proposed is carried out, maintained and preserved during the operating life of the development. Any future expansion must also be integrated into the landscape.

The main short term visual impact will be during the construction phase. This cannot be avoided, but its impact can be reduced by implementing the landscape screening as soon as possible after project approval.

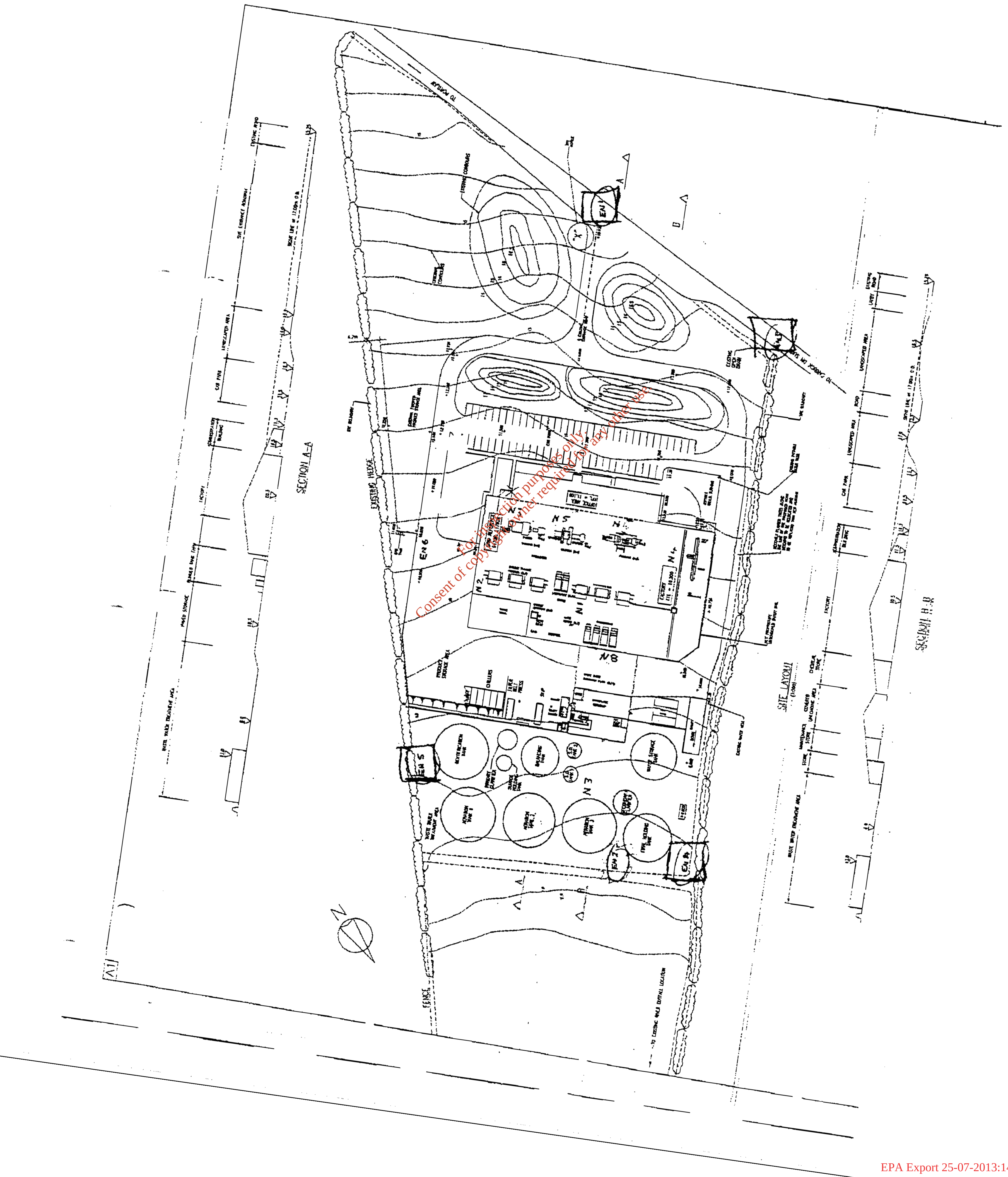
Appendix 3.8

- Noise Results from IPC Licence 238.

NOISE SURVEY

Survey carried out at the AES site at Kilowen, Portlaw, Co. Waterford on 2nd July 2004 at 12.30pm.
EN 1 On road opposite factory gates 30 dBA.
EN 3 North-west boundary corner of field 34 dBA.
EN 4 North-east boundary corner of field 30 dBA.
EN 5 East boundary between Aeration tank 1 and 2nd Balancing tank 31 dBA.

The noise indicator used was a Cirrus 222 Integrating Sound Level meter, which operates using Leq. The measurements were taken for 15 minutes at each point.


SITE LAYOUT
SECTION A-A
SECTION B-B
EXISTING HEDGE
FENCE
FACTORY

3.1.4 Noise

One noise survey was carried out in 2003.

The maximum noise levels recorded are tabled below:

	Maximum noise level	Noise level limit
In side the factory	84 dBA	85 dBA
Noise sensitive location (day time)	40 dBA	55 dBA
Noise sensitive location (night time)	30 dBA	45 dBA

These results are similar to the 2002 results

No clearly audible tones were recorded in the comments at the noise sensitive locations.

3.1.4 Noise

One noise survey was carried out in 2002.

The maximum noise levels recorded are tabled below:

	Maximum noise level	Noise level limit
In side the factory	84 dBA	85 dBA
Noise sensitive location (day time)	38 dBA	55 dBA
Noise sensitive location (night time)	34 dBA	45 dBA

These results are similar to the 2001 results

No clearly audible tones were recorded in the comments at the noise sensitive locations.

Appendix 3.9

- Extracts from IPC Licence Reg. No. 238 relating to Emission Limit Values and Monitoring.
- Copy of Discharge Licence.

Extracts from IPC Licence Reg. No. 238

Schedule 2(i) Emissions to Water

Emission Point Reference No.: EW - 1
Name of Receiving Waters: River Suir
Location : Killowen, Portlaw, Co. Waterford.

Grid reference: S4751 1836 (As shown in drawing IPC9)

Volume to be emitted:
- Maximum in any one day 700 m^3 Note 1
- Maximum rate per hour 87.5 m^3 Note 1

Time of emission: Effluent shall only be discharged during four hours of ebbing tides, commencing half an hour after the ebb tide begins and terminating one and a half hours before the ebb tide ceases. Note 2

Parameter	Emission Limit Value	Emission Limit Value (mg/l)
Temperature	25°C (max.)	
pH	6-9	
Toxicity	10 TU	
Fish tainting	No tainting	
BOD Note 1		100
Suspended Solids Note 1		150
Total Ammonia (as N) Note 1		20
Total Oxidised Nitrogen (as N) Note 1		50
ortho-Phosphate Note 1		2
Total Phosphorus (as P) Note 1		3
Cr (III) Note 1		0.5
Cr(VI) Note 1		0.1
Sulphide (as S) Note 1		1
Phenols Note 1		1
Oils, Fats and Grease Note 1		15

Note 1: Increased flow volumes up to a maximum of 1,000 m^3/day and 125 m^3/day and 125 m^3/hour are permitted provided the specified ELV's are reduced pro rata

Note 2: This restriction on time of discharge applies until 30 April 2000 (or sooner subject to the prior written agreement of the Agency if the lower Emission Limit Values in column three above can be achieved before the said date).

Schedule 2(ii) Monitoring of Emissions to Water

Emission Point Reference No.: EW - 1

Parameter	Monitoring Frequency Note 1	Analysis Method/Technique
Flow	Continuous	On-line flow meter with recorder
Temperature	Continuous	On-line temperature probe with recorder
pH	Continuous	pH electrode/meter and recorder
Chemical Oxygen Demand	Daily	Standard Method
Biochemical Oxygen Demand	Daily	Standard Method
Suspended Solids	Daily	Standard Method
Chromium (total Cr)	Daily	Standard method
Sulphides (as S)	Daily	Standard Method
Ammonia (as N)	Daily	Ion selective electrode
Total Nitrogen (as N)	Weekly	Standard Method
Total Nitrogen (Kjeldahl)	Weekly	Standard Method
Total Phosphorus (as P)	Weekly	Standard Method
ortho-Phosphate (as P)	Weekly	Standard Method

Oils, fats & greases	Weekly	Standard Method
Chloride	Weekly	Standard Method
Phenols	Weekly	Standard Method
Preventol WB Note 2	Quarterly	Standard Method
Chromium (as Cr VI)	Annually	Standard Method
Toxicity Note 3	Annually (24 hour flow proportional composite)	To be agreed with the Agency

Note 1: Upon receipt of test results, the frequency of monitoring shall be reviewed by the Agency.

Note 2: Detection limit of ≤1μg/l.

Note 3: The number of toxic units (Tu) = 100/x hour EC/LC50 in percentage vol/vol so that higher Tu values reflect greater levels of toxicity. For test regimes where species death is not easily detected, immobilisation is considered equivalent to death.

WATERFORD COUNTY COUNCIL

LOCAL GOVERNMENT (WATER POLLUTION) ACTS 1977 & 1990

LICENCE TO DISCHARGE TRADE EFFLUENT TO WATERS

Reference No: WPW/03/2004

Licensee: Bedminster International (Ireland) Ltd.
Killowen
Portlaw
Co. Waterford

Licensing Authority: Waterford County Council

Date of Licence Issued: 22 October 2004.

Schedule of Conditions attached to Licence Ref. No. WPW/03/2004

1. Scope of License

1.1 This Licence refers to the discharge of trade effluent, sewage effluent and contaminated wastewater from the operations of Bedminster International (Ireland) Limited as stated on the Certificate of Incorporation, registered under the Company Act 1963 – 1977.

1.2 The Licensee shall not alter the infrastructure of the licensed premises or treatment system in such a manner so as to lead to a breach of any of the provisions of this license.

1.3 This license shall be operated in compliance with the Local Government (Water Pollution) Act 1977 & 1990 and all other relevant current and future Government legislation.

2 Management of Facility

2.1 The Licensee shall inform the Licensing Authority immediately of any change in ownership of the facilities referred to in this license or any other material facts relating to the company that could effect the compliance with the terms of this License.

2.2 The Licensee shall at all times provide free and unhindered access to its premises, to any authorised representative of the Licensing Authority, or any persons nominated by the Licensing authority, or any other authorised persons as defined under Section 28 of the Local Government (Water Pollution) Act 1977, for the carrying out of such inspection, monitoring, reviewing of records and any other investigation that the Licensing Authority deems necessary.

2.3 No material change in the quality and / or quantity of the trade effluent to surface water shall be made without prior consent of the Licensing Authority.

2.4 No substance shall be discharged in a manner which, or at a concentration which, causes tainting of fish or shellfish, interferes with normal patterns of fish migration or which accumulates in sediments or biological tissues to the detriment of fish, wildlife or their predators.

2.5 The Licensee shall forward a list of suppliers of the liquid waste material to be processed in the plant, including the proposed volume for each supplier and a detailed analysis of the material from each supplier. The detailed analysis should include pH, BOD, COD, Nitrates (as N) and Phosphorous and shall also include analysis for such parameters as Waterford County Council may require from time to time. The referred list shall be updated annually or when new suppliers are proposed.

3 Storm Water

3.1 All uncontaminated storm water from roofs, roadways and other paved areas shall be discharged via an oil interceptor to the River Suir by means of the existing storm water pipeline systems. A readily accessible chamber shall be provided on this pipeline system to allow for sampling of the storm water being discharged. Details of the design and location of this chamber shall be agreed with the Licensing Authority within two months of the date of issue of this Licence and shall be constructed and operational within four months of this same date. Under no circumstances shall trade effluent or contaminated surface water be allowed to discharge to these storm water pipelines.

3.2 Stormwater pH values outside the range 6.0 to 8.0 and conductivity levels in excess of 1000μS/cm shall result in activation of visual and audible alarms on the control panels and also the automatic activation of a sluice valve to immediately terminate the discharge.

3.3 The characteristics of the stormwater shall be sampled at the monitoring chamber at frequencies per the following table and shall not exceed the limits of the following table for grab sampling:

Characteristic	Emission Limit Value	Monitoring Frequency
pH	6.0 – 8.0	Continuous
Conductivity	1000μS/cm	Continuous
Visual Inspection	No discolouration or floating residues	Weekly
BOD	15	Quarterly
Oils Fats and Greases	10	Quarterly

3.4 The results of monitoring of the stormwater shall be submitted to the Licensing Authority prior to the 10th day of the following month. The format for presentation of the monitoring results shall be agreed with the Licensing Authority within two months of the date of issue of the Licence.

4 Trade Effluent

4.1 All trade effluent and contaminated wastewater shall be discharged after treatment via a single pipeline to the River Suir as indicated in the drawings submitted with the application.

4.2 Trade effluent and contaminated waste water shall comprise those arising from the general processing operations and shall include the following:-

(a) Process wastewater.
(b) Aqueous wastes and contaminated run off from bunded areas.
(c) Contaminated wastes from truck loading, unloading and storage areas.
(d) Contaminated storm and firewater.
(e) Floor washings and wash water.
(f) Laboratory waste water.
(g) Domestic Effluent

4.3 The total volume of trade effluent discharged shall not exceed 700m3/day and the maximum flow rate shall not exceed 100m3/hour or 28 litres/second.

4.4 The characteristics of the trade effluent sampled at the monitoring chamber shall not exceed the limits in the following table for grab spot sampling and composite sampling:

Characteristic	Emission Limit Value	Monitoring Frequency
Temperature °C	25°C	Continuous
pH	6.0-8.5	Continuous
BOD	25mg/l	Weekly
COD	500mg/l	Daily
Suspended Solids (S.S.)	35mg/l	Daily
Ammonia (as N)	5mg/l	Daily
Nitrates (as N)	15mg/l	Daily
Phosphorus (as P)	2mg/l	Weekly
Ortho-Phosphorous	1mg/l	Weekly
Sulphates (as SO4)	100mg/l	Weekly
Chlorides (as CL)	500mg/l	Weekly
Phenols (as C6H5OH)	0.1mg/l	Monthly
Detergents (as MBAS)	10mg/l	Monthly
Fats, Oils and Grease (F.O.G.)	10mg/l	Monthly
Pesticides (atrazine, simazine)	10ug/l	Annually
Solvents(Dichloromethane, Toluene, Xylenes)	100ug/l	Annually
Tributlytin	0.01 ug/l and no reproductive effect in gastropods	Annually
Arsenic	200ug/l	Annually
Chromium (VI)	50 ug/l	Annually
Copper	50 ug/l	Annually
Cyanide	100 ug/l	Annually
Fluoride	5000	Annually
Lead	50	Annually
Nickel	80	Annually
Zinc	400	Annually
Toxicity	1 TU	As required

4.5 The results of monitoring of the discharged trade effluent shall be submitted to the Licensing Authority prior to the 10th day of the following month. The format for presentation of the monitoring results shall be agreed with the Licensing Authority within two months of the date of issue of the Licence.

5 Monitoring

5.1 A readily accessible monitoring chamber shall be provided on the trade effluent discharge pipeline to the River Suir. This chamber shall incorporate:

(a) Automatic flow measurement equipment, which shall continuously indicate, integrate, and record the flow in cubic metres/hour and the cumulative daily flow in cubic metres.

(b) Automatic sampling equipment which shall be capable of sampling the effluent on a continuous basis by means of a composite sampler of flow proportionate and time proportionate type.

(c) A manual sampling point, the floor of which shall be 255 mm lower than the invert level of the chamber's inlet and outlet, including a removable v-notch weir or other suitable physical means for flow measurement.

(d) Continuous automatic pH monitoring, complete with recorder and visual and audible alarms with high (8.5) and low (6.0) settings.

5.2 Details of the design and location of this chamber shall be agreed with the Licensing Authority within two months of the date of issue of this Licence and shall be constructed and operational within four months of this same date.

5.3 The equipment specified at 5.1 (a), (b), (c) and (d) above shall be in use at all times during which effluent is being discharged. Any malfunction of this equipment shall be immediately notified to the Licensing Authority in writing.

5.4 All monitoring equipment should be calibrated as per a schedule to be submitted, in writing, for approval by the Licensing Authority, within two months of the date of issue of the Licence.

5.5 The Licence shall, at all times, grant immediate and unhindered access to the factory premises, including the treatment plant and monitoring chambers, to authorised personnel of the Licensing Authority or it's authorised agents or any statutory body having statutory responsibilities for water pollution control, to carry such inspections, monitoring and investigations as deemed necessary.

6 Self Monitoring

6.1 The Company shall carry out monitoring of its trade effluent prior to entry to the receiving watercourse as follows: -

(a) Continuous analysis of Flow, Temperature and pH.

(b) Daily analysis of C.O.D., Suspended Solids, Ammonia and Nitrate based on a Flow Proportionate Composite Sample over the previous 24 hours

(c) At least once per week a Flow Proportionate Composite Sample shall be taken representing a typical 24-hour production period. These samples shall be analysed for all parameters specified at Condition 4.4 above by an independent reputable analyst or laboratory. The name of this analyst or laboratory shall be submitted in writing to the Licensing Authority for approval within two months of the date of issue of this License.

(d) Parameters which require monthly or other sampling frequencies shall be analysed with the weekly samples as required in Condition 4.4 above

6.2 The Licensee shall keep records of all monitoring carried out and all chemicals used and shall retain such records for a period of seven years. These records shall be available for inspection at all reasonable times by authorised personnel of the Licensing Authority or its authorised agents or any body having statutory responsibility for Water Pollution Control. The Licensee shall submit to the licensing Authority, before the tenth day of each calendar month, the results of all monitoring for the previous month referred to above. The format for presentation of results shall be agreed with the Licensing Authority within two months of the date of issue of the Licence.

6.3 The Licensee shall arrange to have an annual biological survey of the River Suir carried out upstream and downstream of the discharge location. These surveys should examine any impact of the discharges from the premises on the densities of the macroinvertebrates. The biological surveys shall be carried out by a reputable independent analyst or laboratory. The name of this analyst or laboratory shall be submitted to the Licensing Authority for approval within four months of the date of issue of the Licence. The number and location of monitoring points shall be agreed with the Licensing Authority at least one month prior to carrying out the surveys. The format for the presentation of the results of these surveys shall be agreed with the Licensing Authority within four months of the date of issue of the Licence. The costs of such testing shall be borne by the Licensee.

6.4 Before February 15th of each calendar year, the Licensee shall submit an environmental audit, which shall assess compliance with the conditions of this Licence. This audit shall be carried out by an independent agency whose name shall be submitted for approval to the Licensing Authority within two months of the date of grant of this Licence.

6.5 All monthly and annual reports shall be signed by the Licensee's plant manager or other senior officer designated by the Licensee.

6.6 The Licensing Authority shall reserve the right, at any time, to increase or decrease the frequency of sampling and analyses required.

7 Toxicity

7.1 Tests to establish the toxicity of the final effluent shall be submitted to the Licensing Authority within 6 months of issue of this Licence, and subsequently determined, if requested in writing by the Licensing Authority. The results shall be submitted to the Licensing Authority within two months of the date of the tests. The costs of such testing shall be borne by the Licensee.

7.2 The toxicity of the final effluent, as expressed in Toxic Units (TU), shall be determined with reference to a representative aquatic organism on the basis of a flow-proportionate composite effluent sample. The determination shall be carried out by a reputable and independent analyst or laboratory, whose name and proposed method shall be submitted, in writing, to the Licensing Authority, for approval, at least one month prior to the date of the test.

8 Groundwater

8.1 The licensee shall agree a programme of groundwater monitoring with the Licensing Authority. This programme shall include the monitoring of a minimum of two borehole wells, one of which shall be located above and one below the site's hydraulic gradient. The programme shall include the monitoring of each well at east once per annum for the following parameters:

Conductivity
Chloride
Iron
Manganese

pH
BOD
COD
Ammonia
Nitrates
Total & Faecal Coliforms

This programme shall also include bi-annual monitoring of the groundwater at the inflow to the water holding tank on-site for the above parameters also. The monitoring programme and the format for presentation of the results shall be agreed with the Licensing Authority within four months of the date of issue of this Licence.

8.2 The Licensing Authority shall reserve the right, at any time, to increase or decrease the frequency of sampling and analyses required.

9 Treatment Plant

9.1 The waste water treatment plant shall be fully constructed, commissioned and operational prior to full commencement of production. All liquid retaining units shall be tested for water tightness. The results of such tests shall be certified by a competent Consulting Engineer and shall be submitted to the Licensing Authority within one month of the date of issue of this Licence.

9.2 The licensee shall submit, in writing, for approval a proposal detailing the measures to be employed within the plant to meet the discharge requirements for Phosphorous. This proposal should include any physico-chemical or biological methods that will be used to ensure that the high Phosphorous content of the incoming effluents will be reduced to the discharge limits. This proposal shall be endorsed by a competent Environmental Engineer or Consultant and shall be submitted to the Licensing Authority within one month of the date of issue of this Licence.

9.3 The waste water treatment plant shall be managed by a competent operator who shall be adequately trained in all appropriate aspects of waste water treatment. A record shall be kept of all training received by such persons that pertains to waste water treatment.

9.4 The licensee shall initiate a maintenance programme for all mechanical and electrical equipment in use in the treatment process or in pollution control. A register shall be kept of all maintenance work carried out on such units and this information shall be made available to the Licensing Authority on request. Duty and standby equipment shall be installed for all critical process stages. A list of such equipment shall be forwarded to the Licensing Authority for approval within 2 months of the date of issue of this Licence.

9.5 All pump sumps or other treatment plant chambers or tanks from which spillages might occur shall be fitted with high level alarms. The alarm condition shall be signified by a visual and audible alarm when maintenance staff are present on site and shall be connected to an autodialing communication and messaging system at all other times.

10 Responsible Person

10.1 The Licensee shall nominate suitably qualified persons who shall be responsible for the supervision, control and monitoring of all discharges arising at the premises as well as giving relevant information on all such discharges to the Licensing Authority. At least one of these persons shall be available at all times during which processing is taking place and effluent is being discharged. The names and telephone numbers of these persons shall be submitted, in writing to the Licensing Authority within two months of the date of grant of this Licence.

11 Storage Facilities

11.1 All storage tank areas and drum storage areas which contain oils, chemicals or other substances, which are, or could be, harmful to the aquatic environment shall be rendered impervious to the materials stored therein. Additionally, these areas shall be bunded, either locally or remotely, to a volume of 110% of the largest tank within each individual bunded area and/or fitted with interceptors, or otherwise designed to the satisfaction of the Licensing Authority in order to give protection to sewers, surface waters and groundwaters on spillage or seepage of the stored materials.

11.2 The integrity and watertightness of all bunded structures and their resistance to penetration by water or other materials stored therein shall be tested and demonstrated by the Licensee to the satisfaction of the Licensing Authority. A competent Structural Engineer shall certify the results of these tests. The results shall be submitted to the Licensing Authority within two months of the date of the tests.

12 Spillages

12.1 The Licensee shall immediately notify the Licensing Authority after the occurrence of any accidental discharge, spillage or deposit of any pollutant or potential pollutant, which enters, or is likely to enter, any waters.

13 Waste Management

13.1 All solid waste shall be disposed of in accordance with the statutory legislation in force during the period of the Licence, and in a manner, which would not endanger human health or harm the environment and in particular:-

(a) create a risk to waters, the atmosphere, land, soil, plants or animals,

(b) create a nuisance through noise, odours, or litter or,

(c) adversely affect the countryside or places of special interest.

13.2 While awaiting disposal, all wastes including empty drums and containers shall be collected and stored at a designated impervious location at the premises to be agreed with the Licensing Authority within two months of the date of issue of the Licence.

\\Watco-fs\sys\GROUPS\SANITARY\Environment\License 2004\Bedminster International (Ireland) Ltd\Licence Rev 2.doc

13.3 All treatment plant sludges shall be mechanically dewatered to not less than 20% solids prior to landspreading off-site. Any liquid extracted shall be returned to the effluent treatment system. A Nutrient Management Plant (NMP) for the landspreading of these sludges shall be submitted within four months of the date of issue of this Licence and prior to February 1st in subsequent years. The NMP shall be endorsed by an independent Agricultural Consultant or other suitably qualified persons. The name of the sludge transporting company along with a copy of the relevant permits, shall be submitted for approval to the Licensing Authority within one month of the date of issue of this Licence.

13.4 An analysis of the typical contents of the sludge shall be carried out by an independent laboratory or analyst on an annual basis. The results of such tests should be included with the NMP for the following year and the proposals within the NMP shall have due regard for the results of such analyses. The analyses shall, as a minimum, measure the following parameters:

% Dry Solids
Nitrogen
Phosphorous
Potassium
Heavy Metals

The name of this analyst or laboratory shall be submitted in writing to the Licensing Authority for approval within two months of the date of issue this License.

13.5 The Licensee shall keep records of all wastes disposed of off-site and shall retain such records for a minimum period of seven years. These records shall be submitted to the Licensing Authority on a monthly basis in a format to be agreed with the Licensing Authority within two months of the date of issue of this Licence.

13.6 No waste shall be dispose of on site by either burial or incineration.

14 Contributions

14.1 The Licensee shall pay the Licensing Authority such annual contributions towards its cost in monitoring the discharges and their effects on the receiving waters as the Authority considers necessary for the performance of its duties under the Local Government (Water Pollution) Acts, 1977 and 1990, as follows:

(a) The contribution for the remainder of 2004 will be €1350.

(b) The contribution for 2005 will be €7000.

(c) The contribution shall, in subsequent years, be index linked in accordance with the Consumer Price Index from the date of grant of this Licence, to the Index value pertaining at the due date of payment of each annual contribution.

(d) Notwithstanding the above, the Licensing Authority shall, at all times, reserve the right to alter the annual rate of contribution having regard to monitoring requirements and actual costs incurred.

Dated this 22nd day of October 2004.

Signed:

John O'Flynn
Deputy County Manager