4.0 DESCRIPTION OF THE LIKELY SIGNIFICANT IMPACTS

4.1 BACKGROUND

Newport Wastewater Treatment Plant - Construction and Proposed Discharges
At present, raw sewage from Newport Town collects in North and South holding tanks and is discharged in an untreated state into Newport Harbour at two outfall locations downstream of the quays. It is now proposed to treat the town's sewage to a secondary level (through the process of screening, primary and secondary treatment including disinfection using UV processes after secondary treatment if deemed appropriate). It is proposed that final effluent from the plant will be treated to comply with legal requirements as set out under the Urban Waste Water Directive.

In addition to the treated sewage discharge, it is also proposed to discharge treated leachate from the Derrinumera Landfill site via the same discharge point as that proposed for Newport wastewater treatment plant effluent discharge. Therefore the proposal is for the dual discharge of treated sewage and treated landfill leachate into inner Clew Bay via a single discharge pipe.

A proposed primary discharge location (A) has been chosen on the north shore of Rosmore Peninsula (E95550, N294230) in the approach channel to the Burrishoole system.

A proposed alternative discharge location (B) has been chosen further into the bay south east of Muckinish Island (E93503, N293116).

Both proposed discharge locations will involve the construction and laying of pipeline from the plant to the discharge point.

a) Proposed Newport waste water treatment plant effluent
The appointed contractor will be required to commit to treating the discharge from the proposed Newport Sewerage Scheme to the following discharge standards;

- BOD_5 25 mg/l
- COD 125 mg/l
- Ammonia (as N) 5 mg/l
- Suspended Solids 35 mg/l
- Faecal Coliforms 2000 no. per 100 ml

This will mean that effluent discharges will have a greatly reduced environmental impact compared to the present discharges in the Newport harbour area (which is effectively raw sewage discharges).

b) Derrinumera Landfill Leachate Constituents
The appointed contractor will be required to commit to treating the leachate generated at Derrinumera landfill to specified levels before discharge (Appendix 18, Table 18.1).

It has been stated that untreated leachate will contain elements of all substances in the landfill that have not been broken down by microbiological activity within the landfill and which are soluble in water (TES Report). It has also been stated that various constituents of the leachate vary greatly depending on the location of sampling (e.g. waste body or holding tanks). The untreated leachate characterisation was implemented by means of weekly grab sampling at the same location over the course of a 5 week summer period in 2003 (July 29th to August 27th). This characterisation applies to untreated leachate, and is used as the basis of the 'worst case scenario' predicted impact.

4.2 DESCRIPTION OF IMPACTS

The construction and operation of a secondary level wastewater treatment plant with discharges to the marine environment in inner Newport Bay has the potential to impact both the immediate and adjacent habitats and species. Furthermore, the inclusion of treated leachate from Derrinumera Landfill in a dual discharge system is an additional variable to be considered and has the potential to adversely impact both the immediate and adjacent habitats and species. Potential impacts include loss of habitats and species, sedimentation and pollution and or contamination of water, sediment and biota. There is also the potential for improved water quality as sewage treatment is carried out to a higher standard than at present.

The 'do nothing' impact

- In the absence of the development of a Newport secondary level waste water treatment plant (with the possible provision of disinfection facilities) it is probable that water quality in the study area will remain unchanged or deteriorate (in the absence of any other impact). Increases in effluent load that would result from increases in local populations over time could result in an associated degradation in water quality in the area.
- In the absence of a discharge of treated landfill leachate to the system it is probable that water quality in the study area will remain unchanged (in the absence of any other impact).

The 'worst case' impact

In the event of project or mitigation measure failure it is possible that the receiving environment could be polluted by untreated leachate and concentrated raw sewage such that profound and irreversible consequences could occur. This 'worst case' scenario could result in the long term negative impact on sensitive habitats and species in an area of recognised nature conservation importance through physical disturbance and pollutant contamination both in the area immediately adjacent to and at some distance from the point discharge.

The description of impacts is divided (for the purpose of descriptive clarity) in terms of:

1. Construction phase impacts
    - Construction of the waste water treatment plant and discharge pipelines.
2. Operational phase impacts:
    - Discharge of sewage effluent from the waste water treatment plant
    - Discharge of treated landfill leachate from Derrinumera Landfill

1. Construction phase impacts - Construction of the waste water treatment plant and discharge pipelines.

Character of impacts

Fauna, flora, water and sediment will be negatively impacted in the short term by the construction process. Significant impacts will include:

a. Loss or alteration of habitats
Littoral and sublittoral habitats are likely to be lost and unavailable for feeding and spawning in the short term during the construction of any in water discharge structures (pipes, etc). This loss of habitat is likely to be temporary and restricted to a narrow corridor of habitat, which is expected to be back-filled naturally, returning the habitats to its natural state over time. The habitats in the development area mainly consist of muddy sand, which naturally shift with the tide and waves.

b. Loss or alteration of species composition
There will be a direct loss of species through the removal of habitat during the construction phase of the discharge pipe, both for sessile species and species with less mobile stages of their life cycles (such as eggs and larvae). There may be an indirect loss of species (invertebrates, vertebrates and plants) through the loss of feeding and spawning grounds available. However, once any pipe laying areas have been back filled and the habitat has been reinstated, it is expected that species will readily recolonise the area from the surrounding habitat. The loss of species due to loss of feeding and spawning grounds is likely to be negligible due to the small area of seabed likely to be impacted in relation to the wide area of similar feeding and spawning habitat available in the area.

c. Increased suspended solids
It is predicted that there will be a short term increase in the turbidity of the water column during the construction and laying of discharge pipes as increased suspended solids enter the water column. The increase in turbidity could result in increased siltation, smothering of organisms and a reduction of light for phytoplankton over the construction period. High levels of suspended solids settling on the seabed can alter habitats resulting in a potential loss of feeding and spawning grounds. Mobile species may move away from unfavourable conditions, however sessile, benthic fauna may be smothered and lost. This is particularly important in terms of local shellfish populations, such as the native oyster beds, *O. edulis,* east and west of proposed outfall A.

Impacts of increased turbidity are likely to be minimal in an overall context as there is a high degree of natural suspended solids in the area due to the high tidal current regime and sedimentary nature of the area. Additional suspended solids are likely to be rapidly dispersed by the strong currents in some areas. The depositional nature of the hydrodynamics in some areas could lead to increased sedimentation in some areas.

d. Noise pollution
Noise and vibrations from pipe laying equipment during the construction phase of the marine discharge may disturb the surrounding marine fauna. Little is known about effects of noise and vibrations on invertebrates; however impacts are likely to be minimal and short term and mainly restricted to the construction phase. Noise impacts would also be likely on vertebrate fauna of the area however again impacts are likely to be minimal and short term and mainly restricted to the construction phase.

e. Pollutants and waste
During the construction phase of the wastewater treatment plant, pollutants and chemicals used could contaminate the area. Potential contamination of sediments and marine organisms from the accidental release of organic polymers or heavy metals associated with cementing and/or grouting materials from the foundations may occur. This material is toxic to marine organisms in sufficient quantities and will potentially contaminate the seabed sediments

adjacent to the development, inhibiting recolonisation of the area after construction. This is particularly important in terms of the native oyster beds, *O. edulis*, east and west of proposed outfall A. Chemical contamination could also occur from accidental spillages, such as oil and other chemicals through poor operational management, the non-removal of spillages, poor storage, handling and transfer of oil and chemicals. However, if suitable precautions are taken and best practice for the storage, handling and disposal of such material are followed, impacts should be minimal. To prevent chemical pollution, all fuels or chemicals kept on the construction site should be stored in bunded containers. All refuelling and maintenance should be carried out in ramped containment areas away from sensitive environments (such as lakeside slopes). Oil interceptors should also be installed in appropriate locations. Equipment should be regularly maintained and leaks repaired immediately. Accidental spillages should be contained and cleaned up immediately. Remediation measures should be carried out in the unlikely event of pollution of adjacent watercourses in accordance with consultant's recommendations. During the construction phase, contained chemical portaloo toilets should be used and all sewage should be removed from the site to an authorised treatment works. Therefore no sewage will be discharged to watercourses.

f.) Physical disturbance
Local otter and seal populations may be subject to disturbance and resulting displacement from the area under construction

<u>Magnitude of impacts</u>

- The amount or intensity by which the quality of the marine flora and fauna will change as a result of construction activities will be minimal once best construction practice is followed. Any short term impacts would be expected to affect only areas in the immediate vicinity of the construction zone.
- The degree of change caused by direct construction impacts on local flora, fauna, sediment and water quality will be slight and should only extend to the footprint area of the pipeline (i.e. the area directly below and immediately adjacent to the pipeline).
- No profound changes of character are expected to result as a consequence of the construction phase other than that change resulting in the footprint area of discharge pipes.

<u>Consequences of impacts</u>

- The more sensitive and significant environmental receptors in the area include native and cultured population of oysters, fish species (particularly migratory species of conservation importance e.g. the Atlantic salmon and the sea trout), local mammal populations (otters and seals) and benthic invertebrate species.
- Short term impacts cannot be avoided but can be minimised by following best construction practice.
- An irreversible impact of the construction phase will be loss of habitat in the pipeline footprint. No other irreversible impacts are likely.

<u>Indirect impacts</u>

Cumulative and synergistic impacts are not anticipated as a consequence of the construction phase.

2. Operational phase impacts - Discharge of waste water treatment plant effluent from Newport Town and landfill leachate from Derrinumera Landfill

Character of impacts

The contractor will be required to treat the landfill leachate to specified levels before discharge. These are shown as 'predicted concentration in treated leachate' (Appendix 18). The table also shows predicted concentration after initial dilution and the relevant Irish regulatory standards.. It should be noted that in assessing the character of impacts of treated leachate discharge, determinations are based on this commitment and an assessment of aquatic ecological baseline conditions in the study area. Should the character of the leachate change, the impacts or significance of the impacts may no longer be valid. Also, if there are other contaminants present in the discharge that have not been declared there could be further significant impacts. Existing levels of contaminants will also affect the capacity of the environment to assimilate the discharge. In some cases the levels of contaminants could still cause problems below the limit of detection for the analyses used. The significance of impacts is generally based on individual contaminants. The synergistic affects of the discharges are not known and would, if present, increase significance.

In general, based on the commitment to treat the leachate to certain standards, the discharge is within legislative values or is within these values after the initial dilution stage. Potential impacts are framed in the context of relevant legislation and international guidelines ([3]1997 OSPAR EACs).

Fauna, flora, water and sediment could be negatively impacted in the short, medium and long term at both the primary discharge point (site A) and the alternative discharge point (site B) by the proposal.

Significant impacts could include:

Biochemical Oxygen Demand, Chemical Oxygen Demand, Suspended Solids

The BOD level for wastewaters set in the Urban Wastewater Treatment Regulations (SI No 254/2001) is 25 mg/l, for COD 125 mg/l and for SS 35 mg/l. The proposed discharge is to reach these standards. There should be no significant adverse impact.

Heavy metal contamination

Recent monitoring programmes, conducted in accordance with guidelines developed under the OSPAR Joint Assessment and Monitoring Programme, focus on a small group of heavy metals i.e. cadmium, mercury, lead, copper and zinc, selected for their intrinsic toxicity and potential to accumulate in biological tissues.

All metals occur naturally and are transported, redistributed and recycled by natural processes. Their status as contaminants stems from their widespread use in industry, their occurrence in waste materials and the tendency of activities such as mining, smelting and construction to augment releases of these metals to water and the atmosphere.

In general, the main repositories of metal contaminants are fine-grained sediments, particularly in bays and estuaries (such as those typical of the inner Newport Bay area) close to densely populated and industrialised areas. The biological significance of metals can be assessed either by comparing existing concentrations to existing food safety and environmental quality standards (EQSs) or to the background reference conditions (OSPAR 2004), as appropriate.

[3] Revised OSPAR EACs are overdue and may influence the potential significance of impacts.

Metals such as mercury bioaccumulate in the marine food chain and high concentrations have been found in marine mammals worldwide. Although much of this mercury is bound in a non-toxic complex with selenium, it has been estimated that the limit of tolerance for mercury in mammalian hepatic tissue is within the range 100 – 400 mg/kg ww. The levels of mercury in the livers of seals, porpoises and dolphins in the northern Irish Sea sometimes exceed 100 mg/kg ww but the toxicological significance of this is not clear. As such the potential impacts of heavy metals on the Newport Bay area is difficult to predict

Based on the relevant national legislation, limit values for the treated leachate discharge have been specified for arsenic, cadmium, chromium, copper, lead, mercury, nickel, silver and zinc. Both mercury and cadmium are included as List I substances in the Dangerous Substances Directive (76/464/EEC) while arsenic, chromium, copper, lead, nickel, silver and zinc are included as List II substances. As such, the discharge of all these metals is specifically regulated with maximum discharge levels set. All of these metals are also specifically mentioned in the Shellfish Waters Regulations (SI 268 of 2006) and should not be present at levels above those specified or that cause harm to shellfish or larva.

The current range of OSPAR EAC values give an indication of when environmental impact is likely to occur. They do not however take into account specific long-term biological effects such as carcinogenicity, genotoxicity and reproductive disruption due to hormone imbalances and do not include combination toxicity.

The treated leachate discharge (prior to mixing with Newport Sewerage Scheme discharges and dilution in the receiving waters, will be required to be achieve the standards as specified in the European Communities (Quality of Shellfish Waters) Regulations, 2006, or where limits for particular analytes are not present in these Regulations, the limits specified in the Water Quality (Dangerous Substances) Regulations, 2001 will be applied. In cases where limits are set in both regulations leachate should be treated such that the standards for both regulations are achieved.

The European Communities (Quality of Shellfish Waters) Regulations 2006 state that the 'synergistic effects of these metals must be taken into consideration'. Also, the receiving environment already contains levels of zinc that may be above statutory limits (Water Quality (Dangerous Substances) Regulations, 2001) and thus its capacity to absorb further discharges is reduced. The receiving environment also already contains elevated levels of silver and manganese.

Standard Ions

Cyanide and fluoride are included as List II substance in the Dangerous Substances Directive (76/464/EEC). The treated leachate discharge will be limited to the standards specified in the Water Quality (Dangerous Substances) Regulations, 2001.

Volatile Organic Compounds (VOCs)

Various VOCs are included as List I and II substances in the Dangerous Substances Directive (76/464/EEC). The treated leachate discharge will be limited to the standards specified in the Water Quality (Dangerous Substances) Regulations, 2001. As regulatory and guide limits are complied with there should be no significant adverse impacts.

Chlorinated pesticides

Many chlorinated pesticides are included as List I substances in the Dangerous Substances Directive (76/464/EEC). One of the primary characteristics of these organic contaminant chemicals is their propensity for biomagnification in the food chain resulting in elevated concentrations in the fatty tissues of top predators particularly marine mammals and piscivorous seabirds. Due to their often high fat content and relatively poor ability to detoxify and excrete organochlorines, very high concentrations can occur in these animals. The presence of certain organochlorines has also been linked to reproductive impairments (Colborn *et al.*, 1993). Toxaphene is a complex mixture of polychlorinated terpenes, predominantly chlorobornanes has been used extensively as a pesticide in both N and S America, Russia and Asia (Saleh, 1991). Until recently this compound has not been regularly monitored in OSPAR countries (de Boer, 1997). With the recognition of significant global transport of volatile contaminants generally, a limited number of studies have recorded toxaphene in biota from European marine waters. It is now clear that toxaphene is a widespread contaminant of fish from the north-eastern Atlantic. Concentrations of organochlorines in the blubber of seals and porpoises are generally similar but residues in the livers of otters from coastal and freshwater areas of south-western Ireland are considerably higher than in the livers of cetaceans. There are no specific limits for Chlorinated Pesticides specified in Irish legislation for the proposed receiving waters and as such it is proposed that they are included on a regular screening programme for treated leachate, receiving waters, sediment and shellfish tissue as part of the monitoring programme which will be implemented as part of the proposed development.

Polychlorinated biphenyls (PCBs)

As a consequence of their hydrophobic and persistent character PCBs are bio-accumulated and high concentrations are found in biota. PCBs are accumulated by marine organisms, especially within the fatty tissues of piscivorous birds and marine mammals in which concentrations may occasionally achieve levels of potential toxicological significance. The negative effects on reproduction due to PCB and other organochlorine contamination have been associated with the decline of the otter in European rivers, and the decline of dolphins and porpoises in the North Sea (WWF, 2000). Furthermore, the detrimental effects of certain organochlorine compounds and PCBs on the immune system may have been a factor in the disease epidemics in marine mammals. These organochlorine compounds are ubiquitous in the marine environment, but concentrations measured in seawater and sediments at Irish coastal and offshore sites are, with a few localised exceptions, very low and within the ranges found throughout the North-east Atlantic. It is possible that in some areas PCBs are more available than elsewhere, perhaps from reservoirs stored in sediments, recycling in the food chain or from localised inputs from land or the atmosphere. There is a commitment to treat total PCBs prior to discharge to 0.3 μg/l. This is within the European Communities (Quality of Shellfish Waters) Regulations 2006 mandatory value of 0.3 μg/l.

Semi-volatile organic compounds (including PAHs)

PAHs are included as List II substances in the Dangerous Substances Directive (76/464/EEC). They are toxic and bioaccumulate, especially in invertebrates. Although vertebrates metabolise them, PAHs are reactive compounds, and some are carcinogenic. OSPAR identified them in 1994 as requiring priority action and they were therefore included in the 1998 OSPAR List of Chemicals for Priority Action. PAH contamination has been linked to reproductive impairment and birth defects. Other potential effects include damage to skin, body fluids and the immune system, which helps the body fight disease. However, these effects have not been seen in humans (US EPA, 2004).

Limit values have been specified in the Water Quality (Dangerous Substances) Regulations, 2001for dichloromethane, xylene and toluene of 10 µg/l.

Organotin compounds

TBT is included as a List I substance in the Dangerous Substances Directive (76/464/EEC). Organic tin compounds comprise mono-, di-, tri- and tetrabutyl and triphenyl tin compounds and their impact on the environment is well known. Tributyl tin compounds are considered to be the most hazardous of all tin compounds and several studies in various parts of the world oceans have shown the effects of tributyl tin compounds: shell malformations of oysters, imposex in marine snails, reduced resistance to infection (e.g. in flounder), effects on the human immune system. The effect of triphenyl tin seems to be the same. Other organic tin compounds (e.g. mono- and dibutyl tins) are considered to be of less importance from the marine environment point of view.

SI 12 of 2001 (Water Quality Dangerous Substances Regulations) prescribes an annual mean concentration of 0.001µg/l for tributyl tin although OSPAR have allocated a firm EAC for TBT in water at 0.00001 - 0.0001 µg/l. The leachate will be treated to ensure that this standard for the Water Quality Dangerous Substances Regulations is achieved prior to discharge and following initial dilution at the discharge point. TBT levels are expected to be 0.00005 µg/l and as such there should be no significant adverse impact.

Endocrine disruptors

EPA interim guidelines for groundwater quality prescribe an interim guideline value of 0.5 µg/l for phenol. The discharge would be below this limit following initial dilution. While there are no guidelines for discharge of endocrine disruptors to coastal waters they are not predicted to have a significant adverse impact at the levels to be discharged. It is proposed that phenol be included on a regular screening programme for treated leachate, receiving waters, sediment and shellfish tissue as part of the monitoring programme which will be implemented as part of the proposed development.

Polychlorinated biphenyls (PCBs)

EPA interim guidelines for groundwater quality prescribe an interim guideline value of 0.01µg/l for PCB's. OSPAR identified them in 1994 as requiring priority action, and they were therefore included in the 1998 OSPAR List of Chemicals for Priority Action. EACs are not currently available for PCBs. As a consequence of their hydrophobic and persistent character PCBs are bio-accumulated and high concentrations are found in biota. PCBs are accumulated by marine organisms, especially within the fatty tissues of piscivorous birds and marine mammals in which concentrations may occasionally achieve levels of potential toxicological significance. The negative effects on reproduction due to PCB and other organochlorine contamination have been associated with the decline of the otter in European rivers, and the decline of dolphins and porpoises in the North Sea (WWF, 2000). Furthermore, the detrimental effects of certain organochlorine compounds and PCBs on the immune system may have been a factor in the disease epidemics in marine mammals. These organochlorine compounds are ubiquitous in the marine environment, but concentrations measured in seawater and sediments at Irish coastal and offshore sites are, with a few localised exceptions, very low and within the ranges found throughout the North-east Atlantic. It is possible that in some areas PCBs are more available than elsewhere, perhaps from reservoirs stored in sediments, recycling in the food chain or from localised inputs from land or the atmosphere. There is a commitment to treat total PCBs in the discharge to 03 μg/l. This is within the European Communities (Quality of Shellfish Waters) Regulations 2006 mandatory value of 0.3 μg/l.

Herbicides
Atrazine and Simazine are both priority substances in the field of water quality and included as list II substances in the Dangerous Substances Directive (76/464/EEC). The impact of herbicides on non-target aquatic organisms can be substantial. Data indicates that the majority of herbicides exhibit low toxicity to fish and invertebrates. However, herbicides are toxic to a variety of aquatic plants including submerged macrophytes and algae. Primary production of facultative and obligate aquatic plants is the primary energy basis for aquatic ecosystems. Thus, herbicide impacts on primary producers are expected to have both direct and indirect impacts on the health of aquatic ecosystems. SI 12, 2001 (Water Quality Dangerous Substances Regulations) prescribes MAC levels of 1 μg/l for each substance. The appointed contractor will be required to treated the leachate to these limits As levels will be within statutory limits no significant adverse impact is predicted.

Magnitude of Impacts
In terms of the proposed primary discharge, hydrodynamic modelling indicates a predominant direction in water movement towards a slack water zone to the northeast of the proposed primary discharge site. This area is a native oyster, *O. edulis* culture zone and is located within the cSAC. In terms of the proposed alternative discharge, hydrodynamic modelling indicates a predominant direction in water movement towards the east (Newport Harbour direction), again impacting on areas within the cSAC. It should be noted that certain faunal elements that may be impacted through bioaccumulation effects will have a range that is more extensive than that simulated for water borne elements in the hydrodynamic models.

Consequences
Significant elements already discussed have the potential to impact many elements of the local aquatic ecosystem. The ecotoxicological significance of some of the potential contamination cannot be determined confidently because of uncertainty in relation to the exact level of contamination in the leachate and the unknown effects of many contaminants.

Fish (including shellfish)
A broad range of particularly sensitive aquatic species in the study area that may be subject to potential impacts include wild and cultured shellfish (especially *O. edulis*), wild and cultured finfish, lobsters, shrimp and scallop fisheries. Ultimately the location of plume point source, oceanography, concentration and type of pollutant, the distribution patterns of larvae, duration of the larval phase and the resistance of larvae to pollution will determine taxa that are most vulnerable.

The proposed discharge location is situated in close proximity to several native oyster (*O. edulis*) beds. Larval counts from areas in the vicinity of the proposed discharge (Rosgibbileen) indicate the area is important for the pelagic larval form of the native oyster (see Appendix 14 – Clew Bay Oyster Co-operative correspondence). This life stage will be particularly vulnerable to the impact of any contaminants present in water and sediment in this area. Aqua-Fact's prediction that mean neap tide simulations for conservative parameters produced higher concentrations in Burrishoole and adjoining bays because of low flushing capabilities is important to note in this context. Analyses indicated a possible impact to the slacker inter-tidal regions of Burrishoole Bay with effluent being carried there on the flooding tide. It is stated that this may give rise to a build up of the more conservative pollutants (nutrients, heavy metals etc.) in these slack flow regions. This slack flow area is also the area where native oyster beds have developed – the slack flow conditions most likely contributing to larval settlement.

Salmonids

Salmonids are not usually exposed to point-source effluent discharges during critical early developmental stages when the reproductive system is particularly sensitive to external influences. In addition, both salmon and migratory brown trout (sea trout) are anadromous fish, spending a significant proportion of their lives at sea. These factors contrast with the potential for life-long exposure to contaminants displayed by non-migratory cyprinid fish which spawn in the main body of the river. Additionally, salmonid fish are less tolerant of poor water quality than cyprinid fish and even the non-migratory brown trout are therefore not normally present in rivers subject to high effluent input. Most rivers which support populations of salmonid fish do not pass through heavily populated or industrialised areas. There is therefore less likelihood that these fish populations will encounter high concentrations of contaminants, particularly endocrine disrupting chemicals (EDCs). Estuaries serve as the natural linkage for salmon migrating between freshwater and ocean environments, providing the necessary habitat for their transition. Recent research has demonstrated that contaminants derived from agriculture, forestry and intensive in-river aquaculture many of which are also present in sewage and dump leachates, have significant effects on salmonids and other migratory fish at "sensitive" stages in their life cycle (e.g. reproduction, embryo development, migration and seawater entry). This research has highlighted that the freshwater and marine environments cannot be considered in isolation and that exposure of fish to poor water quality in freshwater and the transitional (estuarine) zone may be a key factor influencing survival of salmonids in the sea (Appendix 14 – Marine Institute, Document 29). Any water quality degradation in salmonid migratory routes (Newport Bay and particularly Burrishoole and Newport channels) has the potential to significantly impact upon local salmonid populations (Annex II and V, Habitats Directive).

Otters and other mammals

Otters are strictly protected in the Republic of Ireland (ROI) under the Wildlife Acts, 1976 and 2000. Otters are listed under Annex II of the EU Habitats Directive as species of Community Interest. This Directive requires Ireland to establish Special Areas of Conservation for conservation of the otter. Otters are top predators and consequently bioaccumulation of pollutants such as heavy metals and persistent organic chemicals (POC) occurs. Polychlorinated biphenyls (PCBs) are a particular threat (Chanin 2003). Being large mammalian predators, otters are tolerant of a wide range of habitat conditions. Otters are not directly affected by water quality and will forage in conditions that seem extremely unpleasant to humans. However, where deterioration in water quality leads to deterioration in food supply, there will clearly be an indirect effect. Mason (1989) categorised contaminants that might have an effect on otters as:

a) Those having indirect effects (mainly on food supply)

- Organic pollution from sewage treatment works, farms and the brewing, food and dairying industries.
- Eutrophication as a result of run-off from farms and sewage treatment works.
- Acidification mainly in the form of acid rain.
- Acid mine waste.

b) Those with mainly direct effects:

- Oil spillage, mainly in coastal areas.
- Radioactivity.

c) Those with effects as a result of bioaccumulation:

- Metals, particularly mercury, but also cadmium and lead.
- Pesticides and PCBs.

Mason concluded that PCBs have been the most important factor in limiting otter populations in Europe, while heavy metals may have had local effects but were not responsible for declines on a wide scale. This view is widely held in Europe (Chanin, 2003). Mason argues for the importance of these compounds both as a cause of the decline of otters in Britain (and elsewhere) and in hindering its recovery (Mason 1997). The toxic effects of PCBs are mediated particularly by their effect on vitamin A metabolism (Smit *et al.*,1996; Murk *et al.*, 1998). An alternative view was presented by Strachan and Jefferies (1996) who pointed to evidence implicating dieldrin (and related compounds), at least in the initial phases of the otter's decline. This has subsequently been amplified by Jefferies and Hanson (2001) who presented data to support their contention that the introduction of dieldrin was responsible for the decline of the otter in Britain from the mid-1950s, and that PCBs were not implicated, either in the initial decline or in slowing the otter's recovery. The evidence that PCBs can have an adverse effect on the physiology of mammals is clear (Leonards *et al.* 1994) but Kruuk (1997) has pointed out that it is important not to confuse effects on individuals with effects on populations. Otters in Shetland have a relatively high concentration of PCBs but the population is thriving and increased from the 1980s to the 1990s (Kruuk and Conroy 1996). Elsewhere in Europe there is a more general consensus that PCBs have had a significant impact of otter populations, but despite this, the evidence is not clear-cut. PCB Congener 52, 101, 118, 153, 138, 180 and a total congener count for PCBs in proposed leachate was found to be <0.00001 mg/l. The concentration of PCBs in the treated leachate will be required to be limited to the value as specified in the European Communities (Quality of Shellfish Waters) Regulations, 2006. Mercury may be a more serious contaminant of otters than other heavy metals, along with cadmium and lead. Even if there is no agreed basis on which to set targets or standards for levels of pollutants, there is agreement that high levels of PCBs, organochlorine pesticides and heavy metals are all potentially detrimental to otters.

While various standards have been set, some on a firm physiological basis, there is not universal agreement that these are appropriate. Effects on individuals do not necessarily mean that there will be effects on populations, and there is evidence that populations can thrive when otters carry pollutant burdens higher than some of the standards that have been suggested. Ultimately, the most desirable objective is to eliminate toxic chemicals from otter-used waters. In practice, as otter populations recover and contamination of waterways by many pollutants declines, the most important conservation objective should be to continue monitoring to ensure that known pollutants continue to decline and to detect the appearance of new ones. The possibility of local, possibly temporary, high levels of pollutants having a significant effect on otters or their prey should not be ignored. On these grounds, monitoring of pollutant levels in their environment is essential.

Seals

Both grey (*Halichoerus grypus*) and harbour (*Phoca vitulina*) seals are strictly protected in the Republic of Ireland (ROI) under the wildlife Acts, 1976 and 2000. Both species are listed under Annex II of the EU Habitats Directive as species of Community Interest. This Directive requires Ireland to establish Special Areas of Conservation for conservation of both species of seal. The Clew Bay complex is listed as one of seven SACs currently designated in the ROI with the harbour seal as a qualifying interest. Any activity likely to impact upon the seal population requires consent from the Minister. This legal protection affords seals considerable security from hunting and disturbance at haul-out sites. Continued development of coastal areas is perceived as a threat to seal populations (Stone, 2003). Development adjacent to haul-out sites, through increased noise, human presence and foreshore development may significantly reduce the suitability of sites for seals (Kiely and Myers, 1998). This is a particular problem when the amount of suitable habitat is already limited. Planning and licensing authorities should ensure that seals will not be adversely affected before allowing developments in a SAC designated for seals.

Seals are apex predators and consequently bioaccumulation of pollutants such as heavy metals and persistent organic chemicals (POC) occurs. Polychlorinated biphenyls (PCBs) are a particular threat. Female seals feeding on fish with high levels of PCBs may fail to breed and pollution could thus hinder the recovery of some populations that have been reduced by disease (De Swart *et al.*, 1994; Sørmo *et al.*, 2003ab). The levels of these pollutants in Irish Waters are generally low (EPA, 2002). The potential impact of contaminating elements from the leachate extends to apex predators where bioaccumulation through the food chain can magnify concentrations of contaminants many times.

Indirect impacts

Combined effects of contaminants

It is possible that the combined effect of several contaminants will result in a different suite of impacts than those that would occur if individual impacts were acting on the system. The assessment criteria presented in this document were derived for individual substances separately, without specifically addressing the possible interactions with other substances. In the field, especially in estuaries and in coastal areas, organisms are exposed to numerous substances at the same time. Interactions between different (groups of) substances may lead to antagonistic, synergistic or additive effects. For chemicals with a specific toxicity mechanism (such as PCBs, dioxins and dibenzofurans) or a non-specific (narcotic) mode of action the effects of mixtures of chemicals can often be adequately described by concentration addition. The combined toxicity of a mixture of substances with different toxic mechanisms, however, is extremely difficult to estimate. Scope for Growth (SFG) in mussels is a sensitive indicator of general water quality and contaminant concentrations. It quantifies the extent to which growth potential is reduced in surveyed areas compared to clean reference sites. Substances contributing to reduced SFG can be identified through a quantitative toxicological interpretation of tissue contaminant levels.

Fish diseases

During the last twenty-five years, various studies have suggested links between the prevalence of fish diseases and environmental contamination. However, many of the macroscopic external diseases recorded in marine fish are the result of infectious or parasitic aetiologies and are subject to spatial, temporal and biological variations that may have natural or as yet unknown origins. Nevertheless, international guidelines (ICES, 1996) have been developed for recording long-term trends in the prevalence of external macroscopic diseases in populations of flatfish. In conjunction with specific biomarkers for contaminant exposure, disease data can be used as a possible indicator of contaminant effects. There is evidence to suggest, for instance, that liver cancers in selected flatfish species may possibly be linked with PAHs and polychlorinated hydrocarbons in sediments. The presence of particularly sensitive fish species in the Newport Bay area from a conservation perspective (*Salmon salar*) is particularly important to consider in terms of fish health impacts.

Endocrine disruption
There is clear evidence that a diverse range of natural and synthetic substances, including PCBs, dioxins, TBT and various other organo-metallic compounds, pesticides, pharmaceuticals and industrial chemicals, have potential to impair reproduction in aquatic organisms through interference with their endocrine (i.e. hormonal) systems. Studies in freshwater environments have shown that these effects can occur even at very low ambient concentrations, considerably less than concentrations that are either mutagenic or acutely toxic. To date it remains unclear which chemicals or combinations of chemicals are responsible for the observed effects (i.e. feminisation in male fish) but ethynylestradiol (contraceptive agent), PCBs and alkylphenol-ethoxylate (derived from industrial detergents) have been positively implicated. Although TBT-induced imposex is the only confirmed instance of this phenomenon in the Irish coastal region at present, many other endocrine-disrupting substances are known to be present in effluents and river water discharged to the area.

5. MITIGATION MEASURES

It should be noted that all mitigation measure recommendations have been developed in the context of national and international legislative on non-legislative guidance on water and sediment quality, and aquatic species and habitats of conservation importance (particularly the Habitats Directive). The description of mitigation measures are divided (for the purpose of descriptive clarity) in terms of:

1. Construction phase mitigation - Construction of the waste water treatment plant and discharge pipelines.
2. Operational phase impacts:
   - Discharge of sewage effluent from the waste water treatment plant
   - Discharge of treated landfill leachate from Derrinumera Landfill

1. Construction phase impacts - Construction of the waste water treatment plant and discharge pipelines.

<u>Mitigation by avoidance</u>

Waste water treatment plant - pre-construction phase

A comprehensive and integrated approach for water quality protection during construction should be implemented by means of an erosion and sediment control plan to avoid needless disturbance to local aquatic habitats and species. The following elements are important to consider:

- Minimise needless clearing and grading. Some areas of a development site should never be cleared or graded or these activities restricted. Forward planning is required.
- Protect waterways and stabilise drainage channels. Clearing adjacent to waterways should be minimised. Silt control measures (such as silt fences) should be installed along the perimeter of buffer zones.
- Phase construction to limit soil exposure. Large areas of grading should be avoided since this maximises erosion potential. Phased construction where only one section of a site is disturbed at a time minimises sediment load potential.
- Stabilise exposed soils immediately. To provide soil stabilisation, it is important to establish cover over denuded areas within a short period of time of soils being exposed. Covers such as grass, mulch, erosion control blankets and plastic sheeting can be used to achieve this.
- Protect steep slopes and cuts. Where possible clearing and grading should be avoided. Otherwise, special techniques such as uphill flow diversion and silt fencing should be employed.
- Install perimeter controls to filter sediments. Perimeter controls such as earth dykes and silt fences should be installed at the edge of the construction site to retain or filter runoff before discharge into the lake.
- Employ advanced sediment settling controls. Sediment traps or basins should be installed to allow captured sediments to settle out. To improve trapping efficiency, these basins must be designed to incorporate features such as larger volumes, use of baffles, skimmers and other outlet devices and multicell construction. Regular construction and maintenance are critical to the successful operation of these practices.
- Adjust plan as required. To be effective, the plan may require adjustment and modification as construction progresses. Regular inspections are needed to ensure that plan controls are working properly.

Waste water treatment plant - construction phase

Basic mitigation of erosion and sedimentation impacts caused by waste water treatment plant construction will involve following the sediment control plan outlined above. To summarise:

- Limit the area of disturbed land
- Limit the time soil is left exposed
- Maintain best management practices
- Limit equipment maintenance in areas draining directly to the estuary

Some erosion is going to be unavoidable. Resulting sediment must be trapped on the site. Construction of sediment traps (fences) and basins must occur before other land disturbance activities are implemented. Sediment traps must be regularly inspected, maintained and cleaned as necessary.

Pollution

To prevent chemical pollution, all fuels or chemicals kept on the construction site should be stored in bunded containers. All refuelling and maintenance should be carried out in ramped containment areas away from sensitive environments (such as shoreline slopes). Oil interceptors should also be installed in appropriate locations. Equipment should be regularly maintained and leaks repaired immediately. Accidental spillages should be contained and cleaned up immediately. Remediation measures should be carried out in the unlikely event of pollution of adjacent watercourses in accordance with consultant's recommendations.

Sewage

During the construction phase, contained chemical portaloo toilets should be used and all sewage should be removed from the site to an authorised treatment works. Therefore no sewage would be discharged to watercourses.

Pipeline construction – in-water mitigation

Loss or alteration of habitats and species

It is recommended to position the pipeline in areas of lowest species diversity and away from existing shellfish beds where possible, to minimise the loss or disruption of species.

To minimise habitat and species loss and disturbance, efforts should be made to keep the area of seabed and seashore disturbed by the pipeline trenches to a minimum. Following construction of the cable trenches, efforts should be made to restore habitats to their current condition, if impacted upon. Cable trenches should be filled to their pre-construction level, minimising changes in the water flow regime, and with material of a similar particle size to allow recolonisation of benthic species.

Increased suspended solids

To minimise the amount of suspended solids released into the water column during construction, efforts should be made to minimise the area of seabed and seashore disturbed.

Pollutants and waste

Contractors installing pipelines should use chemicals that have been approved for use in the marine environment and employ methods that minimise the release of polluting materials into the water column.

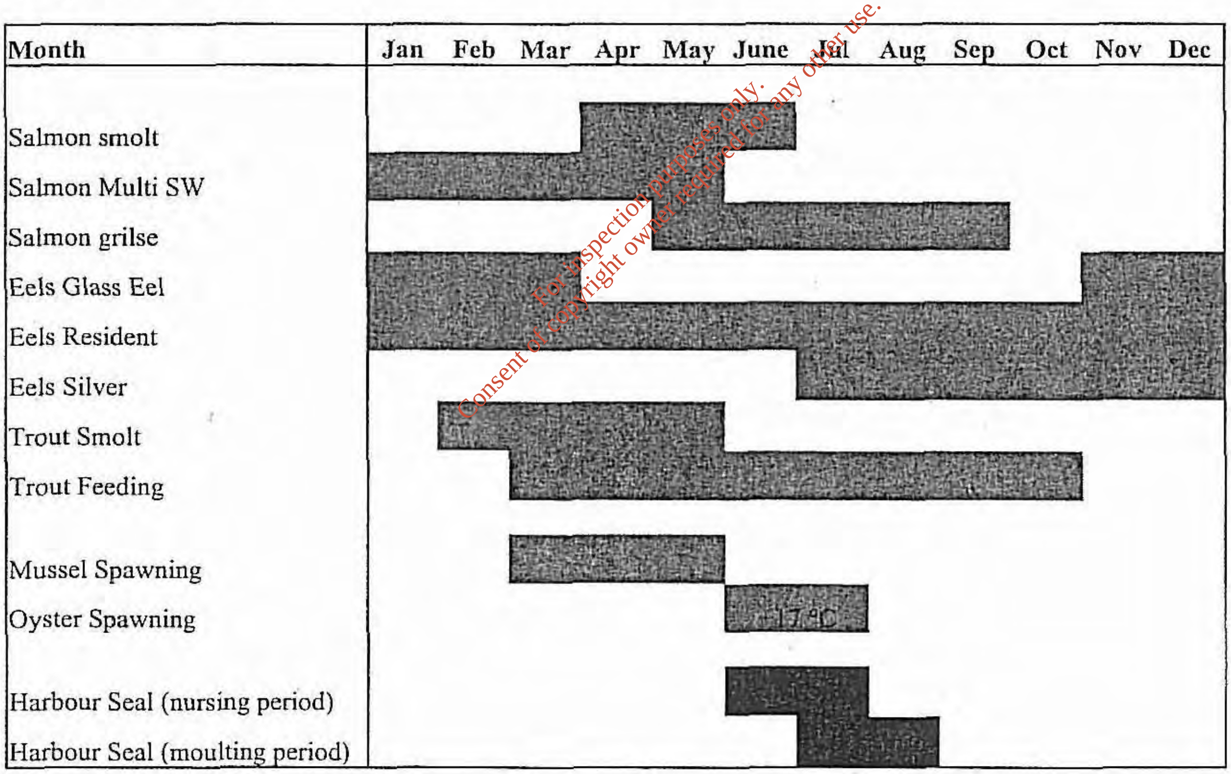
To minimise the impact of pollution and waste from maintenance and boat traffic it is necessary to minimise the likelihood of any spillage or contamination. Potential contaminants should be stored in suitable storage facilities, such as bonded containers while at sea.

Waste and litter generated during construction should be returned to the shore for authorised disposal at suitable facilities. Utmost care and vigilance should be followed to prevent accidental contamination of the site and surrounding environment during construction. Construction and on site operating procedures should be followed to the highest standard to minimise unnecessary disturbance and prevent accidental spillage of contaminants.

Mitigation by reduction

Specific risk construction activities should be timed to avoid sensitive periods such as spawning, nursing and migratory periods, where possible. This would be particularly important for species such as salmonid, shellfish and seals (Table 10). Otters do not have a specific breeding season.

Table 10. Typical migration and spawning seasons within Newport Bay (Marine Institute data, pers comm.).



2. Operational phase mitigation - Discharge of waste water treatment plant effluent from Newport Town and landfill leachate from Derrinumera Landfill

Mitigation by avoidance and reduction

The environmental significance of local ecological characteristics should be considered at all times. The purpose of designating and managing SACs is to maintain at, or to restore to, 'favourable conservation status' the habitats and species listed in Annexes I and II of the Habitats directive.

A precautionary approach is recommended in mitigation measure implementation. It is recommended to mitigate proposed operational potential impacts primarily (or to as great an extent as possible) through avoidance measures. The recommended avoidance strategy would involve ensuring the treatment of leachate to be discharged into Clew Bay cSAC is to a standard that all or as many contaminating substances as possible (according to best available technologies) are removed from the final outfall effluent, while wastewater is treated to the standards required by national legislation. Storm water discharge to the estuary should be avoided or minimised through provision of adequate holding facilities according to best practice (and best technologies, BATNEEC).

For any remaining contaminants, the reduction strategy would involve treating leachate to a standard such that relevant legislative standards are met and in doing so to ensure no deterioration in the existing state of the receiving waters. It is recommended to monitor contaminant levels in leachate and receiving waters with sufficient LODs so that agreed water quality standards can be assessed. It should be noted that relevant limits and ranges are likely to change over time, as may the list of chemicals for priority action. A proactive management system is recommended where regular reviews of statutory and expert guidance is implemented in relation to the proposed discharge. Pre-discharge monitoring should be implemented for all agreed environmental quality standards in the receiving environment as per the proposed monitoring programme included in Appendix 18. Parties to such agreement should include at a minimum, the Environmental Protection Agency, Mayo County Council, the Marine Institute, the National Parks and Wildlife Service and the Department of Communications, Marine and Natural Resources with input from local stakeholders. It is anticipated that regular discharge monitoring for a suitable range of parameters will be specified and enforced by the Environmental Protection Agency for the waste licence at Derrinumera landfill. In addition, regular monitoring of the receiving environment (water, sediment, flora and fauna) in the vicinity of the proposed discharge and at a matrix of sites moving away from the discharge should be implemented to ensure the ecological integrity and in particular the favourable conservation status of the receiving environment is protected at all times.

6. FUTURE MONITORING

A monitoring programme should be established for the construction and operational phases of the proposal having regard to the analytes specified in Appendix 18. Key sites, such as those containing species of interest, should be monitored during the construction phase and on a regular basis during the operational phase as outlined in the mitigation section. Other sites at key locations around the development should also be monitored on a regular basis during the operational phase to detect any change in habitat or species composition. A detailed monitoring programme should be implemented following consultation with the Environmental Protection Agency, Mayo County Council, the Marine Institute, the National Parks and Wildlife Service and the Department of Communications, Marine and Natural Resources with input from local stakeholders (as per the recommended monitoring programme included in Appendix 18). Monitoring should complement the requirements with regard to the European Communities (Quality of Shellfish Waters) Regulations, 2006. All actions should also take into account Mayo County Councils requirements under Regulation 6 of these regulations.

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