

ENVIRONMENTAL IMPACT STATEMENT

Infilling of Lowlying Lands

at

Lissard and Ballyhilloge, Mourneabbey, Co. Cork

**Mallow Contracts Ltd
Island
Burnfort
Mallow
Co. Cork**

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MAY 2014

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SECTION ONE

INTRODUCTION

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PREAMBLE

This Environmental Impact Assessment was prepared following a request from EPA under Section 40(2A) (C) of the Waste Management Act following insertion of Statutory Instrument No 505 of 2013. The project has been undertaken since the granting of planning permission by Cork Co Council 06/10406 and granting of a Waste Facility Permit CK(N) 277/05 by Cork Co. Council. Work commenced on site in 2007. New legislation required Mallow Contracts Ltd to apply to the EPA for a Waste License. This application was made in 2009 and registered as W0266-01.

The work entailed raising the ground for agricultural use. It has been ongoing since 2007. Currently more than half of the ground is already raised and in agricultural use. This has been brought about by the planned sequence of operations which was granted planning permission and waste permitted by Cork Co Council. Since the new legislation the site has been under the surveillance of Cork County Council in conjunction with the EPA.

In recent years the larger stone and concrete portion of the intake has been set aside stacked on the site and pulverized. The uniform resultant material is recycled back to users, mainly agricultural, for roadway and hardstanding use.

The site takes in an area of 2.8 hectares and measures approximately 800m long by 170m at its widest. It is adjacent to the main N20 Cork/Mallow Road and is visible from it.

Attachments:

- Cork Co Council Planning Permission 06/10406
- Cork Co Council Waste Management Permit CK(N) 277/05
- EPA Acknowledgement of Waste License Application W0266-01

CORK COUNTY COUNCIL
PLANNING & DEVELOPMENT ACTS 2000 - 2006
NOTIFICATION OF DECISION TO GRANT PERMISSION
(with conditions)

Reference No. in Planning Register
REG NO. 06/10406

Mallow Contracts Ltd
C/O Mescal & Assoc
Enterprise House
Centre Park Rd
Cork

In pursuance of the powers conferred upon them by the above mentioned Act and for the reason set out in the First Schedule hereto, The Council of the County of Cork has by Order dated

decided to GRANT PERMISSION for the development of land namely; **5 FEB 2007**

infilling of existing low lying lands with topsoil, subsoil, rock fill and minor quantities of construction and demolition material

At: Lissard Ballyhilloge Mourneabbey

In accordance with the plans and particulars submitted by the applicant

On: 07/09/2006 and amended on 11/01/2007

And subject to the conditions (13) set out in Column 1 of the Second Schedule attached hereto. The reasons for the imposition of the said conditions are set out in Column 2 of the schedule.

An appeal against a decision of the Planning Authority may be made to An Bord Pleanála by any authorised person before the EXPIRATION of the period of FOUR WEEKS beginning on the day of the giving (i.e. Date of Order) of the decision of the Planning Authority. (SEE NOTES ATTACHED)

If there is no appeal against the said decision, a grant of PERMISSION in accordance with the decision will be issued after the expiration of the period within which an appeal may be made to An Bord Pleanála. It should be noted that until a grant of has been issued the development in question is NOT AUTHORISED.



Signed on behalf of the said Council

Date:

- 5 FEB 2007

SEE NOTES ATTACHED

FIRST SCHEDULE

It is considered that subject to compliance with the condition stipulated in the attached Schedule, the proposed development would not be prejudicial to the amenities of the area and would be in keeping with the proper planning and sustainable development of the area.

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| | Condition | Reason |
|---|---|--|
| 1 | The proposed development shall be carried out in accordance with plans and particulars lodged with the Planning Authority on 07/09/06, and as per revised submissions of 16/11/06 and 11/01/07 save where amended by the conditions herein. | To clarify the documents to which this permission relates in the interests of the proper development of the site. |
| 2 | There shall be no change in the proposed finished ground levels without the prior agreement of the Planning Authority, and the finished levels shall be in accordance with the sections and layout submitted on 11/01/07. | To minimise the visual impact of the development. |
| 3 | <p>Noise levels emanating from the proposed development when measured at the site boundaries shall not exceed 55 dBa (15 minute Leq) between 08.00 hours and 20.00 hours Mondays to Fridays inclusive and shall not exceed 40 dBa (15 minute Leq) at any other time. Measurements shall be made in accordance with I.S.O. Recommendations R. 1996/1 "Acoustics - Description and Measurement of Environmental Noise, Part 1: Basis Quantities and Procedures".</p> <p>If the noise contains a discrete, continuous note (whine, hiss, screech, hum, etc.), or if there are distinct impulses in the noise (bangs, clicks, clatters, or thumps), or if the noise is irregular enough in character to attract attention, a penalty of +5dBA should be applied to the measured noise level and this increased level shall be used in assessing compliance with the specified levels. (Ref: BS 4142 Section 7.2).</p> | <p>To safeguard the amenities of the area.</p> <p><i>For inspection purposes only. Consent of copy right owner required for any other use.</i></p> |

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| 4 | All operations on-site shall be carried out in such a manner as to ensure that no odour, dust or noise nuisance occurs beyond the site boundary because of such operations. | To safeguard the amenities of the area. |
| 5 | Operations on site shall be carried on in such a manner that no polluting material or contaminated surface water enters any watercourse, storm sewer or public roadway. | To safeguard the amenities of the area. |
| 6 | The developer shall ensure that soiled water containment measures are put in place during the course of the activity to ensure that soiled water runoff from the site shall not enter into any watercourse. | To safeguard the amenities of the area. |
| 7 | The developer shall ensure that the soil water containment measures are maintained for the lifetime of the proposed works. | To safeguard the amenities of the area. |
| 8 | The developer shall ensure at all times that no plant or material shall enter larnoid Eireann lands. | To safeguard the amenities of the area. |
| 9 | The developer shall carry out brushing and washing of the Public Road daily as a minimum or more frequently if required, when wastes recovery activities are being carried out. | To safeguard the amenities of the area. |
| 10 | The number of vehicular movements to and from the site shall be restricted to 30 vehicular movements per day. | To safeguard the amenities of the area. |
| 11 | A wheel washing facility shall be provided and used at the entrance of the site to clean vehicles leaving the site. Details of proposed construction, operation etc. shall be submitted to the road area office Blarney before development commences. | To safeguard the amenities of the area. |
| 12 | The public roads in the vicinity of the site shall be kept clear of all | To safeguard the amenities of the area. |

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| | debris and mud from this development at all times. | |
| 13 | Advance warning signage shall be erected in accordance with the requirements of Chapter 8 of the Department of the Environment and Local Government Traffic Signs Manual. | To safeguard the amenities of the area. |

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Waste Permit
issued under
the Waste Management Acts, 1996 to 2005
and
the Waste Management (Permit) Regulations, 1998

by



Cork County Council
Comhairle Chontae Chorcaí

Waste Permit Register Number: CK(N) 277/05
Permit Holder: Mallow Contracts Ltd
Address: Island,
Burnfort,
Mallow,
Co Cork

Location of Facility: Lissard & Ballyhilloge,
Mourneabbey,
Co. Cork

Date of Issue 1st March 2007
Expiry Date 28th February 2010

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Appendix 1

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Activities Permitted

In pursuance of the powers conferred on it by the Waste Management Act, 1996 to 2005 and the Waste Management (Permit) Regulations, 1998, Cork County Council grants this waste permit under Article 5(1) of said Regulations to Mallow Contracts Ltd, Island, Burnfort, Mallow, Co. Cork to carry on the waste activity listed below at Lissard & Ballyhillige, Mourneabbey, Co. Cork subject to the conditions attached in the permit, with the reason for each condition set out.

Permitted Waste Recovery Activity in accordance with Part 1 of the First Schedule of the Waste Management (Permit) Regulations, 1998:

Activity 5: The recovery of waste (other than hazardous waste) at a facility (other than a facility for the composting of waste where the amount of compost and waste held at the facility exceeds 1000 cubic metres at any time).

Permitted Waste Recovery Activity, in accordance with the Fourth Schedule of the Waste Management Act, 1996 to 2005:

- Class 2: Recycling or reclamation of organic substances which are not used as solvents (including composting and other biological processes).*
- Class 4: Recycling or reclamation of other inorganic materials*
- Class 10: The treatment of any waste on land with a consequential benefit for an agricultural activity or ecological system.*

The granting of this permit, and any condition imposed by it, does not exempt the holder of the permit from complying with the statutory obligations of any relevant legislation, including water pollution, health and safety, air pollution, waste, litter and planning legislation.

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| Condition 1: | Scope |
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- 1.1 This waste permit is issued under the Waste Management (Permit) Regulations, 1998, to Mallow Contracts Ltd, Island, Burnfort, Mallow, Co Cork, for lands at Lissard & Ballyhilloge, Mourneabbey, Co. Cork. This permit is strictly non-transferable.
- 1.2 This waste permit is granted for a period of **3 years** commencing from the date of issue.
- 1.3 The Permit Holder shall ensure that the waste activities shall take place only as specified under the conditions of this permit. No change in the type of waste accepted or the type of activities undertaken shall be made without prior written approval from the Local Authority.
- 1.4 The permit holder shall give notice in writing to the Local Authority of any changes in the information e.g. change of company name, change of landowner name, change of address etc furnished in the application for the permit. Such notice shall be given within three weeks of any such change arising.
- 1.5 The permit holder shall ensure that the permitted recovery activities shall be carried on only within the area outlined in the application and to the finished grounds levels as set out in the drawings attached to the application.
- 1.6 The permit holder shall be responsible for ensuring that the waste activities shall be controlled, operated and maintained in strict accordance with the terms of the application and as modified by the conditions attached to this permit.
- 1.7 Where the Local Authority considers that a non-compliance with the conditions of this permit has occurred, it may serve Notice on the permit holder specifying that;
 - (i) only waste as specified, in the Notice are to be accepted at the site after the date specified in the Notice;
 - (ii) the permit holder shall undertake the works stipulated in the Notice, and/or otherwise comply with the requirements of the Notice as set down therein, within any timescale set out in the Notice.

When the Notice has been complied with, the permit holder shall provide written confirmation to the Local Authority that the requirements of the Notice have been carried out. No waste other than that which is stipulated in the Notice, shall be accepted at the site until written confirmation is received from the Local Authority that the Notice is withdrawn.

1.8 The permit holder shall comply at all times with the provisions of the Community Acts detailed in the table below, insofar as such provisions are relevant to the waste activity to be carried out:

| Relevant Provisions | Community Act |
|----------------------------|---|
| Article 9 and 14 | Council Directive 75/442/EEC of 15 July 1975 on waste, as amended by Council Directive 91/156/EEC of 18 March 1991. |

REASON: To clarify the scope of this waste permit.

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| Condition 2: Management of the Activity |
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- 2.1. The permit holder shall acquaint all staff, employees, lessees and agents, including replacement personnel, of the provisions and conditions of this permit. (Refer to template 1 of Appendix 1)
- 2.2. The permit holder shall ensure that a copy of the permit shall be kept at the principal place of business and at the facility at all times.
- 2.3. The permit holder shall ensure that the site shall be manned and supervised when in use. It shall be maintained to the satisfaction of the Local Authority, and adequate precautions shall be taken to prevent unauthorised access to the site.
- 2.4. The Permit Holder shall ensure that waste shall only be accepted at the site between the hours of 8.00 a.m. and 6.00 p.m., Monday to Friday inclusive and 8.00 a.m. and 2.00 p.m. on Saturdays. This condition may be reviewed and amended by the Local Authority at any time.
- 2.5. The Permit Holder shall ensure that no waste activities are carried out on Sundays or Bank Holidays.
- 2.6. The Permit Holder shall immediately notify the Local Authority by telephone/fax, and full details shall be forwarded in writing on the next working day of any breach of the permit. (Refer to template 2 of Appendix 1).
- 2.7. The Permit Holder shall ensure that hedgerows and mature trees shall be retained.
- 2.8. The Permit Holder shall ensure that any access point from an accessible roadway shall be gated and locked when there is no site supervisor present at the facility. Drivers of waste delivery vehicles are not deemed site supervisory staff.
- 2.9. The Permit Holder shall ensure that waste shall only be accepted at the site when carried by permit holders/waste collectors/carriers authorised in accordance with the Waste Management Acts, 1996 to 2005 and Waste Management (Collection Permit) Regulations 2001 or else persons exempted from holding waste collection permits.
- 2.10. The Permit Holder shall ensure that a hardstanding tipping location(s) shall be maintained at the working area of the site in order to facilitate access to the working area.
- 2.11. The Permit Holder shall ensure that the public road is kept clean at all times and that no material is deposited on the public road by vehicles entering or leaving the facility.

- 2.12. The Permit Holder shall ensure that no plant, equipment or material enters the land of Iarnrod Eireann.
- 2.13. The Permit Holder shall ensure that the fence on the boundary with the land of Iarnrod Eireann is maintained in good condition and that the boundary line is clearly demarcated at all times.
- 2.14. Prior to accepting waste material at the facility, the Permit Holder shall confirm in writing to the ESB, and copy to Cork County Council Environment Directorate, that all measures required by the ESB booklet "Avoidance of Electrical Hazards when Working near Overhead Electrical Lines" have been completed.
- 2.15. The Permit Holder shall notify the ESB in writing prior to depositing waste material within 10m of the overhead electrical lines. The Permit Holder shall copy this written notice to Cork County Council Environment Directorate.
- 2.16. The Permit Holder shall ensure a Temporary Bench Mark (TBM), to which the existing and proposed levels relate shall be maintained for the duration of the permit. The Permit Holder shall submit a site location map identifying the location and value of the TBM prior to commencement of the activity.
- 2.17. Prior to the commencement of each stage of the works on the site the Permit Holder shall prepare a step by step method statement which contains sufficient detail for the facility manager to carry out the works in compliance with the Permit.
- 2.18. The Permit Holder shall ensure that the proposed settlement pond and embankments are designed, constructed and maintained to ensure that soiled water runoff shall be prevented from entering any watercourse. A Chartered Engineer shall provide certification for the design, construction and operation of the pond. The Permit Holder shall submit such certification prior to the commencement of any filling activities on site to the Local Authority.
- 2.19. Prior to the commencement of any activities on site the permit holder shall provide details to the Local Authority in writing of the location and purpose of all construction and demolition waste to be recovered on site. Any written correspondence in this regard between the Permit Holder and the Local Authority shall be deemed a condition of this waste permit.

REASON: To make provision for the proper management of the activity.

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| Condition 3: | Notification and Record Keeping |
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- 3.1 All communications with the Local Authority shall be addressed to:
The Environment Department:
Cork County Council,
Inniscarra,
Co. Cork.

Telephone Number (normal working hours): 021 4532700
Fax Number: 021 4532727

- 3.2 The permit holder shall maintain a register of the following records in respect of each consignment of waste arriving on site and departing from the facility: (Refer to template 3 of Appendix 1)
- a) The names and collection permit numbers of the carriers and the vehicle registration numbers including trailer registration number for articulated vehicles.
 - b) The name(s) of the producer(s) of the waste as appropriate, source of the waste;
 - c) A description of the waste including the associated EWC codes;
 - d) The quantities of wastes accepted at the site, recorded in tonnes;
 - e) The name of the person checking the load;
 - f) Where loads or wastes are removed or rejected, details of the date of occurrence; the types of waste and the facility to which they were removed to;
 - g) The quantity of waste leaving the facility, recorded in tonnes;
 - h) The dates and times of all waste deliveries to and from the site.

Any information which might be required from time to time subject to prior agreement with the Local Authority.

- 3.3 The permit holder shall immediately notify the Local Authority by telephone/fax of any incident that occurs as a result of the activity on the site, and which: (Refer to template 4 of Appendix 1)
- a) has the potential for environmental contamination of surface water or ground water,
 - b) poses an environmental threat to air or land,
 - c) requires an emergency response by the Local Authority.

Full details of any such incident shall be forwarded in writing on the next working day. The permit holder shall include as part of the notification:

- I. the date and time of the incident,
- II. details of the incident and circumstances giving rise to it,
- III. an evaluation of environmental pollution caused, if any,
- IV. actions taken to minimise the effect on the environment,
- V. steps taken to avoid reoccurrence,
- VI. any other remedial action taken.

The permit holder shall make a record of any such incident in a register to be kept at the principal place of business.

- 3.4 The permit holder shall maintain on the principal place of business a register of all complaints received relating to the operation of the activity.

Each such record should give details of the following: (Refer to template 5 of Appendix 1).

- a) Time and date of the complaint.
- b) The name of the complainant.
- c) Details of the nature of the complaint.
- d) Actions taken to deal with the complaint, and the results of such actions.
- e) The response made to each complainant.

The Local Authority shall be immediately notified by telephone/fax after the receipt of the complaint, and full details shall be forwarded in writing on the next working day. The permit holder shall make a record of any such complaint in a register to be maintained.

- 3.5 The permit holder shall make all records available to the Local Authority staff and to the public at all reasonable times, and shall provide any relevant information when so requested by an authorised person of the Local Authority.
- 3.6 The permit holder shall notify the Local Authority, in writing, within 7 days of:
 - The imposition of any requirement on the permit holder by order under Section 57 or 58 of the Waste Management Acts, 1996 to 2005, or
 - Any conviction of the permit holder for an offence prescribed under the Waste Management Acts, 1996 to 2005.
- 3.7 The permit holder shall submit to the Local Authority, an Annual Environmental Report (AER) for the preceding calendar year by no later than February 28th of each year. The AER will include details of:
 - a) any impositions or convictions imposed as outlined above;
 - b) reporting period
 - c) waste activities carried out at the facility and quantity/composition of all wastes accepted and recovered at the facility during the reporting period and each previous year;
 - d) any loads rejected at the facility during the year;
 - e) reportable incidents;
 - f) all complaints
 - g) all monitoring carried out in the previous year
 - h) records as required under condition 3.2
 - i) any other items specified by the Local Authority
 - j) management and staffing structure of the facility.
 - k) A topographical survey of the site.
 - l) Remaining capacity of the site in tonnes/cubic metres

In addition, the permit holder shall include in the report, a written summary of compliance with all of the conditions attached to this permit.

- 3.8 Within one month of waste activities ceasing on the site, the permit holder shall submit a report to the Local Authority which shall include the information contained in the registers described above, and details of any impositions or convictions imposed under the Waste Management Acts, 1996 to 2005. In addition, the permit holder shall include in the report a written summary of compliance with all of the conditions attached to the permit.

REASON: To provide for the notification of incidents, to update information on the activity and to provide for the keeping of proper records.

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Condition 4: Site Access

- 4.1 Prior to the importation of any waste to the site, the permit holder shall erect warning/safety signs as per the Traffic Signs Manual (DOE) on the approaches to the site entrance. The type and location of these signs shall be agreed with the Cork County Council Area Engineer. The permit holder shall bear the cost of the supply, erection and termination of these signs. The permit holder shall maintain written proof of all such agreements and shall make them available to the Local Authority on request.
- 4.2 **The Permit Holder shall agree all access and site layout arrangements with the Local Area Engineer (in this instance Mr Pat Corbett, Cork County Council, Blarney Area Office, Blarney, Co. Cork, Telephone: 021 438 1227), prior to any activities taking place at the site. The Permit Holder shall submit to the Local Authority written correspondence regarding such an agreement. The permit holder shall maintain proof of all such agreements and shall make them available to the Local Authority on request.**
- 4.3 Within 2 months of the date of the grant of this permit, the Permit Holder shall erect an information board at the entrance to the site. The minimum dimensions of the information board shall be 1200mm by 750mm. The board shall show:
- (i) The name, address and telephone number of the facility.
 - (ii) The waste permit reference number.
 - (iii) Emergency contact number outside of operating hours.

REASON: In the interest of safety.

Condition 5: Waste Acceptance and Waste Handling

- 5.1 Only the following inert materials, refer to the European Waste Catalogue and Hazardous Waste List, January 2002 shall be accepted on the site:

17 05 04 Soil and stone (200,000 tonnes in total)

17 01 07 Mixture of concrete, bricks, tiles and ceramics other than those mentioned in 17 01 06 (20,000 tonnes in total)

No other waste types are permitted to be deposited at this facility.

The quantity of material may be reviewed by the Local Authority at any time.

- 5.2 The Permit Holder shall ensure that the permit holder, or his staff, employees, lessees or agents shall subject all waste on arrival at the facility to a visual inspection. Materials other than those permitted shall be removed immediately from the site. Such waste shall be disposed of (or recovered) at an alternative facility with an appropriate waste permit or waste licence. Following delivery of such unauthorised waste to the site, the Local Authority shall be immediately notified by telephone/fax, and full details shall be forwarded in writing on the next working day.
- 5.3 The permit holder shall ensure that adequate steps are taken to prevent unauthorised entry of wastes to the site. The permit holder shall make provisions to control access to the site, and to prevent the fly tipping of waste.
- 5.4 The permit holder shall remove immediately any waste placed on or in the vicinity of the site other than in accordance with the requirements of the permit. If such waste is discovered it shall be taken to a facility with a waste license or waste permit authorising acceptance of such waste by an authorised waste collector.
- 5.5 The Permit Holder shall prepare comprehensive written operating instructions and procedures in respect to waste control to assist personnel with responsibility in this area. These procedures shall be made available to the Local Authority on request.
- 5.6 The Permit Holder shall ensure that employees with responsibilities in the waste control area shall receive training to enable them to execute their tasks in relation to pollution control. (Refer to template 6 of Appendix I).

- 5.7 The permit holder shall operate the site on the basis that a **maximum of 15 truck loads per day (a total of 300 tonnes per day), subject to Condition 5.1,** shall be allowed deposit waste at the facility. This condition may be reviewed and amended by the Local Authority at any time.

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| REASON: | To provide for the acceptance and management of wastes authorised under this waste permit. |
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| Condition 6: | Nuisances, Emissions and Environmental Impacts |
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- 6.1 The permit holder shall ensure that the waste activities on the site shall be carried out in such a manner so as not to have an adverse effect on the drainage of adjacent lands, on watercourses, streams, on field drains or on any other drainage system.
- 6.2 The permit holder shall take adequate precautions to prevent undue noise, fumes, dust, grit, untidiness and other nuisances during the course of the works that would result in an impairment of a significant interference with amenities or the environment beyond the site boundary. If unacceptable increased levels of noise, fumes, dust and grit occur, the permit holder shall abide by the Local Authority's abatement requirements, which may include immediate cessation of operations.
- 6.3 The permit holder shall ensure that a mechanical road sweeper is available while the site is in operation. Any material deposited onto the roadway shall be removed without delay. The permit holder shall be responsible for the removal of any debris on the approach road for a distance of 300 meters either side of the main entrance.
- 6.4 The permit holder shall take adequate steps to prevent dust generation in dry weather periods. The permit holder shall spray the current working area with clean water to minimise dust generation. The access road to the site shall also be sprayed during dry weather.
- 6.5 The permit holder shall inspect the site perimeter twice weekly for the presence of litter and shall remove all litter from the site and its environs without delay. A record shall be maintained of inspections and any action taken as a result of these inspections. (Refer to template 7 of Appendix 1)
- 6.6 The Permit Holder shall ensure that no waste shall be burned on the site.
- 6.7 The Permit Holder shall construct a refuelling point as detailed on drawing no. 6, "Fuel Bunding", submitted to CCC on 11/01/07 prior to storing fuel at the facility. The spillage containment area shall be lined with heavy gauge polythene with joints lapped and taped.
- 6.8 The permit holder shall remain responsible for the maintenance and upkeep of open ditches and drains on site, in order that no flooding occurs on any adjacent lands. The Permit Holder shall ensure that any required works shall have a minimal effect on the buffer zone.

- 6.9 The permit holder shall take adequate steps to minimise noise from the development and shall have regard to BS 5228, 1997 Noise Control on Construction and Open Sites. During permitted operating hours **noise levels shall not exceed 55 dBA (Leq)** inclusive of 5dBA penalty for tone or impulse if appropriate. In order to assess compliance with the noise limits, the Local Authority may require that noise measurements be taken in accordance with ISO1996/1–Acoustics–Description and Measurement of Environment Noise Part 1 and Part 2. In addition, appropriate penalties for tonal and impulsive elements shall be applied to the measured L_{Aeq} values in accordance with Section 4 of ISO 1996/2, to determine the appropriate rating level (L_{AFT}). Noise shall not exceed 45dBA at any other time.

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| REASON: To ensure compliance with the requirements of the conditions of this permit. |
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Condition 7: Environmental Monitoring

- 7.1 The Permit Holder shall ensure that authorised staff of the Local Authority shall have unrestricted access to the site at all reasonable times, on production of identification, for the purpose of their functions under the Waste Management Acts, 1996 to 2005, including such inspections, monitoring and investigations as are deemed necessary by the Local Authority.
- 7.2 If so requested by the Local Authority, the permit holder shall, at his own expense, make a suitable excavator available for the purposes of excavating trial holes in the waste material deposited on the site, and shall arrange for the excavator to carry out whatever works are required by the Local Authority on the site.
- 7.3 If so requested by the Local Authority, the permit holder shall, at his own expense, carry out such further investigations and monitoring of the facility as required by the Local Authority. The scope, detail and programme, including report structure and reporting schedule, for any such investigations and monitoring shall be in accordance with any written instructions issued by the Local Authority. In the event of pollution of waters in the vicinity of the site, or of a leachate discharge onto adjoining lands, input of waste onto the site shall cease, and remedial measures shall be carried out immediately as directed by the the Local Authority.
- 7.4 Dangerous substances. This permit does not permit the discharge of compounds listed in the Water Quality (Dangerous Substances Regulations) S.I. 12, 2001 from any operation arising on this site.**

REASON: To ensure compliance with the requirements of the conditions of this permit.

Condition 8: Restoration and Aftercare

- 8.1 The following items shall be certified by an appropriately qualified person such as a Teagasc advisor or qualified REPS planner as having been carried out to an appropriate standard. Such certification shall be made available to the Local Authority on request:
- a) As soon as is practicable following completion of the waste activities, the Permit Holder shall seed the site with grass and return it to beneficial agricultural use.
 - b) Prior to seeding, the Permit Holder shall spread topsoil evenly over the site to a minimum depth, after compaction and firming, of 225 mm. The topsoil shall be good quality medium loam, and shall comply with BS 882: 1991. The topsoil shall not be spread in wet conditions.
 - c) The Permit Holder shall ensure that the topsoil shall be adequately prepared for seeding by raking or harrowing, and by rolling. Only certified quality grass seed shall be used. Seed shall be spread at a minimum rate of 40 grams per square meter. Seeding shall take place during appropriate weather conditions.
- 8.2 Within 3 months following completion of the waste activities, the Permit Holder shall submit a topographical survey of the site.
- 8.3 The permit holder remains responsible for the proper nuisance-free operation of all drainage systems on site, and for ensuring that no pollution of groundwaters or surface waters shall occur at any time as a result of the proposed waste recovery operation.

REASON: To provide for the restoration and aftercare of the facility.

Condition 9: Charges and Financial Provisions

- 9.1 The Permit Holder shall make an annual payment of €1,000 to Cork County Council. For 2007, the Permit Holder shall pay €830 from the date of this permit to the 31st of December 2007. This amount shall be paid to the Council within one month of the date of grant of this permit and thereafter, no later than 31st January of each year. For 2010, the Permit Holder shall pay €170 from the 1st of January 2010 to the date of expiry of this permit. The Local Authority will use this payment towards the cost of monitoring the activity to the extent that it considers necessary for the performance of its functions under the Waste Management Acts 1996 and 2005. This payment is non-refundable.
- 9.2 In the event that the frequency or extent of monitoring or other functions carried out by the Local Authority requires to be increased for whatsoever reason, the Permit Holder shall contribute such increased and/or additional sums as may be determined by the Local Authority to defray its costs.

REASON: To provide for adequate financing measures to protect the environment

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Environmental Protection Agency
An tAonmhéireacht um an tAonmhéireacht

Mr Paudie Sheehan
Mallow Contracts Limited
Island
Burnfort
Mallow
Co.Cork

Headquarters, PO Box 3000
Johnstown Castle Estate
County Wexford, Ireland
Ceannteathrú, Bosca Poist 3000
Eastát Chaisleán Bhaile Sheáin
Contae Loch Garman, Éire
T: +353 53 916 0600
F: +353 53 916 0699
E: info@epa.ie
W: www.epa.ie
LoCall: 1890 33 55 99

19/02/09

Reg No: W0266-01

Re: Application for a waste licence – Mallow Contracts Limited, Mallow Contracts Limited, Lissard & Ballyhilloge, Mourneabbey, Co. Cork,

Dear Mr Sheehan,

I am to refer to documentation received by the Agency in respect of an application for a waste licence on 13/02/2009 in respect of a facility/premises at Mallow Contracts Limited, Lissard & Ballyhilloge, Mourneabbey, Co. Cork, . The register number assigned to this application is W0266-01.

Please use this number as a reference in all further correspondence on this matter and please address all such correspondence to the Agency at its Headquarters at the *Licensing Unit, EPA, Office of Climate, Licensing & Resource Use, PO Box 3000, Johnstown Castle Estate, County Wexford.*

The application and associated correspondence, including any acknowledgements and notifications, are available to view on the Agency Website at www.epa.ie.

It is noted that the following correspondence person has been nominated in the application:
Mr Michael Mescal, , Mescal & Associates Ltd, Enterprise House, Centre Park Road, Cork, .

Please note that:-

1. All documentation in relation to the application which is received from the nominated correspondence person will be treated as application documentation submitted by the applicant; and
2. Following this letter, the Agency will address all correspondence in relation to the application to the nominated correspondence person.

In the event that you wish to change the nominated correspondence person, please inform the Agency in writing.

Yours sincerely,

Josephine Kennedy
Programme Officer
Office of Climate, Licensing & Resource Use

cc Mr, Michael, Mescal, , Mescal & Associates Ltd, Enterprise House, Centre Park Road, Cork, .

PRIOR CONSULTATIONS

In 2005 and 2006 prior consultation and post application consultations took place with the external interested bodies impacted by the development. These included:

- Southern Regional Fisheries Board
- Irish Rail
- ESB Networks

In addition Teagasc were employed, to meet the requirement of Cork County Council for an external agricultural specialist, to validate the proposed land use.

A traffic survey was carried out and the proposed road use and access arrangements were submitted and agreed with the Roads Section of Cork Co Council.

A Hydrological report was submitted detailing the impact of the works on the River Peastinagh and River Martin.

Attachments:

- Southern Regional Fisheries Board letter (04/01/2007)
- Teagasc Approval (28/02/2006)
- Hydrological Report (04/01/2007)



Southern Regional Fisheries Board

Bord Iascaigh Réigiúnach an Deiscirt



Fisheries Ireland

Our Natural Heritage

SRFB, The Pike, Fermoy, Co. Cork. 025-32795

Mr. Michael Mescal,
Mescall & Associates,
Consulting Engineers,
Enterprise House,
Centre Park Road,
Cork.

4th January 2007

Re: Waste Management (Permit) Regulations 1998 – Application for site bordering the Peastinagh River upstream of Ivyhouse Bridge Reference No. CK(n)277/05

Dear Mr. Mescal,

I refer to the recent correspondence regarding the above waste management permit application. While the river immediately upstream of Ivyhouse Bridge is not significant in terms of salmonids it is significant in terms of spawning habitat a short distance downstream. It is therefore important to incorporate best practices and strategies to minimise discharges of silt/suspended solids to waters. The discharge of silt-laden waters to fisheries streams due to insufficient silt control measures can clog salmonid (salmon and trout) spawning beds and can also precipitate further riverbank erosion downstream. Inevitably this can lead to loss or degradation of valuable habitat.

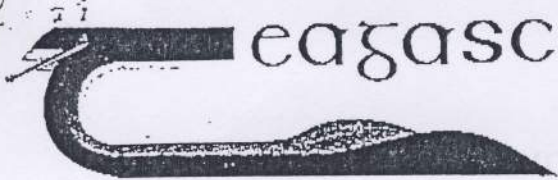
Fuel oils etc. should be stored on a sheltered dry elevated site well removed from aquatic zones. It is our view that refuelling of vehicles should take place in a designated area well away from aquatic zones and fuel oils must not, under any circumstances, discharge into an aquatic zone.

Yours sincerely,

Frank O'Donoghue,
Senior Fisheries Environmental Officer.

**The Southern Regional
Fisheries Board**
Anglesea Street
Clonmel
Co. Tipperary
T: (052) 80055
F: (052) 23971
E: enquiries@srfb.ie
www.srfb.ie



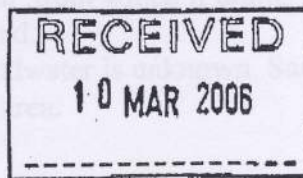


County Advisory and Training Services

SANDFIELD Mallow, Co. Cork Tel: 022-21936/21898/21100 Fax: 022-42657

28th February 2006

Con Mullane Lissard Mourneabbey Mallow Co Cork



Dear Con

Further to my recent visit to your farm, relating to the assessment of land in need of reclamation, I wish to make the following observations:

The land in Plot A is a mixture of grassland and marshy/non productive ground subdivided by a stream (x) which is located going roughly through the middle of A in a basin. The problem area rests between the stream and the road (N20).

Approximately 2 1/2 ha of ground is currently of no agricultural use and would benefit from reclamation, provided that the reclamation works is carried out correctly.

Yours truly,

Handwritten signature of Pat Beecher

Pat Beecher B.Agr. Sc Teagasc Advisor



IMPACT ON THE PEASTINAGH RIVER CATCHMENT AND ON THE RIVER MARTIN CATCHMENT OF THE PROPOSED INFILL AT IVYHOUSE BRIDGE

1. The proposed site is located immediately south of Ivyhouse Bridge. This is close to the sources of the Peastingagh River and of the River Martin. There are no river gauges on either river close to this location.
2. The flow in the Peastingagh River is estimated by identifying its catchment. Reference is then made to An Foras Forbartha / ESB publication which identifies flows for each catchment in the country.
 - The unitised regional flow duration curves in this region, Cork C and Cork E, gives a maximum of 80 l/s per m² per 1m rainfall.
 - The annual rainfall is calculated from the average of the two closest gauges at CSET Mallow and Shournagh i.e. 1309 mm/y and 1219 mm/y averaging at 1261 mm/y.
 - The catchment size is measured at = 0.84 sq.km.

This gives a maximum flow rate resulting from run off the fields to the Peastingagh of :

$$80 \text{ l/s} \times 1261/1000 \times 0.84 / 1000 = 0.084 \text{ m}^3/\text{s}.$$

3. The above is based on An Foras Forbartha / ESB publication 1984. This does not account for increased flow due to paving. The additional runoff due to paving is estimated as follows:

Total paved area in the catchment = 0.013 sq.km

Time of concentration to Ivyhouse Bridge is estimated as

$$T_c = 0.65 \text{ km} @ 1 \text{ m/s} = 10.8 \text{ mins}$$

Reference is made to EC Dillons analysis of rainfall. This shows rainfall maximum for 10.8 mins as 2.4 inches / hr = 60 mm/hr.

Consequently the additional flow due to paving is estimated at :

$$13,000 \text{ m}^2 \times 60/1000 \times 1 \text{ hr} / 3600 \text{ secs} = 0.216 \text{ m}^3/\text{s}$$

4. The total max flow is therefore

$$0.084 \text{ (runoff from total area)} + 0.216 \text{ (runoff from roadway)} = 0.3 \text{ m}^3/\text{s}$$

5. The Peastingagh was cross sectioned and bed elevations were measured. This is summarized as follows :

| | |
|-----------------------------------|--|
| Above Ivyhouse Bridge (new route) | cross section = 2.0 w x 0.3 d (metres) |
| | bed slope , i = 0.009 |
| Below Ivyhouse Bridge | cross section = 1.5 w x 0.3 d (metres) |
| | bed slope , i = 0.043 |
| At Ivyhouse Bridge | section = 0.6 w x 0.38 h (metres) |
| | bed slope , i = 0.048 |

Capacities calculated as follows :

$$V = \frac{1.49}{n} \times r^{2/3} \times i^{1/2} \quad (\text{imp units})$$

V = velocity ft/s

n = roughness = 0.025 (value at Ivyhouse Bridge taken at 0.015 for stone)

r = hydraulic radius in ft

i = bed slope

For above Ivyhouse Bridge , V = 1.9 ft/s = 0.58 m/s

(new route)

$$Q = VA = 0.58 \text{ m/s} \times 0.3 \text{ m} \times 2.0 \text{ m} = 0.348 \text{ m}^3/\text{s}$$

Above greater than total flow max of 0.3 – OK

For below Ivyhouse Bridge , V = 4.39 ft/s = 1.34 m/s

$$Q = VA = 1.34 \text{ m/s} \times 0.3 \text{ m} \times 1.5 \text{ m} = 0.60 \text{ m}^3/\text{s}$$

Above greater than total flow max of 0.3 – OK

For at Ivyhouse Bridge ,

Taken just flowing full with hydraulic radius calculated by area over total perimeter.

$$V = 5.0 \text{ ft/s} = 1.52 \text{ m/s}$$

$$Q = VA = 1.52 \text{ m/s} \times 0.6 \text{ m} \times 0.38 \text{ m} = 0.34 \text{ m}^3/\text{s}$$

Above greater than total flow max of 0.3 – OK

6. The downstream impact of the infill above Ivyhouse Bridge is to reduce any floodwater storage above Ivyhouse Bridge. The quantity of floodwater stored above is small on account of the adequacy of the waterways leading from the area. This is evidenced from the capacity calculated in 5 above.

Check on existing channel above Ivyhouse Bridge as follows:

Cross Section = 4.0 w x 0.3 d (metres)
 Bed Slope , i = 0.0025

$$V = 1.49 \times r \times i$$

$$V = 2.85 \text{ f/s} = 0.87 \text{ m/s}$$

$$Q = VA = 0.87 \text{ m/s} \times 4.0 \text{ m} \times 0.3 \text{ m} = 1.04 \text{ m}^3/\text{s}$$

Above greater than total flow max of 0.3 m³/s

Consequently no backup of significance should occur.

The actual quantity of floodwater stored is difficult to accurately assess. The extent of standing water is marked and dated 22nd Nov , 05 on the site survey drawing no MC 0512 - 05/1. Rainfall records for Nov 05 show Cork had 96% of the normal rainfall for period 1961 to 1990. Nov is historically one of the higher months for rainfall. Consequently the level on the survey date is reasonably close to maximum conditions. The area draining to the Peastingagh shown under water measures at 2300 m². Estimate a mean depth of 0.3 m. This gives a volume of 690 m³.

To estimate change in storage , the volume stored in the new drain above Ivyhouse Bridge must be deducted from the above. At very maximum conditions this , from 5 above , is close to 0.3 m deep. Consequently the volume stored is calculated as 0.3 m x 2.0 m x 600 m = 360 m³.

Therefore storage is reduced by 330 m³ (690 – 360).

The impact of reducing the storage in this upper region of the catchment by 330 m³ is not significant. At Mourneabbey , 3.5 km downstream , where the Peastingagh flows into the Clyda , the impact can be assessed from the following:

Total catchment of Peastingagh @Mourneabbey = 24 sq. km
 Total rainfall for say month of November = 111 mm x 24 sq km
 = 2,664,000 m³

The storage reduction equates of 330 m³ equates to 0.00013 of this.

The storage reduction is consequently of very little significance.



- 7. The impact on the River Martin side is of less significance than the Peastinagh side. This is because only some 20% the area between the N20 and the railway drained to the R.Martin is impacted. The line and gradient of the R.Martin is unchanged. The R.Martin flows under the railway 0.7 km from its high point.

Similar to 2 above . The catchment is measured 0.75 sq.km.

This gives a maximum flow rate from run off the fields to the R. Martin of:

$$80 \text{ l/s} \times 1261/1000 \times 0.75/1.0 = 0.076 \text{ m}^3/\text{s}$$

Similar to 3 above . Total paved area in catchment is 0.010 sq.km.

Time of concentration to crossing is estimated as

$$T_c = 0.70 \text{ km} @ 1 \text{ m/s} = 11.7 \text{ mins}$$

EC Dillons analysis of rainfall shows 11.7 mins as 2.1 inches/hr = 53 mm/hr.

Consequently additional flow due to paving is estimated at ;

$$7500 \text{ m}^2 \times 53/1000 \times 1 \text{ hr} / 3600 \text{ secs} = 0.110 \text{ m}^3/\text{s}$$

Consequently total max flow is therefore:

$$0.076 \text{ (runoff from area)} + 0.110 \text{ (runoff from roadway)} = 0.186 \text{ m}^3/\text{s}$$

- 8. R.Martin cross section is average 1.5 wide x 0.3 deep.(metres)
Bed slope is average of 0.007

Capacity calculates at

$$V = \frac{1.49}{n} \times r^{2/3} \times i^{1/2}$$

$$= 1.80 \text{ f/s} = 0.55 \text{ m/s}$$

$$Q = VA = 0.55 \text{ m/s} \times 1.5 \text{ m} \times 0.3 \text{ m} = 0.247 \text{ m}^3/\text{s}$$

Above greater than total flow max of 0.186 m³/s – OK, doesn't surcharge.

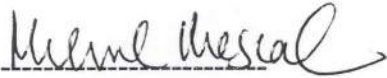
At railway crossing cross section is 0.6 x 0.6 stone section

Velocity at max flow is 0.186 / 0.6 x 0.6 = 0.52 m/s OK , surcharge , if any not significant as head loss is minimal over 10 m length of crossing under railway.

- 9. The loss of upstream storage in the R.Martin is not of any significance. The storage reduction is small and the channel capacity above indicates that storage is not required.

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The stream bed and the wet area at the head of the river is being filled with stone with protective cover to allow flow to continue. Consequently there will be a loss of some 75% of cross section of flow in this region. This is not significant because rising water, if any, is the only contributor to flow in this covered area as surface runoff and the road runoff does not drain in this covered channel.



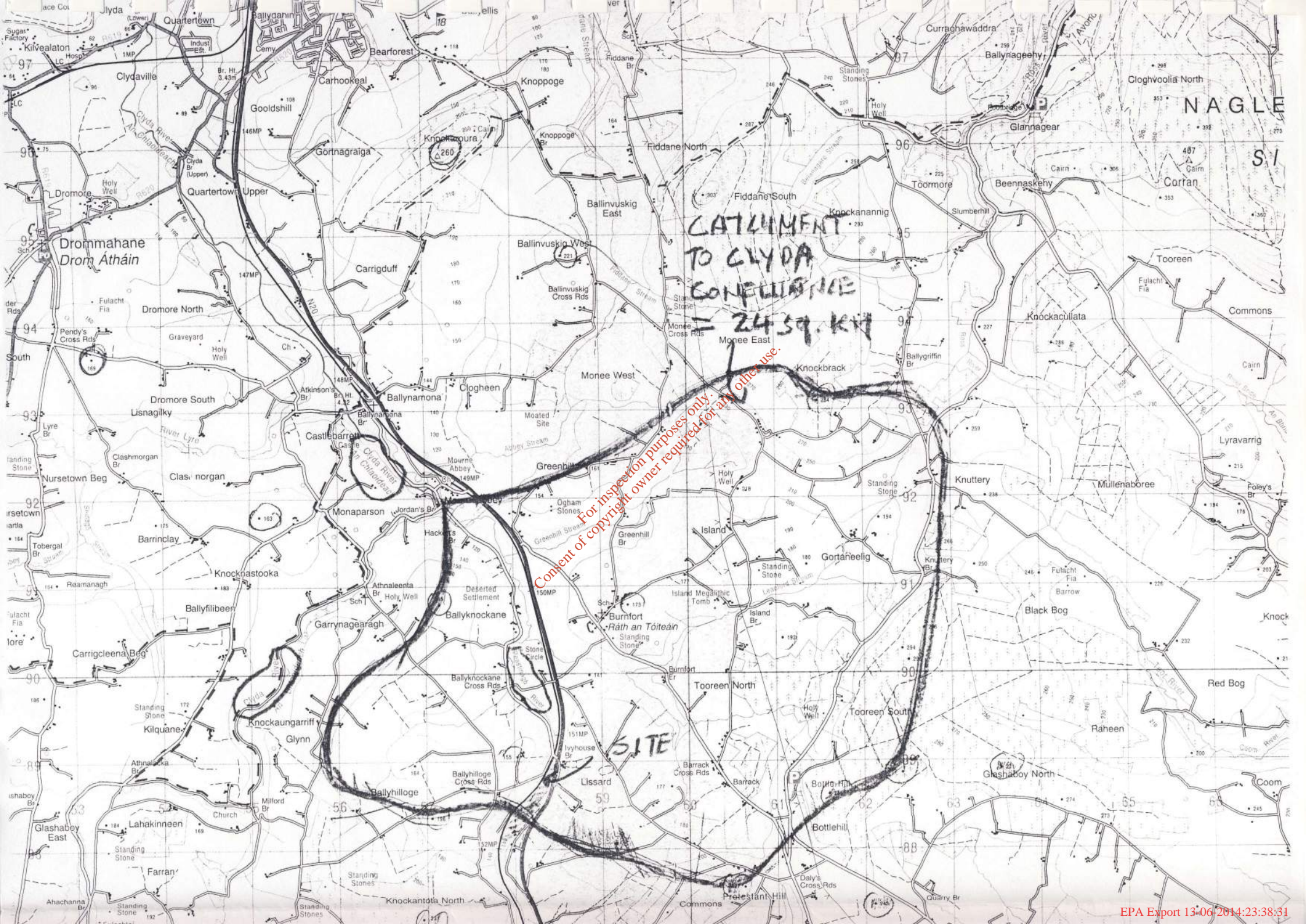
Michael Mescal
Chartered Engineer

04/01/07

Attachments:

- 1/50,000 – showing Peastingagh and Martin complete (marked OS map enclosed)
- 1/10,000 - showing features
- 'Small Scale Hydroelectric Potential for Ireland' 1985, AFF
- Extracts from Drainage Records
- Prof EC Dillons Rainfall
- Extract from 'Sewers' by Bevan & Rees

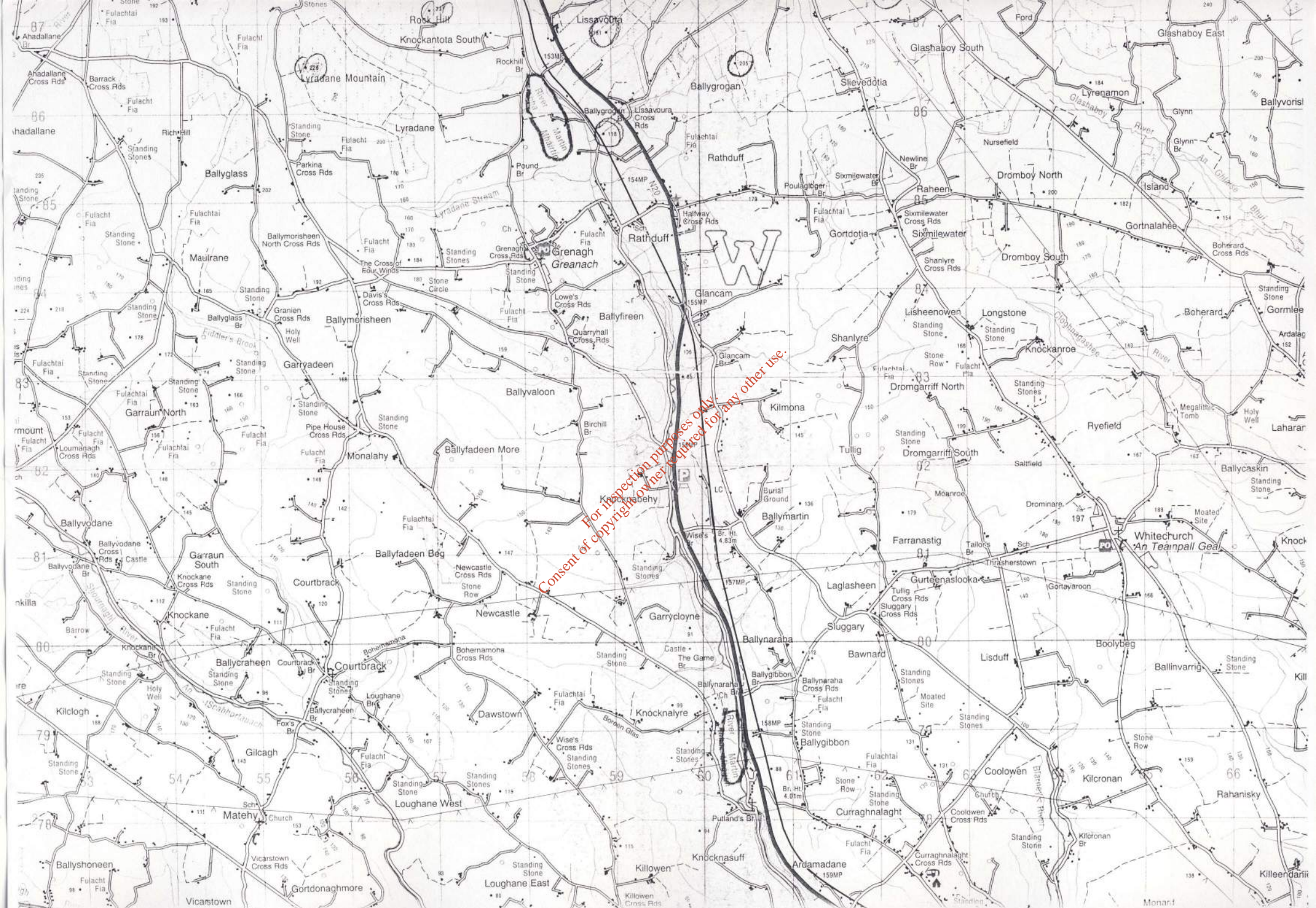
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CATCHMENT
TO CLYDA
COMPLIANCE
= 2439 KM

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SITE



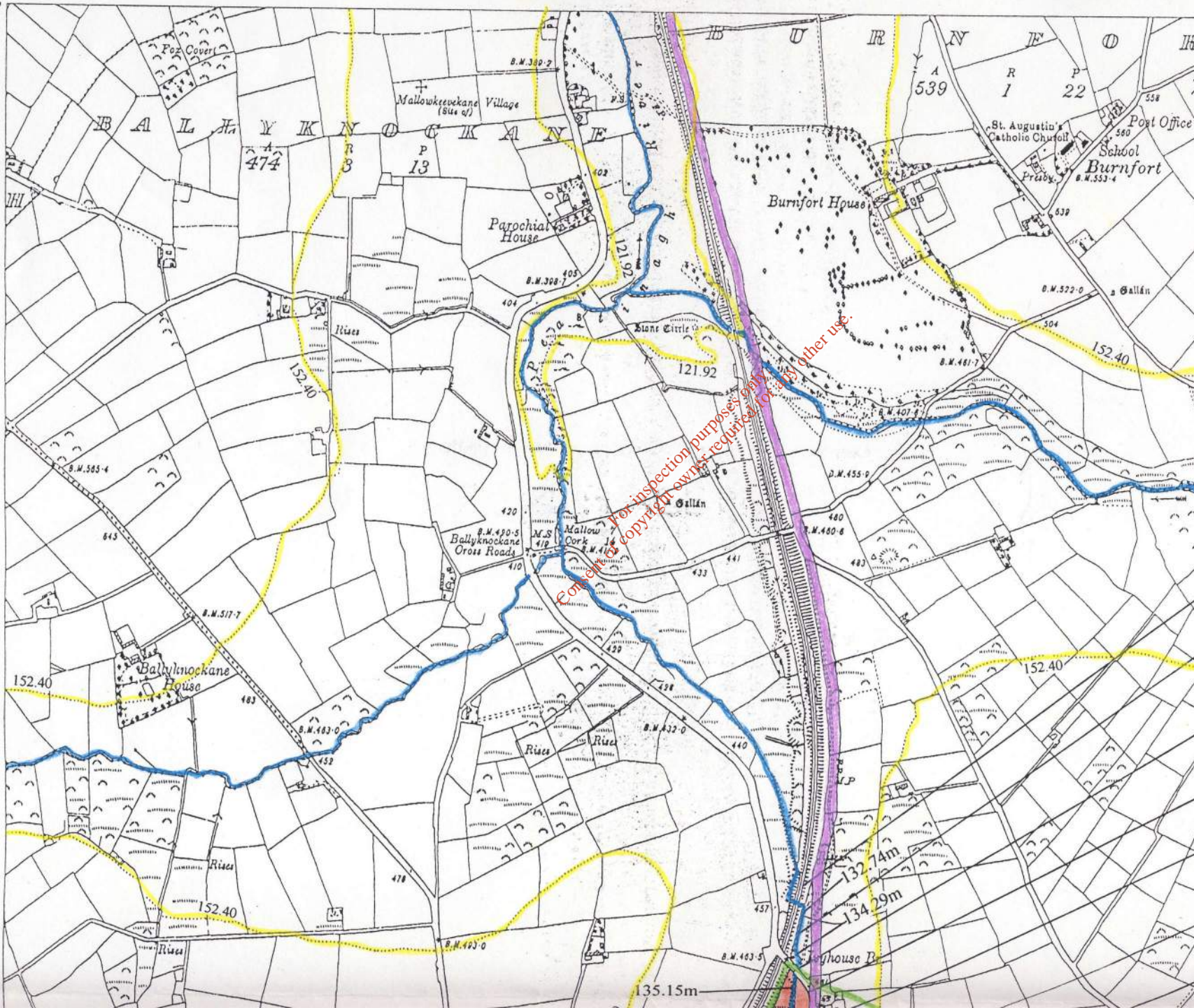
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Surveyed 1842
Revised 1932 - 1933
Levelled 1933

Record PLACE Map



90945



CROSSING 2 x 0.6 x 0.6

$i = 0.043$
SECTION = 1.5w x 0.3d

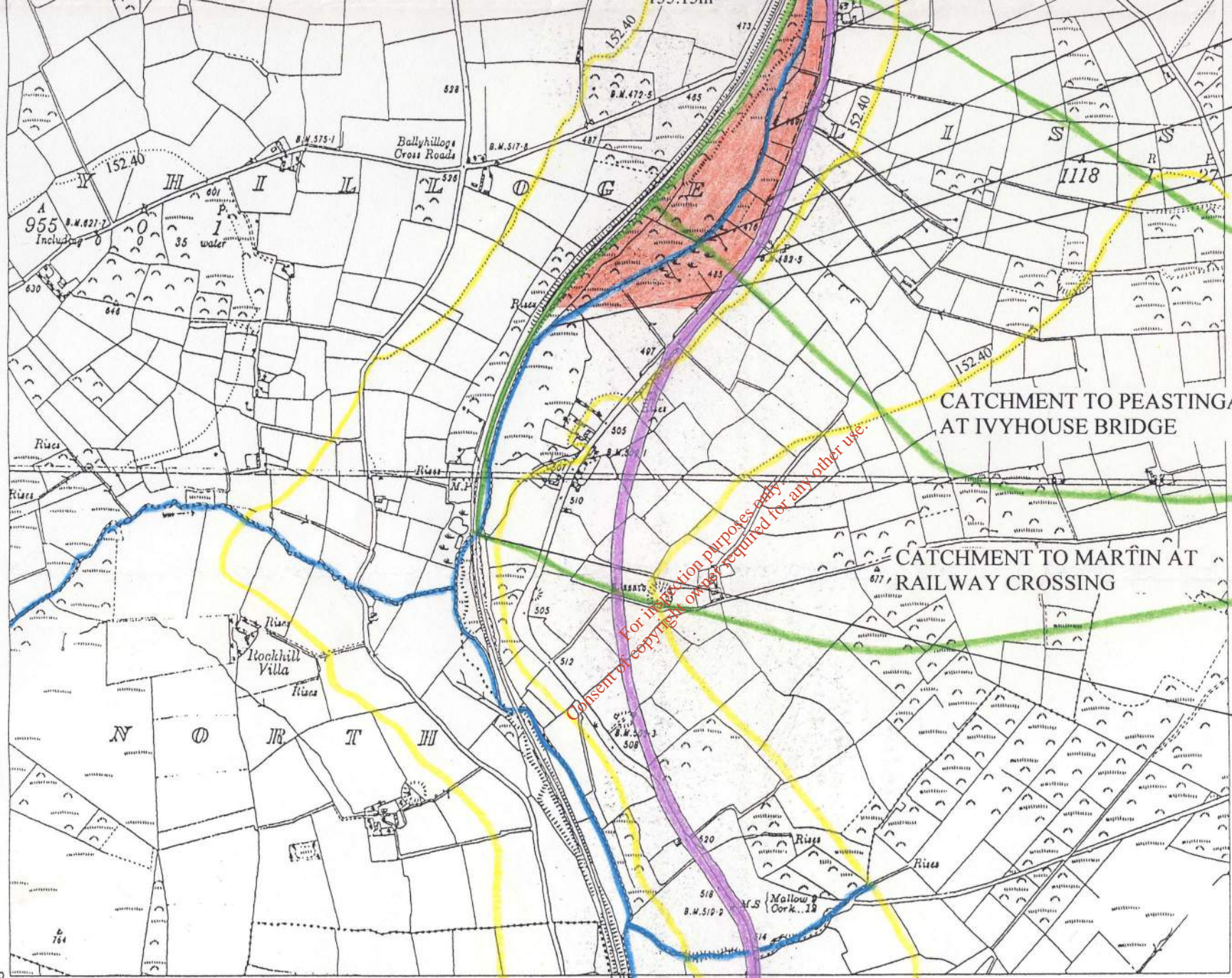
@ CROSSING
SECTION = 0.6w x 0.38d
 $i = 0.048$

ROAD LEVEL 138.10

$i = 0.009$ (NEW DITCH)
SECTION = 2.0w x 0.3d

$i = 0.0025$ (EXIST. DITCH)
SECTION = 4.0w x 0.3d

HIGH POINT OF NEW
DITCH 141.2



HIGHEST EXISTING
INVERT 136.5

ROAD LEVEL 146.6

$i = 0.007$
SECTION = $1.5w \times 0.3d$

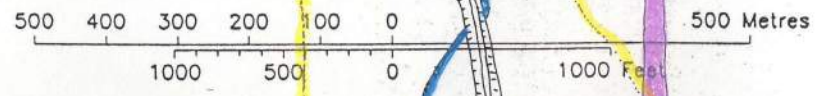
CATCHMENT TO PEASTINGAGH
AT IVYHOUSE BRIDGE

CATCHMENT TO MARTIN AT
RAILWAY CROSSING

CROSSING 0.6 x 0.6

87080
156681

Scale: - 1:10560
Scála: - 1:10560



Plot Ref. No. 43885_1
Plot Date 15-DEC-2006



DEPARTMENT OF ENERGY
IRELAND

SMALL-SCALE
HYDRO-ELECTRIC POTENTIAL
OF IRELAND

WATER RESOURCES DIVISION
AN FORAS FORBARTHA

CIVIL WORKS DEPARTMENT
ELECTRICITY SUPPLY BOARD

OCTOBER 1985

To be purchased from the Department
of Energy, Dublin 2.

Price: £10.00

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Hydrological Analysis

Introduction

2.1 The hydro power available at any site on a river is directly proportional to the fall at that site and to the flow in the river. Consequently the information needed to estimate the hydro power at any site is the height of the fall and the magnitude and frequency of river flows at the site. While in general the determination of the fall or head is a comparatively simple matter, for purposes of this report a method of extrapolation had to be developed so that flow data from gauged catchments could be applied to derive the frequency distribution of flows at all sites including those in ungauged catchments. A synthetic method termed the *regional unit flow duration curve* was employed for this purpose.

Flow Duration Curves (FDC's)

2.2 A flow duration curve is a graph of flow rate versus its exceedence percentile i.e. percentage of time when a given flow rate is equaled or exceeded. The bases for the derivation of regional flow duration curves are the flow duration curves produced from good quality records of daily mean flows from all suitable hydrometric gauging stations. The existing data available from approximately 185 gauging stations representing all the gauged catchments within the survey area were chosen for analysis.

2.3 Tables of daily mean flows were already available for some gauging stations. Where the data were in the form of chart records of water level at the gauging site these records were processed to derive tables of daily mean flows for each calendar year over the period of the record. Flow duration curves were then produced from the tables of daily mean flows.

2.4 The catchment area (in km²) contributing to flow at the site and the long term average rainfall (in m) on that catchment were calculated for each gauge site. Catchment areas were measured by planimetry on 1/2" to 1 mile scale Ordnance Survey maps and rainfall was determined from 1/4" to 1 mile scale isohyetal maps based on observations over the period 1941-1970.

Derivation of Regional Flow Duration Curves

2.5 Using the values of catchment area and rainfall each flow duration curve was normalised to a unit flow duration curve by dividing the flow ordinates by the appropriate catchment area and rainfall. The unit flow duration curve for a site represents the flow at that site generated by 1 km² of contributing catchment with an annual average rainfall of 1 metre. Unit flow duration curves are the basis for the derivation of regional unitised flow duration curves.

2.6 Unitised flow duration curves were produced for 185 hydrometric gauging stations throughout the country. The bodies responsible for data collection at these sites include

Local Authorities, the Office of Public Works and the Electricity Supply Board. Various lengths of records existed for the different gauge sites and the quality of the data also varied to some degree. This resulted in the reduction of the number of unitised curves selected for analysis. Thirty-one of the derived unitised FDC's were considered unsuitable for one or more of the following reasons:—

- (i) The period of record was too short.
- (ii) Flows at some gauging stations were seriously influenced by upstream storage.
- (iii) The rating curve for the gauging station i.e. the relationship between water level and measured flows was of poor quality.
- (iv) Where a particular gauging station was located close to another station with a longer period of record, then the station with the shorter period of record was excluded.

2.7 A total of 154 unitised FDC's were thus used in the determination of regional unitised FDC's. The hydrometric gauging stations to which these relate are listed in Appendix B.

2.8 Having normalised a set of standard flow duration curves with respect to catchment area and average rainfall, the variation in the resulting family of curves from that area depends almost completely on catchment geology and soil, assuming that a standard period of record was employed. Having regard to the quality of the hydrological data available, it was inevitable that considerable variation in flow duration curves would emerge. This was due to several factors which arose from a combination of particular local flow conditions, the use of FDC's from sites with small catchments and high rainfall, the inclusion of variable periods of flow records and the absence of information relating to specific geological and soil types. Typical variations in derived FDC's can be seen in Fig. 2.1 which compares 13 curves for gauging stations all in the catchment area of the river Suir. It was decided therefore that the regions to which a particular group of FDC's applied should be small to compensate for the possible inaccuracies arising from the various sources. Consequently the procedure of selecting regions on a county basis was adopted.

2.9 When a particular group of unit FDC's were considered to adequately represent flow conditions within a region a statistical curve fitting technique was applied to find the curve of best fit for the group. *This curve is then the unitised regional flow duration curve and it indicates the variation in flow rate generated by 1 km² of contributing catchment with an annual rainfall of 1 m anywhere within that region.* A total of 85 regional flow duration curves have been derived using the unit FDC's from 154 hydrometric gauging stations. A total of five maps were prepared to outline all 85 regions for which unitised flow duration curves were derived. These regions and their corresponding unitised regional flow duration curves are shown in Appendix C. In Figure 2.2 the unitised regional flow duration curve for a typical region is shown as an overlay on the group of FDC's in Figure 2.3 which describes that region.

2.10 *Hydrological records show that the mean flow in a natural watercourse is approximately equal to the 30 percentile flow.* The 30% exceedance coefficient of the unitised regional flow duration curve is therefore taken to be the provisional mean flow coefficient for that region. The mean flow at any site can be estimated by multiplying the relevant provisional mean flow coefficient by that catchment area to the site and the average rainfall on that catchment. Unique flow duration characteristics for the site can be established by applying the same parameters to the complete unitised regional FDC.

2.11 The level of installed generating capacity (maximum power output) appropriate to any hydroelectric power site can be determined only when the design parameters of head and flow are established. The measurement of head is usually a relatively simple matter.

The design flow rate of the installation may be chosen to be equal to the mean river flow rate or to some multiple of this flow. The adoption of a particular proportion of the mean

REGION SUIR

UNITISED F. D. C.

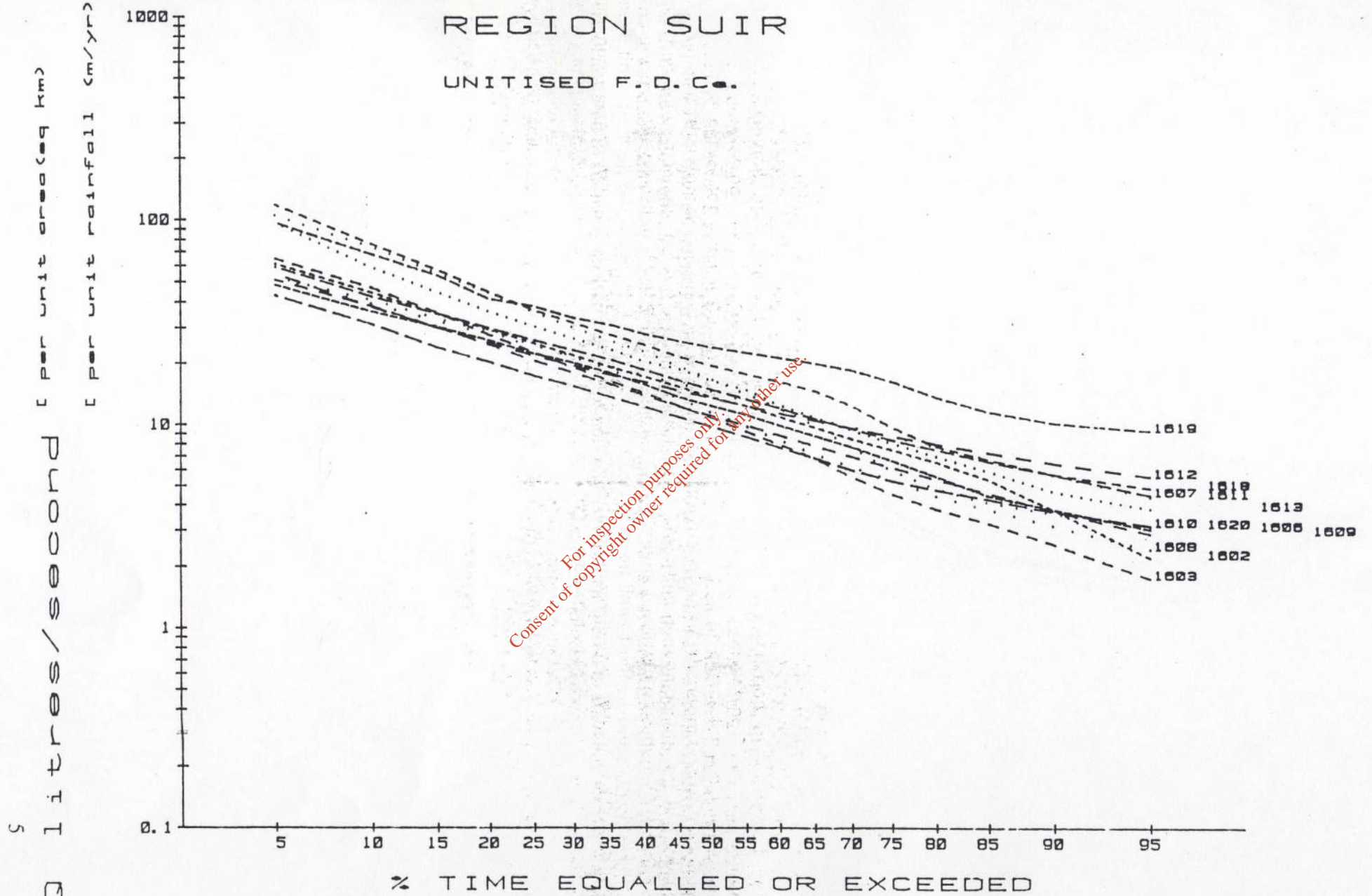


FIG. 2.1 THE VARIATION IN UNITISED FLOW DURATION CURVES FOR THE RIVER SUIR CATCHMENT

Litres/second (per unit area (sq km))
(per unit rainfall (m/yr))

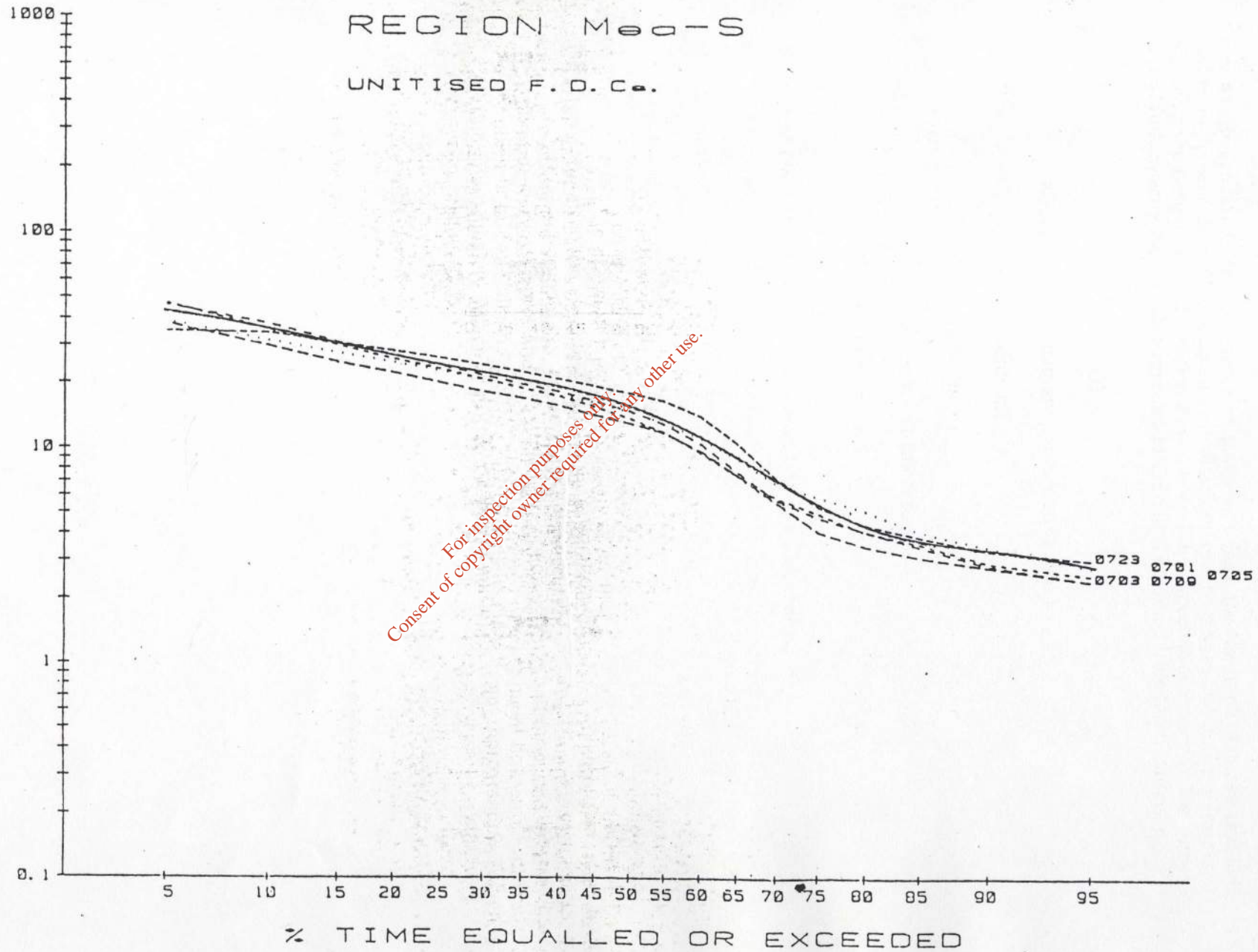


FIG. 2.2 UNITISED REGIONAL FLOW DURATION CURVE FOR REGION MEA-S
 FIG. 2.3 UNITISED FLOW DURATION CURVES WHICH DETERMINE REGION MEA-S

flow as a design flow is based on river size, geomorphology, the condition of intake channels and weirs, power demand, access and the disadvantages to fishery and amenity interests. Knowing the design head, the design flow rate and the expected efficiency of the turbine unit at full capacity the installed capacity of the site is obtained from the relationship

$$P = 9.81 QH\eta$$

where P = maximum power output (kW)

H = Head (m)

Q = flow (m³/s)

η = efficiency at full capacity

1,000 litres = 1m³/s

The Use of Flow Duration Curves in Annual Energy Calculations:

2.12 The expected annual energy output is also of prime importance to the developer. The calculation of this energy potential is based entirely on the derived flow duration curve for the particular site. While the design flow rate will be the upper limit of turbine operation, the lower limit of operation is typically between 25% and 40% of the design flow depending on turbine characteristics. The effect of altering this limit is not large however, since not only are the volumes comparatively small at the lower end of the curve but the efficiency is less than for higher flows. *The lower limit of turbine operation is taken as 25% of the full capacity discharge.*

2.13 In Figure 2.4 a typical flow duration curve is plotted with time as abscissa and discharge as ordinate. The area under this curve represents the volume of water passing the site in unit time. The quantity used to produce electricity corresponds to the area ABCDF where A is the discharge when installed capacity is fully employed and G is one quarter of that volume.

The *annual energy coefficient* for the installation C_e is defined as this area multiplied by 9.81 (g) and 8,760 (the number of hours in a year). Since the area, and consequently the annual energy coefficient, is a function of the particular percentage of the mean flow (Q_m) which is chosen as the design flow (Q), it is necessary that a range of energy coefficients be available to the designer. For this study energy coefficients have been calculated for values of Q in the range of 1.65 Q_m down to 0.2 Q_m .

The *annual energy potential* of the site is given by

$$E = C_e ARH\eta$$

where E = Annual energy in kilowatt hours (kWh)

C_e = Annual energy coefficient

A = Catchment area (km²)

R = Average rainfall (m/year)

H = Design Head (m)

η = Overall efficiency

The coefficients are listed in Tables C2-C6 of Appendix C.

Curve plotted to linear scales to emphasise the slope of the FDC

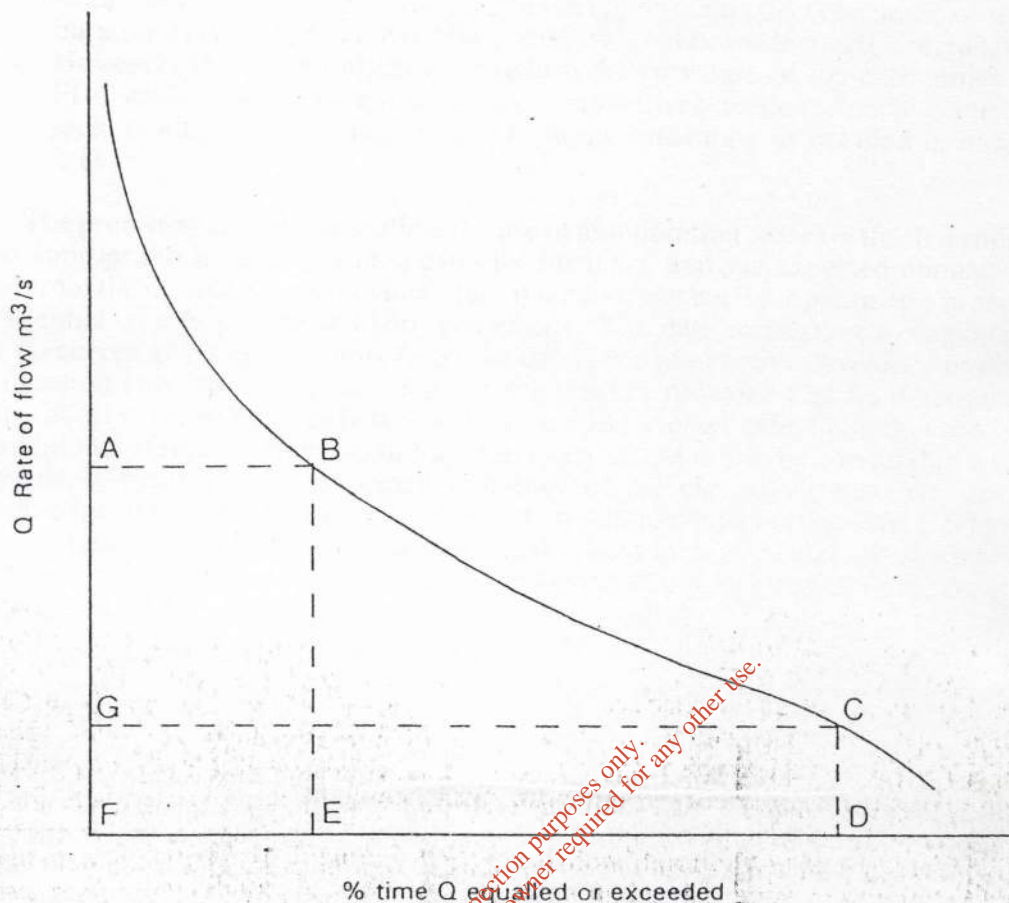


FIG. 2.4 TYPICAL FLOW DURATION CURVE

Possible Errors

2.14 The procedure outlined above to obtain the flow duration characteristics at all potential sites was simple and efficient having regard to the large number of sites where this information was required. However, it should be recognised that it is a synthetic method and there are possible inaccuracies arising both from the derivation of regional FDC's and in their application to ungauged catchments.

- (a) The flow duration curves used to derive the regional curve should ideally be based on a standard period of record of daily mean flows. Relatively large differences in the length of records were inevitable due to the large number which were analysed.
- (b) The basic FDC's do not take into account the effects of catchment geology and soil type.
- (c) The regional flow duration curve is derived from a number of FDC's from a particular region. It represents the general flow conditions and does not show the effects of particular local conditions. Most of the curves are from river sites with relatively large catchment areas and mean average annual rainfall. Many of the actual sites investigated have small catchment areas and high average annual rainfall. The effect of decrease in area is to increase the influence of local conditions.

- (d) Catchment areas have been drawn by study of the topography with no allowance being taken of geology.
- (e) Water abstractions and storage will have appreciable effects on some of the flow duration curves used in the analysis which will not be evident in the regional FDC. However, the overall effect is to reduce the curvature of the extremities of the FDC while leaving the central section comparatively unaltered and it is the central section which is most important for energy generation as detailed in paragraph 2.13.

2.15 The preceding paragraphs outline the use of flow duration curves in the determination of the appropriate level of installed capacity for a site and the expected annual energy output from the installation. It is evident that this curve forms a basic parameter in assessing the potential of any particular hydro power site. The data in relation to regional flow duration curves given in Appendix C can be used by a prospective developer to obtain a flow duration curve for a site anywhere in the country provided that he determines the catchment area contributing to flow at the site and the average rainfall on that catchment. The additional pieces of information required to estimate the energy potential of a site are the available head and the expected efficiency of the chosen turbine/generator. The procedure involved in the application of the data is outlined fully in Appendix C. However, before committing himself to any sizeable investment in a particular development, the developer would be well advised to obtain the advice of a competent engineer on scheme feasibility and optimisation.

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Appendix B

List of Hydrometric Gauging Stations used for FDC Analysis Distribution of Stations

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New 5 digit Nos

0141 → 01041

| Station No. | River | Name of Station | Grid Ref. | Catchment Area km ² | Rainfall mm/yr. |
|-------------|---------------|------------------|-----------|--------------------------------|-----------------|
| 0141 | Deele | Sandy Mills | H273 990 | 113 | 1293 |
| 0142 | Finn | Dreenan Br. | H152 945 | 353 | 1713 |
| 0351 | Blackwater | Faulkland Br. | H704 379 | 126 | 1026 |
| 0611 | Fane | Moyles Mill | H918 076 | 230 | 1073 |
| 0613 | Dee | Charleville | O044 907 | 307 | 907 |
| 0614 | Glyde | Tallanstown | N953 978 | 270 | 943 |
| 0621 | Glyde | Manfieldstown | O023 952 | 321 | 928 |
| 0623 | Dee | Drumgoolestown | O030 909 | 302 | 907 |
| 0625 | Dee | Burley Br. | N925 896 | 176 | 930 |
| 0626 | Glyde | Aclint | N893 981 | 144 | 1072 |
| 0630 | Big | Ballygoly | J152 100 | 12 | 1220 |
| 0631 | Flurry | Curralhir | J083 143 | 46 | 1104 |
| 0633 | White | Coneyburrow Br. | O056 893 | 54 | 957 |
| 0701 | Tremblestown | Tremblestown | N755 577 | 150 | 950 |
| 0703 | Castlerickard | Blackwater | N716 489 | 179 | 850 |
| 0705 | Boyne | Trim | N802 568 | 1282 | 913 |
| 0706 | Moynalty | Fyanstown | N790 757 | 179 | 980 |
| 0709 | Boyne | Navan Weir | N878 667 | 1610 | 898 |
| 0710 | Blackwater | Liscarton | N846 689 | 717 | 984 |
| 0711 | Blackwater | O'Daly's Br. | N652 805 | 294 | 1043 |
| 0712 | Boyne | Slane Castle | N949 738 | 2408 | 920 |
| 0714 | Yellow | Garr Br. | N532 369 | 44 | 912 |
| 0717 | Moynalty | Rosehill | N720 852 | 74 | 1070 |
| 0723 | Athboy | Athboy | N717 640 | 98 | 982 |
| 0802 | Delvin | Naul | O132 612 | 37 | 850 |
| 0803 | Broadmeadow | Fieldstown | O116 503 | 72 | 854 |
| 0804 | Ward | Owens Br. | O132 464 | 42 | 817 |
| 0805 | Sluice | Kinsealy Hall | O220 417 | 10 | 780 |
| 0806 | Mayne | Hole in the Wall | O222 415 | 16 | 780 |
| 0807 | Broadmeadow | Ashbourne | O087 524 | 34 | 869 |
| 0901 | Ryewater | Leixlip | O005 364 | 215 | 836 |
| 0902 | Griffeen | Lucan | O005 352 | 38 | 826 |
| 0905 | Cannock | Clondalkin | O083 321 | 60 | 879 |
| 0999 | Liffey | Burgage Br. | — | 288 | 1356 |
| 1002 | Avonmore | Rathdrum | T197 883 | 233 | 1727 |
| 1003 | Avonmore | Laragh | T146 965 | 107 | 1646 |
| 1004 | Glenmacrass | Laragh | T143 965 | 28 | 1978 |
| 1017 | Ballyman | Ballyman | O227 187 | 3 | 1050 |
| 1101 | Owenavorrigh | Boleany | T170 560 | 148 | 961 |
| 1201 | Slaney | Scarrawalsh | S983 450 | 1036 | 1108 |
| 1213 | Slaney | Rathvilly | S882 844 | 185 | 1231 |
| 1214 | Bann | Pallis Br. | T116 683 | 15 | 1200 |
| 1215 | Bann | Ferns | T030 493 | 161 | 1105 |
| 1216 | Boro | Dunanore | S960 364 | 175 | 1108 |
| 1301 | Corock | Goffs Br. | S874 180 | 56 | 1060 |
| 1302 | Corock | Foulkesmill | S854 183 | 64 | 1050 |
| 1303 | Owenduff | Mullinderry | S814 158 | 90 | 1050 |
| 1404 | Figile | Clonbulloge | N609 235 | 268 | 850 |
| 1405 | Barrow | Portarlinton | N540 126 | 398 | 981 |
| 1406 | Barrow | Pass Br. | N623 109 | 1096 | 897 |
| 1418 | Barrow | Royal Oak | S689 614 | 2415 | 882 |
| 1419 | Barrow | Levitstown | S705 876 | 1660 | 877 |
| 1423 | Barrow | Graiguenamanagh | S727 418 | 2795 | 896 |
| 1424 | Burren | Coolasnachta | S818 567 | 6 | 1182 |
| 1432 | Triogue | Kyle Br. | N437 038 | 31 | 875 |
| 1433 | Owenass | Mountmellick | N452 082 | 91 | 1104 |
| 1434 | Barrow | Bestfield Lock | S717 797 | 2060 | 840 |

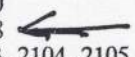
| Station No. | River | Name of Station | Grid Ref. | Catchment Area km ² | Rainfall mm/yr. |
|-------------|-------------|-------------------|-----------|--------------------------------|-----------------|
| 1501 | Kings | Annamult House | S543 443 | 443 | 991 |
| 1502 | Nore | Johns Br. | S506 561 | 1605 | 979 |
| 1503 | Dinan | Dinan Br. | S479 628 | 298 | 1024 |
| 1504 | Nore | McMahons Br. | S418 797 | 491 | 1018 |
| 1506 | Nore | Brownsbarn Br. | S617 391 | 2388 | 978 |
| 1507 | Nore | Kilbricken | S362 899 | 343 | 1063 |
| 1509 | Kings | Callan | S415 438 | 201 | 1034 |
| 1510 | Goul | Ballyboodin Mills | S368 774 | 159 | 934 |
| 1511 | Nore | Mount Juliet | S550 422 | 2201 | 974 |
| 1521 | Delour | Annagh Br. | S441 717 | 72 | 1315 |
| 1602 | Suir | Beakestown | S092 552 | 512 | 970 |
| 1603 | Clodiagh | Rathkennan | S051 530 | 246 | 1177 |
| 1605 | Multeen | Aughnagross | R991 413 | 87 | 1197 |
| 1606 | Multeen | Ballinaclogh | R985 408 | 75 | 1180 |
| 1607 | Aherlow | Killardry | S017 294 | 273 | 1360 |
| 1608 | Suir | New Br | S001 341 | 1120 | 1030 |
| 1609 | Suir | Cahir Park | S052 228 | 1602 | 1075 |
| 1610 | Anner | Anner Br. | S253 256 | 422 | 984 |
| 1612 | Tar | Tar Br. | S107 134 | 228 | 1332 |
| 1613 | Nier | Fourmilewater | S166 135 | 91 | 1394 |
| 1618 | Glengalla | Knockballiniry | S076 117 | 12.5 | 1580 |
| 1620 | Clodiagh | Portlaw | S449 154 | 124 | 1345 |
| 1701 | Mahon | Kilmacthomas | S395 065 | 62 | 1360 |
| 1702 | Tay | Fox's Castle | S340 004 | 33 | 1437 |
| 1802 | Blackwater | Ballyduff | W965 991 | 2338 | 1159 |
| 1804 | Awbeg | Ballynamona | R656 076 | 324 | 1064 |
| 1805 | Funshion | Downing Br. | R822 020 | 363 | 1190 |
| 1806 | Blackwater | Mallow | W525 973 | 1058 | 1303 |
| 1909 | Butlerstown | Brookhill | W736 763 | 43 | 1216 |
| 1914 | Lee | Dromcarra | W296 675 | 184 | 1964 |
| 1915 | Shournagh | Healys Br. | W606 730 | 210 | 1219 |
| 1918 | Shournagh | Tower Br. | W590 746 | 160 | 1234 |
| 1920 | Owencurra | Ballyedmond | W859 766 | 75 | 1224 |
| 2009 | Stick | Belgooly | W663 540 | 37 | 1150 |
| 2102 | Coomhola | Coomhola | V998 548 | 65 | 2168 |
| 2103 | Owvane | Ballylickey | W010 536 | 77 | 1861 |
| 2104 | Mealagh | Inchiclough | W027 511 | 46 | 1809 |
| 2105 | Adrigole | Adrigole | V813 505 | 27.6 | 2128 |
| 2203 | Brown Flesk | Dicksgrove | Q976 145 | 272 | 1354 |
| 2204 | Owgarriff | Owgarriff Weir | W000 856 | 7 | 2800 |
| 2205 | Torc | Torc Weir | V967 838 | 8 | 2504 |
| 2206 | Flesk | Flesk | V970 892 | 325 | 1747 |
| 2301 | Galey | Inch Br. | Q957 363 | 196 | 1120 |
| 2302 | Feale | Listowel | Q996 333 | 646 | 1336 |
| 2306 | Feale | Neodata | R115 269 | 300 | 1425 |
| 2402 | Camoge | Grays Br. | R580 404 | 231 | 978 |
| 2403 | Loobagh | Garoose | R549 274 | 129 | 1051 |
| 2404 | Maigue | Bruree | R550 304 | 246 | 1002 |
| 2405 | Morningstar | Athlacca | R557 343 | 140 | 1002 |
| 2406 | Maigue | Creggane | R533 273 | 88 | 950 |
| 2506 | Brosna | Ferbane | N115 244 | 1207 | 931 |
| 2513 | Brosna | Newells Br. | N383 423 | 221 | 975 |
| 2514 | Silver | Millbrook | N135 188 | 165 | 992 |

| Station No. | River | Name of Station | Grid Ref. | Catchment Area km ² | Rainfall mm/yr. |
|-------------|----------------|-----------------|-----------|--------------------------------|-----------------|
| 2519 | Cappagh | Conicar | M752 071 | 125 | 1151 |
| 2520 | Killimor | Killeen | M796 111 | 197 | 999 |
| 2521 | Little Brosna | Croghan | N053 056 | 493 | 958 |
| 2522 | Camcor | Syngefield | N080 046 | 160 | 1042 |
| 2525 | Ballyfinboy | Ballyhooney | R862 959 | 160 | 919 |
| 2527 | Ollatrim | Gourdeen | R886 797 | 118 | 1077 |
| 2529 | Nenagh | Clarianna | R860 822 | 301 | 1117 |
| 2530 | Graney | Scarriff | R640 843 | 279 | 1280 |
| 2544 | Kilmastulla | Coole Br. | R712 693 | 95 | 1157 |
| 2605 | Suck | Derrycahill | M824 426 | 1050 | 1057 |
| 2606 | Suck | Willsbrook | M692 756 | 182 | 1080 |
| 2612 | Boyle | Tinnecarra | G770 019 | 520 | 1135 |
| 2614 | Lung | Banada Br. | M634 943 | 222 | 1116 |
| 2619 | Camlin | Mullagh | N116 759 | 260 | 981 |
| 2620 | Camlin | Argar | N181 793 | 126 | 997 |
| 2701 | Claureen | Inch Br. | R301 755 | 48 | |
| 3007 | Clare | Ballygaddy | M420 539 | 458 | 1148 |
| 3061 | Corrib | Wolf Tone Br. | M294 249 | 3111 | 1338 |
| 3204 | Owenglin | Clifden | L670 504 | 32 | 1846 |
| 3301 | Glenamoy | Glenamoy | F895 337 | 73 | 1459 |
| 3304 | Owenmore | Kilsallagh | F956 209 | 166 | 1591 |
| 3306 | Owenduff | Srahnamanragh | F812 154 | 121 | 1752 |
| 3401 | Moy | Rahans | G243 180 | 1911 | 1280 |
| 3403 | Moy | Foxford | G267 039 | 1750 | 1270 |
| 3410 | Moy | Cloonacannana | G388 024 | 471 | 1298 |
| 3424 | Pollagh | Kiltimagh | M332 893 | 128 | 1175 |
| 3501 | Owenmore | Ballynacarrow | G639 219 | 299 | 1163 |
| 3502 | Owenbeg | Billa Br. | G638 257 | 90 | 1428 |
| 3503 | Unshin | Ballygrania | G6 97 257 | 212 | 1181 |
| 3505 | Ballisodare | Ballisodare | G669 290 | 658 | 1206 |
| 3511 | Bonet | Dromahaire | G805 309 | 294 | 1394 |
| 3610 | Annalee | Butlers Br. | H408 104 | 774 | 1020 |
| 3615 | Finn | Anlore | H537 256 | 155 | 1058 |
| 3616 | Annalee | Rathkenny | H540 114 | 522 | 1030 |
| 3618 | Dromore | Ashfield Br. | H575 140 | 233 | 1020 |
| 3620 | Blackwater | Killywillan | H203 146 | 95 | 1325 |
| 3627 | Woodford | Ballyhendy | H250 156 | 324 | 1272 |
| 3631 | Cavan | Lisdarn | H414 069 | 62 | 1008 |
| 3678 | Derrygooney L. | Derrygooney | H693 108 | 77 | 1000 |
| 3679 | L. Bawn | Corlea | H716 116 | 67 | 1000 |
| 3801 | Ownea | Clonconwall | G765 927 | 109 | 1684 |
| 3805 | Owengarva | Glenties | G870 935 | 7 | 1900 |
| 3901 | Swilly | Newmills | C117 092 | 49 | 1569 |
| 3903 | Crana | Tullyarvan | C349 330 | 99 | 1429 |

Now 5 digit Nos.

Table C1

| County | Regions | Designation | Stations Used |
|----------|---------|---|---|
| Carlow | 2 | CAR-O CAR-M | 1213, 1216, 1424 1418, 1423, 1434 |
| Cavan | 3 | CAV-E CAV-N CAV-S | 3610, 3616, 3618 3620, 3627 0711, 0717, 3631 |
| Clare | 2 | CLA-SH CLA-F | 2530 2701 |
| Cork | 6 | COR-O COR-C COR-KE COR-S COR-E COR-LW | 1909, 1920 1915, 1918 2102, 2103, 2104, 2105 2009 1802, 1804, 1805, 1806 1914 |
| Donegal | 4 | DON-W DON-EE DON-IO DON-L | 3801 0141, 0142, 3901 3903 3805 |
| Dublin | 5 | DUB-C DUB-N DUB-B DUB-S DUB-L | 0805, 0806, 0902 0802 0803, 0804 0905, 1017 0999, 0906 |
| Galway | 5 | GAL-NE GAL-W GAL-E GAL-C GAL-M | 2605, 2606, 2612, 2614 3204 2519, 2520 3061 3007 |
| Kerry | 3 | KER-CK KER-N KER-C | 2102, 2103, 2104, 2105 2301, 2302, 2306 2203, 2204, 2205, 2206 |
| Kildare | 6 | KID-M KID-L KID-RY KID-H KID-BA KID-BO | 1405, 1406, 1419, 1433, 1434, 1507, 1510, 1504 0999, 0906 0901 1213 1405, 1406, 1419 0703, 0714 |
| Kilkenny | 2 | KIK-O KIK-M | 1501, 1503, 1509 1502, 1504, 1506, 1511 |
| Laois | 2 | LAO-L LAO-H | 1405, 1406, 1419, 1433, 1434, 1507, 1510, 1504 1432, 1521 |
| Leitrim | 1 | LEITM | 2629, 3511, 3620, 3627 |
| Limerick | 4 | LIM-E LIM-CW LIM-C LIM-W | 2402, 2405 2302, 2404 2403, 2404, 2406 2306 |
| Longford | 1 | LONFD | 2619, 2620 |
| Louth | 4 | LOU-C LOU-F LOU-S LOU-N | 0613, 0614, 0621, 0623, 0625, 0626 0611 0633 0630, 0631 |

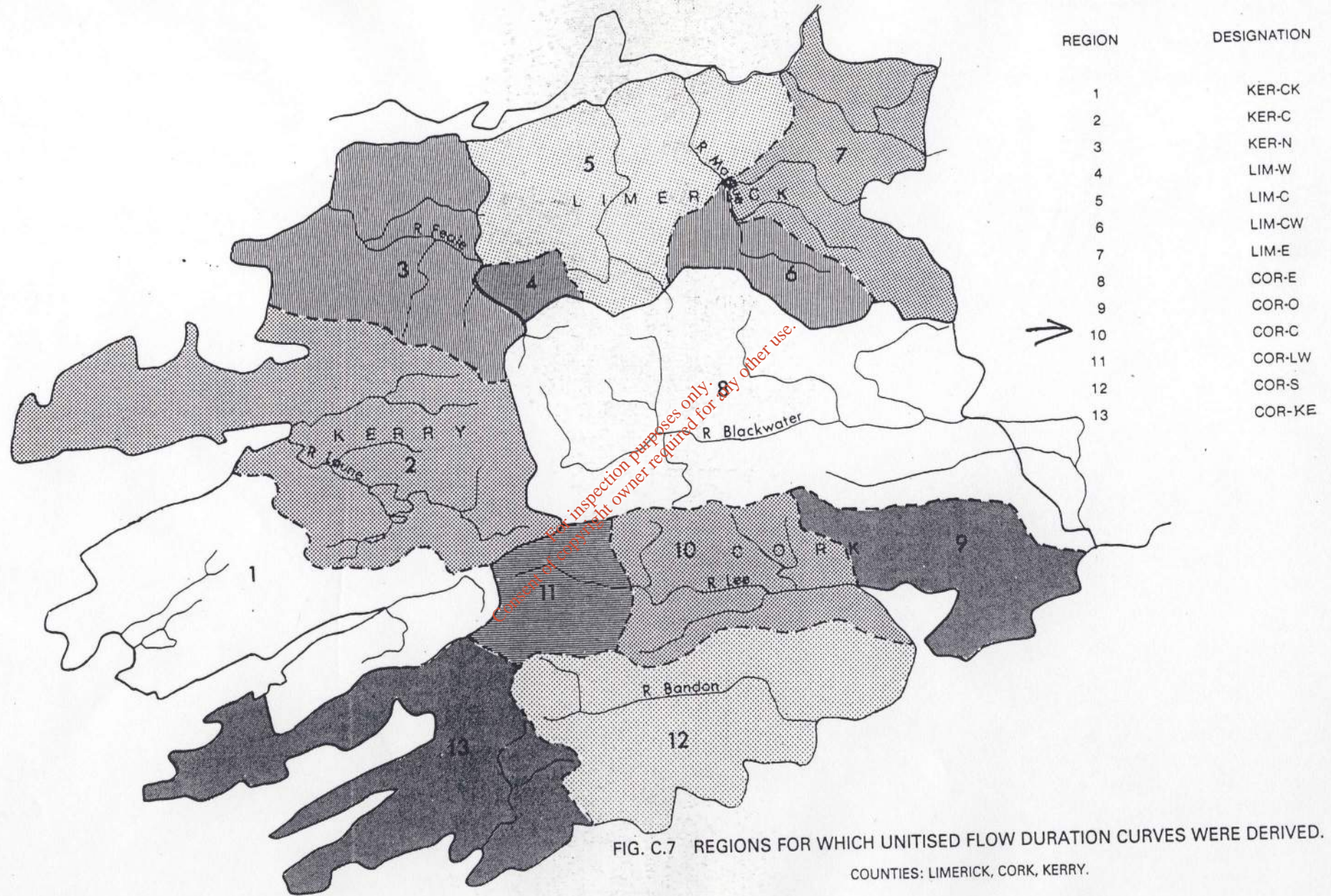


19015 + 19018

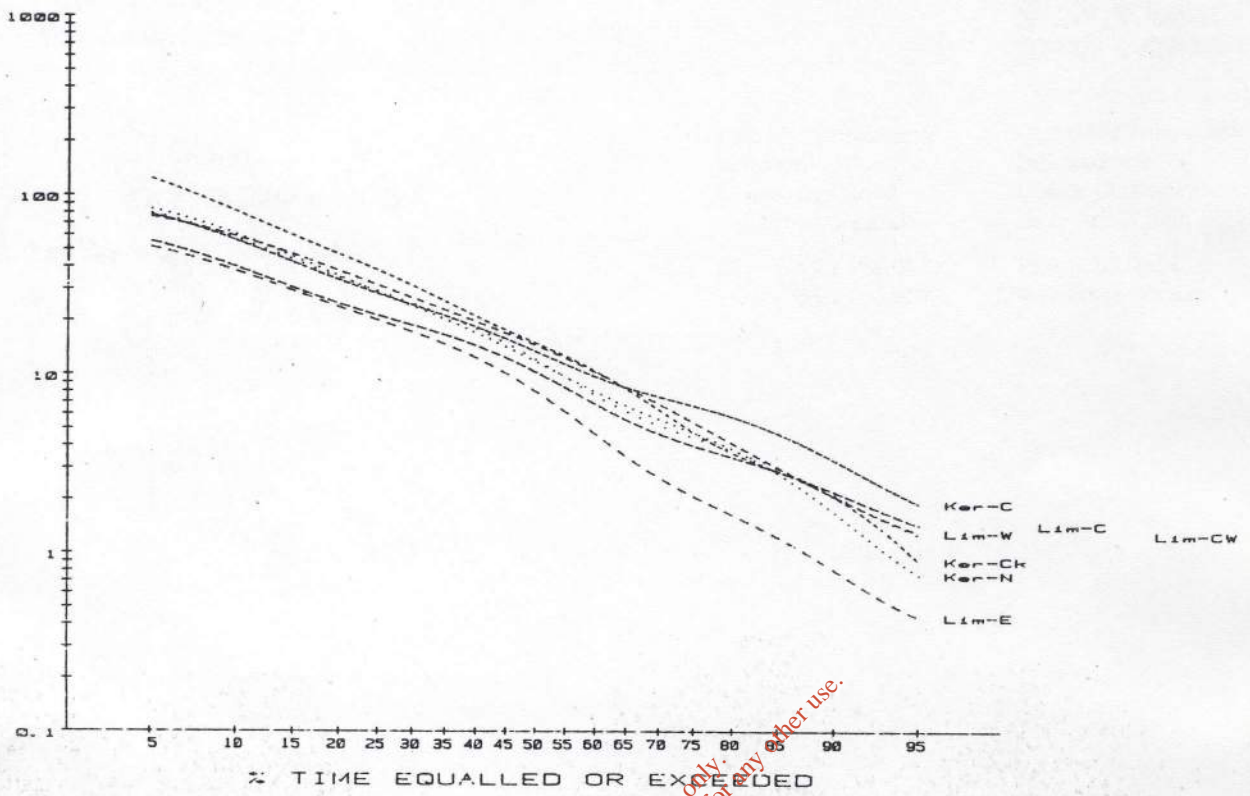
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| County | Regions | Designation | Stations Used |
|-----------|---------|---|--|
| Mayo | 4 | MAYO-M MAYO-H MAYO-S MAYO-W | 3401, 3403, 3410, 3424 3204 3007, 3424 3301, 3304, 3306 |
| Meath | 4 | MEA-S MEA-D MEA-N MEA-B | 0701, 0703, 0705, 0709, 0723 0625, 0626 0706, 0710, 0711, 0712, 0802 0807, 0901 |
| Monaghan | 5 | MON-A MON-G MON-D MON-F MON-N | 3678, 3679 0626 3616, 3618 0611 0351, 3615 |
| Offaly | 2 | OFF-B OFF-E | 2506, 2514, 2521, 2522 1404, 1405 |
| Roscommon | 1 | ROS | 2605, 2606, 2612, 2614 |
| Sligo | 1 | SLIGO | 3501, 3501, 3503, 3505, 3511 |
| Tipperary | 5 | TIP-S1 TIP-S2 TIP-SM TIP-NA TIP-NB | 1602, 1603, 1610 1605, 1606, 1607, 1612 1608, 1609 2525, 2527 2544, 2529 |
| Waterford | 1 | WAT | 1612, 1613, 1618, 1620, 1701, 1702 |
| Westmeath | 3 | WES-M WES-B WES-E | 2506, 2514, 2521, 2522 2513 0703, 0705, 0714, 0723, 1404 |
| Wexford | 3 | WEX-B WEX-R WEX-C | 1301, 1302, 1303 1101 1201, 1214, 1215, 1216 |
| Wicklow | 6 | WIC-S1 WIC-S2 WIC-CR WIC-R WIC-C WIC-M | 1213 1201, 1214 1214 1002 1017, 1101 0999, 1002, 1003, 1004, 1017 |

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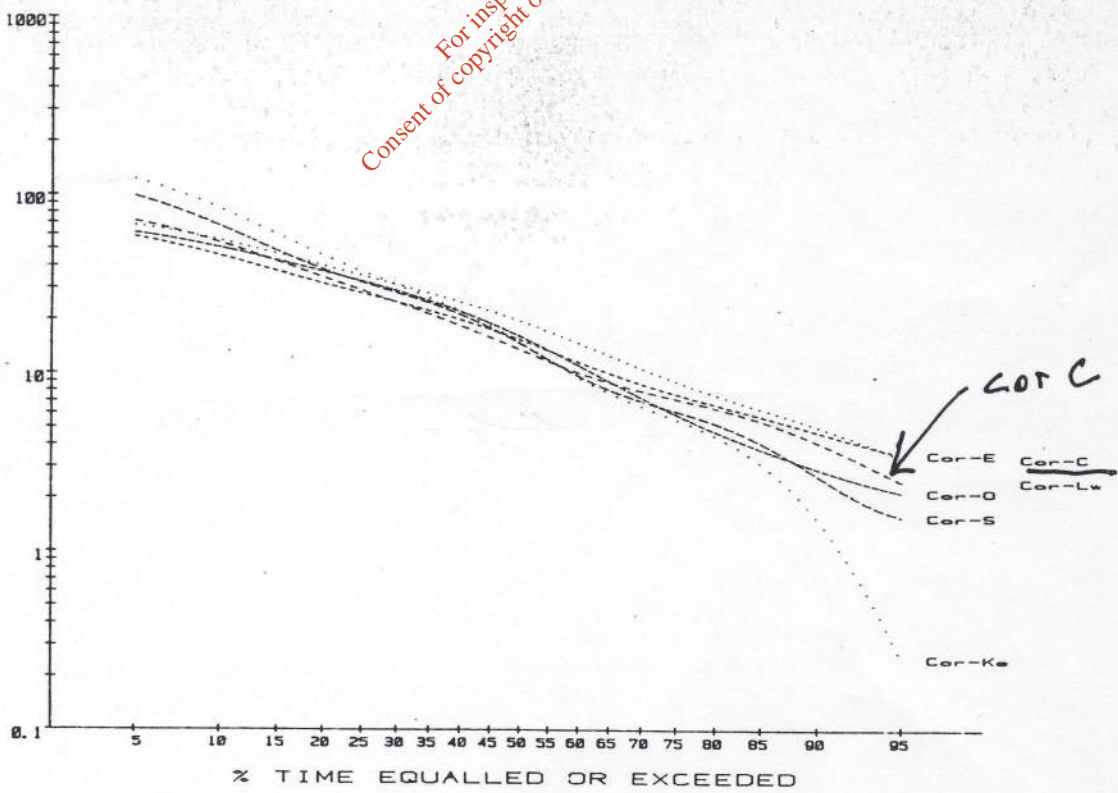


0 litres/second (per unit area (sq km))
(per unit rainfall (m/yr))



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0 litres/second (per unit area (sq km))
(per unit rainfall (m/yr))

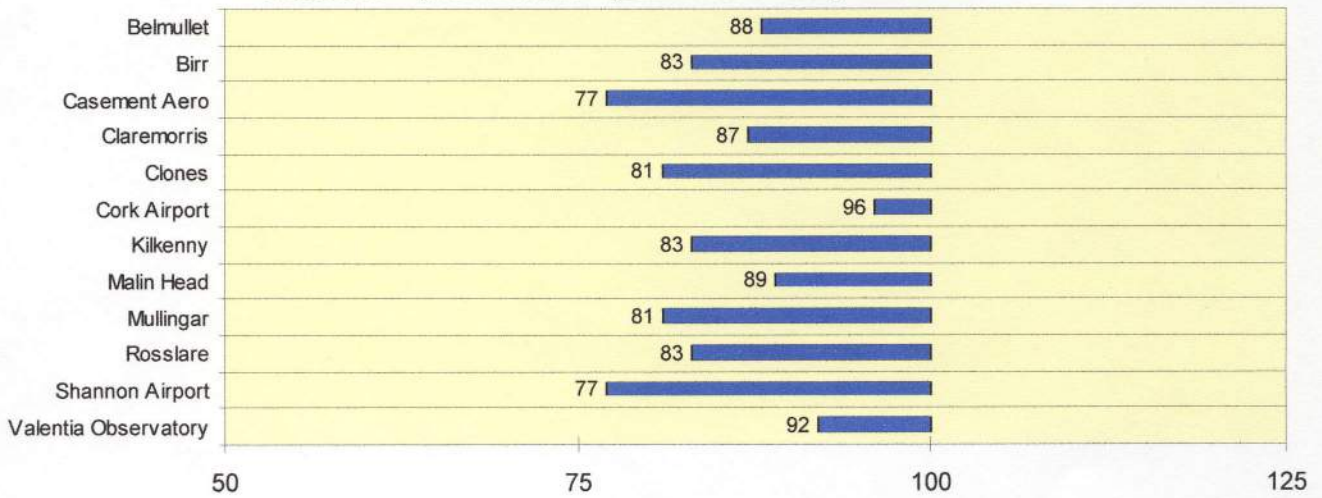


LOT C

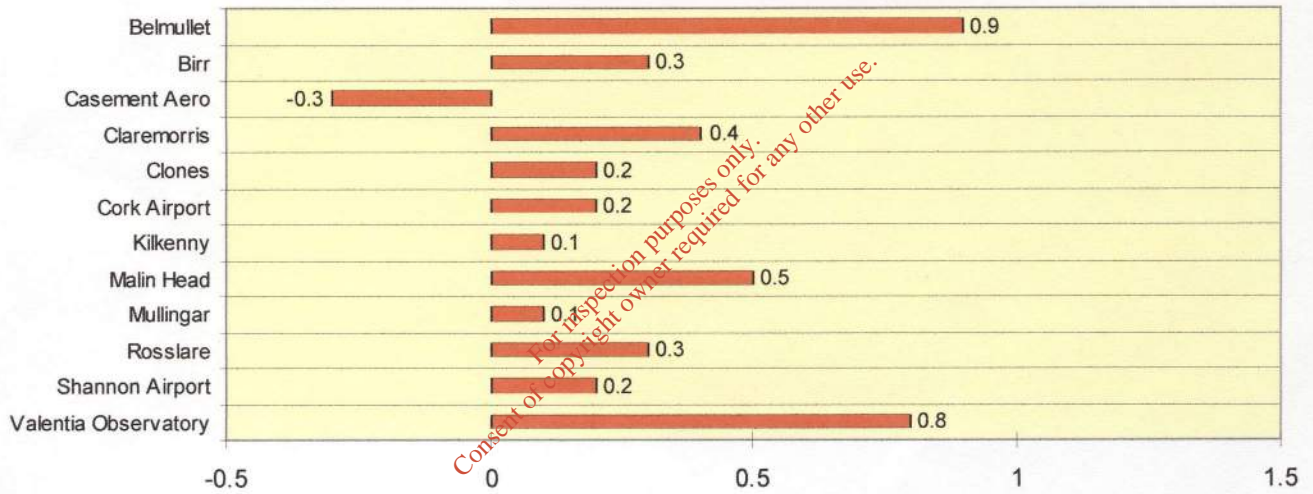
FIG. C8 UNITISED REGIONAL FLOW DURATION CURVES

November 2005 Percentage / Difference from 1961-90 monthly normals

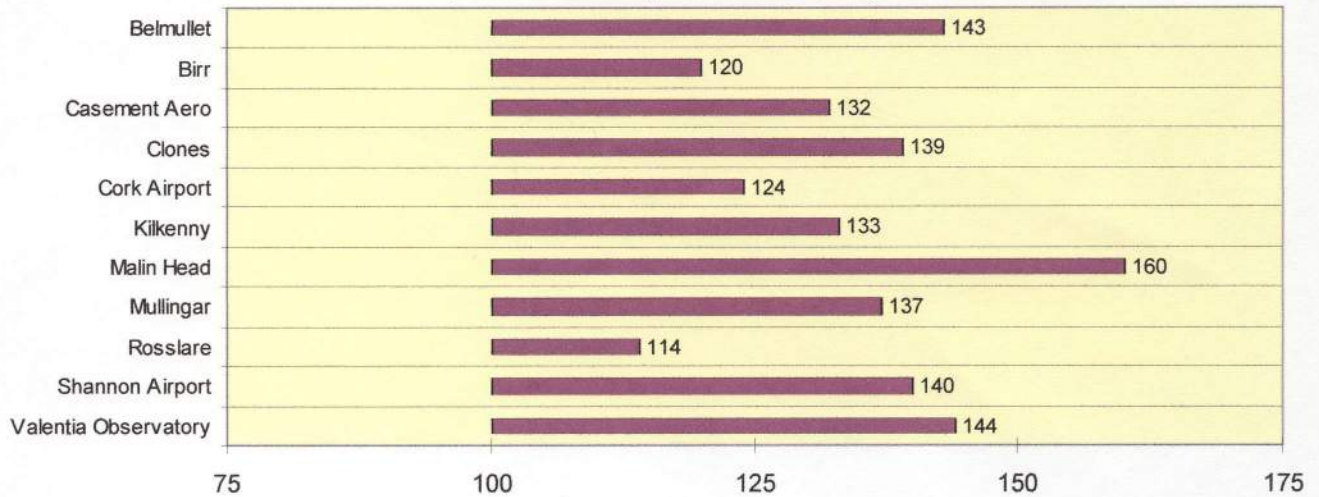
Rainfall (% of normal for period 1961-1990)



Temperature (°C difference from normal for period 1961-1990)



Sunshine (% of normal for period 1961-1990)





met.ie

The Irish Meteorological Service Online

03 January | Dublin | 12 Strong | Search:

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30 Year Averages

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- [Sea Area](#)
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- [Reports & Sea Crossing Forecast](#)
- [Inland Lakes](#)
- [Atlantic Charts](#)
- [3 Hour](#)

Please choose a 30 year average report from any station by clicking on the map or the links below:

- | | |
|----------------------------------|------------------------------------|
| 1 Belmullet | 8 Kilkenny |
| 2 Birr | 9 Malin Head |
| 3 Casement | 10 Mullingar |
| 4 Claremorris | 11 Roches Point |
| 5 Clones | 12 Rosslare |
| 6 Cork Airport | 13 Shannon Airport |
| 7 Dublin Airport | 14 Valentia |



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CORK AIRPORT
monthly and annual mean and extreme values
1962-1991

| TEMPERATURE (degrees Celsius) | jan | feb | mar | apr | may | jun | jul | aug | sep | oct | nov | dec |
|------------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| mean daily max. | 7.6 | 7.5 | 9.3 | 11.3 | 13.8 | 16.6 | 18.5 | 18.2 | 16.0 | 13.1 | 9.9 | 8.0 |
| mean daily min. | 2.6 | 2.5 | 3.1 | 4.2 | 6.5 | 9.2 | 11.1 | 10.9 | 9.4 | 7.5 | 4.5 | 3.0 |
| mean | 5.1 | 5.0 | 6.2 | 7.7 | 10.2 | 12.9 | 14.8 | 14.5 | 12.7 | 10.3 | 7.2 | 6.0 |
| absolute max. | 12.6 | 13.5 | 15.5 | 20.5 | 23.6 | 25.7 | 28.7 | 27.5 | 24.7 | 19.0 | 15.9 | 13.0 |
| absolute min. | -8.5 | -8.6 | -6.1 | -2.4 | -0.9 | 2.4 | 4.8 | 4.9 | 2.3 | -0.4 | -3.3 | -5.0 |
| mean no. of days with air frost | 6.7 | 5.6 | 3.4 | 1.8 | 0.1 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 2.4 | 3.0 |
| mean no. of days with ground frost | 15.0 | 12.7 | 12.0 | 9.4 | 2.9 | 0.2 | 0.0 | 0.0 | 0.4 | 2.6 | 9.5 | 12.0 |

Satellites

- [Ireland - IR](#)
- [Ireland - Vis](#)
- [Europe Nth Atlantic - IR](#)
- [Europe Nth Atlantic - Vis](#)
- [Full Disk - IR](#)
- [Full Disk - Vis](#)

| RELATIVE HUMIDITY (%) | jan | feb | mar | apr | may | jun | jul | aug | sep | oct | nov | dec |
|-----------------------|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|-----|
| mean at 0900UTC | 90 | 90 | 88 | 83 | 81 | 81 | 83 | 86 | 88 | 91 | 90 | 90 |
| mean at 1500UTC | 84 | 80 | 75 | 71 | 71 | 72 | 72 | 73 | 76 | 82 | 83 | 80 |

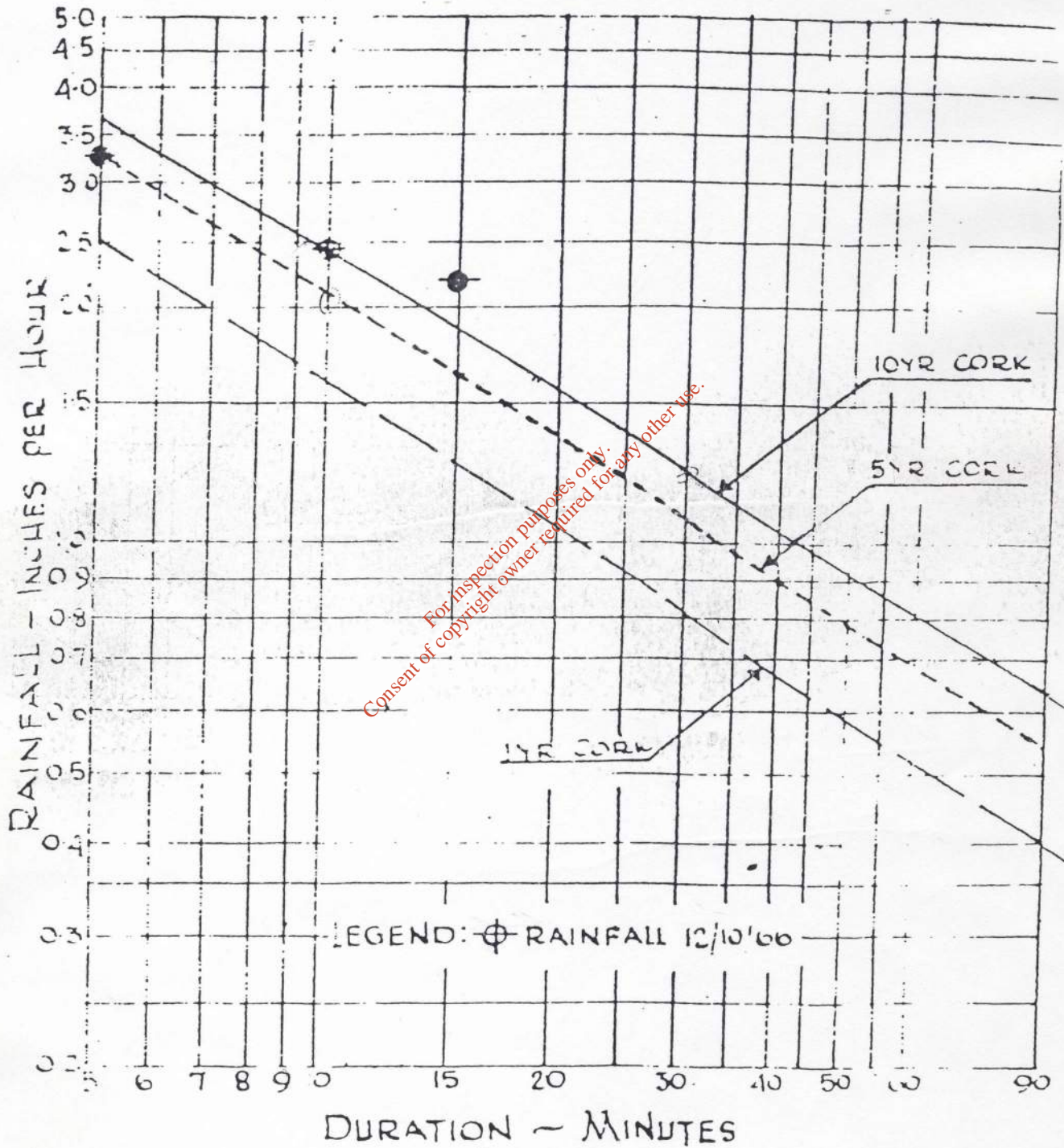
| SUNSHINE (hours) | jan | feb | mar | apr | may | jun | jul | aug | sep | oct | nov | dec |
|------------------------------|------|------|------|------|------|------|------|------|------|------|------|------|
| mean daily duration | 1.70 | 2.28 | 3.51 | 5.21 | 6.02 | 5.73 | 5.40 | 5.14 | 4.13 | 2.80 | 2.16 | 1.00 |
| greatest daily duration | 7.3 | 9.3 | 11.8 | 13.8 | 15.4 | 15.9 | 15.4 | 14.2 | 12.8 | 9.9 | 8.5 | 6.0 |
| mean no. of days with no sun | 11 | 9 | 6 | 4 | 2 | 3 | 2 | 2 | 4 | 7 | 9 | 10 |

Climate

- [Climate of Ireland](#)
- [Temperature](#)
- [Sunshine](#)

| RAINFALL (mm) | jan | feb | mar | apr | may | jun | jul | aug | sep | oct | nov | dec |
|--------------------|-------|-------|------|------|------|------|------|------|------|-------|-------|-------|
| mean monthly total | 138.3 | 115.6 | 98.7 | 67.7 | 83.4 | 68.8 | 66.4 | 88.7 | 96.4 | 125.4 | 111.1 | 130.0 |

CURVES TAKEN FROM PROF. E.C. DILLON'S
 PAPER "THE ANALYSIS OF 35-YEAR
 AUTOMATIC RECORDINGS OF RAINFALL
 AT CORK" I.C.E.I., 1954



CORK CORPORATION

PART SHOWING RAINFALL OF 12TH OCTOBER, 1966
 IN RELATION TO 1, 5 AND 10 YEAR RAIN STORM
 CURVES FOR CORK.

For how unseemly it is when you are speaking about
sewers to use high-sounding expressions.

CICERO, *Orator*, xxi.

THEORY, DESIGN, SPECIFICATION AND
CONSTRUCTION

A REFERENCE BOOK FOR CIVIL, MUNICIPAL, AND
SANITARY ENGINEERS AND A TEXT-BOOK FOR
STUDENTS

BY

EDWARD VAUGHAN BEVAN

Chief Engineering Assistant, Engineer's Dept., Harrow
Formerly Chief Main Drainage Assistant, Cardiff.

AND

BERNARD TREVELYAN REES

B.Sc., A.M.I.C.E., A.M.Inst.M. & Cy.E.

Diploma in Administration

Assistant City Planning Officer, Bristol

Formerly Principal Civil Engineering and Reconstruction
Assistant, Southampton.

SECOND EDITION

Fourth Reprint



LONDON

CHAPMAN & HALL LTD.

37 ESSEX STREET W.C.2

1950

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| Material of Sewer. | Condition of Surface. | | | |
|------------------------------------|-----------------------|-------|-------|-------|
| | Perfect. | Good. | Fair. | Bad. |
| Glazed stoneware pipe | 0.010 | 0.011 | 0.013 | 0.015 |
| Brickwork, ordinary | 0.012 | 0.013 | 0.015 | 0.017 |
| Brickwork, glazed | 0.011 | 0.012 | 0.013 | 0.014 |
| Rendering, cement mortar | 0.011 | 0.012 | 0.013 | 0.015 |
| Rendering, neat cement | 0.010 | 0.011 | 0.012 | 0.013 |
| Ashlar, dressed | 0.013 | 0.014 | 0.015 | 0.017 |
| Iron (cast) uncoated | 0.012 | 0.013 | 0.014 | 0.015 |
| Iron (wrought) and steel | 0.011 | 0.012 | 0.013 | 0.014 |

TABLE II

VALUES OF n ACCORDING TO PROFESSOR LEA, D.Sc.

| | n |
|---|----------------|
| Very smooth cement and planed boards | 0.009 to 0.01 |
| Smooth boards, bricks, concrete | 0.012 to 0.013 |
| Smooth, covered with slime or tuberculated | 0.015 |
| Rough ashlar or rubble masonry | 0.017 to 0.019 |
| Very firm gravel or pitched with stones | 0.02 |
| Earth, in ordinary condition free from stones and weeds | 0.025 |
| Earth, not free from stones and weeds | 0.030 |
| Gravel in bad condition | 0.035 to 0.040 |
| Torrential streams with rough stony beds | 0.05 |

TABLE III

VALUES OF n IN THE FORMULA OF GANGUILLET AND KUTTER, DETERMINED FROM RECENT EXPERIMENTS, ACCORDING TO PROFESSOR LEA, D.Sc.

| | n |
|---|--------|
| Rectangular wooden flume, very smooth | 0.0098 |
| Wood pipe 6 ft. diameter | 0.0132 |
| Brick, washed with cement, basket-shaped sewer, 6 ft. x 6 ft. 8 in., nearly new | 0.0130 |
| Brick, washed with cement, basket-shaped sewer, 6 ft. x 6 ft. 8 in., one year old | 0.0148 |
| Brick, washed with cement, basket-shaped sewer, 6 ft. x 6 ft. 8 in., four years old | 0.0152 |
| Brick, washed with cement, circular sewer, 9 ft. diameter, nearly new | 0.0116 |
| Brick, washed with cement, circular sewer, 9 ft diameter, four years old | 0.0133 |
| Old Croton aqueduct, lined with brick | 0.015 |
| New Croton aqueduct | 0.012 |
| Sudbury aqueduct | 0.01 |
| Glasgow aqueduct, lined with cement | 0.0124 |
| Steel pipe, wetted, clean, 1897 (mean) | 0.0144 |
| Steel pipe, 1899 (mean) | 0.0155 |

Kutter and Ganguillet :

| | n |
|--|-------|
| Channels lined carefully with planed boards or smooth cement | 0.01 |
| " " with common boards | 0.012 |
| " " " ashlar or neatly-jointed brickwork | 0.013 |
| " " " rubble masonry | 0.017 |
| " " " earth in brooks or rivers | 0.025 |
| Streams with detritus or aquatic plants | 0.03 |

Although the Kutter formula is cumbersome to manipulate, given a reliable value for n , the results obtained can be used with confidence.

It has been found that the variation of i produced only a small variation in the value of the coefficient C , and that if a slope of 1 in 1000 be taken as standard ($i = 0.001$) then the difference will not be appreciable.

This enables the coefficient C to be written as :

$$C = \frac{41.6 + \frac{1.811}{n} + \frac{0.00281}{0.001}}{1 + \left(41.6 + \frac{0.00281}{0.001}\right) \frac{n}{\sqrt{m}}}$$

and as m for any known pipe has a definite value, and if the value of n is also known, we can reduce the rather unwieldy form to a constant and thus arrive at the fundamental Chezy form $v = C\sqrt{mi}$. These constants for a comprehensive series of pipe sizes will be found in Table V ($n = 0.013$).

Example

Find the coefficient C in the Kutter and Ganguillet formula if the slope of the pipe which is running full is 1 in 1000, the diameter is 2 feet, and the material of the sewer is glazed stoneware in perfect condition (for then $n = 0.010$. See TABLE I). Then find the velocity in feet per second and the discharge in cubic feet per second.

$$\text{Hydraulic mean depth } m = \frac{A}{P} = D/4 = 2/4 = 0.5$$

$$\text{Hydraulic gradient } = i = \frac{1}{1000}$$

$$\text{Then } C = \frac{41.6 + \frac{1.811}{n} + \frac{0.00281}{i}}{1 + \left(41.6 + \frac{0.00281}{i}\right) \frac{n}{\sqrt{m}}}$$

The formula put forward by Manning took the form:

$$v = C \sqrt[3]{m^2 \sqrt{i}}$$

or

$$v = \frac{1.486}{n} \sqrt[3]{m^2 \sqrt{i}}$$

where n is the coefficient of rugosity according to Kutter.

CRIMP AND BRUGES.

This is the formula in most general use among engineers in this country and is as follows:

$$v = 124 \sqrt[3]{m^2 \sqrt{i}}$$

Observations carried out from time to time have justified its use. The convenient form allows the engineer to convert it into:

$$v = K^1 \sqrt{i} \text{ and } Q = K \sqrt{i}$$

By using the constants given in Table VIII and inserting values for \sqrt{i} , velocities and discharges for pipes from 6 inches to 60 inches diameter may be found.

If we consider in connection with the Manning formula, that C is equal to $1.486/n$, then there emerges the following comparison with the constant of the Crimp and Bruges formula:

$$124 = \frac{1.486}{n}$$

Therefore

$$n = \frac{1.486}{124} = 0.012,$$

so that the Crimp and Bruges formula is practically the same as the Kutter formula with a value of $n = 0.012$. Similarly, if we wish to use the formula with a value of $n = 0.013$ it is simple to arrive at the appropriate value of C by the above method; in this case it would be $C = 1.486/0.013 = 114.3$.

Diagrams for the easy use of the Crimp and Bruges formula are given farther on in this chapter.

Example

By using the Crimp and Bruges formula find the velocity and discharge per second of a 15-inch diameter pipe laid at a gradient of 1 in 100.

$$V = 124 \sqrt[3]{m^2 \sqrt{i}}$$

CIRCULAR PIPES

Crimp and Bruges Formula

Values of A , m , $\sqrt[3]{m^2}$, and K^1 (constant for Velocity) and K (constant for Discharge)

$$v = 124 \sqrt[3]{m^2 \sqrt{i}} \text{ feet per second}$$

| Diam. in Inches. | Area in Square Feet. | m in Feet. | $\sqrt[3]{m^2}$ | For Velocity in Feet per min. $v = K^1 \sqrt{i}$ | For Discharge in Cubic Feet per min. $Q = K \sqrt{i}$ | Diam. in Inches. |
|------------------|----------------------|--------------|-----------------|--|---|------------------|
| 6 | 0.1963 | 0.1250 | 0.2500 | 1,880 | 366 | 6 |
| 9 | 0.4418 | 0.1875 | 0.3276 | 2,440 | 1,076 | 9 |
| 12 | 0.7854 | 0.2500 | 0.3969 | 2,960 | 2,320 | 12 |
| 15 | 1.2272 | 0.3125 | 0.4605 | 3,420 | 4,200 | 15 |
| 18 | 1.7641 | 0.3750 | 0.5200 | 3,860 | 6,850 | 18 |
| 21 | 2.4053 | 0.4375 | 0.5763 | 4,280 | 10,320 | 21 |
| 24 | 3.1416 | 0.5000 | 0.6300 | 4,680 | 14,720 | 24 |
| 27 | 3.9761 | 0.5625 | 0.6814 | 5,060 | 20,160 | 27 |
| 30 | 4.9087 | 0.6250 | 0.7310 | 5,440 | 26,700 | 30 |
| 33 | 5.9396 | 0.6875 | 0.7790 | 5,800 | 34,420 | 33 |
| 36 | 7.0688 | 0.7500 | 0.8255 | 6,140 | 43,420 | 36 |
| 39 | 8.2958 | 0.8125 | 0.8707 | 6,480 | 53,740 | 39 |
| 42 | 9.6211 | 0.8750 | 0.9148 | 6,800 | 65,480 | 42 |
| 45 | 11.045 | 0.9375 | 0.9579 | 7,120 | 78,720 | 45 |
| 48 | 12.566 | 1.0000 | 1.0000 | 7,440 | 93,500 | 48 |
| 51 | 14.186 | 1.0625 | 1.0412 | 7,740 | 109,900 | 51 |
| 54 | 15.904 | 1.1250 | 1.0817 | 8,040 | 128,000 | 54 |
| 57 | 17.721 | 1.1875 | 1.1214 | 8,340 | 147,840 | 57 |
| 60 | 19.635 | 1.2500 | 1.1604 | 8,640 | 169,520 | 60 |

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$$\begin{aligned} \text{The hydraulic mean depth } m &= \frac{A}{P} = \pi/4 D^2 \div \pi D = D/4 \\ &= 0.3125 \end{aligned}$$

$$\begin{aligned} \sqrt[3]{m^2} &= 2/3 \log \text{ of } 0.3125 \\ &= 0.666 \times -0.50516 = -0.33677 \\ \text{Antilog } -0.33677 &= 1.66323 \\ &= 0.4605 \end{aligned}$$

Then

$$\begin{aligned} V &= 124 \sqrt[3]{m^2 \sqrt{i}} \\ &= 124 \times 0.4605 \times \sqrt{\frac{1}{100}} \\ &= 124 \times 0.4605 = 5.72 \text{ feet per second.} \end{aligned}$$

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SCOPE

The EIA addresses the following topics:

- Human Beings
- Air
- Flora
- Climate
- Fauna
- Landscape
- Soils
- Material Assets
- Water
- The Interaction of the Aforementioned

This development is 60% completed. This is referred to and illustrated as appropriate within the above topics.

FORMAT

Following Section One – Introduction and Section Two – The Development, Section 3 – Environmental Topics gives the environmental impact. The format used is the Direct Format Structure. This breaks down each of the topics above as follows:

- Description of the Environment
- Characteristics Affecting
- Residual Impacts

The interaction of the impacts is dealt with in a separate section. The impacts are summarized and an Impact Evaluation Checklist is included.

A Non Technical Summary is also included as required by the regulations.

Impacts are characterized as being positive, neutral or negative along with their duration and significance.

Diagrams, maps, and photographs referred to in the text are kept together at the end of the each topic.

GLOSSARY OF TERMS

QUALITY OF IMPACTS

- Positive Impact – a change which improves the quality of the Environment
- Neutral Impact – a change which does not affect the quality of the Environment
- Negative Impact – a change which reduces the quality of the Environment

SIGNIFICANCE OF IMPACTS

- Imperceptible Impact – capable of measurement but without noticeable consequences
- Slight Impact – causes noticeable changes in character of environment without affecting its sensitivities
- Moderate Impact – alters character of the environment in a manner that is consistent with existing and emerging trends
- Significant Impact – by its character, magnitude, duration or intensity alters a sensitive aspect of the environment
- Profound Impact – obliterates sensitive characteristics

DURATION OF IMPACTS

- Short Term – impact while work in progress
- Medium Term – impact for short number of year after completion of the works
- Long Term – impact lasting fifteen to sixty years

TYPES OF IMPACTS

- Cumulative – addition of many small impacts to create one larger, more significant impact
- Indeterminable – full consequences of a change in the environment cannot be described

- Irreversible – character, distinctiveness, diversity, or reproductive capacity of the environment is permanently lost
- Residual – degree of environmental change that will occur after the proposed mitigation measures have taken effect
- Synergistic – the resultant impact is of greater significance than the sum of its constituents
- ‘Worst Case’ – impacts arising from a development in the case where mitigation measures substantially fail

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PURPOSE OF THE DEVELOPMENT

The purpose of the development is to make land suitable for agricultural purposes by filling it with suitable material that requires to be wasted from other sites. The development serves a dual purpose:

- makes land valuable for agricultural use
- provides location for excavated material from other sites

It was proposed to do the above in a planned and safe manner. Prior to commencement, the proposed development was subject to the following:

- Planning Permission under the Planning Acts from Cork County Council
- Waste Management (Permit) under the Waste Management Acts from Cork County Council

The development received planning permission in 2007. Mallow Contracts Ltd was granted the Waste Management Permit in 2007. Work commenced in 2007.

In 2008, Mallow Contracts Ltd was obliged to apply to the EPA for a Waste License. This application was made in 2009. It is currently with the EPA.

The project is ongoing and over half completed. The initial projected period for the development was 3 years to completion. The development is dependent on ongoing building activity for its supply of material. This building activity has reduced markedly since commencement with the result that the overall project is taking longer to complete than was initially forecast.

The development was permitted to recover waste other than hazardous waste for recycling or reclamation. It was also permitted to treat any waste on land for agricultural or ecological benefit. Since Cork Co Council granted the permit, the EPA has been requested to include a number of non hazardous specific wastes as defined under the European Waste Catalogue. The waste categories are as follows: