4. LANDSCAPE AND VISUAL ASSESSMENT

4.1 INTRODUCTION

This assessment is in accordance with the EPA's *Guidelines on the Information to be Contained in Environmental Impact Statements, 2002* and the Landscape Institute's *Guidelines for Visual Impact Assessment, 2002* (UK).

These documents prescribe that landscape and visual impact assessment address two discrete topics. Landscape impact assessment is concerned with alteration to the physical landscape, which may give rise to changes in its character, how it is experienced and hence, the ascribed value of the landscape. Visual impact assessment is concerned with changes that arise in the composition of available views, the response of people to these changes and the overall effects on the area's visual amenity. Landscape and visual impacts do not necessarily coincide and more importantly, their significance may not be related.

In order to meet the requirements of the relevant guidelines, the landscape and visual impact assessment takes the following form:

- *Description of the proposed development*. The components of the proposed upgrading to the waste water treatment facility are discussed with reference to landscape and visual issues.
- *Description of the receiving environment*. This explains the landscape and associated policy context in which the development would take place. It establishes a basis for, (a) the assessment of impact on the landscape (character, quality), and (b) the assessment of visual impact through the selection and survey of representative viewpoints within the proposed development's visual envelope.
- *Landscape impact assessment*. Based on the above, the appropriateness of the proposed development in terms of potential landscape impacts is discussed.
- *Visual impact assessment*. The assessment of the selected viewpoints, representative of the proposed development's zone of visual influence, is discussed and illustrated by means of photomontages.
- *Mitigation measures* to address specific impacts are set out, to be incorporated into the developments landscape plan.

4.2 METHODOLOGY

An initial desk study of topography, landform, location of archaeologically significant areas/features, ecological designations and scenic views and prospects was carried out using OSI maps and Heritage Council data. Other man-made features such as built environment and land-use were also taken into consideration. The County Development Plan was consulted to help to identify landscape character areas and significant landscape features.

The site was surveyed in detail during site visits in October 2005, when the main landscape features and the landscape character of the area were identified and evaluated in terms of their vulnerability/sensitivity. The potential for visual impact from key locations in the vicinity of the site was assessed and further evaluated using photographic views.

Landscape impacts were analysed based on:

- The capacity of the existing landscape to absorb the proposed development;
- Effects on landscape character and features (e.g. removal or alteration) as well as on the landscape values.

Visual impacts are evaluated taking account of:

- The visual envelope or zone or visual influence;
- The potential level of visual intrusion (i.e. effect impinged upon a view);
- The potential for visual impact dependant on the proximity and extent of the proposed development to a sensitive viewpoint/visual receptor.

4.3 DESCRIPTION OF THE PROPOSED DEVELOPMENT

4.3.1 Main Visual & Landscape Components

The proposed development is located in Clonakilty Harbour on the northern side of a small promontory to the east of the town where the River Fealge enters the harbour. The works comprise upgrading of the existing Clonakilty Wastewater Treatment Works. The detail of the proposed development is described in detail in Section 2 Project Description however the key characteristics of the main components of the development in terms of landscape and visual impact are:

- Prominence of main structures and treatment works apparatus.
- Scale and massing of proposed upgrading
- Contrast with adjacent developments
- Materials and colours of proposed structures

Potential Landscape and Visual impacts are considered in more detail as follows:

Landscape

- The harbour in which the site is located is a 'candidate Special Area of Conservation', a 'proposed Natural Heritage Area' and a 'Special Protection Area'.
- The site is situated in close proximity to a Scenic Landscape which is located along the northern shoreline of the harbour.

- There is potential for significant visual impact at sensitive viewpoints along local routes, in particular the 'A89 & A90 Scenic Routes', from the adjacent Model Railway Village and from the adjacent Gaelic Athletic Association ground.
- The proposed development of the GAA lands which have been re-zoned for residential development.

Visual

- The proposed development could have significant visual prominence on the coastal landscape. It could affect the image of the eastern fringe of the town and impact on a number of regional and local route ways. It could impact upon adjacent tourist leisure and sports facilities and proposed residential area.

4.4 DESCRIPTION OF THE RECEIVING ENVIRONMENT

4.4.1 Plans and Policies

In addition to a site survey, a review of the County Development Plan objectives and policies with regard to the proposed development and the receiving environment was carried out. The relevant objectives and policies are summarised next:

Clonakilty Town Council Development Plan

The Plan notes that the current waste water treatment plant is currently overloaded and requires upgrading. It also highlights the value associated with the quality of the local environment including views, tree cover and walks through the town. The development zones as outlined in the plan are shown on Figure 4.3.

The Skibbereen Electoral Area Draft Local Area Plan (Jan 2005)

The Plan highlights the county status of the Clonakility Town and its important employment, service and social function. It's important tourist and leisure functions are also noted. The continued growth in the population of the town is noted along with the forecast for continued growth in the future.

The Plan describes the attractive estuarine bay in which Clonakilty is located and lists the designations on the surrounding landscape. It states, however, that Scenic Routes will not be used as a blanket ban on development.

Cork County Development Plan, 2003

Strategic aims for the town include promotion of Clonakilty as a key technology based employment location; consolidation of its important tourism and leisure functions and maintenance of its high quality residential and facilities.

An objective of the Plan is to continue the procedure for landscape character assessment, in line with the Draft Guidelines for Landscape Assessment (2000) issued by the Department of the Environment, Heritage and Local Government. These guidelines concentrate on the distinctiveness of different landscapes and an understanding of how different kinds of development can be accommodated within them, having regard to the character and values associated with them.

Action Area Plan, GAA Lands, Clonakilty

The Action Area Plan forms the basis on which the GAA lands have been re-zoned to "Primarily Town Centre Zoning" incorporating primarily residential development with an element of smaller scale retail and retail services, complementary to the residential development. The zoning of the plan is shown on Figure 4.4.

The plan sets out a framework for the proposed mixed use development of the site. Phase one includes the provision of residential and associated retail in an urban block pattern that forms an extension to the existing town centre, a significant area of public open space adjacent to the treatment plant, riverside walkway and bridge links across the River Fealge. The proposed second phase includes a relief road located immediately west of the treatment plant which would divert traffic around the site and facilitate further integration of the site with the town. The third phase proposes a barrage across the inner harbour aimed at preventing tidal flooding and developing the inner harbour for recreational and amenity use.

4.4.1.2 Summary

The landscape is an important element of the environmental resource base. It contributes to the identity of the County, provides the context for the day to day activities of the rural community and plays a role in economic development by underpinning and attracting tourism. In a period of rapid economic growth, declining agriculture and development pressure it is necessary to ensure that the essential character giving elements of the landscape resource are conserved. Consideration must also be given to the use of the landscape in sustaining rural communities, i.e., allowing necessary social and economic development to take place while maintaining the overall quality of the environment.

Landscape assessment should inform decision makers who aim to balance development and landscape conservation. It is incumbent upon decision makers to manage development pressure in a positive way by identifying and protecting vulnerable and sensitive landscapes of strong and distinctive character which have limited capacity to absorb development without fundamentally altering their inherent character, whilst also identifying areas which have the capacity to absorb development subject to adhering to high standards of design and siting.

In seeking to reconcile and balance the conflicting demands made on Clonakilty Harbour and Estuary, it is incumbent upon decision makers not only to conserve and protect the internationally and nationally important habitats and landscape but also to give priority to development which will be of most economic and or social benefit to the locality.

The County Development Plan promotes the principle of sustainable development, recognises that industry contributes to the development of the national and local economies, acknowledges that the landscape is an important element of the environmental resource base of the County and aims to balance development and landscape conservation by a number of policies set in the Development Plan. These guidelines aim to allow necessary development of the resource to take place in a sustainable manner so as to maintain the overall quality of the local environment.

4.4.2 Description of environment

The description of the receiving environment is divided into three main categories of landscape characteristics, namely, *physical*, *cultural* and *visual/sensory*, which in combination generate the landscape character of an area.

Physical Landscape Characteristics

The proposed development is located on an existing waste water treatment works site at the north-western tip of Clonakilty Harbour where the river Fealge emerges from the town and enters the sea. It is situated on a flat promontory close to the confluence of a number of strategic and local route ways at the eastern edge of the town. The site is bordered by the local Gaelic Athletic Association (GAA) ground to the west which has been re-zoned for residential development and associated retail, the Model Railway Village tourist attraction to the south, the river Fealge to the north and the harbour to the east.

Clonakilty Harbour is located in an extremely attractive estuarine bay, which is surrounded by a series of interlocking hills and valleys. The estuary is covered by the following designations:-

- Proposed Natural Heritage Area (pNHA)
- Candidate Special Area of Conservation (SAC)
- Special Protection Area (SPA).'

The area is classified in the County Development Plan as Indented Estuarine Coastline and the landscape to the north and east of the harbour is a designated 'Scenic Landscape'. The land generally rises away from the waters edge on all sides with the exception of the sheltered inlet to the immediate west of the estuary where the town has developed over the years.

The site itself is currently heavily screened by site boundary vegetation that consists of a mixture of native and exotic species including pine (Pinus spp.), willow (Salix spp.) and some groundcover species. As a result, it is hardly discernible as a treatment works plant from most adjacent properties or route ways. There is also a mounded area of high ground on the north-eastern tip of the promontory that adds to the screening effect in views from the eastern side of the estuary.

Cultural Landscape Characteristics (land use/cover, transport, settlement pattern and designations)

The proposed development is situated on a strategically positioned promontory on the waters edge close to the eastern gateway to the town and adjacent to the local GAA ground and the Model Railway Village. However, the promontory site remains largely low key by virtue of the juxtaposition of the surrounding developments (Model Village and GAA ground) and the extent of existing boundary screening vegetation.

The high ground to the south west of the site contains a small number of residential properties some of which have views onto the site. Some properties on elevated ground on the opposite side of the harbour may also have views onto the development site.

The main east–west road (N71) designated as Scenic Route (A89) runs close to the site and could be affected by the proposals along a short stretch of the route way through the town known as 'The Croppy Boy'. Part of the Scenic Route A90 to the north eastern side of the estuary could also be affected by the development.

Stretches of the local route along the western shoreline of the harbour leading to Inchydoney Island could also be affected by the proposed development.

Visual/Sensory Characteristics

The prevailing landscape visual or sensory characteristic of the area is the estuary and its shoreline, where the surrounding landform provides a strong visual backdrop. The hillsides are characterised by rolling agricultural landscape comprising field patterns defined by hedgerows interspersed with clumps of trees in places. There is some woodland cover along the western shoreline of the harbour. This estuarine agricultural setting is interrupted by the urban form of Clonakilty town which nestles in the sheltered inlet and extends upwards along the high ground to the north of the town. The general impression is of residential properties and some noticeably larger institutional buildings such as the school at the eastern end of the town.

The site location itself is currently insignificant as a development site as it retains for all intensive purposes the image of an area of land that has been colonised by vegetation. The proposed development can remain largely undetectable so long as the boundary screening is retained undisturbed and the works apparatus remain in keeping with the existing works elements in terms of scale and materials.

Long range views along the coastline approaches to Clonakilty are dominated by the rolling landscape and ultimately by the form of the town itself as it comes into view. Views along the N71 approaches to the eastern end of the town are largely restricted by the roadside vegetation and tree cover.

Summary

The above descriptions (and the previous sections) identify a number of characteristics and values of the receiving environment that have the potential to be affected by the proposed waste water treatment facility at Clonakilty.

These are summarised and categorised according to their socio-cultural or ecological conservation value and their enhancement value. The conservation values indicate those aspects of the receiving environment which are sensitive and should be complemented and preserved by the proposed new development. Enhancement values are those where inevitable change or degraded features provide the scope to restore or the opportunity to alter or create a new characteristic.

Conservation Values

- The Proposed Natural Heritage Area (NHA), Special Protection Area (SPA) and Candidate Special Area of Conservation (cSAC) designations associated with the harbour.
- The recognised image, identity and sense of place associated with the town as a tourist destination.
- The range of attractive views afforded by routes along the harbour.
- The proximity of the town centre as a tourist destination
- The confluence of strategic routes close to the site.
- Views onto the site from residences on surrounding high ground
- Adjacent sports ground
- Scenic routes associated with the shoreline.

Enhancement Values

- The recognition of the need to provide for the on-going development of the town.
- Facilitate the upgrading of an overloaded system in a positive way.
- Contribute towards the development of a significant new area of the town centre.

4.5 LANDSCAPE IMPACT

The conservation and enhancement values of the receiving environment are described in the previous section. The impact of the development proposal on these is as follows:

4.5.1 Conservation Values

- **The Proposed Natural Heritage Area (NHA), Special Protection Area (SPA) and Candidate Special Area of Conservation (cSAC) designations associated with the harbour.**

The various designations attributed to the harbour and estuary areas will not be compromised by the upgrade of the waste water treatment works which aims to improve the efficiency and sustainability at the plant. In addition the upgrade will not incur any detrimental effect on the ecology of adjacent habitats.

- **The recognised image, identity and sense of place associated with the town as a tourist destination.**
- **The range of attractive views afforded by routes along the harbour.**
- **The proximity of the town centre as a tourist destination.**
- **The confluence of strategic routes close to the site.**
- **Adjacent sports ground.**
- **Scenic routes associated with the shoreline**

The extent to which the proposed upgrading of the plant will be screened by existing boundary vegetation means that there will be no significant impact on the above items.

- **Views onto the site from residences on surrounding high ground.**

The extent of existing boundary screening and the relatively low scale level of development, combined with the diminishing effect of distance, will mean that residential properties will not be significantly affected by the proposed development

4.5.2 Enhancement Values

- **The recognition of the need to provide for the on-going development of the town.**
- **Facilitate the upgrading of an overloaded system in a positive way.**
- **Contribute towards the development of a significant new area of the town centre on the GAA site.**

The proposed upgrading will make a positive contribution to the above objectives which will not have a significant impact on the landscape.

4.5.3 Conclusion

The sensitivity of the landscape resource has to be examined at two separate levels. At the macro scale the site lies within a landscape of recognised scenic character, that exhibits a very strong positive character and as such its sensitivity as a whole must be classified as high. However, the extent to which the site is screened and can remain screened is such that the upgraded works will still blend almost seamlessly into the landscape at a macro level.

The scale or magnitude of landscape effects the proposed development will have at the micro scale are low with the exception of the adjacent Model Railway Village where the boundary between the two sites may require some additional screen planting if the proposed works incur any loss of existing boundary vegetation.

Topography and vegetation limit the sites prominence in the local landscape. While portions of the development may be visible on close scrutiny the development will generally blend unobtrusively into the general setting of the harbour and town. Consequently, it is perceived that the proposed development would have a low and neutral landscape impact (see Section 6.1 for classification of impacts).

Summary

The development is considered acceptable for the following reasons. The upgrading of the waste water treatment works represents an essential improvement to the utilities of the town that will not have any adverse effect on the protected wildlife habitats of harbour and its associated landscape. The proposed structures have been designed to sit as unobtrusively as possible within the site of the existing waste water treatment works.

It is intended that the boundary vegetation will be retained which will have the effect of almost totally obscuring views of the works. If detailed design stage reveals the need to breach any of the surrounding screen vegetation due to the confines of site in the context of the required upgrade, adequate measures will need to be taken to provide replacement planting in the first planting season after completion of the project. Furthermore, the generally low form of the buildings and associated apparatus will mean that any replacement planting would provide a significant level of screening within a relatively short timescale.

The landscape character of the area will therefore remain virtually unaffected. Furthermore, the existing topography, vegetation cover and adjacent development conspire to limit the zone of visual influence that the development will have to a relatively small area. Appropriate mitigation measures including the replacement of any vegetation that may be lost from the existing boundary planting and the possible need for some additional screen planting along the southern boundary with the Model Railway Village will need to be provided for. It is recommended that any replacement planting should consist of a mixture of native species including Scots pine (Pinus sylestris), willow (Salix spp.) and ivy (Hedera spp.) It is noted that the Action Area Plan proposals for the GAA lands recommends additional structure planting between it and the treatment plant which will ensure that a visual buffer is maintained between the two sites.

4.6 VISUAL IMPACT ASSESSMENT

4.6.1 Classification of Impacts

This section addresses the visual impact to be experienced at each viewpoint and the classification of the impact. Key issues in relation to visual impacts are the nature of the visual receptors within the visual envelope i.e. the nature of the viewers and their sensitivity.

The potential landscape impact assessment describes the likely nature and scale of changes to individual landscape elements and characteristics, and the consequential effect on landscape character. Existing trends of change in the landscape are taken into account. The potential landscape impact is assessed based on:

(a) The sensitivity of the landscape resource which is classified as High, Medium or Low.

(b) The scale or magnitude of landscape effects which are classified as High, Medium, Low, Negligible or Neutral.

4.6.2 The Visual Envelope

A visual envelope is used to describe the extent of the developments visual affect on the surrounding environment, illustrated through the creation of a visual envelope map. The extent of visual intrusion the development has on the surrounding environment is dependent upon a variety of factors such as landform, existing vegetation and surrounding built form. It should be noted these maps are indicative only and it is not normally possible to assign a tolerance to them. (The approximate zone of visual influence is set in Fig 4.1. overleaf)

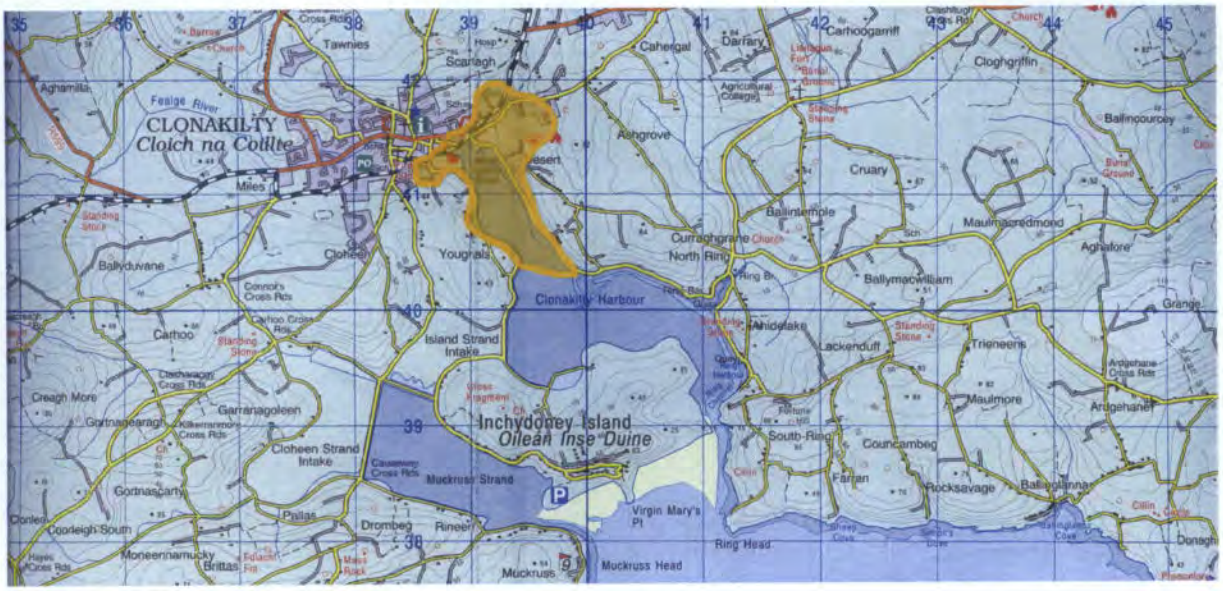


Fig 4.1. ZVI Map

Due to the topographical characteristics of the surrounding landscape area and the low positioning of the proposed waste water treatment plant as well as to the additional screening effect of vegetation, the visual envelope is relatively limited for a structure of this nature. Views to the site are localised and include intermittent views from settlements, local roads, heritage sites and rural dwellings in the area.

4.6.3 The Capacity of the Receiving Environment to Accommodate Change

The capacity of the receiving environment to accommodate change is largely determined by existing topography and vegetation and their potential to screen the proposed development from sensitive viewers within the visual envelope. The type of developments occurring in the area also contributes to the capacity of the local landscape to absorb new developments of the same or similar kind, and must also be considered.

A statement is made as to the significance of the landscape impact that would result from the development, based on the measurement of the magnitude of the landscape effects against the sensitivity of the landscape resource. The predicted impact is classified as high, medium or low as well as beneficial, neutral or adverse. This is not an absolute exercise; it is a professional judgement informed by the assessment methodology described.

4.6.4 Assessment of Viewpoints

The assessment of visual impact involves identifying viewpoints within the visual envelope that are representative within the receiving environment. These viewpoints were selected based on physical inspection of the view. The selected viewpoints are surveyed to ascertain the condition of the existing view (characteristics, features, positive and negative qualities, etc.), and the associated sensitivity of the viewpoint (based on the extent and location type – residential, public road, amenity, etc.). With the aid of representative images the degree of change to be experienced at that location is assessed.

Each viewpoint is categorised in tabular form summarising the significance of the predicted impact on the visual amenity of the view, as well as a classification of the impact as beneficial, neutral or adverse. The assessment of the significance of impact on each view is based on the measurement of the magnitude of change to the view against the sensitivity of the viewpoint.

The criteria for grading impact significance are summarised as follows:

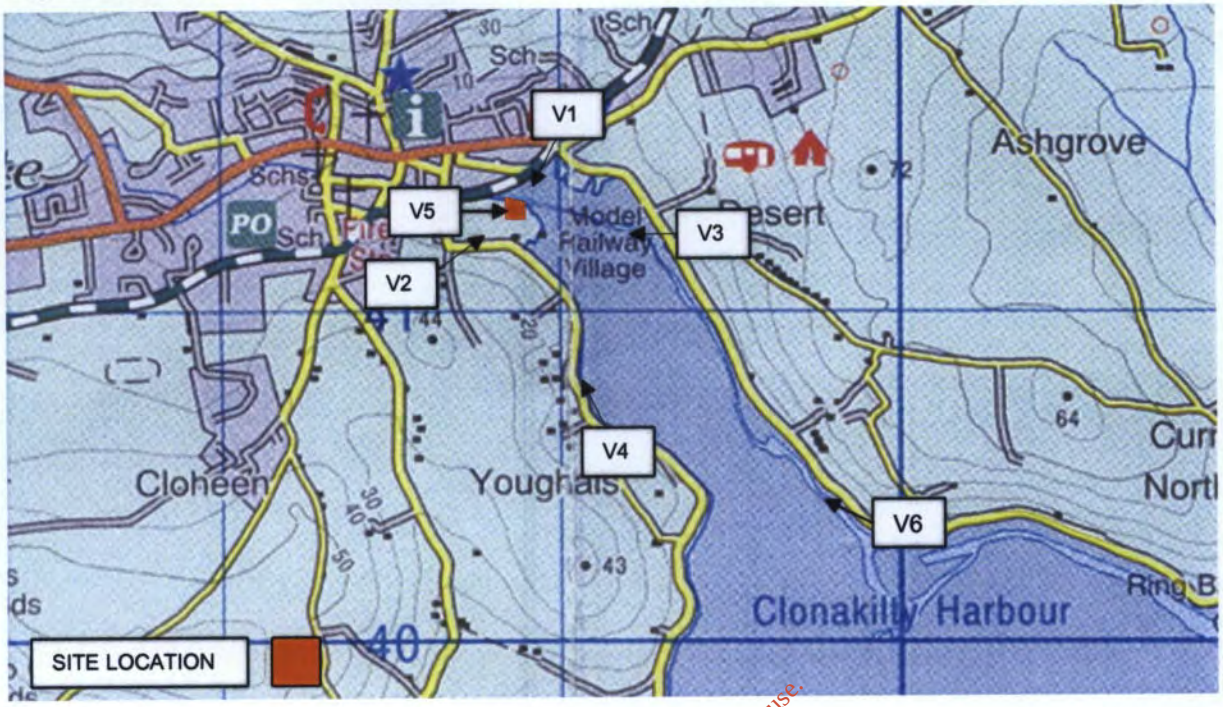
- Where a viewpoint of High sensitivity is subject to a High or Medium magnitude of change, then the impact is classified as of High significance, and
- Where a viewpoint of Medium sensitivity is subject to a High magnitude of change, then the impact is classified as of High significance.
- Where a viewpoint of Medium sensitivity is subject to a Medium or Low magnitude of change, then the impact is classified as of Medium significance, and
- Where a viewpoint of High sensitivity is subject to a Medium or Low magnitude of change, then the impact is classified as of Medium significance.
- Where a viewpoint of Low sensitivity is subject to a High, Medium, Low or Negligible magnitude of change, then the impact is classified as of Low significance.
- Where a viewpoint of Medium or High sensitivity is subject to a negligible magnitude of change, then the impact is classified as of Low significance.

The assessment of visual change and visual impact associated to the proposed development from the selected viewpoints is carried out taking into consideration the proposed development on its own merit but also bearing in mind the existing water treatment plant facilities.

The selected viewpoints are as follows:

No	Location	Mapping Coordinates	Direction Of View	Viewpoint Type	Distance to site
1	Eastern Gateway to Clonakilty Town	W 390 415	South	National Secondary Road	0.25km
2	High ground to South-West of site	W 386 412	SouthEast	Access track / road	0.25km
3	A90 Scenic Route	W 394 413	North west	Third Class Road	0.4km
4	Shoreline South-East of site	W 392 406	SouthEast	Third Class Road	0.7km
5	GAA Sports Ground	W 386 414	West	Carpark	0.15km
6	Opposite Shoreline SouthEast of site	W 399 403	NorthWest	Third Class Road	1.5km

Fig 4.2. Viewpoint location map:



Viewpoint 1 Eastern Gateway to Clonakilty

Site as currently exists

Description of View

The selected viewpoint is located approximately 0.25km from the proposed development site at what is effectively the Eastern gateway to Clonakilty town comprising the confluence of key local and strategic routes including the N71, the A89 and A90 Scenic Routes and the main street network of the town (Wolfe Tone Street). The location is defined by a relatively small roundabout from which there are views along a stretch of the westward N71 known as 'The Croppy Boy' and an extended view over the River Fealge towards the development site.

The view of the site, however, is generally interrupted due to the presence of roadside vegetation along 'The Croppy Boy' and the only feature of the site itself that can be seen is the boundary vegetation which effectively screens all the internal apparatus of the existing treatment works.

On very close scrutiny some glimpses of the treatment works can be gained but the works are generally well hidden behind the boundary vegetation. A tall coniferous hedge (approx. 6-8metres in height) along the northern boundary of the GAA pitch combines with the treatment works boundary vegetation to form a formidable visual barrier along the southern bank of the river Fealge where it enters Clonakilty harbour.

It is not anticipated that the proposed development will significantly impact on this view. Detailed design for the settling tanks in the north-western corner of the site should aim to avoid the removal of any of the existing boundary vegetation. However, if some encroachment is unavoidable, this should be kept to a minimum to avoid opening up significant views into the treatment plant site. Any minor breaches could, however, be mitigated in a relatively short timescale through the provision of additional screen planting.

VIA Result

- The viewpoint sensitivity is considered high, as it represents a key access point to the town from a number of routes of regional and local significance. It is of significance from vehicular and pedestrian viewpoints and it is a circulation hub.

- The degree of change from this viewpoint would be negligible or low adverse in the short term. The degree of change will be negligible in the long term due to the extent to which the site is screened by existing vegetation and the establishment of any small scale mitigation planting if this proves to be required.

- The significance of the visual impact will be neutral or low adverse in the short term and neutral in the long term.

Viewpoint 2 High Ground to South-West of site

Site as currently exists

Description of View

The selected viewpoint is located approximately 0.25km from the site on elevated ground to the south west, along a small access road off the shoreline route that leads to Inchydoney Island. The location represents the view from a small cluster of residential properties, some four in number. The properties currently have views onto the site but the treatment works remain relatively low key by the very nature of their squat form and the screening effect of the boundary vegetation. The predominant view is across the Harbour and along the ridgeline of the rolling agricultural landscape.

VIA Result

- The viewpoint sensitivity is considered high, as it represents the view of residents from an area of elevated ground.

- The degree of change from this viewpoint would be low in the short term and neutral in the long term.

- The significance of the visual impact will be neutral or low adverse in the short term and neutral in the long term.

Viewpoint 3 A90 Scenic Route

Site as currently exists

Description of View

The selected viewpoint is located approximately 0.4km from the proposed development site on the Scenic Route A90 at a point where it emerges onto the northern shoreline of the harbour. This view is typical of short to medium range views towards the proposed site from the northern shoreline of the harbour, with distance having a diminishing effect. The view is generally dominated by the backdrop of the surrounding hills and town where the spire of the church stands out.

The treatment works upgrading proposals will be screened by existing vegetation and landform to the extent that the view from this location will not significantly change.

VIA Result

- The viewpoint sensitivity is considered high, as the area forms part of a designated scenic route as well as hosting several private residences on the more elevated section of the route.
- The degree of change from this viewpoint would be neutral in the short term and neutral in the long term.
- The significance of the visual impact will be neutral in the short term and neutral in the long term.

Viewpoint 4 Shoreline South-East of site

Site as currently exists

Description of View

The selected viewpoint is located approximately 0.7km from the development site at a point along the western shoreline of the harbour known as 'The Youghals'. This view represents medium to long range views of the site in the context of the local topography and circulation network. The proposed development site substantially blends into the backdrop of the town and the general shoreline of the harbour. At shoreline level the predominant feature is the main building block in the Model Railway Village. The proposed development would not be visible due to existing site boundary vegetation and landform combining with distance.

VIA Result

- The viewpoint sensitivity is considered high, as the area forms part of a well used route along the shoreline as well as hosting several private residences.
- The degree of change from this viewpoint would be neutral in the short term and neutral in the long term.
- The significance of the visual impact will be neutral in the short term and neutral in the long term.

Viewpoint 5 GAA Sports Ground

Site as currently exists

Description of View

The selected viewpoint is located approximately 0.15km from the development site at the entrance carpark to the adjacent GAA ground. Views from this location are confined to within the sports ground itself and towards elevated ground to the south of the site. The containment of views is largely imposed by the tall boundary coniferous hedge along the northern boundary and by the mixed vegetation along the eastern boundary with the proposed development site itself.

This viewpoint serves to illustrate the screening effect of the existing boundary vegetation around the development site. It also demonstrates that the GAA ground will remain unaffected by the proposed development.

VIA Result

- The viewpoint sensitivity is considered high, as the area forms part of a well used town facility.
- The degree of change from this viewpoint would be neutral in the short term and neutral in the long term.
- The significance of the visual impact will be neutral in the short term and neutral in the long term.

Viewpoint 6 Opposite Shoreline South-East of site

Site as currently exists

Description of View

The selected viewpoint is located approximately 1.5km from the proposed development site at a point along the opposite shoreline where Clonakilty Town comes into view on the approach from the east. The view is generally framed by the elevated landform around the harbour and the eye is drawn towards the built form of the town in the sheltered inlet. The brightly coloured gable ends of the Model Railway Village buildings are visible on the distant shoreline. The development site itself, by virtue of the surrounding vegetation and landform blends unobtrusively into the foreshore.

This viewpoint serves to illustrate the potential high profile of the site in distant views on the one hand and the extent to which the current treatment plant is actually screened on the other hand. So long as the new development is in keeping with the scale and height of the existing plant, it would have no significant impact from this viewpoint.

VIA Result

- The viewpoint sensitivity is considered high, as the roadway along the shoreline is an attractive route in the context of the tourism potential of Clonakilty and its environs.
- The degree of change from this viewpoint would be neutral in the short term and neutral in the long term.
- The significance of the visual impact will be neutral in the short term and neutral in the long term.

4.6.5 Visual Impact Conclusion

View No.	Location	Distance from Site	Degree of Change	Viewpoint Sensitivity	Classification of impact	Predicted Short term Impact	Predicted Long term Impact
1	Eastern Gateway to Clonakilty	0.25km	Low Adverse	High	**Low Adverse**	**LOW Adverse**	**NEUTRAL**
2	High ground to South-West of site	0.25km	Low Neutral	High	**Low Neutral**	**LOW Neutral**	**NEUTRAL**
3	A90 Scenic Route	0.4km	Negligible	High	**Neutral**	**NEUTRAL**	**NEUTRAL**
4	South East of site	0.7km	Negligible	High	**Neutral**	**NEUTRAL**	**NEUTRAL**
5	GAA sports ground	0.15km	Negligible	High	**Neutral**	**NEUTRAL**	**NEUTRAL**
6	Opposite shoreline SouthEast of site	1.5km	Negligible	High	**Neutral**	**NEUTRAL**	**NEUTRAL**

4.7 POTENTIAL IMPACTS

It is inevitable that there will be some visual impacts associated with the new development. The pertinent question is whether the impacts are such that they may be deemed acceptable, in the context of the receiving environment, or can be reduced to an acceptable level of impact through mitigation measures.

The visual impact of the proposed development has been closely examined and we have seen that;

Of the six viewpoints assessed it is anticipated that:

1. The classification of impact will be:
   - **Low neutral** for one of the viewpoints, **Low adverse** for one of the viewpoints and **Negligible** for the remaining four viewpoints.
2. The long term impact will be (i.e. after completion and development of any mitigating landscape treatment that may be required):
   - **Neutral** for all six of the viewpoints.

4.8 MITIGATION MEASURES

The Layout Plan for the proposed upgrade, (see Figure 1.4 Proposed Layout Plan), show elements of the new development situated in close proximity to the existing site boundary. Detailed design of the new components should seek to avoid impact on the existing boundary vegetation which would ensure that visual impact from Viewpoint 1 would be neutral. However, if some encroachment is unavoidable, this too should be kept to a minimum and mitigation for any loss should be provided for in the form of replacement planting.

Such planting should consist of a mix of predominantly native or naturalised evergreen and deciduous species selected for both their screening value, the extent to which they match the existing boundary vegetation and suitability to site conditions and the surrounding environment. The planting should be of a size that will facilitate successful establishment as well as provide maximum screening impact as early as possible.

It is also recommended that some additional screen planting along the southern boundary with the Model Railway Village be provided for. This should consist of a mixture of native species including Scots pine (Pinus sylestris), willow (Salix spp.) and ivy (Hedera spp.)

4.9 RESIDUAL IMPACTS

There are no residual impacts anticipated after mitigation measures are implemented.

A number of factors contribute towards the ability of the site to absorb development of this scale with such relatively low incidence of negative visual impact:

- The site is currently operating as a waste water treatment plant.
- The proposed development is located on a site that is well screened by the surrounding landform and boundary vegetation.
- The low level form of the proposed development means that it would blend unobtrusively into the existing site.
- The retention of existing vegetation and the provision of mitigating screen planting in the event of any short sections of the boundary planting being breached as part of the new proposals will do much to ensure the appropriate integration of the proposals within the site and the surrounding environment.

4.10 INTERACTIONS

This Landscape and Visual Impact Assessment Report has examined the potential effect of the proposed development on the receiving environment in terms of potential changes to the physical make-up of the landscape and potential visual impact on users of the landscape. The main E.I.S. headings for consideration in relation to interactions are Planning and Policy, Human Beings, Ecology, Air Quality and Climate and Cultural Heritage.

This report has considered the Planning and Policy context for the proposed development and finds that that the proposal is generally in keeping with the objectives of the Development Plan. The Landscape and Visual Impact Assessment has implications for human beings in terms of the perception and image of the site and the quality of adjacent areas as places to visit and live in (model railway village and proposed residential development on the GAA site). The site is situated adjacent to a regional route and the town is a tourist destination location (Cultural Heritage). The upgrading of the treatment plant will not affect the estuary and associated designated habitats (Ecology). It is not anticipated that the proposed upgrading will affect air quality or climate.

4.11 REFERENCES

Reports and documents referred to in the compilation of this report include:-

- EPA's Guidelines on the Information to be Contained in Environmental Impact Statements, 2002
- The Landscape Institute's Guidelines for Visual Impact Assessment, 2002 (UK).
- Landscape and Landscape Assessment Consultation Draft Guidelines for Planning Authorities, 2000 – Department of the Environment and Local Government.
- Cork County Development Plan 2003, Cork County Council.
- The Skibbereen Electoral Area Draft Local Area Plan (Jan 2005)
- Clonakilty Town Council Development Plan 2003
- Action Area Plan, GAA Lands, Clonakilty

5. GEOLOGY, SOILS AND HYDROGEOLOGY

5.1 INTRODUCTION

This chapter describes the geology, soils and hydrogeology at the proposed upgrading of Clonakilty Waste Water Treatment Works. This information is based on a site visit carried out by a WYG hydrogeologist in which a walkover survey was carried out. This assessment of geology and hydrogeology has been undertaken in accordance with the *Draft Guidelines on the Information to be contained in Environmental Impact Statements* (EPA, 2002) and also *Advice Notes on Current Practice in the Preparation of Environmental Impact Statements* (EPA, 2003).

Desk study information was attained from a number of sources including:

- The Geological Survey of Ireland (GSI) 'Geology of South Cork' Sheet 25, 1:100 000 scale geological map and accompanying booklet, dated 1994.
- GSI Groundwater Section Well Search.
- GSI website, www.gsi.ie. Online groundwater maps database.
- General Soil Map, 1:575,000 scale prepared & published by the National Soil Survey, An Foras Taluntais, 1980.
- Existing WYG database.
- Ordnance Survey of Ireland (OSI) Discovery Series Map 89, 1:50,000.
- Environmental Impact Statement for Tidal Baggage in Clonakilty Harbour (MCOS), 2001.

The impact of the upgrading the existing Clonakilty Wastewater Treatment Plant and operation on the underlying soils, geology, and hydrogeology is discussed and evaluated. Potential impacts are noted and mitigation measures are proposed.

5.2 GEOLOGY AND SOILS

5.2.1 Regional Geology

The Geological Survey of Ireland's Sheet 25 – South Cork (GIS, 1994) provided an illustration of geology of this area of Co. Cork. The bedrock of the Clonakilty region is composed of Devonian and Lower Carboniferous rocks and is dominated by the east-west trending Rosscarberry Anticline. The area is composed of east west trending anticlines and synclines.

The geological sequence presented in Figure 5.1 is as follows; the Castlehaven Formation, of Upper Devonian age, forms the centre of the Rosscarberry Anticline. It is composed of purple mudstone and siltstone. The Toe Head Formation overlays the Castlehaven Formation with a grey coloured unit and contains a cross-bedded sandstone with minor mudstone. The Toe Head Formation is overlain by the Old Head Sandstone Formation that underlies the site. The youngest rock of the region of concern is of

6. HYDROLOGY, SURFACE WATER & RECEIVING WATER QUALITY

6.1 HYDROLOGY

This section describes the hydrology and water quality at the proposed upgrading of Clonakilty WWTP. Most of the information is obtained from a desk study from which information that was attained from a number of sources including:

- The Environmental Protection Agency (EPA) website www.epa.ie. Water quality information.
- GSI website, www.gsi.ie. Online groundwater maps database.
- Cork County Council Inniscarra Waterworks. Water Quality Information.
- Existing WYG database.
- Ordnance Survey of Ireland (OSI) Discovery Series Map 89, 1:50,000.
- Environmental Impact Statement for Tidal Baggage in Clonakilty Harbour (MCOS), 2001.
- Met Eireann Website. www.met.ie.
- Irish Geography Journal, Volume 33, 2, 2000.

The Ordnance Survey of Ireland Discovery series map number 89, shows that the site is located on the north-western edge of Clonakilty Harbour W389413.

6.1.1 Regional

This region of West Cork forms part of the Hydrometric Area 20. The main river that drains the area is the Argideen River, which flows in a west to east direction, 3km north of Clonakilty town and enters the sea at Courtmacsherry, to the east of the Clonakilty town. The harbour area is tidal and areas of Clonakilty adjacent to the treatment works are prone to flooding at spring tides.

6.1.2 Local

The Clonakilty treatment plant site is located on the coastline at the north western bank of the Clonakilty Harbour. The tidal estuary has extensive mudflats and is fed by a number the rivers and streams. The Fealge River drains the land to the west of the Clonakilty town and enters the harbour approximately 150 metres west northwest of the site location. An unnamed stream also discharges into the harbour approximately 100 metres to the north of the site as presented in Figure 5.1.

There are no surface water features on the site and any rainfall is likely to drain into the subsoils and into the underlying bedrock aquifer or directly into Clonakilty Harbour.

6.1.3 Meteorology and Recharge

The land surrounding Clonalkilty is undulating, varying from 60 - 100mOD. Rainfall data for the area obtained from the Met Eireann indicates the mean annual rainfall (R) for the area ranges from 1400mm to 1600mm and the actual evapotranspiration (AE) is estimated as 38% of R, or 532 to 608mm/yr. The potential recharge, or effective rainfall can then be calculated as (R - AE = ER) 868 to 992mm/yr.

This effective rainfall (ER), 868 to 992mm/yr, will be partitioned between surface water runoff and groundwater recharge in a ratio that depends on the permeability of the overburden material. Given the close proximity of the site to the coastline the majority of the effective rainfall will end up in Clonakilty Harbour.

6.1.4 Vulnerability of the Aquifer to pollution

The vulnerability of an aquifer to contamination is influenced by the type and thickness of the overburden overlying it. A vulnerability map has not been completed by the GSI for West Cork. The GSI has devised a system to rate the vulnerability of any aquifer to pollution from a potential source on the surface above the aquifer. They have divided vulnerability rating into four classes:

GSI Vulnerability Mapping Guidelines.

Vulnerability Rating	Hydrogeological Requirements (below the point of release of contaminants)				
	Subsoil Permeability (Type) and Thickness			Unsaturated Zone	Recharge Type
	High permeability (sand/gravel)	Moderate permeability (sandy till)	Low permeability (clayey till, clay, peat)	(Sand & Gravel aquifers only)	
Extreme	0-3.0m	0-3.0 m	0-3.0m	0-3.0m	point (<30 m radius)
High	>3.0	3.0-10.0m	3.0-5.0m	>3.0m	N/A
Moderate	N/A	>10m	5.0-10.0m	N/A	N/A
Low	N/A	N/A	>10.0m	N/A	N/A

Notes: (from Daly & Warren 1997)

i) N/A =not applicable

ii) Precise permeability values cannot be given at present

iii) Release point of contaminants is assumed to be 1-2 m below ground surface

Although potentially high permeability fill material beneath the site may have an extreme vulnerability, the underlying marine silt and clay is likely to have a low permeability and therefore reduce the vulnerability rating.

6.2 SURFACE WATER QUALITY

Cork County Council undertakes monthly water quality measurements of the Fealge River at two locations within Clonakilty town (SW-1) and (SW-2) for certain major ions and field measurements as outlined in Tables 6.1 and 6.2. The analysis indicates occasional exceedences of nitrate, ammonia, nitrite and phosphorus in both rivers. Such excess quantities indicate excessive loading of nutrients that are likely to be related to agricultural practices along the catchment of the River Fealge.

Dissolved oxygen levels in the River Feagle are largely recorded in excess of 100% saturation which can be indicative of eutrophication. These elevated dissolved oxygen levels can occur when dense growth can lead to excess production of oxygen. Elevated oxygen levels recorded in the daytime can be mirrored by low levels at night.

The EPA has conducted Biological Quality Rating surveys on the Fealge River at location SW-3 as presented in Figure 5.1. The Fealge River has achieved Q-rating of 4 on each sampling occasion since 1994 (see Table 6.3). This rating level is indicative of satisfactory water quality.

There is no available information on groundwater quality beneath the site. The water is likely to be brackish given the close proximity to the coastline.

6.3 RECEIVING WATER QUALITY

6.3.1 Introduction

Irish Hydrodata Ltd. were commissioned by White Young Green Ireland Ltd. to undertake hydrographic surveys and water quality modelling in Clonakilty Estuary and the sea off Inchydoney Beach in relation to the proposed upgrade of Clonakilty Wastewater Treatment Plant (thereafter referred to as Clonakilty WWTP), located at the head of Clonakilty Estuary (Figure 1.2).

Irish Hydrodata previously carried out hydrographic surveys and water quality assessments to consider the impact of a barrage across Clonakilty Harbour. The findings of that study were included in an Environmental Impact Statement for the proposed barrage and have been included in Appendix 6 of this EIS.

Section 6.3.2 describes the study that was carried out. Section 6.3.3 defines the characteristics of the study area. The field study methodologies and field survey results are described in sections 6.3.4 and 6.3.5 respectively. Section 6.3.6 sets out the approach taken to the water quality modelling and

the methods used while the results of the simulation discharges are shown in section 6.3.7. A summary of the findings of the Tidal and Estuarine Studies which formed part of the EIS for the Tidal Barrage in Clonakilty Harbour (January 2001) is included in section 6.3.8. A summary of the findings of the studies of the receiving waters is described in Section 6.3.9.

Outputs from the modelling are included in Appendix 6.2.

6.3.2 Scope of the Study

This report presents the findings of studies conducted to assess the impacts of treated effluent discharges from the town of Clonakilty to the sea. At present, treated municipal wastewater discharges from an outfall located near the treatment plant adjacent to the town. Proposals for upgrading this facility are being investigated and consideration is being given to relocating the outfall further downstream. The three potential discharge locations are:

i) the existing site;
ii)a site below the proposed tidal barrage;
ii)a site near Ring Pier.

Figure 6.1 – Potential Discharge Locations.

In assessing these outfall sites the requirements of the Urban Waste Water Treatment Directive, the Bathing Water Directive and the voluntary requirements of the Blue Flag Scheme were considered.

Summary Of Study Works

Following a full review of available data and bearing in mind the objectives of the brief the following study works were undertaken:

- *various measurements in Clonakilty Harbour and the sea area off Inchydoney Beach;*

- *set up of a two dimensional circulation model of Clonakilty Harbour and the sea area off Inchydoney Beach;*
- *set up of a two dimensional dispersion model of the sea area outlined above to compare the impacts of discharges from various outfall points.*

The results of these works are described in the following sections of the report.

6.3.3 Characteristics of Area

6.3.3.1 Bathymetry

The town of Clonakilty is situated some 50 kilometres southwest of Cork City and rates as a significant urban centre on the southern seaboard of Ireland. The coast is exposed to the Celtic Sea and the shoreline is fringed by low cliffs and rocky headlands interspersed with sandy beaches. Clonakilty Harbour is a shallow tidal inlet with a surface area of approximately 2 km^2. The Fealge river enters the harbour at the northern end. It has an estimated mean flow of 0.9m^3/s and a 95 percentile low flow of 0.075m^3/s. These flows were derived by scaling data (factor based on catchment areas) from the nearby Argideen river, which has been gauged since 1977.

Information relating to water depths and general bathymetric features of the wider area were obtained from Admiralty Chart No.2092 [1]. These were supplemented by local bathymetric surveys conducted within the harbour during the course of a previous study [2]. The harbour bathymetry is indicated in Figure 6.2. At low tide the majority of the harbour empties of water and Figure 6.3 compares low tides on spring and neaps.

Note hydrographic convention:-
-ve = above datum
+v = below datum

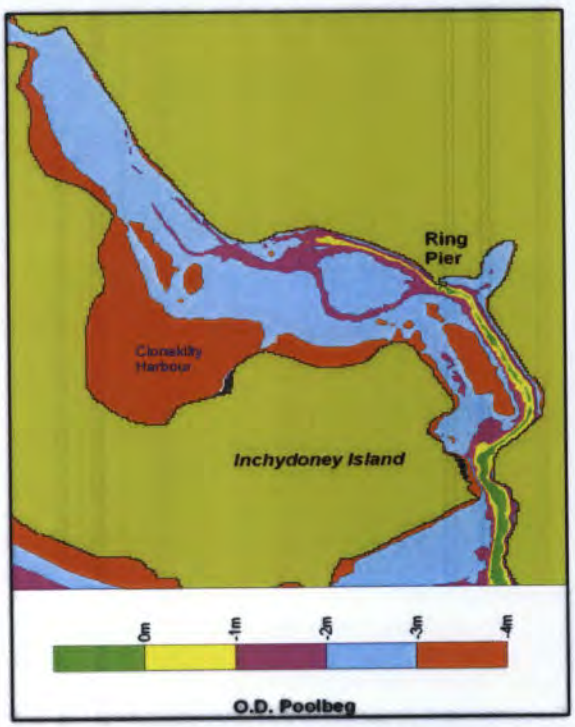


Figure 6.2 – Harbour Bathymetry.

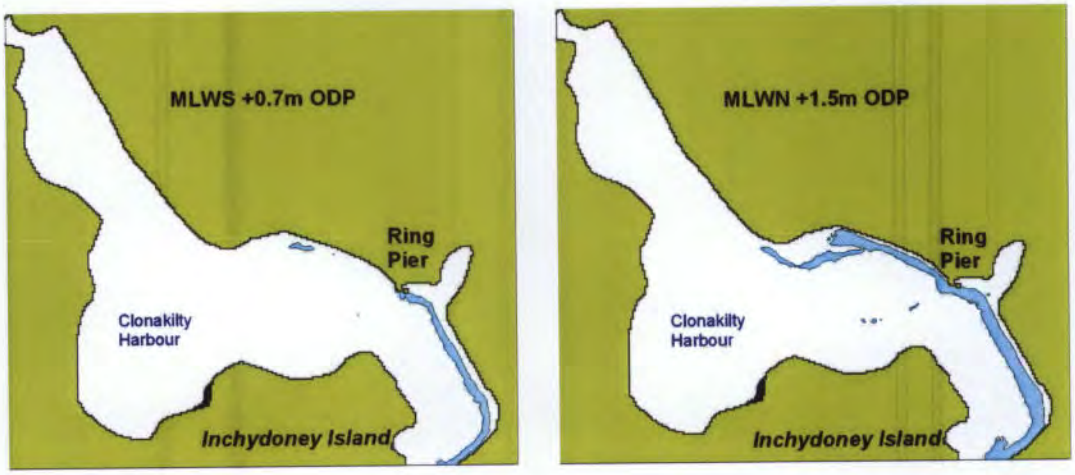


Figure 6.3 – Water Areas at Low Water Spring and Low Water Neap Tide.

6.3.3.2 Tide Levels

The tidal regime off the south coast is semidiurnal with two high waters (HW) and two low waters (LW) each day (24.8 hours) [3]. Tidal statistics, based on measurements made at the Wind Rock near the entrance to the harbour [2], are summarised in Table 6.1.

Table 6.1 Tidal Levels at Wind Rock.

Tide Level	Level to OD Poolbeg
Mean High Water Spring Tide	4.1m
Mean High Water Neap Tide	3.3m
Mean Tide Level	2.4m
Mean Low Water Neap Tide	1.5m
Mean Low Water Spring Tide	0.7m

6.3.3.3 Coastal Tidal Streams and Currents

The general circulation patterns of the Celtic Sea have been well documented through the years. Admiralty charts and tidal atlases [1,4] provide an indication of the current patterns. The offshore tidal currents generally run parallel to the coast. Speeds are relatively low reaching maximum values of about 1.0 knots (.5m/s) during spring tides. Off Inchydoney the circulation patterns are less pronounced with weaker speeds and more varied directions.

6.3.4 Field Studies Methodology

Survey measurements were made to obtain sufficient information for calibration of numerical models. The various activities are summarised briefly below.

6.3.4.1 Current Metering

Two current meters were deployed at mid depth on U-moorings outside the Harbour to record water movements over several tides. The units, Interocean S4's, recorded speed and direction data at 10 minute intervals. The mooring locations are indicated in Figure 6.4.

6.3.4.2 Tide Gauge

A recording tide was deployed at Ring pier for the duration of the current metering works.

6.3.4.3 Drogue Tracking

Cruciform shaped drogues were released from various locations within Clonakilty Harbour on three dates to establish the general water movements. These drogues were set to track the water mass at a depth of 0.5m below the water surface. Positions were recorded by steaming the survey launch close to the drogue at frequent intervals and recordings its position with an onboard DGPS unit and HYPACK software.

6.3.4.4 Dye Releases

The effects of the proposed treated effluent discharges were simulated by releasing Rhodamine WT tracer dye at different locations on four occasions. The dye was diluted with water to provide a patch which would mix readily with the surrounding waters in the manner of municipal effluent. The volume of dye released varied from 200ml to 500ml depending on the location. Tracking was accomplished with a continuously recording Cyclops 7 fluorometer towed 0.5m below the water surface. This unit measures the increased water fluorescence resulting from the dye slug. As the patch dilutes fluorescence levels decrease and eventually reach the natural background of water.

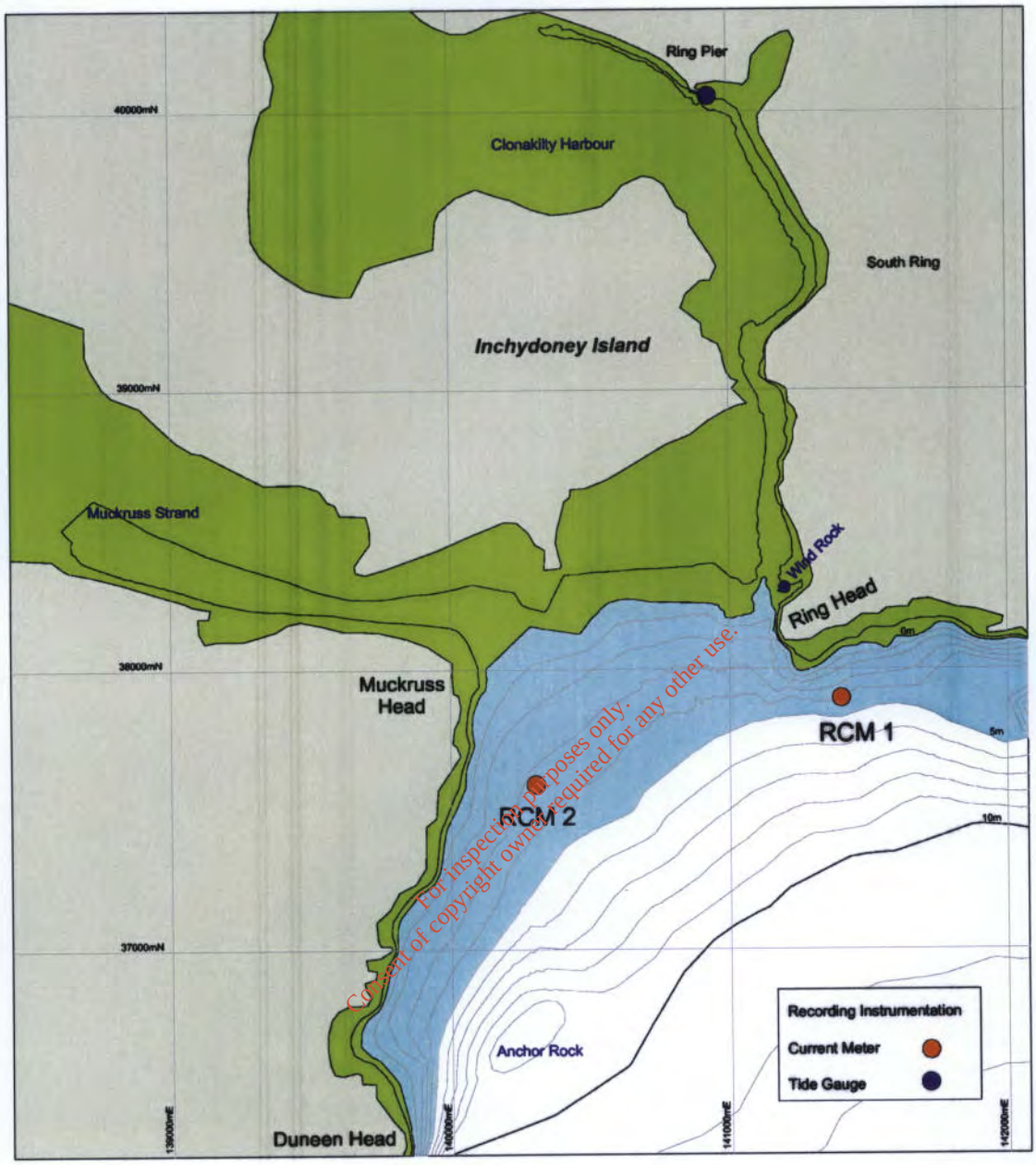


Figure 6.4 – Recording Instrument Locations.

6.3.5 Field Survey Results

6.3.5.1 Current & Tide Measurements

Current speed and direction data recorded at Sites 1 and 2 are presented in Figure 6.5. The meter at Site 1 logged data for 4 days while that at Site 2 stopped after 2 days due to a faulty battery cell. Peak speeds reached approx 0.14m/s at both sites. Directions were variable at both sites, indicating a significant wind impact. Directional distributions of the data are presented in Figure 6.6. At Site 1 the current has an east west bias while at Site 2 the northerly flood direction dominates. Tidal levels

during the deployment are included in the figure. The tidal ranges for the deployment correspond to mean springs.

6.3.5.2 Drogue & Dye Tracking

Day No.1 - 5/12/05

Two surface drogues and a 200ml slug of dye were released at approx 1 hour after high water (HW+1h) from a point just upstream of Ring Pier. Both dye and drogues moved rapidly seawards and by HW+1.75h had passed Wind Rock and were travelling southwards. A further drogue was released in the channel off the eastern tip of Inchydoney Island at HW+1.5h.

Drogue trajectories are indicated in Figure 6.7. At the time of recovery, approx HW+4h, the three drogues were about 1km south of Ring Head and were spread out over a distance of 700m.

The dye patch trajectory was very similar to that of the drogues, passing Ring Head at HW+2h and becoming widely dispersed at HW+3.5h as shown in Figure 6.8.

Weather conditions were good on the day with light westerly winds (1m/s) for the duration of the track. Tidal conditions corresponded to a spring tide.

Day No.2 - 6/12/05

For this release two surface drogues and a 200ml dye slug were again released at a point upstream of Ring Pier at the slightly later time of HW+2.5h.

The two drogues travelled quickly downstream, one exited the harbour and continued to the south southwest while the other passed to the east of Wind Rock and grounded. Two further drogue releases took place in mid-channel at Wind Rock. One release was made at HW+3.25h, the drogue travelling southwards and then to the southeast before recovery at HW+6h, and the other at LW-1h (Low Water -1h). On the latter release two drogues were deployed. Initially both travelled to the south before swinging to the east. One drogue went aground on the rocks below Ring Head while the other drogue was recovered at LW+1.5h still travelling to the east (Figure 6.9).

Two dye releases were made in conjunction with the drogue tracking (Figure 6.10). The first release took place at HW+2.5h off Ring Pier and the second at LW-1h off Wind Rock. The first patch followed the channel downstream from Ring Pier and as it passed Ring Head continued to the south-southwest. Concentrations were low at this time (HW+4.5h) and just above background. The patch from the second release, made at 1 hour before low water, was lying to the south of Ring Head at low water and it continued to move to the east and disperse. The last track was at LW+1.5h by which time concentrations were just above background levels.

Weather conditions were good on the day with light north westerly winds (1m/s) for the duration of the track. Tidal conditions corresponded to a spring tide.

Day No.3 - 13/12/05

These dye and drogue track exercises were undertaken in the outer bay to obtain information on trajectories around low water. Results are presented in Figure 6.11 & 6.12. The drogues/dye slug were released at LW-2.25h and tracked for 4.25 hours until LW+2h. During that time they travelled first to the south and later around LW+1h began to move to the east.

Weather conditions were good on the day with light north westerly winds (1.5m/s) for the duration of the track. Tidal conditions corresponded to a spring tide.

Day No.4 - 14/12/05

On this occasion a slug of 0.5l of dye was released at the existing outfall location at HW+3h. Dye concentrations were monitored at Ring Pier and the dye slug arrived at this location at HW+6h, approx 3 hours after release. The time series of dye concentration is shown in Figure 6.13. The river discharge on this date was estimated to be 0.5m^3/s.

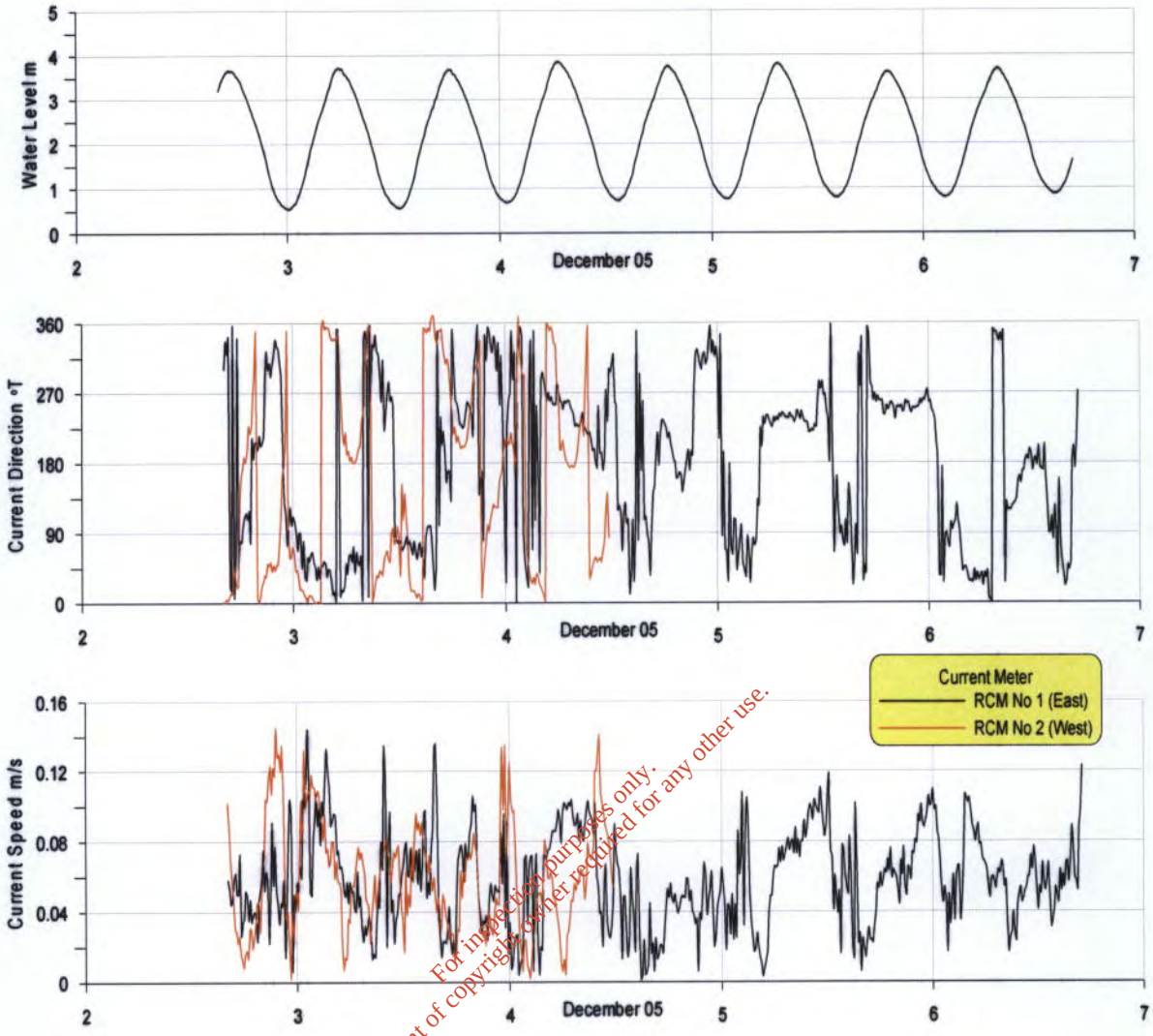


Figure 6.5 - Current and Tide Gauge Time Series.

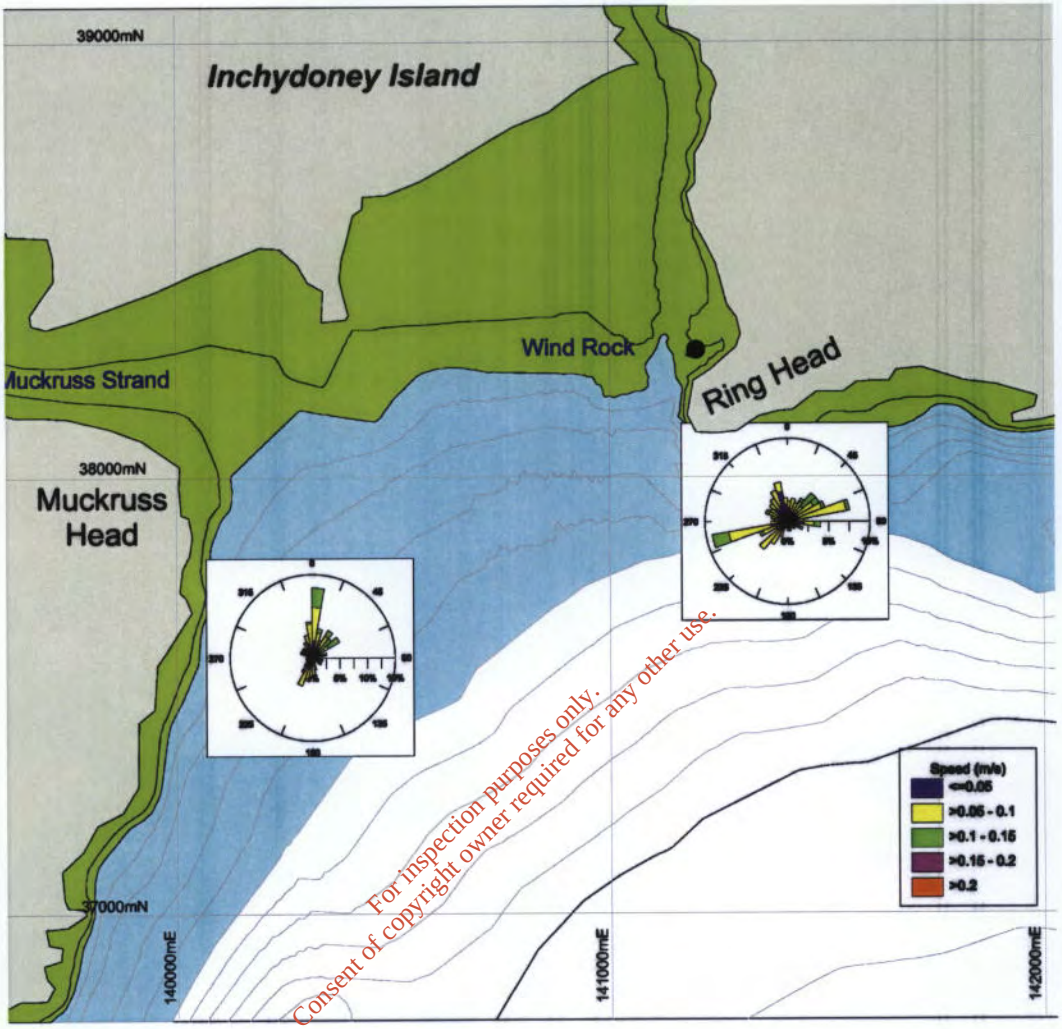


Figure 6.6 - Current Rose Data.

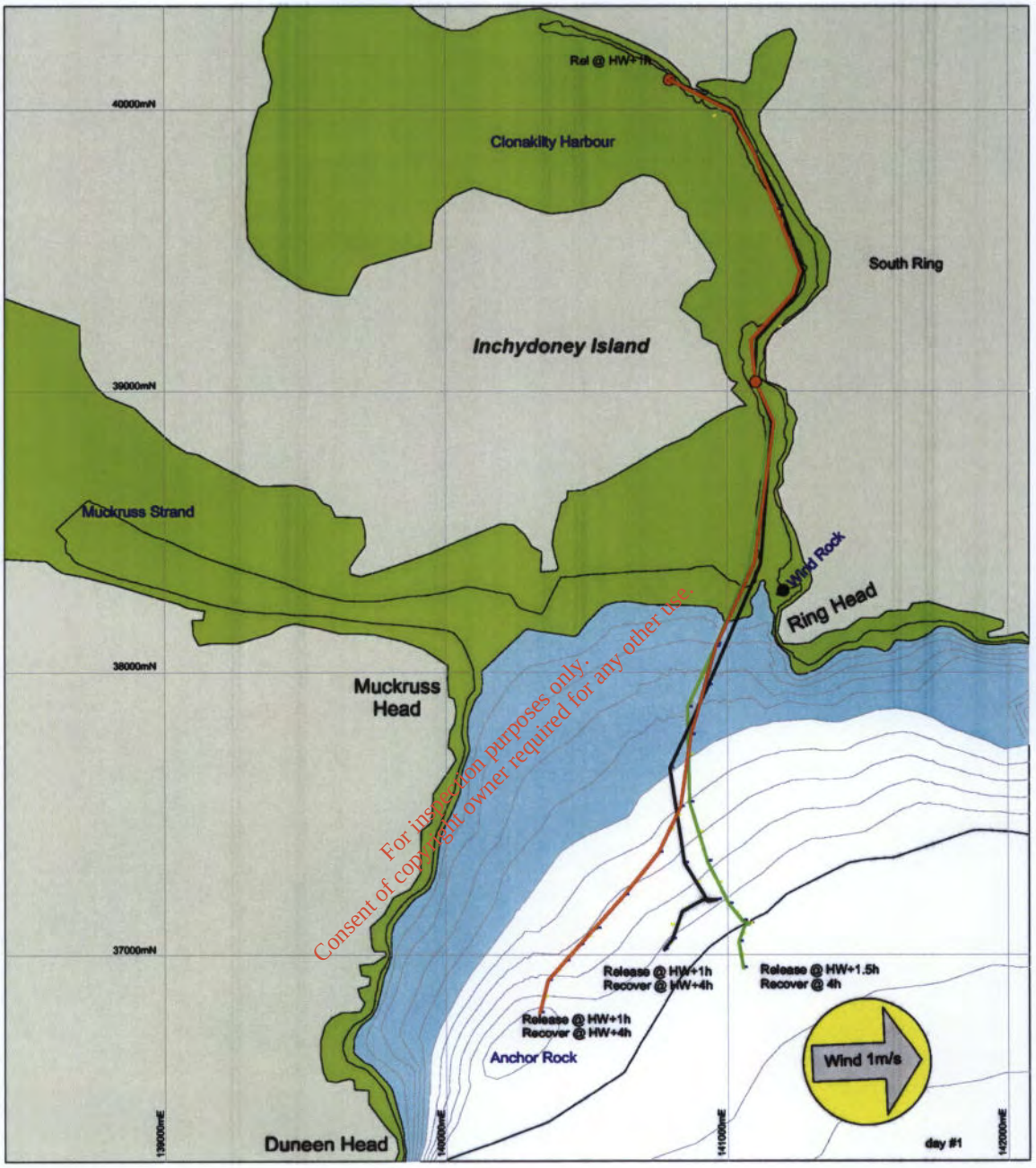


Figure 6.7 – Drogue Track, Day No 1.

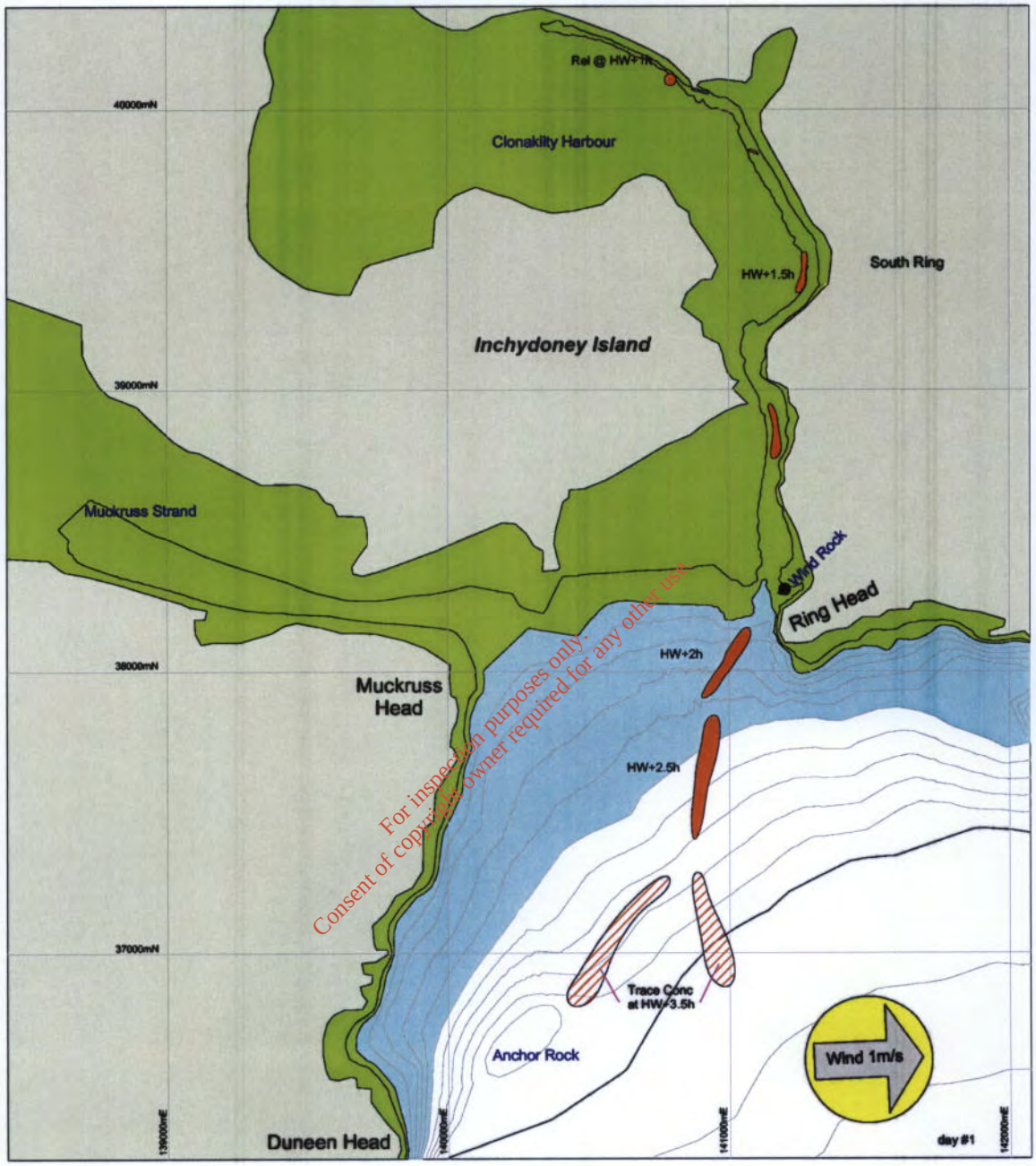


Figure 6.8 – Dye Track, Day No 1.

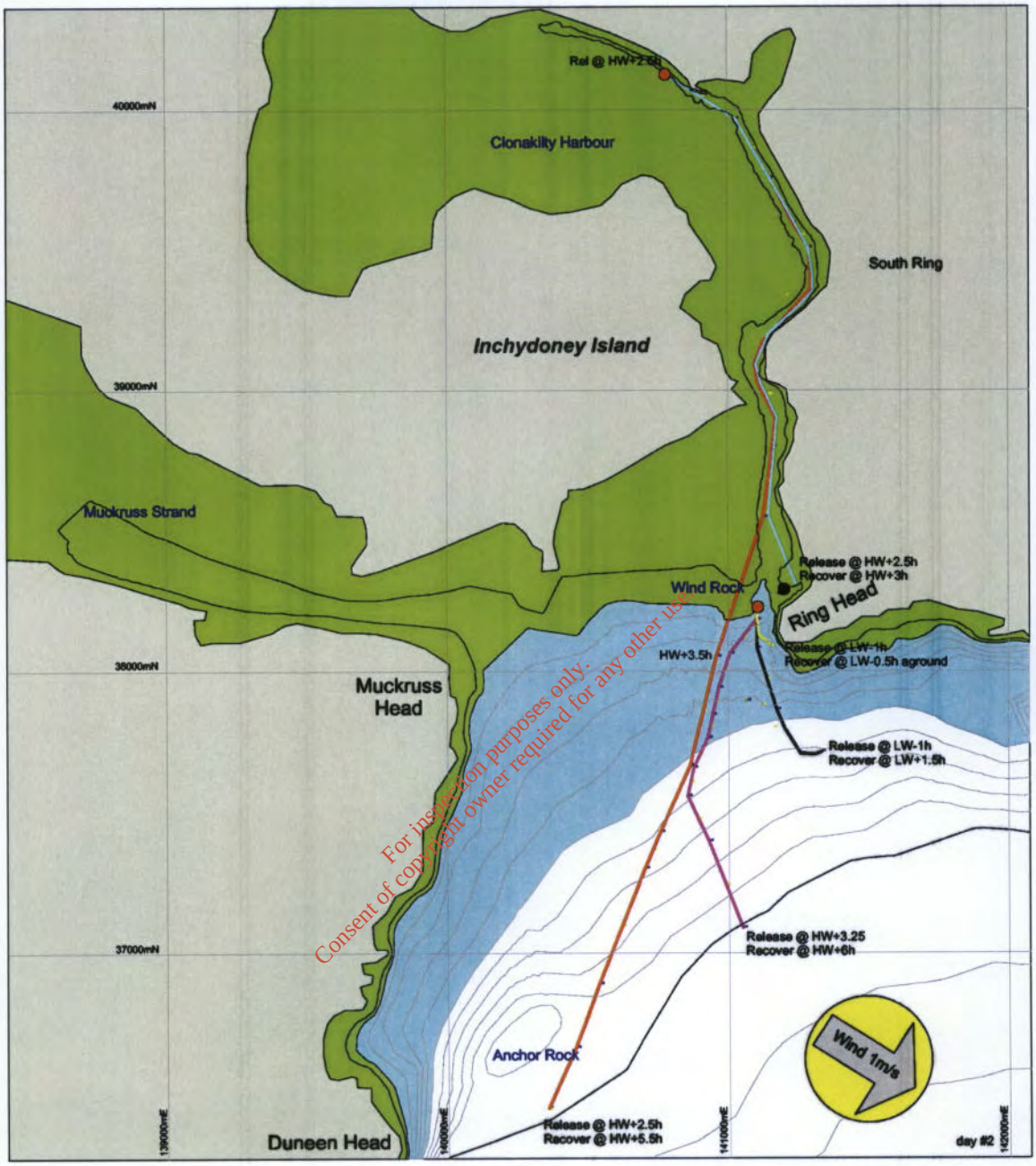


Figure 6.9 – Drogue Track, Day No 2.

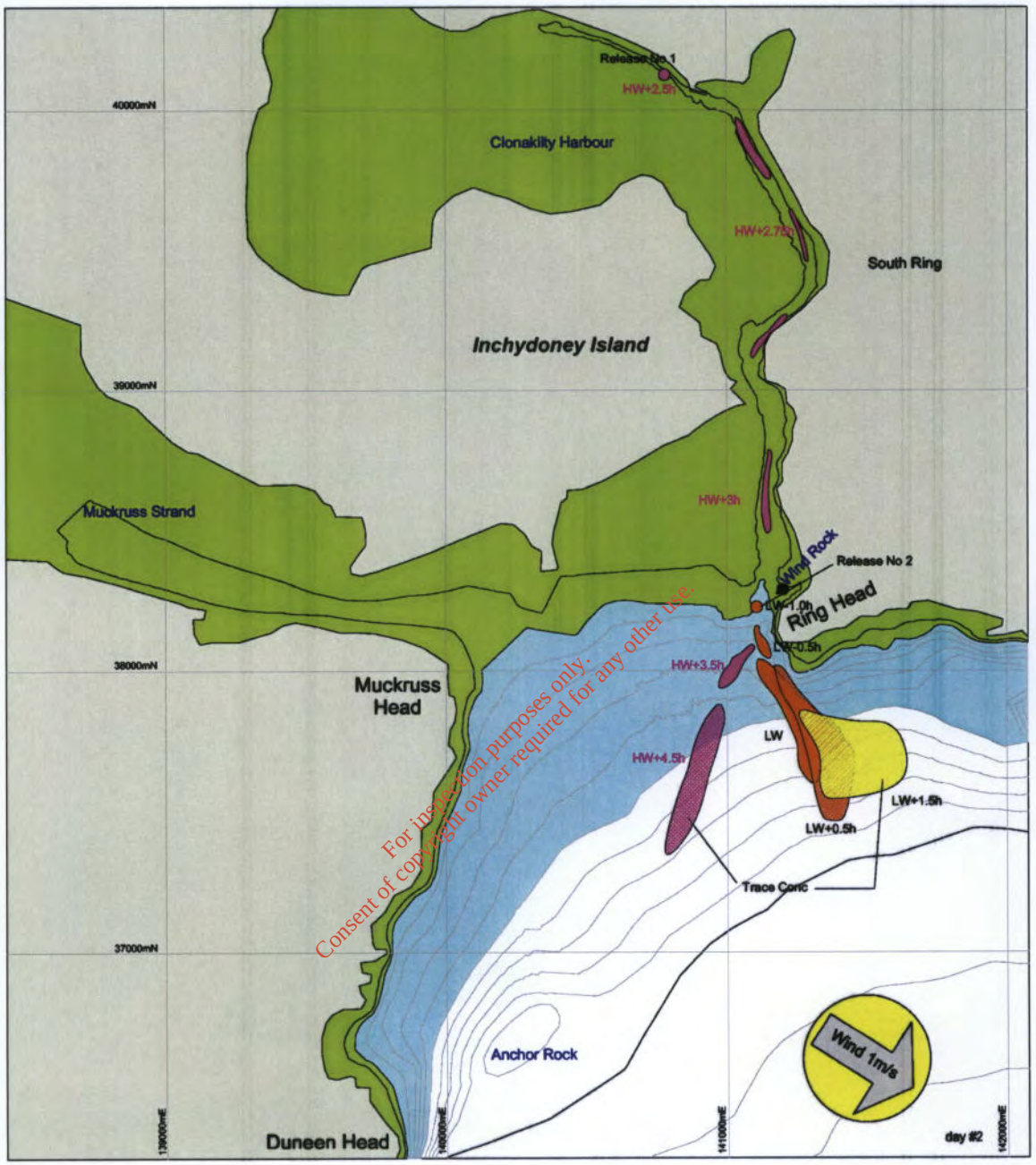


Figure 6.10 – Dye Track, Day No 2.

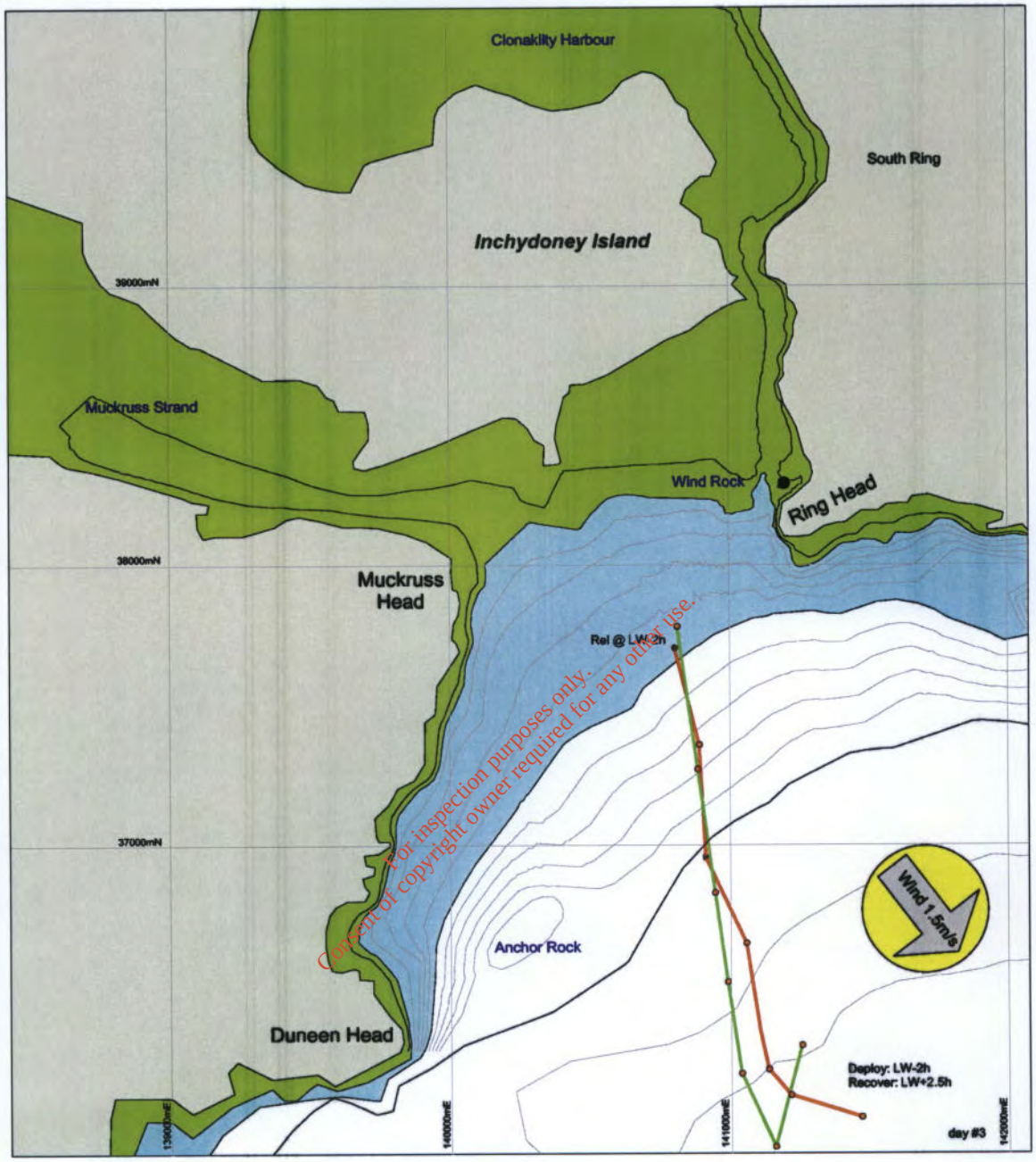


Figure 6.11 – Drogue Track, Day No 3.

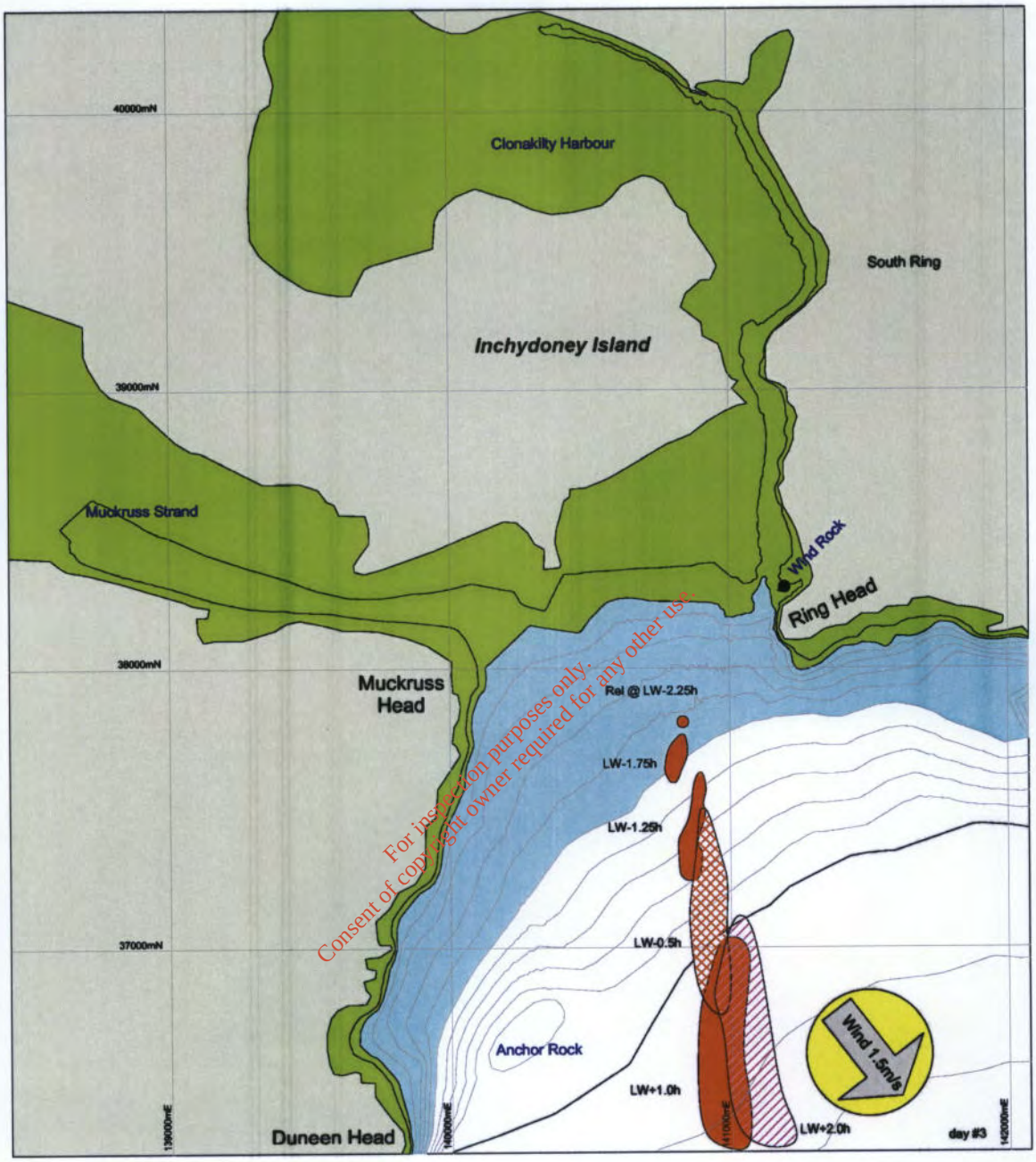


Figure 6.12 – Dye Track, Day No 3.

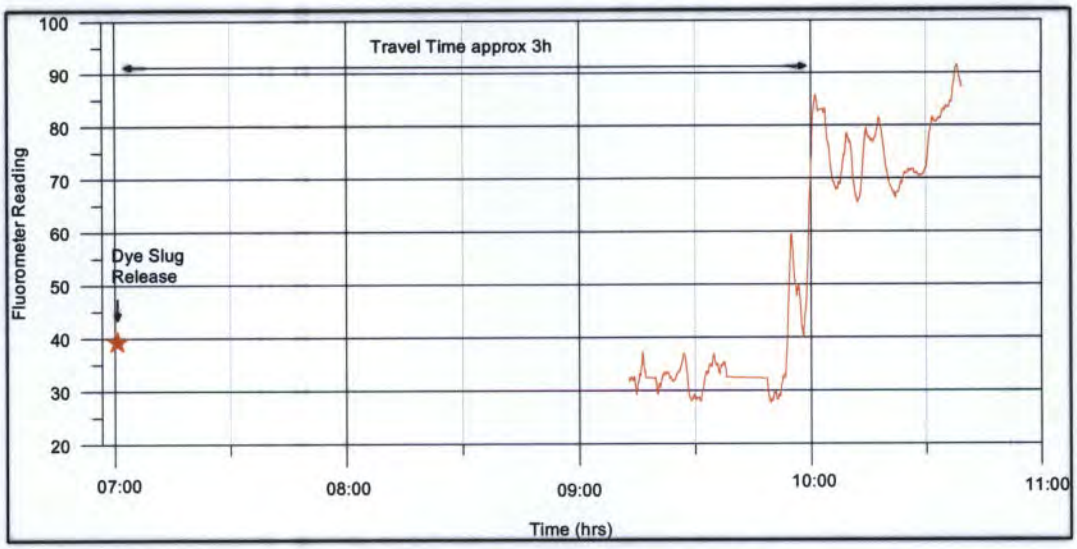


Figure 6.13 – Dye Track, Day No 4.

6.3.6 Predictive Model of Water Quality

6.3.6.1 Modelling Approach and Methods

A two dimensional depth averaged flow model (HM2D, [5]) was used to simulate the tidal circulation in the study area and provide an hourly flow pattern for both the spring and neap tidal cycles. The effects of wind were included in terms of enhanced horizontal mixing.

A particle track model was used for predicting the effluent dispersion patterns (TRACK, [6]). With this technique, a cloud of discrete particles simulates the continuum of dispersing contaminant. The model operates on the same grid as that employed in the flow model.

6.3.6.2 2d - Flow Model

In the 2D circulation model the bathymetry was defined on a rectangular grid with cells of horizontal dimension 10m x 10m. The model included both Clonakilty Harbour and Muckruss Strand and extended seawards beyond Ring Head for a distance of approx. 2km. The large model area was necessary to ensure model boundary effects did not adversely impact the flows in the region of interest and that water exchanges were consistent with estuary volumes.

Boundary conditions were initially taken from co-tidal charts [7] and other references. These indicate spring tidal amplitudes of approximately 3.4m and a small phase difference along the southern boundary. Several model runs were then conducted for a range of boundary parameters to obtain simulations equivalent to mean neap and mean spring tides.

Calibration of the model was first achieved by comparing predicted current speeds with field measurements and adjusting model coefficients as required. Further calibration was achieved by simulating drogue releases with the model and comparing results to those observed in the field.

Simulated surface drogue trajectories corresponding to the spring tide release of 5/12/05 (Figure 6.7) are shown in Figures 6.14. Excursions and trajectories are simulated to a good accuracy.

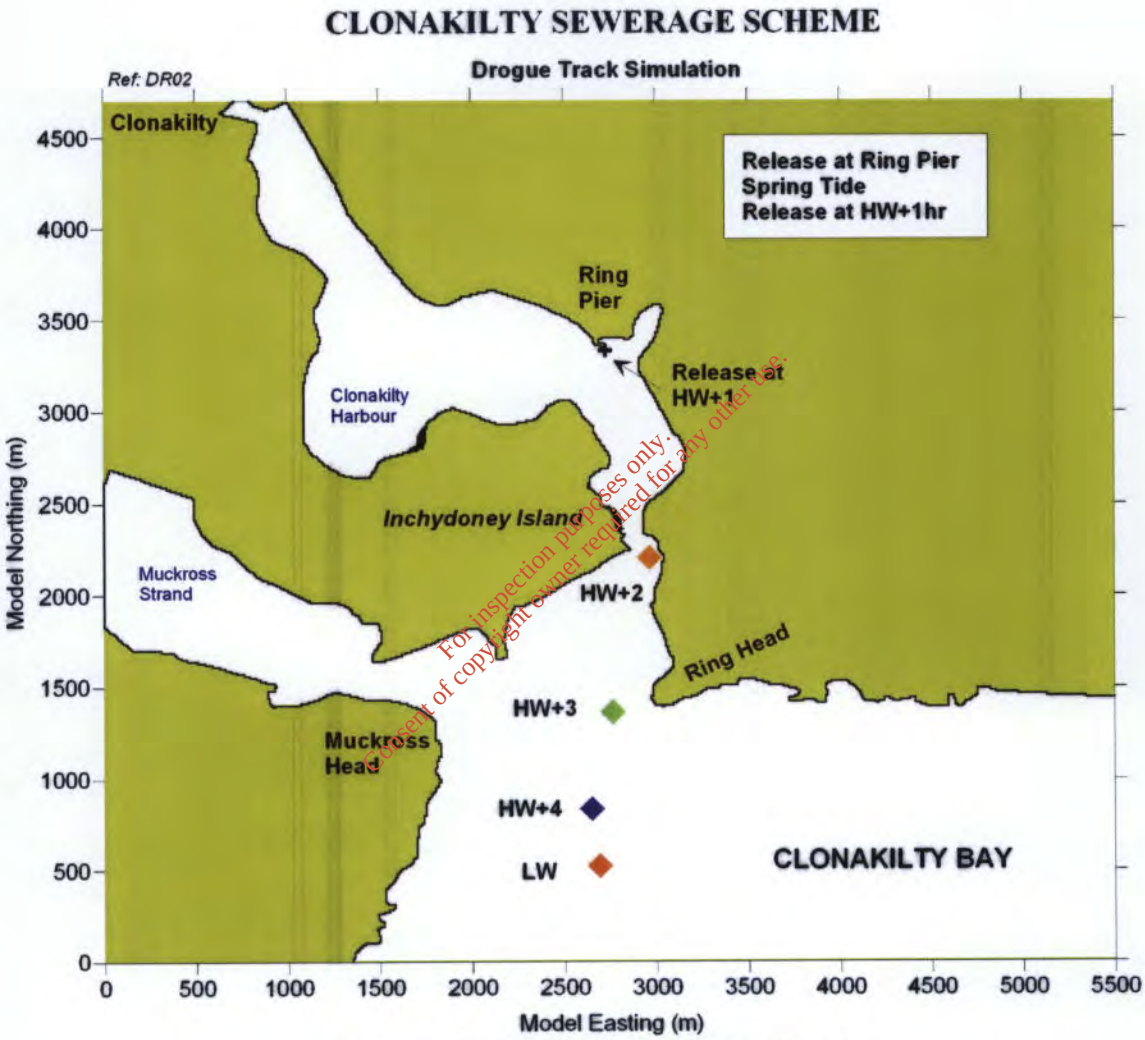


Figure 6.14 – Simulated Drogue Track

6.3.6.3 2d - Dispersion Model

Dispersion was simulated using the particle tracking model TRACK. In the model the discharge of effluent material is represented by a number of discrete particles. As the simulation progresses through time a series of particles are released at the outfall location. During each time step the particles are moved horizontally by the current flows. In addition to these advective steps, each particle is moved by random steps in order to simulate the effects of diffusion. The particle step length which simulated diffusion in the models was selected randomly in the range +/- infinity

according to an appropriate Gaussian probability density function.

In shallow coastal waters dispersion results from a combination of physical mechanisms. These principally relate to the current and the manner in which it varies both vertically and laterally. The greater the 'velocity shear' the more rapid will be the dilution of the effluent. The horizontal diffusion coefficient was estimated from the dye test results. The effect of wind is to promote more rapid mixing and this was simulated by an increased diffusion coefficient.

The process of bacterial decay was included in the model by evaluation of the probability of decay for each particle during each time step. This was expressed as a function of T_{90} where T_{90} is the time for 90 percent decay. In the simulations produced for this study, the decay time was defined to be 12 hours and so the results achieved equilibrium within 10% after one tide and within 1% after two tides.

The simulations made by the model were of 24.8 hours duration (two tides) using a time step of 20 seconds. Concentrations of effluent were estimated by counting the number of particles in each model grid cell (10m x 10m). This produced the number of model particles in a volume of water which was determined by the horizontal cell dimensions and the water depth at that point. If the water depth exceeded 5m then the vertical dimension was set to 5m to allow for incomplete vertical mixing as sometimes occurs in coastal/estuary waters

Verification of the combined flow/particle track dispersion model was achieved by comparing simulated drogue tracks with field data and similarly dye patch releases with dye track data.

6.3.7 Simulation of Effluent Discharges

Following evaluation of the field work data modelling was undertaken to simulate effects of the treated wastewater discharges. Three effluent release points (Figure 6.1) were simulated. Model simulations for each outfall location were made for spring and neap tides.

6.3.7.1 Effluent Characteristics

Effluent parameters used in the simulations were:

Flow Rate:	53 litres per second;
Faecal Coliform Concentration:	1×10^6 fc/100ml;
Decay Time:	T_{90} = 12 hours;
BOD	25 mg/l;
Nitrate	30 mg/l;
Ortho-phosphate	8.0 mg/l.

The bacterial decay time of 12 hours represents a conservative value, typically adopted for coastal waters.

The Fealge river entering at the head of Clonakilty Harbour was assumed to have a discharge corresponding to the 95 percentile condition (i.e. approx 0.075m^3/s).

6.3.7.2 Quality Criteria

The Blue Flag scheme sets the acceptable limit for faecal coliform bacteria on a bathing beach at 100fc/100ml based on 80% sample compliance. Inchydoney beach is a designated Blue Flag beach and therefore must comply with this standard.

Nutrient enrichment of estuary waters is considered to occur when median dissolved Nitrogen levels exceed 1.4mg/l and Ortho-phosphate levels exceed 0.06mg/l (60µg/l). Inner Clonakilty Harbour, i.e. upstream of Ring, could potentially become enriched unless these standards are met.

6.3.7.3 River Flows and Inner Harbour Dilutions

Flows in the Fealge River have been estimated from EPA statistics for the nearby Argideen river. Typical values are outlined in Table 6.1.

Based on these flows it is possible to compute effluent dilutions in the inner reaches of the harbour. As noted in Section 6.3.1 most of the estuary dries at low water leaving a small wet area downstream of Ring Pier. Figure 6.15 shows a profile of the channel extending upstream from Ring Pier to the existing town outfall. It can be seen that for about 50% of the time the channel will contain only river waters.

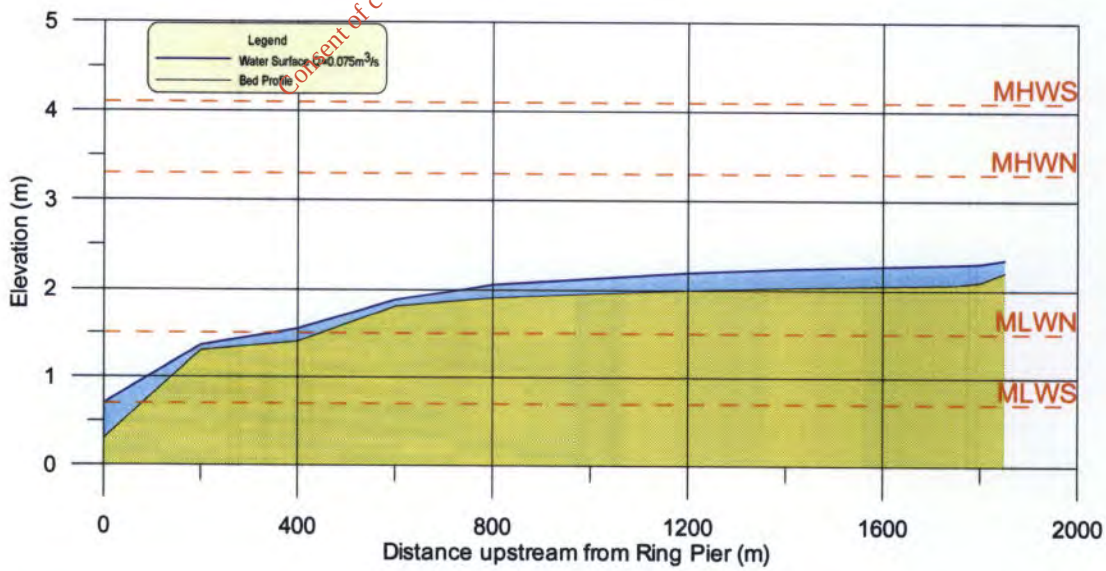


Figure 6.15 – Bed Profile from Ring Pier Upstream to Town Outfall showing tidal levels.

Concentrations of the various parameters in the channel at this time have been calculated and are presented in Table 6.2 below.

River Flow m^3/s	Type	Dissolved Nitrogen mg/l	Ortho-Phosphate mg/l	Faecal Coliform fc/100ml
0.075	95%ile	11	3.3	444×10^3
0.9	Mean Flow	2.3	0.46	55×10^3

Based on: Effluent Flow: 53 l/s, River backgrounds N: = 1mg/l, OP = 0.02mg/l and FC = 0.

Table 6.2 – Computed contaminant concentrations in river channel at low tide.

6.3.7.4 Model Results – Bacterial Simulations

The model simulations were run for two tidal cycles and outputs generated at 1 hour intervals. Outputs are presented in two formats:

(a) contour plots of bacterial concentration;

(b) time series plots of bacterial concentration at selected sampling strips.

The contour plots, output type (a), show the movement of the effluent plume as it is advected and dispersed over the tidal cycle. Examples for the three outfall cases are contained in Appendix 6.2 (Appendices A, B and C). These show high and low water plume excursions for spring and neap tides during calm conditions.

The time series plots, output type (b), provide a more comprehensive method of comparing the impacts of differing discharge locations. The output contains the peak plume bacterial concentration where it enters a sampling strip and is derived from model output at all stages in the tidal cycle. The peak concentration is the highest value recorded in any 10m x 10m cell of the sampling strip. The chosen sampling strip locations are indicated in Figure 6.16. Locations 2 and 3 correspond to the 'Blue Flag' bathing areas while Location 1 is popular with surfing enthusiasts. Locations 4 & 5 within the harbour are chosen for comparative purposes and are not of any special significance.

Time series output plots for each sampling strip are included in Figures 6.17 to 6.20 with a summary of predicted maximum bacterial concentrations extracted from these plots presented in Tables 6.3 to Table 6.6.

The results clearly show that in terms of minimising the bacterial contamination on the Blue Flag beach at Inchydoney the optimum solution is to retain the outfall at the existing location. This applies to both calm and windy conditions.

This result is in keeping with what is intuitively expected for a location such as Clonakilty Harbour where contamination levels at the downstream end of the estuary are of interest. Effluent released from an outfall located furthest upstream has the longest travel time to reach the downstream end and benefits most from the natural mortality of bacteria.

Table 6.3 - Predicted Maximum Faecal Coliform Concentration (fc/100ml) for Spring Tide and Calm Conditions.

Model Strip Sampling Location	Outfall Location		
	Existing (at WWTP)	Below Proposed Barrage	At Ring Pier
1	440	560	955
2	40	135	175
3	20	50	30
4	780	1,170	1,650
5	2,350	3,350	5,000

Table 6.4 - Predicted Maximum Faecal Coliform Concentration (fc/100ml.) for Neap Tide and Calm Conditions.

Model Strip Sampling Location	Outfall Location		
	Existing (at WWTP)	Below Proposed Barrage	At Ring Pier
1	300	890	1,050
2	15	20	70
3	0	20	50
4	1,200	1,600	1,875
5	2,080	3,000	4,150

Table 6.5 - Predicted Maximum Faecal Coliform Concentration (fc/100ml.) for Spring Tide and Onshore Wind Conditions.

Model Strip Sampling Location	Outfall Location		
	Existing (at WWTP)	Below Proposed Barrage	At Ring Pier
1	700	1020	830
2	60	80	125
3	40	60	60
4	1,200	1,300	1,400
5	2,600	2,950	4,550

Table 6.6 - Predicted Maximum Faecal Coliform Concentration (fc/100ml.) for Neap Tide and Onshore Wind Conditions.

Model Strip Sampling Location	Outfall Location		
	Existing (at WWTP)	Below Proposed Barrage	At Ring Pier
1	540	825	1,160
2	40	80	85
3	30	60	90
4	1,220	1,750	1,600
5	2,600	3,000	4,200

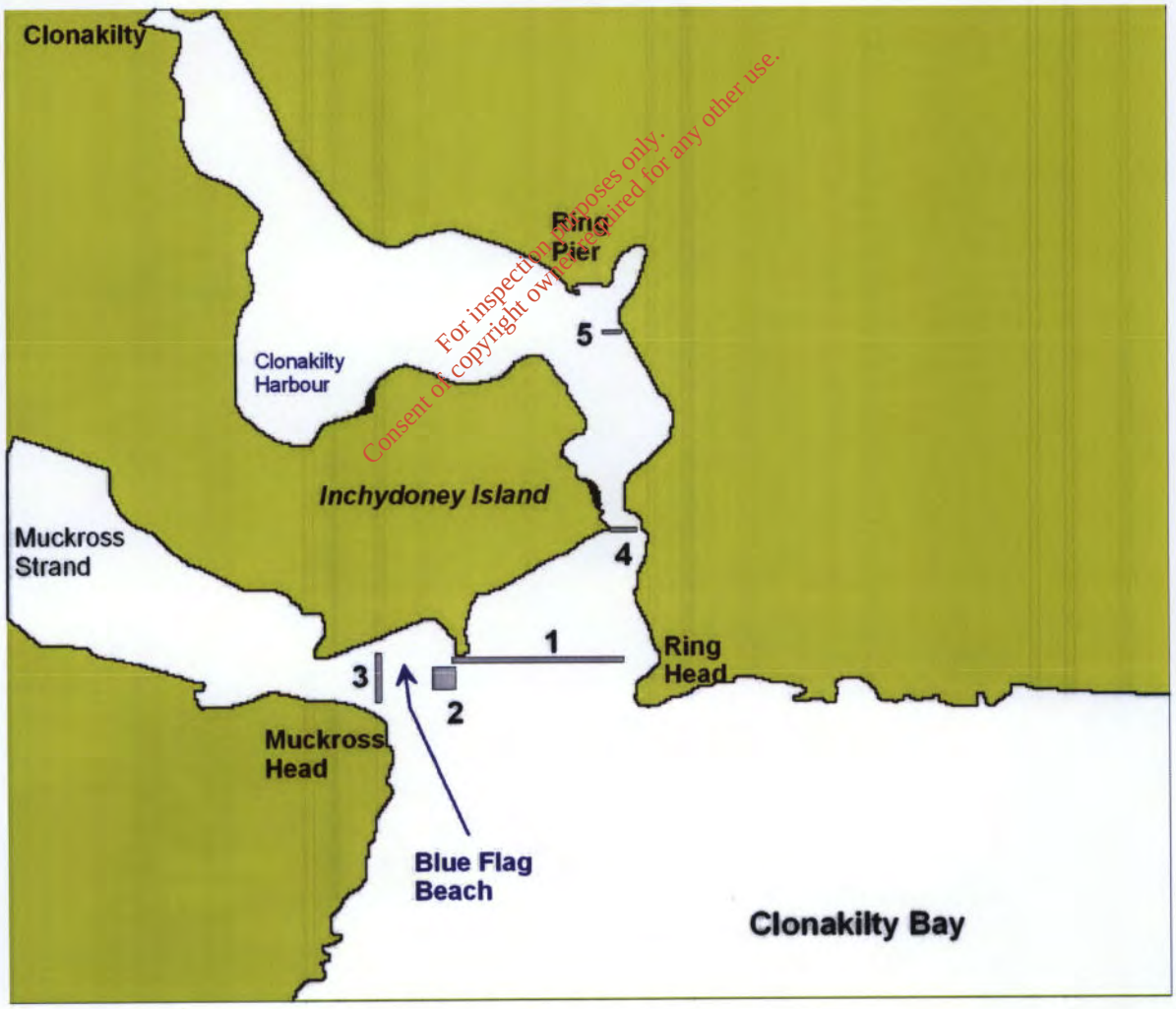


Figure 6.16 – Model Sampling Strips.

CLONAKILTY SEWERAGE SCHEME

Model Case: CM12, CM14 and CM16
Spring Tide
Source flow: 53 litres/sec
Source conc. $1x10^6$ fc/100ml

Legend
- CM14-Town, Spring Tide
- CM12-Pier, Spring Tide
- CM16-Barrage, Spring Tide

Timeseries of concentrations of faecal coliforms in model strips
Peak concentration in any model cell within the inspection strip

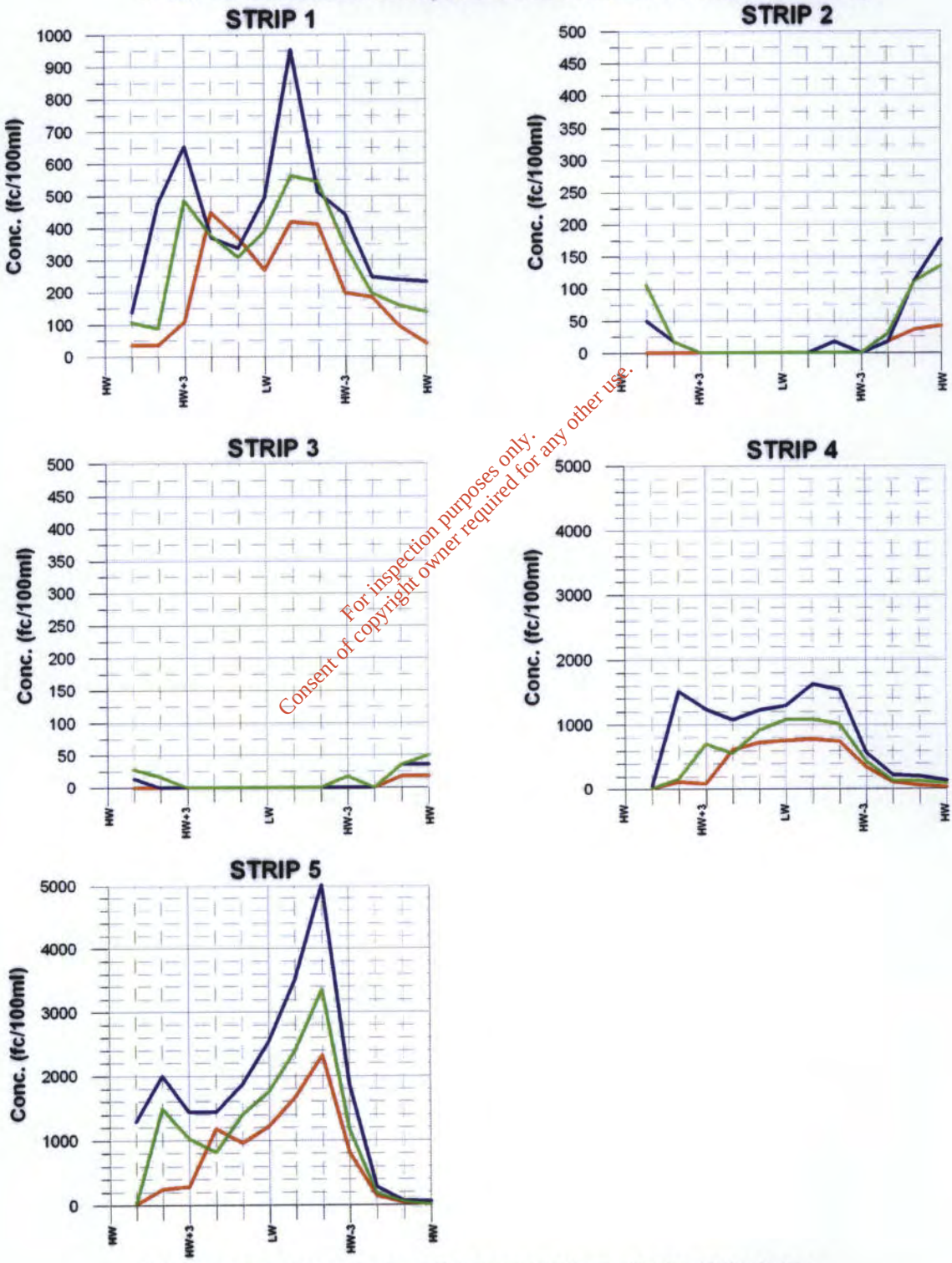


Figure 6.17 – Time Series of Concentration – Spring Tide Calm.

CLONAKILTY SEWERAGE SCHEME

Model Case: CM13, CM15 and CM17
Neap Tide
Source flow: 53 litres/sec
Source conc. $1x10^6$ fc/100ml

Legend
- CM15-Town, Neap Tide
- CM13-Pier, Neap Tide
- CM17-Barrage, Neap Tide

Timeseries of concentrations of faecal coliforms in model strips
Peak concentration in any model cell within the inspection strip

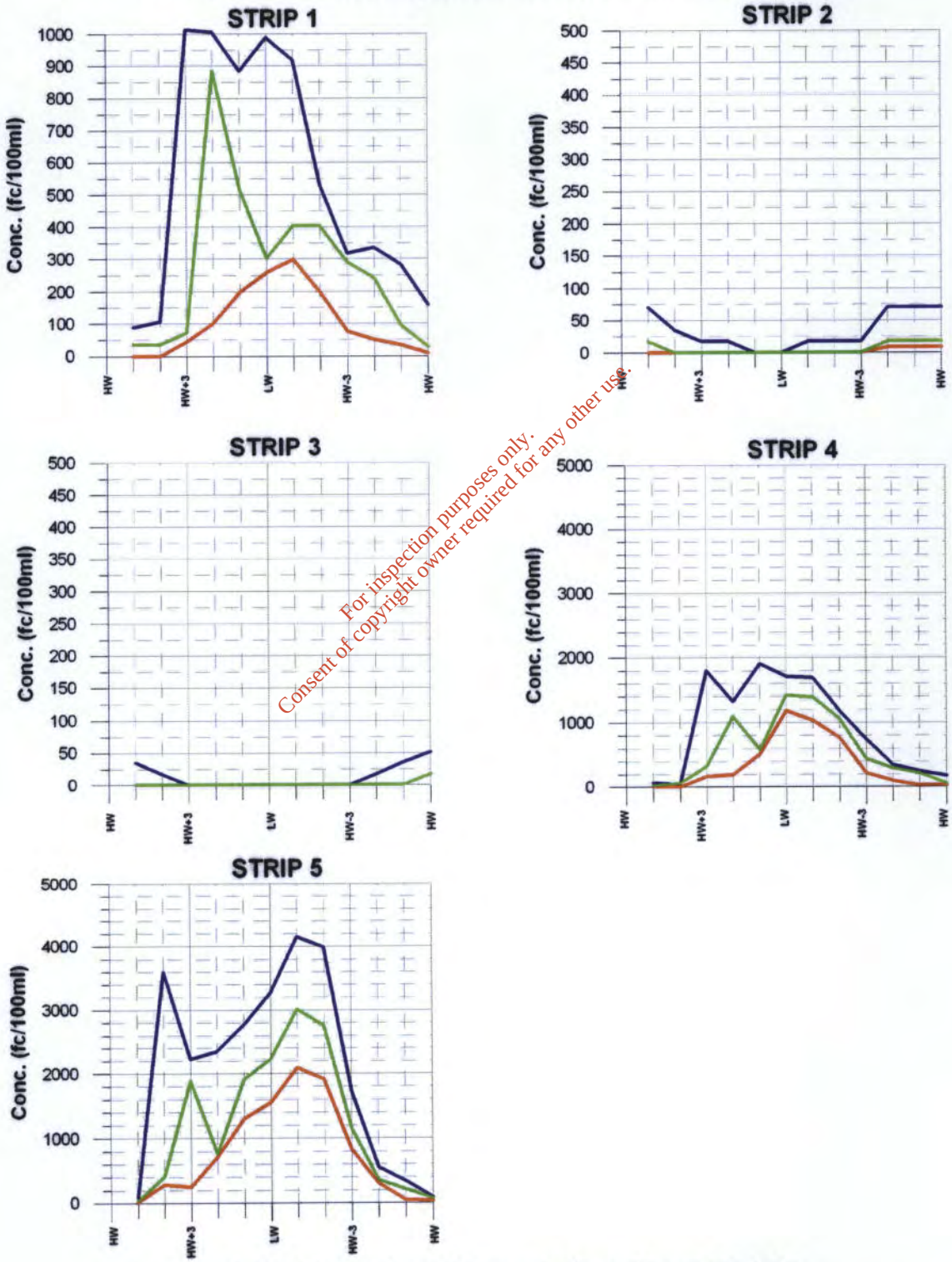


Figure 6.18 – Time Series of Concentration – Neap Tide Calm.

CLONAKILTY SEWERAGE SCHEME

Model Case: CM18, CM19 and CM20
Spring Tide + Onshore Wind
Source flow: 53 litres/sec
Source conc. $1x10^6$ fc/100ml

Legend
- CM20-Town, Spring + Wind
- CM18-Pier, Spring + Wind
- CM19-Barrage, Spring + Wind

Timeseries of concentrations of faecal coliforms in model strips
Peak concentration in any model cell within the inspection strip

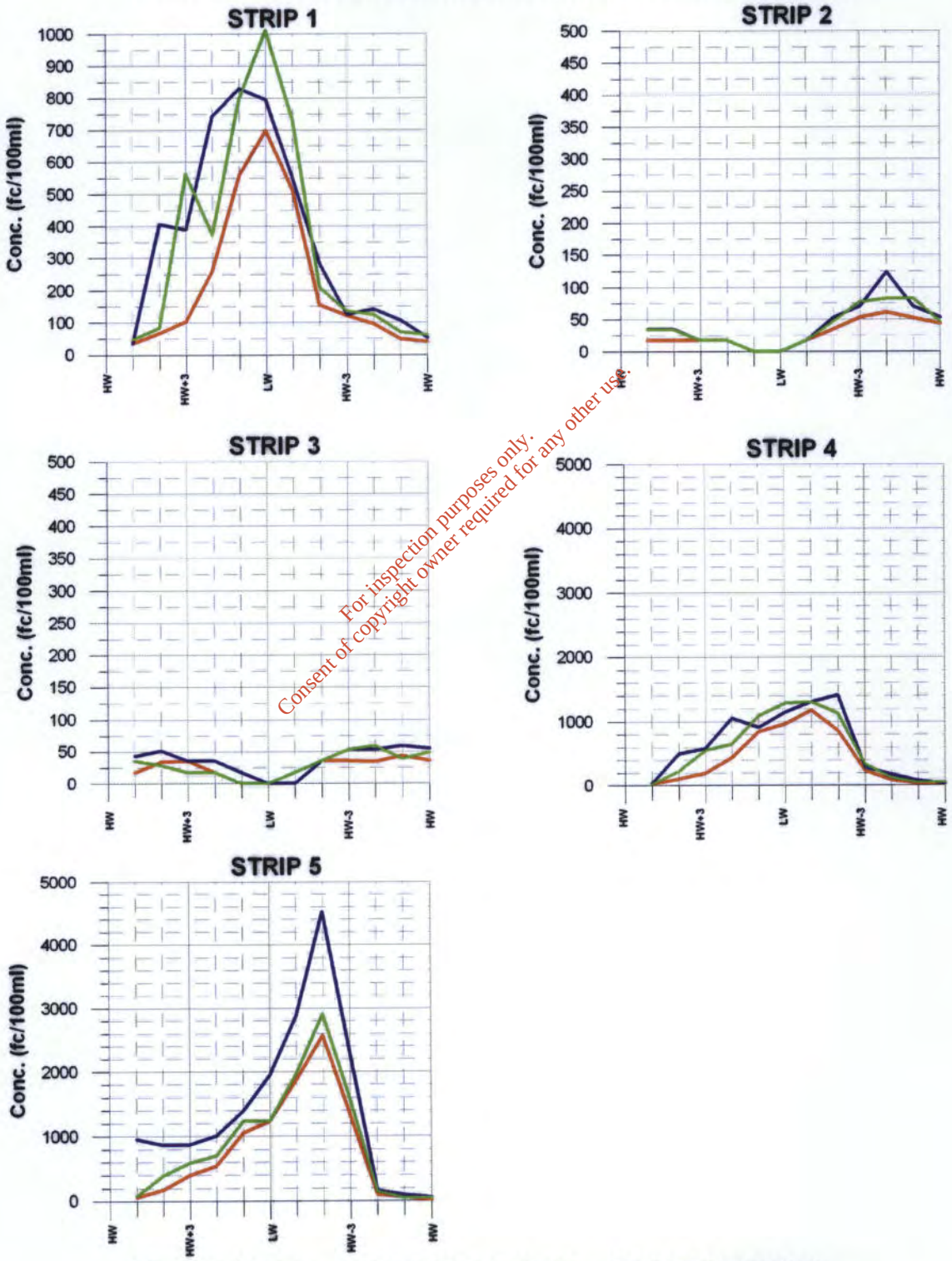


Figure 6.19 – Time Series of Concentration – Spring Tide & Wind.

CLONAKILTY SEWERAGE SCHEME

Model Case: CM21, CM22 and CM23
Neap Tide + Onshore Wind
Source flow: 53 litres/sec
Source conc. $1x10^6$ fc/100ml

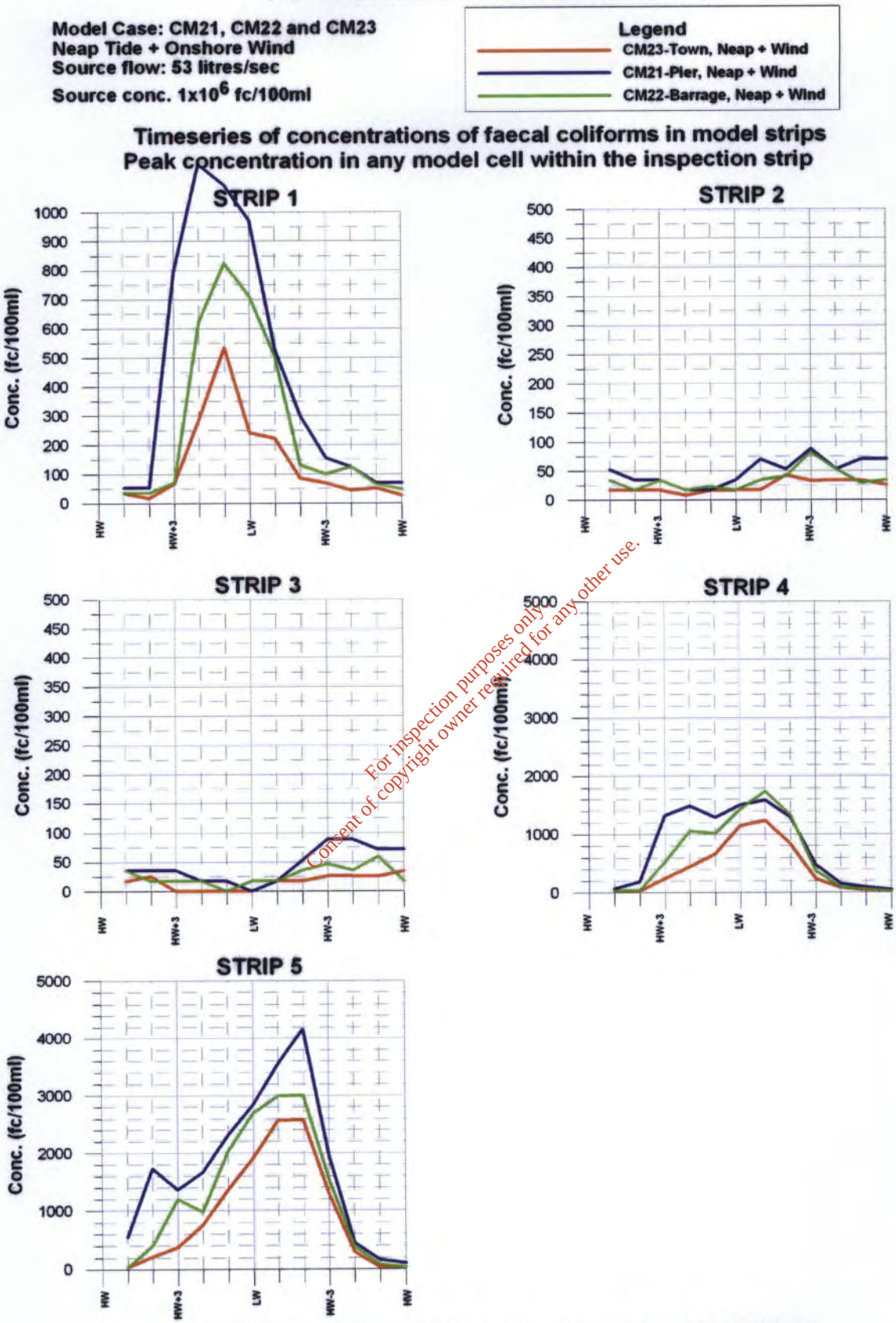


Figure 6.20 – Time Series of Concentration – Neap Tide & Wind.

6.3.7.5 Model Results – Nutrient Simulations

Simulations of nitrates and orthophosphates were made for calm weather conditions. The modelling procedures were similar to those adopted for bacterial predictions except that a longer 5 day decay time was applied. Model results are summarised in Table 6.7 and 6.8 and show that both nitrate and ortho-phosphate levels will be well below the levels which would indicate nutrient enrichment.

Table 6.7 - Predicted Maximum Nitrate Concentration (mg/l) for a Spring or a Neap Tide and Calm Conditions.

Model Strip Sampling Location	Outfall Location		
	Existing (at WWTP)	Below Proposed Barrage	At Ring Pier
1	0.08	0.10	0.10
2	0.04	0.04	0.05
3	0.02	0.02	0.02
4	0.15	0.17	0.17
5	0.20	0.20	0.20

Table 6.8 - Predicted Maximum Ortho-phosphate Concentration (µg/l) for a Spring or a Neap Tide and Calm Conditions.

Model Strip Sampling Location	Outfall Location		
	Existing (at WWTP)	Below Proposed Barrage	At Ring Pier
1	23	28	30
2	12	14	16
3	3	9	9
4	7	52	54
5	56	59	57

6.3.8 EIS for Tidal Barrage

6.3.8.1 Background

The EIS for Tidal Barrage in Clonakilty Harbour (January 2001) included a study of the likely impacts of the proposed barrage on the waters of Clonakilty Harbour. This study addressed a number of issues, the principal ones being:

- Estimates of extreme water levels for design purposes;
- Likely impact on the erosion / deposition patterns in the harbour area;
- Assessment of impact of short term barrage closure on water quality in the inner harbour.

The brief for the preparation of the EIS for the upgrade and extension of the WWTP for Clonakilty required the Consultants to examine the impact of predicted effluent discharges on the receiving waters for two scenarios; with no barrage in the harbour and with the barrage in the harbour. Cork

County Council instructed White Young Green to use the information from the EIS for Tidal Barrage in Clonakilty Harbour (January 2001) to assess the impacts for the situation with the barrage in place.

The relevant section of the EIS for Tidal Barrage in Clonakilty Harbour, titled Appendix E – Tidal and Estuarine Studies, has been included in Appendix 6.3 of this EIS. The main findings of the EIS for Tidal Barrage relating to water quality with the barrage in position are summarised below

6.3.8.2 Water Levels

The model for the barrage showed that, downstream of the proposed location of the barrage, the construction of the barrage would produce no change in tidal amplitude. The high water levels would remain the same as would the duration of the flood and ebb tides at this location. The main differences which would be caused by the barrage would be a reduction in the rate of fall of the tide towards the latter stages of the ebb and a slight change in the speed curve

Upstream of the proposed location of the barrage, there would be a time shift in the tidal curve. This would be due to the delay introduced by flow through the sluice valves. The tidal amplitudes would remain the same while speeds would be altered.

The low water level upstream of the barrage is predicted to be 1.0m above the downstream tide level for spring tides and 0.5m above the downstream tide level for neap tides. This difference would be due to the introduction of a cill for the tidal penstock at a height of 2.0m OD Poolbeg.

6.3.8.3 Water Quality

Under normal operating conditions, it is proposed that the barrage would remain open at all stages of the tide, resulting in a regime that would be little different from the present regime. The barrage may be closed for a period of less than 6 hours around high water when flooding is anticipated. This is not expected to appreciably influence water quality upstream of the barrage during the period when the barrage is closed. The model for the barrage also examined changes in various water quality parameters due to closure of a barrage over an extended period of time. The model examined the situation where the barrage penstock would be closed at high water and maintained closed for 1.25 x tidal cycle The output from the model, included in Appendix 6.3, are summarised below.

Salanity

Salinity would vary with the tidal cycle, being a maximum at high water. There would be a slight reduction in salinity over the period of the barrage closure due to the inflow of fresh water from surface water sources. Variations in levels would return to normal once the barrage is opened. It is expected that salinity levels would be at their minimum level if the barrage was closed at low water. The patterns are similar for all tide and river flow conditions but with a greater reduction in salinity over the period of barrage closure with

lower high tides and greater river inflows.

BOD

The model shows that BOD concentrations in the harbour generally vary with tide levels, being highest at low water when dilution is lowest. With the closure of the barrage at high water, BOD concentration would be initially at its lowest level but would rise gradually with increased input of BOD. On opening of the barrage, BOD levels would revert to normal concentrations.

Coliforms

Coliform concentrations would behave similarly to BOD concentrations. Coliform concentrations in the harbour generally vary with tide levels, being highest at low water when dilution is lowest. With the closure of the barrage at high water, coliform concentration would be initially at its lowest level but would rise gradually with increased input of coliforms. On opening of the barrage, coliform levels would revert to normal concentrations.

Ammonium

Ammonium concentrations would also behave similarly to BOD concentrations. Ammonium concentrations in the harbour generally vary with tide levels, being highest at low water when dilution is lowest. With the closure of the barrage at high water, ammonium concentration would be initially at its lowest level but would rise gradually with increased input of ammonium. On opening of the barrage, ammonium levels would revert to normal concentrations.

6.3.9 Summary

This section presents the findings of a marine study of the proposed treated waste water discharges from the town of Clonakilty. The study assesses the dispersive characteristics of the coastal area and comments on the siting of the outfall with regard to possible impacts, particularly on the 'Blue Flag' bathing beaches at Inchydoney.

The oceanography of the region is typical of coastal sites, though with added complexities due to the shallow inner harbour and the local topographic features. Outside the harbour the surface tidal currents are generally weak and are influenced by prevailing winds. Peak values observed here were about 0.14m/s. Dispersion characteristics are good as shown by dye and drogue data. Tidal ranges in the area are approx. 3.4m on springs and 1.8m on neaps.

A two dimensional flow model together with a particle track dispersion model was used to simulate the discharges. Recorded data from current meter, drogue and dye releases were used for calibration and validation purposes. Twelve separate simulations were conducted.

Five representative sampling sites within the model domain were selected to aid assessment of outfall options (Figure 6.16). The predicted maximum bacterial concentrations at these locations are

presented as time series in Figures 6.17-6.20 and listed in Tables 6.3 to 6.6. Tables 6.9 and 6.10 present a further simplification, listing maximum values on either a spring or a neap condition for calm and windy conditions respectively.

The results show that the optimum location for the outfall in terms of minimising bacterial contamination at Inchydoney beach is the existing site adjacent to the town.

Simulations of nitrate and ortho-phosphate (OP) levels show that for the area downstream of Ring there is little difference between the impacts of the three outfall options. In the inner estuary and the channel area upstream of Ring the town outfall will have the greatest impact on nutrient levels as for about 50% of the time only river water will be present. Dilution calculations show that for mean river flows of 0.9m^3/s the nitrate and OP levels will be 2.3 and 0.46 mg/l respectively. For the lower 95 percentile flow condition these levels increase to 11 and 3.3 mg/l.

A build-up of nutrients is not expected from the wastewater treatment plant as almost full flushing of the estuary occurs on each tide. The incoming tide predominantly floods along the western shoreline past Duneen Head, bringing in cleaner uncontaminated waters.

Table 6.9- Predicted Maximum Faecal Coliform Concentration (fc/100ml) for either a Spring or a Neap Tide and Calm Conditions.

Model Strip Sampling Location	Outfall Location		
	Existing (WWTP)	Below New Barrage	At Ring Pier
1 – Surfing Area	440	890	1,050
2 – Blue Flag Beach	40	135	175
3 – Bathing Area	20	50	50
4	1,200	1,600	1,875
5	2,350	3,350	5,000

Table 6.10 - Predicted Maximum Faecal Coliform Concentration (fc/100ml) for either a Spring or a Neap Tide and Onshore Wind Conditions.

Model Strip Sampling Location	Outfall Location		
	Existing (WWTP)	Below New Barrage	At Ring Pier
1 – Surfing Area	700	1020	1160
2 – Blue Flag Beach	60	80	125
3 – Bathing Area	40	60	90
4	1,220	1,750	1,600
5	2,600	3,000	4,550

The modelling carried out as part of the EIS for Tidal Barrage in Clonakilty Harbour indicates that the construction of the barrage would have little or no impact on water quality when maintained in the open position or if closed for a period of just over one tidal cycle. It is not proposed to close the barrage for longer periods than this.

6.4 POTENTIAL IMPACTS

6.4.1 Construction Phase

The main potential impacts arising out of the construction phase will consist of the following:

- Suspended clay and silt laden rainfall run-off from excavations. Excessive amounts of silt may enter the adjacent harbour.
- Depending on the depth to groundwater and depth of construction foundations dewatering of groundwater may be required.
- Hydrocarbon contaminated run-off from oil storage areas, machinery refuelling areas, leaky site machinery or accidental spillages or leakages.

6.4.2 Operational Phase

The main potential impacts associated with the operational phase will comprise the following:

- Leaks or spills from wastewater holding tanks/associated pipelines.
- Increase in coliform levels above allowable standards in applicable regulations
- Increase in nutrient levels above levels likely to result in euthrophication of Clonakilty Harbour.

6.5 MITIGATION MEASURES

6.5.1 Construction Phase

The implementation of good construction management practices will minimise the risk of pollution to surface water and groundwater.

All oils, chemicals, paints or other potentially polluting substances used during construction will be stored in designated storage areas which will be bunded to a volume of 110% capacity of the largest tank/container within the bunded area(s). Filling and draw-off points will be fully located within the bunded area(s) or vehicles will be re-fuelled off-site. Drainage for the bunded area(s) will be diverted for collection and safe disposal.

Any groundwater that is being dewatered would need to be monitored before discharging. Chemical and biological parameters together with suspended solids would need to be monitored depending on the discharge location.

All refueling or oiling of vehicles or site machinery should be carried out off-site.

6.5.2 Operation Phase

All substances that would have the potential to cause a negative impact on surface water and groundwater will be stored in appropriate containers and placed within bunded areas.

All untreated wastewater entering the facility will be stored in fully contained structures therefore there will be no potential for leakage to groundwater.

All underground piping will be maintained and regularly inspected for integrity.

Storage tanks and associated pipelines will be maintained and regularly inspected for integrity.

The modelling of the receiving waters has indicated that there should be no impact on designated Bathing Waters in the vicinity of Clonakilty Harbour due to the increased discharge of treated effluent from the WWTP. In order to allow for any change in the designation of the receiving waters or any increase in the wastewater flows, the WWTP should be designed to allow retrofitting of disinfection equipment so that coliform levels in the treated effluent could be reduced if necessary. Regular monitoring of the treated effluent and designated bathing waters will identify any excessive levels of coliforms in the treated effluent and any breaches of the bathing water standards.

The study of the receiving waters has indicated that an increase in nutrient levels in Clonakilty Harbour is unlikely to occur due to full tidal flushing of the estuary on each tidal cycle. However, at low river flows, the effluent from the WWTP will result in unacceptable high concentrations of nitrogen and phosphates in the receiving water. Refer also to Section 7.3.4.7 in the following section.

It is recommended that the WWTP should provide for reduction of nitrogen and phosphates in the treated effluent. The maximum levels of total phosphorus (P) and total nitrogen (N) in the treated effluent being discharged to sensitive areas under the Urban Wastewater Treatment Regulations 2001 are 2 mg/l P and 15 mg/l N for population equivalents (PE) between 10,000 and 100,000. These levels are considered appropriate for the upgraded and expanded Clonakilty WWTP which will have a PE of 20,500. Regular monitoring of the nutrient levels (nitrogen and phosphorus) in the receiving waters should be carried out in the future to determine if the nutrients from the WWTP are still considered to be the cause of unacceptable nutrient levels in Clonakilty Harbour after the upgrade

works are carried out. Allowance should be made in the design of the WWTP for the further reduction in nitrogen and phosphates in the effluent if required.

An emergency response procedure should be formulated and employed in the unlikely event of a large scale leakage or spillage on site. This will include immediate containment procedures, contacting relevant authorities and employing specialist consultants to remediate the spill.

6.6 RESIDUAL IMPACTS

With the above mitigation measures in place, neither the construction nor operational phases of the proposed development will result in any significant negative impacts on the existing surface water.

6.7 INTERACTIONS

Surface water interacts with all environmental media to some extent but most significantly with groundwater/ hydrogeology, ecology, and human beings. As part of the proposed development concerns regarding the proper management of construction activities are noted relating to the groundwater and coastal water of Clonakilty Harbour. All construction activities will be conducted in an environmentally safe manner as outlined in all the Sections 3 to 13 and in particular in accordance with Section 5.0 (Geology/Soils and Hydrogeology), Section 7 (Ecology) and Section 3 (Human Beings).

The ongoing interaction of surface water with ecology during the operational phase is also of concern and is addressed in Section 7.

6.8 REFERENCES

- "Guidelines on the Information to be Contained in Environmental Impact Statements" Environmental Protection Agency March 2002
- "Advice Notes on Current Practice (in the preparation of Environmental Impact Statements)" Environmental Protection Agency September 2003
- The Environmental Protection Agency website www.epa.ie. Water quality information.
- Geological Survey of Ireland website, www.gsi.ie. Online groundwater maps database.
- Cork County Council Inniscarra Waterworks. Water Quality Information.
- Environmental Impact Statement for Tidal Baggage in Clonakilty Harbour (MCOS), 2001.