Baseline data were gathered in consultation with a number of organisations and information supplied from a number of sources. These are listed below:

- National Parks and Wildlife Service (NPWS);
- Kirk McClure Morton;
- Galway City Development Board;
- Aqua-fact International Services, Liosbaun, Co. Galway;
- University of Galway Library;
- Irish Whale and Dolphin Group;
- Marine Institute, Co. Galway;
- Department of the Environment, Heritage and Local Government (DEHLG);
- Department of Communications, Marine and Natural Resources (DCMNR) and
- Galway Main Drainage – Proposed Causeway and Sewage Treatment Plant on Mutton Island: Environmental Impact Statement, P.H. McCarthy Son & Partners, May 1992.

11.1.4 Existing Situation

Conservation Designations

Candidate Special Areas of Conservations (cSACs) are designated under the EU Habitats Directive. The Directive includes a list of habitats and species requiring protection under Annexes I and II respectively.

Mutton Island is located within the Galway Bay Complex candidate Special Area of Conservation (Site Code 000268). The site is proposed for designation on the presence of the marine Annex I habitats *Large shallow inlet and bay*, *Mudflats and sandflats not covered by seawater at all times* and *Reefs*. It is also proposed for designation for the presence of the Annex II species common (harbour) seal *Phoca vitulina*. A fuller description of the site is given in the site synopsis shown in Box 9.1.

The National Parks and Wildlife Service (NPWS) provided no specific conservation objectives for marine habitats and species, however, there is an overriding obligation to maintain the habitats and species for which the site was proposed for designation at *favourable conservation status.*

Special Protection Areas (SPAs) are designated within the EU Birds Directive (Anon., 1997a). The Directive includes a list of species requiring special protection (Annex I), and details species that may be hunted or sold. It also affords protection to important sites for migratory species.

The Mutton Island WWTP is located within the Inner Galway Bay SPA. The site provides habitat for two wintering species of international importance and a further sixteen species with populations of national importance. There are three breeding colonies of national importance and seven of the regularly occurring species are Annex I listed. Ornithology is discussed in greater detail in **Section 12**; however, it is noted in correspondence from the NPWS that sewage effluent could be deleterious to benthic communities and could affect food stocks of divers, seaduck and other birds. The SAC and SPA designation boundaries are shown on **Figure 12.1**.

Box 9.1 Site Synopsis of Galway Bay Complex cSAC

Situated on the west coast of Ireland, this site comprises the inner, shallow part of a large bay which is partially sheltered by the Aran Islands. The Burren karstic limestone fringes the southern sides and extends into the sublittoral. West of Galway city the bedrock geology is granite. There are numerous shallow and inter-tidal inlets on the eastern and southern sides, notably Muckinish, Aughinish and Kinvara Bays. A number of small islands composed of glacial deposits are located along the eastern side. These include Eddy Island, Deer Island and Tawin Island. A diverse range of marine, coastal and terrestrial habitats, including several listed on Annex I of the EU Habitats Directive, occur within the site, making the area of high scientific importance.

Galway Bay South holds a very high number of littoral communities. They range from rocky terraces, to sandy beaches with rock or sand dunes behind. The area has the country's only recorded example of the littoral community characterized by *Fucus serratus* with sponges, ascidians and red seaweeds on tide-swept lower eulittoral mixed substrata. This community has very high species richness (85 species), as do the sublittoral fringe communities on the Finavarra reef (88 species). The rare sea urchin *Paracentrotus lividus* and the foliose red alga *Phyllophora sicula* are present at Finavarra, whereas the red alga *Rhodymenia delicatula* and the rare brown alga, *Ascophyllum nodosum var. mackii,* occur in Kinvara and Muckinish Bays. Sublittorally, the area has a number of distinctive and important communities. Of particular note is that Ireland's only reported pidock bed thrives in the shallows of Aughinish Bay. The rare sponge, *Mycale contarenii*, is also found here. There is further interest in an extensive maerl bed of *Phymatolithon calcareum* which occurs in the strong tidal currents of Muckinish Bay. There is also maerl off Finavarra Point and in Kinvara Bay (*Lithothamnion corallioides, Lithophyllum dentatum and Lithophyllum fasciculatum*). An oyster bed in Kinvara Bay and seagrass (*Zostera* spp.) beds off Finavarra Point are also important features. Other significant habitats which occur include secondary maerl beds and communities strongly influenced by tidal streams.

Salt marshes are frequent within this extensive coastal site, with both Atlantic and Mediterranean marshes well represented. Most of the salt marshes are classified as the bay type, with the substrate being mud or mud/sand. There is one lagoon type and one estuary type. Lagoon salt marshes are the rarest type found in Ireland. The best examples of salt marsh are located in inner Galway bay, east of a line running between Galway city and Kinvara. In this area the coastline is highly indented, thus providing the sheltered conditions necessary for extensive salt marsh development. Common salt marsh species include Thrift (*Armeria maritima*), Red Fescue (*Festuca rubra*), Common Scurvygrass (*Cochlearia officinalis*), Sea Lavender (*Limonium humile*), Common Saltmarsh-grass (*Puccinellia maritima*), Saltmarsh Rush (*Juncus gerardii*) and Sea Rush (*Juncus maritimus*). On the lower levels of the salt marshes and within pans there occurs Glasswort (*Salicornia europaea* agg.). A noteworthy feature of the salt-marsh habitat within this site is the presence of dwarfed brown seaweeds in the vegetation. These are also known as "turf fucoids" and typical species include Fucus spp., *Ascophyllum nodosum* and *Pelvetia canaliculata*. A number of locally rare vascular plant species also grow in salt-marsh areas within the site. These include *Puccinellia distans* and Sea Purslane (*Halimione portulacoides*), which are both relatively rare in the western half of the country.

Shingle and stony beaches can be found throughout the site, with the best examples along the more exposed shores to the south and west of Galway city and to the north and east of Finnavara, Co. Clare. In general, these shingle shorelines are sparsely vegetated and frequently occur interspersed with areas of sandy beach and/or bedrock shore. The associated flora is dominated by plant species of frequently disturbed maritime habitats. To the south and west of Galway city, typical plants include Curled Dock (*Rumex crispus*), Common Couch (*Elymus repens*), Sea Sandwort (*Honkenya peploides*), Sea Beet (*Beta vulgaris*), Scentless Mayweed (*Matricaria maritima*), Silverweed (*Potentilla anserina*) and *Atriplex* spp.. Two rare plant species are associated with the habitat: Fat Hen (*Hyoscyamus niger*), a threatened species listed in the Irish Red Data Book, grows on shingle beach to the south of Lough Atalia; there are also old records for the threatened plant species Sea Kale (*Crambe maritima*).

An excellent range of lagoons of different types, sizes and salinities occurs within the site. This habitat is given priority status on Annex I of the Habitat Directive. One unusual type of lagoon, karstic rock lagoon, is particularly well represented. This type of lagoon is common on the Aran Islands, but on mainland Ireland, all but one are confined to this one site including the best example of all karstic lagoons in the country (Lough Murree). The flora of the habitat is rich and diverse, reflecting the range of salinities in the different lagoons, and typically brackish with two species of Tasselweed (*Ruppia* spp.), two Red Data charophytes *Chara canescens* and *Lamprothamnion papulosum*, and

Chaetomorpha linum (all lagoonal specialists). The fauna of the lagoon is also rich, diverse and lagoonal. At least 10 lagoonal specialist species were recorded in 1996 and 1998 from the combined habitat of all the lagoons which is one of the highest number for any lagoonal habitat in the country. Many of the species appear to be rare. The lagoons within this site are an excellent representative of the habitat type and of high conservation importance.

Other terrestrial habitats within this site which are of conservation importance, although having only a minor presence, include an area of fen dominated by Saw Sedge (*Cladium mariscus)* at Oranmore village, a turlough of moderate size at Ballinacourty, limestone pavement mainly along the southern shore, dry calcareous grassland, wet grassland and an area of deciduous woodland at Barna.

Inner Galway Bay provides extensive good quality habitat for Common Seals, a species listed on Annex II of the EU Habitats Directive. In 1984, this seal colony was one of the top three sites in the country, with over 140 animals recorded. The seals use a range of haul-out sites distributed through the bay - these include inner Oranmore Bay, Rabbit Island, St.Brendan's Island, Tawin Island, Kinvara Bay, Aughinish Bay and Ballyvaughan.

Galway Bay is a very important ornithological site. The shallow waters provide excellent habitat for Great Northern Divers (35), Black-throated Divers (28), Scaup (39), Long-tailed Duck (27) and Red-breasted Merganser (232). (Figures given are peak average maxima over the 3 winters 1994/95 to 1996/97). All of these populations are of national importance. The inter-tidal areas and shoreline provides feeding and roosting habitat for wintering waterfowl, with Brent Goose (517) having a population of international importance and a further 11 species having populations of national importance. Four of the regular wintering species are listed on Annex I of the EU Birds Directive - Golden Plover, Bar-tailed Godwit and the two diver species. Breeding birds are also of importance, with significant populations of Sandwich Terns (81 pairs in 1995) and Common Terns (99 pairs in 1995), both also being listed on Annex I of the EU Directive. A large Cormorant colony (c.300 pairs in 1989) occurs on Deer Island.

Fishing and aquaculture are the main commercial activities within the site. A concern is that sewage effluent and detritus of the aquaculture industry could be deleterious to benthic communities. Reef and sediment communities are vulnerable to disturbance or compaction from tractors accessing oyster trestles. The *Paracentrotus lividus* populations have been shown to be vulnerable to over-fishing. Extraction of maerl in Galway Bay is a threat. Owing to the proximity of Galway city, shoreline and terrestrial habitats are under pressure from urban expansion and recreational activities. Eutrophication is probably affecting some of the lagoons and is a continued threat. Drainage is a general threat to the turlough and fen habitats. Bird populations may be disturbed by aquaculture activities.

This large coastal site is of immense conservation importance, with several habitats listed on Annex I of the EU Habitats Directive, three of which have priority status (lagoon, *Cladium* fen, turlough). The examples of shallow bays, reefs, lagoons and salt marshes are amongst the best in the country. The site has an important Common Seal colony, a species listed on Annex II of the EU Habitats Directive, and six regular Annex I Bird Directive species. The site also has four Red Data Book plant species, plus a host of rare or scarce marine and lagoonal animal and plant species.

30.8.1999

Marine Mammals

Cetacean species

The ISCOPE database, published by the Irish Whale and Dolphin Group (IWDG), details reported sightings of whale and dolphin. **Table 11.1** details results for Galway Bay. The recent JNCC Atlas of Cetacean distribution (Reid *et al*., 2003) also provides an excellent point of reference for distribution of species in Irish waters.

Table 11.1 Whale and Dolphin Group Sighting Records

Date	Species	Number recorded
6 May 2001	Medium whale sp	1
28 Sep 1995	Bottlenose dolphin	10
18 Aug 1995	Common dolphin	10
18 Aug 1995	Common dolphin	6
18 Aug 1995	Risso's dolphin	2

Date	Species	Number recorded
18 Aug 1995	Harbour porpoise	2
18 Aug 1995	*Lagenorhynhcus* sp	2
18 Aug 1995	Harbour porpoise	6
18 Aug 1995	Harbour porpoise	2
18 Aug 1995	Harbour porpoise	3
5 Aug 1995	"Dolphin" species	9
22 Jun 1995	Bottlenose dolphin	13
1 Jun 1994	Minke whale	1
30 Oct 1993	Common dolphin	2
30 Oct 1993	"Whale" species	1
27 Oct 1993	Common dolphin	50
23 Oct 1993	Harbour porpoise	4
19 Oct 1993	Patterned dolphin sp	20
28 Sep 1993	Harbour porpoise	4
26 Sep 1993	Harbour porpoise	3
25 Sep 1993	Harbour porpoise	3
23 Sep 1993	Harbour porpoise	3
22 Sep 1993	Harbour porpoise	3
20 Sep 1993	Harbour porpoise	4
15 Aug 1993	"Dolphin" species	20
10 Aug 1993	Harbour porpoise	1
2 Aug 1993	Harbour porpoise	1
27 Jun 1993	Harbour porpoise	5

Source: http://www.iwdg.ie

Whilst the voluntary records presented in **Table 11.1** cannot be relied upon to give population estimates, they can provide an indication of whether particular species are regular annual visitors, occasional or rare visitors to Galway Bay.

Bottlenose dolphins *(Tursiops truncatus)* are reported each year in groups of around 10 individuals while common dolphin (*Delphinus delphis*) has been reported in groups of up to 50 individuals. Harbour porpoise *(Phocoena phocoena)* also appear to be annual visitors in groups of up to 6 individuals.

- *Bottlenose dolphin (Tursiops truncatus)*

It is generally acknowledged that common bottlenose dolphin occurs in all oceans and in a diverse range of habitats. In coastal waters this species favours river estuaries, headlands or sandbanks where there is uneven bottom relief and/ or strong tidal currents (Lewis *et al*., 1993, Liret *et al*., 1994, Wilson *et al*., 1997). In Western Ireland, a

cumulative minimum estimate of 115 dolphins inhabit the Shannon Estuary (Ingram *et al*., (1999)). The sightings reported above indicate that this is one of the more abundant cetacean species in Galway Bay.

- Common dolphin *(Delphinus delphis)*

The common dolphin is the most numerous offshore cetacean species in the temperate north-east Atlantic being distributed mainly south of 60^{o}N. Off the Atlantic coasts of Ireland, the species is found in continental shelf waters in the Western Approaches, and off southern and western shores. Limited survey data also suggest that the species is widespread in waters well offshore to the west of Ireland.

- Risso's dolphin *(Grampus griseus)*

In north west Europe Risso's dolphin appears to be distributed over the continental shelf. Few records have occurred over the shelf break, and none have been recorded from deeper waters further offshore. There does appear to be some seasonality in the pattern of sightings; near shore sightings have generally occurred during the summer while sightings in deeper water have generally occurred during the winter months. Most sightings have been from the waters surrounding the Outer Hebrides, while other clusters have occurred off south west Ireland and in the southern Irish Sea. The species is not encountered frequently.

- Harbour porpoise *(Phocoena phocoena)*

The harbour porpoise is one of the most numerous marine mammals in north-western European shelf waters. An estimated population of 36,000 has been reported over the Celtic Shelf between Brittany and Ireland. On the Atlantic seaboard including south west Ireland, there appear to be locally high densities of porpoises.

- *Lagenorhynhcus* sp.

The genus *Lagenorhynchus* accounts for two species: white beaked dolphin (*L. albirostris*) and white sided dolphin (*L. acutus*). Of the two species, the white beaked dolphin is more likely to be distributed in the waters of the continental shelf west of Ireland. White sided dolphins show a distribution that is further offshore. The identity of the two species is often confused however, and accurate estimates of their respective populations have been difficult to achieve, but numbers in Atlantic waters of the NW European continental shelf are generally considered to be below 10,000.

- Minke whale *(Balaenoptera acutorostrata)*

The minke whale is widely distributed along the Atlantic seaboard of Britain and Ireland. In Irish waters the species is most common along the south coast where it occurs mainly on the continental shelf although it can often be seen close to land where it sometimes enters estuaries, bays and inlets. Sightings in Galway Bay are rare.

The only cetacean species included in Annex II of the EU Habitats Directive for which Special Areas of Conservation (SAC) can be selected are the bottlenose dolphin and harbour porpoise. However, dolphins, porpoises and whales (all species) are listed as

European protected species and are listed under Annex IV of the EU Habitats Directive that relates to the prohibition of killing or taking of wild animals. As such, cetacean species in Irish waters carry European protected status.

Pinnepeds

- Common (harbour) seal (*Phoca vitulina*)

Common seals are also listed under the EU Habitats Directive. They have a wide distribution in the British Isles, and are particularly abundant to the north and west of Scotland. Common seals usually use sand banks and isolated estuarine shore to haul out of the water between foraging and during pupping. Common seals pup between June and July. Feeding usually takes place in proximity to haul out sites (within 40-50 km), and diet usually includes demersal (bottom living) fish, salmonid fish, octopus and squid.

As stated in the SAC site synopsis, Inner Galway Bay provides extensive good quality habitat for common seals. In 1984, this seal colony was one of the top three sites in the country, with over 140 animals recorded. The seals use a range of haul-out sites distributed through the bay - these include inner Oranmore Bay, Rabbit Island, St.Brendan's Island, Tawin Island, Kinvara Bay, Aughinish Bay and Ballyvaughan. The nearest haul out sites: Rabbit Island, St Brendan's Island, and Tawin Island lie within 3.0km to 3.5km of the outfall of the WWTP site (**Figure 11.1**). Data published by the NPWS (Anon., 2004) from 1978-2003 provides a population estimate of 300-400 common seals in Galway Bay as a whole. Aerial surveys have estimated a population of 217 within Inner Galway Bay itself. Long-term monitoring has revealed a greater population flux in Inner Galway Bay than in other coastal areas. Despite this flux in numbers from year to year, overall it has been stated that common seals in Galway Bay are present in relatively low numbers in comparison to the west coast of Scotland, with the exception of several key sheltered breeding sites (Anon., 1999a).

- Grey Seal (*Halichoerus grypus*)

Grey seals are widespread throughout Britain and Ireland, the majority breeding in north and west Scotland, primarily on the islands. Approximately 38% of the world's population occur in Britain. Grey seals haul out of the water between foraging and in autumn to give birth to pups. Diet varies between region and season but is mostly made up of fish, particularly sandeel, whitefish (e.g. cod, haddock, whiting, ling) and flatfish (e.g. plaice, flounder, dab).

Grey seals breed on exposed offshore islands off the south and west coast of Ireland. Deer Island, located in Galway Bay, was estimated to have some 42-54 grey seals during 1980-1983 (Anon., 2004). No more recent survey data are available.

Benthic Ecology

Mutton Island

Little existing information has been identified describing the nature of the marine communities in the vicinity of Mutton Island. Mutton Island comprises a large rocky outcrop, with small outcrops located to the west and to the north between Mutton Island and the northern shore of the bay. The substrate around Mutton Island is extremely varied (British Admiralty Chart - 1984). To the east and south of the island the seabed comprises muddy sand, while to the west there is an area of gravel. The shoreline of the mainland adjacent to Mutton Island is mainly rocky but with areas of sand.

Sub-tidal biotopes

A remotely-operated vehicle (ROV) survey was utilised to survey the sub-tidal marine habitats, flora and fauna around the predicted dispersion pathway of the Mutton Island sewage outfall. A number of reference sites were also surveyed (**Appendix H** and **Figure 11.2)**. The survey was completed between the 18th and 20th May 2005.

Transect A: just to the east of Mutton Island and outfall.

Transect A was located just to the east of the Mutton Island outfall. Weather at the time of survey was sunny with an estimated force 4 wind from the southwest. There was some swell. A line of lobster pots prevented the deployment of the ROV close to the shore side of the transect. Underwater visibility was considerably reduced by what appeared to be a layer of muddy water hanging approximately 1m above the surface of the sediment substratum. Depth varied from 8m BSL on the shoreward side to 13m BSL on the seaward side of the transect.

Toward the northern end of the transect, the substratum appeared to consist of a soft muddy sand. Further south the sediment appeared slightly coarser and was slightly rippled.

Few species were observed on the length of the transect. Tracks in the sediment indicated that possible crabs were present although not observed. The common starfish *Asterias rubens* was also observed although in low numbers. A biotope of IMS.FaMS was assigned indicating shallow muddy sand faunal communities in infra-littoral muddy sand.

Transect B: starts at the outfall itself, south of Mutton Island.

Transect B started from the diffuser of the sewage outfall to the south of Mutton Island and was completed in two sessions. During the first session weather was dry but slightly overcast, with an estimated force 4 winds from the southeast. There was also some swell. During the second session weather was sunny with an estimated force 4 wind from the southwest. Underwater visibility was fair during both sessions. Depth varied from 1.5m BSL in the shallow sub-littoral of Mutton Island to 13m BSL towards the seaward end of the transect.

Towards the shoreward end of the transect the substratum was bedrock that appeared clean with little sedimentation. Progressing seaward along the transect the substratum changed to boulders and mixed sediment before progressing to muddy sand substratum.

The rocky substratum was dominated by a *Laminaria digitata* kelp forest. Smaller quantities of *L. saccharina* were also observed, as was an unidentifiable understorey of red algae. Gastropod snails, the calcareous tubeworm *Pomatoceros* sp., the common starfish *A. rubens*, juvenile fish and epiphytic red algae were recorded. A biotope of MIR.Ldig was assigned indicating *L. digitata* on moderately exposed or tide-swept sub-littoral fringe rock.

The boulder/gravel area was a transitional zone for species composition. Kelp became less dominant and eventually became scarce where a low growth of red algae dominated. Hydroids, the common starfish *A. rubens* and the edible sea urchin *Echinus esculentus* were recorded from the boulder/ gravel seabed. The higher biotopes of IMX indicating infra-littoral mixed sediments and IR indicating infra-littoral rock were assigned.

The common starfish, crabs and seapens (probably *Virgularia mirabilis*) were recorded from the area of muddy sand. A biotope of IMS.FaMS was assigned indicating shallow muddy sand faunal communities in infra-littoral muddy sand. The biotope of CMS.VirOph indicating *Virgularia mirabilis* and *Ophiura* spp. on circa-littoral sandy or shelly mud may also be applicable to the areas with a higher occurrence of seapens.

Transect C: just to the western extent of the inter-tidal sections of Mutton Island, to the west of the outfall.

The shoreward end of Transect C terminated the western extent of the inter-tidal of Mutton Island. The weather was fair with an estimated Force 3-4 wind from the southwest. Underwater visibility was poor. Depth varied from 5m BSL near the island to 13m BSL towards the seaward end of the transect. A line of lobster pots towards the shoreward end of the transect prevented the full completion of the transect.

Towards the shoreward end of the transect the substratum consisted of bedrock. The rock was clean with little sedimentation. Progressing seaward along the transect, the substratum changed to what appeared to be a mixed sediment dominated by coarse muddy sand substratum and light gravel.

The rocky substratum was dominated by a kelp forest of the brown algae *L. digitata*. A biotope of MIR.Ldig was assigned. In the slightly deeper rocky areas the sugar kelp *L. saccharina* was more dominant. Unidentified red algae and hydroids were observed growing in association with the sugar kelp. A biotope of EIR.LsacSac was assigned indicating *L. saccharina* and or *Saccorhiza polyschides* on exposed infra-littoral rock.

Starfish, crabs and sea urchins were occasionally recorded on the sediment. A biotope of IMS.FaMS was assigned to the more uniform sediment with the higher biotope of IMX indicating infra-littoral mixed sediments assigned to the other sediment areas.

11. Marine Ecology

11.1 Existing Environment

11.1.1 Introduction

The proposed increase in treated effluent to Galway Bay has the potential to affect receptors in the marine environment. The magnitude of sensitivity of potential receptors is highlighted by the international environmental importance of inner Galway Bay; specifically, the designation of the Galway Bay Complex candidate Special Area of Conservation (cSAC) under the EU Habitats Directive 92/43/EEC (Anon., 1997a). The potential for adverse effects on sensitive marine receptors from the proposed WWTP upgrade and the associated increased treated effluent discharge has been assessed in relation to baseline conditions determined via dedicated inter-tidal and sub-tidal surveys.

11.1.2 Scope

The scope of this assessment was derived from consultation during the scoping phase. The proposed upgrade to the treatment capacity of the works will be contained entirely within the curtilage of the existing WWTP and the plant will continue to discharge to Galway Bay via the existing outfall. The transfer of sewage from the mainland will also continue via the existing pipeline. As such, no issues relating to these elements is relevant to this EIA. The potential impacts of the operation of the WWTP upgrade on the existing marine environment are discussed in **Section 11.3** in relation to the baseline conditions described below.

11.1.3 Methodology

Baseline data were gathered to identify potential sensitive marine receptors (i.e. specific habitats, species or assemblages excluding birds) that may be affected by the proposal. This included identification of:

1. key marine interest features of the Galway Bay Complex candidate Special Areas of Conservation (SAC, site code 268), that may be directly or indirectly affected by the development proposal; and
2. any other potential habitats, species or ecological pathways that may be directly or indirectly affected by the development proposal.

Direct and indirect effects of the development proposal on the key interest features of the Inner Galway Bay Special Protection Area (SPA, site code 031) are addressed in Section 12: Birds.

Transect D: to the west of Mutton Island.

Transect D was undertaken to the west of Mutton Island. Weather was bright, with an estimated force 4 wind from the southwest. Underwater visibility was poor at depths between 11m and 13m BSL.

The seabed throughout the transect appeared uniform consisting of a fine muddy sand. A small area of this appeared to be rippled.

Only occasional marine life was observed and there was evidence of polychaete worms when the ROV disturbed the sediment, but these could not be identified as to species. The common starfish *A. rubens* was also observed occasionally. A biotope of IMS.FaMS was assigned indicating shallow muddy sand faunal communities in infra-littoral muddy sand.

Transect E: about two kilometres west of the inter-tidal sections of Mutton Island.

Transect E was the furthest west of the parallel transects undertaken in the predicted dispersion pathway of the outfall. The weather gave sunny spells and occasional drizzle and there was an estimated force 5 wind from the southwest. Underwater visibility was poor especially over the muddier sediments at depths between 10m and 12.5m BSL.

Soft sediment substrata was recorded throughout the transect generally consisting of soft muddy sand. One small area of rippled sand was recorded; the ripples were narrow and appeared to be comprised of slightly coarser sediments.

Only occasional marine life was observed. There was evidence of polychaete worms when the ROV disturbed the sediment although these could not be identified to species. The common starfish, *A. rubens* was also observed, as was the sea urchin *Echinus esculentus* and the sea pen *Virgularia mirabilis*. A biotope of IMS.FaMS was assigned indicating shallow muddy sand faunal communities in infra-littoral muddy sand. The biotope of CMS.VirOph indicating *Virgularia mirabilis* and *Ophiura* spp. on circa-littoral sandy or shelly mud may also be applicable to the areas with a higher abundance of seapens.

Transect F: control site from near Kippin Rock (east of Causeway) towards Sugar Rock

Transect F was undertaken from near Kippin Rock in the shallow sub-littoral just to the east of the causeway to Sugar Rock just to the west of Hare Island. Weather was overcast with drizzle and a light wind estimated force 2 from the southwest. Underwater visibility was good and the bottom depth ranged from 3m to 8m BSL.

The sediment throughout the transect was dominated by muddy sand. An area of slightly coarser sand with shell debris was recorded from the middle of the transect. There were also some areas of hard seabed that consisted of both rock and pieces of man made material possibly iron or steel denoting debris.

Casts of the lugworm *Arenicola marina* dominated the shallow sediment especially towards the causeway end of the transect where the fine component was observed to

increase. The sand mason worm *Lanice conchilega* was also recorded in this area. The hermit crab *Pagurus* sp. was recorded in high abundance along parts of the transect. Occasional larger shore crabs (*Carcinus maenas*) were also recorded. Two species of starfish were recorded in low numbers; the common starfish *A. rubens* and the spiny starfish *Marthasterias glacialis* and the biotope IMS.FaMS was assigned. While species indicative of lower level biotopes were recorded, they were not present at a density where it would justify assignation of other biotopes.

The presence of hard substrata allowed for an increase in diversity of sessile organisms including the plumose anemone *Metridium senile* which dominated, and sponges such as the purse sponge *Scypha ciliata*. Unidentified red algae were also recorded. The biotope of IR.CorMetAlc was assigned indicating *Corynactis viridis*, *Metridium senile* and *Alcyonium digitatum* on exposed or moderately exposed vertical infra-littoral rock.

Transect G: control site from Foudra Rock towards west of Causeway.

Transect G extended from Foudra Rock towards the inter-tidal west of the causeway. Weather was changeable from overcast and drizzle to bright with sunny spells, with an estimated force 3 wind from the southeast. There was only a small swell. Underwater visibility was good and depth was between 7m and 11m BSL. A line of lobster pots caused some problems during the traverse but did cause significant effect. A discarded steel barrel was observed on the seabed.

The substratum throughout the transect appeared to be covered by coarse sand. This was generally clean indicating the more exposed nature of the site. There were small rock areas along the length of the transect with a more significant area of rock found towards the shallow sub-littoral off the west of the causeway. The extent of the rocky areas was difficult to determine. There was a substantial area covered by low growth red or brown algae interspersed with sand patches. It is thought that the algae were growing in sandy sediment rather than on bedrock.

Marine life in the sediments showed average diversity with numerous starfish species including abundant *A. rubens* and *Marthasterias glacialis.* The hermit crab *Pagurus* sp., burrowing seacumbers (holothurians), the dahlia anemone *Urctinia felina* and the seapen *Virgularia mirabilis* were also recorded. Extensive areas of small red algae, green algae including the sea whip *Chorda filum,* and brown algae including the sugar kelp *L. saccharina* were recorded. Overall, the higher biotope of IGS.IGS indicating infra-littoral gravels and sands was assigned. The hard substrata allowed for increased diversity of sessile flora and fauna. Unidentified red algae were common, the kelps *L. saccharina* and *L. digitata* were both recorded as was the sea whip *C. filum* and the sea lettuce *Ulva lactuca*. Hydroids, the plumose anemone and sponges were also recorded. A shoal of unidentified juvenile fish and crabs were observed in association with the hard substratum. Overall a higher biotope code of IR.IR indicating infra-littoral rock and other hard substrata was assigned as the species were generally mixed with no single lower biotope dominating an area.

Transect H: control site from near Peter Rock to Tawin Shoals.

Transect H extended from near Peter Rock to the South of Hare Island towards the Tawin Shoals. Weather was bright with sunny spells with an estimated force 5 wind from the southwest. Underwater visibility was good and depth was around 8m BSL. A line of lobster pots towards the Peter Rock end of the transect combined with the navigation buoy led to some problems of manoeuvrability causing a break in continuous footage. Some lost or discarded fishing gear was observed along the transect.

The seabed varied significantly during the transect. The initial stages of the transect towards Peter Rock consisted of coarse muddy sand with shell debris and occasional rock. This led to coarser gravel and loose rock which covered an extended area and rock habitats were also recorded, some of which were of significant size. Towards the Tawin Shoals the seabed comprised cleaner coarse sand and shell fragments in large ripples. What appeared to be a significant bed of maerl substrata was also recorded towards the Tawin Shoals.

The initial stages of the transect did not appear to support diverse or abundant life. However, the other sediment areas supported hermit and shore crabs, dahlia anemones, starfish species including the common starfish, burrowing holothurians, the common sea urchin and the seapen *Virgularia mirabilis*. A biotope of IMS.FaMS was assigned to the muddier substrata towards the Peter Rock end although the biotope of CMS.VirOph may also be applicable to the areas with a higher occurrence of seapens. No single set of species dominated the extensive gravel and loose rock areas, and a biotope of IMX indicating mixed infra-littoral sediments was assigned. The rock substrata allowed for an increased diversity of sessile organisms. The dead mans finger soft coral *Alcyonium digitatum* dominated some of the rocky areas towards the Peter Rock end of the transect and a biotope of IR.CorMetAlc was assigned.

The areas of exposed or moderately exposed lower infra-littoral rock were generally dominated by foliose red algae, and a biotope of EIR.FoR was assigned. The brown algae *L. saccharina* dominated the small rocky area towards the middle and a biotope of EIR.LsacSac was assigned at this point. Hydroids, common sea urchins, sponges and other algae were also recorded from the rocky areas. The coarse sand sediment towards the Tawin Shoals was assigned the biotope of IGS.FaS indicating shallow sand faunal communities. The maerl beds towards the Tawin Shoals end could not be identified to species level, but *Phymatolithon calcareum* has been recorded at several sites along the Atlantic coast of Ireland. It was not possible to confirm the health of the maerl from the video but it did appear to be alive and a biotope of IGS.Phy.HEc was assigned.

The protected status of Maerl

The National Biodiversity Plan (DAHGI, 2002) recognises the need to protect biodiversity in Ireland and accompanies Ireland's National Biodiversity Report (DAHGI, 1999). Annex V of the EU Habitats Directive lists two maerl species, *Lithothamnium (sic) corallioides* and *Phymatolithon calcareum* as species of community interest. Removal and exploitation in the wild may be subject to management measures; however, *Lithothamnion glaciale*, an important constituent of maerl beds in the north, is not included in Annex V.

The possibility of maerl beds becoming protected as an Annex 1 habitat under the EU Habitats Directive is discussed in further detail on the UKBAP website, and a specific Habitat Action Plan for maerl has been compiled for the UK. To date, no Irish equivalent of such detail is available, and the following is adapted from the UK Habitat Action Plan for maerl beds (Anon., 1999b). It highlights the importance of maerl in terms of its contribution to biodiversity and its exploitation and the principles are both relevant and applicable to this assessment.

Maerl is a collective term for several species of calcified red seaweed. It grows as unattached nodules on the seabed, and can form extensive beds in favourable conditions. Maerl is slow-growing, but over long periods its dead calcareous skeleton can accumulate into deep deposits (an important habitat in its own right), overlain by a thin layer of pink, living maerl.

Maerl beds typically develop where there is some tidal flow, such as in the narrows and rapids of sea lochs, or the straits and sounds between islands. Beds may also develop in more open areas where wave action is sufficient to remove fine sediments, but not strong enough to break the brittle maerl branches. Live maerl has been found at depths of 40 m, but beds are typically much shallower, above 20 m and extending up to the low tide level.

Maerl beds are found off the southern and western coasts of Britain and Ireland. They provide an important habitat for a wide variety of marine animals and plants which live amongst, or are attached to its branches, or burrow in the coarse gravel of dead maerl beneath the top living layer.

Because of the wide geographical range over which they occur, Maerl beds are associated with a wide range of animals and plants, with species diversity tending to be greater in the south and west. Due to the fragility of maerl, the beds are easily damaged and have probably declined substantially in some areas. Maerl beds rely on water movement to disperse fine sediment particles, which would otherwise accumulate between the maerl fragments and smother the bed. In this respect, Maerl is likely to be affected by the falling out of suspension of fine particles leading to smothering.

Maerl is of commercial value as a soil conditioner on acidic ground, as an animal food additive, for the filtration of acid drinking water and in pharmaceutical and cosmetic products.

Inter-tidal biotopes

A survey of the inter-tidal marine habitats, fauna and flora of Mutton Island, Mutton Island Causeway and surrounds was completed on the 9th and 10th May 2005. Plates referred to in the text can be found in the accompanying report (**Appendix I** and the surveyed area shown on **Figure 11.2**).

A broad scale survey of the marine biotopes (flora, fauna and habitat) was completed, following procedures (Davies *et al*., 2001., Emblow *et al*., 1998). The survey area was walked and biotopes identified in the field. Where biotopes could not be identified, species were collected and returned to the laboratory for identification. Species

sensitive to eutrophication were noted along with their general locations, as were biotopes particularly sensitive to organic enrichment (see **Table 11.3**). Freshwater inflows were recorded and changes in the marine communities that may be attributable to them were noted.

Twenty-three biotopes were recorded from the survey area. The following description of the survey area is based on biotope distribution.

LR.YG - Yellow and grey lichens on supra-littoral rock.

The upper shore biotope characterised by yellow and grey lichens on supra-littoral rock was restricted to only a few small sites within the study area. The main area where the biotope was recorded was on the supra-littoral bedrock on the east side of Mutton Island above the LR.Ver.Ver biotope (Plate 1). Patches also occurred on the engineered walls backing the shore along the strand to the west of the causeway. Only yellow and grey lichens were recorded.

LR.Ver.Ver - *Verrucaria maura* on very exposed to very sheltered upper littoral fringe rock.

The black lichen biotope on upper littoral fringe rock was restricted in its distribution in the survey area. The biotope was mainly recorded to the east of Mutton Island between the biotopes of LR.YG and SLR.FSpi (Plate 1) and from the rock groynes associated with the strands towards Salthill, above the biotope SLR.Pel. Only *Verrucaria maura* was recorded.

ELR.MytB - *Mytilus edulis* and barnacles on very exposed eulittoral rock.

The common biotope of the edible mussel and barnacles on exposed eulittoral rock (Plate 2.) was recorded from a number of sites in the survey area. This biotope dominated the exposed bedrock areas of the south-eastern shore of Mutton Island, in place of the biotope ELR.BPat. To the north east of Mutton Island and on parts of the rock groynes associated with the strands to the west of the causeway it was recorded below the biotope ELR.BPat (Plate 3). It was generally found in association with the *Fucus serratus* dominated biotopes. Other species found in the biotope included the gastropod snails *Patella vulgata*, *Littorina littorea*, *Gibbula umbilicalis* and *Nucella lapillus*, the red algae *Polysiphonia lanosa* and *Osmundea* sp., and the brown algae *F. serratus* and *F. vesiculosus*. Abundance of the organisms recorded was variable.

ELR.BPat - Barnacles and *P.* spp. on exposed or moderately exposed, or vertical sheltered, eulittoral rock.

The barnacle and limpets on eulittoral rock biotope was one of the more common biotopes found in the survey area. It was recorded from all wave exposed bedrock habitats around Mutton Island, along the entire length of the western side of the Mutton Island Causeway rock armour (Plate 3), and on areas of wave exposed eulittoral bedrock on the groynes associated with the strands to the west of the causeway. It was generally found above the *F. serratus* dominated biotope, and below the biotopes dominated by *F. vesiculosus* and *Ascophyllum nodosum*. On the west of the causeway no littoral biotope

was recorded above it. The same species were recorded as for ELR.MytB but with a lower abundance of the mussel *M. edulis* hence a separate biotope was assigned.

MLR.Fser - *F. serratus* on moderately exposed lower eulittoral rock and **SLR.Fserr** - *F. serratus* on sheltered lower eulittoral rock.

These two similar common biotopes were not distinguishable from each other on this survey. The *F. serratus* dominated biotopes were recorded along much of the lower eulittoral rock shores (Plate 10) including the north-west of Mutton Island, around the south and west of the island, and along the western arm of the causeway. They were also recorded on the lower shore rocky areas to the east and west of the causeway, but in a lower abundance. It was generally recorded below the ELR.BPat and ELR.MytB biotopes. *F. serratus* biotopes were not recorded on the more sheltered eastern side of the causeway arm itself. Species diversity was high in this biotope with 24 species or higher taxa recorded. These included the beadlet anemone *Actinia equina*, sponges, various barnacles, crabs and molluscs, and diverse red and brown algae.

MLR.Rho - *Rhodothamniella floridula* on sand-scoured lower eulittoral rock.

This biotope dominated by the ephemeral red algae *Rhodothamniella floridula* was only recorded from a small area on the lower shore of the strand to the west of the causeway (Plate 5). Species diversity was low with few other species other than *R. floridula* recorded.

MLR.Salv - *Sabellaria alveolata* reefs on sand abraded eulittoral rock.

This relatively scarce biotope of the reef building honeycomb worm on sand abraded eulittoral rock was recorded during the survey in small patches along the north-west of the causeway arm (Plate 6). It also occurred on the strands and rocks towards Salthill (Plate 7). As a reef building worm, *Sabellaria* requires a continuous supply of suspended coarse sediment and initially, an area of hard substratum on which to develop. The areas from which the biotope was recorded were on, or beside, soft sediment substrata with either cobbles or emerging bedrock as the associated hard substratum. Even though this biotope provides increased diversity of habitat, littoral *Sabellaria* reefs are generally relatively low in species diversity compared to their sub-tidal equivalent (*S. spinulosa*). Other species recorded included the beadlet anemone, the hermit crab *Pagurus bernhardus*, the gastropods *P. vulgata*, *Gibbula umbilicalis*, and *L. littorea*, and the algae *F. serratus* and *Enteromorpha* sp.

SLR.EphX - Ephemeral green and red seaweeds on variable salinity or disturbed eulittoral mixed substrata.

This biotope was restricted to a few small patches in the survey area, including to the south of Mutton Island, between the biotopes of SLR.Pel and SLR.Asc (Plate 4), to the east of the island on mixed substrata near the structure shown in Plate 17, and an area to the east of the causeway below an area of *A. nodosum*. It was also recorded from the freshwater outfall shown in Plate19. In general *Enteromorpha* sp., was present and recorded on mixed substrate under the biotope of SLR.EphX. The biotope MLR.Ent,

Enteromorpha spp. found on freshwater influenced or unstable upper eulittoral rock was not assigned as species diversity was low with few other species other than *Enteromorpha* recorded.

SLR.Pel - *Pelvetia canaliculata* on sheltered littoral fringe rock.

This often-common biotope of the channel wrack on littoral fringe rock was recorded from a number of sites along the survey area. It formed an almost continuous band along the upper bedrock shore from the north-east of Mutton Island around to the cobbled beach of the south (Plate 4). It was also recorded on the upper shore of natural bedrock substrata to the west towards Salthill. Species diversity was low with few other species other than *Pelvetia canaliculata* recorded.

SLR.Fspi - *F. spiralis* on moderately exposed to very sheltered upper eulittoral rock.

The common fucoid biotope was common throughout much of the survey area on upper shore hard substrata (Plates 1 and 16). It was recorded on the rock groynes to the east of the causeway, on the strand on emergent bedrock, along the east side of the causeway and around much of the island. It was not found along the more exposed west side of the causeway, but re-established on the more sheltered rocky areas along the coast towards Salthill. Species abundance and diversity within the biotope varied throughout the range and was particularly poor where the causeway reaches Mutton Island (eastern side). The low diversity on the southeast corner of the causeway may be attributable to smothering by the increased percentage of mud in the adjacent soft substrata. The soft muddy substratum of this area is probably caused by its extreme sheltered nature. In general the biotope contained barnacles, gastropods *P. vulgata*, *L. littorea* and *L. saxatilis*, the algae *F. vesiculosus* and *Enteromorpha*, and the lichen *Verrucaria maura* in association with the abundant *F. spiralis*.

SLR.Fves - *F. vesiculosus* on sheltered mid eulittoral rock.

This common biotope was recorded from a number of sheltered mid eulittoral rock sites in the survey area. This included areas just to the east of the causeway at the mainland end, a continuous band along much of the east of the causeway itself (Plate 16), and an extensive area on the south and western side of Mutton Island (Plate 8). It was recorded on the more exposed western side of the causeway, although was not as dominant here. The *F. vesiculosus* dominated biotope was also recorded from mid eulittoral rocky areas, including bedrock emerging from sediments, along the strands and associated rock groynes to the east and west of the causeway along the length of the survey area. The biotope was generally found above the biotope dominated by *F. serratus* and below those of ELR.BPat or SLR.Fspi depending on exposure. The biotope of SLR.Asc.Asc was generally dominant in place of SLR.Fves on more stable sheltered mid eulittoral rock areas. The associated biotope, SLR.FvesX of *F. vesiculosus* on mixed substrata was not recorded directly during the survey. There were places where the fucoid was found on loose cobbles and other substrata but it was also attached to bedrock at those sites – thus all *F. vesiculosus* dominated areas were assigned to the SLR.Fves biotopes. Species diversity was relatively high in this biotope and included barnacles, the shore

crab *Carcinus maenas*, gastropod snails, the edible mussel, diverse red and brown algae in association with the abundant *F. vesiculosus*.

SLR.Asc.Asc - *A. nodosum* on full salinity mid eulittoral rock.

This common biotope was recorded from a number of sheltered mid eulittoral rock sites in the survey area. It was generally dominant on stable sheltered shores in place of SLR.Fves, below the SLR.Fspi biotope and above the biotopes dominated by *F. serratus*. SLR.Asc.Asc was recorded from a small area of bedrock to the north-east of the causeway, within the semi enclosed pool on the north of Mutton Island, and along much of the sheltered north eastern side of the island (Plates 4 and 9). Extensive areas of SLR.Asc.Asc were also recorded from the low-profile south side of the island. The rock groynes associated with the strands towards Nimmo's Pier were generally dominated by this biotope, as were areas of emergent bedrock on the strand itself. It was also recorded from one sheltered area just to the west of the causeway at the mainland end. Species recorded in association with the abundant *A. nodosum* included the beadlet anemone, barnacles, three gastropod snail species, the edible mussel, the epiphytic red algae *Polysiphonia lanosa*, three *Fucus* spp. and the ephemeral green algae *Enteromorpha*.

SLR.BLlit - Barnacles and *L. littorea* on unstable eulittoral mixed substrata.

This generally rare biotope was recorded from one site in the survey area. The site was on the upper shore just to the west of the first strand west of the causeway (Plate 11). It was associated with the base of the concrete defence wall in an area of loose cobbles. The gastropods *L. littorea* (periwinkle) and the limpet *P. vulgata* dominated with small *M. edulis* (common mussel) and barnacles in an area otherwise low in faunal diversity and abundance.

SLR.MytX - *M. edulis* beds on eulittoral mixed substrata

This common biotope was recorded from a small number of sites in the survey area. These included small areas on the strands to the east and west of the causeway (Plate 12). The biotope did not occur in the densities or cover the wide areas that can be encountered. However, it did increase the diversity of flora and fauna slightly by providing a substratum for barnacles, red algae and young fucoids.

LR.Rkp - Rockpools

Small rock pools were encountered in areas of natural bedrock in the survey area. However, they tended to be small and dispersed throughout the survey area.

LGS - Littoral gravels and sands.

The higher biotope of littoral gravels and sands was recorded frequently over the extent of the mainland survey area. They were generally broken up by artificial rock groynes and headlands influenced by coastal defence works. Some sites contained areas of emergent bedrock, large cobbles and other mixed sediments, so the sediment biotopes were associated to some extent with rock biotopes in places and could broadly be

assigned to the biotope of Littoral Mixed Sediments (LMX). With the exception of LGS.Tal and LGS.BarSnd no other sediment biotope could be assigned with confidence. However, the abundances of the lugworm *A. marina* recorded from the sediments over much of the survey area suggest that a biotope of LMS.MacAre, *Macoma balthica* and *A. marina* in muddy sand shores might be applicable (Plates 14 and 15). While the granulometry of the sediments would vary over the survey area the middle shores were predominantly muddy sands, often with a slight anoxic layer below the surface. The main exception was the area immediately east of the causeway which was dominated by a softer sandy mud or mud, indicating the more wave sheltered nature of the area.

LGS.BarSnd - Barren coarse sand shores and **LGS.BarSh** - Barren gravel and shingle shores

The upper shores of sediment areas were generally dominated by the common biotope of barren coarse sand shores, and barren gravel and shingle shores where no flora and fauna was recorded (Plates 13 and 15).

LGS.Tal - Talitrid amphipods in decomposing seaweed on the strandline

This common biotope was recorded along the upper strandline of the beach towards Nimmo's Pier (Plate 13) and on the strand immediately to the west of the pier. It is probable that decomposing seaweeds are removed from other beaches and so this biotope will not establish itself in those areas. The biotope is characterised by a low diversity of fauna and flora, combined with a high abundance of talitrid amphipods

Galway Bay Complex cSAC

As a large shallow bay or inlet, Galway Bay is an Annex 1 habitat under the EU Habitats Directive and as such is provided with protection as the Galway Bay Complex SAC. Thus, as part of the Galway Bay complex SAC all habitats are provided with some degree of protection. The Water Framework Directive 2000/60/EC (Anon., 2000) also provides protection for the habitats and species present under the section that aims for all waters to achieve at least good ecological status by 2015.

Mutton Island forms part of the Galway Bay Complex candidate Special Area of Conservation proposed for designation due to the presence of the marine Annex 1 habitats, Large Shallow Inlets and Bays, Mudflats and Sandflats not covered by seawater at all times and Reefs (See Box 9.2 for further information on these habitats).

Box 9.2 Description and ecological characteristics of relevant Annex I habitats

Large shallow inlets and bays (1160) are habitat complexes which comprise an interdependent mosaic of sub-tidal and inter-tidal habitats. Several of these habitat types (Mudflats and sandflats not covered by sea water at low tide (1140), Sandbanks which are slightly covered by sea water all the time (1110) and Reefs (1170)) are listed as Annex I habitats in their own right. Large shallow inlets and bays are large indentations of the coast, generally more sheltered from wave action than the open coast. They are relatively shallow (with water less than 30 m over most of the area), and in contrast to 1130 estuaries, generally have much lower freshwater influence.

Sandbanks which are slightly covered by sea water all the time (1110) consist of sandy sediments that are permanently covered by shallow sea water, typically at depths of less than 20 m below chart datum (but sometimes including channels or other areas greater than 20 m deep). The habitat comprises distinct banks (i.e. elongated, rounded or irregular 'mound' shapes) which may arise from horizontal or sloping plains of sandy sediment. Where the areas of horizontal or sloping sandy habitat are closely associated with the banks, they are included within the Annex I type.

The diversity and types of community associated with this habitat are determined particularly by sediment type together with a variety of other physical, chemical and hydrographic factors. These include geographical location (influencing water temperature), the relative exposure of the coast (from wave-exposed open coasts to tide-swept coasts or sheltered inlets and estuaries), the topographical structure of the habitat, and differences in the depth, turbidity and salinity of the surrounding water.

Reefs (1170) are rocky marine habitats or biological concretions that rise from the seabed. They are generally sub-tidal but may extend as an unbroken transition into the inter-tidal zone, where they are exposed to the air at low tide. Inter-tidal areas are only included within this Annex I type where they are connected to sub-tidal reefs. Reefs are very variable in form and in the communities that they support. Two main types of reef can be recognised: those where animal and plant communities develop on rock or stable boulders and cobbles, and those where structure is created by the animals themselves (biogenic reefs).

Rocky reefs are extremely variable, both in structure and in the communities they support. A wide range of topographical reef forms meet the EU definition of this habitat type. These range from vertical rock walls to horizontal ledges, sloping or flat bed rock, broken rock, boulder fields, and aggregations of cobbles. Reefs are characterised by communities of attached algae (where there is sufficient light – on the shore and in the shallow sub-tidal) and invertebrates, usually associated with a range of mobile animals, including invertebrates and fish. The specific communities that occur vary according to a number of factors. For example, rock type is important, with particularly distinct communities associated with chalk and limestone. There may be further variety associated with topographical features such as vertical rock walls, gully and canyon systems, outcrops from sediment, and rock-pools on the shore.

The greatest variety of communities is typically found where coastal topography is highly varied, with a wide range of exposures to wave action and tidal streams. Exposure to wave action has a major effect on community structure, with extremely exposed habitats dominated by a robust turf of sponges, anemones and foliose red seaweed, while reefs in the most sheltered sea lochs and rias support delicate or silt-tolerant filamentous algae, fan-worms, ascidians and brachiopods. The presence of enhanced tidal streams often significantly increases species diversity, although some communities require very still conditions. The strength of tidal streams varies considerably, from negligible in many sea loch basins, to very strong at 8-10 knots (4-5 m s^{-1}) or more through tidal rapids or in sounds. In strong tidal streams there are communities of barnacles, the soft coral *Alcyonium digitatum*, massive sponges and hydroids.

A strong vertical zonation is apparent. In the inter-tidal zone, lichens occur at the top of the shore, with littoral biotopes characterised by barnacles, mussels or species of fucoid (wrack) seaweeds. Vertical zonation extends sub-tidally into the circa-littoral (below the photic zone). In contrast to the variety of rocky reefs, there is somewhat less variation in biogenic reefs, but the associated communities can vary according to local conditions of water movement, salinity, depth and turbidity.

Source: http://www.jncc.gov.uk/Publications/JNCC312/UK_habitat_list.asp

The SAC Site Synopsis (Box 9.1) indicates that saltmarsh, both the Atlantic and Mediterranean types, are frequent along the coast of Galway Bay, but that the best examples are seen to the east of Galway city due to the increased shelter of this region. Shingle and stony beaches are also extensive within the SAC with the best examples evident to the west of Galway city. These shingle beaches are generally sparsely vegetated and frequently occur interspersed with areas of sandy beach and/or bedrock.

Aquaculture and Non-Migratory Fisheries

The SAC site synopsis indicates that fishing and aquaculture are the main commercial activities within the site. The nearest shellfish installations in Galway Bay are those for mussels and oysters. These are approximately 4km distant to the South East of the Mutton Island outfall situated in the shelter provided by the Kilcaimin Peninsula.

Several lines of crab and lobster pots were observed within Galway Bay during the sub-tidal survey and it is likely that similar lines of pots are set in the many areas of rocky reef habitat noted during the inter-tidal and sub-tidal surveys.

Migratory Fisheries

The River Corrib, Galway Bay and the tributaries that flow into it support important fisheries for salmon. Salmon is an anadromous migratory species that returns from the sea to freshwater to spawn. Other species including the sea lamprey and river lamprey also return from the sea to spawn while the European eel (*Anguilla anguilla*) is catadromous in that it returns to the marine environment from rivers and lakes to spawn in the Sargasso Sea.

Commercial and recreational fisheries for salmon far outweigh those of other species in the area; however, small fisheries for eels and elvers (young eels returning to the river) exist to supply export markets in Holland and Germany.

Ireland is noted internationally for its salmon fishing. The River Corrib or Galway fishery starts at the defined mouth of the river in Galway Bay and consists of the main river, the Galway City canals, and the two outlet rivers from Lough Corrib and a portion of the lough. The fishery provides approximately 3% of the national catch reporting 4,813 fish landed in 2004 (Anon, 2005). Of these, 942 salmon were reported from the River Corrib river system. The salmon season runs annually from 1st February to 30th September with the spring run of fish returning most fish during April and May. Fishing for grilse (young salmon that have been only once to sea) peaks during May and June.

Catches of sea trout (*Salmo trutta* >40cm) were reported officially as nil during 2003, but smaller and juvenile fish were reported present in low numbers in July and August (Anon, 2004). It was also noted that sea trout were not evident on the tides as used to be the case 10 to 15 years ago.

The eel fishery operates during the autumn/ winter period on the down stream side of the weir and traps are set further upstream to collect silver eels migrating seaward. Although not comprising a fishery in their own right, runs of sea lamprey coincide with the early and late spring runs of salmon and grilse respectively as they move into the freshwater system to spawn.

A baseline summary and details of identified receptors are shown on **Table 11.2**.

Table 11.2 Identified Receptors and baseline Summary

Identified Receptor	Baseline Summary
Annex I habitats:	
Rocky Reefs	Extensive around Mutton Island, northern shoreline of Galway Bay and Earl's Rock 5km SE of outfall
Large Shallow Inlets and Bays,	Extensive within Galway Bay Complex cSAC and surrounding marine area
Mudflats and Sandflats not covered by seawater at all times	Extensive within Galway Bay Complex cSAC and surrounding inter-tidal area
Annex II species (marine mammals):	
Harbour / common seal- (*Phoca vitulina*)	Nearest haul out sites 3 – 3.5km from outfall
Bottlenose dolphin (*Tursiops truncatus*)	Frequently recorded in Galway Bay
Harbour porpoise (*Phocoena phocoena*),	Present in Galway Bay
Other species:	
Grey seal (*Halichoerus grypus*)	Nearest haul out sites 3 – 3.5km from outfall
Aquaculture and fisheries :	
Oyster and mussel aquaculture	Shellfish installations present in Galway Bay, nearest mussels and oysters at 4km (approx) distance SE of outfall, clams 10km (approx) distance South of outfall.
Crabs and Lobsters	Several lines of pots observed around Mutton Island
Migratory Fish	Galway Bay and the River Corrib are important for migratory fish species.
Subtidal marine communities in vicinity of outfall:	Biotopes recorded typical of region. Maerl (IGS.Lgla) and *Sabellaria alveolata* (MLR.Salv) reefs significant in terms of conservation importance, but remote (approx' 1.5km) from outfall

11.1.5 Predicted Trends

In the absence of the proposed increase in treatment capacity, the diversity of habitats and species in the vicinity of Mutton Island and its treated effluent plume would continue to improve in the short term. This would be due to the improvement in water quality since the cessation of raw sewage discharge into Galway Bay in April/May 2004.

11.1.6 Information Gaps

There is no current information available regarding management of the Galway Bay Complex designated sites. A draft management plan report does exist but has never gone to consultation due to outstanding issues over the site boundary, and thus was not released for review by Entec.

11.2 Potential Effects and Incorporated Mitigation

11.2.1 Potential Effects During Construction and Incorporated Mitigation

The Scoping Report (TOBIN, O'Dwyer and Entec, 2005) has identified that no assessment of the construction phase will be progressed in relation to marine ecology (see **Table 4.1**). Effects of construction on sensitive species and habitats, particularly the permanent loss of habitat and the displacement of species is unlikely given the restricted construction footprint and works.

Section 10.2.1 outlines potential water quality effects from the construction process and identifies best practice mitigation techniques. It concludes that use of best practice construction guidelines on this well contained site will result in any significant effects on water quality being unlikely during the construction phase. This reinforces the prediction that no significant effects on marine ecology due to construction will occur.

11.2.2 Potential Effects During Operation and Incorporated Mitigation

The Sensitivity of Biotopes Identified

Potential impacts of the proposed development, both for the littoral and sub-littoral biotopes identified include increase in suspended sediment, increase in turbidity, changes in nutrient levels, localised decrease in salinity, associated changes in oxygenation, and introduction of microbial pathogens. Based on the sensitivity of biotopes recorded, the effects of these impacts that are thought to be of moderate or high significance will be discussed, and mitigation of those effects will be proposed where appropriate. The evaluation of effects has been based on published literature on the impacts of anthropogenic disturbance (Holt *et al*., 1995, Birkett *et al*., 1998, Hill *et al*., 1998) including effluent on marine species.

During the operation of the WWTP there will be an increased loading of nutrients into the receiving waters. The likely significant effects associated with the increased nutrients broadly could include:

- increases in species of ephemeral green algae such as *Enteromorpha* spp in the inter-tidal area; and
- shifts in community species structure, abundance and biomass in the inter-tidal and sub-tidal environments.

On the basis that the treatment plant is already operational, it can be assumed that inter-tidal communities in the vicinity of the outfall are already being subjected to increased levels of nutrients over background levels while immersed. Some reef communities are known to be moderately sensitive to nutrient and organic enrichment. However, the existing secondary treatment of the effluent and the use of a diffuser to spread the distribution of treated effluent are likely to minimise the levels of received nutrients.

The sensitivity of biotopes recorded during the inter-tidal and sub-tidal surveys to these physical, chemical, and biological factors are summarised from the Marine Life

Information Network for Britain and Ireland (*MarLIN*) website in **Table 11.3** and **11.4**. Where sensitivity has been summarised as Moderate or High, the assessment of effects on that biotope is presented in **Section 11.3**.

Table 11.3. The sensitivity of biotopes identified in the inter-tidal environment

Sensitivity of Littoral Biotopes						
Biotope Code	**Increase in Suspended Sediment**	**Increased Turbidity**	**Increased Nutrients**	**Decrease in Salinity**	**Changes in Oxygen level**	**Increase in Microbial Pathogens**
LR.YG	Not relevant	Not relevant	**High**	**High**	Not relevant	Insufficient information
LR.Ver.Ver	Not relevant	Not relevant	**High**	**High**	Not relevant	Insufficient information
ELR.MytB	Very Low	Very Low	Low	Very Low	Not relevant	Low
ELR.BPat	Very Low	Tolerant	Low	**Moderate**	Not sensitive	Low
MLR.Fser	Low	Not sensitive	Tolerant	Low	Low	Insufficient information
SLR.Fserr	Low	Not Sensitive	Very Low	Very Low	Very Low	Insufficient information
MLR.Rho	**Moderate**	Low	Low	Low	Low	Insufficient information
MLR.Salv	Low	Very Low	Very Low	Low	Low	Insufficient information
SLR.EphX (MLR.BF)	Low	Low	Low	Low	Low	Low
SLR.Pel (MLR.BF)	Low	Low	Low	Low	Low	Low
SLR.Fspi (MLR.BF)	Low	Low	Low	Low	Low	Low
SLR.Fves	Very Low	Very Low	Low	Low	Not relevant	Low
SLR.Asc.Asc	Very Low	Not sensitive	**Moderate**	Very Low	Low	**Moderate**
SLR.BLlit	Not sensitive	Tolerant	Very Low	Very Low	Not sensitive	Low
SLR.MytX	Very Low	Very Low	Low	Low	Not relevant	Low

Sensitivity of Littoral Biotopes						
Biotope Code	**Increase in Suspended Sediment**	**Increased Turbidity**	**Increased Nutrients**	**Decrease in Salinity**	**Changes in Oxygen level**	**Increase in Microbial Pathogens**
LMS.MacAre (LMS.MS)	**Moderate**	Tolerant	**Moderate**	**Moderate**	**Moderate**	Not relevant
LGS.BarSnd	Not relevant	Not relevant	Not relevant	Not relevant	Not relevant	Not relevant
LGS.BarSh	Not relevant	Not relevant	Not relevant	Not relevant	Not relevant	Not relevant
LGS.Tal	Not relevant	Not relevant	Not relevant	Tolerant	Not relevant	Insufficient information
Note: The sensitivities shown above are reproduced from the *MarLIN* database and no additional interpretation has been made.						

Table 11.4. The sensitivity of biotopes identified in the sub-tidal environment

Sensitivity of Sub-tidal Biotopes						
Biotope Code	**Increase in Suspended Sediment**	**Increased Turbidity**	**Increased Nutrients**	**Decrease in Salinity**	**Changes in Oxygen level**	**Increase in Microbial Pathogens**
EIR.LsacSac	Not sensitive	Low	Not sensitive	Low	Low	Very Low
EIR.FoR	Low	Very Low	**Moderate**	Low	**Moderate**	Insufficient information
MIR.Ldig.Ldig	Low	Low	Low	Low	Low	Low
IR.CorMetAlc (IR.Alc.ByH)	Very Low	Tolerant	Not sensitive	**Moderate**	**Moderate**	Insufficient information
IGS.FaS (IGS.FabMag)	Very Low	Very Low	Low	Low	Tolerant	Low
IGS.Phy.HEc	**Very High**	**High**	Very Low	**Very High**	**Very High**	**Moderate**
IMS.FaMS (IMS.EcorEns)	Low	Very Low	Low	Low	**Moderate**	Low
CMS.VirOph	Not sensitive	Very Low	Low	**Moderate**	Not sensitive	Insufficient information
Note: The sensitivities shown above are reproduced from the *MarLIN* database and no additional interpretation has been made.						

Littoral Biotopes

None of the species or biotopes recorded during the inter-tidal survey are of specific nature conservation importance or interest. All the species recorded have been widely recorded around Ireland (Picton *et al.*, 1998, Ecoserve unpublished data). However, of particular note is the occurrence of the reef building honeycomb worm *Sabellaria alveolata* (MLR.Salv). While they are not a directly protected habitat, protection is encouraged as part of areas designated for Special Areas of Conservation (SAC).

Of the species recorded, only *Enteromorpha* is thought to be particularly sensitive to organic pollution as it has been shown to have the potential to grow excessively in areas of reduced salinity (due to freshwater influence) and nutrient inputs. Most of the other algal species recorded would be sensitive to eutrophication in the sense that they would not be able to compete with an expanding community of *Enteromorpha*, or would react negatively to reduced salinity.

Of the faunal species, the edible mussel *Mytilus edulis*, while not a direct indicator of organic pollution in itself, is commonly used as an indicator of faecal pollution. Mussels feed by filtering water and any bacteria present can concentrate in the tissues of the bivalve and are thus easier to detect.

Filter feeding shellfish can also accumulate algal toxins due to blooms of some marine algae in conditions where nutrients have become elevated. These may reach levels harmful to public health. Further information on the effects of Nitrogen compounds in marine waters is presented **Section 10**.

Sub-tidal Biotopes

None of the species or biotopes recorded during the current survey with the exception of that of maerl (IGS.Phy.HEc) is of specific nature conservation importance or interest. It should be noted however, that Maerl was recorded on one of the control transects, Transect H, in the vicinity of the Tawin Shoals approximately 1.5km south of Mutton Island. All the species recorded have been widely recorded around Ireland (Picton *et al.*, 1998, Ecoserve unpublished data). It should be noted that ROV surveys do not allow for the detailed description of all species present, and this is particularly true for sediment substrata where many of the associated fauna are buried. It was not possible to assign lower biotopes to many of the sediment areas, as they generally require an examination of the infauna; however, it is considered that the distribution and abundance of epifauna, i.e. those species on the surface of the seabed, provides a reliable indication of the sensitivity of the associated subsurface species assemblage.

Maerl beds can be affected by increases in suspended sediment resulting from sewage outfalls, but the data obtained during the present survey do not allow clear determination of whether or not this is the case in and around Mutton Island. Similarly, the health of the maerl beds could not be determined during the survey, but of those areas observed, there was no clear evidence that the beds were suffering any detrimental effect from the existing levels of water quality and extent of the treated effluent plume i.e. suspended solids.

An indication of current levels of treated effluent discharge on sub-tidal ecology can be gained from the abundance of static fishing gear observed. Lines of lobster pots were observed at the shoreward end of transects A and C, the Foudra Rock end of transect G and the Peter Rock end of transect H. They were also encountered on Transect B where strong currents around the southern edge of the Mutton Island Causeway caused the ROV to foul upon them. In this regard, it is not considered that the current levels of suspended sediment, dissolved Oxygen, nutrients, reduced salinity, and turbidity are having a significant detrimental effect on sub-tidal ecology.

Fisheries

Changes to water quality can affect fish species directly, or indirectly via the food web or habitat change. Changes to suspended sediment concentrations, nutrients, organic loading and effects from toxic compounds such as ammonia can affect fish if concentrations become elevated. **Section 10.2.2** outlines these potential water quality changes.

The final treated effluent of the upgraded WWTP will be subject to strict quality standards that reflect the legislative status of the discharge and designed to be environmentally protective, to ensure that there are no significant adverse effects on the water quality of Galway Bay and therefore no significant effects on fish species.

Avoidance/reduction measures

Table 11.5 summarises the incorporated mitigation measures.

Table 11.5. Avoidance/reduction measures – likely effects

Receptor	Changes and potential effects	Incorporated mitigation measures and rationale for their likely effectiveness
Construction		
Inter-tidal and sub-tidal marine communities	Increase in polluting matter discharged to receiving waters with subsequent effects on inter-tidal and sub-tidal marine communities	High certainty of effectiveness: Construction will be limited to within the existing WWTP site which is a highly controllable environment where pollution can be contained and subsequently treated. A range of best practice mitigation measures will be employed to reduce the likelihood of pollution reaching Galway Bay.
Operation		
Inter-tidal and sub-tidal marine communities	Potential localised increase in nutrient levels from increased volume of discharge, leading to eutrophication	High certainty of effectiveness: Continued use of existing diffuser comprising 10 ports below 10m CD will dissipate energy of the flow and facilitate effective dispersion of the treated effluent.

Receptor	Changes and potential effects	Incorporated mitigation measures and rationale for their likely effectiveness
Inter-tidal and sub-tidal marine communities	Potential localised increase in suspended sediment, leading to localised smothering	High certainty of effectiveness: Water quality standards will be maintained through compliance with the UWWTR standards and effective dilution and dispersion to maintain low levels of suspended sediment
The following mitigation should also be noted to protect water quality in general:		
Waters of Galway Bay	*Increase in treated effluent discharge leading to deterioration of water quality and failure of mandatory (or guideline) water quality standards.*	*High certainty of effectiveness:* *Design of the sewage treatment processes to achieve the UWWTR quality standards will prevent any significant adverse effects on the water quality of the receiving water.* *Standards are designed to be environmentally protective and to comply with the relevant legislation.* *Water quality modelling of the residual effects is presented in* ***Section 10.3****.*

Compensation

Not applicable to this topic.

11.2.3 Implementation of mitigation and enhancement measures

The existing 10 port diffuser will remain in place 10m below chart datum and is capable of handling the additional volume of treated effluent, and thus this mitigation is already in place.

Other relevant mitigation is contained in Table 10.19 (relating to water quality).

11.3 Assessment of Effects

11.3.1 Scope and Methodology

Baseline data were gathered in consultation with a number of organisations and information supplied from a number of sources which are listed in **Section 11.1**. Baseline data were gathered to identify any potential sensitive marine receptors (i.e. specific habitats, species or assemblages) that may be affected by the proposals. This included identification of:

1. key marine interest features of the Galway Bay Complex candidate Special Areas of Conservation (SAC), that may be directly or indirectly affected by the development proposals; and
2. any other potential habitats, species or ecological pathways that may be directly or indirectly affected by the development proposals.

Water quality modelling of the increased treated effluent discharge from the proposed WWTP upgrade has been carried out (see **Section 10.3.3**), and the results of this

modelling used to assess the impacts of the increased discharge characteristics on the identified marine receptors.

These results were then reviewed against the assumed conservation objective of 'maintaining favourable conservation status', which is an obligation of all EU member states in respect of their European site (SAC and SPA) designations.

The results were also reviewed in terms of the potential for any other identified significant alterations to marine inter-tidal or sub-tidal ecological processes and pathways in the context of their potential to affect the health and survivorship of key interest features of the SAC. SPA interest features are considered in **Section 12**.

11.3.2 Significance evaluation methodology

The sensitivity of each of the biotopes identified through the inter-tidal and sub-tidal surveys to increased suspended sediment, increased turbidity, changes in nutrient levels, decrease in salinity, changes in dissolved Oxygen, and introduction of microbial pathogens/ parasites was determined on the basis of the Marine Life Information Network for Britain and Ireland (MarLIN). The MarLIN programme was established in 1998 by the Marine Biological Association with the aim of providing information for marine environmental management, protection and education. The programme was developed in collaboration with the major environmental protection agencies together with academic institutions and was designed to make information freely and rapidly available through the Internet. The Biology and Sensitivity Key Information Web pages are prepared through extensive library research on species and biotopes to summarise knowledge of their biology and environmental preferences and to assess likely sensitivity to a wide range of factors. Sensitivity is assessed through a protocol developed in collaboration with the relevant Government Departments, Agencies and academic institutions.

Where the sensitivity of biotopes to the impacts identified has been shown to be moderate or high (see **Tables 11.3** and **11.4**), each is addressed below relative to habitats listed under Annex 1 of the EU Habitats Directive (Anon., 1997b). Specifically, these habitats are: large shallow inlets and bays, mudflats and sandflats not covered by seawater at all times, and rocky reefs (see Box 9.2).

In terms of Annex II cetaceans and sea mammals, those identified as relevant are also addressed below.

11.3.3 Information gaps

As the facility is in place and no significant construction is required to allow the proposed increase in volume of treated effluent discharge, the assessment of the construction phase was scoped out of the EIA.

11.3.4 Assessment of predicted effects

Construction

No effects have been identified.

Operation

Large Shallow Inlets and Bays

For the purpose of comparison with sensitive biotopes, this habitat is considered in the context of the sub-tidal environment in a broad context. Of all the biotopes identified, those in the sub-tidal were generally more sensitive, but the kelp biotopes (EIR.LsacSac and MIR.Ldig.Ldig) associated with hard substrates are classed as having low sensitivity. Highest sensitivity to increased suspended sediment, turbidity, salinity, dissolved Oxygen, and pathogens/ parasites is assigned to the maerl beds that have been assigned to the IGS.Phy.HEc biotope classification denoting the presence of *Phymatolithon calcareum*. However, it should be noted that this was recorded approximately 1.5km South of Mutton Island on the Tawin Shoals where the dilution of treated effluent will be large and unlikely to have an adverse effect. The water quality standards achieved are presented and discussed in **Section 10.3.3**. On this basis the predicted increase in the volume of treated effluent will not have a significant effect on the highly sensitive maerl beds. The only indication of possible effluent discharge noted during the sub-tidal survey was at a point on Transect A approximately 500m East of the outfall's diffuser where a layer of muddy water approximately 1m above the sea bed was observed. It was also noted that a line of lobster pots was situated in this vicinity.

The moderately sensitive hard substrate biotopes such as bryozoan, hydroid and ascidian turf (IR.AlcByH), or foliose red seaweeds (EIR.FoR) were recorded on the moderately exposed infra-littoral rock encountered along the control transects F, G and H and are therefore not considered at risk. The soft substrate biotopes of moderate sensitivity: *Echinocardium cordatum* and *Ensis* spp (IMS.EcorEns), and *Virgularia mirabilis* and *Ophiura* spp (CMS.Vir.Oph) on sandy or shelly mud comprising sea urchins, razor clams, sea pens, and brittle stars respectively were recorded at various points across the survey area, both in close proximity to the outfall (Transect B) and on the distant control transects. This apparent ubiquity of distribution suggests that the current extent and quality of the treated effluent plume is not having an adverse effect on the sub-tidal habitats and the species assemblages they support. As the increase in treated effluent discharge volume will not affect the quality of the surrounding waters to a significant extent (see Section 10: Water Quality) there is no reason to believe that the distribution or extent of sub-tidal biotopes in the area of the extended plume will change to a significant extent.

Mudflats and Sandflats not covered by seawater at all times

Although a greater number of biotopes was recorded in the inter-tidal (a possible indication of the limitations of underwater remote visual observation techniques), the assessment of their sensitivity to the factors identified as most likely to have an effect

(suspended sediment, turbidity, nutrients, salinity, Oxygen, and pathogens) showed that only the supra-littoral (i.e. those above MHWS) biotope LR.YG (yellow and green lichens), and black lichen (LR.Ver.ver) in the upper littoral (i.e. to MHWS) are highly sensitive to changes in nutrients and salinity.

For the purpose of comparison of the remaining sensitive biotopes to their distribution over inter-tidal mudflats and sandflats, these can be grouped into those characterised by red sea weeds (e.g. *Rhodothamniella floridula*) on the lower shore (MLR.Rho); the brown sea weed *Ascophyllum nodosum* on the mid shore (SLR.Asc); muddy sand shores (LMS.MS) that are often characterised by shellfish beds; and exposed rocky shores characterised by limpets and barnacles (ELR.BPat). Each of these is common to the inter-tidal survey area.

It appears therefore that the current extent of the treated effluent plume is not having a significant adverse effect on the inter-tidal ecology. The only strong evidence that effluent is having a significant adverse environmental effect, albeit one that is highly localised, is at Salthill. From its location, it is clear that this is a remote discharge and is not associated with the operations at Mutton Island.

Rocky Reefs

For the purpose of comparison with sensitive biotopes, this habitat is considered in the context of the inter-tidal and sub-tidal environments where hard substrates dominate. Where they occur, and where they support species sensitive to the factors identified they have been addressed above.

Sea Mammals

Pinnepeds: As noted, Inner Galway Bay accommodates both grey and common seals and the North Bay, east of the outfall, provides extensive good quality haul out sites for common seals, a species listed on Annex II of the EU Habitats Directive. The seals use a range of haul-out sites distributed through the bay including the inner Oranmore Bay, Rabbit Island, St.Brendan's Island, Tawin Island, Kinvara Bay, Aughinish Bay and Ballyvaughan although none of these are particularly close to the diffuser. The nearest haul out sites: Rabbit Island, St Brendan's Island, and Tawin Island lie within 3.0km to 3.5km of the outfall are shown on **Figure 11.1** and are likely to be covered by the modelled maximum extent of the treated effluent plume (which will be highly diluted at this location) (see **Appendix G**). However, predicted levels of faecal coliform (fc) contamination in the vicinity of these sites are at least an order of magnitude below the threshold level for bathing water quality (100 to 1000 fc/100ml), and it is unlikely therefore that seals will be adversely affected to a significant extent.

Given the secondary treatment quality standards required by the UWWTR (see **Table 10.5**), it is considered unlikely that the proposed increase in treated effluent discharge will have a significant effect on the distribution and behaviour of seals in its vicinity.

Cetaceans: There are no records in the literature which show that cetacean species, in particular, dolphins and porpoise are present in Galway Bay in significant numbers.

Any effects upon them that could be attributed to the proposed increase in treated effluent are therefore also likely to be insignificant.

Aquaculture and fisheries

With the continued treatment of wastewater to UWWTR standards, the proposed increase in volume of treated effluent discharge will not have a significant effect on crab and lobster fisheries. Similarly, it is not considered that aquaculture interests will be adversely affected, as identified in **Section 10.3.3**.

The modelling has predicted high levels of dilution (dilutions >60:1 predicted for 50% of the time) for the treated effluent and the influence of ammonia on migratory salmonids is likely to be insignificant. An ammonia standard for protection of salmonid fish has been shown to be complied with in **Section 10.3.3**.

Studies have suggested that during migration, salmonids use olfactory cues together with changes in currents and salinity gradients to find their home rivers (Wooton, 1992). Outside of the zone of influence immediately adjacent to the diffusers, it is unlikely that lower salinity could be detected against natural background fluctuations. Tidal influence around the diffuser ports ensures effective mixing and dispersion of treated effluent so that any effects are restricted to the immediate vicinity and are therefore not significant at nearest receptors.

Whilst effluent plumes may interfere with these cues the reduced salinity is highly localised and considered unlikely to significantly interfere with the homing cues of migrating salmonids.

11.3.5 Cumulative Effects

The discharge of treated sewage effluent from Mutton Island is by far the greatest anthropogenic discharge into Galway Bay in terms of volume. With regard to cumulative effects, the only other locally, significant factor identified is the contribution of dominant loads of nitrogen and suspended sediment from the River Corrib. Modelling studies presented in this EIS have shown that the predicted increase in the spatial extent of the plume of treated effluent where respective concentrations exceed accepted, environmentally protective standards is not significant.

11.3.6 Compensation

No compensation has been identified.

11.3.7 Additional mitigation/enhancement measures

No additional mitigation or enhancement measures have been identified.

11.3.8 Summary of significance evaluation

Table 11.6 Effects on marine ecology and evaluation of significance

Environmental effect	Type of effect	Probability of effect occurring	Policy importance (or sensitivity)	Magnitude of effect	Significance Level	Rationale
Construction						
Increase in polluting matter discharged to receiving waters with subsequent effects on inter-tidal and sub-tidal marine communities	-ve	Unlikely	International	Minor	Not Significant	The small scale of construction and the constraining of construction to within the existing WWTP reduces the risk of a pollution event occurring to a low level.
Operation						
Increased area of distribution of faecal coliforms leading to bio-accumulation in filter feeding species e.g. cultivated shellfish	-ve	Certain	International	Minor	Not Significant	Predicted faecal coliform levels at nearest sensitive receptors are negligible
Nutrient enrichment of receiving waters causing potential effects on Annex 1 habitats and sensitive biotopes via O_2 depletion or increased intra-specific competition	-ve	Likely	International	Minor	Not Significant	The increased loading of nutrients will be small in comparison with the overall loading to inner Galway Bay and is unlikely to have a detectable effect Annex 1 habitats
Smothering of Annex 1 habitats and sensitive biotopes by suspended solids	-ve	Unlikely	International	Minor	N/S	Assessment shows that after initial dilution suspended sediment levels will be in accordance with required water quality standards. Significant secondary dilution and dispersion occurs and significant smothering is not predicted
Changes in water temperature and salinity around diffuser ports precluding near field colonisation by sessile invertebrates	-ve	Certain	International	Minor	Not Significant	The tidal influence around the diffuser ports ensures effective mixing and dispersion of treated effluent so that any effects are restricted to the immediate vicinity and are therefore

Environmental effect	Type of effect	Probability of effect occurring	Policy importance (or sensitivity)	Magnitude of effect	Significance Level	Rationale
						not significant at nearest receptors
Changes in ammonia and salinity negatively affecting migratory fish 9and their migration to/from the Corrib)	-ve	Unlikely	Regional	Minor		The dilutions available mean that any effects on ammonia and salinity concentrations will be small away from the zone immediately around the discharge.

Key:	Type	Probability	Policy Importance	Magnitude	Significance
	- = Negative	Certain	International	Major	Major
	+ = Positive	Likely	National	Medium	Minor
	? = Unknown	Unlikely	Regional	Minor	Not Significant
			District	None	
			Local		

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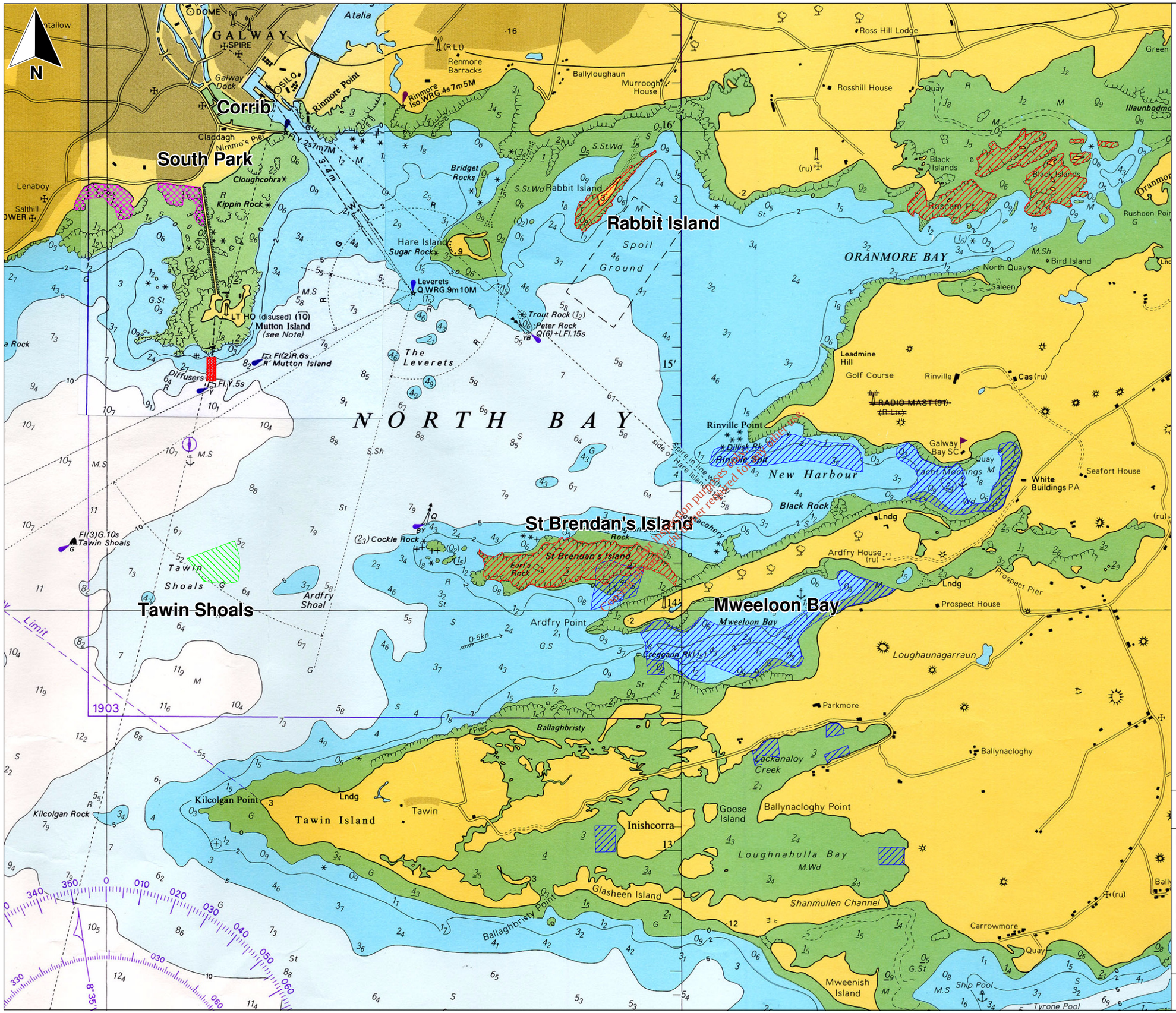

Key:

- Maerl bed
- Currently licenced shellfish beds
- *Sabellaria alveolata*
- Sea haul out site
- WWTP diffusers

Scale 1:25,000 @ A3

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Mutton Island Waste Water Treatment Plant Upgrade - EIS

Figure 11.1 Potentially Sensitive Marine Receptors

February 2006
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Key:

- Sub-tidal photo location
- Sub-tidal survey transects
- Inter-tidal walkover area

Scale 1:20,000 @ A3

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Mutton Island Waste Water Treatment Plant Upgrade - EIS

Figure 11.2
Inter-tidal and Sub-Tidal Survey Coverage

January 2006
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12. Birds

12.1 Existing Environment

12.1.1 Introduction

Mutton Island WWTP is located within the Inner Galway Bay. This area is designated as a Special Protection Area[33] (SPA) and a Ramsar site[34] due to its internationally important populations of wintering wetland birds and nationally important breeding colonies of seabirds. The Inner Galway Bay SPA/Ramsar site covers 11,905ha (both designations have the same boundary; see **Figure 12.1**) and consists of a number of habitats including mudflats, salt marsh and dune systems.

Internationally important populations of great northern diver (*Gavia immer*) and brent goose (*Branta bernicla*) winter on the SPA, whilst a further 16 wintering species of wetland bird occur in nationally important numbers. During the spring/summer period nationally important breeding colonies of sandwich tern (*Sterna sandvicensis*) and common tern (*Sterna hirundo*) are present.

The potential effects of the upgrading of the WWTP on the ornithological interests of Mutton Island and the SPA are from disturbance due to construction activities and from the increased input of treated effluent influencing the species composition, abundance or distribution of the flora or fauna utilised by birds as food.

12.1.2 Scope

Due to the international importance of the Inner Galway Bay SPA, the impact of any developments within the area must be sensitive to the ornithological interests for which the site is designated. The assessment of impacts upon avian communities is based upon existing survey data and knowledge of the species present. The survey data collected is both specific to the developmental site (collected as part of the EIA for Mutton Island WWTP and subsequent monitoring programme) and also covers the wider area by the collation of data collected throughout the SPA (Irish Wetland Bird Survey (I-WeBS) data).

On Mutton Island, surveys specific to the existing WWTP began in the winter prior to the beginning of works (1998/99) and during the construction period (1999/2000-

[33] Special Protection Areas are designated through Council Directive 79/409/EEC on the conservation of wild birds.

[34] The Convention on Wetlands of International Importance especially as Waterfowl Habitat (held at Ramsar, Iran 1971), an intergovernmental treaty which provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources.

2002/03). For the purposes of this assessment these results have been augmented by I-WeBS data. These data will be used to assess the potential impacts of disturbance on the bird community due to the proposed construction within the existing works. In addition, the potential effects of an increase in the amount of treated sewage being discharged on the avifauna will be considered in light of the results of the water quality assessment (see **Section 10**).

12.1.3 Methodology

Winter surveys – Mutton Island

Surveys of birds on Mutton Island, covering all intertidal areas within 1km of the island, were undertaken by Natura Environmental Consultants both before and during the construction of the existing WWTP. Surveys were carried out on a once monthly basis between November and March inclusive, and involved counts of birds feeding at low tide followed by counts of birds roosting at high tide. All counts were carried out using a 20x wide-angled telescope. This programme was repeated each year over the five years of survey (winter 98/99 to winter 02/03).

The limits of the survey area were the beach at Seapoint to the west and Nimmo's pier to the east. The habitat within the survey area consists of a mosaic of rock, sand and fine mud. The intertidal area of Mutton Island consists of a rocky shore interspersed with areas of sand and fine sediments.

Summer surveys – Mutton Island

During each of the five years of study (1999-2003), three surveys of breeding birds were undertaken between late May and Early July. Surveys were timed to coincide with high tide to assess the usage of the island as a summer roost. All birds present were noted and their breeding status recorded.

I-WeBS data

I-WeBS high tide count data was obtained for four long-term count areas within the Inner Galway Bay SPA (**Figure 12.1**), this data covered the five year period between winter 1998/99 to 2002/03 inclusive. Mutton Island lies adjacent to one of these count sites, namely the Barna – Oranmore area.

12.1.4 Existing Situation

Mutton Island and its surrounds support large numbers of birds, especially during the winter period. During construction of the causeway and existing WWTP, winter surveys of birds feeding at low tide recorded normal fluctuations in 21 of the 24 species around the island (i.e. bird numbers for each species showed no trend in numbers; see **Appendix J** for a list of species observed). The results of the surveys suggest that the construction activities did not disturb the majority of birds present (Natura, 2003). However, the relatively small numbers of redshank (*Tringa totanus*) and oystercatcher (*Haematopus ostralegus*) recorded declined steadily over the course of the study,

though the dunlin (*Calidris alpina*) population increased dramatically from 393 individuals in the winter of 1998/99 to 1118 in the winter of 2002/03[35]. Curlew (*Numenius arquata*) numbers fell steadily from a high of 35 at the beginning of construction to a low of 7 in the last year of survey. However, prior to any construction disturbance in the winter of 98/99 the number of curlew present was 9 suggesting that the decline is a part of a normal fluctuation in numbers. The surveys indicated that the construction activity on Mutton Island did not result in noticeable declines in the number of birds feeding at low tide (Natura 2003).

Winter roosts on Mutton Island were observed to become more concentrated on the eastern side of the island, away from the construction works. Despite this small geographical shift, the majority of species recorded (23 of 26) did not show either a positive or negative trend in population size over the course of the surveys. Two species that showed a negative trend in numbers over the course of the study were cormorant (*Phalacrocorax carbo*) and teal (*Anas crecca*), whereas number of wigeon (*Anas penelope*) roosting on Mutton Island increased. In general however, construction activities appeared to have little impact on the number of birds roosting on Mutton Island (Natura 2003).

Only 9 species of birds have been recorded as breeding on Mutton Island, with the numbers recorded being small. Shelduck (*Tadorna tadorna*) and Ringed Plover (*Charadrius hiaticula*) are the only species that consistently nested on the island during the survey period, although ringed plover were absent in 2003. The numbers of both of these species were small with no more than 3 breeding pairs of each recorded during the summers of 1999 to 2003. Common terns, one of the breeding species listed on the SPA designation, were observed breeding on Mutton Island in relatively high numbers during construction (46 breeding pairs in both 2000 and 2001, more than 1% of the Irish population), though they were absent during 1999, 2002 and 2003. Common tern often move from an established breeding site for one or two seasons, the motivation for these movements in some cases is thought to be high predation levels. During the seasons in which the terns nested on Mutton Island predation levels of eggs and young were high (Natura 2003). Whilst these records demonstrate that Mutton Island can be of use to common terns as a breeding site, its sporadic usage makes its importance difficult to assess, although it appears that they were not unduly disturbed by construction activities. Herring gull (*Larus argentatus*) was the only species that appeared to have given up breeding on the island due to the disturbance caused by the construction activities of the WWTP (Natura 2003).

The I-WeBS data shows that the area of Barna – Oranmore count sector supported 44 species over the 5 winters that data were available for. Of these 44 species, only 5 have shown a significant trend in population size, these being dunlin, little grebe (*Tachybaptus ruficollis*), mallard (*Anas platyrhynchos*), redshank and black-headed gull

[35] Trends over this relatively short period can give an indication of the current population dynamic but should be treated with caution due to possibility that the numbers recorded could be part of the longer-term fluctuations common in wintering wetland birds.

(*Larus ridibundus*). In all cases this trend was positive i.e. numbers have increased. When compared to the other count sites around the SPA the Barna – Oranmore area supported the greatest number of teal, scaup (*Aythya marila*), ringed plover, golden plover (*Pluvialis apricaria*), lapwing (*Vanellus vanellus*), black headed gull (*Larus Ridibundus*) and common gull (*Larus canus*) over the 5 years data was available for.

The ornithological baseline of Mutton Island and its surrounds are outlined in **Table 12.1**.

Table 12.1 Identified Receptors and baseline Summary

Identified Receptor	Baseline Summary
Wintering Birds Feeding at Low Tide around Mutton Island	The majority of birds feeding at low tide around Mutton Island over-winter show populations that are apparently stable, although prone to fluctuations in number.
Wintering Birds Roosting on Mutton Island	The numbers of roosting birds on Mutton Island has remained relatively stable, although there has been a minor change in the geographical location away from construction areas.
Birds Breeding on Mutton Island	Nine species of birds have been recorded as breeding on Mutton Island. Of these only shelduck and ringed plover are consistent nesters. The common terns that bred on the island in 2000 and 2001 are thought to have moved to a different breeding site due to predation pressure.
Inner Galway Bay SPA	The Inner Galway Bay is an internationally important site for wetland birds. The I-WeBS data shows that there are good populations of a wide range of species and on the whole these populations appear to be relatively stable. The construction of the Mutton Island WWTP does not appear to have had any effect on the integrity of the SPA.

12.1.5 Predicted Trends

The operation of the WWTP appears to have had no detectable effect on the birds using Mutton Island and, in general, bird populations in the area appear relatively stable. No changes in the use of Mutton Island and surrounding areas are predicted in the long-term.

12.1.6 Information Gaps

No significant information gaps have been identified.

12.2 Potential Effects and Incorporated Mitigation

12.2.1 Predicted Effects During Construction and Incorporated Mitigation

Disturbance

The main effect of construction on the birds feeding, roosting or breeding on Mutton Island is likely to be disturbance due to increased levels of activity and noise. This disturbance will be temporary and will affect no more than one breeding and/or one winter season.

To ensure that construction disturbance is minimal, construction work will be limited to within the existing WWTP site. Construction worker access will be restricted to the WWTP and its access route, with access to the wider island and South Park prohibited.

Pollution

Any aquatic species around (or in the pollutant pathway) of the works could be affected by accidental pollution arising from construction activities. Without the implementation of control measures this could lead to significant effects on many of the birds for which the SPA has been designated as a result of changes in food abundance.

12.2.2 Predicted Effects During Operation and Incorporated Mitigation

Disturbance

Increases in site operations (including traffic movements) and increased access to the causeway could result in increases of long-term, disturbance.

Food resources

The potential increase in nutrient (Nitrogen) loading, due to the higher throughput of sewage, could result in a change in the amount of food available to foraging birds. Additionally, other deleterious changes in water quality may affect the food resources within the bay (e.g. high concentrations of ammonia, or other toxic compounds/chemicals, or low dissolved oxygen). Some species may increase in abundance, while others decrease. Significant reductions in the amount of food available may lead to a reduction in numbers of birds using the area and/or a reduction in the body condition or reproductive output of individuals still utilising the area, while the converse may be the case if food abundance increases.

As identified in **Section 10.2.2** the final treated effluent of the upgraded WWTP will be subject to strict quality standards that reflect the legislative status of the discharge and designed to be environmentally protective, to ensure that there are no significant adverse effects on the water quality of Galway Bay and the ecology that depends on it.

Avoidance/reduction measures

Table 12.2 summarises the incorporated mitigation measures.

Table 12.2 Avoidance/reduction measures – likely effects

Receptor	Changes and potential effects	Incorporated mitigation measures and rationale for their likely effectiveness
Construction		
Birds feeding, brooding or roosting on Mutton Island	Disturbance due to increased levels of activity.	High certainty of effectiveness: Construction worker access will be restricted to the WWTP and its access route with access to the wider island and South Park prohibited.
Birds feeding offshore of Mutton Island or on inter-tidal areas	Increase in polluting matter discharged to receiving waters with subsequent effects on feeding resources	High certainty of effectiveness: Construction will be limited to within the existing WWTP site which is a highly controllable environment where pollution can be contained and subsequently treated. A range of best practice mitigation measures will be employed to reduce the likelihood of pollution reaching Galway Bay.
Operation		
Foraging birds within Galway Bay	Increase in treated effluent discharge leading to deterioration of water quality and affecting food resources	High certainty of effectiveness: Continued use of existing diffuser comprising 10 ports below 10m CD will dissipate energy of the flow and facilitate effective dispersion of the treated effluent. Design of the sewage treatment processes to achieve the UWWTR quality standards will prevent any significant adverse effects on the water quality of the receiving water.

Compensation

No compensation has been identified or is relevant.

12.2.3 Implementation of mitigation and enhancement measures

The implementation mechanisms for the identified mitigation measures are given in **Table 12.3**.

Table 12.3 Implementation of incorporated mitigation and enhancement measures

Description of measures including any monitoring requirement	Responsibility for implementation	Implementation mechanism
Construction		
Construction worker access will be restricted to the WWTP and its access route with access to the wider island and South Park prohibited.	Construction Contractor	Contract documents
A range of best practice mitigation measures will be employed to reduce the likelihood of pollution reaching Galway Bay.	Construction Contractor	Contract documents
Operation		
Design and operation of the sewage treatment processes to achieve the UWWTR quality standards will prevent any adverse effects on the water quality of the receiving water.	Site Designer and Operator	Contract Documents

12.3 Assessment of Effects

12.3.1 Scope and Methodology

Construction

The assessment of the effects of construction were based upon the results of the ornithological survey results of the larger development of the WWTP (Natura, 2003) and its high levels of disturbance, experience of similar development projects and knowledge of the species present and their status at the European and national level.

Operation

The assessment of the operational effects of the upgraded WWTP are based on the knowledge of the amount of activity expected (i.e. minimal change over current levels) and the survey results, supplemented by I-WeBs data, from the survey data collected during the construction of the existing WWTP.

12.3.2 Significance Evaluation Methodology

Evaluation Criteria

Four criteria were used in our evaluation of the predicted effects of the proposed development:

- the type of effect, (i.e. whether it is positive, negative or unknown);
- the probability of the effect occurring based on the scale of certain, likely or unlikely. If there is uncertainty this will be noted;

- the policy importance (or sensitivity) for the evaluation, (i.e. international, national, county, district or local/parish importance). An effect can have a policy importance (or sensitivity) at more than one level;
- the magnitude, which is quantified using a simple scale of major, some, minor or no effect. In some cases it is not possible to quantify the magnitude of effect and therefore not quantified is used in these instances.

The findings in relation to all of these criteria were brought together to give an assessment of significance for each effect, based on professional judgement. Effects were considered to be of major, minor or no significance.

12.3.3 Predicted Effects and their Significance

Construction

Disturbance

In general, evidence from the aforementioned surveys indicates that birds were not significantly disturbed by the construction of the existing WWTP. Therefore, since the proposed works are of a much smaller scale and will only involve activity within the existing WWTP site (reducing the potential for visual disturbance), it is unlikely that significant disturbance will occur as a result of the proposed works.

Food resources

As a result of the construction being carried out within the boundary of the existing WWTP (which is a well contained area as set out in **Section 10.2.1**), it is unlikely that any pollution incidents would affect flora and fauna in the wider area. Nonetheless, the three main types of polluting matter which could theoretically enter the Inner Galway Bay are suspended solids, cement/concrete and oils/hydrocarbons. A range of site practices will be established to reduce the potential for pollution to reach Galway Bay to the lowest practicable level and these are set out in **Section 10.2.1**.

Assuming that the pollution prevention techniques outlined are followed it is considered that there will be no adverse effect on flora and fauna and therefore no effects on the birds feeding on this resource.

Operation

Disturbance

Increasing the capacity of the Mutton Island WWTP will not lead to any significantly greater level of operational activity than is currently experienced (and indeed tanker movements could potentially reduce). The greatest change may well be the increase in people having access to the causeway. However, the amount of disturbance would be very small compared to the total SPA resource and therefore, it is concluded that there will be no increased effect of disturbance on the ornithological interest of the site and its surrounds.

Food resources

Section 10.3.3 ('Trophic Status' sub-section), indicates that the main source of Nitrogen (the bio-limiting nutrient in marine waters) is the River Corrib. The additional effects of the discharge from the upgraded WWTP on Nitrogen concentrations in inner Galway Bay are not significant in terms of altering the nutrient concentrations and the trophic status of these waters.

It is therefore considered that the effects on avian food resources will be negligible and most likely undetectable.

12.3.4 Cumulative Effects

No additional development has been identified which could cause additional cumulative effects with respect to disturbance.

Cumulative effects affecting marine food resources are discussed in **Section 11.3.5**.

12.3.5 Compensation

No compensation has been identified.

12.3.6 Additional mitigation/enhancement measures

No additional mitigation or enhancement measures have been identified.

12.3.7 Summary of Significance Evaluation

Table 12.4 Effects on flora and fauna and evaluation of significance

Environmental effect on receptors	Type of effect	Probability of effect occurring	Policy Importance (or sensitivity)	Magnitude of effect	Significance Level	Rationale
Construction						
Disturbance of birds breeding, feeding or roosting on or around Mutton Island	-ve	Unlikely	International	None	Not significant	Any disturbance effects will be temporary, with activity confined within the existing boundary of WWTP. There was no detectable effect on the ornithological interest due to the construction of the existing WWTP.
Pollution of avian feeding grounds through spillages during construction.	-ve	Unlikely	International	Medium	Not significant	Pollution prevention controls will be implemented to reduce risk of spillages/run-off entering the marine environment (see **Section 10.2.1**)

Environmental effect on receptors	Type of effect	Probability of effect occurring	Policy Importance (or sensitivity)	Magnitude of effect	Significance Level	Rationale
Operation						
Disturbance of birds breeding, feeding or roosting on or around Mutton Island	-ve	Likely	International	Minor	Not significant	There will be a very small level of disturbance associated with increased public access to the causeway. However, this additional disturbance is considered to be tiny considering the whole SPA resource.
Changes in food resources resulting from water quality changes	-ve or +ve (depending on species)	Unlikely	International	Major	Not significant	The increased loading of nutrients will be small in comparison with the overall loading to inner Galway Bay and is unlikely to have a detectable effect on avian food resources.

Key:	Type	Probability	Policy Importance	Magnitude	Significance
	- = Negative	Certain	International	Major	Major
	+ = Positive	Likely	National	Medium	Minor
	? = Unknown	Unlikely	Regional	Minor	Not Significant
			District	None	
			Local		

12.4 References

Natura Environmental Consultants (2003) *Galway Main Drainage Environmental Monitoring Programme – Bird Populations*.

N

Barna - Oranmore

Oranmore - Clarinbridge

Clarinbridge Aughinish

Coranroo - Rinn

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Key

Irish Wetland Bird Survey count sites

SPA boundary

SAC boundary

Not to Scale

TOBIN Patrick J. Tobin & Co. Ltd. | Nicholas O'Dwyer CONSULTING ENGINEERS | Entec

Mutton Island Waste Water Treatment Plant Upgrade
EIS

Figure 12.1
Location of Wetland Bird Count Sites and The SPA and SAC Boundaries

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13. Summary of Predicted Residual Effects

Table 13.1 summarises the significant effects (Major and Minor) of the proposed WWTP upgrade on Mutton Island.

Table 13.1 Summary of Predicted Residual Significant Effects

Environmental topic	Receptor and summary of predicted significant effects	Mitigation and opportunities to reduce negative effects
MAJOR SIGNIFICANT EFFECTS A consequence that is of such significance that it should be considered as a major factor that should influence whether or not the development should be allowed to proceed (if the effect is negative).		
Odour	None Identified	
Air Quality	None Identified	
Noise and Vibration	None Identified	
Socio-Economics	Increased capacity will allow for growth of the economy in Galway City, County Galway and the West Region in line with plans and policies	N/A as this is a major **BENEFICIAL** effect
Landscape and Visual	None Identified	
Water Quality	None Identified	
Marine Ecology	None Identified	
Birds	None Identified	
MINOR SIGNIFICANT EFFECTS A consequence that merited detailed assessment because it might have been of major significance - such consequences are not normally considered to of sufficient significance to influence whether or not the development should be allowed to proceed.		
Odour	None Identified	
Air Quality	None Identified	
Noise and Vibration	None Identified	
Socio-Economics	None Identified	
Landscape and Visual	None Identified	
Water Quality	None Identified	
Marine Ecology	None Identified	
Birds	None Identified	

Appendices