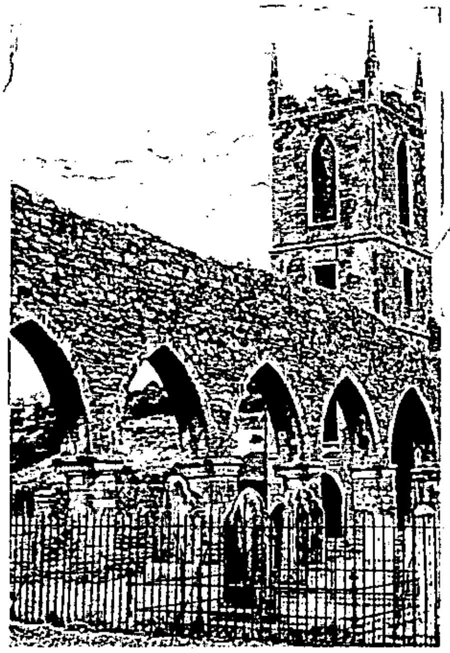
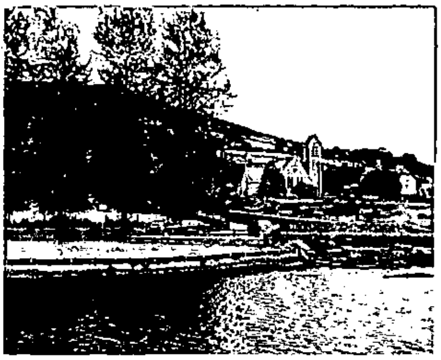
EIS NO
1654
PART 1 of 3

Comhairle Chontae Chill Mhantáin
WICKLOW COUNTY COUNCIL



Environmental Impact Statement for Proposed Extension to Rampere Landfill



VOLUME 1

Non-Technical Summary

COWI

November 2002

MCOS

DOCUMENT CONTROL SHEET

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Project Title	Proposed Extension to Rampere Landfill					
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F01	Final Issue	Warren Phelan	Conall Boland	Larry O'Toole	Carnegie House	September 2002

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1 INTRODUCTION

1.1 BACKGROUND

The Waste Management Plan for County Wicklow was adopted in April 2000. In accordance with the Plan, Wicklow County Council is proposing to undertake an extension to the existing municipal waste landfill at Rampere, Baltinglass. The current site operates under a Waste licence granted by the Environmental Protection Agency (EPA) in April 2002, which permits a total of 11,500 tonnes of municipal waste to be accepted at the site per annum.

The proposal is to provide additional capacity at the extended site of the order of 50,000 tonnes per annum, in order to meet the requirements of the entire County. This arrangement would provide a short term solution to the waste disposal crisis in the County for a period of approximately 5 years, allowing alternative facilities to be established in East Wicklow.

The proposal to extend Rampere Landfill requires the preparation of a revised and updated Environmental Impact Statement (EIS) together with a Review Application of the Waste Licence to be submitted to the EPA. It is in this context that this EIS has been prepared by M.C.O'Sullivan & Co. Ltd for Wicklow County Council.

1.2 WHAT IS AN EIS?

An EIS is defined in Irish legislation as follows:

'A statement of the effects if any which a proposed development, if carried out, would have on the environment'.

In other words an EIS is the document produced to express the anticipating effects on the environment caused by a proposed development. An EIS provides information, which the competent authority uses in determining whether or not to grant consent. This information is also used by affected parties to evaluate the acceptability of the development and its impacts.

1.3 WHAT IS A WASTE LICENCE?

Landfills and other significant waste disposal facilities in Ireland require a Waste Licence from the EPA. The EPA must be satisfied that the activity will not cause environmental pollution when it is carried on in accordance with the conditions of a Waste Licence. The Conditions of a Waste Licence cater for design, operations, management and environmental monitoring at the site.

A Waste Licence is a single integrated licence, which deals with emissions to all environmental media, in addition to the environmental management of the facility. All related waste operations carried on by the applicant in, on or adjacent to the facility are taken into consideration.

2 THE NEED FOR THE PROJECT

2.1 WICKLOW WASTE MANAGEMENT PLAN

The Wicklow Waste Management Plan 2000-2004 adresses the need for further improvement in waste management practices in the County. In particular the increased diversion of waste from landfill to recovery, in the form of materials recycling and composting, is targetted. The Plan contains a medium to long term objective to achieve recovery of energy from waste that is not recycled. It also states that a new landfill is required in East Wicklow.

Various alternative options were explored to provide landfill capacity within the county in the short-term, namely:

- Seek approval to landfill Wicklow's waste in a neighbouring county or further afield
- Seeking a private sector disposal option
- Privatise collection and disposal service completely
- Limited short-term extension to Rampere Landfill
- A planning application and Waste Licence Application has been lodges by Celtic Waste for a proposed landfill in East Wicklow but no decision has yet been made.

Apart from the Rampere option, the various options pursued proved to be unsuccessful leaving the county facing an imminent waste crisis. In December 2002 Ballymurtagh Landfill in East Wicklow will close leaving Rampere Landfill as the only operational municipal landfill in the County. For the interim period the Plan recommends an extension to the Rampere Landfill for a limited period of time (3-5 years). This is required to ensure that Wicklow County Council can meet its statutory obligations to provide for safe disposal of the household waste generated in the County.

2.2 WASTE QUANTITIES WITHIN THE COUNTY

Information on waste generation and waste management in County Wicklow is contained in the County's Waste Management Plan. In total, over 900,000 tonnes of waste are generated in the County each year, when agricultural and quarrying wastes are included. The following table summarises the position with regard to four principal waste streams:

Table 2.1: Summary of Waste Generation and Recycling (Wicklow Waste Plan 2000-2004)

Waste Type	Arising Tonnes/ annum	Recycled	% Recycling
Household waste	41,600	2,000	4.8%
Commercial waste	21,280	2,350	11.0%
Industrial waste (non hazardous)	21,600	2,500	11.6%
Construction Demolition waste	72,000	6,000	8.3%
Total	**156,480**	**12,850**	**8.2%**

In addition to the above, an estimated 3,500 tonnes of street sweepings / litter, and over 4,500 tonnes of municipal sludges are generated each year.

Municipal waste landfill figures for 2000 and 2001 are presented in Table 2.2 below. It should be borne in mind that commercial waste is currently not accepted at either of Wicklow County Council's landfills.

Table 2.2: Waste Intake at Ballymurtagh and Rampere Landfills

Year	Rampere	Ballymurtagh
2000	1,710	49,103
2001	8,042	50,919

Overall it is projected that approximately 40,000 – 50,000 tonnes per annum of municipal waste (mainly household waste) will require landfill capacity in the short term.

3 PROJECT DESCRIPTION

3.1 EXISTING SITE

Rampere landfill is located approximately 2 Km north of Baltinglass in West Wicklow, at a short distance from the N81 National Secondary route. The existing landfill site covers 1.7 hectares in total. The site is in a rural agricultural area where pastureland predominates. The Rampere Stream, a tributary of the River Slaney, is a small watercourse which passes adjacent to the site boundary. **Figure 1** shows the location of the proposed landfill.

The site has been in operation since 1980 and an approximate 124,000 tonnes of non-hazardous and inert waste has been deposited at the site up to the end of 2001. There are two operatives employed at the site. There is a site office and storage container, and equipment includes a compactor unit for waste handling.

The site was granted a Waste Licence in April 2002, with a maximum annual intake of 11,500 tonnes of municipal waste. During summer 2002 a new lined cell was constructed in compliance with the existing Waste Licence. The lifespan of this cell is expected to be approximately 12 months. The Waste Licence stipulates on-going monitoring, improvements to site infrastructure, and development of an Environmental Management System at the facility.

3.2 PROPOSED EXTENSION

The landfill area will extend to include 5.5 hectares (13.5 acres) adjoining the existing landfill to the west, giving a total site area of 7.2 hectare (17.8 acres). The extension area is a pasture field and is bordered to the south and west by public roadways, and along the northern boundary by the Rampere stream. Waste cells will take up approximately 72% of the extension area, the remaining space will be used as a buffer area, drainage, fencing and an access road. An area of the existing landfill will be developed as a waste reception area and will provide access to the new cells. The landfill extension is based on the requirement to provide landfill capacity of approximately 50,000 tonnes per annum for a five-year period – the overall capacity of the extension area is approximately 250,000 - 300,000 m^3.

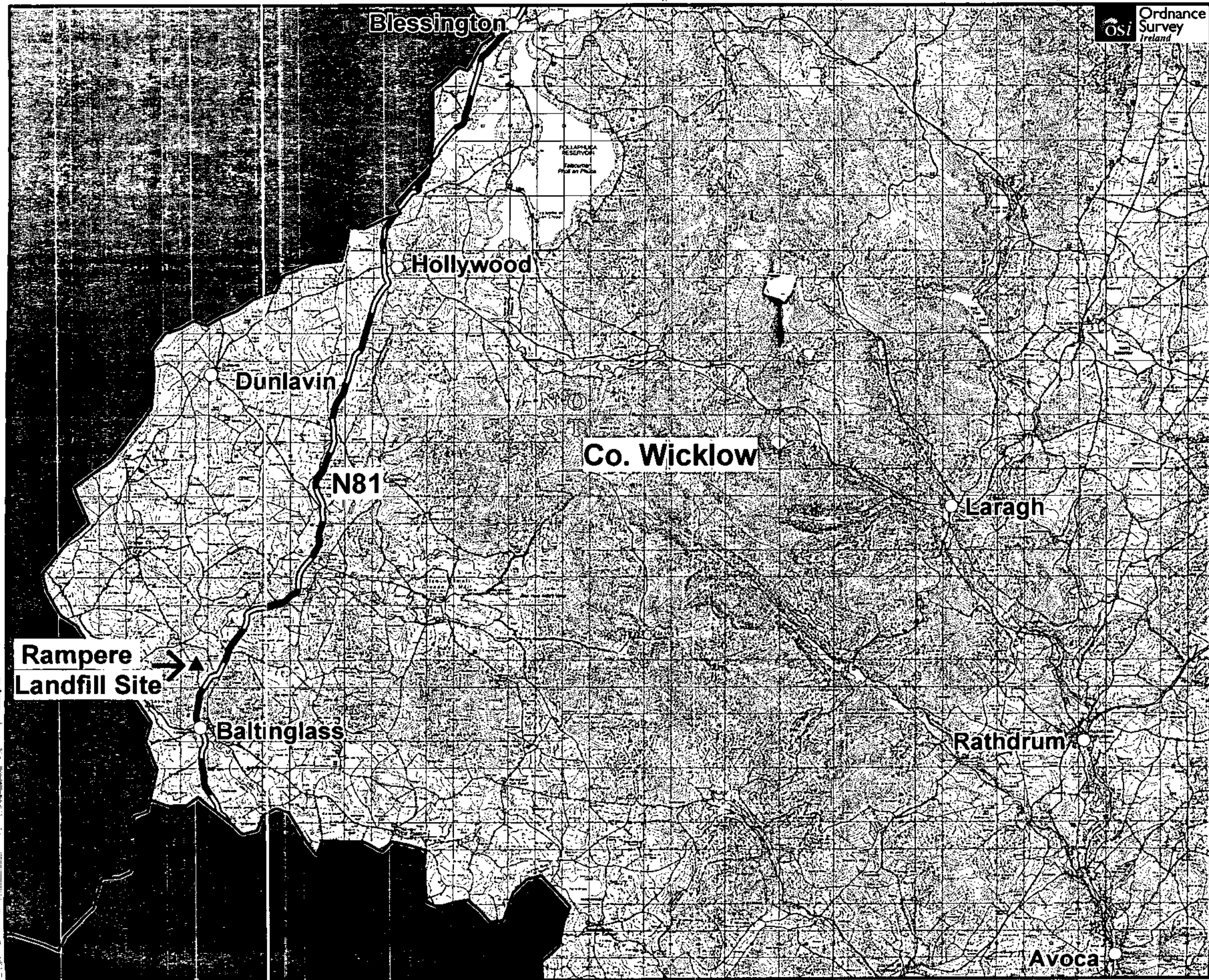
3.2.1 Lined Containment Cells

It is proposed to construct three new waste disposal cells in the extended area. The cells will have a combined area of approximately 40,700 m^2 and their base will generally follow the existing ground contour, which slopes south-north towards the bottom of the valley. Embankments will be constructed at the northern (lower) end of the cells, which will provide for stability, containment of leachate within the waste body, and also provide visual screening. The maximum depth of waste would be approximately 10-15 metres.

3.2.2 Site Infrastructure

The layout for the proposed site extension is detailed in **Figure 2** and the key layout changes and improvements of the existing site are as follows:

- Revised entrance area – wider opening onto public roadway improving sightlines and turning capabilities for all types of vehicles, increased paved area, improved recycling (civic amenity) area, and parking spaces.
- The weighbridge will be relocated, a new administration building and a new paved road connecting these to the entrance area will be provided. A wheelwash will also be provided at this area.
- A proposed Waste Inspection/Quarantine area, adjacent to the administration area
- An internal service road servicing the northern end of the extension area will be provided
- Security fencing (chainlink) will surround the site, behind the existing hedgerows
- A surface water overflow retention tank will be installed close to the civic amenity area below ground level and water from a spring to the south of the site will be pumped to the tank. The water needs of the site office and wheelwash will be piped from the tank with excess water discharged from the tank to the Rampere Stream. The capacity of the tank will be approximately 3,500 litres.



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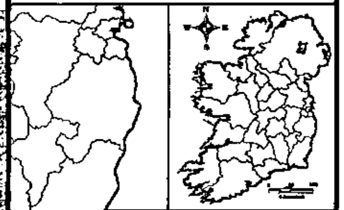

Wicklow County Council

Project

Rampere Landfill Proposed Extension

Title

Rampere Landfill Location Map

Figure 1

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Issue Details

Drawn: WP		Project No. 067509001	
Checked: CB		File Ref.	
Approved: LOT		067-509-001-MI-0001	
Scale: 1:50,000		Drawing No.	Rev.
Date: Sept 2002		XXXX	A01

Notes

1. This drawing is the property of M. C. O'Sullivan & Co. Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent
2. All levels are referred to Ordnance Datum, Malin Head
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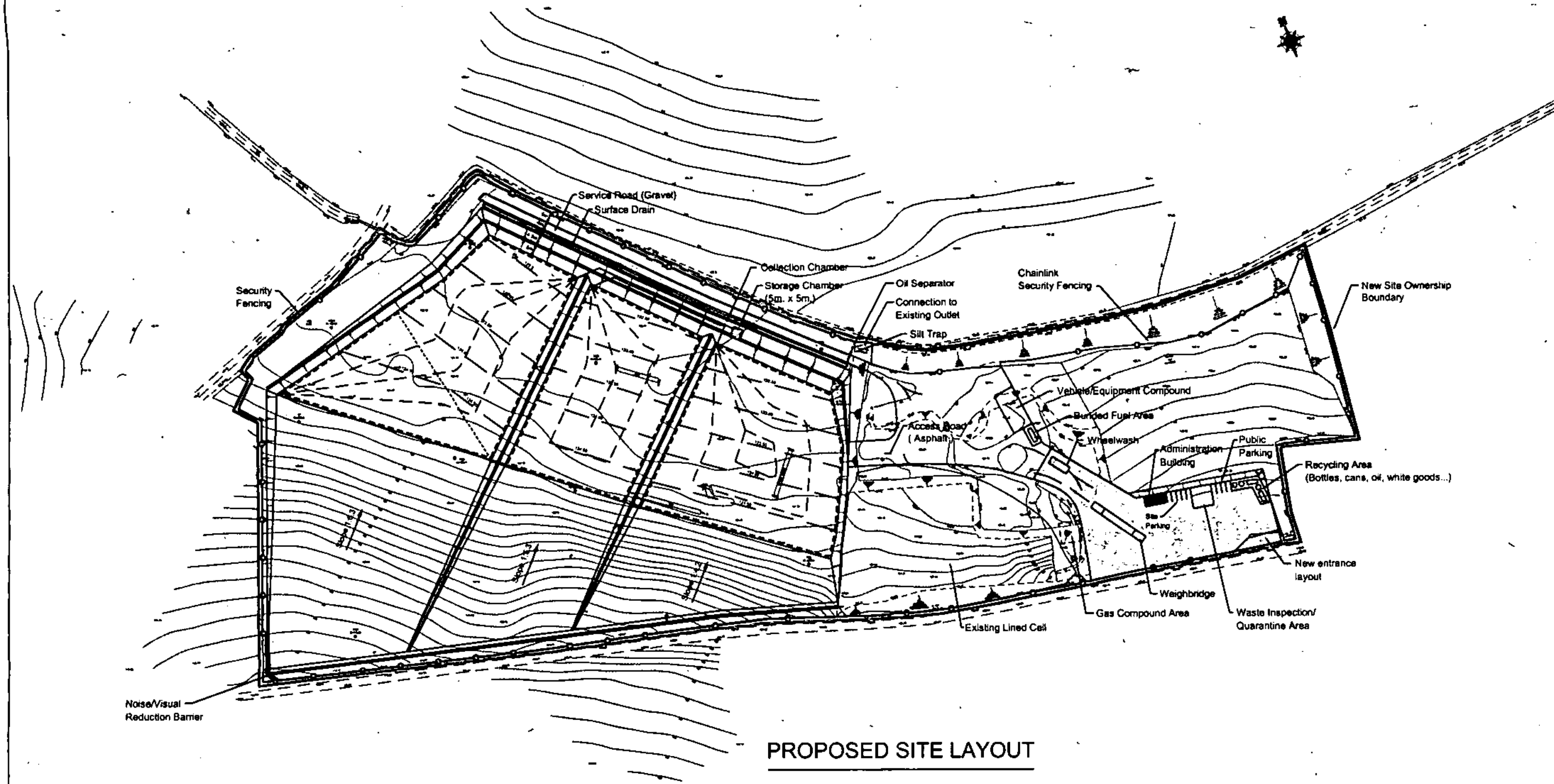


PROPOSED SITE LAYOUT

Client:		Job:	Title:		
WICKLOW COUNTY COUNCIL County Buildings, Wicklow.	MCOS COWI Carnegie House, Library Road, Dun Laoghaire, Co. Dublin. Phone: 01-2020870 Fax. No: 01-2020707	Rampere Landfill Proposed Extension	PROPOSED SITE LAYOUT	Drawn: SBG Checked: WP Approved: CB Scale: NTS Date: SEP'02	File Ref.: 067/509/001/FG2.0.DWG Figure No. 2.0

3.2.3 Buffer Zone

A buffer area will be provided between the stream and the new landfill cells along the northern perimeter of the extension area. The service road alongside this perimeter will allow access to the leachate collection area, and to monitoring locations. A Noise Barrier will be erected at the south-west corner of the extension area, to reduce noise impacts upon an adjacent dwelling.

3.2.4 Phased Construction

It is proposed to undertake the extension and improvement works in a phased manner as follows:

Phase 1- This will include the upgrading of the existing entrance and revision of site infrastructure as described above so as to facilitate the construction of new cells without creating difficulty for continued landfill operation on the existing site. This will facilitate any increase in construction traffic for the development of the extension area. Upgrading of the public road allowing access to the landfill is also planned for this initial phase of work.

Phase 2 - Construction of the three new lined cells will be carried out as a single construction contract. All leachate collection and treatment infrastructure, service roads, bunds etc. will also be constructed at this stage. Construction of internal haul roads within the landfill - using imported gravel or hardcore material, or suitable construction waste, will be required on an intermittent basis during the landfill lifetime. Similarly, capping and reinstatement of filled cells will be an ongoing procedure as the landfill develops.

3.3 OPERATIONAL PRACTICES

The site will be operated in accordance with best international practice for similar facilities and in accordance with the Waste Management Act 1996, Waste Management (Licensing) Regulations 2002, EPA Landfill *"Operational Practices"* Manual (1997) and the EU Directive on Landfill of Waste (99/31/EC).

A comprehensive Environmental Management Plan will be prepared pursuant to these objectives, the purpose of which is to set out the measures, procedures and guidance *"to prevent or reduce as far as possible negative effects on the environment, in particular the pollution of surface water, groundwater, soil and air, as well as the resulting risk to human and animal health, from landfilling of waste"* (from Article 1 of the EU Directive on Landfill of Waste (99/31/EC)).

Site Operation will be in accordance with conditions as laid down the Waste Licence for the existing site, which outlines procedures for waste acceptance, waste handling, management of tipping procedures, covering of waste and all other aspects of landfilling activities.

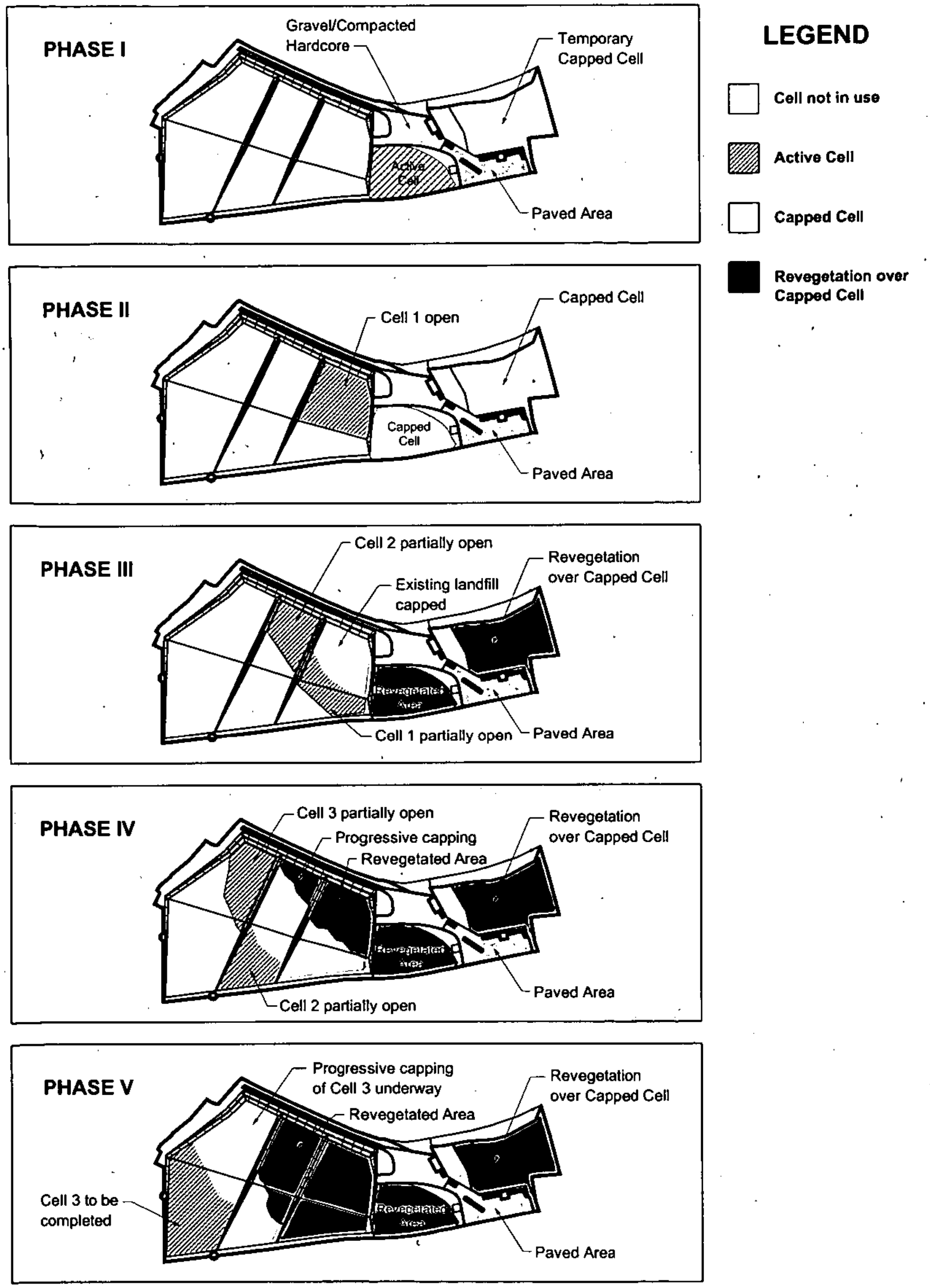
The site will be open for acceptance of waste between the hours of 07:30 – 18:30 weekdays summertime, 08:00 – 17:00 weekdays wintertime and between the hours of 08:00 and 13:00 on Saturdays. The site will be closed on Sundays and Bank Holidays.

3.4 FILLING

The filling of waste into the existing landfill area will continue until the newly lined cell has been filled to meet the required ground profile as set out in the revised landscape plan, **see Figure 4.** Once the required landform has been reached, filling would then proceed in the newly constructed lined cells in the extension area.

It is proposed that the new cells are filled in the order Cell 1 to Cell 3. Waste will be filled starting at the north (or lower) end and will progress in a southerly direction. The active face of waste will be minimised. The sequence of filling will require that filling of Cell 2 will commence before Cell 1 is completed, in order to allow that Cell 1 be filled to its final level in safety. (and so on for Cell 2 and 3). **Figure 3** outlines in schematic form the phased manner in which the cells will be filled.

Once the level of waste has reached the required height, capping and reinstatement will be undertaken progressively as outlined in **Figure 3.** This expedient capping of waste will serve to minimise both visual impact and leachate generation.



WICKLOW COUNTY COUNCIL	MCOS COWI Carnegie House, Library Road, Dun Laoghaire, Co. Dublin.	Job: Rampere Landfill Proposed Extension	Drawn: SBG	File Ref.: 067/509/001/FG3.0
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		Title: PHASING OF LANDFILL DEVELOPMENT	Approved: CB	Figure No. 3.0
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			Date: SEP'02	

3.5 LEACHATE: COLLECTION AND STORAGE

Leachate is defined as any liquid percolating through a body of waste. It is planned to collect leachate generated within the lined cells in a network of slotted pipes laid in the base of each cell, draining to a sump (collection chamber) constructed in the lowest point of each cell. From the sump in each cell, leachate will be pumped to a Leachate Collection Chamber. The collection chamber is designed as a lined concrete structure with a capacity of 50 m^3. Rather than treating leachate on-site it is preferred to treat leachate along with municipal wastewater at the Baltinglass Treatment Plant, see Volume 2 Section 3.8 of the EIS for details. An alternative option is to tanker leachate but this is less desirable than the pumping option.

3.6 LANDFILL GAS EXTRACTION AND UTILISATION

The degradation of waste creates landfill gas within the waste cells. This gas comprises methane and other gases, which must be properly managed. It is proposed to establish an active gas extraction system including abstraction wells, collector pipes and a gas flare at the proposed extension site. The system will be installed in a phased manner as follows:

Phase 1 Installation of a series of gas extraction wells (spaced 40-50m apart), a gas pipe collection network, and a gas flare compound. The option of including the existing unlined cells into the active system will be assessed.

Phase 2 Based on the amount of gas generated the feasibility of energy recovery at the site can be assessed.

Phase 3 If economically feasible establish a gas utilisation plant for the production of electricity. Monitoring of gas wells and the gas flare will continue as part of the aftercare management programme.

3.7 CLOSURE AND AFTERCARE

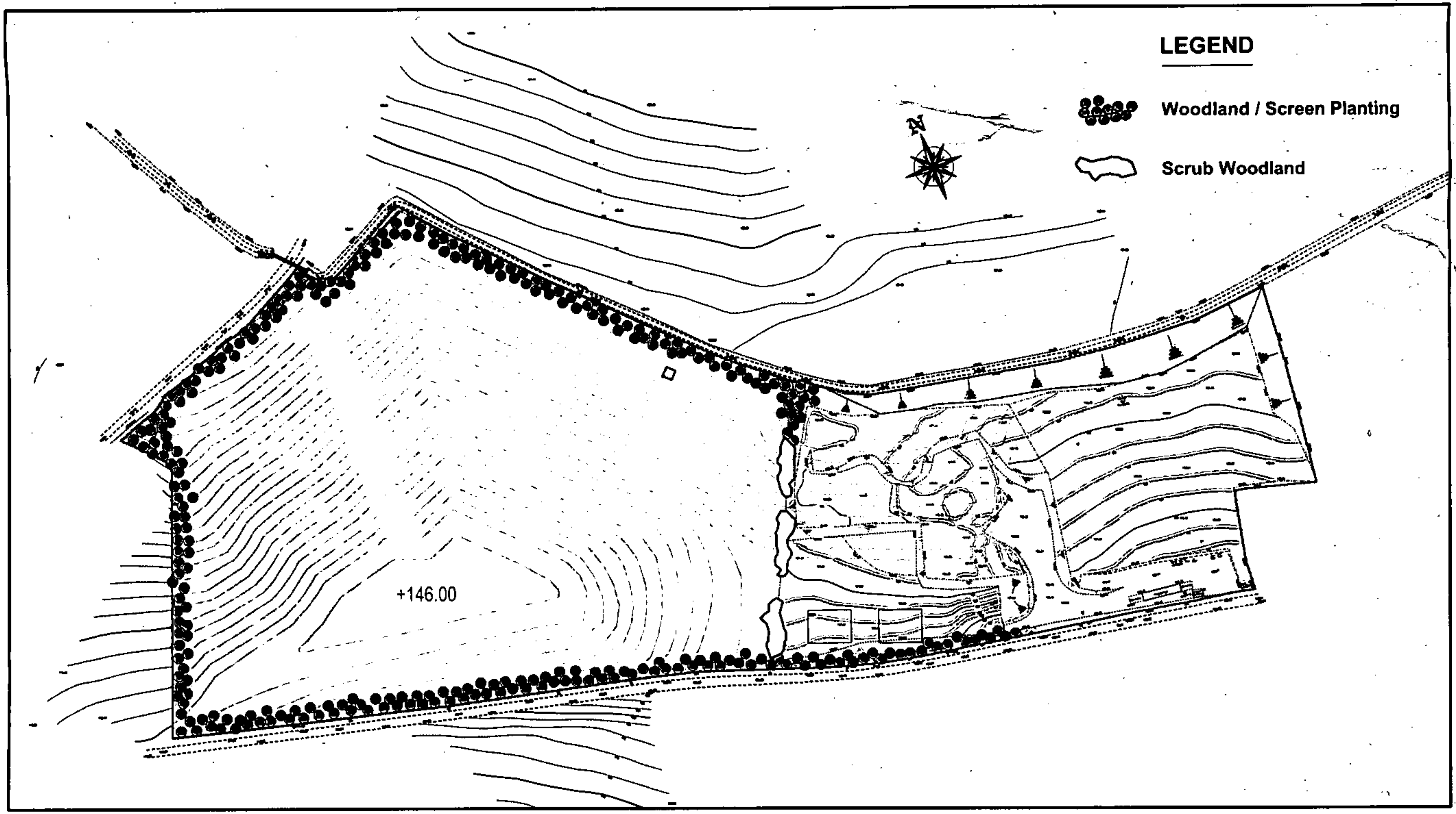
Closure and restoration of the landfill will generally be carried out in accordance with the EPA Manual "Landfill Restoration and Aftercare" (1999). The final profile of the landfill together with a suggested planting scheme, refer to **Figure 4**. The land will be returned to green pasture field in keeping with the surrounding landscape.

The fundamental principle of the closure process however will be that final cover will be placed and sown or planted in an ongoing basis as the individual landfill cells are filled.

The leachate collection system, control facilities (monitoring boreholes) and monitoring points (surface water control points) will be in operation and maintained until the waste has stabilised (30 years). Monitoring of groundwater, surface water, leachate and gas will continue for 30 years after closure of the landfill as recommended in the EU Directive on Landfill of Waste (99/31/EC) or such period as may be specified by the EPA.

3.8 OFF-SITE DEVELOPMENTS

- Measures to improve road access to the landfill will be required in order to deal with increased waste intake at the facility. This will involve both widening and resurfacing.
- The preferred option for treatment of leachate generated within the extension area is to co-treat it with municipal wastewater at the Baltinglass Wastewater Treatment Plant (WWTP). There are two main aims for transporting the leachate from the landfill to the WWTP namely tankering and pumping. Preliminary assessments suggest that pumping is the preferred option. This would require a rising main to be installed approximately 500m along the landfill access road. This could be carried out in tandem with road improvements to avoid inconvenience.
- In order to ensure adequate treatment capacity for the peak levels of leachate generation, it will be necessary to upgrade the treatment capacity at the Baltinglass WWTP. A preliminary assessment of



Client: WICKLOW COUNTY COUNCIL County Buildings, Wicklow.	MCOS COWI Carnegie House, Library Road, Dun Laoghaire, Co. Dublin. Phone: 01-2020870 Fax. No: 01-2020707	Job: Rampere Landfill Proposed Extension	Drawn: SBG	File Ref.: 067/509/001/FG4.0
			Checked: WP	
		Title: LANDSCAPE LAYOUT (Mitchell & Associates)	Approved: CB	Figure No. 4.0
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			Date: SEP'02	

the WWTP for this EIS suggests this is acceptable. Wicklow County Council will need to undertake further assessment and planning of this work at the WWTP, and a separate planning process will be required.

- Electricity supply lines currently traversing the proposed extension area in an north-east/ south-west direction would have to be moved to accommodate the development of new landfill cells.

4 ENVIRONMENTAL ASSESSMENT

The environmental topics of the EIS are summarised in the following section under the general classification of *'Natural Environment'* and *'Human Beings'*. Each section commences with a summary of the existing environment, predicted impacts of the proposed development and planned mitigation measures to deal with these impacts. Specialist sub-consultants were employed to carry out specific environmental work at the site.

4.1 NATURAL ENVIRONMENT

4.1.1 Geology and Groundwater

Existing

The existing site and the proposed landfill extension is underlain by a water bearing bedrock classified as locally important aquifer – moderately productive only in local zones (LI) by the Geological Survey of Ireland. In general terms an engineered/lined landfill can be sited in such an area although measures to minimise impact on the groundwater need to be implemented.

Overburden (subsoil) at the proposed site was found to comprise gravelly sandy clay (Boulder Clay) and alluvial deposits (inter-bedded sands, silts and peats) of varying thickness from 0.5m to 5m. In general groundwater will flow into the River Slaney via streams and surface drainage channels.

Groundwater monitoring has been in place at the existing site since September 1998 and at the proposed extension since July 2000. Chemical analyses of samples in the existing site indicate that the samples were generally not contaminated by leachate and they met the EPA quality criteria. Samples analysed from the proposed extension indicate that the groundwater beneath the site is of good quality but has naturally occurring high levels of iron and manganese.

Impact

The risk of groundwater contamination is a key potential impact that the proposed development proposes. This potential negative impact on the local groundwater is considered to be a medium term risk impact.

Mitigation Measures

In order to minimise impact on the local groundwater the following measures will be implemented:

- Containment of the base and sides of the landfill cells using a flexible membrane liner overlying a clay liner. This will prevent leachate escape.
- Leachate from the proposed cells will be collected and conveyed for treatment at Baltinglass WWTP
- The proposed cells will be constructed above the groundwater level

Regular monitoring of the local groundwater will continue at the site while landfill operations continue and following closure.

4.1.2 Aquatic Ecology and Surface Water Quality

Existing

The Rampere stream is situated along both the existing and proposed landfill areas west of the existing site. The stream is a tributary to the Slaney and it joins the Slaney approximately 1.75 km downstream of the landfill site. The stream is moderately polluted both upstream and downstream of the existing landfill with a small population of juvenile trout. The Slaney holds salmon, sea-trout and brown trout and it is regarded as one of the top rivers in Ireland.

A biological water quality assessment carried out on the Rampere Stream updated a previous study from August 2000 and indicated that the landfill was having no impact on the stream. The improvement in the water quality of the Rampere Stream immediately downstream of the landfill recorded in 2000 was maintained in 2002.

Surface water monitoring has been in place in the vicinity of the existing site since September 1998. The results of the chemical monitoring of the water quality indicate that the existing landfill has a very limited if any impact on the water quality of the Rampere stream. The water generally meets the EPA Water Quality criteria for surface water and there is generally no significant increasing trend in the measured parameters from upstream to downstream of the landfill.

Impact
There are potential negative impacts on the stream and hence the Slaney due to the increased runoff from the proposed development, sedimentation from the construction phase, and possible leachate leakage from the chamber. The duration of any such potential impact would be short-term.

Mitigation
In order to minimise the impact on the Rampere stream during the construction and operation of the proposed development the following mitigation measures will be implemented:

- Surface water drains will be provided to the north and south of the proposed cells to cater for runoff
- Surface water runoff from paved areas will flow through silt traps before discharging into the stream
- Runoff from service roads will be channelled to an oil separator before discharging
- Leachate management will be put in place including collection in the waste cells and off-site treatment and disposal
- Surface water management measures to be implemented during construction phase

Regular chemical and biological monitoring of the local stream will continue to be carried out at the site while operational.

4.1.3 Terrestrial Flora and Fauna

Existing
This site is not included in any designated area under national law or the EU Habitats or Bird Directives. The nearest proposed National Heritage Area is Lowtown Fen which is 1.5km to the northwest. All fields around the landfill and on adjacent land are under grass, which is used as pasture for cattle and horses. Hedges surround the field entirely.

The rabbit is the only obvious mammal present with burrows at the south-eastern edge of the field. However brown rat, house mouse and field mouse are very likely to be present with foxes occasionally visiting. The birds using this field consist of regular 'field' species such as rook (5 nests occur in the pine trees), magpie, woodpigoen and starling.

Impact
The landfill extension is a short-term negative impact in terms of terrestrial ecology and will obliterate the grassland habitat; although it would not have a significant ecological impact on the surrounding area.

Mitigation Measures
The landfill operation will attract nuisance birds and pests but the following measures will be implemented to minimise the impact:

- A small working area (maximum extent 20 x 50 metres) will be used
- The waste will be compacted with a high tonnage steel wheel compactor
- The waste will be covered at the end of each working day with a layer of daily cover
- Vermin control specialists will be employed to advise on and maintain any control systems on an ongoing basis

4.1.4 Landscape

Existing
The site is agricultural land in pasture for cattle. Vegetation on site consists of grassland, hedgerow planting around the site boundary with some tree planting located in the hedgerow. The subject site

has a high point of 145m O.D. at the southwest corner adjacent to the local access road to the south. From here the land falls steeply towards the centre of the site, where the land levels off, falling gently to the northern boundary.

Impact
The visual impact during the construction and operational stage will be significant and negative but a short-term impact. Overall the long-term visual impact can be gauged from the previous reinstated cell at the existing site, which has been reinstated as grassland and has blended into the surrounding landscape quite well.

Mitigation Measures
In the interim mitigation of the impact of landfill operations will be by virtue of the height of the ground level of the reinstated landfill, which will screen the operations to the south, together with the existing hedgerow. Dense woodland and screen planting will be provided to the north, west and south of the site while existing hedgerows will be maintained. A progressive screen/fence will be used to shield operational activities and the active face of the cell from surrounding houses overlooking the site. The lined cells will be progressively capped and reinstated as filling proceeds from cell to cell reducing visual impact.

4.1.5 Climate

Existing
Air emissions from the site will generally be dispersed in the direction of the prevailing conditions for the region. However, during calm weather conditions the air flow would tend to follow the form of the surrounding slopes with cold air drainage down slope at night time.

Impact
The landfill extension will result in changes to the slope between the public road and the Rampere stream. However this change will not have a significant impact on the overall wind field in the locality.

4.1.6 Archaeology and Cultural Heritage

Existing
No known archaeological sites, as identified in the Sites and Monuments Record (SMR) of *Dúchas (Heritage Service),* are affected by the proposed development and there is no substantial issue in respect of archaeology envisaged for the proposed landfill extension. The public road leading to the landfill has cut through a recorded ringfort, although little evidence remains above round of the structure.

Impact
Associated plans for widening the access road to the existing landfill, to cater for the increased capacity and subsequent increased traffic, will, however, have a direct impact on a recorded ringfort.

Mitigation
The immediate and wider vicinity has been the focus of settlement throughout the prehistoric, early historic and medieval periods, and for this reason it is recommended that all ground preparation works be monitored by a licensed archaeologist.

It will also be necessary to test excavate the ringfort area, under license from *Dúchas*, in advance of road widening, to determine whether archaeological features or deposits relating to the site survive at this location

4.2 HUMAN BEINGS

4.2.1 Community

Existing
The community in the Rampere area is characterised by a combination of non-agricultural dwellings and agricultural residential farms. There are 12 residences situated between the N81 and the landfill. A number of residences look directly onto the valley where the landfill is situated. Two dwellings in

particular overlook the site with one dwelling recently constructed (August 2002) adjacent to the western boundary of the site. There are 2 more dwellings slightly further removed to the west.

Land use is agricultural and there are no businesses or community facilities situated in the vicinity of the landfill. Apart from activity on the landfill site, other activity in the area would be by agricultural vehicles engaged in day to day activities with crops and livestock. Community facilities for the area are situated at Baltinglass, 3 Km from Rampere.

Impact

The landfill will have a number of short-term negative impacts of the community in the townland of Rampere. There will be a significant impact on the visual amenity of the area beside the landfill, which will impact on a small number of dwellings overlooking the site, and to a slight extent on local road users. The increased number of Heavy Commercial Vehicles using the access road will impact significantly on local residents.

Mitigation

This visual impact on the community can be minimised by proper procedures for covering waste, capping and reinstating the landfill as the site progresses. In the longer term, the reinstatement and revegetation of the site will replace the disamenity caused. Significant improvements of the local access road – by widening, resurfacing, improved junctions and speed controls – will mitigate the impact due to increased traffic. In the longer term, following closure of the facility, the improved road layout will be of benefit to the community compared to the current situation. The extension of the sewer network to serve the Rampere area will also be a benefit.

A local community fund will be established from landfill gate fees for the Rampere Community and the Baltinglass area to be used to develop local amenities to off-set the short-term impact. A model for such a scheme is already operating at the Ballymurtagh Facility, Avoca, East Wicklow.

4.2.2 Tourism

Existing

Tourism is a major source of revenue to County Wicklow, and the County contains a number of top attractions. The number of tourists visiting the area of Baltinglass is not high compared with the rest of the county. Tourism in the general vicinity of the area is less developed compared to other parts of County Wicklow, but efforts are being made to improve this situation and to develop the industry.

The landfill is located on a local road and is well screened from the roads that pass alongside the present landfill and the main tourist traffic route of the N81. This local road is not likely to be heavily frequented by tourists based on available information.

Impact

There is no indication that the current landfill is having any detrimental impact on tourism in the area and it is thought that the proposed development will also have a neutral impact on the

Mitigation

It is recommended that waste transport vehicles using the landfill site be kept in good repair and of a high standard of appearance. Measures by landfill staff and by Wicklow County Council under the Waste Management (Collection Permit) Regulations (2001) should prevent litter or liquid falling from trucks, excessive exhaust emissions, dirty vehicles, or excessively slow vehicles.

4.2.3 Traffic

Existing

The existing landfill site is situated on the local access road L4284 approx 1.2km off the N81. The N81 is the main North-South transport artery for the western side of County Wicklow; it provides a link between Dublin, Wicklow and Carlow. The roads immediately surrounding the landfill are quite narrow and in some places in poor condition. The roads vary in width from 3.5m to 5.0m, with no verges or hardshoulders. In 2001, over 8,000 tonnes of waste was deposited at the landfill site, which in terms of traffic flow breaks down to approximately 12-13 vehicles entering the site per day, 5 of which were HCV's.

Impact

Impacts on local residents and other road users will include the following:

- Increase in noise, vibration and vehicle emissions due to additional traffic
- Increased number of turning movements at junction with N81 and at landfill entrance
- General impact on road safety from increased numbers of HCVs

Mitigation

The local road accessing the landfill will be widened and resurfaced and junction improvements will be carried out where the local road meets the N81 to improve road safety and to allow HCV's to pass comfortably. Wicklow County Council will ensure that all haulage vehicles are kept clean and in proper order and that litter of liquid does not fall from vehicles. Use of the weighbridge on site will ensure that no overloading of vehicles takes place. Improved signage and warning signs at the landfill will also be beneficial.

4.2.4 Air Quality

Existing

The air quality of the surrounding area is good with no evidence of any adverse impact from dust emissions from the landfill operation. No dust deposition sampling has been carried out along the boundary of the existing landfill due to the rural location and low level of activity within the landfill operation. There have been no reports of a local odour nuisance due to the site operations in recent years. The primary sources of air emissions, apart from the landfill, are from traffic travelling along the local roads, and agricultural activities on adjoining fields.

Impact

Possible emission sources from the landfilling activity include:

- Emissions from the active part of the cell where waste is being tipped compacted and covered
- Vehicle emissions while travelling along internal haul roads or adjacent public roadways
- Point source emissions – e.g. emissions from gas venting pipes

These potential impacts are short-term negative impacts.

Mitigation

The following mitigation measures will be implemented to reduce air quality impacts:

- Paving of entrance area and surfacing of internal roads with compacted hardcore
- A mobile water sprayer will be employed during dry weather conditions to reduce dust emissions from the access road and near the entrance to the landfill.
- Vehicles departing the site having delivered waste will pass through the proposed wheel wash
- The active tipping area will be kept small, and waste will be covered with a daily cover of soil
- Landfill gas will be collected and burned in a flare to prevent methane emissions
- Leachate control will be in place to minimise build up of leachate in the landfill cells
- Landfill plant such as the compactor will be regularly maintained to prevent excessive exhaust emissions of particulates and other pollutants
- Monitoring of air quality parameters such as dust deposition will be undertaken on a regular basis. Monitoring of landfill gas emissions will also form part of the overall monitoring programme for the site.

4.2.5 Noise

Existing

The principal 'residual' noise source in the area is distant traffic. The nearest residence to the proposed extension is located c.50 metres from the southwest corner of the site. There is also a house recently constructed (August 2002) c.60 metres from the western boundary. The on-site machinery consists of a Landfill Compactor used to compact and level the waste and construct cells and occasionally an excavator is hired to clear drains and clean the site.

Impact
The projected timescale for the operation of the landfill facility is less than five years. The increase in tonnage will increase site activity with a significant increase in vehicle movements. The maximum noise level predicted at the nearest residence taking into account attenuation by distance and landscape effects may exceed daytime EPA criteria. All noise related impacts are considered negative short-term impacts.

The construction phase of the facility could give rise to short-term noise levels higher than that due to typical on site operations.

Mitigation
Mitigation measures in the form of a landscaped embankment or vertical barrier on the south-western corner of the site and cell construction are available and will be used to control the noise emissions from the site. Compaction equipment on the site will be upgraded or replaced which will reduce noise emissions compared to the existing plant.

4.2.6 Agriculture

Existing
The land adjacent to the landfill is intensively farmed with most of the land being used for either tillage or pasture. Two of the landowners adjacent to the site have some thorough bred horses and the other farmers are involved in dairying, dry cattle and tillage.

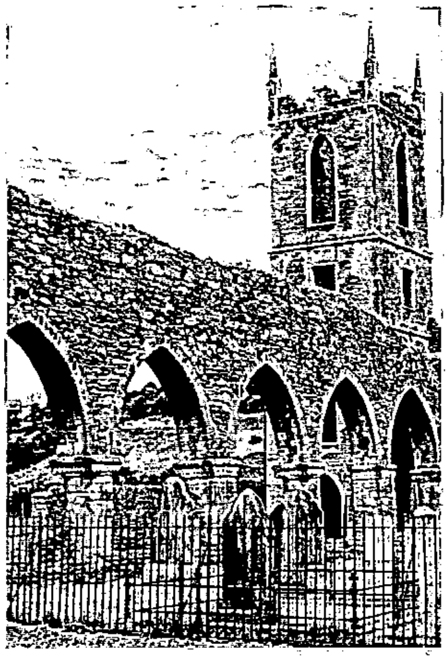
Impact
Neighbouring landowners highlighted a number of potential short-term impacts on the agriculture of the area namely:

- Contamination of ground water and surface water
- Spread of windblown litter and debris.
- Scavenging Birds.
- Vermin, Pests & Insects

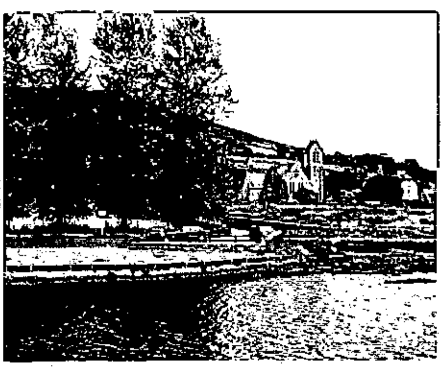
Mitigation
It is considered that proper management of the site in accordance with the EPA Manual on Landfill Operational Practices will result in no impact on the surrounding agricultural land. The following measure will mitigate concerns expressed by local landowners:

- Containment of all leachate generated within the cells
- Control of litter by use of catch fencing around the active tipping area and litter pickers following windy periods
- Undertaking active pest and vermin control measures using a specialised contractor
- Bird control measures including the use of a falconer as required

Comhairle Chontae Chill Mhantáin
WICKLOW COUNTY COUNCIL



Environmental Impact Statement for Proposed Extension to Rampere Landfill



VOLUME 2

Main EIS Document

COWI

November 2002

MCOS

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DOCUMENT CONTROL SHEET

Client	Wicklow County Council					
Project Title	Proposed Extension to Rampere Landfill					
Document Title	Environmental Impact Statement – Non Technical Summary – Volume 1					
Document No.	067-509-001-Rp0002					
This Document Comprises	DCS	TOC	Text	List of Tables	List of Figures	No. of Appendices
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ENVIRONMENTAL IMPACT STATEMENT FOR PROPOSED EXTENSION TO RAMPERE LANDFILL

VOLUME 2 – MAIN EIS DOCUMENT

SEPTEMBER 2002

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1 INTRODUCTION

1.1 BACKGROUND

The Waste Management Plan for County Wicklow was adopted in April 2000. In accordance with the Plan, Wicklow County Council is proposing to undertake an extension to the existing municipal waste landfill at Rampere, Baltinglass. The current site caters for waste generated in West Wicklow, with a typical intake in the region of 5,000 to 10,000 tonnes per annum. The proposal is to provide additional capacity at the extended site of the order of 50,000 tonnes per annum, in order to meet the requirements of the entire County. This arrangement would provide a short term solution to the waste disposal crisis in the County for a period of approximately 5 years, allowing alternative facilities to be established in East Wicklow. The location of the landfill is shown on **Figure 1.1.**

Wicklow County Council submitted a Waste Licence Application, Reg. No 66-1, to the Environmental Protection Agency (EPA) in September 1998 for the continued operation of Rampere Landfill in west County Wicklow. Subsequently additional information was forwarded to the EPA in response to request made under Article 14 (February 1999), Article 16(July 2000), Article 17(June 2001) and Article 27(September 2001). A Waste Licence was issued by the EPA for the site in April 2002, this enables ongoing filling of municipal waste in a new lined cell with a maximum annual intake of 11,500 tonnes.

1.2 E.I.S. AND PLANNING REQUIREMENTS

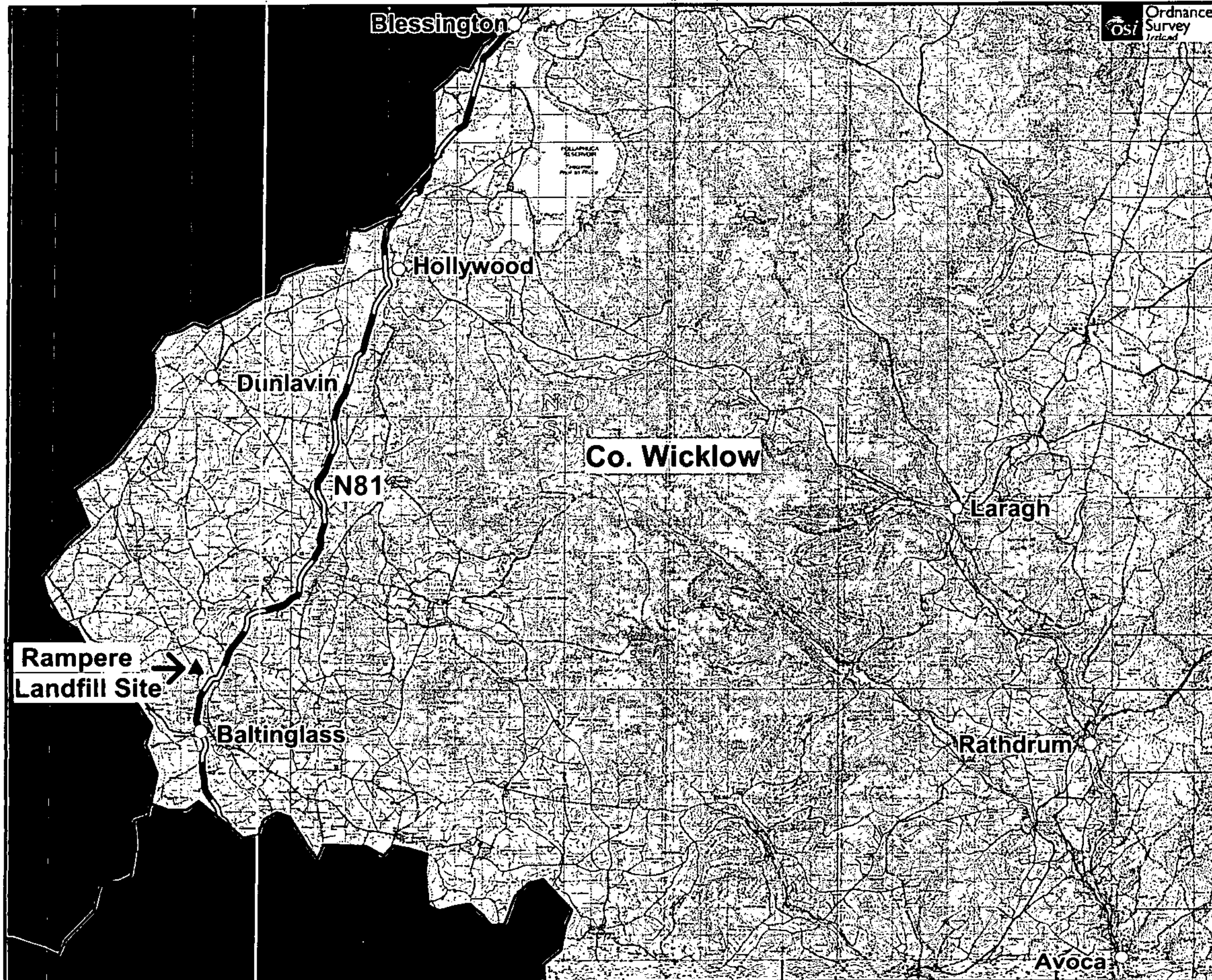
This E.I.S. has been prepared in accordance with the requirements of Part II of the First Schedule of the European Communities (Environmental Impact Assessment Regulations 1989). On the 19th of June 1997, Local Government (Planning and Development No. 3) Regulations amended previous planning legislation. Details of these amendments are contained in Statutory Instrument S.I. No. 261 of 1997.

The amendments are largely consequential on recent Regulations, made under the Waste Management Act, 1996, which introduced a licensing system for waste disposal activities. Such activities, including local authority operations, require a waste licence from the Environmental Protection Agency. The Regulations include a number of amendments to ensure that the planning process operates in a fashion consistent with the new licensing regime. The EPA will consider the environmental impact statement as part of the application for a waste licence. The Regulations also exempt from planning permission development carried out in compliance with a notice under Section 55 of the Waste Management Act.

This E.I.S. has been prepared having regard to all relevant national legislation and EU Directives and is based on the best available information at this time.

1.3 CONTENT OF E.I.S.

The scope and content of this Environmental Impact Statement for Rampere Landfill Extension has been prepared having regard to the information requirements specified in the Second Schedule of the 1989 E.U. Regulations, i.e., effects on human beings, plants, animals, soil, water, air, climate, landscape, the interaction of these elements of the environment, material assets and cultural heritage. The document "Guidelines on the information to be contained in Environmental Impact Statements" as published by the Environmental Protection Agency (2002) was used as a guideline document in the preparation of this E.I.S.



Legend

Wicklow County Council

Project
Rampere Landfill Proposed Extension

Title
Rampere Landfill Location Map

Figure 1.1

MCOS

Issue Details			
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Notes

2 COUNTY WICKLOW WASTE MANAGEMENT POLICY

2.1 INTRODUCTION

Wicklow County Council in April 2000 adopted a Waste Management Plan under the Waste Management Act 1996. This Act and subsequent Waste Management Regulations enacted by the Government form the legislative basis for Waste Management in the Country. All local authorities have a Statutory Obligation to provide for adequate waste disposal facilities for the household waste generated in their functional area.

Previous waste management policies pursued by Wicklow County Council were derived from the East Wicklow Waste Strategy 1993, which was adopted by the Council at the time. Wicklow County Council has since expanded and developed recycling infrastructure particularly for householders, and has invested significant resources in waste minimisation campaigns. However development of a new landfill in East Wicklow has not yet been undertaken, leaving the County in a waste disposal crisis due to the imminent closure of the only remaining municipal landfill in East Wicklow at Ballymurtagh – this facility will close in December 2002.

The Wicklow Waste Management Plan 2000-2004 adresses the need for further improvement in waste management practices in the County. In particular the increased diversion of waste from landfill to recovery, in the form of materials recycling and composting, is targetted. The Plan contains a medium to long term objective to achieve recovery of energy from waste that is not recycled. It also states that a new landfill is required in East Wicklow. For the interim period it recommends an extension to the Rampere Landfill for a limited period of time. This is required to ensure that Wicklow County Council can meet its statutory obligations to provide for safe disposal of the household waste generated in the County.

2.2 NATIONAL WASTE POLICY

National Policy with regard to waste management has been outlined by the Department of Environment and Local Government, in the document entitled 'Changing Our Ways' which was launched in October 1998. This policy seeks to guide the direction of waste management in Ireland away from the current reliance on landfill towards a combination of recycling, energy recovery and residual waste disposal.

There are a number of areas where the new policy gives particular direction to the local authorities as regards future planning for waste management:

- The *Polluter Pays Principle* should form the basis for waste management at all levels i.e. all who produce waste should directly assume the costs associated with collection treatment and disposal.
- Inter-county and regional co-operation is supported strongly, as a means of achieving economies of scale and making new technologies feasible for individual counties.
- Greater involvement of the private sector, at all levels of collection, treatment and disposal, is promoted.
- The local authority must focus on public education and awareness, which will facilitate waste minimisation and increased recycling.

Where a shortage of landfill disposal occurs, the policy favours extending the life of existing facilities where possible, by diverting waste to recycling, diverting sludges from landfill or by seeking landfill capacity in neighbouring counties. Where additional capacity is still required, it recommends intensifying and extending existing landfill sites as an interim solution. Provision of long-term capacity for residual waste disposal by landfill should be in parallel with and should not jeopardise other initiatives for waste minimisation, recycling and recovery.

In relation to the development of new facilities that may have any disamenity on a local community, 'Changing Our Ways' proposes that the local authority should use a proportion of the incoming gate fee to support appropriate environmental improvement projects, thereby mitigating any negative impacts.

The policy underpins many of the restrictions on landfilling that will become legal obligations under the recently adopted European Council Landfill Directive. In particular, a number of targets for waste recycling and diversion from landfill are specifically set out in the National Policy. Local Authorities must realise these targets within a 15 year period. This Directive stipulates that subsidising the cost of landfilling of waste will no longer be allowed.

National waste management targets:

- Diversion of 50% of overall household waste away from landfill.
- Minimum of 65% reduction in biodegradable waste consigned to landfill.
- Development of waste recovery facilities employing environmentally beneficial technologies, as an alternative to landfill including the development of composting and other feasible biological treatment facilities capable of treating up to 300,000 tonnes of waste per annum.
- Recycling of 35% of municipal waste.
- Recycling of at least 50% of C & D waste within a 5 year period with a progressive increase to at least 85% over 15 years.
- Rationalisation of waste landfills with programmed and sustained reductions in numbers leading to an integrated network of some 20 state of the art facilities incorporating energy recovery and high standards of environmental protection.
- 80% reduction in methane emissions from landfills.

These targets represent an important challenge for County Wicklow. To put them in perspective, the 1999 recycling rate for municipal waste was approximately 7 % and approximately 8% of construction/ demolition waste was recycled. There are no facilities at present, apart from home composting, for separation or diversion of organic waste from landfill.

National Policy on Preventing and Recycling Waste

In March 2002 the Government advanced a specific policy on waste reduction and recycling entitled 'Delivering Change'. This discusses the responsibilities and recommended actions for preventing and minimizing waste production. It also recommends a framework for increasing recycling levels and expanding the markets for recyclable wastes. In particular the increased diversion of biodegradable waste such as paper and food waste from landfill is a key target.

2.3 WICKLOW WASTE PLAN 2000 - 2004

Development of Wicklow's Waste Management Plan took place between March 1999 and April 2000. The Plan had to address the short-term difficulties due to diminishing landfill capacity in the County, and also set out a policy for future improved waste management in accordance with the EU Waste Hierarchy, which favours waste prevention & minimisation, followed by reuse and recycling, energy recovery with landfill disposal being the least favoured option.

Two separate periods of public consultation were undertaken in the development of the Plan. The first was between March and June 1999 and it helped in the formulation of the Draft Plan. This Draft was then the subject of a further period of consultation during September and November 1999, following which the Draft Plan was revised, before being submitted to the Elected Members for adoption. The options to be pursued in terms of short-term landfill capacity formed part of both consultation periods, including the option to extend Rampere Landfill.

In order to achieve prevention and minimisation of waste, Wicklow's policy is to commit further resources to education and awareness campaigns involving schools, at community level, at businesses and also the farming and agricultural sector. Programmes already underway such as the Green Schools programme and home composting programmes will be extended, and other new projects will be undertaken. A further aim is to introduce use-related charges where possible, since this can assist in waste reduction at source by householders and businesses.

The Plan policy sets out a combination of measures to be undertaken by the Council over the Plan Period. Recycling will focus on both dry recyclables (such as packaging, paper, plastic metals etc.) and on the composting of garden and food wastes. Specific policies to increase waste recovery include the following:

- Implement source segregation for household waste and commercial waste.
- Provide for separate collection of household packaging waste by *door-to-door (e.g. Kerbside) Collection* in all suitable urban areas, and an *intensive bring-bank network* in rural zones.
- Switch to separate collection of organic waste from households in urban areas by 2003.
- Provide *Waste Recycling Centres* for recyclable waste and bulky wastes.
- To provide facilities for separate collection or delivery of hazardous waste and provide necessary supportive information to the public in this regard.
- To provide for sorting and baling capacity for household recyclable waste.
- To establish facilities for composting of green waste (garden waste) arising in the county.
- To provide for a biological treatment facility for composting or anaerobic digestion of the food waste and organic waste collected separately in the county.
- To provide for additional sorting and baling capacity for recyclable commercial / industrial waste.

The overall waste stream targets for the year 2007 are set out below. This envisages that in excess of 40 % of municipal waste will be recycled. If thermal treatment can be provided for residual waste generated in the county, the overall requirement for landfill can be reduces to approximately 10 % of the municipal waste stream.

Table 2.1: Waste Stream Targets for 2007 in Wicklow Waste Plan 2000-2004

Waste Stream	Recycling	Recovery	Disposal
Household	46%	46%	8%
Commercial	38%	50%	12%
Industrial	28%	51%	22%
Total	**41 %**	**48 %**	**11 %**

The Plan outlines the need for increased staffing and resourcing of the Environment Section of the Council who have an increased role in implementing the Waste Plan, and also in regulating waste activities throughout the County. Public participation and ongoing public consultation in the implementation of the Plan are recommended.

Plan Implementation to Date (August 2002)

Wicklow County Council has continued to expand its public awareness programmes and home composting initiative. Waste collection at household level is carried out entirely by private collectors. A number of these have introduced 'use-related' charges by means of a 'tag-a bag' volume-related system.

Recycling facilities have continued to expand although progress on separate collections (e.g. kerbside collection and separation of organic waste in urban areas) remains to be implemented. Wicklow County Council sought 'Expressions of Interest' for the development of a composting facility in East Wicklow in accordance with the Waste Management Plan. In August 2002 a Waste Permit was granted to Richard Sharpe to compost green waste and sewage sludges. At present Wicklow County are supplying 175 tonnes per month of sludge to the facility and are making arrangements to supply this facility with green waste.

Wicklow County Council has also advanced proposals for four new Waste Recycling Centres across the County. The proposals are as follows:

Location	Description	Projected Capacity (tonnes/ annum)
Wicklow Town	Development of new Recycling Centre to replace/ upgrade existing 'greenvalleys' depot. Education/ Awareness office to be set up for community involvement programmes	2,350
Arklow	Development of new Recycling Centre with Materials Recovery and Green Waste Composting elements, some capacity for commercial paper/ cardboard	2,200
Blessington	Development of new Recycling Centre to serve West Wicklow and to tie-in with WCC 'One-stop-shop' Regional Office.	1,000
Avoca	Upgrading of new Recycling Area at the closed Ballymurtagh Landfill.	350

A Grant Application for these facilities has been made to the Department of Environment and Part VIII Planning Applications will be made for the urban centres in September 2002.

2.4 QUANTITY AND NATURE OF WASTE ARISING AND RESIDUAL LANDFILL REQUIREMENT

Information on waste generation and waste management in County Wicklow is contained in the County's Waste Management Plan. In total, over 900,000 tonnes of waste are generated in the County each year, when agricultural and quarrying wastes are included. The following table summarises the position with regard to four principal waste streams:

Table 2.2: Summary of Waste Generation and Recycling (Wicklow Waste Plan 2000-2004)

Waste Type	Arising Tonnes/ annum	Recycled	% Recycling
Household waste	**41,600**	**2,000**	4.8%
Commercial waste	**21,280**	**2,350**	11.0%
Industrial waste (non hazardous)	**21,600**	**2,500**	11.6%
Construction Demolition waste	**72,000**	**6,000**	8.3%
Total	156,480	12,850	8.2%

In addition to the above, an estimated 3,500 tonnes of street sweepings / litter, and over 4,500 tonnes of municipal sludges are generated each year.

Landfill figures for 1997 were presented in the Waste Plan for both municipal landfills in the County. 63,852 tonnes were deposited at Ballymurtagh, and 11,395 tonnes at Rampere Landfill.

Updated data is now available for both landfills from weighbridge records over the last number of years, as presented in Table 2.3 below. Although many of the waste collectors in Wicklow collect both householsd and commercial waste the quantity of the waste accepted at either of Wicklow County Council landfills is restricted to houshold waste only.

Table 2.3: Waste Intake at Ballymurtagh and Rampere Landfills

Year	Rampere (Tonnes/annum)	Ballymurtagh (Tonnes/annum)
2000	1,710	49,103
2001	8,042	50,919

Overall it is projected that approximately 40,000 – 50,000 tonnes of municipal waste (mainly household waste) will require landfill capacity in the short term.

2.5 ALTERNATIVES ASSESSED FOR SHORT TERM LANDFILL CAPACITY

The crisis due to lack of municipal landfill disposal capacity in the County was expressed to the Elected Members of Wicklow County Council in March 1999, at the beginning of the process of drawing up a Draft Plan. It was pointed out that there were four possible avenues towards finding a solution, with particular emphasis on household waste, namely:

- Seek approval to landfill Wicklow's waste in a neighbouring county or further afield
- Extend the existing landfill at Rampere in West Wicklow
- Seek a private sector disposal option
- Privatise collection and disposal service completely

Each of these options was explored during the preparation of the Draft Waste Plan policy, with the following results:

2.5.1 Landfill in a Neighbouring County

Local Authorities neighbouring Wicklow and including the four Dublin local authorities were approached formally in this regard. Wicklow County Council sought interim capacity of up to 40,000-45,000 tonnes per annum of household waste over a 3 year period, or any part thereof. None of the local authorities approached offered any possibility of co-operating with this request. Counties Wexford, Kildare, Carlow and Fingal all replied that they too were facing disposal crises, and that they could not be of assistance.

Update in 2002: the situation in neighbouring counties has generally disimproved with landfill capacity becoming increasingly scarce – for example Balleally landfill in Fingal has restricted waste intake, in order to conserve void space. A new baling station for municipal waste will be completed by 2004 in Dun Laoghaire Rathdown but given the shortage of municipal landfill capacity in the Dublin Region it is likely to be conserved for household waste arising in the County. The local authorities in Carlow, Wexford and Kildare are trying to conserve remaining landfill void space (in some cases through limited landfill extension) until new facilities can be developed.

2.5.2 Extend the existing landfill at Rampere in West Wicklow

The current facility at Rampere accepts less than 10,000 tonnes of waste per year at present and has a limited remaining capacity in its present form, hence a significant extension would be required in order for it to accept larger volumes of waste. Whilst it was recognised that transfer of waste to this site would be costly and not the ideal solution, government policy does favour extension of existing sites to deal with a short term crisis.

A preliminary assessment of an extension to Rampere landfill was carried out in 1999. An extension to cater for approximately 50,000 tonnes / annum of waste for a 3-5 year period was considered, with reference to site layout and conditions. An extension would require additional land and some road improvement work. The proposed extension would consist of a fully lined cell with leachate collection. Treatment would be required for the leachate whether

on-site or at a municipal treatment plant. All development works would be carried out in accordance with the EPA Manual "Landfill Site Design" (Draft) and operational procedures would conform to the EPA Landfill Manual "Operational Practices" (1997). It was concluded that an extension could be carried out at a cost of approximately £5-6.5million, and could be completed within 12-18 months of project approval. The development would require application to the EPA for a modification of the Waste Licence Application for the site. The gate fee cost per tonne at a transfer facility in East Wicklow was estimated at € 116/ tonne including transfer costs (1999).

Update 2002: The Waste Licence for Rampere Landfill was issued by the EPA in April 2002, following a lengthy licensing phase which required additional investigation of the hydrology & hydrogeology of the existing site to confirm that no adverse impacts are being experienced on the local Rampere Stream. The Licence enables landfilling to continue at a new lined cell on the site, up to a maximum 11,500 tonnes/ annum. This equates to approximately 1 year additional filling at the site with current intake levels. Various site improvements in terms of infrastructure, management systems and monitoring are required under the Waste Licence and implementation is underway.

2.5.3 Seek a private sector disposal option

The only definite short term proposal in this regard came from the KTK group (a consortium involving KTK Sand and Gravel, and Celtic Waste) who currently operate a new landfill facility at Kilcullen in Co. Kildare. A Waste Licence has been issued by the EPA for a waste treatment/ recycling and landfill facility at this site. The licence stipulates that no putrescible organic waste (e.g. food, garden waste, sludge or liquid) may be accepted and the annual intake of waste must not exceed 220,000 tonnes per annum. The group consulted with Wicklow County Council and were able to propose transfer of waste by road to their landfill facility from a transfer station in East Wicklow. The dry fraction of commercial/ industrial waste and household waste would be accepted. Segregation of the putrescible component of for example household waste would have to be undertaken in advance, possibly by mechanical means at the transfer station. However, the Council would still have to provide a disposal facility for the putrescible element that had been screened out.

The cost of this proposal would result in a gate fee at the transfer station of approximately € 85 excluding VAT (price in 1999 prior to Government Tax), providing there was an outlet for disposal of the organic residual within County Wicklow (e.g. at Rampere).

2.5.4 Privatise collection and disposal service completely.

An advertisement calling for expressions of interest in the provision of waste management service from the private sector was placed in national newspapers during May 1999. Eleven companies submitted replies to this advertisement, offering services in waste collection and treatment including recycling and composting. However, whilst there was significant interest in other aspects of collection and recycling, apart from the KTK / Celtic Waste group none of these parties could guarantee a licensed disposal facility for residual waste in the short term.

2.5.5 Realistic options

The two realistic solutions for short term waste disposal were offered by an extension to Rampere landfill and the proposal of KTK group. The Rampere proposal could cater for household waste but could not provide for commercial/ industrial waste. Whilst the KTK group could handle the majority of Wicklow's commercial and industrial waste, and a significant proportion of the household waste, an outlet is still required for the organic waste generated in the county. The cost per tonne of both proposals is similar. Therefore the most secure short term policy for the County Wicklow is to pursue the extension of Rampere landfill and at the same time to co-operate with the proposal of the KTK group. This is the policy as adopted in the Waste Management Plan for County Wicklow. An extended facility at Rampere could potentially be available in early 2004, depending on the duration of the Waste Licence (Review) Application.

2.5.6 Proposed Landfill in East Wicklow (Celtic Waste)

A Planning Application has been lodged by Celtic Waste Ltd., for a municipal landfill at Ballynagran in East Wicklow. The application is for a landfill with a capacity for 180,000 tones/ annum which would accept waste from Wicklow and the Dublin Region. No decision has been made on the application by the planning authority. A Waste Licence Application has also been made to the EPA – there is no proposed decision on the Licence Application as yet. It is difficult to predict whether and when this facility will become operational. The most ambitious programme for this facility would envisage a final decision on Planning (appeal) by late 2003, and if successful construction during 2004 and commissioning in 2005. Further delays due to High Court Appeal etc. would not be unusual for such an application, therefore a more realistic time frame for opening a new landfill would see waste acceptance in 2006/ 2007.

2.6 CONCLUSION

Wicklow's Waste Plan sets out to achieve a more sustainable waste management systems for the County, by developing waste minimisation, rapidly increasing recycling of waste, and eventually achieving energy recovery for residual waste leading to a reduction in the amount of residual waste to be landfilled. Nevertheless in the short-term landfill capacity must be provided so that the County can meets its Statutory Obligation to provide for safe disposal of household waste in the County.

Various options were pursued to seek alternative locations for landfilling of the waste, but these did not prove successful. A private sector proposal for a landfill in East Wicklow is in the planning process but completion of a site is unlikely before 2005/ 2006, if the application if successful. The extension of the landfill at Rampere is considered necessary and feasible, in order to provide landfill capacity for a five-year period. This time frame will allow alternative disposal and recovery facilities to be provided in East Wicklow.

3 DESCRIPTION OF PROPOSED DEVELOPMENT

3.1 INTRODUCTION

The proposed development outlined in this EIS will comprise the following components:

- The extension of the landfill incorporating a land area of 5.5 hectares (13.5 acres) which will be developed in discrete lined cells, including the provision of leachate collection and treatment.
- The modification and improvement of site layout and infrastructure to cater for increased volumes of traffic and improved recycling facilities for civic users.

The proposed development will cause divergence from the design outlined in the original Waste Licence Application for the existing landfill site, including a revised landscape plan for the completed landfill area.

Off site developments required in parallel with the landfill extension will include:

- Road widening and improvement of the public road linking the landfill to the adjacent National road
- Improvement of the water supply to the site and extension of the foul sewer network from Baltinglass to the landfill
- Expansion of the wastewater treatment capacity at the Baltinglass treatment plant.

Overhead electricity lines that cross the extension area will have to be moved to accommodate the new cells.

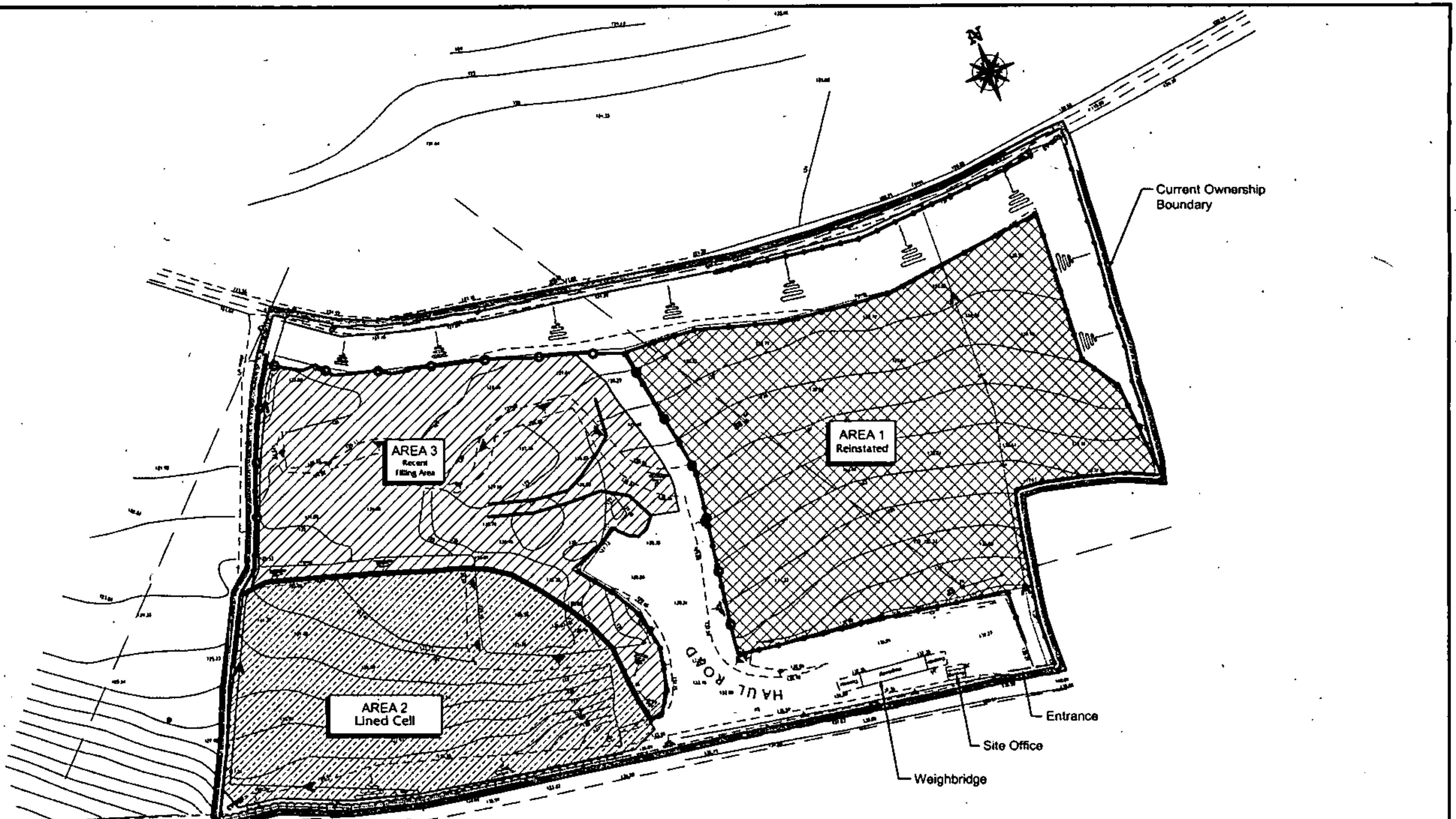
A description is given below of the existing landfill and the proposed new development.

3.2 DESCRIPTION OF THE EXISTING LANDFILL

Rampere landfill is located approximately 2 Km north of Baltinglass in West Wicklow, at a short distance from the N81 National Secondary route. The existing landfill site covers 1.7 hectares in total. The site is in a rural agricultural area where pastureland predominates. The Rampere Stream, a tributary of the River Slaney, is a small watercourse, which passes adjacent to the site boundary, refer to **Figure 3.1**.

The site operates under Waste Licence, Reg. 66-1, issued by the EPA in April 2002. Condition 4 of the current Licence outlines various improvements to the site infrastructure some of which are underway at the site at present.

The site has been in operation since 1980, and an approximate 109,000 tonnes of municipal and inert waste has been deposited at the site up to September 1998. There are two operatives employed at the site. There is a site office, weighbridge and storage container, and equipment includes a compactor unit for waste handling. Management and day-to-day operational procedures are carried out in accordance with the Environmental Management Plan as submitted with the Waste Licence Application of September 1998. The proposed closure, restoration and post-closure monitoring plans are also outlined in the Waste Licence Application.



EXISTING SITE LAYOUT

Client: WICKLOW COUNTY COUNCIL, County Buildings, Wicklow.	MCOS COWI	Carnegie House, Library Road, Dun Laoghaire, Co. Dublin. Phone: 01-2020870 Fax. No: 01-2020707	Job: Rampere Landfill Proposed Extension	Drawn: RH	File Ref.: 067/509/001/FG3.1
				Checked: WP	
				Approved: CB	Figure No. 3.1
			Title: EXISTING SITE LAYOUT	Scale: NTS	
				Date: AUG'02	

A quarterly monitoring programme for groundwater and surface water quality has been established in accordance with the EPA Landfill Monitoring Manual (1995).

3.2.1 Waste Details

Prior to September 1998 the site accepted non-hazardous household, commercial and industrial waste, as well as municipal sludges – the maximum waste intake in recent years was approximately 11,400 tonnes in 1997. Since then Wicklow County Council has restricted waste intake to household waste and municipal sludges, and the total intake for 2001 was approximately 8,100 tonnes. This decrease was due mainly to a restriction on acceptance of commercial waste imposed by the Council during 1998.

A weighbridge was installed at the site in early 2000 to accurately record waste quantities being disposed off at the site. **Table 3.1** details the level of waste intake at the site from 1997 to 2001.

Table 3.1: Total Waste Intake to Rampere Landfill 1997- 2001

Year	Household	Commercial and Industrial	Other	Total
1997	4,374	3,921	3,100	11,395
1998	4,505	2,307	3,618	10,430
1999	5,555	-	n/a	5,555
2000	1,710	-	n/a	1,710
2001	8,042	-	n/a	8,042

In June 2002 the construction of the new lined cell commenced and all operations at the site have temporarily ceased. It is planned to reopen the site to waste loads by November 2002 when all waste will be landfilled in the lined cell.

3.3 PROPOSED DEVELOPMENT - PRELIMINARY DESIGN

3.3.1 Scale of Development

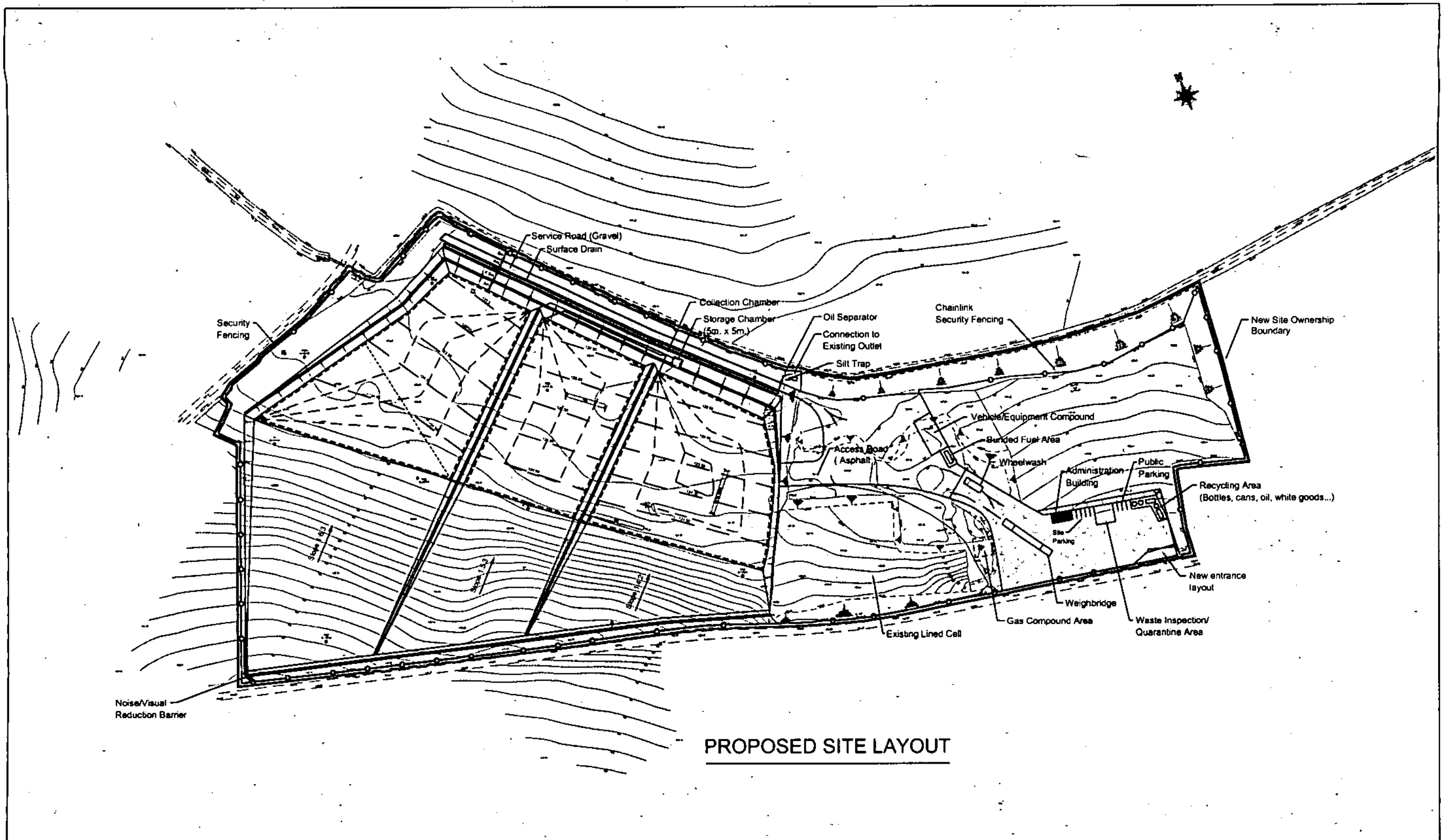
The landfill area will extend to include 5.5 hectares (13.5 acres) adjoining the existing landfill to the west, giving a total site area of 7.2 hectare (17.8 acres). The extension area is bordered to the south and west by public roadways, and along the northern boundary by the Rampere stream. Approximately 72% of the extension area will be taken up by waste cells, the remaining space will be used a buffer area, drainage, fencing and an service road. An area of the existing landfill will be developed as a waste reception area and will provide access to the new cells.

The landfill extension is based on the requirement to provide landfill capacity of approximately 50,000 tonnes per annum for a five-year period – the overall capacity of the extension area is approximately 250,000 - 300,000 m3. This waste intake represents a significant increase compared to previous years: the maximum annual intake reported was 11,395 tonnes in 1997, and this has fluctuated in the intervening years.

3.3.2 Site Layout and Infrastructure

Modified Site Layout

The layout for the proposed site extension is detailed in **Figure 3.2**. The key layout changes and improvements are as follows:



PROPOSED SITE LAYOUT

Client: WICKLOW COUNTY COUNCIL, County Buildings, Wicklow.	MCOS COWI, Carnegie House, Library Road, Dun Laoghaire, Co. Dublin. Phone: 01-2020870 Fax. No: 01-2020707	Job: Rampere Landfill Proposed Extension	Title: PROPOSED SITE LAYOUT	Drawn: RH; Checked: WP; Approved: CB; Scale: NTS; Date: AUG'02	File Ref.: 067/509/001/FG3.2.DWG; Figure No. 3.2

- Revised entrance area – wider opening onto public roadway improving sightlines and turning capabilities for all types of vehicles, increased paved area, improved recycling (civic amenity) area, and parking spaces.
- Weighbridge and administration building will be moved to a new location west of the current entrance, with a new paved road connecting these to the entrance area. A wheelwash will also be provided at this area.
- A surface water overflow retention tank will be installed close to the civic amenity area below ground level and water from a spring to the south of the site will be pumped to the tank. The water needs of the site office and wheelwash will be piped from the tank with excess water discharged from the tank to the Rampere Stream. The capacity of the tank will be approximately 3,500 litres.
- Waste Inspection/quarantine area, adjacent to the administration area
- A service road servicing the northern end of the extension area for monitoring and maintenance
- Security fencing (chainlink) surrounding the landfill, behind the existing hedgerows

New lined cells

It is proposed to construct three new waste disposal cells in the extended area, as shown in Figure 3.2. The cells will have a combined area of approximately 40,700 m^2 and their base will generally follow the existing ground contour which slopes south-north towards the bottom of the valley. Bunds will be constructed at the northern (lower) end of the cells, which will provide for stability, containment of leachate within the waste body, and also provide visual screening. The maximum depth of waste will be approximately 10-15 metres.

A buffer area will be provided between the stream and the new landfill cells along the northern perimeter of the extension area. The service road alongside this perimeter will allow access to the leachate collection area, and to groundwater monitoring locations. A Noise Barrier will be erected at the south-west corner of the extension area, to prevent noise impacts upon an adjacent dwelling.

The development will necessitate the moving of overhead ESB powerlines that traverse the extension area diagonally.

All hedgerows around the perimeter of the extended site will be protected and maintained.

3.3.3 Operational Principles

The site will be operated in accordance with best international practice for similar facilities and in accordance with the Waste Management Act 1996, Waste Management (Licensing) Regulations 1997, EPA Landfill *"Operational Practices"* Manual (1997) and the EU Directive on Landfill of Waste (99/31/EC).

A comprehensive Environmental Management Plan will be prepared pursuant to these objectives, the purpose of which is to set out the measures, procedures and guidance *"to prevent or reduce as far as possible negative effects on the environment, in particular the pollution of surface water, groundwater, soil and air, as well as the resulting risk to human and animal health, from landfilling of waste"* (from Article 1 of the EU Directive on Landfill of Waste (99/31/EC).

Site Operation will be in accordance with conditions as laid down the Waste Licence for the existing site, which outlines procedures for waste acceptance, waste handling, management of tipping procedures , covering of waste and all other aspects of landfilling activities.

3.3.4 Landfill Construction Phasing

It is proposed to undertake the extension and improvement works in a phased manner as follows:

Phase 1- This will include the upgrading of the existing entrance revision of the layout on the existing site, including parking areas, waste inspection and other infrastructure so as to facilitate the construction of new cells without creating difficulty for continued landfill operation on the existing site. This will facilitate any increase in construction traffic for the development of the extension area.

Upgrading of the public road allowing access to the landfill is also planned for this initial phase of work.

Phase 2 - Construction of the three new lined cells will be carried out as a single construction contract, albeit in a phased manner. All leachate collection and treatment infrastructure, service roads, bunds etc. will also be constructed at this stage.

Construction of internal haul roads within the landfill - using imported gravel or hardcore material, or suitable construction waste, will be required on an intermittent basis during the landfill lifetime. Similarly, capping and reinstatement of filled cells will be an ongoing procedure as the landfill develops.

3.3.5 Phasing of Landfill Development

The filling of waste in the existing landfill area will continue until the newly lined cell has been filled to meet the required ground profile as set out in the revised landscape plan, see **Figure 3.11**. This includes a void space of approximately 20,000 m^3. Once the required landform has been reached, filling would then proceed in the newly constructed lined cells in the extension area.

It is proposed that the new cells are filled in the order Cell 1 to Cell 3. Waste will be filled starting at the north (or lower) end and will progress in a southerly direction. The active face of waste will be minimised. The sequence of filling will require that filling of Cell 2 will commence before Cell 1 is completed, in order to allow that Cell 1 be filled to its final level in safety. (and so on for Cell 2 and 3). **Figure 3.3** outlines in schematic form the phased manner in which the cells will be filled.

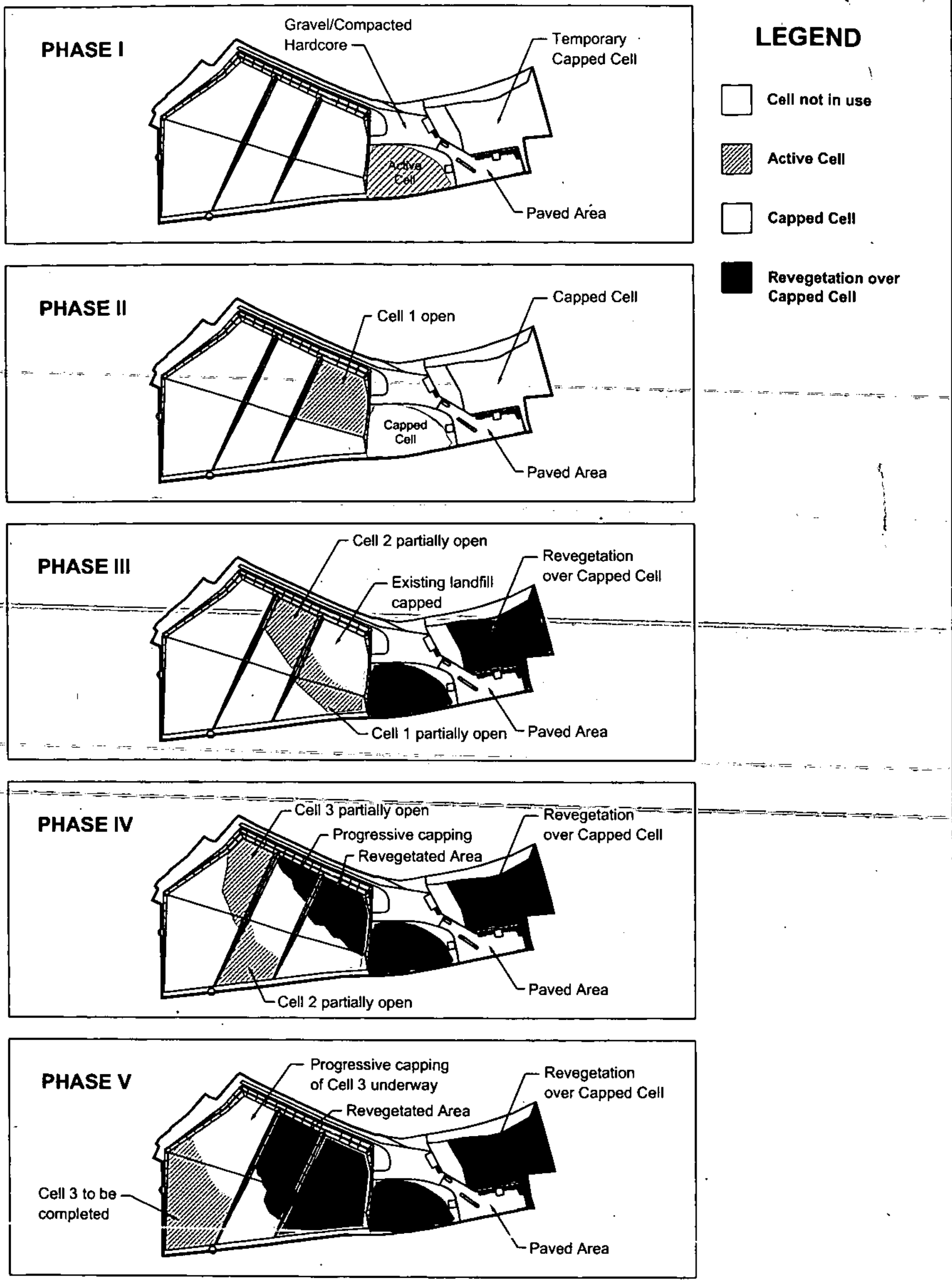
Once the level of waste has reached the required height, capping and reinstatement will be undertaken progressively as outlined in 3.3.7 below. This expedient capping of waste will serve to minimise both visual impact and leachate generation.

Completion of final landform

In order to complete the required final landform for the entire site, some additional soil material will be required. For example the interface between the existing and new cells will be landscaped to form a continuous landform. Upon decommissioning of the weighbridge and site buildings at the south west of the existing site, the proposed final contour levels for the area will require suitable material be imported and placed in this area.

3.3.6 Lining System

To comply with the EU Directive on Landfill of Waste (99/31/EC) must be situated and designed so as to meet the necessary conditions for preventing pollution of the soil, groundwater or surface water and to ensure efficient collection of leachate. In this respect the EPA have prepared a Manual on *"Landfill Site Design"* (2000) for consultation to *"assist landfill operators and designers to conform to the standards required, including the BATNEEC (Best Available Technology Not Exceeding Excessive Cost) principle, and to ensure that the long term environmental risks posed by landfills are minimised through effective containment monitoring and control"*. The design of



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			Checked: WP	
		Title: PHASING OF LANDFILL DEVELOPMENT	Approved: CB	Figure No. 3.3
			Scale: NTS	
			Date: AUG'02	

the landfill will generally be carried out in accordance with the recommendations in the Manual. During the operational/active phase, protection of soil, groundwater and surface water is to be achieved by the combination of a geological barrier and a bottom liner.

According to the EPA Manual, for a non-hazardous waste landfill the landfill base and sides should consist of a composite liner comprising a minimum 2mm HDPE or flexible membrane liner on a compacted soil layer which meets the following requirements:

- *Permeability* $k \leq 1 \times 10^{-9}$ *m/s*
- *Thickness* $\geq$ *1m*

Where the in-situ geology does not naturally meet the above conditions it can be completed artificially and reinforced by other means giving equivalent protection.

In addition to the composite liner a leachate collection system must be provided. This system should comprise a drainage layer with a thickness of 0.5 m with a minimum hydraulic conductivity of $1 * 10^{-3}$ m/s and drainpipes spaced by the mound model, refer to section 7.3.2 of the Landfill Site Design Manual (2000). The maximum leachate head on top of liner will then be 1m.

A typical cross section through the proposed landfill outlining the composite lining system is shown on **Figure 3.4**. This comprises:

- 1 m of suitable clay ($k < 1*10^{-9}$ m/s), or equivalent layer of bentonite enhanced soil (BES) or geocomposite layer (GCL)
- 2 mm HDPE membrane liner
- Protection layer (geotextile or drainage layer with max 20 mm grain size)
- Drainage layer with a minimum thickness of 0.5m and minimum hydraulic gradient, $k > 1* 10^{-3}$ m/s)

The HDPE liner membrane will be at least one metre higher than the groundwater level at all points. Excavation of soil cover overlying the bedrock is minimised in the chosen profile. The depth of soil requiring excavation will vary from 0.5 m to 2.0 m.

Boulder clay will be excavated from the extension area as part of cell construction. Preliminary soil test suggest that the sandy gravelly clay in question has a relatively low clay content, and may be unsuitable for use as a liner. Further sampling and analysis of the soil will be required to confirm this. It may be necessary to import the clay from an off-site source during the construction phase to meet the liner requirements. If any excess soil is generated after the construction phase, this will be stored on the site for use as daily cover material and capping material during the operational phase.

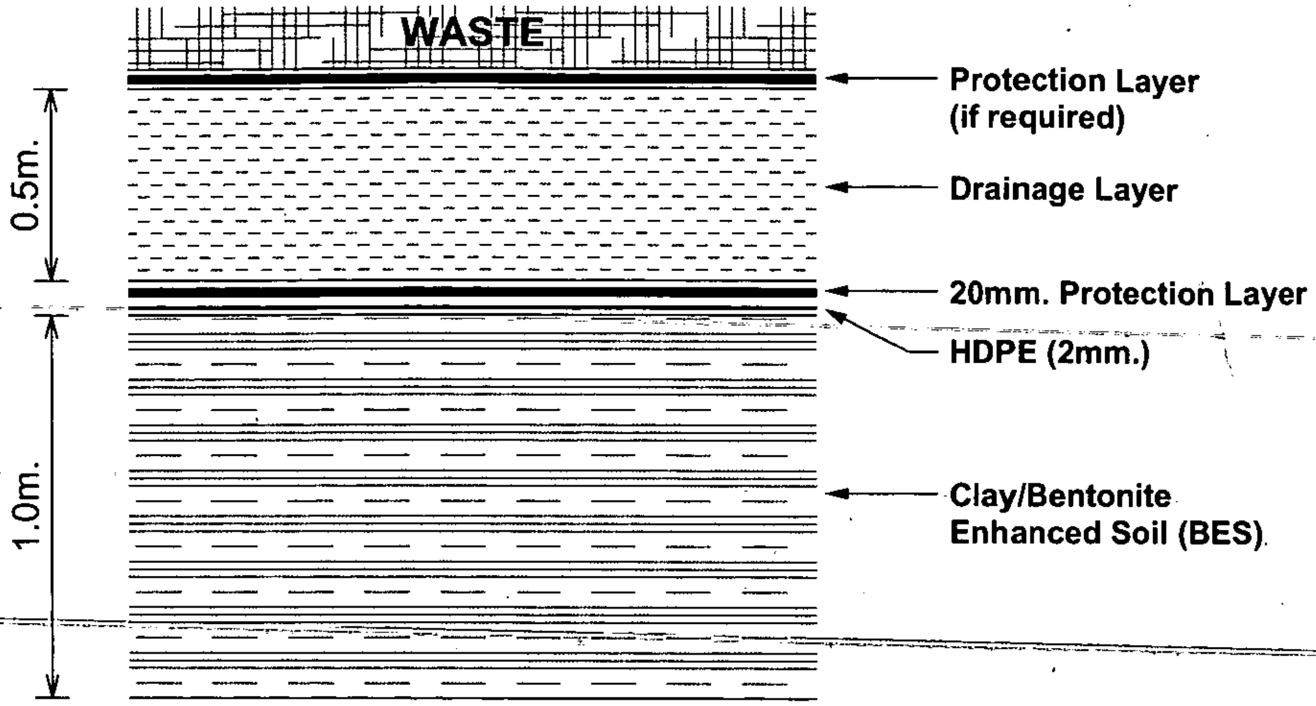
Given the variable ground conditions on the site, further investigation of overburden material beneath the liner will be required during the detailed Design stage. In particular any soft soils that could potentially lead to settlement or instability beneath the waste will either be excavated and replaced, or enhanced.

3.3.7 Capping of Landfill

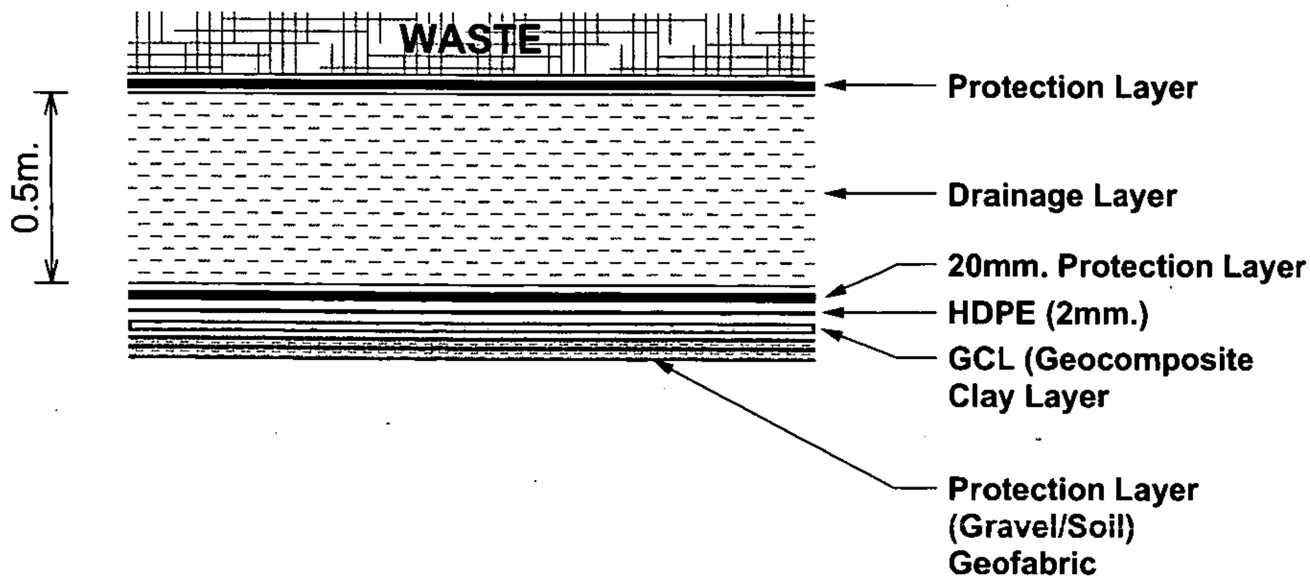
Annex 1 of the EU Directive on the Landfill of Waste notes that "if the competent authority after a consideration of potential hazards to the environment finds that the prevention of leachate formation is necessary, a surface sealing may be prescribed".

The recommendations given in the EU Directive for the surface sealing are:

Option 1



Option 2



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			Checked: WP	
		Title: LINER CROSS-SECTIONS	Approved: CB	Figure No. 3.4
			Scale: 1:200	
			Date: AUG'02	

- Gas drainage layer
- Impermeable mineral layer
- Drainage layer of depth 0.5 m ($k \geq 1*10^4$) or equivalent geosynthetic medium
- Topsoil/subsoil cover of minimum depth 1m

However complete surface sealing of the extended landfill is not proposed. The main reason for this is that the prevention of leachate production impedes or prevents the decomposition process and the stabilisation of the waste body which is not in the interests of environmental sustainability.

It is proposed therefore to adopt the following surface system for the landfill extension as shown in **Figure 3.5**.

- 150-300mm of topsoil
- 700-850 mm subsoil
- 300-500mm drainage layer or equivalent geosynthetic fabric ($k = 1*10^{-4}$ m/s)
- 600mm compacted mineral layer ($k<1*10^{-9}$ m/s)
- 300mm gas collection or equivalent geosynthetic material

Capping material will be excavated during the construction of cells. Excavated soil not used in the construction phase for screening bunds etc. will temporarily be stockpiled and separated as clayey soil, top soil and sand/gravel. There is likely to be a requirement for such excavated material for the purpose of capping for the existing and new landfill cells. Clayey soil and top soil will be used on an on-going process for final covering. Sand / gravel for drainage layer will be imported from external sources. If clay or gravels are in short supply alternative materials such as geosynthetic fabrics with an equivalent degree of protection will be utilized.

3.3.8 Leachate Generation & Characteristics

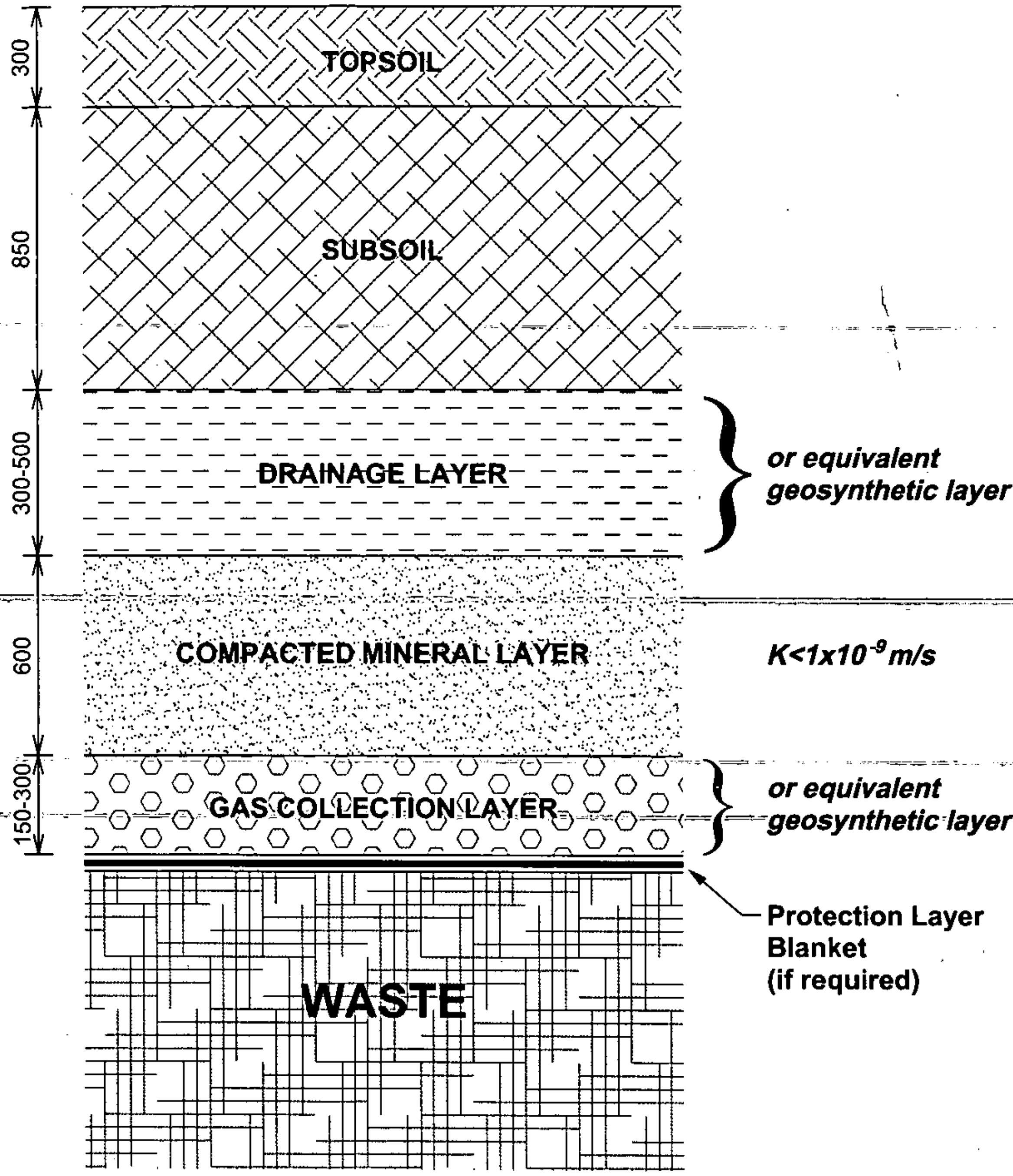
Leachate is the high strength liquid waste which would be generated in the proposed landfill extension at Rampere. It is generated mainly as a result of rainfall on the landfill which percolates through the solid waste thereby becoming contaminated by various chemical and biological processes within the waste. It is now mandatory to collect the leachate in an underdrainage system within the landfill to avoid risk of pollution of the groundwater. Loss of leachate to the groundwater could result in the pollution of the stream adjacent to the landfill and ultimately to the River Slaney.

Leachate is generated as a result of rainfall on the landfill facility. However, there are other factors which influence the generation of leachate, including evapotranspiration, and moisture content in the incoming waste. Leachate varies both in the short and long term in terms of its composition and concentration. The main characteristics of leachate are:

- High concentrations of
  - Organics (short chained acids)
  - Ammonia
  - Iron (Fe)
  - Calcium (Ca)

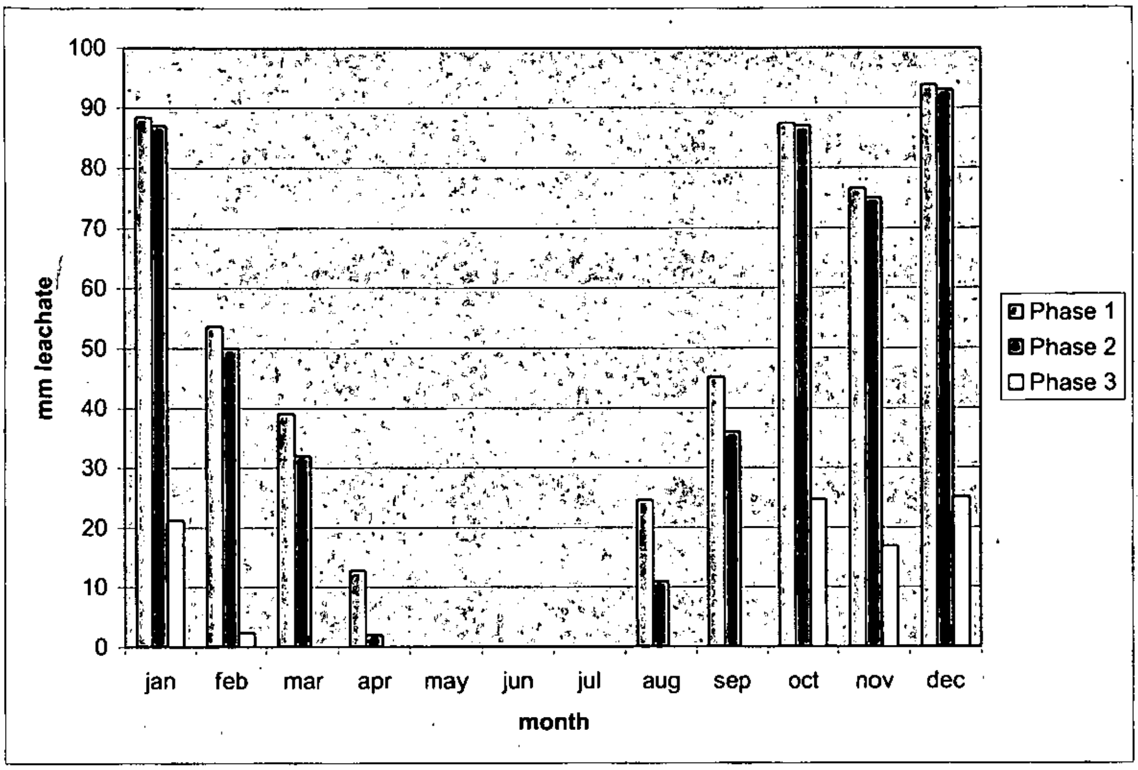
- Content of Toxic Organics and Heavy metals, depending on the type of waste typically deposited at the landfill. Household waste will generally only create low to negligible amounts of toxic organics and heavy metals.

Based on the mean monthly precipitation and Potential Evapotranspiration figures as supplied by the Met Office for Rathvilly, Co Carlow, the volumes of leachate generated monthly for a new cell (covered with ≤ 2m depth of waste - Phase 1), an open cell (covered with ≥ 2m depth of waste - Phase 2) and a capped cell- Phase 3- are shown in **Figure 3.6** :



WICKLOW COUNTY COUNCIL	MCOS COWI Carnegie House, Library Road, Dun Laoghaire, Co. Dublin.	Job: Rampere Landfill Proposed Extension	Drawn: RH Checked: WP	File Ref.: 067/509/001/FG3.5
		Title: CAPPING CROSS-SECTIONS	Approved: CB Scale: 1:200 Date: AUG'02	Figure No. 3.5

Figure 3.6: Monthly Leachate Generation at Rampere Landfill



Based on the data in **Figure 3.6** above the estimated annual leachate generation for different stages over the lifetime of the landfill are shown in **Table 3.2** below.

Table 3.2: Leachate Generation During the Development of the Landfill

	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Year 7	Year 8
Cell 1	5673	5673	1702	1702	1702	1702	1702	1702
Cell 2	0	7932	7932	7932	2379	2379	2379	2379
Cell 3	0	0	0	7495	7495	7495	2248	2248
Hydraulic Load (m3/year)	5673	13604	9633	17128	11576	11576	6330	6330

The various assumptions used in generating these projected leachate volumes are outlined in Appendix 12 of Volume III of this EIS.

The estimated developments of BOD_5, COD and the BOD_5/COD ratio in the leachate from 1 unit of waste are shown in **Figure 3.3**. By combining the leachate curve for each cell with the estimated BOD, the strength of the leachate in each year can be determined (**Figure 3.7**). The evolution of ammonia concentration has also been considered.

Figure 3.7: Estimated development of BOD_5, COD and BOD_5/COD Ratio

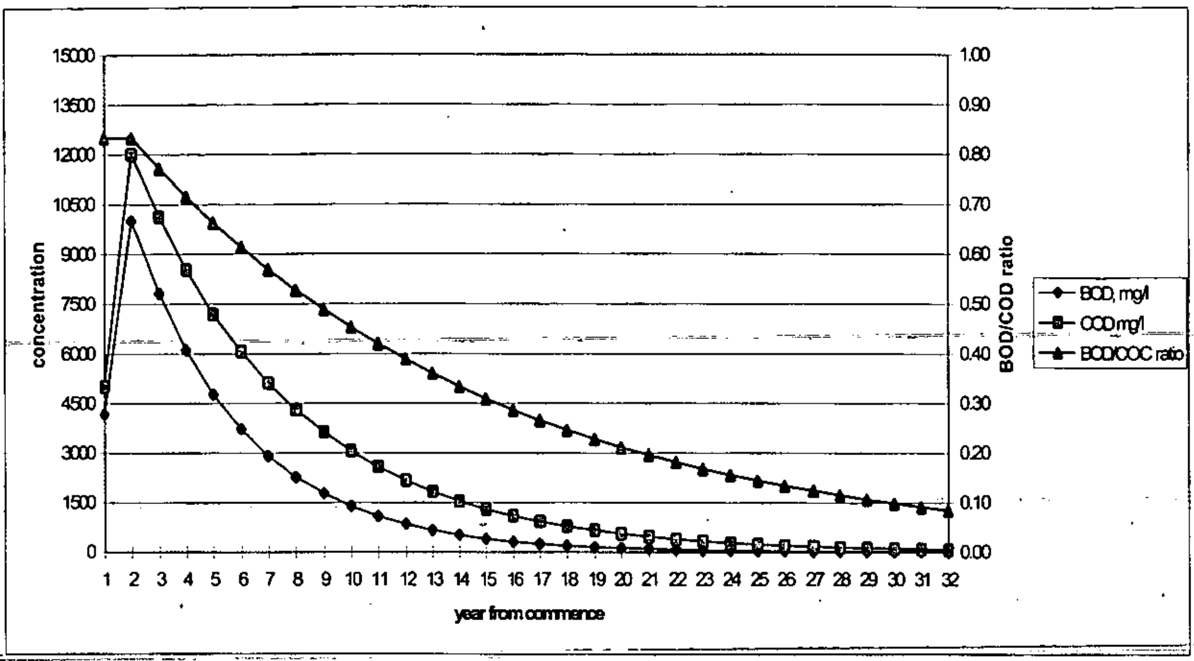
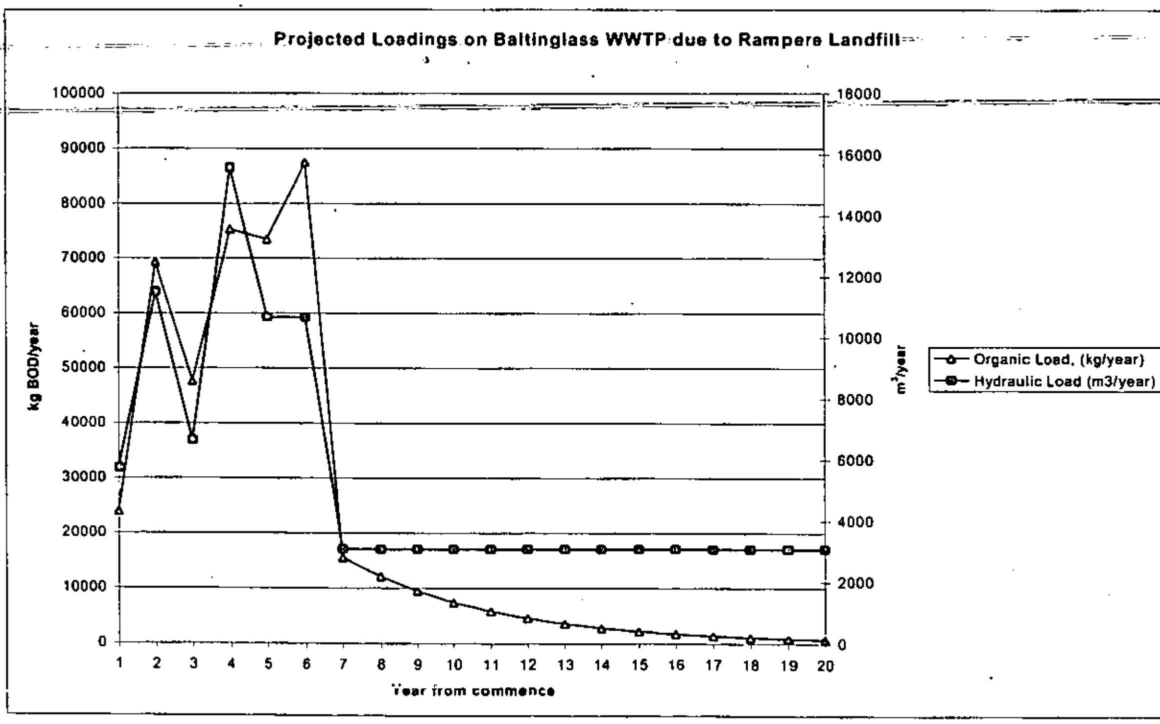


Figure 3.8: Leachate Generation and BOD Load from Rampere Landfill



3.3.9 Leachate Collection

Leachate will be collected in a network of slotted pipes laid in the base of each cell and draining to a sump constructed in the lowest point of each cell. The slotted pipes will be spaced apart to ensure a maximum leachate head on top of liner will be a maximum of 1 m or less.

Each cell will have its own leachate collection system consisting of:

- 0.5m thick drainage blanket consisting of rounded with a hydraulic conductivity of 1×10^{-3} m/s or greater, or equivalent geosynthetic
- A minimum of 200mm diameter perforated pipes within the drainage blanket to collect leachate and carry it to the sump.
- Leachate collection chamber at low point of cell to allow gravitational drainage of leachate.

Leachate generated will flow by gravity to the leachate collection system. From the sump in each cell, leachate is collected and conveyed in separate pipes to a Leachate Collection Chamber. The layout of leachate drainage pipework and collection system is shown in Figure 3.2. The collection chamber is designed as a concrete structure with inner HDPE lining. The dimensions will give a capacity of 50 m^3.

The leachate collection system will have the following features:

- Facilities for sampling of leachate for analysis
- Possibility to divert clean surface water from the unopened cells to the surface water network
- Level indicators in the collection chamber will monitor leachate levels, these will be equipped with alarms

Effluent from the wheelwash facility may be contaminated by suspended solids and other impurities and will be drained to the leachate system, along with wastewater from the administration building etc.

The leachate storage chamber is designed to cater for one days average leachate generation in the wettest month (scenario where cells 1+2 are closed and covered, and cell 3 is open). Additional leachate storage is provided within the waste cells, where a 1m head of leachate is allowed under the EPA design manual – this provides storage capacity for an additional 4 days average capacity for the wettest month. The bunds of the waste cells are set at an elevation that allows for an additional 'emergency' capacity of a further 3 days average leachate generation for the wettest month. Such capacity is unlikely to be required – options for servicing of the leachate collection chamber are discussed in the section 3.3.10.

3.3.10 Leachate Treatment

There are two options for the treatment of the leachate emanating from the landfill:

- Separate treatment of the leachate on site
- Co-treatment with municipal wastewater

Separate treatment of the leachate in a biological treatment process can be a difficult and expensive process, and in general treating leachate in combination with urban wastewater is preferred from a treatment point of view, giving a more stable process generally. There are also constraints on directly discharging treated wastewater to a minor waterbody such as the Rampere stream which make off-site co-treatment more feasible.

A summary assessment was carried out as to the available treatment capacity at the municipal wastewater treatment plant (WWTP) at Baltinglass, which is approximately 3 Km from the landfill site.

Baltinglass WWTP is designed for a *population equivalent* (P.E.) of 3,000 but there is space allocated on the site for a doubling of capacity with the addition of a second activated sludge plant and clarifier. A recent audit by Wicklow County Council suggests that approximately half of the current capacity (1,456 PE) is being utilized. The town's population is forecast to reach 2,500 by 2015 in the County Development Plan.

Projected overall loading on the plant due to the population and the addition of landfill leachate are shown in **Table 3.3** below.

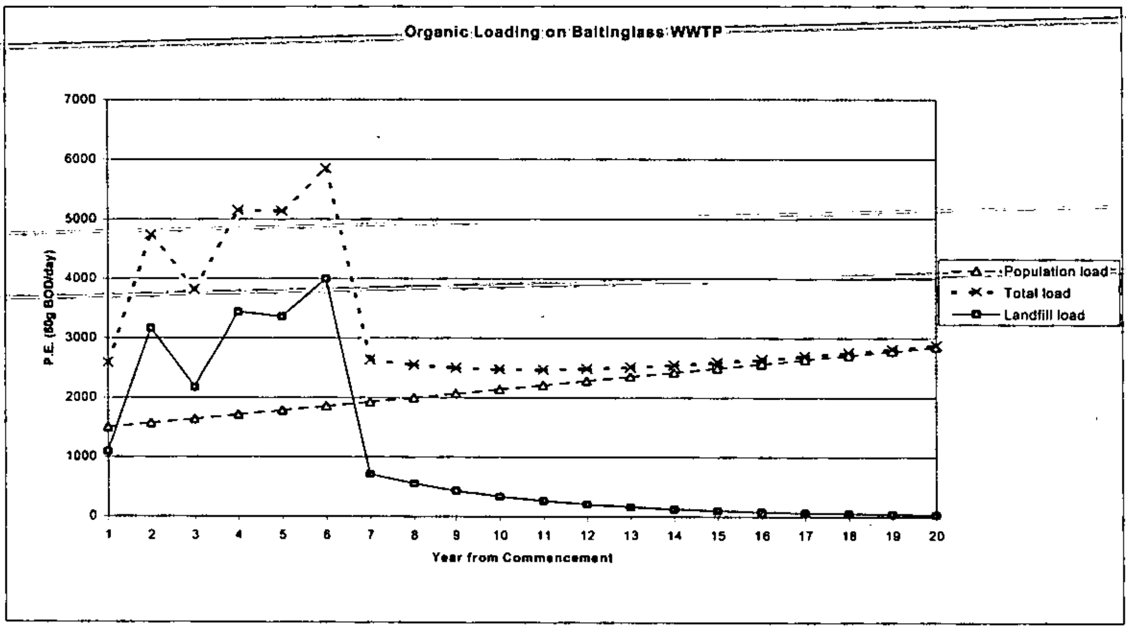
Table 3.3: Projected Loadings on Baltinglass WWTP

Year	1	2	3	4	5	6	7	8	9	10
Population	1500	1571	1642	1713	1784	1855	1926	1997	2068	2139
Background BOD load*(kg/day)	90	94.26	98.52	102.78	107.04	111.3	115.56	119.82	124.08	128.34
Landfill BOD load (kg/day)	65	190	130	206	201	240	42	33	26	20
Total BOD load (kg/day)	155	284	229	309	308	351	158	153	150	149

* - due to population of Baltinglass

The maximum P.E. is anticipated to be 5,849 in year 6. The estimated mean loading on the plant will exceed current capacity between 1 to 2 years after the commencement of operations at the landfill. The mean loading will exceed capacity for a further 5 years after the commencement of operations at the landfill, and will be close to but will not exceed current capacity again for over 20 years.

Figure 3.9: Total Organic Loading on Baltinglass WWTP



As the current WWTP in Baltinglass does not have sufficient capacity to satisfactorily treat the leachate, extension of the current plant would be required to meet the additional load. Space is available at the plant for the construction of a new aeration basin and secondary clarifier. The extended plant would require a capacity of approximately 10,400 P.E. based on the peak BOD load. To provide such capacity, the following developments would be necessary:

- Construction of 2 deep aeration basins each incorporating a surface high-speed aerator
- As the sludge production will increase, it may be necessary to upgrade the sludge treatment systems, pipework etc.

Effluent Quality Standards at the WWTP

The relevant water quality criteria, regulatory standards and proposed design effluent quality standards are assessed in Appendix 12, Volume III of this report.

Current situation
Typically, a plant of this size would operate at approximately a 25/35 standard (BOD/ Suspended Solids, mg/l) and these are the standards that any WWTP processing the leachate would be designed to reach. Based on a limited preliminary assessment, the effluent from Baltinglass WWTP appears to be satisfactory with the possible exception of the phosphorous concentrations. However leachate tends to have a negligible phosphorous concentration and so should not contribute significantly to the phosphorous load.

Further sampling will be required to confirm the current treatment standard of the plant. Upgrading of the plant may provide an opportunity to introduce tertiary treatment for phosphorous removal for the WWTP effluent. Further studies of performance of the existing WWTP and future treatment requirements need to be carried out by Wicklow County Council in advance of the upgrading works.

Conveyance of leachate to Baltinglass WWTP
There are two main options for transporting the leachate from the landfill to Baltinglass WWTP, namely tankering and pumping. These options were compared in terms of the overall efficiency and dependability for leachate removal (and avoidance of critical conditions), capital and operation costs, and other environmental factors.

Tankering would involve regular collection of leachate at the landfill and transport by road to Baltinglass WWTP. The tankering firm would have to be on standby at all times to ensure that the leachate levels were kept below the required level. While there is a low capital investment required, operational costs and provision of round-the-clock service would be significant annual costs.

Pumping would require a rising main to be installed approximately 500m along the landfill access road, and the town foul-sewer to be extended north along the N81 to meet the rising main. Pumps would be installed in the leachate collection chamber. The initial capital outlay is relatively high for this option, and there would be disruption during the construction phase. However the provision of a sewer connection may be useful for dwellings along the route.

Preliminary assessment suggests that pumping is the preferable option, since it offers a lower risk for overall leachate management. Further study of the capacity of the existing sewer to safely cater for the additional flow is recommended. Whichever system is chosen, strict conditions apply as to the levels of leachate allowable in the landfill and in the leachate collection chamber. In the case of tankering, these would be as follows:

- Leachate level to be kept as low as possible
- Storage chamber to be emptied every work day
- Adequate tankering capacity available
- Adequate capacity available at the WWTP to accept worst-case volumes
- Tankering contractor to provide 24-hour cover, 365 days/ year.

If the pumping option is pursued similar procedures and systems will be established to cover pump maintenance, alarm systems and adequate standby pumping capacity.

3.3.11 Surface water generation and handling

Surface water from the proposed landfill site will be generated mainly from rainfall running off the side slopes of the landfill and from paved areas. The area contributing to surface water run-off will increase with time as the landfill is progressively capped and restored.

The total surface area contributing to surface water run-off from the extension area will vary depending on whether the individual cells are open, in use, or capped. After closure and final restoration of the site the total area contributing will be approximately 55,000 m^2.

The surface drain surrounding the extension area will collect all surface water runoff and will discharge into the Rampere Stream north of the landfill site as shown on **Figure 3.2.** Prior to discharge, surface water will pass through a silt trap as a precautionary measure.

Surface water from paved roads in the reception area will pass through an oil separator and a silt trap before entering the surface drain. The annual amount of surface water from paved areas (estimated to be 3,795m^2) will contribute some 3,455m^3/year.

3.3.12 Landfill gas generation and handling

The generation of landfill gas within the layers of refuse is a source of air emissions both during the operation and also after the cells have been completed. The primary constituents of landfill gas are methane (CH_4) and carbon dioxide (CO_2) which are produced by the microorganisms within the landfill under anaerobic conditions. In addition, there are a large number of trace compounds comprising of non-methane hydrocarbon compounds (NMHC) which result from the microbial activity within the landfill layers and can be present in concentrations of parts per million (ppm) or parts per billion (ppb) in the landfill gas. The trace constituents give the distinctive odour of landfill gas since CH_4 and CO_2 are both odourless.

Table 3.4: Typical Composition of Landfill Gas

Component	Typical vol (%)	Max vol (%)
Methane	63.8	88.0
Carbon Dioxide	33.6	89.3
Oxygen	0.16	20.9
Nitrogen	2.4	87.0
Hydrogen	0.05	21.1
Carbon Monoxide	0.001	0.09
Ethane	0.005	0.0139
Ethene	0.018	-
Acetaldehyde	0.005	-
Propane	0.002	0.0171
Butanes	0.003	0.023
Helium	0.00005	-
Higher Alkanes	<0.05	0.07
Unsaturated Hydrocarbons	0.009	0.048
Halogenated Hydrocarbons	0.00002	0.032
Hydrogen Sulphide	0.00002	35.0
Organosulphur compounds	0.00001	0.028
Alcohols	0.00001	0.0127
Others	0.00005	0.023

Source: U.K. Dept of Environment Waste Management Paper No 27 (1989)

The typical composition of landfill gas is given in **Table 3.4** and it is evident that over 99% of the gas volume is comprised of methane, carbon dioxide and nitrogen with the remainder consisting of a large number of trace gases.

Landfill gas comprises about 63% methane and 37% carbon dioxide but this can vary during the life of the landfill, especially during the early and later phases of operation. Initially, carbon dioxide is the dominant gas during the early stages of the decomposition while aerobic conditions prevail. As the oxygen is depleted due to the compaction of the waste material anaerobic conditions develop as organic waste matter decays and methane becomes the dominant gas. Eventually the levels of methane and CO_2 decrease and air is drawn into the pore spaces within the landfill and the fill then becomes biologically inert.

Uncontrolled landfill gas emissions from the surface of a landfill are dependent on the gas production rate and degree of lateral and vertical migration. Vertical movement of gas through a landfill depends primarily on a difference in pressure. Landfill gas may migrate by diffusion or convection or both. During low atmospheric pressure high landfill gas migration from a landfill can be observed. Gas pressure depends on changes in the atmospheric pressure and also changes in the water table and changes in bacterial activity.

Capping the surface with clay and covering with topsoil can substantially reduce vertical diffusion of landfill gas from the surface of the completed cells.

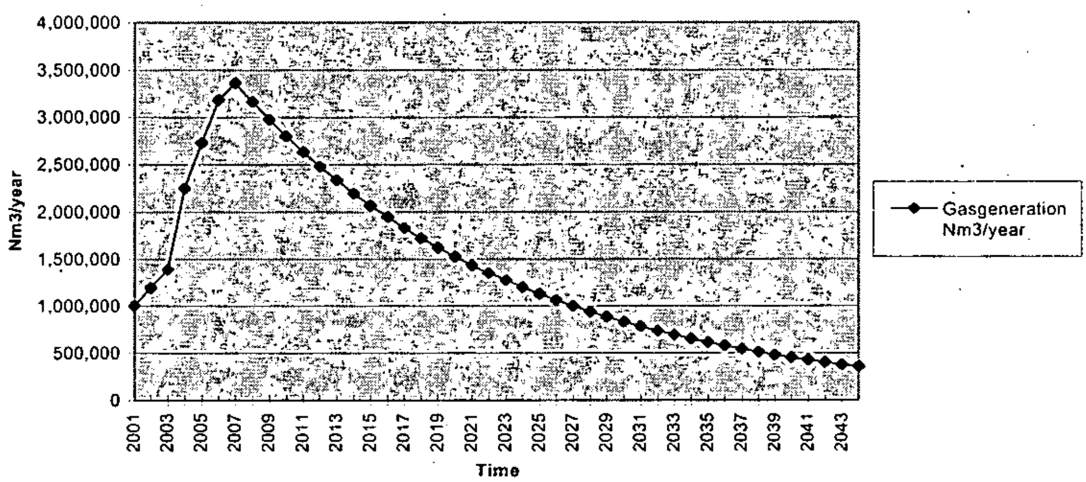
Landfill gas emissions will be controlled by a gas collection network, which is installed as the layers of deposited waste are built up and the cells are completed.

Requirements for Collection

Article 14 of EU Directive on the Landfill of Waste (99/31/EC) discusses the requirements for existing landfill sites and notes that the operator of a landfill shall, within 8 years from entry into force of the Directive, *"take the necessary measures to comply with the requirements of Annex 1(4) of this Directive"*. Annex 1(4) deals with gas control and specifies that all landfills receiving biodegradable waste shall have the gas collected, treated and used or, as a minimum, flared.

Figure 3.10 below outlines the estimated combined level of generation of landfill gas from the existing site and the proposed extension area. The calculation assumed that 250,000 tonnes of waste would be landfilled in the extension area over a 5-year period, with 50% of the waste being organic. The contribution of the existing landfill was also included, the waste body was estimated as 100,000 tonnes with an average age of 5 years old. The capping system as outlined in 3.3.7 above would be used to cap cells.

Figure 3.10 - Gas generation from Rampere Landfill



It is proposed to establish an active gas extraction system including abstraction wells, collector pipes and a gas flare at the proposed extension site. The system will be installed in a phased manner as follows:

Phase 1	Installation of a series of gas extraction wells (spaced 40-50m apart) , a gas pipe collection network, and a gas flare compound. Examine the feasibility of including the existing unlined cells into the active system.
Phase 2	Use Phase 1 as a large scale 'field pumping' tests. Carry out analysis of the pumping from these wells and determine if energy recovery is a viable option.
Phase 3	If economically feasible establish a gas utilisation plant for the production of electricity. Alternatively all three lined cells will be connected to the gas flare. Monitoring of gas wells and the gas flare will continue as part of the aftercare management programme.

3.4 CLOSURE AND AFTERCARE

Closure and restoration of the landfill will generally be carried out in accordance with the EPA Manual "Landfill Restoration and Aftercare" (1999). The final profile of the landfill together with a suggested planting scheme are shown in **Figure 3.11** and in the report on landscape in Volume 3 of the EIS.

The fundamental principle of the closure process however will be that final cover will be placed and sown or planted in an ongoing basis as the individual landfill cells are filled.

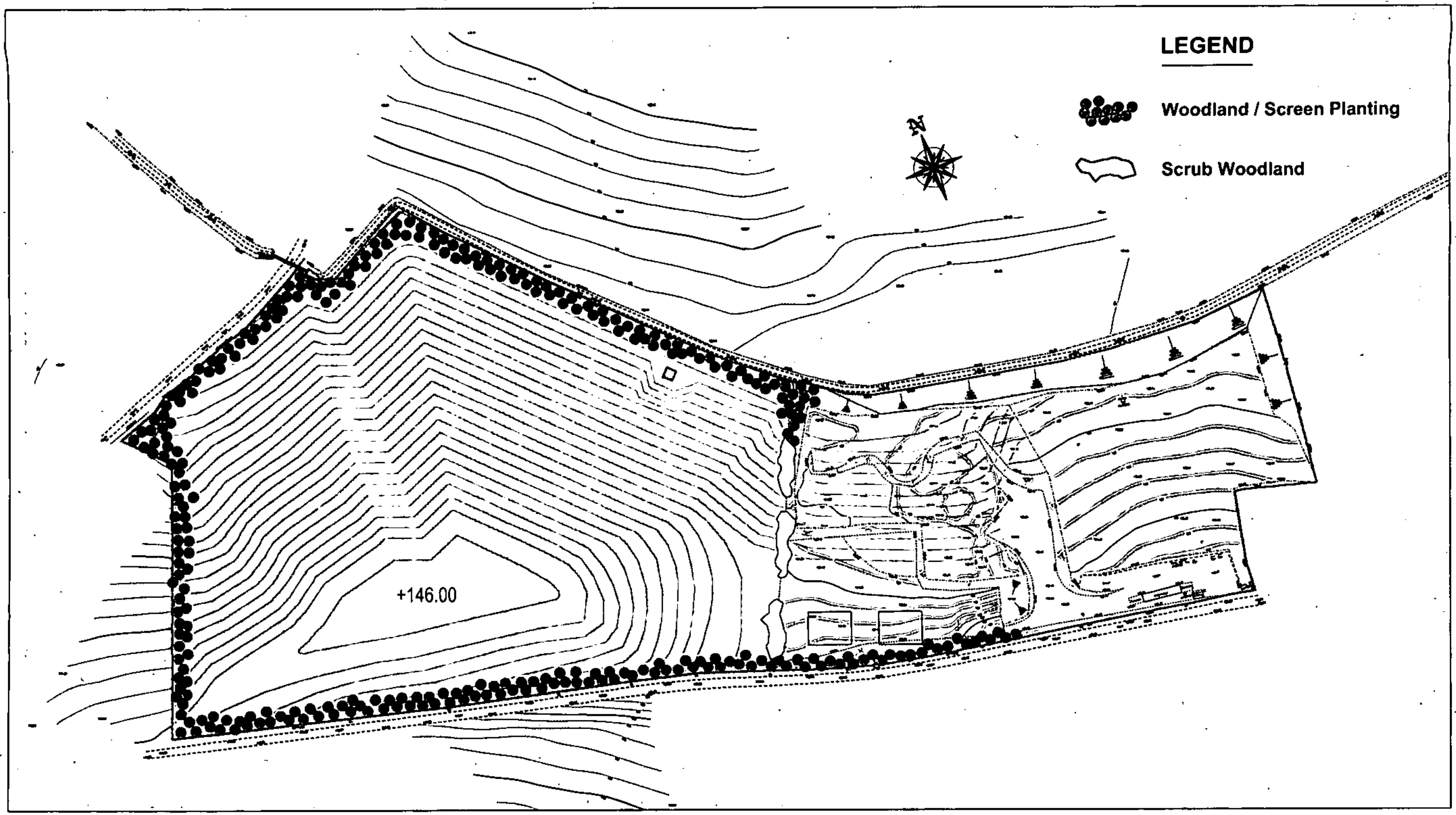
The leachate collection system, control facilities (monitoring boreholes) and monitoring points (surface water control points) will be in operation and maintained until the waste has stabilised (30 years). Monitoring of groundwater, surface water, leachate and gas will continue for 30 years after closure of the landfill as recommended in the EU Directive on Landfill of Waste (99/31/EC) or such period as may be specified in the Directive upon its adoption.

3.5 OFF-SITE DEVELOPMENTS

As described in Section 3.3.10 above, the preferred option for treatment of leachate from the extension area is to co-treat it with municipal wastewater at the Baltinglass Wastewater Treatment Plant (WWTP). In order to ensure adequate treatment capacity for the peak levels of leachate generation, it will be necessary to upgrade the treatment capacity at the WWTP. Wicklow County Council will undertake further assessment and planning of this work at the WWTP, and a separate planning process will be required.

Measures to improve road access to the landfill will be required in order to deal with increased waste intake at the facility – these issues are dealt with in Section 5 of this Volume of the EIS.

Electricity supply lines currently traversing the proposed extension area in an north-east/ south-west direction would have to be moved to accommodate the development of new landfill cells.



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			Checked: WP	
		Title: LANDSCAPE LAYOUT (Mitchell & Associates)	Approved: CB	Figure No. 3.11
			Scale: NTS	
			Date: AUG'02	

4 DESCRIPTION OF EXISTING ENVIRONMENT

4.1 INTRODUCTION

The existing environment at Rampere Landfill, including the proposed extension area, is described below under the following headings:

- Geology & Hydrogeology
- Aquatic Ecology & Surface Water Quality
- Terrestrial Ecology
- Land Use & Agriculture
- Landscape
- Climate
- Air Quality
- Noise
- Traffic
- Archaeology/ Cultural Heritage
- Tourism
- Community

More detailed reports on these aspects of the existing environment are presented in Volume 3 of this EIS.

4.2 GEOLOGY & HYDROGEOLOGY

A study of the geology and hydrogeology of the existing landfill and the proposed extension area was carried out by B.J. Murphy & Associates (BMA) from May to August 2000. The study also examined the hydrology of the site. Previously in September 1998 BMA completed a similar study for the Waste License application for the existing landfill at Rampere which was submitted to the EPA. The more recent study can be found in Volume 3, Appendix 1 of this report and it is summarised below.

4.2.1 Scope of Work

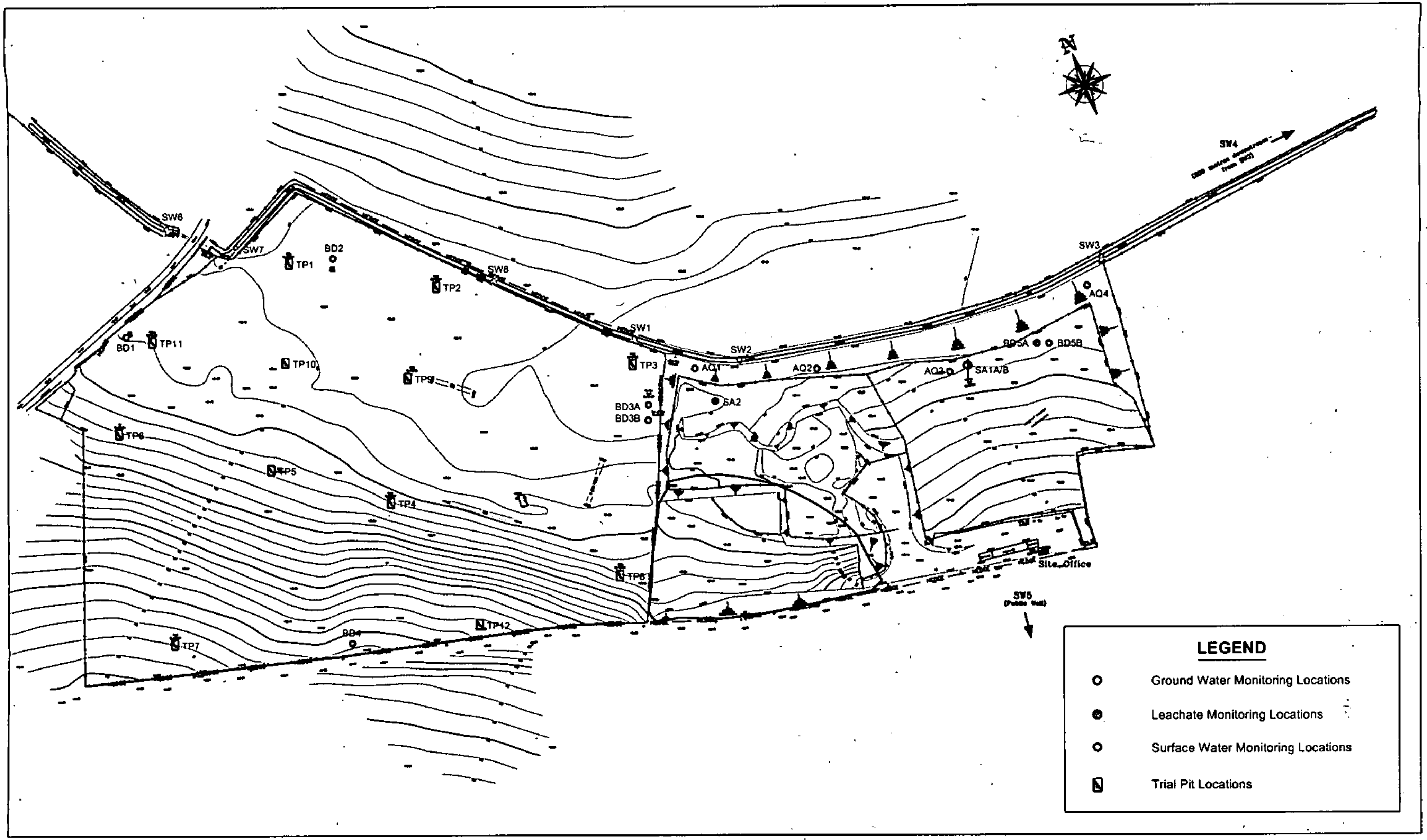
The scope of work comprised of:

- A review of existing data from previous site investigation work.
- A review of existing published data on the region.
- Completion of a site investigation to include 12 no trial pits, 3 no trial trenches, and 8 no Rotary Coreholes.
- Completion of a geophysical survey of the site.
- Assessment of stream flow along the northern boundary of the site.
- Assessment of stream hydrochemistry along the northern boundary of the site.
- Completion of falling head tests in boreholes.
- Reporting on geology and hydrogeology of the proposed extension to the site.

Figure 4.1 outlines the location of the boreholes, trial trenches and trial pits.

4.2.2 Regional Geology

The existing site and the proposed landfill extension is mapped as being underlain by the Butter Mountain Formation (GSi, 1996). These are Lower Ordovician in age and consist of dark blue-grey slates, with pale siltstone and quartzite laminae. The Butter Mountain Formation is known to



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WICKLOW COUNTY COUNCIL County Buildings, Wicklow.	MCOS COWI Carnegie House, Library Road, Dun Laoghaire, Co. Dublin. Phone: 01-2020870 Fax. No: 01-2020707	Rampere Landfill Proposed Extension	TRIAL PIT AND BOREHOLE LOCATIONS	Drawn: RH Checked: WP Approved: CB Scale: NTS Date: AUG'02	File Ref.: 067/509/001/FG4.1.DWG Figure No. 4.1

have metamorphosed to phyllites and schists close to the Granite aureole to the south and to the east of the site.

The intersection between the Butter Mountain Formation and the Pollaphuca Formation is mapped approximately 300m to the west of the proposed landfill site (GSI, 1996). The Pollaphuca Formation consists of coarse grey greywacke sandstone and grits, and dark grey shales.

4.2.3 Overburden Geology

Exposures of overburden were noted in the southwest of the existing site on the steep bank below the road. The overburden at this location consisted of a brown gravelly clay. Towards the southeast of the existing site an exposure of sandy clayey gravel was recorded. The Ordnance Survey maps of the area also indicate that the area underlying the existing site and some of the ground on the proposed site is boggy.

Overburden at the proposed site was found to comprise gravelly sandy clay (Boulder Clay) and alluvial deposits (inter-bedded sands, silts and peats) of varying thickness. It is apparent from 2D- Resistivity profiles (Geophysical Survey) that the overburden varies in thickness from 0.5m to 5m over the proposed site.

A peat layer was recorded in some of the trial pits. Sand and gravel was noted in the stream banks and bed to the north of the site. Lacustrine Clay and some peat layers were noted locally in the stream along the northern boundary of the proposed site and the existing site.

A summary of the logs from trial pitting is presented in **Table 4.1**.

Made Ground
The results of the drilling indicated that the depth of Made Ground (mainly decomposed domestic waste) varies from approximately 9.8m in the completed cell in the east to approximately 5.5 m in the active area in the west of the existing landfill. In the north-eastern corner of the capped area of the existing landfill, made Ground was found to exist to a depth of 9.10m below ground level.

Clay
Boulder clay (gravelly sandy clay) was encountered in TP7, TP8, and TP12 on the higher ground at the south of the proposed site. The boulder clay was found to have a varying thickness of between 2m to 5m. The boulder clay is underlain by weathered rock.

Alluvial Deposits
These consist of silts, fine sands and gravels, which are found in the lower ground along the central and northern areas of the site. This area is the flood plain for the stream, which forms the northern boundary of the site. The stream deposited the silts and sands over time, with the peat layers being deposited during episodes of flooding. The gravel is sandy, clayey, with rounded cobbles of sandstone and shale. The silt is soft to firm, with an increasing sand content with depth.

It seems likely that the stream to the north of the site was diverted at the western end of the proposed site possibly during construction of the old railway line. This would account for the variability of the overburden, including the alluvial deposits, on the northern edge of the proposed site.

Table 4.1: Trial Pit log summary

Trial Pit	Depth (m)	Description
TP1	0-0.6	Topsoil
	0.6-1.2	Very sandy Gravel
	1.2-3.85	Grey fine sand, some peat
	3.85-5.3	Dark grey weathered bedrock
TP2	0-0.4	Topsoil
	0.4-3.8	Sandy gravelly Clay
	3.8-4.8	Grey sandy Gravel, some cobbles
TP3	0-0.5	Topsoil
	0.5-1.1	Brown Peat
	1.1-1.7	Grey gravelly Sand
	1.7-3.45	Grey sandy Silt
	3.45-4.2	Sandy Gravel
TP4	0-0.55	Topsoil
	0.55-1.4	Brown gravelly sandy Clay
	1.4-2.7	Weathered shale cobbles
TP5	0-0.4	Topsoil
	0.4-2.3	Brown sandy Clay
	2.3-3.2	Brown gravelly Clay
	3.2-3.5	Dark grey weathered Shale
TP6	0-0.45	Topsoil
	0.45-1.9	Brown clayey Gravel
	1.9-2.5	Brown sandy clayey Gravel
	2.5-3.7	Pale green sandy weathered Sandstone
TP7	0-0.5	Topsoil
	0.5-4.2	Brown gravelly Clay
	4.2-4.9	Slightly weathered Bedrock
TP8	0-2.3	Brown slightly gravelly sandy Clay
	2.3-3.8	Pale grey weathered Shale
TP9	0-0.2	Topsoil
	0.2-5.1	Sandy Silt
TP10	0-0.3	Topsoil
	0.3-0.7	Brown sandy Clay
	0.7-1.9	Very sandy Gravel
	1.9-3.9	Sandy gravelly Clay
TP11	0-0.3	Topsoil
	0.3-0.6	Brown sandy Clay
	0.6-1.1	Very sandy Gravel
	1.1-1.35	Brown Peat
	1.35-1.66	Grey Marl
	1.66-4.4	Brown sandy gravelly Clay
TP12	0-03	Topsoil
	0.3-3.6	Brown sandy gravelly Clay
	3.6-4.0	Light brown coarse Sand
	4.0-4.6	Pale green weathered Sandstone

4.2.4 Bedrock Geology

A fault (north-south orientation) which forms the boundary between the Butter Mountain Formation and the Pollaphuca Formation is mapped approximately 300m west of the site. Small-scale faulting associated with the main fault seems to have affected the rock quality in the area causing numerous fractures and secondary faulting to occur in the weaker mudstones.

Three rock types were identified during the drilling, which was corroborated by the geophysical sections produced from the interpreted geophysical data. These were

- An inter-bedded Fine grained Mudstone
- Fine grained Sandstone
- Fine grained calcareous Limestone

Table 4.2 below summarises the drilling log records:

Table 4.2: Summary of Drilling Logs

RC No.	Depth (m)	Description
BD1	0-6 6-8.73 8.73-12	Overburden Dark grey fine grained Mudstone Grey fine grained Sandstone
BD2	0-6 6-15	Overburden Dark grey very fine grained Mudstone
BD3A	0-5.6 5.6-7	Overburden Mudstone
BD3B	0-5.6 5.6-15	Overburden Dark grey fine grained Mudstone
BD4	0-5.95 5.95-9.5 9.5-10 10-23.5	Overburden Dark grey very fine grained Mudstone Dark grey fine grained Limestone Dark grey very fine grained Mudstone
BD5A	0-8	Fill (Household Waste)
BD5B	0-9.0 9.1-14 14-19	Fill (Household Waste) Overburden Black very fine grained Mudstone
BD6	0-0.15 0.15-10.75	Overburden Dark grey fine grained Mudstone

4.2.5 Hydrology

Drainage

Drainage over the general area of the proposed extension area is fairly good, probably due to the steep slopes causing rapid runoff. The lower flat lying areas seem to be poorly drained as some ponding of water during periods of rainfall was noted. The presence of peat in some of the trial pits and rotary coreholes also suggests the existence of older wetter areas within the site.

Surface Water

The Rampere site lies within the Slaney River catchment. The northern boundary of the site is marked by a stream, which flows to the east and meets the Slaney river approximately 1.7 Km downstream of the existing landfill. The estimated dry weather flow for the Slaney, calculated from a gauging station at Rathvilly approximately 10 km downstream, is 0.64 m^3/s. Average flows for the period 1976 to 1981 were 5.59 m^3/s (MacCartaigh, 1997).

Flow monitoring was undertaken in the stream as part of the BMA study. Three stage-boards (SG1, SG2 and SG3) were installed in the stream at the locations shown on Drawing 008_002 on 18th June 2000. Flow monitoring was completed on 26th June and 29th June 2000. The calculated flows are presented in **Table 4.3**.

Table 4.3: Stream Flow Measurement Results

Stage board No.	Flow (m^3) 26/06/00	Flow (m^3) 29/06/00
SG1	0.0472	0.0492
SG2	0.0509	0.0526
SG3	0.0496	0.0523

From the measurements made there is no increase in flow in the stream from the western end of the site toward the eastern end of the site. The variations in flow at each of the stage boards on the 26th and 29th June can be attributed to measurement errors. Measurement errors can be caused by turbulent flows, eddies, moving stream beds and channel roughness. Further measurements at higher stream flows will enable a stage-discharge relationship to be established for the stream flow.

Stream Hydrochemistry
An Electrical Conductivity (EC, µS/cm @ 25°C) and Temperature (°C) survey was carried out on 07th July 2000 along the stream to the west and the north of the site. The survey was carried out to assess the contribution of groundwater flow to stream flow along the site boundary.

It is apparent from the results of the survey that the EC and temperature of the stream water in ST1 was fairly consistent over the length of the site. The EC values recorded in the stream ranged between 431-610µS/cm and the temperatures recorded ranged between 11.7-12.0°C. A lower EC value of 431µS/cm was recorded in the stream to the west of the site (ST2). This may be because the stream flows from higher ground and more of the stream water can be attributed to surface run-off rather than groundwater baseflow. It is likely that most of the water flowing in the stream on the day of the EC and Temperature survey was surface water.

Water was also sampled from the drains that discharge in the stream at the eastern and western end of the existing landfill. These drains apparently allow water to drain from the road and a spring on the higher southern boundary of the site. Water sampled from the drain to the east of the existing landfill had an EC of 450 µS/cm and a temperature of 14.7°C. Water sampled from the drain to the west of the existing landfill had an EC of 315 µS/cm and a temperature of 12.0°C.

4.2.6 Hydrogeology

Regional Hydrogeology
The River Slaney dominates the regional hydrogeology of the Rampere area. In general groundwater will flow into the River Slaney via streams and surface drainage channels as baseflow. The Butter Mountain Formation has been classified as a locally important aquifer – moderately productive only in local zones (LI) by the Geological Survey of Ireland under the Groundwater Protection Scheme for Co. Wicklow.

Local Hydrogeology
Locally groundwater was generally encountered in the weathered bedrock strata. In some instances the groundwater was found to be confined by the (sandy clays, silts) alluvial deposits and the organic peat strata. In flows in the base of trial pits were generally fast.

Due to the nature of the overburden groundwater flow in this material is likely to be inter-granular (i.e. primary permeability). Permeabilities in the alluvial deposits are probably moderate to high due to the sandy nature of the material. The boulder clays encountered over the southern area of the site probably have a lower permeability.

Measurement of inflows of groundwater at trial pits TP1, TP2, and TP9 suggested permeabilities in the range of $1.3*10^{-3}$ to $5.8*10^{-4}$.

Bedrock Hydrogeology

The drilling has indicated that the bedrock in the area of the proposed extension to the landfill is moderately to highly weathered and the rock quality is generally moderate to poor having RQD ranging from 0 to 40%. This implies that the bedrock is highly fractured and it is within these fracture zones that the majority of groundwater flow is likely to occur (i.e. secondary permeability).

Falling-head tests were completed in all of the new boreholes. Water level recovery in all of the boreholes was very fast. In some cases the recovery was too fast to measure. **Table 4.4** presents the results of this testing.

Table 4.4: Falling Head Test Results

Borehole No.	Permeability (k, m/s)	Comment
BD1	1.9×10^{-4}	Test completed twice (average value)
BD2	-	Test completed twice, but recovery was too fast to measure
BD3A	-	Test completed twice, but recovery was too fast to measure
BD3B	7.0×10^{-4}	Test completed once
BD4	6.2×10^{-5}	Test completed once
BD5A	8.6×10^{-5}	Test completed once
BD5B	3.3×10^{-5}	Test completed once
BD6	-	Test completed twice, but recovery was too fast to measure

Groundwater Levels

It is apparent from the available data that groundwater flows from the southwest of the site towards the northeast into the stream at the site boundary. Recharge to the bedrock aquifer probably occurs on higher ground to the south and southwest of the Rampere site. Groundwater levels are likely to fluctuate according to seasonal variations in recharge (i.e. winter and summer groundwater levels).

The groundwater levels measure in boreholes BD3A and BD3B suggest there is hydraulic continuity between the bedrock aquifer and the overburden.

Groundwater Vulnerability

In the area of the proposed extension to the landfill site the overburden cover consists of alluvial deposits and boulder clays as described above. The thickness of the overburden cover varies from 1m to 5m. The alluvial deposits probably have a moderate to high permeability due to the sandy nature of that material. Therefore the groundwater vulnerability category for the proposed extension to the landfill is assessed as *High to Extreme* using the guidelines of the Groundwater Protection Scheme (DoELG/PA/SI, 1999).

Aquifer Potential

The Butter Mountain Formation has been classified as a locally important aquifer – moderately productive only in local zones (LI) by the Geological Survey of Ireland under the groundwater protection scheme for Co. Wicklow.

Large groundwater strikes were encountered during drilling in the bedrock in the area of the proposed extension indicating that the bedrock aquifer in the are is probably a locally important aquifer. However, the groundwater was generally found to be of poor quality and contains high levels of levels of iron and manganese (TE Lab Results, 2000).

The Butter Mountain Formation has been classified as a locally important aquifer (LI). The proposed extension area to the landfill has a vulnerability rating of high to extreme.

This implies that the proposed site lies within zone $R2^1$ to $R2^2$ of the Groundwater Protection Scheme Response Matrix for Landfills. **Table 4.5** below outlines the classification systems for groundwater protection at landfill sites.

Table 4.5 Groundwater Response Matrix for Landfills

VULNERABILITY RATING	SOURCE PROTECTION AREA		RESOURCE PROTECTION Aquifer Category					
			Regionally Important (R)		Locally Important (L)		Poor Aquifers (P)	
	Inner	Outer	Rk	Rf/Rg.	Lm/Lg.	LI	PI	Pu
Extreme	R4	R4	R4	R4	$R3^2$	$R2^2$	$R2^2$	$R2^1$
High	R4	R4	R4	R4	$R3^1$	$R2^1$	$R2^1$	R1
Moderate	R4	R4	R4	$R3^1$	$R2^2$	$R2^1$	$R2^1$	R1
Low	R4	$R3^1$	$R3^1$	$R3^1$	R1	R1	R1	R1

Source: GSI Groundwater Protection Schemes (1999)

Summary of Matrix Terms:

R1 Acceptable subject to guidance in the EPA landfill Design Manual or conditions of a waste Licence.

$R2^1$ Acceptable subject to guidance in the EPA landfill Design Manual or conditions of a waste Licence.

$R2^2$ Acceptable subject to guidance in the EPA landfill Design Manual or conditions of a waste Licence.

$R3^1$ Not generally acceptable

$R3^2$ Not generally acceptable

R4 Not acceptable

4.2.7 Pumping Test

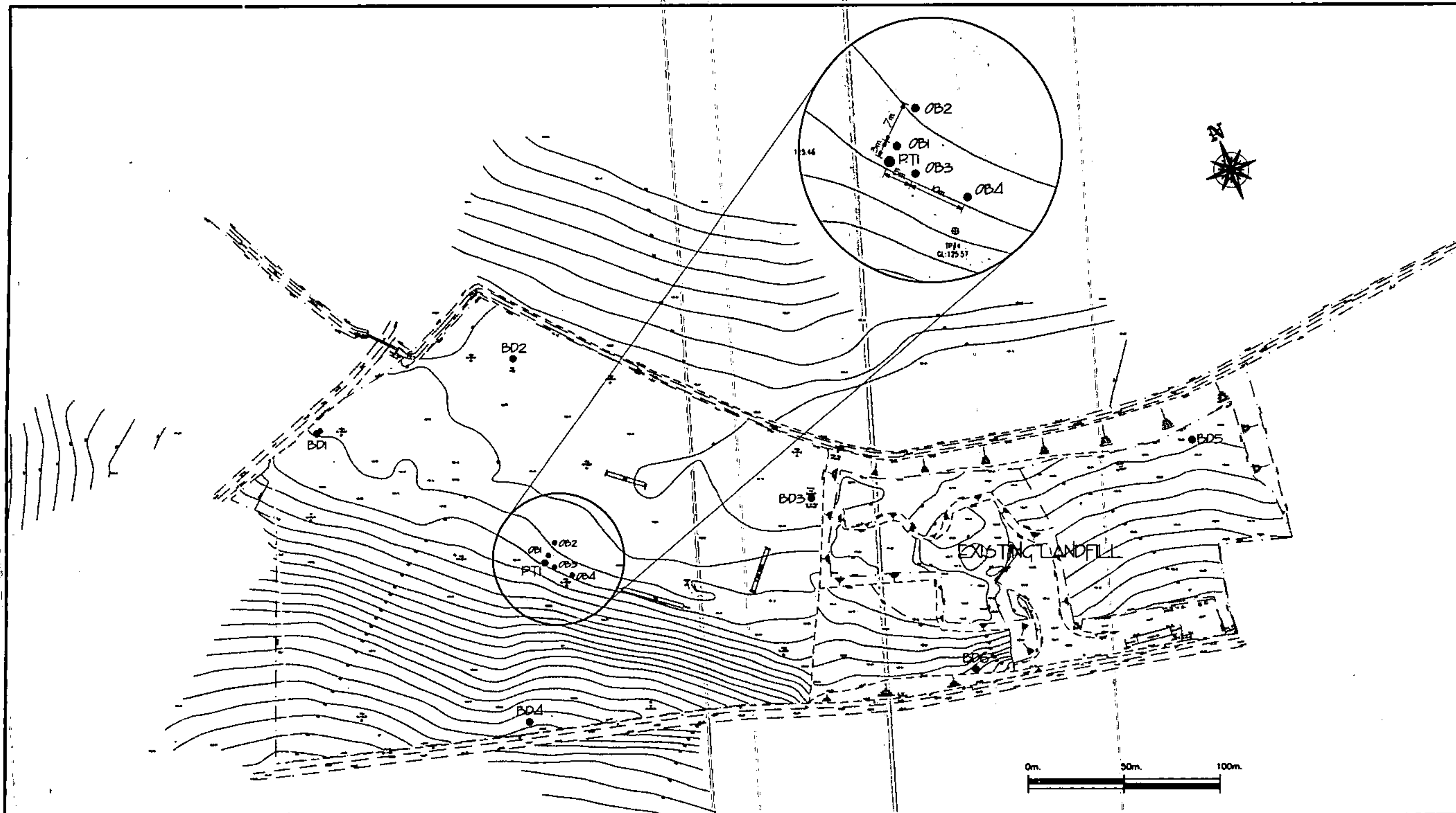
A pumping test was designed and supervised by M.C. O'Sullivan. The test was carried out on site by Fogarty Drilling Ltd. between the 15th and 24th of August 2001. The objective of the test was to determine the transmissivity, (T) , of the Aquifer.

Five wells were constructed between the 24th July and 1st August. The main well, PT1, a 312mm diameter borehole, was drilled to a depth of 27m bgl. with a 200mm screen installation. A total of 4 no. monitoring wells were installed in the immediate surroundings of the well (see **Figure 4.2** for Layout Plan).

After drilling and well installation the wells were left to stabilize for a period of two weeks. A step down test was carried out on 15th August 2001. A pump was placed in the main well PT1 at a depth of 23.5m and the test was preformed with the purpose of determining the borehole capacity and the optimum rate at which the pump should run during the constant rate test. The execution of the Rampere Landfill step-drawdown test is presented in **Table 4.6**.

Table 4.6: Rampere Landfill Step-drawdown Test

Step No.	Pumping Rate m^3/hr	Drawdown m (bgl)	Pumping Time (min)
1	1.0	-1.64	30
2	2.0	-7.28	240
3	3.0	-10.27	110
4	4.0	-15.4	190
5	5.5	20.0	60
		(dewatering the well)	
6	4.6	-15.92	235



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			Checked: WP
		Title: PUMP TEST PLAN	Approved: CB
			Scale: NTS
			Date: AUG'02

File Ref.: 067/509/001/FG4.2

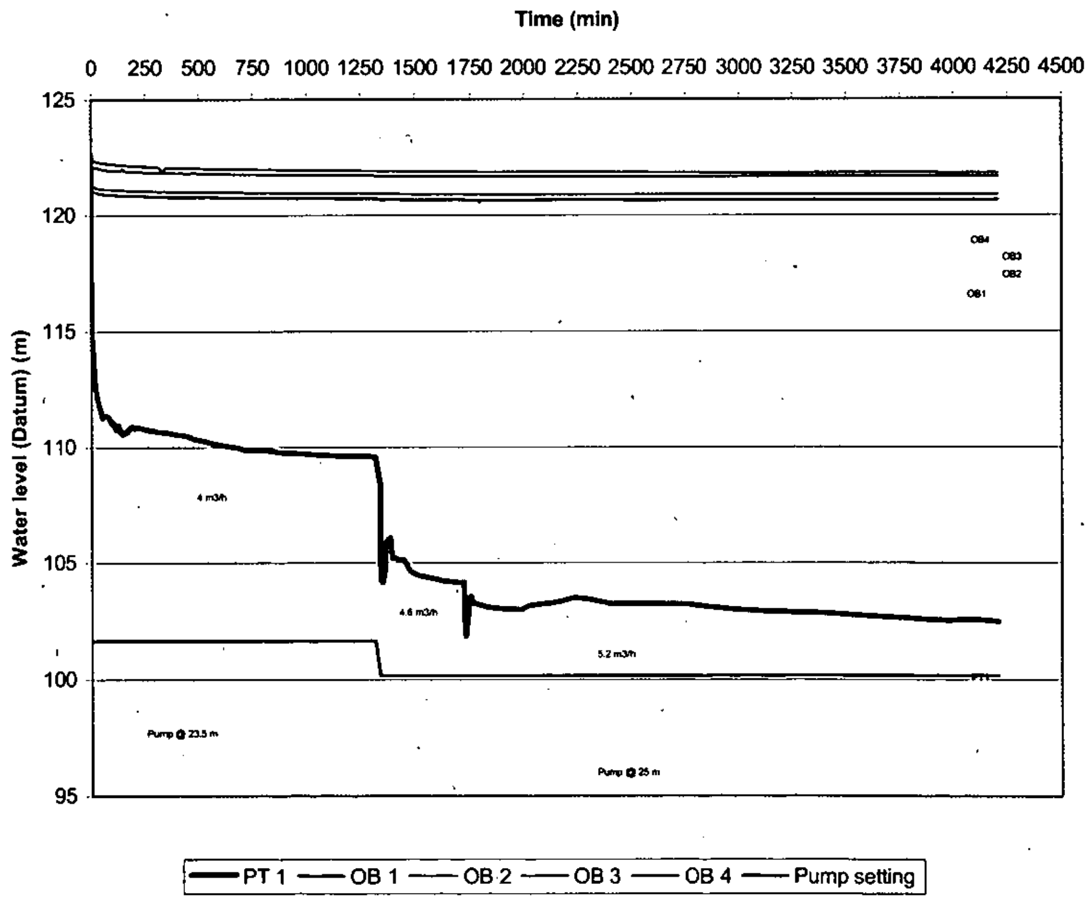
Figure No. 4.2

The step-down test started at an initial pumping rate of $1m^3/hr$. The well was pumped at this value continually until the water level remained unchanged in the well PT1 and in the monitoring wells. The pumping rate was then increased in $1m^3/hr$ increments until a value of $4m^3/hr$ was reached with equilibrium being obtained at each increment. The pumping rate was then stepped up to $5.5m^3/hr$ and the well was subsequently pumped dry. A rate of $4.6m^3/hr$ was then selected and this also caused purging of the well. It was therefore decided to use the value $4m^3/hr$ for the constant yield test.

The constant yield pump test started on 21st August 2001 pumping at a capacity of $4m^3/hr$. After a period of 22hrs the water level in the main well had dropped by 13m however, the drop in the monitoring wells was only 1.0m. Due to an insignificant decrease in the water levels, the pump was lowered to a depth of 25m and its capacity increased to $4.3m^3/hr$. After a further 6.5hrs the capacity of the pump was increased to $5.2m^3/hr$, again as a result of nominal decreases in water levels in both the main well and monitoring wells. The water was continually pumped at this capacity for a further 49.5hrs until 10am 24th August, providing a total test duration of 70 hours. A summary of the test results are presented in **Figure 4.3**.

The constant yield test data were analysed with the Jacob Method and provided a transmissivity value of $1.35x10^{-4}$ m^2/s and, assuming an aquifer thickness of 22m and a pumping rate of $4.0m^3/hr$, a permeability value of $0.6x10^{-5}$ m/s (0.5 m/day). Permeability values of $2.6x10^{-5}$ m/s were also obtained for both the confined aquifer and the unconfined situation using the formulas provided in BS5930.

Figure 4.3: Rampere Landfill Extension. Constant Yeild Test August 2001
Output 4, 4.6 & 5.2 m3/h (70 hours)



The maximum yield of the borehole during the test was 5.5m^3/hr which equates to 132 m^3/day. In terms of productivity this well would be classified as having a good production rate, (Class IV). The well is located in a locally important aquifer, which has been classified by the GSI as moderately productive in local zones, or LI. In general wells within this classification produce yields <100 m^3/day, indicating that the well PT1 is located in a moderately productive zone within the aquifer. The overburden at the site comprises gravely sandy clay and alluvial deposits of varying thickness (0.5-5m). The vulnerability of the aquifer has been classified as extreme to high in the "Wicklow County Council Groundwater Protection Scheme" Report as published by the GSI (2001).

The vulnerability rating and the aquifer category information can assist in classifying the site in terms of groundwater protection responses for landfills. According to the GSI Response Matrix for Landfills the Rampere Extension site is categorised as $R2^2$. The site is generally acceptable for use as a landfill subject to certain guidance as outlined in the EPA Landfill Design Manual or conditions of a waste Licence with special attention given to checking for the presence if high permeability zones. There is no simple method in determining whether or not there are high permeability zones within an aquifer. Bedrock maps of the area indicate that there are no major faults running through the proposed site nor are there any areas of dolomitisation. Examining the drawdown results from the constant rate yield test the results appear to decrease consistently as the pump rate was increased, see **Figure 4.3**. If high permeability zones were present a distinctive kick or rise in the constant yield test graph would have been observed.

To summarise, the best available information indicates that the proposed extension site to the Rampere Landfill is a moderately productive zone of a locally important aquifer and can be classified as $R2^2$ in terms of the GSI Response Matrix for Landfills.

4.2.8 Groundwater Quality

From March 2001 to May 2002 five rounds of groundwater samples were collected from both the existing site and the proposed extension. The locations of the groundwater monitoring points are as follows:

- Four boreholes on the proposed extension area for the landfill (BD-1, BD-2, BD3, BD-3A and BD4, **Figure 4.1**)
- Two boreholes on the existing landfill (BD-5, BD-5A (leachate) and BD-6. **Figure 4.1**)

The samples were collected and analysed by T.E. Laboratories Ltd. in accordance with the specifications in the EPA Monitoring Guidelines for landfill sites. The results of the samples are included in Appendix 2, Volume 3. **Table 4.7** summarises the results of groundwater analysis.

The leachate sample (BD-5A) was contaminated and did not meet the water quality standards for drinking water.

The groundwater samples from the existing landfill site and the proposed extension were generally not contaminated by leachate components and they met the EPA quality criteria for drinking water for all parameters except for Iron at most of the boreholes and for Manganese at two of the boreholes. The quality standards for Iron were exceeded at BD1, BD2, BD3-A, BD 5 and BD6 and for Manganese at BD2 and BD6.

The elevated Iron and Manganese concentrations at the proposed new landfill site cannot be an effect of pollution from the existing landfill as the groundwater flow is towards the north-east.

Table 4.7: Selection of Results from the Chemical Analysis of Groundwater from boreholes installed in Landfill Extension Area compared with EC Quality of Surface Water Intended for the abstraction of Drinking Water Regulations, 1989 S.I. No. 294 (Surface Water Stds).

Sampling Location	BD-1	BD-2	BD-3 A	BD-3B	BD-4	BD-5 A	Surface Water Standards
PH PH units	7.1	7.4		6.9	7.2	6.4	5.5≤ pH ≤ 8.5
Conductivity US/cm @ 25 C	554	583		509	510	378	1000
Iron Mg/l Fe	<0.03	0.12		0.14	0.01	0.24	0.2
Manganese Mg/l Mn	<0.05	<0.03		0.13	<0.03	0.05	0.05
Chloride Mg/l Cl	17	17		24	16	17	250
Nitrate Mg/l NO_3	26	26		22	48	26	50
Ammonia Mg/l NH_4-N	<0.1	<0.1		<0.1	<0.08	<0.1	0.2
TOC Mg/l C	<0.5	0.3		1.9	<0.6	0.6	-
Total Coliforms (No./100mls)	>100	1		2	-	15	5000
Faecal Coliforms (No./100mls	NIL	NIL	NIL	NIL	-	9	1000

4.3 AQUATIC ECOLOGY AND SURFACE WATER QUALITY

4.3.1 Surface water

A small stream (the Rampere stream) is situated along the northern boundary of the existing landfill and the proposed site for landfill extension west of the existing site. The stream is a tributary to the Slaney and it joins the Slaney approximately 1.75 km downstream of the landfill site. Surface water from the existing landfill is discharged to the stream.

During the period September 1998-May 2000 chemical analyses were carried out on water samples collected at the following points (see **Figure 4.1**):

- SW1, immediately upstream of the existing landfill
- SW2, at the surface water discharge pipe from the landfill
- SW3 immediately downstream of the landfill
- SW4 200m downstream of the landfill

During the period sampling and analyses were undertaken nine times. In May 2000 three additional sampling sites were included along the proposed extension upstream of the existing site (SW6, SW7 and SW8). These eight sites have been monitored approximately every three months with the most recent sampling and analysis carried out in August 2002.

The samples were collected and analysed by T.E. Laboratories Ltd in accordance with the specifications in the EPA Monitoring Guidelines for landfill sites.

Conservation Services, Killarney, carried out a baseline field survey of the Rampere Stream and the Slaney River in June 2002. The study comprised:

- Biological water quality assessment, based on invertebrate sampling (EPA Q- rating method)

- Habitat assessment (including salmonid habitat quality)
- Assessment of fish stocks based on electrofishing

This recent study updated a more detailed aquatic survey carried out by Conservation Services in August 2000, which included an assessment of fish stocks based on electrofishing.

The sampling sites are shown on **Figure 4.4**. Samples for biological water quality assessment was collected at sites 1, 3, 4, A & B. The reports prepared by Conservation Services is included in Volume 3, Appendix 3.

Figure 4.4 shows the monitoring locations sampled for biological water quality assessment (Q rating) in August 2002.

4.3.2 Results of chemical monitoring of water quality

The results of the chemical monitoring of the water quality indicate that the existing landfill has a very limited if any impact on the water quality of the Rampere stream. The water generally meets the EPA Water Quality criteria for surface water and there is no significant increasing trend of the measured parameters from upstream to downstream of the landfill. However, elevated levels of nitrite exceeding the quality criteria have been measured downstream of the landfill site and on two occasions elevated concentrations of COD were encountered downstream of the landfill. The range of results recorded at each sampling point from March 2001 to May 2002 are summarised in **Table 4.8** and all surface water results are included in Volume 3, Appendix 2.

Table 4.8: Selected results of chemical analysis of surface water sampled in the Rampere stream during the period March 2001-May 2002. The values represent the range measured in four sampling rounds. The results are compared with EC Quality of Surface Water Intended for the abstraction of Drinking Water Regulations, 1989 S.I. No. 294 (Surface Water Stds).

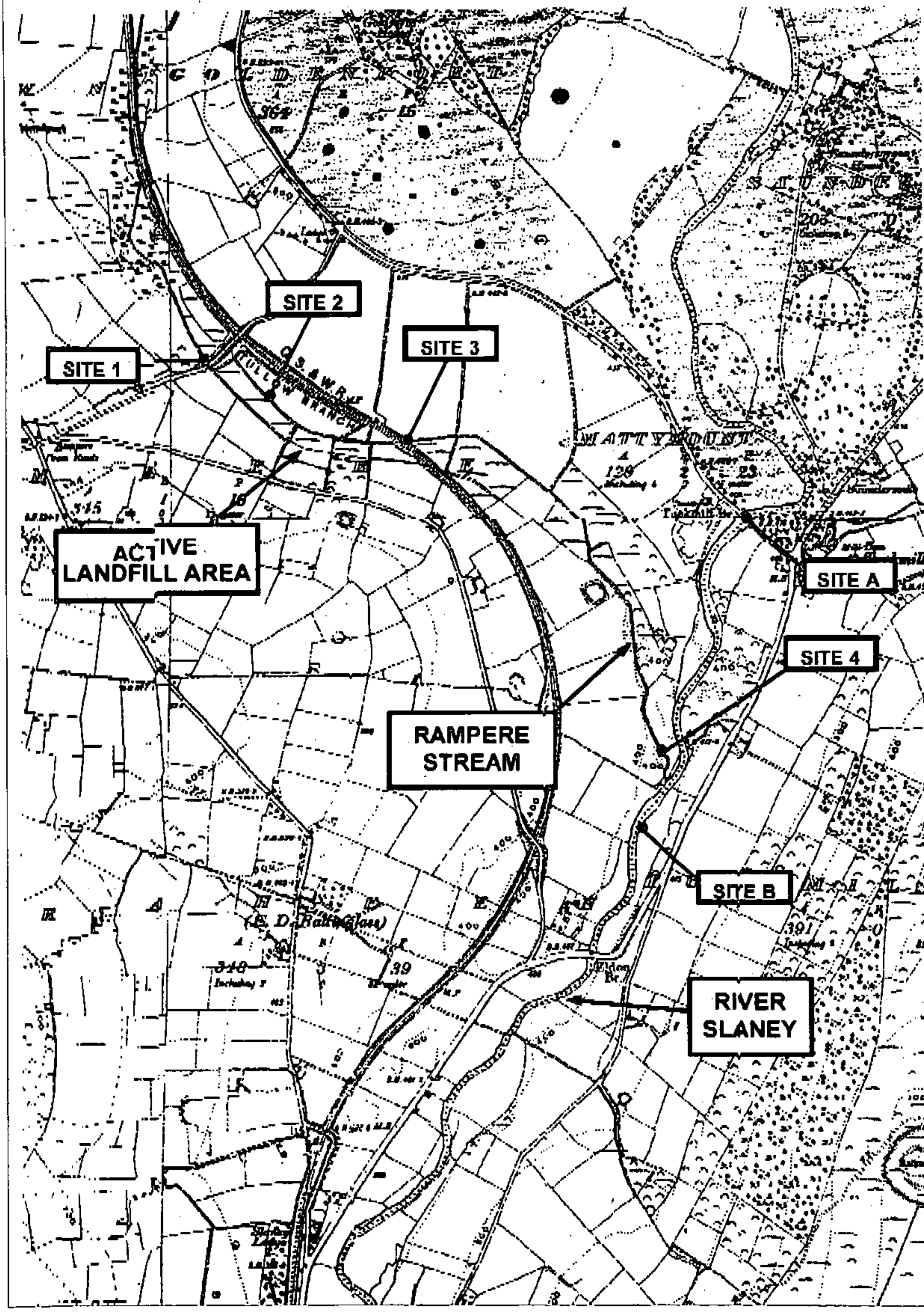
Parameter	SW6 Up-stream	SW7 Up-stream	SW8 Up-stream	SW 1 Up-stream	SW2	SW3 Down-stream	SW4 Down-stream	Surface Water Standards
Conductivity uS/cm	497-546	499-541	499-538	485-513	485-513	490-536	495-538	1000
BOD mg/l O_2	<2	<2	<2	<2	<2	<2-4	<2-4	≤ 5
COD mg/l O_2	<4-10	4-9	4-7	7-12	4-14	<4-6	6-18	N/A
TOC mg/l C	1.5-2.7	1.7-2.6	1.4-2.6	1.9-3.0	1.2-3.3	1.6-3.3	1.4-1.7	N/A
TON mg/l N	6.8-8	7-7.2	6.9-7	7-7.2	7	7-7.2	7-7.3	N/A
NH_4 mg/l	<0.08-<0.1	<0.1	<0.08-<0.1	<0.08-<0.1	<0.08-<0.1	0.08-0.3	<0.08-<0.1	0.2
NO_2 mg/l	0.02	0.5-0.8	0.2-0.8	<0.2-0.8	<0.2	0.3-0.8	0.2-0.9	0.05 *
NO_3 mg/l	30-33	31	29-33	30-31	31-33	30-33	29-32	50

**Salmonid Waters Regulations*

4.3.3 Results of Biological monitoring of water quality

The results of the biological monitoring of water quality in June 2002 did not indicate any impact of the landfill on the stream. Based on the relative abundance of indicator species, a biotic index (Q-rating) was determined for each site in accordance with the biological assessment procedure used by the Environmental Protection Agency. The results are given in **Table 4.9**.

MAP 1 BIOLOGICAL SAMPLING SITES



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		Title: SURFACE WATER AND BIOLOGICAL SAMPLING SITES (Conservation Services)	Approved: CB	Figure No. 4.4
			Scale: NTS	
			Date: AUG'02	

Table 4.9: Biological Water Quality. Invertebrate Q-ratings Aug 2000-June 2002.

Site number		Q-rating August 2000	Q-rating June 2002	Pollution status
Site 1	Rampere stream. Upstream of existing landfill	Q3	Q3	Moderately polluted
Site 2	Rampere Stream. Just upstream of existing landfill	-	Q3	Moderately polluted
Site 3	Rampere stream. Just downstream of existing landfill	Q3	Q3	Moderately polluted
Site 4	Rampere stream. Just upstream of its confluence with the Slaney	Q4	Q3	Moderately polluted
Site A	Slaney. Upstream of confluence with Rampere stream	Q3	Q4-5	Unpolluted; but early indication of eutrophication
Site B	Slaney. Just downstream of confluence with the Rampere stream	Q4	Q4-5	Unpolluted; but early indication of eutrophication

The improvement in the water quality of the Rampere Stream immediately downstream of the landfill (Site 3) recorded in 2000 was maintained in 2002. In 2000, high densities of pollution tolerant invertebrates at the Slaney sites (Sites A & B) limited the Q-values at these sites to a Q4. In 2002 the pollution tolerant invertebrates had returned to a lower density and the Q-values had improved to a Q4-5 at both Slaney sites.

4.3.4 Fish assessment

The Rampere stream in the immediate vicinity of and downstream of the proposed landfill extension can be characterised as a salmonid nursery habitat of moderate quality and juvenile brown trout were recorded in the stream.

The Slaney is a salmonid habitat of very high quality between its confluence with the Rampere stream and Baltinglass and it is particularly important as a spawning area for salmon. The Slaney holds salmon, sea- trout and brown trout. It is regarded as one of the top rivers in Ireland for early spring salmon fishing and is therefore of national importance as an angling amenity. The Slaney is designated salmonid water under the E.C. (Quality of Salmonid Waters) Regulations, 1988.

All three Irish species of lamprey, listed for conservation in Annex II of EU Habitats Directive 92/43/EEC have been recorded in the Slaney. Salmon, which occur in the Slaney, are listed in Part 2 of the First Schedule of Regulations SI No 94 of 1997 and listed in Annex II of the Habitats Directive.

4.3.5 Surface Water - Summary

The Rampere stream is a moderately polluted stream, which is not affected by the existing landfill and with a small population of juvenile trout. The stream is a tributary to the Slaney and it joins the Slaney approximately 1.75 km downstream of the landfill site. The Slaney is unpolluted but with early signs of eutrophication and it is a salmon habitat and spawning ground of very high quality down stream of the confluence with the Rampere stream.

4.4 TERRESTRIAL ECOLOGY

In August 2000 a field survey of vegetation and vertebrate fauna was carried out by Goodwillie and Associates to assess the importance of the proposed site in terms of terrestrial ecology. The existing site had previously been seen in September 1998. The findings of the most recent study are summarised below. The complete study can be found in Volume III, Appendix 4 of this report.

The existing Rampere landfill occurs on the southern side of a small NW-SE stream, a tributary of the River Slaney. The proposed extension into the field to the west takes in a section of the disused floodplain (the stream has been deepened) and the valley side up to the road. It is currently in pasture with deep, clayey soil in the northern half, shallowing on the slope.

This site is not included in any designated area under national law or the EU Habitats (92/43/EEC) or birds (79/409/EEC) Directives. The nearest proposed National Heritage Area is Lowtown Fen (# 1764) which is 1.5km to the northwest. No specially protected habitat or species occur in this area.

Three different habitats were identified in the study area (i.e. area of proposed extension):

- Grassland
- Hedges
- The Stream

The flora and fauna encountered in these habitats are reviewed below.

4.4.1 Grassland

All fields around the landfill and on adjacent land are under grass which is used as pasture for cattle and horses. The plant species that are present and to their varying extents are summarised in **Table 4.9**.

The field can be divided up into an upper section and a lower, damper one though both parts still share a good proportion of plant species.

The upper section can be described as well drained and sloping. It has been well trampled at its western end where animals have been fed. The lower section can be described as being damper and flat and is at the floor of the valley. The lower section has a broader range of plant species, especially around a few long-lasting pools which are probably seasonal springs, other muddy places and vehicle ruts. **Table 4.10** details the plant species found in both the upper and lower sections of the study area.

4.4.2 Hedgerow

Hedges surround the field entirely. There are six well-grown pine trees *Pinus sylvestris* on the SE margin. The stream is lined with flora and the roadside hedge has a good range of associated plants because in certain places it is out of the range of grazing cattle. Elsewhere the base of the hedge is usually concealed by a tall growth. Details of the various plant species in the hedgerow can be found in **Table 4.10**.

4.4.3 Stream

There are two distinct parts of this habitat, the rapid section that flows under the road and takes a sharp bend to the NE and the broader and slower channel at the base of the field. The former section is fenced off which allows the growth of other species in the adjacent grassland. **Table 4.10** contains the details of the plant species present.

4.4.4 Adjacent and other habitats

Much of the surrounding land has been improved agriculturally so that natural ecological features have disappeared. There is no rough grazing as indicated on the 6" map and all fields are in pasture. A little gorse remains at the north-west corner with hard rush *Juncus inflexus* and meadowsweet *Filipendula ulmaria*. A larger, unimproved habitat - willow scrub - occurs about 0.5km away to the north-west.

Table 4.10: Summary of species encountered in the different habitats in the study area.

Grassland	**Plant Species on proposed extension area**	**Hedgerow**	**Stream**
Ubiquitous Occurrence	***Upper***	***Hedge Foundations***	***Plant Species existing around the rapid section***
Ryegrass	Annual meadowgrass	Hawthorn	Sweet grass
White Clover	Chickweed	Bramble	Fool's watercress
Rough-stalked meadow grass	Knotgrass	Elder	Great willowherb
Yorkshire fog	Redshank	Clipped Ash	Reed grass
Mouse-ear	Nettle	Snowberry	Meadowsweet
Scattered Occurrence	***Lower – Generally***	Stream Lining	Yellow flag
Creeping thistle	Crested dogstail	Hawthorn	Wild angelica
Docks	Marsh foxtail	Blackthorn	Adjacent Grassland
Creeping buttercup	Creeping bent	Wild rose	Red fescue
	Autumn hawkbit	Tormentil	Sorrel
	Oval sedge	***Roadside Hedges***	Tefted hairgrass
	Hairy sedge	Cow parsley	
	Silverweed	Shield fern	***Slower Section - Aquatic species***
	Lower – Wetter Places	Male fern	Reed grass
	Marsh foxtail	Hartstongue	Meadowsweet
	Sweet grass	Violet	Wild angelica
	Greater plantation	Herb robert	Fool's watercress
	Marsh ragwort	Barren strawberry	***Slower section - Hedge Species***
	Toad rush	Willowherb	Goosegrass
	Cudweed	Nipplewort	Nettle
	Lower – Wheel Ruts	Pearlwort	
	Pale persicaria	Tall Growths	
	Water pepper	Nettle	
	Hoary willowherb	Goosegrass	
	Brooklime	Cocksfoot	
		False oat	
		Bramble	
		Western End	
		Birdsfoot trefoil	
		Common bent	
		Germander speedwell	

Note: The Latin names for the plant species in table 4.10 can be obtained in Volume 3, Appendix 5, of this report.

A previous report by Goodwillie and Associates was included in the Waste License Application for the original landfill dated September 1998. In this report two more habitats were mentioned as existing on the site. These were Exposed Rock and Disturbed soil.

Exposed Rock

The existing landfill site includes a small exposure of rock with a few piles of stone. It is too small for a characteristic flora to develop fully and contains many of the species from the surroundings. Sorrel *Rumex acetosa*, ragwort *Senecio jocobaea*, willowherb *Epilobium parviflorum* and hawksbeard *Crepis capellaris* are conspicuous with some pearlwort *Sagina procumbens* and speedwell *Veronica serpyllifolia*.

Disturbed Soil
The landfill is surrounded by banks and other surfaces of clayey soil that contains a limited flora. After one or two years perennial species take over from these and tall thistles and nettles tend to dominate.

4.4.5 Fauna

In relation to the study area the rabbit is the only obvious mammal present with burrows at the south-eastern edge of the field. However brown rat, house mouse and field mouse are very likely to be present with foxes occasionally visiting. There is no evidence of badgers though they are likely to be in the general area.

The birds using this field consist of regular 'field' species such as rook (5 nests occur in the pine trees), magpie, woodpigoen and starling and those that depend more on the hedges for cover and food. These include chaffinch, redpoll, wren, dunnock, robin and blackbird. Outside the breeding season there are a few meadow pipits in the area with the occasional snipe.
Many of the species associated with the adjoining landfill make some use of the area, usually resting after feeding. A count of bird species was carried out on the landfill in September 1998 the results of which are included in Volume III, Appendix 4.

The stream is small and offers limited feeding to the vertebrates normally associated with the habitat. Grey wagtail and dipper are likely to occur in open places and there could be occasional use by kingfisher, mallard and heron. Fish in this area are likely to consist mainly of stickleback though trout would occur lower down where it flows into the Slaney. It would have little importance as a trout nursery stream because of its small size in summer.

4.5 LAND USE AND AGRICULTURE

An assessment of current landuse and agricultural activities at the proposed site and in its immediate vicinity was carried out by Edward J. Bolger and Associates, Farm Management Consultants Ltd in July 2000. A previous study in relation to the existing landfill had already been carried out by the same company in September 1998 and. The detailed results of the most recent assessment are included in Volume III, Appendix 5 of this report. A summary of the assessment is included below.

4.5.1 Soils

The two main soil types within the study area are Acid Brown Earths and Grey Brown Podzolics. Acid Brown Earths are relatively mature, well drained and are good arable soils. They respond well to artificial fertilisers and with good management they can support high quality grassland. The Podzolic is heavier in texture than the Acid Brown Earth and is well to moderately well drained. It is a good all-purpose soil. When adequately manured and managed they are very productive and suitable for most agricultural enterprises.

4.5.2 Current land Use

The land adjacent to the landfill is intensively farmed with most of the land being used for either tillage or pasture. Two of the landowners adjacent to the site have some thorough bred horses and the other farmers are involved in dairying, dry cattle and tillage.
It was reported that the existing landfill site is reasonably well managed and this is borne out by the comments of the adjacent landowners.

4.6 LANDSCAPE

A ladscape assessment of the proposed extension and existing site was undertaken by Mitchell & Associates, Landsscape Architects, in August 2000. This report updates a previous assessment of the existing site which was submitted as part of the Waste Licence in

September 1998. The report and detailed drawings are included in Volume III, Appendix 6 of this report. A summary is incuded below.

4.6.1 Topography

The subject site has a high point of 145m O.D. at the south west corner adjacent to the local access road to the south. From here the land falls steeply towards the centre of the site to a level of 125m O.D. where the land levels off, falling gently to the northern boundary, to a level of 121m O.D., refer to Volume III, Appendix 6, Fig. 1. Steep slopes are confined to the south western portion of the site, where the slope regime varies between 1 in 5 and 1 in 20. At the north eastern portion of the site the land levels off having a slope regime of 1 in 50 and less, refer to Volume III, Appendix 6, Fig. 2.

4.6.2 Land Use

Vegetation on site consists of grassland, hedgerow planting around the site boundary with some tree planting located in the hedgerow. The subject site is agricultural land in pasture for cattle, horses and sheep. To the east is the existing landfill site, which is in operation at present. The land to the west, south and north is in agricultural production.

4.6.3 Visual Analysis

The subject site presents as a visually-unremarkable sub-section of a much larger agricultural landscape. Views into the site from the public domain are primarily along the local access roads to the south and west of the site. Views along the access road to the south are limited due to the existing hedgerow, while views in from the road to the west are more open.

Views into the site from private residences are as follows:-

- There is a newly built private residence located approximately 60m from the south western corner of the proposed extension with views into the site extension.
- There is a farm house located approximately 275m to the north of the site with open views into the site.
- There are 3 no. bungalows further to the north.
- Views into the site from these houses are not full views and only a portion of the site can be seen.
- There is a house located to the south of the site across the local access road with a partial view to the northern end of the site.

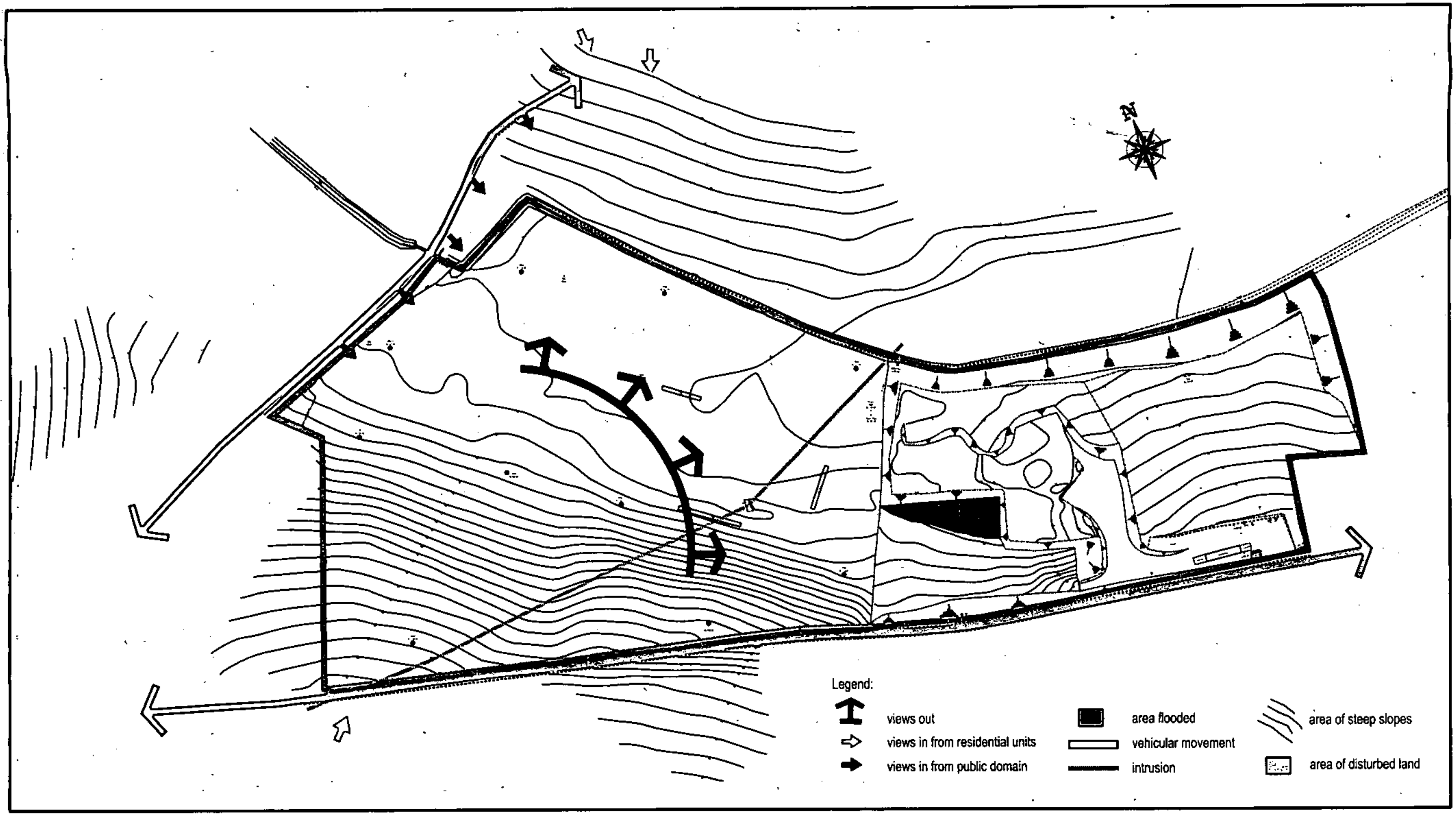
Views out of the site look north-east over the agricultural pastureland towards the Wicklow Mountains. **Figure 4.5** details the visual analysis of the site landscape and views in/ out of the site.

4.7 CLIMATE

An assessment of climatic conditions prevalent in the general vicinity of the Rampere Landfill and Baltinglass was carried out by Envirocon Ltd. for the purpose of this EIS. The Report prepared is presented in Appendix 7 of Volume 3 of this EIS.

4.7.1 General

The climate of the region of the West Co. Wicklow region is characterised by the passage of Atlantic low pressure weather systems and associated frontal rain belts from the west during much of the winter period. The presence of the Wicklow Mountain Range to the east provides a sheltering effect from easterly winds. In the summer the influence of anticyclonic weather systems will occasionally result in prolonged dry periods over this part of Ireland interspersed by the passage of Atlantic frontal systems. The establishment of a high pressure area over Ireland and Britain will result in calm conditions and during the winter months these are characterised by clear skies and the formation of low level temperature inversions with slack wind conditions at night-time. If anticylconic conditions become established for a few days or more, especially during the summer months, then high daytime temperatures may be



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			Checked: WP	
		Title: VISUAL ANALYSIS (Mitchell & Associates)	Approved: CB	Figure No. 4.5
			Scale: NTS	
			Date: AUG'02	

recorded in this region. Prolonged dry weather conditions are relatively infrequent. If continental air masses dominate over Ireland, drought conditions may occur which could last up to 2 or 3 weeks. Air masses from the Polar Regions can move down over the west Co.

Wicklow region in the winter and this may lead to very cold conditions. However, the duration of arctic conditions is unlikely to last for more than a few days with rapid thaws normally following this type of weather.

4.7.2 Wind

The nearest meteorological station is located at Casement Aerodrome (approx. 40km to the N). Long-term wind direction and speed statistics are available for the period 1984-93 inclusive. From these statistics, it is evident that the prevailing winds in the West Wicklow region are from a SW direction with about 45% of the hourly observations from a direction of 190-250 degrees. Approximately 55% of winds are from the western sector of 200-290 degrees with an incidence of calm 'slack' wind conditions of about 2.6%. The wind field is generally dominated by winds of less than 5 m/s from 48% of hourly observations less than 5 m/s. Winds in excess of 9 m/s occur for about 25% of the time and these are associated with SW-W winds. In the Baltinglass area, it is likely that the incidence of low wind speeds will be slightly higher due to the sheltering effect from the local topography. Further details of wind direction and speed are given in Appendix 7 of Volume 3 of this Report.

4.7.3 Precipitation

Results of the long-term monthly precipitation amounts at climatological stations in the area are given in **Table 4.11**. The annual rate in the Baltinglass area is about 830-1000 mm. Ballytore is about 8km to the NW and in similar terrain to Rampere, whereas Hollywood is about 16km to the north and is closer to the Wicklow Mountains. The area along the western flank of the Wicklow Mountains will experience higher rainfall amounts than places further to the west and so it is likely that annual rainfall rates at Rampere will be about 900mm/yr due to the rising ground to the east.

The amount of rainfall that occurs during the winter months (October -March) is similar to that recorded in the summer period (April-September). However, while the precipitation occurring during the winter period is normally associated with more pro-longed Atlantic frontal depressions passing over Ireland, during the summer intense local showery conditions may develop giving rise to short periods of heavy rainfall. This may result in local flooding in the area.

Table 4.11: Precipitation rates in locality of Rampere (mm)

Period	J	F	M	A	M	J	J	A	S	O	N	D	Ann
Hollywood	101	71	77	63	74	71	62	88	87	97	95	106	992
Ballytore, Co. Kildare	84	60	60	53	65	59	55	74	76	83	74	86	829

Note: Hollywood Grid: N937070 (1949-83)Ballytore Grid: S800960(1944-90)

4.7.4 Air Temperature

The pattern of long-term daily temperatures at Casement Aerodrome (1964-80) is shown in **Table 4.12**. A similar seasonal pattern would be experienced in the locality of the landfill site with a small number of days during the period June-August likely to record an average of over 20C. Mean minimum daily average temperatures during the winter period are unlikely to fall below about 2°C.

Table 4.12: Long-term mean daily air temperature at Casement Aerodrome (1964-80)

	J	F	M	A	M	J	J	A	S	O	N	D	Ann
Mean	4.8	4.7	5.8	7.5	10.3	13.4	14.9	14.7	12.9	10.5	6.4	5.5	9.3

4.7.5 Microclimate

The microclimate is defined as the climate within the immediate locality of the landfill site over an area, typically within 1-2km of the site. The microclimate can be characterised by the site being situated on the NE facing slope of a small gently sloping valley surrounded by undulating terrain, which form the eastern foothills of the Wicklow Mountains. Air emissions from the site will generally be dispersed in the direction of the prevailing conditions for the region. However, during calm weather conditions the air flow would tend to follow the form of the surrounding slopes with cold air drainage downslope at nighttime.

The microclimatological conditions in the locality would be typical of conditions prevailing over the surrounding area around Baltinglass and Dunlavin and typical of air movement over undulating ground.

There are no land-use practices in the locality of the site where the amenity value of the land use is enhanced because of micro-climatological conditions specific to the location.

4.8 AIR QUALITY

An assessment of air quality in the vicinity of Rampere Landfill was carried out by Envirocon Ltd. for the purpose of this EIS. The Report prepared is presented in Appendix 7 of Volume 3 of this EIS.

4.8.1 Ambient Air Quality

General

The air quality of the surrounding area is good with no evidence of any adverse impact from dust emissions from the landfill operation. The existing landfill site is relatively small with a total area of about 7 acres and is surrounded by open pasture lands to the north with a mature vegetated slope to the south. It has been in operation for a number of years and there have been no reports of dust levels creating a local nuisance in the vicinity of the nearby houses. It is located within a small valley at about 150m O.D. draining south eastwards into the River Slaney. There are no significant sources of dust emissions apart from isolated residential properties and farming activities within 1km of the site. There is extensive mature vegetation cover along the public road running along the southern side of the landfill site which acts as an effective screen and so reduces the dispersion of dust emissions from the landfill activities.

Dust

No dust deposition sampling has been carried out along the boundary of the existing landfill due to the rural location and low level of activity within the landfill operation. Due to the relatively small-scale operation at Rampere, it is estimated that monthly average rates of dust deposition near the site boundary and close to Rampere Cross Roads will be generally less than 75 mg/m^2.day. The highest dust levels are likely close to the entrance to the site due to resuspension of material from the road surface by passing vehicles. Beyond a few metres from the haul road deposition rates will decrease significantly to near to background levels close to the site boundary.

Dust deposition rates experienced along the public road bordering the south of the site will be primarily due to passing vehicles with dust emissions from the landfill only making a minor contribution to total dust levels.

Odours

There have been no reports of a local odour nuisance due to the site operations in recent years. The older areas of the landfill, in the eastern portion have been re-instated and so the active tipping area is restricted to the western end of the site. Strong malodours were identified during the site visit in September 2000 in the locality of the active tipping area where uncovered municipal waste was observed. During the site visit the weather conditions were characterised by overcast relatively mild conditions with a wind of less than 5m/s and so it is likely that pungent malodours would be prevalent from areas of uncovered waste during warm

dry conditions. However, during the site visit no malodours associated with landfilling operations could be detected near the road running along the southern site boundary.

4.8.2 Ambient air concentrations

Sulphur dioxide and Nitrogen oxides
Ambient concentrations of sulphur dioxide and nitrogen dioxide downwind of the landfill would be comparable to background concentrations measured at other rural locations in Ireland, well removed from any major industrial sources. There are no significant industrial emission sources within 2km of the site boundary with livestock and pasture land to the north of the site. Baltinglass is about 2km to the east of the site and so would not have any significant impact on ambient air quality at Rampere.

Aerosols and PM_{10}
The ambient concentrations of PM_{10} experienced in the locality of Rampere Cross Roads will be primarily due to agricultural emissions and dust resuspended from the road verge by passing vehicles.

4.9 NOISE

Noise aspects at Rampere landfill were examined by Environmental Services a department of Enterprise Ireland, Glasnevin who provided an analysis of noise data obtained at the site. A report was compiled in July 2002 which updated an initial report carried out in August 2000. The complete report is contained in Appendix 8 Volume III.

4.9.1 Background to noise measurement

Sound levels are measured with a meter in units called decibels (dB), and noise has often been defined as unwanted sound. Environmental noise levels are usually assessed in terms of A-weighted decibels, the dB (A). The A-weighting approximates to the response of the human ear. Industrial, occupational and environmental noise is usually expressed in equivalent continuous levels, $L_{Aeq,T}$. This is based on the energy average level over the relevant time interval. Environmental noise may be corrected for tonal or impulsive characteristics and the unit is the rating level, $L_{Ar,T}$. Statistical parameters are also used as noise descriptors.

There are no statutory limits for environmental noise emissions for this type of activity, or industry in general, in this country. In general, noise is likely to provoke complaints when its level exceeds the level of the background noise by a certain margin or when certain absolute levels are attained. A day time limit of 55bB(A) and a night time limit of 45dB(A) are suggested by the EPA as the target level appropriate for noise sensitive locations.

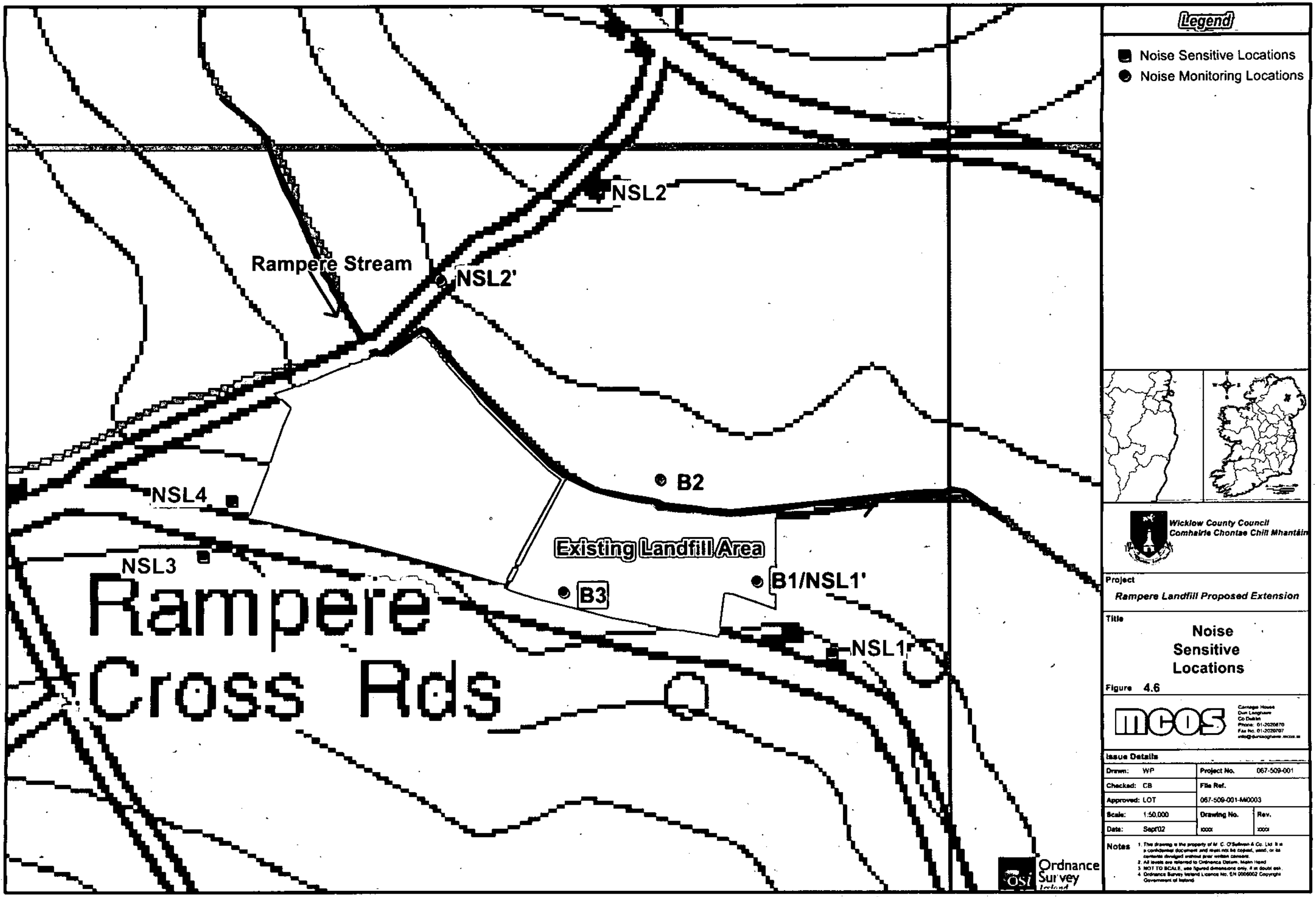
4.9.2 Monitoring Locations

The site is located in an agricultural area near Rampere cross roads c.1km east of the N81 and the principal 'residual' noise source in the area is distant traffic. The nearest residence to the existing landfill is located c.160 metres east of the entrance, NSL1 and c.300 metres south-east of the landfill area, NSL2.

The nearest residence to the proposed extension is located c.50 metres from the southwest corner of the site, NSL3. There is also a house currently under construction (August 2002) c.60 metres from the western boundary, NSL4.

Noise measurements were undertaken at two sets of locations, as shown on **Figure 4.6.**

- Points close to NSL1 and NSL2, denoted NSL1' and NSL2'
- Points at the boundary of the existing site in the direction of the NSLs (denoted B1, B2, and B3)


Rampere Stream
NSL2
NSL2'
NSL4
NSL3
B2
B3
B1/NSL1'
NSL1
Existing Landfill Area
Rampere Cross Rds
Ordnance Survey Ireland
Legend
Noise Sensitive Locations
Noise Monitoring Locations
Wicklow County Council
Comhairle Chontae Chill Mhantáin
Project
Rampere Landfill Proposed Extension
Title
Noise Sensitive Locations
Figure 4.6
MCOS
Issue Details
Drawn: WP
Checked: CB
Approved: LOT
Scale: 1:50,000
Date: Sept'02
Project No. 067-509-001
File Ref.
067-509-001-M0003
Drawing No.
Rev.
Notes

The existing landfill currently opens between the hours of 08:00 and 16:45 weekdays and between the hours of 08:00 and 13:00 on Saturdays. The on-site machinery consists of a JCB type 428 Landfill Compactor used to compact and level the waste and construct cells. Occasionally a backhoe excavator is hired to clear drains and clean the site. However the construction phase of the facility could give rise to short-term noise levels higher than that due to the operational phase.

4.9.3 Noise levels in Existing Environment

Measurements were made 1.5m above the local ground level. The following parameters were measured:

- $L_{Aeq,T}$ the equivalent continuous noise level for the measurement period. This parameter is very sensitive to local high level short time sources, e.g. local traffic, etc.
- $L_{A01,T}$ the sound level equalled or exceeded for 1% of the measurement period, the maximum levels.
- $L_{A10,T}$ the sound level equalled or exceeded for 10% of the measurement period, the parameter usually used for traffic noise assessment.
- $L_{A90,T}$ the sound level equalled or exceeded for 90% of the measurement period. This level is sometimes taken to represent the "background" noise level.

Noise measurements were made on the current boundary at two locations designated B2 and B3. Boundary B1 is coincident with NSL1' and the results are shown in table 3. In the absence of passing traffic on the local roads the landfill operation is the predominant noise source. The principal source of noise will be one landfill compactor. Measurements of the A-weighted and octave band sound pressure levels were made at a reference distance to the existing compactor.

All noise measurement results are presented in Appendix 8 of Volume 3 of this Report.

4.10 TRAFFIC

An assessment of the existing environment in terms of road access and traffic was carried out by MCOS as part of this EIS. This is presented in Appendix 9 of Volume III of this EIS.

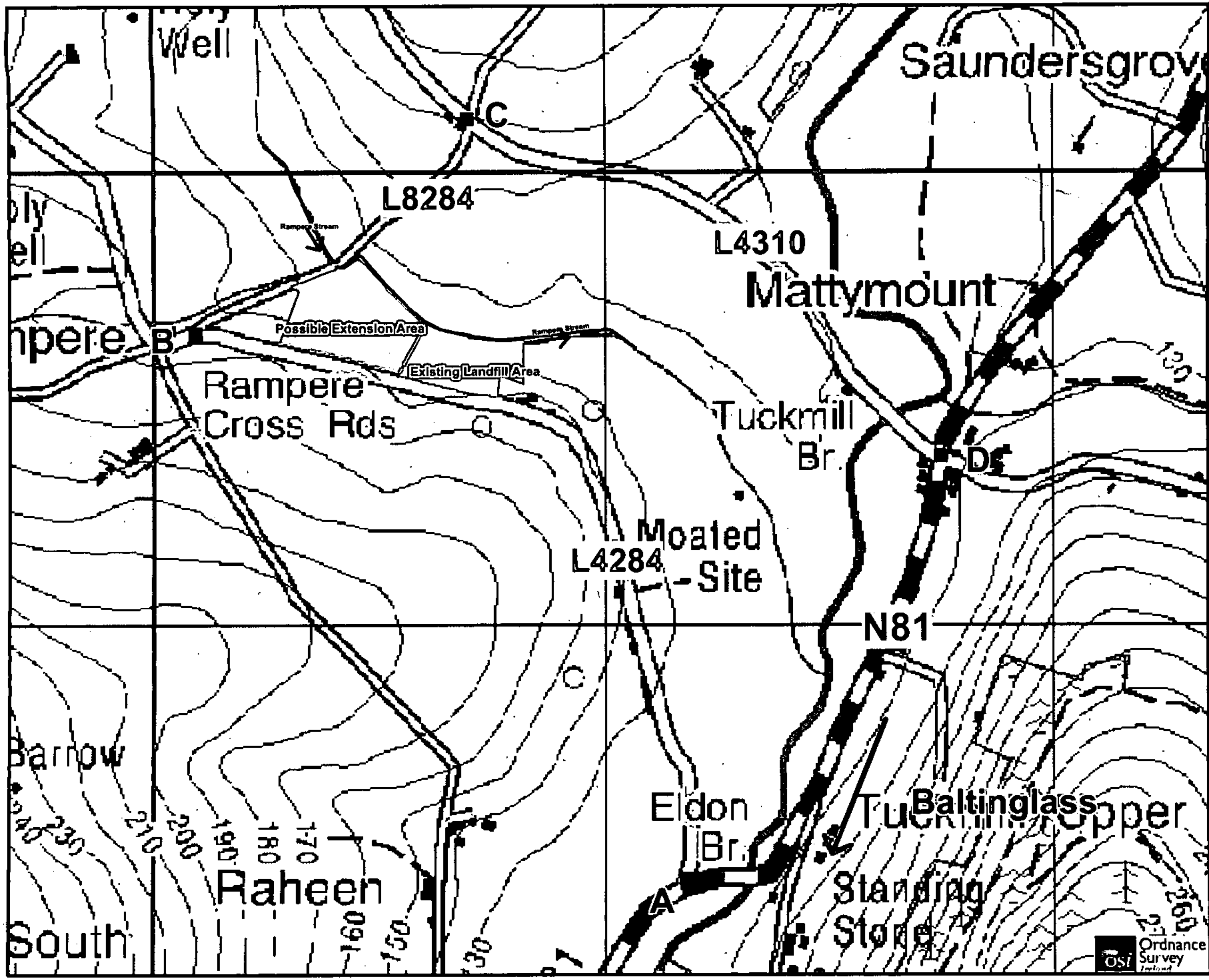
4.10.1 Introduction

The existing landfill site and the proposed extension are located in the townland of Rampere, approximately 3 km north of Baltinglass. Baltinglass is situated on the N81 National Secondary Road. The N81 is the main North-South transport artery for the western side of County Wicklow; it provides a link between Dublin, Wicklow and Carlow. The N81 will provide access to the landfill from Baltinglass, Blessington and other parts of County Wicklow. The location of the landfill in relation to Baltinglass, the N81 and the rest of Wicklow is shown on Figure 1.1 of this Volume. **Figure 4.7** shows the Site Location in relation to local roads.

4.10.2 Existing Road Network

Regional Access Roads

The landfill entrance is currently situated on the L4284, approx. 1.2km west by road off the N81 from the junction just south of Eldon Bridge. The majority of vehicles access the landfill via the N81 and then the L4284. The N81 is a heavily trafficked National Secondary Route with an Annual Average Daily Traffic (AADT) of 3021 vehicles (of which 11% are HCVs, Heavy Commercial Vehicles), north of Baltinglass at the junction to Dunlavin (NRA publication "National Roads and Traffic Flow 1998"). At present the N81 carries almost all the traffic to the landfill, mainly from West Wicklow, i.e. Blessington, Baltinglass and surrounding areas.



Legend

Wicklow County Council
Comhairle Chontae Chill Mhantáin

Project
Rampere Landfill Proposed Extension

Title
Local Road Access

Figure 4.7

MCOS

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Issue Details

Drawn:	WP	Project No.	067-509-001
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Scale:	1:50,000	Drawing No.	Rev.
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Notes
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There are 3 main regional roads serving the landfill from the rest of the county. These routes are; the R759 crossing the north of the county between Roundwood and Blessington, the R756 crossing the centre of the county between Laragh and Hollywood and the R747 crossing the south of the county between Arklow and Baltinglass. These routes are quite busy regional roads and will serve as the main arteries between Rampere and the rest of the county.

Local Access Roads
The roads immediately surrounding the landfill are quite narrow and, in some places, in poor condition. The roads vary in width from 3.5m to 5.0m, with no verges or hardshoulders. Certain sections of the roads are deficient in vertical and horizontal alignment. These narrow roads make it difficult for larger vehicles, travelling in opposite directions, to pass safely. At present, the majority of traffic on these roads consists of residential and agricultural vehicles accessing properties along the routes, as well as existing landfill traffic.

Along the N81, the main junction for traffic accessing the landfill is south of Eldon Bridge, as shown in Figure 4.7. There is a short radius curve south of the junction and this results in poor sight lines and stopping distances for vehicles travelling north from Baltinglass. Due to the fact that the junction is outside the town's speed control zone, northbound vehicles approaching the bend are moving quite fast, approx. 50mph

The other junction on the N81, which may be affected by the landfill extension, is at Tuckmill Bridge in the Mattymount area, which is approx. 1km north of Eldon Bridge. This is a crossroads with average sight lines and stopping distances. Again the speed of the traffic on the N81 plays a role in traffic entering and exiting at this junction.

4.10.3 Current Traffic Generation

The total tonnage deposited at Rampere in 2001 was approximately 8,000 tonnes (over the 2-year period from 1998-2000 was 5,000-6,000 tonnes per annum on average). In terms of numbers of vehicles, this breaks down to an average of 5-6 (3-4) HCV's and 7-8 cars/vans entering the landfill per day.

A survey of vehicles entering and exiting the existing landfill site was carried out using Wicklow County Council record sheets for the months of April, May and June 2000, during opening hours of the landfill. When averaged into a daily count, a total of 10 vehicles entered the site per day, of which 1 vehicle was a HCV. Hence, there were 20 daily vehicular trips generated by the landfill, of which, 2 trips are HCV's. A further breakdown shows the average loads carried on the 2 and 3 axle vehicles was approx. 8 tonnes and cars, vans and trailers carried an approx. 150kg of waste per vehicle. It must be noted that the traffic flow recorded during the 3-month period (April to June 2000) was unusually low – waste intake has dropped significantly in early 2000 when gate fees at the facility were increased.

In 2001 the intake of waste at the landfill was over 8,000 tonnes and represents a higher traffic flow period in comparison to the traffic survey from 2000. The traffic flow entering the site during the period August to October 2001 was compiled and averaged into a daily count. A total of 12-13 vehicles entered the landfill on a daily basis, 5 of which were HCV's. It is considered that these figures will approximately represent the level of traffic entering the site to dispose of waste at the lined cell.

4.10.4 Baseline Traffic Volumes

Traffic surveys were organised and carried out on the local road network surrounding the landfill site with the following objectives:

- To determine the existing traffic flows on roadways, both major and minor, surrounding the landfill.
- To determine the existing traffic patterns at the junctions surrounding the landfill.
- To assess the existing and possible future landfill access routes.

- To enable an overall assessment to be made of the impact of the estimated future traffic generated by the landfill.

The traffic study was carried out on Thursday October 12th, 2000. The survey involved counting all turning movements at 4 No. Junctions over a 10 hour period between 8am and 6pm. Figure 4.8 shows the turning movements recorded over the 10-hour period. The surveyed junctions are marked A to D in the figure.

The count results show that a similar level of traffic used the l4284 (current landfill access road) and the L4310 which also carries traffic to and from the N81. Approximately 100 vehicles travelled in each direction on these roads in the 10 hour period of the count. A similar number of turning movements were recorded at both junctions onto the N81 from these roads. The L8284 which links the L4284 and L4310 was less busy with 30-40 cars in each direction.

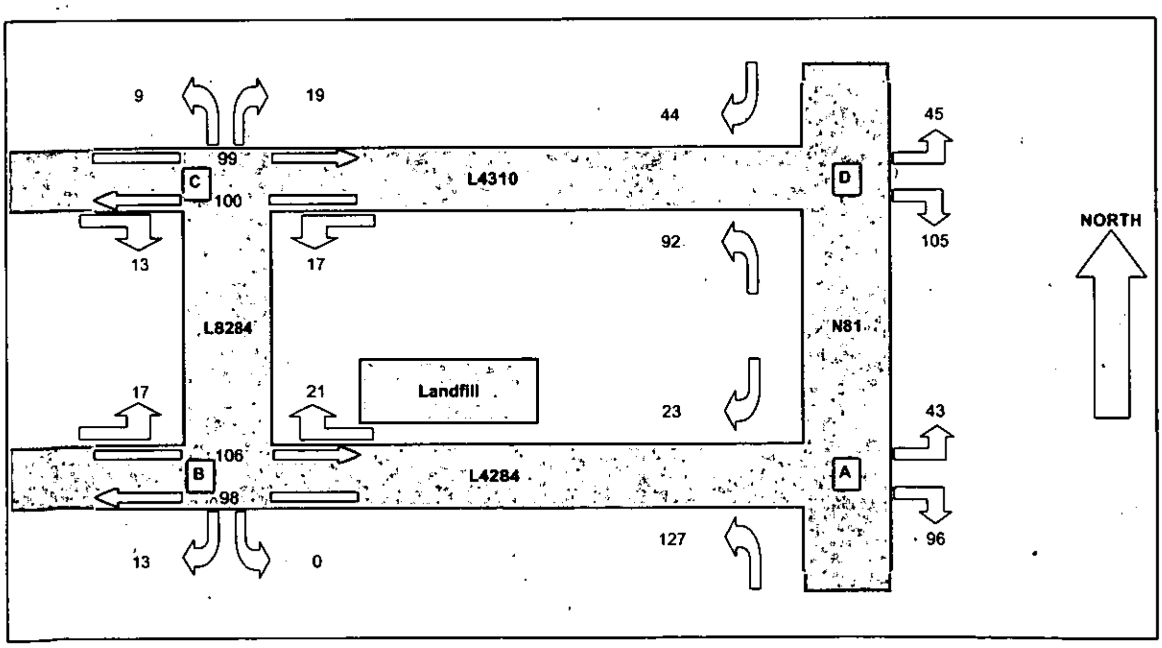
Hourly traffic flow was relatively even during the day. However there was a more noticeable peak in traffic flow in the early morning , lunch-time (12.00 – 14.00) and late evening on the L4310 as opposed to the L4284.

There was not much queuing of traffic at any of the junctions observed at any stage, indicating that junction capacity appears to be adequate. Some repeat traffic (i.e. multiple trips by the same vehicle) was observed during the count at certain junctions.

4.10.5 Road access and Traffic - Summary

The landfill site is located a short distance from the N81 National Secondary Route which serves west Wicklow. The L4284 connects the landfill to the N81 over a distance of 1.2 Km – this road is relatively narrow and in common with other local county roads in the area has sections that are deficient in terms of width, horizontal and vertical alignment. Volumes of traffic are presented in the schematic diagram **Figure 4.8**. Traffic volumes using the landfill currently are relatively low and do not appear to be having a significant impact on road or junction capacity, either on the L4284 or the N81.

Figure 4.8: Schematic of total traffic flow at recorded at Rampere, Baltinglass on 16-10-00, from 08:00 to 18:00 hrs



4.11 ARCHAEOLOGY / CULTURAL HERITAGE

An assessment of the archaeological and historical importance of the proposed extension area was conducted by Margaret Gowen and Co. Ltd. as part of the EIS for the proposed extension of Rampere Landfill. The report was based on a desk study together with a field inspection of the area under consideration. This complete report can be found in Volume III, Appendix 10.

The desk study obtained information from a number of sources, including the Sites and Monuments records of Duchas, the heritage service of the department of Arts, Culture, Gaeltacht and the Islands, and a number of published sources detailed in Volume III, Appendix 10 of this Report. The topological files on stray finds held in the National Museum of Ireland (NMI) archive were also consulted. The report includes a survey of the historical and archaeological background to the area, an account of the monuments in and around Rampere townland, a brief field report, and a number of recommendations and conclusions.

4.11.1 Historical Background

The region around Baltinglass has a rich and varied archaeological and historical heritage. A well known group of hillforts and ritual burial cairns, concentrated in commanding positions overlooking the Slaney valley, testify to the strategic importance of the region. A number of ringforts and enclosure sites in the Rampere townland also reflect continuity of settlement into Early Christian and later medieval times.

4.11.2 Recorded Archaeological Monuments

The following is a list of recorded archaeological monuments, listed in the Sites and Monuments Record (SMR) of Duchas. These sites are invaluable indicators of settlement activity in the vicinity of the proposed landfill extension at Rampere. These sites are invaluable indicators of settlement activity in the vicinity of the proposed landfill extension at Rampere, and date from prehistoric through Early Christian, medieval and modern historic times. None of the following sites will be directly impacted upon by the landfill extension; however, they are outlined as indicators of the archaeological potential of the landscape at this point in west Wicklow. All recorded SMR sites are shown on the site location map **Figure 4.9.**

Archaeological sites are generally classified for the purpose of impact assessment in such a way that their importance in the archaeological record is suggested. The classification acts as a general guideline to the status of a site, and the potential implications for development. An Area of Interest is suggested for each site. This is a zone of archaeological potential around the known extant remains in which related archaeological features are likely to occur. The national grid reference (NGR) is provided for each site, as is the townland in which it is located. The NGR is presented as a ten-figure co-ordinate and indicates the position or siting of each monument. The Distance indicates the proximity of each monument to the proposed extension boundary, and is an approximate only. A complete listing of all sites mentioned can be found in the complete report (Appendix 10, Volume III). Those listed below in **Table 4.13** below occur within 600m of the existing and proposed site.

4.11.3 Field Inspection

No features of obvious archaeological significance were discovered during the field inspection of the site. Monuments adjacent to the site were inspected. Details of the field inspection are included in the Report in Appendix 10, Volume 3 of this EIS.

4.11.4 Archaeology - Summary

No known archaeological sites, as identified in the SMR of *Dúchas,* are affected by the proposed development and there is no substantial issue in respect of archaeology envisaged

for the proposed landfill extension. However, aassociated plans for widening the access road to the existing landfill, to cater for the increased capacity and subsequent increased traffic, will, have a direct impact on a listed ringfort. It will also be necessary to test excavate this area, under license from *Dúchas*, in advance of construction, to determine whether archaeological features or deposits relating to the site survive at this location, refer to Section 5.10 for further details.

The immediate and wider vicinity has been the focus of settlement throughout the prehistoric, early historic and medieval periods, and for this reason it is recommended that all ground preparation works be monitored by a licensed archaeologist. This will ensure the full recognition and proper recording of all archaeological soils, features, finds and deposits that may be revealed during construction.

4.12 TOURISM

An appraisal of Tourism in West Wicklow and the vicinity of Baltinglass and Rampere Landfill was undertaken as part of the EIS. The Report can be found in Volume 3 Appendix 11 and is summarised below.

County Wicklow is defined by granite mountains, sandy beaches and a rich cultural heritage. Over one million visits are made annually to Wicklow's tourist attractions - these include individual renowned attractions (e.g. Powerscourt House and Gardens, Glendalough) as well as other natural attractions not formally recording the number of visitors such as beauty spots (e.g. Wicklow Gap). The Wicklow County Guide for 2000 lists 21 individual visitor attractions in the County, these range from monuments, museums and craft workshops to the villages of Kilcoole and Avoca made famous through television series.

4.12.1 Tourism figures and general statistics

Tourism is managed by Bord Failte according to a number of Regional Groupings. In the Midlands East Region, of which Wicklow and Kildare are members there has been a 3.1% growth rate in tourism between 1993 and 1997. While in the South-East Region where County Carlow lies the growth rate is slightly lower at 1.2%, between the same periods as above. Estimates of revenues generated from tourism in 1997 are presented in **Table 4.14,** the revenue is broken down into counties and it can be seen that County Wicklow generated approximately £40 million.

Wicklow is among one of the counties in the Midlands East Region that receives the highest number of visits from overseas markets, and in particular it is a popular destination with British tourists as can be seen in **Table 4.15** below.

Table 4.14: Revenue Generated from Tourism in 1997.

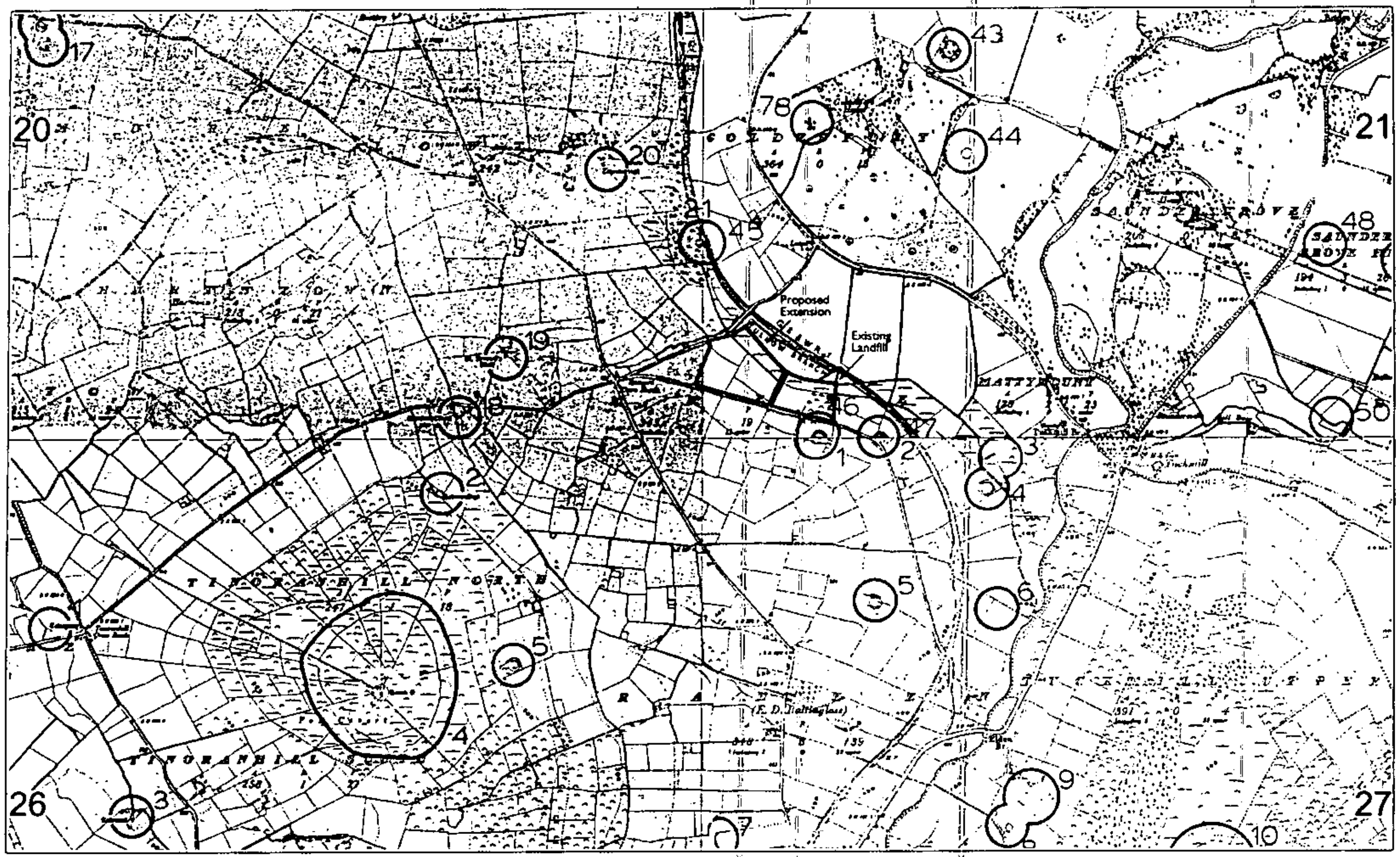
County	Total (£m)	Britain	Mainland Europe	North America	Other Areas
Wicklow	40	20	12	5	3
Kildare	28	15	8	3	1
Carlow	10	6	2	1	N/a

Source: Bord Fáilte Perspectives on Irish Tourism Midlands East and South East
N/a: Information not available

Table 4.15: Overseas Visitors to Counties in the Midlands East and South East Regions 1997

County	Total	Britain	Mainland Europe	North America	Other Areas
Wicklow	265,000	139,000	69,000	39,000	18,000
Kildare	132,000	76,000	26,000	24,000	6,000
Carlow	43,000	28,000	7,000	5,000	4,000

Source: Bord Fáilte, Perspectives on Irish Tourism Midlands East and South East



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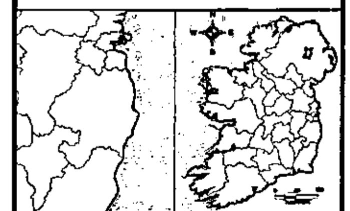
◯ SMR Sites



Wicklow County Council
Comhairle Chontae Chill Mhantáin

Project

Rampere Landfill Proposed Extension

Title

Archaeology Site Map

Figure 4.9

MCOS

Carriage House
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Issue Details			
Drawn: WP	Project No. 067-509-001		
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Approved: LOT			
Scale: xxxx	Drawing No. xxxx	Rev. A01	
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Archaeological Consultants & Project Managers

Job Rampere Landfill Extension, Co. Wicklow
Ref. 00170
Date 03.08.00
Client MC O'Sullivan
Scale Not applicable
Fig. 1 SMR and landfill site locations

SMR No.	WI027:001/021:046	WI020:021/021:045	WI027:002/021:047	WI020:019	WI020:020
Site Type	Ringfort Site	Circular Enclosure	Ringfort	Holy Well	Holy well
Classification	D/G	G	C	D	D
Distance	c.130m to the southeast	c.250m to the north	c. 300m to the southeast	c. 530m to the west	c. 550m to the south
Townland	Rampere	Goldenfort	Rampere	Rampere	Lowtown
NGR	28473/18319	28629/19209	28692/19145	28562/19169	28594/19235
Area of Interest	30m	30m	30m	10m	10m
Description	Marked as a circular area (dia. c.30m) on both the 1838 and 1907 OS 6"maps. The site, of which there is no visible trace at ground level, but which is visible on aerial photographs, is situated on a gentle north facing slope.	Marked on both the 1838 and 1907 editions of the OS as a circular enclosure (dia. c.30m) partly intruded on by a railway embankment. The site, of which there is no visible trace at ground level, is situated on flat marshy terrain at the western foot of a gentle slope.	Marked on the 1838 and 1910 editions of theOS.The monument is situated at a break in a northeast-facing slope and comprises of a circular area (dia. c41m) defined by an earthen bank (Wth 7.3m; max. H 2m) and a poorly defined external fosse (Wth 4m). About one-third of the site has been removed by the road to the southwest. No indication of an enterance or internal features.	Marked 'St. Bernard's Well' on both the 1838 and 1907 editions of the OS. The well is located 250m to the northeast of 'Ramphere Chapel' (020:018), with which it was associated. Part of a farm building 20m NNE of the well is believed locally to be the remnants of a grange. The well, comprising of a strong spring within a concrete shaft, is situated on level, low-lying swampy ground with a higher ground to the north, west and south. The Patron day was held on the 20th of Aug., until the well was closed following a faction fight in the 1930s.	Marked 'Tobernagoagh' on the 1838 and 1910 editions of the OS. The name possibly means 'well of the cuckoo' (tobar na gcuach). The well is situated in very marshy area, and is visable only as a wetter area within this. The spring, according to the OS Name Books, was believed to have had curative powers.

Table 4.13: Sites & Monuments Record (SMR) sites within 600m of Rampere existing and proposed landfill sites.

West Wicklow, situated between the Wicklow Mountains and Counties Carlow and Kildare, is not as heavily frequented by tourists as East and Central Wicklow. However there are a number of important attractions for tourism and outdoor enthusiasts, including Russborough House, just South of Blessinton, the Blessington Lakes, and the Glen of Imaal.

4.12.2 Features within a 10Km radius of Rampere Landfill Site.

A 10km radius was drawn from the landfill site, and within this a number of tourism attractions were identified. These included Baltinglass town, Baltinglass Abbey, 1798 Monument, Megalithic tombs, Baltinglass Hillforts, Glen of Imaal, Dunlavin and The River Slaney. This radius also extended into Counties Kildare and Carlow and a summary is given on each. Distances (as the crow flies) from Rampere Landfill Site to the principal tourist attractions are given in **Table 4.16** below.

Table 4.16: Tourist Attractions within a 10km radius of Rampere Landfill Site

Tourist Attraction	County	Approximate Distance from landfill site (as the crow flies)	Visitor Numbers
Baltinglass HeritageTown	Wicklow	3km south	Approx. 130 signatures from Jun. to Aug 00 *
Baltinglass Abbey	Wicklow	3.3km south	N/a
Bronze Age burial chamber	Wicklow	3.1km south east	N/a
Castleruddery Stone Circle	Wicklow	5.6km south west	N/a
Glen of Imaal	Wicklow	9.3km north east	N/a
Dunlavin Courthouse	Wicklow	10.1km	N/a
Dwyer McAllister Cottage	Wicklow	10.2km east	N/a
Stratford on Slaney	Wicklow	3.2km north	N/a
Donard	Wicklow	8.8km north east	N/a
Ballitore Quaker Museum	Kildare	8.6km north west	N/a
Castledermot, Tower	Kildare	10.5km south west	N/a
Timolin The Pewter Mill	Kildare	7km west	5,000 (1996)
Crookstown Mill	Kildare	8.5km north west	N/a
Bolton Abbey	Kildare	7.6km west	N/a
Rathvilly village	Carlow	9.7km south	N/a

Source: Bord Failte
** Baltinglass Tourist Office*
N/a: Information not available

Rampere landfill site is located in an area of rolling topography and undulating hills. Baltinglass (1,127 inhabitants), is the nearest town to the landfill has been recently designated a Heritage Town. This is the most significant tourist attraction with respect to Rampere. Baltinglass has a Heritage Centre/Tourist Office situated in the basement of the Courthouse in the Market Square which was officially opened on the 11th of January 2000. The Heritage Centre is has information on the town of Baltinglass and the surrounding area. The building won an Irish Architecture 2000 Award for the Courthouse and Heritage Centre. Other prominent attractions in the town include Baltinglass Abbey, situated beside the River Slaney, and the 1798 Monument in the centre of the town.

Archaeological remains in the vicinty include the Baltinglass Hillforts and megalithic tombs on the Pinnacle a hill to the East of the town. To the north of Baltinglass, the picturesque Glen of Imall Valley is the location of the Dwyer McAllister Cottage, a traditional white-washed cottage associated with the 1798 Rebellion. Villages in the district include Dunlavin, Stratford on Slaney, and Donard. The River Slaney, which runs close to the N81 at a short distance from the landfill is a prime angling river.

4.12.3 Summary

Tourism in the general vicinity of the area is less developed compared to other parts of County Wicklow, but efforts are being made to improve this situation and to develop the industry. Although there are a number of tourist attractions in the region of the landfill the attractions that are most frequented lie to the north, east and centre of the County.

The Rampere Landfill site being located near the base of Tinoranhill is visually well removed from the town of Baltinglass by the 140m to 180 metre contours. The Tinoranhill (312metres) is situated to the north of Baltinglass town providing a good screen for the town. The landfill is well screened from the roads that pass alongside the present landfill as is the proposed extension. The landfill is also well removed from the main tourist traffic route of the N81, being located on a local road. This local road is not likely to be heavily frequented by tourists based on available information. There is no indication that the current landfill is having any detrimental impact on tourism in the area.

4.13 COMMUNITY

The Rampere Landfill Site is located in the townland of Rampere, approximately 3 Km north of the town of Baltinglass in West Wicklow. The site and proposed extension area is close to the 'Rampere Cross Roads", where a number of local roads converge.

The community in the Rampere area is characterised by a combination of non-agricultural dwellings and agricultural residential farms. There are 12 residences situated between the N81 and the landfill. A number of residences look directly onto the valley where the landfill is situated. Two dwellings in particular overlook the site, with 2 more dwellings slightly further removed to the west (see Figure 4.6 in relation to noise monitoring).

Land use is agricultural and there are no businesses or community facilities situated in the vicinity of the landfill. Apart from activity on the landfill site, other activity in the area would be by agricultural vehicles engaged in day to day activities with crops and livestock.

Community facilities for the area are situated at Baltinglass, 3 Km from Rampere. These include churches, schools, a health centre, and commercial outlets. Baltinglass is a busy rural market town situated on the River Slaney. Employment for the community in the vicinity of Rampere would be provided to a certain extent in Baltinglass but also in the surrounding towns, extending to the greater Dublin area.

Baltinglass town has been expanding in recent years and has been designated as a 'primary growth centre' in the Wicklow County Development Plan, meaning the population is expected to increase from its current level (1,127 in the 1996 Census) to 2,500 by the year 2015. Transport from Rampere to the town of Baltinglass would be mainly via the L4284, but there are a number of local roads linking the Rampere Cross Roads and the town.

Baltinglass area has been recognised as having a rich heritage in terms of archaeology and local history. Efforts are now being made by the townsfolk to develop and enhanse the tourism potential of the area, and to foster a better appreciation of the local heritage. Baltinglass Abbey in the town is a tourist attraction, and a visitor centre has recently been opened, with seasonal opening hours. The River Slaney has important angling and amenity value.

In general the current landfill has not created complaint by the local community during its lifetime, although objections were made to the granting of a Waste Licence to the existing facility mainly on a environment grounds. Its scale and environmental impact (in terms of noise, traffic, odour etc.) has been limited. The site also provides a convenient civic facility for waste disposal and recycling for those in the Baltinglass area. A number of new dwelling have been constructed in the area in recent years, and further planning applications have been received.

The principal concerns expressed previously by the local community in relation to the landfill would include the following:

- Possibility of harm to agriculture caused by birds, vermin, litter of other landfill nuisances
- potential for pollution of the adjacent Rampere Stream and hence the sensitive River Slaney, and potential to pollute groundwater
- Visual impact of the site

5 DESCRIPTION OF LIKELY SIGNIFICANT IMPACTS AND MITIGATING MEASURES

5.1 INTRODUCTION

Potential impacts on the existing environment due to the extension of Rampere Landfill Site are discussed below. Where significant impacts are identified, mitigation measures are proposed. The assessment is discussed under the following headings:

Groundwater
Surface Water
Terrestrial Ecology
Land Use & Agriculture
Nuisances
Landscape
Air Quality / Climate
Noise
Traffic
Archaeology
Tourism
Community Well Being
Material Assets

5.1 GROUNDWATER

In assessing the risk to groundwater there are two aspects which need to be considered:-

- *The importance of the groundwater for supply purposes*
- *The degree to which the groundwater is made vulnerable by the proposed landfill*

Aquifer Potential
The Butter Mountain Formation has been classified as a locally important aquifer – moderately productive only in local zones (LI). Large groundwater strikes were encountered during drilling in the bedrock in the area of the proposed extension. However, the groundwater was generally found to be of poor quality and contains high levels of iron and manganese. It is therefore unlikely to be developed as a source of potable water. The presence of the existing landfill aould also mitigate against any large scale abstractions in the immediate vicinity.

Groundwater Vulnerability
In the area of the proposed extension to the landfill site the overburden cover consists of alluvial deposits and boulder clays as described in Section 2.3. The thickness of the overburden cover [[varies from 1m to 5m. The alluvial deposits probably have a moderate to high permeability due to the sandy nature of that material. Therefore the groundwater vulnerability category for the proposed extension to the landfill is assessed as *High to Extreme* using the guidelines of the Groundwater.Protection Scheme (DoELG/PA/SI, 1999).

Falling head permeability teats were completed in all of the new boreholes. The permeability values recorded varied between 7.0×10^{-4}m/s and 3.3×10^{-5}m/s.

It is apparent from both the drilling logs and the geophysical survey that numerous fractures and discontinuities are present in the bedrock under the site. However, measurements of stream flows and electrical conductivity along the Rampere Stream did not identify any major groundwater inflow from fault zones.

Given the aquifer potential and vulnerability characteristics of the site, the site lies within zone R2[1] to R2[2] of the Groundwater Protection Scheme Response Matrix for Landfills using the guidelines of the Groundwater Protection Scheme (DoELG/PA/SI, 1999). This implies that construction of an extension to the landfill is geologically and hydrogeologically acceptable, although certain design considerations must be considered in order to obviate the possibility of leachate migration to groundwater and surface water.

Mitigation Measures - Groundwater

Measures which will be undertaken to protect groundwater are as follows:

Provide complete containment of the base and sides of the landfill extension:
This will be achieved by providing a composite lining to the landfill cells, consisting of a 2mm flexible membrane liner (FML), underlain by one metre of low permeability natural clay. The FML is made of high density polyethylene (HDPE). This will be laid directly on the clay layer, which will be constructed such that its permeability is very low, acting as a fail-safe layer for the liner. The combination of clay liner and HDPE membrane will provide complete containment for leachate. Furthermore, a gravel drainage layer is provided on top of the FYM to drain leachate and protect the liner.

Provide a leachate collection and removal system in order to maintain a low leachate head
The leachate collection system proposed for the extension is described in Section 3.3.9. The leachate collection/ pumping system will be designed to maintain the head of below one metre depth within the waste body. Instrumentation and alarm systems will allow monitoring and control of leachate levels within the collection chamber and the landfill cell. Leachate will be collected and conveyed to the wastewater treatment plant at Baltinglass.

Other mitigation measures
The landfill will be designed and constructed such that the base remains above the groundwater level. Any areas of soft soil identified in the lower (northern) area of the extension area will be excavated and replaced or improved such that settlement of the landfill cell is prevented.

5.2 SURFACE WATER

The Rampere stream is a moderately polluted stream, which is not affected by the existing landfill and with a small population of juvenile trout. The stream is a tributary to the Slaney and it joins the Slaney approximately 1.75 km downstream of the landfill site. The Slaney is unpolluted but with early signs of eutrophication and it is a salmon habitat and spawning ground of very high quality down stream of the confluence with the Rampere stream.

It is therefore important that measures are taken to ensure that the new development will not have a detrimental effect on water quality and the salmon habitats especially the important spawning grounds on the Slaney.

Landfill leachate contains a large variety of potentially serious pollutants, which may affect the water quality and the salmon stock.

The present landfill site does not affect the water quality of the Rampere stream or the Slaney and impacts on the salmon stock were not observed. In the proposed future development, the risk of pollution by leachate and impact on salmonid stocks in the Rampere stream and the Slaney due to toxic effects of leachate will be even less than today, since leachate will be contained, collected and treated in the extended landfill site

Clean surface water run-off from the capped landfill will be discharged to the Rampere stream. This is not expected to affect the existing moderately polluted status of the stream.

During construction of the site great care should be taken to avoid the discharge of soil and other solid material into Rampere stream. Suspended solids that are transported downstream may induce significant detrimental impacts on salmonid habitats:

- Suspended sediments can settle on spawning areas and smother the eggs and alevins in the gravel
- Settled sediments can infill pools and riffles, reducing the availability and quality of rearing habitat for fish
- Suspended sediment can reduce water clarity and visibility of the stream, impairing the ability of fish to find food.
- Settled sediments can smother and displace aquatic organisms, reducing the amount of food available to fish
- Increased levels of sediment can displace fish out of prime habitat into less suitable areas.

Mitigation Measures – Surface Water
In order to prevent pollution from paved areas oil separators should be placed on drains from the paved areas.

Construction works where there may be a risk of spillage or run-off of sediment to the stream should not be carried out in the spawning and hatching period for salmonids (beginning of October to end of March).

Surface water drains will be provided north and south of the new landfill cells to cater for surface run-off from the capped cells. These drains will connect to a silt trap to remove any sediment, and then discharge to the Rampere stream via existing surface water outlets.

Leachate generated within each of the lined cells will be collected in a network of slotted pipes and conveyed to a leachate collection chamber. A rising main will pump leachate from the site to Baltinglass WWTP. To prevent the leakage of leachate from the landfill, collection pipes and chamber will be fitted with alarm sensors to alert site staff of high leachate levels.

5.3 TERRESTRIAL ECOLOGY

There are no features in this field or its immediate environs that are of significant ecological interest. All the species are typical of surrounding farmland except for the scavenging birds which are attracted and concentrated by the neighbouring landfill.

The site is not included in any designated area under national law or the EU Habitats (92/43/EEC) or birds (79/409/EEC) Directives. The nearest proposed Natural Heritage Area is Lowtown Fen (~1764) which is 1.5Km to the north -west. No specially protected habitat or species occurs in the area.

The landfill extension would obliterate the grassland habitat but would not have a significant ecological impact on the surrounding area provided leachate does not enter the stream in large quantities. Existing agriculture obviously causes some eutrophication of this habitat already.

As long as a landfill operates there will be slight nutrient enrichment of adjacent fields and a potential risk of bacterial contamination from bird droppings. Some transport of plastic and paper into the surroundings is also likely.

Each cell within the landfill area will gradually be covered, seeded and planted so that new habitats will be established following completion of the cells. Details of the landscaping and replanting of the landfill are presented in Section 3.4

Mitigation Measures – Terrestrial Ecology
Attention will be paid to the maintenance of existing site hedgerows during the construction phase of the project.

Landfill Operation will be carried out in accordance with an Environmental Management Plan drawn up for the site in accordance with the EPA *Landfill Operational Practices Manual 1997*. Measures will be to prevent scavenging by birds and to control pests, are discussed in Section 5.5 below.

5.4 LAND USE AND AGRICULURE

The land adjacent to the landfill is intensively farmed with most of the land being suitable for either tillage or pasture. Two of the landowners adjacent to the site have horses and the other farmers are involved in dairying, dry cattle and tillage. In general the landowners were satisfied with the way the existing landfill was managed.

The Report carried out by Edward J. Bolger & Associates identified various potential impacts on the practice of agriculture in the immediate vicinity of the landfill, based on site visits and consultation with landowners. These are summarised as follows

Contamination of ground water and surface water: some of the landowners did express serious concerns about contaminated surface water and ground water, and the potential effect this could have on animal health and dairy hygiene

Spread of litter and debris by windblow: litter on the landfill site or blown on to neighbouring lands (where it could be ingested by livestock) is offensive to neighbours.

Scavenging Birds: the presence of scavenging birds is undesirable because they may contaminate the grass and crops with high density droppings, or contaminate feed and water troughs with the possibility of spreading salmonella. Crows will also feed on mature grain crops and one landowner did say he had a problem with crow damage.

Vermin, Pests & Insects: pests could spread disease e.g. leptospirosis, tuberculoses and salmonella. The control of flies is very important in relation to animal health, dairy hygiene and general hygiene.

Traffic Noise & Hazard: noise and general disturbance associated with truck movements may disturb the solitude of the rural setting. Heavy traffic flows on poor roads do not impact on the general farm operations and cause a nuisance to local farm traffic. Most of the landowners contacted did express concerns about the impact of numerous truck movements on local farm traffic.

Other potential impacts associated with landfilling identified that could have an affect on the farmers in the area included odours, dust, fires, fly tipping, fires and the need to prevent the spread of weeds from the landfill onto adjacent lands.

Mitigation Measures – Land Use and Agriculture

Proper landfill management and operational practice in accordance with the EPA *Landfill Operational Practices Manual 1997* should ensure that the development of the proposed extension to the landfill at Rampere will have no significant impact on the surrounding lands.

These practices will include

- application of daily landfill cover to waste,
- active compaction of waste in layers

- minimising the active tipping area
- control of litter by use of catch fencing around the active tipping area
- minimising the formation of puddles (suitable for gulls to rest)
- control on the vehicles waste delivering waste to ensure litter that is avoided
- undertaking active pest and vermin control measures using a specialised contractor
- measures to control growth of weeds or spread of seeds to adjacent lands
- bird control measures (see 5.5 below)

The progressive capping and reinstatement (seeding and revegetation) of the landfilling area will be undertaken, so that the area may be restored to agricultural use.
Potential impact from nuisances are dealt with in greater detail in Section 5.5. below. Traffic impacts are dealt with in Section 5.9.

5.5 NUISANCES

5.5.1 Vermin, Pests and Flies

Vermin and pests are attracted to waste disposal areas due to the organic components of the waste which serve as a food source and because poorly compacted waste disposal areas can create shelter and habitats for a number of species (flies, rats, etc.).

Good management practices and control measures can significantly reduce the risk of such adverse impacts occurring. The objective of these control measures is to make food sources inaccessible and living conditions as unattractive as possible. The following landfill operation procedures will be implemented in the daily routine as mitigating measures against vermin and pests:-

- The working area will be kept as small as possible (maximum extent 20 x 50 metres). All other areas will be covered with not less than 10 cm of soil.
- The waste will be compacted with a high tonnage steel wheel compactor (layer thickness < 0.5 m and 3-4 passes by compactor)
- The waste will be covered at the end of each working day
- Active waste disposal areas will be temporarily covered by approximately 0.5 m of soil when there is no disposing of waste taking place for a lengthy period of time
- Vermin control specialists will be employed to advise on and maintain any control systems on an ongoing basis
- The effective use of biodegradable insecticides on exposed places may also be employed.

Preventative baiting programmes, both on the disposal area and in the buffer zone can reduce vermin and other pests.

5.5.2 Scavenging Birds

Scavenging birds such as gulls and crows are attracted to poorly managed landfill sites in large numbers where appreciable amounts of food wastes are available.

Good management practices and control measures can significantly reduce the risk of such adverse impacts occurring. A feature of gull behaviour is that after feeding they rest on flat areas with good visibility and preferably shallow, standing water to bathe in. Therefore the development of puddles on compacted areas should be avoided. Bird control techniques will be carefully planned so as to mitigate bird nuisance. The following mitigating measures will be implemented:-

- The working area will be kept as small as possible (max. 20 x 50 metres) all others areas must be covered with not less than 10 cm of soil.

- The waste will be compacted with a steel wheel compactor (layer thickness < 0.5 m and 3-4 passes by compactor)
- The waste will be covered at the end of each working day
- The formation of puddles will be minimised

The effectiveness of scarecrows, birds of prey or mimicking birds of prey, gas guns etc. deteriorates in time and will need to be varied regularly to achieve maximum effect.

Canopy net systems totally covering the working area can be introduced if it is felt it is necessary. However, bird control should mainly be executed by sound landfill operational practice.

5.5.3 Windblown Litter

Windblown litter can arise from tipping, handling and compaction of waste in the active disposal area and transport of waste in vehicles to the tipping area. In addition to being visually unattractive, litter might be ingested by animals in neighbouring farmland.

Operation of the landfill will be organised in a way that reduces the impact from litter by implementing the following:-

- A high degree of compaction of waste in thin layers using high tonnage compactors
- Application of daily cover to the working area
- Establishment of a catch fence (litter net) in the perimeter of the active tipping area
- Tipping front always to be established below surrounding soil bund
- Tipping front to be established in shelter from wind direction (possibility for 2-3 different working areas according to wind direction)
- Employment of litter pickers in the event that litter leaves the active tipping area

The proper management of the landfill with daily covering of refuse and the use of catch fencing will significantly reduce any risk from windborne litter.

5.5.4 Fire

Fire in waste at landfills can arise in the event of burning waste being delivered to the site, or self ignition of the waste due to increased temperatures from decomposition of organic waste. Smoke and ash generated by such fires can have a detrimental impact on air quality and surrounding lands if allowed to burn uncontrollably.

If there is a suspicion that waste being delivered is on fire or smoking, the vehicle will be directed to the inspection area where closer inspection will be carried out. If a fire is detected this will either be distinguished at once or the fire fighting service will be notified.

To prevent occurrences of fire in the waste disposal area, the availability of oxygen or air will be limited by the following operational practices:-

- High compaction of waste with a steel wheel compactor (layer thickness < 0.5 m and 3-4 passes by compactor)
- Application of daily cover to the waste
- The active waste disposal areas will be temporarily covered with approximately 0.5 m of soil when not in use

A stockpile of soil will be located close to the working area in case of fire. If fire is observed in areas away from the working area it should be isolated by spreading of soil followed by sealing of all possible sources of oxygen (vents, exposed surfaces etc) thus eventually extinguishing the fire.

All fire incidents will be reported to the local fire station and guidelines for fire prevention dealing with emergencies of this nature will be included in the landfill operators' manual.

The local fire station will be issued a set of keys for all security gates and buildings.

5.6 LANDSCAPE/ VISUAL IMPACT

The visual impact during the construction stage will be significant and negative. The visual impact can be gauged from the previous landfill, a large area that has been reinstated as grassland and has blended into the surrounding landscape quite well.

5.6.1 Impact and Mitigation

The impact on the landscape will be a short-term impact and will consist of the following elements:

- Movements of refuse trucks to and from site.
- Landfill operations.

In the interim the impact of landfill operations will be mitigated by a number of temporary measures and efficient site management.

- As detailed in Section 3.3.5 the filling of the cells will be carried in a phased manner. To reduce the visual impact of landfill operations at the active face berms will be progressively built to provide screening. Berms will be designed to with an outside slope of one in three. The active face of waste within the cell will slope away from the berm and have a slope of no greater than one in three.

- The gradient of the proposed site rises steeply towards the northern boundary as shown in **Figure 5.1**. It is proposed to place litter fences incorporating visual screens on top of the berms to provide additional visual protection, see Figure 5.1 for further details. The screens will be progressively moved as the phased development of the landfill continues.

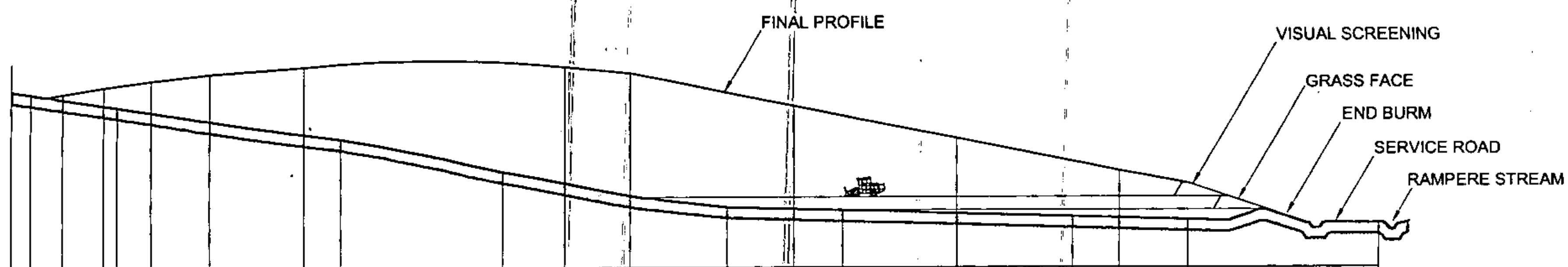
- Stockpiles/excess clay may be staggered throughout the site to provide continuous screening of all activities on the site. Grassing of these piles will provide further visual amelioration. A schematic site plan incorporating these temporary stockpiles is shown in **Figure 5.2**

- Screening at those houses directly overlooking the site would provide the most effective visual screening of the site and the active face. The planting of native woodland trees and other shrubs specifically at each dwelling would almost reduce all possible views into the site. This form of screening would be dependent on an agreement being reached between Wicklow County Council and the landowner.

- The height of the ground level of the reinstated landfill will screen the operations to the south, together with the existing hedgerow. The provision of dense woodland screen planting to the site boundaries to the north, west and south will further mitigated the visual impact on the local landscape and community.

In the long term the proposed landfill will have a significant and neutral impact on the landscape. The proposed landfill will be formed as a graded mound with a high point of 146m O.D. located at the southwestern corner of the site.

From this high point the landform will slope towards the northern boundary, at a slope of approximately 1 in 5, until it grades gradually in with the existing land to the north of the site. The mound will also be graded to the ground level of the existing landfill site. The land will then be returned to grassland to blend in with the surrounding agricultural land. Native woodland screen planting will be planted along the boundaries to the north, west and south with some scrub woodland planting between the proposed and existing landfill sites.

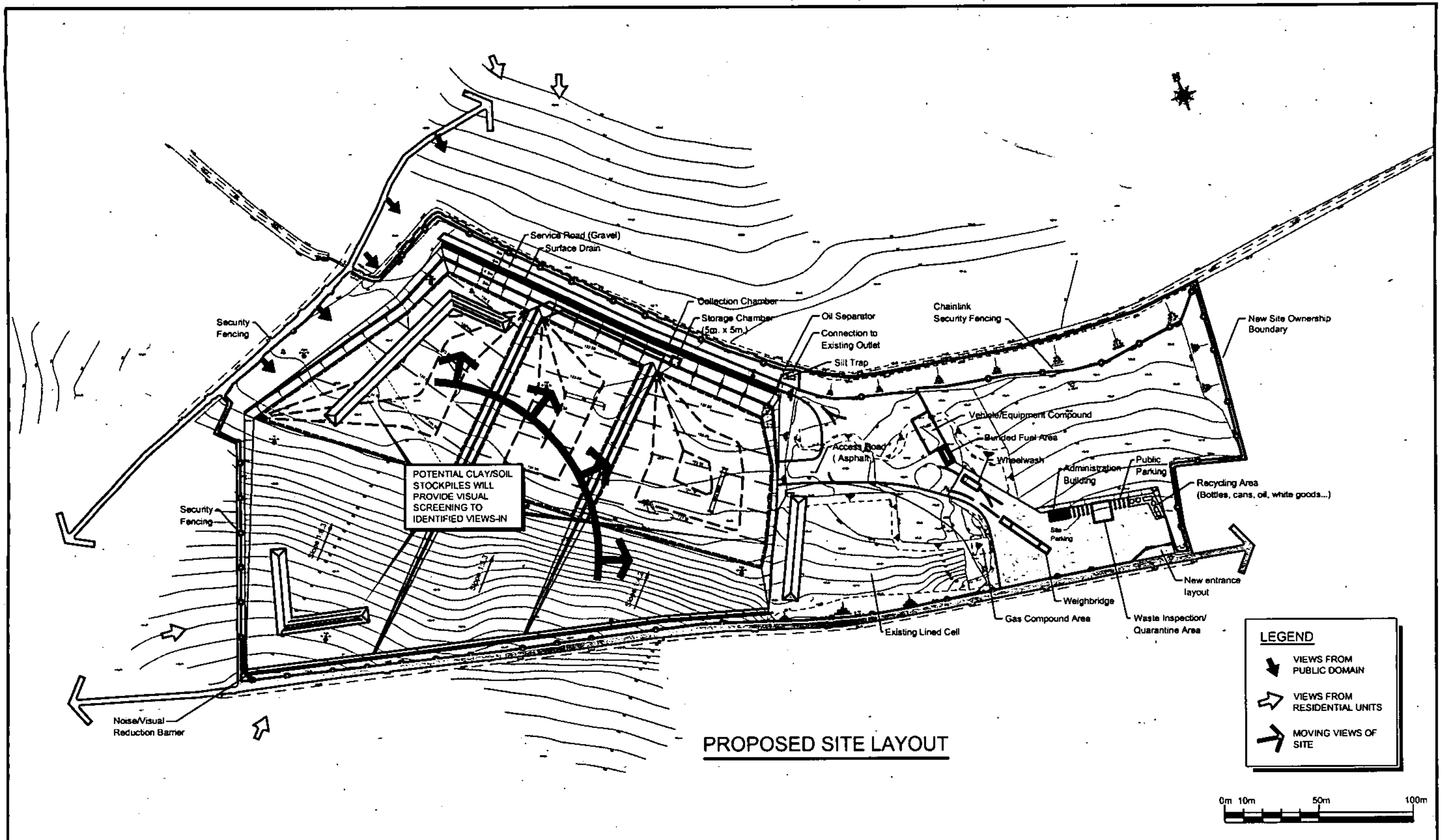


DATUM = 115.00m

CHAINAGE	EXISTING GROUND LEVEL	FINISHED GROUND LEVEL
2.981	142.00	
7.889		142.00
14.157		143.00
16.223	140.00	
21.421		144.00
30.414		145.00
44.879		148.00
50.561	135.00	
75.530	130.00	
85.112		146.00
95.138		145.00
110.069	124.50	
120.249		140.00
127.729	124.00	
145.379	123.50	135.00
163.049	123.00	
170.049		130.00
180.709	122.50	
209.920		

TYPICAL CROSS SECTION

Client:		Job:	Title:			
WICKLOW COUNTY COUNCIL County Buildings, Wicklow.	MCOS COWI Carnegie House, Library Road, Dun Laoghaire, Co. Dublin. Phone: 01-2020870 Fax. No: 01-2020707	Rampere Landfill Proposed Extension	PROGRESSIVE VISUAL SCREENING	Drawn: SBG Checked: WP Approved: CB Scale: 1:750 (A3) Date: SEP'02	File Ref.: 067/509/001/FG5.1.DWG	Figure No. 5.1



PROPOSED SITE LAYOUT

Client:		Job:	Title:			
WICKLOW COUNTY COUNCIL County Buildings, Wicklow.	MCOS COWI Carnegie House, Library Road, Dun Laoghaire, Co. Dublin. Phone: 01-2020870 Fax. No: 01-2020707	Rampere Landfill Proposed Extension	TEMPORARY SCREENING BUNDS	Drawn:	SBG	File Ref.: 067/509/001/FG5.2.DWG
				Checked:	WP	
				Approved:	CB	Figure No. 5.2
				Scale:	NTS	
				Date:	SEP'02	

5.7 AIR QUALITY / CLIMATE

Potential impacts due to the proposed development occur during the construction phase, the operational phase, and the aftercare phase of the landfill extension.

5.7.1 Construction Phase

When the new cells are being developed equipment such as excavators and dozers and movements of heavy vehicles may create dust emissions, as well as exhaust gasses containing particulates.

Mitigation measures at this phase will include:

- Use of a mobile water sprayer during dry conditions on internal haul roads
- Minimising movement offsite of construction equipment
- Use of the paved site entrance area for construction traffic

5.7.2 Operational Phase

Possible emission sources from the landfilling activity include:

Area sources – active part of the cell where waste is being tipped compacted and covered
Line emissions – from vehicles travelling along internal haul roads or adjacent public roadways
Point sources – e.g. emissions from gas venting pipes

Emissions are grouped under the following headings: dust, aerosols and particulates, odours, and landfill gas.

Dust Emissions: the primary source is from trucks moving along internal haul roads to and from the tipping area, particularly in dry weather. Occasionally tipping of fine dry material could also create dust emissions.

Aerosols and airborne particulates: aerosols are defined as fine particulate material, water droplets and microbial emissions from the activities carried out on the landfill. Very small sized particles may be inhaled and enter the lower respiratory tract, or the presence of various micro-organisms in the refuse or cover material could be inhaled or ingested. Potential sources on the landfill are silt and fine material on internal haul roads, or the active landfill area. Overall impact on aerosol levels in the area surrounding the landfill is not considered significant, with no detectable increase in levels or particulates at Rampere crossroads, once mitigation measures as described below are implemented.

Odours: The potential for strong malodours tends to be greatest during the placement of fresh organic domestic waste, as it rapidly decomposes due to aerobic and anaerobic reactions taking place. Volatilisation occurs and the rate of release depends on a number of factors including type of refuse, moisture content of the waste, temperature and site operational factors. The rate at which malodours are emitted from the cell depends on the length of time the deposited material is left uncovered, weather conditions, effectiveness of the cell drainage system for removing leachate.

Covering deposited waste on a daily basis with clay will substantially reduce the emissions of malodours from the deposited refuse.

The impact on air quality due to malodorous emissions from the proposed landfill extension is predicted to be slight in the vicinity of Rampere. Reduction and control of odours will be achieved by means of mitigation measures outlined below.

Landfill Gas: the generation of landfill gas within the layers of refuse is a major source of air emissions both during the operation and also after the cells have been completed. The primary constituents of landfill gas are methane (CH_4) and carbon dioxide (CO_2) which are

both odourless. The remaining volume is made up of a large range of non-methane hydrocarbon compounds, which result from the microbial activity within the landfill layers and can be present in concentrations of parts per million (ppm) or parts per billion (ppb). These trace constituents give the distinctive pungent odour of landfill gas.

Potential health risks arise where large uncontrolled surface emissions of landfill gas occur within confined areas of a site. However, although the gas is highly odorous, emissions from the landfill will not result in toxic concentrations of individual trace compounds beyond the site boundary. Dilution rates in the order of several hundred times are normally available above the surface of a landfill cell, even during slack wind conditions. The distance between the exposed cell or working face and the site boundary will result in a further substantial reduction in the ambient concentrations due to natural dispersion mechanisms. No adverse impact on the health of the local community is predicted due to emissions of landfill gas from the landfill.

Mitigation Measures – Air Quality

- The entrance to the landfill and hard paved areas will be regularly maintained to ensure any spillages or accumulation of dust is removed.
- Internal haul roads will be covered with compacted hardcore material to reduce dust emissions form vehicles on the site.
- A mobile water sprayer will be employed during dry weather conditions to reduce dust emissions from the access road and near the entrance to the landfill.
- Vehicles departing the site having delivered waste will pass through a wheel wash
- Tipping of waste material will be controlled within the landfill extension
- The active tipping area will be minimised to reduce the amount of exposed waste
- Waste material will be covered daily to with suitable material to control emissions of dust or malodours from the active cell
- If potentially odorous material such as sewage sludge is to be landfilled, this will be deposited by deep burial and promptly covered
- Burning of any waste on-site will be prohibited.
- Landfill gas generated within the lined cells will be abstracted from the cells and flare on site reducing the level of CH_4 escaping to the atmosphere.
- Leachate control will be in place to minimise build up of leachate in the landfill cells, Leachate collect and treatment systems will be established as outlined in Section 3.3.9, 3.3.10.
- When the waste has reached the appropriate height, it will be capped, restored and reseeded according to the landscape plan set out in Section 3.4. This progressive reinstatement will prevent malodorous emission and revegetation will control dust emissions.
- Landfill plant such as the compactor will be regularly maintained to prevent excessive exhaust emissions of particulates and other pollutants
- Monitoring of air quality parameters such as dust deposition will be undertaken on a regular basis. Monitoring of landfill gas emissions will also form part of the overall monitoring programme for the site.

5.7.3 Closure Phase

Procedures for capping and reinstatement of the extended landfill are outlined in Section 3.4, and Section 4.6. Landfill gas will continue to be generated following the closure of the site, which will require flaring of the gas, and monitoring of gas generation.

5.7.4 Climate

The landfill extension will result in changes to the slope between the public road and the Rampere stream. However this change will not have a significant impact on the overall wind field in the locality.

5.8 NOISE

The following noise levels are suggest by the EPA as appropriate target levels for noise sensitive locations. The criteria – outlined below – are not currently exceeded and the noise from the existing site has 'marginal' impact on residences in the area.

Night time:	Noise from landfill site:	45 dB(A), $L_{Aeq,\ 1\ hour}$
Day time:	Noise from landfill site:	55 dB(A), $L_{Aeq,\ 1\ hour}$

5.8.1 Potential Impact

The projected timescale for the operation of the landfill facility is less than five years. The maximum noise level predicted at the nearest residence taking into account attenuation by distance and landscape effects, but without specific mitigation measures, would exceed a criterion of 55 dB(A) and a significant adverse impact would be anticipated. There is potential for a significant adverse impact at the nearest residences, NSL3 and NSL4 due to the operation of the proposed landfill extension, refer to Figure 4.4. Amelioration measures are available to achieve a 55 dB(A) criterion.

The ground vibration from the compaction operations generates high levels in the immediate vicinity but due to the distances involved there are no off-site vibration effects.

Earth moving machinery will be used to construct the proposed cells and noise control measures and for a very short period noise emissions will be in excess of normal operational criteria. Construction work is of a temporary nature, and the resulting higher noise levels are usually acceptable.

The residual impact will be a negative, short-term and of moderate quality.

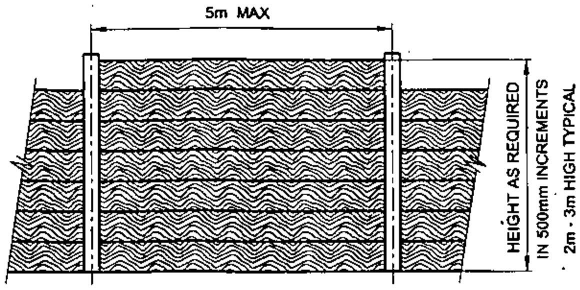
5.8.2 Mitigation Measures - Noise

Amelioration measures in the form of a noise reduction barrier on the south-western corner of the site will be used to control the noise emissions from the site and between NSL3 and NSL4.

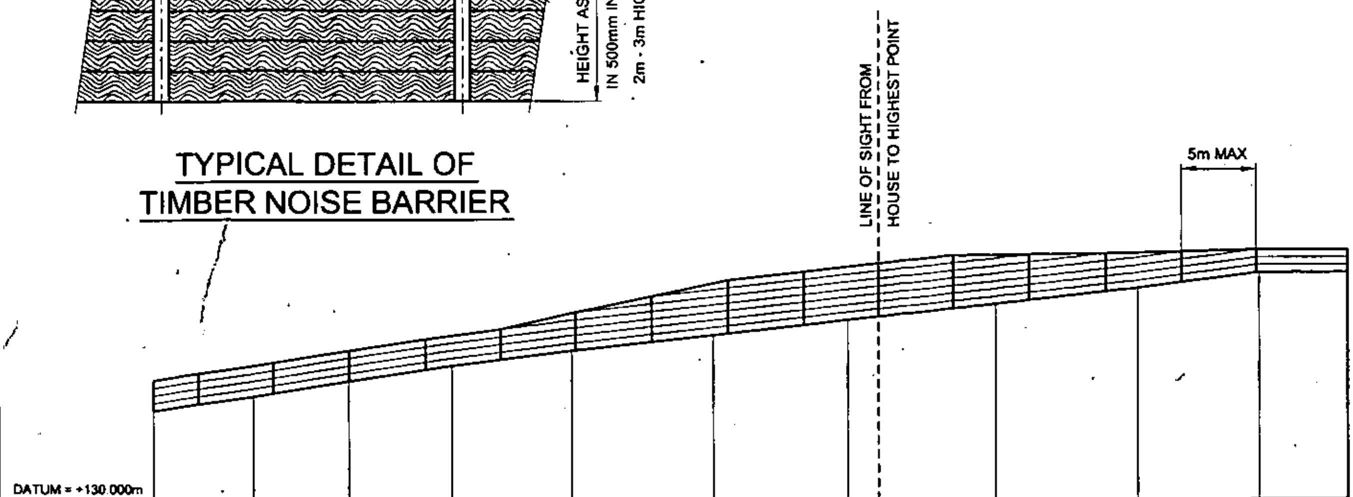
Noise barriers do not completely block all noise they only reduce overall noise levels, with effective noise barriers typically reduce noise levels by 5 to 10 decibels (dB). Barriers can be in the form of clay berms or vertical walls. Earth berms have a very natural appearance and usually blend into the surrounding environment. Typically landscaped earth berrms have been constructed at landfills in an attempt to mitigate noise and visual impact on the nearby community. However clay berms can require lot of land to construct. At the proposed extension site the land slopes from the southwestern boundary towards the Rampere Stream, with a gradient of one in six. The construction of an earthen berm to adequately reduce noise from the landfill would use a considerable amount of void space see **Figure 5.3**.

The preferred option would be to construct a vertical noise reduction barrier along the southwestern boundary. Vertical barriers require less space would require less construction than an earthen berm. At Rampere a noise deflective barrier comprising of solid timber panels and supported by I-section steel posts is proposed to be constructed along the northern and eastern boundaries from the south-western corner of the site. It is considered that a timber barrier would blend well into the surrounding rural landscape. The addition of planting such as hedging and creepers will further improve the aesthetic value of the barrier see **Figure 5.3**.

It is recommended that the vertical noise barrier should be approximately 3m above the noise source and long enough to sufficiently screen both dwellings from the landfill. The vertical barrier will vary in height along the length of the boundary. The highest sections of the barrier will mitigate noise and views from the dwelling overlooking the site.

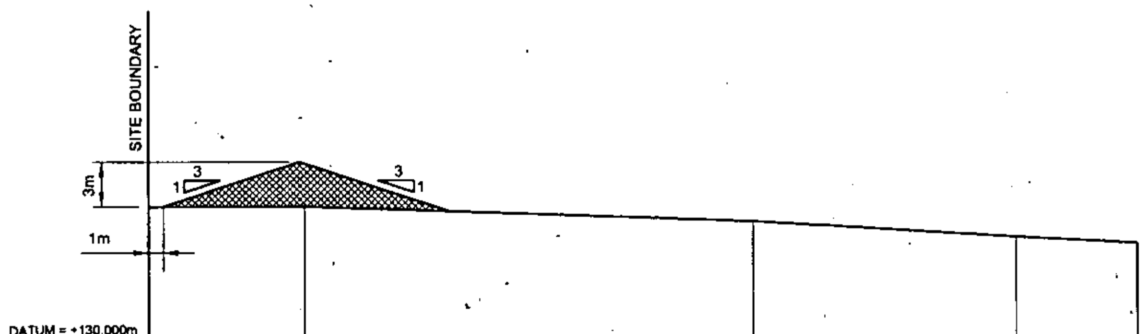


TYPICAL DETAIL OF TIMBER NOISE BARRIER



CHAINAGE	0.000	6.677	12.973	19.795	27.762	37.017	45.963	55.794	65.128	73.152	79.010
LEVEL	136.000	137.000	138.000	139.000	140.000	141.000	142.000	143.000	144.000	145.000	145.000

TYPICAL ELEVATION SHOWING TIMBER NOISE BARRIER OPTION AND GROUND PROFILE ALONG SECTION OF THE SITE BOUNDARY



CHAINAGE	0.000	10.334	40.019	57.460	65.475
LEVEL	139.000	139.000	138.000	137.000	

TYPICAL SECTION OF BERM OPTION ON EXISTING GROUND PROFILE

WICKLOW COUNTY COUNCIL

MCOS COWI
Carnegie House, Library Road, Dun Laoghaire, Co. Dublin.

Job: Rampere Landfill Proposed Extension

Title: TYPICAL DETAILS OF NOISE REDUCTION BARRIERS

Drawn: SBG
Checked: WP
Approved: CB
Scale: 1:500
Date: SEP'02

File Ref.: 067/509/001/FG5.3

Figure No. 5.3

Compaction equipment on the site will be upgraded. This will reduce noise emissions compared to the existing plant. Compactors and other equipment will regularly maintained to prevent excessive noise generation. The extension will require improvement or replacement of the compactor currently on site.

5.9 TRAFFIC

The extension and increased waste intake at the facility will generate increased traffic to and from the site. Based on the traffic data available from Rampere landfill and Ballymurtagh landfill in East Wicklow, it is estimated that the increased tonnage (approx. 40,000 additional tonnes, for an approximate 5 year period) will generate a total of 16 HCV's entering the landfill each day based on an average axle-load of 10 Tonnes per vehicle. This will result in approximately 32 HCV trips generated by the future landfill per day.

Recycling facilities will be improved but the overall catchment area for civic users of the facility will remain the same. Therefore it is estimated that approx. 5 additional cars/vans/trailers will enter the extended landfill, in addition to the 10 vehicles already using the site.

Therefore, the future Rampere landfill is likely to generate 62 vehicular trips to and from the site per day, of which, 32 trips would be HCV's. These vehicular trips will be made up of cars, vans, trailers and HCV's.

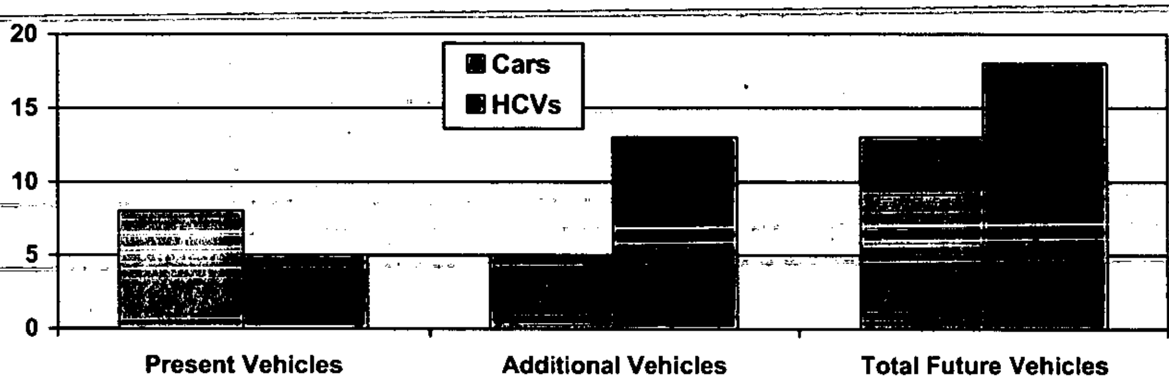
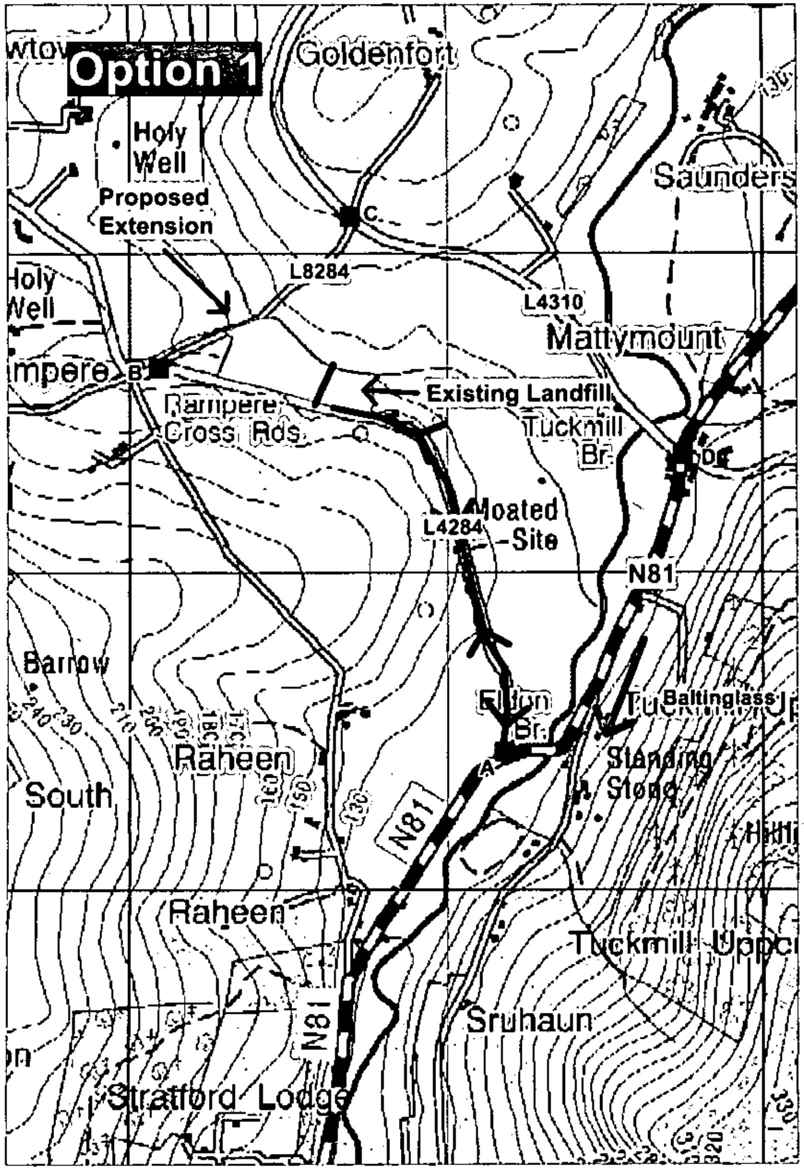


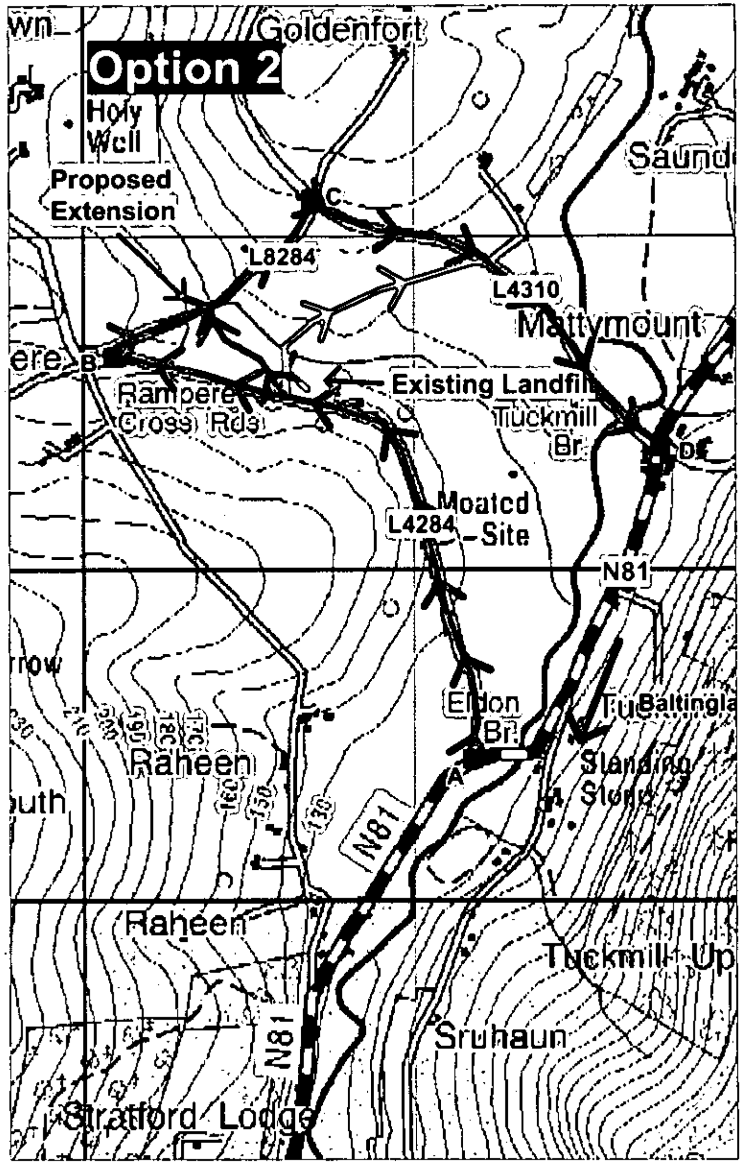
Figure 5.4 Daily Traffic to Rampere Landfill (current and projected)

As regards the N81 National Secondary Road, the increase in traffic due to the landfill extension would be very slight. The same can be said for additional haulage of waste from east to west Wicklow. However on local roads, landfill traffic would account for up to 20% of all traffic and 85% of HCVs between the landfill and the N81.

The current local road network serving the landfill has some limitation as discussed in Section 4.10. The impact of increased traffic on the road was assessed and is discussed in Appendix 9, Volume III. A number of possible scenarios for traffic routing to and from the landfill were compared. The main alternative to the current traffic system to the site would be to create a one-way system for vehicles leaving the landfill, such that they would take an alternative route to the N81 via Tuckmill Bridge, further north along the N81.

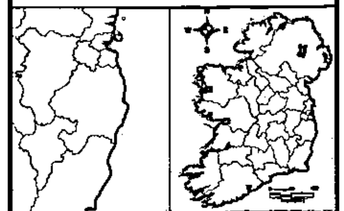
The alternative route options are presented in **Figure 5.5.** The routes were compared in terms of environmental and safety aspects and costs. The option of introducing a one-way system has certain advantages, but was found to be less favourable overall. The overall length of local road used by landfill traffic would be increased, and the numbers of houses and farm entrances affected by the traffic would also increase. It is proposed to retain the current traffic flow arrangements (Option 1A) to and from the site.





Legend

- Option 1 2-way Traffic Flow
- Option 2A 1-way Traffic Flow
- Option 2B 1-way Traffic Flow
- Option 2C 1-way Traffic Flow



Wicklow County Council
Comhairle Chontae Chill Mhantáin

Project
Rampere Landfill Proposed Extension

Title
Traffic Route Options

Figure 5.5

MCOS

Carriage House
Dun Laoghaire
Co Dublin
Phone 01-2020870
Fax No. 01-2020787

Issue Details

Drawn: WP		Project No.	067-509-001
Checked: CB		File Ref. 067-509-001-MO004	
Approved: LOT			
Scale: 1:50,000		Drawing No. xxxx	Rev. A01
Date: Aug 2002			

Notes
1. This drawing is the property of M. C. O'Sullivan & Co. Ltd. It is a confidential document and must not be copied, used, or its contents divulged without prior written consent.
2. All levels are referred to Ordnance Datum, Malin Head.
3. NOT TO SCALE, use figured dimensions only, if in doubt ask
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Impacts on local residents and other road users will include the following:

- Increase in noise, vibration and vehicle emissions due to additional traffic
- Increased number of turning movements at junction with N81 and at landfill entrance
- General impact on road safety from increased numbers of HCVs

There is an archaeological site along the L4284 approx. 300m south east of the landfill entrance. This is a ringfort which has been previously damaged when the existing road was constructed. The archaeologist's report states that any development or widening of the road should take place in conjunction with Dúchas and should preferably take place on the southwest side of the road. An existing bridge along this route may also require remedial works or strengthening.

Mitigation Measures – Road Access/ Transportation

The following measures should be incorporated as or part of the landfill extension.

N81 National Secondary Road – junction improvements should be carried out where the L4284 access road meets the N81 just south of Eldon Bridge. If possible a right turning lane for southbound landfill traffic should be provided. Improved road markings and signage should be provided at all approaches to the junction. Wicklow County Council should consider extending the 40 mph Baltinglass town speed restriction as far as the junction.

Improvement of local access road, L4284 – road widening and resurfacing should be undertaken along the 1.2 Km stretch of this road connecting the landfill to the N81, in order to improve road safety and to allow HCVs to pass comfortably. Resurfacing, drainage and pavement improvements will reduce noise and vibration effects. Improvements of the landfill entrance are required for the increased traffic. Speed controls should be introduced on this access road, in particular at the landfill entrance. The widening of the L4284 should be carried out in accordance with the recommendations of the archaeology report. Further assessment should be carried out of the condition of the bridge on the L4284.

Landfill Site - certain steps should also be undertaken in order to reduce impact on local road users. This will include maintaining a clean entrance area, and use by all HCVs of the wheelwash. Wicklow County Council can also ensure that all haulage vehicles are kept clean and in proper order and that litter of liquid does not fall from vehicles. Use of the weighbridge on site will ensure that no overloading of vehicles takes place. Improved signage and warning signs at the landfill will also be beneficial.

5.10 ARCHAEOLOGY

The region around Baltinglass has a rich and varied archaeological and historical heritage. A well known group of hillforts and ritual burial cairns, concentrated in commanding positions overlooking the Slaney valley, testify to the strategic importance of the region. A number of ringforts and enclosure sites in Rampere townland also reflects continuity of settlement into Early Christian and later medieval times.

No known archaeological sites, as identified in the SMR of *Dúchas,* are affected by the proposed development and there is no substantial issue in respect of archaeology envisaged for the proposed landfill extension. However, the immediate and wider vicinity has been the focus of settlement throughout the prehistoric, early historic and medieval periods, and for this reason it is recommended that all ground preparation works be monitored by a licensed archaeologist. This will ensure the full recognition and proper recording of all archaeological soils, features, finds and deposits that may be revealed during construction.

Associated plans for widening the access road to the existing landfill, to cater for the increased capacity and subsequent increased traffic, will, however, have a direct impact on

ringfort 027:002/021:047. If such plans are forwarded, it is recommended that the road be widened on its southwestern side, where construction of the original road has previously removed a large portion of the ringfort's southwestern bank and fosse. It will also be necessary to test excavate this area, under license from *Dúchas*, in advance of construction, to determine whether archaeological features or deposits relating to the site survive at this location. The results of test excavation must be submitted to *Dúchas* for analysis, which will then decide whether further remedial action may be necessary. Protection of the upstanding portion of the monument against construction traffic or other damage must also be ensured during all development works at this location.

A 30m buffer zone must also be maintained around ringfort site 027:001/021:046 should any road widening works be undertaken at the existing landfill entrance. As there is no visible expression of the site above ground, the site should be located by an archaeologist in the field before a buffer zone is established. The site and its buffer zone must then be protected form adverse impact associated with the road widening or any ancillary works.

Mitigation Measures – Summary
A Licensed Archaeologist will monitor all ground preparation work on the extension area. This will ensure full recognition and proper recording of all archaeological soils, features, finds and deposits that may be revealed during construction. In relation to road widening or improvement associated with the landfill extension, procedures will be in place relating to protection of ringforts identified in the archaeologists report.

5.11 TOURISM

Tourism is a major source of revenue to County Wicklow, and the County contains a number of top attractions. The number of tourists visiting the area of Baltinglass is not high compared with the rest of the county. However the area does have tourist potential and tourism is growing and being actively developed. It is important that this proposed landfill development would not counteract further increases in tourism.

This landfill site, although situated close to Baltinglass a Heritage Town is not visible from the town or the main N81 Secondary Road that passes to the east of the site. The Tinoranhill (312metres) is situated to the north of Baltinglass town providing a good screen for the town. The site is accessed from a third class road and is well screened by a large hedgerow making it difficult to view by passing traffic. The local road is not likely to be used frequently by tourist traffic. Traffic using the landfill may travel along routes used by tourists and Wicklow County Council should ensure high standards of vehicle control (no litter, cleanliness and good vehicles) to avoid any possible impacts.

Although there are a number of tourist attractions in the region of the Landfill the attractions that are frequented the most lie to the north, east and centre of the County. Tourism is being developed such as the newly converted courthouse in Baltinglass which now provides a tourist office and heritage centre. Overall the extension is unlikely to have any detrimental effect on Tourism in the Baltinglass/ West Wicklow area.

Mitigation Measures – Tourism
It is recommended that waste transport vehicles using the landfill site be kept in good repair and of a high standard of appearance. Landfill management staff should monitor vehicles and prevent litter or liquid falling from trucks, excessive exhaust emissions, dirty vehicles, or excessively slow vehicles. Wicklow County Council will use its powers under the Waste Management (Collection Permitting) Regulations 2001 to implement these measures.

Operational procedures on a day to day level should be carried out to prevent any local nuisances created by litter, odours, scavenging birds etc.. The mitigation measures to be carried out are detailed in Section 5.5.

5.12 COMMUNITY WELL BEING

Landfill facilities in general have the potential to create local nuisance and loss of amenity, and to impact community identity. In relation to the proposed development, impact on the local community in Rampere townland is most relevant, since the landfill is removed from the town and facilities within Baltinglass itself.

By ensuring that the landfill is well designed and properly operated in accordance with the conditions of the EPA Waste Licence, nuisances such as odours, litter, scavanging birds etc. will be avoided or minimised.

There will be an impact on the visual amenity of the area beside the landfill, which will impact a small number of dwellings overlooking the site, and impact to a slight extent on local road users. This impact can be minimised by proper procedures as set out in this EIS for covering, capping and reinstating the landfill as the site progresses. In the longer term, the reinstatement and revegetation of the site will replace any disamenity caused.

Impacts on local residents due to increased traffic have been identified, in particular the number of Heavy Commercial Vehicles (HCVs) using the access road. Significant improvement of this road – by widening, resurfacing, improved junctions and speed controls – will mitigate this impact. In the longer term, following closure of the facility, the improved road layout will be of benefit to the community compared to the current situation.

Having the landfill facility available as a civic waste facility provides the Baltinglass community with a convenient access to a waste disposal site, which is perceived as an advantage. By upgrading the recycling and disposal facilities at the landfill this facility may be enhanced.

Government Policy on Waste Management ('Changing Our Ways', October 1998) suggests that where local communities are affected by new waste facilities, a proportion of gate fees from these facilities may be used to support appropriate environmental improvement projects. It is recommended that Wicklow County Council take this opportunity to offset any local loss of amenity in Rampere and the general Baltinglass area by supporting suitable local initiatives using an element of landfill gate fees. Such initiatives could include local landscaping and gardening, improving local recycling facilities, or developing heritage or tourism facilities.

Good levels of communication between the local community and Wicklow County Council will also mitigate against local anxiety, and provide an ongoing feedback to the Council if any element of landfill operation is creating local nuisance. It is also recommended that Wicklow County Council provide the public with regular up to date information on site activities and environmental monitoring information.

5.13 MATERIAL ASSETS

Landfilling of municipal waste has been ongoing at the landfill for over 20 years, and in the intervening period a number of new dwellings have been built in Rampere townland, with continuing agricultural activity on all neighbouring lands. The scale of landfill will increase due to the extension, however once it is complete (assumed to be five years after opening of the extension) the site will be closed and fully reinstated.

During operation of the site, there may be an impact on the residential potential of the area immediately adjacent to the landfill. This can be mitigated by good operational practices on a day to day basis at the site, as outlined in this EIS. In the medium to long term, once the landfill is reinstated, there should be no impact on property value.

An increase in traffic could potentially impact on agricultural activity on farms in the area, making access to lands less convenient – approximately 12 field entrances are directly impacted between the N81 and the landfill. By improving local access road such that agricultural and commercial vehicles can pass in safety, any impact due to increased traffic

will be offset. Farmers may also be concerned over water quality in local stream and in groundwater. Provision of all monitoring results in relation to local water quality will help allay fears over the risk of water contamination due to the landfill. In the long term there should not be any detrimental impact on material assets due to the proposed landfill extension.

Leachate that is collected from the new lined landfill cells will be pumped via a rising main for treatment to Baltinglass Wastewater Treatment Plant (WWTP). The plant itself needs to be upgraded to cater for this increased loading. In the longer term, once generation of leachate falls off, there will be spare capacity at the treatment plant allowing continued expansion and development of the town without jeopardising the River Slaney water quality, with a subsequent positive impact on property values. Leachate will be conveyed to the WWTP either by extending the public sewer from Baltinglass to Rampere townland, or by tankering. If the sewer extension is the chosen method this would possibly allow connection by dwellings in the Rampere townland, and on the access road to the landfill. This would impact positively on property values in the area.

As outlined in Section 5.12 above, Wicklow County Council are recommended to divert financial assistance from landfill gate fees to local environmental enhancement projects. Such projects could have an overall beneficial impact on the Rampere and general Baltinglass area, which would also offset any short-term negative impact on material assets.

6 INTERACTION OF EFFECTS

Specialist sub-consultants examined potential impacts of the proposed extension. This section presents the significance of potential impacts following the implementation of mitigation measures.

The structure used for assessing the significance of effects of the development is based on individual impact assessments and the following criterion taken from the EPA *' Guidelines on the information to be contained in Environmental Impact Statements'* (EPA, 2002).

Table 6.1: EPA Classification Criteria

Impact Quality	**Description**
Negative	A change which reduces the quality of the environment
Positive	A change which improves the quality of the environment
Neutral	A change which does not affect the quality of the environment
Duration of Impacts	**Description**
Temporary	Impact lasting for one year or less
Short-term	Impact lasting one to seven years
Medium-term	Impact lasting seven to twenty years
Long-term	Impact lasting twenty to fifty years
Permanent	Impact lasting over fifty years
Significance of Impacts	**Description**
Slight	An impact which causes changes in the character of the environment which are not significant or profound
Moderate	An impact that alters the character of the environment in a manner that is consistent with existing and emerging trends
Significant	An impact which by its magnitude, duration or intensity alters an important aspect of the environment

As the EIS tends to assess the environmental factors of the development individually, it is necessary that the interactions between these environmental factors be considered to ensure that potential interactive effects of the project can be identified.

Interactions are usually very complex. A change to any one of the environmental factors could affect one or all of the other related factors, e.g. low intensity farming maintains pristine water quality which provides feeding and breeding sites for game fish. In turn game fish provide tourism related economic activity which eases pressure for more intensive farming.

The potential interactions between identified socio/environmental issues/effects and the proposed development are assessed to determine potential effects. A receptor is defined as a factor of the natural or man made environment such as water, air or a plant that is potentially affected by an impact.

Tables 6.2 and 6.3 illustrate the direct impacts of the proposed landfill extension to Rampere project that may result in relevant interactions between receptors associated with the development.

Potential interactions identified mainly relate to a reduction in residential quality. Therefore, human beings are the impacted receptor. However, as suitable mitigation measures will eliminate/reduce the possibility of potential effects, the above interactions will be avoided.

Table 6.2: Potential Effects and Impacts on the Natural Environment Resulting from the Proposed Landfill Extension

Receptor	Potential Effect	Impacted Receptor	Potential Impact
Terrestrial Flora and Fauna	Loss of habitat/species	Flora & Fauna Human Beings	Loss of habitat Reduced recreational amenity
Water Quality	Contamination of waters	Flora & Fauna Human Beings	Loss of habitat Reduced recreational amenity & residential quality
Landscape	Increase in height of land	Human Beings	Reduced recreational amenity & residential quality
Archaeology	Disturbance of archaeological finds	Human Beings	Impact on cultural heritage
Climate	Contribution to greenhouse gases	Flora & Fauna	Loss of habitat

Table 6.3: Potential Effects and Impacts on Human Beings Resulting from the Proposed Landfill Extension

Receptor	Potential Effect	Impacted Receptor	Potential Impact
Community	Loss of amenity Increase in nuisances Increase in heavy traffic	Human Beings	Reduced residential quality Reduced recreational amenity Reduced community well being
Traffic	Increase in traffic and dust emissions	Human Beings	Reduced residential quality Reduced recreational amenity
Air	Increase in dust/aerosol/odour emissions	Human Beings	Reduced residential quality Reduced recreational amenity
Noise	Increase in noise	Human Beings	Reduced residential quality Reduced recreational amenity
Agriculture	Nuisances	Human Beings	Loss of income Reduced agricultural amenity

The existing landfill operates without creating significant local impact and residential amenity as evidenced by the construction of new homes in the immediate vicinity of the site. This can be attributed to its relatively small size, low waste intake and good management practices.

The tables above suggest that residential amenity in the vicinity can potentially be affected by the proposed extension. All mitigation measures outlined in this EIS must be implemented to avoid and reduce any disamenity to local residents. Once closed and restored there will be no residual impact on the area.

As the potential negative interactions between factors associated with the operation of the landfill will be mitigated appropriately, the overall project will result in a net slight short-term impact to the local community.

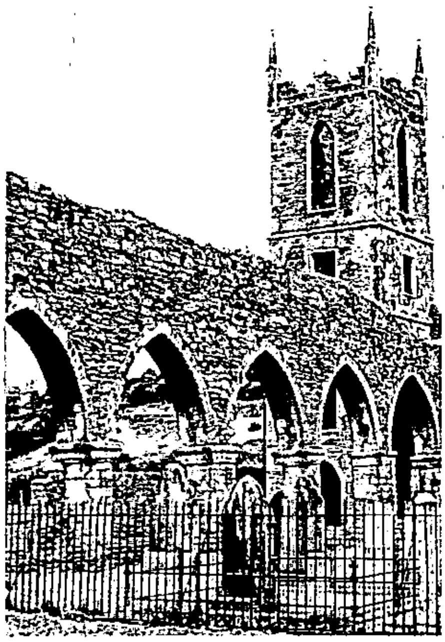
A local community fund will be established from landfill gate fees for the Rampere Community and the Baltinglass area to be used to develop local amenities to off-set the short-term impact. This fund will be managed by local directly affected by the landfill and will provide a significant resource to the community. A model for such a scheme is already operating at the Ballymurtagh Facility, Avoca, East Wicklow.

It is recommended that a local liaison group be established to review and discuss operation of the extended facility with the site management and members of Wicklow County Council on a regular basis.

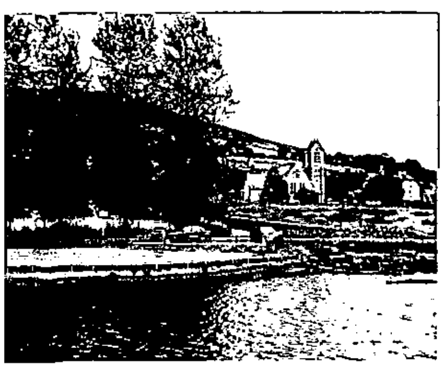
The proposal is part of a short-term strategic approach towards the better management of the County's waste and once closed and restored to an amenity area it will be beneficial to the local community.

EIS NO.
1654
PART 3 of 3

Comhairle Chontae Chill Mhantáin
WICKLOW COUNTY COUNCIL



Environmental Impact Statement for Proposed Extension to Rampere Landfill



VOLUME 3

Technical Appendices

COWI

November 2002

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DOCUMENT CONTROL SHEET

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F01	Final Issue	Warren Phelan	Conall Boland	Larry O'Toole	Sept 2002

ENVIRONMENTAL IMPACT STATEMENT

for the

Proposed Extension to Rampere Landfill

SEPTEMBER 2002

VOLUME 1	NON-TECHNICAL SUMMARY
VOLUME 2	MAIN REPORT
VOLUME 3	TECHNICAL APPENDICES

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GEOLOGY & HYDROGEOLOGY

B. J. MURPHY & ASSOCIATES (BMA)

BMA GeoServices

Geophysical Geotechnical Environmental

Report

Geological and Hydrogeological Study of the Proposed Landfill Extension at Rampere, West Co. Wicklow.

21st November 2001

BMA GeoServices Ltd.
Reg No. 335742
VAT No. 6355742G

DIRECTORS:
B.J. Murphy BSc (Hons), MSc,DIC,MIEI,FGS,
J.Murphy BSc.

AUTHORS	CHECKED	REPORT STATUS	DATE
Michael Gill/Davide Gallazzi Date	Bernard Murphy Date	Final Report	21st November 2001

Foreword

This report has been prepared by B.J. Murphy & Associates in line with best current practice and with all reasonable skill, care and diligence within the limits imposed by the survey technique applied and the resources devoted to it by agreement with the client. The interpretative basis for any conclusions or opinions contained therein should be taken into account in any future use of this report by the client and/or third parties

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	Drawing 608_009	Cross-Section 2
	Drawing 608_010	Cross-Section 3
	Drawing 608_011	Cross-Section 4 and Cross-Section 5

Appendix F **Surface Water Flow Monitoring Data**

Appendix G **Hydrochemical Data**

Appendix H **Geophysical Site Investigation Report**

1. INTRODUCTION

B.J. Murphy & Associates (BMA) were requested by M.C. O'Sullivan & Co. Ltd. on behalf of Wicklow County Council to undertake a study of the geology and hydrogeology of the Rampere area as part of the Environmental Impact Statement and waste license application for the proposed extension to the Rampere Landfill Facility.

1.1 Background

Rampere is located in west County Wicklow approximately 3 km north of Baltinglass as shown on Drawing 608_001 (Appendix A). The site of the existing landfill and the proposed extension area is bound to the south by the Rampere road and to the north by a stream that flows to the east into the River Slaney as shown on Drawing 608_002 (Appendix A). The existing landfill covers an area of approximately 5 acres. The proposed extension to the west will cover an additional area of 13.5 acres.

1.1.1 Topography

The topography of the Rampere area is hilly. The site is located in the valley between Tinoranhill (312 m high) and Ballyhook Hill (288m high) just east of Rampere crossroads. The stream that flows in the valley at Rampere has an invert level of 120.03maOD at the northwestern boundary of the existing landfill. Further to the east the valley joins the Slaney river valley and is bound by Saundergrove Hill (240m) and Tuckmill Hill (382m).

1.1.2 Land Use

Land use throughout the area is generally for pasture with some tillage in the valleys. Previously the field on the northern side of the stream opposite the proposed extension to the landfill at Rampere was also a landfill. This facility was closed and covered approximate 20 years ago. The old Tullow Branch of the Great Southern and Wicklow Railway passed through the valley at Rampere just to the north of the existing landfill facility. This line was closed and only some of the old railway bridges in the area remain and indicate its prior existence.

1.2 Objectives

A clearer understanding of the geological and hydrogeological conditions underlying the site is essential in understanding the impact that the proposed extension on the natural environment.

The detailed objectives of this study are to:

- Identify the ground conditions.
- Assess the aquifer potential.
- Assess the suitability of the proposed extension site with regard to geological and hydrogeological considerations.
- Determine the potential impact of the proposed extension on the hydrogeological regime in the area.

1.3 Scope of Work

The scope of work comprised:

1) A review of existing data from previous site investigation work.
2) A review of existing published data on the region.
3) Completion of a site investigation to include 12 no. trial pits, 3 no. trial trenches and 8 no. rotary coreholes.
4) Completion of a geophysical survey of the site.
5) Assessment of stream flow along the northern boundary of the site.
6) Assessment of stream hydrochemistry along the northern boundary of the site.
7) Completion of falling head tests.
8) Reporting on geology and hydrogeology of the proposed extension to the site.

1.4 Previous Work

The geological and hydrogeological conditions of the existing landfill site were considered in a previous geological and hydrogeological investigation carried out by B.J.Murphy & Associates for a full EIS and Waste Licence application for the existing landfill at Rampere, which was submitted to the EPA in September 1998.

2. FIELD INVESTIGATIONS

2.1 Geophysical Survey

A geophysical survey of the proposed site was completed during May 2000. The survey consisted of an EM31 Survey of the proposed site, 6 no. 2D-Resistivity profiles and 4 no. Seismic Spread profiles. The geophysical Report and associated maps and results are attached in Appendix H.

2.2 Site Investigation

2.2.1` Previous Drilling

Two Shell and Auger Boreholes were drilled on the existing landfill site in October 1998 by IGSL (Irish Geotechnical Services Ltd). The location of the boreholes is shown on Drawing 608_003 (Appendix A).

2.2.2` Trial Pits

A total of 12 no. trial pits were completed on the proposed site at the locations shown on Drawing 608_003. The trial pits were excavated using a Komatsu RC120. The pits were logged and sampled by BMA. Trail pit logs are attached in Appendix B.

2.2.3` Trial Trenches

A total of 3 no. trial trenches were completed on the proposed site at the locations shown on Drawing 608_003. The trial trenches were excavated using a Komatsu RC120. The trenches were logged by BMA. Trial trench logs are attached in Appendix C.

2.2.4` Rotary Drilling

A total of 8 no. rotary coreholes (BD1, BD2, BD3A, BD3B, BD4, BD5A, BD5B, BD6) were completed on site during June/July 2000. Of these 5 no. rotary coreholes were completed in the area of the proposed extension and 3 no. were completed on the existing site.

The drilling was carried out by Briody-Davis Site Investigation Ltd. using a Knebel Rotary Rig.

The logs for these boreholes are presented in Appendix D.

2.2.5 Flow Monitoring, Electrical Conductivity and Temperature Surveys

Surface flow monitoring surveys were conducted on four different occasions by BMA. Surface water flow in the streams was found to be in the order of 0.05 m^3/s (50 l/s). The full results of the flow monitoring surveys are included in Appendix F.

Electrical Conductivity and Temperature surveys were conducted in the streams adjacent to the site in two different occasions by BMA. EC and T were found to range 413-610 μS/cm and 11.7-12.3 °C respectively. Slightly different values were found for the running off discharge points and for the stream on the west of the site.

3. GEOLOGY

3.1 Regional Geology

The existing site and the proposed landfill extension is mapped as being underlain by the Butter Mountain Formation (GSI, 1996) as shown in Drawing 608_004. These are Lower Ordovician in age and consist of dark blue-grey slates, with pale siltstone and quartzite laminae. The Butter Mountain Formation is known to have metamorphosed to phyllites and schists close to the Granite aureole to the south and to the east of the site.

The intersection between the Butter Mountain Formation and the Pollaphuca Formation is mapped approximately 300 m to the west of the proposed landfill site (GSI, 1996). The Pollaphuca Formation consists of coarse grey greywacke sandstone and grits, and dark grey shales.

3.2 Site Geology

Exposures of overburden were noted in the southwest of the existing site on the steep bank below the road. The overburden at this location consisted of a brown gravelly clay. Towards the southeast of the existing site an exposure of sandy clayey gravel was recorded. The Ordnance Survey maps of the area also indicate that the area underlying the existing site and some of the ground on the proposed site is boggy.

A bedrock outcrop was noted below the road at the southeastern end of the existing site (beside the weighbridge) and this consisted of a light grey weathered slate dipping 30° to 55° to the northwest. Bedrock was also encountered in Trial Trench 3 and consisted of dark grey thinly laminated weathered MUDSTONE dipping 30° to 40° to the northwest.

The Ordnance Survey maps indicate that prior to landfilling the bedrock outcropped in a steep ridge in the southeastern corner of the landfill. The in-filled capped cell has subsequently covered this exposure.

3.2.1 Overburden Geology

Overburden at the proposed site was found to comprise gravelly sandy clay (Boulder Clay) and alluvial deposits (inter-bedded sands, silts and peats) of varying thickness. It is apparent from 2D- Resistivity profiles (*ref:* Appendix H) that the overburden varies in thickness from 0.5 m to 5 m over the proposed site.

A peat layer was recorded in some of the trial pits (*ref.* Section 3.2.4). Sand and gravel was noted in the stream banks and bed to the north of the site. Lacustrine Clay and some peat

layers were noted locally in the stream along the northern boundary of the proposed site and the existing site. Trial Pit logs are shown in Appendix C and summarised in Table 3.2.1.1.

Table 3.2.1.1 Summary of Trial Pits

Trial Pit	Depth (m)	Description
TP1	0-0.6 0.6-1.2 1.2-3.85 3.85-5.3	Topsoil Very sandy Gravel Grey fine sand, some peat Dark grey weathered bedrock
TP2	0-0.4 0.4-3.8 3.8-4.8	Topsoil Sandy gravelly Clay Grey sandy Gravel, some cobbles
TP3	0-0.5 0.5-1.1 1.1-1.7 1.7-3.45 3.45-4.2	Topsoil Brown Peat Grey gravelly Sand Grey sandy Silt Sandy Gravel
TP4	0-0.55 0.55-1.4 1.4-2.7	Topsoil Brown gravelly sandy Clay Weathered shale cobbles
TP5	0-0.4 0.4-2.3 2.3-3.2 3.2-3.5	Topsoil Brown sandy Clay Brown gravelly Clay Dark grey weathered Shale
TP6	0-0.45 0.45-1.9 1.9-2.5 2.5-3.7	Topsoil Brown clayey Gravel Brown sandy clayey Gravel Pale green sandy weathered Sandstone
TP7	0-0.5 0.5-4.2 4.2-4.9	Topsoil Brown gravelly Clay Slightly weathered Bedrock
TP8	0-2.3 2.3-3.8	Brown slightly gravelly sandy Clay Pale grey weathered Shale
TP9	0-0.2 0.2-5.1	Topsoil Sandy Silt
TP10	0-0.3 0.3-0.7 0.7-1.9 1.9-3.9	Topsoil Brown sandy Clay Very sandy Gravel Sandy gravelly Clay
TP11	0-0.3 0.3-0.6 0.6-1.1 1.1-1.35 1.35-1.66 1.66-4.4	Topsoil Brown sandy Clay Very sandy Gravel Brown Peat Grey Marl Brown sandy gravelly Clay
TP12	0-03 0.3-3.6 3.6-4.0 4.0-4.6	Topsoil Brown sandy gravelly Clay Light brown coarse Sand Pale green weathered Sandstone

3.2.2 Made ground

In 1998 two shell and auger boreholes were drilled in the existing landfill. SA1 (Shell & Auger Borehole No.1) was completed in the capped cell at the eastern end of the existing landfill. SA2 was completed at the northwestern edge of the existing landfill. The results of

the drilling indicated that the depth of Made Ground (mainly decomposed domestic waste) varies from approximately 9.8 m in the completed cell (SA1) in the east to approximately 5.5 m in the active area to the existing site to the west.

One further open-hole rotary corehole (BD5A, Appendix D) was completed in northeastern corner of the capped area of the existing landfill during June 2000. Made Ground was found to exist to a depth of 9.10 m below ground level at that location.

3.2.3 Clay

Boulder Clay (gravelly sandy clay) was encountered in TP7, TP8 and TP12 on the higher ground at the south of the proposed site. Boulder Clay was found to have a varying thickness of between 2 m to 5 m. Boulder Clay thickness of between 0.5 m and 2.2 m were recorded along 2D-Resistivity Profile 4 (*ref:* Appendix H). Boulder Clay thickness of 4.2 m and 3.6 m were recorded in Trial Pits TP7 and TP12 respectively (Appendix B). The 2D-Resistivity profiles (2D-Resistivity Profile 1 to 2D Resistivity Profile 6, Appendix H) show that Boulder Clay is underlain by weathered rock. Map 3 (Appendix H) shows the distribution (in thickness and coverage) of Boulder Clay over the proposed site.

3.2.4 Alluvial Deposits

These consist of silts, fine sands and gravels, which are found in the lower ground along the central and northern areas of the site. This area is the flood plain for the stream, which forms the northern boundary of the site. The silts, sands and gravels were found in four of the trial pits, with the sands containing some peat layers. The stream deposited the silts and sands over time, with the peat layers being deposited during episodes of flooding. The gravel is sandy, clayey, with rounded cobbles of sandstone and shale. The silt is soft to firm, with increasing sand content with depth.

It seems likely that the stream to the north of the site was diverted at the western end of the proposed site possibly during construction of the old railway line. This would account for the variability of the overburden, including the alluvial deposits, on the northern edge of the proposed site.

Some alluvial deposits were also recorded during drilling under the existing landfill in 1998. Sand and silt layers were encountered and the sand layer was found to contain some layers of peat similar to those recorded in TP1, TP3 and TP11.

3.2.5 Bedrock Geology

A fault (north-south orientation) which forms the boundary between the Butter Mountain Formation and the Pollaphuca Formation is mapped approximately 300 m west of the site.

Small-scale faulting associated with the main fault seem to have affected the rock quality in the area causing numerous fractures and secondary faulting to occur in the weaker mudstones.

A total of six rotary core boreholes were drilled across the site. Two of these, BD5 and BD6, were drilled within the boundary of the existing landfill. BD4 was drilled at the top of the slope at the southern boundary of the proposed site and BD1, BD2, and BD3 were drilled across the central and northern areas of the proposed site. The rotary corehole drilling logs are presented in Appendix D and summarised in Table 3.2.5.1. Geophysical sections were carried out across the site, with a line of seismic spreads carried out along the southern boundary of the site. A resistivity profile was carried out parallel to the seismic line and slightly to the north. A further five resistivity profiles were carried out running N-S across the site.

Three rock types were identified during the drilling, which was corroborated by the geophysical sections produced from the interpreted geophysical data. A fine-grained Mudstone, a fine-grained Sandstone and a fine grained calcareous Limestone.

Dark grey to black, very fine grained, thinly laminated, highly to slightly weathered MUDSTONE, being weak to moderately strong and having quartz veining in places was encountered in all of the drilled rotary coreholes (i.e. BD1 to BD6, excluding BD3A and BD5A). Total core recovery (TCR) for the mudstone ranged 50-100%, with the solid core recovery (SCR) ranging from 0-66% and the Rock Quality Designation (RQD) ranging 0-40%.

Table 3.2.5.1 Summary of Drilling Logs

BD No.	Depth (m)	Description
BD1	0-6 6-8.73 8.73-12	Overburden Dark grey fine grained Mudstone Grey fine grained Sandstone
BD2	0-6 6-15	Overburden Dark grey very fine grained Mudstone
BD3A	0-5.6 5.6-7	Overburden Mudstone
BD3B	0-5.6 5.6-15	Overburden Dark grey fine grained Mudstone
BD4	0-5.95 5.95-9.5 9.5-10 10-23.5	Overburden Dark grey very fine grained Mudstone Dark grey fine grained Limestone Dark grey very fine grained Mudstone
BD5A	0-8	Fill (Household Waste)
BD5B	0-9.0 9.1-14 14-19	Fill (Household Waste) Overburden Black very fine grained Mudstone
BD6	0-0.15 0.15-10.75	Overburden Dark grey fine grained Mudstone

A grey fine grained moderately weathered and moderately strong to strong SANDSTONE was encountered in BD1 at a depth of 8.73 mbgl. The TCR for the Sandstone was 100%, the SCR 30% and the RQD 10%.

A small bed (0.5 m thick) of limestone was encountered in BD4 at a depth of 9.5 mbgl, and consisted of a dark grey calcareous, slightly to moderately weathered LIMESTONE, being moderately strong to strong, and having some iron staining along the discontinuity surfaces. The TCR for the Limestone was 66%, the SCR 20% and the RQD 12%.

Core recovery moderate to poor and RQD's (Rock Quality Designation) ranged from 0 to 40%.

3.3 Geological Cross-Sections

Five geological cross-sections are shown in Appendix E. The plan locations of these cross-sections are shown on Drawing 608_007 (Appendix E). The geological profile along the cross-sections was generated using data from rotary corehole logs, shell and auger logs, trial pit logs, trial trench logs, and interpreted engineering geophysical data (*ref.* Appendix B, C, D, E and G respectively).

4. HYDROLOGY AND HYDROCHEMISTRY

4.1 Drainage

Drainage over the general area is fairly good, probably due to the steep slopes causing rapid runoff. The lower flat lying areas seem to be poorly drained as some ponding of water during periods of rainfall was noted. The presence of peat in some of the trial pits and rotary coreholes also suggests the existence of older wetter areas within the site. A concrete pipe (D2), approximately 1 m od (outer diameter) discharges to the stream at the northwestern corner of the landfill and this is reported to drain surface water from the road to the west of the site. A wavin pipe (D1), approximately 0.1m od, discharges to the stream at the north-eastern corner of the landfill and this is reported to drain surface water from the road to the east of the site. The locations of these pipes are shown on drawing 608_005.

4.2 Surface Water

The Rampere site lies within the Slaney River catchment. The northern boundary of the site is marked by a stream (ST1), which flows to the east and meets the Slaney River approximately 700 m downstream of the existing landfill. The estimated dry weather flow for the Slaney, calculated from a gauging station at Rathvilly approximately 10 km downstream, is 0.64 m^3/s. Average flows for the period 1976 to 1981 were 5.59 m^3/s (MacCartaigh, 1997).

Three stage-boards (SG1, SG2 and SG3) were installed in the stream at the locations shown on Drawing 608_002 on 18th June 2000. Flow monitoring was completed on 26th June 2000, 29th June 2000, 16th March 2001 and 10th May 2001. The calculated flows are presented in Table 4.2.1., while the complete data is included in Appendix F.

On 26th June the flow in the stream was approximately 0.050 m^3/s (50 l/s) over the length of the site. The flow was measured again on the 29th June but the water flow was only slightly larger than on 26th June. Further flow measurements were taken on the 16th March and 10th May 2001. Data from these flow measurements indicate that the flow across is due mainly to surface water with a slight influence from groundwater.

Minor variations in flow at each of the stage boards can be attributed to measurement errors. caused by turbulent flows, eddies, moving stream beds and channel roughness.

From the measurements made on the 26th and 29th June there is no increase in flow in the stream from the western end of the site toward the eastern end of the site. Measurements made on the 16th March and 10th May 2001 indicate that there is a slight increase in flow in the stream from the western end of the site toward the eastern end of the site.

Table 4.2.1 Stream Flow Data

Borehole No.	Flow (m^3/s) 26/06/00	Flow (m^3/s) 29/06/00	Flow (m^3/s) 16/03/01	Flow (m^3/s) 10/05/01
SG1	0.0472	0.0492	0.110	0.058
SG2	0.0509	0.0526	0.133	0.072
SG3	0.0496	0.0523	0.123	0.085

4.3 Hydrochemistry

An Electrical Conductivity (EC, µS/cm @ 25°C) and Temperature (°C) survey was carried out on 7th July 2000 and repeated on 10th May 2001, along the streams to the west and the north of the site. The survey was carried out to assess the contribution of groundwater flow to stream flow along the site boundary. If there were significant contributions from groundwater sources then a slight increase in electrical conductivity would be detected during the survey. This would help to locate fault zones as they intersect the stream.

The results of the Electrical Conductivity and Temperature survey are presented in Appendix G. The locations and data from the survey are presented on Drawing 608_005 (Appendix A).

It is apparent from the results of the survey that the EC and temperature of the stream water in ST1 was fairly consistent over the length of the site. The EC values recorded in the stream ranged between 431-610µS/cm and the temperatures recorded ranged between 11.7-12.3°C. Lower EC values were recorded in the stream to the west of the site (ST2). This may be because the stream flows from higher ground and more of the stream water can be attributed to surface run-off rather than groundwater baseflow.

Water was also surveyed from the drains that discharge in the stream at the eastern and western end of the existing landfill. These drains apparently allow water to drain from the road and a spring on the higher southern boundary of the site. Water from monitoring point No. 27 to the east of the existing landfill had an EC of 450 µS/cm and a temperature of

14.7°C on 07/07/2000 and 468 µS/cm and 10.7°C respectively on 10/05/2001. Water from monitoring point No. 17 to the west of the existing landfill had an EC of 315 µS/cm and a temperature of 12.0°C on 07/07/2000 (328 µS/cm and 10.3°C respectively on 10/05/2001).

It is our opinion that most of the water flowing in the stream on the day of the EC and Temperature survey was surface water.

5. HYDROGEOLOGY

5.1 Regional Hydrogeology

The River Slaney dominates the regional hydrogeology of the Rampere area. In general groundwater will flow into the River Slaney via streams and surface drainage channels as baseflow. The Butter Mountain Formation has been classified as a locally important aquifer – moderately productive only in local zones (LI) by the Geological Survey of Ireland under the groundwater protection scheme for Co. Wicklow.

5.2 Local Hydrogeology

Locally groundwater was generally encountered in the weathered bedrock strata. In some instances the groundwater was found to be confined by the (sandy clays, silts) alluvial deposits and the organic peat strata. In flows in the base of trial pits were generally fast. TP1 filled from the base (5.3 mbgl) of the trial pit to a depth of 4.6 mbgl in 40 minutes implying an inflow of $5.8 \cdot 10^{-4}$ m^3/s. TP2 filled from 3.4 mbgl to a depth of 2.4 mbgl in 25 minutes, implying an inflow of approximately $1.3 \cdot 10^{-3}$ m^3/s. An inflow of $8.7 \cdot 10^{-4}$ m^3/s was recorded at TP9.

The groundwater recorded in trial pits was generally an orange/brown colour. Examination of the rock cores from the site investigation showed the presence of iron staining. The existence of iron staining in fractures and discontinuities and the disturbance caused by the trial pitting would have caused the orange brown colour in the groundwater. No colour change was noted along the stream to the north of the site during the electrical conductivity survey.

Due to the nature of the overburden groundwater flow in this material is likely to be inter-granular (i.e. primary permeability). Permeability in the alluvial deposits is probably moderate to high due to the sandy nature of the material. The boulder clay encountered over the southern area of the site probably has a lower permeability. This material may be suitable for use as liner clay. Permeability testing and PSD (Particle Size Distribution) analysis should be carried out to assess its suitability.

5.3 Bedrock Hydrogeology

The drilling has indicated that the bedrock in the area of the proposed extension to the landfill is moderately to highly weathered and the rock quality is generally moderate to poor having RQD ranging from 0 to 40%. This implies that the bedrock is highly fractured and it is within these fracture zones that the majority of groundwater flow is likely to occur (i.e. secondary permeability).

Falling-head tests were completed in all of the new boreholes (BD1-BD6). The results of the tests are presented in Table 5.3.1.

Water level recovery in all of the boreholes was very fast. In some cases the recovery was too fast to measure.

Table 5.3.1. Falling-head tests results.

Borehole No.	Permeability (k, m/s)	Comment
BD1	1.9×10^{-4}	Test completed twice (average value)
BD2	-	Test completed twice, but recovery was too fast to measure
BD3A	-	Test completed twice, but recovery was too fast to measure
BD3B	7.0×10^{-4}	Test completed once
BD4	6.2×10^{-5}	Test completed once
BD5A	8.6×10^{-5}	Test completed once
BD5B	3.3×10^{-5}	Test completed once
BD6	-	Test completed twice, but recovery was too fast to measure

5.4 Groundwater levels

Groundwater levels recorded on 29th June and 06th July are presented in Table 5.4.1. The existing ground level and reduced water levels, in meters above Ordnance datum, are also shown in the same Table.

Table 5.4.1 Groundwater Levels.

Borehole No.	Ref Level (moD)	Ground Level (moD)	w/l mbref 29/06/00	Reduced w/l 29/06/00	w/l mbref 06/07/00	Reduced w/l 06/07/00	w/l mbref 16/03/01	Reduced w/l 16/03/01	w/l mbref 10/05/01	Reduced w/l 10/05/01
BD1	124.84	124.09	1.1	123.74	1.15	123.690	0.62	124.22	0.88	123.96
BD2	123.165	122.71	1.77	121.395	1.79	121.375	1.22	121.945	1.65	121.515
BD3A	122.235	121.91	1.575	120.66	1.50	120.735	0.89	121.345	0.55	121.685
BD3B	122.12	121.87	1.37	120.75	1.38	120.74	1.02	121.1	1.42	120.7
BD4	142.08	141.69	17.61	124.47	17.71	124.37	14.62	127.46	16.21	125.87
BD5A	128.95	128.56	2.99	125.96	n/a	--	--	--	8.73	120.22
BD5B	128.86	128.54	8.90	119.96	8.91	119.95	--	--	6.47	122.39
BD6	129.59	129.19	8.81	120.78	8.84	120.75	--	--	8.83	120.76

A groundwater contour map for the site of the proposed extension to the landfill and the existing landfill is shown on Drawing 608_005 (Appendix A). It is apparent from the available data that groundwater flows from the southwest of the site towards the northeast in the direction of the stream at of the site boundary. Recharge to the bedrock aquifer probably occurs on higher ground to the south and southwest of the Rampere site.

Groundwater levels are likely to fluctuate according to seasonal variations in recharge (i.e. winter and summer groundwater levels).

Groundwater levels in BD3A and BD3B are similar and suggests that there is hydraulic continuity between the bedrock aquifer and the overburden

5.5 Pump Test

MCOS designed and supervised a pump test which was carried out on site by Fogarty Drilling Ltd. between the 15th of August and the 24th of August 2001, in order to determine the transmissivity of the aquifer. A copy of the report was forwarded by MCOS to BMA for review.

A well, 20 cm in diameter, was drilled on site to a depth of 27m bgl. A total of 4 no. monitoring wells were installed in the immediate surroundings of the well.

A step down test was carried out on 15th August 2001, which allowed selecting a discharge value of 4m^3/hour for the constant yield pump test.

The constant yield pump test started on 21st August 2001 and ended on 24th August 2001. During the test the discharge rate was increased to 4.3 m^3/hour and then to 5.2 m^3/hour, rate that was maintained for ca. 49.5 hours.

The test data were analysed with the Jacob Method and provided a transmissivity value of 1.35×10^{-4} m^2/s and, assuming an aquifer thickness of 22m, a permeability value of 0.6×10^{-5} m/s. Permeability values of 2.6×10^{-5} m/s were also obtained for both the confined aquifer and the unconfined situation.

These values are consistent with the values inferred by the falling head tests

5.6 Groundwater Vulnerability

In the area of the proposed extension to the landfill site the overburden cover consists of alluvial deposits and boulder clays as described in Section 2.3. The thickness of the overburden cover varies from 1 m to 5 m. The alluvial deposits have a moderate to high permeability due to the sandy nature of that material. Therefore the groundwater

vulnerability category for the proposed extension to the landfill is assessed as *High to Extreme* using the guidelines of the Groundwater Protection Scheme (DoELG/PA/SI, 1999).

5.7 Aquifer Potential

The Butter Mountain Formation has been classified as a locally important aquifer – moderately productive only in local zones (LI) by the Geological Survey of Ireland under the groundwater protection scheme for Co. Wicklow. The well yield determined during the pump test confirms this classification.

Large groundwater strikes were encountered during drilling in the bedrock in the area of the proposed extension indicating that the bedrock aquifer in the area is probably a locally important aquifer. However, the groundwater was generally found to be of poor quality and contains high levels of levels of iron and manganese (TE Lab Results, 2000).

5.8 Summary

The Butter Mountain Formation has been classified as a locally important aquifer (LI). The proposed extension area to the landfill has a vulnerability rating of high to extreme. This implies that the proposed site lies within zone $R2^1$ to $R2^2$ of the Groundwater Protection Scheme Response Matrix for Landfills.

6. CONCLUSIONS

a) The overburden deposits at the site comprise clays and alluvial deposits. The clays comprise dry firm brown sandy gravelly clay (Boulder clay) and are found on the higher ground to the south of the site. The alluvial deposits consist of silts, fine sands and gravels and are found close to the stream along the northern boundary of the site.

b) The inter-bedded soft silts and peat that exist on the northern edge of the proposed landfill are likely to settle under loading from the proposed extension to the landfill.

c) The variability of the overburden deposits and the presence of sand and sandy gravel layers found in TP1, TP3, and TP10 suggest possible preferential pathways for groundwater flow (and leachate migration) may exist in the overburden on the northern edge of the proposed site.

d) The boulder clay encountered over the southern area of the site could be used as a liner clay but further testing, both in-situ and laboratory, must be undertaken in order to assess its suitability.

e) The bedrock geology of the site is complex and comprises of inter-bedded fine-grained Mudstone, fine grained Sandstone and fine grained calcareous limestone.

f) Total core recovery (TCR) for the Mudstone ranged from 50-100%, with the solid core recovery (SCR) ranging from 0-66% and the Rock Quality Designation (RQD) ranging from 0-40%.

g) The TCR for the Sandstone was 100%, the SCR 30% and the RQD 10%.

h) The TCR for the Limestone was 66%, the SCR 20% and the RQD 12%.

i) Core recovery during drilling was moderate to poor and RQD's ranged from 0 to 40%.

j) The fault that forms the boundary between the Butter Mountain Formation and the Pollaphuca Formation passes close to the site. Small-scale faulting associated with this main fault seems to have affected the rock quality at the site. It is apparent from both the drilling logs and the geophysical survey that numerous fractures and discontinuities are present in the bedrock under the site.

k) Stream flows were recorded on the 26/06/2000, 29/06/2000, 16/03/2001 and 10/05/2001 at SG1, SG2 and SG3. The flows recorded varied from 0.0472 m^3/s to 0.133 m^3/s. There was very little recorded change in flow over the length of the site. It is possible that there is a small baseflow contribution to the stream along the length of the site but there seems to be no major inflow from fault zones.

l) No major baseflow contributions to ST1 were identified during the electrical conductivity survey. The EC values recorded in the streams (ST1 and ST2) ranged between 431-610μS/cm and the temperatures recorded ranged between 11.7-12.3°C. Lower EC values were recorded in the stream to the west of the site (ST2).

m) Electroconductivity and Temperature data registered from monitoring point No.27 to the east of the existing landfill and monitoring point No. 17 to the west of the existing landfill are in line with what is expected for surface water.

n) Groundwater inflows were recorded in TP1, TP2, TP3, TP7, TP9, TP10 and TP11. Large water strikes were also recorded during rotary corehole drilling.

o) It is apparent from the available data that groundwater flows from the southwest of the site towards the northeast in the direction of the stream at of the site boundary. However the EC and Temperature surveys suggest that there is no significant groundwater contribution to the stream flow. Recharge to the bedrock aquifer probably occurs on higher ground to the south and southwest of the Rampere site.

p) Groundwater levels are likely to fluctuate according to seasonal variations in recharge (i.e. winter and summer groundwater levels).

q) Falling head permeability tests were completed in all of the new boreholes. The permeability values recorded varied between 7.0×10^{-4} m/s and 3.3×10^{-5} m/s.

r) A pump test was undertaken, revealing a transmissivity value of $1.35\text{x}10^{-4}$ m^2/s. Permeability values of 2.6 10^{-5} m/s were inferred using the formulas provided in BS5930. These values are consistent with those inferred by the falling head tests and reported in the above paragraph.

s) The Butter Mountain Formation has been classified as a locally important aquifer – moderately productive only in local zones (Ll). This classification is confirmed by the well yield as

determined during the pump test. Large groundwater strikes were encountered during drilling in the bedrock in the area of the proposed extension. However, the groundwater was generally found to be of poor quality and contains high levels of iron and manganese. .

t) The groundwater vulnerability category for the proposed extension to the landfill is assessed as *High to Extreme*.

u) The site lies within zone $R2^1$ to $R2^2$ of the Groundwater Protection Scheme Response Matrix for Landfills. This implies that construction of an extension to the landfill is geologically and hydrogeologically acceptable, although certain design considerations must be considered in order to prevent the possibility of leachate migration to groundwater and surface water.

7. RECOMMENDATIONS

a) The thickness of overburden cover at the site is less than 5 m in places and the bedrock quality is poor. In order to protect the groundwater at the site any proposed landfill design should be engineered to eliminate the potential risk of groundwater contamination.

b) In order to protect the surface water stream (ST1) along the northern boundary of the site any proposed landfill design should be engineered to eliminate the potential risk of surface water contamination.

c) Groundwater monitoring and surface water monitoring should be continued to comply with EPA requirements (EPA, 1995).

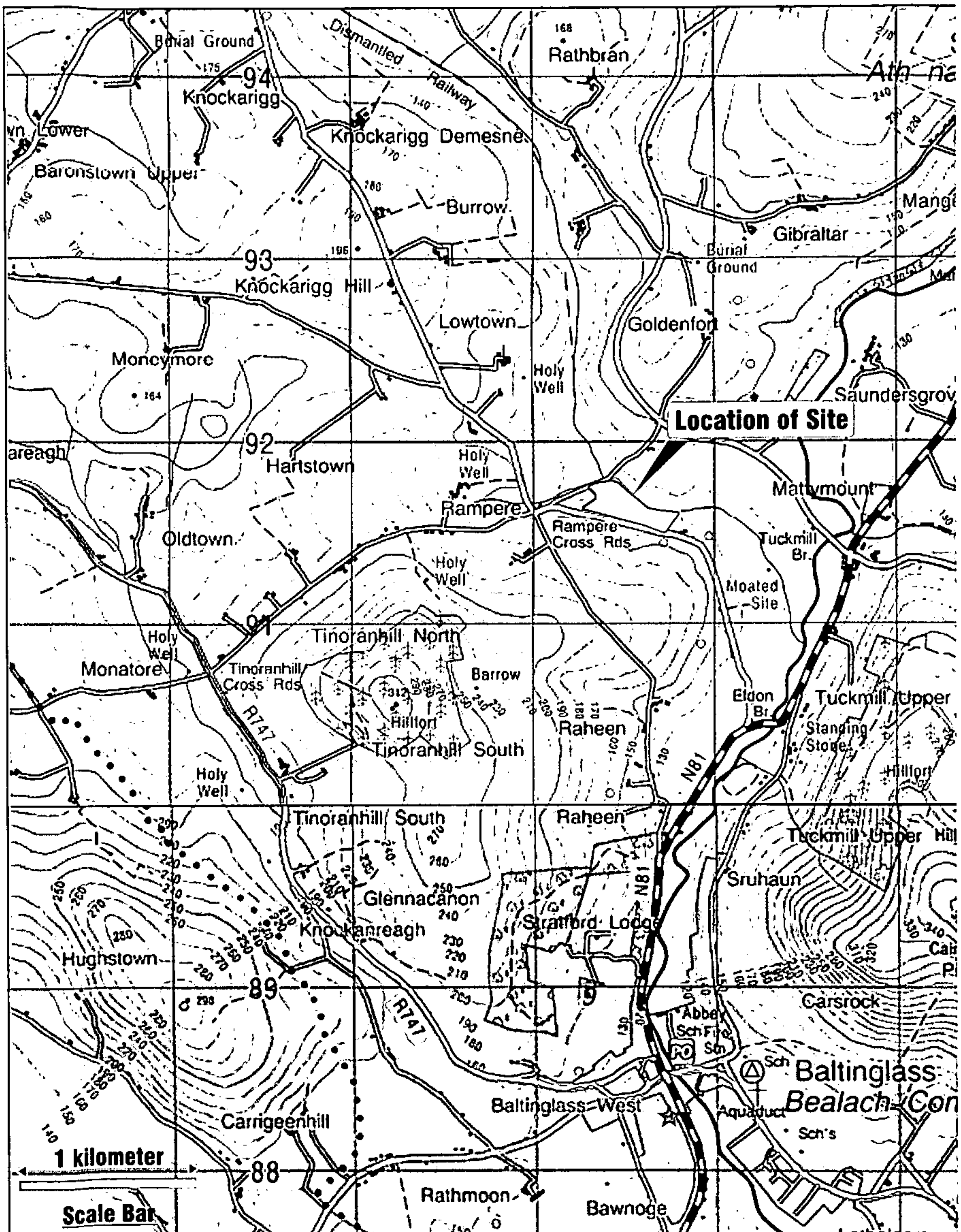
d) Groundwater quality monitoring and surface water quality monitoring should be continued as per EPA specifications (EPA, 1995).

e) In order to assess the suitability of the boulder clay encountered over the southern area of the site as a liner material further in-situ and laboratory testing of the boulder clay should be completed. The permeability and soil classification of the various overburden materials encountered at the proposed site should be tested.

References

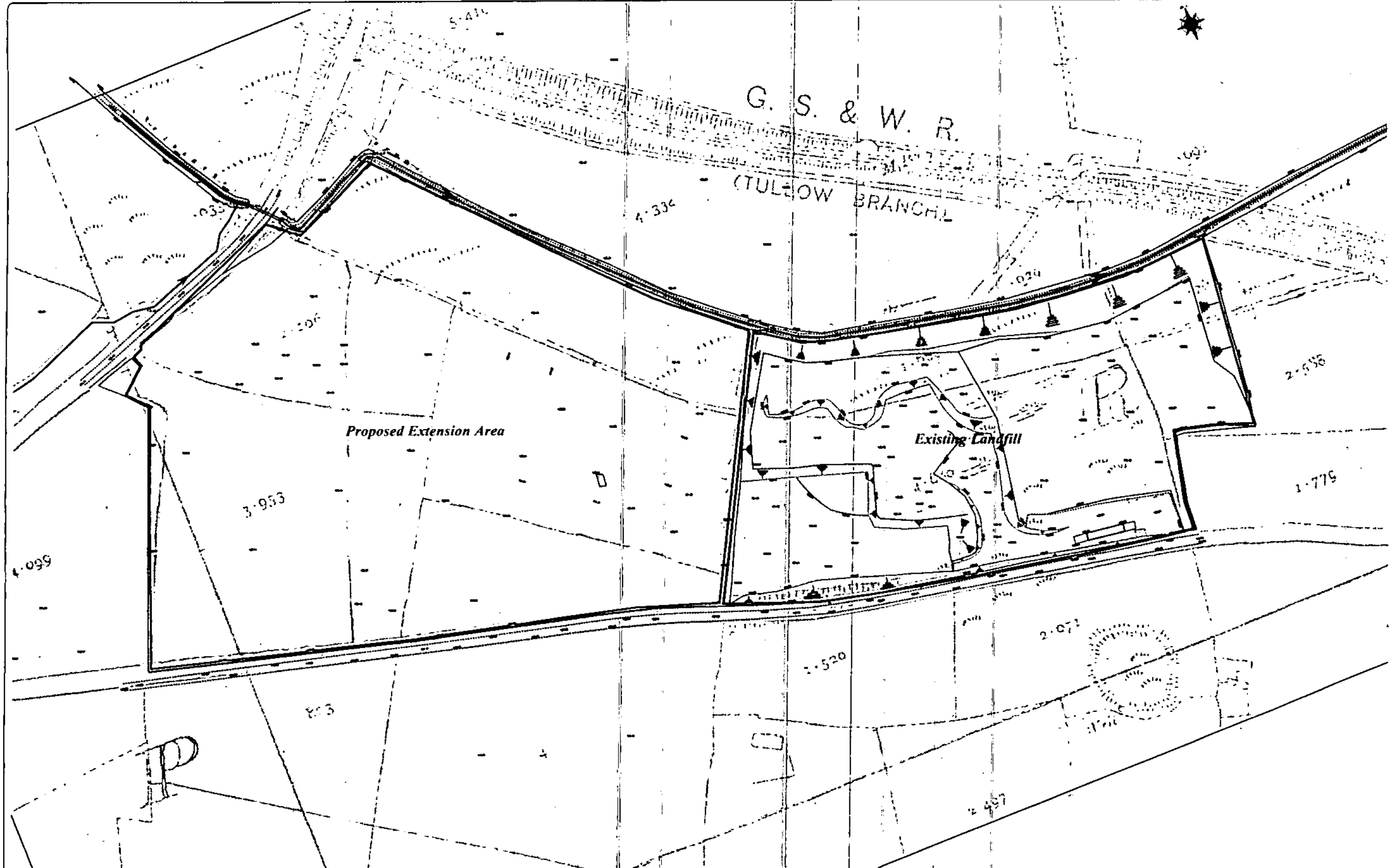
- Environmental Protection Agency, Landfill Manuals: Landfill Monitoring, 1995.
- MacCartaigh, M. (1997). Hydrological Data, Environmental Protection Agency.
- McConnell, B. and Philcox, M.E., 1995. Geology of Kildare and Wicklow. Geological Survey of Ireland.

APPENDIX A



ORDNANCE SURVEY IRELAND LICENCE NUMBER EN 0003100 © GOVERNMENT OF IRELAND. THIS IS A SCHEMATIC.

CLIENT Wicklow County Council ENGINEER M.C. O'Sullivan Consulting Engineers	JOB Proposed Rampere Landfill Extension	BMA B J Murphy & Associates Geotechnical Engineering Engineering Geology Engineering Geophysics Groundwater Engineering
DRG NO: 608001 — DRAWN: PAUL O'REILLY SCALE: SEE ABOVE — CHECKED: M.O. DATE: JULY 2000 — BASED ON: O.S. SHEETS 55 & 61	TITLE Site Location Figure	BMA, Kennedy Street, Carlow Town, Co. Carlow, Ireland. PHONE: 353-503-34488 FAX: 353-503-34490 E-MAIL: BMACARLOW@BMA.IE



Site Map

Proposed Rampere Landfill Extension.

Client: Wicklow Co.Co.

Engineer: M.C.O'Sullivan & Co. Ltd.

Drg No: 608_002

BMA
B J Murphy & Associates
Geotechnical Engineering
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Mobile: 087-2477923
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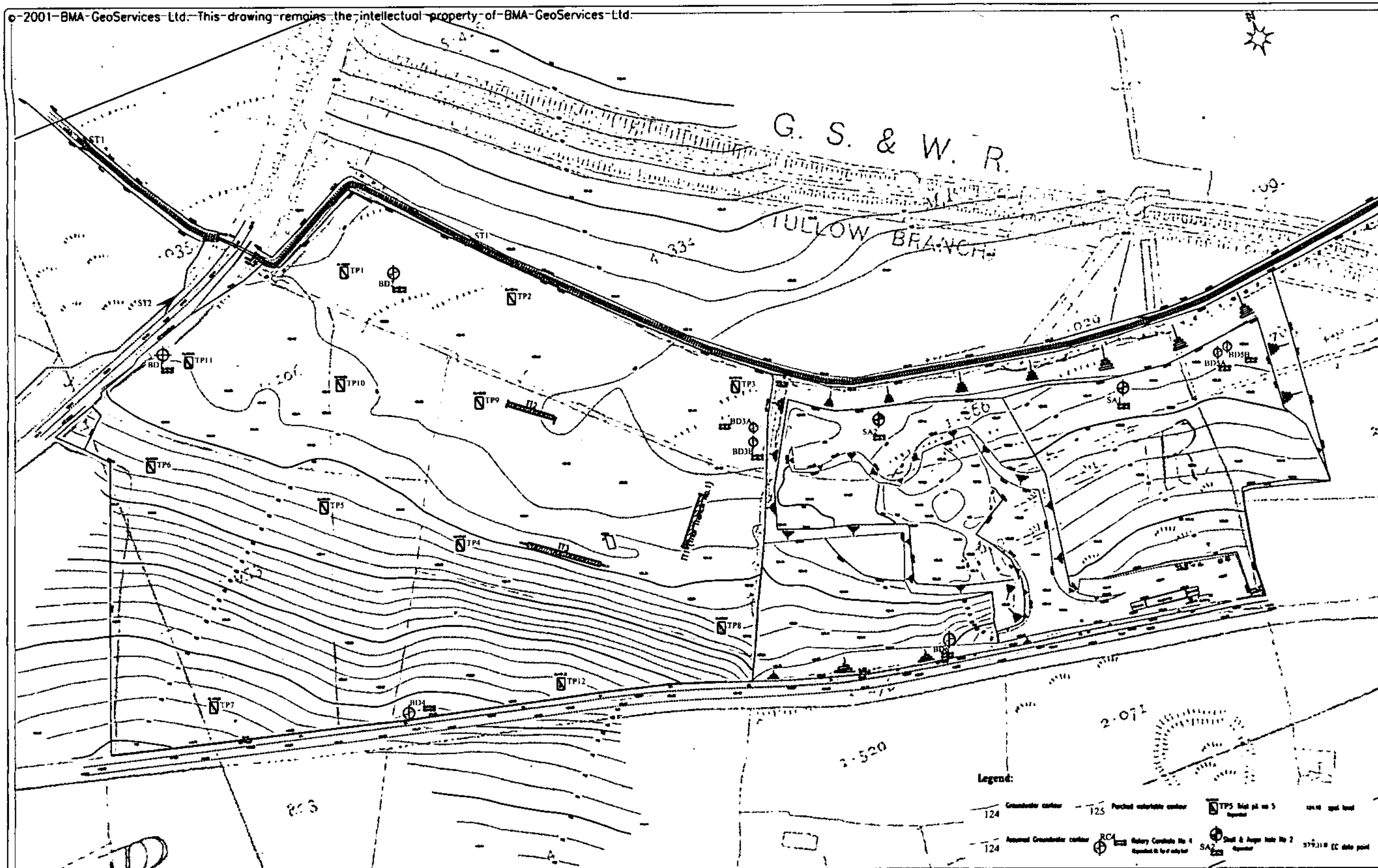

BMA Geotechnical Geological Geophysical Environmental
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Co. Carlow
Ireland.
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Fax: 353-503-34490
E-mail: bmacarlow@bma.ie

Site Investigation Location Map including site survey data.

Proposed Rampere Landfill Extension.

Wicklow Co.Co.

M.C.O'Sullivan & Co. Ltd.

Drg No: bma608_004

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E-mail: bmacarlow@bma.ie

1 Kilometer
Scale Bar

KEY:

▭	Site Location
GD:	Glen Ding Formation
PO:	Pollaphuca Formation
BZdo:	Donard Andesite Member
BZ:	Butter Mountain Formation
LqCw:	Carrowoystick Aplite
Tw2e:	Type 2 Equigranular Granite
app:	Appinite

Title:	Job:	Client:	
REGIONAL GEOLOGY	Proposed Extension to Existing Landfill	Wicklow Co. Council Engineer: M.C. O' Sullivan & Co. Ltd.	Drg No: 608_004

Drawn: P.O'Reilly	Scale: See Above	Date: Nov. 2001	Checked: M.G.	Based On: G.S.I. 1995

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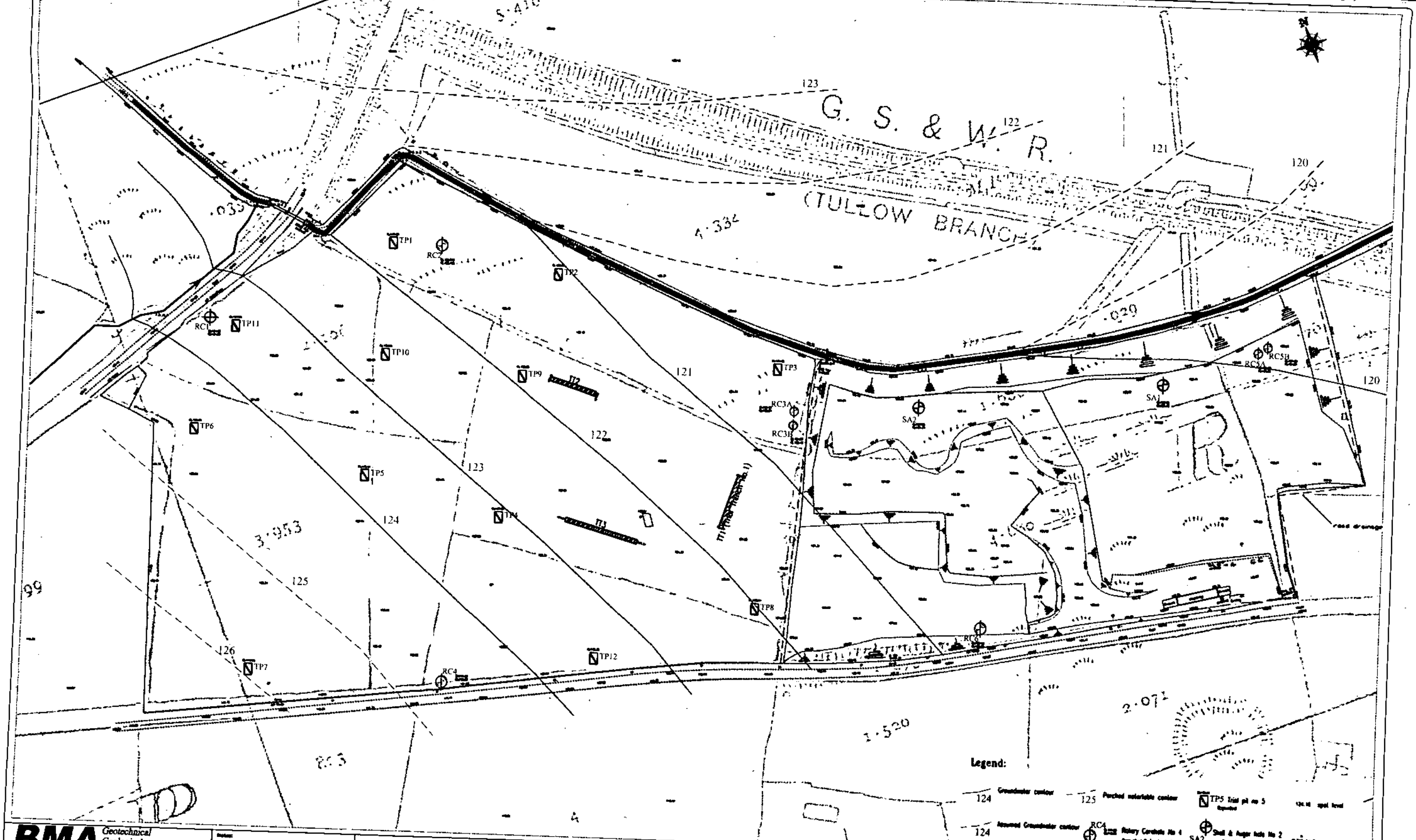
Fax: 353-503-34490
E-mail: bmacarlow@bma.ie



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Title:	Groundwater Contour Map. Electrical Conductivity Survey Data.
Job:	Proposed Rampere Landfill Extension.
Client:	Wicklow Co.Co.
Engineer:	M.C.O'Sullivan Consulting Engineers
Scale:	1:1500
Drg No:	bma608_004

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APPENDIX B

Geotechnical Trial Pit Record

BMA — B J Murphy & Associates — Geotechnical Engineering, Engineering Geology, Engineering Geophysics, Environmental Hydrology

Client : Wicklow County Council

Contractor :

Location : Rampere, Co Wicklow
Ground Level (mod) :
Date Excavated : 13/06/2000
Excavated By :

Logged By : M Gill
Final Depth : 5.3
Sheet 1 of 1

Project : Rampere Landfill Extension

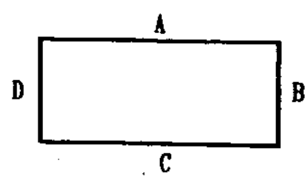
Trial Pit No : TP1

DOWNHOLE DEPTH (m)	DESCRIPTION	LEGEND	ELEVATION	DEPTH (m)	SAMPLES REFERENCE NUMBER	SAMPLES SAMPLE TYPE	SAMPLES DEPTH RECOVERED	WATER DEPTH	FIELD TEST RESULTS N-Value
0	Brown sandy Clay, TOPSOIL			0.60					
	Orange very sandy GRAVEL			1.20	S1	Bag	1.0		
1	Grey fine SAND with some layers of Peat								
2					S2	Bag	2.5		
3				3.85					
4	Dark grey sandy weathered bedrock, some Shale and Sandstone								
5				5.30				∇ 5.2	

KEY
∇ – Water Strike
D – Disturbed Sample
B – Bulk Disturbed Sample
W – Water Sample
U – Undisturbed Sample
P – Piston Sample
C(N) – Cone Penetration Test
S(N) – Standard Penetration Test
N – Blows /300mm
V – Vane Test

Remarks :

Orientation :



Geotechnical Trial Pit Record

BMA — B J Murphy & Associates — Geotechnical Engineering, Engineering Geology, Engineering Geophysics, Environmental Hydrology

Client : Wicklow County Council

Contractor :

Location : Rampere, Co Wicklow
Ground Level (mod) :
Date Excavated : 13/06/2000
Excavated By :

Logged By : M Gill
Final Depth : 4.8
Sheet 1 of 1

Project : Rampere Landfill Extension

Trial Pit No : TP2

DOWNHOLE DEPTH (m)	DESCRIPTION	LEGEND	ELEVATION	DEPTH (m)	SAMPLES: REFERENCE NUMBER	SAMPLES: SAMPLE TYPE	SAMPLES: DEPTH RECOVERED	WATER DEPTH	FIELD TEST RESULTS N-Value
0	Grey sandy Clay, TOPSOIL			0.40					
	Orange/brown sandy CLAY with some cobbles								
1				1.80					
2	Firm grey slightly gravelly CLAY				S1	Bag	2.2		
3				3.80				∇ 3.4	
4	Grey rounded sandy GRAVEL, with rounded Sandstone and laminated Shale cobbles				S2	Bag	4.6		
				4.80					

KEY
∇ - Water Strike
D - Disturbed Sample
B - Bulk Disturbed Sample
W - Water Sample
U - Undisturbed Sample
P - Piston Sample
C(N) - Cone Penetration Test
S(N) - Standard Penetration Test
N - Blows /300mm
V - Vane Test

Remarks :

Base of pit collapsing

Orientation :

A
D B
C

Geotechnical Trial Pit Record

BMA
B J Murphy & Associates
Geotechnical Engineering
Engineering Geology
Engineering Geophysics
Environmental Hydrology

Client : Wicklow County Council
Contractor :

Location : Rampere, Co Wicklow
Ground Level (mod) :
Date Excavated : 13/06/2000
Excavated By :

Logged By : M Gill
Final Depth : 4.2
Sheet 1 of 1

Project : Rampere Landfill Extension

Trial Pit No : TP3

DOWNHOLE DEPTH (m)	DESCRIPTION	LEGEND	ELEVATION	DEPTH (m)	SAMPLES REFERENCE NUMBER	SAMPLES SAMPLE TYPE	SAMPLES DEPTH RECOVERED	WATER DEPTH	FIELD TEST RESULTS N-Value
0	Light brown sandy Clay TOPSOIL								
	Brown fibrous PEAT			0.50					
1	Grey coarse gravelly SAND			1.10					
2	Firm grey sandy SILT			1.70					
3									
4	Sandy GRAVEL, with rounded cobbles of Sandstone			3.45					
				4.20					

KEY
∇ – Water Strike
D – Disturbed Sample
B – Bulk Disturbed Sample
W – Water Sample
U – Undisturbed Sample
P – Piston Sample
C(N) – Cone Penetration Test
S(N) – Standard Penetration Test
N – Blows /300mm
V – Vane Test

Remarks :

Orientation :

A
D B
C

Geotechnical Trial Pit Record

BMA — B J Murphy & Associates — Geotechnical Engineering, Engineering Geology, Engineering Geophysics, Environmental Hydrology

Client : Wicklow County Council

Contractor :

Location : Rampere, Co Wicklow
Ground Level (mod) :
Date Excavated : 13/06/2000
Excavated By :

Logged By : M Gill
Final Depth : 2.3
Sheet 1 of 1

Project : Rampere Landfill Extension

Trial Pit No : TP4

DOWNHOLE DEPTH (m)	DESCRIPTION	LEGEND	ELEVATION	DEPTH (m)	SAMPLES: REFERENCE NUMBER	SAMPLES: SAMPLE TYPE	SAMPLES: DEPTH RECOVERED	WATER DEPTH	FIELD TEST RESULTS N-Value
0	Brown sandy Clay TOPSOIL			0.55					
1	Brown slightly gravelly sandy CLAY			1.40					
2	Grey/black angular weathered Shale cobbles			2.70					

KEY
∇ – Water Strike
D – Disturbed Sample
B – Bulk Disturbed Sample
W – Water Sample
U – Undisturbed Sample
P – Piston Sample
C(N) – Cone Penetration Test
S(N) – Standard Penetration Test
N – Blows /300mm
V – Vane Test

Remarks :

Orientation :

A

D B

C

Geotechnical Trial Pit Record

BMA — B J Murphy & Associates
Geotechnical Engineering
Engineering Geology
Engineering Geophysics
Environmental Hydrology

Client : Wicklow County Council

Contractor :

Location : Rampere, Co Wicklow
Ground Level (mod) :
Date Excavated : 13/06/2000
Excavated By :

Logged By : M Gill
Final Depth : 3.5
Sheet 1 of 1

Project : Rampere Landfill Extension

Trial Pit No : TP5

DOWNHOLE DEPTH (m)	DESCRIPTION	LEGEND	ELEVATION	DEPTH (m)	SAMPLES: REFERENCE NUMBER	SAMPLES: SAMPLE TYPE	SAMPLES: DEPTH RECOVERED	WATER DEPTH	FIELD TEST RESULTS N-Value
0	Brown sandy Clay TOPSOIL			0.40					
1	Brown loose sandy CLAY			2.30					
2	Firm brown gravelly CLAY			3.20					
3	Dark grey/black laminated weathered Shale			3.50					

KEY
∇ – Water Strike
D – Disturbed Sample
B – Bulk Disturbed Sample
W – Water Sample
U – Undisturbed Sample
P – Piston Sample
C(N) – Cone Penetration Test
S(N) – Standard Penetration Test
N – Blows /300mm
V – Vane Test

Remarks :

Orientation :

A
D B
C

Geotechnical Trial Pit Record

BMA B J Murphy & Associates — Geotechnical Engineering, Engineering Geology, Engineering Geophysics, Environmental Hydrology

Client : Wicklow County Council

Contractor :

Location : Rampere, Co Wicklow
Ground Level (mod) :
Date Excavated : 13/06/2000
Excavated By :

Logged By : M Gill
Final Depth : 3.7
Sheet 1 of 1

Project : Rampere Landfill Extension

Trial Pit No : TP6

DOWNHOLE DEPTH (m)	DESCRIPTION	LEGEND	ELEVATION	DEPTH (m)	SAMPLES REFERENCE NUMBER	SAMPLES SAMPLE TYPE	SAMPLES DEPTH RECOVERED	WATER DEPTH	FIELD TEST RESULTS N-Value
0	Brown sandy Clay TOPSOIL			0.45					
1	Brown clayey GRAVEL			1.90					
2	Brown sandy clayey GRAVEL			2.50					
3	Pale green sandy weathered Shale.Sandstone			3.70					

KEY
- ∇ – Water Strike
- D – Disturbed Sample
- B – Bulk Disturbed Sample
- W – Water Sample
- U – Undisturbed Sample
- P – Piston Sample
- C(N) – Cone Penetration Test
- S(N) – Standard Penetration Test
- N – Blows /300mm
- V – Vane Test

Remarks :

Orientation :

A

D B

C

Geotechnical Trial Pit Record

BMA
B J Murphy & Associates
Geotechnical Engineering
Engineering Geology
Engineering Geophysics
Environmental Hydrology

Client : Wicklow County Council
Contractor :

Location : Rampere, Co Wicklow
Ground Level (mod) :
Date Excavated : 13/06/2000
Excavated By :

Logged By : M Gill
Final Depth : 4.9
Sheet 1 of 1

Project : Rampere Landfill Extension

Trial Pit No : TP7

DOWNHOLE DEPTH (m)	DESCRIPTION	LEGEND	ELEVATION	DEPTH (m)	SAMPLES: REFERENCE NUMBER	SAMPLES: SAMPLE TYPE	SAMPLES: DEPTH RECOVERED	WATER DEPTH	FIELD TEST RESULTS N-Value
0	Brown sandy Clay TOPSOIL			0.50					
1, 2, 3, 4	Brown soft/firm gravelly CLAY			4.20					
	Slightly weathered bedrock			4.90					

KEY
∇ – Water Strike
D – Disturbed Sample
B – Bulk Disturbed Sample
W – Water Sample
U – Undisturbed Sample
P – Piston Sample
C(N) – Cone Penetration Test
S(N) – Standard Penetration Test
N – Blows /300mm
V – Vane Test

Remarks :

Orientation :

A
D B
C

Geotechnical Trial Pit Record

BMA
B J Murphy & Associates
Geotechnical Engineering
Engineering Geology
Engineering Geophysics
Environmental Hydrology

Client : Wicklow County Council

Contractor :

Location : Rampere, Co Wicklow
Ground Level (mod) :
Date Excavated : 13/06/2000
Excavated By :

Logged By : M Gill
Final Depth : 3.8
Sheet 1 of 1

Project : Rampere Landfill Extension

Trial Pit No : TP8

DOWNHOLE DEPTH (m)	DESCRIPTION	LEGEND	ELEVATION	DEPTH (m)	SAMPLES REFERENCE NUMBER	SAMPLES SAMPLE TYPE	SAMPLES DEPTH RECOVERED	WATER DEPTH	FIELD TEST RESULTS N-Value
0	Brown slightly gravelly sandy CLAY								
1									
2					S1	Bag	2		
				2.30					
	Pale grey weathered Shale								
3					S2	Bag	3.4		
				3.80					

KEY
▽ - Water Strike
D - Disturbed Sample
B - Bulk Disturbed Sample
W - Water Sample
U - Undisturbed Sample
P - Piston Sample
C(N) - Cone Penetration Test
S(N) - Standard Penetration Test
N - Blows /300mm
V - Vane Test

Remarks :

Orientation :

A

D B

C

Geotechnical Trial Pit Record

BMA — B J Murphy & Associates — Geotechnical Engineering, Engineering Geology, Engineering Geophysics, Environmental Hydrology

Client : Wicklow County Council

Contractor :

Location : Rampere, Co Wicklow
Ground Level (mod) :
Date Excavated : 14/06/2000
Excavated By :

Logged By : M Gill
Final Depth : 5.1
Sheet 1 of 1

Project : Rampere Landfill Extension

Trial Pit No : TP9

DOWNHOLE DEPTH (m)	DESCRIPTION	LEGEND	ELEVATION	DEPTH (m)	SAMPLES: REFERENCE NUMBER	SAMPLES: SAMPLE TYPE	SAMPLES: DEPTH RECOVERED	WATER DEPTH	FIELD TEST RESULTS N-Value
0	Brown/grey sandy Clay TOPSOIL			0.20					
	Soft/firm sandy SILT, some large Sandstone boulders. More sand with depth			5.10				∇ 5	

KEY
∇ - Water Strike
D - Disturbed Sample
B - Bulk Disturbed Sample
W - Water Sample
U - Undisturbed Sample
P - Piston Sample
C(N) - Cone Penetration Test
S(N) - Standard Penetration Test
N - Blows /300mm
V - Vane Test

Remarks :

Orientation :

A
D B
C

Geotechnical Trial Pit Record

BMA — B J Murphy & Associates — Geotechnical Engineering, Engineering Geology, Engineering Geophysics, Environmental Hydrology

Client : Wicklow County Council | Contractor :

Location : Rampere, Co Wicklow
Ground Level (mod) :
Date Excavated : 14/06/2000
Excavated By :

Logged By : M Gleeson
Final Depth : 3.9
Sheet 1 of 1

Project : Rampere Landfill Extension

Trial Pit No : TP10

DOWNHOLE DEPTH (m)	DESCRIPTION	LEGEND	ELEVATION	DEPTH (m)	SAMPLES REFERENCE NUMBER	SAMPLES SAMPLE TYPE	SAMPLES DEPTH RECOVERED	WATER DEPTH	FIELD TEST RESULTS N-Value
0	Brown sandy Clay TOPSOIL			0.30					
	Brown sandy CLAY			0.70					
1	Very sandy GRAVEL			1.90				∇ 1.5	
2	Sandy gravelly CLAY, some ironstaining								
3				3.90	S1	Bag	3.5		

KEY
∇ - Water Strike
D - Disturbed Sample
B - Bulk Disturbed Sample
W - Water Sample
U - Undisturbed Sample
P - Piston Sample
C(N) - Cone Penetration Test
S(N) - Standard Penetration Test
N - Blows /300mm
V - Vane Test

Remarks :

Base of pit collapsing

Orientation :

A
D B
C

Geotechnical Trial Pit Record

Client : Wicklow County Council | Contractor :

BMA — B J Murphy & Associates — Geotechnical Engineering, Engineering Geology, Engineering Geophysics, Environmental Hydrology

Location : Rampere, Co Wicklow
Ground Level (mod) :
Date Excavated : 14/06/2000
Excavated By :

Logged By : M Gleeson
Final Depth : 4.4
Sheet 1 of 1

Project : Rampere Landfill Extension

Trial Pit No : TP11

DOWNHOLE DEPTH (m)	DESCRIPTION	LEGEND	ELEVATION	DEPTH (m)	SAMPLES REFERENCE NUMBER	SAMPLES SAMPLE TYPE	SAMPLES DEPTH RECOVERED	WATER DEPTH	FIELD TEST RESULTS N-Value
0	TOPSOIL			0.30					
	Brown sandy CLAY			0.60					
	Very sandy GRAVEL			1.10					
1	Brown PEAT			1.35					
	Grey MARL			1.66					
2	Brown sandy gravelly CLAY								
3									
4					S1	Bag	4.0	∇ 4.15	
				4.40					

KEY
∇ - Water Strike
D - Disturbed Sample
B - Bulk Disturbed Sample
W - Water Sample
U - Undisturbed Sample
P - Piston Sample
C(N) - Cone Penetration Test
S(N) - Standard Penetration Test
N - Blows /300mm
V - Vane Test

Remarks :

Orientation :

A
D B
C

Geotechnical Trial Pit Record

BMA — B J Murphy & Associates — Geotechnical Engineering, Engineering Geology, Engineering Geophysics, Environmental Hydrology

Client : Wicklow County Council

Contractor :

Location : Rampere, Co Wicklow
Ground Level (mod) :
Date Excavated : 14/06/2000
Excavated By :

Logged By : M Gleeson
Final Depth : 4.5
Sheet 1 of 1

Project : Rampere Landfill Extension

Trial Pit No : TP12

DOWNHOLE DEPTH (m)	DESCRIPTION	LEGEND	ELEVATION	DEPTH (m)	SAMPLES REFERENCE NUMBER	SAMPLES SAMPLE TYPE	SAMPLES DEPTH RECOVERED	WATER DEPTH	FIELD TEST RESULTS N-Value
0	Brown Clay TOPSOIL			0.30					
	Brown sandy gravelly CLAY								
1									
2									
3					S1	Bag	3.25		
	SAND			3.60	S2	Bag	3.75		
4	SHALE			4.00					
				4.60	S3	Bag	4.5		

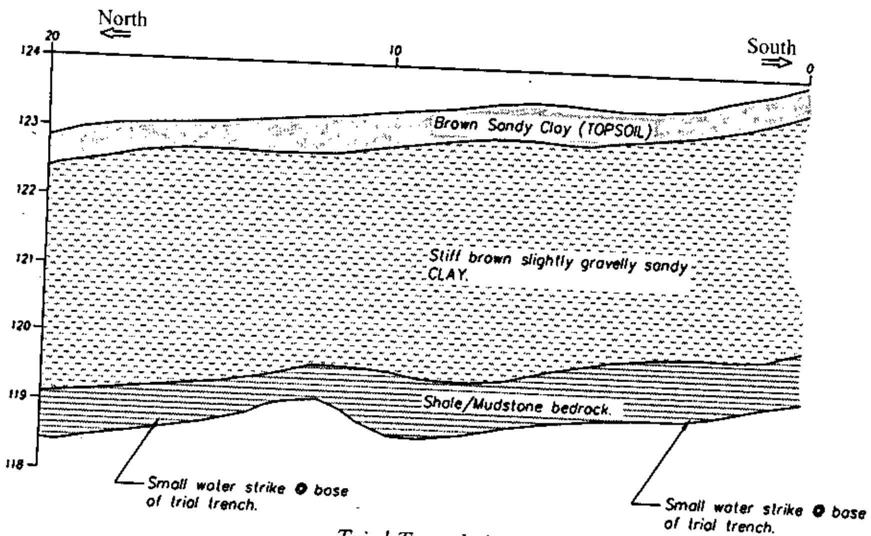
KEY
∇ – Water Strike
D – Disturbed Sample
B – Bulk Disturbed Sample
W – Water Sample
U – Undisturbed Sample
P – Piston Sample
C(N) – Cone Penetration Test
S(N) – Standard Penetration Test
N – Blows /300mm
V – Vane Test

Remarks :

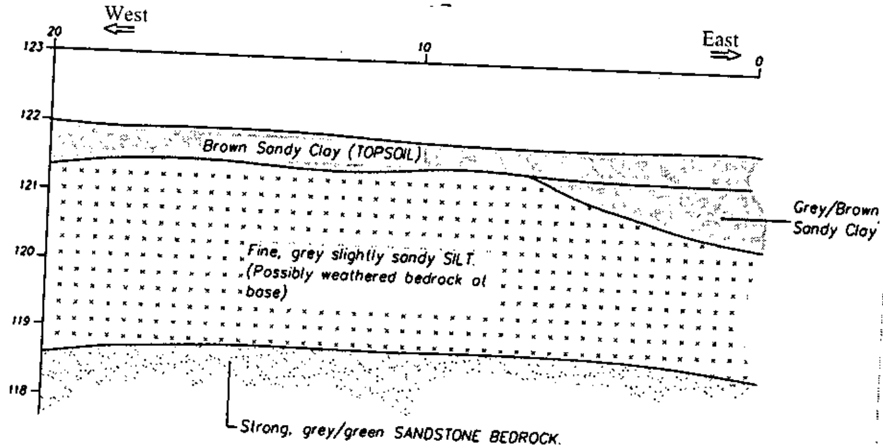
Orientation :

A
D B
C

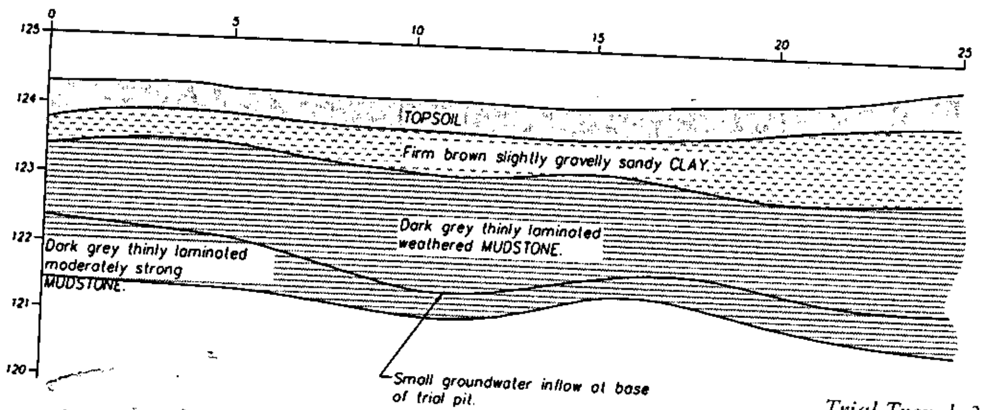
APPENDIX C



Trial Trench 1



Trial Trench 2



Trial Trench 3

Notes:		Title:	Job:	Client:	
Numbers on trench section are in meters. Measurements not to be scaled from this schematic.	Drawn: P.O'Reilly Scale: N.T.S. Date: Nov. 2001 Checked: M.G. Based On:	TRIAL TRENCHES	Proposed Extension to Rampere Landfill.	M.C. O'Sullivan & Wicklow Co. Council.	Drg No: 608_006

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Fax: 353-503-34490
E-mail: bmacarlow@bma.ie

APPENDIX D

Geotechnical Core Log Record

BMA
B J Murphy & Associates
Geotechnical Engineering
Engineering Geology
Engineering Geophysics
Environmental Hydrology

Client : Wicklow County Council	Contractor :

Casing : Diameter (mm) : Location : Rampere, Co Wicklow Ground Level (mod) : 124.09	Inclination : Casing Depth : Drilling Commenced : 06/22/2000 Drilling Ceased : 06/22/2000 Drilled By :	Logged By : N.Rogers Final Depth : 20 Sheet 1 of 2	Project : Rampere Landfill Extension Borehole No : BD1

CORE RUN DEPTH (m)	TCR %	SCR %	RQD %	FI	DISCONTINUITIES	ELEVATION	UNIT DEPTH (m)	GEOLOGICAL DESCRIPTION
						123.99	0.10	Topsoil
						123.14	0.95	Grey brown sandy Gravel (Drillers Description)
						122.79	1.30	Peat (Drillers Description)
						121.89	2.20	Grey silty Sand and Gravel (Drillers Description)
						118.59	5.50	Brown sandy Clay with gravel (Drillers Description)
						118.09	6.00	Grey silty Clay with mudstone fragments
6.75						117.34	6.75	Weathered Mudstone
6.75–8.25	66	52	6	6.25	Discontinuities extremely closely to very closely spaced, dipping 50-70 degrees, planar, smooth, ironstaining on surface.	115.36	8.73	Dark grey moderately weathered MUDSTONE, moderately weak to moderately strong. 7.6m: Quartz Vein, 20cm thick 8.15-8.65m: Band of Siltstone, moderately strong
8.25–9.75	100	30	10	6.25	Very closely to closely spaced discontinuities, planar and irregular, rough, ironstaining on surfaces, dipping 50 degrees			Grey moderately weathered fine grained SANDSTONE, moderately strong to strong.

Downhole depth scale (m): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9

Columns also headed: LEGEND, PIEZOMETER DETAILS

Remarks : 50mm standpipe, Gravel pack screen between 7.5-10.5m, Bentonite seal to surface with steel lockable cover

Scale : 1 : 50

Edition Date : 05/04/2001

Geotechnical Core Log Record

BMA
B J Murphy & Associates
Geotechnical Engineering
Engineering Geology
Engineering Geophysics
Environmental Hydrology

Client : Wicklow County Council

Contractor :

Casing :
Diameter (mm) :
Location : Rampere, Co Wicklow
Ground Level (mod) : 124.09

Inclination :
Casing Depth :
Drilling Commenced : 06/22/2000
Drilling Ceased : 06/22/2000
Drilled By :

Logged By : N.Rogers
Final Depth : 20
Sheet 2 of 2

Project : Rampere Landfill Extension

Borehole No : BD1

DOWNHOLE DEPTH (m)	CORE RUN DEPTH (m)	TCR %	SCR %	RQD %	FI	DISCONTINUITIES	LEGEND	ELEVATION	UNIT DEPTH (m)	GEOLOGICAL DESCRIPTION	PIEZOMETER DETAILS
10											
11											
								112.09	12.00		
12											
13											
14											
15											
16											
17											
18											
19											

Remarks : 50mm standpipe, Gravel pack screen between 7.5-10.5m, Bentonite seal to surface with steel lockable cover

Scale : 1 : 50

Edition Date : 05/04/2001

Geotechnical Core Log Record

BMA
B J Murphy & Associates
Geotechnical Engineering
Engineering Geology
Engineering Geophysics
Environmental Hydrology

Client : Wicklow County Council

Contractor :

Casing :
Diameter (mm) :
Location : Rampere, Co Wicklow
Ground Level (mod) : 122.71

Inclination :
Casing Depth :
Drilling Commenced : 06/21/2000
Drilling Ceased : 06/21/2000
Drilled By :

Logged By : I.Higgins
Final Depth : 15
Sheet 2 of 2

Project : Rampere Landfill Extension

Borehole No : BD2

DOWNHOLE DEPTH (m)	CORE RUN DEPTH (m)	TCR %	SCR %	RQD %	FI	DISCONTINUITIES	LEGEND	ELEVATION	UNIT DEPTH (m)	GEOLOGICAL DESCRIPTION	PIEZOMETER DETAILS
10	10.20										
11	11.70	66	0	0	37.5			111.21	11.50	Dark grey to black moderately strong very fine grained MUDSTONE fragments, slightly weathered with ironstaining along the surface	
12	12.10	62	0	0	NI			110.46	12.25	Dark grey weak MUDSTONE, highly weathered.	
	13.10	85	0	0	NI			109.71	13.00	Moderately weak to moderately strong MUDSTONE, highly to moderately weathered.	
13–14	15.00	79	15	0	NI	Discontinuities extremely to closely spaced, planar, with some ironstaining along surfaces and some clay smearing, and steeply dipping.		107.71	15.00		
15											
16											
17											
18											
19											

Remarks : 50 mm standpipe, Gravel pack screen 6-9m, Bentonite seal to surface, Steel lockable cover

Scale : 1 : 50

Edition Date : 05/04/2001

Geotechnical Core Log Record

BMA
B J Murphy & Associates
Geotechnical Engineering
Engineering Geology
Engineering Geophysics
Environmental Hydrology

Client : Wicklow County Council

Contractor :

Casing :
Diameter (mm) :
Location : Rampere, Co Wicklow
Ground Level (mod) : 122.71

Inclination :
Casing Depth :
Drilling Commenced : 06/21/2000
Drilling Ceased : 06/21/2000
Drilled By :

Logged By : I.Higgins
Final Depth : 15
Sheet 1 of 2

Project : Rampere Landfill Extension

Borehole No : BD2

ELEVATION	UNIT DEPTH (m)	GEOLOGICAL DESCRIPTION
122.61	0.10	Topsoil
121.36	1.35	Brown sandy Clay (Drillers Description)
120.51	2.20	Slightly peaty Gravel (Drillers Description)
119.21	3.50	Grey silty Clay (Drillers Description)
118.21	4.50	Gravel (Drillers Description)
116.71	6.00	Gravel with mudstone fragments (Drillers Description)
		Dark grey to black very fine grained weak MUDSTONE, highly weathered with ironstaining present through core between 9 and 10m.

CORE RUN DEPTH (m)	TCR %	SCR %	RQD %	FI	DISCONTINUITIES
7.20 – 8.70	69	0	0	NI	Discontinuities planar, smooth, ironstained along surface and clay smeared, steeply dipping.
8.70 –	83	0	0	20	

Remarks : 50 mm standpipe, Gravel pack screen 6-9m, Bentonite seal to surface, Steel lockable cover

Scale : 1 : 50

Edition Date : 05/04/2001

Geotechnical Core Log Record

BMA — B J Murphy & Associates — Geotechnical Engineering, Engineering Geology, Engineering Geophysics, Environmental Hydrology

Client : Wicklow County Council | Contractor :

Project : Rampere Landfill Extension

Casing : Diameter (mm) : Location : Rampere, Co Wicklow Ground Level (mod) : 121.91	Inclination : Casing Depth : Drilling Commenced : 06/20/2000 Drilling Ceased : 06/20/2000 Drilled By :	Logged By : I.Higgins Final Depth : 7 Sheet 1 of 1	Borehole No : BD3A

DOWNHOLE DEPTH (m)	CORE RUN DEPTH (m)	TCR %	SCR %	RQD %	FI	DISCONTINUITIES	LEGEND	ELEVATION	UNIT DEPTH (m)	GEOLOGICAL DESCRIPTION	PIEZOMETER DETAILS
0										Brown Sandy Clay	
								120.71	1.20	Fine brown Sand and Gravel (Drillers Description)	
								120.11	1.80	Coarse grey sandy GRAVEL (Drillers Description)	
								119.11	2.80	Dark grey weak to moderately weak MUDSTONE, moderately to highly weathered	
										Brown sandy GRAVEL (Drillers Description)	
								116.31	5.60		
								114.91	7.00		

Depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9

Remarks : Open hole to 7mbgl. 50mm standpipe, Gravel pack screen 5-7m, Bentonite seal to surface, Steel lockable cover

Scale : 1 : 50 | Edition Date : 05/04/2001

Geotechnical Core Log Record

BMA
B J Murphy & Associates
Geotechnical Engineering
Engineering Geology
Engineering Geophysics
Environmental Hydrology

Client : Wicklow County Council

Contractor :

Casing :
Diameter (mm) :
Location : Rampere, Co Wicklow
Ground Level (mod) : 121.87

Inclination :
Casing Depth :
Drilling Commenced : 06/20/2000
Drilling Ceased : 06/20/2000
Drilled By :

Logged By : I.Higgins
Final Depth : 15
Sheet 1 of 2

Project : Rampere Landfill Extension

Borehole No : BD3B

CORE RUN DEPTH (m)	TCR %	SCR %	RQD %	FI	DISCONTINUITIES	ELEVATION	UNIT DEPTH (m)	GEOLOGICAL DESCRIPTION
						120.67	1.20	Brown sandy Clay (Drillers Description)
						120.07	1.60	Fine brown Sand and Gravel (Drillers Description)
						119.07	2.60	Coarse grey sandy Gravel (Drillers Description)
5.65						116.27	5.60	Brown sandy Gravel (Drillers Description)
7.15	43	10	0	30				
8.05	81	28	0	70				
9.05	90	5	0	40		112.82	9.05	Dark grey weak to moderately weak MUDSTONE, moderately to highly weathered
9.45	100	26	26	250				Dark grey moderately weak to moderately strong MUDSTONE, slightly weathered, some quartz veining.

Remarks : 50mm standpipe, Gravel pack screen 8-15m, Bentonite seal to surface, Steel lockable cover

Scale : 1 : 50

Edition Date : 05/04/2001

Geotechnical Core Log Record

BMA
B J Murphy & Associates
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Engineering Geology
Engineering Geophysics
Environmental Hydrology

Client : Wicklow County Council | Contractor :

Casing :
Diameter (mm) :
Location : Rampere, Co Wicklow
Ground Level (mod) : 121.87

Inclination :
Casing Depth :
Drilling Commenced : 06/20/2000
Drilling Ceased : 06/20/2000
Drilled By :

Logged By : I.Higgins
Final Depth : 15
Sheet 2 of 2

Project : Rampere Landfill Extension

Borehole No : BD3B

DOWNHOLE DEPTH (m)	CORE RUN DEPTH (m)	TCR %	SCR %	RQD %	FI	DISCONTINUITIES	LEGEND	ELEVATION	UNIT DEPTH (m)	GEOLOGICAL DESCRIPTION	PIEZOMETER DETAILS
10											
								111.02	10.85	Dark grey to black weak to moderately weak MUDSTONE, moderately to highly weathered.	
11		47	30	11	50						
12											
13	13.50										
14		92	10	10	45						
	15.00							106.87	15.00		
15											
16											
17											
18											
19											

Remarks : 50mm standpipe, Gravel pack screen 8-15m, Bentonite seal to surface, Steel lockable cover

Scale : 1 : 50

Edition Date : 05/04/2001

Geotechnical Core Log Record

BMA
B J Murphy & Associates
Geotechnical Engineering
Engineering Geology
Engineering Geophysics
Environmental Hydrology

Client : Wicklow County Council | Contractor :

Casing :
Diameter (mm) :
Location : Rampere, Co Wicklow
Ground Level (mod) : 141.69

Inclination :
Casing Depth :
Drilling Commenced : 06/22/2000
Drilling Ceased : 06/23/2000
Drilled By :

Logged By : I.Higgins
Final Depth : 22
Sheet 1 of 3

Project : Rampere Landfill Extension

Borehole No : BD4

DOWNHOLE DEPTH (m)	CORE RUN DEPTH (m)	TCR %	SCR %	RQD %	FI	DISCONTINUITIES	LEGEND	ELEVATION	UNIT DEPTH (m)	GEOLOGICAL DESCRIPTION	PIEZOMETER DETAILS
0								141.59	0.10	Topsoil	
										Brown sandy Boulder Clay (Drillers Description)	
1											
2								139.24	2.45		
										Sand and Gravel with some clay (Drillers Description)	
3											
4								137.64	4.05		
										Gravelly Boulder Clay (Drillers Description)	
5											
6								135.74	5.95		
										Grey to dark grey weak to moderately strong very fine grained MUDSTONE, moderatley to highly weathered	
	7.00										
7		65	0	0	50						
8	8.50					Discontinuities extremely closely to closely spaced, planar, smooth, ironstained, with some clay smearing.					
9		66	0	0	75			132.19	9.50		
	10.00							131.69	10.00	Dark grey fine grained moderately strong to strong (LST), slightly to moderately	

Remarks : 50mm standpipe, Gravel pack screen 20-23.5m, Bentonite seal to surface, Steel lockable cover

Scale : 1 : 50

Edition Date : 05/04/2001

Geotechnical Core Log Record

Client : Wicklow County Council	Contractor :	BMA — B J Murphy & Associates — Geotechnical Engineering, Engineering Geology, Engineering Geophysics, Environmental Hydrology

Casing : Diameter (mm) : Location : Rampere, Co Wicklow Ground Level (mod) : 141.69	Inclination : Casing Depth : Drilling Commenced : 06/22/2000 Drilling Ceased : 06/23/2000 Drilled By :	Logged By : I.Higgins Final Depth : 22 Sheet 2 of 3	Project : Rampere Landfill Extension Borehole No : BD4

DOWNHOLE DEPTH (m)	CORE RUN DEPTH (m)	TCR %	SCR %	RQD %	FI	DISCONTINUITIES	LEGEND	ELEVATION	UNIT DEPTH (m)	GEOLOGICAL DESCRIPTION	PIEZOMETER DETAILS
10										weathered, ironstained along joint surfaces with possible copper staining also present.	
										Light grey moderately weak to moderately strong very fine grained MUDSTONE, slightly to moderately weathered, quartz veining present at 11m	
11	11.50	66	20	12	80						
12											
13		56	12	0	90			128.69	13.00	Dark grey moderately weak MUDSTONE, highly weathered	
14	14.50							127.69	14.00	Light grey moderately weak to moderately strong MUDSTONE	
								127.19	14.50	Dark grey weak to moderately weak SHALE, slightly to moderately weathered.	
15	16.00	90	0	0	30			126.69	15.00	Light to dark grey very fine grained moderately weak to moderately strong MUDSTONE, slightly to moderately weathered, highly weathered in places.	
16–17	17.50	86	0	0	80	Discontinuities planar, smooth, some ironstaining and clay smearing along surfaces, steeply dipping					
18	19.00	90	10	0	68			123.69	18.00	Dark grey moderately strong MUDSTONE, slightly weathered, quartz veining, ironstaining along joint surfaces.	
19		80	0	0	75						

Remarks : 50mm standpipe, Gravel pack screen 20-23.5m, Bentonite seal to surface, Steel lockable cover

Scale : 1 : 50

Edition Date : 05/04/2001

Geotechnical Core Log Record

BMA B J Murphy & Associates — Geotechnical Engineering, Engineering Geology, Engineering Geophysics, Environmental Hydrology

Client : Wicklow County Council

Contractor :

Casing :
Diameter (mm) :
Location : Rampere, Co Wicklow
Ground Level (mod) : 141.69

Inclination :
Casing Depth :
Drilling Commenced : 06/22/2000
Drilling Ceased : 06/23/2000
Drilled By :

Logged By : I.Higgins
Final Depth : 22
Sheet 3 of 3

Project : Rampere Landfill Extension

Borehole No : BD4

DOWNHOLE DEPTH (m)	CORE RUN DEPTH (m)	TCR %	SCR %	RQD %	FI	DISCONTINUITIES	LEGEND	ELEVATION	UNIT DEPTH (m)	GEOLOGICAL DESCRIPTION	PIEZOMETER DETAILS
20	20.50										
21											
22		88	60	35	75						
23	23.50							118.19	23.50		
24											
25											
26											
27											
28											
29											

Remarks : 50mm standpipe, Gravel pack screen 20-23.5m, Bentonite seal to surface, Steel lockable cover

Scale : 1 : 50

Edition Date : 05/04/2001

Geotechnical Core Log Record

BMA — B J Murphy & Associates — Geotechnical Engineering, Engineering Geology, Engineering Geophysics, Environmental Hydrology

Client : Wicklow County Council

Contractor :

Casing :
Diameter (mm) :
Location : Rampere, Co Wicklow
Ground Level (mod) : 128.54

Inclination :
Casing Depth :
Drilling Commenced : 06/23/2000
Drilling Ceased : 06/24/2000
Drilled By :

Logged By : I.Higgins
Final Depth : 19
Sheet 1 of 2

Project : Rampere Landfill Extension

Borehole No : BD5B

DOWNHOLE DEPTH (m)	CORE RUN DEPTH (m)	TCR %	SCR %	RQD %	FI	DISCONTINUITIES	LEGEND	ELEVATION	UNIT DEPTH (m)	GEOLOGICAL DESCRIPTION	PIEZOMETER DETAILS
0								128.04	0.50	Clay	
0.50–9.10								119.44	9.10	Fill (Decomposed Household Waste)	
9.10–										Grey brown sand and Gravel (Drillers Description)	

Remarks : 50mm standpipe, Gravel pack screen 16-19m, Bentonite seal to surface, Steel lockable cover

Scale : 1 : 50

Edition Date : 05/04/2001

Geotechnical Core Log Record

BMA — B J Murphy & Associates — Geotechnical Engineering, Engineering Geology, Engineering Geophysics, Environmental Hydrology

Client : Wicklow County Council | Contractor :

Casing :
Diameter (mm) :
Location : Rampere, Co Wicklow
Ground Level (mod) : 128.56

Inclination :
Casing Depth :
Drilling Commenced : 06/24/2000
Drilling Ceased : 06/24/2000
Drilled By :

Logged By : I.Higgins
Final Depth : 8
Sheet 1 of 1

Project : Rampere Landfill Extension

Borehole No : BD5A

DOWNHOLE DEPTH (m)	CORE RUN DEPTH (m)	TCR %	SCR %	RQD %	FI	DISCONTINUITIES	LEGEND	ELEVATION	UNIT DEPTH (m)	GEOLOGICAL DESCRIPTION	PIEZOMETER DETAILS
0								128.06	0.50	Clay (TOPSOIL)	
								120.56	8.00	Fill (Decomposed Household Waste)	

Downhole depth scale: 0, 1, 2, 3, 4, 5, 6, 7, 8, 9

Remarks: Open hole to 8mbgl. No water encountered during drilling. 50mm standpipe, Gravel pack screen 1-8m, Bentonite seal to surface, Steel lockable cover

Scale : 1 : 50

Edition Date : 05/04/2001

Geotechnical Core Log Record

BMA — B J Murphy & Associates — Geotechnical Engineering, Engineering Geology, Engineering Geophysics, Environmental Hydrology

Client : Wicklow County Council

Contractor :

Casing :
Diameter (mm) :
Location : Rampere, Co Wicklow
Ground Level (mod) : 129.19

Inclination :
Casing Depth :
Drilling Commenced : 06/25/2000
Drilling Ceased : 06/25/2000
Drilled By :

Logged By : I.Higgins
Final Depth : 20
Sheet 1 of 2

Project : Rampere Landfill Extension

Borehole No : BD6

CORE RUN DEPTH (m)	TCR %	SCR %	RQD %	FI	DISCONTINUITIES	ELEVATION	UNIT DEPTH (m)	GEOLOGICAL DESCRIPTION
						129.04	0.15	Topsoil
2.00						127.19	2.00	Weathered Shale/Mudstone
3.25	56	0	0	NI				Dark grey weak to moderately strong fine grained thinly laminated MUDSTONE, highly weathered.
5.00	48	5	0	80	Discontinuities extremely closely to closely spaced planar smooth, ironstained with some clay infill.			
6.25	85	5	0	80		122.94	6.25	
7.75	93	7	0	60				Dark grey MUDSTONE, moderately weathered becoming slightly weathered with depth, occasional bands of highly weathered material.
9.25	66	0	0	90	Discontinuities extremely closely to closely spaced planar smooth, ironstained with some clay infill.			

Remarks : 50mm standpipe, Gravel pack screen 7.5-10.5m, Bentonite seal to surface, Steel lockable cover

Scale : 1 : 50

Edition Date : 05/04/2001

Geotechnical Core Log Record

BMA — B J Murphy & Associates — Geotechnical Engineering, Engineering Geology, Engineering Geophysics, Environmental Hydrology

Client : Wicklow County Council

Contractor :

Casing :
Diameter (mm) :
Location : Rampere, Co Wicklow
Ground Level (mod) : 128.54

Inclination :
Casing Depth :
Drilling Commenced : 06/23/2000
Drilling Ceased : 06/24/2000
Drilled By :

Logged By : LHiggins
Final Depth : 19
Sheet 2 of 2

Project : Rampere Landfill Extension

Borehole No : BD5B

DOWNHOLE DEPTH (m)	CORE RUN DEPTH (m)	TCR %	SCR %	RQD %	FI	DISCONTINUITIES	LEGEND	ELEVATION	UNIT DEPTH (m)	GEOLOGICAL DESCRIPTION	PIEZOMETER DETAILS
10–14	14.00							114.54	14.00		
14–15.5	15.50	86	15	0	40					Black very fine grained moderately weak to moderately strong MUDSTONE, moderately to highly weathered, with clay smearing and ironstaining on core surface.	
15.5–17	17.00	80	5	0	60			111.54	17.00		
17–19	19.00	80	66	40	200			109.54	19.00	Black thinly laminated MUDSTONE, slightly weathered with some ironstaining.	

Remarks : 50mm standpipe, Gravel pack screen 16-19m, Bentonite seal to surface, Steel lockable cover

Scale : 1 : 50

Edition Date : 05/04/2001

Geotechnical Core Log Record

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Client : Wicklow County Council	Contractor :
Casing : Diameter (mm) : Location : Rampere, Co Wicklow Ground Level (mod) : 129.19	Inclination : Casing Depth : Drilling Commenced : 06/25/2000 Drilling Ceased : 06/25/2000 Drilled By :
Logged By : LHiggins Final Depth : 20 Sheet 2 of 2	Project : Rampere Landfill Extension Borehole No : BD6

DOWNHOLE DEPTH (m)	CORE RUN DEPTH (m)	TCR %	SCR %	RQD %	FI	DISCONTINUITIES	LEGEND	ELEVATION	UNIT DEPTH (m)	GEOLOGICAL DESCRIPTION	PIEZOMETER DETAILS
10	10.75	63	20	16	150			118.44	10.75		
11											
12											
13											
14											
15											
16											
17											
18											
19											

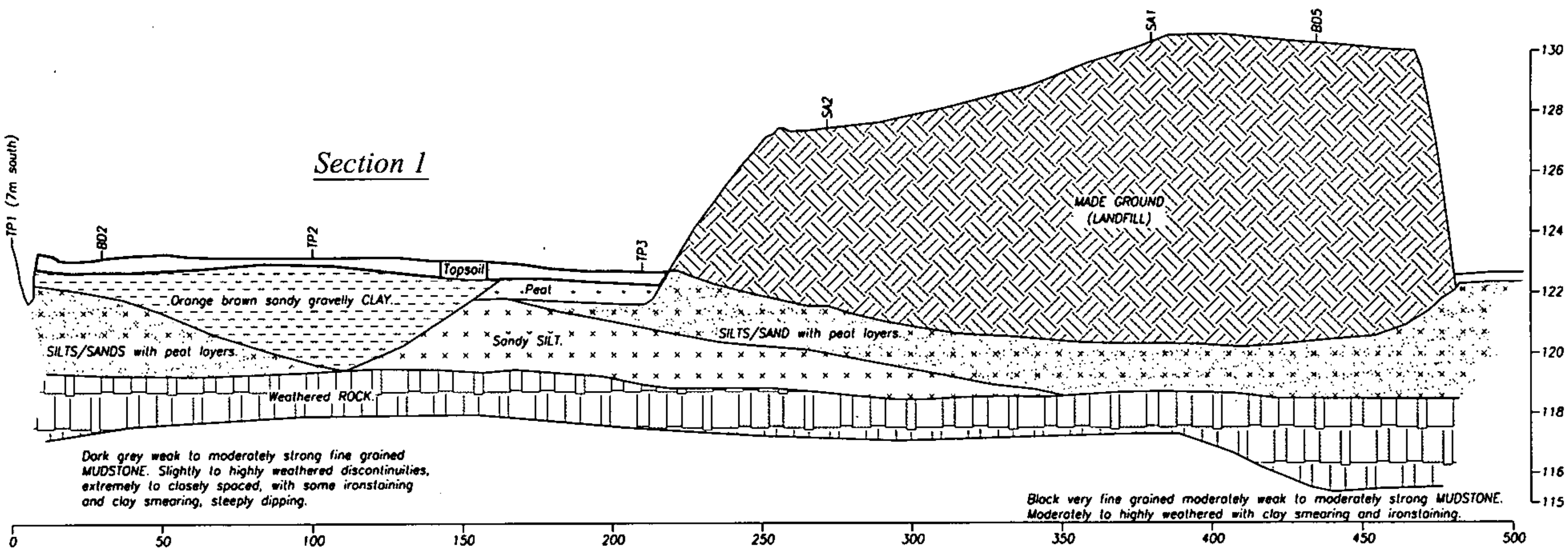
Remarks: 50mm standpipe, Gravel pack screen 7.5-10.5m, Bentonite seal to surface, Steel lockable cover

Scale : 1 : 50

Edition Date : 05/04/2001

APPENDIXE

Section 1



Notes: This drawing is not to scale. Measurements are to be read from this drawing and not scaled.	Drawn: P.O'Reilly Scale: N.T.S. Date: Nov. 2001 Checked: M.G. Based On:	Title: CROSS SECTION 1	Job: Proposed Rampere Landfill Extension	Client: Wicklow Co. Council Client: M.C. O'Sullivan Consulting Engineers	Drg No: 608_008

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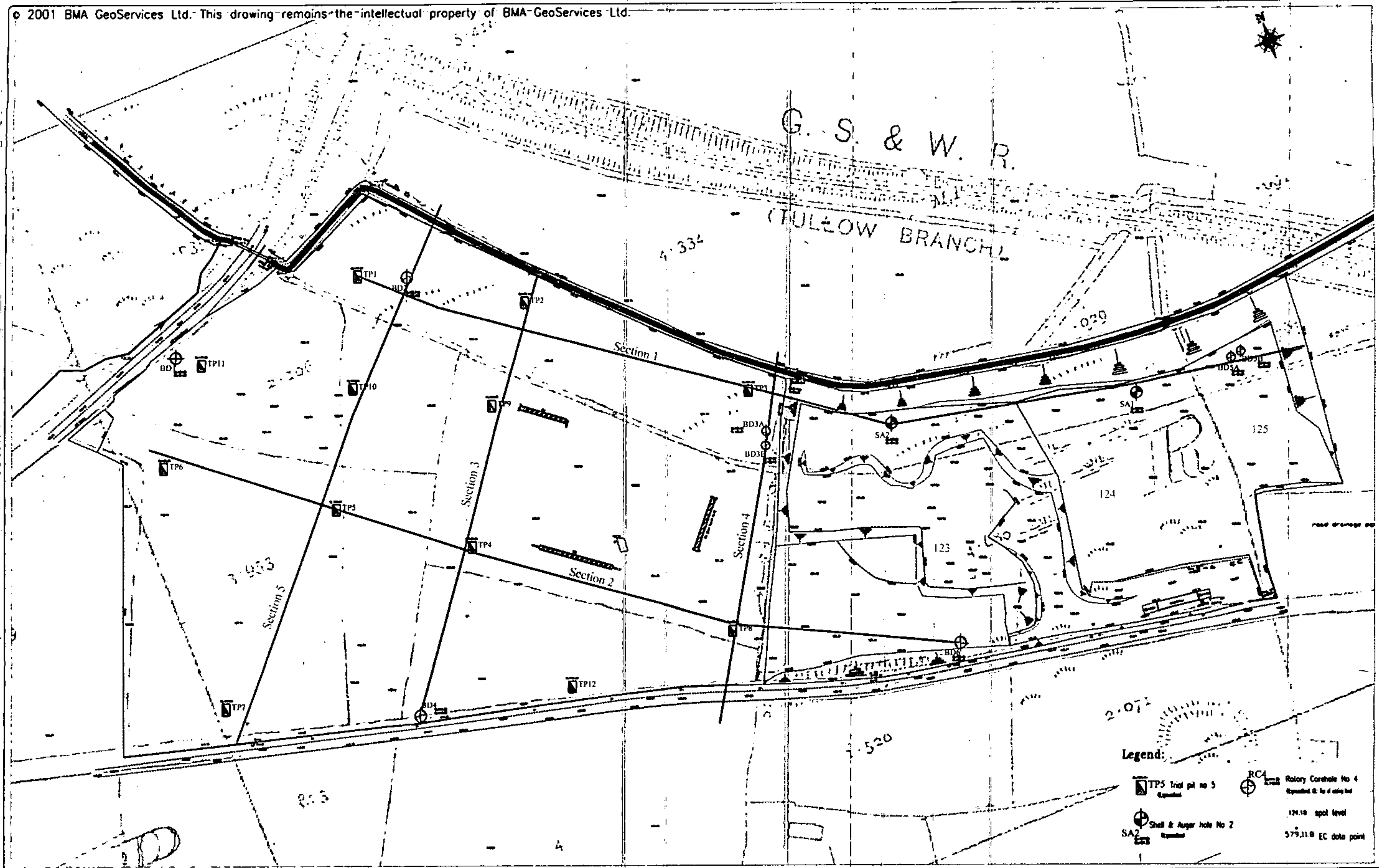

Title:	Job:	Client:
SITE LAYOUT SHOWING PLAN LOCATIONS OF CROSS SECTIONS	Proposed Rampere Landfill Extension.	Wicklow Co.Co.
		Engineer: M.C.O'Sullivan Consulting Engineers

Drawn: Scale: 1:1500 Date: 21/11/01 Checked: Based On:

Dwg No: 608_007

BMA Geotechnical Engineering, Engineering Geology, Engineering Geophysics, Groundwater Engineering

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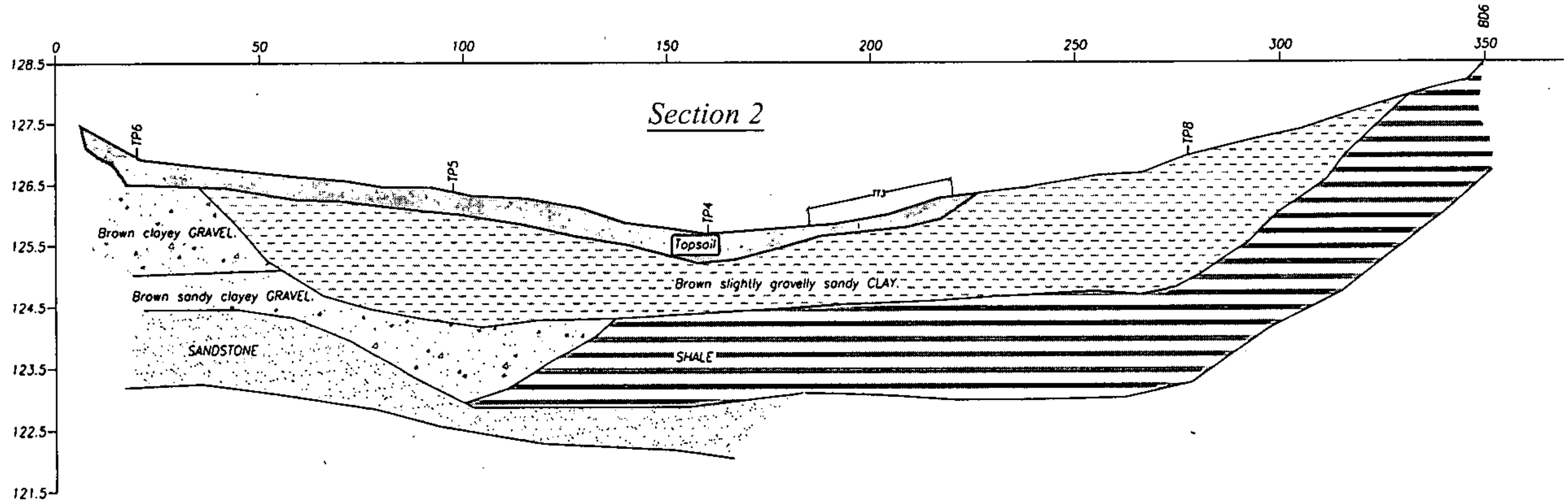

Notes: This drawing is not to scale. Measurements are to be read from the drawing and not scaled.	Drawn: P.O'Reilly Scale: N.T.S. Date: Nov. 2001 Checked: M.G. Based On:	Title: CROSS SECTION 2	Job: Proposed Rampere Landfill Extension	Client: Wicklow Co. Council Client: M.C. O'Sullivan Consulting Engineers	Drg No: 608_009

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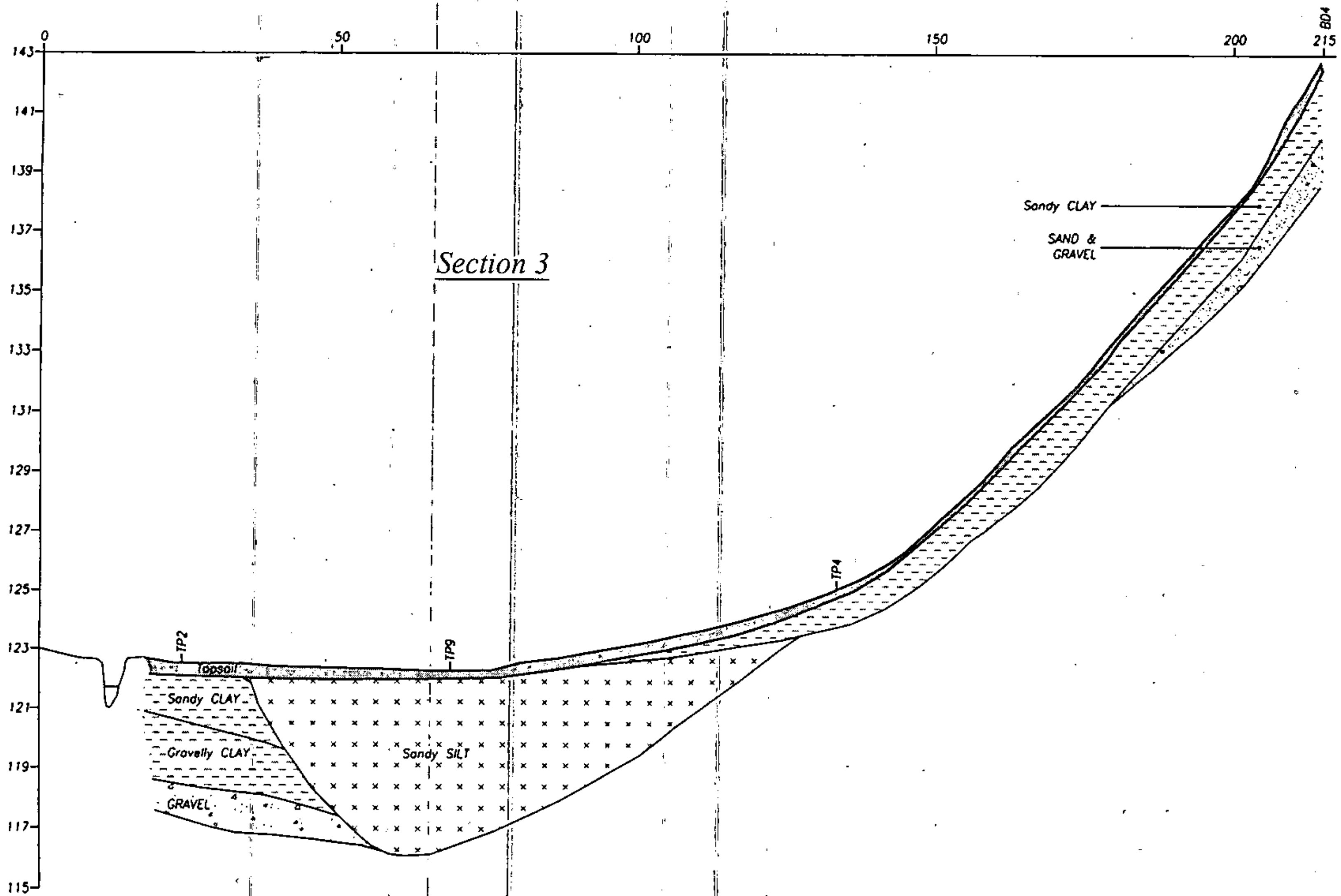

Notes: This drawing is not to scale. Measurements are to be read from this drawing and not scaled.

Drawn:	P.O'Reilly
Scale:	N.T.S.
Date:	Nov. 2001
Checked:	M.G.
Based On:	

Title: CROSS SECTION 3

Job: Proposed Rampere Landfill Extension

Client: Wicklow Co. Council

Client: M.C. O'Sullivan Consulting Engineers

Drg No: 608_010

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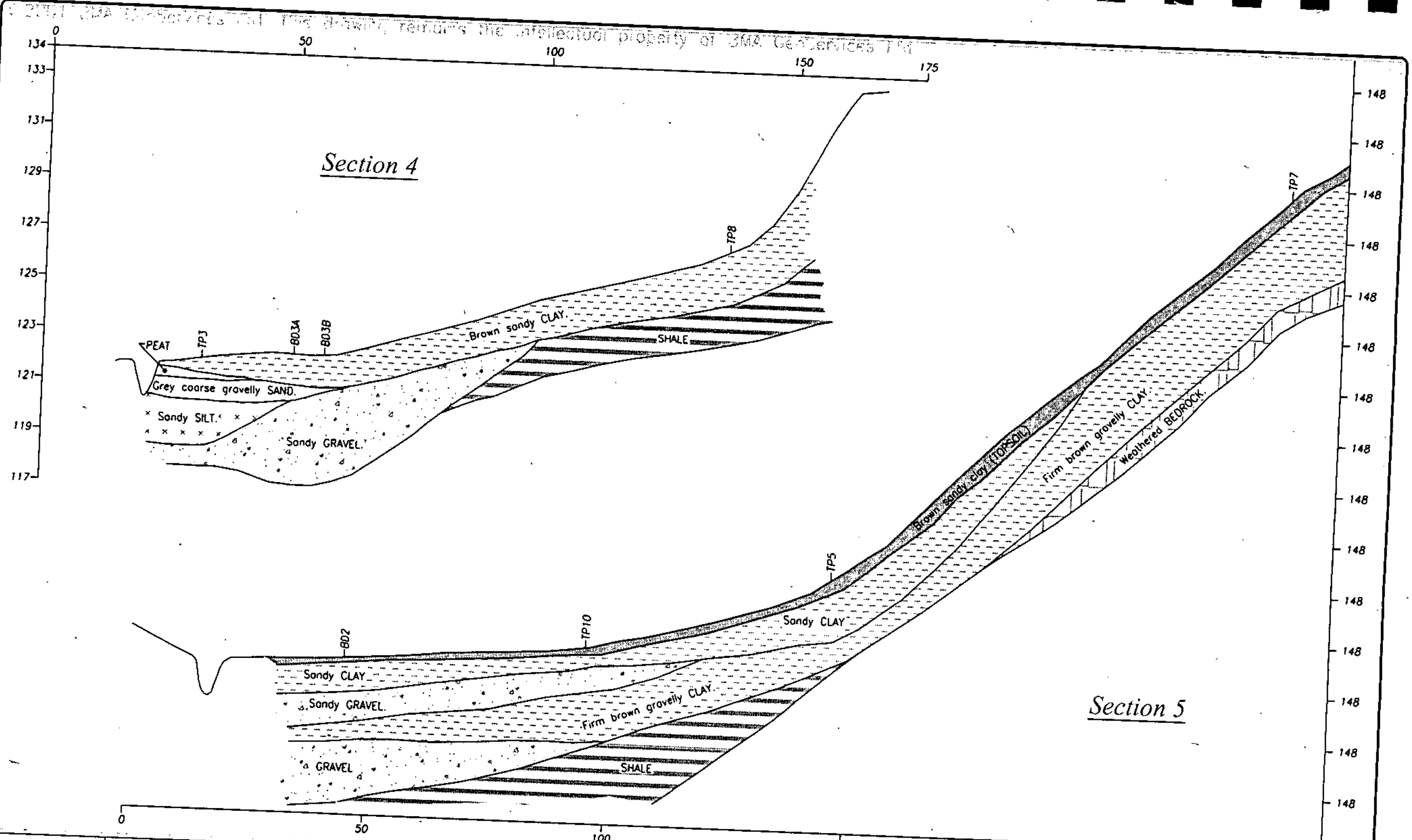

Notes: This drawing is not to scale. Measurements are to be read from this drawing and not scaled.	Drawn: P.O'Reilly Scale: N.T.S. Date: Nov. 2001 Checked: M.G. Based On:	Title: CROSS SECTIONS 4 & 5	Job: Proposed Rampere Landfill Extension	Client: Wicklow Co. Council Client: M.C. O'Sullivan Consulting Engineers	Drg No: 608_011

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APPENDIX F

Surface Water Flows at SG1

Location:	Rampere Landfill, Co. Carlow
Associated staff gauge:	none
Flow measurement method:	Universal Current Meter
Method of discharge calculation:	Mid Section Method (USGS recommended)

Date & Time: 16/03/01
Field Operatives: M.Gleeson/K. Byrne
Weather:

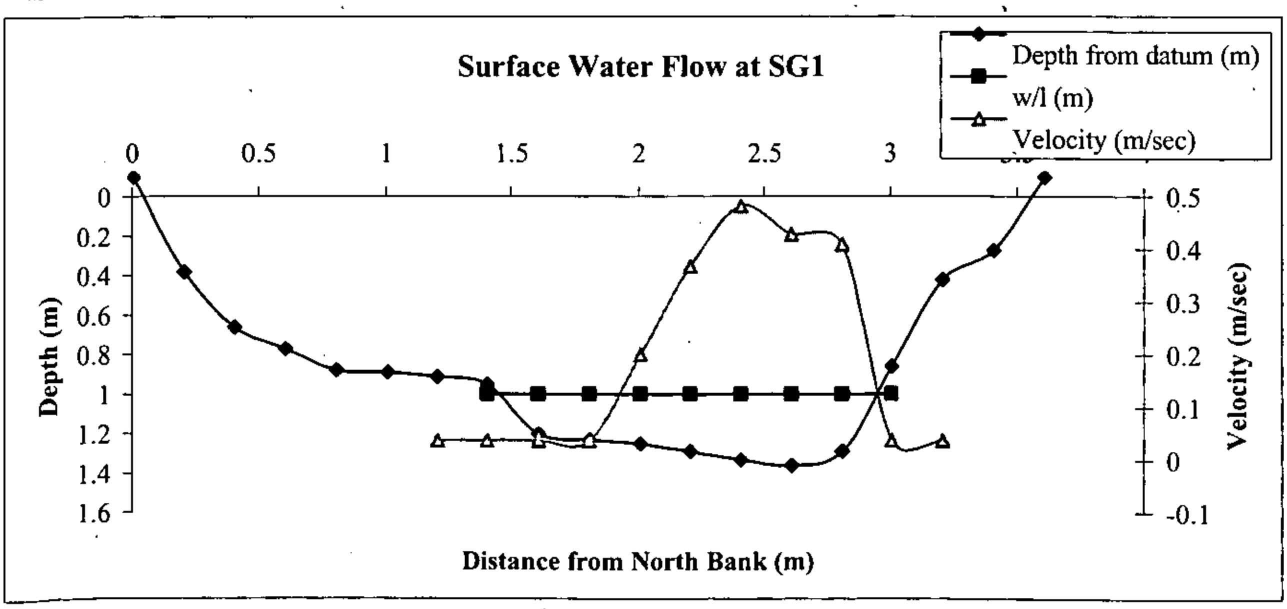
Initial stage (mbRef maMD) -
Final stage (mbRef maMD)

Data logger comments

Remarks

Propellor set at 0.6d

Position	Distance from n.bank b_i (m)	Water depth y_i (m)	No. of Revolutions (N) per 30 sec	Velocity averaged over 30 sec 0.8d (m/sec)	0.6d (m/sec)	0.2d (m/sec)	Average velocity u_i (m/s)	Section width (m)	X-Section area (m^2)	Discharge q_i (m^3/s)	% of Total Discharge
0	0	0		n/a		n/a		0.2			
1	0.2	0		n/a		n/a		0.2			
2	0.4	0		n/a		n/a		0.2			
3	0.6	0		n/a		n/a		0.2			
4	0.8	0		n/a		n/a		0.2			
5	1.0	0		n/a		n/a		0.2			
6	1.2	0		n/a		n/a		0.2			
7	1.4	0		n/a		n/a		0.2			
8	1.6	0.2		n/a	0.028	n/a	0.028	0.2	0.04	0.001	1.02
9	1.8	0.23		n/a	0.028	n/a	0.028	0.2	0.046	0.001	1.17
11	2.0	0.25	13	n/a	0.163	n/a	0.163	0.2	0.05	0.008	7.42
12	2.2	0.29	29	n/a	0.330	n/a	0.330	0.2	0.058	0.019	17.42
13	2.4	0.33	40	n/a	0.452	n/a	0.452	0.2	0.066	0.030	27.15
14	2.6	0.36	35	n/a	0.397	n/a	0.397	0.2	0.072	0.029	26.02
15	2.8	0.29	33	n/a	0.375	n/a	0.375	0.2	0.058	0.022	19.80
17	3	0		n/a		n/a		0.2			
19	3.2	0		n/a		n/a		0.2			
20	3.4	0		n/a		n/a		0.2			
21	3.6	0		n/a		n/a		0.2			
22	3.8	0		n/a		n/a		0.2			
								Total Discharge Q_i =		0.110 9492	m^3/s m^3/day



Surface Water Flows at SG2

Location: Rampere Landfill, Co. Wicklow
Associated staff gauge: none
Flow measurement method: Universal Current Meter
Method of discharge calculation: Mid-section method (USGS recommended)

Date & Time: 16.03.01
Field Operatives: M.Gleeson/K.Byrne
Weather: Overcast

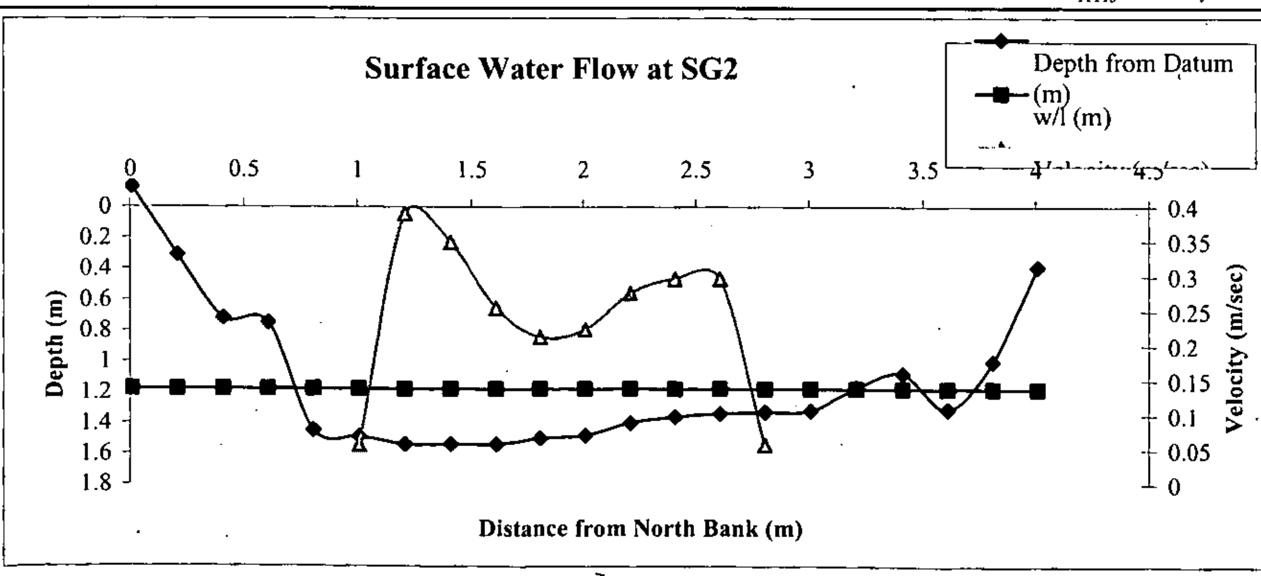
Initial stage (mbRef maMD)
Final stage (mbRef maMD)

Remarks

Propellor set at 0.6d for all measurements

Data logger comments

Position	*Distance from n.bank b_i (m)*	*Water depth y_i (m)*	*No. of Revolutions (N) per 30 sec*	*Velocity averaged over 30 sec* 0.8d (m/sec)	0.6d (m/sec)	0.2d (m/sec)	*Average velocity u_i (m/s)*	*Section width (m)*	*X-Section area (m^2)*	*Discharge q_i (m^3/s)*	*% of Total Discharge*
0	0	0		n/a		n/a		0.2	0		
1	0.2	0		n/a		n/a		0.2	0		
2	0.4	0		n/a		n/a		0.2	0		
3	0.6	0		n/a		n/a		0.2	0		
4	0.8	0.27		n/a	0.028	n/a	0.028	0.2	0	0.000	
5	1.0	0.31		n/a	0.028	n/a	0.028	0.2	0.054	0.002	
6	1.2	0.36	31.67	n/a	0.360	n/a	0.364	0.2	0.062	0.023	17.55
7	1.4	0.36	28	n/a	0.320	n/a	0.320	0.2	0.072	0.023	17.91
8	1.6	0.36	19.33	n/a	0.229	n/a	0.226	0.2	0.072	0.016	12.65
9	1.8	0.32	14.67	n/a	0.181	n/a	0.184	0.2	0.072	0.013	10.30
11	2.0	0.3	16	n/a	0.195	n/a	0.195	0.2	0.064	0.012	9.70
12	2.2	0.22	20.67	n/a	0.243	n/a	0.247	0.2	0.06	0.015	11.52
13	2.4	0.18	23.33	n/a	0.271	n/a	0.268	0.2	0.044	0.012	9.17
14	2.6	0.16	23	n/a	0.268	n/a	0.268	0.2	0.036	0.010	7.50
15	2.8	0.15		n/a	0.028	n/a	0.028	0.2	0.032	0.001	0.70
17	3	0.14		n/a	0.028	n/a	0.028	0.2	0.03	0.001	0.65
19	3.2	0		n/a	0.028	n/a	0.028	0.2	0.028	0.001	0.61
20	3.4	0		n/a	0.028	n/a	0.028	0.2	0	0.000	0.00
21	3.6	0.13		n/a	0.028	n/a	0.028	0.2	0	0.000	0.00
22	3.8	0		n/a	0.028	n/a	0.028	0.2	0.026	0.001	0.57
23	4	0		n/a		n/a		0.2	0		
24	4.2	0		n/a		n/a		0.2	0		
								Total Discharge Q_t =		0.129	m^3/s
										11113	m^3/day



Surface Water Flows at SG3

Location:	Rampere Landfill, Co. Wicklow
Associated staff gauge:	None
Flow measurement method:	Univeral Current Meter
Method of discharge calculation:	Mid-section Method (USGS recommended)

Date & Time:	16.03.01
Field Operatives:	M.Gleeson/K.Byrne
Weather:	Overcast

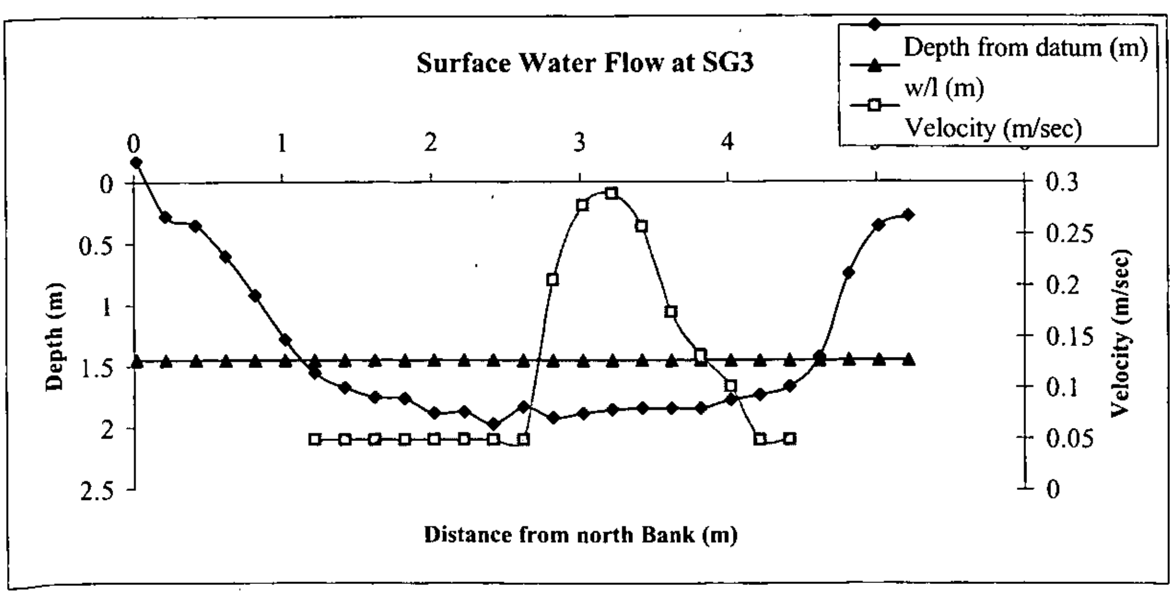
Initial stage (mbRef maMD)
Final stage (mbRef maMD)

Remarks

Propellor set at 0.6d for all measruement points

Data logger comments

Position	Distance from n.bank b_i (m)	Water depth y_i (m)	No. of Revolutions (N) per 30 sec	Velocity averaged over 30 sec 0.8d (m/sec)	0.6d (m/sec)	0.2d (m/sec)	Average velocity u_i (m/s)	Section width (m)	X-Section area (m^2)	Discharge q_i (m^3/s)	% of Total Discharge
0	0			n/a		n/a		0.2			
1	0.2			n/a		n/a		0.2			
2	0.4			n/a		n/a		0.2			
3	0.6			n/a		n/a		0.2			
4	0.8			n/a		n/a		0.2			
5	1.0		0	n/a		n/a	0.000	0.2			
6	1.2	0.1	0	n/a	0.028	n/a	0.028	0.2	0.02	0.001	0.46
7	1.4	0.22	0	n/a	0.028	n/a	0.028	0.2	0.044	0.001	1.00
8	1.6	0.3	0	n/a	0.028	n/a	0.028	0.2	0.06	0.002	1.37
9	1.8	0.31	0	n/a	0.028	n/a	0.028	0.2	0.062	0.002	1.41
11	2.0	0.43	0	n/a	0.028	n/a	0.028	0.2	0.086	0.002	1.96
12	2.2	0.42	0	n/a	0.028	n/a	0.028	0.2	0.084	0.002	1.92
13	2.4	0.52	0	n/a	0.028	n/a	0.028	0.2	0.104	0.003	2.37
14	2.6	0.38	0	n/a	0.028	n/a	0.028	0.2	0.076	0.002	1.73
15	2.8	0.47	15	n/a	0.184	n/a	0.184	0.2	0.094	0.017	14.10
17	3	0.43	22	n/a	0.257	n/a	0.257	0.2	0.086.	0.022	18.01
19	3.2	0.4	23	n/a	0.268	n/a	0.268	0.2	0.08	0.021	17.47
20	3.4	0.39	20	n/a	0.236	n/a	0.236	0.2	0.078	0.018	15.00
21	3.6	0.39	12	n/a	0.153	n/a	0.153	0.2	0.078	0.012	9.73
22	3.8	0.39	8	n/a	0.111	n/a	0.111	0.2	0.078	0.009	7.06
23	4	0.32	5	n/a	0.080	n/a	0.080	0.2	0.064	0.005	4.17
24	4.2	0.28	0	n/a	0.028	n/a	0.028	0.2	0.056	0.002	1.28
25	4.4	0.21	0	n/a	0.028	n/a	0.028	0.2	0.042	0.001	0.96
26	4.6		0	n/a		n/a	0.000	0.2			
27	4.8			n/a		n/a		0.2			
28	5			n/a		n/a		0.2			
29	5.2			n/a		n/a		0.2			
30	5.4			n/a		n/a		0.2			
31	5.6			n/a		n/a		0.2			
32	5.8			n/a		n/a		0.2			
									Total Discharge Q_t =	0.123	m^3/s
										10602	m^3/day



Surface Water Flows at SG1

Location: Rampere Landfill, Co. Carlow
Associated staff gauge: none
Flow measurement method: Universal Current Meter
Method of discharge calculation: Mid Section Method (USGS recommended)

Date & Time: 10.05.01
Field Operatives: M.Gleeson/D. Gallazi
Weather: Dry / Clear

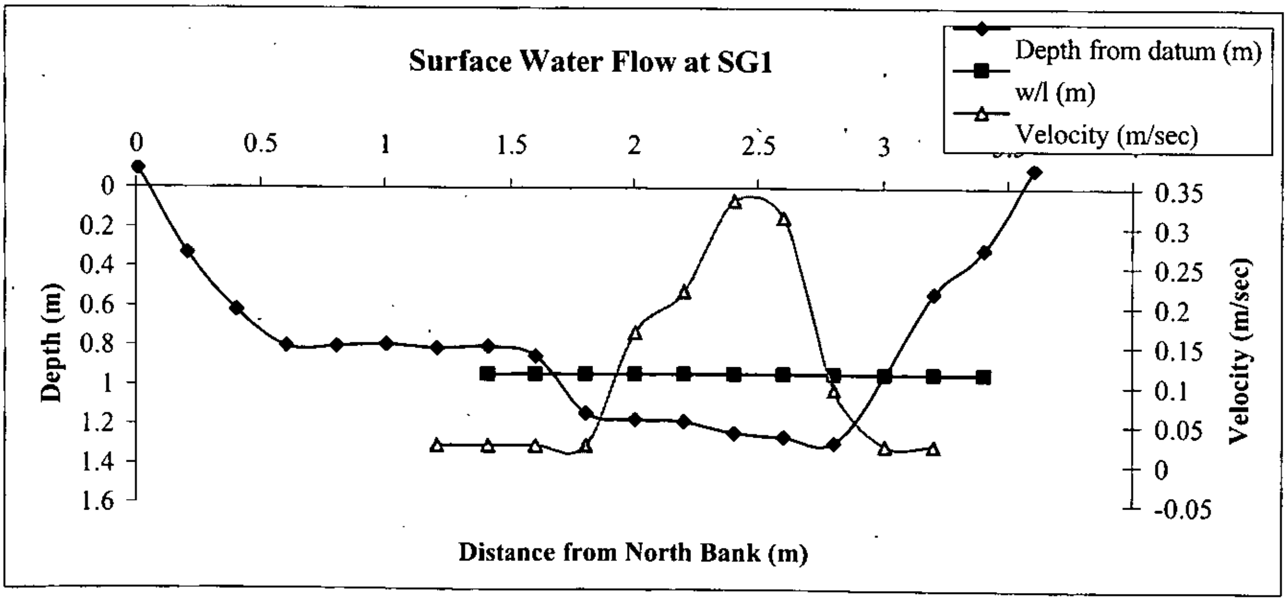
Initial stage (mbRef maMD)
Final stage (mbRef maMD)

Data logger comments

<u>Remarks</u>

Propellor set at 0.6d for all measurements

Position	Distance from n.bank b_i (m)	Water depth y_i (m)	No. of Revolutions (N) per 30 sec	Velocity averaged over 30 sec 0.8d (m/sec)	0.6d (m/sec)	0.2d (m/sec)	Average velocity u_i (m/s)	Section width (m)	X-Section area (m^2)	Discharge q_i (m^3/s)	% of Total Discharge
0	0	0		n/a		n/a		0.2			
1	0.2	0		n/a		n/a		0.2			
2	0.4	0		n/a		n/a		0.2			
3	0.6	0		n/a		n/a		0.2			
4	0.8	0		n/a		n/a		0.2			
5	1.0	0		n/a		n/a		0.2			
6	1.2	0		n/a		n/a		0.2			
7	1.4	0		n/a		n/a		0.2			
8	1.6	0		n/a		n/a		0.2			
9	1.8	0.2		n/a		n/a		0.2			
11	2.0	0.23	11	n/a	0.143	n/a	0.143	0.2	0.046	0.007	11.38
12	2.2	0.24	16	n/a	0.195	n/a	0.195	0.2	0.048	0.009	16.19
13	2.4	0.3	27	n/a	0.309	n/a	0.309	0.2	0.06	0.019	32.07
14	2.6	0.32	25	n/a	0.288	n/a	0.288	0.2	0.064	0.018	31.88
15	2.8	0.35	4	n/a	0.070	n/a	0.070	0.2	0.07	0.005	8.48
17	3	0		n/a		n/a		0.2			
19	3.2	0		n/a		n/a		0.2			
20	3.4	0		n/a		n/a		0.2			
21	3.6	0		n/a		n/a		0.2			
22	3.8	0		n/a		n/a		0.2			
								Total Discharge Q_i =		0.058	m^3/s
										4995	m^3/day



Surface Water Flows at SG2

Location:	Rampere Landfill, Co. Wicklow
Associated staff gauge:	none
Flow measurement method:	Universal Current Meter
Method of discharge calculation:	Mid-section method (USGS recommended)
Date & Time:	10.05.01
Field Operatives:	M. Gleeson / D. Gallazzi
Weather:	Dry / Clear

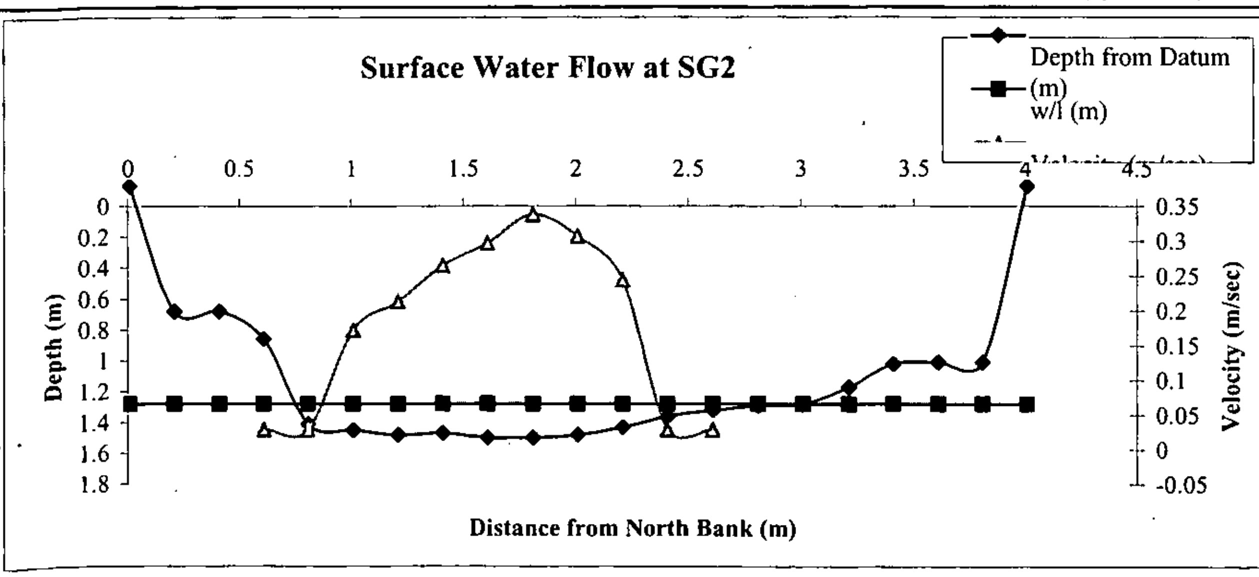
Initial stage (mbRef maMD)
Final stage (mbRef maMD)

Data logger comments

Remarks

Propellor set at 0.6d for all measurements

Position	Distance from n.bank b_i (m)	Water depth y_i (m)	No. of Revolutions (N) per 30 sec	Velocity averaged over 30 sec			Average velocity u_i (m/s)	Section width (m)	X-Section area (m^2)	Discharge q_i (m^3/s)	% of Total Total
				0.8d (m/sec)	0.6d (m/sec)	0.2d (m/sec)					
0	0	0		n/a		n/a		0.2	0		
1	0.2	0		n/a		n/a		0.2	0		
2	0.4	0		n/a		n/a		0.2	0		
3	0.6	0		n/a		n/a		0.2	0		
4	0.8	0.17		n/a	0.028	n/a	0.028	0.2	0.034	0.001	1.29
5	1.0	0.21	11	n/a	0.143	n/a	0.143	0.2	0.042	0.006	8.13
6	1.2	0.26	15	n/a	0.184	n/a	0.184	0.2	0.052	0.010	12.95
7	1.4	0.26	20	n/a	0.236	n/a	0.236	0.2	0.052	0.012	16.61
8	1.6	0.26	23	n/a	0.268	n/a	0.268	0.2	0.052	0.014	18.86
9	1.8	0.22	27	n/a	0.309	n/a	0.309	0.2	0.044	0.014	18.40
11	2.0	0.2	24	n/a	0.278	n/a	0.278	0.2	0.04	0.011	15.05
12	2.2	0.12	18	n/a	0.215	n/a	0.215	0.2	0.024	0.005	6.98
13	2.4	0.08		n/a	0.028	n/a	0.028	0.2	0.016	0.000	0.61
14	2.6	0.06		n/a	0.028	n/a	0.028	0.2	0.012	0.000	0.45
15	2.8	0.05		n/a	0.028	n/a	0.028	0.2	0.01	0.000	0.38
17	3	0.04		n/a	0.028	n/a	0.028	0.2	0.008	0.000	0.30
19	3.2	0		n/a		n/a		0.2	0		
20	3.4	0		n/a		n/a		0.2	0		
21	3.6	0		n/a		n/a		0.2	0		
22	3.8	0		n/a		n/a		0.2	0		
23	4	0		n/a		n/a		0.2	0		
24	4.2	0		n/a		n/a		0.2	0		
							Total Discharge Q_t =			0.074	m^3/s
										6385	m^3/day



Surface Water Flows at SG3

Location:	Rampere Landfill, Co. Wicklow
Associated staff gauge:	None
Flow measurement method:	Univeral Current Meter
Method of discharge calculation:	Mid-section Method (USGS recommended)
Date & Time:	10.05.01
Field Operatives:	M.Gleeson/D. Gallazi
Weather:	Dry / Clear

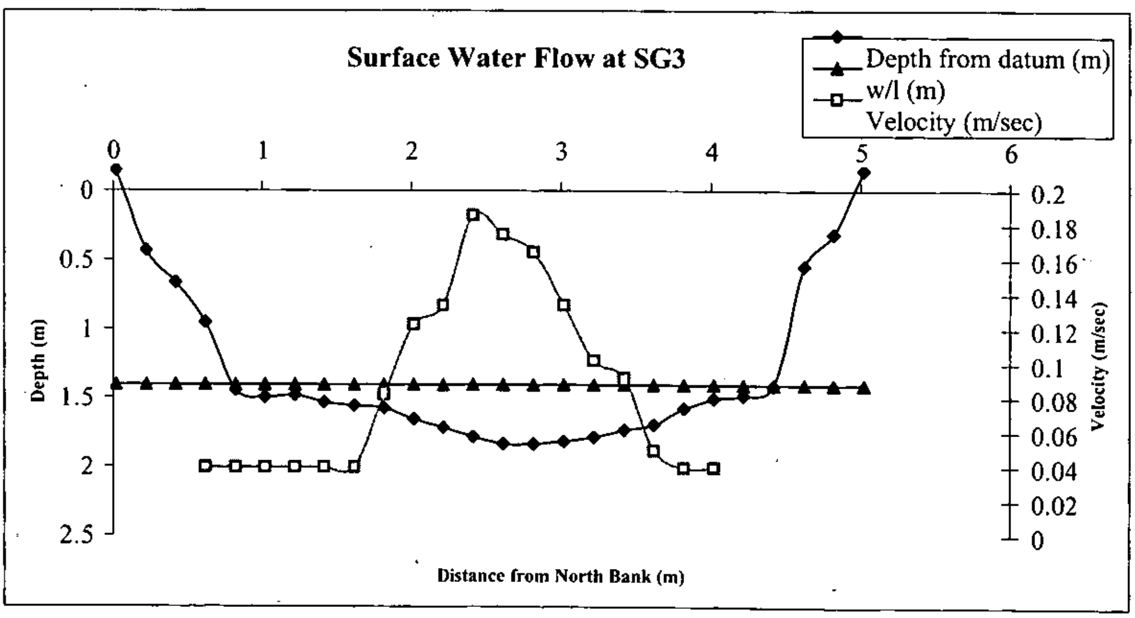
Remarks

Propellor set at 0.6d for all measruement points

Initial stage (mbRef maMD)
Final stage (mbRef maMD)

Data logger comments

Position	*Distance from n.bank b_i (m)*	*Water depth y_i (m)*	*No. of Revolutions (N) per 30 sec*	*Velocity averaged over 30 sec* 0.8d (m/sec)	0.6d (m/sec)	0.2d (m/sec)	*Average velocity u_i (m/s)*	*Section width (m)*	*X-Section area (m^2)*	*Discharge q_i (m^3/s)*	*% of Total Discharge*
0	0	0		n/a		n/a		0.2			
1	0.2	0		n/a		n/a		0.2			
2	0.4	0		n/a		n/a		0.2			
3	0.6	0	0	n/a	0.028	n/a	0.028	0.2	0	0.000	0.00
4	0.8	0.04	0	n/a	0.028	n/a	0.028	0.2	0.008	0.000	0.26
5	1.0	0.09	0	n/a	0.028	n/a	0.028	0.2	0.018	0.001	0.59
6	1.2	0.08	0	n/a	0.028	n/a	0.028	0.2	0.016	0.000	0.53
7	1.4	0.13	0	n/a	0.028	n/a	0.028	0.2	0.026	0.001	0.86
8	1.6	0.15	0	n/a	0.028	n/a	0.028	0.2	0.03	0.001	0.99
9	1.8	0.17	4	n/a	0.070	n/a	0.070	0.2	0.034	0.002	2.80
11	2.0	0.25	8	n/a	0.111	n/a	0.111	0.2	0.05	0.006	6.53
12	2.2	0.31	9	n/a	0.122	n/a	0.122	0.2	0.062	0.008	8.90
13	2.4	0.38	14	n/a	0.174	n/a	0.174	0.2	0.076	0.013	15.56
14	2.6	0.43	13	n/a	0.163	n/a	0.163	0.2	0.086	0.014	16.50
15	2.8	0.43	12	n/a	0.153	n/a	0.153	0.2	0.086	0.013	15.48
17	3	0.41	9	n/a	0.122	n/a	0.122	0.2	0.082	0.010	11.77
19	3.2	0.38	6	n/a	0.090	n/a	0.090	0.2	0.076	0.007	8.05
20	3.4	0.33	5	n/a	0.080	n/a	0.080	0.2	0.066	0.005	6.21
21	3.6	0.29	1	n/a	0.038	n/a	0.038	0.2	0.058	0.002	2.59
22	3.8	0.17	0	n/a	0.028	n/a	0.028	0.2	0.034	0.001	1.12
23	4	0.1	0	n/a	0.028	n/a	0.028	0.2	0.02	0.001	0.66
24	4.2	0.08	0	n/a	0.028	n/a	0.028	0.2	0.016	0.000	0.53
25	4.4	0.01	0	n/a	0.028	n/a	0.028	0.2	0.002	0.000	0.07
26	4.6	0	0	n/a	0.028	n/a	0.028	0.2	0	0.000	0.00
27	4.8	0		n/a		n/a		0.2			
28	5	0		n/a		n/a		0.2			
							Total Discharge Q_t =			0.085	m^3/s
										7342	m^3/day



APPENDIX G

Electroconductivity & Temperature Survey

		07/07/2000		10/05/2001	
Monitoring Point No.	Location	EC, @ 25 °C µS/cm	Temp, °C	EC @ 25 °C µS/cm	Temp. °C
1	At gate over western tributary, 30 south of road bridge	431	11.4	433	11.6
2	20m upstream of bridge	610	11.8	604	11.6
3	5m upstream of road bridge	613	11.8	607	11.5
4	Under bridge at western side	591	11.6	584	11.4
5	Under bridge at eastern side	569	11.8	577	11.3
6	At drinking pool	580	11.7	578	11.1
7	At SG1	579	11.8	588	11.4
8	1m upstream of bend in stream	579	11.8	575	11.9
9	2m downstream of bend in stream	580	11.8	577	11.9
10	In stream opposite BD2	577	11.8	577	11.8
11	In stream 20 downstream of BD2	578	11.8	577	11.9.
12	In stream opposite TP2	578	11.8	575	12.2
13	Between TP2 and TP3	578	11.8	576	12.0
14	5m upstream of TP3	578	11.8	577	12.0
15	In corner of field opposite TP3	577	11.8	576	12.3
16	1m upstream of concrete 300ϕ pipe inlet	579	11.8	577	12
17	Discharge from pipe	315	12.0	328	10.3
18	2m downstream of pipe inlet	576	11.8	578	12.1
19	At SG2	576	11.8	577	12.0
20	15m downstream of SG2	576	11.8	576	12.2
21	20m upstream of corner of working cell	573	12.0	576	12.2
22	Opposite intersection of reinstated and working landfill	574	12.0	574	11.8
23	20m downstream	570	11.9	575	11.8
24	12m upstream of field boundary on northern bank of stream	577	12.0	573	11.8
25	20m upstream from end of landfill	571	12.0	576	12.0
26	1m upstream of pipe inlet close to SG3	575	12.0	578	12.0
27	Discharge from pipe	450	14.7	468	10.7
28	At SG3	574	11.9	580	11.8

APPENDIX H

BMA GeoServices

- Geology
- Geophysics
- Geotechnical
- Environmental

Report Final

Report on the Geophysical Survey for the proposed landfill extension at Rampere, Baltinglass, Co Wicklow.

for

M.C. O'Sullivan & Co. Ltd.

GEOTECHNICS IRELAND LTD.
8 WOODBINE PARK
BLACKROCK, CO. DUBLIN.
REG. NO. 171945

FOREWORD

Geophysical surveying is an indirect, non-invasive process and involves interpretation of readings made at the ground surface in terms of likely subsurface conditions. This interpretation is based on the existing knowledge of ground conditions, typical geophysical responses of known materials and the experience of the author. This report has been prepared by Bernard Murphy & Associates in line with best current practice and with all reasonable skill, care and diligence within the limitations imposed by the survey technique applied and the resources devoted to it by agreement with the client. The client should take the interpretative basis for any conclusions or opinions contained therein into account in any future use of this report.

BMA GEOSERVICES
STRAWHALL BUSSINESS PARK
ATHY ROAD
CARLOW

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Tables Enclosed

- Table 1 EM31 Ground Conductivity Values.
- Table 2 Resistivity Values.
- Table 3 Seismic Refraction Velocities.

Maps Enclosed

- Map 1 Location of Geophysical Readings.
- Map 2 EM31 Conductivity Contours.
- Map 3 Summary Map.

Appendices

Appendix I Geophysical Methodology.

Appendix II 2D-Resistivity Data.

Appendix III Seismic Refraction Data.

1. Summary

- The geophysical survey has outlined lateral and vertical variations in the overburden type and thickness and in bedrock lithology and quality.

- Areas of high EM31 conductivity values (10-25mS/m), have been mapped in the north and extreme south of the site. These have been interpreted as >4m of gravelly, sandy clay overburden.

- A zone of lower EM31 conductivity values (5-10 m/S/m), occur across the southern part of the site and has been interpreted as 2-4m of gravelly, sandy clay overburden.

- The zone of lowest EM31 conductivity values (0-5 m/S/m), in the southern part of the site has been interpreted as 0-2m of gravelly, sandy clay overburden.

- Lateral and vertical changes in resistivity values outline variations in the type of bedrock. Variations have been interpreted as weathered/fractured rock, interbedded shale/mudstone and interbedded sandstone/shale.

- The seismic velocities indicate stiffness of overburden material, the presence of weathered/fractured bedrock and fresh bedrock. The seismic velocities of the overburden indicate generally firm to stiff material at depth with some soft to firm material at the surface.

- Bedrock has velocities in the range 2350 to 3150 m/s interpreted strong to very strong shale/mudstone.

2. Introduction

B.J. Murphy & Associates (BMA), Geological and Geophysical Consultants, were requested by M.C. O'Sullivan & Co. Ltd., to carry out a Geophysical Survey as part of the site investigation for a proposed extension to an existing landfill at Rampere, Baltinglass, Co. Wicklow.

Objectives

- Map variations in overburden type and thickness, outlining areas of alluvial sediments and soft ground.
- Map variations of bedrock lithologies with depth and distance outlining the bedrock profile.
- Estimate the geotechnical properties of the overburden and bedrock materials and provide information to assist in the site characterisation, particularly with respect to any high permeability fracture zones that might be present in the bedrock.

Methodology

- Measuring EM31 Ground Conductivity to give a rapid outline of lateral variations in overburden thickness.
- Measuring 2-D Resistivity Profiles at selected locations across the survey area to map the different layers of ground material and any lateral variations within these layers.
- Seismic refraction spreads to map depth to bedrock and determine the seismic velocities of the different materials present.

The locations of the geophysical readings are shown on Map 1. The basemap of the survey area was supplied by the client.

Report Outline

The results are discussed in Section 3. A detailed account of the geophysical methods, equipment used and data processing is contained in Appendix I.

Geological Setting

The geological map (*Geology of Kildare-Wicklow, Sheet 16, GSI 1995*) shows the site to be underlain by Cambrian Butter Formation, described as slate-schist with interbedded quartzite in places.

3. Results

This section integrates the geophysical results with the available geological data. The interpretation is based on the available factual information, typical geophysical responses of known materials and the experience of the author. Estimates of soil stiffness and rock quality are based on the measured geophysical data.

The EM31 data indicate variations in the thickness of overburden material across the site (Maps 2 & 3). The overburden appears to increase in thickness from south to north. To the south, in the area of high ground, overburden is relatively thin (<2m) and increases in thickness northwards towards the river, where overburden thickness are interpreted as generally >4m.

Table 1. EM31 Conductivity Values

Conductivity (mS/m)	Interpretation
0 – 5	0 – 2m Gravelly, Sandy CLAY Overburden
5-10	2 – 4m Gravelly, Sandy CLAY Overburden
10-25	>4m Gravelly, Sandy CLAY Overburden

The six 2D-Resistivity profiles have been interpreted as indicating overburden material with resistivities in the range 50-250 ohm-m. This has been interpreted as gravelly, sandy clay.

Bedrock resistivities are generally low, <500 ohm-m, interpreted as interdedded shales, mudstone and sandstone. Some high resistivity values >500 ohm-m have been interpreted as probable weathered/fractured shale/mudstone.

Profile 4 from west to east across the site has been interpreted to indicate a number of probable faults in the bedrock.

The resistivity data are summarised as follows:

Table 2. Resistivity Values

Resistivity (Ohm-m)	Interpretation
50-250	Gravelly Sandy CLAY
150-1000	Probable Weathered/Fractured Rock
100-250	Shale/Mudstone
250-500	Sandstone/Shale

Four seismic profiles were carried out along the southern boundary of the site (Map 1 & Appendix III). The profiles indicate three seismic layers. The first layer has velocities in the range 300-550m/s and is interpreted as soft to firm, topsoil and gravelly, sandy clay. This is

underlain by a higher velocity layer (650-1350m/s), interpreted as firm to stiff, gravelly, sandy clay with probable weathered/fractured shale/mudstone at it's base.

Bedrock velocities range from 2350-3150m/s and are interpreted as shale/mudstone from 5.0-13.5m below ground level. The seismic data are summarised as follows:

Table 3. Seismic Refraction Velocities

Layer	Thickness (m)	P-Seismic Velocity (m/s)	Est. Stiffness /Rock Quality	Rippability
Topsoil & gravelly sandy CLAY	1.25-4.0	300-550	Soft-Firm	Diggable
Gravelly sandy CLAY & Probable Weathered/Fractured SHALE/ MUDSTONE	3.5-10.0	650-1350	Firm-Stiff	Diggable/ Rippable
SHALE/ MUDSTONE	-	2350-3150	Strong-Very Strong	Blast

References

Bell F.G.,(1993) Engineering Geology, Blackwell Scientific Press.

Campus Geophysical Instruments, 1994: User Manuals for computer programs IMAGE50 and PRMFILE, Birmingham, England.

Campus Geophysical Instruments, 1997: User Manual for computer program RES2DINV, Birmingham, England.

Golden Software, 1994: WINSURF Surface Mapping System, Users Manual, Golden Software, CO., USA.

Hagedoorn, J.G., 1959: The plus - minus method of interpreting seismic refraction sections, Geophysical Prospecting, 7, 158 - 182.

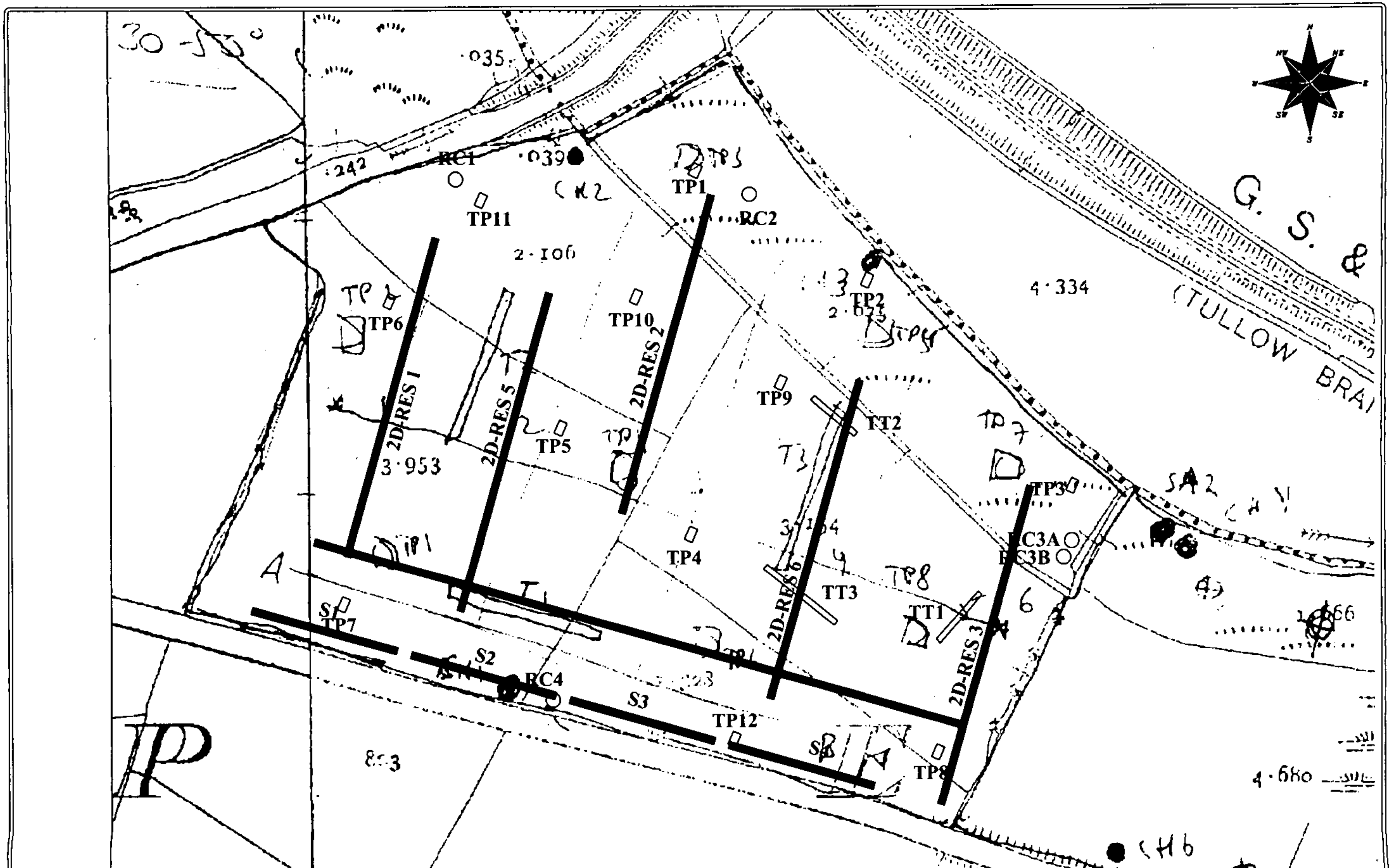
Interpex, 1997: GREMIX users manual. Golden, CO, USA.

Interpex, 1998: FIRSTPIX users manual. Golden, CO, USA.

Palmer, D., 1980: The Generalized Reciprocal Method of seismic refraction interpretation, SEG.

Redpath, B.B., 1973: Seismic refraction exploration for engineering site investigations, NTIS, U.S. Dept. of Commerce

Soske, J.L., 1959: The blind zone problem in engineering geophysics, Geophysics, 24, pp 359-365.



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Legend
- 2D-Resistivity Profile
- Seismic Spread
- Trial Pit
- Trial Trench
- Borehole

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Scale: 1 / 1,250
Date: November 2001
Checked: Peter O'Connor

Title: MAP 1 LOCATION OF GEOPHYSICAL READINGS

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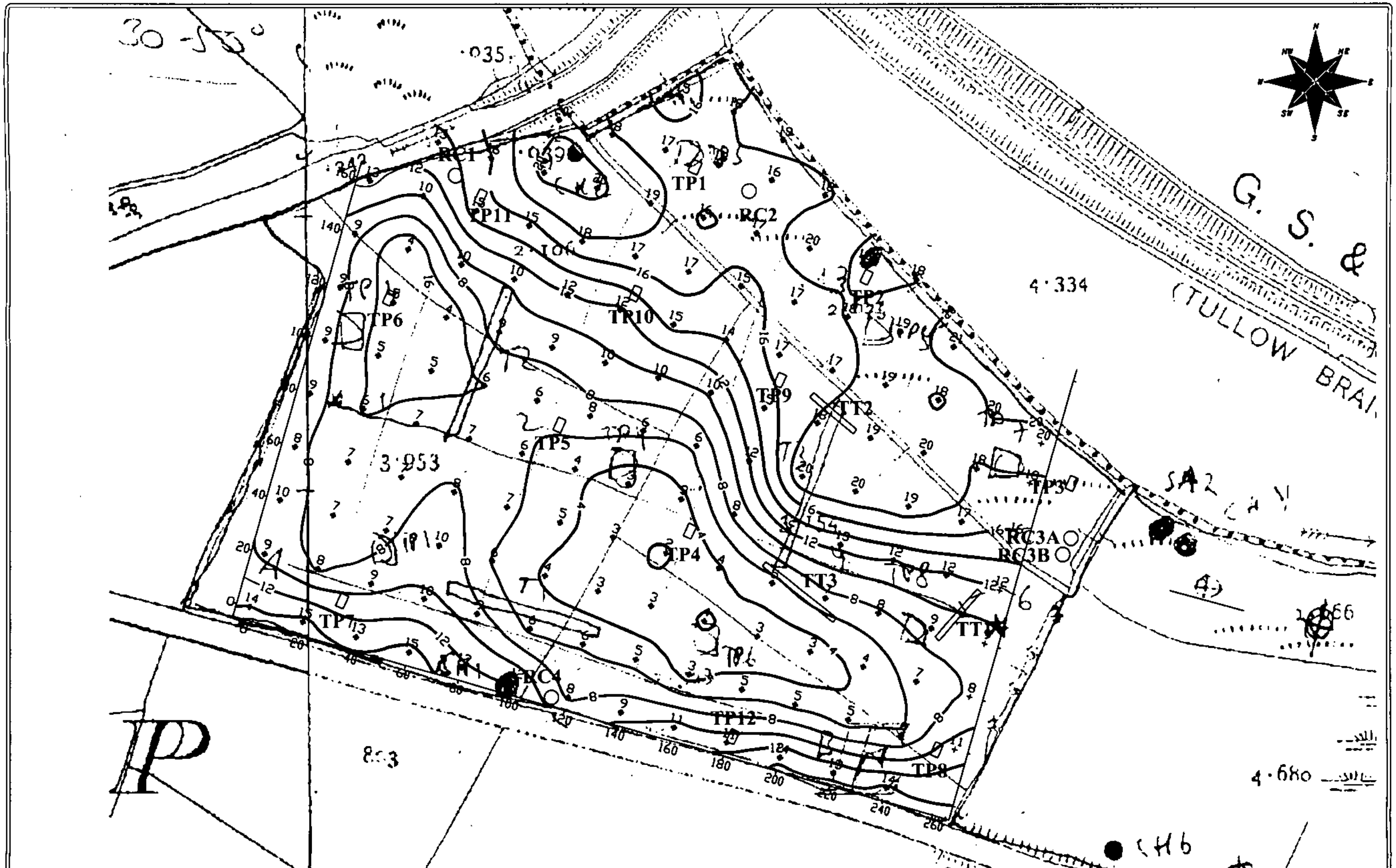

BMA Geotechnical Engineering, Engineering Geology, Engineering Geophysics, Environmental Hydrogeology. B J Murphy & Associates. BMA, Kennedy Street, Carlow Town, Co.Carlow, Ireland. Phone: 353-503-34486 Mobile: 087-2477923 Fax: 353-503-34490 E-mail: bmacarlow@bma.ie	Conductivity Values: 2-4 mS/m; 5-8 mS/m; 9-12 mS/m; 13-16 mS/m; 16-20 mS/m	Scale 1 / 1,250; Date July 2000	Map 2 EM31 CONDUCTIVITY CONTOURS	RAMPERE, BALTINGLASS, CO. WICKLOW.	M.C.O.S. & CO. LTD.

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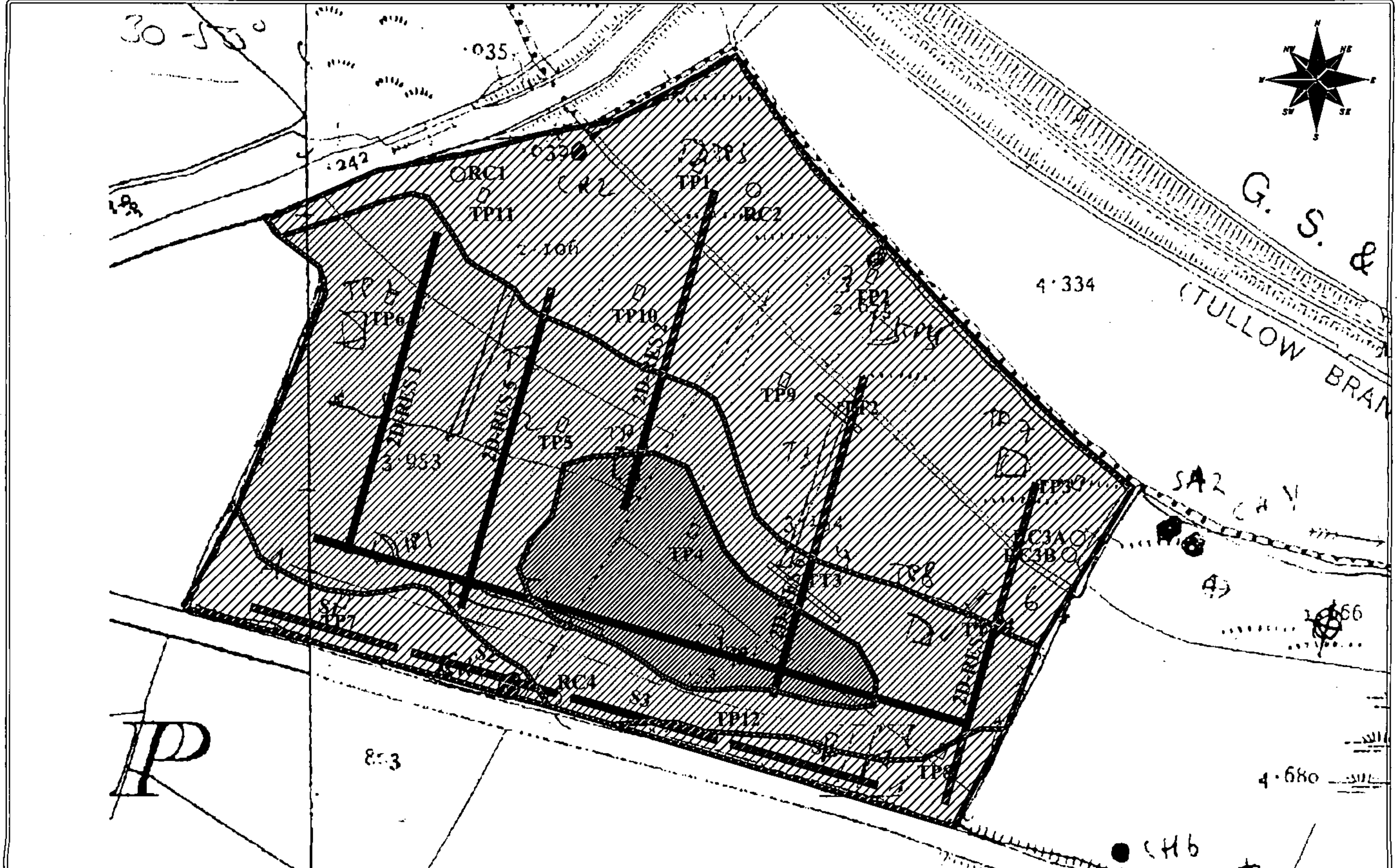

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- 0-2m Gravelly Sandy Clay
- 2-4m Gravelly Sandy Clay
- >4m Gravelly Sandy Clay

Revision Details	Issue	By	Date	Rev

Scale: 1 / 1250

Map 3
SUMMARY MAP

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Appendix I Geophysical Methodology.

A1. Methods Used

A1.1 EM31 Ground Conductivity

This method operates on the principle of inducing currents in conductive substrata and measuring the resultant secondary electro-magnetic field. The strength of this secondary EM field is calibrated to give apparent ground conductivity in milliSiemens/m (mS/m). As the effective penetration of this method is around 6m b.g.l., the measured conductivity is a function of the different overburden layers and/or rock from 0 to 6m b.g.l.

A1.2 2D-Resistivity Profiling

A basic measurement technique in resistivity work is the Wenner array, whereby four electrodes are planted along a line in the ground and a current is introduced through the two outer electrodes. The potential difference across the two inner electrodes is then measured and the resistance (physical unit: Ohm) is determined as the quotient of the potential and the current. All measurements are made with a resistivity meter.

To obtain the resistivity (physical unit: Ohm * m), which is a quantity independent of test conditions and characteristic for different soils and liquids, the following formula is applied:

Resistivity = 2 * Pi * Spacing * Resistance

In 2D-Resistivity a large number of resistivity measurements are taken both laterally and vertically in order to map changes in material types in these directions. This is achieved in a very efficient way by connecting many electrodes to the resistivity meter and using a computer to control the process of data collection and storage.

A1.3 Seismic Refraction

This method measures the traveltimes of the refracted seismic waves through the overburden and rock material and allows an assessment of the thickness and quality of the materials to be made. More compact materials tend to have higher seismic velocities. The depth range of the method varies with geophone spacing but for typical engineering surveys is of the order of 1 to 30 m.

A2. Equipment Used

A2.1 EM31 Ground Conductivity

The equipment used was a Geonics EM31 conductivity meter and data logging system. The instrument does not require ground contact and can be operated by one person.

A2.2 2D-Resistivity Profiling

The GEOPULSE resistivity meter with an IMAGER-50 module, 1 or 2 multi-core cables with 25 takeouts each, 25 or 50 stainless steel electrodes and a portable computer with the 2D-Resistivity collection software IMAGE50 (Campus Geophysical Instruments, 1994) was used to measure the resistivity sections.

A second portable computer was used on site to run the RES2DINV software for processing and viewing the data immediately after the survey (Campus Geophysical Instruments, 1997).

A2.3 Seismic Refraction

The seismic data was recorded using a 12-channel Geometrics Smartseis signal enhancement seismograph with a seismic cable and 12 vertical geophones. The seismic source was a hammer and a striking plate.

A3. Field Procedure

The locations of the geophysical measurements are shown on Map 1.

A3.1 EM31 Ground Conductivity

Conductivity values were recorded on a grid at 20x20m intervals (Map 1). A total of 143 station locations were recorded. Stations were located on the grid by pacing with reference to landmarks and site boundaries. Notes were taken of any potential sources of interference and of changes in topography and soil type.

A3.2 2D-Resistivity Profiling

Six 2D-Resistivity profiles were carried out at selected locations across the site. The recording parameters for each profile are listed below.

Table 1: 2D-Resistivity Profile locations

PROFILE No.	NO. OF ELECTRODES	SPACING (m)	LENGTH (m)	AZIMUTH (m)	NOMINAL DEPTH (m)
1	25	5	120	S-N	16
2	25	5	120	S-N	16
3	25	5	120	S-N	16
4	50	5	245	W-E	30
5	25	5	120	S-N	16
6	25	5	120	S-N	16

A3.3 Seismic Refraction

Four seismic refraction spreads were recorded from west to east along the southern boundary of the site. Each seismic spread consisted of 12 collinear geophones at spacings of 5m. Records from up to five different positions were taken on each spread (2 x off-end, 2 x end, 1 x middle) to ensure optimum coverage of all refractors.

A4. Data Processing

A4.1 EM31 Ground Conductivity

The conductivity values have been gridded, blanked and contoured with the program WINSURF (Golden Software, 1994). The contours are displayed on Map 2, and the measured conductivities are annotated at their locations..

Note: The gridding method used was the Kriging technique. It should be noted that computer-based gridding and contouring methods interpolate and extrapolate between data points, and reference should be made to the location and value of the original data points when using the contoured data.

A4.2 2D-Resistivity Profiling

The field data were stored in computer files, which were converted with the computer program PRMFILE (Campus Geophysical Instruments, 1994). The resulting files were loaded into RES2DINV (Campus Geophysical Instruments, 1997), where an inversion with up to 5 iterations of the measured data was carried out for each profile to obtain a 2D-Depth model of the resistivities.

These 2D-Resistivity models and interpreted geology are displayed on Sections 1-6 (Appendix II). The horizontal axis shows the distance along the profile, while the depth (b.g.l.) is indicated at the sides. Constant contour intervals and colour codes have been used for Sections 1-6.

Note: Care should be taken when using these sections. The data displayed is real physical data that can be measured with a high repeatability, but transforming resistivities directly into geological layers requires interpretation of the geophysical results.

A4.3 Seismic Refraction

The data were processed as follows:

(i) 'first breaks' were picked on the field records and traveltime plots constructed for each spread.

(ii) seismic velocity phases were picked on each traveltime plot and the thickness of each velocity unit was calculated using the intercept - time method (Redpath, 1973).

(iii) further velocity and thickness information was then obtained using a combination of the "plus-minus" method (Hagedoorn, 1959) and the "Generalised Reciprocal Method", (GRM), (Palmer, 1980).

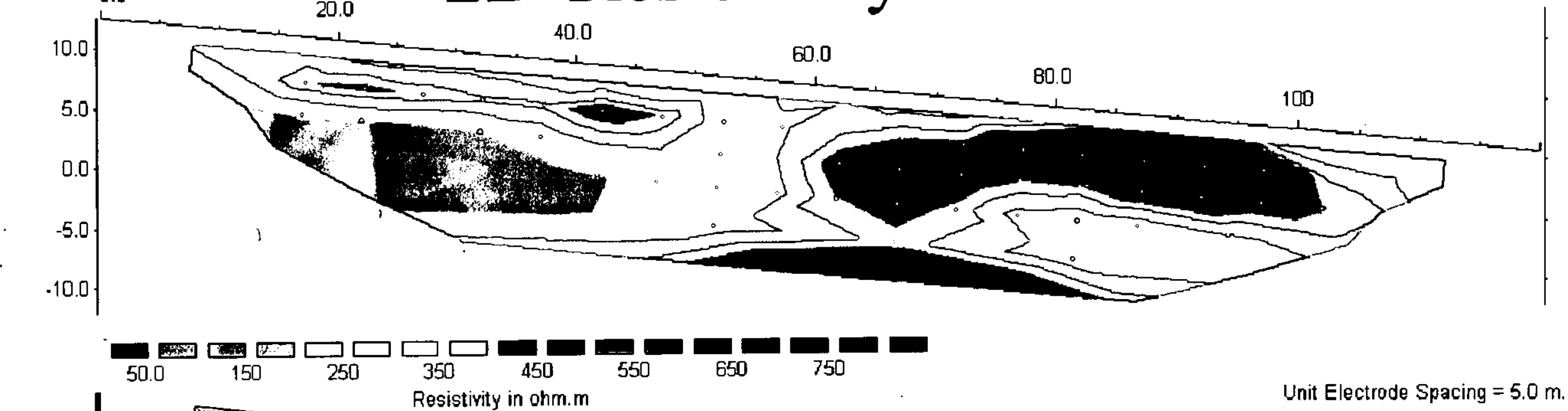
(iv) depth and velocity sections were constructed for each spread using the information obtained in (ii) and (iii) above.

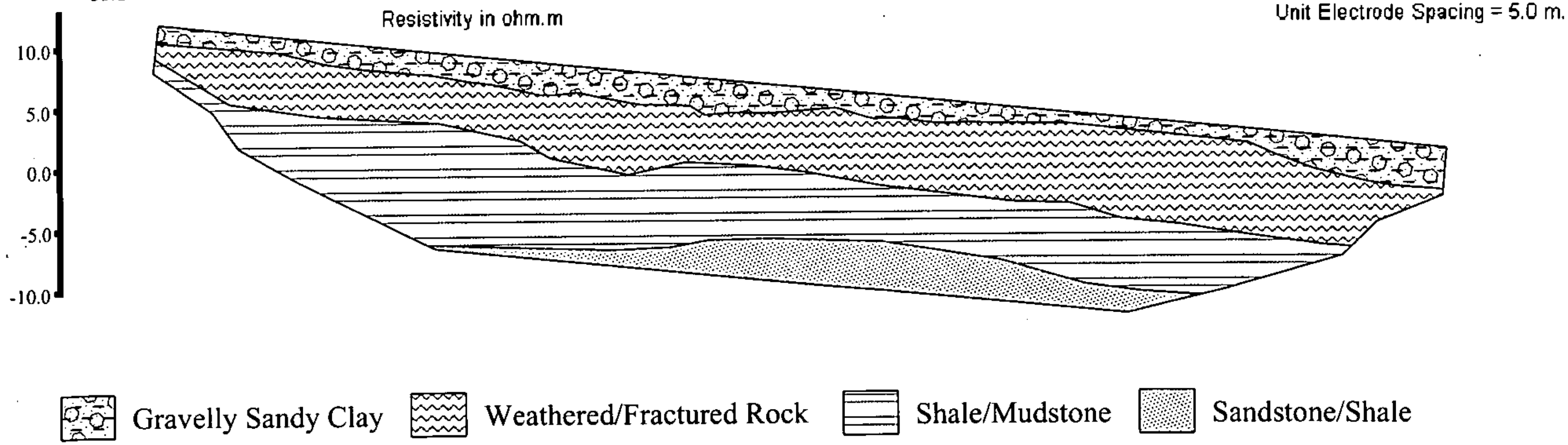
The data processing was carried out using the "FIRSTPIX' and "GREMIX" computer programs (Interpex, 1997, 1998). The traveltime graphs, depth sections and velocity graphs for each spread are contained in Appendix III.

Approximate errors for velocities are estimated to be +/- 10%. Errors for the calculated layer thicknesses are of the order of +/-20%. Possible errors due to the "hidden layer" and "velocity inversion" effects may also occur (Soske, 1959).

APPENDIX II 2D-Resistivity Profiling Data.

2D-Resistivity Profile 1





Notes:
Notes

Drawn: Y O'Connell
Scale: 1 / 500
Date: July 2000
Checked: Peter O'Connor
Based On:

Title:
SECTION 1
INTERPRETATION
2D-RESISTIVITY PROFILE 1

Job:
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Client:
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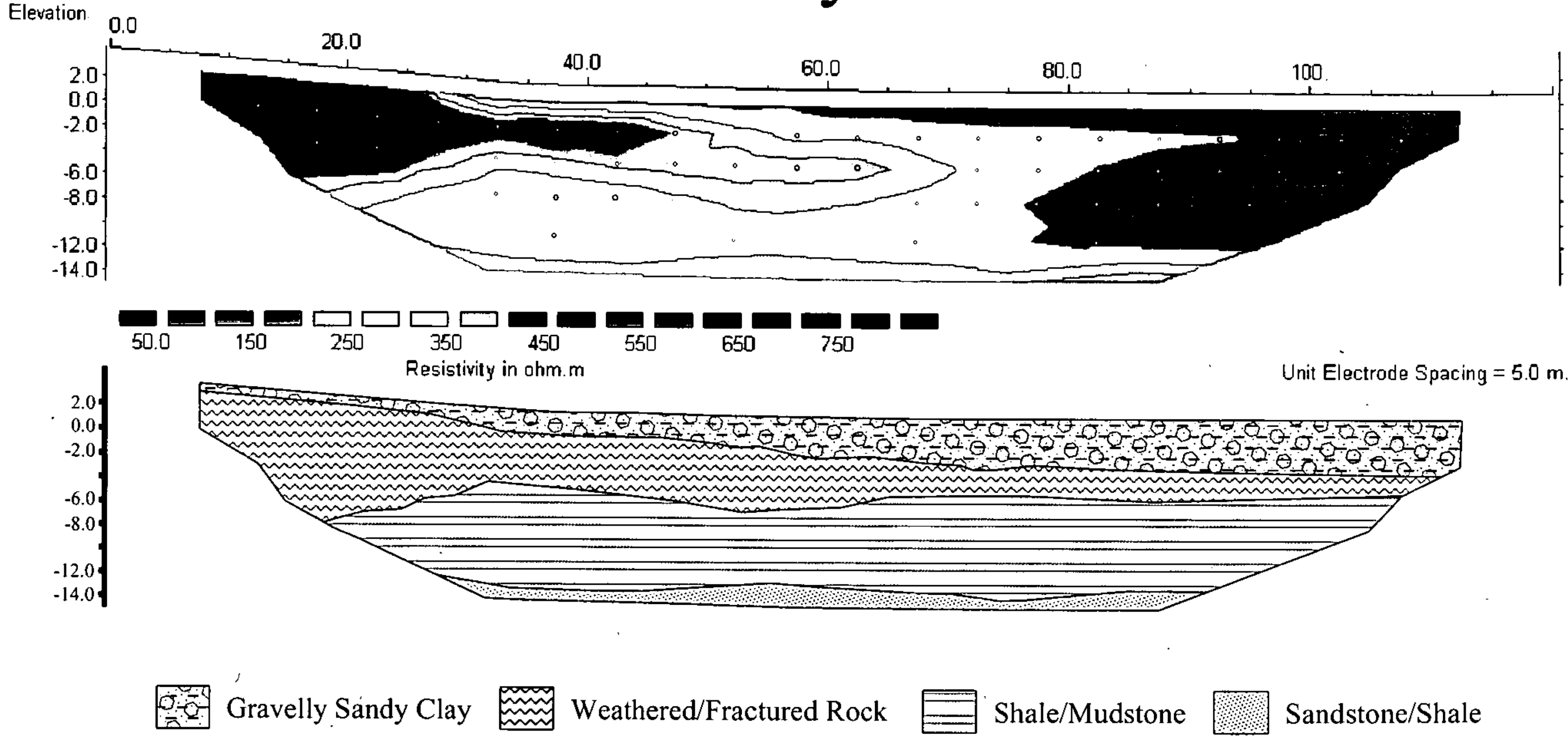
2D-Resistivity Profile 2



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	Scale: 1 / 500	SECTION 2 INTERPRETATION 2D-RESISTIVITY PROFILE 2	RAMPERE, BALTINGLASS, CO. WICKLOW.	M.C.O.S. & CO. LTD.	
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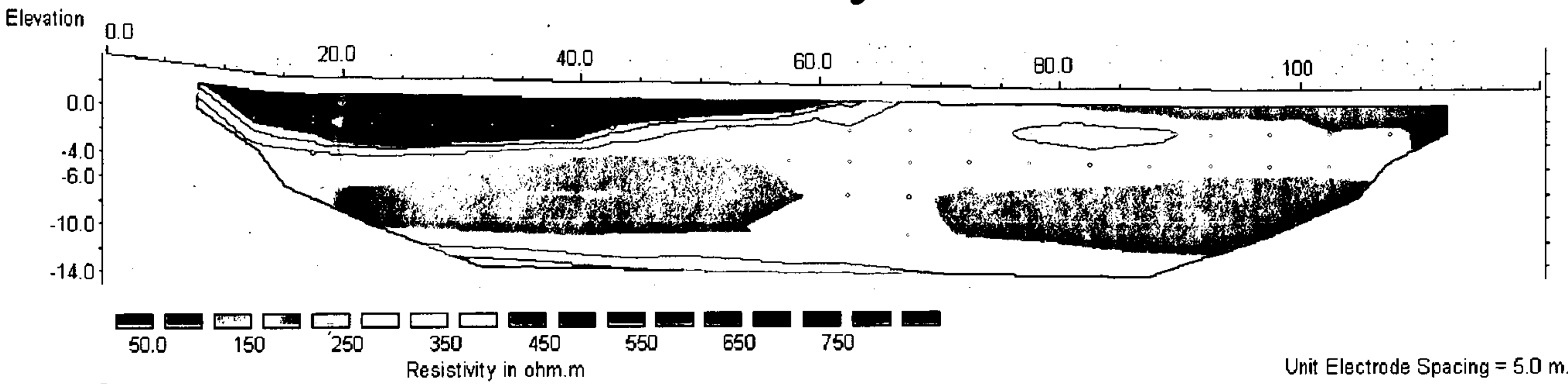
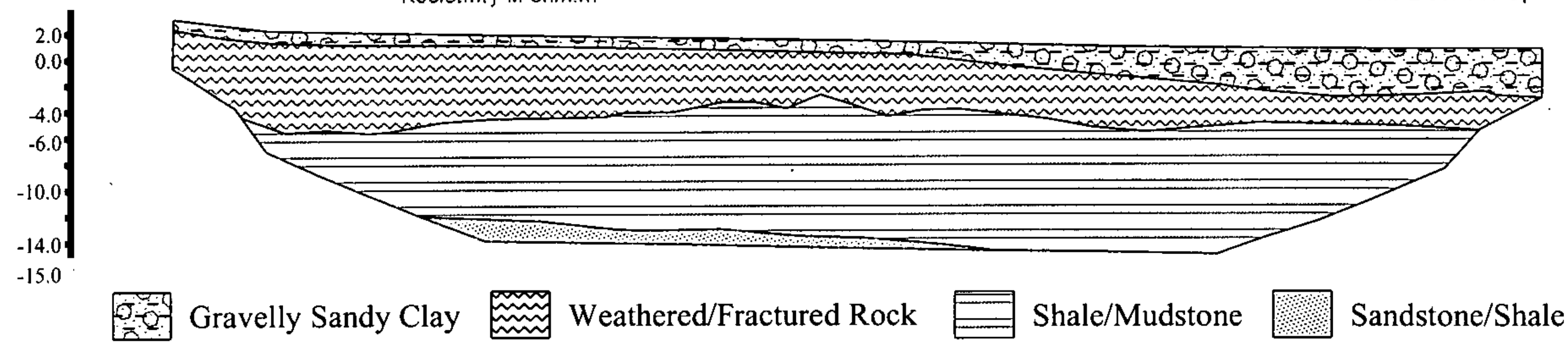
2D-Resistivity Profile 3





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Notes	Drawn: Y O'Connell Scale: 1 / 500 Date: July 2000 Checked: Peter O'Connor Based On:	SECTION 3 INTERPRETATION 2D-RESISTIVITY PROFILE 3	RAMPERE, BALTINGLASS, CO. WICKLOW.	M.C.O.S. & CO. LTD.	Drg No: GP0000

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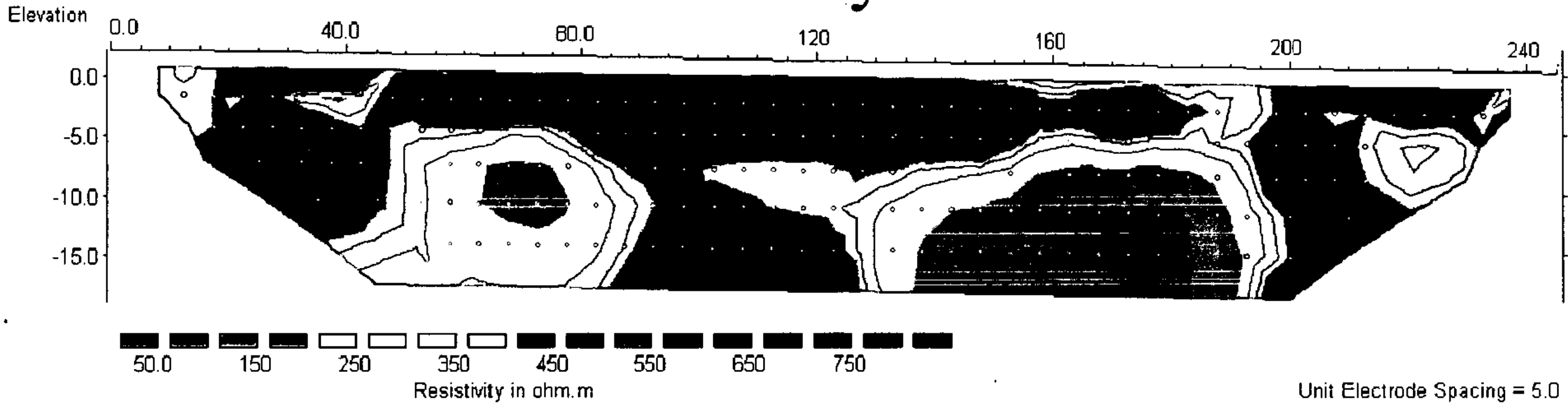
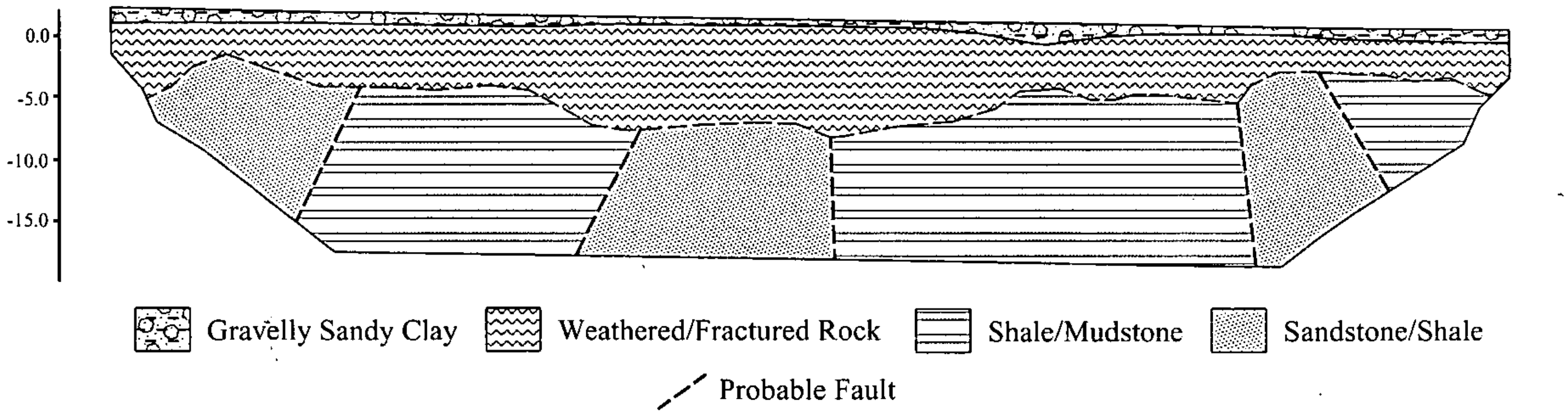
2D-Resistivity Profile 4





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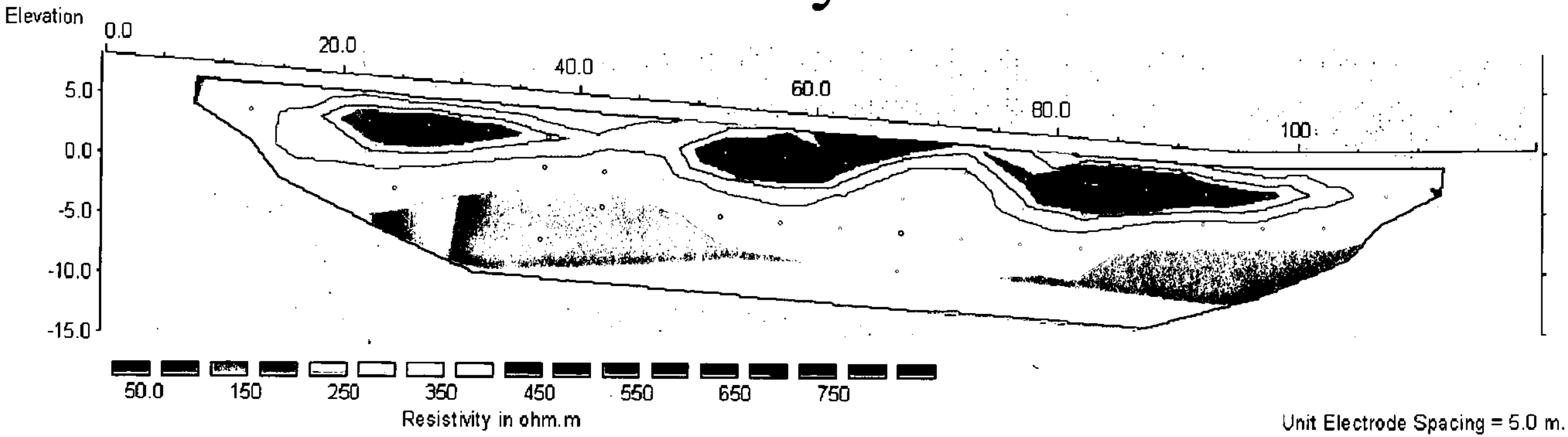
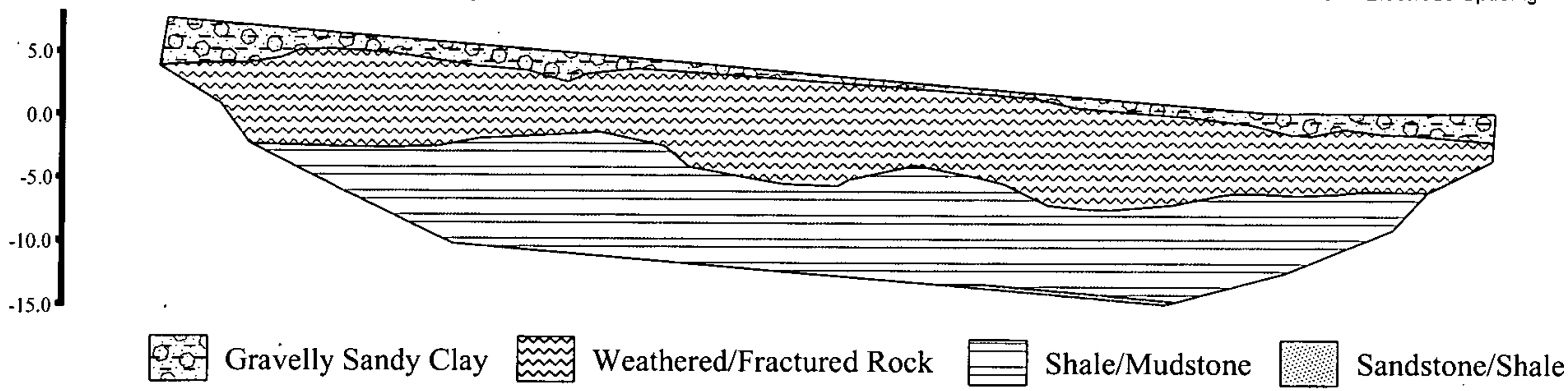
2D-Resistivity Profile 5



Unit Electrode Spacing = 5.0 m.



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Scale: 1 / 500
Date: July 2000
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Title:
SECTION 5
INTERPRETATION
2D-RESISTIVITY PROFILE 5

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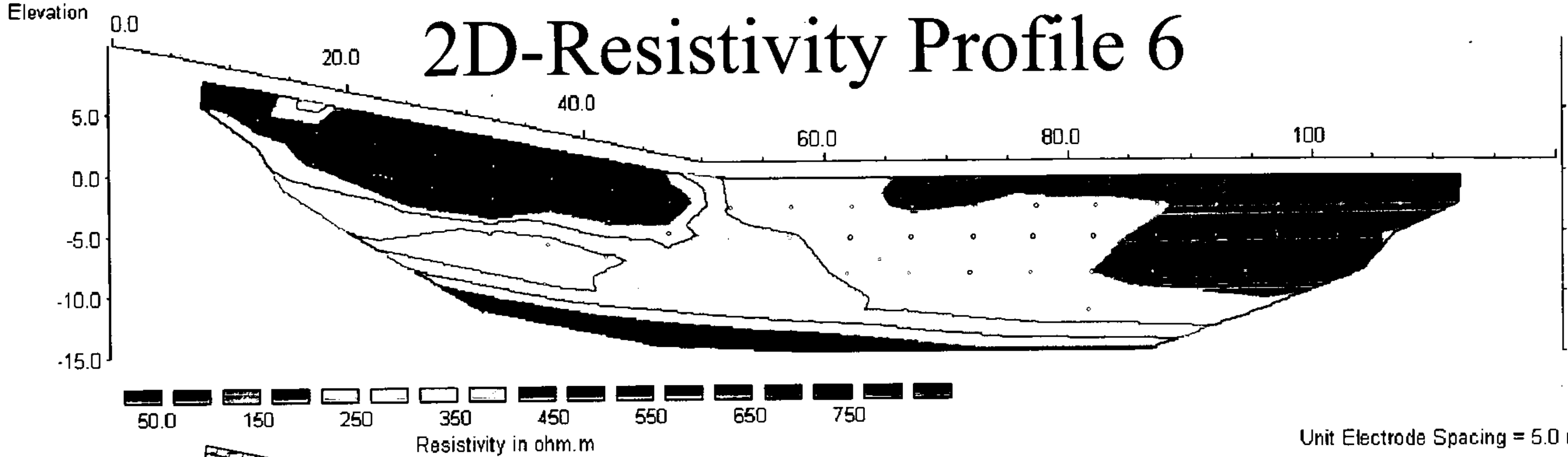
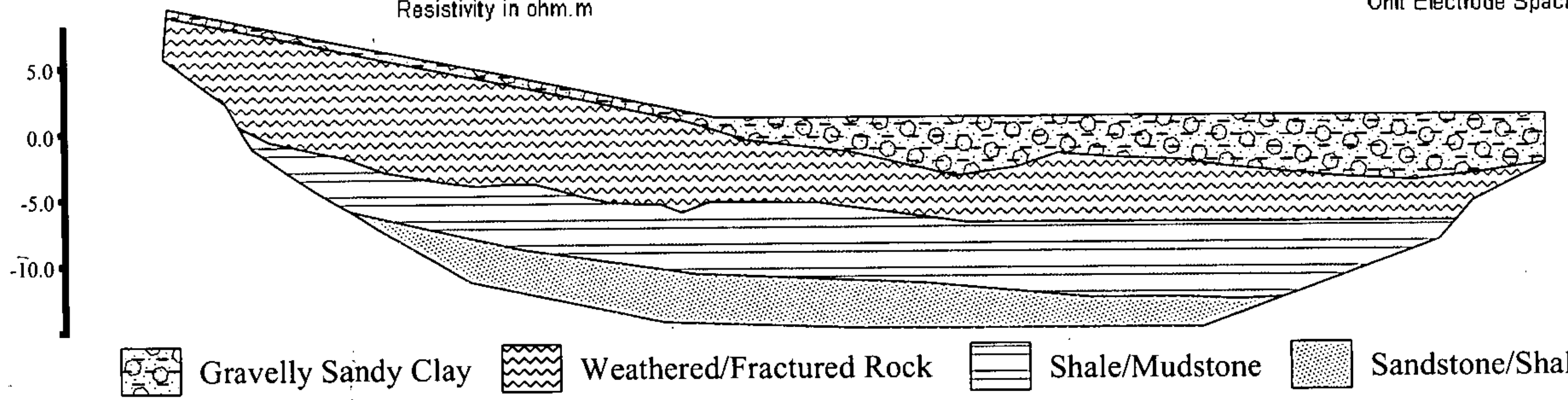
2D-Resistivity Profile 6





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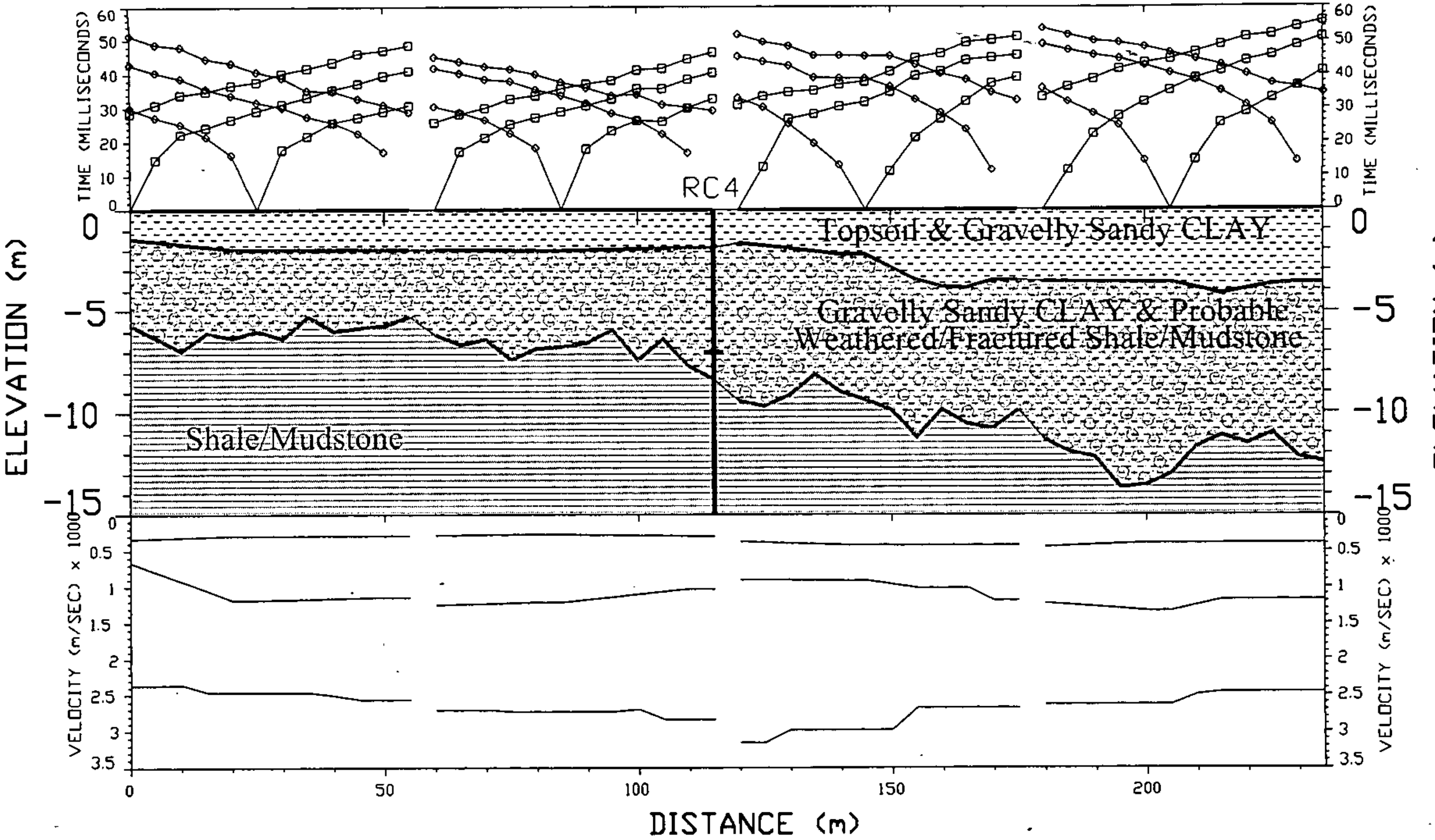
APPENDIX III Seismic Refraction Data.



for: M.C. O'Sullivan		Rampere
by: B.J. Murphy & Associates		Baltinglass Co. Wicklow
Data Set S1-4	Date: 15/MAY/00	
Equipment: GEOMETRICS Sna	Spread: 1-4	Azimuth: West-East

Groundwater Monitoring Results

Monitoring Location SA1A

** I Lab Accredited ++ Subcontracted Analysis n/a Non Accredited	Results (mg/l)		Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method / technique
Date Sampled: LAB ID :	13.03.01 24181	On-site Measure.	20.08.01 26924	On-site Measure.			
Ammoniacal nitrogen NH_4-N ++	290		288		Bailer	0.1-12.9	Colourimetry/FIA
Arsenic As ++	0.04		<0.01		Bailer	0.01-1.00	ICP-OES
Barium Ba ++	0.09		0.02		Bailer	0.01-1.00	ICP-OES
Borehole Depth (m)		10.9			Bailer		Dip tape
Boron B ++	1.8		2.1		Bailer	0.07-1.0	ICP-OES
Cadmium Cd **	<0.03		<0.03		Bailer	0.03-2.00	Direct aspiration/flame AAS
Calcium Ca n/a	163		116		Bailer	1-100	Ion chromatography
Chloride Cl^- **	368		373		Bailer	0.5-50	Ion chromatography
Chromium Cr **	<0.05		<0.05		Bailer	0.05-5.00	Direct aspiration/flame AAS
Copper Cu **	<0.05		<0.05		Bailer	0.05-5.00	Direct aspiration/flame AAS
Cyanide Cn, total ++	<0.05		<0.05		Bailer	0.05-1.0	Distillation/colorimetry
Dissolved oxygen DO n/a	1.6		1.2		Bailer	N/A	DO Probe
Electrical conductivity EC uS/cm n/a	5050		4550		Bailer	1-100,000	Electrometry
Faecal coliforms (/100mls) ++	NIL		8		Bailer		Membrane Filtration
Fluoride F **	0.2		<0.1		Bailer	0.1-5.0	Ion chromatography
Iron Fe **	12.6		1.56		Bailer	0.05-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.2		<0.20		Bailer	0.20-9.00	Direct aspiration/flame AAS
Magnesium Mg n/a	172		176		Bailer	Jan-25	Ion chromatography
Manganese Mn **	0.78		0.33		Bailer	0.03-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		<0.001		Bailer	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni **	<0.10		<0.10		Bailer	0.10-2.00	Direct aspiration/flame AAS
Nitrate NO_3 **	<0.5		1		Bailer	0.5-50	Ion chromatography
Nitrite NO_2 **	<0.2		<1		Bailer	0.2-10	Ion chromatography
pH **	7.2		7.2		Bailer	Jan-14	Hydrogen Ion Selective Electrode
Phenol ++	<0.05		<0.05		Bailer	0.05-1.0	Distillation/colorimetry
Phosphate PO_4^- **	<1		<1		Bailer	1.0-10.0	Ion chromatography
Phosphorus P n/a	4		9.5		Bailer	0.05-1.5	Digestion / colorimetry
Potassium K n/a	384		409		Bailer	Jan-25	Ion chromatography
Residue on evaporation (180°C) n/a	2393		2294		Bailer	N/A	Gravimetric
Selenium Se ++	<0.01		0.02		Bailer	0.01-0.25	Direct aspiration/Hydride ICP
Silver Ag ++	<0.01		<0.01		Bailer	0.01-5.00	Direct aspiration/flame AAS
Sodium Na n/a	239		248		Bailer	1-100	Ion chromatography
Sulphate SO_4 **	13		4		Bailer	0.25-100	Ion chromatography
Temperature (°C)	-	8.9		7.2	Bailer	0-100°C	Temperature Probe
Total alkalinity (as HCO3) n/a	2600		2700		Bailer	N/A	Titration
Total coliforms (/100mls) ++	NIL		>100		Bailer		Membrane Filtration
Total organic carbon TOC ++	99.7		95.7		Bailer	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen TON n/a	<0.2		0.3		Bailer		Sum of nitrate & nitrite
Water level (m OD)		7	7.2		Bailer		Dip tape
Zinc Zn **	0.07		0.05		Bailer	0.01-1.00	Direct aspiration/flame AAS

Groundwater Monitoring Results

Monitoring Location BD1

** I Lab Accredited ++ Subcontracted Analysis n/a Non Accredited	Results				Sampling method	Normal Analytical Range	Analysis method / technique
Date Sampled: LAB ID :	13.03.01 24174	On-site Measurements	20.08.01 26920	On-site Measurement			
Ammoniacal nitrogen NH_4-N ++	<0.10		<0.1		Bailer	0.1-12.9	Colourimetry/FIA
Arsenic As ++	<0.01		<0.01		Bailer	0.01-1.00	ICP-OES
Barium Ba ++	<0.01		0.01		Bailer	0.01-1.00	ICP-OES
Borehole Depth (m)		10.3			Bailer		Dip tape
Boron B ++	<0.07		<0.07		Bailer	0.07-1.0	ICP-OES
Cadmium Cd **	<0.03		<0.03		Bailer	0.03-2.00	Direct aspiration/flame AAS
Calcium Ca n/a	151		136		Bailer	1-100	Ion chromatography
Chloride Cl **	15		17		Bailer	0.5-50	Ion chromatography
Chromium Cr **	<0.05		<0.05		Bailer	0.05-5.00	Direct aspiration/flame AAS
Copper Cu **	<0.05		<0.05		Bailer	0.05-5.00	Direct aspiration/flame AAS
Cyanide Cn, total ++	<0.05		<0.05		Bailer	0.05-1.0	Distillation/colorimetry
Dissolved oxygen DO n/a	6.7		8.4		Bailer	N/A	DO Probe
Electrical conductivity EC uS/cm n/a	602		554		Bailer	1-100,000	Electrometry
Faecal coliforms (/100mls) ++	NIL		NIL		Bailer		Membrane Filtration
Fluoride F **	0.1		0.1		Bailer	0.1-5.0	Ion chromatography
Iron Fe **	0.1		<0.05		Bailer	0.05-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.20		<0.20		Bailer	0.20-9.00	Direct aspiration/flame AAS
Magnesium Mg n/a	6		6		Bailer	Jan-25	Ion chromatography
Manganese Mn **	<0.03		<0.03		Bailer	0.03-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		<0.001		Bailer	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni **	<0.10		<0.10		Bailer	0.10-2.00	Direct aspiration/flame AAS
Nitrate NO_3 **	22		26		Bailer	0.5-50	Ion chromatography
Nitrite NO_2 **	<0.2		<0.2		Bailer	0.2-10	Ion chromatography
pH **	7.3		7.1		Bailer	Jan-14	Hydrogen Ion Selective Electrode
Phenol ++	<0.05		<0.05		Bailer	0.05-1.0	Distillation/colorimetry
Phosphate PO_4 **	<1		<1		Bailer	1.0-10.0	Ion chromatography
Phosphorus P n/a	0.13		0.15		Bailer	0.05-1.5	Digestion / colorimetry
Potassium K n/a	1		<1		Bailer	Jan-25	Ion chromatography
Residue on evaporation (180°C) n/a	405		411		Bailer	N/A	Gravimetric
Selenium Se ++	<0.01		<0.01		Bailer	0.01-0.25	Direct aspiration/Hydride ICP
Silver Ag ++	<0.01		<0.01		Bailer	0.01-5.00	Direct aspiration/flame AAS
Sodium Na n/a	9		10		Bailer	1-100	Ion chromatography
Sulphate SO_4 **	11		10		Bailer	0.25-100	Ion chromatography
Temperature (°C)		6.6		14.1	Bailer	0-100°C	Temperature Probe
Total alkalinity (as HCO3) n/a	320		310		Bailer	N/A	Titration
Total coliforms (/100mls) ++	NIL		>100		Bailer		Membrane Filtration
Total organic carbon TOC ++	0.3		<0.05		Bailer	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen TON n/a	4.9		6		Bailer		Sum of nitrate & nitrite
Water level (m OD)		0.6	1.4		Bailer		Dip tape
Zinc Zn **	<0.01		0.01		Bailer	0.01-1.00	Direct aspiration/flame AAS

Groundwater Monitoring Results

Monitoring Location BD2

** I Lab Accredited ++ Subcontracted Analysis n/a Non Accredited	Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method / technique
Date Sampled: **LAB ID :**	13.03.01 24175	On-site Measuremen			
Ammoniacal nitrogen NH_4-N ++	<0.10		Bailer	0.1-12.9	Colourimetry/FIA
Arsenic As ++	<0.01		Bailer	0.01-1.00	ICP-OES
Barium Ba ++	<0.01		Bailer	0.01-1.00	ICP-OES
Borehole Depth (m)		8.7	Bailer		Dip tape
Boron B ++	<0.07		Bailer	0.07-1.0	ICP-OES
Cadmium Cd **	<0.03		Bailer	0.03-2.00	Direct aspiration/flame AAS
Calcium Ca n/a	147		Bailer	1-100	Ion chromatography
Chloride Cl **	17		Bailer	0.5-50	Ion chromatography
Chromium Cr **	<0.05		Bailer	0.05-5.00	Direct aspiration/flame AAS
Copper Cu **	<0.05		Bailer	0.05-5.00	Direct aspiration/flame AAS
Cyanide Cn, total ++	<0.05		Bailer	0.05-1.0	Distillation/colorimetry
Dissolved oxygen DO n/a	7.2		Bailer	N/A	DO Probe
Electrical conductivity EC uS/cm n/a	583		Bailer	1-100,000	Electrometry
Faecal coliforms (/100mls) ++	NIL		Bailer		Membrane Filtration
Fluoride F **	0.1		Bailer	0.1-5.0	Ion chromatography
Iron Fe **	0.12		Bailer	0.05-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.20		Bailer	0.20-9.00	Direct aspiration/flame AAS
Magnesium Mg n/a	7		Bailer	Jan-25	Ion chromatography
Manganese Mn **	<0.03		Bailer	0.03-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		Bailer	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni **	<0.10		Bailer	0.10-2.00	Direct aspiration/flame AAS
Nitrate NO_3 **	26		Bailer	0.5-50	Ion chromatography
Nitrite NO_2 **	<0.2		Bailer	0.2-10	Ion chromatography
pH **	7.4		Bailer	Jan-14	Hydrogen Ion Selective Electrode
Phenol ++	<0.05		Bailer	0.05-1.0	Distillation/colorimetry
Phosphate PO_4 **	<1		Bailer	1.0-10.0	Ion chromatography
Phosphorus P n/a	0.5		Bailer	0.05-1.5	Digestion / colorimetry
Potassium K n/a	1		Bailer	Jan-25	Ion chromatography
Residue on evaporation (180°C) n/a	388		Bailer	N/A	Gravimetric
Selenium Se ++	<0.01		Bailer	0.01-0.25	Direct aspiration/Hydride ICP
Silver Ag ++	<0.01		Bailer	0.01-5.00	Direct aspiration/flame AAS
Sodium Na n/a	9		Bailer	1-100	Ion chromatography
Sulphate SO_4 **	12		Bailer	0.25-100	Ion chromatography
Temperature (°C)		6.8	Bailer	0-100°C	Temperature Probe
Total alkalinity (as HCO3) n/a	295		Bailer	N/A	Titration
Total coliforms (/100mls) ++	1		Bailer		Membrane Filtration
Total organic carbon TOC ++	0.3		Bailer	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen TON n/a	6		Bailer		Sum of nitrate & nitrite
Water level (m OD)		0.8	Bailer		Dip tape
Zinc Zn **	<0.01		Bailer	0.01-1.00	Direct aspiration/flame AAS

Groundwater Monitoring Results
Monitoring Location BD3A

** 1 Lab Accredited, ++ Subcontracted Analysis n/a Non Accredited	Results (mg/l)		Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method / technique
Date Sampled: LAB ID:	13.03.01 24181	On-site Measurements.	13.03.02 30408	On-site Measurement			
Ammoniacal nitrogen NH_4-N ++	<0.10		<0.08		Bailer	0.1-12.9	Colourimetry/FIA
Arsenic As ++	<0.01		5		Bailer	0.01-1.00	ICP-OES
Barium Ba ++	<0.01		<0.01		Bailer	0.01-1.00	ICP-OES
Borehole Depth (m)		6.1			Bailer		Dip tape
Boron B ++	<0.07		0.023		Bailer	0.07-1.0	ICP-OES
Cadmium Cd **	<0.03		<0.03		Bailer	0.03-2.00	Direct aspiration/flame AAS
Calcium Ca n/a	99		94		Bailer	1-100	Ion chromatography
Chloride Cl **	15		15		Bailer	0.5-50	Ion chromatography
Chromium Cr **	<0.05		<0.05		Bailer	0.05-5.00	Direct aspiration/flame AAS
Copper Cu **	<0.05		<0.05		Bailer	0.05-5.00	Direct aspiration/flame AAS
Cyanide Cn, total ++	<0.05		<5		Bailer	0.05-1.0	Distillation/colorimetry
Dissolved oxygen DO n/a	7.6		10		Bailer	N/A	DO Probe
Electrical conductivity EC uS/cm n/a	462		468		Bailer	1-100,000	Electrometry
Faecal coliforms (/100mls) ++	2				Bailer		Membrane Filtration
Fluoride F **	0.1		0.2		Bailer	0.1-5.0	Ion chromatography
Iron Fe **	0.62		1.31		Bailer	0.05-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.20		<0.2		Bailer	0.20-9.00	Direct aspiration/flame AAS
Magnesium Mg n/a	4		4		Bailer	Jan-25	Ion chromatography
Manganese Mn **	0.04		0.1		Bailer	0.03-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		<0.1		Bailer	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni **	<0.10		<0.1		Bailer	0.10-2.00	Direct aspiration/flame AAS
Nitrate NO_3 **	35		34		Bailer	0.5-50	Ion chromatography
Nitrite NO_2 **	<0.2		<0.2		Bailer	0.2-10	Ion chromatography
pH **	6.9		7.1		Bailer	Jan-14	Hydrogen Ion Selective Electrode
Phenol ++	<0.05		<0.05		Bailer	0.05-1.0	Distillation/colorimetry
Phosphate PO_4 **	<1				Bailer	1.0-10.0	Ion chromatography
Phosphorus P n/a	0.76		14		Bailer	0.05-1.5	Digestion / colorimetry
Potassium K n/a	<1		<1		Bailer	Jan-25	Ion chromatography
Residue on evaporation (180°C) n/a	342		436		Bailer	N/A	Gravimetric
Selenium Se ++	<0.01		<0.05		Bailer	0.01-0.25	Direct aspiration/Hydride ICP
Silver Ag ++	<0.01		<0.01		Bailer	0.01-5.00	Direct aspiration/flame AAS
Sodium Na n/a	9		7		Bailer	1-100	Ion chromatography
Sulphate SO_4 **	11		11		Bailer	0.25-100	Ion chromatography
Temperature (°C)	-	6.6			Bailer	0-100°C	Temperature Probe
Total alkalinity (as HCO3) n/a	200		810		Bailer	N/A	Titration
Total coliforms (/100mls) ++	>100				Bailer		Membrane Filtration
Total organic carbon TOC ++	<0.3		0.9		Bailer	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen TON n/a	8		8		Bailer		Sum of nitrate & nitrite
Water level (m OD)		0.8			Bailer		Dip tape
Zinc Zn **	0.01		0.02		Bailer	0.01-1.00	Direct aspiration/flame AAS

Groundwater Monitoring Results
Monitoring Location BD3B

** 1 Lab Accredited ++ Subcontracted Analysis n/a Non Accredited	Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method / technique
Date Sampled: **LAB ID :**	**13.03.01** **24177**	**On-site Measureme**			
Ammoniacal nitrogen NH_4-N ++	<0.10		Bailer	0.1-12.9	Colourimetry/FIA
Arsenic As ++	<0.01		Bailer	0.01-1.00	ICP-OES
Barium Ba ++	<0.01		Bailer	0.01-1.00	ICP-OES
Borehole Depth (m)		14.8	Bailer		Dip tape
Boron B ++	<0.07		Bailer	0.07-1.0	ICP-OES
Cadmium Cd **	<0.03		Bailer	0.03-2.00	Direct aspiration/flame AAS
Calcium Ca n/a	74		Bailer	1-100	Ion chromatography
Chloride Cl **	15		Bailer	0.5-50	Ion chromatography
Chromium Cr **	<0.05		Bailer	0.05-5.00	Direct aspiration/flame AAS
Copper Cu **	<0.05		Bailer	0.05-5.00	Direct aspiration/flame AAS
Cyanide Cn, total ++	<0.05		Bailer	0.05-1.0	Distillation/colorimetry
Dissolved oxygen DO n/a	7.6		Bailer	N/A	DO Probe
Electrical conductivity EC uS/cm n/a	368		Bailer	1-100,000	Electrometry
Faecal coliforms (/100mls) ++	NIL		Bailer		Membrane Filtration
Fluoride F **	0.1		Bailer	0.1-5.0	Ion chromatography
Iron Fe **	0.06		Bailer	0.05-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.20		Bailer	0.20-9.00	Direct aspiration/flame AAS
Magnesium Mg n/a	4		Bailer	Jan-25	Ion chromatography
Manganese Mn **	<0.03		Bailer	0.03-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		Bailer	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni **	<0.10		Bailer	0.10-2.00	Direct aspiration/flame AAS
Nitrate NO_3 **	35		Bailer	0.5-50	Ion chromatography
Nitrite NO_2 **	<0.2		Bailer	0.2-10	Ion chromatography
pH **	6.8		Bailer	Jan-14	Hydrogen Ion Selective Electrode
Phenol ++	<0.05		Bailer	0.05-1.0	Distillation/colorimetry
Phosphate PO_4 **	<1		Bailer	1.0-10.0	Ion chromatography
Phosphorus P n/a	0.08		Bailer	0.05-1.5	Digestion / colorimetry
Potassium K n/a	<1		Bailer	Jan-25	Ion chromatography
Residue on evaporation (180°C) n/a	260		Bailer	N/A	Gravimetric
Selenium Se ++	<0.01		Bailer	0.01-0.25	Direct aspiration/Hydride ICP
Silver Ag ++	<0.01		Bailer	0.01-5.00	Direct aspiration/flame AAS
Sodium Na n/a	9		Bailer	1-100	Ion chromatography
Sulphate SO_4 **	10		Bailer	0.25-100	Ion chromatography
Temperature (°C)		6.9	Bailer	0-100°C	Temperature Probe
Total alkalinity (as HCO3) n/a	155		Bailer	N/A	Titration
Total coliforms (/100mls) ++	NIL		Bailer		Membrane Filtration
Total organic carbon TOC ++	0.3		Bailer	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen TON n/a	7.8		Bailer		Sum of nitrate & nitrite
Water level (m OD)		0.7	Bailer		Dip tape
Zinc Zn **	<0.01		Bailer	0.01-1.00	Direct aspiration/flame AAS

Groundwater Monitoring Results

Monitoring Location BD4

** I Lab Accredited ++ Subcontracted Analysis n/a Non Accredited	Results (mg/l)		Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method / technique
Date Sampled: LAB ID :	13.03.01 24177	On-site Measureme	20.08.01 26923	On-site Measure			
Ammoniacal nitrogen NH_4-N ++	<0.10		<0.1		Bailer	0.1-12.9	Colourimetry/FIA
Arsenic As ++	<0.01		<0.01		Bailer	0.01-1.00	ICP-OES
Barium Ba ++	<0.01		0.01		Bailer	0.01-1.00	ICP-OES
Borehole Depth (m)		24			Bailer		Dip tape
Boron B ++	<0.07		<0.07		Bailer	0.07-1.0	ICP-OES
Cadmium Cd **	<0.03		<0.03		Bailer	0.03-2.00	Direct aspiration/flame AAS
Calcium Ca n/a	109		94		Bailer	1-100	Ion chromatography
Chloride Cl **	15		16		Bailer	0.5-50	Ion chromatography
Chromium Cr **	<0.05		<0.05		Bailer	0.05-5.00	Direct aspiration/flame AAS
Copper Cu **	<0.05		<0.05		Bailer	0.05-5.00	Direct aspiration/flame AAS
Cyanide Cn, total ++	<0.05		<0.05		Bailer	0.05-1.0	Distillation/colorimetry
Dissolved oxygen DO n/a	7.1		8.2		Bailer	N/A	DO Probe
Electrical conductivity EC uS/cm n/a	523		441		Bailer	1-100,000	Electrometry
Faecal coliforms (/100mls) ++	NIL		NIL		Bailer		Membrane Filtration
Fluoride F **	0.1		0.1		Bailer	0.1-5.0	Ion chromatography
Iron Fe **	0.06		0.11		Bailer	0.05-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.20		<0.20		Bailer	0.20-9.00	Direct aspiration/flame AAS
Magnesium Mg n/a	5		5		Bailer	Jan-25	Ion chromatography
Manganese Mn **	<0.03		<0.03		Bailer	0.03-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		<0.001		Bailer	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni **	<0.10		<0.10		Bailer	0.10-2.00	Direct aspiration/flame AAS
Nitrate NO_3 **	43		36		Bailer	0.5-50	Ion chromatography
Nitrite NO_2 **	<0.2		<0.2		Bailer	0.2-10	Ion chromatography
pH **	7.2		7		Bailer	Jan-14	Hydrogen Ion Selective Electrode
Phenol ++	<0.05		<0.05		Bailer	0.05-1.0	Distillation/colorimetry
Phosphate PO_4 **	<1		<1		Bailer	1.0-10.0	Ion chromatography
Phosphorus P n/a	0.21		0.9		Bailer	0.05-1.5	Digestion / colorimetry
Potassium K n/a	1		1		Bailer	Jan-25	Ion chromatography
Residue on evaporation (180°C) n/a	384		398		Bailer	N/A	Gravimetric
Selenium Se ++	<0.01		<0.01		Bailer	0.01-0.25	Direct aspiration/Hydride ICP
Silver Ag ++	<0.01		<0.01		Bailer	0.01-5.00	Direct aspiration/flame AAS
Sodium Na n/a	9		9		Bailer	1-100	Ion chromatography
Sulphate SO_4 **	12		12		Bailer	0.25-100	Ion chromatography
Temperature (°C)				14.5	Bailer	0-100°C	Temperature Probe
Total alkalinity (as HCO3) n/a	245		215		Bailer	N/A	Titration
Total coliforms (/100mls) ++	NIL		>100		Bailer		Membrane Filtration
Total organic carbon TOC ++	0.4		0.8		Bailer	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen TON n/a	9.6		8		Bailer		Sum of nitrate & nitrite
Water level (m OD)		14.5	14.5		Bailer		Dip tape
Zinc Zn **	0.01		0.01		Bailer	0.01-1.00	Direct aspiration/flame AAS

Groundwater Monitoring Results

Monitoring Location BD6

** Lab Accredited ++ Subcontracted Analysis n/a Non Accredited	Results (mg/l)		Results (mg/l)		Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method / technique
Date Sampled: LAB ID:	13.03.01	On-site Measure.	20.08.01. 26925	On-site Measure.	19.03.02 30492	On-site Measure.			
Ammoniacal nitrogen NH_4-N ++	<0.10		0.7		<0.08		Bailer	0.1-12.9	Colourimetry/FIA
Arsenic As ++	<0.01		<0.01		<1		Bailer	0.01-1.00	ICP-OES
Barium Ba ++	<0.01		<0.01		<30		Bailer	0.01-1.00	ICP-OES
Borehole Depth (m)							Bailer		Dip tape
Boron B ++	<0.07		<0.07		38		Bailer	0.07-1.0	ICP-OES
Cadmium Cd **	<0.03		<0.03		<0.03		Bailer	0.03-2.00	Direct aspiration/flame AAS
Calcium Ca n/a	51		45		36		Bailer	1-100	Ion chromatography
Chloride Cl **	18		18		18		Bailer	0.5-50	Ion chromatography
Chromium Cr **	<0.05		<0.05		<0.05		Bailer	0.05-5.00	Direct aspiration/flame AAS
Copper Cu **	<0.05		<0.05		<0.05		Bailer	0.05-5.00	Direct aspiration/flame AAS
Cyanide Cn, total ++	<0.05		<0.05		<5		Bailer	0.05-1.0	Distillation/colorimetry
Dissolved oxygen DO n/a	6.7		7.5		8		Bailer	N/A	DO Probe
Electrical conductivity EC uS/cm n/a	326		30.8		288		Bailer	1-100,000	Electrometry
Faecal coliforms (/100mls) ++	NIL		Nill				Bailer		Membrane Filtration
Fluoride F **	0.1		<0.1		0.1		Bailer	0.1-5.0	Ion chromatography
Iron Fe **	1.31		0.933		0.44		Bailer	0.05-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.20		<0.20		<0.2		Bailer	0.20-9.00	Direct aspiration/flame AAS
Magnesium Mg n/a	6		5		5		Bailer	Jan-25	Ion chromatography
Manganese Mn **	0.07		<0.03		<0.03		Bailer	0.03-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		<0.001		0.0004		Bailer	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni **	<0.10		<0.10		<0.1		Bailer	0.10-2.00	Direct aspiration/flame AAS
pH **	6.5		7.2		6.1		Bailer	Jan-14	Hydrogen Ion Selective Electrode
Phenol ++	<0.05		<0.05		<0.05		Bailer	0.05-1.0	Distillation/colorimetry
Phosphate PO_4 **	<1		<1				Bailer	1.0-10.0	Ion chromatography
Phosphorus P n/a	3.7		9.5		1		Bailer	0.05-1.5	Digestion / colorimetry
Potassium K n/a	<1		409		1		Bailer	Jan-25	Ion chromatography
Residue on evaporation (180°C) n/a	282		2294		278		Bailer	N/A	Gravimetric
Selenium Se ++	<0.01		0.02		<0.05		Bailer	0.01-0.25	Direct aspiration/Hydride ICP
Silver Ag ++	<0.01		<0.01		<0.01		Bailer	0.01-5.00	Direct aspiration/flame AAS
Sodium Na n/a	9		248		8		Bailer	1-100	Ion chromatography
Sulphate SO_4 **	10		4		9		Bailer	0.25-100	Ion chromatography
Temperature (°C)		8.9		15.4	10		Bailer	0-100°C	Temperature Probe
Total alkalinity (as HCO3) n/a	105		300				Bailer	N/A	Titration
Total coliforms (/100mls) ++	NIL		2				Bailer		Membrane Filtration
Total organic carbon TOC ++	0.5		0.8		0.4		Bailer	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen TON n/a	9.7		10		10		Bailer		Sum of nitrate & nitrite
Water level (m OD)		9	7.3				Bailer		Dip tape
Zinc Zn **	0.03		0.02		0.02		Bailer	0.01-1.00	Direct aspiration/flame AAS

Groundwater Monitoring Results

Monitoring Location AQ1

** I Lab Accredited ++ Subcontracted Analysis n/a Non Accredited	Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method / technique
Date Sampled: LAB ID:	23.05.02 31418	On-site Measurements			
Ammoniacal nitrogen NH_4-N ++	<0.08		Bailer	0.1-12.9	Colourimetry/FIA
Arsenic As ++			Bailer	0.01-1.00	ICP-OES
Barium Ba ++			Bailer	0.01-1.00	ICP-OES
Borehole Depth (m)			Bailer		Dip tape
Boron B ++			Bailer	0.07-1.0	ICP-OES
Cadmium Cd **			Bailer	0.03-2.00	Direct aspiration/flame AAS
Calcium Ca n/a			Bailer	1-100	Ion chromatography
Chloride Cl **	16		Bailer	0.5-50	Ion chromatography
Chromium Cr **			Bailer	0.05-5.00	Direct aspiration/flame AAS
Copper Cu **			Bailer	0.05-5.00	Direct aspiration/flame AAS
Cyanide Cn, total ++			Bailer	0.05-1.0	Distillation/colorimetry
Dissolved oxygen DO n/a	9		Bailer	N/A	DO Probe
Electrical conductivity EC uS/cm n/a	296		Bailer	1-100.000	Electrometry
Faecal coliforms (/100mls) ++	0		Bailer		Membrane Filtration
Fluoride F **			Bailer	0.1-5.0	Ion chromatography
Iron Fe **	0.15		Bailer	0.05-5.00	Direct aspiration/flame AAS
Lead Pb **			Bailer	0.20-9.00	Direct aspiration/flame AAS
Magnesium Mg n/a			Bailer	Jan-25	Ion chromatography
Manganese Mn **			Bailer	0.03-2.00	Direct aspiration/flame AAS
Mercury Hg ++			Bailer	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni **			Bailer	0.10-2.00	Direct aspiration/flame AAS
Nitrate NO_3 **	34		Bailer	0.5-50	Ion chromatography
Nitrite NO_2 **	<0.2		Bailer	0.2-10	Ion chromatography
pH **			Bailer	Jan-14	Hydrogen Ion Selective Electrode
Phenol ++	<5		Bailer	0.05-1.0	Distillation/colorimetry
Phosphate PO_4 **			Bailer	1.0-10.0	Ion chromatography
Phosphorus P n/a			Bailer	0.05-1.5	Digestion / colorimetry
Potassium K n/a	<1		Bailer	Jan-25	Ion chromatography
Residue on evaporation (180°C) n/a			Bailer	N/A	Gravimetric
Selenium Se ++			Bailer	0.01-0.25	Direct aspiration/Hydride ICP
Silver Ag ++			Bailer	0.01-5.00	Direct aspiration/flame AAS
Sodium Na n/a	9		Bailer	1-100	Ion chromatography
Sulphate SO_4 **			Bailer	0.25-100	Ion chromatography
Temperature (°C)			Bailer	0-100°C	Temperature Probe
Total alkalinity (as HCO3) n/a			Bailer	N/A	Titration
Total coliforms (/100mls) ++	4		Bailer		Membrane Filtration
Total organic carbon TOC ++	2.2		Bailer	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen TON n/a	8		Bailer		Sum of nitrate & nitrite
Water level (m OD)			Bailer		Dip tape
Zinc Zn **			Bailer	0.01-1.00	Direct aspiration/flame AAS

Groundwater Monitoring Results

Monitoring Location AQ2

** 1 Lab Accredited ++ Subcontracted Analysis n/a Non Accredited	Results (mg/l)		Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method / technique
Date Sampled: LAB ID:	**20.08.01 26939**	**On-site Measurement**	**19.03.02 30493**	**On-site Measurements.**			
Ammoniacal nitrogen NH_4-N ++	148		1008		Bailer	0.1-12.9	Colourimetry/FIA
Arsenic As ++	<0.01		0.04		Bailer	0.01-1.00	ICP-OES
Barium Ba ++	0.06		0.143		Bailer	0.01-1.00	ICP-OES
Borehole Depth (m)	7.6				Bailer		Dip tape
Boron B ++	1.4		3.06		Bailer	0.07-1.0	ICP-OES
Cadmium Cd **	<0.03		<0.03		Bailer	0.03-2.00	Direct aspiration/flame AAS
Calcium Ca n/a	112		120		Bailer	1-100	Ion chromatography
Chloride Cl **	195		1083		Bailer	0.5-50	Ion chromatography
Chromium Cr **	<0.05		0.08		Bailer	0.05-5.00	Direct aspiration/flame AAS
Copper Cu **	<0.05		<0.05		Bailer	0.05-5.00	Direct aspiration/flame AAS
Cyanide Cn, total ++	<0.05		<5		Bailer	0.05-1.0	Distillation/colorimetry
Dissolved oxygen DO n/a	3.1		2		Bailer	N/A	DO Probe
Electrical conductivity EC uS/cm n/a	2910		12390		Bailer	1-100,000	Electrometry
Faecal coliforms (/100mls) ++					Bailer		Membrane Filtration
Fluoride F **	<0.1		0.1		Bailer	0.1-5.0	Ion chromatography
Iron Fe **	2.28		10.96		Bailer	0.05-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.20		<0.2		Bailer	0.20-9.00	Direct aspiration/flame AAS
Magnesium Mg n/a	105		239		Bailer	Jan-25	Ion chromatography
Manganese Mn **	0.43		1.02		Bailer	0.03-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		0.0003		Bailer	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni **	<0.10		0.12		Bailer	0.10-2.00	Direct aspiration/flame AAS
Nitrate NO_3 **	2		0.6		Bailer	0.5-50	Ion chromatography
Nitrite NO_2 **	<0.2		<1		Bailer	0.2-10	Ion chromatography
pH **	7.2		7.5		Bailer	Jan-14	Hydrogen Ion Selective Electrode
Phenol ++	<0.05		<0.05		Bailer	0.05-1.0	Distillation/colorimetry
Phosphate PO_4 **	<1				Bailer	1.0-10.0	Ion chromatography
Phosphorus P n/a	5.5		7		Bailer	0.05-1.5	Digestion / colorimetry
Potassium K n/a	230		894		Bailer	Jan-25	Ion chromatography
Residue on evaporation (180°C) n/a	1521		5594		Bailer	N/A	Gravimetric
Selenium Se ++	0.02		<5		Bailer	0.01-0.25	Direct aspiration/Hydride ICP
Silver Ag ++	<0.01		<0.01		Bailer	0.01-5.00	Direct aspiration/flame AAS
Sodium Na n/a	151		989		Bailer	1-100	Ion chromatography
Sulphate SO_4 **	7		6		Bailer	0.25-100	Ion chromatography
Temperature (°C)		16.8	11		Bailer	0-100°C	Temperature Probe
Total alkalinity (as HCO3) n/a	1600		13.6		Bailer	N/A	Titration
Total coliforms (/100mls) ++					Bailer		Membrane Filtration
Total organic carbon TOC ++	61.6		258		Bailer	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen TON n/a	0.4		0.1		Bailer		Sum of nitrate & nitrite
Water level (m OD)					Bailer		Dip tape
Zinc Zn **	0.07		0.21		Bailer	0.01-1.00	Direct aspiration/flame AAS

Groundwater Monitoring Results

Monitoring Location AQ4

** 1 Lab Accredited ++ Subcontracted Analysis n/a Non Accredited	Results (mg/l)		Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method / technique
Date Sampled: LAB ID:	13.03.02 30411	On-site Measurements	23.05.02 31403	On-site Measuremen			
Ammoniacal nitrogen NH_4-N ++	0.4		0.3		Bailer	0.1-12.9	Colourimetry/FIA
Arsenic As ++	3				Bailer	0.01-1.00	ICP-OES
Barium Ba ++	10				Bailer	0.01-1.00	ICP-OES
Borehole Depth (m)					Bailer		Dip tape
Boron B ++	45				Bailer	0.07-1.0	ICP-OES
Cadmium Cd **	<0.03				Bailer	0.03-2.00	Direct aspiration/flame AAS
Calcium Ca n/a	57				Bailer	1-100	Ion chromatography
Chloride Cl **	24		24		Bailer	0.5-50	Ion chromatography
Chromium Cr **	<0.05				Bailer	0.05-5.00	Direct aspiration/flame AAS
Copper Cu **	<0.05				Bailer	0.05-5.00	Direct aspiration/flame AAS
Cyanide Cn, total ++	<5				Bailer	0.05-1.0	Distillation/colorimetry
Dissolved oxygen DO n/a	4		6		Bailer	N/A	DO Probe
Electrical conductivity EC uS/cm n/a	364		354		Bailer	1-100,000	Electrometry
Faecal coliforms (/100mls) ++			0		Bailer		Membrane Filtration
Fluoride F **	0.2				Bailer	0.1-5.0	Ion chromatography
Iron Fe **	0.36		0.15		Bailer	0.05-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.2				Bailer	0.20-9.00	Direct aspiration/flame AAS
Magnesium Mg n/a	7				Bailer	Jan-25	Ion chromatography
Manganese Mn **	0.42				Bailer	0.03-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.1				Bailer	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni **	<0.1				Bailer	0.10-2.00	Direct aspiration/flame AAS
Nitrate NO_3 **	13		2		Bailer	0.5-50	Ion chromatography
Nitrite NO_2 **	<0.2		0.4		Bailer	0.2-10	Ion chromatography
pH **	6.3				Bailer	Jan-14	Hydrogen Ion Selective Electrode
Phenol ++	<5		<5		Bailer	0.05-1.0	Distillation/colorimetry
Phosphate PO_4 **					Bailer	1.0-10.0	Ion chromatography
Phosphorus P n/a	1				Bailer	0.05-1.5	Digestion / colorimetry
Potassium K n/a	3		4		Bailer	Jan-25	Ion chromatography
Residue on evaporation (180°C) n/a	300				Bailer	N/A	Gravimetric
Selenium Se ++	<5				Bailer	0.01-0.25	Direct aspiration/Hydride ICP
Silver Ag ++	<1				Bailer	0.01-5.00	Direct aspiration/flame AAS
Sodium Na n/a	12		13		Bailer	1-100	Ion chromatography
Sulphate SO_4 **	35				Bailer	0.25-100	Ion chromatography
Temperature (°C)					Bailer	0-100°C	Temperature Probe
Total alkalinity (as HCO3) n/a	135				Bailer	N/A	Titration
Total coliforms (/100mls) ++			3		Bailer		Membrane Filtration
Total organic carbon TOC ++	1.1		0.8		Bailer	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen TON n/a	3		3		Bailer		Sum of nitrate & nitrite
Water level (m OD)					Bailer		Dip tape
Zinc Zn **	0.03				Bailer	0.01-1.00	Direct aspiration/flame AAS

Surface Water Monitoring Results

Monitoring Location SW1

** I Lab Accredited Tests ++ Subcontracted Analysis n/a Non-Accredited		Results (mg/l)						Sampling method	Normal Analytical Range	Analysis method
DATE SAMPLED: LAB ID:		13.03.01 24166	On-site Measurements.	20.08.01 26926	On-site Measurements.	23.05.02	On-site Measurements.			
Ammoniacal nitrogen NH_4-N	++	<0.10		<0.1		<0.08		Grab	0.1-12.9	Colourimetry/FIA
Biochemical oxygen demand	n/a	<2		<2		<2		Grab	01-Jul	DO probe
Cadmium Cd	**	<0.03		<0.03				Grab	0.03-2.00	Direct aspiration/flame AAS
Calcium Ca	n/a	124		121				Grab	1-100	Ion chromatography
Chemical oxygen demand	n/a	10		7		12		Grab	0-150, 0-1500	Digestion/colorimetry
Chloride Cl	**	16		18		14		Grab	0.5-50	Ion chromatography
Chromium Cr	**	<0.05		<0.05				Grab	0.05-5.00	Direct aspiration/flame AAS
Copper Cu	**	<0.05		<0.05				Grab	0.05-5.00	Direct aspiration/flame AAS
Dissolved Oxygen	n/a	6.1		9.2		10		Grab	N/A	Dissolved Oxygen Probe
Electrical conductivity EC uS/cm	n/a	506		513		485		Grab	1-100,000	Electrometry
Faecal Coliforms /100ml	++	>100		>100				Grab		Membrane Filtration
Iron Fe	**	<0.05		<0.05				Grab	0.05-5.00	Direct aspiration/flame AAS
Lead Pb	**	<0.20		<0.20				Grab	0.20-9.00	Direct aspiration/flame AAS
Magnesium Mg	n/a	6		6				Grab	Jan-25	Ion chromatography
Manganese Mn	**	<0.03		<0.03				Grab	0.03-2.00	Direct aspiration/flame AAS
Mercury Hg	++	<0.001		<0.001				Grab	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni	**	<0.10		<0.10				Grab	0.10-2.00	Direct aspiration/flame AAS
Nitrate NO_3	**	31		30				Grab	0.5-50	Ion chromatography
Nitrite NO_2	**	0.8		<0.02				Grab	0.2-10	Ion chromatography
PH	**	7.7		7.9		7.6		Grab	Jan-14	Hydrogen Ion Selective Electrode
Phosphate PO_4	**	<1		<1				Grab	1.0-10	Ion Chromatography
Potassium K	n/a	1		2				Grab	Jan-25	Ion chromatography
Sodium	n/a	9		9				Grab	1-100	Ion chromatography
Sulphate SO_4	**	12		14				Grab	0.25-100	Ion chromatography
Temperature (°C)		-	7.1	-			10	Grab	0-100°C	Temperature Probe
Total alkalinity (as HCO_3)	n/a	265		260				Grab	N/A	Titration
Total Coliforms /100ml	++	>100		>100				Grab		Membrane Filtration
Total organic carbon TOC	++	1.9		3				Grab	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen	n/a	7.2		7				Grab		Sum of nitrate & nitrite
Zinc Zn	**	0.01		<0.01				Grab	0.01-1.00	Direct aspiration/flame AAS

Surface Water Monitoring Results

Monitoring Location SW2

** 1 Lab Accredited Tests ++ Subcontracted Analysis n/a Non-Accredited	Results (mg/l)		Results (mg/l)		Results (mg/l)		Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method
DATE SAMPLED: LAB ID:	13.03.01 24167	On-site Measurements.	20.08.01 26927	On-site Measurements.	13.03.02 30404	On-site Measurements.	23.05.02 31417	On-site Measuremen			
Ammoniacal nitrogen NH_4-N ++	<0.10		<0.1		0.1		<0.08		Grab	0.1-12.9	Colourimetry/FIA
Biochemical oxygen demand n/a	<2		<2		<2		<3		Grab	01-Jul	DO probe
Cadmium Cd **	<0.03		<0.03		<0.03				Grab	0.03-2.00	Direct aspiration/flame AAS
Calcium Ca n/a	126		119		108				Grab	1-100	Ion chromatography
Chemical oxygen demand n/a	6		9		4		14		Grab	0-150, 0-1500	Digestion/colorimetry
Chloride Cl **	15		18		16		14		Grab	0.5-50	Ion chromatography
Chromium Cr **	<0.05		<0.05		<0.05				Grab	0.05-5.00	Direct aspiration/flame AAS
Copper Cu **	<0.05		<0.05		<0.05				Grab	0.05-5.00	Direct aspiration/flame AAS
Dissolved Oxygen n/a	6.5		9.3		10		10		Grab	N/A	Dissolved Oxygen Probe
Electrical conductivity EC uS/cm n/a	484		508		502		490		Grab	1-100,000	Electrometry
Faecal Coliforms /100ml ++	>100		>100						Grab		Membrane Filtration
Iron Fe **	<0.05		0.07		<0.05				Grab	0.05-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.20		<0.20		<0.2				Grab	0.20-9.00	Direct aspiration/flame AAS
Magnesium Mg n/a	6		7		6				Grab	Jan-25	Ion chromatography
Manganese Mn **	<0.03		<0.03		<0.03				Grab	0.03-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		<0.001		<0.1				Grab	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni **	<0.10		<0.10		<0.1				Grab	0.10-2.00	Direct aspiration/flame AAS
Nitrate NO_3 **	31		319.3		33				Grab	0.5-50	Ion chromatography
Nitrite NO_2 **	<0.2		<0.2		0.2				Grab	0.2-10	Ion chromatography
PH **	7.8		7.9		7.9		7.5		Grab	Jan-14	Hydrogen Ion Selective Electrode
Phosphate PO_4 **	<1		<1						Grab	1.0-10	Ion Chromatography
Potassium K n/a	1		2		1				Grab	Jan-25	Ion chromatography
Sodium n/a	8		9		8				Grab	1-100	Ion chromatography
Sulphate SO_4 **	12		14		12				Grab	0.25-100	Ion chromatography
Temperature (°C)		7.1			7		10		Grab	0-100°C	Temperature Probe
Total alkalinity (as HCO_3) n/a	245		265		255				Grab	N/A	Titration
Total Coliforms /100ml ++	>100		>100						Grab		Membrane Filtration
Total organic carbon TOC ++	2.1		3.3		1.5				Grab	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen n/a	7		7		7				Grab		Sum of nitrate & nitrite
Zinc Zn **	<0.01		<0.01		<0.01				Grab	0.01-1.00	Direct aspiration/flame AAS

Surface Water Monitoring Results

Monitoring Location SW3

** I Lab Accredited Tests ++ Subcontracted Analysis n/a Non-Accrediated	Results (mg/l)		Results (mg/l)		Results (mg/l)		Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method
DATE SAMPLED: LAB ID:	13.03.01 24168	On-site Measurements.	20.08.01 26928	On-site Measurements	13.03.02 30403	On-site Measurement	23.05.02 31404	On-site Measureme			
Ammoniacal nitrogen NH_4-N ++	<0.10		<0.1		0.3		0.2		Grab	0.1-12.9	Colourimetry/FIA
Biochemical oxygen demand n/a	<2		<2		4		<2		Grab	01-Jul	DO probe
Cadmium Cd **	<0.03		<0.03		<0.03				Grab	0.03-2.00	Direct aspiration/flame AAS
Calcium Ca n/a	121		118		107				Grab	1-100	Ion chromatography
Chemical oxygen demand n/a	<4		6		<4		11		Grab	0-150, 0-1500	Digestion/colorimetry
Chloride Cl **	16		19		16		14		Grab	0.5-50	Ion chromatography
Chromium Cr **	<0.05		<0.05		<0.05				Grab	0.05-5.00	Direct aspiration/flame AAS
Copper Cu **	<0.05		<0.05		<0.05				Grab	0.05-5.00	Direct aspiration flame AAS
Dissolved Oxygen n/a	6.8		8.4				9		Grab	N/A	Dissolved Oxygen Probe
Electrical conductivity EC uS/cm n/a	505		536		506		490		Grab	1-100,000	Electrometry
Faecal Coliforms /100ml ++	>100		>100						Grab		Membrane Filtration
Iron Fe **	0.08		<0.05		0.07				Grab	0.05-5.00	Direct aspiration flame AAS
Lead Pb **	<0.20		<0.20		<0.2				Grab	0.20-9.00	Direct aspiration/flame AAS
Magnesium Mg n/a	6		7		6				Grab	Jan-25	Ion chromatography
Manganese Mn **	<0.03		<0.03		<0.03				Grab	0.03-2.00	Direct aspiration flame AAS
Mercury Hg ++	<0.001		<0.001		<0.1				Grab	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni **	<0.10		<0.10		<0.1				Grab	0.10-2.00	Direct aspiration/flame AAS
Nitrate NO_3^- **	31		30		33				Grab	0.5-50	Ion chromatography
Nitrite NO_2 **	0.8		0.4		0.3				Grab	0.2-10	Ion chromatography
PH **	7.7		7.6		7.8		6.4		Grab	Jan-14	Hydrogen Ion Selective Electrode
Phosphate PO_4 **	<1		<1						Grab	1.0-10	Ion Chromatography
Potassium K n/a	1		2		2				Grab	Jan-25	Ion chromatography
Sodium n/a	9		9		8				Grab	1-100	Ion chromatography
Sulphate SO_4 **	12		14		12				Grab	0.25-100	Ion chromatography
Temperature (°C)		7			7		11		Grab	0-100°C	Temperature Probe
Total alkalinity (as HCO_3) n/a	250		265		255				Grab	N/A	Titration
Total Coliforms /100ml ++	>100		>100						Grab		Membrane Filtration
Total organic carbon TOC ++	1.6		3.3		1.6				Grab	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen n/a	7.2		7		7				Grab		Sum of nitrate & nitrite
Zinc Zn **	<0.01		<0.01		<0.01				Grab	0.01-1.00	Direct aspiration/flame AAS

Surface Water Monitoring Results

Monitoring Location SW4

** I Lab Accredited Tests ++ Subcontracted Analysis n/a Non-Accredited	Results (mg/l)		Results (mg/l)		Results (mg/l)		Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method
DATE SAMPLED: LAB ID:	13.03.01 24169	On-site Measurement	20.08.01 26929	On-site Measurements	13.03.01 30402	On-site Measurements	23.05.02 31402	On-site Measuremen			
Ammoniacal nitrogen NH_4-N ++	<0.10		<0.1		0.3		0.1		Grab	0.1-12.9	Colourimetry/FIA
Biochemical oxygen demand n/a	<2		<2		<2		4		Grab	01-Jul	DO probe
Cadmium Cd **	<0.03		<0.03		<0.03				Grab	0.03-2.00	Direct aspiration/flame AAS
Calcium Ca n/a	124		118		108				Grab	1-100	Ion chromatography
Chemical oxygen demand n/a	6		7		<4		18		Grab	0-150, 0-1500	Digestion/colorimetry
Chloride Cl **	16		19		16		15		Grab	0.5-50	Ion chromatography
Chromium Cr **	<0.05		<0.05		<0.05				Grab	0.05-5.00	Direct aspiration/flame AAS
Copper Cu **	<0.05		<0.05		<0.05				Grab	0.05-5.00	Direct aspiration/flame AAS
Dissolved Oxygen n/a	7.8		8.2		10		10		Grab	N/A	Dissolved Oxygen Probe
Electrical conductivity EC uS/cm n/a	508		538		503		495		Grab	1-100,000	Electrometry
Faecal Coliforms /100ml ++	>100		>100						Grab		Membrane Filtration
Iron Fe **	<0.05		<0.05		<0.05				Grab	0.05-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.20		<0.20		<0.2				Grab	0.20-9.00	Direct aspiration/flame AAS
Magnesium Mg n/a	6		7		6				Grab	Jan-25	Ion chromatography
Manganese Mn **	<0.03		<0.03		<0.03				Grab	0.03-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		<0.001		<0.1				Grab	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni **	<0.10		<0.10		<0.1				Grab	0.10-2.00	Direct aspiration/flame AAS
Nitrate NO_3 **	31		29		32				Grab	0.5-50	Ion chromatography
Nitrite NO_2 **	0.9		0.5		0.2				Grab	0.2-10	Ion chromatography
PH **	7.8		7.6		7.7		7.5		Grab	Jan-14	Hydrogen Ion Selective Electrode
Phosphate PO_4 **	<1		<1						Grab	1.0-10	Ion Chromatography
Potassium K n/a	1		2		2				Grab	Jan-25	Ion chromatography
Sodium n/a	9		9		8				Grab	1-100	Ion chromatography
Sulphate SO_4 **	12		14		12				Grab	0.25-100	Ion chromatography
Temperature (°C)		7.4			7		12		Grab	0-100°C	Temperature Probe
Total alkalinity (as HCO_3) n/a	240		260		230				Grab	N/A	Titration
Total Coliforms /100ml ++	>100		>100						Grab		Membrane Filtration
Total organic carbon TOC ++	1.6		2.7		1.5				Grab	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen n/a	7.3		7		7				Grab		Sum of nitrate & nitrite
Zinc Zn **	<0.01		<0.01		<0.01				Grab	0.01-1.00	Direct aspiration/flame AAS

Surface Water Monitoring Results

Monitoring Location SW5

** Lab Accredited Tests ++ Subcontracted Analysis n/a Non-Accrediated	Results (mg/l)		Results (mg/l)		Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method
DATE SAMPLED: LAB ID:	13.03.01 24170	On-site Measureme	20.08.01 26930	On-site Measuremen	23.05.02 31414	On-site Measurement			
Ammoniacal nitrogen NH_4-N ++	<0.10		<0.1		<0.08		Grab	0.1-12.9	Colourimetry/FIA
Biochemical oxygen demand n/a	<2		<2		4		Grab	01-Jul	DO probe
Cadmium Cd **	<0.03		<0.03				Grab	0.03-2.00	Direct aspiration/flame AAS
Calcium Ca n/a	54		63				Grab	1-100	Ion chromatography
Chemical oxygen demand n/a	<4		<4		4		Grab	0-150, 0-1500	Digestion/colorimetry
Chloride Cl **	13		16		15		Grab	0.5-50	Ion chromatography
Chromium Cr **	<0.05		<0.05				Grab	0.05-5.00	Direct aspiration/flame AAS
Copper Cu **	<0.05		<0.05				Grab	0.05-5.00	Direct aspiration/flame AAS
Dissolved Oxygen n/a	6.7		8		8		Grab	N/A	Dissolved Oxygen Probe
Electrical conductivity EC µS/cm n/a	294		342		391		Grab	1-100,000	Electrometry
Faecal Coliforms /100ml ++	NIL		3				Grab		Membrane Filtration
Iron Fe **	0.07		0.07				Grab	0.05-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.20		<0.20				Grab	0.20-9.00	Direct aspiration/flame AAS
Magnesium Mg n/a	3		4				Grab	Jan-25	Ion chromatography
Manganese Mn **	<0.03		<0.03				Grab	0.03-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		<0.001				Grab	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni **	<0.10		<0.10				Grab	0.10-2.00	Direct aspiration/flame AAS
Nitrate NO_3 **	25		21				Grab	0.5-50	Ion chromatography
Nitrite NO_2 **	<0.2		<0.2				Grab	0.2-10	Ion chromatography
PH **	6.8		6.7		6.7		Grab	Jan-14	Hydrogen Ion Selective Electrode
Phosphate PO_4 **	<1		<1				Grab	1.0-10	Ion Chromatography
Potassium K n/a	<1		<1				Grab	Jan-25	Ion chromatography
Sodium n/a	10		10				Grab	1-100	Ion chromatography
Sulphate SO_4 **	6		16				Grab	0.25-100	Ion chromatography
Temperature (°C)		6			10		Grab	0-100°C	Temperature Probe
Total alkalinity (as HCO_3) n/a	125		135				Grab	N/A	Titration
Total Coliforms /100ml ++	NIL		16				Grab		Membrane Filtration
Total organic carbon TOC ++	<0.3		0.7				Grab	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen n/a	5.7		5				Grab		Sum of nitrate & nitrite
Zinc Zn **	<0.01		0.02				Grab	0.01-1.00	Direct aspiration/flame AAS

Surface Water Monitoring Results

Monitoring Locatio SW6

** I Lab Accredited, ++ Subcontracted n/a Non-Accredited	Results (mg/l)		Results (mg/l)		Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method
DATE SAMPLED: LAB ID:	**13.03.01 24171**	**On-site Measurem**	**20.08.01 26931**	**On-site Measurement**	**13.03.02 30486**	**On-site Measurement**			
Ammoniacal nitrogen NH_4-N ++	<0.10		<0.1		0.1		Grab	0.1-12.9	Colourimetry/FIA
Biochemical oxygen demand n/a	<2		2		<2		Grab	01-Jul	DO probe
Cadmium Cd **	<0.03		<0.03		<0.03		Grab	0.03-2.00	Direct aspiration/flame AAS
Calcium Ca n/a	115		122		107		Grab	1-100	Ion chromatography
Chemical oxygen demand n/a	6		10		<4		Grab	0-150, 0-1500	Digestion/colorimetry
Chloride Cl **	16		18		15		Grab	0.5-50	Ion chromatography
Chromium Cr **	<0.05		<0.05		<0.05		Grab	0.05-5.00	Direct aspiration/flame AAS
Copper Cu **	<0.05		<0.05		<0.05		Grab	0.05-5.00	Direct aspiration/flame AAS
Dissolved Oxygen n/a	8.1		9		11		Grab	N/A	Dissolved Oxygen Probe
Electrical conductivity EC µS/cm n/a	527		546		497		Grab	1-100,000	Electrometry
Faecal Coliforms /100ml ++	NIL		>100				Grab		Membrane Filtration
Iron Fe **	<0.05		<0.05		<0.05		Grab	0.05-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.20		<0.20		<0.2		Grab	0.20-9.00	Direct aspiration/flame AAS
Magnesium Mg n/a	6		7		6		Grab	Jan-25	Ion chromatography
Manganese Mn **	<0.03		<0.03		<0.03		Grab	0.03-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		<0.001		<0.1		Grab	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni **	<0.10		<0.10		<0.1		Grab	0.10-2.00	Direct aspiration/flame AAS
Nitrate NO_3 **	30		32		33		Grab	0.5-50	Ion chromatography
Nitrite NO_2 **	<0.2		<0.2		0.2		Grab	0.2-10	Ion chromatography
PH **	7.7		7.7		7.7		Grab	Jan-14	Hydrogen Ion Selective Electrode
Phosphate PO_4 **	<1		<1				Grab	1.0-10	Ion Chromatography
Potassium K n/a	1		<1		2		Grab	Jan-25	Ion chromatography
Sodium n/a	8		9		8		Grab	1-100	Ion chromatography
Sulphate SO_4 **	12		14		11		Grab	0.25-100	Ion chromatography
Temperature (°C)		6.8					Grab	0-100°C	Temperature Probe
Total alkalinity (as HCO_3) n/a	245		265		245		Grab	N/A	Titration
Total Coliforms /100ml ++	NIL		>100				Grab		Membrane Filtration
Total organic carbon TOC ++	1.6		2.7		1.6		Grab	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen n/a	6.8		7		7		Grab		Sum of nitrate & nitrite
Zinc Zn **	<0.01		<0.01		<0.01		Grab	0.01-1.00	Direct aspiration/flame AAS

Surface Water Monitoring Results

Monitoring Location SW7

** I Lab Accredited Tests ++ Subcontracted Analysis n/a Non-Accredited	Results (mg/l)		Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method
DATE SAMPLED: LAB ID :	13.03.01 24172	On-site Measurement	20.08.01 26932	On-site Measuremen			
Ammoniacal nitrogen NH_4-N ++	<0.10		<0.1		Grab	0.1-12.9	Colourimetry/FIA
Biochemical oxygen demand n/a	<2		<2		Grab	01-Jul	DO probe
Cadmium Cd **	<0.03		<0.03		Grab	0.03-2.00	Direct aspiration/flame AAS
Calcium Ca n/a	114		117		Grab	1-100	Ion chromatography
Chemical oxygen demand n/a	4		9		Grab	0-150, 0-1500	Digestion/colorimetry
Chloride Cl **	16		19		Grab	0.5-50	Ion chromatography
Chromium Cr **	<0.05		<0.05		Grab	0.05-5.00	Direct aspiration/flame AAS
Copper Cu **	<0.05		<0.05		Grab	0.05-5.00	Direct aspiration/flame AAS
Dissolved Oxygen n/a	7.8		9.1		Grab	N/A	Dissolved Oxygen Probe
Electrical conductivity EC uS/cm n/a	499		541		Grab	1-100,000	Electrometry
Faecal Coliforms /100ml ++	>100		>100		Grab		Membrane Filtration
Iron Fe **	<0.05		<0.05		Grab	0.05-5.00	Direct aspiration flame AAS
Lead Pb **	<0.20		<0.20		Grab	0.20-9.00	Direct aspiration flame AAS
Magnesium Mg n/a	6		7		Grab	Jan-25	Ion chromatography
Manganese Mn **	<0.03		<0.03		Grab	0.03-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		<0.001		Grab	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni **	<0.10		<0.10		Grab	0.10-2.00	Direct aspiration flame AAS
Nitrate NO_3 **	31		31		Grab	0.5-50	Ion chromatography
Nitrite NO_2 **	0.8		0.5		Grab	0.2-10	Ion chromatography
PH **	7.8		7.8		Grab	Jan-14	Hydrogen Ion Selective Electrode
Phosphate PO_4 **	<1		<1		Grab	1.0-10	Ion Chromatography
Potassium K n/a	1		2		Grab	Jan-25	Ion chromatography
Sodium n/a	8		9		Grab	1-100	Ion chromatography
Sulphate SO_4 **	12		14		Grab	0.25-100	Ion chromatography
Temperature (°C)		6.9			Grab	0-100°C	Temperature Probe
Total alkalinity (as HCO_3) n/a	235		260		Grab	N/A	Titration
Total Coliforms /100ml ++	>100		>100		Grab		Membrane Filtration
Total organic carbon TOC ++	1.7		2.6		Grab	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen n/a	7.2		7		Grab		Sum of nitrate & nitrite
Zinc Zn **	<0.01		<0.01		Grab	0.01-1.00	Direct aspiration flame AAS

Surface Water Monitoring Results

Monitoring Location SW8

** I Lab Accredited Tests ++ Subcontracted Analysis n/a Non-Accredited	Results (mg/l)		Results (mg/l)		Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method
DATE SAMPLED: LAB ID:	13.03.01 24173	On-site Measurement	20.08.01 26933	On-site Measurements	13.03.02 30407	On-site Measurement			
Ammoniacal nitrogen NH_4-N ++	<0.10		<0.1		0.1		Grab	0.1-12.9	Colourimetry/FIA
Biochemical oxygen demand n/a	<2		<2		<2		Grab	01-Jul	DO probe
Cadmium Cd **	<0.03		<0.03		<0.03		Grab	0.03-2.00	Direct aspiration/flame AAS
Calcium Ca n/a	117		118		108		Grab	1-100	Ion chromatography
Chemical oxygen demand n/a	7		4		<4		Grab	0-150, 0-1500	Digestion/colorimetry
Chloride Cl **	16		19		15		Grab	0.5-50	Ion chromatography
Chromium Cr **	<0.05		<0.05		<0.05		Grab	0.05-5.00	Direct aspiration/flame AAS
Copper Cu **	<0.05		<0.05		<0.05		Grab	0.05-5.00	Direct aspiration/flame AAS
Dissolved Oxygen n/a	8.1		9.1		11		Grab	N/A	Dissolved Oxygen Probe
Electrical conductivity EC µS/cm n/a	504		538		499		Grab	1-100,000	Electrometry
Faecal Coliforms /100ml ++	>100		>100				Grab		Membrane Filtration
Iron Fe **	<0.05		<0.05		<0.05		Grab	0.05-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.20		<0.20		<0.2		Grab	0.20-9.00	Direct aspiration/flame AAS
Magnesium Mg n/a	6		7		6		Grab	Jan-25	Ion chromatography
Manganese Mn **	<0.03		<0.03		<0.03		Grab	0.03-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		<0.001		<0.1		Grab	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni **	<0.10		<0.10		<0.1		Grab	0.10-2.00	Direct aspiration/flame AAS
Nitrate NO_3 **	29		31		33		Grab	0.5-50	Ion chromatography
Nitrite NO_2 **	0.8		<0.2		0.2		Grab	0.2-10	Ion chromatography
PH **	7.8		7.9		7.8		Grab	Jan-14	Hydrogen Ion Selective Electrode
Phosphate PO_4 **	<1		<1				Grab	1.0-10	Ion Chromatography
Potassium K n/a	1		2		1		Grab	Jan-25	Ion chromatography
Sodium n/a	9		9		7		Grab	1-100	Ion chromatography
Sulphate SO_4 **	12		14		11		Grab	0.25-100	Ion chromatography
Temperature (°C)		6.9					Grab	0-100°C	Temperature Probe
Total alkalinity (as HCO_3) n/a	240		260		240		Grab	N/A	Titration
Total Coliforms /100ml ++	>100		>100				Grab		Membrane Filtration
Total organic carbon TOC ++	1.6		2.6		1.7		Grab	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen n/a	6.9		7		7		Grab		Sum of nitrate & nitrite
Zinc Zn **	<0.01		<0.01		<0.01		Grab	0.01-1.00	Direct aspiration/flame AAS

Leachate Monitoring Results

Monitoring Location SA1B

** I Lab Accredited ++ Subcontracted Analysis n/a Non Accredited	Results (mg/l)		Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method / technique
Lab ID Date sampled:	24182 13.03.01	On-site Measurements.	31408 23.05.02	On-site Measurements.			
Ammoniacal nitrogen NH_4-N ++	272		256		Bailer	0.1-12.9	Colourimetry/FIA
Biological Oxygen Demand n/a	26		42		Bailer	01-Jul	DO Probe
Borehole Depth (m)		8.8			Bailer		Dip tape
Cadmium Cd **	<0.03				Bailer	0.03-2.00	Direct aspiration/flame AAS
Calcium Ca n/a	161				Bailer	1-100	Ion chromatography
Chemical Oxygen Demand n/a	340		478		Bailer	0-150, 0-1500	Digestion / Colorimetry
Chloride Cl **	344		275		Bailer	0.5-50	Ion chromatography
Chromium Cr **	<0.05				Bailer	0.05-5.00	Direct aspiration/flame AAS
Copper Cu **	<0.05				Bailer	0.05-5.00	Direct aspiration/flame AAS
Electrical conductivity EC uS/cm n/a	4840		4480		Bailer	1-100,000	Electrometry
Iron Fe **	2.03				Bailer	0.050-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.20				Bailer	0.20-9.00	Direct aspiration/flame AAS
Magnesium Mg n/a	159				Bailer	Jan-25	Ion chromatography
Manganese Mn **	0.89				Bailer	0.03-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001				Bailer	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni **	<0.10				Bailer	0.10-2.00	Direct aspiration/flame AAS
Nitrate NO_3 ***	<0.5		<0.5		Bailer	0.5-50	Ion chromatography
Nitrite NO_2 **	<1		<0.2		Bailer	0.2-10	Ion chromatography
PH **	7.1		7.2		Bailer	Jan-14	Hydrogen Ion Selective Electrode
Phosphate PO_4 **	<1				Bailer	1.0-10.0	Ion chromatography
Potassium K n/a	365				Bailer	Jan-25	Ion chromatography
Sodium Na n/a	231				Bailer	1-100	Ion chromatography
Sulphate SO_4 **	25				Bailer	0.25-100	Ion chromatography
Temperature (°C)	-	7.2			Bailer	0-100°C	Temperature Probe
Total alkalinity (as HCO_3) n/a	2500				Bailer	N/A	Titration
Total organic carbon TOC ++	93.5				Bailer	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen TON n/a	<0.5		<0.2		Bailer		Sum of nitrate & nitrite
Water level (m OD)		7.1			Bailer		Dip tape
Zinc Zn **	0.04				Bailer	0.01-1.00	Direct aspiration/flame AAS

Leachate Monitoring Results

Monitoring Location SA2

** Lab Accredited ++ Subcontracted Analysis n/a Non Accredited	Results (mg/l)		Results (mg/l)		Results (mg/l)		Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method / technique
Lab ID Date sampled:	24183 13.03.01	On-site Measuremen	26934 20.08.01	On-site Measuremen	30491 19.03.02	On-site Measurement	31411 23.05.02	On-site Measurement			
Ammoniacal nitrogen NH_4-N ++	1021		1050		899		1090		Bailer	0.1-12.9	Colourimetry/FIA
Biological Oxygen Demand n/a	92		141		103		455		Bailer	01-Jul	DO Probe
Borehole Depth (m)		5.3							Bailer		Dip tape
Cadmium Cd **	<0.03		<0.03		<0.03				Bailer	0.03-2.00	Direct aspiration/flame AAS
Calcium Ca n/a	136		105		104				Bailer	1-100	Ion chromatography
Chemical Oxygen Demand n/a	1385		1415		1481		1500		Bailer	0-150, 0-1500	Digestion / Colorimetry
Chloride Cl **	1397		1389		1252		1293		Bailer	0.5-50	Ion chromatography
Chromium Cr **	<0.05		<0.05		0.09				Bailer	0.05-5.00	Direct aspiration/flame AAS
Copper Cu **	<0.05		<0.05		<0.05				Bailer	0.05-5.00	Direct aspiration/flame AAS
Electrical conductivity EC uS/cm n/a	14370		12970		12350		13840		Bailer	1-100,000	Electrometry
Iron Fe **	5.7		9.3		18.26				Bailer	0.050-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.20		<0.20		14				Bailer	0.20-9.00	Direct aspiration/flame AAS
Magnesium Mg n/a	404		307		294				Bailer	Jan-25	Ion chromatography
Manganese Mn **	0.33		0.22		0.28				Bailer	0.03-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		<0.001		0.6				Bailer	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni **	0.14		0.16		<0.1				Bailer	0.10-2.00	Direct aspiration/flame AAS
Nitrate NO_3 **	<2.5		4		0.6		<0.5		Bailer	0.5-50	Ion chromatography
Nitrite NO_2 **	<1		<1		<1		<1		Bailer	0.2-10	Ion chromatography
PH **	7.4		7.4		7.4		7.4		Bailer	Jan-14	Hydrogen Ion Selective Electrode
Phosphate PO_4 **	3		<1						Bailer	1.0-10.0	Ion chromatography
Potassium K n/a	845		870		885				Bailer	Jan-25	Ion chromatography
Sodium Na n/a	1104		1143		1110				Bailer	1-100	Ion chromatography
Sulphate SO_4 **	144		7		3				Bailer	0.25-100	Ion chromatography
Temperature (°C)		7		18.3	10		11		Bailer	0-100°C	Temperature Probe
Total alkalinity (as HCO_3) n/a	7800		7350		6600				Bailer	N/A	Titration
Total organic carbon TOC ++	312		30.2		245				Bailer	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen TON n/a	<1		1		0.1		<0.4		Bailer		Sum of nitrate & nitrite
Water level (m OD)		2.7	2.2						Bailer		Dip tape
Zinc Zn **	0.4		0.82		1.14				Bailer	0.01-1.00	Direct aspiration/flame AAS

Leachate Monitoring Results

Monitoring Location BD5A

** I Lab Accredited ++ Subcontracted Analysis n/a Non Accredited	Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method / technique
Lab ID Date sampled:	31406 23.05.02	On-site Measurement			
Ammoniacal nitrogen NH_4-N ++	52		Bailer	0.1-12.9	Colourimetry/FIA
Biological Oxygen Demand n/a	51		Bailer	01-Jul	DO Probe
Borehole Depth (m)			Bailer		Dip tape
Cadmium Cd **			Bailer	0.03-2.00	Direct aspiration/flame AAS
Calcium Ca n/a			Bailer	1-100	Ion chromatography
Chemical Oxygen Demand n/a	476		Bailer	0-150, 0-1500	Digestion / Colorimetry
Chloride Cl **	29		Bailer	0.5-50	Ion chromatography
Chromium Cr **			Bailer	0.05-5.00	Direct aspiration/flame AAS
Copper Cu **			Bailer	0.05-5.00	Direct aspiration/flame AAS
Electrical conductivity EC uS/cm n/a	1350		Bailer	1-100,000	Electrometry
Iron Fe **			Bailer	0.050-5.00	Direct aspiration/flame AAS
Lead Pb **			Bailer	0.20-9.00	Direct aspiration/flame AAS
Magnesium Mg n/a			Bailer	Jan-25	Ion chromatography
Manganese Mn **			Bailer	0.03-2.00	Direct aspiration/flame AAS
Mercury Hg ++			Bailer	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni **			Bailer	0.10-2.00	Direct aspiration/flame AAS
Nitrate NO_3 **	<0.5		Bailer	0.5-50	Ion chromatography
Nitrite NO_2 **	<0.2		Bailer	0.2-10	Ion chromatography
PH **	6.6		Bailer	Jan-14	Hydrogen Ion Selective Electrode
Phosphate PO_4 **			Bailer	1.0-10.0	Ion chromatography
Potassium K n/a			Bailer	Jan-25	Ion chromatography
Sodium Na n/a			Bailer	1-100	Ion chromatography
Sulphate SO_4 **			Bailer	0.25-100	Ion chromatography
Temperature (°C)	11		Bailer	0-100°C	Temperature Probe
Total alkalinity (as HCO_3) n/a			Bailer	N/A	Titration
Total organic carbon TOC ++			Bailer	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen TON n/a	<0.2		Bailer		Sum of nitrate & nitrite
Water level (m OD)			Bailer		Dip tape
Zinc Zn **			Bailer	0.01-1.00	Direct aspiration/flame AAS

APPENDIX 3

FRESHWATER FLORA & FAUNA

CONSERVATION SERVICES LTD

AQUATIC ENVIRONMENTAL SURVEY FOR THE EIS FOR THE PROPOSED EXTENSION TO THE LANDFILL AT RAMPERE, COUNTY WICKLOW

August 2000

CS

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Tel/Fax 064 30130 E-Mail conserv@eircom.net

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APPENDIX 6	DÚCHAS PROTECTED AREA SITE SYNOPSES
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1 INTRODUCTION

As part of the EIS for the proposed extension to Rampere landfill site, County Wicklow, M.C. O'Sullivan, Consulting Engineers have commissioned Conservation Services, Ecological and Environmental Consultants to carry out an aquatic ecological survey. The aims of the survey are:

- To assess the present fish populations, fishery amenity value, invertebrate fauna, aquatic flora, water quality, habitat value and general ecological condition of streams/rivers in the vicinity of the proposed development and provide baseline data against which future changes can be assessed

- To assess the general status of the streams/rivers from an ecological and fisheries perspective in the context of downstream catchments

- To assess the potential impact of the proposed development on water quality and aquatic flora and fauna

- To suggest amelioration measures where negative impacts are predicted

The following bodies were invited to provided information/comments for this report:

Central Fisheries Board
Eastern Regional Fisheries Board
Fisheries Research Centre
Dúchas - Parks & Wildlife

2 METHODOLOGY

2.1 SELECTION OF SITES FOR ASSESSMENT

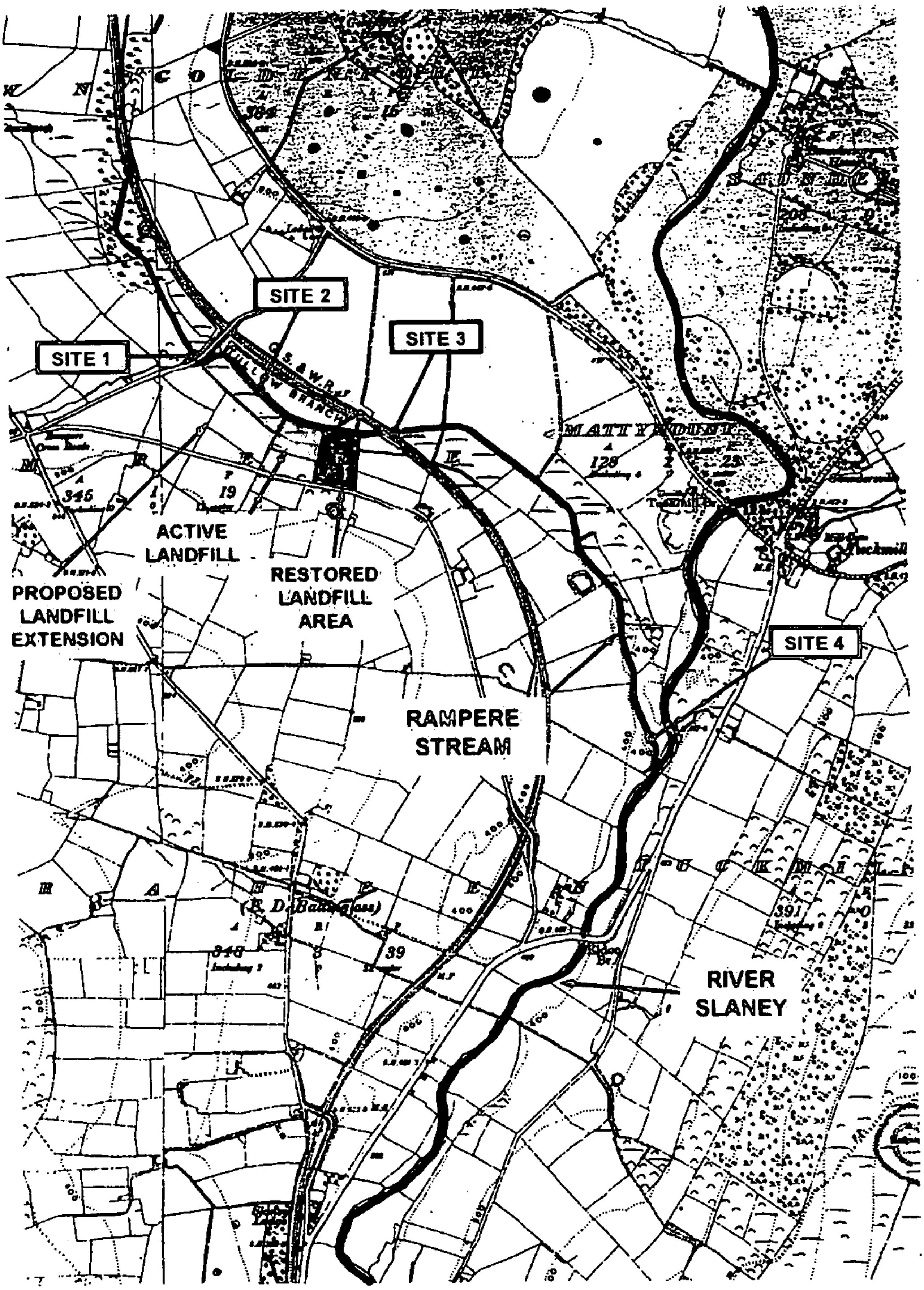
Eight sites were selected for biological assessment:

	Grid Reference	Location
Site 1	S8640 9181	On Rampere Stream upstream of existing landfill site and upstream of proposed landfill extension
Site 2	S8652 9174	On Rampere Stream adjacent to proposed landfill extension
Site 3	S8683 9161	On Rampere Stream just downstream of the active landfill, the restored landfill area and the proposed landfill extension.
Site 4	S 8750 9089	On Rampere Stream just upstream of its confluence with the Slaney River.
Site A	S8762 9145	On Slaney at Tuckmill Bridge (EPA Site 12S02-0600) upstream of confluence with Rampere Stream.
Site B	S8746 9081	On Slaney just downstream of confluence with the Rampere Stream.
Site C	S8731 9044	On Slaney at Eldon Bridge c.500m downstream of confluence with Rampere Stream.
Site D	S8680 8851	On Slaney at Baltinglass Bridge (EPA site 12SO2-0700) c.3km downstream of confluence with Rampere Stream

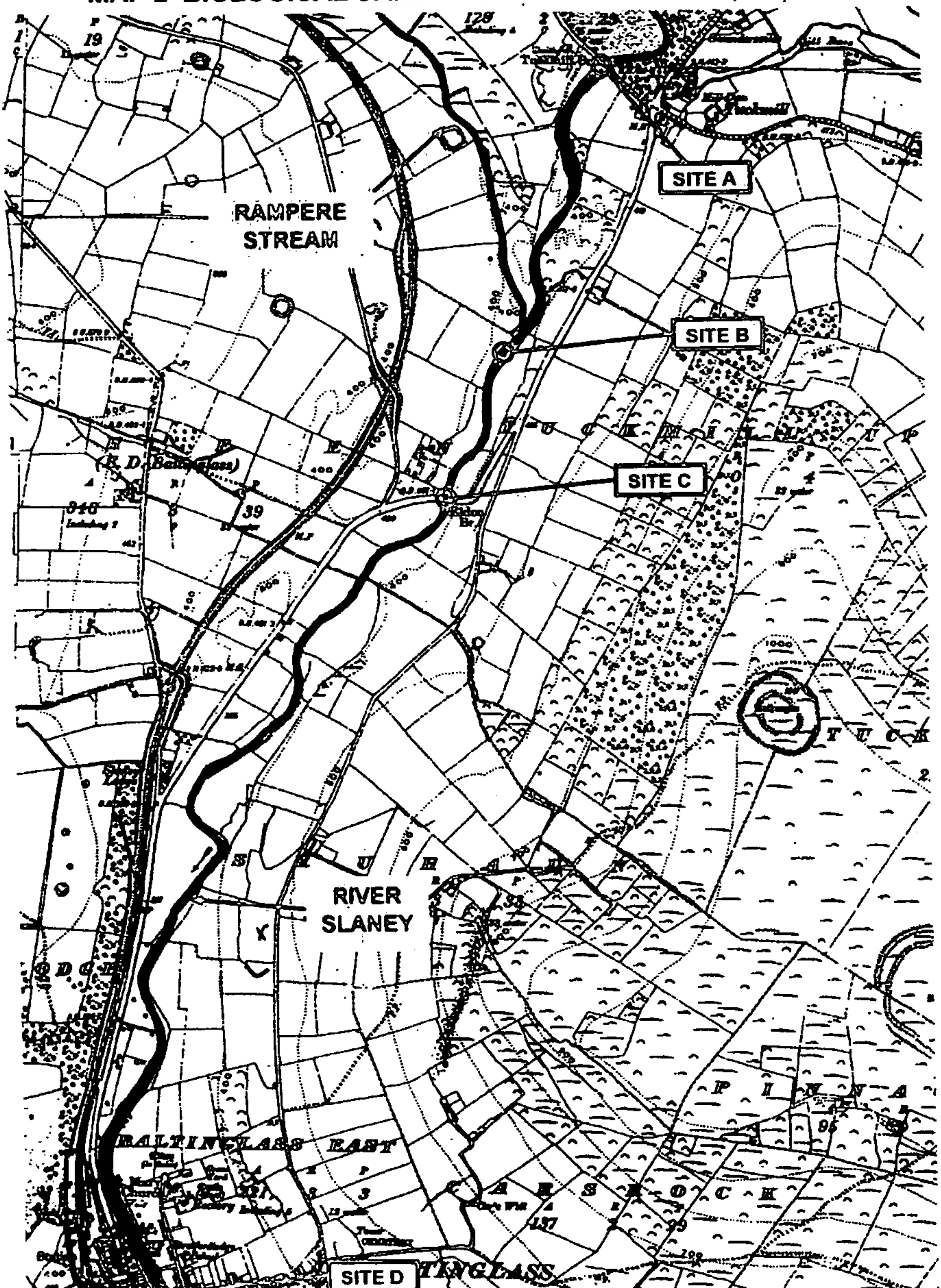
Site locations were recorded as Irish grid references using a GARMIN GPS 38 and are shown on Maps 1 & 2.

Field work was carried out on 10th July 2000.

MAP 1 BIOLOGICAL SAMPLING SITES ON RAMPERE STREAM



MAP 2 BIOLOGICAL SAMPLING SITES ON RIVER SLANEY



2.2 HABITAT ASSESSMENT

Habitat quality for fish, riparian bird life, mammalian wildlife, and the riparian and in-stream invertebrate and plant communities on which the fish, mammal and bird life depend, is primarily a function of 'naturalness' and diversity. The more diverse the river/stream habitat in terms of substrate, flow rate, depth, riparian vegetation, light conditions etc., the richer the biological community is likely to be, and the more suitable it is likely to be for salmonid fish (trout and salmon). Habitat assessment was carried out at the eight biological sampling sites. These sites were assessed in terms of:

- Stream width and depth

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

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

- Instream vegetation, listing plant species occurring and their percentage coverage of the stream bottom at the sampling site

- Dominant bankside vegetation, listing the main species overhanging the stream

- Estimated cover by bankside vegetation, giving percentage shade of the sampling site

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

stream could support salmonid fish in the relevant life stage. A rating of "None - Poor" indicates that it is regarded as possible but extremely unlikely that the stream could support salmonid fish in the relevant life stage.

A general assessment of salmonid habitat quality was carried out on the Rampere Stream from upstream of the proposed landfill extension to the confluence with the Slaney, and on the Slaney from the confluence with the Rampere Stream as far downstream as Baltinglass, a total of approximately 5 km of stream/river channel. This assessment consisted of walking/wading the stream channel. Salmonid habitat quality was assessed, taking into account width, depth, type of flow (riffle/glide/pool), bottom material, bankside vegetation, etc. Based on these criteria, the value of each stream section for spawning, as a nursery area for juveniles, and as an area for adult salmonids, was estimated. Locations for identification of habitat sections were recorded as Irish Grid References using a Garmin GPS 38. To illustrate the habitat quality photographs were taken using a Rollei 35 LED camera.

2.3 INVERTEBRATE SAMPLING AND WATER QUALITY ASSESSMENT

Invertebrate assessment was carried out at seven of the biological sampling sites, i.e. Sites 1, 3, 4, A, B, C & D. A five-minute kick and stone wash sample was taken. Each sample was live sorted for at least 30 minutes, and macroinvertebrates were stored in 70% alcohol. Invertebrates were identified to the lowest practicable taxonomic level using a Nikon Alhpaphot-2 high-power microscope and an Olympus low-power microscope. Taxonomic keys used are listed in the references section of this report.

Based on the relative abundance of indicator species, a biotic index (Q-rating) was determined for each site in accordance with the biological assessment procedure used by the Environmental Protection Agency (Lucey *et al*, 1999) and more detailed unpublished methodology (McGarrigle, Clabby and Lucey pers. comm.). For depositing sites the assessment procedure used was as described by the Environmental Protection Agency (Clabby *et al* 1992).

2.4 ASSESSMENT OF FISH STOCK

Timed electrofishing was carried out at each of the four biological sampling sites on the Rampere Stream to provide a Catch Per Unit Effort (CPUE) index of the salmonid population density. Fish were captured using a Safari Research Surveyor pulsed direct current backpack electrofisher. Prior to handling, salmonid fish were anaesthetised in a benzocaine solution to reduce handling stress. Fork length of salmonids was measured to the nearest mm. Salmonid age was determined by length frequency distribution combined with scale reading using a high power binocular microscope.

2.5 LIMITATIONS ENCOUNTERED

No significant limitations were encountered.

3 EXISTING ENVIRONMENT

3.1 HABITAT ASSESSMENT

Habitat sections are shown on Maps 3 & 4.

Description

Section 1: Rampere Stream adjacent to proposed landfill extension. Small stream heavily shaded and overgrown with hawthorn. Flow and substrate diversity low consisting mostly of riffle over cobble, gravel and mud.

Section 2: Rampere Stream from the upstream end of the active landfill to close to the confluence with the River Slaney. Consists mostly of fast glide over substrates of mud with a layer of gravel and cobble. This section of stream has very little bank side cover of bushes or trees. The stream has an abundant but not choking growth of aquatic vegetation including *Callitriche* sp., *Apium nodiflorum*, *Rorippa nasturtium-aquaticum* agg., *Sparganium erectum*, *Phalaris arundinacea*, & *Phragmites* .

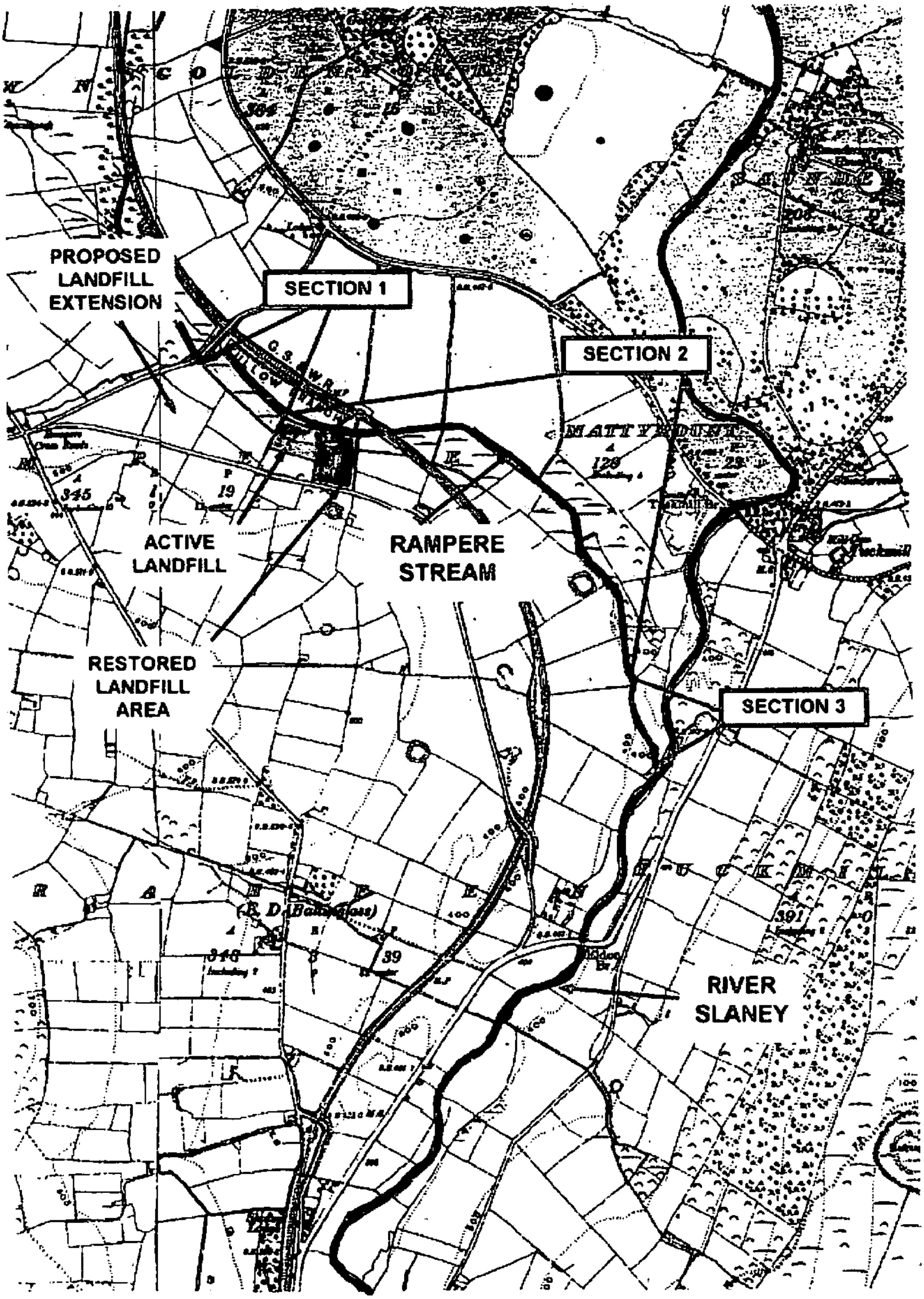
Section 3: The lowest section of the Rampere Stream consists of glide over substrate of sand, gravel, cobble, mud and large rocks. *Ranunculus* sp is the dominant instream vegetation and there is good bankside cover of alders.

Section 4: The Slaney river from its confluence with the Rampere Stream to Grid Reference S8674 8948. Mixture of fast shallow glide over gravel and cobble with some deeper glide and some riffle. The river has good substrate, flow diversity and sinuosity. Instream vegetation quite sparse with some patches of

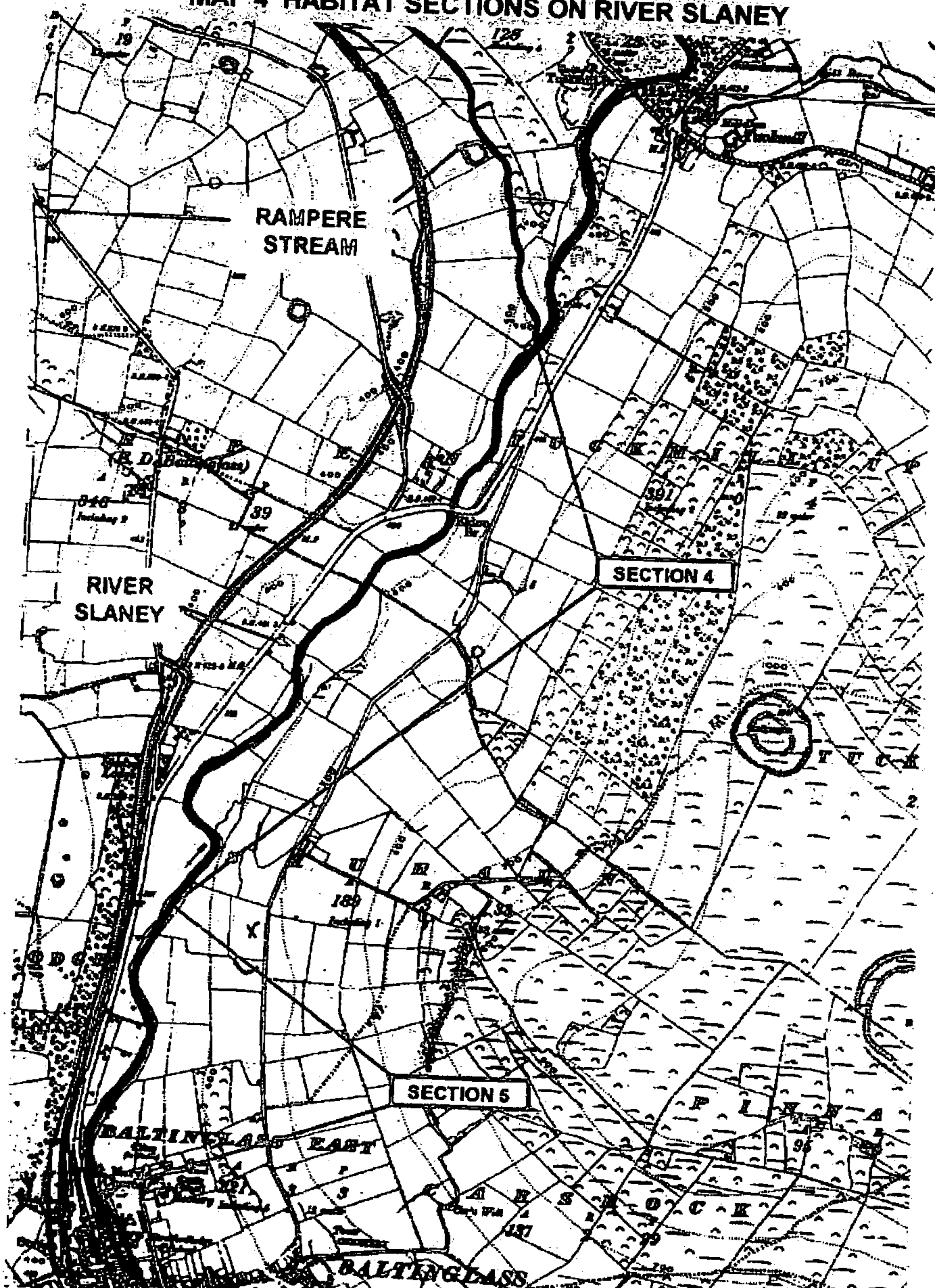
	Ranunculus sp. Bankside vegetation consists of a good scatter of Alder.
	Section 5: The Slaney River from Grid Reference S8674 8948 to the weir at Baltinglass. Predominantly deep glide.
Photograph Number	**Section 1**: None **Section 2**: 3 - 6 **Section 3:** 7 **Section 4:** 9 & 10 **Section 5:** 11 - 13
Salmonid Adult Habitat	**Section 1**: Poor - Fair **Section 2**: Poor **Section 3**: Poor - Fair **Section 4:** Very Good - Excellent **Section 5:** Good
Salmonid Nursery Habitat	**Section 1**: Fair - Good **Section 2**: Fair **Section 3**: Fair - Good **Section 4:** Good **Section 5:** Poor
Salmonid Spawning Habitat	**Section 1**: Fair **Section 2**: Poor **Section 3**: Fair **Section 4:** Good **Section 5:** Poor

Bankside Habitat Quality	**Section 1**: Fair **Section 2**: Fair **Section 3**: Fair **Section 4:** Fair **Section 5:** Fair

MAP 3 HABITAT SECTIONS ON RAMPERE STREAM



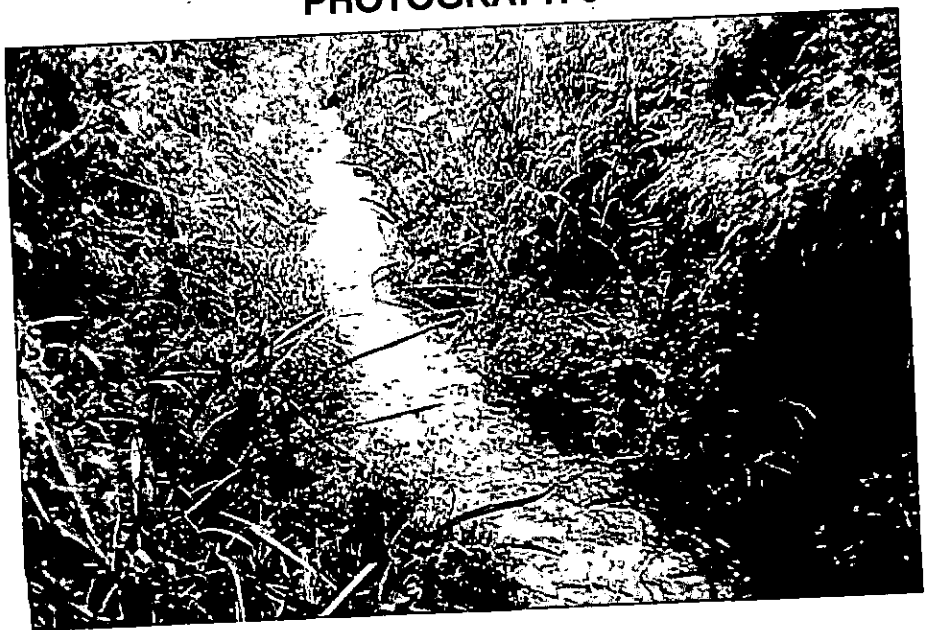
MAP 4 HABITAT SECTIONS ON RIVER SLANEY



PHOTOGRAPH 1

PHOTOGRAPH 2

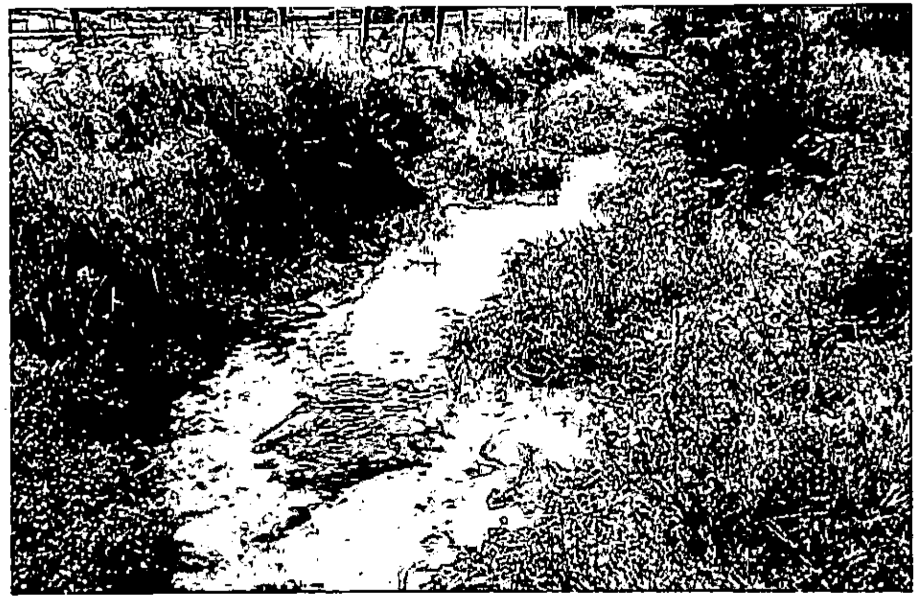
PHOTOGRAPH 3



PHOTOGRAPH 4

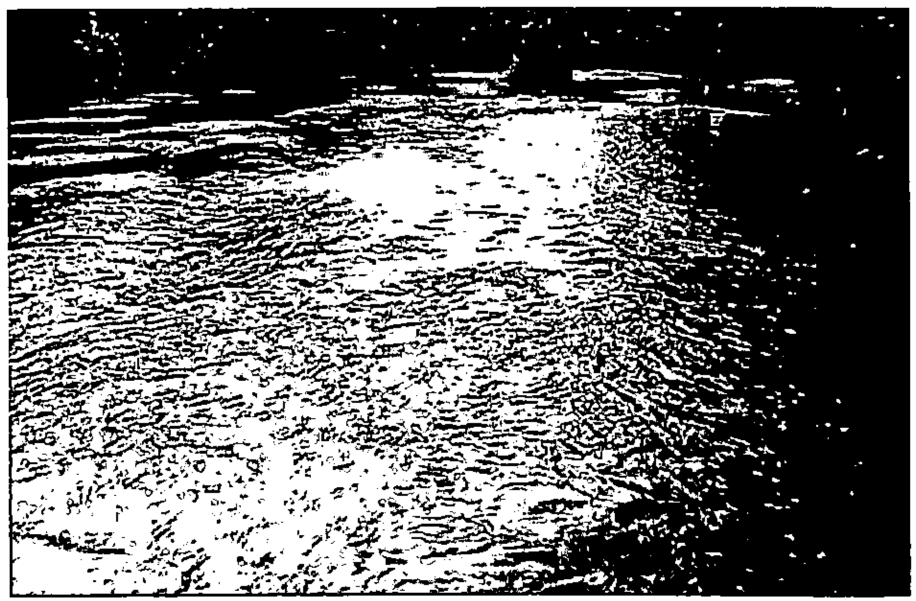
PHOTOGRAPH 5

PHOTOGRAPH 6



PHOTOGRAPH 7

PHOTOGRAPH 8

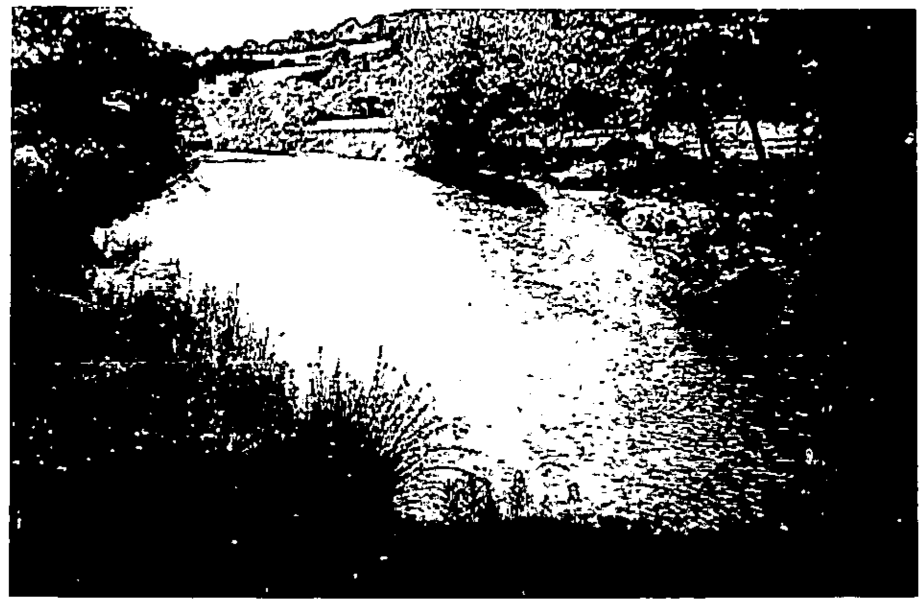


PHOTOGRAPH 9

PHOTOGRAPH 10

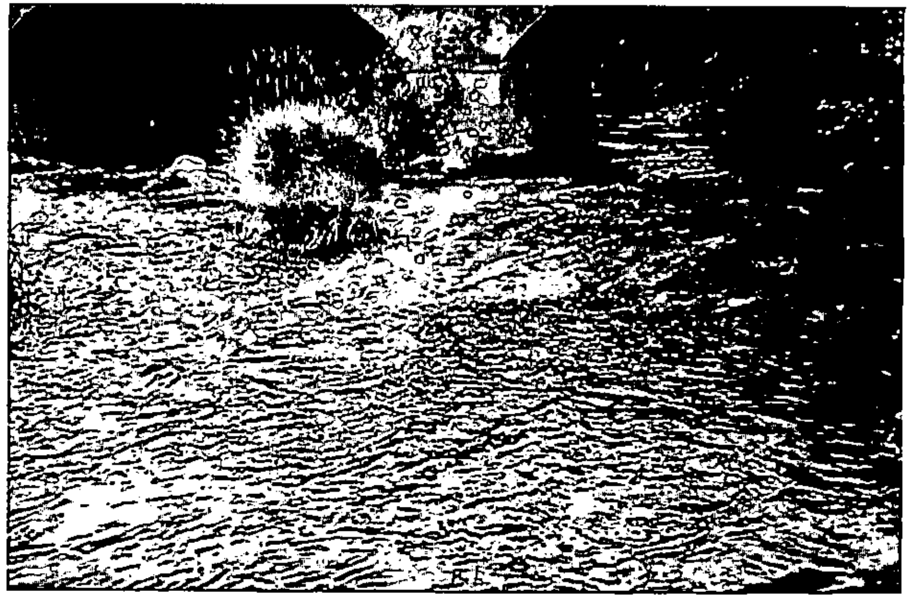
PHOTOGRAPH 11

PHOTOGRAPH 12



PHOTOGRAPH 13

PHOTOGRAPH 14



3.2 INVERTEBRATES AND WATER QUALITY

Habitat at the biological sampling sites is described in Appendix 1. A full listing of invertebrate species with abundance data for each site is given in Appendix 2. Ecological notes for the species recorded are tabulated in appendix 3.

3.2.1 Rampere Stream

3.2.1.1 Biological Water Quality of Rampere Stream

Site 1: Twenty two invertebrate taxa were recorded at this site which represents a good invertebrate species richness. With the exception of two specimens of the moderately pollution sensitive mayfly species *Ephemerella ignita*, no pollution sensitive invertebrate taxa were recorded at the site. The site is dominated by moderately pollution tolerant (group C) species. *Gammarus duebeni* were particularly abundant with hundreds of individuals recorded. Simuliidae were also plentiful with eighty four individuals recorded. Pollution tolerant Group D mollusc species were well represented with twenty five *Potamopyrgus antipodarum*, five *Lymnea peregra* and five *Ancylus fluviatilis*. Three highly pollution tolerant (group E) tubificids, two *Limnodrilus* sp. and one *Tubifex* sp. were recorded at the site.

The invertebrate community at this site merits a Q-rating of Q3 indicating moderately polluted conditions. This is the same Q-rating as recorded at this site in 1998 (Conservation Services 1998).

Site 3: Twenty seven invertebrate taxa were recorded at this site which represents a good invertebrate species richness. Five of the moderately pollution sensitive (group B) mayfly species *Ephemerella ignita* and a single specimen of the caddis fly *Sericostoma personatum* were recorded at this site. Otherwise no pollution sensitive invertebrate taxa were recorded at the site. The site is dominated by pollution tolerant (group C and group D) species. Sixteen

highly pollution tolerant (group E) tubificids consisting of fifteen *Limnodrilus* sp. and one *Tubifex* sp. were recorded at the site.

The invertebrate community at this site merits a Q-rating of Q3 indicating moderately polluted conditions. This is a significant improvement on the Q-rating of Q2 recorded at this site in 1998 (Conservation Services 1998). It is notable that the Q-ratings upstream and downstream of the landfill site are now the same.

Site 4: Thirty invertebrate taxa were recorded at this site which represents a very good invertebrate species richness for a stream of this size. Two moderately pollution sensitive caddis fly species were recorded at this site; seven *Odontocerum albicorne* and eleven *Sericostoma personatum*. The site is dominated by pollution tolerant (group C & D) species. *Gammarus duebeni* were most abundant with sixty three individuals recorded. Two highly pollution tolerant (group E) *Tubifex* sp. were recorded at the site.

The invertebrate community at this site merits a Q-rating of Q3 indicating moderately polluted conditions, the same Q-rating as at the two sites sampled upstream.

3.2.1.2 Chemical Water Quality of Rampere Stream

The results of recent sampling, undertaken by TE Laboratories, are tabulated in Appendix 7 and summarised in the following table (data provided by M.C. O'Sullivan Ltd. chemical sampling sites are shown on Map 5.

MAP 5 CHEMICAL SAMPLING SITES ON RAMPERE STREAM

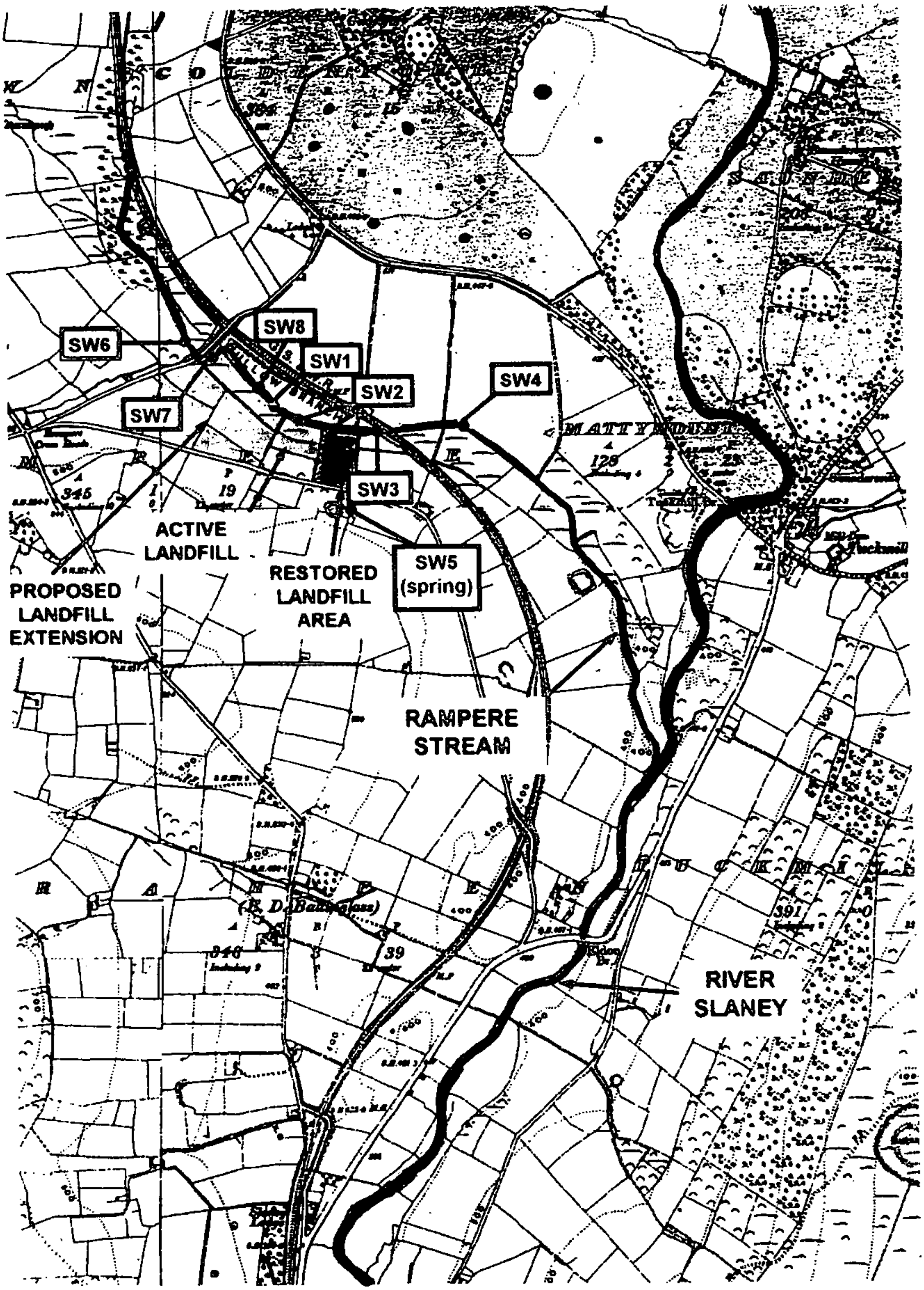


Table 1 Summary of Surface Water Results at Rampere Landfill September 1998- May 2000

Station No.	pH	Conductivity (mg/l)	NH_4 (mg/l)	NO_3 (mg/l)	NO_2 (mg/l)	BOD	COD	TOC	TON
SW1	7.0-7.7	410-624	<0.1-<1	24.3-34	<0.5	1.4-2	<4-14	1.6-5.5	5.5-7.6
SW2	7.0-7.8	307-570	<0.1-<1	24.4-33	<0.5	<1-<3	<4-44	1-6.3	5.2-7.5
SW3	6.9-7.8	480-628	<0.1-<1	25.1-33.1	0.09-0.6	1.2-<10	<4-119	1.2-4.8	5.7-7.65
SW4	6.9-7.6	482-631	<0.1-<1	24-35	0.5-0.15	<1-<5	<4-38	0.4-6.2	5.4-9.6
SW5	6.0-7.6	340-631	<0.1-<1	20-35	<0.5	<1-<5	2.7-22	<0.2-1.9	<6-7.8
Water Qual. Std*	**<=6>=9**	-	**<=1**	**50**	**0.2**	**<=5**	-	-	-

**Source: Environmental Quality Objectives and Environmental Quality Standards - The Aquatic Environment (A Discussion Document) EPA (1997)*

These results indicate that there was no significant change in the surface water hydrochemistry between the surface water monitoring points upstream and downstream of the existing landfill during the monitoring period. Levels of pH, conductivity, ammonia, nitrate, BOD and TOC were normal. Although some of the nitrite levels found in the stream are greater than 0.2mg/l, i.e. the EQO standard proposed by the EPA, levels only breached 0.5 mg/l on 3 occasions and these were at SW3 and SW4 on the first two sampling occasions in October 1998. As noted above biological assessment indicated unsatisfactory conditions downstream of the landfill in September 1998 (Conservation Services 1998). The surface water regulations set a limit of 40mg/l (MAC) for COD on A3 Class Waters, no limits are set for A1 & A2 Class Waters. All COD levels recorded were normal except on two occasions at SW2 and SW3. Most sampling rounds recorded levels of less than 4mg/l COD, indicating satisfactory conditions.

3.2.2 River Slaney

Site A: Thirty six invertebrate taxa were recorded at this site, indicating a good species richness. Pollution sensitive taxa recorded were the highly pollution sensitive (group A) mayfly species *Ecdyonurus venosus* of which eleven were recorded and *Rhithrogena semicolorata* of which one was recorded, and moderately pollution sensitive (group B) mayfly species *Ephemerella ignita* of which seventy eight were recorded, the stone fly *Leuctra fusca* (two recorded) and the caddis flies *Athripsodes albifrons* (three recorded), *Odontocerum albicorne* (two recorded) and *Silo pallipes* (two recorded). Despite the good representation of pollution sensitive species hundreds of Simuliidae (group C) were recorded at this site, and were observed to be present in high densities on rocks in the river. This is an early indication of eutrophication. On the basis of the good representation of pollution sensitive species the site is given a Q-rating of Q4 which is the same as recorded at this site in 1998 by Conservation Services (1998) but a deterioration from the unpolluted Q5 recorded at the site by EPA in 1998 (Clabby *et al* 1999).

Site B: Thirty invertebrate taxa were recorded at this site, indicating a good species richness. Pollution sensitive taxa recorded were the highly pollution sensitive (group A) mayfly species *Ecdyonurus dispar* (four recorded) *Ecdyonurus venosus* (three recorded) and the stone fly species *Perla bipunctata* (four recorded), and moderately pollution sensitive (group B) mayfly species *Ephemerella ignita* of which ninety eight were recorded, the stone fly *Leuctra fusca* (four recorded) and the caddis flies *Athripsodes albifrons* (twelve recorded), and *Lepidostoma hirtum* (one recorded). Despite the good representation of pollution sensitive species hundreds of Simuliidae (group C) were recorded at this site, and were observed to be present in high densities on rocks in the river. This is an early indication of eutrophication. On the basis of the good representation of pollution sensitive species the site is given a Q-rating of Q4.

Site C: Twenty six invertebrate taxa were recorded at this site, indicating a moderate species richness. Pollution sensitive taxa recorded were the highly

pollution sensitive (group A) mayfly species *Ecdyonurus dispar* (one recorded) *Ecdyonurus venosus* (twelve recorded) and the stone fly species *Perla bipunctata* (three recorded), and *Chloroperla tripunctata* (five recorded) and moderately pollution sensitive (group B) mayfly species *Ephemerella ignita* (fifty three recorded), the stone fly *Leuctra fusca* (three recorded) and the caddis flies *Athripsodes albifrons* (eleven recorded). Despite the good representation of pollution sensitive species hundreds of Simuliidae (group C) were recorded at this site, and were observed to be present in high densities on rocks in the river. This is an early indication of eutrophication. On the basis of the good representation of pollution sensitive species the site is given a Q-rating of Q4

Site D: Twenty eight invertebrate taxa were recorded at this site, indicating a moderate species richness. Pollution sensitive taxa recorded were the highly pollution sensitive (group A) mayfly species *Ecdyonurus dispar* (nine recorded), *Ecdyonurus venosus* (five recorded) and Rhithrogena semicolorata (two recorded) and the stone fly species *Perla bipunctata* (six recorded) and *Chloroperla tripunctata* (two recorded), and moderately pollution sensitive (group B) mayfly species *Ephemerella ignita* (one hundred and eleven recorded), the stone fly *Leuctra fusca* (two recorded) and the caddis flies *Athripsodes albifrons* (thirteen recorded), and *Lepidostoma hirtum* (one recorded). Despite the good representation of pollution sensitive species hundreds of Simuliidae (group C) were recorded at this site, and were observed to be present in high densities on rocks in the river. This is an early indication of eutrophication. On the basis of the good representation of pollution sensitive species the site is given a Q-rating of Q4 which is a decline from the unpolluted Q4-5 recorded at this site in 1998 by EPA (Clabby *et al* 1999).

3.3 FISH ASSESSMENT OF RAMPERE STREAM

Fish data are presented in Appendix 1. Summary of the fish caught at each site is given in Table 1 and the catch per unit effort (CPUE) at each site is tabulated in Table 2. The length frequency distribution of the trout caught is illustrated in Fig.1. Trout (CPUE) is illustrated in Fig. 2.

Juvenile trout were present at low densities upstream of the proposed landfill extension and adjacent to the proposed extension. Downstream of the existing landfill, close to the confluence with the Slaney, a moderate density of juvenile brown trout was recorded; catch per unit effort (CPUE) of 33 fish per hour equivalent of electrofishing. No trout were recorded immediately downstream of the existing landfill; this is likely to be due to the poor habitat quality at the sampling site.

Fig. 1 Trout length-frequency

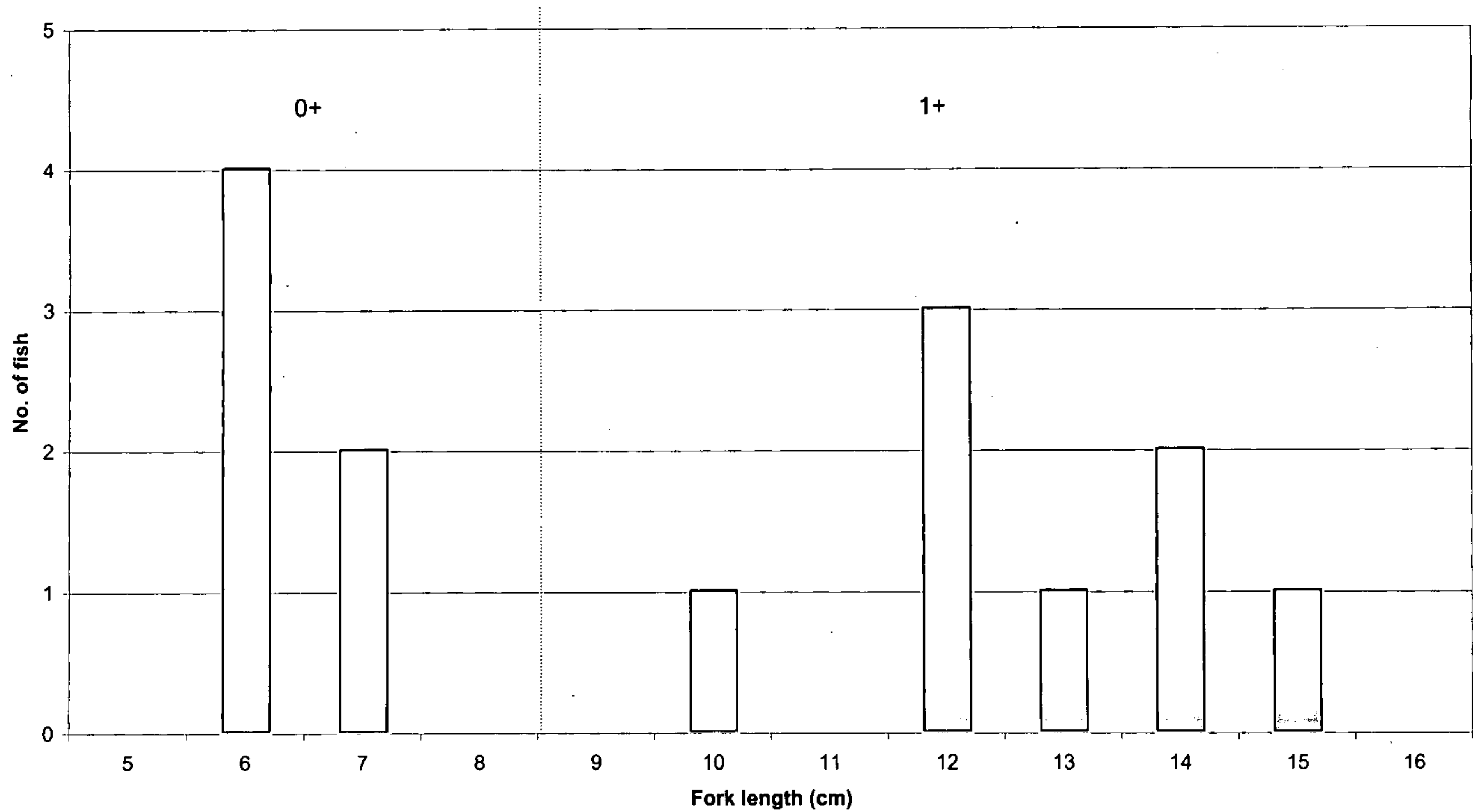
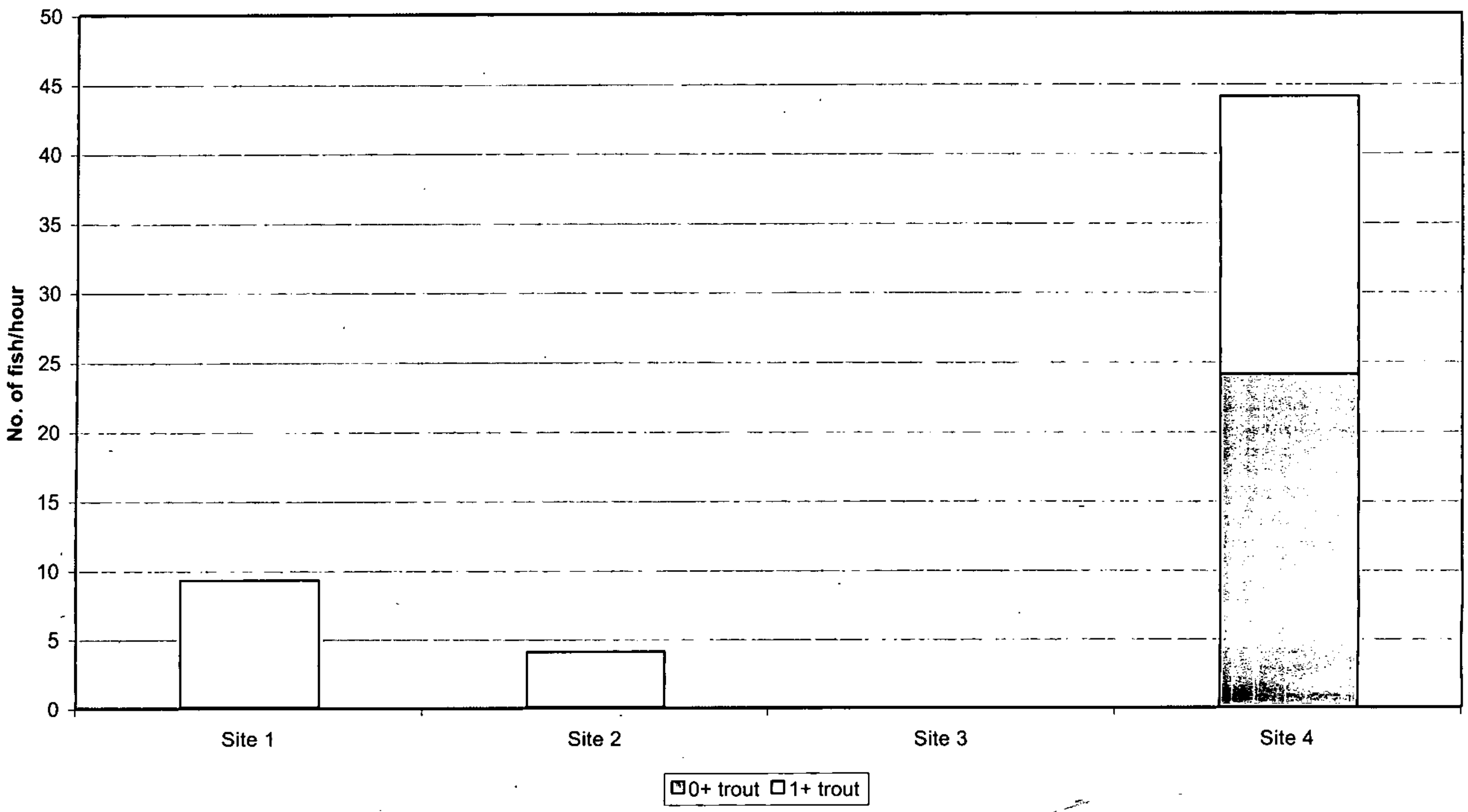


Fig. 2 Trout catch per unit effort



3.4 GENERAL ASSESSMENT OF RIVER SLANEY

3.4.1 Fishery Value

The Slaney is a designated salmonid water under the E.C. (Quality of Salmonid Waters) Regulations, 1988. Eastern Regional Fisheries Board state that the Slaney supports a healthy salmon population and the Baltinglass area is particularly important for spawning. In 1996 the Eastern Regional Fisheries Board recorded 342 salmon redds (spawning sites) in the Slaney upstream of Baltinglass. The maximum number or Redds recorded in this section was 547 in 1994 (Appendix 8). In 1997 the Eastern Regional Fisheries Board carried out a survey of juvenile salmonid densities in the Slaney. Upstream of Eldon bridge (which is just downstream of the confluence with the Rampere Stream) juvenile salmonid densities recorded per square metre were 0.32 salmon fry, 0.05 salmon parr, 0.11 brown trout fry and 0.003 brown trout parr (Appendix 8).

O'Reilly (1993) states that in spring the Slaney "*Is a beautiful big fast flowing river, ideally suited for salmon fishing. Later in the season the water tends to run off rather quickly due to extensive land drainage works carried out by farmers. The Slaney holds salmon, sea-trout and brown trout. The Slaney is primarily a spring salmon fishery and is regarded as one of the top rivers in Ireland for early spring salmon fishing. It is probably for this reason that it has been called 'The Queen of Irish Rivers'. .... The river gets a very good run of sea-trout ... (and) holds plenty of small brown trout*".

3.4.2 Water Quality

EPA biological water quality data from 1971 to 1998, and summary of chemical water quality data from 1995 to 1997 are tabulated in Appendix 4. The lower section of the Slaney (downstream of Tullow) deteriorated significantly during the 1970s and early 1980s. Water quality was very good throughout the river in 1971; by 1983 all sites downstream of Tullow were slightly polluted. Substantial sections became moderately polluted in the 1980s but recovered to a slightly

polluted state by 1995. After the 1998 EPA biological survey Clabby *et al* (1999) concluded that high flows of 1998 had been of considerable benefit to the Slaney. This was particularly apparent below Tullow and Clohamon where the estimated length of slightly polluted channel was reduced to five and thirteen kilometres respectively. This was a marked contrast to the 1995 situation where the entire 49 km freshwater reach from Tullow to below Enniscorthy was assessed as slightly polluted/eutrophic.

3.5 RARE AND PROTECTED SPECIES AND PROTECTED AREAS

Mr Iain Long of Dúchas has confirmed the existence of three protected areas downstream of the proposed development. These are Wexford Slobs and Harbour Special Protected Area (Dúchas site code 000712), Slaney River Valley candidate Special Area of Conservation (Dúchas site code 000781) and Slaney Valley Above Kilcarry proposed Natural Heritage Area (Dúchas site code 000815). Dúchas site synopses for these sites are contained in Appendix 6.

All three Irish species of lamprey are listed for conservation in Annex II of EU Habitats Directive 92/43/EEC. Kurz and Costello (1998) state that river lamprey (*Lampetra fluviatilis*) and brook lamprey (*Lampetra planeri*) seem to be widespread in the River Slaney and in the lower reaches of some of its tributaries. They also state that sea lamprey (*Petromyzon marinus*) has occasionally been observed downstream of Enniscorthy. McGurdy, quoted by Kurz and Costello (1998) stated that brook lampreys have commonly been seen spawning in small streams in the Slaney catchment. Lucey also quoted by Kurz and Costello (1998) observed a group of *L. planeri* spawning in the Slaney main channel downstream of Baltinglass. Lamprey therefore occur in the Slaney close to the proposed landfill extension and may occur in the Rampere stream itself, though none were recorded in the survey carried out in the present report.

Salmon (*Salmo salar)* which occur in the Slaney are listed in Part 2 of the First Schedule of Regulations SI No. 94 of 1997 and listed in Annex II of the Habitats Directive.

With the exception of the beetle species *Ilybius guttiger* which is described as occurring occasionally in Ireland (Friday 1988), no rare or unusual invertebrate species were recorded in the present survey.

4 ASSESSMENT OF IMPACTS

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

4.1.1 Pollution of streams/rivers with suspended solids

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

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

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

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

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

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

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

As trout are present in the Rampere stream adjacent to and downstream of the proposed development, and as the Slaney River downstream of the proposed development is a salmonid river of major importance with very good spawning habitat, any suspended solids entering the Rampere stream and the Slaney river would have a seriously detrimental impact, both directly in the fish and on the pollution sensitive invertebrate species on which they feed.

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

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

- Raw or uncured concrete and grouts
- Wash down water from exposed aggregate surfaces, cast-in-place concrete and from concrete trucks
- Fuels, lubricants and hydraulic fluids for equipment used on the development site
- Waste from on site toilet and wash facilities

4.2 AN ASSESSMENT OF THE POTENTIAL AQUATIC ENVIRONMENTAL IMPACT OF THE PROPOSED DEVELOPMENT DURING AND AFTER ITS PERIOD OF OPERATION

4.2.1 Landfill Leachate

The impact of the Rampere landfill on the Rampere stream and the Slaney River, will depend on the quantity and quality of treated or untreated leachate, if any, which enters surface waters in future years.

4.2.1.1 Composition of Leachate One of the consequences of the disposal of wastes in landfills is the generation of leachate, which is the noxious liquid that is produced as a result of the interactions in the waste as water passes through it. The volume of leachate produced by a landfill is related to the in-place density of the refuse, decreasing from 50% to 15% of the yearly precipitation with increasing compaction of the waste (Stegman 1980). The concentration of various potentially polluting substances in leachate varies depending on a variety of factors such as the waste being disposed of, water content, design and operation of the site, and the age of the waste. Composition of leachate from landfills in the United States and Canada have been described by Farquhar (1989) and in Britain by Robinson and Maris (1985) and Robinson and Gronow (1993). Some typical components of leachates from domestic wastes at various stages of decomposition are tabulated below.

Parameter	Recent Waste	Aged Waste	E.C. Maximum Admissible Concentration	Effects on Aquatic Environment
pH	6.2	7.5	6.0 - 9.0 (Salmonid Waters Regulations)	The optimal range of pH for fish from 6.5 to 8.5. Alkaline pH values above 9.2 and acidity below 4.8 can damage and kill salmonids. (EIFAC 1993)

Parameter	Recent Waste	Aged Waste	E.C. Maximum Admissible Concentration	Effects on Aquatic Environment
C.O.D.	23,800	1,160		Measures concentration of organic substances in water in terms of their maximum capacity for taking oxygen from the water. Therefore critical for fish and other aquatic life. The upper limit of COD for salmonids is 10 mg/l. (EIFAC 1993)
B.O.D.	11,900	260	<5 (Salmonid Waters Regulations)	Measures the potential for bacterial degradation of organic substances in water. Therefore critical for fish and other aquatic life. The upper limit of BOD for salmonids is 5 mg/l. (EIFAC 1993)
T.O.C. (Total Organic Carbon)	8,000	465		Large number of compounds, some of which have seriously detrimental biological effects (see below).
Fatty Acids (as C)	5,688	5		
Ammon-iacal N	790	370	1.0 (Salmonid Waters Regulations)	When ammonia dissolves in water, it can react with water to give a mixture of the original ammonia (NH_3) and a new form, the ammonium ion (NH_4^+). The mixture is held in balance, but a shift in pH can shift the proportion of each type. The toxicity of ammonia is due to the unionized form NH_3, and not to the ionized ammonium ion NH_4^+. Unionized ammonia is very rare at pH 7, only 0.19% being NH_3 at 10°C. At pH 8 ten times this percentage is NH_3, so water containing ammonia and ammonium will be ten times more toxic at pH 8 that in neutral water. (Solbe 1988)

Parameter	Recent Waste	Aged Waste	E.C. Maximum Admissible Concentration	Effects on Aquatic Environment
Ortho-phosphate	0.73	1.4		A limiting nutrient in many freshwater systems and a primary cause of eutrophication. Concentrations of 0.07 mg/l would be characteristic of moderately polluted rivers (Bowman *et al.* 1996). 0.2 mg/l recommended limit for salmonid streams (Solbe 1988).
Chloride	1,315	2,080	250 (Surface Water Regulations)	Natural levels in rivers are usually in the range 15 - 35 mg/l
Sodium	960	1,300	150 (Drinking Water Regulations)	
Magnesium	252	185	50 (Drinking Water Regulations)	
Potassium	780	590	12	
Calcium	1,820	250	200 (Drinking Water Regulations)	
Manganese	27	2.1	0.05 (Surface Waters Regulations)	
Iron	540	23	0.2 (Surface Waters Regulations)	The lethal concentration of iron for fish is hard to measure because it depends on other physical and chemical properties of the water. In salmonid culture it is generally accepted that the concentration of the soluble ionized forms of iron should not exceed 0.1 mg per litre. (EIFAC 1993)

Parameter	Recent Waste	Aged Waste	E.C. Maximum Admissible Concentration	Effects on Aquatic Environment
Nickel	0.6	0.1	0.05 (Drinking Water Regulations)	Variable harmful effects on aquatic life also toxic to plant life (Flanagan 1992). The toxicity of nickel compounds to aquatic organisms is markedly influenced by the physico-chemical properties of water. In soft waters with low calcium concentrations, the lethal concentration of nickel compounds for the stickleback were less than 10 mg/l. (EIFAC 1993)
Copper	0.12	0.03	<0.005 at hardness of 10 mg/l $CaCO_3$. <0.112 at hardness of 300 mg/l $CaCO_3$. (Salmonid Waters Regulations)	Although copper is highly toxic to fish, the physical and chemical properties of the water exert a strong influence on this toxicity. In water containing high concentrations of organic substances, copper can become bound into soluble and insoluble complexes. In very alkaline water it forms hydroxides of low solubility, and in water with a high bicarbonate/carbonate concentration copper precipitates as poorly soluble or insoluble carbonate. Compounds that are slow to dissolve or are insoluble are unlikely to be taken up to any extent into the fish body, so their toxicity to fish is low. (EIFAC 1993)
Zinc	21.5	0.4	<0.03 at hardness of 10 mg/l $CaCO_3$. <0.5 at hardness of 500 mg/l $CaCO_3$. (Salmonid Waters Regulations)	The lethal concentrations for salmonid fish are around 0.1 mg/l (some authors even suggest a level of 0.01mg/l). Toxicity to fish is influenced by the chemical characteristics of water; in particular, increasing calcium concentrations reduce the toxicity of zinc (EIFAC 1993). Fish eggs are 'rather resistant to zinc compared with the early free-living stages' (Solbe 1988)

Parameter	Recent Waste	Aged Waste	E.C. Maximum Admissible Concentration	Effects on Aquatic Environment
Lead	0.40	0.14	0.05 (Surface Waters Regulations)	Lead toxicity to fish and other aquatic organisms is significantly influenced by the water quality and depends on the solubility of lead compounds and on the concentration of calcium and magnesium in water. The water solubility of lead compounds is reduced with increasing alkalinity and pH value of the water. The acute toxic concentration in different types of water are in the range of 1 to 10 mg per litre for salmonids. (EIFAC 1993)

(Sources for leachate concentrations: Davies and Hammond 1991 and Daly 1987. N.B. The leachate analysis figures are largely from U.K. sources which may not be representative of Irish conditions, where the proportion of landfilled waste from industrial sources may be less than under average U.K. conditions.)

Organic Contaminants The number and quantity of organic chemicals that are produced has increased at a phenomenal rate since 1945. More than 40,000 organic compounds are currently manufactured (Cherry *et al.* 1984). Many of these chemicals are hazardous or potentially hazardous (McGinley and Kmet 1984). Reinhard *et al.* (1984), in a study of two municipal tip sites in Canada, have found that the main fraction of dissolved organic carbon (DOC) in leachate appeared to be derived from decomposing plant material. Aliphatic and aromatic acids, phenols, resin acids and terpene compounds were the main components. Compounds of commercial or industrial origin were detected at both sites. Those included chlorinated benzenes, aromatic hydrocarbons, alkyl phosphates, alkylphenol ethoxylates and nitrogen-containing compounds. The following table of organics in leachate was compiled by Reitzel *et al* (1992) from a variety of sources. The data, particularly averages, may not accurately represent leachate conditions at Irish landfills. However, in the absence of

comprehensive Irish data on organic contaminants in leachate, the international data are of relevance.

Organic Compound	Range	Average
Adsorbable organic halides (AOX)	320-3500	2000
	<10-45000	2500
Phenols	1-4000	1210
	<10-11300	1750
		120
Polynuclear Aromatic Hydrocarbons (PAH)	<1-3	
	<10-100	
Benzene	3-13	
	100-600	230
Toluene	85-385	
	<10-3200	720
Ethylbenzene	7-13	
	<10-4900	400
Xylene	35-46	
Chlorobenzene	<1-7	
		1

Many organic compounds which may be found in landfill leachate are of environmental significance in very low concentrations - parts per billion (ppb) or parts per trillion (ppt) quantities. Consequently very small amounts can cause severe pollution (Daly 1991). Of particular concern are compounds such as

polychlorinated biphenyls (PCBs) which are hydrophobic, fat-soluble and biologically stable so that they accumulate in body fats. They also biomagnify along food chains and in some ecosystems concentration factors from water to top predators may be as high as 10 to the power of 7 (Mason 1996). For three decades, until the mid-1970s, PCBs were widely used in the sealants that fill gaps between concrete blocks in buildings. In 1973 their use started to be restricted, and they were totally banned across Europe in 1986 (Edwards 1997). PCBs have also been widely used in transformers, capacitors, heat exchangers, hydraulic systems, vacuum pumps, lubricating oils and as plasticizers in paints and inks. Despite restrictions on use, it is estimated that there are still significant quantities of PCBs in electrical equipment, in landfills or in storage (Tanabe 1988).

The principal classes of chemical reactions that can affect organic contaminants in water are hydrolysis and oxidation, although these reactions are slow unless the transformations are aided by micro-organisms. However there is no assurance that the transformation of an organic solute will result in a harmless or less harmful product (MacKay *et al.* 1985). Certain organic substances such as halogenated aliphatics, phenols and pesticides may degrade under anaerobic conditions but degrade only very slowly under aerobic conditions such as occur in normal river water.

4.2.1.2 Timescale for Leachate Generation The sequence of microbiological breakdown processes which occurs in landfills is now well established, in that the landfill progresses through the aerobic, acetogenic, methanogenic and finally semi-aerobic phases. Whilst these phases will ensure that organic matter is eventually completely broken down and the carbon is released in the form of methane and carbon dioxide gases, some of the end products of these degradation processes remain as soluble components of leachate. Thus, waste components which constitute pollutants in the solid phase are gradually transposed into a liquid phase and can only be eliminated from a landfill providing waste encapsulation by the removal and treatment of the leachate. Robinson and Gronow (1993) state that a large, deep, high-density domestic

waste landfill, operated in a typical manner as at present in the UK, will continue to produce strong and polluting leachates well in excess of values considered acceptable for discharge to surface or ground water for a large number of decades, and possibly over time scales in excess of a century.

Probably the most difficult component of leachate to eliminate is ammonia, since this is the soluble end product of the anaerobic breakdown of nitrogenous components of wastes. Typically the ammonia content of leachates is 1000 mg/l, and for direct discharge to controlled waters a limit of say perhaps 1 mg/l would be required. Thus a dilution ratio of 1000:1 would be required for all leachate contained within a site. Walker (1993) calculates that if an engineered landfill site were capped over a depth of refuse of 10m with an average drained moisture content of 40%, then the hydraulic retention time (HRT) for the infiltration rate of 50mm per annum is given by: 10m x 0.4 ÷ 0.05m/a = 80 years. Knox (1990) calculates that for a hydraulic retention time of 80 years, the time to reduce the concentration of ammonia from 1000 mg/l to 1 mg/l is 552 years. Thus extremely protracted time scales may be involved for the operation of leachate control measures at fully engineered sites. This conclusion is supported by Freeze and Cherry (1979) who state that "in some cases leachate production may continue for many decades or even hundreds of years". The concept of very protracted time scales for leachate control is discussed in more detail by Belvi and Baccini (1989).

4.2.1.3 Worst Case Scenario

If leachate containment, collection and treatment measures were to fail or not be implemented, very significant quantities of leachate entering surface waters would result in serious contamination of the Rampere Stream and significant pollution of the River Slaney in the vicinity of its confluence with the Rampere Stream, possibly including the exclusion of salmonid fish from this section of the river. The possibility would also exist for significant contamination of the aquatic food chain with a variety of pollutants in downstream sections of the Slaney.

4.2.2 Pollution of streams/rivers with contaminated water draining from paved areas

As a wide range of vehicles will have access to the site there is the possibility of pollution of surface water with fuels, lubricants and waste material. The following effects of oil pollution in freshwaters have been documented:

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

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

- Oil products may contain various highly toxic substances, such as benzene, toluene, naphthenic acids and xylene which are to some extent soluble in water; these penetrate into the fish and can have a direct toxic effect. It is generally agreed that the lighter oil fractions (including kerosene, petrol, benzene, toluene and xylene) are much more toxic to fish than the heavy fractions (heavy paraffins and tars) reduced (Svobodova *et al* 1993).

5 MITIGATION MEASURES

5.1 MITIGATION OF THE POTENTIAL ENVIRONMENTAL IMPACT ON RIVER/STREAM ECOLOGY OF THE PROPOSED DEVELOPMENT DURING THE PERIOD OF CONSTRUCTION

5.1.1 Reduction and prevention of suspended solids pollution

Release of suspended solids to the Rampere Stream should be avoided. The key factors in erosion and sediment control are to intercept and manage off- and on-site runoff. This limits the potential for soils to be eroded and enter streams in runoff. Runoff and surface erosion control is more effective and less expensive than sediment control with sediment control ponds only.

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

i. No works likely to cause suspended solids contamination of the stream should take place in the period from the beginning of October to the end of April.

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

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

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

v. Divert runoff away from denuded areas.

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

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

viii. Retain eroded sediments on site with erosion and sediment control structures such as sediment traps, silt fences and sediment control ponds.

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

x. If possible instream work should be avoided. If unavoidable keep instream work to a minimum and as far as possible protect the natural stream conditions and structure to promote stability of bank and bed structures and retain riparian vegetation.

xi. All water pumped from instream contained work areas should be discharged on a land site to allow sediment removal before it re-enters the river.

5.1.2 Reduction or elimination of pollution with other substances associated with the construction process.

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

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

ii. Wash down water from exposed aggregate surfaces, cast-in-place concrete and from concrete trucks should be trapped on-site to allow sediment to settle out and reach neutral pH before clarified water is released to the stream or drain system or allowed to percolate into the ground.

iii. Fuels, lubricants and hydraulic fluids for equipment used on the construction site should be carefully handled to avoid spillage, properly secured against unauthorised access or vandalism, and provided with spill containment according to codes of practice.

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

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

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

vii. Prior to any instream work ensure that all construction equipment is mechanically sound to avoid leaks of oil, fuel, hydraulic fluids and grease.

viii. Foul drainage from site offices etc. should be removed to a suitable treatment facility or charged to a septic tank system constructed in accordance with SR6:1991 (Standard Recommendation for Septic Tank Systems - National Standards Authority of Ireland)

5.2 MITIGATION OF THE POTENTIAL ENVIRONMENTAL IMPACT ON RIVER/STREAM ECOLOGY OF THE PROPOSED DEVELOPMENT DURING ITS OPERATION AND FOLLOWING REHABILITATION

5.2.1 MITIGATION OF LEACHATE POLLUTION

If adverse impacts on the ecology, fish populations and amenity value of surface waters are to be avoided, it will be necessary to prevent biologically significant quantities of leachate pollutants from reaching surface waters over a prolonged period of time. This could most effectively be accomplished by designing the landfill extension to achieve total containment of leachate, and by removing leachate for treatment and disposal elsewhere. However, there are potential impacts on the environment due to the piping or the haulage of leachate by road tanker and subsequent treatment and release of treated effluent. These impacts would have to be assessed if this option is considered. If removal of leachate for treatment elsewhere is deemed to be the less suitable option, protection of the Rampere Stream and the River Slaney would require collecting leachate and treating it to such a standard as to preclude adverse biological impacts before releasing it to the stream.

If treated leachate is released to the Slaney system, it would be important that the biological impact, if any, should be carefully monitored, and that fish from the system should be periodically tested for a broad spectrum of contaminants.

5.2.2 MITIGATION OF POLLUTION WITH CONTAMINATED WATER DRAINING FROM PAVED AREAS

Runoff from area which could be contaminated by spillage or leakage of waste material should be treated to the same standard as landfill leachate.

An oil interceptor should be provided on any outfall from other paved areas to surface waters.

6 NON TECHNICAL SUMMARY

6.1 EXISTING ENVIRONMENT

- The existing landfill site at Rampere, County Wicklow is located in the catchment of a small tributary of the River Slaney (called for the purposes of this report the "Rampere Stream") which joins the River Slaney south of Stratford, approximately 1.75 km downstream of the landfill site.

- The proposed extension to the Rampere landfill site is situated to the west of the existing Rampere landfill. The Rampere stream flows along the northern boundary of the proposed landfill extension.

- Biological assessment carried out in 1998 indicated that the stream deteriorated from a moderately polluted condition to a seriously polluted condition as it passed Rampere landfill. Biological investigations carried out for this report indicate that Rampere stream is at present moderately polluted both upstream and downstream of the existing landfill, indicating that the existing landfill does not have a significant impact on the water quality of the stream.

- The River Slaney upstream and downstream of its confluence with the Rampere stream has an invertebrate community with good densities of pollution sensitive species, normally indicative of unpolluted conditions. However, abnormally high densities of some pollution tolerant species indicate the early stages of eutrophication. These early warning signs of eutrophication are equally evident upstream and downstream of the Rampere stream, and can therefore not be attributed to any impact from the existing landfill.

- The Rampere stream in the vicinity of and downstream of the proposed landfill extension constitutes salmonid nursery habitat of moderate quality.

Juvenile brown trout were recorded upstream, adjacent to, and downstream of the proposed landfill extension.

- The River Slaney between its confluence with the Rampere stream and Baltinglass constitutes salmonid habitat of a very high quality and is particularly important as a spawning area for salmon.

- The Slaney holds salmon, sea-trout and brown trout. The Slaney is primarily a spring salmon fishery and is regarded as one of the top rivers in Ireland for early spring salmon fishing. The river is therefore of national importance as an angling amenity. The Slaney is a designated salmonid water under the E.C. (Quality of Salmonid Waters) Regulations.

- All three Irish species of lamprey, listed for conservation in Annex II of EU Habitats Directive 92/43/EEC, have been recorded in the Slaney. Salmon, which occur in the Slaney, are listed in Part 2 of the First Schedule of Regulations SI No. 94 of 1997 and listed in Annex II of the Habitats Directive. The mid and lower reaches of the River Slaney from below Tullow to the estuary is a candidate Special Area of Conservation. The Slaney estuary better known as the Wexford Slobs is a Special Protected Area (SPA) of international importance for its wintering birdlife.

6.2 POTENTIAL IMPACTS ON AQUATIC INVERTEBRATE FAUNA, FLORA, FISH AND HABITATS

- Pollution of watercourses with suspended solids due to runoff of soil from construction areas, or due to disturbance of fine subsurface substrates in the course of instream construction and excavation.

- Pollution of watercourses with other substances such as fuels, lubricants, waste concrete, waste water from site toilet and wash facilities, etc.

- Landfill leachate contains a large variety of potentially serious pollutants. The future impact of the Rampere landfill on the Rampere stream and the River Slaney will depend on the quantity and quality of treated or untreated leachate (if any) which enters surface waters in future years.

6.3 RECOMMENDED MITIGATION MEASURES

- If adverse impacts on the ecology, fish populations and amenity value of surface waters are to be avoided, it will be necessary to prevent biologically significant quantities of leachate pollutants from reaching the Rampere Stream and the River Slaney over a prolonged period of time. This could most effectively be accomplished by total containment of leachate at the landfill and collecting and removing leachate for treatment and disposal. However, there are potential impacts on the environment due to piping or haulage of leachate by road tanker and subsequent treatment and release of treated effluents. These impacts would have to be assessed if this option is considered. If removal of leachate for treatment elsewhere is deemed to be the less suitable option, protection of the river would require collecting leachate and treating it to such a standard as to preclude any adverse biological impacts before releasing it to the stream.

- As the entire site is in close proximity to the Rampere Stream, strict control of erosion and sediment generation and other pollutants associated with the construction process should be implemented.

- Construction likely to generate significant suspended solids pollution should not take place between the beginning of October and the end of March.

- Where the proposed development is to be constructed in close proximity to streams/rivers, well marked leave strips should be established and left undisturbed, in order to protect the waterside habitat and minimise runoff pollution during the construction process.

- Runoff from area which could be contaminated by spillage or leakage of waste material should be treated to the same standard as landfill leachate.

- Oil separators should be placed on drains from other paved areas.

7 REFERENCES

Belvi, H. and P. Baccini (1989) Long-term behaviour of municipal solid waste landfills. Waste Management and Research 7: 43-56

Bowman, J.J., K.J. Clabby, J. Lucey, M.L. McGarrigle & P.F. Toner (1996) Water Quality in Ireland 1991-1994. Environmental Protection Agency.

Cherry, J.A., R.W. Gillham & J.F. Barker (1984) Contaminants in groundwater: chemical processes. Groundwater Contamination. National Academy Press 46 - 66

Chilibeck, B., G. Chislett, and G. Norris (1992) Land development guidelines for the protection of aquatic habitat. Department of Fisheries and Oceans, Canada. Habitat management division. Ministry of Environment Lands and Parks. Integrated Management Branch.

Clabby, K.J. *et al.* (1992) Water Quality in Ireland 1987-1990. Part one General Assessment. Environmental Research Unit

Clabby, K.J. *et al* (1999) Interim Report on the Biological Survey of River Quality - Results of the 1998 Investigations. Environmental Protection Agency.

Conservation Services (1998) Baseline aquatic environmental survey for the waste licence application for the landfill at Rampere, County Wicklow. Unpublished Report to M.C. O'Sullivan Ltd.

Daly, D. (1987) Waste Disposal Sites and the Environment. Paper given to I.A.H. Meeting Portlaoise 1987.

Daly, D. (1991) Selection and management of landfill sites: Geological and Groundwater Aspects. In Management of Landfill Sites 7th Annual International Conference organised by Sherkin Island Marine Station, Cork, 1991.

Davies, J. & J. Hammonds (1991) The control of leachate. Reprints of Conference "The Planning and Engineering of Landfills". The Midlands Geotechnical Society, Birmingham.

Edwards, E. (1997) Toxic shock in the concrete jungle. New Scientist No.2075: p 7.

EIFAC (1993) see Svobodova et al (1993)

Farquhar, G.J. (1989) Leachate: production and characterisation. Canadian Journal of Civil Engineering 16: 317-325

Flanagan, P.J. (1992) Parameters of Water Quality. Environmental Research Unit.

Freeze, R.A. and J.A. Cherry (1979) Groundwater. Prentice-Hall.

Goldman, S.J., K. Jackson and I.A. Bursztynsky (1986) Erosion and Sediment Control Handbook. McGraw - Hill Book Company. New York

Kennedy G.J.A. (1984) Evaluation of techniques for classifying habitats for juvenile Atlantic Salmon (*Salmo salar* L.) Atlantic Salmon Trust Workshop on Stock enhancement.

Knox, K. (1990) The relationship between leachate and gas. Proceedings of International Conference. Landfill Gas: Energy and Environment '90. Bournemouth, October 1990.

Kurz, I. & M.J. Costello (1998) An outline of the biology distribution and conservation of Lampreys in Ireland. Irish Wildlife Manuals No. 5. Dúchas - the Heritage Services

Lucey, J. *et al* (1999) Water Quality in Ireland 1995-1997. Environmental Protection Agency.

MacKay, D.M., P.V. Roberts and J.A. Cherry (1985) Transport of organic contaminants in groundwater. Environmental Science and Technology 19: 384-392

Mason, C.F (1996) Biology of Freshwater Pollution. Longman, Essex.

McGinley, P.M and P. Kmet (1984) Formation , characteristics, treatment and disposal of leachate from solid waste landfills, Special Report, Wisconsin Dept. of Natural resources, Madison, Wisconsin

O'Reilly P. (1993) Trout and Salmon Rivers of Ireland. Merlin Unwin Books

Reinhart, M., N.L. Goodman & J.F. Barker (1984) Occurrence and distribution of organic chemicals in two landfill leachate plumes. Environmental Science and Technology 18:953 - 961.

Reitzel, S., G. Farquhar and E. McBean (1992) Temporal characterisation of municipal waste leachate. Canadian Journal of Civil Engineering 19: 668-679

Robinson, H.D and J.R. Gronow (1993) A review of landfill leachate composition in the UK. IV th International Landfill Symposium, Sardinia 1993.

Robinson, H.D. and P.J. Maris (1985) The treatment of leachates from domestic wastes in landfill sites. Journal of the Water Pollution Control Federation, 57: 30-38

Solbe J. (1988) Water Quality for Salmon and Trout. Atlantic Salmon Trust.

Stegman, R. (1980) Leachate treatment in Europe. In Proceedings of a leachate managment seminar held at University of Toronto, Ontario, ed. P. H. Byer

Svobodova et al (1993) Water Quality and Fish Health. EIFAC Technical Paper 54. European Inland Fisheries Advisory Commission.

Tanabe, S. (1988) PCB problems in the future: foresight from current knowledge. Environmental Pollution 50:5-28

Walker, N. (1993) Landfill leachate control: a diagnosis and prognosis. Waste Management Proceedings January 1993 pp 3-10.

Wolman & Schick 1967 Impacts of development on fluvial systems in Maryland. Cited in U.S. Environmental Protection Agency document on storm water pollution. Internet Site www.epa.gov/owmitnet/pipes/7.htm

Taxonomic keys used for identification

Brinkhurst, R.O. (1971) A guide for the identification of British aquatic Oligochaeta. F.B.A. Scientific Publication No. 22. Second edition.

Edington, J.M. & A.G. Hildrew (1981) A key to the caseless caddis larvae of the British Isles. F.B.A. Scientific Publication No. 43.

Elliott, J.M. (1996) British freshwater Megaloptera and Neuroptera: A key with ecological notes. F.B.A. Scientific Publication No. 54.

Elliott, J.M., U.H. Humpesch & T.T. Macan (1988) Larvae of the British Ephemeroptera. F.B.A. Scientific Publication No. 49.

Elliott, J.M. & K.H. Mann (1979) A key to the British freshwater leeches. F.B.A. Scientific Publication No. 40.

Fitter, R. & R. Manuel (1986) A guide to the freshwater life of Britain and north-west Europe. Collins, London.

Friday, L.E. (1988) A key to the adults of British water beetles. Field Studies 7, 1-151.

Gledhill, T., D.W. Sutcliffe & W.D. Williams (1993) British Freshwater Crustacea Malacostraca. F.B.A. Scientific Publication No. 52.

Haslam, S.M., C.A. Sinker & P.A. Wolsely (1975) British water plants. Field Studies 4, 243-351.

Hammond, C.O. (1983) The dragonflies of Great Britain and Ireland. Harley Books, Essex, England. Second edition.

Hynes, H.B.N. (1977) A key to the adults and nymphs of the British stoneflies (Plecoptera). F.B.A. Scientific Publication No. 17. Third edition.

Macan, T.T. & R.D. Cooper (1977) A key to the British fresh- and brackish-water gastropods. F.B.A. Scientific Publication No. 13. Fourth edition.

Moore, J.A. (1986) Charophytes of Great Britain and Ireland. BSBI Handbook No. 5.

Preston, C.D. (1995) Pondweeds of Great Britain and Ireland. BSBI Handbook No. 8.

Reynoldson, T.B. (1967) A key to the British species of freshwater triclads. F.B.A. Scientific Publication No. 23.

Richoux, P. (1982) Introduction pratique a la systematique des organismes des eaux continentales françaises. 2. Coléoptères Aquatiques. Bulletin de la Societé Linnéenne de Lyon 51, 105-128.

Savage, A.A. (1989) Adults of the British Aquatic Hemiptera Heteroptera. F.B.A. Scientific Publication No. 50.

Wallace, I.D., B. Wallace & G.N. Philipson (1990) A key to the case-bearing caddis larvae of Britain and Ireland. F.B.A. Scientific Publication No. 51.

Webb, D.A. (1977) An Irish Flora. Dundalgan Press, Dundalk. Sixth edition.

Wiederholm, T. (1983) Chironomidae of the Holarctic Region. Keys and diagnoses. Part 1 - Larvae. Entomologica Scandinavica Supplement No. 19.

APPENDIX 1

HABITAT DESCRIPTION AT SAMPLING SITES AND FISH SURVEY RAW DATA

SITE 1

Site Code	1
Site Location	S8640 9181
Photograph Number	Photo. 2 (invertebrate sampling area) Photos. 1 & 2 (fish sampling area)
Width	1.5m
Depth	6 - 12 cm.
Substrate	Gravel, Cobble, Sand, Mud
Flow Type	Riffle 60% Glide 40%
Instream Vegetation	*Apium nodiflorum* 5% *Callitriche* sp. <5%
Dominant Bankside Vegetation	Willow
Estimated % summer Cover of Stream by Bankside Vegetation	20%
Trout Adult Habitat	Poor - Fair*
Trout Nursery Habitat	Poor - Fair*
Trout Spawning Habitat	None*
Fishing Time	13 minutes*
Fish Species Recorded	Three spined stickleback, Eel, Brown Trout*

*Fish assessment was carried out c. 50m upstream of the invertebrate sampling site

SITE 2

Site Code	2
Site Location	S8652 9174
Photograph Number	None
Width	2 m
Depth	6 cm
Substrate	Gravel, Sand, Mud
Flow Type	Fast Glide 100%
Instream Vegetation	None
Dominant Bankside Vegetation	Hawthorn
Estimated % summer Cover of Stream by Bankside Vegetation	90%
Trout Adult Habitat	Poor - Fair
Trout Nursery Habitat	Fair - Good
Trout Spawning Habitat	Fair
Fishing Time	15 minutes
Fish Species Recorded	Brown Trout

Details of salmonids captured

Brown Trout	
Fork length (mm)	Age
127	1+

SITE 3

Site Code	3
Site Location	S8683 9161
Photograph Number	4
Width	3m
Depth	20cm
Substrate	Mud, Sand, Gravel, Cobble (few)
Flow Type	Glide 100%
Instream Vegetation	*Apium nodiflorum* <5% *Rorippa nasturtium aquaticum* ag. <5% *Callitriche* sp. <5%
Dominant Bankside Vegetation	Grass, Nettle
Estimated % summer Cover of Stream by Bankside Vegetation	5%
Trout Adult Habitat	Poor
Trout Nursery Habitat	Poor - Fair
Trout Spawning Habitat	None
Fishing Time	12 minutes
Fish Species Recorded	Eel

SITE 4

Site Code	4
Site Location	S 8750 9089
Photograph Number	7
Width	2-3 m
Depth	30 cm.
Substrate	Sand, Gravel, Cobble, Mud, Large Rocks
Flow Type	Glide 100%
Instream Vegetation	*Ranunculus* sp. 20% *Lemna minor* <5% *Apium nodiflorum* <5% *Rorippa nasturtium aquaticum* agg. <5% *Sparganium* sp. <1%
Dominant Bankside Vegetation	Alder
Estimated % summer Cover of Stream by Bankside Vegetation	20%
Trout Adult Habitat	Poor - Fair
Trout Nursery Habitat	Fair - Good
Trout Spawning Habitat	Fair
Fishing Time	15 minutes
Fish Species Recorded	Stone loach, Eel, Brown Trout

Details of salmonids captured

Brown Trout	
Fork length (mm)	Age
60	
61	
65	0+
66	
70	
70	
109	
125	
139	1+
144	
155	

SITE A

Site Code	A
Site Location	S8762 9145
Photograph Number	8
Width	C. 20m
Depth	10 - 30 cm
Substrate	Gravel, Cobble, Sand, Large rocks
Flow Type	Riffle 35% Glide 65%
Instream Vegetation	*Ranunculus* sp. 10%
Dominant Bankside Vegetation	Alder, Hawthorn
Estimated % summer Cover of Stream by Bankside Vegetation	<5%
Trout Adult Habitat	Good - Very Good
Trout Nursery Habitat	Good - Very Good
Trout Spawning Habitat	Good - Very Good

SITE B

Site Code	B
Site Location	S8746 9081
Photograph Number	9
Width	c. 18 m
Depth	50 cm.
Substrate	Gravel, Cobble, Sand
Flow Type	Riffle 20% Glide 80%
Instream Vegetation	*Ranunculus* sp. 20%
Dominant Bankside Vegetation	Alder
Estimated % summer Cover of Stream by Bankside Vegetation	5%
Trout Adult Habitat	Good - Very Good
Trout Nursery Habitat	Fair
Trout Spawning Habitat	Good - Very Good

SITE C

Site Code	C
Site Location	S8731 9044
Photograph Number	10
Width	c. 20m
Depth	10 - 30 cm,
Substrate	Cobble, Gravel, Large Rocks, Sand
Flow Type	Riffle 90% Glide 10%
Instream Vegetation	*Ranunculus* sp. <5% Moss <5%
Dominant Bankside Vegetation	Ash, Sycamore, Alder
Estimated % summer Cover of Stream by Bankside Vegetation	10%
Trout Adult Habitat	Very Good
Trout Nursery Habitat	Very Good
Trout Spawning Habitat	Very Good

SITE D

Site Code	D
Site Location	S8680 8851 (Just downstream of Baltinglass Bridge)
Photograph Number	14
Width	20 - 25 m
Depth	10 - 30 cm.
Substrate	Gravel, Cobble, Sand, Large Rocks
Flow Type	Riffle 75% Glide 25%
Instream Vegetation	*Ranunculus* sp. 20% *Phalaris arundinacea* <5%
Dominant Bankside Vegetation	Grass
Estimated % summer Cover of Stream by Bankside Vegetation	<5%
Trout Adult Habitat	Good
Trout Nursery Habitat	Very Good
Trout Spawning Habitat	Very Good

APPENDIX 2

INVERTEBRATE SPECIES LIST WITH ABUNDANCE RATINGS

	Site A	Site B	Site C	Site D	Site 1	Site 3	Site 4	Group
Oligochaeta (Segmented worms)								
Enchytraeidae	20	5	20					-
Limnodrilus sp.					2	15		E
Lumbricidae			2	5	37		3	-
Lumbriculus variegatus					2			-
Stylodrilus heringianus	7	4	1	7			26	-
Tubifex sp. (immature)					1	1	2	E
Hirudinea (Leeches)								
Erpobdella octoculata/testacea		2			3	1	5	D
Glossiphonia complanata					1		6	D
Gastropoda (Snails and limpets)								
Ancylus fluviatilis	2	4	2	4	5		4	C
Lymnea peregra					5	1		D
Potamopyrgus antipodarum					25	8	18	D
Bivalvia (Freshwater Mussels)								
Pisidium sp.					11	2	2	D
Hydracarina (Water mites)	4	1		1		1		C
Amphipoda (Freshwater shrimps)								
Gammarus duebeni	5	9	1	30	100s	21	63	C
Ephemeroptera (Mayflies)								
Baetis rhodani	13	16	47	60	9	9	1	C
Baetis fuscatus/scambus	1		2	1				B
Ecdyonurus dispar		4	1	9				A
Ecdyonurus venosus	11	3	12	5				A
Ephemerella ignita	78	98	53	111	2	5	21	B
Rhithrogena semicolorata	1			2				A
Plecoptera (Stoneflies)								
Chloroperla tripunctata			5	2				A
Leuctra fusca	2	4	3	2				B
Perla bipunctata		4	3	6				A

	Site A	Site B	Site C	Site D	Site 1	Site 3	Site 4	Group
Hemiptera (Water Bugs)								
Mesovelia furcata						1		C
Trichoptera (Caddis flies)								
Agapetus fuscipes					5			C
Athripsodes albifrons	3	12	11	13				B
Drusus annulatus					10			C
Glossosoma boltoni						1		C
Halesus digitatus	1			1			2	C
Halesus radiatus	1			1		1		C
Hydropsyche siltali	14	22	16		1			C
Lepidostoma hirtum		1		1				B
Odontocerum albicorne	2	3					7	B
Potamophylax cingulatus		1						C
Potamophylax latipennis	2				2	1	6	C
Psychomyia pusilla	3							C
Rhyacophila dorsalis	8	8	6	6				C
Rhyacophila munda	1	1	4					C
Sericostoma personatum						1		B
Silo pallipes	2						11	B
Tipulidae (Crane flies)	8	5	1	8	12	25	2	C
Ceratopogonidae (Biting midges)	1							-
Simuliidae (Black-flies)	100s	100s	100s	100s	84	5	21	C
Chironomidae (Non-biting midges)								
Cricotopus/ Orthocladius sp.	45	27	52	9		2	1	D
Demicryptochironomus sp.	1			1				D
Diamesa sp	17	14	4					D
Micropsectra sp.	1					8	1	D
Paratanytarsus sp.	1		1					D
Pentaneurini	4	4	2				1	D
Polypedilum sp.	9	12	9	1			1	D
Procladius sp						5	1	D
Prodiamesa sp.						6		D
Psectrocladius sp.	2	2				1		D
Stictochironomus sp.		1						D
Thienemanniella sp.	1			2			1	
Tvetenia sp.	23	26	12	6	1	2	4	D
Coleoptera (Beetles)								
Brychius elevatus						1		C
Elmis aenea	2	3	3	6	29		4	C
Haliplus confinis						4	1	C

	Site A	Site B	Site C	Site D	Site 1	Site 3	Site 4	Group
Helophorus sp.						29	4	C
Ilybius fuliginosus						2	1	C
Ilybius guttiger							1	C
Limnius volckmari	4	10	8	6	1		2	C
Number of Taxa	**36**	**30**	**26**	**28**	**22**	**27**	**30**	
Q-rating	**Q4**	**Q4**	**Q4**	**Q4**	**Q3**	**Q3**	**Q3**	

APPENDIX 3

INVERTEBRATE SPECIES LIST WITH NOTES ON ECOLOGY AND DISTRIBUTION

	Group	Ecology and Distribution in Freshwater
Oligochaeta (Segmented worms)		
Enchytraeidae	-	Found in detritus and mud
Limnodrilus sp. (immature)	E	Common and abundant in many habitats.
Lumbriculus variegatus	-	Common in a variety of habitats
Stylodrilus heringianus	-	Widespread. Commonly found in sandy habitats.
Tubifex ignotus	E	Found in rivers, regarded as local and scarce in Britain; probably more common in Ireland
Hirudinea (Leeches)		
Erpobdella octoculata/testacea	D	Common in many habitats
Glossiphonia complanata	D	Common in many habitats
Gastropoda (Snails and limpets)		
Ancylus fluviatilis	C	Common in rivers and still waters, usually on hard substrates - stones etc.
Lymnaea peregra	D	Probably the commonest water snail in Europe, occurring in a wide variety of habitats
Potamopyrgus antipodarum	D	Common, often very abundant in many habitats
Bivalvia (Freshwater Mussels)		
Pisidium sp.	D	Common in many habitats
Hydracarina (Water mites)	C	Common in many habitats
Amphipoda (Freshwater shrimps)		
Gammarus duebeni	C	Common in Ireland in a wide range of habitats
Ephemeroptera (Mayflies)		
Baetis rhodani	C	Common and abundant in small streams; extending into rivers
Baetis fuscatus/scambus	B	Common in rivers with fairly swift flow
Ecdyonurus dispar	A	Found in stony rivers and lake shores
Ecdyonurus venosus	A	Found in stony rivers and streams

Ephemerella ignita	B	Common, occurring mostly in running waters amongst vegetation
Rhithrogena semicolorata	A	Common in stony rivers and streams
Plecoptera (Stoneflies)		
Chloroperla tripunctata	A	Fairly common, fairly abundant; rivers and streams with stony substrata.
Leuctra fusca	B	Common and widespread, occurring mostly in stony streams
Perla bipunctata	A	Common and abundant. Found in rivers and streams with unstable stony substrata
Trichoptera (Caddis flies)		
Agapetus fuscipes	C	Widespread and abundant. Found on stony substrates of streams, rivers and lake shores
Athripsodes albifrons	B	Common in rivers in these islands, also on lake shores in Ireland
Drusus annulatus	C	Widespread and common; usually in streams; stony substratum and among weeds.
Glossosoma boltoni	C	Widespread and common in Ireland. Usually found on stony substrates in large rivers and streams
Halesus digitatus	C	Widespread and common in streams and rivers; commoner than *H. radiatus* in small streams, less frequent than *H. radiatus* in rivers.
Halesus radiatus	C	Common in streams, rivers and lake shores.
Hydropsyche siltalai	C	Common, usually found in fast-running waters.
Lepidostoma hirtum	B	Widespread and common in rivers, large streams and sometimes on lake shores
Odontocerum albicorne	B	Common and widespread in stony streams and rivers
Potamophylax cingulatus	C	Widespread and common. Found in stony substrates in streams and rivers and lake shores
Potamophylax latipennis	C	Widespread and common. Found on stony substrates of streams rivers and lake shores
Rhyacophila dorsalis	C	Common in fast-running waters
Rhyacophila munda	C	Found under stones in running waters. Localised distribution.
Sericostoma personatum	B	Common on stony substrates.
Silo pallipes	B	Widespread and common. Found in streams and rivers

Tipulidae (Crane flies)	C	Common in a variety of habitats.
Ceratopogonidae (Biting midges)	-	Common in a variety of habitats.
Simuliidae (Black-flies)	C	Common and often abundant in all types of flowing waters.
Chironomidae (Non-biting midges)		
Cricotopus/Orthocladius sp.	D	Common in all types of freshwater, frequently associated with aquatic plants. (*Orthocladius* larvae cannot be distinguished from some *Cricotopus* larvae with certainty.)
Demicryptochironomus sp.	D	Occur in lakes and rivers in sandy and muddy substrata.
Diamesa sp.	D	Mostly found in cool flowing water & springs; also shallow still water.
Microtendipes sp.	D	Found in sediments and submerged mosses.
Paratanytarsus sp.	D	Found in a wide variety of still and flowing water habitats
Pentaneurini	D	Common in a variety of habitats.
Polypedilum sp.	D	Common in a variety of habitats.
Procladius sp.	D	Common in muddy substrata of standing or slow-flowing waters.
Prodiamesa sp.	D	Common in a variety of habitats.
Psectrocladius sp.	D	Common in a variety of habitats.
Stictochironomus sp.	D	Found in lakes, streams and slow-flowing rivers
Thienemaniella sp.	D	Found in a variety of flowing water habitats
Tvetenia sp.	D	Common in flowing water.
Coleoptera (Beetles)		
Brychius elevatus	C	Common in running water and wave-washed lakeshores
Elmis aenea	C	Common in running water in riffles.
Haliplus confinis	C	Common in pools, streams, fen ditches and dykes
Helophorus sp.	C	Some species common or ubiquitous
Ilybius guttiger	C	Occasional in this country in stagnant water, fens and bogs
Limnius volckmari	C	Common in running water and upland lakes.

APPENDIX 4

EPA WATER CHEMICAL AND BIOLOGICAL DATA FOR THE SLANEY

(data copied from disc provided by EPA and 1998 biological data from Clabby *et al* 1999)

River and Code : **SLANEY** **12/S/02**
Tributary of : Sea - Wexford Harbour OS Catchment No: 175
OS Grid Ref : S 975 314

Sampling Stations — Biological Quality Ratings (Q Values)

No.	Location	1971	1975	1979	1981	1983	1984	1987	1991	1995	1998
0100	Seskin Bridge	-	-	5	-	-	4	4	5	4-5	5
0200	Kelsha Bridge	-	-	4	-	-	4-5	4-5	5	5	4-5
0400	Waterloo Bridge	-	-	4-5	-	-	4-5	4	4-5	4-5	5
0600	Tuckmill Bridge	-	-	4	-	-	4-5	4-5	4-5	4-5	5
0700	Just d/s Baltinglass Bridge	5	5	4	-	-	4-5	4	**3**	4-5	4-5
0770	Maiden's Ford	-	-	-	-	-	-	-	-	4-5	4-5
0900	Ford u/s Rathvilly	5	5	4	-	-	4-5	4	4	4	4
1020	1km d/s Rathvilly Br	-	-	-	-	-	-	-	4	4-5	4-5
1100	Rathmore Bridge	-	-	-	-	-	4	4	4	4-5	4-5
1200	Moatabower Bridge	5	4-5	4-5	5	4-5	4-5	4-5	4	4-5	4-5
1290	500 m u/s Tullow Bridge	-	-	-	-	-	-	4	4	4	4-5
1400	Ford 3 km d/s Tullow Bridge	4-5	4-5	**3-4**	**3-4**	**3-4**	**3-4**	**3-4**	**3-4**	**3-4**	**3-4**
1530	W of Ballinastraw	-	-	-	-	-	-	-	**3-4**	**3-4**	4
1600	Kilcarry Bridge	-	-	-	-	-	**3-4**	**3-4**	**3-4**	**3-4**	4-5
1800	Bunclody: Slaney Bridge	4-5	4	4	4	-	**3-4**	**3-4**	4	**3-4**	4-5
1900	Clohamon Bridge	4-5	-	**3-4**	**3**	**3-4**	**3**	**3**	**3**	**3-4**	
2000	1.3 km d/s Clohamon Bridge	5	**3-4**	**3-4**	**3-4**	**3-4**	**3**	**3**	**3**	**3-4**	**3-4**
2100	Ballycarney Bridge	5	4	4	-	-	**3-4**	4	**3**	**3-4**	**3-4**
2200	Scarawalsh Bridge	-	4-5	4	-	-	**3-4**	4	**3-4**	-	
2220	Just W of Salsborough Br	-	-	-	-	-	-	-	-	**3-4**	**4**

Results of Chemical Analyses 1995 to 1997:
Hardness Range : 6-173 mg l^{-1} $CaCO_3$
Alkalinity Range : 10-319 mg l^{-1} $CaCO_3$
Data Set: 1 12S02 EPA

Station No.	pH				Conductivity µS cm^{-1}				Temperature oC			
	No.	Min	Med	Max	*No.*	Min	Med	Max	*No.*	Min	Med	Max
0800	*30*	7.5	7.9	8.8	*30*	141	238	301	*30*	3.3	10.4	18.0
0950	*30*	7.6	7.9	8.6	*30*	148	253	312	*30*	3.7	10.6	18.4
1100	*30*	7.6	8.0	8.8	*30*	157	278	329	*30*	3.9	10.7	18.8
1200	*30*	7.7	8.0	8.7	*30*	162	290	344	*30*	3.9	10.9	18.8
1300	*33*	7.8	8.1	8.8	*33*	170	289	344	*33*	4.0	11.2	19.3
1400	*30*	7.4	8.2	9.0	*30*	182	306	355	*30*	4.1	11.4	20.2
1500	*30*	7.7	8.2	9.1	*30*	219	327	366	*30*	4.0	11.2	19.9
1600	*30*	7.8	8.2	9.0	*30*	207	318	361	*30*	4.3	11.2	20.8

Station No.	pH				Conductivity $\mu S\ cm^{-1}$				Temperature oC			
	No.	Min	Med	Max	*No.*	Min	Med	Max	*No.*	Min	Med	Max
1700	*30*	7.7	8.4	9.3	*30*	200	298	326	*30*	4.5	11.4	20.8
1800	*30*	7.6	8.2	9.4	*30*	209	278	610	*30*	4.7	11.8	20.9
1900	*30*	7.6	8.1	9.3	*30*	202	271	321	*30*	4.8	11.8	20.7
2000	*30*	7.5	8.1	9.2	*30*	201	271	331	*30*	4.7	11.9	**21.9**
2100	*31*	7.3	8.1	9.2	*31*	201	272	326	*31*	4.8	11.8	21.0
2200	*32*	7.5	8.0	9.4	*32*	201	268	325	*32*	4.9	11.8	**21.9**
2250	*9*	7.8	7.9	9.4	*9*	244	276	302	*9*	5.2	13.4	18.7
2300	*30*	7.5	8.0	9.3	*30*	212	262	306	*30*	4.9	11.6	21.5
2400	*30*	7.6	8.0	9.2	*30*	219	263	311	*30*	5.1	11.6	21.3
2500	*30*	7.4	7.8	9.0	*30*	213	250	999	*30*	5.0	11.6	21.2
2600	*29*	7.4	7.8	9.0	*19*	10	271	1669	*30*	4.3	12.6	**22.9**
2700	*30*	7.3	8.0	9.5	*6*	247	638	1752	*29*	4.6	11.9	**22.6**
2800	*30*	7.7	8.2	9.4	-	-	-	-	*30*	5.8	13.6	**22.6**

Station No.	Dissolved Oxygen % Saturation				Dissolved Oxygen mg $O_2 1^{-1}$				B.O.D mg $O_2 1^{-1}$			
	No.	Min	Med	Max	*No.*	Min	Med	Max	*No.*	Min	Med	Max
0800	*30*	91	98	**139**	*30*	9	11	13	*29*	<0.3	1.5	**5.8**
0950	*30*	86	98	118	*30*	9	11	13	*29*	<0.3	1.5	**6.2**
1100	*30*	89	101	128	*30*	9	11	14	*29*	0.6	1.3	3.7
1200	*30*	92	100	119	*30*	9	11	14	*29*	0.5	1.1	2.6
1300	*33*	88	100	110	*33*	9	11	14	*32*	0.4	1.2	3.4
1400	*30*	94	101	**136**	*30*	10	11	14	*29*	0.5	1.5	2.8
1500	*30*	95	101	121	*30*	10	11	13	*29*	0.6	1.5	5.0
1600	*30*	94	102	**145**	*30*	10	11	13	*29*	0.5	1.4	4.8
1700	*30*	93	106	**160**	*30*	10	12	14	*29*	0.4	1.3	3.0
1800	*30*	93	103	**140**	*30*	10	12	14	*29*	0.6	1.2	2.6
1900	*30*	92	102	**140**	*30*	10	11	14	*29*	0.7	2.0	**7.0**
2000	*30*	**9**	100	**138**	*30*	**1**	11	14	*29*	0.8	2.1	**12.5**
2100	*31*	93	103	**157**	*31*	10	11	14	*30*	0.9	1.5	**5.4**
2200	*32*	91	102	**174**	*32*	10	11	15	*30*	0.6	1.6	3.4
2250	*9*	93	101	128	*9*	9	12	13	*8*	0.7	2.0	2.9
2300	*30*	80	98	**160**	*30*	8	11	14	*29*	0.7	1.9	**5.8**
2400	*30*	78	98	124	*30*	8	11	13	*29*	0.6	2.1	3.6
2500	*30*	76	93	**132**	*30*	8	10	12	*29*	0.6	1.6	4.3
2600	*30*	82	94	**162**	*30*	8	10	14	*28*	0.6	1.6	**9.0**
2700	*30*	77	91	**182**	*29*	8	11	14	*28*	0.5	1.8	**7.1**
2800	*30*	70	96	**179**	*30*	7	11	16	*28*	0.5	1.6	3.5

Station No.	Chloride mg Cl 1^{-1}				Total Ammonia mg N 1^{-1}				Un-Ionised Ammonia mg NH_3 1^{-1}			
	No.	Min	Med	Max	*No.*	Min	Med	Max	*No.*	Min	Med	Max
0800	*29*	9	12	15	*30*	<0.01	<0.01	0.112	*30*	0.0001	0.0003	0.0024
0950	*29*	9	13	16	*30*	<0.01	0.024	0.179	*30*	0.0001	0.0004	0.0031
1100	*29*	11	13	16	*30*	<0.01	0.020	0.121	*30*	0.0001	0.0005	0.0039
1200	*29*	10	13	16	*30*	<0.01	0.014	0.064	*30*	0.0002	0.0005	0.0026
1300	*32*	10	13	44	*33*	<0.01	<0.01	0.080	*33*	0.0002	0.0005	0.0024
1400	*29*	10	14	24	*30*	<0.01	<0.01	0.082	*30*	0.0001	0.0006	0.0108
1500	*29*	14	17	19	*30*	<0.01	0.012	0.135	*30*	0.0001	0.0009	0.0032
1600	*29*	12	17	23	*30*	<0.01	0.016	0.283	*30*	0.0001	0.0007	0.0118
1700	*29*	15	18	39	*30*	<0.01	<0.01	0.178	*30*	0.0001	0.0009	0.0075
1800	*29*	14	18	62	*30*	<0.01	<0.01	0.173	*30*	0.0001	0.0006	0.0053
1900	*29*	15	18	25	*30*	<0.01	0.092	**0.994**	*30*	0.0002	0.0027	**0.0835**
2000	*29*	15	18	23	*30*	<0.01	0.089	**1.475**	*30*	0.0002	0.0025	**0.1200**
2100	*30*	15	18	65	*31*	<0.01	0.042	0.271	*31*	0.0001	0.0013	**0.0673**
2200	*31*	15	19	21	*32*	<0.01	0.054	0.255	*32*	0.0002	0.0012	**0.0461**
2250	*8*	19	21	25	*9*	<0.01	0.036	0.081	*9*	0.0004	0.0014	0.0055

Station No.	Chloride mg Cl 1^{-1}				Total Ammonia mg N 1^{-1}				Un-Ionised Ammonia mg NH_3 1^{-1}			
	No.	Min	Med	Max	*No.*	Min	Med	Max	*No.*	Min	Med	Max
2300	*29*	16	20	24	*30*	<0.01	0.020	**0.332**	*30*	0.0001	0.0008	0.0102
2400	*29*	16	20	28	*30*	<0.01	0.040	**0.322**	*30*	0.0002	0.0010	**0.0217**
2500	*29*	19	20	232	*30*	<0.01	0.039	0.167	*30*	0.0002	0.0006	0.0058
2600	*16*	19	24	928	*30*	<0.01	0.067	0.285	*29*	0.0002	0.0009	**0.0267**
2700	*6*	23	247	540	*30*	<0.01	0.082	0.283	*29*	0.0003	0.0011	**0.0288**
2800	-	-	-	-	*30*	<0.01	0.072	**0.510**	*30*	0.0002	0.0018	0.0200

Station No.	Oxidised Nitrogen mg N 1^{-1}				Ortho-Phosphate mg P 1^{-1}				Colour Hazen			
	No.	Min	Med	Max	*No.*	Min	Med	Max	*No.*	Min	Med	Max
0800	*56*	1.04	2.34	4.50	*28*	<0.02	<0.02	**0.513**	*30*	<5	20	**150**
0950	*56*	1.18	2.73	4.94	*28*	<0.02	0.022	0.046	*30*	<5	25	100
1100	*56*	1.21	3.18	5.46	*28*	<0.02	0.023	0.056	*30*	<5	20	100
1200	*56*	1.28	3.00	**5.66**	*28*	<0.02	0.022	0.052	*30*	<5	20	**125**
1300	*62*	1.30	2.96	**5.94**	*31*	<0.02	0.025	0.048	*33*	<5	20	**150**
1400	*56*	1.56	3.18	**6.15**	*28*	<0.02	**0.036**	0.110	*30*	<5	20	**125**
1500	*56*	2.23	4.29	**7.42**	*28*	<0.02	**0.036**	0.090	*30*	<5	30	100
1600	*56*	2.04	4.23	**7.53**	*28*	<0.02	**0.036**	0.083	*30*	15	30	**125**
1700	*56*	2.23	4.26	**7.37**	*28*	<0.02	**0.030**	0.085	*30*	10	30	**125**
1800	*56*	2.36	4.27	**7.25**	*28*	<0.02	0.029	0.089	*30*	15	30	**125**
1900	*56*	1.90	4.14	**7.11**	*28*	<0.02	**0.032**	0.092	*30*	<5	30	**125**
2000	*56*	2.00	4.05	**7.35**	*28*	<0.02	**0.038**	0.094	*30*	<5	30	**125**
2100	*58*	2.26	4.05	**7.72**	*29*	<0.02	0.026	0.089	*31*	<5	30	100
2200	*60*	2.09	4.54	**7.51**	*30*	<0.02	0.025	0.092	*30*	10	30	**150**
2250	*16*	2.20	3.90	5.45	*8*	<0.02	0.024	0.089	*9*	10	30	70
2300	*56*	2.11	4.74	**7.86**	*28*	<0.02	**0.031**	**0.152**	*30*	<5	25	85
2400	*56*	2.18	4.71	**7.77**	*28*	<0.02	**0.033**	**0.169**	*30*	<5	25	85
2500	*56*	2.40	4.71	**7.47**	*28*	<0.02	**0.036**	**0.573**	*30*	<5	20	85
2600	*56*	0.79	4.27	**7.60**	*28*	<0.02	0.030	0.131	*27*	10	20	**125**
2700	*56*	0.16	3.12	**6.23**	*28*	<0.02	**0.034**	0.095	*26*	10	20	70
2800	*56*	0.10	1.19	5.11	*27*	<0.02	0.026	0.067	*26*	<5	15	60

Results of Chemical Analyses 1995 to 1997:
Hardness Range : 6-173 mg l^{-1} $CaCO_3$
Alkalinity Range : 10-319 mg l^{-1} $CaCO_3$
Data Set: 2 12S02 Wicklow Co Co

Station No.	pH				Conductivity µS cm^{-1}				Temperature oC			
	No.	Min	Med	Max	*No.*	Min	Med	Max	*No.*	Min	Med	Max
0100	*13*	**6.0**	6.8	7.8	*13*	21	39	45	*13*	3.8	10.7	17.0
0200	*13*	**6.1**	6.9	7.5	*13*	44	76	113	*13*	4.2	11.0	16.4
0300	*13*	6.7	7.1	7.7	*13*	45	81	110	*13*	4.1	11.0	17.2
0350	-	-	-	-	-	-	-	-	-	-	-	-
0400	*13*	**6.3**	7.4	7.9	*13*	50	101	131	*13*	4.2	11.0	17.1
0500	*13*	**6.3**	7.4	8.0	*13*	72	143	190	*13*	5.1	11.2	16.4
0600	*13*	**6.4**	7.3	8.0	*13*	72	147	198	*13*	5.2	11.2	16.2
0770	*13*	**6.5**	7.2	8.0	*13*	89	163	214	*13*	5.4	11.2	16.7
0800	*13*	**6.5**	7.5	8.1	*13*	111	175	230	*13*	5.4	11.4	17.0

Station No.	Dissolved Oxygen % Saturation				Dissolved Oxygen mg $O_2 1^{-1}$				B.O.D mg $O_2 1^{-1}$			
	No.	Min	Med	Max	*No.*	Min	Med	Max	*No.*	Min	Med	Max
0100	*13*	78	102	127	*13*	9	11	14	*13*	0.3	1.0	2.6
0200	*13*	88	100	110	*13*	9	11	13	*13*	0.1	1.2	2.6
0300	*13*	73	101	122	*13*	8	11	15	*13*	0.3	1.0	2.8

Station No.	Dissolved Oxygen % Saturation				Dissolved Oxygen mg $O_2 1^{-1}$				B.O.D mg $O_2 1^{-1}$			
	No.	Min	Med	Max	*No.*	Min	Med	Max	*No.*	Min	Med	Max
0350	-	-	-	-	-	-	-	-	-	-	-	-
0400	*13*	86	103	118	*13*	8	11	15	*13*	0.3	1.1	2.6
0500	*13*	88	101	124	*13*	9	11	15	*13*	0.2	1.4	2.9
0600	*13*	76	101	**132**	*13*	9	11	16	*13*	0.2	1.3	3.7
0770	*13*	73	102	**131**	*13*	8	11	16	*13*	0.1	1.2	2.8
0800	*13*	72	102	130	*13*	8	11	16	*13*	0.4	1.2	2.8

Station No.	Chloride mg Cl 1^{-1}				Total Ammonia mg N 1^{-1}				Un-Ionised Ammonia mg NH_3 1^{-1}			
	No.	Min	Med	Max	*No.*	Min	Med	Max	*No.*	Min	Med	Max
0100	*11*	5	7	11	*12*	0.008	0.017	0.083	*12*	<0.0001	<0.0001	0.0009
0200	*12*	5	9	20	*12*	0.017	0.033	0.066	*12*	<0.0001	0.0001	0.0003
0300	*13*	5	8	12	*11*	0.008	0.025	0.041	*11*	<0.0001	0.0001	0.0003
0350	-	-	-	-	-	-	-	-	-	-	-	-
0400	*12*	7	9	15	*9*	0.017	0.025	0.074	*9*	<0.0001	0.0001	0.0004
0500	*13*	5	11	19	*12*	0.008	0.017	0.058	*12*	<0.0001	0.0001	0.0008
0600	*12*	5	11	14	*11*	0.008	0.025	0.099	*11*	<0.0001	0.0003	0.0009
0770	*13*	6	12	15	*12*	0.017	0.033	0.058	*12*	<0.0001	0.0001	0.0012
0800	*13*	7	12	15	*11*	0.008	0.033	0.099	*11*	<0.0001	0.0002	0.0029

Station No.	Oxidised Nitrogen mg N 1^{-1}				Ortho-Phosphate mg P 1^{-1}				Colour Hazen			
	No.	Min	Med	Max	*No.*	Min	Med	Max	*No.*	Min	Med	Max
0100	*13*	0.02	0.09	0.30	-	-	-	-	*13*	26	36	**150**
0200	*13*	0.09	0.14	0.27	-	-	-	-	*13*	18	35	**175**
0300	*13*	0.02	0.16	0.34	-	-	-	-	*13*	20	43	**175**
0350	-	-	-	-	-	-	-	-	-	-	-	-
0400	*13*	0.07	0.18	0.34	-	-	-	-	*13*	20	35	**175**
0500	*13*	0.03	0.30	0.59	-	-	-	-	*13*	15	32	**150**
0600	*13*	0.09	0.34	0.61	-	-	-	-	*13*	15	32	**150**
0770	*13*	0.16	0.34	0.70	-	-	-	-	*13*	15	28	75
0800	*13*	0.20	0.41	0.72	-	-	-	-	*13*	13	23	58

APPENDIX 5

SUBMISSIONS

The following bodies were invited by letters to submit comments and information for this report:

Central Fisheries Board (26 June 2000)
Eastern Regional Fisheries Board (20 June 2000)
Fisheries Research Centre (20 June 2000)
Dúchas - Parks & Wildlife (26 June 2000)

Of the bodies contacted the Eastern Regional Fisheries Board responded by letter of 3 July 2000 and data faxed on 14/8/00. Mr Iain Long of Dúchas provided information on protected areas by phone on 17/8/00.

Eastern Regional Fisheries Board
An Bord Iascaigh Réigiunach an Oirthir
Balnagowan, Mobhi Boreen, Glasnevin, Dublin 9.
'Phone: 8379209. Fax: 8360060.

Mr. Bill Quirke
Conservation Services
Tullaha
Glenflesk
Killarney
Co. Kerry

3 July, 2000

**Re: Rampere (County Wicklow)Landfill
Extension EIS**

Dear Mr. Quirke,

As you are aware the Slaney is a designated salmonid water under the E.C. (Quality of Salmonid Waters) Regulations, 1988. It supports a healthy salmon population and the Baltinglass area is particularly important for spawning.

The Rampere stream would be mainly a trout stream. We do not have actual figures on paper however for this stream.

Our main concern will of course be the impact on quality during construction, operation and following rehabilitation. The Board would require that no polluting matter enters the watercourse now or at any point in the future.

We are aware that all of this will be addressed in your study and look forward to receiving it when it is complete.

Yours sincerely,

pp Pat Doherty
Alan McGurdy
CHIEF EXECUTIVE OFFICER.

APPENDIX 6

DÚCHAS PROTECTED AREA SITE SYNOPSES

(Information copied directly from disk provided by Dúchas)

SITE NAME: WEXFORD SLOBS AND HARBOUR

SITE CODE: 000712

Below Wexford the Slaney river opens out into an extensive shallow estuary which dries out considerably at low tide. The seaward side is protected by the Raven and Rosslare Points and behind these the North and South Slobs, consisting of two empoldered areas of farmland behind nineteenths century sea-walls. The reclaimed land is predominantly pasture and arable; flat, large, treeless fields give the area an open quality which many of the waterfowl species are dependant on. Extensive marshes occur around the inner northern part of the harbour, to the west of Castlebridge.

The original NNR on the North Slob of 110 ha., now a Ramsar site and an SPA, has been extended by a further 84 ha. The Raven (589 ha.) has been separately designated as a NNR and Ramsar site. Recently the whole site has been proposed as one SPA and Ramsar site.

The primary interest of the Slobs and Habour is its wintering birdlife. Counts for the late eighties (Grimmet and Jones 1989) show internationally important numbers of Cygnus columbianus (3-yr. av. max. 168; max. 700), Anser albifrons flavirostris (5-yr. av. max. 7581; max. 11,000; most important wintering site inthe world), Branta bernicla hrota (4-yr. av. max. 1245; max. 2000) and nationally important numbers of Anas penelope (3-yr. av. max. 4842), A. platyrhynchos (2500), Pluvialis apricaria (8400), Vanellus vanellus (22,000) and Limosa limosa islandica (3-yr. av. max. 816; max. 2400). More recent counts of the site are available but, except for the goose species, coverage of the three major subsites has not been synchronised (Sheppard 1993) and count totals for the entire site have not therefore been produced. In general the status of individual species has probably not changed significantly in the interim, with the exceptions of L. limosa and A. penelope which may now qualify as internationally important and ducks which as a group have decreased since the 1970s (Sheppard 1993). The protected flora species, Borrer's Salt-marsh Grass, Puccenellia fasceculata, which is confined to S.E. Ireland, is found along the channels of the North Slob NNR.

The Raven NNR is important for its large number of dune slacks and as a site for four species of rare vascular plants (Pyrola rotundifolia ssp. maritima, Centaurium pulchellum, Epipactis phyllanthes, Monotropa hypopitys).

A rich invertebrate fauna occurs on the beach and in the dunes, including species sensitive to disturbance that have disappeared elsewhere.

15th February 1995.

SITE NAME: SLANEY RIVER VALLEY

SITE CODE: 000781

This site comprises the mid and lower reaches of the Slaney River from below Tullow at Aghade Bridge, passing through Bunclody and Enniscorthy to the estuary at Ferrycarrig. The river is up to 100 m wide in places and is tidal at the southern end from Edermine Bridge below Enniscorthy. In the upper regions the geology consists of granite, above Kilcarry Bridge, the Slaney has cut a gorge into the granite plain. South of Kildavin the river flows through an area of Ordovician slates and grits.

The site supports populations of several species listed on Annex II of the EU Habitats Directive, three habitats listed on Annex I of the same Directive, as well as important numbers of wintering wildfowl including some species listed on Annex I of the EU Birds Directive. Annex II animal species found in the river include the three Lampreys - Sea Lamprey (*Petromyzon marinus*), River Lamprey (*Lampetra fluviatilis*) and Brook Lamprey (*Lampetra planeri*), the Otter (*Lutra lutra*), Salmon (*Salmo salar*), small numbers of Freshwater Pearl Mussel (*Margaritifera margaritifera*) and in the tidal stretches, Twaite Shad (*Alosa fallax fallax*).

The EU Habitats Directive Annex I habitats, estuaries, mudflats and floating river vegetation are found within the site. The site is considered to contain a very good example of the extreme upper reaches of an estuary. Tidal reedbeds with wet woodland are present in places The fringing reed communities support Sea Club-rush (*Scirpus maritimus*), Grey Club-rush (*S. tabernaemontani*) and abundant Common Reed (*Phragmites australis*). Other species occurring are Bulrush (*Typha latifolia*), Reed Canary-grass (*Phalaris arundinacea*) and Branched Bur-reed (*Sparganium erectum*). The reed-swamp is extensive around Macmine, where the river widens and there are islands with swamp and marsh vegetation.

Further south of Macmine are expanses of intertidal mudflats and sandflats and shingly shore often fringed with a narrow band of salt marsh and brackish vegetation. Narrow shingle beaches up to 10 m wide occur in places along the river banks and are exposed at low tide. Upslope the shingle is sometimes colonised by Saltmarsh Rush (*Juncus gerardi*), Townsend's Cord-grass (*Spartina townsendii*), Common Saltmarsh-grass (*Puccinellia maritima*), Sea Aster (*Aster tripolium*), Hemlock Water-dropwort (*Oenanthe crocata*) and Himalayan Balsam (*Impatiens glandulifera*).

Floating river vegetation is found along much of the freshwater stretches within the site. Species present here include Pond Water-crowfoot (*Ranunculus peltatus*), Water-crowfoot (*Ranunculus* spp.), Canadian Pondweed (*Elodea canadensis*), Broad-leaved Pondweed (*Potamogeton natans*), Water Milfoil (*Myriophyllum* spp.), Common Club-rush (*Scirpus lacustris*), Water-starwort (*Callitriche* spp.), Hemlock Water-dropwort, Fine-leaved Water-dropwort (*Oenanthe aquatica*), Common Duckweed (*Lemna minor*), Yellow Water-lily (*Nuphar lutea*), Unbranched Bur-reed (*Sparganium emersum*) and the moss *Fontinalis antipyretica*. Two rare aquatic plant species have been recorded in this site: Short-leaved Water-starwort (*Callitriche truncata*), a very rare, small aquatic herb found nowhere else in Ireland; and Opposite-leaved Pondweed (*Groenlandia densa*), a species that is legally protected under the Flora Protection Order, 1999.

Other habitats present within the site include species-rich marsh in which sedges such as *Carex disticha, Carex riparia* and *Carex vesicaria* are common. Among the other species found in this habitat are Yellow Iris (*Iris pseudacorus*), Water Mint (*Mentha aquatica*), Purple Loosestrife (*Lythrum salicaria*) and Soft Rush (*Juncus effusus*).

Grey Willow (*Salix cinerea*) scrub and pockets of wet woodland dominated by Alder (*Alnus glutinosa*) have become established in places. Ash (*Fraxinus excelsior*) and Birch (*Betula pubescens*) are common in the latter and the ground flora is typical of wet woodland with Meadowsweet (*Filipendula ulmaria*), Angelica (*Angelica sylvestris*), Yellow Iris, Horsetail (*Equisetum* spp.) and occasional tussocks of Greater Tussock-sedge (*Carex paniculata*).

North of Bunclody, the river valley still has a number of dry woodlands though these have mostly been managed by the estates with the introduction of Beech (*Fagus sylvatica*) and occasional conifers, and sometimes of Rhododendron and Laurel. The steeper sides are covered in a thick scrub from which taller trees protrude such as Oak (*Quercus* spp.) and conifers. The scrub layer consists mainly of Holly (*Ilex aquifolium*) and Hazel (*Corylus avellana*). Other woodland species include Lords-and-Ladies (*Arum maculatum*), Marsh Hawk's-beard (*Crepis paludosa*), Hemp Agrimony (*Eupatorium cannabinum*), Hedge Woundwort (*Stachys sylvatica*), Nettle (*Urtica dioica*), Bluebell (*Hyacinthoides non-scriptus*), Rough Meadow-grass (*Poa trivialis*) and Creeping Soft-grass (*Holcus mollis*). At the southern end of the site, the Red Data Book species Yellow Archangel (*Lamiastrum galeobdolon*) occurs. Three more Red Data Book species have also been recorded from the site: Basil Thyme (*Acinos arvensis*), Blue Fleabane (*Erigeron acer*) and Small Cudweed (*Filago minima*). A nationally rare species Summer Snowflake (*Leucojum aestivum*) is also found within the site.

Mixed woodlands occur at Carrickduff and Coolaphuca in Bunclody. Oak trees, which make up the greater part of the canopy, were originally planted and at the present time are not regenerating actively. In time, if permitted, the woodland will probably go to Beech. A fair number of Yew (*Taxus baccata*) trees have also reached a large size and these, together with Holly give to the site the aspect of a south-western Oak wood. The lowest ground in the wood is occupied by Birch and Hazel scrub. These sites provide the largest area of deciduous tree canopy in Co. Carlow.

Below Enniscorthy there are several areas of woodland with a mixed canopy of Oak, Beech, Sycamore (*Acer pseudoplatanus*), Ash and generally a good diverse ground flora. Near the mouth of the river at Ferrycarrig is a steep south facing slope covered with Oak woodland. Holly and Hazel are the main species in the shrub layer and a species-rich ground flora typical of this type of Oak woodland has abundant ferns - *Dryopteris filix-mas, Polystichum setiferum, Phyllitis scolopendrium* - and mosses - *Thuidium tamariscinum, Mnium hornum, Eurynchium praelongum.* Other species present include Wood Sanicle (*Sanicula europaea*), Wood Sedge (*Carex sylvatica*) and Great Wood-rush (*Luzula sylvatica*).

The site supports important numbers of birds in winter. Little Egret are found annually along the river. This bird is only now beginning to gain a foothold in Ireland and the south-east appears to be its stronghold. Nationally important numbers of Black-tailed

Godwit, Teal, Tufted Duck, Mute Swan, Little Grebe and Black-headed Gull are found along the estuarine stretch of the river. The mean of the maximum counts over four winters (1994/98) along the stretch between Enniscorthy and Ferrycarrig is: Little Egret (6), Golden Plover (6), Wigeon (139), Teal (429), Mallard (265), Tufted Duck (171), Lapwing (603), Shelduck (16), Black-tailed Godwit (93), Curlew (81), Red-breasted Merganser (11), Black-headed Gull (3030), Goldeneye (45), Oystercatcher (19), Redshank (65), Lesser Black-backed Gull (727), Herring Gull (179), Common Gull (67), Grey Heron (39), Mute Swan (259) and Little Grebe (17).

The Reed Warbler, which is a scarce breeding species in Ireland, is regularly found in Macmine Marshes but it is not known whether or not it breeds in the site. The Dipper also occurs on the river. This is a declining species nationally.

The site supports many of the mammal species occurring in Ireland. Those which are listed in the Irish Red Data Book include Pine Marten, Badger, Irish Hare and Daubenton's Bat. Common Frog (*Rana temporaria*), another Red Data Book species, also occurs within the site.

Agriculture is the main landuse along the Slaney. Arable crops are important, improved grassland and silage account for much of the remainder. Fishing is carried out particularly along the freshwater stretches. This is carried out from both boats and the banks. Fishing stands have been erected in places. There are some gravel pits along the river below Bunclody and many of these are active. There is a large landfill site adjacent to the river at Killurin.

The spreading of slurry and fertiliser poses a threat to the water quality of this salmonid river and to the populations of Annex II animal species within it. Runoff from intensive agricultural enterprises, a meat factory at Clohamon and a landfill site adjacent to the river and further industrial development upstream in Enniscorthy could all have potential adverse impacts on the water quality unless they are carefully managed. The spread of exotic species is reducing the quality of the woodlands.

The site supports populations of several species listed on Annex II of the EU Habitats Directive, three habitats listed on Annex I of the same Directive (estuaries, mudflats and floating river vegetation), as well as important numbers of wintering wildfowl including some species listed on Annex I of the EU Birds Directive. The presence of wet and broad-leaved woodlands increases the overall habitat diversity and the occurrence of a number of Red Data Book plant and animal species adds further importance to the Slaney River site.

3.6.1999

SITE NAME: SLANEY VALLEY ABOVE KILCARRY

SITE CODE: 000815

The site is a U-shaped valley on the Slaney River. It extends from Aghade Bridge in the north to Kilcarry Bridge in the south, near to Clonegall.

Some of the flatter parts of the area are used as grazing land, but the steeper sides are covered in a thick scrub from which taller trees protrude. The trees include Oak (Quercus spp.) and conifers. The scrub layer consists mainly of Holly (Ilex aquifolium) and Hazel (Corylus avellana).

At the southern end of the site the threatened Yellow Archangel (Lamiastrum galeobdolon) occurs, a species which is listed in the Irish Red Data Book. This species is found in hedges and woods in the south-east of Ireland.

Other woodland species include Lords-and-ladies (Arum maculatum), Marsh Hawks-beard (Crepis paludosa), Hemp-agrimony (Eupatorium cannabinum), Bluebell (Hyacinthoides non-scripta), Hedge Woundwort (Stachys sylvatica), Nettle (Urtica dioica), Rough Meadow-grass (Poa trivialis) and Creeping Soft-grass (Holcus mollis).

An area of the site in the south has been planted with conifers and this form of landuse is a threat to the interest of the site.

APPENDIX 7

CHEMICAL WATER QUALITY MONITORING DATA FOR RAMPERE STREAM 1998 - 2000

(Data copied directly from e-mailed files provided by M.C. O'Sullivan Ltd)

MONITORING POINT / GRID REFERENCE : SW1, RAMPERE LANDFILL, CO. WICKLOW

Parameter	Results (mg/l)						Sampling method	Normal Analytical	Analysis method
DATE : LAB ID :	11/09/98 10568	18/09/98 10671	12/10/98 10973	16/03/99 13147	28.9.99 15608	01/12/99 16593			
pH	7.7	7.6	7.4	7.7	7.6	7.1	Grab	1-14	Hydrogen Ion Selective
Temperature (°C)	-	-	-	10.6	11.9	9.1	Grab	0-100? C	Temperature Probe
Electrical conductivity EC	624	610	617	560	491	508	Grab	1-100,000	Electrometry
Ammoniacal nitrogen NH_4-N	<0.5	<0.5	<1	<0.1	<0.1	<0.1	Grab	0.1-12.9	Digestion/distillation/titration
Chemical oxygen demand	8.3	<4	<4	11	14	<4	Grab	0-150, 0-1500	Digestion/colorimetry
Biochemical oxygen demand	<2	<2	1.4	<2	<2	2	Grab	1-7	DO probe
Calcium Ca	100.6	106	108.8	76	90	111	Grab	0.1-4.00	Ion Chromatography (IC)
Cadmium Cd	<0.01	<0.01	<0.01	<0.03	<0.03	<0.03	Grab	0.03-2.00	Direct aspiration/flame AAS
Chromium Cr	<0.05	<0.05	<0.05	<0.08	<0.08	<0.08	Grab	0.08-5.00	Direct aspiration/flame AAS
Chloride Cl	21.5	17.4	19.4	17	15.5	17	Grab	0.5-50	Ion chromatography
Copper Cu	<0.01	<0.01	<0.01	<0.08	<0.08	<0.08	Grab	0.08-5.00	Direct aspiration/flame AAS
Iron Fe	<0.05	<0.05	<0.05	<0.10	<0.10	<0.10	Grab	0.10-5.00	Direct aspiration/flame AAS
Lead Pb	<0.10	<0.25	<0.25	<0.25	<0.25	<0.25	Grab	0.25-9.00	Direct aspiration/flame AAS
Magnesium Mg	7.2	6.4	6.8	6.1	6.7	7	Grab	0.10-50	Ion Chromatography
Manganese Mn	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05	Grab	0.05-2.00	Direct aspiration/flame AAS
Mercury Hg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	Grab	0.001-0.4	Direct aspiration/cold vapour
Nickel Ni	0.06	<0.02	<0.02	<0.14	<0.14	<0.14	Grab	0.14-2.00	Direct aspiration/flame AAS
Potassium K	2.2	2.0	2.9	1.0	2.5	16	Grab	0.10-4.00	Ion Chromatography
Sodium	66	21.7	30.1	6.8	16	13	Grab	0.10-1.00	Ion Chromatography
Sulphate SO_4	12.5	12.5	14.5	10.9	16.2	15	Grab	0.5-100	Ion chromatography
Zinc Zn	<0.01	<0.01	<0.01	<0.02	0.02	<0.02	Grab	0.02-1.00	Direct aspiration/flame AAS
Total alkalinity (as HCO_3)	330	315	270	280	355	250	Grab	N/A	Titration
Total organic carbon TOC	2.9	2.7	1.7	2.2	5.5	2.4	Grab	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen	6.8	7.52	6.82	7.6	5.5	<7	Grab		Sum of nitrate & nitrite by IC
Nitrite NO_2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	Grab	0.5-10	Ion chromatography
Nitrate NO_3	30.1	33.3	30.2	34	24.3	30	Grab	0.5-50	Ion chromatography
Dissolved Oxygen	-	-	-	-	8.6	10	Grab	N/A	-
Phosphate PO_4	<0.5	<0.1	<0.5	<0.5	<1	<1	Grab	1.0-10	Ion Chromatography
Faecal Coliforms /100ml	-	-	>100	>100	4 (cfu/ml)	>100	Grab		MPN
Total Coliforms /100ml	-	-	>100	>100	1,100	>100	Grab		MPN

MONITORING POINT / GRID REFERENCE : SW2, RAMPERE LANDFILL, CO. WICKLOW

Parameter	Results (mg/l)						Sampling method	Normal Analytical Range	Analysis method / technique
DATE : LAB ID :	11/09/98 10569	18/09/98 10672	12/10/98 10974	16/03/99 13148	28.9.99 15609	01/12/99 16594			
PH	7.4	7.7	7.5	7.8	7.6	7.0	Grab	1-14	Hydrogen Ion Selective
Temperature (°C)	12.8	-	-	10.7	11.5	9.0	Grab	0-100? C	Temperature Probe
Electrical conductivity EC	323	307	307	531	491	525	Grab	1-100,000	Electrometry
Ammoniacal nitrogen NH_4-N	<0.5	<0.5	<1	<0.1	<0.1	<0.1	Grab	0.1-12.9	Digestion/distillation/titr
Chemical oxygen demand	13.8	<4	19.4	17	44	<4	Grab	0-150, 0-1500	Digestion/colorimetry
Biochemical oxygen demand	<1	<2	<5	<2	<2	<2	Grab	1-7	DO probe
Calcium Ca	55	231	50	77	87	100	Grab	0.1-4.00	Ion Chromatography
Cadmium Cd	<0.01	<0.01	<0.01	<0.03	<0.03	<0.03	Grab	0.03-2.00	Direct aspiration/flame
Chromium Cr	<0.05	<0.05	<0.05	<0.08	<0.08	<0.08	Grab	0.08-5.00	Direct aspiration/flame
Chloride Cl	17.3	14.6	17.0	17.2	15.6	17	Grab	0.5-50	Ion chromatography
Copper Cu	<0.01	<0.01	<0.01	<0.08	<0.08	<0.08	Grab	0.08-5.00	Direct aspiration/flame
Iron Fe	0.56	<0.05	<0.05	<0.10	0.36	<0.10	Grab	0.10-5.00	Direct aspiration/flame
Lead Pb	<0.10	<0.25	<0.25	<0.25	<0.25	<0.25	Grab	0.25-9.00	Direct aspiration/flame
Magnesium Mg	5.4	<0.5	3.5	6.2	7.5	6.8	Grab	0.10-50	Ion Chromatography
Manganese Mn	0.05	<0.01	<0.01	<0.05	0.15	<0.05	Grab	0.05-2.00	Direct aspiration/flame
Mercury Hg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	Grab	0.001-0.4	Direct aspiration/cold
Nickel Ni	<0.02	<0.02	<0.02	<0.14	<0.14	<0.14	Grab	0.14-2.00	Direct aspiration/flame
Potassium K	5.2	9.7	3.7	1.0	3.9	1.6	Grab	0.10-4.00	Ion Chromatography
Sodium	14.2	114	33.3	6.2	14	13	Grab	0.10-1.00	Ion Chromatography
Sulphate SO_4	6.4	5.5	7.6	10.9	16.2	14	Grab	0.5-100	Ion chromatography
Zinc Zn	<0.01	<0.01	<0.01	<0.02	0.04	0.08	Grab	0.02-1.00	Direct aspiration/flame
Total alkalinity (as HCO_3)	145	140	135	275	235	250	Grab	N/A	Titration
Total organic carbon TOC	2.2	1.9	1.	1.0	6.3	2.1	Grab	0.2-20	Oxidation/IR
Total oxidised nitrogen	6.3	6.27	5.92	7.5	5.5	<7	Grab		Sum of nitrate & nitrite
Nitrite NO_2	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	Grab	0.5-10	Ion chromatography
Nitrate NO_3	28.1	27.8	26.2	33	24.4	30	Grab	0.5-50	Ion chromatography
Dissolved Oxygen	-	-	-	-	8.9	9	Grab	N/A	-
Phosphate PO_4	<0.5	<0.1	<0.5	<0.5	<1	<1	Grab	1.0-10	Ion Chromatography
Faecal Coliforms /100ml	-	-	>100	>100	4cfu/ml	>100	Grab		MPN
Total Coliforms /100ml	-	-	>100	>100	1,100	>100	Grab		MPN

MONITORING POINT / GRID REFERENCE : SW3, RAMPERE LANDFILL, CO. WICKLOW

Parameter	Results (mg/l)						Sampling method	Normal Analytical Range	*Analysis method / technique*
DATE : LAB ID :	**11/09/98 10570**	**18/09/98 10673**	**12/10/98 10975**	**16/3/99 13149**	**28.9.99 15610**	**01/12/99 16595**			
pH	7.7	7.8	7.4	7.7	7.5	7.0	Grab	1-14	Hydrogen Ion Selective
Temperature (°C)	12.5	-	-	10.8	12.6	9.0	Grab	0-100? C	Temperature Probe
Electrical conductivity EC	626	604	628	543	480	507	Grab	1-100,000	Electrometry
Ammoniacal nitrogen NH_4-N	<0.5	<0.5	<1	<0.1	<0.1	<0.1	Grab	0.1-12.9	Digestion/distillation/titr
Chemical oxygen demand	11.1	<4	119	14	14	<4	Grab	0-150, 0-1500	Digestion/colorimetry
Biochemical oxygen demand	1.2	<2	<10	<2	<2	<2	Grab	1-7	DO probe
Calcium Ca	114	106	105	72	84	109	Grab	0.1-4.00	Ion Chromatography
Cadmium Cd	<0.01	<0.01	<0.01	<0.03	<0.03	<0.03	Grab	0.03-2.00	Direct aspiration/flame
Chromium Cr	<0.05	<0.05	<0.05	<0.08	<0.08	<0.08	Grab	0.08-5.00	Direct aspiration/flame
Chloride Cl	21.2	17.5	18.9	17.7	16.3	17	Grab	0.5-50	Ion chromatography
Copper Cu	<0.01	<0.01	<0.01	<0.08	<0.08	<0.08	Grab	0.08-5.00	Direct aspiration/flame
Iron Fe	<0.05	<0.05	<0.05	<0.10	0.13	<0.10	Grab	0.10-5.00	Direct aspiration/flame
Lead Pb	<0.10	<0.25	<0.25	<0.25	<0.25	<0.25	Grab	0.25-9.00	Direct aspiration/flame
Magnesium Mg	8.2	6.6	6.6	6.2	7.0	6.9	Grab	0.10-50	Ion Chromatography
Manganese Mn	<0.01	<0.01	<0.01	<0.05	<0.05	<0.05	Grab	0.05-2.00	Direct aspiration/flame
Mercury Hg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	Grab	0.001-0.4	Direct aspiration/cold
Nickel Ni	<0.02	<0.02	<0.02	<0.14	<0.14	<0.14	Grab	0.14-2.00	Direct aspiration/flame
Potassium K	5.2	2.3	3.5	1.3	3.1	2	Grab	0.10-4.00	Ion Chromatography
Sodium	14	21.4	29.3	6.2	17	12	Grab	0.10-1.00	Ion Chromatography
Sulphate SO_4	13.2	13.7	14.1	11.7	16.7	15	Grab	0.5-100	Ion chromatography
Zinc Zn	<0.01	<0.01	<0.01	<0.02	0.02	<0.02	Grab	0.02-1.00	Direct aspiration/flame
Total alkalinity (as HCO_3)	290	315	310	255	330	250	Grab	N/A	Titration
Total organic carbon TOC	3.0	2.0	1.6	1.2	4.8	2.1	Grab	0.2-20	Oxidation/IR
Total oxidised nitrogen	7.2	7.65	6.62	7.4	5.7	<7	Grab		Sum of nitrate & nitrite
Nitrite NO_2	0.6	0.59	<0.5	<0.5	<0.5	<0.5	Grab	0.5-10	Ion chromatography
Nitrate NO_3	31	33.1	29.3	32.8	25.1	30	Grab	0.5-50	Ion chromatography
Dissolved Oxygen	-	-	-	-	8.9	9	Grab	N/A	-
Phosphate PO_4	<0.5	0.1	<0.5	<0.5	<1	<1	Grab	1.0-10	Ion Chromatography
Faecal Coliforms /100ml	-	-	>100	26	11 cfu/ml	>100	Grab		MPN
Total Coliforms /100ml	-	-	>100	50	1,100	>100	Grab		MPN

MONITORING POINT / GRID REFERENCE : SW4, RAMPERE LANDFILL, CO. WICKLOW

Parameter	Results (mg/l)						Sampling method	Normal Analytical Range	Analysis method / technique
DATE : LAB ID :	11/09/98 10571	18/09/98 10674	12/10/98 10976	16/3/99 13150	28.9.99 15611	1/12/99 16596			
PH	7.6	7.4	7.4	7.5	7.5	7.0	Grab	1-14	Hydrogen Ion Selective
Temperature (°C)	12.3	-	-	10.7	12.1	9.1	Grab	0-100? C	Temperature Probe
Electrical conductivity EC	624	611	631	572	482	507	Grab	1-100,000	Electrometry
Ammoniacal nitrogen NH_4-N	<0.5	<0.5	<1	<0.1	<0.1	<0.1	Grab	0.1-12.9	Digestion/distillation/titr
Chemical oxygen demand	13.8	2.7	<4	22	13	<4	Grab	0-150, 0-1500	Digestion/colorimetry
Biochemical oxygen demand	<1	<2	<5	<2	2	<2	Grab	1-7	DO probe
Calcium Ca	113	105	108	75	81	101	Grab	0.1-4.00	Ion Chromatography
Cadmium Cd	<0.01	<0.01	<0.01	<0.03	<0.03	<0.03	Grab	0.03-2.00	Direct aspiration/flame
Chromium Cr	<0.05	<0.05	<0.05	<0.08	<0.08	<0.08	Grab	0.08-5.00	Direct aspiration/flame
Chloride Cl	21.2	17.7	19.0	17.6	16	18	Grab	0.5-50	Ion chromatography
Copper Cu	<0.01	<0.01	<0.01	<0.08	<0.08	<0.08	Grab	0.08-5.00	Direct aspiration/flame
Iron Fe	<0.05	<0.05	<0.05	<0.10	1.11	<0.10	Grab	0.10-5.00	Direct aspiration/flame
Lead Pb	<0.10	<0.25	<0.25	<0.25	<0.25	<0.25	Grab	0.25-9.00	Direct aspiration/flame
Magnesium Mg	8.2	<0.5	6.6	4.3	6.8	6.9	Grab	0.10-50	Ion Chromatography
Manganese Mn	0.01	<0.01	<0.01	<0.05	<0.05	<0.05	Grab	0.05-2.00	Direct aspiration/flame
Mercury Hg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	Grab	0.001-0.4	Direct aspiration/cold
Nickel Ni	<0.02	<0.02	<0.02	<0.14	<0.14	<0.14	Grab	0.14-2.00	Direct aspiration/flame
Potassium K	5.3	2.8	4	1.5	3.1	2	Grab	0.10-4.00	Ion Chromatography
Sodium	10.3	<0.5	30.5	6.3	10	16	Grab	0.10-1.00	Ion Chromatography
Sulphate SO_4	13.8	13.1	14.5	12.2	17.5	15	Grab	0.5-100	Ion chromatography
Zinc Zn	<0.01	<0.01	<0.01	<0.02	0.03	<0.02	Grab	0.02-1.00	Direct aspiration/flame
Total alkalinity (as HCO_3)	315	315	315	275	435	255	Grab	N/A	Titration
Total organic carbon TOC	0.4	1.9	1.9	1.0	6.2	1.8	Grab	0.2-20	Oxidation/IR
Total oxidised nitrogen	7	7.63	6.89	7.8	5.4	<7	Grab		Sum of nitrate & nitrite
Nitrite NO_2	<0.5	0.59	<0.5	<0.5	<0.5	<0.5	Grab	0.5-10	Ion chromatography
Nitrate NO_3	30.8	33	30.5	35	24	29	Grab	0.5-50	Ion chromatography
Dissolved Oxygen	-	-	-	-	7.3	10	Grab	N/A	-
Phosphate PO_4	<0.5	<0.1	<0.5	<0.5	<1	<1	Grab	1.0-10	Ion Chromatography
Faecal Coliforms /100ml	-	-	>100	32	1,100	>100	Grab		MPN
Total Coliforms /100ml	-	-	>100	38	1,100	>100	Grab		MPN

MONITORING POINT / GRID REFERENCE : SW5 SPRING, RAMPERE LANDFILL, CO. WICKLOW

Parameter	Results (mg/l)						Sampling method	Normal Analytical Range	Analysis method / technique
DATE : LAB ID :	11/09/98 10571	18/09/98 10674	12/10/98 10976	16/3/99 13150	28.9.99 15612	1/12/99 16596			
PH	7.6	7.4	7.4	7.5	6.6	7.0	Grab	1-14	Hydrogen Ion Selective
Temperature (°C)	12.3	-	-	10.7	12.4	9.1	Grab	0-100? C	Temperature Probe
Electrical conductivity EC	624	611	631	572	340	507	Grab	1-100,000	Electrometry
Ammoniacal nitrogen NH_4-N	<0.5	<0.5	<1	<0.1	<0.1	<0.1	Grab	0.1-12.9	Digestion/distillation/titr
Chemical oxygen demand	13.8	2.7	<4	22	<4	<4	Grab	0-150, 0-1500	Digestion/colorimetry
Biochemical oxygen demand	<1	<2	<5	<2	<2	<2	Grab	1-7	DO probe
Calcium Ca	113	105	108	75	61	101	Grab	0.1-4.00	Ion Chromatography
Cadmium Cd	<0.01	<0.01	<0.01	<0.03	<0.03	<0.03	Grab	0.03-2.00	Direct aspiration/flame
Chromium Cr	<0.05	<0.05	<0.05	<0.08	<0.08	<0.08	Grab	0.08-5.00	Direct aspiration/flame
Chloride Cl	21.2	17.7	19.0	17.6	13.7	18	Grab	0.5-50	Ion chromatography
Copper Cu	<0.01	<0.01	<0.01	<0.08	<0.08	<0.08	Grab	0.08-5.00	Direct aspiration/flame
Iron Fe	<0.05	<0.05	<0.05	<0.10	<0.10	<0.10	Grab	0.10-5.00	Direct aspiration/flame
Lead Pb	<0.10	<0.25	<0.25	<0.25	<0.25	<0.25	Grab	0.25-9.00	Direct aspiration/flame
Magnesium Mg	8.2	<0.5	6.6	4.3	4.8	6.9	Grab	0.10-50	Ion Chromatography
Manganese Mn	0.01	<0.01	<0.01	<0.05	<0.05	<0.05	Grab	0.05-2.00	Direct aspiration/flame
Mercury Hg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	Grab	0.001-0.4	Direct aspiration/cold
Nickel Ni	<0.02	<0.02	<0.02	<0.14	<0.14	<0.14	Grab	0.14-2.00	Direct aspiration/flame
Potassium K	5.3	2.8	4	1.5	1.0	2	Grab	0.10-4.00	Ion Chromatography
Sodium	10.3	<0.5	30.5	6.3	19	16	Grab	0.10-1.00	Ion Chromatography
Sulphate SO_4	13.8	13.1	14.5	12.2	12.1	15	Grab	0.5-100	Ion chromatography
Zinc Zn	<0.01	<0.01	<0.01	<0.02	<0.02	<0.02	Grab	0.02-1.00	Direct aspiration/flame
Total alkalinity (as HCO_3)	315	315	315	275	205	255	Grab	N/A	Titration
Total organic carbon TOC	0.4	1.9	1.9	1.0	0.3	1.8	Grab	0.2-20	Oxidation/IR
Total oxidised nitrogen	7	7.63	6.89	7.8	7.8	<7	Grab		Sum of nitrate & nitrite
Nitrite NO_2	<0.5	0.59	<0.5	<0.5	<0.5	<0.5	Grab	0.5-10	Ion chromatography
Nitrate NO_3	30.8	33	30.5	35	34.4	29	Grab	0.5-50	Ion chromatography
Dissolved Oxygen	-	-	-	-	10	10	Grab	N/A	-
Phosphate PO_4	<0.5	<0.1	<0.5	<0.5	<1	<1	Grab	1.0-10	Ion Chromatography
*Total Cyanide						<0.05	Grab	0.05-1.0	Distillation /
* Phosphorous						<0.10	Grab	0.10-50.0	ICP/OES

MONITORING POINT / GRID REFERENCE : SW5 SPRING, RAMPERE LANDFILL, CO. WICKLOW

Parameter	Results (mg/l)						Sampling method	Normal Analytical Range	Analysis method / technique
DATE : LAB ID :	11/09/98 10571	18/09/98 10674	12/10/98 10976	16/3/99 13150	28.9.99 15612	1/12/99 16596			
* Arsenic						0.01	Grab	0.01-1.00	ICP/OES
* Boron						<0.01	Grab	0.01-1.00	ICP/OES
* Selenium						<0.01	Grab	0.01-0.25	ICP/OES
* Barium						<0.01	Grab	0.01-1.00	ICP/OES
* Silver						<0.01	Grab	0.01-5.00	ICP/OES
* Mono-phenols						<0.05	Grab	0.05-1.00	Distillation /
Fluoride						0.11	Grab	0.1-5.0	Ion chromatography
Residue on Evaporation @						415	Grab	N/A	Gravimetric
Faecal Coliforms /100ml	-	-	>100	32	<3 cfu/ml	NIL	Grab		MPN
Total Coliforms /100ml	-	-	>100	38	21 MPN	16	Grab		MPN

MONITORING POINT / GRID REFERENCE : SW1, RAMPERE LANDFILL, CO. WICKLOW

Parameter * = Subcontracted	Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method
DATE : LAB ID :	01/12/99 16593				
pH	7.1		Grab	1-14	Hydrogen Ion Selective
Temperature (°C)	9.1		Grab	0-100°C	Temperature Probe
Electrical conductivity EC	508		Grab	1-100,000	Electrometry
*Ammoniacal nitrogen NH_4-N	<0.1		Grab	0.1-12.9	Colourimetry/FIA
Chemical oxygen demand	<4		Grab	0-150, 0-1500	Digestion/colorimetry
Biochemical oxygen demand	2		Grab	1-7	DO probe
Calcium Ca	111		Grab	0.1-4.00	Direct aspiration/flame AAS
Cadmium Cd	<0.03		Grab	0.03-2.00	Direct aspiration/flame AAS
Chromium Cr	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Chloride Cl	17		Grab	0.5-50	Ion chromatography
Copper Cu	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Iron Fe	<0.10		Grab	0.10-5.00	Direct aspiration/flame AAS
Lead Pb	<0.25		Grab	0.25-9.00	Direct aspiration/flame AAS
*Magnesium Mg	7		Grab	0.10-50	ICP/OES
Manganese Mn	<0.05		Grab	0.05-2.00	Direct aspiration/flame AAS
*Mercury Hg	<0.001		Grab	0.001-0.4	Direct aspiration/cold vapour
Nickel Ni	<0.14		Grab	0.14-2.00	Direct aspiration/flame AAS
Potassium K	16		Grab	0.10-4.00	Direct aspiration/flame AAS
Sodium	13		Grab	0.10-1.00	Direct aspiration/flame AAS
Sulphate SO_4	15		Grab	0.5-100	Ion chromatography
Zinc Zn	<0.02		Grab	0.02-1.00	Direct aspiration/flame AAS
Total alkalinity (as HCO_3)	250		Grab	N/A	Titration
*Total organic carbon TOC	2.4		Grab	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen	<7		Grab		Sum of nitrate & nitrite by IC
Nitrite NO_2	<0.5		Grab	0.5-10	Ion chromatography
Nitrate NO_3	30		Grab	0.5-50	Ion chromatography
Dissolved Oxygen	10		Grab	N/A	Dissolved Oxygen Probe
Phosphate PO_4	<1		Grab	1.0-10	Ion Chromatography
*Faecal Coliforms /100ml	>100		Grab		Membrane Filtration
*Total Coliforms /100ml	>100		Grab		Membrane Filtration

MONITORING POINT / GRID REFERENCE : SW2, RAMPERE LANDFILL, CO. WICKLOW

Parameter * = Subcontracted	Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method / technique
DATE : LAB ID :	01/12/99 16594				
pH	7.0		Grab	1-14	Hydrogen Ion Selective Electrode
Temperature (°C)	9.0		Grab	0-100? C	Temperature Probe
Electrical conductivity EC	525		Grab	1-100,000	Electrometry
*Ammoniacal nitrogen NH_4-N	<0.1		Grab	0.1-12.9	Colourimetry/FIA
Chemical oxygen demand	<4		Grab	0-150, 0-1500	Digestion/colorimetry
Biochemical oxygen demand	<2		Grab	1-7	DO probe
Calcium Ca	100		Grab	0.1-4.00	Direct aspiration/flame AAS """""onromatography
Cadmium Cd	<0.03		Grab	0.03-2.00	Direct aspiration/flame AAS
Chromium Cr	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Chloride Cl	17		Grab	0.5-50	Ion chromatography
Copper Cu	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Iron Fe	<0.10		Grab	0.10-5.00	Direct aspiration/flame AAS
Lead Pb	<0.25		Grab	0.25-9.00	Direct aspiration/flame AAS
*Magnesium Mg	6.8		Grab	0.10-50	ICP/OES
Manganese Mn	<0.05		Grab	0.05-2.00	Direct aspiration/flame AAS
*Mercury Hg	<0.001		Grab	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni	<0.14		Grab	0.14-2.00	Direct aspiration/flame AAS
Potassium K	1.6		Grab	0.10-4.00	Direct aspiration/flame AAS
Sodium	13		Grab	0.10-1.00	Direct aspiration/flame AAS
Sulphate SO_4	14		Grab	0.5-100	Ion chromatography
Zinc Zn	0.08		Grab	0.02-1.00	Direct aspiration/flame AAS
Total alkalinity (as HCO_3)	250		Grab	N/A	Titration
*Total organic carbon TOC	2.1		Grab	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen	<7		Grab		Sum of nitrate & nitrite by IC
Nitrite NO_2	<0.5		Grab	0.5-10	Ion chromatography
Nitrate NO_3	30		Grab	0.5-50	Ion chromatography
Dissolved Oxygen	9		Grab	N/A	Dissolved Oxygen Probe
Phosphate PO_4	<1		Grab	1.0-10	Ion Chromatography
*Faecal Coliforms /100ml	>100		Grab		Membrane Filtration
*Total Coliforms /100ml	>100		Grab		Membrane Filtration

MONITORING POINT / GRID REFERENCE : SW3, RAMPERE LANDFILL, CO. WICKLOW

Parameter * = Subcontracted	Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method / technique
DATE : LAB ID :	01/12/99 16595				
pH	7.0		Grab	1-14	Hydrogen Ion Selective Electrode
Temperature (°C)	9.0		Grab	0-100? C	Temperature Probe
Electrical conductivity EC	507		Grab	1-100,000	Electrometry
*Ammoniacal nitrogen NH_4-N	<0.1		Grab	0.1-12.9	Colourimetry/FIA
Chemical oxygen demand	<4		Grab	0-150, 0-	Digestion/colorimetry
Biochemical oxygen demand	<2		Grab	1-7	DO probe
Calcium Ca	109		Grab	0.1-4.00	Direct aspiration/flame AAS
Cadmium Cd	<0.03		Grab	0.03-2.00	Direct aspiration/flame AAS
Chromium Cr	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Chloride Cl	17		Grab	0.5-50	Ion chromatography
Copper Cu	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Iron Fe	<0.10		Grab	0.10-5.00	Direct aspiration/flame AAS
Lead Pb	<0.25		Grab	0.25-9.00	Direct aspiration/flame AAS
*Magnesium Mg	6.9		Grab	0.10-50	ICP/OES
Manganese Mn	<0.05		Grab	0.05-2.00	Direct aspiration/flame AAS
*Mercury Hg	<0.001		Grab	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni	<0.14		Grab	0.14-2.00	Direct aspiration/flame AAS
Potassium K	2		Grab	0.10-4.00	Direct aspiration/flame AAS
Sodium	12		Grab	0.10-1.00	Direct aspiration/flame AAS
Sulphate SO_4	15		Grab	0.5-100	Ion chromatography
Zinc Zn	<0.02		Grab	0.02-1.00	Direct aspiration/flame AAS
Total alkalinity (as HCO_3)	250		Grab	N/A	Titration
*Total organic carbon TOC	2.1		Grab	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen	<7		Grab		Sum of nitrate & nitrite by IC
Nitrite NO_2	<0.5		Grab	0.5-10	Ion chromatography
Nitrate NO_3	30		Grab	0.5-50	Ion chromatography
Dissolved Oxygen	9		Grab	N/A	Dissolved Oxygen Probe
Phosphate PO_4	<1		Grab	1.0-10	Ion Chromatography
*Faecal Coliforms /100ml	>100		Grab		Membrane Filtration
*Total Coliforms /100ml	>100		Grab		Membrane Filtration

MONITORING POINT / GRID REFERENCE : SW4, RAMPERE LANDFILL, CO. WICKLOW

Parameter * = Subcontracted	Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method / technique
DATE : LAB ID :	1/12/99 16596				
pH	7.0		Grab	1-14	Hydrogen Ion Selective Electrode
Temperature (°C)	9.1		Grab	0-100? C	Temperature Probe
Electrical conductivity EC	507		Grab	1-100,000	Electrometry
*Ammoniacal nitrogen NH_4-N	<0.1		Grab	0.1-12.9	Colourimetry/FIA
Chemical oxygen demand	<4		Grab	0-150, 0-1500	Digestion/colorimetry
Biochemical oxygen demand	<2		Grab	1-7	DO probe
Calcium Ca	101		Grab	0.1-4.00	Direct aspiration/flame AAS
Cadmium Cd	<0.03		Grab	0.03-2.00	Direct aspiration/flame AAS
Chromium Cr	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Chloride Cl	18		Grab	0.5-50	Ion chromatography
Copper Cu	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Iron Fe	<0.10		Grab	0.10-5.00	Direct aspiration/flame AAS
Lead Pb	<0.25		Grab	0.25-9.00	Direct aspiration/flame AAS
*Magnesium Mg	6.9		Grab	0.10-50	ICP/OES
Manganese Mn	<0.05		Grab	0.05-2.00	Direct aspiration/flame AAS
*Mercury Hg	<0.001		Grab	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni	<0.14		Grab	0.14-2.00	Direct aspiration/flame AAS
Potassium K	2		Grab	0.10-4.00	Direct aspiration/flame AAS
Sodium	16		Grab	0.10-1.00	Direct aspiration/flame AAS
Sulphate SO_4	15		Grab	0.5-100	Ion chromatography
Zinc Zn	<0.02		Grab	0.02-1.00	Direct aspiration/flame AAS
Total alkalinity (as HCO_3)	255		Grab	N/A	Titration
*Total organic carbon TOC	1.8		Grab	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen	<7		Grab		Sum of nitrate & nitrite by IC
Nitrite NO_2	<0.5		Grab	0.5-10	Ion chromatography
Nitrate NO_3	29		Grab	0.5-50	Ion chromatography
Dissolved Oxygen	10		Grab	N/A	Dissolved Oxygen Probe
Phosphate PO_4	<1		Grab	1.0-10	Ion Chromatography
*Faecal Coliforms /100ml	>100		Grab		Membrane Filtration
*Total Coliforms /100ml	>100		Grab		Membrane Filtration

MONITORING POINT / GRID REFERENCE : SW5 SPRING, RAMPERE LANDFILL, CO. WICKLOW

Parameter * = Subcontracted	Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method / technique
DATE : LAB ID :	01/12/99 16597				
pH	6.0		Grab	1-14	Hydrogen Ion Selective
Temperature (°C)	9.5		Grab	0-100°C	Temperature Probe
Electrical conductivity EC	396		Grab	1-100,000	Electrometry
*Ammoniacal nitrogen NH_4-N	<0.1		Grab	0.1-12.9	Colourimetry/FIA
Chemical oxygen demand	<4		Grab	0-150, 0-1500	Digestion/colorimetry
Biochemical oxygen demand	<2		Grab	1-7	DO probe
Calcium Ca	66		Grab	0.1-4.00	Direct aspiration/flame AAS
Cadmium Cd	<0.03		Grab	0.03-2.00	Direct aspiration/flame AAS
Chromium Cr	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Chloride Cl	15		Grab	0.5-50	Ion chromatography
Copper Cu	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Iron Fe	<0.10		Grab	0.10-5.00	Direct aspiration/flame AAS
Lead Pb	<0.25		Grab	0.25-9.00	Direct aspiration/flame AAS
*Magnesium Mg	5.1		Grab	0.10-50	ICP/OES
Manganese Mn	<0.05		Grab	0.05-2.00	Direct aspiration/flame AAS
*Mercury Hg	<0.001		Grab	0.001-0.4	Direct aspiration/cold vapour
Nickel Ni	<0.14		Grab	0.14-2.00	Direct aspiration/flame AAS
Potassium K	1		Grab	0.10-4.00	Direct aspiration/flame AAS
Sodium	14		Grab	0.10-1.00	Direct aspiration/flame AAS
Sulphate SO_4	19		Grab	0.5-100	Ion chromatography
Zinc Zn	0.06		Grab	0.02-1.00	Direct aspiration/flame AAS
Total alkalinity (as HCO_3)	170		Grab	N/A	Titration
*Total organic carbon TOC	<0.2		Grab	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen	<6		Grab		Sum of nitrate & nitrite by IC
Nitrite NO_2	<0.5		Grab	0.5-10	Ion chromatography
Nitrate NO_3	28		Grab	0.5-50	Ion chromatography
Dissolved Oxygen	6		Grab	N/A	Dissolved Oxygen Probe
Phosphate PO_4	<1		Grab	1.0-10	Ion Chromatography
*Total Cyanide	<0.05		Grab	0.05-1.0	Distillation / colourimetry
* Phosphorous	<0.10		Grab	0.10-50.0	ICP/OES

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MONITORING POINT / GRID REFERENCE : SW5/SPRING, RAMPERE LANDFILL, CO. WICKLOW

* Arsenic	0.01		Grab	0.01-1.00	ICP/OES
* Boron	<0.01		Grab	0.01-1.00	ICP/OES
* Selenium	<0.01		Grab	0.01-0.25	ICP/OES
* Barium	<0.01		Grab	0.01-1.00	ICP/OES
* Silver	<0.01		Grab	0.01-5.00	ICP/OES
* Mono-phenols	<0.05		Grab	0.05-1.00	Distillation / colourimetry
Fluoride	0.11		Grab	0.1-5.0	Ion chromatography
Residue on Evaporation @	415		Grab	N/A	Gravimetric
*Faecal Coliforms /100ml	NIL		Grab		Membrane Filtration
*Total Coliforms /100ml	16		Grab		Membrane Filtration

MONITORING POINT / GRID REFERENCE : SW1, RAMPERE LANDFILL, CO. WICKLOW

** I Lab Accredited Tests ++ Subcontracted Analysis	Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method
DATE : LAB ID :	29/02/00 17654	On-site Measurements.			
PH **	7.4		Grab	1-14	Hydrogen Ion Selective
Temperature (°C)	-	8.2	Grab	0-100°C	Temperature Probe
Electrical conductivity EC	410		Grab	1-100,000	Electrometry
Ammoniacal nitrogen NH_4-N	<0.10		Grab	0.1-12.9	Colourimetry/FIA
Chemical oxygen demand	10		Grab	0-150, 0-1500	Digestion/colorimetry
Biochemical oxygen demand	<2		Grab	1-7	DO probe
Calcium Ca	113		Grab	1-100	Ion chromatography (IC)
Cadmium Cd	<0.03		Grab	0.03-2.00	Direct aspiration/flame AAS
Chromium Cr **	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Chloride Cl	16		Grab	0.5-50	Ion chromatography
Copper Cu **	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Iron Fe **	<0.10		Grab	0.10-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.25		Grab	0.25-9.00	Direct aspiration/flame AAS
Magnesium Mg	6		Grab	1-25	Ion Chromatography
Manganese Mn	<0.05		Grab	0.05-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		Grab	0.001-0.4	Direct aspiration/cold vapour
Nickel Ni **	<0.14		Grab	0.14-2.00	Direct aspiration/flame AAS
Potassium K	2		Grab	1-25	Ion Chromatography
Sodium	11		Grab	1-100	Ion Chromatography
Sulphate SO_4	11		Grab	0.5-100	Ion chromatography
Zinc Zn **	0.08		Grab	0.02-1.00	Direct aspiration/flame AAS
Total alkalinity (as HCO_3)	250		Grab	N/A	Titration
Total organic carbon TOC ++	1.6		Grab	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen	6.6		Grab		Sum of nitrate & nitrite
Nitrite NO_2^-	0.26		Grab	0.05-2.00	Spectrophotometric using
Nitrate NO_3	29		Grab	0.5-50	Ion chromatography
Dissolved Oxygen	9.8		Grab	N/A	Dissolved Oxygen Probe
Phosphate PO_4	<1		Grab	1.0-10	Ion Chromatography
Faecal Coliforms /100ml ++	>100		Grab		Membrane Filtration
Total Coliforms /100ml ++	>100		Grab		Membrane Filtration

MONITORING POINT / GRID REFERENCE : SW2, RAMPERE LANDFILL, CO. WICKLOW

** I Lab Accredited Tests ++ Subcontracted Analysis	Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method / technique
DATE : LAB ID :	29/02/00 17655	On-site Measurements.			
PH **	7.4	8.1	Grab	1-14	Hydrogen Ion Selective Electrode
Temperature (°C)	-	8.1	Grab	0-100°C	Temperature Probe
Electrical conductivity EC	487		Grab	1-100,000	Electrometry
Ammoniacal nitrogen NH_4-N	<0.10		Grab	0.1-12.9	Colourimetry/FIA
Chemical oxygen demand	29		Grab	0-150, 0-1500	Digestion/colorimetry
Biochemical oxygen demand	<3		Grab	1-7	DO probe
Calcium Ca	119		Grab	1-100	Ion chromatography (IC)
Cadmium Cd	<0.03		Grab	0.03-2.00	Direct aspiration/flame AAS.
Chromium Cr **	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Chloride Cl	16		Grab	0.5-50	Ion chromatography
Copper Cu **	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Iron Fe **	<0.10		Grab	0.10-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.25		Grab	0.25-9.00	Direct aspiration/flame AAS
Magnesium Mg	6		Grab	1-25	Ion Chromatography
Manganese Mn	<0.05		Grab	0.05-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		Grab	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni **	<0.14		Grab	0.14-2.00	Direct aspiration/flame AAS
Potassium K	2		Grab	1-25	Ion Chromatography
Sodium	12		Grab	1-100	Ion Chromatography
Sulphate SO_4	11		Grab	0.5-100	Ion chromatography
Zinc Zn **	0.04		Grab	0.02-1.00	Direct aspiration/flame AAS
Total alkalinity (as HCO_3)	255		Grab	N/A	Titration
Total organic carbon TOC ++	1.7		Grab	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen	6.6		Grab		Sum of nitrate & nitrite
Nitrite NO_2	0.26		Grab	0.05-2.00	Spectrophotometric using Kone
Nitrate NO_3	29		Grab	0.5-50	Ion chromatography
Dissolved Oxygen	9.9		Grab	N/A	Dissolved Oxygen Probe
Phosphate PO_4	<1		Grab	1.0-10	Ion Chromatography
Faecal Coliforms /100ml ++	>100		Grab		Membrane Filtration
Total Coliforms /100ml ++	>100		Grab		Membrane Filtration

MONITORING POINT / GRID REFERENCE : SW3, RAMPERE LANDFILL, CO. WICKLOW

** I Lab Accredited Tests ++ Subcontracted Analysis	Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method / technique
DATE : LAB ID :	29/02/00 17656	On-site Measurements.			
PH **	7.4	7.5	Grab	1-14	Hydrogen Ion Selective Electrode
Temperature (°C)	-	8.2	Grab	0-100°C	Temperature Probe
Electrical conductivity EC	492	440	Grab	1-100,000	Electrometry
Ammoniacal nitrogen NH_4-N	<0.10		Grab	0.1-12.9	Colourimetry/FIA
Chemical oxygen demand	22		Grab	0-150, 0-	Digestion/colorimetry
Biochemical oxygen demand	<2		Grab	1-7	DO probe
Calcium Ca	119		Grab	1-100	Ion chromatography (IC)
Cadmium Cd	<0.03		Grab	0.03-2.00	Direct aspiration/flame AAS
Chromium Cr **	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Chloride Cl	16		Grab	0.5-50	Ion chromatography
Copper Cu **	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Iron Fe **	0.11		Grab	0.10-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.25		Grab	0.25-9.00	Direct aspiration/flame AAS
Magnesium Mg	6		Grab	1-25	Ion Chromatography
Manganese Mn	<0.05		Grab	0.05-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		Grab	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni **	<0.14		Grab	0.14-2.00	Direct aspiration/flame AAS
Potassium K	2		Grab	1-25	Ion Chromatography
Sodium	12		Grab	1-100	Ion Chromatography
Sulphate SO_4	12		Grab	0.5-100	Ion chromatography
Zinc Zn **	0.02		Grab	0.02-1.00	Direct aspiration/flame AAS
Total alkalinity (as HCO_3)	250		Grab	N/A	Titration
Total organic carbon TOC ++	1.7		Grab	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen	6.8		Grab		Sum of nitrate & nitrite
Nitrite NO_2	0.23		Grab	0.05-2.00	Spectrophotometric using Kone
Nitrate NO_3	30		Grab	0.5-50	Ion chromatography
Dissolved Oxygen	10		Grab	N/A	Dissolved Oxygen Probe
Phosphate PO_4	<1		Grab	1.0-10	Ion Chromatography
Faecal Coliforms /100ml ++	>100		Grab		Membrane Filtration
Total Coliforms /100ml ++	>100		Grab		Membrane Filtration

MONITORING POINT / GRID REFERENCE : SW4, RAMPERE LANDFILL, CO. WICKLOW

** Lab Accredited Tests ++ Subcontracted Analysis	Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method / technique
DATE : LAB ID :	29/02/00 17657	On-site Measurements.			
PH **	7.4	8.6	Grab	1-14	Hydrogen Ion Selective Electrode
Temperature (°C)	-	8.5	Grab	0-100°C	Temperature Probe
Electrical conductivity EC	498	470	Grab	1-100,000	Electrometry
Ammoniacal nitrogen NH_4-N	<0.10		Grab	0.1-12.9	Colourimetry/FIA
Chemical oxygen demand	38		Grab	0-150, 0-1500	Digestion/colorimetry
Biochemical oxygen demand	<3		Grab	1-7	DO probe
Calcium Ca	119		Grab	1-100	Ion chromatography (IC)
Cadmium Cd	<0.03		Grab	0.03-2.00	Direct aspiration/flame AAS
Chromium Cr **	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Chloride Cl	17		Grab	0.5-50	Ion chromatography
Copper Cu **	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Iron Fe **	0.11		Grab	0.10-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.25		Grab	0.25-9.00	Direct aspiration/flame AAS
Magnesium Mg	7		Grab	1-25	Ion Chromatography
Manganese Mn	<0.05		Grab	0.05-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		Grab	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni **	<0.14		Grab	0.14-2.00	Direct aspiration/flame AAS
Potassium K	2		Grab	1-25	Ion Chromatography
Sodium	12		Grab	1-100	Ion Chromatography
Sulphate SO_4	12		Grab	0.5-100	Ion chromatography
Zinc Zn **	0.02		Grab	0.02-1.00	Direct aspiration/flame AAS
Total alkalinity (as HCO_3)	260		Grab	N/A	Titration
Total organic carbon TOC ++	1.6		Grab	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen	6.6		Grab		Sum of nitrate & nitrite
Nitrite NO_2	0.22		Grab	0.05-2.00	Spectrophotometric using Kone
Nitrate NO_3	29		Grab	0.5-50	Ion chromatography
Dissolved Oxygen	9.9		Grab	N/A	Dissolved Oxygen Probe
Phosphate PO_4	<1		Grab	1.0-10	Ion Chromatography
Faecal Coliforms /100ml ++	>100		Grab		Membrane Filtration
Total Coliforms /100ml ++	>100		Grab		Membrane Filtration

MONITORING POINT / GRID REFERENCE : SW5, RAMPERE LANDFILL, CO. WICKLOW

** I Lab Accredited Tests ++ Subcontracted Analysis	Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method / technique
DATE : LAB ID :	29/02/00 17658	On-site Measurements.			
PH **	6.5		Grab	1-14	Hydrogen Ion Selective
Temperature (°C)	-	8.5	Grab	0-100°C	Temperature Probe
Electrical conductivity EC	404		Grab	1-100,000	Electrometry
Ammoniacal nitrogen NH_4-N	<0.10		Grab	0.1-12.9	Colourimetry/FIA
Chemical oxygen demand	<4		Grab	0-150, 0-1500	Digestion/colorimetry
Biochemical oxygen demand	<2		Grab	1-7	DO probe
Calcium Ca	76		Grab	1-100	Ion Chromatography (IC)
Cadmium Cd	<0.03		Grab	0.03-2.00	Direct aspiration/flame AAS
Chromium Cr **	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Chloride Cl	14		Grab	0.5-50	Ion chromatography
Copper Cu **	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Iron Fe **	<0.10		Grab	0.10-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.25		Grab	0.25-9.00	Direct aspiration/flame AAS
Magnesium Mg	5		Grab	1-25	Ion Chromatography (IC)
Manganese Mn	<0.05		Grab	0.05-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		Grab	0.001-0.4	Direct aspiration/cold vapour
Nickel Ni **	<0.14		Grab	0.14-2.00	Direct aspiration/flame AAS
Potassium K	<1		Grab	1-25	Ion Chromatography (IC)
Sodium	10		Grab	1-100	Ion Chromatography (IC)
Sulphate SO_4	18		Grab	0.5-100	Ion chromatography
Zinc Zn **	<0.02		Grab	0.02-1.00	Direct aspiration/flame AAS
Total alkalinity (as HCO_3)	180		Grab	N/A	Titration
Total organic carbon TOC ++	<0.2		Grab	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen	7.2		Grab		Sum of nitrate & nitrite
Nitrite NO_2	<0.05		Grab	0.05-2.00	Spectrophotometric using Kone
Nitrate NO_3	32		Grab	0.5-50	Ion chromatography
Dissolved Oxygen	7		Grab	N/A	Dissolved Oxygen Probe
Phosphate PO_4	<1		Grab	1.0-10	Ion Chromatography
Total Cyanide ++	<0.05		Grab	0.05-1.0	Distillation / colourimetry

Monitoring Point / Grid reference : SW5, Rampere Landfill, Co. Wicklow

** I Lab Accredited Tests ++ Subcontracted Analysis	Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method / technique -
DATE : LAB ID :	29/02/00 17658	On-site Measurements.			
Phosphorous ++	0.056		Grab	0.10-50.0	ICP/OES
Arsenic ++	<0.01		Grab	0.01-1.00	ICP/OES
Boron ++	<0.07		Grab	0.01-1.00	ICP/OES
Selenium ++	<0.01		Grab	0.01-0.25	ICP/OES
Barium ++	<0.01		Grab	0.01-1.00	ICP/OES
Silver ++	<0.01		Grab	0.01-5.00	ICP/OES
Mono-phenols ++	<0.05		Grab	0.05-1.00	Distillation / colourimetry
Fluoride	0.1		Grab	0.1-5.0	Ion chromatography
Residue on Evaporation @	312		Grab	N/A	Gravimetric
Faecal Coliforms /100ml ++	NIL		Grab		Membrane Filtration
Total Coliforms /100ml ++	66		Grab		Membrane Filtration

MONITORING POINT / GRID REFERENCE : SW1, RAMPERE LANDFILL, CO. WICKLOW

** I Lab Accredited Tests ++ Subcontracted Analysis	Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method
DATE : LAB ID :	30/05/00 18930	On-site Measurements.			
PH **	7.0	7.7	Grab	1-14	Hydrogen Ion Selective
Temperature (°C)	-	14	Grab	0-100°C	Temperature Probe
Electrical conductivity EC	580	460	Grab	1-100,000	Electrometry
Ammoniacal nitrogen NH_4-N	<0.1		Grab	0.1-12.9	Colourimetry/FIA
Chemical oxygen demand	5		Grab	0-150, 0-1500	Digestion/colorimetry
Biochemical oxygen demand	<2		Grab	1-7	DO probe
Calcium Ca	93		Grab	0.5-4.0	Direct aspiration/flame AAS
Cadmium Cd	<0.03		Grab	0.03-2.00	Direct aspiration/flame AAS
Chromium Cr **	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Chloride Cl	16		Grab	0.5-50	Ion chromatography
Copper Cu **	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Iron Fe **	<0.10		Grab	0.10-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.25		Grab	0.25-9.00	Direct aspiration/flame AAS
Magnesium Mg	6.8		Grab	0.10-50	ICP/OES
Manganese Mn	<0.05		Grab	0.05-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		Grab	0.001-0.4	Direct aspiration/cold vapour
Nickel Ni **	<0.14		Grab	0.14-2.00	Direct aspiration/flame AAS
Potassium K	1.2		Grab	0.5-4.0	Direct aspiration/flame AAS
Sodium	12		Grab	0.25-1.00	Direct aspiration/flame AAS
Sulphate SO_4	13		Grab	0.5-100	Ion chromatography
Zinc Zn **	<0.02		Grab	0.02-1.00	Direct aspiration/flame AAS
Total alkalinity (as HCO_3)	275		Grab	N/A	Titration
Total organic carbon TOC ++	1.8		Grab	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen	6.3		Grab		Sum of nitrate & nitrite
Nitrite NO_2 ++	0.09		Grab	0.05-2.00	Spectrophotometric using
Nitrate NO_3	28		Grab	0.5-50	Ion chromatography
Dissolved Oxygen	9.3		Grab	N/A	Dissolved Oxygen Probe
Phosphate PO_4	<1		Grab	1.0-10	Ion Chromatography
Faecal Coliforms /100ml ++	NIL		Grab		Membrane Filtration
Total Coliforms /100ml ++	>100		Grab		Membrane Filtration

MONITORING POINT / GRID REFERENCE : SW2, RAMPERE LANDFILL, CO. WICKLOW

** I Lab Accredited Tests ++ Subcontracted Analysis	Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method / technique
DATE : LAB ID :	30/05/2000 18931	On-site Measurements.			
PH **	7.0	7.7	Grab	1-14	Hydrogen Ion Selective Electrode
Temperature (°C)	-	15	Grab	0-100°C	Temperature Probe
Electrical conductivity EC	570	640	Grab	1-100,000	Electrometry
Ammoniacal nitrogen NH_4-N	<0.1		Grab	0.1-12.9	Colourimetry/FIA
Chemical oxygen demand	11		Grab	0-150, 0-1500	Digestion/colorimetry
Biochemical oxygen demand	<2		Grab	1-7	DO probe
Calcium Ca	90		Grab	0.5-4.0	Direct aspiration/flame AAS
Cadmium Cd	<0.03		Grab	0.03-2.00	Direct aspiration/flame AAS
Chromium Cr **	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Chloride Cl	17		Grab	0.5-50	Ion chromatography
Copper Cu **	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Iron Fe **	<0.10		Grab	0.10-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.25		Grab	0.25-9.00	Direct aspiration/flame AAS
Magnesium Mg	6.9		Grab	0.10-50	ICP/OES
Manganese Mn	<0.05		Grab	0.05-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		Grab	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni **	<0.14		Grab	0.14-2.00	Direct aspiration/flame AAS
Potassium K	1.2		Grab	0.5-4.0	Direct aspiration/flame AAS
Sodium	12		Grab	0.25-1.00	Direct aspiration/flame AAS
Sulphate SO_4	13		Grab	0.5-100	Ion chromatography
Zinc Zn **	<0.02		Grab	0.02-1.00	Direct aspiration/flame AAS
Total alkalinity (as HCO_3)	255		Grab	N/A	Titration
Total organic carbon TOC ++	1.4		Grab	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen	5.2		Grab		Sum of nitrate & nitrite
Nitrite NO_2 ++	0.08		Grab	0.05-2.00	Spectrophotometric using Kone
Nitrate NO_3	29		Grab	0.5-50	Ion chromatography
Dissolved Oxygen	9.1		Grab	N/A	Dissolved Oxygen Probe
Phosphate PO_4	<1.0		Grab	1.0-10	Ion Chromatography
Faecal Coliforms /100ml ++	NIL		Grab		Membrane Filtration
Total Coliforms /100ml ++	>100		Grab		Membrane Filtration

MONITORING POINT / GRID REFERENCE : SW3, RAMPERE LANDFILL, CO. WICKLOW

** I Lab Accredited Tests ++ Subcontracted Analysis	Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method / technique
DATE : LAB ID :	30/05/00 18932	On-site Measurements.			
PH **	6.9	7.5	Grab	1-14	Hydrogen Ion Selective Electrode
Temperature (°C)	-	14	Grab	0-100°C	Temperature Probe
Electrical conductivity EC	569	500	Grab	1-100,000	Electrometry
Ammoniacal nitrogen NH_4-N	<0.1		Grab	0.1-12.9	Colourimetry/FIA
Chemical oxygen demand	6		Grab	0-150, 0-	Digestion/colorimetry
Biochemical oxygen demand	<2		Grab	1-7	DO probe
Calcium Ca	91		Grab	0.5-4.0	Direct aspiration/flame AAS
Cadmium Cd	<0.03		Grab	0.03-2.00	Direct aspiration/flame AAS
Chromium Cr **	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Chloride Cl	16		Grab	0.5-50	Ion chromatography
Copper Cu **	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Iron Fe **	<0.10		Grab	0.10-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.25		Grab	0.25-9.00	Direct aspiration/flame AAS
Magnesium Mg	6.8		Grab	0.10-50	ICP/OES
Manganese Mn	<0.05		Grab	0.05-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		Grab	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni **	<0.14		Grab	0.14-2.00	Direct aspiration/flame AAS
Potassium K	1.4		Grab	0.5-4.0	Direct aspiration/flame AAS
Sodium	28		Grab	0.25-1.00	Direct aspiration/flame AAS
Sulphate SO_4	13		Grab	0.5-100	Ion chromatography
Zinc Zn **	0.02		Grab	0.02-1.00	Direct aspiration/flame AAS
Total alkalinity (as HCO_3)	250		Grab	N/A	Titration
Total organic carbon TOC ++	1.4		Grab	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen	6.3		Grab		Sum of nitrate & nitrite
Nitrite NO_2 ++	0.09		Grab	0.05-2.00	Spectrophotometric using Kone
Nitrate NO_3	28		Grab	0.5-50	Ion chromatography
Dissolved Oxygen	9.1		Grab	N/A	Dissolved Oxygen Probe
Phosphate PO_4	<1		Grab	1.0-10	Ion Chromatography
Faecal Coliforms /100ml ++	NIL		Grab		Membrane Filtration
Total Coliforms /100ml ++	>100		Grab		Membrane Filtration

MONITORING POINT / GRID REFERENCE : SW4, RAMPERE LANDFILL, CO. WICKLOW

** I Lab Accredited Tests ++ Subcontracted Analysis	Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method / technique
DATE : LAB ID :	30.05.00 18933	On-site Measurements.			
PH **	6.9	7.6	Grab	1-14	Hydrogen Ion Selective Electrode
Temperature (°C)	-	14	Grab	0-100°C	Temperature Probe
Electrical conductivity EC	563	460	Grab	1-100,000	Electrometry
Ammoniacal nitrogen NH_4-N	0.1		Grab	0.1-12.9	Colourimetry/FIA
Chemical oxygen demand	4		Grab	0-150, 0-1500	Digestion/colorimetry
Biochemical oxygen demand	<2		Grab	1-7	DO probe
Calcium Ca	90		Grab	0.5-4.0	Direct aspiration/flame AAS
Cadmium Cd	<0.03		Grab	0.03-2.00	Direct aspiration/flame AAS
Chromium Cr **	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Chloride Cl	17		Grab	0.5-50	Ion chromatography
Copper Cu **	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Iron Fe **	<0.10		Grab	0.10-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.25		Grab	0.25-9.00	Direct aspiration/flame AAS
Magnesium Mg	7.1		Grab	0.10-50	ICP/OES
Manganese Mn	<0.05		Grab	0.05-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		Grab	0.001-0.4	Direct aspiration/cold vapour AAS
Nickel Ni **	<0.14		Grab	0.14-2.00	Direct aspiration/flame AAS
Potassium K	1.6		Grab	0.5-4.0	Direct aspiration/flame AAS
Sodium	11		Grab	0.25-1.00	Direct aspiration/flame AAS
Sulphate SO_4	12		Grab	0.5-100	Ion chromatography
Zinc Zn **	<0.02		Grab	0.02-1.00	Direct aspiration/flame AAS
Total alkalinity (as HCO_3)	250		Grab	N/A	Titration
Total organic carbon TOC ++	1.1		Grab	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen	6.4		Grab		Sum of nitrate & nitrite
Nitrite NO_2 ++	0.15		Grab	0.05-2.00	Spectrophotometric using Kone
Nitrate NO_3	28		Grab	0.5-50	Ion chromatography
Dissolved Oxygen	9.2		Grab	N/A	Dissolved Oxygen Probe
Phosphate PO_4	<1		Grab	1.0-10	Ion Chromatography
Faecal Coliforms /100ml ++	>100		Grab		Membrane Filtration
Total Coliforms /100ml ++	>100		Grab		Membrane Filtration

MONITORING POINT / GRID REFERENCE : SW5/PUBLIC SUPPLY WELL, RAMPERE LANDFILL, CO. WICKLOW

** I Lab Accredited Tests ++ Subcontracted Analysis	Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method / technique
DATE : LAB ID :	30.05.00 18937	On-site Measurements.			
PH **	6.1	6.7	Grab	1-14	Hydrogen Ion Selective
Temperature (°C)	-	12	Grab	0-100°C	Temperature Probe
Electrical conductivity EC	451	400	Grab	1-100,000	Electrometry
Ammoniacal nitrogen NH_4-N	<0.1		Grab	0.1-12.9	Colourimetry/FIA
Chemical oxygen demand	<4		Grab	0-150, 0-1500	Digestion/colorimetry
Biochemical oxygen demand	<2		Grab	1-7	DO probe
Calcium Ca	56		Grab	1-100	Ion Chromatography (IC)
Cadmium Cd	<0.03		Grab	0.03-2.00	Direct aspiration/flame AAS
Chromium Cr **	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Chloride Cl	16		Grab	0.5-50	Ion chromatography
Copper Cu **	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Iron Fe **	<0.10		Grab	0.10-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.25		Grab	0.25-9.00	Direct aspiration/flame AAS
Magnesium Mg	5.1		Grab	0.10-50	ICP/OES
Manganese Mn	<0.05		Grab	0.05-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		Grab	0.001-0.4	Direct aspiration/cold vapour
Nickel Ni **	<0.14		Grab	0.14-2.00	Direct aspiration/flame AAS
Potassium K	0.9		Grab	1-25	Ion Chromatography (IC)
Sodium	11		Grab	1-100	Ion Chromatography (IC)
Sulphate SO_4	22		Grab	0.5-100	Ion chromatography
Zinc Zn **	<0.02		Grab	0.02-1.00	Direct aspiration/flame AAS
Total alkalinity (as HCO_3)	170		Grab	N/A	Titration
Total organic carbon TOC ++	0.5		Grab	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen	5.0		Grab		Sum of nitrate & nitrite
Nitrite NO_2 ++	<0.05		Grab	0.05-2.00	Spectrophotometric using Kone
Nitrate NO_3	22		Grab	0.5-50	Ion chromatography
Dissolved Oxygen	9.6		Grab	N/A	Dissolved Oxygen Probe
Phosphate PO_4	<1		Grab	1.0-10	Ion Chromatography
Total Cyanide ++	<0.05		Grab	0.05-1.0	Distillation / colourimetry

Monitoring Point / Grid reference : SW5/Public Supply Well Rampere Landfill, Co. Wicklow

** I Lab Accredited Tests ++ Subcontracted Analysis	Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method / technique
DATE : LAB ID :	30.05.00 18937	On-site Measurements.			
Phosphorous ++	<0.10		Grab	0.10-50.0	ICP/OES
Arsenic ++	<0.01		Grab	0.01-1.00	ICP/OES
Boron ++	<0.07		Grab	0.01-1.00	ICP/OES
Selenium ++	<0.01		Grab	0.01-0.25	ICP/OES
Barium ++	<0.01		Grab	0.01-1.00	ICP/OES
Silver ++	<0.01		Grab	0.01-5.00	ICP/OES
Mono-phenols ++	<0.05		Grab	0.05-1.00	Distillation / colourimetry
Fluoride	0.1		Grab	0.1-5.0	Ion chromatography
Residue on Evaporation @	298		Grab	N/A	Gravimetric
Faecal Coliforms /100ml ++	NIL		Grab		Membrane Filtration
Total Coliforms /100ml ++	84		Grab		Membrane Filtration

MONITORING POINT / GRID REFERENCE : SW6, RAMPERE LANDFILL, CO. WICKLOW

** I Lab Accredited Tests ++ Subcontracted Analysis	Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method
DATE : LAB ID :	30/05/00 18934	On-site Measurements.			
PH **	6.7	7.5	Grab	1-14	Hydrogen Ion Selective
Temperature (°C)	-	12	Grab	0-100°C	Temperature Probe
Electrical conductivity EC	610	550	Grab	1-100,000	Electrometry
Ammoniacal nitrogen NH_4-N	<0.1		Grab	0.1-12.9	Colourimetry/FIA
Chemical oxygen demand	5		Grab	0-150, 0-1500	Digestion/colorimetry
Biochemical oxygen demand	<2		Grab	1-7	DO probe
Calcium Ca	98		Grab	0.5-4.0	Direct aspiration/flame AAS
Cadmium Cd	<0.03		Grab	0.03-2.00	Direct aspiration/flame AAS
Chromium Cr **	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Chloride Cl	16		Grab	0.5-50	Ion chromatography
Copper Cu **	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Iron Fe **	<0.10		Grab	0.10-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.25		Grab	0.25-9.00	Direct aspiration/flame AAS
Magnesium Mg	7.3		Grab	0.10-50	ICP/OES
Manganese Mn	<0.05		Grab	0.05-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		Grab	0.001-0.4	Direct aspiration/cold vapour
Nickel Ni **	<0.14		Grab	0.14-2.00	Direct aspiration/flame AAS
Potassium K	0.8		Grab	0.5-4.0	Direct aspiration/flame AAS
Sodium	12		Grab	0.25-1.00	Direct aspiration/flame AAS
Sulphate SO_4	12		Grab	0.5-100	Ion chromatography
Zinc Zn **	<0.02		Grab	0.02-1.00	Direct aspiration/flame AAS
Total alkalinity (as HCO_3)	265		Grab	N/A	Titration
Total organic carbon TOC ++	1.8		Grab	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen	6.3		Grab		Sum of nitrate & nitrite
Nitrite NO_2 ++	0.05		Grab	0.05-2.00	Spectrophotometric using
Nitrate NO_3	28		Grab	0.5-50	Ion chromatography
Dissolved Oxygen	6.7		Grab	N/A	Dissolved Oxygen Probe
Phosphate PO_4	<1		Grab	1.0-10	Ion Chromatography
Faecal Coliforms /100ml ++	>100		Grab		Membrane Filtration
Total Coliforms /100ml ++	>100		Grab		Membrane Filtration

MONITORING POINT / GRID REFERENCE : SW7, RAMPERE LANDFILL, CO. WICKLOW

** I Lab Accredited Tests ++ Subcontracted Analysis	Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method
DATE : LAB ID :	30/05/00 18935	On-site Measurements.			
PH **	6.9	7.6	Grab	1-14	Hydrogen Ion Selective
Temperature (°C)	-	14	Grab	0-100°C	Temperature Probe
Electrical conductivity EC	574	520	Grab	1-100,000	Electrometry
Ammoniacal nitrogen NH_4-N	0.1		Grab	0.1-12.9	Colourimetry/FIA
Chemical oxygen demand	7		Grab	0-150, 0-1500	Digestion/colorimetry
Biochemical oxygen demand	<2		Grab	1-7	DO probe
Calcium Ca	90		Grab	0.5-4.0	Direct aspiration/flame AAS
Cadmium Cd	<0.03		Grab	0.03-2.00	Direct aspiration/flame AAS
Chromium Cr **	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Chloride Cl	17		Grab	0.5-50	Ion chromatography
Copper Cu **	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Iron Fe **	<0.10		Grab	0.10-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.25		Grab	0.25-9.00	Direct aspiration/flame AAS
Magnesium Mg	6.8		Grab	0.10-50	ICP/OES
Manganese Mn	<0.05		Grab	0.05-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		Grab	0.001-0.4	Direct aspiration/cold vapour
Nickel Ni **	<0.14		Grab	0.14-2.00	Direct aspiration/flame AAS
Potassium K	1.1		Grab	0.5-4.0	Direct aspiration/flame AAS
Sodium	17		Grab	0.25-1.00	Direct aspiration/flame AAS
Sulphate SO_4	11		Grab	0.5-100	Ion chromatography
Zinc Zn **	<0.02		Grab	0.02-1.00	Direct aspiration/flame AAS
Total alkalinity (as HCO_3)	250		Grab	N/A	Titration
Total organic carbon TOC ++	1.2		Grab	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen	6.3		Grab		Sum of nitrate & nitrite
Nitrite NO_2 ++	0.07		Grab	0.05-2.00	Spectrophotometric using
Nitrate NO_3	28		Grab	0.5-50	Ion chromatography
Dissolved Oxygen	9.3		Grab	N/A	Dissolved Oxygen Probe
Phosphate PO_4	<1		Grab	1.0-10	Ion Chromatography
Faecal Coliforms /100ml ++	>100		Grab		Membrane Filtration
Total Coliforms /100ml ++	>100		Grab		Membrane Filtration

MONITORING POINT / GRID REFERENCE : SW8, RAMPERE LANDFILL, CO. WICKLOW

** I Lab Accredited Tests ++ Subcontracted Analysis	Results (mg/l)		Sampling method	Normal Analytical Range	Analysis method
DATE : LAB ID :	30/05/00 18936	On-site Measurements.			
PH **	6.9		Grab	1-14	Hydrogen Ion Selective
Temperature (°C)	-	14	Grab	0-100°C	Temperature Probe
Electrical conductivity EC	563	530	Grab	1-100,000	Electrometry
Ammoniacal nitrogen NH_4-N	0.6		Grab	0.1-12.9	Colourimetry/FIA
Chemical oxygen demand	<4		Grab	0-150, 0-1500	Digestion/colorimetry
Biochemical oxygen demand	<2		Grab	1-7	DO probe
Calcium Ca	92		Grab	0.5-4.0	Direct aspiration/flame AAS
Cadmium Cd	<0.03		Grab	0.03-2.00	Direct aspiration/flame AAS
Chromium Cr **	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Chloride Cl	16		Grab	0.5-50	Ion chromatography
Copper Cu **	<0.08		Grab	0.08-5.00	Direct aspiration/flame AAS
Iron Fe **	<0.10		Grab	0.10-5.00	Direct aspiration/flame AAS
Lead Pb **	<0.25		Grab	0.25-9.00	Direct aspiration/flame AAS
Magnesium Mg	6.8		Grab	0.10-50	ICP/OES
Manganese Mn	<0.05		Grab	0.05-2.00	Direct aspiration/flame AAS
Mercury Hg ++	<0.001		Grab	0.001-0.4	Direct aspiration/cold vapour
Nickel Ni **	<0.14		Grab	0.14-2.00	Direct aspiration/flame AAS
Potassium K	1.1		Grab	0.5-4.0	Direct aspiration/flame AAS
Sodium	12		Grab	0.25-1.00	Direct aspiration/flame AAS
Sulphate SO_4	11		Grab	0.5-100	Ion chromatography
Zinc Zn **	<0.02		Grab	0.02-1.00	Direct aspiration/flame AAS
Total alkalinity (as HCO_3)	255		Grab	N/A	Titration
Total organic carbon TOC ++	1.3		Grab	0.2-20	Oxidation/IR spectroscopy
Total oxidised nitrogen	6.3		Grab		Sum of nitrate & nitrite
Nitrite NO_2 ++	0.09		Grab	0.05-2.00	Spectrophotometric using
Nitrate NO_3	28		Grab	0.5-50	Ion chromatography
Dissolved Oxygen	9.7		Grab	N/A	Dissolved Oxygen Probe
Phosphate PO_4	<1		Grab	1.0-10	Ion Chromatography
Faecal Coliforms /100ml ++	>100		Grab		Membrane Filtration
Total Coliforms /100ml ++	>100		Grab		Membrane Filtration

APPENDIX 8

FISHERY SURVEY DATA FOR THE RIVER SLANEY

(Data provided by Eastern Regional Fisheries Board)

N.B. Juvenile salmonid densities expressed as numbers per square metre

Breakdown of salmon redd count data for the River Slaney catchment

	1981	1986	1991	1994	1995	1996
River Slaney (Main channel)						
Leoh R. to Baltinglass	92 (28%)	375 (52%)	319 (36%)	547(46%)	478(41%)	342(25%)
Baltinglass to Rathvilly	34	166	69*	NA	212	189*
Tullow Br.	NA	5	NA	NA	10	NA
Glasheavy Br.	NA	6	NA	NA	NA	NA
Little Slaney	NA	NA	NA	NA	NA	9
Carriggower River						
Carriggower Br. to confluence with R. Slaney	NA	59	NA	31	120	64
Derreen River						
Liscolman H. To Hacketstown	29	NA	NA	NA	NA	NA
Hacketstown to source	37	NA	NA	NA	8	NA
Ratholl Br. to Saulsford Br.	NA	NA	172	95	245	122
Douglas River (Ballon)						
Confluence with R. Slaney to source	18	16	7	NA	NA	8
Glasheavy River	NA	NA	6	NA	NA	NA
Derry River						
Ballingate Br. to Tinahely	63	62	96	244	NA	246
Bann River						
Camolin to source	33	NA	NA	-	-	-
Camolin to fish pass	NA	NA	108	123	NA	252
Urrin River						
Kiltrea Br. to Doran's Crossroads	9	NA	NA	NA	-	-
Confluence with Slaney to Source	NA	NA	41	NA	0	7
Boro River						
Ballymackessy to source	14	37	NA	NA	NA	NA
Kilcarby Br. to Rathnure	NA	NA	72	63	84	85
Clody River	NA	NA	NA	61	NA	37
Tuckmill River	NA	NA	NA	0	0	NA
TOTAL	329	726	890	1164	1157	1361

* to Kilmurray Bridge only

Percentage refers total number of redds in the main channel upstream of Baltinglass

NA - data not available

Juvenile Salmon densities in the Slaney Catchment (numbers per square metre)

Site No.	RIVER/site	Salmon fry			Salmon parr		
		1991/92/93	1995	1997	1991/92/93	1995	1997
	CARRIGGOWER RIVER						
2	*middle reaches (maintained)*	0.00	0.00	-	0.00	0.013	-
4	*u/s Whitestown Br.*	0.05	0.032	0.59	0.032	0.003	0.04
	DONARD STREAM						
6	*1500m d/s Donard*	0.00	0.00	0.00	0.00	0.00	0.006
	KNICKEEN RIVER						
9	*upper reaches*	0.00	0.12*	0.47*	0.09	0.05*	0.13
	LITTLE SLANEY RIVER						
12	*at Coolmoney Army camp*	0.044	0.02	0.24	0.006	0.004	0.02
	TUCKMILL STREAM						
13	*upper reaches*	0.00	0.00	0.00	0.00	0.025	0.00
	SLANEY RIVER (main channel)						
16	*d/s Seskin Br.*	0.055	0.34	0.70	0.04	0.08	0.19
19	*d/s Gibstown Br.*	0.125	0.4	0.43	0.022	0.04	0.05
22	*u/s Eldon Br.*	0.65	0.32	0.32	0.021	0.11	0.05
40	*d/s Rathmore Ho.Br.*	0.27	0.4	-	0.13	0.034	-
	DERREEN RIVER						
25	*Tinkers Br.*	0.51*	0.31	0.20*	0.016	0.01	0.10
26	*u/s Hacketstown*	0.2	0.27	0.20	0.07	0.04	0.06*
	DOUGLAS RIVER 1						
34	*d/s Barnhill Br.*	0.035	0.07*	0.33*	0.02	0.019	0.21
	DOUGLAS RIVER 2						
85	*lower reaches*	0	-	0	0	-	0.05
	DERRY RIVER						
42	*u/s Tinahely*	0.00	0.00	0.01*	0.00	0.02	0.04*
44	*at Shillelagh*	0.14	-	0.34*	0.23	-	0.09
	BALLYCARNEY STREAM						
50	*at Ballycarney*	0.27	0.008*	0.21	0.025	0.12*	0.10
	RIVER BANN						
53	*d/s Hollyfort*	0.29	0.04*	-	0.06	0.15	-
56	*u/s Camolin*	0.086	0.09*	0.15*	0.04	0.11	0.07*
94	u/s Lask river	-	-	0.05	0.03	-	0.06
	RIVER BORO						
64	*u/s Aughnagappel Br.*	0.12	1.19	0.08	0.02	0.24	0.04
	RIVER URRIN						
75	*u/s St.Johns Br.*	0.009	0.05*	0.08	0.18	0.13*	0.16
	RIVER GLASHA						
78	*u/s br. on main road*	0.07	0.22*	0.11	0.05	0.19*	0.07
	CLODY RIVER						
80	*Rahanshask Br.*	0.05	0.37	0.13	0.11	0.2	0.11
	LASK RIVER						
93	*middle reaches*	-	-	0.12	-	-	0.03

*minimum density figures

Juvenile Trout densities in the Slaney Catchment (numbers per square metre)

Site No.	RIVER/site	Trout fry			Trout parr		
		1991/92/93	1995	1997	1991/92/93	1995	1997
	CARRIGGOWER RIVER						
2	*middle reaches (maintained)*	0.33	0.24	-	0	0	-
4	*u/s Whitestown Br.*	0.14	0.16	0.93	0.1	0.035	0.072
	DONARD STREAM						
6	*1500m d/s Donard*	0.65	0.41	0.24	0.05	0.018	0.02
	KNICKEEN RIVER						
9	*upper reaches*	0.09	0.1	0.15	0.11	0.13	0.34
	LITTLE SLANEY RIVER						
12	*at Coolmoney Army camp*	0.06	0.35	0.1	0.09	0.05	0.12
	TUCKMILL STREAM						
13	*upper reaches*	0.13	0.7	0.83	0.05	0.07	0.04
	SLANEY RIVER (main channel)						
16	*d/s Seskin Br.*	0.01	0.07	0.05	0.04	0.09	0.08
19	*d/s Gibstown Br.*	0.11	0.28	0.17	0.02	0.078	0.02
22	*u/s Eldon Br.*	0.13	0.13	0.11	0.03	0.05	0.003
40	*d/s Rathmore Ho.Br.*	0.05	0.036	-	0.06	0.03	-
	DERREEN RIVER						
25	*Tinkers Br.*	0.15	0.04	0.13	0.09	0.09	0.13
26	*u/s Hacketstown*	0.12	0.1	0.1	0.13	0.22	0.15
	DOUGLAS RIVER 1						
34	*d/s Barnhill Br.*	0.04*	0.075	0.23	0.02	0.17	0.12
	DOUGLAS RIVER 2						
85	*lower reaches*	0.07	-	0.34	0.005	-	0
	DERRY RIVER						
42	*u/s Tinahely*	0.13	0.03	0.21	0.25	0.37	0.12
44	*at Shillelagh*	0.06	-	0.25	0.15	-	0.14
	BALLYCARNEY STREAM						
50	*at Ballycarney*	0.27	0.02	0.31	0.18	0.125	0.2
	RIVER BANN						
53	*d/s Hollyfort*	0.12*	0.25	-	0.14	0.17	-
56	*u/s Camolin*	0.01	0	0.16	0.1	0.18	0.03
94	u/s Lask river	-	-	0.28	-	-	0.03
	RIVER BORO						
64	*u/s Aughnagappel Br.*	0.11	0.087	0.16	0.2	0.32	0.04
	RIVER URRIN						
75	*u/s St.Johns Br.*	0	0.019	0.006	0.04	0.107	0.09
	RIVER GLASHA						
78	*u/s br. on main road*	0.05	0.08	0.08	0.07	0.15	0.03
	CLODY RIVER						
80	*Rahanahask Br.*	0.2	0.18	0.1	0.32	0.35	0.06
	LASK RIVER						
93	*middle reaches*	-	-	0.35	-	-	0.01

*=average density figures per sub-catchment

BIOLOGICAL MONITORING OF SURFACE WATER QUALITY IN THE VICINITY OF RAMPERE LANDFILL, COUNTY WICKLOW

June 2002

Conservation Services, Tullaha, Glenflesk, Killarney, Co. Kerry
Tel/Fax 064 30130 e-mail conserv@eircom.net

CONTENTS

1. INTRODUCTION

Conservation Services, Ecological & Environmental Consultants have been commissioned by M.C. O'Sullivan & Co. Ltd. to carry out biological sampling and water quality assessment of streams/rivers in the vicinity of the landfill at Rampere, County Wicklow. Sampling was carried out on 14th June 2002.

Biological water quality assessment was previously carried out in the vicinity of the landfill in 1998 and 2000 (Conservation Services 1998; Conservation Services 2000).

2. METHODOLOGY

2.1. SITE SELECTION

Sampling was carried out at sites specified by M.C. O'Sullivan & Co. Ltd. (See Map 1). Site locations were recorded using a GARMIN GPS 38.

2.2. HABITAT ASSESSMENT

Habitat assessment was carried out at each of the sites selected for invertebrate/water quality assessment. These sites were assessed in terms of:

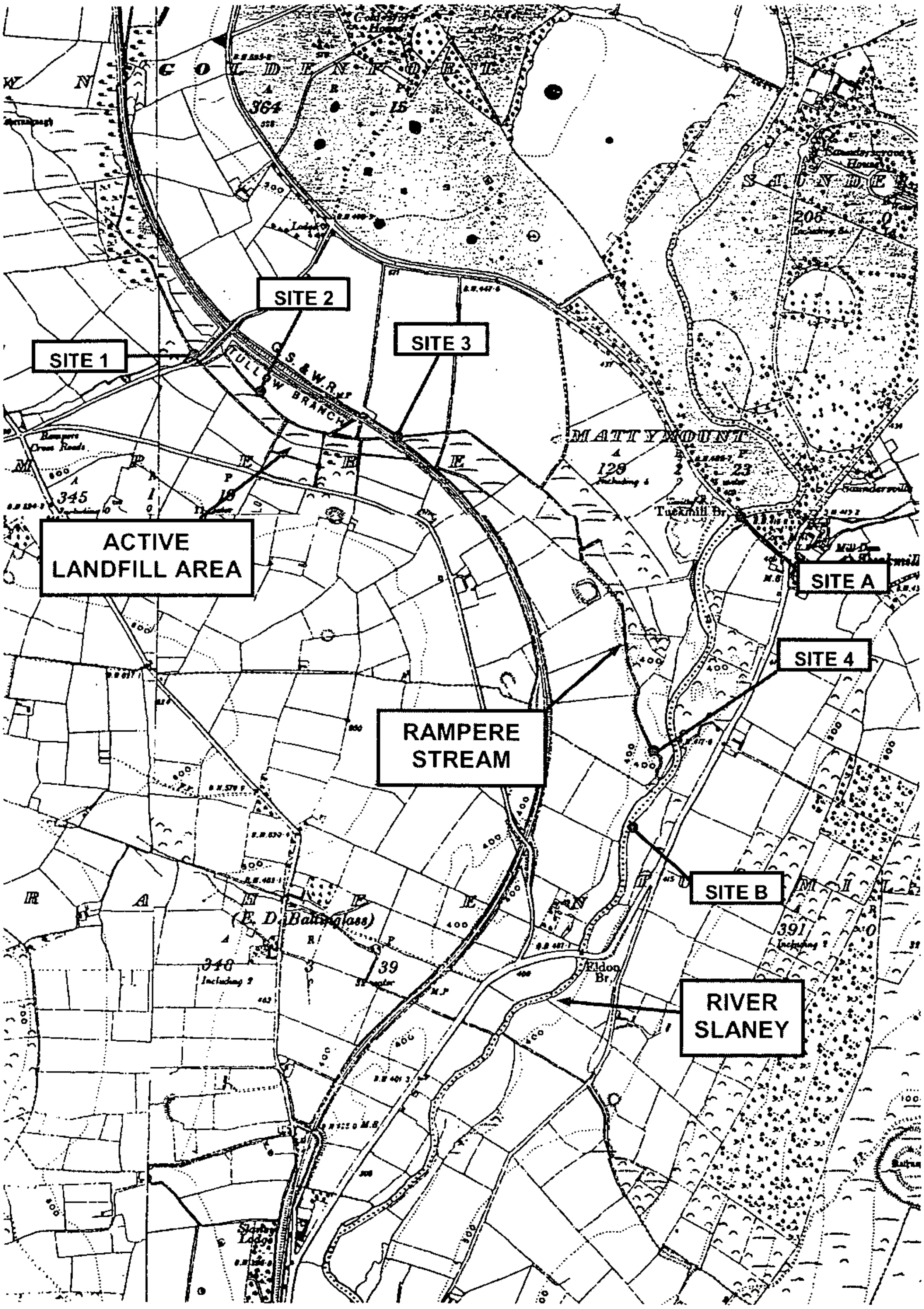
- Stream width and depth
- Substrate type, listing substrate fractions in order of dominance, i.e. large rocks, cobble, gravel, sand, mud etc.
- Flow type, listing percentage of riffle, glide and pool in the sampling area
- Instream vegetation, listing plant species occurring and their percentage coverage of the stream bottom at the sampling site
- Dominant bankside vegetation, listing the main species overhanging the stream
- Estimated summer cover by bankside vegetation, giving percentage shade of the sampling site
- Rating of the site as habitat for trout adult, nursery and spawning on a scale of Poor/Fair/Good/Very Good/Excellent. This rating assesses the physical suitability of the habitat; the presence/absence/density of salmonids at the site will also depend on present and historical water quality and accessibility of the site to fish.

2.3. INVERTEBRATE SAMPLING AND WATER QUALITY ASSESSMENT

A five-minute kick sample was taken at each of the six sampling sites. Each sample was live sorted for at least 30 minutes, and macroinvertebrates were stored in 70% alcohol. Invertebrates were identified to the level required for the EPA Q-rating method using high-power and low-power binocular microscopes.

Based on the relative abundance of indicator species, a biotic index (Q-rating) was determined for each site in accordance with the biological assessment procedure used by the Environmental Protection Agency (McGarrigle *et al*, 2002) and more detailed unpublished methodology (McGarrigle, Clabby and Lucey pers. comm.).

MAP 1 BIOLOGICAL SAMPLING SITES



3. RESULTS

3.1. SITE 1

Habitat at Site 1 is described in Appendix 1. The abundance of invertebrate indicators recorded at Site 1 in May 2002 are tabulated below. The invertebrate community at this site merits a Q-rating of Q3 indicating moderately polluted conditions.

INDICATOR GROUP	TAXON	Abundance
Group A - Pollution Sensitive	None	
Group B - Less Pollution Sensitive	Limnephilidae	17
Group C - Pollution Tolerant	Simuliidae	149
	Gammarus	88
	Chironomidae (excluding *Chironomus*)	1
	Ancylidae	3
	Coleoptera	4
	Tipulidae	4
	Baetis rhodani	11
Group D - Very Pollution Tolerant	*Lymnaea peregra*	1
Group E - Most Pollution Tolerant	Tubificidae	1
Not assigned to any indicator group	Lumbriculidae	5
	Lumbricidae	11
	Enchytraeidae	1

3.2. SITE 2

Habitat at Site 2 is described in Appendix 1. The abundance of invertebrate indicators recorded at Site 2 in May 2002 are tabulated below. The invertebrate community at this site merits a Q-rating of Q3 indicating moderately polluted conditions.

INDICATOR GROUP	TAXON	Abundance
Group A - Pollution Sensitive	None	
Group B - Less Pollution Sensitive	Limnephilidae	18
Group C - Pollution Tolerant	Simuliidae	1000s
	Gammarus	13
	Chironomidae (excluding *Chironomus*)	1
	Gastropoda (ex. *Lymnea peregra* & *Physa sp.*)	3
	Ephemerellidae	2
Group D - Very Pollution Tolerant	Hirudinea	7
Group E - Most Pollution Tolerant	None	
Not assigned to any indicator group	Nematoda	1
	Lumbricidae	7
	Stylodrilus sp.	1

3.3. SITE 3

Habitat at Site 3 is described in Appendix 1. The abundance of invertebrate indicators recorded at Site 3 in May 2002 are tabulated below. The invertebrate community at this site merits a Q-rating of Q3 indicating moderately polluted conditions.

INDICATOR GROUP	TAXON	Abundance
Group A - Pollution Sensitive	None	
Group B - Less Pollution Sensitive	Limnephilidae	7
Group C - Pollution Tolerant	Simuliidae	1
	Gammarus	3
	Chironomidae (excluding *Chironomus*)	31
	Tipulidae	2
Group D - Very Pollution Tolerant	Hirudinea	21
	Lymnaea peregra	3
Group E - Most Pollution Tolerant	Tubificidae	47
Not assigned to any indicator group	Ceratopogonidae	2
	Naididae	1

3.4. SITE 4

Habitat at Site 2 is described in Appendix 1. The abundance of invertebrate indicators recorded at Site 4 in May 2002 are tabulated below. The invertebrate community at this site merits a Q-rating of Q3 indicating moderately polluted conditions.

INDICATOR GROUP	TAXON	Abundance
Group A - Pollution Sensitive	None	
Group B - Less Pollution Sensitive	Limnephilidae	50
	Odontoceridae	6
	Goeridae	1
Group C - Pollution Tolerant	Simuliidae	6
	Gammarus	91
	Chironomidae (excluding *Chironomus*)	19
	Tipulidae	13
	Gastropoda (ex. *Lymnea peregra* & *Physa sp.*)	4.
	Ephemerellidae	1
	Coleoptera (Elminthidae)	1
Group D - Very Pollution Tolerant	Hirudinea	1
Group E - Most Pollution Tolerant	None	
Not assigned to any indicator group	*Eiseniella sp.*	3
	Stylodrilus sp.	6

3.5. SITE A

Habitat at Site A is described in Appendix 1. The abundance of invertebrate indicators recorded at Site A in May 2002 are tabulated below. The invertebrate community at this site merits a Q-rating of Q4-5 indicating unpolluted conditions.

INDICATOR GROUP	TAXON	Abundance
Group A - Pollution Sensitive	*Rhithrogena* sp.	16
	Ecdyonurus sp.	4
	Isoperla sp.	3
	Chloroperla sp.	1
	Perla sp.	1
Group B - Less Pollution Sensitive	Limnephilidae	2
	Goeridae	26
	Odontoceridae	2
	Sericostomatidae	3
	Glossosomatidae	15
	Leptoceridae	1
	Leuctra sp.	1
Group C - Pollution Tolerant	Hydropsychidae	35
	Rhyacophilidae	5
	Baetis rhodani	1
	Coleoptera (Elminthidae)	28
	Tipulidae	13
	Gammarus	1
	Hydracarina	1
	Chironomidae (excluding *Chironomus*)	1
	Ephemerellidae	12
Group D - Very Pollution Tolerant	None	
Group E - Most Pollution Tolerant	None	
Not assigned to any indicator group	*Eiseniella sp.*	1
	Enchytraeidae	9
	Stylodrilus sp.	8

3.6. SITE B

Habitat at Site B is described in Appendix 1. The abundance of invertebrate indicators recorded at Site B in May 2002 are tabulated below. The invertebrate community at this site merits a Q-rating of Q4-5 indicating unpolluted conditions.

INDICATOR GROUP	TAXON	Abundance
Group A - Pollution Sensitive	*Rhithrogena* sp.	17
	Ecdyonurus sp.	5
	Isoperla sp.	2
	Chloroperla sp.	3
	Perla sp.	2
Group B - Less Pollution Sensitive	Lepidostomatidae	1
	Goeridae	2
	Odontoceridae	1
	Glossosomatidae	15
	Leuctra sp.	1
Group C - Pollution Tolerant	Hydropsychidae	38
	Rhyacophilidae	10
	Psychomyidae	3
	Baetis rhodani	2
	Ephemerellidae	17
	Caenidae	1
	Coleoptera (Elminthidae)	31
	Tipulidae	1
	Gammarus	20
	Hydracarina	1
	Chironomidae (excluding *Chironomus*)	3
	Ancylidae	1
	Simuliidae	4
Group D - Very Pollution Tolerant	Hirudinea	1
Group E - Most Pollution Tolerant	Tubificidae	1
Not assigned to any indicator group	*Eiseniella tetraedra*	2
	Enchytraeidae	2
	Stylodrilus sp.	10
	Nematoda	1

4. DISCUSSION & CONCLUSIONS

The results of the 2002 monitoring do not indicate any significant impact from Rampere Landfill on the water quality of the Rampere Stream or on the Slaney River.

Q-values from 1998 to 2002 are tabulated in Table 1. The improvement in the water quality of the Rampere Stream immediately downstream of the landfill (Site 3) between 1998 and 2000 was maintained in 2002. In 1998 and 2000, high densities of pollution tolerant invertebrates at the Slaney sites (Sites a & B) limited the Q-values at these sites to a Q4. In 2002 the pollution tolerant invertebrates had returned to a lower density and the Q-values had improved to a Q4-5 at both Slaney sites.

TABLE 1 Q-VALUES IN THE VICINITY OF RAMPERE LANDFILL 1998-2002

		EPA	Conservation Services		
		1998*	**1998**	**2000**	**2002**
Rampere Stream Upstream of Landfill	**Site 1**	-	3	3	3
	Site 2	-	-	-	3
Rampere Stream Downstream of Landfill	**Site 3**	-	2	3	3
	Site 4	-	-	3	3
Slaney u/s Rampere	**Site A**	5	4	4	4-5
Slaney d/s Rampere	**Site B**	-	4	4	4-5

* Clabby *et al* 1999

REFERENCES

Clabby et al (1999) *Interim report on the biological survey of river quality - Results of the 1998 investigations.* Environmental Protection Agency.

Conservation Services (September 1998) *Baseline aquatic environmental survey for the waste licence application for the landfill at Rampere, County Wicklow.* Unpublished report to M.C. O'Sullivan Ltd.

Conservation Services (August 2000) *Aquatic environmental survey for the EIS for the landfill at Rampere, County Wicklow.* Unpublished report to M.C. O'Sullivan Ltd.

McGarrigle, M.L. *et al* (2002) *Water Quality in Ireland 1998-2000.* Environmental Protection Agency.

SITE 1

Site Code	1
Site Location	S8640 9181
Width	1.5m
Depth	6 - 12 cm.
Substrate	Gravel, Cobble, Sand
Flow Type	Riffle 60% Glide 40%
Instream Vegetation	*Apium nodiflorum* 5% *Phalaris arundinacea* <5%
Dominant Bankside Vegetation	Willow
Estimated % summer Cover of Stream by Bankside Vegetation	20%
Trout Adult Habitat	Fair
Trout Nursery Habitat	Good
Trout Spawning Habitat	Fair-Good

SITE 2

Site Code	2
Site Location	S8654 9171
Width	2m
Depth	12cm
Substrate	Cobble, Gravel, Sand
Flow Type	Fast Glide 100%
Instream Vegetation	*Sparganium erectum* <5% *Iris pseudacorus* <5% *Apium nodiflorum* <5%
Dominant Bankside Vegetation	Hawthorn
Estimated % summer Cover of Stream by Bankside Vegetation	40%
Trout Adult Habitat	Fair
Trout Nursery Habitat	Good
Trout Spawning Habitat	Fair-Good

SITE 3

Site Code	3
Site Location	S8683 9161
Width	3m
Depth	25cm
Substrate	Mud, Sand, Gravel
Flow Type	Glide 100%
Instream Vegetation	*Apium nodiflorum* <5% *Phalaris arundinacea* <5% *Callitriche* sp. <5%
Dominant Bankside Vegetation	Grass, Nettle
Estimated % summer Cover of Stream by Bankside Vegetation	5%
Trout Adult Habitat	Fair
Trout Nursery Habitat	Poor - Fair
Trout Spawning Habitat	None

SITE 4

Site Code	4
Site Location	S 8749 9089
Width	2-3m
Depth	45cm
Substrate	Sand, Gravel, Mud
Flow Type	Glide 100%
Instream Vegetation	*Ranunculus* sp. 80% *Phalaris arundinacea* 10%
Dominant Bankside Vegetation	Alder
Estimated % summer Cover of Stream by Bankside Vegetation	20%
Trout Adult Habitat	Poor - Fair
Trout Nursery Habitat	Fair
Trout Spawning Habitat	Poor

SITE A

Site Code	A
Site Location	S8762 9145
Width	C. 20m
Depth	30-60cm
Substrate	Gravel, Sand
Flow Type	Riffle 35% Glide 65%
Instream Vegetation	None
Dominant Bankside Vegetation	Chestnut, Ash
Estimated % summer Cover of Stream by Bankside Vegetation	<5%
Trout Adult Habitat	Good - Very Good
Trout Nursery Habitat	Good - Very Good
Trout Spawning Habitat	Good - Very Good

SITE B

Site Code	B
Site Location	S8744 9078
Width	c. 18m
Depth	25cm
Substrate	Gravel, Cobble, Sand
Flow Type	Riffle 20% Glide 80%
Instream Vegetation	*Ranunculus* sp. 30%
Dominant Bankside Vegetation	Alder
Estimated % summer Cover of Stream by Bankside Vegetation	5%
Trout Adult Habitat	Good - Very Good
Trout Nursery Habitat	Fair
Trout Spawning Habitat	Good - Very Good

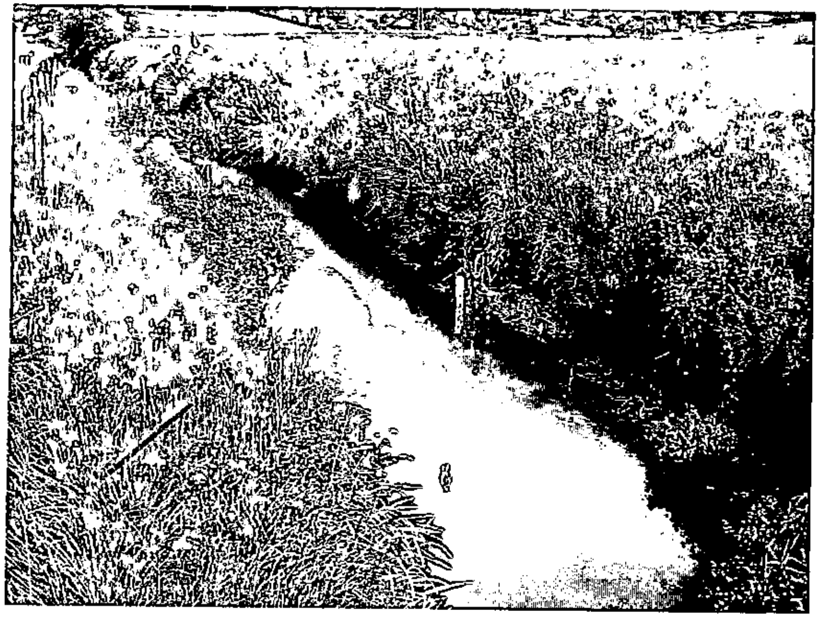
APPENDIX 2

PHOTOGRAPHS OF SAMPLING SITES

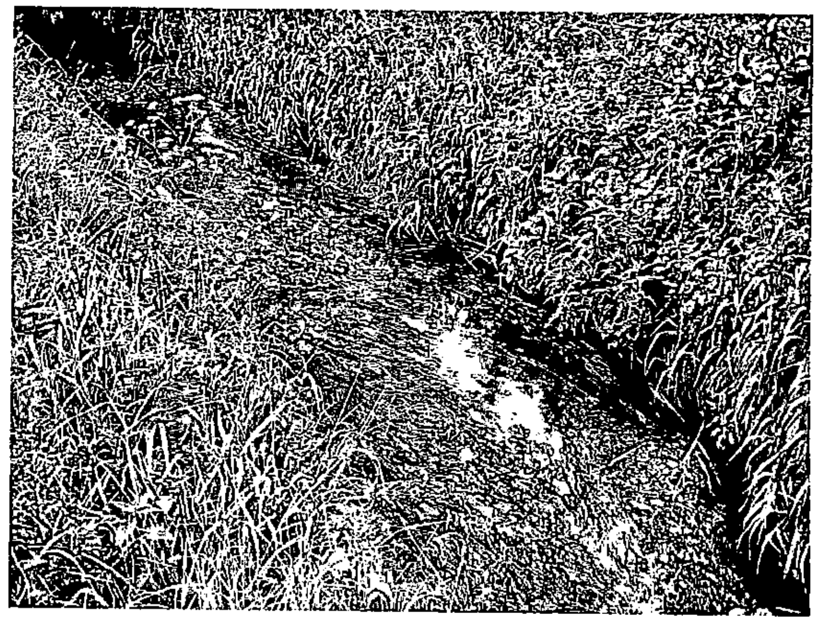
SITE 1

SITE 2

SITE 3

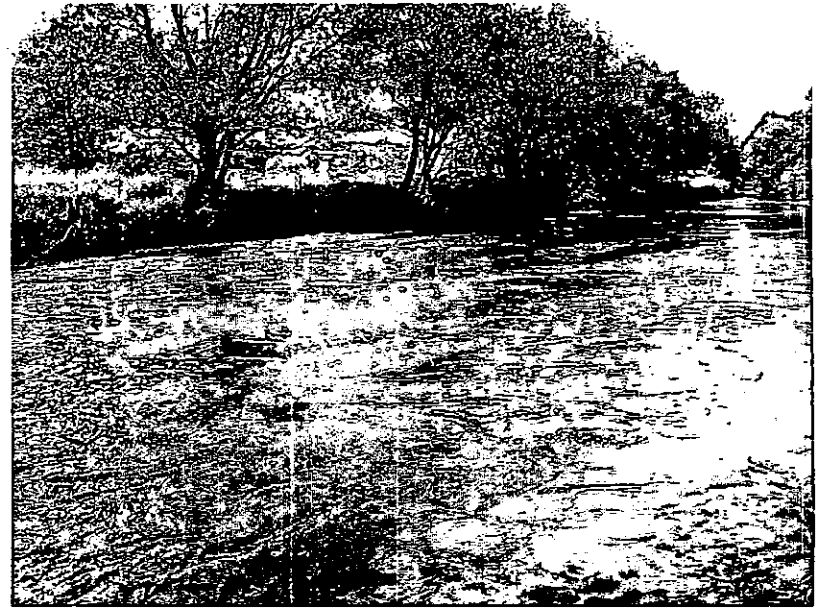


SITE 4



SITE A

SITE B



APPENDIX 4

FLORA & FAUNA

ROGER GOODWILLIE & ASSOCIATES

Landfill at Rampere, Co. Wicklow

Flora & Fauna Survey

Report for M.C.O'Sullivan Ltd.

August 2002

Roger Goodwillie & Associates, Lavistown House, Kilkenny.
Tel. 056-65145

1. INTRODUCTION

The Rampere landfill occurs on the southern side of a small NW-SE stream, a tributary of the Slaney. The proposed extension into the field to the west takes in a section of the disused floodplain (the stream has been deepened) and the valley side up to the road. It is currently in pasture with deep, clayey soil in the northern half, shallowing on the slope. The drain marked on the 6" sheet, parallel to the stream has been filled in and probably piped.

The area was examined in August 2000 and had previously been seen in September 1998.

2. HABITATS

The habitats that occur are grassland, hedges and the stream and they will be described in this order. The vegetation is first dealt with followed by notes on the vertebrate fauna. No investigation of invertebrates was done as there were no natural habitats of significant interest.

2.1 Grassland

The field can be divided into an upper well-drained section and a lower, damper one though the parts share a good proportion of plant species. Thus ryegrass *Lolium perenne*, white clover *Trifolium repens*, rough-stalked meadowgrass *Poa trivialis*, Yorkshire fog *Holcus lanatus* and mouse-ear *Cerastium fontanum* are ubiquitous and there is scattered creeping thistle *Cirsium arvense*, docks *Rumex obtusifolius* and creeping buttercup *Ranunculus repens* throughout. The sloping section has been well trampled at its western end where animals have been fed and the weed species there are

Poa annua	annual meadowgrass
Stellaria media	chickweed
Polygonum aviculare	knotgrass
Persicaria maculosa	redshank
Urtica dioica	nettle

The flat land on the floor of the valley has a broader range of plant species, especially around a few long-lasting pools which are probably seasonal springs, other muddy places and vehicle ruts. These generally include crested dogstail *Cynosurus cristatus*, marsh foxtail *Alopecurus geniculatus*, creeping bent *Agrostis stolonifera*, autumn hawkbit *Leontodon autumnalis* with a little oval sedge *Carex ovalis*, hairy sedge *C.hirta* and silverweed *Potentilla anserina*. In the wetter places the marsh foxtail

Alopecurus geniculatus predominates, often with sweet grass *Glyceria declinata* and some greater plantain *Plantago major*, marsh ragwort *Senecio aquaticus*, toad rush *Juncus bufonius* and cudweed *Gnaphalium uliginosum*. Wheel ruts in the NE corner add pale persicaria *Persicaria lapathifolium*, water pepper *P.hydropiper*, hoary willowherb *Epilobium parviflorum* and brooklime *Veronica beccabunga*.

2.2 Hedgerow

Hedges surround the field entirely and are based on hawthorn Crataegus monogyna and bramble Rubus fruticosus with elder *Sambucus nigra*, clipped ash *Fraxinus excelsior* and snowberry *Symphoricarpos albus* along the road and six, well-grown pine trees *Pinus sylvestris* on the SE margin. The stream is also lined by hawthorn with some blackthorn *Prunus spinosa* and wild rose *Rosa canina*. The roadside hedge has a good range of associated plants as in places it is out of the range of grazing cattle. The following occur

Anthriscus sylvestris	cow parsley
Polystichum setiferum	shield fern
Dryopteris filix-mas	male fern
Phyllitis scolopendrium	hartstongue
Viola riviniana	violet
Geranium robertianum	herb robert
Potentilla sterilis	barren strawberry
Epilobium montanum	willowherb
Lapsana communis	nipplewort
Sagina procumbens	pearlwort

Elsewhere the base of the hedge is usually concealed by a tall growth of nettle *Urtica dioica*, goosegrass *Galium aparine*, cocksfoot *Dactylis glomerata* and false oat *Arrhenatherum elatius* or by spreading stems of bramble *Rubus fruticosus*. The hedge by the stream incorporates a little tormentil *Potentilla erecta* while the western end has birdsfoot trefoil *Lotus corniculatus*, common bent *Agrostis capillaris* and germander speedwell *Veronica chamaedrys*.

2.3 Stream

There are two distinct parts of this habitat, the rapid section that flows under the road and takes a sharp bend to the NE and the broader and slower channel at the base of the field. The former is open and characterised by

Glyceria notata	sweet grass
Apium nodiflorum	fool's watercress
Epilobium hirsutum	great willowherb
Phalaris arundinacea	reed grass
Filipendula ulmaria	meadowsweet
Iris pseudacorus	yellow flag
Angelica sylvestris	wild angelica

It is fenced off so that red fescue *Festuca rubra*, sorrel *Rumex acetosa* and tufted häirgrass *Deschampsia cespitosa* grow in the adjacent grassland.

When it turns SE the stream becomes overgrown with hawthorn and brambles, as mentioned. Aquatic species such as reed grass *Phalaris arundinacea*, meadowsweet *Filipendula ulmaria*, wild angelica *Angelica sylvestris* and fool's watercress Apium nodiflorum mange to persist in places but they have to compete with hedge species, especially goosegrass *Galium aparine* and nettle *Urtica dioica*.

2.4 Adjacent habitats

Much of the surrounding land has been improved agriculturally so that natural ecological features have disappeared. There is no rough grazing such as is marked on the 6" map and all fields are in pasture. A little gorse *Ulex europaeus* remains at the north-west corner with hard rush *Juncus inflexus* and meadowsweet *Filipendula ulmaria*. A larger, unimproved habitat - willow scrub - occurs about 0.5km away to the north-west.

3. FAUNA

The rabbit is the only obvious mammal present with burrows at the south-eastern edge of the field. However brown rat, house mouse and field mouse are very likely to be present with foxes occasionally visiting. There is no evidence of badgers though they are likely to be in the general area.

The birds using this field consist of regular 'field' species such as rook (5 nests occur in the pine trees), magpie, woodpigeon and starling and those that depend more on the hedges for cover and food. These include chaffinch, redpoll, wren, dunnock, robin and blackbird. Outside the breeding season there are a few meadow pipits in the area with occasional snipe

Many of the species associated with the adjoining landfill make some use of the area, usually for resting after feeding. A count on the landfill in September 1998 gave

Lesser black-backed gull	152
Rook	60
Jackdaw	150
Hooded crow	25
Raven	4
Magpie	8
Linnet	20
Chaffinch	1
Goldfinch	2
Pied wagtail	4

Some of the gulls at that time were in the field where there was standing water but the other species would only use it sporadically. In the evening the gulls seem to leave the area and probably follow the Slaney down to Wexford, to roost in the Harbour. The rooks and other corvids roost in trees north-east of the site where some additional ones nest.

The stream is small and offers limited feeding to the vertebrates normally associated with the habitat. Grey wagtail and dipper are likely to occur in open places and there could be occasional use by kingfisher, mallard and heron. Fish in this area are likely to consist mainly of stickleback though trout would occur lower down where it flows into the Slaney. It would have limited importance as a trout nursery stream because of its small size in summer.

4. EVALUATION

There are no features in this field or its immediate environs which are of significant ecological interest. All the species are typical of surrounding farmland except for the scavenging birds which are attracted and concentrated by the neighbouring landfill.

4.1 Designations

The site is not included in any designated area under national law or the EU Habitats (92/43/EEC) or Birds (79/409/EEC) Directives. The nearest proposed Natural Heritage Area is Lowtown Fen (# 1764) which is 1.5km to the north-west. No specially protected habitat or species occurs in the area.

5. IMPACT OF LANDFILL

The landfill extension would obliterate the grassland habitat but would not have a significant ecological impact on the surrounding area provided leachate does not enter the stream in large quantities. Existing agriculture obviously causes some eutrophication of this habitat already.

As long as a landfill operates there will be slight nutrient enrichment of adjacent fields and a potential risk of bacterial contamination from bird droppings. Some transport of plastic and paper into the surroundings is also likely.

APPENDIX 5

AGRICULTURAL IMPACT STUDY

DR. EDWARD J. BOLGER

FARM MANAGEMENT CONSULTANTS LTD.

RAMPERE LANDFILL

AGRICULTURAL ACTIVITIES AND THE IMPACTS WHICH THE DEVELOPMENT OF A WASTE LANDFILL COULD HAVE ON THESE ACTIVITIES

PREPARED BY

DR. EDWARD J. BOLGER
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35 WILLIAM STREET
LISTOWEL
CO. KERRY

E.J.B/C.P. **AUGUST 2000**

AGRICULTURAL ACTIVITIES AND THE IMPACTS WHICH THE DEVELOPMENT OF A WASTE LANDFILL COULD HAVE ON THESE ACTIVITIES

Farm Management Consultants Ltd. were requested by M. C. O'Sullivan & Co. for Wicklow County Council to carry out a study of agriculture in the vicinity of the Rampere Landfill site. The purpose of the study was to examine current agricultural activities in the area and to assess the impacts of the extension of the landfill on these activities.

Description of the Site, Soil Potential and Current Land Use

The writer visited the site on the 10th September 1998 and on the 7/7/2000 and met with a number of landowners adjacent to the site.

Description of the Site

Rampere Landfill is sited 2.0 Km north of Baltinglass just off the N81. The land adjacent to the landfill is intensively farmed with most of the land being suitable for either tillage or pasture. Two of the landowners adjacent to the site have horses and the other farmers are involved in dairying, dry cattle and tillage.

Soil Potential

The soils of County Wicklow were not classified in detail by an Foras Taluntais.
However, on examination it is apparent that most of the lands in the immediate vicinity of the landfill consists of Acid Brown Earth and Grey Brown Podzolic soils.

Acid Brown Earths

Acid brown earths are relatively mature and well drained, they normally possess medium texture (sandy loam, loam, sandy clay loam), they are generally good arable soils. Although normally of rather low nutrient status in their natural state they respond well to artificial fertilisers. With good management they can support high quality grassland.

Grey Brown Podzolic

In general the Grey Brown Podzolic soils possess a somewhat heavier texture than the Acid Brown Earth's, they are well to moderately well drained. Under Irish Climatic conditions the lighter textured members of the Grey Brown Podzolic group are good all purpose soils. When adequately manured and managed they are very productive and suitable for most agricultural enterprises. The heavier textured members are more suitable grassland soils, responding well to good manurial and management practises.

All the lands in the immediate area are used for tillage or grassland. The grassland enterprises are mainly dairying and dry cattle production, but two of the landowners adjacent to the site have some thorough bred horses.

Possible Agricultural Impacts Associated with a Landfill

A landfill has a potential to cause harm to animals and crops on adjacent farmland unless it is contained and controlled.

The potential impacts on the practise of agriculture in the immediate vicinity of a landfill may be summarised as follows.

1. **Contamination of ground water and surface water**

   Contaminated ground water could affect the quality of water in wells and watercourses. Contaminated water could have an effect on animal health and dairy hygiene. It is essential that leachate is properly controlled so as to eliminate the risk of contamination. Some of the landowners did express serious concerns about contaminated surface water and ground water.

2. **Spread of litter and debris by windblow**

   Poor litter control both on and off site is particularly offensive to neighbours.
   In addition, plastic debris may be blown about and come to lie on adjacent farmland where it might be ingested by animals. The proper management of the landfill with the covering of refuse and the use of catch fencing should reduce this problem considerably.

3. **Scavenging Birds**

   Birds are attracted to landfill sites in large numbers, particularly where appreciable amounts of food wastes are available. The presence of scavenging birds is undesirable because they may contaminate the grass and crops with high density droppings. In addition, crows and gulls can contaminate feed and water troughs with the possibility of spreading salmonella. Crows will also feed on mature grain crops and one landowner did say he had a problem with crow damage. Bird control techniques should be carefully planned so as to mitigate bird nuisance and damage.

4. **Vermin and Pests**

These pests could spread disease e.g. leptospirosis, tuberculoses and salmonella.
It is important to have a preventative baiting programme in place so as to avoid build up of these pests.

5. **Insects**

The control of flies is very important in relation to animal health, dairy hygiene and general hygiene and it is important that flies are controlled.

6. **Odours**

Offensive odours at landfill sites may emanate from a number of sources namely old refuse disturbed by digging, leachates and landfill gases.
The impact of general site smell can be reduced by effective landfill gas management, use of appropriate types of cover, progressive capping and restoration.

7. **Traffic Noise**

Noise and general disturbance associated with truck movements may disturb the solitude of the rural setting. Soil bunding and tree planting should reduce the effect of noise.

8. **Traffic Hazard**

It is important that there is a proper road access to the landfill.
Heavy traffic flows on poor roads do impact on general farm operations and cause a nuisance to local farm traffic. Most of the landowners contacted did express concerns about the impact of numerous truck movements on local farm traffic.

9. **Dust**

Dust and air-borne bacteria may spread from the site and act as respiratory irritants for animals. Dust suppression can be effective by spraying roads with water. Seeding bare earth surfaces as quickly as possible after soil materials have been placed will also reduce the effects of dust.

10. **Fly Tipping and Unauthorised Dumping**

Fly tipping and the unauthorised dumping of toxic waste, butchers waste and dead animals must be carefully controlled as it could seriously impact on agriculture in the area.

11. **Fires**

The effect of fires on the landfill site with the consequent smoke and ash spreading to adjacent lands could also have an adverse impact. It is important that waste is covered to minimise the risk of fire.

12. **Noxious Weeds and Site Restoration**

Noxious weeds (Ragweed) may grow on the site and seeds may blow over the boundary and infest farmland. These weeds will have to be controlled either by spraying or mowing. The site must be properly capped and restored and returned to agriculture, forestry or amenity use as soon as possible.

Overall General Impact on Agriculture in the Area

The writer met a number of landowners on all four sides of the landfill.
In general the landowners were satisfied with the way the existing landfill was managed, but did express concerns about the extension of the landfill.

There was some concern that crows and gulls were carrying waste into adjoining pasture and depositing waste in water and feed troughs. Farmers expressed genuine concern about the danger of the spread of brucellosis, salmonella, leptospirosis and tuberculoses.

Some landowners did express concern about contaminating both ground water and surface water.

Most farmers were concerned about the impact on local traffic if the landfill is extended. There was very little complaint about noise, flies or smells.

In general the writer would say that existing landfill site is reasonably well managed and this is borne out by the comments of the adjacent landowners.

Prepared by: ____________________

Dr. Edward J. Bolger
(Agricultural Consultant)

Date: **4^{th} August 2000**

APPENDIX 6

LANDSCAPE & VISUAL ASSESSMENT

GERRY MITCHELL & ASSOCIATES.

1.0 Introduction:

The proposed extension to the existing landfill site at Rampere is situated approximately 1 Km north of Baltinglass, Co. Wicklow to the west of the Baltinglass to Dublin road (N81). The site is located on the south side of a valley with the existing landfill located to the east, which is currently being filled. To the west, south and north of the site are agricultural fields in pastureland. At the northern boundary there is a stream running in a west-to-east direction beyond which is the alignment of a former railway line.

1.1 Topography:

The subject site has a high point of 145m O.D. at the south west corner adjacent to the local access road to the south.

From here the land falls steeply towards the centre of the site to a level of 125m O.D. where the land levels off, falling gently to the northern boundary, to a level of 121m O.D. (see Fig. 1)

1.2 Slope Regime:

Steep slopes are confined to the south western portion of the site, where the slope regime varies between 1 in 5 and 1 in 20.

At the north eastern portion of the site the land levels off having a slope regime of 1 in 50 and less. (see Fig. 2)

1.3 Existing Vegetation:

Vegetation on site consists of grassland, hedgerow planting around the site boundary with some tree planting located in the hedgerow.

The main tree species are as follows:-

Pine (located along the western boundary of the existing landfill site)

Beech (located along roadway at the southern boundary). For further plant species see Flora and Fauna section of EIS.

1.4 LAND USE

The subject site is agricultural land in pasture for cattle, horses and sheep. To the east is the existing landfill site, which is in operation at present. The land to the west, south and north is in agricultural production.

There are a number of residential units located around the site as follows:

- four units to the north
- one unit located to the west at Rampere Cross Roads
- one unit to the south, across the local access road.
- three units to the east of the existing landfill site

1.5 VISUAL ANALYSIS

The subject site presents as a visually-unremarkable sub-section of a much larger agricultural landscape.

Views into the site from the public domain are primarily along the local access roads to the south and west of the site. Views along the access road to the south are limited due to the existing hedgerow, while views in from the road to the west are more open.

Views into the site from private residences are as follows:-

- There is a farm house located approximately 275m to the north of the site with open views into the site.
- There are 3 no. bungalows further to the north.
  Views into the site from these houses are not full views and only a portion of the site can be seen.

- There is a house located to the south of the site across the local access road with a partial view to the northern end of the site.

Views out of the site look north-east over the agricultural pastureland towards the Dublin Mountains.

2.0 Description of Project:

The project consists of the extension to the west of the existing landfill site at Rampere, Co. Wicklow.

On site facilities will include the following:

- Service road
- Administration building
- Weighbridge
- Recycling area
- Parking area
- Gas compound area
- Waste inspection area
- Storage chamber (5m x 5m x 2m high)

3.0 Impact During Construction Stage:

The visual impact during the construction stage will be significant and negative.

The impact will be a short-term impact and will consist of the following elements

- Movement of refuse trucks to and from site.
- Landfill operations.

Mitigation of the impact of the interim landfill operations will be by virtue of the height of the ground level of the reinstated landfill, which will

screen the operations to the south, together with the existing hedgerow.

Provision of dense woodland screen planting to the site boundaries to the north, west and south.

4.0 Impact and Mitigation:

The proposed landfill will have a significant and neutral impact on the landscape. The visual impact can be gauged from the previous landfill which has been reinstated as grassland and has blended into the surrounding landscape quite well. The proposed landfill will be formed as a graded mound with a high point of 146m O.D. located at the south western corner of the site. From this high point the land form will slope towards the northern boundary, at a slope of approximately 1 in 5, until it grades gradually in with the existing land to the north of the site. The mound will also be graded to the ground level of the existing landfill site. The land will then be returned to grassland to blend in with the surrounding agricultural land.

Native woodland screen planting will be planted along the boundaries to the north, west and south with some scrub woodland planting between the proposed and existing landfill sites.

FIG. 1 TOPOGRAPHY MAP

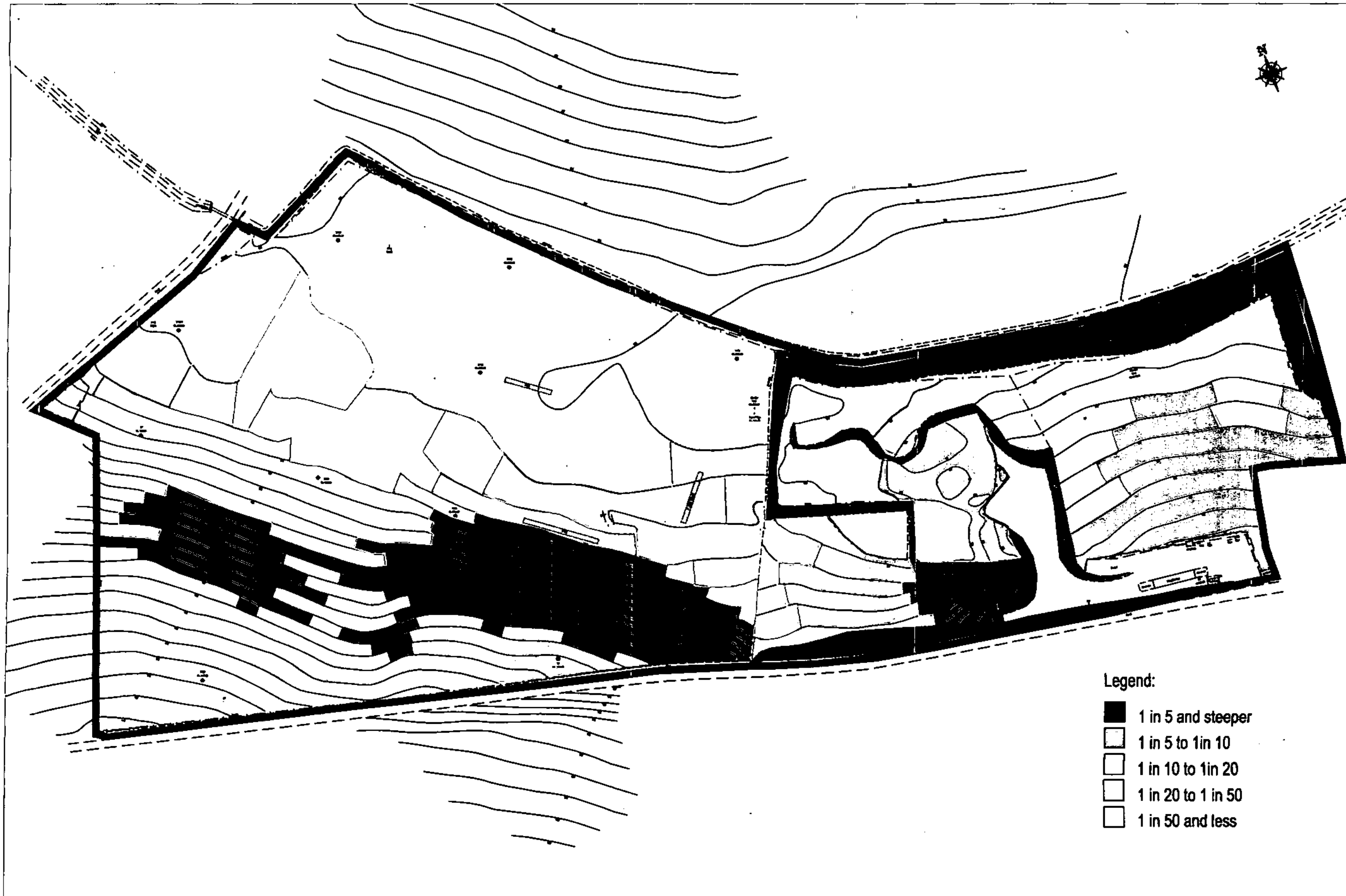


FIG. 2 SLOPE MAP

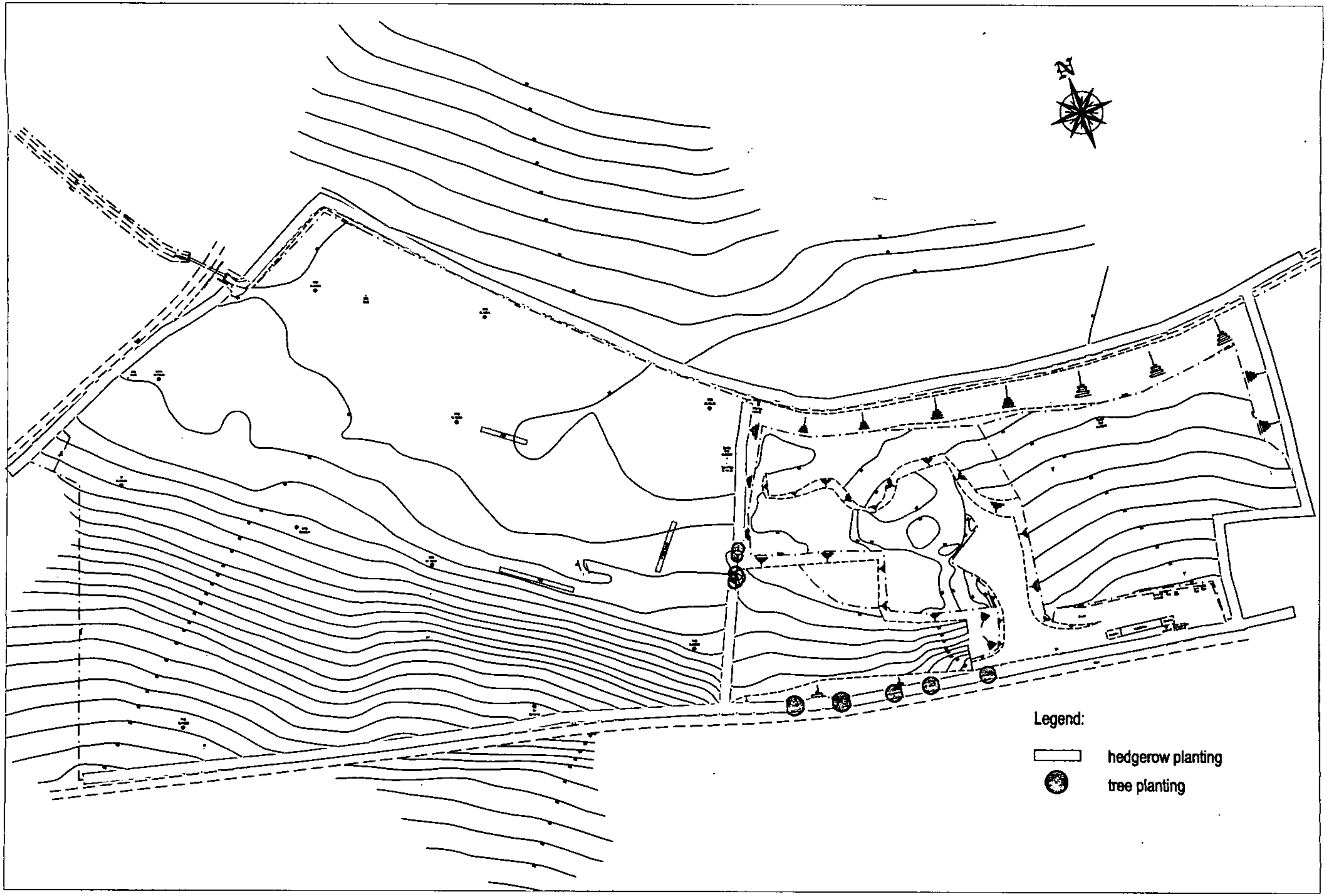


FIG. 3 VEGETATION MAP

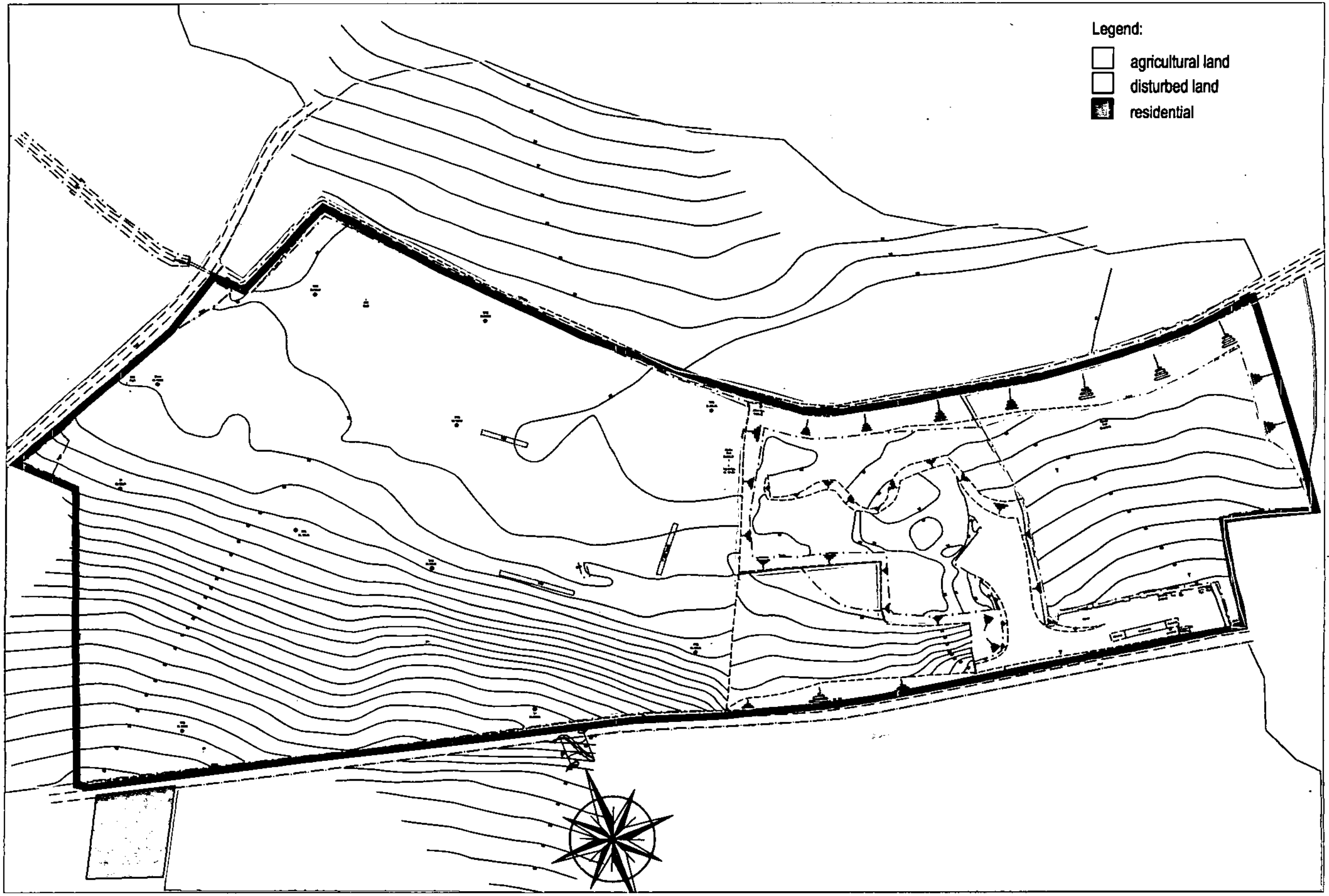


FIG.4 LAND USE MAP

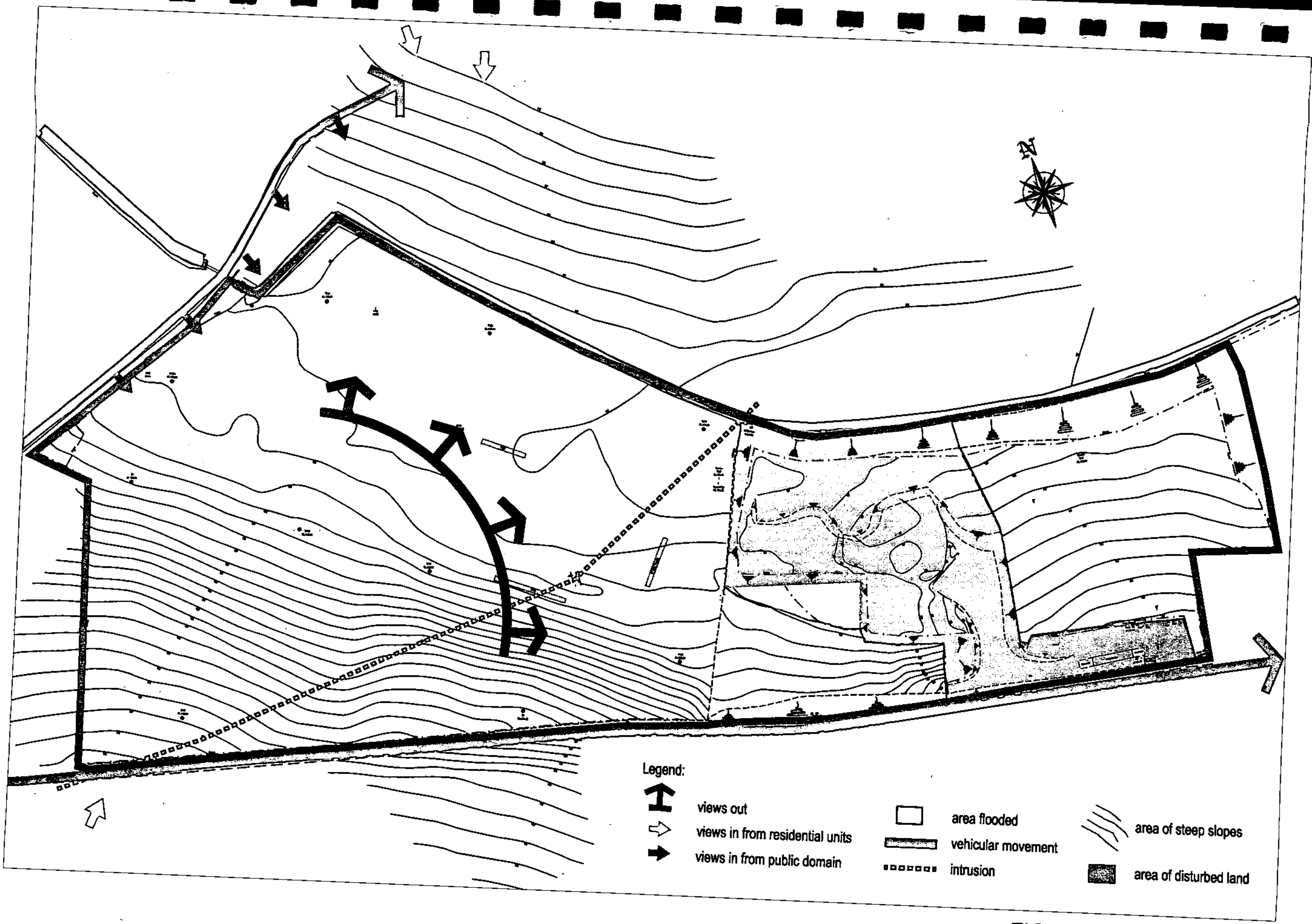
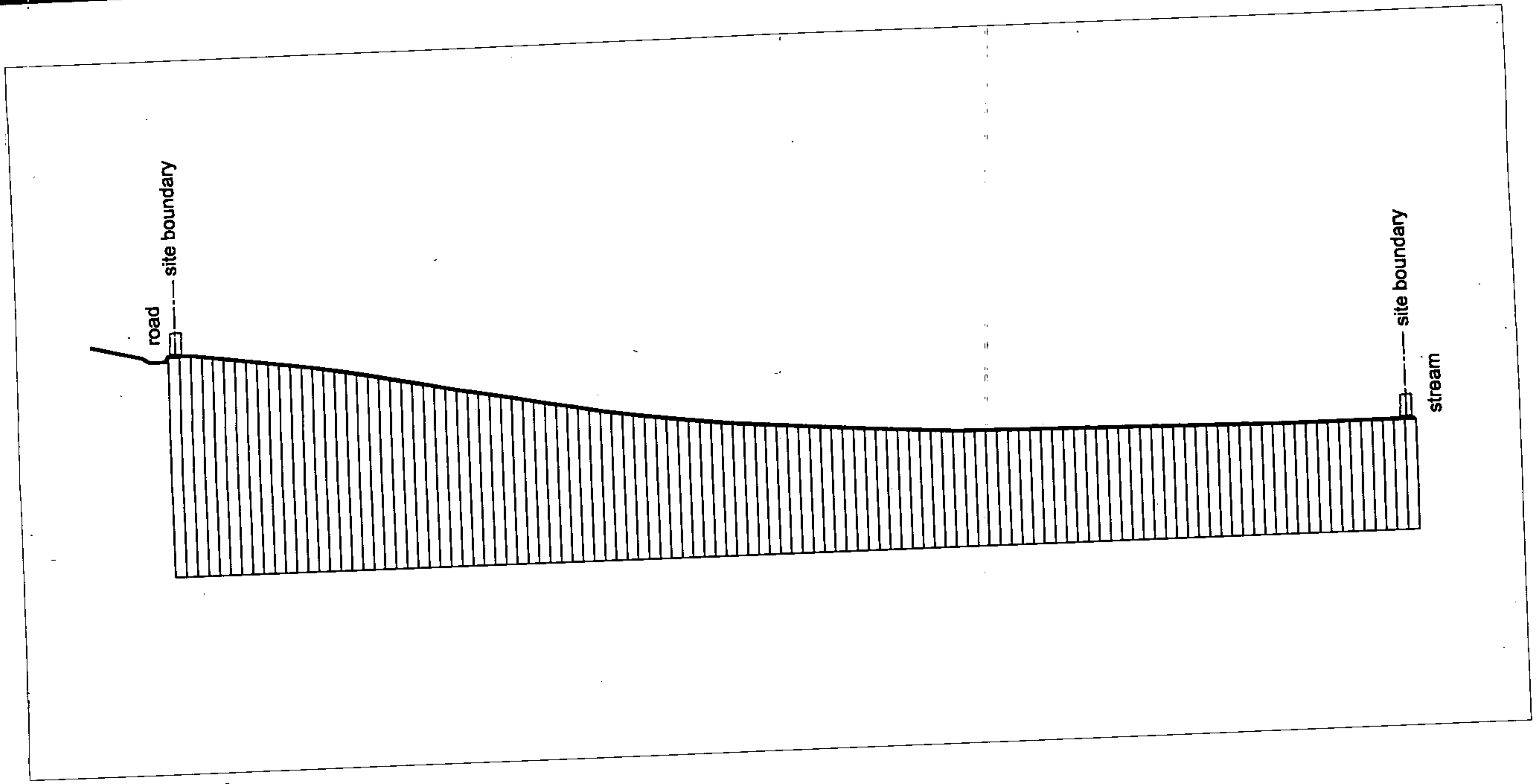
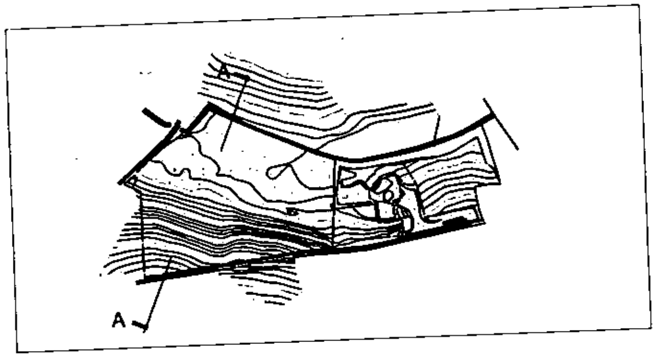


FIG. 5 VISUAL ANALYSIS



SECTION A - A



KEY PLAN

Fig. 6 SITE TRANSECT

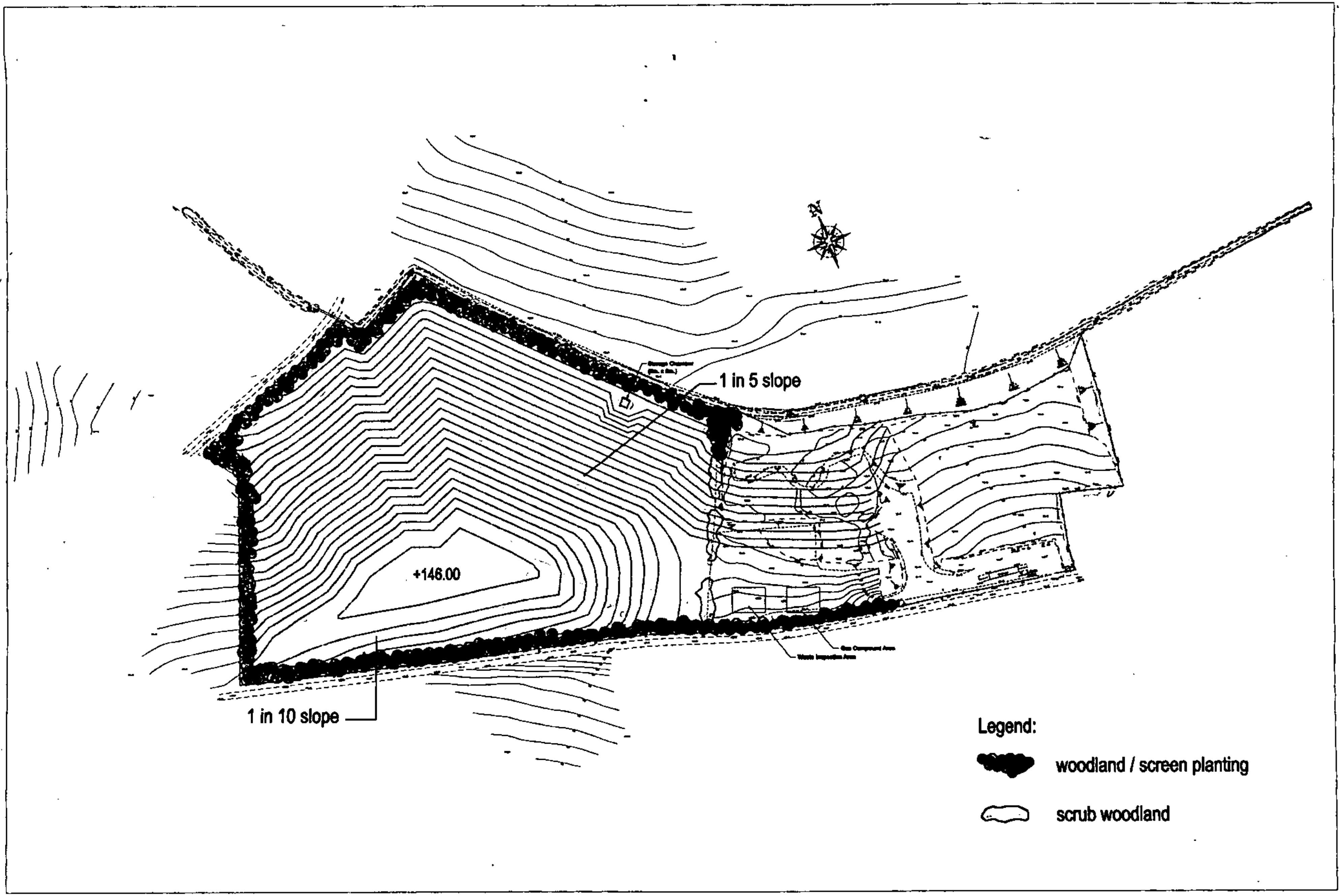


Fig. 7 LANDSCAPE LAYOUT

View looking east along local access road to the south

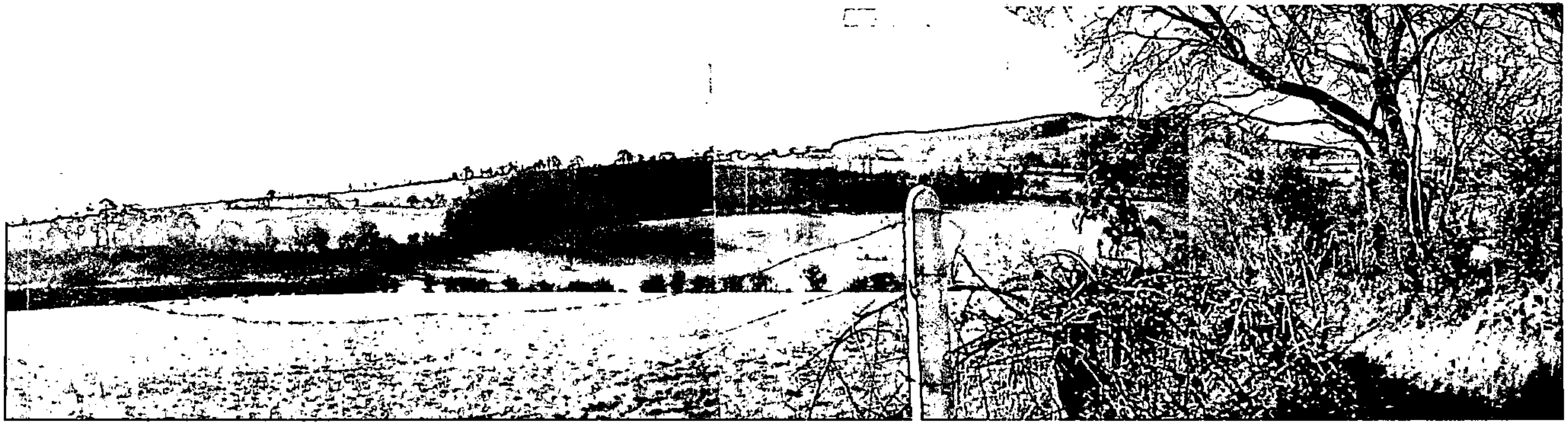
View looking west along local access road to the south

Plate 1

View looking north into site with existing landfill to the east

View looking north into site showing site character

Plate 2



View looking south into site from residential unit to the north

View looking south into site from local access road to the west showing site character

Plate 3

View looking east towards site from Rampere Cross Roads

Plate 4

APPENDIX 7

AIR ASSESSMENT

ENVIROCON LTD.

AIR POLLUTION & ENVIRONMENTAL CONSULTANCY

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Air Quality Impact of Proposed Landfill Extension Rampere, Co. Wicklow

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Date: 20 September 2000

Report By: Michael L. Bailey

1.0 INTRODUCTION

The existing landfill at Rampere, Baltinglass, Co. Wicklow, is to be extended to provide short-term additional capacity for the disposal of municipal waste from the west Co. Wicklow region. The proposed extension is on land west of the existing landfill area. As part of the evaluation of the environmental impact of this proposed development, an assessment of the impact on air quality was undertaken by Envirocon Ltd.

2.0 EXISTING ENVIRONMENT

2.1 Ambient Air Quality

2.1.1 General

The air quality of the surrounding area is good with no evidence of any adverse impact from dust emissions from the landfill operation. The existing landfill site is relatively small with a total area of about 7 acres and is surrounded by open pasture lands to the north with a mature vegetated slope to the south. It has been in operation for a number of years and there have been no reports of dust levels creating a local nuisance in the vicinity of the nearby houses. It is located within a small valley at about 150m O.D. draining south eastwards into the River Slaney. There are no significant sources of dust emissions apart from isolated residential properties and farming activities within 1km of the site. There is extensive mature vegetation cover along the public road running along the southern side of the landfill site which acts as an effective screen and so reduces the dispersion of dust emissions from the landfill activities.

2.1.2 Dust

No dust deposition sampling has been carried out along the boundary of the existing landfill due to the rural location and low level of activity within the landfill operation. Due to the relatively small-scale operation at Rampere, it is estimated that monthly average rates of dust deposition near the site boundary and close to Rampere Cross Roads will be generally less than 75 mg/m^2.day. The highest dust levels are likely close to the entrance to the site due to resuspension of material from the road surface by passing vehicles. Beyond a few metres from the haul road deposition rates will decrease significantly to near to background levels close to the site boundary.

Dust deposition rates experienced along the public road bordering the south of the site will be primarily due to passing vehicles with dust emissions from the landfill only making a minor contribution to total dust levels.

A monthly average deposition rate of 100-130 mg/m^2.day is widely used as a dust deposition limit value by Local Authorities in Ireland in relation to Planning or Air Pollution Licence conditions for quarrying and related activities to prevent a community nuisance.

2.1.3 Odours

There have been no reports of a local odour nuisance due to the site operations in recent years. The older areas of the landfill, in the eastern portion have been re-instated and so the active tipping area is restricted to the western end of the site. Strong malodours were identified during the site visit in September 2000 in the locality of the active tipping area where uncovered municipal waste was observed

During the site visit the weather conditions were characterised by overcast relatively mild conditions with a wind of less than 5m/s and so it is likely that pungent malodours would be prevalent from areas of uncovered waste during warm dry conditions. However, during the site visit no malodours associated with landfilling operations could be detected near the road running along the southern site boundary.

The odours observed was typical of those identified at other landfill sites and result from a mixture of decomposing older waste material along with odours from freshly tipped waste. The types of compounds associated with these malodours include, organic sulphides (e.g. carbon disulphide, methyl mercaptan), esters and other hydrocarbons (e.g. benzene, toluene, ethyl benzene, thiophene, and limonenes), some of which have very low levels of odour detection.

2.1.4 Ambient air concentrations

21.4.1 Sulphur dioxide and Nitrogen oxides

Ambient concentrations of sulphur dioxide and nitrogen dioxide downwind of the landfill would be comparable to background concentrations measured at other rural locations in Ireland, well removed from any major industrial sources. There are no significant industrial emission sources within 2km of the site boundary with livestock and pasture land to the north of the site. Baltinglass is about 2km to the east of the site and so would not have any significant impact on ambient air quality at Rampere.

The levels of air pollutants in the area would be well below the current National Air Quality Standards (NAQS), (SI.No 244 of 1987). Daily concentrations of sulphur dioxide would not exceed about 15 $\mu g/m^3$, which is less than 5% of the current NAQS of 350 $\mu g/m^3$. In terms of nitrogen dioxide concentrations, the highest levels in the area would be observed adjacent to the minor public roads in the area. Annual concentrations would typically be in the range of 5-10 $\mu g/m^3$. These levels are well below the annual limit value specified in the E.U. 1999 Air Quality Directive (1999/30/EC) which specifies an annual limit value for nitrogen dioxide of 40 $\mu g/m^3$, to be met by 2010. The current NAQS legislation is shortly to be revised, to comply with the limit values specified in this Air Quality Directive.

2.1.4.2 Aerosols and PM_{10}

There are no existing National Air Quality Standards for aerosols or PM_{10} (particles less than 10 μm aerodynamic diameter). The 1999 E.U. Air Quality Directive

specifies a daily limit value of 50 $\mu g/m^3$, not to be exceeded more than 35 times in a year, with a corresponding annual limit value of 40 $\mu g/m^3$. These limit values are to be met is 2005. Given the rural location, levels will be well below these ambient limit values with daily levels typically 10-20 $\mu g/m^3$.

The ambient concentrations of PM_{10} experienced in the locality of Rampere Cross Roads will be primarily due to agricultural emissions and dust resuspended from the road verge by passing vehicles.

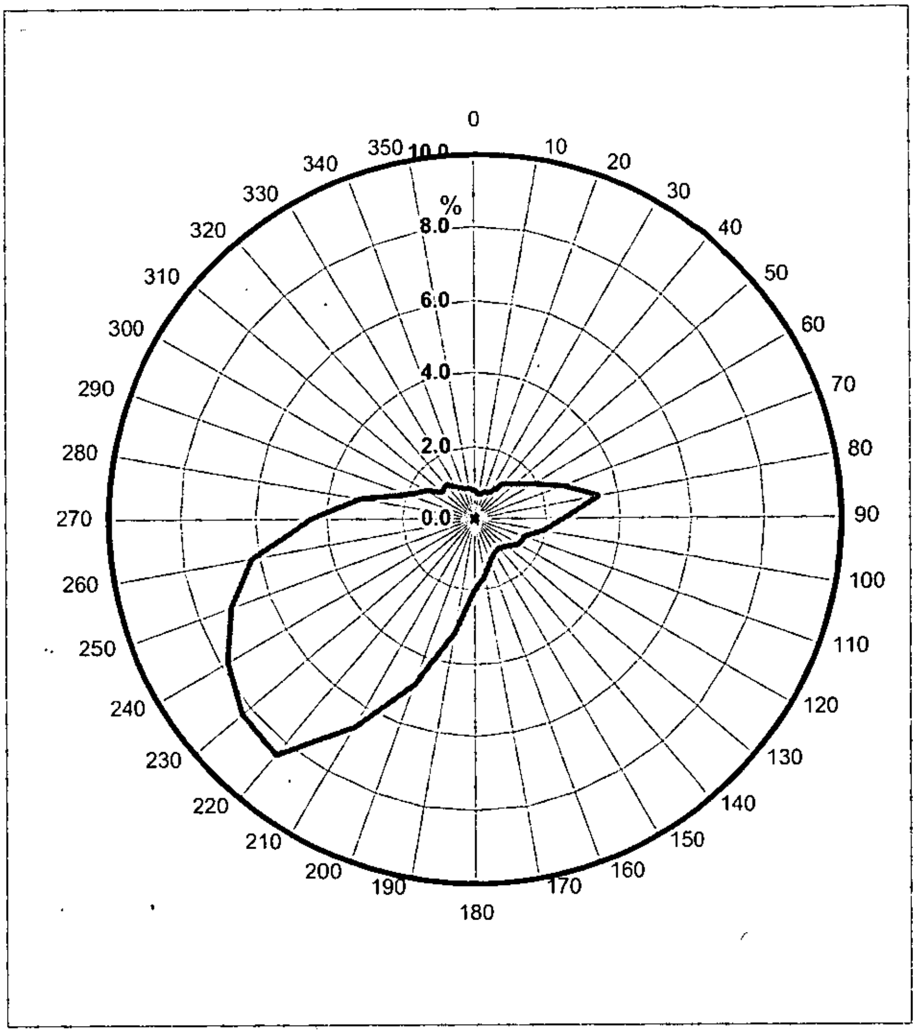
2.2 Climate

2.2.1 General

The climate of the region of the West Co. Wicklow region is characterised by the passage of Atlantic low pressure weather systems and associated frontal rain belts from the west during much of the winter period. The presence of the Wicklow Mountain Range to the east provides a sheltering effect from easterly winds. In the summer the influence of anticyclonic weather systems will occasionally result in prolonged dry periods over this part of Ireland interspersed by the passage of Atlantic frontal systems. The establishment of a high pressure area over Ireland and Britain will result in calm conditions and during the winter months these are characterised by clear skies and the formation of low level temperature inversions with slack wind conditions at night-time. If anticylconic conditions become established for a few days or more, especially during the summer months, then high daytime temperatures may be recorded in this region. Prolonged dry weather conditions are relatively infrequent. If continental air masses dominate over Ireland, drought conditions may occur which could last up to 2 or 3 weeks. Air masses from the Polar Regions can move down over the west Co. Wicklow region in the winter and this may lead to very cold conditions. However, the duration of arctic conditions is unlikely to last for more than a few days with rapid thaws normally following this type of weather.

2.2.2 Wind

The nearest meteorological station is located at Casement Aerodrome (approx. 40km to the N). Long-term wind direction and speed statistics are presented in Fig 1 for the period 1984-93 inclusive. From these statistics, it is evident that the prevailing winds in the West Wicklow region are from a SW direction with about 45% of the hourly observations from a direction of 190-250 degrees. Approximately 55% of winds are from the western sector of 200-290 degrees with an incidence of calm 'slack' wind conditions of about 2.6%. The wind field is generally dominated by winds of less than 5 m/s from 48% of hourly observations less than 5 m/s. Winds in excess of 9 m/s occur for about 25% of the time and these are associated with SW-W winds. In the Baltinglass area, it is likely that the incidence of low wind speeds will be slightly higher due to the sheltering effect from the local topography.



HOURLY WIND DIRECTION FREQUENCY - ALL WIND SPEEDS

Direction	Percentage Occurrence of Wind Speeds (m/s)						
	<2	2-3	3-5	6-8	9-11	>11	All
350-10	0.5	0.6	0.7	0.4	0.1	<0.1	2.28
20-40	0.7	0.6	0.7	0.5	0.2	<0.1	2.76
50-70	1.1	1.2	1.8	1.4	0.4	0.1	5.97
80-100	1.3	1.6	2.5	1.9	0.4	0.1	7.90
110-130	0.9	0.8	1.0	1.1	0.2	<0.1	4.06
140-160	0.7	0.6	0.7	0.9	0.3	0.2	3.33
170-190	0.6	0.9	1.4	1.6	0.9	1.2	6.74
200-220	1.1	1.2	2.6	5.9	4.5	4.5	19.84
230-250	1.3	2.0	4.6	7.5	4.5	3.0	23.02
260-280	1.4	1.7	3.3	4.2	1.8	1.3	13.75
290-310	0.8	0.9	1.3	1.2	0.2	0.1	4.60
320-340	0.6	0.7	1.0	0.7	0.1	<0.1	3.15
Calms	2.6						2.59
Total	**13.6**	**12.7**	**21.8**	**27.5**	**13.6**	**10.7**	**100.00**

FIG 1: FREQUENCY OF WIND DIRECTION AND WIND SPEED FOR HOURLY OBSERVATIONS AT CASEMENT AERODROME (1984-93)

2.2.3 Precipitation

Results of the long-term monthly precipitation amounts at climatological stations in the area are given in Table 1. The annual rate in the Baltinglass area is about 830-1000 mm. Ballytore is about 8km to the NW and in similar terrain to Rampere, whereas Hollywood is about 16km to the north and is closer to the Wicklow Mountains. The area along the western flank of the Wicklow Mountains will experience higher rainfall amounts than places further to the west and so it is likely that annual rainfall rates at Rampere will be about 900mm/yr due to the rising ground to the east.

The amount of rainfall that occurs during the winter months (October -March) is similar to that recorded in the summer period (April-September). However, while the precipitation occurring during the winter period is normally associated with more prolonged Atlantic frontal depressions passing over Ireland, during the summer intense local showery conditions may develop giving rise to short periods of heavy rainfall. This may result in local flooding in the area.

Table 1
Precipitation rates in locality of Rampere (mm)

Period	J	F	M	A	M	J	J	A	S	O	N	D	ann
Hollywood	101	71	77	63	74	71	62	88	87	97	95	106	992
Ballytore, Co. Kildare	84	60	60	53	65	59	55	74	76	83	74	86	829

Note: Hollywood Grid: N937070 (1949-83)Ballytore Grid: S800960(1944-90)

2.2.4 Air Temperature

The pattern of long-term daily temperatures at Casement Aerodrome (1964-80) is shown in Table 2. A similar seasonal pattern would be experienced in the locality of the landfill site with a small number of days during the period June-August likely to record an average of over 20C. Mean minimum daily average temperatures during the winter period are unlikely to fall below about 2 C.

Table 2
Long-term mean daily air temperature at Casement Aerodrome (1964-80)

	J	F	M	A	M	J	J	A	S	O	N	D	Ann
Mean	4.8	4.7	5.8	7.5	10.3	13.4	14.9	14.7	12.9	10.5	6.4	5.5	9.3

2.2.5 Microclimate

The microclimate is defined as the climate within the immediate locality of the landfill site over an area, typically within 1-2km of the site. The microclimate can be characterised by the site being situated on the NE facing slope of a small gently

sloping valley surrounded by undulating terrain, which form the eastern foothills of the Wicklow Mountains. Air emissions from the site will generally be dispersed in the direction of the prevailing conditions for the region. However, during calm weather conditions the air flow would tend to follow the form of the surrounding slopes with cold air drainage downslope at nighttime.

The microclimatological conditions in the locality would be typical of conditions prevailing over the surrounding area around Baltinglass and Dunlavin and typical of air movement over undulating ground.

There are no land-use practices in the locality of the site, where the amenity value of the land use is enhanced because of micro-climatological conditions specific to the location.

3.0 PROPOSED DEVELOPMENT OF THE LANDFILL EXTENSION

3.1 Overview

The existing landfill is to be extended along the western boundary to provide for additional short-term disposal capacity for an additional 50,000 of municipal refuse. It is proposed that 3 cells will be constructed, each fully lined with a separate leachate collection system.

The development of the extension area will require two new access roads to the site, one running along the southern edge and the other along the northern boundary of the site. The existing site entrance and reception infrastructure including the weighbridge, civic amenity disposal area will remain at their present locations. A wheel wash will also be constructed near the site entrance adjacent to the reception office and weighbridge.

3.2 Construction

Three cells are to be constructed west of the existing landfill area. It is proposed that the cells will be filled southwards so that on completion of the cells the completed surface will be close to the elevation of the existing public road. The cells will be built on the subsoil with only a limited amount of excavation to provide a suitable firm base and it will be lined with a synthetic liner to contain leachate and landfill gas emissions. Dust emissions will originate from the movement of vehicles and heavy plant equipment used in constructing the cell along the internal haul roads.

On-site construction equipment will consist of standard 50 tonne earth-removal excavators and dozers and this machinery will be kept on-site during the construction phase. Dust emissions will occur in dry weather conditions during the construction phase as a result of the movement of overburden, cell construction and from machinery travelling along the temporary haul roads within the extension area.

Operation of plant machinery and equipment will generate particulate and gaseous emissions from the exhausts of the diesel engines.

3.3 Operation

3.3.1 General

Atmospheric emissions from the operation of the proposed landfill extension at Rampere can be categorised as continuous or fugitive (short-term due to the execution of a specific activity). The types of emission sources are as follows: -

1) Area sources include the active areas of the cells where the waste material is being tipped, compacted and covered.

2) Line emission sources are the emissions generated from vehicles travelling to the site along the haul road to the tipping area. In addition, there may be a substantial component of total dust-emissions from the landfill operation generated by trucks travelling along the public road near the entrance to the site. Depending on the road surface conditions, fugitive dust emissions caused by re-suspension of particulate material from the surface by tyre action and by the vehicle exhaust pipe facing downwards may be significant. Emissions of dust from roadways can be referred to as fugitive sources, if the volume of traffic is relatively low.

3) Point sources are specific emission points within the landfill extension and these are normally associated with pipes for landfill gas venting. These types of emissions tend to be continuous.

The types of air pollutants emitted from the landfill can be grouped under the following headings:-

- Dust
- Aerosols and airborne particulates
- Odours
- Landfill Gas

3.3.2 Dust

Dust emissions will occur within the landfill extension from trucks travelling along the access and internal haul roads and from tipping the waste material into the designated areas. Generally, trucks travelling along internal loosely surfaced (unpaved) haul roads are the main source of dust within a landfill. The action of the wheels moving along the surface generates substantial resuspension of loose material from the road surface. A hard-paved road surface such as asphalt or concrete or compacted rock chippings, dramatically reduces the potential for dust emissions compared to an unpaved surface, which are normally covered with accumulations of silt and other loose material. The emission rate of dust from a road surface depends on.

the type of surface cover, the speed of vehicles and the weight of the trucks travelling along the road.

Dust emissions from the internal haul roads and tipping area will be low in the winter months and reach a maximum during dry windy weather conditions in the summer period when the ground surface is dry. A wind speed above 5m/s will quickly dry the road surface and result in significant dust blow under strong winds. Hard paved or asphalt road surfaces have a much lower emission rate compared to unsurfaced roads, although emissions from loose material along the shoulders of these roads may be re-suspended by passing vehicles. An effective method of dust control is regular wetting of the surface of the road with a mobile-tanker sprayer.

Emissions of dust from the tipping area are normally minor in comparison to total emissions from a landfill. The disposal of ordinary domestic waste in plastic bags substantially will reduce the quantity of loose refuse that could create visible clouds of dust. However, fine-sized materials such as waste cement, plaster etc. would occasionally be disposed with the standard municipal waste and this can generate substantial dust emissions as it is deposited.

3.3.3 Aerosols and airborne particulates (PM_{10})

Aerosols are defined as fine particulate material, water droplets and microbial emissions from the activities carried out at the landfill. They are typically particles which remain airborne for a reasonable length of time and generally range in size from less than 0.1 µm to about 100 µm. Small sized particles such as PM_{10} have potential health implications, as they may be inhaled and enter the lower respiratory tract. Airborne particles greater than about 30-50 µm will tend to remain airborne for only a few tens of metres downwind of the emission source, whereas the finer-sized fraction can travel a significant distance under windy conditions.

The primary sources of particulate aerosols within the proposed landfill extension will be from the haul roads, especially unpaved sections or where silt has accumulated on the road surface. This will also include 'unpaved shoulders' along the side of a paved road where vehicles may drive along which can result in re-suspension of loose material by tyre action which migrates onto the hard-paved road surface. Another source of particulate aerosol emissions is from the exhaust-pipes of diesel engines for operating plant machinery and trucks delivering waste to the site.

Aerosol liquid droplet emissions will be negligible from the landfill extension operations as the leachate from the lined cells will be collected in a storage lagoon for off-site treatment at a nearby wastewater treatment plant.

3.3.4 Odours

The potential for strong malodours tends to be greatest during the placement of fresh organic domestic waste, as it rapidly decomposes due to aerobic and anaerobic reactions taking place. Volatilisation occurs and the rate of release depends on a

number of factors including type of refuse, moisture content of the waste, temperature and site operational factors. The rate at which malodours are emitted from the cell depends on the length of time the deposited material is left uncovered, weather conditions, effectiveness of the cell drainage system for removing leachate. Covering deposited waste on a daily basis with clay will substantially reduce the emissions of malodours from the deposited refuse.

3.3.5 Landfill Gas

The generation of landfill gas within the layers of refuse is a major source of air emissions both during the operation and also after the cells have been completed. The primary constituents of landfill gas are methane (CH_4) and carbon dioxide (CO_2) which are both odourless. The remaining volume is made up of a large range of non-methane hydrocarbon compounds, which result from the microbial activity within the landfill layers and can be present in concentrations of parts per million (ppm) or parts per billion (ppb). These trace constituents give the distinctive pungent odour of landfill gas.

Table 4
Typical composition of a landfill gas

Component	Typical vol (%)	Max vol (%)
Methane	63.8	88.0
Carbon Dioxide	33.6	89.3
Oxygen	0.16	20.9
Nitrogen	2.4	87.0
Hydrogen	0.05	21.1
Carbon Monoxide	0.001	0.09
Ethane	0.005	0.0139
Ethene	0.018	-
Acetaldehyde	0.005	-
Propane	0.002	0.0171
Butanes	0.003	0.023
Helium	0.00005	-
Higher Alkanes	<0.05	0.07
Unsaturated Hydrocarbons	0.009	0.048
Halogenated Hydrocarbons	0.00002	0.032
Hydrogen Sulphide	0.00002	35.0
Organosulphur compounds	0.00001	0.028
Alcohols	0.00001	0.0127
Others	0.00005	0.023

Source: U.K. Dept of Environment Waste Management Paper No 27 (1989)

The typical composition of landfill gas is given in Table 4 and it is evident that over 99% of the gas volume is comprised of methane, carbon dioxide and nitrogen with the remainder consisting of a large number of trace gases.

Uncontrolled landfill gas emissions from the surface of a landfill are dependent on the gas production rate and degree of lateral and vertical migration. Vertical movement involves the migration of the gas to the surface of the landfill, through the air layer in contact with the surface and into the atmosphere by diffusion and convection by solar heating of the ground and wind over the surface. Capping the surface with clay and covering with top-soil can substantially reduce vertical diffusion of landfill gas from the surface of the completed cells.

Landfill gas emissions from the proposed extension will be vented through vertical vent pipes. No flaring or gas collection system is proposed for the site.

3.4 Closure of the landfill extension

The cells in the extension area will be filled, capped and graded to prevent malodorous emissions and ground cover vegetation will be re-instated to control dust emissions from the surface.

4.0 IMPACT OF PROPOSED LANDFILL EXTENSION

4.1 Dust emissions

4.1.1 Emission estimates

The surface of the entrance and access road into the existing site is hard-paved with an asphalt and stone chipping covering. This type of road surface covering, substantially reduces dust and particulate emissions compared to an unpaved road surfaces. The unpaved haul road surface within the proposed extension area will be constructed of compacted stone chippings.

The perceived impact on air quality in terms of dust deposition within the local community will depend on the distance to the nearest houses, amount of dust emissions from the site and degree of screening around the landfill boundary.

The steep gradient of the access road down to the tipping area significantly restricts the speed of vehicles and hence reduces the potential for dust emissions from the unpaved road. The use of a mechanical compactor further reduces the potential for dust emissions from the tipping area.

The volume of traffic travelling along the access road is projected be about 20-30 trucks, which is equivalent to about 40-60 vehicle movements per day. The average load of waste being transported is estimated to be about 8 tonnes/truck. This gives an average gross vehicle weight travelling along the access road for laden trucks of about 18-20 tonnes (truck weight unladen is 10-12 tonnes) or an average truck weight (laden and unladen) of about 14-16 tonnes per truck.

Estimates of emissions in terms of g/VKT (grammes per vehicle kilometre travelled) were made for dust emissions from the road surface and also from the tipping of the waste. These emission rates were based on the emission factors published by the U.S. Environmental Protection Agency (AP-42 Volume 1 5th Edition, revisions 1997/1998). For the asphalt surfaced access road near the reception/weighbridge area, the emission rate was estimated to be in the order of 0.005/s per VKT. Projected total maximum uncontrolled dust emissions from the hard-paved access road were estimated to be about 45 kg/day (0.04 g/s). This estimate is based on a road length of about 0.3 km from the site entrance to the tipping area within the landfill.

These dust emissions will be below the elevation of the public road and Rampere Cross Roads and this will also provide a degree of shelter from emissions within the landfill extension. In addition, there will be a substantial reduction in dust emissions from the haul road by spraying the surface with water using a mobile tanker during dry weather conditions. The total suspended particulate emission rates (defined as material less than 30 μm), referred to above tend to represent 'worst-case' maximum levels that can occur under dry weather conditions with no dust suppression.

The landfill extension management plan includes spraying the access and haul road surfaces with a mobile water sprayer. Therefore, actual emission rates from the roads in the extension will be substantially lower than under uncontrolled conditions. This type of dust control measure can reduce dust emissions by upwards of 80% as surface wetting effectively reduces the potential for re-suspension of material from the road surface by passing trucks or wind-blow.

To control dust emissions during the tipping and compaction of the waste daily tipping will be over a limited area of about 500m^2 (approx. 25 x 20m). The waste material will be compacted and covered on a daily basis with clay. This will substantially reduce the potential for dust emissions from fine-sized refuse deposited in the active filling area of the cell. Maximum projected levels of waste material deposited at the proposed landfill on a daily basis are estimated to be about 20-30 tonnes/day, based on the estimated annual disposal rate for 5,000-10,000 tonnes.

Particulate emissions from the active tipping area within the cell are estimated to be less than 0.1 kg/day, which is equivalent to about 0.001 g/s. Overall, the emissions of total airborne particulates from tipping waste are predicted to be minor. Particulate emissions from areas where the exposed surface has stabilised under natural weathering or vegetation is growing, such as on the slopes of the boundary bund will not be significant.

4.2 Aerosols

Implementation of regular dust control measures on the internal haul road surfaces and compaction and covering the refuse in the tipping area, on a daily basis will minimise the release of particulate aerosols from the landfill site.

Direct contact with particulates from a landfill significantly increase the risk of certain infections, due to the presence of various micro-organisms present in the refuse and cover material which may be inhaled or ingested. These could present a health risk for

on-site workers, if certain health and safety conditions are not enforced. However, the risk to the local community, due to particulate aerosol emissions from the landfill is predicted to be very low in terms of the exposure risk to health.

The scale of operation for the proposed landfill extension is relatively small with only 10-20 trucks per day and a small number of other vehicles. In addition, the vehicle speed is restricted by the steep slope of the access road down to the site area.

The impact on the air quality of the surrounding area is predicted to be minor or not significant with no detectable change in the present ambient levels of PM_{10} at Rampere Cross Roads. Control measures (Refer Section 5) will reduce fugitive particulate emissions near the landfill site entrance.

No leachate treatment pond system is proposed for the site and so emissions of liquid droplet aerosols from the site will be negligible. No adverse impact on air quality is predicted.

4.3 Odours

The impact of odours on the ambient air quality will depend on the emission rate, the distance downwind to the sensitive receptor location and the dispersive properties of the lower air layers. The distance downwind at which the 'odour detection' concentration is reached may be within a few metres of the odour source if the rate of emission is low or a considerable distance if the emission rate is very strong. The wind speed and direction are also major factors in determining whether emissions from the landfill will cause a community nuisance beyond the site boundary.

The management of the landfill extension includes daily cover of compacted waste and this significantly reduces the potential for malodorous emissions from the surface of the cell. Lining the cells prevents lateral migration of landfill gas and so reduces the emissions of malodorous gases beyond the boundary of the landfill cell.

In the case of odours from the disposal of sewage sludge, the procedure of deep burial of this type of waste and then immediately covering the pit will prevent any significant malodorous emissions occurring.

The impact on air quality due to malodorous emissions from the proposed landfill extension is predicted to be slight in the vicinity of Rampere. The present high incidence of malodours observed within the existing site should decrease significantly with the recommended improvements in the operation of the landfill extension.

4.4 Landfill Gas

4.4.1 Uncontrolled Emissions

The dominant source in terms of potential health risk is where large uncontrolled surface emissions of landfill gas occur within confined areas of a site. However,

although the gas is highly odorous, emissions from the landfill will not result in toxic concentrations of individual trace compounds beyond the site boundary. Dilution rates in the order of several hundred times are normally available above the surface of a landfill cell, even during slack wind conditions. The distance between the exposed cell or working face and the site boundary will result in a further substantial reduction in the ambient concentrations due to natural dispersion mechanisms.

Although many of these trace compounds are recognised toxins, the levels encountered near a landfill are well below the established threshold exposure levels, which could affect the health of the local community. Certain trace organic compounds are also known to be carcinogenic but studies in the U.S. have estimated the exposure risk beyond the boundary at less than 1 death per million in the population (continuous exposure over a 70 year lifetime). This is broadly considered to be a negligible risk to the health of the local community.

Total emissions and consequently health risks associated with certain trace components will decrease, with improvements in the management of Rampere landfill. No adverse impact on the health of the local community is predicted due to emissions of landfill gas from the landfill.

4.5 Impact on Climate

The extension of the landfill at Rampere will result in substantial changes to the existing slope leading down from the public road along the southern boundary to the stream. The slope of the completed landfill will be about 1:5 compared to the existing slope of 1:3. However, this change in the local slope form will not have a significant impact on the overall wind field in the locality of Rampere Cross Roads and further down-valley, towards Baltinglass.

5.0 MITIGATION MEASURES

5.1 Construction Phase

- Control of dust emissions from the surface of temporary haul roads used by machinery preparing the landfill extension area should be carried out with a mobile water sprayer during dry weather conditions.

- All vehicles will use the existing site entrance.

- Construction machinery will be kept on-site during the construction of the cells.

5.2 Operational Phase

- Tipping of waste material will be controlled within the landfill extension.

- Disposal of animal wastes and commercial/industrial waste will be prohibited.

- Waste material will be covered daily with suitable inert material, such as stone, rocks, bricks, crushed concrete etc., to control emissions of dust and malodours from the surface of the active cell.

- When the surface of the waste layers has reached the design height of the extension boundary embankments, the ground will be capped, restored and re-seeded with grass.

- Burning of any waste material on-site will be prohibited.

- Sewage sludge will be deposited by deep burial and promptly covered.

- Leachate will be collected by a network of pipes and discharged to a leachate collection lagoon, where it will be tankered for off-site treatment at wastewater treatment facility.

- Mobile plant equipment used on-site will be regularly maintained to prevent excessive exhaust emissions of particulates and other pollutants.

- Haul roads within the landfill extension will be covered with compacted hardcore to reduce dust emissions from trucks travelling to and from the tipping area.

- The entrance to the landfill and hard-paved road surfaces within the site reception area will be maintained to ensure any spillages of material from vehicles will be removed to reduce dust emissions from the road surface.

- A mobile water sprayer will be employed during dry weather conditions to reduce dust emissions from the access road and near the entrance to the landfill site.

- All waste vehicles departing from the site will pass through the proposed wheel wash, which shall be maintained with the silt removed and deposited at the working landfill face on a regular basis.

6.0 ENVIRONMENTAL MONITORING

6.1 Ambient Air Quality

6.1.1 Dust deposition

It is recommended that monthly measurements of dust deposition will be undertaken at 3 sites at locations indicated in Fig 3. The locations would be along the boundaries of the landfill site. The Frisbee dust gauge sampling method should be used in the annual survey.

The Frisbee gauge is widely used in Ireland for Planning and Air Pollution Licence conditions and in baseline studies for landfills, quarries, asphalt plants and similar stone processing activities. The Frisbee dust gauge is generally viewed as the 'defacto' British Standard method for sampling dust deposition rates and is the preferred method for this type of air quality survey.

A limit value of 130 mg/m^2.day, expressed as a monthly average, of undissolved particulate matter, should ensure that no adverse impacts on air quality occur within the local community.

6.1.2 Aerosols (PM_{10})

Monitoring particulate aerosols (PM_{10}) downwind of the landfill extension site boundary is not proposed. However, should complaints of fine-sized airborne particulates be received by local residents then these will be investigated on a case by case basis.

6.1.3 Odours

No regular monitoring for odours is proposed. The proposed control measures for the Rampere landfill extension will reduce the potential for malodours to be detected downwind of the site boundary. However, should complaints of odours be received from residents within the locality then these will be investigated on a case by case basis.

6.1.4 Landfill Gas

Monitoring landfill gas emissions is proposed as part of the overall Landfill Gas Monitoring Programme for the proposed landfill extension, which includes sampling locations beyond the site boundary as well as within the site.

6.2 Climatology

It is not proposed to install a wind direction/speed climatological station on site due to the relatively small-scale operation carried out at the landfill. However, to provide information for calculating leachate volumes a continuous 'tipping-bucket' rainfall recorder located on-site is proposed.

APPENDIX 8

NOISE & VIBRATION ASPECTS

ENTERPRISE IRELAND

Environment Department

CONFIDENTIAL REPORT

Client:	Title:
M C O'Sullivan, Consulting Engineers Carnegie House Library Road Dun Laoghaire Co. Dublin	Wicklow County Council Rampere Landfill Site Extension Environmental Impact Study Noise and Vibration Aspects

Report Ref:	131817	Report by:	Larry Kenny
File no:	R.6/00210M	Approved by:	Martin Reilly
Order No:	067-515-001 / file 320	Issue Date:	16th August 2002.

CONTENTS

1 INTRODUCTION

1.1. This report was undertaken at the request of M.C. O'Sullivan, Consulting Engineers to Wicklow County Council. The object of this report is to present the noise and vibration aspects of an Environmental Impact Study for an extension to the Rampere Landfill Site.

1.2 Sound levels are measured in units called decibels (dB), and noise has often been defined as unwanted sound. Environmental noise levels are usually assessed in terms of A-weighted decibels, the dB(A). The A-weighting approximates to the response of the human ear. Industrial, occupational and environmental noise is usually expressed in equivalent continuous levels, $L_{Aeq,T}$. This is based on the energy average level over the relevant time interval. Statistical parameters are also used as noise descriptors.

2. SUMMARY

2.1 It is proposed to extend the existing landfill activity to a contiguous area.

2.2 The existing noise environment in the immediate vicinity of the site is principally controlled by activity on the site, and the existing impact on residences is not significant.

2.3 There is a potential for significant short-term adverse impact due to the proposed extension and the proximity to residences. Noise control measures will be undertaken to ensure that the residual impact on the noise environment at residences is not significant.

2.4 There are no existing or anticipated off-site vibration effects

3 PROPOSED DEVELOPMENT

3.1 The site of the proposed development is contiguous to the existing landfill site at Rampere, Baltinglass, Co. Wicklow. The site is located in an agricultural area with scattered housing, near Rampere cross roads, c.1km west of the N81. The principal 'residual' noise source in the area is distant traffic. A site plan is shown in Figure 1.

3.2 The nearest residence to the proposed extension is located c.50 metres from the southwest corner of the site. There is also a house currently under construction (August 2002) c.60 metres from the western boundary. The proposed landfill extension is to the west of the current site and will move the area of activity away from the existing nearest Noise Sensitive Location to other similar locations.

3.3 The principal source of noise will be one landfill compactor. Measurements of the A-weighted and octave band sound pressure levels were made at a reference distance to the existing compactor and results are shown in table 1.

3.4 The construction phase of the facility and the provision of mitigation measures could give rise to very short-term noise levels higher than that due to the operational phase.

4 EXISTING ENVIRONMENT

4.1. The existing landfill site operates between the hours of 08:00 and 16:45 weekdays and between the hours of 08:00 and 13:00 on Saturdays. The current on-site machinery consists of a JCB type 428 Landfill Compactor used to compact and level the waste and construct cells. Occasionally a backhoe excavator is hired to clear drains and clean the site.

4.2 The nearest residences to the existing landfill site are located c.160 metres east of the entrance, NSL1, and c.300 metres north of the existing landfill area, NSL2. Noise measurements were made near the two current noise sensitive locations at

the locations marked NSL1′ and NSL2′ in figure 2 and the results are shown in table 2. The instrumentation used for the noise survey consisted of a Bruel & Kjaer type 2231 Precision Sound Level Meter and CEL environmental noise analysers. Calibration was by a Bruel & Kjaer type 4230 Sound Level Calibrator and measurements were made 1.5 m above the local ground level. The following parameters were measured:

$L_{Aeq,T}$ the equivalent continuous noise level for the measurement period. This parameter is very sensitive to local high level short time sources, e.g. local traffic, etc.

$L_{A01,T}$ the sound level equalled or exceeded for 1% of the measurement period, the maximum levels.

$L_{A10,T}$ the sound level equalled or exceeded for 10% of the measurement period, the parameter usually used for traffic noise assessment.

$L_{A90,T}$ the sound level equalled or exceeded for 90% of the measurement period. This level is sometimes taken to represent the "background" noise level.

4.3 Noise measurements were made on the current boundary at two locations designated B2 and B3. Boundary B1 is coincident with NSL1′ and the results are shown in table 3. In the absence of passing traffic on the local roads the landfill operation is the predominant noise source.

4.4 There are no statutory limits for environmental noise emissions for this type of activity in this country. In general, noise is likely to provoke complaints when its level exceeds the level of the background noise by a certain margin or when certain absolute levels are attained.

4.5 A daytime limit of 55 dB(A) and a night-time limit of 45 dB(A) are suggested by the EPA as the target level appropriate for noise sensitive locations. These levels are not exceeded due to the current activity.

5 IMPACT OF PROPOSED DEVELOPMENT

5.1 The projected timescale for the operation of the landfill facility is less than five years. The maximum noise level predicted at the nearest residence taking into account attenuation by distance and landscape effects, but without specific mitigation measures, is $L_{Aeq,1h.}$ 65 dB.

5.2 The noise levels at the nearest house without amelioration measures would exceed a criterion of 55 dB(A) and a significant adverse impact would be anticipated. There is potential for a significant adverse impact at the nearest residences, NSL3 and NSL4 in figure 2, due to the operation of the proposed landfill extension. Amelioration measures are available to achieve a 55 dB(A) criterion.

5.3 The ground vibration from the compaction operations generates high levels in the immediate vicinity but due to the distances involved there are no off-site vibration effects.

5.4 Earth moving machinery will be used to construct the noise control measures and for a very short period noise emissions will be in excess of normal operational criteria. Construction work is of a temporary nature, and the resulting higher noise levels are usually acceptable.

5.5 The residual impact will be a negative, short-term and of moderate quality.

6 AMELIORATION MEASURES

6.1 Amelioration measures in the form of a landscaped embankment or other form of barrier on the south-western corner of the site and cell construction are available and will be used to control the noise emissions from the site. Compactor plant selection or sound attenuation of the existing plant could also be used.

Table 1 Noise Emissions

Source 11/9/98	Location	**LAeq dB**	distance metres	Octave bands (Hz) Sound Pressure Levels, dB									Impulsive / Tonal	Periods of Emission	Note
				31.5	**63**	**125**	**250**	**500**	**1k**	**2k**	**4k**	**8k**			
JCB428 Compactor	mobile	**80**	10	71	82	88	80	79	78	72	69	67	no	daytime	

Source	Duration minutes	**LAeq dB**	distance metres	**L_{A1}** dB	**L_{A10}** dB	**L_{A90}** dB
JCB428 Compactor	5	**80**	10	86	84	69

Table 2 Current Noise sensitive locations

Location 16/8/00	**Time start**	**Duration minutes**	**L_{Aeq} dB**	**L_{A01} dB**	**L_{A10} dB**	**L_{A90} dB**	Comments
NSL 1′	14:00	30	52	60	55	44	Landfill machinery audible, constant working
	14:30	30	49	58	51	38	Landfill machinery audible, constant working
NSL 2′	14:00	30	47	55	48	40	Landfill machinery audible, constant working

Table 3 Current Boundary Noise Levels

Location 16/8/00	**Time start**	**Duration minutes**	**L_{Aeq} dB**	**L_{A01} dB**	**L_{A10} dB**	**L_{A90} dB**	Comments
B1/NSL1′	14:00	15	52	60	55	44	Compactor audible, constant working
B2	14:45	10	59	64	61	46	Compactor audible, constant working
B3	14:40	15	56	63	60	48	Compactor audible, constant working

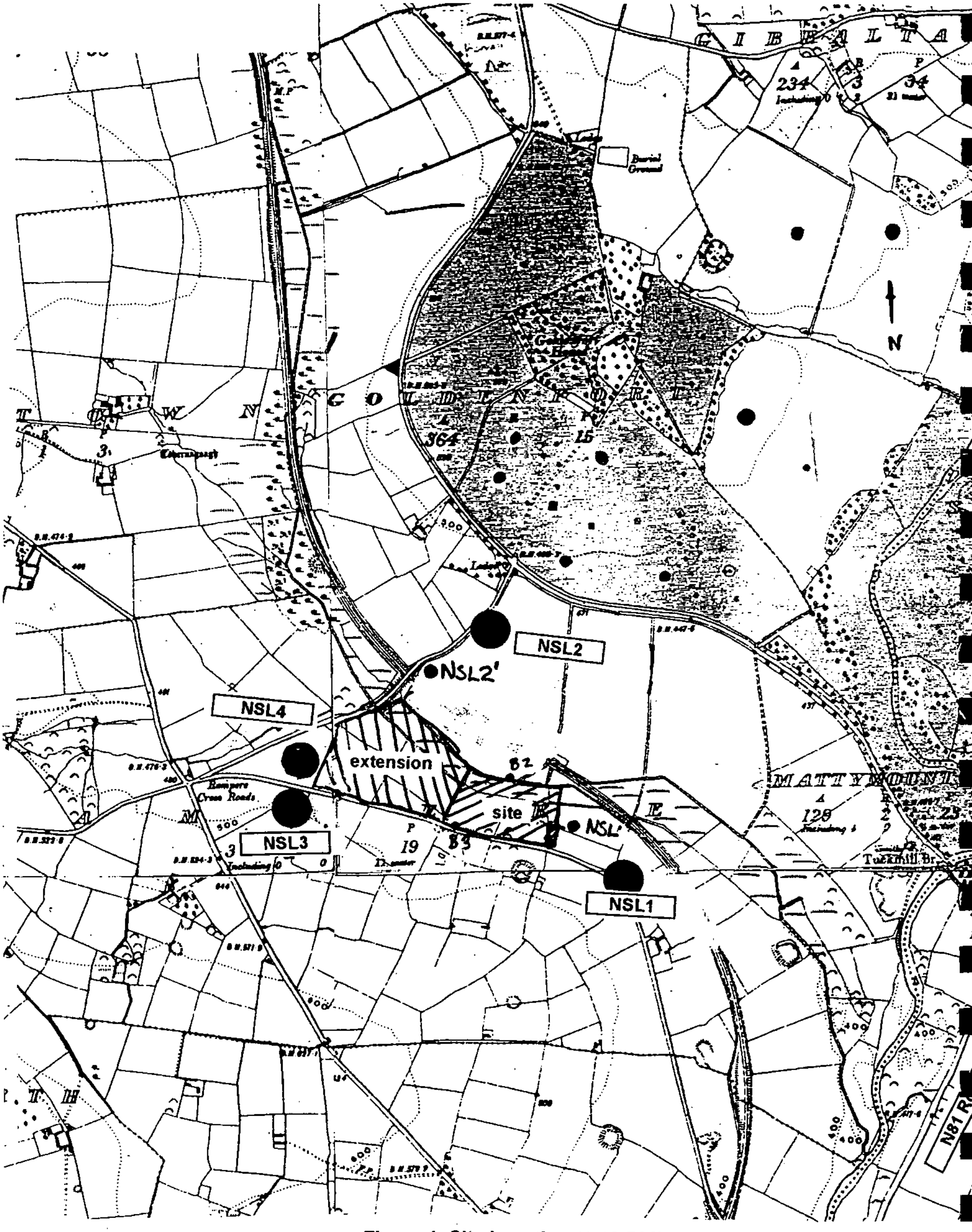


Figure 1, Site Location (1:10,560)
Noise Sensitive (NSL1 –NSL4) Locations

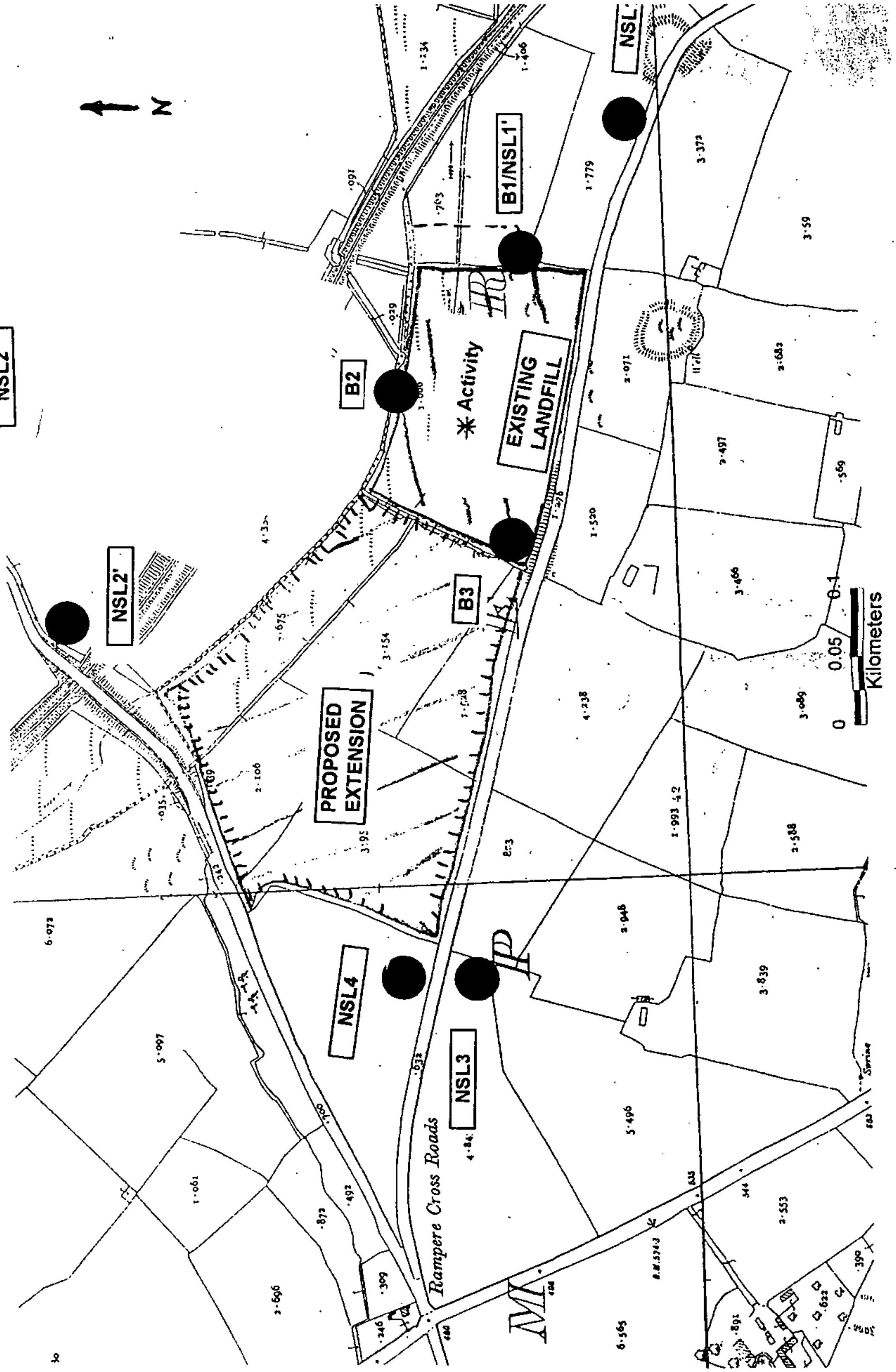


Figure 2, Site Plan Do not scale
Measurement Locations

APPENDIX 9

TRAFFIC

MCOS

MCOS

DOCUMENT CONTROL SHEET

Client	Wicklow County Council					
Project Title	Rampere Landfill Extension					
Document Title	Transportation Access and Traffic Report					
Document No.	067/509/001/Rp0004					
This Document Comprises	DCS	TOC	Text	List of Tables	List of Figures	No. of Appendices
	1	1	13	0	0	0

Rev.	Status	Author(s)	Reviewed By	Approved By	Office of Origin	Issue Date
F01	Final	Emma Treacy Conall Boland	Conall Boland	Larry O'Toole	Dun Laoghaire	September 2002

TABLE OF CONTENTS

1 INTRODUCTION

The existing landfill site and the proposed extension are located in the townland of Rampere, approximately 3 km north of Baltinglass. Baltinglass is situated on the N81 National Secondary Road. The N81 is the main North-South transport artery for the western side of County Wicklow; it provides a link between Dublin, Wicklow and Carlow. The N81 will provide access to the landfill from Baltinglass, Blessington and other parts of County Wicklow. The location of the landfill in relation to Baltinglass, the N81 and the rest of Wicklow is shown on Figure 1.1.

The landfill has been servicing the population in the West Wicklow area. It is proposed to extend and improve Rampere landfill to cater for all waste from County Wicklow. This increased catchment will lead to an increase in waste tonnage and traffic volumes accessing the site.

2 BASELINE TRAFFIC VOLUMES

Traffic surveys were organised and carried out on the local road network (Figure 2.1) surrounding the landfill site with the following objectives:

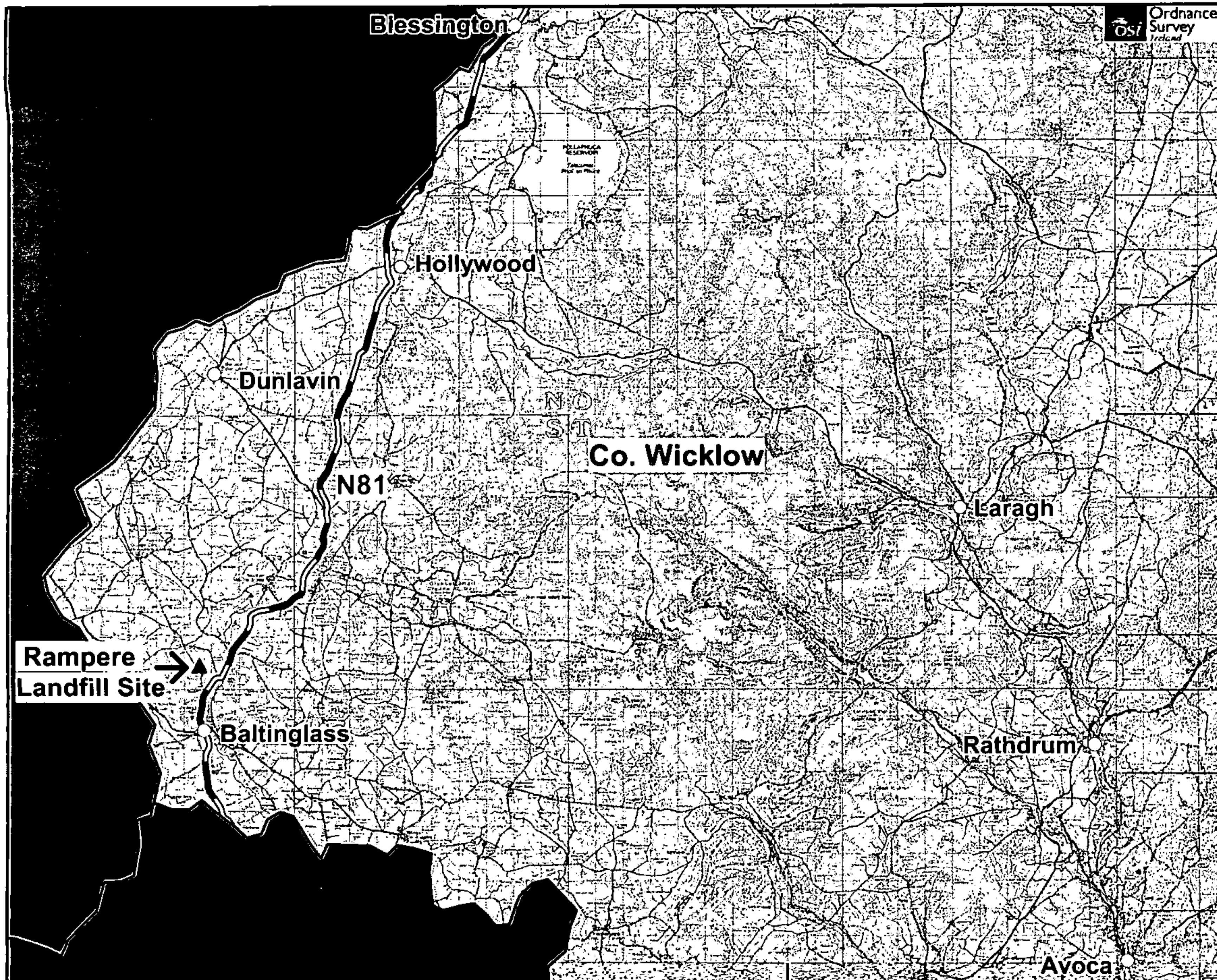
- To determine the existing traffic flows on roadways, both major and minor, surrounding the landfill.
- To determine the existing traffic patterns at the junctions surrounding the landfill.
- To assess the existing and possible future landfill access routes.
- To enable an overall assessment to be made of the impact of the estimated future traffic generated by the landfill.

The traffic study was carried out on Thursday October 12th, 2000. The survey involved counting all turning movements at 4 No. junctions over a 10 hour period between 8am and 6pm. Figure 2.2 shows the turning movements recorded over the 10-hour period. The surveyed junctions are marked A to D in Fig 2.1.

The count results show that a similar level of traffic used the l4284 (current landfill access road) and the L4310 which also carries traffic to and from the N81. Approximately 100 vehicles travelled in each direction on these roads in the 10 hour period of the count. A similar number of turning movements were recorded at both junctions onto the N81 from these roads. The L8284 which links the L4284 and L4310 was less busy with 30-40 cars in each direction.

Hourly traffic flow was relatively even during the day. However there was a more noticeable peak in traffic flow in the early morning, lunch-time (12.00 – 14.00) and late evening on theL4310 as opposed to the L4284.

There was not much queuing of traffic at any of the junctions observed at any stage, indicating that junction capacity appears to be adequate. Some repeat traffic (i.e. multiple trips by the same vehicle) was observed during the count at certain junctions.



Legend

Wicklow County Council
Comhairle Chontae Chill Mhantáin

Project
Rampere Landfill Proposed Extension

Title
Rampere Landfill Location Map

Figure 1.1

MCOS
Carnegie House
Dun Laoghaire
Co Dublin
Phone: 01-2020876
Fax No: 01-2020707

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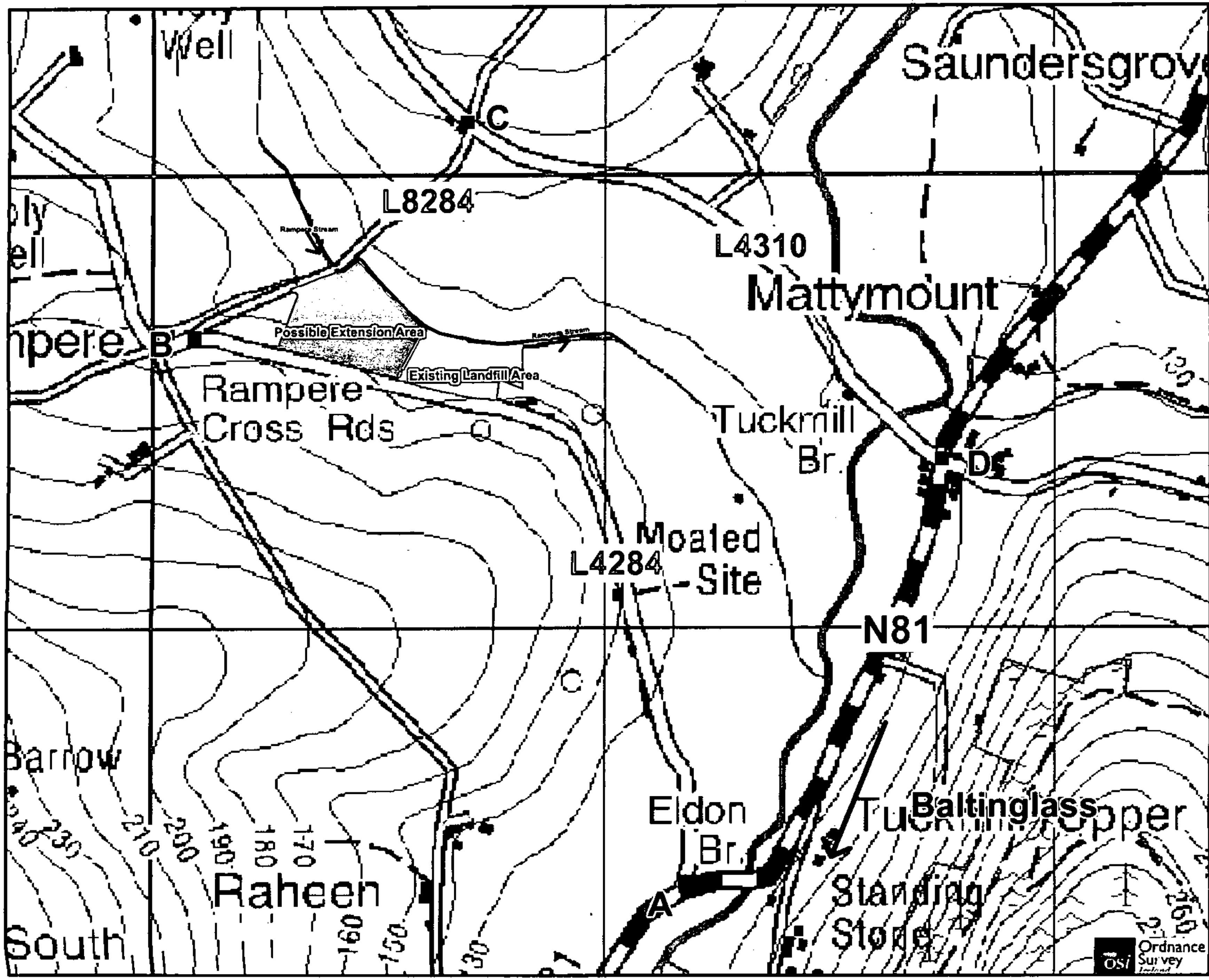

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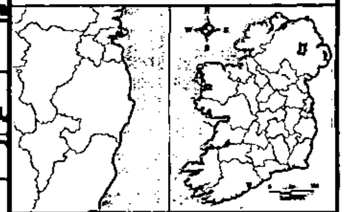

Wicklow County Council
Comhairle Chontae Chill Mhantáin

Project
Rampere Landfill Proposed Extension

Title
Local Road Access

Figure 2.1

MCOS

Carriage House
Dun Laoghaire
Co Dublin
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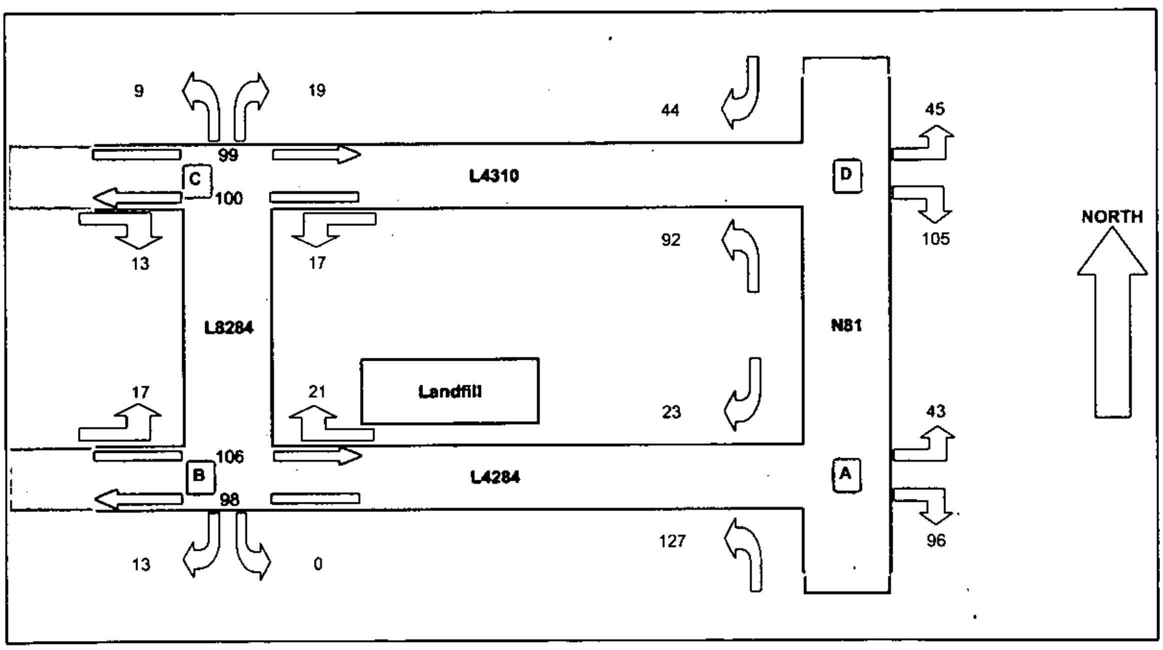
Figure 2.2: Schematic of total traffic flow at recorded at Rampere, Baltinglass on 16-10-00, from 08:00 to 18:00 hrs



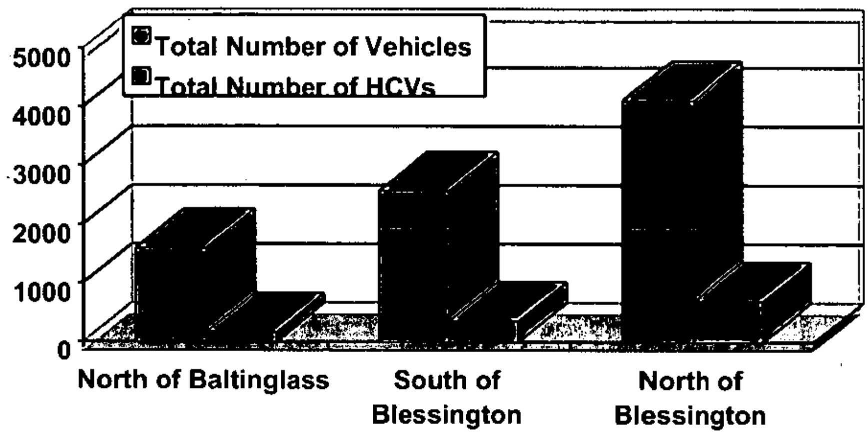
3 EXISTING ROAD NETWORK

The landfill entrance is currently situated on the L4284, approx. 1.2km west, by road, off the N81 from the junction just south of Eldon Bridge (Figure 2.1). The majority of vehicles access the landfill via the N81 and then the L4284. The N81 is a heavily trafficked National Secondary Route with approx. 3021 AADT (11% HCV, Heavy Commercial Vehicles), north of Baltinglass at the junction to Dunlavin.

Traffic information was collected from Wicklow County Council's Area Engineers and the NRA publication "National Roads and Traffic Flow 1998". The information consisted of traffic and weighbridge data from Rampere and Ballymurtagh Landfills for the months of April, May and June 2000 and traffic counts along the N81 National Secondary Road.

At present the N81 carries almost all the traffic to the landfill, mainly from West Wicklow, i.e. Blessington, Baltinglass and surrounding areas. Fig. 3.1 below outlines the total amount of traffic on the N81 in the Baltinglass/Blessington area.

Figure 3.1: Total Vehicles & Heavy Commercial Vehicles on the N81, Sept.1999



The roads immediately surrounding the landfill are quite narrow and, in some places, in poor condition. The roads vary in width from 3.5m to 5.0m, with no verges or hardshoulders. Certain sections of the roads are deficient in vertical and horizontal alignment. These narrow roads make it difficult for larger vehicles, travelling in opposite directions, to pass safely. At present, the majority of traffic on these roads consists of residential and agricultural vehicles accessing properties along the routes, as well as existing landfill traffic.

Along the N81, the main junction for traffic accessing the landfill is south of Eldon Bridge, as shown in Figure 2.1. There is a short radius curve south of the junction and this results in poor sight lines and stopping distances for vehicles travelling north from Baltinglass. Due to the fact that the junction is outside the town's speed control zone, northbound vehicles approaching the bend are moving quite fast, approx. 50mph.

The other junction on the N81, which may be affected by the landfill extension, is at Tuckmill Bridge in the Mattymount area, which is approx. 1km north of Eldon Bridge. This is a crossroads with average sight lines and stopping distances. Again the speed of the traffic on the N81 plays a role in traffic entering and exiting at this junction.

There are 3 main regional roads serving the landfill from the rest of the county. These routes are; the R759 crossing the north of the county between Roundwood and Blessington, the R756 crossing the centre of the county between Laragh and Hollywood and the R747 crossing the south of the county between Arklow and Baltinglass. These routes are quite busy regional roads and will serve as the main arteries between Rampere and the rest of the county.

4 CURRENT TRAFFIC GENERATION

The total tonnage deposited at Rampere over the 2-year period from 1998-2000 was approx. 5,000-6,000 tonnes per annum. In terms of numbers of vehicles, this breaks down to an average of 2-3 HCV's and 10 cars/vans entering the landfill per day. As an explanation to the following numbers of vehicles, it must be noted that they are unusually low for the 3-month period (April to June 2000).

A survey of vehicles entering and exiting the existing landfill site was carried out using Wicklow County Council record sheets for the months of April, May and June 2000, during opening hours of the landfill. When averaged into a daily count, a total of 10 vehicles entered the site per day, of which, 1 vehicle was a HCV. Hence, there are presently 20 vehicular trips generated by the landfill, of which, 2 trips are HCV's. A further breakdown shows the average loads carried on the 2 and 3 axle vehicles was approx. 8 tonnes and cars, vans and trailers carried an approx. 150kg of waste per vehicle.

5 FUTURE TRAFFIC GENERATION

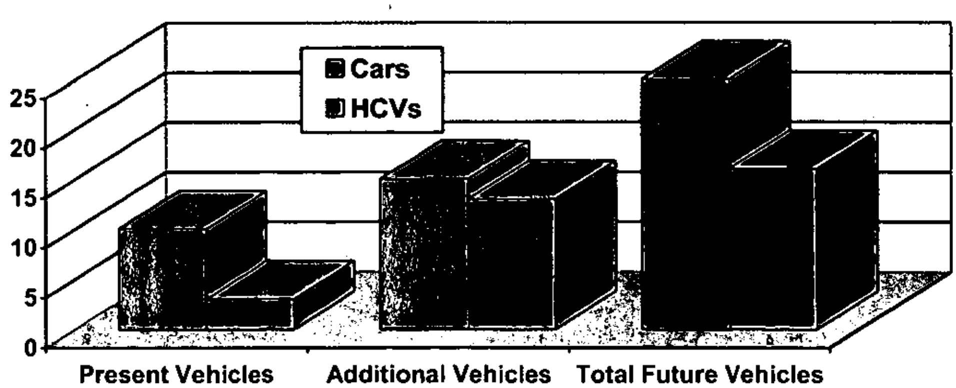
It is proposed to extend and improve the existing landfill facility. The expected future average tonnage per annum deposited at the landfill is approx. 40,000-50,000 tonnes and the catchment served will be the entire county of Wicklow. The proposed life of the extended landfill is 5 years.

Based on the traffic data available from Rampere landfill and Ballymurtagh landfill in East Wicklow, it is estimated that the increased tonnage (approx. 40,000 additional tonnes) will generate a total of 16 HCV's entering the landfill each day based on an average axle-load of 10 Tonnes per vehicle. This will result in a "worst case scenario" of 32 HCV trips generated by the future landfill per day.

It is also anticipated that approx. 15 additional cars/vans/trailers will enter the extended landfill. Recycling facilities will be improved but the overall catchment area for the facility will remain the same.

Therefore, the future Rampere landfill is likely to generate 82 vehicular trips to and from the site per day, of which, 32 trips would be HCV's. These vehicular trips will be made up of cars, vans, trailers and HCV's.

Figure 5.1: Current Daily Traffic to Rampere Landfill and Projected Increase due to Extension



6 ROAD ACCESS OPTIONS

Rampere is located approx. 3km north of Baltinglass and approx. 1km west of the N81 National Secondary Road. The majority of the waste will be transported along the N81 from the east of the county. A number of route options have been considered to provide access to and from the landfill via the N81.

These route options are shown in Fig. 6.1 (Map Info Figure).

Option 1(a) Upgrade and widen the existing access road (L4284) to the landfill and continue with the present arrangement whereby traffic enters the landfill from the L4284 Eldon Bridge route and, having deposited its waste, exits the same way.

Option 1(b) Allow traffic to enter from the L4284 Eldon Bridge side, continue through the landfill and into the proposed extension, upgrade and improve the existing exit onto the L8284, exit left on the same road and continue back along the L4284 to the N81 at Eldon Bridge.

Option 2(a) Allow traffic to enter from the L4284 Eldon Bridge side but instruct vehicles to turn right out of the existing landfill entrance and continue right onto the L8284 and then right onto the L4310 to exit onto the N81 again at Tuckmill Bridge.

Option 2(b) Allow traffic to enter from the L4284 Eldon Bridge side but upgrade and improve an existing exit from the boundary of the proposed landfill extension and the L8284. The traffic would then be instructed to turn right out of the landfill and right again onto the L4310 at the crossroads on the way to the Tuckmill Bridge access onto the N81. This would allow a one-way system to operate inside and outside the landfill.

Option 2(c) Provide a new access road along a "Greenfield" site from the northern boundary of the proposed extension towards Mattymount linking with the L4310 and accessing the N81 at Tuckmill Bridge.

7 TRAFFIC IMPACT FOR THE PREFERRED OPTION

7.1 ROAD AND JUNCTION ANALYSIS

As discussed in Section 6, the increase in traffic on the less busy roads surrounding the landfill will have only have a small effect on road and junction capacity. As shown in the traffic count data, the affected junction at the N81 and L4284 is currently operating well below capacity, averaging 16 vehicles per hour exiting onto the N81 and 15 vehicles per hour turning onto the L4284. There is no obvious queuing at the N81 junction.

It is estimated that an additional 28 vehicles per day will enter and exit the landfill. This will add 3 vehicles per hour on each road. The increased traffic volumes will have a negligible effect on the capacity of the roads and junctions.

7.2 ENVIRONMENTAL AND SAFETY IMPACTS

The N81 is a busy route and, as stated previously, the landfill traffic would have a negligible environmental impact. Although from a safety aspect right turning traffic may potentially reduce safety, these can be alleviated by measures outlined in Section 8, Mitigation Measures.
The increased traffic on the local roads surrounding the landfill will increase the traffic flows and will have a moderate environmental impact on the residential properties adjoining the road and a safety impact on other road-users in the area. However, these can be offset by improved junction and road conditions, speed controls and other improvements outlined in Section 8, Mitigation Measures.

7.3 REGIONAL TRAFFIC PATTERNS

Traffic from East Wicklow will travel to the landfill via one of 3 routes; the R759 Sallygap to the north of the county, the R756 Wicklow Gap in the centre and the R747 to the south. There will be approx. 40,000 tonnes of waste transported from the East Wicklow and the majority of this, approx. 30,000 tonnes, will come from the north of the county.

8 MITIGATION MEASURES

The following measures should be incorporated as or part of the landfill extension.

N81 National Secondary Road

- Junction improvements at the N81 and L4284 access road, south of Eldon Bridge, to the landfill. Possibly the provision of a right turning lane for southbound traffic.

- Improved road markings and signage approaching the junction, from both directions, to alert drivers of heavy traffic turning ahead.

- Consideration should be given by Wicklow County Council to extending the 40mph Baltinglass town speed limit north to Eldon Bridge.

- Additional signage and speed controls either side of the junction between the N81 and the L4284 access road.

Local Roads

- Substantial improvements on all roads which will carry increased traffic. This will include approx. 1.2km of road widening and resurfacing on the L4284 access road.

- Widening of the existing carriageway to allow HCVs and cars to pass comfortably and safely.

- Pavement resurfacing and reconstruction, where required. This will significantly reduce the noise and vibration impact and accident risk on existing roads.

- Improved road drainage where required to reduce the risk of standing water and aquaplaning in wet weather.

- Improved roadmarkings and road signage approaching the landfill entrance and exit to alert drivers of traffic movements ahead.

- Possible strengthening and remedial works to the bridge and parapets along the roads to reduce the risk of failure under increased loads. Further inspections and surveys should be carried out by Wicklow County Council regarding this bridge.

- Inclusion of Dúchas and an archaeologist for site inspections and recommendations if the L4284 is to be widened on the approach to the landfill. The widening of the L4284 should be carried out in accordance with the recommendations of the archaeology report which states that "the road be widened on its southwestern side" and also that "it will also be necessary to test excavate this area, under license from Dúchas, in advance of construction".

- Implementation of local 30mph speed controls on the L4284 approaching the landfill.

Landfill Access

- Widening and improvement of the existing landfill access.

- Improved signage and information regarding the landfill and its location.

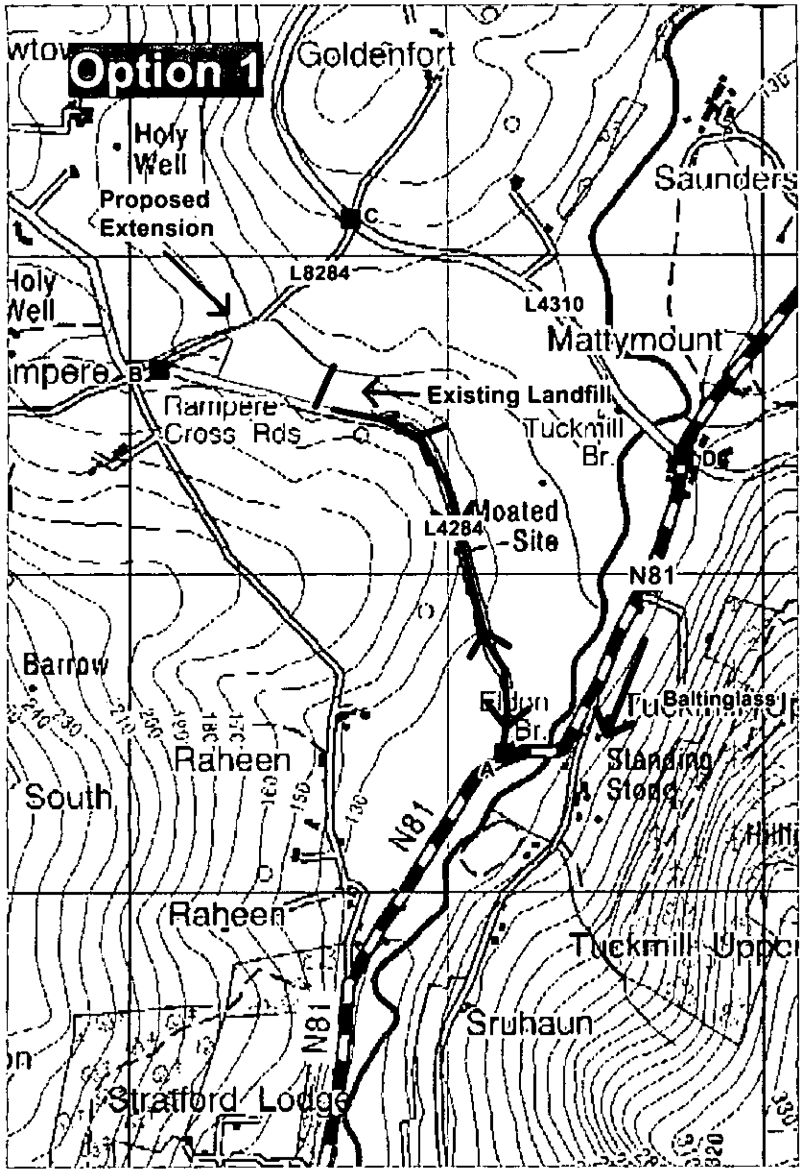
- Ensure that the wheelwash is used and that no litter or mud etc. is carried onto the public roads from the landfill.

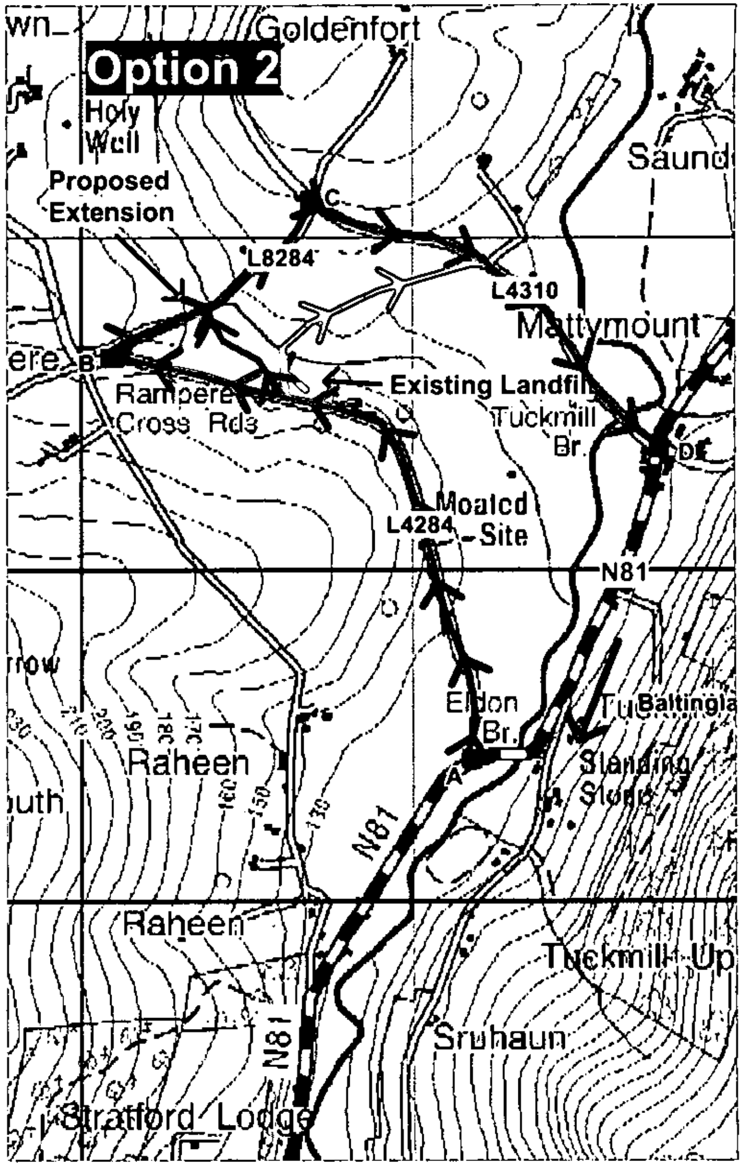
- Wicklow County Council can use the forthcoming Waste Management (Collection) Regulations to address the need for proper and well-maintained waste collection and transfer vehicles.

APPENDIX 10

ARCHAEOLOGY & CULTURAL HERITAGE

MARGARET GOWEN & CO. LTD.





Legend

- Option 1 2-way Traffic Flow
- Option 2A 1-way Traffic Flow
- Option 2B 1-way Traffic Flow
- Option 2C 1-way Traffic Flow

Wicklow County Council
Comhairle Chontae Chill Mhantáin

Project
Rampere Landfill Proposed Extension

Title
Traffic Route Options

Figure 6.1

MCOS

Issue Details

Drawn: WP		Project No.	067-509-001
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Approved: LOT		067-509-001-M0004	
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The possible route options have been assessed under the following headings:

- Road/Junction Layout
- Environmental Effects
- Safety
- Cost

In general, additional traffic on a busy road will have more impact on capacity and less environmental impact, while additional traffic on a less busy road will have less impact on capacity and more of an environmental impact.

6.1 ROAD/JUNCTION LAYOUT

From a Road/Junction Layout perspective, the proposed increase in landfill traffic will have a significant effect on each of the 4 remaining options. These will include road widening, resurfacing and junction realignment.

Option 1(a) will require approx. 1.2km of road widening and resurfacing, upgrading of the existing landfill entrance and internal haul roads, realignment of the L4284 at its junction with the N81, the provision of a right-turning lane on the southbound lane of the N81 south of Eldon Bridge and possible remedial work to the bridge crossing the railway line.

Option 1(b) will require the same measures as Option 1(a) with an additional 500m of road widening and resurfacing.

Option 2(a) will require similar measures to Option 1(a) with the following additions; an extra 2.5 km of road widening towards Rampere crossroads and around to Tuckmill Bridge, realignment of the right-turn junction at Rampere crossroads and possible remedial work to 2 additional bridges along the route.

Option 2(b) will require the same measures as Option 1(a) with the following additions; the improvement of an existing exit from the proposed extension onto the L8284, an additional 2.0km of road widening from the proposed exit around to Tuckmill Bridge and possible remedial work to 2 additional bridges along the route.

As the landfill will close in 2005, Option 2(c) is not a viable option. There would be land severance, land acquisition and a visual impact due to the embankment. This new section of road, solely dedicated to landfill traffic, incorporating a river bridge and embankment construction, will become redundant in a very short space of time.

6.2 ENVIRONMENTAL EFFECTS

From an environmental perspective, the landfill traffic generated on the N81 would have only a very slight effect because it would account for approx. 2% of the total daily traffic and approx. 7% of the HCV's.

When the landfill traffic exits the N81 and is routed onto the local roads the impact is more significant and would account for approx. 20% of the total daily traffic and approx. 85% of HCV's. This large increase in traffic on minor roads will not cause any problems with capacity; however, it will result in additional local environmental impact in terms of vehicle emissions, noise and vibrations along the route.

There is an archaeological site along the L4284 approx. 300m south east of the landfill entrance. This is a ringfort which has been previously damaged when the existing road was constructed. The archaeologist's report states that any development or widening of the road should take place in conjunction with Dúchas and should preferably take place on the southwest side of the road.

Along the L4284, between the N81 and Rampere Crossroads, there are 12 house entrances and 12 field entrances, as shown in Fig. 6.1. Between Rampere Crossroads along the L8284 and its junction with the L4310, there are 2 house entrances and 2 field entrances. Along the L4310 between its junction with the L8284 and the N81 there are 2 house entrances, 11 field entrances and possibly 2 new houses under construction.

Depending on the route selected these houses and entrances could be affected to varying degrees by the extended landfill. An example of this would be, if Option 1(a) were chosen, then 12 house and 12 field entrances would be affected by landfill traffic travelling in both directions. However, if Option 2(b) were chosen then 16 (possibly 18) house and 25 field entrances would be affected by landfill traffic travelling in one direction.

6.3 SAFETY

From a Safety perspective, there are a number of issues which require attention.

Traffic from the north, accessing the landfill, would be required to turn right off the N81. Right turning traffic is a significant cause of accidents on the National Road Network and, therefore, is an important safety issue when the high proportion of heavy vehicles accessing the landfill is considered. A right turning lane on the N81, south of Eldon Bridge, would significantly reduce the risk of accidents from right turning movements.

The junction at Tuckmill Bridge, on the N81, may also be affected by the increased landfill traffic. This will depend on which option is chosen. The section of the N81, either side of Tuckmill junction, is in reasonable condition and sight lines are moderate. However, there may be a requirement for some traffic calming in the form of additional road signage and improved road markings to advise drivers that heavy vehicles may be crossing at the junction.

Although the condition and surfacing on some of the roads around the landfill is poor, these problems may be remedied with localised road widening and resurfacing.

There are also 3 bridges which may require attention. From information we have received, there are 2 No. jack-arch and 1 No. masonry bridges under the roads, which may be affected by the landfill extension, depending on the route selected. These bridges may require some remedial works to be carried out on them. This may include; replacing parapets, strengthening arches, grouting and propping decks.

Another issue is the safety of residents along the roads where increased traffic will occur. There will be a need for additional signage on the local roads, increased sightlines, road widening, improved drainage and possible speed restrictions. These measures will help minimise the risk to pedestrians and drivers alike, travelling on the roads surrounding the landfill.

6.4 COST

The overall cost of each Option will be an important factor is choosing a preferred solution. The cost of each option ranges from £460,000 to £1,210,000. The estimates for each Option are based on approximate rates for the required works.

Figure 6.2: Cost Comparison of Traffic Options

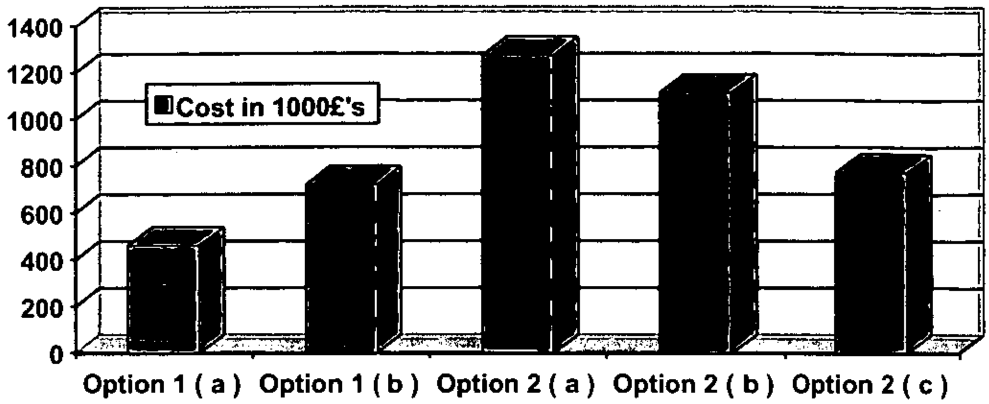

Figure 6.3: Summary of Traffic Options

	Roads			Properties		
Option	**Km of Improvement**	**No. of Bridges**	**No. of Junctions**	**House Entrances**	**Field Accesses**	**Estimated Cost**
1 (a)	1.2	1	1	11	10	IR£460,000.00
1 (b)	1.7	1	2	12	12	IR£720,000.00
2 (a)	3.7	3	4	16	25	IR£1,210,000.00
2 (b)	3.2	3	3	15	23	IR£1,110,000.00
2 (c)	1.7	1	1	2	11	IR£770,000.00

Note: Option 2 (c) does not include land acquisition.

6.5 PREFERRED OPTION

Based on an assessment of the above options, the preferred route is Option 1(a). This entails all landfill traffic entering the site off the L4284 from the Eldon Bridge junction on the N81. The same route should be used for traffic leaving the landfill. This is the current general traffic pattern to and from the landfill.

Option 1(b) did not offer any environmental or safety advantages over Option 1(a). It is also preferable that landfill traffic enters and exits through the same area, passing over the weighbridge, through the wheelwash and past the site office.

Options 2(a) and 2(b) would involve landfill traffic using additional roads not currently used by landfill traffic. A greater number of dwellings and fields would be affected by the additional traffic compared to Options 1(a) and 1(b). The significant additional cost associated with Options 2(a) and 2(b) would not result in any increase in overall safety or overall environmental benefit.

Option 2(c) would cause land severance and have a visual impact due to the embankment construction across the river. This new section of road, solely dedicated to landfill traffic, incorporating a river bridge and embankment construction, would become redundant in a very short space of time.

Rampere Landfill Extension
Environmental Impact Statement (EIS)
Co. Wicklow

Archaeology

By
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For
MC O'Sullivan

On behalf of
Wicklow County Council

August 2nd, 2000

Illustrations

Figures

Plates

1 Introduction

1.1 This report describes an assessment of the archaeological and historical importance of land under consideration for a proposed extension to an existing landfill in Rampere townland, Co. Wicklow. The main purpose of the study is to evaluate the impact of the project on the receiving archaeological environment and to propose measures to safeguard any monuments, features or finds of antiquity.

1.2 The study was based primarily on the Sites and Monuments Record (SMR) of *Dúchas*, the Heritage Service of the Department of Arts, Culture, Gaeltacht and the Islands, and a number of published sources detailed at the end of the report. The topographical files on stray finds held in the National Museum of Ireland (NMI) archive were also consulted. The report includes a survey of the historical and archaeological background to the area, an account of the monuments in and around Rampere townland, a brief field report, and a number of recommendations and conclusions. Appendices deal with EIS site classifications and the National Monuments Act.

1.3 The existing landfill at Rampere is situated on the lower slopes of a network of hills in west Wicklow, roughly 3km to the north of Baltinglass. Covering a land area of over six acres, the Rampere Stream and the now disused Great Southern and Western Rail line delimit the landfill to the north and east. The proposed extension will cover an additional 14 acres immediately adjacent to the northwest. No recorded archaeological monuments, listed in the SMR of *Dúchas*, are located within the proposed boundary of extension. However, the site is situated on the foothills of one of the greatest concentrations of hillforts in the country, which are located to the north and east of Baltinglass.

2 Historical background

2.1 This part of western Wicklow formed part of the territory of the *Uí Máil*, one of the most powerful Wicklow tribes in the early historic period. The *Uí Máil*, who ruled Leinster at various stages throughout this period, struggled with their rivals to hold onto their share of this circulating kingship. One of these rivals were the *Uí Cheinnselaig*, a powerful tribe in southern Leinster, and at the opening of the seventh century Brandub mac Echnach, belonging to the *Uí Cheinnselaig*, had succeeded Áed mac Senaig, a king of the *Uí Máil*, as king of the Leinstermen (Smyth, 1994).

2.2 The *Uí Máil* kings ruled from the western foothills of the Wicklow Mountains, and it appears that this tradition prevailed during Brandub's reign. Historical accounts show that Brandub slew the overlord of the *Uí Néill*, Áed mac Ainmerech, at *Dún Bolg* in 598. The precise location of *Dún Bolg* is unclear, but it has been identified with the Iron Age hillfort at Brusselstown Ring near Baltinglass (*Belach Con Glais*; the road or pass of *Cuglas)*. The Annals of Ulster also make an obscure reference to *Bolg Luatha* ('Sack of Ashes'), which may have been a hillfort or ringfort associated with the kings of the *Uí Cheinnselaig* in the first half of the seventh century. Besieged by the *Uí Neill* in 626 *Bolg Luatha* has been tentatively identified with *Dún Bolg* or Brusselstown Ring near Baltinglass.

2.3 Brandub is also said to have had a fortress or *dún* on the Slaney near Baltinglass. This house has been variously named as *Tech mBranduib*, *Ráith Branduib*, or *Ráith Brainn*, and has been identified with a ringfort on the Slaney in Gibralter townland, two miles north of Baltinglass. In the saga of the *Bóruma Laigen* ('Cattle-tribute of the Leinstermen'), in which Brandub is the central hero, it is recorded that the son of *Áed mac Ainmerech*, Cummascach, invaded Leinster but that Brandub was careful to withdraw from his house at *Belach nDubthaire*, or Baltinglass, before Cummascach arrived there (Smyth, 1994).

2.4 The *Uí Máil* fell from power in the eighth century, at which time the *Uí Dúnlainge* established themselves as kings of the Leinstermen, and reigned until the eleventh century. The *Uí Dúnlainge* were the ancestors of the O'Byrnes and the O'Tooles, Gaelic lords who survived and ruled over their embattled territories in Wicklow until the end of the sixteenth century (Smyth, 1994). Forced to retreat into the Wicklow Mountains following the Anglo-Norman invasion in 1169, the O'Byrnes and the O'Tooles frequently

attacked the new manorial settlements that were established on the lowland perimeters of the county throughout the medieval period. The region around Baltinglass was no exception, and in 1275 a guard was established in Baltinglass to protect the manor and lowlands.

2.5 Baltinglass was an occupied region prior to the Anglo-Norman conquest, and already had a Cistercian monastery there that was founded in 1148 by Dermot Mac Murrough. The monks of Baltinglass Abbey brought prosperity, agriculture and industry to the community. The monastery was surpressed in 1537, but with its extensive possessions, including the castle and manor of Baltinglass, was granted in 1541 to Thomas Eustace, Lord Kilcullen, whom Henry VIII created Viscount Baltinglass. During the reign of Elizabeth the manor was granted to Sir John Harrington. In 1617, James I granted permission to Sire Thomas Willmott to organise markets and fairs in the town. Later the manor was possessed by Henry Carroll, Esq., of Ballynure, and the castle, town and considerable property in the vicinity by the Earl of Aldborough, who substantially improved the town in the latter half of the eighteenth century. During the rebellion of 1798 Baltinglass again became the focus of attack from insurgents who stationed themselves on the surrounding mountains and hills.

3 Archaeological background

3.1 The landscape in this part of west Wicklow comprises the foothills of the Wicklow Mountains, and its rolling topography has dictated the type and range of monuments which appear in this part of the county: its low undulating hills are favoured by ringforts, while the prevalence of prominent hilltops has led in turn to a significant complex of hilltop cairns, passage tombs and hillforts crowning the upland summits surrounding Baltinglass.

3.2 Neolithic (*c.* 4000-2300 BC) and Bronze Age (*c.* 2300 to *c.* 500 BC) ritual activity is conspicuous in this part of the county in comparison to a relative dearth of prehistoric activity on the eastern side. The Neolithic, which saw the arrival of the first farmers and the adoption of a farming economy in Ireland, also saw new developments in ritual activity, and the first permanent monuments were built in the Irish landscape. The most famous and spectacular of Neolithic monuments are the megalithic tombs (from the Greek, meaning big stones), and two burial mounds of this period are visible among the Baltinglass hills. Within Rathcoran hillfort on the summit of Baltinglass Hill is a passage tomb (a burial chamber entered by means of a passage) and cairn (a mound of stone often used to cover the burial), which has provided, upon excavation, evidence for pre-tomb habitation on the old ground surface beneath the cairn. This substantiates evidence gathered to date, which suggests that the vicinity of this hilltop was being cultivated during this period. The remains of a prehistoric cemetery are also present on the northern summit of Spinans Hill. These remains comprise a very large cairn on the summit of the hill itself with the remains of four other small cairns in the near vicinity. The layout of this cemetery is reminiscent of a passage tomb cemetery (Condit, 1998).

3.3 The Bronze Age is characterised by a range of different ritual monument types, and is represented in the area by a ring-barrow (SMR 026:005) in Tinoranhill North townland and a tumulus (SMR 027:006) in Raheen townland. Barrows are burial monuments of both the Bronze Age and Iron Age, and consist of a central mound defined by a ditch and bank. These monument types are relatively rare in Wicklow. Tumuli are mounds of earth also used to cover burials. These burials usually consist of stone-lined pits or cists into which the cremated or inhumed remains of the dead were placed, often with associated grave goods such as a pottery vessel or urn. One such cist burial (SMR 027:074) was found in Tuckmill Lower townland in 1969, while a second was found within a burial mound (SMR 027:008) in Tuckmill Upper in the mid 1920s, about 150m south of the site

of a standing stone (SMR 027:009). Standing stones, too, are generally dated to the Neolithic and the Bronze Age, and while they occasionally mark burials, they often appear to mark routeways through the landscape, or the presence of sacred areas, or territorial boundaries.

3.4 The hillforts (large ramparts enclosing the summits of hills, which were used for defensive and habitation purposes), which crown the summits of the hills to the north and east of Baltinglass, probably originated during the Late Bronze Age/Early Iron Age (*c.* 1000 BC to *c.* 500 AD). During this turbulent period of prehistory centres of power were being redefined and territories consolidated, and hillforts constituted the defended enclosures of a powerful elite. An individual trivallate hillfort (SMR 026:004) occupies the summit of Tinoran Hill. A stone enclosure or 'citadel' (diam. *c.* 50m) called the 'Round O' is located within its interior. Baltinglass Hill, which overlooks the town, has two hillforts on its summit, Rathcoran (SMR 027:026) and Rathnagree (SMR 027:010). A more remarkable complex of hillforts occurs on Spinans Hill *c.* 4km northeast of Baltinglass, and includes Brusselstown Ring, a hillfort identified with the legendary *Dún Bolg* in historic records (section 2.2 above). Hillforts are an important component of royal landscapes, and when taken in combination with the megalithic tombs and cairns provide strong evidence of widespread prehistoric ritual in the immediate vicinity of the hillforts.

3.5 The Early Christian/Early Historic period (*c.* 500 AD to 1100) is equally represented in the area. There are at least three ringforts and two enclosures in the immediate vicinity of the landfill extension. Two of these ringforts (SMRs 027:001/021:046 & 027:002/021:047) are located in Rampere townland, while the third is located in Raheen (SMR 020:005). Ringforts are among the most common archaeological monuments in Ireland, and range in date from around 500AD to the late medieval period. They are usually roughly circular areas defined by an earthen or stone bank and an external ditch. Ringforts are usually located on gentle slopes, with good views over the surrounding landscape. They also usually contained the dwellings and farm buildings of the extended family, and could be used to house farm animals. The enclosures (SMRs 020:021/021:045 & 027:003) in this area, in Goldenfort and Mattymount townlands respectively, which are now visible only as cropmarks, may also be the remains of ringforts.

3.6 Among ecclesiastical, or at least Christian sites, there are several monument types that are not, strictly speaking, 'official' church sites. These include holy wells, which are a Christian adaptation of a pre-Christian tradition of sacred springs, which, like their pagan

predecessors, were often visited at certain times of the year, such as saints' or other holy days, and often had the reputation for effecting cures. One hundred and six holy wells have been recorded in Co. Wicklow and three of these are located within *c*. 900m of the existing landfill at Rampere (SMRs 020:019, 020:020 & 026:002). Less than fifty per cent of wells in Wicklow are located near church property. However, 'St Bernard's well' (SMR 020:019) in Rampere townland is believed to have been associated with Rampere Chapel (SMR 020: 018), indicated on Ordnance Survey maps (1839) as 'Rampere Chapel (in ruins)' roughly 250m southwest of the well.

3.7 The remnants of a grange (a farm run by the lay brethren of a monastic order) are locally believed to be located 20m north-northeast of the well. Price (1949) in 'The Place Names of Co. Wicklow, Vol. III', records that according to deeds of the early nineteenth century Rampere was regarded as part of the townland of Raheen. He goes on to suggest that the original name of the whole townland was Walsheton, where, as Justiciary Rolls show, there was a grange or monastic outfarm belonging to Baltinglass Abbey.

3.8 Moated sites are Anglo-Norman earthworks or defended settlements of the thirteenth and fourteenth centuries. They are usually square or rectangular areas, defined by banks and ditches, often built in areas where the ditch is naturally waterlogged. They also appear to have had palisade fencing on top of the banks, which often retain traces of stone facing. There is one moated site at Rampere (SMR 027:004), situated downstream of the existing landfill on the south bank of Rampere Stream. According to John O'Donovan, in the Ordnance Survey Name Books, Rampere is the English word for rampier, meaning a rampart, and it is speculated that the name refers to the quadrangular moated fort situated in the low-lying land near the stream.

3.9 Townland names, many of which relate directly to Early Christian earthworks, are significant indicators of archaeological potential in the landscape in and around the existing landfill at Rampere. In addition to Rampere, the existence of forts is preserved in names such as Goldenfort and Raheen. Raheen translates simply as little rath or fort. Mattymount is a possible translation of an old Irish personalised place name, the suffix, mount, representing either a mound or hill. Alternatively the townland name may be a later English place name, and may have replaced an earlier name when taken down by the Ordnance Survey in the 1830s.

3.10 Later houses of note in this part of the county include the early eighteenth-century brick house at Saunders Grove, situated roughly 1km away to the northeast of the existing landfill. Morley Saunders, MP, '2nd Serjeant-at-Law', who bought the estate, built the house in 1716 (Bence-Jones, 1978).

4 Recorded archaeological monuments

4.1 The following is a list of recorded archaeological monuments, listed in the Sites and Monuments Record (SMR) of *Dúchas* (the Heritage Service of the Department of Arts, Culture, Gaeltacht and the Islands). These sites are invaluable indicators of settlement activity in the vicinity of the proposed landfill extension at Rampere, and date from prehistoric through Early Christian, medieval and modern historic times. None of the following sites will be directly impacted upon by the landfill extension; however, they are outlined as indicators of the archaeological potential of the landscape at this point in west Wicklow. All recorded SMR sites are shown on the accompanying site location map (Fig. 1).

4.2 The SMR sheets relevant to the proposed landfill extension are sheets 20, 21, 26 and 27 (6-inch series) for Co. Wicklow. The sites are numbered according to the Ordnance Survey (O.S.) 6-inch sheet on which they are located, so that site 18, on 6-inch sheet 20, is listed as 020:018. A county code, WI for Wicklow, is included.

4.3 Archaeological sites are generally classified for the purpose of impact assessment in such a way that their importance in the archaeological record is suggested. The classification acts as a general guideline to the status of a site, and the potential implications for development (Appendix 1). An *Area of Interest* is suggested for each site. This is a zone of archaeological potential around the known extant remains in which related archaeological features are likely to occur. The national grid reference (NGR) is provided for each site, as is the townland in which it is located. The NGR is presented as a ten-figure co-ordinate and indicates the position or siting of each monument. The *Distance* indicates the proximity of each monument to the proposed extension boundary, and is an approximate only.

4.4 *SMR sites*

SMR No	WI020:018	**Townland**	Rampere
Site Type	Chapel	**NGR**	28546/19149
Classification	C/D	**Area of Interest**	100m
Distance	*c.* 650m to the southwest		
Description	Marked as 'Rampere Chapel (in ruins)' on the 1838 edition Ordnance Survey map, and is said to have been formerly the parish chapel (O'Donovan, 1838/40, (94) pg. 36). The only		

surviving feature of the church is the restored western wall, which forms a boundary between an orchard (E) and garden (W). The church is situated on a gentle northeast-facing slope overlooking steeper terrain.

SMR No	WI020:019	**Townland**	Rampere
Site Type	Holy well	**NGR**	28562/19169
Classification	D	**Area of Interest**	10m
Distance	*c*. 530m to the west		
Description	Marked 'St. Bernard's Well' on both the 1838 and 1910 editions of the Ordnance Survey. The well is located 250m to the northeast of 'Rampere Chapel' (020:018), with which it was associated. Part of a farm building 20m NNE of the well is believed locally to be the remnants of a grange. The well, comprising of a strong spring within a concrete shaft, is situated on level, low-lying swampy ground with higher ground to the north, west and south. The Patron day was held on the 20th of August, until the well was closed following a faction fight in the 1930s.		

SMR No	WI020:020	**Townland**	Lowtown
Site Type	Holy well	**NGR**	28594/19235
Classification	D	**Area of Interest**	10m
Distance	*c*. 550m to the northwest		
Description	Marked 'Tobernagoagh' on the 1838 and 1910 editions of the Ordnance Survey. The name possibly means 'well of the cuckoo' (*tobar na gcuach*). The well is situated in a very marshy area, and is visible only as a wetter area within this. The spring, according to the Ordnance Survey Name Books, was believed to have had curative powers.		

SMR No	WI020:021/021:045	**Townland**	Goldenfort
Site Type	Circular enclosure (site)	**NGR**	28629/19209
Classification	G	**Area of Interest**	30m
Distance	*c*. 250m to the north		

Description	Marked on both the 1838 and 1907 editions of the Ordnance Survey as a circular enclosure (diameter *c.* 30m) partly intruded on by a railway embankment. The site, of which there is no visible trace at ground level, is situated on flat marshy terrain at the western foot of a gentle slope.		

SMR No	WI027:001/021:046	**Townland**	Rampere
Site Type	Ringfort site	**NGR**	28473/18319
Classification	D/G	**Area of Interest**	30m
Distance	*c.* 130m to the southeast		
Description	Marked as a circular area (diameter *c.* 30m) on both the 1838 and 1907 Ordnance Survey 6-inch maps. The site, of which there is no visible trace at ground level, but which is visible on aerial photographs (CUCAP, BDR 43), is situated on a gentle north-facing slope.		

SMR No	WI027:002/021:047	**Townland**	Rampere
Site Type	Ringfort	**NGR**	28692/19145
Classification	D	**Area of Interest**	30m
Distance	*c.* 300m to the southeast		
Description	Marked on the 1838 and 1910 editions of the Ordnance Survey. The monument is situated at a break in a northeast-facing slope and comprises a circular area (diameter *c.* 41m) defined by an earthen bank (Wth 7.3m; max. H 2m) and a poorly defined external fosse (Wth 4m). About one-third of the site has been removed by the road to the southwest. No indication of an entrance or internal features.		

SMR No	WI027:003	**Townland**	Mattymount
Site Type	Enclosure	**NGR**	28733/19140
Classification	D	**Area of Interest**	30m
Distance	*c.* 650m to the southeast		
Description	Not marked of the Ordnance Survey map editions, this site is situated in flat marshy terrain on the floor of a stream valley. The site appears as a poorly preserved circular enclosure (diameter *c.*		

25m) defined by a fosse (Wth 4m). The interior is slightly domed.

SMR No	WI027:004	**Townland**	Rampere
Site Type	Moated site	**NGR**	28928/19129
Classification	C	**Area of Interest**	30m
Distance	*c*. 650m to the southeast		
Description	The site is situated on the flat marshy floor of a stream valley. It consists of a quadrangular enclosure (max. int. dims. 42m N-S; 42-48m E-W) that is largely levelled but defined by an outer bank (Wth 2m), an external fosse (Wth 5m) and an outer bank (Wth 2m) surviving as cropmarks. These features are visible on aerial photographs (CUCAP, BDR 42). A well defined entrance (Wth 4m) is at the centre of the east side adjacent to the stream. This site may have given the townland Rampere, a rampart, its name.		

SMR No	WI027:005	**Townland**	Raheen
Site Type	Ringfort	**NGR**	28691/19090
Classification	C	**Area of Interest**	30m
Distance	c. 600m to the south		
Description	Marked on the 1838 and 1910 editions of the Ordnance Survey. The site is situated at a break in an east-southeast facing slope on a gentle gradient. The site is well preserved and comprises a bivallate circular ringfort (diameter *c*. 42m) defined by an earthen bank (Wth 4-7.5m; int. H 1.2-2m; ext. H 0.6-1.8m) and external fosse (Wth 3.5-4m; D 1.5-1.9m). An outer bank exists (Wth 2-2.5m) from the north, east and south. These is no definable entrance or indication of internal features.		

SMR No	WI027:006	**Townland**	Raheen
Site Type	Tumulus (site)	**NGR**	28732/19087
Classification	G	**Area of Interest**	20m
Distance	*c*. 850m to the southeast		
Description	Marked on the 1838 edition Ordnance Survey map but not on later editions. The site, which is not visible at ground level, is		

situated on a gentle southeast-facing slope overlooking the River Slaney. Site consists of a circular mound (diameter *c.* 50m; H *c.* 2.4m).

SMR No	WI026:002	**Townland**	Tinoranhill North
Site Type	Holy well	**NGR**	28543/19122
Classification	G	**Area of Interest**	10m
Distance	*c.* 750m to the southwest		
Description	Marked 'Tobernasleigà', this well is situated on a northeast-facing slope near the foot of Tinoran Hill. This natural unmarked spring was reported in the Ordnance Survey name books as having 'been good for various purposes'. There are no surviving local traditions.		

SMR No	WI026:004	**Townland**	Tinoranhill North/ Tinoranhill South
Site Type	Hillfort	**NGR**	28524/19054
Classification	B	**Area of Interest**	100m
Distance	*c.* 1km to the southwest		
Description	This trivallate hillfort encloses the summit of Tinoran Hill. The inner oval enclosure (dimensions 50m northwest-southeast; 45m northeast–southwest, marked 'Round O' on the 1838 and 1907 editions of the Ordnance Survey maps, is defined by an earth and stone bank with an external fosse. An internal fosse is visible at the southwest. Both faces of the bank and outer edge of the outer fosse have drystone facing. The slightly domed interior has been planted with trees. A second enclosing element (indicated as field boundaries on the 1907 Ordnance Survey map) is situated just above the 900ft contour and encloses an oval area (dimensions *c.* 450m north–south; 400m east-west). A third outermost rampart, 150m outside this, survives only at the southeast in the field boundary. There is a hut site inside the second rampart at the southwest, and a ringbarrow (026:005) outside this rampart at the east. Virtually all of this hillfort is afforested.		

SMR No	WI026:005	**Townland**	Tinoranhill North
Site Type	Ring-barrow	**NGR**	28570/19064
Classification	C/D	**Area of Interest**	30m
Distance	*c*. 900m to the southwest		
Description	Marked on the 1838 and 1910 editions of the Ordnance Survey maps. The site is situated at a break in a northeast-facing slope on the east side of Tinoran Hill and immediately east of the outer rampart of the hillfort (026:004). Site is comprised of a low domed interior (diameter 11m) enclosed by a fosse (Wth *c*. 7m; D 0.2m) and a low outer bank (Wth *c*. 10m)		

4.5 ***Stray Finds***

Only one isolated or stray find is recorded in the files on finds held in National Museum's topographical archive for townlands in the vicinity of the existing landfill at Rampere. The find was made in Goldenfort townland, and consisted of bone fragments and three skulls. No further details were available.

5 Field inspection

5.1 The site of the proposed landfill extension in Rampere townland was visited in slightly overcast conditions on July 12th, 2000. The site, which is under grazing pasture at present, is located on the lower slopes of one of a series of hills and ridges which define the topography of the Baltinglass region. To the west and south, the hills rise to the summit of Tinoran Hill. Baltinglass Hill and Spinans Hill are visible to the southeast.

5.2 The southwestern half of the site, which consists of a single large field of average pasture, slopes upward to a third class road and on towards Tinoran Hill (Plate 1). The road, from which the existing landfill is accessed, connects Rampere to the N81 to Baltinglass, roughly 2km north of the town. This road was not present in 1838, at which time the county was first surveyed by the Ordnance Survey (Fig. 2). The road is visible however, on a later map, published by the Ordnance Survey and dated to 1910, on which it is seen to cut through the southwest side of ringfort 027:002/021:047 (Fig. 1).

5.3 The site to the northeast is low lying in comparison, forming the floor of a stream valley known as Rampere Stream (*c.* 1.5m in width; 30cm in depth from water surface to channel floor; Plate 2). The stream, which also forms the northern boundary of the existing landfill, is relatively fast flowing at this location. From the stream, to the outside of the current study area, the ground slopes upward again to the north and east, on the line of the former Great Southern and Western Railway (Tullow Branch). The rail corridor, which was subsequently infilled as part of a landfill and reinstated, is perceptible today only as a slight colour variation in the surface vegetation (Plate 3). A railway bridge, outside the study area at its northernmost corner, is all that remains upstanding of the former railway line (Plate 4). The topography of the landscape to the immediate northeast of Rampere Stream has therefore been substantially modified during the recent past.

5.4 Internally, a large number of hedgerow boundaries have been removed from the site to form the single pasture field in existence at present. The former existence of field boundaries is evident on cartographic sources (Figs. 1 and 2), and may be evident on the ground as a series of very slight surface undulations. Following publication of the first Ordnance Survey map of the area in 1839 field divisions were first altered by construction of the current access road to the existing landfill (on the southwest side of the study area) (Fig. 2). By 1910 (Fig. 1) the study area was comprised of five separate field plots, the boundaries of which have all since been removed. It is possible that the low-lying ground

adjacent to Rampere Stream, which is indicated on the 1910 Ordnance Survey map (Fig. 2) by symbols representative of rougher or damper ground, was delineated by a second stream no longer evident above ground. Visible as a field boundary on both editions of the Ordnance Survey maps (Figs. 1 and 2), the stream may have been diverted into the existing Rampere Stream and drained.

5.5 A ringfort (SMR 027:002/021:047), located outside the study area *c.* 300m to the southeast of the existing landfill, was also inspected during the field inspection. This ringfort was partially damaged during construction of the original road from which the existing landfill is now accessed, and any plans to widen the road will directly impact upon the remaining monument. On the 1910 edition Ordnance Survey map (Fig. 1) remains of the ringfort, which are indicated as hachured, are shown on the southwestern side of the road. However, evidence for remains of the southwestern bank and fosse were not visible at ground level during field inspection, and it is possible that the entire southwestern side of the ringfort was completely removed during road construction. It was not possible to inspect the remainder of the ringfort, surviving on the opposite side of the road, owing to a dense covering of scrub vegetation and evergreen trees (see section 4 above, *Recorded Archaeological Monuments*, for a brief description).

6 Conclusions and recommendations

6.1 The region around Baltinglass has a rich and varied archaeological and historical heritage. A well known group of hillforts and ritual burial cairns, concentrated in commanding positions overlooking the Slaney valley, testify to the strategic importance of the region. A number of ringforts and enclosure sites in Rampere townland also reflects continuity of settlement into Early Christian and later medieval times.

6.2 No known archaeological sites, as identified in the SMR of *Dúchas*, are affected by the proposed development and there is no substantial issue in respect of archaeology envisaged for the proposed landfill extension. However, the immediate and wider vicinity has been the focus of settlement throughout the prehistoric, early historic and medieval periods, and for this reason it is recommended that all ground preparation works be monitored by a licensed archaeologist. This will ensure the full recognition and proper recording of all archaeological soils, features, finds and deposits that may be revealed during construction.

6.3 Associated plans for widening the access road to the existing landfill, to cater for the increased capacity and subsequent increased traffic, will, however, have a direct impact on ringfort 027:002/021:047. If such plans are forwarded, it is recommended that the road be widened on its southwestern side, where construction of the original road has previously removed a large portion of the ringfort's southwestern bank and fosse. It will also be necessary to test excavate this area, under license from *Dúchas*, in advance of construction, to determine whether archaeological features or deposits relating to the site survive at this location. The results of test excavation must be submitted to *Dúchas* for analysis, which will then decide whether further remedial action may be necessary. Protection of the upstanding portion of the monument against construction traffic or other damage must also be ensured during all development works at this location.

6.4 A 30m buffer zone must also be maintained around ringfort site 027:001/021:046 should any road widening works be undertaken at the existing landfill entrance. As there is no visible expression of the site above ground, the site should be located by an archaeologist in the field before a buffer zone is established. The site and its buffer zone must then be protected form adverse impact associated with the road widening or any ancillary works.

6.5 The attention of the developer is drawn to the relevant portion of national monuments legislation (summarised in Appendix 2), which states that in the event of the discovery of

archaeological finds or remains, *Dúchas* and the NMI should be notified immediately. The developer should make provision to allow for and to fund whatever archaeological works may be needed if any remains should be noted during construction.

6.6 All recommendations in this report will be subject to discussion with, and approval from, *Dúchas*, which may advise on any further remedial measures that need to be taken.

Marion Sutton
2nd. August 2000

Bibliography

Bence-Jones, M. (1978) *Burke's Guide To Country Houses*, Burke's Peerage Ltd., London.

Condit, T. (1998) Observations on aspects of the Baltinglass hillfort complex, in *Wicklow Archaeology and History*, Vol. 1, Corlett and O'Sullivan editors, County Wicklow Archaeological Society.

Flanagan, L. (1992) *A Dictionary of Irish Archaeology*, Gill and Macmillan, Dublin.

Grogan, E. & Kilfeather, A. (1997) *Archaeological Inventory of County Wicklow*, The Stationery Office, Dublin.

Joyce, P.W. (1996 ed.) *Irish Local Names Explained*, Roberts Books, Dublin.

Killanin, Lord, and Duignan, M. V. Revised and updated by Peter Harbison (1995) *The Shell Guide to Ireland*, Gill & Macmillan, Dublin

Lewis, S. (1837) *A Topographical Dictionary of Ireland*, Vol. 1, S. Lewis & Co., London.

Lynch, G. (1994) The Holy Wells of County Wicklow: Traditions and Legends, in *Wicklow History and Society*, Hannigan and Nolan ed., Geography Publications, Dublin.

Smyth, A.P. (1994) Kings, Saints and Sagas, in *Wicklow History and Society*, Hannigan and Nolan ed., Geography Publications, Dublin.

Appendix 1 Classification Table

EPA Impacts	Impact Level	Criteria for EIS	Category	Status	Implications
Profound or significant, (negative effect only)	Severe	Reserved for adverse effects only. Applies where mitigation would be unlikely to remove such effects. The effects are generally but not exclusively associated with sites and features of international or national importance	A	National Monument	Sites must be avoided
Significant impact, (positive or negative)	Major	Important considerations at a national to regional level. If adverse, they have the capacity to become key components in the structuring of the project. Mitigation measures are unlikely to remove all effects upon the affected communities or interests	B	Nationally important site/ or very rare in the archaeological record	Sites must be avoided
	Moderate	Represents issues where mitigation measures and detailed design work may ameliorate/enhance some of the consequences upon affected interests. If adverse, they are important but not likely to be key decision makers on the EIS. The effects can be mitigated.	C	Extensive, well-preserved sites (ringforts, castles, churches, graveyards, burial mounds) not necessarily rare in the archaeological record	Sites should be avoided, if possible. All archaeological investigation work should take place pre-development well in advance of construction
			D	Sites similar to those in category C, but not as well preserved or extensive	Avoidance is recommended. If not an option, full archaeological excavation ensuring preservation by record would be required. Archaeological work should be conducted at the pre-development stage
			E	Historical Building Sites, post 1700AD and industrial buildings and/or structures.	Archaeological/architectural building survey. Sites are assessed by survey and photographic and historic record. To take place at the pre-construction and/or construction phase
			F	Low visibility sites/features, i.e., fuluchta fiadh, souterrains/ lithic scatters	Monitoring prior to the construction phase. If archaeological material is found, excavation or avoidance can then be cited
	Minor	Not significant in the decision making process. Can be of relevance to the subsequent design of the project	G	Sites of sites, destroyed or delisted, marked on the OS, or known from documentary sources	Area needs to be archaeologically assessed in the field. Sometimes monitoring is required during the construction phase
	Unknown		UC	Sites of possible archaeological potential but of unquantified extent and significance	Trial excavations for a detailed assessment would be required and a full excavation may be recommended. To take place pre-construction
Neutral or slight Impact	Not significant	The forecasting framework cannot envisage any effect on the environment	N/A	N/A	An area of archaeological potential must be observed around all sites

Appendix 2 National Monuments Legislation

All archaeological sites have the full protection of the national monuments legislation (Principal Act 1930; Amendments 1954, 1987 and 1994).

In the 1987 Amendment of Section 2 of the Principal Act (1930), the definition of a national monument is specified as:

> any artificial or partly artificial building, structure or erection or group of such buildings, structures or erections,
>
> any artificial cave, stone or natural product, whether forming part of the ground, that has been artificially carved, sculptured or worked upon or which (where it does not form part of the place where it is) appears to have been purposely put or arranged in position,
>
> any, or any part of any, prehistoric or ancient
> (i) tomb, grave or burial deposit, or
> (ii) ritual, industrial or habitation site,
>
> and
>
> any place comprising the remains or traces of any such building, structure or erection, any cave, stone or natural product or any such tomb, grave, burial deposit or ritual, industrial or habitation site...

Under Section 14 of the Principal Act (1930):

> It shall be unlawful...
>
> to demolish or remove wholly or in part or to disfigure, deface, alter, or in any manner injure or interfere with any such national monument without or otherwise than in accordance with the consent hereinafter mentioned (a licence issued by the Office of Public Works National Monuments Branch),
>
> or
>
> to excavate, dig, plough or otherwise disturb the ground within, around, or in the proximity to any such national monument without or otherwise than in accordance...

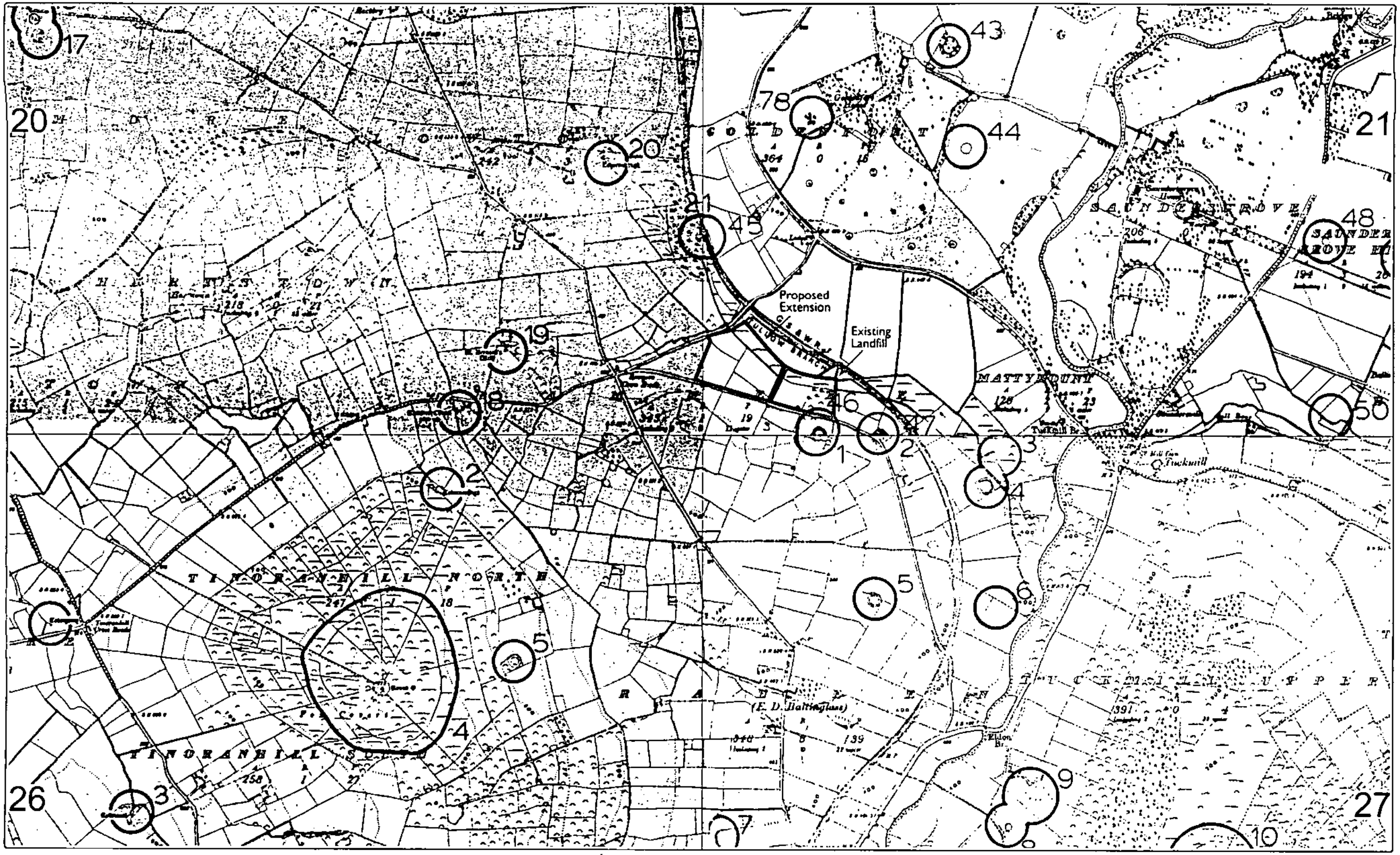
Under Amendment to Section 23 of the Principal Act (1930),

> A person who finds an archaeological object shall, within four days after the finding, make a report of it to a member of the Garda Siochana...or the Director of the National Museum...

The latter is of relevance to any finds made during a watching brief.

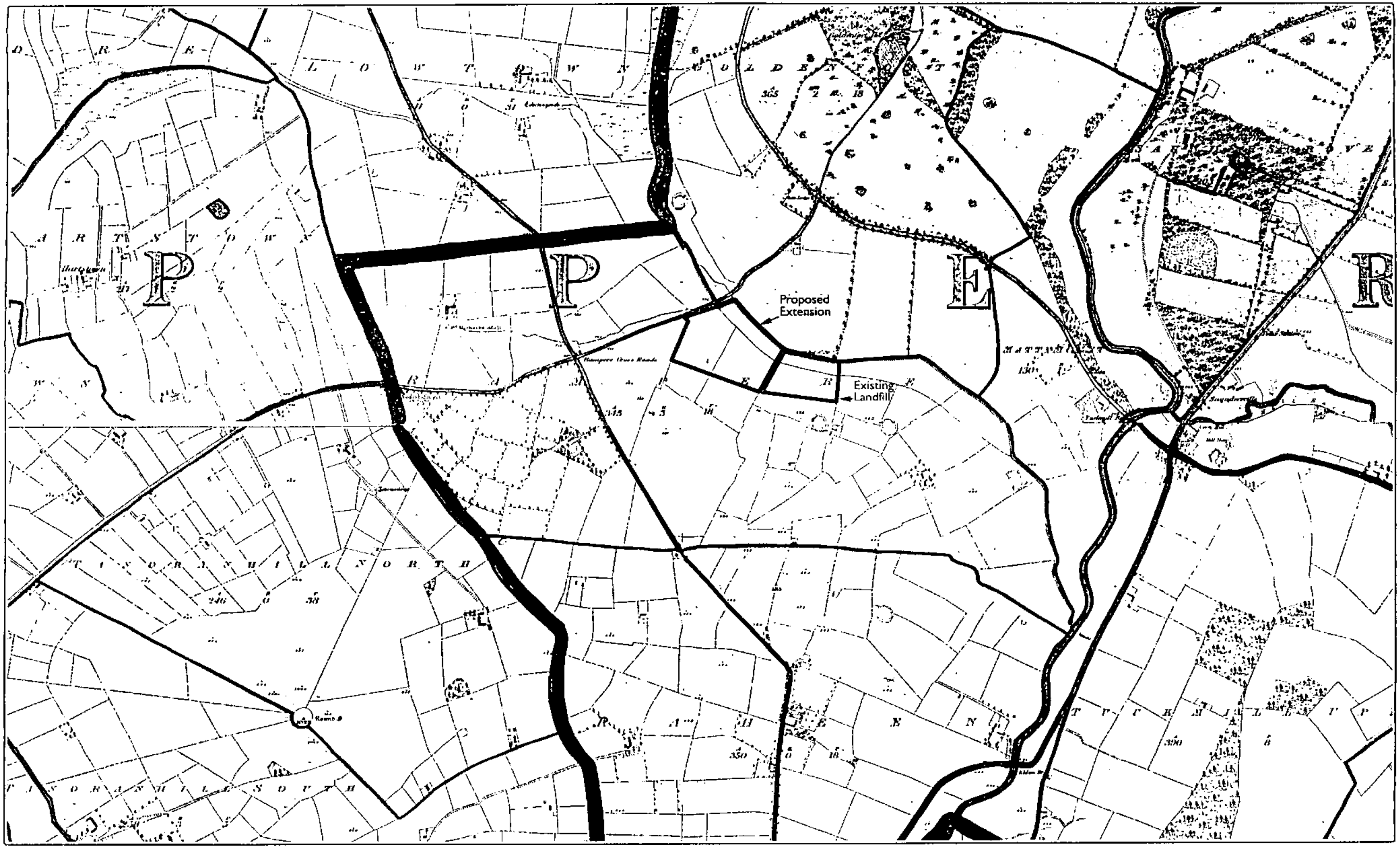
In the 1994 Amendment of Section 12 of the Principal Act (1930), all the sites and 'places' recorded by the Sites and Monuments Record of the Office of Public Works are provided with a new status in law. This new status provides a level of protection to the listed sites that is equivalent to that accorded to 'registered' sites (Section 8(1), National Monuments Amendment Act 1954) as follows:

> The Commissioners shall establish and maintain a record of monuments and places where they believe there are monuments and the record shall be comprised of a list of monuments and such places and a map or maps showing each monument and such place in respect of each county in the State.
>
> The Commissioners shall cause to be exhibited in a prescribed manner in each county the list and map or maps of the county drawn up and publish in a prescribed manner information about when and where the lists and maps may be consulted.
>
> In addition, when the owner or occupier (not being the Commissioners) of a monument or place which has been recorded, or any person proposes to carry out, or to cause or permit the carrying out of, any work at or in relation to such monument or place, he shall give notice in writing of his proposal to carry out the work to the Commissioners and shall not, except in the case of urgent necessity and with the consent of the Commissioners, commence the work for a period of two months after having given the notice.



Margaret Gowen & Co Ltd
Archaeological Consultants & Project Managers

Job	Rampere Landfill Extension, Co. Wicklow
Ref.	00170
Date	03.08.00
Client	MC O'Sullivan
Scale	Not applicable
Fig. 1	SMR and landfill site locations



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Job	Rampere Landfill Extension, Co. Wicklow
Ref.	00170
Date	03.08.00
Client	MC O'Sullivan
Scale	Not applicable
Fig. 2	Ordnance Survey map (1839) with landfill site locations

Plate 1 Proposed site of landfill extension looking upward to the southwest and west (to the access road of the existing landfill) and sloping downward to the north; portion of the existing landfill site is visible to the left

Plate 2 Proposed site of landfill extension looking downward (towards Rampere Stream) to the north, east and southeast; the existing landfill is visible to the right

Plate 3 Proposed site of landfill extension looking north and east to the line of the former Great Southern & Western Railway line, which is visible as a colour variation in upward sloping pasture in the centre; the Baltinglass Hills are visible on the horizon to the right

Plate 4 North corner of the proposed landfill extension site bounded by Rampere Stream; the railway bridge visible just left of centre, is all that remains of the Great Southern & Western Railway line that ran at this location

APPENDIX 11

TOURISM APPRAISAL

MCOS

TABLE OF CONTENTS

1 INTRODUCTION

The main purpose of this appraisal is to examine tourism in West Wicklow and to assess the impact which the exposed extension to the Rampere landfill site may have upon tourism in the surrounding area.

Counties Kildare and Carlow lie 4km to the east and 5.6km to the south of the Rampere site respectively. In order to fully assess the tourist impact on the landfill site it was necessary to extend analysis across the county boundaries into south Kildare and north Carlow.

1.1 THE EXISTING LANDFILL FACILITY

Rampere Landfill Site is located approximately 3 km north of Baltinglass in West Wicklow, and is situated 1.3 km by third class road to the main N81 National Secondary Route. The site is relatively small covering 1.7 hectares in total and is located in a rural agricultural area where pastureland predominates. The Rampere Stream, a tributary of the River Slaney, is a small watercourse which passes adjacent to the site boundary.

This site has been in operation since 1980, and an approximate 108,000 tonnes of non hazardous and inert waste has been deposited at the site up to September 1998. The current intake is in the order of 5,000 tonnes per annum and with the proposed extension this will increase to 50,000 tpa for five years with waste being placed in new lined cells.

1.2 METHODOLOGY

Counties Wicklow and Kildare are part of Midlands/ East Tourism while County Carlow is part of South East Tourism. Tourist Information and Statistics have been taken from the following sources:

General Information:

- The Wicklow County Guide; Wicklow The Garden of Ireland, *by Wicklow Rural Partnership and FAS January 2000*
- County Carlow, South East Ireland, *by Carlow Tourism & EU Tourism Grant*
- Irelands South East Top Visitor Attractions, *by Heritage South East*
- Irelands East Coast and Midlands Top Visitor Attractions, *by Regional Tourism Authority*
- Wicklow Trail Sheet No. 5, *by Wicklow Tourism Monitor 1991*
- Visits by M.C. O'Sullivan and Co. Ltd to Rampere Landfill Site and to the tourist attractions in the surrounding area.

Statistical Information

- Perspectives on Irish Tourism 1993-1997, *Bord Fáilte Irish Tourism Board*
- Wicklow Tourism Monitor 1998, *by Wicklow County Tourism*
- Tourism Facts 99, *Bord Fáilte Irish Tourism Board, June 1999*
- Tourism Facts 98, *Bord Fáilte Irish Tourism Board, July 2000*

Web Sites

- Bord Fáilte: http://www.ireland.travel.ie
- Wicklow Tourism: http://wicklow.local.ie
- Kildare Tourist Guide: http://www.kildare.ie/tourism
- South East Tourist Guide: http://www.southeastireland.travel.ie

1.3 OVERVIEW OF THE COUNTIES

Granite mountains, spectacular valleys, sandy beaches, and a rich cultural heritage define County Wicklow. Over one million visits are made annually to Wicklow's tourist attractions- these include individual attractions requiring entry fee (e.g. Powerscourt House and Gardens) as well as other natural attractions not formally recording the number of visitors such as beauty spots (e.g. Wicklow Gap). Further details are provided in Section 2.

County Carlow is Irelands smallest inland county and contains some 807 field monuments such as Haroldstown Dolmen south of Rathvilly. It lies in the sunny south-east of Ireland and provides an unspoilt environment for the golfer, rider, walker and angler. Browns Hill Dolmen near Carlow Town and Altamont Gardens in Tullow are listed among the top visitor attractions for the region. Altamont Gardens have on average 1,000 visitors per month. The capstone of Browns Hill Dolmen is believed to be the largest in Europe and is mostly likely to be the burial place of a local King. The informal gardens at Altamont House have rare shrubs and a glen overlooks the River Slaney. Other attractions include Duiske Abbey, the largest of Irish Cistercian Monasteries which overlooks the River Barrow. Another attraction is Carlow Museum which displays aspects of 19th & 20th Century domestic and commercial life in Carlow.

County Kildare is renowned for its equine industry. The Irish National Stud, Japanese Gardens and the Curragh Race Course are the main attractions in the County. The Stud is home to some of Irelands finest thoroughbreds and visitors to the centre can visit the Horse Museum, which presents a history of the stud farm's success. The Japanese Gardens on the grounds of the National Stud are acclaimed as the finest in Europe, also Castletown House built in 1722 was opened to the public in April of 1999 after Dúchas undertook extensive renovation. Other attractions are Kilkea Castle, now a hotel with a golf course, Mondello Race track and Whites Castle in Athy.

Table 1.1: Visitor Numbers at the main tourist attractions in Counties Kildare and Carlow

Name of Attraction	County	1995	1996	1997	1998
Irish National Stud	Kildare	131,325	137,261	131,684	129,453
Castletown House	Kildare	11,684	8,070	3,027	N/a
The Irish Pewter Mill	Kildare	N/a	5,000	N/a	N/a
Duiske Abbey	Carlow	N/a	N/a	670	943
Carlow County Museum	Carlow	645	785	N/a	N/a

N/a: Information not available
Source: Bord Fáilte Irish Tourism Board

2 TOURISM IN COUNTY WICKLOW

The Wicklow County Guide for 2000 lists 21 individual visitor attractions in the County, these range from monuments, museums and craft workshops to the villages of Kilcoole and Avoca made famous through television series. The Office of Public Works lists 21 individual National Monuments in County Wicklow. There are four main heritage sites in Wicklow all containing tourist facilities; Wicklow Mountains National Park, Glendalough Visitor Centre, Kilmacurragh and Dwyer-McAllister Cottage. Figure 2.1 'A Tourist Map of County Wicklow' displays many of the tourist sites mentioned in this report.

Glendalough – the monastic settlement set in spectacular scenery in the Wicklow Mountains – is internationally renowned. The visitor centre provides informative guided tours of the monastic site as well as several exhibitions and a colourful audio-visual show. The Wicklow Mountains National Park established in 1991 encompasses 20,000 hectares including large areas of mountain blanket bogs and varied forms of wildlife. Kilmacurragh situated 6km east of Rathdrum is an arboretum particularly famous for its conifers and calcifuges. South East of Kilmacurragh in the Glen of Imaal is the Dwyer McAllister Cottage a fine example of a vernacular thatched cottage.

Figure 2.1: Glendalough

Besides the four heritage sites mentioned above there are numerous other visitor attractions in County Wicklow. Every year upwards on 200,000 people visit Powerscourt House and Gardens, and on the same estate the Powerscourt Waterfall is one of the most spectacular in Ireland. The annual County Wicklow Gardens Festival is a particular highlight in the tourism calendar. It is launched each May and helps highlight the wealth and variety of gardens in the area. Mount Usher Gardens and Kilruddery House and Gardens are amongst the best known of these. Wicklow hosts a number of stately homes which are open to the public, the best know of which are Russborough House near Blessington, and Avondale house near Rathdrum, the former home of Charles Stewart Parnell.

In addition to its status as a holiday destination, Wicklow is also an important day-visitor destination for both the population of the Dublin area, other nearby Counties, and for tourists based in the city. The mountainous areas of the county- which comprise the largest mountain mass in the country- provide

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F01	Final	Emma Treacy Conall Boland	Conall Boland	Larry O'Toole	Dun Laoghaire	September 2002

spectacular scenery and are used for touring, general sightseeing, mountaineering, and walking. The mountain passes between East and West Wicklow- the Sally Gap and the Wicklow Gap- are renowned for spectacular scenery and attract much tourist traffic.

The Wicklow Way is a walking path stretching the length of the County from the Dublin Mountains to County Carlow via the spectacular scenery of the Wicklow Mountains. This famous trail opened in 1981 and attracts many visitors each year, with a number of hostels and camping locations along the way. There are also Walking Festivals in May and October.

Outdoor pursuits such as pony trekking and adventure activities are very popular. The county's public parks and forests are another significant tourist resource, with woodland covering approximately 32,000 hectares or 16% of the county's area. Other sporting pursuits that attract visitors to the County are golf, fishing, and watersports.

The following table gives an overall view of the visitor numbers to day visitor attractions in County Wicklow between 1995 and 1998.

Table 2.1: Overview of Visitors to Fee Paying Tourist Attractions in County Wicklow

Name of Attraction	1995	1996	1997	1998
Powerscourt Gardens	146,282	153,626	220,140	220,073
Glendalough Visitor Centre	105,801	111,168	112,504	113,207
National Garden Exhibition Centre	N/a	N/a	27,000	36,289
Russborough House	18,600	25,000	25,000	26,000
Mount Usher Gardens	25,000	26,500	26,500	25,000
Avondale House	20,250	22,000	18,000	13,000
Kilruddery House and Gardens	2,887	3,000	N/a	N/a
Arklow Maritime Museum	972	N/a	N/a	N/a

N/a: Information not available
Source: Bord Fáilte Irish Tourism Board

3 TOURISM FIGURES AND GENERAL STATISTICS

In the Midlands East Region, of which Wicklow and Kildare are members there has been a 3.1% growth rate in tourism between 1993 and 1997. While in the South-East Region where County Carlow lies the growth rate is slightly lower at 1.2%, between the same periods as above. Estimates of revenues generated from tourism are presented in Table 3.1. In Table 3.3 the revenue is broken down into counties and it can be seen that County Wicklow generated in 1997 approximately £40 million.

Wicklow is among one of the counties in the Midlands East Region that receives the highest number of visits from overseas markets, and in particular it is a popular destination with British tourists as can be seen in Table 3.2 below.

Table 3.1: Revenue Generated in the Midlands East and South East Regions in 1998 and 1999

Region Numbers of visitors (000s) Revenue (IR£m)	Midlands East 1998	Midlands East 1999	South East 1998	South East 1999
Overseas Tourists	869 194.2m	903 177.3m	917 131.9m	870 122.9m
Northern Ireland	37 6.1m	37 4.6m	23 5.1m	17 4.4m
Domestic	787 74.7m	932 102.5m	1,090 130.0m	1,230 149.6m
Total	*1,693* *275.0m*	*1,872* *284.4m*	*2,030* *267.0m*	*2,117* *276.9m*

Source: Bord Fáilte Tourism Facts 1998 & 1999

Table 3.2: Overseas Visitors to Counties in the Midlands East and South East Regions 1997

County	Total (000s)	Britain	Mainland Europe	North America	Other Areas
Wicklow	265	139	69	39	18
Kildare	132	76	26	24	6
Carlow	43	28	7	5	4

Source: Bord Fáilte, Perspectives on Irish Tourism Midlands East and South East

Table 3.3: Revenue Generated by Overseas Visitors to Counties in the Midlands East and South East Regions – 1997

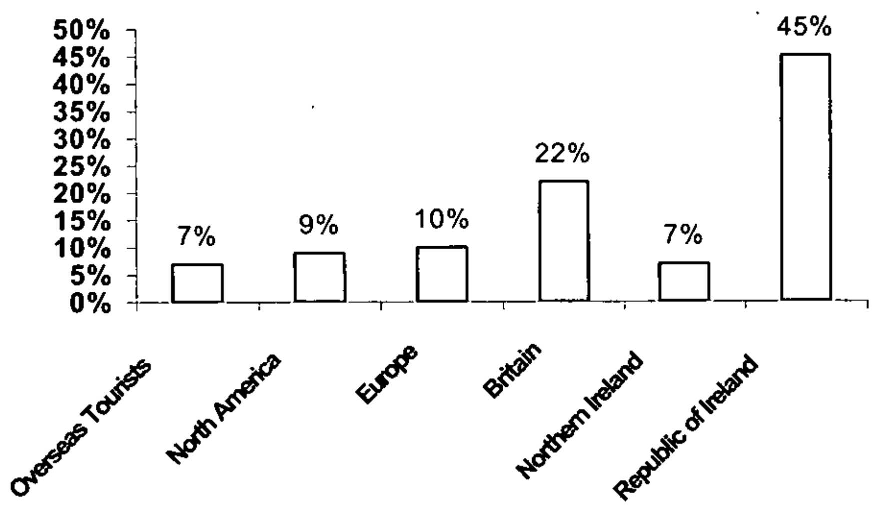
County	Total (£m)	Britain	Mainland Europe	North America	Other Areas
Wicklow	40	20	12	5	3
Kildare	28	15	8	3	1
Carlow	10	6	2	1	N/a

Source: Bord Fáilte Perspectives on Irish Tourism Midlands East and South East
N/a: Information not available

The above information gives the relative scale of tourism in the three counties of Wicklow, Kildare and Carlow.

The "Wicklow County Strategy 1999" is a survey that was commissioned by Wicklow County Tourism to provide detailed up to date information on tourism in the County. Tourism Development International carried out this strategy with the aim of providing information to "enable informed decision making and planning" (Wicklow Tourism Monitor, 98). From analysis it was found that an estimated 580,000 overnight visitors stayed in the County in 1998 with 45% of these coming from other counties in Ireland. Total expenditure by these visitors totalled at £107 million. It was discovered that the most attracting characteristics posed by the county is the beautiful scenery, countryside and lakes.

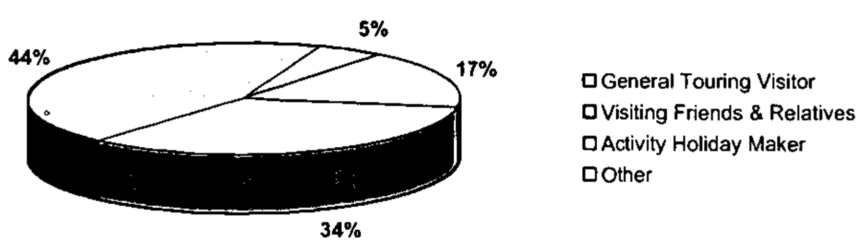
Figure 3.1: Percentage of Overnight Visitors to County Wicklow



Source: Wicklow Tourism Monitor, 1998

From the estimated 580,000 overnight visitors, the Wicklow Tourism Monitor broke the visitors down according to the visiting sector that they fall into as shown in the pie chart below.

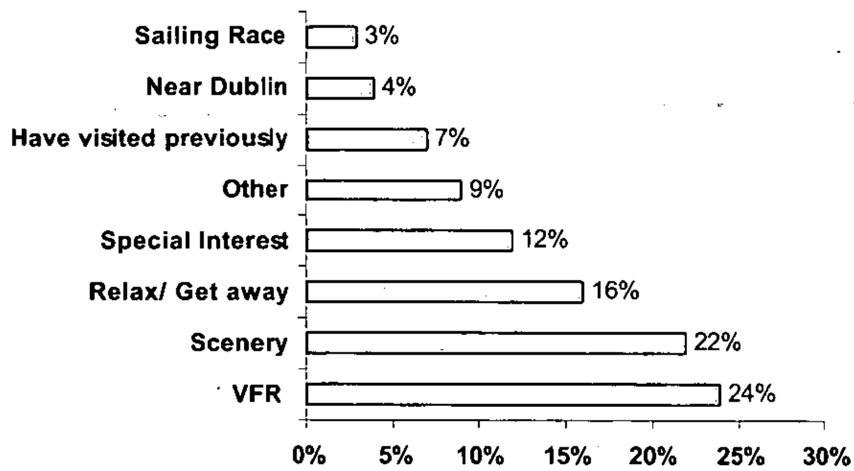
Figure 3.2: Visitors by Market Segment



Source: Wicklow Tourism Monitor

As part of the Wicklow County Tourism review 1998, a survey of visitors to West Wicklow was conducted with numerous interviews taking place through the months of April to August. The interviews were conducted in north (128 interviews), south (78), east (106) and west (55) Wicklow in the main tourist attractions for that region. In West Wicklow (the area where Rampere Landfill is located) 55 interviews took place and out of this 7 occurred at Baltinglass Abbey, 3 at the Tourist Information Point in Baltinglass with the remainder occurring at Russborough House and Blessington. From the survey it was learned that 45% of those asked had visited the Wicklow Mountains with only 1% visiting the Glen of Imaal.

Figure 3.3: The graph below displays the results as to why people visit County Wicklow



VFR – Visit Friends and Relatives
Source: Wicklow Tourism Monitor, 1998

4 TOURISM IN WEST WICKLOW, BALTINGLASS REGION

Tourism in the whole of West Wicklow and its neighbouring counties was analysed. The study then focussed in detail on tourism within a 10km radius of Rampere landfill site. The radius extends to cover areas of County Kildare and a small area of County Carlow as well as County Wicklow.

4.1 WEST WICKLOW

West Wicklow; a strip between Wicklow Mountains to the east and the flatter agricultural plains of Kildare and Carlow to the west. These mountains cover approximately 320 square metres over the 1000m altitude. The highest point is at Lugnaquilla Mountain (925metres), situated near the centre of Wicklow, 17km from Baltinglass. These mountains are based on bedrock of granite and the uplands are covered in a blanket of heather.

West Wicklow has a large amount to offer in terms of sports activities, such as sailing, canoeing, windsurfing and mountain climbing. In 1998 the Tour de France passed through Wicklow travelling from Dublin down to Arklow back up to Rathdrum and then over the Wicklow Gap to Blessington and onwards to Dublin. It passed through the town of Hollywood situated approximately 0.6km from the N81. Tourists can view a large sign on one of the main pubs in the town centre dedicated to the Tour de France. The Hollywood Stone was found near the bridge on the Kings River and is said to be a marker stone on the pilgrim path to Glendalough. It is now in the National Museum in Dublin.

Situated in the north western part of Wicklow is Blessington, a town located on the banks of a large lake that stretches both north and southwards. The town that was built in 1667 has changed along with the surrounding countryside due to the flooding of the Liffey Valley in 1940 to form the Blessington Lakes. The town attracts a number of tourists due to its close location to Dublin.

The lakes cover 5,000 acres of clean water and were formed by the building of the Poulaphoca Dam and hydro-electric power station. It now forms the potable water supply for much of greater Dublin. The area provides the perfect setting for Blessington Adventure Centre which offers both land and water sports.

Russborough House situated 3.2km south of Blessington is one of the best preserved large houses in Co. Wicklow and one of the main attractions in West Wicklow. The house is built of Wicklow Granite and is built in the Palladian style. In 1976 the house was opened to the public, it contains paintings from the Beit Collection, fine furniture, carpets, tapestries, silver and bronzes.

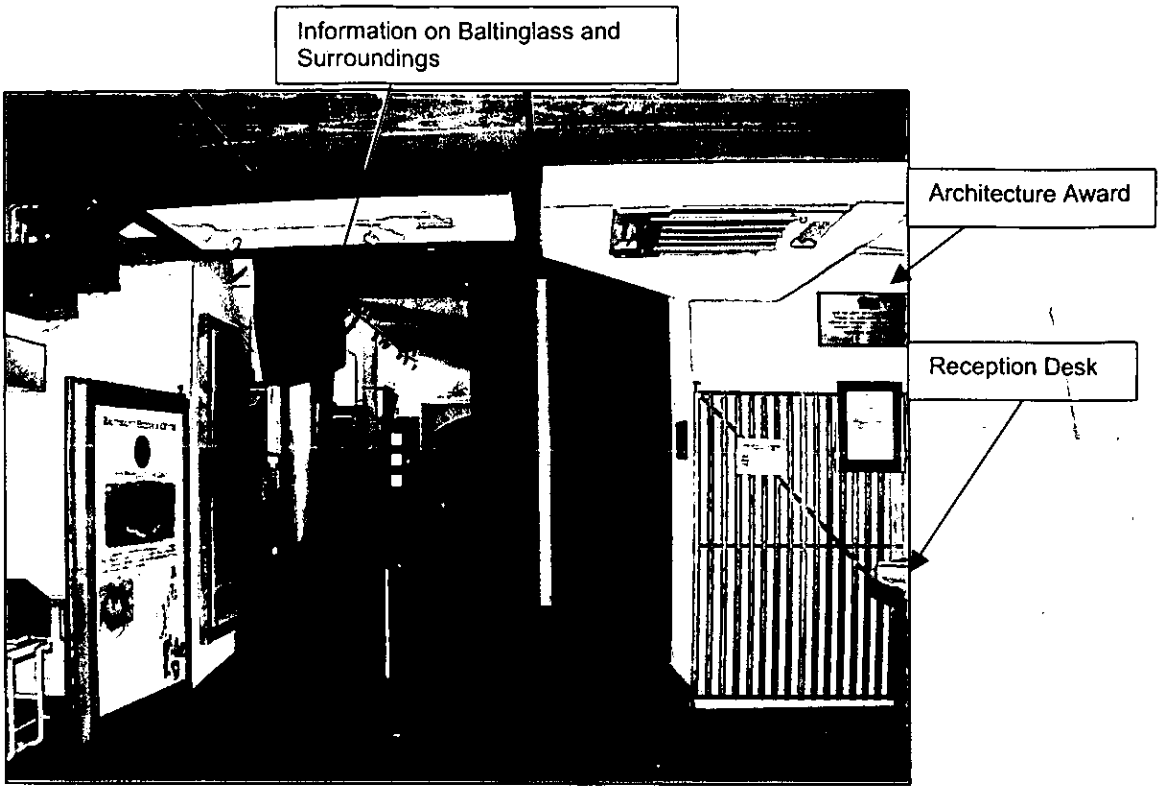
4.2 FEATURES WITHIN A 10KM RADIUS OF RAMPERE LANDFILL SITE

A 10km radius was drawn from the landfill site, and within this a number of tourism attractions were identified. These were for example Baltinglass town, Baltinglass Abbey, 1798 Monument, Megalithic tombs, Baltinglass Hillforts, Glen of Imaal, Dunlavin and The River Slaney. This radius also extended into Counties Kildare and Carlow and a summary is given on each. Distances (as the crow flies) from Rampere Landfill Site to the principal tourist attractions are given in Table 4.1

4.2.1 Baltinglass Town and Heritage Centre

Rampere landfill site is located in an area of rolling topography and undulating hills. Baltinglass (1,127 inhabitants), is the nearest town to the landfill has been recently designated a Heritage Town. The town has a Heritage Centre/Tourist Office situated in the basement of the Courthouse in the Market Square which was officially opened on the 11th of January 2000. The Heritage Centre is has information on the town of Baltinglass and the surrounding area (see Figure 4.1). The building won an Irish Architecture 2000 Award for the Courthouse and Heritage Centre. Nearly every year in the month of August the town of Baltinglass holds a street festival which is organised by the publicans of the town and includes appearances by famous Irish groups.

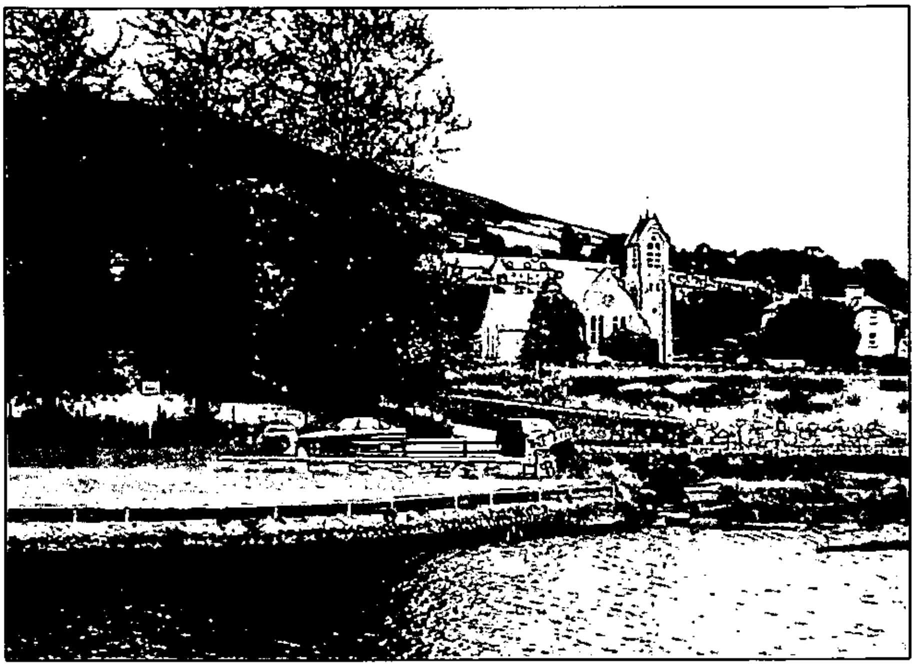
Figure 4.1: Baltinglass Heritage Centre/Tourist Office



4.2.2 Baltinglass Abbey

The town is thought to lie on an ancient route from Tara Co. Meath to Ferns in Co. Wexford. It developed as a market centre for the surrounding countryside as can be noted from the large market square. On the northside of the town situated on the east bank of the River Slaney is Baltinglass Abbey. This Abbey was the second Cistercian monastery to be built in Ireland. Fragments of the Church and traces of the cloister are still standing today and the two Romanesque doorways attract many visitors. Beside the River Slaney and in front of the Abbey are wooden picnic tables that provide as a recreation facility for visitors. The 3-arch stone bridge in the centre of the town is an attractive feature of Baltinglass.

Figure 4.2: Baltinglass Abbey and the River Slaney



4.2.3 1798 Monument

Another feature of interest in Baltinglass town is the 1798 Monument situated in the centre of the town in front of the Courthouse. This monument commemorates the 1798 rising, and in particular Sam McAllister. He was killed whilst distracting the soldiers attention at a cottage in Derrynamuck in order to let Michael Dwyer escape. To the east across the Slaney River is the old Railway that connected West Wicklow to Dublin. It opened in 1885 but was discontinued in 1959. Some of the old Railway buildings and signal boxes still exist but several new buildings have obscured the line.

4.2.4 Megalithic Tombs

To the east of the town on the Pinnacle, a 1,258 ft hill, is a cairn that contains Bronze Age burial chambers around 5,000 years old. These Megalithic tombs were excavated by the National Museum in the 1930's. The cairn was used as a burial site since remains were found. Whoever built the famous passage graves at Newgrange also constructed this burial cairn. The fact that there is a cairn there means that Baltinglass Hill was seen as an important place for the local people of that time. Encircling the top of the hill is a hillfort called Rathcoran which was used for either ceremonial or defensive purposes.

4.2.5 Baltinglass Hillforts

In fact, Baltinglass is at the centre of a huge complex of five hillforts that can be dated to around 1,000 BC or earlier. They are named the Rathcoran, Rathnagtee, Spinans, Tinoran and Hughstown Hills. The Rathcoran Hillfort lies at the top of Baltinglass Hill and surrounds the Cairn that exists there. It is roughly oval in shape and around 400m at its widest point. The Spinans Hill is part of Brusselstown hillfort complex, and is a massive structure north-east of Baltinglass. The outer rampart encloses an area of 130 acres and is over 1.5km at its longest point. This is one of the most impressive constructions of this period in Western Europe.

4.2.6 Glen of Imaal

Glen of Imaal, north-east of the landfill is a spectacular valley along which the River Slaney and Little River Slaney join. The Army has an Artillery range there and also in this valley is Dwyer McAllister

Cottage. It is a fine example of a traditional whitewashed thatched cottage that was associated with 1798 rebel figures. A fire destroyed the cottage over 150 years ago but it was restored as a monument in 1946 and later in 1992 it was extensively repaired and re-roofed. It's situated at the base of the Keadeen Mountain in the Derrynamuck townland on the Knockanarrigan/ Rathdangan Road. This area is unspoilt and well sign posted owing to public interest in the restored cottage which was opened in August of 1948. In the month of June a Deer Fair is held in the Glen of Imaal.

Figure 4.3: Dwyer McAllister Cottage

4.2.7 Dunlavin

Approximately 10km north of Rampere Landfill is the village of Dunlavin situated 5km west of the N81 close to Kildare county border. This peaceful village has a Courthouse built in the centre of an unusually wide street. This Courthouse has recently been restored and converted to a library. It was built in the ancient Doric style of Grecian architecture and is one of three such buildings in Ireland.

Figure 4.4: Dunlavin Courthouse

4.2.8 Stratford on Slaney and Donard

Stratford on Slaney situated 8km south of Dunlavin and 3.5km north of Rampere is a village high above the Slaney River and has been County Wicklow's tidiest village every year for the last twenty years. Donard situated 9km north of Rampere is a village situated in the Glen of Imaal. There is a camping and caravan park in the village and 3km to the south is a former rectory that now provides residential holistic courses.

4.2.9 The River Slaney

The River Slaney flows beside the N81 through the town of Baltinglass. It rises in the Wicklow Hills and flows for some 100km southwards where it reaches the sea at Co. Wexford. This River is one of the foremost salmon fishing rivers in Ireland. Salmon angling is available downstream from Tullow town in Co. Carlow. In the County Wicklow stretch of the Slaney north of Tullow, brown trout is the dominant species.

4.3 COUNTY KILDARE

Ballitore is a charming village in south east County Kildare that was founded by the Quakers. The Quaker Museum was restored as a contribution to the European Architectural Heritage Year. On the road between Ballitore and Burtown is an Iron Age ringfort where a massacre of the seven septs of Laois took place. South of Ballitore along the N9 is Castledermot where Franciscans established a friary and where today there remains a 15th Century Tower. At Timolin also along this route visitors can see the traditional way of making Irish Pewter. Crookstown Heritage Mill less than a kilometre from Ballitore is a restored Cornmill that has exhibitions throughout the year. North of Castledermot is Bolton Abbey, a Cistercian monastery with a medieval tower house. All of the distances from the proposed landfill to these features are listed in Table 4.1.

4.4 COUNTY CARLOW

Rathvilly situated directly south of Baltinglass is the main village in County Carlow within the 10km radius. It is an attractive riverside village that has received many National Tidy Town awards. Many of the County guides suggest following the 'megalithic drive' through Carlow and part of this runs from Rathvilly eastwards to Hacketstown. However the main features are situated further to the south of Carlow.

Table 4.1: Approximate Distance of Tourist Attractions within a 10km radius of Rampere Landfill Site

Tourist Attraction	County	Approximate Distance from landfill site (as the crow flies)	Visitor Numbers
Baltinglass Heritage Town	Wicklow	3km south	Approx. 130 signatures from Jun. to Aug 00 *
Baltinglass Abbey	Wicklow	3.3km south	N/a
Bronze Age burial chamber	Wicklow	3.1km south east	N/a
Castleruddery Stone Circle	Wicklow	5.6km north east	N/a
Glen of Imaal	Wicklow	9.3km north east	N/a
Dunlavin Courthouse	Wicklow	10.1km	N/a
Dwyer McAllister Cottage	Wicklow	10.2km east	N/a
Stratford on Slaney	Wicklow	3.2km north	N/a
Donard	Wicklow	8.8km north east	N/a

Tourist Attraction	County	Approximate Distance from landfill site (as the crow flies)	Visitor Numbers
Ballitore Quaker Museum	Kildare	8.6km north west	N/a
Castledermot, Tower	Kildare	10.5km south west	N/a
Timolin The Pewter Mill	Kildare	7km west	5,000 (1996)
Crookstown Mill	Kildare	8.5km north west	N/a
Bolton Abbey	Kildare	7.6km west	N/a
Rathvilly Village	Carlow	9.7km south	N/a

Source: Bord Fáilte
* Baltinglass Tourist Office
N/a: Information not available

4.5 MAIN TOURISM ROUTES

The main road used by tourists in the area would be the N81 which runs in a north south direction. This route starts in Dublin and passes through Blessington, close to Russborough House, Hollywood, Stratford-on-Slaney and on to Baltinglass where it then travels into County Carlow and further south. The cross-county tourism traffic would mainly come through the Wicklow Gap and Sally Gap to the north and centre and the main route in the south would be from Rathdrum to Tinahely. The Wicklow Gap would probably be the more prominent route for tourists as this route passes alongside Glendalough. The Wicklow Gap connects Hollywood to Laragh where the road divides to the north east and south. The Sally Gap passes across north Wicklow with the road dividing and travelling south to Laragh, north to Glencree and east past Lough Tay towards Roundwood.

5 POTENTIAL IMPACTS ON TOURISM OF PROPOSED LANDFILL EXTENSION

5.1 PRESENT LANDFILL SITUATION

The Rampere Landfill site being located near the base of Tinoranhill is visually well hidden from the town of Baltinglass by the 140m to 180 metre contours. The Tinoranhill (312metres) is situated to the north of Baltinglass town providing a good screen for the town.

The landfill is well screened from the roads that pass alongside the present landfill as is the proposed extension, see Fig 5.1 and 5.2. The landfill is well removed from the main tourist traffic route of the N81, being located on a local road. This local road is not likely to be used by tourists based on available information. The current site is not apparently having any ill effect on tourism.

5.2 TOURISM POTENTIAL

From the statistics given in Chapter 3 it can be seen that the number of tourists visiting the area of Baltinglass is not high compared with the rest of the county. Powerscourt and Glendalough both in the north of Wicklow received in 1998, 220,073 and 113,207 visitors respectively. The Wicklow Tourism Monitor when conducting its survey of West Wicklow obtained most of its interviews at Blessington and Russborough House rather than at attractions in Baltinglass town and surroundings. However the area does have tourist potential and tourism is growing and being actively developed. It is though important that this proposed landfill development would not counteract further increases in tourism.

5.3 POTENTIAL IMPACTS FROM PROPOSED EXTENSION

From visits to the site and consultation with locals there is no evidence to suggest that the proposed extension will have a negative impact on tourism. The nearest attraction to the landfill is the visitor centre in Baltinglass approximately 3km south of the site. The tourist register at the entrance to the Heritage Centre is for visitors to sign and comment on. Between June and August 2000 approximately 130 visitors to the centre have signed the register with a large proportion of these being locals visitors from the surrounding area. There were a number of overseas signatures from e.g. Europe, the United States and Australia but these were few in comparison to the Irish signatures.

From the above information given it is unlikely that this new proposed landfill extension will impact tourism in the area.

Figure 5.1: Screening of the Landfill

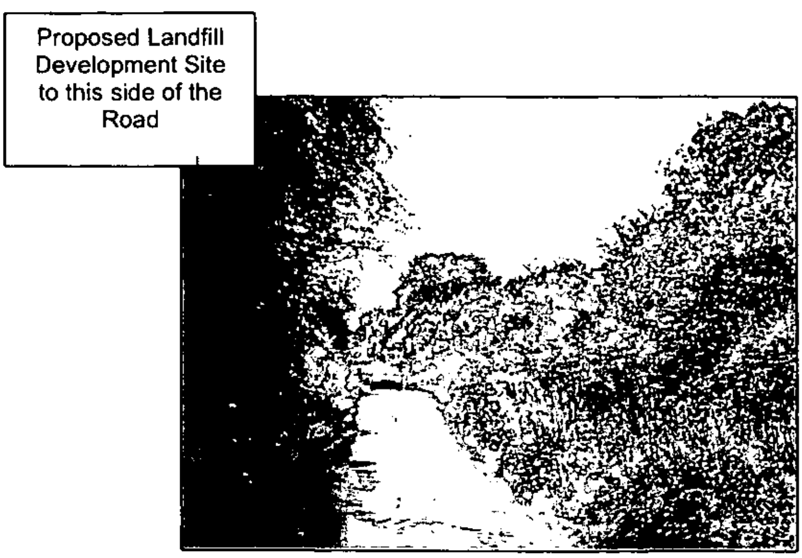
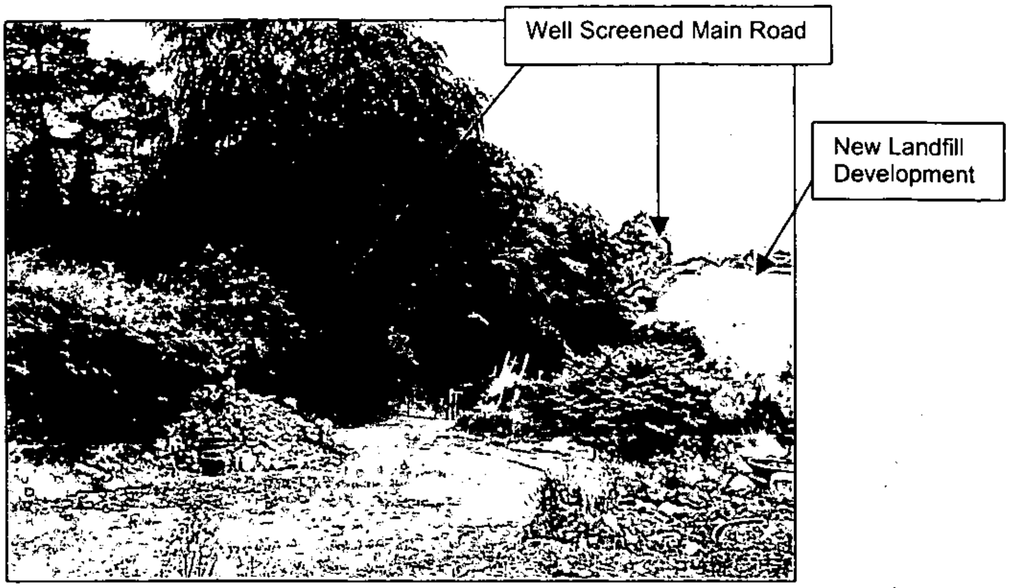


Figure 5.2: View from Inside the Existing Landfill



6 MITIGATION MEASURES

6.1 VEHICLES STANDARDS

Due to vehicles having to transport the waste from different parts of Wicklow it would be necessary to ensure that there is proper maintenance of these vehicles in relation to their cleanliness and visual appearance. Waste trucks may have to use routes such as the N81, and the Wicklow Gap R756 which are busy routes including significant numbers of tourists particularly in the summer months. There should be proper control on waste delivery vehicles such that litter or leachate shall not fall from the vehicle.

6.2 MAINTANENCE OF LANDFILL SITE

It is important to note that this landfill should be kept and maintained to a high standard. Some of the potential posed by any landfill that would cause impact on tourism would be visual deterioration of the landfill, an increase in noise, odour or litter and lastly an increase in birds or vermin in the surroundings of the landfill. A properly operated landfill is essential to avoid any nuisance effects such as noise, birds or litter.

7 CONCLUSION

This landfill site, although situated close to Baltinglass a Heritage Town is not visible from the town or the main N81 Secondary Road that passes to the east of the site. The site is accessed from a third class road and is well screened by a large hedgerow making it difficult to view by passing traffic. The local road is not likely to be used in the future by tourist traffic. Traffic using the landfill may travel along routes used by tourists and Wicklow County Council should ensure high standards of vehicle control (no litter, cleanliness and good vehicles) to avoid any possible impacts.

Although there are a number of tourist attractions in the region of the Landfill the attractions that are frequented the most lie to the north, east and centre of the County, as can be seen in Table 2.1. Tourism is being developed such as the newly converted courthouse in Baltinglass which now provides a tourist office and heritage centre. Overall the extension is unlikely to have any detrimental effect on Tourism in the Baltinglass/ West Wicklow area.

APPENDIX 12

PUMP TEST

FOGARTY DRILLING AND MCOS

DOCUMENT CONTROL SHEET

Client	Wicklow County Council					
Project Title	Rampere Landfill Extension					
Document Title	Pumping Tests					
Document No.	067509001RP002ASH					
This Document Comprises	DCS	TOC	Text	List of Tables	List of Figures	No. of Appendices
	1	1	5			2

Revision	Status	Author(s)	Reviewed By	Approved By	Issue Date
D01	Final	JC, UP, WO			11 Oct 01

Table of Contents

1 INTRODUCTION

Fogarty Drilling Ltd. were commissioned by M.C.O'Sullivan & Co. Ltd. on behalf of Wicklow County Council to conduct a pumping test. This test is part of an intended application to the Environmental Protection Agency to extend the existing Rampere Landfill in Baltinglass, Co. Wicklow.

A pump test was required in order to determine the groundwater flow rates in the underlying geological strata and apply a suitable aquifer classification for the proposed extension site. Work commenced on 24th July 2001 and was completed on 24th August 2001. These works included the construction of one main well and four monitoring wells, a developing step test and a constant yield pump test.

2 SITE DESCRIPTION

Rampere Landfill is located in Co. Wicklow; approximately 2.5km north of the town of Baltinglass just off the N81. The site, which is under consideration for the proposed extension, lies to the west of the existing landfill and covers an area of 13.5acres. The site is bounded to the north by Rampere stream and to the south by a regional road (see site Plan in Appendix A).

The site is presently a large pasture field that tends to slope towards the stream. There is an approximate 20m variation in height between the higher part at the road and the lowest point at the stream. During the time of the test there was no surface water on the low-lying parts but it is believed that there.is a tendency for rainwater to pond during the winter months.

3 OVERVIEW OF PUMPING TESTS

3.1 WELL CONSTRUCTION

Five boreholes were constructed, adhering to the specifications laid out in the contract document, between 24th July and 1st August. The main well (PT1) is a 312mm diameter borehole to a depth of 27m bgl with a 200mm screen installation. Four monitoring wells were also constructed, each with a hole diameter of 165mm and a 52mm standpipe installation. OB2 and OB4 were drilled to a depth of 21m, OB1 and OB3 were drilled to a depth of 27m and each of these were placed at measured distances from the main monitoring well. See Layout Plan in Appendix A for details. These wells were left to recover for a period of two weeks and a pump was then placed in the main well to a depth of 23.5m.

3.2 STEP DRAWDOWN TEST

On 15th August the step-down test was performed in order to determine the borehole capacity and the optimum rate at which the pump should run during the constant yield test. The step-down test started at an initial pumping rate of $1m^3/hr$. The well was pumped at this value continually until the water level remained unchanged. The pumping rate was then increased in $1m^3/hr$ increments until a value of $4m^3/hr$ was reached with equilibrium being obtained at each increment. The pumping rate was then stepped up to $5.5m^3/hr$ and the well was subsequently pumped dry. A rate of $4.6m^3/hr$ was then selected and this also caused purging of the well. It was therefore decided to use the value $4m^3/hr$ for the constant yield test. A summary of the test results are presented in Figure 1, Appendix B.

3.3 CONSTANT YIELD TEST

The constant yield test commenced at midday on 21st August 2001, pumping at a capacity of $4m^3$/hr. After a period of 22hrs the water level in the main well had dropped by 13m however, the drop in the monitoring wells was only 1.0m. Due to an insignificant decrease in the water levels, the pump was lowered to a depth of 25m and its capacity increased to $4.3m^3$/hr. After a further 6.5hrs the capacity of the pump was increased to $5.2m^3$/hr, again as a result of nominal decreases in water levels in both the main well and monitoring wells. The water was continually pumped at this capacity for a further 49.5hrs until 10am 24th August, providing a total test duration of 70 hours. A summary of the test results are presented in Figure 2, Appendix B.

4 GEOLOGY AND HYDROGEOLOGY

4.1 PREVIOUS WORK

The geological and hydrogeological conditions were considered in a previous investigation carried out by B.J.Murphy & Associates in August 2000.

Bedrock encountered on the site is dominated by fine-grained mudstone with some calcareous limestone and fine-grained sandstone. Overburden materials were found to be in the region 5-6m thick and comprised of boulder clay (gravelly, sandy clay) and alluvial deposits (inter-bedded sands, silts and peats). The boulder clay tends to be found on the higher ground and the alluvial deposits form the lower-lying parts of the site along the historic flood plain of the stream.

Using a groundwater contour map for the area it is apparent that groundwater flows from the southwest of the site to the northeast into the stream.

4.2 REGIONAL GEOLOGY

The findings of the previous site investigation undertaken are in agreement with the information supplied by the Geological Survey of Ireland (GSI). They indicate that the site is underlain by the Butter Mountain Formation, which is part of the Ribband Group and Lower Ordovician in age. Lithologies within this formation consist of dark blue-grey slates that tend to become schistose towards the Tullow pluton of the Leinster Granite, which has its boundary quite close to the site. As a result of this site being within the contact aureole, many of the sediments have been metamorphosed to phyllites and schists. A fault with north-south orientation forms the boundary between the Butter Mountain Formation and the overlying Pollaphouca Formation. It lies approximately 300m west of the site and has affected rock quality in the area causing numerous fractures and secondary faulting to occur within the weaker members of the formation.

4.3 SITE GEOLOGY

The five boreholes constructed for this pump test, were all done using open hole drilling techniques and therefore no detailed descriptions of the underlying strata were obtained. However, the information gathered from tailings tends to concur with previous work. Bedrock was encountered at approximately 5m in all boreholes and consisted of a blue-grey, slaty mudstone.

4.4 REGIONAL HYDROGEOLOGY

The Butter Mountain Formation has been classified as a locally important aquifer by the GSI under the groundwater protection scheme for Co. Wicklow (Draft, April 1998). It is moderately productive only in local zones (LI).

The hydrogeology of the Butter Mountain formation is poorly known as insufficient hydrogeological data exists. The GSI has identified five water wells with yields ranging from 40 to 100 m3/day in the area. The aquifer is classified (relating to its productivity) on the basis of its lithological similarity to the better known Maulin Formation, as a **"Locally important aquifer, moderately productive only in local zones (LI)".**

4.5 SITE HYDROGEOLOGY

The overburden encountered in the site is largely comprised of boulder clay with some thin layers of alluvial material and occurs to a depth of between 5-6m bgl.

The vulnerability of the aquifer as defined by the GSI, refers to the characteristics that determine the ease with which groundwater may be contaminated by human activities and is based on subsoil composition and thickness. For these low permeability overburden conditions encountered, the aquifer vulnerability is regarded as "**high to extreme**".

During drilling, a significant variation in the depth at which water strikes occurred. A summary of the depths is presented in Table 1.

Table 1: Summary of water strikes during drilling.

Borehole	**Water Strike**
PT1	14m
OB1	25m
OB2	17m
OB3	9m
OB4	9m

The variability in strikes indicate that the groundwater flows through fissures and fractures within the bedrock with limited interconnection. After a period of 2-week leading up to the pump test, the water levels in all the wells had risen and stabilized to a standing level of about 3m.

Groundwater flow through fractures and fissures in bedrock is considered to be secondary permeability.

5 RESULTS OF PUMP TEST

Analysis of data coming from the step drawdown test performed in well PT1 show that the aquifer in the area is confined, with elevated head losses. This behaviour can also be explained with the existence of the water course feeding the aquifer in the vicinity of the pumping well.

The constant yield test data, analysed with the Jacob Method (semilog plot drawdown vs. log time) provides an aquifer transmissivity value of $1.35*10^{-4}$ m^2/s. Assuming an aquifer thickness of 22.0m, the corresponding value of the aquifer permeability is $0.6*10^{-5}$ m/s. An analysis using the formulas provided in BS5930, gives a value for aquifer permeability of $2.6*10^{-5}$ m/s for a confined aquifer and similar results for the unconfined situation.

6 GROUNDWATER PROTECTION RESPONSE FOR LANDFILL

Groundwater protection responses are concerned with the site selection process for landfills and the associated design, operation and monitoring and assess the acceptability of landfills in each groundwater protection zone and the recommended level of response/restriction. This is dependent on the groundwater vulnerability, the value of the groundwater resource and the type of contamination.

The GSI has developed a methodology called **response matrix for landfills** for the siting of landfills. It is based on the aquifer classification and the vulnerability rating of the aquifer in the area where the landfill is to be located.

Based on the information obtained through the pump test and desktop study, the site for the Rampere Landfill extension falls between $R2^1$ and $R2^2$. As a precaution measure, the more conservative category of $R2^2$ is recommended.

Conditions for $R2^2$ areas are as follows (GSI Groundwater Protection Schemes - DELG, EPA, GSI, 1999):

- acceptable for landfills, subject to guidance outlined in the EPA Landfill design manual or conditions of a waste licence.
- Special attention should be given to checking for high permeability zones (karst features etc). If such zones are present, then the landfill should only be allowed if it can be proved that the risk of leachate movement to these zones is insignificant.
- Special attention must be given to existing wells downgradient of the site and to the projected future development of the aquifer.
- Groundwater control measures (cut-offs or interceptor drains) may be necessary to control high water table.

Water in the aquifer flows through existing fractures and fissures within the bedrock, this is considered to be a secondary permeability and there is no evidence to suggest the existence of high permeability zones.
All local wells are upgradient of the site. Rampere stream is downgradient of the site but it is very unlikely that that the aquifer at depth is in fact a water source for the stream.

7 CONCLUSIONS

1. The results of the pump test indicate the following –
   - The groundwater flow is through fractures and fissures in the bedrock and is therefore considered to be secondary permeability.
   - The maximum yield of the borehole was $5.5m^3/hr$ and the overall permeability of the underlying rock horizon is in the order of $2.6E^{-5}$ m/s.

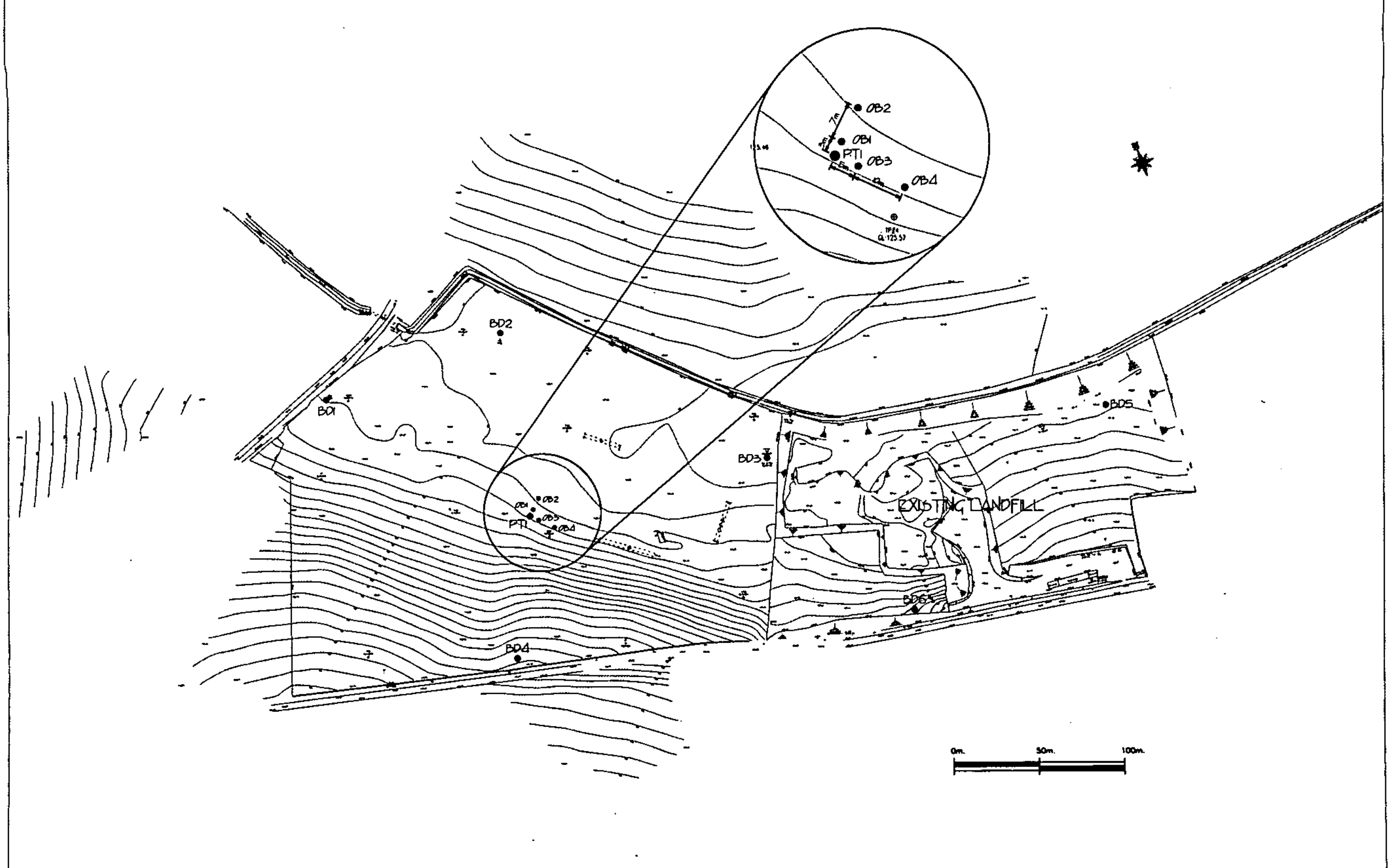
   The aquifer is therefore classified as a **"Locally important aquifer, moderately productive only in local zones (LI)".**

2. Information obtained in previous investigations and this pump test indicates that the overburden soil is typically boulder clay with some thin layers of alluvial material and occurs to a depth of between 5-6m bgl. For these low permeability overburden conditions encountered, the aquifer vulnerability is regarded as **"moderate to high"**.

3. Based on the information obtained through the pump test and desktop study relating to the importance and vulnerability of the underlying bedrock aquifer, the site for the Rampere Landfill extension falls between $R2^1$ and $R2^2$ on the response matrix. As a precaution measure, the more conservative category of $\mathbf{R2^2}$ is recommended.

Appendix A

Location Maps



WICKLOW CO. COUNCIL
County Buildings,
Wicklow.

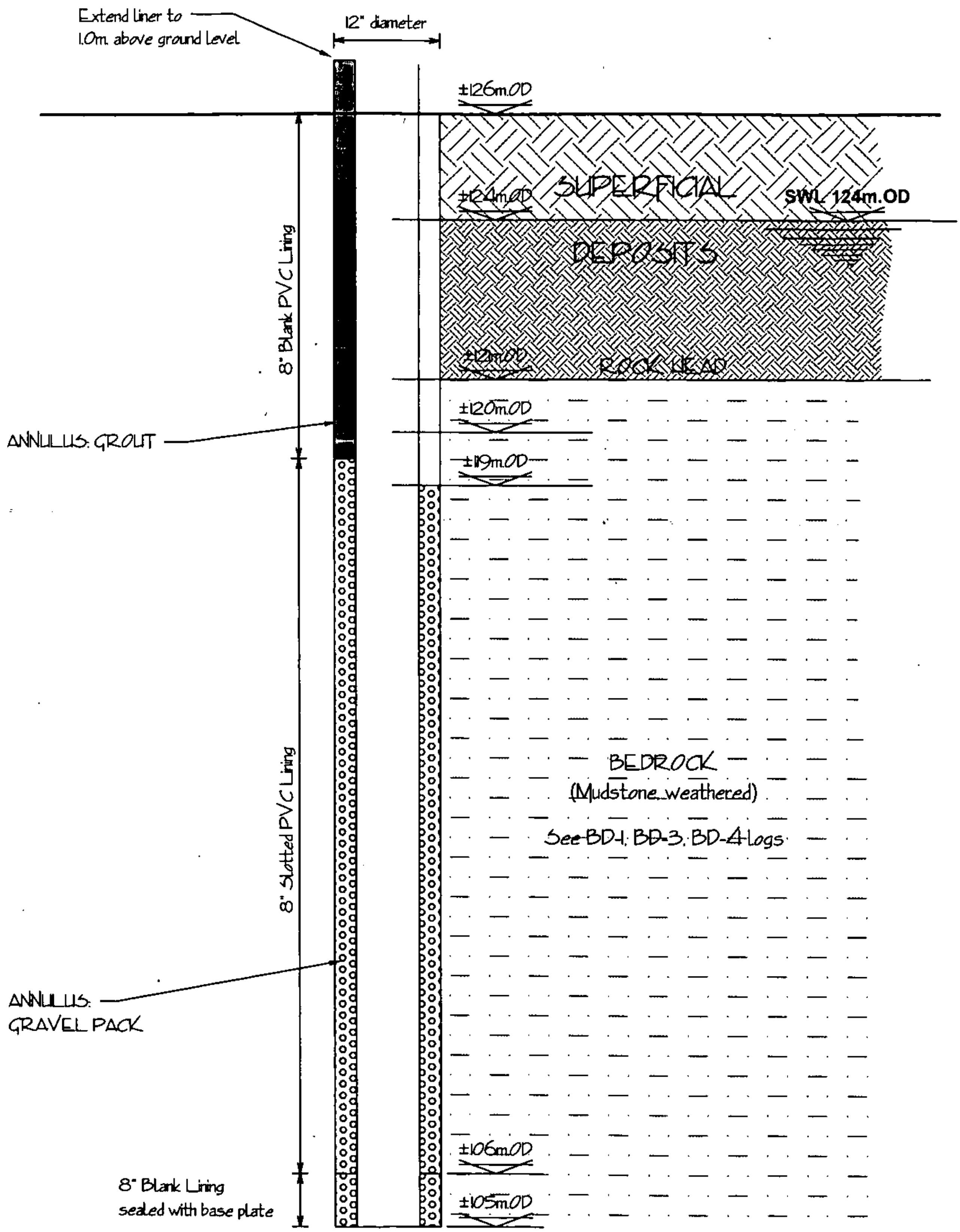
M.J. LOOBY
B.E.,C.Eng.,F.I.E.I.
County Engineer

A			Issue for Approval
No	Date	By	Amendments

Job: ENVIRONMENTAL IMPACT STATEMENT FOR PROPOSED EXTENSION TO RAMPERE LANDFILL

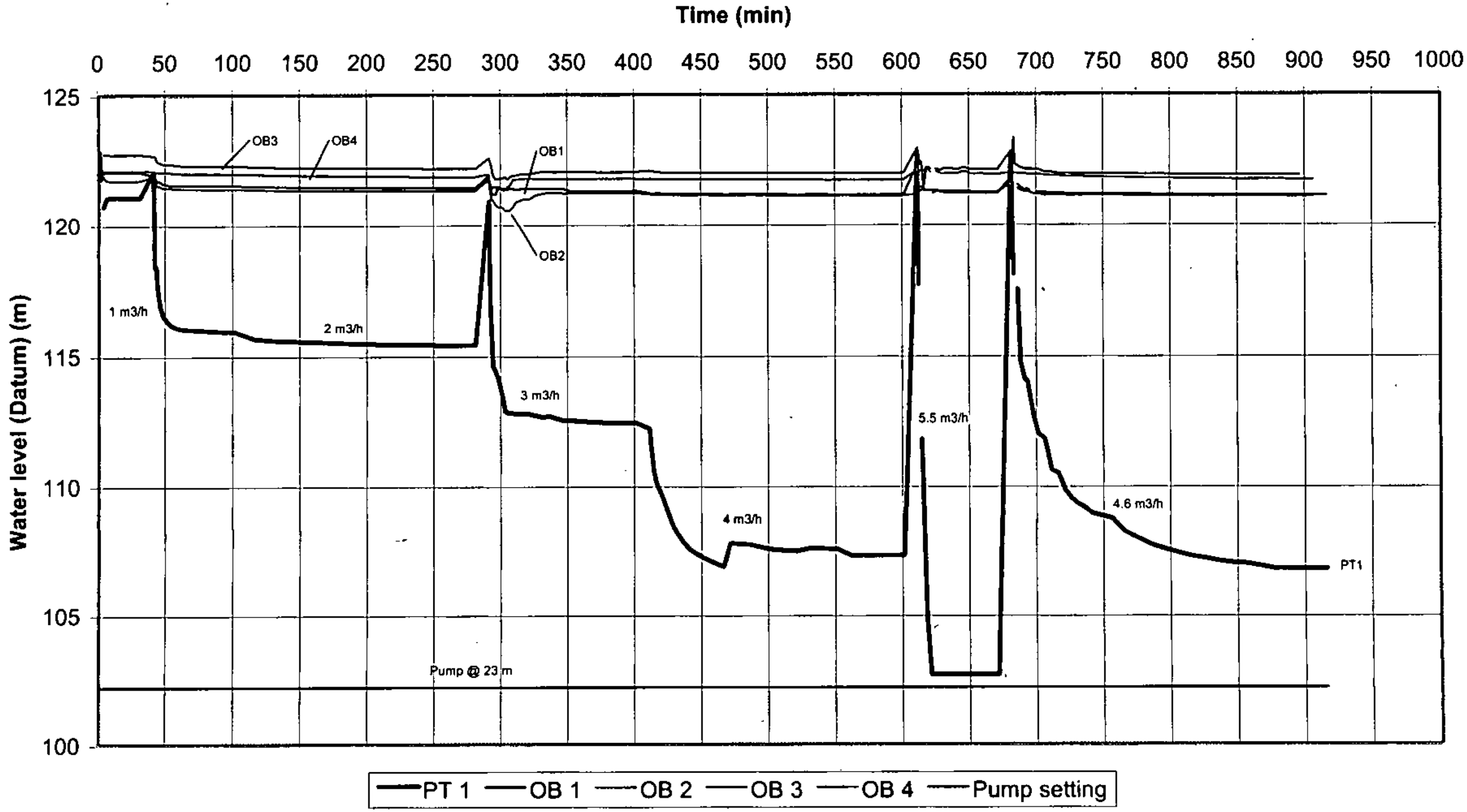
Title: PUMP TEST LOCATION

Issue Details		Office Use Only	
Drawn:	RH	Job No.	
Checked:		File Ref.	00-00
Approved:		Drawing No.	Rev.
Scale:	NTS	1	A
Date:	March 2001		

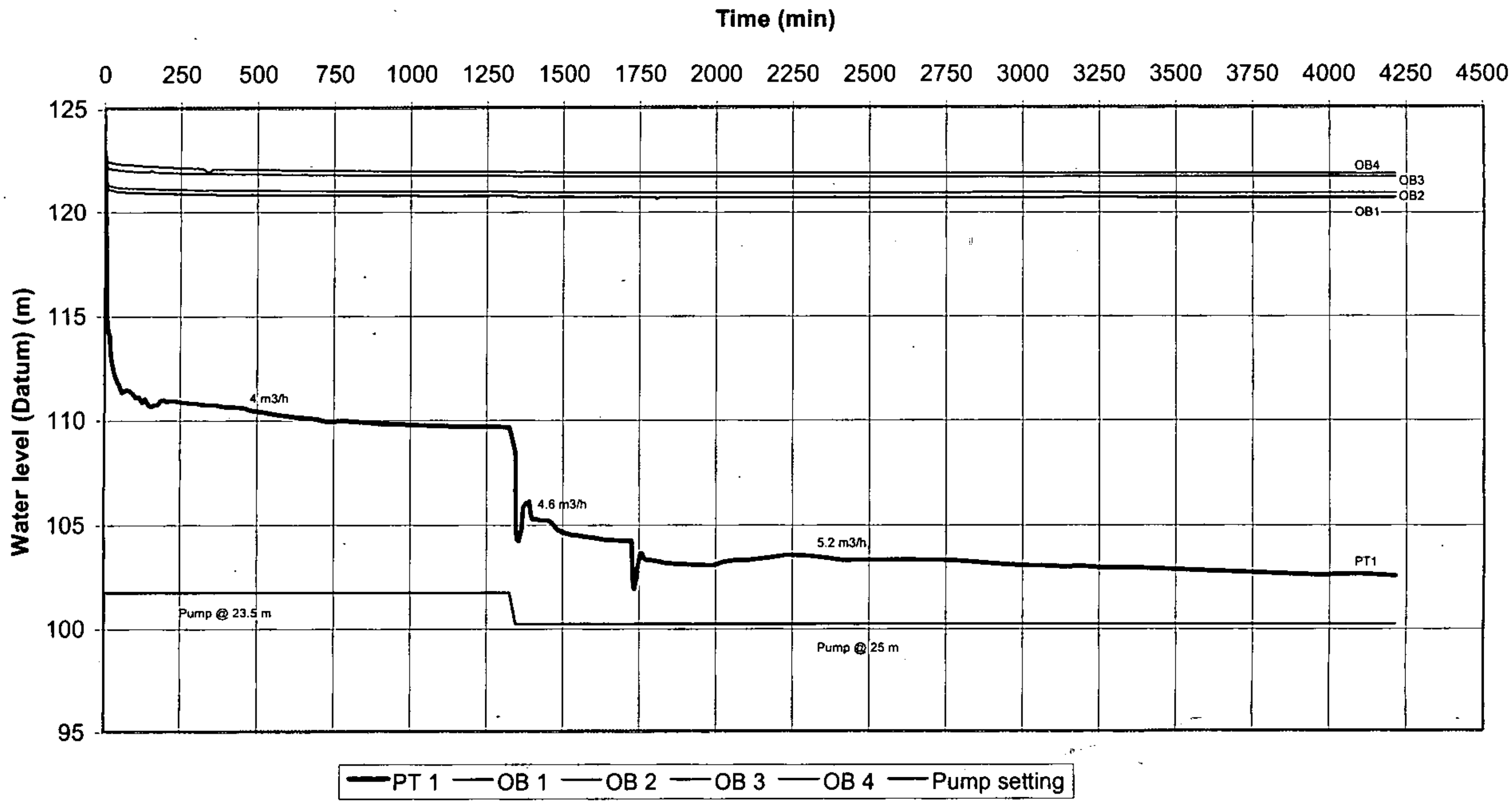


Wicklow County Council	mcos Issued from – Dublin ■ Cork □	Job: **ENVIRONMENTAL IMPACT STATEMENT FOR PROPOSED EXTENSION TO RAMPERE LANDFILL**	**Fig. 2**
		Title: **PUMP TEST WELL AT POINT PT-1**	Scale: N.T.S. Date: March 2001

Rampere Landfill Extension. Pump Test
Step-down test. August 2001
Output 1, 2, 3, 4, 5.5 & 4.6 m3/h



Rampere Landfill Extension. Pump Test
Constant Yeild Test. August 2001
Output 4, 4.6 & 5.2 m3/h (70 hours)

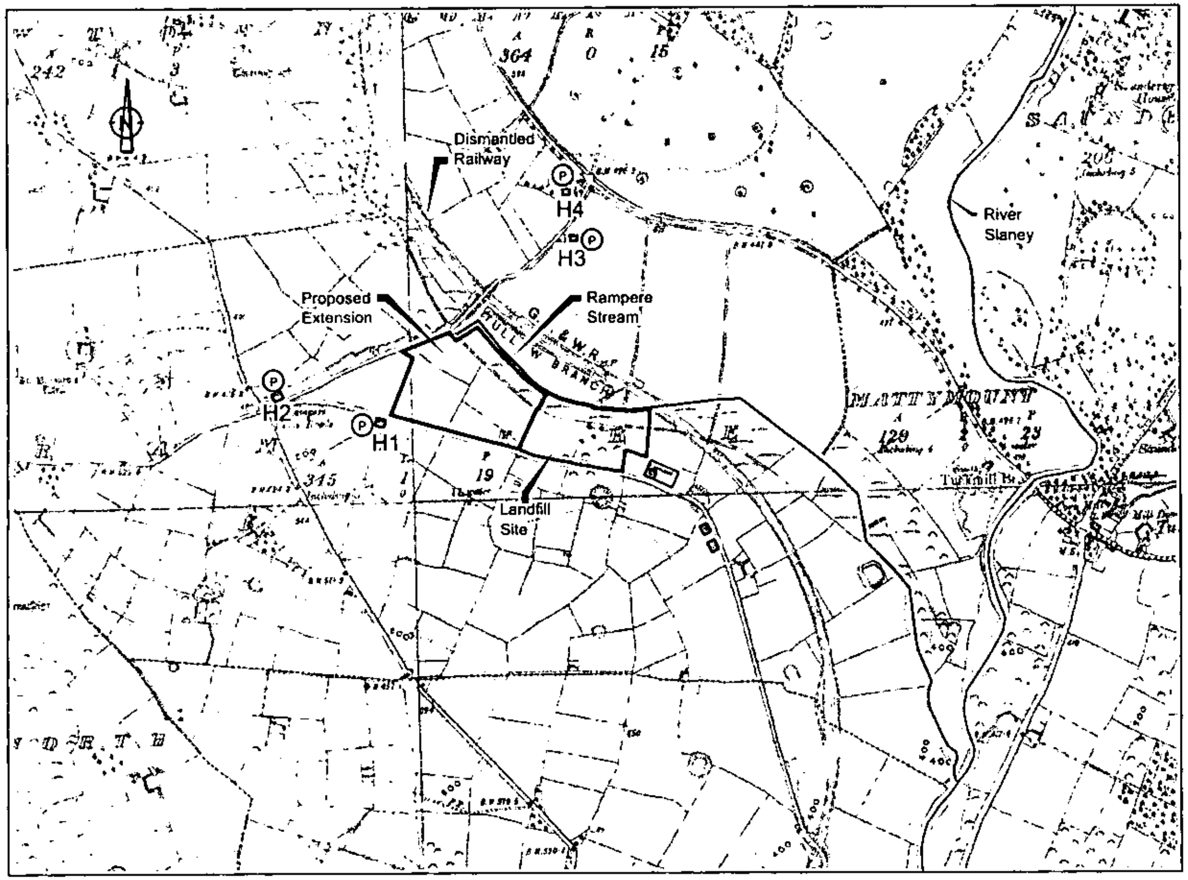


Appendix B

Figure 1 and Figure 2

Appendix C

Borehole Logs



LEGEND

—	Site Boundary
▭	House
Ⓟ	Private Water Well
—	River

WICKLOW COUNTY COUNCIL

MICHAEL J. LOOBY,
B.E. C.Eng. F.I.E.I.
County Engineer.

ENVIRONMENTAL IMPACT STATEMENT FOR PROPOSED EXTENSION TO RAMPERE LANDFILL

LOCATIONS OF NEARBY PRIVATE WATER WELLS

Issue Details		Office Use Only	
Drawn	B.O'D.	File Ref.	067-043-FINAL
Checked		Job No.	067-043
Approved		Drawing No.	3
Scale	1 : 10560	Rev.	A
Date	March 2001		

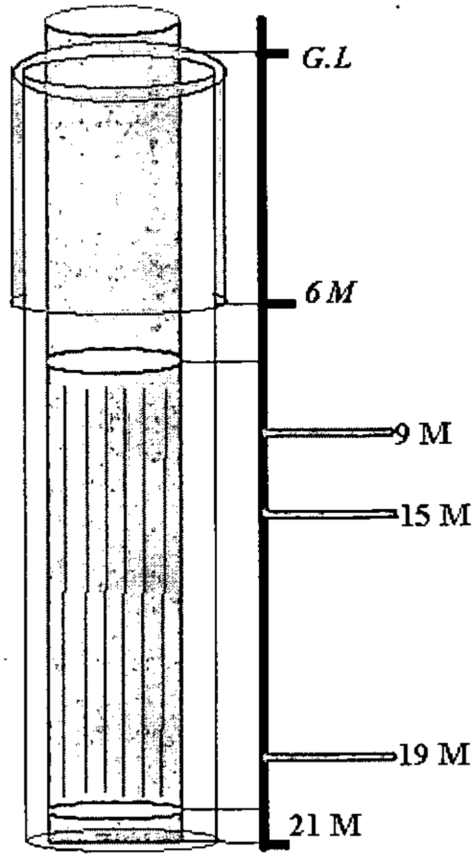
Observation well OB4 @ Rampere

A 165mm borehole was drilled to 21 Mtrs as specified. Bedrock was met at 5 Mtrs and 6 Mtrs of temporary steel casing was installed.
12 Mtrs of 55mm uPVC screen and 9 Mtrs of casing was installed, the annulus was backfilled with pea gravel and the upper portion was grouted with bentonite - cement grout A lockable steel cap was installed to complete.
The output of OB4 was gauged at 8.5 cubic Mtrs per hour with water entry levels as follows;

Water entry level @ 9 Mtrs-- ~ 2 cubic M/hr
@15Mtrs-- ~ 3 cubic M/hr
@19Mtrs-- ~3.5cubicM /hr.

These levels correspond with water bearing fissures as met in OB3. The aquifer is a hard mudstone - Limestone type rock with calcite veining.

Elevation of OB 4 is 124.437 M to G.L and + 0.465 to top of well head.



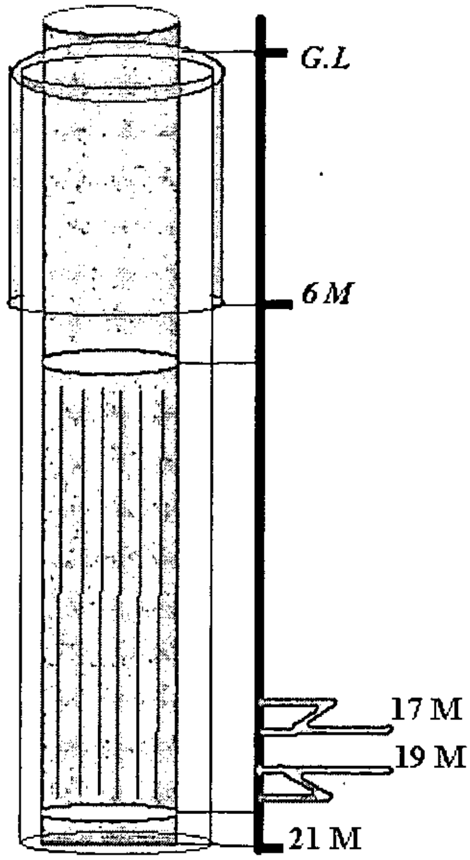
Observation well OB 2 @ Rampere

A 165 mm borehole was drilled to 21 Mtrs as specified, bedrock was met at 5 Mtrs and 6 Mtrs of temporary casing was installed to bedrock.

12 Mtr of 55mm uPVC screen and 9 Mtrs of casing was installed, the annulus was backfilled with pea gravel and the upper section grouted with a bentonite-cement grout. A lockable steel cap was installed to complete.

No water was encountered till a large fissure which extended from 17 M to 19 M and yielded 7 cubic Mtrs / hr.
The aquifer was a dark mudstone - Limestone type rock with just one large fissure, the aquifer was inconsistant in this profile away from PT 1.

Elevation of OB 2 is 123.625 to G.L .



Observation well OB3 @ Rampere

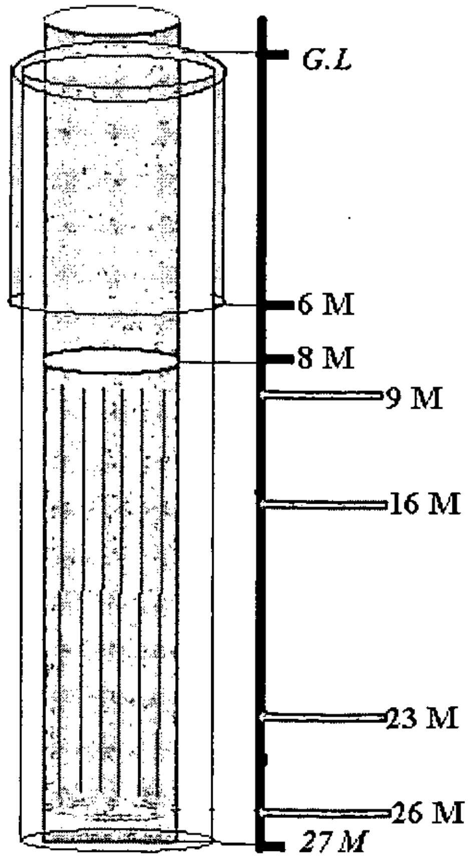
A 165mm borehole was drilled to 27 Mtrs to conrrespond to the depth of PT1. Bedrock was met at 5 Mtrs and a temporary casing installed.

18 Mtrs of 55mm I.D uPVC screen and 9 Mtrs of casing were installed, the annulus was gravel packed with non-calcaeous pea gravel and the remaining area grouted to surface. A lockable steel cap was fitted to complete.

Water entry levels @ 9 Mtrs-- ~ 1 cubic M /hr.
16Mtrs-- ~ 1 cubic M/hr.
23Mtrs-- ~ 1 cubic M /hr.
26Mtrs-- ~ 1 cubic M/hr.

Total output estimated at 4 cubic Mtrs / hour.
Each water entry was due to discrete fissures in the hard mudstone - Limestone aquifer, numereous calcite veining was also present.

Elevation of OB 3 is 124.635 M to G.L and + 0.655 to top of well head.



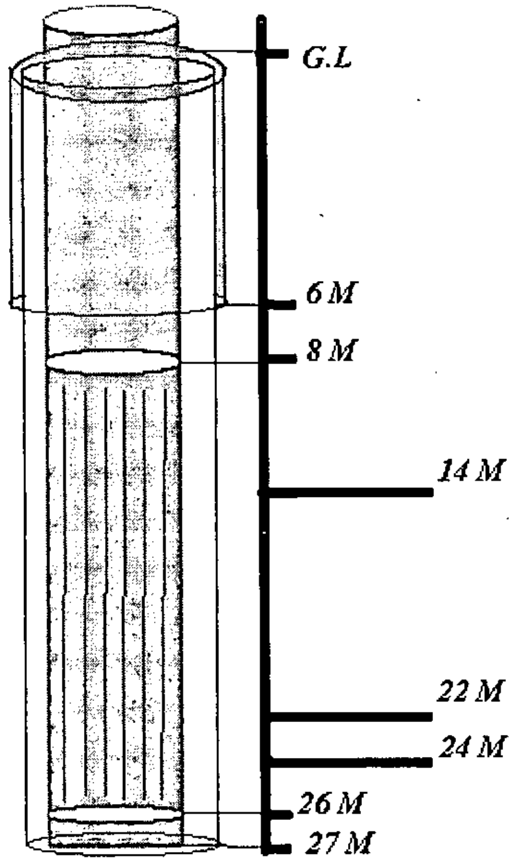
Production Well PT 1 @ Rampere

A 312 mmm borehole drilled to 21 Mtrs as per specification , @ 21 Mtrs output was gauged at 4cubic Mtrs / hour and drilling continued to 27Mtrs. At 27 Mtrs output gauged at 9 cu M / hour due to additional water entry levels at 22M &@ 24M.

A 1Mtr section of 202mmI.D casing was added to 18Mtrs of screen and topped with 8 Mtrs of casing and installed into borehole . The annulus was backfilled with pea-gravel to 7 M below G.L and developed by airlift .

The remaining annulus was grouted to G.L with a bentonite- cement grout and a lock-cap fitted.

Water entry levels at 14 Mtrs --- ~ 4 cubic M /hr.
22 Mtrs --- ~ 2 cubic M/hr.
24 Mtrs --- ~ 3 cubic M/hr.
Static water level recorded at 3 Mtrs below G.L. Elevation of PT1 is 124.511 Mtrs @ G.L and + 0.630 to top of well head .



Observation well OB 1@ Rampere

A 165mm borehole was drilled to 21 Mtrs as specified , as no water was encountered , then drilling continued to 27 Mtrs to correspond to production well PT1.Bedrock was met at 5 Mtrs and 6 Mtrs of temp steel casing was installed.

The output of OB1 was gauged at 1 cubicM/hr which was encountered only @ 25 Mtr depth.

The aquifer type was a dark muddy limestone sediment with no calcite veining. the aquifer was inconsistant in this profile away from PT1.

Elevation of OB 1 is 124.030 to G.L and + 0.215 to top of well head .