| Submission | |
|---|---|
| Submitter: | Mr David Hugh-Jones |
| Organisation Name: | Alantic Shellfish Ltd. |
| Submission Title: | Fifth Submission re Dairygold P1103-01 to dischrage at Rathcoursey Point. |
| Submission Reference No.: | S005963 |
| Submission Received: | 31 January 2020 |
| **Application** | |
| Applicant: | Dairygold Co-Operative Society Ltd and TINE Ireland Ltd |
| Reg. No.: | P1103-01 |
| | |
| See below for Submission details.<br><br>Attachments are displayed on the following page(s). | |

# FIFTH

# Submission to the EPA by Atlantic Shellfish Ltd.

**(David Hugh-Jones, MA, Dip. Agric. (Cantab.), MMBA, FRGS)**

## with reference to the

## Application for an Industrial Emissions Licence

## by

## Dairygold Co-Operative Society Ltd. and TINE Ireland Ltd.

## of Mogeely, Co. Cork

## Environmental Licensing Programme
## Office of Environmental Sustainability

## EPA Licence Application Reference No: P1103-01



**Continuing the objection to the discharge of the treated wastewater from the enlarged cheese-making facility of Dairygold Co-Op and TINE Ireland Ltd. at Mogeely, Co. Cork, which is proposed to be made to the North Channel of Cork Harbour through the Midleton WWTP Primary Discharge at Rathcoursey Point in the North Channel of Cork Harbour.**

**With observations on:**

**(1) Earlier drogue study evidence as to water movements from the proposed outfall at Rathcoursey Point by M.C. O'Sullivan in 1972 & 1976**

**(2) New material placed in the public domain by the EPA & DHPLG**

**Together with an analysis of further current meter measurements made over a full spring/neap tidal cycle of 14 days in January 2020.**

## Contents

# 1 Observations on new material casting further light on the unsuitability of Rathcoursey Point as a place to discharge waste water.

## 1.1 Work of M.C. O'Sullivan in his 1972 float tests and 1976 Statement of Evidence for the Midleton Sewerage Scheme.

With reference to the Submission (No. S005925 of 03 January 2020) made by Mark Bentley of JBA Consulting regarding this Application to the EPA, I see that a caveat he alludes to in his measured comparison of the "tidal prism" method of estimating flushing versus "numerical modelling" in s. 2.1, is that,

"*Even making allowances for shortcomings in the tidal prism method it still produces a single estimate of the time it takes to flush an estuary. That estimate though is not necessarily representative for the time required to flush all parts of the estuary.* ***Many estuaries such as Cork Harbour have a complicated topography, which includes isolated depressions and secluded embayments with little water exchange.*** *While most areas of the harbour may be flushed in the time estimated using the tidal prism method, there can remain pockets of stagnant water with much longer flushing times".*



You will remember that we too indeed found such pockets of stagnant water, together with gyres at both top and bottom of East Ferry in our own drogue work. For instance in our first spring tide run on 14.10.19 (s. 2.1.1 of my Fourth Submission), when I commented on p. 9

"*21.30 entered East Ferry. Left to run, but caught in a gyre at the Marina.*

and also in the summary, re *"Information acquired:*

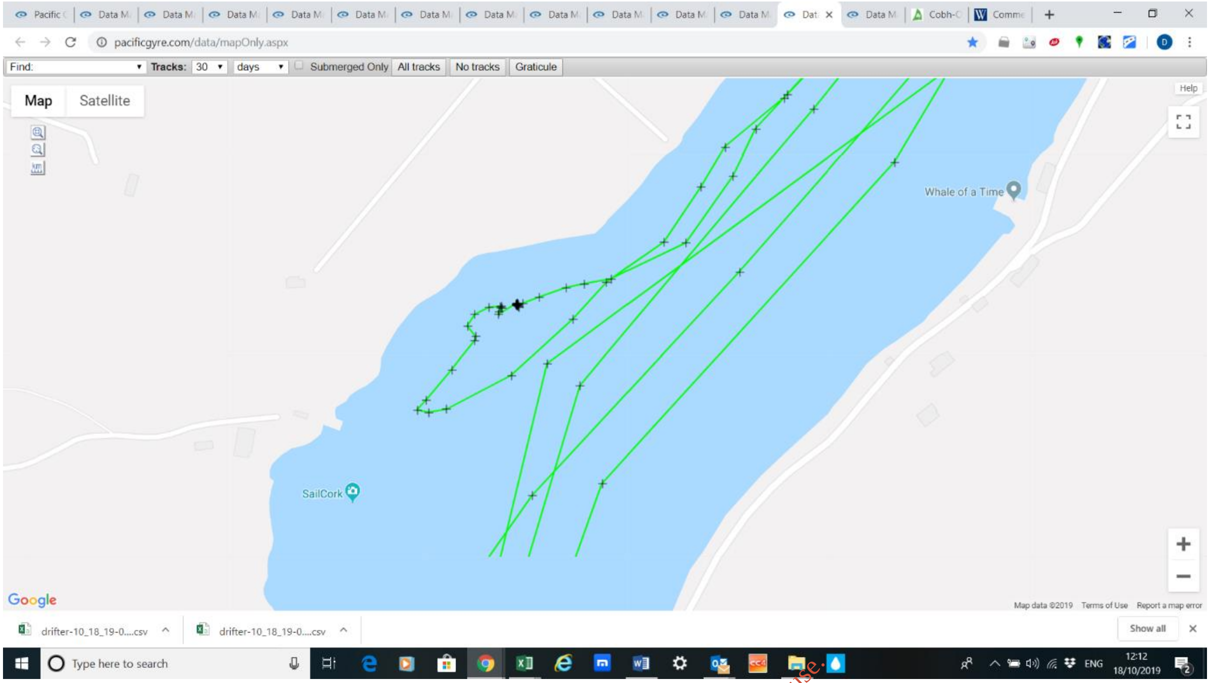
*With the drogue getting caught in the gyre at the mouth of East Ferry and on the continuing run in a gyre or obstruction in the Marina, halfway down East Ferry…………*

This detail of the entry of the drogue into the gyre, shown below, lasted from 22.00hrs with the drogue making a slow circle until 23.45, when it then entered a stationary period. The tide turned at 01.10, but the drogue did not start to move north and out of the gyre on the flood tide for another hour at 02.15. Thus this pocket of water had remained in the Marina area for 4¼ hours – two thirds of the ebb tide.

The gyre at Bagwell's Hill to the west of the top of East Ferry is well known, demonstrated with a short sojourn in the LW plot of the drogue on 09.11.19 (Fourth submission s. 3.1.2 p.17) and gyres to both west (s. 2.1.1 at 09.25hrs) and east of the mouth of East Ferry to the Lower Harbour (s. 2.1.3 at 12.25hrs).

The importance of any such slowing down, or in later discharge of effluent at Rathcoursey, causing the plume to miss the fastest flow in the middle of the ebb tide in the Lower Harbour, can be seen in the reach of the drogue in s. 2.1.2 released at HW+2hrs, when it reached Corkbeg Island and in s. 2.1.3 released at HW+3½hrs, when it travelled only half the distance across the Harbour the following day. The release just 1½hrs later made an enormous differenceto the distance then travelled.

**Drogue run on 14.10.19 showing the gyre at the Marina embayment in East Ferry**




These water movements are well-known to all those who use East Ferry, and was also found and noted in the float tests carried out by M.C. O'Sullivan in his Statement of Evidence for the Public Sworn Enquiry of June 1976 for the Midleton Sewerage Scheme[1] , where he alluded to the float studies carried out in 1972 for the Scheme. I attach a copy of the relevant pages, of this record – with my emphasis added:



p.17 (10) *A release of floats at Rathcoursey Point (head of the East Passage) indicated that **not all materials released here would get down to the southern end of the East passage before the tide turned** and in fact **the floats were inclined to ebb in towards the side of the passage and lodge on the shore."***

p.22 *Appendix. Feasibility study for discharge of effluent from Midleton sewerage scheme at Rathcoursey – East Passage.*

*"The design philosophy underlying the study is that **it is more desirable <u>economically</u> to pipe effluent to a tidal location downstream from the source and discharge effluent raw, rather than install a treatment plant at the source location.***

*"In this context it is proposed to discharge the effluent from Midleton sewerage scheme at Rathcoursey – head of the East Passage. Total estimated load is 12,800 lb BOD/day. **Discharge is to be intermittent commencing on the ebb tide one hour after high water and terminating four hours after high water.***

*"Hence the **large volume of water contained in the North Channel**, behind Gt. Island, becomes available for mixing and dispersion. Also the main body of the discharge is carried*

[1] M.C. O'Sullivan. Midleton Sewerage Scheme. CPO on Site Acquisition. Statement of Evdience for Public Sworn Enquiry. June 1976

*into the Lower Harbour, where* ***hopefully*** *the increased mixing and dispersion ensures a minimum return of effluent on the flood tide".*

Having thus raised our hopes, he still allows the next paragraph to remain:

*"The feasibility study centres around the efficiency of the design procedure selected, and the environmental impact that the discharge is liable to have* ***on the semi-enclosed water body of the East Passage and North Channel."***

It would seem to be difficult to have a "*large volume of water contained"* which is "*available for mixing and dispersion"* and then admit that both North Channel and East Passage are a "*semi-enclosed waterbody*".

One only has to look at the Admiralty chart to see that apart from the deep channel itself, one can walk from one end of the oyster beds to the other in waders at LW on a good spring tide – hardly an adequate sump to use for *"mixing and dispersion*".

If we search the original work, the MC O'Sullivan Preliminary Report on Midleton Sewerage Scheme 1972[2] , we find that his 3 earliest floats from Ballinacurra (A, B & C) took respectively 3hours; 1 hour and 1 hour to progress down the Owenacurra Estuary and reach Rathcoursey (para. 13 p.55).

In para. 15 he reports:

*"Float E which was released on a falling tide, but rather late in the tide, went downstream for the period of 1 hour and then was carried right back up the estuary on the rising tide. All floats after this were carried back up the estuary."*

Para. 16 "*The float survey seems to indicate clearly two points:-*

*a) That material released over a 2 hour period at Ballinacurra would be swept down to the east passage and hence to the lower harbour provided the release was carried out no later than 3½ hours after high tide.*

*b) That material released later than 3½ hours after high tide would be carried back right up the estuary to the mouth of the Owenacurra and Dungourney Rivers.*

Thus, if we add an hour to this latter batch of releases, for the usual travel time from Ballinacurra to Rathcoursey, MCOS would have to agree that anything released at Rathcoursey after HW+4½ hrs would be "*carried back right up the Estuary*" (28%) - and North Channel (72%). Thus the Dairygold requirement to release their discharge for the full ebb tide will have the same water returning at least for 1½ hrs.

As has been required, over and over again, and up to the present day, is for an idea of what dispersion can be obtained, once the discharge has reached the Lower Harbour.

In para. 20 on p. 57 of the 1972 Report, MCOS states:



[2] M.C. O'Sullivan Preliminary Report on Midleton Sewerage Scheme for Midleton UDC. 1972

"*If the outfall point were brought further downstream to Rathcoursey, that is, to the head of the east passage, **every vestige of pollution would be swept away down into the lower harbour.**"*

But his statement then continues:

***"The exact pattern of flow has not been ascertained in the lower harbour** as it was felt that this kind of survey did not lie within the limited terms of reference".*

This is, of course, the nub of the problem. In his 1976 sworn statement, MCOS could say no more than, "*the discharge is carried into the Lower Harbour, where **hopefully** the increased mixing and dispersion ensures a minimum return of effluent on the flood tide"* (see p.4 above) - and it has been the same ever since, even up to the latest display of hopefulness in the revised, latest version of the Rathcoursey Outfall Investigation of the Impact of Treated Wastewater Discharges arising from the Dairygold Mogeely Plant to Cork Harbour, prepared for Irish Water by Irish Hydrodata of 11th July 2019:

*"All of these prism calculations **assume good mixing** which is **believed to be a reasonable assumption** given the tidal volumes, shallow depths and expansive areas discussed previously."*



The intensive drogue runs that we carried out in October and November, reported in our fourth submission, at least went a long way towards showing that a discharge in the middle of the 3½ hr period allowed at Rathcoursey, does not reach the Main Cork Channel and thus the main flow out to the open sea, even on a spring tide. On neap tides (s. 2.2.1 & 2.2.2), of course, the drogues only went half the distance, whether released at the start or end of the 3½hr period. We also saw, over and over again, that water discharged to the Rostellan area, re-entering the East Passage, would flow back over all the oyster beds in the North Channel and, indeed, as close to the Belvelly end as the draught of the drogue would permit in the shallow seagrass meadows there.

## 1.2 Water Quality in Ireland 2013-2018. EPA

This work was published on 9th December 2019 and thus was not included in my last submission. It does, however, bring us right up to date:

https://www.epa.ie/pubs/reports/water/waterqua/Water%20Quality%20in%20Ireland%202013-2018%20(web).pdf

### p.5 Executive Summary

"*The report finds that 52.8% of surface water bodies assessed are in satisfactory ecological health being in either good or high ecological status. The remaining 47.2% of surface water bodies are in moderate, poor, or bad ecological status.*

**p.7 Transitional and coastal waters**

*"Transitional waters, the collective term for estuaries and lagoons, have the poorest water quality; only 38% of water bodies are in good or better ecological status. While the status of these waters has changed little since the last report, the large percentage of water bodies at less than good status indicates* ***these waters are under significant pressure from human activities.*** *Phosphorus and nitrogen inputs to the marine environment have increased by 31% and 16%, respectively, since 2014, indicating that these water bodies are seeing an increase in pressures from catchment-wide sources.*

p.9 *"The main problem impacting on our waters is* ***nutrient pollution (nitrogen and phosphorus) which can cause excessive plant growth and increase the likelihood of harmful algal blooms*** *…… **a quarter of estuaries are failing to meet their nutrient-based environmental quality standards.** Nitrogen emissions to water are a particular concern in the south …. where losses to the marine environment are elevated and increasing…..**Nitrogen loss reduction measures need to be targeted in these areas.***

*The key to improving our water quality will be implementing the right measure in the right place. Moreover, there is significant potential to deliver multiple benefits for* <u>*human health*</u> *and for the environment in terms of biodiversity and climate from measures to improve water quality.*

Map 1.2 on p. 24 shows that the Owenacurra and Dungourney River catchments have been prioritised by the EPA as "Areas for Action" during the period of the second cycle of the WFD. The decline in water quality of the Owenacurra Estuary, North Channel and even Cork Harbour itself is shown up in more detail in the data given in the EPA's "Catchments.ie", which are tabulated further below.



p.61 ***Sec. 4 Transitional and Coastal Waters***

4.2 *"49 (62%) are in moderate, poor or bad ecological status* (Map 4.1 shows all the water bodies of Cork Harbour are now all only rated as moderate).

*"A quarter (24.5%) of transitional and coastal water bodies failed the environmental quality standard and assessment criteria for dissolved inorganic nitrogen (DIN).*

p.66 *"4.4. Phytoplankton is assessed in most transitional water bodies, and 41% of the water bodies assessed are in moderate or worse status based on the condition of this biological element.*

*For the supporting physico-chemical elements, oxygenation conditions are the main driver of status. Water bodies are assessed against two standards for dissolved oxygen, one to look at reduced oxygen concentration because of oxygen consumption of polluting organic matter and the second to look at elevated concentration which can indicate excessive algal growth*

p.68 *"In coastal waters the main physico-chemical elements assessed are dissolved oxygen (DO) and nitrogen (as dissolved inorganic nitrogen (DIN)) which is generally considered to be the limiting nutrient in marine waters. This means that this nutrient is typically found in relatively low concentrations which limits the growth of algae.* ***When there is too much nitrogen present this can cause problems with the excessive growth of algae which in turn***

***can harm other plants and animals.*** *All of the coastal water bodies assessed passed the environmental quality standard for DIN****. For dissolved oxygen, five water bodies failed the environmental quality standard.***

Cork Harbour was one of these five failing coastal water bodies.

### p.69 4.5 Hydromorphology in Transitional and Coastal Waters

*Hydromorphology was assessed in 30 transitional and coastal waters using the Hydromorphological Quality Index. Nineteen water bodies (63%) were in high or good hydromorphological condition and 10 were in* ***moderate*** *condition,* ***of which only two are coastal water bodies, Cork Harbour*** *and Dungarvan Harbour*

### p.71 4.7 Nutrients in Estuaries and Coastal Waters: Nitrogen Winter Exceedances

Map 4.2 on p.72 shows that the Owenacurra is still one of only four water bodies in the country with percentage exceedances of Winter DIN at over 50% for 2016-2018

### p.75 4.8 Nutrient Inputs to the Marine Environment



*"Since 2014 however, the* (improving) *trend has reversed and we are now seeing an increase in nutrient inputs to the marine environment. Average total nitrogen in 2016–2018 has increased by 8,806 tonnes (16%) since 2012–2014, the majority of which is coming from the catchments to the south and southeast of the country."*

## 1.3 Data taken from the records in "Catchments.ie".

https://www.catchments.ie/

The data collected by the EPA and presented in this June 2016 website, are divided into four time periods:

2007 -2009
2010 -2012
2010 -2015
2013 -2018

The Water Framework Directive parameters listed that are relevant, tabulated below, show a progressive decline in water quality in the Owenacurra, North Channel and Cork Harbour over each of the four periods:

# Table of EPA Surface Water Data from Catchments.ie

**Overall Decline in Water quality**

| Parameter | 2007-2009 | | | 2010-2012 | | | 2010-2015 | | | 2013-2018 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Owenacurra Est. | N. Channel | Cork Harbour | Owenacurra Est. | N. Channel | Cork Harbour | Owenacurra Est. | N. Channel | Cork Harbour | Owenacurra Est. | N. Channel | Cork Harbour |
| Ecological Status or Potential | Good | Moderate | Good | Moderate | Good | Moderate | Moderate | Good | Good | Moderate | Moderate | Moderate |
| Biological Status or Potential | Good | Moderate | Good | Good | Good | Good | Moderate | Good | Good | Moderate | Moderate | Good |
| Hydromorphological Conditions* | Below good | n/a | Good | Below good | n/a | Below good | n/a | n/a | Moderate | n/a | n/a | Moderate |
| Supporting Chemistry Conditions | Good | Moderate | Moderate | Moderate | Good | Good | Moderate | Good | Moderate | Moderate | Moderate | Moderate |
| General Conditions | Good | Moderate | Moderate | Moderate | Good | Good | Moderate | Good | Good | Moderate | Moderate | Moderate |
| Phytoplankton Status or Potential** | Good | Moderate | Good | Good | Good | Good | Good | Good | High | Moderate** | Moderate** | High |
| Oxygenation Conditions | Good | Moderate | Good | Moderate | Good | Moderate | Moderate | Good | Moderate | Moderate | Moderate | Moderate |
| Dissolved Oxygen % | Good | Moderate | Good | Moderate | Good | Moderate | Moderate | Good | Moderate | Moderate | Moderate | Moderate |
| Nutrient Conditions | Moderate | Moderate | Good | High | High | High | Moderate | Moderate | Good | Moderate | Moderate | Good |

*Hydromorphology considers the physical character and water content of water bodies. Good hydromorphological conditions support aquatic ecosystems (i.e. hydromorphological elements such as water flow and substrate provide physical habitat for biota such as fish, invertebrates and aquatic macrophytes).

**The EPA advise that the phytoplankton biomass assessment consists of two parts: biomass (chlorophyll) and phytoplankton composition (cell numbers and composition) and that in the **Owenacurra is classed as moderate as both parts of the tool failed with high chlorophyll values and high individual species cell numbers**. While the North Channel failed on the phytoplankton composition, where there was high cell numbers of single species, but these tended to be of small diatoms which may explain why the Chlorophyll values were within the range of normal conditions.



**Comparison of Water Quality alternating in the Owenacurra Estuary v. North Channel in the same years up to 2015 - now both waters "Moderate" in the latest period.**

| Parameter | 2007-2009 | | | 2010-2012 | | | 2010-2015 | | | 2013-2018 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Owenacurra Est. | N. Channel | | Owenacurra Est. | N. Channel | | Owenacurra Est. | N. Channel | | Owenacurra Est. | N. Channel | |
| Ecological Status or Potential | Good | Moderate | | Moderate | Good | | Moderate | Good | | Moderate | Moderate | |
| Biological Status or Potential | Good | Moderate | | Good | Good | | Moderate | Good | | Moderate | Moderate | |
| Hydromorphological Conditions | Below good | n/a | | Below good | n/a | | n/a | n/a | | n/a | n/a | |
| Supporting Chemistry Conditions | Good | Moderate | | Moderate | Good | | Moderate | Good | | Moderate | Moderate | |
| General Conditions | Good | Moderate | | Moderate | Good | | Moderate | Good | | Moderate | Moderate | |
| Phytoplankton Status or Potential * | Good | Moderate | | Good | Good | | Good | Good | | Moderate | Moderate | |
| Oxygenation Conditions | Good | Moderate | | Moderate | Good | | Moderate | Good | | Moderate | Moderate | |
| Dissolved Oxygen % | Good | Moderate | | Moderate | Good | | Moderate | Good | | Moderate | Moderate | |
| Nutrient Conditions | Moderate | Moderate | | High | High | | Moderate | Moderate | | Moderate | Moderate | |
| **Av. overflow m3 p.a. in Owenacurra:** | **356,812** | | | **399,182** | | | **315,460** | | | **235,711** | | |

(2019 EPA Water Quality 2007-2018)

**Note:**

WWTP increased by 50% in February 2012.

Reduction in Owenacurra spills 21%

## 1.4 Recent Trends in Nutrient Inputs to Estuarine Waters. Ni Longphuirt S. and Stengel D. B. EPA Res. Prog. 2014-2020 (2016)

***"Executive Summary.*** *Increases in the nutrient loads into estuarine and coastal systems have resulted in a concurrent biological response with an increase in the occurrence of micro and macroalgal blooms.* ***In fact, moderate changes in phytoplankton biomass and the frequency of blooms, due to nutrient enrichment, have contributed to over 20% of transitional waters being classed as having a less than "good" ecological status****, as assessed under the European Union Water Framework Directive (WFD).*

*"This study has shown that, in the Irish context, the impact of measures to reduce nutrient loadings is largely dependent on load source and input magnitude, as well as on nutrient cycling processes and modulating factors, such as light and* ***residence time.***

p.2 "***A further consequence of excess nutrient loading is an increase in the frequency of phytoplankton blooms****. Blooms occur if biomass levels are outside what is considered the normal range for a given area (Carstensen et al., 2004).* ***In particular, the frequencies of harmful algal blooms of species that are considered toxic have been increasing worldwide*** *(Van Dolah, 2000).* ***Some of these species are considered a serious health risk to humans and can have important impacts on shellfish production.***



## 1.5 River Basin Management Plan for Ireland 2018-2021. (2018)

This new RBMP was launched by the Minister with a stirring foreword on the new and revised policies in the Plan, including:

"*Over the last decade, the quality of our water has stood still. As we look to the future, we are faced with increasing demands on our water resources from a growing population and economy. It is essential that we take strong steps to protect and improve our water quality; by both making river basin management plans and implementing them. We are addressing this imperative. This River Basin Management Plan is a new approach to the protection, improvement and sustainable management of the water environment. We now have a much-improved evidence base to support the development of new national policies and initiatives, and to more effectively guide the deployment of supporting measures at local level".*

https://www.housing.gov.ie/sites/default/files/publications/files/rbmp_full_reportweb.pdf

The North Channel of Cork Harbour has been noted as one of the 64 shellfish areas in Ireland most frequently failing the guide value set for designated shellfish waters:

**p.32 "4.7.4 Shellfish Waters**

*"Between 2009 and 2015,* ***the areas that most frequently failed*** *to meet the guide value were: Adrigole Harbour, Bannow Bay, Bantry,* ***Cork North Channel****, Cromane, Gweedore Bay, Kinsale, Loughras Beg, Tralee Bay and Wexford Harbour (inner and outer). Urban waste-water discharges in the vicinity of shellfish waters are being assessed to determine whether they are contributing to failures in shellfish-water objectives and, in turn, whether more stringent waste-water treatment is required.*

**p.33 "4.7.5 Protected Water-Dependent Habitats and Species**

*There are 44 different designated Natura 2000 water-dependent habitat types that have been identified by National Parks and Wildlife Service. In meeting their conservation objectives in 2013-2015, the NPWS found only 5 have Favourable Conservation Status, the remaining 39 (89%) have Unfavourable Conservation Status.*

When we read through the RBMP, we come to:

**p.47 Section 6: Environmental Objectives of the Water Framework Directive**

**Prioritisation of Resources**

*The Water Framework Directive (WFD) sets out the environmental objectives which are required to be met through the process of river basin planning and implementation of those plans. Specific objectives are set out for surface water, groundwater and protected areas. The challenges that must be overcome in order to achieve those objectives are very significant. Therefore,* ***a key purpose of the River Basin Management Plan (RBMP) is to set out priorities and ensure that implementation is guided by these priorities.***

6.2 *"Very significant challenges must be overcome in order to achieve the objectives that are clearly set out in the Directive. Therefore, a key purpose of this Plan is to set out priorities and* ***ensure that implementation of this Plan is guided by this prioritisation****.*

*In line with the above, and with the characterisation work undertaken to date by the Environmental Protection Agency (EPA), the following prioritisation was decided upon for this cycle of the Plan:*



- *Ensure full compliance with relevant existing EU legislation*
- *Prevent deterioration*
- *Meet the specific water-related objectives required for our protected areas*

p.48 6.3 The map shows that the SW Region has nine Priority Transitional Water Bodies identified - nearly twice the number of the rest of the country added together (5 in all). It is explained again that:

"*During the development of this Plan, a prioritisation exercise was undertaken by the local authorities, the EPA and other stakeholders to identify those water bodies that require immediate action within this plan cycle to 2021.*

**Midleton and the Owenacurra/Dungourney River catchments are "Prioritised Areas for Action"**

Map 13.1 on p.138 pinpoints these "*Areas for Action"*, giving the data source as EPA/OSi dated 23/03/2018, on which the Owenacurra and Dungourney River catchments are detailed and then in Appendix 2 on p.158 in the 190 Prioritised Areas for Action – Midleton is listed as one of the 21 areas in Co. Cork, which, as a County, has approximately twice as many prioritised areas as the next 3 worse performing counties of Donegal, Galway and Mayo.

## 2. The hydro-morphology of Cork Harbour

I have taken the bathymetry of Cork Harbour from *Modelling the Norovirus in Cork Harbour* by Prof. O'Kane and Barry K. Nov. 2007[3], p.24

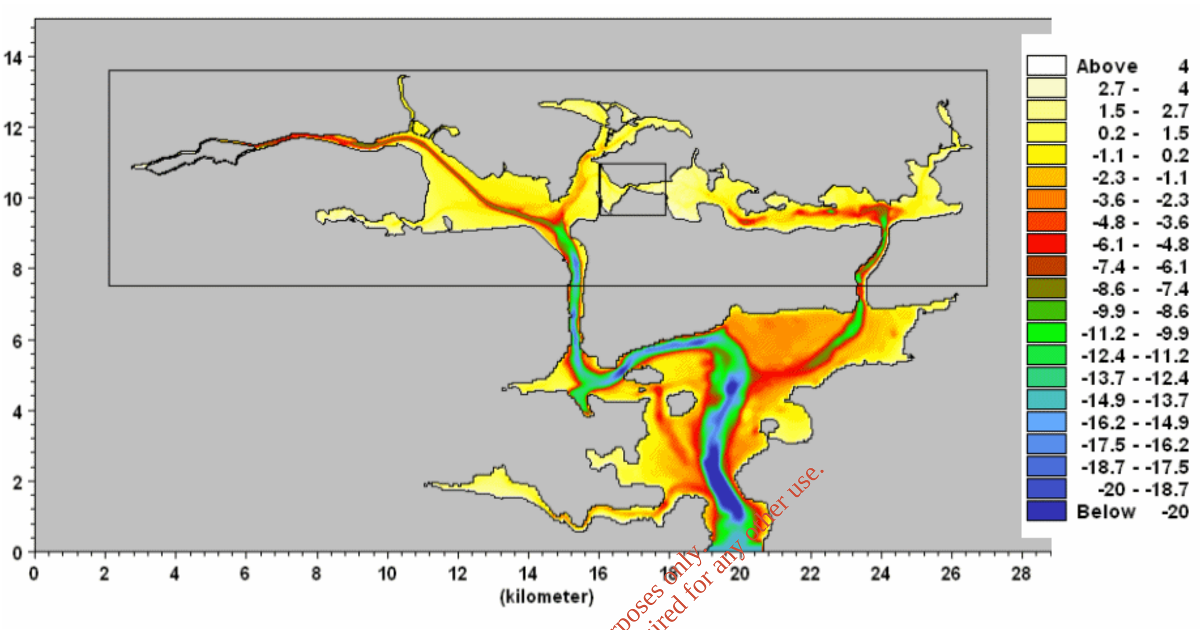



***Fig. 1.3 RP bathymetry plot – 54m, 18m & 6m nested grids. The colour palette on the right-hand-side indicates the depth of the harbour bed in metres.***



It can be seen that Cork Harbour is a submerged river system, with two branches that have cut through the Old Red Sandstone ridge of Great Island, which meet in the main harbour to the east of Spike Island. The branch coming down from Midleton via East Ferry arrives at this confluence at a LW depth of 4-5m, joining the very much wider Cork Main Channel of 15-20m depth and passing out of the Harbour between the Forts in a channel becoming 25m deep, as is shown above.

The depths of these two river beds across the Harbour is a reflection of the size of the streams that have made them. The catchment area of the River Lee, at about 2,000 $km^2$ , is ten times the size of the 200 $km^2$ catchment of the Owenacurra and Dungourney Rivers coming down the Owenacurra Estuary.  However, precipitation in West Cork is also far greater than East Cork and the median flow down the Lee at 185m3/s is 70 times the average annual flow down the Owenacurra and Dungourney Rivers at about 2.6m3/s.

Thus the behaviour of the flooding tide, driven by the rising water level in the Lower Harbour (as at Cobh), up the two branches, is quite different. The cross-sectional area of Passage West is only 3½ - 4 times that of East Ferry, yet on average 70 times as much fresh water is coming down it as comes down the eastern branch.

[3] Modelling the *Norovirus* contamination of an Oyster Farm in Cork Harbour *Final Report Nov. 2007* Professor J.P.J. O'Kane and Kevin Barry

It is thus easy to understand from this overall picture, that with less resistance being offered to the flood tide by the East Ferry Channel, than up Passage West to Cork, there should be the possibility of an anti-clockwise flow around Great Island when the two waters are joined at the top end of the North Channel at Belvelly, which occurs every time the tidal amplitude rises towards the level of springs.

The local tide tables for Cobh and Cork City and the notes that they give on the tides and currents around the harbour are instructive:

*"The flood does not make on the surface at Cobh for an hour longer after it has begun at the mouth of the harbour. The tide from Cobh up to Cork depends very much on the fresh in the river,"* and,

"*High water takes place at Cork twenty minutes later* (than Cobh)"

Meanwhile, we determined in our last submission at the end of s. 3.3 on p.27 that, apart from the outflow of surface fresh water, the turn of tide at the top of East Ferry at Rathcoursey Point, is exactly the same as that given for Cobh.

Thus this imbalance of the flood tide up the two branches leads to the height of the tide reaching Lough Mahon always being some minutes behind the rise of tide in the North Channel. I have also always felt that the last century further filling in of the Lough Mahon to Belvelly channel for the Cork to Cobh railway line, in the placement of the small single span bridge there, must also restrict the entry of water from Lough Mahon at the top of the tide (see the aerial photo below in the next section, showing how much of the highest part of the inlet was cut off by about HW- 2hrs).



Any difference in levels will then, of course, allow some flow out of the North Channel into Lough Mahon as the tide level rises in the channel joining the North Channel via Belvelly to Lough Mahon.

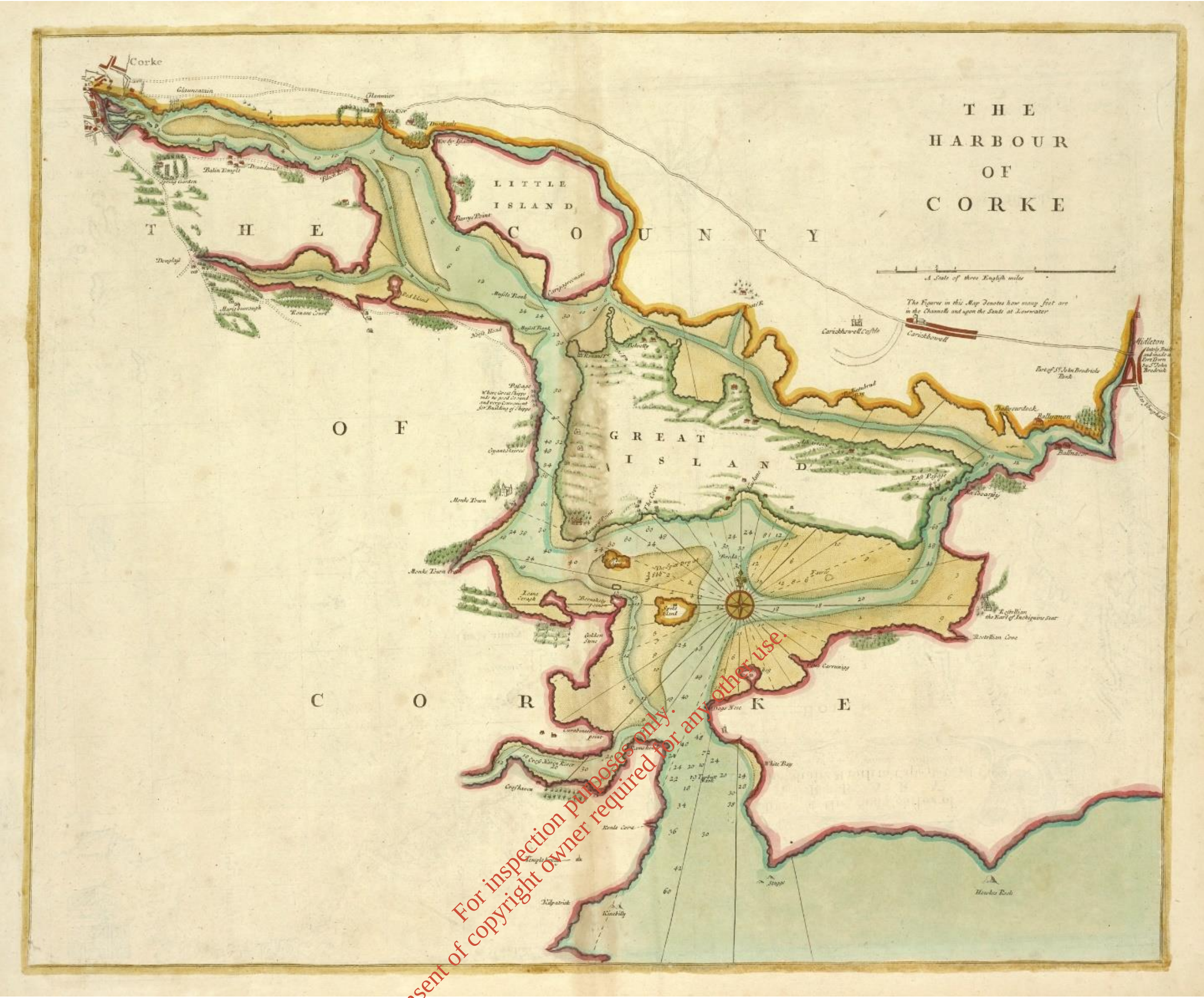
On the ebb, the proportionately much greater flow of freshwater from the Lee is now increasing the overall speed of flow down Passage West, in fact it is easily observable that:

*"if there is much fresh in the river, there is a strong surface ebb at Cobh before high water,"*

Thus, at the southern end of Passage West, and also shown every day in the tide tables, we find that the tide at Cobh is now running 8-10 minutes ahead of the times given for Cork City, which continues the difference in water levels between the Lough Mahon and North Channel sides of Belvelly Bridge and allows water to continue to flow from the North Channel until the connecting channel dries out.

This scenario can be appreciated in this old map of Cork Harbour, drawn when "*Midleton lately built and made a Port Town by St. John Broderick"*, (Sir St John Brodrick 1627-1711), which shows the positions where the later Belvelly Bridge and railway bridge were built. In those days there was clearly a deeper channel of 6', 6' and 10' depths at LW in Lough Mahon, which is considerably deeper than the channel at the very top of the North Channel, and then joining the main channel from the City at a depth of 30ft off Carrigrennan, would have been the channel carrying surplus flow from any anti-clockwise flow around the central island, set up by any imbalance in flows up the two river arms.

**Map of the Harbour of Corke c. 1680?**

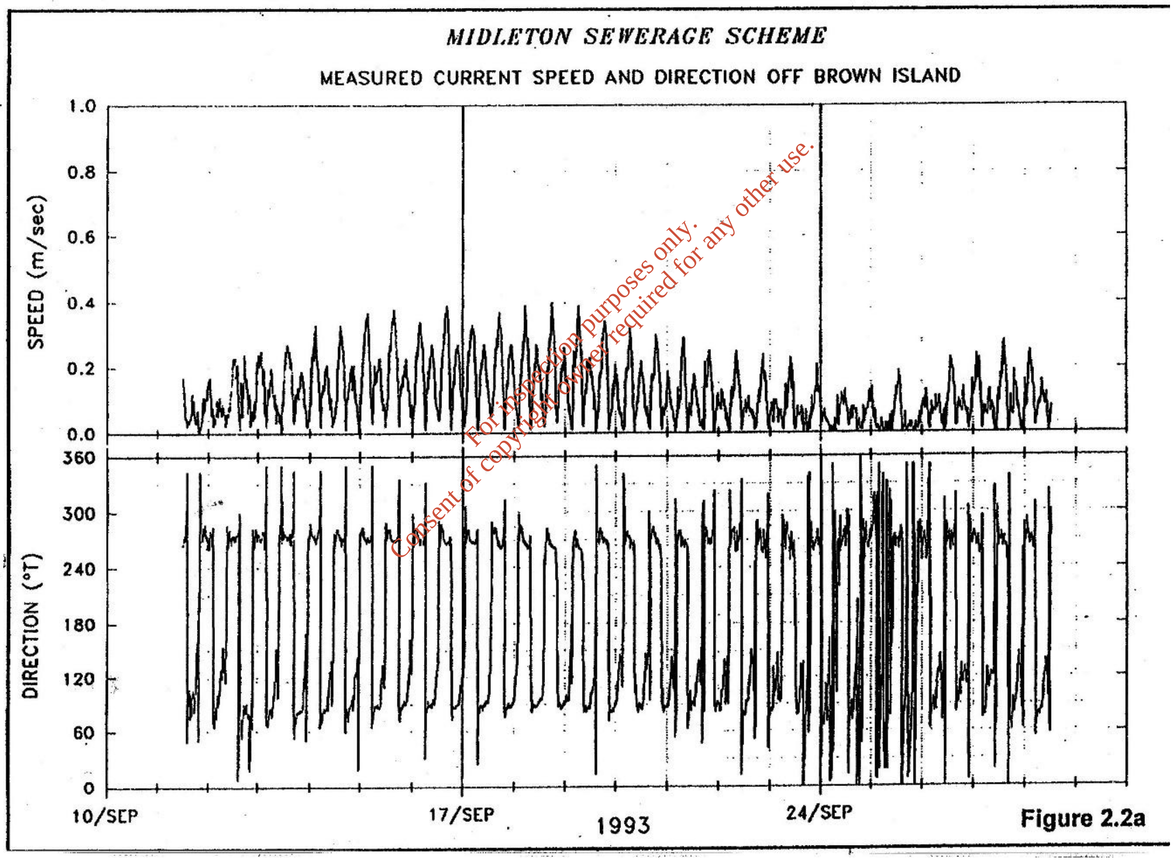


## 3 Results from Current Meter Records over a Full Neap/Spring Tide Cycle.

In our last submission we had intended to be able to put forward data from two complete tidal cycles over the period of a month, which was shown only in graphical form, below, in the Marine Outfall Study of Irish Hydrodata in the EIS for Midleton Waste Water Treatment Plant of November 1993 and repeated in the Midleton WWTP EIS Technical Appendices, November 1996, as the Hydrographic Survey Report by Irish Hydrodata, presented to the Minister of the Marine to obtain a further foreshore licence for the WWTP.

It seems to be quite clear from this graphical presentation that the flow of water in the North Channel on the flood tide is very much greater than the returning flow on the ebb, indicating that there is a residual flow in the North Channel to the west.

**Current speeds and directions at Brick Island. Midleton WWTP 1993. EIS 1996**






In sec. 5 of our First Submission, I listed the observed evidence for this in practice:

5.1 Half-submerged branches; boats breaking loose from moorings; drownings in East Ferry – all of which are most often found upstream and even up to the far west end of the North Channel.

5.2 & 5.3 Evidence from all the dye studies carried out (MCOS 1977 and Irish Hydrodata 1993) showing the highest concentrations of dye at the <u>west</u> end of the North Channel, furthest away from the discharge point at Rathcoursey.

All of which are supported by the NUIG computer-based flushing model, which shows the water retention in the North Channel increasing from 50 days over the oyster beds to 70 days further west towards the exit at Belvelly.

5.4 EPA winter sampling of nutrients in 2016 and 2017 shows some of the highest concentrations of TON and PO4 in the North Channel at Station LE420 (Weir Island) rather than the station north of East Ferry which must be closer to the entry point of these nutrients.

**Positioning of the two current meters**

Two Acoustic Doppler Current Profilers, kindly provided again by BIM, were deployed on Thursday 9 January, as shown by:

1) the westerly star, just east of Brick Island in this figure given in the EIS, to recreate the data for the 1993 position:

**EIS Fig. 2.1, Position of the current meter close to the east end of Brick Island.**
***This figure precedes the above current speed and direction data in the EIS. The position of the another meter in the Bagwell's Hill gyre is shown close to the top of East Ferry.***

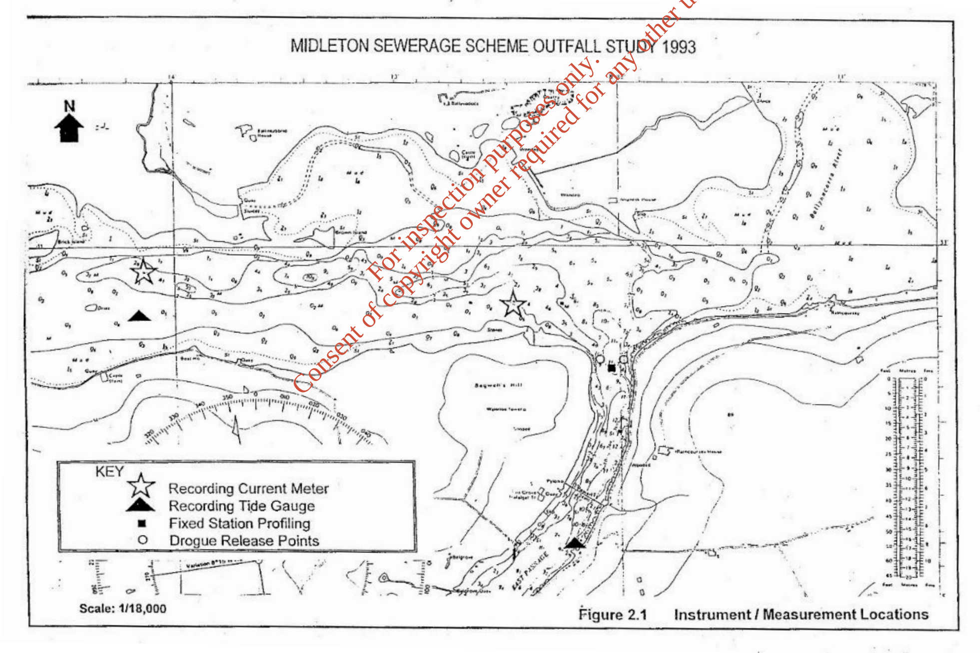


Figure 2.1 Instrument / Measurement Locations



and 2) in the channel about 1,200m further west, on the bend before the channel heads NW, which was the most westerly deployment where the ADCP would still be underwater at LW.

However, we unfortunately did not get a record from this second ADCP, as Dr. McCoy of BIM advised after lifting it:

*"However, there was a problem with ADCP 0614 unit placed closer the Belvelly Bridge side of the North Chanel {coordinates East (182006.502 m), North (69749.470 m)}. When we retrieved this unit from the water it was hanging upside down. The unit collected data but unfortunately looking at the pitch (39.27337) and roll angle (174.8647) which is way off,*

*means the data from this unit is unusable and is full of errors as this confirms that it was on its side facing into the mud.*

He advised that we were left with good data from the Brick Island ADCP, which we had deployed as closely as we could to the position used for the 1993 Irish Hydrodata record.

In the Summary of Field Works Section in the Irish Hydrodata November 1993 Report, we find details of this earlier deployment on p.2:

*2. Field Studies  2.1 Current and tide measurements*

*2.1.1 Two recording current meter were deployed in the North Channel at the locations shown in figure 2.1, for a 17 day period. The meters were attached to U-moorings and set to record the currents **at 1.3m above the seabed** every ten minutes.*

*2.1.2 Data from the current meters are shown in figures 2.2a, 2.2b* (the Bagwell's Hill gyre) . *At the site off Brown* (actually Brick see fig. 2.1) *Island the flows were regular and peak flood tide speeds of 0.4m/s were reached during the large spring tides of 17th/19th Sept. Ebb tide values almost reached 0.3m/s. During average spring tides the corresponding values would be approximately 0.35m/s on the flood and 0.26m/s on the ebb. During the average neap tides of the 25th/25th Sept. flood tides fell to 0.2m/s and ebb values to below 0.1m/s.*

Apart from noting the height above the seabed at which the currents were measured as 1.3m, it should also be noted that Irish Hydrodata give us their own appreciation of the relative speeds of the flood and ebb currents in the second paragraph:

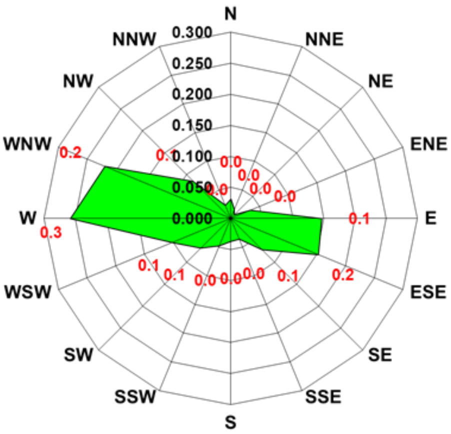
| | Flood tide | Neap tide | % greater flood |
|---|---|---|---|
| **Peak** | 0.35m/s | 0.26m/s | 35% |
| **Average spring tide** | 0.4m/s | 0.3m/s | 33% |
| **Average neap tide** | 0.2m/s | <0.1m/s | >50% |



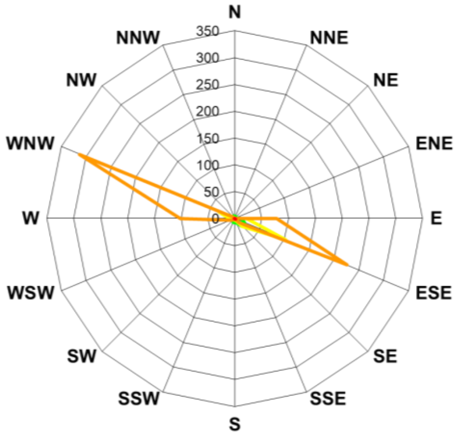
**Data obtained from the January deployment of the current meter at Brick Island**

BIM have given us the average current speed and direction rose at the 1.1m from the bottom:

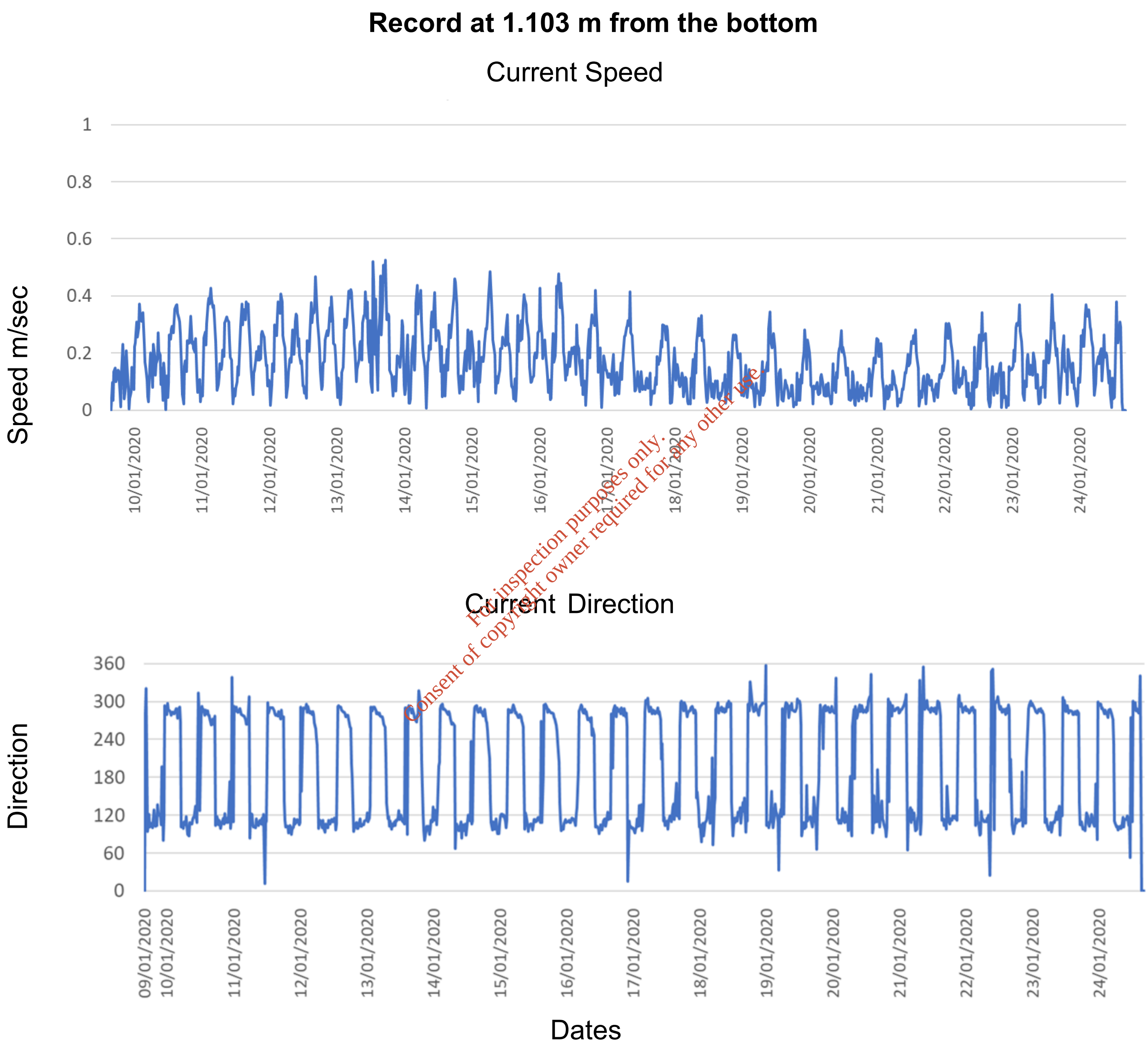
0615 ADCP Bottom Average Speed (m/s)




0615 ADCP Bottom Current Rose

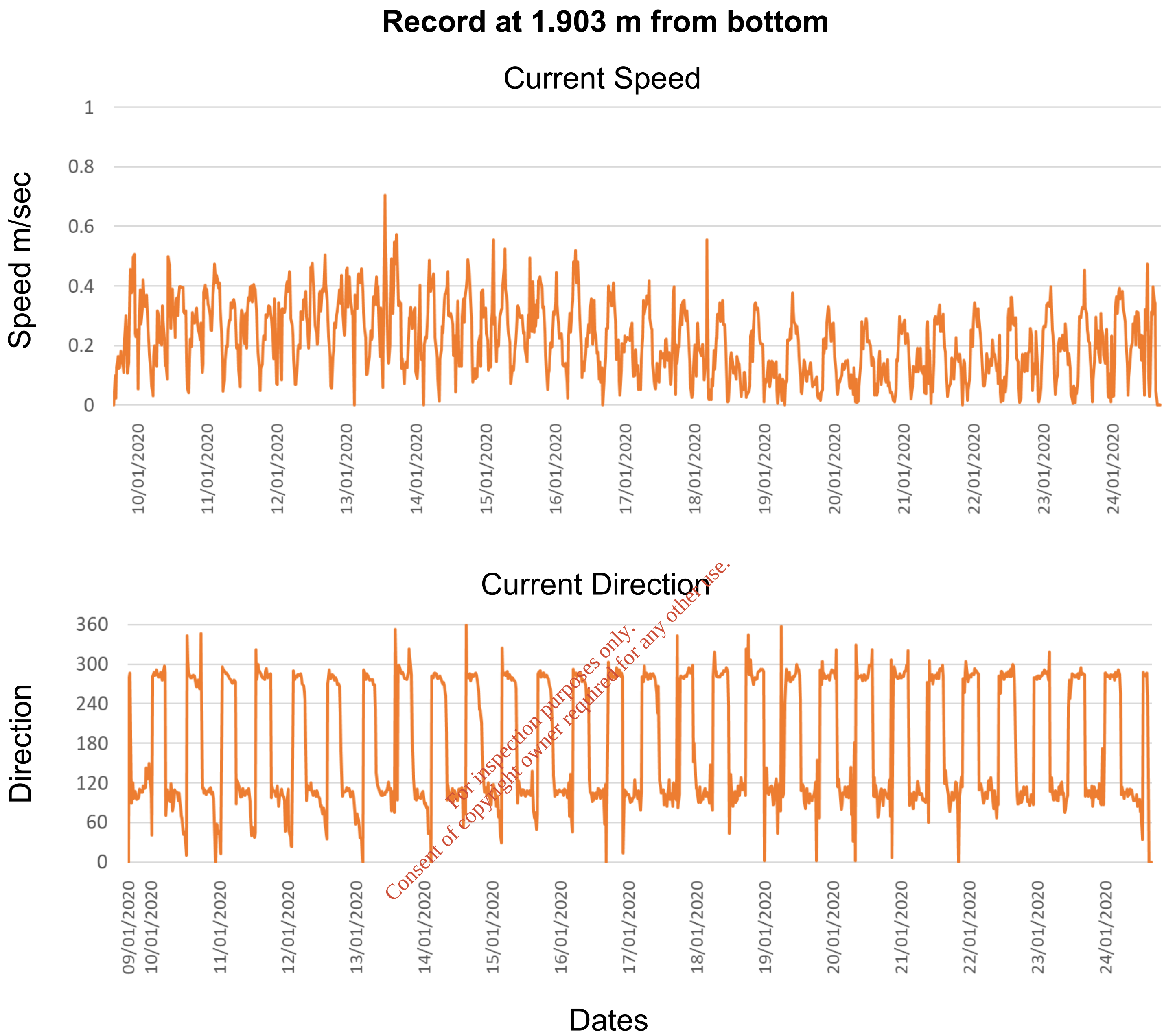


We did not set the current meters to the same depth as measured in 1993 of 1.3m, but we have measurements at 1.103m and 1.903m, which would give us an average of 1.5m and this comparable data to Irish Hydrodata's, shows a very similar pattern to that found in 1993:






It is easy to see that the peak current speeds are associated with the current flowing virtually due west, in other words with the flood tide and that they are considerably larger than the ebb tides flowing to the east.






At this average depth of 1.5m, the average residual tide to the west is 0.027 m/s, which over the course of a tidal cycle of 12 hours 25 minutes, would represent a tidal movement of 1.2 km in a direction of between 275.5° and 317.2°, i.e. between W and WNW as shown in the BIM rose above.

This water movement towards Belvelly and Lough Mahon can be observed in a boat at HW west of Weir Island at the start of the ebb tide, when the boat will follow the flow of water westwards.

The size of this residual movement was similar to the observation we made with the consecutive drogue runs that were made on the 8th and 9th of November (s. 3.1.2 and Table 3.1.2.1 on p. 18 of our fourth submission) when I calculated that the westerly drift might be about 900m on the second tide.

# 4. Conclusions and Acknowledgements

We are very grateful to the EPA for extending the time-limit for us to complete the full tidal cycle with these current meters in order to come up with the best scientific re-assessment of the 1993 data, which was of such fundamental importance in allowing the continued use of the outfall at Rathcoursey Point to discharge waste material.

We had also been grateful to Irish Water for having been asked to read the submissions made after 13th December in the EPA's request of 24th December 2019, which included our fourth submission, with its practical demonstration of water movements from Rathcoursey, made with the drogue runs, and confirm to the EPA whether or not the issues raised would alter their assessment and the consent granted to the proposed discharge to sewer under Section 99E of the EPA Act, as amended, and we had thought, for not endorsing their original consent for this Dairygold discharge. However, we now see that Irish Water have lodged a response dated 29th January, but its contents appear not to be allowed to be divulged. This would seem to go against the principle of transparency, which lies at the heart of the EIA process, which I discussed in my third submission.

The 1993 tidal current meter data from a point close to Brick Island, at the west end of the oyster beds, appeared to show very clearly that the flood tide currents were so much faster than the ebb currents, with not enough difference in duration of the tides to even out the overall movement, that there must be a residual flow to the west, which would actually retain any discharges made at the top of East Ferry.



The piece of work we have reported here explains a great deal about the problems we have experienced on the oyster farm. We believe that the knowledge that there was an anti-clockwise residual movement of water around Great Island was known to the Consulting Engineers and their Hydrographic Advisors and they would have been privy to its size.

An exact calculation of the size of any such residual flow can, of course, only be made by computer analysis of the original data and although we have now asked for this to be done several times and Dairygold and their advisors have had all this extra time to do it, they have not provided us with the answer.

The re-deployment of a current meter in the same position and depth as in the 1993 Irish Hydrodata survey, has allowed us to obtain the raw data with which to come up with an estimate of the size of the residual tide which was found in 1993. Although the height of the meter was not specifically set to exactly 1.3m above the seabed, as in 1993, our two records at 1.1m and 1.9m, with an average at 1.5m, show that there is indeed a residual flow to the west and that it has a magnitude of 0.027m/s, which could represent a movement of 1,200m per tide to the west.

A residual movement of water to the west would carry any discharge from Rathcoursey towards Belvelly and the limited access to Lough Mahon would result in the very lengthy retention time of the water there, predicted by the NUIG hydrodynamic papers. Such an overall westerly flow and the very poor flushing that all this work indicates, shows that the North Channel simply becomes a sump for discharges made at Rathcoursey.

In the case of the discharge we are considering here, the additional nutrients that will be added by a volume of water that is nearly as much as from the town of 13,000 people in Midleton, into the one waterbody in Ireland that has this regular toxic algal bloom of Paralytic Shellfish Poisoning, must surely be considered a non-starter.

The pipeline already laid by Dairygold to the Whitegate Road, could be extended now to the open sea at Ballycroneen down public roads, as suggested already by two sets of Consulting Engineers, or they could consider the many alternatives that have been put forward, but I hope that in these five submissions and a further submission from our Hydrographic Consultant, that we have now shown that Rathcoursey Point is about the worst location for a discharge of waste water, that could ever have been chosen, and that the EPA will not now allow it to be augmented by this further discharge from Dairygold/TINE.

**References attached:**


1. C.P.O. on Site Acquisition. Statement of Sworn Evidence for Public Sworn Enquiry. June 1976. M.C. O'Sullivan, Consulting Engineer. 2pp.

2. Preliminary Report on Midleton Sewerage Scheme for Midleton U.D.C. 1972. M.C. O'Sullivan, Consulting Engineer.

# MIDLETON SEWERAGE SCHEME

## C.P.O. ON SITE ACQUISITION

## STATEMENT OF EVIDENCE

for

## PUBLIC SWORN ENQUIRY



Consulting Engineer:
M. C. O'Sullivan BE., FIEI., MICE.,
MIWE., M.Cons. EI.,
39 Sunday's Well,
Cork.

June 1976

8. Float studies indicated that release of effluent at the present point of discharge would result in the bulk of the effluent going down the East Channel into the Lower Harbour but that some would remain in the North Channel and would return. Nevertheless it was calculated that if the release was intermittent and properly timed the overall effect on the B.O.D. of the receiving water would be to raise it by lp.p.m. based on the assumption that there would be 40% exchange of new water at the head of the East Passage and that there would be no re-aeration.

9. It is interesting to note that a subsequent study done quite recently which assumed an zero exchange at the head of the East Passage but took the normal factors for re-aeration (that is assumed the North Channel was in fact a lake) gave a figure also of l.p.p.m. practically speaking.

10. A release of floats at Rathcoursey Point (ahead of the East Passage) indicated that not all materials released here would get down to the southern end of the East Passage before the tide turned and in fact the floats were inclined to ebb in towards the side of the Passage and lodge on the shore.

= East Ferry



11. It was decided that as a long term aim with the build up of organic pollution loads the ideal discharge point would be at the north end of the East Passage off Rathcoursey Point. For the present and with the existing pollution load a discharge point downstream of the proposed barage site would be adequate provided that the discharge was intermittent on outgoing tides.

12. Obviously as a long term solution it would be better to discharge to the head of the East Passage but no matter where the discharge point is, that is either at Ballinacurra or at the head of the East Passage, the correct siting for the tidal tanks is on the present site.

13. The present site combined two very important factors:-

(a) It gives the minimum pumping head which will permit an eventual discharge to the head of the East Passage.

(b) It is the maximum distance that one could place the tanks from any inhabited dwelling.

APPENDIX

# FEASIBILITY STUDY FOR DISCHARGE OF EFFLUENT FROM MIDLETON SEWERAGE SCHEME AT RATHCOURSEY - EAST PASSAGE:

## Introduction:

The design philosophy underlying the study is that it is more desirable economically to pipe effluent to a tidal location downstream from the source and discharge the effluent raw, rather than instal a treatment plant at the source location.



In this context it is proposed to discharge the effluent from the Midleton sewerage scheme at Rathcoursey - head of the East Passage. Total estimated load is 12,800 lb. $BOD_5$/day. Discharge is to be intermittent commencing on the ebb tide one hour after high water and terminating four hours after high water.

Hence the large volume of water contained in the North Channel, behind Gt. Island, becomes available for mixing and dispersion. Also the main body of the discharge is carried into the Lower Harbour, where hopefully the increased mixing and dispersion ensures a minimum return of effluent on the flood tide.

The feasibility study centres around the efficiency of the design procedure selected, and the environmental impact that the discharge is liable to have on the semi closed water body of the East Passage and North Channel.

## Proposed Study Solution:

Two complementary approaches have been considered:-

(a) A desk study which gives a gross picture of the average pollutant concentration to be expected throughout the region for different exchange rates with the Lower Harbour.

(b) A model study (computer based which aims to predict the

# PRELIMINARY REPORT

ON

MIDLETON SEWERAGE SCHEME



FOR

MIDLETON U.D.C.

**Consulting Engineer :**
M. C. O'SULLIVAN, B.E., F.I.E.I., M.I.C.E.,
M.I.W.E., M.Cons. E.I.,
39, Sunday's Well,
CORK.

10. The magnitude of the pollution problem can be gauged from this figure. This is entirely an organic pollution practically speaking with the exception of some dye waste from Midleton Worsted and Woolcombers Ltd.

11. The first method of disposal, which comes to mind, is the comminution of the sewage and the release of the effluent on a falling tide. This proposal is shown on drawing no. 25 (Proposal No. 1). This visualises building two large tidal tanks at Ballinacurra townland, comminuting the sewage before discharging it to the tidal tanks and releasing the sewage on a falling tide.

12. Floats surveys were carried out at three points in the estuary and the results of these float surveys are indicated on drawing no. 16, 17 and 18. Drawing no. 18 indicates what happens to the floats when released at the selected disposal point at Ballinacurra. The first float was released 1½ hours after high tide and a total of 11 floats were released at 1 hourly intervals over the next ten hours.



13. The first float released 1½ hours after high tide meandered a bit over the mud flats downstream of the release point and it took 3 hours to reach the head of the east channel. Once it reached this point it was swept swiftly downstream towards the lower harbour. Float B, which was released 2½ hours after high tide, was pulled downstream practically to the head of the east passage in one hour, while Float C, which was released 3½ hours after high tide, was pulled down to the head of the east channel in one hour.

14. All three floats, A, B and C released on the falling tide went rapidly down the east passage to the lower harbour once they had reached the head of the east passage.

15. Float E which was released on a falling tide, but rather late in the tide, went downstream for the period of 1 hour and then was carried right back up the estuary on the rising tide. All floats after this were carried back up the estuary.

16. This float survey seem to indicate clearly two points:-

a) That material released over a 2 hour period at Ballinacurra would be swept down to the east passage and hence to the lower harbour provided the release was carried out not later than 3½ hours after high tide.

b) That material released later than 3½ hours after high tide would be carried right back up the estuary to the mouth of the Owenacurra and Dungourney Rivers.

17. In Appendix XVI the cost of a comminutor plus tidal tanks at Ballinacurra is given and this works out at £147,600.00. This includes the cost of rising and pressure mains from pumphouse No. 2. These are shown on plan on drawing no. 1 and on section on drawing No. 8. It would be essential to bring the outfall works down to this area because at this point in the channel it is suggested that a tidal barrage might be built in the future so that, a marine lake could be created upstream of the barrage.



18. The construction of this barrage would of course diminish the dilution available for the sewage outfall.

19. At first glance it appears that this outfall point at Ballinacurra would be adequate. However, there are a number of factors which should be taken into account and which militate against this particular outfall point. These are as follows:-

a) There is a possibility of the tidal barrage being built immediately above the outfall point, which would seriously diminish the volume of tidal water especially at neap tides, which would be available to sweep the sewage to the head of the east passage.

b) Should any of the sewage remain in the tidal area between the Great Island and the mainland, suggestions might be made that it is damaging the oyster beds in the area. This, of course, is already happening and is much more serious now since the effluents are much more likely to remain in the area than they would if the sewage was piped down to Ballinacurra. However, if the new scheme were constructed and the barrage built, it could give rise to complaints in this particular field.

20. If the outfall point were brought further downstream to Rathcoursey, that is, to the head of the east passage, and the sewage then released on a falling tide down the east passage, every vestige of pollution would be swept away down into the lower harbour. The exact pattern of flow has not been ascertained in the lower harbour as it was felt that this kind of survey did not lie within the limited terms of reference. There is no doubt, however, that the dilutions available in the lower harbour and the recharge capacity of it would be more than adequate to cope with a pollution load of 12,800 lbs. If the sewage were discharged at Rathcoursey, it would appear that the dilution upstream of this discharge point would be at least 2.5 million times the B.O.D. load. If the re-charge factor were only 0.4 and no cognisances were taken of the dilution available in the lower harbour, the most that the B.O.D. load could raise the natural B.O.D. of the water would be by 1 p.p.m.. However, as this is likely to be far lower, the effect on the dissolved oxygen content would be extremely small.

|| NB

21. The extra cost of bringing the sewage down to Rathcoursey over and above the discharge at Ballinacurra would be £93,000.00 making the total cost of comminution, tidal tanks and discharge at Rathcoursey to be £240,600. Details of this estimate is given in Appendix XVI of the Report. This amount includes the cost of rising and pressure mains from pumphouse No. 2 to Rathcoursey. These are shown on plan on drawing no. 1 and on section on drawing no. 34.



22. The matter was also approached from another point of view. An investigation was done into the cost of treatment of the effluent to a Royal Commission Standard, that is, a standard of effluent giving a B.O.D. of 20 p.p.m. and a suspended solids content not exceeding 30 p.p.m. The investigations were done into disposal costs in the following ways:-

a) Full treatment at Ballinacurra was investigated for the full B.O.D. load of 12,800 lbs. by the following methods:-

   1. Alternating double filtration.
   2. Oxidation ditch method.
   3. Extended aeration by Cavitair Process.

b) Treatment of approximately one-third of the B.O.D. load at Ballinacurra by:-

   1. Low-rate filtration loading.
   2. Oxidation ditch method.
   3. Extended aeration by Cavitair Process.