

INSPECTORS REPORT

WASTE LICENCE REGISTER NUMBER 161-1

Facility: Bottlehill Landfill

Recommendation: That the proposed decision as recommended to the Board be approved.

(1) Introduction:

The application from Cork County Council, is for the development of a green-field site for a new regional waste facility for the Cork region at Bottlehill Co. Cork. The proposed facility is an engineered landfill for the disposal of non-hazardous municipal, commercial and industrial wastes and the recovery of inert waste to be used for facility development, cover, capping and restoration.

The proposed location of the facility is within a large commercial forest site owned by Coillte, located approximately 3.3km south east of Burnfort village and 3.6 kms east of the N20 – the main Cork-Mallow road.

Within the proposed facility boundary a buffer zone has been dedicated that lies outside the proposed landfill footprint. The width of the buffer zone varies from 75m at its narrowest point to almost 250m at its widest point but it is 195m over most of the site. The surrounding forestry site will also provide an effective visual screen and buffer zone.

Also proposed within the facility boundary is a clay borrow area and its associated buffer zone and site access roads (see Fig. 2 ‘Site Plan’, Appendix 2). There is one farm building within 500m of the facility boundary and one residential property within a 1km radius of the landfill footprint (approximately 700m from the landfill footprint).

The proposed landfill footprint of approximately 45.8 hectares will provide a landfill capacity for 5,391,600 tonnes of waste for disposal over its proposed 20-year lifespan. This equates to an estimated 189,418 tpa in the first full year of operation, rising to 335,872 tpa 20 years later in the final full year of operation. It is proposed to construct a fully engineered landfill, incorporating leachate and landfill gas collection, consisting of eight lined phases, each consisting of five separate cells. The average depth of the landfill will be 20m.

The classes of activity applied for were Classes 4, 5 and 13 of the Third Schedule of the WMA, 1996 and Class 4 of the 4th Schedule. The recommended PD recommends that all these classes be granted.

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| Quantity of waste (tpa) | 217,000 (year 4 of operation, see Schedule A) |
| Application received | 01/08/01 |

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| EIS Required and valid | Yes. The EIS has been assessed in accordance with the EIA Regulations and I am satisfied that it complies with Article 25 of the EIA Regulations. |
| Planning Permission status | This is a Local Authority application. |
| Number of valid submissions received | 78 by 14/05/02 |

FACILITY VISITS:

| DATE | PURPOSE | PERSONNEL | OBSERVATIONS |
|-------------|-------------------|--|---------------------------------|
| 22/07/01 | Site notice check | Maeve McHugh, Regina Campbell | Site notice present and correct |
| 10/10/01 | Site visit | Anne Butler, Brian, Donlon, Maeve McHugh | |

(2) Facility Development

The infrastructure proposed for the facility includes the following: two weighbridges, a wheelwash, a waste quarantine area, a waste inspection area, site security arrangements (including gates and fencing, CCTV and anti-intruder alarms), car parking facilities, sheds, an administration building, a fire control system, a surface water drainage system, a baled waste marshalling area and fuel and chemical storage area. Laboratory facilities will be provided in the administration building for the routine monitoring of a limited number of parameters including BOD, COD, Conductivity, Dissolved Oxygen, Ammonia, Phosphorus etc. Traffic control measures are also proposed for the area near the site entrance, as well as for internal access. The installation of all infrastructure is controlled by Condition 3 of the recommended PD.

Tree Felling

It is proposed that the landfill will be constructed in eight phases with the felling of trees at each phase taking place prior to the development of the phase. The felling of trees is controlled by Conditions 3.13 and 3.14 to provide for the protection of the buffer zone and the ecological environment. Due to the importance of the protection of the buffer zone, Condition 3.13.3 requires that a surveyor should be present during the felling of trees to ensure that felling does not extend into the buffer zone.

Phasing

Each of the eight phases will be developed in turn. After filling is completed in each phase (for example filling of phase 1 will take an estimated 3 years) the phase will be temporarily capped and seeded. Twelve months will be allowed for settlement before final capping.

Liner System

The proposed liner system consists of a leachate drainage layer, a protecting layer of geotextile, and a HDPE barrier layer. It is proposed by the applicant that the underlying mineral layer will consist of 1,250mm of clay of permeability = 1×10^{-9} m/s re-engineered and recompacted in five separate 250mm lifts, as opposed to four separate 250mm lifts as specified in the EPA 'Landfill Site Design' manual. In parts of the site the existing ground level and depth-to-bedrock is slightly higher than the proposed formation level. In such areas the applicant proposed that the bedrock would be excavated to a depth of a further 500mm and replaced with 500mm of re-engineered and recompacted clay. It was proposed that the clay borrow area within the site boundary would provide sufficient quantity of clay of hydraulic conductivity of less than or equal to 1×10^{-9} m/sec. Condition 3.12 requires that the standard 1m of engineered clay is overlain by a geocomposite layer as well as a HDPE layer, rather than using 1.25m of clay and HDPE, as proposed by the applicant. It is however my opinion that, due to the extreme vulnerability of the site, from a groundwater protection point of view (i.e. subsoil thickness of <3m in places), that the existing ground level should not be lowered in order to reach formation level. In other words the existing natural barrier should be left undisturbed. The geology and hydrogeology of the site are further discussed in section 5 below.

Leachate Management

Leachate will be allowed to be stored in the lined cells up to a maximum leachate head of 1m. Leachate will be pumped from the lined cells to one of two concrete leachate-holding tanks. The two leachate-holding tanks will be located within a bunded area, along with a leachate pump chamber from where the 23m³ (5,000 gallons) road tankers will be filled. These tankers will transport the leachate to Mallow WWTP for treatment approximately 9 miles from the site. The estimated annual average quantity of leachate produced in the first full year of operation is 22,800m³, rising to a maximum of 63,600m³ in 2016. On-site leachate treatment was not proposed but the licensee is required to submit a feasibility study for the treatment of leachate on site.

A SCADA system will be used in order to monitor the leachate head in lined cells, and to remotely activate the leachate pumps in each leachate collection sump. If capacity is unavailable in one of the leachate holding tanks the SCADA system will activate an alarm in the administration building and additional tankering capacity will be arranged.

Leachate recirculation is proposed. The recommended PD states that leachate recirculation cannot be undertaken without the prior agreement of the Agency.

Capping and Cover System

The capping system will be standard as specified in Condition 4.3 of the proposed decision. Material from the clay borrow area may be used for the purpose of

intermediate cover. Any other inert waste accepted at the facility for recovery must comply with the requirements of Schedule C.7.

Landfill Gas Control System

Section D.5 of the application and E.I.S. section 3.8.3 details the proposed landfill gas control system consisting of vertical gas wells, horizontal gas drainage system and flaring equipment. The exact specification of the flaring equipment to be used has not been detailed in the application. It is proposed that the gas collection system will be installed in stages on the installation of the capping layer for each phase. Filled cells will be permanently capped within 12 months of the cells having been filled to the required level. Landfill gas pumping trials will then be carried out and the appropriate system for landfill gas flaring will be chosen.

Restoration and Aftercare

As regards the restoration and aftercare of the facility it is stated in the E.I.S. that it is proposed to return the site, after filling has ceased, to a largely native woodland which can be used as a recreational amenity. This will include the retention and improvement of existing woodland to visually screen the site. The licensee is required to submit a detailed Restoration and Aftercare Plan (Condition 4.1), which will incorporate these proposals.

Nuisance Control

Environmental Nuisances are controlled by Condition 7 of the recommended recommended PD.

▪ **Facility Operation**

Facility Operation

The operation of the facility in general is controlled by Condition 5 of the recommended recommended PD. It is proposed that the facility will not be allowed to accept waste delivered by members of the public. It is proposed to accept both baled and unbaled waste at the facility. Baled waste containers will be deposited at the baled waste marshalling area where they will be reloaded and brought to the working face of the landfill by off-road baled waste haulage trucks. The baled waste will be visually inspected at the working face of the landfill.

Condition 5.3 of the PD requires that a report detailing all waste acceptance and handling procedures be submitted to the Agency for agreement.

From the date of grant of the licence a proportion of the waste accepted at the facility should be in baled form. E.I.S. section 3.1.2 states that on average 85,000tpa of waste will be accepted at the facility in baled form, with this amount increasing to 135,000 by

the year 2007 and to 185,000 by 2012. This proposal has been included as a condition of the recommended PD (Condition 5.8.2). Increases in the proportion of waste accepted in baled form should be included in the schedule of objectives and targets (listed in Schedule F).

Hours of Operation

Hours of operation at the facility are controlled by Condition 1.6 and are as applied for.

(3) Waste Types and Quantities

In order to meet the requirements of the Landfill Directive the waste going to landfill will have to undergo 'treatment', as defined in Article 2 of the Landfill Directive. In accordance with Article 5 of the Directive 'treatment' will have to reduce the biodegradable component of the waste.

The non-technical summary of the E.I.S. states that 'it is estimated that the facility will accept a total of approximately 5,391,600 tonnes of waste for disposal, including residual municipal waste, which will arise from the operation of a WRF, inert waste and other non-hazardous municipal waste which is not suitable for treatment'.

The E.I.S. (p 182) refers to the pre-treatment of household, commercial and non-hazardous industrial wastes. Suitable construction and demolition waste will also be accepted on-site for construction of various elements of the landfill site. Condition 1.5.3 requires that, by the year 2008 (the first target year identified in Article 5 of the Landfill Directive) all municipal waste will have to have undergone treatment to reduce its biodegradable component, in order to be acceptable at the facility. Condition 5.3 requires the licensee to submit procedures, prior to the acceptance of waste at the facility, which will include details of the pre-treatment criteria of commercial and industrial waste required prior to acceptance at the facility.

With regard to the acceptance of inert waste for recovery, restoration and site development works, Table A.2 of Schedule A limits the quantity which is acceptable for each landfill Phase.

(4) Emissions to Air, Including Noise

Air

The current air quality in the vicinity of the facility is good. Dust deposition rates were measured using the standard Bergerhoff method for the period 27/04/01 to 26/05/01. The levels recorded at five monitoring locations ranged only from 39 to 40 mg/m²/day. This represents low background dust deposition levels well within the limits proposed

by Schedule C.3. Dust emissions from the proposed activity are controlled by Conditions 7.1 and 7.4.

Background readings of methane and carbon dioxide were also taken at 13 locations both inside and outside of the site boundary. All readings for CO₂ and CH₄ were 0% v/v. Given the distances to the nearest residential properties and the design of the landfill lining system etc. It is anticipated that uncontrolled gas migration will not give rise to any increased levels of these parameters in the adjacent properties. Perimeter landfill gas monitoring boreholes will be constructed around the landfill footprint at 45m intervals in order to monitor any migrating landfill gas. All enclosed on-site buildings will be fitted with permanent gas monitoring system. Emission limits for emissions from the landfill gas flare are controlled by Condition 6.1 and Schedule C.5. Monitoring of emissions from the flare is controlled by Condition 8.1 and Schedule D.2.1.

Due to the distance of properties from the facility boundary (farm building at 500m) and from the landfill footprint (residence at 700m) it is not thought that activities at the proposed facility will result in odour nuisance. For this reason a requirement for odour monitoring has not been included in the recommended PD. Condition 7.1 however, requires that odours do not give rise to nuisance.

Noise

The E.I.S. examined the potential impact of noise emissions at the nearest noise receptors to the landfill activity boundary and to the clay borrow area. The nearest residence to the landfill activity boundary is 550m to the north-east. It is estimated in the E.I.S. that, assuming a worst case scenario of a maximum of three items of plant operating at the north-east of the facility boundary will result in 43 dBA at the nearest house.

With regard to the noise emissions from the clay borrow area the nearest house to the screening plant for processing clay is 500m and the estimated impact of the operation of this plant at the nearest house is 40 dBA. Therefore I am satisfied that noise emissions from operations within the facility boundary should not cause a breach of the noise emission limit values at the relevant noise sensitive receptors.

The most significant noise impact is likely to be generated by the additional traffic on local roads, in particular heavy commercial vehicle (HCV) traffic. The E.I.S. outlines a preferred route from the N20 to the landfill for most of the traffic associated with the proposed activities. This preferred route was chosen on the basis of various different factors including the number of houses on the route. There are eleven residential properties on the preferred route. The background noise levels measured in the locality were typically day-time L₉₀ levels of between 27 and 30 dBA at residential properties. It is estimated that on initial waste acceptance at the proposed facility there will be approximately 94 HCV movements per day, over time rising to a maximum of approximately 140. By way of estimating the sound levels which will be associated

with these vehicle movements, measurements were taken of similar vehicles – the maximum sound exposure level recorded for a passing HCV at a distance of 10m from the roadside, was 87dBA. The impact from these vehicles alone at noise sensitive locations (residences) is estimated as being between 60 dBA (Laeq, 12 hour) and 62 dBA (Laeq, 12 hour) for 94 and 139 HCV movements per day respectively. This would appear to represent a substantial increase over pre-existing levels. Condition 7.8 requires the licensee to propose, implement and report on an annual basis as part of the AER measures to reduce the effects of traffic associated with the facility. In addition the volume of inert material brought on-site is restricted by Table A.2 of Schedule A.

The route which HCV traffic should take to and from the landfill from the N20 has not been specified as a condition of the recommended PD. Instead Condition 3.19.1 requires that, in consultation with the relevant authority, road improvements are carried out on any road to be used by heavy vehicles either approaching the landfill from the N20, or leaving the landfill.

(5) Emissions to Groundwater

The Regional Geology of the proposed site consists of rock of Devonian age, commonly referred to as the ‘Old Red Sandstone’. Bedrock core logs and borehole logs describe the bedrock immediately beneath the site as consisting of fine to medium grained pale red sandstone with some dark red siltstone/ mudstone interbeds. Significantly, the bedrock is fractured to varying degrees. It is described as being highly weathered to an average depth of 2m below rockhead, and below this level ‘generally fresh with slightly weathered joints, occasionally with highly weathered joints’. One borehole displayed highly weathered rock to a depth of 20m.

The groundwater vulnerability in the area is described as extreme (as per GSI, DoE, EPA publication ‘Groundwater Protection Schemes’, (1999)). This is due to the fact that there is a thin (<3m) cover of subsoils over bedrock in the area. The subsoils consist of low permeability clay.

The bedrock aquifer is a locally important aquifer. The Ballytrasna formation in the vicinity of the site has been classified on the basis of Geological Survey of Ireland information, drilling and field observations as ‘LI’ – bedrock which is moderately productive only in local zones. The response matrix for the groundwater underlying the site is therefore R2².

The Groundwater response R2² means that a landfill is ‘*acceptable subject to guidance outlined in the EPA landfill Design manual or conditions of a waste licence*’. It also states that (1) ‘*special attention should be given to checking for the presence of high permeability zones. If such zones are present then the landfill should only be allowed if it can be shown that the risk of leachate movement to these zones is insignificant*’. (2) ‘*Special attention must be given to existing wells downgradient of the site and to*

the projected future development of the aquifer'. (3) 'Groundwater control measures such as cut-off walls or interceptor drains may be necessary to control high water table or the head of leachate may be required to be maintained at a level lower than the water table depending on site conditions'.

With regard to (1) above, it is clear from the site investigation work that secondary permeability in the form of fracturing has produced localised higher permeability zones in the bedrock in the vicinity of the proposed landfill. The risk of leachate movement to these zones is controlled by the lining system, as described above (Condition 3.12.1). It will be controlled by the maintenance of leachate head at a level of no greater than 1m over the top of the liner at the base of the landfill. As for point number (3) above although the water table is relatively close to the surface (generally within the top few metres) it is not thought that any special measures will be necessary in order to control the water table.

With regard to (2) above (i.e. wells down gradient of the site, including private wells) the groundwater flow in the vicinity of the site is generally only within the top few metres and the groundwater table follows the morphology of topography. Therefore the surface water divides will be the same as the groundwater divides. Groundwater flow is generally downslope/ to the East in the vicinity of the site. To the west, the site is bounded by a hydraulic divide, and between it and the landfill site no groundwater abstractions have been identified in the E.I.S. Therefore groundwater flow from the vicinity of the landfill cannot exert any influence on any abstractions lying to the west of the site.

To the east of the site any groundwater flow from the footprint area is bound by two topographic lows where two rivers, Coom and Toor flow. Therefore the groundwater flow from the footprint area is confined to supplying baseflow to these streams as it reaches a topographic low point and cannot flow upgradient. No groundwater abstraction points have been identified in the E.I.S. as lying between the landfill footprint and these surface water channels. Therefore groundwater flow from the vicinity of the landfill cannot exert any influence on any abstractions lying to the north, east or south of the site. Nonetheless Condition 8.15 of the recommended recommended PD requires that a programme of monitoring of the groundwater quality of private wells will commence prior to the commencement of waste activities.

(6) Emissions to Surface Water

The existing surface water quality is similar to that of the groundwater as could be expected as the groundwater is contributing to surface water baseflow. Typically for a sandstone aquifer the levels of conductivity, calcium and hardness are low. An obvious difference between groundwater and surface water quality is the bacteriological contamination of surface water, which is not present in the groundwater. Apart from coliforms, exceedences of the Drinking water MACs were found for ammonia, iron and aluminium. While elevated iron and aluminium could be naturally occurring the levels of ammonia (just exceeding the MAC) are anomalous.

As described in section 5 above all groundwater flow from the landfill footprint area will ultimately reach the Coom and Toor Rivers. This mirrors the flow of surface water in the area and so likewise all surface water flow from the landfill footprint area will ultimately reach the Coom and Toor Rivers. Surface water in these channels could therefore be influenced by flow from the landfill footprint area. In view of this the Conditions of the recommended PD require various measures to be taken to ensure the protection of surface water quality.

The runoff from hardstanding areas used for the handling and storage of waste, such as the waste inspection area and the waste quarantine area will be pumped to a lined cell of the landfill to be dealt with as part of the leachate control system. Condition 3.17 controls the surface water management infrastructure required at the facility. Surface water from site roads will be directed to gulleys, settlement tanks, oil interceptors and finally to the surface water lagoons.

A surface water settlement lagoon will also be installed at the clay borrow area. Each lagoon will be capable of holding 5,500m³ of water, which equates to approximately 3 days of maximum rainfall. The outflow from the lagoon to the adjoining surface water stream will be controlled using a floating arm and a penstock valve.

(7) Other Significant Environmental Impacts

The ecology of this commercial forestry site is dominated by conifer plantations, predominantly of sitka spruce but with smaller areas of lodgepole pine, larch and fir at various stages of maturity. There are areas of recent clear-fell and areas of semi-natural vegetation with heather, gorse, rush, grass and sedge exist in young conifer stands. There are also some smaller areas of hardwood plantations, scrub, heath and bracken.

With regard to birds it is stated in the E.I.S. that the observed assemblage is typical of the habitat types present. Sparrowhawk and kestrel were observed hunting within the site. Of particular importance was the recording, during the course of ecological surveys for site selection, of a breeding pair of hen harriers at Bottlehill.

The hen harrier is one of the rarest bird species breeding in Ireland and Europe. It is legally protected under Annex 1 of the EU Birds Directive (79/409/EEC) and under the Wildlife Act, 1976. This makes it an offence to disturb the bird, nest, eggs or habitat of the species. The hen harrier is a ground nesting large bird of prey and although there are no recent estimates available it is considered that there are no more than 50-70 breeding pairs of hen harriers in Ireland today. The low numbers can be ascribed to a reduction in its breeding and feeding habitats through the clearance of bog, scrub and marginal land for agriculture and forestry, and the maturation of forest plantations. It is suggested that the recovery of the species in Wicklow has been adversely affected by the aggressive behaviour of Peregrines. Amongst suggested

measures for conservation action are additional surveying and wider countryside conservation (The Irish Red Data Book 2 for Threatened Mammals, Birds, Amphibians and Fish in Ireland (A. Whilde)).

Figure 14 in the E.I.S. shows the existing observed hen harrier nesting site to be immediately adjacent to the proposed landfill footprint area. The E.I.S. (Section 4.6.1) states that the proposed development 'is likely to have a significant negative impact on breeding hen harriers as a result of disturbance during the construction and operation of the landfill, and the loss of breeding and feeding territory'.

The birds are ground nesting birds and tend to breed in young conifer plantations and clear-felled areas.

As regards mitigation measures proposed by the applicant, alternative potential nest sites were identified using colour aerial photographs and information supplied by Coillte regarding the status of conifer blocks in the Coillte owned forestry site. It is proposed that these potential nesting sites will be managed so as to enhance their value as nest sites. Other mitigation measures proposed include limiting construction and other activities to a period of time outside the breeding season which is between May and July.

Along with the mitigation measures proposed in the E.I.S. Condition 5.13 requires the identification of the nesting site and the delineation of a protection zone around it. It also requires that all on-site staff (including construction staff) receive training in relation to the hen harrier, its nesting, site and the measures to be put in place in relation to its protection.

(8) Waste Management, Air Quality and Water Quality Management Plans

Air Quality Management Plan

There is no air Quality Management Plan for County Cork.

Water Quality Management Plan

There is no water Quality Management Plan for County Cork. There is a draft Plan in place for the River Blackwater but this is not thought to be relevant as the surface water flow from the landfill footprint area will ultimately reach the Coom and Toor rivers, but not the Blackwater.

Waste Management Plan

There are two such relevant plans: (1) Cork County Council Waste Management Plan (1999), Cork City Waste Management Plan (2000).

The Cork County Council Waste Management Plan (1999) identifies the trend towards pre-treatment and recovery of waste and the fact that this has resulted in the planned

rationalisation in the number of landfills in the country as a whole, including Cork County. The need for a new engineered landfill is identified in the Plan to serve the needs of the region.

Other

The Waste Management Strategy for the Cork Region (1995). The Cork Region Waste Management Strategy proposed that a site for a new landfill for residual materials to serve the Cork region be identified and developed in the immediate future. This new landfill was proposed to serve the needs of the region following the closure of all other landfills in Cork.

The 1996 Cork County Development Plan was subject to a variation, dated 25th June 2001 in order to 'implement the broad policy already adopted in 1996 to develop a landfill site in the South Cork area. One of the amendments made was to a zoning map, which, under the amendment identified the site at Bottlehill.

(9) Submissions/Complaints

Seventy-six submissions were received by the Agency in relation to this application. A list of submitters is enclosed at Appendix 1. I have had regard to the submissions in making my recommendation to the Board. Below is a summary of the main concerns raised in the submissions. The specific details in some submissions are highlighted to give an overview of the concerns raised. One submission, from Mr David Malone was lengthy and due to the nature of the issues involved it has been dealt with separately.

SUBMISSIONS BY GENERAL TOPIC HEADING

- (1) ***Procedures:*** *The submissions sought information as to the procedures to be followed in relation to the making of submissions etc.*

The Agency forwarded a copy of 'Waste Management Licensing – Guide to Implementation and Enforcement in Ireland'.

- (2) ***Health:*** *Reference was made to some unnamed studies on the health impacts of landfills as well as the study, published in the British Medical Journal regarding the health impacts of living close to landfill sites, and the hope that the Agency will refuse the granting of the licence on health grounds. Concerns regarding potential for birth defects associated with the facility and the health and welfare of children. People want a guarantee of the protection of their health. There is concern regarding the health implications associated with water contamination/pollution by various parameters.*

The report referred to above, which was published in the British Medical Journal looked at populations in the UK living within 2km of landfill sites. Studies such as these have been difficult to interpret due to problems of

exposure classification, small sample size and reporting bias. In fact the authors themselves highlighted the need for further investigations to determine whether the association of raised risk is a causal one.

Issues regarding the protection of water resources are dealt under the heading 'Groundwater' and 'Surface Water' below.

- (3) **Consultation.** *A submitter stated that it is a requirement of the Agency that the applicant consult with those who will be affected by the development. He goes on to state that the committee which he represents was not adequately represented in the consultative forum set up by the applicant and was in fact, refused equal treatment in comparison with other affected groups.*

People felt that the site selection was flawed and that this site was chosen since area has small councillor representation from the area and a small population. They expressed dismay with TDs and dismay that plans regarding the landfill location were not highlighted sooner/ when property was purchased.

Other issues raised included a request for an oral hearing,

There is an EPA document in existence in draft form in relation to guidance on Landfill Site Selection. This manual refers to the fact that various different forms of consultation with the public should be undertaken by the proposed developer during the site selection stage, starting with the commencement of the Waste Management Plan. An appendix to the draft document lists examples of the various different forms of consultation which may take place, at the discretion of proposed developer.

The legal requirements of the Agency in relation to landfill site selection, as detailed in the E.I.S. Regulations are that the developer provide an outline of the main alternatives examined, and that the developer should provide an indication of the main reasons for his choice, taking into account the environmental effects. The Agency is satisfied that these requirements have been met.

As regards a request for an oral hearing, the decision as to whether or not to grant an oral hearing will be a matter for the Agency once a PD has been issued and objections and requests for oral have been received. Details of the relevant procedures are available on the EPA website.

- (4) **Landscape Character.** *People feel that the beauty and landscape character of Bottlehill Wood merits preservation as an area of outstanding natural beauty and that the wood should be promoted as a tourist attraction, and express*

concern for its future. They think that the E.I.S. submitted as part of the licence application gave no recognition to the landscape character of the area and are unable to comprehend the reasons for the siting of a landfill in productive agricultural land. There is also concern regarding the loss of trees and scenic countryside and that the local amenity value of the area will be damaged. It was also stated that this area can be subject to severe fog and ice and that the site is inappropriate for a landfill for that reason.

The licence application includes information on the potential views of the facility, buffer zones around the facility etc. The E.I.S. Regulation requirements, including requirements to provide information on the landscape and the likely significant effects of the proposed development on the landscape as well as mitigation measures, have been deemed by the Agency to have been met. With regard to the operation of the facility in adverse weather conditions, as a required of Condition 11.4.3 of the PD the licensee will be required to submit to the Agency for its agreement proposals for the operation of the facility in adverse wind and weather conditions.

- (5) ***Tourism.*** *Submitters state that Bottlehill Wood is a designated tourist attraction as per ordnance survey maps and promotional tourist pamphlets of the area, also that Bottlehill Wood is a unique tourist attraction and attracts >3,000 international and national visitors annually but that these issues were not addressed in the E.I.S. Concern was also expressed with regard to the effects on the visitors to the archaeological sites in the local area and loss of heritage.*

The tourism status of the proposed site is discussed as part of the E.I.S. under the heading of material assets. The tourism status of the Cork/Kerry regions, the greater Cork area and North Cork specifically are discussed. In the North Cork area 26 tourist attractions are listed in Buttevant, Castletownroche, Charleville, Castlelyons, Doneraile, Fermoy, Glanworth, Kanturk, Mallow Millstreet, Mitchelstown and Mourneabbey. The closest of these to the Bottlehill site is Mallow Golf Course, which is 9.5km distance from the proposed site. The Cork/Kerry Regional Tourism Plan 1999-2006 identifies tourism development goals for North Cork. The E.I.S. discussed the fact that the Coillte owned commercial forestry site in which the landfill site is proposed has an amenity value but that it not in close proximity to any of the eight tourism goals identified by the Cork Kerry Tourism Plan.

- (6) ***Rural Character.*** *Submitters feel that the proposed development should be refused as it is an inappropriate development in a tranquil rural area, which has no significant industry within ten miles. People fear that the proposed landfill will affect their way of life and find it unfair that Bottlehill will be subjected to accepting waste from Cork City. One submitter feared that*

astronomical observation will no longer be possible in the area due to light pollution, the burn off of gases and the introduction of artificial lighting. Some people feared the effect on sites of archaeological interest and a grotto in the vicinity of the site.

The activities at the proposed facility, operated within the conditions of the licence should not affect the rural character of the area to any great extent. The facility will be effectively screened by tree planting within the buffer zone and by the fact that it is situated within a forestry site. As stated above there is one farm building but no residential property within 500m of the facility boundary and one residential property within a 1km radius (approximately 700m from the landfill footprint).

The archaeological assessment carried for the E.I.S. found a record of one archaeological monument within the boundary of the Bottlehill forestry site. The monument, thought to be the burial place of a highwayman is located 100m inside the southern boundary of the forestry. Field inspection revealed no visible trace of the monument – the area is now forested. Condition 8.11 of the recommended PD requires that the advice of Duchas is sought prior to the development of any new area and that a report detailing the results of any archaeological monitoring is submitted to the Agency and to Duchas.

The submitter's comments in relation to astronomical observation are noted. The hours of operation of the facility, as applied for are 8am to 6.30pm Monday to Friday and 8am to 3.30pm on Saturdays. While there is a requirement for the licensee to provide adequate lighting during the operation of the facility in hours of darkness, there is no requirement to provide lighting outside of these hours so that light throughout the night should not cause a problem. The controlled flaring of landfill gas is a necessary requirement of the PD to ensure that emissions are within prescribed limits.

- (7) **Traffic.** *Concern with regard to increased fatalities on roads due to increased road traffic, inadequacy of existing roads infrastructure, effect on farmers and their animals using the roads, the impact on low-flying air traffic. One submitter, writing on behalf of a local Environmental Committee was concerned about the capacity of 'Lissavoura Cross Roads' to cope with the projected volumes of traffic associated with the proposed landfill. He wrote to Mr. Declan Daly of Cork County Council in relation to the matter and received a response. The response stated that the Council's consultants had completed their review of the matter and that they had concluded that the junction does have adequate capacity for the projected traffic volumes, which will arise following development of the landfill site. Unhappy with this response, the submitter contacted the NRA who responded with the recommendation that Cork County Council should carry out a Road Safety Audit at this junction should it be used as the main access route to the landfill.*

The E.I.S. examined in some detail the issue of traffic and potential routes from the main Cork-Mallow road to the proposed facility. Route options were identified in the E.I.S taking into account the length of the routes, the number of houses and farmyards located along the route, the width of the carriageways, the number of junctions along the route, the condition of the road and the potential for undertaking road improvements etc. It is estimated that the facility will generate 9 HCV trips per hour in 2005, rising to 14 per hour in 2022 as well as a further 5 trips per hour consisting of cars or light goods vehicles, over the life of the facility. Condition 7.8 requires the licensee to propose, implement and report on an annual basis as part of the AER measures to reduce the effects of traffic associated the facility. Condition 3.19.1 requires that no facility development should be carried out until the necessary road improvements have been carried out on any road to be used by heavy vehicles either approaching the landfill from the N20, or leaving the landfill.

With regard to air traffic flight paths, although submission have, in the past been received from the Irish Aviation Authority in relation to landfill applications in the Cork area, none were received from them in relation to this waste licence application.

Condition 3.19.2 of the recommended PD requires that a Road Safety Audit be carried out at any junction on the N20 to be used by heavy vehicles either approaching the landfill from the N20, or leaving the landfill. The licensee shall consult with the relevant authority on the necessary improvements in road signage and road safety and carry out any works recommended.

- (8) ***Elevated Site.** Because the proposed site is elevated, all waste placed in it will be subject to the laws of gravity over time resulting in contamination of surface water and groundwater. High elevation and rainfall make the site unsuitable and it is too far from the sea.*

The protection of groundwater resources is dealt with under section (4) above. The protection of surface water resources is dealt with under section (5) above. Condition 8.12 requires that an annual assessment of the stability of the side slopes of the facility.

- (9) ***Waste Management Legislation, Regulations etc:** Several submitters feel that constructing a new landfill site is in contravention of the Landfill Directive, because the Directive calls for fewer landfill sites. The Waste Management Strategy for Cork Region (1995) promised new recycling facilities etc., but this did not happen. People feel that the applicant is not dealing with the waste disposal problem properly and not looking at other recycling options.*

The proposed facility contradicts the European waste management hierarchy and Cork County Council's own Waste Management Plan.

The destruction of the hen harrier habitat is in contravention of the E.U. Habitat Directive.

Concern was expressed for water quality, in light of the Water Framework Directive.

Excessive areas of land have been rezoned.

There are a number of houses within one kilometer of Bottlehill which would bring the site within the ambit of EU Regulations on site selection.

The Landfill Directive calls for state-of-the-art engineered landfill sites, as opposed to smaller uncontrolled facilities, as was the case in the past. In order to achieve this aim, older landfills need to be closed and restored and new, state of the art facilities developed. The development of a new landfill facility is therefore not in contravention of the Landfill Directive. As regards the European waste management hierarchy, the disposal of waste is the least favoured option. The PD requires that, in accordance with the waste recovery targets of the Landfill Directive, by the year 2008 all municipal waste will have to have undergone treatment to reduce its biodegradable component and to separate out recyclable components, in order to be acceptable at the facility. The relevant Waste Management Plans are dealt with under Section 8 of this report.

The Conditions of the licence require that, in consultation with Duchas, and prior to the acceptance of waste at the facility, a programme should be implemented to ensure the ongoing protection of the hen harrier and its nesting site(s). This programme will include the training of all staff with regard to the hen harrier, its nesting site(s) and measures to ensure its protection. The nesting site, including a protection zone will be demarcated. Construction works, fencing works and tree felling in certain areas will take place only outside the breeding season for the hen harrier. As a measure to limit disturbance caused by noise on the site, the conditions of the licence require that speed restrictions are put in place, low sound level plant is used on site, and that all heavy machinery used on-site is fitted with acoustic panels in the engine bays and acoustic mufflers.

The protection of water resources is dealt with under Sections 5 and 6 of this report.

As referred to under Section 8 of this report, the Cork County Development Plan of 1996 was subject to a variation in order to rezone areas of land to allow

for the development of a landfill site at Bottlehill. While the comments of the submitter are noted, the rezoning of land under the County Development Plan is a matter for the Local Authority and not the Agency, to consider.

There are no EU Regulations on Landfill Site Selection in existence. The Landfill Directive (Annex I, Section II) refers to the requirement that the distance from the boundary of the landfill to residential areas be taken into consideration.

- (10) ***Animals/ Wildlife/ Ecology:*** *Concern over the health of wildlife and the diversity of birds, particularly the hen harrier, the possible effects of the facility on the quality of meat and milk products, the presence of rodents and other pests, vermin control measures and the effects on fish. Concerns regarding animal health and the potential for spread of disease associated with landfill. Concern was expressed over the cutting down of trees and the potential loss of habitat and upset caused to the ecological balance.*

In one submission, received on 4th April 2002 the submitter stated that he had already informed Duchas of the destruction of the hen harrier habitat. He stated that they acknowledged the importance of the Nagle Mountains as a habitat for the hen harriers and confirmed in a report that 6% of the Hen harrier population of the entire country frequent the Nagle Mountains. He said that he pointed out to Duchas their obligations under the European Habitat Directive and that he trusted that they would honour their obligations on the matter.

The potential pathways for contamination of meat and dairy products from the proposed facility are through the water and the air. The protection of surface water and groundwater, as well as the water of private well users are dealt with under Sections 5 and 6 of this report. Emission limits of suspended solids for discharges to surface water are imposed for the protection of fish life. The monitoring of landfill gas in buildings on site and around the landfilled area is required by the conditions of the PD, so that potential offsite migration of landfill gas would be detected. Landfill gas collection and flaring infrastructure will be installed at the facility. Emissions limits have been set in the recommended PD for dust deposition and emissions from landfill gas flares. The recommended PD requires that a buffer zone is maintained around the facility and this will provide an effective screen between the landfill and farmland. With regard to the potential for the spread of disease via vermin and birds Condition 7 of the PD controls environmental nuisances. Condition 7.6 of the recommended PD requires that bird control measures are in place at least two weeks prior to any waste being disposed of etc.

Tree felling will take place on a phased basis for the construction of landfill cells. When full, each cell will be permanently capped and in keeping with the proposed restoration plan for the facility will be replanted with trees.

In relation to the hen harrier the mitigation measures as described under the response to Waste Management Legislation, Regulations etc (heading no. 9 above) are required by the licence. The comments of the submitter in relation to the hen harrier and his contact with Duchas are noted. The submitter stated that the importance of the Nagle Mountains as a habitat for hen harriers was acknowledged in a report by Duchas. The title of the Duchas report referred to was not given. No submission was received from Duchas in relation to this application.

- (11) **Geology:** *That EPA Guidelines on Geology should be observed.*

The EPA has not issued guidelines on geology. The guidance in the GSI, DoE, EPA document on Groundwater Protection Schemes have been used in this evaluation.

- (12) **Groundwater:** *Three river catchments have tributaries on the site, aquifers of poor quality will be jeopardised. Consultants told submitters that if the water is affected it will have to be chemically treated and they find this situation unacceptable. Groundwater contamination/pollution by leachate is feared. People want a guarantee of drinking water safety at nearby towns. Some people in the area are dependent on wells and want to know who will be responsible if they become contaminated and whether they will need to be monitored. People want to know what steps are taken to protect groundwater.*

The protection of the groundwater environment is dealt with under Section 5 of this report. Leachate management is described under section 2 of this report.

- (13) **Surface Water:** *Site is not designated but is adjacent to the headwaters of the River Bride, which is proposed as a SAC on account of its salmonid population. Concerns over silt deposition on gravel beds which will harm spawning but fears that the effects could take up to 15 years to be seen by which time the damage will be done. People want to know what will be the effects of the facility on the rivers which have tributaries at or near the site. They are also concerned that the application of pesticides and rodent poison will contaminate surface water. Concerns re: farming – that farmers will lose their dairy certificate if the water they use becomes contaminated. Water contamination and disease spread could be caused by birds dropping rubbish etc. Concern over changes in: Water quality, macroinvertebrates & fish health, amenity value of the R. Bride especially in light of Water Framework Directive (2000/60/EEC). Concern regarding the pollution of the River Clyda as it is the main source of supply to the town of Mallow.*

All runoff from areas on site used for the handling and storage of waste will be pumped to a lined cell of the landfill and to leachate holding tanks to be dealt with as part of the leachate control system and will therefore not impact upon the quality of surface water. Some runoff from the facility will reach surface water streams i.e. the runoff from capped cells and lined but unfilled cells will discharge via settlement tanks etc and a surface water lagoon. Runoff from site roads and hardstanding will discharge to the surface water lagoon also by a Class I oil interceptor. An ELV for suspended solids has been placed on the discharge from the surface water lagoon to streams. The recommended PD requires that the surface water lagoons and surface water management infrastructure will be constructed and operational prior to the commencement of other construction works or excavation of the clay borrow area. Surface water quality will be monitored regularly. The control of nuisances such as rodents and birds is dealt with under Condition 7. Condition 11.5 requires that prior to the commencement of waste activities the licensee will have to agree a proposal with the Agency for the control and eradication of vermin and fly infestations at the facility. This proposal will include details on the pesticide(s), rodenticide(s) and insecticide(s) to be used, mode and frequency of application and measures to contain sprays within the facility boundary.

- (14) ***Air:** Concern regarding air pollution, from landfill gas and dust, pesticide and poison control of flies and vermin and problems with odours.*

The landfill gas control system is dealt with in Section 2 of this report. Emissions to air are dealt with in Section 4 of this report. The boundary of the landfill footprint area is 700m from the nearest residential property. With regard to pesticide application see response to issue no. 13 above.

- (15) ***Noise:** People are concerned that the peace and quiet of this rural area may be affected by traffic noise and disturbance.*

As discussed in Section 4 of this report, I am satisfied that noise emissions from activities within the facility boundary will be within prescribed limits.

- (16) ***Economics:** Is it viable to transport waste from the south of the city and beyond to Bottlehill. The agricultural industry will be affected due to impacts of landfill. There is also a threat to fisheries. People cannot comprehend the tendering of the project by Cork County Council prior to licence approval. Threat to tourism. Concern over dairy hygiene certs, if water becomes contaminated. Who will compensate if water becomes contaminated. Property depreciation - will council reimburse those people whose properties have become devalued or relocate them. The facility will make the area unattractive for people to buy their homes in. - Fear over reduced property value and hence capital when seeking loans. Needs confirmation from C.C.C that such*

devaluation will not occur. Farms and farmers - how will they be affected (traffic on road/ harvest time/ health/ foodchain). Fear over effect on livelihood (& future generations).

- Concern regarding proposed new farming methods and enterprises - including organic farming. Concern that Bottlehill is chosen as a disposal site even though the local authority do not collect waste in the vicinity. Once landfill closes, monetary gains cease who takes responsibility for aftercare & leachate. Loss of income from viable projects.

The facility to be developed is a modern landfill. Nuisances are controlled by Condition 7 of the recommended PD. The buffer zone around the landfill, as well as the existing forestry site will effectively shield the landfill activities from neighbouring activities. The control of emissions to surface water and groundwater have been dealt with in this report. The restoration and aftercare of the facility is the responsibility of Cork County Council, as required by Condition 4 of the recommended PD. As a requirement of the Annual Environmental Report, the licensee will be required to report on the use of a portion of the gate fees and charges on local environmental improvement projects.

- (17)** *Waste: People want to know what will happen to waste and sludge. Concerned that there is no MRF in place. Concerned that there is no plan for toxic waste disposal. Concerned about the reliability of the liner system, and the lack of recycling facilities. The Agency should encourage recycling.*

No hazardous waste or sludges will be allowed to be accepted at the facility. With regard to recycling of waste and in line with the targets of the Landfill Directive, all municipal waste will have undergone treatment in order to reduce its biodegradable component, by the year 2008.

SUBMISSION FROM MR. DAVID MALONE (EAA-I)

Mr Malone made a submission which consisted of a copy of a complaint made by Environmental Action Alliance-Ireland (EAA-I) to the European Commission concerning the proposed landfill site at Bottlehill. He says that this complaint was registered in January 2002 under reference number 2002/431. The Submission was extensive and was presented under a number of headings, each dealt with below:

Introduction: The introduction states that the Bottlehill Environmental Alliance enlisted the services of EAA-I to examine the waste licence application submitted by

Cork County Council to the EPA to establish whether it complies with the relevant European Directives. On foot of this examination he wished to submit a complaint against Cork County Council and the EPA for infringement of the following European Directives and Programmes: Directive 85/337/EEC and 97/11/EC (EIA), 75/442/EEC and 91/156/EEC (Water), 97/62/EC (Habitat), 99/31/EC (Landfill), 91/689/EEC (Hazardous Waste), and the European Fifth Environmental Action Programme (1992-1999).

He states that the complaint will show that the Irish Authorities have failed to transpose many European Directives into Irish Law in an integrated manner, which is necessary in order to give effect to European Directives and to attain the objectives of sustainable development. He states that the EPA is of the opinion that, in relation to landfill sites for Local Authorities the EPA is the competent authority, but that this is not the case and that therefore all licences thus issued by the EPA to Local Authorities for landfill sites are legally flawed.

Response: The topics are dealt with under various headings below.

The European (EIA) Directives not Correctly Transposed into Irish Law: In this section the submitter enters into a detailed explanation as to why he feels the Irish Authorities have not correctly transposed the EIA Directives into Irish Law. He says that the biggest barrier is the EPA's assertion that they have a role in relation to the EIA Directives, which they have not. The Elementary Rule of Construction of Legislation: Irish Authorities before transposing a European Directive into Irish Law must first establish the fundamental objective of the Directive.

Response: The argument is a general one and not directly related to the waste licence application on hand. In relation to the transposition of legislation the argument is a general one and not directly related to the Agency or the waste licence application on hand.

Infringements of the European (EIA) Directive 97/11/EC: Concerning projects like the landfill at Bottlehill the Irish Authorities are allowing the EPA grant development consent but that in fact the planning authorities are the designated competent authorities. This is due to the fact that the Minister for the Environment designated the Irish planning authorities as the competent authority for performing the duties arising out of the European EIA Directives. Cork County Council claims that no development consent is required for the proposed landfill at Bottlehill but this is incorrect. In compliance with the provisions of the EIA Directive 97/11/EC, Cork County Council requires development consent from An Bord Pleanála and not the EPA. Cork County Council is fully aware that the EPA never refuses a licence and that if it gives the EPA enough money and ambiguous information it will be granted a licence for the landfill at Bottlehill. The EIA carried out for the landfill at Bottlehill is legally flawed

as it failed to contain a significant amount of the information specified under Section 25 of the European (EIA) Regulations 1989 and 1999. The EPA Act gives guidelines on information to be contained in an EIS but these guidelines are not legally binding and encroach upon the objectives of the EIA Directives. Nonetheless the EPA attempts to make it mandatory on planning authorities to comply with the EPA guidelines and not the provisions of the EIA Directive.

Response: The onus is on the applicant or licensee to obtain development consent from the appropriate authority. In reaching a decision on an application the Agency has regard to all relevant waste management legislation, directives and policies. The EIS submitted was assessed, when all information as requested was submitted to the Agency and was found to be in compliance with the relevant Regulations.

Non Compliance with the European Fifth Environmental Action Programme: The submitter entered into a general discussion on the topic, which was not directly related to the waste licence application on hand. He also noted that the E.I.S. for Bottlehill referred to a waste recovery facility, which will not now be used.

Response: the argument given is a general one and not directly related to the waste licence application on hand. The recycling targets set out in the recommended PD are based on the Landfill Directive targets for the reduction in the quantity of biodegradable material going to landfill. This is a requirement of the proposed recommended PD, regardless of the site in which the applicant proposed to place a waste recovery facility.

Infringements of the European (Habitat) Directive 97/62/EC: This topic is discussed in relation to the hen harrier habitat at Bottlehill.

Response: See Section 7 of this report.

Infringements of the European (Landfill) Directive 99/31/EC: these infringements are discussed under three main arguments: (1) that the landfill was not classified by the applicant under one of the following classes: landfill for hazardous waste, landfill for non-hazardous waste and landfill for inert waste. (2) That the application contains no information as to how Cork County Council intends to comply with the provisions of Article 10 of the Landfill Directive with regard to financial provisions including the cost of closure and aftercare of the site for a period of at least 30 years. (3) That Article 5(3) of the European (Landfill) Directive 1999/31/EC prohibits the disposal of liquid waste in landfill sites but that the EIS states that it is proposed to recirculate leachate in the waste body.

Response: The proposed facility is a landfill for non-hazardous waste. Condition 12 of the recommended PD governs the financial provision requirements. Condition 5.11.6 of the recommended PD requires that recirculation of leachate or other contaminated

water shall not be undertaken without the prior agreement of the Agency. The recirculation of leachate is not considered to be 'disposal' of the liquid.

Infringements of the (Waste) Directive 75/442/EEC: The submitter refers to the EC referring Ireland to the European Court of Justice for breaches of the Waste Directive. He also refers to what he considers to be Cork County Council's 'extremely bad record' when it comes to complying with European Directives and refers to various licences granted by the EPA to waste facilities in the Cork area. He discusses his assertion that the EIS and waste licence application for Bottlehill failed to describe how the provisions of various European Directives (groundwater, asbestos, IPPC, and Hazardous waste Directives) will be complied with, and that this objective should be achieved before the EPA grants a waste licence to the applicant.

Response: Much of the discussion centres around general issues which are not directly relevant to this waste licence application. The application and E.I.S. were assessed by the Agency and found to be in compliance with the relevant legislation.

It is noted that the transposition of Directives into national legislation is a matter for the relevant Government Department. The Environmental Impact Statement that was submitted with the application has been taken into account in considering the application for the licence in accordance with the requirements of Section 40 of the Waste management Act 1996. The application was supported with the appropriate number of copies of the EIS and I am satisfied that having assessed the EIS it complies with Article 25 of the Environmental Impact Assessment Regulations.

Signed _____

Dated:

Inspector
Environmental Management and Planning

APPENDIX 1
List of Submitters

| | |
|---------|------------------------------|
| 1 | N.Doherty |
| 2 | D.Cronin |
| 3 | Cllr. Joe Sherlock |
| 4 | J & K Curtin |
| 5 | Cllr. Joe Sherlock |
| 6 | J.& F. Buckley |
| 7 | C. Buchanan |
| 8 | P. King Chairman |
| 9 | E. Hickey |
| 10 | N. Doherty |
| 11 | J. Murray |
| 12 | M. Sheehan |
| 13 | C. Doyle |
| 14 - 15 | L & S Colley |
| 16 | J . Dorgan |
| 17 - 18 | C. & J Meehan |
| 19 | J. Cahill |
| 20 | N & N Costello |
| 21 | J. Curtin |
| 22 | J. Jones |
| 23 - 24 | T Barrett |
| 25 | A. Goodman |
| 26 | D. Malone |
| 27 - 35 | D/ R/ T/ M/ S/ L/ M/ D Carey |
| 36 | N. Doherty |
| 37 | M o'Sullivan |
| 38 | D. Burke |
| 39 | E. O Donoghue |
| 40 | J. O Riordan |
| 41 - 42 | V & C Twomey |
| 43 - 44 | J & K Graham |
| 45 - 46 | J & S Walsh |
| 47 - 49 | C. P & K Dennehy |
| 50 | C Dennehy |
| 51 | M Dennehy |
| 52 - 53 | N & D O'Sullivan |
| 54 -55 | R & M O Connell |
| 56 | J O' Riordan |
| 57 | Murphy Family |
| 58 | B Dolan |
| 59 | K Creedon |
| 60+61 | N Cronin and Thomas Kenny |
| 62 | P O Grady - Noonan |
| 63 - 64 | K & P O Connell |
| 65 | P Buckley |
| 66 | D Lee |
| 67 | M Buckley |
| 68 | M Buckley |
| 69 | N. Buckley |
| 70 | N. Buckley |

| | |
|---------|--|
| 71 | J Mullane |
| 72 | B Buckley |
| 73 | T Mc Sweeney |
| 74 | Nora Doherty |
| 75 - 76 | Michael Mullins and Mary Condon Mullins. |
| 77 | Diarmuid Cronin |
| 78 | George C. Mellamphy |

APPENDIX 2

Site Plan (Figure 2 of Non-Technical Summary)