SECTION THREE

ENVIRONMENTAL TOPICS

ENVIRONMENTAL TOPICS

HUMAN BEINGS

Existing Environment

Prior to commencement of the current project the site consisted of 70% marshy land with the remainder, a narrow strip along its west side partly usable for agriculture. After some 7 years of filling, over one half of the land is now recovered and usable for agriculture.

The site was and still is gated off and thus does not permit public access.

The site has been made more visible to adjacent motorists on the N20 Cork/Mallow Road by virtue of the land raising.

Characteristics Affecting

Economic

The project will make some 2.5 hectares of land available for agriculture. Prior to this the land had little agricultural value.

Facility for Disposal

The site has been used and will continue to be used until completed to accept excess excavation from building and various civil engineering activities in the region. At present it serves this very useful function as one of the few available sites between the north of Cork City and Mallow. This provides a necessary facility for builders and developers.

Traffic

The site requires additional lorry traffic entering and exiting the main N20 Cork/Mallow Road at a minor junction. The N20 Cork/Mallow Road is much used and has had a relatively high frequency of motor accidents over the years. The junction is well marked and visible on both sides for considerable distance. Since commencement there have been no incidents with lorries serving the site.

The minor road, of which the access to the site is, leads to Mourneabbey. This road was subject to a traffic survey prior to granting planning permission. The total no. of journeys taken on this road during operating hours in Sept 2006 was 279. The maximum number of vehicle entry/exits permitted is 30 per day. The purpose of this was to limit impact and ensure traffic build-ups at the junction did not occur.

Advance warning signs to oncoming traffic have been erected complying with planning conditions granted by Cork Co Council.

Railway

The proximity of the railway below and close to the ongoing large vehicles was a concern. The developer was required by the planning permission to erect a secure barrier across the opening above the railway line. This was to prohibit any trucks from exiting the road and going down onto the railway line.

Recycling

The project recycles pulverized stone for mainly agricultural use for roadways and hard-standing areas.

Residual Impacts

The residual impact will be the increased agricultural value of the lands.

Availability of pulverized stone for agricultural roadways and hard-standing areas.

Environmental Impact Assessment Mallow Contracts Site

Flora and Fauna Assessment Prepared by Dr. Mary O'Connor

The Receiving Environment

General Area

The general area in which the site is located is undulating and underlain for the most part by Old Red Sandstone ridges and inter-ridge river and stream valleys. Valleys support Lower Avonian shales and sandstones and the hills are principally old red sandstone. The Peastinagh and Martin Rivers and their minor tributaries principally drain the area. The principal underlying bedrock old red sandstone is covered by a layer of boulder clay in the area which produces rich pastureland and some arable land upon which the agricultural economy of the area is based.

The ecological interest of the general area is for the most part concentrated in the river and stream valleys, in particular steep valleys where remnant natural woodlands persist; but for the most part the land is improved agricultural grassland interspersed by hedgerows. This pattern is typical of a cultural landscape which supports only small remnant natural/semi-natural habitat patches (i.e. small woods, scrub, watercourses, etc.), which are scattered through a matrix of more intensively managed agricultural fields or urban areas and are thus separated by land which is inhospitable for many species (Opdam, 1997).

The overwhelming predominance of improved agricultural habitat in the vicinity of the site does not support a high degree of ecological interest. This is recognised by the scarcity of national and international conservation designations within the area of the proposed road corridors.

The Site

The site is located directly to the west of the main Mallow Cork Road and to the east of the main railway line. The site prior to development comprised an area of agricultural grassland bounded by hedgerows and treelines.

Prior to development the site consisted of marshy ground towards the roadway and slightly firmer ground toward the railway line. The marshy ground was very soft and waterlogged during winter months, with the summer months being slightly more passable. The principle benefit to be obtained in reclaiming this wet land is for agricultural uses.

The site is located in the area where the Peastinagh River and the River Martin rise. The Peastinagh River rises and flows north from the site, approx. 1km downstream it joins the River Clyda which eventually joins the River Blackwater. The River Martin rises and flows south from the site eventually joining the River Bride.

The Development

The project was completed in 3 phases working from the north. Ground would be made good, topsoiled and grassed at the end of each phase. Each phase involves the following steps:

- Strip topsoil and store
- Import material and then place, compacting in layers
- On achievement of elevation clear any top stone
- Allow to rest/consolidate
- Re-spread topsoil over the surface and rake
- Grassed at next suitable time of year
- Available for normal agricultural use

Statutory Designations

The development site lies entirely outside any area which possesses a European designation for nature conservation, i.e. candidate Special Area of Conservation (cSAC), or Special Protection Area (SPA) for birds. The site also lies outside any area designated as an area of national conservation interest.

The nearest areas carrying conservation designations include:

The Blackwater River SAC

The Shournagh River proposed NHA 000103

The Blarney Bog NHA

Any potential impact to the Blackwater River SAC is discussed in detail in the Screening for Appropriate Assessment for this development which is also provided.

Legal Protection

The National Parks and Wildlife Service (NPWS) is the statutory body with responsibility for the implementation of the Wildlife Act in Ireland under which NHA sites are designated, the local authorities also provide part of the chain of protection of these sites through recognition of such sites in the local development plans, e.g Cork County Development Plan.

Appropriately the NPWS should be kept informed at all times of the nature and progress of any proposed developments which may impact these sites and additional survey for these areas may be required by these bodies.

Under legislation, i.e. The Wildlife Act and Orders made there-under, certain birds, animals and plants whose habitat lies outside the aforementioned statutorily protected areas are protected species under the Wildlife Act and Flora Protection Order (see Appendix 4C for details).

Habitat and Flora Assessment

Habitat and flora species and communities recorded during the study were assessed in relation to their conservation importance.

The ecological impact of the development of the Mallow Contracts site centres primarily on:

- Direct habitat loss
- Habitat severance
- Habitat fragmentation
- Disruption to local hydrology

It is obvious that the greater the area of natural or semi-natural habitat directly in the area of the development the higher the level of impact on local ecology/biodiversity under the above headings.

Ecological evaluation and impact assessment were based upon guidelines set out by the National Roads Authority Guidelines (2005) (see Appendix 4A).

Occurrence of rare species

In consultation with the local Botanical recorders any species of rare occurrence regionally and within the study area were outlined.

No plant listed as protected under the Flora Protection Order (1999) was recorded from the footprint of the proposed route options during the course of the surveys.

Occurrence of protected habitats

No nationally or internationally designated habits occur or occurred at the site prior to development

Site Assessment and Survey

An initial site walkover was carried out in March 2014 and a follow up survey within the flowering period in May 2014. Habitat terminology follows Fossitt (2000). Habitat maps are included for before and after development with this report.

Existing Habitat and Habitat which occurred at the site prior to development

Agricultural Habitats (existing and existed prior to development)

Agricultural habitat, i.e. areas of Improved Grassland (GA1)

The principal habitat of the site is improved agricultural grassland which has been seeded over the entire site with perennial rye grass (*Lolium perenne*) Associated with this pasture are common weed species, thistles (*Cirsium* spp.), buttercups (*Ranunculus* spp.), docks (*Rumex* spp,) and clovers (*Trifolium* spp.).

Wet Grassland GS4 (existed at the site prior to site development)

Prior to the development of the site the areas adjacent to the water courses and low lying wet depressions at the site supported areas of of wet grassland which support the grasses, such as Timothy grass (*Phleum pratense*), Creeping Bent (*Agrostis stolonifera*), Rough Meadow-grass (*Poa trivialis*) and rushes Soft Rush (*Juncus effusus*). Forb species associated with the grassland vegetetation include, Buttercups (*Ranunculus. repens, R. acris*), Meadowsweet (*Filipendula ulmaria*), and Nettle (*Urtica dioica*). Creeping Buttercup (*Ranunculus repens*), Silverweed (*Potentilla anserina*), Sorrel (*Rumex acetosa*), Marsh ragwort (*Senecio aquaticus*) Chick-weed (*Stellaria alsine*) and Cuckooflower (*Cardamine pratensis*) occurred similarly to grassland still extant near the site.

Hedgerows WL1/Treelines WL2 (existing and existed prior to development)

Existing Hedgerows (WL1) and Treelines (WL2) along the site boundaries are generally good examples of their habitat types supporting a variety of shrub and tree species and providing an important network of wildlife corridor at the site evaluated as of Moderate-Low Locally Important conservation value. In general treelines within the area of the route corridor are dominated by Sycamore (Acer pseudoplantanus), Ash Beech (Fagus sylvatica) Poplar (*Populus* spp.), Ash (*Fraxinus excelsior*), Willows (*Salix* spp.) and occasional Oak (*Quercus robur*)

Hedgerows along the route corridor are very much dominated by Hawthorn (*Crataegus monogyna*). In addition Gorse (*Ulex europaeus*), Bramble (*Rubus fruticosus* agg.), occasional Elder (*Sambucus nigra*), and willows (*Salix* spp.).

Hedgerows also support climbing plants such as Ivy (*Hedera helix*), Honeysuckle (*Lonicera periclymenum*), Cleavers (*Galium aparine*) and tall grasses, including False Oat grass (*Arrhenatherum elatius*), Cock's-foot grass (*Dactylis glomerata*), False Brome (*Brachypodium sylvaticum*) ferns, and woodland herbs are also abundant.

Scrub WS1 (existing and existed prior to development)

Gorse Scrub occurs in the vicinity of the site. This scrub is dominated by European Gorse (*Ulex europaeus*), which gives almost total shade and thus suppresses the growth of ground flora species beneath. Other scrub species, which occur at the site include Bramble (*Rubus* Hawthorn (*Crataegus monogyna*), Bramble (*Rubus fruticosus* agg.) and Willow species (*Salix repens*). Some patches of willow (*Salix* spp.) scrub, also exist at the site. Small patches of gorse and willow scrub was lost as a result of the site development.

Dry meadows and grassy verges GS2 (existing and existed prior to development)

Along the road-side fringes of the existing road and along field boundaries the habitat Grassy verge is very commonly encountered. This habitat is dominated by the tussocky grasses False Oat-grass (*Arrhenatherum elatius*) and Cock's-foot grass (*Dactylis glomerata*). Other grasses include Yorkshire-fog (Holcus lanatus) and Smooth Meadow-grass (Poa pratensis). The herb component by tall species such as Hogweed (Heracleum sphondylium) Nettle (*Urtica dioica*), and Common Knapweed (Centaurea nigra). Scrambling plants also occur commonly in the grassy margin and include Bush Vetch (*Vicia sepium*).

Drainage Channel (Ditch) FW4 (existing and existed prior to development)

Along some field margins and adjacent to some of the hedgerows at the site linear water bodies or wet channels that are entirely artificial in origin occur. At the site such ditches contain some water (stagnant) and in some parts merely damp but still support wetland vegetation. As with canals drainage ditches must be maintained and cleared in order to keep them open. It is a part of the cyclical management routine for this habitat that the ditch is occasionally dredged to facilitate a functioning drainage channel.

Species which are found to occur within this habitat at the site are representative of a suite or wetland or aquatic species these include the following species;

Callitriche stagnalis, C. obtusangula,	starworts
Mentha aquatica	Water mint
Polygonum amphibium	Amphibious bistort

Bare ground ED2

This category includes areas of bare ground that are either very transient in nature, or persist for longer periods of time because of ongoing disturbance or maintenance. Bare ground of exposed soil is very transient at the site as the topsoil is consistently re-worked and spread and seeded.

Alien Species

There is no indication of spread of invasive species at the site as a result of the site works, i.e. no invasive species were found to occur within the footprint of the site development. This is in spite some such species occur in the greater area outside the site along the main Mallow-Cork Road.

Impact of Site Development to Habitats and Flora

The development resulted in the loss of some areas of habitat from the site, these areas of habitat were wet grassland, improved grassland and very small areas of hedgerow and scrub. A watercourse/drainage ditch was also diverted to a newly created drainage ditch on the site.

The majority of the habitats at the site can be considered to be of moderate or low local ecological value and the general impact was imperceptible or only very slightly negative resulting from the permanent ecological change to the site.

No habitat which is considered to be of high ecological value exists or existed at the site i.e. no nationally or internationally protected habitat.

Site Evaluation Scheme (National Roads Authority, 2006).

Rating	Qualifying criteria
	Internationally Important
A	Sites designated (or qualifying for designation) as an SAC* or SPA* under the EU Habitats or Habitat and flora Directives. Undesignated sites containing good examples of Annex I priority habitats under the EU Habitats Directive.
B	Nationally Important Sites or waters designated or proposed as an NHA* or Statutory Nature Reserve. Undesignated sites containing good examples of Annex I habitats (under EU Habitats Directive). Undesignated sites containing significant numbers of resident or regularly occurring assemblages of Annex II species under the EU Habitats Directive or Annex I species under the EU Habitat and flora Directive or species protected under the Wildlife (Amendment) Act 2000.
C	High Value, Locally Important Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or significant assemblages of locally rare species. Sites containing any resident or regularly occurring assemblages of Annex II species under the EU Habitats Directive or Annex I species under the EU Habitat and flora Directive.
D	Moderate Value, Locally Important Sites containing some semi-natural habitat or locally important for wildlife.
E	Low value, locally important Artificial or highly modified habitats with low species diversity and low wildlife value.

SAC = Special Area of Conservation; SPA = Special Protection Area; NHA = Natural Heritage Area.

Impact Assessment Matrix (National Roads Authority, 2006).

Table 1 Impact Assessment Matrix (National Roads Authority, 2006).

Impact Level	A Sites Internationally Important	B Sites Nationally Important	C Sites High Value, Locally important	D Sites Moderate value, Locally important.	E Sites Low Value, Locally Important
Severe (Profound) Negative	Any permanent impacts	Permanent impacts on a large part of a site.			
Major (Significant) Negative	Temporary impacts on a large part of a site	Permanent impacts on a small part of a site	Permanent impacts on a large part of a site		
Moderate Negative	Temporary impacts on a small part of a site	Temporary impacts on a large part of a site	Permanent impacts on a small part of a site	Permanent impacts on a large part of a site	
Minor (Slight) Negative		Temporary impacts on a small part of a site	Temporary impacts on a large part of a site	Permanent impacts on a small part of a site	Permanent impacts on a large part of a site
Neutral (Imperceptible)	No Impacts	No Impacts	No Impacts	No Impacts	Permanent impacts on a small part of a site
Minor (Slight) Positive				Permanent beneficial impacts on a small part of a site	Permanent beneficial impacts on a large part of a site
Moderate Positive			Permanent beneficial impacts on a small part of a site	Permanent beneficial impacts on a large part of a site	

Major (Significant) Positive		Permanent beneficial impacts on a small part of a site	Permanent beneficial impacts on a large part of a site		

Table 2 Habitat Assessment

Habitat Type	Value	Area Lost	Impact	Mitigation
Wet Grassland	D Sites Moderate value, Locally important	Small area less than one sixth of site area	Minor Slight Negative	None required
Improved Grassland	E Low Value	N/A	No Impact	None required
Scrub	D Sites Moderate value, Locally important	Very small area	Minor Slight Negative	Natural scrub maintained where possible Disturbance not allowed from March-September
Hedgerow treeline	D Sites Moderate value, Locally important	Very small area	Minor Slight Negative	Hedgerows retained where possible New boundary planting carried out Disturbance not allowed from March-

				September
Drainage Ditch	D Sites Moderate value, Locally important	Circa 350m	Minor Slight Negative	Water flow diverted to another channel

Impact to designated areas

No impact occurred directly to any designated area as a result of the site development.

Any potential impact to the Blackwater River SAC is discussed in detail in the Screening for Appropriate Assessment for this development which is also provided, where a finding of no significant impact is concluded.

Mitigation

Mitigation for Habitats and Flora is outlined in Table 2 above. Appropriate species for boundary planting are hawthorn, willow and birch.

Assessment of Wild Birds

As part of the ecological assessment for the Mallow Contracts Site this section examines the avian interests of the site. Bird communities and important habitats for birds were assessed.

The site is not directly adjacent to any area of ecological designation (NHA, SAC or SPA)

Desk-top Studies and Field Surveys

The avian ecological assessment was carried out using a simplified methodology incorporating a combination of consultation and field-based survey. Desk-top studies were as follows:

- Consultation with statutory consultee in relation to the avian ecology of the site
- Review of designated sites in the vicinity of the development site and their qualifying interests.

Field survey was undertaken during May 2014. During the field surveys, all birds that were observed or heard (i.e. bird songs or calls) were recorded together with a note of the habitat type within which they were situated.

Surveys were undertaken at in the morning before 11:00.

Following the above procedure it was possible to identify the important ecological resources for birds within the site or forming the boundary of the site

Bird species names are given in English within the text. Habitat codes follow Fossitt (2000).

Assessing the Conservation Importance of Birds

Bird species and communities recorded during the study were assessed in relation to their conservation importance. The conservation importance of a bird species relates largely to its population status either within its breeding and/or wintering range. Bird species of conservation importance may be listed within one or any of the following:

- Council Directive of 2 April 1979 on the Conservation of Wild Birds (79/409/EEC) ('Birds Directive'): The directive applies to the birds, their eggs, nests and habitats.

- Irish Red Data Book - Vertebrates (Whilde, 1993): This book uses criteria laid down by the International Union for the Conservation of Nature and Natural Resources (IUNC). Species are listed as Extinct (Ex), Endangered (E), Vulnerable (V), Rare (R) or Indeterminate (I). Taxa that are common and/or widespread within Ireland but are considered to be rare or threatened in Europe are also listed (II).

- Birds of Conservation Concern in Ireland (Newton *et al.*, 1999): This document, by BirdWatch Ireland and RSPB Northern Ireland, presents a priority list of bird species within Ireland and was published in 1999 as a new framework for bird conservation in Ireland, updating Whilde (1993). The list is divided into Red List Species of high conservation concern e.g. species that have undergone significant population declines (>50%) since 1900. Amber List Species are defined as having medium conservation concern e.g. species whose breeding population has declined by 25-50% in the past 25 years. Green List Species are species whose conservation status is presently considered as favourable.

Ecological Evaluation

Ecological evaluation and impact assessment were based upon guidelines set out by the National Roads Authority Guidelines (2005) and following criteria described in Appendix 3A. Terminology follows the EPA (2003).

Impact to Wild Birds

At the site there was a minimal loss of scrub and hedgerow habitat and loss of some patches of wet grassland. It can be concluded that there was a slight negative impact to birds at the site. However the occurrence of an abundance of these habitat types in the adjacent area and the maintenance of good areas of scrub associated with the railway line and the western portion of the site will facilitate a continued good population of bird species at the site. This is represented by the number of birds recorded on site during the May 2014 walkover survey. The turning over of top-soil also benefits some bird species such as blackbirds and thrushes.

Mitigation

It is recommended that wherever possible on site scrub and treeline/hedgerow habitat is retained and some additional planting carried out where possible, suitable species include hawthorn, willow and birch.

Hedegrows, treelines and scrub are not to be cut back or removed on site during the bird nesting season March-September.

TABLE 3 Bird species recorded and potentially present within habitats of the site

Habitat Type	Bird Species recorded during field surveys	Additional bird species that have the potential to be present within the habitats
Agricultural Grasslands incl. Improved Agricultural Grassland (GA1) and Wet Grassland (GS4)	Pheasant Magpie Jackdaw Rook Starling	Skylark Linnet Meadow Pipit Yellowhammer Hooded Crow
Hedgerows/Treelines (WL1/WL2)	Woodpigeon Wren Robin Song Thrush Blackbird Chaffinch Magpie Jackdaw	Linnet Common Whitethroat Dunnock Long-tailed Tit Mistle Thrush Great Tit Blue Tit Goldfinch Rook
Scrub (WS1)	Wren Robin Dunnock Blackbird Jackdaw Magpie Rook Chaffinch	Blue Tit Common Whitethroat Stonechat Goldfinch

Mammals

The time of year of survey was not appropriate for a full mammal survey of the site however because of the occurrence of suitable habitat on site it is likely that the following species occur within or utilize the area of the development.

Wood Mouse

Pygmy shrew

Rabbit

Hedgehog

Fox

Bat species

It is likely that pipistrelle bat species may utilise the area of scrub adjacent to and within the site.

There is no indication of badger setts in the area and the main area of semi-natural habitat lost to the development i.e. the areas wet grassland would not have provided a suitable sett or significant forage area for badgers.

Impact to Mammals

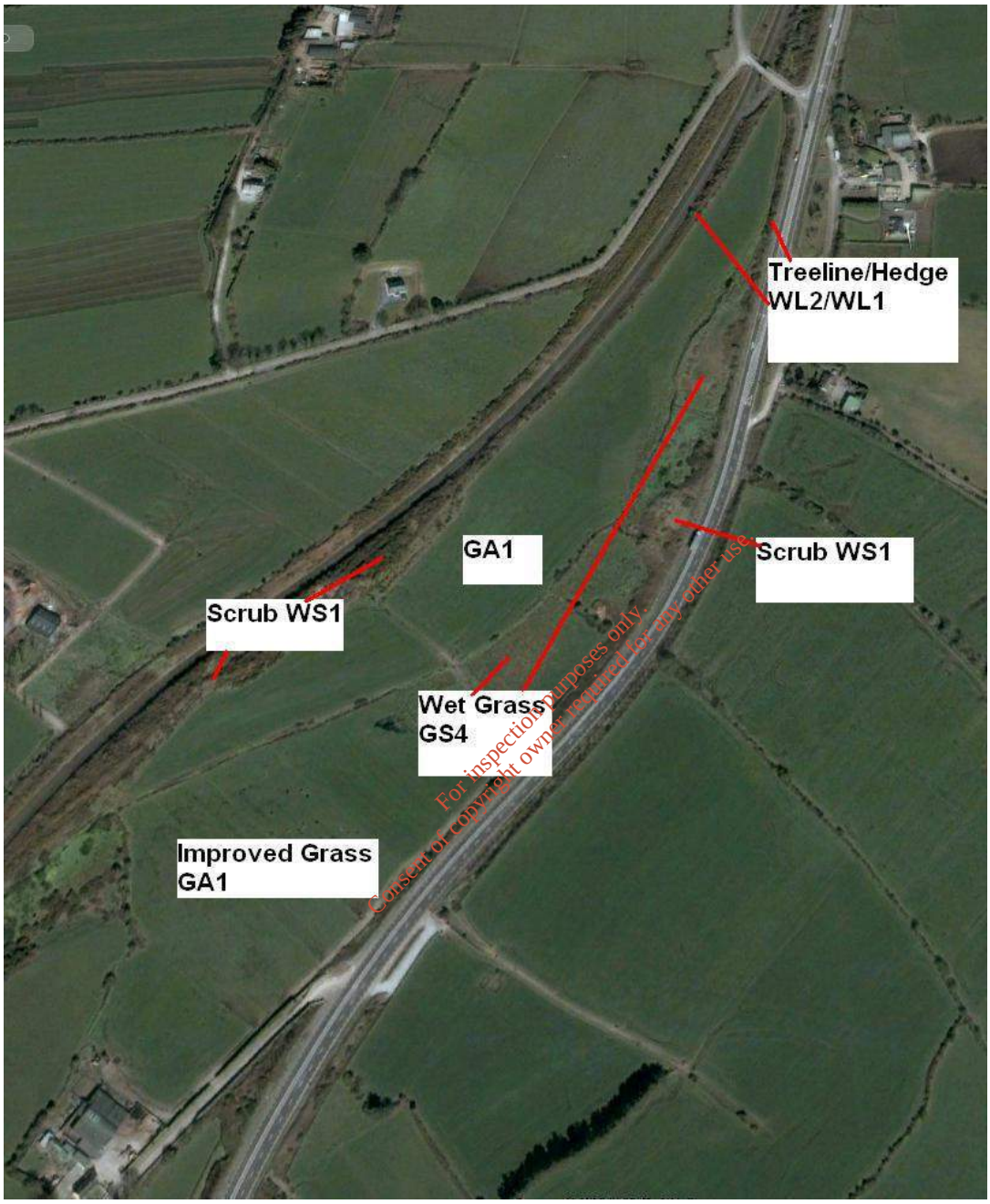
Conservation of mammals at the site is intrinsically linked to the maintenance of areas of suitable habitat at the site, in particular scrub, tree lines, and hedgerows.

Open habitat has been retained at the site in fields of the works and will provide continued open habitat for species. There is a substantial retained area of scrub also at the site in particular along the western fringes of the site and along the steep Cork Mallow railway line embankment. Boundary Treelines and hedgerows have also been retained. It can thus be concluded that the site development had a slight negative impact to mammals but that this impact was lessened by the maintenance of the most part of the boundary treelines and scrub at the site.

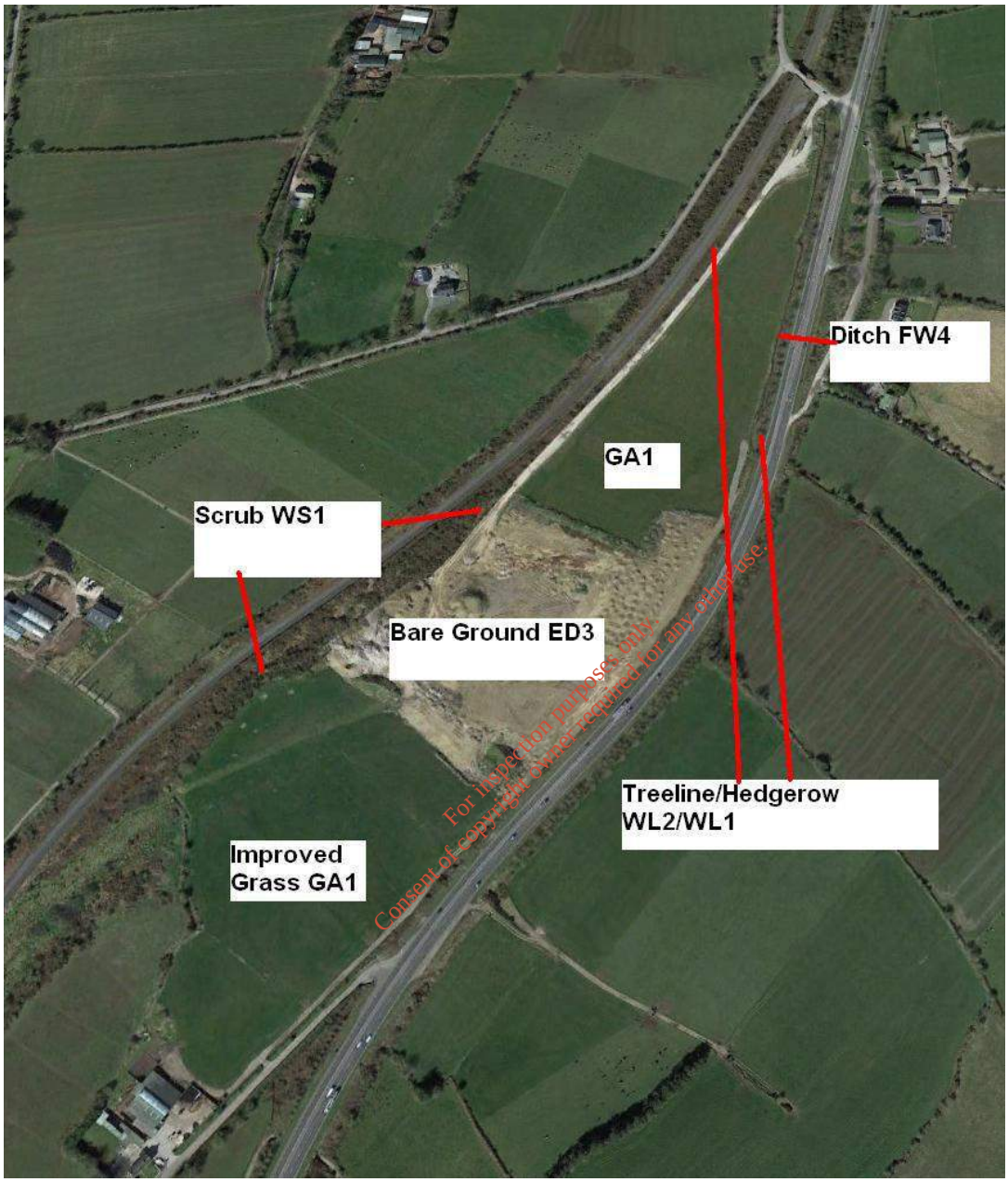
Mitigation

It is recommended that wherever possible on site scrub and treeline/hedgerow habitat is retained and some additional planting carried out where possible, suitable species include hawthorn, willow and birch.

Appendix 1 Habitat Map for Site of Mallow Contracts Before Development 2006



Appendix 1 Habitat Map for Site of Mallow Contracts Post Development 2013



Appendix 3 Site Photographs

Photo 1 Scrub at Mallow Contracts Site

Photo 2 Overview of Mallow Contracts Site

SOILS

Existing Environment

The west side of the site was moderately good grassland showing some ponding. The east side of the site was unusable for agriculture as it was wet with some reeds and thick growth. Currently more than half of the ground has been raised and completed. It has been topsoiled with soil removed from the original ground. It is in agricultural use.

Characteristics Affecting

The ground throughout is being raised by up to 3m with original topsoil replaced on it. The overall drainage will be markedly improved and the surface will be usable throughout for agriculture.

Residual Impact

The original heavy wet land will be up to 3m below the surface. The surface will be drier and usable for agriculture.

Attachments

- Proposed Levels

NOTES:
THE CAPACITY OF THE FACILITY IS APPROXIMATELY 110,000m3

IT IS PROPOSED SOME CONSTRUCTION AND DEMOLITION MATERIAL (APPROX 10000-12000m3) WOULD BE STRATEGICALLY PLACED TO MAXIMISE ITS DRAINAGE CAPACITY THEN THE LAND WOULD BE FILLED TO DESIRED LEVEL WITH CLEAN SUBSOIL/ROCK.

A NEW DRAINAGE DITCH AS SHOWN, RUNNING PARELELL WITH THE ROAD WOULD BE EXCAVATED AT THE LEVELS SHOWN. THIS WOULD ENSURE ALL SURFACE WATER RUNOFF WOULD BE DIRECTED TO THE STREAM.

AFTER WHICH TOPSOIL WOULD BE LAID BACK ON TOP AND RESEEDED WITH GRASS.

STOCK PROOF FENCING WOULD THEN BE ERECTED TO ENSURE THE AREA WOULD BE PUT BACK INTO AGRICULTURAL USE.

NOTES:
IT IS PROPOSED THE LAND WOULD BE ACCESSED FROM ONE AREA ONLY.

THE IMPORTANCE OF KEEPING THE PUBLIC ROAD CLEAN AT ALL COSTS IS THE DESIRED OBJECTIVE. IT IS PROPOSED THAT WHILE MATERIAL IS BEING PLACED IT WOULD BE TIPPED FROM THE ROAD GOING VEHICLE FROM A RAISED SURFACE, THUS KEEPING THE VEHICLES TYRES CLEAN.

A FIELD BASED 360° EXCAVATOR WOULD MOVE THE MATERIAL AS REQUIRED TO ALLOW A BULLDOZER TO PUSH THE FILL OVER THE FIELD COMPACTING THE IMPORTED MATERIAL TO THE REQUIRED LEVELS.

A RAISED ACCESS ROAD WOULD BE MADE FROM SUITABLE STONE FILL AS REQUIRED. THE ROAD WOULD BE OF A SHAPE AND ELEVATION ABOVE THE FIELD LEVEL AS TO PREVENT WATER LODGING AND ALLOW THE VEHICLE CLEAN AND SAFE PASSAGE.

THE SITE WOULD BE SECURLY LOCKED AND A RESTRICTED ACCESS POLICY WOULD BE IN PLACE.

SITE NOTICE (ON PILLAR)

TBM 137.660H

TBM Value = 137.660m
NOTE ALL LEVELS RELATED TO O.S. ROAD CENTRE SPOT

EXISTING ACCESS WIDENED AND SPLAYED BACK TO ALLOW SAFE ACCESS

GATE

COPPICE TREES TO 1.2M OVER ROAD LEVEL AND TRIM REMAINING BRANCHES

COPPICE TREE TO 1.2M OVER ROAD LEVEL AND TRIM REMAINING BRANCHES

RAILTRACK

CONIFER PLANTATION

ROAD SAFETY BARRIER

EDGE OF TARMAC

TOP OF EMBANKMENT TO EXISTING STREAM

EXISTING ROADWAY TO BE RAISED WITH SUITABLE STONE FILL TO PROVIDE SAFE ACCESS ROAD

EXISTING ROADWAY TO BE RETAINED BUT RAISED WITH SUITABLE STONE FILL TO PROVIDE SAFE ACCESS ROAD

NEW DRAINAGE DITCH TO FLOW IN OPPOSITE DIRECTION TO EXISTING

MALLOW

N20

OVERHEAD POWER LINES ARE SHOWN APPROXIMATELY

POSITION OF CONSTRUCTION & DEMOLITION WASTE TO INCREASE THE SITES DRAINAGE ABILITY

EXISTING FARM ROADWAY TO BE RAISED WITH SUITABLE STONE FILL AS REQUIRED.

THE ROAD WOULD BE OF A SHAPE AND ELEVATION ABOVE THE FIELD LEVEL AS TO PREVENT WATER LODGING AND ALLOW THE VEHICLE CLEAN AND SAFE PASSAGE.

NEW DRAINAGE DITCH TO PEASTINAGH RIVER

CORK

CONSTRUCTION OF BUND AT LOWEST POINT TO CONTAIN SOILED WATER RUNOFF - SETTLED MATERIAL TO BE EXCAVATED OUT AT INTERVALS OR AFTER HEAVY RAIN. BUND TO BE DEMOLISHED AND ORIGINAL INTENDED LEVELS REINSTATED WHEN COMPLETED.

DRAINAGE DITCH TO MARTIN RIVER

150MM PLASTIC PIPE OUTFALL INTO EXISTING STREAM

3	AE	2/01/2009	FOR IPPC APPLICATION
2	KT	15/12/2006	ROAD NOTE ON RAILROAD REMOVED
1	KT	25/08/2006	FOR PLANNING PERMISSION
0	MB	15/12/2005	INITIAL ISSUE
REV.	DRW.	DATE	DESCRIPTION

MB PRECISION
LAND, SITE & BUILDING SURVEYORS, SITE CONTROL, SETTING OUT, GPS, CIVIL ENGINEERING
FERMOY, BALLYHOOREY, WATERFALL, CORK.
TEL: 021-4865551 FAX: 021-4865556 PH: 087-6139953 e-mail: mb@eircom.net

CLIENT: MALLOW CONTRACTS LTD

JOB TITLE: APPLICATION FOR WASTE MANAGEMENT PERMIT AT LISSARD & BALLYHILLOGE, MOURNABBY MALLOW, CO. CORK.

DRAWING TITLE: PROPOSED LEVELS

SCALES: 1=750 | DRAWN: MB SURVEYS MB | DATE: 12/12/2005

DRG NO. 3 | PG.

100.000M
SCALE: 1=750 (FIT ON A1)

WATER

Existing Environment

The area is in the rises of both the River Martin and the River Peastinagh.

The River Martin flows southwards from the area. The channel at the southern end of the site is approximately 1.5m wide and 0.3m deep. Flow is slow. The biological water quality rating recorded by the EPA was 'good' in 1990, at station Lissavoura, 1.5km downriver of the site. A more recent survey in 1994 indicated satisfactory conditions at Rathduff, some 3.5m down downriver.

The River Peastinagh flows northwards from the area. The contributing channel in the land filled area is low flowing and ponded. There are no biological ratings recorded on the river. There are no references to the River Peastinagh in the ERU reports. They refer to the River Clyda which the River Peastinagh flows into 3km downstream of the site. The reach of the River Clyda into which the Peastinagh flows was identified with an EPA quality rating (Q) of 4 in 1990. The 1994 survey indicates satisfactory conditions at the confluence with the River Clyda.

The ponded area is located roughly 2/3rd of the distance down the site. This indicates rising water. This is close to a high point in a 3km reach with a number of springs. These springs are sources of the River Peastinagh and River Martin.

The Aquifer and Vulnerability Maps of the region are attached. The underlying aquifer is Pu – 'Poor aquifer, generally non productive'. It is not used for well water supply. The vulnerability of this aquifer is generally high with some extreme. This is due to limited cover or overburden.

Characteristics Affecting

The construction of the raised land involved maintaining the free-flow passage in the existing channel. T his was done by open joint piping and large stoning on the bed of the channel. They

were both overlain with geotextile Terram to keep placed soil out of the channel and to allow drainage into the channel.

Immediately outside the raised area, a grit interceptor was located both north and south of the landfill. This removed grit particles entering the channel during construction of the landfill. This is serviced regularly to ensure effectiveness. When the land is raised and grassed there is no further requirement for the interceptor. That is the current position with the northern interceptor as this area is now completed.

The southern interceptor discharged to the vegetated slow moving drainage ditch outside the land filled area which ran southwards to an open channel by the railway. The vegetated drainage ditch is now stoned and soiled over by the landowner. The southern portion of the landfill is stanked. Surface run-off seeps through the ground to the stone filled drainage ditch.

There is no runoff change from the development. There has been no noticeable change in the spring water quantity flowing to the rivers from the area raised.

Well and drain analyses was recently carried out both north and south of the landfill. Results and sampling locations are attached. The well water quality does not show any impact. The northern drain similarly indicates no impact. The southern 'drain' is very low flowing but does indicate slight impact. The reason for this is the elimination of the interceptor while the work in the southern area continues. The interceptor should be installed to reduce solids to normal run-off for agricultural land.

Residual Impacts

Noticeable solids in southern run-off at present. Same to be eliminated by interceptor.

Attachments:

- Impact on Peastinagh and Martin River Catchments
- Overall Channel Drainage
- Sundry Details
- Monitoring Points
- Well and Drain Analysis & Sample Locations Map

mescal & associates

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 Peastinagh 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 Peastinagh of :

   80 l/s x 1261/1000 x 0.84 / 1.0 = 0.084 m3/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
   Tc = 0.65 km @ 1 m/s = 10.8 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 m2 x 60/ 1000 x 1 hr / 3600 secs = 0.216 m3/s

4. The total max flow is therefore

   0.084 (runoff from total area) + 0.216 (runoff from roadway) = 0.3 m3/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 :

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

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 , (new route)
V = 1.9 ft/s = 0.58 m/s
Q = VA = 0.58 m/s x 0.3 m x 2.0 m = 0.348 m3/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 m/s x 0.3 m x 1.5 m = 0.60 m3/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 ft/s = 1.52 m/s
Q = VA = 1.52 m/s x 0.6 m x 0..38 m = 0.34 m3/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 x r x i

V = 2.85 f/s = 0.87 m/s
Q = VA = 0.87 m/s x 4.0 m x 0.3 m = 1.04 m3/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 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 Peastinagh 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 Peastinagh 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 l/s x 1261/1000 x 0.75/1.0 =0.076 m3/s

Similar to 3 above . Total paved area in catchment is 0.010 sq.km.
Time of concentration to crossing is estimated as
Tc =0.70 km@1 m/s = 11.7 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 m2 x 53/1000 x 1hr / 3600 secs = 0.110 m3/s

Consequently total max flow is therefore:

0.076 (runoff from area) + 0.110 (runoff from roadway) = 0.186 m3/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 f/s = 0.55 m/s
Q = VA = 0.55 m/s x 1.5 m x 0.3 m = 0.247 m3/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.

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.

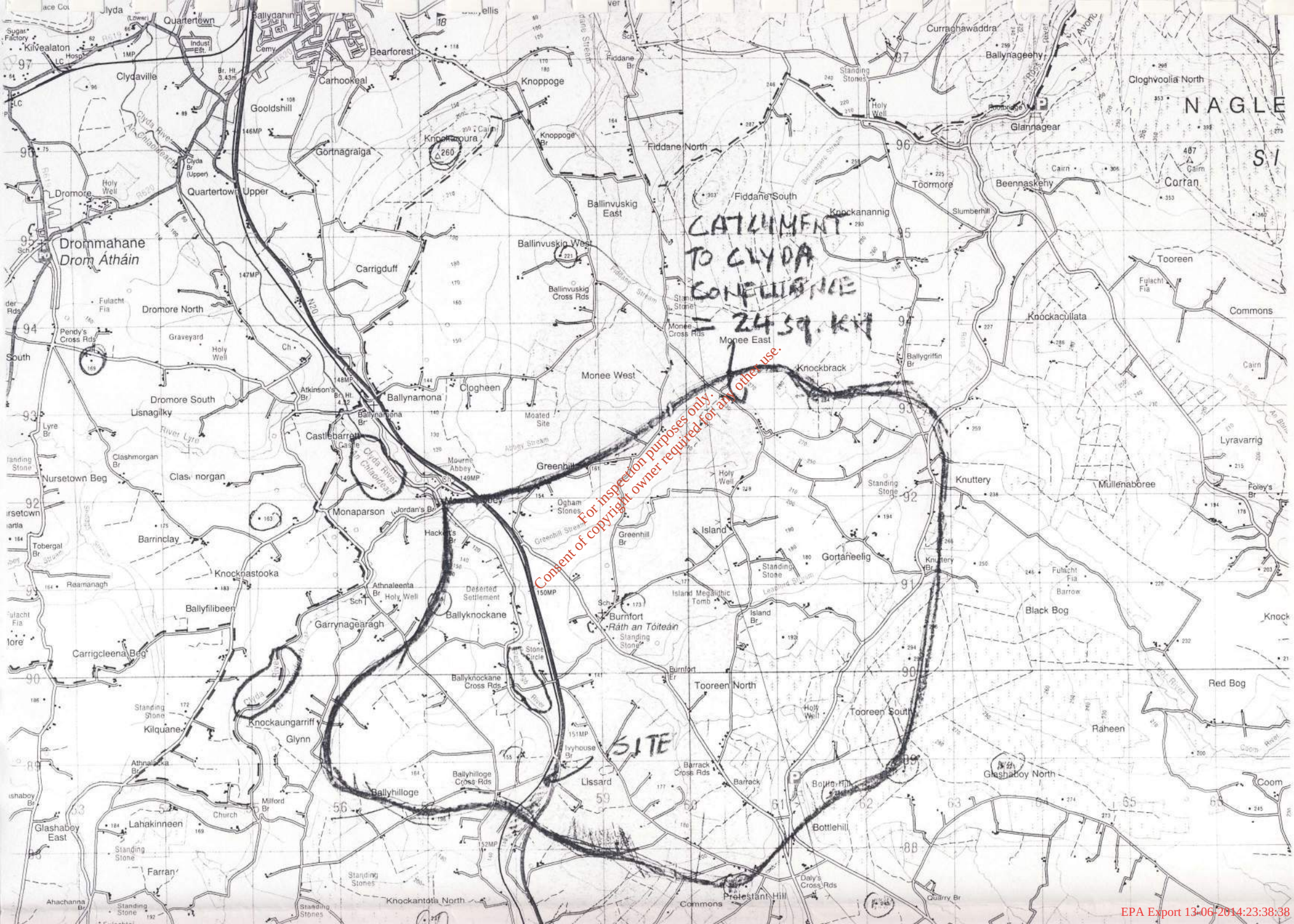
Michael Mescal

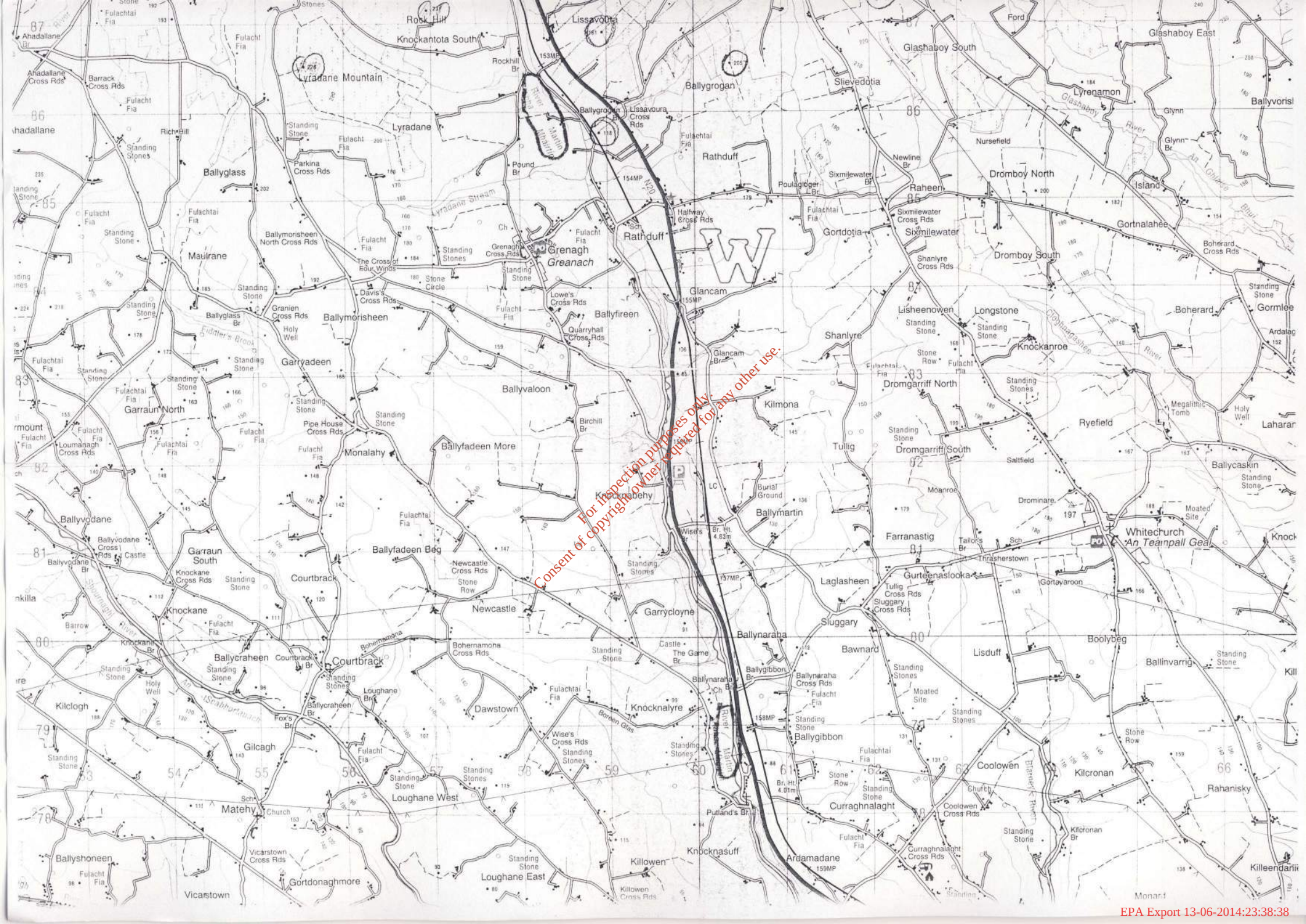
Michael Mescal
Chartered Engineer

04/01/07

Attachments:

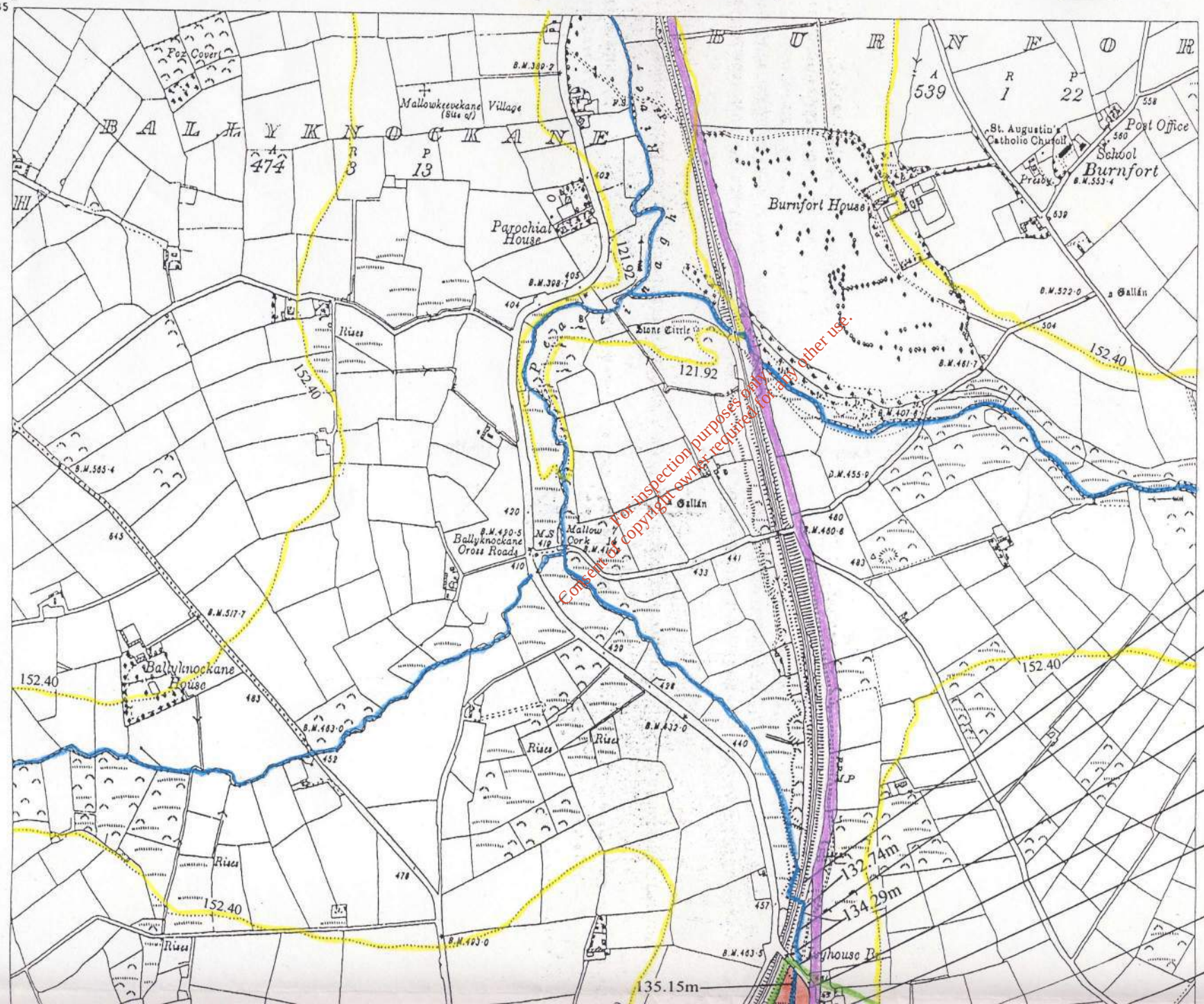
- 1/50,000 – showing Peastingagh and Martin complete (marked OS map enclosed)
- 1/10,000 - showing features
- 'Small Scale Hydroelectric Potential for Ireland' 1985 , AFF
- Extracts from Drainage Records
- Prof EC Dillons Rainfall
- Extract from 'Sewers' by Bevan & Rees

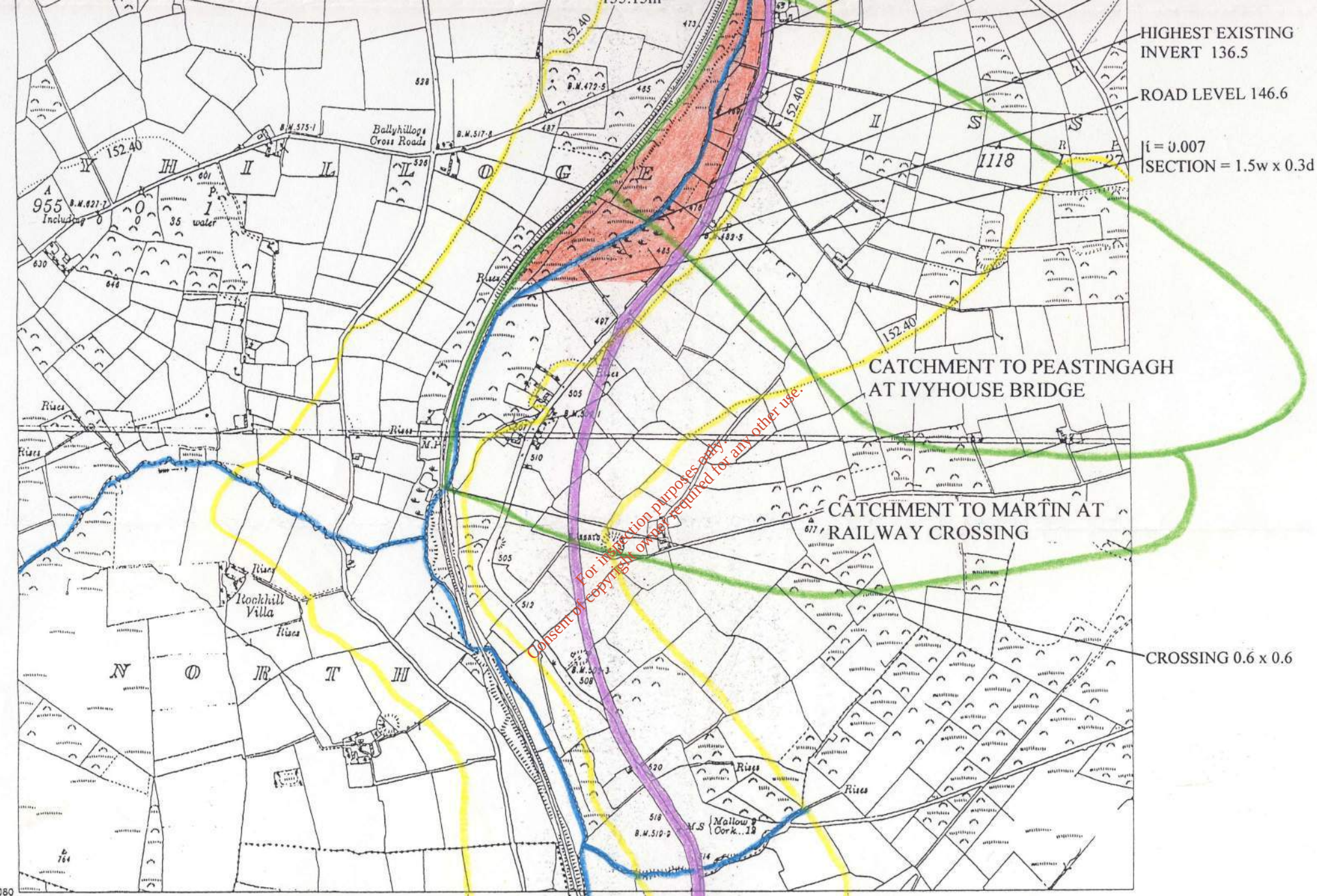




Surveyed 1842
Revised 1932 - 1933
Levelled 1933

Record PLACE Map





DEPARTMENT OF ENERGY
IRELAND

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WATER RESOURCES DIVISION
AN FORAS FORBARTHA

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Chapter 2

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 equalled 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 km^2) 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 planimetering $\frac{1}{2}$" to 1 mile scale Ordnance Survey maps and rainfall was determined from $\frac{1}{4}$" 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 km^2 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

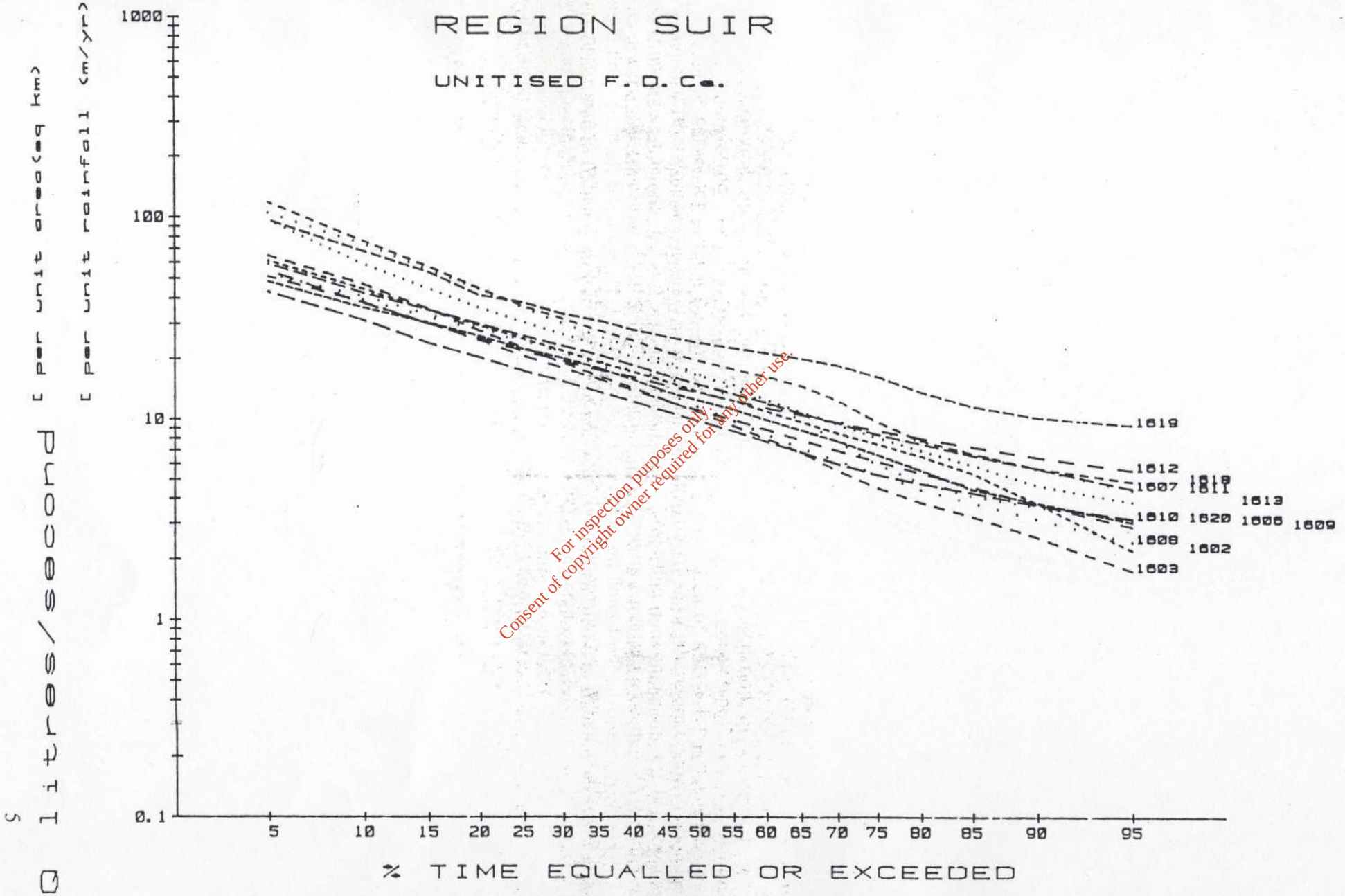


FIG. 2.1 THE VARIATION IN UNITISED FLOW DURATION CURVES FOR THE RIVER SUIR CATCHMENT

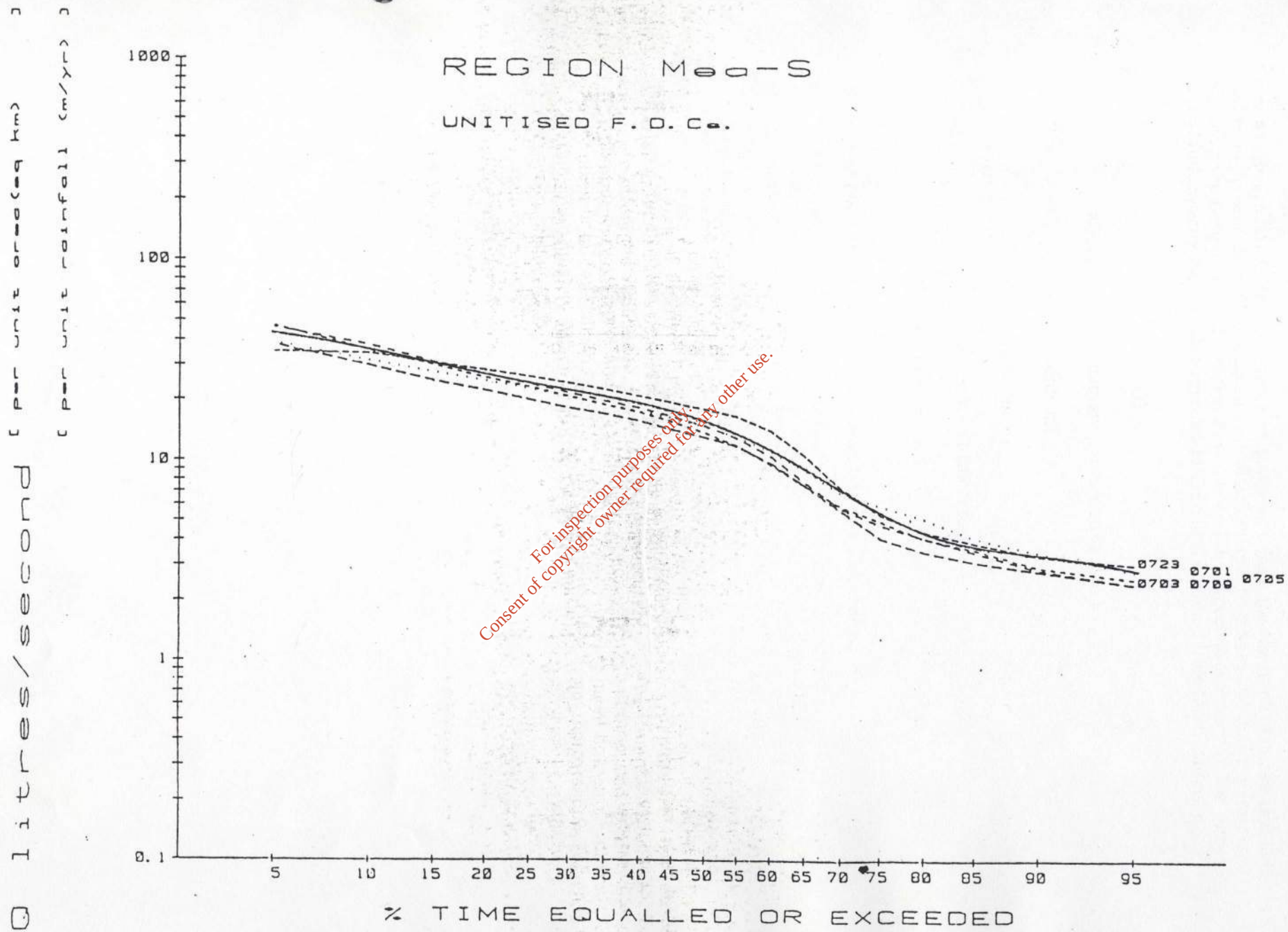


FIG. 2.2 UNITISED REGIONAL FLOW DURATION CURVE FOR REGION MEA—S

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 (m^3/s)

η = efficiency at full capacity

1,000 litres = $1 m^3/s$

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 Ce 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 Qm down to 0.2 Qm.

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

$$E = Ce\ ARH\eta$$

where E = Annual energy in kilowatt hours (kWh)

Ce = Annual energy coefficient

A = Catchment area (km^2)

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

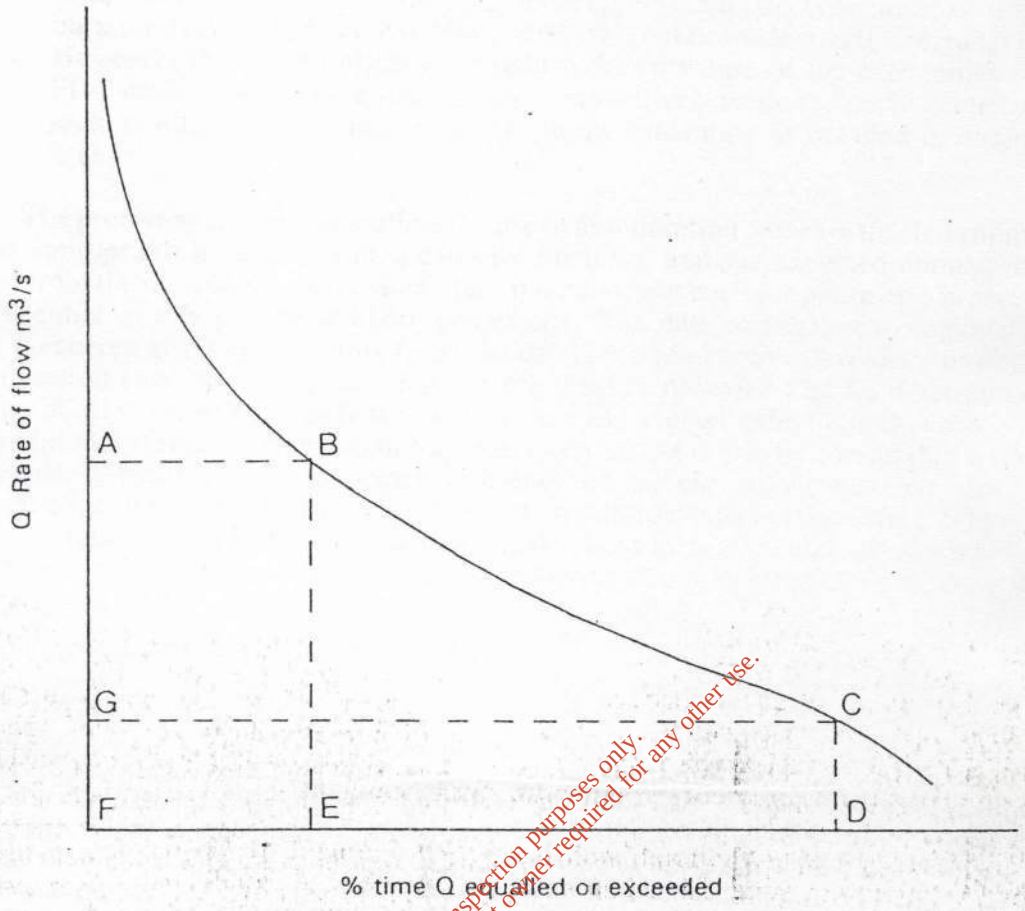


FIG. 2.4 TYPICAL FLOW DURATION CURVE

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.

Appendix B

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

Now 5 digit Nos
0141 → 01041

Station No.	River	Name of Station	Grid Ref.	Catchment Area km²	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	Owenavorragh	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	Portarlington	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 km²	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
1'504	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 km²	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	1213, 1216, 1424
		CAR-M	1418, 1423, 1434
Cavan	3	CAV-E	3610, 3616, 3618
		CAV-N	3620, 3627
		CAV-S	0711, 0717, 3631
Clare	2	CLA-SH	2530
		CLA-F	2701
Cork	6	COR-O	1909, 1920
		COR-C	1915, 1918 ← 19015 + 19018
		COR-KE	2102, 2103, 2104, 2105
		COR-S	2009
		COR-E	1802, 1804, 1805, 1806
		COR-LW	1914
Donegal	4	DON-W	3801
		DON-EE	0141, 0142, 3901
		DON-IO	3903
		DON-L	3805
Dublin	5	DUB-C	0805, 0806, 0902
		DUB-N	0802
		DUB-B	0803, 0804
		DUB-S	0905, 1017
		DUB-L	0999, 0906
Galway	5	GAL-NE	2605, 2606, 2612, 2614
		GAL-W	3204
		GAL-E	2519, 2520
		GAL-C	3061
		GAL-M	3007
Kerry	3	KER-CK	2102, 2103, 2104, 2105
		KER-N	2301, 2302, 2306
		KER-C	2203, 2204, 2205, 2206
Kildare	6	KID-M	1405, 1406, 1419, 1433, 1434, 1507, 1510, 1504
		KID-L	0999, 0906
		KID-RY	0901
		KID-H	1213
		KID-BA	1405, 1406, 1419
		KID-BO	0703, 0714
Kilkenny	2	KIK-O	1501, 1503, 1509
		KIK-M	1502, 1504, 1506, 1511
Laois	2	LAO-L	1405, 1406, 1419, 1433, 1434, 1507, 1510, 1504
		LAO-H	1432, 1521
Leitrim	1	LEITM	2629, 3511, 3620, 3627
Limerick	4	LIM-E	2402, 2405
		LIM-CW	2302, 2404
		LIM-C	2403, 2404, 2406
		LIM-W	2306
Longford	1	LONFD	2619, 2620
Louth	4	LOU-C	0613, 0614, 0621, 0623, 0625, 0626
		LOU-F	0611
		LOU-S	0633
		LOU-N	0630, 0631

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

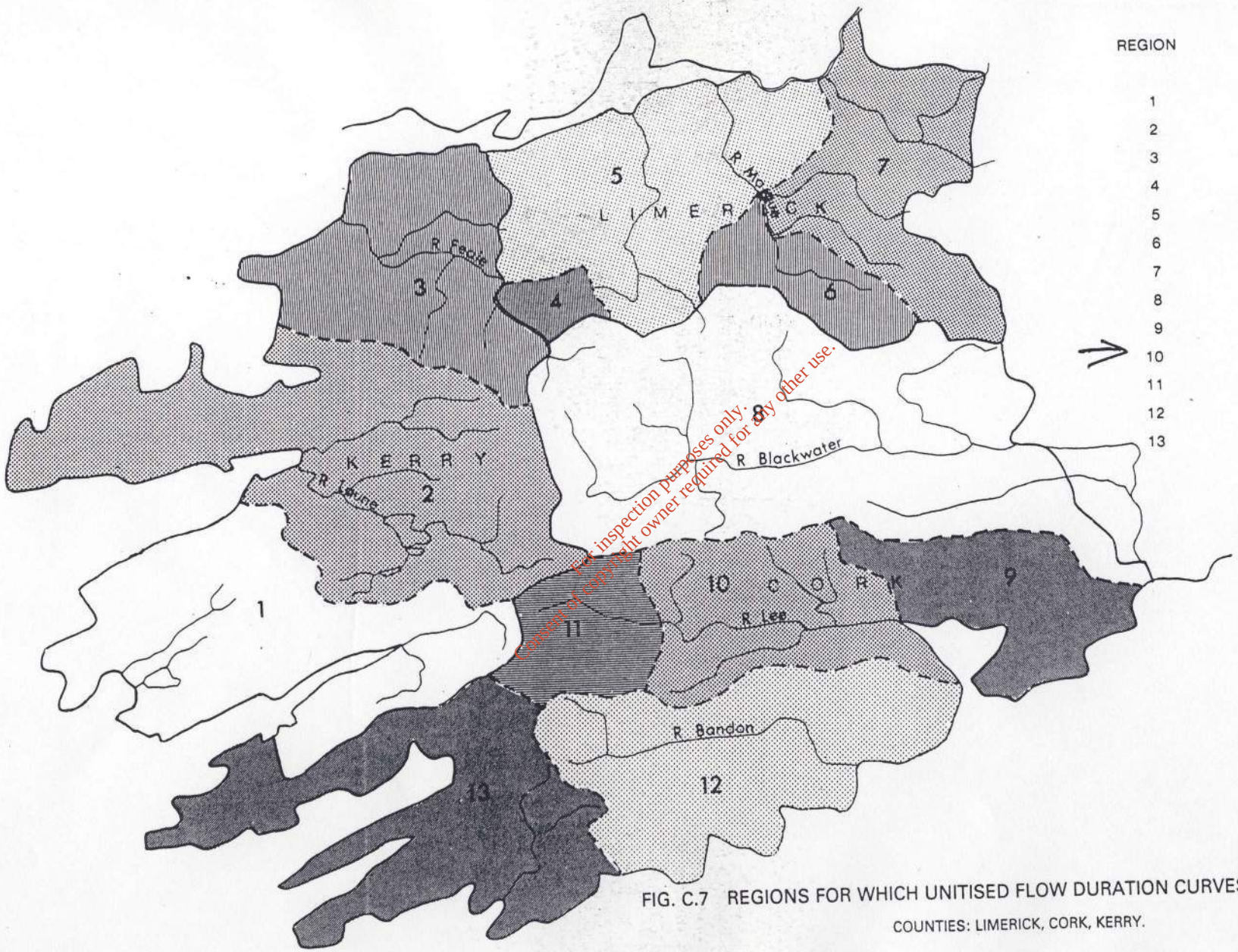
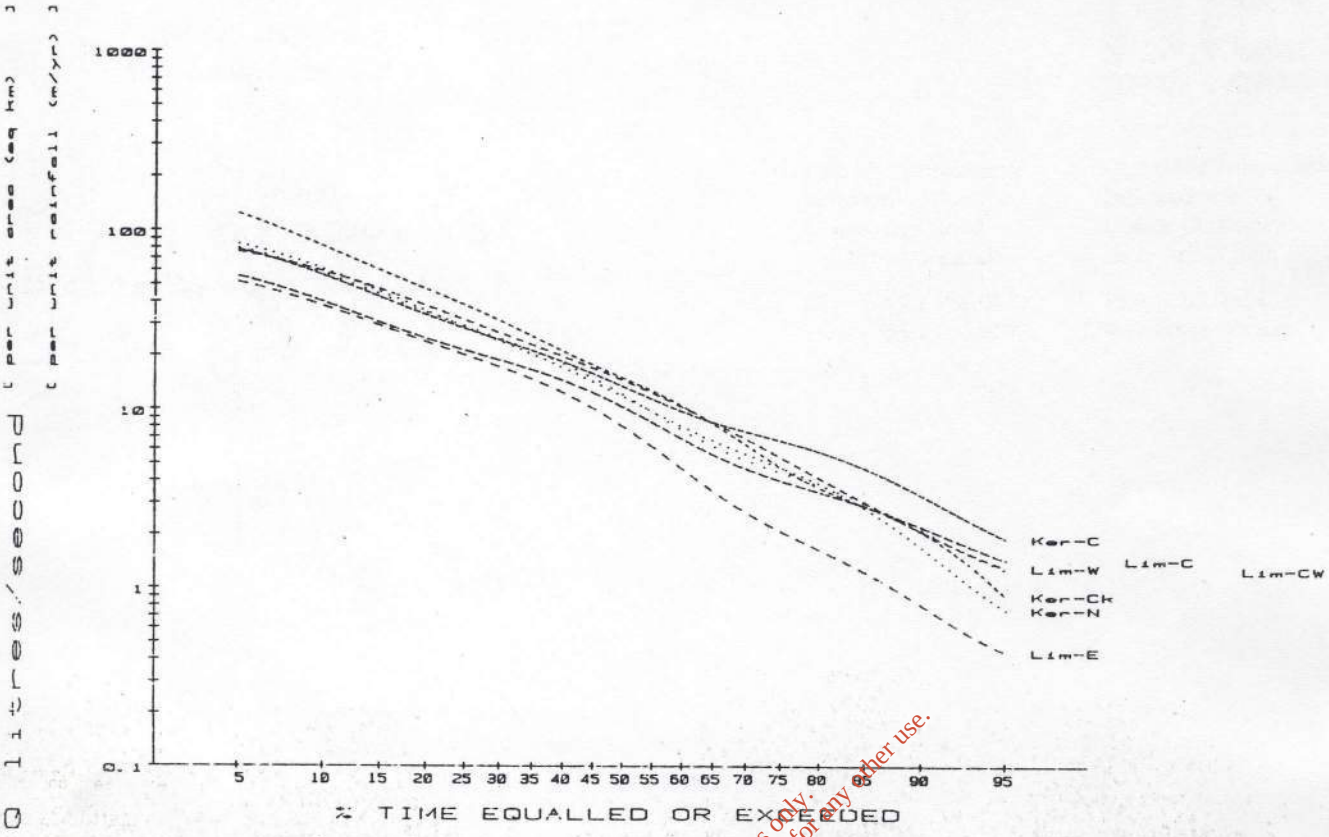


FIG. C.7 REGIONS FOR WHICH UNITISED FLOW DURATION CURVES WERE DERIVED.

COUNTIES: LIMERICK, CORK, KERRY.



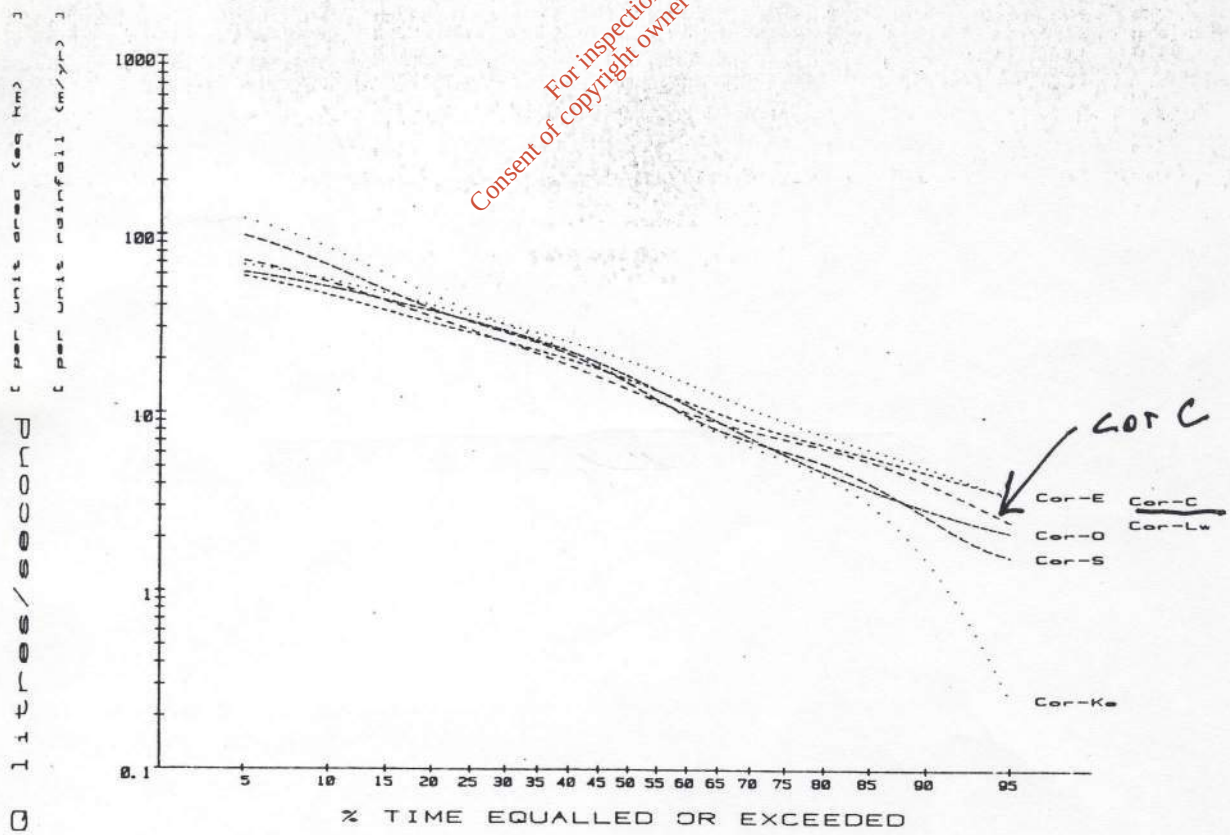
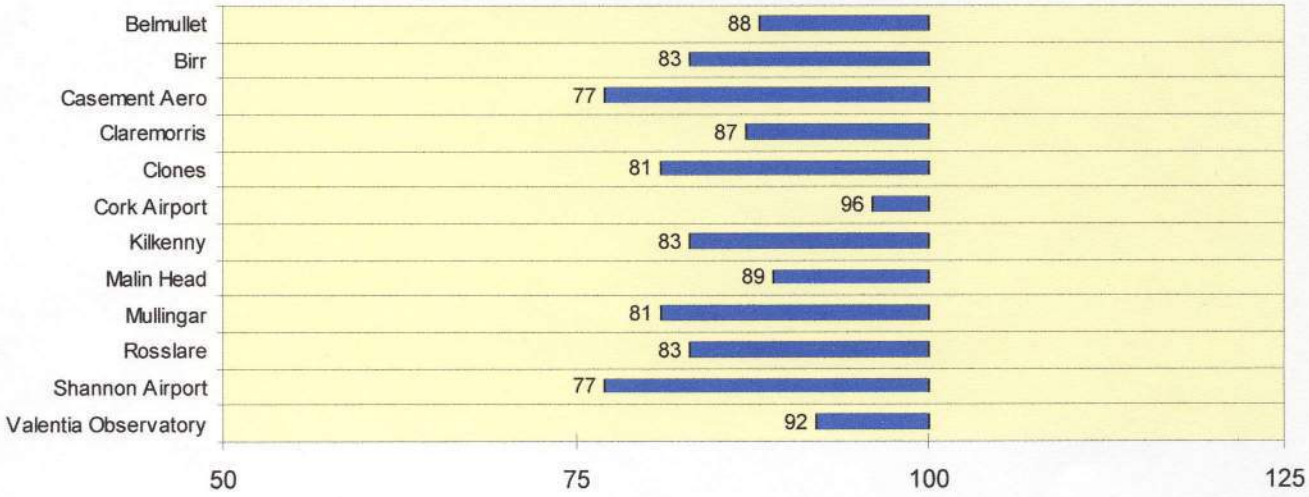


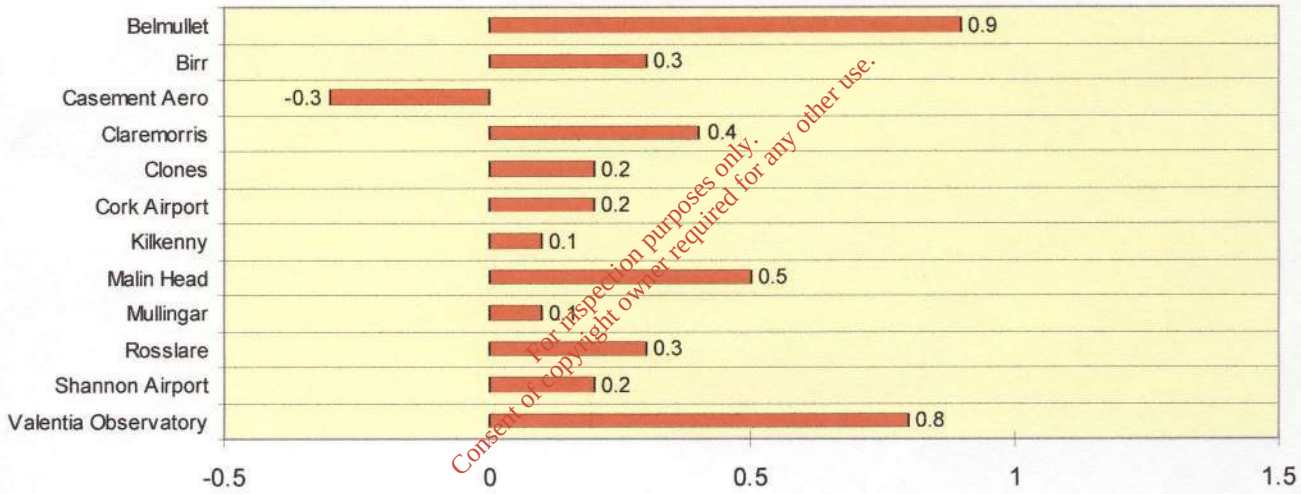
FIG. C8 UNITISED REGIONAL FLOW DURATION CURVES

November 2005 Percentage / Difference from 1961-90 monthly normals

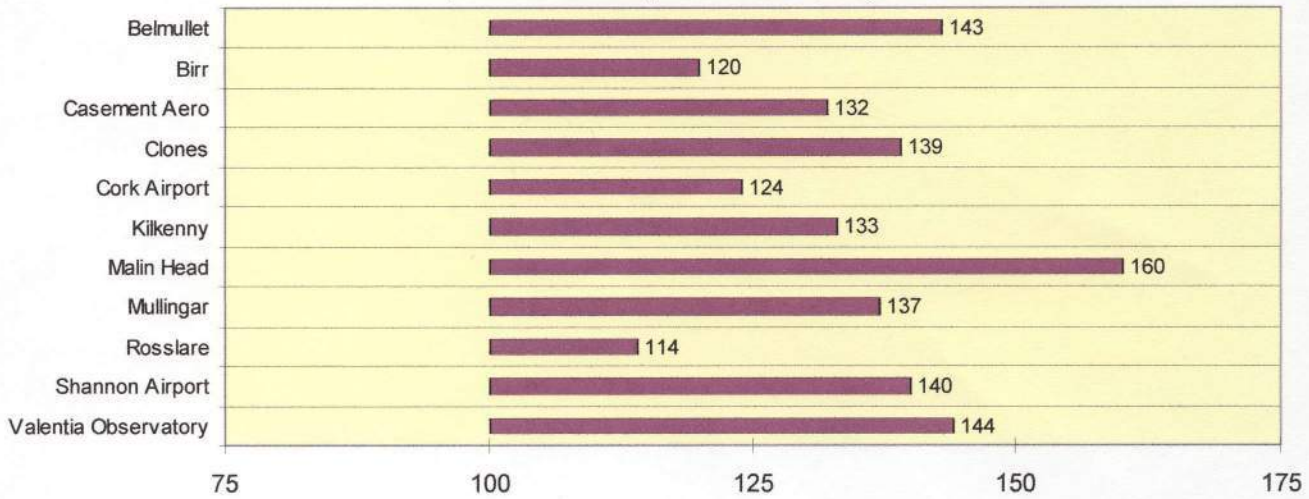
Rainfall *(% of normal for period 1961-1990)*



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



Sunshine *(% of normal for period 1961-1990)*



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- Full Disk - Vis

Climate
- Climate of Ireland
- Temperature
- Sunshine

30 Year Averages

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

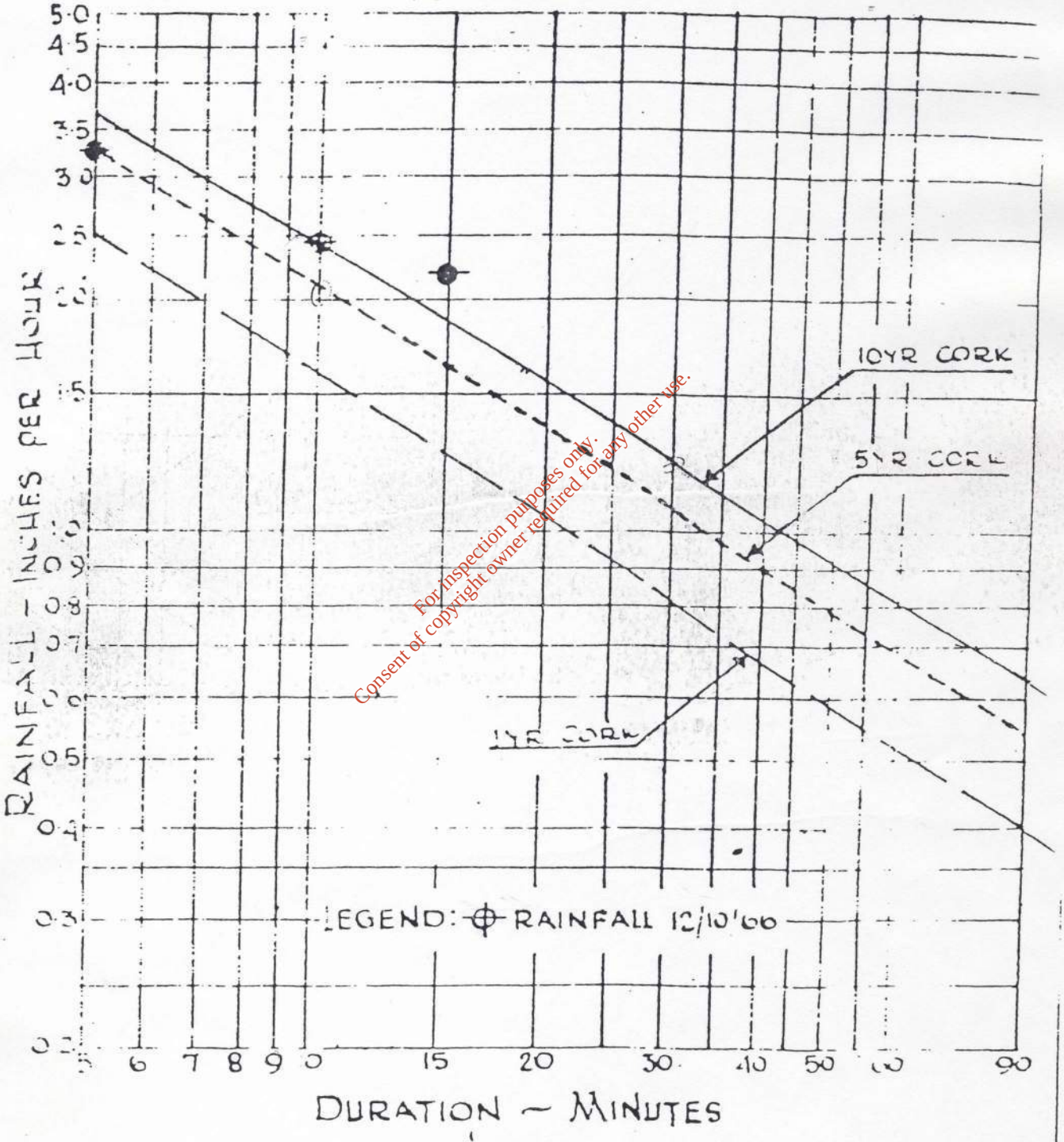
CORK AIRPORT

monthly and annual mean and extreme values

1962-1991

TEMPERATURE *(degrees Celsius)*	*jan*	*feb*	*mar*	*apr*	*may*	*jun*	*jul*	*aug*	*sep*	*oct*	*nov*	*de*
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.
mean daily min.	3.6	2.5	3.1	4.2	6.5	9.2	11.1	10.9	9.4	7.5	4.5	3.
mean	5.1	5.0	6.2	7.7	10.2	12.9	14.8	14.5	12.7	10.3	7.2	6.
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
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
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.
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
RELATIVE HUMIDITY *(%)*												
mean at 0900UTC	90	90	88	83	81	81	83	86	88	91	90	9
mean at 1500UTC	84	80	75	71	71	72	72	73	76	82	83	8
SUNSHINE *(hours)*												
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.:
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.
mean no. of days with no sun	11	9	6	4	2	3	2	2	4	7	9	1
RAINFALL *(mm)*												
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	13:

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

CHART 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.

SEWERS

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

VARIATIONS IN VALUE OF n AVERAGE ACCORDING TO ALBERT WOLLHEIM, A.M.I.C.E.

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. × 6 ft. 8 in., nearly new	0·0130
Brick, washed with cement, basket-shaped sewer, 6 ft. × 6 ft. 8 in., one year old	0·0148
Brick, washed with cement, basket-shaped sewer, 6 ft. × 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

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

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 ($i = 0{\cdot}001$) then the difference will not be appreciable.

This enables the coefficient C to be written as :

$$\left[\frac{41{\cdot}6 + \frac{1{\cdot}811}{n} + \frac{0{\cdot}00281}{0{\cdot}001}}{1 + \left(41{\cdot}6 + \frac{0{\cdot}00281}{0{\cdot}001}\right)\frac{n}{\sqrt{m}}}\right]$$

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 ($n = 0{\cdot}013$).

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 $n = 0{\cdot}010$. See TABLE I). Then find the velocity in feet per second and the discharge in cubic feet per second.

Hydraulic mean depth $m = \frac{A}{P} = D/4 = 2/4 = 0{\cdot}5$

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

Then $$C = \left[\frac{41{\cdot}6 + \frac{1{\cdot}811}{n} + \frac{0{\cdot}00281}{i}}{1 + \left(41{\cdot}6 + \frac{0{\cdot}00281}{i}\right)\frac{n}{\sqrt{m}}}\right]$$

The formula put forward by Manning took the form :

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

or

$$v = \frac{1{\cdot}486}{n}\cdot\sqrt[3]{m^2}\sqrt{i}$$

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 $1{\cdot}486/n$, then there emerges the following comparison with the constant of the Crimp and Bruges formula :

$$124 = \frac{1{\cdot}486}{n}$$

Therefore

$$n = \frac{1{\cdot}486}{124} = 0{\cdot}012,$$

so that the Crimp and Bruges formula is practically the same as the Kutter formula with a value of $n = 0{\cdot}012$. Similarly, if we wish to use the formula with a value of $n = 0{\cdot}013$ it is simple to arrive at the appropriate value of C by the above method ; in this case it would be $C = 1{\cdot}486/0{\cdot}013 = 114{\cdot}3$.

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.

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

Crimp and Bruges Formula

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

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

Diam. in Inches.	Area in Square Feet.	m in Feet.	$\sqrt[3]{m^2}$	For Velocity in Feet per min. K^1 in $v = K^1\sqrt{i}$	For Discharge in Cubic Feet per min. K in $Q = K\sqrt{i}$	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	7·0686	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

The hydraulic mean depth $m = \frac{A}{P} = \pi/4D^2 \div \pi D = D/4$

$= 0{\cdot}3125$

$\sqrt[3]{m^2} = 2/3$ log of $0{\cdot}3125$

$= 0{\cdot}666 \times -0{\cdot}50516 = -0{\cdot}33677$

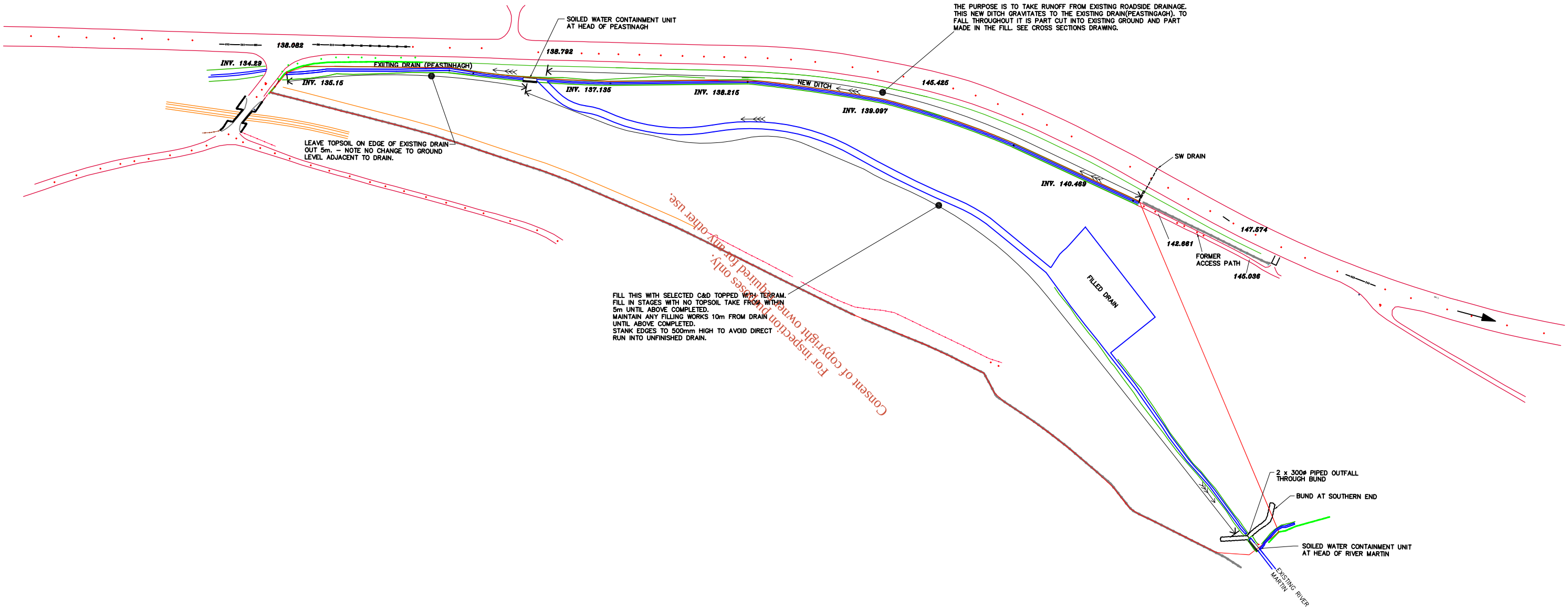
Antilog $-0{\cdot}33677 = \bar{1}{\cdot}66323$

$= 0{\cdot}4605$

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

$= 124 \times 0{\cdot}4605 \times \sqrt{\frac{1}{100}}$

$= 124 \times 0{\cdot}04605 = 5{\cdot}72$ feet per second.



no	revision	date
1	FOR IPPC APPLICATION	12/01/09
0	INITIAL ISSUE	18/12/06

client	MALLOW CONTRACTS LTD.
project	APPLICATION FOR WASTE MANAGEMENT PERMIT
drawing	OVERALL CHANNEL DRAINAGE

100.00M
SCALE 1=2000

CONSULTING ENGINEERS

mescal & associates
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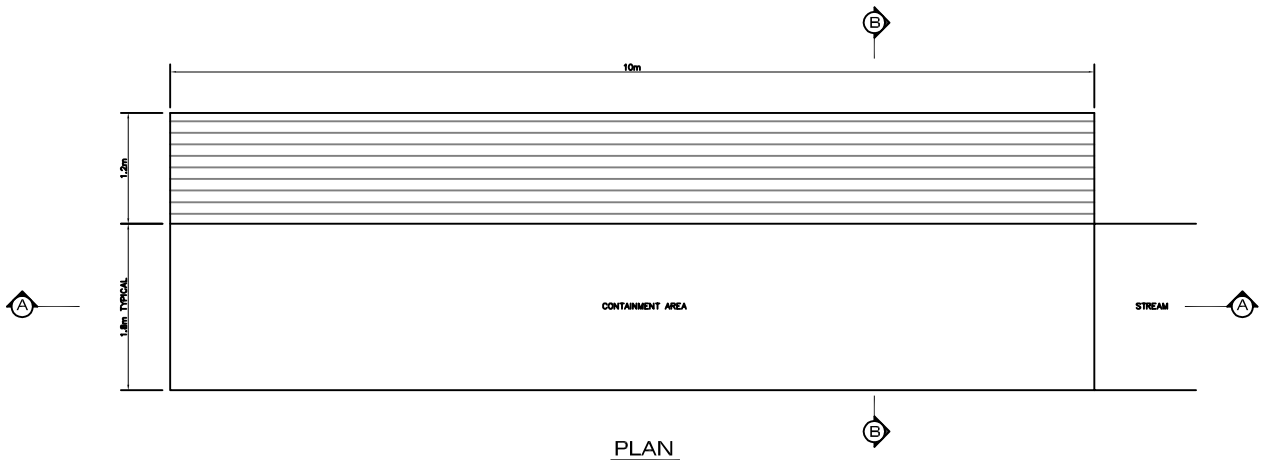
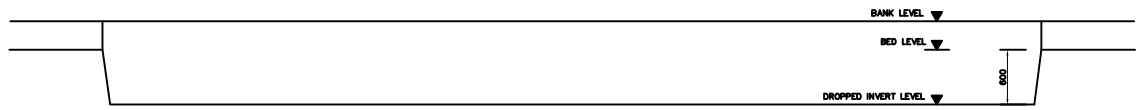
tel 021-4314388
fax 021-4314369

scale	date	job no	drg no
As Shown	DECEMBER 2006		5

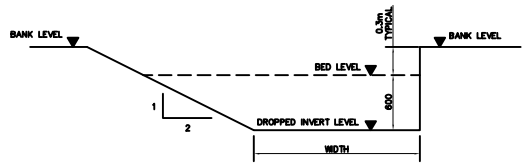
RATHDUTGRD



PLAN



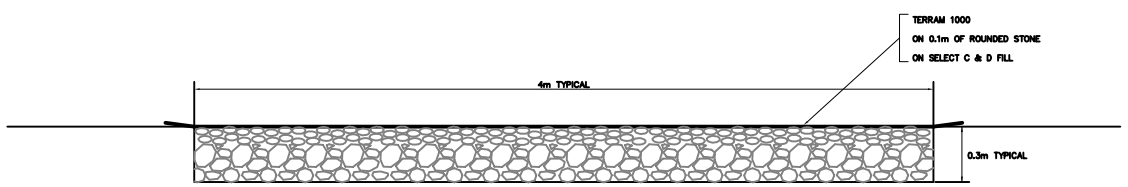
LONG SECTION A-A



CROSS SECTION B-B

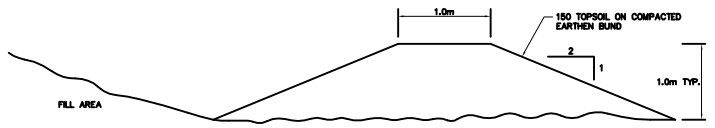
NOTE:-
- SETTLED MATERIAL EXCAVATED OUT AND DEPOSITED IN FILL AREA. EXCAVATION CARRIED OUT IN STILL CONDITIONS. EXCAVATION AT INTERVALS.
- 1 No. AT OUTFALL TO RIVER MARTIN.
- 1 No. AT OUTFALL TO RIVER PEASTINGAGH.

DETAILS OF SOILED WATER CONTAINMENT MEASURES NTS

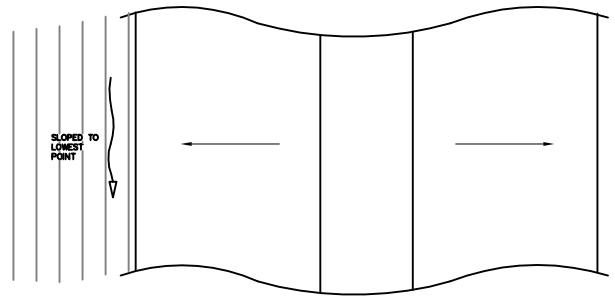


NOTE:- "POND" AT CENTRE POINT SHOWN PART YEAR2, PART YEAR 3 TO BE TREATED AS ABOVE OVER WIDTH OF "POND".

PROPOSED FILLING OF EXISTING DRAIN NTS

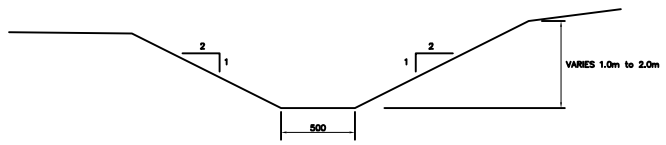


SECTION



PLAN

BUND AT SOUTHERN END NTS



NEW DRAINAGE DITCH LINKING TO EXISTING STREAM (HEAD OF PEASTINGAGH RIVER) BESIDE N20 NTS

no	revision	date
3	FOR IPPC APPLICATION	12/01/09
2	MINOR CLARIFICATIONS TO DIMENSIONS	14/12/06
1	NEW DITCH BESIDE N20 SHOWN	08/11/06
0	INITIAL ISSUE	18/10/06

client	MALLOW CONTRACTS LTD.
project	APPLICATION OF WASTE MANAGEMENT PERMIT
drawing	SUNDRY DETAILS

CONSULTING ENGINEERS
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tel 021-4314388
fax 021-4314369

scale	date	job no	drg no
As Shown	OCTOBER 2006		13

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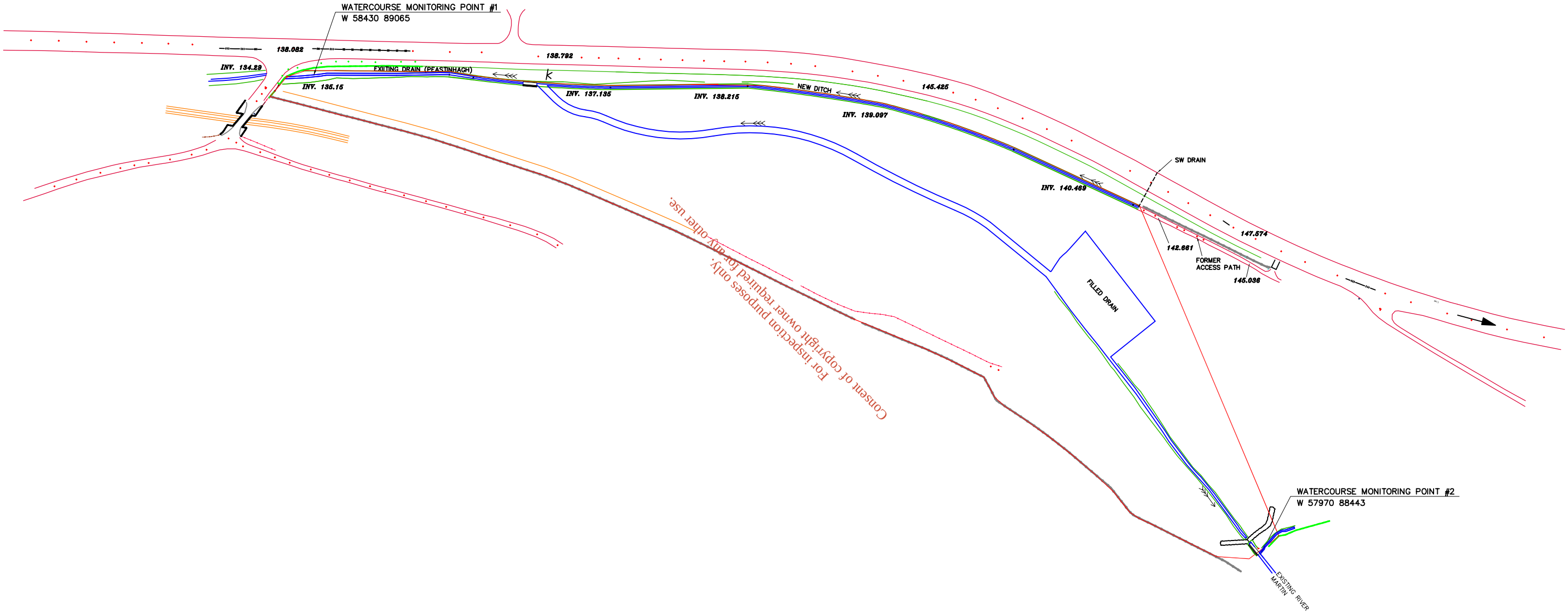

no	revision	date
1	FOR IPPC APPLICATION	12/01/09
0	INITIAL ISSUE	08/12/08

client	MALLOW CONTRACTS LTD.
project	APPLICATION FOR WASTE LICENCE
drawing	WATERCOURSE MONITORING POINTS

100.00M
SCALE 1=2000

CONSULTING ENGINEERS

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scale	date	job no	drg no
As Shown	DECEMBER 2008		7

water technology limited

TOGHER INDUSTRIAL EST.,
CORK,
IRELAND.

Telephone: 021-4965600
Fax: 021-4965614

Email:
krsheehan@eircom.net

Date: 21st May 2014

LABORATORY REPORT ***Drain North***

Date Submitted: 6th May 2014

Lab Ref:

Sample 4 4/050614

Mallow Contracts Limited

Test	***Results***
Temperature	Ambient
pH	6.54
BOD	<2
COD	<1
Suspended Solids	2.1
Total Ammonia -N	0.14
Conductivity	294
Molybdate Reactive Phosphorus MRP	0.05
Nitrate as N	3.2
Total Phosphate-P	0.07
Oils Fats Grease	<1
Sulphates as(M)	25
Chlorides as(Cl)	28.4
Phenols	<0.002
Detergents(as Lauryl Sulphate)	0.156
Arsenic	0.000656
Chromium	0.0105
Copper	0.00295
Cyanide	<0.05
Fluoride	<0.5
Lead	0.000079
Nickel	0.0012
Zinc	0.00245

Results expressed in milligrams per Litre

Water Technology Ltd is an ISO 9001 certified Company

Kim Sheehan

Kim Sheehan

water technology limited

TOGHER INDUSTRIAL EST.,
CORK,
IRELAND.

Telephone: 021-4965600
Fax: 021-4965614

Email:
krsheehan@eircom.net

Date: 21st May 2014

LABORATORY REPORT ***Drain South***

Date Submitted: 6th May 2014

Lab Ref:

Sample 4 5/050614

Mallow Contracts Limited

Test	***Results***
Temperature	Ambient
pH	6.56
BOD	2.6
COD	33
Suspended Solids	12.3
Total Ammonia -N	0.57
Conductivity	364
Molybdate Reactive Phosphorus MRP	0.27
Nitrate as N	4.3
Total Phosphate-P	0.30
Oils Fats Grease	<1
Sulphates as(M)	34
Chlorides as(Cl)	28.4
Phenols	<0.002
Detergents(as Lauryl Sulphate)	0.235
Arsenic	0.00112
Chromium	0.0125
Copper	0.00522
Cyanide	<0.05
Fluoride	<0.5
Lead	0.000046
Nickel	0.00104
Zinc	0.00223

Results expressed in milligrams per Litre

Water Technology Ltd is an ISO 9001 certified Company

Kim Sheehan

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TOGHER INDUSTRIAL EST.,
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IRELAND.

Telephone: 021-4965600
Fax: 021-4965614

Email:
krsheehan@eircom.net

Date: 21st May 2014

LABORATORY REPORT ***Well North***

Date Submitted: 6th May 2014

Lab Ref:

Sample 4 3/050614

Mallow Contracts Limited

Test	***Results***
Temperature	Ambient
pH	6.33
BOD	<2
COD	<1
Suspended Solids	1.6
Total Ammonia -N	0.09
Conductivity	251
Molybdate Reactive Phosphorus MRP	0.08
Nitrate as N	3.9
Total Phosphate-P	0.09
Oils Fats Grease	<1
Sulphates as(M)	13
Chlorides as(Cl)	28.4
Phenols	<0.002
Detergents(as Lauryl Sulphate)	0.013
Arsenic	0.000835
Chromium	0.00696
Copper	0.0169
Cyanide	<0.05
Fluoride	<0.5
Lead	0.000059
Nickel	0.000746
Zinc	0.0293

Results expressed in milligrams per Litre

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Email:
krsheehan@eircom.net

Date: 21st May 2014

LABORATORY REPORT ***Well South***

Date Submitted: 6th May 2014

Lab Ref:

Sample 4 2/050614

Mallow Contracts Limited

Test	***Results***
Temperature	Ambient
pH	6.65
BOD	<2
COD	<1
Suspended Solids	1.3
Total Ammonia -N	0.13
Conductivity	305
Molybdate Reactive Phosphorus MRP	0.02
Nitrate as N	2.6
Total Phosphate-P	0.04
Oils Fats Grease	<1
Sulphates as(N)	14
Chlorides as(Cl)	42.8
Phenols	<0.002
Detergents(as Lauryl Sulphate)	0.031
Arsenic	0.00116
Chromium	0.0126
Copper	0.0249
Cyanide	<0.05
Fluoride	<0.5
Lead	0.000452
Nickel	0.000932
Zinc	0.0272

Results expressed in milligrams per Litre

Water Technology Ltd is an ISO 9001 certified Company

Kim Sheehan

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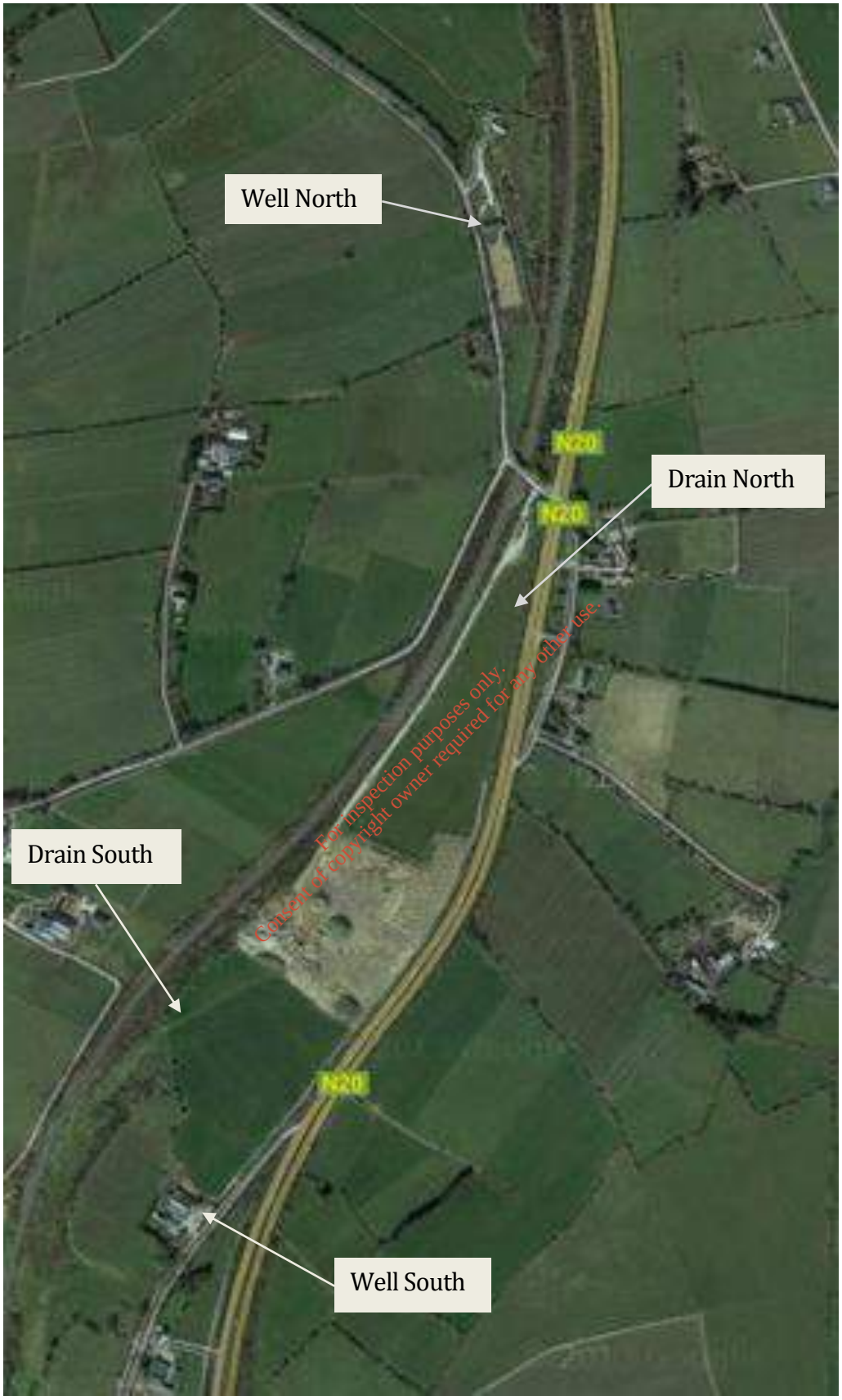


SAMPLE LOCATIONS

AIR

Existing Environment

Odour

There was no distinctive odour from the site. The background is of normal agricultural activity with a busy roadway running alongside it.

Noise

The noticeable noise in the vicinity is from traffic on the adjacent roadway and trains on the railway on the west side. There was little noise associated with agricultural activity in the area.

Dust

During dry weather, particularly summertime, moving vehicles on the site and working vehicles raise dust.

Characteristics Affecting

Noise

There is increased noise in the area due to trucks coming to site, depositing, and leaving site. There is also noise from the bulldozing and from the crushing taking place on-site. The nearest dwelling houses are approx. 400m away from this activity. The noise is limited to 55dBa (15 min Leq) on the site boundaries. This is equivalent to normal face to face conversation. This noise is limited to working hours.

Dust

The planning permission limits the dust deposition to 250mg/m^2/d at the site boundary and it also prohibits any dust from entering the rivers. In order to achieve this, the contractor is obliged to dampen down the access ways on particularly dry summer days.

Residual Impacts

On completion the contractor will leave the access road in place to facilitate the landowner access. The access road is away from the rivers. Consequently dust rising will not impact them.

Attachments:

- Access Road Photograph

Access Road Photograph

CLIMATE

Existing Environment

The existing impact was that of normal agricultural activity with a very small amount of stagnant gasses from the marshy area.

Characteristics Affecting

The machinery activity give rise to waste exhaust fumes during construction.

The raising of the land will blind off the marshy areas and eliminate the small amount of stagnant gasses.

Additional cattle herd on the area will give rise to small additional flatulence methane to the atmosphere. The herd number is not significant in general terms as it is limited by the area of grassland available.

Residual Affects

The elimination of stagnant gasses from the marshy area and additional flatulence methane from animals will remain. As it is very localized and refer to a small area the impact is not significant.

LANDSCAPE

Existing Environment

The existing landscape was characterized by largely wet overgrown land in the immediate vicinity of a busy motorway on one side and a railway track on the other. Extending in southward direction the land married into a grassland river valley. Extending in the northward direction the land is dominated by railway, heavily treed river and dense bushes. Roadway and the railway line dominate.

It is in a lightly populated agricultural area with few residential or agricultural holdings.

The views in the area are attached.

The Landscape Type is Fissured Fertile Middle ground (10). Landscape Character is Mourneabbey – Rolling Patchwork Upper – Middle Valley. This landscape is not adversely impacted by the provision of grassland in the area.

There are no locations or sites of heritage or scenic amenity in the area. The closest Heritage Site is at Mourneabbey which is 3km due north. The closest Scenic Route is north of Bottlehill which is 3km due east. The closest Nature Conservation Area is the Blackwater Valley which is 9km due north.

Characteristics Affecting

The view of the area from the N20 Cork/Mallow Road and from the few residences due south and southwest will see a green field in agricultural use where there was a small area of marshy ground.

The access road will be left in place.

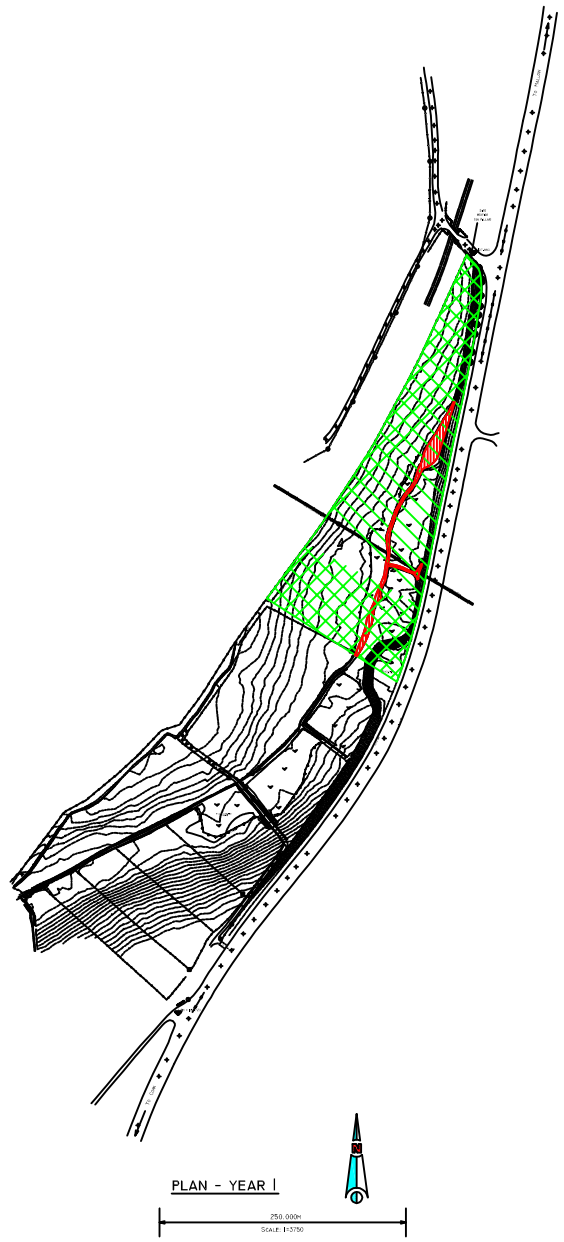
Residual Impact

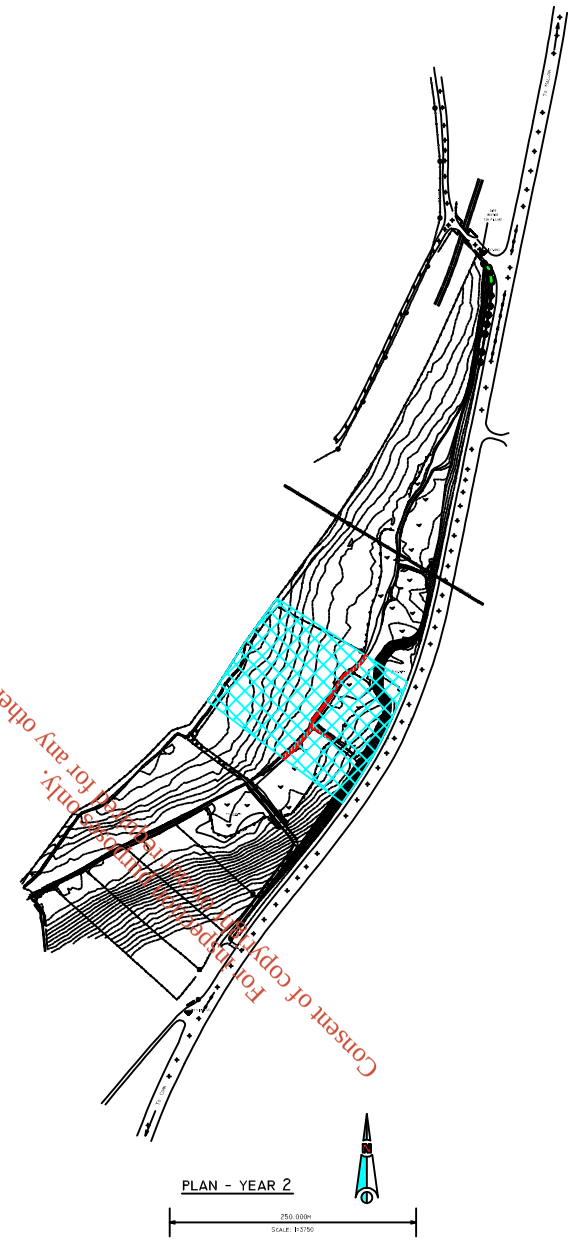
The land will be a continuation of that immediately south of it – agriculturally used. With an access road running to the gateway southwards along the railway boundary.

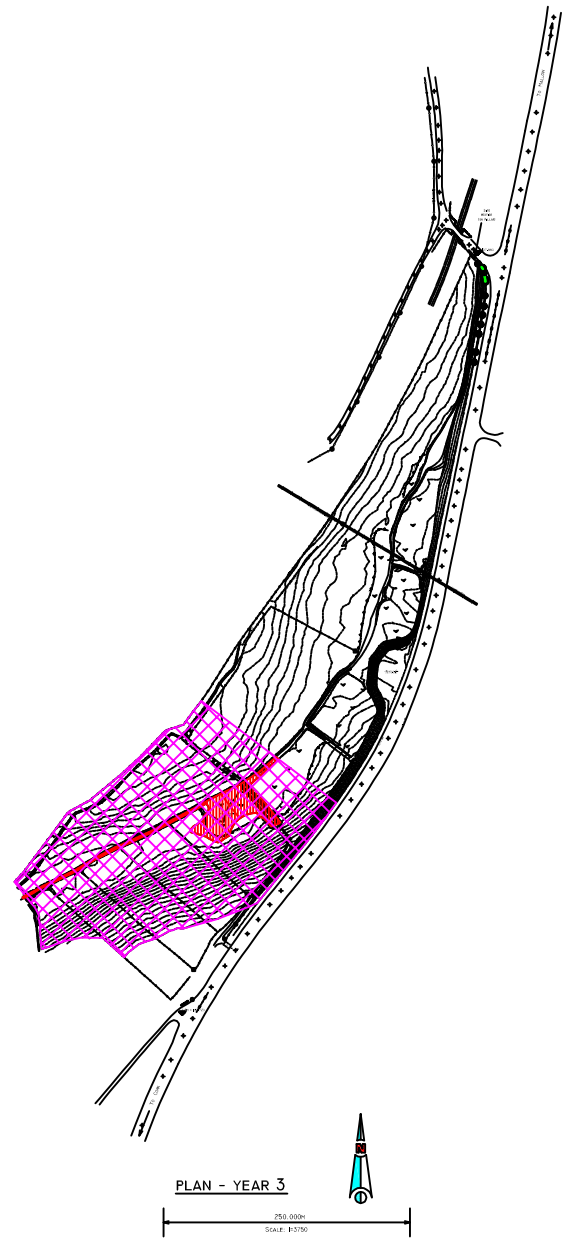
Attachments:

- Work Schedule Outline

-Completed Part Photograph







YEAR ONE - APPX. 37,000 m^3

C & D CHANNEL WORK

YEAR TWO - APPX. 37,000 m^3

C & D CHANNEL WORK

YEAR THREE - APPX. 37,000 m^3

C & D CHANNEL WORK

NOTE :- EXISTING TOPSOIL STRIPPED IN ADVANCE OF FILLING AND REPLACED AFTER CONSOLIDATION OF FILL AT NEW ELEVATION

no	revision	date
1	FOR EIS	19/03/14
0	INITIAL ISSUE	18/10/06

client: MALLOW CONTRACTS LTD.

project: APPLICATION FOR WASTE MANAGEMENT PERMIT

drawing: ANNUAL WORK SCHEDULE OUTLINE

CONSULTING ENGINEERS

mescal & associates
Enterprise House, Centre Park Road, Cork, Ireland.
tel 021-4314388
fax 021-4314369

scale	date	job no	drg no
As Shown	OCTOBER 2006		8

KATHCUFFDWG

Completed Part Photograph

MATERIAL ASSETS

Existing Environment

The area is devoid of local or nearby features of Archaeological Heritage, Architecture or Monuments. This is evidenced from the Cork County Development Plan.

There are no renewable resources in the marshy soil in the area.

The assimilative capacity the two rivers – Peastinagh and Martin – is a non renewable resource.

Characteristics Affecting

The marshy soil will be largely buried and will be lost. Grass growing topsoil will be placed on the raised ground.

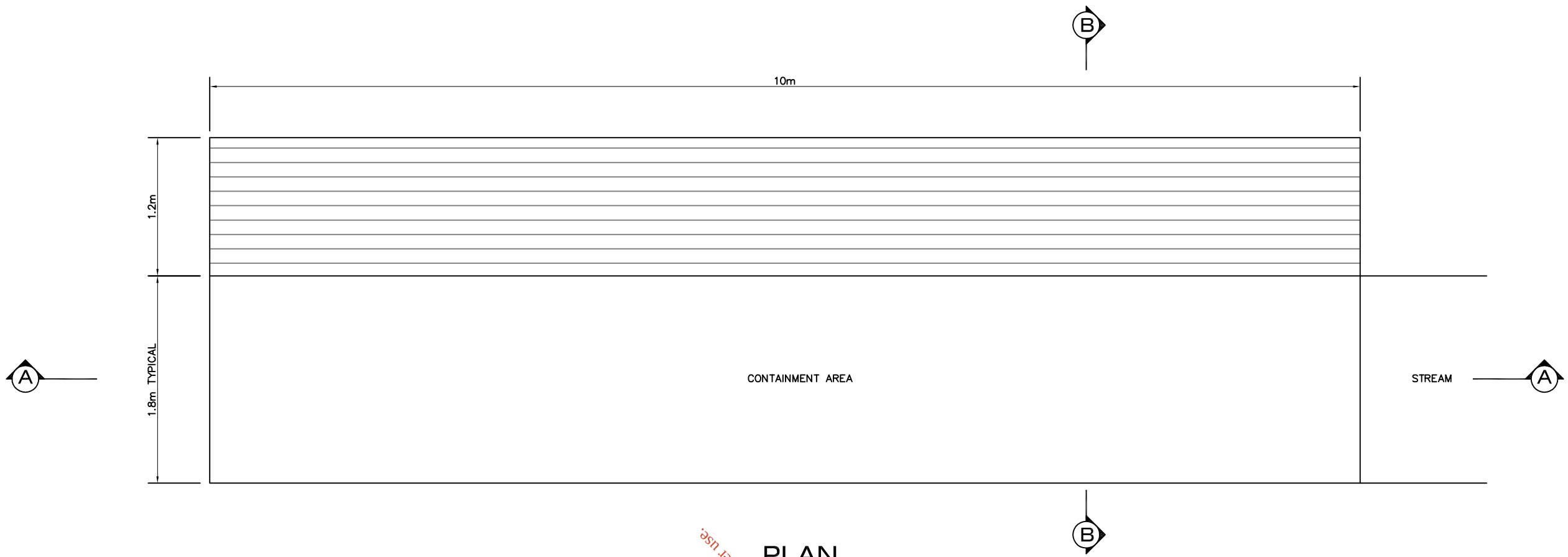
Steps, e.g. careful practice and physical interceptors, are used to ensure the rivers are not affected from spillage or dust during construction.

Residual Impact

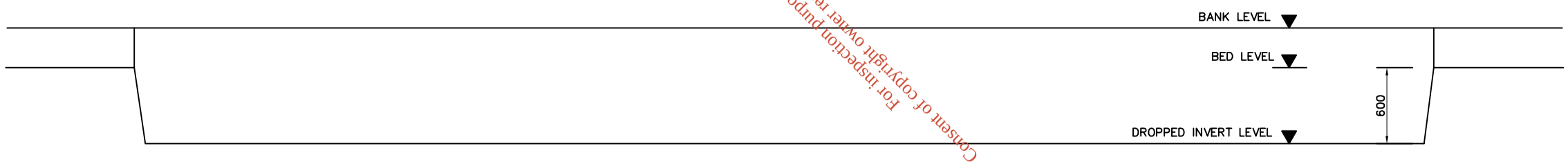
The marsh area will be replaced with grass growing soil at a higher level.

Attachments:

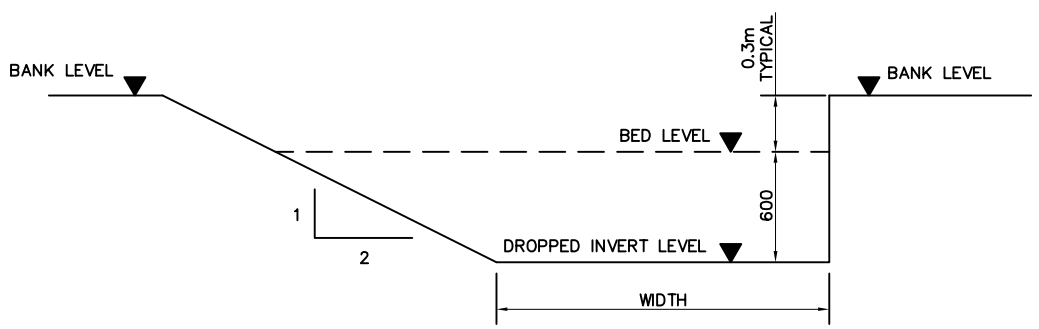
- Physical Interceptors (ex Sundry details)



PLAN



LONG SECTION A-A



CROSS SECTION B-B

NOTE:-

- SETTLED MATERIAL EXCAVATED OUT AND DEPOSITED IN FILL AREA. EXCAVATION CARRIED OUT IN STILL CONDITIONS. EXCAVATION AT INTERVALS.
- 1 No. AT OUTFALL TO RIVER MARTIN.
- 1 No. AT OUTFALL TO RIVER PEASTINGAGH.

DETAILS OF SOILED WATER CONTAINMENT MEASURES

NTS

no	revision	date
1	FOR EIS	19/03/14
0	INITIAL ISSUE	18/10/06

client: MALLOW CONTRACTS LTD.
project: APPLICATION OF WASTE MANAGEMENT PERMIT
drawing: SUNDRY DETAILS

CONSULTING ENGINEERS
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tel 021-4314388
fax 021-4314369

scale	date	job no	drg no
As Shown	MARCH 2014		9

INTERRELATIONSHIP BETWEEN THE ABOVE FACTORS

The Changing Environment

This project commenced in 2007 and was due to complete in 3 years. The project has extended well beyond that initial timeline and is likely it will continue to do so. This has been caused by the downturn in the construction industry which commenced at the end of the last decade and is likely to continue for some time yet. This has resulted in this activity continuing in this location for a long time.

Characteristics Affecting

There is an ongoing earth handling activity in the area over an extended period. The contractor has tried to minimize this impact by completing and grassing annually the area finished. This area has then been used for agriculture with no presence of machinery on it. This will continue to completion after which there will be no longer any machinery presence on site.

Significant Environments

The environment in which this work is being carried out is agricultural without any particular sensitivity or significance apart from the rising River Peastinagh and River Martin. These rivers are safeguarded during and following site activity. The site itself and its environs are not characterized by any areas under particular National or European protection. Neither is there any area of particular professional, hobby, or leisure interest e.g. mountains, forest areas, or wetlands preservation.

MITIGATION MEASURES

The impacts are summarized on the attached chart.

There are no significant impacts. There are a number of lesser impacts that are negative in character. These impacts are minimized from the outset as follows:

- Traffic is restricted to normal working hours.

- Plant Noise is limited to normal working hours.

- Rising Dust when is arises is sprayed down.

- Exhaust Fumes are restricted to operating hours.

- Prolonged Activity on-site is brought about by the lack of building activity. Completion and grassing of stages limits the area affected by this.

Attachments:

- Impact Summary Chart

		DESCRIPTION				EVALUATION	
Topic	***Impact***	***Character***	***Magnitude***	***Duration***	***Consequence***	***Significance***	***Certainty***
Human Beings	Economic	Positive	Local	Long Term	Increased agricultural output	Slight	High
	Traffic	Negative	Local	Short Term	Safety Concern	Slight	High
	Disposal Facility for Civil Works	Positive	North Cork City & Environs	Short Term	General Construction Assisted	Slight	Medium
	Recycling	Positive	Local Agriculture	Short Term	Local supply of hard-standing	Slight	High
Flora/ Habitat	Loss of Habitat (very small areas loss of scrub, hedge & wet grassland & drainage ditch re-directed)	Negative	Local	Long Term	Local (very small areas loss of scrub, hedge & wet grassland & drainage ditch re-directed)	Slight	High
	Fragmentation of Habitat	Negative	Local	Long Term	Local (a very small area of hedgerow is disrupted)	Slight	High
Fauna/Birds	Loss of Habitat (very small areas of loss of scrub, hedge & wet grassland)	Negative	Local	Long Term	Local (a small amount of habitat for nesting and foraging lost)	Slight	High
Fauna/ Mammals	Loss of Habitat (very small areas loss of scrub and hedge)	Negative	Local	Long Term	Local (a small amount of habitat for cover and foraging lost)	Slight	High

		DESCRIPTION				EVALUATION	
Topic	***Impact***	***Character***	***Magnitude***	***Duration***	***Consequence***	***Significance***	***Certainty***
Soils	More Agricultural Land	Positive	Local	Long Term	Increased Agricultural Output	Imperceptible	High
Water	Noticeable solids in southern drain	Negative	Upper reach of R. Martin	Short Term	River Water Quality	Slight	High
Air	Plant noise	Negative	Local	Short Term	Local Annoyance	Slight	High
	Rising Dust	Negative	Local	Short Term	Air Quality Impacted	Imperceptible	Medium
Climate	Exhaust Fumes	Negative	Local	Short Term	Air quality impacted	Imperceptible	High
	Animal 'belch gas'	Negative	Local	Long Term	Air Quality Impacted	Imperceptible	High
	Stagnant Gasses	Neutral	Local	Long Term	Change in Local Smell	Imperceptible	High
Landscape	More Greenfield	Positive	Local	Long term	Improved appearance	Moderate	High
Landscape	Access Roadway	Neutral	Local	Long Term	Road in Field	Slight	High
Material Assets	Wetland Soil Replaced by Grass	Positive	Local	Long Term	Land Available for Agriculture	Slight	High
Inter relationship	Prolonged Activity on-site	Negative	Local	Short Term	Prolonged Construction Impact	Moderate	High